Labs for InRoads V8i SELECTseries 2

Colorado Department of Transportation

CADD and Engineering Innovation
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Notice

Software Versions

The software products referred to in this publication are furnished under a license and may only be used in accordance with the terms of such license. This document intended for use with the following software versions:

MicroStation® version 0811.07.443
InRoads® version 08.11.07.428
CDOT Configuration Version 05.00.00

Document Conventions

There are several conventions that are used throughout this document to indicate actions to be taken or to highlight important information. The conventions are as follows:

Item	Meaning
View Perimeter	a command name or a file that you are to select
Tools > Options	a command path that you are to select – usually from the pull-down menus
Document Name	the name of a document that is not hyperlinked
Emphasis	style used when referring to important word or phrases
Hyperlink	style used when you have a direct link to another document on the web
Key in	entering data with the keyboard
Quote	style used to indicate an external source quotation
Note: text	information about a command or process that you should pay particular attention to
1. Numbered Steps	actions that you are to perform as part of the lab activities
<D> or Data	press the data button on the mouse
<R> or Reset	press the reset button on the mouse
<T> or Tentative	press the tentative button on the mouse

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Labs

LAB 1 - Getting Started in InRoads

This lab demonstrates how to start and set up InRoads to work on a project. It demonstrates the Project Creation Utility, starting InRoads, loading data, and changing some InRoads settings.

Chapter Objectives:

- Create a new project folder structure.
- Start InRoads and set up the InRoads project defaults.
- Load the initial project data.
- Demonstrate how the Locks work.
- Demonstrate Precisions and Factors.

The following files are used in this lab:

- C:\Projects\12345\Design\Drawings\Reference_Files\12345DES_Model.dgn
- C:\Projects\12345\Design\InRoads\12345DES_Geometry.alg
- C:\Projects\12345\Design\InRoads\12345 existing ground.dtm
- C:\Projects\12345\Design\InRoads\DES12345_Templates.itl

Lab 1.1 - Creating a Project Directory

The first step when beginning a project is to create a project directory structure. Use the Project Creation Utility to generate a uniform directory structure which will allow other users easy access to the project data when they need it.

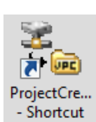
Section Objectives:

- ♦ Create a project directory.
- ♦ Explore the folder structure created.
- ♦ Demonstrate how the PCF file works

1. From the Windows Explorer, navigate to:

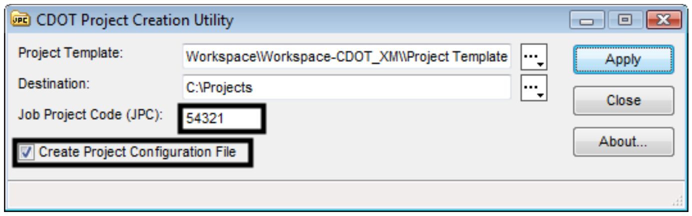
   C:\Workspace\Workspace-CDOT_V8i\Standards-Global\MicroStation \exes

2. **<D>** the **Project Creation Utility** icon to open the ***CDOT Project Creation Utility*** dialog box.

3. In the ***CDOT Project Creation Utility*** dialog box, **<D>** in the ***Job Project Code (JPC)*** field and key in ***54321***.

4. Verify that ***Create Project Configuration File*** is toggled on. This file automatically sets the directory path in MicroStation so that navigating to the correct project folder is easier.



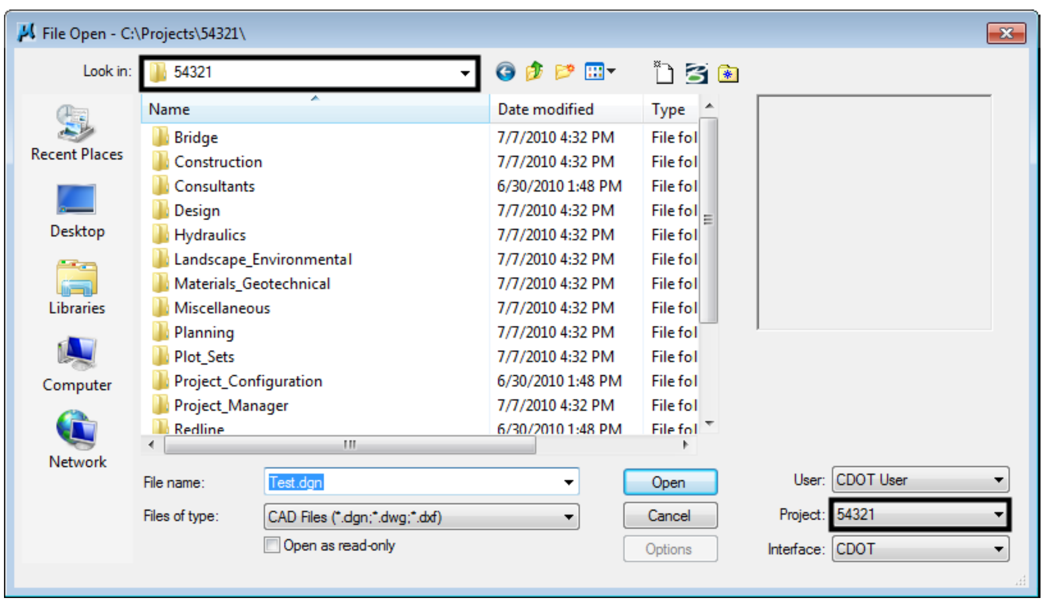
5. **<D> Apply** then **<D> Close** to dismiss the dialog box.

6. Open Windows Explorer and navigate to **C:\Projects\54321\Design\Drawings**. Notice that the directory structure has been built for all disciplines and it has been populated with the standard drawings.

7. Close the Windows Explorer.

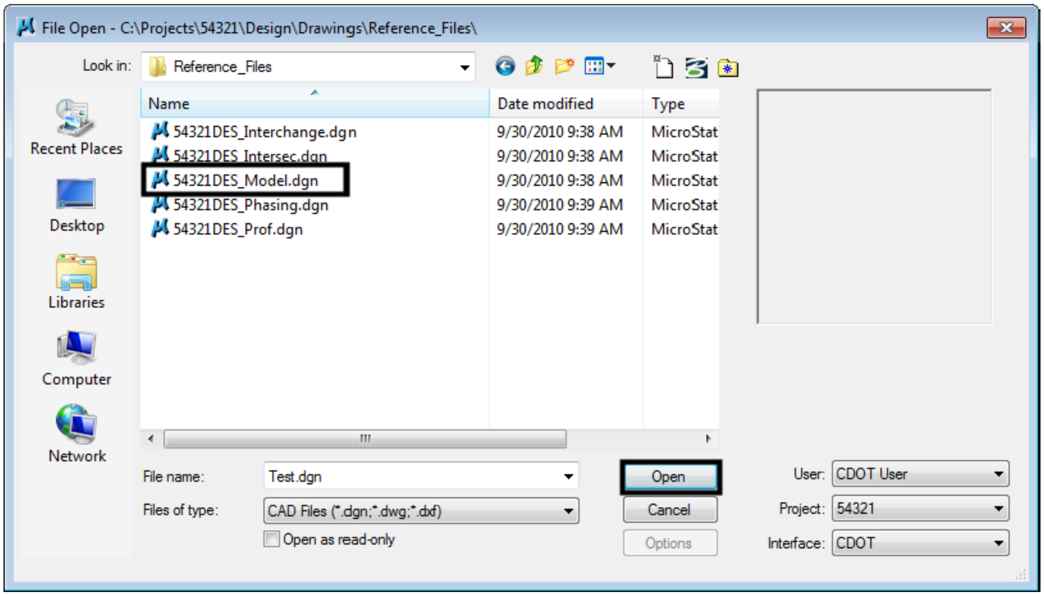
8. Start **MicroStation**.

9. In the ***MicroStation Manager*** dialog box, set the ***Project:*** to **54321**. Notice that the ***Look In:*** folder automatically changes to the 54321 directory.



10. In the ***MicroStation Manager*** dialog box, navigate to the **Design > Drawings > Reference Files** folder.

11. **<D>** on **54321DES_Model.dgn** then **<D> Open**. This is the location and file that most Roadway Design work is done in.



12. Close MicroStation.

Section Summary:

- Using the Project Creation Utility builds a standard directory structure for the project.
- Standard drawing files with project specific names are included in the project directories.
- Using the PCF file in MicroStation make navigation within the project directory easy.

Lab 1.2 - Initial InRoads Set-up

MicroStation uses the pcf file to set directory paths. InRoads use a different method called Project Defaults. The process of setting project defaults is normally a tedious job. However, using the ***CDOT_V8i Disciplines.reg*** file supplied with the CDOT workspace makes this job very simple. The .reg file uses variables stored in the pcf to set the directory paths when opening or saving InRoads related data files.

In addition to setting up the project defaults, students will learn how to create a project file which allows several data files to be loaded into InRoads simultaneously.

Note: This lab uses the 12345 project directory which already has the initial InRoads data for the remaining labs.

Section Objectives:

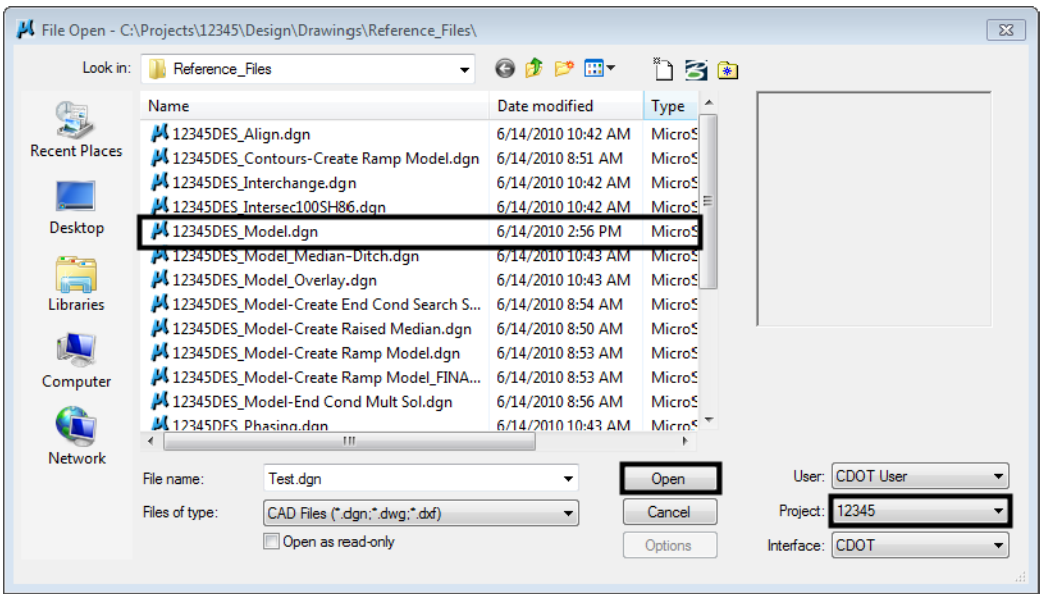
- Open MicroStation and InRoads using the 12345.pcf file.
- Import the CDOT_V8i Disciplines.reg file into the project defaults.
- Load the project alignment, surface, and template data.
- Create a project (rwk) file.

1. Start MicroStation and InRoads by selecting **Start > All Programs > Bentley > InRoads Group V8i (SELECTsceries 2) > InRoads** or select the **InRoads** desktop icon.

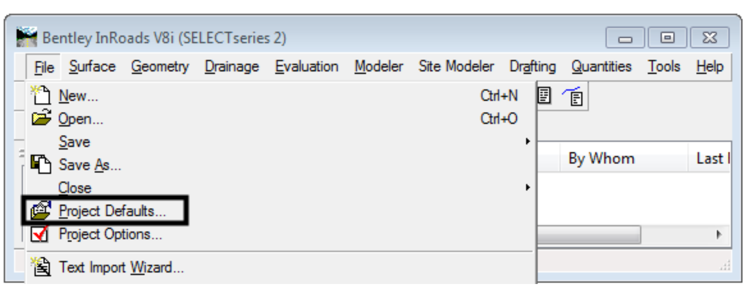
2. In the ***MicroStation Manager*** dialog box, set the ***Project:*** to **12345**. This setting accesses the 12345.pcf file.

3. In the ***MicroStation Manager*** dialog box, navigate to the **Design > Drawings > Reference Files** folder.

4. **<D>** on **12345DES_Model.dgn** then **<D> Open**. This opens MicroStation and InRoads.



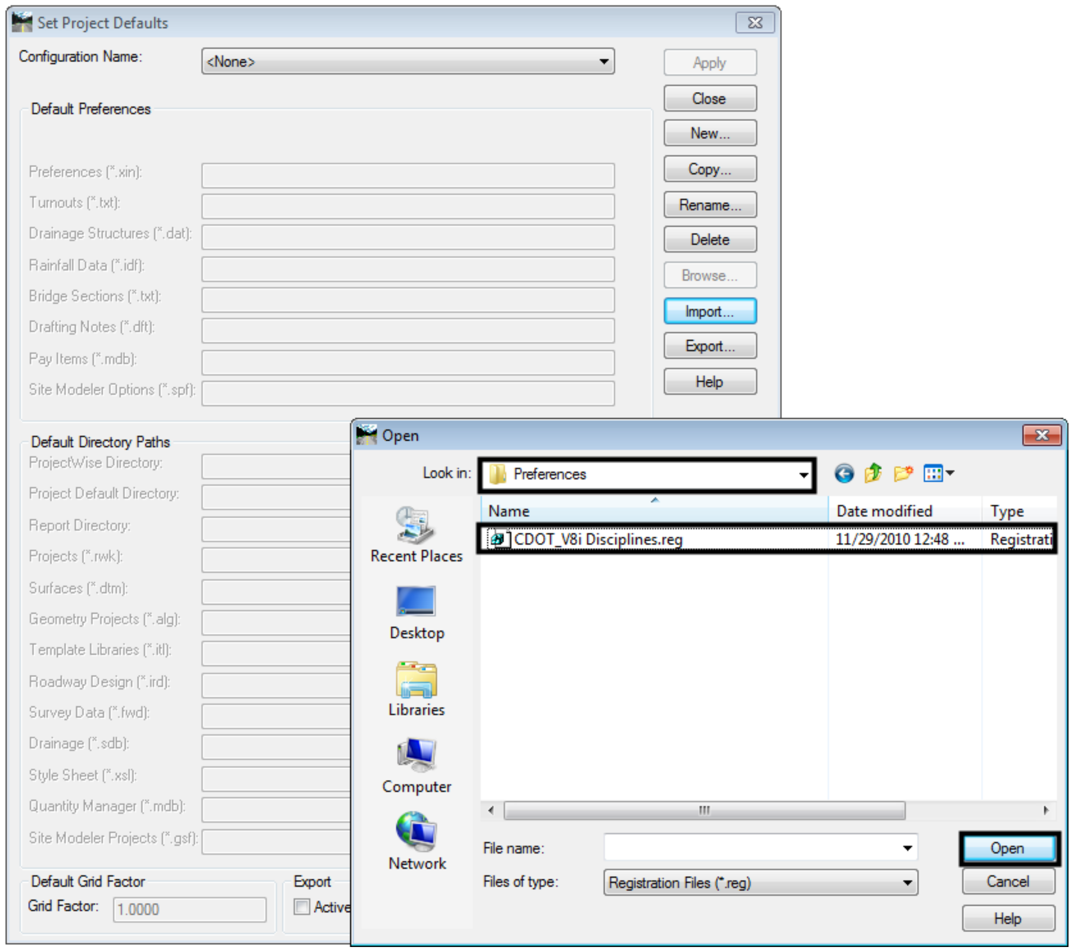
5. From the InRoads menu bar, select **File > Project Defaults**. This displays the ***Project Defaults*** dialog box.



6. On the ***Project Defaults*** dialog box, **<D>** the **Import** button. This displays the ***Open*** dialog box.

7. In the ***Open*** dialog box, navigate to **C:\Workspace\Workspace-CDOT_V8i\Standards-Global\InRoads\Preferences** and highlight the **CDOT_V8i Disciplines.reg** file.

8. **<D> Open**.



This loads the data into the Project Defaults dialog box. This file only has to be loaded one time. Once loaded, it will work with any project so long as the pcf file is used when starting MicroStation and InRoads.

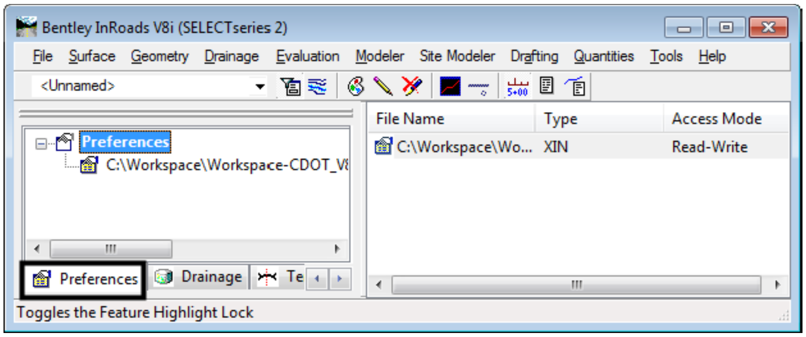
9. Back on the ***Set Project Defaults*** dialog box, set the ***Configuration Name*** to **CDOT Design Discipline**.

Note: Although the Design Discipline is used for this lab, there are project defaults for each of the other disciplines as well.

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

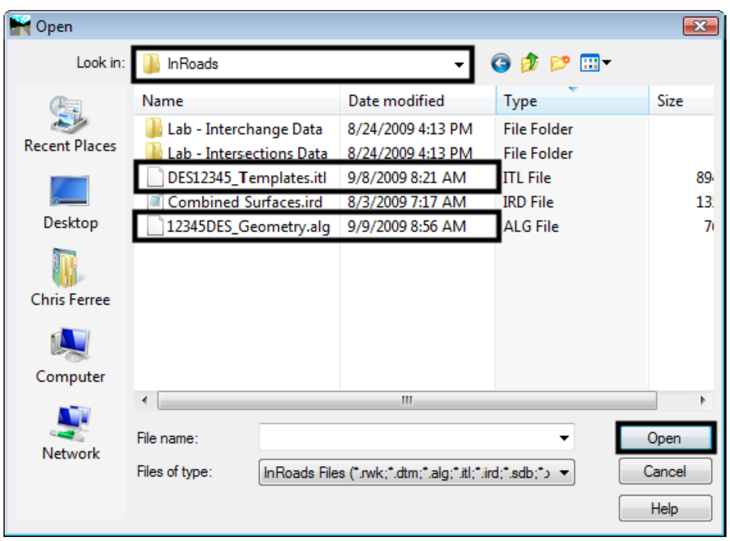
Setting the project defaults using this method defines the default locations for both general InRoads resource files and project specific data files. This will make it easier to conform to graphics standards and assist in navigating to the correct project directories when loading or saving data files.

11. Select the **Preferences** tab on the Workspace bar and verify that the correct InRoads Project resource file (CDOT_Civil.xin) is loaded.



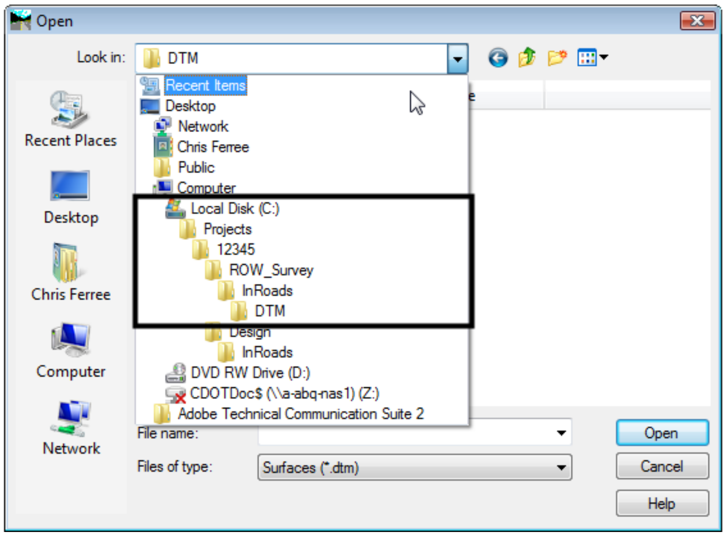
Next, the initial InRoads data files are loaded.

12. From the InRoads menu bar, select **File > Open**. This displays the ***Open*** dialog box.
13. The ***Open*** dialog box defaults to the ***C:\Projects\12345\Design*** folder. **<D> <D>** on the **InRoads** folder.
14. Highlight **12345DES_Geometry.alg** and **<D> Open**.
15. Highlight **12345DES_Templates.itl** and **<D> Open**.



Typically, the template library is copied from C:\Workspace\Workspace-CDOT_V8i\Stam\ndards-Global\InRoads\Templates\ , however, for future labs the template library (with additional data) was provided in the Design\InRoads\ folder.

16. In the ***Open*** dialog box, use the ***Look In*** drop down menu and navigate to the ***C:\Projects\12345\ROW_Survey\InRoads\DTM*** folder.



17. Highlight **12345 existing ground.dtm** and **<D> Open**.

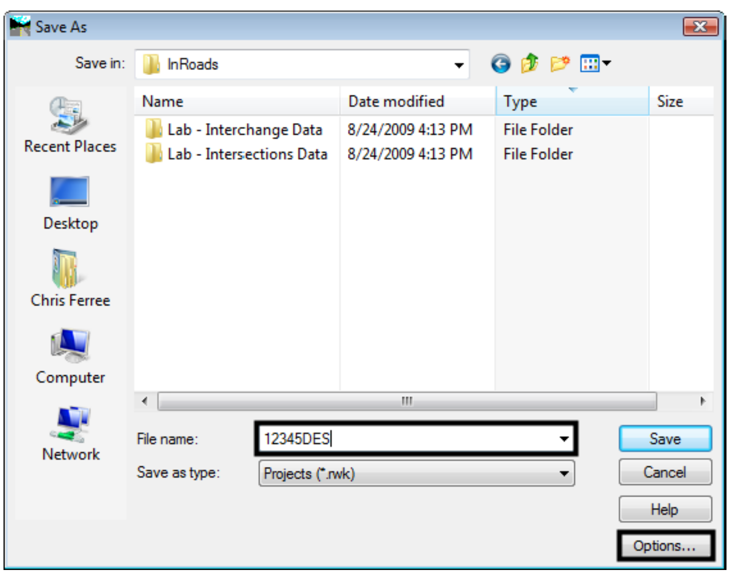
18. **<D> Cancel** to close the ***Open*** dialog box.

The project (rwk) file is used to load or save all of the project data files at one time. This file can be updated as new data files are added to the project.

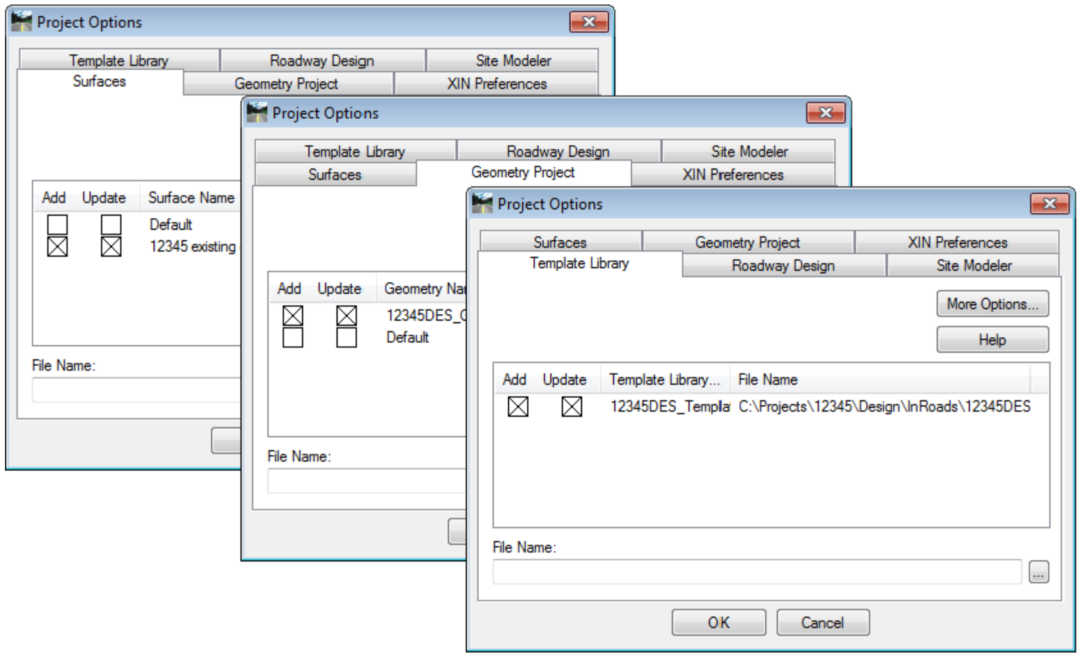
19. Select **File > Save > Project** from the InRoads menu bar. This displays the ***Save As*** dialog box.

20. In the ***File name*** field, key in ***12345DES***, ***do not*** press the ***Enter*** key.

21. **<D>** the **Options** button. This displays the ***Project Options*** dialog box.



22. In the ***Project Options*** dialog box, toggle on the ***Update*** check box for the data files loaded above.



23. **<D> OK** to dismiss the ***Project Options*** dialog box.

24. In the ***Save As*** dialog box, **<D> Save** then **<D> Cancel** to dismiss the dialog box.

Section Summary:

- The CDOT_V8i Disciplines.reg file only needs to be imported one time, then it can be used for any project.
- Initial project data is loaded after the project defaults are set up. This data must include an existing ground dtm and may include geometry as well.
- Creating a project (rwk) file speeds up the process of loading and saving project data.

Lab 1.3 - Toolbars

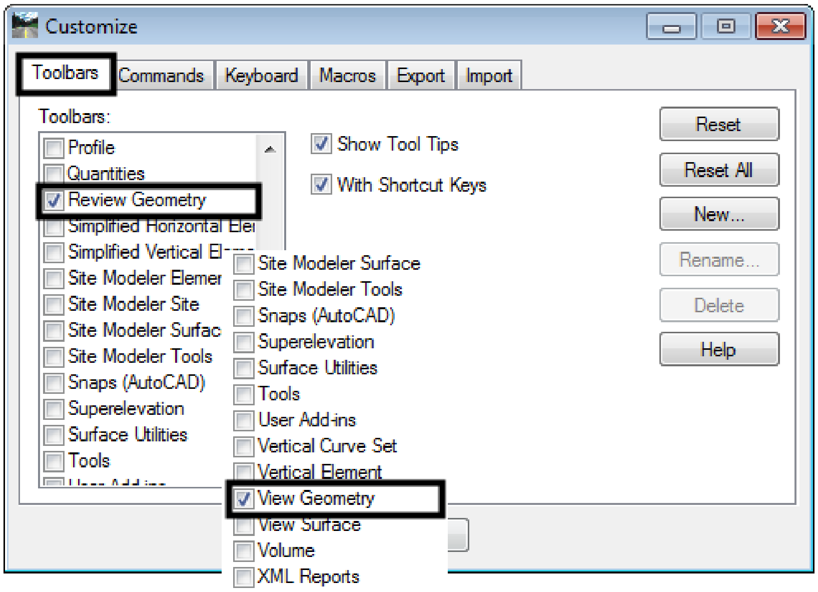
This lab demonstrates how the InRoads Interface can be populated with toolbars for easy access to commands. The drop-down menus can be used to select the correct tool, but it may be more convenient to use toolbar icons. All InRoads toolbars can be customized to fit your workflow or personal preferences.

Section Objectives:

- Learn how to access addition toolbars used for viewing and reviewing geometry.
- Learn how to access and use the Global Scale Factor Add-in

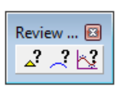
Opening Additional Toolbars

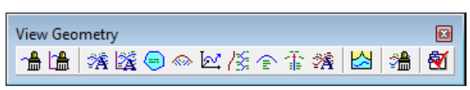
1. From the drop-down menu select **Tools > Customize**. The ***Customize*** dialog box appears.



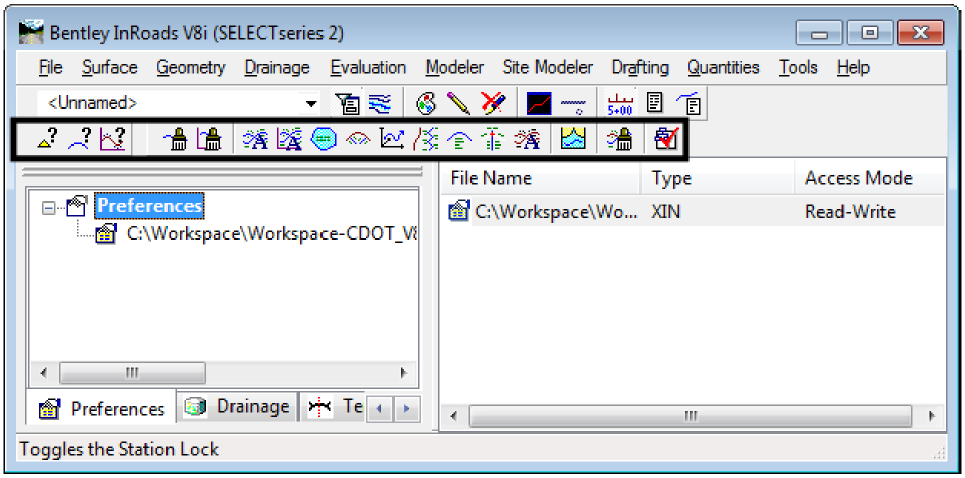
2. Under the **Toolbars** tab, toggle on the boxes for **Review Geometry** and **View Geometry** are selected. When checked on, the toolbars are displayed on the InRoads interface or as floating toolbars.

3. **<D>** the **Close** button in the ***Customize*** dialog box.

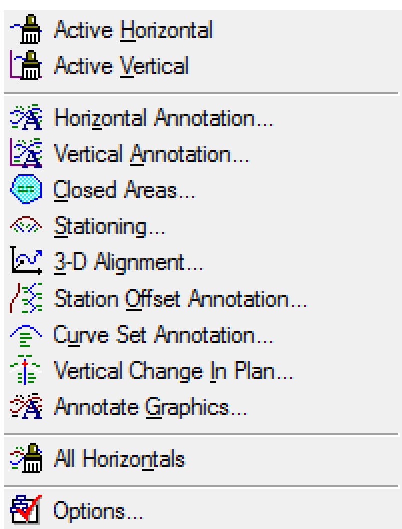


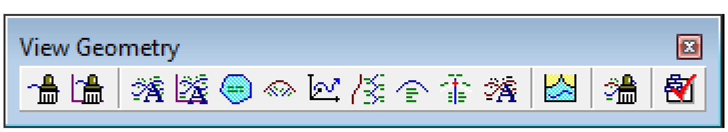


4. **Dock**, **Undock** and **Resize** the toolbars until you are comfortable repositioning them. Notice how toolbars can be docked in the InRoads interface but not in MicroStation's.



5. From the drop-down menu, select **Geometry > View Geometry** and look at each command and its associated icon. Notice the correlation of the icons between the drop-down menu and the toolbar.





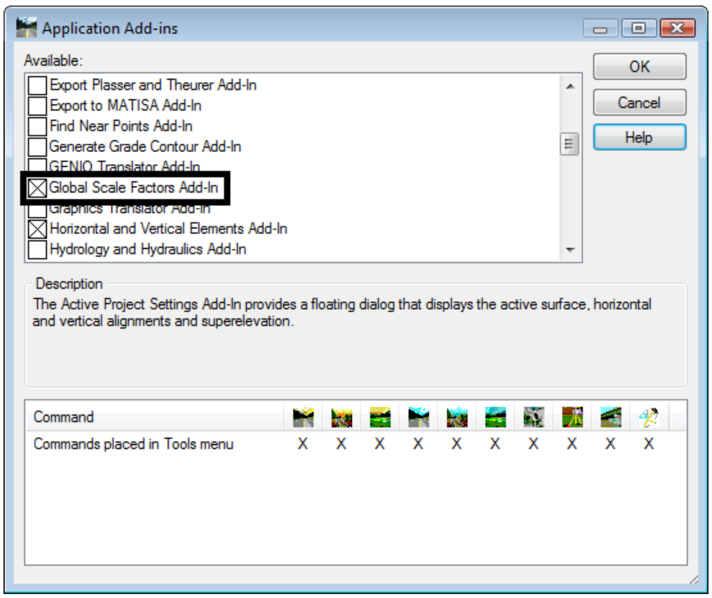
6. Place the cursor over an icon in any toolbar. A ***Tool Tip*** will appear at the lower right of the cursor, additionally a description of the command shows in the status field.

- The tool tip feature is controlled in the ***Customize*** dialog (***Tools*** > ***Customize***) box via the ***Show Tool Tips*** check box and is turned on by default.

Global Scale Factors

Global scale factors are used to determine the size of displayed text, cells, and linestyles. The global scale factor function can be found under the ***File > Project Options [Factors]*** tab. However, enabling the command directly from the menu bar is more efficient.

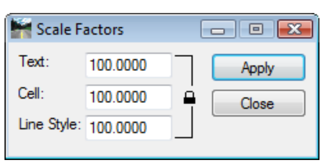
7. Select **Tools > Application Add-ins** to display a list of available InRoads commands and functions that can be added to the InRoads interface.



   Selecting an item displays a description of the tool(s). The command category shows both the menu location and the InRoads product(s) it can be activated with.

8. Toggle on **Global Scale Factor**, **<D> OK,** and **Close** the dialog box.

9. Select **Tools > Global Scale Factors**…



10. Set the ***Text*** and ***Cell*** factors to ***100***. Set the ***Line Style*** factor to ***1***.

11. **<D> Apply** then **Close**.

   These settings are multipliers for displayed graphics. Generally the values should be set to correspond to the plotting scale factor. As with most MicroStation or InRoads commands, you have the option of either enabling or disabling the lock symbol to input values universally or individually.

Note: Global Scale Factors apply to all InRoads data displayed. This includes the display of features from a DTM. While it is possible to 'regenerate' plan view topography by displaying the features from a survey-supplied DTM, this is NOT an accepted workflow. The reason for this is because any attributes collected in the field are processed by InRoads Survey. These attributes (rotation, Q & Z reports, etc) are not stored in the DTM and the resulting graphics will be incomplete and/or incorrect without being evident.

Section Summary:

- Students learned how to access the Review Geometry and View Geometry toolbars and how they compare with the pull-down menus.
- Students learned how to access the Global Scale Factors Add-in and how the global scale factors impacts graphics generated from InRoads commands.

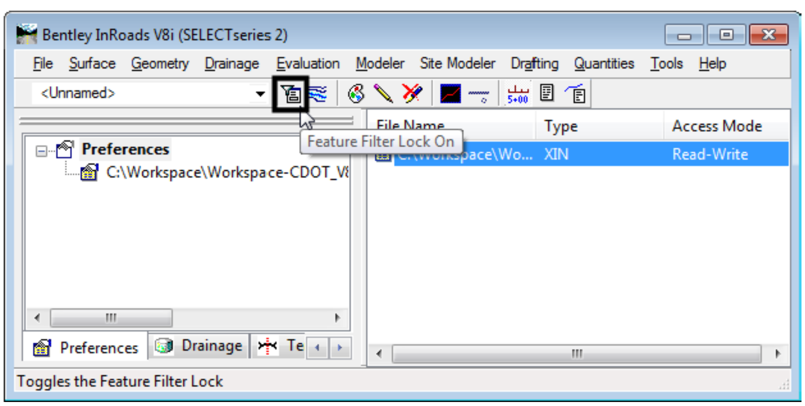
Lab 1.4 - Locks

This lab illustrates the use of the Feature Filter lock, Pen/Pencil Mode, and Station Lock.

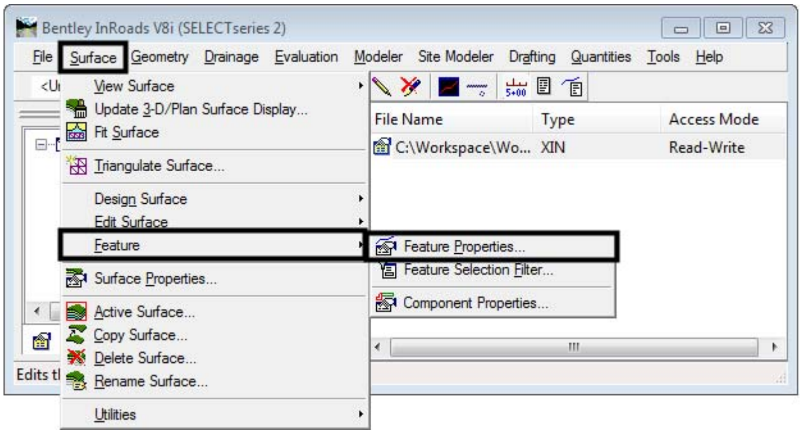
Section Objectives:

- Demonstrate how the Feature Filter lock reduces items in list boxes.
- Demonstrate the difference between Pen and Pencil mode.
- Demonstrate the effects of Station lock.

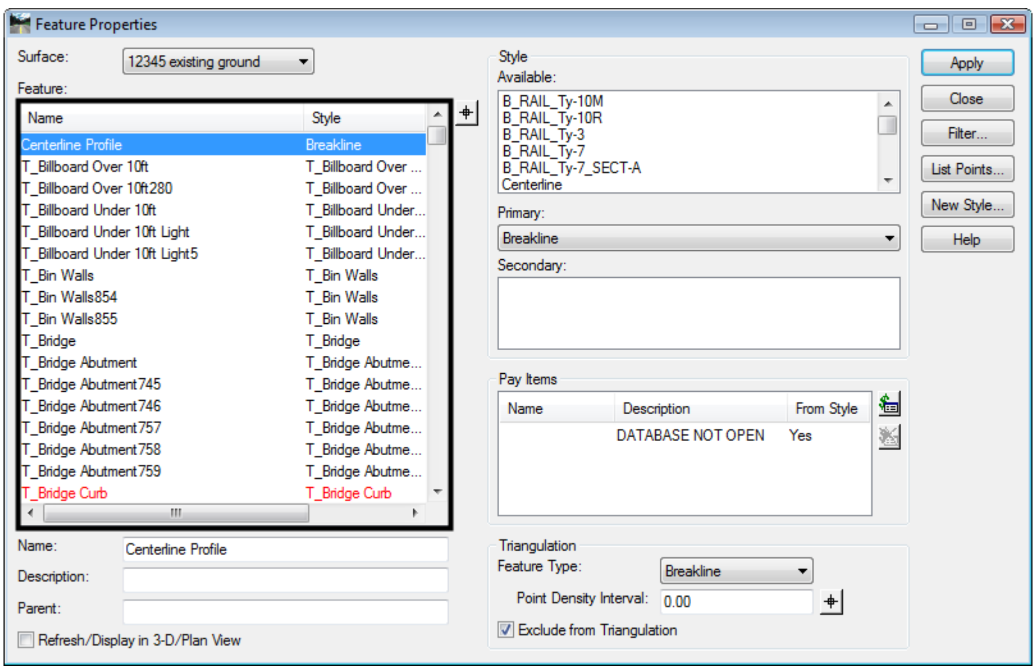
1. On the InRoads main dialog box, verify that the ***Feature Filter*** lock is ***on*** and the filter name is set to **<Unnamed>**. Unnamed is in effect no filter.



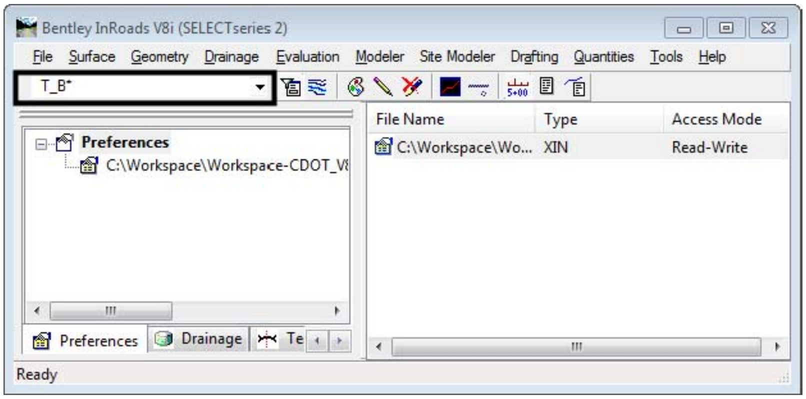
2. From the InRoads menu bar, select **Surface > Feature > Feature Properties**.



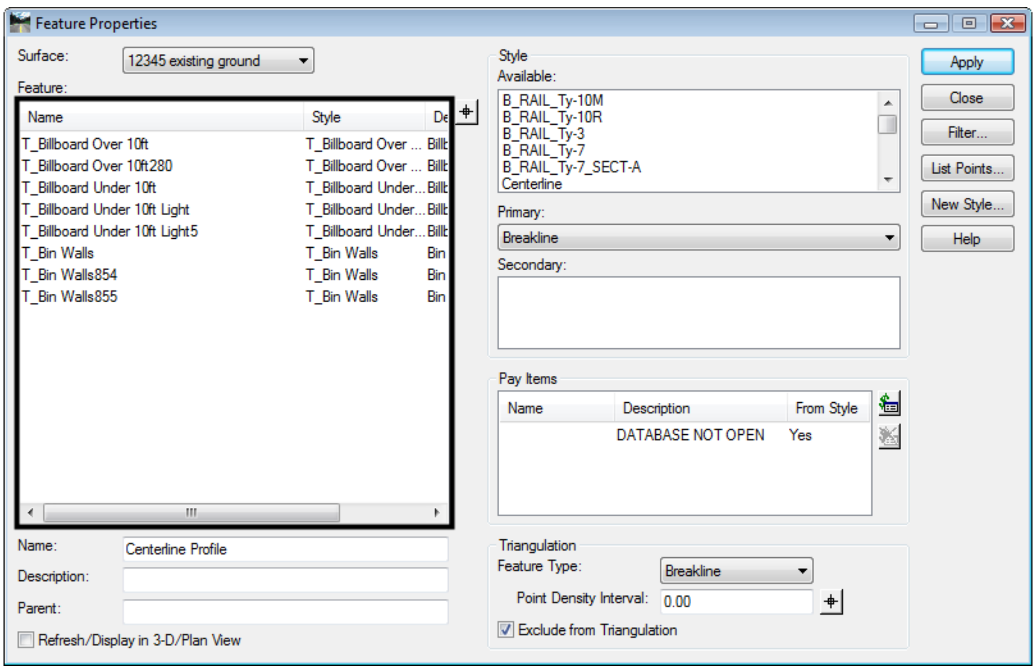
The illustration below shows the Feature Properties dialog box as displayed with no active feature filter.



3. On the InRoads main dialog box, set the Feature Filter to **T_B***.



Notice that in the ***Feature Properties*** dialog box only features that start with T_B are displayed. The illustration below shows the dialog box with the filter active.



4. **<D>** the **Filter** button. This displays the ***Feature Selection Filter*** dialog box.

5. Notice, in the ***Rules*** area of the dialog box, the rule **Exclude Style = T_Bridge***. This rule prevents the bridge features from being displayed.

6. **<D> Cancel** to dismiss the ***Feature Selection Filter*** dialog box.

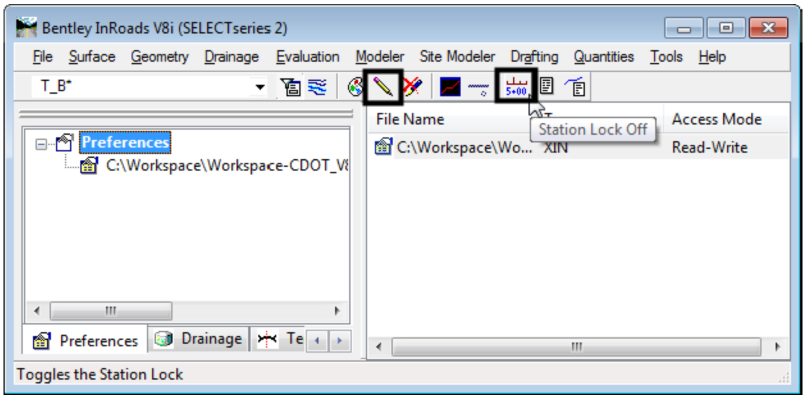
7. Close the ***Feature Properties*** dialog box.

8. Set the Feature Filter back to **<Unnamed>**.

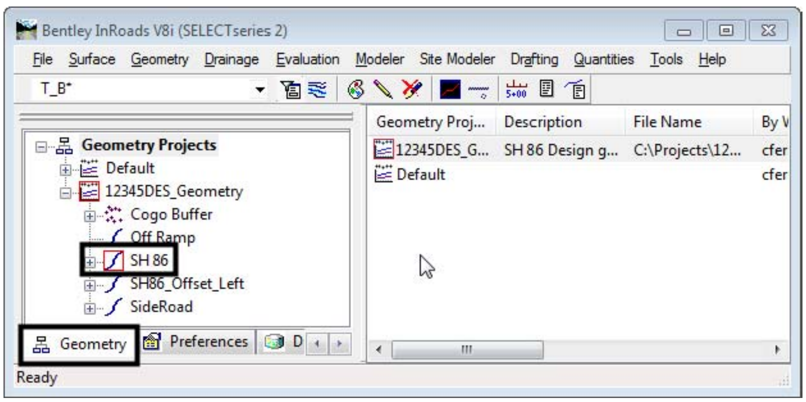
Next, the Pen/Pencil mode and the Station lock are demonstrated.

9. On the InRoads main dialog box, set the ***Pen/Pencil*** mode to **Pencil**.

10. Turn the ***Station*** lock off.



11. **<D>** the **Geometry** tab in the InRoads Explorer and verify that the ***SH 86*** alignment is active.

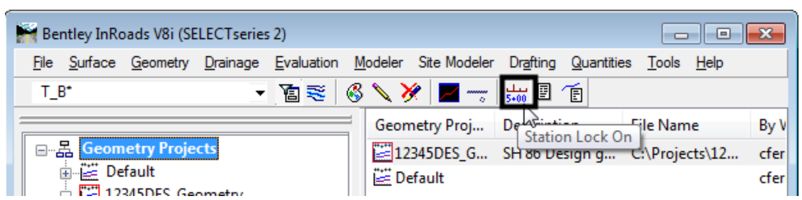


12. From the InRoads menu bar, select **Geometry > View Geometry > Stationing**.

13. On the ***View Stationing*** dialog box, **<D> Apply**.

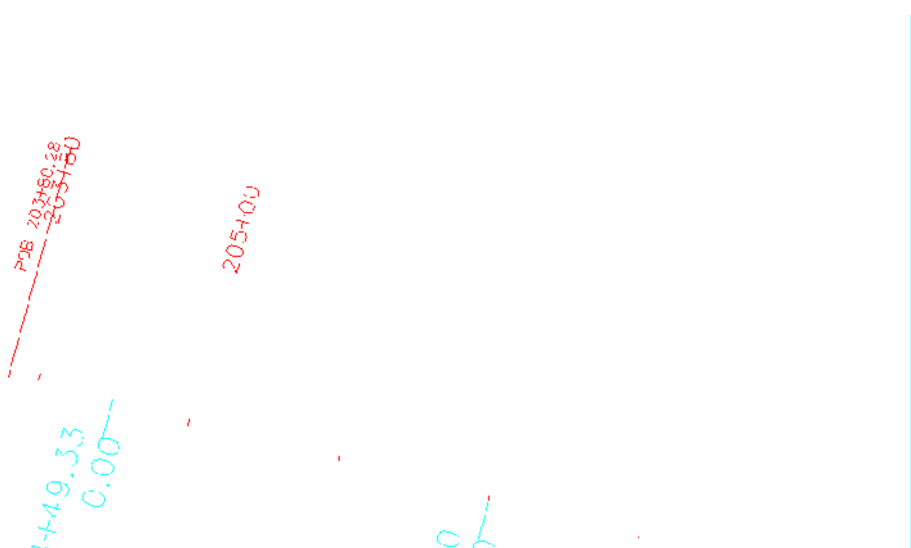
14. Examine the stationing displayed. The regular stations end in ***"+80"***. This is not CDOT standard.

15. On the InRoads main dialog box, turn the ***Station*** lock on.

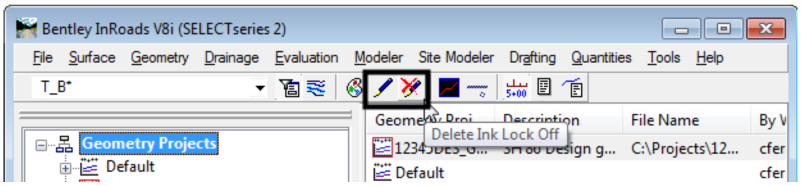


16. Redisplay the Stationing.

17. Examine the stationing displayed. There are two things to note. First, the original stationing was deleted and the new stationing was displayed. This is a result of the Pencil mode. Second, the stations end in "+00" in even 500 foot intervals.

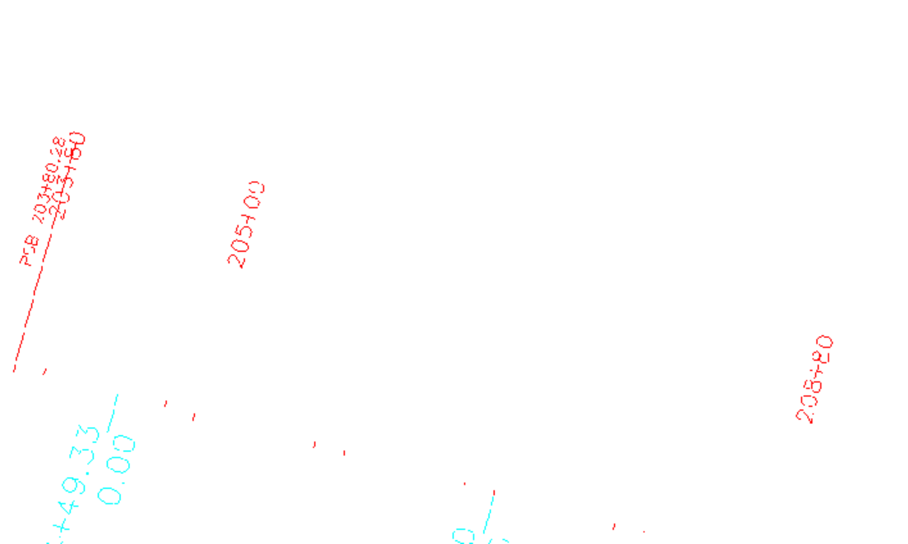


18. On the InRoads main dialog box, set the ***Pen/Pencil*** mode to **Pen**.
19. Turn **Delete Ink** off. ***Delete Ink*** makes ***Pen*** mode behave like ***Pencil*** mode. It is turned off here to illustrate ***Pen*** mode.



Next, Pen mode is demonstrated.

20. Redisplay the Stationing. The stationing will appear the same as it did in the previous step. This is done so that the stations are redisplayed with Pen mode. The original stationing was displayed in Pencil mode so it will always behave in Pencil mode.
21. Turn off the **Station lock** and redisplay the stationing. This time the original stationing is left in place and the new stationing is also displayed.



22. Turn the **Station Lock** back on and set the ***Pen/Pencil Mode*** back to **Pencil**.
23. Delete the stationing that was displayed.

Section Summary:

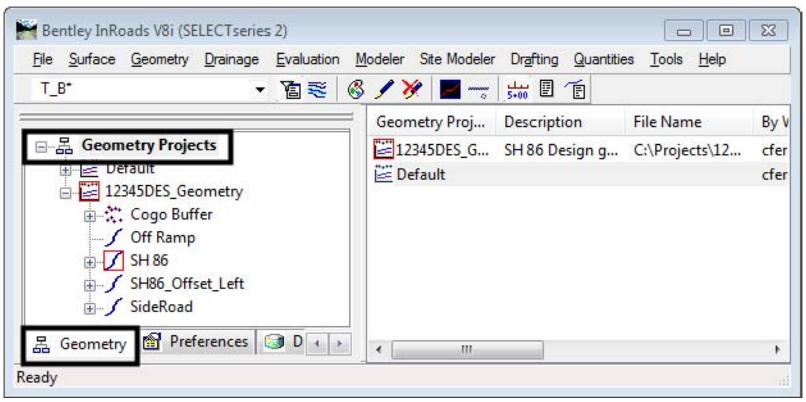
- The Feature Filter lock has two items to set; The Filter Name and the Filter lock On/Off switch.
- Items placed retain the Pen/Pencil mode they were placed with, regardless of the mode setting at the time the items are placed again.
- Station lock On is the standard operating mode for CDOT.

Lab 1.5 - Precision and Factors

Precision affects the number of decimal places used in InRoads dialog boxes. Factors determine the size of graphic elements displayed by InRoads. This lab illustrates these affects.

First, precision is examined. The Review Horizontal Alignment command is used to illustrate the affects.

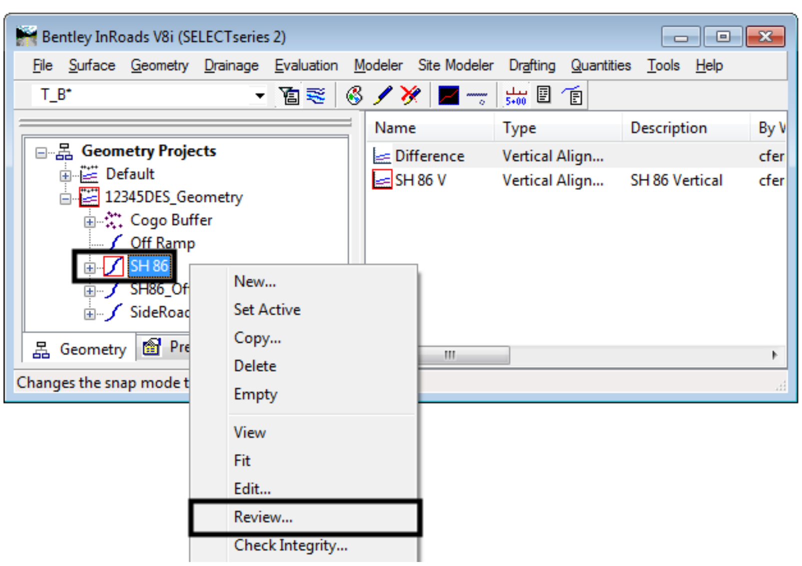
1. In the InRoads Explorer, select the **Geometry** tab.
2. Expand the **12345DES_Geometry** geometry project to show the ***SH 86*** alignment.



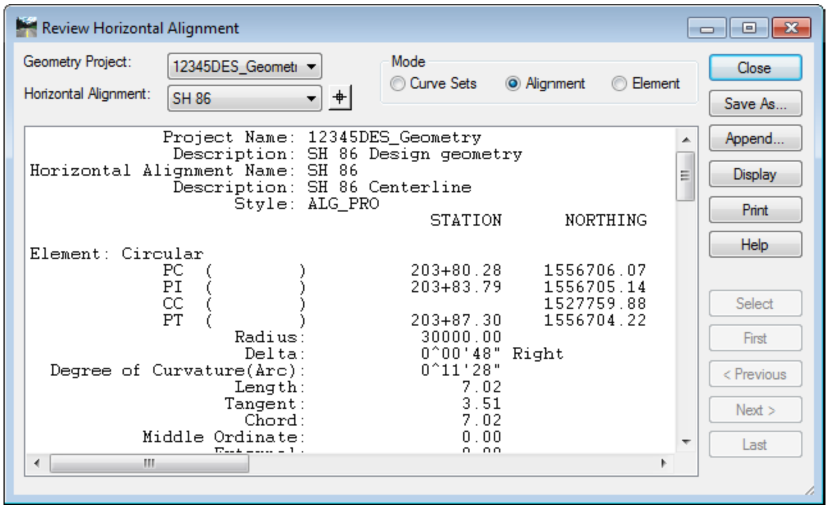
3. From the InRoads menu bar, select **File > Project Options**.
4. Verify that the ***Precision*** tab is active.

Notice that the precision for ***Station*** is set to **0.12**.

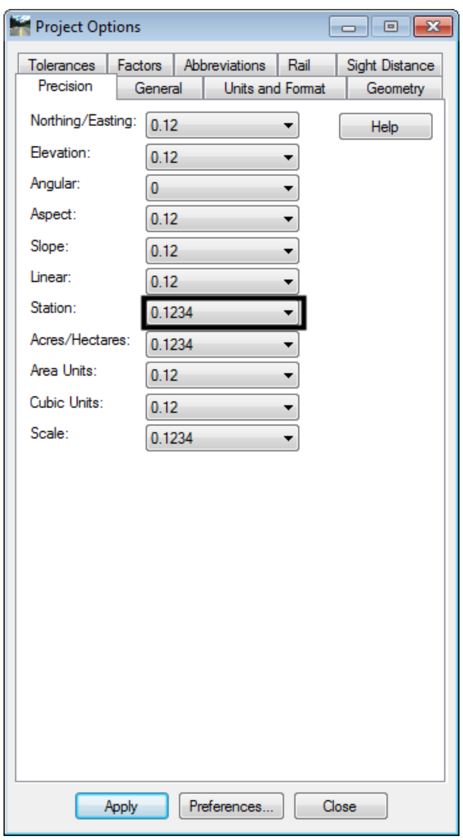
5. In the InRoads Explorer, **<R>** on the **SH 86** alignment and select **Review** from the right click menu.



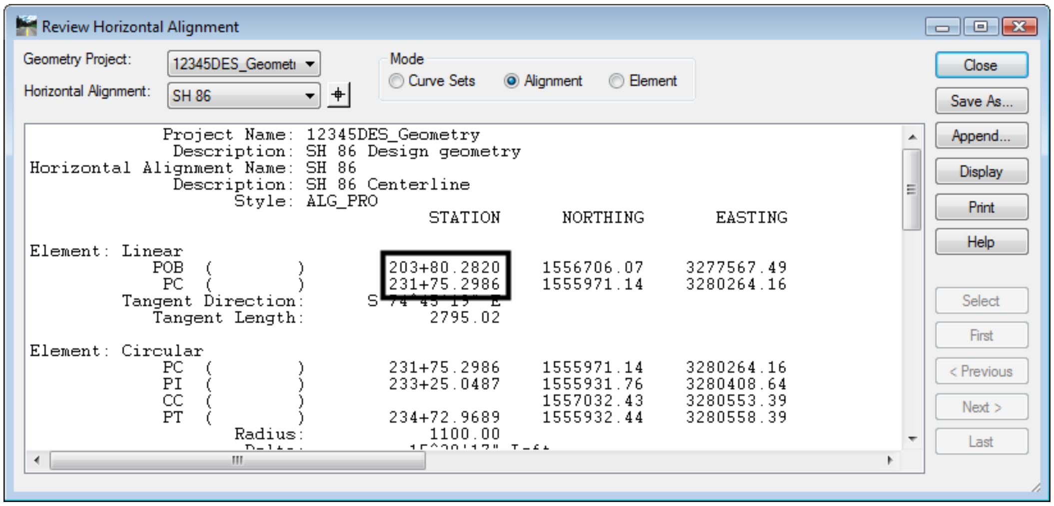
In the ***Review Horizontal Alignment*** dialog box, notice that the stations have 2 decimal places.



6. **Close** the ***Review Horizontal Alignment*** dialog box.
7. In the ***Project Options*** dialog box, change the ***Station*** precision to **0.1234**.
8. **<D> Apply**.



9. Redisplay the ***Review Horizontal Alignment*** dialog box for SH 86.

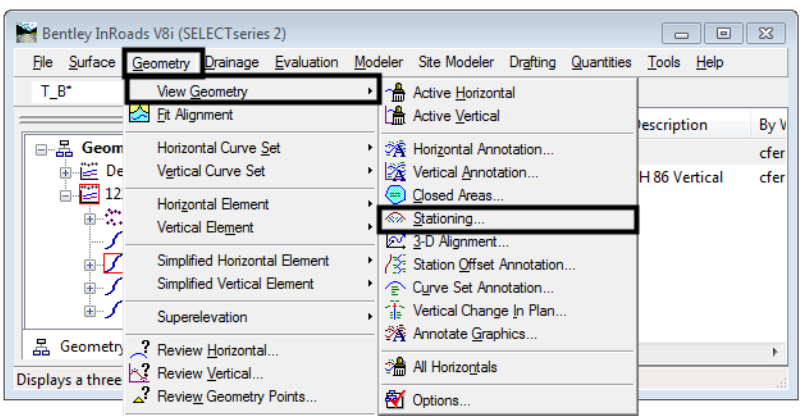


Notice that the stations now show 4 decimal places. Next the affects of factors is demonstrated.

10. Reset the ***Station*** precision back to **0.12**.

11. On the ***Project Options*** dialog box, **<D>** the **Factors** tab. Notice that the ***Text Scale Factor*** is set to **100**.

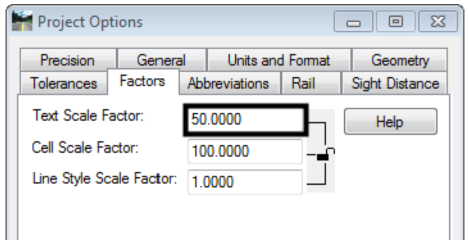
12. From the InRoads main menu, select **Geometry > View Geometry > Stationing**.



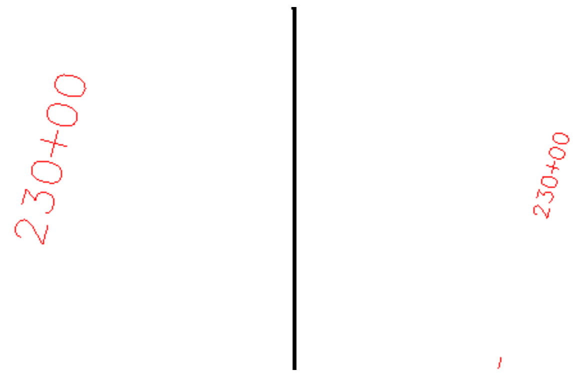
13. On the ***View Stationing*** dialog box, **<D> Apply**.

14. Zoom in on a station and note the size of the text.

15. On the ***Project Options*** dialog box, key in ***50*** for the ***Text Scale Factor*** and **<D> Apply**.



16. Redisplay the stationing and notice the change in the text size. The illustration below shows the difference.



17. Reset the ***Text Scale Factor*** to ***100***.

18. Delete all of the graphics displayed in the drawing, then close InRoads and MicroStation.

Section Summary:

- ♦ Precision controls the decimal places displayed in InRoads dialog boxes only.
- ♦ Factors control the size of text, cells, and linestyles displayed by InRoads.
- ♦ The Linestyle Scale should be set to 1, Text and Cell scales should be set to the plot scale.

Chapter Summary:

- Start a project by creating the directory for the project.
- Project defaults make it easier to Open and Save project data files.
- Locks affect the way InRoads works and displays information. These should be set as desired prior to work on the project.
- Precision and Factors affect displays in InRoads dialog boxes and items placed by InRoads. These should be set as desired prior to work on the project

LAB 2 - Review Geometry

The purpose of this lab is to go into a detailed review of the contents of the ***12345DES_Design*** geometry project ***(12345DES_Design.alg)*** file.

In subsequent labs geometry data will also be loaded from the ROW_Survey directory structure for reference purposes only. To maintain the integrity of the ROW_Survey geometry data, subsequent exercises will show you how to copy geometry projects in their entirety and also how to selectively copy information (alignments and cogo points) to a separate geometry project.

Important! Data from the ROW/Survey directory should only be modified by the ROW/Survey group. Staff from other disciplines should not modify ROW/Survey geometry projects in any way and take any precautions to ensure that it is not changed.

Chapter Objectives:

- Illustrate the process of setting active geometry.
- Review an existing geometry project.
- Review alignment attributes.
- Review alignment stationing.

The following files are used in this lab:

- C:\Projects\12345\Design\Drawings\Reference_Files\12345DES_Model.dgn
- C:\Projects\12345\Design\InRoads\12345DES_Design.alg

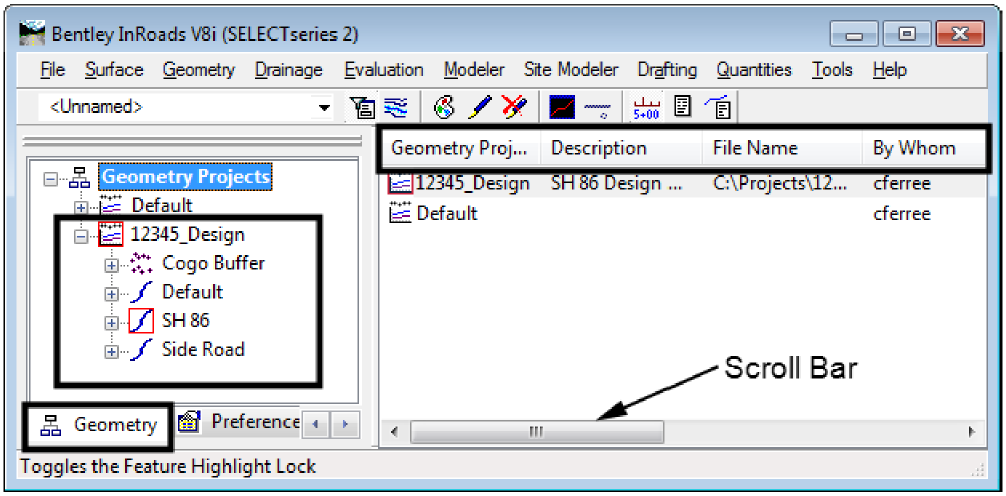
Lab 2.1 - Review Geometry Project

Section Objectives:

- ♦ Learn how to identify and change the “active” geometry.
- ♦ Learn how to review and view geometry including cogo points.
- ♦ Learn how to save the results of an InRoads report.
- ♦ Learn how to clean up MicroStation graphics and keep them in sync with InRoads data.
- ♦ Practice gathering alignment information.

1. Open the file in the **12345DES_Model.dgn** file from the **C:\Projects\12345\Design\Drawings\Reference Files** folder.
2. Open the geometry project named **12345DES_Design.alg** located in the folder **C:\Projects\12345\Design\InRoads**.

3. **Expand** the geometry project tree by selecting the + (plus) symbol located to the left of the geometry project name. You should see something similar to the image below



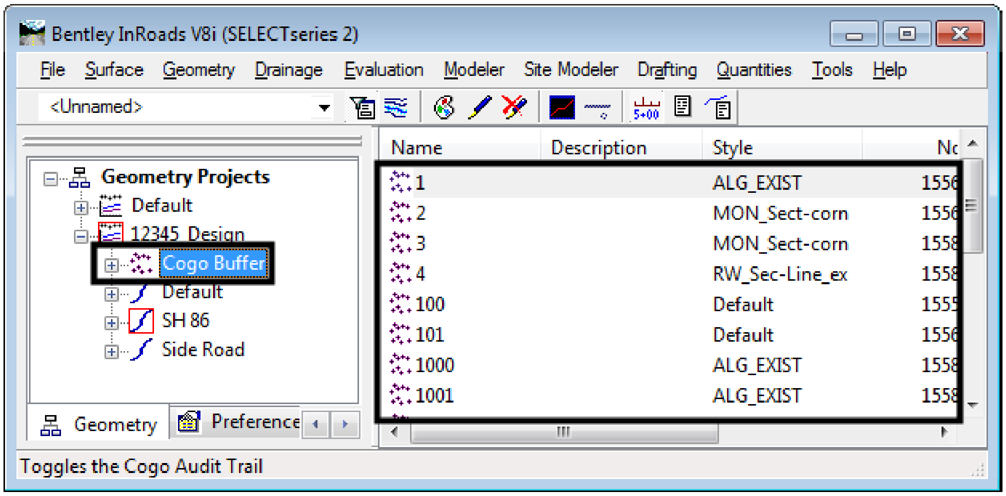
4. Look at the information pane on the right side of the InRoads main menu. Use the **Scroll bar** at the bottom of the window to view the columns of information to the right. The following is a list of columns you will see (they may be in a different order):

   - ***Name*** - The horizontal alignment name and the Cogo Buffer are shown here.
   - ***Style*** - The Style name attached the horizontal alignment is listed here.
   - ***Description*** - The horizontal alignment's description, if any, is shown here.
   - ***By Whom*** - The Windows user ID of the person who created the alignment is shown here.
   - ***Last Revised*** - This column lists the most recent revision date for the file.
   - ***Access Mode*** - This column indicates whether the file has write access or is read only.
   - ***Integrity*** - This column indicates whether the alignment elements are connected properly or not.
   - ***Curve Definition*** - This column indicates whether curves are defined by arc or chord.
   - ***Start Station*** - This column lists the beginning station value for the alignment.
   - ***End Station*** - This column lists the ending station value for the alignment.
   - ***Number of VAs*** - This column lists the number of associated vertical alignments.
   - ***Number of Superelevations*** - This column lists the number of associated superelevation definitions.

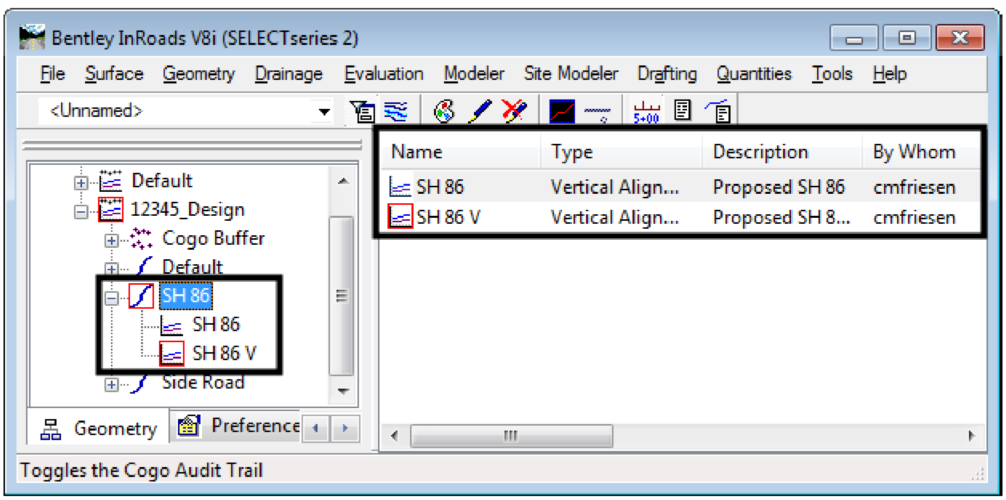
5. **<D>** on any of column headings to sort ascending or descending.

6. To reposition the columns either to the left or right, **<D>** and hold down the column heading and slide the mouse on to any of the column headings.

7. **<D>** on the **Cogo Buffer**. Notice the detail screen to the right showing the contents of the Cogo buffer. Also notice the columns showing Northing, Easting, and Elevation by adjusting the view pane.

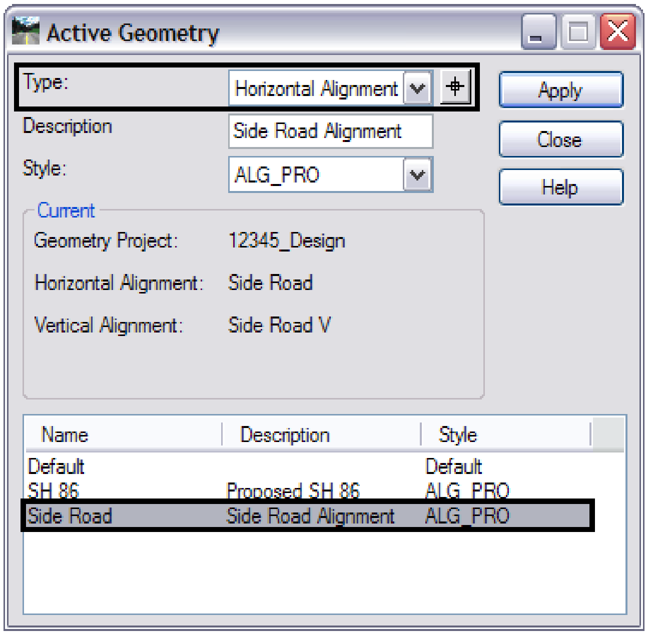


8. **<D>** on the first horizontal alignment listed. Notice the associated vertical alignment.



Only one horizontal alignment can be active at a time. Being ***active*** specifies the alignment to be modified, displayed, or defined by default in dialog boxes. To set a horizontal alignment active:

9. Select **Geometry > Active Geometry.** To display the ***Active Geometry*** dialog box.

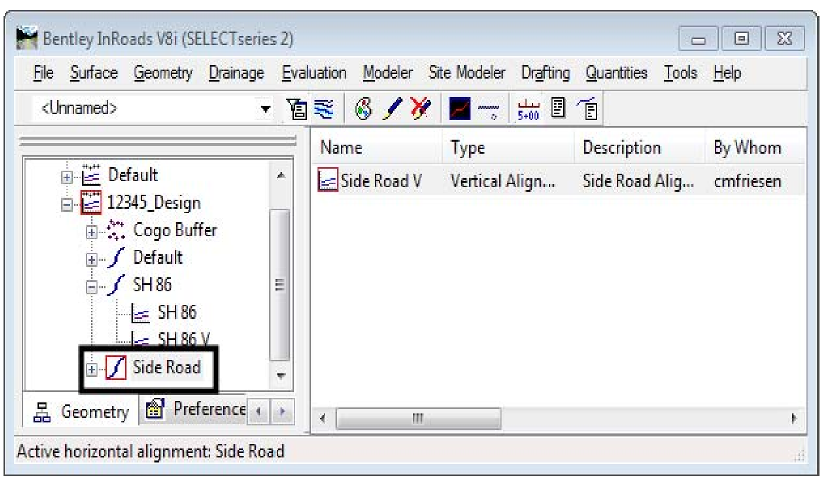


10. Set ***Type*** to **Horizontal Alignment.**

11. **<D>** on alignment **Side Road.**

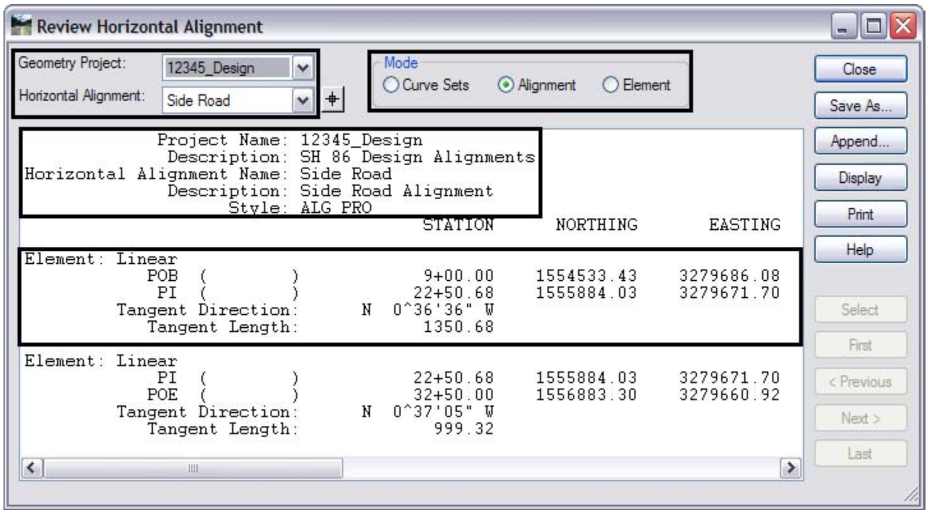
12. **<D> Apply** then **Close**.

Notice that the alignment called ***Side Road*** in the InRoads explorer pane shows a red indicator box around it signifying that it is the ***active*** alignment.



13. Select **Geometry > Review Horizontal** for a textual display of the active alignment. When reviewing an alignment, a temporary dynamic display is shown in MicroStation representing the location of the alignment being reviewed.

14. Explore the four main areas of the dialog box.



- ***Geometry Project*** and ***Horizontal Alignment (in the dialog box frame)***
  - Change the Horizontal Alignment
- ***Mode (in the dialog box frame)***
  - Change the Mode and watch how the information in the dialog box changes
- ***Geometry header (in the view port)(not displayed in Element Mode)***
  - Note the change to the **P*roject Name, Description, Alignment name***, ***Description, Geometry Style***
- ***Element Details (in the view port)***
  - The element details change according to what mode is selected.

15. Review this display for alignment information such as Cogo point ID assignments, bearings, distances, northing, easting, etc.

16. **<D>** the **Close** button**.**

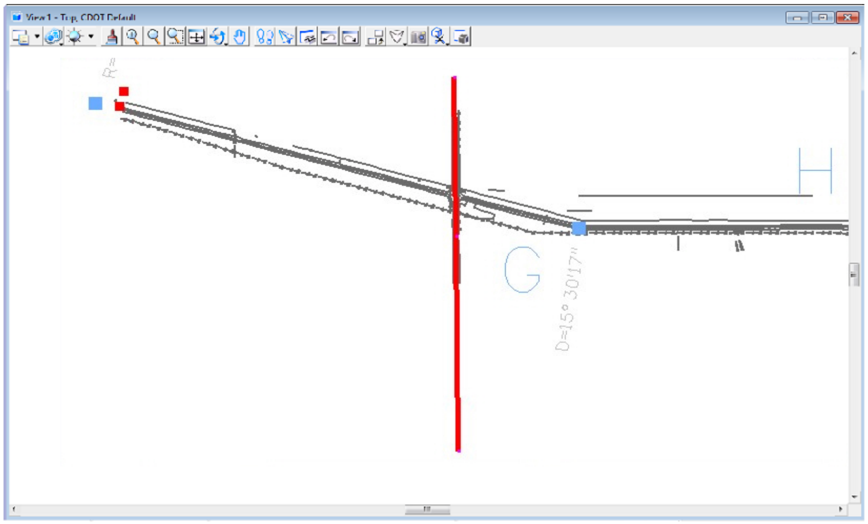
17. Verify that the ***Side Road*** alignment is active.

18. Select **Geometry > View Geometry > Active Horizontal** to display the alignment in the MicroStation file**.**

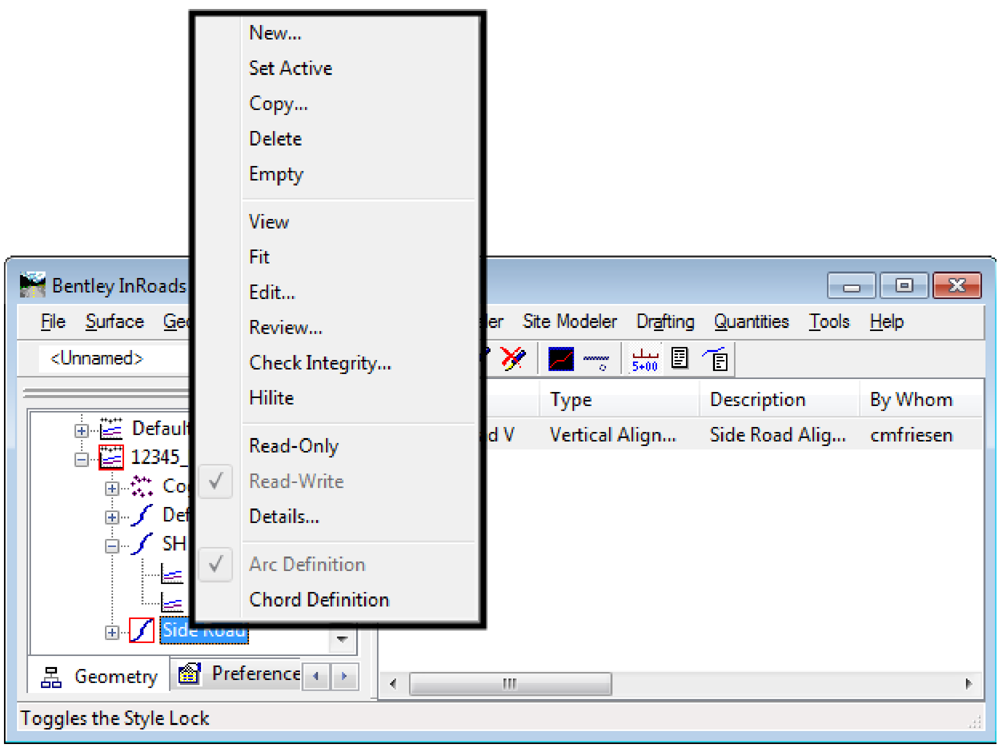
Note: It may appear that nothing happened. This is because the view window is not positioned correctly to see the data. The next step will resolve this.

19. Select **Geometry > Fit Alignment** and **<R>** (press the right mouse button) in a MicroStation view to reposition the MicroStation view to the limits of the active alignment**.**

Note: If the graphics for the existing features disappear, use the key in ***dp = -10000, 30000*** and left click in ***View 1*** to expand the MicroStation clipping planes.

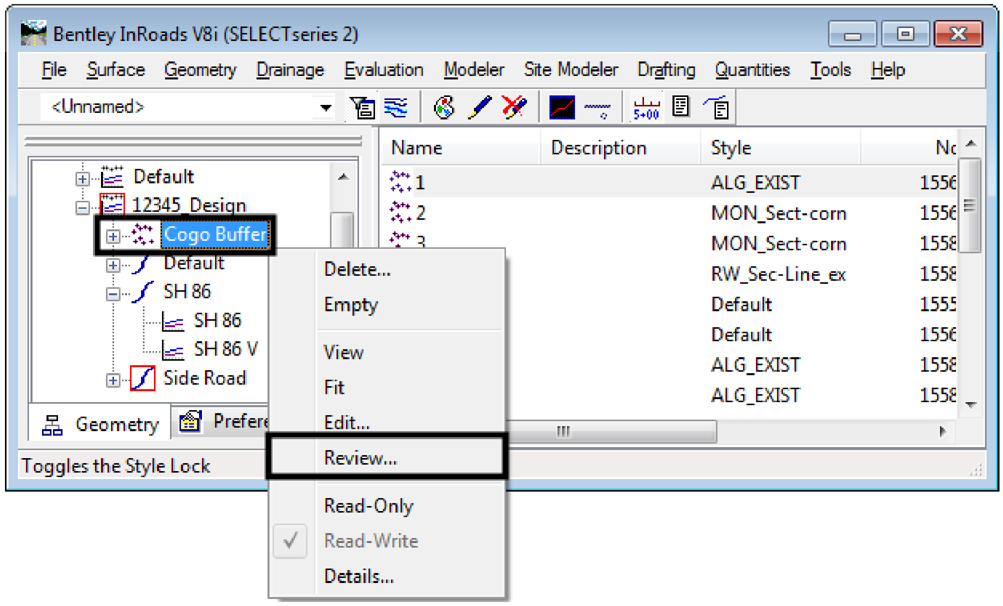


20. In the InRoads Explorer pane **<R>** (right-click) on the active alignment name. Note the ***Active***, ***View***, ***Fit***, and ***Review*** commands are available from the right click menu.



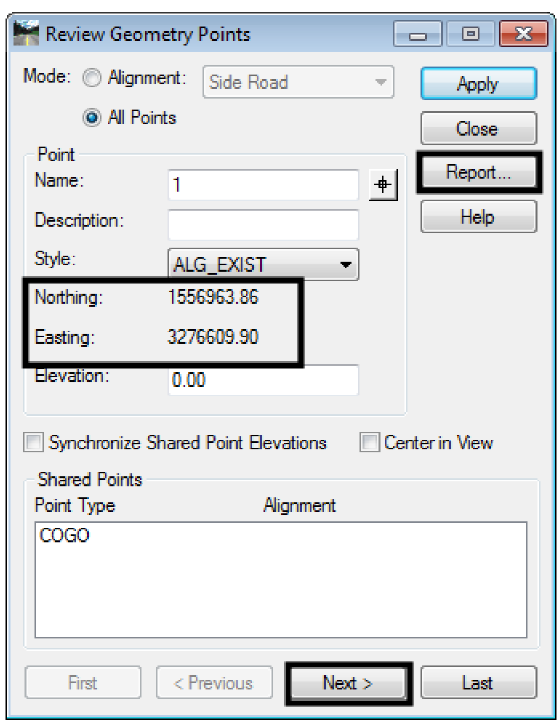
21. Experiment using this right click menu with any alignment.

22. In the InRoads Explorer pane **<R>** on the **Cogo Buffer** and select **Review...** to display the ***Review Geometry Points*** dialog box.

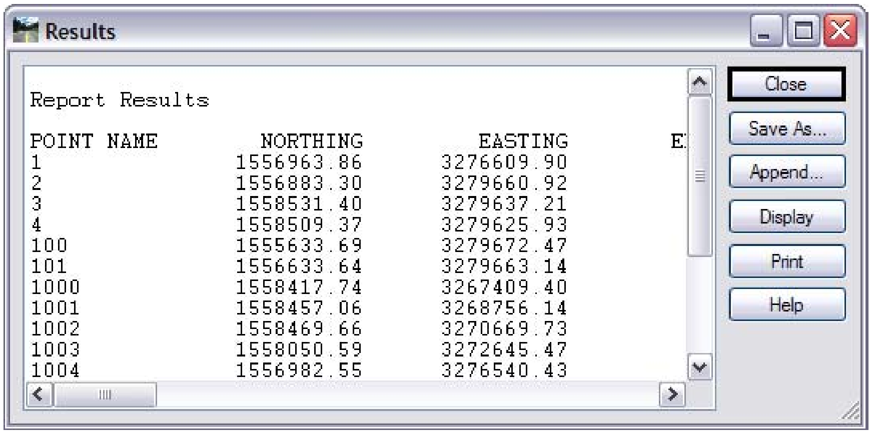


23. **<D>** the **Next** button to review the information about subsequent points. Notice the available navigation buttons ***First, Previous, Next,*** and ***Last***.

24. **<D> Report** to list all Cogo points stored in the active geometry project.



25. Examine the Results dialog box.



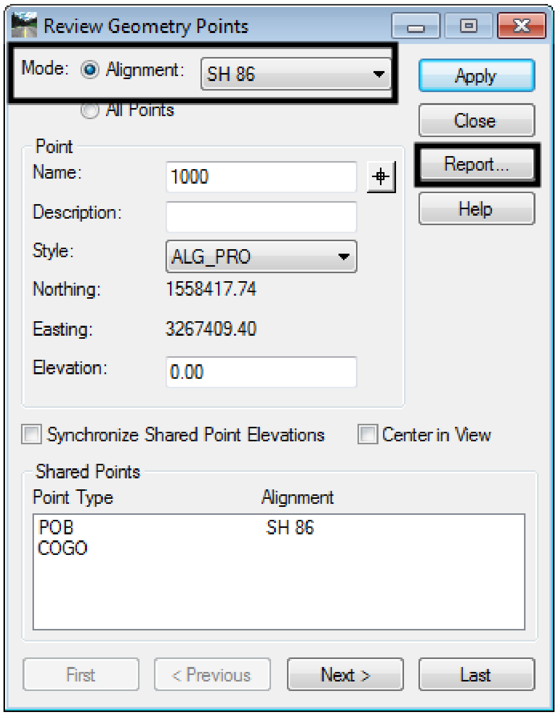
The buttons on the right side of the ***Results*** dialog box allow you to save or display this report. Below is a description of each button's function:

- ***Close*** - closes the ***Results*** dialog box
- ***Save As*** - saves the contents of the dialog box to an ASCII (text) file
- ***Append*** - appends to an existing ASCII file
- ***Display*** - allows the user to select a location in the MicroStation drawing to place the dialog contents as text and using the active text and element settings when writing the text to the CADD file
- ***Print*** - sends the contents to the default system printer
- ***Help*** - displays the InRoads help file for this command

26. **<D>** the **Close** button in the ***Results*** dialog box

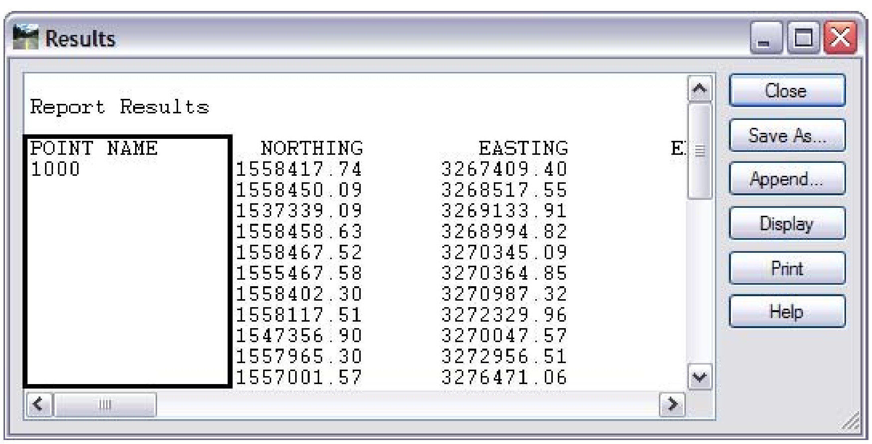
27. In the ***Mode*** section of the ***Review Geometry Points*** dialog, toggle on **Alignment**. Notice that the Alignment drop-down list is activated.

28. Select **SH86** in the ***Alignment*** drop-down list.



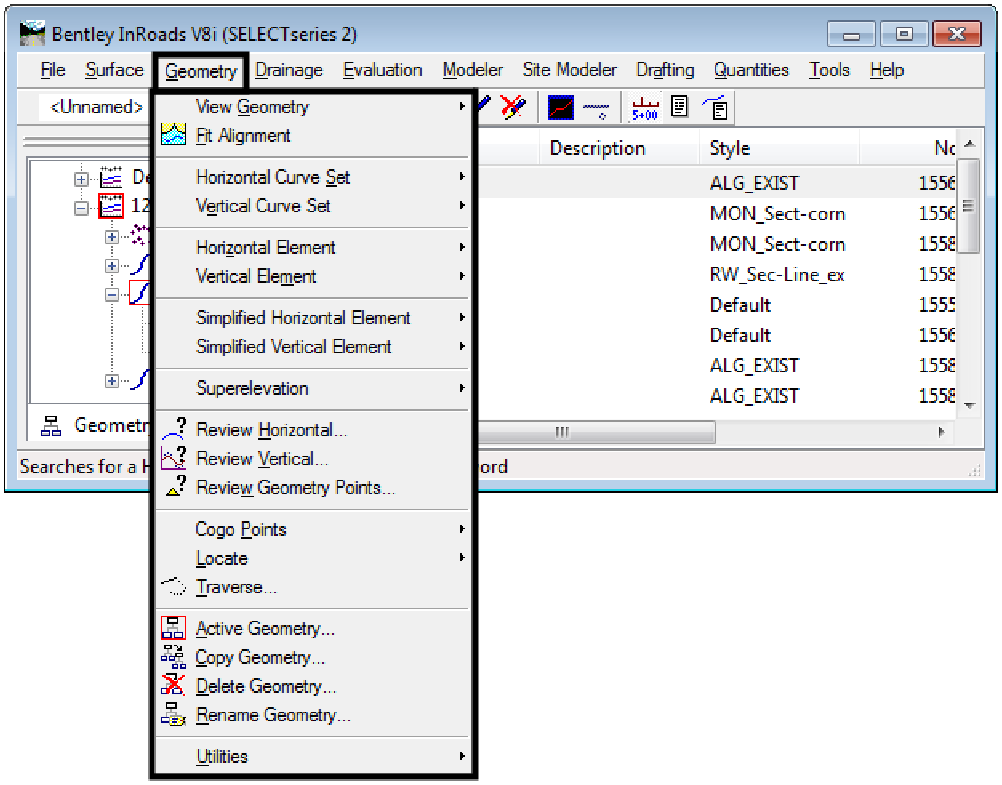
29. **<D>** the **Report** button again to review the vertices of the selected alignment.

Note: The ***Point Name*** column is not showing point numbers or names (except for point 1000) indicating this alignment was created as unnamed geometry points.

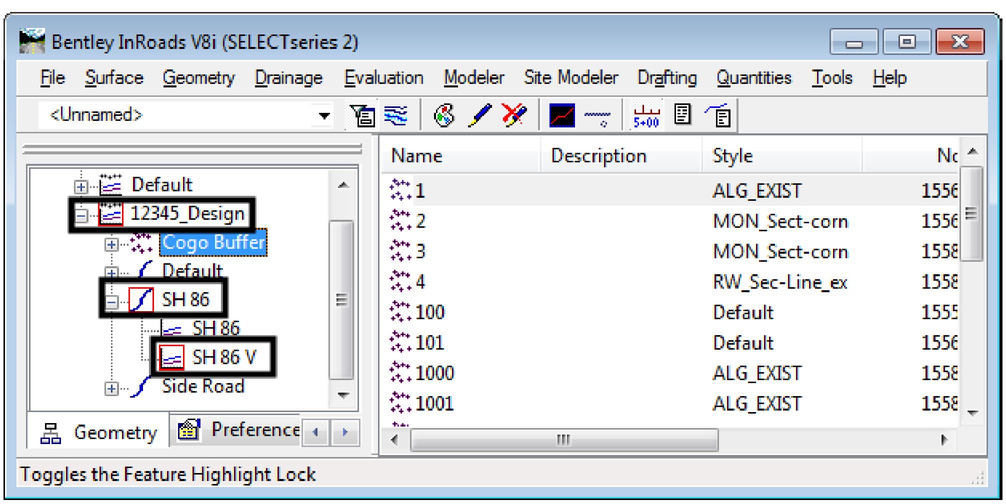


30. **<D>** the **Close** button in both the ***Results*** and ***Review Geometry Points*** dialog boxes.

Note: The previous steps used the right click menus, all actions can also be found under the ***Geometry*** pull-down menus.



Multiple Geometry Projects can be loaded into memory simultaneously. However, only one geometry project, horizontal, and vertical alignment can be active at any given time.



31. Use the previously covered commands to display the horizontal alignments ***SH 86*** and ***Side Road***.

32. Use the review command to investigate the various data for the same two alignments.

    - What is the beginning station value for:

SH 86 ________________

Side Road _________________

- ♦ What is the overall length of:

SH 86 ________________

Side Road _________________

- ♦ What is the shortest radius used in:

SH 86 _________________

Side Road _________________

Section Summary:

- ♦ Many of the view and review commands can be accessed from the right click menu as well as the main toolbar
- ♦ Reports displayed by review commands can be saved to a text file
- ♦ Use the Mode options, where available, to display data in different formats

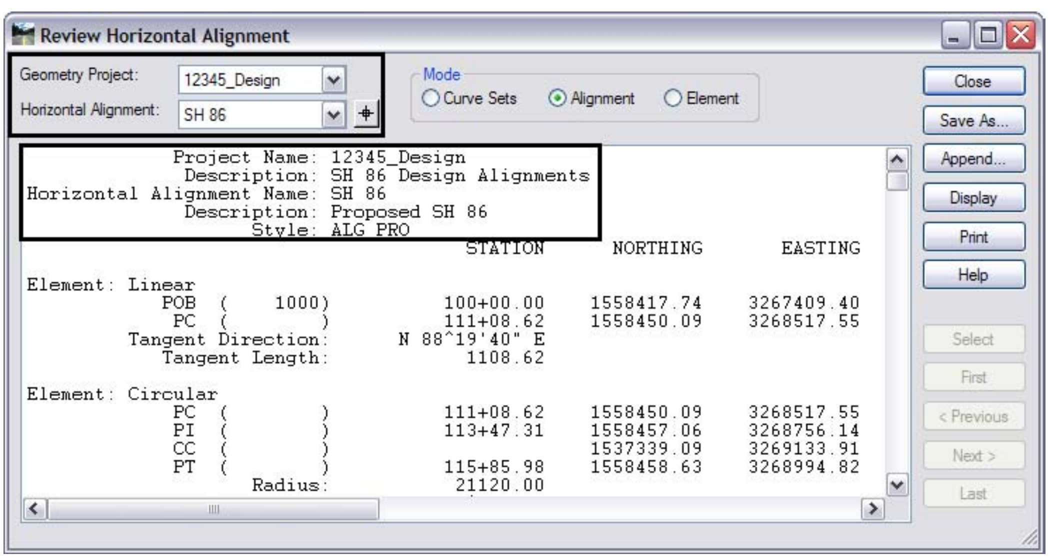
Lab 2.2 - Review Alignment Attributes

The geometry ***Name***, ***Description***, and ***Style*** are assigned to an alignment or Cogo point when it is created. These attributes can be queried by utilizing the review geometry command.

Section Objectives:

- ♦ Review Alignment Attributes
- ♦ Review Cogo Point Attributes

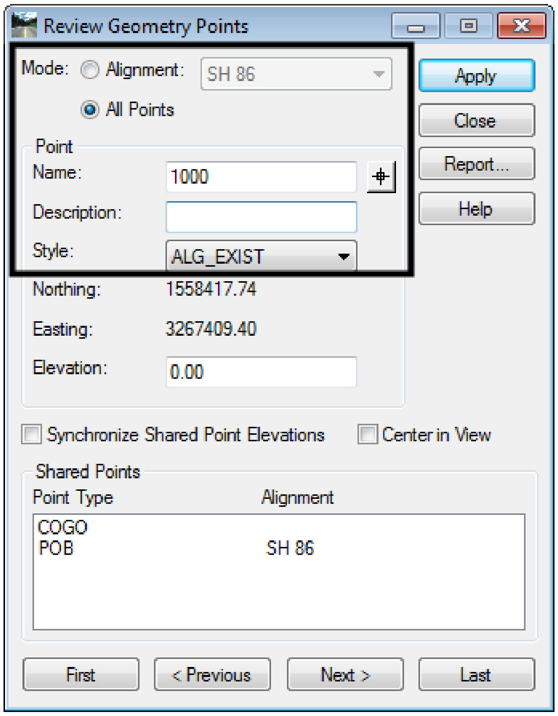
1. Select **Geometry > Review Horizontal...**



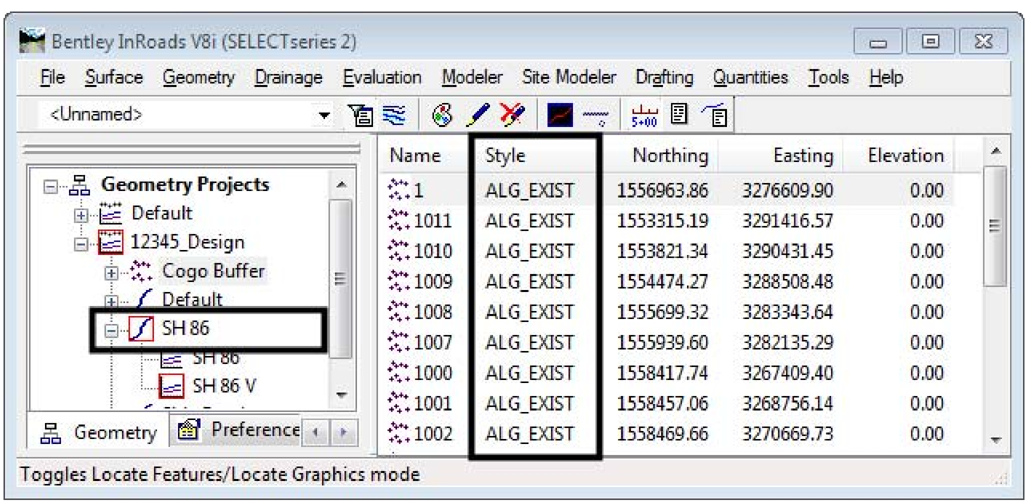
2. Using the selection box labeled ***Horizontal Alignment***, Compare the settings for alignment **SH 86** with the attributes for ***alignment*** **Side Road**. Note the changes in Description and Style.

3. Close the ***Review Horizontal Alignment*** dialog box.
4. Select **Geometry > Review Geometry Points…** to review Cogo point names, descriptions, and style assignments.

   Note: This dialog box is used to review both alignments and Cogo points based on the ***Mode*** setting.



5. This information can also be accessed through the InRoads explorer pane.**<D>** on the ***Cogo Buffer*** and notice the description(s) and Style(s) as displayed in the information pane.



Section Summary:

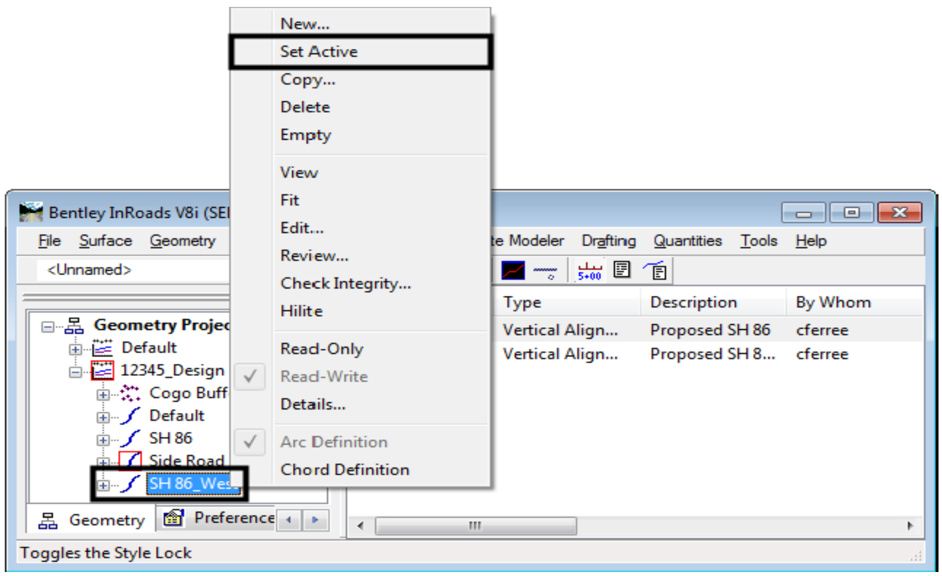
- Geometry data can be reviewed through a variety of commands, accessed through the Geometry menu on the main bar or from right click menus

Lab 2.3 - Review Alignment Stationing

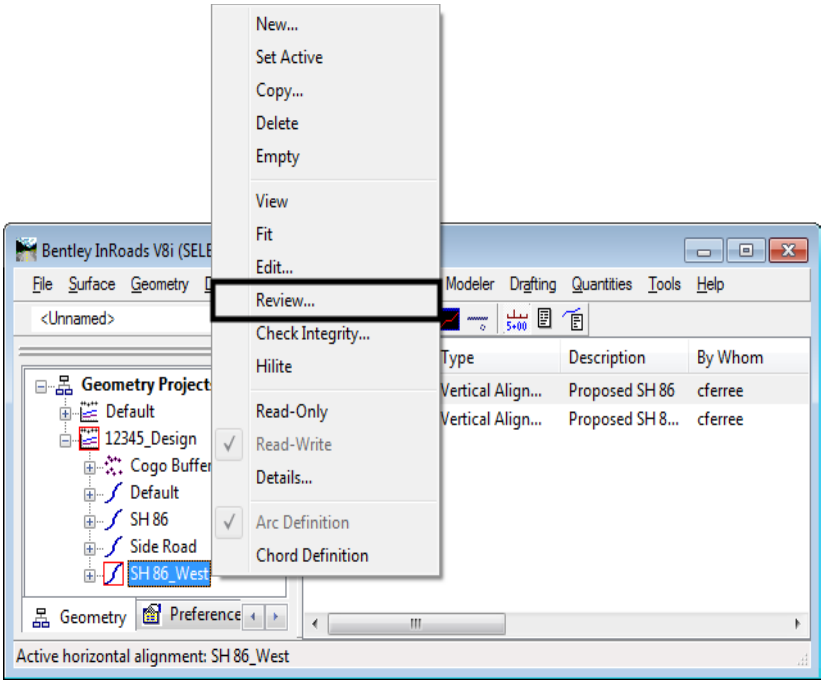
The default station at the beginning of a newly created horizontal alignment is 0+00. If the alignment previously existed, the beginning station may not be 0+00. The beginning station value can be changed to accommodate the needs of the project as shown in a later lab.

The first thing to do is to determine the current beginning station by using the review alignment commands.

1. Make **SH 86_West** alignment active by **right-clicking** on the alignment name and selecting **Set Active** from the right click menu.

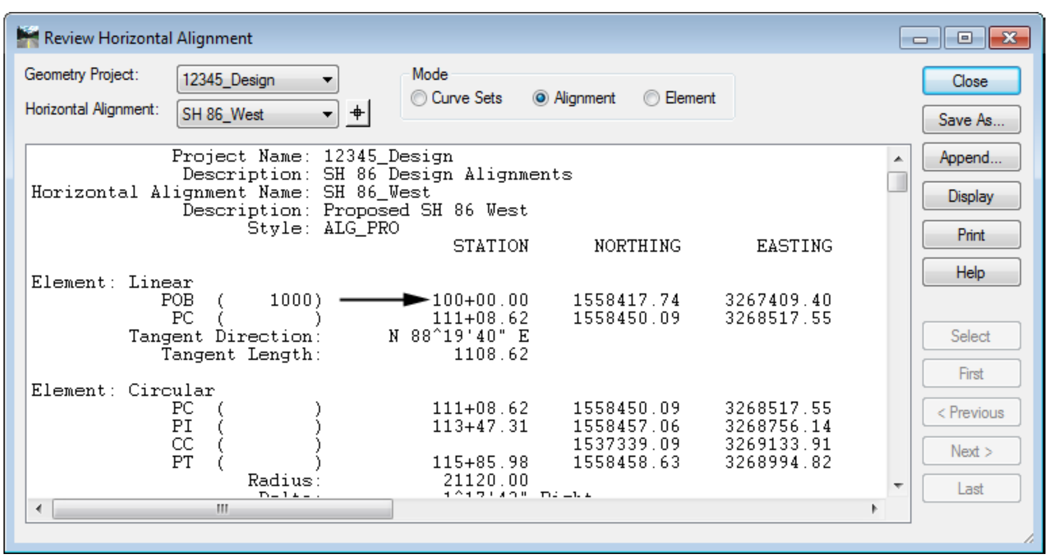


2. **Right-click** on the alignment **SH 86_West** and select ***Review*** from the right click menu. The ***Review Horizontal Alignment*** dialog box is displayed.



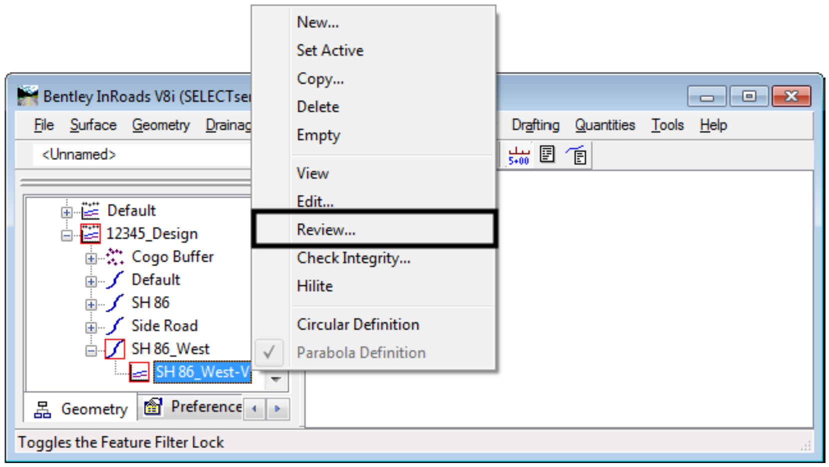
Note: Right click menus can be accessed from either the InRoads explorer or information panes. Also note that selecting an alignment for review switches it to being the ***active*** alignment.

3. Write down the initial station value assigned to horizontal alignment **SH 86_West:** ____________.

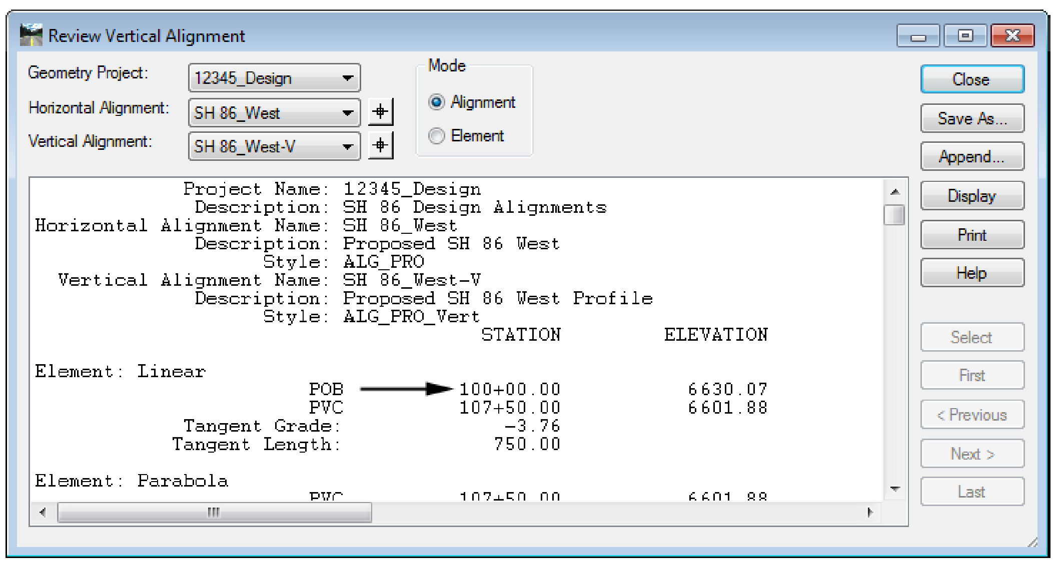


4. Close the ***Review Horizontal Alignment*** dialog box.

5. Review the ***Vertical*** alignment **SH 86_West-V** associated with the horizontal alignment SH 86_West.



6. Write down the initial station value assigned to vertical alignment **SH 86-West-V:** ____________.



7. Close the ***Review Vertical Alignment*** dialog box.

8. Delete all of the graphics in this file, then close InRoads and MicroStation.

Section Summary:

- ♦ The beginning and ending stations can be found in the information pane or the review alignment dialog boxes

Chapter Summary:

- Use the right click menus to find many of the view and review geometry commands without searching the InRoads main menu
- Use the navigation buttons provided in the review dialog boxes to move through long reports

- The attributes for geometry elements can be found in the information pane or in review reports

LAB 3 - Geometry Annotation

This lab demonstrates how annotate horizontal geometry, set and display alignment stationing, and use horizontal alignment tracking tools.

Chapter Objectives:

- Display horizontal alignments.
- Annotate horizontal alignments and cogo points.
- Reset stationing on an alignment.
- Display stationing.
- Add a station equation.
- Use Tracking and Horizontal Alignments Tracking.

The following files are used in this lab:

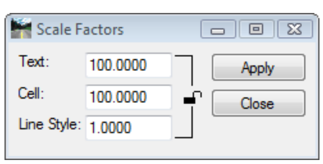
- C:\Projects\12345\Design\Drawings\Reference_Files\12345DES_Geometry-Annotation.dgn
- C:\Projects\12345\Design\InRoads\12345DES_Design.alg
- C:\Projects\12345\Design\InRoads\12345 existing ground.dtm

Lab 3.1 - Geometry Display

Section Objectives:

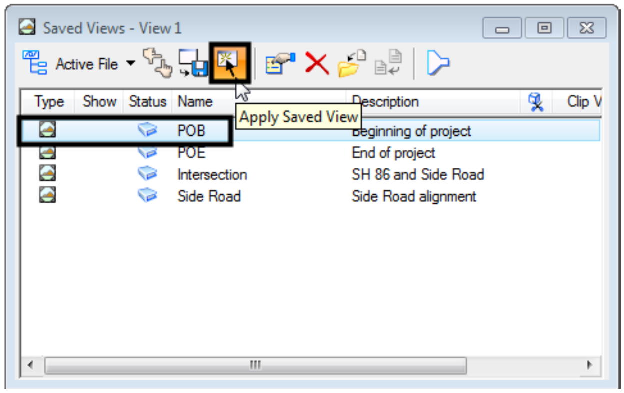
- Set the proper scale factors.
- Open a saved view in MicroStation.
- Display alignments using the View and Annotation commands.

1. Select **Tools > Global Scale Factors** and set the scales to ***100*** for ***Text*** and ***Cell*** and ***1*** for ***Line Style***.



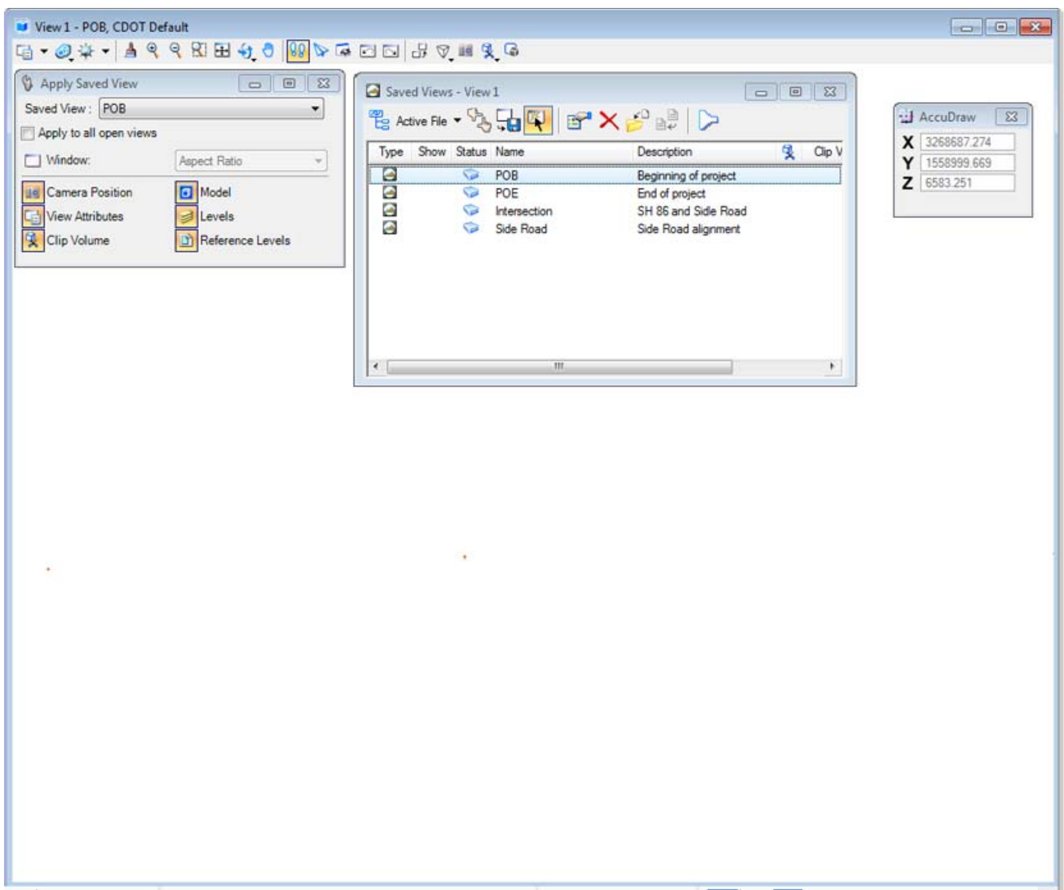
2. **<D> Apply** then **Close** to accept the changes and dismiss the dialog box.
3. Using the ***MicroStation*** menus, select **Utilities > Saved Views** to open the saved views dialog box.

4. **<D>** on the name **POB**, **<D>** the **Apply Saved View** button, then **<D>** in **View 1**.

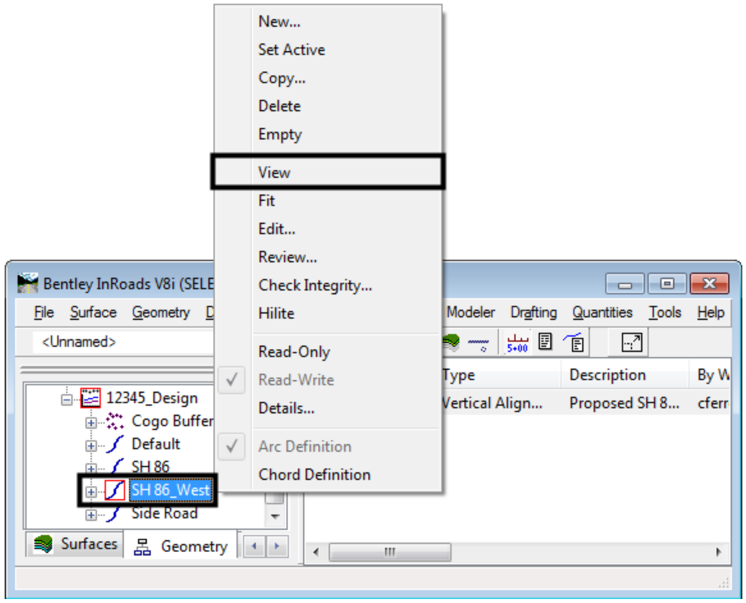


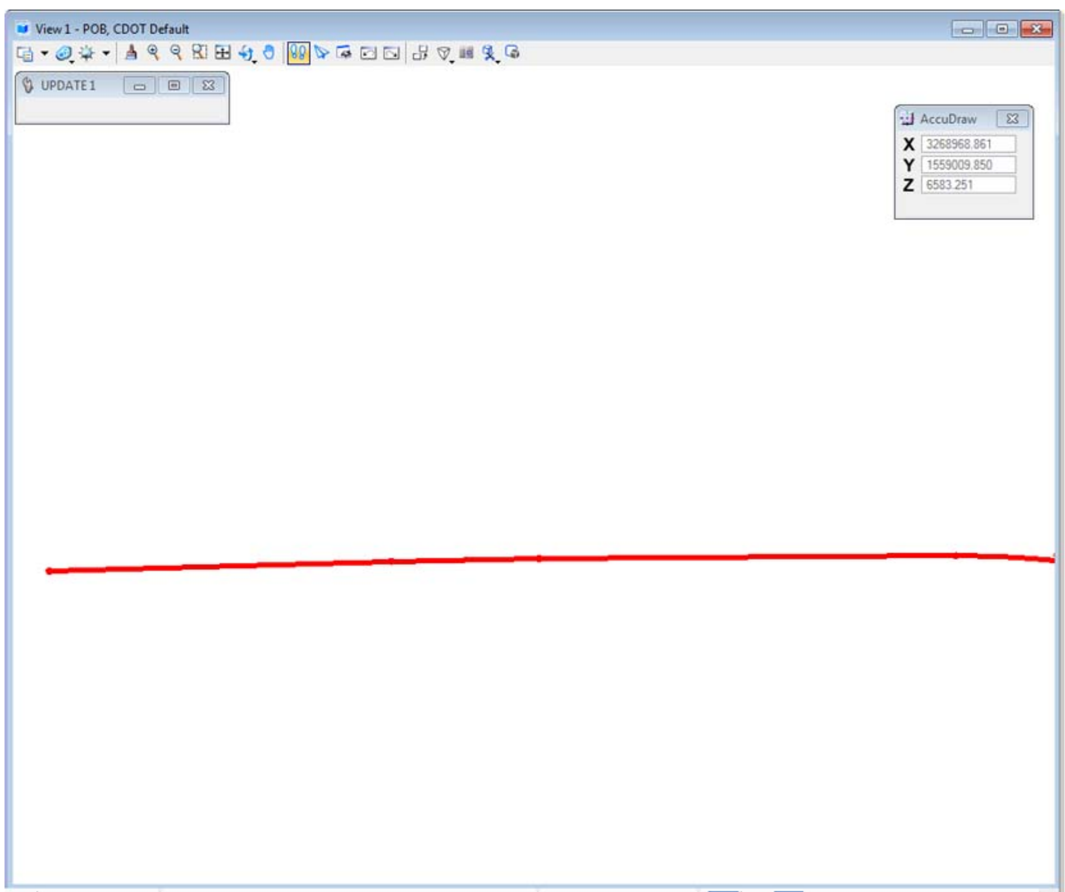
5. Close the ***Saved Views*** dialog box.

Below is an example of the saved view. Only two small symbols are visible.



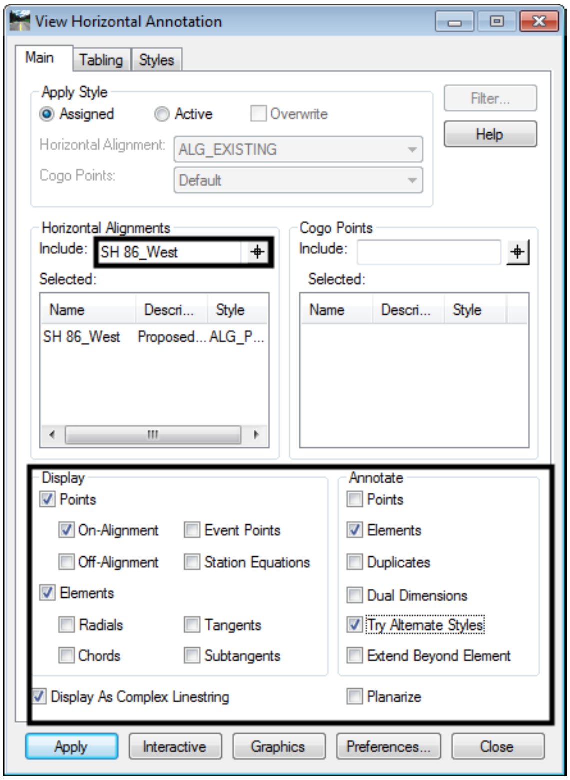
6. Display alignment **SH 86_West** from the Geometry Project ***12345_Design*** by right-clicking **<R>** on the alignment name and selecting **View** from the right click menu.





The alignment display is based on the geometry style assigned to the alignment. This display method does not allow the user to annotate of the geometry. The next steps illustrate how to display various types of horizontal alignment data.

7. Select **Geometry > View Geometry > Horizontal Annotation**.

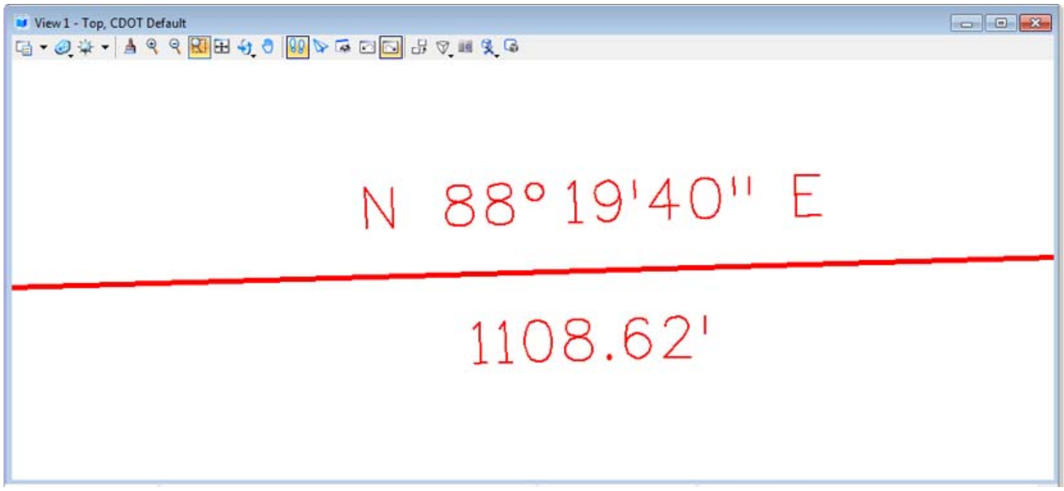


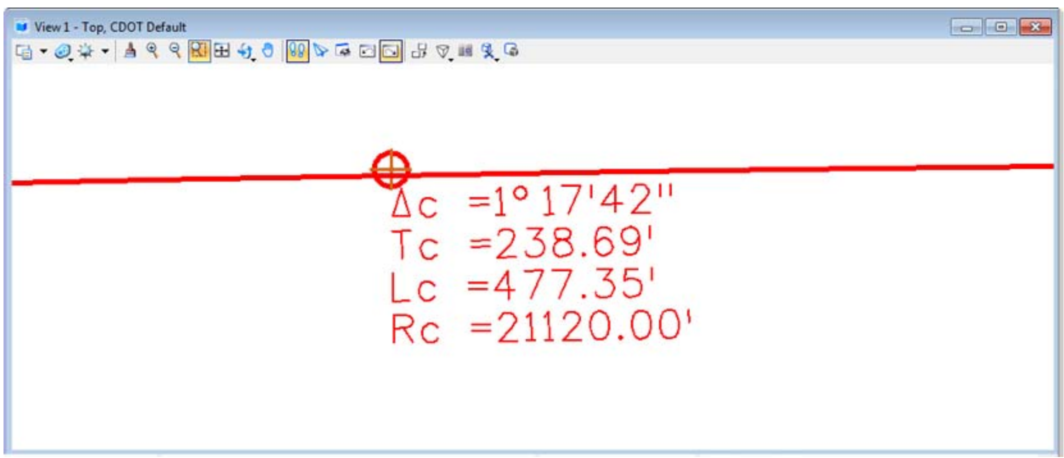
8. Key in ***SH 86_ West*** in the ***Annotate*** field and ***Tab*** from the field.

9. Set options for the ***Display*** and ***Annotate*** sections of the dialog box as shown in the above illustration.

10. **<D>** the **Apply** button. The ***SH86_West*** alignment and its annotation are displayed.

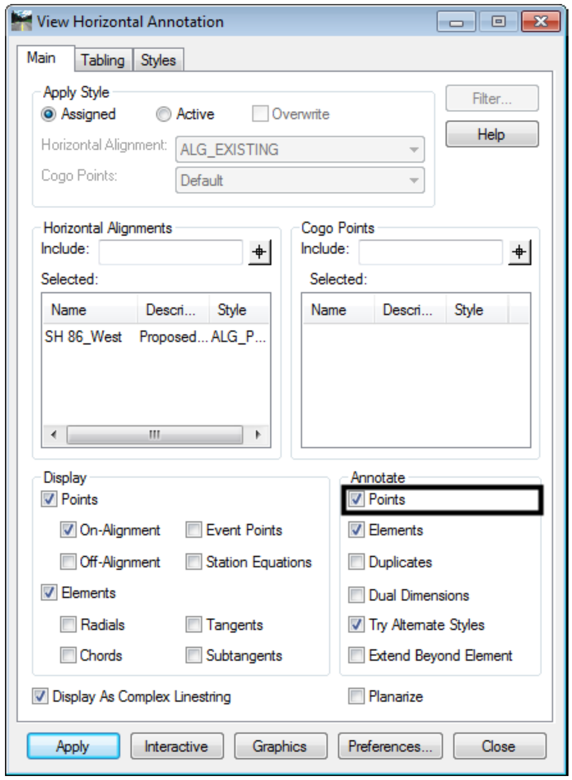
11. Note how ***Bearing*** and ***Distance*** annotation is displayed along the tangents. If the alignment contains horizontal curves, curve data will be displayed.



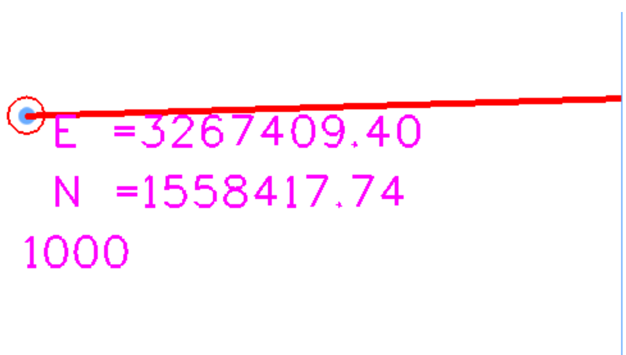


12. Return to the **View Horizontal Annotation** dialog box.

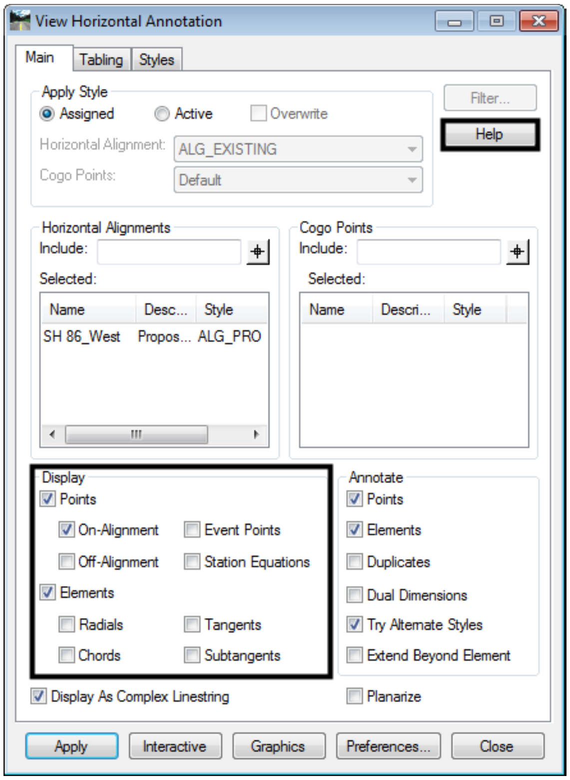
13. In the ***Annotate*** area of the ***Main*** tab, Toggle on ***Points*** and **<D> Apply**



In addition to annotation for tangents and curves, notice that alignment vertices are also annotated.



14. On the **Main** tab, click the **Help** button and review the descriptions for the various components that can be displayed.



15. Experiment displaying an alignment with ***Points*** and ***Elements*** turned on or off in both the ***Display*** area and the ***Annotate*** area.

16. Close the ***View Horizontal Annotation*** dialog box.

Section Summary:

- InRoads displayed graphics are governed by the Global Scale Factor in InRoads. The MicroStation Annotation Scale has no affect on these elements.
- The view alignment commands (from the right click menu or from Geometry > View Geometry > Active Horizontal) only display the lines and arcs that make of the alignments path.
- Horizontal Annotation also displays the alignment's path and it can display other geometry data as well.

Lab 3.2 - Selecting Multiple Alignments for display and/or Annotation

Section Objectives:

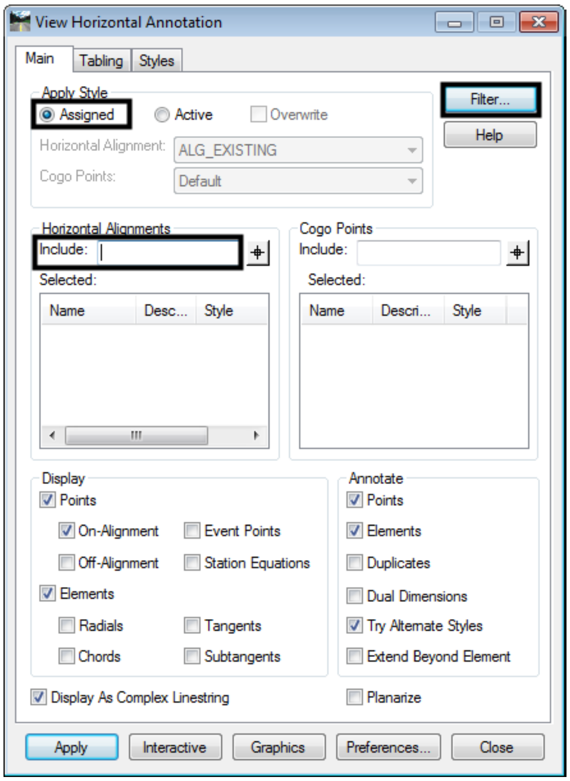
- Illustrate how to display and annotate multiple horizontal alignments at one time.

1. Select **Geometry > View Geometry > Horizontal Annotation**.

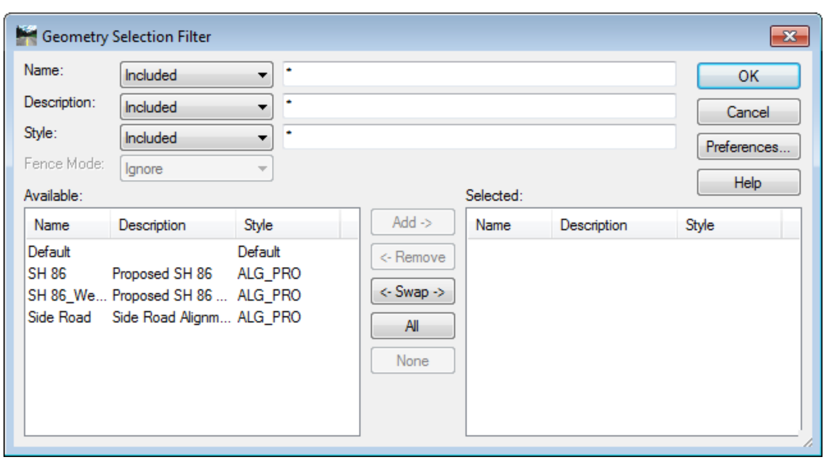
2. **<D>** the ***Main*** tab.

3. Set the ***Apply Style*** to **Assigned**.

4. **<D>** in the ***Include*** field in the ***Horizontal Alignments*** area. The ***Filter*** button becomes active.



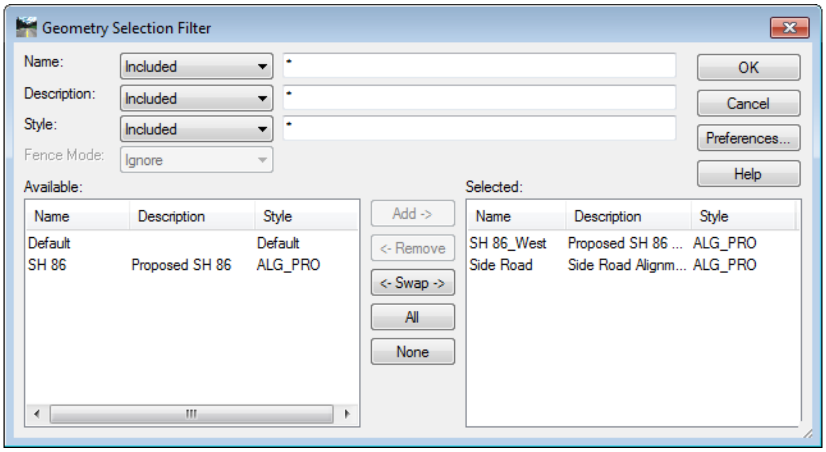
5. **<D>** the **Filter** button to display the ***Geometry Selection Filter*** dialog box.



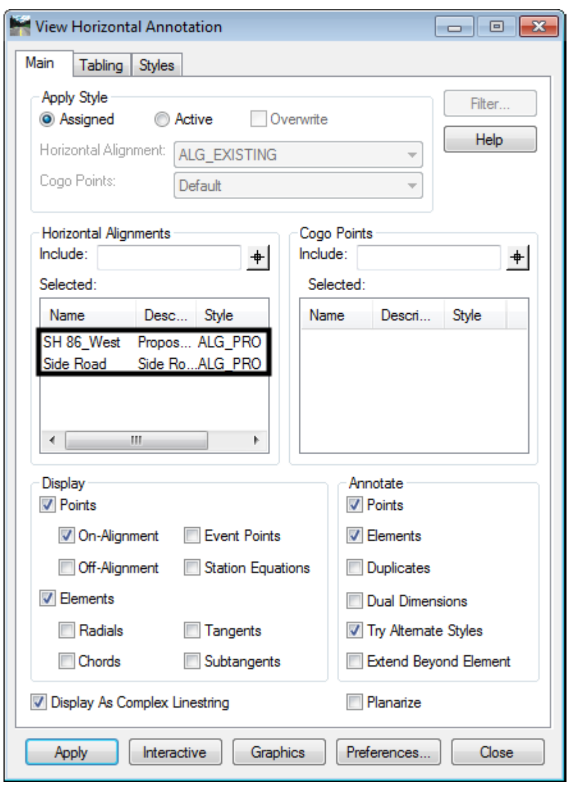
Note: ***Available*** alignments are shown on the left, ***Selected*** (for display or annotation) alignments are shown on the right. This makes it possible to select multiple alignments for display or annotation.

6. Move the alignments **SH 86_West** and **Side Road** from the ***Available*** list to the ***Selected*** list by highlighting their names in the ***Available*** list and then **<D>** the **ADD** button (or **<D><D>** on the names).

   Note: To sort the data in this dialog box, **<D>** on the column headers. To select multiple alignments use of the ***<CTRL>*** or ***<Shift>*** keys.

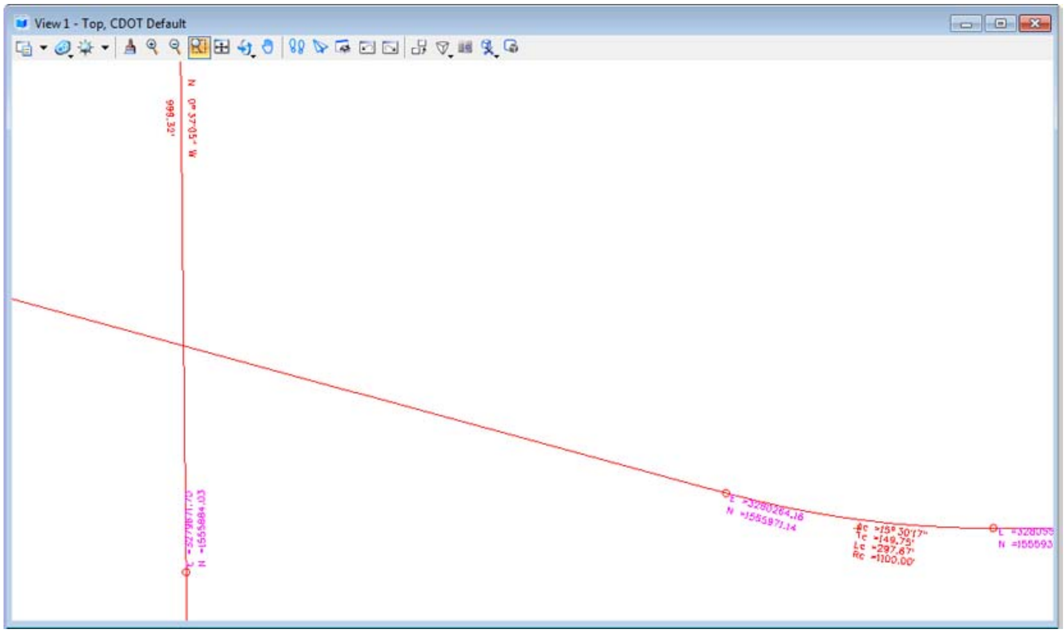


7. **<D> OK** to dismiss the ***Geometry Selection Filter*** dialog box and populate the ***Horizontal Alignments Selected*** field of the ***View Horizontal Annotation*** dialog box.



8. **<D> Apply** and the selected alignments are displayed in MicroStation.

9. Review the results in MicroStation.



Section Summary:

- Alignments can be selected for annotation by key in, graphic selection using the  button, or by using the Filter options.
- The Display area is used to turn on or off the display of the geometry elements.
- The Annotate area is used to turn on and off the text data associated with the geometry elements.

Lab 3.3 - Display or Annotation of Cogo Points

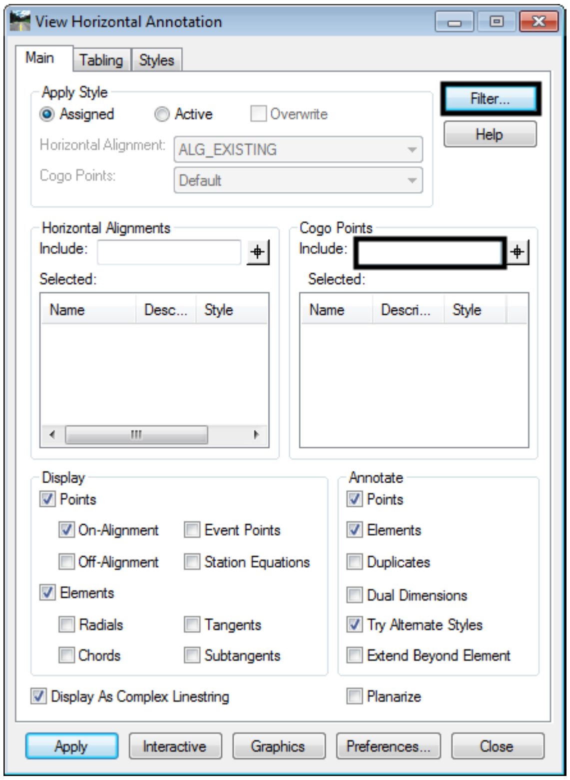
Section Objectives:

- Illustrate a method for defining cogo points for display and/or annotation.

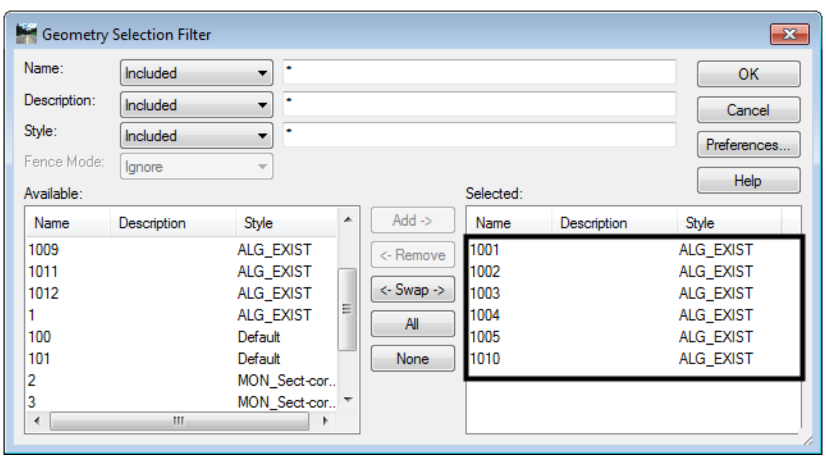
  Note: Whether you are annotating Points or Alignments, keep in mind that the element selection button  can be used to graphically identify the geometry of interest. This is universally true in InRoads whenever the selection button is displayed.

10. **<D>** the ***Include*** field in the ***Cogo Points*** area to activate the ***Filter*** button

11. **<D>** the **Filter** button. The ***Geometry Selection Filter*** dialog box is displayed.



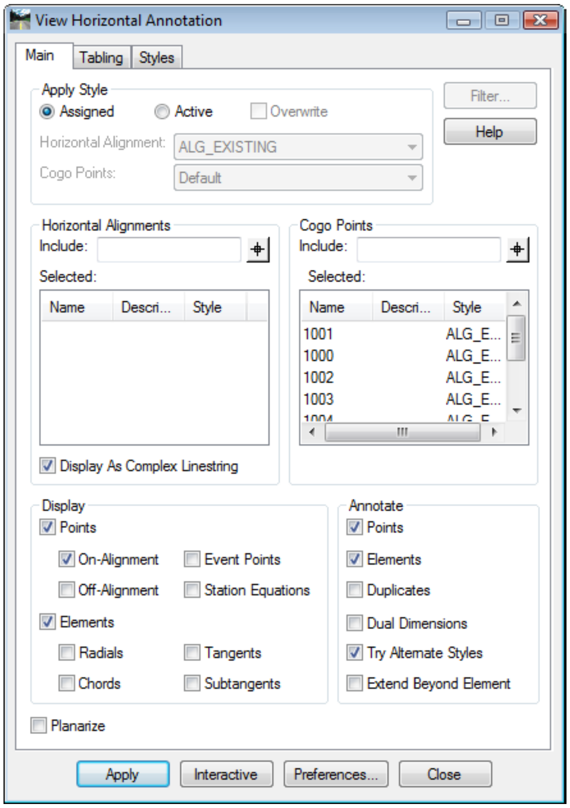
12. Select points **1001-1005 & 1010** from the ***Available*** field and add them to the ***Selected*** field.

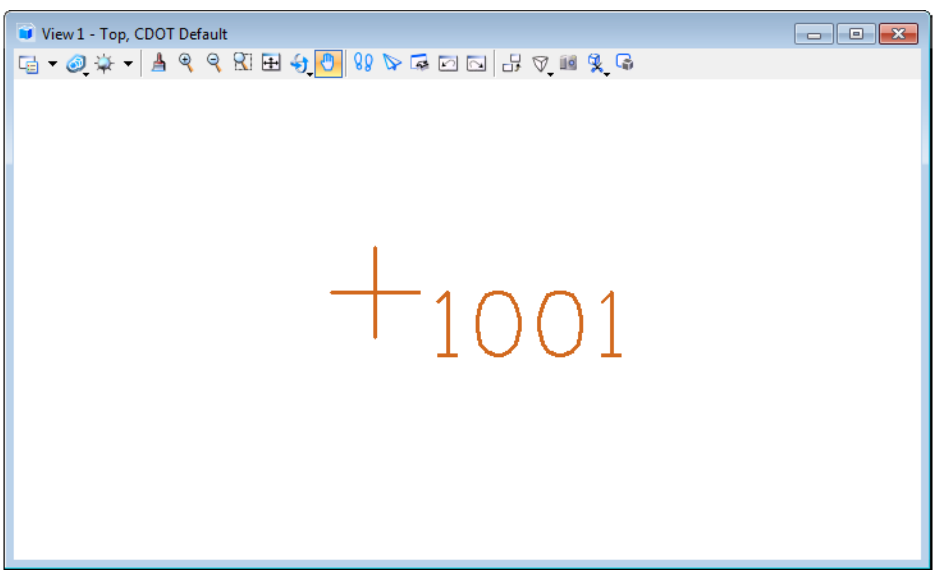


13. **<D>** the **OK** button. The points populate the ***Selected*** field.

14. **<D> OK** to dismiss the ***Geometry Selection Filter*** dialog box and populate the ***Cogo Points Selected*** field of the ***View Horizontal Annotation*** dialog box.

15. **<D>** the **Apply** button in the ***View Horizontal Annotation*** dialog box.





16. Experiment displaying various ***Alignments*** and ***Points*** with the assorted settings.

17. Close the ***View Horizontal Annotation*** dialog box.

Section Summary:

- Cogo Points can be selected for annotation by key in, graphic selection using the  button, or by using the Filter options.
- In the Display area, the Points toggle is used to turn on or off the display of the geometry points.
- The Annotate area is used to turn on and off the text data associated with the geometry elements.

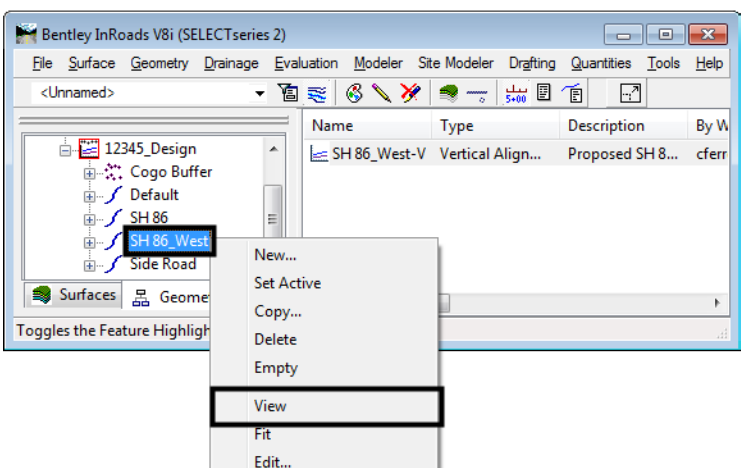
Lab 3.4 - Displaying Stationing

Section Objectives:

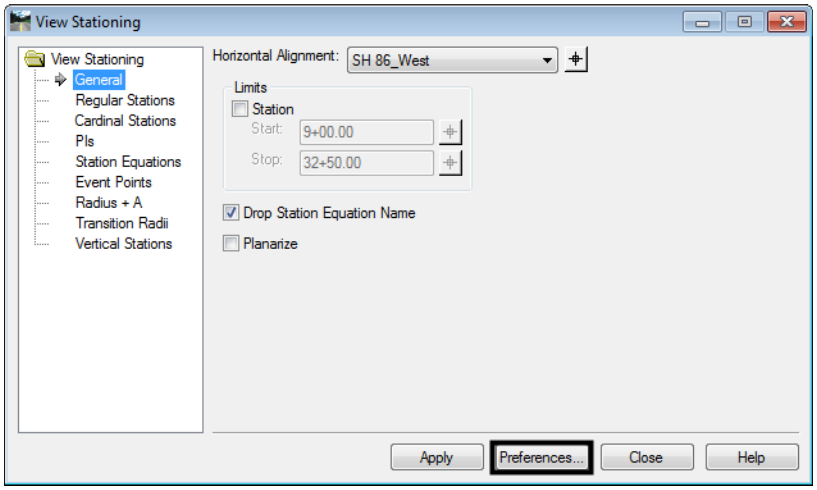
- Display stationing and alignment keypoints.
- Use the Symbology toggles to turn on and off various items.

1. Prior to displaying the stationing, display the linework for the horizontal alignment **SH 86_West.**

   Right-click on the alignment name in the InRoads explorer pane and select ***View*** from the right click menu.



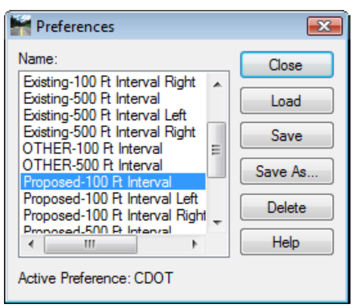
2. Select **Geometry > View Geometry > Stationing.** The ***View Stationing*** dialog box is displayed.



3. **<D>** the ***Preferences*** button.

   Note: The Preferences dialog box is used to load predefined settings for a particular tool. In the View Stationing dialog box the preference sets the interval and symbology of the display graphics.

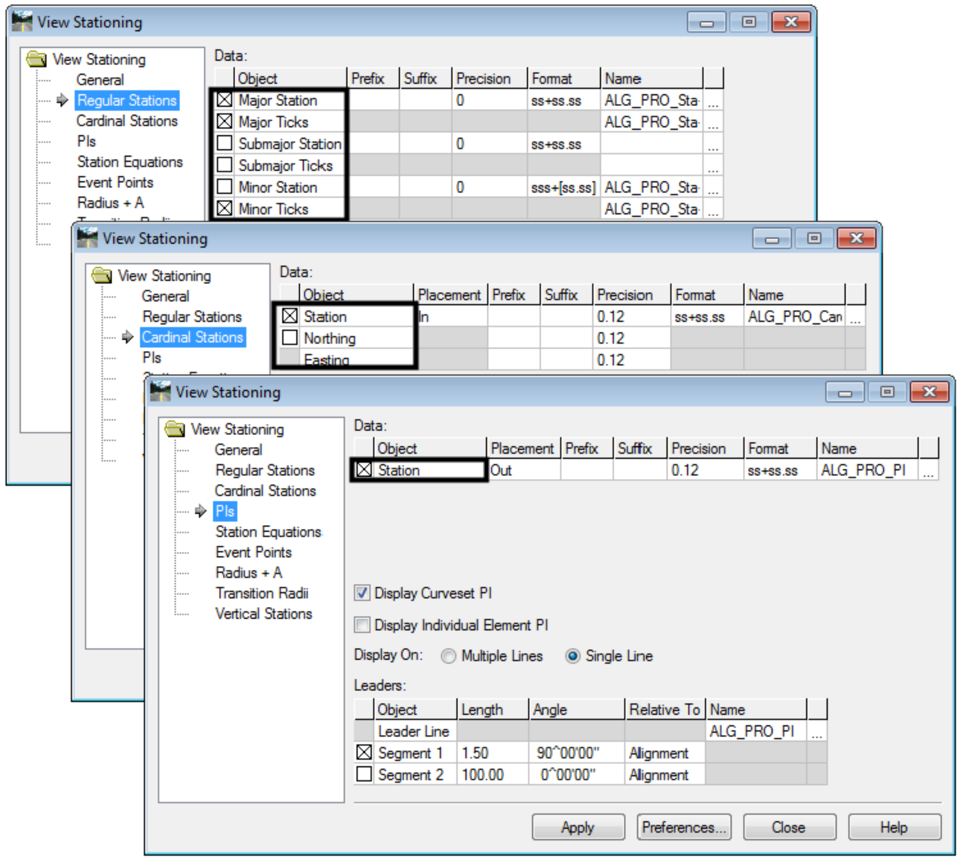
The following steps load the Preference Proposed–100 Ft Interval as the active symbology.



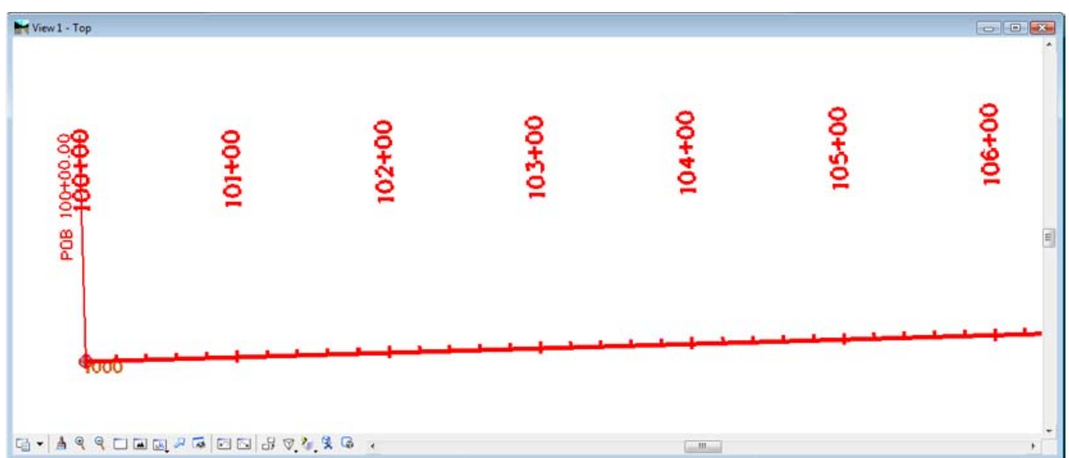
4. **<D> Proposed-100 Ft Interval**.

5. **<D> Load** then **Close** button.

6. Using the dialog box explorer, select or de-select alignment stationing components for display.



7. **<D> Apply** to display the stationing.



The ***View Stationing*** dialog box is populated with the predefined settings from the preference. The display toggles define what will display; the name column identifies the named symbology used for that station type.

There are several standard CDOT preferences to choose from. These are based on the type of alignment and station interval. Choose the appropriate **Preference** and **<D> Apply** to see the stationing.

Keep in mind that text size is dependent on the active ***Global Scale Factor*** at time of display. If necessary, select **File > Project Options [Factors**] to change the value of the Global Scale factors.

8. **Change** the ***Global Scale Factor*** and redisplay stationing.
9. **Experiment** displaying stationing using various CDOT preferences.
10. **Experiment** with the various settings in the ***View Stationing*** dialog box and investigate what changes are made when stationing is redisplayed.

Section Summary:

- The stationing Preferences are set to CDOT standards and should be used in most cases.
- Using the Pencil mode automatically deletes old stationing when new stationing is displayed.

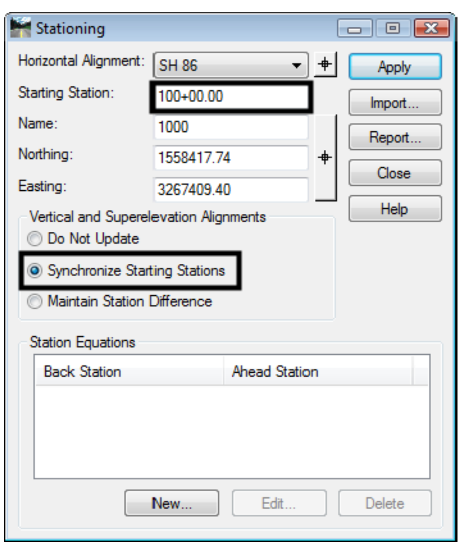
Lab 3.5 - Defining Stationing

Section Objectives:

- Change the beginning station of an alignment.

Upon creation, alignments are defined with a beginning stationing of 0+00. Stationing can be redefined from any location along the alignment.

1. Select **Geometry > Horizontal Curve Set > Stationing**. By default, this dialog box displays the beginning station value of the active alignment.

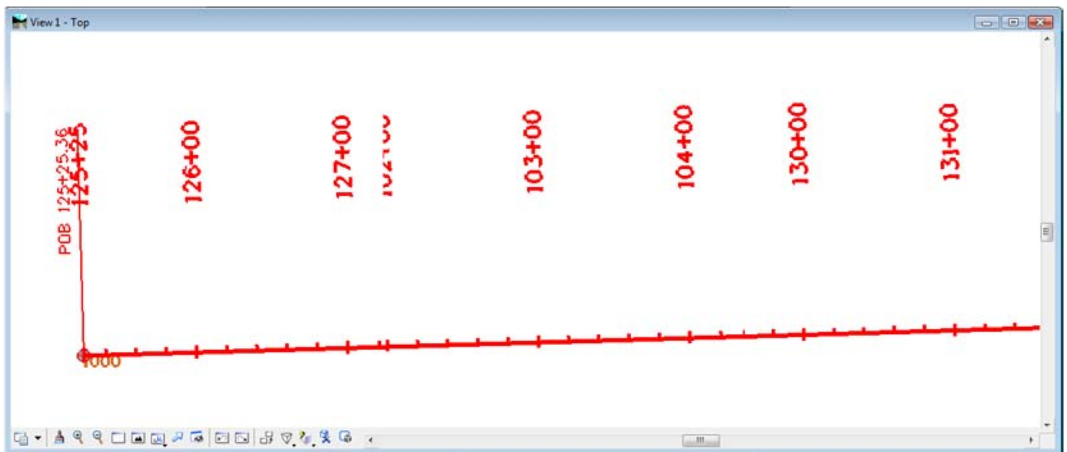


2. Verify that **SH86_West** is set as the ***Horizontal Alignment***.
3. Select **Synchronize Starting Stations** in the ***Vertical and Superelevation Alignments*** section.

Important! Do not use this option if any of the vertical alignments associated with the horizontal do not start at the beginning of the horizontal alignment. Using this option will move those vertical alignments that start after the beginning of the horizontal alignment to the beginning station of the horizontal alignment.

4. In the ***Starting Station*** field, key in ***125+25.36*** then **<D>** the **Apply** button.

5. **Verify** the change has been applied by redisplaying the stationing. Also, check the beginning station value of the associated vertical alignments by using the review command.



Note: The options for ***Vertical Alignments*** should be considered carefully. **Do Not Update** will leave the stationing of vertical application stations as is, **Synchronize Starting Stations** will update their stationing to match that of the horizontal and **Maintain Station Difference** will keep any difference (delta) in the current starting stations.

- InRoads does not require a '+' when keying in a station. The plus sign will be added automatically.
- Stationing can be set from any alignment point. If the point selected is not the POB, the stationing is computed for the POB from the selected point.

Section Summary:

- When stationing is set for a particular point, the stationing for the remainder of the alignment (forwards and backwards).
- The reference to Superelevation in the Vertical and Superelevation Alignments area refers to geometry created in the 2004 edition of InRoads. It does not affect the superelevation contained in the Roadway Designer.

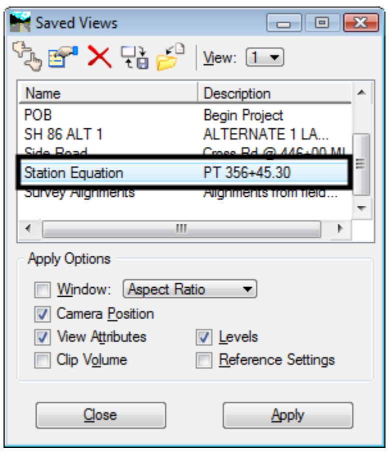
Lab 3.6 - Station Equations

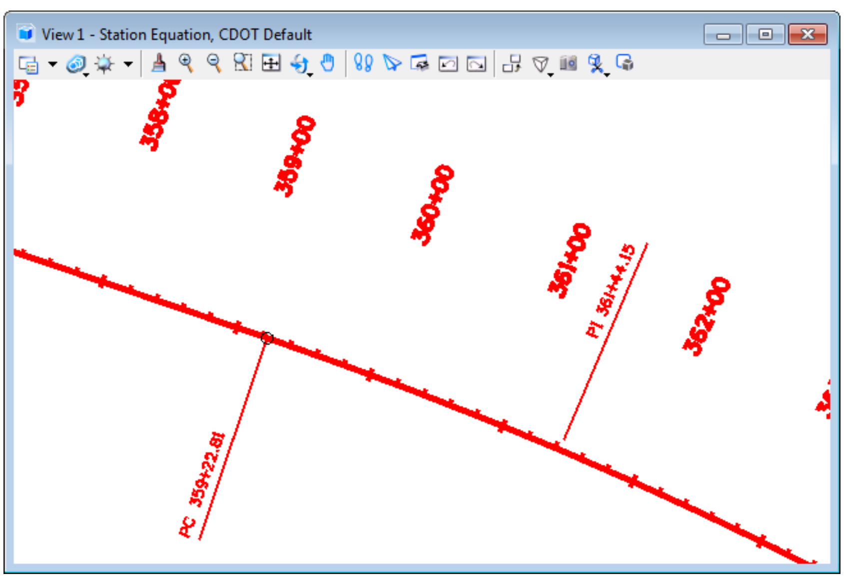
If there are inequalities in the alignment, station equations may be required. These equations can be either gap or overlap equations.

Section Objectives:

- Add a station equation to an existing alignment.
- Redisplay stationing to show the station equation.

1. From MicroStation, select **Utilities > Saved Views.**
2. Highlight the **Station Equation** saved view and **<D> Apply** then **Close** the ***Saved View*** dialog box.



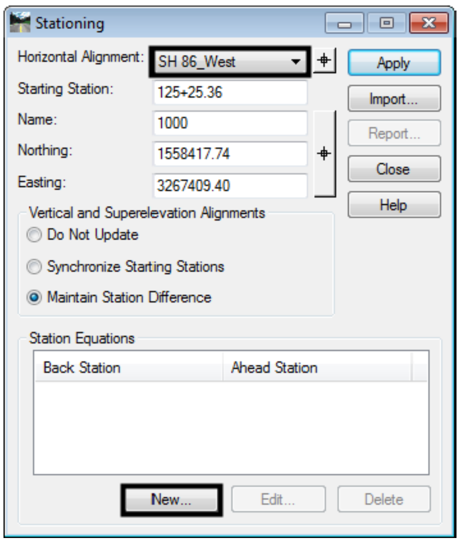


At the PT of the curve a station equation is necessary to tie to previous work. The values are:
Back = 359+22.81
Ahead = 359+27.81

3. Select **Geometry > Horizontal Curve Sets > Stationing** to display the ***Stationing*** dialog box.

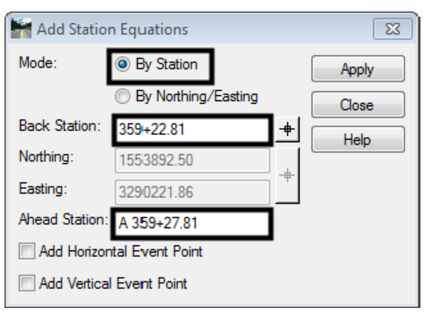
4. Verify **SH 86_West** is the horizontal alignment.

5. At the bottom of the dialog box, choose **New**. The ***Add Station Equation*** dialog box is displayed.



6. In the ***Add Station Equation*** dialog box, set the ***Mode*** to **By Station**.

7. Enter the ***Back Station*** and the ***Ahead Station*** as shown below.



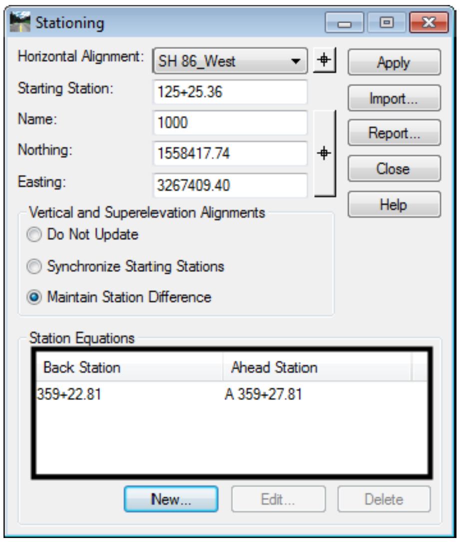
8. **<D> Apply**.

Note: The ahead station must be prefixed with an equation name. The name must consist of at least one alpha character.

- An alignment can contain multiple station equations.

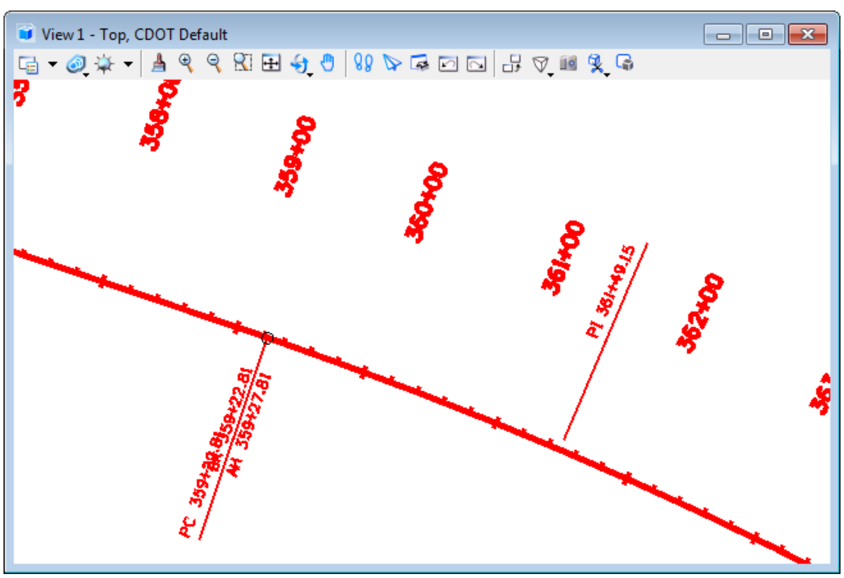
- Annotation of stationing lying within the range of a station equation will be prefixed with the equation name. The toggle ***Drop Station Equation Name*** in the ***General*** leaf of the ***View Stationing*** dialog box is on so that the equation name is not displayed.

9. **<D> Close** to dismiss the ***Add Station Equation*** dialog box. The station equation is shown in the parent dialog box.



10. **<D> Close** in the ***Stationing*** dialog box.

11. Redisplay the stationing for alignment **SH 86_West**.



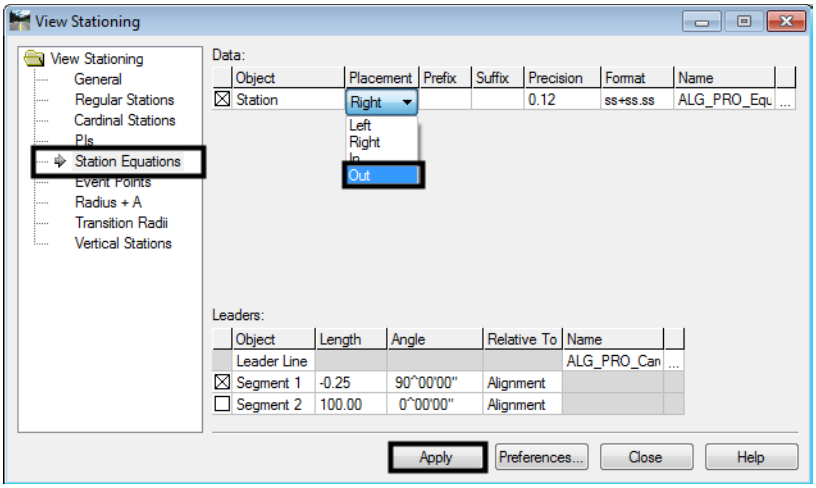
Notice that the station equation text is on top of the PC station text. To fix this problem:

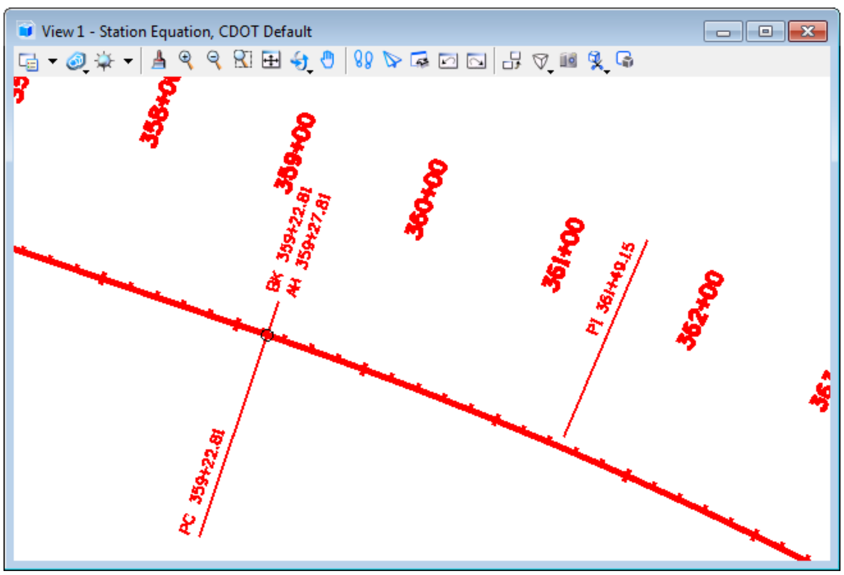
12. Select **Geometry > View Geometry > Stationing**.

13. Select the **Station Equation** leaf.

14. Toggle the ***Placement*** to **Out**.

15. **<D> Apply** to redisplay the stationing.





The equation is now displayed on the opposite side of the alignment from the PC stationing text.

Section Summary:

- Station equations are used to change the stationing from a given spot forward, along the alignment. Stationing prior to the equation retains its original stationing.
- The ahead station must have a prefix, containing at least 1 letter, followed by the new station number.

Lab 3.7 - Horizontal Alignment Tracking

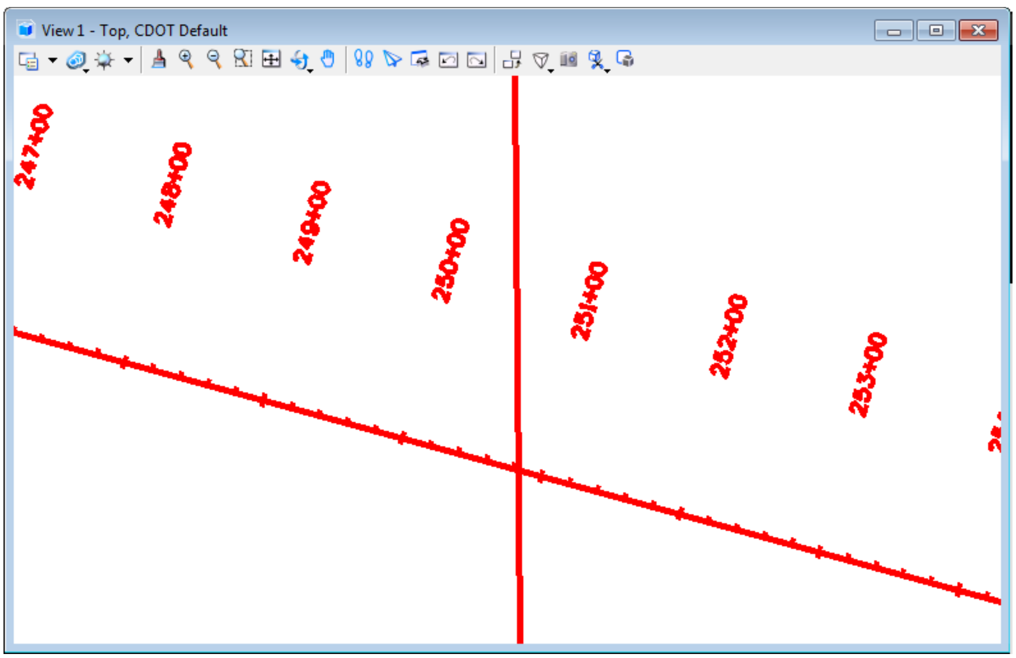
Two methods exist for receiving interactive information relative to a horizontal alignment. These are Tracking and Horizontal Alignment Tracking. Both methods report on stationing, offset, elevation, etc. Tracking reports the elevation of the active surface, Horizontal Alignment Tracking reports the elevation of the active vertical alignment.

Section Objectives:

- Demonstrate the Tracking command.
- Demonstrate the Tracking Horizontal Alignments command

Tracking (horizontal alignment and surface data)

1. **Recall** Saved View **Side Road**.
2. If the ***Side Road*** alignment is not visible, display it.



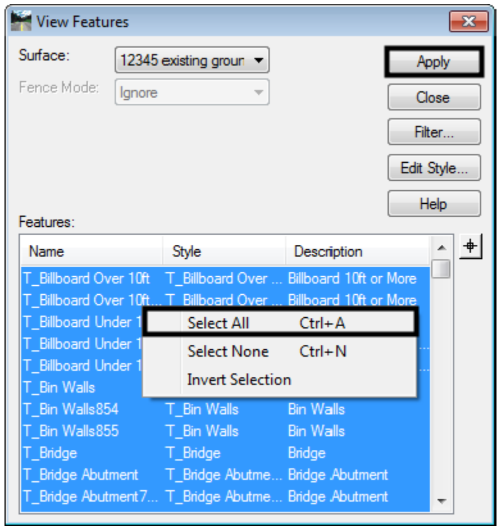
Tracking reports on station and offset information relative to the active alignment along with information relative to the active surface.

3. Select **File > Open** and load the surface **12345SURV_Existing_Ground.dtm** from the **C:\Projects\12345\ROW_Survey\InRoads\DTM** folder.

To display the surface features from the existing ground dtm:

4. Select **Surface > View Surface > Features**.

5. **<R>** in the ***Features*** list and **<D> Select All**.



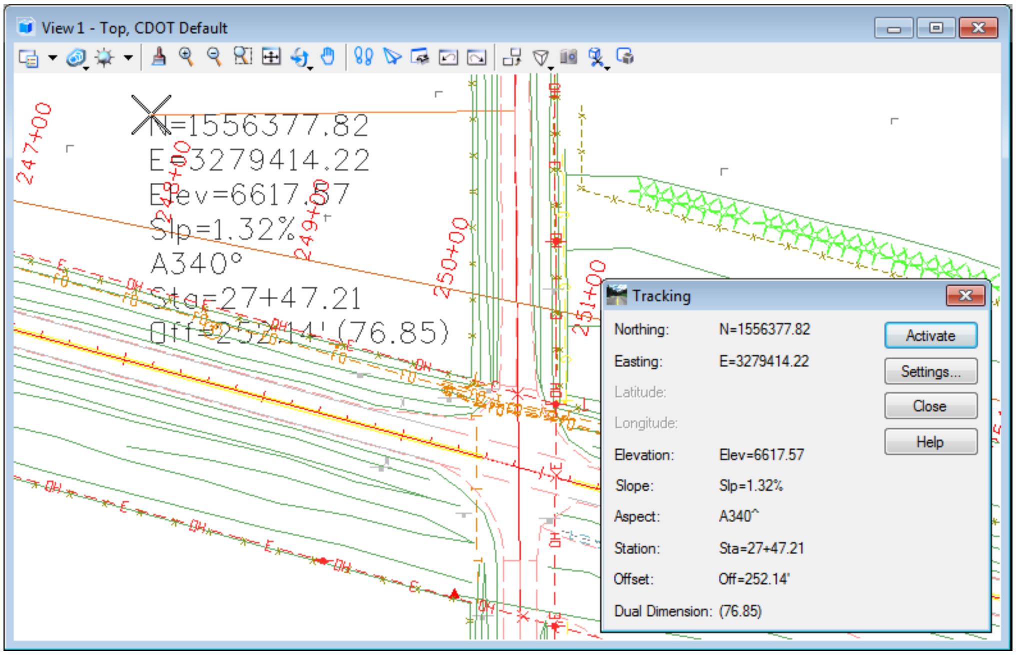
6. **<D> Apply** then **Close**.

Displaying surface features is a good way to orient yourself to the location you are at in the model.

7. Select **Tools > Tracking > Tracking** to track both the active horizontal alignment and information relative to the active surface.

Note: This command will display information about any data that is present. Neither geometry or a dtm are required to get some feedback from this command.

8. Select **Activate** to initialize the command. Slide the cursor along the alignment to interactively update the display in the ***Tracking*** dialog box. If a **<D>** (data point) is entered in the design file the information toggled on is displayed graphically.

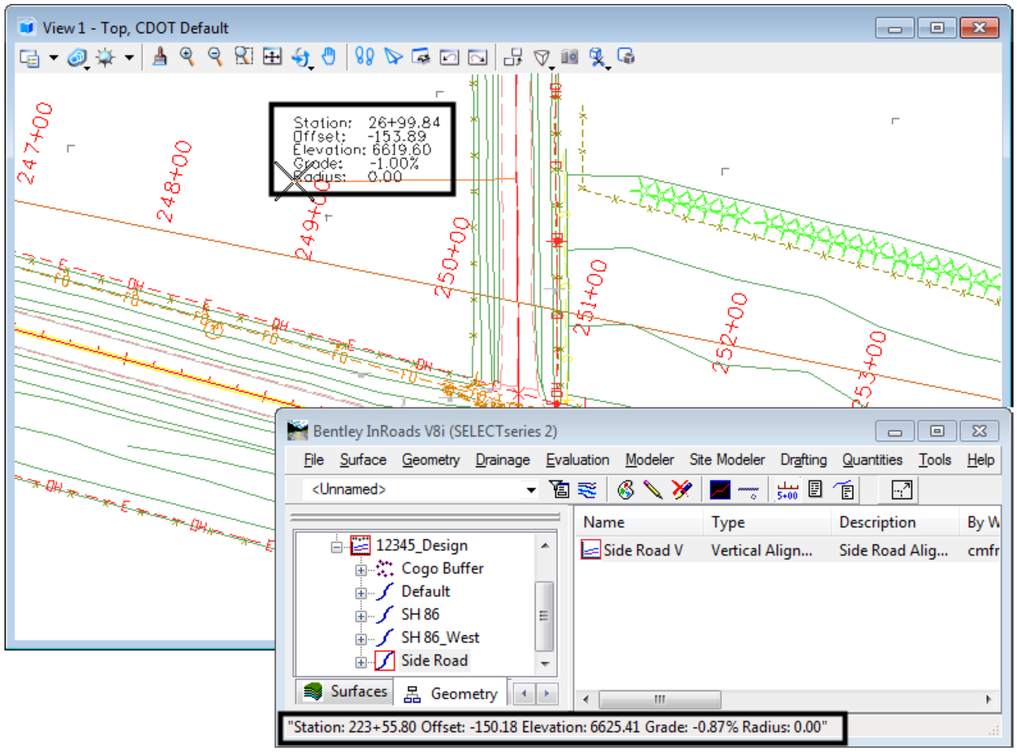


Note: Select the **Settings** button in the ***Tracking*** dialog box to examine the attributes assigned to annotation placed in the MicroStation design file.

Horizontal Alignment Tracking (with vertical alignment data)

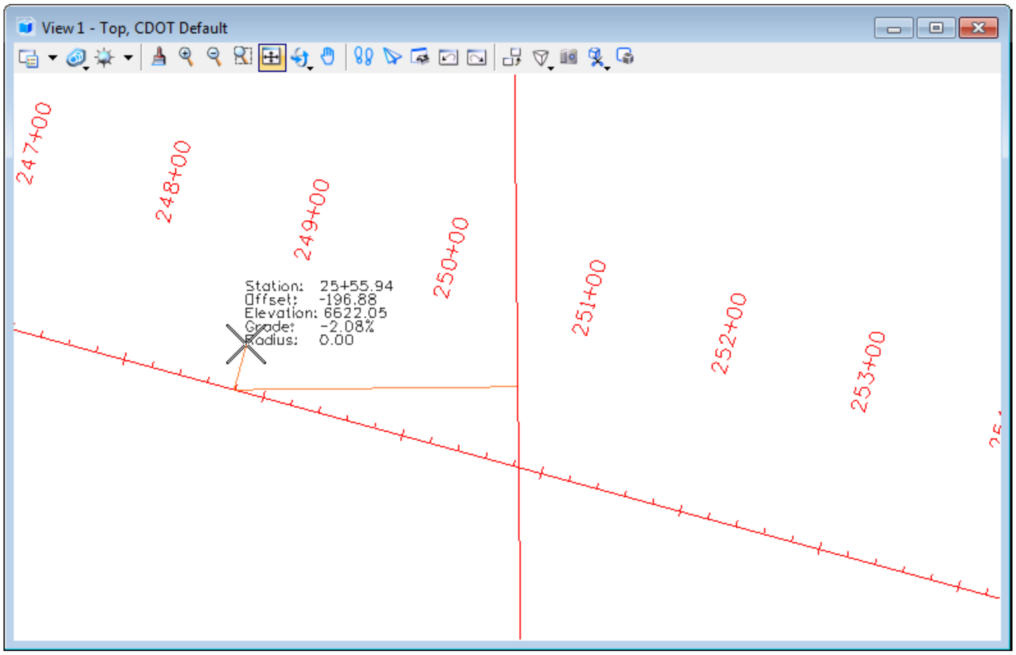
This tracks the station and offset relative to the active horizontal alignment along with the elevation of the active vertical alignment. Station, Offset, and Elevation information is displayed in the message field of the InRoads interface. Note: A horizontal alignment must be present for this command to work.

1. Select **Tools > Tracking > Horizontal Alignment** to track the active horizontal alignment.



The results display at the cursor and in the status bar of the InRoads interface.

Note: The readout interactively reflects the location of the cursor relative to the active alignment. If a second horizontal alignment is selected with a data point, the offset displayed will be the distance to intersect the selected alignment from the active alignment, perpendicular to the active alignment.



Section Summary:

- Use the Tracking command to get surface information in relation the horizontal alignment.
- The Tracking command can be used to display the information in its dialog box as MicroStation graphics.
- The tracking Settings options are used to enable and disable the graphic display of items in the Tracking dialog box.
- Use the Horizontal Alignments tracking to get vertical alignment information in relation the horizontal alignment.
- Horizontal Alignments tracking can not be displayed graphically.

Chapter Summary:

- Horizontal alignments can be displayed using the View and View All Horizontals from the right click menu or from the main tool bar, or by using the horizontal alignment annotation command.
- Use the preferences to set up the Stationing dialog box. Items in the Stationing dialog box should only be changed for special circumstances.
- Use the Stationing options under the Horizontal Curve Set commands to change the stationing for the entire alignment.
- Use station Equations to change the stationing from a point on the alignment to the end.
- Tracking is used to gain station and offset information at the cursors location.

- Tracking also collects surface data, while Horizontal Alignment tracking gets vertical alignment data.

LAB 4 - Geometry Management

This lab illustrates some of the common commands used to manage geometry for a project.

Chapter Objectives:

- Copy a geometry project
- Rename alignments

The following files are used in this lab:

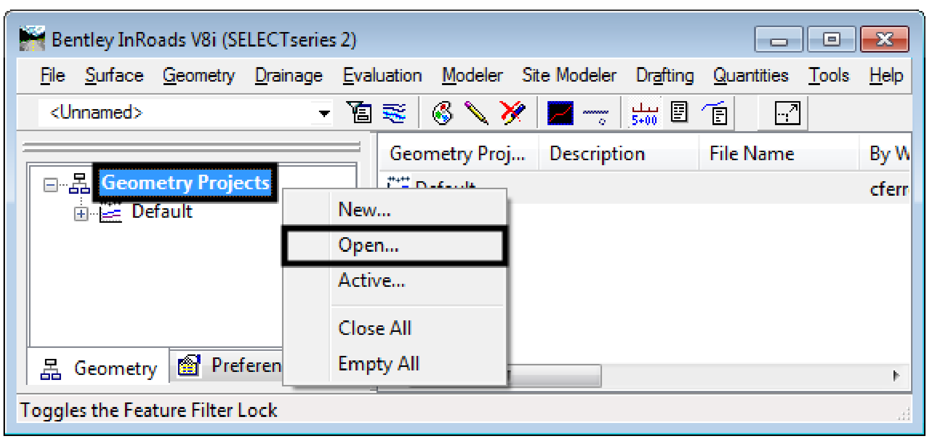
- C:\Projects\12345\Design\Drawings\Reference_Files\12345DES_Geometry-Management.dgn
- C:\Projects\12345\ROW_Survey\InRoads\Geometry\12345SURV_Fieldbook.alg

Lab 4.1 - Copy a Geometry Project

Section Objectives:

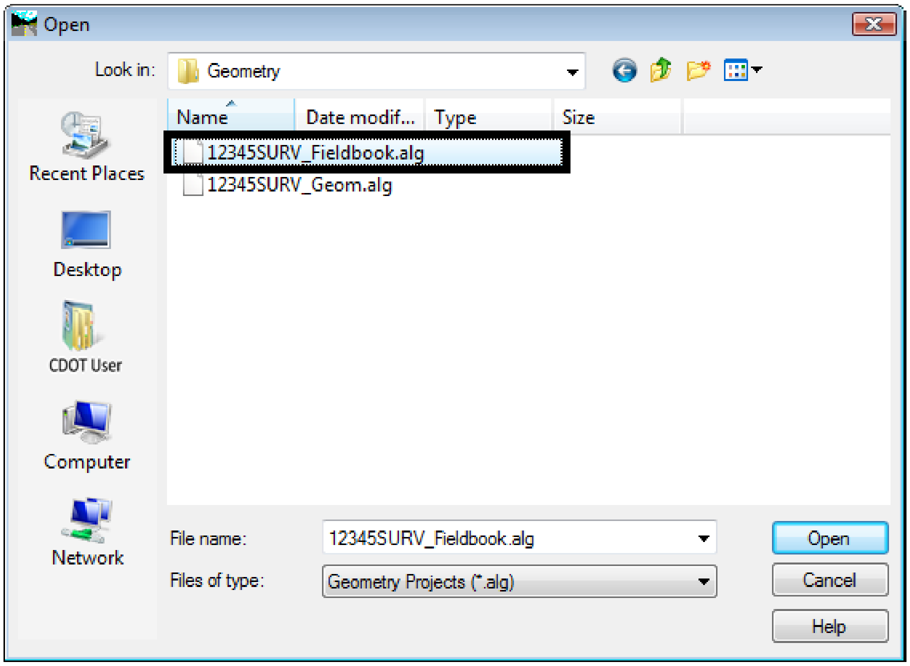
- ♦ Access a Geometry Project created by the Survey/ROW discipline
- ♦ Save the renamed Geometry Project in the Design project folder (vs. the Survey folder)
- ♦ Rename horizontal alignment names, add/modify descriptions, and review the geometry styles assigned to the alignments

1. From the **Geometry** tab in the InRoads ***Explorer*** window, right-click on **Geometry Projects** and select **Open** from the right click menu.

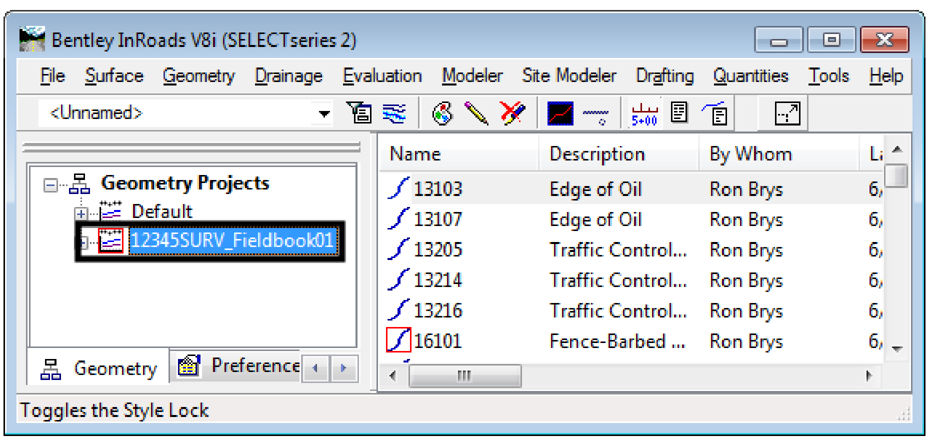


2. Navigate to the directory **C:\Projects\12345\ROW_Survey\InRoads\Geometry**.

3. **<D>** the Geometry Project **12345SURV_Fieldbook.alg**.



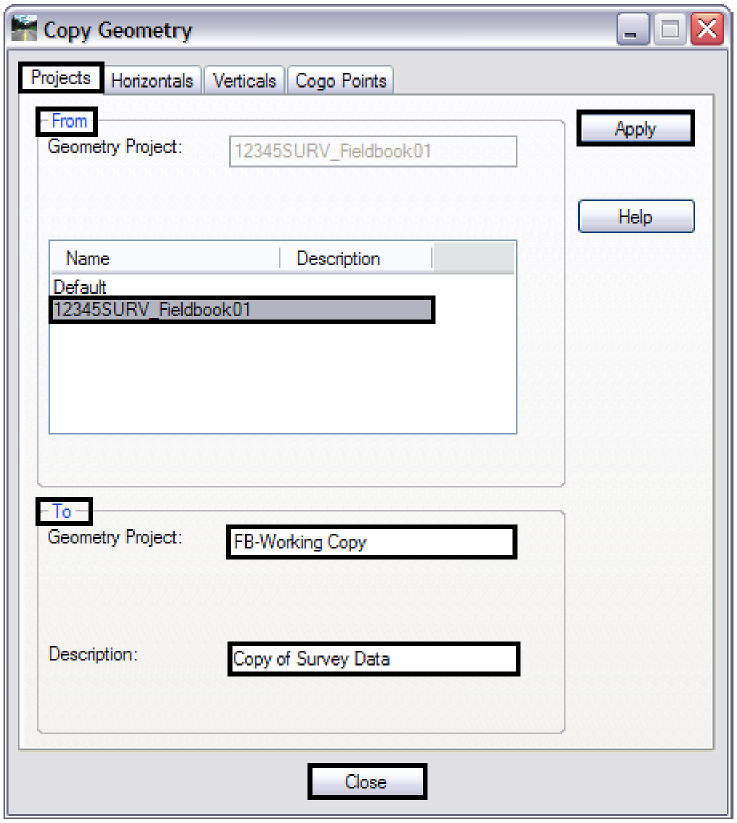
4. **<D> Open** then **Cancel** button. The ***Open*** dialog box is dismissed



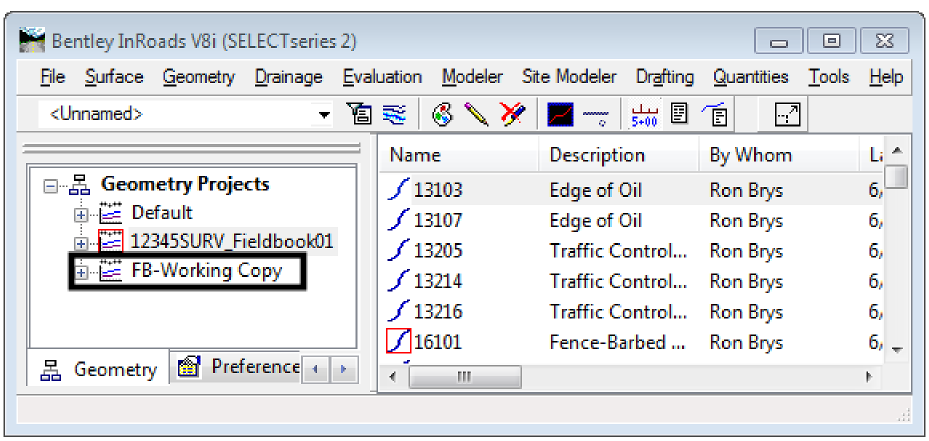
At this point, a ‘copy’ of the survey geometry project is loaded into memory. The following steps will rename the geometry project and save this copy in the Design discipline folder.

Note: Loading a file into InRoads makes it the active entity by default.

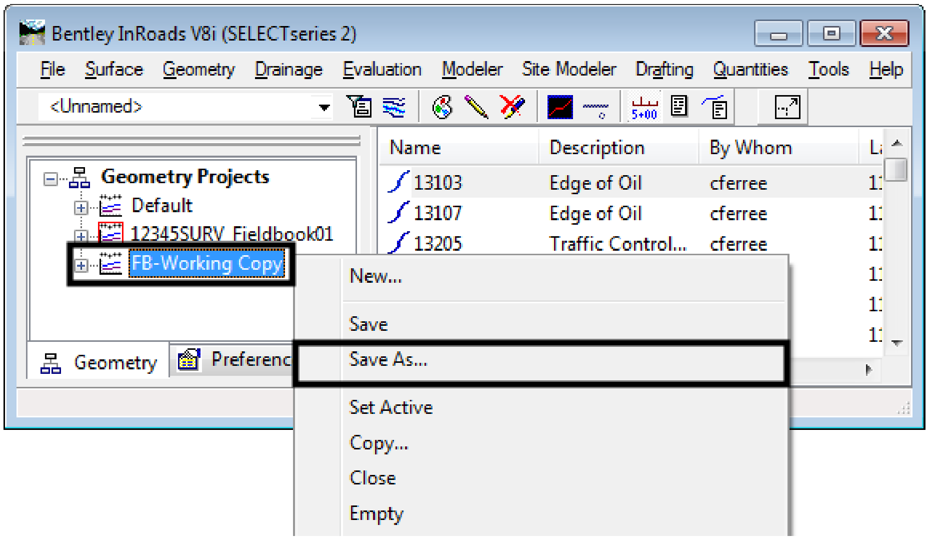
5. Select **Geometry > Copy Geometry**.

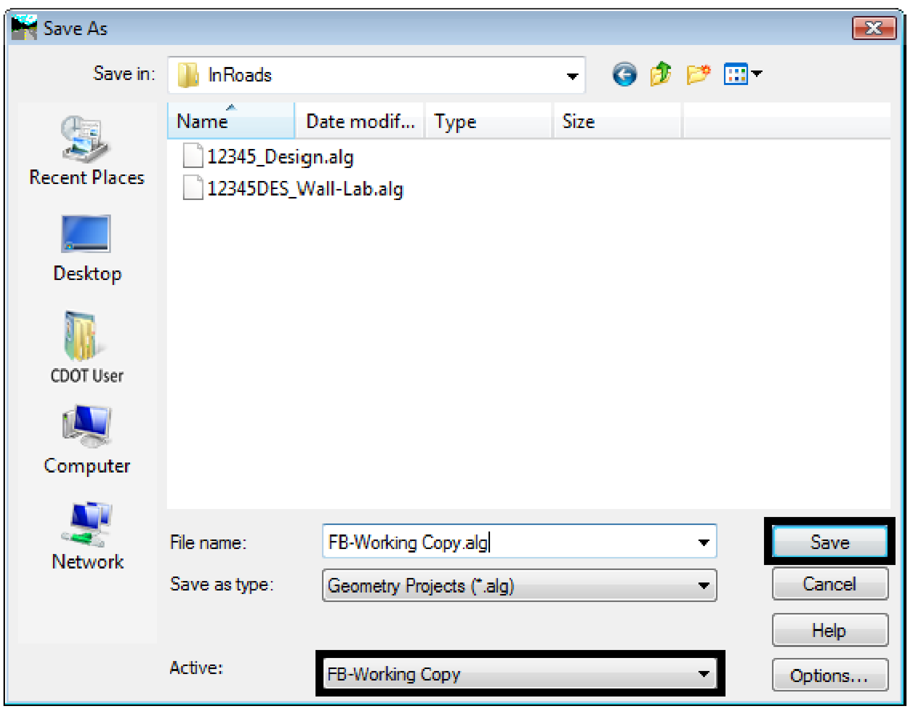


6. On the ***Projects*** tab, in the ***From*** section select **12345SURV_Fieldbook01**.
7. In the ***To:*** field key in ***FB-Working Copy***.
8. In the ***Description:*** field key in ***Copy of Survey data***.
9. **<D>** the **Apply** then **Close** buttons.
10. Verify the copy is created by checking the InRoads Explorer pane.



11. In the InRoads explorer pane, **<R>** on the **FB-Working Copy** geometry project and select **Save As…** from the right click menu. The ***Save As*** dialog box is displayed.



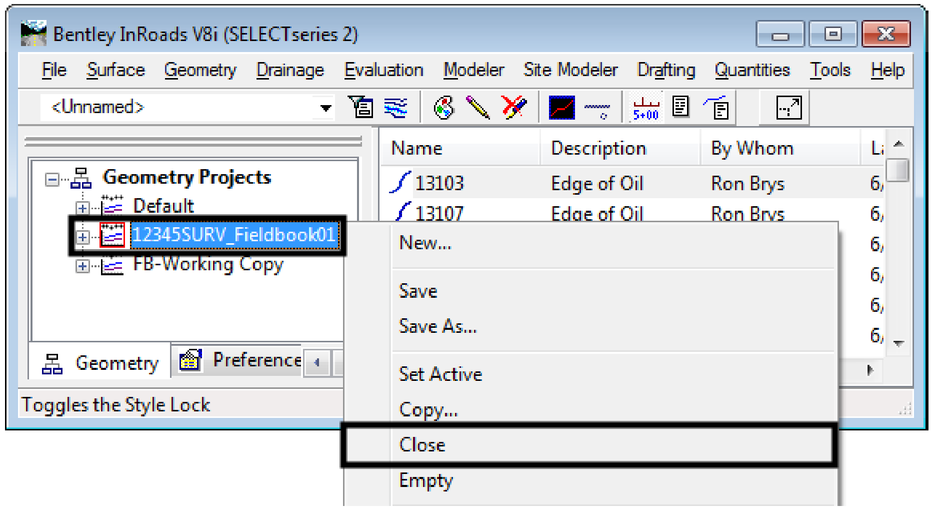


12. Navigate to the **C:\Projects\12345\Design\InRoads** folder. If necessary, use the drop-down arrow in the ***Active*** field and reselect **FB-Working Copy** to ensure the saved file name will match the active surface name.

13. **<D>** the **Save** then the **Cancel** buttons. The ***Save As*** dialog will close.

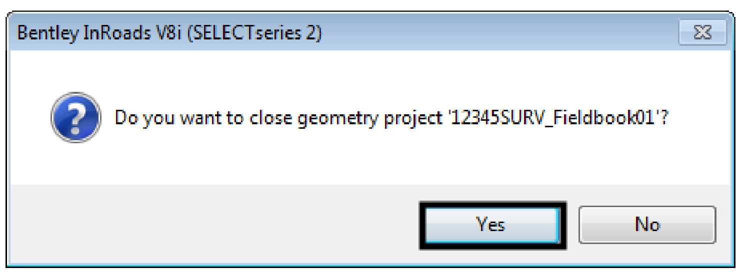
Note: To minimize confusion, be sure to save the geometry project with the same name seen in the InRoads Explorer pane.

14. The original geometry project generated by the survey staff is no longer required. In the InRoads explorer pane, **<R>** on the geometry project name **12345SURV_Fieldbook** and select **Close** from the right click menu.



Note: This will 'unload' the geometry project from memory. It does not delete any files from the hard drive.

15. **<D> Yes** and verify the geometry project is removed from memory.



Section Summary:

- Specialty groups using ROW/Survey geometry files should always make their own copy of the original data.

Lab 4.2 - Renaming Alignments

In the case of the geometry project copied in the previous exercise, the horizontal alignment names (and geometry styles) were assigned when the survey fieldbook was exported based on the InRoads Survey feature table (FWF file). These attributes are assigned based on the feature coding assigned in the field. These names accurately reflect the coding used in the field, but could benefit from more intuitive naming.

Section Objectives:

- Modify the alignment names, add descriptions, and assign appropriate Geometry Styles.

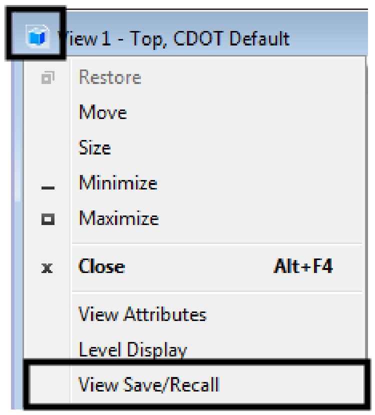
Graphics clean-up

Before continuing with this lab, delete all visible graphics in your MicroStation file using the element selection tool or a fence. Note that you are deleting the graphical display of data, not the data itself. The graphics could be redisplayed using the InRoads display commands shown in previous sections.

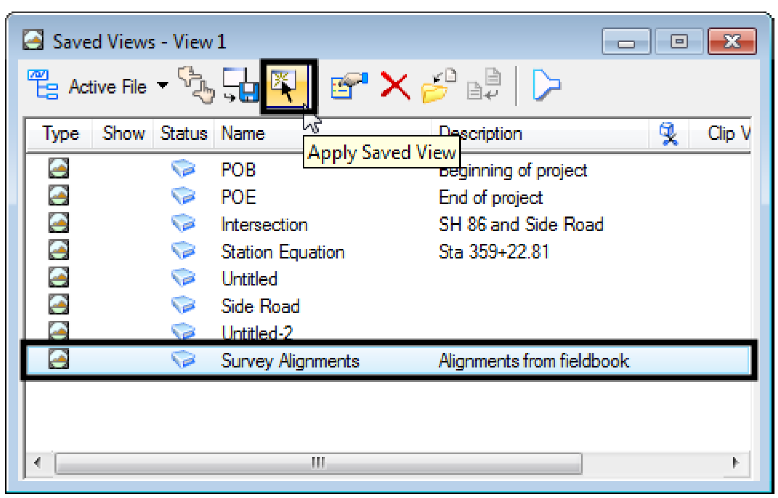
Note: The screened topography and the training guides are either locked graphics or in an attached reference file, you will not be able to delete these graphics and will use them for orientation.

Renaming Horizontal Alignments

1. **<D>** on the InRoads icon in the top left corner of the view window and **<D> View Save/ Recall** from the menu.

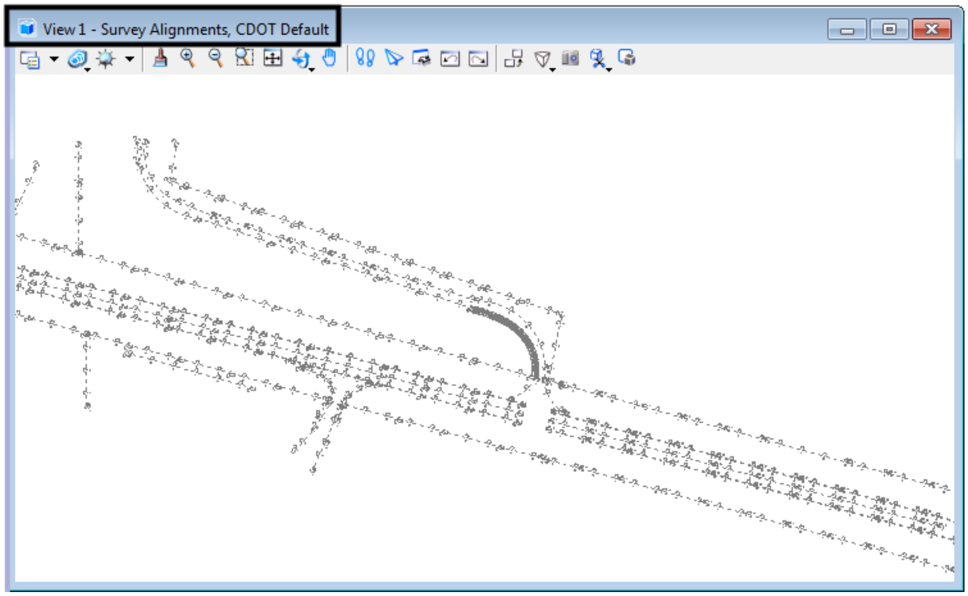


2. From the ***Saved View*** dialog box highlight **Survey Alignments**.
3. **<D>** the **Apply Saved View** and then **<D>** in **View 1**.

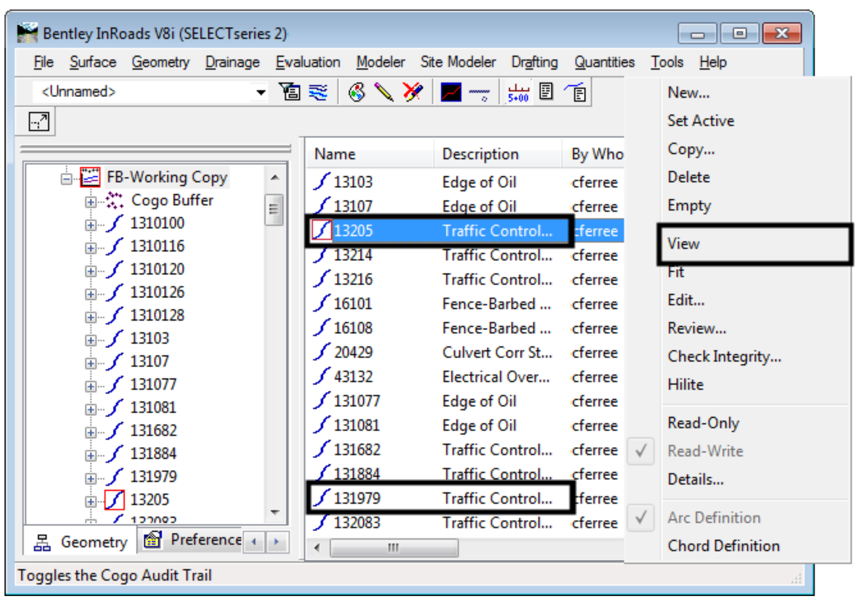


4. Close the ***Saved Views*** dialog box.

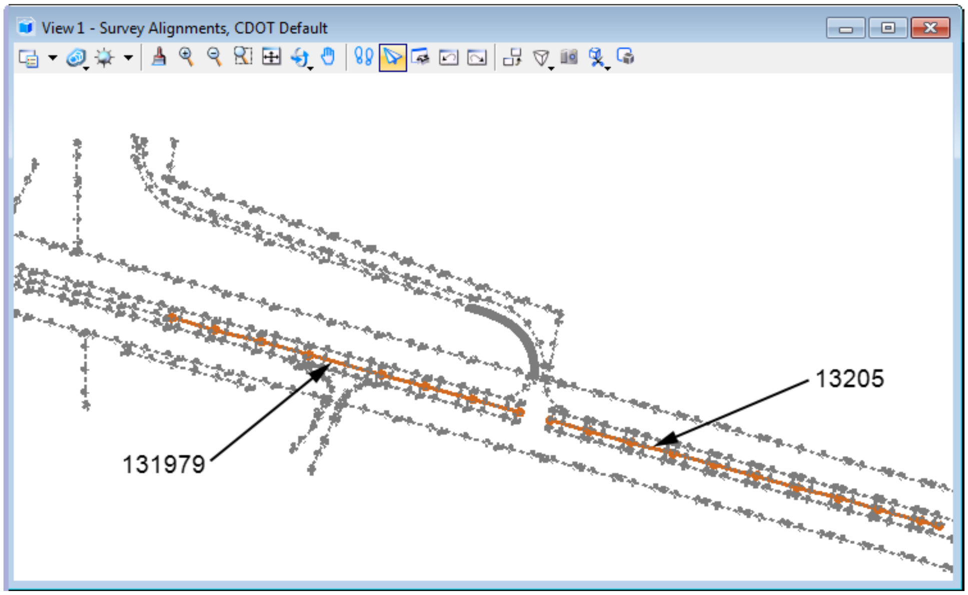
5. Verify that the view name includes Survey Alignments. The view window should look similar to the following image.



6. Display alignments **13205** and **131979**. **<R>** on the alignment and select **View** from the right click menu.

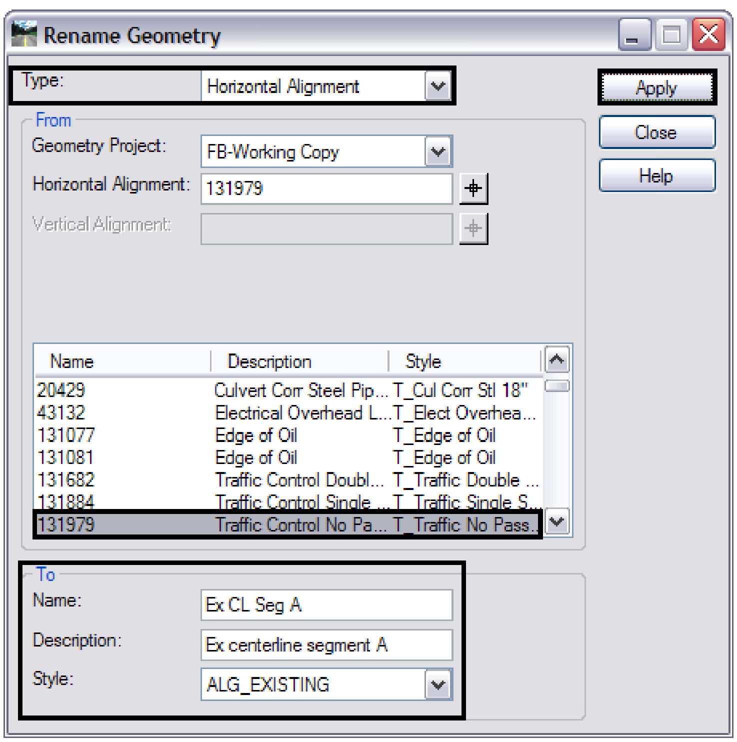


The the alignments should show up in the view window as shown below.



7. Select **Geometry > Rename Geometry** from the InRoads main menu. The ***Rename Geometry*** dialog box is displayed.

8. From the ***Type:*** drop-down menu select **Horizontal Alignment**.

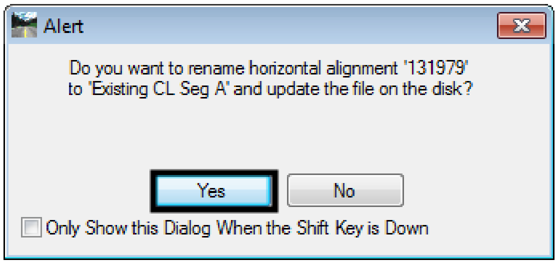


9. In the ***From*** section, verify the ***Geometry Project*** is **FB-Working Copy**.

10. In the ***From*** section list locate and **<D>** on alignment **131979.**

Note: This alignment represents the centerline of existing pavement.

11. In the ***To*** section key in the ***Name:*** ***Existing CL Seg A***.
12. Key in the ***Description:*** ***Ex centerline segment A***.
13. Set the ***Style:*** ***ALG_EXISTING***
14. **<D>** the **Apply** button. A confirmation dialog box is displayed.



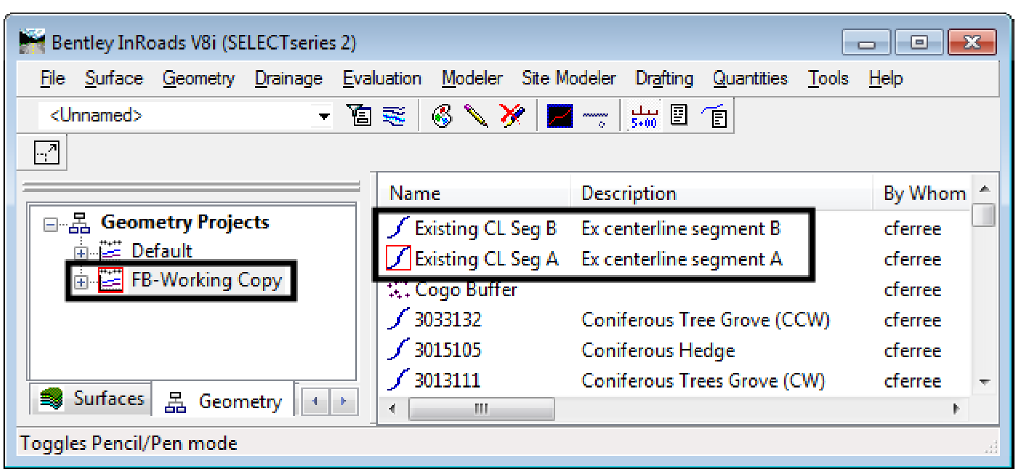
15. **<D>** the **Yes** button to confirm the change and dismiss the confirmation box.
16. **Rename** the centerline alignment ***13205*** using the following information:

- Name: ***Existing CL Seg B***
- Description: ***Ex centerline segment B***
- Style: ***ALG_EXISTING***

Note: You can use the dialog selection icon to graphically identify the alignments for renaming.

Important! Profile or Cross Section sets that were created based on the original alignment names will lose their linkage to the alignment names after renaming of the alignments. Geometry renaming should be done prior to the generation of Profile or Cross Section sets.

17. **Close** the ***Rename*** dialog box and check the InRoads explorer window to verify the results.

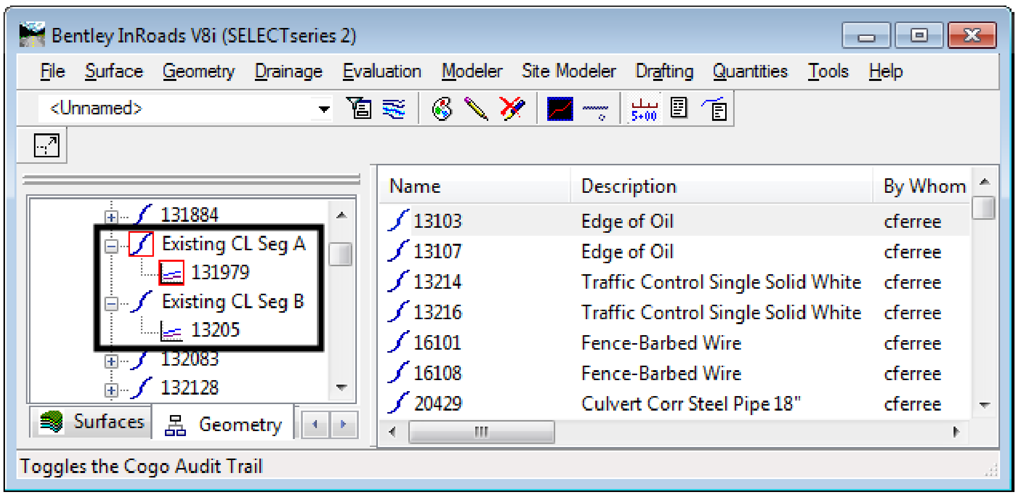


Renaming Vertical Alignments

Two horizontal alignments have been renamed, a description has been added and the alignments are assigned the appropriate geometry style. Horizontal alignments are ‘parent’ alignments which can contain ‘child’ vertical alignments.

18. In the InRoads explorer, **<D>** the **Geometry** tab.

19. Check the horizontal alignments for associated vertical alignments by expanding the **+** icon.



20. Select **Geometry > Rename Geometry**. The ***Rename Geometry*** dialog box is displayed.

21. From the ***Type:*** drop-down menu select **Vertical Alignment**.

22. In the ***From*** section verify the ***Geometry Project*** is set to **FB-Working Copy**.

23. Verify the active ***Horizontal Alignment*** is set to **Existing CL Seg A**.

24. **<D>** on alignment **131979** from the ***Vertical Alignment*** list.

    Note: This alignment represents the vertical elevations of existing pavement.

25. In the ***To*** section **key in** the ***Name: Existing Pavement***.

26. In the ***Description:*** field, key in ***Surveyed elevations***.

27. Set the ***Style:*** to **ALG_EXISTING_Vert.**

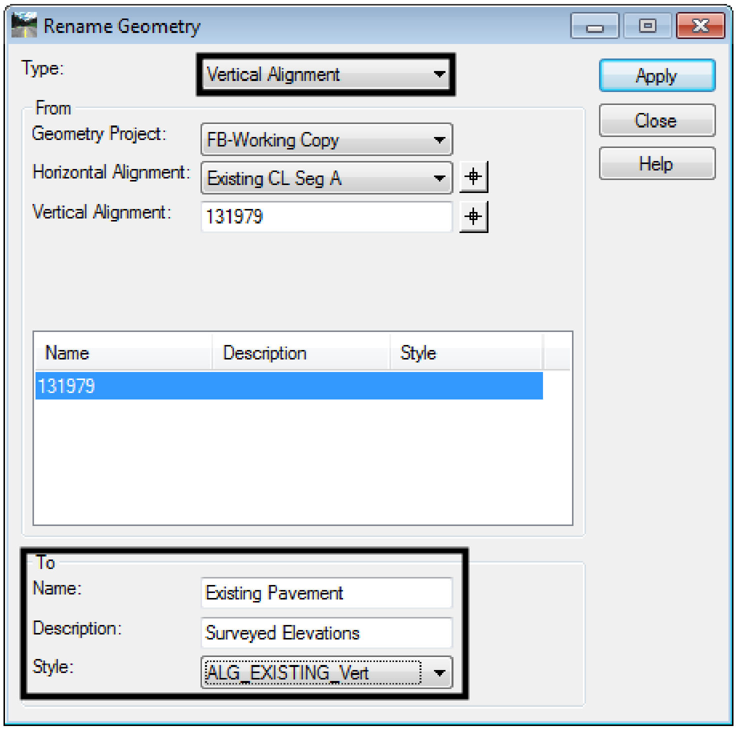
28. **<D> Apply** then **<D> Yes** button.

Next, change the name of the vertical alignment attached to Existing CL Seg B.

29. Now set the active ***Horizontal Alignment*** to **Existing CL Seg B** in the ***From*** area of the ***Rename Geometry*** dialog box.

    Note: You can use the graphic selection icon to graphically identify the alignments for renaming.

30. In the ***To*** section, key in the ***Name:*** ***Existing Pavement***.
31. key in ***Surveyed elevations*** for the ***Description:***.
32. Set the ***Style:*** **ALG_EXISTING_Vert**.

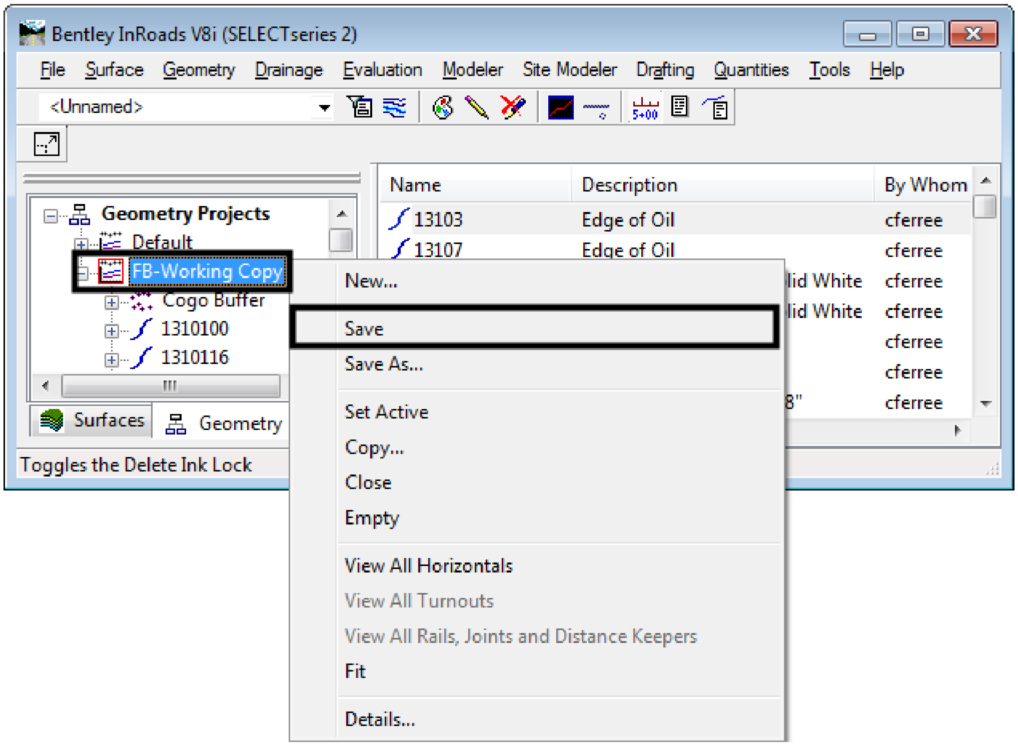


33. **<D> Apply** then **<D>** the **Yes** button in the confirmation box.
34. **<D> Close** the ***Rename Geometry*** dialog box.

A copy of the ROW/Survey's geometry project was made. Key alignments were renamed and assigned appropriate styles. The alignments now have intuitive name and conform to CDOT design standards.

This is a good time to save the Geometry Project to disk.

35. **<R>** on the geometry project **FB-Working copy** and select **Save As** from the right click menu.



36. This will overwrite the geometry project FB-Working Copy stored in the folder ***C:\Projects\12345\Design\InRoads***.

Section Summary:

♦ Rename Geometry is used to rename geometry, add or revise a description, and/or update the associated style

Chapter Summary:

- Take care not to inadvertently edit or delete another group's work. Communication is the key to reducing data loss.
- Survey geometry has names meaningful to them, but possibly not to other groups. Rename your copy of survey's geometry data.

LAB 5 - Horizontal Alignments

Although there are multiple methods for creating horizontal geometry in InRoads, this lab will concentrate on the using the horizontal curve set commands and importing geometry from graphics. Additional methods covered in the Geometry for ROW course include cogo and traverse commands.

This lab also demonstrates how to modify an existing alignment and create a parallel alignment to an existing alignment. An example of this would be to create parallel/offset alignment from a road centerline to represent the edge of road or other feature that parallels the centerline.

Chapter Objectives:

- Create a new geometry
- Create alignment tangents
- Understand the difference between Named and Unnamed cogo points and how to apply cogo point names
- Define alignment curves
- Define and modify alignment stationing
- Annotate an alignment
- Create a horizontal alignment from graphics
- Modify an existing alignment
- Create parallel horizontal alignments

The following files are used in this lab:

- C:\Projects\12345\Design\Drawings\Reference_Files\12345_Horizontal Alignments.dgn
- C:\Projects\12345\ROW_Survey\InRoads\Geometry\12345SURV_Fieldbook.alg
- C:\Projects\12345\Design\InRoads\12345DES_Design.alg

A typical workflow is:

1. Create or open a geometry project
2. Create horizontal alignments
3. Assign stationing for alignments
4. Define station equations, if any
5. Define alignment key-points (unique points of interest)
6. Review alignments
7. View created alignments
8. Display stationing for alignments
9. Annotate created alignments

Note: The screened topography and the training guides are either locked graphics or in an attached reference file, you will not be able to delete these graphics and will use them for orientation.

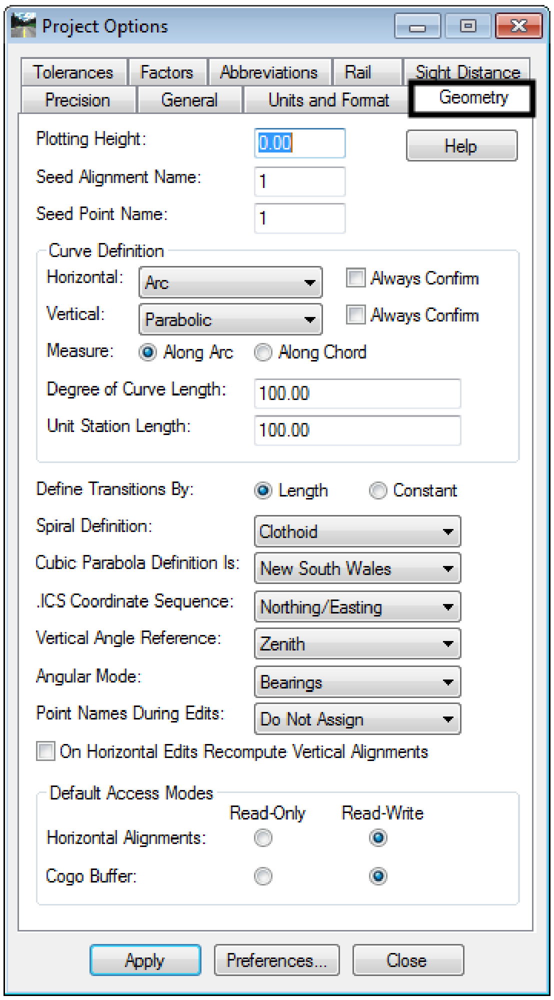
Lab 5.1 - Name Alignment Points

Section Objectives:

- Add names to unnamed points on an alignment

1. Start InRoads opening the file **12345DES_Horizontal Alignments.dgn** from the **C:\Projects\12345\Design\Drawings\Reference_Files** directory.

2. Select **File > Project Options** from the InRoads main menu and review the settings in the **Geometry** tab.



Note: If ***Point Name During Edits*** is set to **Assign** on the ***Geometry*** tab of the ***Options*** dialog box, alignment key-points are generated with a name based on the next available ID as specified in the ***Seed Point Name*** field. The specified seed point name can be alpha, numeric, or alphanumeric characters. The assigned name is also reserved in the Cogo buffer. However the point is not written to the Cogo Buffer automatically.

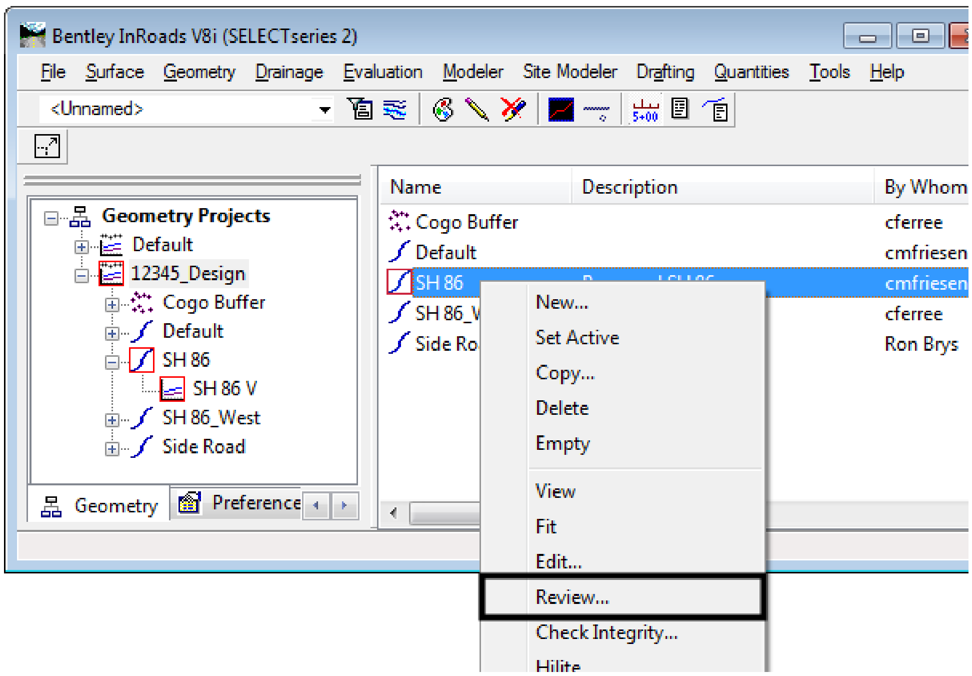
For descriptions of each of the items in the **Geometry** tab, refer to the ***Practical Guide for Using InRoads***.

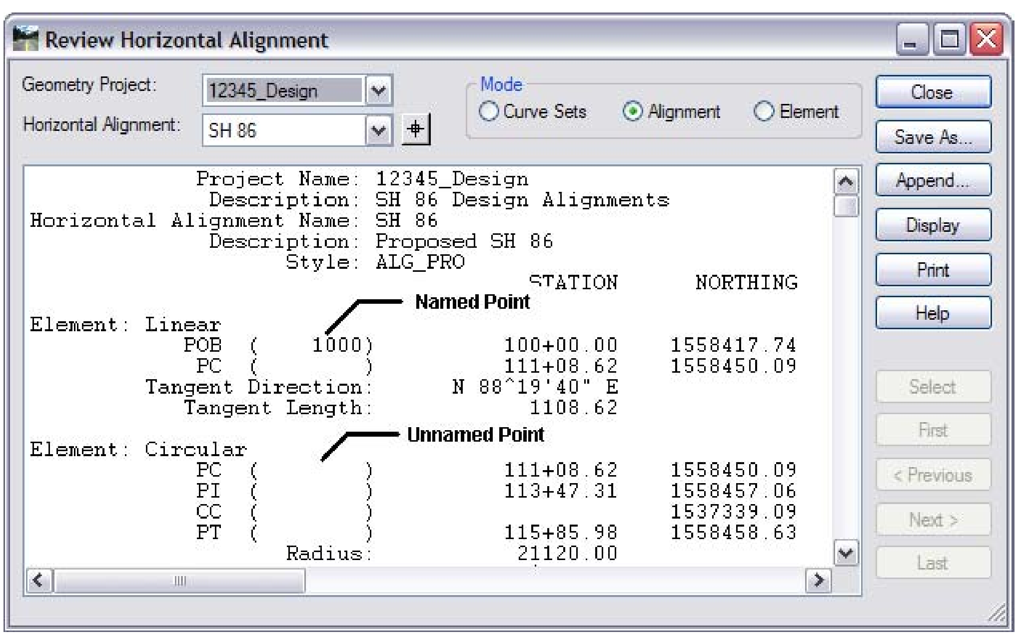
3. Load the geometry project **12345DES_Design.alg** from the folder **C:\Projects\12345\Design\InRoads**.

Alignment key-points (PC, PI, PT, CC, etc) exist in one of three states:

- Unnamed
- Named
- Cogo Points

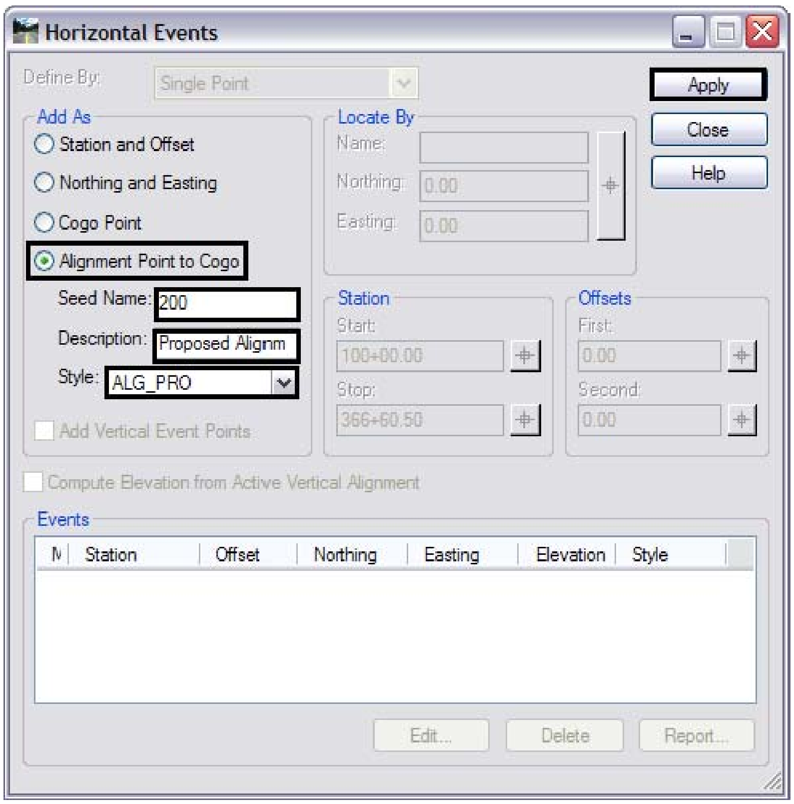
4. Review the horizontal alignment and notice that many points on the alignment are not named.



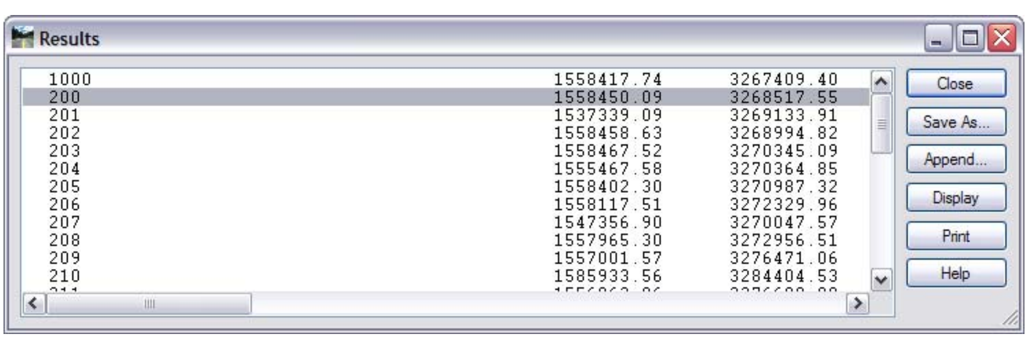


In the next series of steps, the alignment points are named and added to the Cogo buffer.

5. Select **Geometry > Horizontal Curve Set > Events**.
6. In the ***Horizontal Events*** dialog box, toggle on **Alignment Point to Cogo** in the ***Add As*** section.
7. Key in ***200*** for the ***Seed Name:***.
8. ***Proposed Alignment*** for ***Description:***.
9. Select **ALG_PRO** for the ***Style:***.
10. Click **Apply**.



A ***Results*** dialog box appears with the new point name and the associated coordinates of the point. All alignment key points that were not previously assigned a name are written to the Cogo buffer beginning with the ID number of 200.



Note: The command **Geometry > Utilities > Assign Names** can also be used to add, delete, or rename geometry points. However, names added using this command are not added to the Cogo Buffer.

11. **Close** the **Results** and **Horizontal Events** dialog boxes.

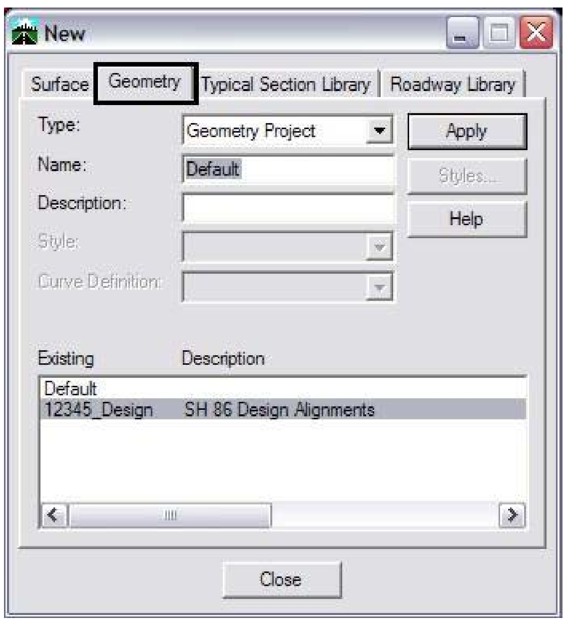
Lab 5.2 - Create New Geometry

Next we will create a new geometry project and a placeholder for horizontal alignment data.

Section Objectives:

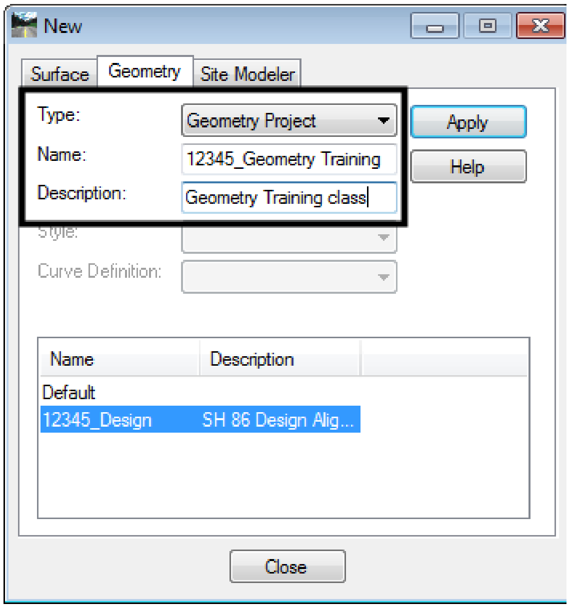
- ♦ Create a geometry project and place holders for horizontal geometry data.

1. From the InRoads main menu **File > New**.



2. **<D>** the **Geometry** tab.
3. For the ***Type***, select **Geometry Project**.
4. In the ***Name*** field, key in ***12345_Geometry Training***.

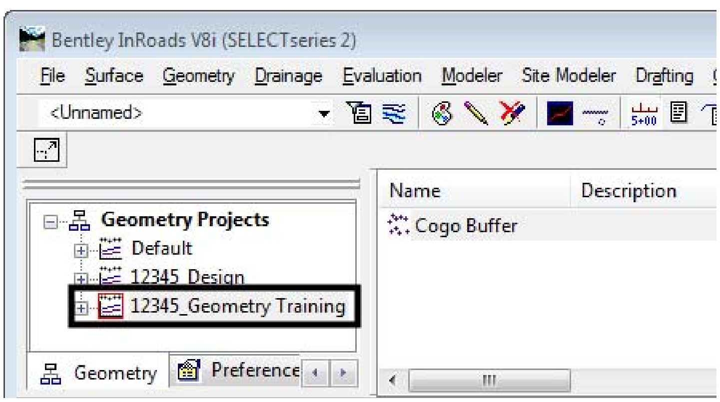
5. In the ***Description*** field, key in ***Geometry Training class***.



Note: The lower portion of the ***New*** dialog displays geometry projects that are currently loaded.

6. **<D> Apply** (Do not Close the New dialog box yet). This creates the geometry project where all new alignment data for this class will be stored. At this point, it is held in RAM (Random Access Memory).

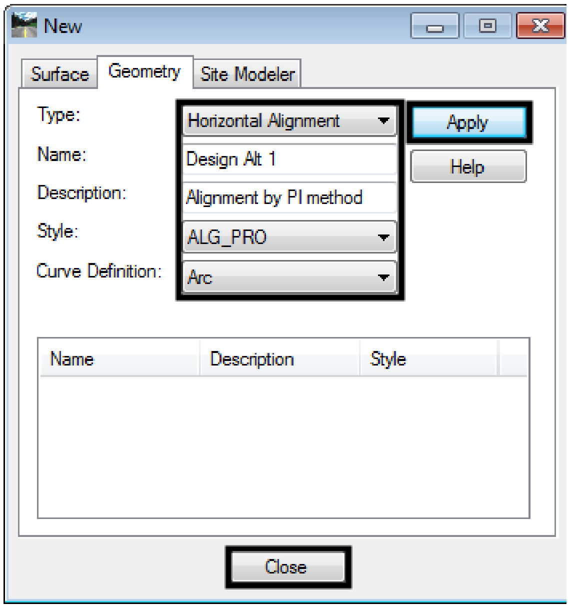
7. **Verify** that the new geometry project was created.



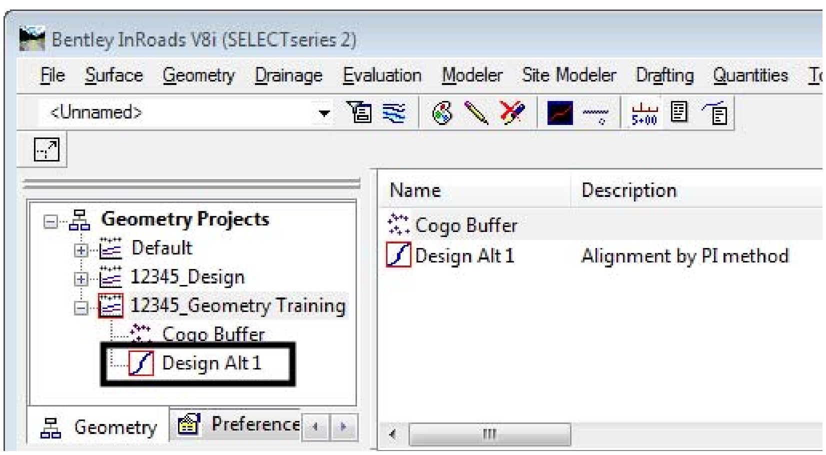
8. Use the following data to create a place holder for horizontal geometry data.

- *Type:* **Horizontal Alignment**
- *Name:* ***Design Alt 1***
- *Description:* ***Alignment by PI method***
- *Style:* **ALG_PRO**

- ***Curve Definition:* ARC**



9. **<D>** the **Apply** then the **Close** buttons.



10. Verify the horizontal alignment is created in the active geometry project.

11. **<R>** on the **12345_Geometry Training** geometry project in the InRoads Explorer pane and **<D> Save** from the right click menu.

12. Verify that the directory path is set to **C:\Projects\12345\Design\InRoads**.

13. Key in ***12345_Geometry Training*** for the ***File name***.

14. **<D> Save** then **Cancel** to save the file and dismiss the Save As dialog box.

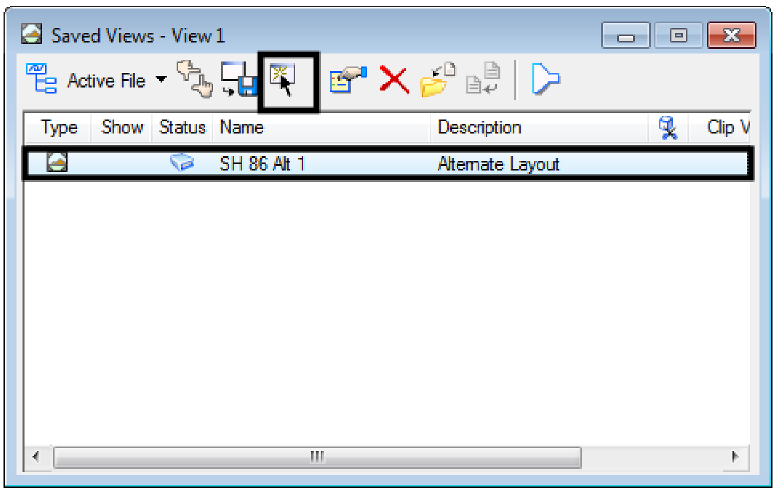
The following exercises will step you through creating an alignment using the Horizontal Curve Set, or PI method. While these exercises are based on a roadway alignment, the tools and logic apply to any new alignment whether it is for drainage, utilities, pavement marking, bridge geometry, parcels, or any other purpose.

Lab 5.3 - Create Alignment Tangents

Section Objectives:

- Create horizontal alignments from PI to PI.

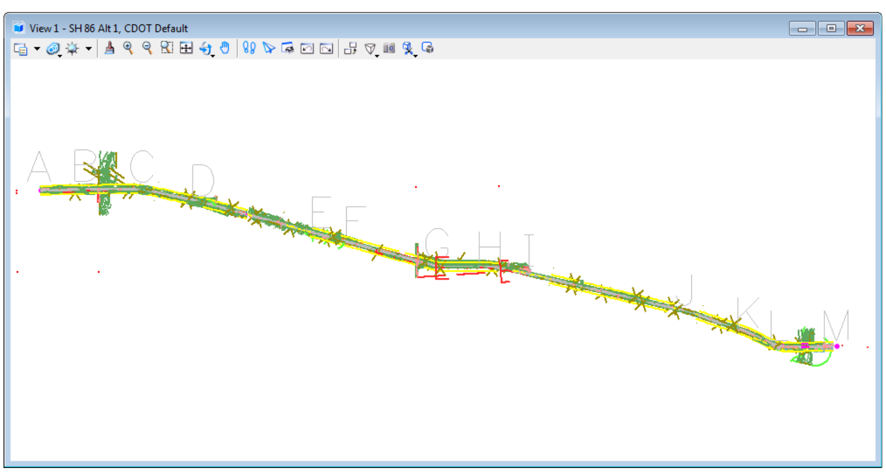
1. From the MicroStation pull-down menu select **Utilities > Saved Views**.
2. From the ***Saved Views*** dialog box **<D>** saved view name **SH 86 ALT 1**.



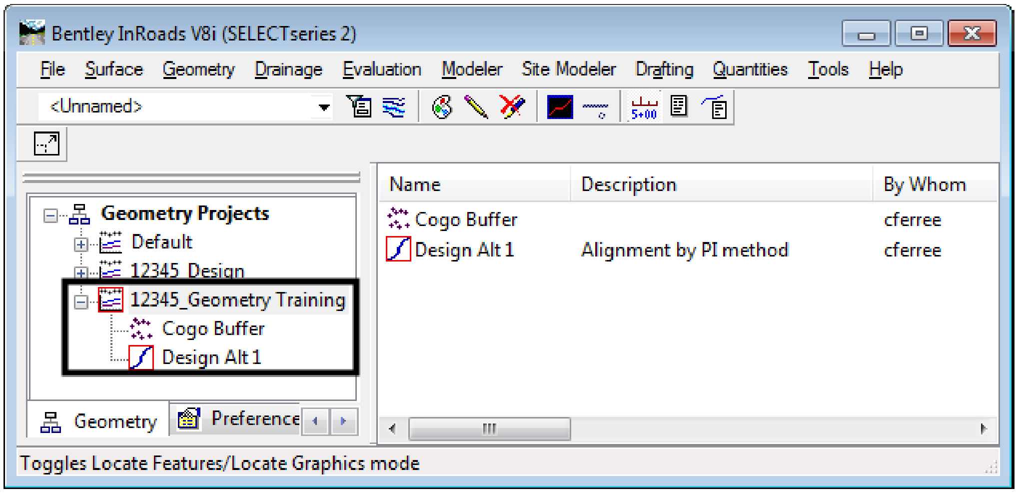
3. **<D>** the **Apply** button.

   Points A-M represent the required location of alignment PI's.

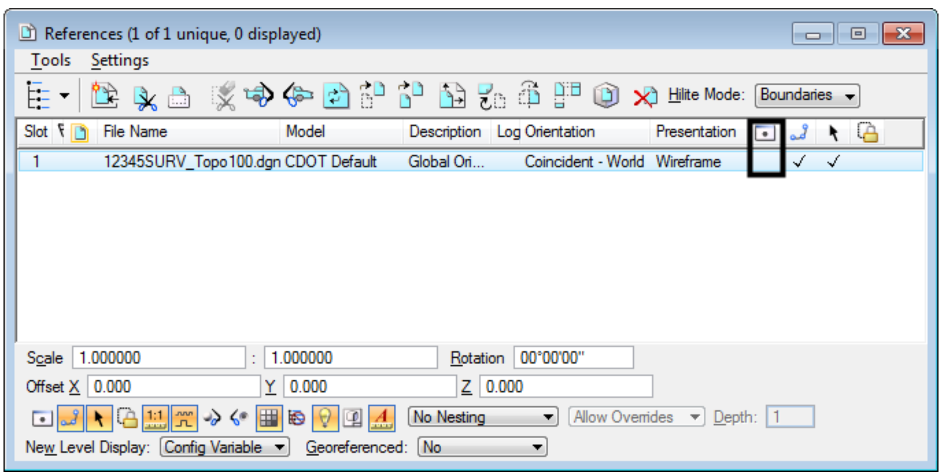
   Horizontal curve set commands will be used to create the horizontal alignment. The next series of steps are used to construct the tangents.



4. Before beginning, verify that the **Design Alt 1** alignment is ***Active***. Any geometry data entered will be added to this alignment.



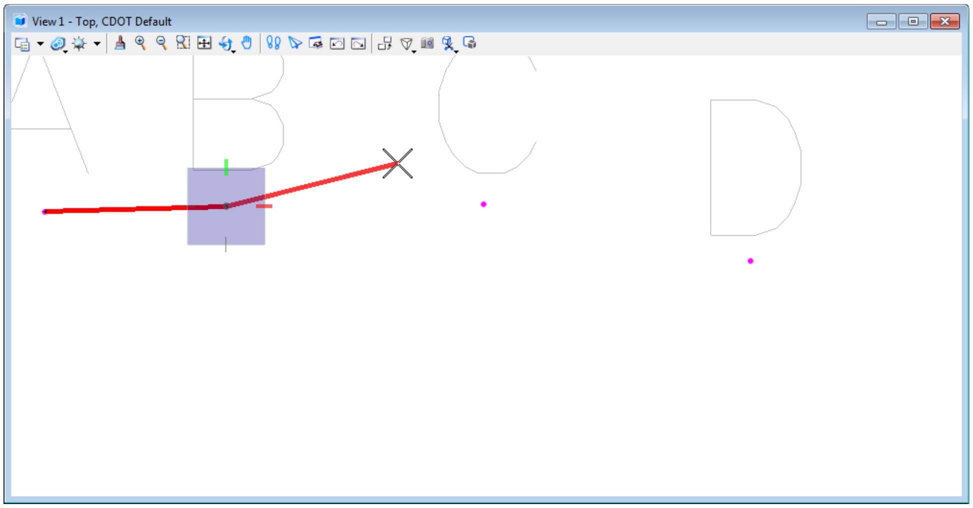
5. To clear the MicroStation view, toggle **Off** the Reference Display for the **12345SURV_Topo100Scale01.dgn** in the ***References*** dialog box.



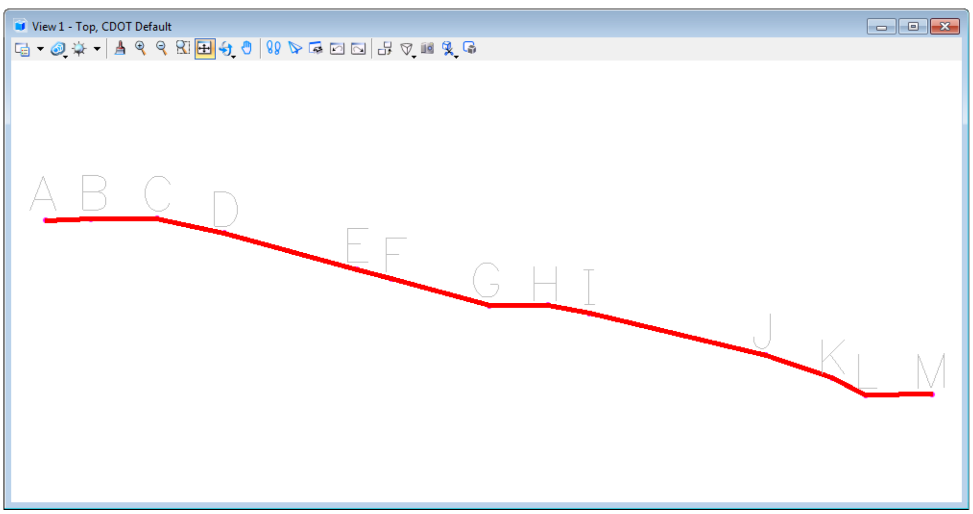
6. Select **Geometry > Horizontal Curve Set > Add PI** from the Inroads main menu. You are prompted in the MicroStation status bar to ***Identify Alignment End***.

Note: There is not a dialog box for this command.

7. **<T>** then **<D>** at point **A** (tentative or snap, and Data point). The alignment interactively displays as you move the cursor.



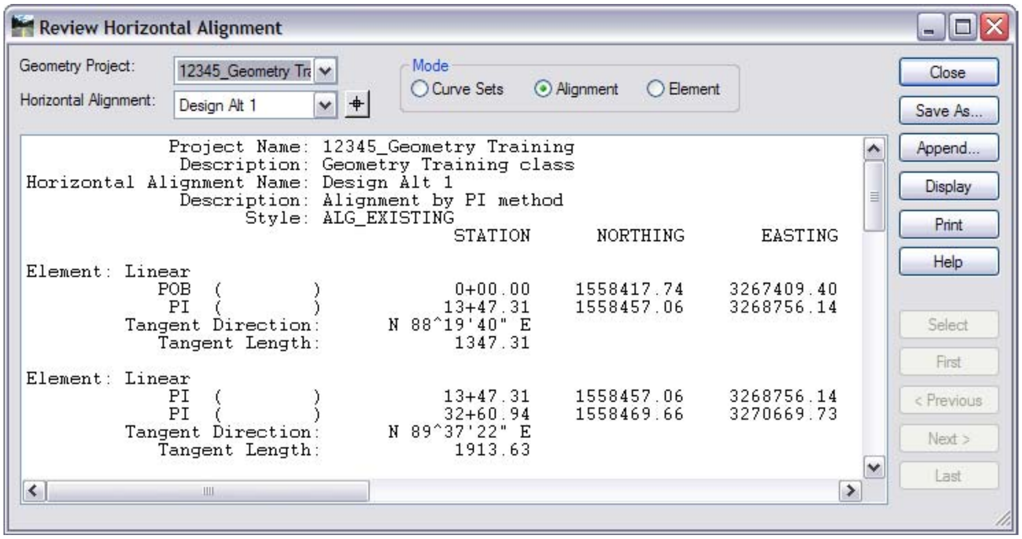
8. Repeat step 7 for points **B** through **M**.



9. **<R>** (reset) when complete.

10. If the alignment created does not pass through points A-M, use the ***Insert***, ***Move***, or ***Delete*** PI commands from the Horizontal Curve Set tools to correct the locations.

11. Review the new alignment using **Geometry > Review Horizontal**



Following is a summary of the PI locations

PI	NORTHING	EASTING	BEARING	DISTANCE	STA.
A	1,558,417.74	3,267,409.40			0+00.00
B	1,558,457.06	3,268,756.14	N 88°19'39.62" E	1,347.31'	13+47.30
C	1,558,469.66	3,270,669.73	N 89°37'21.60" E	1,913.63'	32+60.94
D	1,558,050.59	3,272,645.47	S 78°01'28.88" E	2,019.69'	52+80.63
E	1,556,982.55	3,276,540.43	S 74°39'56.80" E	4,038.75'	93+19.38
F	1,556,716.98	3,277,527.47	S 74°56'25.98" E	1,022.14'	103+41.51
G	1,555,931.76	3,280,408.64	S 74°45'18.96" E	2,986.25'	133+27.77
H	1,555,939.60	3,282,135.29	N 89°44'23.81" E	1,726.67'	150+54.44
I	1,555,699.32	3,283,343.64	S 78°45'12.06" E	1,232.01'	162+86.44
J	1,554,474.27	3,288,508.48	S 76°39'23.63" E	5,308.14'	215+94.58
K	1,553,821.34	3,290,431.45	S 71°14'44.01" E	2,030.79'	236+25.37
L	1,553,315.19	3,291,416.57	S 62°48'22.55" E	1,107.55'	247+32.92
M	1,553,346.54	3,293,367.43	N 89°04'46.05" E	1,951.11'	266+84.03

Note: Results may vary based on the specific PI locations defined by the user.

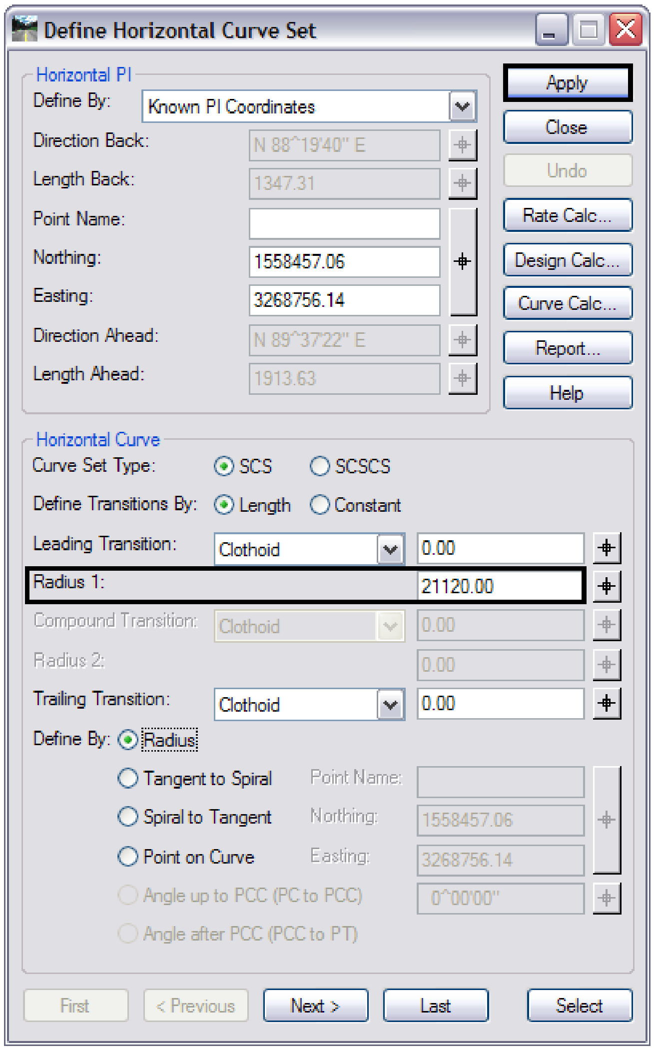
Lab 5.4 - Define Alignment Curves

The ***Define Horizontal Curve Set*** command is used to create curves between alignment tangents or to revise existing curve definition. The ***Previous*** and ***Next*** buttons are used to step sequentially through the alignment. The Select button can be used to graphically identify an alignment location for editing. As alignment components are selected, they highlight in the MicroStation view.

Section Objectives:

- ♦ Add curves to horizontal alignments using various methods
- ♦ Use the Curve Calculator to determine the radius of a curve

1. Select **Geometry > Horizontal Curve Set > Define Curve.** The first two tangents A-B and B-C highlight.
2. Key in ***Radius 1: 21120***.



3. **<D>** the **Apply** button. The curve is created and displays.
4. **<D>** the **Next** button. Tangents B-C and C-D highlight.
5. Key in **Radius 1: *3000***.
6. **<D>** the **Apply** button.
7. Repeat steps 4-6 for the curves at locations:

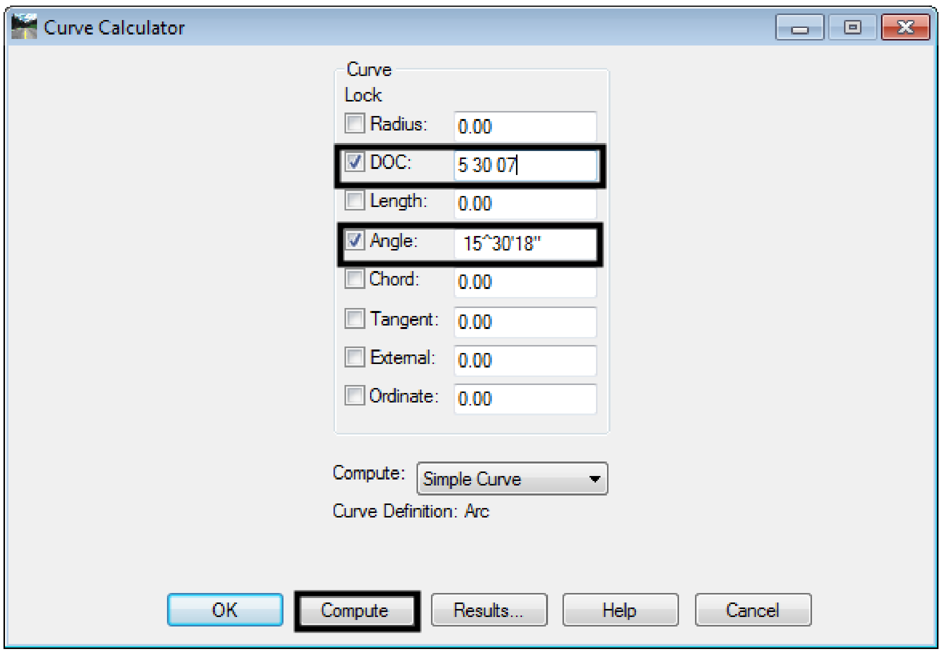
   D Radius = 11,000.00
   E Radius = 3,000.00
   F Radius = 3,000.00

For the first 5 curves, radii were input to define the curves. For the curve located at point G, the degree of curve is the known component (along with the external deflection angle). The Curve Calc… button is used to solve the curve data.

8. **<D>** the **Next** button to define the curve at point G.
9. **<D>** the **Curve Calc…** button.
10. **Set** Compute: to **Simple Curve**.

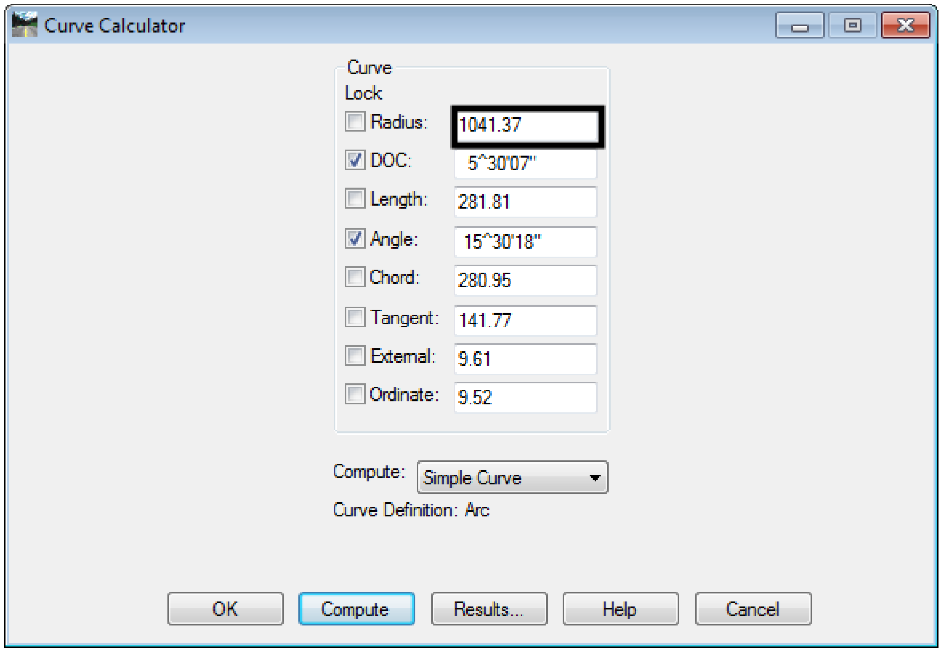
The calculation is based on a 5 degree 30 minute 17 second curve.

11. Toggle on ***DOC:*** and key in ***5 30 07***.
12. Verify that the ***Angle*** field is toggled on.

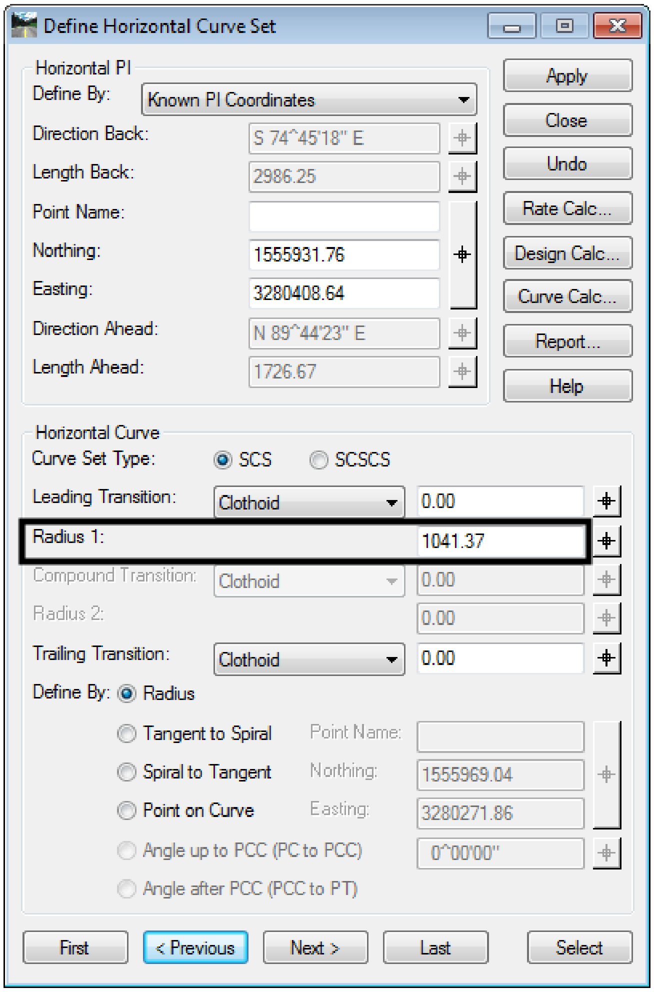


13. **<D> Compute**.

Notice the changes that occur in the dialog box. The values in the unlocked fields are modified based on the locked fields.



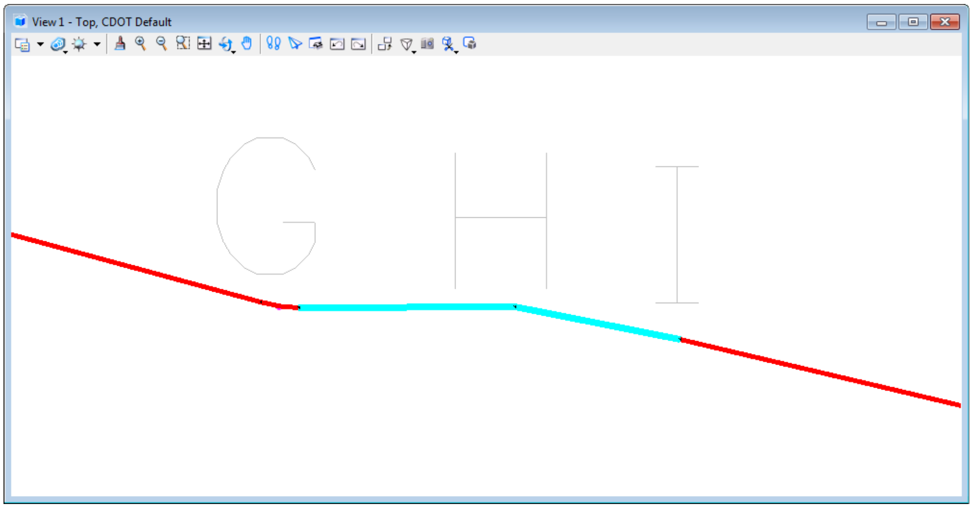
14. **<D> OK**. The ***Curve Calculator*** dialog box is dismissed and the calculated radius is added to the ***Radius 1*** field in the parent dialog box.



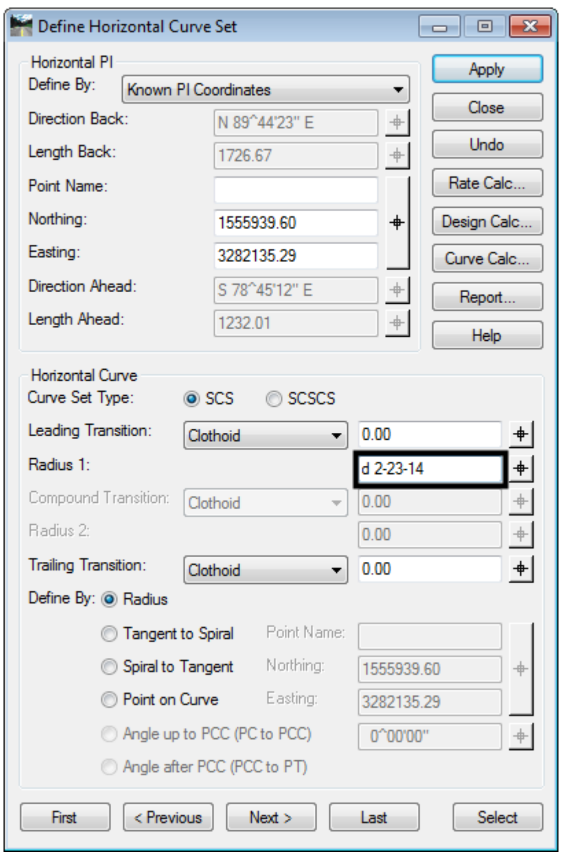
15. **<D> Apply** and the curve will be created.

The next curve (location H) will also be calculated using the degree-of-curve. However a short-cut will be used to generate the input for the Radius 1 field.

16. **<D> Next** to select the tangents on either side of point H.



17. In the ***Radius 1:*** Field Key in ***D 2-23-14***. The key in stands for D.O.C. 2^ 23' 14".



18. Press the keyboard **<TAB>** key to leave the field. The radius (2400.10) will compute for the selected location.

19. **<D> Apply** to form the curve.

20. If time permits, complete the remainder of the curves using the data listed below:

I Radius = 15,000.00
J Radius = 5,000.00
K Radius = 3,000.00
L DOC = 3-34-52

21. Review the alignment data select **Geometry > Review Horizontal**.

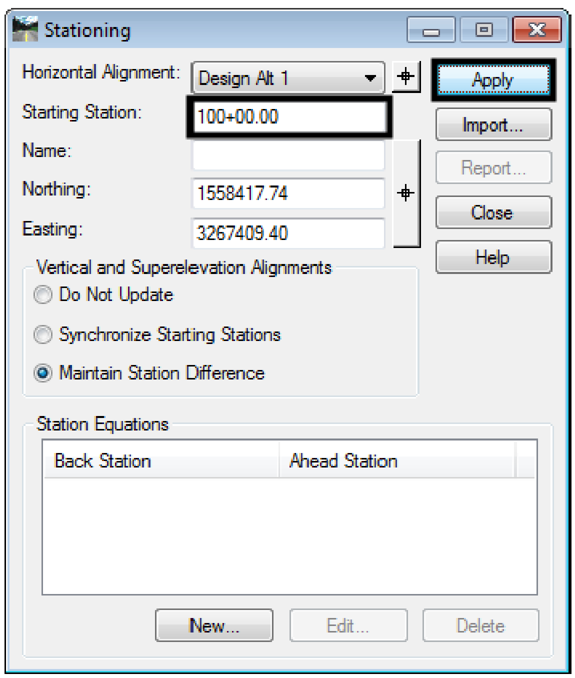
Lab 5.5 - Alignment Stationing

Section Objectives:

♦ Change the assigned stationing of an alignment.

The default station value assigned to the start of a new alignment is 0+00. Redefine the beginning station to 100+00.00

1. Select **Geometry > Horizontal Curve Set > Stationing**.
2. In the ***Stationing*** dialog box, key in ***100+00***. (Can be entered as 10000 and then tab out of the field) in the ***Starting Station*** field.
3. **<D>** the **Apply** button.

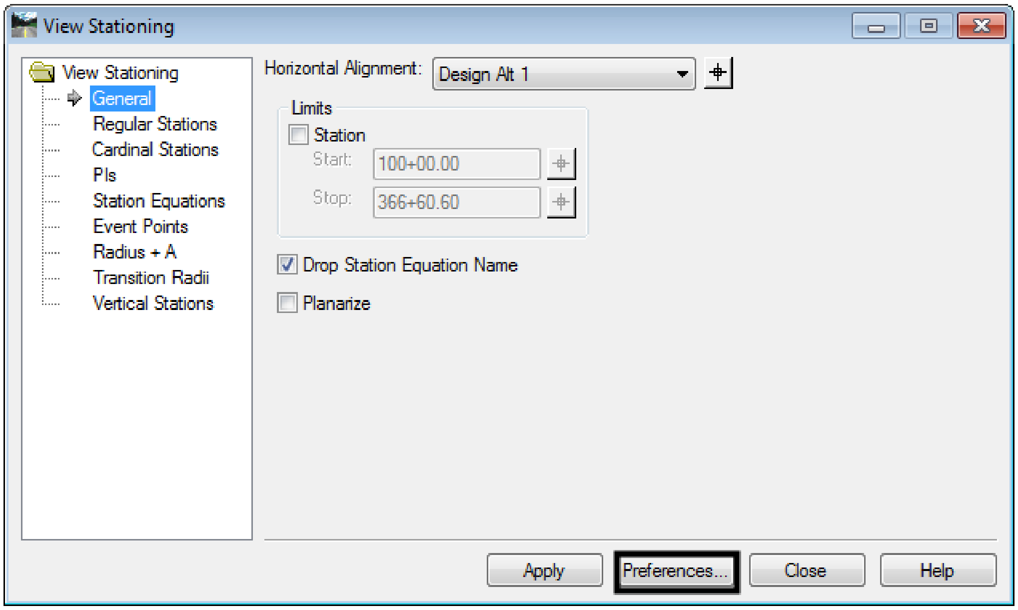


4. Verify your results using both of these methods:

♦ **Geometry > Review Horizontal**

♦ **Tools > Tracking > Horizontal Alignments**

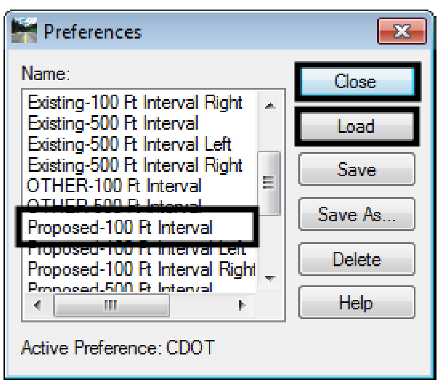
5. Select **Geometry > View Geometry > Stationing** from the InRoads main menu.



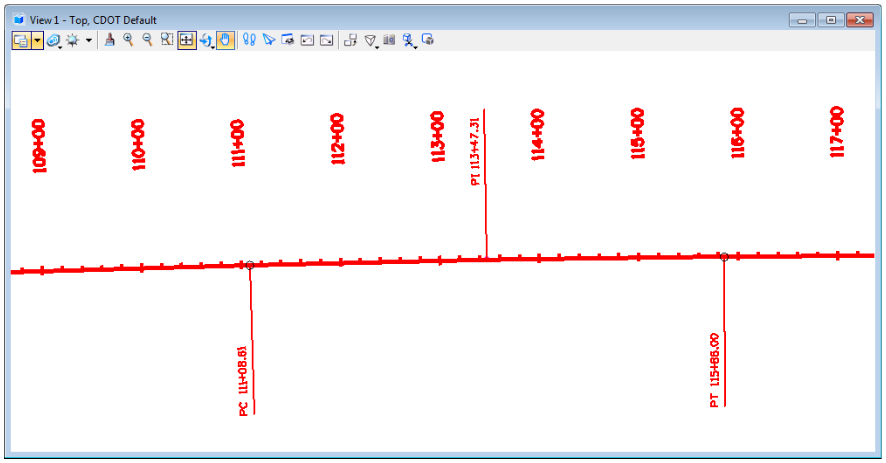
6. **<D>** the **Preferences** button.

7. Highlight the **Proposed-100 Ft Interval** preference.

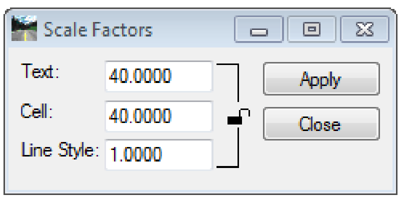
8. **<D> Load** and **Close**.



9. **<D>** the **Apply** button from the ***View Stationing*** dialog box. Stationing is displayed.



10. Experiment with changing the global scale factor value for text and redisplaying the stationing.

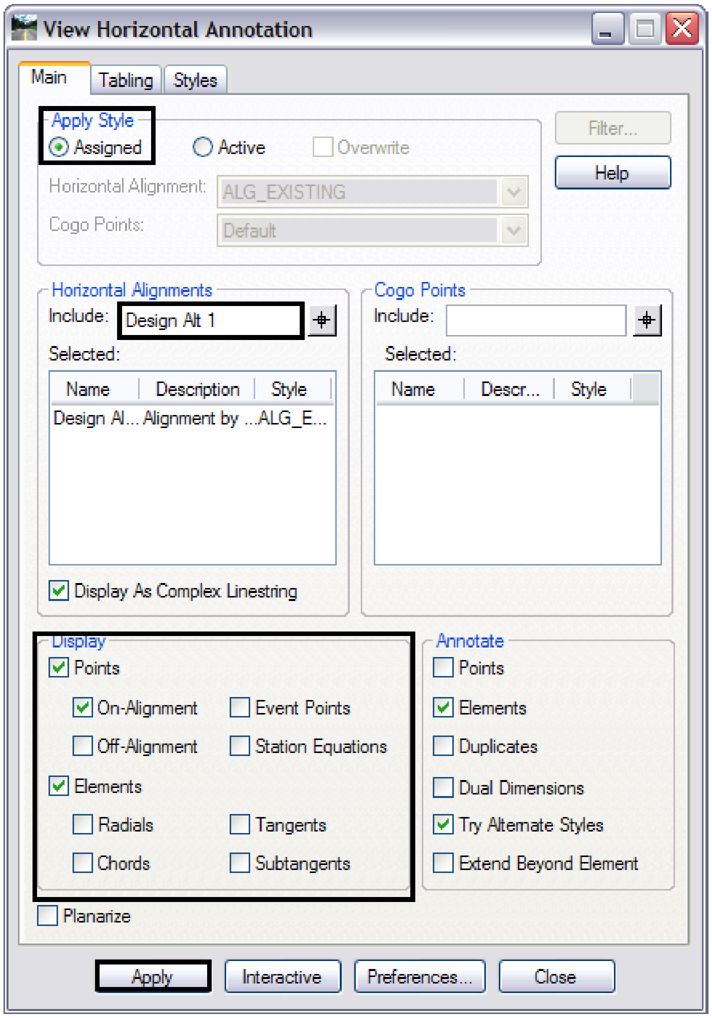


Lab 5.6 - Annotating an Alignment

Section Objectives:

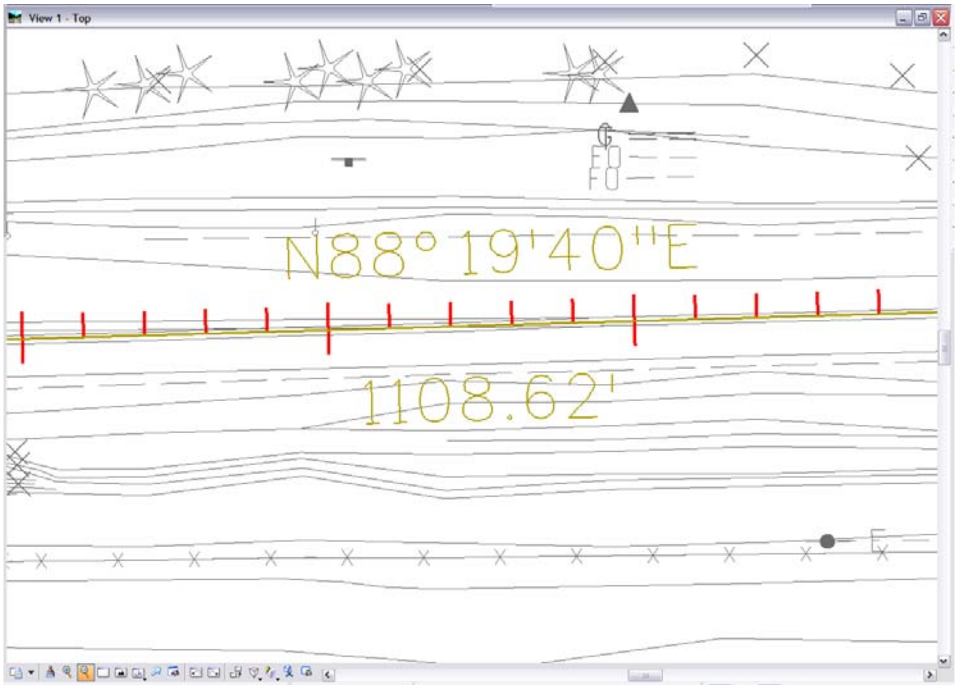
- Annotate an alignment.

1. Select **Geometry > View Geometry > Horizontal Annotation** from the InRoads main menu.



2. Verify the settings as shown above and click **Apply** to display the alignment annotation.

3. **Review** the results in MicroStation.



Challenge Exercise:

1. Use **Geometry>Copy Geometry** to copy alignment **Design ALT 1** to a new horizontal alignment named **Design ALT 1 Modified.**
2. Perform the following actions to the copied alignment:
   - ♦ Move a PI
   - ♦ Redefine one or more horizontal curves
   - ♦ Define alignment stationing to end at station 382+00
   - ♦ Redisplay stationing at a 500 foot interval
   - ♦ Introduce 2 station equations; one overlap and one gap.
   - ♦ Revert the alignment to a simple PI at point B (remove the curve definition)
   - ♦ Transpose the direction of the alignment

Lab 5.7 - Horizontal Alignment from Graphics

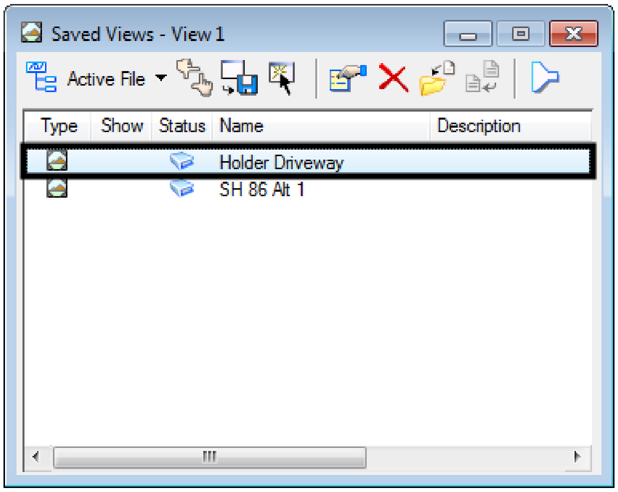
Alignments can be created from existing MicroStation graphics. In this exercise a chained MicroStation element will be used to create an alignment.

Section Objectives:

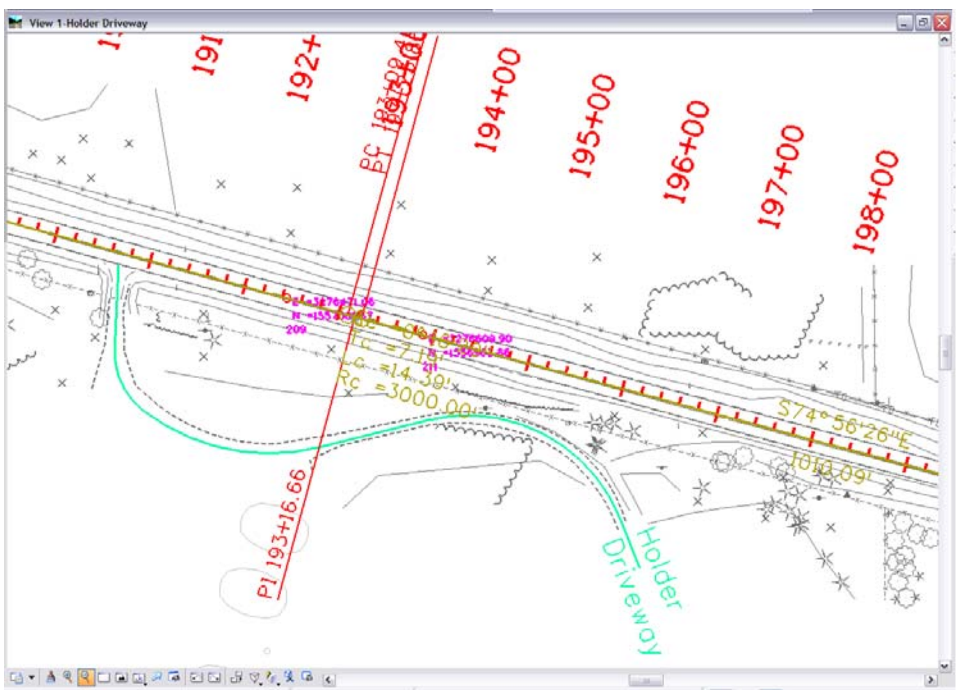
- ♦ Create a new horizontal alignment from MicroStation graphics.

1. From the MicroStation pull-down menu select **Utilities > Saved Views**.

2. From the ***Saved Views*** dialog box, highlight **Holder Driveway**.

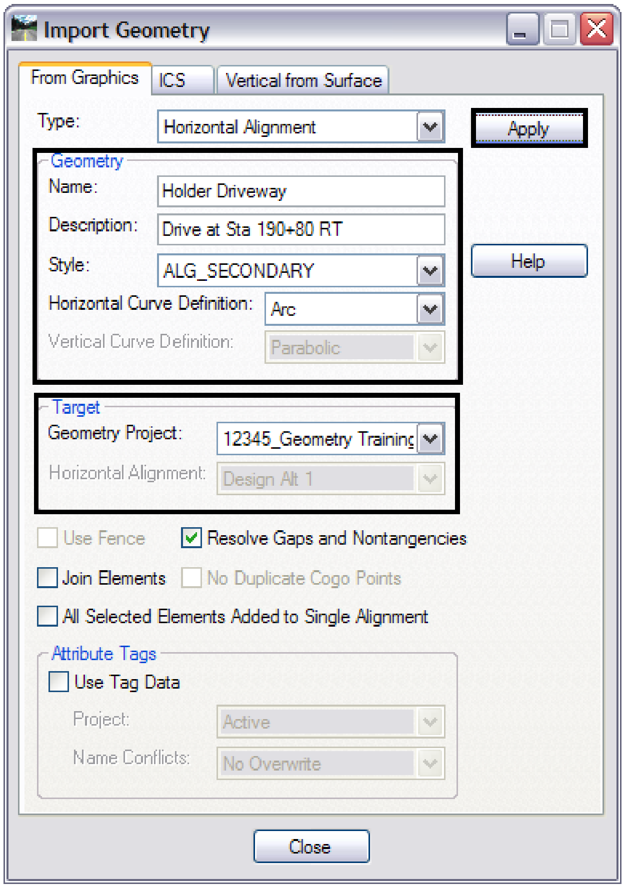


3. **<D>** the **Apply** button then **Close**.



4. Select **File > Import > Geometry.** The ***Import Geometry*** dialog box will open.
5. Fill in the following information on the **From Graphics** tab:
6. Set the Type: to **Horizontal Alignment**
7. Key in ***Holder Driveway*** for the ***Name:***.
8. Key in ***Driveway at Sta 190+80 RT*** for the ***Description:***.

9. Set the Style: to ***ALG_SECONDARY***.
10. Verify the ***Geometry Project:*** is set to **1234_Geometry Training.**
11. **<D>** the **Apply** button. The ***Import Geometry*** dialog box is minimized.

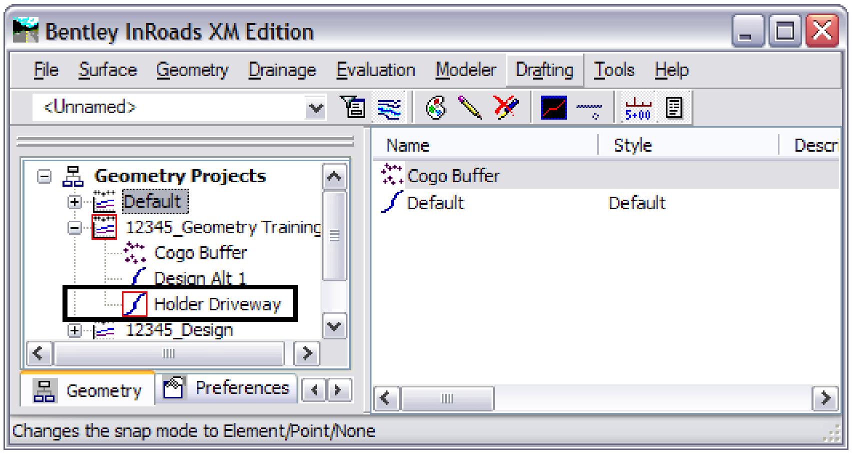


12. You are prompted to ***Identify Element***. **<D>** on the MicroStation graphic drawn in the center of the driveway.
13. **<D>** again to accept the highlighted graphics in the MicroStation view.
14. **<R>** in the MicroStation view to terminate the command. The ***Import Geometry*** dialog box is redisplayed. The MicroStation graphics have been imported as an alignment.

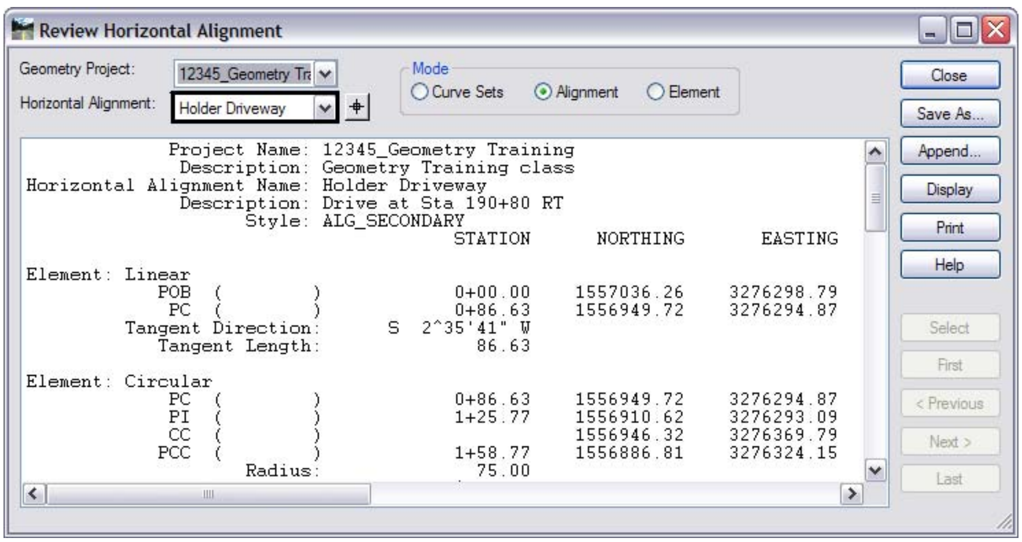
    Note: The geometry name field increments for additional selection(s).

15. **<D>** the **Close** button to dismiss the ***Import Geometry*** dialog box.

16. **Verify** the alignment was created.



17. Review the alignment using **Geometry > Review Horizontal**.



18. When finished **Close** the ***Review Horizontal Alignment*** dialog box.

19. Time permitting, display the alignment graphics, stationing, and curve information.

Lab 5.8 - Extend Alignment

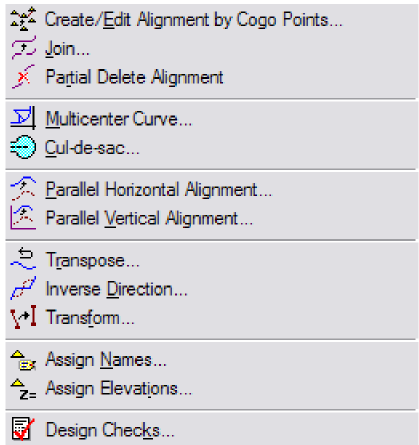
The alignment ***Holder Driveway*** does not intersect the reference line alignment ***Design Alt 1***. Standard practice necessitates the driveway alignment to commence at the main-line reference line.

Section Objectives:

- Learn one of the tools used to modify existing alignments.

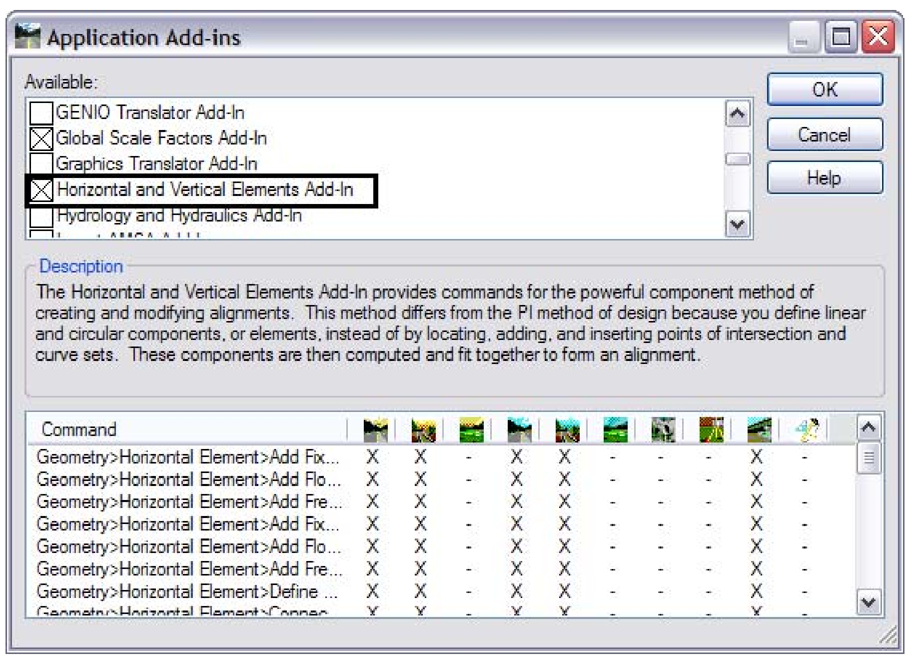
1. **Select Geometry > Utilities >** and hold.

Note: If the commands for Trim and Extend Alignment are not listed in the menu, this means that they are not enabled. These 2 commands are an extension of the Horizontal & Vertical Elements command set which must be enabled.

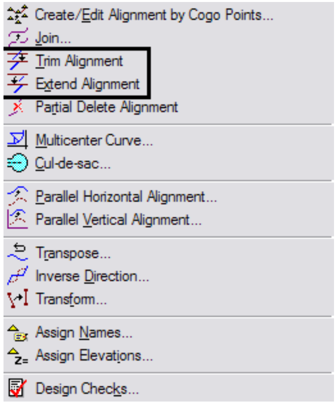


2. Select **Tools > Application ADD-Ins**.

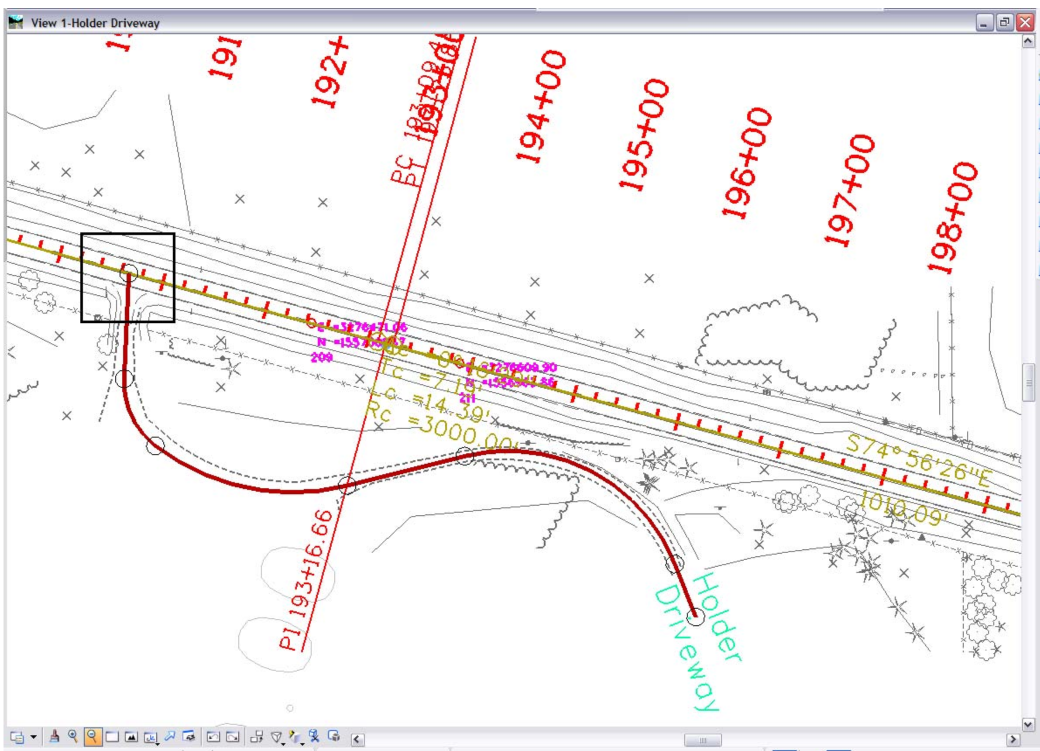
3. Enable **Horizontal and Vertical Elements Add-In**.



4. Once enabled, **Select Geometry > Utilities > Extend Alignment**.



5. At the prompt: ***Identify Alignment to extend to***, **<D>** on the alignment **Design Alt 1**.
6. At the prompt: ***Identify Alignment to extend***, **<D>** on the alignment **Holder Driveway**.
7. **<D>** to ***accept*** the presented solution.



Note: The alignment-alignment intersection is now the initial point of the driveway alignment. Because the alignment was edited (extended) from its beginning, the initial station value was recalculated to -0+12.41. Because the original beginning point retains its station value (0+00), the new beginning point is given a negative station value.

8. From the InRoads main menu, select **Geometry > Horizontal Curve Set > Stationing** define the driveway beginning station as **3+25**.

Challenge Exercises:

- ♦ Display stationing at a 100 foot interval for Holder Drive.
- ♦ Display alignment annotation for Holder Drive.
- ♦ Recall saved view Drive @ 180+00.
- ♦ Import the graphics representing the driveway centerline into an alignment named Drive 180+00**.**
- ♦ Use the command **Geometry > Utilities > Trim Alignment** to remove the portion of the driveway alignment that lies north of the main-line reference line.

Note: The order selecting alignments is not important when using the trim alignment command. The location of the data point in response to ***Identify portion to clip*** determines both the alignment and the portion of that alignment that is eliminated.

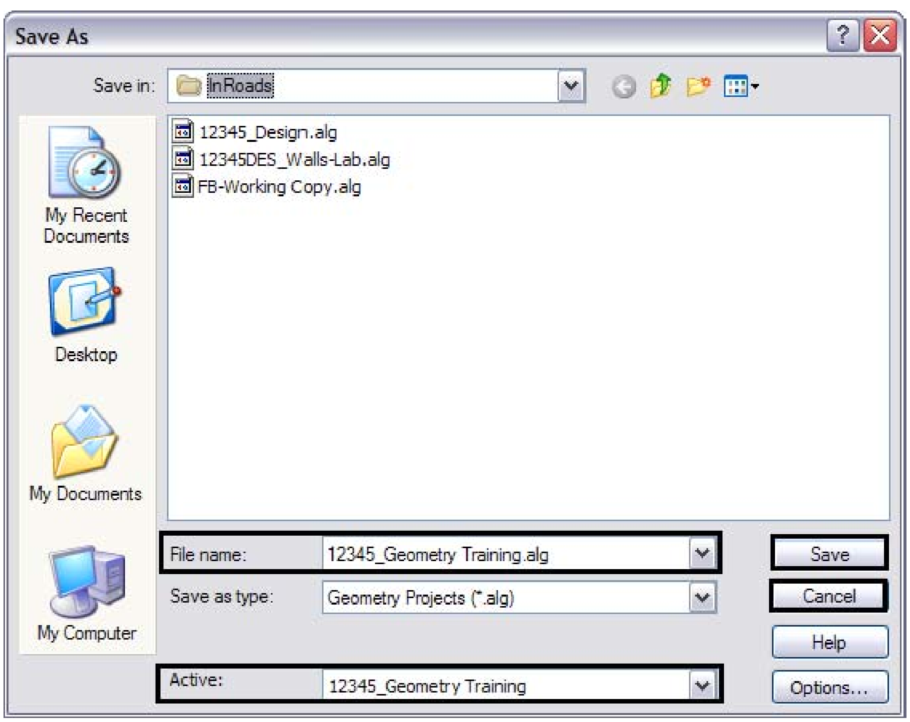
Lab 5.9 - Saving Geometry

Alignments cannot be saved individually. They are saved when the geometry project is saved. Due to the fact InRoads works on geometry that is loaded in memory, the geometry project must be saved at appropriate times.

Section Objectives:

- ♦ Save InRoads design data.

1. From the InRoads main menu, select **File > Save > Geometry Project**. The ***Save As*** dialog box is displayed with the ***Save as type:*** set to **Geometry (*.alg)**.
2. Verify you are in the correct project directory; **C:\Projects\12345\Design\InRoads**.



3. The file name should match the ***Active:*** name at the bottom of the ***Save As*** dialog box. If necessary, use ***Active*** drop-down menu and reselect the desired name to ensure the saved file name will match the geometry project name.

   Note: Geometry projects have both an internal name that appears in the dialog boxes in InRoads and a name on the hard drive that has an.ALG extension. To minimize any confusion between these two names, ensure that the saved Geometry name in the project folder matches the Geometry name displayed in InRoads explorer.

4. **<D>** the **Save** button and then the **Cancel** button. The file will be saved to disk and the ***Save As*** dialog is dismissed.

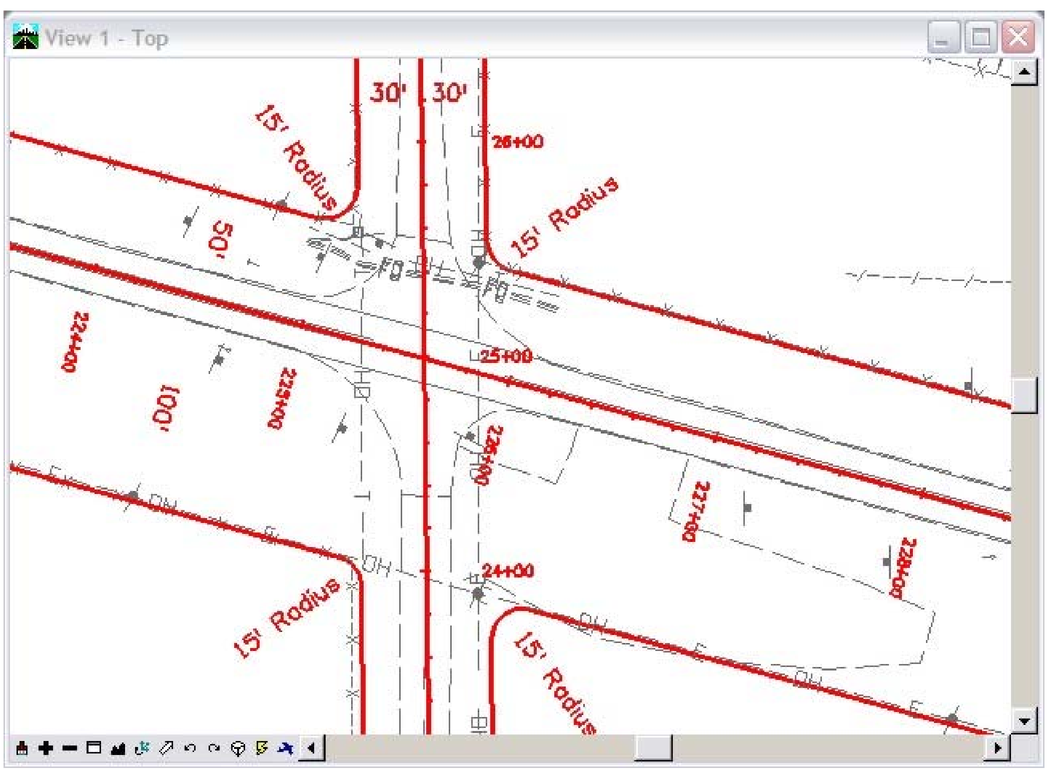
Lab 5.10 - Creating Parallel Horizontal Alignments

Offset alignments can be created to generate geometry for elements such as right-of-way limits, easement limits, under-drains, retaining walls, bridge decks, etc.

Section Objectives:

- Learn additional tools for creating alignments.

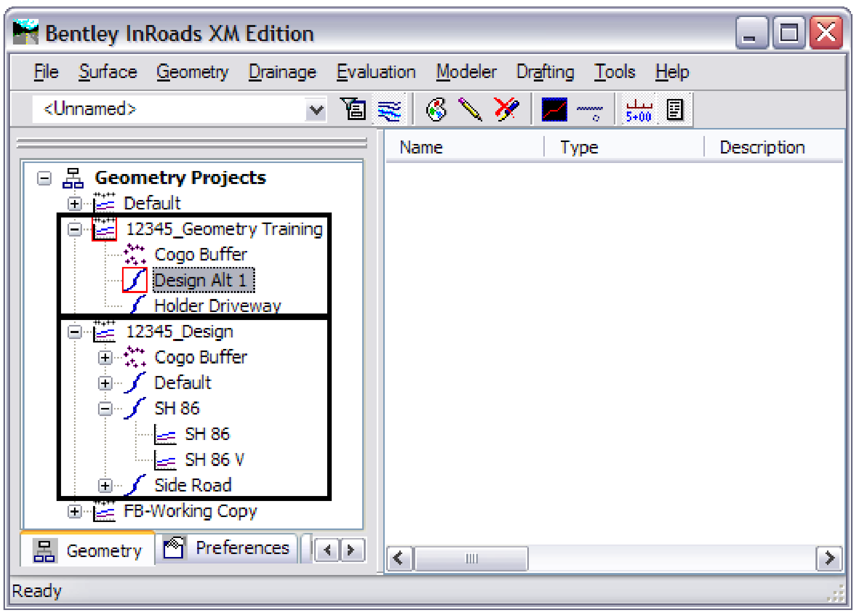
In this lab horizontal alignments are created to define the right-of-way limits for the mainline road and the side road. The Side Road has a right-of-way width of 60’ (30’ on each side of centerline). The mainline alignment has a total right-of-way width of 150’; 50’ feet north of the reference line and 100’ south. At the intersection of the right-of-way lines a radius of 15’ is required.



The workflow will consist of using an assortment of geometry commands:

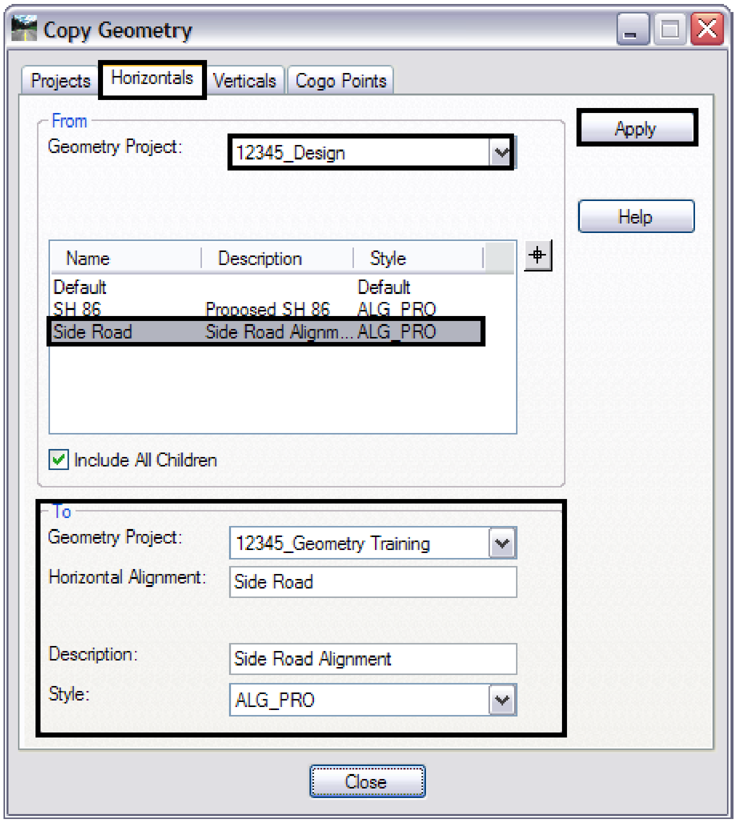
- **Copying Geometry** - used to combine geometry residing in two different geometry projects into one project
- **Multi-Center Curve** – to create radius returns
- **Parallel Horizontal Alignment -** to offset alignments
- **Join Alignments** – to connect separate alignments
- **Join Elements** – to simplify geometry

The first step is to create alignments relative to both the mainline alignment (SH 86) and the side road alignment (Side Road). These two horizontal alignments reside in two different geometry projects. To work efficiently, they should reside in a single geometry project. The ***Copy Geometry*** command is used to achieve this result.



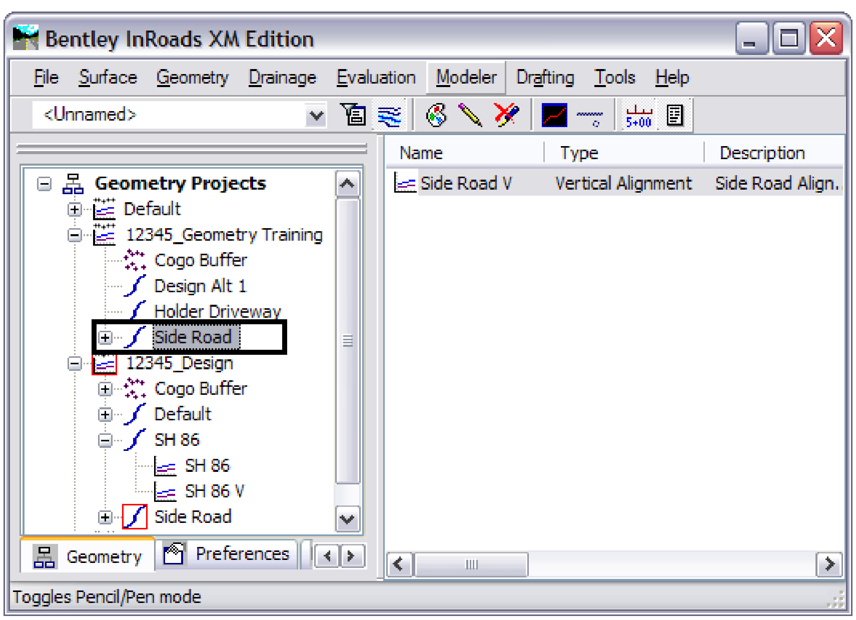
1. Select **Geometry>Copy Geometry** from the Inroads main menu.
2. In the From area, select **12345_Design** for the geometry project.
3. Highlight the alignment **Side Road** from list.
4. Verify that **Include All Children** is toggled on.
5. In the ***To*** area, Select **12345_Geometry Training** for the ***Geometry Project***.
6. Key in ***Side Road*** for the ***Horizontal Alignment*** name.
7. Key in ***Side Road Alignment*** for the ***Description***.
8. Select **ALG_PRO** for the ***Style***.

9. **<D> Apply** then **Close** to copy the alignment and dismiss the dialog box.



10. Verify the alignment was copied.

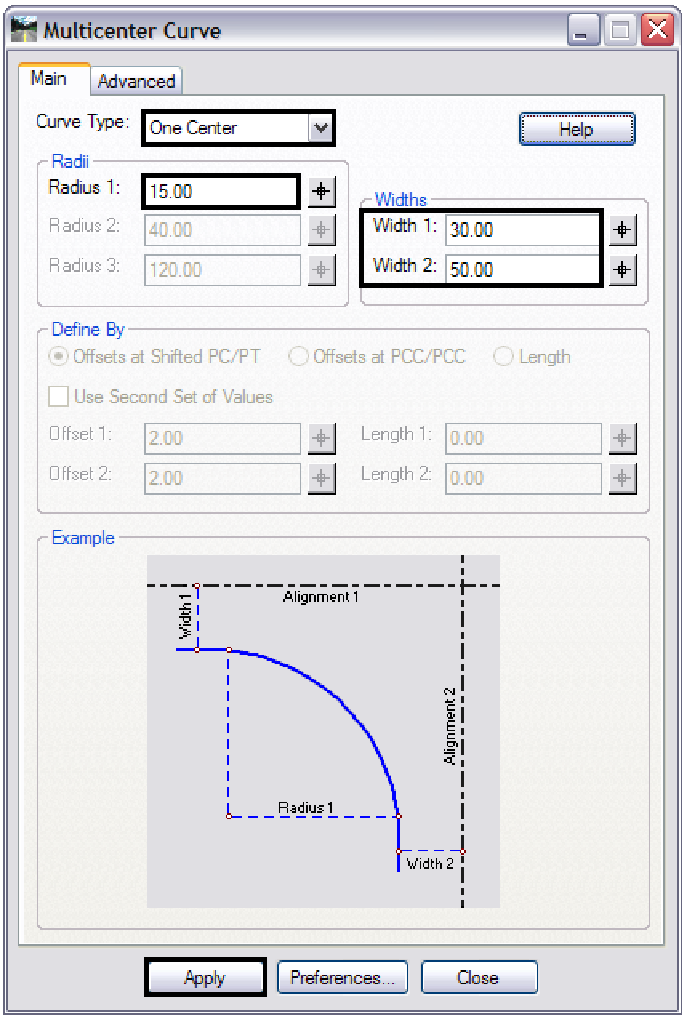
11. Copy alignment **SH 86** as **SH 86 ALT 1** if you feel the mainline alignment created in an earlier lab exercise may contain errors



12. Set the geometry project **12345_Geometry Training** as ***Active***.

The next step is to generate the radius returns. This is done by using the Multicenter Curve command. Begin by creating the radius returns north of the mainline alignment.

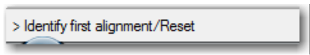
13. From the ***Saved Views*** dialog box, **<D>** saved view name **Side Road**.
14. Click **Apply**.
15. Select **Geometry > Utilities > MultiCenter Curve** from the InRoads main menu.



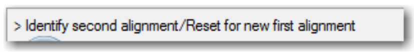
16. Select **One Center**.
17. Input the following values:

- ***Radius: 15***
- ***Width 1: 30***
- ***Width 2: 50***

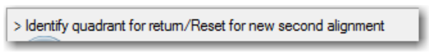
18. **<D>** the **Apply** button. The following prompts are displayed.



19. In the MicroStation view **<D>** on the **Side Road** alignment.



20. **<D>** on the **Design ALT 1** alignment.



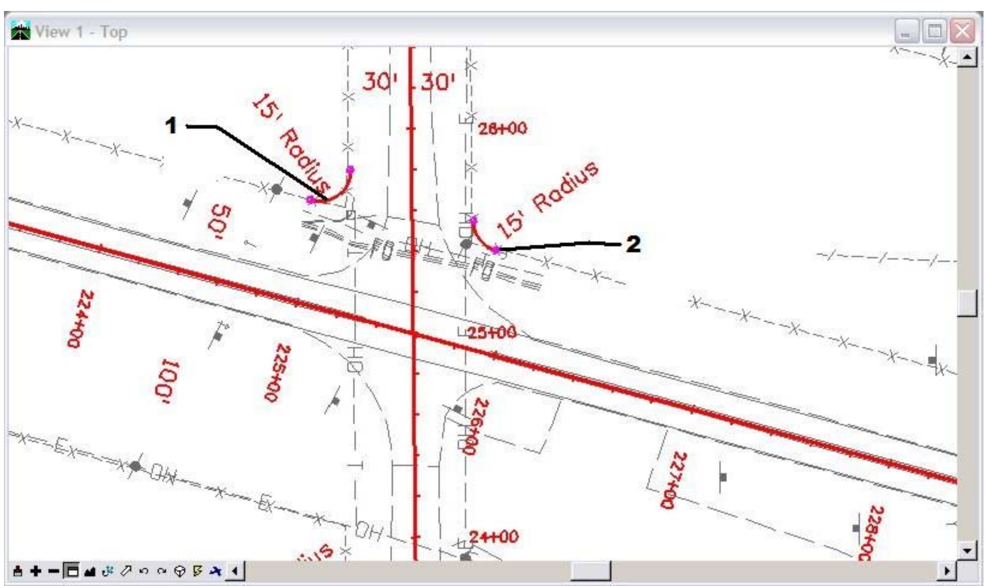
21. **<D>** in the ***Northwest*** quadrant

22. **<D>** to accept and create an alignment representing the radius return.

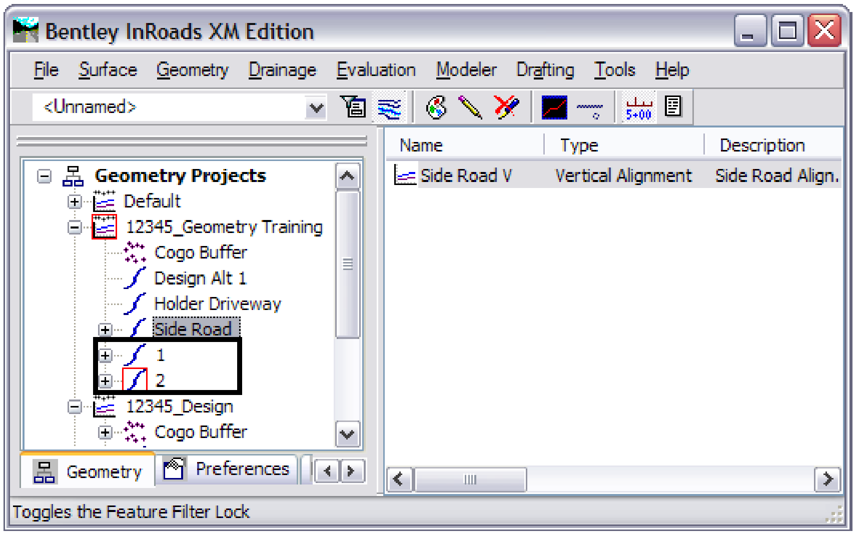
23. To add the radius returns to the remaining quadrants, **<D>** in the quadrant then **<D>** again to **Accept**.

    New alignments will be assigned names based on the seed alignment name specified in **Tools > Options [Geometry]**.

    Two new alignments are created, ***1***and ***2***.



Note: Your stationing graphics may appear at a different location than shown above.

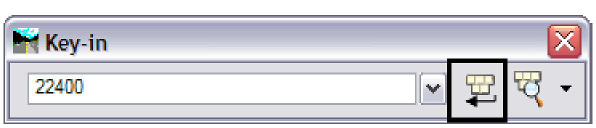


The next steps will be to offset the mainline and side road alignments so they match up with the returns that were just created. This is done using the ***Parallel Horizontal Alignment*** command.

24. From the MicroStation drop-down menu, select **Utilities > Keyin**. The key in window is needed to input the desired station limits and offset distances.

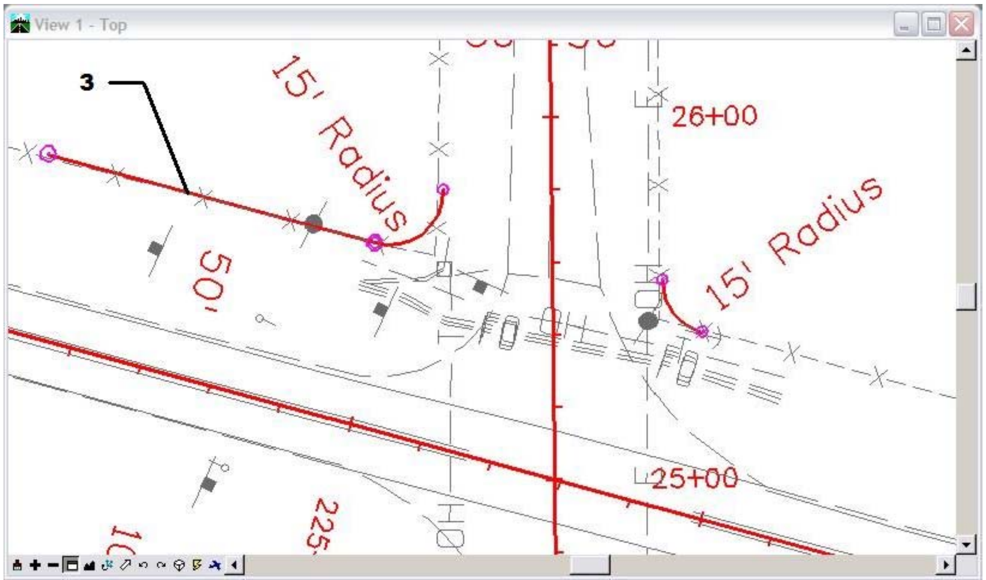
    Note: Stations and offsets can be identified graphically. However, using key-in's provides greater accuracy.

25. From the InRoads main menu select **Geometry > Utilities > Parallel Horizontal Alignment...**.
26. In the ***Parallel Horizontal Alignment*** dialog box, toggle on **Interactive By Station**
27. **<D>** the **Apply** button.
28. In the MicroStation view **<D>** on the mainline alignment.
29. At the prompt ***Identify First Station/Key in Station***, key in ***224+00*** in the MicroStation Key-in window.
30. Press the ***Enter*** key.



31. At the prompt ***Identify Second Station/Key in Station***, key in ***224+93.20*** in the MicroStation Key-in window.

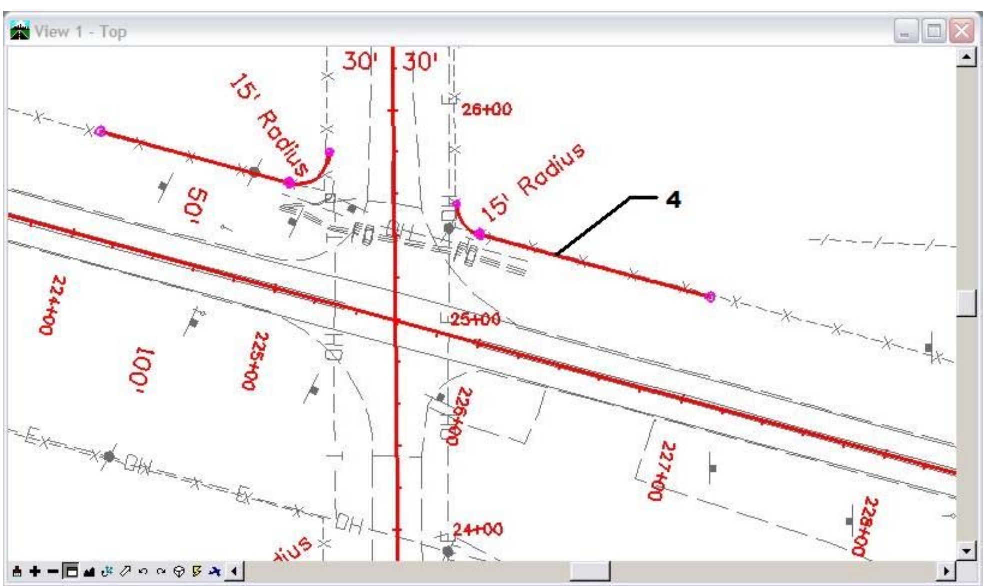
32. Press the ***Enter*** key.
33. For ***Identify Location:*** key in ***-50*** (50' to the left) in the MicroStation Key-in window.
34. Press the ***Enter*** key.
35. **<D>** the in the view window to accept the solution. Alignment 3 is created and displayed.



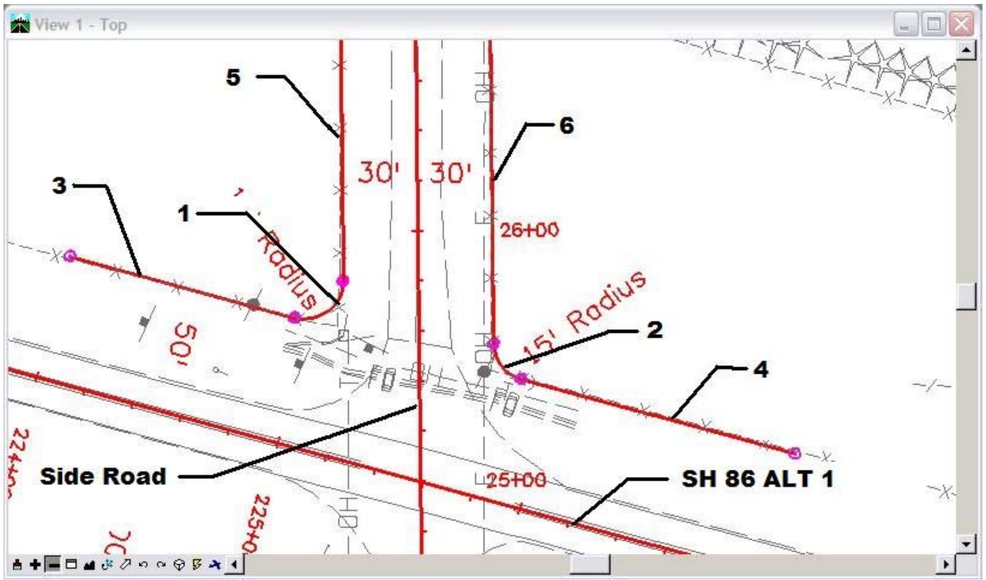
36. Repeat the **Geometry > Utilities > Parallel Horizontal by Station** command to the east of the side road using the following data:

    ♦ Station limits of: **225+86.76** to **227+00, 50'** left of Design Alt 1

    Alignment 4 is created and displayed.



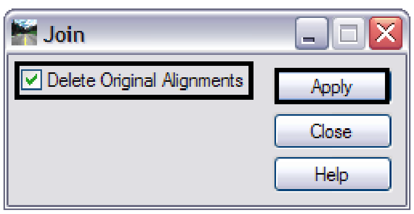
37. Repeat the process to create the alignments along the Side Road north of the radius returns.



Next use the Join Alignment command to connect the alignments created in the previous steps single alignments for each quadrant.

Join alignments 3, 1, & 5 to create the Northwest quadrant's right-of-way limits.

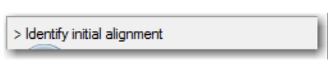
38. Select **Geometry > Utilities > Join**.



39. toggle on ***Delete Original Alignments***.

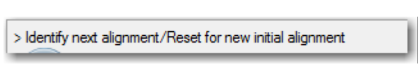
Note: The first alignment identified (3) will become the final alignment name and alignments (1) and (5) will be deleted upon completion of the command.

40. **<D>** the **Apply** button and follow the prompts.



41. **<D>** on alignment **3**.

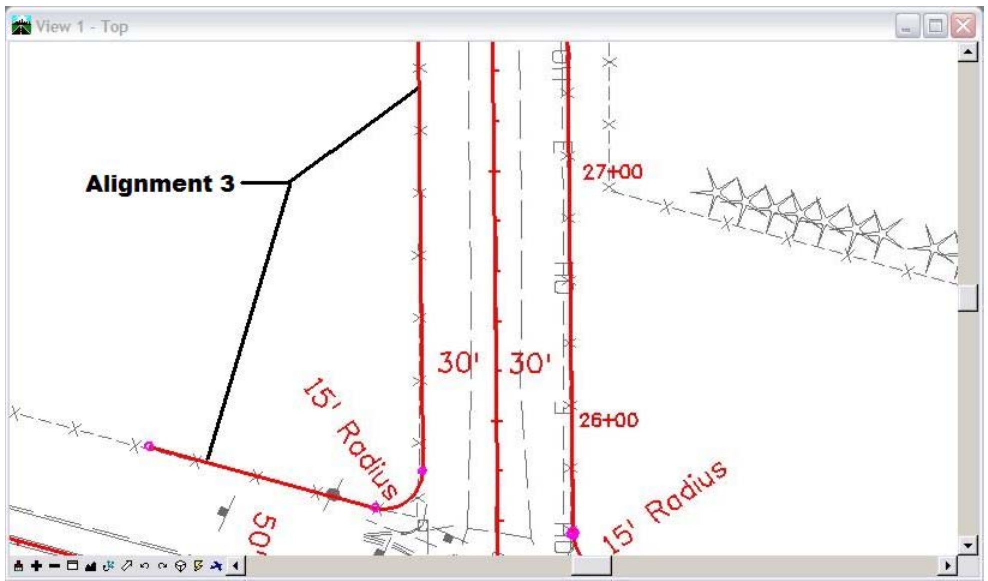
42. **<D>** alignment **1**.



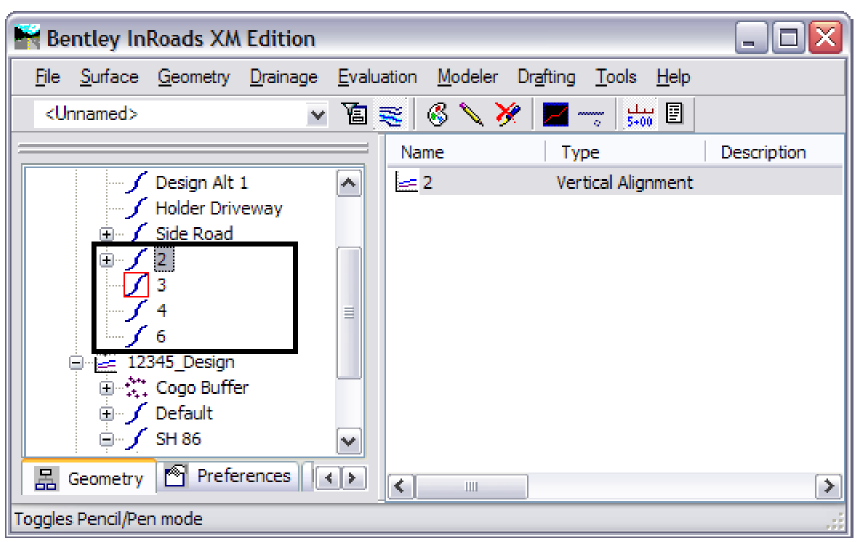
43. **<D>** on alignment **5**.

44. **<D>** to accept the results.

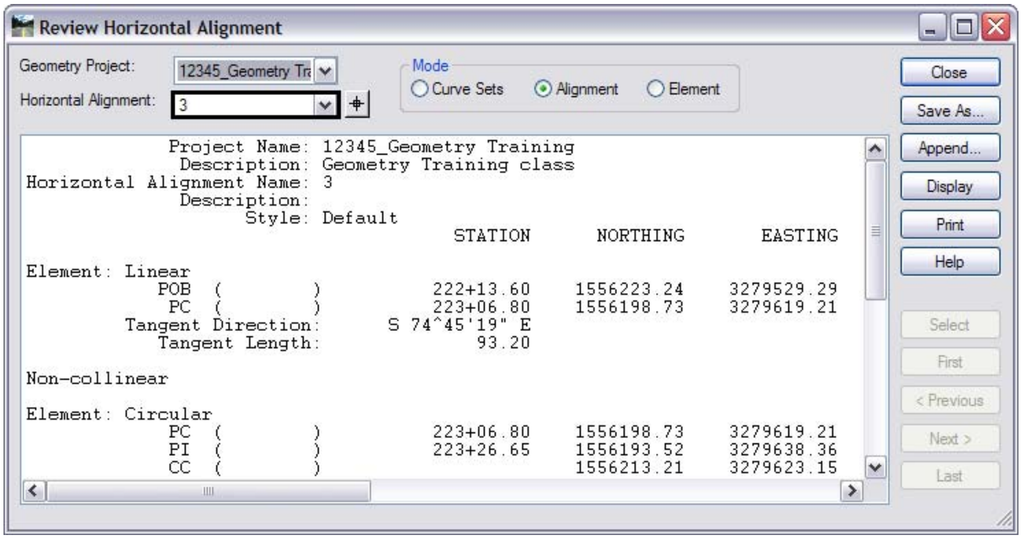
45. Reset **<R> <R>** to exit the command.



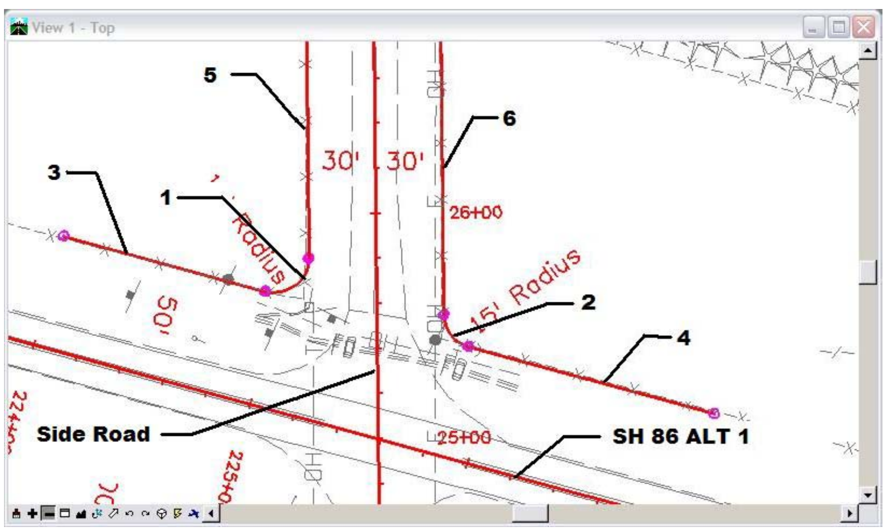
Alignment 3 is now the combination of the alignments 3, 1, and 5. Alignments 1 and 5 have been removed from the geometry project.



46. **Review** alignment **3**.



47. Using the same steps above, join alignments 6, 2, and 4 (in that order) to create the northeast quadrant's right-of-way limits; begin with alignment **6**.

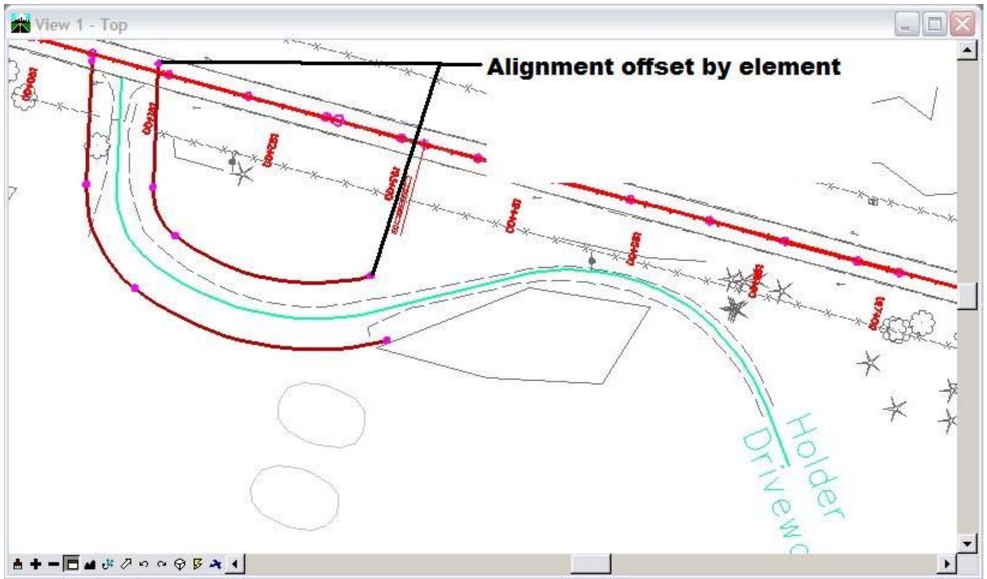


Once the above step is completed, alignments 3 and 6 define the right-of-way limits on the north side of the intersection.

Another method of creating parallel alignments is by element instead of by station.

48. Select **Geometry > Utilities > Parallel Horizontal Alignment**.

Parallel Horizontal Alignment ***by Element*** differs from ***by Station*** in that you can select the limits of the alignment to offset by selecting alignment components (tangents or curves) to define the desired limits.



LAB 6 - Profiles and Vertical Alignments

Once the horizontal alignment is defined, then the profile and vertical alignment can be created. Profiles are a graphic representation of a surface along a specified path (alignment, graphic element, etc.). Profiles are also used to create and display vertical alignments.

Chapter Objectives:

- Review an existing vertical alignment.
- Create a profile.
- Update the profile with a variety of features.
- Display profile annotation data.
- Use vertical alignment tracking.
- Create a new vertical alignment.

The following files are used in this lab:

- C:\Projects\12345\Design\Drawings\Reference_Files\12345DES_Model.dgn
- C:\Projects\12345\Design\InRoads\12345DES_Design.alg
- C:\Projects\12345\Design\InRoads\12345 existing ground.dtm

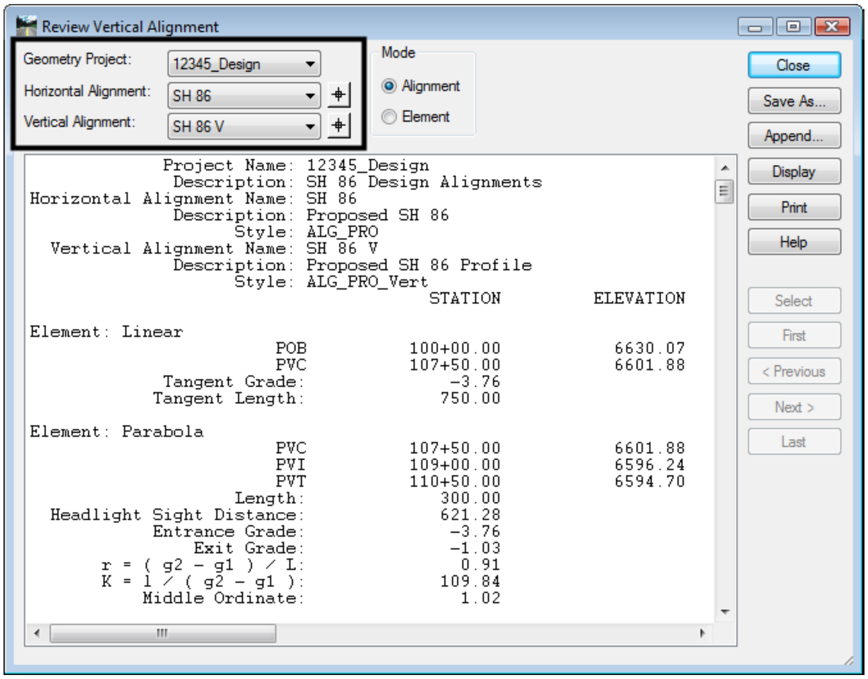
Lab 6.1 - Reviewing Vertical Alignments

Section Objectives:

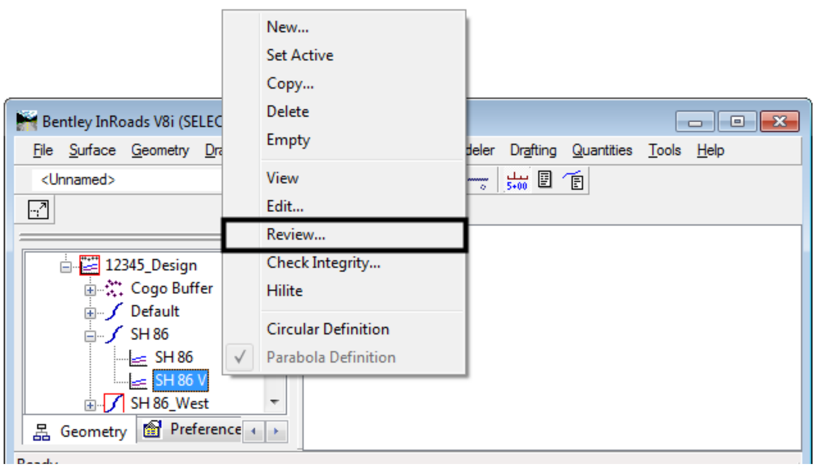
♦ Examine the Review Vertical Geometry window and explore the functionality of the dialog box.

Reviewing vertical alignments is similar to reviewing horizontal alignments. The ***Review Vertical Alignment*** dialog box allows you to easily change between multiple Geometry Projects, Horizontal, and Vertical alignments.

1. Select **Geometry > Review Vertical** from the InRoads main menu.



The review dialog box can also be opened with the right-click menu.



Section Summary:

- Reviewing vertical alignments works the same as reviewing horizontal alignments.

Lab 6.2 - Creating Profiles

Before a vertical alignment can be displayed graphically, a profile must be created. These are referred to as profile sets in InRoads. A profile set can be created from a horizontal alignment, a MicroStation element, or a series of data points. A profile can contain DTM surfaces, vertical alignments and DTM features. Once a profile set has been created, items displayed can be turned on or off and elements can be updated based on current data.

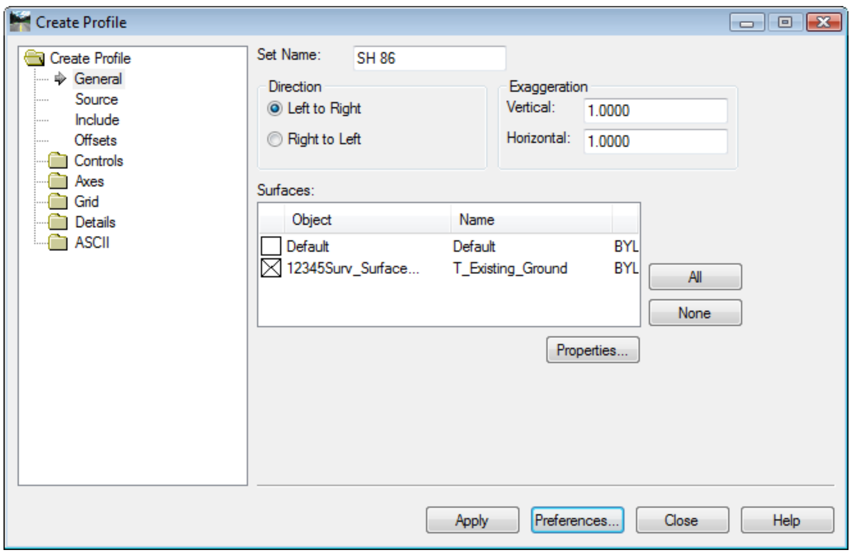
Section Objectives:

- Examine the profile dialog box.
- Select profile Preferences.
- Display vertical alignment annotation.

The DTM **12345Surv_Surface_Existing** surface will be used to display an existing ground-line

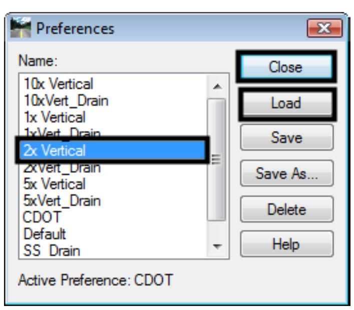
1. In the InRoads explorer, select the **Geometry** tab, verify that **12345_Design** is the ***active*** geometry project and that the horizontal alignment **SH86** is the ***active*** alignment.

2. Select **Evaluation > Profile > Create Profile** from the InRoads main menu. The ***Create Profile*** dialog will appear.



3. **<D>** the **Preferences** button. The ***Preferences*** dialog box is displayed.

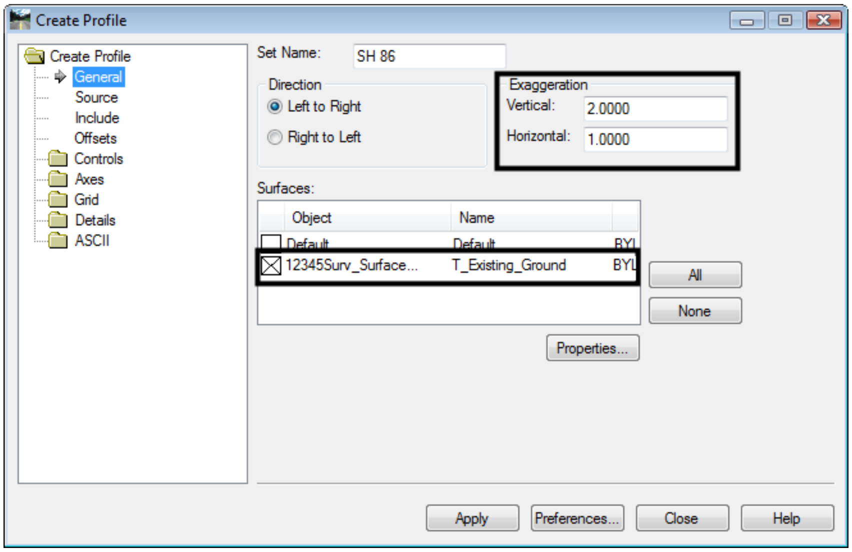
4. Highlight the **2x vertical** preference.



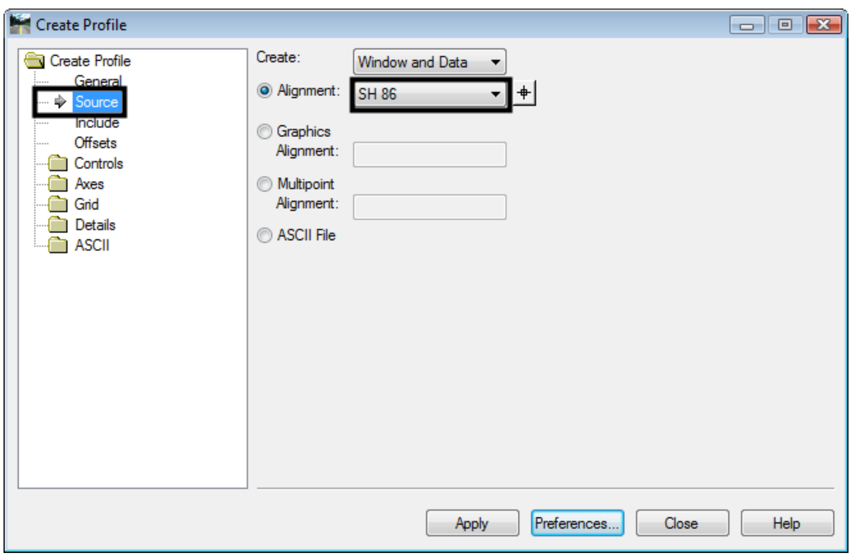
5. **<D>** the **Load** then **Close** buttons. Notice that the ***Exaggeration*** has changed to ***2.00***.

   Note: Load preferences before making any other menu settings. Loading Preferences resets all menu settings to those predefined in the preference.

6. In the ***Surfaces*** area of the dialog box, Verify that the **12345SURV_Surface_Existing** surface is toggled on.

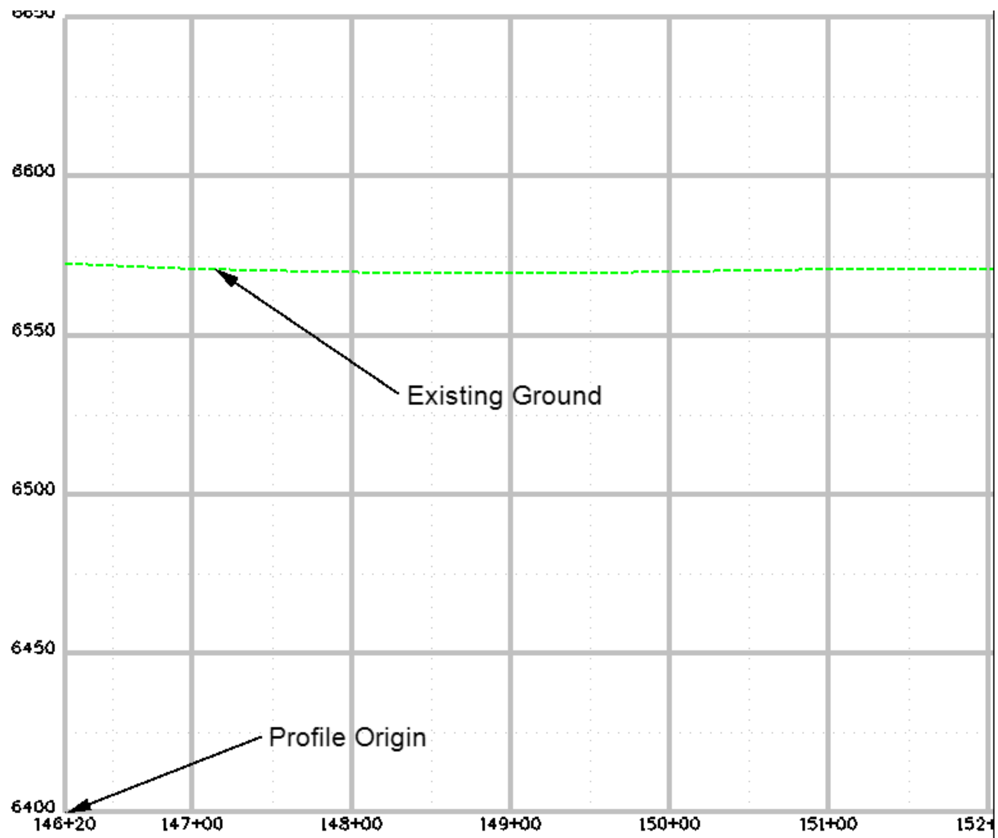


7. **<D>** the **Source** leaf. Verify that the **SH 86** alignment is selected.



8. **<D>** the **Apply** button. The ***Create Profile*** dialog box is temporarily minimized.

9. You are prompted by MicroStation to ‘Identify location’. **<D>** in the MicroStation view. The Profile window is placed and the ***Create Profiles*** dialog box is restored.



Note: For convenience, we are displaying the profile in the current drawing. Normally, Profiles and cross sections are created in their own dgn files. Consult the directory structure and file naming convention for your specific discipline to determine standards relating to profile display.

Lab 6.3 - Viewing Vertical Alignments and Annotation

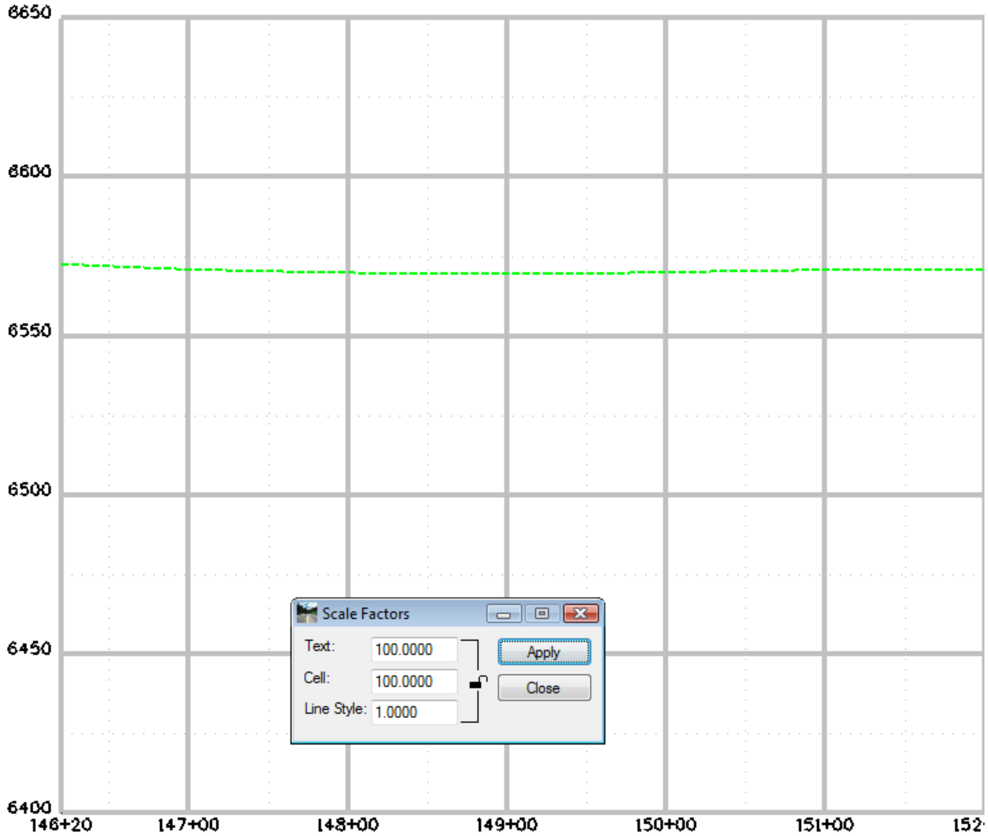
Once a profile is created from a horizontal alignment, vertical alignments associated with that horizontal alignment can be displayed.

Section Objectives:

- Display the vertical alignment line i a profile
- Display vertical alignment annotation

1. Select **Geometry > View Geometry > Active Vertical** to display a graphic of the active vertical alignment.

- Alternately in the ***Workspace Bar*** under the ***Geometry*** tab you can **<R>** on the Vertical Alignment and select ***View*** just as you did with Horizontal Alignments.

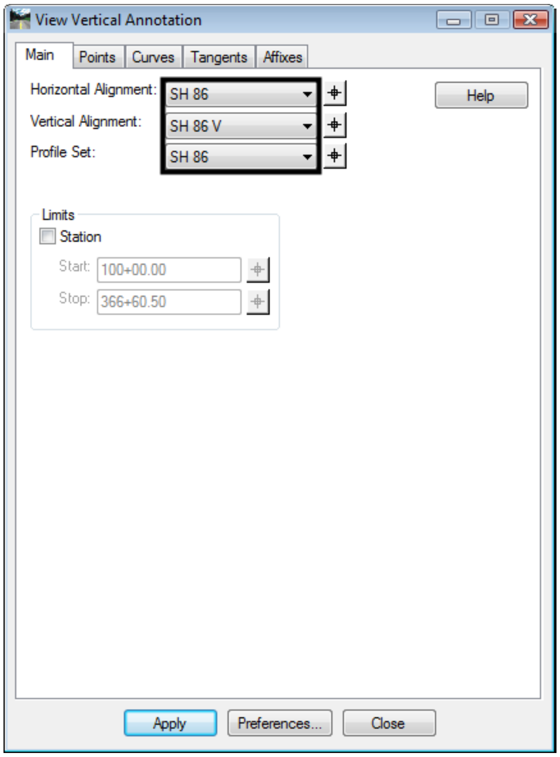


Note: Annotation size for the index elevations and stationing calculated using the global scale factor. The profile text size can not be changes once the profile is displayed. To change the text size, the original profile is deleted and a new one is created using the desired global scale factor.

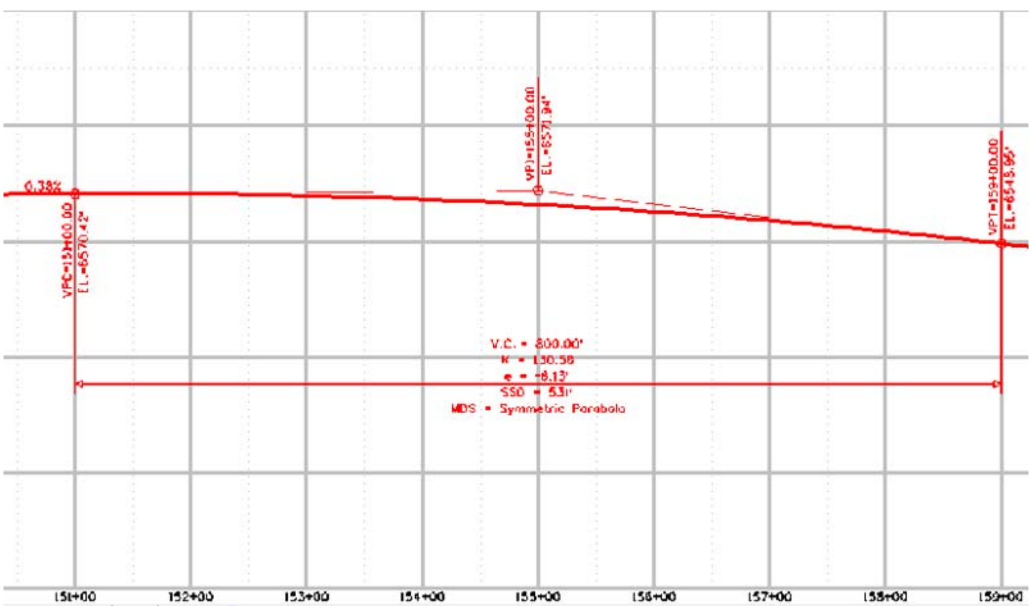
Vertical alignment annotation is used to display the vertical alignment line and other data in a profile set.

2. Select **Geometry > View Geometry > Vertical Annotation from** the InRoads main menu. This displays the ***View Vertical Annotation*** dialog box.

3. Verify the appropriate ***Horizontal***, ***Vertical Alignments***, and ***Profile Set*** are correctly identified.

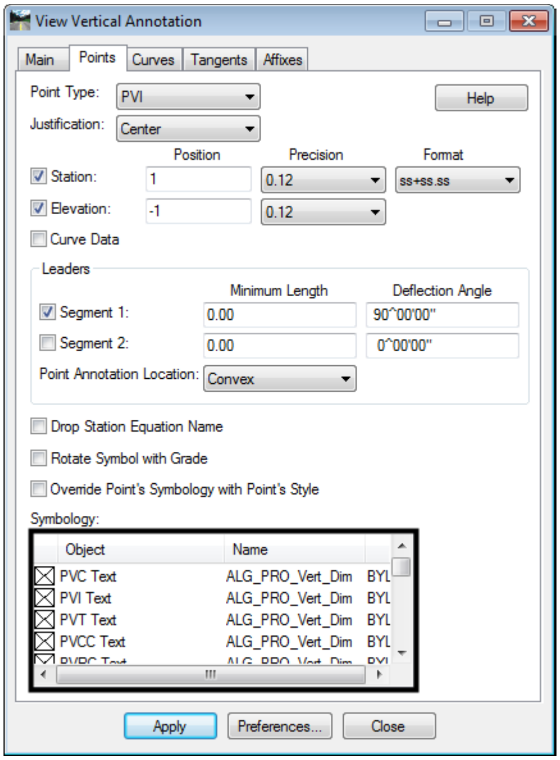


4. **<D>** the **Apply** button.

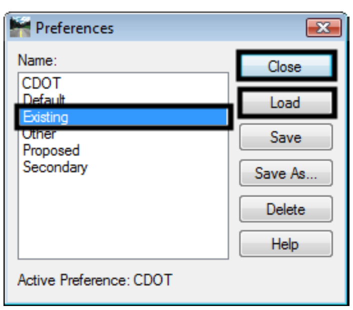


Take some time and investigate the remaining tabs along the top of the ***View Vertical Annotation*** dialog box and the individual settings for each.

5. **<D>** the **Points** tab. Note the settings in the ***Symbology*** portion of the dialog box. By default, the ***Proposed*** preferences are used.



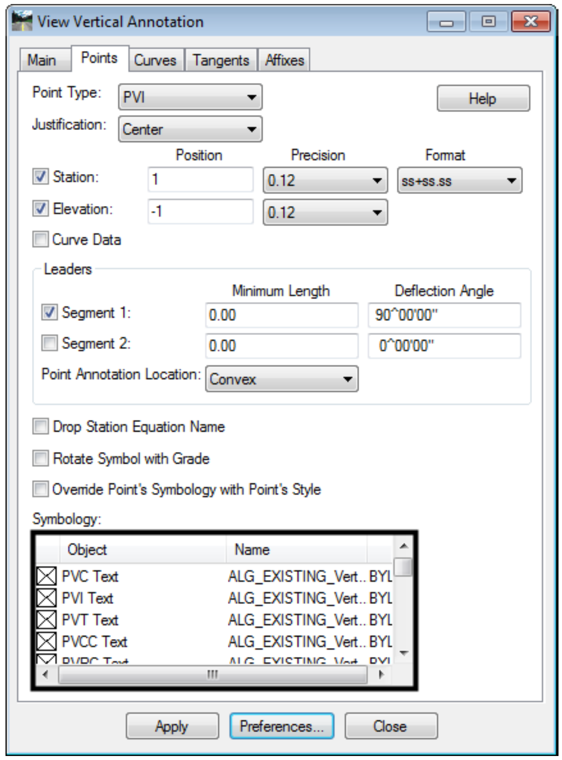
6. **<D>** the **Preferences** button.



7. **<D>** the **Existing** preference.

8. **<D>** the **Load** then **Close** buttons.

9. Note the change in the defined ***Symbology***.



10. **<D>** the **Apply** button. Review the results in the MicroStation drawing. Notice that the data remains the same, however the symbology (level, color, etc.) is changed.

11. For practice, continue to ***Load*** and ***Display*** additional preferences. Investigate what levels the elements are being placed on. The various preferences determine the location of graphics.

Section Summary:

- Use the Preferences to make the major settings in the Create Profile and Vertical Alignment Annotation dialog boxes.
- View Active Vertical only displays the geometry elements that make up the vertical alignment.
- Vertical Alignment Annotation displays the geometry elements and text data that describe the alignment.

Lab 6.4 - Updating Profiles

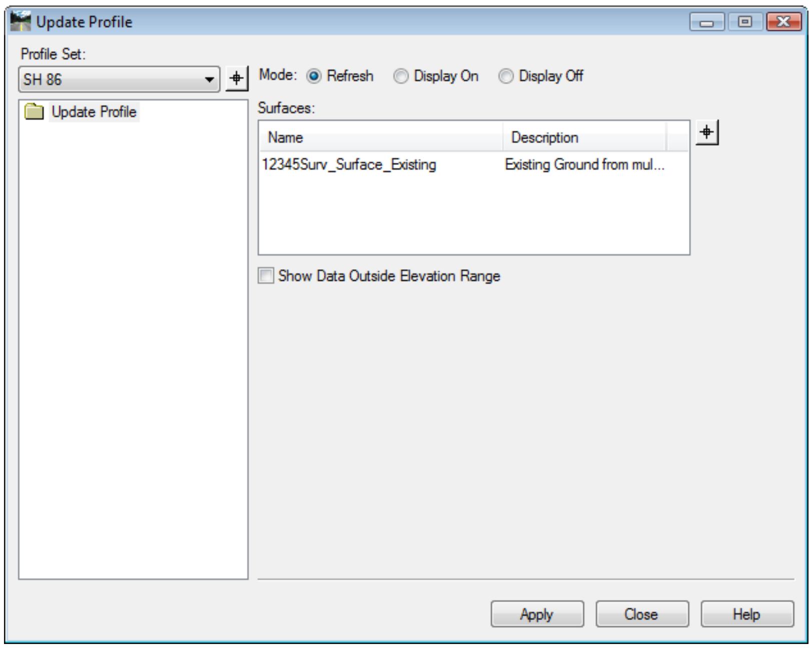
When a profile is created the user has the option to display items such as: multiple surfaces, profile lines offset from the horizontal alignment, and features such as underground utilities and pipes. However, the Create Profile command does not allow the user to specify which features are displayed.

The Update Profile command should be used to add, remove, or update data within an existing profile set. This command allows the user to specify which features will be affected by the command and can also be used to update and surface data that has changed since the profile was created.

Section Objectives:

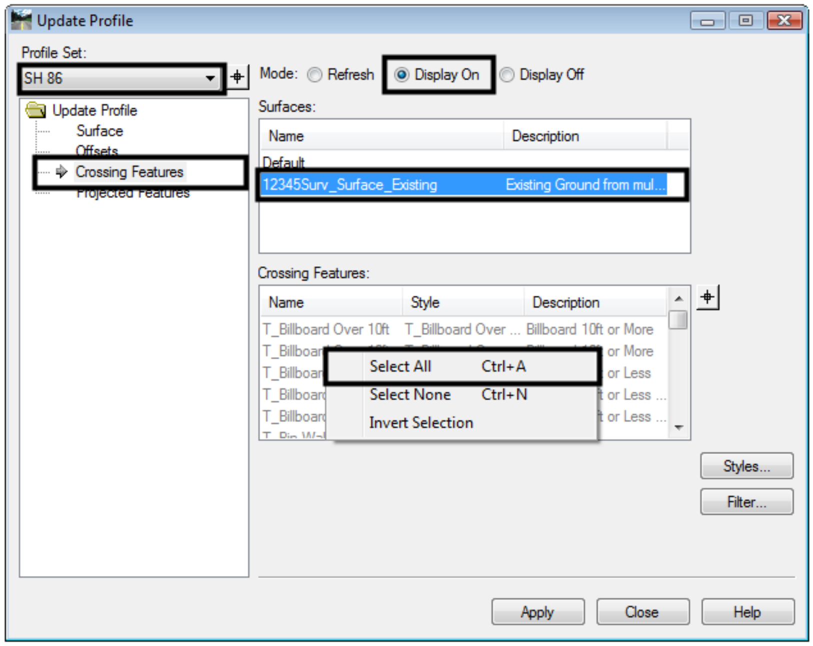
- ♦ Use the Update Profile command to add features to the display.
- ♦ Illustrate how Global Scale Factors affect cell size.
- ♦ Examine how Feature Filters affect dialog box lists.

1. From the InRoads main menu, select **Evaluation > Profile > Update Profile.** The ***Update Profile*** dialog box is displayed.

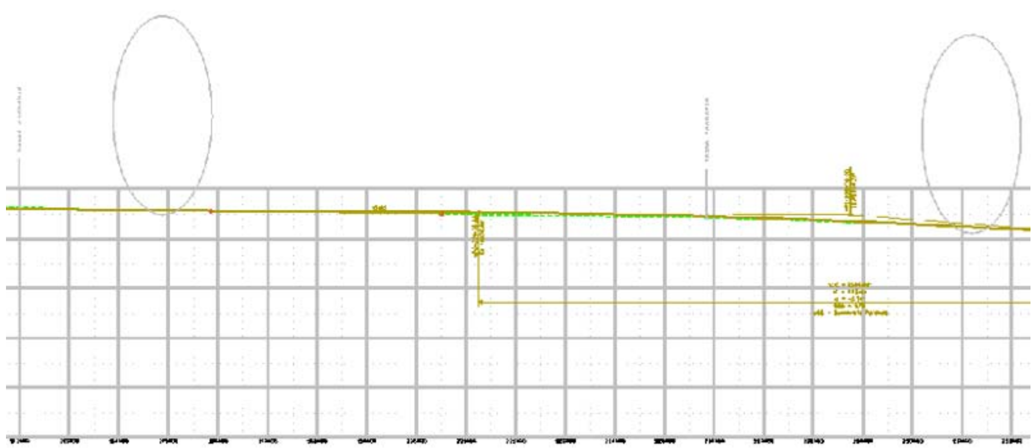


2. Verify **SH 86** is the active ***Profile Set***.
3. In the ***Mode*** section toggle on **Display On**.
4. **<D>** the **Crossing Features** leaf.
5. In the ***Surfaces*** section highlight **12345SUR_Surface.**

6. **<R>** in the ***Crossing Features*** list and **<D> Select All** from the right click menu.



7. **<D>** the **Apply** button. Using MicroStation viewing tools locate a crossing culvert.



Profile and cross section displays are drawn at true horizontal scale. A vertical exaggeration is applied to cells displayed in profiles or cross sections based on the vertical scale applied to the grid.

Note: Two classes of elements can be displayed on profiles; 1) True scale items such as culverts and 2) items represented by text such as utility crossings, flow-lines, ROW, etc.

For True Scale items:

The global scale factor for cells should be set to 1.

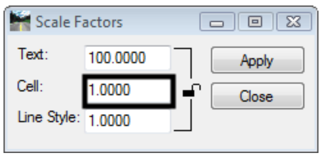
For Informational items:

The global scale factor should be set equal to the plot scale.

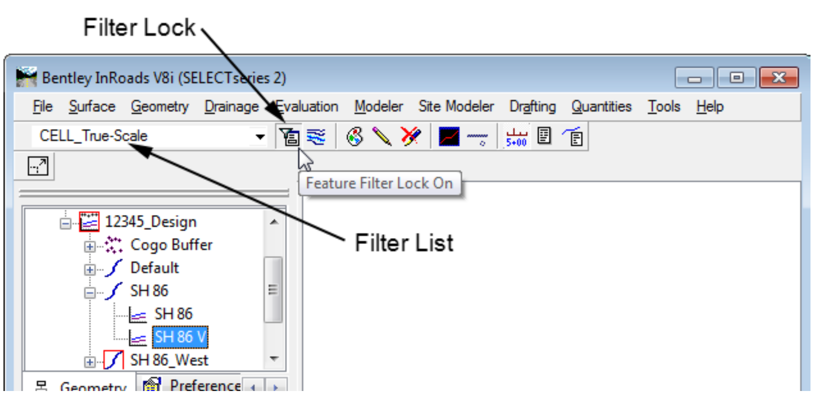
Lab 6.5 - Refreshing a Profile Display

First, true-scale items such as the culverts.

1. Select **Tools > Global Scale Factors**.
2. **<D>** on the **Scale Factor Lock** icon so that it is in the open position. This allows modification to the cell scale only. This allows annotation and other commands to remain unaffected by the scale factor that is used specific for cells.

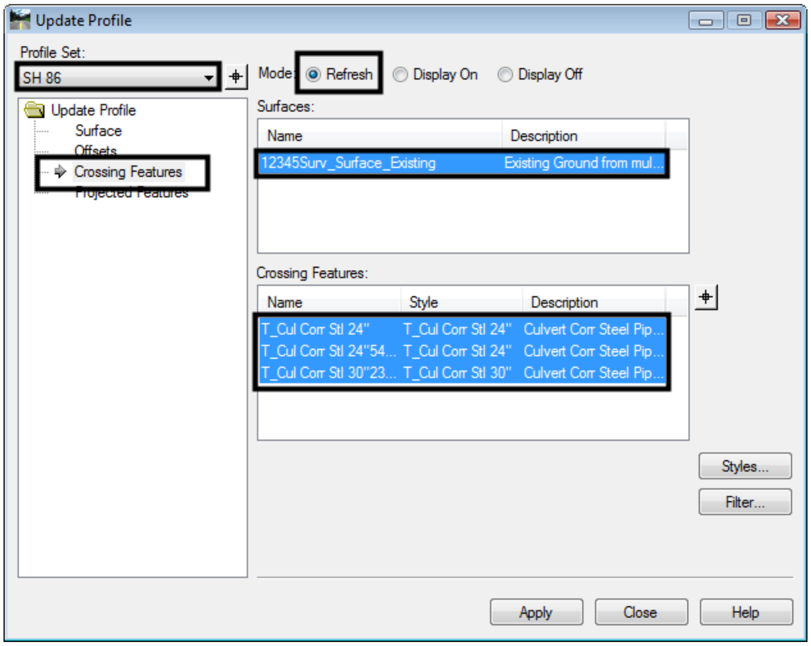


3. In the ***Cell*** field, key in ***1***.
4. **<D>** the **Apply** then **Close** buttons in the ***Global Scale Factor*** dialog box.
5. From the ***Locks*** toolbar, select **CELL_True-Scale** from the ***Feature Filter*** list.
6. Toggle on the ***Feature Filter*** lock.



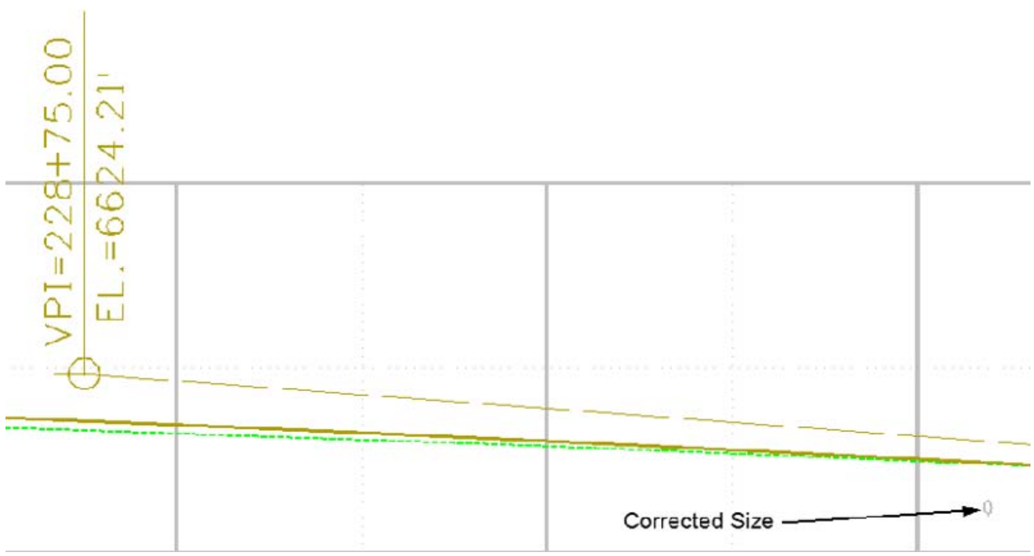
7. Close and reopen the ***Update Profile*** dialog box.
8. Verify **SH 86** is still the active ***Profile Set***.
9. In the ***Mode*** section toggle on **Refresh**.
10. **<D>** the **Crossing Features** leaf.
11. Highlight the **12345SURV_Surface** in the ***Surfaces*** area.

12. Select all of the ***Crossing Features*** listed.



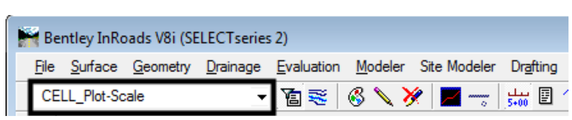
13. **<D>** the **Apply** button.

14. Use MicroStation viewing tools to locate a crossing culvert and review the results.



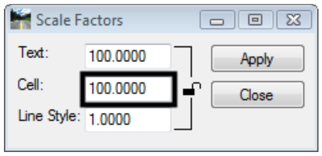
15. Use MicroStation Measuring tools to verify pipe size(s).

16. From the ***Locks*** toolbar select **CELL_Plot-Scale** from the Feature Filter list.



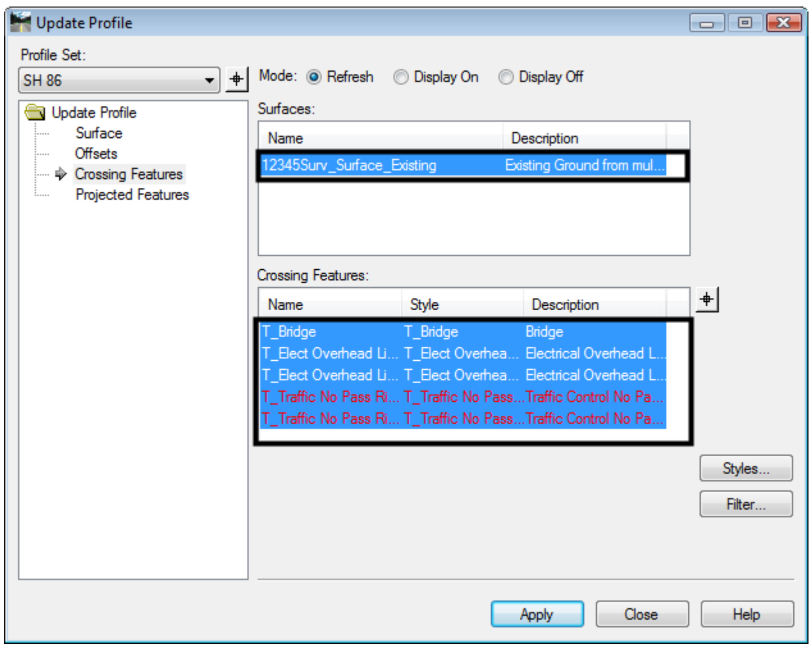
Note: Verify that the feature filter is toggled on.

17. Change the InRoads Scale Factor to ***100*** for cells.



Note: This is the desired plot scale change accordingly.

18. **Close** and reopen the ***Update Profile*** dialog box.



19. Verify **SH 86** is still the active Profile Set. Use the target button next to the Profile Set to graphically change the active profile set.

20. In the Mode section toggle the radio **Refresh** button.

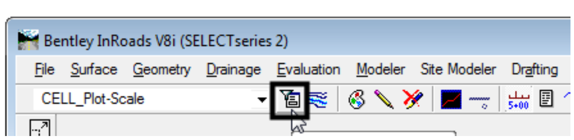
21. **<D>** the **Crossing Features** leaf.

22. **<D>** the surface name **12345SURV_Surface.**

23. Select all of the ***Crossing Features*** listed.

24. **<D>** the **Apply** button.

25. Turn **Off** the ***Feature Filter*** lock.



Section Summary:

- Update Profile is the better tool to use when adding features to a profile. With Update Profile the user can choose which features to display. With Create Profile, all features that can be displayed (based on feature style settings) are displayed.
- There are two types of feature cells used in profiles; true scale cells that use a global scale factor of 1 and plot scale cell that use a global scale factor the same as the plot scale.

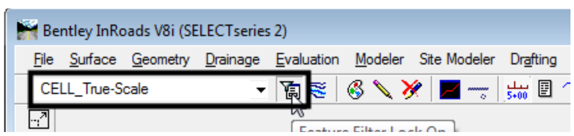
Lab 6.6 - Annotating a Feature in a Profile

Features that have been displayed in profiles (or cross sections) can be annotated with information extracted from the surface model.

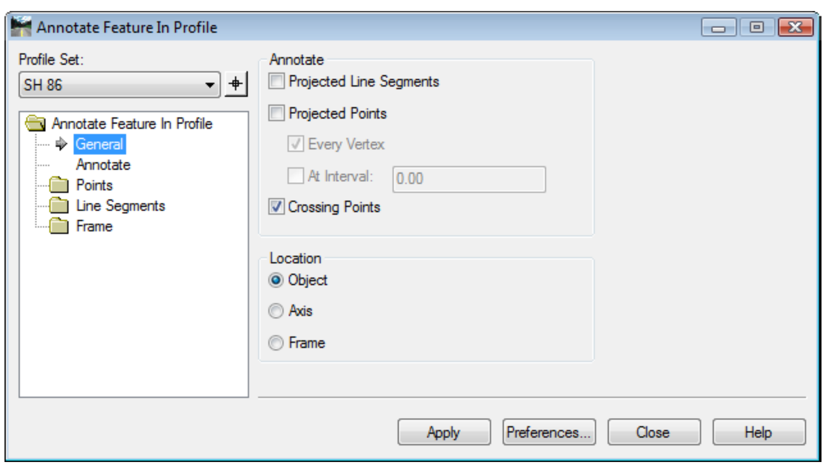
Section Objectives:

- Annotate the true scale features in the profile.

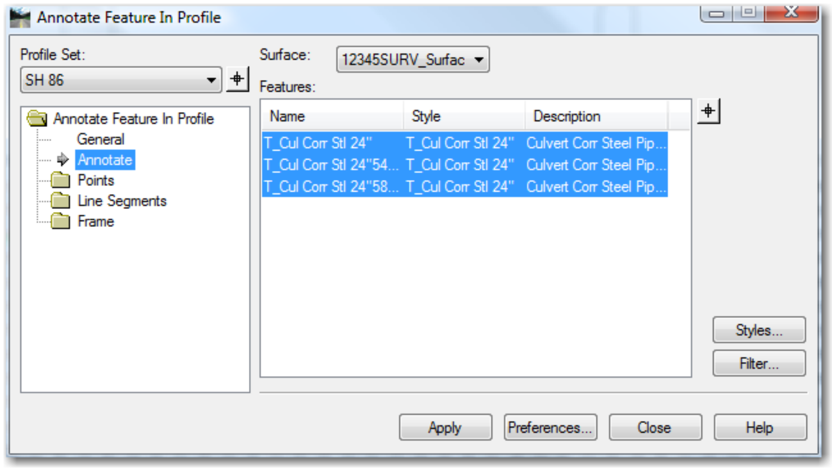
1. Using MicroStation commands, window into any culvert displayed in the profile created in the previous lab.
2. From the ***Locks*** toolbar select **CELL_PLOT-Scale** filter and verify the feature filter is toggled **On**.



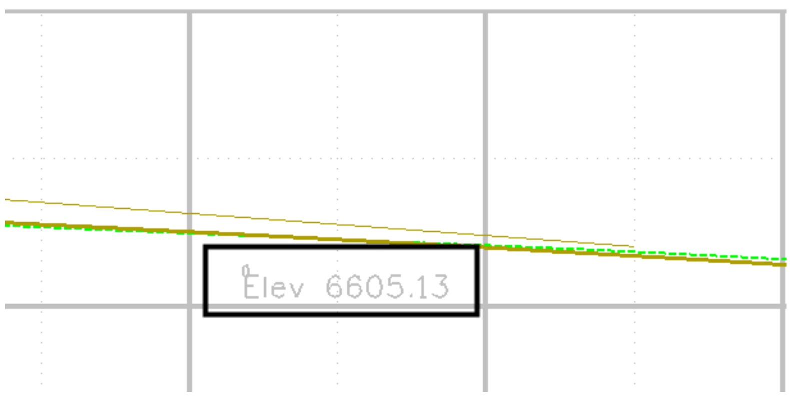
3. Select **Evaluation > Profile > Annotate Feature** from the InRoads main menu. The ***Annotate Feature In Profile*** dialog box is displayed.



4. Select the ***Annotate*** leaf. Notice that the features are already highlighted. Also, there is a drop down menu that is used for selecting the surface that contains the features to be annotated.

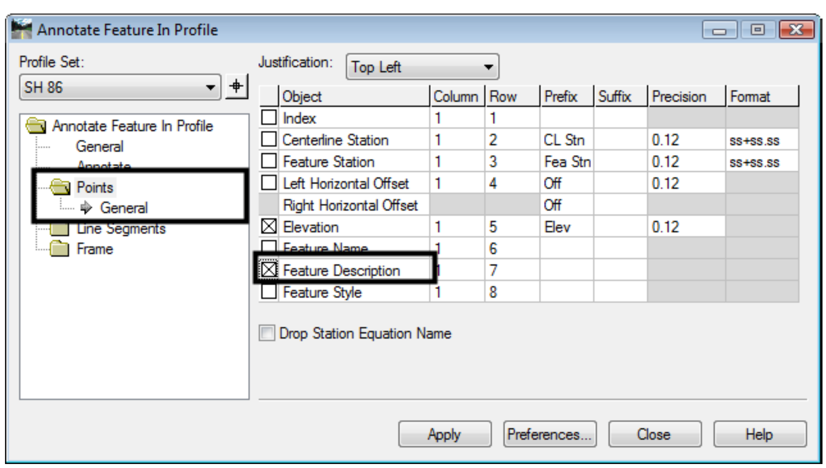


5. **<D>** the **Apply** button and review the results.

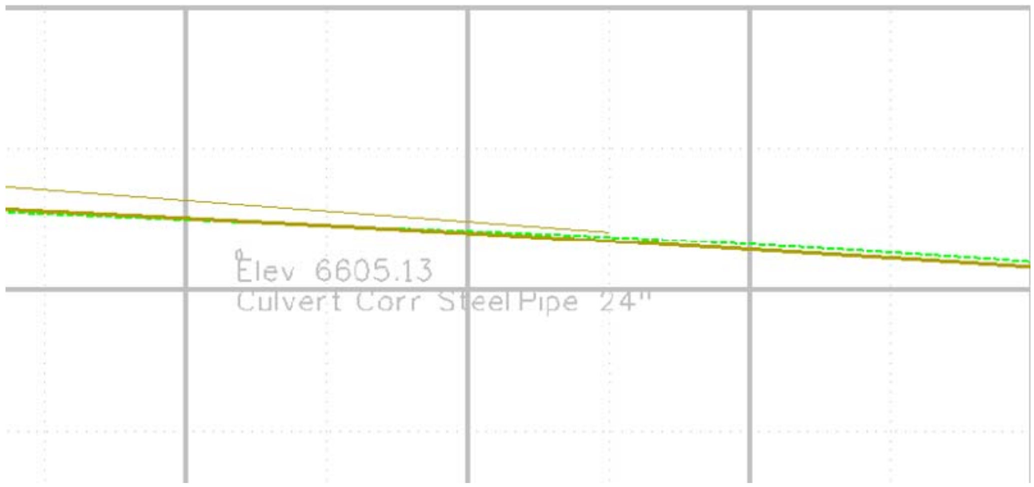


6. **<D>** the **Points** branch.

7. Toggle on the **Feature Description**.



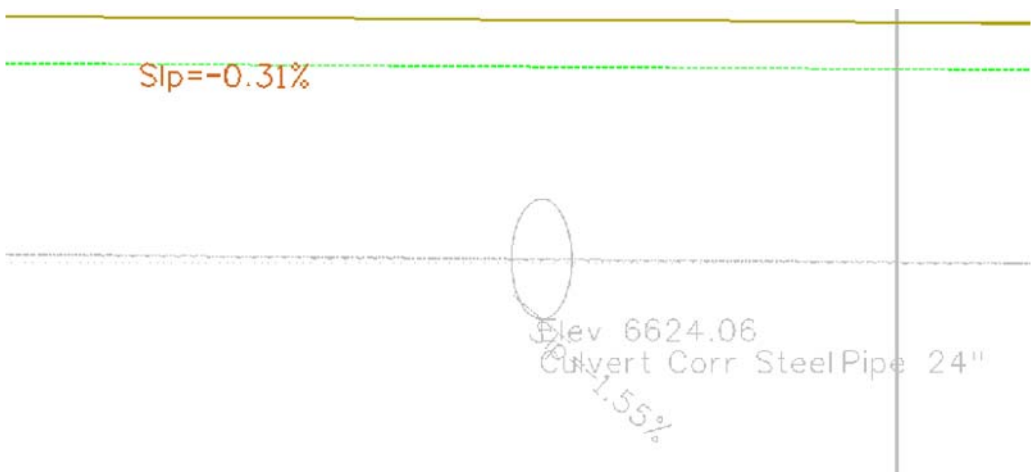
8. **<D>** the **Apply** button and review the results in your profile.



9. Experiment with enabling other options in the ***Point*** branch and redisplaying the annotation.

Challenge Exercise:

Update your profile to show ***projected features***. Annotate the projected features.



Section Summary:

- Only features displayed in the profile can be annotated.
- Set the global scale factor for text to the plot scale before executing the command.

Lab 6.7 - Annotating a Profile

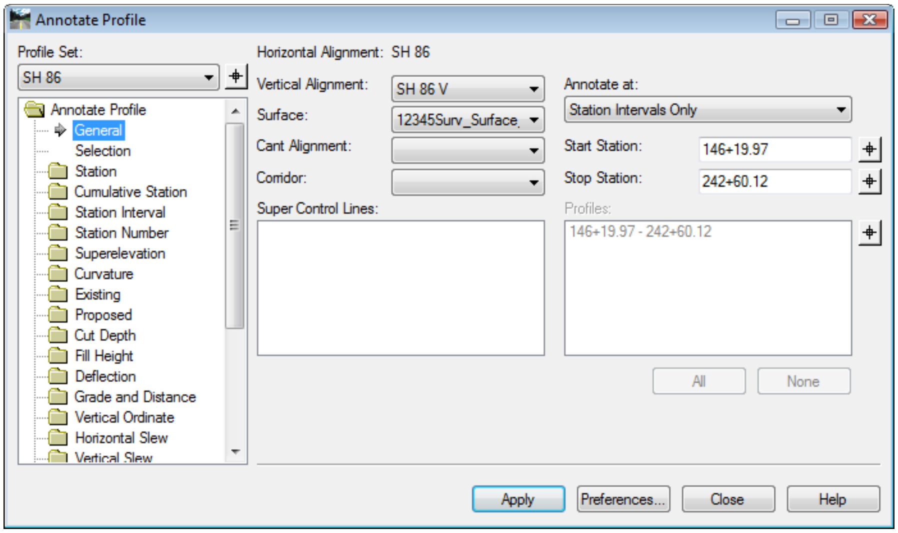
In addition to annotating vertical alignments, profiles can be annotated with both existing and design information.

Section Objectives:

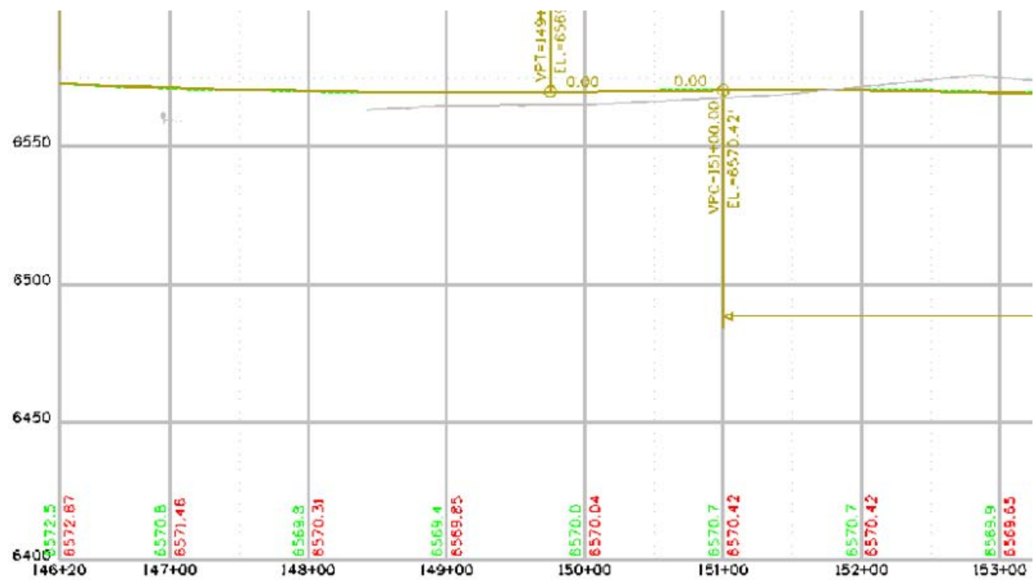
- Add Existing and proposed elevation information to the profile.

- ♦ Add Cut Depth and fill height information to the profile.

1. Select **Evaluation > Profile > Annotate Profile** from the InRoads main menu.

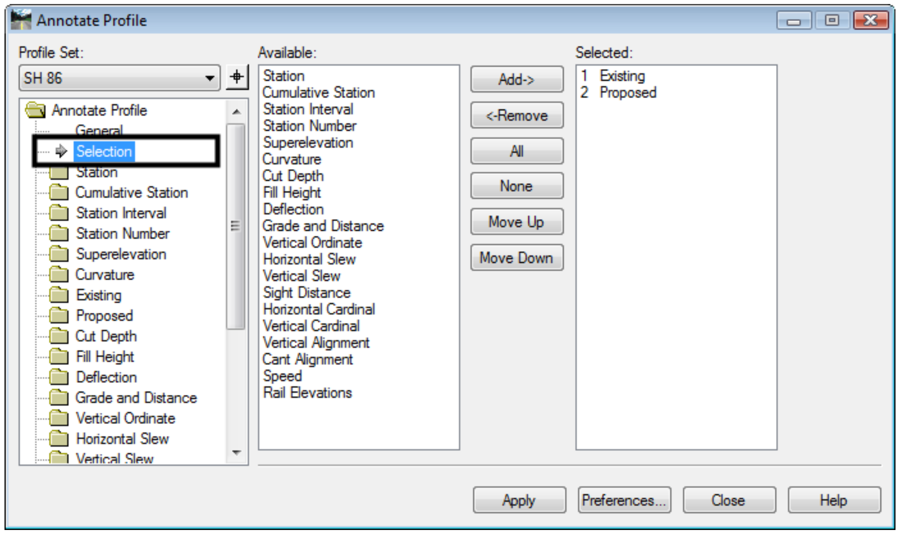


2. **<D> Apply**. The existing and proposed grades annotate the profile.



3. Take some time and review the leaves of the ***Annotate Profile*** dialog box. Investigate the individual settings for each.

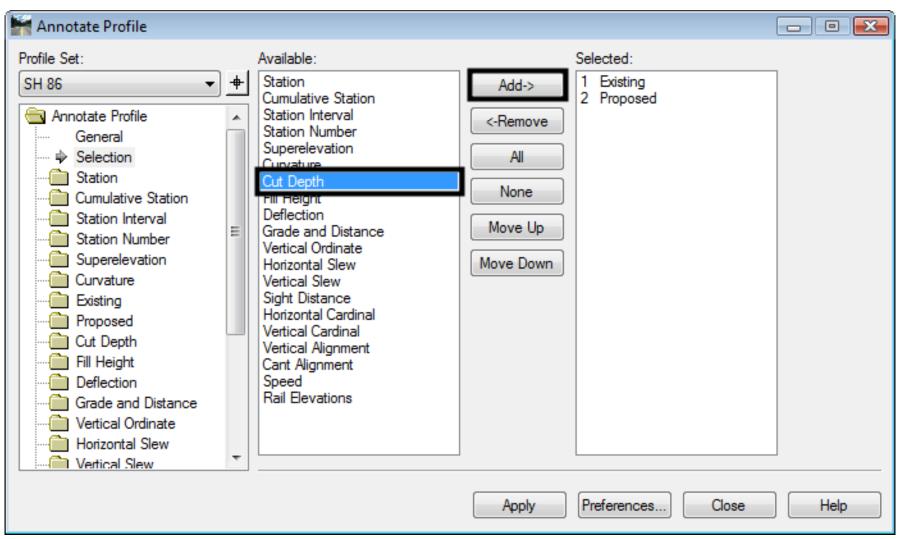
4. Now go back and **<D>** the **Selection** leaf.



Note: The dialog box shows two categories; ***Available*** and ***Selected. Available*** lists the items that can be annotated in a profile, ***Selected*** identifies the items chosen for annotation.

5. **<D>** the item **Cut Depth** from the Available list.

6. **<D>** the **Add** button. Cut Depth will be added to the ***Selected*** list.



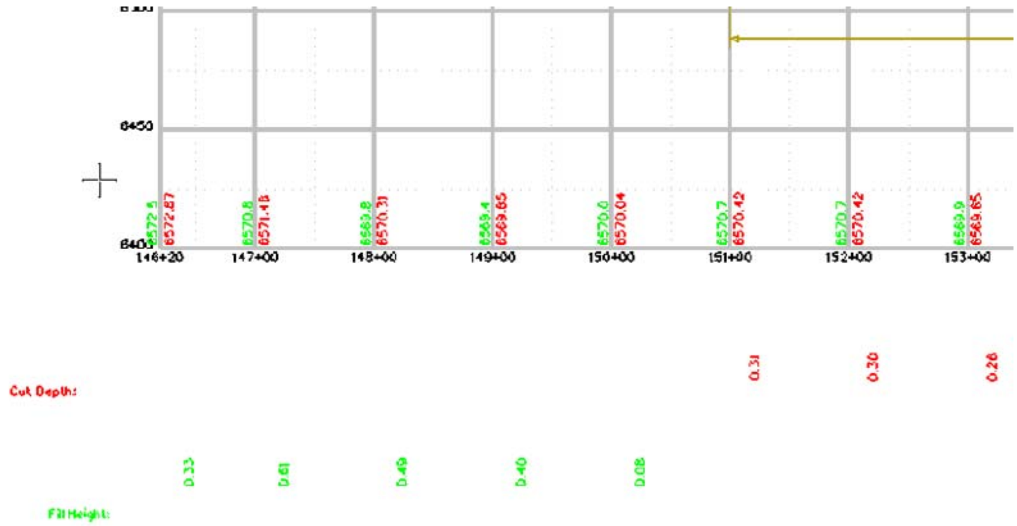
7. **<D>** the item **Fill Height** from the Available list.

8. **<D>** the **Add** button. Fill Height will be added to the Selected list.

Note: Make sure that ***Existing*** and ***Proposed*** remain in the 1 and 2 slots. To move a selected item, highlight the item and **<D>** the **Move Up** or **Move Down** buttons

9. **<D>** the **Apply** button and review the profile display.

Note: You may have to zoom out to view the additional annotation.



Section Summary:

- Annotate Profile is used to place existing surface elevations and vertical alignment elevations on the profile set.
- Other data related to profiles can also be displayed.
- When displaying additional data, make sure Existing and Proposed stay at the top of the list.
- Change the settings on the Frame leaf to move additional data closer to the profile window.

Lab 6.8 - Vertical Alignment Tracking

Vertical alignments can be interactively queried similar to horizontal alignments.

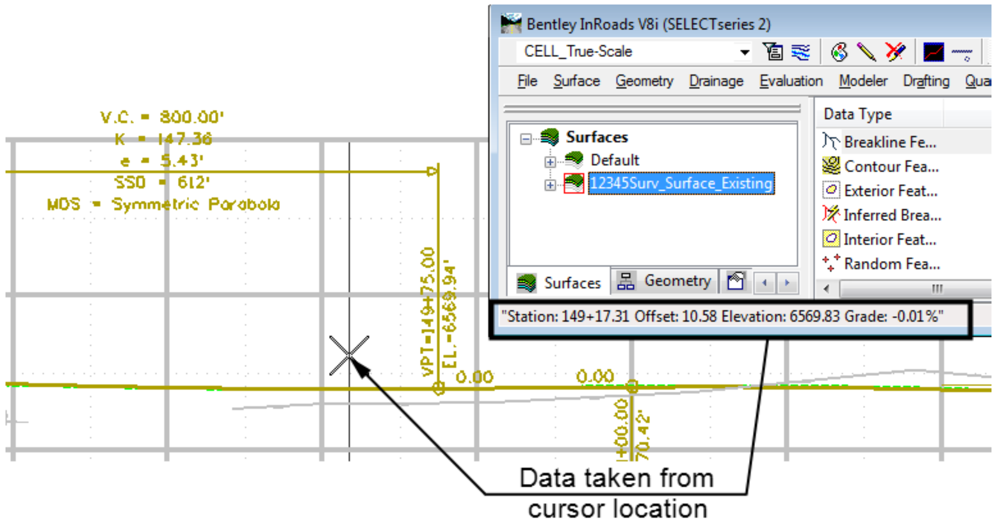
Section Objectives:

- Examine Vertical Alignment tracking in the profile.
- Examine the vertical alignment data in Horizontal Alignment tracking.

The next series of steps illustrates Vertical Alignment tracking.

1. Select **Tools > Tracking > Vertical Alignments** from the InRoads main menu.

2. Move the cursor inside the Profile Set window and review the output in the InRoads Status bar.

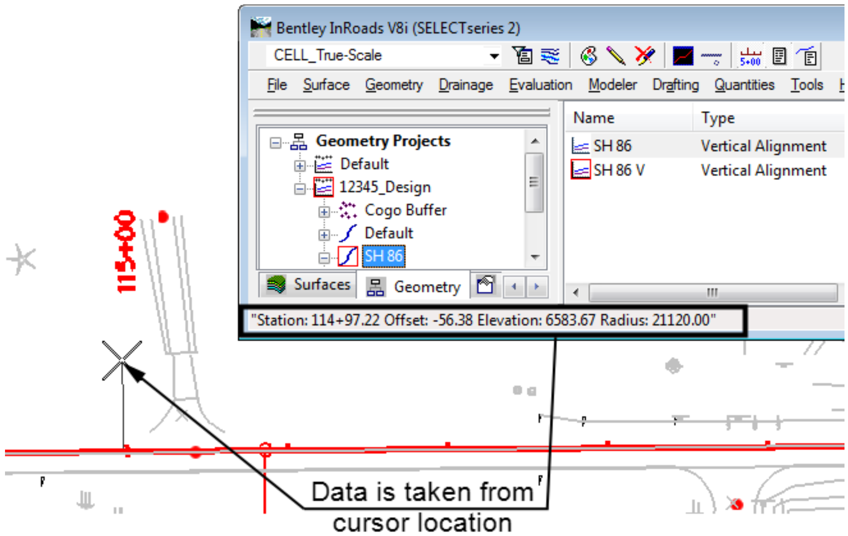


Note: As you move your cursor in the profile set window InRoads displays vertical alignment information in the status field. There is ***not*** an option to write this information to the MicroStation file.

This series of steps illustrates tracking vertical data in the plan view

3. Select **Tools > Tracking > Horizontal Alignment**.

4. Move the cursor along the active horizontal alignment and review the readout in the InRoads Status bar.



Results displayed are the station and offset relative to the active horizontal alignment. The elevation is relative to the active vertical alignment.

Section Summary:

- Tracking is used to gain information that is related to the horizontal and vertical alignments.

Lab 6.9 - Create a Vertical Alignment

Vertical alignments define an elevation path for the proposed design to follow. It is stored under the parent horizontal alignment.

Section Summary:

- Create a new vertical alignment slot.
- Add PIs to the vertical alignment.
- Define the vertical curves.

Create a slot in the active geometry project for your vertical alignment.

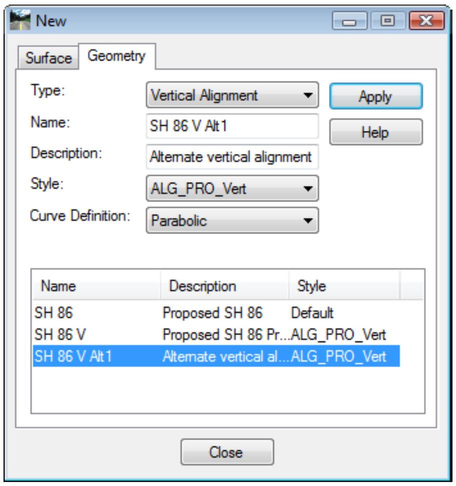
1. Select **File > New.**

2. **<D>** the **Geometry** tab.

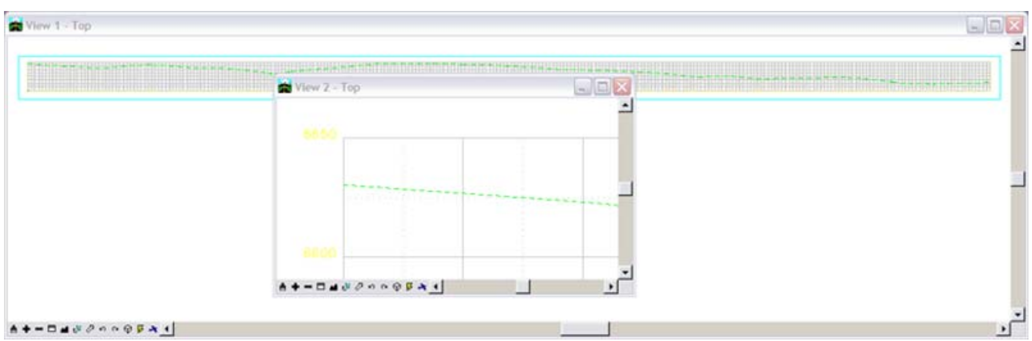
3. Set the ***Type*** to **Vertical Alignment**.

4. Key in ***SH 86 V Alt1*** for the ***Name***.

5. Key in ***Alternate vertical alignment*** for the ***Description***.
6. Set the ***Style*** to **ALG_PRO_Vert**.
7. Verify that the ***Curve Definition*** is set to **Parabolic**.
8. Select **Apply** then **Close**

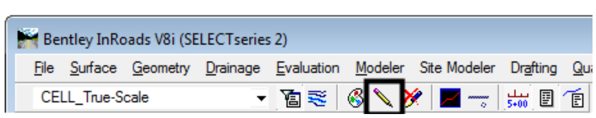


9. Set up your MicroStation windows so the entire profile is visible in one window, then open another MicroStation window and Zoom in to the beginning of the profile as shown.

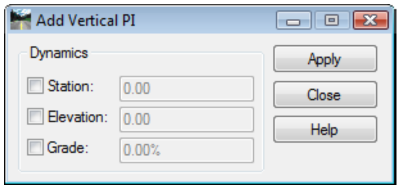


Next, add PVIs to the Vertical Alignment.

10. Verify that the ***Write Mode*** is set **Pencil**.

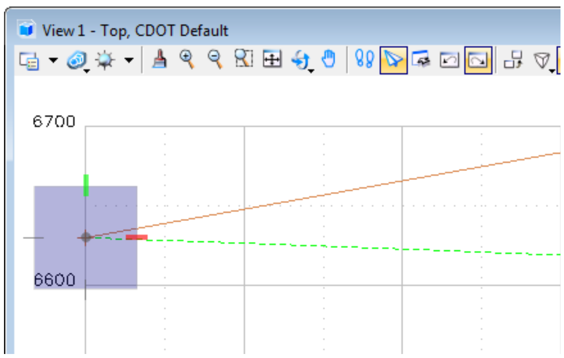


11. Select **Geometry > Vertical Curve Set > Add PI** from the InRoads main menu.



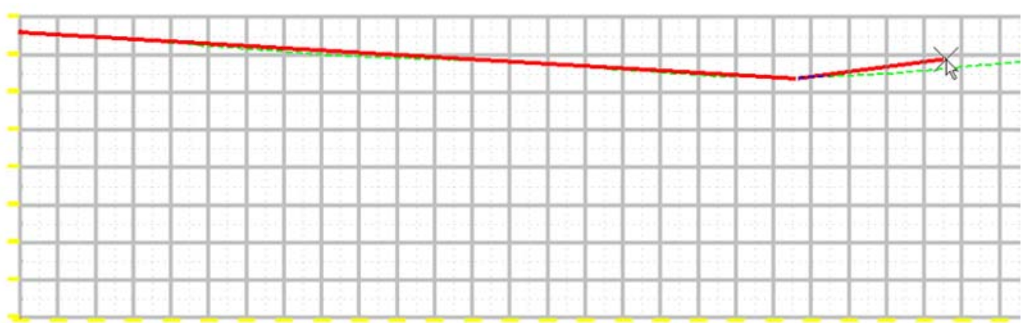
12. Select **Apply**.

13. For the first PVI, snap to the beginning of the ground line in the window where you are zoomed in.



14. In the MicroStation key in field, enter the following commands: (Be certain to use the % sign in the key-in.)

    - ***dg=900,-3.76%***



    - ***dg=400,1.03%***
    - ***dg=425,-4.29%***
    - ***se=11725,6574.78***

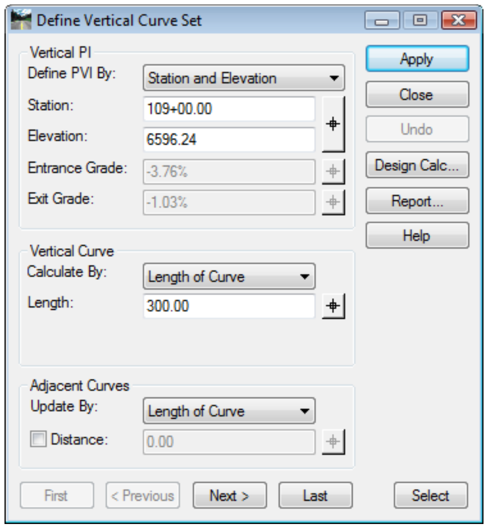
    The ***dg=*** key-ins place a PI at the specified distance and grade from the previous point. The ***se=*** key-in places a PI at the specified station and elevation.

15. **<R>** twice to exit, then **Close** the ***Add Vertical PI*** dialog box.

16. Update the view.

The vertical alignment is displayed permanently in the design file. Because Pencil mode is active, the tangents will automatically update when the curves are added.

17. Select **Geometry > Vertical Curve Set > Define Curve** from the InRoads main menu.

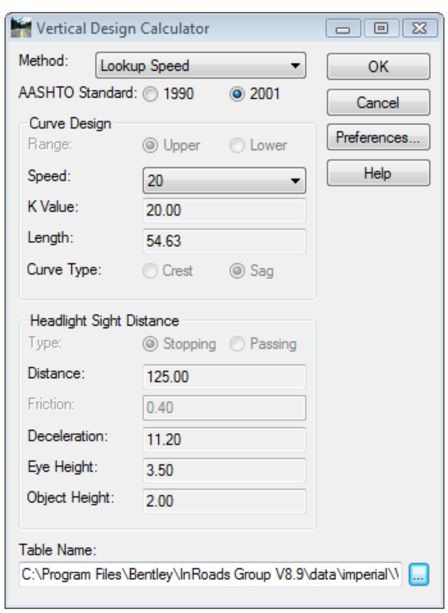


The Define Vertical Curve dialog box is automatically displayed ready to accept input for the first curve on the vertical alignment. To step to other curve sets, you can use ***Previous*** and ***Next***, or ***First*** and ***Last***.

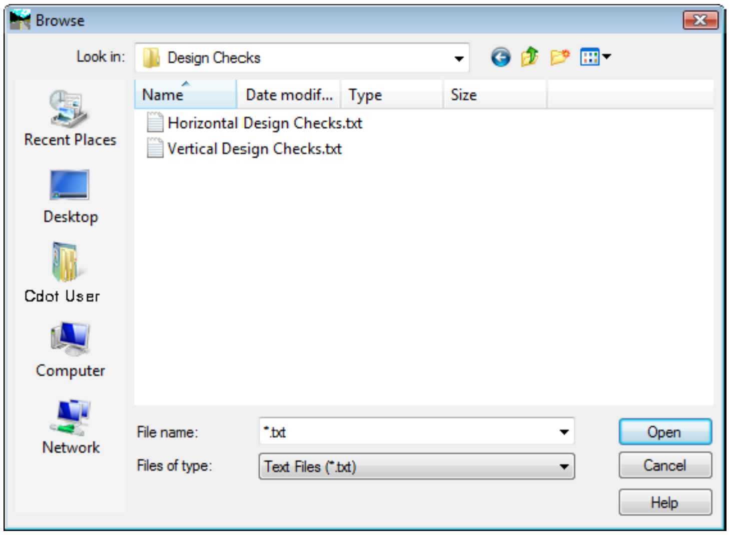
18. Under the ***Vertical Curve*** area, set ***Calculate By*** to **Length of Curve**.

19. Key in ***300*** for the ***Length***.

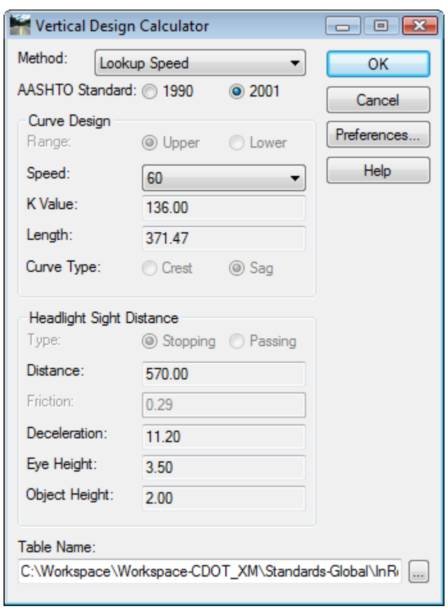
20. Select **Design Calc**.



21. Click in the ***Table Name*** field and Browse to the **C:\Workspace\Workspace-CDOT_V8i\ Standards-Global \ InRoads\Design Checks** folder and select the file **Vertical Design Checks.txt**.

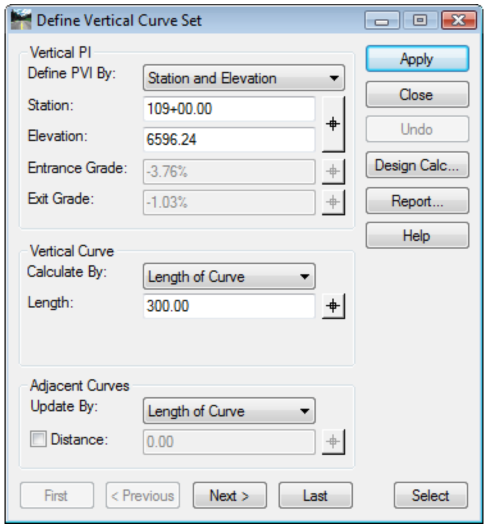


22. Verify that the length of curve meets your design criteria.

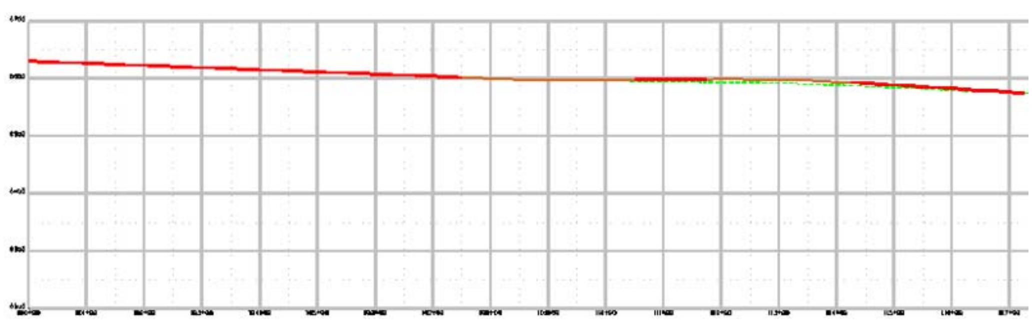


23. **<D> Cancel** when done. Do not accept the minimum curve, just verify that yours meets the criteria.

24. Select **Apply**



25. Select **Next** to move to the second intersection of tangents.
26. Verify that ***Calculate By:*** is set to **Length of Curve**.
27. Key in ***250*** for the ***Length***.
28. Select **Design Calc**.
29. Verify that the length of curve meets your design criteria.
30. Select **Apply**.
31. Close the **Define Vertical Curve Set** dialog box.



32. Save the geometry project.
33. Close InRoads and MicroStation.Labs for InRoads V8i SS2

Section Summary:

- Vertical alignments are defined in the profile window.
- Vertical PIs can be added by data point or key in.
- The Define Curve dialog box can also be used to adjust PI stations and elevations.

Chapter Summary:

- Use the review vertical alignment command to examine vertical alignment data when a profile is not required.
- Profiles are required to view vertical alignments graphically.
- Use Update Profile to add, remove, or revise data in a profile set.
- Annotate Feature in Profile only affects features displayed in the profile.
- Annotate Profile is used to display existing surface and vertical alignment elevations in the profile.
- Vertical Alignment Tracking displays Station, Offset, Elevation, and Grade information in the InRoads main dialog box.
- Typically, vertical alignments are defined by locating all of the VPIs then placing the curves.

LAB 7 - Introduction to DTMs

This lab demonstrates the commands used for sorting and reviewing surface data. The lab will also demonstrate how to set some surface properties and explains how different features behave within the terrain model.

Chapter Objectives:

- Illustrate how different Feature Types affect the triangulated model
- Describe how to set the Symbology for Cross Sections and Profile display
- Illustrate how to create and use Feature Filters
- Describe how to display surface features and the surface perimeter
- Describe how to set up and display contours

The files used in this lab are:

- C:\Projects\12345\Design\Drawings\Reference_Files\12345DES_Model_Intro-DTM.dgn
- C:\Projects\12345\Design\InRoads\12345_Intro-DTM.dtm

Lab 7.1 - How Feature Types Work

Section Objectives:

♦ Illustrate how different feature types work within the DTM.

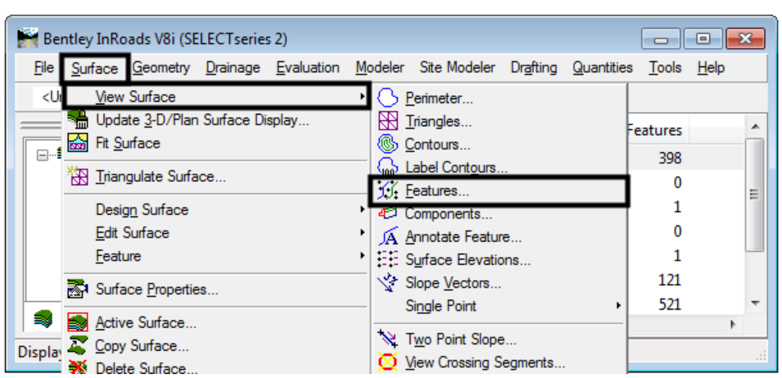
This lab illustrates how different feature types work within the dtm.

1. Open MicroStation and InRoads using the drawing: **C:\Projects\12345\Design \Drawings\Reference_Files\12345DES_Model_Intro-DTM.dgn**.

2. From the InRoads dialog box, open the dtm: **C:\Projects\12345\Design\InRoads\12345_Intro-DTM.dtm**

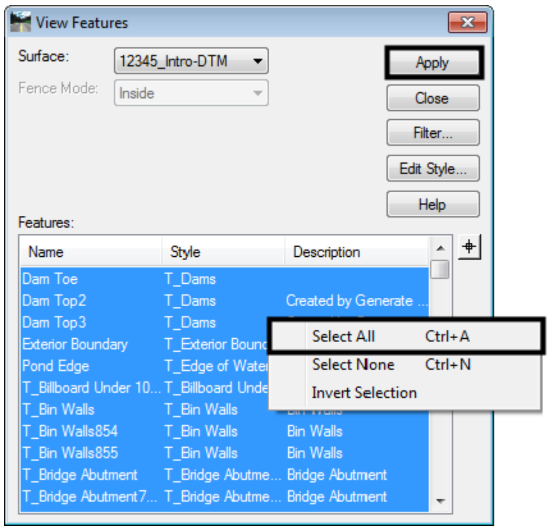
First, all of the features within the dtm are displayed.

3. From the InRoads menu, select **Surface > View Surface > Features**. The **View Features** dialog box is displayed.



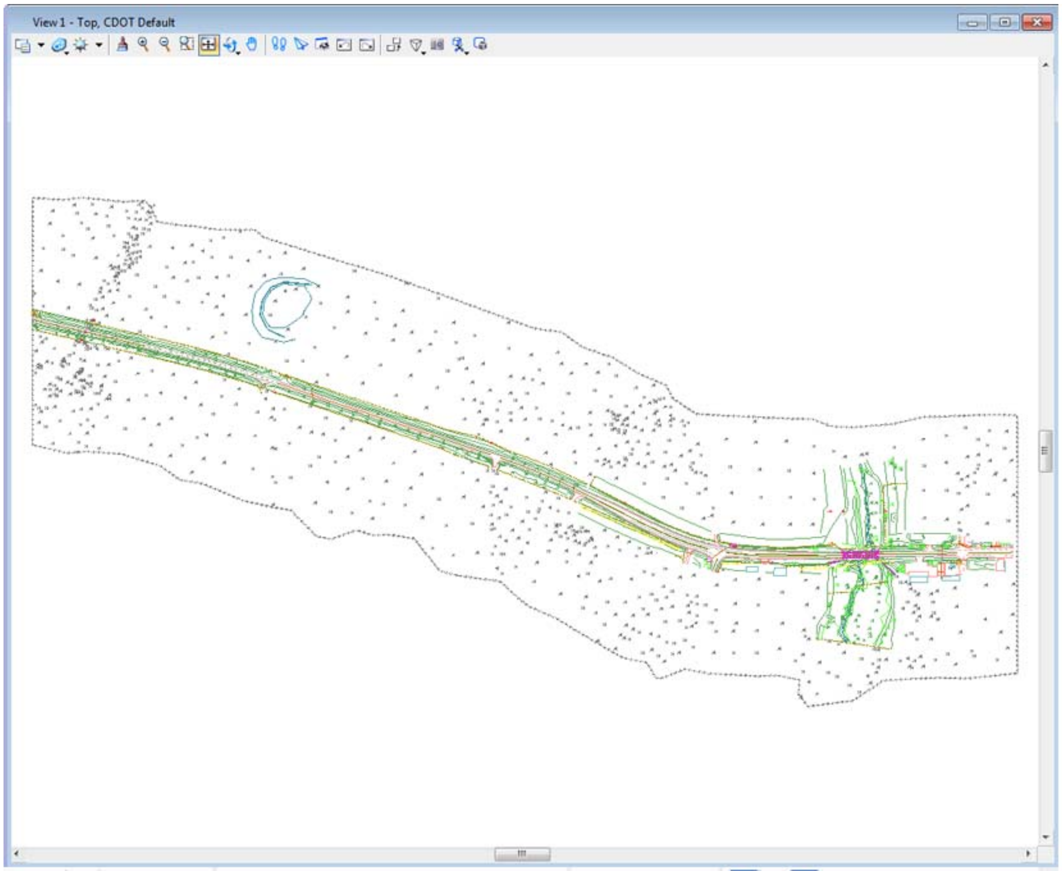
4. In the ***View Features*** dialog box, right click in the ***Features*** list and choose **Select All** from the menu.

5. **<D>** the **Apply** button. All of the features in the dtm are displayed.



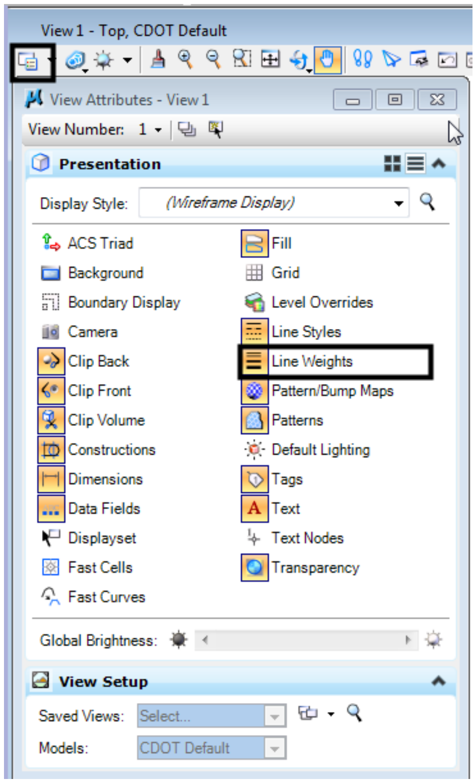
6. Dismiss the ***View Features*** dialog box.

7. If necessary, do a **Fit View** to see the displayed features.

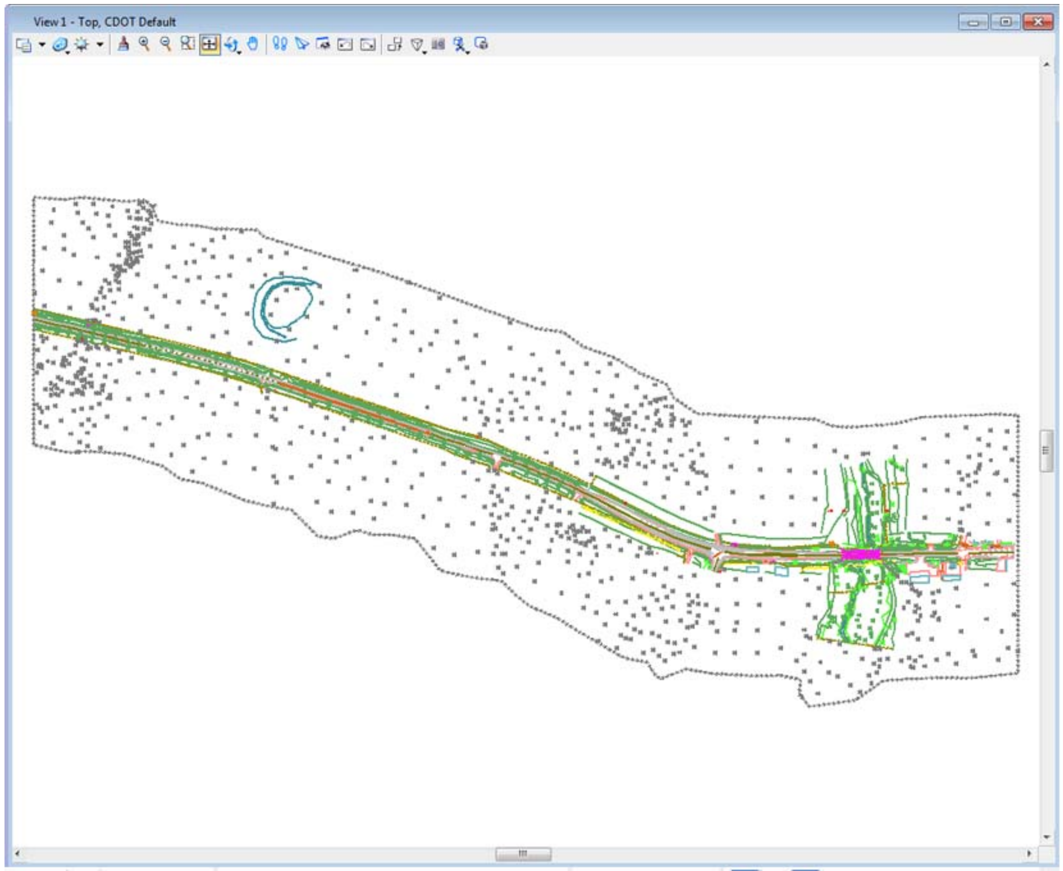


Using the Line Weights view attribute will make it easier to see the features when the triangles are displayed.

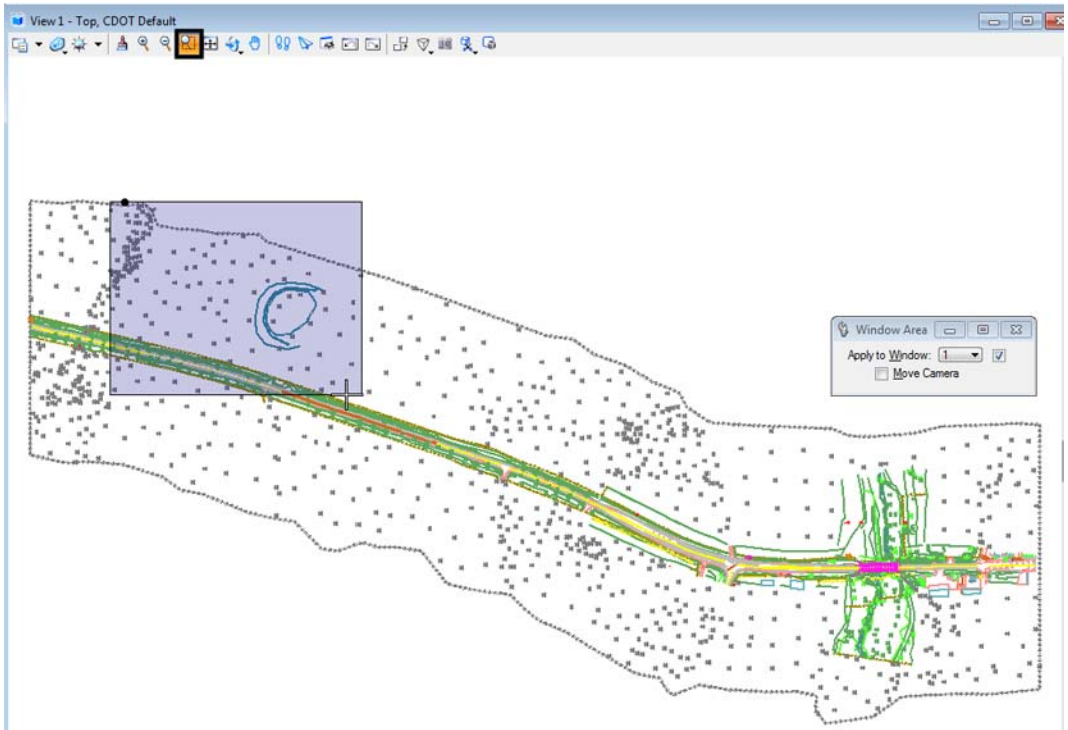
8. **<D>** the ***View Attributes*** icon and toggle on **Line Weights.**



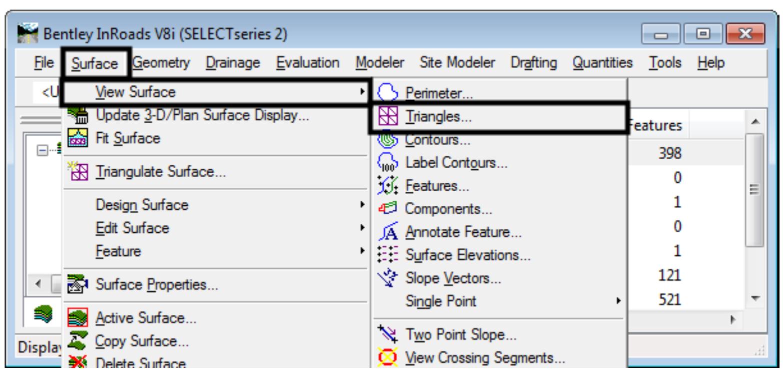
9. Notice that the feature lines are thicker now. When the triangles that make up the surface are displayed, the features will still be visible underneath.



10. Window area around the pond at the upper left of the DTM.

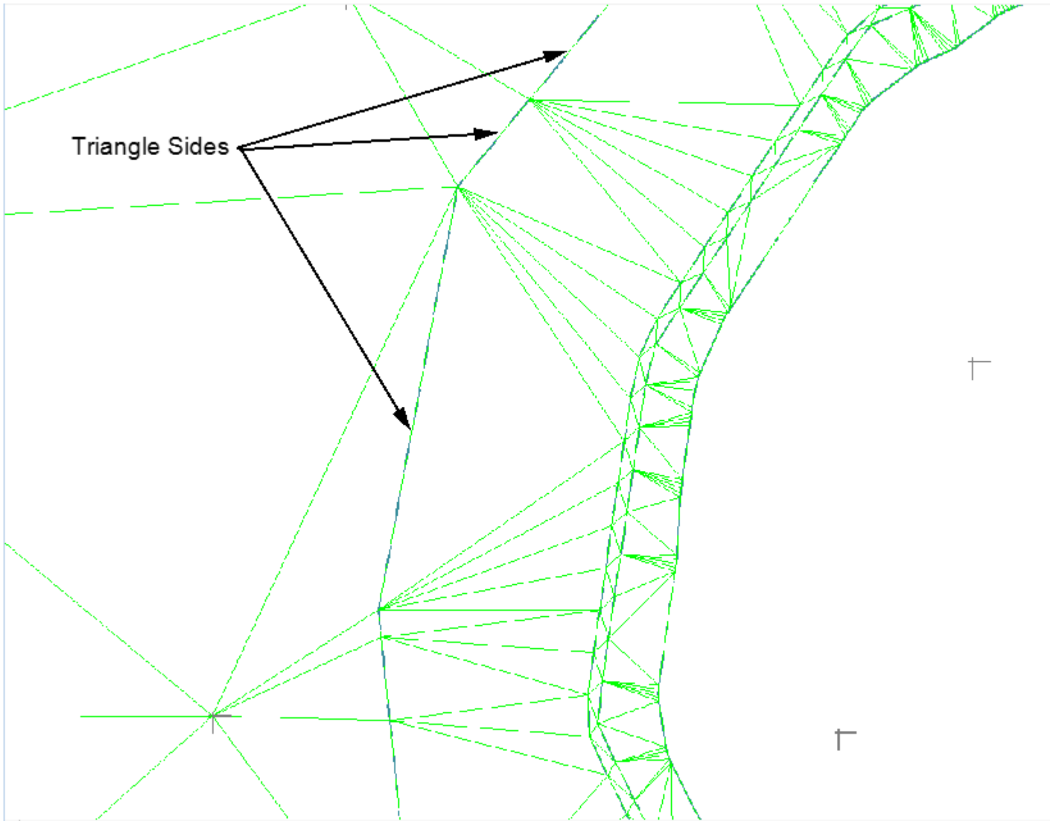


11. From the InRoads menu, select **Surface > View Surface > Triangles**.



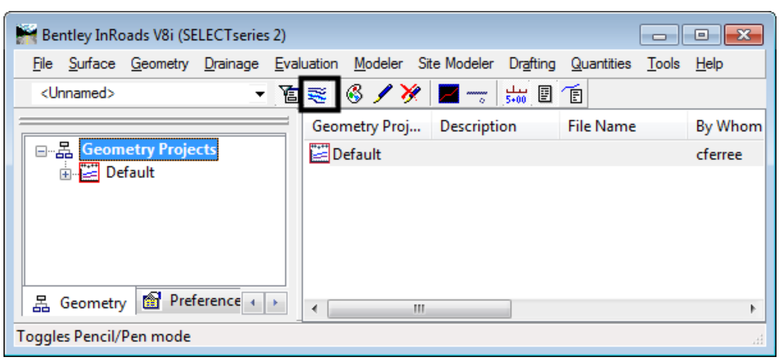
12. Dismiss the **View Triangles** dialog box.

13. Notice around the toe of the pond dam that the triangle sides match the feature. InRoads forms linear terrain features by creating triangle edges along those features. All breakline, interior, and exterior features are formed in this manner.

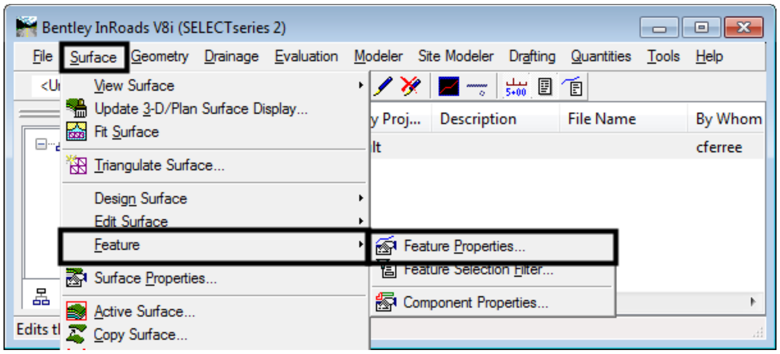


Next the difference between breakline, interior, and exterior features are illustrated.

14. On the InRoads ***Locks*** toolbar, turn on the **Feature Highlight** lock. This will highlight the feature being discussed.

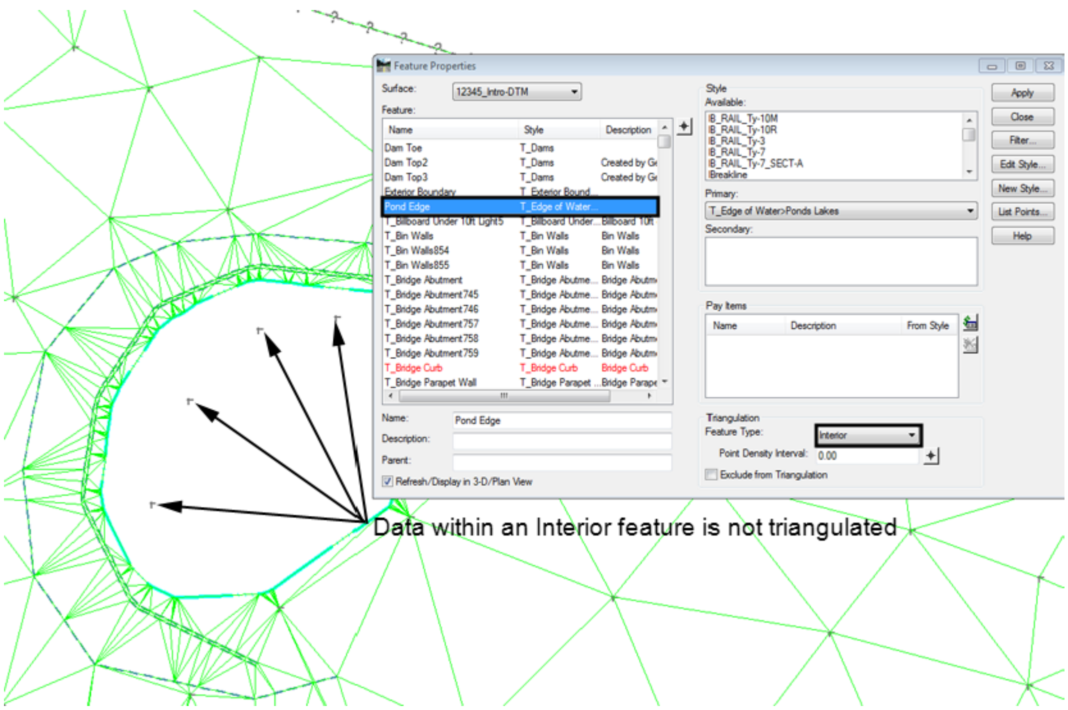


15. From the InRoads menu bar, select **Surface > Feature > Feature Properties**. From here, the features can be selected and the properties that make them different can be seen.



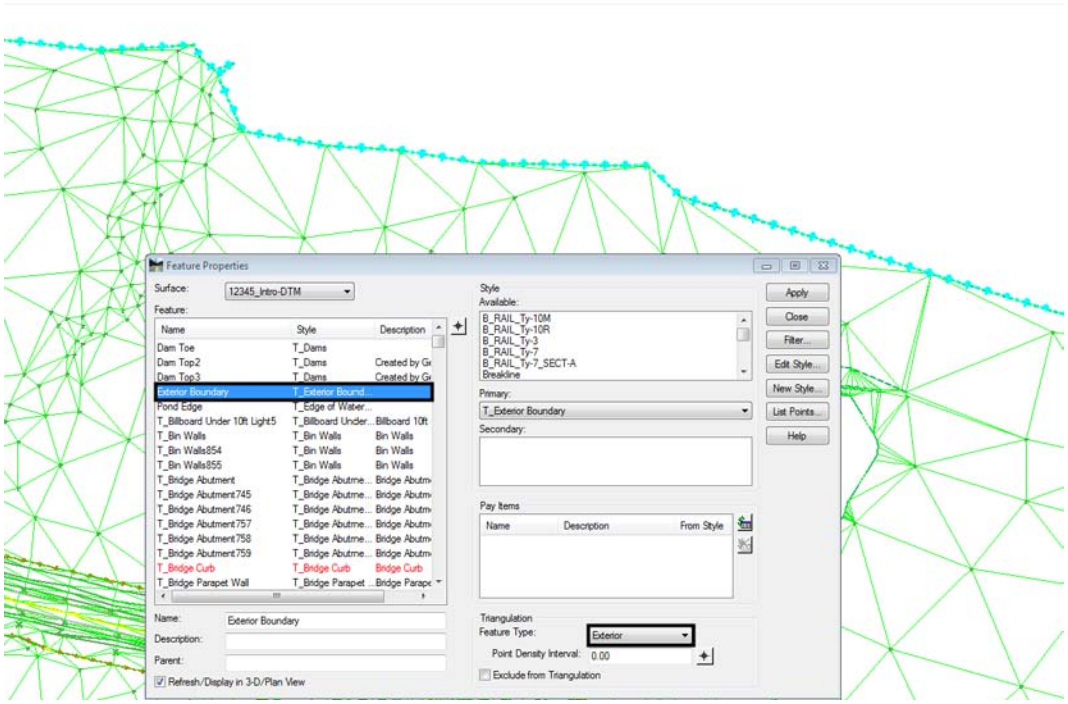
16. In the ***Feature Properties*** dialog box, highlight the **Pond Edge** feature from the ***Feature*** list.

17. Notice that there are no triangles displayed inside the feature. This is because the ***Interior*** feature type denotes an area of unknown elevation, which is not triangulated by the program.



18. In the ***Feature Properties*** dialog box, highlight the **Exterior Boundary** feature from the ***Feature*** list.

19. Notice that there are no triangles outside of the ***Exterior Boundary*** feature. An Exterior feature type denotes the limits of data and does not allow triangulation to occur outside those limits. This prevents triangles from being built in areas where no data was collected.



Note: There can be only one Exterior type feature in a DTM. There can be any number of Interior type features in a DTM.

Section Summary:

- Breakline features are defined by triangle sides in the surface (triangulated model)
- Interior features are closed shape breaklines that describe the limits of an area of unknown elevation. They can also be used in design surfaces to indicate an area where no construction occurs, for example on a project that has widening on both sides of the pavement but no overlay.
- Exterior features are closed shape breaklines that describe the limits of data for a surface

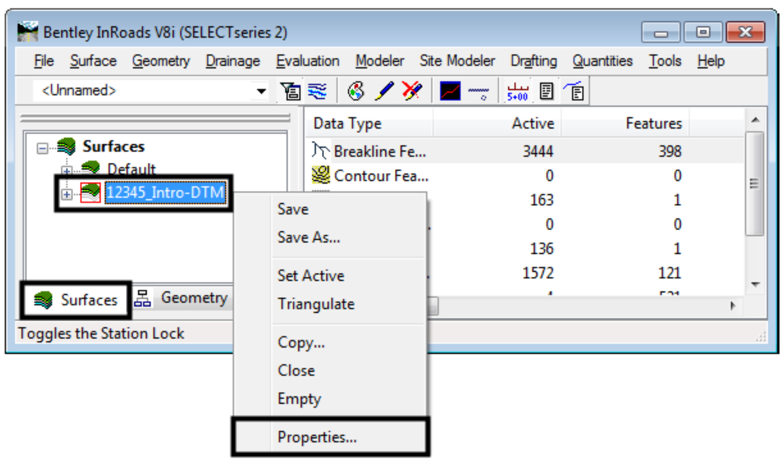
Lab 7.2 - Set the Symbology for Cross Sections and Profile Display

The symbology for a data line for a surface displayed in a profile or cross sections is controlled by the surface properties. This lab illustrates how to change those settings.

Section Objectives:

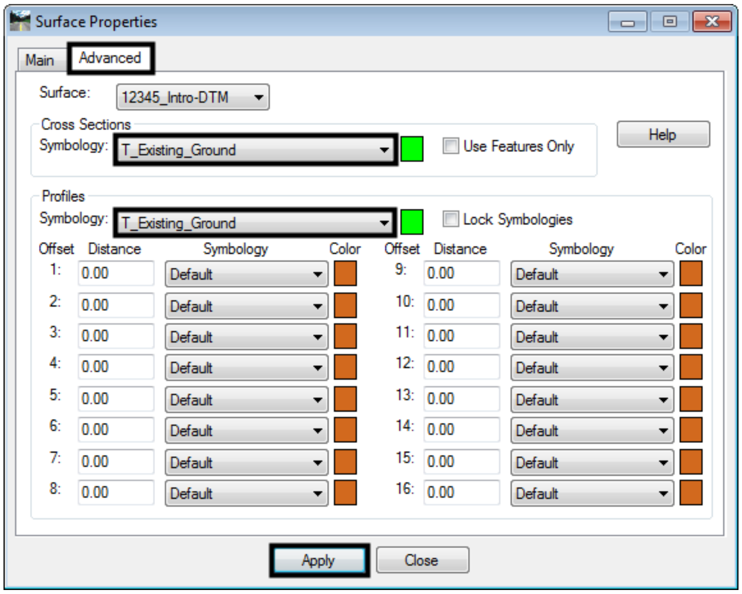
- Describe how to set the symbology for profile or cross sections display

1. From the InRoads Explorer, select the **Surfaces** tab.
2. **<R>** on the **12345_Intro-DTM** surface and select **Properties** from the menu.



3. In the ***Surface Properties*** dialog box, select the **Advanced** tab.
4. Select **T_Existing_Ground** from the ***Symbology*** drop down menu in the ***Cross Section*** area.
5. Set the ***Symbology*** in the ***Profiles*** area to **T_Existing_Ground** also.

6. **<D>** the **Apply** button to accept the changes.



7. Close the **Surface Properties** dialog box.

Section Summary:

- Symbology settings for Cross Section and Profile display are stored in the Surface Properties.
- The symbology For Cross Section and Profile should be set the same for a surface in order to maintain consistency.

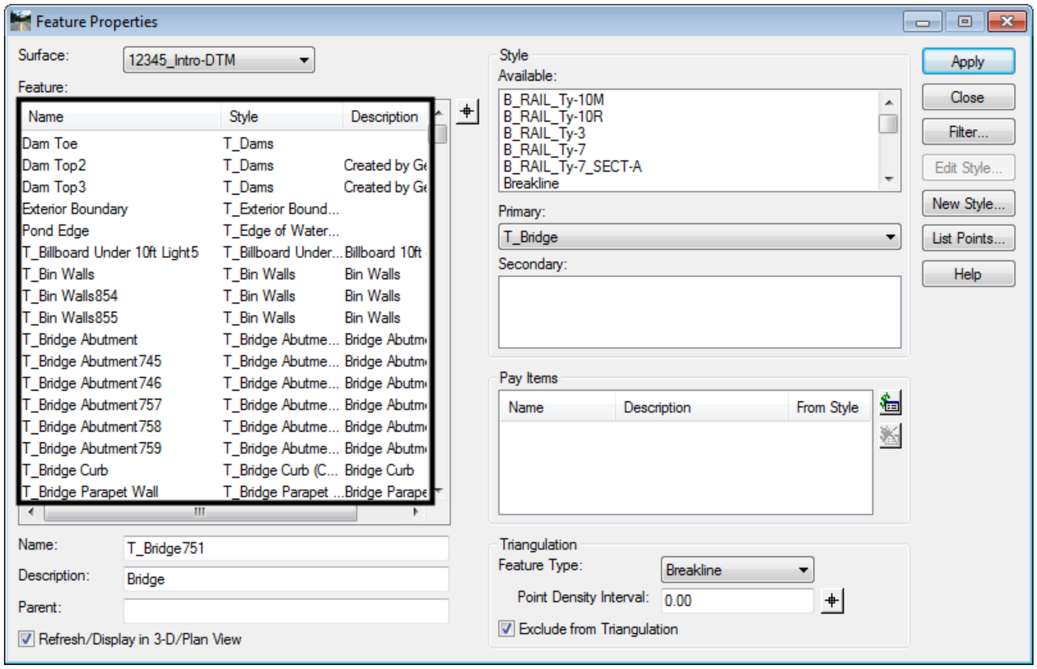
Lab 7.3 - Feature Filters

Feature Filters are used to reduce the number of features displayed in dialog boxes and menus to make it easier to find the desired feature. Feature Filters use predefined criteria to determine if a feature will be displayed.

First, lets examine how an existing filter works.

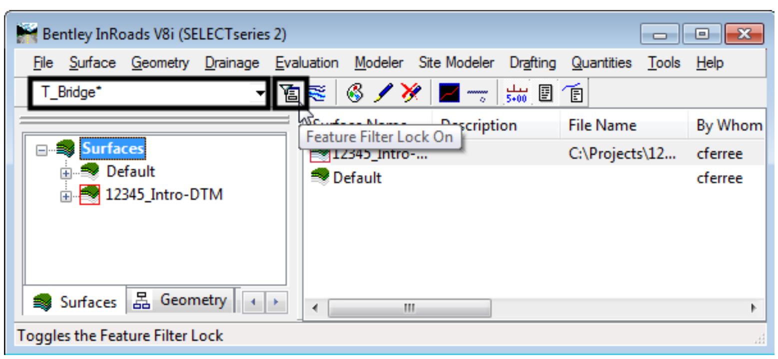
1. Select **Surface > Feature > Feature Properties** from the InRoads menu.

2. Notice that the Feature list contains all of the DTM's features.

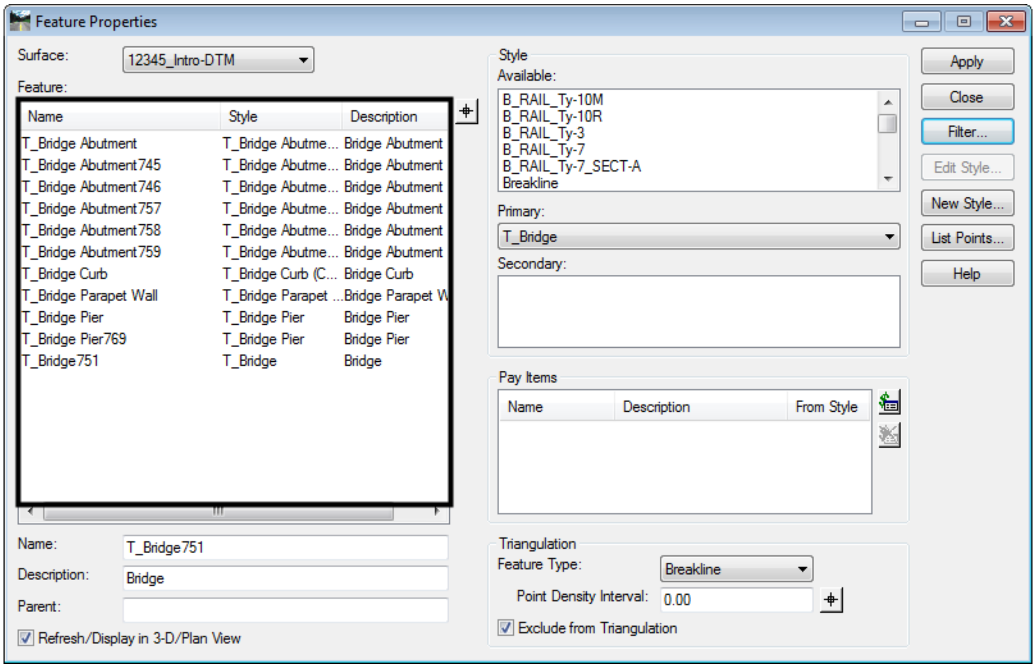


3. On the InRoads ***Locks*** toolbar, set the Filter Name to **T_Bridge*.**

4. Toggle on the **Feature Filter Lock**.

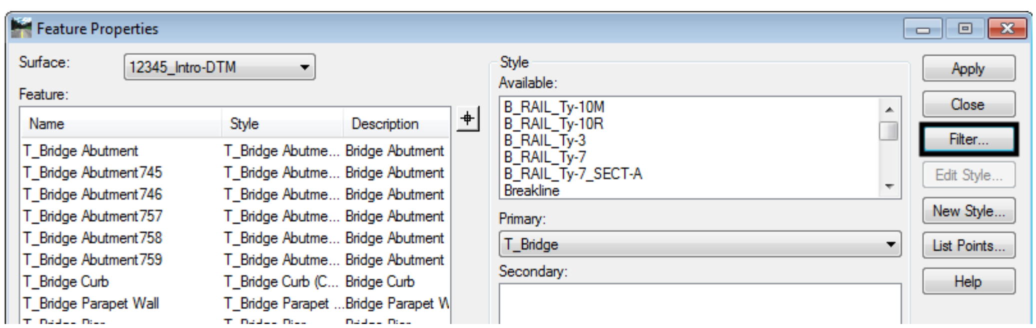


5. Notice that the Feature list contains only features that have a style name containing ***T_Bridge*** in it.

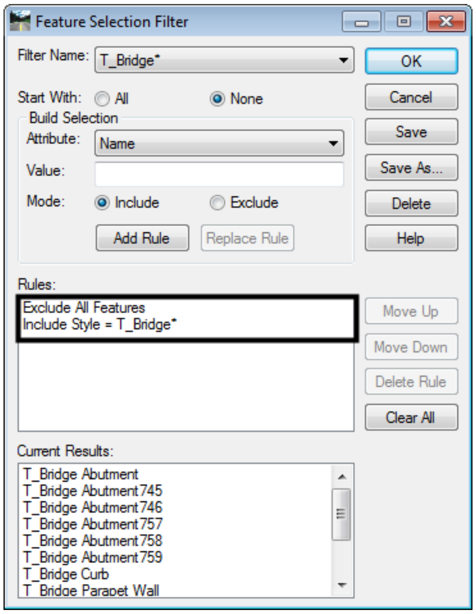


To see what makes this filter work:

6. **<D>** the **Filter** button on the ***Feature Properties*** dialog box. This displays the ***Feature Selection Filter*** dialog box.



7. Notice in the Rules area, that there are two entries, or rules.

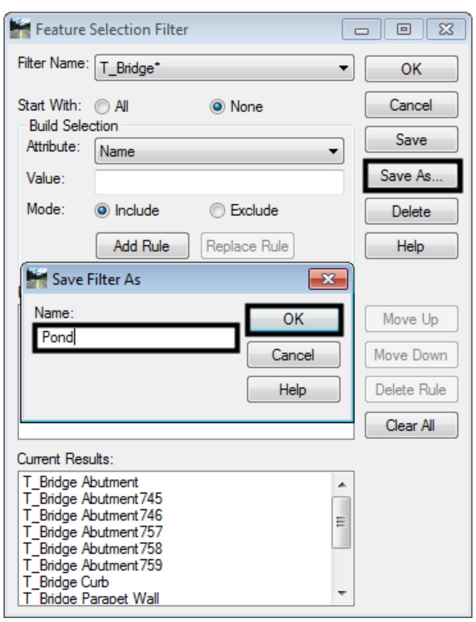


The first rule, "Exclude All Features", causes no features to be added to the list. The second rule, "Include Style T_Bridge*", adds the features with the targeted style to the list. The "*" in the second rule allows and feature that has a style name that starts with "T_Bridge" to be added to the list.

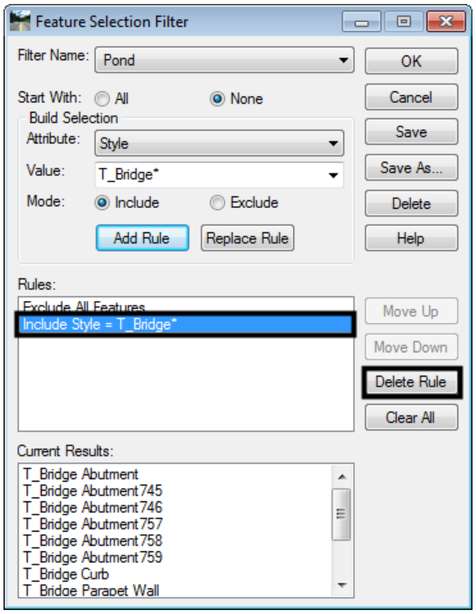
To illustrate this concept better, a new rule will be created to look for the pond features

8. In the ***Feature Selection Filter*** dialog box, **<D>** the **Save As** button. This displays the ***Save Filter As*** dialog box.

9. In the ***Save Filter As*** dialog box, Key in ***Pond*** and **<D> OK**.

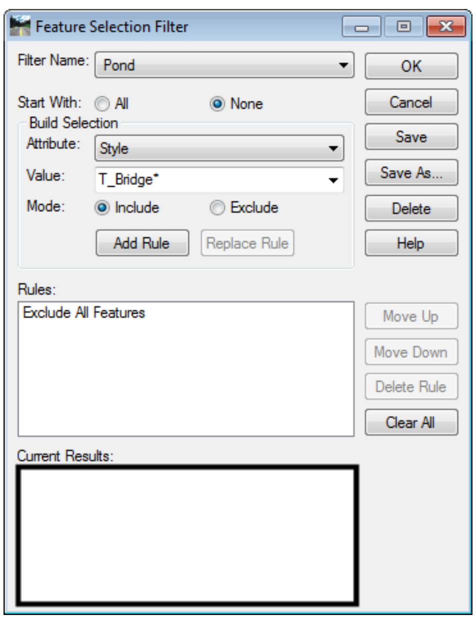


10. Highlight the "**Include Style T_Bridge***" rule then **<D>** the **Delete Rule** button.



The remaining rule, ***Exclude All Features***, is a result of the ***Start With*** toggle at the top of the dialog box. Because the toggle is currently set to None, the ***Exclude All Features*** rule is used.

11. Notice in the ***Feature Selection Filter*** dialog box, that the ***Current Results*** area is empty. This area shows which features in the active surface pass through the filter in its current state. Because the filter excludes all of the features, nothing is displayed in the ***Current Results*** area.



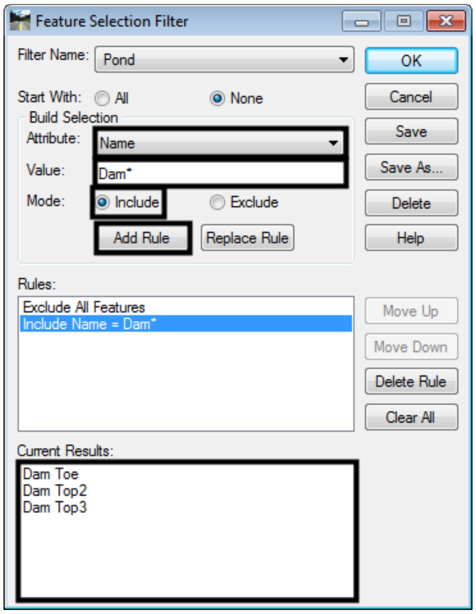
Next, a rule is added to search for DAM in the feature name.

12. In the ***Feature Selection Filter*** dialog box, select **Name** from the ***Attribute*** drop down menu.

13. In the ***Value*** field, key in ***Dam****.

14. Verify that **Include** is toggled on for the ***Mode***.

15. **<D>** the **Add Rule** button. Notice that three features appear in the ***Current Results*** area.



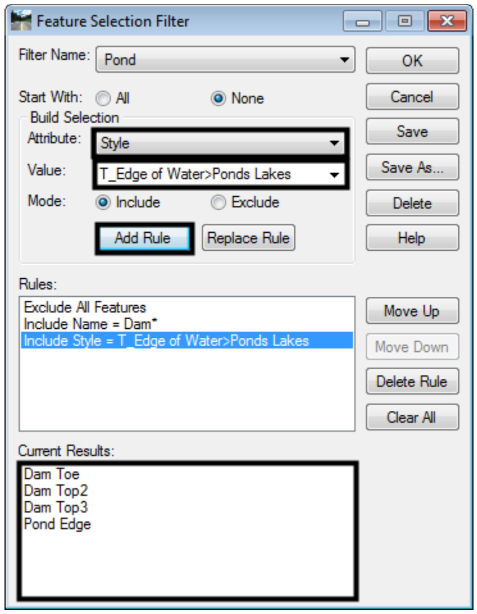
Finally, a style rule is added to find the edge of water for the pond.

16. In the ***Feature Selection Filter*** dialog box, select **Style** from the ***Attribute*** drop down menu.

17. In the ***Value*** field, select **T_Edge of Water>Ponds Lakes** from the drop down menu.

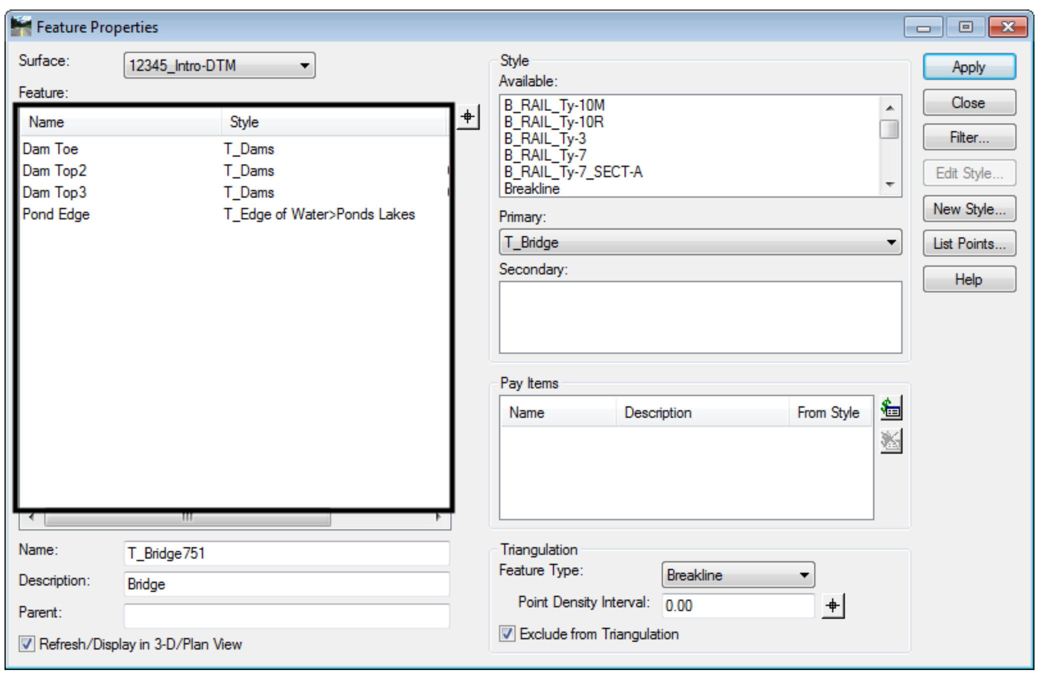
    Note: The key in ***T_Edge of Water**** could also be used.

18. **<D>** the **Add Rule** button. Notice that the **Pond Edge** feature is added to the ***Current Results*** area.



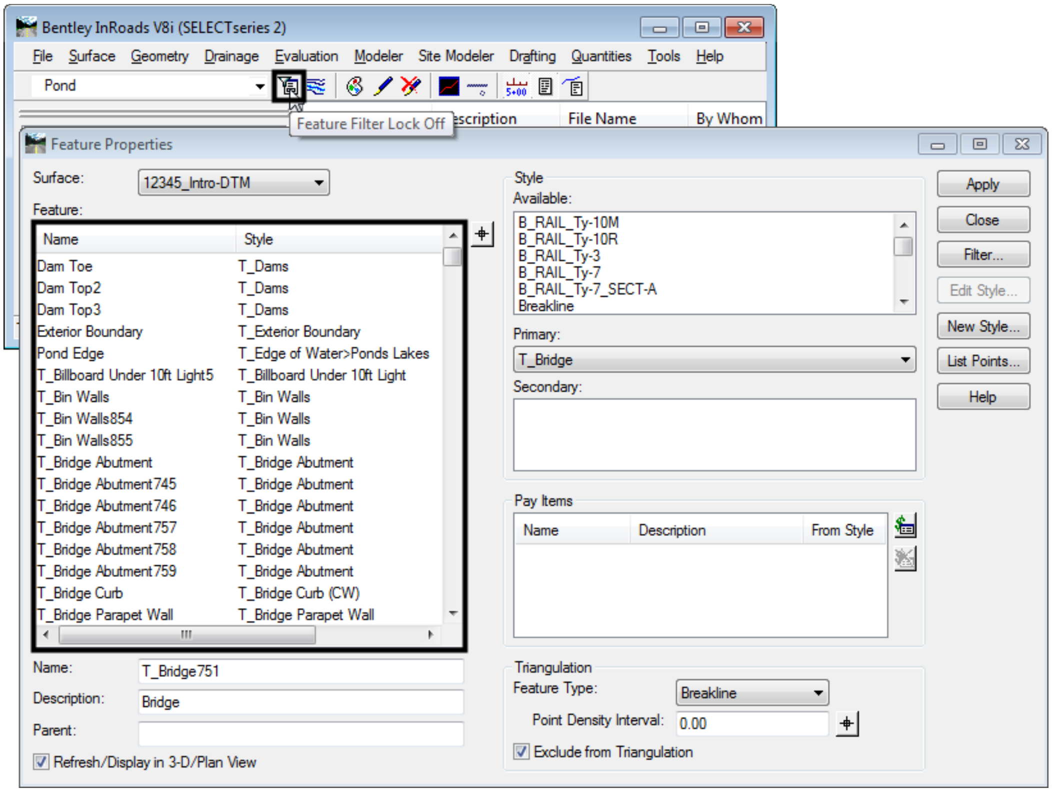
19. **<D>** the **OK** button to dismiss the ***Feature Selection Filter*** dialog box.

20. Notice that in the Feature Properties dialog box, only the three dam feature and the Pond Edge feature are present.



This will be the case for any dialog box that displays features so long as the Feature Filter Lock is toggled on.

21. On the InRoads ***Locks*** toolbar, toggle off the **Feature Filter Lock**. Notice that all the features in the DTM are displayed again.



22. **<D> Close** on the ***Feature Properties*** dialog box to dismiss it.

23. On the InRoads ***Locks*** toolbar, set the filter name to **<Unnamed>**.

Section Summary:

- Feature Filters are used to limit the number of features displayed in a dialog box to make it easier to find the desired feature.
- Feature Filters are only applied when the Feature Filter Lock is toggled on.
- Feature Filters are stored as part of the XIN file and will be overwritten when the computer is logged on, unless the XIN file is saved to a different location.

Lab 7.4 - Displaying Surface Data

There are many ways to view DTM or surface data. This lab demonstrates three methods of displaying surface data to the MicroStation file; View Perimeter, View Features, and View Contours.

Section Objectives:

- Describe how to display a surface's perimeter
- Describe how to display features from a DTM
- Illustrate how to display contours at different intervals using predefined preferences

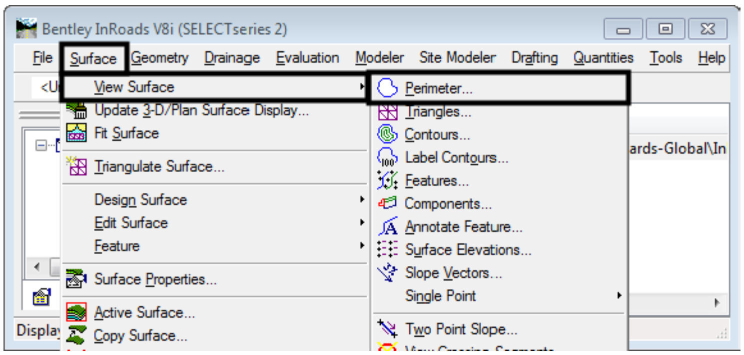
First, any pre-existing graphics are removed.

1. From the MicroStation menu bar, select **Edit > Select All**.

2. Select **Delete** from the MicroStation Main Task toolbar or press the ***Delete*** key on the keyboard.

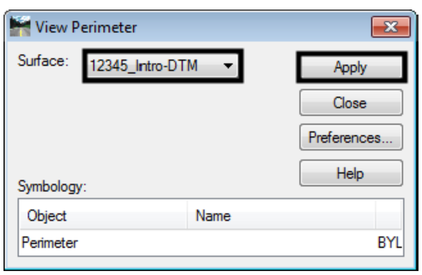
The perimeter (limits of triangulated data) is displayed.

3. From the InRoads Menu, select **Surface > View Surface > Perimeter**. The ***View Perimeter*** dialog box is displayed.



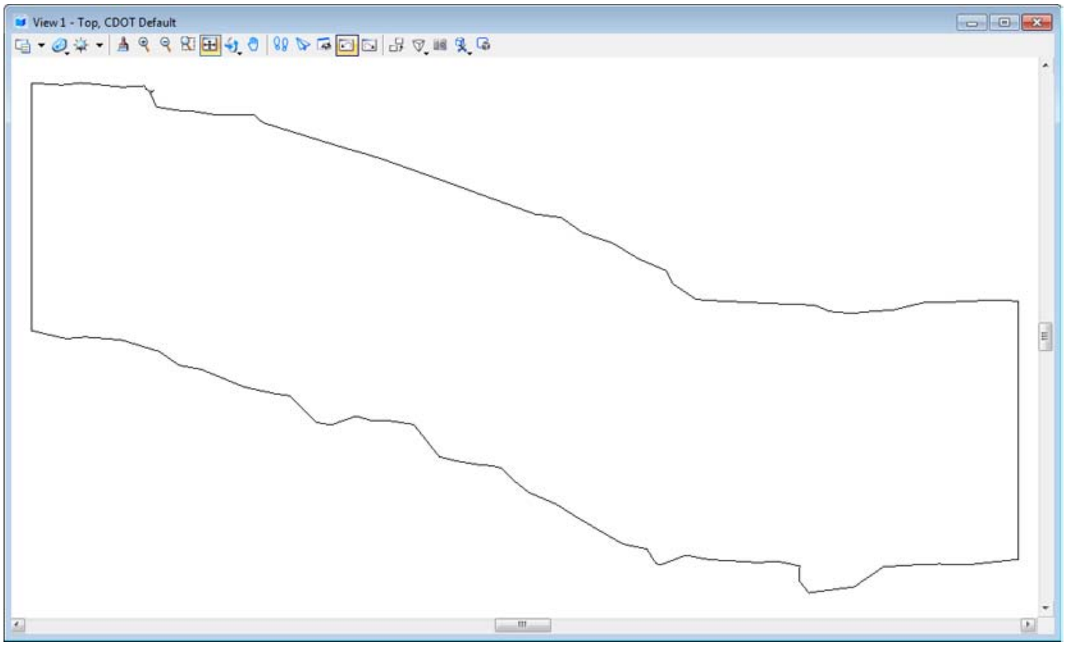
4. Verify that the **12345_Intro-DTM** surface is selected.

5. **<D>** the **Apply** button.



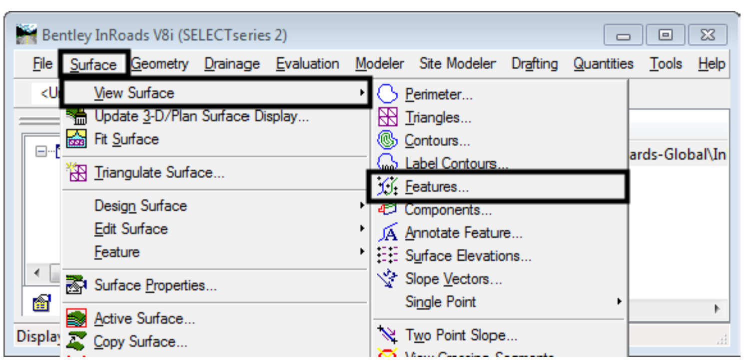
6. **<D>** the **Close** button to dismiss the ***View Perimeter*** dialog box.

7. **Fit** the view if necessary to see the perimeter. Below is an example of the perimeter.



Next, the dam features are displayed.

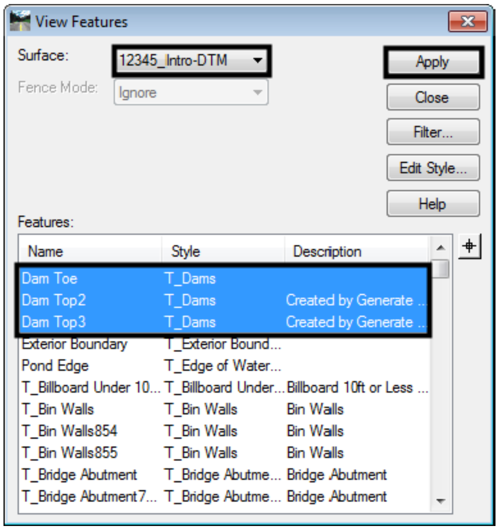
8. From the InRoads Menu, select **Surface > View Surface > Features**. The ***View Features*** dialog box is displayed.



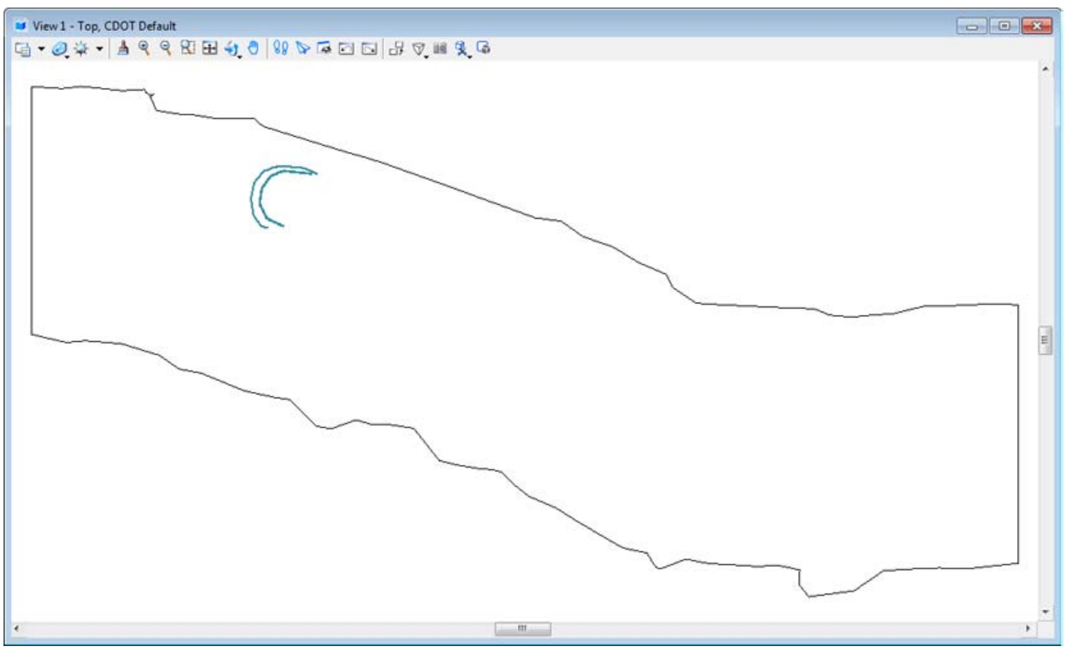
9. Verify that the **12345_Intro-DTM** surface is selected.

10. Highlight the top three features in the list (<D> on the top feature, Hold the Shift key, then <D> on the third feature).

11. **<D>** the **Apply** button. The three features that make up the pond dam are displayed.



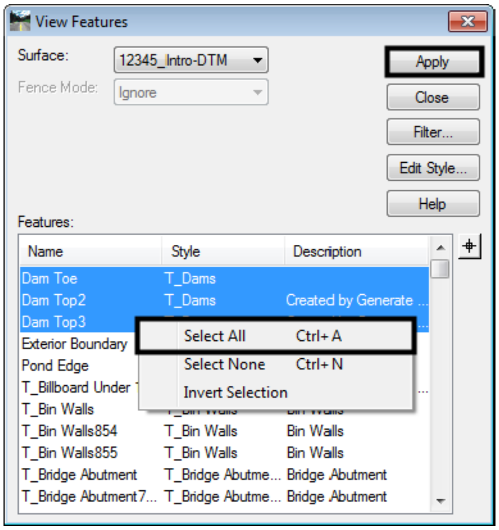
Below is the finished display.



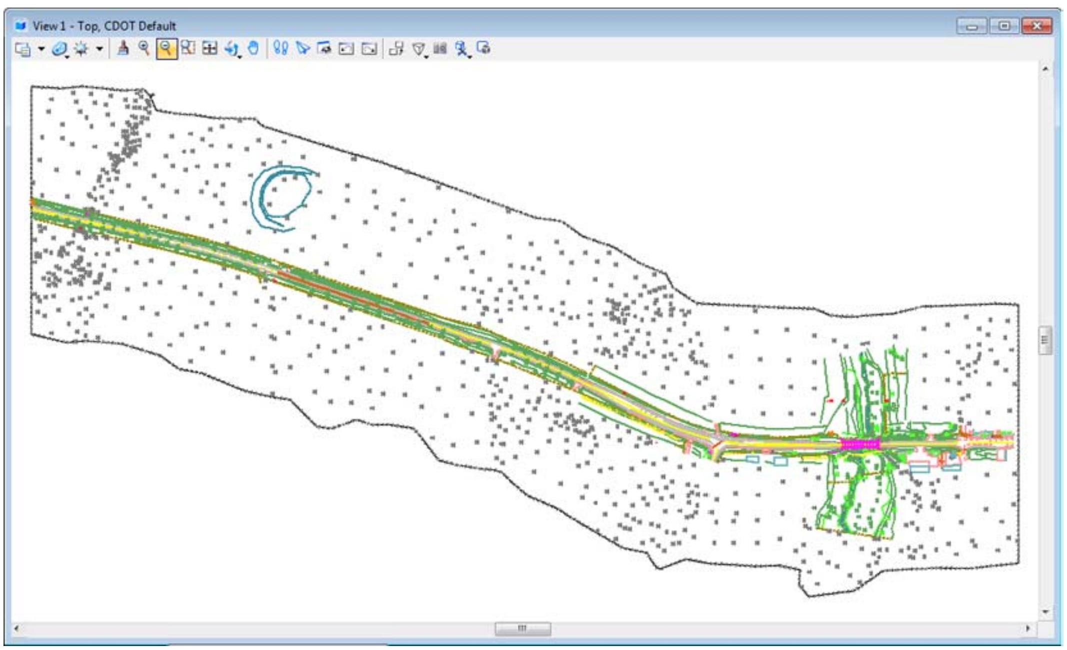
Display all of the features in the DTM.

12. In the ***View Features*** dialog box, **<R>** in the ***Features*** list and choose **Select All** from the right click menu.

13. **<D>** the **Apply** button.



Below is an illustration of the updated view.



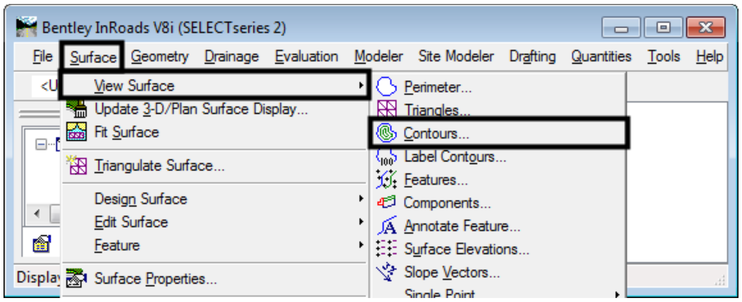
14. **<D>** the **Close** button to dismiss the ***View Features*** dialog box.

Finally, contours for the surface are displayed. In order for the contours to be clearly visible, the current data in the MicroStation file will be deleted.

15. From the MicroStation menu bar, select **Edit > Select All**.

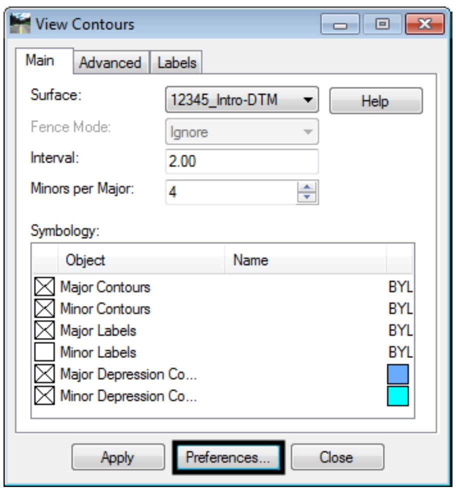
16. Select **Delete** from the MicroStation Main Task toolbar or press the ***Delete*** key on the keyboard.

17. From the InRoads main menu, select **Surface > View Surface > Contours**. This displays the ***View Contours*** dialog box.



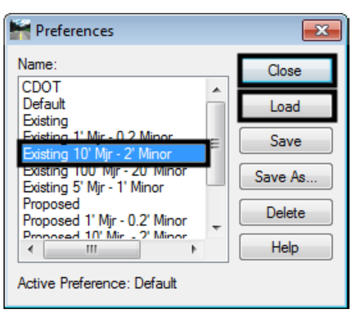
First, contours with a 10’ major interval will be displayed.

18. In the ***View Contours*** dialog box, **<D>** the **Preferences** button. This displays the ***Preferences*** dialog box.

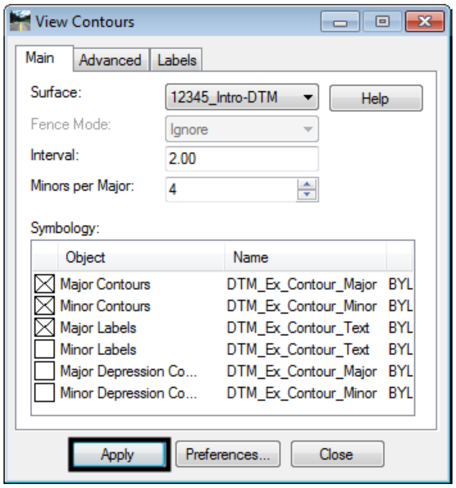


19. In the ***Preferences*** dialog box, highlight **Existing 10’ Mjr - 2’ Minor** in the ***Name*** list.

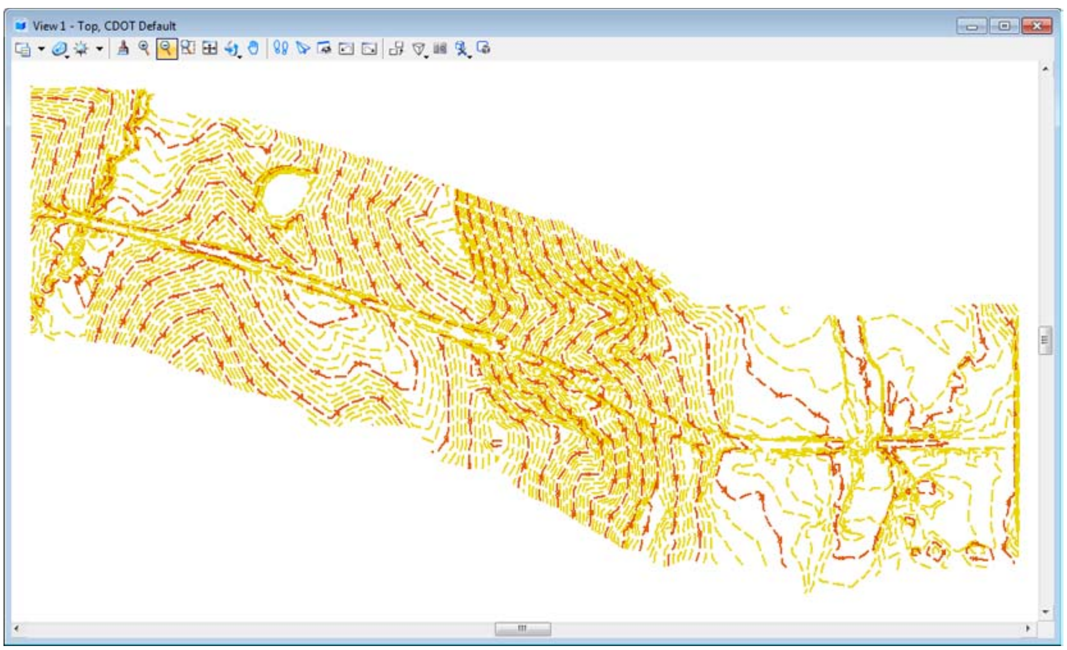
20. **<D>** the **Load** button to apply the preference, then **<D>** the **Close** button to dismiss the ***Preferences*** dialog box.



21. In the ***View Contours*** dialog box, **<D>** the **Apply** button.



22. Examine the contours displayed. Below is an illustration of the contours.

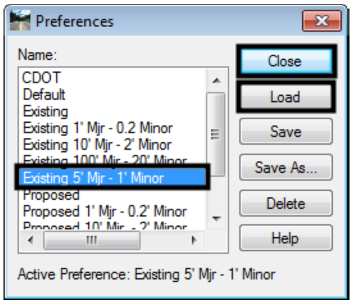


Finally, the contours will be changed to a 5’ major interval.

23. In the ***View Contours*** dialog box, **<D>** the **Preferences** button. This displays the ***Preferences*** dialog box.

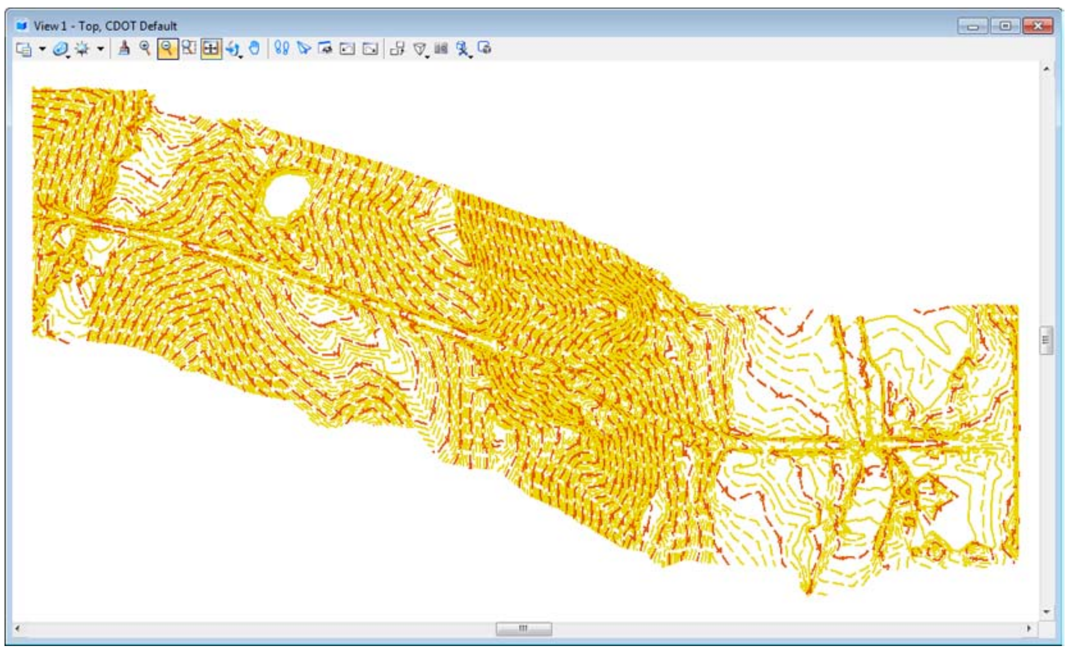
24. In the ***Preferences*** dialog box, highlight **Existing 5’ Mjr - 1’ Minor** in the ***Name*** list.

25. **<D>** the **Load** button to apply the preference, then **<D>** the **Close** button to dismiss the ***Preferences*** dialog box.



26. n the ***View Contours*** dialog box, **<D>** the **Apply** button.

27. Examine the contours displayed. Below is an illustration of the contours.



Because the Write Lock is set to Pencil Mode, the previous contours do not have to be deleted prior to displaying the new ones.

Section Summary:

- ♦ Data like the Perimeter, Contours, or Triangles is derived from the surface, the triangle mesh stored in the DTM.
- ♦ View Features can be used to display the Triangulated and Untriangulated data contained within the DTM.

Chapter Summary:

- Of the 5 different Feature Types Random, Breakline, and Exterior are used on almost every existing DTM
- The Exterior feature describes the limit of triangulated data for a surface

- Interior features describe an area of unknown elevation
- The Symbology for Cross Sections and Profile is set in the Surface Properties dialog box
- Cross Sections and Profile symbology should be set the same for a surface in order to maintain the consistency of appearance
- Feature Filters are used to reduce the number of features displayed in menu lists
- Feature Filters are used to limit feature lists to items of interest to the user
- Only features that pass the filter can be displayed, selected, edited, etc.
- There are a variety of standard preferences that control the display contours

LAB 8 - Building Components

This lab demonstrates the various methods of creating components, setting component and point properties, and illustrating how point constraints work. There are three basic options used to create components; simple, constrained/unconstrained, and end condition.

Chapter Objectives:

- Build a simple component
- Build a constrained component
- Build an end condition component
- Demonstrate the commonly used constraints; horizontal, vertical, slope, and vector/offset

Before beginning this lab, verify that the following files are loaded:

- C:\Projects\12345\Design\Drawings\Reference_Files\12345DES_Model.dgn
- C:\Workspace\Workspace-CDOT_V8i\Standards-Global\InRoads\Preferences\CDOT_Civil.xin
- C:\Projects\12345\Design\InRoads\12345DES_Geometry.alg
- C:\Projects\12345\Design\InRoads\12345 existing ground.dtm
- C:\Projects\12345\Design\InRoads\12345DES.ird
- C:\Projects\12345\Design\InRoads\DES12345_Templates.itl

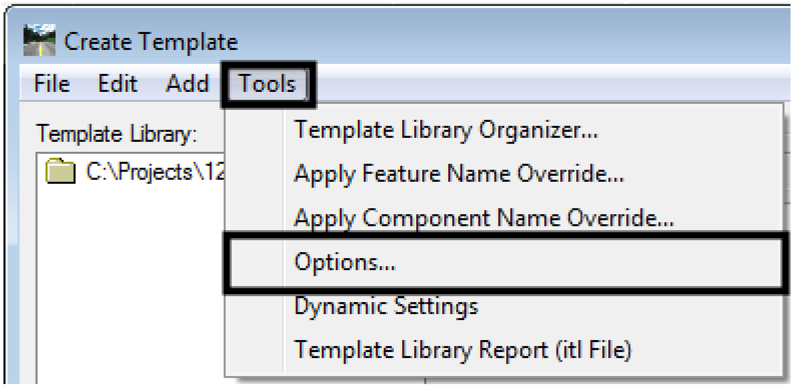
Lab 8.1 - Build A Simple Component

Use the simple option to build a regular closed shape component with horizontal and slope constraints such as those used for building pavement components.

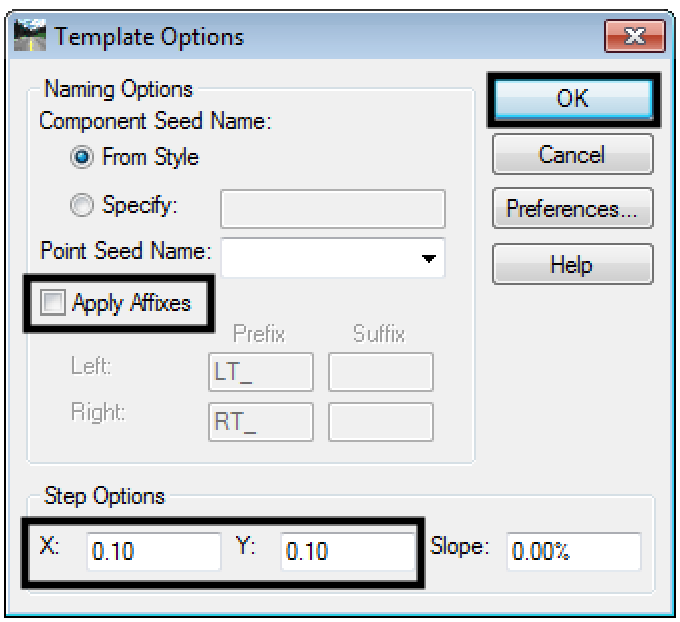
1. Open MicroStation and InRoads using the ***12345DES_Model.dgn*** file found in the directory ***C:\Projects\12345\Design\Drawings\Reference_Files***.
2. Select **File > Open** from the InRoads menu bar.
3. Select the ***C:\Projects\12345\Design\InRoads\DES12345_Templates.itl*** from the available files.
4. **<D> Open** then **<D> Cancel** the ***Open*** dialog box.
5. Select **Modeler > Create Template** from the InRoads menu bar.

Setting up ***Template Options*** makes point placement easier. For this lab, affixes will be turned off so that the component can be used on either side of the template. The step value will be set so to a small value so that when creating a template, components will snap to the correct points.

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



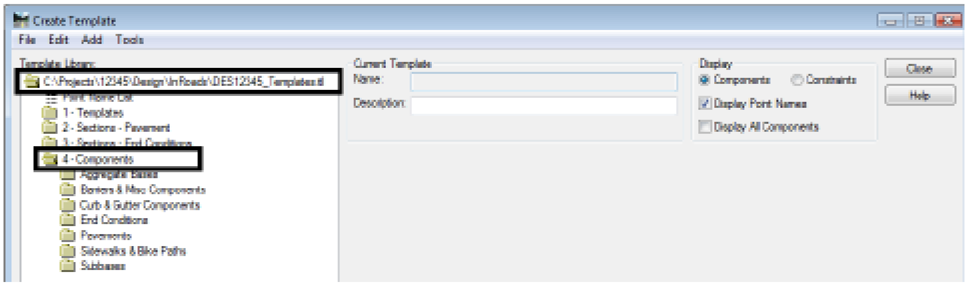
7. Toggle off ***Apply Affixes***.
8. Set the ***X*** and ***Y Step Options*** to ***0.10***.
9. **<D> OK**.



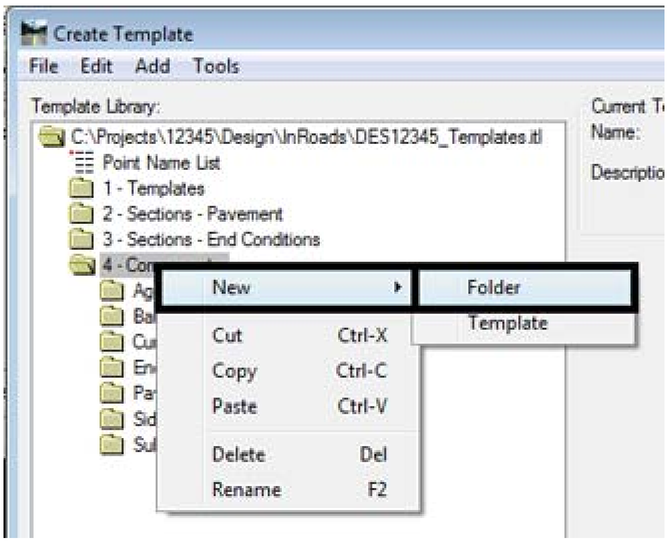
The next series of steps creates a new project specific folder to store the components that will be created in the lab. Creating project specific folders in the template library makes easier to find project specific components.

10. **<D> <D>** on the root folder in the Template Library pane to expand the folder structure.

11. **<D> <D>** on the ***4 - Components*** folder to expand the folder.



12. **<R>** on the ***4 – Components*** and select **New > Folder** from the right click menu.

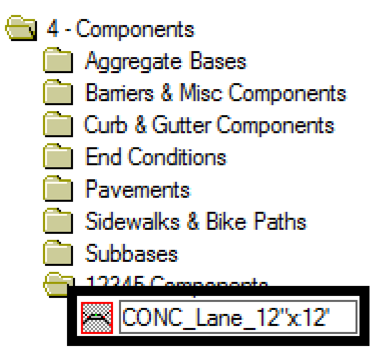


13. Key in ***12345 Components*** for the folder name.

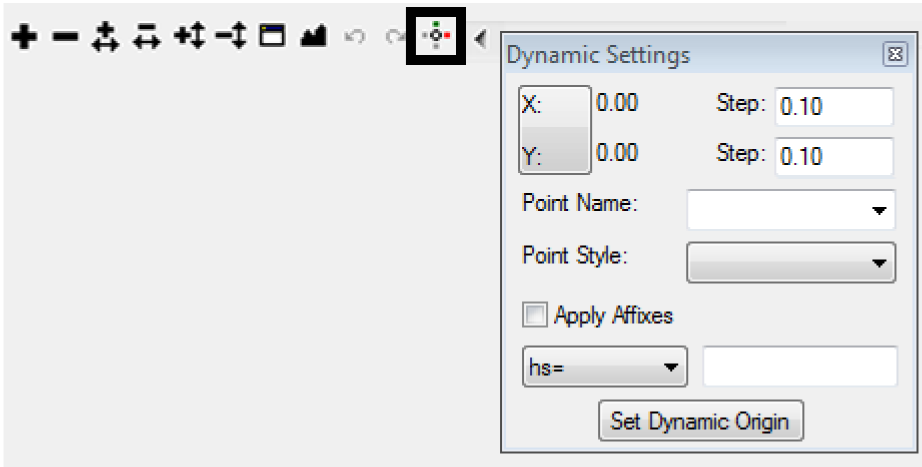
Components are the building blocks of templates. Create a pavement component using the ***Simple*** option. This option is used because it automatically sets up the constraints of the component.

14. **<R>** on the ***12345 Components*** folder and select **New > Template** from the right click menu.

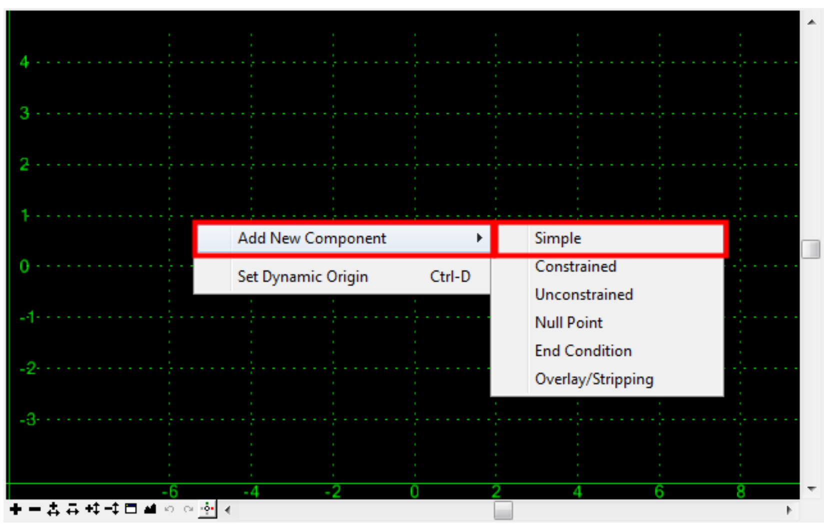
15. Key in ***CONC_Lane_12"x12'*** for the component name.



16. **<D>** on the ***Dynamic Settings*** button to display the ***Dynamic Settings*** tool settings box.



17. **<R>** In the Template View window and Select **Add New Component > Simple** from the right click menu.



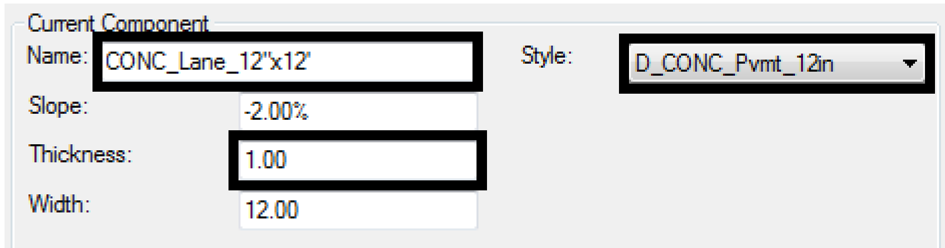
The next steps define the style that the component will use, the point names, and the origin of the component.

18. In the ***Current Component*** area, key in ***CONC_Lane_12"x12'*** into the ***Name*** field.

19. Set the Style to **D_CONC_Pvmt_12in** using the drop down menu.

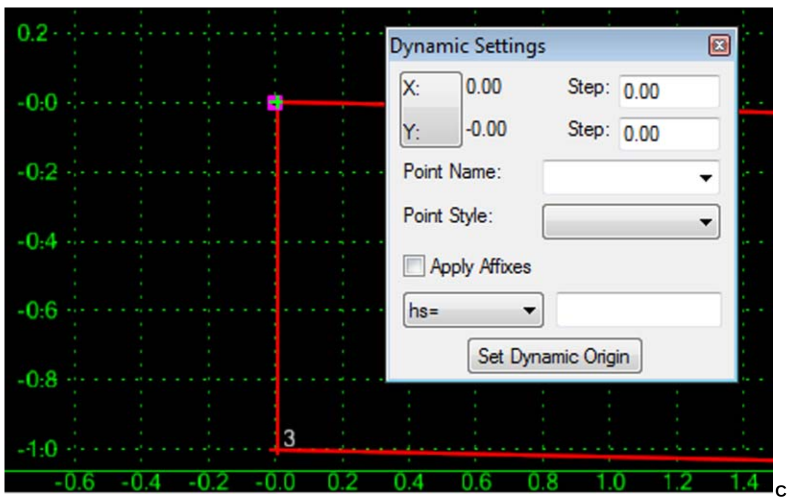
20. Key in ***1*** for the ***Thickness.***

Note: This is where the values of all the constraints are set. If needed, these values can be modified later.



21. Move the pointer into the magenta square (this is the template origin and is usually at the coordinate 0,0). Adjust the pointer location until the ***Dynamic Settings*** readout is ***0.00*** for both ***X*** and ***Y***.

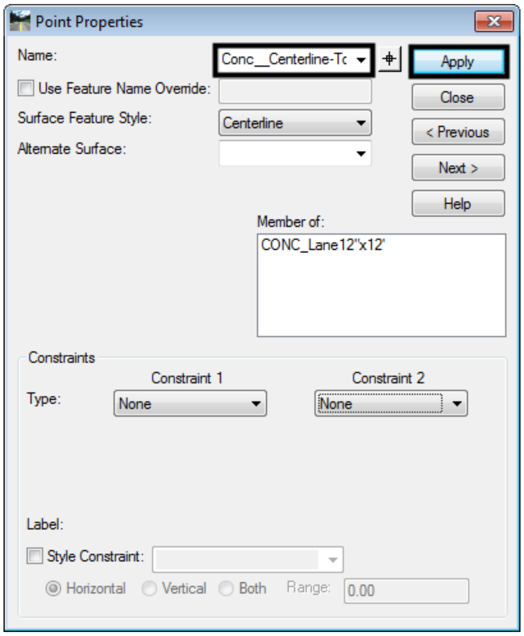
22. **<D>** to place the element.



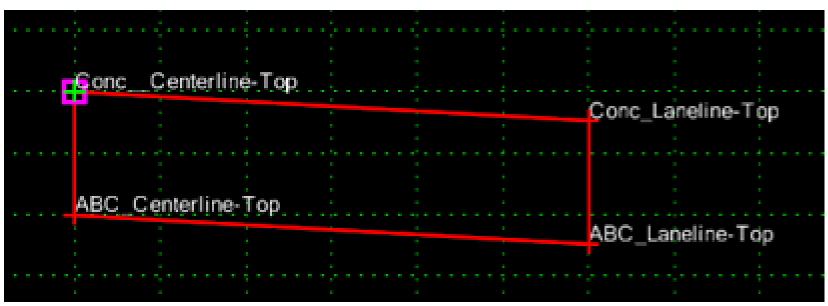
23. **<D> <D>** on the origin.

24. Select ***Conc_Centerline-Top*** from the ***Name*** drop down menu.

25. **<D> Apply**.



26. **<D> Next** and rename the remaining points as shown below using the ***Name*** pull-down menu.



This completes the creation of a simple, closed shaped component with horizontal and slope constraints.

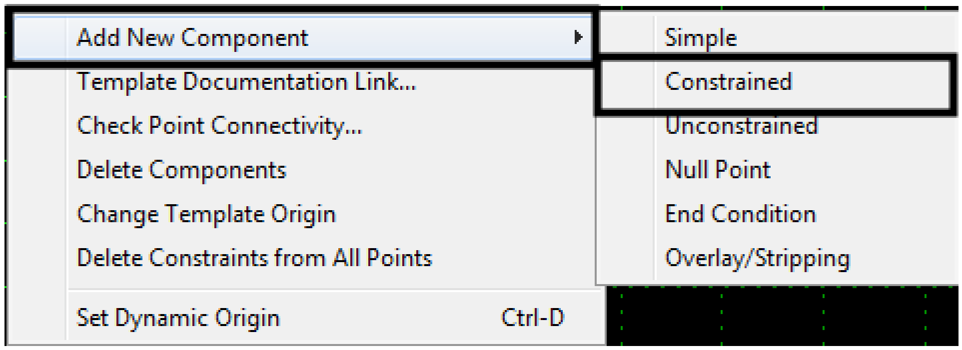
Lab 8.2 - Build a Constrained Component

In addition to building regular closed shape components, irregular and/or open shaped components can be created using the constrained or unconstrained options for adding components. They can also be used to build linear, non-end condition components. Use the constrained option to define horizontal and/or vertical constraints (such as a horizontal or vertical offset from another point). Use the unconstrained method to define points that don't depend on other points for their placement.

1. **<R>** on the ***12345 Components*** folder and select **New > Template** from the right click menu.

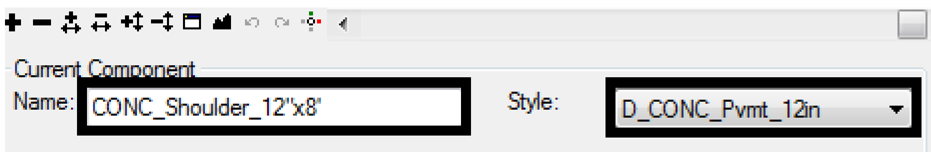
2. Key in ***CONC_Shoulder_12"x8'*** for the component name.

3. **<R>** In the Template View window and Select **Add New Component > Constrained** from the right click menu.



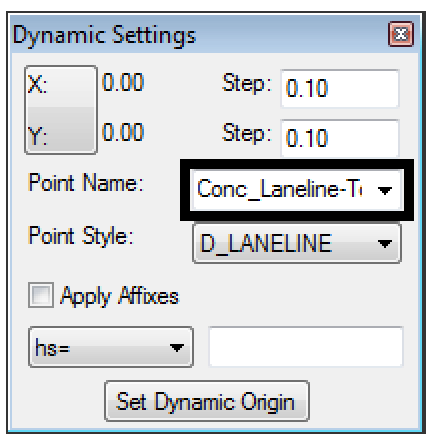
4. In the ***Current Component*** area, key in ***CONC_Shoulder_12"x8'*** into the ***Name*** field.

5. Set the Style to **D_CONC_Pvmt_12in** using the drop down menu.



When placing constrained or unconstrained components, each point of the component must be placed individually. Use the ***Dynamic Settings*** dialog box is to enter point names, styles, and locations.

6. Select ***Conc_Laneline-Top*** from the ***Point Name*** drop down menu on the ***Dynamic Settings*** dialog box.

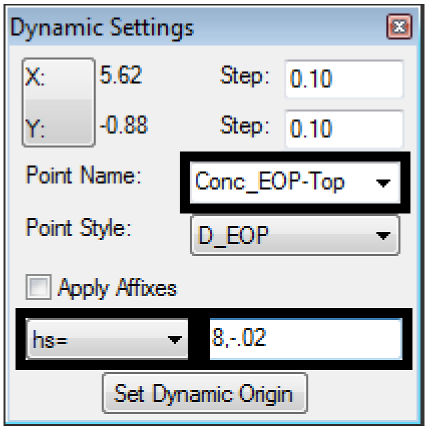


7. Move the pointer on to the template origin and **<D>**.

8. ***Dynamic Settings*** dialog box, Select ***Conc_EOP-Top*** from the ***Point Name*** drop down menu.

9. Change the key in mode to ***hs=*** (horizontal distance and slope).

10. Key in ***8,-.02*** in the key in field. This is the horizontal distance and slope from the previously placed point.

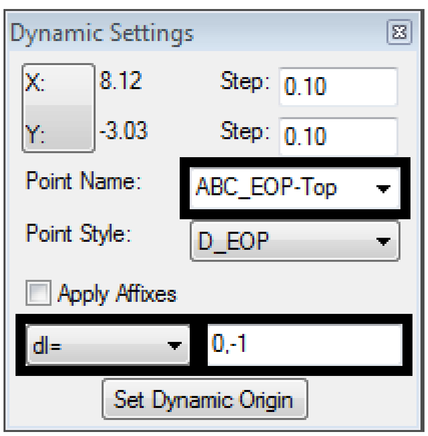


11. Press the ***Enter*** key to place the point.

12. Select ***ABC_EOP-Top*** from the ***Point Name*** drop down menu.

13. Change the key in mode to ***dl=*** (horizontal and vertical distance from the last entered point).

14. Key in ***0,-1*** in the key in field. This is the horizontal distance and vertical distance from the previously placed point.

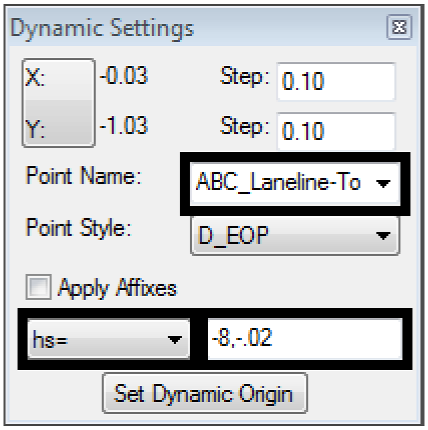


15. Press the ***Enter*** key to place the point.

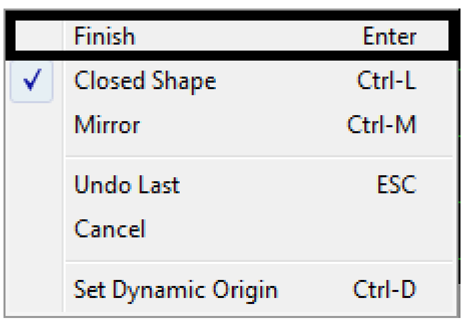
16. Select ***ABC_Laneline-Top*** from the ***Point Name*** drop down menu.

17. Change the key in mode back to ***hs=*** (horizontal distance and slope).

18. Key in ***-8,-.02*** in the key in field.



19. Press the ***Enter*** key to place the point.
20. **<R>** anywhere. This dialog box is where you define if the shape is closed or not.
21. Verify that ***Closed Shape*** is toggled **On.**
22. Select ***Finish*** from the right click menu to complete the component.



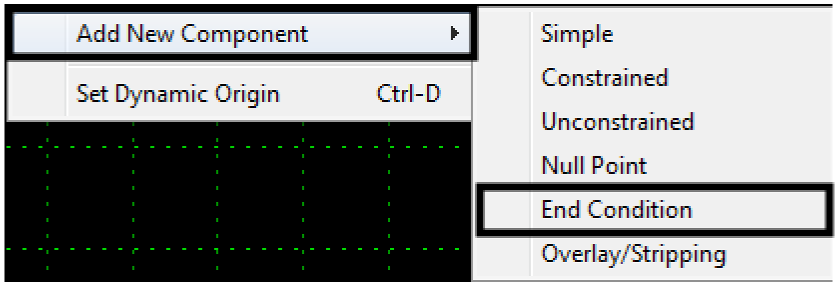
You should now understand how to create a constrained, closed shaped component. By reviewing the steps above, now you should also be able to also create unconstrained and open shaped components simply by choosing different options from the dialog boxes that were introduced.

Lab 8.3 - Build an End Condition Component

In theses next steps you will use the end condition option to create a linear component that can seek a target. This lab will focus on the point property called ***End Condition is Infinite***. Once you understand the steps to evaluate the effects of this property on and end condition, use the same steps to test the effects of other end condition point properties. Many of these properties determine how the component will behave when a target is found.

1. Create a new template as described in the previous lab and name it ***6to1_Fill***.

2. **<R>** In the Template View window and Select **Add New Component > End Condition** from the right click menu.

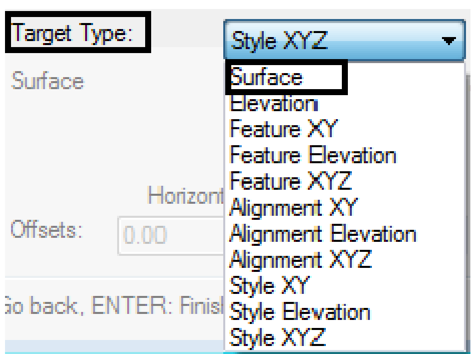


3. Key in ***6 to 1 Fill*** for the ***Name***.

4. Select ***D_Toe-of-Fill*** for the ***Style***.

Additional component properties are required for end conditions. These determine what the end condition attempts to tie to (the Target) and the order in which it is processed (the Priority).

5. **<D>** on the ***Target Type*** drop down menu. Examine the options available.

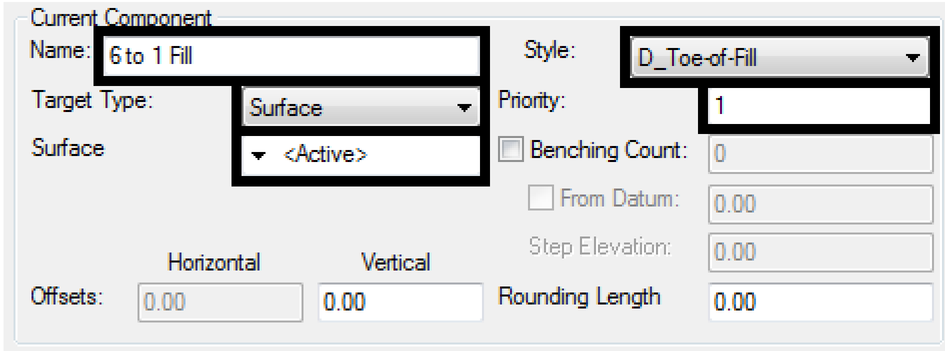


6. Select ***Surface*** from the ***Target Type*** drop down menu.

7. **<D>** on the ***Surface*** drop down menu. Notice that either Active or a particular surface can be selected.

8. Select ***Active*** from the drop down menu**.** This will allow the end condition to solve regardless of the surface specified in Roadway Designer.

9. Key in ***1*** for the ***Priority***.



Note: This example illustrates an end section with one component. When there are several components defined in an end condition, they are evaluated in order of their assigned ***priority***. A component with a priority of 1 will be evaluated before a component with a priority of 2.

Next, additional point properties, such as point names, will be defined for the end condition. Use the ***Dynamic Settings*** dialog box to finish defining these properties.

10. In the ***Dynamic Settings*** dialog box, select ***POSS*** for the ***Point Name***.

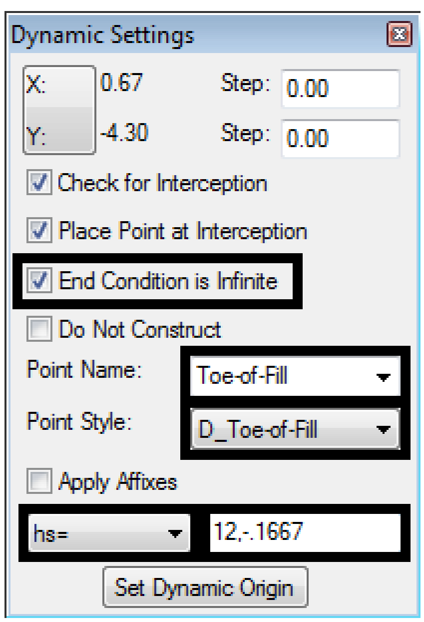
11. Move the pointer on to the template origin and **<D>**.

12. In the ***Dynamic Settings*** dialog box, toggle on ***End Condition is Infinite***. This option allows a component to "stretch" until a target is found.

13. Select ***Toe-of-Fill*** for the ***Point Name***.

14. Change the key in mode to ***hs=.***

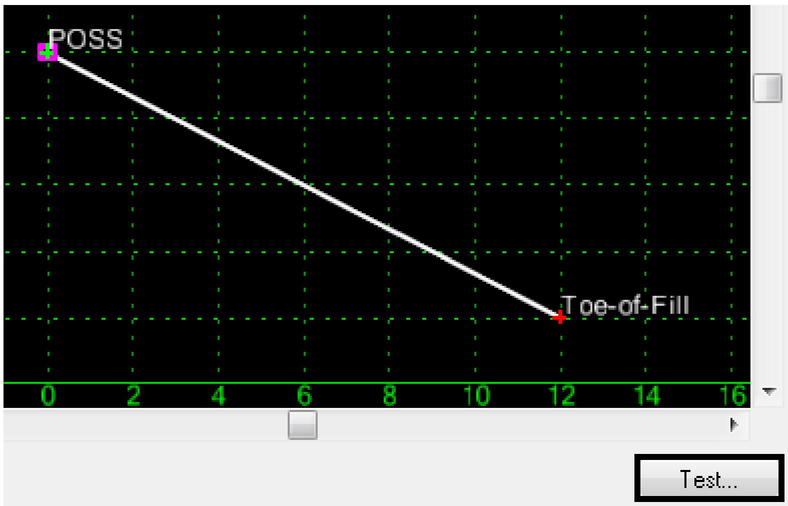
15. Key in ***12,-.1667***. and press ***Enter***. (This value could also be typed in as ***12,-1:6***).



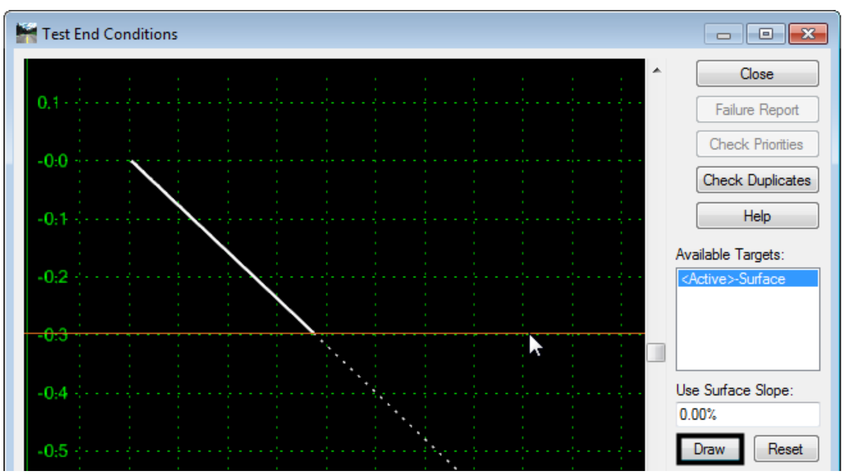
16. **<R>** and select ***Finish*** from the right click menu.

The steps above created a component that will seek a target at a -1:6 slope for a horizontal distance up to 12 feet. However, because the option ***End Condition is Infinite*** was toggled ***On***, the component ignores the horizontal distance criteria and will seek a target beyond the 12 foot limitation.

17. In the ***Create Template*** dialog box, **<D>** the ***Test*** button located to the bottom right of the Template View window as shown below.



18. In the ***Test End Conditions*** dialog box, **<D>** the **Draw** button.



19. Move the pointer up and down in the view area to see how the end condition performs.

Note: The dotted line in the ***Test End Condition*** view window shows the component at the defined slope and length. As the proposed surface moves beyond the limits of the defined component, the result of the ***End Condition is Infinite*** toggled **On** is that the end condition solution expands beyond the original limits of the component. **<D> Close**.

20. **<D> <D>** on the ***Toe-of-Fill*** point.

21. Toggle off ***End Condition is Infinite*.**

22. **<D> Apply** and **<D> Close**.

23. **<D> Test**.

24. In the ***Test End Conditions*** dialog box, **<D> Draw** and notice how the end condition behaves.

25. **<D> Close**.

Note: When the ***End Condition is Infinite*** option is **Off,** the end condition solution is limited to the limits of the originally defined component.

26. Select **File > Save** the ***Create Template*** dialog box.

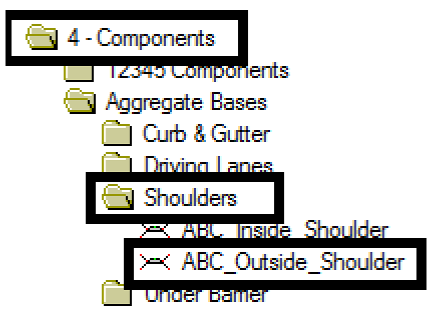
Lab 8.4 - How Point Constraints Work

Point constraints are used to form a relationship between points. This relationship is used to change the shape of the components based on events that occur within the corridor. The following steps will demonstrate how to assign and modify point controls, and how to evaluate a component by making changes to point controls. change, create the impact of

1. Verify the ***Create Template*** dialog box is open.

2. Open the folder ***4 – Components > Aggregate Bases > Shoulders***.

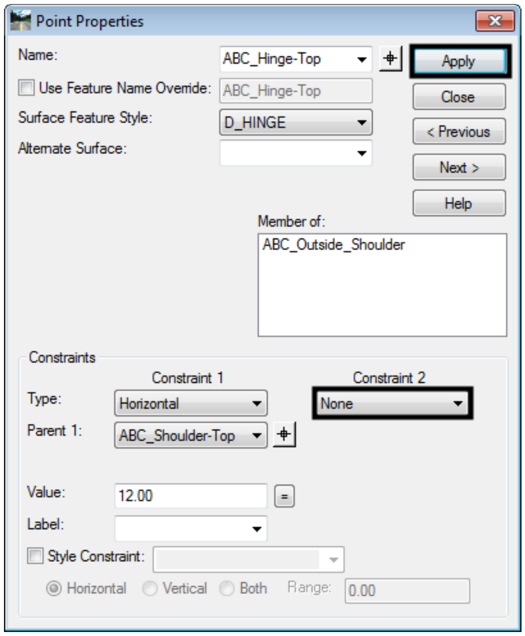
3. **<D> <D>** on the **ABC_Outside_Shoulder** component.



4. **<D> <D>** on the **ABC_Hinge-Top** point.

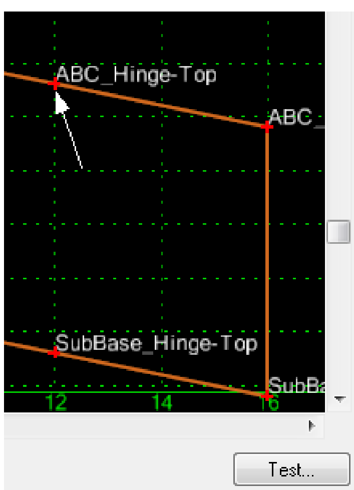
5. In the **Point Properties** dialog box, notice that this point has both a ***Horizontal*** and ***Slope*** constraint.

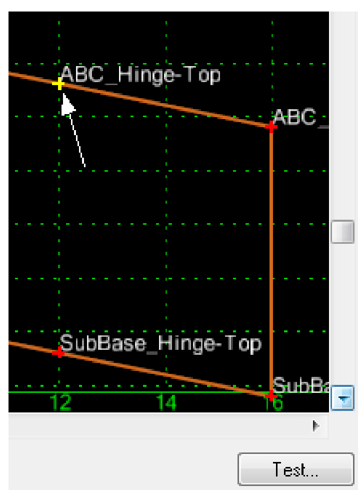
6. Change the ***Slope*** constraint to **None** and **<D> Apply**. This will allow the point to move up and down independent of any other point.



7. **<D> Close**.

8. Notice in the ***Create Template*** view window how the point symbol (+) changes from red to yellow. This color change means the point has changed from fully constrained to partially constrained.





9. **<R>** on the **ABC_Hinge-Top** point and select **Move Point** from the menu.

   Note: The ***Move Point*** command will not appear in the menu if the point is fully constrained.

10. Because the point still has a ***Horizontal*** constraint, it will only move up and down while maintaining the 12 foot offset from the constraint point, ***ABC_Shoulder-Top***.

11. **<R>** to exit the **Move** command.
12. **<D> <D>** on the **Subbase_Hinge-Top** point.
13. Notice that ***Subbase_Hinge-Top*** is constrained both horizontally and vertically to ***ABC_Hinge-Top***. Therefore, if ABC_Hinge-Top moves, Subbase_Hinge-Top will follow according to what is entered in the constraint ***Value:*** field. The next few step will demonstrate how this works.
14. **<D> Close**.
15. **<R>** on the **ABC_Hinge-Top** point and select **Move Point** from the menu.
16. Notice how the point ***Subbase_Hinge-Top*** stays 0.5 feet directly below point ***ABC_Hinge-Top.*** This is because the point has a ***Horizontal*** constraint of **0** and a ***Vertical*** constraint of **-0.5**. from ABC_Hinge-Top.
17. **<R>** to exit the **Move** command.

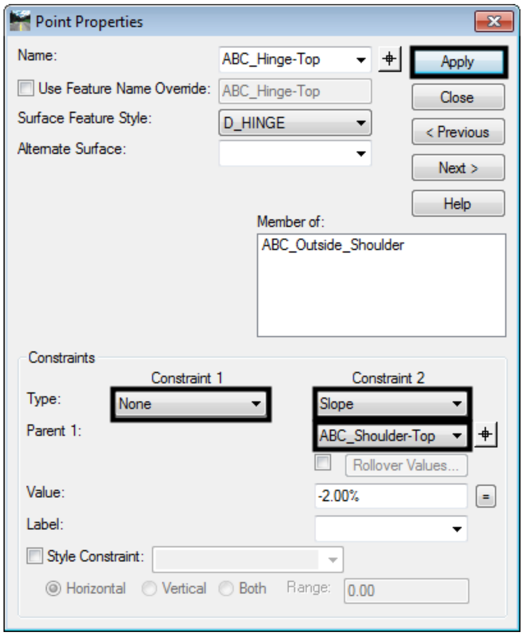
    The point ***ABC_EOP-Top*** is also fully constrained by ***ABC_Hinge-Top.*** The difference with this point it that it that the second constraint is by ***Vector-Offset*** instead of Vertical.

18. **<D> <D>** on the **ABC_EOP-Top** to look at the ***Vector/Offset*** constraint.
19. Notice that this type of constraint uses two parent points instead of one. The slope between the two parent points determines the "vector" at which the point will be placed.
20. **<D> Close**.
21. Move the point ***ABC_Hinge-Top*** again and notice how the point ***ABC_EOP-Top*** moves with it. The ***Vector/Offset*** constraint forces the point ***ABC_EOP-Top*** to maintain the same slope defined by ***ABC_Shoulder-Top*** and ***ABC_Hinge-Top.***
22. **<R>** to exit the **Move** command.

The next few steps demonstrate how ABC_Hinge-Top behave with a vertical constraint and without a horizontal constraint.

23. **<D> <D>** on the **ABC_Hinge-Top** point.
24. Change the **None** constraint back to **Slope.**

25. Set the **Parent 1** to ***ABC_Shoulder-Top*** and change the **Horizontal** constraint to **None**.



26. **<D> Apply**.

    Note: When you click ***Apply***, the two constraints will switch places. This is because the ***None*** constraint will always end up as ***Constraint 2***.

27. **<D> Close**.

28. **Move the point ABC_Hinge-Top** again an notice that now the point only moves to the left and right. The ***Slope*** constraint forces it to maintain a -2.0% slope from the point ***ABC_Shoulder-Top***.

29. **<R>** to exit the **Move** command.

30. Reset the point ***ABC_Hinge-Top*** back to its original setup. **<D> <D>** on the point, change the **None** constraint back to **Horizontal**, and set **Parent 1:** to ***ABC_Shoulder-Top.***

31. **<D> Apply**.

32. **<D> Close**.

Chapter Summary:

- Use a simple component to quickly generate an unconstrained closed shape. *Lab 8.1 -Build A Simple Component* showed how to modify point names in using the Point Properties dialog.
- The next lab, *Lab 8.2 -Build a Constrained Component*, demonstrated how to create a constrained component from scratch using the Dynamic Settings dialog box and various methods for the key-in.

- *Lab 8.3 -Build an End Condition Component* explored the special features of an end condition component. For end condition components there are additional options in the Dynamic Settings dialog box which determine how end condition points in relation to a target.
- In *Lab 8.4 -How Point Constraints Work* several constraint options were explored including Horizontal, Vertical and Vector-Offset. This lab demonstrated how changing the constraint method affects the points position and how points react to the Parent it is constrained to.

LAB 9 - Building Sections

This lab demonstrates how to create the sub-assemblies known as sections and illustrates the use of parent components and display rules.

Chapter Objectives:

- Build a section with existing components using the drag and drop method
- Build an end condition section and reset the priorities so that it functions properly
- Build a section from new and existing components
- Set up the parent/child relationship between components and demonstrate how it works
- Create display rules, apply them to components, and demonstrate their functionality

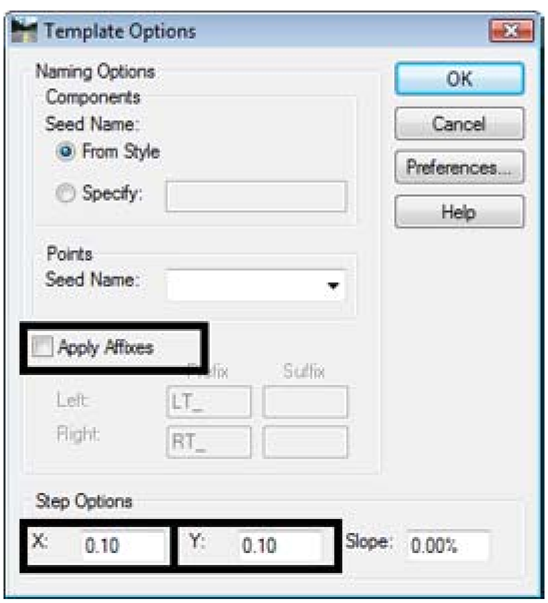
Before beginning this lab, verify that the following files are loaded:

- C:\Projects\12345\Design\Drawings\Reference_Files\12345DES_Model.dgn
- C:\Workspace\Workspace-CDOT_V8i\Standards-Global\InRoads\Preferences\CDOT_Civil.xin
- C:\Projects\12345\12345\Design\InRoads\DES12345_Templates.itl (This file was modified in Lab 1)

Lab 9.1 - Build a Lane Section

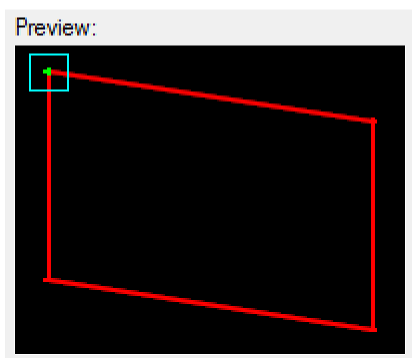
This example demonstrates how to assemble basic components into sections using the drag and drop method. This lab builds on the concepts and used data from ***Lab 1 - Building Components***. Open the ***Create Template*** dialog box.

1. Select **Tools > Options** from the ***Create Template*** menu bar.
2. Make sure that ***Apply Affixes*** is toggled off and the ***X*** and ***Y Step Options*** are set to ***0.10***.

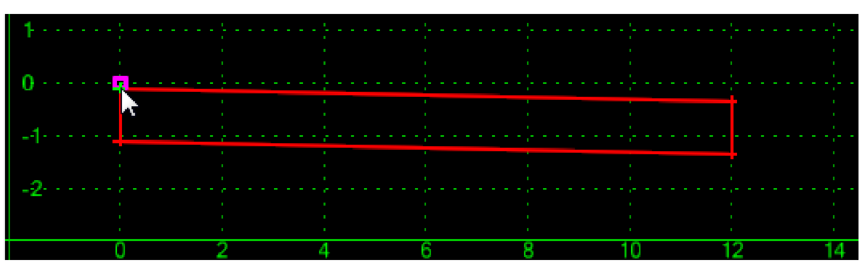


3. **<D> <D>** on the root folder in the Template Library pane to expand the folder structure.
4. Expand the ***2 – Sections – Pavement*** folder.
5. Create a new folder under ***2 – Sections – Pavement*** called ***12345 Sections***.

6. Create a new template in the ***12345 Sections*** folder. Name it ***Conc_Driving_Lane***.
7. Expand the ***4 – Components*** folder. Also expand the ***12345 Components*** folder created in Lab 1.
8. **<D>** on the ***Conc_Lane_12"x12'*** component. The component is displayed in the Preview window.
9. **<D> and hold** on the component's origin (the green dot).

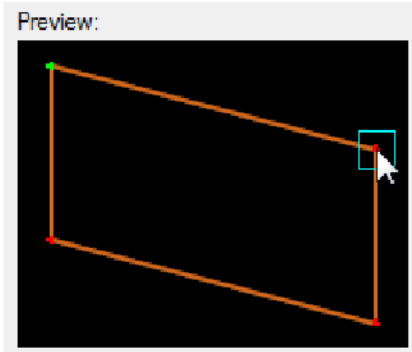


10. **Drag** the component into the template view and **drop** (release the data button) it on the new section's origin.

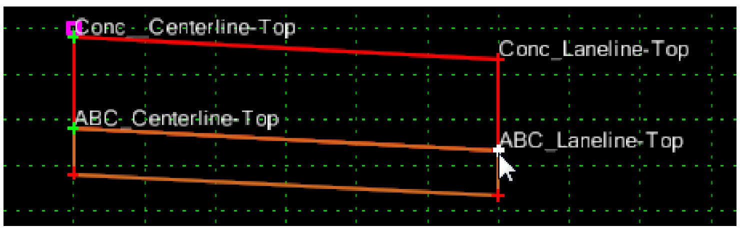


11. Expand the ***4 – Components >Aggregate Bases > Driving Lanes*** folder.
12. **<D>** on the ***ABC_Lane*** component.

13. **<D> and hold** on the upper right point of the component in the preview window.



14. **Drag** the component into the Template View and move the pointer on to the lower right corner of the concrete component and **Drop**. The "+" on the concrete component turns white when to pointer is on it.



Note: Steps 14 and 15 were done to show that components do not have to be placed by the origin.

This completes the Conc_Driving_Lane section. This section is now ready to use to create a complete template. This lab illustrates how to build a "backbone" section from existing components. It also shows that components do not have to be placed by their origin, they can be placed using any point on the component.

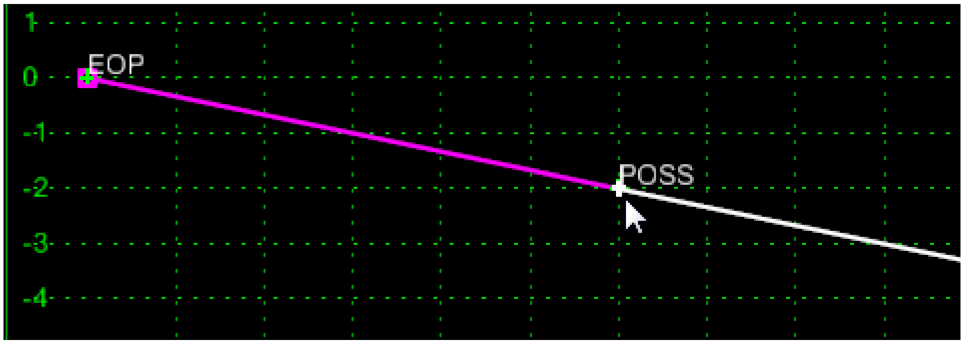
Lab 9.2 - Build an End Condition Section

This example demonstrates the construction of an end condition. End conditions are more complicated than a simple component and require additional editing to make complete. The drag and drop method will be used to create a new end condition section and the end condition priorities will be modified so that the section operates properly.

1. Create a new template in the ***12345 Sections*** folder named ***12345_End-Condition***.
2. Expand the ***4 – Components >End Condition > Z-Slope > High Speed*** folder.
3. **<D>** on the ***Z-Slope_12_6_to_1*** component.
4. **<D> and hold** the component's origin in the preview window.

5. **Drag and Drop** the component on the origin in the Template View.

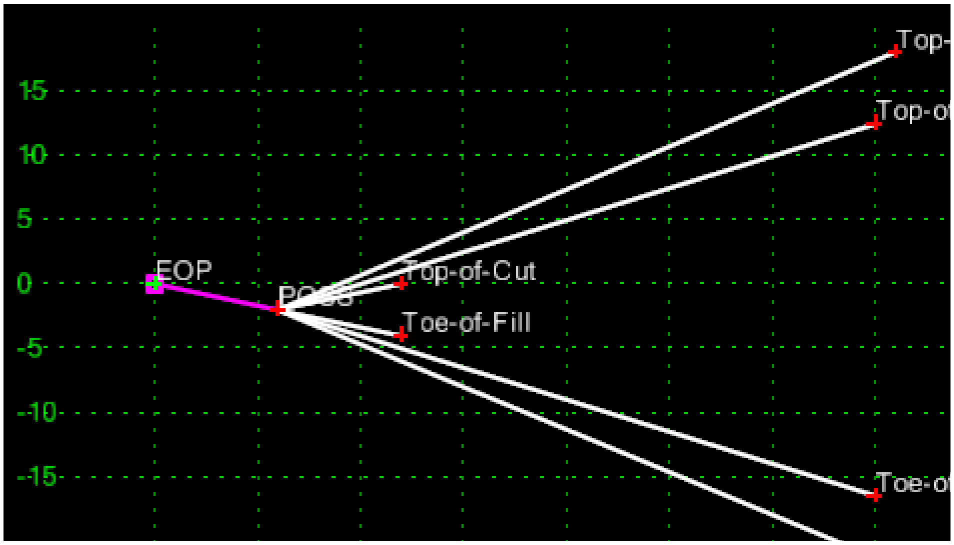
6. Expand the ***4 – Components >End Condition > Fill Slope Components*** folder.
7. **<D>** on the ***Fill_6_to_1*** component.
8. **Drag and Drop** the component on to the ***POSS*** point.



9. Repeat steps 8 and 9 using ***Fill_4_to_1*** and ***Fill_3_to_1.***

10. Expand the ***4 – Components >End Condition > Cut Slope Components*** folder.

11. **Drag and Drop** the ***Cut_6_to_1, Cut_4_to_1*** and ***Cut_3_to_1*** components on to the ***POSS*** point.

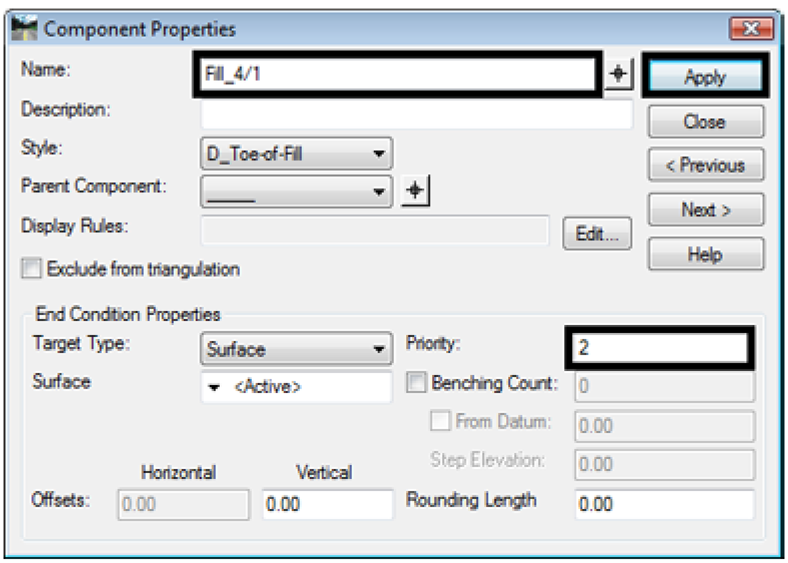


12. **<D> <D>** on the ***Fill 6/1*** component.

13. Verify that the ***Priority*** is set to ***1.***

14. **<D> Next.** This shows the properties for the **Fill_4/1** component.

15. Set the ***Priority*** is set to ***2.*** **<D> Apply.**



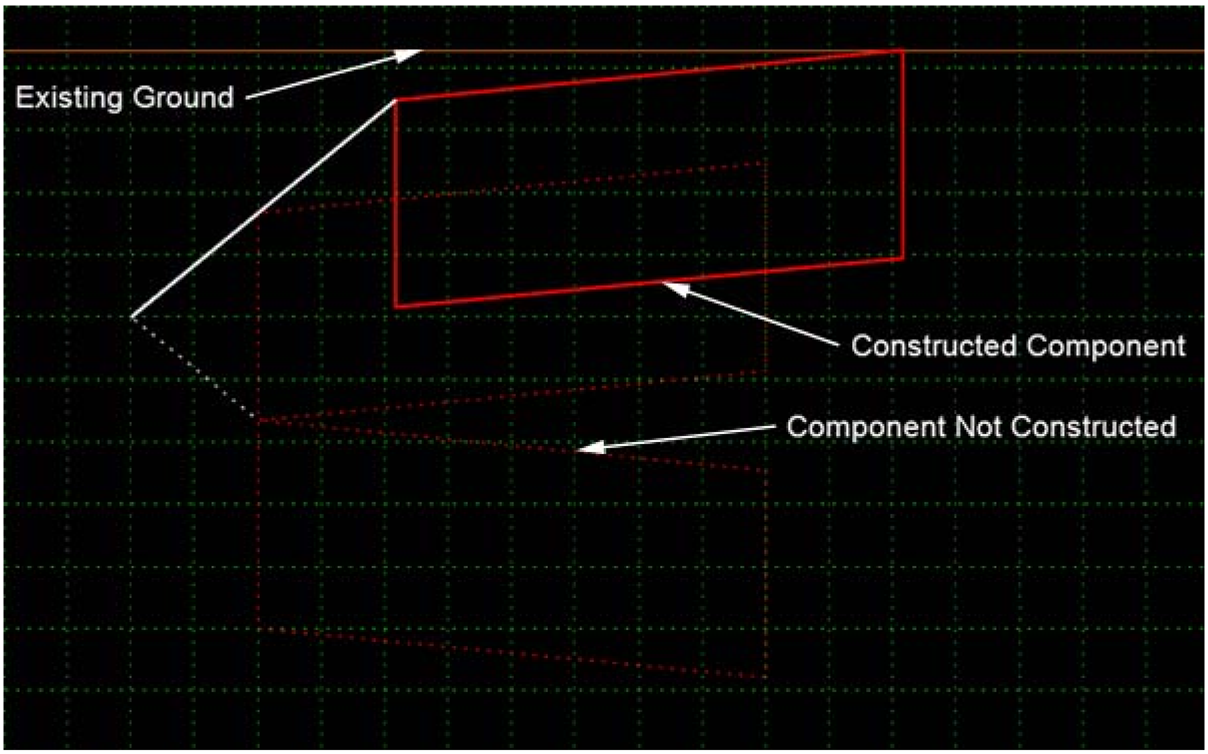
16. Set the remaining priorities as follows

- **Fill_3/1** = ***3***
- **Cut_6/1** = ***4***
- **Cut_4/1** = ***5***
- **Cut_3/1** = ***6***

17. Close the Component Properties dialog box
18. **<D>** the **Test** button.
19. In the ***Test End Conditions*** dialog box, **<D> Draw** and notice how the end condition behaves.
20. **<D> Close**.

Lab 9.3 - Using Parent Components

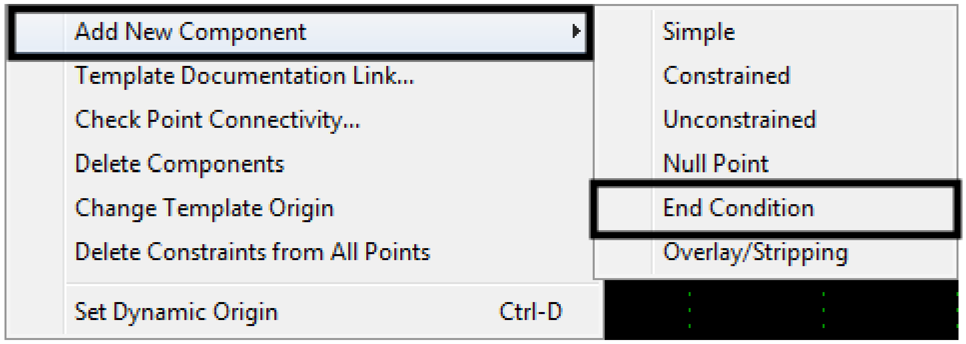
This example places a sidewalk at the end of a cut or fill slope. It illustrates how the parent/child relationship between components can be used. The sidewalk position end conditions are parents to the sidewalk components. This “turns off” the sidewalk when its parent end condition does not intercept the target surface.



1. Create a new template in the ***12345 Sections*** folder named ***Parent Component Example***.

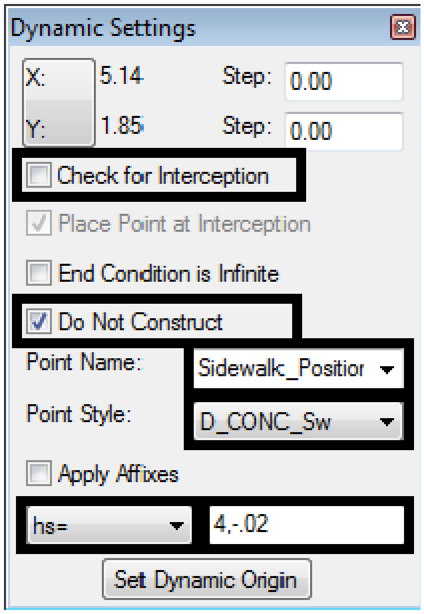
The end condition component is used to locate the position of the sidewalk. It contains two segments. The first segment matches the sidewalk’s width and slope. The second segment intercepts the target surface where the actual sidewalk goes. The Do Not Construct point property is used so that the points will be located but the end condition component will not be added to the finished template.

2. **<R>** in the Template View and select **Add New Component > End Condition**.

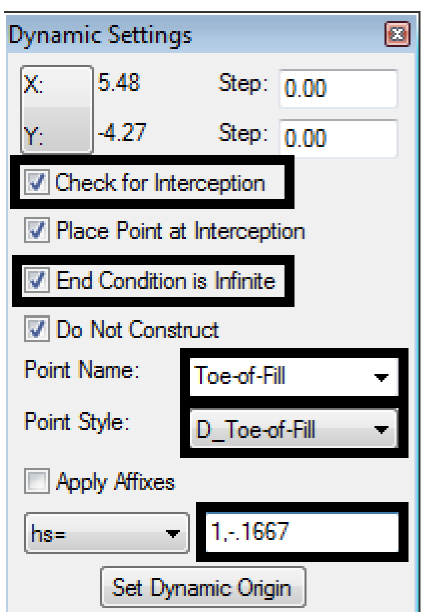


3. Key in ***Fill*** for the component ***Name***.
4. Select ***D_Toe-of-Fill*** for the ***Style***.
5. Key in ***1*** for the ***Priority***.
6. In the ***Dynamic Settings*** dialog box, set the ***Point Name*** to **POSS**.
7. Place the point on the template origin.
8. In the ***Dynamic Settings*** dialog box, toggle off ***Check for Interception***.
9. Verify ***End Condition is Infinite*** is toggled off.
10. Toggle on ***Do Not Construct***.
11. Key in ***Sidewalk_Position*** for the ***Point Name***.
12. Select **D_CONC_Sw** for the ***Point Style***.
13. Set the key in mode to **hs=**.
14. Key in ***4,-.02*** and press ***Enter***.

Note: Because the ***Do Not Construct*** was toggled on, a line from POSS to Sidewalk Position is not created.



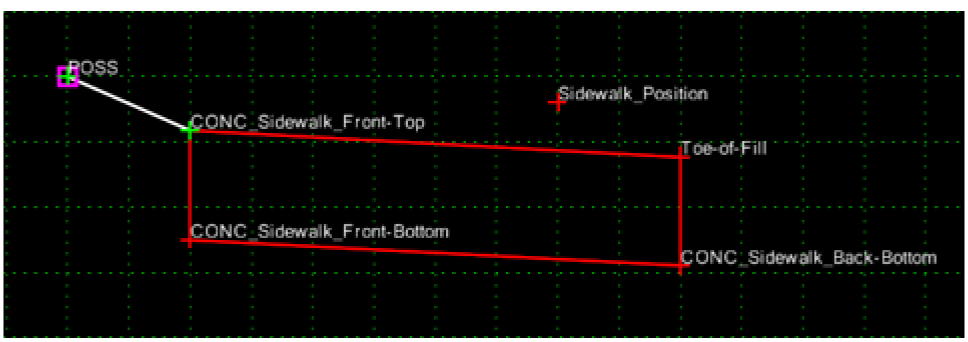
15. In the ***Dynamic Settings*** dialog box, toggle on ***Check for Interception***.
16. Toggle on ***End Condition is Infinite***.
17. Set the ***Point Name*** to **Toe-of-Fill**.
18. Key in ***1,-.1667*** and press ***Enter***.



19. **<R>** in the template view and select **Finish**.

The Sidewalk and fill slope components that will be used as part of the template are built from the toe located by the end condition back to the POSS.

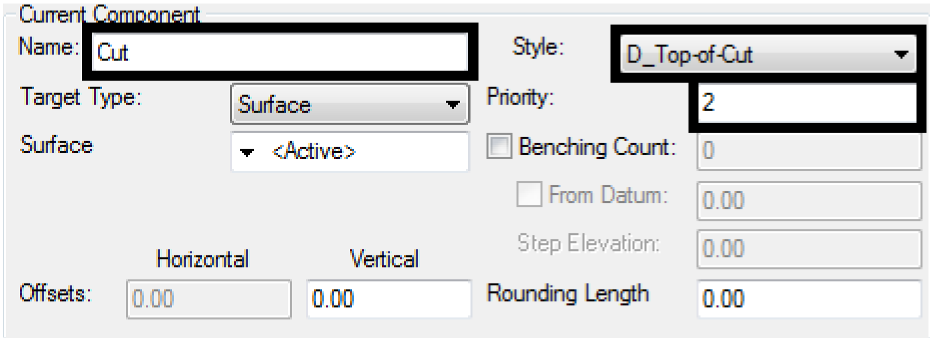
20. Expand the ***4 – Components >Sidewalks & Bike Paths > Sidewalks*** folder.
21. **<D>** on the ***4"_CONC_Sidewalk*** component.
22. **<D> and hold** on the upper right point in the Preview.
23. **Drag and Drop** the component on the ***Toe-of-Fill*** point.
24. **<D> <D>** on the ***CONC_Sidewalk_Front-Top*** point.
25. Set Constraint 1 ***Type***: to **Horizontal,** the ***Parent 1***: field to **Toe-of-Fill,** and key in ***-4.00*** for the ***Value***.
26. Set Constraint 2 ***Type***: to **Slope** constraint, the ***Parent 1:*** field to **Toe-of-Fill,** and key in ***-2.00 %*** for the ***Value.***
27. **<D> Apply** and **Close**.
28. **<R>** in the template view and select **Add New Component > Unconstrained.**
29. Key in ***Fill_6_to_1*** for the component ***Name.***
30. Select **D_Toe-of-Fill** for the ***Style***.
31. Place the first point on the ***POSS*** (also the template origin).
32. Place the second point on the ***CONC_Sidewalk_Front-Top*** point.
33. **<R>** and select **Finish**. The illustration below shows the template completed to this point.



The cut components work the same as the fill components built above.

34. **<R>** in the template view and select **Add New Component > End Condition.**
35. Key in ***Cut*** for the component ***Name***.
36. Set the ***Style*** to **D_Top-of-Cut**.

37. Key in ***2*** for the ***Priority***.



38. In the ***Dynamic Settings*** dialog box, set the ***Point Name*** to **POSS**.

39. Place the point on the ***POSS***.

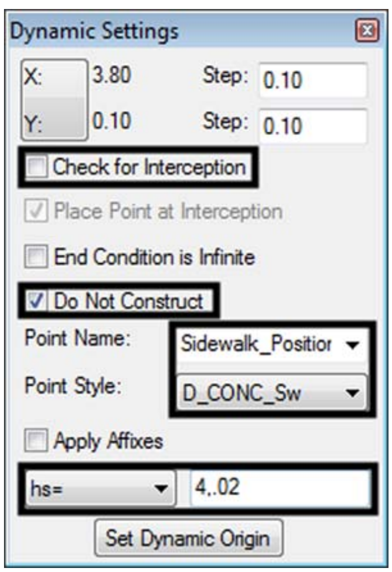
40. In the ***Dynamic Settings*** dialog box, toggle off ***Check for Interception***.

41. Toggle on ***Do Not Construct***.

42. Key in ***Sidewalk_Position1*** for the ***Point Name***.

43. Select **D_CONC_Sw** for the ***Point Style***.

44. Key in ***4,.02*** and press ***Enter***.

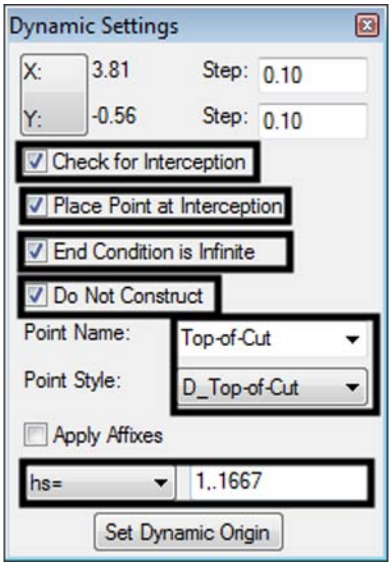


45. In the ***Dynamic Settings*** dialog box, toggle on ***Check for Interception***.

46. Toggle on ***End Condition is Infinite***.

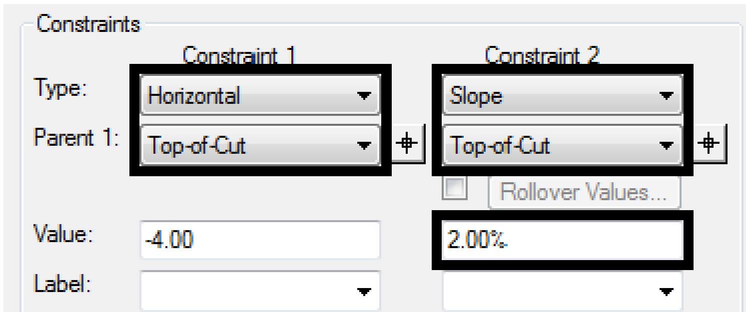
47. Set the ***Point Name*** to **Top-of-Cut**.

48. Key in ***1,.1667*** and press ***Enter***.

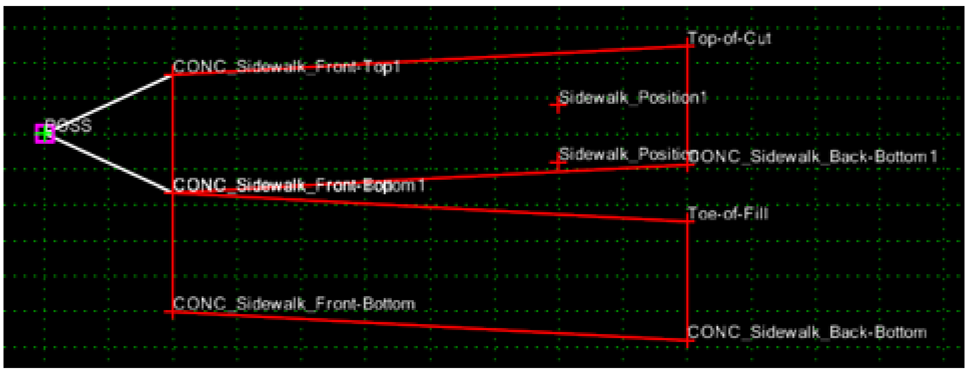


49. **<R>** and select **Finish**.
50. **<D>** on the ***4"_CONC_Sidewalk*** component.
51. **<D> and hold** on the upper right point in the Preview.
52. **Drag and Drop** the component on the ***Top-of-Cut*** point**.**
53. **<R>** and select **Finish**.
54. **<D> <D>** on the **CONC_Sidewalk_Front-Top1** point.
55. Set ***Constraint 1*** to **Horizontal** and make the ***Parent 1*** **Top-of-Cut**.
56. Set ***Constraint 2*** to **Slope** and make the ***Parent 1*** **Top-of-Cut**.
57. Key in ***2.00%*** for the slope ***Value***.
58. **<D> Apply**.
59. **<D> Close**.
60. **<R>** in the template view and select **Add New Component > Constrained.**
61. Key in ***Cut_6_to_1*** for the component ***Name.***
62. Select **D_Top-of-Cut** for the ***Style***.
63. Place the first point on the ***POSS*** (also the template origin).

64. Place the second point on the ***CONC_Sidewalk_Front-Top1*** point.



65. **<R>** and select **Finish**. The completed template is shown below.



66. **<D>** the **Test** button.

In the ***Test End Conditions*** dialog box, **<D> Draw** and notice how the template behaves. Notice that both sidewalks remain visible and a third is added as the ground line is moved. This is because there is no relationship between the hidden end conditions and the sidewalk components.

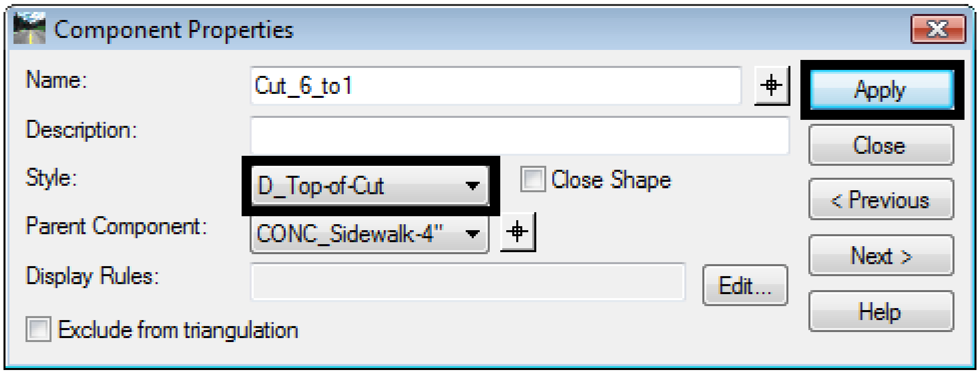
67. **<D> Close**.

The steps below set up the parent/child relationships that will turn off the components for the end condition that is not used.

68. **<D> <D>** on the **Cut_6_to_1** Component.

69. Set the ***Parent Component*** to **CONC_Sidewalk-4".**

70. **<D> Apply**.



71. **<D>** the **Next** button until ***Fill_6_to_1*** is listed.
72. Set the ***Parent Component*** to **CONC_Sidewalk-4".**
73. **<D> Apply**.
74. **<D>** the **Next** button until **CONC_Sidewalk-4"** is listed.
75. Set the ***Parent Component*** to **Fill.**
76. **<D> Apply.**
77. **<D>** the **Next** button until **CONC_Sidewalk-4"1** is listed.
78. Set the ***Parent Component*** to **Cut.**
79. **<D> Apply**.
80. **<D>** the **Test** button.
81. In the ***Test End Conditions*** dialog box, **<D> Draw** and notice how the end condition behaves; only the components that are children of the end condition solution are displayed.

Lab 9.4 - Using Display Rules

Display rules turn on or off the display of components based on user defined criteria. In this example, display rules are used to exchange the normal end condition for a guardrail end condition.

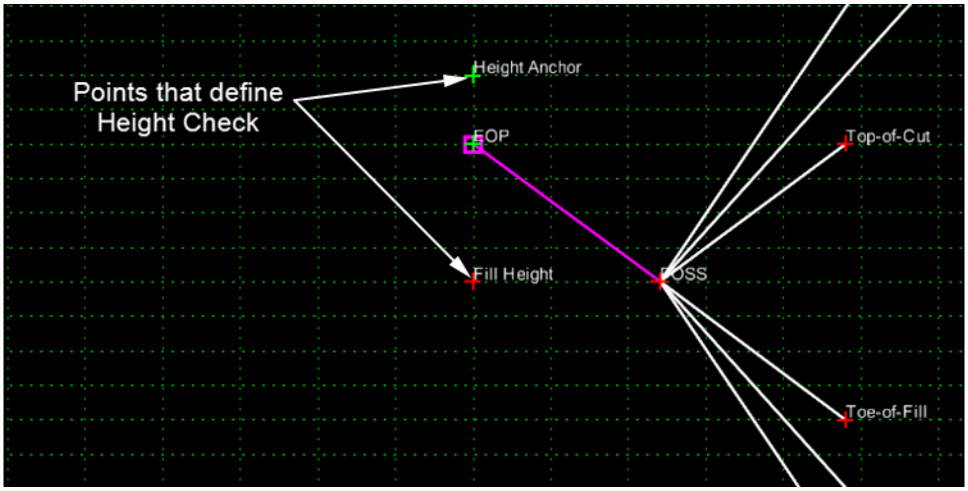
The typical section created in this lab contains two separate end conditions, the standard Z12_6_to_1 section and an end condition used with guardrail. Both end conditions could apply at any given template drop. To determine which end condition will be used, the ***Height Check*** component is added to the template. This component determines the fill height from the edge of pavement to the existing ground. If the fill height exceeds the maximum value the guardrail end condition is used.

The standard end condition section is added to the template.

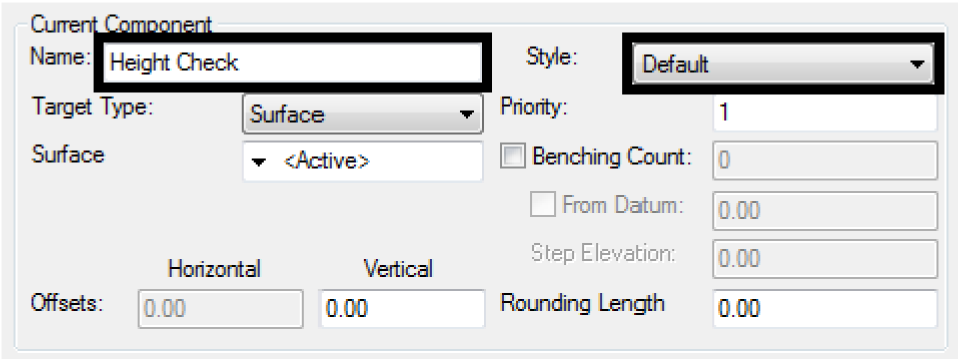
1. Create a new template in the ***12345 Sections*** folder. named ***Display Rules Example***.
2. Expand the ***3 – Sections - End Sections > Z-Slope End Conditions > High Speed End Conditions*** folder.

3. **<D>** on the ***Z12_6_to_1*** Section.
4. **<D> and Hold** the section's origin in the ***Preview*** window.
5. **Drag and Drop** the section on the new template's origin.

Height Check is an end condition component. It runs vertically through the template origin (which will also contain the EOP point) to intercept the existing ground. The distance between the Fill Height point and the EOP is used to determine if the guardrail is used.

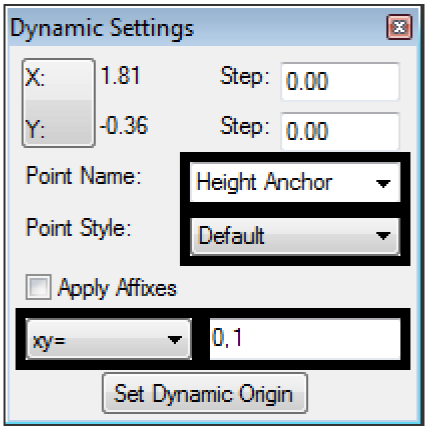


6. **<R>** in the Template View and select **Add New Component > End Condition**.
7. Key in ***Height Check*** for the ***Name***.
8. Select **Default** for the ***Style***.



9. In the ***Dynamic Settings*** dialog box, key in ***Height Anchor*** for the ***Point Name***.
10. Select **Default** for the ***Point Style***.
11. Set the key in mode to **XY=**.

12. Key in ***0,1*** and press ***Enter***.

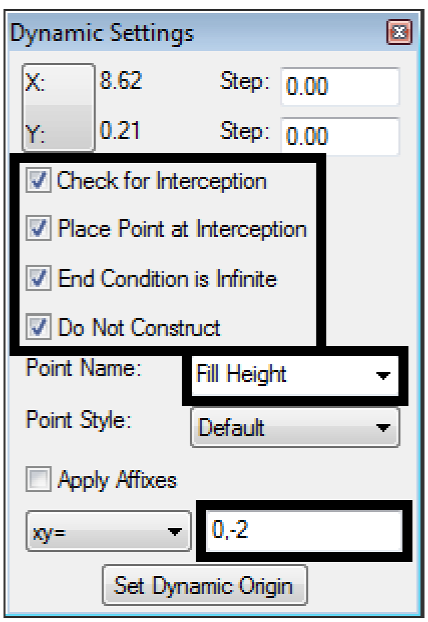


This point sets the Height Check end condition over the EOP so that the fill height can be checked vertically at this point.

13. Key in ***Fill Height*** for the ***Point Name***.

14. Toggle on **Check for Interception**, **Place Point at Interception**, **End Condition is Infinite**, and **Do Not Construct**.

15. Key in ***0,-2*** and press ***Enter***.



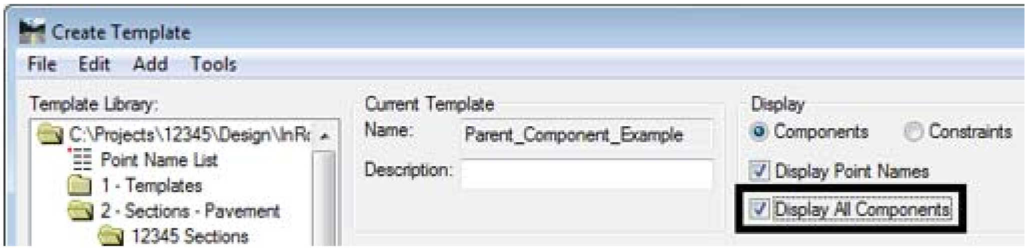
This sets the starting location for the Fill Height point. This point intercepts the existing ground directly under the EOP to determine the fill height. The 2 foot distance below the template origin is an arbitrary value, so long as the Fill Height point is placed below the Height Anchor point the template will work properly.

16. **<R>** and select **Finish**.

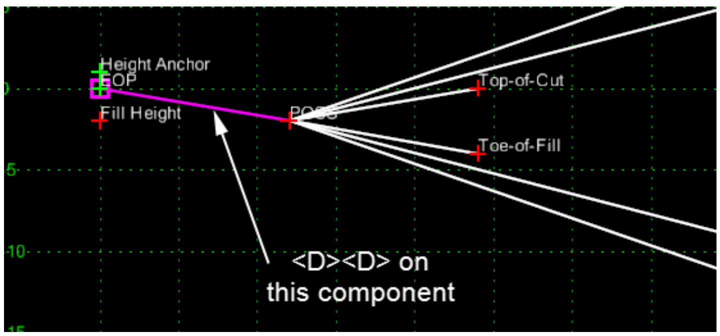
17. Select **File > Save**. (This is an intermediate save to prevent loss of information.)

The Z-Slope_12_6_to_1 component will be set to a child of the Height Check so that its display can be turned on and off based on the fill height.

18. Toggle on ***Display All Components***.



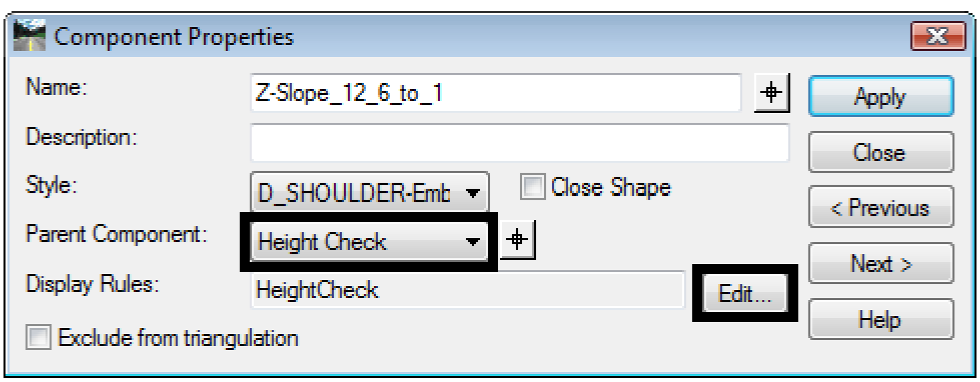
19. **<D> <D>** on the **Z-Slope_12_6_to_1** component.



20. In the ***Component Properties*** dialog box, set the ***Parent Component*** to **Height Check.**

The Display Rule sets the criteria for the component to be displayed.

21. **<D> Edit** to display the ***Component Display Conditional Expression*** dialog box.

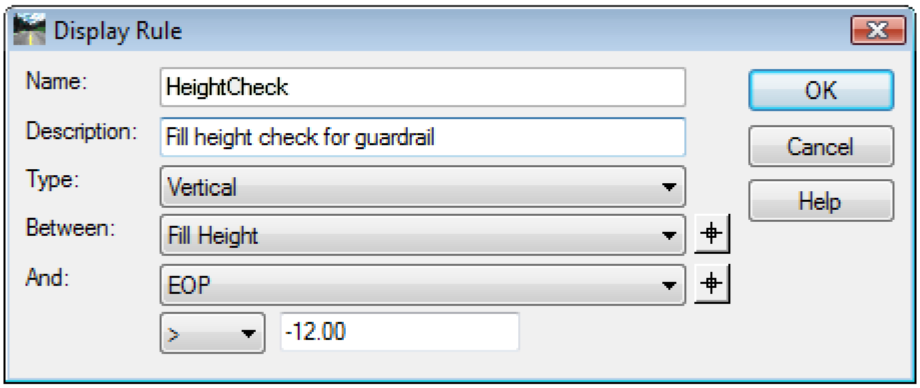


22. In the ***Component Display Conditional Expression*** dialog box, **<D> Add**. The ***Display Rule*** dialog box is displayed.

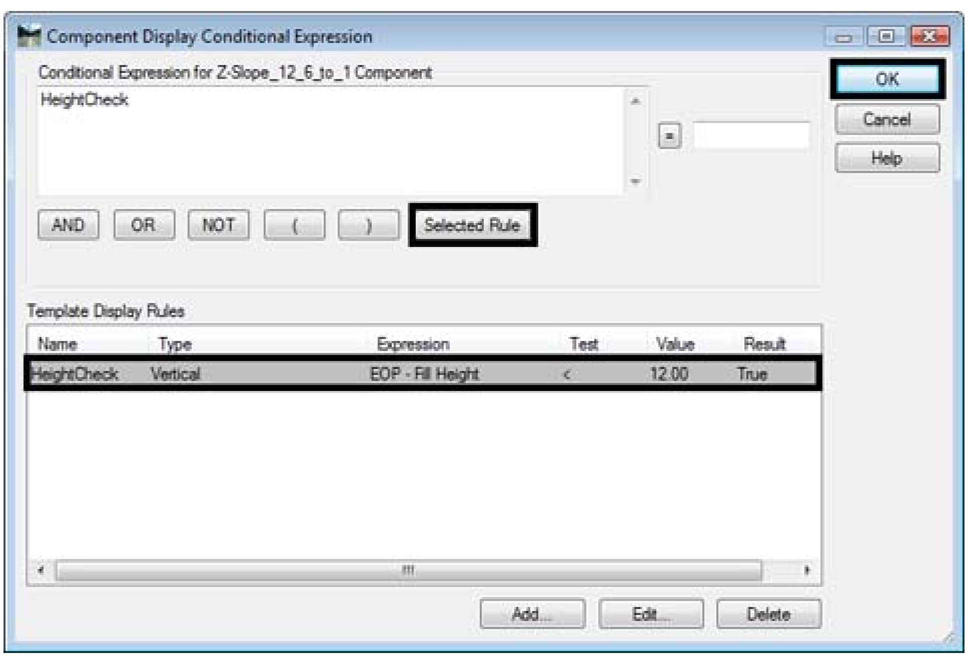
The Display Rule determines when the Z-Slope_12_6_to_1 component is displayed. It is set so that when the fill height at the edge of pavement is more than 12 feet, the normal end condition is turned off.

23. In the ***Display Rule*** dialog box, key in ***Height Check*** for the ***Name***.

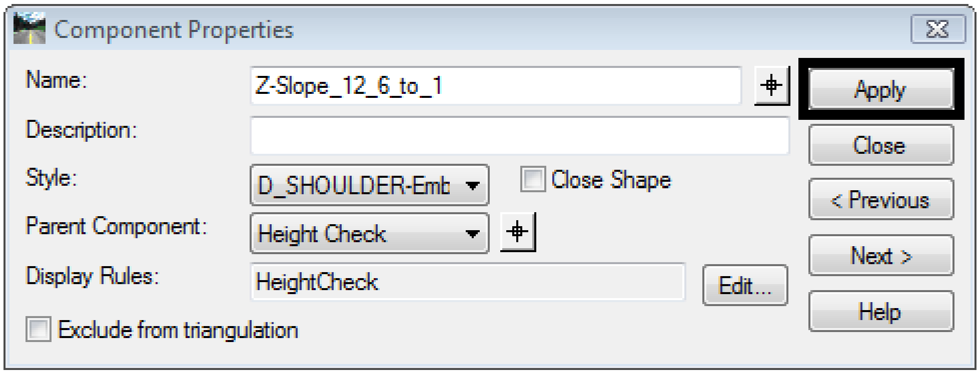
24. Key in ***Fill height check for guardrail*** in the ***Description*** field.
25. Set the ***Type*** to **Vertical**.
26. Set ***Between*** to **Fill Height**.
27. Set ***And*** to **EOP**.
28. Set the expression to **>.**
29. Key in **-12** in the value field.
30. **<D> OK**.



31. Back in the ***Component Display Conditional Expression*** dialog box, highlight the **Height Check** entry in the ***Template Display Rules*** area.
32. **<D>** the **Selected Rule** button.
33. **<D> OK**.



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



35. **<D> Close**.

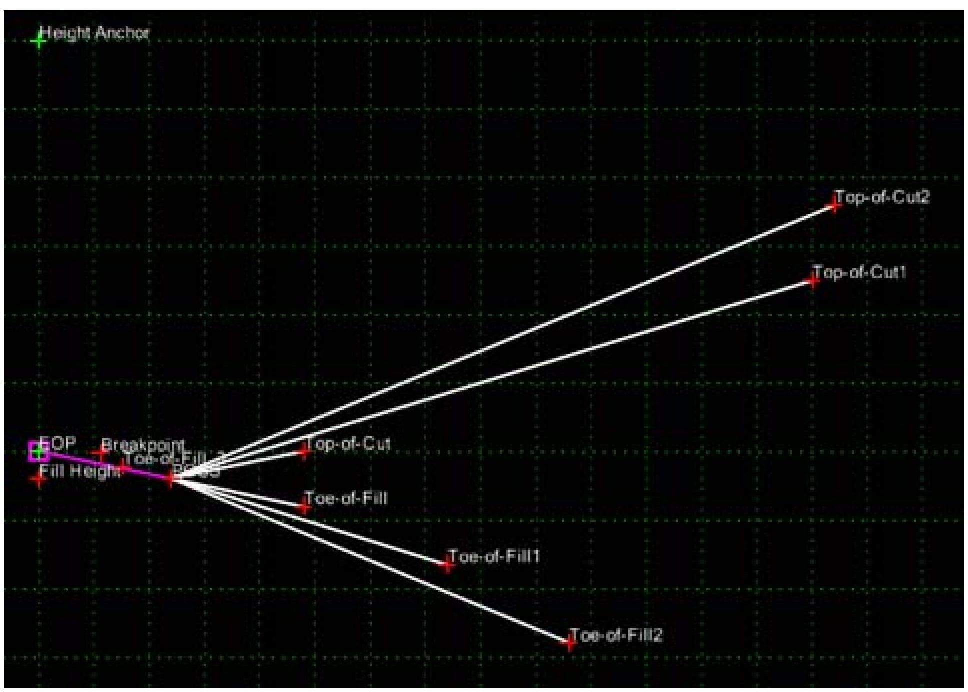
As defined in the Z12_6_to_1 Section, the 3 to 1 fill slope will never be used. This is because the guardrail component is activated before the 4 to 1 option reaches its maximum distance. By changing the value on the horizontal constraint to 32 on the 4 to 1 slope, it will reach its maximum length before the guardrail end condition is used.

36. **<D> <D> on the Toe-of-Fill1 point**.

37. Change the ***Value*** of the ***Horizontal Constraint*** to **32.**

38. **<D> Apply**.

39. **<D> Close**. The template looks like the illustration below.



40. **<D> Test**.

41. **<D> Draw**. Notice that once the ground line drops 12 feet below the EOP, the **Z-Slope_12_6_to_1** component disappears.

42. **<D> Close** to return to the ***Create Template*** dialog box.

Now we will add the Normal_Paved_Installation-6ft-Shoulder component to the template. This component uses the Height Check display rule along with the NOT operator to display the guardrail components only when the standard end condition is not used.

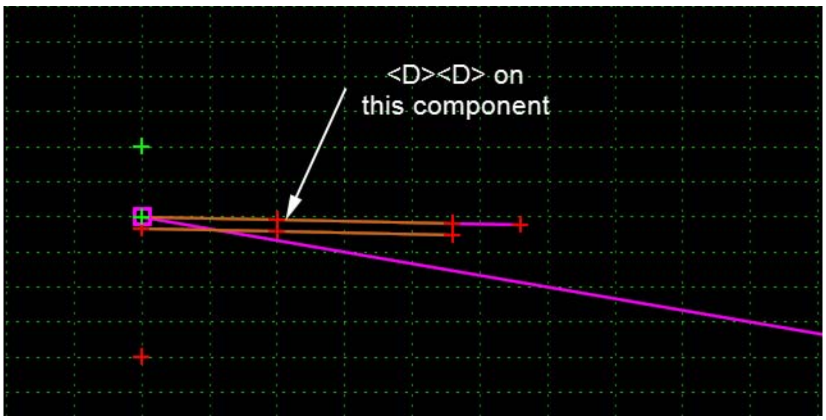
43. Expand the ***4 – Components > Barriers & Misc Components > Guardrail Widening*** folder.

44. **<D>** on **Normal_Paved_Installation-6ft-Shoulder** in the library tree view.

45. **<D> and Hold** on the component's origin (the upper left point) in the ***Preview*** window.

46. **Drag and Drop** the section on the ***EOP*** point in the template view.

47. **<D> <D>** on the **HMA_GRAIL-Widening_Normal_6ft-Shoulder** component.



48. **<D>** the **Edit** button for the ***Display Rules***.

49. In the ***Component Display Conditional Expression*** dialog box, **<D>** the **NOT** button.

50. Highlight **Height Check** in the ***Template Display Rules*** area, then **<D>** the **Selected Rule** button.

51. **<D> OK**.

52. In the ***Component Properties*** dialog box, **<D> Apply** and **Close**.

    Because the display rules don't work well with end conditions, this component is used to locate the toe of the fill slope from the end of the guardrail section.

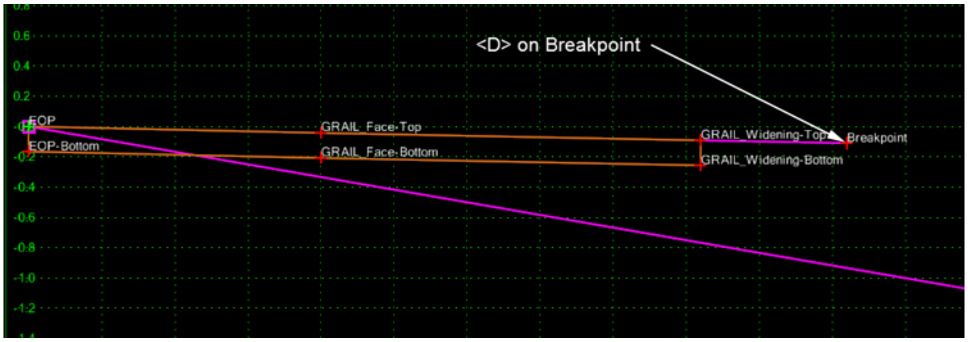
53. Zoom in around the guardrail widening component placed above.

54. **<R>** in the Template View and select **Add New Component > End Condition**.

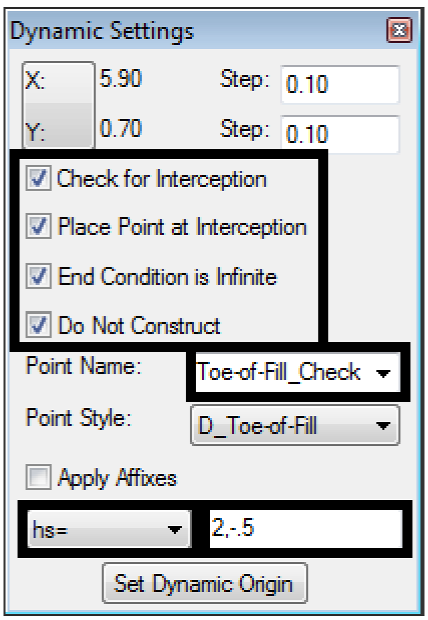
55. Key in ***Fill_2_to_1*** for the ***Name***.

56. Select **Default** for the ***Style***.

57. **<D>** on the **Breakpoint** point.



58. In the ***Dynamic Settings*** dialog box, Key in ***Toe-of-Fill_3*** for the ***Point Name***.
59. Toggle on **Check for Interception**, **Place Point at Interception**, **End Condition is Infinite**, and **Do Not Construct**.
60. Set the key in mode to **hs=**
61. Key in ***2,-.5*** and press ***Enter***.



62. **<R>** and select **Finish**.

The final component actually constructs the fill slope in the template. It will be made a child of the guardrail widening component so that it displays only when the guardrail widening component is displayed.

63. **<R>** in the Template View and select **Add New Component > Constrained**
64. Key in ***Fill_2_to_1*** for the ***Name.***
65. Set the ***Style*** to **D_Toe-of-Fill.**

66. **<D>** on the **Breakpoint** point.
67. **<D>** on the ***Toe-of-Fill_3*** point.
68. **<R>** and select **Finish.**
69. **<D> <D>** on the **Fill_2_to_1** component.
70. Set the ***Parent Component*** to **HMA_GRAIL-Widening_Normal_6ft-Shoulder.**
71. **<D> Apply**.
72. **<D> Close.**
73. **<D> Test**.
74. **<D> Draw**. Notice that when the **Z-Slope_12_6_to_1** component disappears the guardrail component and its children are shown.

Chapter Summary:

- All four exercises used the drag and drop method to add components to a section.
- In *Lab 9.2 -Build an End Condition Section*, the special properties of end condition components were illustrated. Setting the end condition priority determines the processing order of end condition components.
- *Lab 9.3 -Using Parent Components* and *Lab 9.4 -Using Display Rules* built sections from new and existing components. A variety of methods can be used to put data into a template.
- *Lab 9.3 -Using Parent Components* and *Lab 9.4 -Using Display Rules* used the parent/child relationship between components to display the proper solution. This groups components so that if the parent is displayed then the children are also displayed.
- In *Lab 9.4 -Using Display Rules* display rules were created to turn on and off components that are not part of the solution. Display Rules set criteria used to determine if a component will be displayed.

LAB 10 - Modifying Templates

This lab demonstrates how to modify existing templates by changing point constraints, deleting existing components and adding new ones.

Chapter Objectives:

- Modify pavement lift thickness.
- Add a sub-base component to the template.
- Add an additional lane to one side of a template.
- Add a median barrier to a divided highway template.

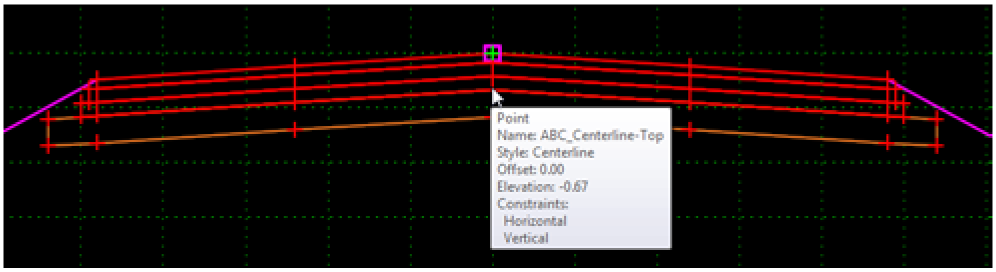
Before beginning this lab, verify that the following files are loaded:

- C:\Projects\12345\Design\Drawings\Reference_Files\12345DES_Model.dgn
- C:\Workspace\Workspace-CDOT_V8i\Standards-Global\InRoads\Preferences\CDOT_Civil.xin
- C:\Projects\12345\Design\InRoads\DES12345_Templates.itl (This file was modified in Lab 1)

Lab 10.1 - Modify pavement lift thickness

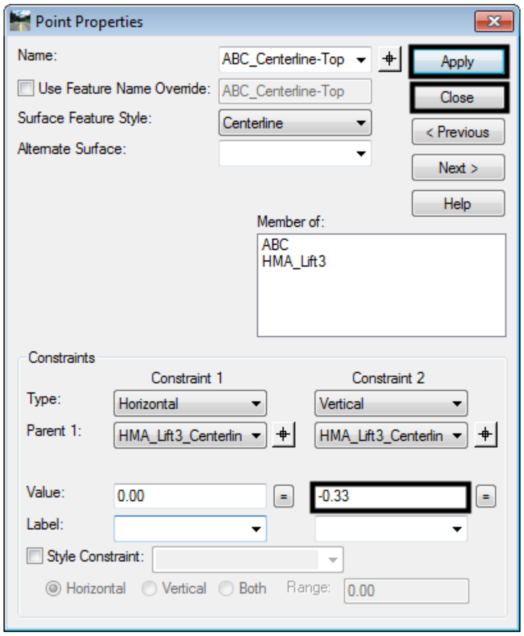
This exercise demonstrates how to modify point constraints in order to change the lift thickness on an existing template. The HMA_Crowned_B10 template from the template library will be modified so that the bottom lift of asphalt will be 4 inches thick.

1. Open the ***Create Template*** dialog box.
2. **<D> <D>** on the root folder and expand the ***1– Templates*** folder.
3. **<D> <D>** on the **HMA_Crowned_B10** template.
4. **<D> <D>** on the **ABC_Centerline-Top** point to display the Point Properties dialog box.



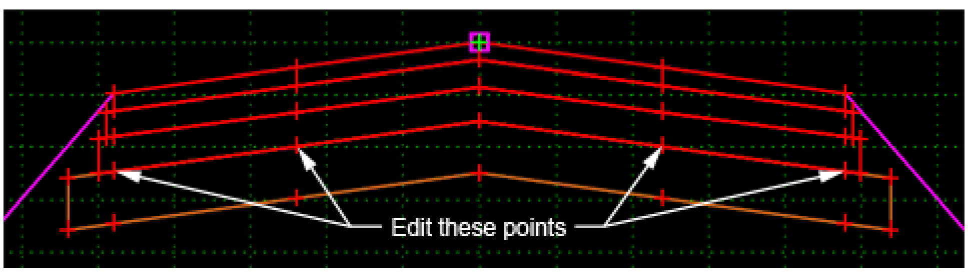
5. Key in **-0.33** for the ***Value*** of the ***Vertical*** constraint**.**
6. **<D> Apply.**

7. **<D> Close**.



8. Repeat steps 4 through 7 for the following points:

- ♦ RT_ABC_Laneline-Top
- ♦ RT_ABC_Hinge-Top
- ♦ LT_ABC_Laneline-Top
- ♦ LT_ABC_Hinge-Top



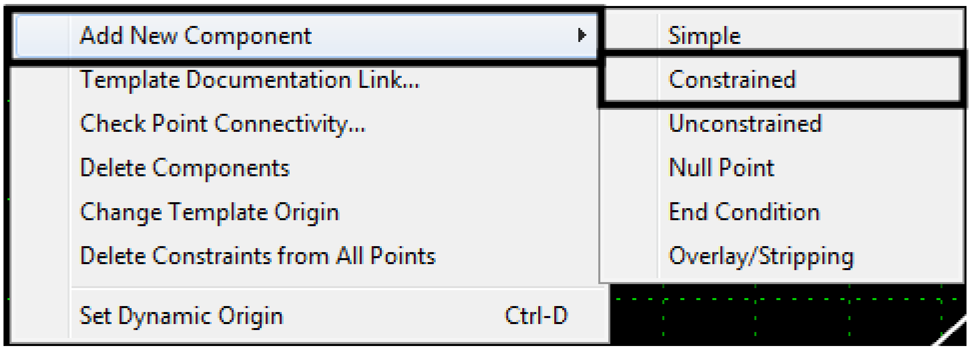
Note: The two outside points (HMA_Lift3_EOP-Bottom and ABC_EOP-Top) do not need to be modified. This is because they are built with Vector/Offset constraints which keeps them in line with the other points on that row.

Lab 10.2 - Add a sub-base component to the template

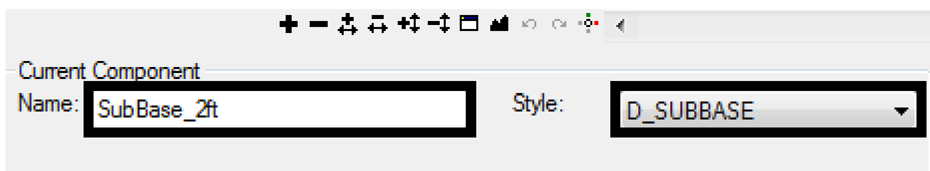
This exercise show how to add and modify a component to an existing template in order to add a sub-base component to the bottom of the HMA_Crowned_B10 template used above. The sub-base will be added as a new component instead of using one from the library in order to minimize the amount of editing.

1. **<D> <D>** on the **HMA_Crowned_B10** template (if it is not already displayed).

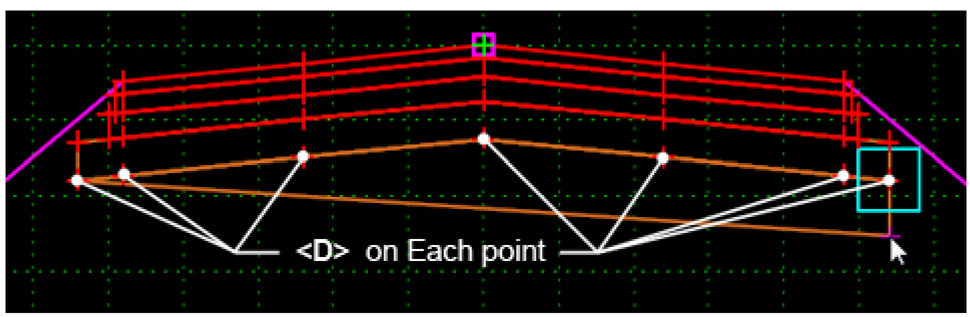
2. **<R>** in the template view and select **New Component > Constrained** from the menu.



3. Key in ***SubBase_2 ft*** in the ***Name*** field.
4. Set the ***Style*** to **D_SUBBASE**.



5. Starting at the left, **<D>** on the points across the bottom of the ABC component.
6. After placing the first point, **<R>** and verify that ***Closed Shape*** is checked on.

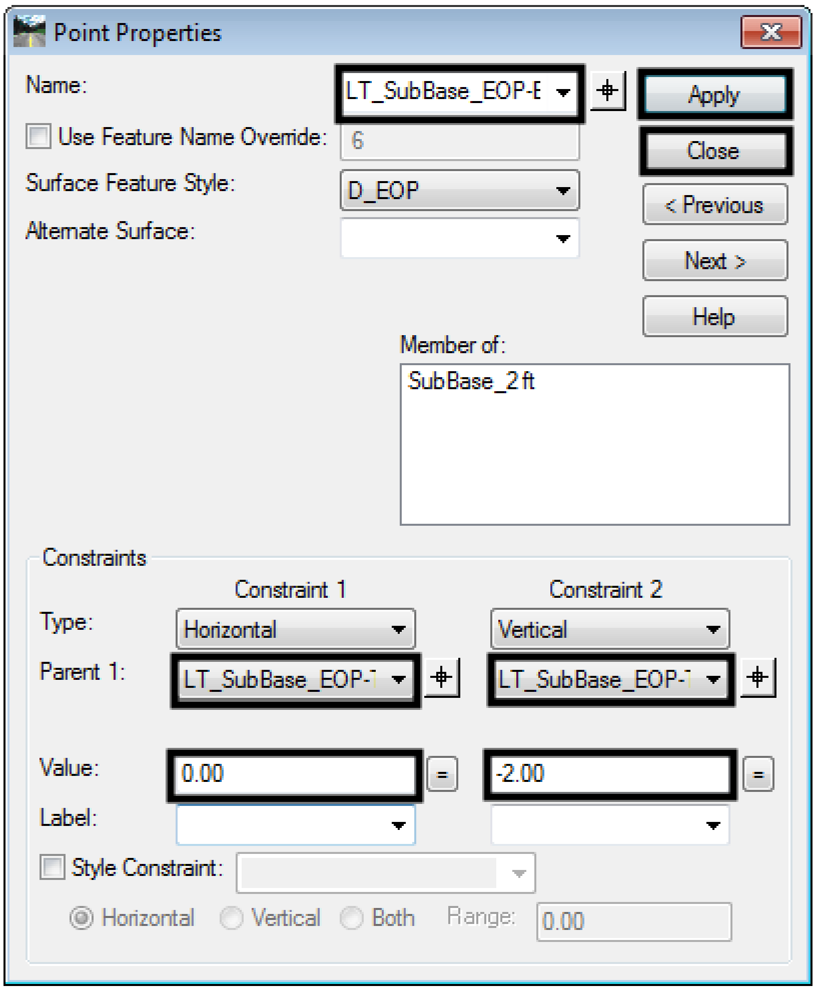


The next steps build the bottom of the subbase. The points are placed in the approximate location. There final position is set by editing the point constraints.

7. Place a point approximately below each of the points just entered, working back from right to left.
8. **<R>** in the template view and select **Finish** from the menu.
9. **<D> <D>** on the lower left corner of the new sub-base component.
10. In the ***Point Properties*** dialog box, change the ***Name*** to ***LT_SubBase_EOP-Bottom***.

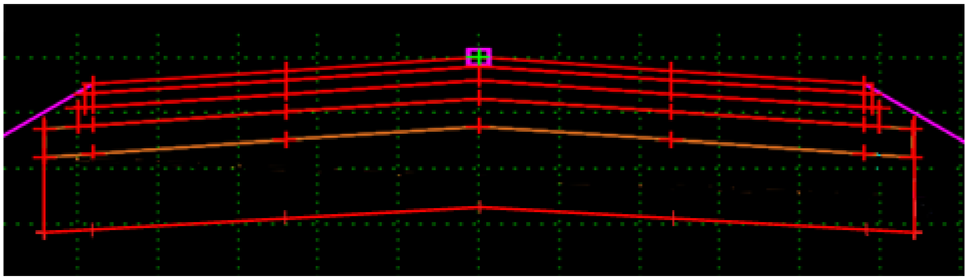
    Note: The name is the same as the point above it, except that the word Top is replaced with the word Bottom.

11. Set the ***Parent 1*** for both constraints to the point directly above (in this case **LT_SubBase_EOP-Top**).
12. Key in **0** for the ***Horizontal*** constraint value**.**
13. Key in **-2** for the ***Vertical*** constraint value.
14. **<D> Apply**.
15. **<D> Close**.



16. Repeat steps 8 through 14 for the remaining points across the bottom of the sub-base component.

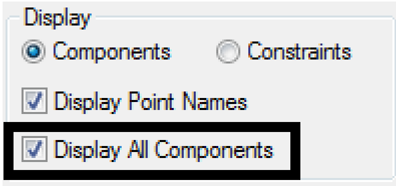
The finished template is illustrated below:



Lab 10.3 - Add an Additional Lane to One Side of a Template

This exercise demonstrates how to add new components to an existing template in order to add an addition travel lane. Using the template HMA_Urban_4Lane from the template library, the right curb, ABC, and End Conditions will be deleted and a new lane with curb and gutter will be added.

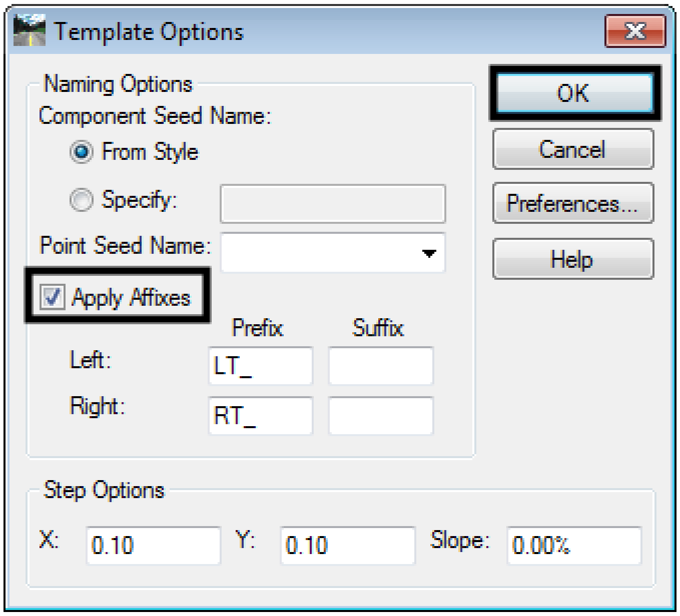
1. **<D> <D>** on the **HMA_Urban_4Lane** template.
2. Toggle on ***Display All Components***.



Affixes are used so that point names added to the template are updated to reflect their location with respect to the control line.

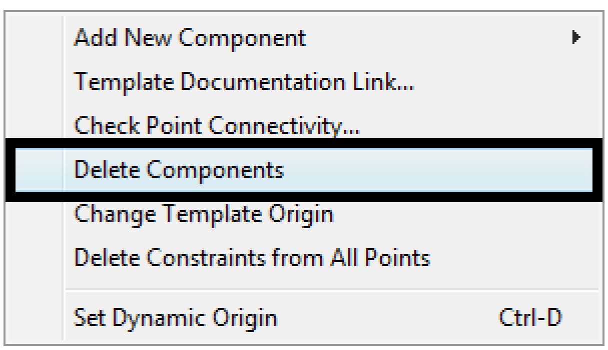
3. Select **Tools > Options** from the ***Create Template*** menu bar.
4. Toggle on **Apply Affixes**.

5. **<D> OK**.

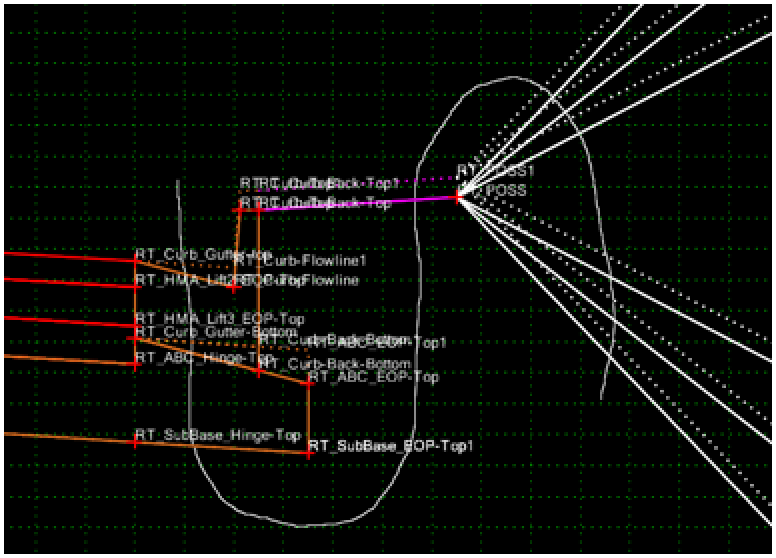


The existing curb and gutter on the right side of the template and its ABC component must be removed from the template to make room for the new lane.

6. **<R>** in the template view and select **Delete Components** from the menu.



7. **<D> and hold**, then draw a line through the curb, sub-base, and end conditions components on the right side of the template as shown below. Release the mouse button to complete the delete.



The exposed points still have names used by the curb and gutter component. These must be changed to reflect the new role of the point.

8. Rename the points at the right end of the template as follows:

    - ***RT_HMA_Lift1_Laneline-Top1***
    - ***RT_HMA_Lift2_Laneline-Top1***
    - ***RT_HMA_Lift3_Laneline-Top1***
    - ***RT_ABC_Laneline-Top1***

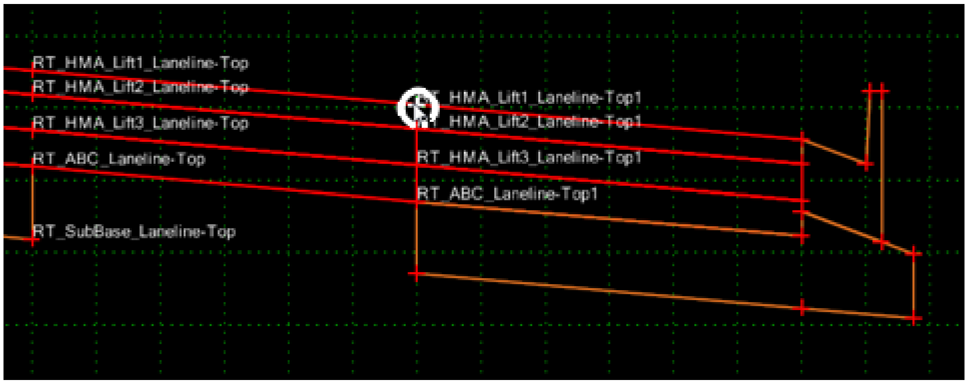
The template library contains a three lift asphalt driving lane section with curb and gutter attached. Use this section to complete the backbone of the template.

9. Expand the ***2 – Sections - Pavement > Curb & Gutter Sections*** folder in the template library explorer.

10. **<D>** on the **C/G_Type2-IIB** section.

11. **<D> and Hold** on the section's origin in the ***Preview*** window.

12. Drag and Drop the section onto the ***RT_HMA_Lift1_Laneline-Top1*** point.

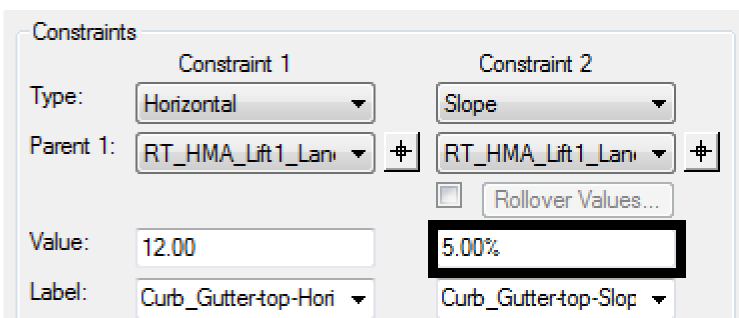


The new section that was added accommodates a design decision on when to generate a gutter with a normal slope and when to generate the gutter with a slope to match the driving lanes. This section has two curb components. Therefore, two end condition sections are required, one attached to each curb. These next steps show how to modify the criteria for the design decision.

13. Zoom in on the right curb components, there are two (one is shown with dotted lines).

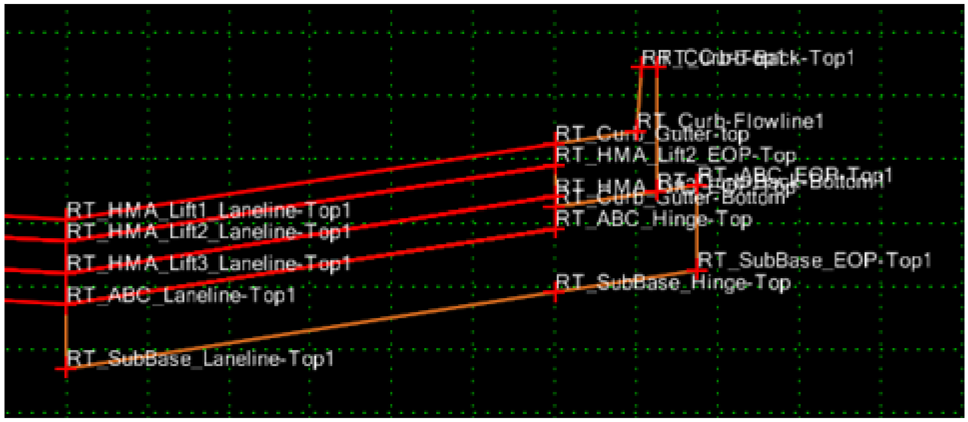
14. **<D> <D>** on the **RT_Curb_Gutter-top** point.

15. Change the ***Slope*** constraint ***Value*** to ***5.00%.*** This is done so that hidden (dotted) curb component is displayed. It will also allow the points to merge as desired in the following steps.

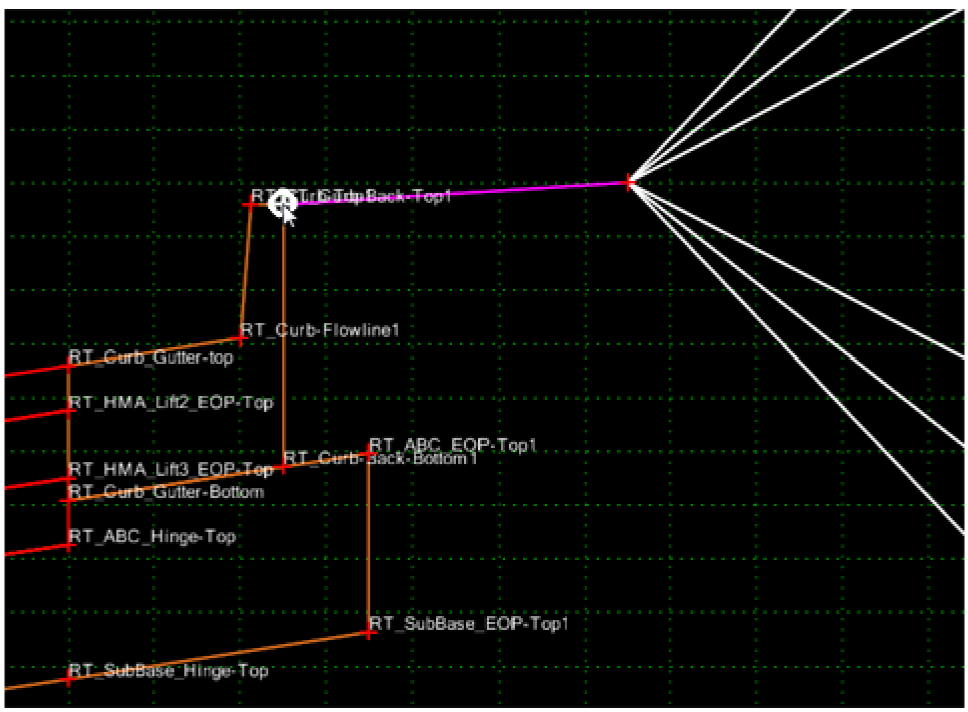


16. **<D> Apply**.

17. **<D> Close**.

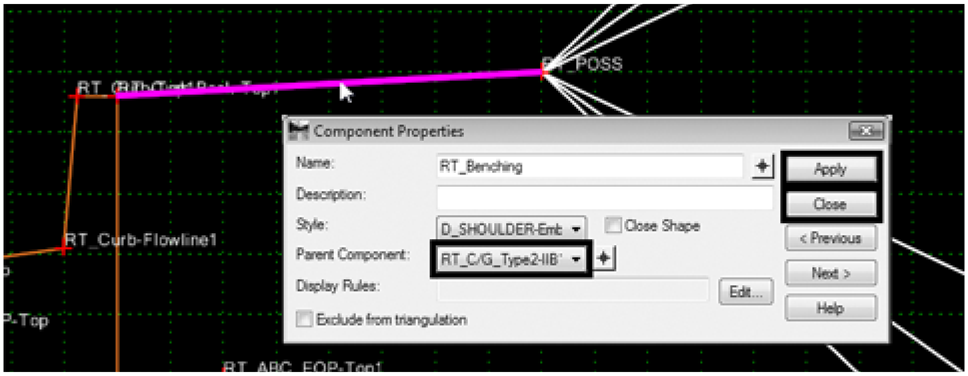


18. Expand the ***3 – Sections End Conditions > Curb & Gutter Sections*** folder in the template library explorer.
19. **<D>** on the **Bench_4_6_to_1** section to display it in the Preview window.
20. **<D> and Hold** on the section's origin in the ***Preview*** window.
21. **Drag and Drop** the section on to the **RT_Curb_Back-Top1** point.

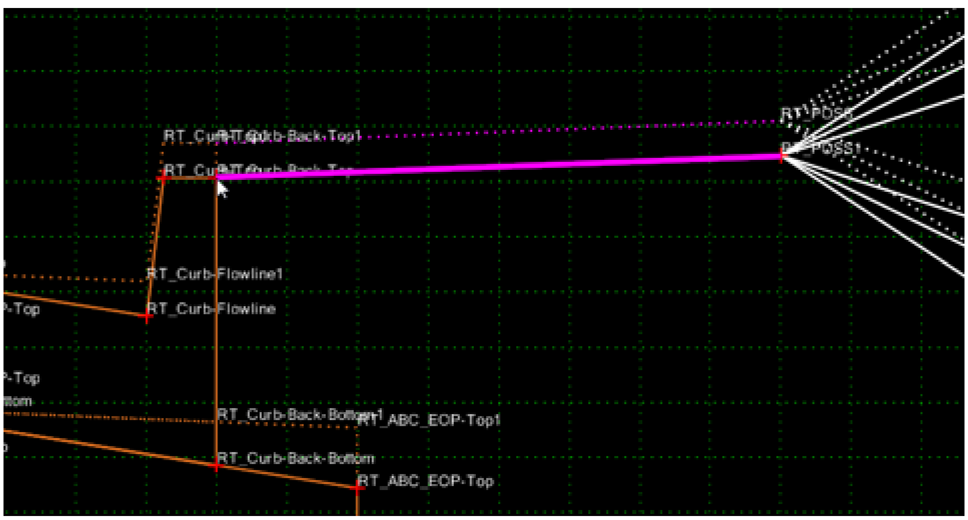


22. **<D> <D>** on the **RT_Benching** component that was just placed.
23. Set the ***Parent Component*** to **RT_C/G_Type2-IIB1**.
24. **<D> Apply**.

25. **<D> Close**.



26. **<D> <D>** on the **RT_Curb_Gutter-top** point.
27. Change the ***Slope*** constraint ***Value*** to ***-2.00%.*** This is done so that the hidden (dotted) curb component is displayed. It will also allow the points to merge as desired in the following steps.
28. **<D> Apply**.
29. **<D> Close**.
30. **<D> and Hold** on the **Bench_4_6_to_1** section's origin in the ***Preview*** window.
31. **Drag and Drop** the section on to the ***RT_Curb_Back-Top*** point.

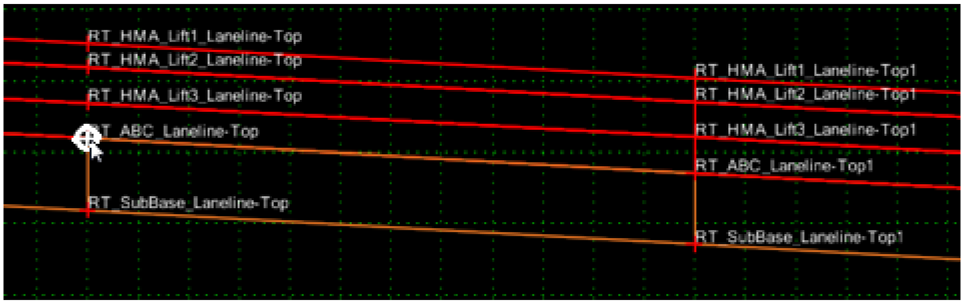


32. **<D> <D>** on the **RT_Benching1** component that was just placed.
33. Set the ***Parent Component*** to **RT_C/G_Type2-IIB**.
34. **<D> Apply**.
35. **<D> Close**.

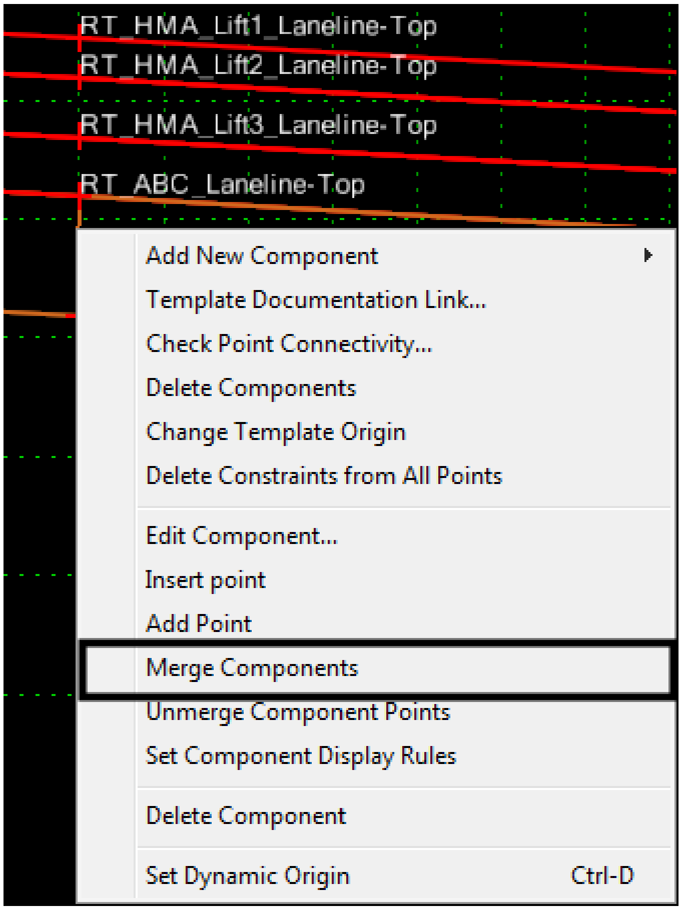
Note: Applying the Parent Component settings to the Benching components will make the proper end condition display based on the pavement cross slope.

Finally, the missing ABC component is added under the new driving lane.

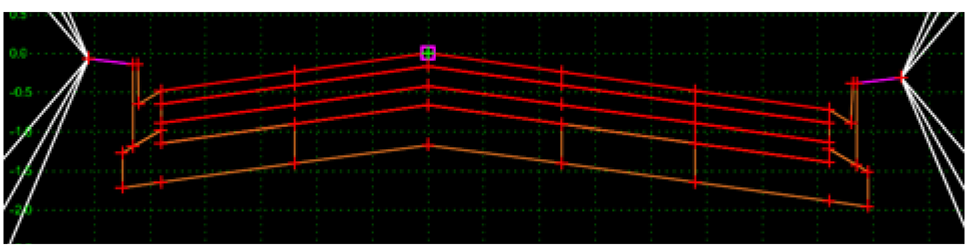
36. Expand the ***4 - Components > Aggregate Bases > Driving Lanes*** folder in the template library explorer.
37. **<D>** on the **ABC_Lane** component to display it in the Preview window.
38. **<D> and Hold** on the section's origin in the ***Preview*** window.
39. **Drag and Drop** the section on to the ***RT_ABC_Laneline-Top*** point.



40. **<R>** on the vertical line between ***RT_ABC_Laneline-Top*** and ***RT_SubBase_Laneline-Top*** and select **Merge Components** from the menu.



The finished template is illustrated below:



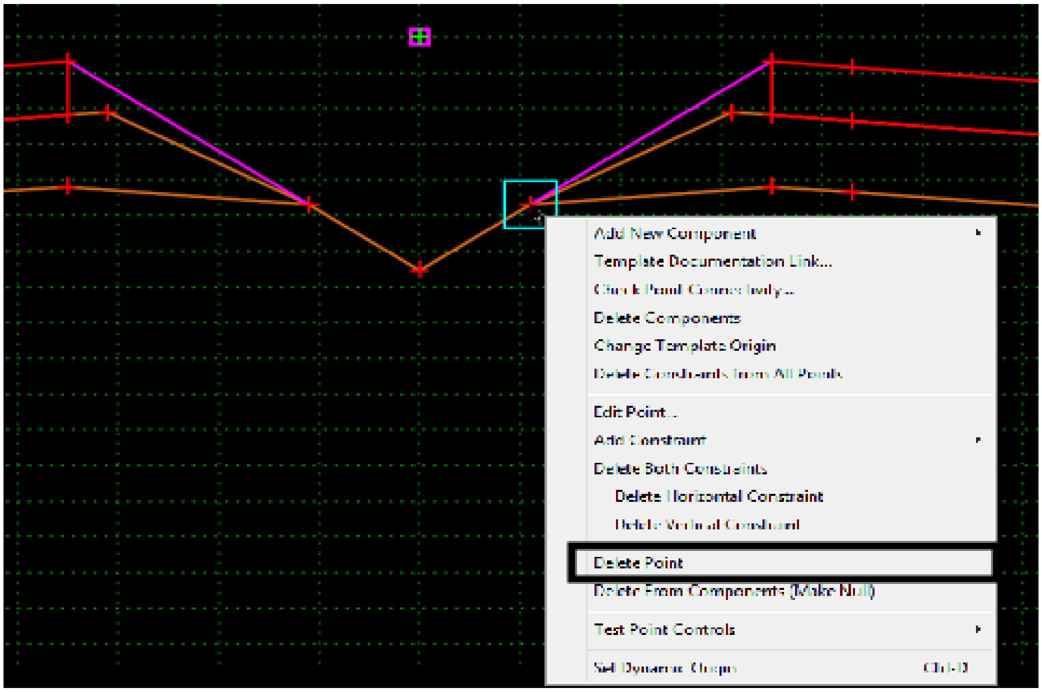
Lab 10.4 - Add a Median Barrier to a Divided Highway Template

In order to add a median barrier to the CONC_Divided_TypeA_4Lane template, the slope components will be deleted, the ABC components will be modified, a Guardrail_Type 7-CE component will be added, and the pavements will be tied to the barrier.

To start the process, the points that define the median ditch are deleted, removing the ditch from the template.

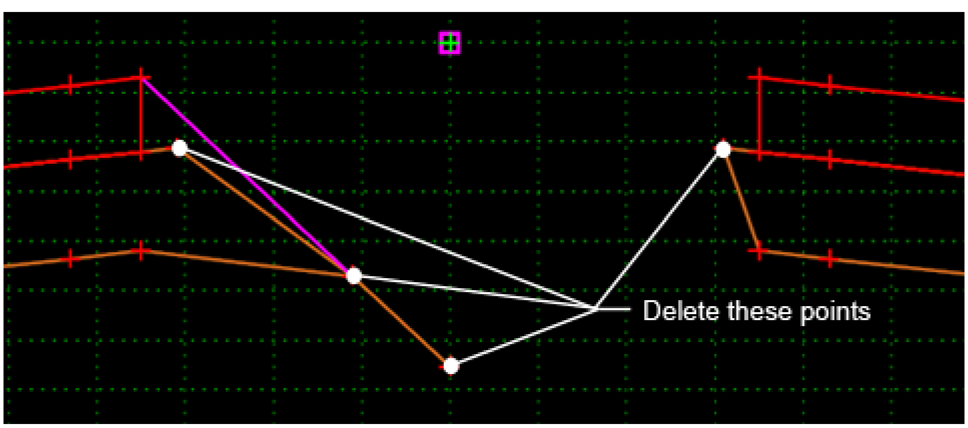
1. **<D> <D>** on the **CONC_Divided_TypeA_4Lane** template.

2. **<R>** on the **RT_Median_POSS point** and select **Delete Point.**



3. In the **Delete Point** dialog box, **<D> All.**
4. **<D> OK**. This deletes the point from ***RT_SubBase_Shoulder*** and deletes the ***Z-Slope_12_6_to_12*** and ***RT_Median*** components.
5. **<R>** on the **RT_Inside_SubBase_EOP-Top2** point and select **Delete Point.**
6. Using the same method as the steps above, delete the following points:

   - LT_Median_POSS
   - LT_SubBase_EOP-Top
   - Median_Flowline



Place a Type-7 barrier in the template. In this case, the center bottom of the barrier is placed on the template origin.

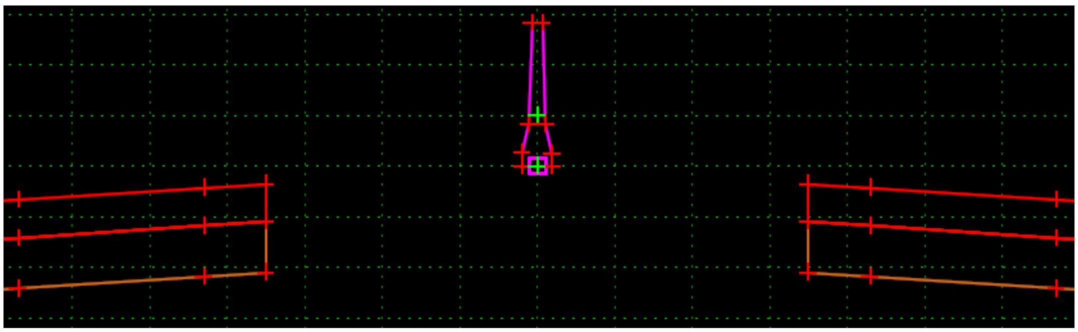
7. Toggle off **Apply Affixes** (either on the ***Dynamic Settings*** dialog or from ***Tools*** > ***Options***).

8. Expand the ***4 – Components > Barriers & Misc Components > Guardrail Type 7*** folder in the template library explorer.

9. **<D>** on the **Guardrail_Type 7-CE** component to highlight it; do not make it active.

10. In the ***Preview*** window, **<D> and Hold** on the component's ***Insertion Point*** (The green + sign in the middle of the barrier).

11. **Drag and Drop** the component to the template's origin.



Now the pavement edges need to be attached to the barrier. This is done by modifying the constraints for the those points.

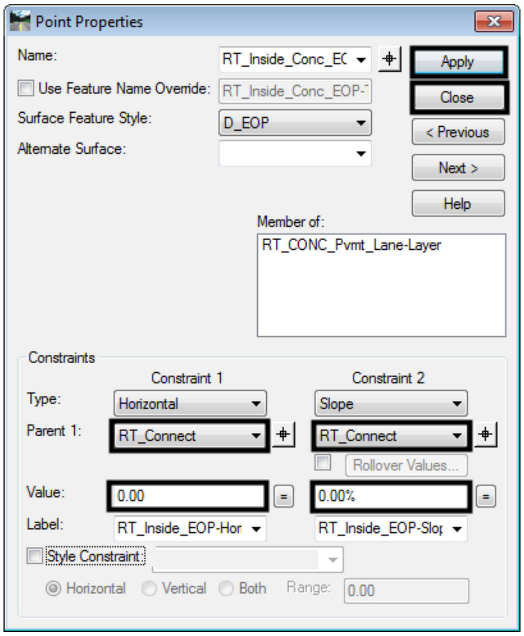
12. **<D> <D>** on the point **RT_Inside_Conc_EOP-Top**.

13. Set the ***Parent 1*** for both constraints to **RT_Connect**.

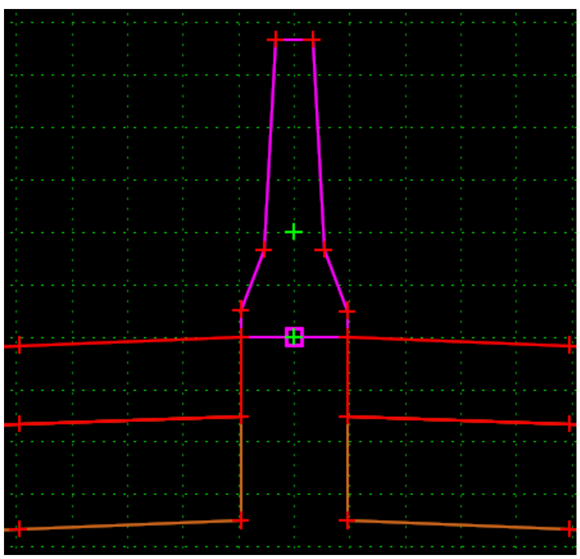
14. Key in ***0*** for the ***Value*** of both constraints.

15. **<D> Apply**.

16. **<D> Close**.



17. Repeat steps 12 through 15 for point **LT_Inside_Conc_EOP-Top** using **LT_Connect** as the ***Parent 1*** point.



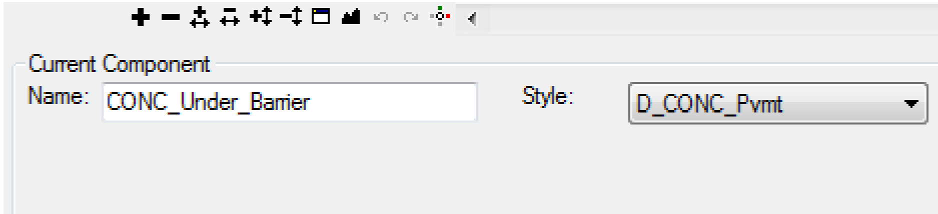
18. Zoom in to the area under the barrier.

    The next series of steps places a concrete component under the barrier. This component is placed independent of other points in the template. It is then constrained so that it will move with the barrier.

19. **<R>** and select **Add New Component > Unconstrained**.

20. Key in ***CONC_Under_ Barrier*** for the component ***Name***.

21. Select **D_CONC_Pvmt** for the ***Style***.



22. In the Dynamic Settings dialog box, key in ***RT_ CONC_Under_Barrier-Top*** for the ***Point Name.***

23. **<D>** under the right edge of the barrier but not on any existing point or component.

24. In the Dynamic Settings dialog box, key in ***RT_ ABC_Under_Barrier-Top*** for the ***Point Name.***

25. **<D>** below the **RT_** ***CONC_Under_Barrier-Top*** point that was just placed.

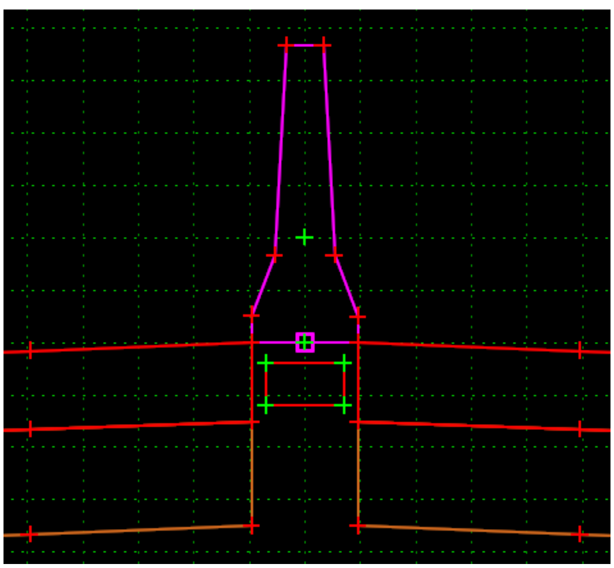
26. In the Dynamic Settings dialog box, key in ***LT_ ABC_Under_Barrier-Top*** for the ***Point Name.***

27. **<D>** to the left of the point that was just placed.

28. In the Dynamic Settings dialog box, key in ***LT_ CONC_Under_Barrier-Top*** for the ***Point Name.***

29. **<D>** above the point that was just placed.

30. **<R>** and select **Finish**.



31. **<D> <D>** on the **RT_ CONC_Under_Barrier-Top** point.

32. Set the ***Constraint 1 Type*** to **Horizontal**.

33. Set the ***Constraint 2 Type*** to **Vertical**.

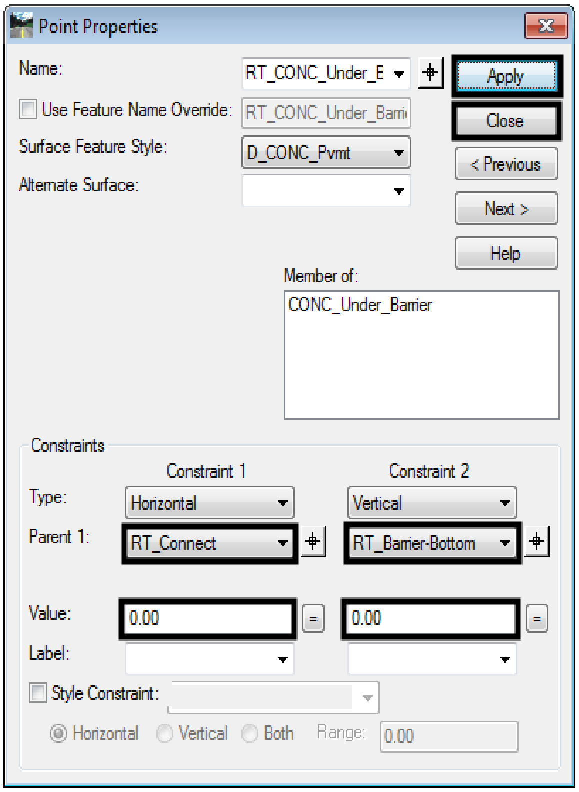
34. Set the ***Constraint 1 Parent 1*** to **RT_Barrier-Bottom**.

35. Set the ***Constraint 2 Parent 1*** to **RT_Barrier-Bottom**.

36. Key in ***0*** for the ***Value*** of both constraints.

37. **<D> Apply**.

38. **<D> Close**.



39. **<D> <D>** on the **LT_ CONC_Under_Barrier-Top** point.

40. Set the ***Constraint 1 Type*** to **Horizontal**.

41. Set the ***Constraint 2 Type*** to **Vertical**.

42. Set the ***Constraint 1 Parent 1*** to **LT_Barrier-Bottom**.

43. Set the ***Constraint 2 Parent 1*** to **LT_Barrier-Bottom**.

44. Key in ***0*** for the ***Value*** of both constraints.

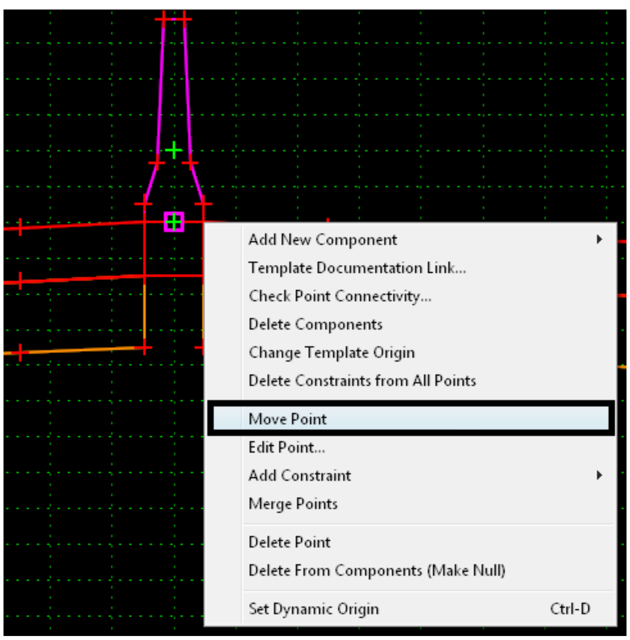
45. **<D> Apply**.

46. **<D> Close**.

47. **<D> <D>** on the **RT_ ABC_Under_Barrier-Top** point.

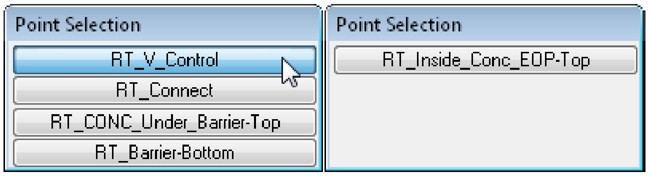
48. Set the ***Constraint 1 Type*** to **Horizontal**.

49. Set the ***Constraint 2 Type*** to **Vertical**.
50. Set the ***Parent 1*** to **RT_ CONC_Under_Barrier-Top** for both constraints.
51. Key in ***0*** for the ***Value*** of the ***Horizontal*** constraint.
52. Key in -***0.75*** for the ***Value*** of the ***Vertical*** constraint.
53. **<D> Apply**.
54. **<D> Close**.
55. **<D> <D>** on the **LT_ ABC_Under_Barrier-Top** point.
56. Set the ***Constraint 1 Type*** to **Horizontal**.
57. Set the ***Constraint 2 Type*** to **Vertical**.
58. Set the ***Parent 1*** to **LT_ CONC_Under_Barrier-Top** for both constraints.
59. Key in ***0*** for the ***Value*** of the ***Horizontal*** constraint.
60. Key in -***0.75*** for the ***Value*** of the ***Vertical*** constraint.
61. **<D> Apply**.
62. **<D> Close**.



63. **<R>** on the **RT_Connect** point and select **Move Point**.

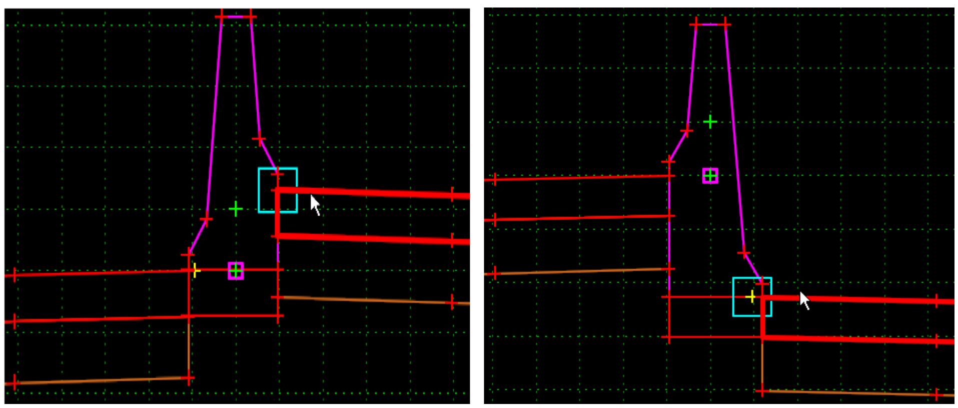
64. **<D>** on **RT_V_Control** in the box that pops up listing all available points at this location.



Note: If more than four points are available, **<ESC>** on your keyboard pages down in the list.

65. Move the pointer up and down and notice how the components behave.

66. **<R>** to end the Move command



Note: This barrier has both a variable height *and* a variable width. If the height is 34" or less, the base is 23" wide. As the height increases above 34" the base varies from 23" to a maximum of 26.75". The maximum height is 40".

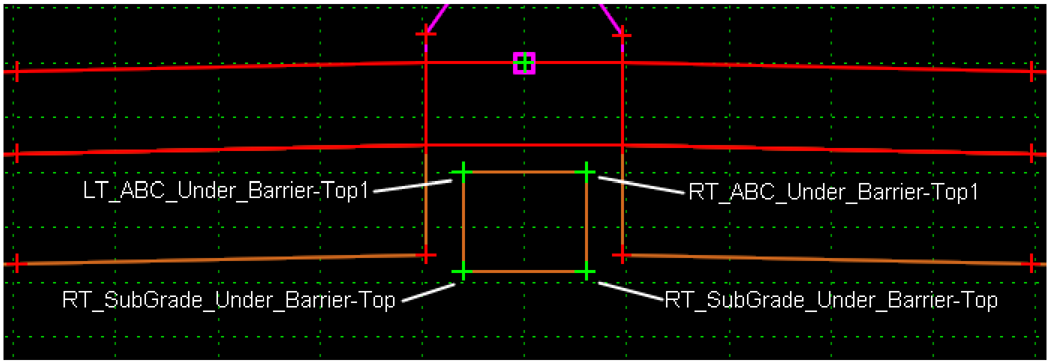
Important! Since the barrier width is variable, the adjacent shoulder, lanes, etc. are 'pushed out' as the barrier widens. A decision must be made if this is acceptable, or if you want another solution, such as varying the width of the shoulder to accommodate the widened barrier. If so, change the Parent of the Horizontal Constraint on the inside shoulder point to the V_Control point. Since it does not widen with the barrier, the shoulder will be variable width. The maximum variation is 3.75".

An ABC component can be added under the barrier in a similar manner to the concrete component described above.

67. **<R>** and select **Add New Component > Unconstrained**.

68. Key in ***ABC_Under_ Barrier*** for the component ***Name***.

69. Select **D_ABC_Class 6** for the ***Style***.



70. In the Dynamic Settings dialog box, key in ***RT_ ABC_Under_Barrier-Top1*** for the ***Point Name.***

71. **<D>** under the right edge of the component just added but not on any existing point or component.

72. Continue adding the other three points (as was done with the concrete component) Naming them:

- **RT_ SubGrade_Under_Barrier-Top**
- **LT_ SubGrade_Under_Barrier-Top**
- **LT_ ABC_Under_Barrier-Top1**

73. **<R>** and select **Finish**.

74. **<D> <D>** on **RT_ SubGrade_Under_Barrier-Top.**

75. Set the Parent 1 to ***RT_ ABC_Under_Barrier-Top1*** on both constraints.

76. Key in ***0*** for the ***Value*** of the ***Horizontal*** constraint.

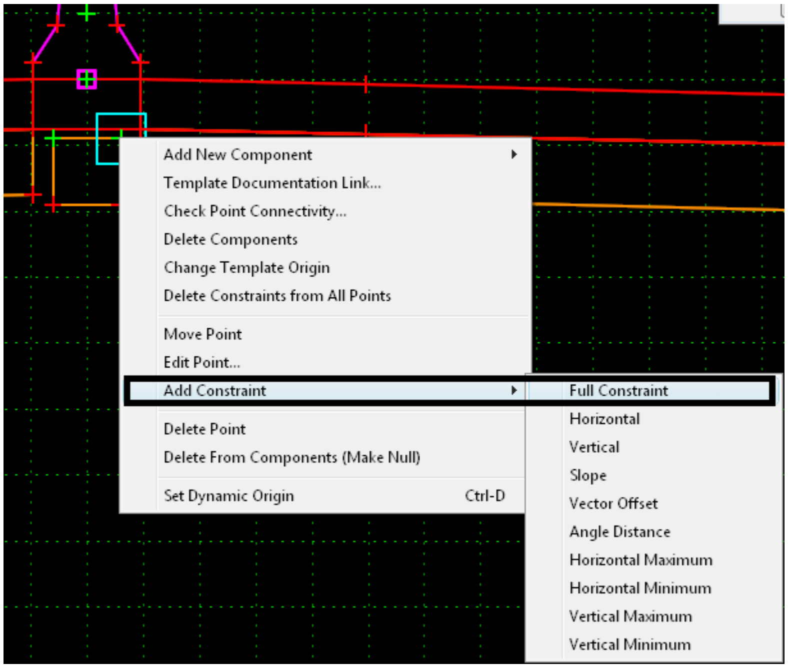
77. Key in -***1.00*** for the ***Value*** of the ***Vertical*** constraint.

78. **<D> Apply**.

79. **<D> Close**.

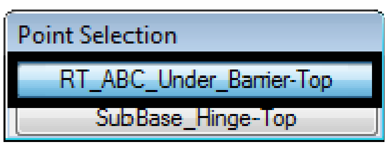
80. Repeat steps 71 through 76 for ***LT_ SubGrade_Under_Barrier-Top***, using ***LT_ ABC_Under_Barrier-Top1*** as the ***Parent 1*** point.

81. **<R>** on the ***RT_ ABC_Under_Barrier-Top1*** point and select **Add Constraint > Full Constraint**.



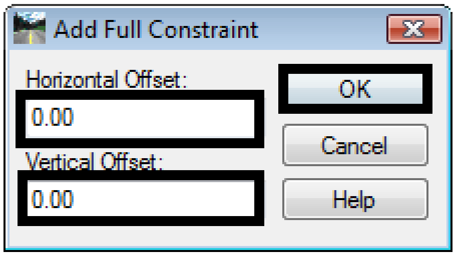
82. **<D>** on the **RT_ ABC_Under_Barrier-Top.**

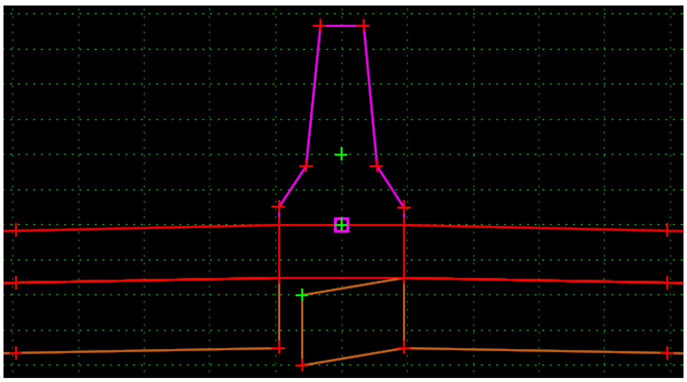
83. **<D>** on **RT_ ABC_Under_Barrier-Top** on the ***Point Selection*** dialog box.



84. In the ***Add Full Constraint*** dialog box, key in ***0*** for both offsets.

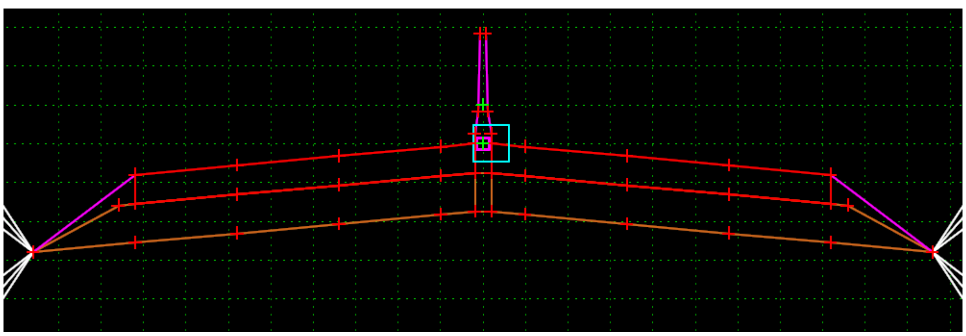
85. **<D> OK**.





86. Repeat steps 79 through 82 for the point **LT_ ABC_Under_Barrier-Top1,** selecting point **LT_ ABC_Under_Barrier-Top** in the ***Point Selection*** dialog box.

    The template is now completed.



Chapter Summary:

- In some cases, only minor alterations can change a standard template into a project specific one. In *Lab 10.1 -Modify pavement lift thickness* point constraints were changed to modify the thickness of a pavement lift.
- Other minor modifications include the addition of components. In *Lab 10.2 -Add a sub-base component to the template* a new component was created to add a sub-base component to the template.
- There are some case when major modifications can be made to an existing template. In *Lab 10.3 -Add an Additional Lane to One Side of a Template* components were deleted from an existing template and new components were added from the template library to add an additional lane to one side of a template.
- Editing a template does not always require deleting and/or adding whole components. Sometimes the desired results can be achieved working with the points on components. In *Lab 10.4 -Add a Median Barrier to a Divided Highway Template* components and specific component points were deleted, new components from the library and ones built from scratch were added and point constraints were modified to add a median barrier to a divided highway template.

LAB 11 - Corridors and Template Drops

This lab demonstrates the initial procedures used when starting Roadway Designer. The exercises below define the path and cross section for the design model and determine what information is displayed in the Roadway Designer views.

Chapter Objectives:

- Create a corridor using a horizontal and vertical alignment
- Develop initial template drops
- Generate additional template drop details

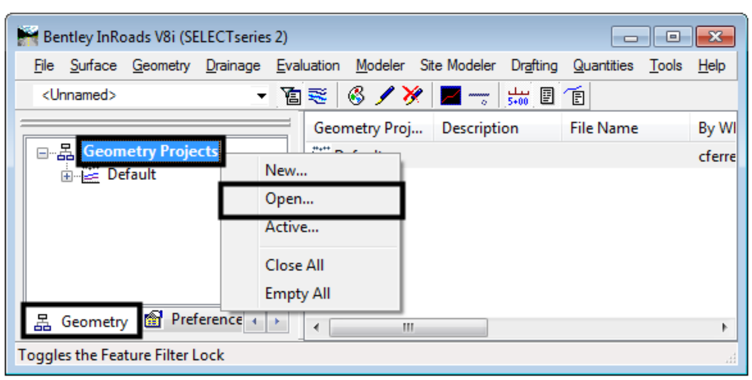
Before beginning this lab, verify that the following files are loaded:

- C:\Projects\12345\Design\Drawings\Reference_Files\12345DES_Model.dgn
- C:\Workspace\Workspace-CDOT_V8i\Standards-Global\InRoads\Preferences\CDOT_Civil.xin
- C:\Projects\12345\Design\InRoads\12345 existing ground.dtm
- C:\Projects\12345\Design\InRoads\12345DES_Geometry.alg
- C:\Projects\12345\Design\InRoads\DES12345_Templates.itl

Lab 11.1 - Create a Corridor

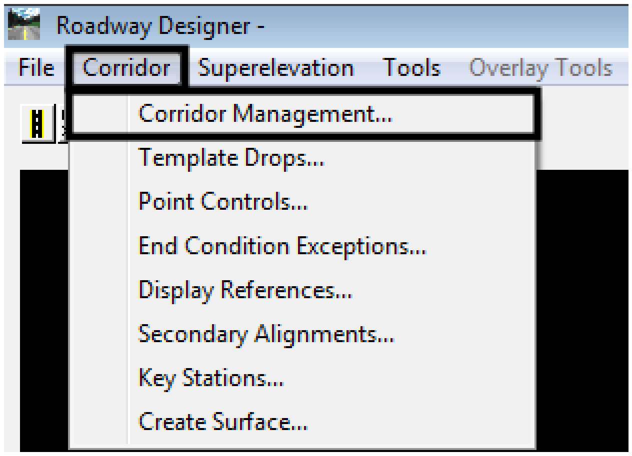
The first step in creating a design model is to create a corridor. The corridor defines where the model is located, both horizontally and vertically. The corridor in this example runs the total length of the alignment so no station limits are needed.

1. Select the **Geometry** tab in the ***InRoads Explorer***.
2. **<R> Geometry Projects,** select **Open,** and select the **12345DES_Geometry.alg** file from the ***\12345\Design\InRoads*** directory.

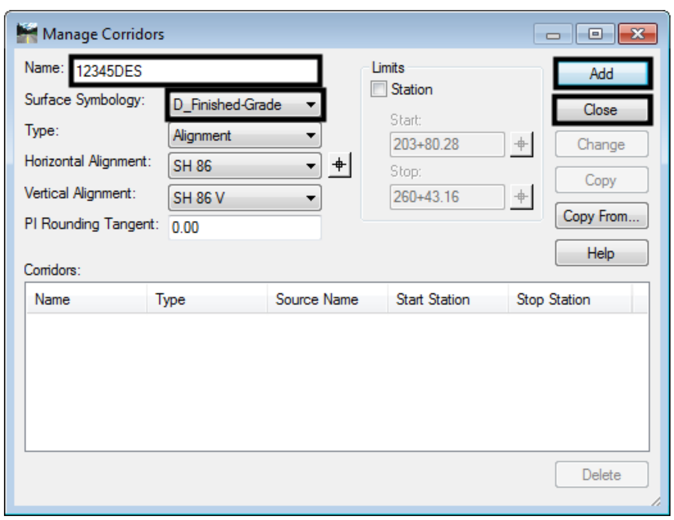


3. Verify that ***SH 86*** is the active horizontal alignment and ***SH 86 V*** is the active vertical alignment.
4. Select **Modeler > Roadway Designer** from the InRoads menu bar.

5. Select **Corridor > Corridor Management** from the Roadway Designer menu bar or **<D>** the corridor management button .



6. In the ***Manage Corridors*** dialog box, key in ***12345DES*** in the ***Name*** field.
7. Select **D_Finished-Grade** for the ***Surface Symbology***.
8. **<D> Add**.
9. **<D> Close**.

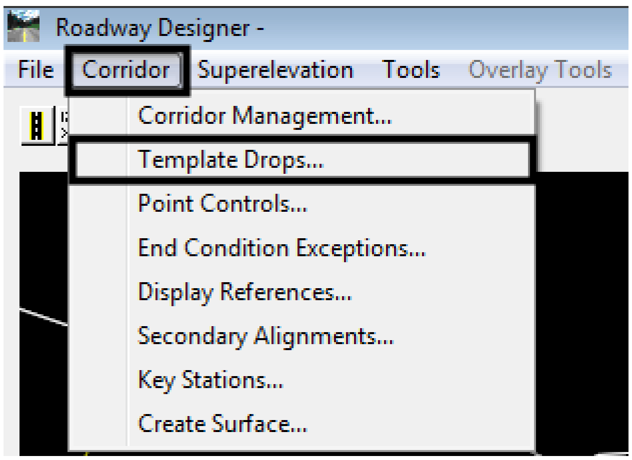


Note: By default, the ***Type*** is set to ***Alignment*** and the ***Horizontal Alignment*** and ***Vertical Alignment*** are set to the active alignments, though any alignment can be selected. Notice that data is now displayed in the Roadway Designer views.

Lab 11.2 - Develop Initial Template Drops

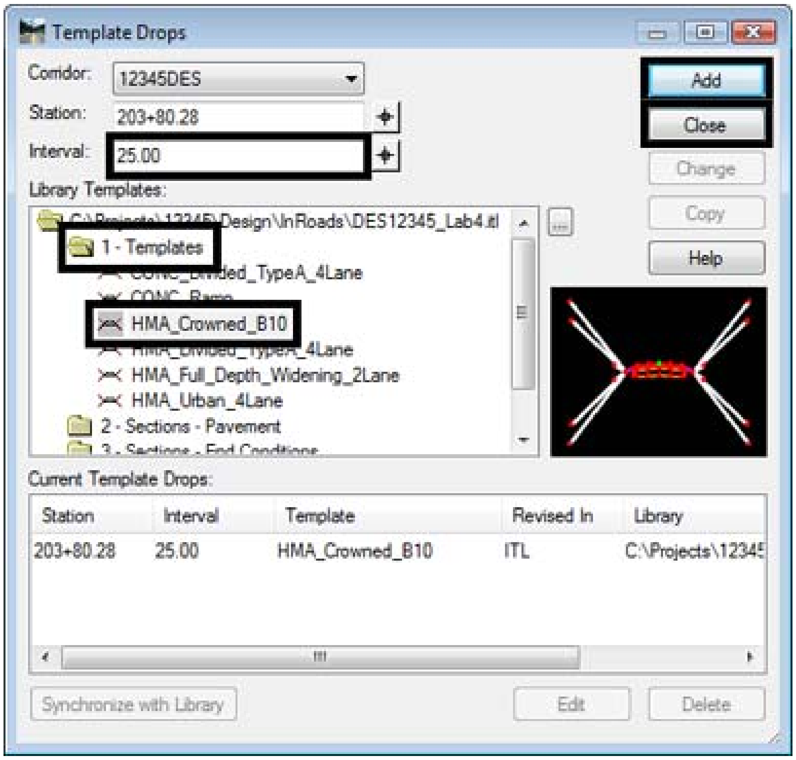
Design model cross sections are developed by applying templates along a corridor. A template drop needs to be defined at any location where the cross section of the corridor changes. Template drops are assigned to the corridor through the Template Drops dialog box. This exercise uses a single template drop that runs the entire length of the corridor. The starting station for the template drop defaults to the beginning of the alignment. Therefore, all that needs to be done is to select the desired template and set the interval.

1. Select **Corridor > Template Drops** from the Roadway Designer menu bar or **<D>** the template drops button .



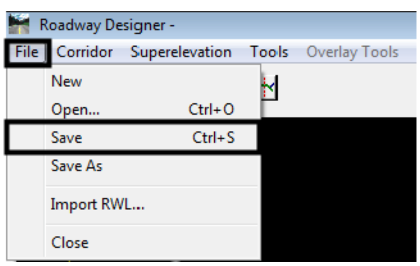
2. In the ***Template Drops*** dialog box, key in ***25*** for the ***Interval***.
3. Expand the **1- Templates** folder in the ***Library Templates*** area. of the ***Template Drops*** dialog box.
4. **<D>** on the **HMA_Crowned_B10** template.
5. **<D> Add**.

6. **<D> Close**.



This is a good spot to save the roadway designer (IRD) file.

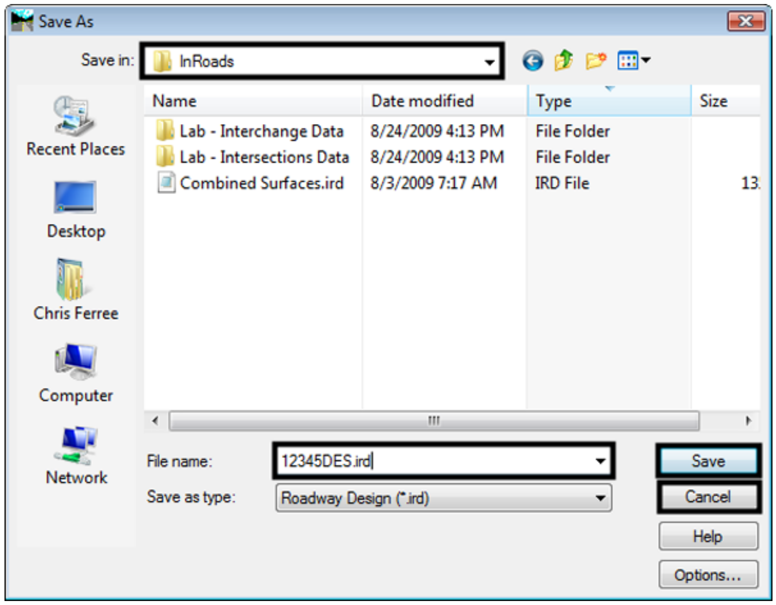
7. Select **File > Save** from the Roadway Designer menu bar.



8. Verify that the file is being saved to the directory ***C:\Projects\12345\Design\InRoads\.***

9. In the ***File name*** field, key in ***12345DES.ird***.

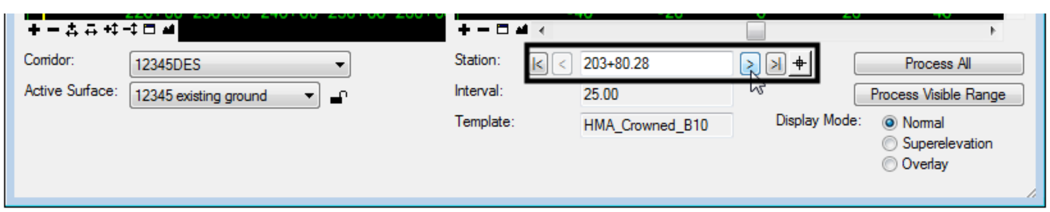
10. **<D> Save** then **<D> Cancel**.



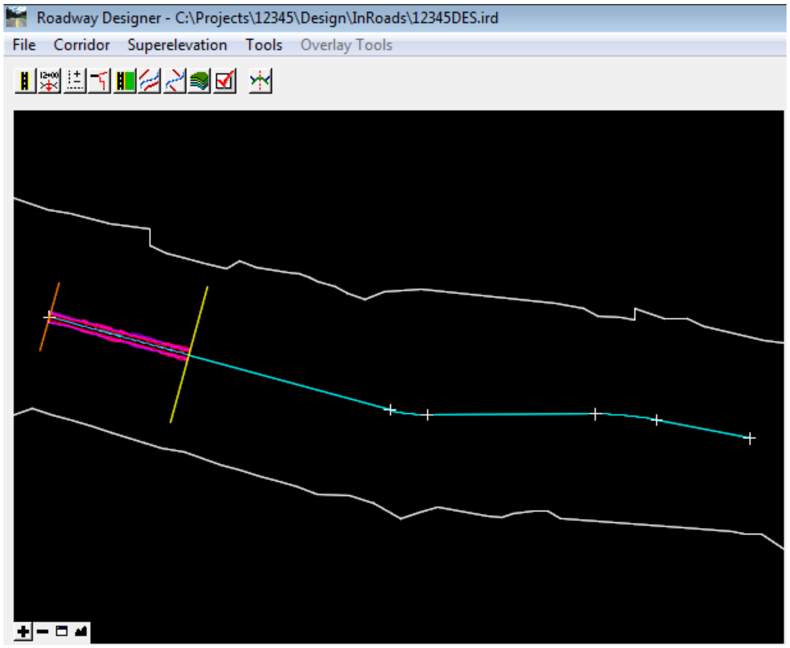
The template data is displayed in the cross section view of the Roadway Design. Notice, in the template view of the Roadway Designer, that the end conditions have already been solved.

There are two options for scrolling through the design, 1) using the station arrows below the template view and 2) using the station line in the plan view.

11. To navigate to a specific station **<D>** on the station arrows to scroll through the stations or type in the station to review.



12. To get a quick overview of how the template is working through the corridor, **<D> and Hold** on the yellow station line. Move the pointer back and forth to scroll through the design.



The model is now ready to be evaluated.

Lab 11.3 - Generate Additional Details for Template Drops

Between the regular station intervals defined by a template drop, design data is generated using straight line interpolation. In order to generate precise data at "stations of interest" other than a regular station (i.e. stations for drainage structures), those stations need to be identified as an ***Event Points*** and then processed using the Roadway Designer. Other standard "stations of interest" that are usually not at regular station intervals are ***Cardinal Points***.

The Roadway Designer Options dialog box determines which of the "stations of interest" get processed and what information is added to the template view window. The data generated by the Roadway Designer options provides the designer additional real time information that is useful in the evaluation and analysis of the proposed design.

This exercise will demonstrate several of the options including:

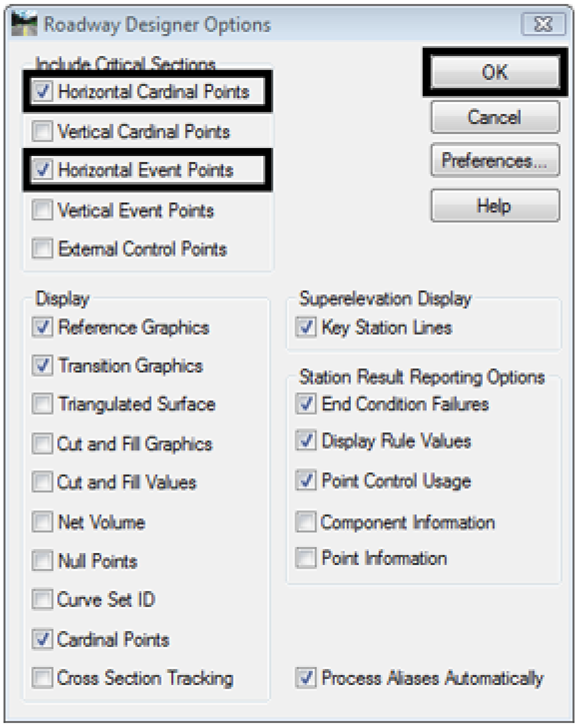
- Processing cardinal and event points
- Displaying cut and fill information
- and Generating a report of component and point information.

The first series of steps tell the Roadway Designer to process the horizontal cardinal and event points.

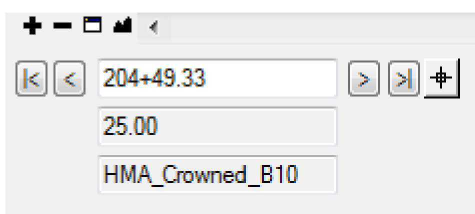
1. From the Roadway Designer menu bar, select **Tools > Options**.

2. In the ***Roadway Designer Options*** dialog box, toggle on **Horizontal Cardinal Points** and **Horizontal Event Points**.

3. **<D> OK**.



4. Scroll through the stations and notice that some stations do not fall on even intervals. These are the cardinal and event points.

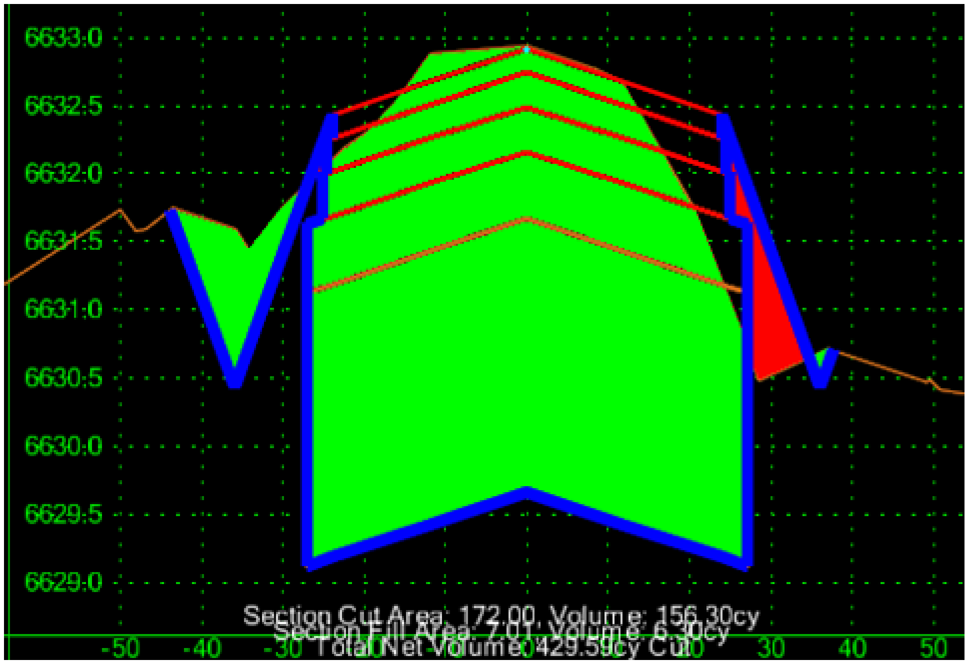


The following series of steps adds volume information to the template view of the Roadway Designer.

5. Open the ***Roadway Designer Options*** dialog box again.

6. Toggle on **Cut and Fill Graphics**, **Cut and Fill Values**, and **Net Volume**.

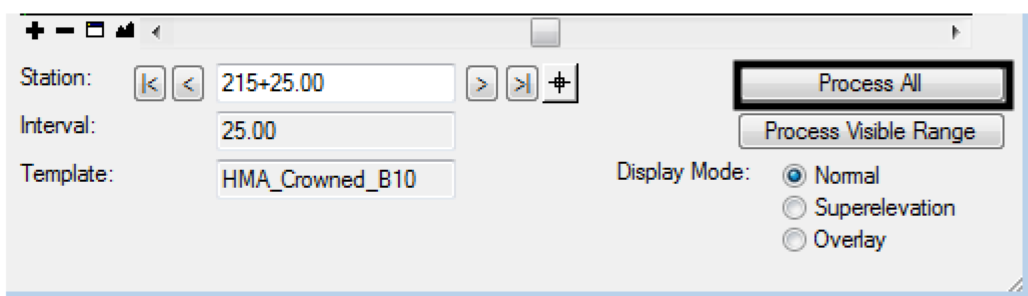
7. **<D> OK**.



8. Scroll through the stations and notice that Cut and Fill areas are shown graphically and areas and volumes are shown in text format at the bottom of the template view.

The final series of steps illustrates what is included in the default processing report and shows what information can be added to the report.

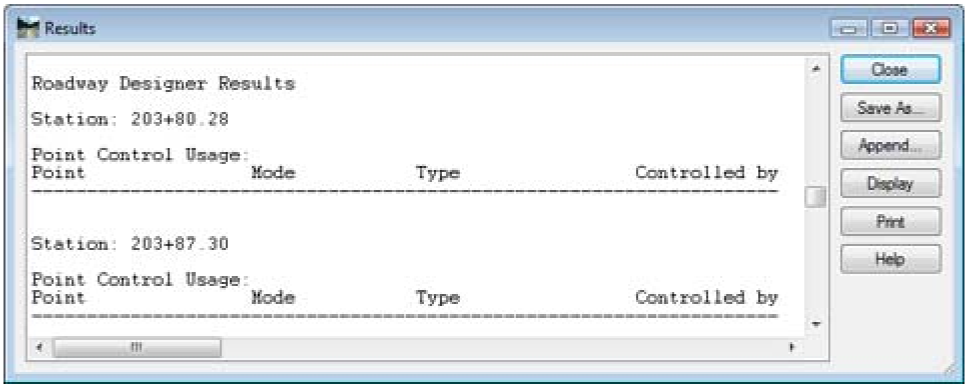
9. **<D>** the **Process All** button.



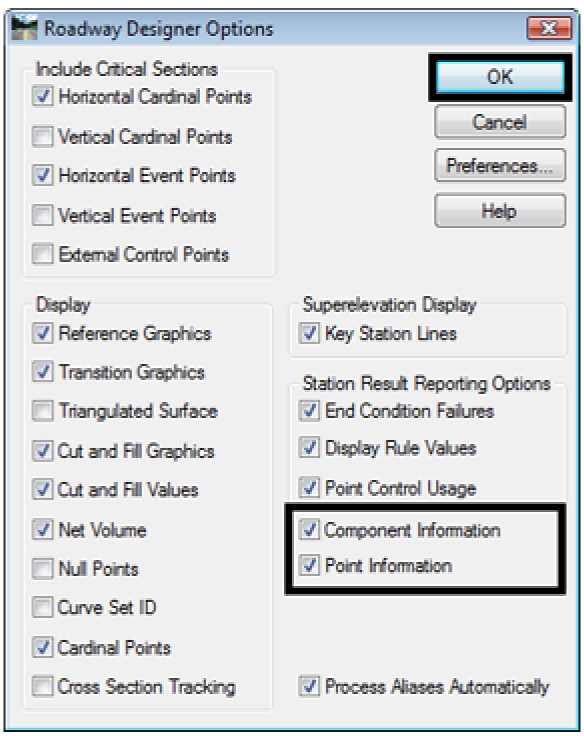
10. This displays the ***Results*** dialog box. Some of the information displayed includes:

- Stations where end conditions failed to intercept their target
- Results of display rule calculations, and
- Which point controls were used for each station processed.

This information should be used to determine problems areas of the model and what modifications should be made to the template or corridor controls.

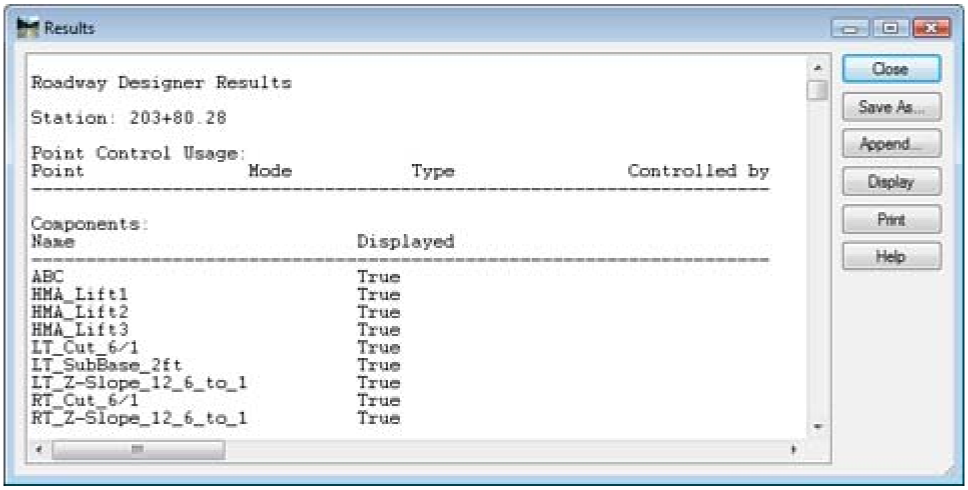


11. **<D> Close** on the ***Result*** dialog box.
12. Open the ***Roadway Designer Options*** dialog box again.
13. Toggle on **Component Information** and **Point Information**.
14. **<D> OK**.



15. **<D>** the **Process All** button.

16. This report list detailed information about every component and point in the model. Like the previous report, this information can be used to help troubleshoot problems with templates and corridor controls.



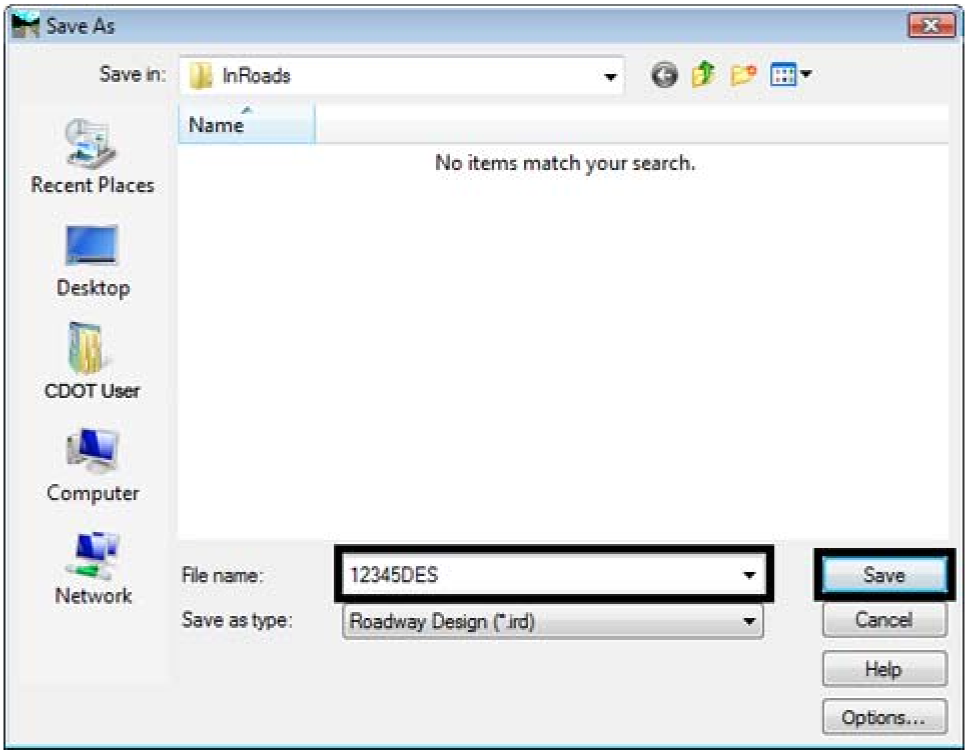
Note: The Results dialog box is limited to a report of up to approximately 16,000 lines. This equals about 220 template drops (about a mile at a 25' interval) when using the HMA_Crowned_B10 template.

17. **<D> Close** on the ***Result*** dialog box.

18. Select **File > Save** from the Roadway Designer menu bar.

19. In the ***Save As*** dialog box, key in ***12345DES*** for the file name.

20. **<D> Save**.



21. **<D> Cancel** to dismiss the ***Save As*** dialog box.

22. **<D> Close** to dismiss the Roadway Designer window.

Chapter Summary:

- A corridor defines the horizontal and vertical location of the design. In *Lab 11.1 -Create a Corridor* a corridor was created using the active horizontal and vertical alignment.
- Templates define the prism of the project. These are processed at specific intervals along the corridor. In *Lab 11.2 -Develop Initial Template Drops* Template Drops for a two lane road template were added to the corridor.
- The options in Roadway Designer allow the user to see design evaluation information in real time. The user can also specify that geometry points are processed with template drops. In *Lab 11.3 -Generate Additional Details for Template Drops* various settings for the Roadway Designer options were used to add specific stations for processing, display volume information in the designer's template view, and add more detail to the processing report.

LAB 12 - The Superelevation Wizard

This lab demonstrates the use of the Superelevation Wizard. The wizard is the easiest way to add superelevation to a corridor.

Chapter Objectives:

- Use the Superelevation Wizard to enter data into the corridor.
- Edit a Superelevation Control Line.

Before beginning this lab, verify that the following files are loaded:

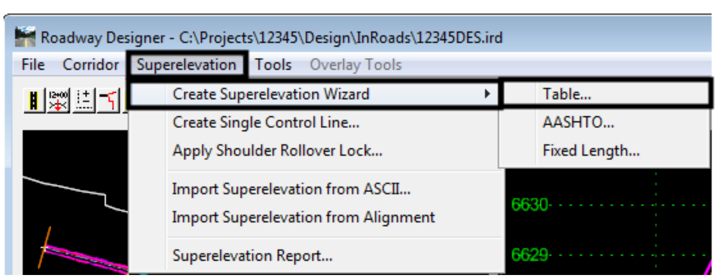
- C:\Projects\12345\Design\Drawings\Reference_Files\12345DES_Model.dgn
- C:\Workspace\Workspace-CDOT_V8i\Standards-Global\InRoads\Preferences\CDOT_Civil.xin
- C:\Projects\12345\Design\InRoads\12345 existing ground.dtm
- C:\Projects\12345\Design\InRoads\12345DES_Geometry.alg
- C:\Projects\12345\Design\InRoads\DES12345_Templates.itl

Lab 12.1 - Using the Superelevation Wizard

This lab uses the DES12345 corridor built in the previous lab. There are two main steps to using superelevation:

- ♦ Select the superelevation rate table and
- ♦ Calculate the rate for each curve

1. Select **Modeler > Roadway Designer** from the InRoads menu bar.
2. From the Roadway Designer dialog box, select **Superelevation > Create Superelevation Wizard > Table** from the menu bar. The Table Wizard is displayed.

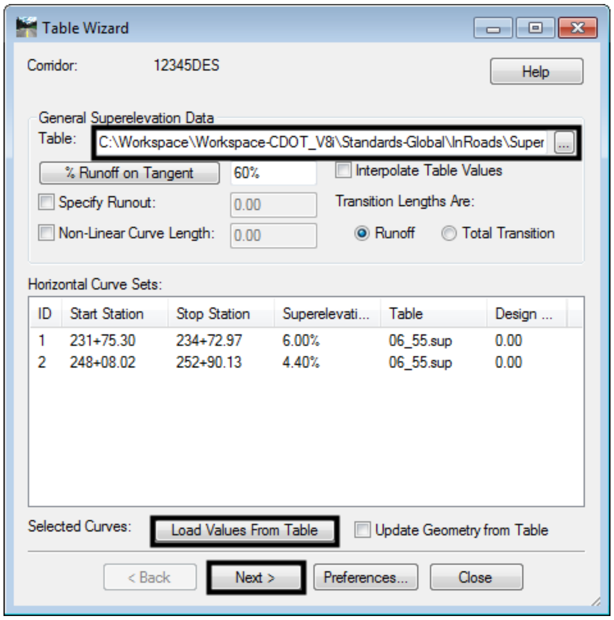


3. **<D>** the **Browse** button and select:

   C:\Workspace\Workspace-CDOT_V8i\Standards-Global\InRoads\Superelevation Tables\AASHTO 2004\06_55.sup.

4. **<D>** the **Load Values From Table** button. The superelevation table has been selected.

5. **<D> Next**.



On this screen the template points that define the superelevation range and pivot points are identified. It doesn't matter which station is active when these points are selected.

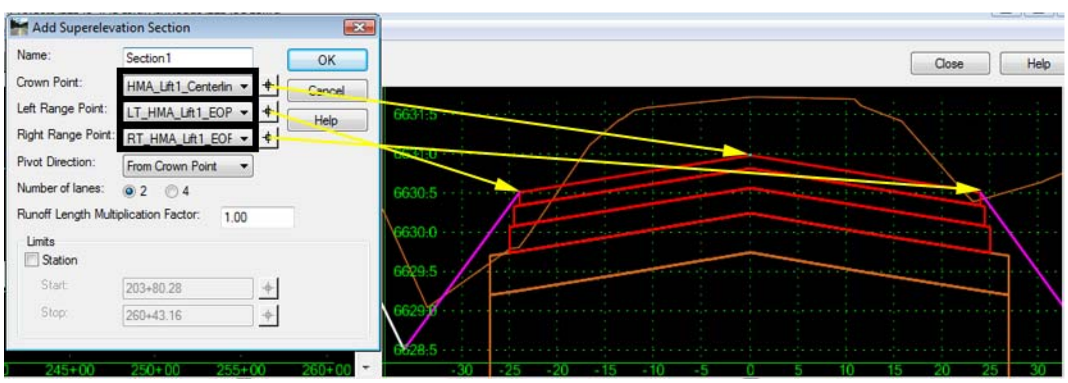
6. On the ***Superelevation Section Definitions*** dialog box, **<D> Add**. This displays the ***Add Superelevation Section*** dialog box.

7. **<D>** the target button for the ***Crown Point***. Then **<D>** on the finish grade centerline point.

8. **<D>** the target button for the ***Left Range Point***. Then **<D>** on the finish grade left edge of pavement point.

9. **<D>** the target button for the ***Right Range Point***. Then **<D>** on the finish grade right edge of pavement point.

10. **<D> OK**.



o

11. **<D> Next** on the ***Superelevation Section Definitions*** dialog box. This displays the ***Superelevation Controls*** dialog box.

This dialog box is mainly for informational purposes. It is provide so that the superelevation control line properties can be reviewed/updated before they are applied.

12. **<D>** the **Finish** button to complete the superelevation entry.

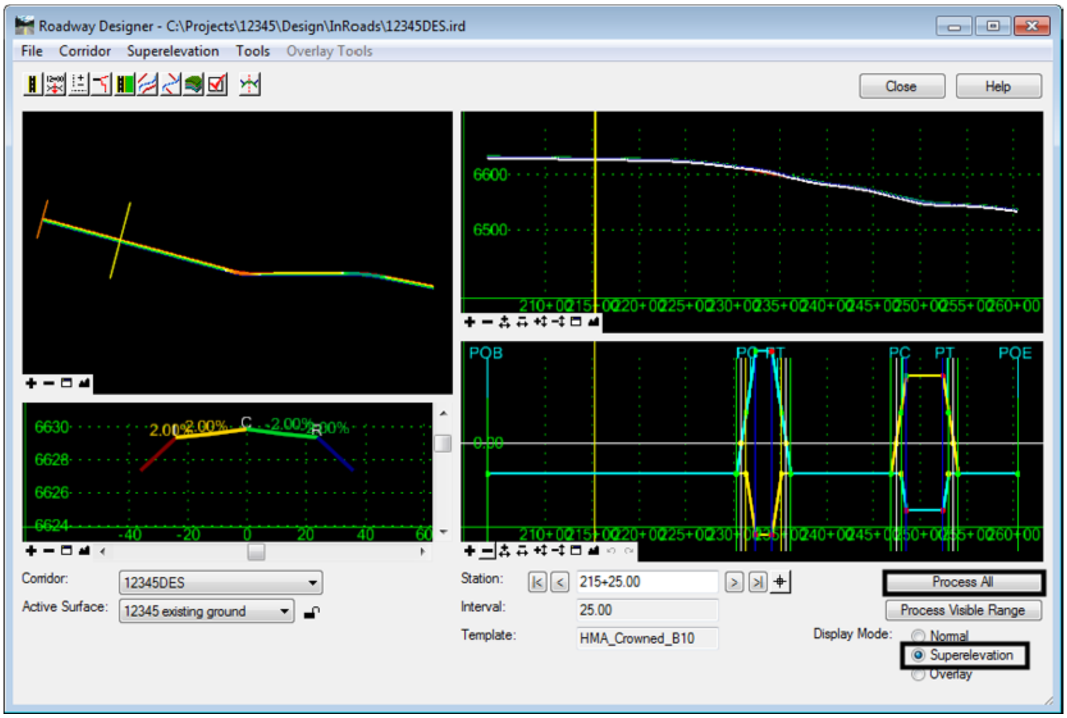
13. Toggle on **Superelevation** for the ***Display Mode*** on the ***Roadway Designer*** dialog box.

This adds the superelevation view window to the Roadway Designer dialog box.

14. **<D>** the **Process All** button. If it appears, Close the Results window.

15. **<D>** the **Fit button** for the ***Plan View*** and the ***Superelevation Control Line*** views.

    The illustration below shows the data generated by the ***Superelevation Wizard.***



The data in the plan view is color coded to show different cross slopes. The colors that represent the cross-slope values are:

- Green-Blue for slopes from 0.5% to 10% to the right with dark blue representing slopes greater than 10% to the right
- Yellow-Red colors for slopes from 0.5% to 10% to the left with dark red representing slopes greater than 10% to the left

- ♦ White for slopes less than 0.5%

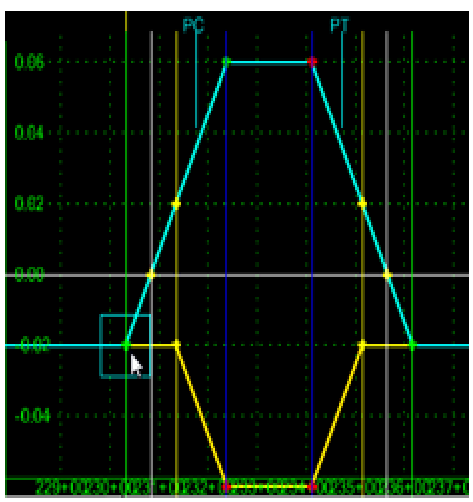
16. Select **File > Save** from the Roadway Designer menu bar.

Lab 12.2 - Edit a Superelevation Control Line

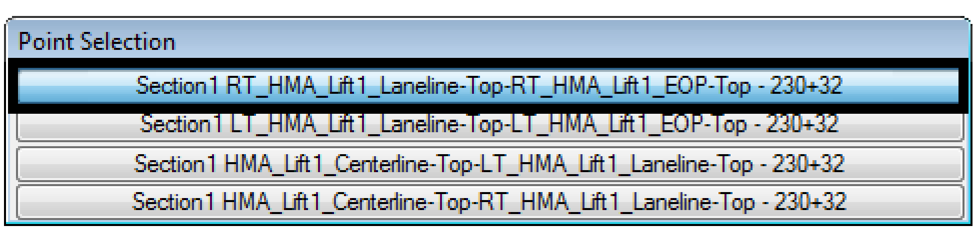
In this exercise the superelevation stations for the first curve are edited to even stations. This illustrates the procedure for editing superelevation. There are a couple of methods for editing superelevation stations:

- Edit the superelevation points from the superelevation view and
- Use the **Edit Curve Set Stations** tool

1. This first example is to edit the superelevation points directly from the view window. **<D> <D>** on the first superelevation point.



2. The ***Point Selection*** dialog box is displayed. **<D> <D>** on the **Section1 RT_HMA_Lift1_Laneline-Top-RT_HMA_Lift1_EOP-Top - 230+32.50.**



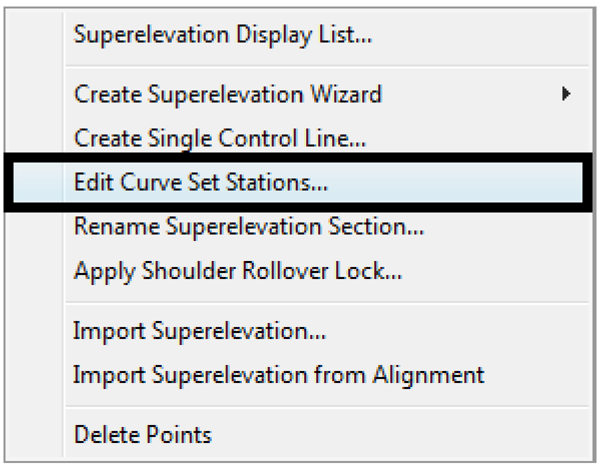
3. The ***Superelevation Point Properties*** dialog box is displayed. Key in ***230+32.00*** in the ***Station*** field.

4. **<D> Apply**.

5. **<D> Close**.

The other method is to use the Edit Curve Set Stations command. The dialog box may be more use since it uses common terminology used to define superelevation stations such as Full Super, Reverse Crown, Super Runoff, and Normal Crown.

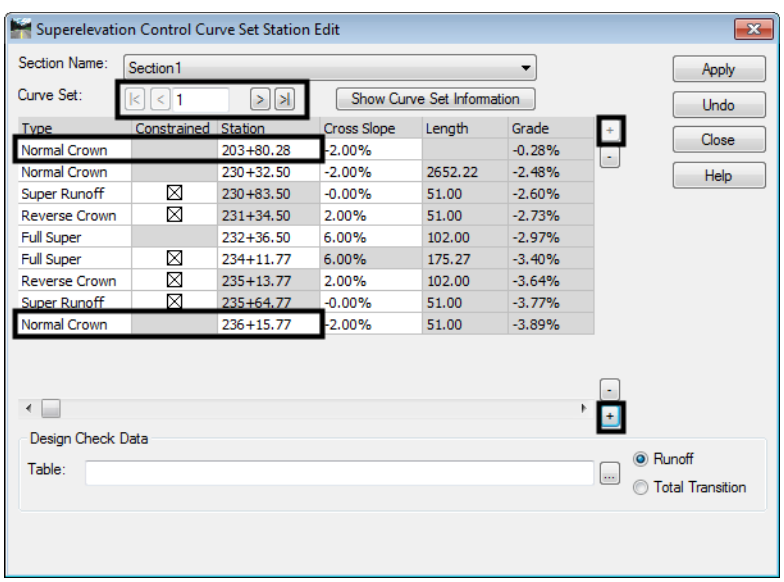
6. **<R>** in the Superelevation Control Line view and select **Edit Curve Set Stations** from the menu. The ***Superelevation Control Curve Set Station Edit*** dialog box displays.



7. Set the ***Curve Set*** to ***1***. This can be done with a key in or by using the arrow buttons.

8. **<D>** the upper "+" button to display additional stations. Continue to display additional stations until the ***Normal Crown*** at station ***230+32.00*** appears at the top of the list.

9. **<D>** the lower "+" button until the ***Normal Crown*** at station ***236+15.77*** is displayed.



10. **Toggle off** the ***Constrained*** toggle for Super Runoff at station **230+83.12**. Superelevation station that have a ***Grey*** background cannot be changed without turning off the ***Constrained*** toggle.

11. Round the Station value from **230+83.12** to ***230+83.00***. Be sure to use the Tab key to accept the new value.

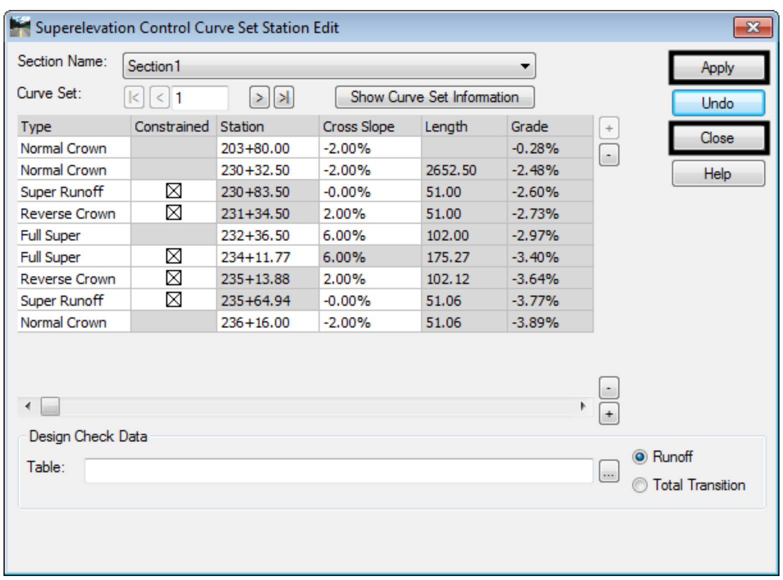
    Note: The rounding of stations is a design decision. Consult the Project Manager for guidance with this change.

12. Repeat steps 10 and 11 as needed and round the other stations as indicated below.

    - Reverse Crown ***231+34.00***
    - Full Super ***232+37.00***
    - Full Super ***234+12.00***
    - Reverse Crown ***235+14.00***
    - Super Runoff ***235+65.00***
    - Normal Crown ***236+16.00***

13. **<D> Apply**.

14. **<D> Close**. This dismisses the ***Superelevation Control Curve Set Station Edit*** dialog box.



Note: If the constraints are toggled back on, the stations will revert back to those calculated by the wizard.

15. **<D>** the **Process All** button. The computer will now apply the template drops and superelevation to all the stations in the corridor.

16. Scroll through the first curve to see how the superelevation works.

17. Select **File > Save** from the Roadway Designer menu bar.

18. **<D> Close**.

Chapter Summary:

- *Lab 12.1 -Using the Superelevation Wizard* demonstrated how to use the Superelevation Wizard to define the location of the Crown and Range points using the cross section view window. These points are used to determine how the template superelevates through a curve.
- *Lab 12.2 -Edit a Superelevation Control Line* showed two methods to edit a Superelevation Control Line; 1) manually and 2) using the Edit Curve Stations... dialog box. It is important to remember that editing superelevation stations is a design decision based on standard design criteria from the AASHTO manual and project specific conditions.

LAB 13 - Point Controls, Secondary Alignments, and Parametric Constraints

This lab demonstrates the use of various controls to modify a template during processing. It will highlight various settings in point controls, illustrate the effects of a secondary alignment, and demonstrate the use of parametric constraints.

Chapter Objectives:

- Create a Horizontal Point Control to add an additional lane using offsets.
- Create a Horizontal and Vertical Point Control to add a scab-on detour.
- Create a Horizontal Point Control using a Secondary Alignment.
- Use Parametric Constraints to widen the road surface.

Before beginning this lab, verify that the following files are loaded:

- C:\Projects\12345\Design\Drawings\Reference_Files\12345DES_Model.dgn
- C:\Workspace\Workspace-CDOT_V8i\Standards-Global\InRoads\Preferences\CDOT_Civil.xin
- C:\Projects\12345\Design\InRoads\12345DES_Geometry.alg
- C:\Projects\12345\Design\InRoads\12345 existing ground.dtm
- C:\Projects\12345\Design\InRoads\12345DES.ird
- C:\Projects\12345\Design\InRoads\DES12345_Templates.itl

Lab 13.1 - Adding an Additional Lane with Offset Point Controls

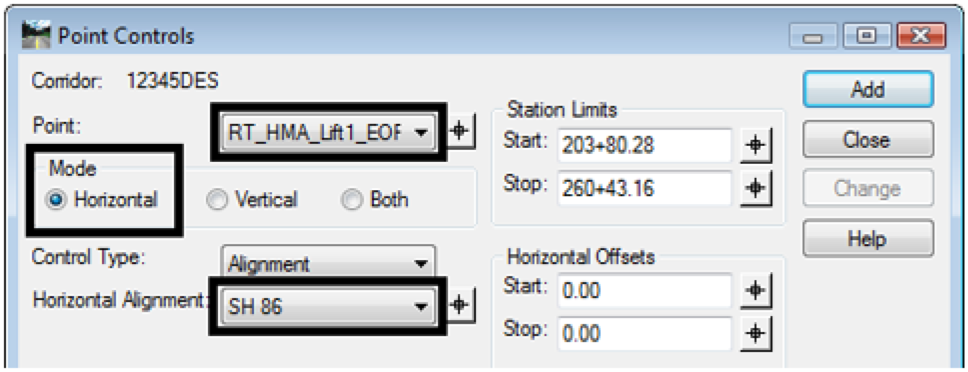
In this exercise the corridor created in the previous lab is modified by adding an additional lane to the right side of the template using a standard point control. This control is based on the centerline (SH 86) alignment and uses offset distances from this alignment to modify the template. Three control entries are required to complete the transition.

1. Select **Modeler > Roadway Designer** from InRoads.
2. Verify that the ***12345DES*** corridor is active.

The first point control transitions from two lanes to three lanes.

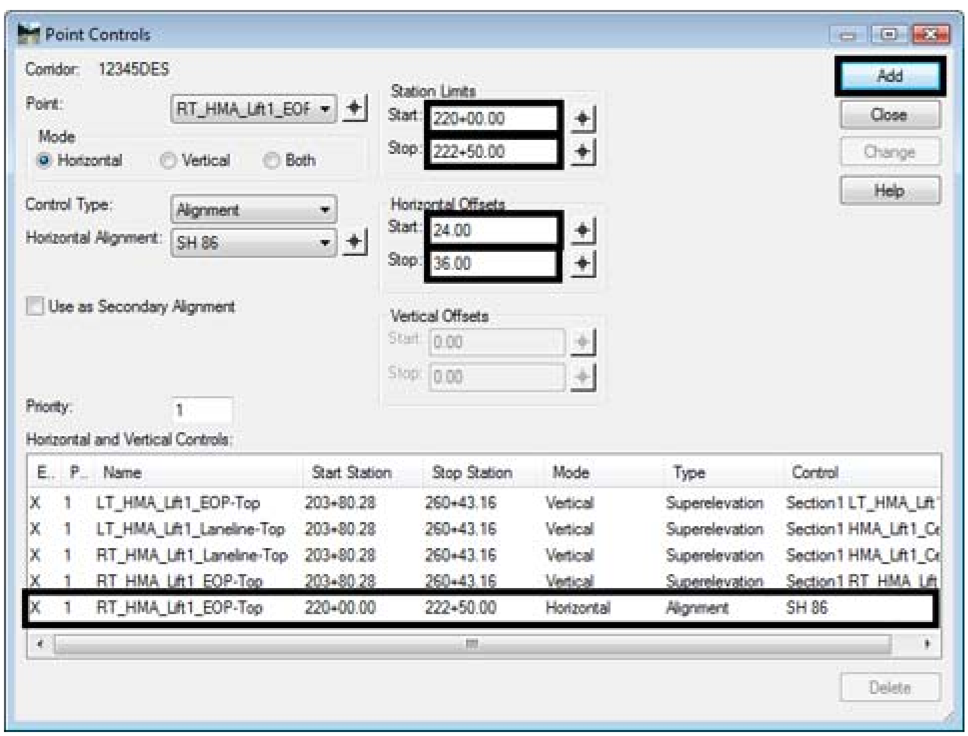
3. In the ***Roadway Designer*** dialog box, select **Corridor > Point Controls** from the menu bar or **<D>** the point controls button .
4. In the ***Point Controls*** dialog box, select **RT_HMA_Lift1_EOP-Top** for the point. Use the drop down menu or **<D>** the “target”  button and then **<D>** the point in the template view to make the selection.
5. Toggle on **Horizontal** for the ***Mode***.

6. Set the ***Horizontal Alignment*** to **SH 86**.



7. Key in ***220+00.00*** in the ***Station Limits Start*** field.
8. Key in ***222+50.00*** in the ***Station Limits Stop*** field.
9. Key in ***24*** in the ***Horizontal Offsets Start*** field.
10. Key in ***36*** in the ***Horizontal Offsets Stop*** field.
11. **<D> Add**. The entry is added to the ***Horizontal and Vertical Controls*** list.

This creates the beginning transition for the additional lane.



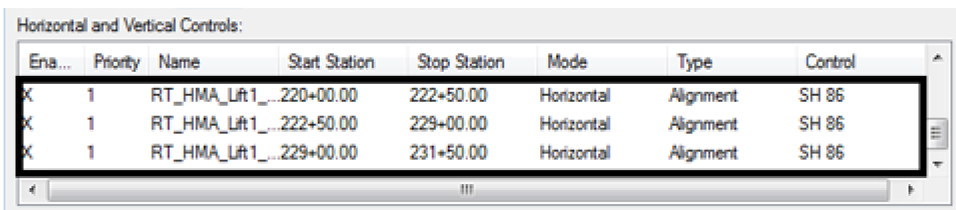
The Point, Mode, Control Type, and Horizontal Alignment stay the same for the two remaining entries. Only the Stations and Offsets change. the second point control maintains the third lane.

12. Key in ***222+50.00*** in the ***Station Limits Start*** field.

13. Key in ***229+00.00*** in the ***Station Limits Stop*** field.
14. Key in ***36.00*** in the ***Horizontal Offsets Start*** field.
15. Key in ***36.00*** in the ***Horizontal Offsets Stop*** field.
16. **<D> Add**. This entry maintains the full width of the additional lane.

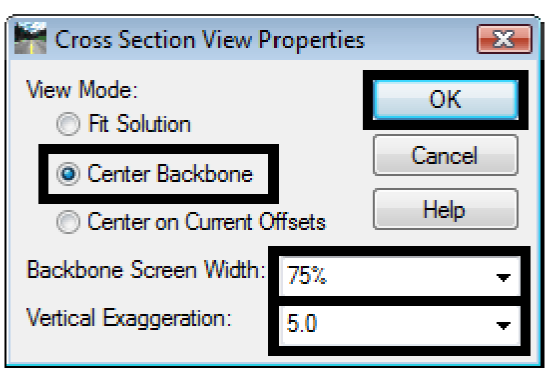
The third point control transitions from three lanes back to two lanes.

17. Key in ***229+00.00*** in the ***Station Limits Start*** field.
18. Key in ***231+50.00*** in the ***Station Limits Stop*** field.
19. Key in ***36.00*** in the ***Horizontal Offsets Start*** field.
20. Key in ***24.00*** in the ***Horizontal Offsets Stop*** field.
21. **<D> Add**. This entry transitions the template back to its normal width.
22. **<D> Close** to dismiss the ***Point Controls*** dialog box.



This series of steps sets the display in the template view to a specific size. This makes it easier to see the transitions occur when scrolling through the stations.

23. **<R>** in the template view of the Roadway Designer dialog box and select **Display Properties** from the menu.
24. Toggle on **Center Backbone**.
25. Key in **75%** (.75) for the ***Backbone Screen Width***.
26. **Select 5** for the ***Vertical Exaggeration.***
27. **<D> OK**. This makes the template change easier to see when scrolling through the stations.



28. Scroll through the stations between 220+00.00 and 231+50.00 and notice how the template behaves.

29. Select **File > Save** from the Roadway Designer menu bar.

Lab 13.2 - Creating a Scab-On Detour using Point Controls

In this exercise a scab-on detour is added to the left side of the existing pavement from station 206+00 to 215+00. This requires a new corridor, template drop, and two sets of point controls. One is a horizontal and vertical control that follows the existing edge of pavement. The second is a horizontal offset control that transitions the detour to its full width.

1. Select **Corridor > Corridor Management** from the Roadway Designer menu bar or **<D>** the **Manage Corridors** button .

2. In the ***Manage Corridors*** dialog box, key in ***Scab-on Detour*** for the ***Name***.

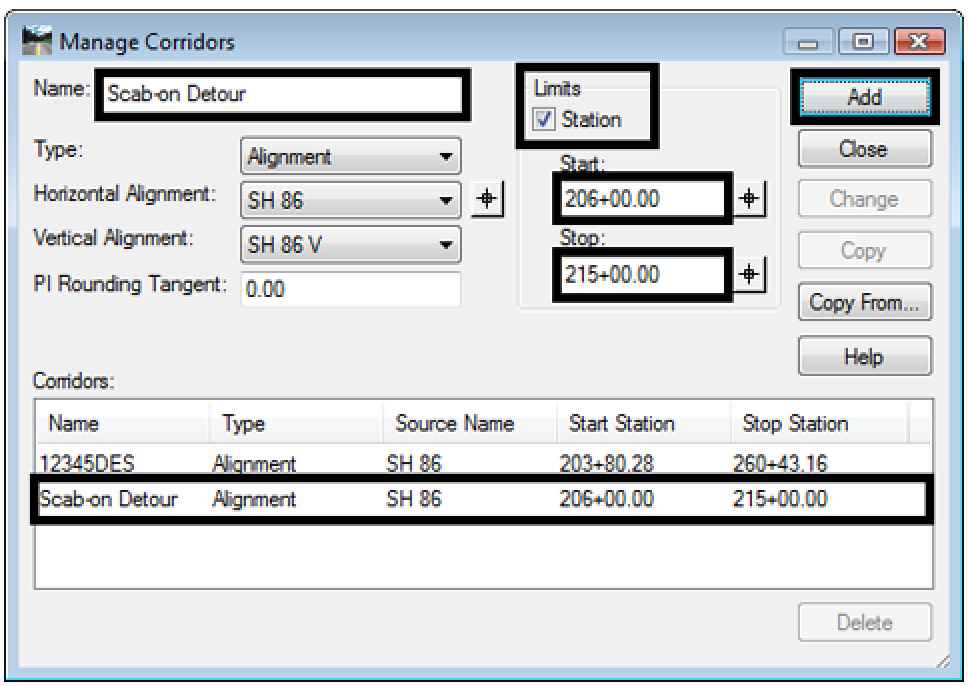
3. Toggle on the ***Station Limits***.

4. Key in ***206+00.00*** for the ***Start*** station.

5. Key in ***215+00.00*** for the ***Stop*** station.

6. **<D> Add**.

7. **<D> Close**.



This corridor could have been built on the edge of pavement feature from the dtm, but by using the alignment it will be easier to locate stations.

8. Select **Corridor > Template Drops** from the Roadway Designer menu bar or **<D>** the **Template Drops** button 

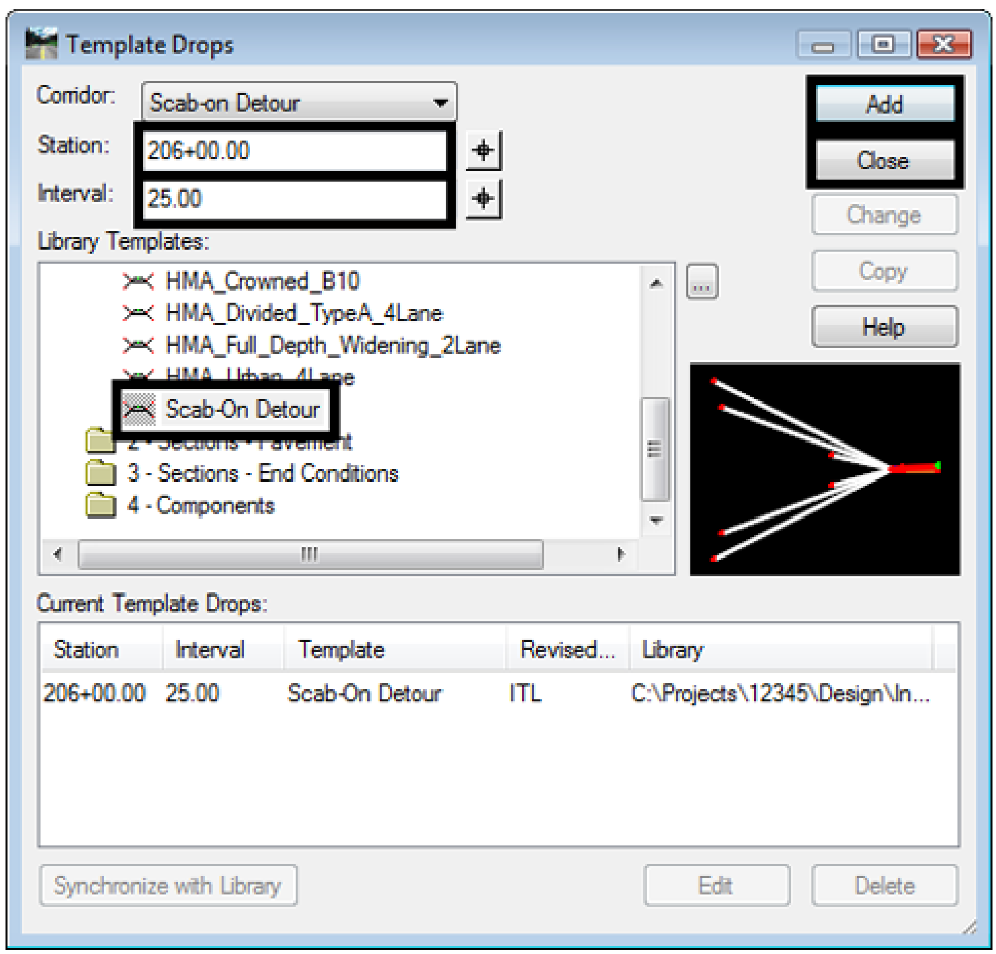
9. In the ***Template Drops*** dialog box, key in ***206+00.00*** for the ***Station***.

10. Key in ***25*** for the ***Interval***.

11. Expand the **C:\Projects\12345\Design\InRoads\DES12345-Templates.itl > 1- Templates** folder in the ***Library Templates*** area and highlight the **Scab-on Detour** template.

12. **<D> Add**.

13. **<D> Close**.



The first point control moves the origin of the template from the SH 86 alignment to the left edge of pavement feature in the 12345 Existing Ground surface.

14. In the Roadway Designer dialog box, select **Corridor > Point Controls** from the menu bar or **<D>** the point controls button.

15. In the ***Point Controls*** dialog box, select **HMA_Lift1_Shoulder-Top** for the ***Point***.

16. Toggle on **Both** for the ***Mode***.

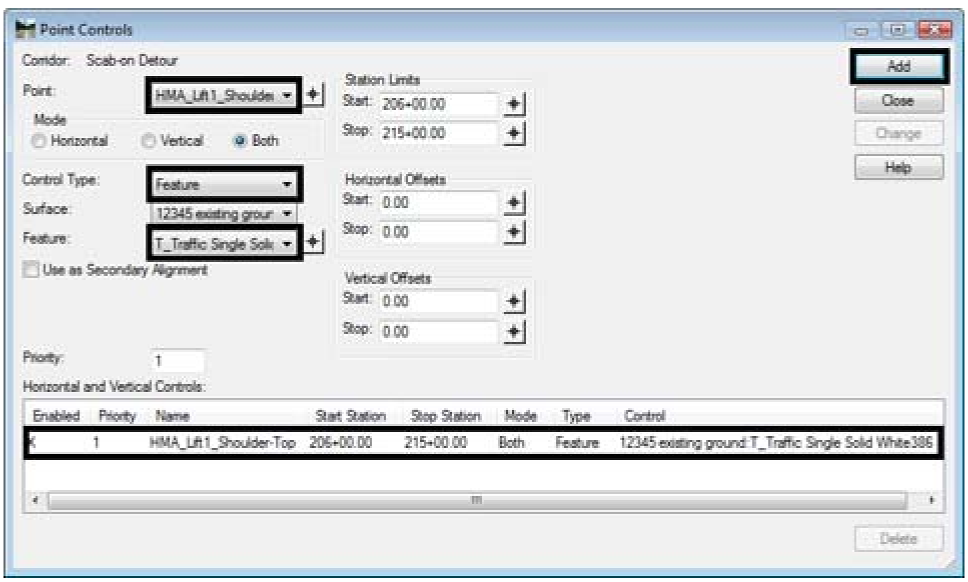
17. Select **Feature** for the ***Control Type***.

18. Select **T_Traffic Single Solid White386** for the feature (This is the 18th T_Traffic Single Solid in the pull down list).

    Note: Creating a feature filter will make it easier to locate the desired feature. The filter should ***Start With*** **None**, use the **Name** ***Attribute***, and have a ***Value*** of ****386****. See the module *"Initial Surface Procedures"* of the *"Practical Guide for InRoads V8i"* for more information in feature filters.

    Note: The 12345 existing ground surface is the only dtm loaded so it is selected by default.

19. **<D> Add**.



Notice that the template has moved to approximately 12 feet to the left. Next, a horizontal point control is created that transitions the detour to its full width.

20. In the ***Point Controls dialog*** box, set the ***Point*** to **LT_HMA_Lift1_EOP-Top**.

21. Toggle on **Horizontal** for the ***Mode***.

22. Set the ***Control Type*** to **Alignment**.

23. Set the ***Horizontal Alignment*** to **SH 86**.

24. In the ***Station Limits*** area, key in ***206+00.00*** for the ***Start*** station.

25. Key in ***208+50.00*** for the ***Stop*** station.

26. In the ***Horizontal Offsets*** area, key in ***-11.93*** for the ***Start*** offset.

27. Key in ***-24.00*** for the ***Stop*** offset.

28. **<D> Add**.

The Point, Mode, Control Type, and Horizontal Alignment stay the same for the two remaining entries. Only the Stations and Offsets change. The steps below create a point control that maintains the detour's full width.

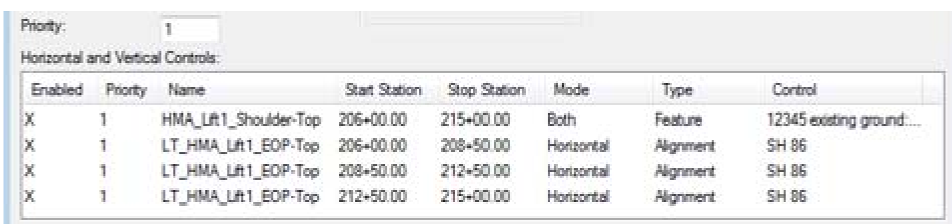
29. Key in ***208+50.00*** in the ***Station Limits Start*** field.
30. Key in ***212+50.00*** in the ***Station Limits Stop*** field.
31. Key in ***-24.00*** in the ***Horizontal Offsets Start*** field.
32. Key in ***-24.00*** in the ***Horizontal Offsets Stop*** field.
33. **<D> Add**. This entry maintains the full width of the additional lane.

The final point control transitions from the full width to the end of the detour.

34. Key in ***212+50.00*** in the ***Station Limits Start*** field.
35. Key in ***215+00.00*** in the ***Station Limits Stop*** field.
36. Key in ***-24*** in the ***Horizontal Offsets Start*** field.
37. Key in ***-12.22*** in the ***Horizontal Offsets Stop*** field.

Note: The offset distances entered are measured from the specified Horizontal alignment and not from the origin of the template.

38. **<D> Add**.



Priority: 1

Horizontal and Vertical Controls:

Enabled	Priority	Name	Start Station	Stop Station	Mode	Type	Control
X	1	HMA_Lift1_Shoulder-Top	206+00.00	215+00.00	Both	Feature	12345 existing ground:...
X	1	LT_HMA_Lift1_EOP-Top	206+00.00	208+50.00	Horizontal	Alignment	SH 86
X	1	LT_HMA_Lift1_EOP-Top	208+50.00	212+50.00	Horizontal	Alignment	SH 86
X	1	LT_HMA_Lift1_EOP-Top	212+50.00	215+00.00	Horizontal	Alignment	SH 86

39. **<D> Close** to dismiss the ***Point Controls*** dialog box.

Scroll through the stations and notice how the template behaves. From station 206+00 to station 208+50 the template expands from the existing edge of pavement until it reaches its full width. Then it maintains that width from station 208+50 to station 212+50. Finally, it contracts back to the pavement edge from station 212+50 to station 215+00.

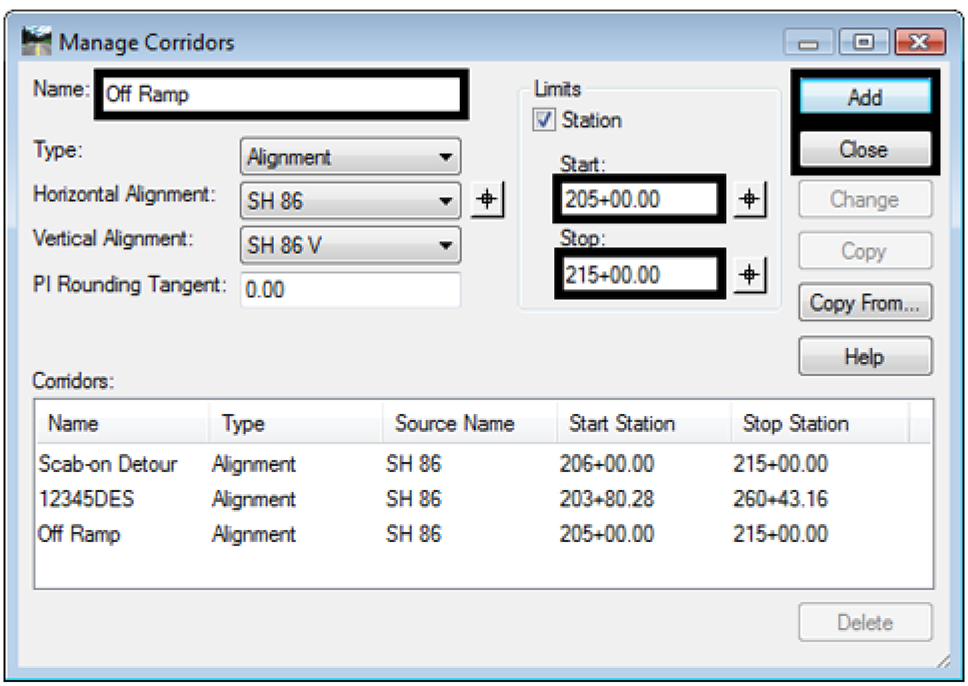
40. Select **File > Save** from the Roadway Designer menu bar.

Lab 13.3 - Using Horizontal Point Control and a Secondary Alignment

Alignments other than the design centerline can be used for horizontal controls. Typically, they are used to modify the width of the template. They can also be used to change the direction (in relation to the design centerline) that the template components are placed. When an alignment is used in this manner, it is called a secondary alignment.

This exercise uses a secondary alignment to create the beginning of an off ramp. A new corridor is created using the SH 86 alignment.

1. Select **Corridor > Corridor Management** from the Roadway Designer menu bar or **<D>** the **Corridor Management** button.
2. In the ***Manage Corridors*** dialog box, key in ***Off Ramp*** for the ***Name***.
3. Toggle on the ***Station Limits***.
4. Key in ***205+00.00*** for the ***Start*** station.
5. Key in ***215+00.00*** for the ***Stop*** station.
6. **<D> Add**.
7. **<D> Close**.



A single template drop is required for this corridor.

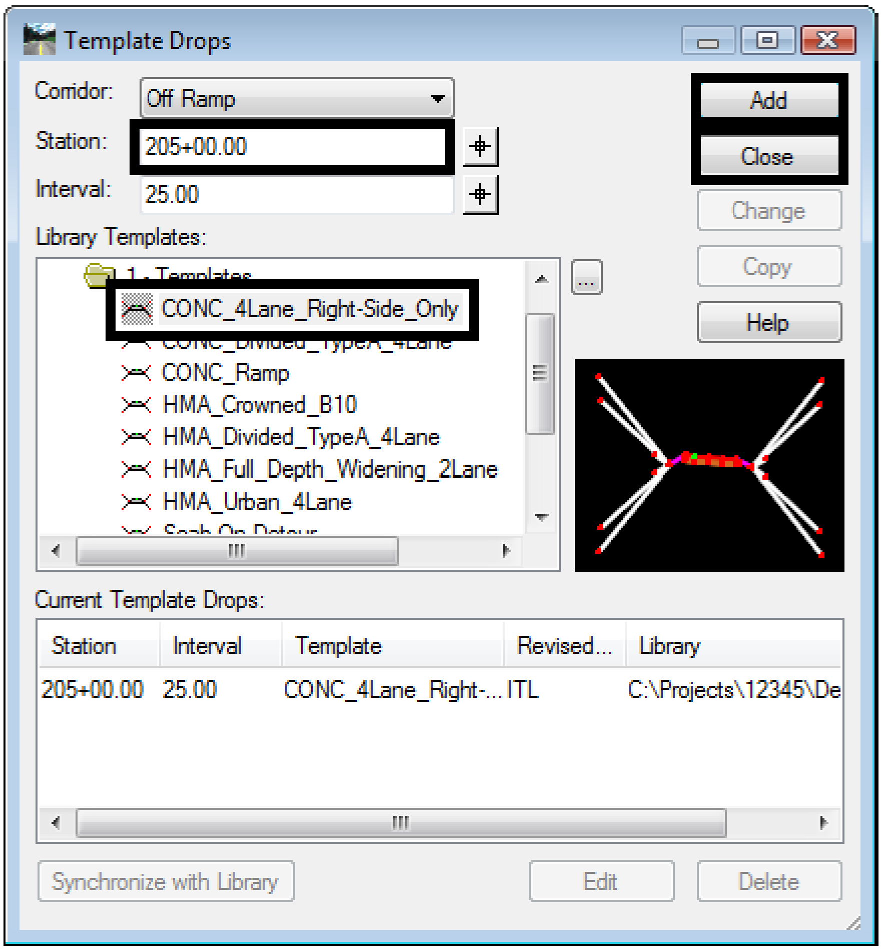
8. Select **Corridor > Template Drops** from the Roadway Designer menu bar or **<D>** the **Template Drops** button.
9. In the ***Template Drops*** dialog box, key in ***205+00.00*** for the ***Start*** station.

10. Key in ***25*** for the ***Interval***.

11. Expand the **C:\Projects\12345\Design\InRoads\DES12345-Templates.itl > 1- Templates** folder in the ***Library Templates*** area and highlight the **CONC_4Lane_Right-Side_Only** template.

12. **<D> Add**.

13. **<D> Close**.



A horizontal point control is used to widen the template and reposition its components perpendicular to the Off Ramp alignment.

14. In the Roadway Designer dialog box, select **Corridor > Point Controls** from the menu bar or **<D>** the point controls button.

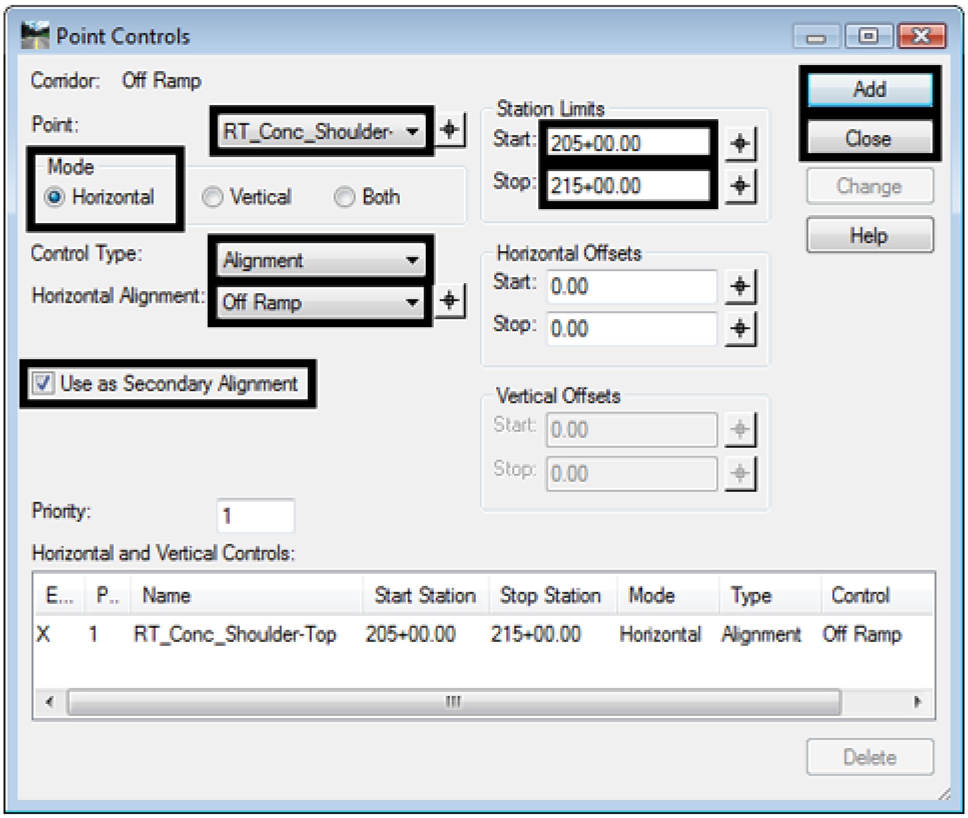
15. In the ***Point Controls*** dialog box, select **RT_Conc_Shoulder-Top** for the ***Point***.

16. Toggle on **Horizontal** for the ***Mode***.

17. Select **Alignment** for the ***Control Type***.

18. Select **Off Ramp** for the ***Horizontal Alignment***.

19. In the Station Limits area, key in ***205+00.00*** for the ***Start*** station.
20. Key in ***215+00.00*** for the ***Stop*** station.
21. Make sure the ***Horizontal Offsets*** are set to ***0***.
22. Toggle on **Use as Secondary Alignment**.
23. **<D> Add**.
24. **<D> Close**.



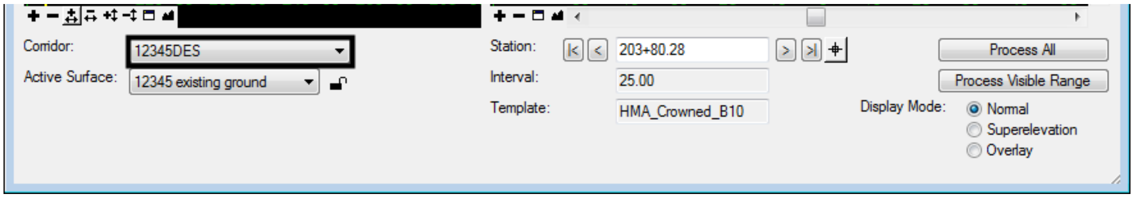
25. Scroll through the stations between ***205+00.00*** and ***215+00.00*** and notice how the template behaves. The orange line in the plan view and the template view represents the Off Ramp alignment. Notice how the template line (the yellow line in the plan view) outside the Off Ramp alignment changes so that it is perpendicular to the Off Ramp alignment.
26. Select **File > Save** from the ***Roadway Designer*** menu bar.

Lab 13.4 - Using Parametric Constraints to Widen the Road Surface

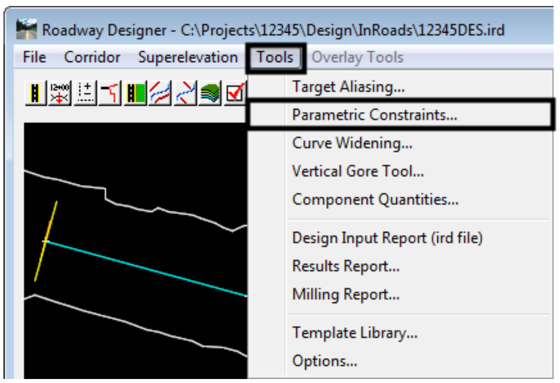
Parametric Constraints are used to modify the value of the constraint. This option allows greater flexibility of what can be modified during processing as slopes and vector/offsets can be modified in addition to the usual horizontal and vertical controls. In this exercise, the ***Horizontal Constraint*** of a template point is modified to widen the template on the left side. This is done in a similar manner to the first exercise.

The corridor used in Lab 6.1 is also used here.

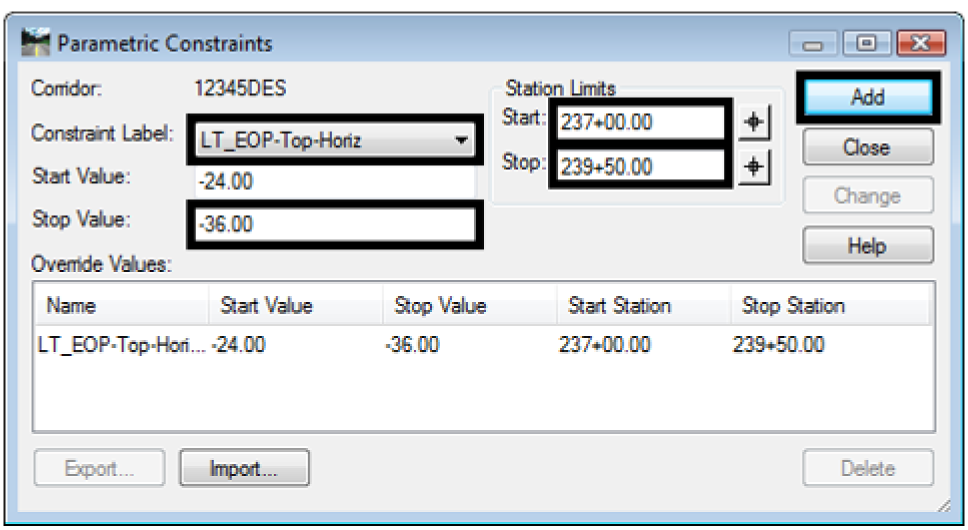
1. In the Roadway Designer dialog box, select **12345DES** for the corridor.



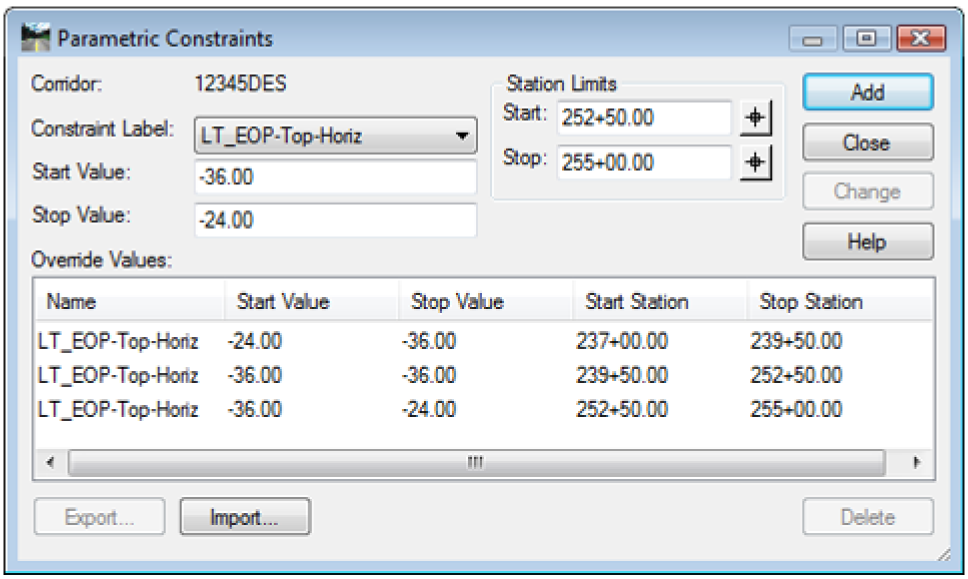
2. Select **Tools > Parametric Constraints** from the Roadway Designer menu bar.



3. In the ***Parametric Constraints*** dialog box, select **LT_EOP-Top-Horiz** for the ***Constraint Label***.
4. Key in ***-36*** for the ***Stop Value*** (the ***Start Value*** stays the same for this entry).
5. In the ***Station Limits*** area, key in ***237+00.00*** for the ***Start*** station.
6. Key in ***239+50.00*** for the ***Stop*** station.
7. **<D> Add**.



8. Key in ***-36*** for the ***Start Value*** (the ***Stop Value*** stays at -36).
9. In the ***Station Limits*** area, key in ***239+50.00*** for the ***Start*** station.
10. Key in ***252+50.00*** for the ***Stop*** station.
11. **<D> Add**.
12. Key in ***-24*** for the ***Stop Value*** (the ***Start Value*** stays at -36).
13. In the ***Station Limits*** area, key in ***252+50.00*** for the ***Start*** station.
14. Key in ***255+00.00*** for the ***Stop*** station.
15. **<D> Add**.
16. **<D> Close**. This dismisses the ***Parametric Constraints*** dialog box.



17. Scroll through the stations between ***237+00.00*** and ***255+00.00*** and notice how the template behaves.
18. Select **File > Save** from the ***Roadway Designer*** menu bar.
19. **<D> Close** to dismiss the Roadway Designer dialog box.

Chapter Summary:

- In *Lab 13.1 -Adding an Additional Lane with Offset Point Controls* Horizontal Point Controls were used to add an additional lane to the design. The control was based off the design centerline with offset distances measured from that alignment.
- *Lab 13.2 -Creating a Scab-On Detour using Point Controls* a Horizontal and Vertical Point Control was created to locate a template on the edge of the existing pavement. The edge of pavement feature from the existing ground surface was used to locate the template. A horizontal control based off the design centerline was also used to transition the template, creating the scab-on detour.

- In *Lab 13.3 -Using Horizontal Point Control and a Secondary Alignment* a Horizontal Point Control using a Secondary Alignment was created. By changing the angle of the components outside of the secondary alignment, their shape is maintained around curves making this option ideal for ramps and street returns.
- *Lab 13.4 -Using Parametric Constraints to Widen the Road Surface* used Parametric Constraints to widen the road surface. The results were similar to those achieved in the first exercise but a different method was used.

LAB 14 - Template Transitions and End Condition Overrides

This lab demonstrates how template transitions and end condition overrides are set up. Template transitions are used to make a smooth change from one template to another. End condition overrides are used to make changes in end conditions without having to create a new template.

Chapter Objectives:

- Set up a template to template transition.
- Create an end condition transition.
- Create an end condition override.

Before beginning this lab, verify that the following files are loaded:

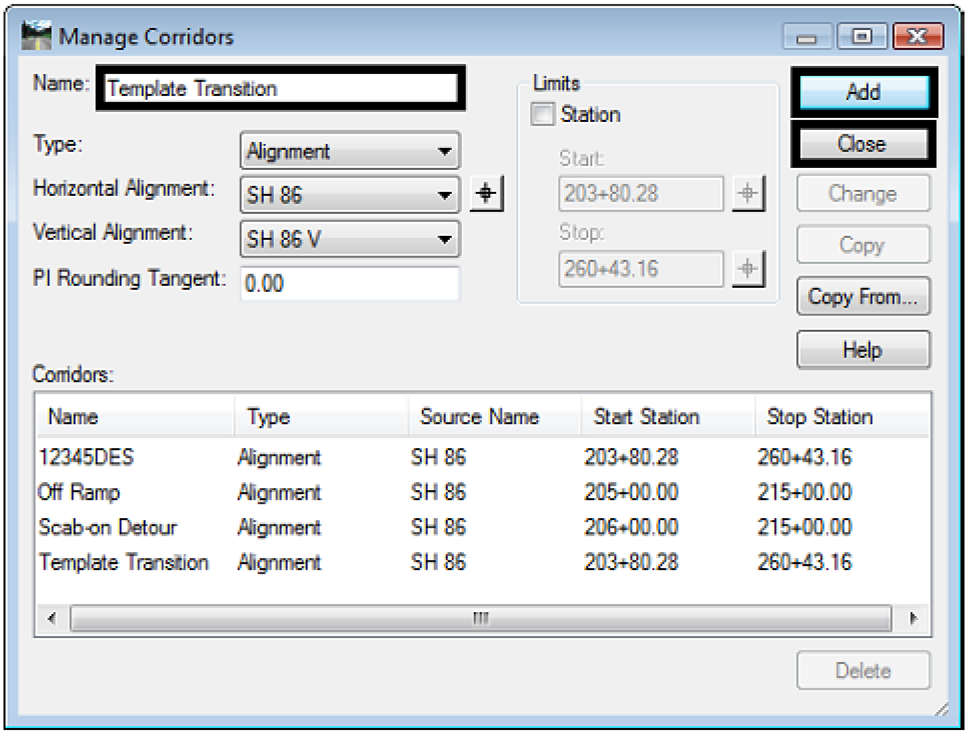
- C:\Projects\12345\Design\Drawings\Reference_Files\12345DES_Model.dgn
- C:\Workspace\Workspace-CDOT_V8i\Standards-Global\InRoads\Preferences\CDOT_Civil.xin
- C:\Projects\12345\Design\InRoads\12345DES_Geometry.alg
- C:\Projects\12345\Design\InRoads\12345 existing ground.dtm
- C:\Projects\12345\Design\InRoads\12345DES.ird
- C:\Projects\12345\Design\InRoads\DES12345_Templates.itl

Lab 14.1 - Set Up a Template to Template Transition

In this exercise a new corridor is defined with two template drops. The transition area is identified in the plan view by a colored block at the transition location. The transition between the templates is defined using this block.

1. Select **Modeler > Roadway Designer** from the InRoads menu bar.
2. Select **Corridor > Corridor Management** from the Roadway Designer menu bar or **<D>** the corridor management button .
3. In the ***Manage Corridors*** dialog box, key in ***Template Transition*** in the Name field.
4. **<D> Add**.

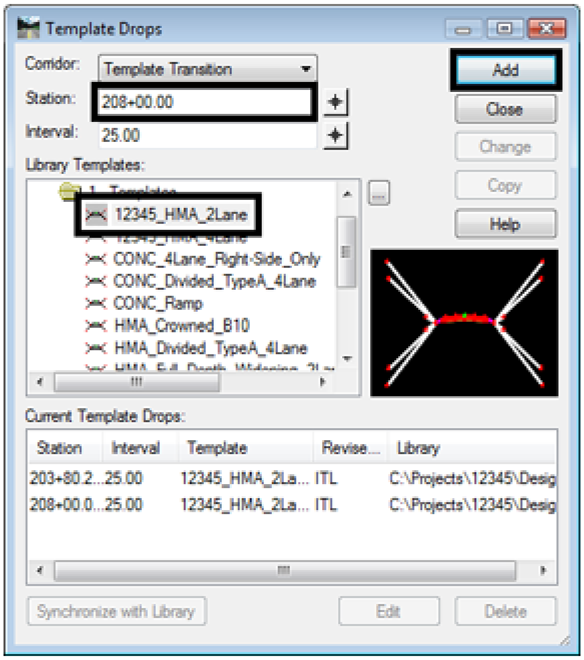
5. **<D> Close**.



Next, the template drops are defined. The first template requires two template drops, one at the beginning of the project and the second at the beginning of the transition.

6. Select **Corridor > Template Drops** from the Roadway Designer menu bar or **<D>** the template drops button .
7. Select ***Template Transition*** for the corridor name.
8. Key in ***25*** for the ***Interval***.
9. Expand the **1- Templates** folder in the ***Library Templates*** area.
10. **<D>** on the **12345_HMA_2Lane** template.
11. **<D> Add**.
12. In the ***Template Drops*** dialog box, key in ***208+00.00*** for the ***Station***.
13. **<D>** on the **12345_HMA_2Lane** template.

14. **<D> Add**.



The final template drop is used from the end of the transition to the end of the project.

15. In the ***Template Drops*** dialog box, key in ***211+00.00*** for the ***Station***.

16. **<D>** on the **12345_HMA_4Lane** template.

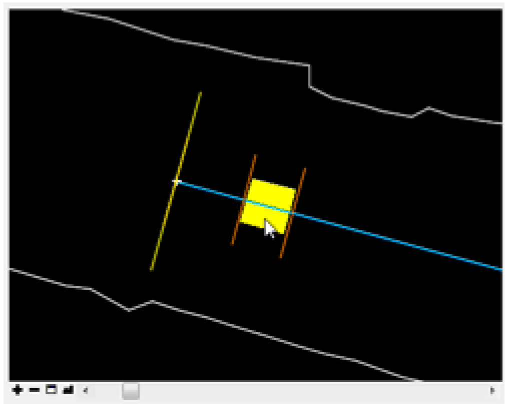
17. **<D> Add**.

18. **<D> Close**.

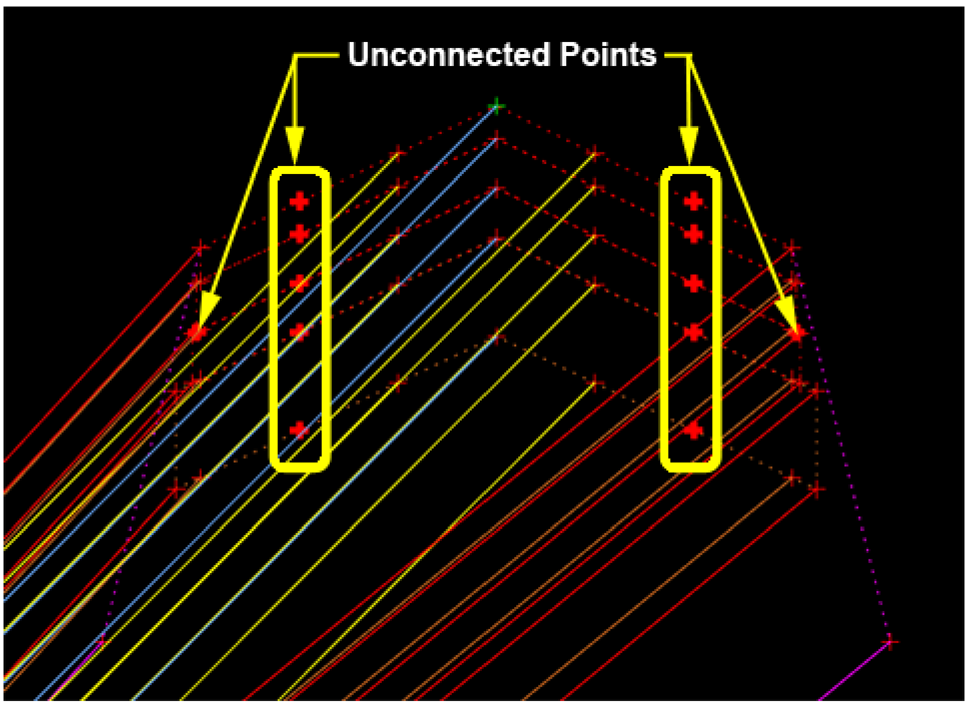
Note: Notice in the Plan view a yellow box has been displayed. This is the area of the transition. The yellow indicates that some of the points have been connected between the templates. Next, the remainder of the points are connected.

The color coding indicates that not all of the template points are connected. The steps blow connect the remaining unconnected points.

19. **<D> <D>** on the transition area. This displays the ***Edit Transition – 208+00.00 to 211+00.00*** dialog box.

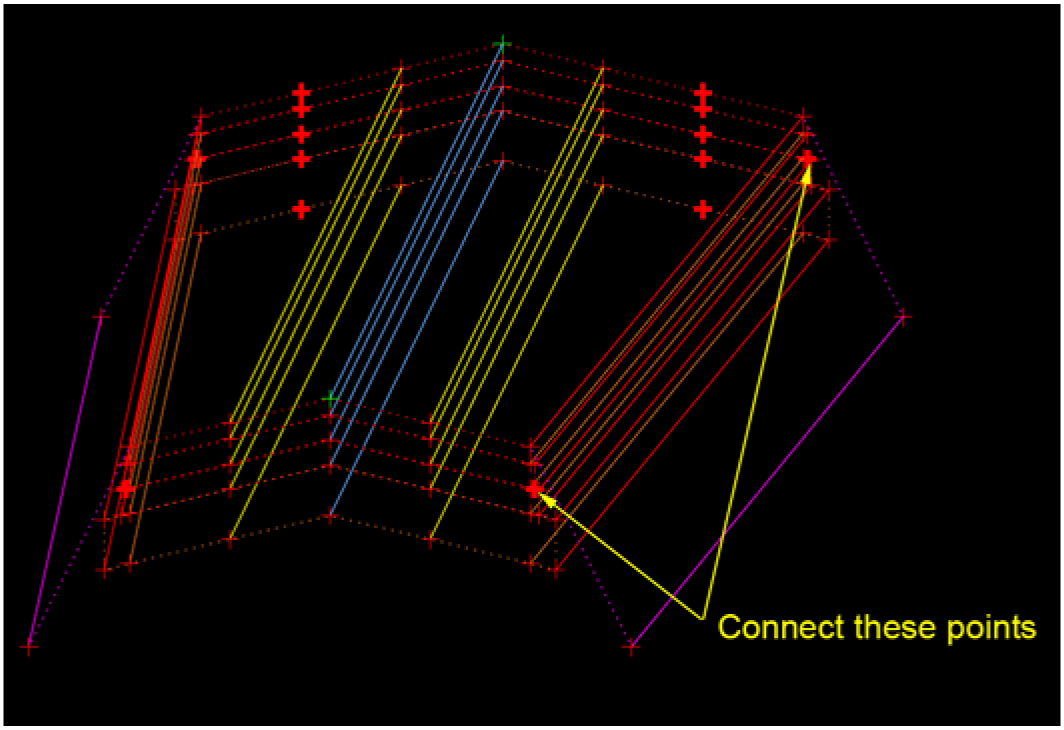


The display in the ***Edit Transition – 208+00.00 to 211+00.00*** dialog box shows the connections between points and the points that are not connected. The illustration below shows examples of unconnected points.



20. Zoom in on the bold "+" on the right side of the bottom template.
21. **<D>** on the "**+**". A line is attached to the "+" and the pointer.
22. Zoom out, then zoom in on the corresponding point on the upper template.

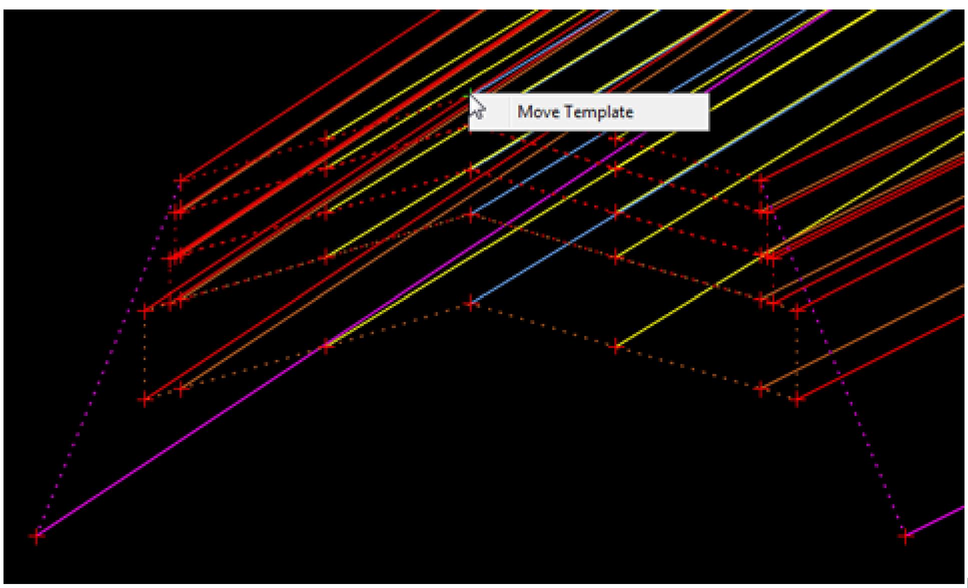
23. **<D>** on the "**+**". The line is now attached to the "+" and it is unbolded.



24. Repeat steps 19 through 22 on the left side.

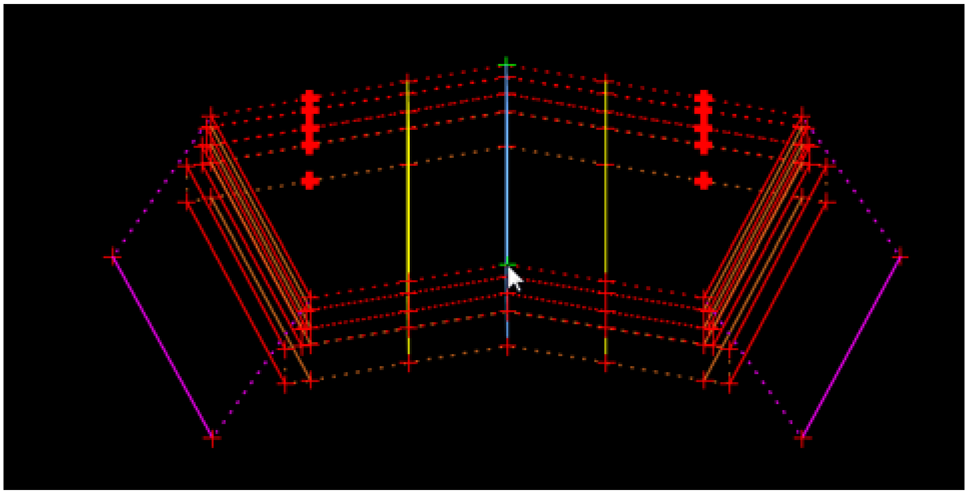
    All of the points on the bottom template have been attached to points on the top template. However, points on the top template remain unconnected. These are connected to the appropriate laneline points of the bottom template.

25. **<R>** on the green "**+**" on the bottom template and select **Move Template**.

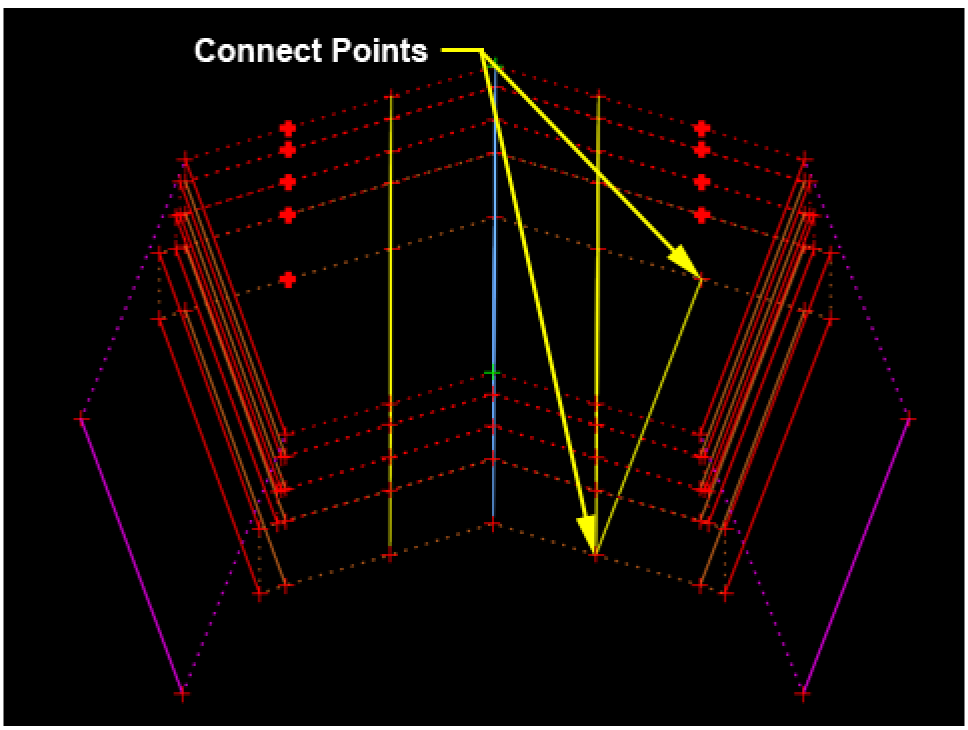


26. Move the bottom template so that it is easier to see the points to be connected.

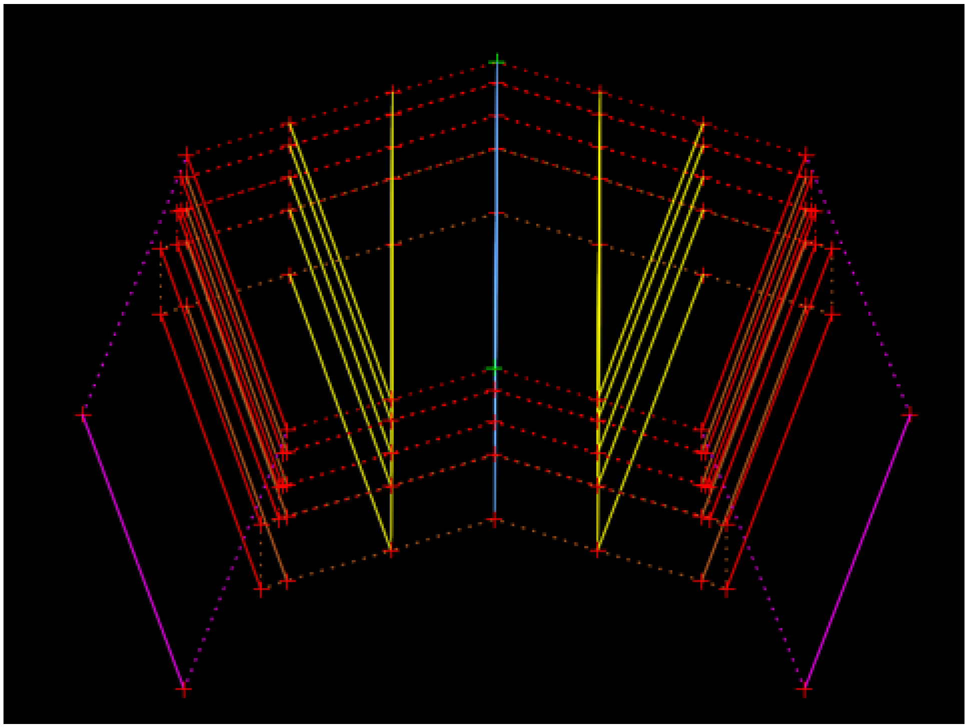
27. **<D>** to complete the move.



28. Starting at the bottom of the template, connect the outside lanelines on the four lane template to the lanelines on the two lane template.



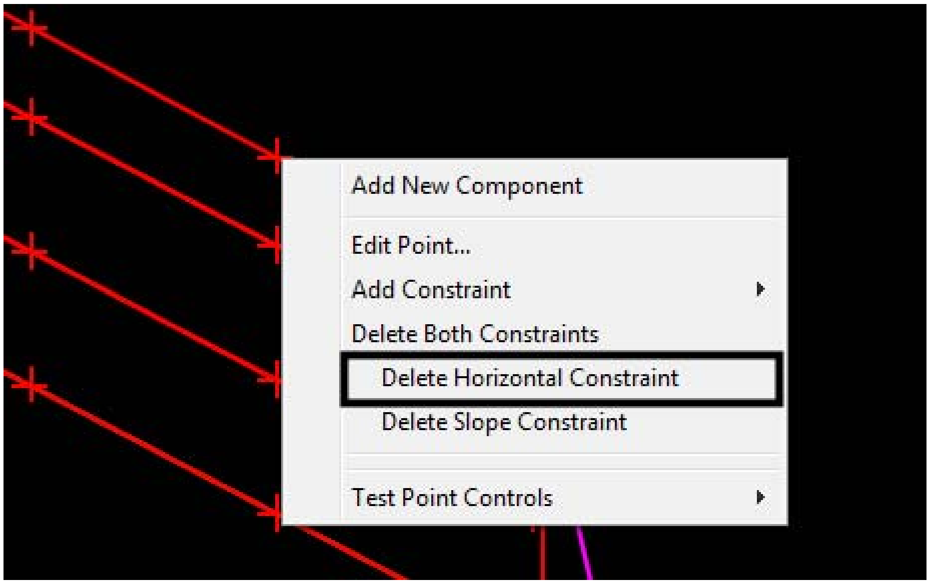
29. Connect the remaining points as shown below.



30. **<D> OK**. This displays the ***Edit Transition Midpoint – 208+00.00 to 211+00.00*** dialog box.

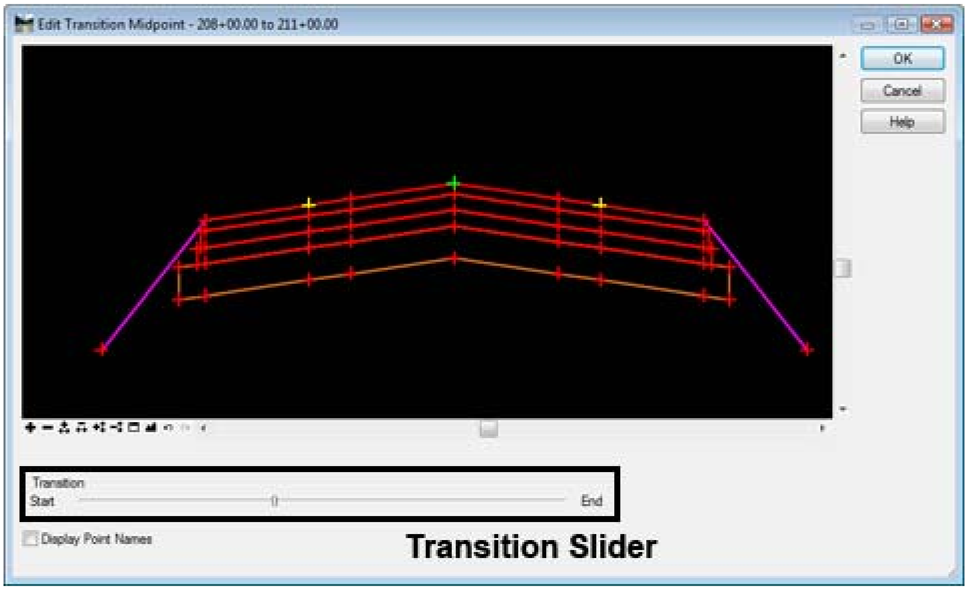
    In order for the transition to function properly, the horizontal constraints on the lanelines must be deleted.

31. **<R>** on the **RT_HMA_Lift1_Laneline-Top1** point and select **Delete Horizontal Constraint** from the menu.



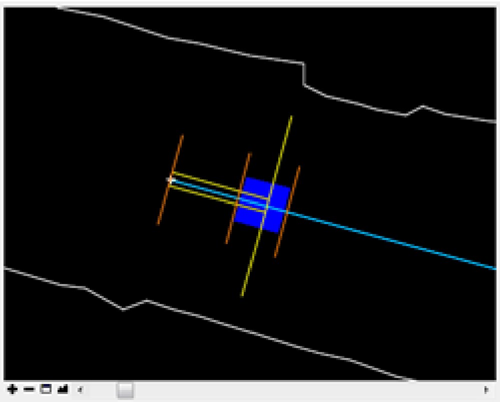
32. **<R>** on the **LT_HMA_Lift1_Laneline-Top1** point and select **Delete Horizontal Constraint** from the menu.

33. Move the Transition slider and notice how the template behaves. The additional lane expands and contracts as the slider is moved back and forth.



34. **<D> OK** to complete the transition edit.

    Notice in the plan view that the transition area is now dark blue. This signifies that all of the points are connected.

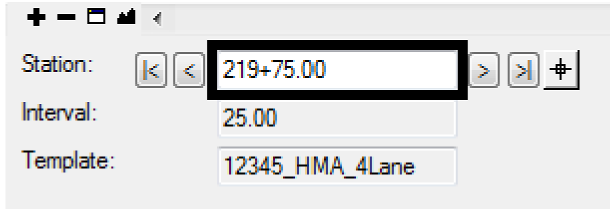


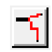
35. Select **File > Save** from the Roadway Designer menu bar.

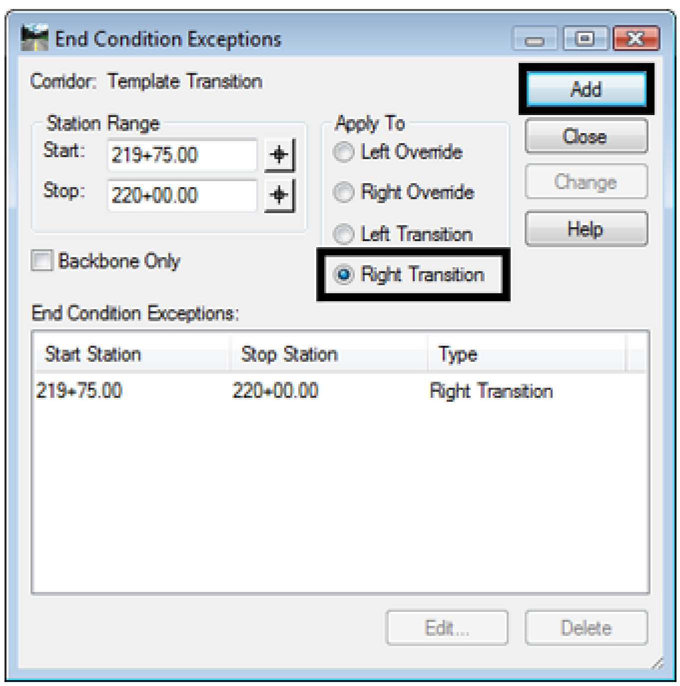
Lab 14.2 - Set Up an End Condition Transition

In this exercise the transition between a cut slope and a fill slope between stations 219+75 to 220+00 is defined. This is done in a similar manner as the transition of two templates but it is accessed differently.

1. In the ***Roadway Designer*** dialog box, use the station indicator to select station **219+75.00**.

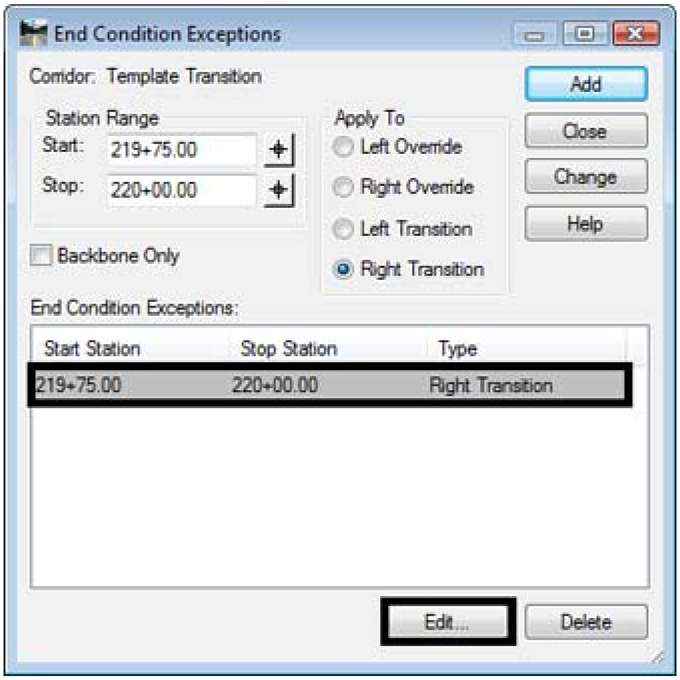


2. Select **Corridor > End Condition Exceptions** from the Roadway Designer menu bar or **<D>** the **End Condition Exceptions** button .
3. In the ***End Condition*** Exceptions dialog box, note that the desired stations are already selected.
4. Toggle on ***Right Transition***.
5. **<D> Add**. This adds the data to the ***End Condition Exceptions*** list.



6. Highlight the entry.

7. **<D> Edit**. This displays the ***Edit Transition – 219+75.00 to 220+00.00 Right*** dialog box.



8. Connect the two bold "**+**" symbols.

9. **<D> OK**. This displays the ***Edit Transition Midpoint – 219+75.00 to 220+00.00 Right*** dialog box.
10. Move the Transition slider and notice how the template behaves.
11. **<D> OK** to complete the transition edit.
12. **<D> Close** to dismiss the End Condition Exceptions dialog box.
13. Select **File > Save** from the Roadway Designer menu bar.

Note: This exercise illustrates the use of the End Condition transition command. Typically, these transitions occur in areas where there is a template change. The transitions between typical cuts and fills do not have to be defined.

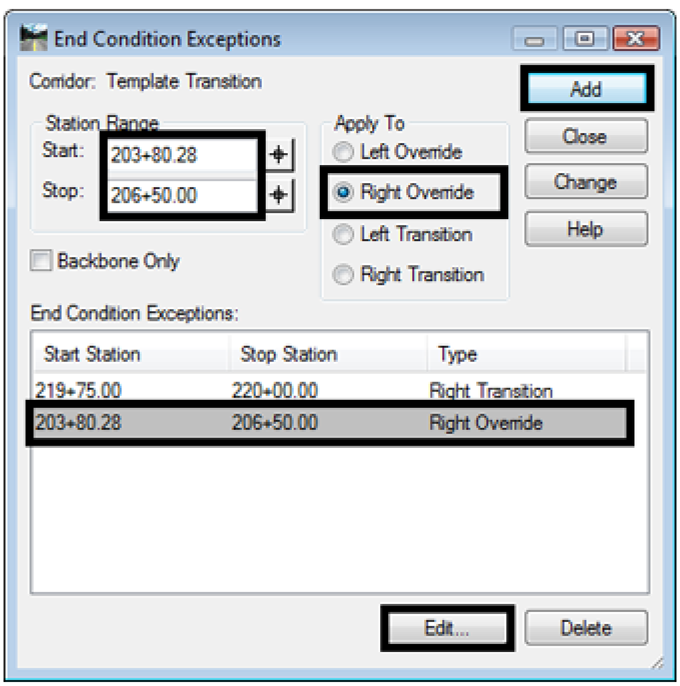
Lab 14.3 - Set Up an End Condition Exception

With using end condition exceptions, end condition points and components can be added, deleted, and/or modified. In this exercise an end condition override is used to create a deeper ditch from station 203+80.28 to 206+50.00. The existing cut slope is deleted and a new end condition is added to extend the ditch foreslope and create the backslope.

1. In the ***Roadway Designer*** dialog box, use the station indicator to select station **203+80.28**.
2. Select **Corridor > End Condition Exceptions** from the Roadway Designer menu bar or **<D>** the **End Condition Exceptions** button.
3. In the ***End Condition Exceptions*** dialog box, key in ***206+50.00*** for the ***Stop*** station (the ***Start*** station is already set).
4. Toggle on ***Right Override***.
5. **<D> Add**. This adds the data to the ***End Condition Exceptions*** list.

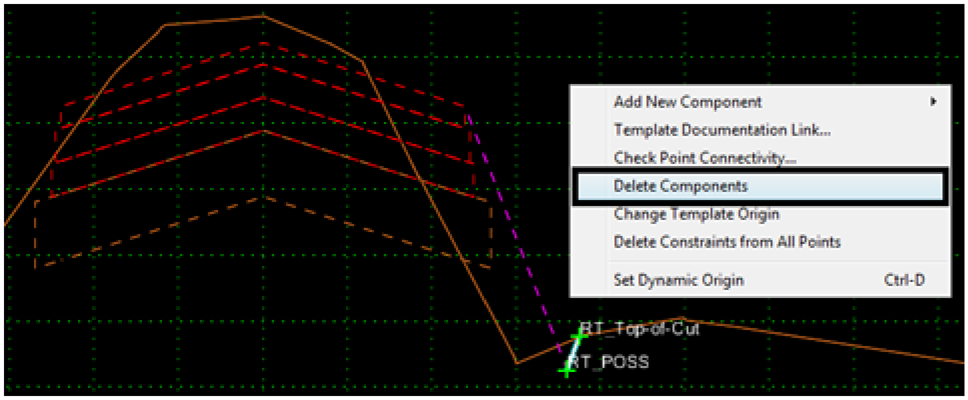
The steps below are used to actually modify the end condition data.

6. Highlight the entry.
7. **<D> Edit**. This displays the ***Right Override – 203+80.28 to 206+50.00*** dialog box.



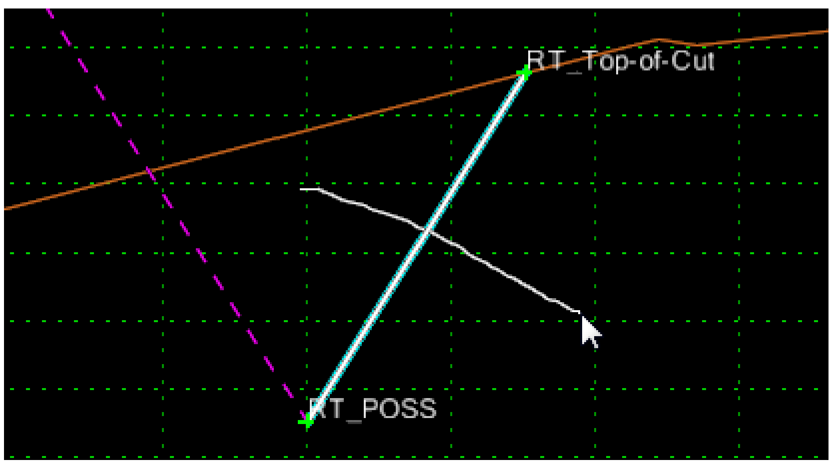
The existing end condition components are deleted from the right side of the template. Deleting the existing components is done in the same way as in the Create Template dialog box. However, when using an end condition override, the backbone components can not be deleted.

8. In the ***Right Override – 203+80.28 to 206+50.00*** dialog box, **<R>** and select **Delete Components**.



9. Zoom in around the existing cut slope component.

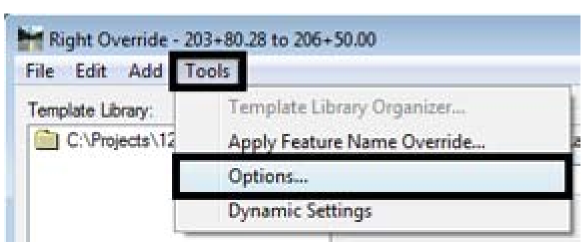
10. **<D> and hold**, then drag a line through the existing cut slope component. Release the mouse button to complete the delete.



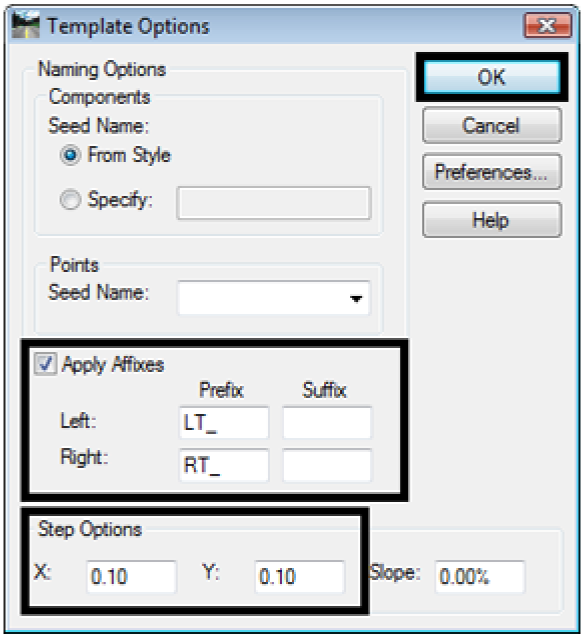
Note: The deleted component remains visible shown in light blue. However it is not incorporated into the model.

Next, the new ditch components are added. Adding new components is done in the same way as in the Create Template dialog box. However, when using an end condition override, only end condition components can be selected.

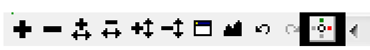
11. Select **Tools > Options** from the menu bar.



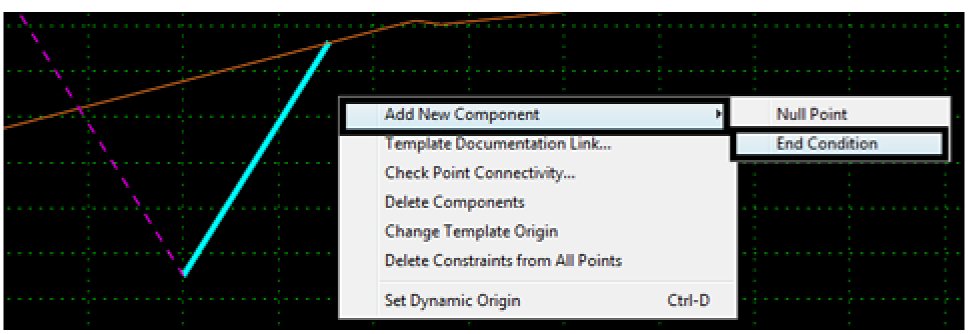
12. Toggle on **Apply Affixes**.
13. Key in ***0.10*** for the ***X*** and ***Y Step Options***.
14. **<D> OK**.



15. **<D>** the **Dynamic Setting button** on the view control button bar. This displays the ***Dynamic Settings*** dialog box.

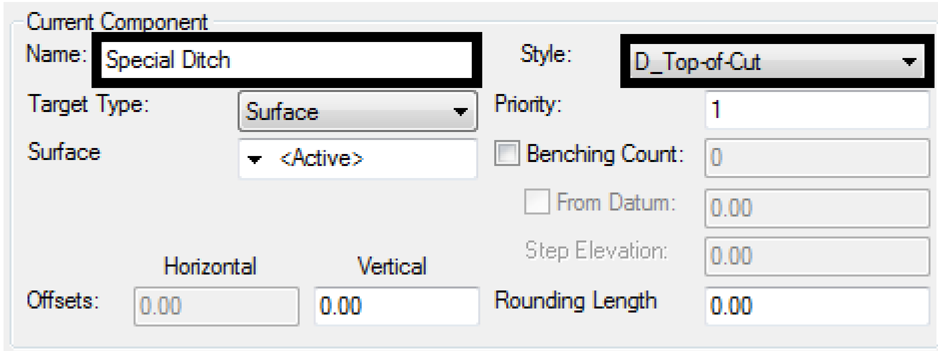


16. **<R>** in the template view and select **New Component > End Condition** from the menu.



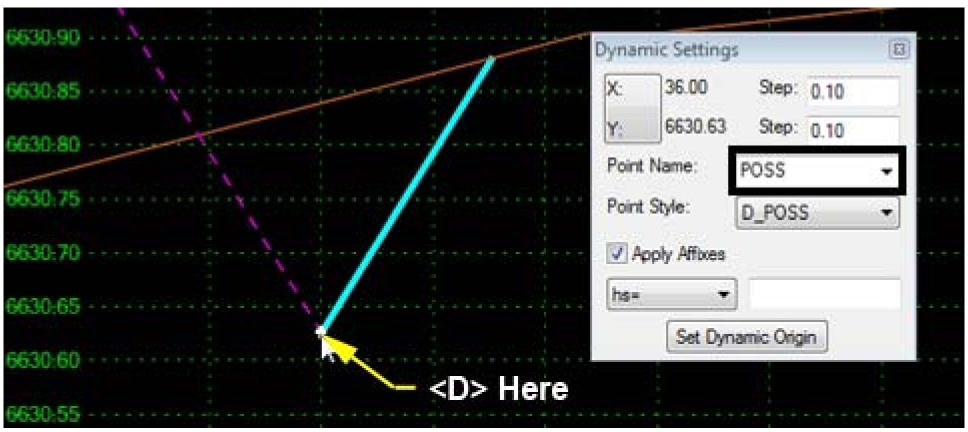
17. In the Current Component area, key in ***Special Ditch*** for the ***Name***.

18. Select **D_Top-of-Cut** for the ***Style***.



19. In the ***Dynamic Settings*** dialog box, select **POSS** for the ***Point Name***.

20. **<D>** on the ***RT_POSS*** point.

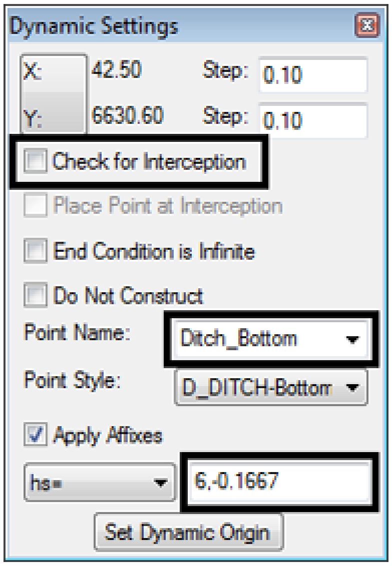


21. In the ***Dynamic Settings*** dialog box, toggle off **Check for Interception**.

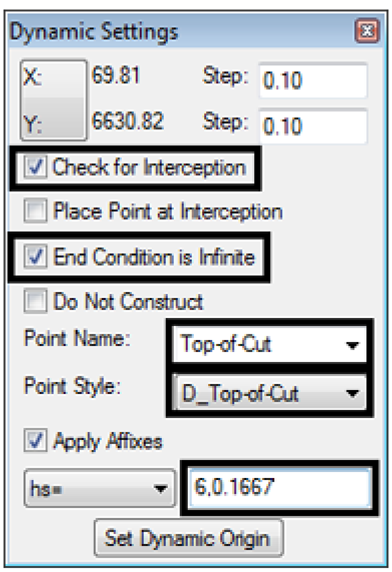
22. Key in ***Ditch_Bottom*** for the ***Point Name***.

23. Set the ***Point Style*** to **D_DITCH-Bottom.**

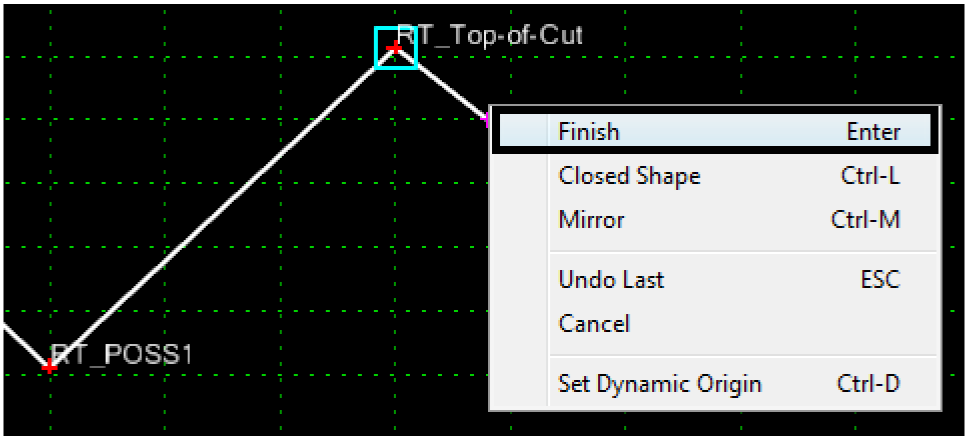
24. In the precision key-in field, key in ***6,-0.1667.***



25. Press the ***Enter*** key.
26. In the ***Dynamic Settings*** dialog box, toggle on **Check for Interception**.
27. Toggle on End Condition is Infinite.
28. Select **Top-of-Cut** for the ***Point Name***.
29. In the precision key-in field, key in ***6,0.1667.***
30. Press the ***Enter*** key.



31. **<R>** in the template view and select **Finish** from the menu.



32. **<D> OK**. This completes the edit of the override.

33. **<D> Close** to dismiss the End Condition Override dialog box.

34. Use the ***Station*** indicator to scroll through the affected stations. Notice the changes.

35. Select **File > Save** from the Roadway Designer menu bar.

36. **<D> Close** to exit the Roadway Designer.

Chapter Summary:

- In *Lab 14.1 -Set Up a Template to Template Transition* the process of setting up a template to template transition was demonstrated. This included the necessary template drops, connecting template points and changing point constraints.
- In *Lab 14.2 -Set Up an End Condition Transition* an end condition transition was built. This involved selecting station a for the transition and connecting end condition points.
- In *Lab 14.3 -Set Up an End Condition Exception* an end condition override was created. This involved selecting a station for the override, deleting existing end condition components, and adding a new component.

LAB 15 - Modifying Single Template Drops and Target Aliasing

This lab demonstrates the procedure for editing a single template drop and setting up a corridor for ***target aliasing***. Modifying single template drops is used for making minor corrections to the design prior to creating a surface. Target aliasing is used to specify alternate targets for end condition interception.

Chapter Objectives:

- Modify a single template drop by moving a point.
- Add a parallel corridor and use target aliasing to tie to the original corridor as needed.

Before beginning this lab, verify that the following files are loaded:

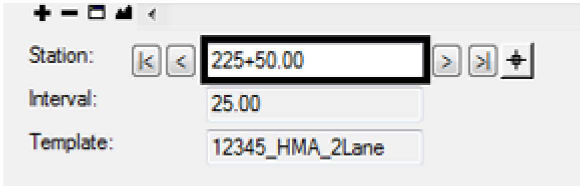
- C:\Projects\12345\Design\Drawings\Reference_Files\12345DES_Model.dgn
- C:\Workspace\Workspace-CDOT_V8i\Standards-Global\InRoads\Preferences\CDOT_Civil.xin
- C:\Projects\12345\Design\InRoads\12345DES_Geometry.alg
- C:\Projects\12345\Design\InRoads\12345 existing ground.dtm
- C:\Projects\12345\Design\InRoads\12345DES.ird
- C:\Projects\12345\Design\InRoads\DES12345_Templates.itl

Lab 15.1 - Modifying a Single Template Drop

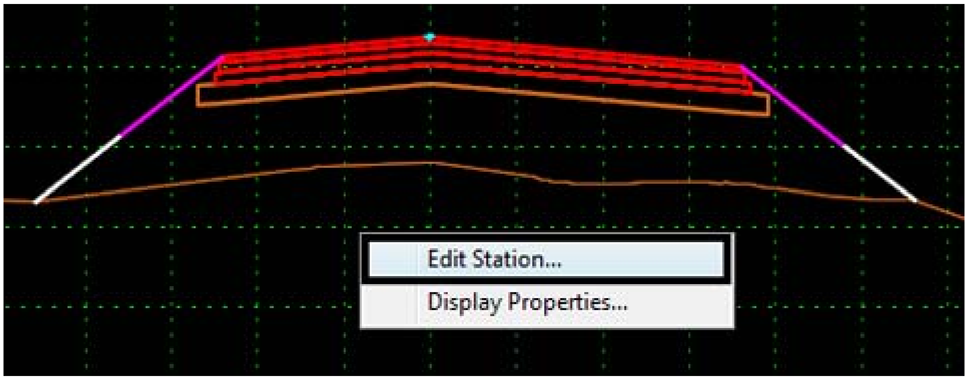
At station ***225+50.00*** the design toe falls inside a small rise in the natural ground creating an area that pools water. This station is edited to move the toe to the top of that rise.

1. Select **Modeler > Roadway Designer** from the InRoads menu bar.
2. Select **12345DES** for the corridor (created in lab 4).

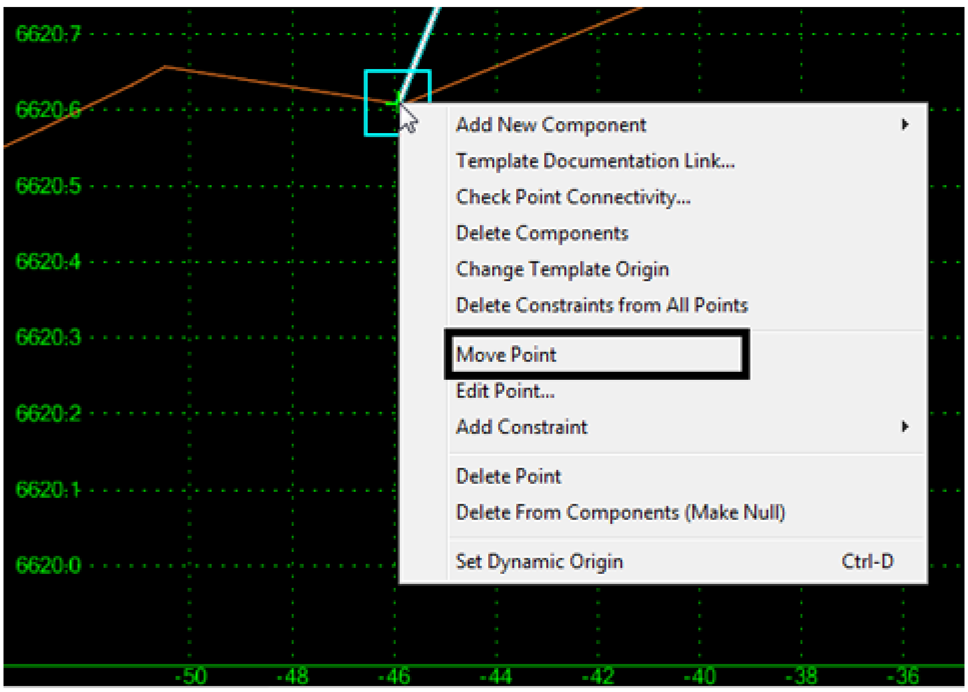
3. Key in **225+50.00** in the Station indicator and press the Tab key.



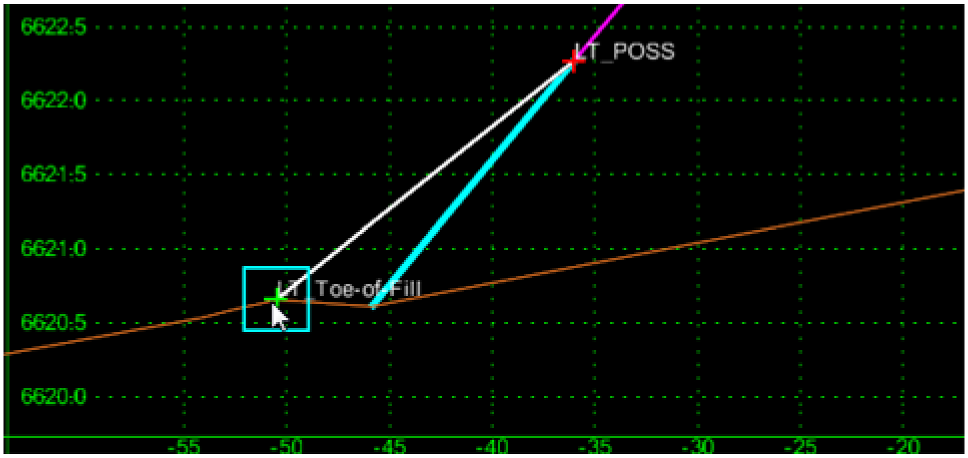
4. **<R>** in the template view and select **Edit Station** from the menu.



5. In the ***Editing Template at Station 225+50.00 Only*** dialog box, **<R>** on the **LT_Toe-of-Fill** point and select **Move Point**.



6. Move the pointer to the small rise approximately 50’ to the left of the centerline. The point snaps to the ground line. **<D>** at that location to complete the move.



7. **<D> OK** to dismiss the ***Editing Template at Station 225+50.00 Only*** dialog box.

8. Select **File > Save**.

This method of modifying template drops should be used sparingly. If there are more than a couple of locations that require editing, modifying the template should be considered over editing single template drops.

Lab 15.2 - Target Aliasing

Target aliasing is used to define multiple targets for an end condition. In this exercise two parallel corridors are constructed. The first corridor ties to the existing ground exclusively. The second corridor ties to the existing ground or the first corridor. This lab uses the ***12345DES*** corridor created in lab 4 in addition to a new corridor created in this lab.

First, the offset corridor is created.

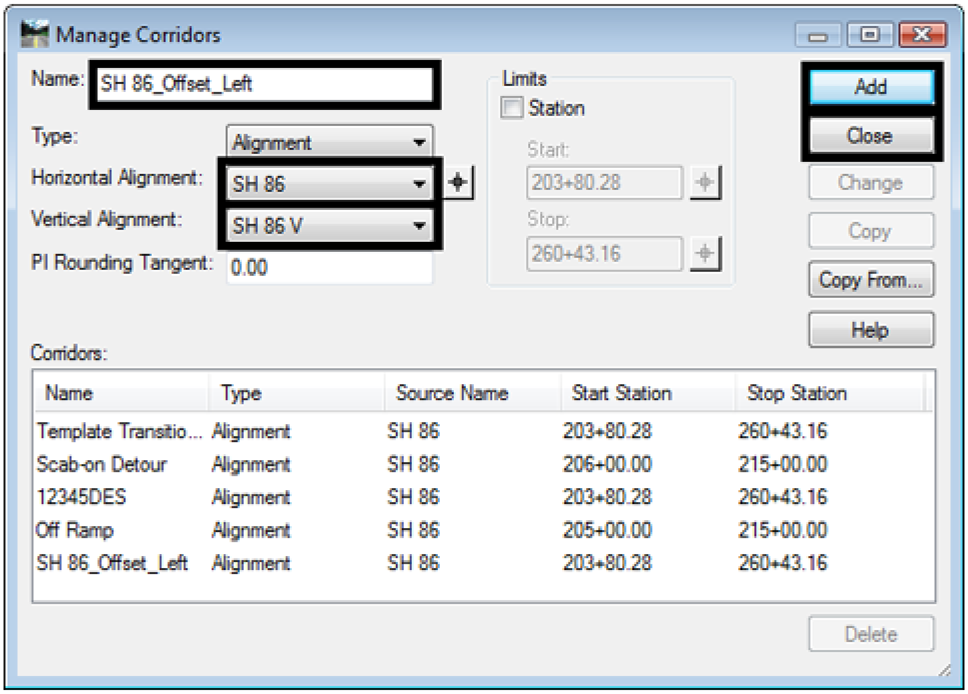
1. Select **Corridor > Corridor Management** from the Roadway Designer menu bar or **<D>** the Corridor Management button.

2. In the Manage Corridors dialog box, key in ***SH 86_Offset_Left*** for the ***Name***.

3. Verify that the ***Horizontal Alignment*** is ***SH 86*** and the ***Vertical Alignment*** is ***SH 86 V***.

4. **<D> Add**.

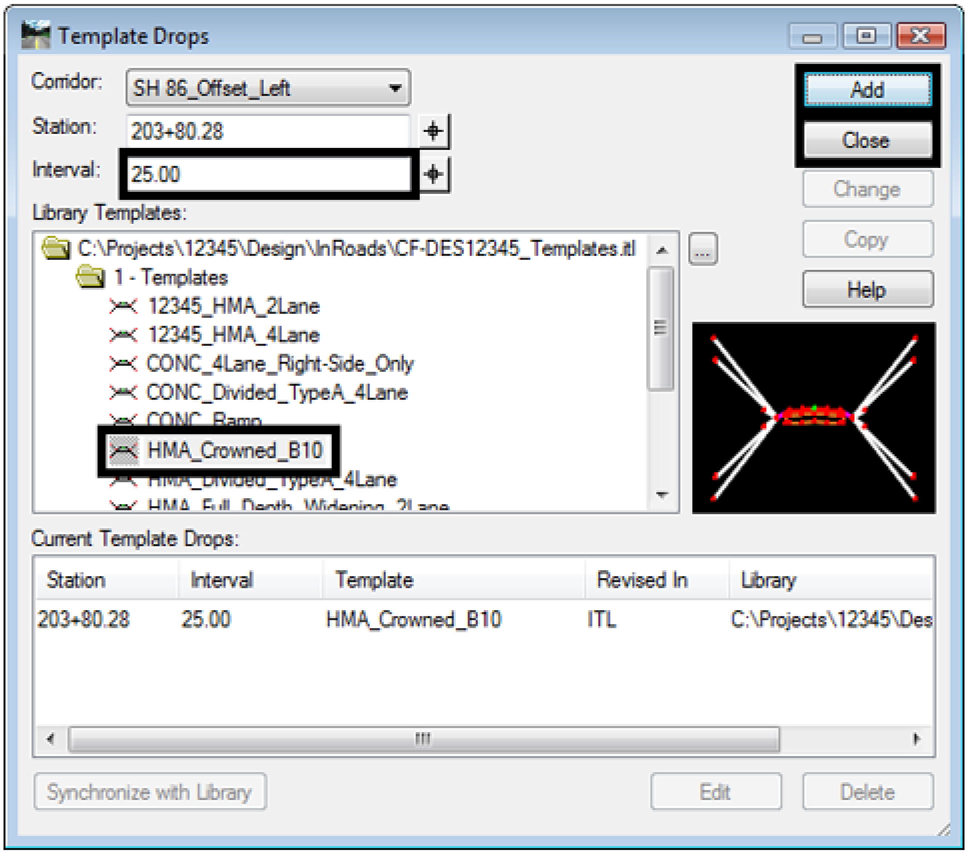
5. **<D> Close**.



A template drop is added to the offset corridor.

6. Select **Corridor > Template Drops** from the Roadway Designer menu bar or **<D>** the Template Drops button.
7. In the ***Template Drops*** dialog box, key in ***25*** for the ***Interval***.
8. Expand the ***1 – Templates*** folder.
9. Highlight the **HMA_Crowned_B10** template.
10. **<D> Add**.

11. **<D> Close**.



The corridor is built on the same alignment as the 12345DES alignment. A point control is used to move ***SH 86_Offset_Left*** corridor 80' to the left.

12. Select **Corridor > Point Controls** from the Roadway Designer menu bar or **<D>** the Point Controls button.

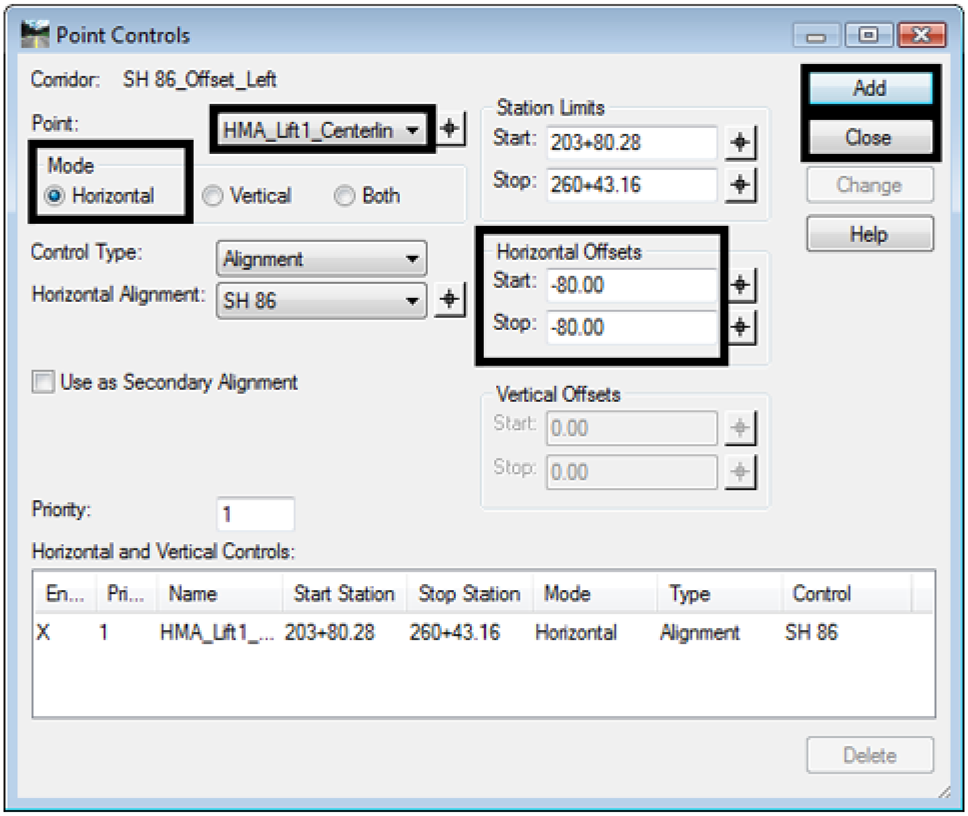
13. In the ***Point Controls*** dialog box, select **HMA_Lift1_Centerline-Top** for the ***Point***.

14. Toggle on **Horizontal** for the Mode.

15. In the ***Horizontal Offsets*** area, key in ***-80*** for both the ***Start*** and ***Stop*** offsets.

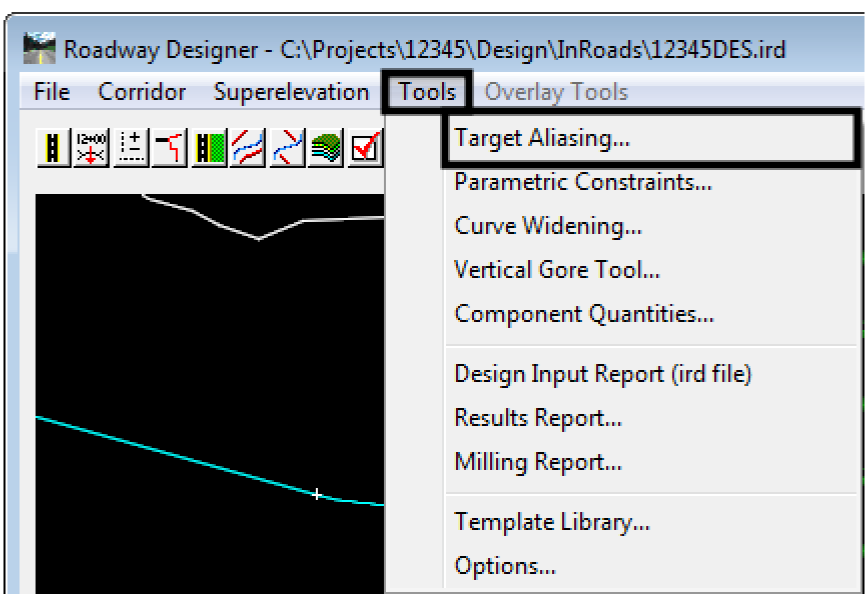
16. **<D> Add**.

17. **<D> Close**.



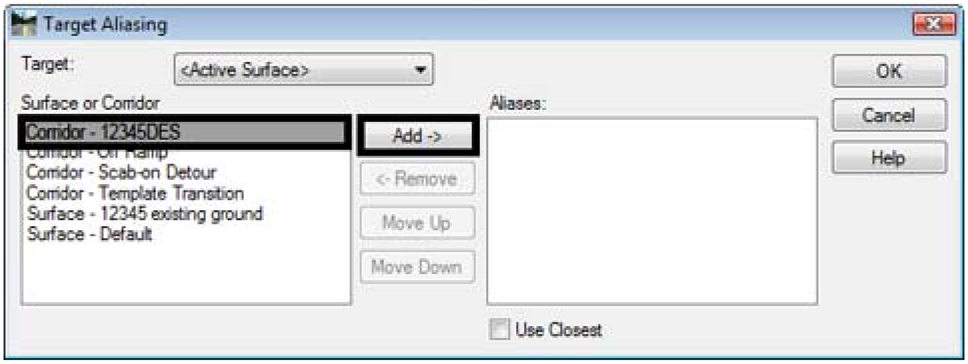
The final step is to add the target aliasing.

18. Select **Tools > Target Aliasing** from the Roadway Designer menu. The ***Target Aliasing*** dialog box is displayed.



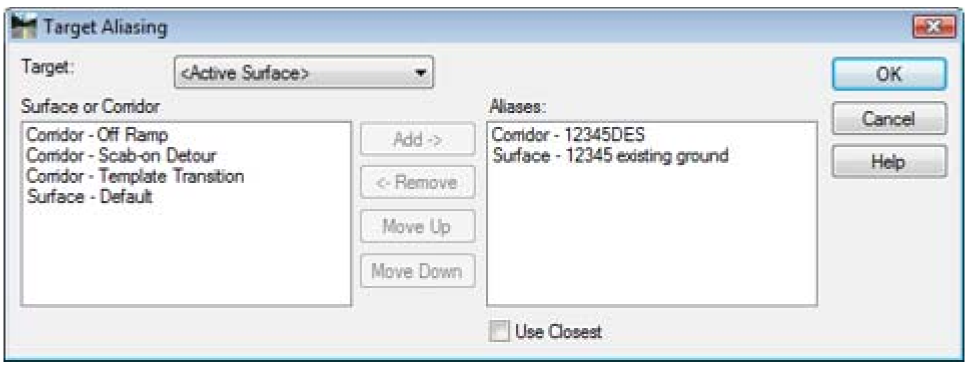
19. In the ***Target Aliasing*** dialog box, Highlight **Corridor – 12345DES** from the ***Surface or Corridor*** list.

20. **<D> Add**. The highlighted entry is moved to the Aliases list.



21. Highlight **Surface – 12345 Existing Ground** from the ***Surface or Corridor*** list.

22. **<D> Add**.



23. **<D> Cancel** to dismiss the ***Target Aliasing*** dialog box.

The order that aliases are listed is important because it determines the testing order. In this exercise, the end condition tests against the ***Corridor – 12345DES*** first. If it cannot tie to the corridor it tests against the ***Surface – 12345 Existing Ground***.

24. Scroll through the stations and notice how the right end condition behaves.

25. Select **File > Save** from the Roadway Designer menu bar.

26. **<D> Close** to dismiss the Roadway Designer dialog box.

Chapter Summary:

- In *Lab 15.1 -Modifying a Single Template Drop* a single template drop was modified by moving a point.
- In*Lab 15.2 -Target Aliasing* target aliasing was used to tie one corridor to another. This method also allowed the corridor to tie to the existing ground as needed.

LAB 16 - Creating Design Surfaces

This lab demonstrates the methods of creating design surfaces. These range from creating a single surface from a single corridor to creating multiple surfaces from multiple corridors to creating a single surface from multiple corridors.

Chapter Objectives:

- Create a surface from a single corridor.
- Create multiple surfaces from multiple corridors.
- Create an alternate surface for a corridor.
- Create a single surface by combining corridors.

Before beginning this lab, verify that the following files are loaded:

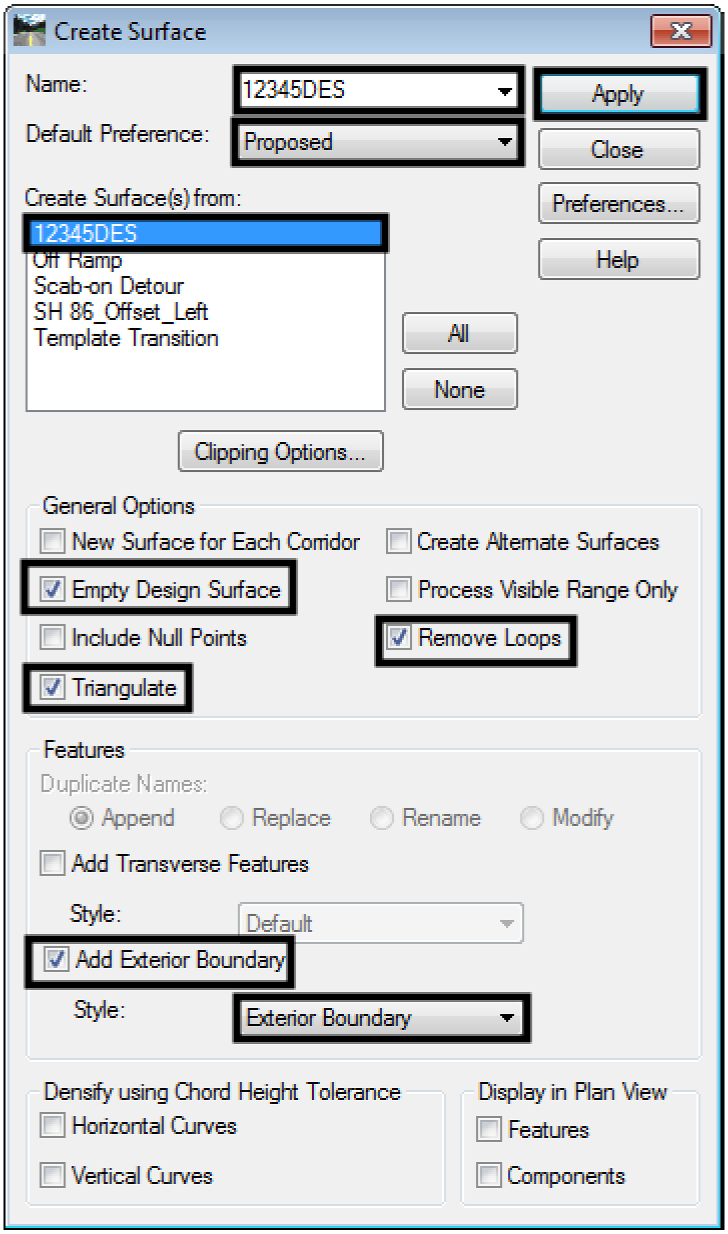
- C:\Projects\12345\Design\InRoads\12345DES_Geometry.alg
- C:\Projects\12345\Design\InRoads\12345 existing ground.dtm
- C:\Projects\12345\Design\InRoads\12345DES.ird (created in lab 4)
- C:\Projects\12345\Design\InRoads\DES12345_Templates.itl
- C:\Projects\12345\Design\InRoads\Combine Surfaces.ird

Lab 16.1 - Create a Surface (dtm) From a Single Corridor

Creating a surface from a single corridor uses the basic functionality of the ***Create Surface*** command. Here, a single design surface is created from the 12345DES corridor.

1. Select **Modeler > Roadway Designer** from the InRoads menu bar.
2. Select **Corridor > Create Surface** from the Roadway Designer menu bar or **<D>** the **Create Surface** button .
3. In the ***Create Surface*** dialog box, key in **12345DES** for the ***Name***. To avoid confusion later on, it is best to use the corridor name for the surface name.
4. Set the ***Default Preference*** to **Proposed**.
5. Verify that the following check boxes are toggled on:
   - **Empty Design Surface** (to ensure no residual data is used)
   - **Triangulate** (to create the triangulated model)
   - **Remove Loops** (to correct areas where template drops cross)
   - **Add Exterior Boundary** (to eliminate erroneous triangles in concave areas of the design model)
6. Set the exterior boundary style to **Exterior Boundary** or **DTM_Exterior**.
7. Highlight the **12345DES** corridor from the ***Create Surface(s) From*** list.

8. **<D> Apply**. This creates the surface and displays the ***Results*** window.



9. Examine the contents of the ***Results*** window then Close it. The information displayed will depend on the Option settings. These are found under Tools > Options on the Roadway Designer menu bar.

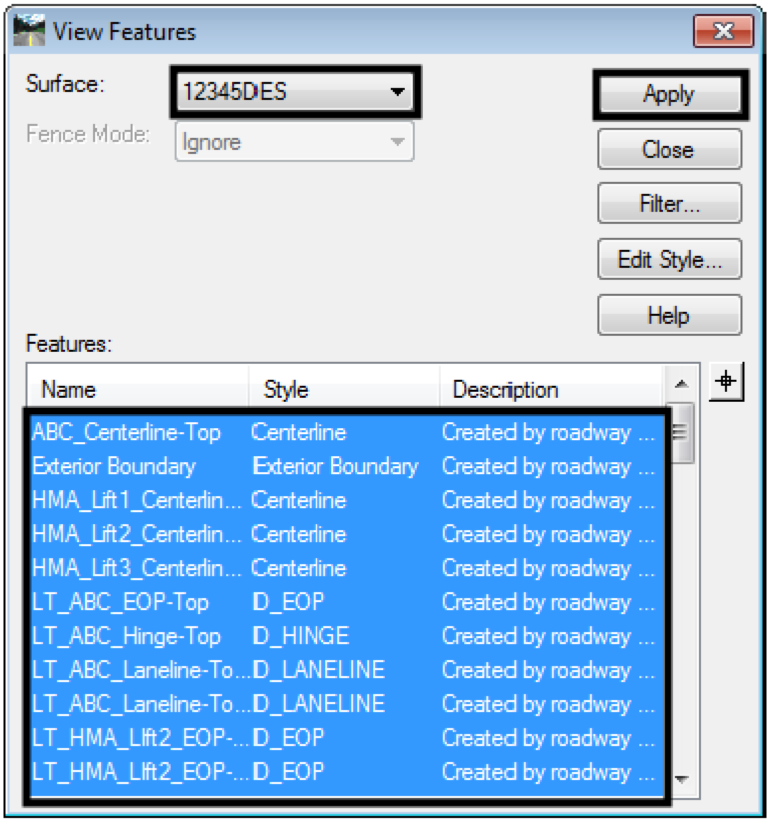
10. **<D> Close** to dismiss the ***Create Surface*** dialog box.

11. Minimize the **Roadway Designer** dialog box.

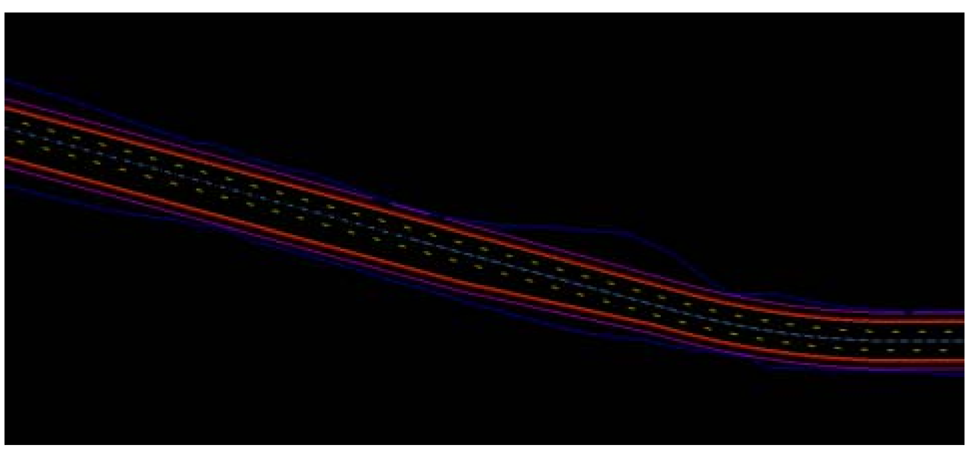
One method of reviewing the dtm is to display the features into the MicroStation file. Follow the steps below to display the features from the newly created surface.

12. From the ***InRoads*** menu bar, select **Surface > View Surface > Features**.

13. In the ***View Features*** dialog box, select **12345DES** for the ***Surface***.
14. Verify that all features are highlighted in the ***Features*** list.
15. **<D> Apply**.

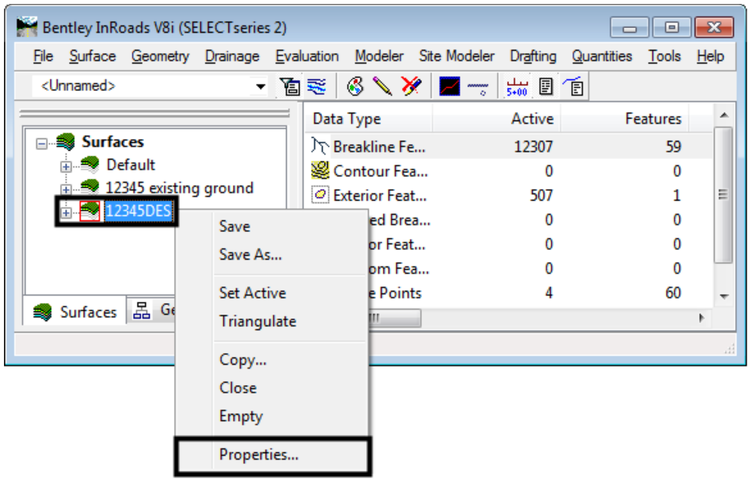


16. **<D> Close** to dismiss the View Features dialog box.
17. Examine the displayed features.

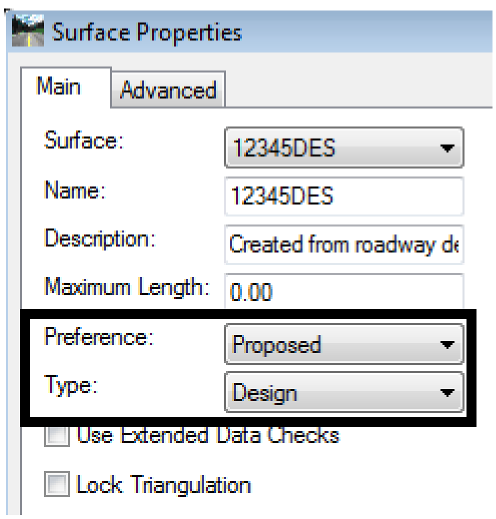


DTMs created with the Roadway Designer have some properties that need to be set. These control how the surface is displayed and how it is used in volume calculations. Follow the steps below to make the settings changes.

18. In the ***InRoads*** main dialog box, select the **Surfaces** bottom tab.
19. **<R>** on **12345DES** and select **Properties** from the menu.



20. Notice the ***Preference*** and ***Type*** in the ***Surface Properties*** dialog box. The Preference controls some display properties and the Type determines how the surface is used when calculating volumes.



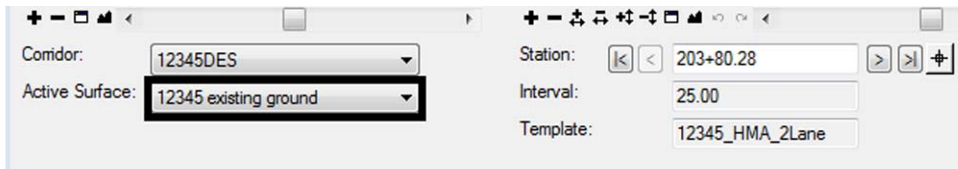
21. **<D>** the **Advanced Tab**.
22. In both the ***Cross Sections*** and ***Profiles*** areas, set the ***Symbology*** to **D_Finished-Grade**.
23. **<D> Apply** to accept the changes.
24. **<D> Close** to dismiss the ***Surface Properties*** dialog box.

Lab 16.2 - Creating Multiple Surfaces from Multiple Corridors.

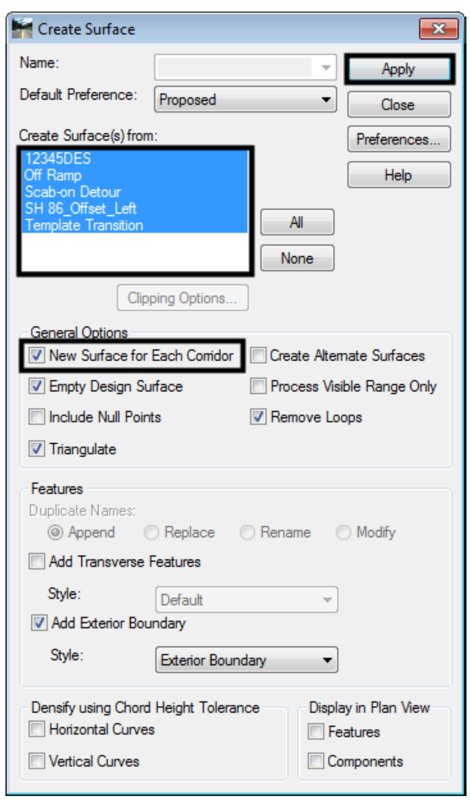
This exercise illustrates the process of creating multiple surfaces at one time.

When the surface properties were accessed in the previous lab, the active surface was set to the 12345DES surface. The active surface needs to be set to the 12345_Existing Ground surface in order for the corridors to process correctly.

1. Expand the **Roadway Designer** dialog box.
2. Set the ***Active Surface*** to **12345_Existing Ground**.



3. Select **Corridor > Create Surface** from the Roadway Designer menu bar or **<D>** the **Create Surface** button.
4. Toggle on the **New Surface for Each Corridor** check box. This disables the Name field and each new surface is named after its corridor.
5. Verify that the settings made in the previous lab are still in affect.
6. Highlight all of the corridors in the ***Create Surface(s) From*** list.
7. **<D> Apply**.



8. Examine the contents of the ***Results*** window. Note the point control information from the previous labs. Close the ***Results*** window

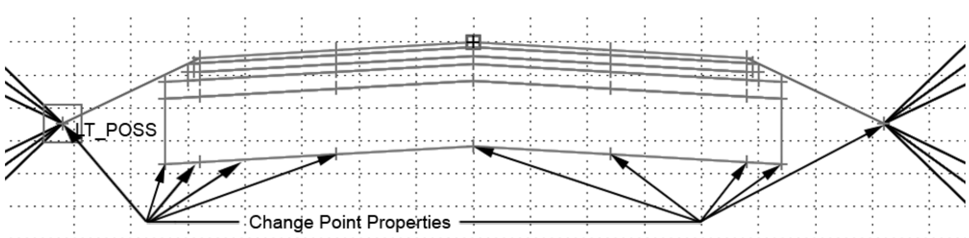
9. **<D> Close** to dismiss the ***Create Surface*** dialog box.
10. Minimize the **Roadway Designer** dialog box.
11. In the ***InRoads*** dialog box, notice that there is a new surface for each corridor (the 12345DES surface created in the first exercise was emptied and the data replaced with this run). InRoads uses the corridor name for the surface name when creating multiple surfaces.
12. Expand the ***Roadway Designer*** dialog box and select **File > Save** from the menu bar.
13. **<D> Close** to Dismiss the Roadway Designer dialog box.

Lab 16.3 - Create an Alternate Surface

The Alternate Surface option is used to create a surface from points specified in the template. This is in addition to the normal, finished grade surface that is created. This exercise illustrates the process of creating an alternate surface. The HMA_Crowned_B10 template is modified to create the alternate surface, the Template Drop is updated, and the surfaces are created.

In the first series of steps the template is updated to specify the points that are used for the alternate surface.

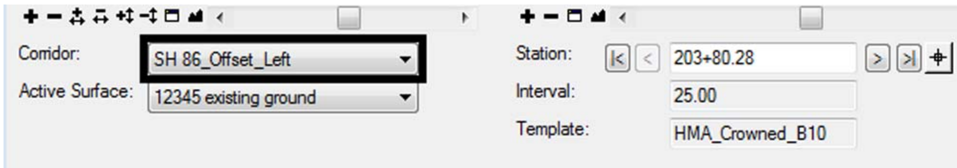
1. From the ***InRoads*** menu bar, select **Modeler > Create Templates**.
2. In the ***Template Library*** area, expand the ***C:\Projects\12345\Design\InRoads\DES12345_Templates.itl*** folder.
3. Expand the **1 – Templates** folder.
4. **<D> <D>** on the **HMA_Crowned_B10** template.
5. **<D> <D>** on the **LT_POSS** point.
6. Toggle on the **Alternate Surface** check box.
7. In the ***Alternate Surface*** key in field, type ***Subgrade***.
8. **<D> Apply**.
9. **<D> Close**.



10. Repeat steps 3 through 8 for the points indicated in the illustration above.
11. Select **File > Save** from the ***Create Template*** menu bar.
12. **<D> Close**.

The template is prepared to create the alternate surface. Next the template drop is updated.

13. From the ***InRoads*** menu bar, select **Modeler > Roadway Designer**.
14. Set the Corridor to **SH 86_Left_Offset**.

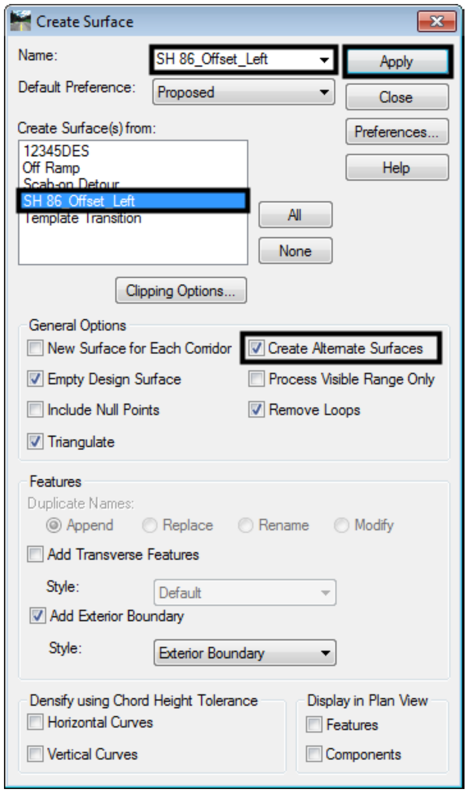


15. Select **Corridor > Template Drops** from the ***Roadway Designer*** dialog box, or **<D>** the **Template Drops** button.
16. In the ***Template Drops*** dialog box, highlight the entry in the ***Current Template Drops*** list.
17. **<D> Synchronize With Library** button.
18. **<D> Close**.

Everything is ready to create the alternate surface. The finished grade design surface and the alternate surface are created at the same time.

19. Select **Corridor > Create Surface** from the Roadway Designer menu bar or **<D>** the **Create Surface** button.
20. Toggle off the **New Surface for Each Corridor** check box.
21. In the ***Create Surface*** dialog box, key in **SH 86_Left_Offset** for the ***Name***.
22. Highlight the **SH 86_Left_Offset** corridor from the ***Create Surface(s) From*** list.
23. Toggle on the **Create Alternate Surfaces** check box.

24. **<D> Apply**.



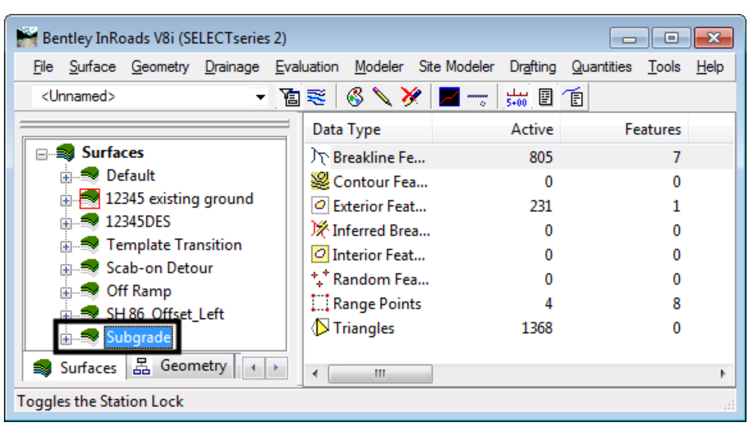
25. Review the report displayed in the Results dialog box, then **<D> Close** the ***Results*** dialog box.

26. **<D> Close** to dismiss the ***Create Surfaces*** dialog box.

27. Select **File > Save** from the ***Roadway Designer*** menu bar.

28. Minimize the **Roadway Designer** dialog box.

29. Notice, in the InRoads dialog box, that the Subgrade surface has been created.

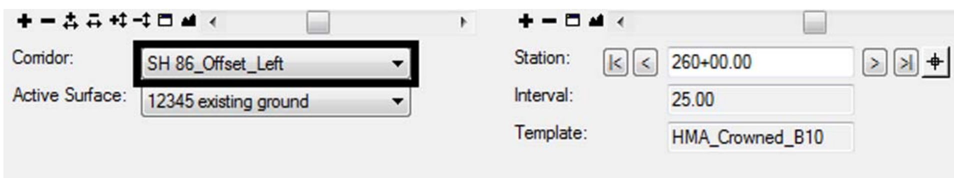


Lab 16.4 - Create a single surface from two corridors

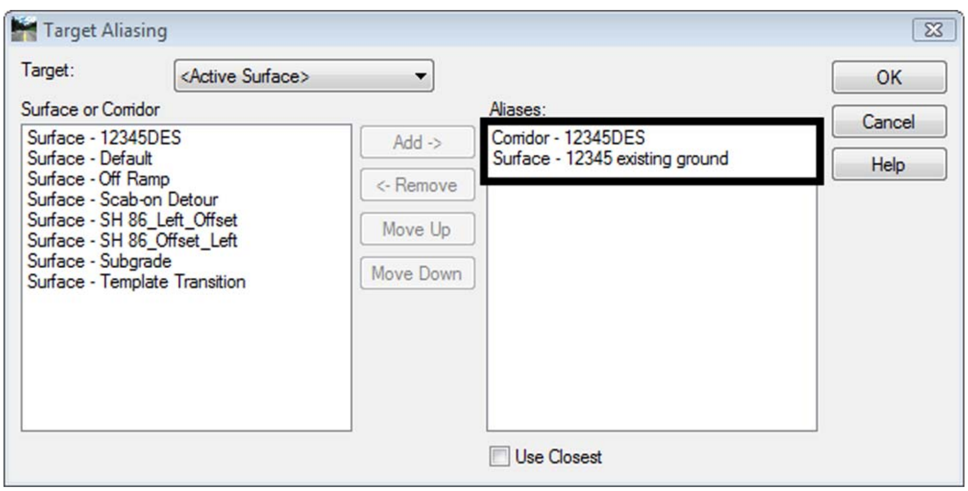
Many design types have multiple corridors. Divided highways, intersections, and interchanges can use two or more corridors. Often, it is desirable to have a surface model of the entire project instead of a separate surface for each part. This exercise demonstrates how to a create single surface from two parallel corridors.

This exercise uses a different corridor than the previous exercises. The first steps load the Combine Surfaces.ird file.

1. Expand the **Roadway Designer** dialog box.
2. Select **File > Open** from the ***Roadway Designer*** menu bar.
3. Highlight the **C:\Projects\12345\Design\InRoads\Combine Surfaces.ird** file and **<D> Open**.
4. Scroll through the stations for both corridors. The 12345DES corridor is the initial phase of construction and is tied to the existing ground. The SH86_Offset_Left corridor is the second phase and ties to the 12345DES corridor on the right and the existing ground on the left.
5. Select the **SH86_Offset_Left** corridor.



6. Select **Tools > Target Aliasing** from the Roadway Designer menu bar.
7. Notice that aliases have been set up for this corridor. Target Aliasing is used to determine how corridors are clipped when combining corridors.



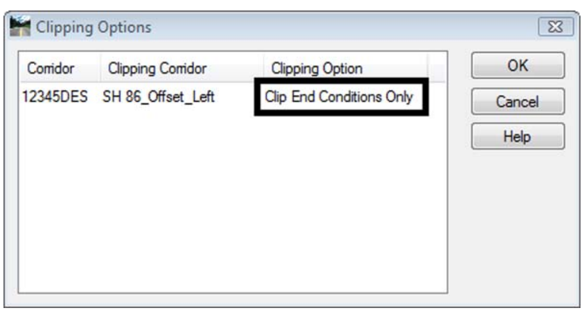
8. **<D> Cancel** to dismiss the ***Target Aliasing*** dialog box.

The next series of steps identifies the settings used in the Create Surface dialog box.

9. Select **Corridor > Create Surface** from the Roadway Designer menu bar or **<D>** the **Create Surface** button.
10. Key in **SH 86_Combined** for the ***Name***.
11. Set the ***Default Preference*** to **Proposed**.
12. Verify that the following check boxes are toggled on:
    - **Empty Design Surface**
    - **Add Exterior Boundary**
    - **Triangulate**
    - **Remove Loops**
13. Set the exterior boundary style to **Exterior Boundary** or **DTM_Exterior**.
14. Highlight the **12345DES** and the **SH86_Offset_Left** corridors from the ***Create Surface(s) From*** list. Hold the **Ctrl** key and **<D>** on each corridor.

Clipping options determine how the two corridors will be combined into one surface. The option used here, Clip End Conditions Only, will delete overlapping end condition features from the 12345DES corridor.

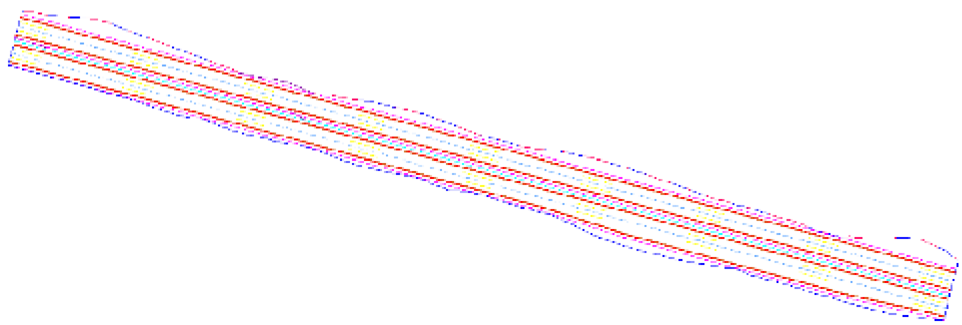
15. **<D>** the **Clipping Options** button.
16. In the ***Clipping Options*** dialog box**, <D>** on the entry in the ***Clipping Option*** column until it reads Clip End Conditions Only.
17. **<D> OK**. This dismisses the Clipping Options dialog box.



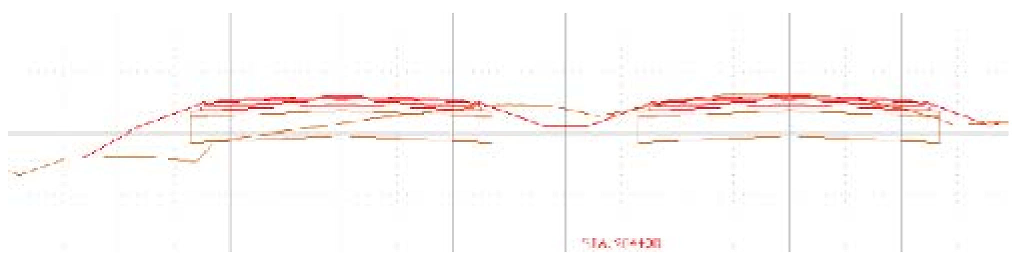
18. In the ***Create Surface*** dialog box, verify that **New Surface for Each Corridor** and **Create Alternate Surfaces** are toggle off.
19. **<D> Apply** to create the combined surface.
20. Review then **<D> Close** on the ***Results*** dialog box.
21. **<D> Close** to dismiss the ***Create Surface*** dialog box.
22. Select **File > Save** from the ***Roadway Designer*** menu bar.
23. **<D> Close** to dismiss the ***Roadway Designer*** dialog box.

The last series of steps displays the combined surface's features into the MicroStation file for review.

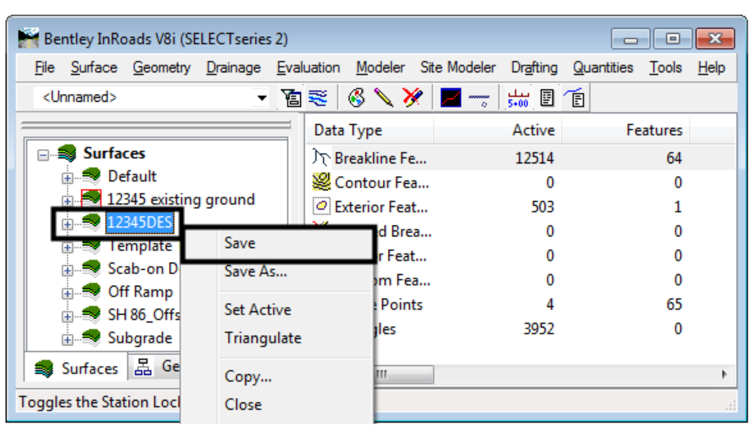
24. Delete any graphics displayed in the drawing.
25. From the InRoads Menu bar, select **Surface > View Surface > Features**.
26. In the ***View Features*** dialog box, select **SH 86_Combined** for the ***Surface***.
27. Verify that all features are highlighted in the ***Features*** list.
28. **<D> Apply**.
29. **<D> Close** to dismiss the ***View Features*** dialog box. The illustration below shows the features in the combined surface.



Cross sections are discussed in the next chapter, however, below is a sample cross section of the combined surface.



30. In the ***InRoads*** dialog box, **<R>** on the **12345DES** Surface and select **Save** from the menu. This surface is used in the next lab.



Chapter Summary:

- In *Lab 16.1 -Create a Surface (dtm) From a Single Corridor* a surface was created from a single corridor. The basic settings used when creating most surfaces were demonstrated.
- In *Lab 16.2 -Creating Multiple Surfaces from Multiple Corridors.* multiple surfaces were created from multiple corridors. When generating multiple surfaces, each surface is named after the corridor that created it.
- In *Lab 16.3 -Create an Alternate Surface* an Alternate surface was created. The template was modified to identify which points are used to create the alternate surface. The template drops were updated and setting changed in the Create Surface command.
- In *Lab 16.4 -Create a single surface from two corridors* a single surface created by two combining corridors. Target Aliasing was used to identify how corridors are clipped to create the combined surface.

LAB 17 - Cross Sections, Volumes, and Reports

This lab illustrates the changes in cross sections, volumes, and reporting from InRoads 2004 to InRoads V8i. These changes came about due to changes in the templates and dtm.

Chapter Objectives:

- Create and update a set of cross sections to show the design surface and components.
- Calculate End Area Volumes for the cross sections.
- Add an area of unsuitable material to the volume calculation.
- Use a volume exception when calculating End Area Volumes
- Examine the End Area Volume reports.
- Create a Station Base report to an alignment.
- Create a Station Base report to a feature.

Before beginning this lab, verify that the following files are loaded:

- C:\Projects\12345\Design\Drawings\Reference_Files\12345DES_Model.dgn
- C:\Workspace\Workspace-CDOT_V8i\Standards-Global\InRoads\Preferences\CDOT_Civil.xin
- C:\Projects\12345\Design\InRoads\12345DES_Geometry.alg
- C:\Projects\12345\Design\InRoads\12345 existing ground.dtm
- C:\Projects\12345\Design\InRoads\12345DES.ird
- C:\Projects\12345\Design\InRoads\DES12345_Templates.itl

Lab 17.1 - Create Cross Sections

This lab demonstrates the changes made in the Create Cross Sections command and illustrates the changes made in the surface (dtm) from the 2004 edition to the V8i edition of InRoads.

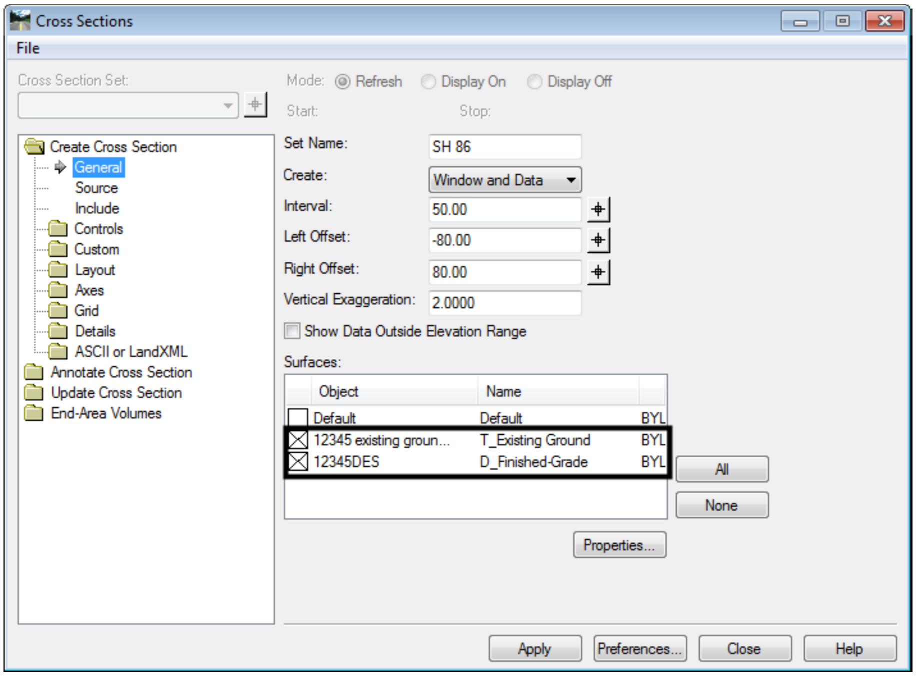
Step 1 resets the text scale factor for InRoads so that the cross sections will display correctly.

1. Select **Tools > Options** and **<D>** the **Factors** tab and set the scale factors to ***30***. This can also be done from the ***Global Scale Factors*** dialog box.
2. **<D> Apply**.
3. **<D> Close**.

The cross sections created in the following steps display the existing ground and the triangulated design surface only. This is to illustrate what features (template points) are used to create the triangulated surface model.

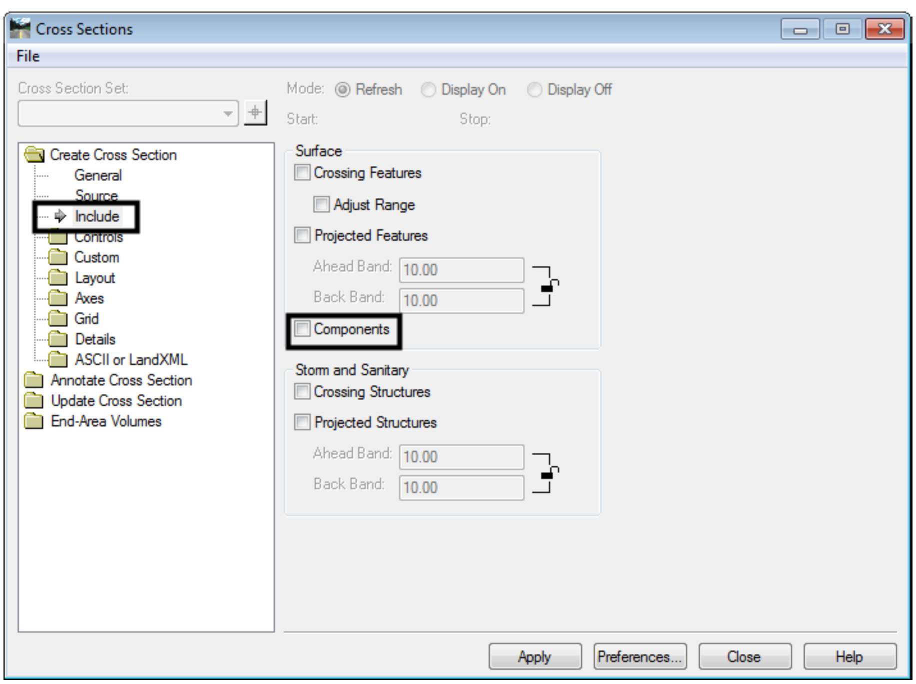
4. Select **Evaluation > Cross Section > Cross Sections** from the InRoads menu bar.

5. In the ***Create Cross Section*** dialog box, toggle on the **12345 Existing Ground** and the **12345DES** surfaces.



6. **<D> Include** in the ***Create Cross Section*** explorer.

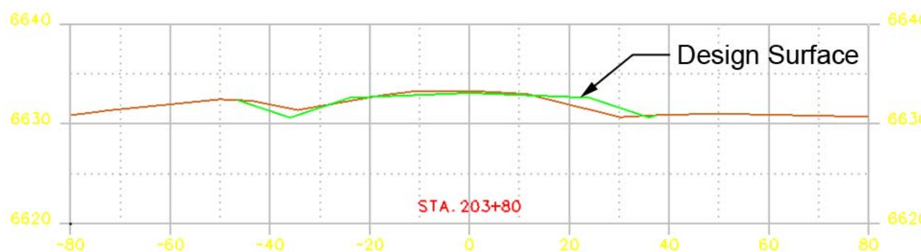
7. Toggle off **Components**. This is done to illustrate what is stored as a surface. Normally, this toggle is left on. The components will be added to the cross sections in later steps.



8. **<D> Apply**, then **<D>** in the MicroStation view window to place the cross sections.

9. **<D> Close** to dismiss the ***Create Cross Section*** dialog box.

10. Examine the first cross section. The design surface (12345DES) represents the upper most points of the template. The remaining features (created from the template points) are stored in the dtm as untriangulated features.



Next, the components are added to the cross sections using the Update Cross Section command.

11. Select **Evaluation > Cross Section > Cross Sections** from the InRoads menu bar.

12. Select the **Update Cross Section** folder from the dialog box explorer.

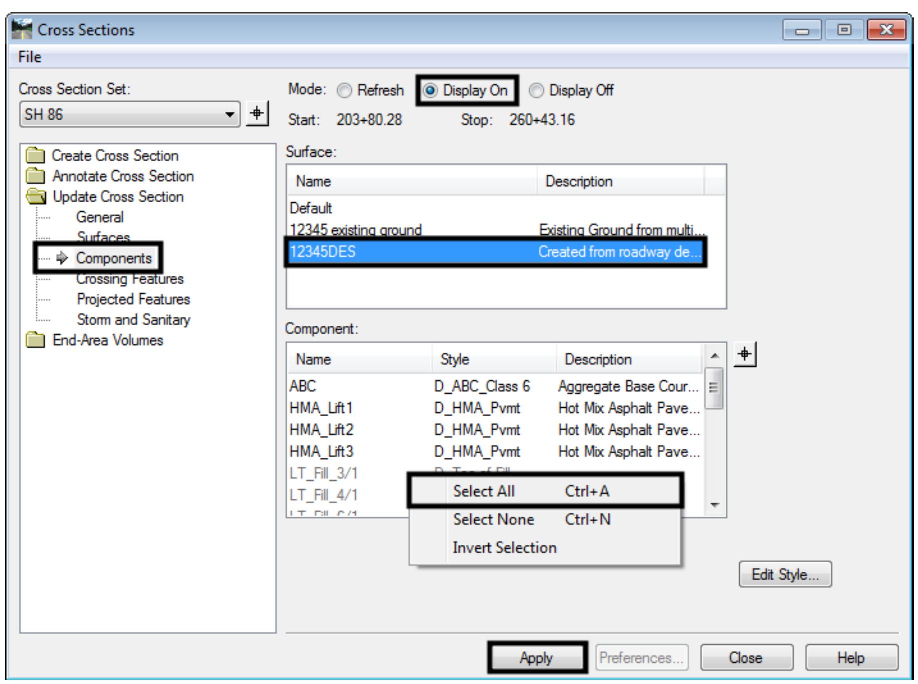
13. Toggle on the **Display On** radio button.

14. **<D> Components** leaf in the dialog box explorer.

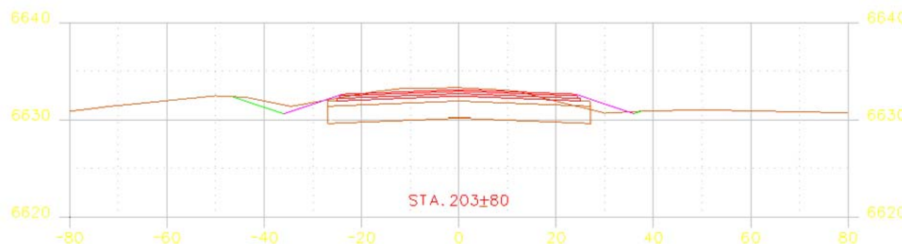
15. Highlight **12345DES** in the ***Surface*** area.

16. **<R>** in the ***Component*** area and select **Select All** from the menu.

17. **<D> Apply**.



18. **<D> Close** to dismiss the ***Cross Sections*** dialog box.
19. Examine the first cross section. The surfacing components are shown. End condition components are not shown in the cross sections because they are also part of the surface.

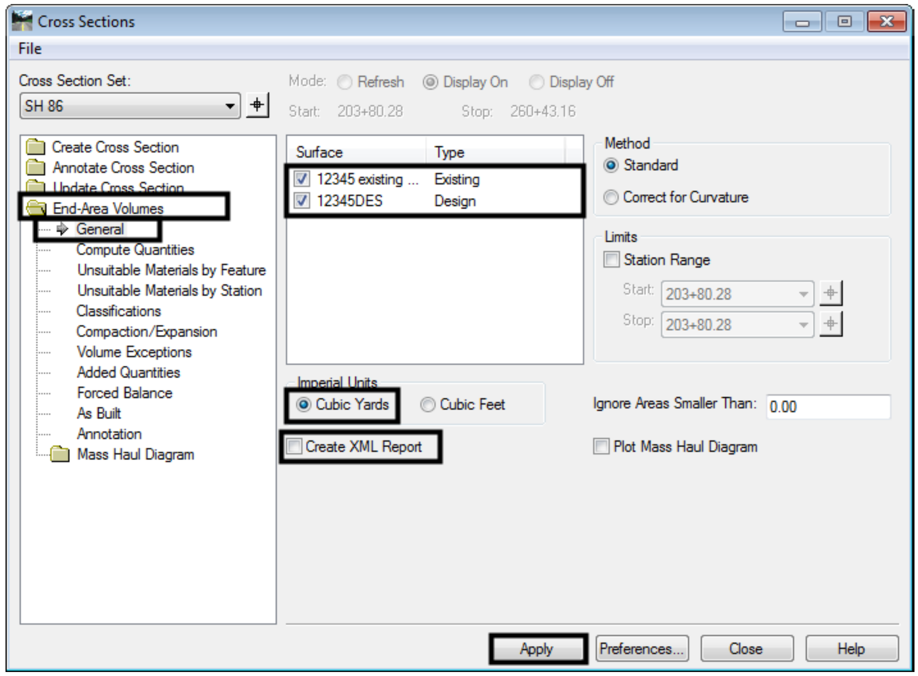


Lab 17.2 - Calculate End Area Volumes

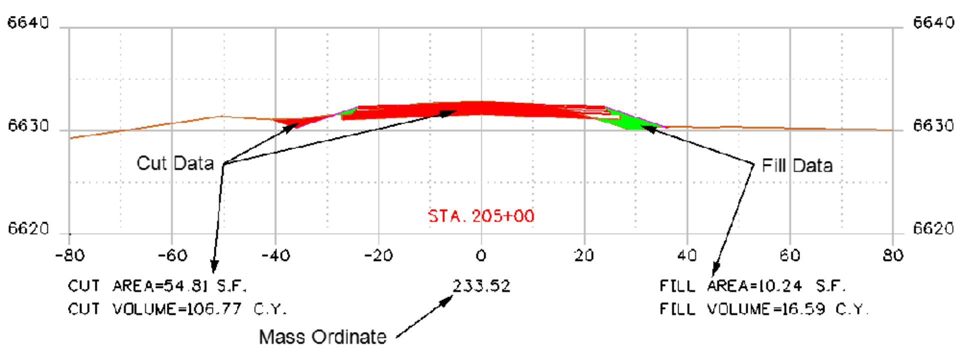
This exercise demonstrates the basic End Area Volume command. This command has changed due to changes in the dtm data, however, the concept is the same. The design surface (specified by the surface ***Type*** in the ***Surface Properties***) is compared to the existing surface (also specified by the surface ***Type***) to determine the amount of Cut and Fill.

1. Select **Evaluation >Cross Section > Cross Sections** from the InRoads menu bar.
2. Select the **End Area Volumes** folder form the dialog box explorer.
3. On the ***General*** leaf, notice the Surfaces selected. Surface 12345 Existing Ground has the Type of Existing and 12345DES has the type of Design.
4. Toggle off **Create XML Report**.
5. Toggle on **Cubic Yards**.

6. **<D> Apply.**



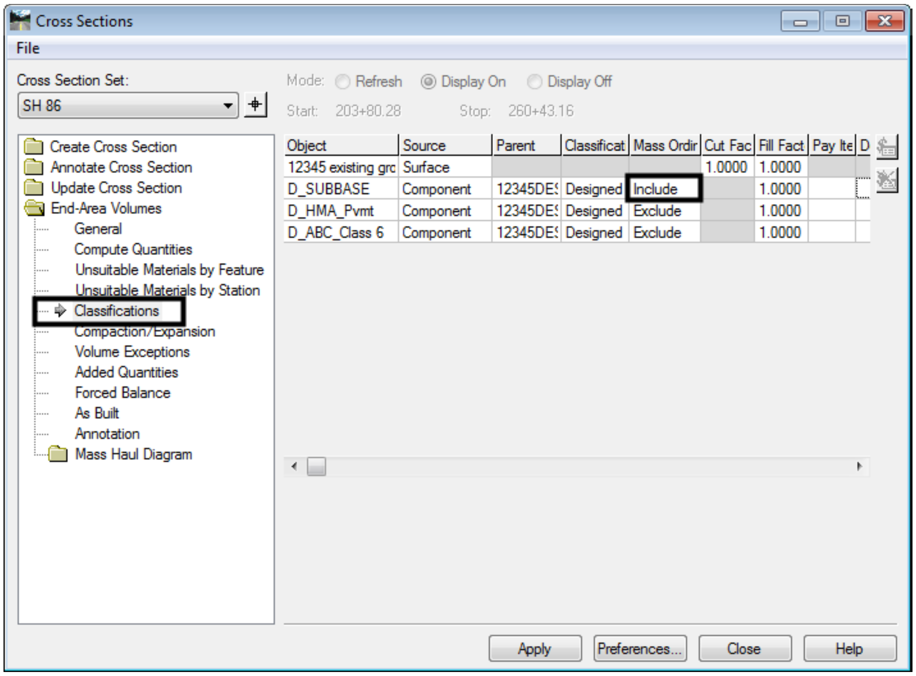
7. Examine the cross sections. Notice the various types of data shown in the illustration below.



Some materials shown in the template are computed as normal embankment. In this example, the D_SUBBASE material is included as embankment. The steps below change the settings for the subbase so that it can be included as embankment.

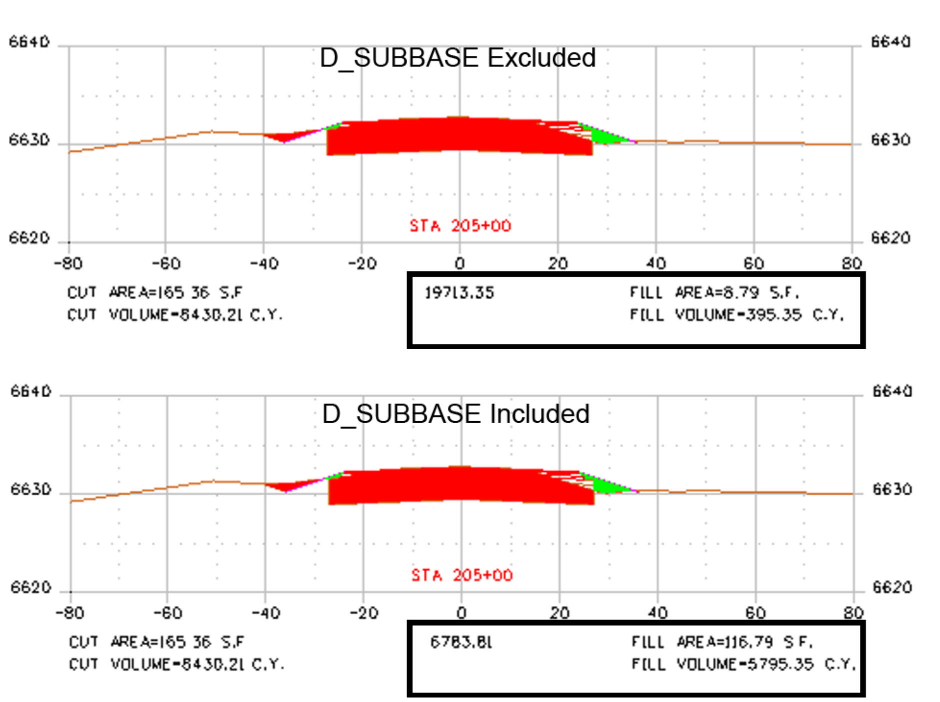
8. **<D>** on the **Classifications** leaf in the under the ***End Area Volumes*** folder.

9. **<D>** in the cell of the ***D_SUBBASE*** row and the ***Mass Ordinate*** column so that it reads **Include.**



10. **<D> Apply**.

11. Examine the cross sections. Notice the change in the data.



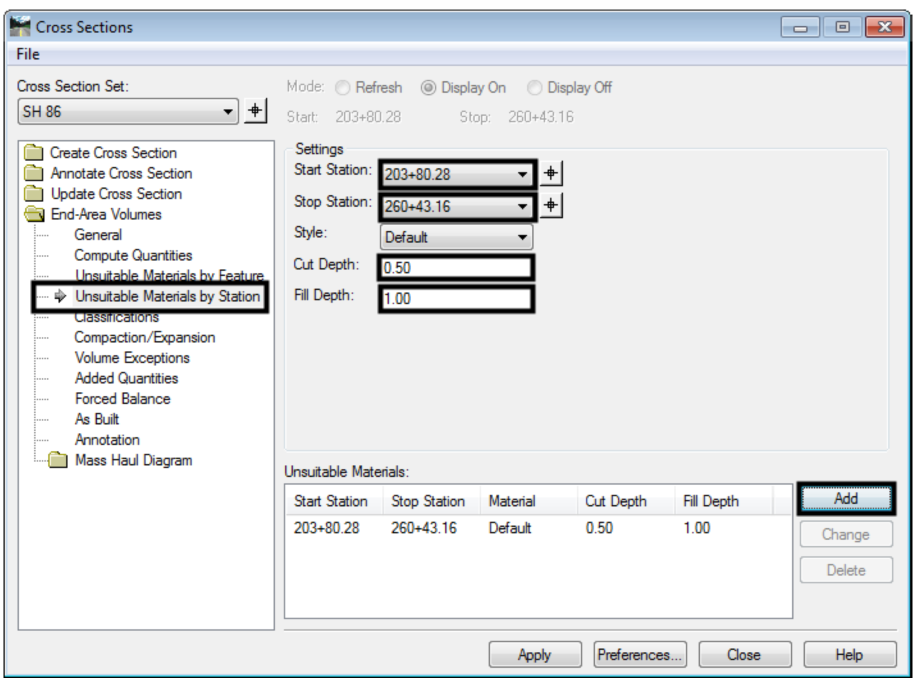
Lab 17.3 - Unsuitable Material

The existing ground may contain material that cannot be used in the construction of the design project. This exercise demonstrates the use of the ***Unsuitable Materials by Station*** option.

The steps below set up the dialog box to use the unsuitable material options. The other settings remain the same.

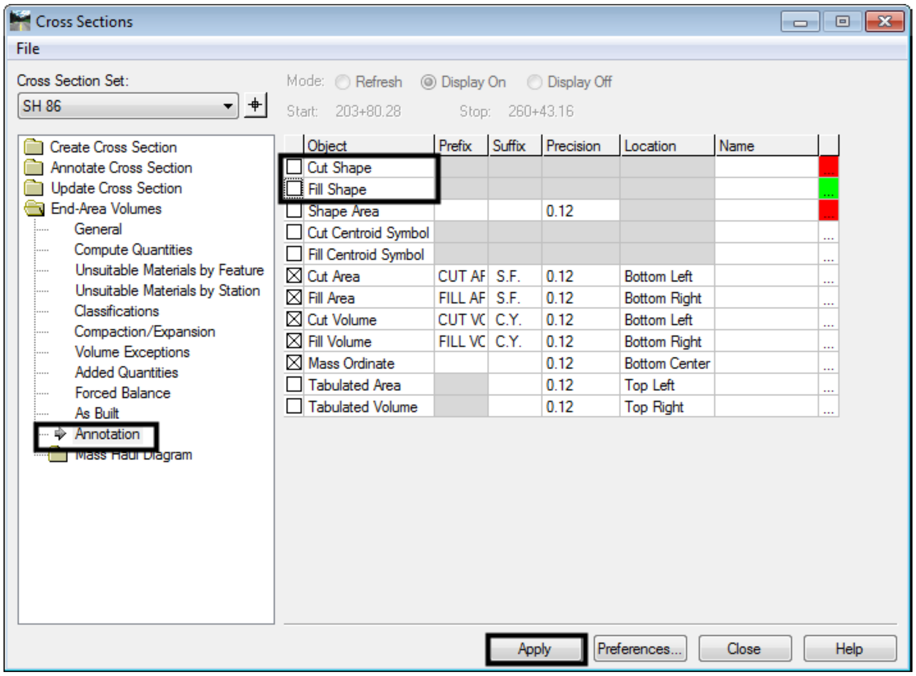
1. In the ***End Area Volumes*** folder, **<D> Unsuitable Materials by Station**.
2. Select **203+80.28** for the ***Start Station***.
3. Select **260+43.16** for the ***Stop Station***.
4. Key in ***0.50*** for the ***Cut Depth***.
5. Key in ***1.00*** for the ***Fill Depth***.
6. **<D> Add**. The data is placed in the Unsuitable Materials list.

   Note: There is currently not a style for unsuitable material. That is why Default is used here.

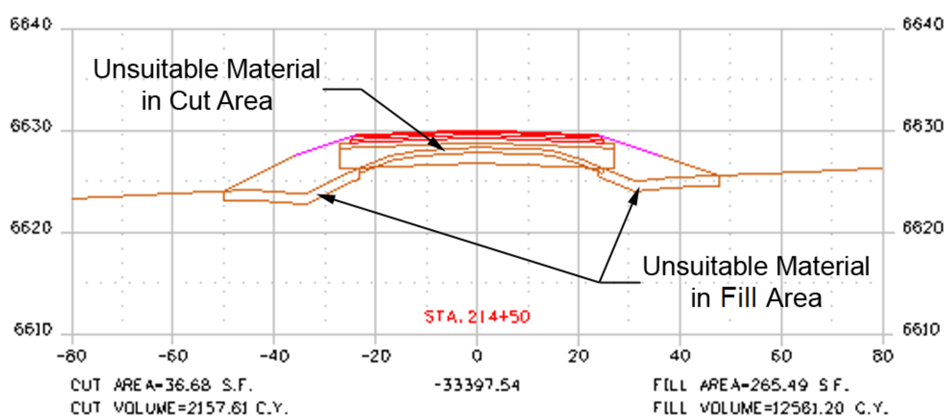


7. **<D> Annotation** under the ***End Area Volumes*** folder.
8. ***Toggle off*** **Cut Shape** and **Fill Shape.** This is so that the unsuitable material shapes can be seen.

9. **<D> Apply.**



10. Examine the cross sections. Notice the change in the data. The cut and fill volumes have changed to account for the unsuitable material.



11. **<D> Close** on the ***End Area Volumes*** dialog box.

12. **<D> No** on the dialog box that is displayed.

Lab 17.4 - Volume Exceptions

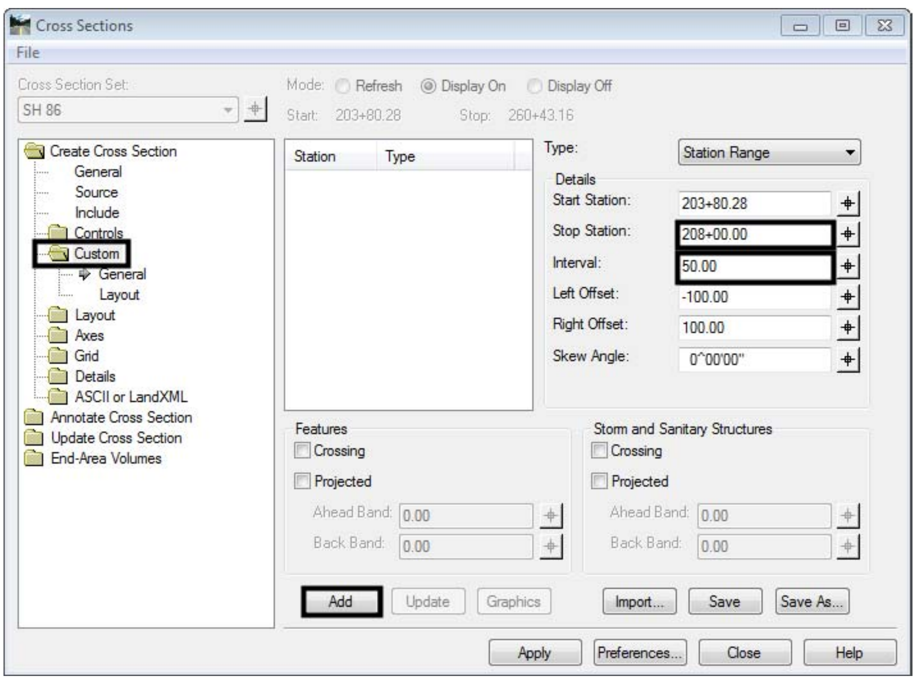
Volume exceptions are used to omit specified cross sections from earthwork calculations. This allows the design model to be run continuously through the project and still account for the area where no earthwork is done. This option is commonly used at bridges. In the exercise, a set of custom cross sections is generated to show the beginning and end of the volume exception. Then the exception is set up in the End Area Volume command. The volume exception runs from station ***208+15.83*** to station ***212+89.50.***

The first series of steps is used to set up the custom cross section set.

1. Select **Cross Section > Cross Sections** from the InRoads menu bar.
2. In the ***Create Cross Section*** folder, on the ***General*** leaf, verify that the **12345 Existing Ground** and **12345DES** surfaces are selected.
3. **<D> Include** in the ***Create Cross Section*** folder.
4. Toggle on **Components**.
5. **<D>** the **Custom** folder under the ***Create Cross Section*** folder.

The steps below are used to display cross sections normally, from the beginning of the project to station 208+00.

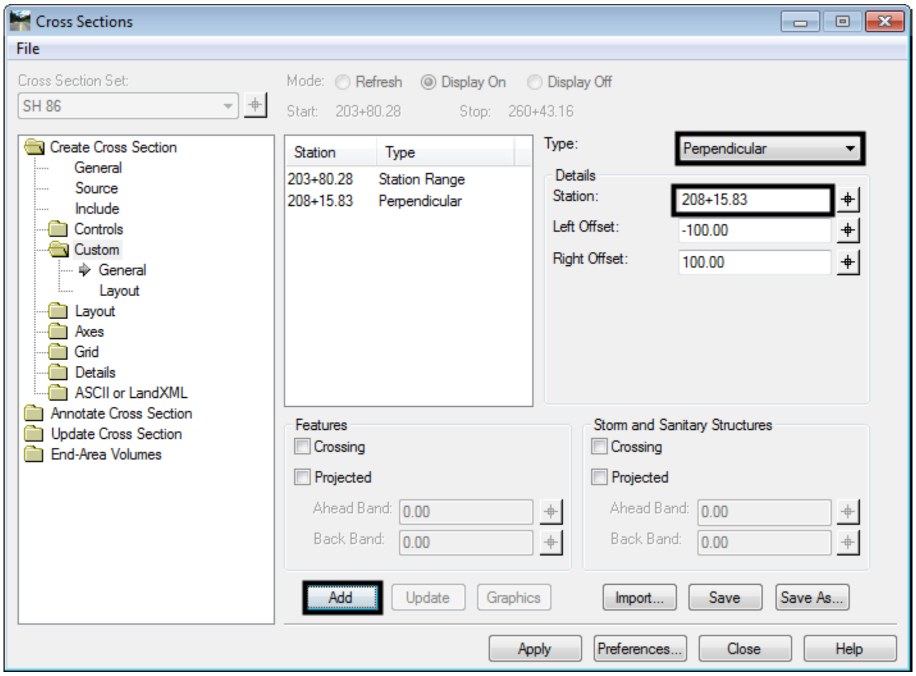
6. Key in ***208+00.00*** for the ***Stop Station*** (the Start Station is set to the beginning station by default).
7. Key in ***50.00*** for the ***Interval***.
8. **<D> Add**.



The steps below are used to display a single cross section at station 208+15.83and at station 212+89.50.

9. Set the ***Type*** to **Perpendicular**.
10. Key in ***208+15.83*** for the ***Station***.

11. **<D> Add**.



12. Key in ***212+89.50*** for the ***Station***. (all other settings remain the same)

13. **<D> Add**.

The steps below are used to display cross sections normally, from station 213+00 to the end of the project.

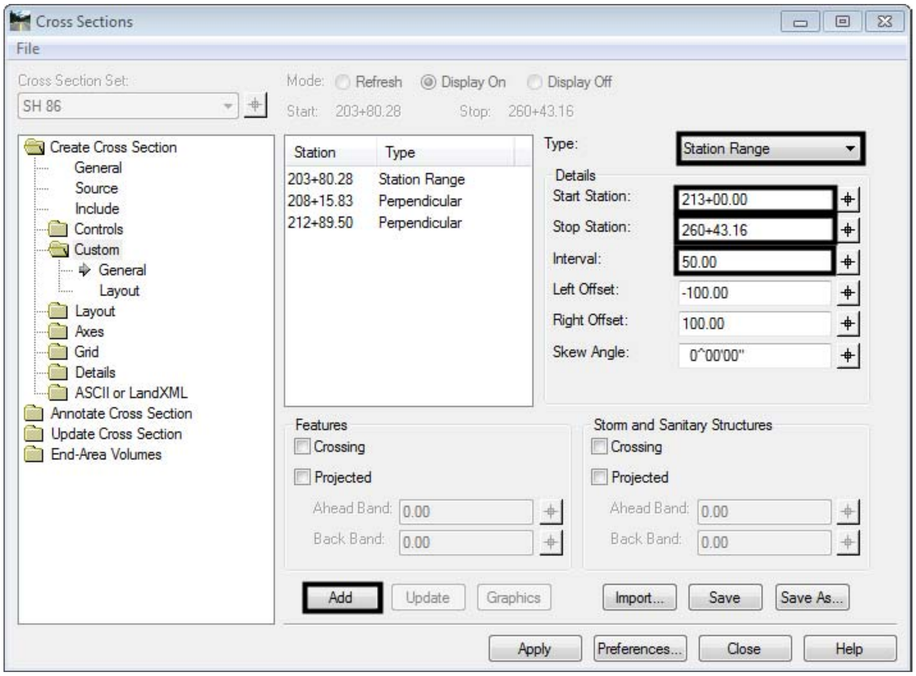
14. Set the ***Type*** to **Station Range**.

15. Key in ***213+00.00*** for the ***Start Station.***

16. Key in ***260+43.16*** for the ***Stop Station.***

17. Key in ***50.00*** for the ***Interval***.

18. **<D> Add**.



19. **<D> Apply**. **<D>** a blank area of the MicroStation view window to display the cross sections.

The data used for the custom cross section set can be saved for use at a later time. The steps below save the data.

20.

21. **<D> Save** to display the **Save As** dialog box.

22. In the ***Save AS*** dialog box, navigate to ***C:/Projects/12345/Design/InRoads/*** directory.

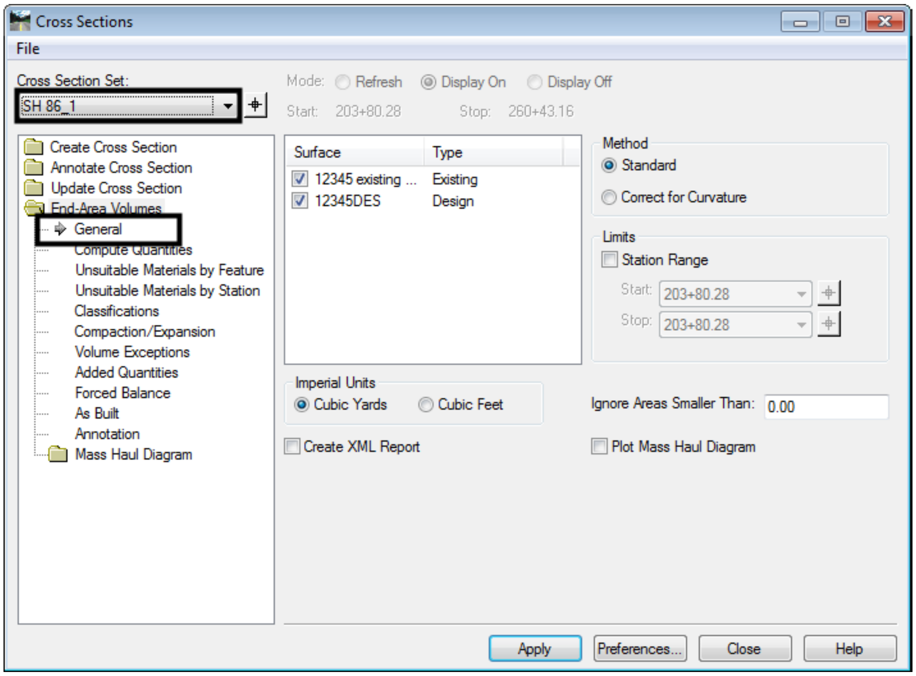
23. Key in ***SH 86.xsc*** for the file name and **<D> Save**.

To exclude the material within the volume exception, end area volumes must be recalculated. The following steps create the volume exception and recalculate the volumes.

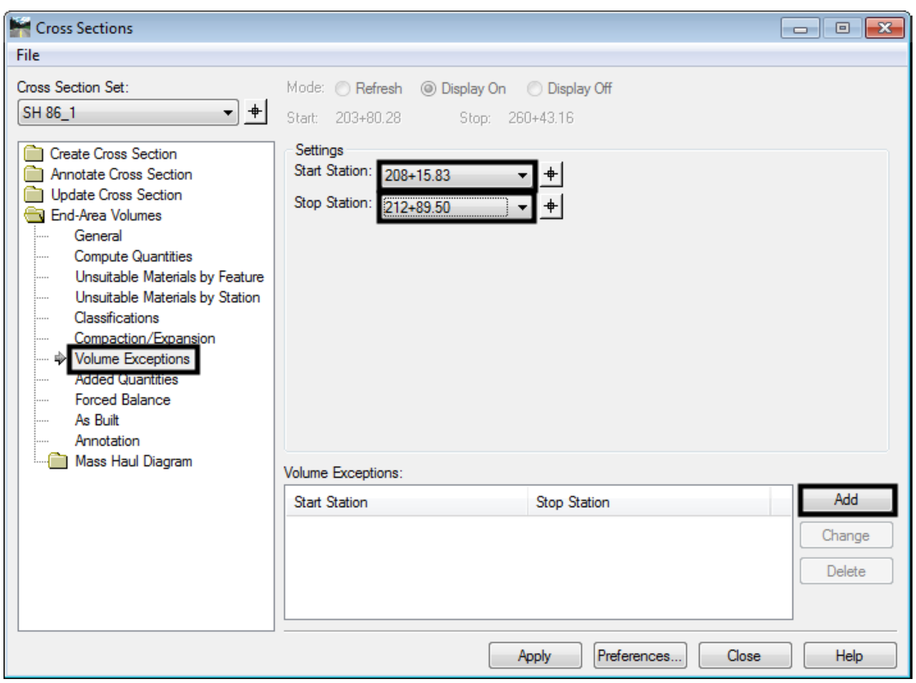
24. Select **End Area Volumes** from the dialog box explorer.

25. **<D> General** under the ***End Area Volumes*** folder.

26. Select **SH 86_1** for the ***Cross Section Set***. The other settings are correct.

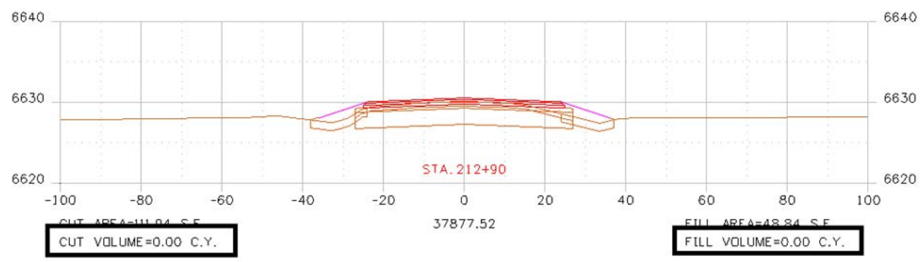


27. **<D> Volume Exceptions** in the ***End Area Volumes*** folder.
28. Select **208+15.83** for the ***Start Station***.
29. Select **212+89.50** for the Stop Station.
30. **<D> Add**.



31. **<D> Apply** to calculate the volumes.

32. Examine the cross section at station ***212+89.50***. Notice the volumes listed for both cut and fill are 0.00. No earthwork was calculated between the stations ***208+15.83*** and ***212+89.50.***



Lab 17.5 - Volume Reports

In addition to having volume information displayed on the cross sections, it can also be written to a tabular report. This exercise demonstrates how to create the report and the various templates used with the report.

The steps below create the XML data used for the report.

1. In the ***End Area Volumes*** folder, **<D>** the **General** leaf.

2. Select **SH 86_1** for the ***Cross Section Set***.

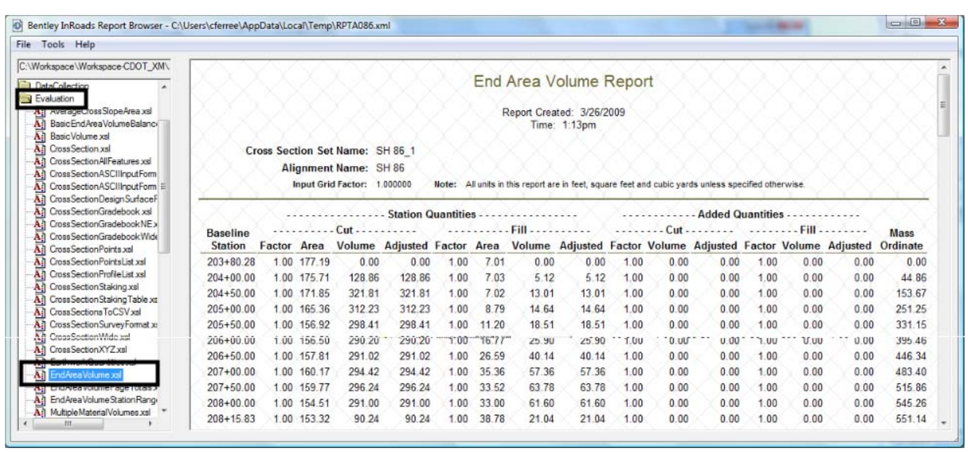
3. Toggle on **Create XML Report**.

4. **<D> Apply**. This displays the ***Bentley InRoads Report Browser***.

The XML data is passed to the Bentley InRoads Report Browser so that it can be displayed in a useful manner. The steps below use several report templates to present the volume data in different ways.

5. In the ***Bentley InRoads Report Browser***, **<D>** the ***Evaluation*** folder.

6. **<D>** the **EndAreaVolume.xsl** template.


End Area Volume Report

Report Created: 3/26/2009
Time: 1:13pm

Cross Section Set Name: SH 86_1
Alignment Name: SH 86
Input Grid Factor: 1.000000 Note: All units in this report are in feet, square feet and cubic yards unless specified otherwise.

	Station Quantities								Added Quantities						
	Cut				Fill				Cut			Fill			
Baseline Station	Factor	Area	Volume	Adjusted	Factor	Area	Volume	Adjusted	Factor	Volume	Adjusted	Factor	Volume	Adjusted	Mass Ordinate
203+80.28	1.00	177.19	0.00	0.00	1.00	7.01	0.00	0.00	1.00	0.00	0.00	1.00	0.00	0.00	0.00
204+00.00	1.00	175.71	128.86	128.86	1.00	7.03	5.12	5.12	1.00	0.00	0.00	1.00	0.00	0.00	44.86
204+50.00	1.00	171.85	321.81	321.81	1.00	7.02	13.01	13.01	1.00	0.00	0.00	1.00	0.00	0.00	153.67
205+00.00	1.00	165.36	312.23	312.23	1.00	8.79	14.64	14.64	1.00	0.00	0.00	1.00	0.00	0.00	251.25
205+50.00	1.00	156.92	298.41	298.41	1.00	11.20	18.51	18.51	1.00	0.00	0.00	1.00	0.00	0.00	331.15
206+00.00	1.00	156.50	290.20	290.20	1.00	16.77	25.90	25.90	1.00	0.00	0.00	1.00	0.00	0.00	395.46
206+50.00	1.00	157.81	291.02	291.02	1.00	26.59	40.14	40.14	1.00	0.00	0.00	1.00	0.00	0.00	446.34
207+00.00	1.00	160.17	294.42	294.42	1.00	35.36	57.36	57.36	1.00	0.00	0.00	1.00	0.00	0.00	483.40
207+50.00	1.00	159.77	296.24	296.24	1.00	33.52	63.78	63.78	1.00	0.00	0.00	1.00	0.00	0.00	515.86
208+00.00	1.00	154.51	291.00	291.00	1.00	33.00	61.60	61.60	1.00	0.00	0.00	1.00	0.00	0.00	545.26
208+15.83	1.00	153.32	90.24	90.24	1.00	38.78	21.04	21.04	1.00	0.00	0.00	1.00	0.00	0.00	551.14

7. Examine the report in the right pane of the browser. This report only has a grand total line.

8. **<D>** on the **EndAreaVolumePageTotals.xsl** template.
9. Examine the report in the right pane of the browser. This report only has page totals as well as a grand total line.
10. **<D>** on the **Volumes.xsl** template.
11. Examine the report in the right pane of the browser. This report lists areas and volumes for cut and fill along with the volumes for the components in the design dtm.

Volumes Report

Report Created: 3/26/2009
Time: 1:32pm

Cross Section Set Name: SH 86_1
Alignment Name: SH 86
Input Grid Factor: 1.000000

Note: All units in this report are in feet, square feet and cubic yards unless specified otherwise.

Station	Type	Area	Volume	Factor	Adjusted Volume	Included in Mass Ordinate?	Mass Ordinate
203+80.28							0.00
	Normal Cut:	177.19	0.00	1.00	0.00	Yes	
	Normal Fill:	7.01	0.00	1.00	0.00	Yes	
	Added Cut:		0.00	1.00	0.00	Yes	
	Added Fill:		0.00	1.00	0.00	Yes	
	D_SUBBASE:	108.00	0.00	1.00	0.00	Yes	
	D_HMA_Pvmt:	36.75	0.00	1.00	0.00	No	
	D_ABC_Class 6:	27.00	0.00	1.00	0.00	No	
204+00.00							44.86
	Normal Cut:	175.71	128.86	1.00	128.86	Yes	
	Normal Fill:	7.03	5.12	1.00	5.12	Yes	
	Added Cut:		0.00	1.00	0.00	Yes	
	Added Fill:		0.00	1.00	0.00	Yes	
	D_SUBBASE:	108.00	78.87	1.00	78.87	Yes	
	D_HMA_Pvmt:	36.75	26.84	1.00	26.84	No	
	D_ABC_Class 6:	27.00	19.72	1.00	19.72	No	

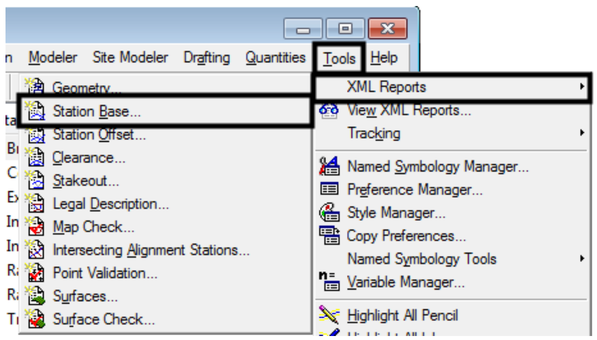
12. Close the ***Bentley InRoads Report Browser*** and all open dialog boxes (except the main InRoads dialog box).

Lab 17.6 - Station Base Reports

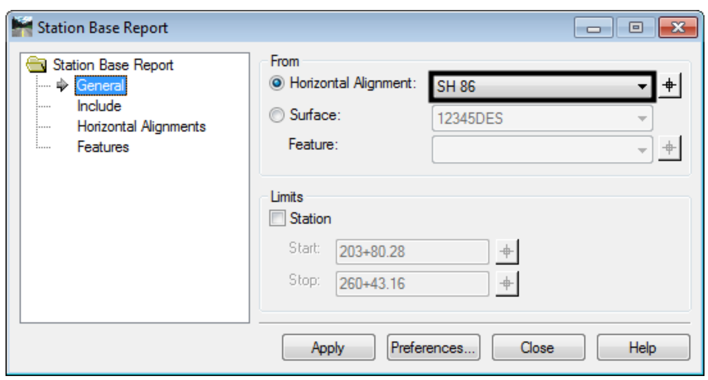
There are numerous other reports that can be generated from InRoads. they all function in a similar manner. This lab demonstrates the process of creating reports. The Geometry Station Base report is used for an example.

The Station Base report measures the offset distance from the active alignment to a specified alignment (or feature) at given intervals along the active alignment. This report can be used to generate staking reports for items like sawcuts or curb flowlines. The steps below create the XML data file for the station base report, then uses several report templates to present the data in a variety of formats.

1. From the InRoads menu bar, select **Tools > XML Reports > Station Base**.

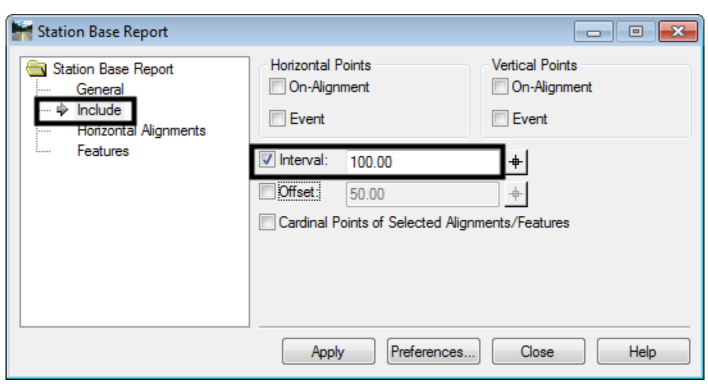


2. In the ***From*** area of the ***Station Base Report*** dialog box, note that the alignment ***SH 86*** is selected. Measurements are made perpendicular to this alignment.



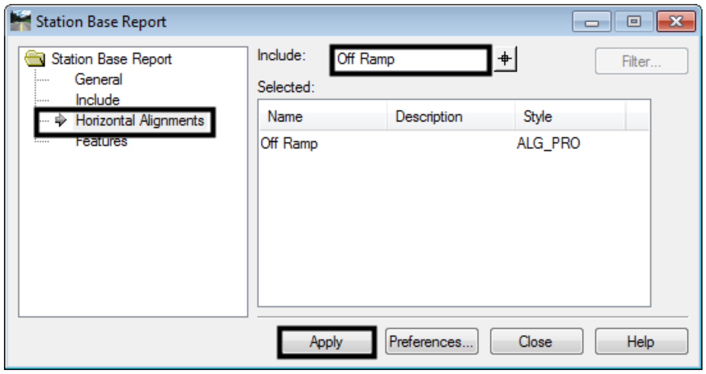
3. **<D> Include** from the ***Station Base Report*** explorer.

4. In the ***Interval*** field, key in **100**.

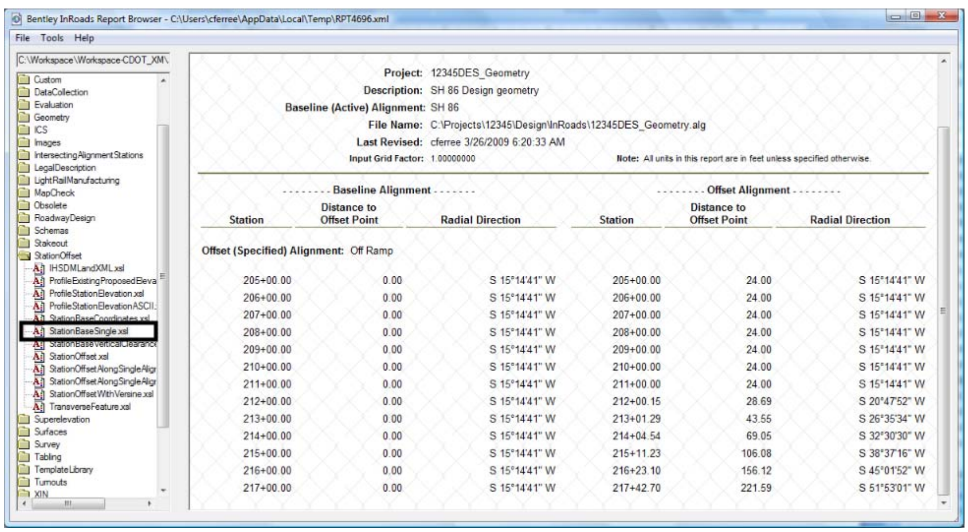


5. **<D> Horizontal Alignments** from the ***Station Base Report*** explorer.

6. In the ***Include*** field, key in ***Off Ramp***. Press the ***Tab*** key to accept the entry.
7. **<D> Apply**. This displays the ***Bentley InRoads Report Browser.***



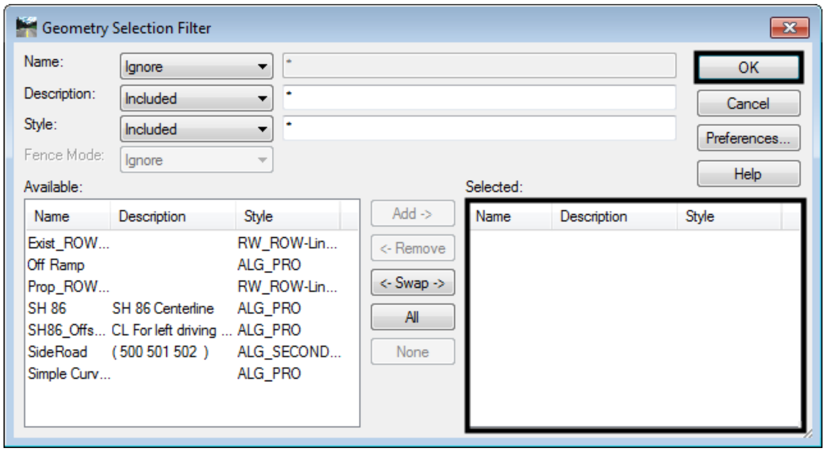
8. In the ***Bentley InRoads Report Browser,* <D>** the **StationBaseSingle.xls**.
9. Examine the report in the right pane.



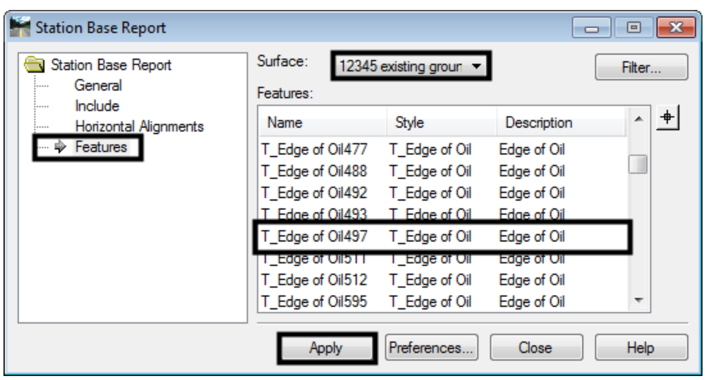
This report is useful for determining the distance between two alignments. It can also be used to determine the distance from an alignment to a surface feature. The steps below create a station base report between an alignment and a surface feature.

10. Minimize the ***Bentley InRoads Report Browser***.
11. In the ***Station Base Report*** dialog box, **<D> Horizontal Alignments** in the explorer.
12. **<D>** in the ***Include*** field then **<D>** the **Filter** button.
13. In the ***Geometry Selection Filter*** dialog box, verify that the ***Selected*** list is empty.

14. **<D> OK** to dismiss the ***Geometry Selection Filter*** dialog box.



15. **<D> Features** in the explorer.
16. Select **12345 Existing Ground** for the ***Surface***.
17. In the ***Features*** list, Highlight **T_Edge of Oil497**.
18. **<D> Apply**.



19. In the ***Bentley InRoads Report Browser,*** **<D>** the **StationBaseSingle.xls**.

20. Examine the report in the right pane.

Station Base Report

Report Created: 3/26/2009
Time: 2:41pm

Project: 12345DES_Geometry
Description: SH 86 Design geometry
Baseline (Active) Alignment: SH 86
File Name: C:\Projects\12345\Design\InRoads\12345DES_Geometry.alg
Last Revised: cferree 3/26/2009 6:20:33 AM
Input Grid Factor: 1.00000000   **Note:** All units in this report are in feet unless specified otherwise.

-------- Baseline Alignment -------			-------- Offset Alignment --------		
Station	Distance to Offset Point	Radial Direction	Station	Distance to Offset Point	Radial Direction
Offset (Specified) Alignment: T_Edge of Oil497					
226+50.00	0.00	S 15°14'41" W	0+35.23	-13.20	S 15°34'50" W
227+00.00	0.00	S 15°14'41" W	0+85.23	-13.36	S 15°00'34" W
227+50.00	0.00	S 15°14'41" W	1+35.23	-13.11	S 15°34'39" W
228+00.00	0.00	S 15°14'41" W	1+85.23	-12.99	S 15°20'33" W
228+50.00	0.00	S 15°14'41" W	2+35.23	-12.94	S 15°16'24" W
229+00.00	0.00	S 15°14'41" W	2+85.23	-13.07	S 15°01'46" W
229+50.00	0.00	S 15°14'41" W	3+35.23	-13.20	S 15°09'46" W
230+00.00	0.00	S 15°14'41" W	3+85.23	-13.33	S 15°00'27" W
230+50.00	0.00	S 15°14'41" W	4+35.23	-13.60	S 14°49'03" W

21. Close the ***Bentley InRoads Report Browser*** and all open dialog boxes (except the main InRoads dialog box).

22. Save the InRoads project then close InRoads.

Chapter Summary:

- In *Lab 17.1 -Create Cross Sections* a set of cross sections was created showing the existing ground and design finished grade. These were updated to show the design components.
- In *Lab 17.2 -Calculate End Area Volumes* the cross sections generated above were used to calculate End Area Volumes. The ability to include or exclude components from the volume calculations was demonstrated.
- In *Lab 17.3 -Unsuitable Material* an area of unsuitable material was defined using the station method. This was used to modify the volume calculation.
- In *Lab 17.4 -Volume Exceptions* A set of custom cross sections was created, then a volume exception was defined.
- In *Lab 17.5 -Volume Reports* the various templates for End Area Volume reports were examined.
- In *Lab 17.6 -Station Base Reports* the procedure for creating a Station Base report was demonstrated. Reports from alignment to alignment and alignment to feature were created

LAB 18 - Creating Plan Sheets

Creating Plan and Profile sheets is a repetitive and time consuming process. InRoads has automated this process. This lab demonstrates P and P sheet creation and editing with the InRoads Plan and Profile Generator command.

Chapter Objectives:

- Input data for the initial P and P sheet creation
- Prepare the seed files for the Plan and Profile Generator command
- Edit sheet extents and recreate sheets
- Move reference files within the sheet border
- Add a model file to a single sheet

Before beginning this lab, verify that the following files are loaded:

- C:\Projects\12345\Design\InRoads\12345DES_Geometry.alg
- C:\Projects\12345\Design\InRoads\12345DES.ird
- C:\Projects\12345\Design\InRoads\12345 existing ground.dtm
- C:\Projects\12345\Design\InRoads\12345DES.dtm
- C:\Projects\12345\Design\Drawings\Reference Files\12345DES_Prof.dgn
- C:\Projects\12345\Design\Drawings\Reference Files\12345DES_Model.dgn

Note: The 12345DES_Model.dgn file should have feature data displayed from previous labs. If this file is empty or if data not appropriate for plan sheets is near the SH 86 alignment, then all data in the file should be deleted and surface features from the 12345DES.dtm and the SH 86 alignment should be displayed prior to working the lab.

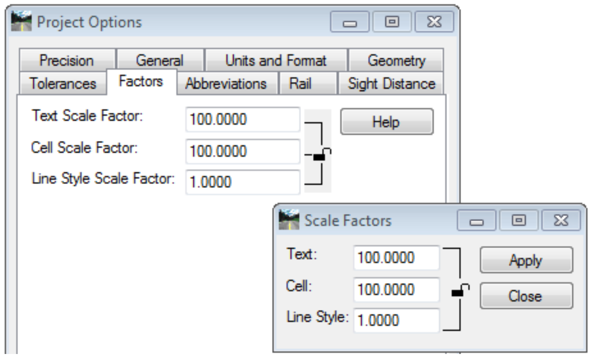
Lab 18.1 - Creating 100 Scale P and P Sheets

This lab illustrates the user input required to produce an initial set of P and P sheets.

1. Open the ***C:\Projects\12345\Design\Drawings\Reference Files\12345DES_Prof.dgn*** file in MicroStation.

The step below sets the scale factor so that text displayed by InRoads will be the proper size for a 100 scale plan set.

2. Select **File > Project Options** and **<D>** the **Factors** tab and set the scale factors to ***100*** for the ***Text Scale Factor*** and the ***Cell Scale Factor***. Set the ***Linestyle Scale Factor*** to ***1***. This can also be done from the ***Global Scale Factors*** dialog box.

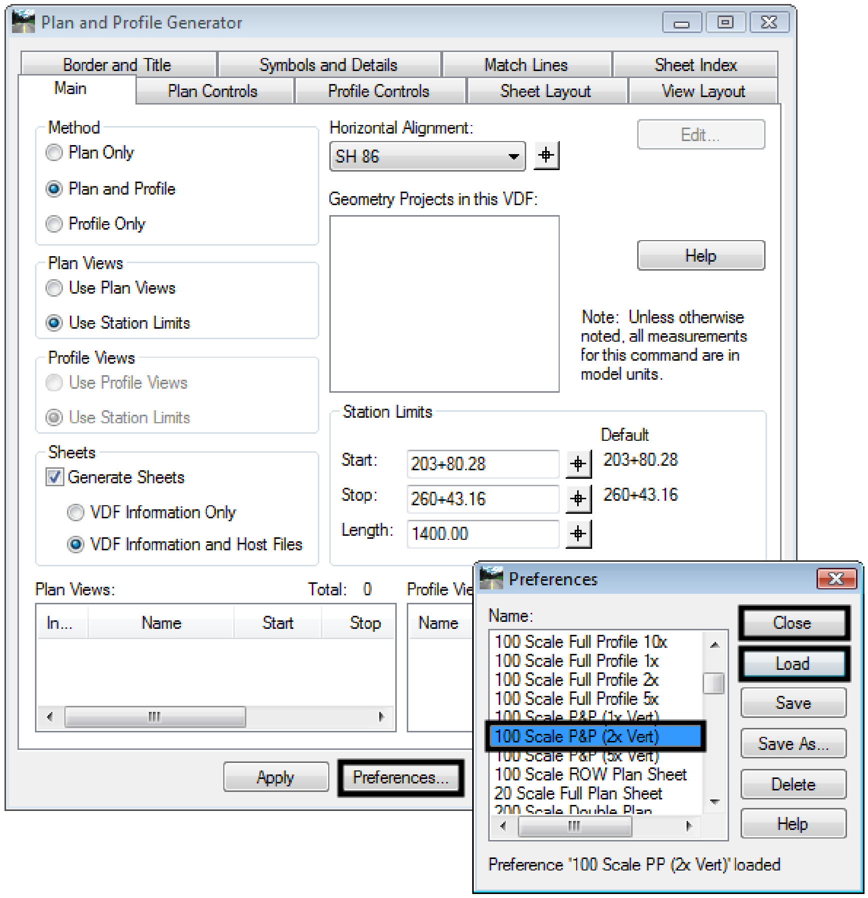


3. **<D> Apply** then **Close**.

Preferences are predefined menu settings that are used to set up the dialog box for a particular style of plan sheet. In this case, a 100 scale plan and profile sheet with a 2 times vertical exaggeration is desired. The steps below select the desired preference.

4. From the InRoads menu bar, select **Drafting > Plan and Profile Generator**. The ***Plan and Profile Generator*** dialog box is displayed.
5. On the Plan and Profile Generator ***Main*** tab, **<D>** the **Preferences** button. This displays the ***Preferences*** dialog box.
6. From the ***Preferences*** dialog box, highlight **100 Scale P&P (2x Vert).**
7. **<D> Load.**

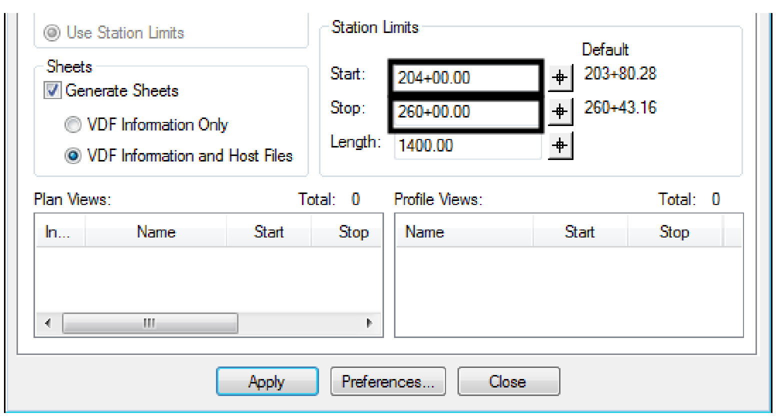
8. **<D> Close.** This dismisses the Preferences dialog box.



Preferences do not make all of the desired changes to menu settings, in particular those that are project specific. The steps below make the project specific changes to the menu settings.

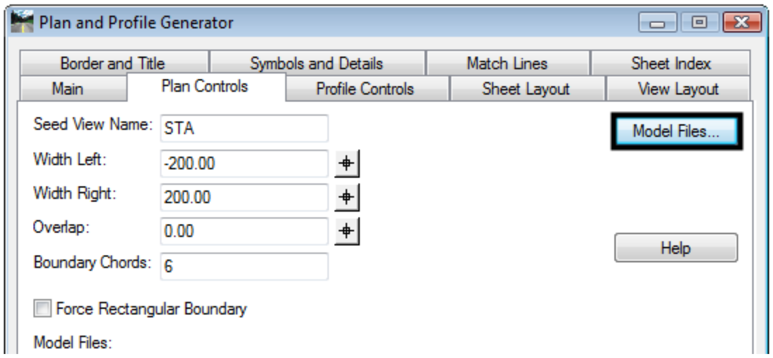
9. Back on the ***Main*** tab, in the Station Limits area, key in ***204+00.00*** for the ***Start*** station.

10. key in ***260+00.00*** for the ***Stop*** station.

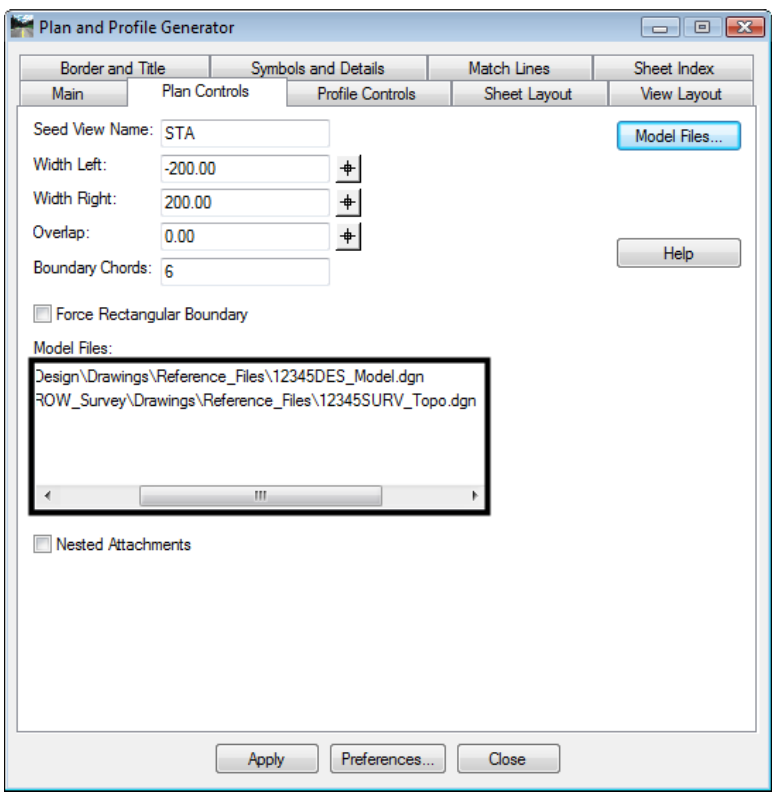


Reference files that make up the plan portion of the sheets are selected from the Plan Controls tab. The following steps are used to select the desired files.

11. **<D>** the **Plan Controls** tab.
12. **<D>** the **Model Files** button. This displays the ***Open Model File*** dialog box.



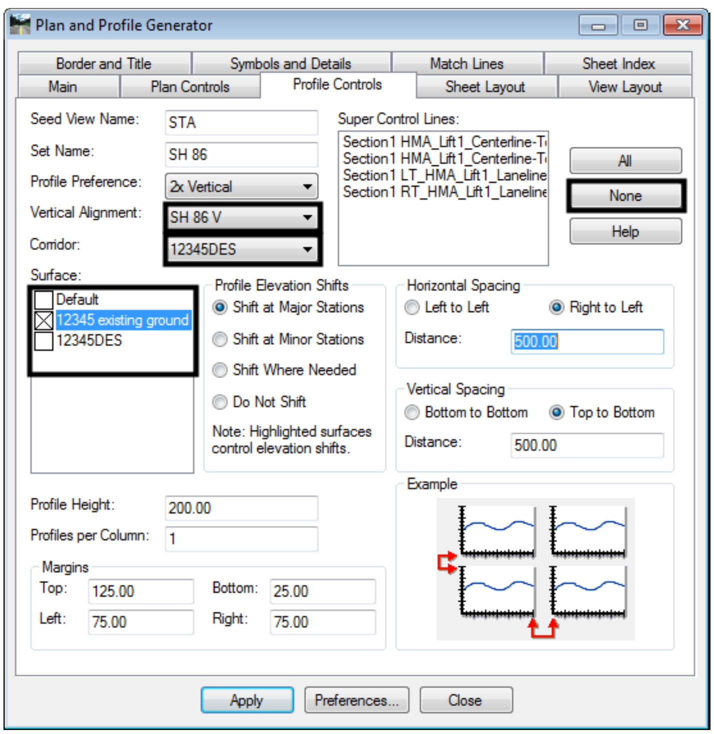
13. Highlight the ***C:\Projects\12345\Design\Drawings\Reference Files\12345DES_Model.dgn*** file.
14. **<D> Open**. The file is added to the ***Model Files*** list and the ***Open Model File*** dialog box is dismissed.
15. **<D>** the **Model Files** button. This displays the ***Open Model File*** dialog box.
16. Highlight the ***C:\Projects\12345\ROW_Survey\Drawings\Reference Files\12345SURV_Topo.dgn*** file.
17. **<D> Open**. The illustration below shows the ***Plan Controls*** tab with the two files added.



The Profile controls tab determines how the profiles will be displayed. Most of the settings are by the selected preference, however, it is a good idea to check the Surface area and make sure it is set up as desired. In this exercise, only the existing ground is to be displayed in the profile so it is the only one toggled on. The highlighted surface is used to determine where elevation shifts occur. Because the existing ground is the only surface displayed, it is also used to determine elevation shifts.

18. **<D>** the **Profile Controls** tab.
19. Select **SH 86 V** as the ***Vertical Alignment***.
20. Select **12345DES** as the ***Corridor***.
21. In the ***Surface*** area, toggle off all surfaces except ***12345 existing ground***.
22. Verify that the surface ***12345 existing ground*** is toggled on and highlighted.
23. **<D>** the **None** button to the right of the **Super Control Lines** list box to deselect all of the superelevation control lines.

The illustration below shows the tab as completed.



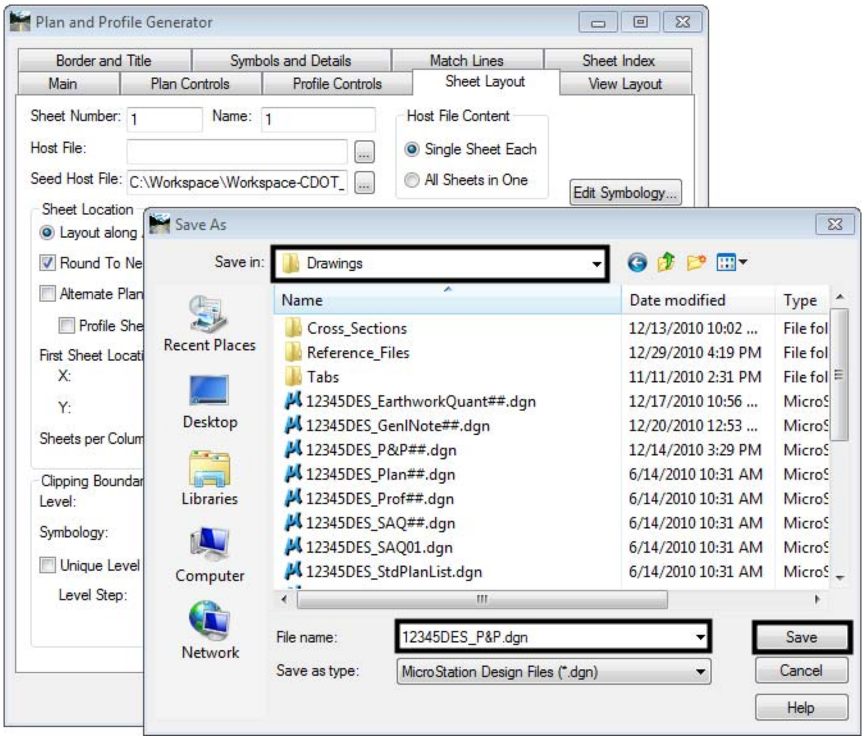
With the exception of the Host File, the Sheet Layout tab is set by the preference selected. The Host File is the base name that the finished sheets will be called. The host file name is incremented for each sheet created so that they will all have a unique name. In the steps below, the host file name is entered.

24. **<D>** the **Sheet Layout** tab.
25. **<D>** in the ***Host File*** field, then **<D>** the  button. This displays the ***Save As*** dialog box.

26. In the ***Save As*** dialog box, navigate to the ***C:\Projects\12345\Design\Drawings*** folder.

27. In the ***File Name*** field, key in ***12345DES_PnP.dgn***.

28. **<D>** the **Save** button. This dismisses the ***Save As*** dialog box adds the file name to the ***Host file*** field.

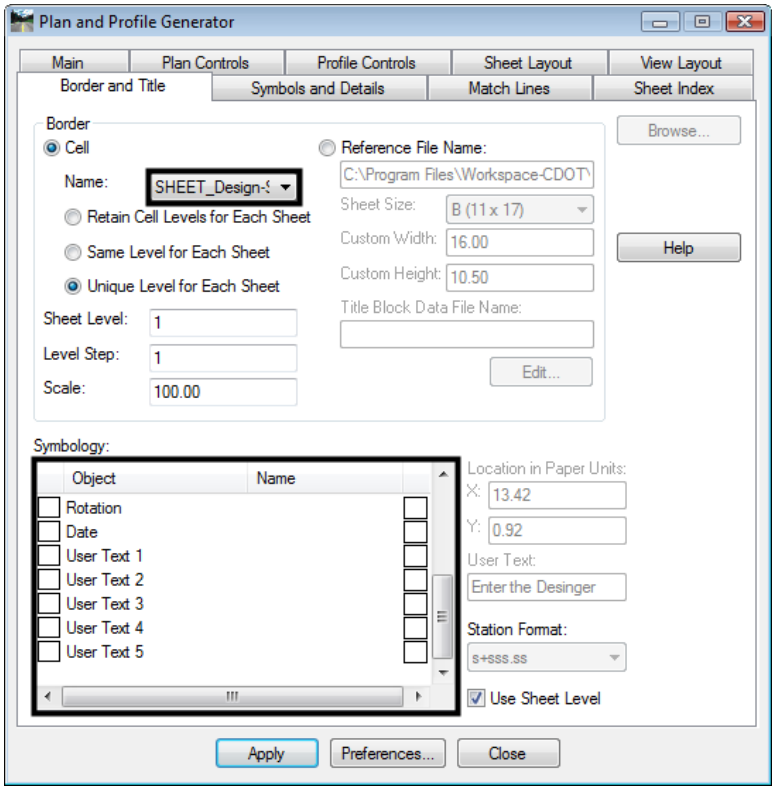


The Border and Title tab identifies the cell used for the sheet border. This tab should be checked to ensure that the proper border cell is being used. Also check to make sure that all of the toggles in the symbology area are turned off. If left on, erroneous data could be displayed on the sheets.

29. **<D>** the **Border and Title** tab.

30. Verify that the **Sheet_Design-Sheet** cell is selected for the cell ***Name***.

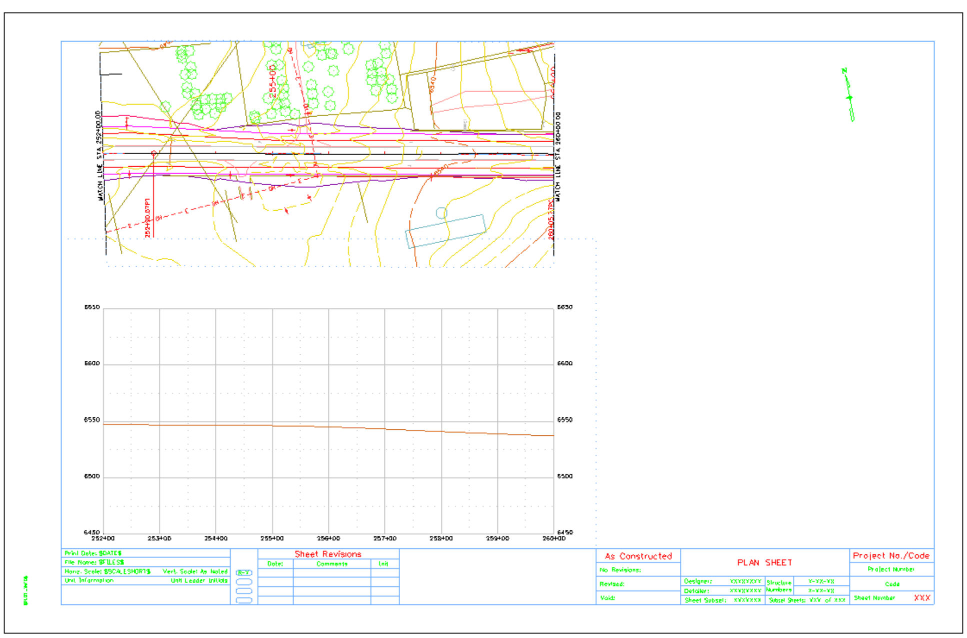
31. Verify that all of the check boxes in the ***Symbology*** area are toggled off.



32. **<D>** the **Apply** button.

33. **<D>** in the MicroStation view window.

The command creates a profile for each sheet (there are 5 sheets in this project) and then creates the sheets, each as a separate dgn file. The last sheet is shown below.

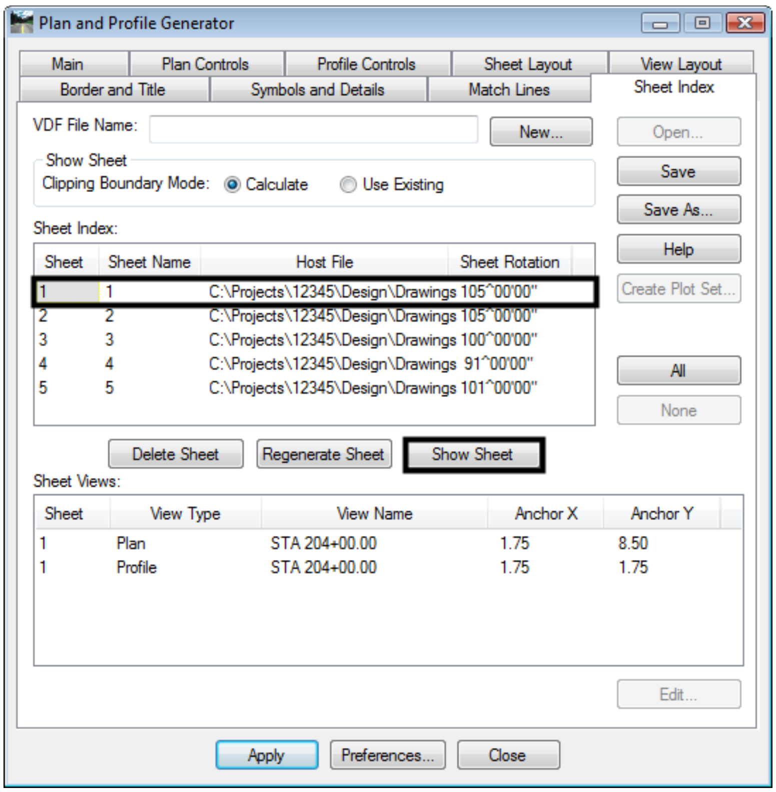


The plan and Profile generator offers an easy to move between generated sheets. Using the Sheet Index tab, sheets can be opened in without having to navigate through the MicroStation menus. Use the steps below to review the other sheets.

34. **<D>** the **Sheet Index** tab.

35. Highlight sheet **1** in the ***Sheet Index*** list.

36. **<D>** the **Show Sheet** button.



37. Repeat steps 31 and 32 for the remaining sheets.

Lab 18.2 - Creating 50 Scale P and P Sheets

To switch from 100 scale sheets to 50 scale requires some additional setting changes. Most of these are handled through the preferences, however the Annotation Scale for the profile and seed host file and the InRoads Scale Factors must be set before executing the command. This insures that the correct annotation scale is applied to each sheet.

The (MicroStation) annotation scale does not affect graphic elements displayed by InRoads but it will affect elements added with MicroStation commands.

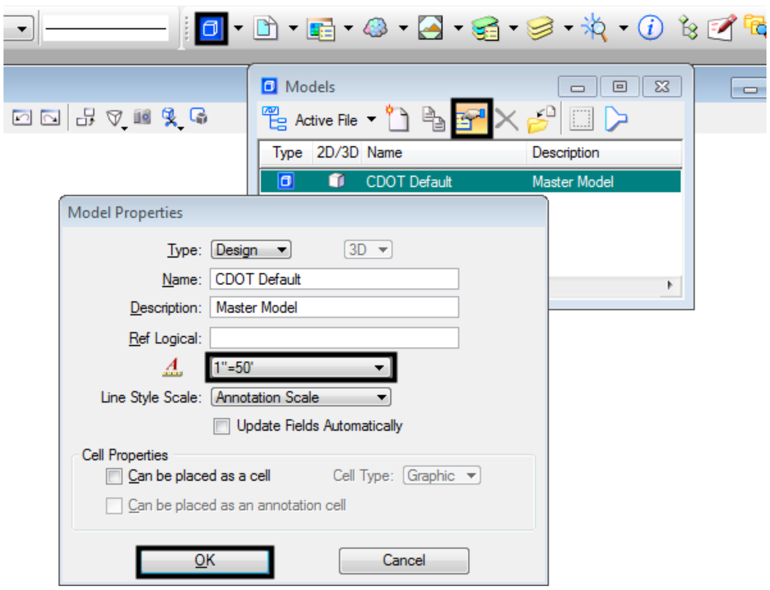
This lab uses the same data as above to create a set of 50 scale P&P sheets.

In the steps below, the model properties are changed in the 3D-Seed_CDOT.dgn (seed host file). This will ensure that each P and P sheet created will have the proper annotation scale for the project.

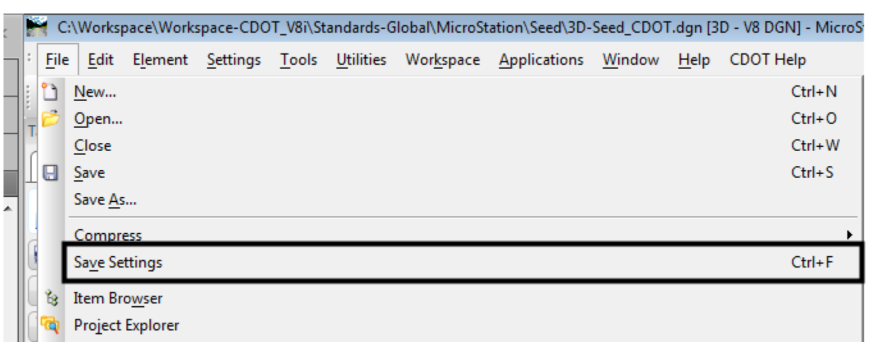
1. Using the MicroStation menu bar, open the:

C:\Workspace\Workspace-CDOT_XM\Standards-Global\MicroStation\Seed\3D-Seed_CDOT.dgn

2. **<D>** The **Models** button on the MicroStation ***Primary*** toolbar. This displays the Models dialog box.
3. On the **Models** dialog box, **<D>** the **Edit Model Properties** button. This displays the ***Model Properties*** dialog box.
4. Set the ***Annotation Scale*** to **1" = 50'** using the drop down menu.
5. **<D> OK**. This dismisses the ***Model Properties*** dialog box.



6. **<D> Yes** on the message window that is displayed. This has no effect because the drawing is empty.
7. **Close** the ***Models*** dialog box.
8. From the MicroStation menu bar, select **File > Save Settings**.



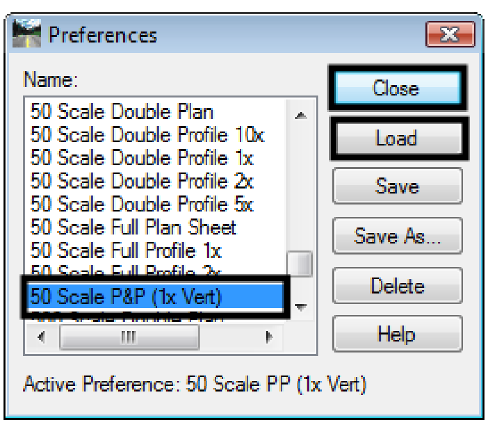
Note: The changes to the seed file only last until the computer is logged off. At the next log in, the settings revert back their original state. The sheets created from the seed file maintain the changes.

The same setting made above must also be made in the dgn file that will contain the profile information. The following steps remove the data from the previous lab and update the model properties and InRoads scale factors for 50 scale sheets.

9. Open the ***C:\Projects\12345\Design\Drawings\Reference Files\12345DES_Prof.dgn*** file.
10. Select **File > Save As** from the MicroStation menu bar. Navigate to: ***C:\Projects\12345\Design\Drawings\Reference Files***
11. Key in ***12345DES_Prof_50Scale.dgn*** for the file name.
12. **<D> Save**.
13. Delete all of the data in the dgn file.
14. Repeat steps 2 through 8 above.

    The dgn files are ready for the new scale. Next the InRoads settings are changed for 50 scale.

15. From the InRoads menu bar, select **Tools > Options** and **<D>** the **Factors** tab and set the scale factors to ***50***. This can also be done from the ***Global Scale Factors*** dialog box.
16. **<D> Apply** and then **<D> Close** to dismiss the dialog box used.
17. Display the ***Plan and Profile Generator*** dialog box.
18. **<D>** the **Main** tab.
19. **<D>** the **Preferences** button. This displays the ***Preferences*** dialog box.
20. From the ***Preferences*** dialog box, highlight **50 Scale P&P (1x Vert).**
21. **<D> Load.**
22. **<D> Close.** This dismisses the Preferences dialog box.



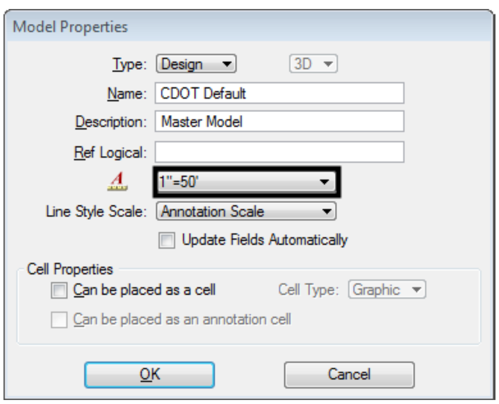
Except for the Host File name, the user defined settings are still active and are used for this lab. To set the Host File name:

23. **<D>** the **Sheet Layout** tab.

24. **<D>** in the ***Host File*** field, then **<D>** the button. This displays the ***Save As*** dialog box.
25. In the ***Save As*** dialog box, navigate to the ***C:\Projects\12345\Design\Drawings*** folder.
26. In the ***File Name*** field, key in ***12345DES_PnP_50Scale.dgn***.
27. **<D>** the **Save** button. This dismisses the ***Save As*** dialog box and adds the file name to the ***Host file*** field.
28. **<D>** the **Apply** button.
29. In the ***"Do you want to regenerate Plan Views?"*** message box, **<D> Yes**.
30. In the ***"Do you want to regenerate Profile Views?"*** message box, **<D> Yes**.
31. **<D>** in the MicroStation view window.

Nine 50 scale sheets are created. Follow the steps below to check that the correct annotation scale was used.

32. **<D>** The **Models** button on the MicroStation ***Primary*** toolbar. This displays the Models dialog box.
33. On the **Models** dialog box, **<D>** the **Edit Model Properties** button. The ***Model Prope***rties dialog looks like the illustration below.



34. **<D> Cancel** to dismiss the ***Model Properties*** dialog box.
35. **Close** the ***Models*** dialog box.

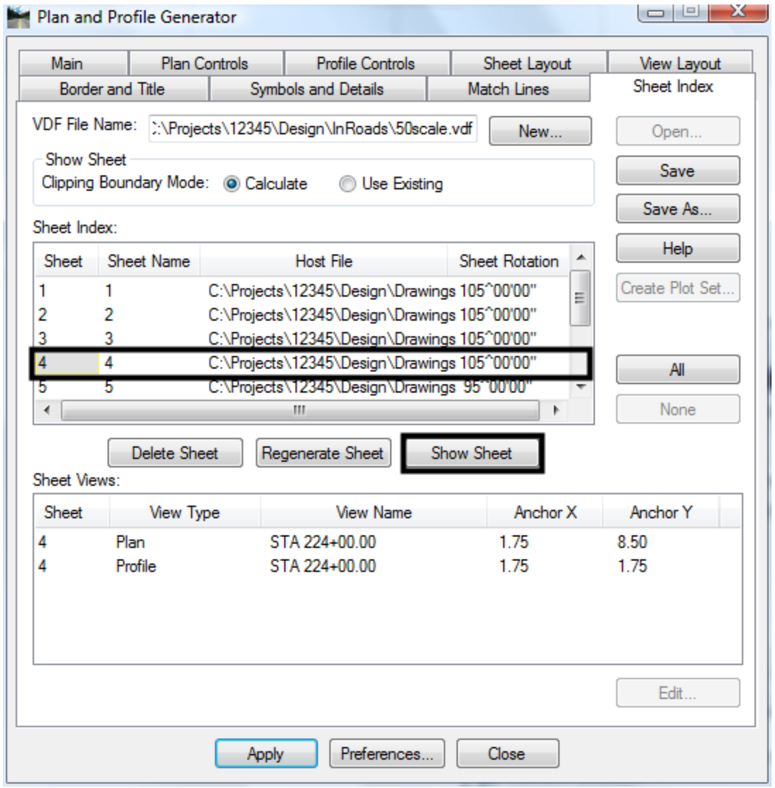
Lab 18.3 - Edit Sheet Extents

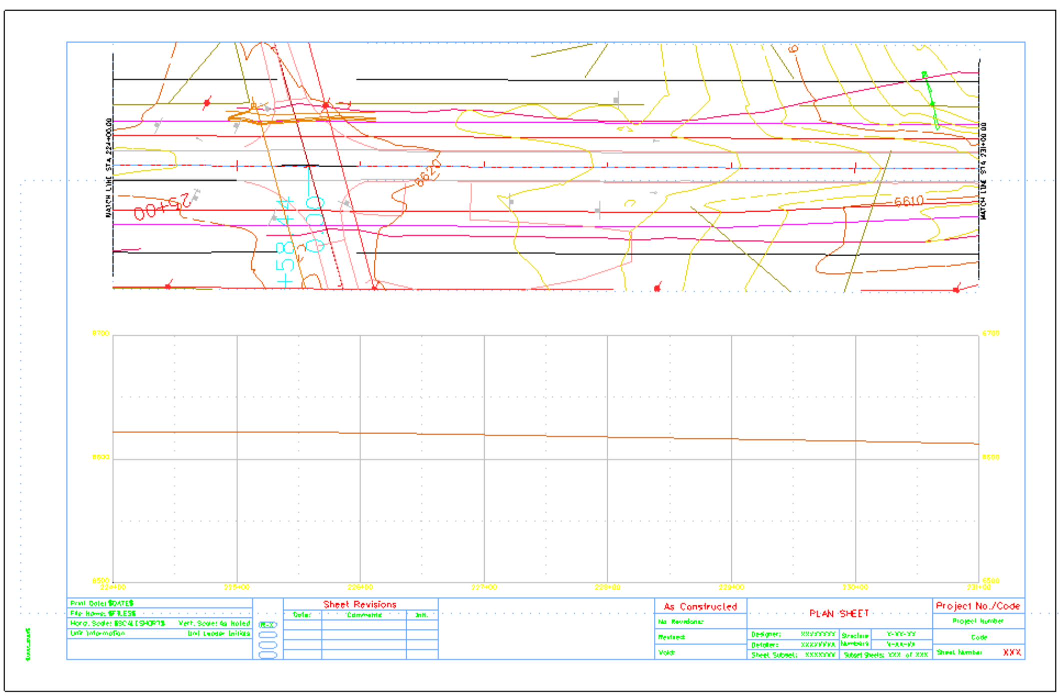
After examining the sheets created in the last lab, the intersection on sheet 4 should be centered on the sheet. In this lab, the sheet extents are changed to center the intersection.

First, view sheet 4 to determine the amount of shift required.

1. **<D>** the **Sheet Index** tab.
2. Highlight sheet **4** from the ***Sheet Index*** list.

3. **<D>** the **Show Sheet** button.



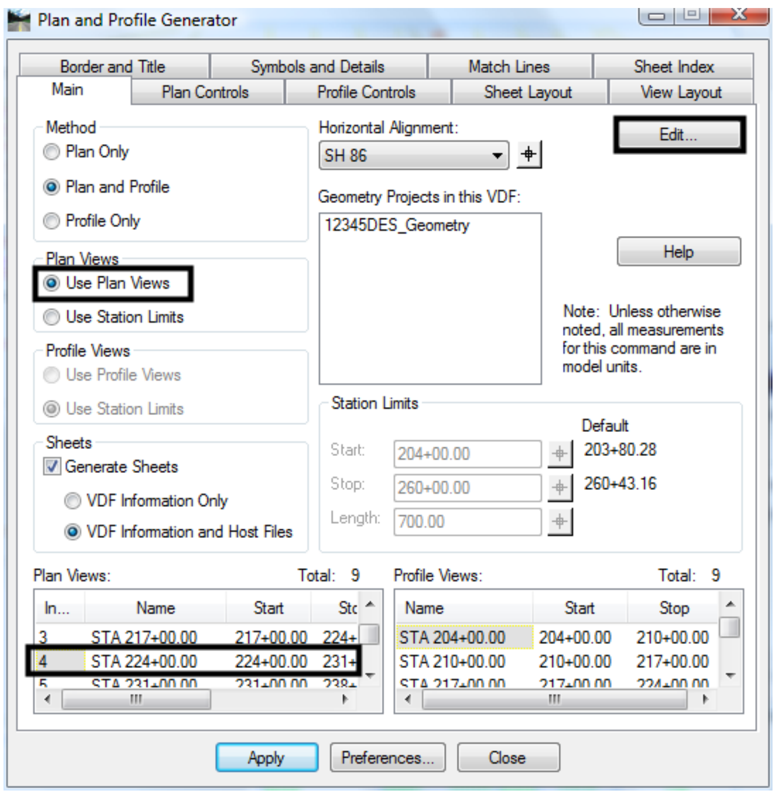


Examining sheet 4 shifting two stations (200 feet) to the left centers the intersection.

4. Open the ***C:\Projects\12345\Design\Drawing\Reference Files\12345DES_Prof.dgn*** file.
5. Delete the previously displayed profiles.

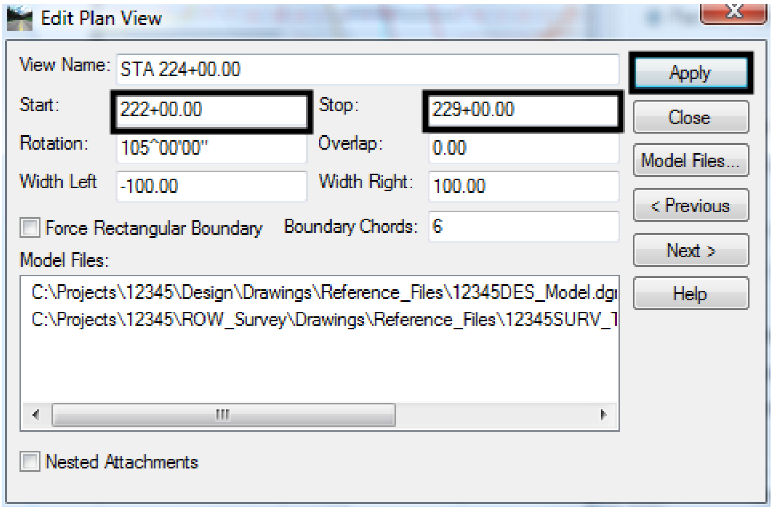
Plan and Profile Generator can be used to specify the station extents of any sheet. Here, sheet 4 is adjusted to center the intersection and the other sheets will automatically be changed to match. The steps below update the station extents on sheet 4.

6. **<D>** the **Main** tab.
7. Toggle on **Use Plan Views**.
8. Highlight sheet **4** in the ***Plan Views*** list.
9. **<D>** the **Edit** button. This displays the ***Edit Plan View*** dialog box.



10. In the ***Edit Plan View*** dialog box, key in ***222+00.00*** for the ***Start*** station.
11. Key in ***229+00.00*** for the ***Stop*** station.

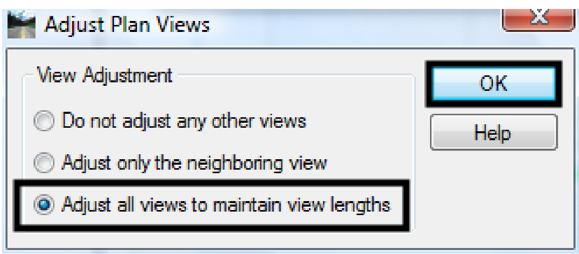
12. **<D> Apply**. This displays the ***Adjust Plan Views*** dialog box.



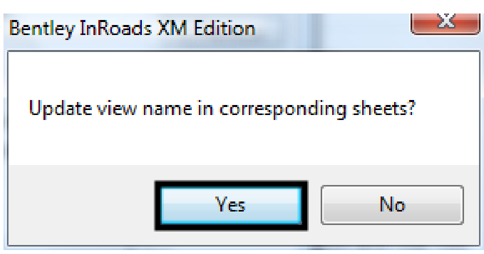
The next steps update the remaining sheets to match the changes made to sheet 4.

13. In the ***Adjust Plan Views*** dialog box, toggle on **Adjust all views to maintain view lengths**.

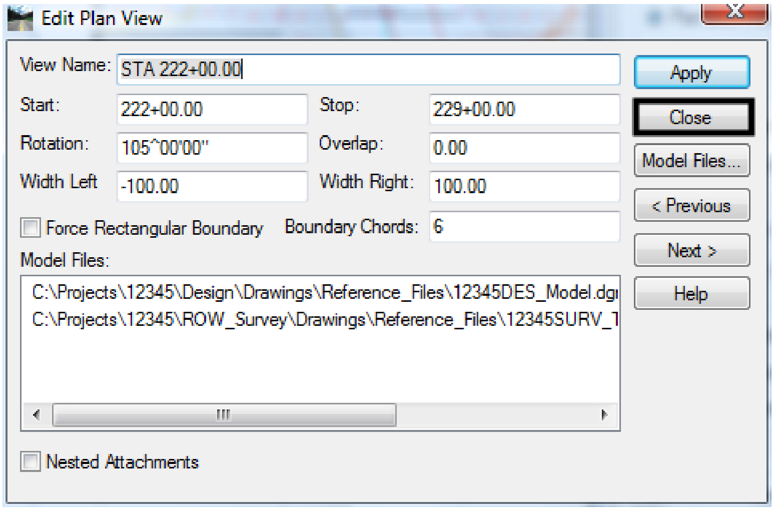
14. **<D>** the **OK** button.



15. **<D> Yes** on the ***"Update view names in corresponding sheets?"*** Message box.



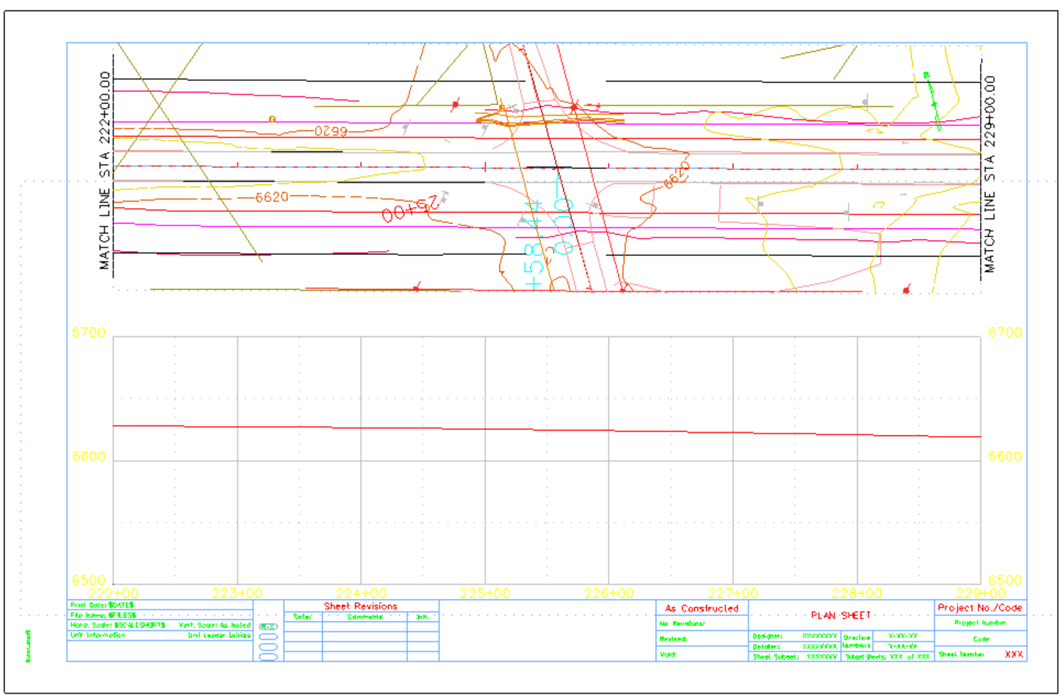
16. In the ***Edit Plan View*** dialog box, **<D> Close**.



Reducing the start station by 2, shifts the intersection to the middle of the sheet. Toggling on ***Adjust all views to maintain view lengths,*** resets the stations on the remaining sheets.

Finally, the steps below regenerate the sheets.

17. On the ***Plan and Profile Generator*** dialog box, **<D> Apply**.
18. **<D> Yes** in the, ***"Do you want to regenerate Profile Views?"*** message.
19. **<D>** in the MicroStation view window.
20. After processing is complete, examine sheet 4 as described at the first of the lab. The illustration below shows how the sheet looks.



Lab 18.4 - Moving Reference Files Within the Sheet Border

After adjusting the sheets in the last lab, the first sheet has only 400 feet of data. The data is aligned with the left margin of the sheet border, but should be aligned with the right margin.

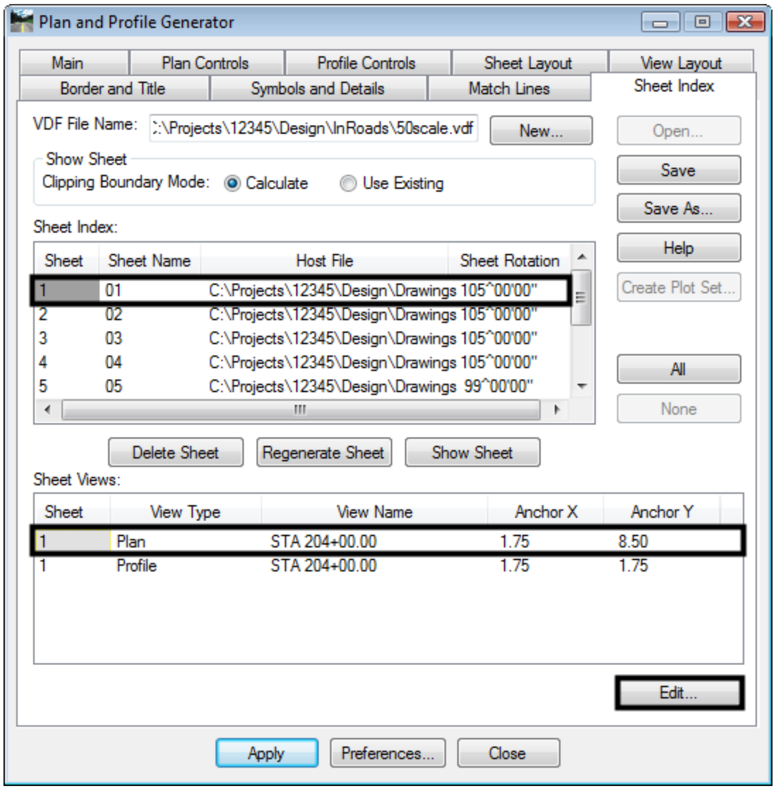
This lab demonstrates how to shift the data within the sheet border.

1. Examine sheet 1, as described at the first of the lab. The illustration below shows sheet 1. The reference files for the plan and profile need to be shifted 300 feet or 6” (paper scale) to the right.

2. On the Plan and Profile Generator’s ***Sheet Index*** tab, highlight sheet **1** in the ***Sheet Index*** list.

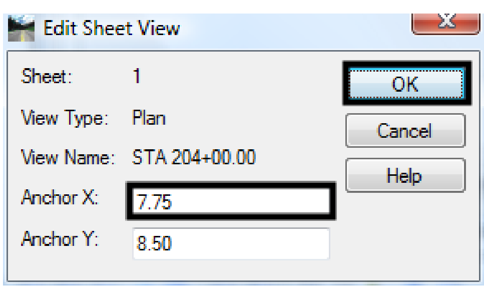
3. In the ***Sheet Views*** list, highlight sheet **1 Plan.**

4. **<D> Edit**. This displays the ***Edit Sheet View*** dialog box.



5. **In the *Anchor X* field, key in *7.75*.**

6. **<D> OK**. This dismisses the ***Edit Sheet View*** dialog box.

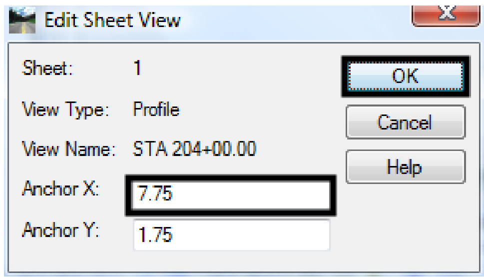


7. In the ***Sheet Views*** list, highlight sheet **1 Profile.**

8. **<D> Edit**. This displays the ***Edit Sheet View*** dialog box.

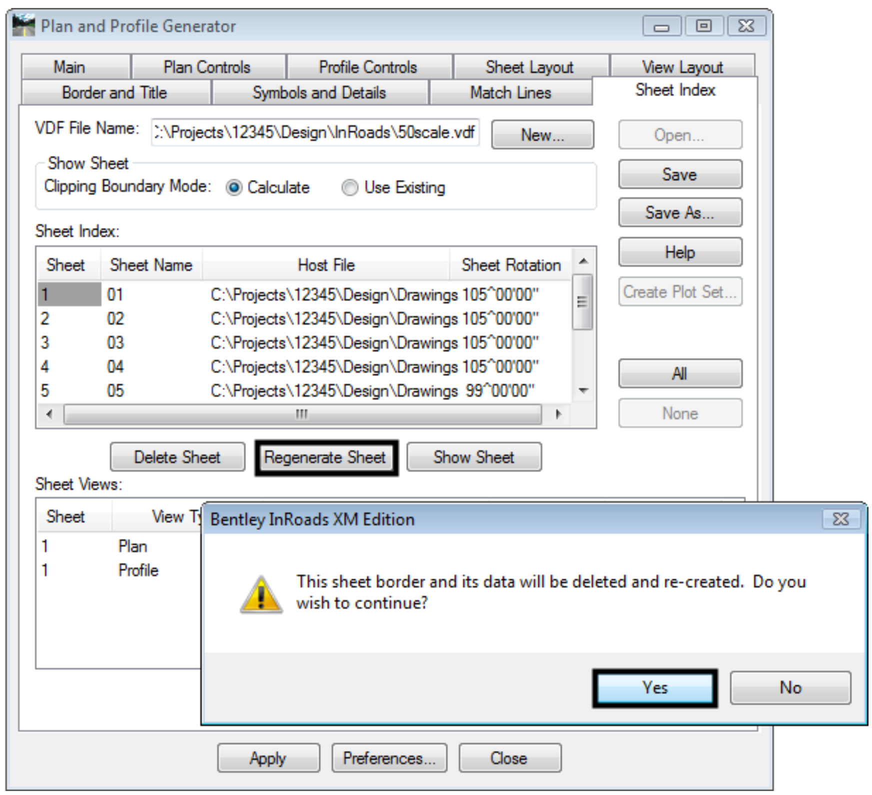
9. **In the *Anchor X* field, key in *7.75*.**

10. **<D> OK**.

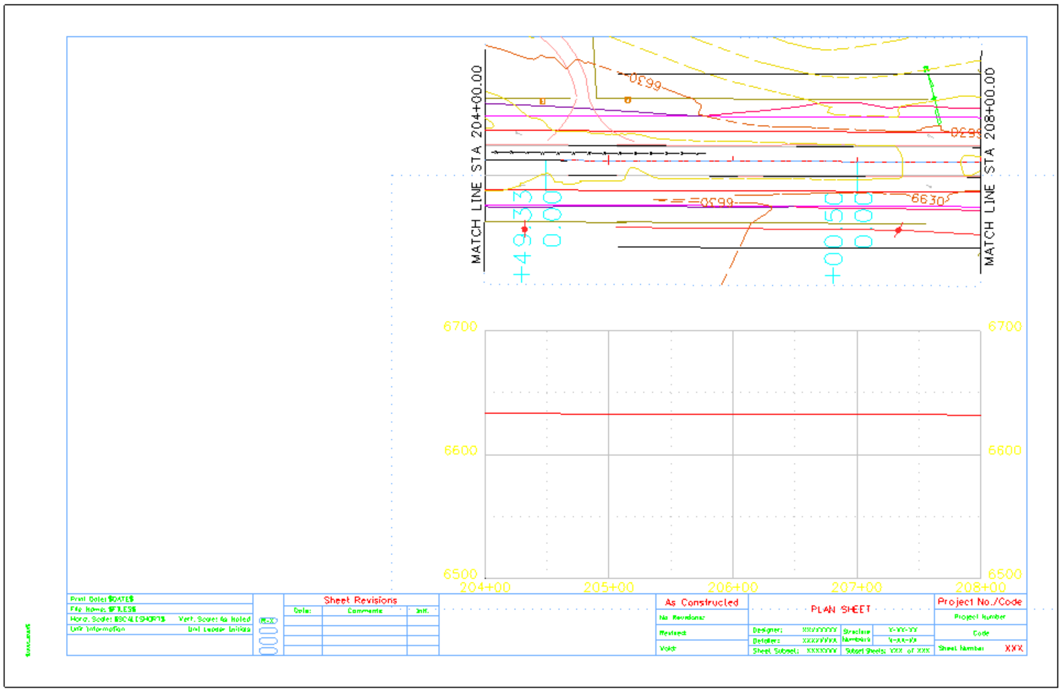


11. **<D>** the **Regenerate Sheet** button.

12. **<D> Yes** on the message box that is displayed.



The sheet now looks like the illustration below.

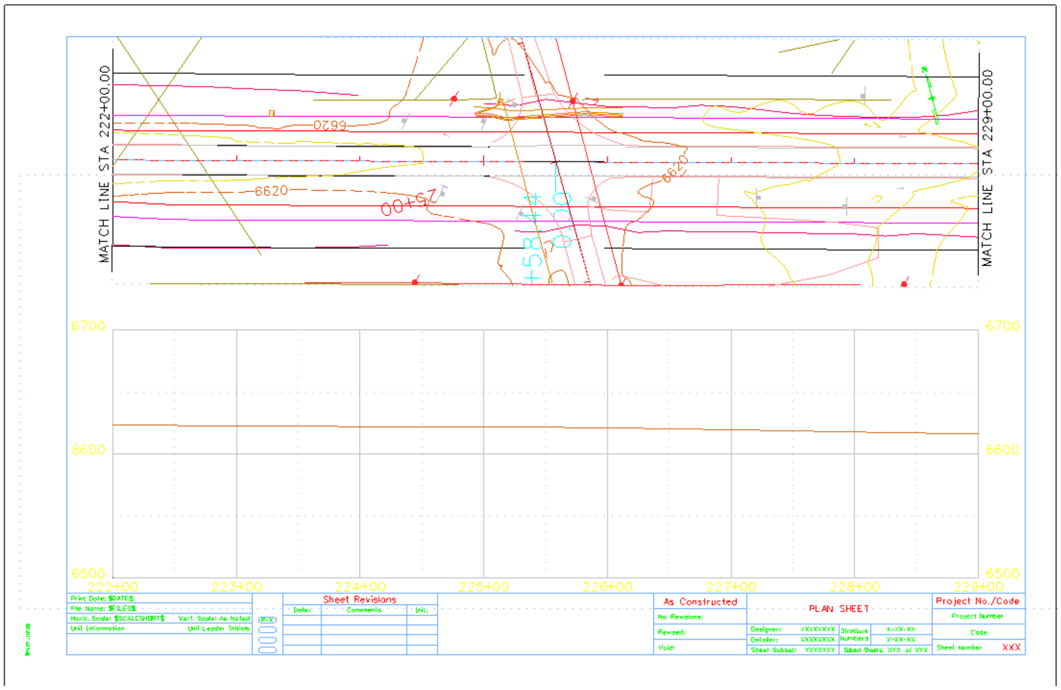


Lab 18.5 - Adding a Model File to a Single Sheet

Many of the specialty groups create data that is included on the plan sheets. However, much of this information applies to a localized area and is contained on one or two sheets in the set (a bridge or intersection, for example).

This lab demonstrates how to attach a Model File to a single P&P Sheet. A traffic signal plan is added to Sheet 4.

1. Examine sheet 4, as described at the first of the lab. The illustration below shows sheet 4.

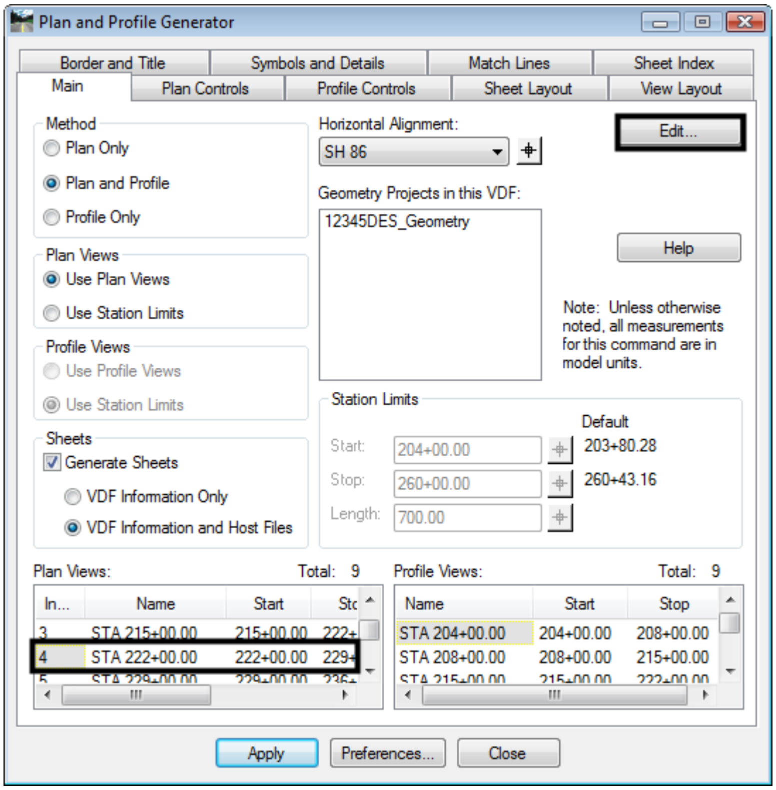


Additional models are added from the Edit options on the Main tab of the Plan and Profile Generator dialog box. The steps below illustrate this process.

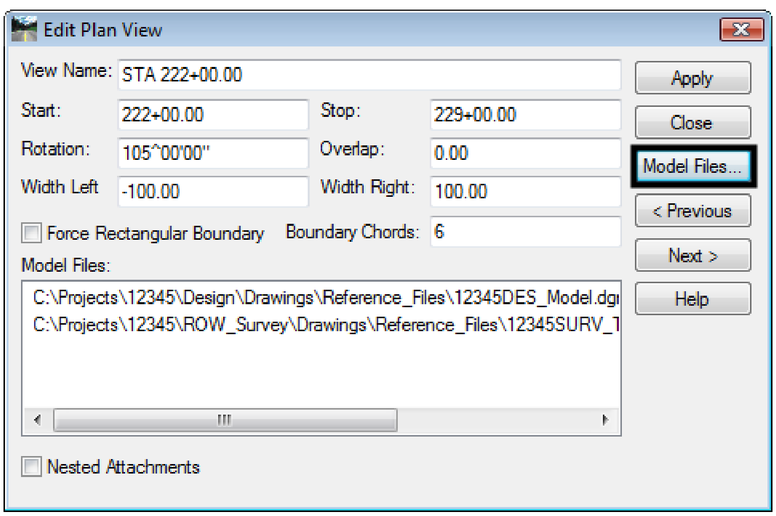
2. **<D>** the **Main** tab.

3. Highlight sheet **4** in the ***Plan Views*** list.

4. **<D>** the **Edit** button. This displays the ***Edit Plan View*** dialog box.



5. In the ***Edit Plan Views*** dialog box, **<D>** the **Model Files** button.



6. In the ***Open Model File*** dialog box, navigate to **C:\Projects\12345\Traffic_ITS\Drawings\Reference_Files**.

7. Highlight the **12345Signal01.dgn** file.

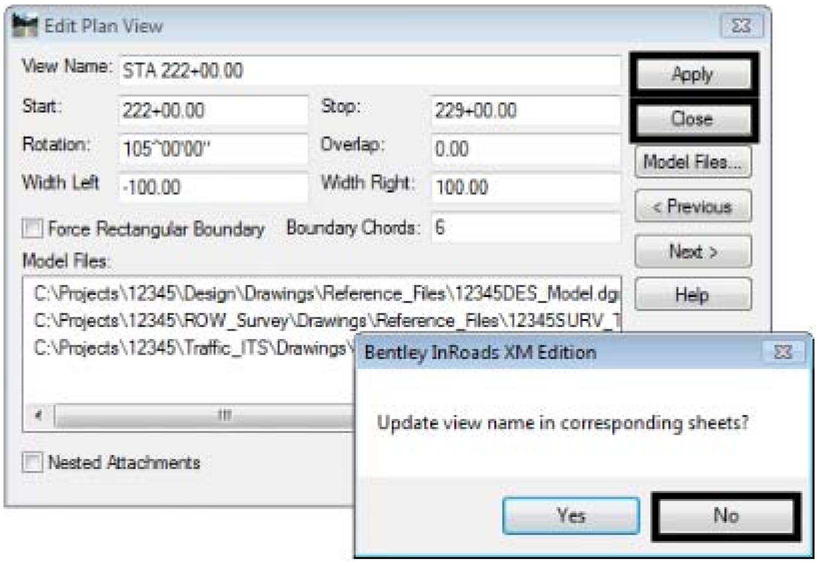
8. **<D> Open**.

9. Back in the ***Edit Plan Views*** dialog box, **<D> Apply.**

This change only occurs on sheet 4. Therefore. there is no need to update the other sheets.

10. **<D> No** in the message box that is displayed.

11. **<D> Close** to dismiss the ***Edit Plan View*** dialog box.



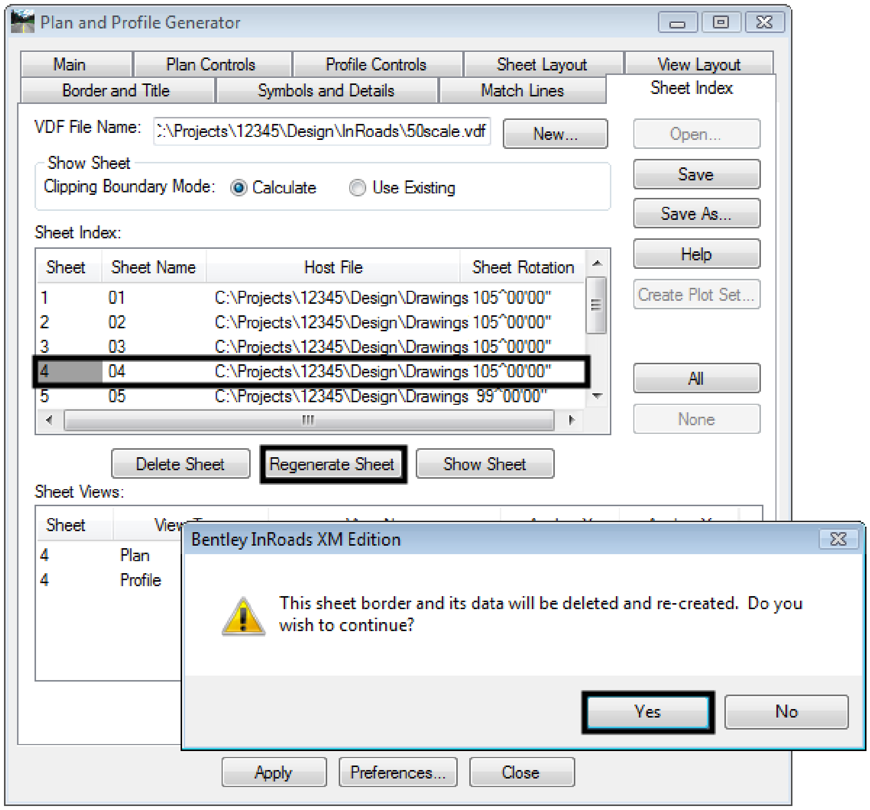
Since the added model file only affects on sheet (sheet 4), there is no need to generate a new complete set. Instead, only sheet 4 is updated. The steps below are used to update the sheet.

12. In the ***Plan and Profile Generator*** dialog box, **<D>** the **Sheet Index** tab.

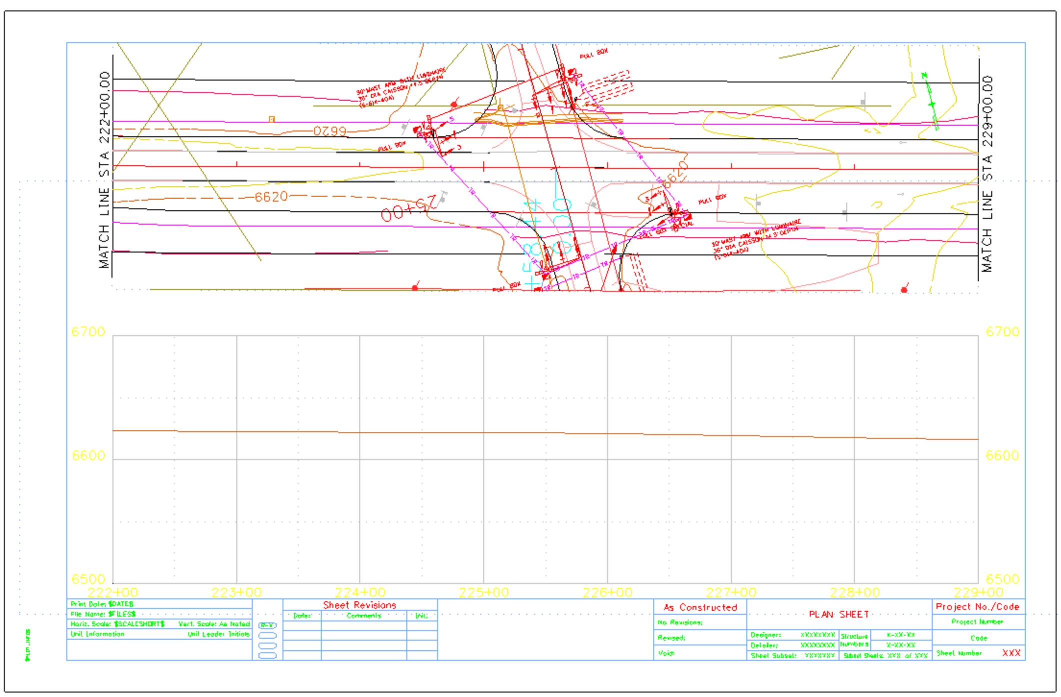
13. In the ***Sheet Views*** list, highlight sheet **4.**

14. **<D>** the **Regenerate Sheet** button.

15. **<D> Yes** on the message box that is displayed.

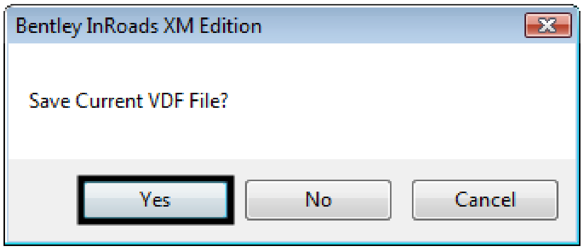


The sheet now looks like the illustration below.



16. Close the **Plan and Profile Generator** dialog box.

17. **<D> Yes** on the message box that is displayed. Navigate to ***C:\Projects\12345\Design\InRoads*** and name it ***12345DES_50Scale.vdf.***



18. Save all of the data files and Close InRoads.

19. Close MicroStation.

Chapter Summary:

- In *Lab 18.1 -Creating 100 Scale P and P Sheets* the input data for the initial 100 scale Plan and Profile Generator run was described
- In *Lab 18.2 -Creating 50 Scale P and P Sheets* the annotation scale in the seed files was changed for 50 scale sheets along with the InRoads scale factors and the Plan and Profile Generator settings. Then a new set of sheets was generated
- In *Lab 18.3 -Edit Sheet Extents* the sheet extents for the 50 scale plans were modified to center the intersection and the sheets were regenerated
- In *Lab 18.4 -Moving Reference Files Within the Sheet Border* the reference files (plan and profile) were moved within the sheet border to the right margin
- In *Lab 18.5 -Adding a Model File to a Single Sheet* a traffic signal plan model file was added to sheet 4 only

LAB 19 - Tab Sheets

This lab demonstrates the functionality built into the standardized tab sheets. It highlights the ability to quickly modify the sheet's structure by adding and removing columns and dividing the sheet so that it will fit within the sheet border. The functionality is similar with all of the standardized tab sheets. This lab uses the DES_Tabulation of Surfacing.xls file for the exercises.

Chapter Objectives:

- Open and review the tab sheet instructions
- Update the Pay Item File location
- Add additional columns to the table
- Delete columns from the table
- Modify fields associated with asphalt pay items
- Add additional rows to the table
- Enter data in the new rows and columns
- Divide the main sheet into sub sheets
- Link the sub sheets to a MicroStation sheet border.

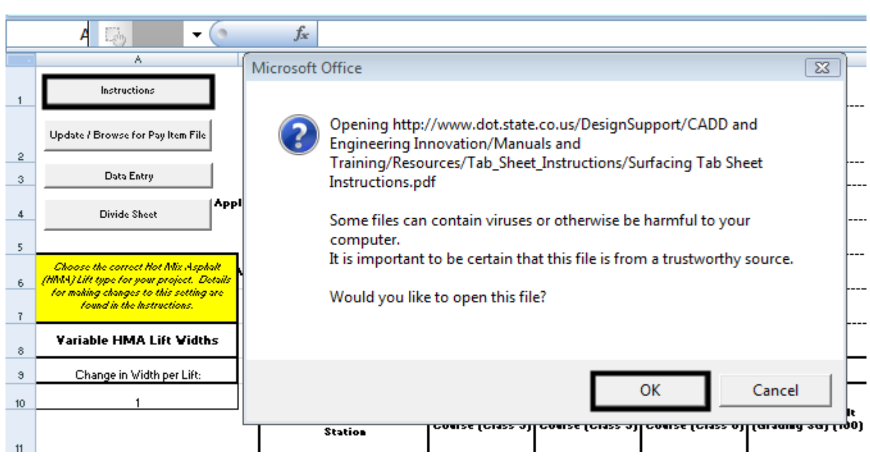
The files used in this lab are:

- C:\Projects\12345\Design\Drawings\Tabs\12345DES_Tabulation of Surfacing.xls
- C:\Projects\12345\Design\Drawings\12345DES_TabMisc##.dgn

Lab 19.1 - Review the Tab Sheet Instructions

1. Start Excel and ***Open*** the **12345DES_Tabulation of Surfacing.xls** file from ***C:\Projects\12345\Design\Drawings\Tabs***.

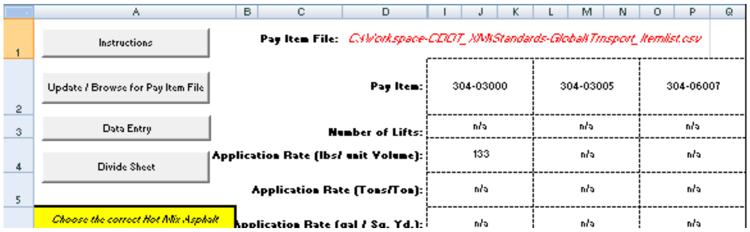
2. **<D>** the **Instruction**s button in the upper right corner of the spreadsheet. A warning message is displayed. **<D> OK** on the message window.



3. Take a few minutes and review the instructions and then minimize or dismiss them.

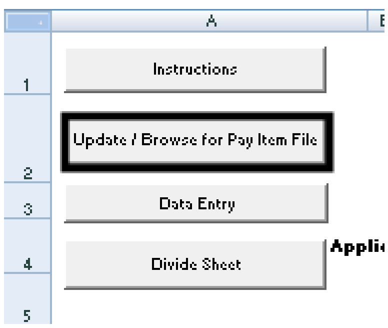
Lab 19.2 - Update the Pay Item File Location

In order for the tab sheet to function properly, it must access the ***Trnsport_Itemlist.csv*** file. The location of this file is specified in cell ***D1*** of the worksheet. This exercise demonstrates how to load the Trnsport_Itemlist.csv file.

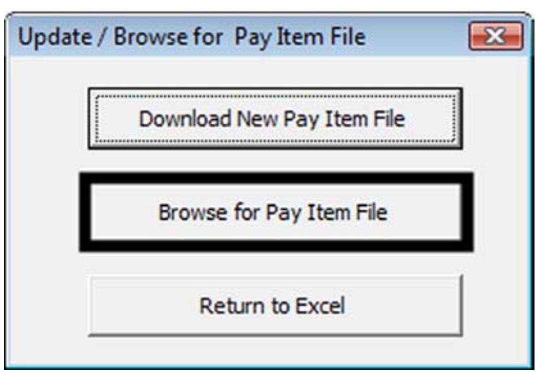


Notice that the text for the Pay Item File is red. This indicates that the file is not found. Without this file, additional pay items cannot be added. To locate the Trnsport_Itemlist.csv file:

4. **<D>** the **Update / Browse for Pay Item File** button. This displays the ***Update / Browse for Pay Item File*** dialog box.

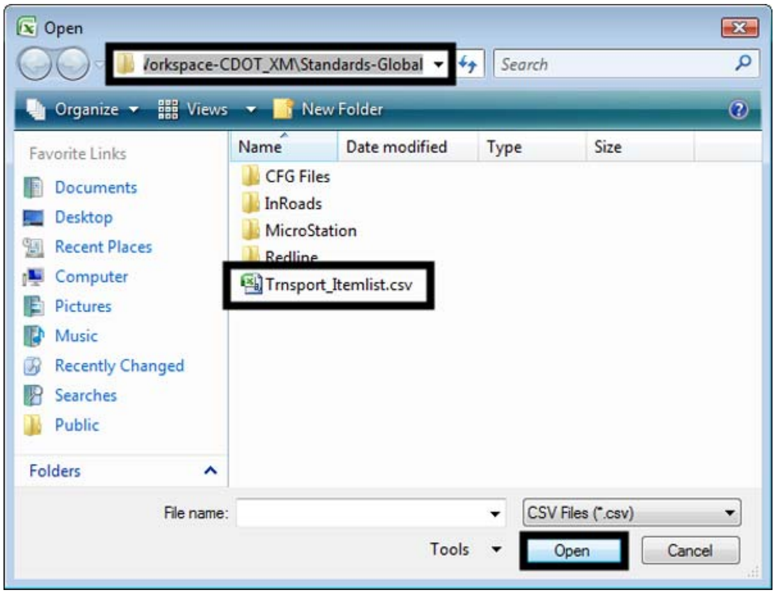


5. **<D>** The **Browse for Pay Item File** button. This displays the ***Open*** dialog box.

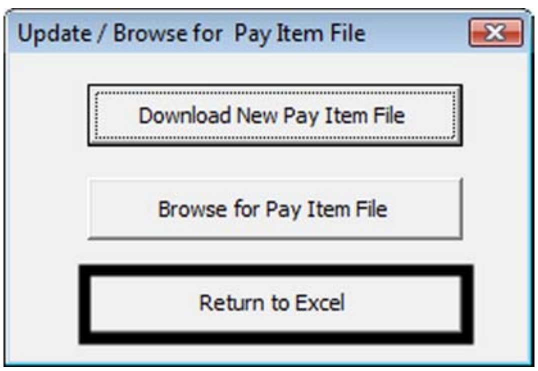


6. Navigate to the ***C:\Workspace\Workspace-CDOT_V8i\Standards-Global*** directory.

7. Highlight the **Trnsport_Itemlist.csv** file and **<D> Open**.



8. **<D>** the **Return to Excel** button in the ***Update / Browse for Pay Item File*** dialog box.



The text for the Pay Item File is now black, indicating that the Trnsport_Itemlist.csv file is available for use.

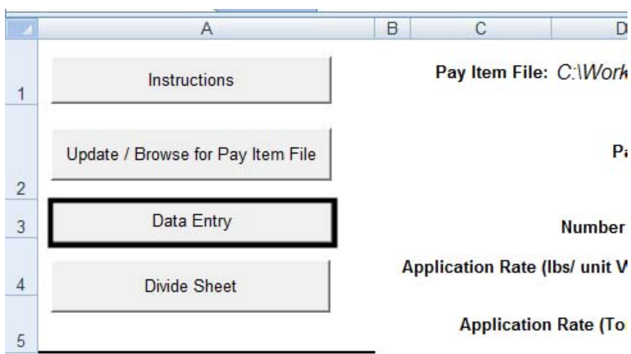
Lab 19.3 - Adding a Pay Item

There are times when additional pay items need to be added after work has begun on the tabulation sheet. The standardized tab sheet can add and sort the additional columns, keeping the existing data in the sheet with its proper pay item. In this exercise, a column for removal of concrete pavement is added.

0																									
Station		Sawing Concrete (10.5 Inch)			Aggregate Base Course (Class 6)			Hot Mix Asphalt (Patching) (Asphalt)			Hot Mix Asphalt (Grading SG) (100) (PG 64-22)												Hot Mix Asphalt (Grading SG) (100) (PG 76-28)		
		LF			TON			SY			TON												TON		
From	To										Bottom			Lift 2			Lift 3			Lift 4			Top		
xxx	xxx	xxx	xxx	LF	Wid (ft)	Thk (in)	TON	Wid (ft)	xxx	SY	Wid (ft)	Thk (in)	TON	Wid (ft)	Thk (in)	TON	Wid (ft)	Thk (in)	TON	Wid (ft)	Thk (in)	TON	Wid (ft)	Thk (in)	TON
1+00	5+00			400	48	6	638			0	44	4	430	43	3	315	42	3	308	41	3	301	40	2.5	244
5+00	12+00			700	48	6	1117			0	44	4	753	43	3	552	42	3	539	41	3	526	40	2.5	428
12+00	19+00			700	48	6	1117			0	44	4	753	43	3	552	42	3	539	41	3	526	40	2.5	428
19+00	26+00			700	48	6	1117			0	44	4	753	43	3	552	42	3	539	41	3	526	40	2.5	428
26+00	33+00			700	48	6	1117			0	44	4	753	43	3	552	42	3	539	41	3	526	40	2.5	428

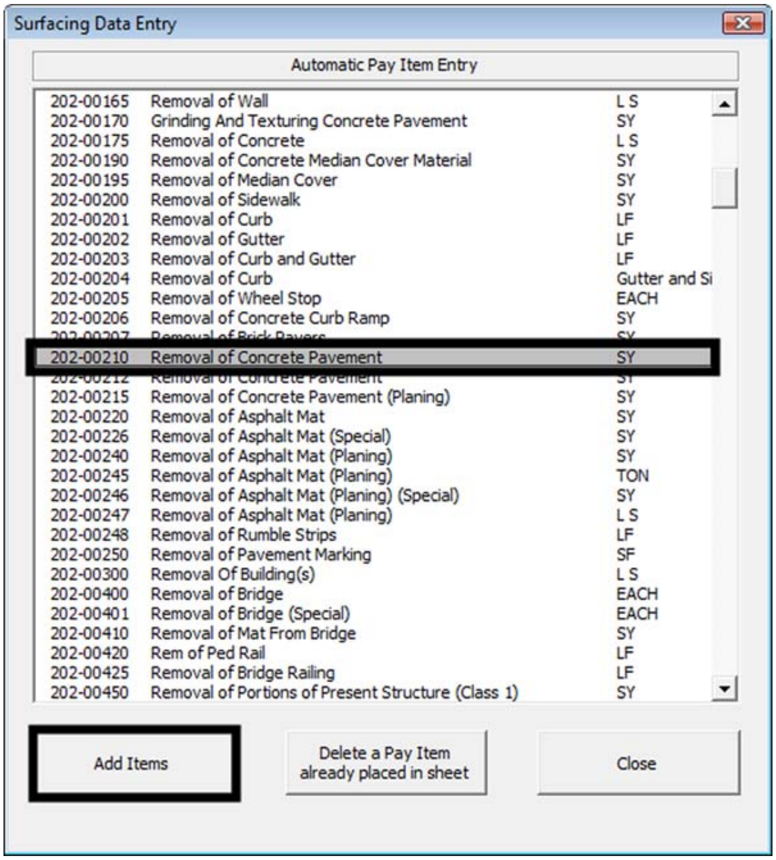
The illustration above shows the sheet before adding the column.

1. **<D>** the **Data Entry** button. This displays the ***Surfacing Data Entry*** dialog box.



2. Scroll down the list of pay items and highlight the **202-00210 Removal of Concrete Pavement** pay item.

3. **<D>** the **Add Items** button.



4. **<D> Close** to dismiss the ***Surfacing Data Entry*** dialog box.

Notice that the Removal of Concrete Pavement is now the first pay item column on the sheet. Also note that the data in the sheet was shifted to keep it with the proper pay item.

														0														
Station		Removal of Concrete Pavement			Sawing Concrete (10.5 Inch)			Aggregate Base Course (Class 6)			Hot Mix Asphalt (Patching) (Asphalt)			Hot Mix Asphalt (Grading SG) (100) (PG 64-22)												Hot Mix Asphalt (Grading SG) (100) (PG 76-28)		
		SY			LF			TON			SY			TON												TON		
From	To													Bottom			Lift 2			Lift 3			Lift 4			Top		
xxx	xxx	Wid (ft)	xxx	SY	xxx	xxx	LF	Wid (ft)	Thk (in)	TON	Wid (ft)	xxx	SY	Wid (ft)	Thk (in)	TON	Wid (ft)	Thk (in)	TON	Wid (ft)	Thk (in)	TON	Wid (ft)	Thk (in)	TON	Wid (ft)	Thk (in)	TON
1+00	5+00			0			400	48	6	638			0	44	4	430	43	3	315	42	3	308	41	3	301	40	2.5	244
5+00	12+00			0			700	48	6	1117			0	44	4	753	43	3	552	42	3	539	41	3	526	40	2.5	428
12+30	19+00			0			700	48	6	1117			0	44	4	753	43	3	552	42	3	539	41	3	526	40	2.5	428
19+30	26+00			0			700	48	6	1117			0	44	4	753	43	3	552	42	3	539	41	3	526	40	2.5	428
26+00	33+00			0			700	48	6	1117			0	44	4	753	43	3	552	42	3	539	41	3	526	40	2.5	428

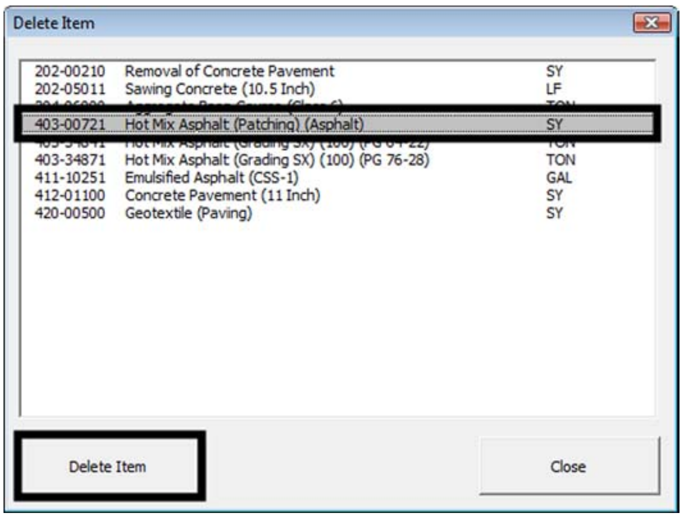
The illustration above shows the sheet after the new column is added.

5. Next, add pay item ***411-10300 Emulsified Asphalt (Prime Coat)***.

Lab 19.4 - Deleting a Pay Item

Sometimes pay items originally added to the sheet are not used. The standardized tab sheet can remove the specified columns and reorganize the remaining data. In this exercise, the column for patching asphalt is removed.

1. **<D>** the **Data Entry** button. This displays the ***Surfacing Data Entry*** dialog box.
2. **<D>** the **Delete a Pay Item already placed in sheet** button. This displays the ***Delete Item*** dialog box.
3. Highlight the **403-00721 Hot Mix Asphalt (Patching) (Asphalt)** pay item.
4. **<D>** the **Delete Item** button.



5. **<D> Close** on the ***Delete Item*** and the ***Surfacing Data Entry*** dialog boxes.

Notice that the patching asphalt column is gone and the columns to the right have shifted over. The illustration below shows the final layout.

0																									
Station		Removal of Concrete Pavement			Sawing Concrete (10.5 Inch)			Aggregate Base Course (Class 6)			Hot Mix Asphalt (Grading SG) (100) (PG 64-22)												Hot Mix Asphalt (Grading SG) (100) (PG 76-28)		
		SY			LF			TON			TON												TON		
From	To										Bottom			Lift 2			Lift 3			Lift 4			Top		
xxx	xxx	Wid (ft)	xxx	SY	xxx	xxx	LF	Wid (ft)	Thk (in)	TON	Wid (ft)	Thk (in)	TON	Wid (ft)	Thk (in)	TON	Wid (ft)	Thk (in)	TON	Wid (ft)	Thk (in)	TON	Wid (ft)	Thk (in)	TON
1+00	5+00			0			400	48	6	638	44	4	430	43	3	315	42	3	308	41	3	301	40	2.5	244
5+00	12+00			0			700	48	6	1117	44	4	753	43	3	552	42	3	539	41	3	526	40	2.5	428
12+00	19+00			0			700	48	6	1117	44	4	753	43	3	552	42	3	539	41	3	526	40	2.5	428
19+00	26+00			0			700	48	6	1117	44	4	753	43	3	552	42	3	539	41	3	526	40	2.5	428
26+00	33+00			0			700	48	6	1117	44	4	753	43	3	552	42	3	539	41	3	526	40	2.5	428

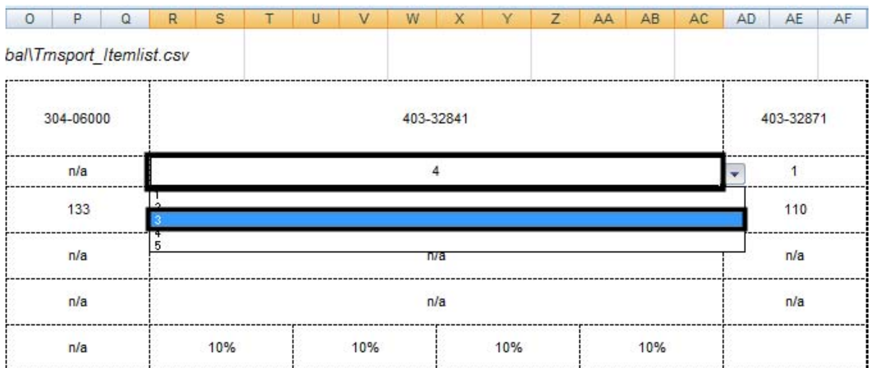
Lab 19.5 - Additional Fields Associated with HMA Pay Items

Unlike concrete, asphalt pavement is laid down in a series of lifts. Each lift making up the total pavement could be a different thickness, width, and/or a different grade (which uses a different pay item code). In addition, the tab sheet can account for assumed irregularities in the paving process. These items are accounted for in the tabulation sheet with three fields outside of the table and a heading row within the table.

For the exercise below, the final pavement consists of three lifts of PG 64-22 asphalt and one lift (the Top lift) of PG 76-28 asphalt. The existing tab sheet consists of four lifts of PG 64-22 asphalt which will be corrected in this exercise. An irregularity factor of 5% will be used for the Bottom lift only.

1. **<D>** in the Number of Lifts cell for the ***403-32841 Hot Mix Asphalt (Grading SG) (100) (PG 64-22)*** pay item.

2. Use the drop down menu and select **3** from the list.



	0				
Aggregate Base Course (Class 6)	Hot Mix Asphalt (Grading SG) (100) (PG 64-22)				Hot Mix Asphalt (Grading SG) (100) (PG 76-28)
TON	TON				TON
	Bottom	Lift 2	Lift 3	Lift 4	Top

The pay item now consists of three lifts instead of four. The original Lift 2 row was deleted (including the data). The Lift 3 and Lift 4 rows were shifted over and renamed. The illustration below shows the results.

0														
Aggregate Base Course (Class 6)			Hot Mix Asphalt (Grading SG) (100) (PG 64-22)									Hot Mix Asphalt (Grading SG) (100) (PG 76-28)		
TON			TON									TON		
			Bottom			Lift 2			Lift 3			Top		
Wid (ft)	Thk (in)	TON	Wid (ft)	Thk (in)	TON	Wid (ft)	Thk (in)	TON	Wid (ft)	Thk (in)	TON	Wid (ft)	Thk (in)	TON
48	6	638.4	44	4	430.2	42	3	308	41	3	300.7	40	2.5	244.4
48	6	1117	44	4	752.9	42	3	539	41	3	526.2	40	2.5	427.8

Now change the irregularity factor for the PG 64-22 pay item. The irregularity factor for the PG 76-28 does not have to be changed because it is already 0.

3. **<D>** in cell **R7**. This is the ***% Irreg to Apply:*** cell for the Bottom lift of the 4***03-32841 Hot Mix Asphalt (Grading SG) (100) (PG 64-22)*** pay item.
4. Key in ***5*** and press the ***Tab*** key. The change is made in cell R7. This value is used to determine the total amount of material used for irregularities at the bottom of the sheet.
5. Using the ***Tab*** has moved the cursor to the *U7* cell. Press the ***Delete*** key to clear this cell.
6. ***Tab*** again and ***Delete*** the contents of cell *X7*. The Irregularities quantity is shown at the bottom of the sheet in the totals area.

O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC
bal\Trnsport_Itemlist.csv														
304-06000			403-32841									403-32871		
n/a			3									1		
133			110									110		
n/a			n/a									n/a		
n/a			n/a									n/a		
n/a			5%											

0

Aggregate Base Course (Class 6)			Hot Mix Asphalt (Grading SG) (100) (PG 64-22)									Hot Mix Asphalt (Grading SG) (100) (PG 76-28)		
TON			TON									TON		
			Bottom			Lift 2			Lift 3			Top		
Wid (ft)	Thk (in)	TON	Wid (ft)	Thk (in)	TON	Wid (ft)	Thk (in)	TON	Wid (ft)	Thk (in)	TON	Wid (ft)	Thk (in)	TON
48	6	638.4	43	4	420.4	42	3	308	41	3	300.7	40	2.5	244.4
48	6	1117	43	4	735.8	42	3	539	41	3	526.2	40	2.5	427.8
		0	43		0	42		0	41		0	40		0
		0			0			0			0			0
		0			0			0			0			0
			783											
23780			15662			11473			11200			9106		
23780			**16445**			**11473**			**11200**			**9106**		

The width for each asphalt lift may be fixed, so that they are all the same, or they may be variable with each successive lift one foot wider than the lift above.

The width for each HMA lift is based on the width of the Top lift. The values for the Top widths were entered prior to deleting the extra lift and were entered as Variable HMA Lift Widths. Notice that the data entered in the table has not been re-calculated since deleting the extra lift. Therefore, the bottom lift is one foot too wide.

0															
Aggregate Base Course (Class 6)			Hot Mix Asphalt (Grading SG) (100) (PG 64-22)									Hot Mix Asphalt (Grading SG) (100) (PG 76-28)		
TON			TON									TON		
			Bottom			Lift 2			Lift 3			Top		
Wid (ft)	Thk (in)	TON	Wid (ft)	Thk (in)	TON	Wid (ft)	Thk (in)	TON	Wid (ft)	Thk (in)	TON	Wid (ft)	Thk (in)	TON
48	6	638.4	44	4	430.2	42	3	308	41	3	300.7	40	2.5	244.4
48	6	1117	44	4	752.9	42	3	539	41	3	526.2	40	2.5	427.8
48	6	1117	44	4	752.9	42	3	539	41	3	526.2	40	2.5	427.8
48	6	1117	44	4	752.9	42	3	539	41	3	526.2	40	2.5	427.8
48	6	1117	44	4	752.9	42	3	539	41	3	526.2	40	2.5	427.8
48	6	1117	44	4	752.9	42	3	539	41	3	526.2	40	2.5	427.8
48	6	1117	44	4	752.9	42	3	539	41	3	526.2	40	2.5	427.8
48	6	798	44	4	537.8	42	3	385	41	3	375.8	40	2.5	305.6

To correct the Bottom width:

7. **<D>** in cell **AA15**.

   Note: Changing the width of an HMA Top lift triggers a re-calculation of HMA lower lift widths on a row by row basis.

8. Key in ***40*** and press ***Enter***.

9. Repeat step 8 for the remaining rows that contain data.

0															
Aggregate Base Course (Class 6)			Hot Mix Asphalt (Grading SG) (100) (PG 64-22)									Hot Mix Asphalt (Grading SG) (100) (PG 76-28)			Emuls
TON			TON									TON			
			Bottom			Lift 2			Lift 3			Top			
Wid (ft)	Thk (in)	TON	Wid (ft)	Thk (in)	TON	Wid (ft)	Thk (in)	TON	Wid (ft)	Thk (in)	TON	Wid (ft)	Thk (in)	TON	Wid (ft)
48	6	638.4	43	4	420.4	42	3	308	41	3	300.7	40	2.5	244.4	43
48	6	1117	43	4	735.8	42	3	539	41	3	526.2	40	2.5	427.8	43
48	6	1117	43	4	735.8	42	3	539	41	3	526.2	40	2.5	427.8	43
48	6	1117	43	4	735.8	42	3	539	41	3	526.2	40	2.5	427.8	43
48	6	1117	43	4	735.8	42	3	539	41	3	526.2	40	2.5	427.8	43
48	6	1117	43	4	735.8	42	3	539	41	3	526.2	40	2.5	427.8	43
48	6	1117	43	4	735.8	42	3	539	41	3	526.2	40	2.5	427.8	43
48	6	798	43	4	525.6	42	3	385	41	3	375.8	40	2.5	305.6	43

Note: Values for any column can also be entered manually. However, re-entering the width in the Top column ensures that all columns of HMA items using a unit of TONs are updated correctly.

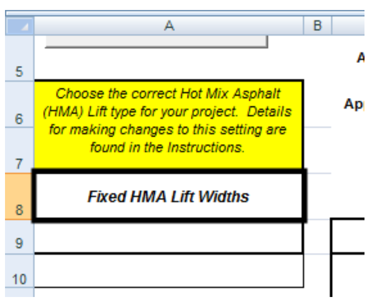
Important! Non-HMA quantities based on pavement widths (like Aggregate Base Course) are not automatically updated and must be corrected manually.

The next series of steps will illustrate the difference between fixed and variable lift width by entering additional data into rows 37 and 38.

10. Verify that cell *A8* is set to **Variable HMA Lift Widths**.
11. **<D>** in cell **C37** and enter ***157+00*** for the ***From*** station, then ***Tab*** to the next column.
12. In cell ***D37***, key in ***164+00*** for the ***To*** station.
13. **<D>** in cell **AA37**. This is the cell for the Top lift of all of the HMA pay items.
14. Key in ***40*** for the width. Notice that the widths for each of the other HMA lifts on the row are automatically calculated, increasing by one foot for each lift.

C	D	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC
136+00	143+00			0			700	48	6	1117	43	4	735.8	42	3	539	41	3	526.2	40	2.5	427.8
143+00	150+00			0			700	48	6	1117	43	4	735.8	42	3	539	41	3	526.2	40	2.5	427.8
157+00	164+00			0			700			0	43		0	42		0	41		0	40		0
				0			0			0			0			0			0			0
				0			0			0			0			0			0			0
Irregularities											783											
SubTotals		0			15600			23780			15662			11473			11200			9106		
Project Totals		**0**			**15600**			**23780**			**16445**			**11473**			**11200**			**9106**		

15. Change cell *A8* to **Fixed HMA Lift Widths**.



16. **<D>** in cell **C38** and enter ***164+00*** for the ***From*** station, then ***Tab*** to the next column.
17. In cell ***D37***, key in ***171+00*** for the ***To*** station.
18. **<D>** in cell **AA38**. This is the cell for the Top lift of all of the HMA pay items.

19. Key in ***40*** for the width. Notice that the widths for each of the other HMA lifts on the row are populated with the same value for each lift.

C	D	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC
136+00	143+00			0			700	48	6	1117	43	4	735.8	42	3	539	41	3	526.2	40	2.5	427.8
143+00	150+00			0			700	48	6	1117	43	4	735.8	42	3	539	41	3	526.2	40	2.5	427.8
157+00	164+00			0			700			0	43		0	42		0	41		0	40		0
164+00	171+00			0			700			0	40		0	40		0	40		0	40		0
				0			0			0			0			0			0			0
Irregularities												783										
SubTotals			0			16300			23780			15662			11473			11200			9106	
Project Totals			**0**			**16300**			**23780**			**16445**			**11473**			**11200**			**9106**	

Note: Category 411 pay items with a unit of GALs use the same value as the Bottom HMA width to calculate quantities.

20. Copy the Thickness value down to the two new rows for each of the HMA columns.

C	D	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC
136+00	143+00			0			700	48	6	1117	43	4	735.8	42	3	539	41	3	526.2	40	2.5	427.8
143+00	150+00			0			700	48	6	1117	43	4	735.8	42	3	539	41	3	526.2	40	2.5	427.8
157+00	164+00			0			700			0	43	4	735.8	42	3	539	41	3	526.2	40	2.5	427.8
164+00	171+00			0			700			0	40	4	684.4	40	3	513.3	40	3	513.3	40	2.5	427.8
				0			0			0			0			0			0			0
Irregularities												854										
SubTotals			0			16300			23780			17082			12525			12239			9961	
Project Totals			**0**			**16300**			**23780**			**17936**			**12525**			**12239**			**9961**	

Rows 4, 5, and 6 in the spreadsheet are reserved for the application rates of various materials. Although standard default values are automatically entered when a pay item is added to the tab sheet, these values can be changed manually. In this exercise, the application rate for 411-10300 Emulsified Asphalt (Prime Coat) needs to be changed from 0.1 gallons per square yard to 0.2 gallons per square yard.

21. **<D>** in cell **AH6**.

22. Key in ***0.2*** and press ***Enter***.

411-10251	411-10300
n/a	n/a
n/a	n/a
n/a	n/a
0.1	0.2
n/a	n/a

Emulsified Asphalt (CSS-1)			Emulsified Asphalt (Prime Coat)		
GAL			GAL		
Wid (ft)	xxx	GAL	Wid (ft)	xxx	GAL
43		764.4	43		1529
43		1338	43		2676
43		1338	43		2676

Notice that the quantities in column ***AI*** automatically update to reflect the new application rate.

Lab 19.6 - Add Additional Data to the Sheet

Two additional rows are needed for this next exercise.

1. **<R>** on the row number **39** and follow the steps in ***Section 2.4*** of the ***Tabulation of Surfacing*** instructions to add two additional rows.

   The next few steps will consist of entering new station extents for the last three rows, removing unwanted data values for Sawing Concrete pay item, and adding pay item quantities for Removal of Concrete Pavement, Sawing Concrete Pavement, and 11" Concrete Pavement

2. First, enter the station extents for the last three lines using the following data:

   - 171+00 to 178+00
   - 178+00 to 185+00
   - 185+00 to 192+00

3. Next, remove the quantities for Sawing Concrete for all rows except for station 185+00 to 192+00. **<D>** in cell **N15**. This is the first quantity cell of the sawing concrete pavement pay item.

4. Press the ***Delete*** key to remove the quantity.

5. **<D> and hold** on the little box in the lower right corner of the ***N15*** cell.

6. Drag down the ***N*** column to row ***40*** then release the mouse button. This deletes all of the unneeded quantities.

N15

	A	B	C	D	I	J	K	L	M	N	O	P	Q
12						SY			LF			TON	
13			From	To									
14	This row for worksheet only		xxx	xxx	Wid (ft)	xxx	SY	xxx	xxx	LF	Wid (ft)	Thk (in)	TON
15			1+00	5+00			0				48	6	638.4
16			5+00	12+00			0			700	48	6	1117
17			12+00	19+00			0			700	48	6	1117
18			19+00	26+00			0			700	48	6	1117
19			26+00	33+00			0			700	48	6	1117
20			33+00	40+00			0			700	48	6	1117
21			40+00	47+00			0			700	48	6	1117
22			47+00	52+00			0			500	48	6	798
23			52+00	59+00			0			700	48	6	1117
24			59+00	66+00			0			700	48	6	1117
25			66+00	73+00			0			700	48	6	1117
26			73+00	80+00			0			700	48	6	1117
27			80+00	87+00			0			700	48	6	1117
28			87+00	94+00			0			700	48	6	1117
29			94+00	101+00			0			700	48	6	1117
30			101+00	108+00			0			700	48	6	1117
31			108+00	115+00			0			700	48	6	1117
32			115+00	122+00			0			700	48	6	1117
33			122+00	129+00			0			700	48	6	1117
34			129+00	136+00			0			700	48	6	1117
35			136+00	143+00			0			700	48	6	1117
36			143+00	150+00			0			700	48	6	1117
37			157+00	164+00			0			700			0
38			164+00	171+00			0			700			0
39													

7. The illustration below shows the completed station columns.

129+00	136+00			0				48	6	1117	43
136+00	143+00			0				48	6	1117	43
143+00	150+00			0				48	6	1117	43
157+00	164+00			0						0	43
164+00	171+00			0						0	40
171+00	178+00			0						0	
178+00	185+00			0						0	
185+00	192+00			0			700			0	
Irregularities											
SubTotals		0			700			23780			
Project Totals		**0**			**700**			**23780**			

The project requires 36' of concrete sawing for the extents from Sta. 171+00 to Sta.178+00 and from Sta. 185+00 to Sta. 192+00.

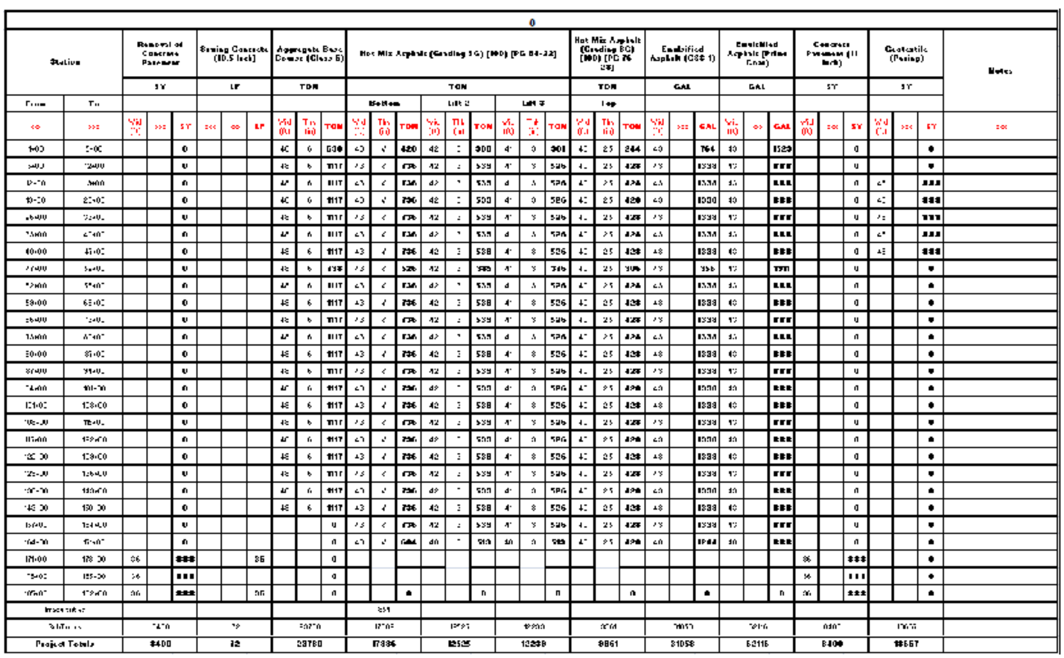
8. **<D>** in cell **N39**.
9. Key in a value of ***36*** in cell ***N39*** and cell ***N41***.

This completes the changes for Sawing Concrete.

Next, the Removal of Concrete Pavement quantities are added. This occurs from Sta. 171+00 to the end of the job. The width of the pavement being removed is 36’

10. **<D>** in cell **I39**.
11. Key in ***36***.
12. **<D> and hold** on the little box in the lower right corner of the ***I39*** cell.
13. Drag down the ***I*** column to row ***41*** then release the mouse button. This adds the 36’ width to each row.
14. To calculate the quantity for 11” Concrete Pavement, enter ***36*** in cells ***AJ39*** through ***AJ41***.

Below is an illustration of the completed sheet.

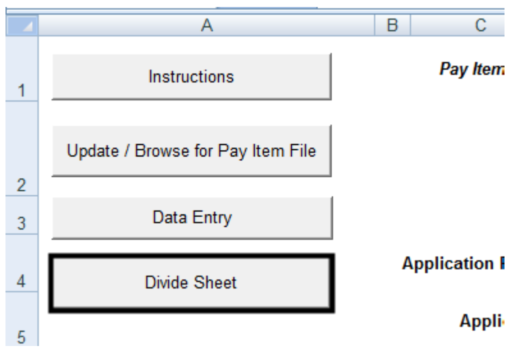


15. **Save** the file.

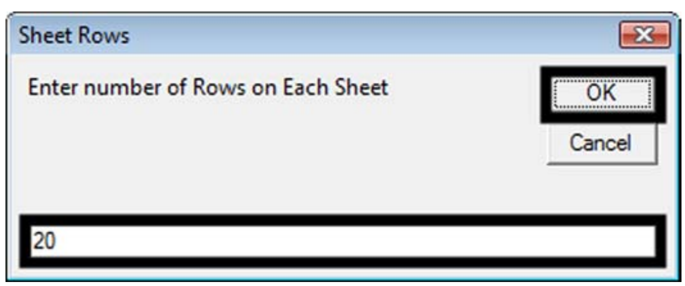
Lab 19.7 - Dividing the Surfacing Sheet into Sub Sheets

It the sheet is too long to fit inside the sheet border, there is a option to divide the master sheet into sub sheets of a specified number of data rows. When this option is selected, additional worksheets are added to the file that contain a part of the master sheet along with a sheet totals table. In this exercise, it was decided that 20 rows of data was the maximum per sheet. (this number will vary based on the tab sheet being used and additional information that may be included in the printable sheet.)

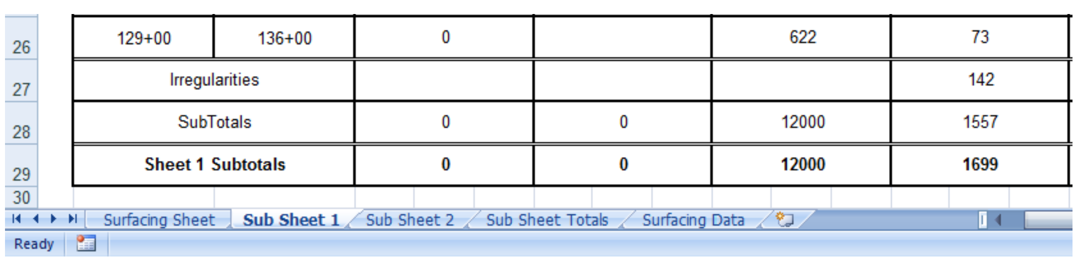
1. In the top left portion of the tab sheet, **<D>** the **Divide Sheet** button. This displays the ***Sheet Rows*** dialog box.



2. Key in ***20***. This is the number of data rows used on each sub sheet.
3. **<D> OK**.



Two sub sheets (Sub Sheet 1 and Sub Sheet 2) are created along with Sub Sheet Totals.



The master sheet (Surfacing Sheet) is left intact. To re-divide the master sheet by a different number of rows, delete all the Sub Sheet and Sub Sheet Totals worksheets and run through the process again.

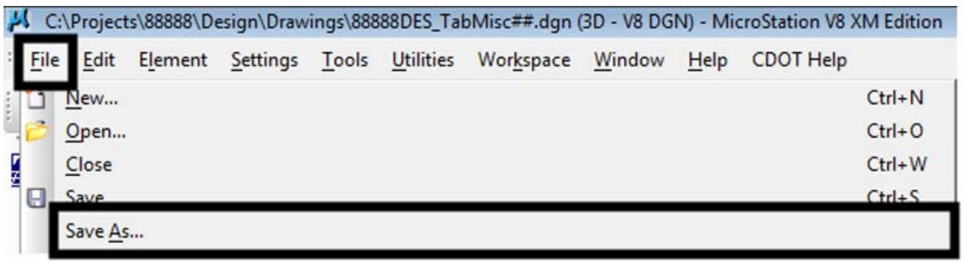
4. **Save** but do not close the file.

Lab 19.8 - Link the Sub Sheets to a MicroStation Sheet Border

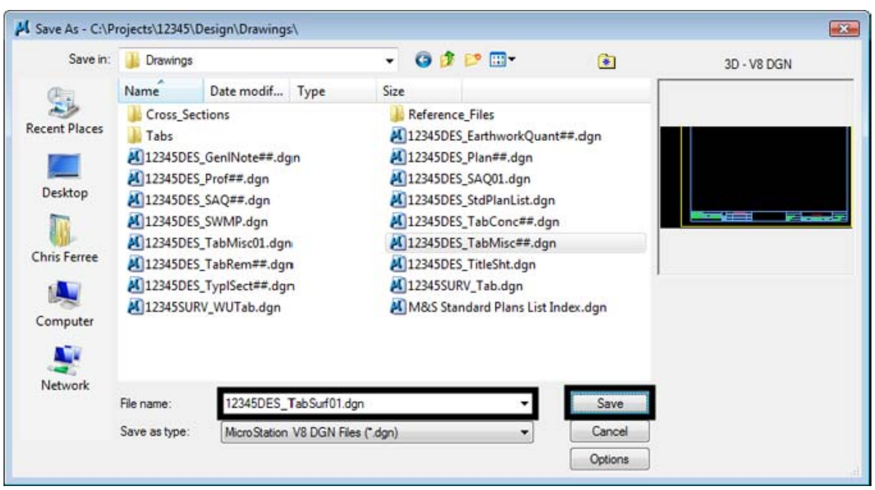
The final step in creating the tab sheet is to link the Excel file to the MicroStation sheet border. Linking allows the Excel file to be updated and reflect those updates in the MicroStation file. In this exercise, Sub Sheet 1 is linked to the sheet border file. The process is the same for the other sub sheets.

The first step in linking the spreadsheet is to prepare the MicroStation file. The miscellaneous tab sheet border is copied and renamed to be the surfacing tab sheet.

1. Start MicroStation and open **12345DES_TabMisc##.dgn**.
2. Select **File > Save As** from the MicroStation menu bar.

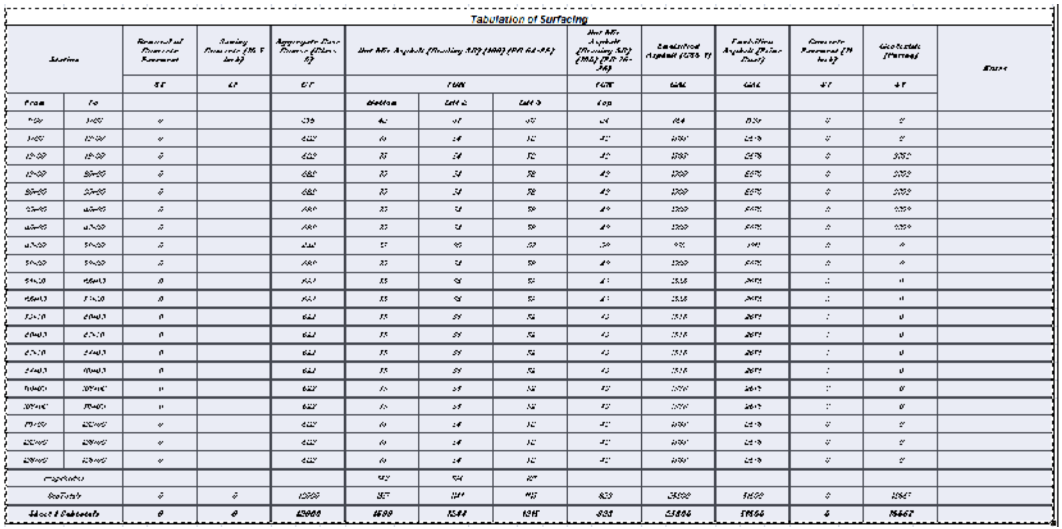


3. Key in ***12345DES_TabSurf01.dgn*** in the ***File name*** field.
4. **<D> Save**. This creates the new file and opens it.



5. Bring Excel to the front.
6. Select the **Sub Sheet 1** worksheet.

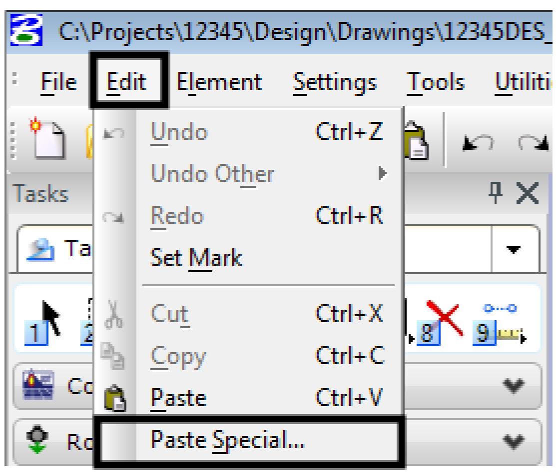
7. Highlight the entire table (cells **C2** through **AP29**).



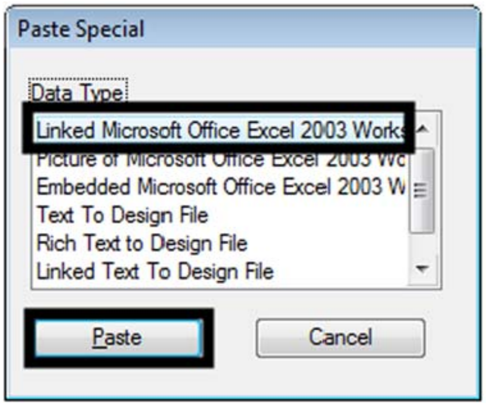
8. Select **Edit > Copy** from the Excel menu bar.

9. Bring MicroStation to the front.

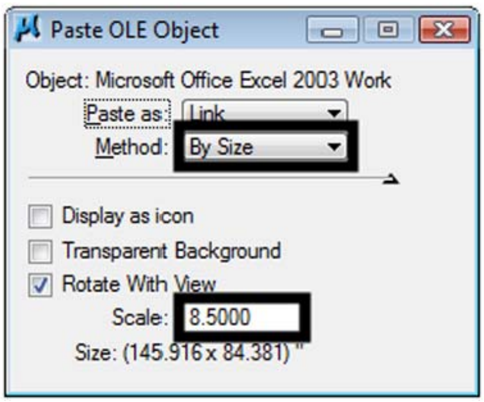
10. Select **Edit > Paste Special** from the menu bar. This displays the ***Paste Special*** dialog box.



11. In the ***Paste Special*** dialog box, highlight **Linked Microsoft Office Excel 2003 Worksheet**.

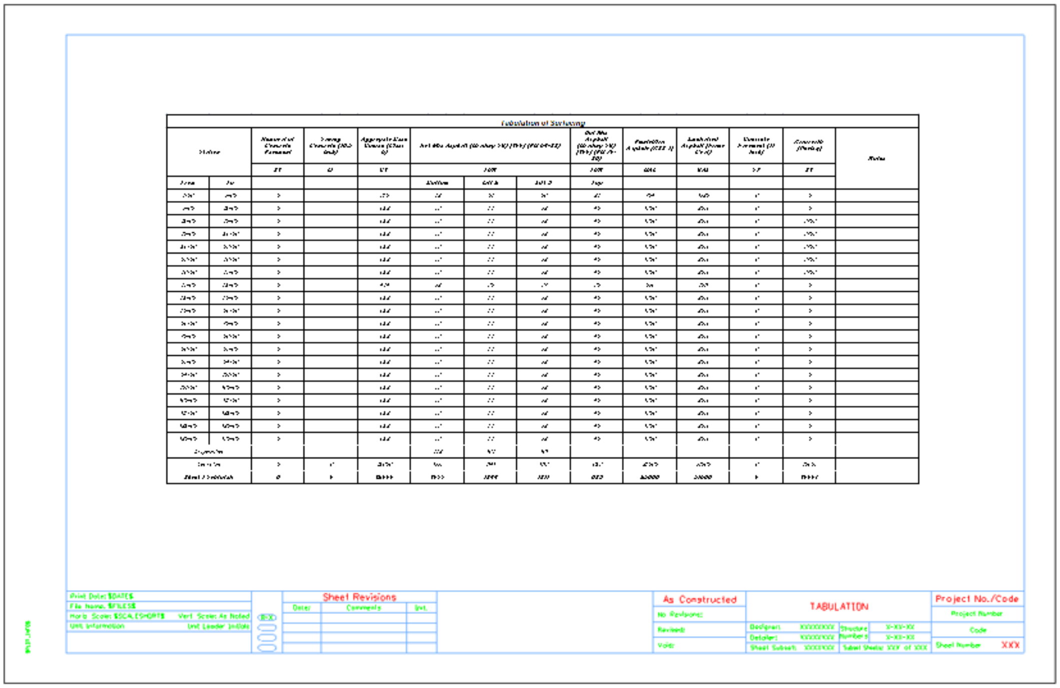


12. **<D> Paste**. This displays the ***Paste OLE Object*** tool settings box.
13. In the ***Paste OLE Object*** tool settings box, set the ***Method*** to **By Size**.
14. In the ***Scale*** field key in ***8.500***. This makes the text in the Excel file the proper size for the MicroStation file.



15. A box is connected to the cursor. This represents the size of the table that is being placed. Center it inside the sheet border and **<D>**. The file is now linked to the sheet border file.

16. The hatching in the table indicates that the Excel file is open. Bring Excel to the front and close it to remove the hatching. The illustration shows the final result.



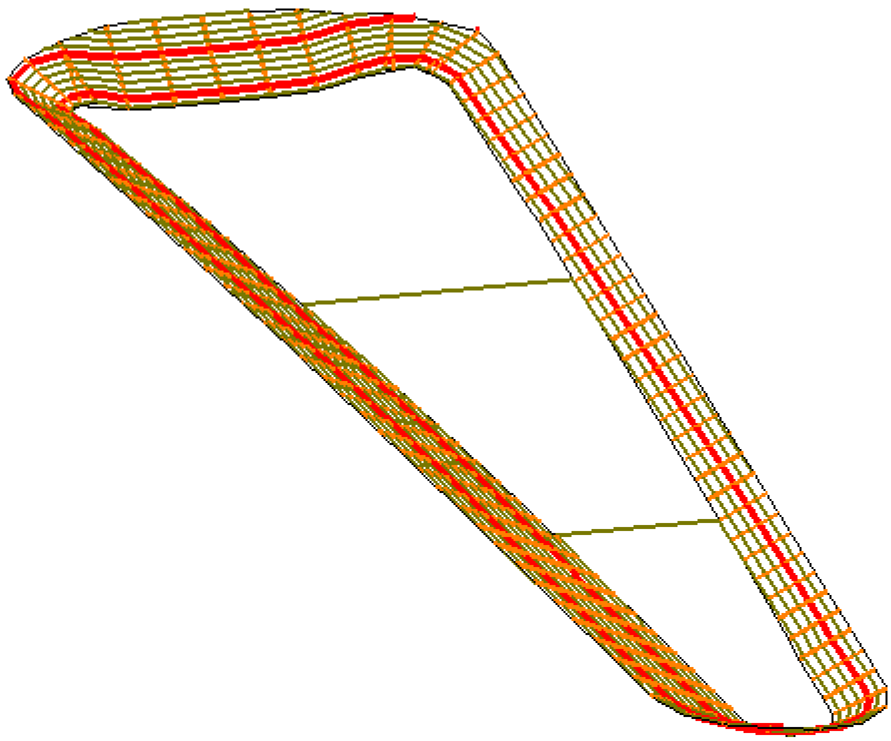
17. **Close** MicroStation.

Chapter Summary:

- The tab sheets use the Trnsport_Itemlist.csv file to set the column headings for the tab sheet.
- The Trnsport_Itemlist.csv file is updated by ServerCop at log in or it can be manually updated.
- Programming that automates the layout and revision of the column headings is accessed through various buttons placed in the worksheet.
- Rows are added or deleted using standard Excel functionality.
- Large tab sheets can be divided to fit into multiple sheet borders.
- If the tab sheet is divided, a sheet totals table is also created.
- The tab sheets are linked to a MicroStation sheet border for printing

LAB 20 - Creating a Detention Pond

In this exercise, you will create a proposed digital terrain model (DTM) without using Roadway Modeler. Instead, a combination of feature creation and editing tools is used to develop the breaklines for a pond.



Chapter Objectives:

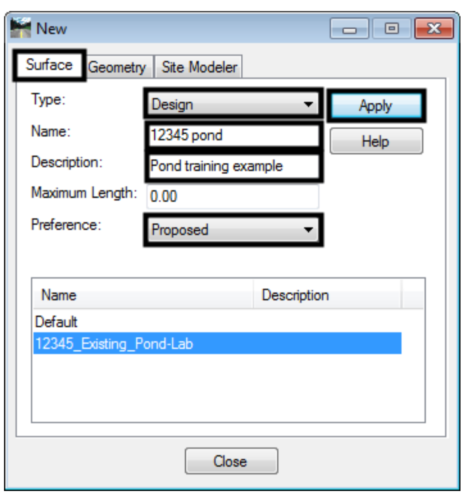
- Use a combination of feature tools to create a proposed design
- Understand the concept of creating a surface of features solely for use as a target

The following files are used for this lab:

- C:\Projects\12345\Bridge\Working \CU12345BRDG_Model.dgn
- C:\Projects\12345\ROW_Survey\InRoads\DTM\12345_Existing_Pond-Lab.dtm
- C:\Projects\12345\Design\Drawings\Reference Files\12345DES_Pond.dgn as a reference file

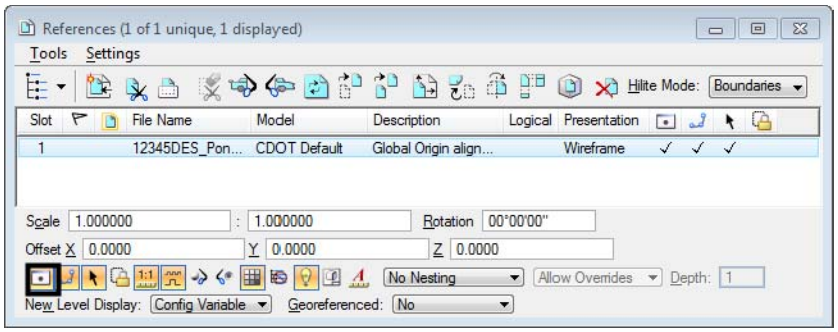
Lab 20.1 - Load and Create Surfaces

1. Open MicroStation and InRoads using the ***C:\Projects\12345\Bridge\Working \CU12345BRDG_Model.dgn*** file.
2. Delete any MicroStation graphics currently in the design file.
3. Verify the correct ***XIN*** file is loaded.
4. Delete any MicroStation graphics currently in the design file.
5. Select **File > Open** from the InRoads menu.
6. Open ***C:\Projects\12345\ROW_Survey\InRoads\DTM\12345_Existing_Pond-Lab.dtm***.
7. **Cancel** the ***Open*** dialog box.
8. Toggle ***Locate Features/Locate Graphics*** to ***Locate Graphics***.
9. Select **File > New**.
10. Select the ***Surface*** tab.
11. Set the ***Type*** to ***Design***
12. Key in ***12345 pond*** for the ***Name***.
13. Key in ***Pond training example*** for the ***Description***.
14. Set the ***Preference*** to ***Proposed***
15. **<D> Apply** and **Close** the ***New*** dialog box.

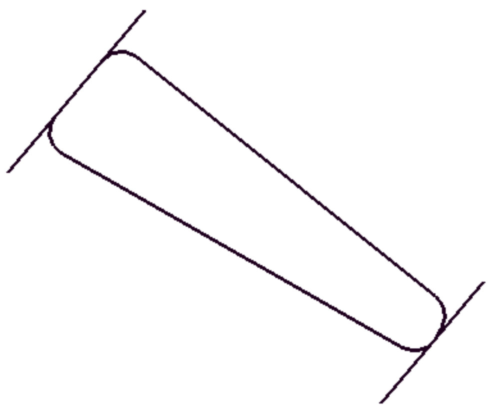


Lab 20.2 - Display the Pond Graphics

1. Toggle on the display for the ***12345DES_Pond.dgn*** reference file.



2. **Fit** the view to see the pond graphics.



The pond you are going to create is beside a new roadway SH52. The toe of slope for the roadway is the boundary for the pond on the South side, with the existing ROW limiting the size on the North and other existing features dictating the basic shape of the pond. The graphic that you just toggled on shows what has previously been determined as the outer limit of the pond.

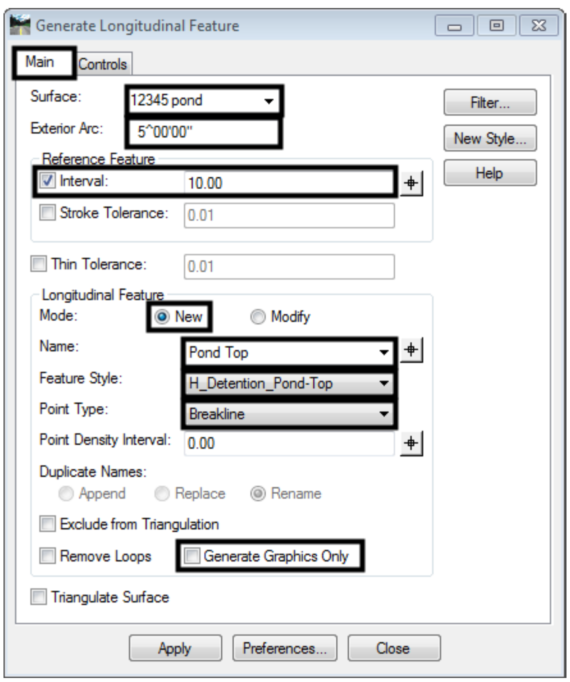
Lab 20.3 - Creating a feature for the top of pond

In this case, you are going to start with the known outside of the pond, so you must first set the elevations of this boundary. You will do this by draping the graphic element onto the existing topo.

1. Select **Surface > Design Surface > Generate Longitudinal Feature**.

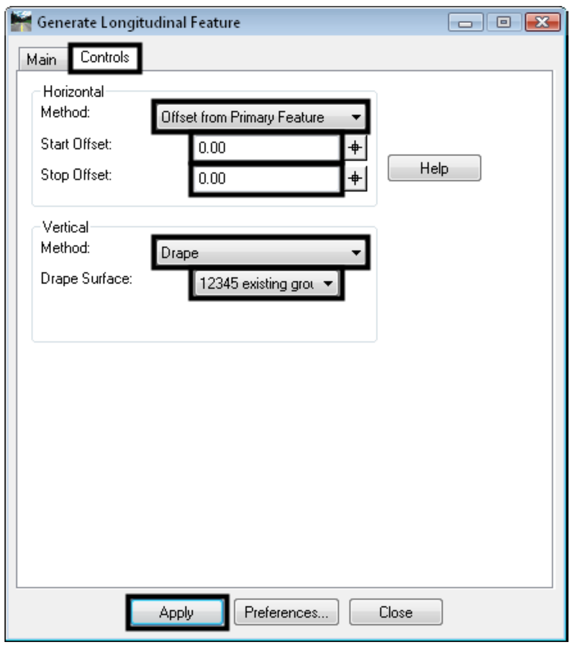
On the ***Main*** tab:

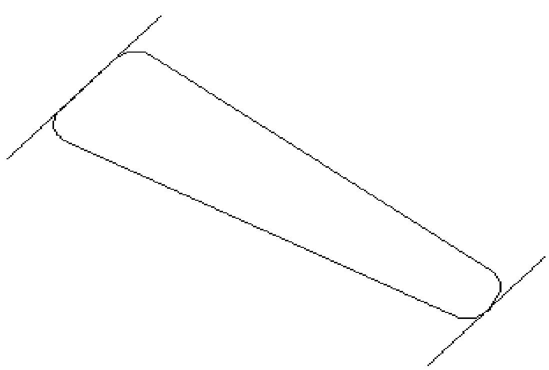
2. Toggle off **Generate Graphics Only.**
3. Select **12345 pond** as the ***Surface***.
4. Toggle on **Interval** and set it to ***10***.
5. Toggle on **New** for the ***Mode***.
6. Key in ***Pond top*** for the feature ***Name***.
7. Set the ***Feature Style*** to **H_Detention_Pond-Top**.
8. Set the ***Point Type*** to **Breakline**.
9. Leave the ***Point Density Interval*** set to ***0***.



On the ***Controls*** tab:

10. Set the ***Horizontal Method*** to **Offset from Primary Feature**.
11. Set both ***Offsets*** to ***0.00***.
12. Set the ***Vertical Method*** to **Drape**.
13. Set the ***Drape Surface*** to **12345_Existing_Pond-Lab**.
14. **<D> Apply**, then **<D>** to Identify and **<D>** to Accept the pond outline as the ***Primary Element***.





15. **<D>** to Identify and **<D>** to Accept the same shape again as the ***Reference Element***.

16. Reset **<R>** for the ***Entire shape***.

17. **<D>** anywhere for the ***Location***.

    Note: If your ***Horizontal Offsets*** were not 0, you would be telling InRoads which side to offset by moving your cursor to that location before **<D>**; since they are both 0, it does not matter where you identify the location.

The shape is draped on the existing model, but placed in the new surface.

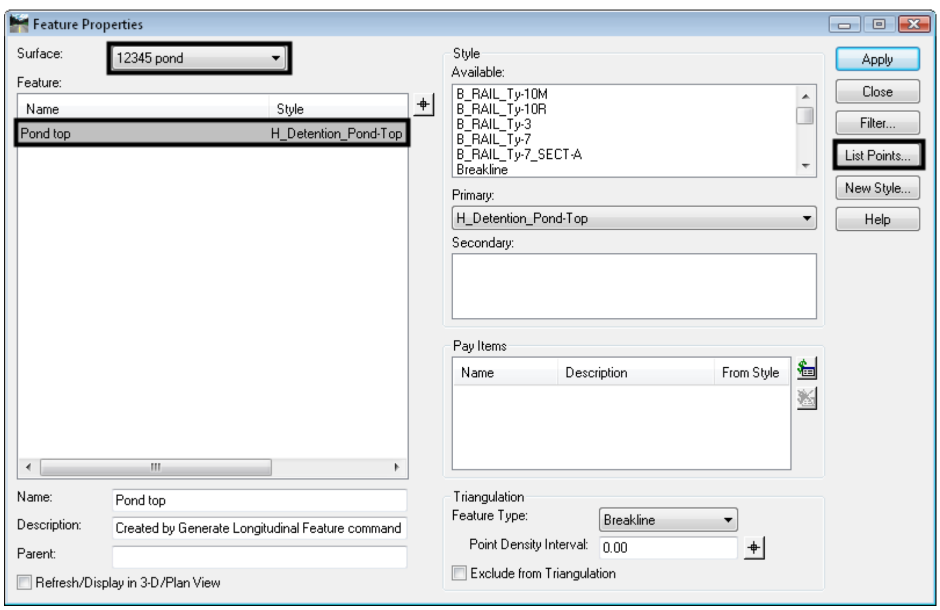
18. **<D> Close** on the ***Generate Longitudinal Feature*** dialog box.

Lab 20.4 - Review the feature

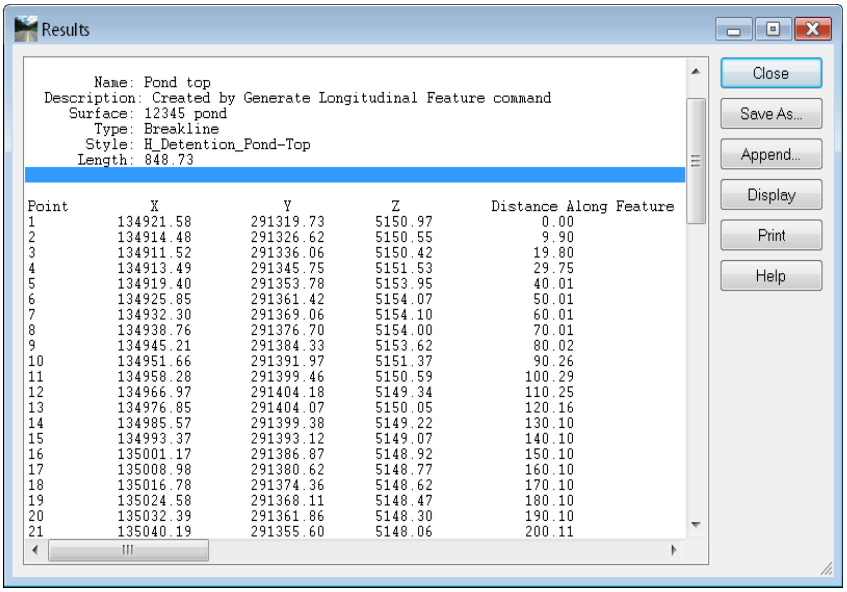
1. Select **Surface > Feature > Feature Properties** from the InRoads main menu.

2. Set the ***Surface*** to ***12345 pond***.

3. Highlight the ***Pond top*** feature and choose ***List Points***.



Note: If you do not see the ***Pond top*** feature in the surface, go back and try the **Generate Longitudinal Feature** command again.



4. You should see all different elevations for the feature. If you have a feature listed, but the elevations are not in the range shown, use **Surface > Edit Surface > Delete Feature** to delete the feature, then try again.

5. **<D> Close** on the ***Results*** dialog box and again on ***Feature Properties*** dialog box.

Lab 20.5 - Create a target for the pond bottom

In this series of steps, you will create features from the two lines at either end of the pond. The one on the West side represents the 5144 elevation and on the East end 5141. These features will then be triangulated to form a 'dummy' surface that can be used as a target to create the pond bottom.

1. Select **File > New** from the InRoads main menu.

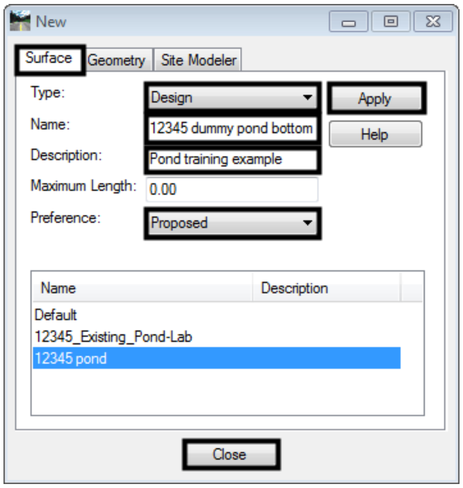
2. Set the ***Type*** to **Design**.

3. Key in ***12345 dummy pond bottom*** for the ***Name***.

4. Key in ***Pond training example*** for the ***Description***.

5. Set the ***Preference*** to **Proposed**.

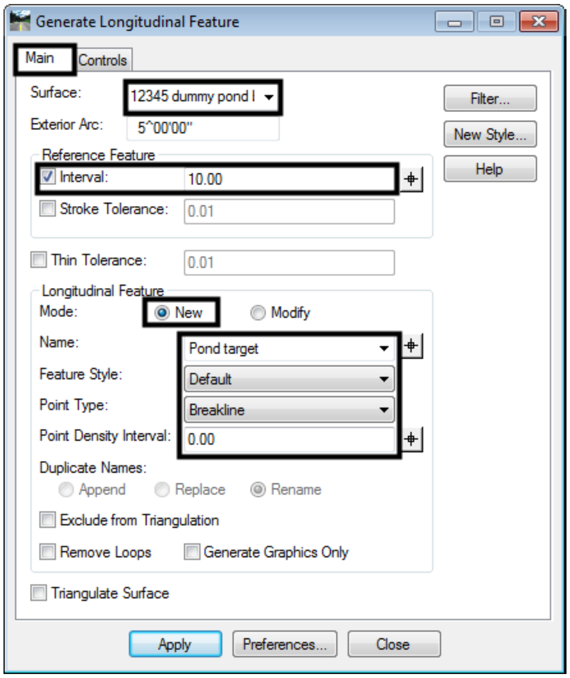
6. **<D> Apply** and **Close** the ***New*** dialog box.

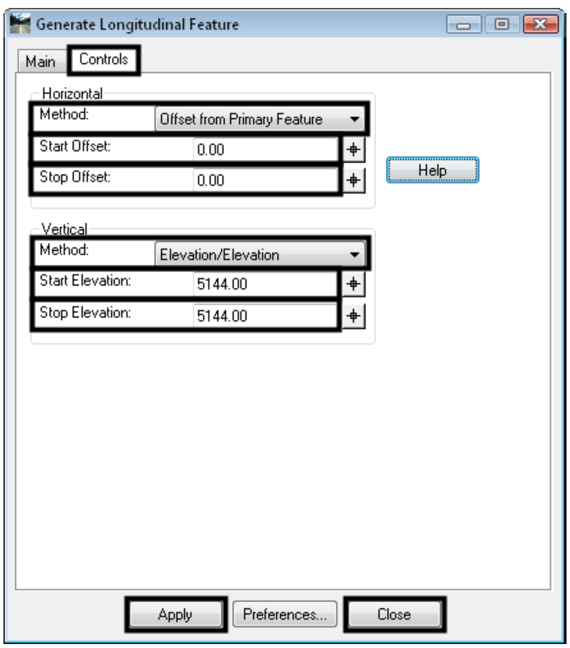


7. Select **Surface > Design Surface > Generate Longitudinal Feature** (**GLF**) from the InRoads main menu.

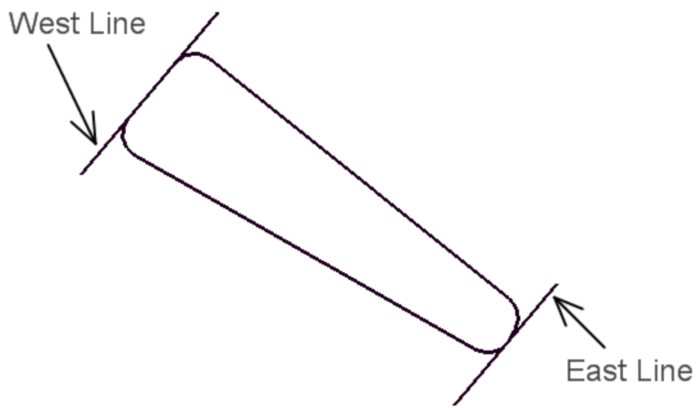
8. Set the ***Surface*** to ***12345 dummy pond bottom***.

9. Set the other criteria as shown in the illustrations below to create a new feature.





10. **<D> Apply**.
11. Select the West linestring with a data point **<D>**.



The linestring highlights and you are prompted to ***Accept/Reject***.

12. **<D>** to accept.

You are prompted to ***Identify Reference Element***.

13. Select the same linestring again with a **<D>** and **<D>** again to ***Accept*** when the linestring highlights.

A tracking line appear and you are prompted to ***Identify Beginning (Reset for Entire Element)***.

14. **<R>** Reset to copy the entire element.
15. **<D>** for the location.

Note: Since the horizontal offsets are 0.00, the location of the data point does not matter. If there were horizontal offsets, the data point would tell the software which way to make the copy, similar to a MicroStation copy command.

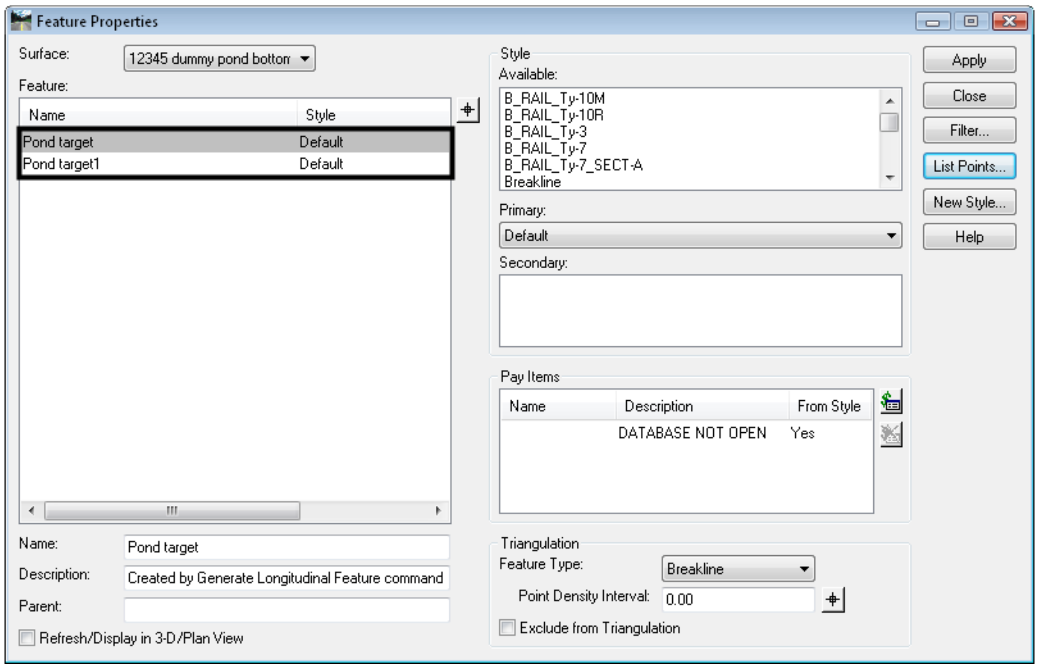
The line is made into a feature at elevation 5144 in the surface dummy pond bottom.

16. Repeat steps 7-14 to create a feature in the same surface for the East line, which should be set to an elevation of ***5141***.
17. **<D> Close** to dismiss the ***GLF*** dialog box.

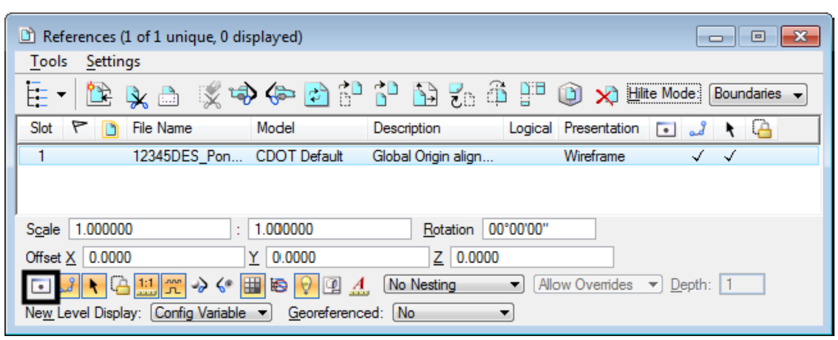
Lab 20.6 - Review the feature

1. Select **Surface > Feature > Feature Properties** from the InRoads main menu.
2. Set the ***Surface*** to **12345 dummy pond bottom**.
3. Highlight the **Pond target** (5144 elevation) feature and **<D>** the **List Points** button.

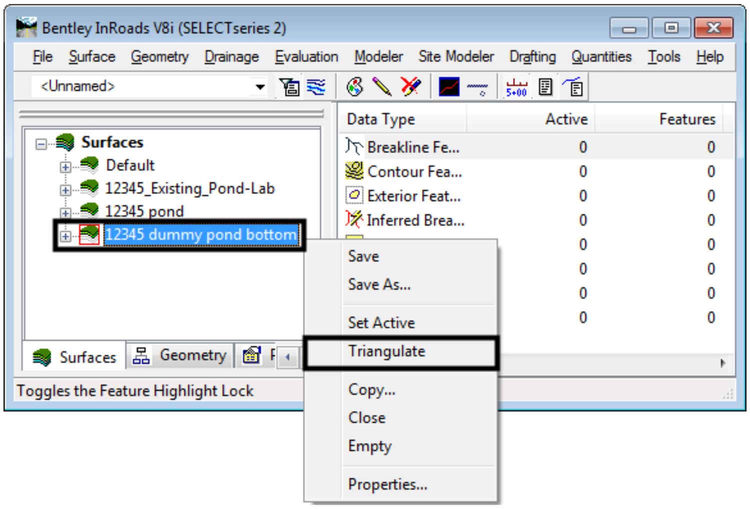
   You should see all 5144 elevations for the feature.



4. **<D> Close** on both the ***Results*** and ***Feature Properties*** dialog boxes.
5. Turn off the reference with the original pond graphics.



6. **Triangulate** the dummy pond bottom surface.



Lab 20.7 - Define the pond side slopes

This series of steps takes you through creating sideslopes from the new top-of-pond outline down to the target DTM.

1. Set the ***Locate*** mode to **Features**.

   Since the source for the slopes is the feature created for the top of the pond, you must first change the ***Locate*** mode.

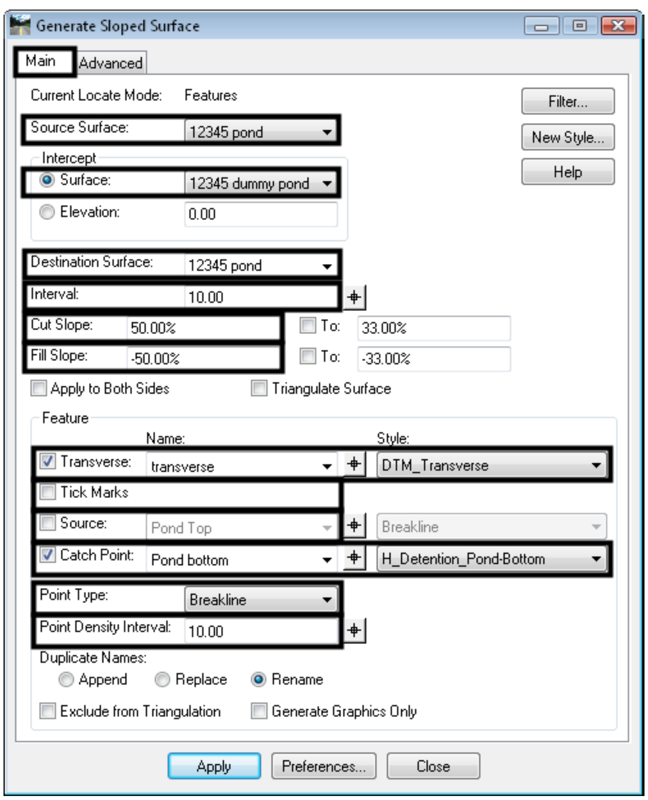
2. Select the **Surface > Design Surface > Generate Sloped Surface** (**GSS**) from the InRoads main menu.

On the ***Main*** tab:

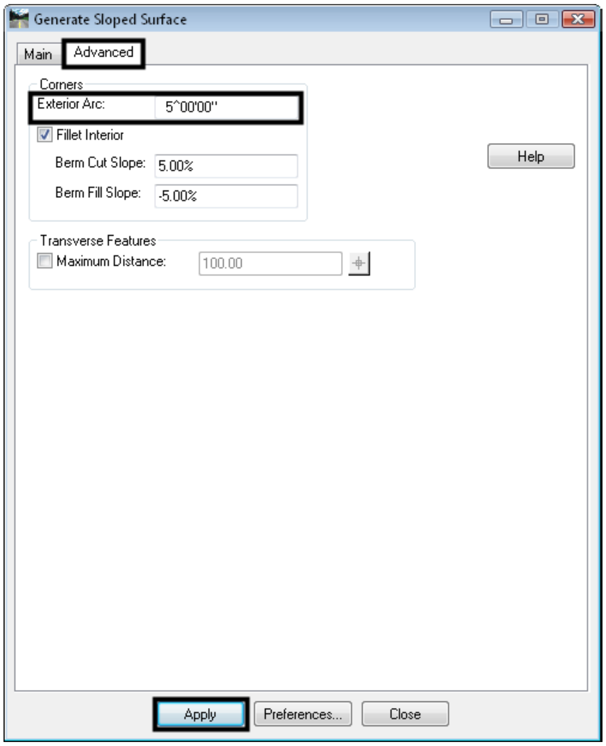
3. Set ***Source Surface*** to **12345 pond**.
4. Set ***Intercept Surface*** to **12345 dummy pond bottom**.
5. Set ***Destination Surface*** to **12345 pond**.
6. For ***Interval*** key in ***10***.
7. For ***Cut Slope*** key in ***50%***.
8. For ***Fill Slope*** key in ***-50%***.

In the ***Feature*** area:

9. Toggle off **Generate Graphics Only**.
10. Toggle off **Tic Marks** and **Source**.
11. Toggle on **Transverse**. Key in ***transverse*** for the ***Name*** and set the ***Feature Style*** to **DTM_Transverse**.
12. Toggle on ***Catch Point.*** For ***Catch Point*** key in ***Pond bottom*** and set the ***Feature Style*** to **H_Detention_Pond-Bottom**.
13. Set the ***Point Type*** to **Breakline**.
14. For ***Point Density Interval*** key in ***10.000***.



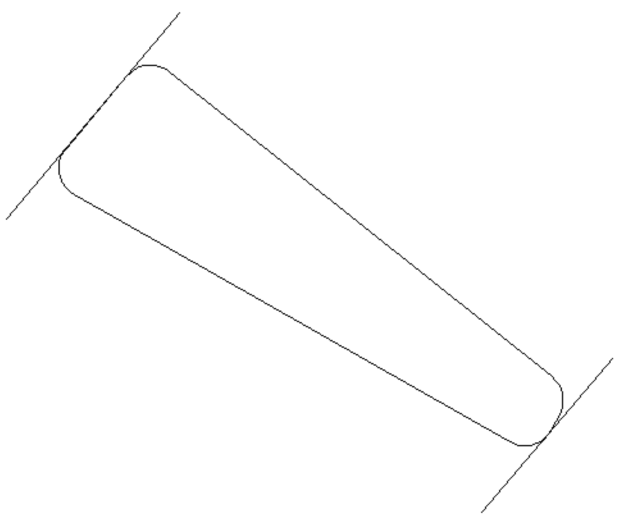
15. On the ***Advanced*** tab, key in ***5^00’00.00”*** for ***Exterior Arc***.



16. **<D> Apply** to run the **GSS** command.

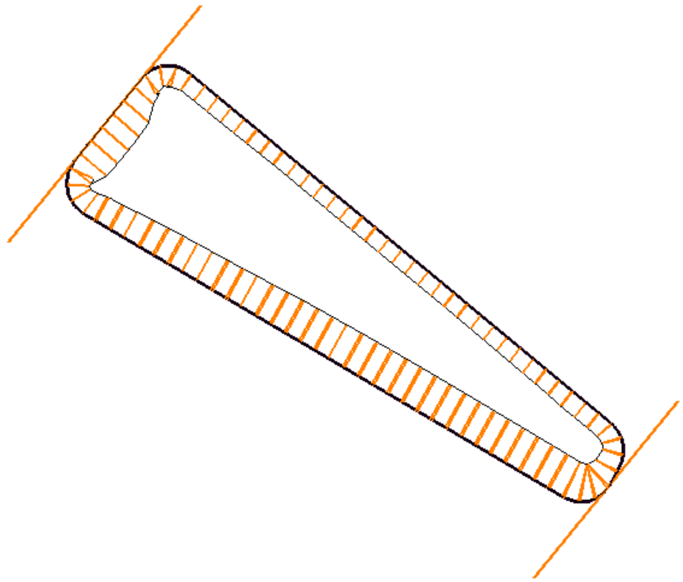
    You will be prompted to ***Identify Feature***.

17. **<D>** on the closed feature that represents the top of your pond.



The entire pond top will highlight and you will be prompted to ***<Accept/Reject>***.

18. **<D>** in an area away from the shape to accept the pond top.
19. When prompted to ***Identify beginning/Reset for Entire***, **<R>** to run side slopes around the entire complex shape.
20. When prompted for ***Location***, **<D>** inside the shape, so the sideslopes will go in instead of out.

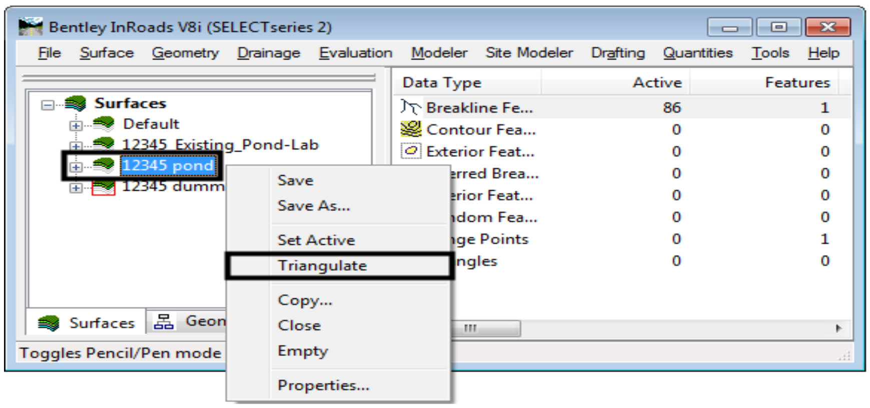


Graphics appear as shown above.

21. **<R>** and then select **Close** to dismiss the dialog box.

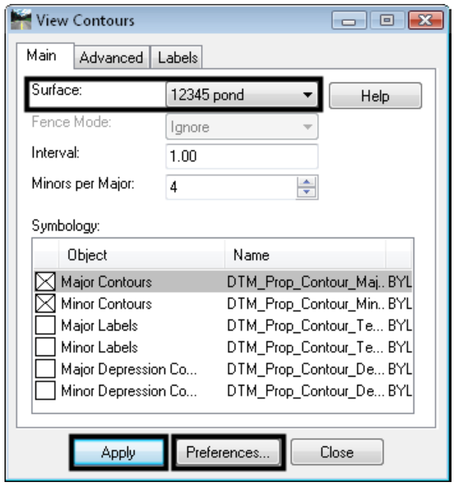
Lab 20.8 - Evaluate the pond surface

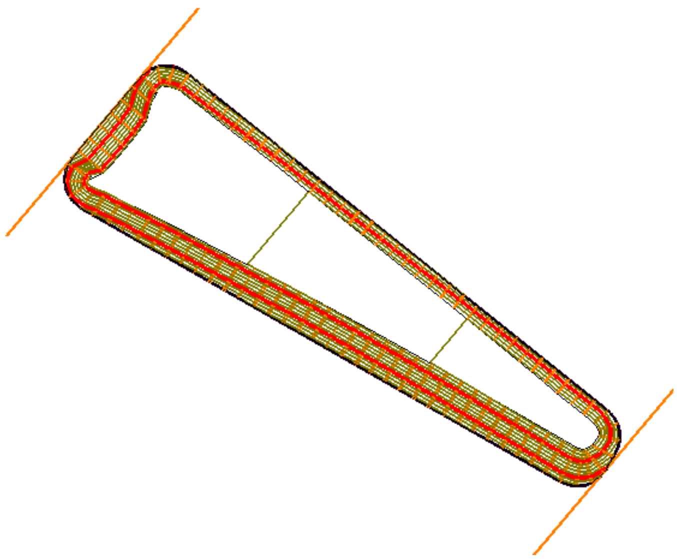
1. **<R>** on the pond surface in the Explorer portion of the InRoads menu and select **Triangulate**.



2. Select **Surface > View Surface > Contours** from the InRoads main menu.
3. Select **Preferences**.
4. Highlight the **Proposed 5' Mjr – 1' Minor** preference.
5. **<D> Load**, then **Close**.
6. Set the ***Surface*** to **12345 pond**.

7. **<D> Apply**.


View Contours
Main
Advanced
Labels
Surface:
12345 pond
Help
Fence Mode:
Ignore
Interval:
1.00
Minors per Major:
4
Symbology:
Object
Name
Major Contours
DTM_Prop_Contour_Maj.. BYL
Minor Contours
DTM_Prop_Contour_Min.. BYL
Major Labels
DTM_Prop_Contour_Te... BYL
Minor Labels
DTM_Prop_Contour_Te... BYL
Major Depression Co...
DTM_Prop_Contour_De... BYL
Minor Depression Co...
DTM_Prop_Contour_De... BYL
Apply
Preferences...
Close

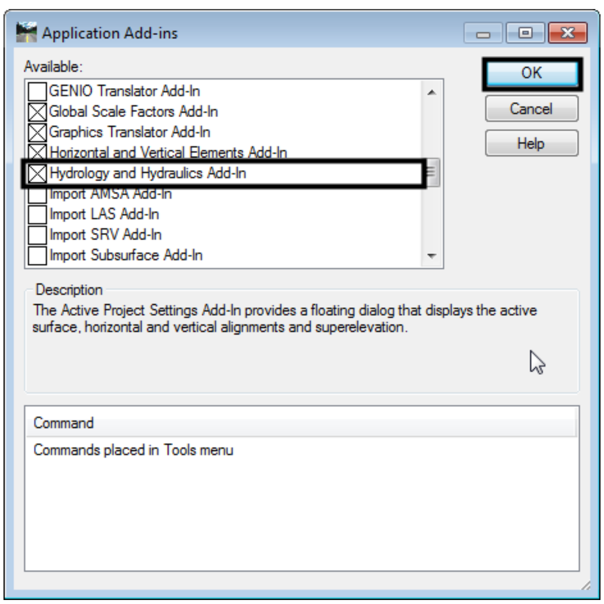


Lab 20.9 - Save the pond surface to the hard disk

1. Select **File > Save As** from the InRoads main menu.
2. Set the ***Save as type*** to **Surfaces (*.dtm)**.
3. Set the ***Active Surface*** to **12345 pond**.
4. Verify the ***Name*** is **12345 pond.dtm**.
5. Verify the folder is **c:\12345\Design\InRoads**.
6. Select **Save**.
7. **Cancel** the ***Save As*** dialog box.

Lab 20.10 - Calculate the pond's capacity

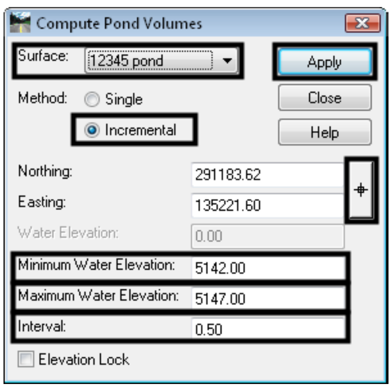
1. Select **Tools > Application Add-ins from the InRoads main menu.**
2. Toggle on **Hydrology and Hydraulics Add-in** (if it's not already on).
3. **<D> OK** then **<D> Close**.

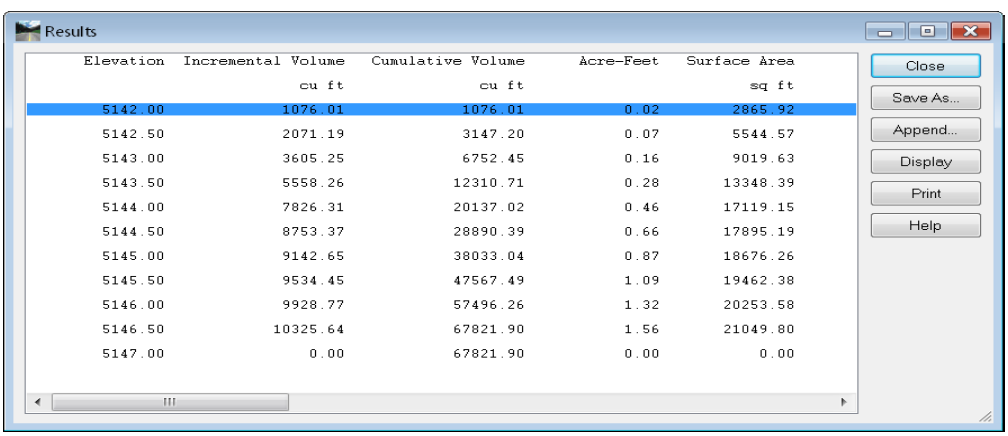


The command for calculating the pond volume is located on this add-in.

Next, compute the volume of water your pond will hold for a range of water elevations.

4. Select **Evaluation > Hydrology and Hydraulics > Compute Pond Volumes** from the InRoads main menu.
5. Set the ***Surface*** to **12345 pond**.
6. Set the ***Method*** to **Incremental**.
7. For the ***Minimum Water Elevation*** key in ***5142***.
8. For the ***Maximum Water Elevation*** key in ***5147***.
9. For the ***Interval*** key in ***0.5***.
10. Select the ***Target*** button next to the ***Northing*** and ***Easting*** fields and place a **<D>** in the middle of your pond toward the lower end.
11. **<D> Apply** and the volume is calculated for the range of elevations you entered. A report is shown with the incremental volumes.



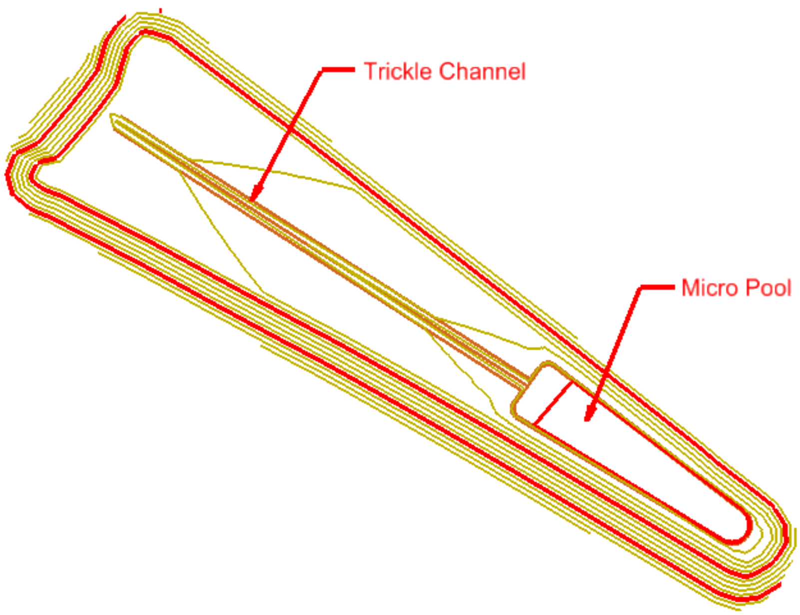


Elevation	Incremental Volume cu ft	Cumulative Volume cu ft	Acre-Feet	Surface Area sq ft
5142.00	1076.01	1076.01	0.02	2865.92
5142.50	2071.19	3147.20	0.07	5544.57
5143.00	3605.25	6752.45	0.16	9019.63
5143.50	5558.26	12310.71	0.28	13348.39
5144.00	7826.31	20137.02	0.46	17119.15
5144.50	8753.37	28890.39	0.66	17895.19
5145.00	9142.65	38033.04	0.87	18676.26
5145.50	9534.45	47567.49	1.09	19462.38
5146.00	9928.77	57496.26	1.32	20253.58
5146.50	10325.64	67821.90	1.56	21049.80
5147.00	0.00	67821.90	0.00	0.00

12. **Save** the report to your hard drive if desired.
13. **Close** the ***Compute Pond Volumes*** dialog box.

Lab 20.11 - Challenge

If you would like a challenge on this activity, complete the following steps.



1. Add a micro pool of your own design at the deep end of the pond.
2. Add a trickle channel from the upper end down to the micro pool.
3. Zoom in close to the upper end of the pond and look at the pond toe line. Clean up the problems in the corner using **Design Surface** and **Edit Surface** tools.

Chapter Summary:

- Design surfaces can be created using a variety of tools to create features.
- Dummy surfaces can be created just to use as intercept targets for design commands.
- The Generate Longitudinal Feature command is a very powerful tool for creating 3D features.
- Simple sideslopes can be formed with Generate Sloped Surface command.
- Staged water volumes can be computed for DTMs using the Pond Volumes command on the Hydrology and Hydraulics Add-in.

LAB 21 - Constructing A Driveway

Driveway modeling should not be done to the level of detail that mainline corridor modeling is done. However, there may be times when a drive should be modeled accurately. This lab describes a workflow for modeling driveways quickly and easily.

Chapter Objectives: This lab models a driveway from the proposed edge of pavement of the design corridor to the existing ground at the right of way line. The following InRoads tools are used to complete the model:

- Tracking to determine the location of the ramp.
- Generate Longitudinal Feature to construct the centerline and edge features of the ramp.
- Drape Surface to create the end of the drive.
- Import Surface to create features from MicroStation graphics.
- Fillet Feature to construct the drive returns.
- Join Features to create a continuous feature from the driveway edges and returns.
- Apply Template create sideslopes for the driveway.

The following files are used for this lab:

- C:\Projects\12345\ROW_Survey\InRoads\DTM\12345 existing ground.dtm
- C:\Projects\12345\Design\InRoads\SH86.dtm
- C:\Projects\12345\Design\InRoads\12345DES_Geometry.alg
- C:\Projects\12345\Design\InRoads\DES12345_Templates.itl

The driveway is 12’ wide extending from the proposed edge of pavement to the right of way, 60’ to the right of the SH 86 centerline. The driveway returns have a 15’ radius. There is a 12:1 slope for 20’ from the edge of pavement.

Lab 21.1 - Locating The Driveway

The new driveway is located on top of the existing driveway between stations 254+00 and 255+00 or the right side of the mainline.

Section Objectives:

- Use Tracking to determine the centerline station of the driveway.
- Use MicroStation key-ins to construct a line for the driveway centerline and end line.

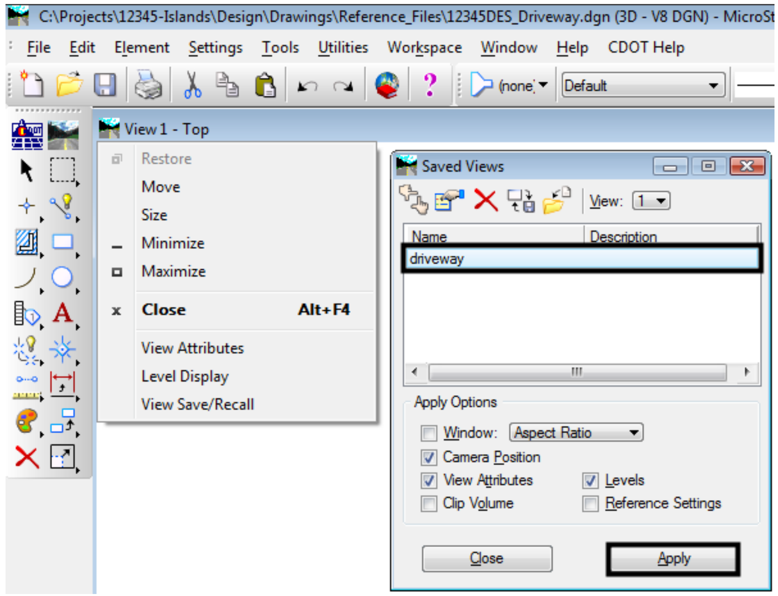
1. Open InRoads using the ***12345DES_Driveway.dgn*** file.

   Note: If the existing drive is not visible, display the driveway saved view. To display a saved view:

   a. **<D>** the icon in the left corner of the view title bar and select **View Save/Recall**.

   b. In the ***Saved Views*** dialog box, highlight **driveway**.

c. **<D> Apply** and then **<D> Close** to dismiss the ***Saved Views*** dialog box.

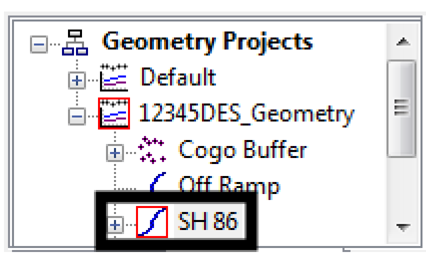


2. Open the following InRoads data files:

- C:\Projects\12345\ROW_Survey\InRoads\DTM\12345 existing ground.dtm
- C:\Projects\12345\Design\InRoads\SH86.dtm
- C:\Projects\12345\Design\InRoads\12345DES_Geometry.alg
- C:\Projects\12345\Design\InRoads\DES12345_Templates.itl

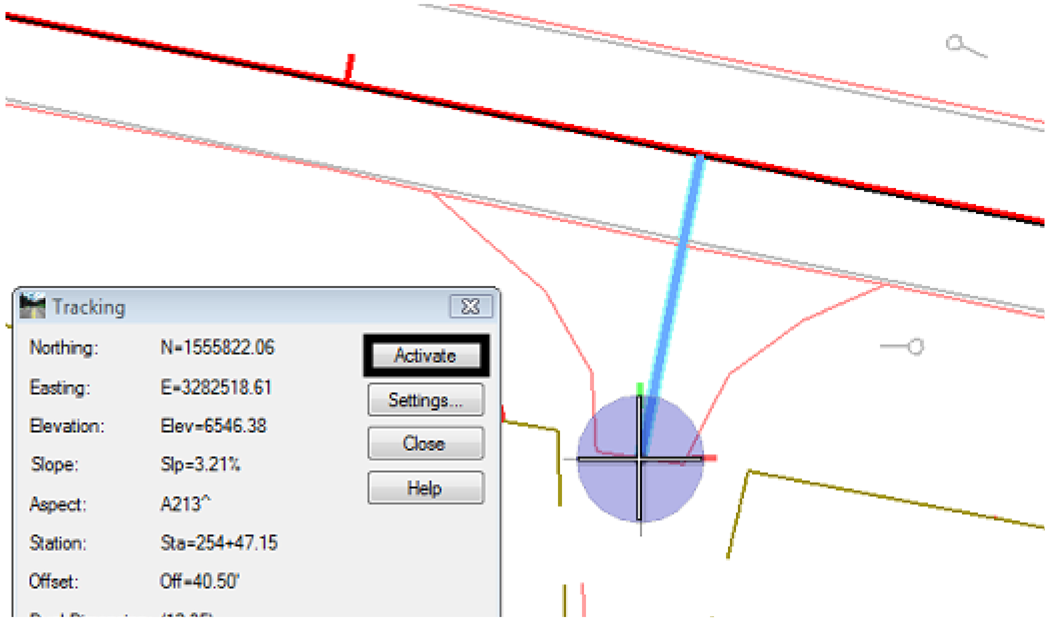
3. Verify that the **C:\Workspace\Workspace-CDOT_V8i\Standards-Global\InRoads\Preferences\CDOT_Civil.xin** file is loaded.

4. Verify that the **SH 86** alignment is active.

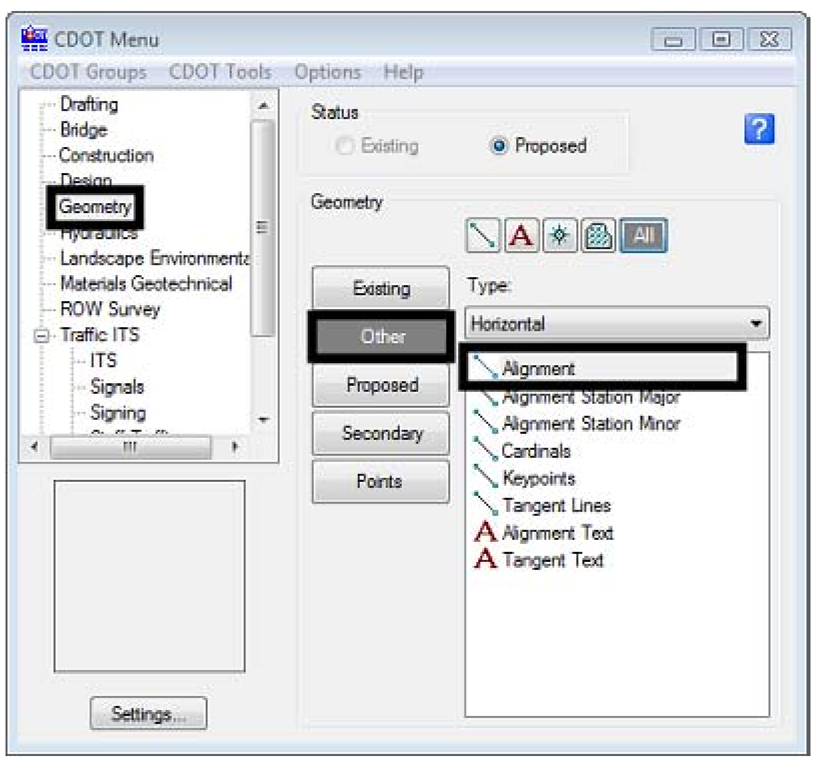


5. Select **Tools > Tracking > Tracking** from the InRoads menu bar.

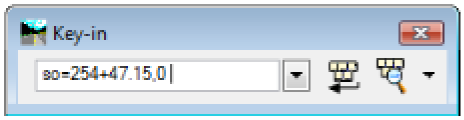
6. **Activate** the tracking and **<T>** to the center of the back of the driveway.



7. Write down the **Station** listed in the ***Tracking*** dialog box.
8. **<D> Close** to dismiss the ***Tracking*** dialog box.
9. From the ***CDOT Menu***, highlight the **Geometry** group.
10. **<D>** the **Other** button and select **Alignment** from the item list.



11. In the MicroStation key-in window, type ***so=254+47.15,0*** and ***Enter***.

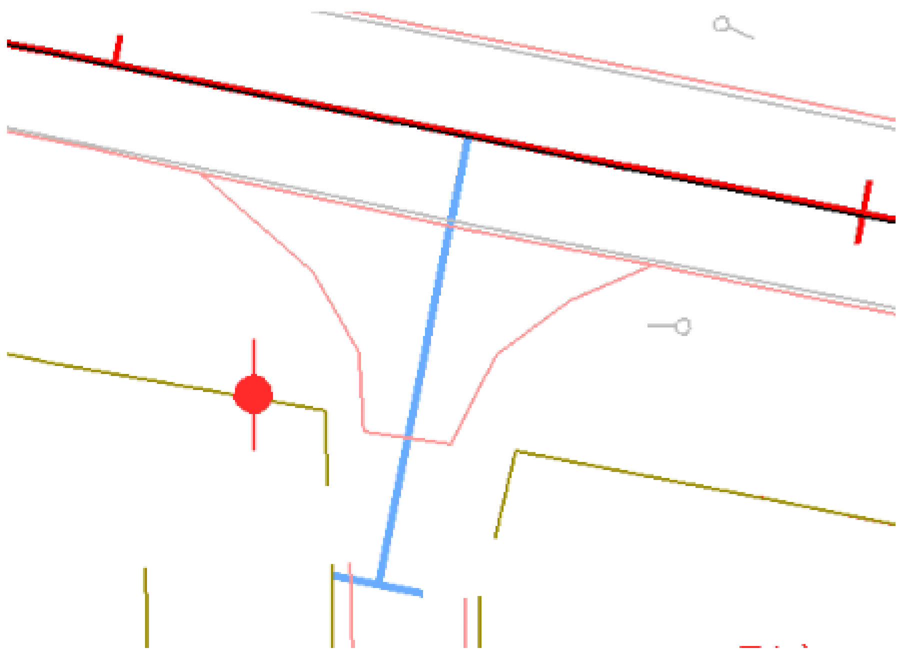


Note: Use the station that you wrote down in step 6.

12. Key in ***so=254+47.15,60*** and ***Enter***. **<R>** to end the line.

This places a line at the centerline of the driveway. This line is used as a reference line when constructing the driveway surface features.

13. Key in ***so=254+41.15,60*** and ***Enter***.
14. Key in ***so=254+53.15,60*** and ***Enter***. **<R>** to end the line.



Note: Use stations 6' before and 6' after the one you wrote down in step 6.

This places a 12' long line at the end of the driveway representing the width of the drive. This line is also used as a reference line when constructing the driveway surface features.

Section Summary:

The location of the driveway was identified and elements needed to create the driveway centerline and end line were placed.

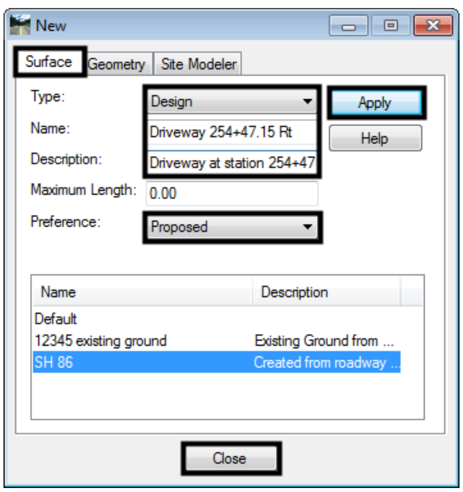
Lab 21.2 - Setting Elevations

In this section, the driveway end line is draped to the existing surface to acquire the elevations for that feature. The line for the driveway centerline is moved to the proper elevation, then is modified to give it the proper slopes.

Section Objectives:

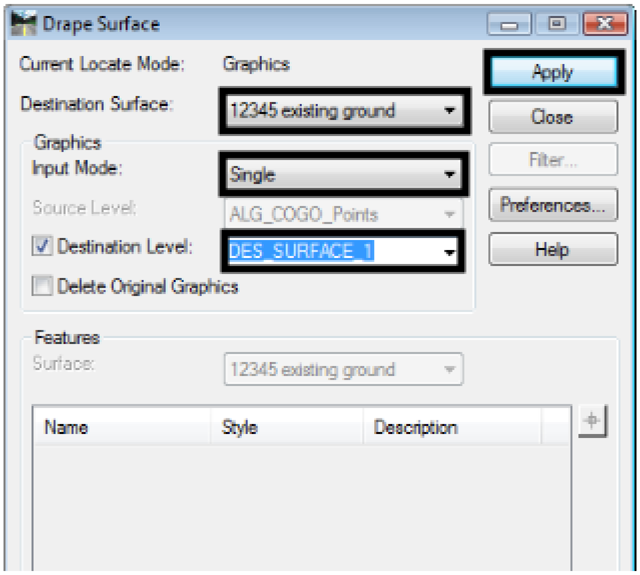
- Create a surface for the driveway.
- Use the Drape Surface command to create the driveway end line feature.
- Display the design surface (SH 86) triangulated features.
- Move the driveway centerline to its proper location (horizontally and vertically).
- Create a centerline feature with the proper slopes using Generate Longitudinal Feature and Edit Feature Point.

1. Select **File > New** from the InRoads menu bar.
2. On the ***Surface*** tab, set the ***Type*** to **Design**.
3. In the ***Name*** field, key in ***Driveway 254+47.15 Rt***.
4. In the ***Description*** field, key in ***Driveway at station 254+47.15 on the right***.
5. Set the ***Preference*** to **Proposed** and **<D> Apply** then **Close**.



6. From the InRoads menu bar, select **Surface > Design Surface > Drape Surface**.
7. Set the ***Destination Surface*** to **12345 existing ground**.
8. Set the ***Input Mode*** to **Single.**
9. Set the ***Destination Level*** to **DES_SURFACE _1**.
10. Toggle on **Delete Original Graphics**.

11. **<D> Apply** then follow the prompts in the MicroStation message window (lower left corner of the screen).

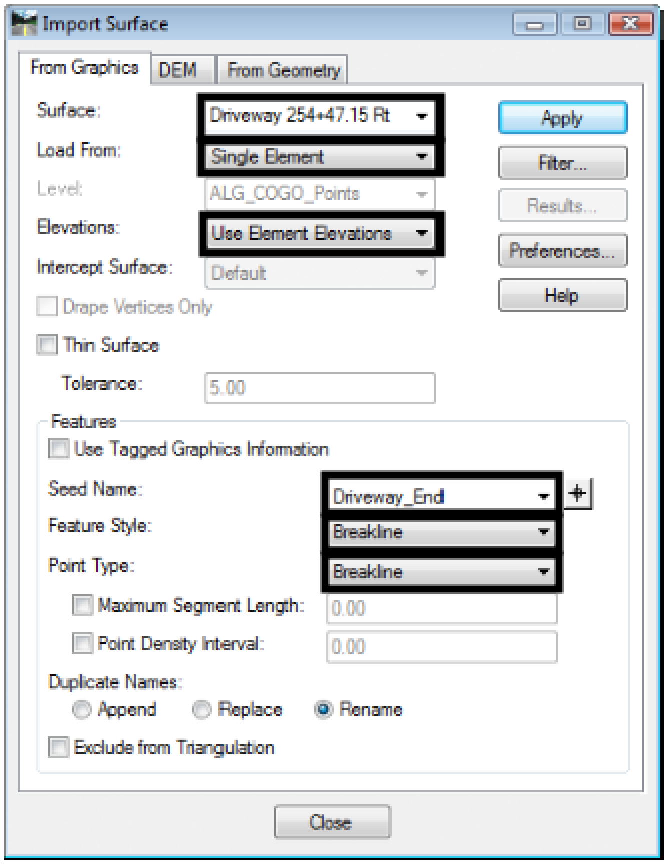


12. **Close** the Drape Surface dialog box.

This creates a MicroStation graphic element that matches the elevations of the existing ground. Next that element is imported into the Driveway 254+47.15 Rt surface.

13. Select **File > Import > Surface** from the InRoads menu bar.
14. In the ***Import Surface*** dialog box, set the ***Surface*** to **Driveway 254+47.15 Rt**.
15. Set ***Load From*** to **Single Element**.
16. Set ***Elevations*** to **Use Element Elevations**.
17. In the ***Seed Name*** field, key in ***Driveway_End***.

18. Set the ***Feature Style*** and ***Point Type*** to **Breakline**.



19. <D> Apply.

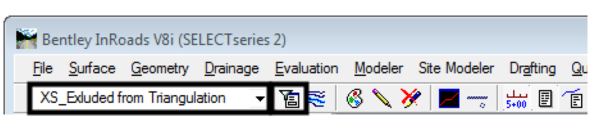
20. **<D>** the element created by the Drape Surface command. **<D>** in a blank area to accept the element.

21. **Close** the ***Import Surface*** dialog box.

The driveway end line is now stored as a surface feature. To place the driveway center line at the correct location, the features of the SH86 surface must be displayed. Use the feature filter to display only the triangulated features of the SH86 surface, then move the driveway centerline to the proper location.

22. On the InRoads Locks toolbar, set the feature filter to **XS_Excluded from Triangulation**.

23. Toggle on the **Feature Filter Lock**.

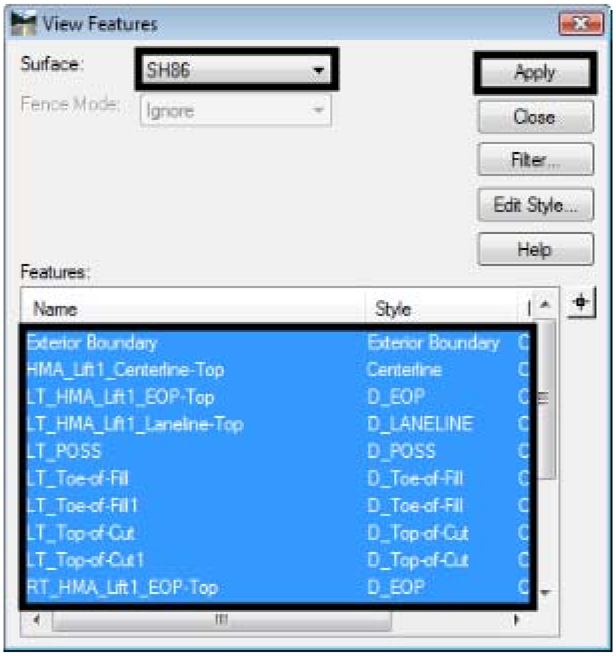


24. Select **Surface > View Surface > Features** from the InRoads menu bar.

25. Select **SH86** for the ***Surface***.

26. Highlight all of the features in the ***Features*** list.

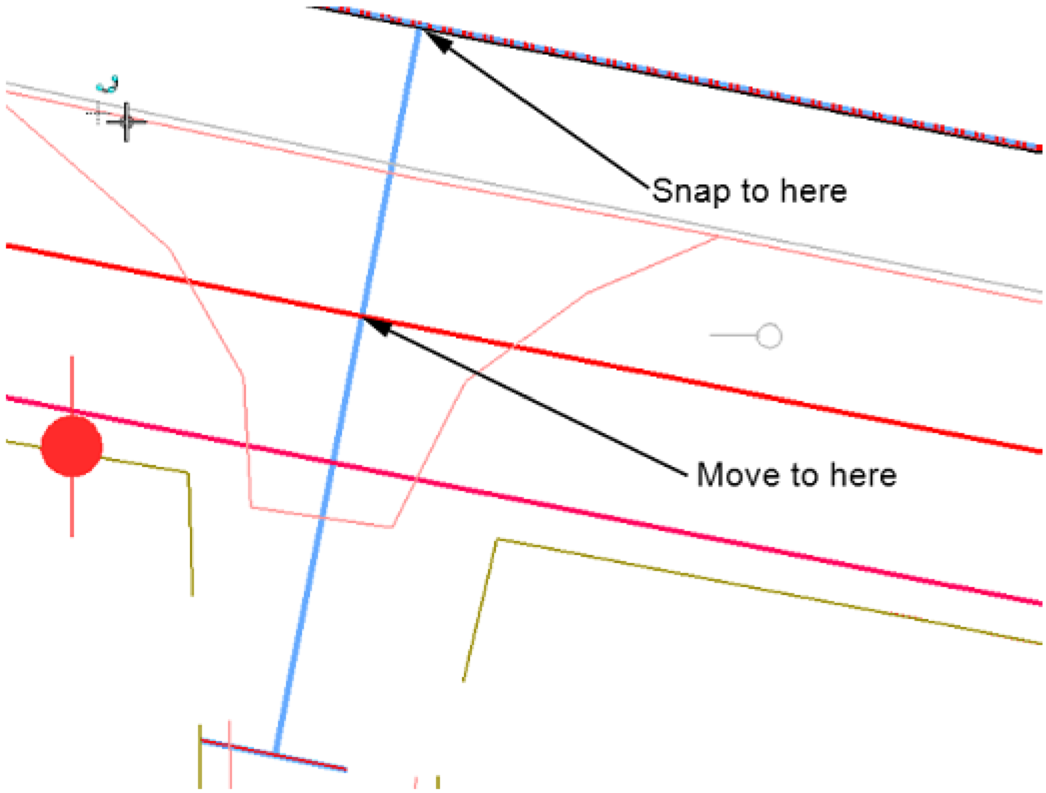
27. **<D> Apply** then **Close** the ***View Features*** dialog box.



The red line running through the existing driveway is the proposed edge of pavement. The driveway centerline needs to be moved to start at this edge line.

28. Use the MicroStation **Move** command and pick up the driveway centerline, snapping to the end on the mainline centerline.

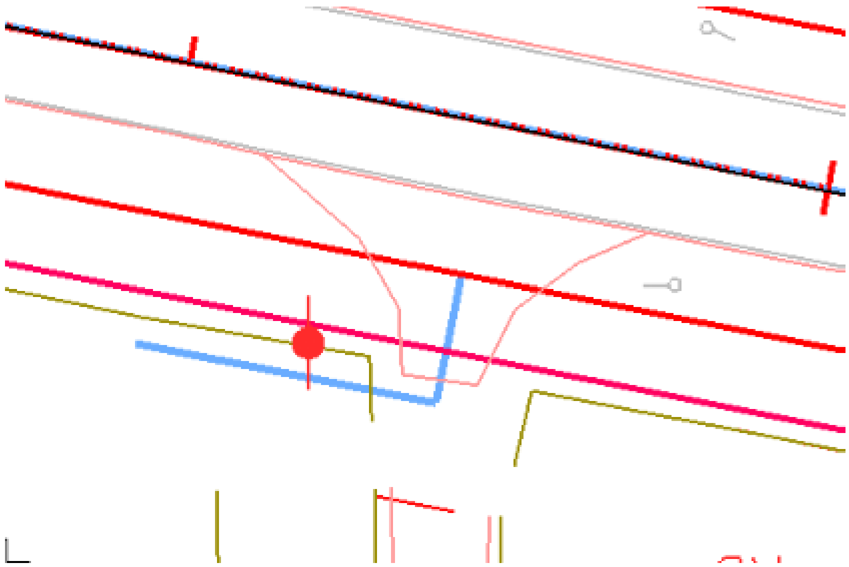
29. Snap to the intersection of the driveway centerline and the edge of pavement feature to place the line in its new location. **<D>** to complete the move then **<R>** to exit the command.



Next, the point of the “breakover” from the 12 to 1 slope must be located. This point is 20’ from the proposed edge of pavement, or 44’ from the mainline centerline.

30. Select the MicroStation Place Smartline command.
31. In the MicroStation Key-in window, type ***so=254+00,44*** and press Enter. The starting station of this line is not important as it will be deleted once the driveway centerline is modified.
32. Key in ***so=254+47.15,44*** and press **Enter**. **<R>** to end the line.

33. Select **Extend Element to Intersection** from the MicroStation main toolbar and shorten the driveway centerline back to the line just placed. The illustration below shows the result.



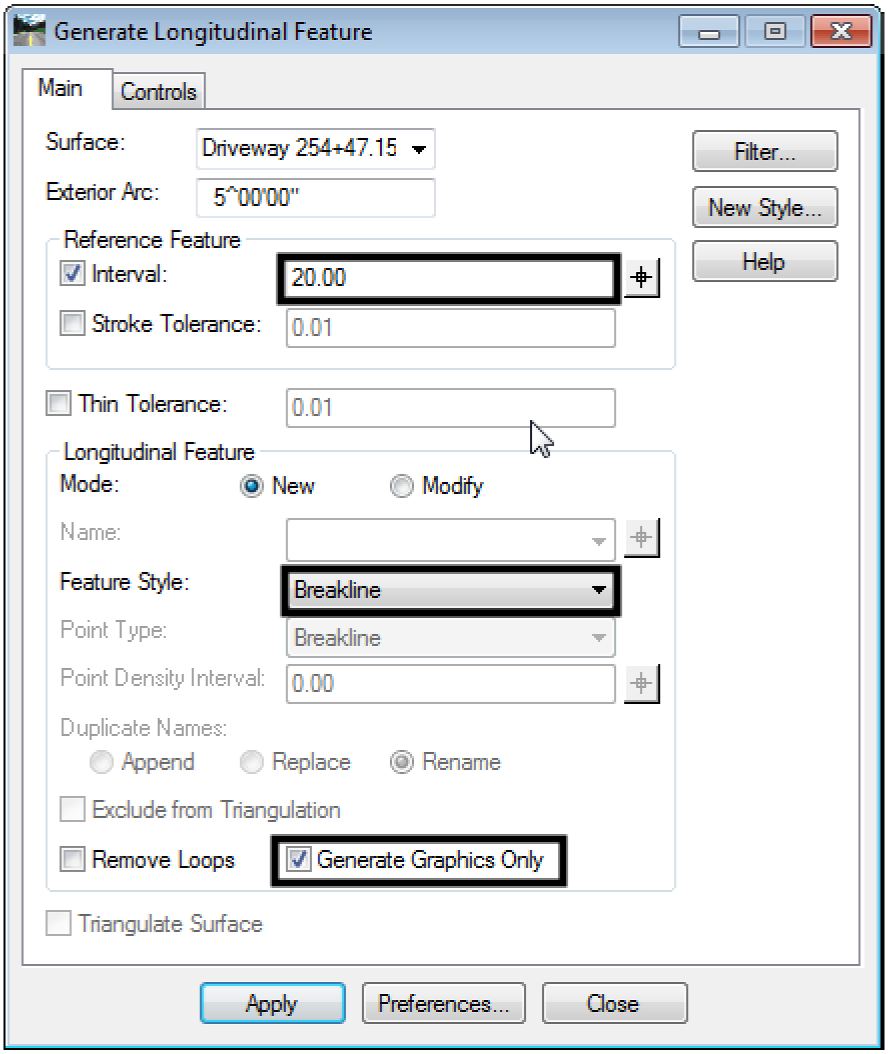
Now the 12 to 1 slope is added to the line. The Generate Longitudinal Feature command is used to create the sloped element. The Generate Graphic Only option is used because additional editing is required.

34. From the InRoads menu bar, select **Surface > Design Surface > Generate Longitudinal Feature**.

35. On the ***Main*** tab of the ***Generate Longitudinal Feature*** dialog box, key in ***20*** for the ***Interval***.

36. set the ***Feature Style*** to **Breakline**.

37. Toggle on **Generate Graphic Only**.



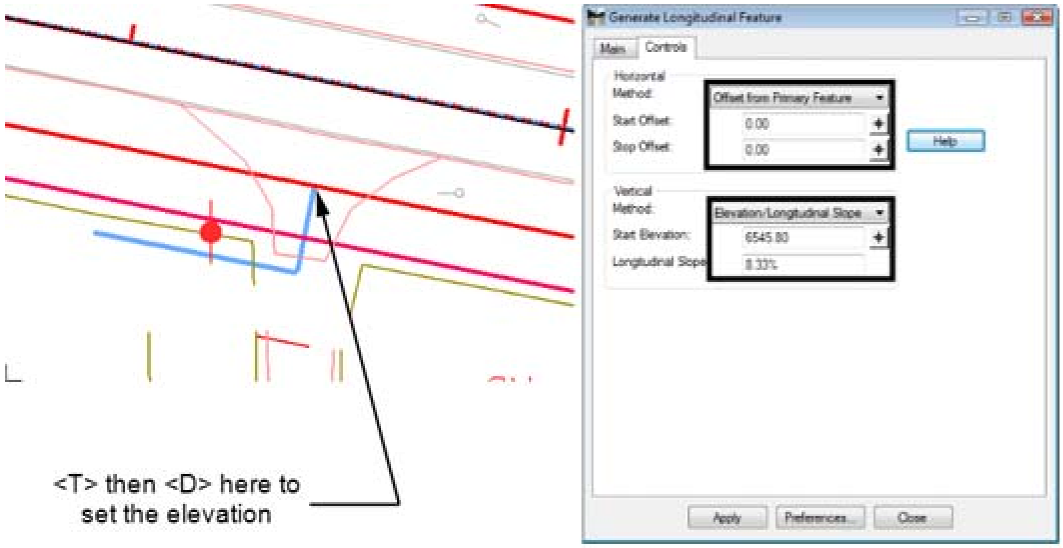
38. Select the **Controls** tab.

39. For the ***Horizontal*** control, use **Offset from Primary Feature** with ***Start*** and ***Stop*** values of ***0.00***.

40. Set the ***Vertical*** control ***Method*** to **Elevation/Longitudinal Slope**.

41. Set the ***Start Elevation*** by selecting the “Target” button then **<T>** to the beginning of the driveway centerline, **<D>** to accept. The elevation should be around 6545.80.

42. Key in ***1/12*** for the ***Longitudinal Slope***. The result is 8.33%.



43. **<D> Apply**, then follow the prompts in the lower left corner of the MicroStation window.

44. Select the driveway centerline as the primary and reference element.

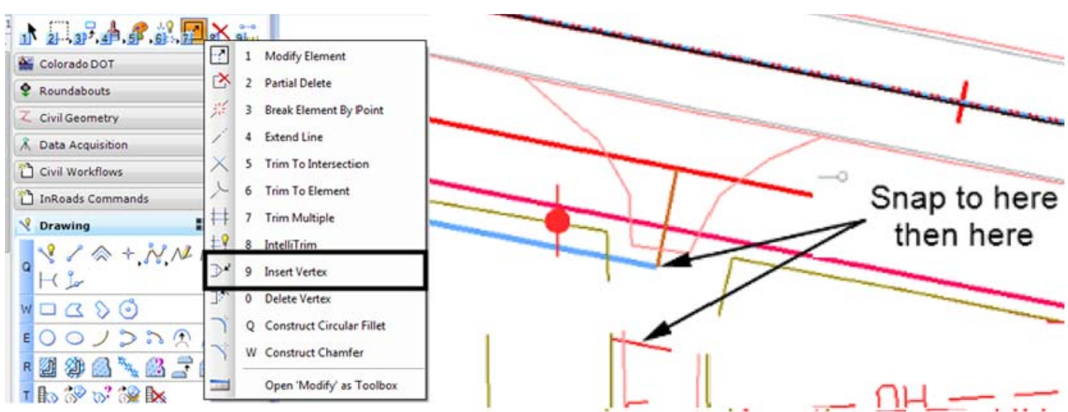
45. **<R>** to use the entire line, then **<D>** to finish the command.

Be careful in the next steps, because the original line is under the line just created. This new line is modified by adding a vertex, extending it to the driveway end line.

46. Select **Insert Vertex** form the MicroStation main toolbar.

47. **<T>** to the end of the new driveway centerline, then **<D>** to accept.

48. **<T>** to the center of the driveway end line and **<D>** to accept. **<R>** to exit the command.



49. Delete the original driveway centerline and the reference line, they are not used to create the driveway surface.

The elevation of the driveway centerline at the edge of pavement was set when the line was moved. The elevation at the end of the initial slope was set using the Generate Longitudinal Feature command. Finally. the elevation at the end of the drive was set by snapping the new vertex to the driveway end line created earlier. The driveway centerline now represents the profile of the driveway.

Section Summary:

In this section, the features of the mainline road were displayed as an aid in designing the driveway. The driveway end line was draped to the existing ground and stored in the driveway surface. A 3D centerline was created with the desired slopes.

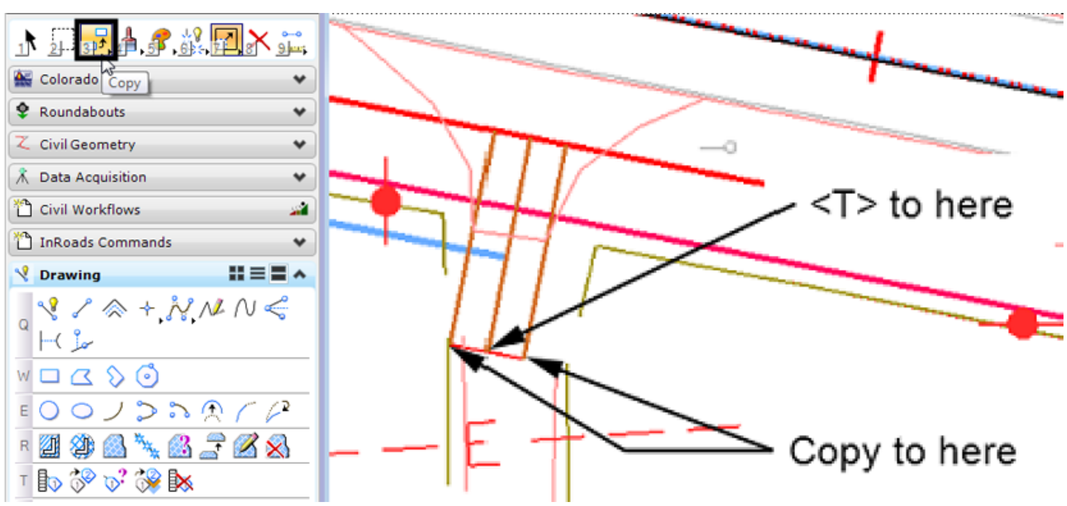
Lab 21.3 - Create Driveway Edges

The Driveway centerline is used to define the driveway edge features, then the Fillet Feature command is used to create the drive returns. The driveway edge lines are then joined to the driveway return to create a single feature.

Section Objectives:

- Copy the Driveway centerline to form the edge lines.
- Use Import Surface to create surface features from the edge line graphic elements.
- Use Fillet Feature to create the driveway returns.
- Use Partial Delete on the edge line features to clear the driveway ramp.
- Use Join Feature to create a single feature from the driveway edge line an the return.

1. Select the Copy command from the MicroStation Main toolbar.
2. **<T>** to the driveway centerline near the driveway end line and **<D>** to accept.
3. **<T>** and accept to each end of the driveway end line. The illustration below shows the results.

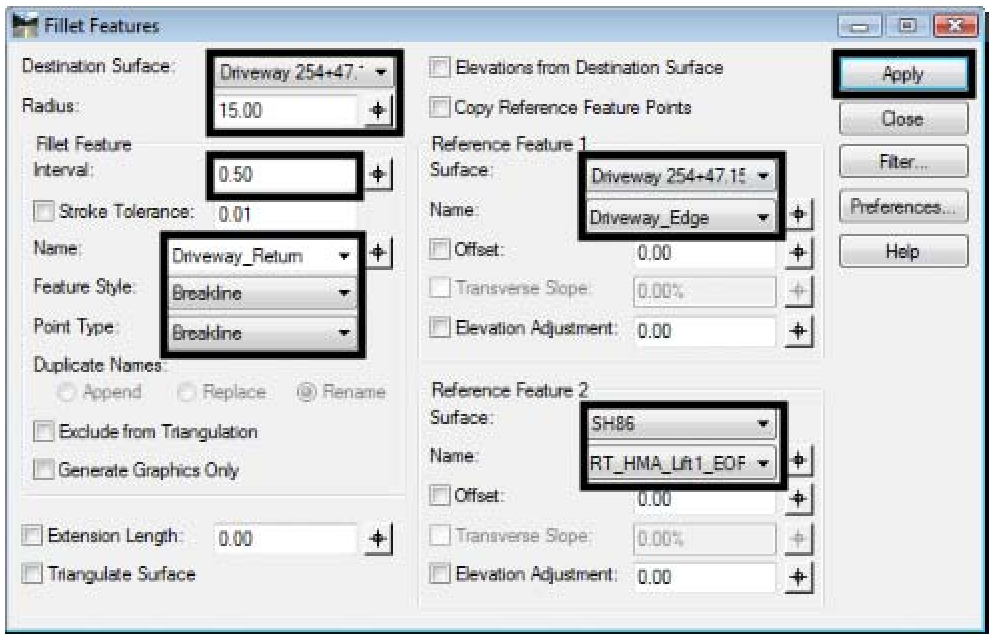


4. From the InRoads menu bar, Select **File > Import > Surface**.

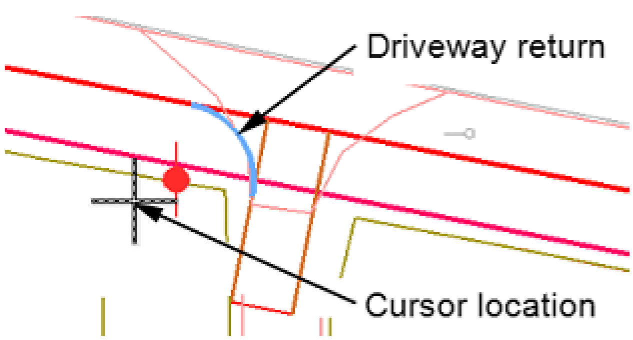
5. Set up the ***Import Surface*** dialog box as in the *Setting Elevations* section above, using ***Driveway Edge*** as the ***Seed Name***.
6. **<D> Apply** then **<D>** on one of the edge lines. Repeat the process with the other edge line.
7. **Close** the ***Import Surface*** dialog box.

With the driveway edge features added to the surface, the driveway returns can be added.

8. Select **Surface > Design Surface > Fillet Feature** from the InRoads menu bar.
9. Make the settings as shown in the illustration below.

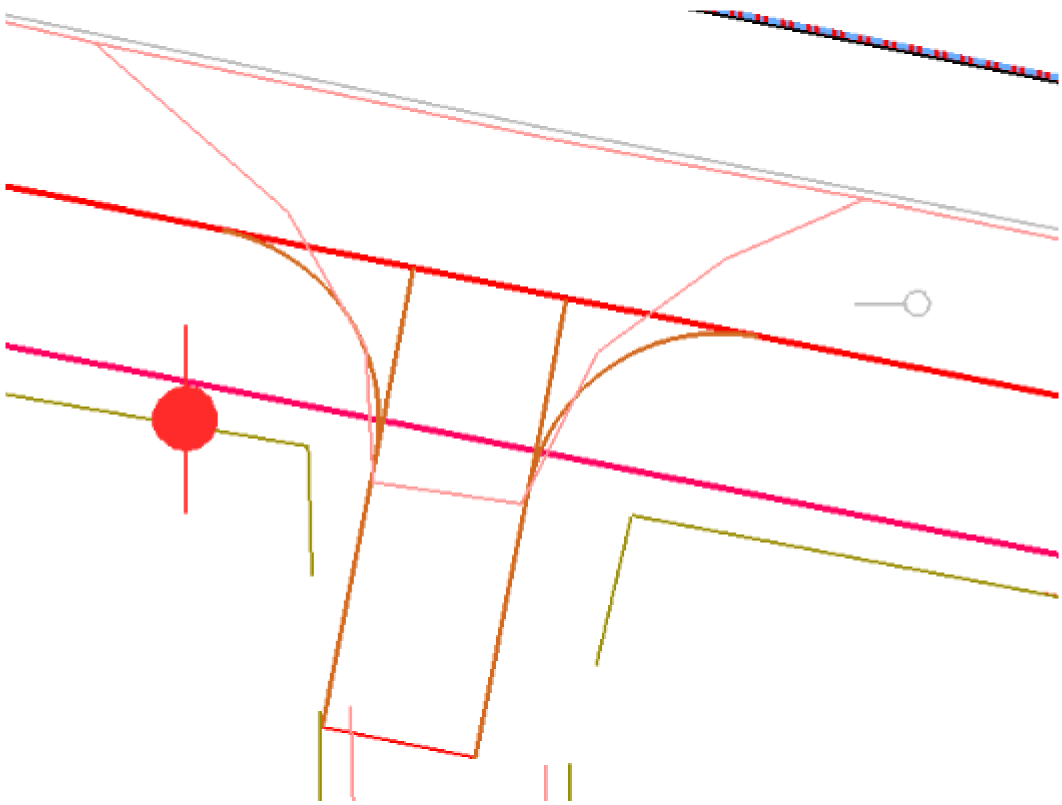


10. **<D> Apply**, then move the cursor into the quadrant for the return and **<D>**. The return is added to the driveway surface.



11. Set the Reference Feature 1 Name to the other driveway edge feature.

12. Repeat step 10 to create the other driveway return feature. The illustration below shows the results.

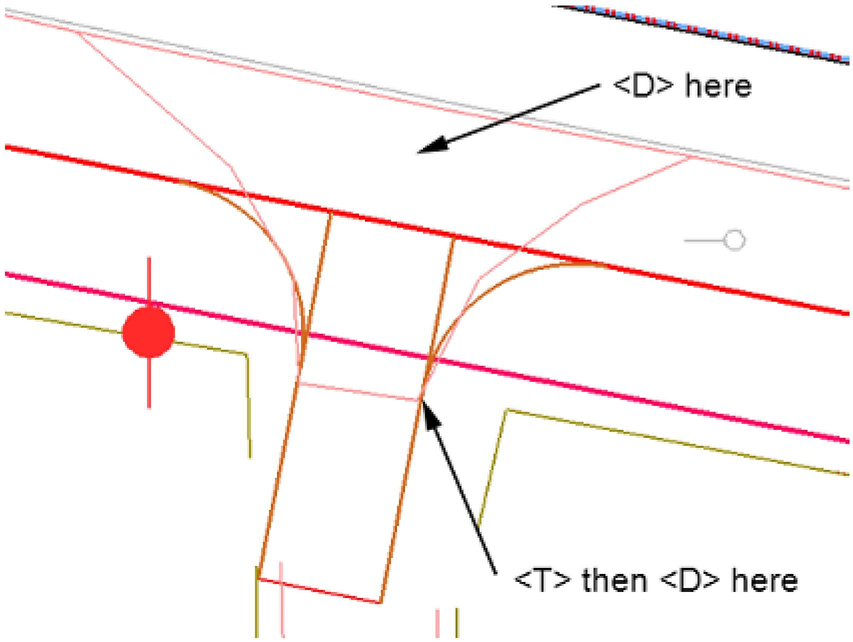


13. **Close** the ***Fillet Feature*** dialog box.
14. Save the driveway surface.

Next, the driveway edges from the end of the fillet to the edge of the mainline are trimmed to create a smooth cross slope.

15. Verify that the ***Driveway 254+47.15 Rt*** surface is active.
16. Select **Surface > Edit Surface > Partial Delete** from the InRoads menu bar.
17. **<D>** on a Driveway Edge line and **<D>** to accept it.
18. move the cursor above the mainline edge of pavement line and **<D>**. This sets the partial delete to the end of the driveway edge line.

19. **<T>** to the end of the fillet on the drive way edge line then **<D>** to complete the partial delete.



20. Repeat steps 17 through 19 for the other edge line.

21. **Save** the driveway surface.

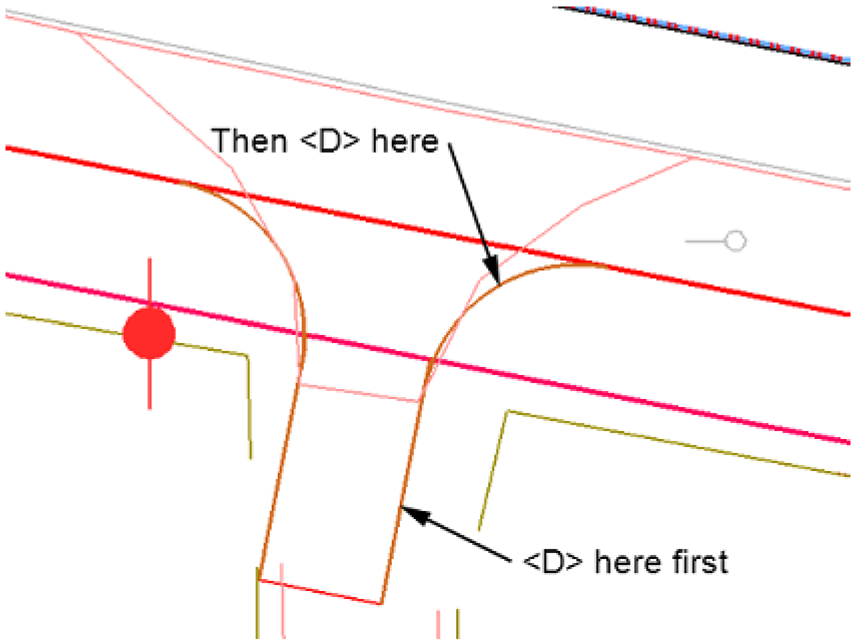
The final step in creating the driveway edge lines is to join the line and return features to form a single feature. This will make it easier to construct the side slopes for the drive way.

22. Verify that the ***Driveway 254+47.15 Rt*** surface is active.

23. Select **Surface > Edit Surface > Join Features**.

24. **<D>** on a driveway edge line and **<D>** to accept.

25. **<D>** on the corresponding driveway return and **<D>** to accept. **<R>** to exit the ***Join Features*** command. The two features are now combined into a single feature. The name for the combined feature is that of the first feature selected.



26. Repeat steps 23 through 25 for the other driveway edge.

27. **Save** the driveway surface.

This completes the backbone of the driveway.

Section Summary:

The 3D centerline was copied to the ends of the driveway end line, forming the basis of the driveway edge lines. These were imported into the driveway surface. Fillet feature was used to form the driveway returns. Then the edge lines were trimmed back to the ends of the returns. Finally, the edges and returns were joined to make a single feature out of each.

Lab 21.4 - Sideslopes and the Exterior Boundary

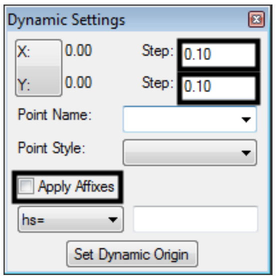
With the backbone of the driveway complete, the sideslopes and exterior boundary can be added to finish the driveway model.

Section Objectives:

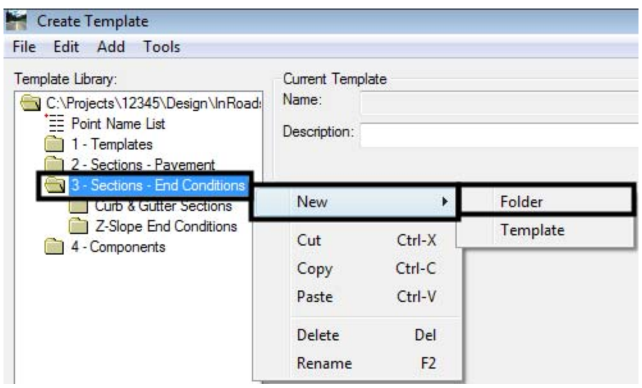
- Modify an end condition section to search for a specific surface.
- Use Apply Template to create driveway sideslopes.
- Create an exterior boundary from graphic elements.

The sideslopes for the driveway must tie to two different surfaces, the proposed (SH86) surface and the existing (12345 existing ground) surface. This is accomplished by modifying the end condition section to seek a specific surface then applying the section to the area where that surface is sought.

1. Turn off the reference file display. This will make it easier to see the data that is used.
2. Select **Modeler > Create Template** from the InRoads menu bar.
3. Display the ***Dynamic Settings*** dialog box.
4. Set the Steps to ***0.10*** and toggle off **Apply Affixes**.



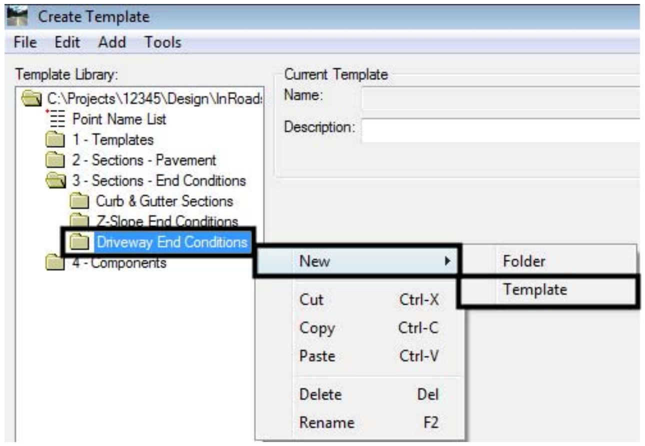
5. Navigate to the **3 - Sections - End Conditions** folder in the template library explorer.
6. **<R>** on the ***3 - Sections - End Conditions*** folder and select **New > Folder**.



7. Key in ***Driveway End Conditions*** for the name.

The next step is to build a new end condition section for the driveway. It uses components that are already in the template library.

8. **<R>** on the ***Driveway End Conditions*** folder and select **New > Template**.

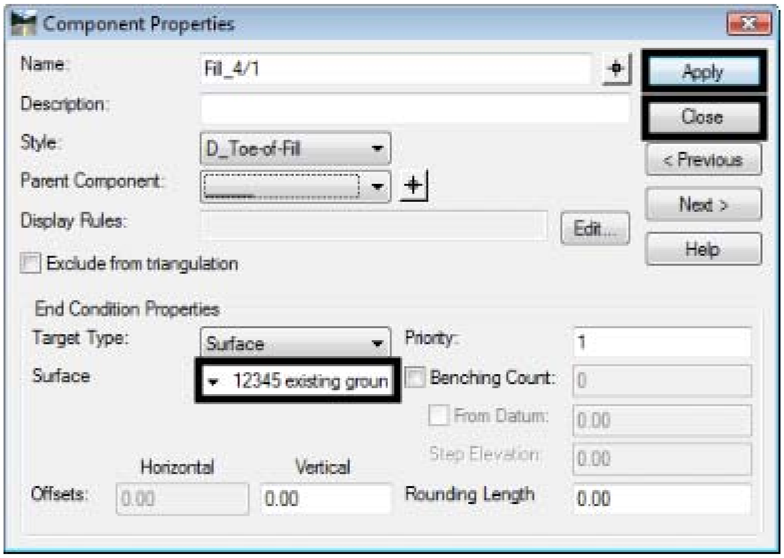


9. Key in ***4_to_1-Existing*** for the name.

Now that the template placeholder is built, data can be added to it. The data for this new section comes from the end condition components folders.

10. Navigate to the **4 - Components > End Conditions > Fill Slope Components** folder.
11. **<D>** on the **Fill_4_to_1** component to display it in the ***Preview*** window.
12. Drag the component from the ***Preview*** window into the ***4_to_1-Existing*** section by its origin and place it on the origin of the new section.
13. Expand the ***Cut Slope Components*** folder and **<D>** on the **Cut_4_to_1** component.
14. Drag and drop this component into the new section on the origin.
15. Edit the fill component.
16. In the ***Component Properties*** dialog box, ***End Condition Properties*** area, set the ***Surface*** to **12345 Existing Ground**.

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



18. Repeat steps 15 and 16 for the cut component.

19. Key in ***2*** for the ***Priority*** of the cut component.

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

21. Save the template library.

This completes the end condition used to tie to the existing surface. Next, copy this template and modify it to seek the design surface.

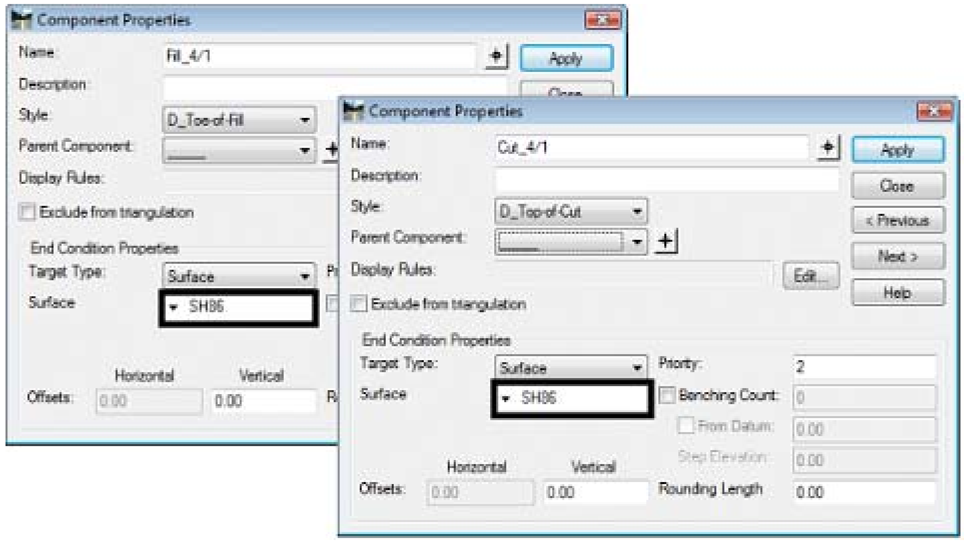
22. **<R>** on the **4_to_1-Existing** section and select **Copy**.

23. **<R>** on the ***Driveway End Conditions*** folder and select **Paste**.

24. Rename the section to ***4_to_1-Proposed***.

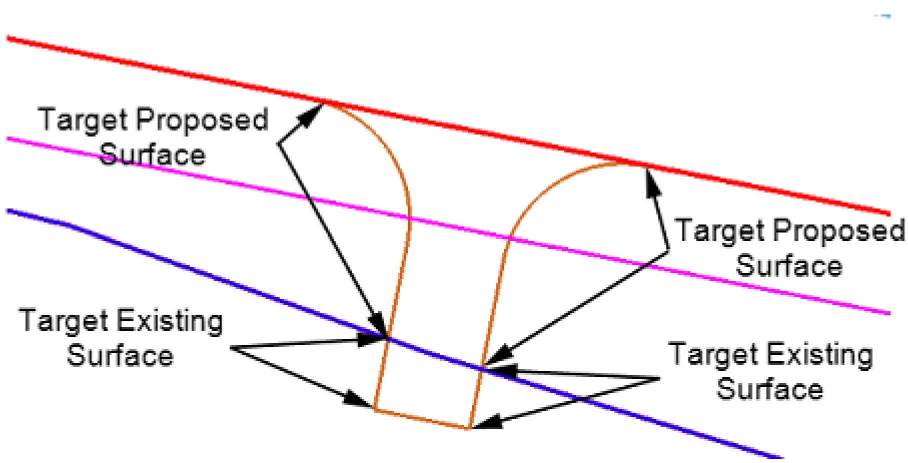
25. **<D> <D>** on the ***4_to_1-Proposed*** section to make it active.

26. Edit the component properties as described above, changing the target surface to **SH86**.



27. Save the template library.

These sections (templates) are used to create the sideslopes on both sides of the driveway. They are applied to specific parts of the driveway to target the desired surface in that area.



28. Select **Surface > Design Surface > Apply Template** from the InRoads menu bar.

29. In the ***Apply Template*** dialog box, set the ***Design Surface*** to **Driveway 254+47.15 Rt.**

30. Toggle on **Interval** and key in ***1.00*** for the value.

31. Toggle on **Stroke Tolerance** and key in ***0.01*** for the value.

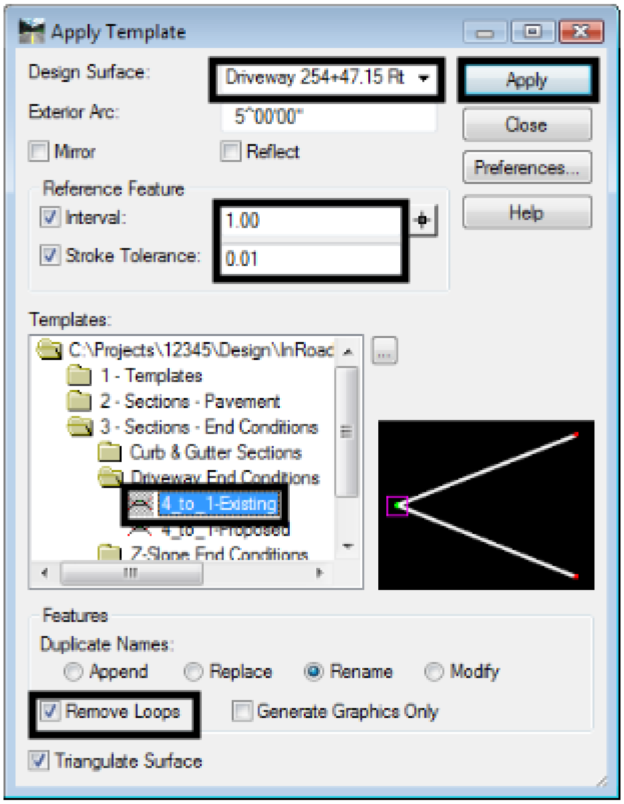
32. Navigate to ***3 - Sections - End Conditions*** > ***Driveway End Conditions*** in the template library.

33. **<D>** on the **4_to_1-Existing** section.

34. Verify that **Generate Graphics Only** is toggled off.

35. Toggle on **Remove Loops** and **Triangulate Surface**.

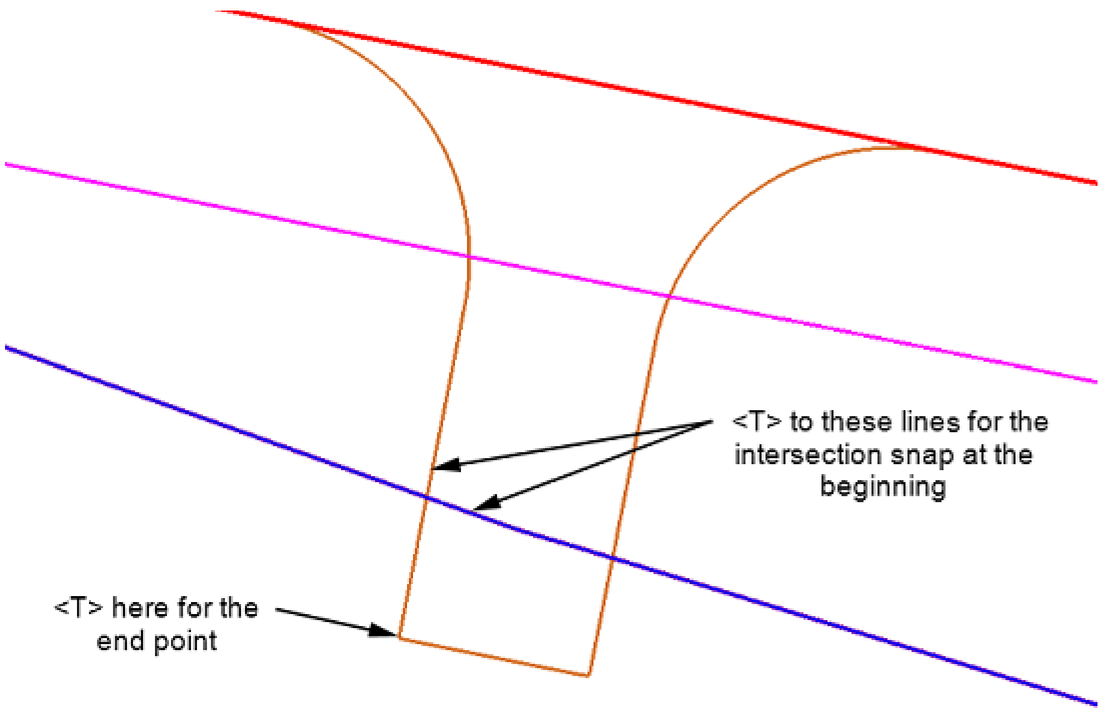
36. **<D> Apply**.



37. Follow the prompts displayed in the lower left corner of the MicroStation window.

38. Select the left driveway edge as the Primary and Reference elements.

39. At the prompt, “Identify Beginning/Reset for Entire”, Set the MicroStation snap mode to Intersection.

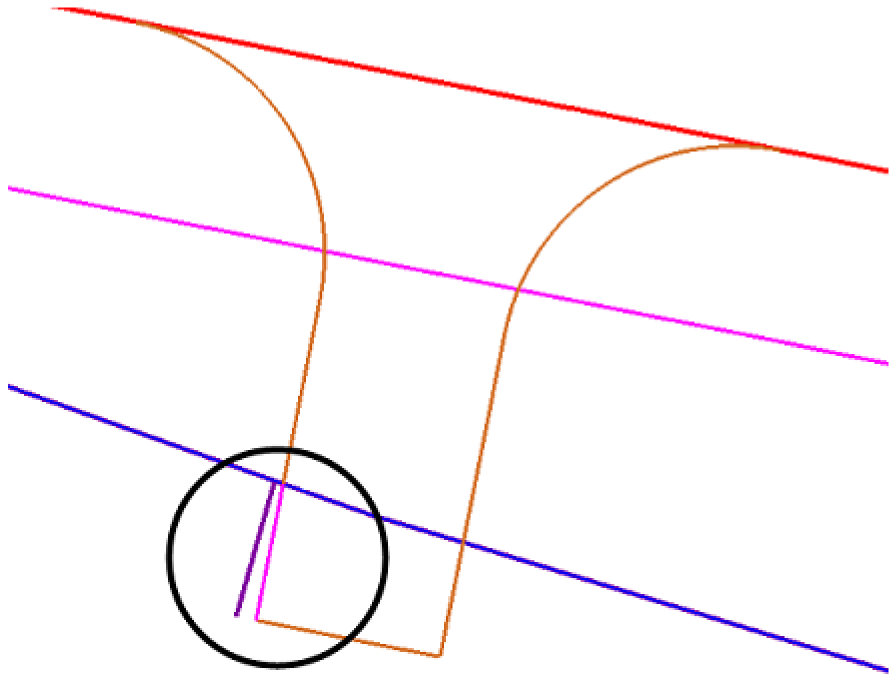


40. **<T>** on the mainline top of cut feature then **<T>** on the driveway edge feature then **<D>** to accept the location.

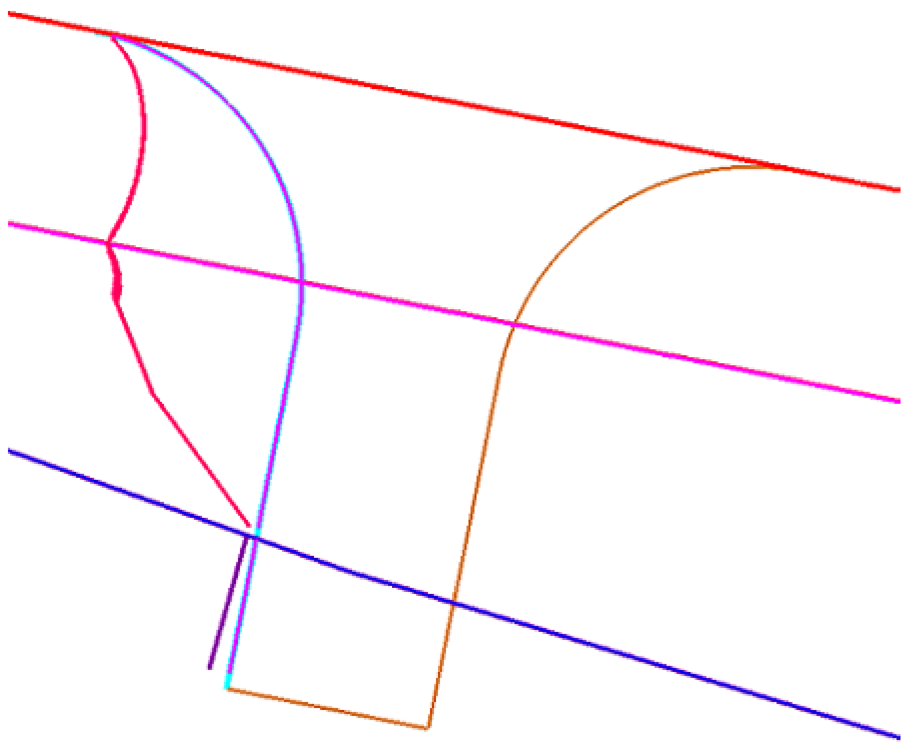
41. Use the keypoint snap to select the end point then **<D>** to accept the location.

Important! After selecting the location to apply the section, the ***Apply Template*** dialog box reappears. However, there is still one more prompt to answer. Do not forget the final **<D>** to accept the solution.

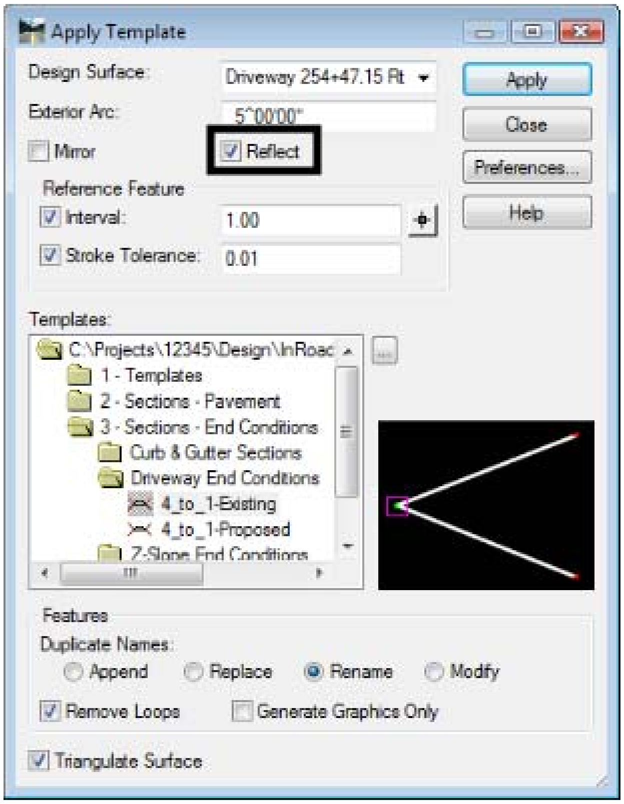
The result of the Apply Template is shown below (shown inside the circle).



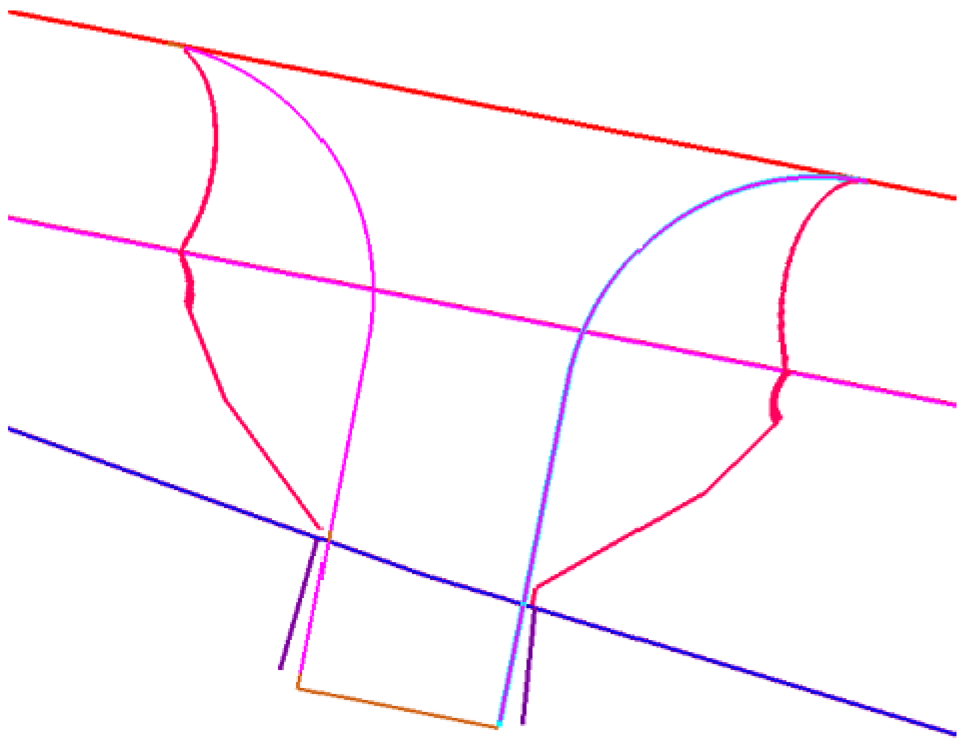
42. Repeat the Apply Template process, using the ***4_to_1-Proposed*** section, to model the sideslope to the (proposed) SH86 surface. The illustration below shows the results after applying both sections to the left side.



43. In the ***Apply Template*** dialog box, toggle on **Reflect**.



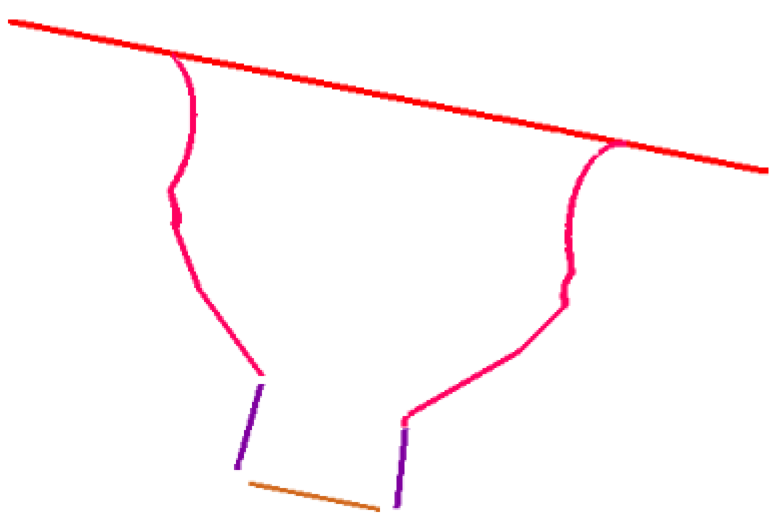
44. Apply both sections to the right side of the driveway as described above. The results of all of the Apply Template commands are shown below.



The final step for the drive is to create an exterior boundary. The boundary is defined using the graphics of the cut and fill features along with the driveway end feature and the proposed edge of pavement from Sh86.

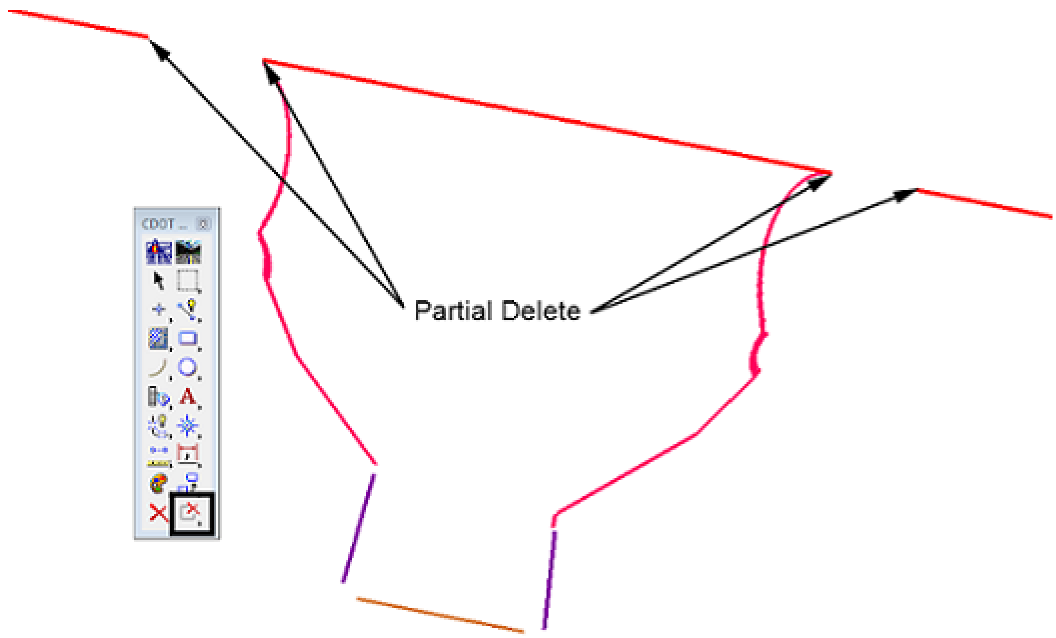
45. Select the MicroStation **Delete** command from the Main toolbar.

46. Delete the graphic elements that will not be used for the exterior boundary. The illustration below shows the elements needed.

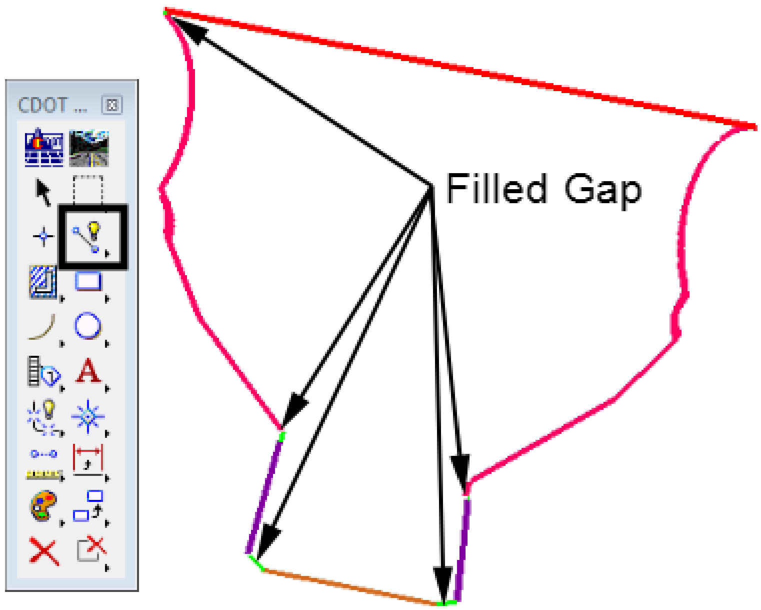


To create the boundary, the edge of pavement line needs to be trimmed and the gaps between elements need to be filled.

47. In MicroStation, toggle of the **Graphic Group** lock.
48. Select the **Partial Delete** command from the MicroStation Main toolbar.
49. Partial delete the edge of pavement lines from where the driveway toes intersect away from the driveway.



50. Select the MicroStation **Place Smartline** command. Use this command to fill in the gaps between elements. Be sure to **<T>** to the ends of the lines. This will ensure that the elements are connected properly. Not snapping to the lines could result in erroneous elevation data. The gaps filled are illustrated below.

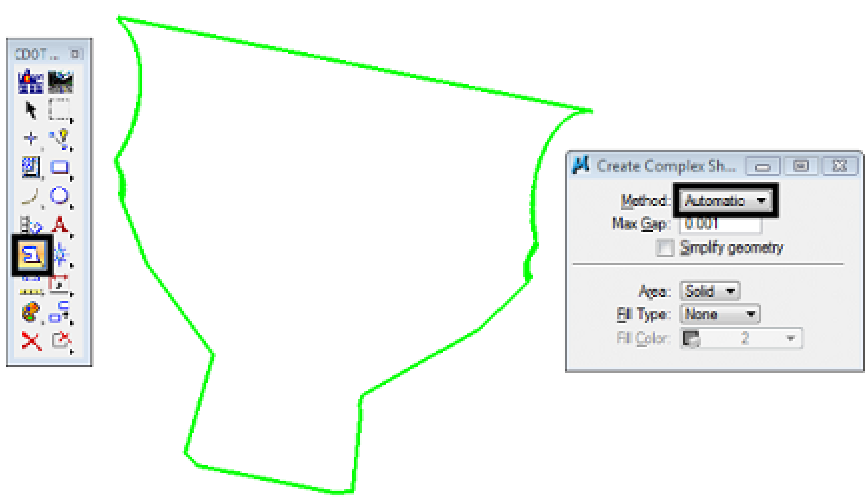


A closed shape element is created from the linework defining the exterior boundary

51. Select the MicroStation **Create Complex Shape** command.

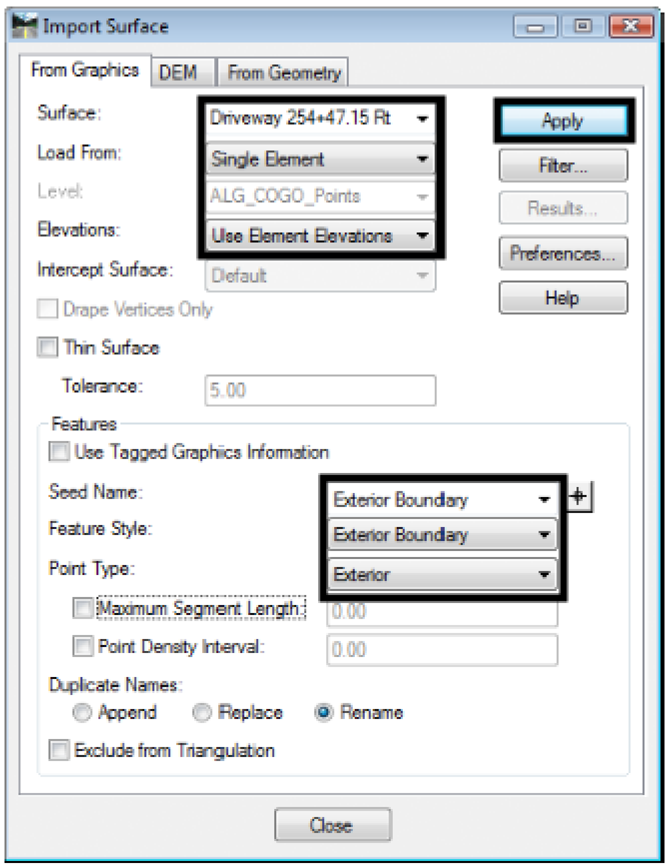
52. In the toolsettings dialog box, set the ***Method*** to **Automatic**.

53. **<D>** on an element of the boundary the **<D>** anywhere. This creates a closed shape from the graphic elements that makeup the exterior boundary.



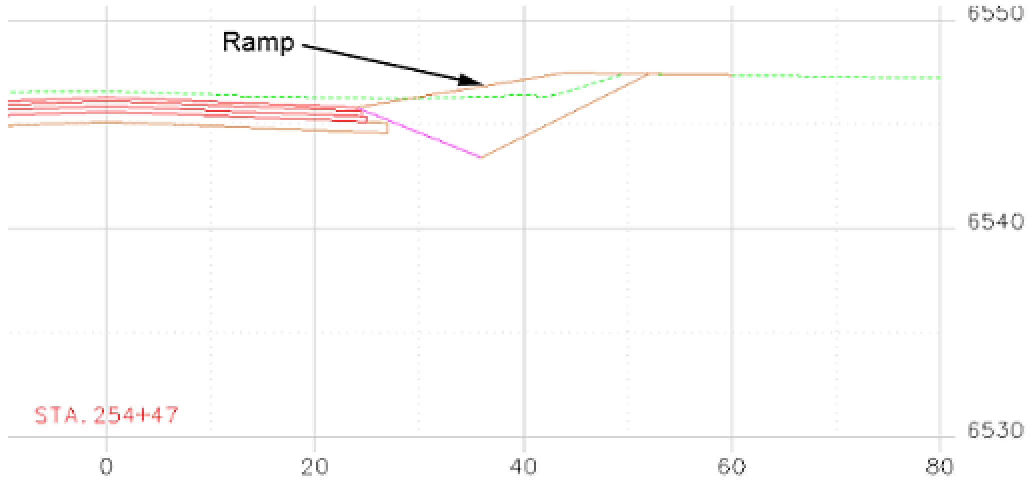
Import complex shape into the driveway surface as an exterior boundary, to complete the model.

54. From the InRoads menu bar, select **File > Import > Surface**.
55. In the I***mport Surface*** dialog box, set the ***Surface*** to **Driveway 254+47.15 Rt**.
56. Set ***Load From*** to **Single Element**.
57. Set ***Elevations*** to **Use Element Elevations**.
58. In the ***Seed Name*** field, key in ***Exterior Boundary***.
59. Set the ***Feature Style*** to **Exterior Boundary**.
60. Set the ***Point Type*** to **Exterior**.
61. **<D> Apply** then **<D>** on the boundary graphic element.

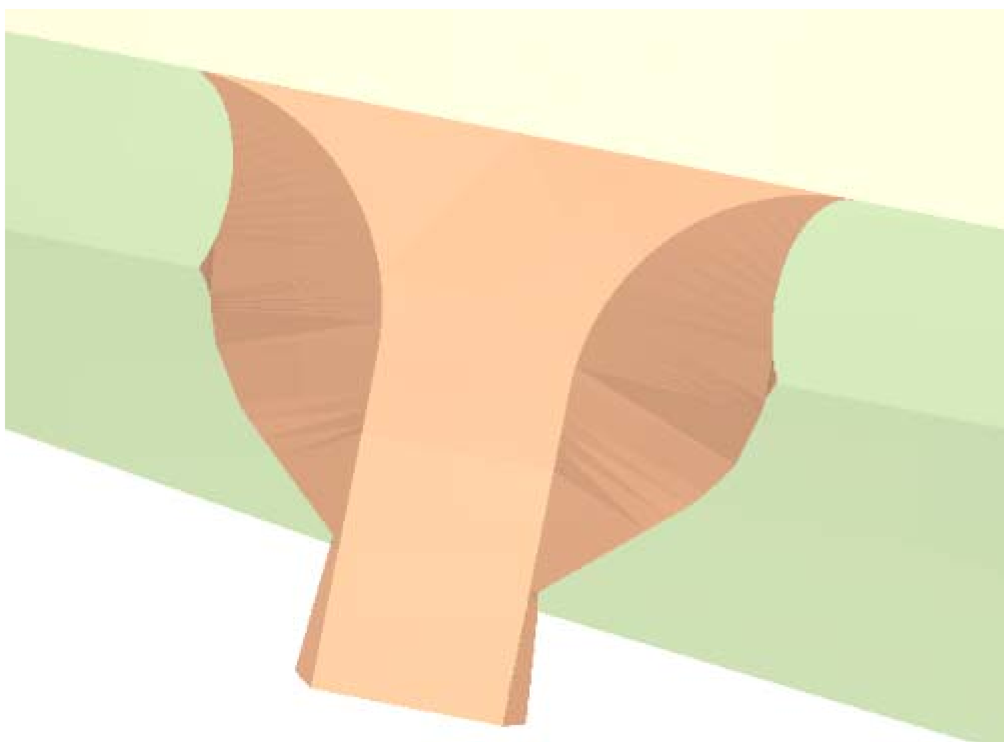


62. **Close** the ***Import Surface*** dialog box.
63. From the InRoads explorer, **<R>** on the **Driveway 254+47.15 Rt** surface and select **Triangulate**.

64. To evaluate the ramp, create a single cross section at station 254+47.15.



Below is a rendered view of the driveway



Section Summary:

In this section, end conditions were developed and applied to the driveway edges to form the side slopes. Features from the driveway surface and the mainline (SH86) surface were displayed and used to build the exterior boundary graphically. This graphic was imported into the driveway surface to finish the model. A cross section was created to review the ramp.

Chapter Summary:

In this lab, a driveway was designed using a variety of InRoads and MicroStation tools. From InRoads, the following tools were used:

- Tracking
- Create Surface
- Drape Surface
- Generate Longitudinal Feature
- Import Surface from Graphics
- View Features
- Fillet Feature
- Partial Delete (Feature)
- Join Features
- Create Template
- Apply Template

From MicroStation, the following tools were used:

- Place Smartline
- Copy
- Partial Delete (Graphic)
- Delete
- Create Complex Shape

LAB 22 - Creating an Island

In this lab, and island with pedestrian ramps is constructed on the southeast corner of the intersection. Surface features of the island are built using various MicroStation commands and InRoads surface design and editing tools. The island model is added to the proposed intersection model to create a triangulated model of the finished grade surface. Because the island is constructed by feature modeling techniques, there are no components included in the model.

Chapter Objectives:

- Lay out the horizontal geometry of the island.
- Identify ramp locations.
- Add elevations to the island shape.
- Create curb and ramp features.

The following files are used with this lab:

- C:\Projects\12345\Design\Drawings\Reference_Files\12345DES_Intersec100SH86.dgn
- C:\Projects\12345\Design\InRoads\12345DES_Geometry-Islands.alg
- C:\Projects\12345\Design\InRoads\Intersection.dtm

The two roads of the intersection are 4 lane curb and gutter. Each has an additional lane through the intersection for a turn bay and acceleration lane. The island protects the right turn lane from through traffic on SH 86.

The SE Curb Return alignment (in the quadrant of the island) represents the edge of pavement for the right turn lane. The features constructed for the island represent the gutter flowline around the island and the pedestrian ramps leading on to the island.

Lab 22.1 - Layout the Island Geometry

Section Objectives:

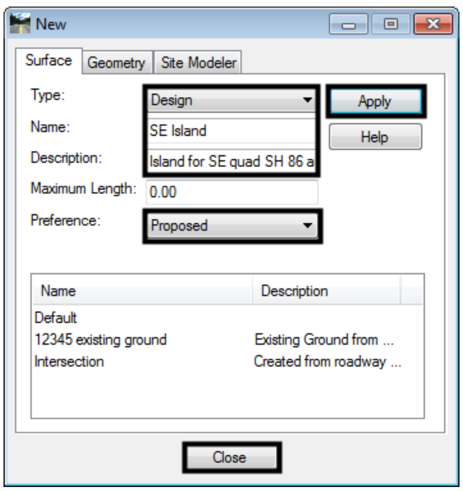
- Use horizontal alignment graphics to create the basic outline of the island.
- Define the radii for the island corners.
- Layout the initial geometry for the pedestrian ramps.

The basic outline of the island is created by offseting the alignment graphics. This is done by displaying the alignments from InRoads then using the MicroStation Move Parallel command to copy the graphics to the desired locations. Construct Circular Fillet is used to create the rounded corners for the island. The pedestrian ramps are laid out with a variety of MicroStation tools like, Place Smartline, Construct Line at Active Angle, Extend Element to Intersect, etc.

1. Open MicroStation and InRoads with the ***C:\Projects\12345\Design\Drawings\Reference_Files\12345DES_Intersec100SH86.dgn*** file.
2. Verify that the **C:\Workspace\Workspace-CDOT_XM\Standards-Global\InRoads\Preferences\CDOT_Civil.xin** is loaded.
3. Open the following InRoads files (they are all in the ***C:\Projects\12345\Design\InRoads*** folder):

- 12345DES_Geometry-Islands.alg
- Intersection.dtm

4. From the InRoads menu bar, select **File > New**.
5. Select the **Surface** tab in the ***New*** dialog box.
6. Set the ***Type*** to **Design**.
7. Key in ***SE Island*** for the ***Name***.
8. Key in ***Island for SE quad SH 86 and Side Road*** for the ***Description***.
9. Set the ***Preference*** to **Proposed**.
10. **<D> Apply** then **<D> Close**.



This surface is used to store the island surface data as its being created. It also protects the data in the Intersection.dtm from being accidently modified while editing the island surface features.

11. In the InRoads Explorer, expand the **12345DES_Geometry** geometry project.
12. **<R>** on the **SH 86** horizontal alignment and select **View** from the menu.
13. Repeat the process for the **SideRoad** and **SE Curb Return** horizontal alignment

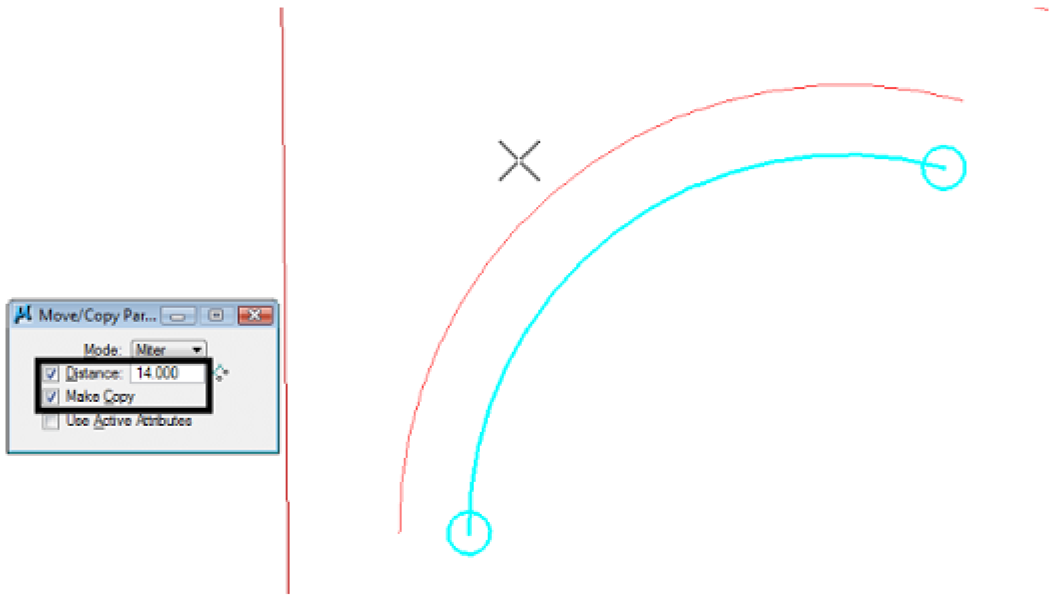
The MicroStation Move Parallel command is used to offset these lines. The SE Curb Return line is offset 14’ (12’ for the driving lane and 2’ for the gutter) to the left to form one side of the island. The SH 86 and SideRoad lines are offset 26’ (24’ for the driving lane and 2’ for the gutter) to the right to form the other two sides.

14. From the MicroStation ***Main*** toolbar, select **Move Parallel**.
15. In the ***Move/Copy Parallel*** tool settings box, toggle on ***Distance***.
16. Key in ***14*** for the value.
17. Toggle on **Make Copy**.

`

18. **<D>** on the **SE Curb Return** line.

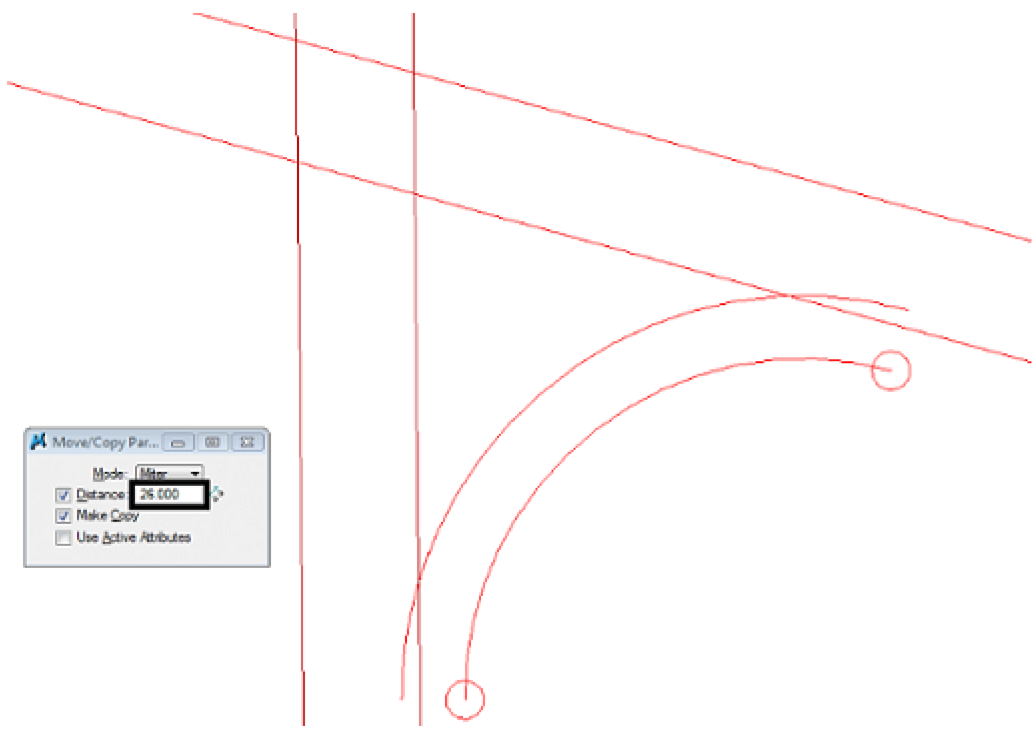
19. Move the cursor to the left of the line and **<D>** to make the copy. **<R>** to exit the command.



20. In the ***Move/Copy Parallel*** tool settings box, key in ***26*** for the value.

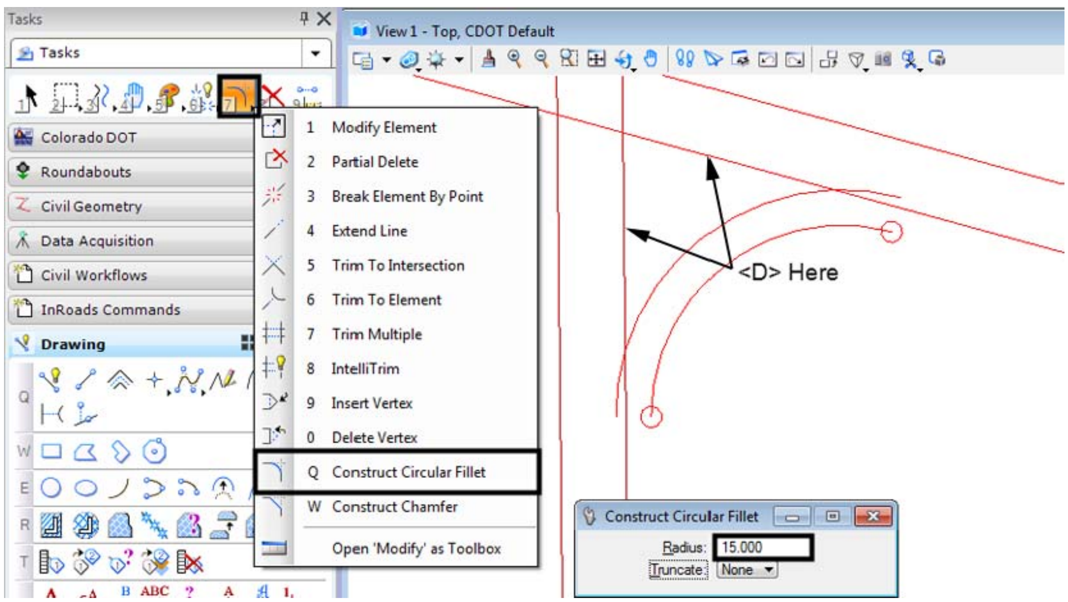
21. **<D>** on the **SH 86** line then **<D>** to the right of the line. **<R>** to exit the command.

22. **<D>** on the **SideRoad** line then **<D>** to the right of the line. **<R>** to exit the command. The illustration below shows the results.

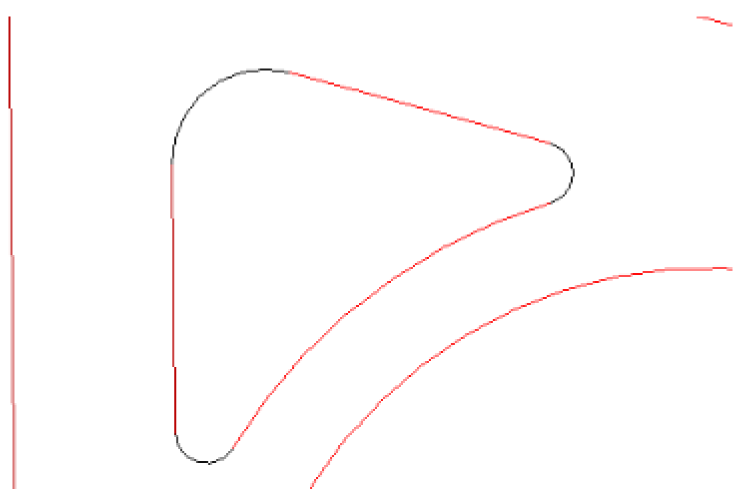


Next the radii for the island corners are added. The corner facing into the intersection has a 15' radius. The other two have a radius of 5'. These are placed using the Construct Circular Fillet command.

23. Select the **Construct Circular Fillet** command from the MicroStation Main toolbar.
24. In the tool settings box, key in ***15*** for the ***Radius***.
25. Set ***Truncate*** to **Both**.
26. **<D>** on the lines as shown in the illustration below.



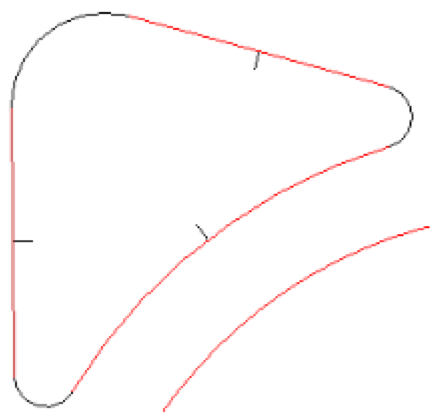
27. In the tool settings box, key in ***5*** for the ***Radius***.
28. Place the other two fillets as done in step 25. The illustration shows the results.



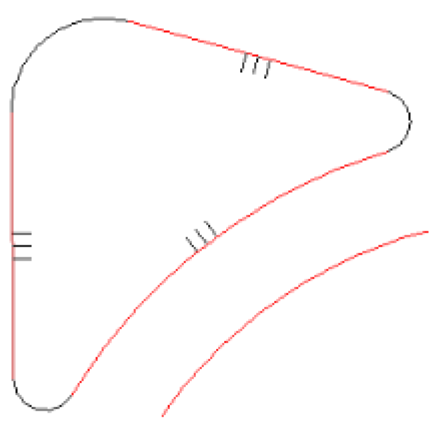
With the outline of the island in place, the pedestrian ramps can be located. These are placed in the center of each side of the island. The MicroStation Construct Line At Active Angle command is used to place the ramp centerline perpendicular to the island side.

Note: The dimensions for the pedestrian ramp are taken from the M-608-1 Curb Ramps standard, page 104 of the M & S Standards July 2006 edition.

29. Select the **Construct Line At Active Angle** command from the MicroStation Main toolbar.
30. In the tool settings dialog box, set the ***Method*** to **From Point**.
31. Set the ***Active Angle*** to **90^00'00"**.
32. Toggle on ***Length*** and key in ***3*** for the value. This is the length of the 20:1 slope at the mouth of the ramp.
33. **<T>** to the center of a side of the island, move the cursor inside the island and **<D>**.
34. Repeat step 33 for the other two sides. The illustration shows the results.

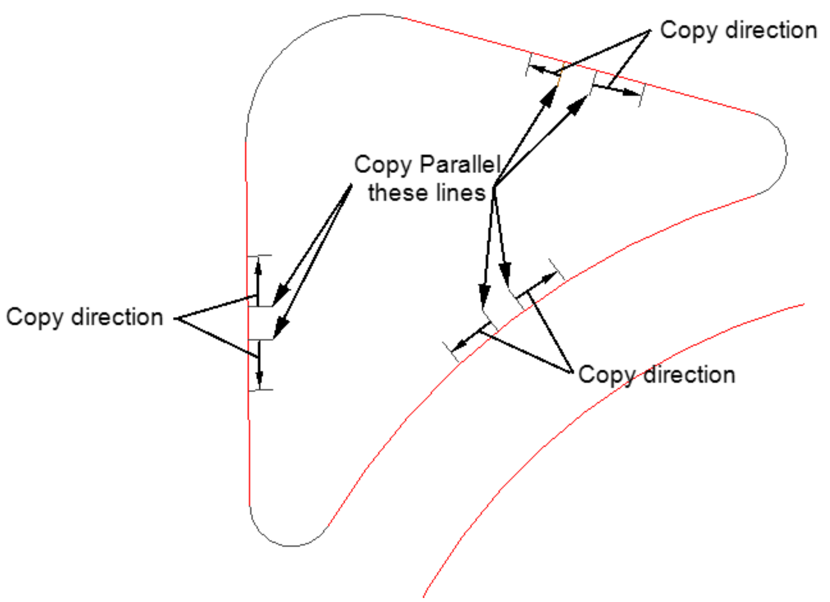


35. From the MicroStation ***Main*** toolbar, select **Move Parallel**.
36. In the ***Move/Copy Parallel*** tool settings box, toggle on ***Distance***.
37. Key in ***2*** for the value.
38. Copy each of the ramp centerlines to either side of itself. These will make up the edges of the ramp tread. The illustration shows the results.



39. Delete the ramp centerline elements, they will not be used again.

40. From the MicroStation ***Main*** toolbar, select **Move Parallel**.
41. In the ***Move/Copy Parallel*** tool settings box, toggle on ***Distance***.
42. Key in ***6*** for the value.
43. Copy each of the ramp edge lines to the outside of itself. These lines are used to create the ramps "wings". The illustration shows the results.



Section Summary:

InRoads was used to display the alignments that are the basis of the island. These were copied to their exact XY location using the MicroStation Move Parallel command. Rounded corners were added to the island using the Construct Circular Fillet command. The initial parts of the pedestrian ramps were added using the Construct Line At Active Angle command.

Lab 22.2 - Create Ramp and Curb Graphic Elements

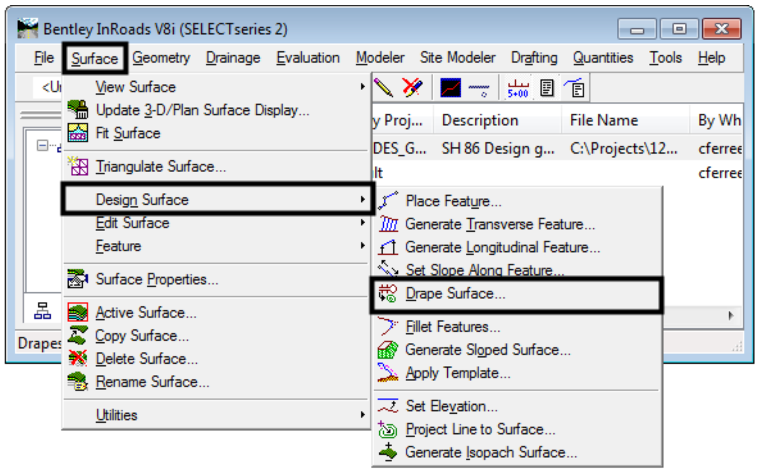
The outline of the island is complete. Now this outline needs to match the elevations in the design surface. The Drape Surface and Import Surface From Graphics commands are used to create dtm features of the island at the desired elevations. The ramp elements are draped to set the initial elevation, then Generate Longitudinal Feature is used to apply the proper slope to the element.

Section Objectives:

- Create graphic elements of the island at the design surface elevation.
- Modify slope on ramp landing elements.
- Create curb elements.
- Modify the curb elements for the ramp wings.
- Add the ramp wing elements.

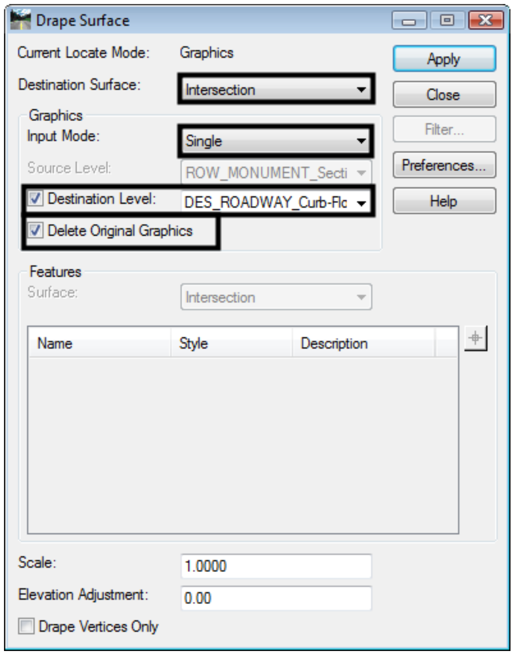
All of the graphic elements that make up the island and curb ramps are draped to the intersection surface. This sets the graphic elements of the island outline to the proper elevation. It also sets the initial elevations for the curb ramp features.

1. Highlight all of the elements that make up the island and ramp.
2. Select **Surface > Design Surface > Drape Surface** from the InRoads main menu. This displays the ***Drape Surface*** dialog box.

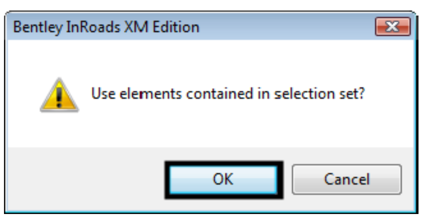


3. In the ***Drape Surface*** dialog box, set the ***Destination Surface*** to **Intersection** (this is the surface whose elevations are going to be matched).
4. Set the ***Input Mode*** to **Single**.
5. Toggle on **Destination Level** and select **DES_ROADWAY_Curb-Flowline** from the drop down menu.

6. Toggle on **Delete Original Graphics**.



7. **<D> Apply**. This displays a message window asking, “Use elements contained in selection set?”. **<D> OK** to complete the processing.

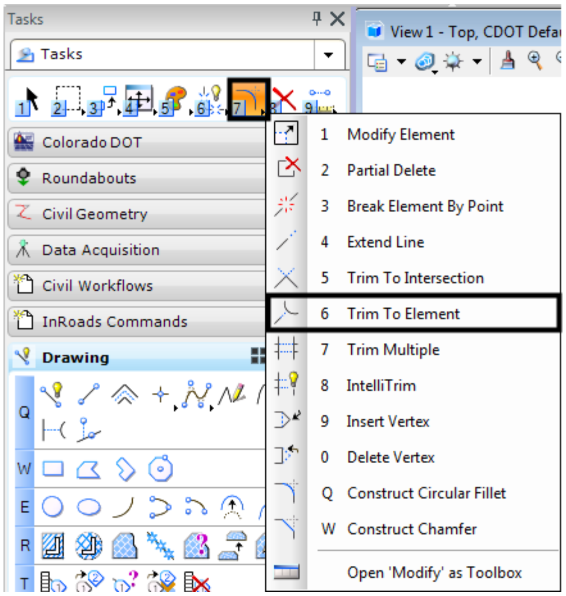


8. **<D> Close** to dismiss the ***Drape Surface*** dialog box.

The result of the command is that the graphic elements selected are redrawn at the elevation of the intersection surface. Next, the lines representing the pedestrian ramps are given the proper slope. These elements represent the landing pad of the pedestrian ramp and have a 20:1 slope.

9. Zoom In around the ramp lines on the long arc of the island.

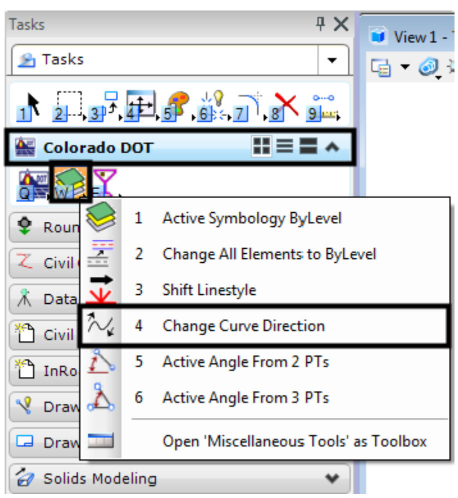
10. Select **Trim to Element** from the MicroStation main menu.



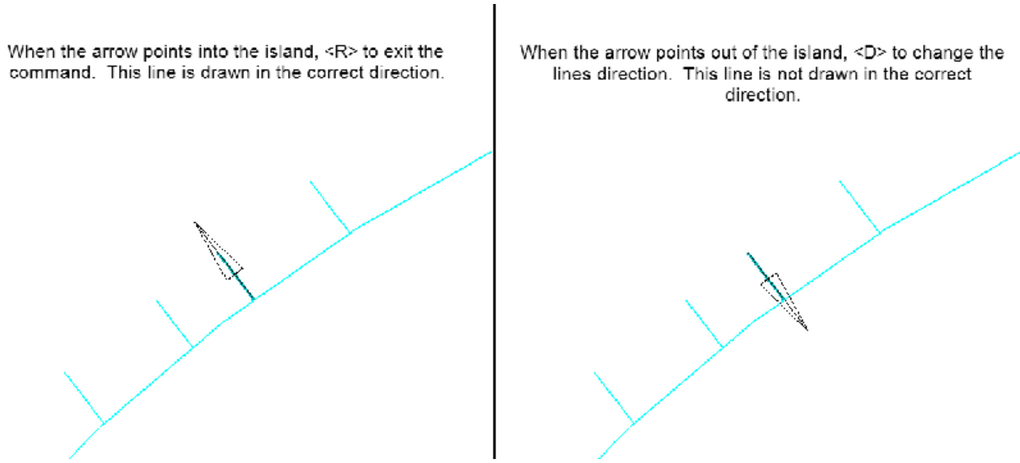
11. Extend the ramp wing lines to meet the Island line.

Next, check the direction of the lines. This will affect how the Generate Longitudinal Feature command operates.

12. **<D>** the **Change Curve Direction** tool from the ***Misc. Tools*** bar under the ***Colorado DOT*** task tab.

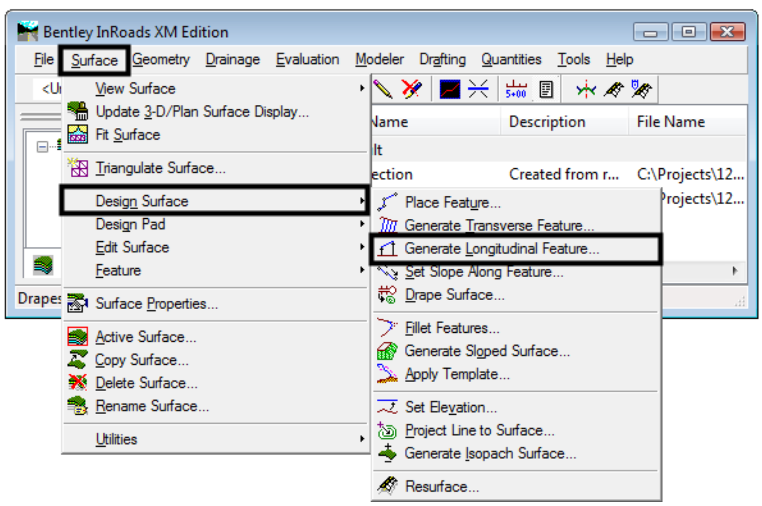


13. **<D>** on one of the ramp landing edge lines. An arrow appears on the line.



14. Repeat step 13 for each of the ramp lines

15. Select **Surface > Design Surface > Generate Longitudinal Feature** from the InRoads main menu. This displays the ***Generate Longitudinal Feature*** dialog box.

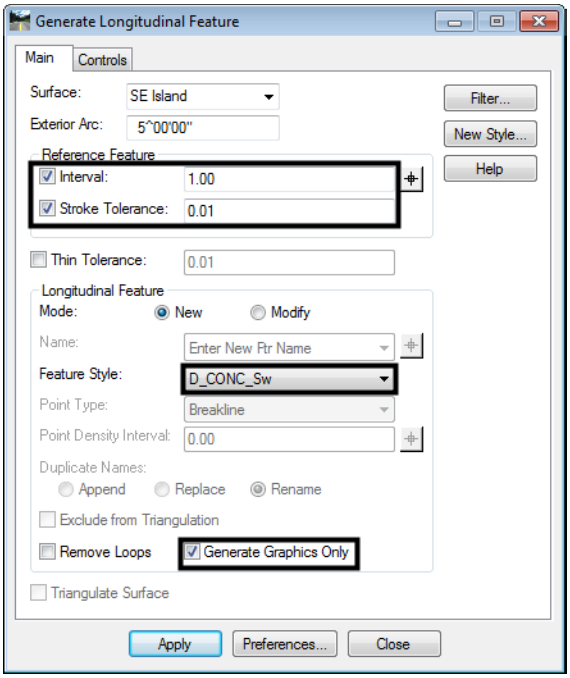


16. On the ***Generate Longitudinal Feature*** dialog box ***Main*** tab, Toggle on **Interval** and set the value to ***1.00***.

17. Toggle on **Stroke Tolerance** and set the value to ***0.01.***

18. Use the ***Feature Style*** drop down menu and select **D_CONC_Sw**.

19. Toggle on **Generate Graphics Only**.



20. **<D>** the **Controls** tab.

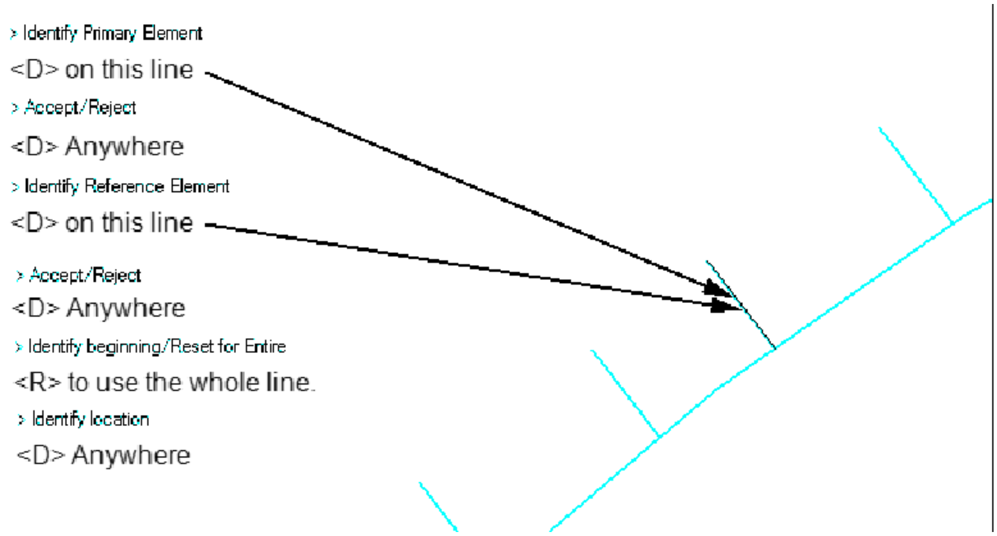
21. Set the ***Horizontal Method*** to **Offset From Primary Feature**. Leave the ***Start*** and ***Stop*** values at ***0.00***.

22. Set the ***Vertical Method*** to **Elevation/Longitudinal Slope**.

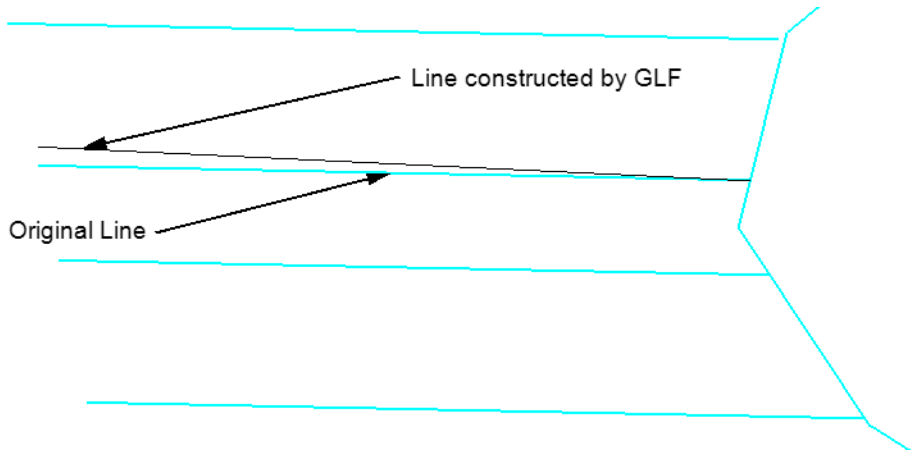
23. **<D>** the 'target" button for ***Start Elevation***, then **<T>** to the ramp landing line where it intersects the island outline and **<D>** to accept.

24. Key in ***5.00%*** (1:20) for the ***Longitudinal Slope***.

25. **<D> Apply**. Follow the prompts located in the lower left corner of the MicroStation window. Use the same line for the Primary and Secondary element. The illustration below lists the prompts and the action taken.



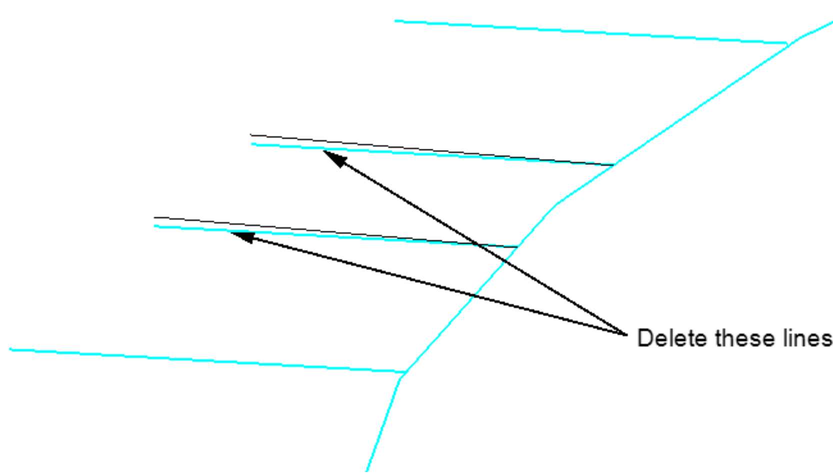
The illustration below shows the results of the ***Generate Longitudinal Feature*** command in a rotated view.



26. Repeat steps 23 through 25 for the remaining ramp landing lines (there are 5 more).

27. Rotate the view so the original ramp tread lines can be seen under the new lines.

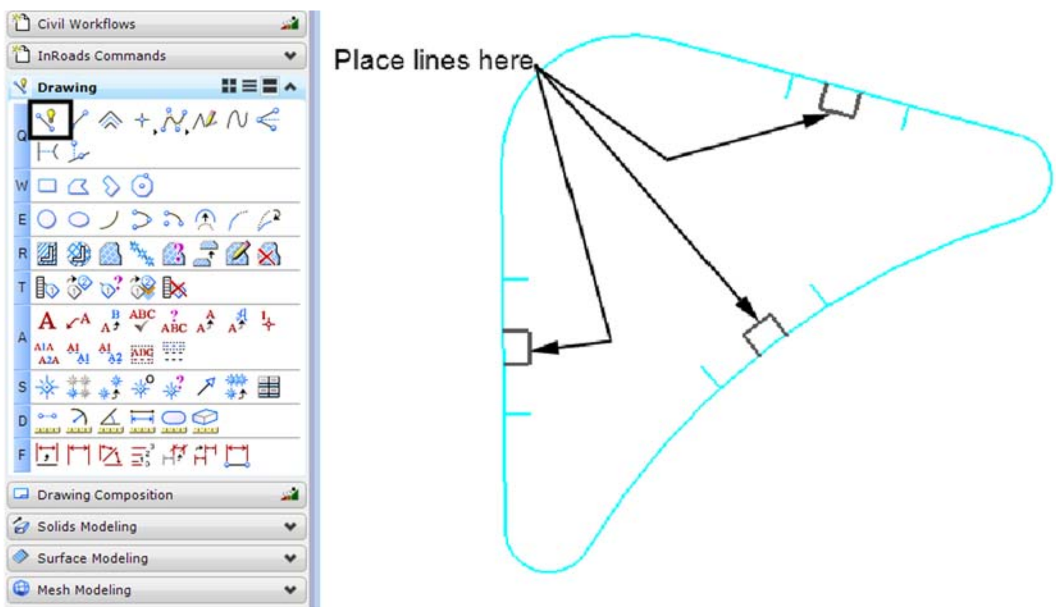
28. Delete the original ramp tread lines from each ramp.



29. Rotate the view back to a ***Top*** view.

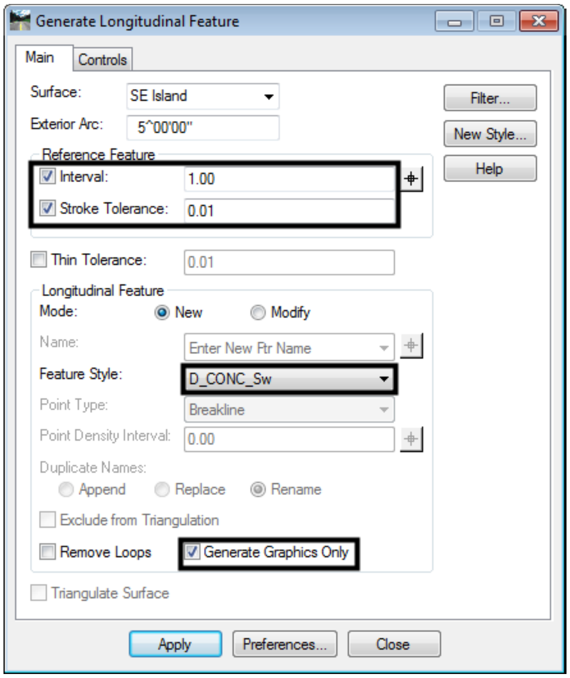
30. Select the MicroStation **Place Smartline** command.

31. Place a line connecting the back of each ramp tread line. Be sure to **<T>** to the end of each line so that the elevation of the new line will be correct.



Next, the generate longitudinal feature command is used to create the back of the pedestrian ramps.

32. From the InRoads main menu, select **Surface > Design Surface > Generate Longitudinal Feature**. The settings on the Main tab are the same as those set earlier.



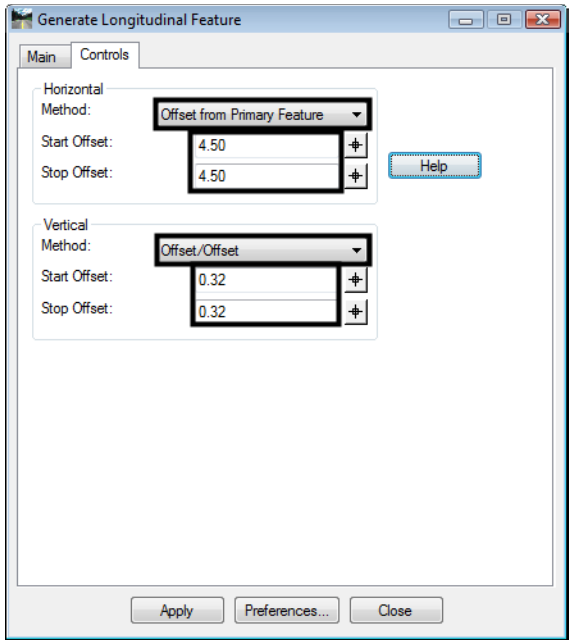
33. **<D>** the **Controls** tab.

34. In the ***Horizontal*** area, set the ***Method*** to **Offset from Primary Feature**.

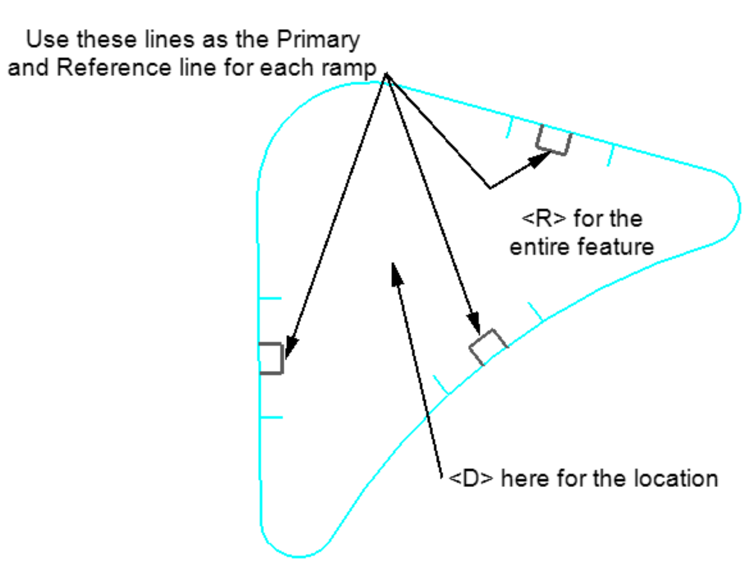
35. Key in ***4.50*** for the ***Start Offset*** and ***Stop Offset***. This is the minimum length for this section of the ramp according to the M & S Standard.

36. In the ***Vertical*** area, set the ***Method*** to **Offset/Offset**.

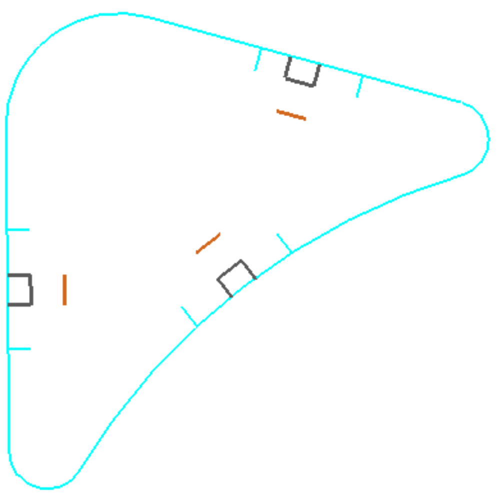
37. Key in ***0.32*** for the ***Start Offset*** and ***Stop Offset***. This is the difference in height from the end of the 20 to 1 tread slope to the top of the curb.



38. **<D> Apply**. Then follow the prompts. Use the ramp tread end line as the primary and reference element. **<R>** to use the entire line. **<D>** in the middle of the Island for the location.

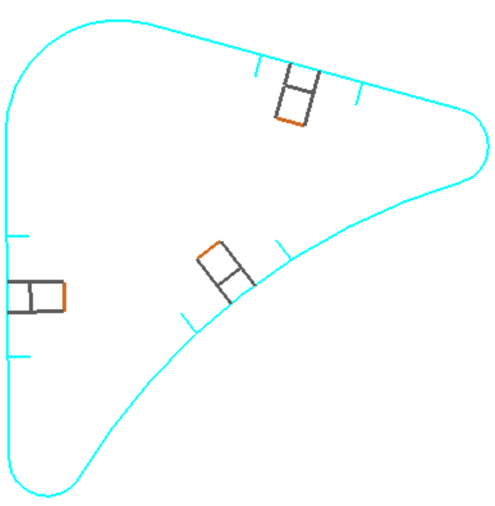


39. Repeat step 38 for each ramp. The illustration below shows the results. Dismiss the ***Generate Longitudinal Feature*** dialog box when finished.



40. Select the MicroStation **Place Smartline** command.

41. Place a lines to complete the sides of each ramp tread. Be sure to **<T>** to the end of each line so that the elevation of the new line will be correct. The illustration below shows the results.

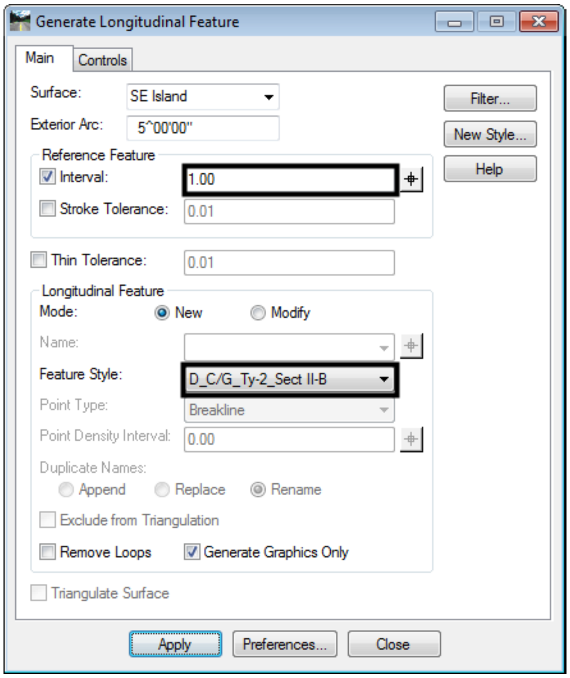


Next, elements defining the curb are added. The Generate Longitudinal Feature command is used for this.

42. From the InRoads main menu, select **Surface > Design Surface > Generate Longitudinal Feature**.

43. On the ***Main*** tab, key in ***1.00*** for the Interval.

44. Set the ***Feature Style*** to **D_C/G_Ty2_Sect II-B**. The other settings remain as set.



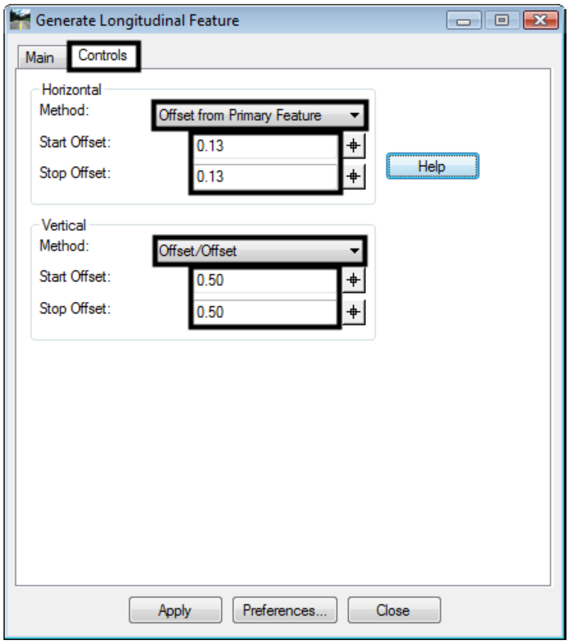
45. **<D>** the **Controls** tab.

46. Verify that the ***Horizontal Method*** is set to **Offset from Primary Feature**.

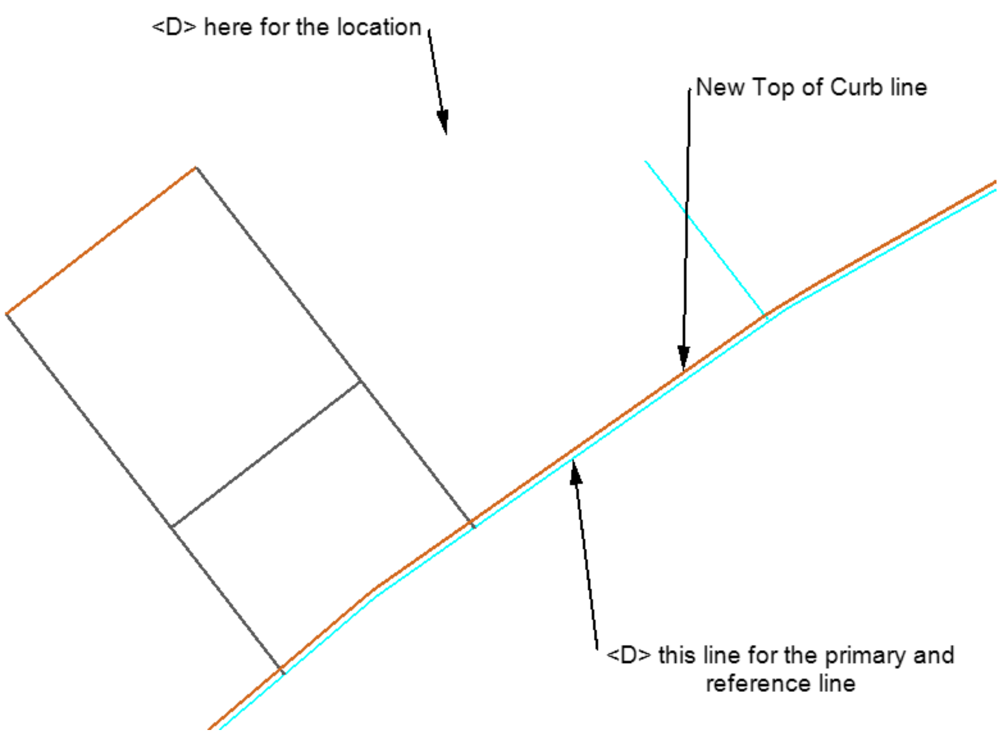
47. Key in ***0.125*** for the ***Start Offset*** and ***Stop Offset***. This is the horizontal distance from the gutter flowline to the top front of the curb according to the M & S Standard. Note: the entry will be rounded to 0.13 in the dialog box.

48. Verify that the ***Vertical Method*** is set to **Offset/Offset**.

49. Key in ***0.50*** for the ***Start Offset*** and ***Stop Offset***. This is the height of the curb.



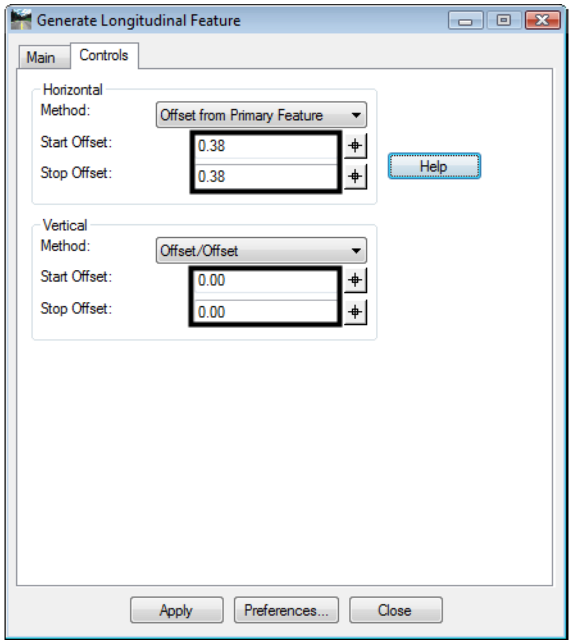
50. **<D> Apply**. Then follow the prompts. **<D>** an island outline element for the primary feature and use the same one for the reference feature. **<D>** in the middle of the Island for the location. The illustration shows an example of the results.



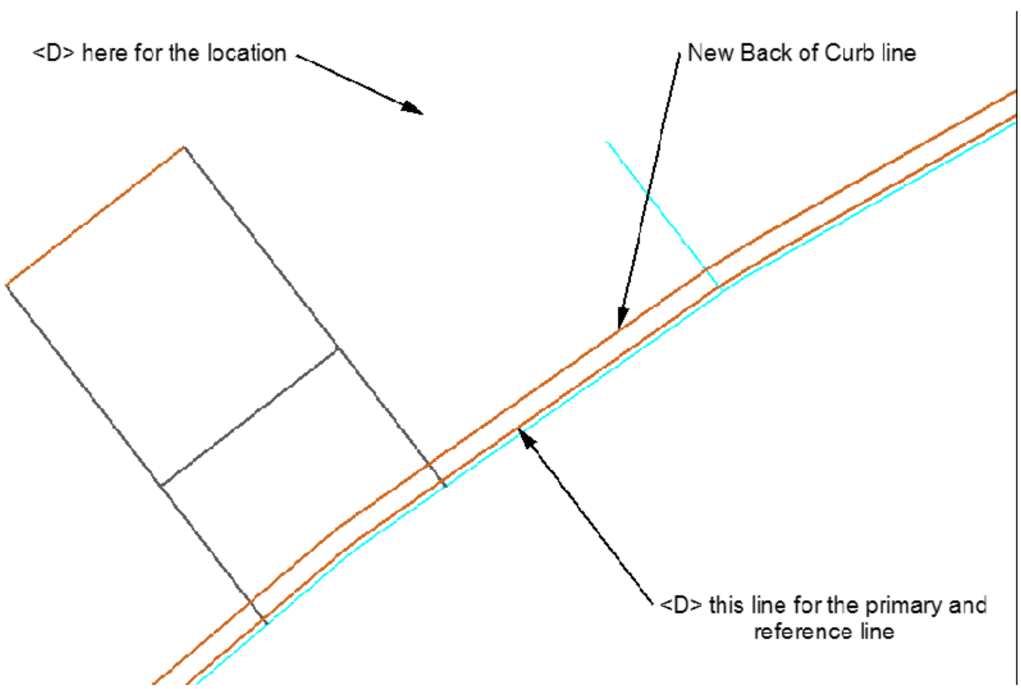
51. Repeat step 49 for each element in the island outline.

52. On the Generate Longitudinal Feature's ***Controls*** tab, key in ***0.375*** for the ***Horizontal Start Offset*** and ***Stop Offset***. This is the width of the curb top. Note: the entry will be rounded to 0.38 in the dialog box.

53. In the ***Vertical*** area, key in ***0.00*** for the ***Start Offset*** and ***Stop Offset***.



54. **<D> Apply**. Then follow the prompts. **<D>** a top of curb element for the primary feature and use the same one for the reference feature. **<D>** in the middle of the Island for the location. The illustration shows an example of the results.



55. **<D> Close** to dismiss the ***Generate Longitudinal Feature*** dialog box.

The final step, before importing the graphics into the surface is to modify the curbs and add the ramp wings. This includes partial deleting the top of curb lines in the area of the ramps and drawing lines for the wings.

56. Zoom in around one of the ramps so that the wing lines and each of the curb lines are visible.

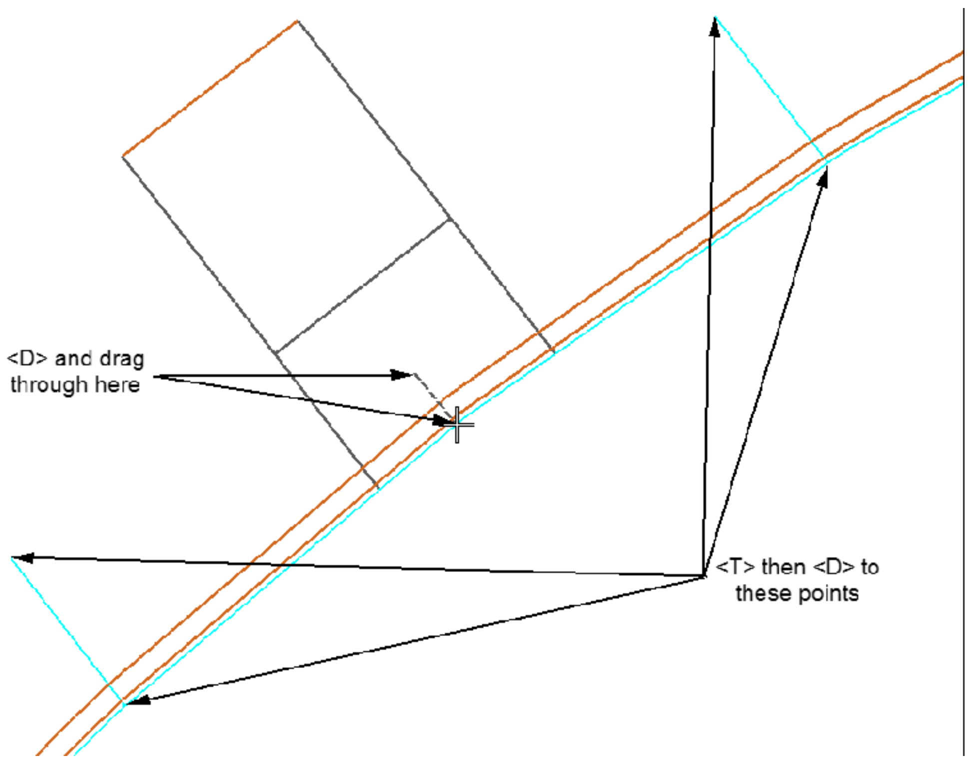
57. From the MicroStation main toolbar, select the **IntelliTrim** command.

58. In the tool settings dialog box, set the ***Mode*** to **Quick**.

59. Set the ***Operation*** to **Cut**.

60. **<T>** then **<D>** on the ends of each of the wing lines. This cuts the curb top lines in these locations.

61. **<D>** and **drag** through the curb top lines inside the ramp tread as shown in the illustration below.



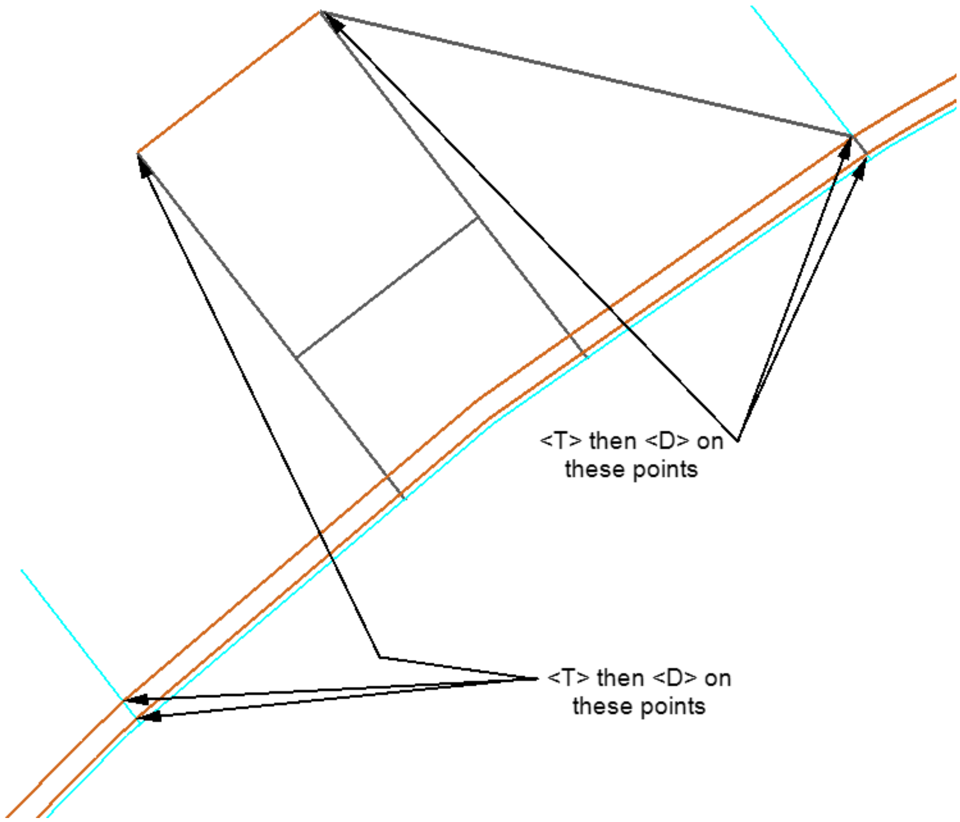
This has broken each of the curb top lines into four sections. The sections inside the ramp area will be modified after they are imported into the surface. Those outside will be left as is.

Next the lines representing the ramp wings are drawn.

62. From the MicroStation main toolbar, select the **Place SmartLine** command.

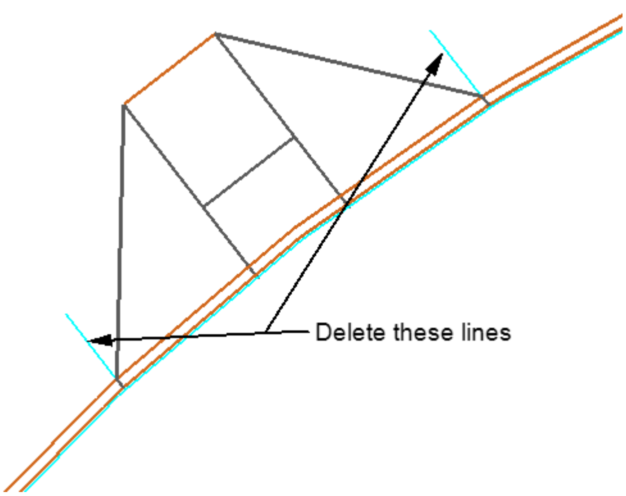
63. **<T>** then **<D>** to the points indicated in the illustration below.

Important! Be sure to snap to the curb top lines. Snapping to any of the line in this area will result in the wing being placed at the wrong elevation.

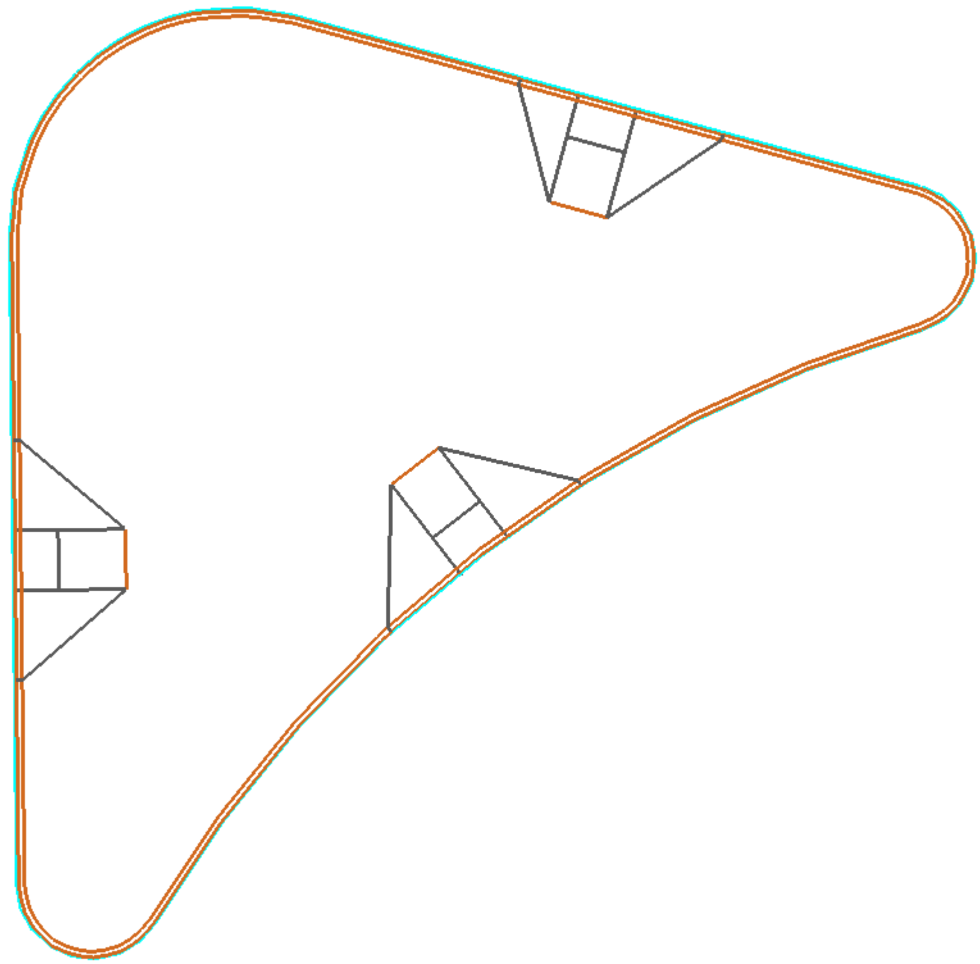


64. Select the MicroStation **Delete** command.

65. Delete the wing position lines.



66. Repeat steps 56 through 65 for the other two ramps. The illustration below shows the island and ramps completed to this point.



Section Summary:

- The InRoads Generate Longitudinal Feature command is used to provide elevation to graphic elements.
- When creating additional elements to be imported into a surface, snapping to elements at the proper elevation creates additional elements at the proper elevation.

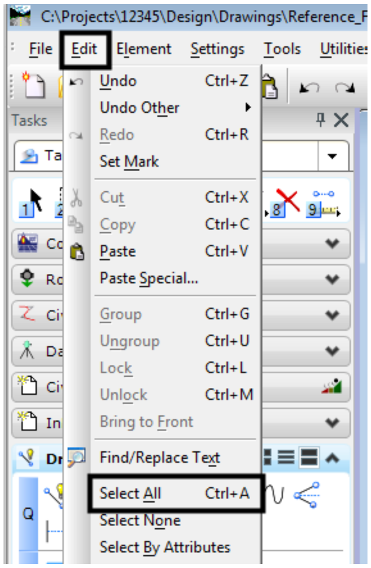
Lab 22.3 - Importing Graphics to Surface and Modifying Features

With the exception of the curb top lines inside the ramp areas, the graphic elements for creating the island surface are in place. In this section, the graphic elements are imported into a surface and InRoads tools are used to modify the curb features inside the ramp areas.

Section Objectives:

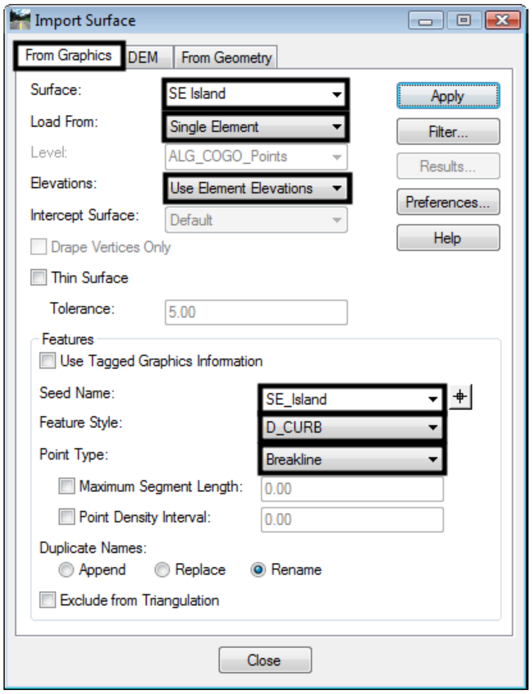
- Import Graphics to create a surface.
- Use Trim Feature to modify curb top features in the ramp areas.
- Use Edit Feature Point for the final cleanup of the curb top features.

1. Zoom out in the MicroStation view so that the entire Island can be seen.
2. On the MicroStation menu bar, select **Edit > Select All**. This highlights all of the elements in the drawing.



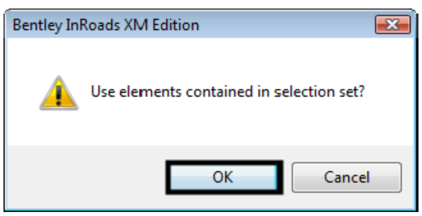
3. From the InRoads menu bar, select **File > Import > Surface**.
4. In the ***Import Surface*** dialog box, verify that the **From Graphics** tab is selected.
5. Select **SE Island** for the ***Surface***.
6. Verify that ***Load From*** is set to **Single Element**.
7. Verify that ***Elevations*** is set to **Use Element Elevations**.
8. In the ***Seed Name*** field, key in ***SE_Island***.
9. Set the ***Feature Style*** to **D_Curb**.

10. Verify that the ***Point Type*** is set to **Breakline**.



11. **<D> Apply**.

12. **<D> OK** on the "***Use elements contained in selection set?***" message window.

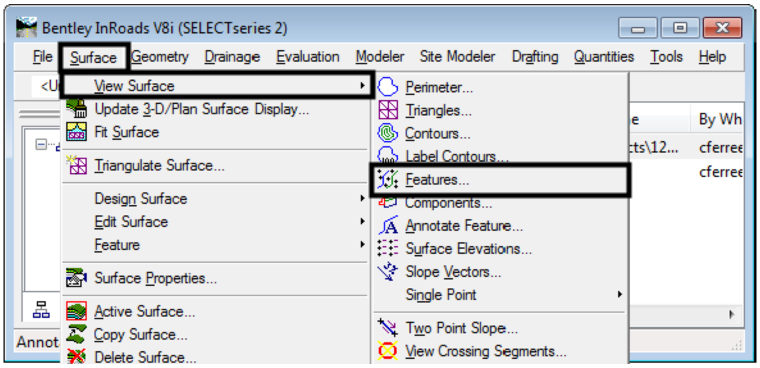


13. **<D> Close** to dismiss the ***Import Surface*** dialog box.

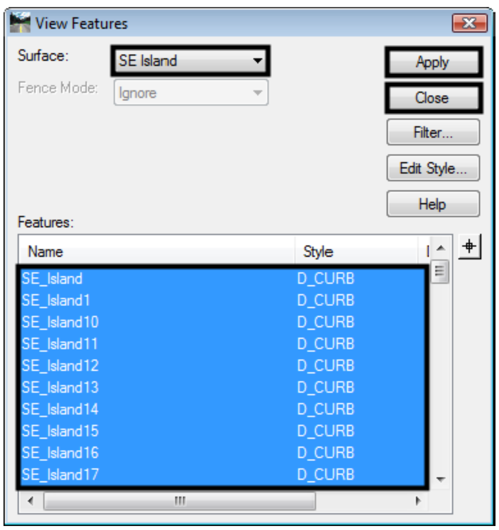
All of the graphic elements have been saved into the dtm (surface). The elements used to create the surface are deleted because they will be in the way when performing the next steps. The feature editing commands will automatically update displayed feature graphics but not the MicroStation elements originally used to create those features.

14. Select the MicroStation **Delete** command or press the **Delete** key to delete the graphic elements.

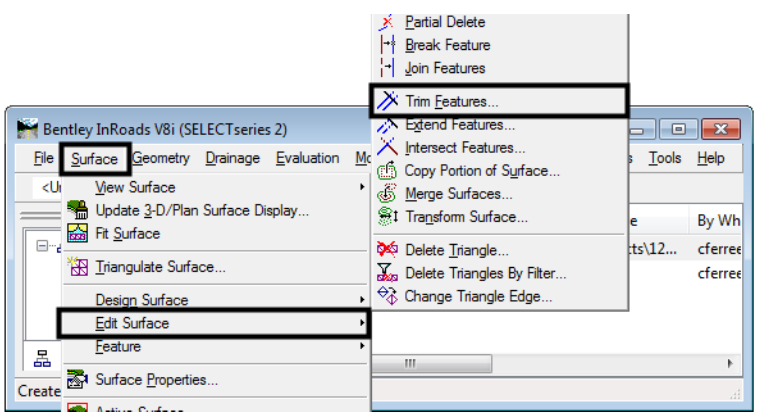
15. Select **Surface > View Surface > Features** from the InRoads menu bar.



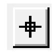
16. In the ***View Features*** dialog box, verify that the ***Surface*** is set to **SE Island**.
17. Verify that all of the features are highlighted.
18. **<D> Apply** then **<D> Close** to dismiss the ***View Features*** dialog box.



19. In the MicroStation view, zoom in on one of the ramps.
20. From the InRoads menu bar select **Surface > Edit Surface > Trim Features**.



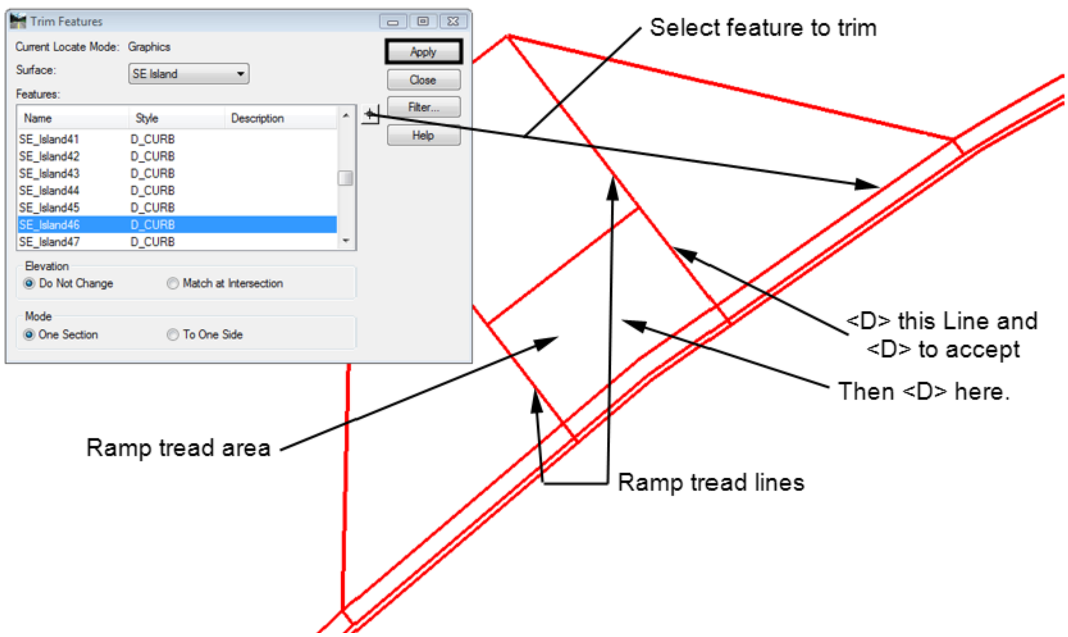
21. In the ***Trim Features*** dialog box, in the ***Elevation*** area, toggle on **Match at Intersection**.

22. **<D>** the target button  Then **<D>** the curb back line. This highlights that feature in the list.

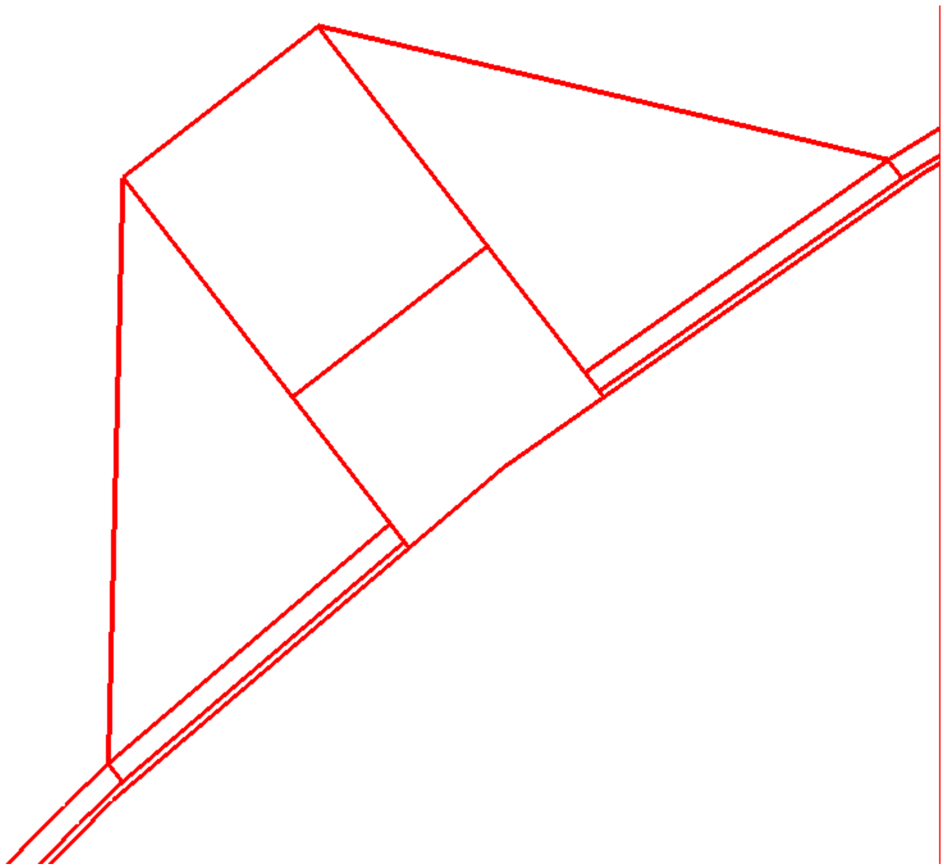
23. **<D> Apply** then **<D> to Accept**.

24. **<D>** the ramp tread line then **<D>** again to accept it.

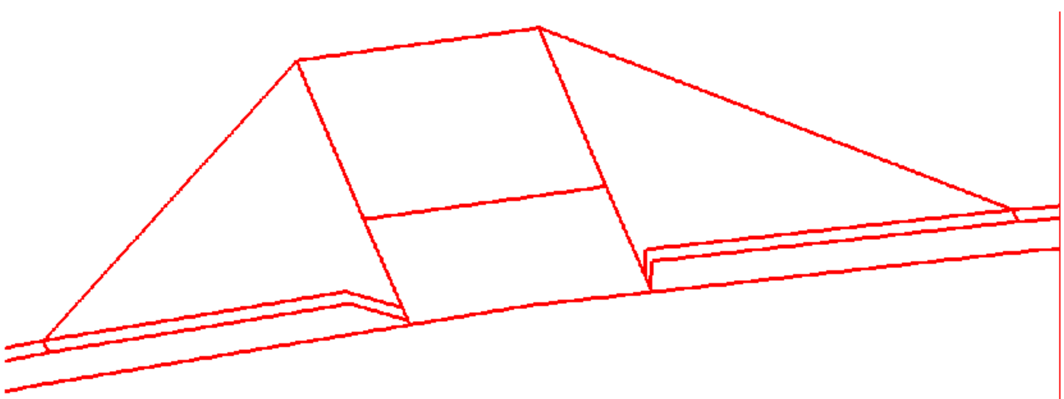
25. **<D>** inside the tread area to accept the command and trim the curb feature.



26. Repeat steps 22 through 25 for the other curb top features in the ramp area. The illustration shows the results.



In a rotated view, notice that the curb top lines do not slope consistently from the wing to the tread. This is because the Trim Feature command matches the elevation from the intersection of the features to the next vertex in the trimmed feature.



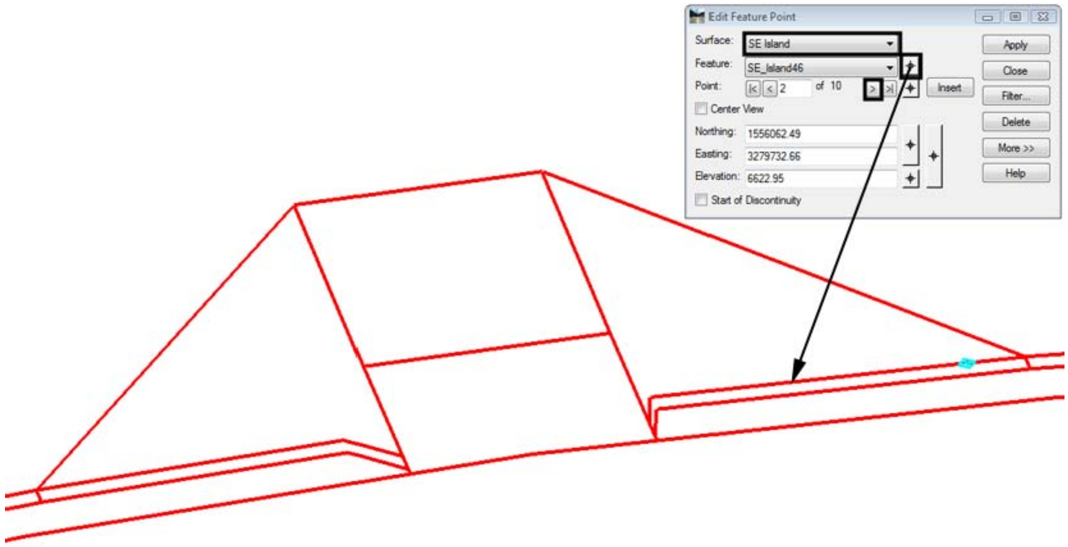
To correct this, the feature points between the beginning and end point are deleted.

27. From the InRoads menu bar, select **Surface > Edit Surface > Edit Feature Point**.

28. Verify that the ***Surface*** is set to **SE Island**.

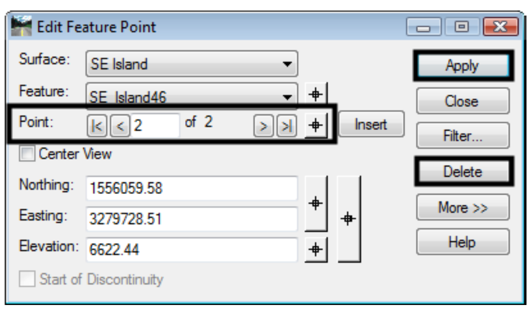
29. **<D>** the target button for ***Feature***, then **<D>** on the curb back line.

30. **<D>** the advance point button to select point **2** on the feature.

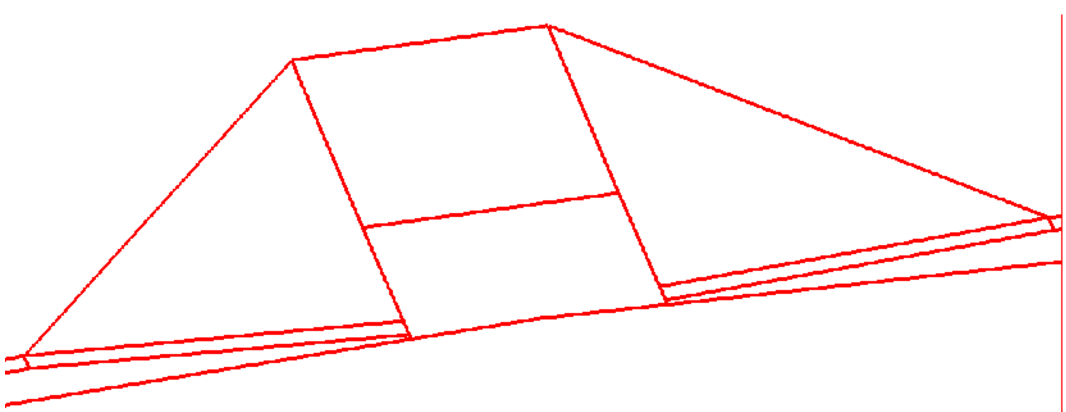


31. **<D>** the **Delete** button then **<D> Apply**.

32. Repeat step 31 until only two points are left in the feature.



33. Repeat steps 29 through 32 to the remaining curb top features within the ramp area. The illustration below shows a completed ramp.



34. Repeat steps 19 through 33 for the other two ramps.

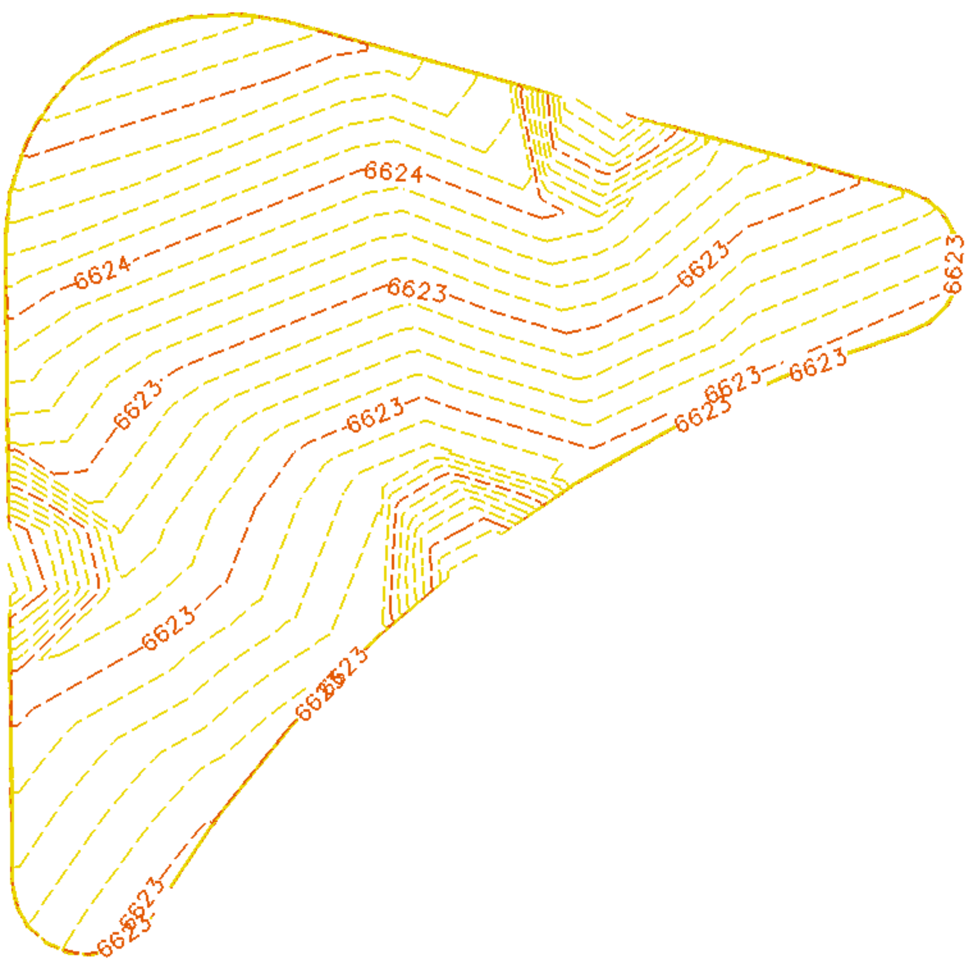
    Important! Be sure to rotate to a Top view when performing the Trim Feature command. This will make it easier to identify the trim location.

35. In the InRoads Explorer, **<R>** on **SE Surface** and select **Triangulate** from the right click menu.

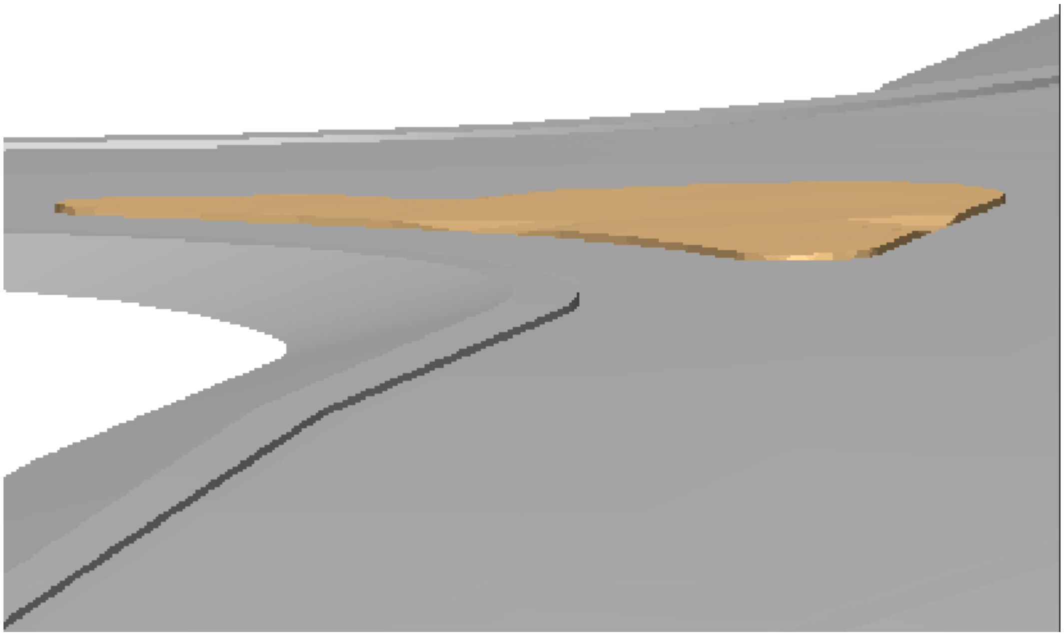
36. **<R>** on **SE Surface** and select **Save**.

37. Exit InRoads and MicroStation.

The illustration below shows the contours for the island.



Below is a rendering of the Island surface on the Intersection surface.



Section Summary:

- ♦ When importing graphic elements into a surface, if the elements are not selected ahead of time, each element can be given a unique name.
- ♦ Use the Trim Feature command in a top view. This helps when indicating which part of the feature to trim.
- ♦ Use the Edit Feature Point command to remove points from a feature. Delete Feature Point only works with Random points.

Chapter Summary:

- The island was created using MicroStation commands and InRoads surface editing commands.
- Because it was created as surface features only, there are no components in the island surface.
- The Drape Surface and Generate Longitudinal Feature commands were used to create graphic elements that were edited before they were imported into the surface.

LAB 23 - Modeling Around Bridge Abutments

Modeling the surface at the ends of a bridge can accomplished using a variety of tools. This lab illustrates a simple slope, but more complex slopes can be modeled using the same tools and methodologies. In general, you will be using InRoads tools to create breaklines that define the desired surface. For additional information on the tools used here as well as others, please see the ***Surface Editing*** chapter of the ***Practical Guide for Using InRoads XM***.

Chapter Objectives::

- Develop an understanding of modeling surfaces without templates.
- Learn how some of InRoads' Surface tools can create breaklines necessary for modeling surfaces at the ends of a bridge.

The following files are used with this lab:

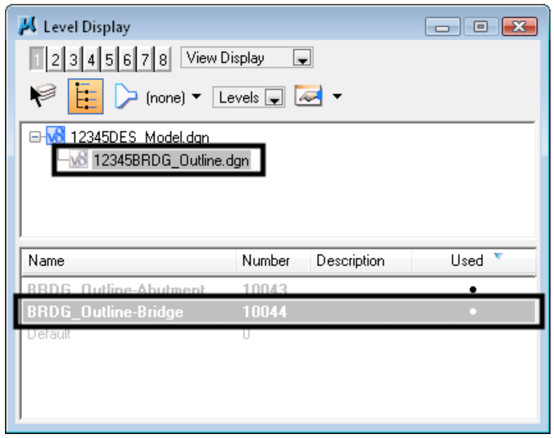
- C:\Projects\12345\Design\Drawings\Reference_Files\12345DES_Model.dgn
- C:\Projects\12345\Bridge\Drawings\Reference_Files\12345BRDG_Outline.dgn as a reference file
- C:\Projects\12345\Design\InRoads\12345 SH119 SH52 interchange.alg
- C:\Projects\12345\Design\InRoads\12345 SH52 71st intersection.dtm
- C:\Projects\12345\ROW_Survey\InRoads\DTM\12345 existing ground for interchange.dtm

Lab 23.1 - Create the Surface East of the Bridge

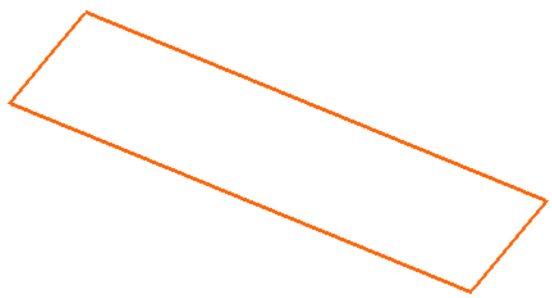
In this section, the design surface is used to create a smaller surface for the portion of the roadway East of the bridge. This surface will subsequently be used as the basis for the grading around the bridge abutment.

1. Open MicroStation and InRoads using the ***12345DES_Model.dgn*** file.
2. Delete in existing graphics in the file.
3. Select **File > Open** from the InRoads menu.
4. Navigate to the ***C:\Projects\12345\Design\InRoads*** folder.
5. Open the following files:
    - **C:\Projects\12345\Design\InRoads\12345 SH52 71st intersection.dtm**
    - **C:\Projects\12345\Design\InRoads\12345 SH119 SH52 interchange.alg**
    - **C:\Projects\12345\ROW_Survey\InRoads\DTM\12345 existing ground for interchange.dtm**
6. Select **File > Reference** from the MicroStation menu.
7. Select **Tools > Attach**.
8. Select ***C:\Projects\12345\Bridge\Drawings\Reference_Files\12345BRDG_Outline.dgn***.
9. **<D> OK** to accept the default reference settings.

10. In the ***Level Display*** dialog box, toggle on the reference file level ***BRDG_Outline-Bridge.***

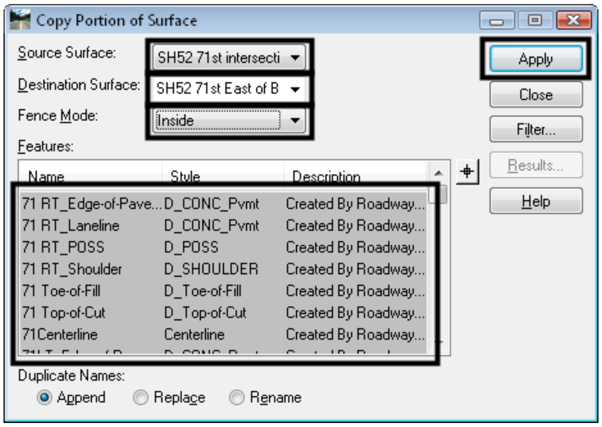


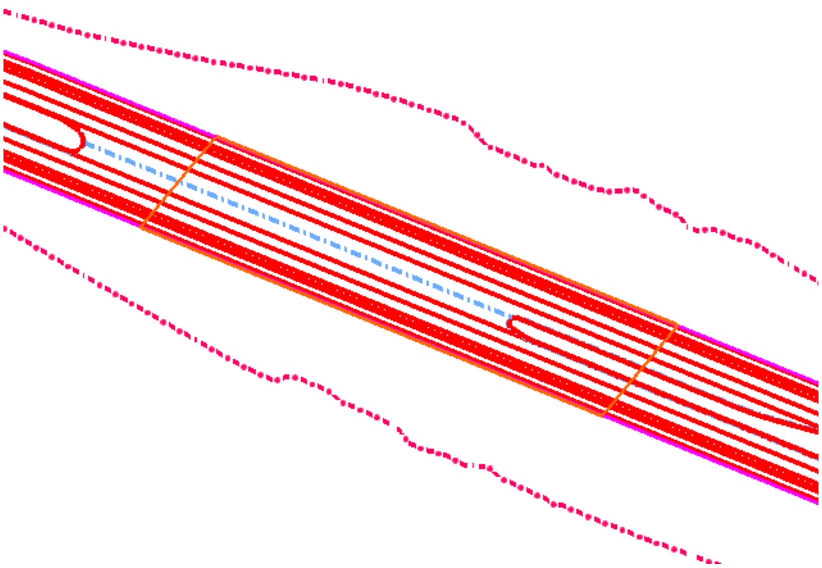
11. ***Fit*** the view. An outline of the proposed bridge is shown in the file.



12. Set the ***Pen/Pencil*** lock to **Pencil.**
13. Select **Surface > Update 3D/Plan Surface Display** from the InRoads main menu.
14. **<R>** in the ***Features*** list box and choose **Select All** from the menu. This displays the selected features.

15. **<D> Close**.



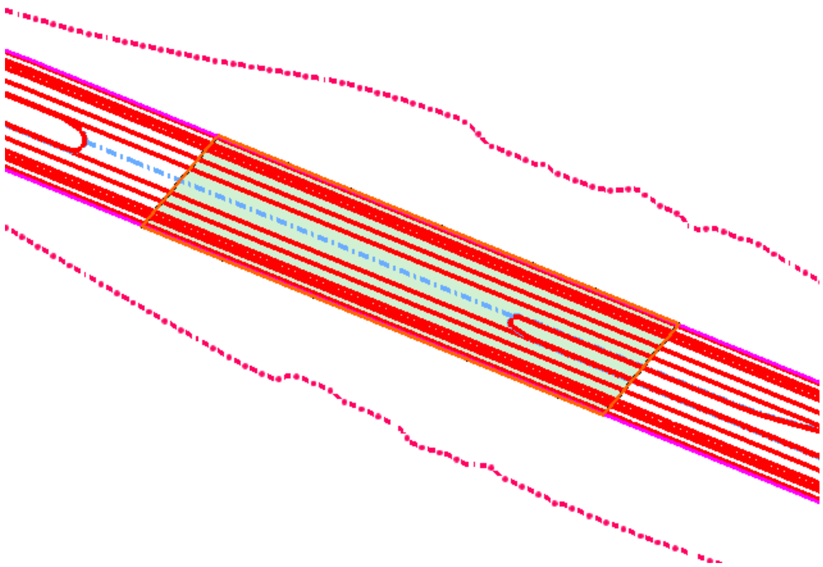


All of the features are shown in the file.

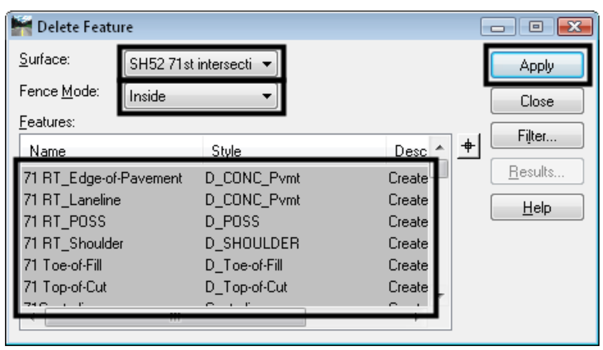
16. On the MicroStation main toolbar, select **Place Fence**.

17. In the ***Tool Settings*** dialog box, change the ***Fence Type*** to **Element**.

18. **<D>** on the bridge outline in the design file.

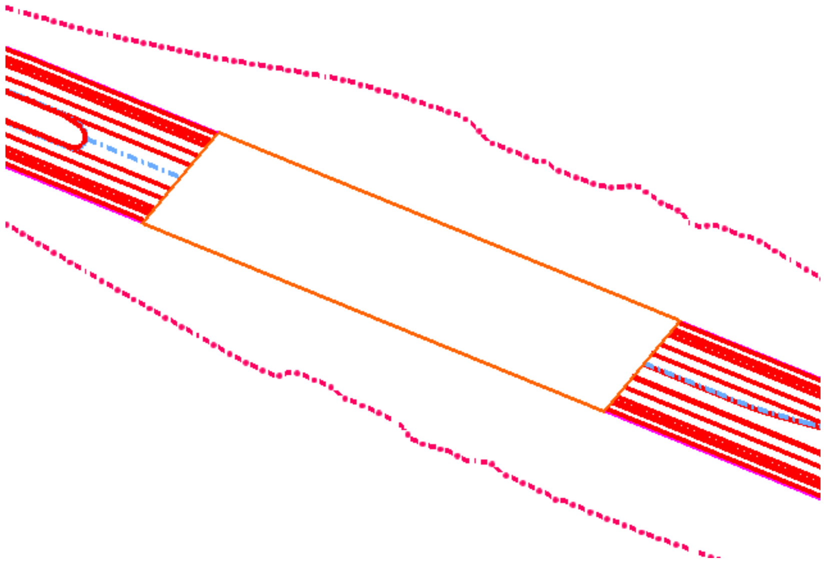


19. Select **Surface > Edit Surface > Delete Feature** from the InRoads main menu.
20. Set the ***Surface*** to **SH5271st Intersection**.
21. Set the ***Fence Mode*** to **Inside**.
22. **<R>** in the feature list and select **Select All**.

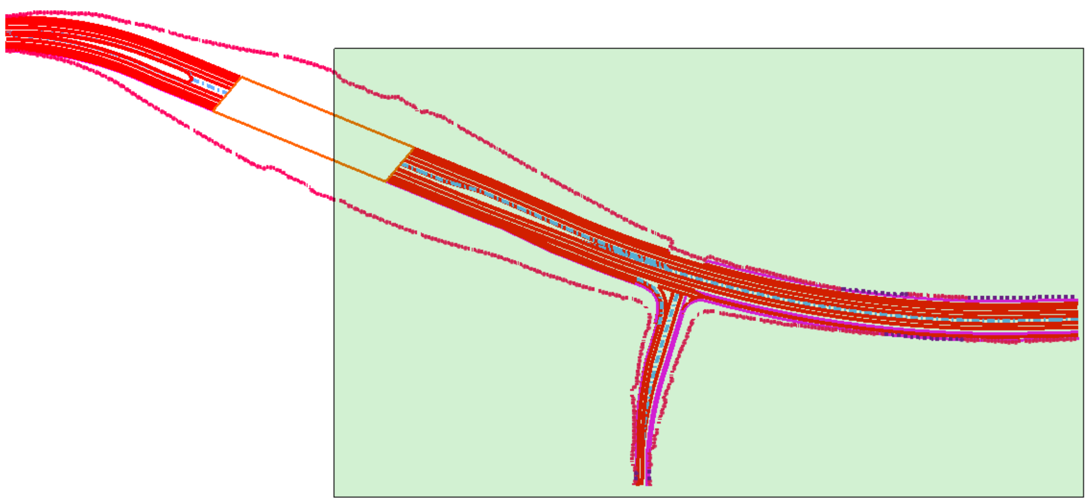


23. **<D> Apply**.
24. When prompted to ***Delete selected feature(s)***, select **OK**.
25. **Close** the dialog box.
26. Clear the fence.

The features inside the bridge outline are removed from the surface. Next, the features on the East side of the bridge are copied to create a new surface.

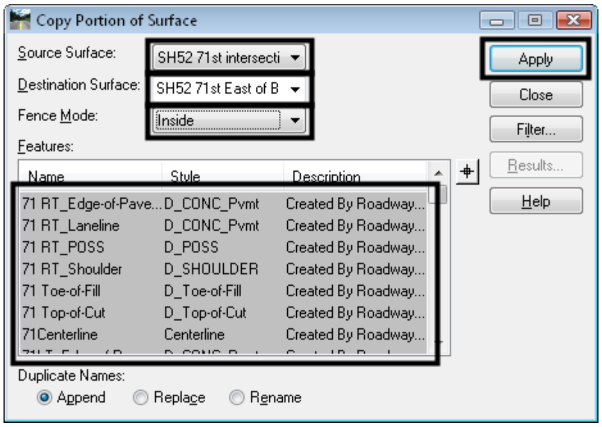


27. Select **Place Fence**.
28. In the ***Tool Settings*** box, change the ***Fence Type*** to **Block**.
29. Place a fence that encompasses all features East of the bridge as shown.



30. Select **Surface > Edit Surface > Copy Portion of Surface**.
31. Set the ***Surface*** to **SH52 71st intersection**.
32. Key in ***SH52 71st East of Bridge*** for the ***Destination Surface***.
33. Set the ***Fence Mode*** to **Inside**.

34. If all Features are not highlighted, **<R>** in the feature list and select **Select All**.



35. **<D> Apply**, then **Close** the dialog box.

36. Choose **File > Save As**.

37. Set the ***Save As Type*** to **Surfaces (*.dtm)**.

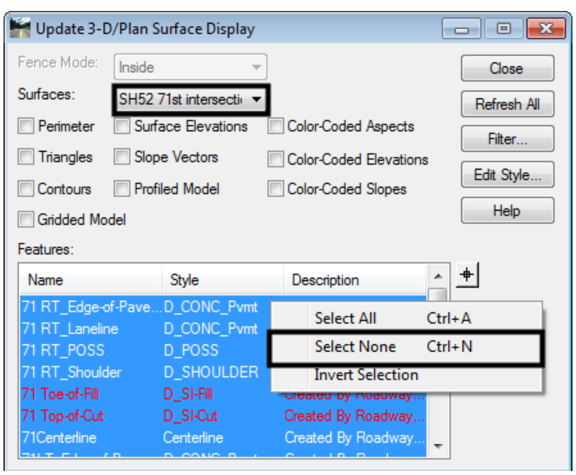
38. Use the drop-down to set the ***Active Surface*** to **12345 SH52 71st East of Bridge**.

Note: If the file name is not listed, use the drop-down again to select the active surface and the same name will appear in the ***Name*** field. You can then add the 12345 prefix to the file name on the hard drive.

39. **<D> Save**.

40. Select **Surface > Update 3D/Plan Surface Display**.

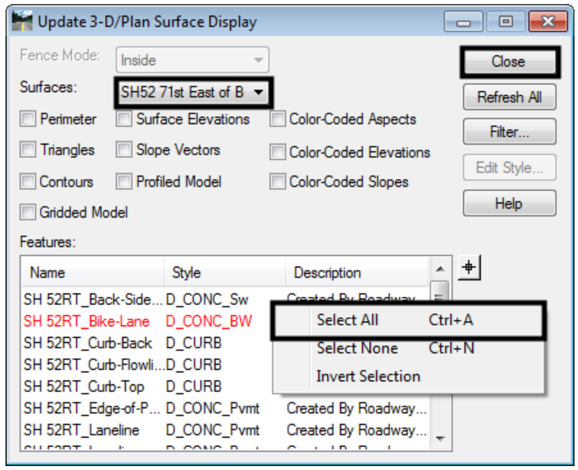
41. **<R>** in the feature list and choose **Select None**.

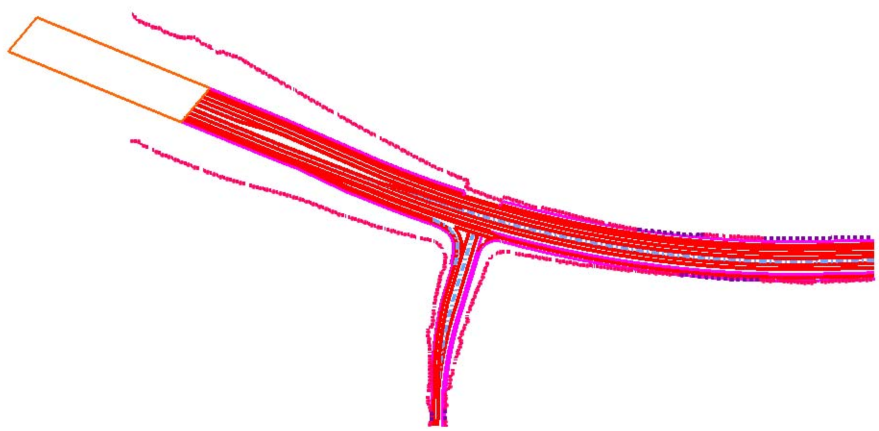


42. Select the **SH52 71st East of Bridge** surface from the ***Surfaces*** drop down menu.

43. **<R>** in the ***Features*** list box and choose **Select All** from the menu. This displays the selected features

44. **<D> Close**





Note: If there are any features in the area where the bridge was clipped, these shoud be deleted. Use the Surface > Edit Surface > Delete Feature command to remove these extra features.

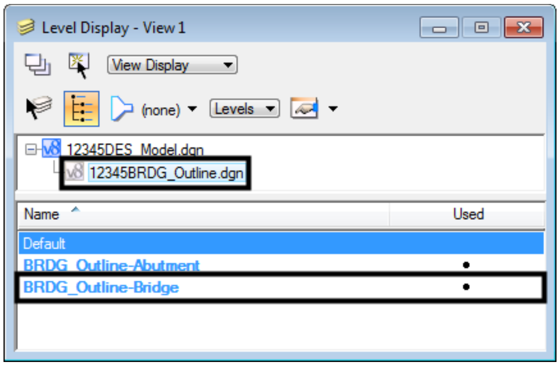
Section Summary:

- A fence and the Delete Feature command are used to remove the design features from the bridge area.
- The design features on the east side of the bridge are saved as a separate surface. Design surfaces for each side of the bridge are required otherwise InRoads will triangulate the across the gap made for the bridge

Lab 23.2 - Create a Feature at the Bridge

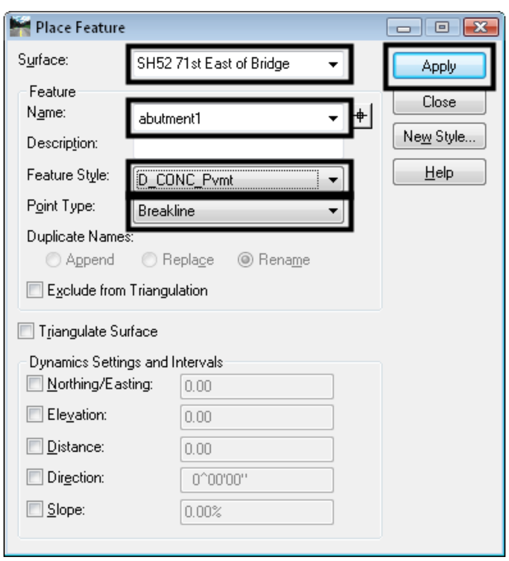
In this section, a breakline feature is created to ‘cap’ the end of the roadway features where the bridge starts.

1. In the ***Level Display*** dialog box, toggle off the reference file level **BRDG_Outline-Bridge**.



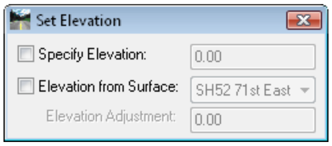
This line represents the path for the path that is used to create the abutment slope.

2. Select **Surface > Design Surface > Place Feature**.
3. Set the ***Surface*** to **SH52 71st East of Bridge**.
4. Key in ***abutment1*** for the **Feature Name**.
5. Key in a description if desired.
6. Set the ***Feature Style*** to **D_CONC_Pvmt.**
7. Set the ***Point Type*** to **Breakline**.

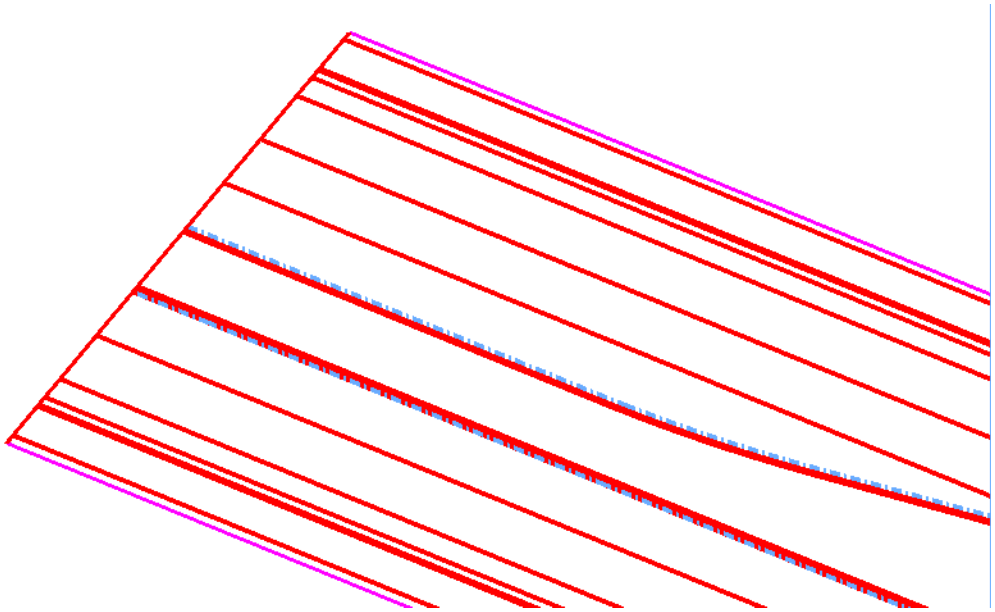


8. **<D> Apply**.

9. ***Do not*** toggle on either option on the ***Set Elevation*** dialog box that appears.



10. Snap to the end of each of the roadway features from POSS to POSS as shown.



Note: If you want to use ***AccuSnap***, hold down your <***Ctrl***> and <***Shift***> keys and MicroStation's AccuSnap works while using InRoads commands.

11. **<R>** when done.

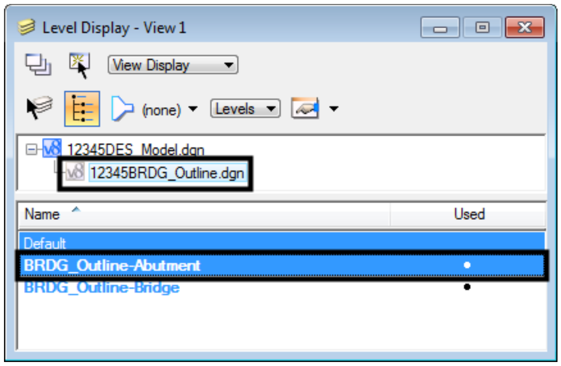
Section Summary:

- This feature defines the end of roadway/beginning of bridge in the design surface

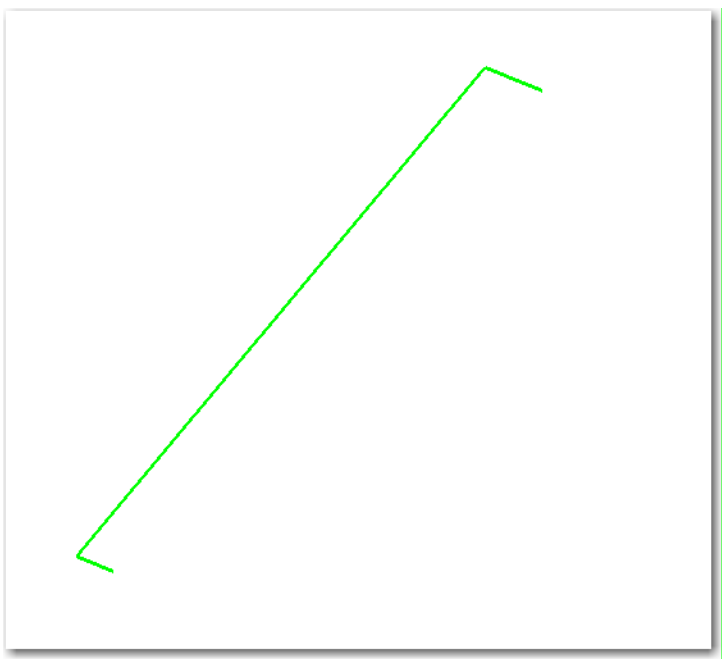
Lab 23.3 - Create the Grading Surface

In this section, the ***Generate Sloped Surface*** command is used to create a grading surface from the roadway down to the existing ground, effectively under the bridge.

1. In the ***Level Display*** dialog box, toggle on the reference file level **BRDG_Outline-Abutment**.



A green line displays that wraps around the edge of the roadway. This is the line from which the sloped surface is generated. It was created in a similar manner as the feature built in the last section, with the addition of the segments running parallel to the road. These additional segments allow the sloped surface to wrap around the entire front of the roadway.



2. Select **Surface > Design Surface > Generate Sloped Surface**.

3. Make sure the ***Locate Feature / Locate Graphics*** lock is set to **Locate Graphics**.

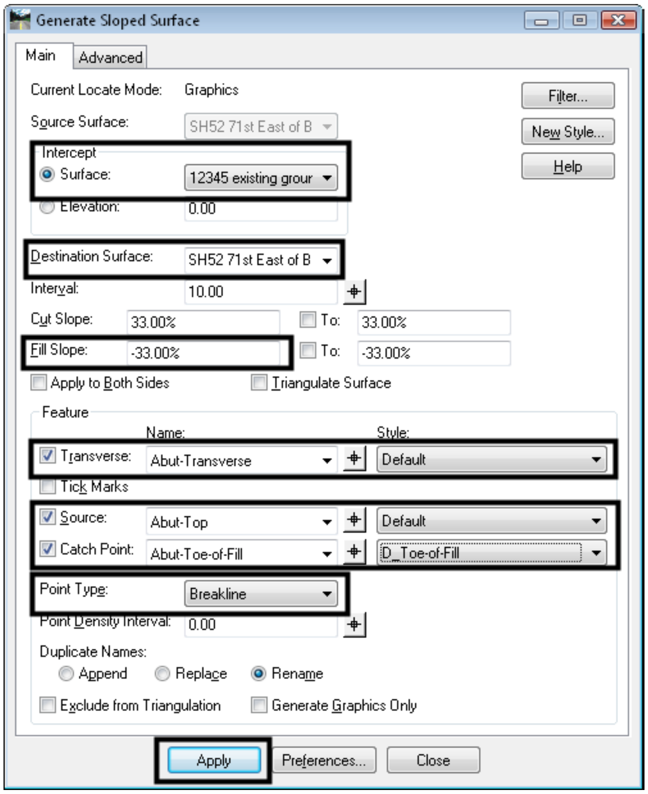
4. Set the ***Intercept Surface*** to **12345 existing ground for interchange**.

5. Set the ***Destination Surface*** to **SH52 71st East of Bridge**.

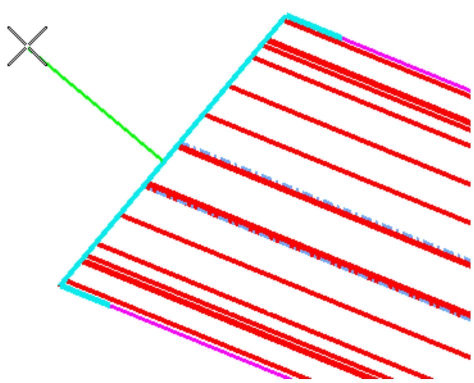
6. Set the other options as shown in the illustration below. Be sure to toggle on and key in the feature names for the following:

   - ***Transverse*** - ***Abut-Transverse***

- *Source* - ***Abut-Top***
- *Catch Point* - ***Abut-Toe-of-Fill***



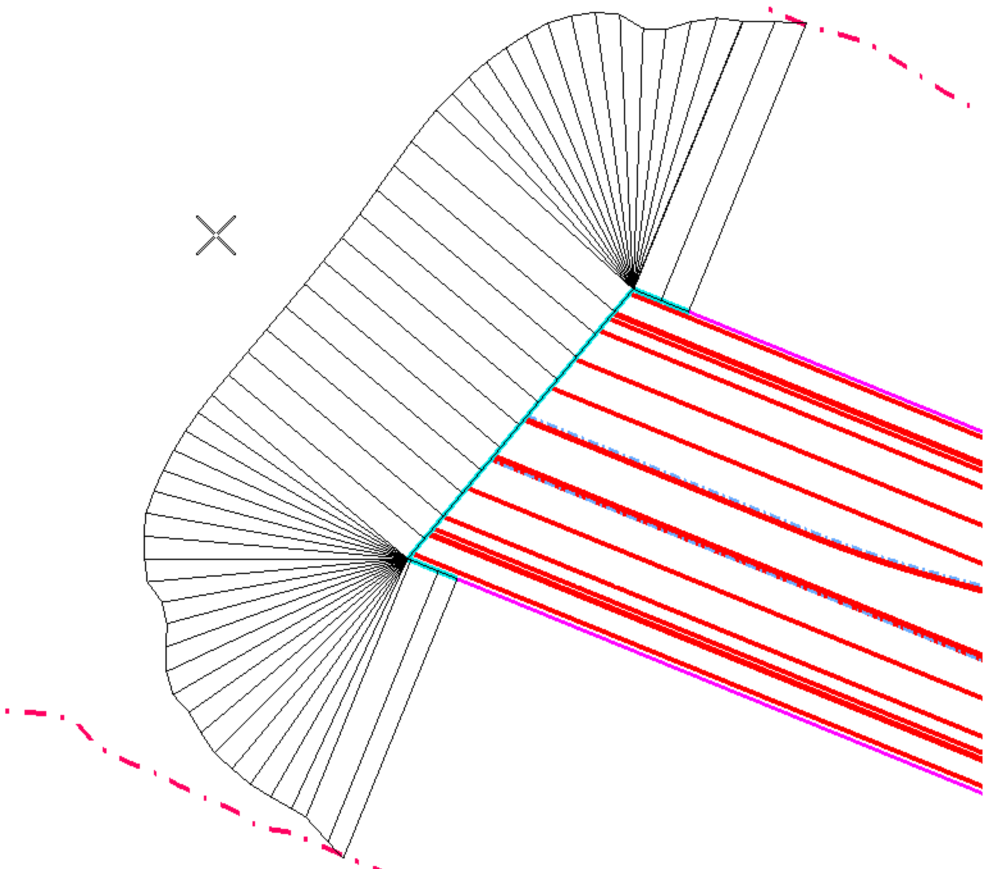
7. **<D> Apply**.
8. **<D>** to select the green line at the edge of the roadway.
9. **<D>** again to accept the line.



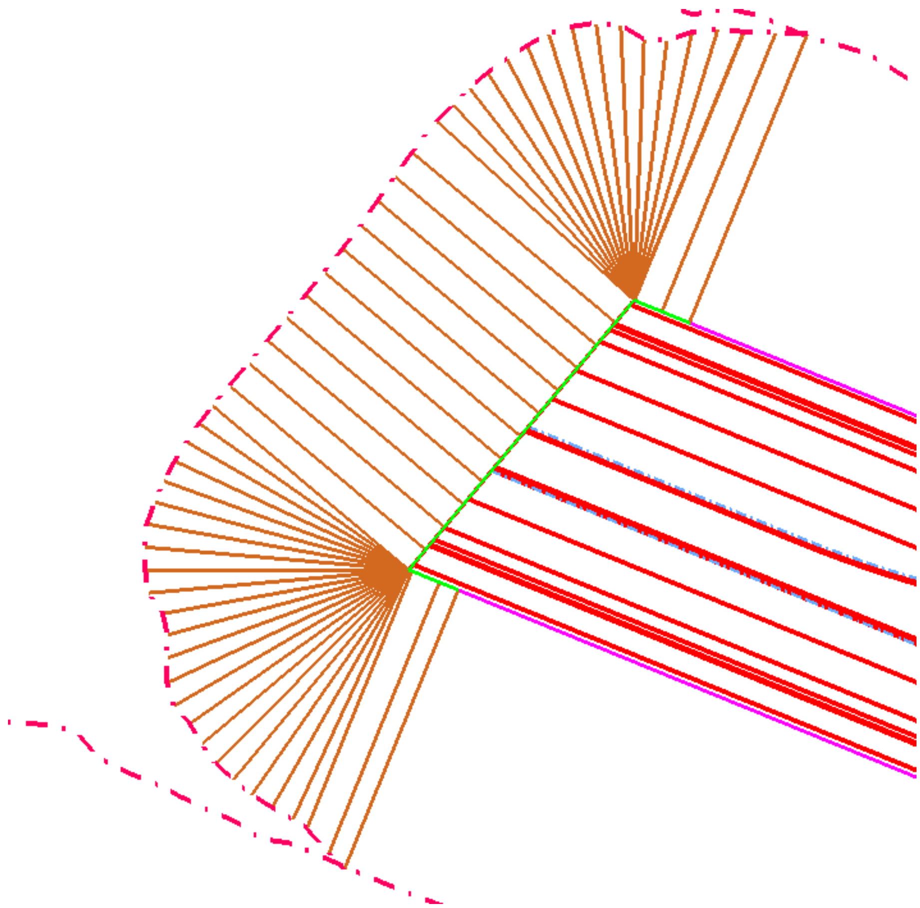
10. **<R>** to Reset for entire line.

The ***Generate Sloped Surface*** command can be used to create a slope from just a portion of the line, which is why the prompts allow specifying a ***Start*** and ***End*** location. Here, an **<R>** is used, since the slopes need to be created for the entire source line.

11. Move your cursor to the left of the line until you see the sideslopes form.



12. **<D>** to Accept the location.

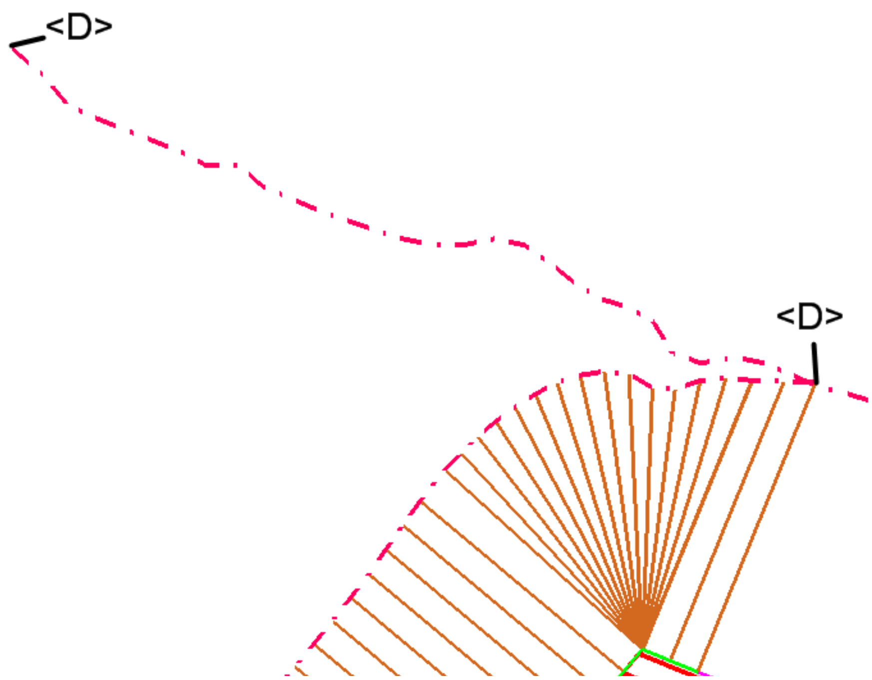


13. **<R>** to exit the command.
14. **<D> Close** to dismiss the dialog box.
15. Save the Surface.
16. Select **Surface > Edit Surface > Partial Delete** from the InRoads main menu.

    Note: ***Partial Delete*** is used just like the MicroStation ***Partial Delete***, except it works on features. Here it is used to clean up the toes of slope that extend beyond the sloped surface.

17. **<D>** on the Toe-of-Fill on the North side of the roadway to select it as the feature to partial delete.

18. **<D>** on the left end to identify the ***Start Point***, then again where the new toe and old toe come together as shown for the ***End Point***.

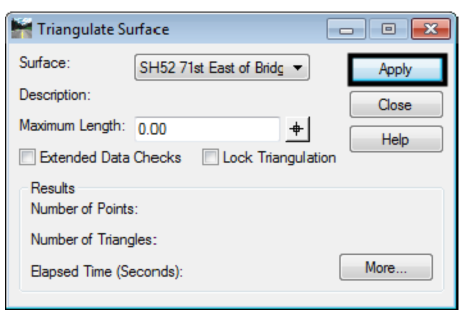


19. Repeat for the Toe-of-Fill on the South side of the roadway.

Note: You may want to toggle off ***Line Styles*** under **Settings > View Attributes** to see the ends of the lines more clearly.

20. Save the Surface.

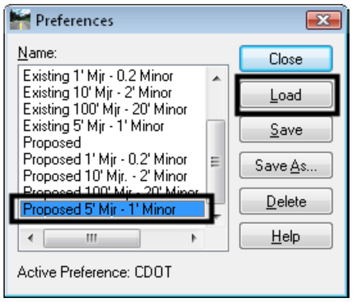
21. Select **Surface > Triangulate Surface**.



22. **<D> Apply** then **Close**.

23. Select **Surface > View Surface > Contours**.

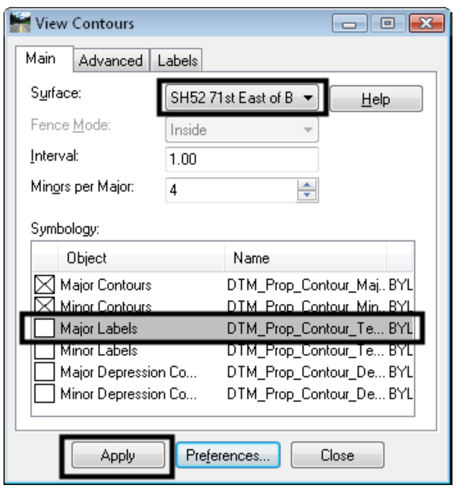
24. **<D> Preferences** and highlight ***Proposed 5' Mjr – 1' Minor***.



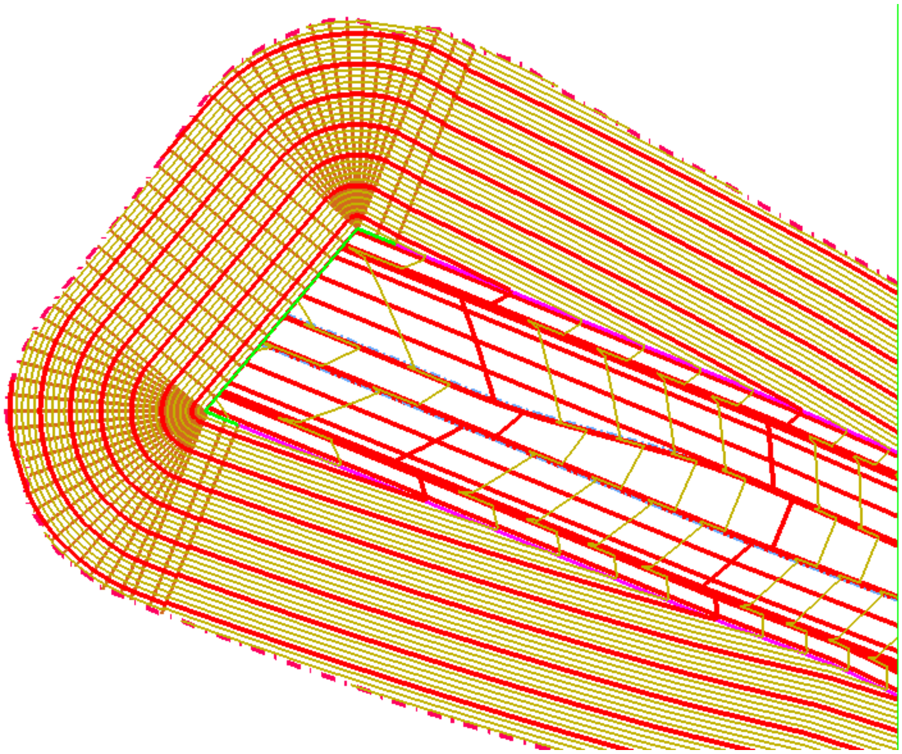
25. **<D> Load**, then **Close**.

26. Set the ***Surface*** to ***SH52 71st East of Bridge***.

27. Toggle off ***Labels*** if desired.



28. **<D> Apply** to see the contours.



29. **<D> Close**.

30. Close InRoads and MicroStation.

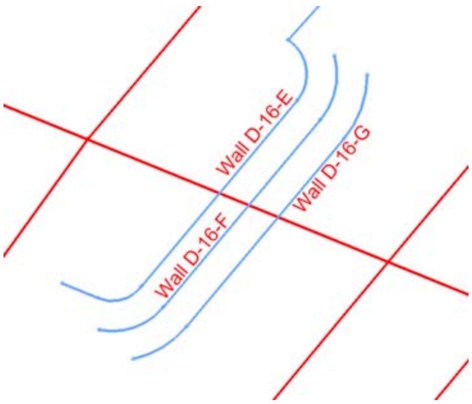
Chapter Summary:

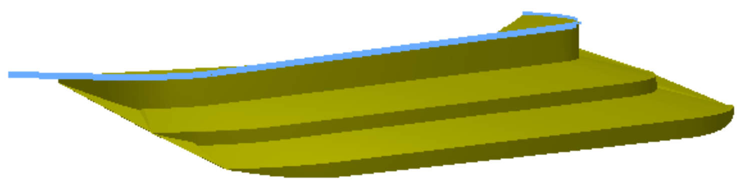
- The ***Design Surface*** and ***Edit Surface*** tools can be used to modify existing surfaces and add to them as necessary to accomplish your design model.
- Modeling the ends of a bridge can be accomplished using a base model of the roadway, and adding features to define the desired surface.

LAB 24 - Terraced Walls

This lab covers how to use Surface Design and Editing tools to create a terraced wall under a bridge. For more information on the commands shown here, please see the ***Surface Editing*** chapter of ***A Practical Guide for Using InRoads V8i (SELECTseries 2)***.

In this scenario, three terraced walls are to be used under the SH52 bridge over SH119. Horizontal alignments have already been defined for the three walls along with verticals for the tops of the walls. A template will be created and run along the top wall to seek the other two walls and create the slopes between them.





Chapter Objectives::

- To learn to use additional Surface Design tools.
- To expand your knowledge of templates by creating a special case terraced wall template.
- To learn how to use templates without setting up a corridor in Roadway Designer.

The following files are used for this lab:

- C:\Projects\12345\Design\Drawings\Reference Files \12345DES_Model.dgn
- C:\Projects\12345\ROW_Survey\InRoads\DTM\12345 existing ground for interchange.dtm
- C:\Projects\12345\Design\InRoads\12345 SH119.dtm
- C:\Projects\12345\Design\InRoads\12345 SH52.dtm
- C:\Projects\12345\Design\InRoads\12345 SH119 SH52 interchange.alg
- C:\Projects\12345\Design\InRoads\12345DES_Templates.itl

Lab 24.1 - Open Data Files

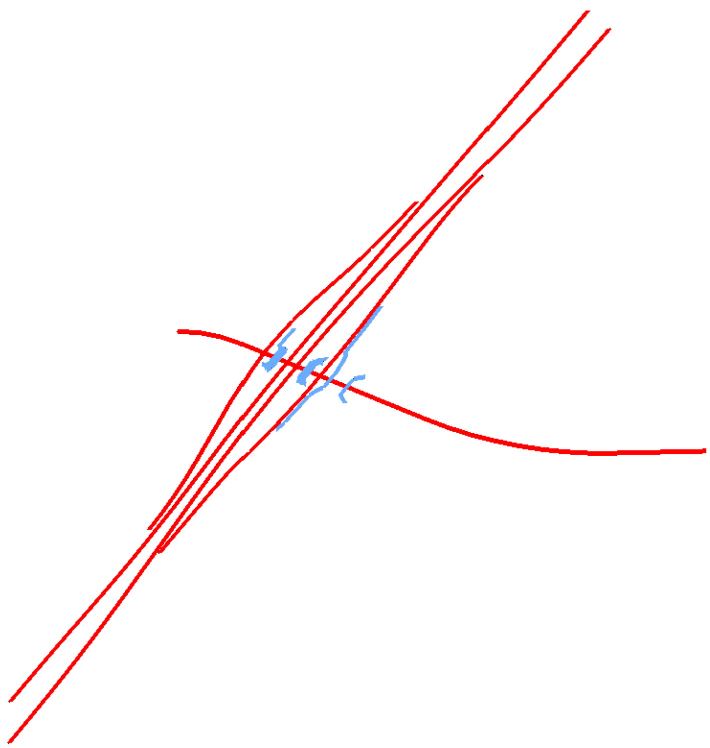
1. Open MicroStation and InRoads using the ***C:\Projects\12345\Design\Drawings\Reference Files \12345DES_Model.dgn*** file.
2. Delete any graphic elements in the file.
3. Verify the correct ***XIN*** file is loaded.
4. Select **File > Open** from the InRoads menu.
5. Open ***C:\Projects\12345\Design\InRoads\12345 SH119.dtm***, ***12345 SH52.dtm***, ***12345DES_Templates.itl*** and ***12345 SH119 SH52 interchange.alg***.

6. Open ***C:\Projects\12345\ROW_Survey\InRoads\DTM\12345 existing ground for interchange.dtm***.

Lab 24.2 - Create Components for the Wall and Slope

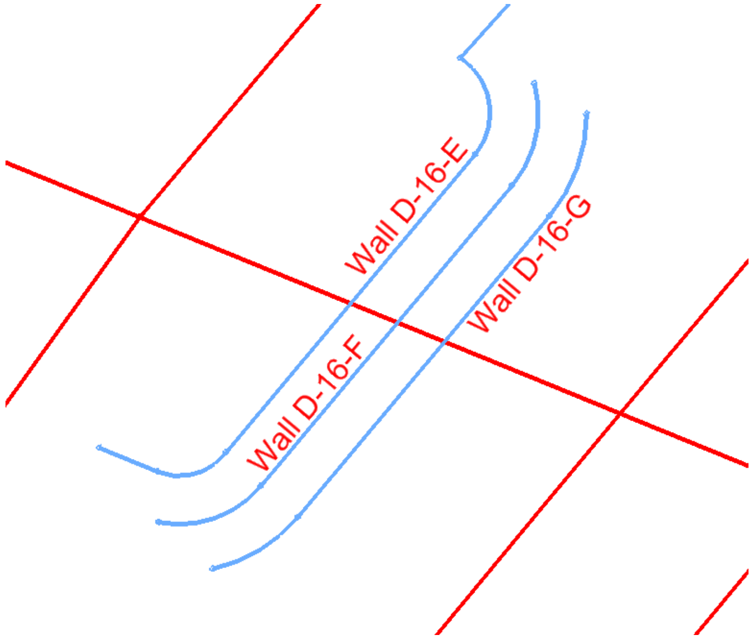
The three walls are very similar and therefore one set of components can be created and used multiple times in the final template. To start, components are created that will be run off of Wall D-16-E and will 'find' or 'target' Wall D-16-F. This is used in areas where there is a terrace.

1. **Delete** any MicroStation graphics currently in the design file.
2. Select **Geometry > View Geometry > All Horizontals**.
3. **Fit** the view.



4. Window around the terraced wall area to the left of SH119.

Note: The wall names in the illustration below are for information only. The walls are not labeled in your file.

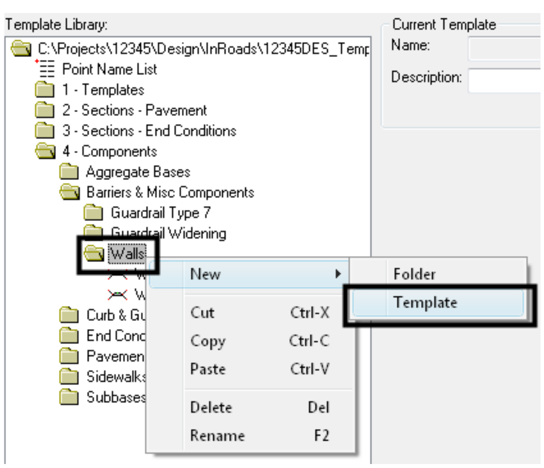


Note: Walls ***D-16-E***, ***D-16-F*** and ***D-16-G*** will be created using a terraced wall template.

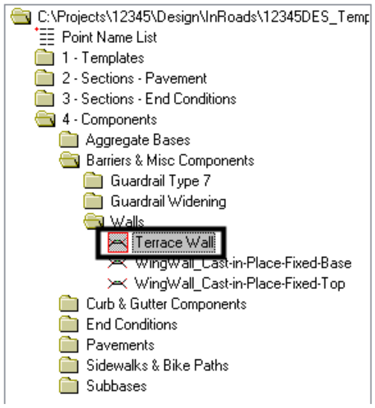
5. Select **Modeler > Create Template**.
6. Verify the template library is ***12345DES_Templates.itl***.

   Note: Since there is no similar template to the one needed, a new one is created.

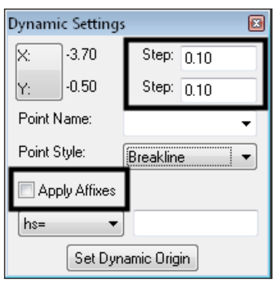
7. Expand the library folder structure for ***Components*** > ***Barriers & Misc Components*** > ***Walls***.
8. Right-click on the ***Walls*** folder and select **New > Template**.



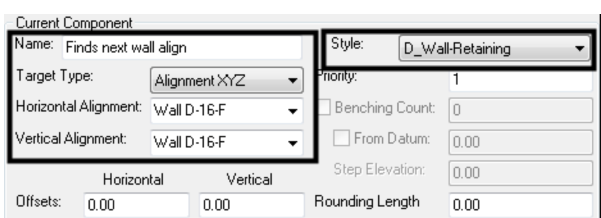
9. While the name is highlighted, type over it with ***Terrace_Wall***.



10. Select **Tools > Dynamic Settings**.
11. Toggle off **Apply Affixes**.
12. For **X** and **Y Step**, key in ***0.1***.

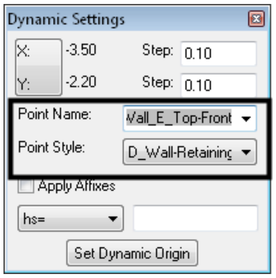


13. Right-click in the template view and select **Add New Component > End Condition**.
14. Under ***Current Component***, key in ***Finds next wall align*** for the ***Name***.
15. Set the ***Style*** to **D_Wall-Retaining**.
16. Set the ***Target Type*** to **Alignment XYZ**.
17. Set the **Horizontal Alignment to Wall D-16-F**.
18. Set the ***Vertical Alignment*** to **Wall D-16-F**.

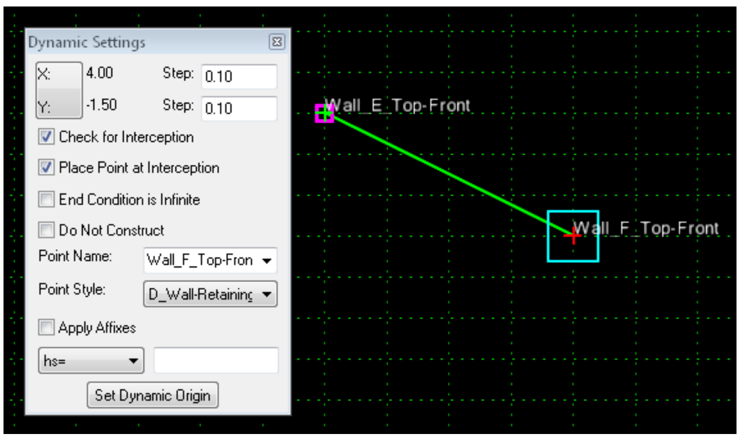


Note: Since the template will start at ***Wall D-16-E***, ***Wall D-16-F*** is the next wall alignment. With a target of ***Alignment XYZ***, the component will use a variable slope to 'find' the horizontal and vertical alignment.

19. In the ***Dynamic Settings*** dialog box, key in ***Wall_E_Top-Front*** for the ***Name***.
20. Select **D_Wall-Retaining** for the ***Style***.

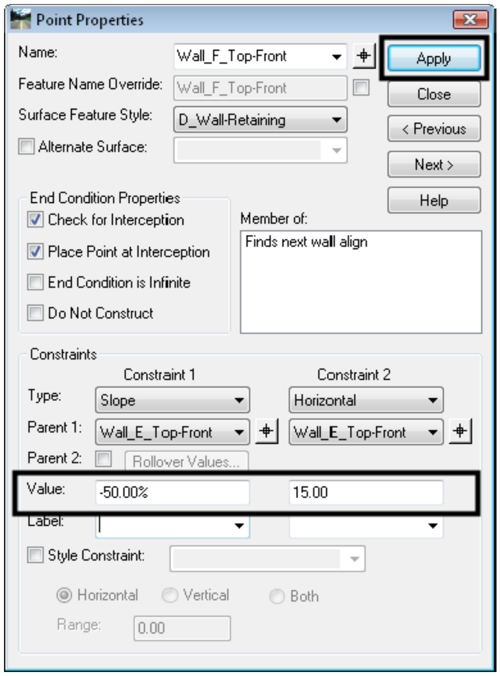


21. **<D>** on the origin point (0,0).
22. Back in the ***Dynamic Settings*** dialog box, change the name to ***Wall_F_Top-Front***.
23. **<D>** on a point down and to the right of the first point as shown.



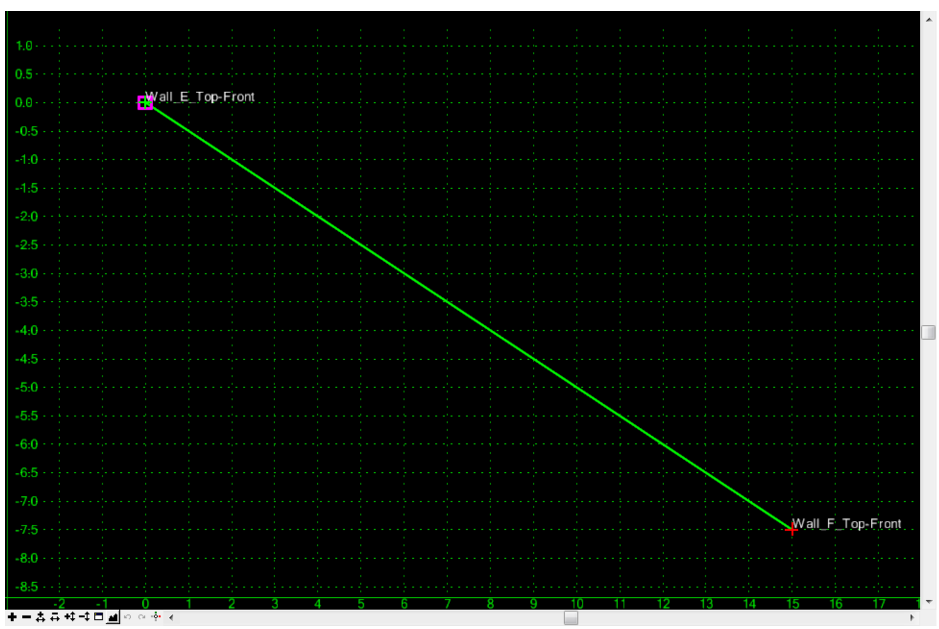
24. **<R>** and **<D> Finish** to complete the component.
25. **Edit** the second point, ***Wall_F_Top-Front***. (Either double-click the point or right-click and choose **Edit**.)
26. For the ***Slope Constraint***, set the ***Value*** to ***50.00%***.
27. For the ***Horizontal Constraint***, set the ***Value*** to ***15.00***.

Note: Because the target for this end condition is both a horizontal and a vertical alignment, these values are actually ignored when the template is run. However, it gives a more accurate picture to use realistic values.



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

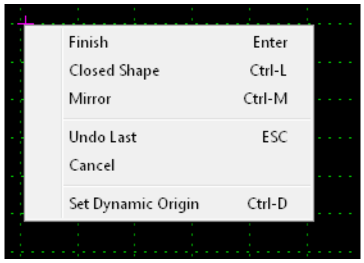
29. **Fit** the template.



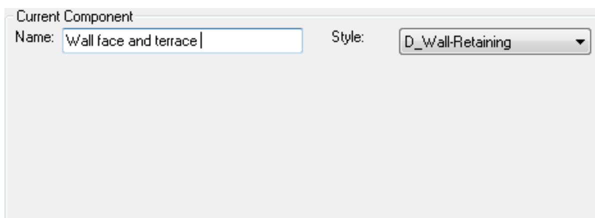
In the following series of steps, another component is added to create the face of the wall, a 25% slope to the next wall and a flat top for the next wall.

30. Right-click in the template view and select **Add New Component > Unconstrained**.

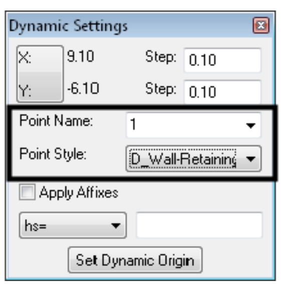
31. Right-click again and make certain all options are toggled off.



32. **<Esc>** to dismiss the menu if everything was already off.
33. Under ***Current Component***, key in ***Wall face and terrace*** for the ***Name***.
34. Set the ***Style*** to **D_Wall-Retaining**.



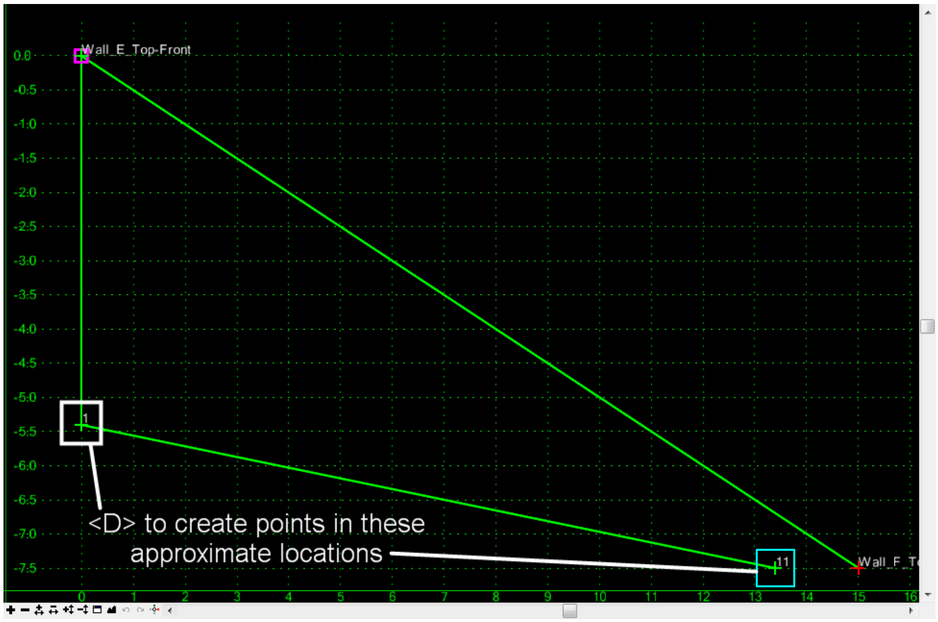
35. In the ***Dynamic Settings*** dialog box, select **D_Wall-Retaining** for the ***Style***.
36. Key in ***1*** for the ***Point Name***.



Note: This is just a temporary seed name to place points. You will later rename the points.

37. **<D>** on the ***Wall_E_Top-Front*** point to start the component.

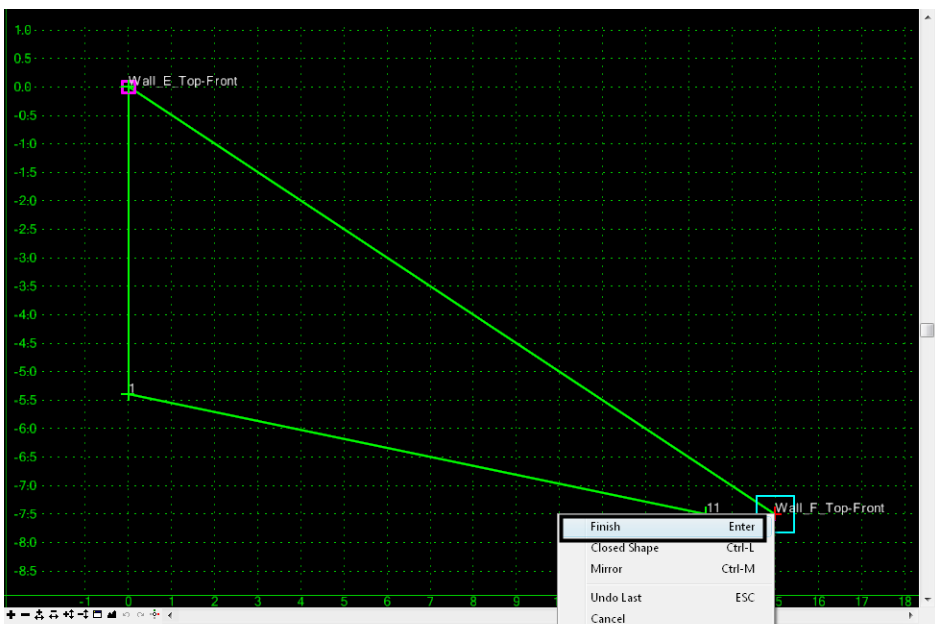
38. **<D>** to create two additional points similar to what is shown.



Note: Do not worry about getting them exact. The slopes and distances will be set with constraints.

39. **<D>** on the ***Wall_F_Top-Front*** point for the final point in this component.

40. Right click and select **Finish**.

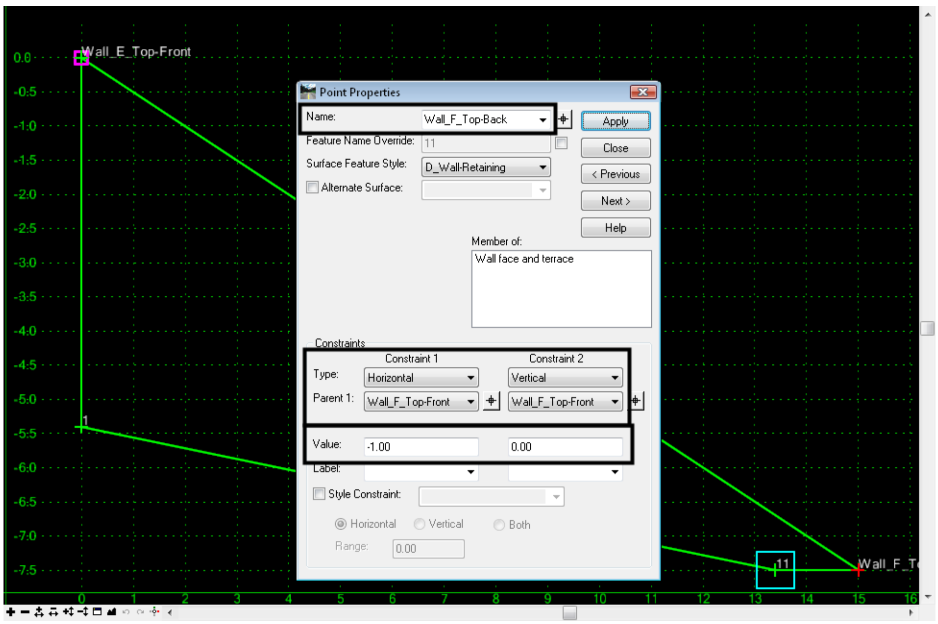


41. **Edit** the point ***11*** just inside the ***Wall_F_Top-Front*** point.

    Note: This point will create the flat top on Wall F.

42. Key in ***Wall_F_Top-Back*** for the ***Name***.

43. Set ***Constraint 1*** to **Horizontal**.
44. Set ***Parent 1*** to **Wall_F_Top-Front**.
45. Key in a ***Value*** of ***1.00***.
46. Set ***Constraint 2*** to **Vertical**.
47. Set ***Parent 1*** to **Wall_F_Top-Front**.
48. Key in a ***Value*** of ***0.00***.



49. **<D> Apply**, then **Close**.
50. **Edit** the point **1** below ***Wall_E_Top-Front***.

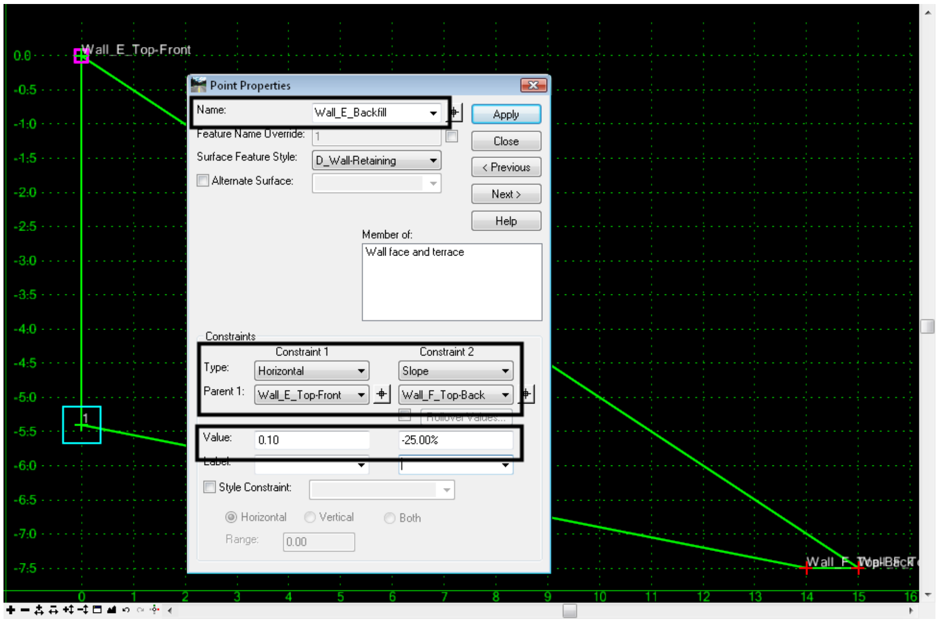
    Note: This point will become the location where the face of the wall is intercepted by the 25% backfill slope.

51. Key in ***Wall_E_Backfill*** for the ***Name***.
52. Set ***Constraint 1*** to **Horizontal.**
53. Set ***Parent 1*** to **Wall_E_Top-Front**.
54. Key in a ***Value*** of ***0.1***.

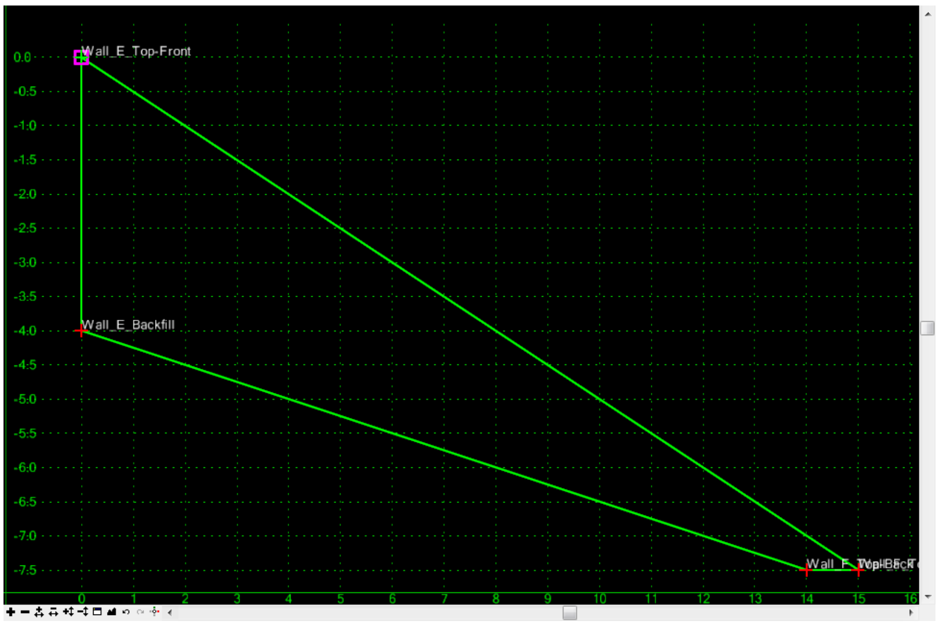
    Note: This will force a small slope on the front face of the wall to allow triangulation.

55. Set ***Constraint 2*** to **Slope**.
56. Set ***Parent 1*** to **Wall_F_Top-Back**.

57. Key in a ***Value*** of ***-25.00%***.



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



Note: Since the horizontal and slope constraints have two different parent points, the location of this point varies when either of the parents moves.

59. **<D> Test**.

60. Under ***Available Targets***, **<D>** on the wall alignment.

61. **<D> Draw**.

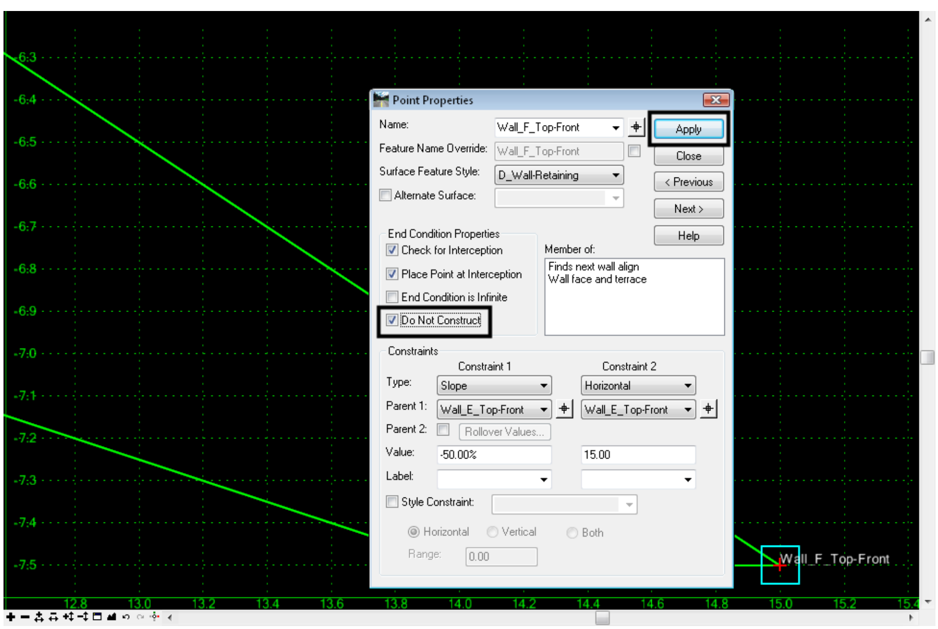
62. Move your cursor into the template view to see how the components react.

Note: The original component has a variable slope, while the ***Wall face and terrace*** component maintains all slopes. It should also be noted that there is no need to display the original component. Also, if the original component fails the ***Wall face and terrace*** component should not display either. Both of these situations will be taken care of next.

63. **<D> Close** on the ***Test End Conditions*** dialog box.

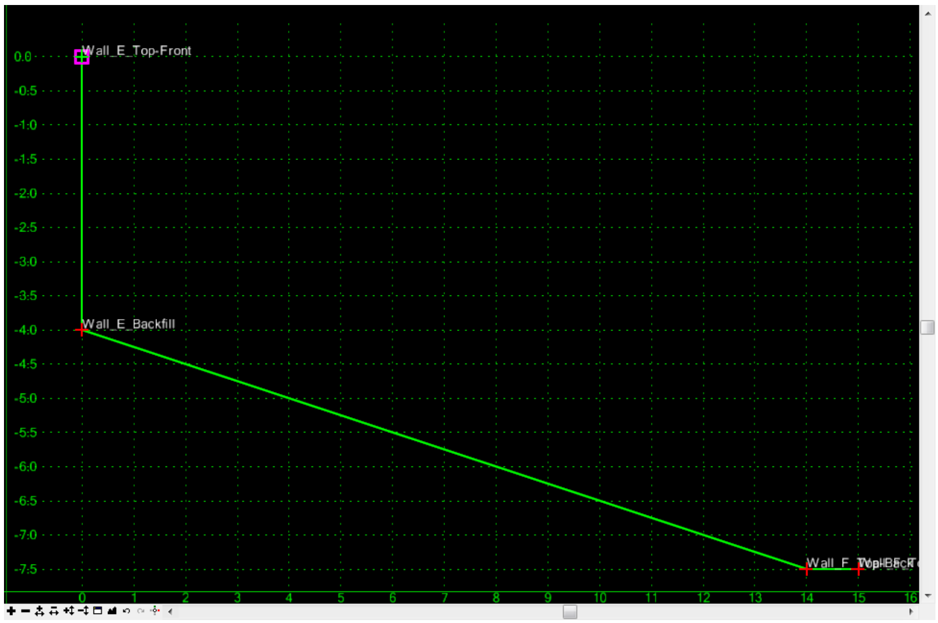
64. **Edit** the **Wall_F_Top-Front** point.

65. Toggle on **Do Not Construct**.



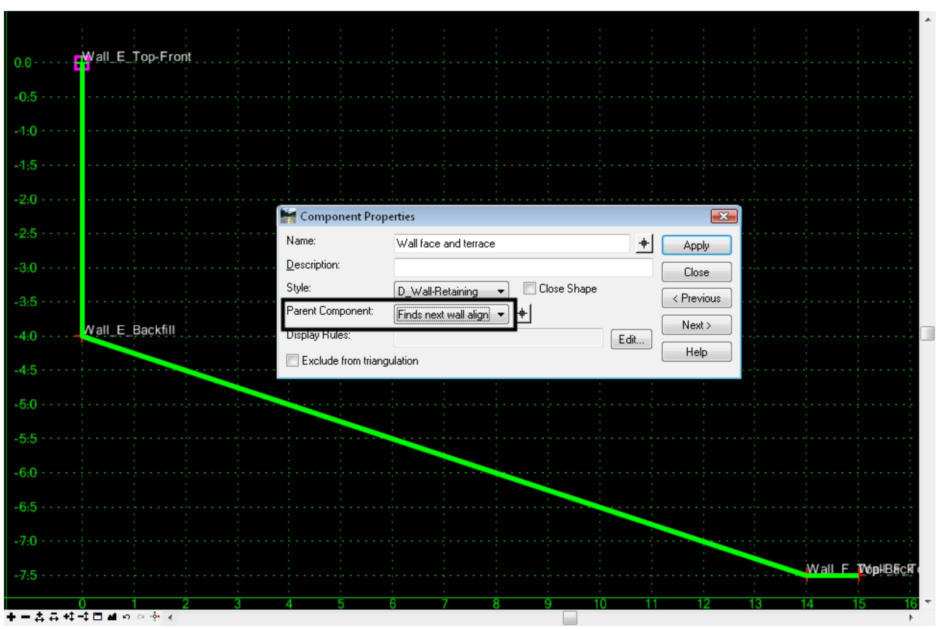
66. **<D> Apply**, then **Close**.

Note: The ***Finds next wall align*** component disappears. However, the portion of the ***Wall face and terrace*** component that contains the ***Wall_F_Top-Front*** point remains. This is because ***Do Not Construct*** only affects end condition components.



67. **Edit** the **Wall face and terrace** component. (Double-click the component or right-click on the component and choose **Edit**.)

68. Set the ***Parent Component*** to **Finds next wall align**.



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

Note: Now, if the ***Finds next wall align*** end condition fails, neither component is used.

70. **Test** the template again to see the difference.

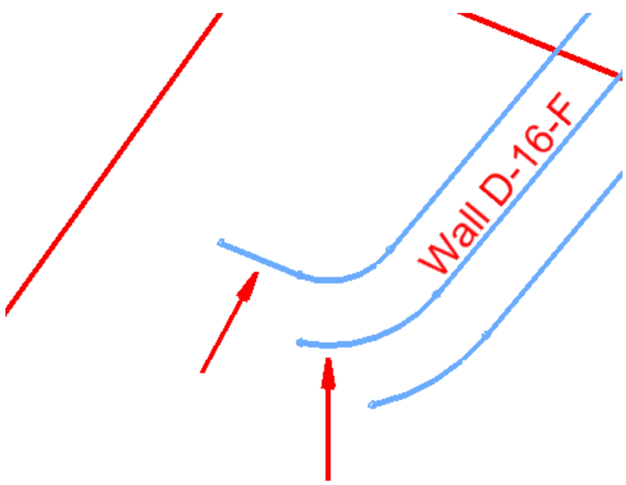
Note: Now, only a dashed line is shown initially, indicating when the end condition fails, nothing is displayed. When the end condition succeeds, only the ***Wall face and terrace*** is displayed.

71. **<D> Close** on the ***Test End Conditions*** dialog box.

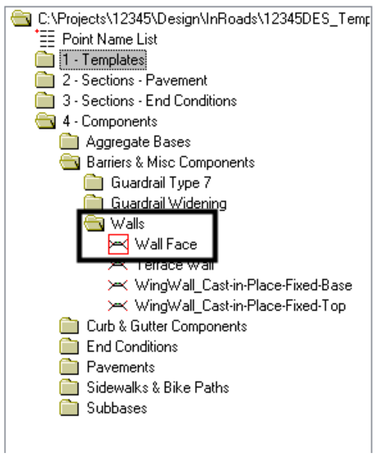
72. **Save** the template library.

Lab 24.3 - Create a Component for the Wall Face

In the areas where a perpendicular application of the template from the upper wall alignment would not find the next wall, the template should create a wall face. This situation will be covered in a new template and combined with the other template later.



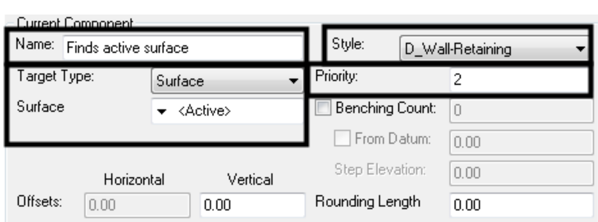
1. Right-click on the ***Walls*** folder again in the library and select **New > Template**.
2. While the name is highlighted, type over it with ***Wall_Face***.



Note: Since the face of the wall will eventually be attached to the ***Wall_Top-Front*** points which are set to ***Do Not Construct***, the face of the wall must be made up of a non-end condition component. However, the face of the wall must also be an end condition so it will stop when it intercepts the target surface. Therefore, the same theory is used for the face as for the terrace: an end condition that doesn't display is used along with a 'regular' component that does display.

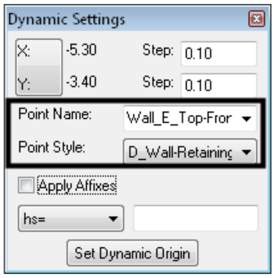
3. Right-click and select **Add New Component > End Condition**.
4. Under ***Current Component***, key in ***Finds active surface*** for the ***Name***.
5. Set the ***Style*** to **D_Wall-Retaining**.
6. Set the ***Target Type*** to **Surface**.
7. Set the ***Surface*** to **<Active>**.
8. Set the ***Priority*** to ***2***.

Note: Since this component is to be used only where the terraced wall doesn't work, it will need to be second in priority.

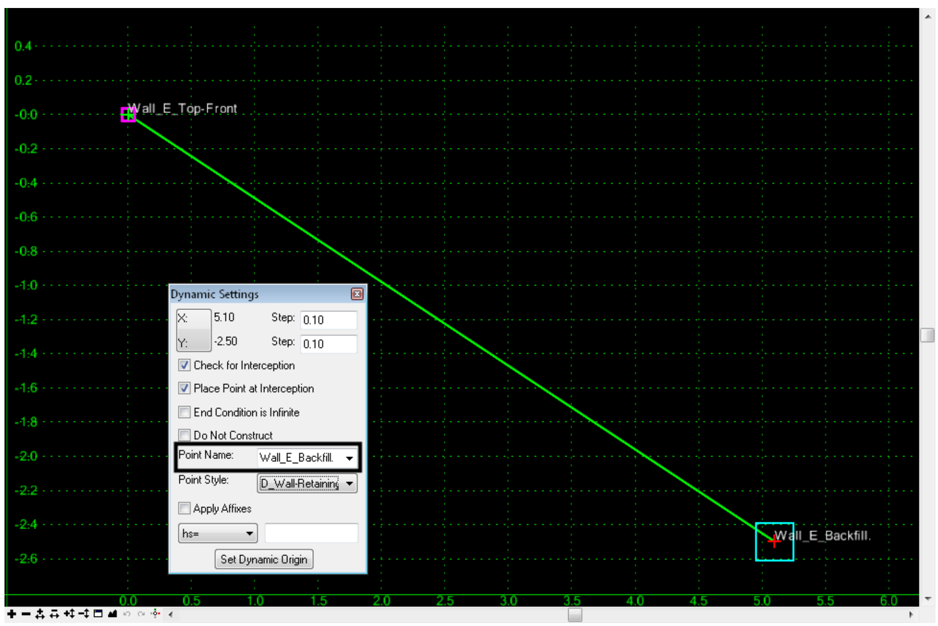


9. In the ***Dynamic Settings*** dialog box, key in ***Wall_E_Top-Front*** for the ***Name***.

10. Select **D_Wall-Retaining** for the ***Style***.

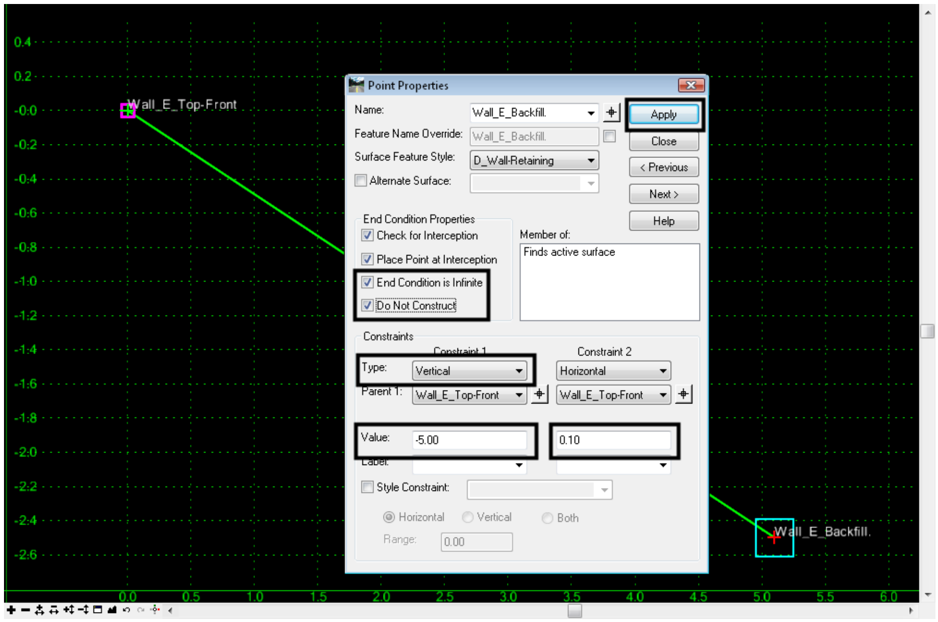


11. **<D>** on the origin point (0,0).
12. Back in the ***Dynamic Settings*** dialog box, change the name to ***Wall_E_Backfill***.
13. **<D>** on a point down and to the right of the first point as shown.



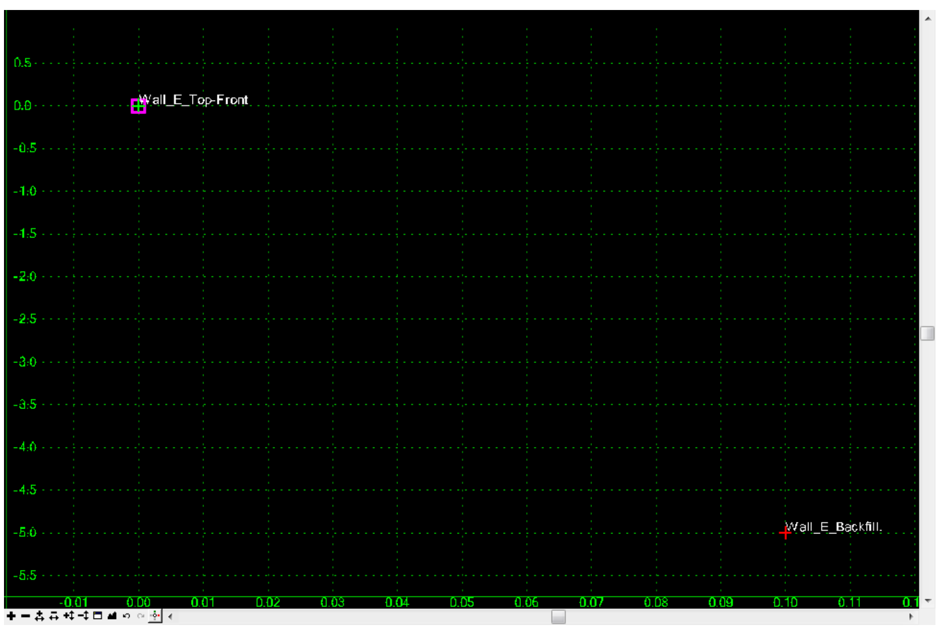
14. Right click and select **Finish**.
15. **Edit** the second point, **Wall_E_Backfill**.
16. Change the ***Slope Constraint*** to **Vertical** and key in ***-5.00*** for the value.
17. For the ***Horizontal Constraint***, key in ***0.1*** for the ***Value***.
18. Toggle on **End Condition is Infinite**.

19. Toggle on **Do No Construct**.



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

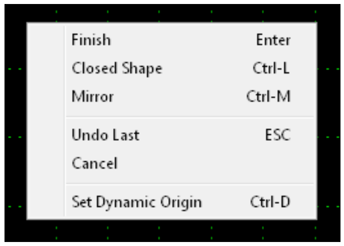
21. **Fit** the template.



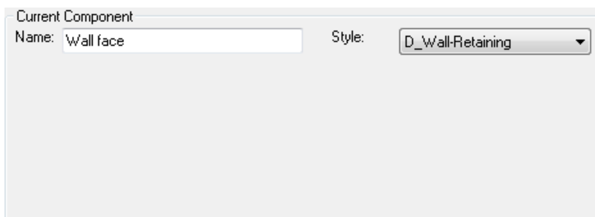
Note: The line forming the component disappears, but the points are still there.

22. Right-click in the template view and select **Add New Component > Unconstrained**.

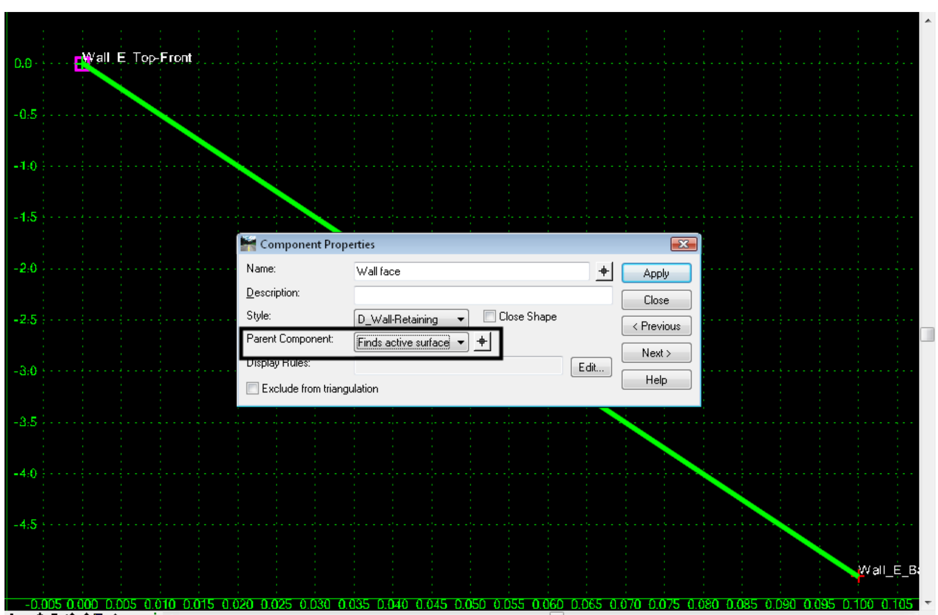
23. Right-click again and make certain all options are toggled off.



24. **<Esc>** to dismiss the menu if everything was already off.
25. Under ***Current Component***, key in ***Wall face*** for the Name.
26. Set the ***Style*** to **D_Wall-Retaining**.

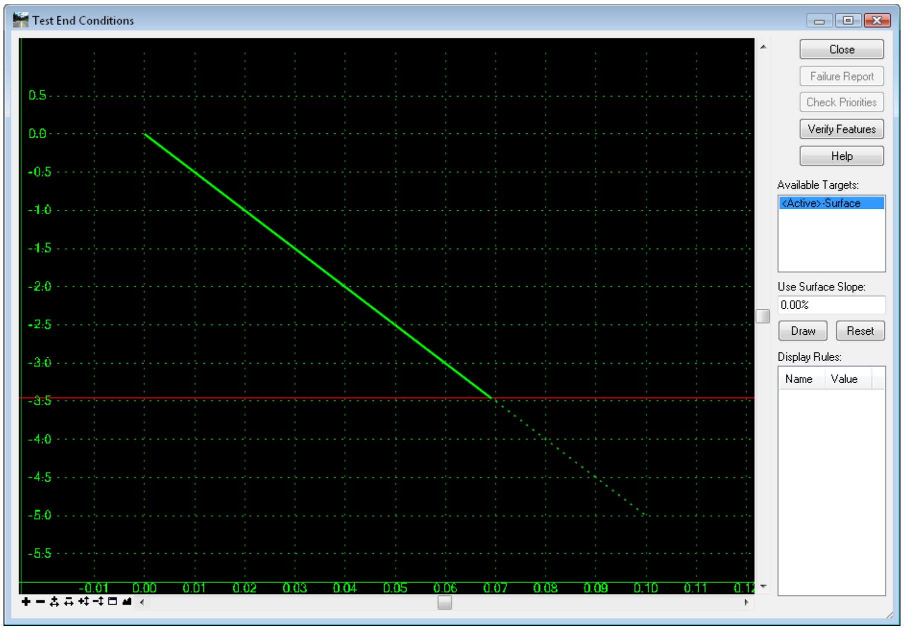


27. **<D>** on the ***Wall_E_Top-Front*** point to start the component.
28. **<D>** on the ***Wall_E_Backfill*** point.
29. Right click and select **Finish**.
30. **Edit** the **Wall face** component.
31. Set the ***Parent Component*** to **Finds active surface**.



Note: Now, if the ***Finds active surface*** end condition fails, neither component is used.

32. **Test** the template.



Note: Only a dashed line is shown initially, indicating when the end condition fails, nothing is displayed. When the end condition succeeds, only the Wall face is displayed. The template is 'fit' to the view, so the slope seen here is not indicative of the final slope.

33. **<D> Close** on the ***Test End Conditions*** dialog box.

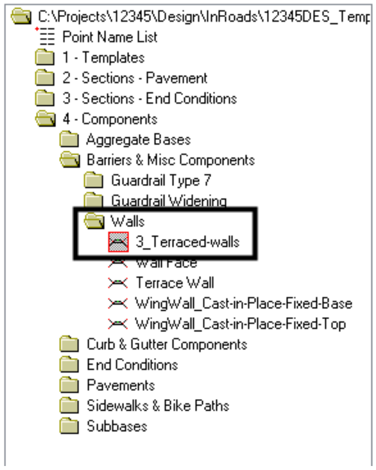
34. **Save** the template library.

Lab 24.4 - Create the Final Wall Template

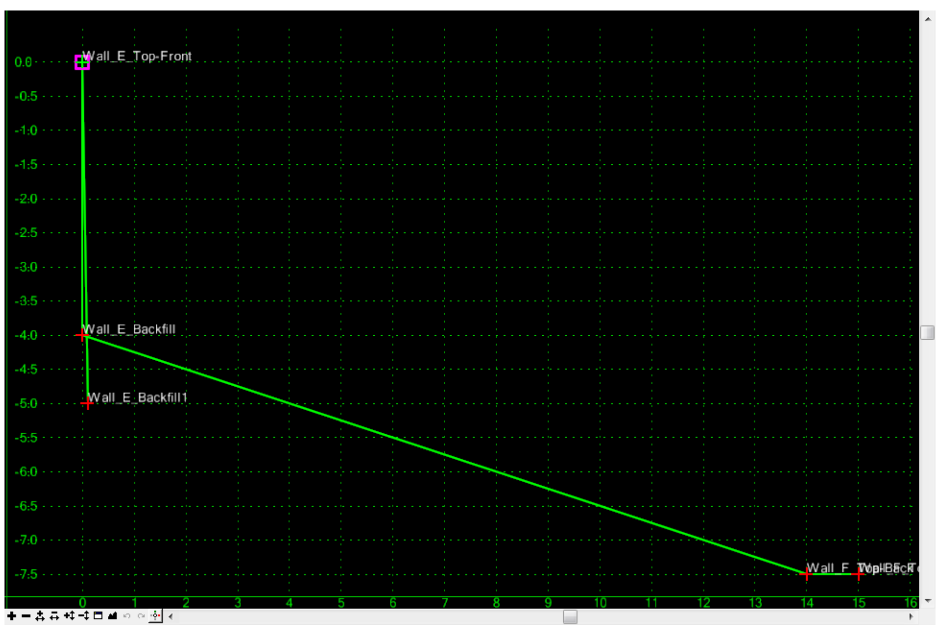
Next, these templates are combined to create the final wall template.

1. Right-click on ***Walls*** folder again in the library and select **New > Template**.

2. While the name is highlighted, type over with ***3_Terraced-walls***.

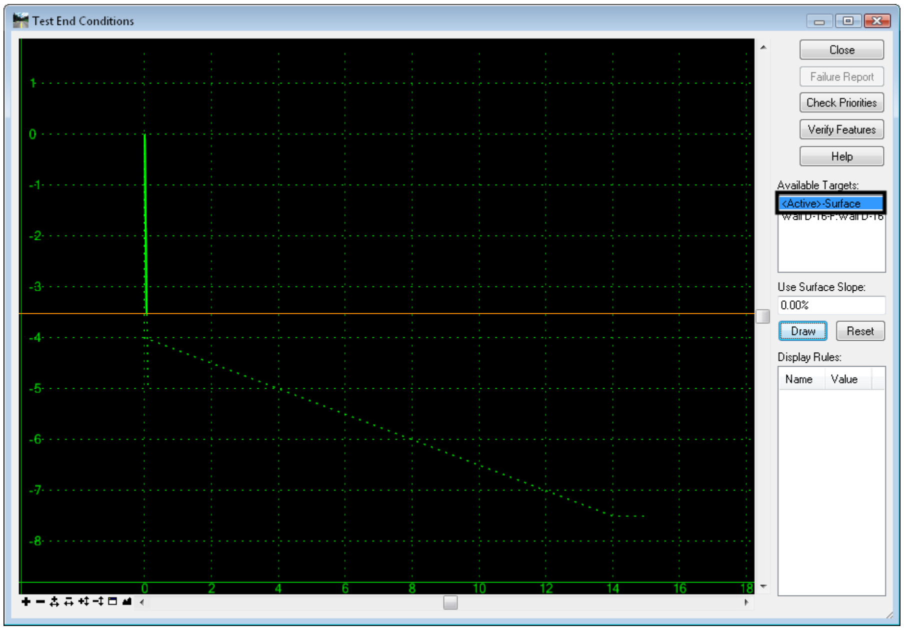


3. Highlight, but do not make active, ***Terrace_Wall***.
4. Drag the ***Terrace_Wall*** template from the ***Preview*** window and drop it on the origin of the new template.
5. Highlight, but do not make active, ***Wall_Face***.
6. Drag the ***Wall_Face*** template from the ***Preview*** window and drop it on the origin, making certain the ***Wall_E_Top-Front*** point turns white.



7. **<D> Test**.
8. **<D>** on the ***<Active>-Surface*** under ***Available Targets***.
9. **<D>** on **Draw**.

10. Move your cursor into the template view.

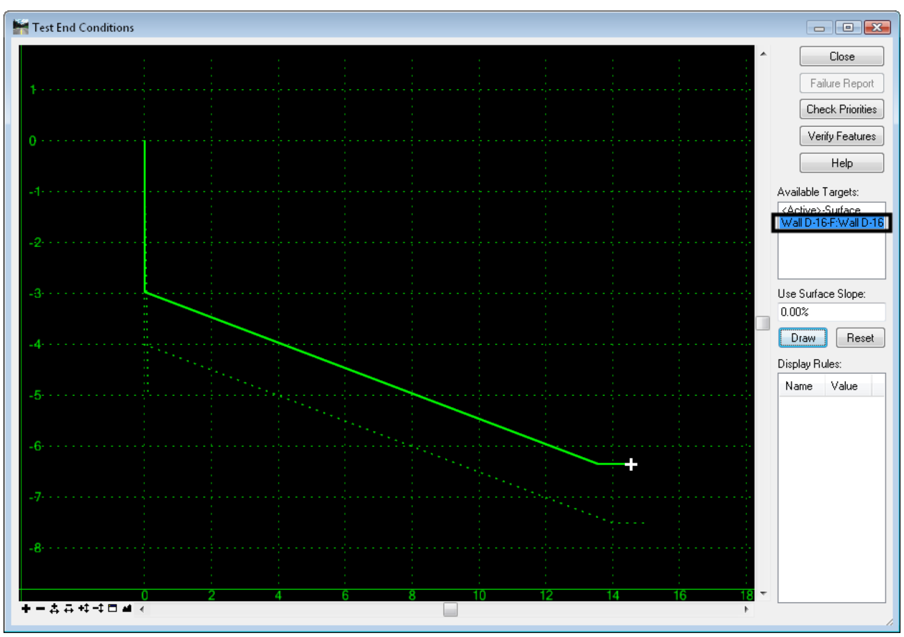


Note: The wall face appears, indicating that when the first option, the ***Wall face and terrace***, fails, the wall face alone will be created.

11. **<D>** on the ***Wall D-16-F*** alignment under ***Available Targets***.

12. **<D>** on **Draw**.

13. Move your cursor into the template view.



Note: The wall face and terrace appear.

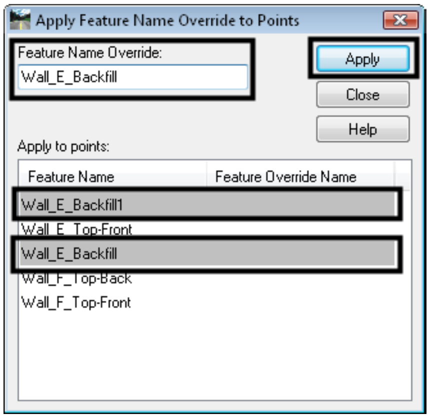
14. **<D> Close** to dismiss the ***Test End Conditions*** dialog box.

There are two ***Wall_E_Backfill*** points in the template, so one was renamed with a suffix. In the model, only one of these points will be used at any given location and together, they should form just one breakline. This is accomplished with ***Feature Name Overrides***.

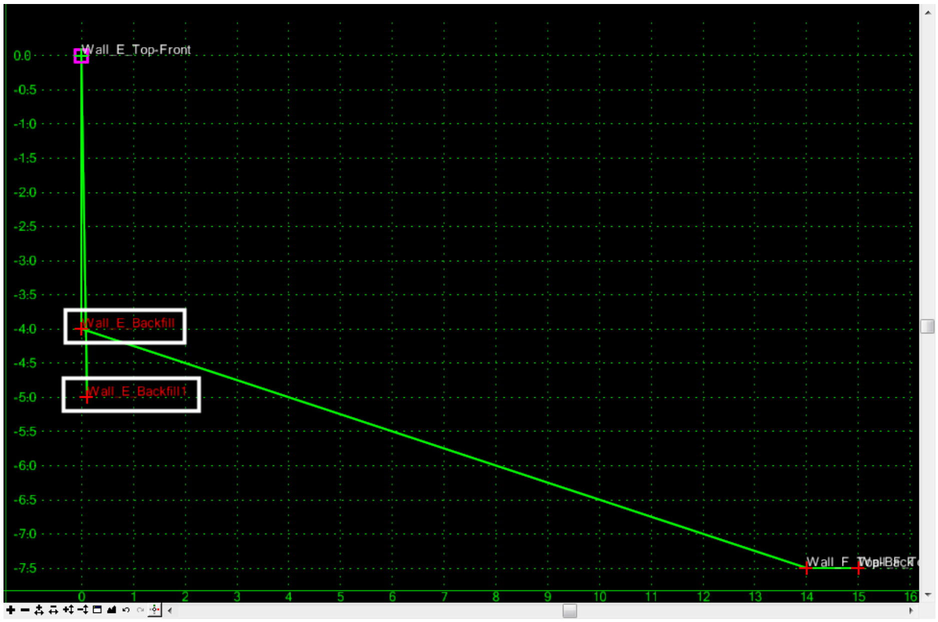
15. Select **Tools > Apply Feature Name Override**.

16. Highlight the two ***Wall_E_Backfill*** points

17. Key in ***Wall_E_Backfill*** for the ***Feature Name Override***.



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

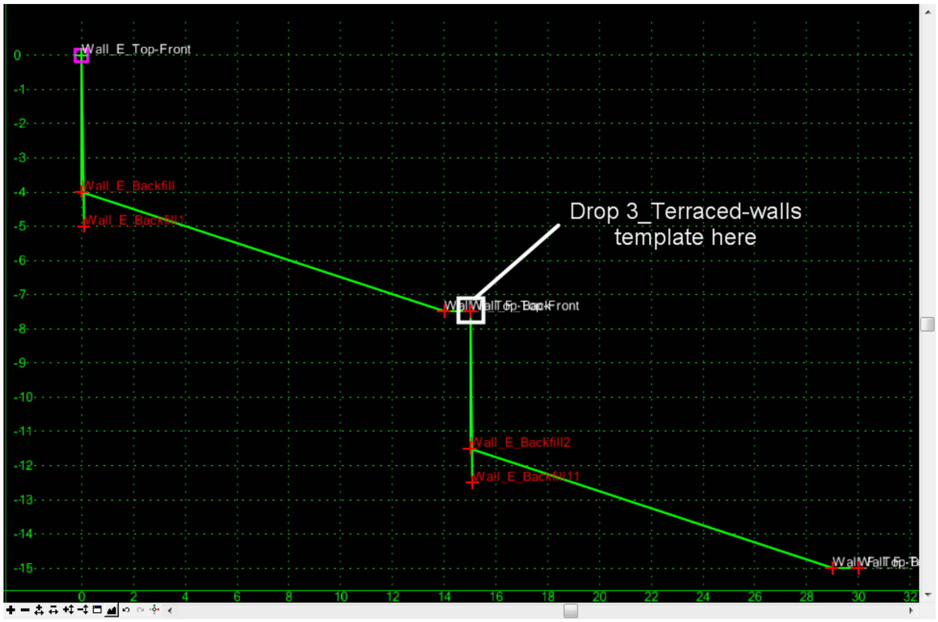


Note: The names turn red in the template view, indicating the names have been overridden.

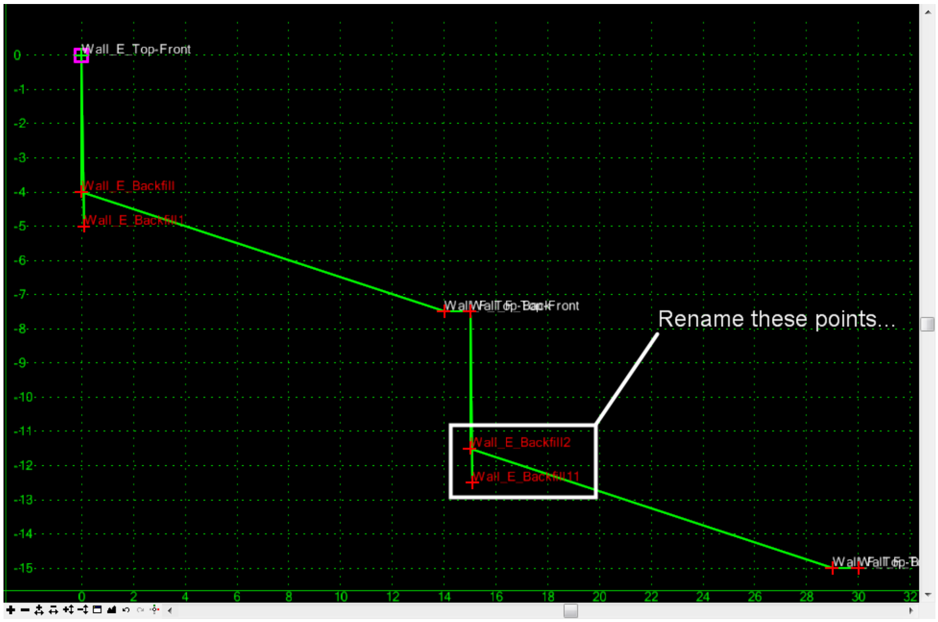
19. **Save** the template library.

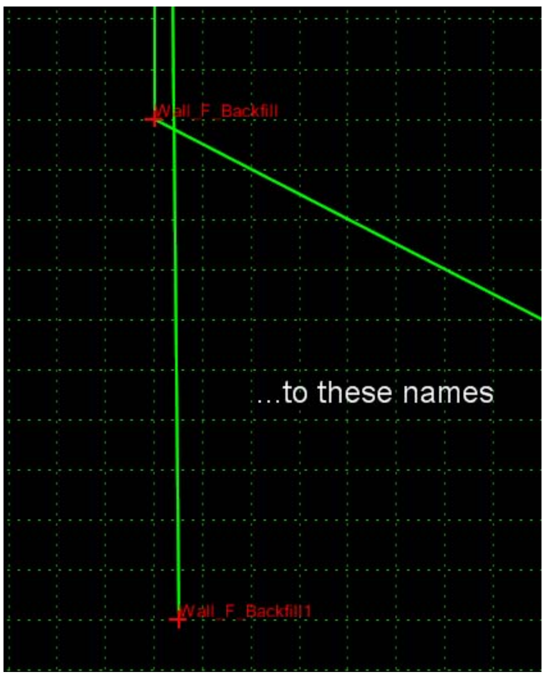
20. Highlight the ***3_Terraced-walls*** template in the list at left.

21. Drag and drop the template from the ***Preview*** window onto the ***Wall_F_Top-Front*** point, making certain the point turns white.



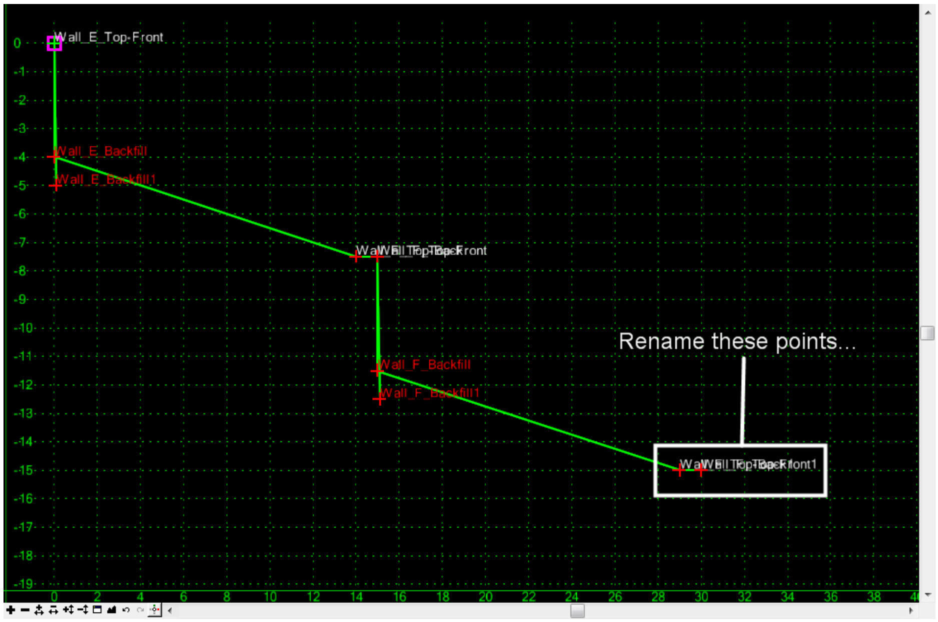
22. **Edit** the two backfill points for ***Wall F*** and rename the points to ***Wall_F_Backfill*** and ***Wall_F_Backfill1.***

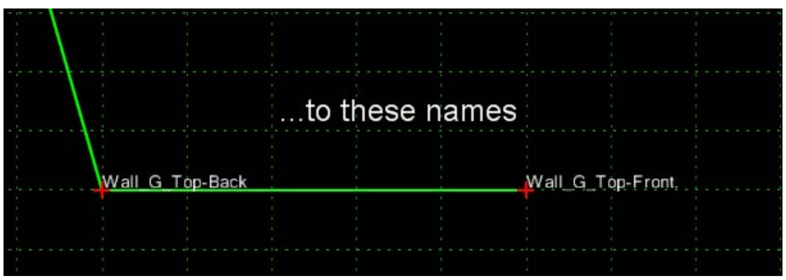




23. Rename the ***Wall_F_Top-Front1*** point to ***Wall_G_Top-Front***.

24. Rename the ***Wall_F_Top-Back1*** point to ***Wall_G_Top-Back***.

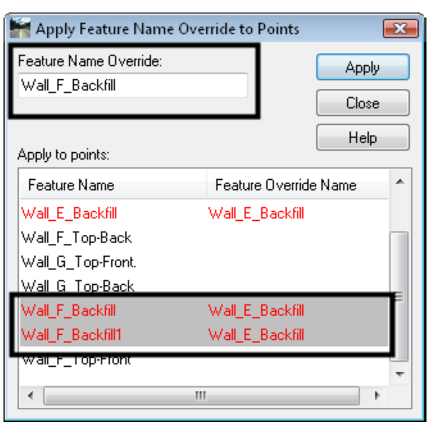




25. Select **Tools > Apply Feature Name Override**.

26. Highlight the two ***Wall_F_Backfill*** points

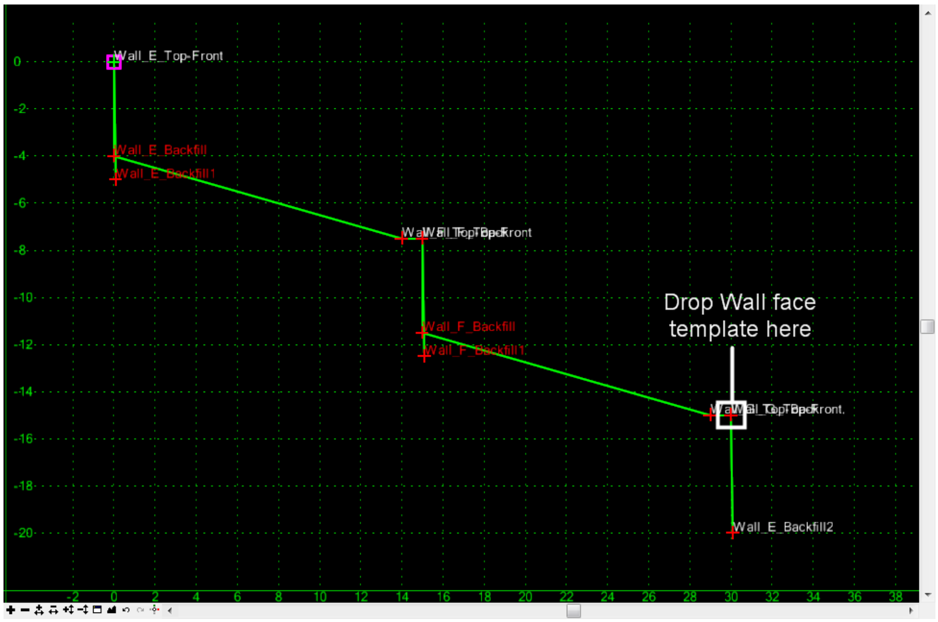
27. Key in ***Wall_F_Backfill*** for the ***Feature Name Override***.



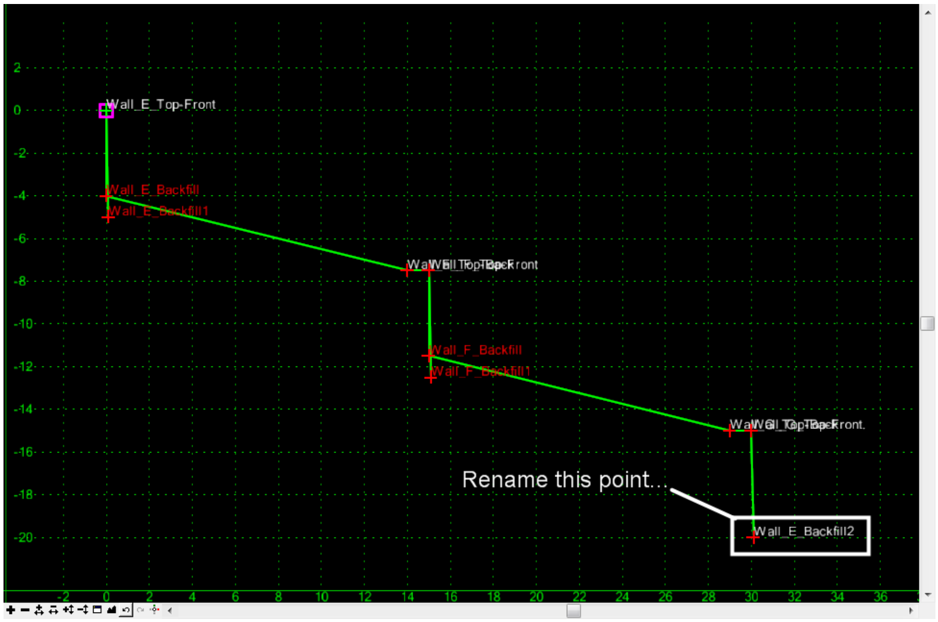
28. **<D> Apply**, then **Close**.

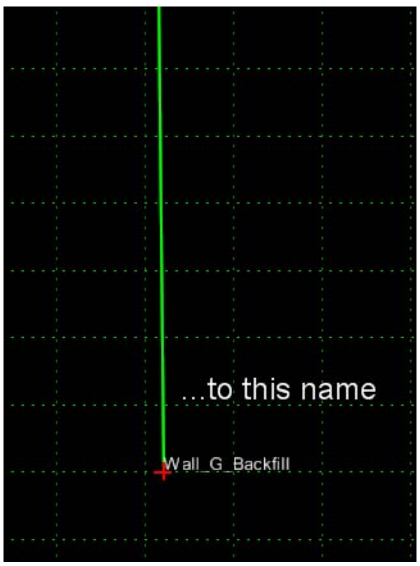
29. Highlight, but do not make active, ***Wall_Face***.

30. Drag the ***Wall_Face*** template from the ***Preview*** window and drop it on ***Wall_G_Top-Front***, making certain the ***Wall_G_Top-Front*** point turns white.



31. Change the new ***Wall_E_Backfill2*** point to ***Wall_G_Backfill***.

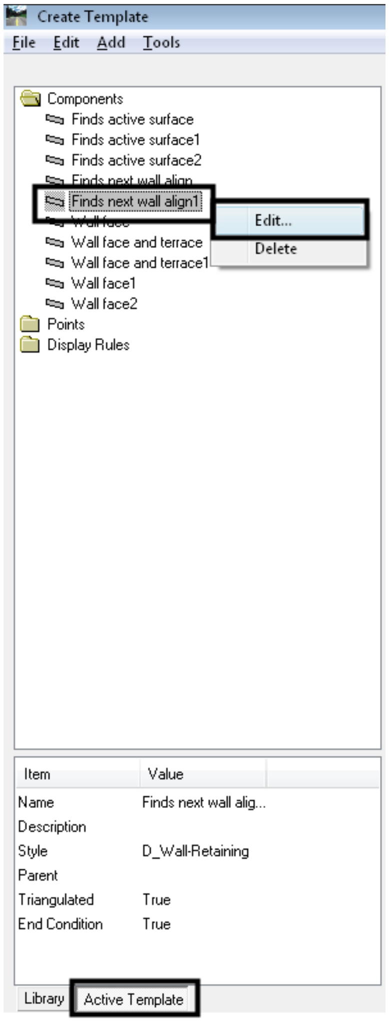




32. At the bottom of the Template Library list at left, select the ***Active Template*** tab.

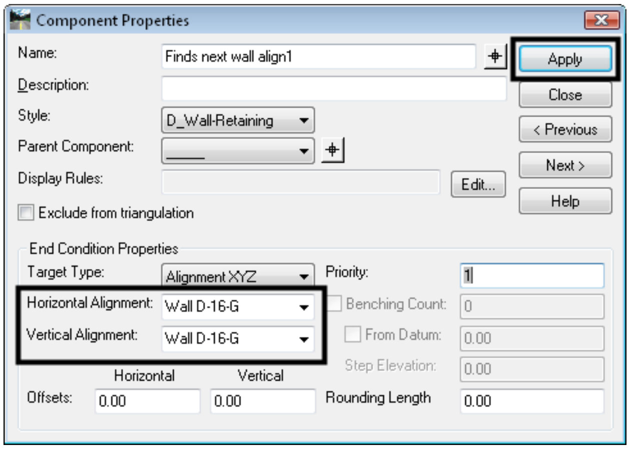
33. Expand the ***Components*** list.

34. Right-click on ***Finds next wall align1*** and select **Edit**.



Note: Since this component was created from the original one, it is still seeking the ***Wall F alignments***. Here, you'll change it to seek ***Wall G***.

35. Change the ***Horizontal*** and ***Vertical Alignments*** to **Wall-D-16-G**.



36. **<D> Apply**, then **Close**.
37. **Save** the template library.
38. At the bottom of the Template Library list at left, select the ***Library*** tab.
39. **Test** the ***3_Terrace-walls*** template.

40. **<D> Close** on the ***Test End Conditions*** dialog box.
41. **<D> Close** on the ***Create Template*** dialog box.

Lab 24.5 - Create the Terraced Wall Surface

In this section, the template is used to create a surface representing the terraced walls. The template is run along a graphic element created from the horizontal and vertical alignment for Wall E using the ***Apply Template*** command. As an alternative, ***Roadway Designer*** could be used.

1. **Delete** the alignment graphics in the file.

   Important! If the original graphics remain in the file, you are likely to accidentally identify them when selecting the path for the template, so it is best to delete the original alignment display. The original graphics are at elevation 0. The graphic you are creating is 3D.

2. Select **Geometry > View > 3D Alignment**.

   Note: This command creates a 3D linestring, taking the X and Y coordinates from the specified horizontal alignment and the Z coordinate from the specified vertical alignment.

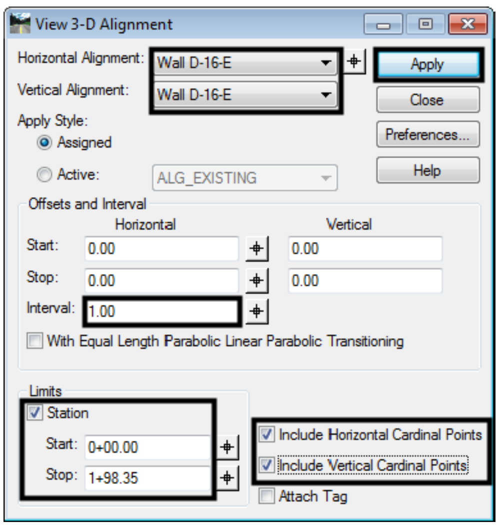
3. Select the ***Horizontal*** and ***Vertical*** alignments **Wall-D-16-E**.

4. Toggle on **Station Limits**.
5. Leave the ***Start Station*** set to ***0+00.00***.
6. Key in ***1+98.35*** for the ***Stop Station***.

   Note: This is the station at the end of the second curve in the wall alignment. From that point on, the wall will be created with the ramp.

7. Under ***Include Cardinal Points***, toggle on **Horizontal** and **Vertical**.
8. Key in ***1.00*** for the ***Interval***.

   Note: This is how often a vertex is created on the resulting linestring.

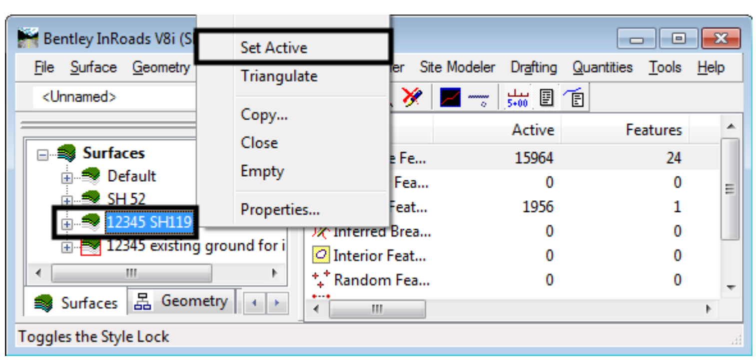


9. **<D> Apply**, then **Close**.

10. **Fit** the view.

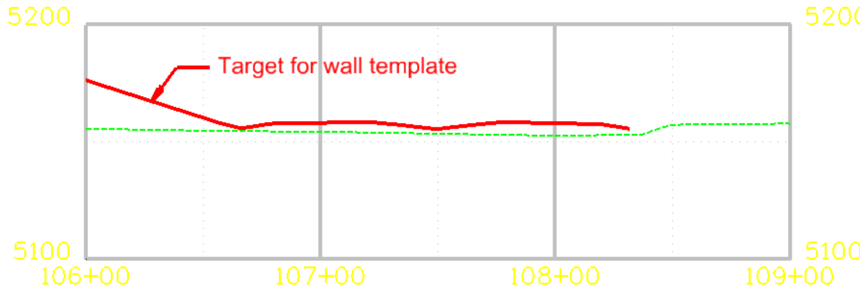
Note: The 3D linestring is shown here in plan and in a rotated view. It forms the origin point for the wall template.

11. Make ***12345 SH119*** the active surface.



Note: The SH119 surface has a 3:1 slope from the bottom of the ditch that creates a 'target' for the walls.

Important! Since the template was created to search for the active surface, ***SH119*** must be active.



12. Set the ***Locate Features / Locate Graphics*** toggle to **Locate Graphics**.
13. Select **Surface > Design Surface > Apply Template**.
14. Key in ***12345 walls E F G*** for the ***Design Surface***.

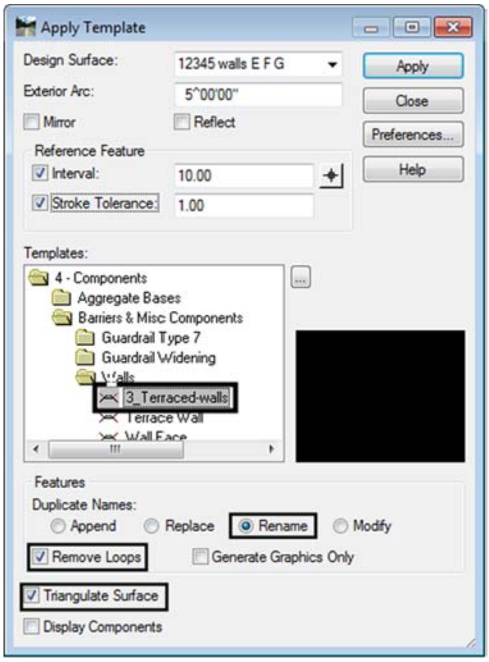
    Note: The design surface does not have to exist. It is created when the command is applied.

15. Set the ***Reference Feature Interval*** to ***10.00***.
16. Toggle on **Stroke Tolerance**.

    Note: The Value does not matter unless the reference graphic has an arc in it. Using ***View 3D Alignment*** creates a linestring that does not contain arcs.

17. Highlight the ***3_Terraced_Walls*** template in the ***4 Components/Barriers & Misc Components/Walls*** folder.
18. Set ***Duplicate Names*** to **Rename**.
19. Toggle on **Remove Loops**.
20. Toggle off **Generate Graphics Only**.

21. Toggle on **Triangulate Surface**.



22. **<D> Apply**.

23. **<D>** on the 3D alignment graphic to identify the ***Primary Element***.

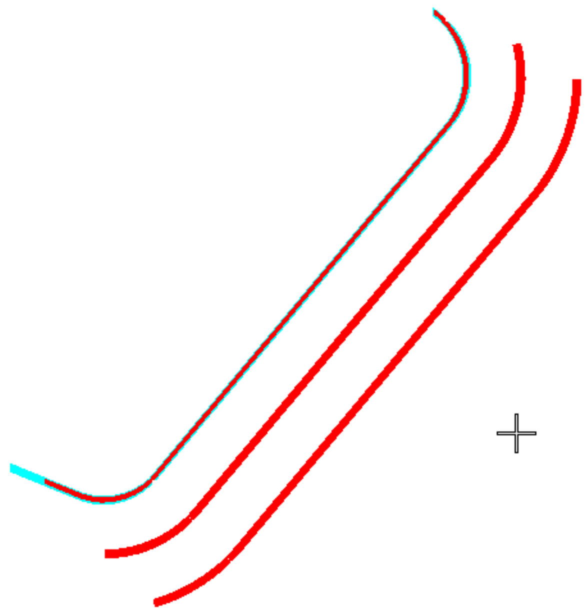
24. **<D>** anywhere in the view to accept.

25. **<D>** on the 3D alignment graphic again to identify the ***Reference Element***.

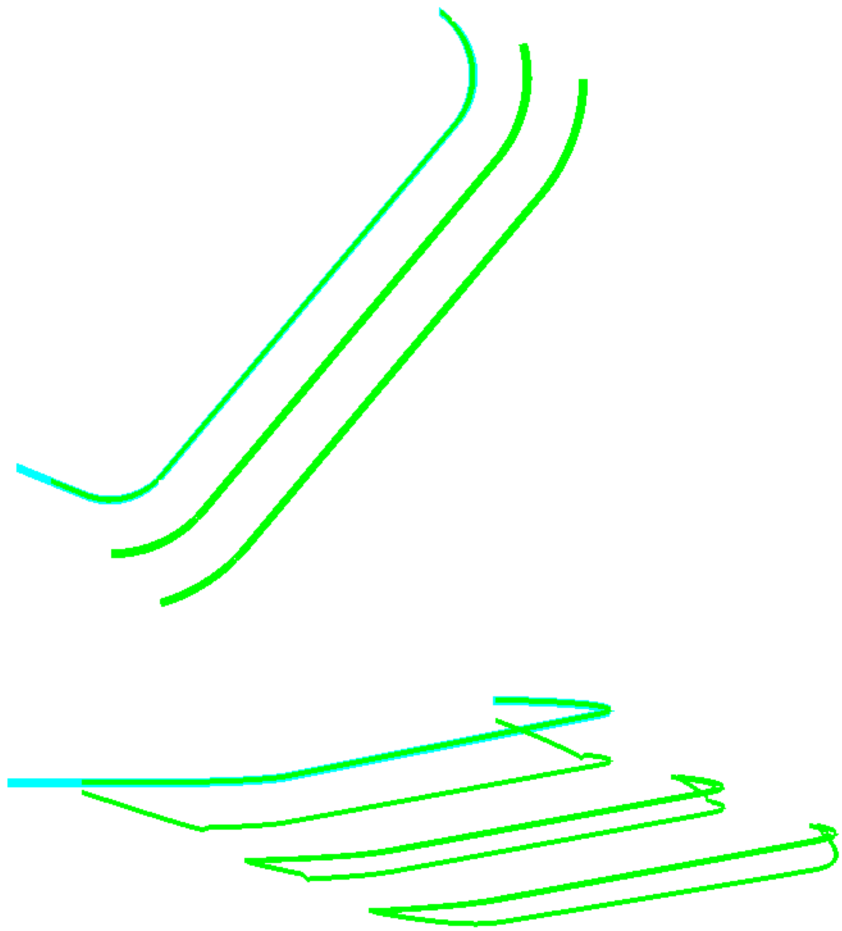
26. **<D>** anywhere in the view to accept.

27. **<R>** to apply the template to the entire element.

Note: Temporary graphics appear showing the resulting feature locations.



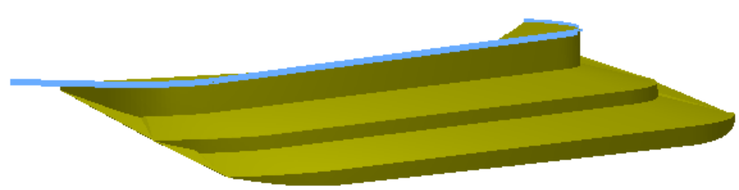
28. **<D>** anywhere in the view for the location.



Note: The ***Results*** dialog box appears showing any end condition failures. Above, you see the plan and rotated views of the graphics. There may be failures at either end of the graphics, since the alignment actually begins slightly underground.

29. **Save** the wall surface to the ***c:\Projects\12345\Design\InRoads*** folder.

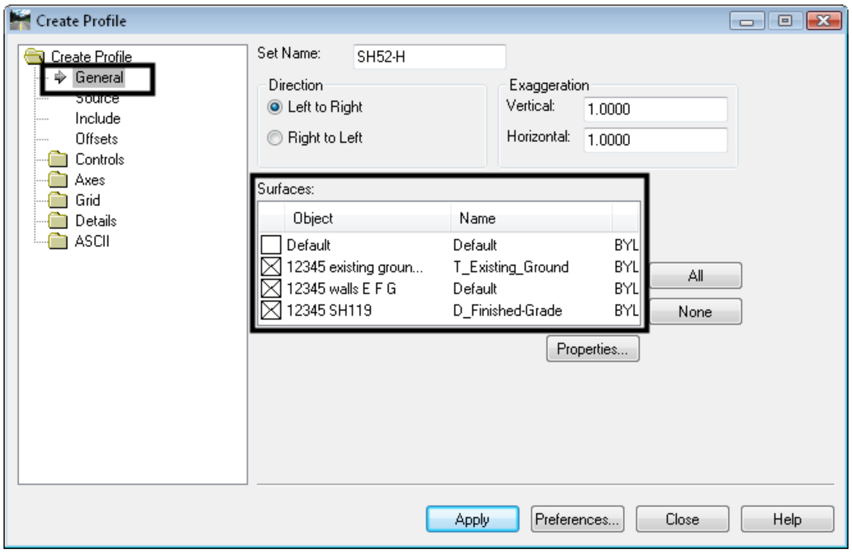
30. Review the surface by displaying triangles and/or contours.



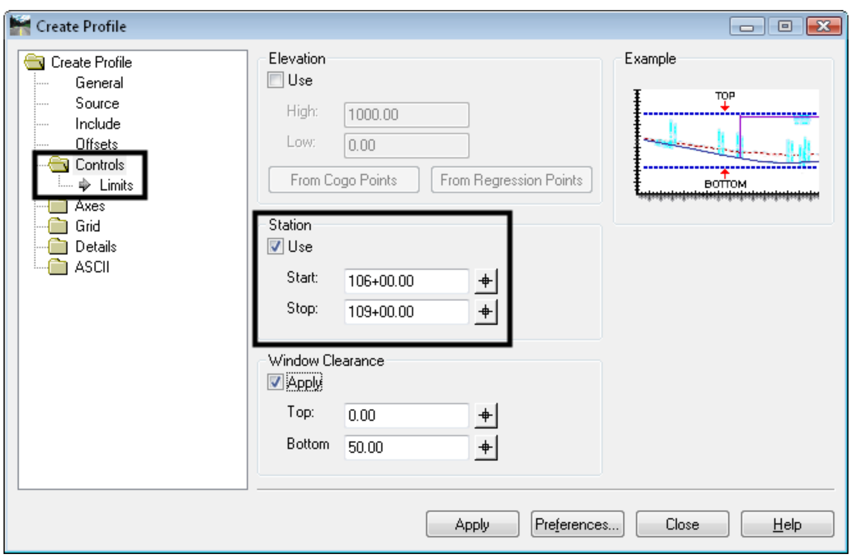
Note: If the view is rotated, return to a top view when done.

31. Set the active alignment to **SH52-H**.

32. Select **Evaluation > Profile > Create Profile**.
33. In the ***Surfaces*** area, toggle on **12345 existing ground for interchange**, **12345 SH52**, **12345 SH119** and **12345 walls E F G**.

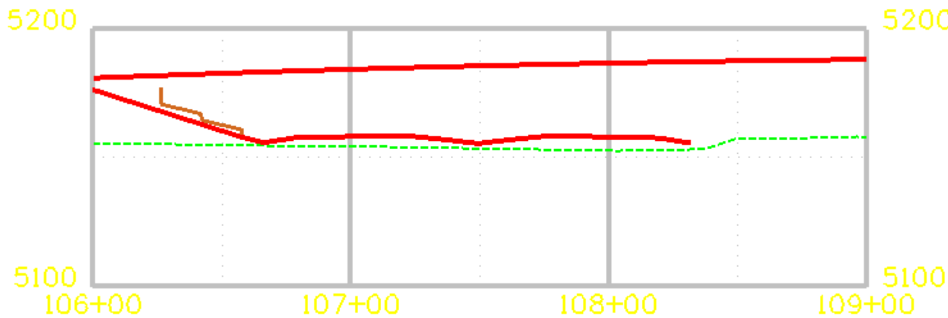


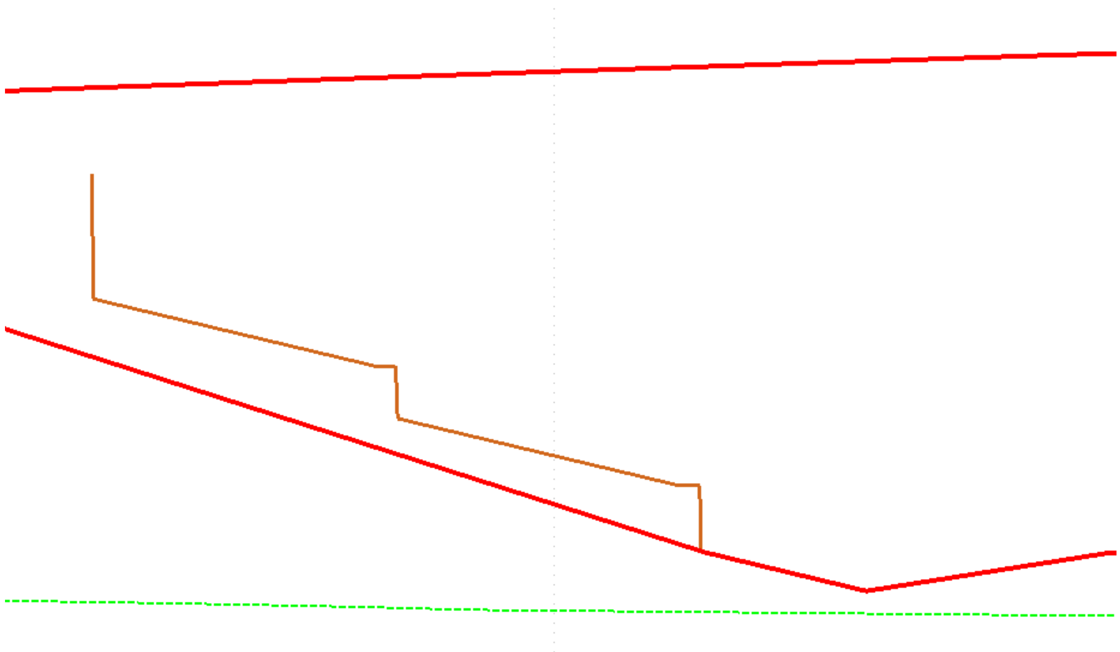
34. Select the ***Controls*** branch.
35. Set the ***Station Limits*** to ***106+00*** to ***109+00***.



36. **<D> Apply**.
37. **<D>** a clear area in the design file for the location of the profile.

38. Window in to see the wall surface.





Note: Since templates can also contain non-triangulating and closed shape components, walls, footers, leveling pads, etc. can be created as part of the template if desired.

Note: The features developed here can be combined with features from the other models to create an overall interchange model.

Chapter Summary:

- Templates can be used to create features for surfaces other than roadways.
- Templates can be used without ***Roadway Designer*** by 'running' them on a 3D elements or features.
- Using targets other than surfaces can greatly expand the capability of templates, allowing them to create features for a variety of design applications.

LAB 25 - Widening and Overlay

Widening and overlay projects are an increasingly large part of the CDOT workload. This lab illustrates the MicroStation and InRoads tools used for projects that require pavement widening, overlay, and pavement milling (stripping in InRoads terminology).

In conjunction with overlay and stripping components a slope optimization function is available to constrain transverse design slopes relative to existing conditions. This utility can be utilized for design development whether the design template contains standard components or the new overlay and stripping components introduced with the SELECTseries release of InRoads.

Chapter Objectives:

- Create a complex chains for the pavement edges from existing ground features.
- Import the chains as horizontal and vertical alignments.
- Develop a slope optimization solution.
- Develop a widening and overlay template.
- Define corridors for the project.
- Model the corridor and apply slope optimization.
- Model the corridor with overlay and stripping components.

The Following files are used in this lab:

- C:\Projects\12345\Design\Drawings\Reference_Files\12345DES_Model_Overlay.dgn
- C:\Projects\12345\Design\InRoads\12345DES_Geometry_Overlay.alg
- C:\Workspace\Workspace-CDOT_V8i\Standards-Global\InRoads\Templates\CDOT_Template-Library.itl
- C:\Projects\12345\Design\InRoads\12345 existing ground-Overlay.dtm

This project runs the length of the SH 86 alignment from station 205+00 to 259+00. Therefore, the display of features, etc. will be restricted to an area from station 204+00 to 260+00. This will ensure that enough data is available for the full length of the project.

> ***Note:*** The first two labs in this chapter illustrate a workflow to develop horizontal and vertical alignments which represent the left and right edges of existing pavement. These alignments can be used as point controls on widening projects if the proposed design must vary width, elevation, or both, relative to the existing roadway.
> A slope optimization utility is also available which offers additional flexibility for vertical design development. If the design calls for it, point controls can be used to constrain the design template to the existing pavement width. Also the template can be constrained vertically based on user defined delta tolerances between the design template cross slope and the existing cross slope. Allowing the designer flexibility to match existing conditions (0% tolerance) or to define slope deviation as a user input for maximum delta tolerance.

Lab 25.1 - Chain Pavement Edge Features

As single continuous lines are easier to use for point controls than a number of unconnected lines. Creating the complex chain also provides the opportunity to close gaps in the pavement edge features.

1. Open MicroStation and InRoads using the **C:\Projects\12345\Design\Drawings\Reference_Files\12345DES_Model_Overlay.dgn** file.

2. Load the following files into InRoads:

   ♦ **C:\Projects\12345\Design\InRoads\12345DES_Geometry_Overlay.alg**

   ♦ **C:\Projects\12345\ROW_Survey\InRoads\DTM\12345 existing ground-Overlay.dtm**

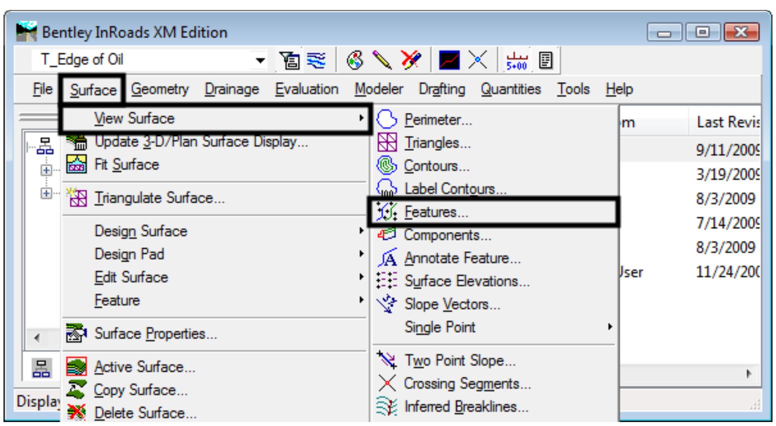
   ♦ **C:\Workspace\Workspace-CDOT_V8i\Standards-Global\InRoads\Templates\CDOT_Template-Library.itl**

3. Verify that the **C:\Workspace\Workspace-CDOT_V8i\Standards-Global\InRoads\ Preferences\CDOT_Civil.xin** file is loaded.

   The first step is to mark out the limits of construction. Then a MicroStation fence is used to limit InRoads displays to this area.

4. In the InRoads explorer, **<D>** the **Geometry** tab.

5. **<R>** on the **SH 86** horizontal alignment and select **View** from the right click menu.

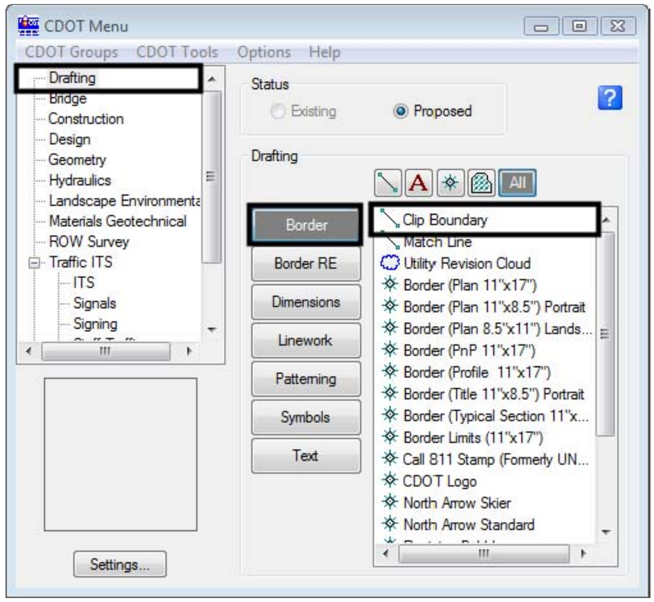


6. Select **Fit View** from the MicroStation view controls.

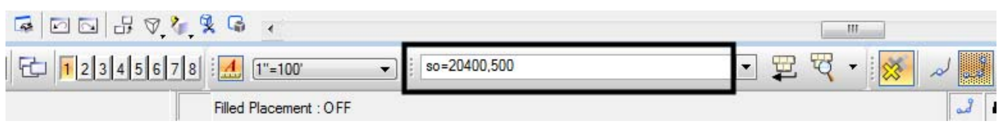
7. From the ***CDOT Menu***, select the **Drafting** group.

8. **<D>** the **Border** button.

9. Highlight **Clip Boundary** from the item list. This activates the ***Place SmartLine*** command.



10. In the MicroStation key-in window, key in ***so=204+00,500*** and press ***Enter***.

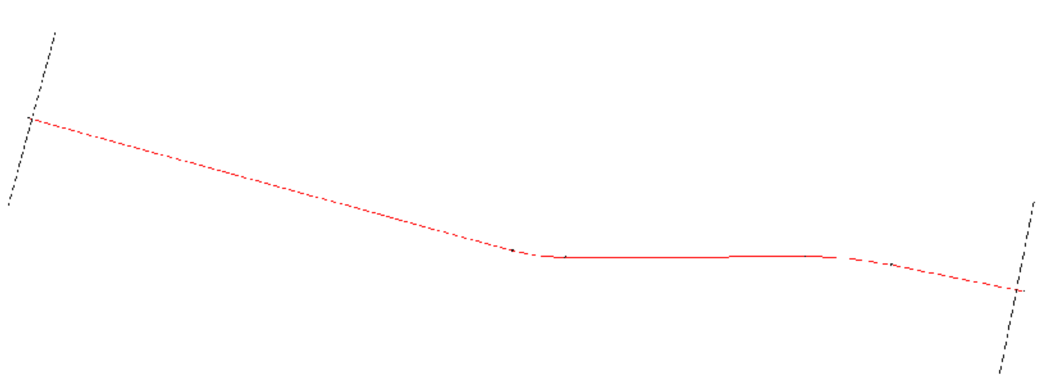


11. Key in ***so=204+00,-500*** and press ***Enter***. **<R>** to finish the line.

    This places a line perpendicular to the alignment at the beginning of the project.

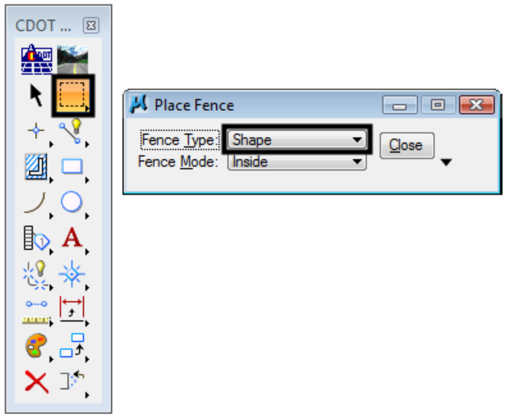
12. The Place SmartLine command is still active. Key in ***so=260+00,500*** and press ***Enter***.

13. Key in ***so=260+00,-500*** and press ***Enter***. **<R>** to finish the line.

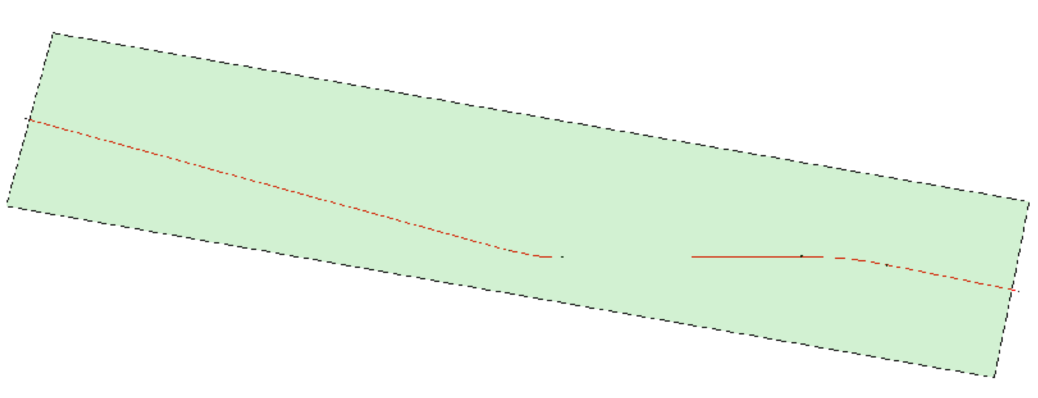


14. From the MicroStation Main toolbar, **<D> Place Fence**.

15. In the Tool Settings dialog box, set the ***Fence Type*** to **Shape**.

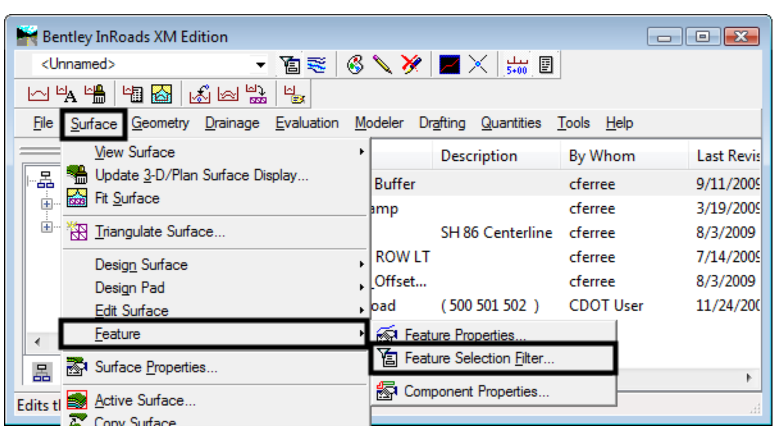


16. **<T>** then **<D>** to the ends of the lines. The fence is shown in the illustration below.



Next, a feature filter is set up that will only display edge of pavement features. In this case these features are named T-Edge of Oil.

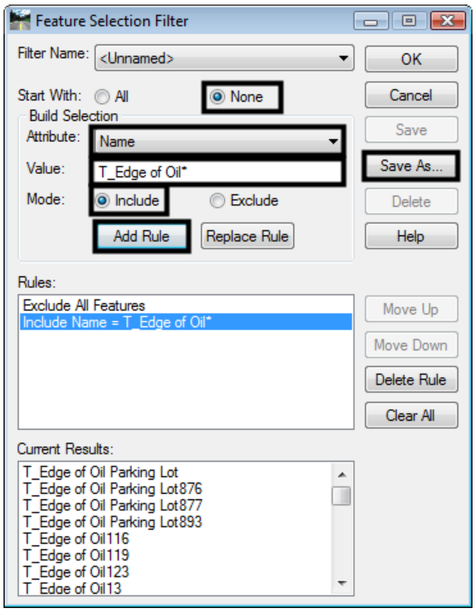
17. From the InRoads menu bar, select **Surface > Feature > Feature Selection Filter**.



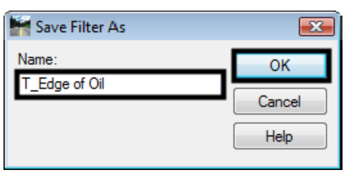
18. From the ***Feature Selection Filter*** dialog box, toggle on **None** for the ***Start With*** option.

19. Verify that the ***Attribute*** is set to **Name**.

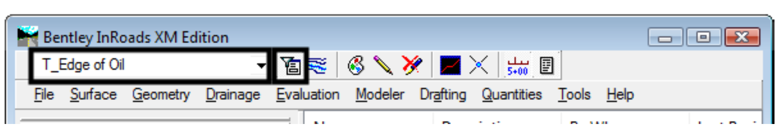
20. Key in ***T_Edge of Oil**** for the ***Value***.
21. Toggle on **Include** for the ***Mode***.
22. **<D>** the **Add Rule** button.
23. **<D>** the **Save As** button.



24. In the Save Filter As dialog box, key in ***T_Edge of Oil.***
25. **<D>** The **OK** button. This creates the filter and dismisses the ***Save Filter As*** dialog box.

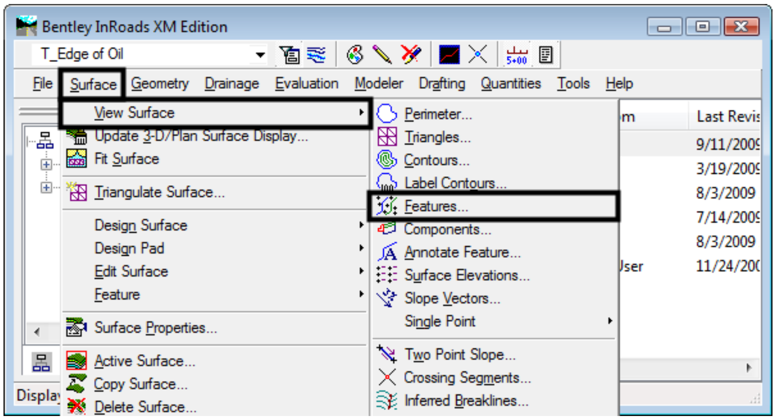


26. **<D>** the **OK** button to dismiss the ***Feature Selection Filter*** dialog box.
27. On the InRoads Locks toolbar, verify that the **T_Edge of Oil filter** is selected and that the **Feature Filter Lock** is turned on.



With the Feature Filter defined and set active, The pavement features needed can now be displayed.

28. Select **Surface > View Surface > Features** from the InRoads menu bar.

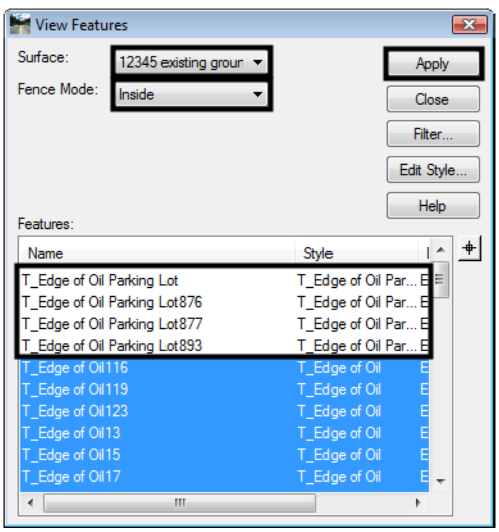


29. In the ***View Features*** dialog box, verify that **12345 existing ground-Overlay** is set as the ***Surface***.

30. Set the ***Fence Mode*** to **Inside**.

31. Hold the ***Ctrl*** key and **<D>** on each of the ***Parking Lot*** features to de-select them.

32. **<D>** the **Apply** button to display the features inside the fenced area.

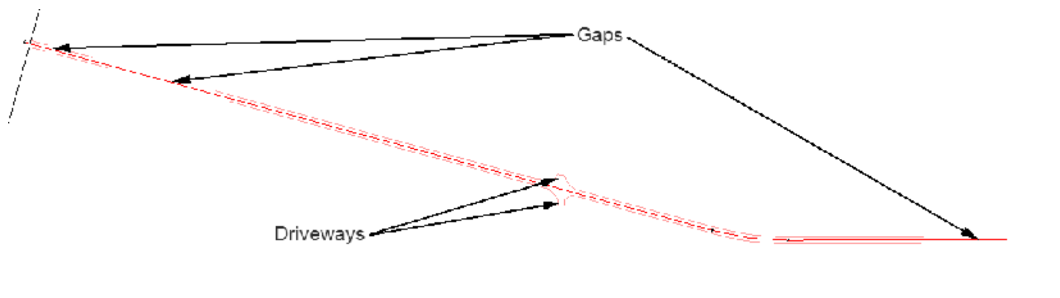


33. **<D> Close** to dismiss the ***View Features*** dialog box.

Note: If the features do not appear in the MicroStation window, **<D>** the **Fit View** from the view controls button bar.

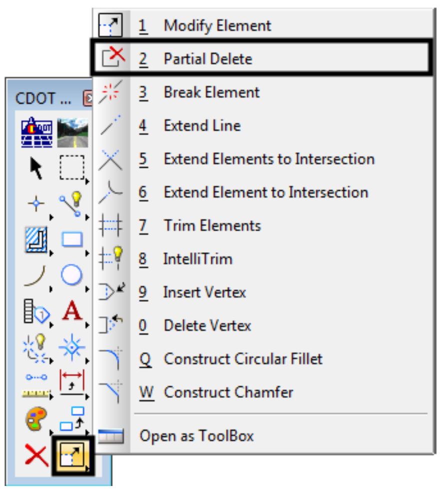
34. From the MicroStation Main toolbar, **<D> Place Fence** to dismiss the fence that was placed earlier.

Notice that each of the edge of oil features displayed has three gaps and a driveway in it. The driveways must be removed and gaps filled in before the pavement edges can be chained together. In order for the corridor to function properly, the lines placed to fill in the gaps must also include elevation information.

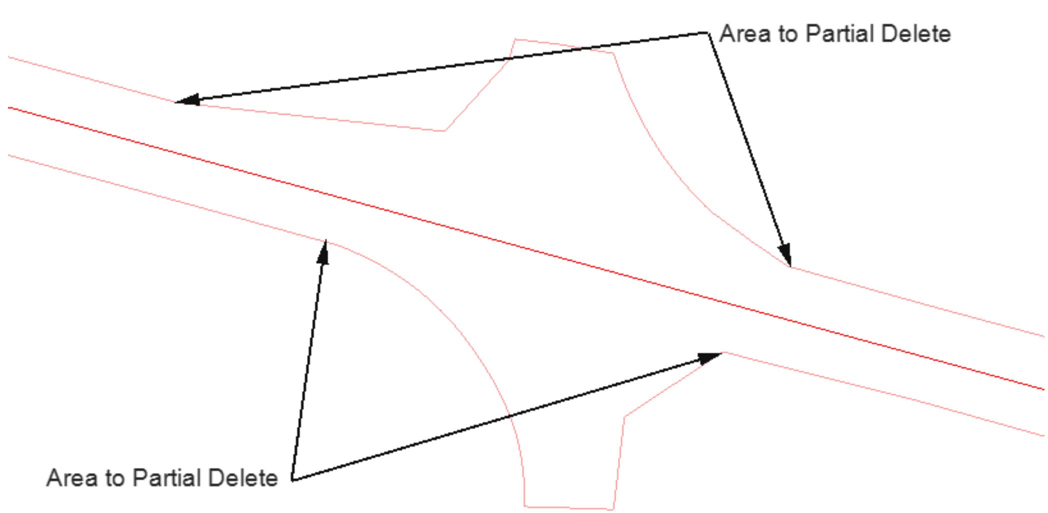


35. Use the MicroStation view controls to zoom in on the area with the driveways.

36. From the InRoads main toolbar, select the **Partial Delete** command.



37. **<D>** on the lines as indicated in the illustration below to remove the driveways.

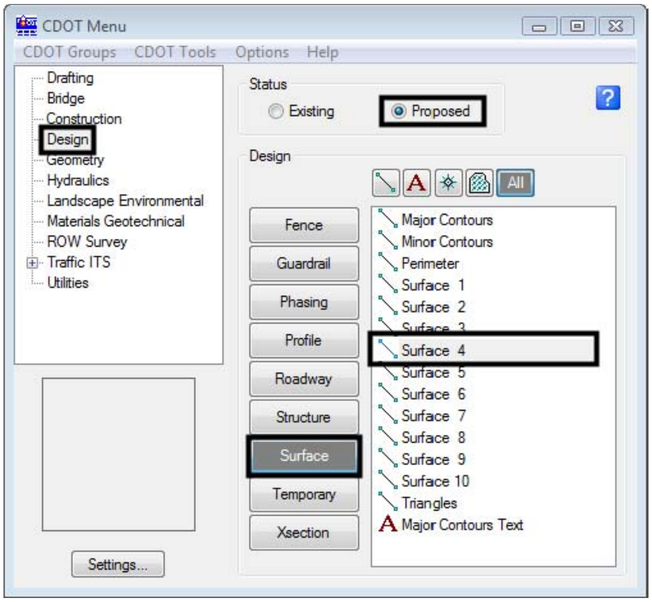


38. On the ***CDOT Menu***, select the **Design** group.

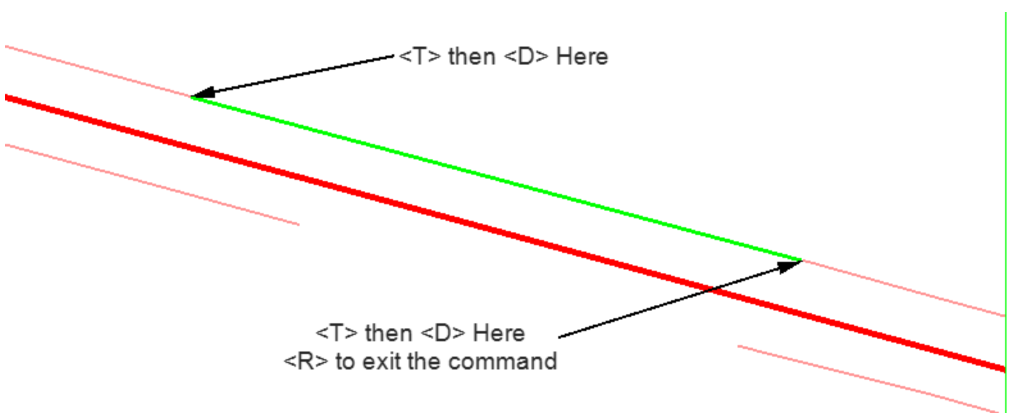
39. Verify that the ***Status*** is set to **Proposed**.

40. **<D>** the **Surface** button.

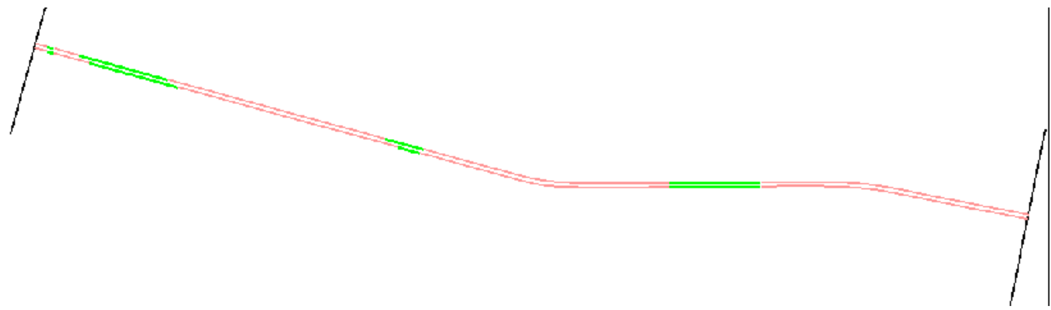
41. Highlight **Surface 4** from the item list. This level was selected because of the contrast to the features displayed.



42. **<T>** then **<D>** at each end of the gap created in the upper pavement edge line and then **<R>** to exit the place line command.

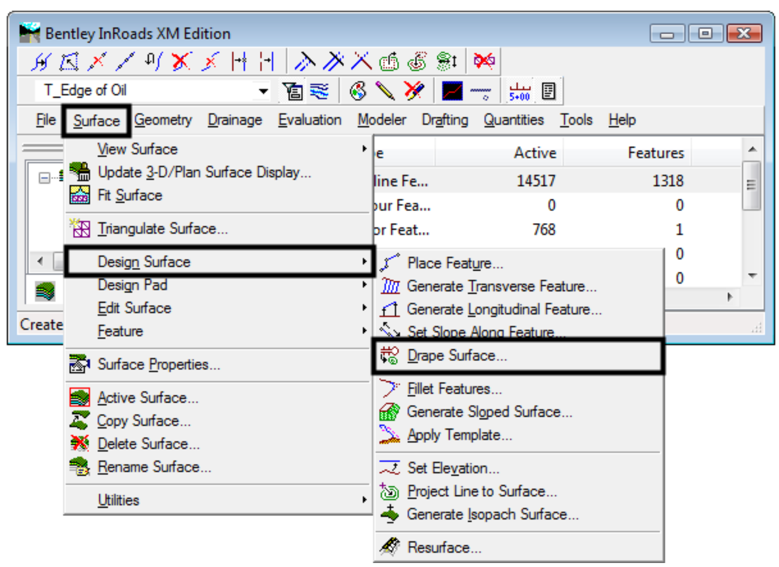


43. Repeat step 41 for each gap in the pavement edge lines. The illustration below shows all of the gaps closed.



The lines drawn are accurate to the surface only at the points where they were snapped to the features. To ensure that the lines represent the surface over the length of the line, the InRoads Drape Surface command is used.

44. From the InRoads menu bar, select **Surface > Design Surface > Drape Surface**.



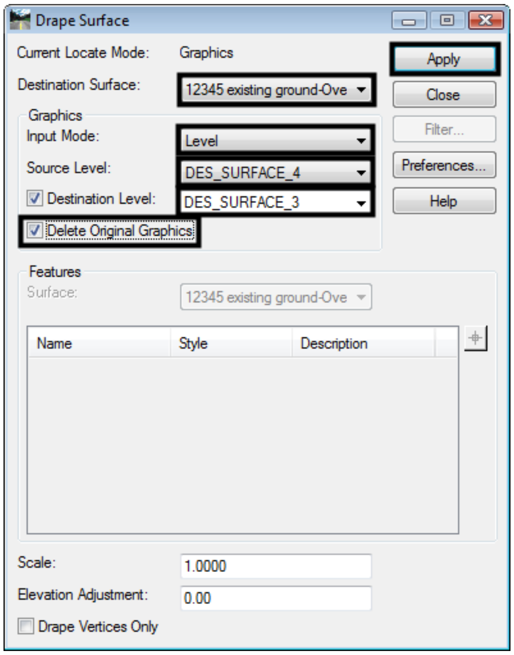
45. In the Drape Surface dialog box, verify that the Destination Surface is set to **12345 existing ground-Overlay**.

46. Set the ***Input Mode*** to **Level**.

47. Set the ***Source Level*** to **DES_Surface_4**.

48. Set the ***Destination Level*** to **DES_Surface_3**. This level was chosen because its display is different from both the lines drawn and the features displayed.

49. Toggle on **Delete Original Graphics**.



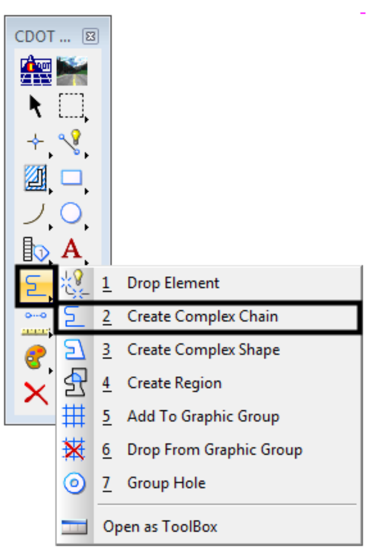
50. **<D> Apply**. The original lines are deleted and replaced with linestrings on the destination level, DES_SURFACE_3. The new linestrings contain a vertex at each point where the original line crossed a triangle in the destination surface.

Now the edge of oil lines can be chained into a single element.

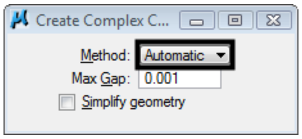
51. Select **Fit View** from the MicroStation ***View Controls***.

52. From the MicroStation main toolbar, select the **Delete** command and delete the lines that mark the begin and end of the project. This is to ensure that they are not accidentally included into one of the chains.

53. From the MicroStation main toolbar, select the **Create Complex Chain** command.



54. In the tool settings box, set the ***Method*** to **Automatic**.



55. **<D>** on the left most element in the top line then **<D>** in a blank area. All of the elements that make up the upper pavement edge highlight.

56. **<D>** in a blank area to accept the selection set and create a single chain from the elements.

57. **<D>** on the left most element in the bottom line then **<D>** in a blank area.

58. **<D>** in a blank area to accept the selection set and create the second chain.

Section Summary:

- Use Feature Selection Filters to limit the number of features to those needed.
- Use a MicroStation fence to further limit what is displayed to the area of the project.
- Once displayed, the feature graphics are like any other MicroStation element.
- Be careful if the Gap setting is increased for the Create Complex Chain command. Increasing the gap could allow the program to grab elements that are not intended to be part of the chain.

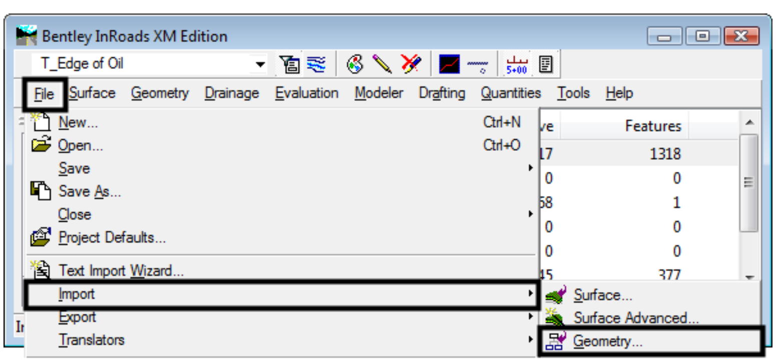
Lab 25.2 - Creating Alignments from Graphic Chains

Now that the pavement edges have been chained together, these linestrings can be imported as horizontal and vertical alignments.These alignments will be used for point controls in a later exercise.

Section Objectives:

- Import the graphic elements created in the previous exercise as horizontal and vertical alignments.

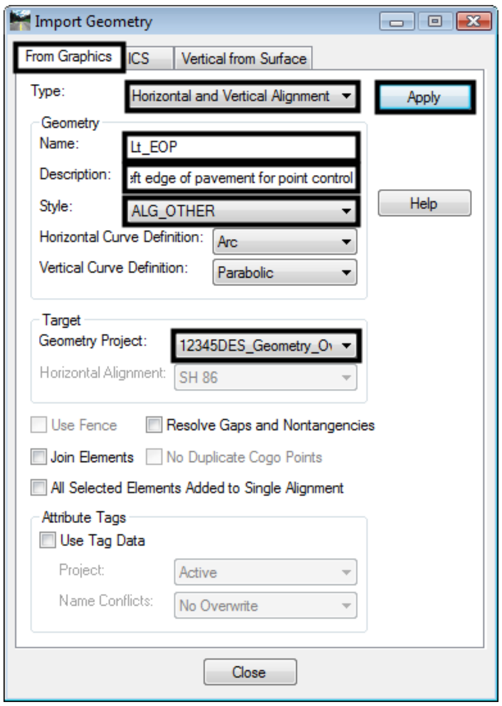
1. From the InRoads menu bar, select **File > Import > Geometry**.



2. On the ***Import Geometry*** dialog box, verify that the **From Graphics** tab is selected.

3. Set the ***Type*** to **Horizontal and Vertical Alignment**.

4. In the ***Name*** field, key in ***Lt_EOP***.
5. In the ***Description*** field, key in ***Left edge of pavement for point control***.
6. Select **ALG_OTHER** for the ***Style***.
7. Verify that the ***Geometry Project*** in the ***Target*** area is set to **12345DES_Geometry _Overlay**.
8. **<D> Apply**.



9. **<D>** on the upper chain, then **<D>** again to accept the selection. **<R>** to redisplay the ***Import Geometry*** dialog box.
10. In the ***Import Geometry*** dialog box, key in ***Rt_EOP*** for the ***Name***.
11. In the ***Description*** field, key in ***Right edge of pavement for point control***.
12. **<D> Apply**.
13. **<D>** on the lower chain, then **<D>** again to accept the selection. **<R>** to redisplay the ***Import Geometry*** dialog box.
14. **<D> Close** to dismiss the ***Import Geometry*** dialog box.
15. In the InRoads explorer, **<D>** the **Geometry** tab and verify that ***Lt_EOP*** and ***Rt_EOP*** are in the geometry project.
16. **Save** the **12345DES_Geometry_Overlay** geometry project.

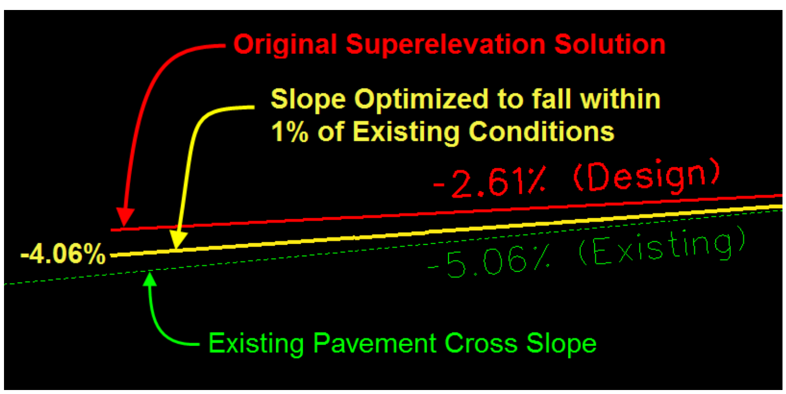
Section Summary:

- ♦ Take care when importing feature graphics as alignments, overlapping and gaps in elements are common and can cause problems in Roadway Designer.
- ♦ One way to tell if the Import Geometry command worked is to look in the Name field after the command was executed. If the last letter in the name has changed, then geometry was created.

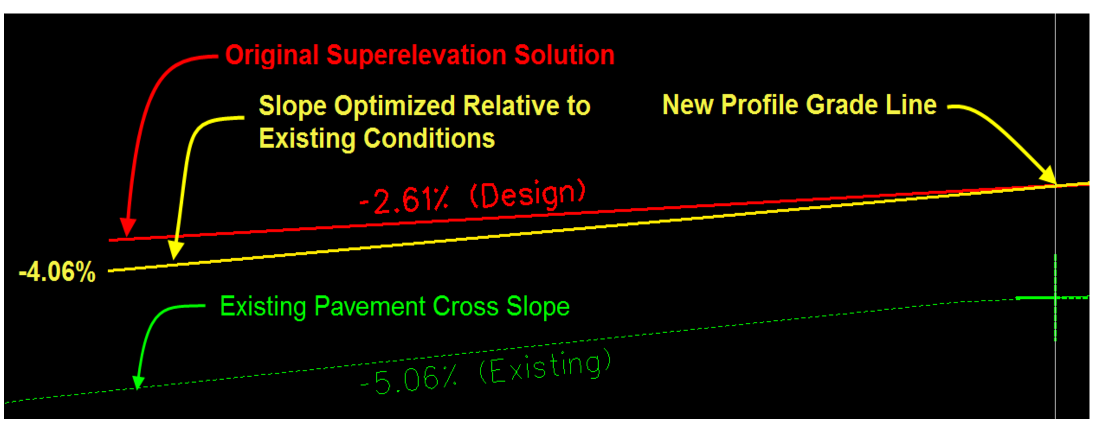
Lab 25.3 - Cross Slope Optimization - Concept Lab

Specialized tools for overlay and stripping projects have been included in the SELECTseries release of InRoads. Included in these tools is a slope optimization utility which defines the cross slope of a template relative to existing conditions. Also new components are available for refining a template to address overlay, pavement leveling, and milling requirements.

The slope optimization utility compares design cross slopes (as created through roadway designer, including superelevation) vs. existing conditions (from the existing ground DTM) at template application locations. Based on the Slope Tolerance provided by the user, a corrected slope value is calculated for each template drop. This information is used to modify the superelevation control line and adjust the template cross slope.



Slope optimization can be utilized if the design profile is coincident or offset from existing conditions.



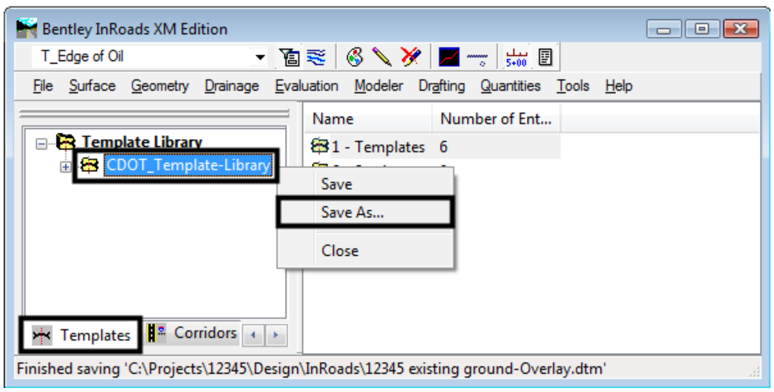
Section Objectives:

- ♦ Copy the standard template library into the project folder.

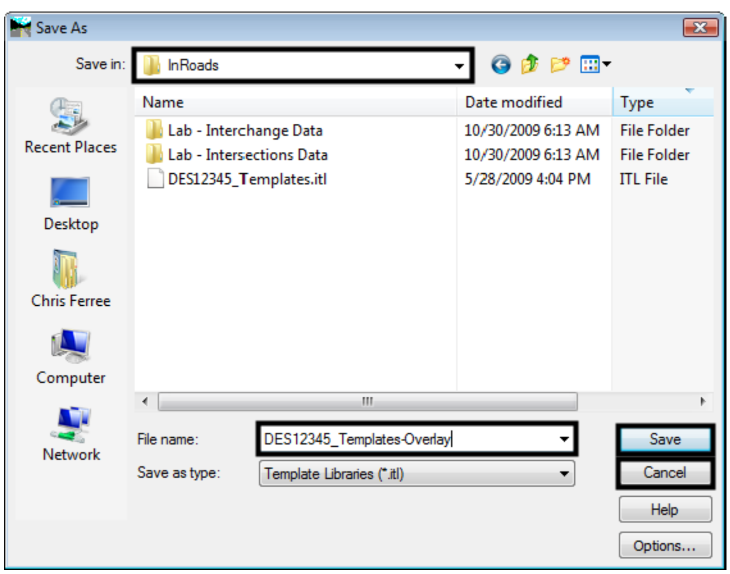
- Create a new template placeholder.
- Add simple components to define the template.
- Illustrate the function of the slope optimization tool.
- A subsequent lab will utilize slope optimization to model an overlay and widening project.

First, the standard template library is copied into the project directory.

1. In the InRoads explorer, **<D>** the **Template** tab.
2. **<R>** on the **CDOT_Template-Library** and select **Save As** from the right click menu.

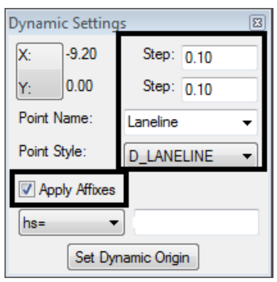


3. In the **Save As** dialog box, verify that the **C:\Projects\12345\Design\InRoads** directory is selected.
4. In the ***File name*** field, key in ***DES12345_Templates-Overlay***.
5. **<D> Save** then **<D> Cancel**.

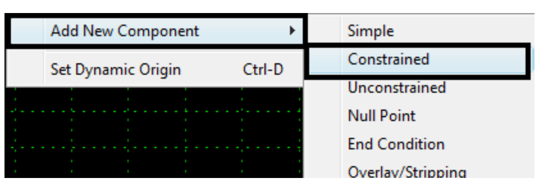


Next, a new template is created in the template library. The template will be very basic to illustrate the slope optimization utility however the concept can be applied to any template created.

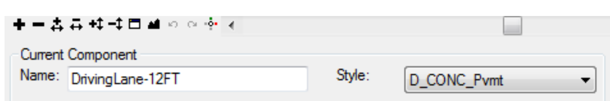
6. On the InRoads menu bar, select **Modeler > Create Template**.
7. In the Create Template dialog box, expand the **C:\Projects\12345\Design\InRoads\DES12345_Templates-Overlay.itl > 1 - Templates** folder.
8. **<R>** on the **1 - Templates** folder and select **New > Template** from the right click menu.
9. Key in ***12345_Slope-Optimization*** for the ***template name***.
10. Key in **12 FT lane with 2% Cross Slope** for the ***description***
11. Display the **Dynamic Settings** dialog box (Tools>Dynamic Settings)
12. Key in ***0.10*** for the ***X*** and ***Y Steps***.
13. Toggle on **Apply Affixes**.
14. Select Point Name: **Laneline**
15. Select Point Style: **D_LANELINE**



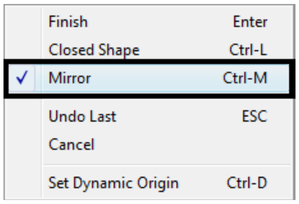
16. **<R>** in the template view and select **Add New Component > Constrained** from the right click menu.



17. In the ***Current Component*** area, key in ***DrivingLane-12FT*** for the ***Name***.
18. Select **D_CONC_Pvmt** for the ***Style***.

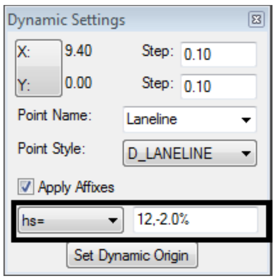


19. **<R>** in the template view and select **Mirror** from the right click menu.



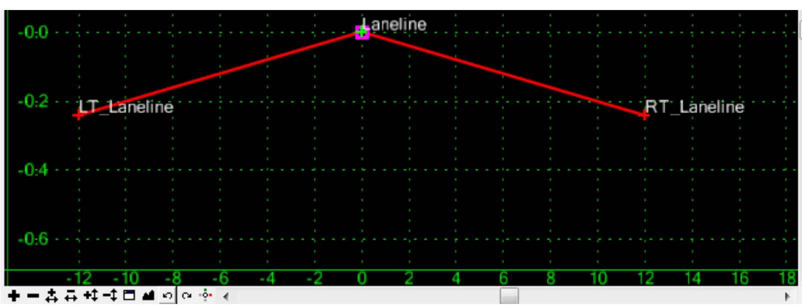
20. **<D>** on the template origin.

21. key in ***12,-2.0%*** in the **hs=** field and **<enter>** to build the components

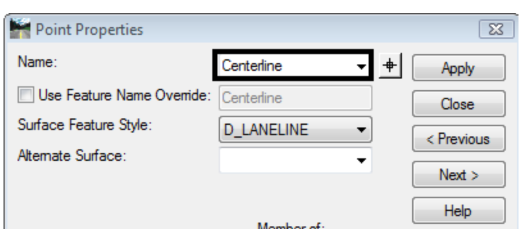


22. **<enter>** a second time to finish the component.

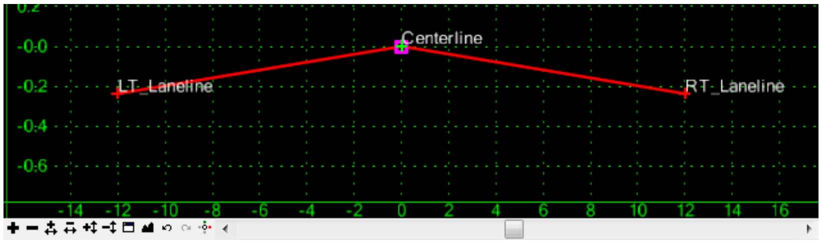
23. This creates two components representing left and right lanes.



24. ***Rename*** the template origin to **Centerline by <D><D>** on the point.



25. Key in ***Centerline*** and Select **Apply**



26. ***Save*** the template library by selecting **File>Save**

27. The Create Template dialog is no longer needed, select **Close.**

Lab 25.4 - Creating the Slope Optimized Corridor

A corridor is constructed using the template developed and slope optimization will be applied.

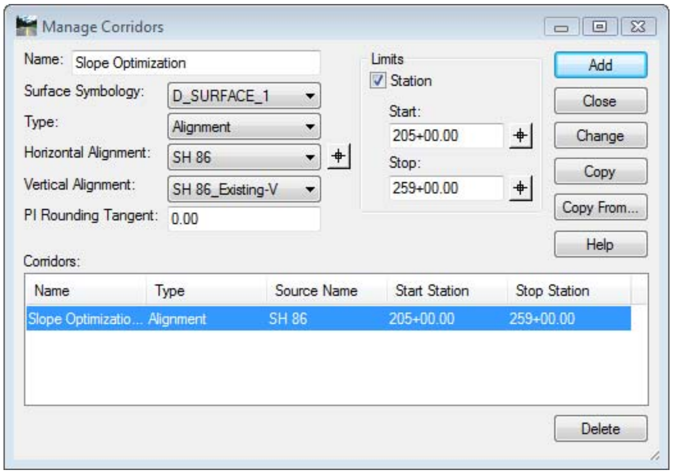
Section Objectives:

- Create a corridor for the SH 86 alignment.
- Add a template drop using the developed template.
- Develop a Superelevation solution for the corridor.
- Review the superelevation solution in Roadway Designer.
- Apply slope optimization to modify the superelevation control lines
- Review the revised corridor

This corridor will contain a single template application. Superelevation is required for this corridor because of design speed criteria. However once the superelevation solution is calculated it will be modified to minimize the cross slope variation relative to existing conditions.

1. From the InRoads menu bar, select **Modeler > Roadway Designer**.
2. In the ***Roadway Designer*** dialog box, select **Corridor > Corridor Management** from the menu bar.
3. In the ***Manage Corridors*** dialog box, key in ***Slope Optimization*** for the ***Name***.
4. ***Surface Symbology:*** **D_Surface_1**
5. ***Horizontal Alignment:*** **SH 86**
6. ***Vertical Alignment:*** **SH 86_Existing-V**
7. Toggle on **Station Limits**.
8. Key in ***205+00.00*** for the ***Start*** station.
9. Key in ***259+00.00*** for the ***Stop*** station.

10. **<D> Add** then **<D> Close** to dismiss the dialog box.



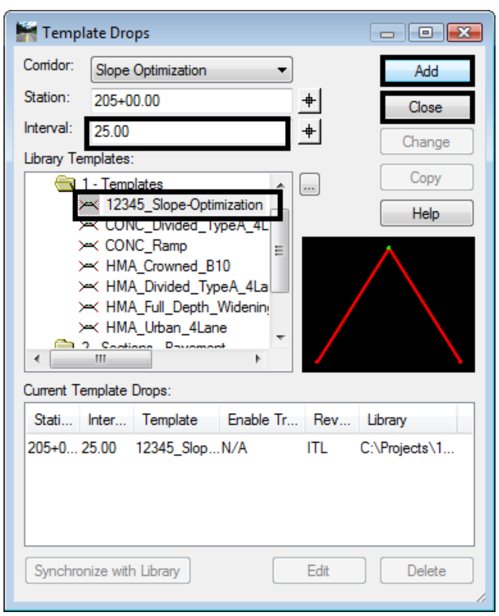
11. In the ***Roadway Designer*** dialog box, select **Corridor > Template Drops** from the menu bar.

12. In the ***Template Drops*** dialog box, key in ***25.00*** for the ***Interval***.

13. Expand the **C:\Projects\12345\Design\InRoads\DES12345_Templates-Overlay** template library to show the contents of the **1 - Templates** folder.

14. Highlight the **12345_Slope-Optimization** template.

15. **<D>** the **Add** button then **<D>** the **Close** button to dismiss the ***Template Drops*** dialog box.



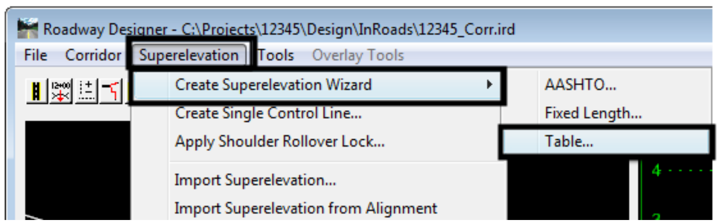
The template is now displayed in the cross section view. Next, superelevation controls are added to the corridor.

Calculating the Initial Superelevation

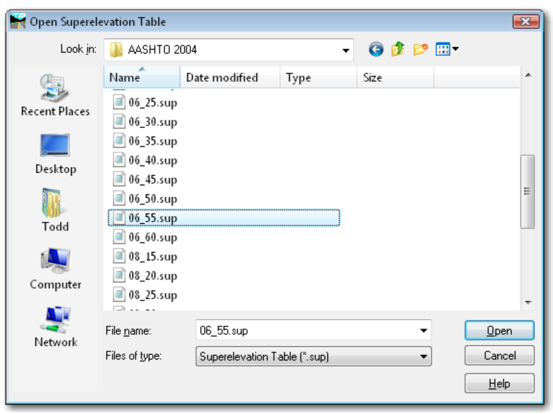
Superelevation is computed to develop a control line along each edge of pavement. In a subsequent command, Cross Slope Optimization, the computed design cross slopes are evaluated relative to existing conditions. When developing an optimized cross slope the superelevation control lines are copied and modified to develop a revised solution.

Use the Superelevation Wizard:

1. Select **Superelevation > Create Superelevation Wizard > Table** from ***the Roadway Designer*** menu bar.

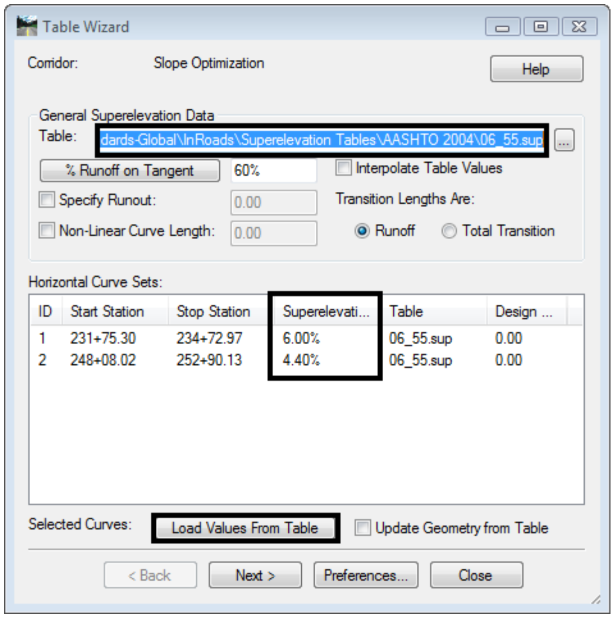


2. In the ***Table Wizard*** dialog box, select the desired super table. These are located in the ***C:\Workspace\Workspace-CDOT_V8i\Standards-Global\InRoads\Superelevation Tables\AASHTO 2004*** folder.



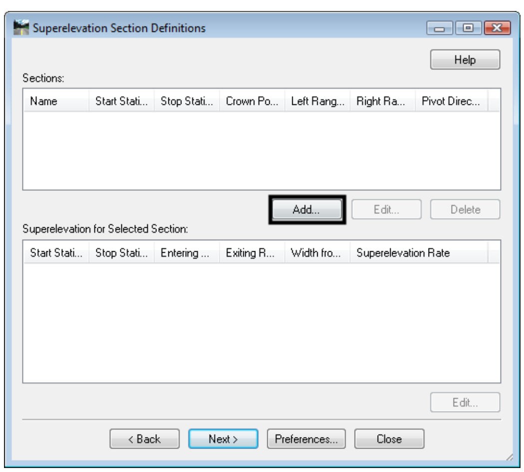
3. Select ***06-55.sup*** and **<D>** the **Open** button.

4. **<D>** the **Load Values From Table** button.

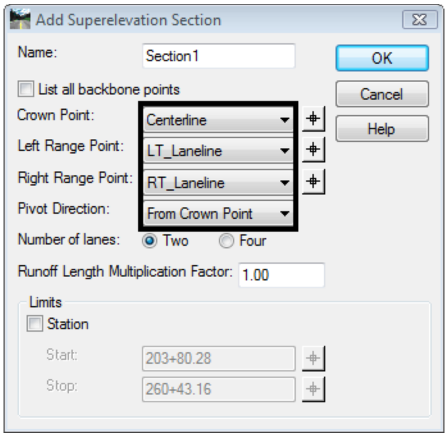


The rate values are read from the table and updated for each horizontal curve set listed in the dialog box or highlighted.

5. **<D> Next**.



6. **<D>** the **ADD** button on the ***Superelevation Section Definitions*** pane. This displays the ***Add Superelevation Section*** dialog box.



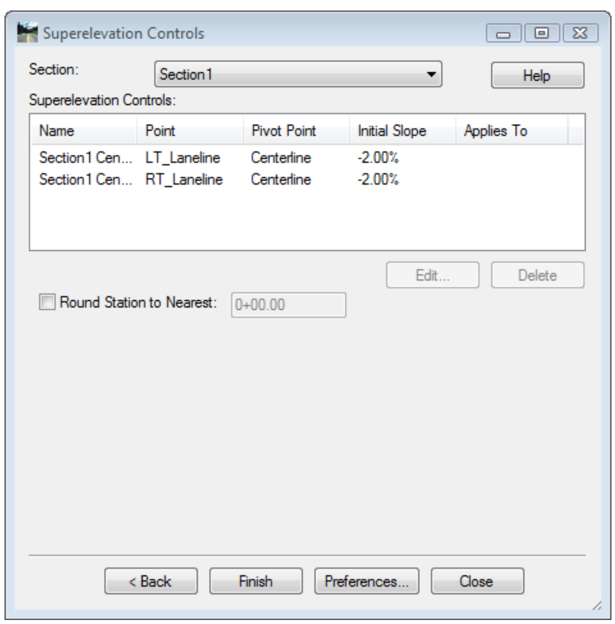
7. Use the drop down menu or the target  button to select the ***Crown Point:*** **Centerline**.

8. Use the drop down menu or the target button to select the ***Left Range Point:*** **LT_Laneline.**

9. Use the drop down menu or the target button to select the ***Right Range Point:*** **RT_Laneline.**

10. **<D>** OK

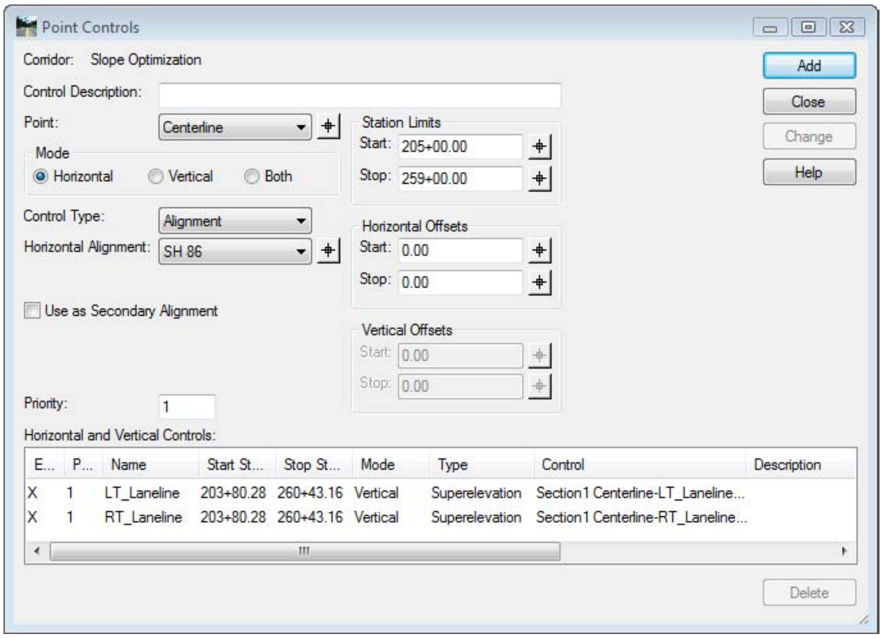
11. **<D> Next** on the ***Superelevation Section Definitions*** pane. This displays the ***Superelevation Controls*** pane.



Note: This box lists point controls that are created automatically when you step through the Superelevation Wizard. The point controls determine the vertical location (by defining a cross slope) of template points (those at and inside the range points) while rotating in superelevation.

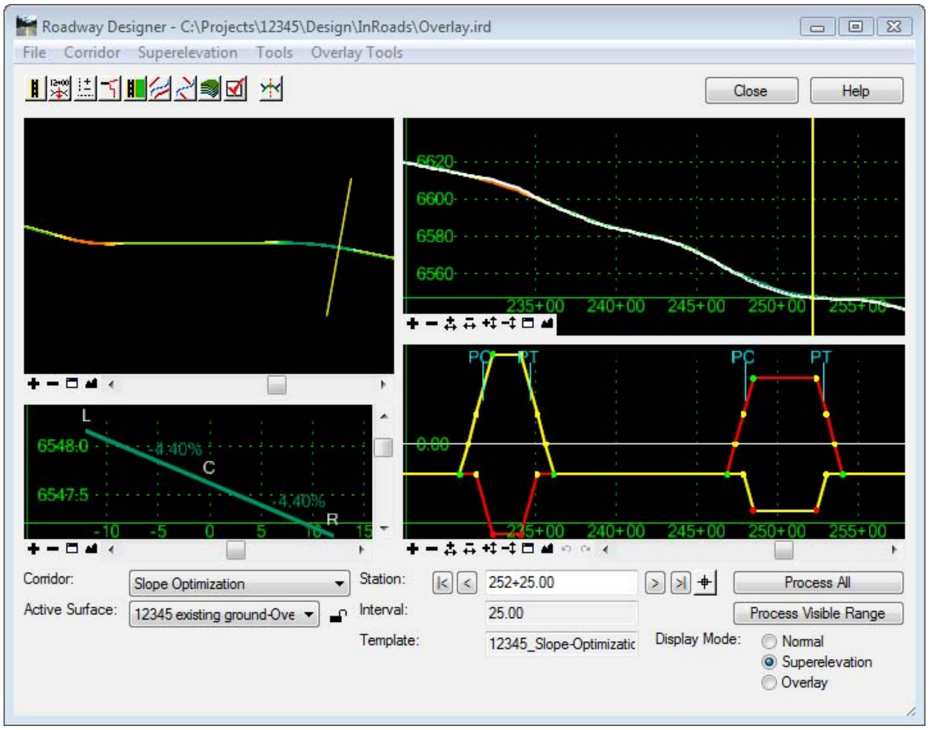
12. **<D> Finish**. This completes the development of superelevation for the corridor.

The Wizard creates superelevation control lines and uses point controls to assign them to template points located within the superelevation range.



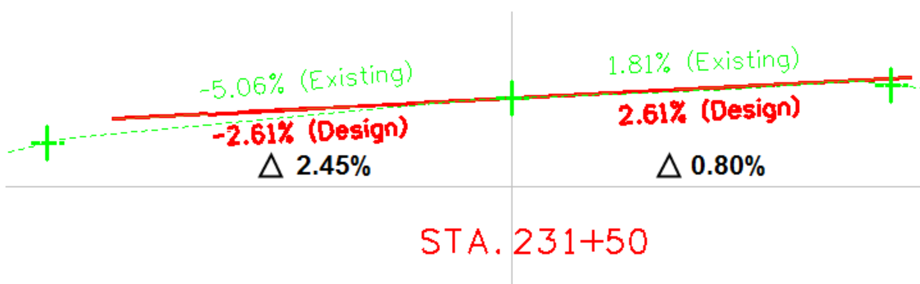
You will need to process your design to see the superelevation results. Each point control corresponds to a control line on the superelevation diagram.

The superelevation control lines are displayed on the superelevation diagram view in Roadway Designer. The control lines represent the percent cross slope (vertical axis) at each station (horizontal axis) for each point that is superelevated in the super range.



13. Toggle between ***Superelevation*** and ***Normal*** display mode to evaluate the design cross slopes vs. the existing conditions along the corridor.

14. In particular review station **231+50**



InRoads has developed the design cross slope based on a theoretical superelevation solution. Due to the nature of this project it is necessary to minimize the amount of cross slope deviation between the design and existing conditions. The slope optimization tool lets a designer add overrides to the computed Superelevation solution.

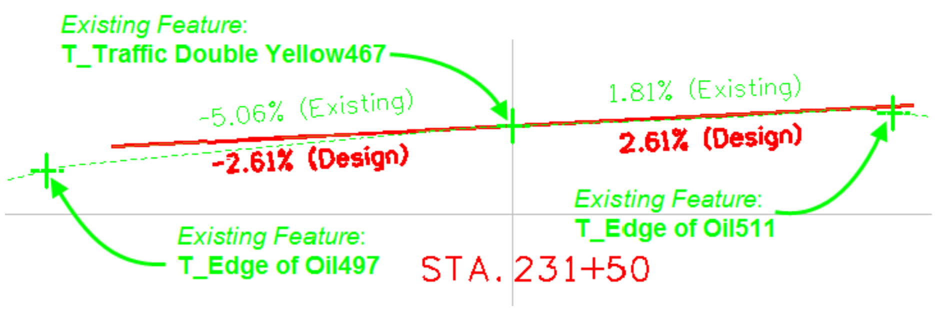
Developing a Slope Optimized Solution

For the following exercise, assume that the desired maximum delta cross slope has been determined to be a maximum of 1.0%.

- Slope optimization develops additional control lines based on modifications to the superelevation solution developed for the design. The new control line takes precedence over the original superelevation solution by automatically disabling the original solution.
- Slope optimization has to be developed independently for each lane or side of the roadway.
- Station ranges can be used to isolate curves or may be necessary based on the location of controlling features contained in the existing DTM.
- Slope optimization may be used whether the design templates contain overlay/ stripping components or not.

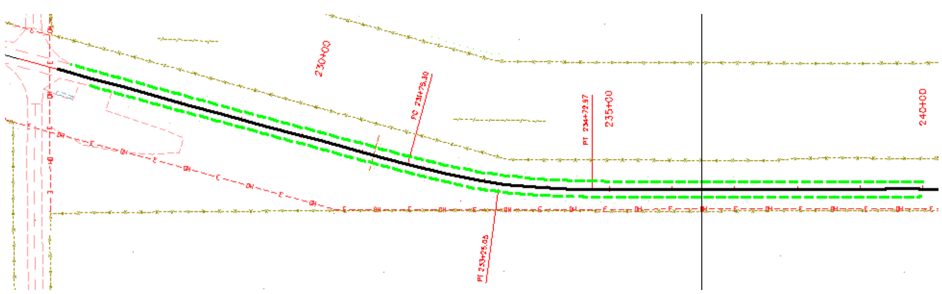
At each template application location the existing ground cross slope is determined by computing the delta elevation divided by the absolute distance between the existing pivot point and either a feature in the existing DTM or an alignment that represents the existing edge of pavement.

In the ***Cross Slope Optimization*** dialog, the alignments developed in labs 15.1 and 15.2 can be used as the ***Existing Ground Cross Slope Definition***. However for this exercise, features that reside in the existing DTM will be used to illustrate an optional workflow.



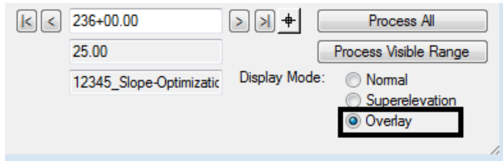
By reviewing the physical location of features contained in the existing DTM it has been determined that a solution can be developed between station range 226+55 and 239+75 which encompasses a superelevated area of the design.

The left side of the roadway will be processed first followed by the right side.

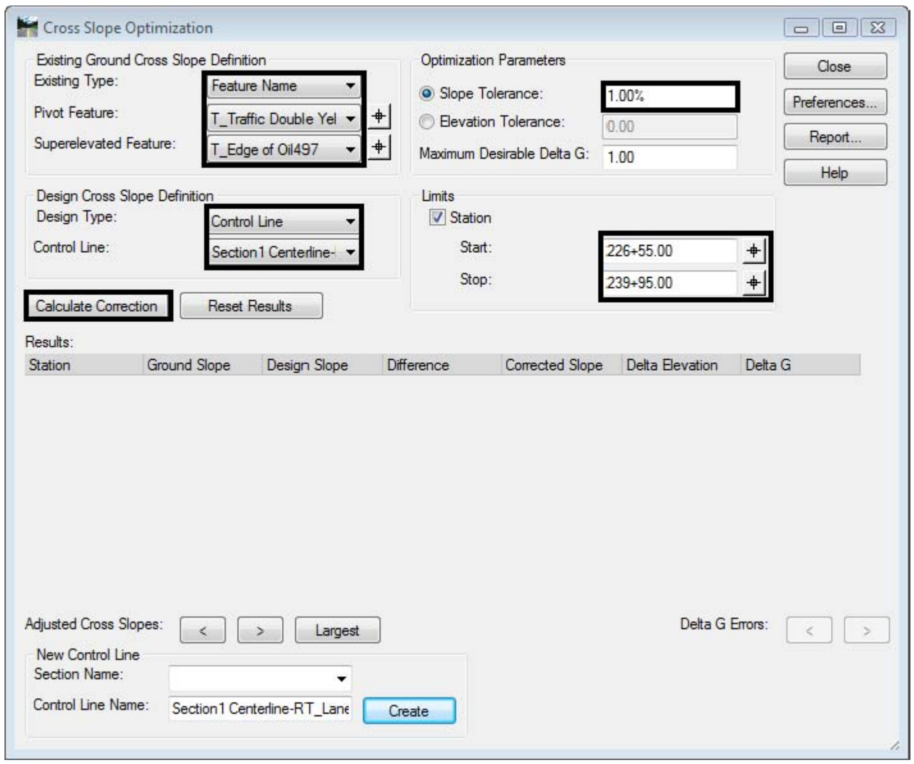


1. In ***Roadway Designer*** toggle on ***Display Mode:*** **Overlay.**

   Note: The display mode ***must*** be set to overlay to access the overlay toolset.



2. In ***Roadway Designer*** Select **Overlay Tools>Cross Slope Optimization.**



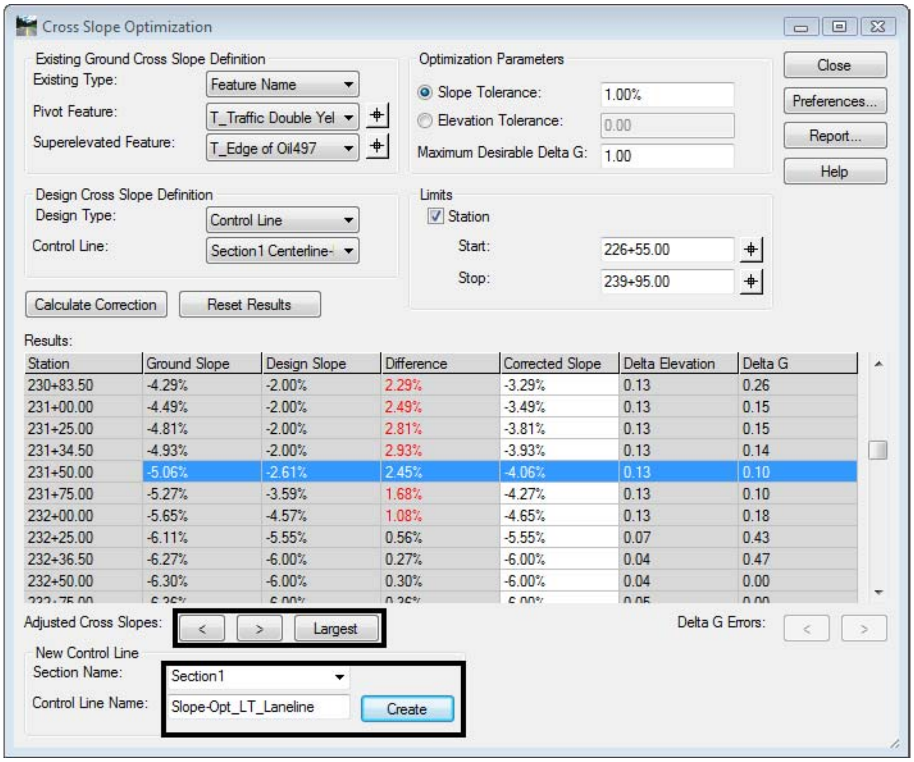
Enter the following criteria to define the ***Existing Ground Cross Slope Definition.***

3. ***Existing Type:*** **Feature Name**
4. ***Pivot Feature:*** **T_Traffic Double Yellow 467**
5. ***Superelevated Feature:*** **T_Edge of Oil497**

For the ***Design Cross Slope Definition*** select the superelevation control line developed previously for the ***left*** edge of pavement.

6. ***Design Type:*** **Control Line**
7. ***Control Line:*** **Section 1 Centerline-LT**
8. Key in ***1.00%*** for the ***Optimization Parameters - Slope Tolerance***
9. Toggle on ***Station Limits*** and define limits ***Start 226+55 Stop 239+50***

10. **<D>** ***Calculate Correction*** a solution is presented.



11. Use the navigation arrows to move between the ***Adjusted Cross Slopes*** or to the largest adjustment.

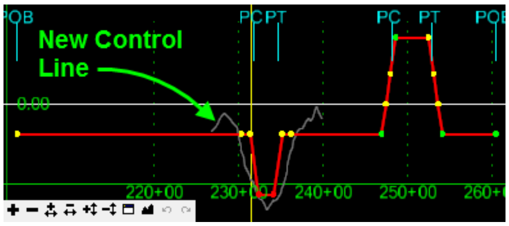
12. Navigation arrows also exist to review any ***Delta G*** values that exceed the desirable maximum between stations. This value is not used for computing Corrected Slopes and is used for reporting only.

13. Review station **231+50**. The ***Corrected Slope*** (-4.06%) is equal to the existing ***Ground Slope*** (-5.06%) less the specified ***Slope Tolerance*** (1.0%).

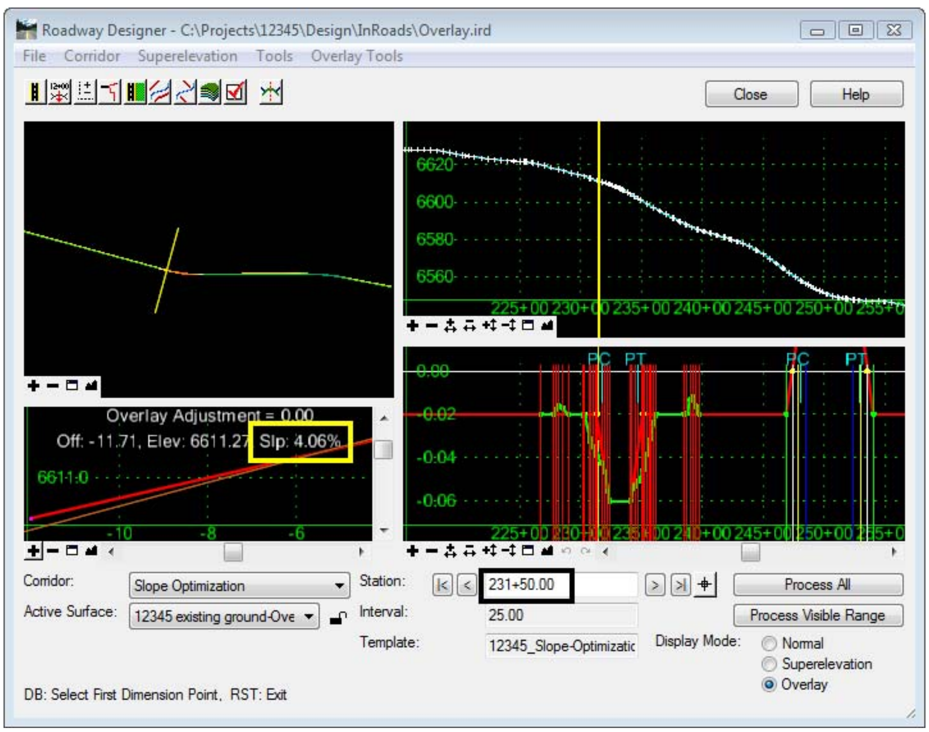
14. Select **Report** to generate an XML report for the solution. Dismiss the report after reviewing.

Note: If it's determined the solution is not valid, selecting ***Rest Results*** will clear the results grid.

Note the ***Corrected Slope*** column. New cross slopes have been computed based on the existing conditions cross slope and the allowable ***Slope Tolerance.*** Edits to the corrected values can be made at this time if necessary. Once the new control line is saved edits can also be made to the new control line as with any other superelevation control line. Also note that the solutions are applied at template locations as defined in the corridor. As you navigate between station entries, the ***Roadway Designer*** views synchronize and both the original and the new control line are displayed in the superelevation diagram window.

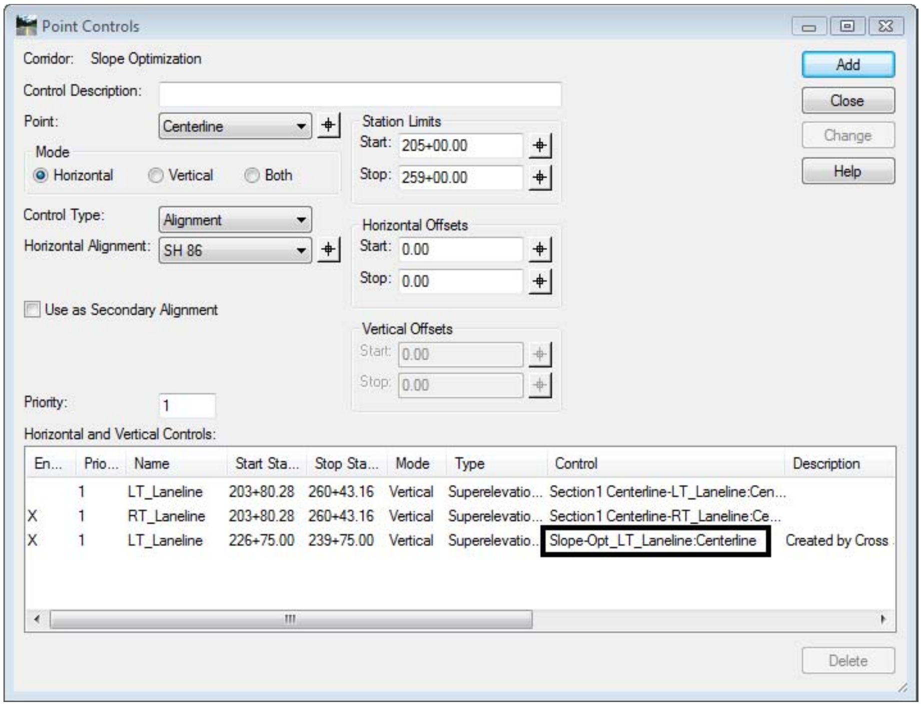


15. Under ***New Control Line***, select ***Section Name:*** **Section 1.**
16. For ***Control Line Name***: Key in ***Slope-Opt_Lt_Laneline.***
17. **<D>** ***Create***.



18. Review the new control line in the superelevation view and as point controls.
19. The **Superelevation>Superelevation Report** command can also be used to review the results. When creating reports include ***Control Line Definitions*** to verify which control line is being reviewed.

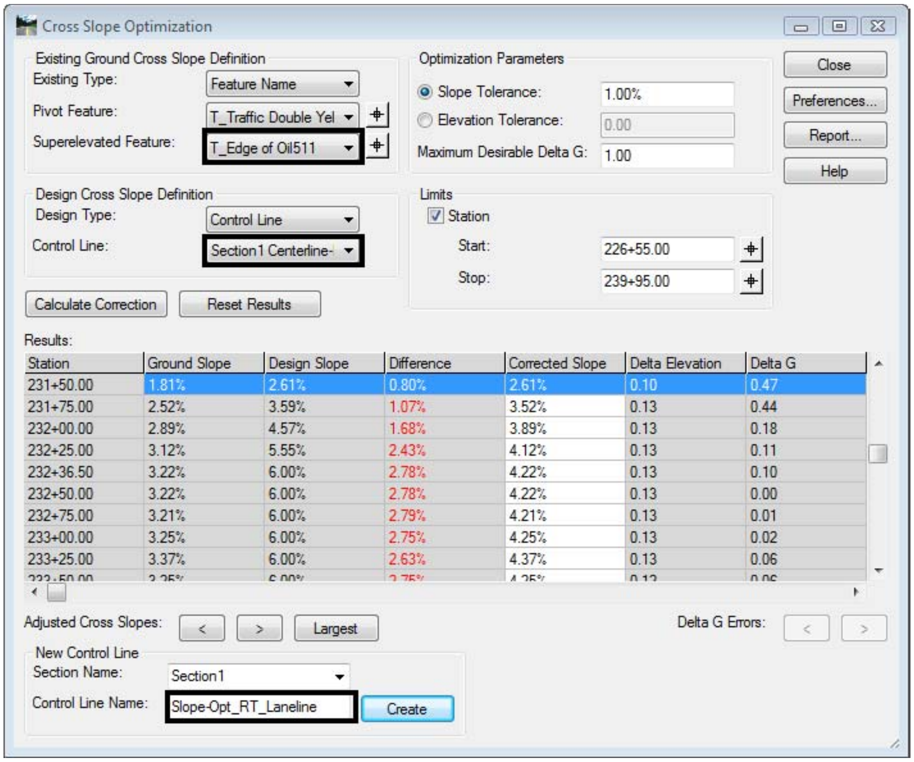
20. Select **Corridor>Point Controls** to view the added control line. Note that is automatically enabled and the original superelevation control line is disabled.



21. ***Repeat*** steps 2 thru 15 to develop the solution for the right side of the roadway using the following input changes:

- ♦ Existing Ground Cross Slope Definition: Superelevated Feature: **T_Edge of Oil511**
- ♦ Design Cross Slope Definition: Control Line: **Section1 Centerline-RT_Laneline**

- New Control Line: Control Line Name: **Slope-Opt_RT_Laneline**



22. Review the results as in steps 16-18.
23. Once the results have been reviewed and confirmed save the roadway definition.
24. From the Roadway Designer menu bar, select **File > Save**.
25. In the ***File name*** field of the ***Save As*** dialog box, key in ***12345_DES_Overlay.IRD***

Section Summary:

- The width of the template can be controlled by adding additional point controls or through the use of parametric constraints.
- Slope Optimization can be used to create a design surface that is vertically offset but constrained (parallel or within a delta tolerance) to existing conditions.
- A superelevation control line is not a requirement. If matching existing grade, a Design Cross Slope of any value can be input. With Slope Tolerance set to 0% the Corrected Slope will match existing conditions.
- An Elevation Tolerance can be used in place of a slope tolerance.
- Review the point controls created in Roadway Designer. Those created by the Cross Slope Optimization tool should be active and the control lines created by the superelevation control wizard should not be enabled.
- Look for and resolve any conflicting point controls (shown in orange).
- Cross Slope Optimization can be used on any template.

Lab 25.5 - Creating a Overlay/Stripping Template with Widening

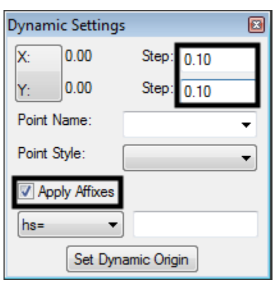
The goal of this lab is to overlay the existing roadway and add paved shoulders outside the existing pavement. In Labs 15.1 & 15.2 alignments were created that represent the existing pavement edges. These alignments will be used as horizontal point controls to maintain the existing pavement width.

Note: Stripping and milling are interchangeable terms. They both refer to the uniform removal of some amount of pavement material from an existing roadway. InRoads menus and reference material use the term stripping.

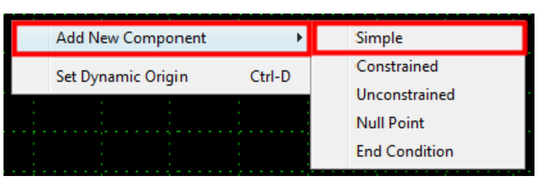
Section Objectives:

- A 2” pavement overlay is required.
- Existing pavement cross slopes will be maintained.
- Existing pavement can be stripped to a depth of 1”.
- Pavement leveling using a material that differs from the overlay course is necessary.
- 8’ paved shoulders will be added to the outside of the existing pavement.

1. Key in ***12345_Overlay*** for the template name.
2. Key in ***2” overlay with 1” milling & pavement widening*** for the description.
3. Display the **Dynamic Settings** dialog box.
4. Key in ***0.10*** for the ***X*** and ***Y Steps***.
5. Toggle on **Apply Affixes**.

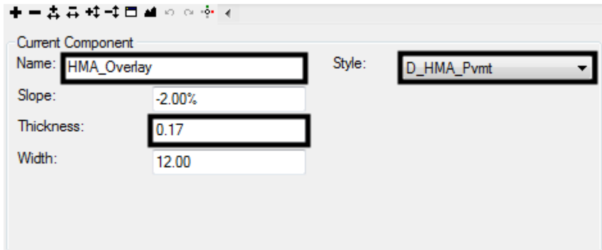


6. **<R>** in the template view and select **Add New Component > Simple** from the right click menu.

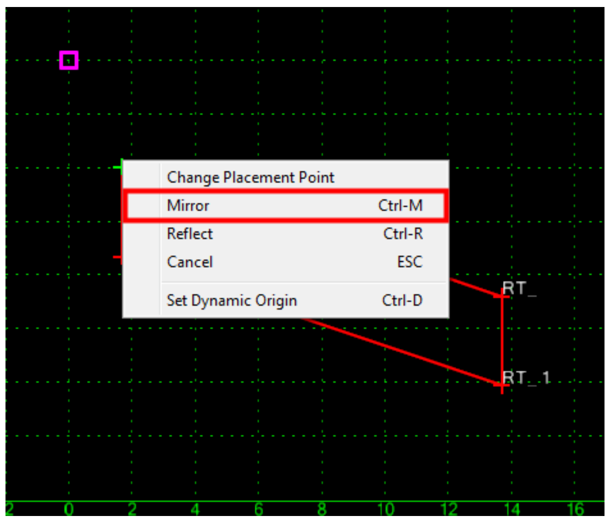


7. In the ***Current Component*** area, key in ***HMA_Overlay*** for the ***Name***.
8. Select **D_HMA_Pvmt** for the ***Style***.

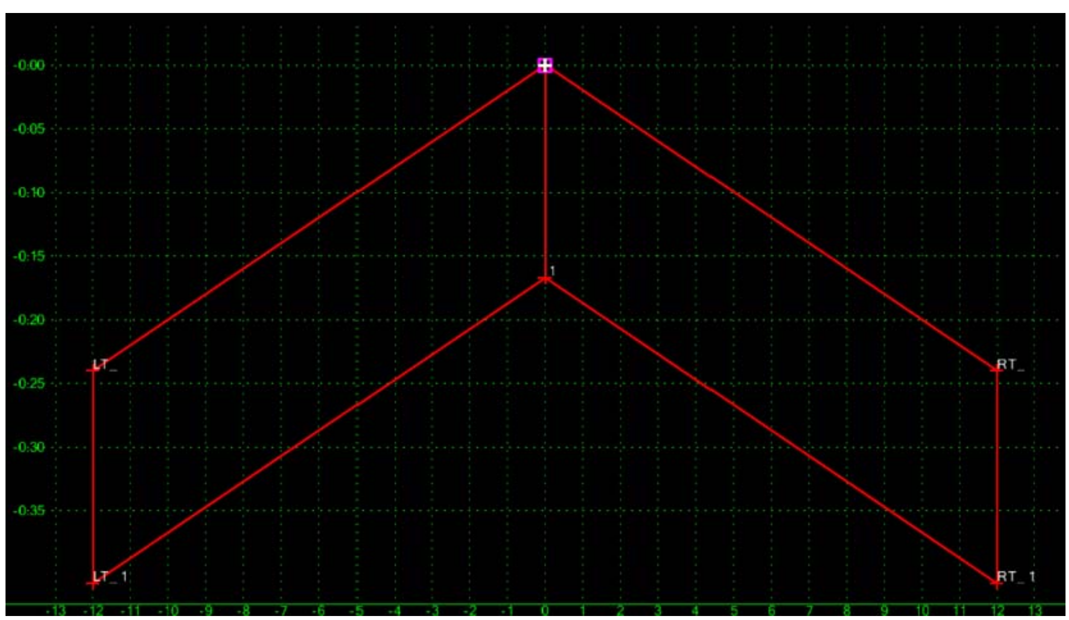
9. Key in ***0.1667*** for the ***Thickness***. Note: this will round to 0.17 in the dialog box.



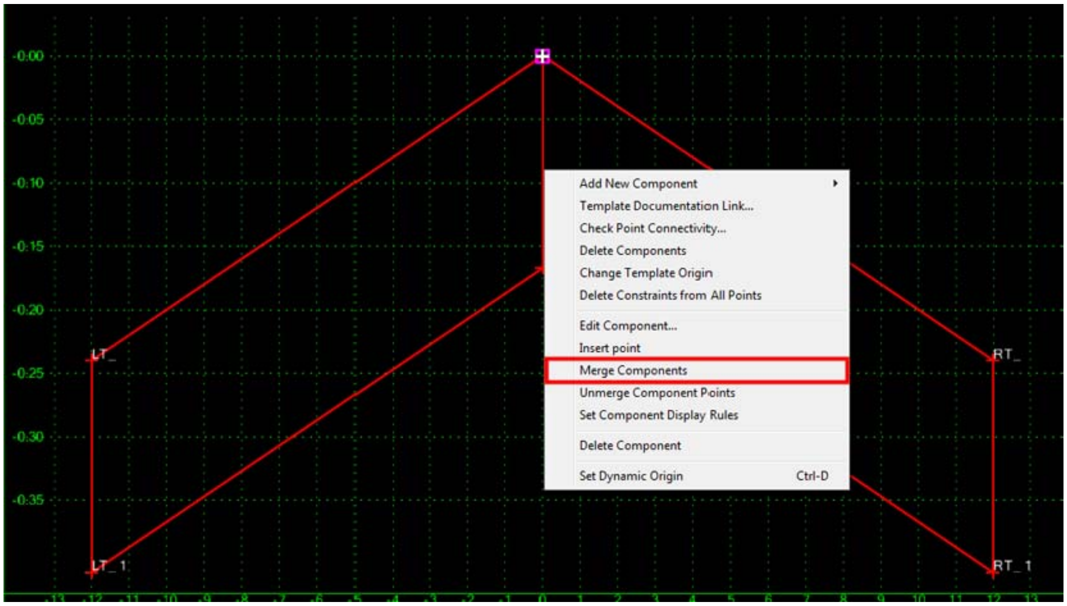
10. **<R>** in the template view and select **Mirror** from the right click menu.



11. **<D>** on the template origin. This creates the two components shown in the illustration below.



12. **<R>** on the vertical line in the center of the template and select **Merge Components** from the right click menu.

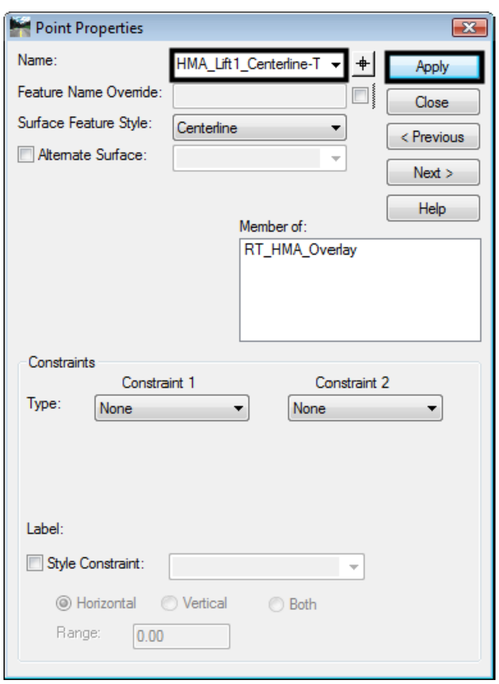


13. **<D> <D>** on the centerline point of the template to display the ***Point Properties*** dialog box.

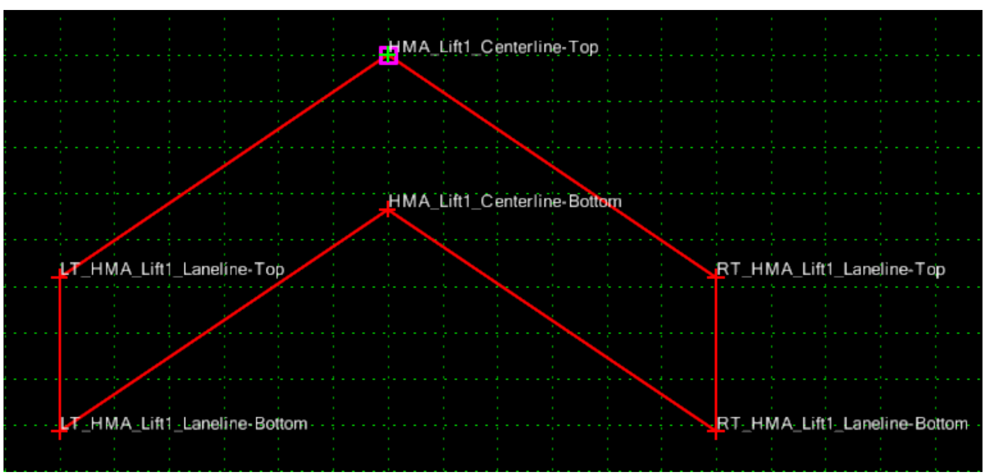
14. In the ***Point Properties*** dialog box, select **HMA_Liftx_Centerline-Top** in the ***Name*** field. This also sets the ***Surface Feature Style*** to **Centerline**.

15. Change the ***x*** to a ***1*** in the ***liftx*** part of the name.

16. **<D> Apply** to accept the change.



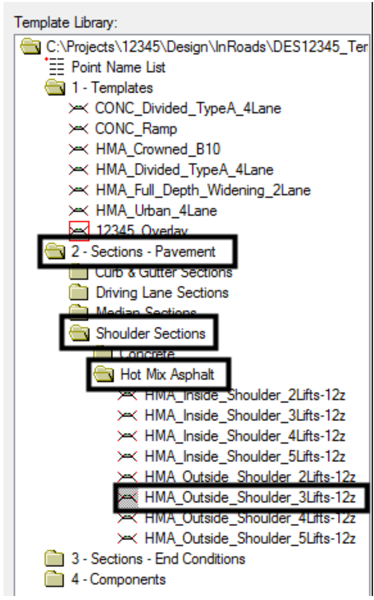
17. **<D>** the **Next** button to select the center bottom point (***1***).
18. Select **HMA_Liftx_Centerline-Top** in the ***Name*** field.
19. **<D> Apply** to accept the change.
20. **<D>** the **Next** button to select the right top point (***RT_***).
21. In the same manner as done in steps 22 and 26, change the name of the point to ***RT_HMA_Lift1_Laneline-Top***.
22. **<D> Apply** to accept the change.
23. **<D>** the **Next** button to select the right bottom point (***RT_1***).
24. Change the name of the point to ***RT_HMA_Lift1_Laneline-Bottom***.
25. **<D> Apply** to accept the change.
26. **<D>** the **Next** button to select the right top point (***LT_***).
27. In the same manner as done in steps 22 and 26, change the name of the point to ***LT_HMA_Lift1_Laneline-Top***.
28. **<D> Apply** to accept the change.
29. **<D>** the **Next** button to select the right bottom point (***LT_1***).
30. Change the name of the point to ***LT_HMA_Lift1_Laneline-Bottom***.
31. **<D> Apply** to accept the change.
32. **<D> Close** to dismiss the ***Point Properties*** dialog box. The template looks like the illustration below:



Now the shoulders and end conditions are added.

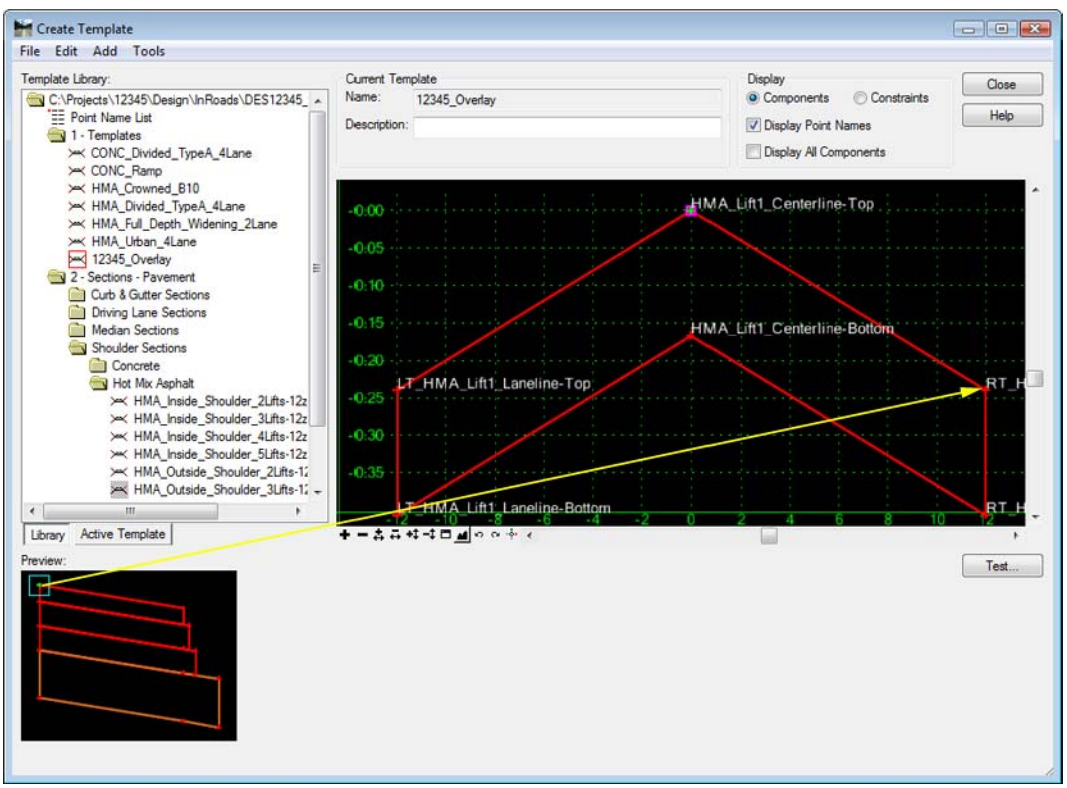
33. Expand the template library to show the contents of the **2 - Sections - Pavement > Shoulder Sections > Hot Mix Asphalt** folder.

34. **<D>** on the **HMA_Outside_Shoulder_3Lifts-12z** section.



35. In the Preview window, **<D>** and hold on the shoulder's origin (the upper left point).

36. Drag and drop the section onto the **RT_HMA_Lift1_Laneline-Top** point.



Note: Because ***Mirror*** was turned on when placing the overlay component, both shoulders are now placed in the template.

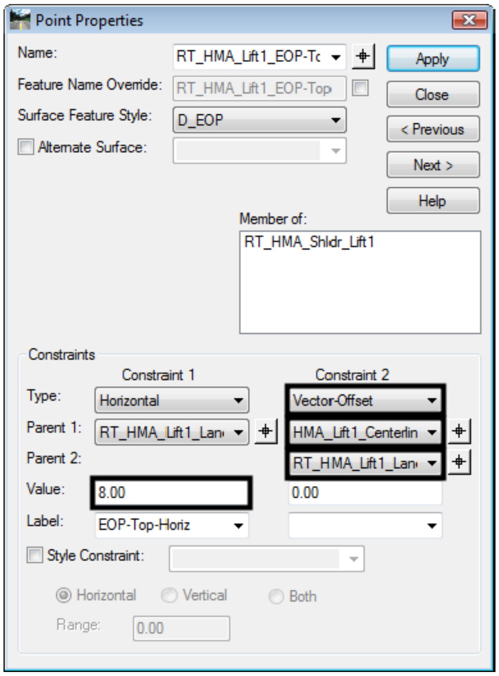
37. **<D> <D>** on the **RT_HMA_Lift1_EOP-Top** point to display the ***Point Properties*** dialog box.

38. The shoulders should be 8' wide. Change the ***Value*** of the ***Horizontal*** constraint (***Constraint 1*** in this example) to ***8.00***.

39. Change the ***Slope*** constraint (***Constraint 2*** in this example) to a **Vector-Offset** ***Type***.

40. Set the ***Parent 1*** to **HMA_Lift1_Centerline-Top**.

41. Set the ***Parent 2*** to **RT_HMA_Lift1_Laneline-Top**.



42. Repeat for point **LT_HMA_Lift1_EOP-Top**, using the corresponding points from the left side of the template. Remember to use ***-8.00*** for the value of the horizontal constraint.

43. **<D> Apply** and then **<D> Close** to dismiss the ***Point Properties*** dialog box.

44. Expand the template library to show the contents of the **3 - Sections - End Conditions > Z-Slope End Conditions > High Speed End Conditions** folder.

45. **<D>** on the **Z12_6_to_1** section.

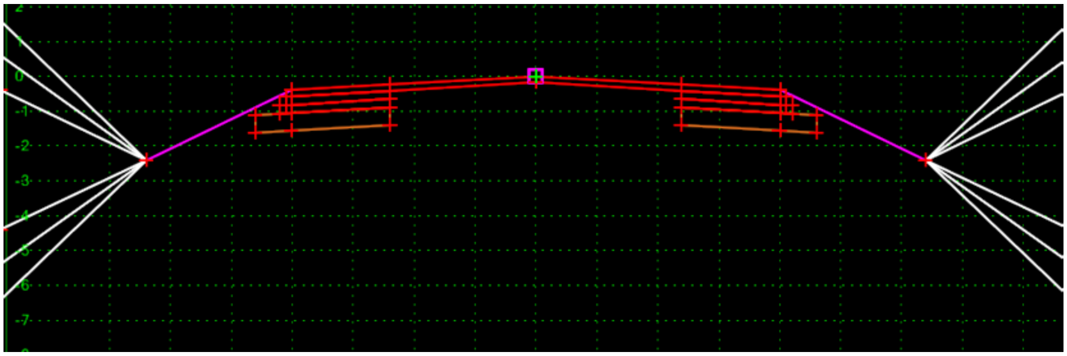
46. In the Preview window, **<D>** and hold on the section's origin (the upper left point).

47. Drag and drop the section onto the **RT_HMA_Lift1_EOP-Top** point.

48. This completes the template. Select **File > Save** from the ***Create Template*** menu bar.

49. **<D> Close** to dismiss the ***Create Template*** dialog box.

The illustration below shows the completed template:



Section Summary:

- By using the vector offset constraint the shoulders will maintain the same slope as the overlay section.
- Once the right click options of Mirror and Reflect are turned on, they remain active until they are turned off.

Lab 25.6 - Creating the Overlay Corridor

Finally, a corridor is constructed using the alignments and template developed earlier.

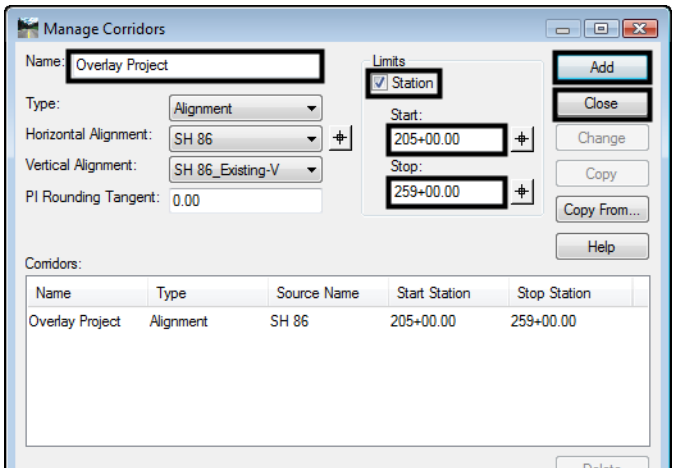
Section Objectives:

- Create a corridor for the SH 86 alignment.
- Add a template drop using the widening and overlay template.
- Add point controls using the edge of pavement and SH 86 alignments.
- Review the results in Roadway Designer.
- Add a superelevation solution to the corridor.
- Refine the corridor using Cross Slope Optimization.
- Add a Leveling course to the template.
- Add a stripping course to the template.
- Add vertical alignment adjustments.
- Regress the refined vertical alignment.
- Apply the regressed vertical alignment to the corridor.

This corridor will contain a single template drop along with point controls. Horizontal controls will define the width of the overlay section. Vertical controls will be generated initially through superelevation and ultimately refined by cross slope optimization. Overlay and stripping criteria will be defined to adjust and smooth the vertical alignment.

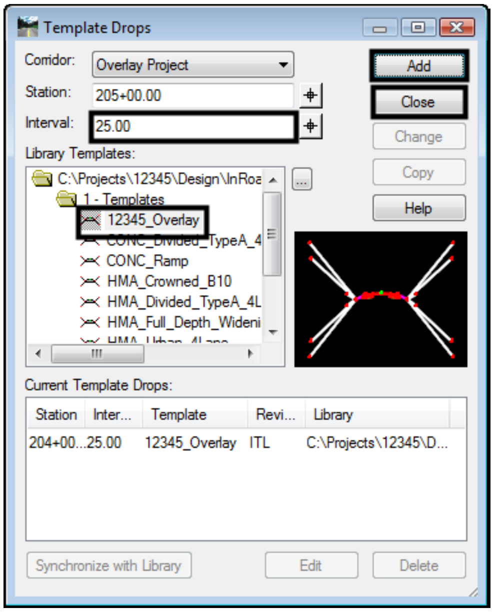
1. From the InRoads menu bar, select **Modeler > Roadway Designer**.
2. If not already set, toggle Display Mode: to ***Normal***
3. In the ***Roadway Designer*** dialog box, select **Corridor > Corridor Management** from the menu bar.

4. In the ***Manage Corridors*** dialog box, key in ***Overlay Project*** for the ***Name***.
5. ***Set Surface Symbology:*** **D_ROADWAY-Asphalt**
6. Set ***Horizontal Alignment:*** **SH 86**
7. Set ***Vertical Alignment:*** **SH 86_Existing-V**
8. Toggle on **Station Limits**.
9. Key in ***205+00.00*** for the ***Start*** station.
10. Key in ***259+00.00*** for the ***Stop*** station.
11. **<D>Add** then **<D> Close** to dismiss the dialog box.



12. In the ***Roadway Designer*** dialog box, select **Corridor > Template Drops** from the menu bar.
13. In the ***Template Drops*** dialog box, key in ***25.00*** for the ***Interval***.
14. Expand the **C:\Projects\12345\Design\InRoads\DES12345_Templates-Overlay** template library to show the contents of the **1 - Templates** folder.
15. Highlight the **12345_Overlay** template.

16. **<D>** the **Add** button then **<D>** the **Close** button to dismiss the ***Template Drops*** dialog box.



The template is now displayed in the cross section view. Next, point controls are added to make the design template match the width of the existing roadway.

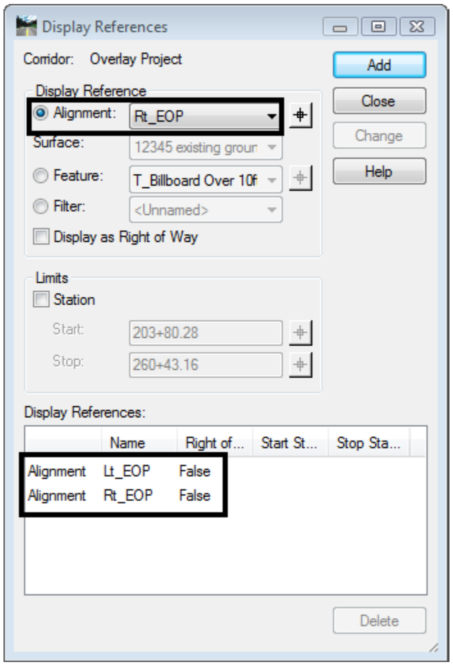
Lab 25.7 - Horizontal Point Controls

Before assigning horizontal controls to the template points, for visual reference, display the controlling elements in the roadway designer views.

1. In the ***Roadway Designer*** dialog box, select **Corridor > Display References**

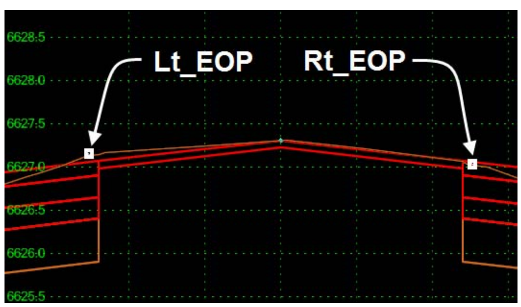
Add the alignments Lt_EOP and Rt_EOP created earlier in this chapter that represent the left and right edges of existing pavement.

2. **Add** alignments ***Lt_EOP*** and ***Rt_EOP*** as displayed references.



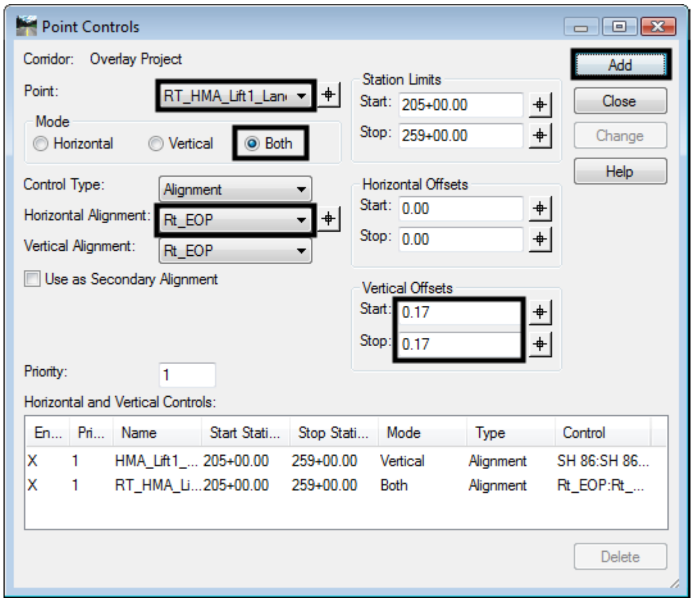
3. **<D>** the **Add** button then **<D>** the **Close** button to dismiss the ***Display References*** dialog box.

The alignments are displayed in Roadway Designer.



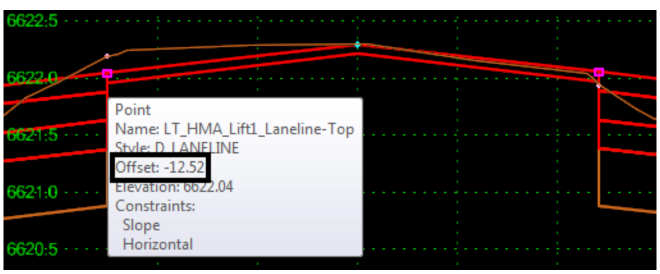
4. In the ***Point Controls*** dialog box, set the Point to **RT_HMA_Lift1_Laneline-Top**.
5. Toggle on **Horizontal** for the ***Mode***.
6. Select **Rt_EOP** for the ***Horizontal Alignment***.
7. Add ***Control Description:*** ***Horizontal location for right lane***
8. **<D>** the **Add** button.
9. In the ***Point Controls*** dialog box, set the Point to **LT_HMA_Lift1_Laneline-Top**.
10. Select **Lt_EOP** for the ***Horizontal Alignment***.
11. Add ***Control Description:*** ***Horizontal location for left lane***

12. **<D>** the **Add** button the **<D> Close** to dismiss the Point Controls dialog box.



This completes the corridor definition. Now the corridor can be reviewed in Roadway Designer.

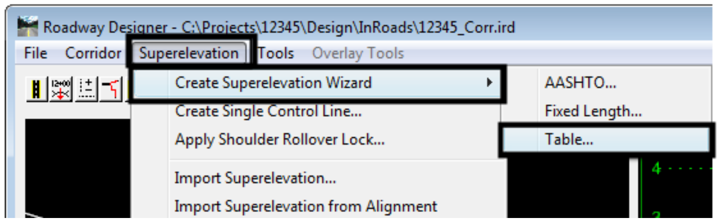
13. Scroll through the template drops using the station controls under the cross section view. Notice that the template width matches the horizontal location of the existing pavement.



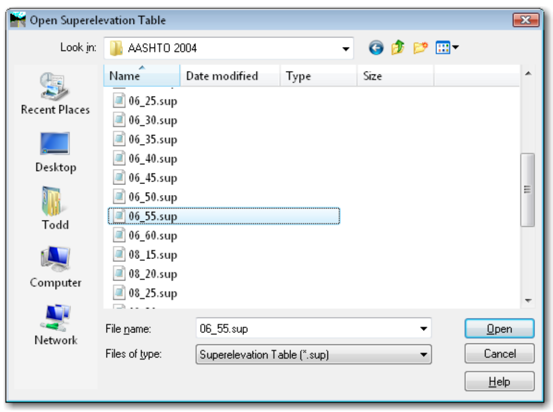
The template has been constrained to match the width of the existing pavement. Next Cross Slope Optimization will be used to match the existing pavement cross slope. First superelevation control lines will be created. These superelevation control lines will overwritten by new control lines developed using cross slope optimization.

Use the Superelevation Wizard:

14. Select **Superelevation > Create Superelevation Wizard > Table** from ***the Roadway Designer*** menu bar.

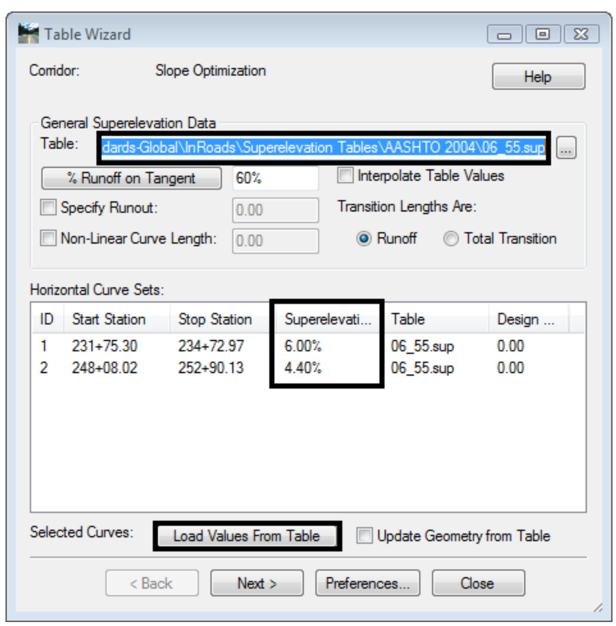


15. In the ***Table Wizard*** dialog box, select the desired super table. These are located in the ***C:\Workspace\Workspace-CDOT_V8i\Standards-Global\InRoads\Superelevation Tables\AASHTO 2004*** folder.



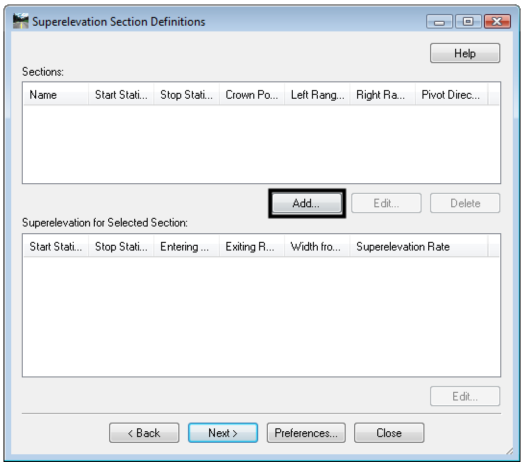
16. Select ***06-55.sup*** and **<D>** the **Open** button.

17. **<D>** the **Load Values From Table** button.

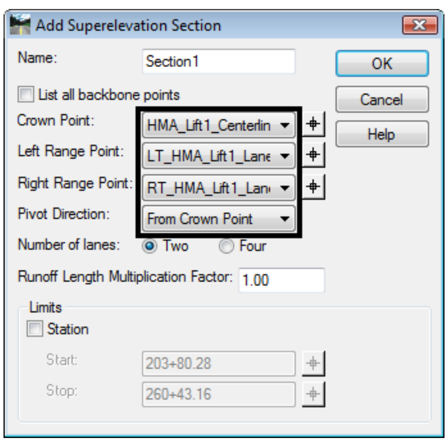


The rate values are read from the table and updated for each horizontal curve set listed in the dialog box or highlighted.

18. **<D> Next**.



19. **<D>** the **ADD** button on the ***Superelevation Section Definitions*** pane. This displays the ***Add Superelevation Section*** dialog box.



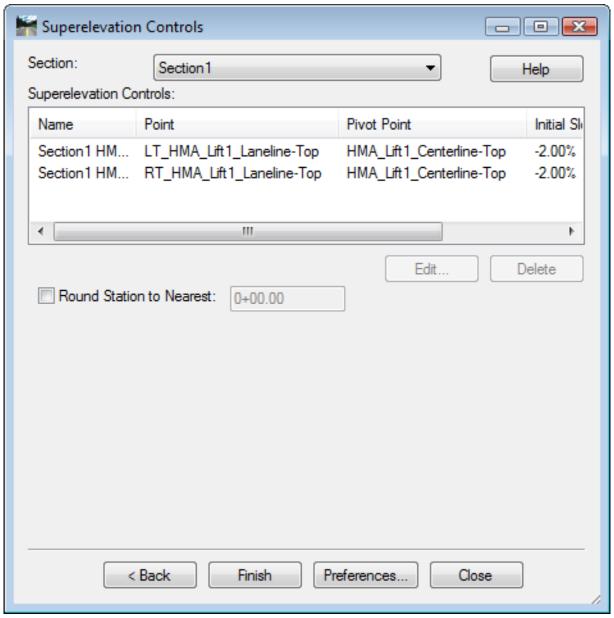
20. Use the drop down menu or the target  button to select the ***Crown Point:*** **HMA_Lift1_Centerline**.

21. Use the drop down menu or the target button to select the ***Left Range Point:*** **LT_ HMA_Lift1_Laneline.**

22. Use the drop down menu or the target button to select the ***Right Range Point:*** **RT_HMA_Lift1_Laneline.**

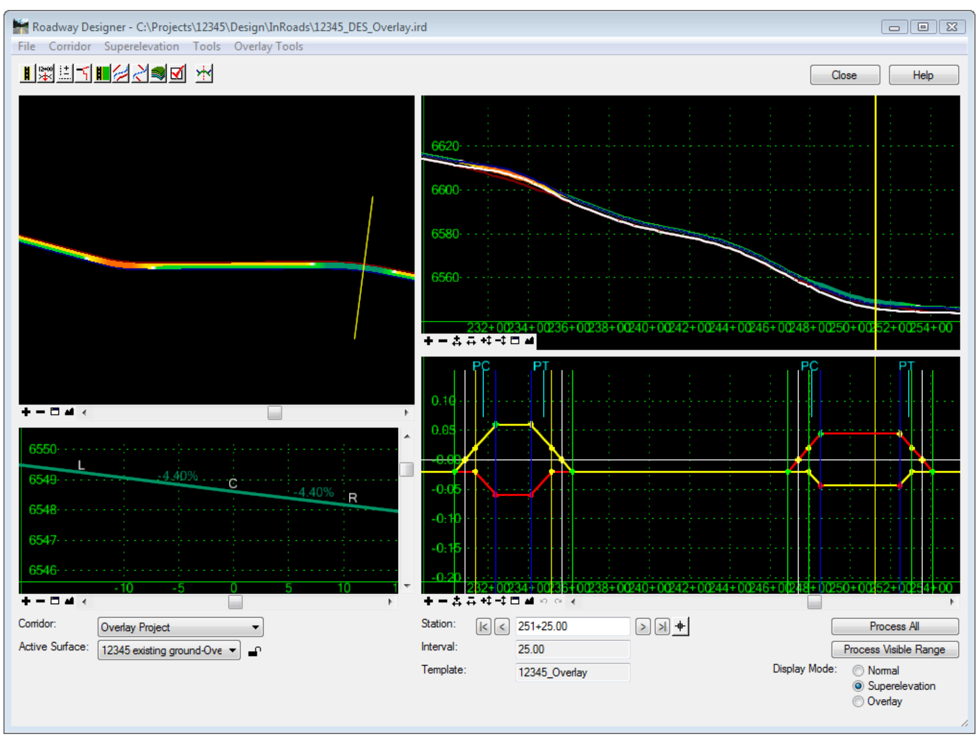
23. **<D>** OK

24. **<D> Next** on the ***Superelevation Section Definitions*** pane. This displays the ***Superelevation Controls*** pane.



25. **<D> Finish**. This completes the development of the initial superelevation control lines.

26. Review the computed superelevation in the Roadway Designer views and by selecting ***Corridor>Point Controls***.



Lab 25.8 - Optimize the Overlay Corridor

Now Cross Slope Optimization will be used to related the template cross slopes to the existing pavement cross slopes.

1. In ***Roadway Designer*** toggle on ***Display Mode:*** **Overlay.**

   Note: The display mode ***must*** be set to overlay to access the overlay tools.

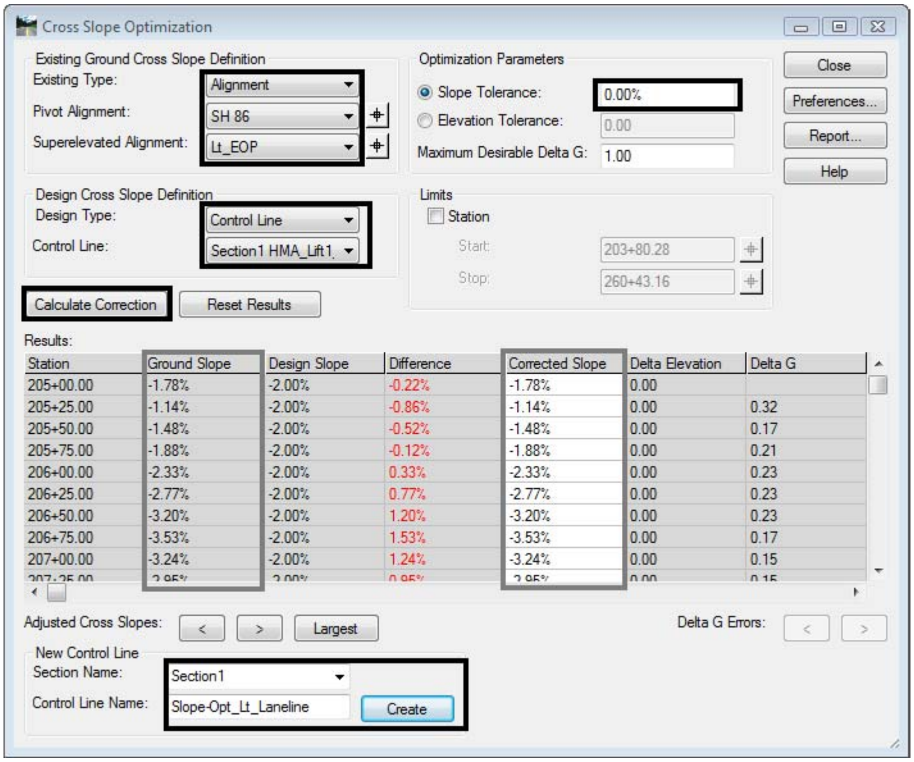
2. In ***Roadway Designer*** Select **Overlay Tools>Cross Slope Optimization.**

Enter the following criteria to define the ***Existing Ground Cross Slope Definition.***

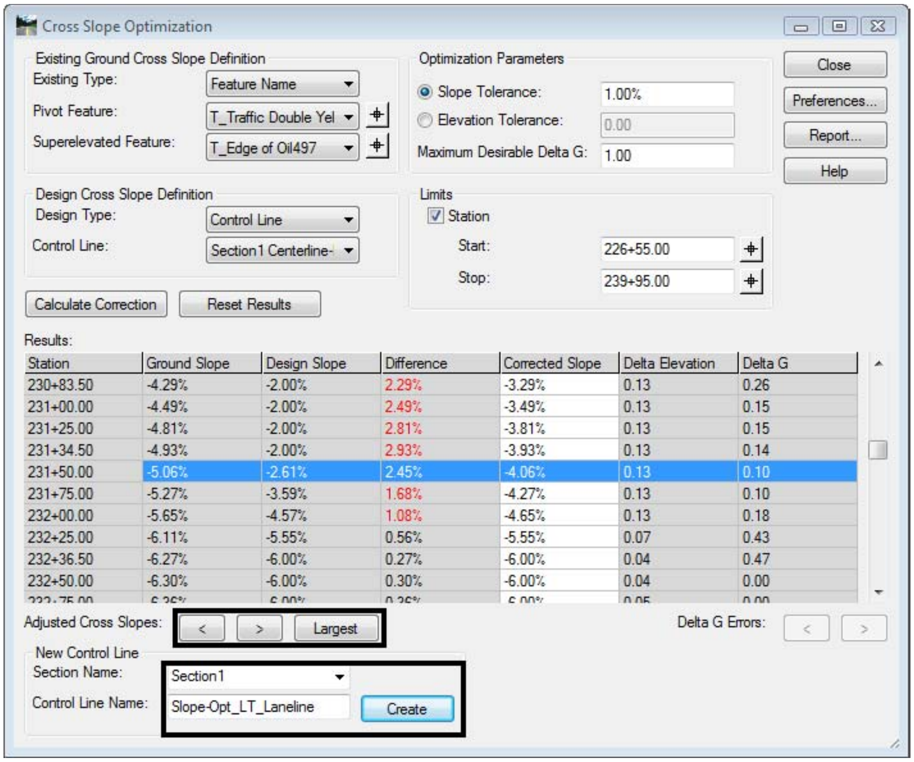
3. ***Existing Type:*** **Alignment**
4. ***Pivot Alignment:*** **Lt_EOP**

For the ***Design Cross Slope Definition*** select the superelevation control line developed previously for the ***left*** edge of pavement.

5. ***Design Type:*** **Control Line**
6. ***Control Line:*** **Section1 HMA_Lift1_Centerline-Top-LT_HMA_Lift1_Laneline-Top**
7. Key in ***0.00%*** for the ***Optimization Parameters - Slope Tolerance***
8. **<D>** ***Calculate Correction*** a solution is presented.



Note the values in columns Ground Slope & Corrected Slope match indicating the design cross slope now matches existing conditions.

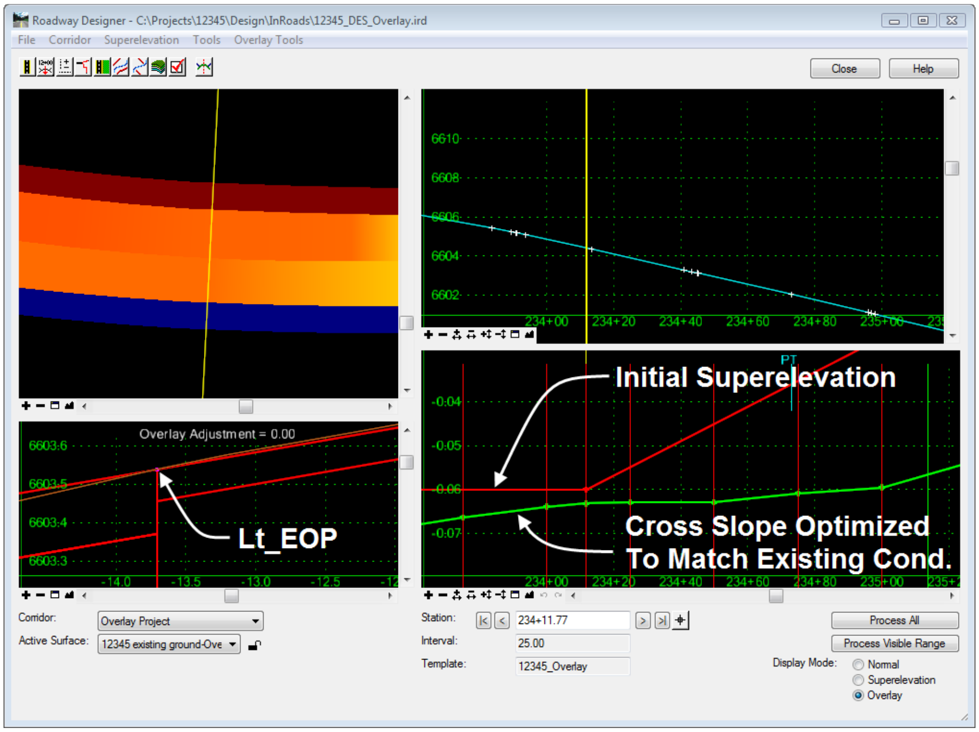


9. Select ***Section Name***: **Section 1**

10. Key in for ***Control Line***: ***Slope-Opt_Lt_Laneline***

11. **<D>** ***Create.*** New point controls are created for the left lane.

12. **<D>** ***Close*** and review the new control line in the superelevation view and under Corridor > Point Controls.



13. ***Repeat*** **Overlay Tools > Cross Slope Optimization** to develop the solution for the right side of the roadway using the following input changes:

Enter the following criteria to define the ***Existing Ground Cross Slope Definition.***

14. ***Existing Type:*** **Alignment**

15. ***Pivot Alignment:*** **Rt_EOP**

For the ***Design Cross Slope Definition*** select the superelevation control line developed previously for the ***right*** edge of pavement.

16. ***Design Type:*** **Control Line**

17. Design Cross Slope Definition: Control Line:
Section1 HMA_Lift1_Centerline-Top-RT_HMA_Lift1_Laneline-Top

18. Select ***Section Name***: **Section 1**

19. Key in for ***Control Line***: ***Slope-Opt_Rt_Laneline***

20. **<D>** ***Create.*** New point controls are created for the left lane.

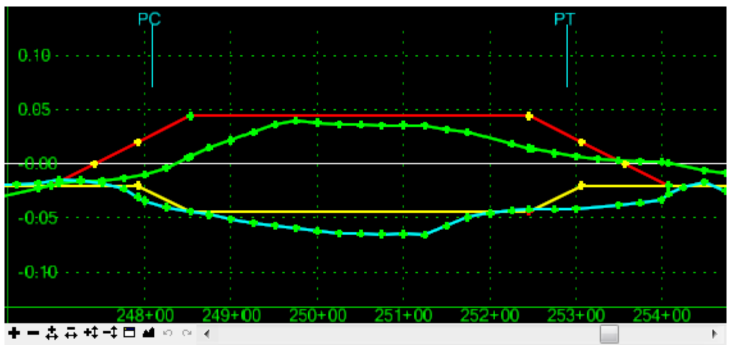
21. **<D>** ***Close*** to dismiss the Cross Slope Optimization dialog.

22. Select **Corridor > Point Controls**

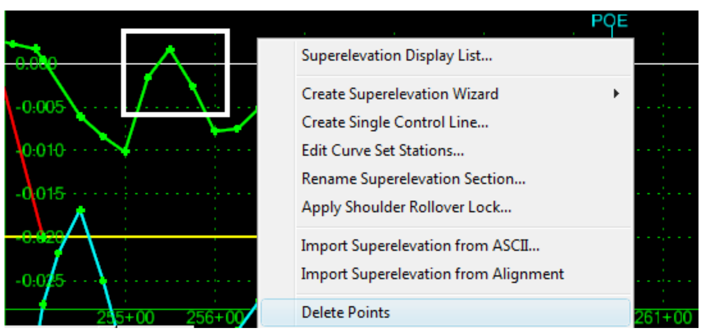
Enabled	Priority	Name	Start Station	Stop Station	Mode	Type	Control
	1	LT_HMA_Lift1_Laneline-Top	203+80.28	260+43.16	Vertical	Superelevation	Section1 HMA_Lift1_Centerline-Top-LT_HMA_Lift1_Laneline-.
	1	RT_HMA_Lift1_Laneline-Top	203+80.28	260+43.16	Vertical	Superelevation	Section1 HMA_Lift1_Centerline-Top-RT_HMA_Lift1_Laneline.
X	1	LT_HMA_Lift1_Laneline-Top	205+00.00	259+00.00	Horizontal	Alignment	Lt_EOP
X	1	RT_HMA_Lift1_Laneline-Top	205+00.00	259+00.00	Horizontal	Alignment	Rt_EOP
X	1	LT_HMA_Lift1_Laneline-Top	205+00.00	259+00.00	Vertical	Superelevation	Slope-Opt_Lt_Laneline:HMA_Lift1_Centerline-Top
X	1	RT_HMA_Lift1_Laneline-Top	205+00.00	259+00.00	Vertical	Superelevation	Slope-Opt_Rt_Laneline:HMA_Lift1_Centerline-Top

The original two superelevation control lines should be automatically disabled. The remaining four controls effect with and slope of the template.

23. Review the new control lines in the superelevation view.



24. **<R>** in the superelevation view and make any edits you think are necessary.



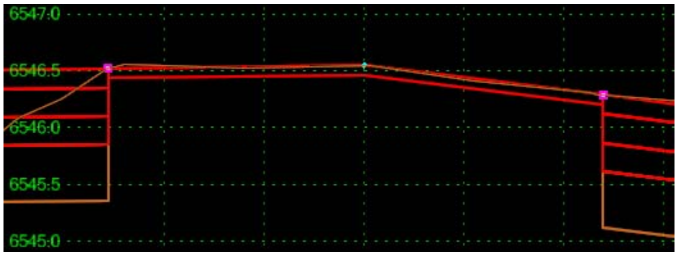
25. From the Roadway Designer menu bar, select **File > Save**.

Lab 25.9 - Corridor Review and Vertical Adjustment

Currently the corridor has horizontal and slope controls relative to existing conditions. In subsequent labs the corridor will be modified to adjust for the overlay thickness, pavement leveling and pavement stripping requirements. Prior to making those adjustments, review the current state of the corridor and related quantities.

1. In ***Roadway Designer*** toggle on ***Display Mode:*** **Normal.**

2. Scroll through the template drops and note the location of the template relative to existing conditions

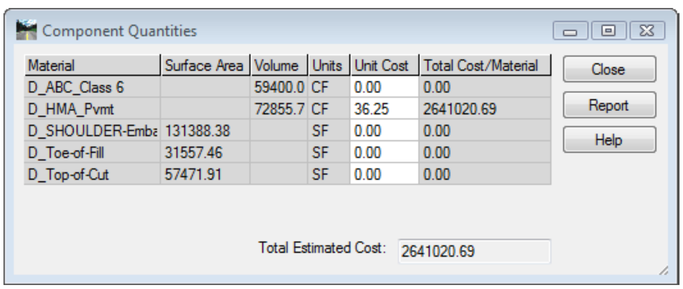


It can be seen that the overlay falls almost entirely below the existing conditions. This will be addressed with overlay tools.

3. **<D>** ***Process All***, in Roadway Designer

4. Using the scroll buttons navigate to the ***last*** station.

5. From the Roadway Designer menu bar select **Tools > Component Quantities** to take a quick look at quantities and cost.



The cost of the overlay is all we will address for this lab.

6. For the ***D_HMA_Pvmt*** unit cost key in $***36.25***

The current cost for the overlay is approximately $2,409,000. A combination of changes to the design will be made by adjusting the vertical grade, adding pavement stripping and pavement leveling components to the template to determine the optimum solution.

7. **<D> Close** the Component Quantities dialog.

8. Select **Tools > Options** in the ***Roadway Designer dialog***, toggle on **Cut and Fill Graphics**.

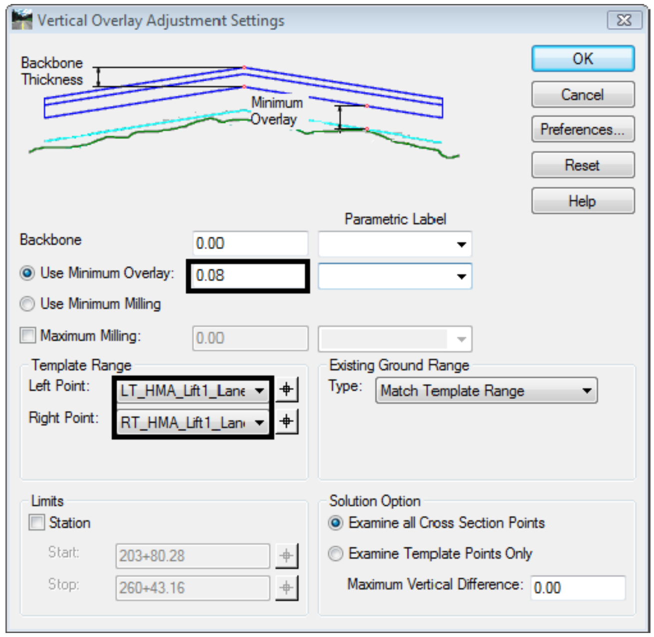
9. **<D> OK** to accept the changes and dismiss the dialog box.

Review the limits of cut, note that the overlay is almost entirely in cut because the design profile is coincident with the existing grade. Overlay tools will be used to make adjustments to the design profile alignment.

10. Select **Tools > Options** in the ***Roadway Designer dialog***, toggle off **Cut and Fill Graphics**.

11. In ***Roadway Designer*** toggle on ***Display Mode:*** **Overlay.**

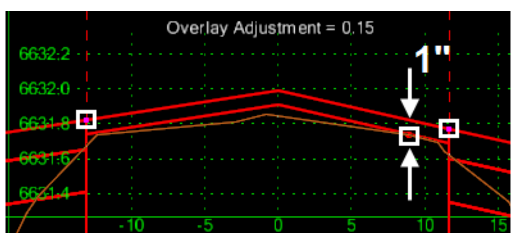
12. Select **Overlay Tools > Vertical Adjustment Settings**.



13. Toggle on Use ***Minimum Overlay*** and key in ***1"*** which will raise the profile alignment by an amount equal to the overlay pavement thickness.

14. Under ***Template Range*** set:
    Left Range: **LT_HMA_Lift1_Laneline-Top**
    Right Range: **RT_HMA_Lift1_Laneline-Top**

15. **<D> OK** & **<D> Cancel** to close the Vertical Overlay Adjustments Settings dialog.



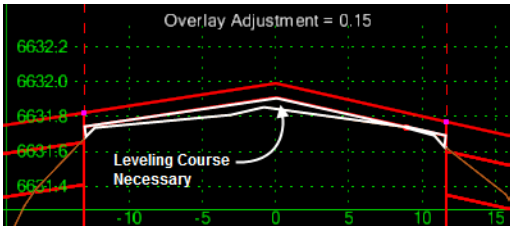
16. **<D> *Process All***

Between the template range points an evaluation is performed comparing existing conditions to the design template. At template application stations the template is raised to maintain the minimum overlay thickness. The value of the vertical adjustment at the centerline is displayed.

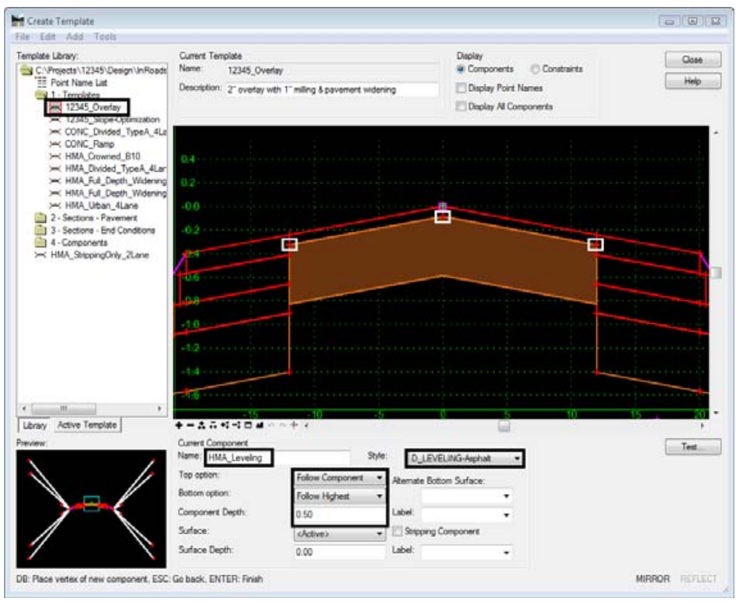
> ***Note:*** It's okay to toggle between Normal and Overlay display modes. However the overlay adjustments are only reflected while the Overlay display mode is active.

Lab 25.10 - Creating a Pavement Leveling Component

A review of the overlay adjustments shows a gap area between the bottom of the asphalt overlay component and the existing ground. This area will be addressed by adding a leveling component to the template.

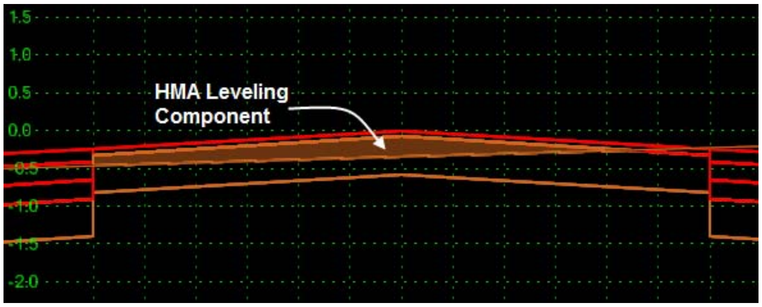


1. Open the template library ***12345DES_Templates-Overlay*** for editing.
2. **<D><D>** on template ***12345-Overlay*** to open it for editing.
3. **<D> Add > Overlay/Stripping** (component)



4. Key-in or Select the following:
   Name: ***HMA_Leveling***
   Top option: **Follow Component**
   Bottom option: **Follow Highest**
   Component Depth: ***6"***
   Style: **D_LEVELING-Asphalt**
5. Create the component by selecting the three points representing the ***bottom*** of the 1" overlay compliment.
6. **<R>** ***Finish***

7. **<D>** ***Test*** to evaluate the added component.

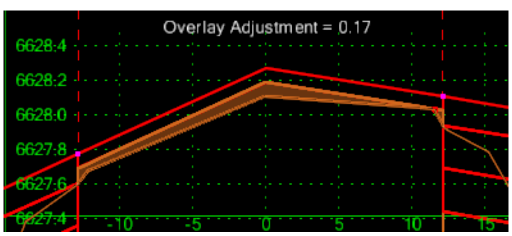


Note: The option selected for ***Top*** option instructs the added component to follow or tie to the bottom of the 1" overlay asphalt component. The bottom option could have been set to follow surface (existing conditions) but by selecting follow highest a second leveling course could be added if a second leveling material is desired. Having done so the first leveling course will tie to the higher of the existing conditions or the second leveling course. In this exercise 6" should suffice for all leveling needs.

8. **File > Save** to save the template library.
9. **<D>** ***Close***

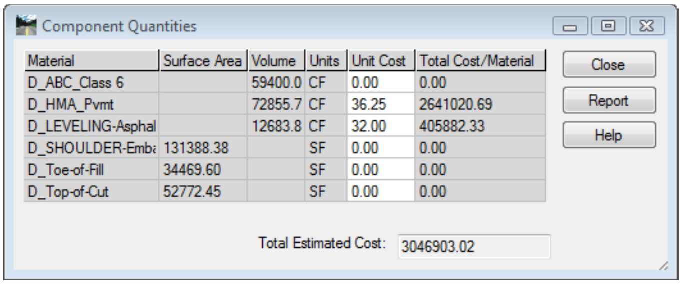
In Roadway Designer synchronize the revised template with the corridor.

10. **<D> Corridor >Template Drops**.
11. **<D>** ***the single template drop***
12. **<D>** ***Synchronize with Library***
13. **<D>** ***Close***
14. ***Review*** the overlay adjustments and the additional leveling course.



15. **<D>** ***Process All***, in Roadway Designer
16. Using the scroll buttons navigate to the ***last*** station.
17. From the Roadway Designer menu bar select **Tools > Component Quantities** to review quantities and cost.
18. For the ***D_LEVELING_Asphalt*** unit cost key in $***32.00***

The leveling course requires approximately 12,700 CF of material at a cost of $406,000. The additional cost for the leveling increases the project cost to approximately $3,047,000.



Material	Surface Area	Volume	Units	Unit Cost	Total Cost/Material
D_ABC_Class 6		59400.0	CF	0.00	0.00
D_HMA_Pvmt		72855.7	CF	36.25	2641020.69
D_LEVELING-Asphal		12683.8	CF	32.00	405882.33
D_SHOULDER-Emb:	131388.38		SF	0.00	0.00
D_Toe-of-Fill	34469.60		SF	0.00	0.00
D_Top-of-Cut	52772.45		SF	0.00	0.00

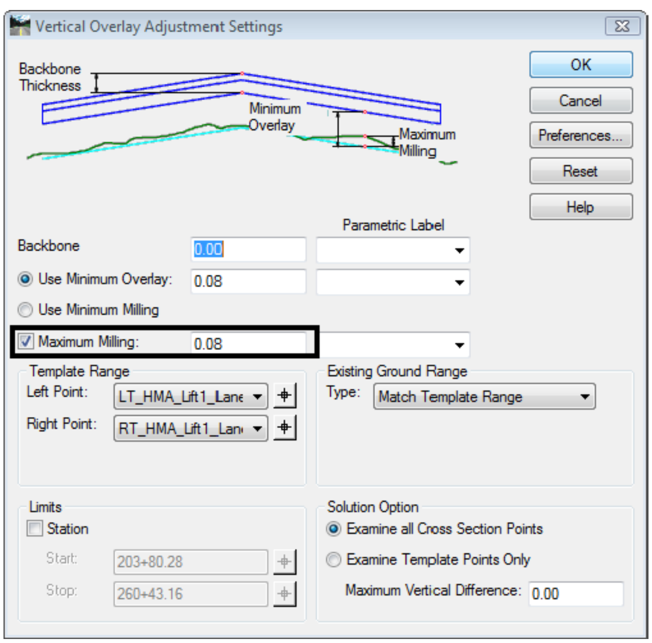
19. **<D> Close** the Component Quantities dialog.

Lab 25.11 - Creating a Pavement Stripping Component

Adding a pavement stripping component to the template can reduce the amount of leveling material required. Two items need to be addressed. First a vertical adjustment will be made to allow for a milling depth. Secondly a component will be added to the template to quantify the amount of material milled.

1. From the Roadway Designer menu bar select **Overlay Tools > Vertical Overlay Adjustment Settings**.

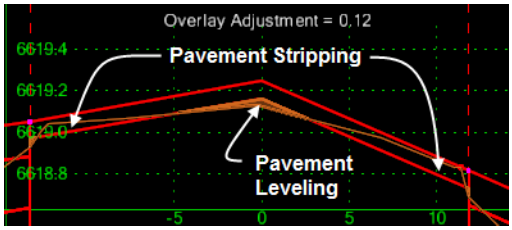
2. Toggle on ***Maximum Milling*** and key-in ***1"***.



3. **<D> OK** to close the Vertical Overlay Adjustment Settings dialog.

4. **<D>** ***Process All***, in Roadway Designer

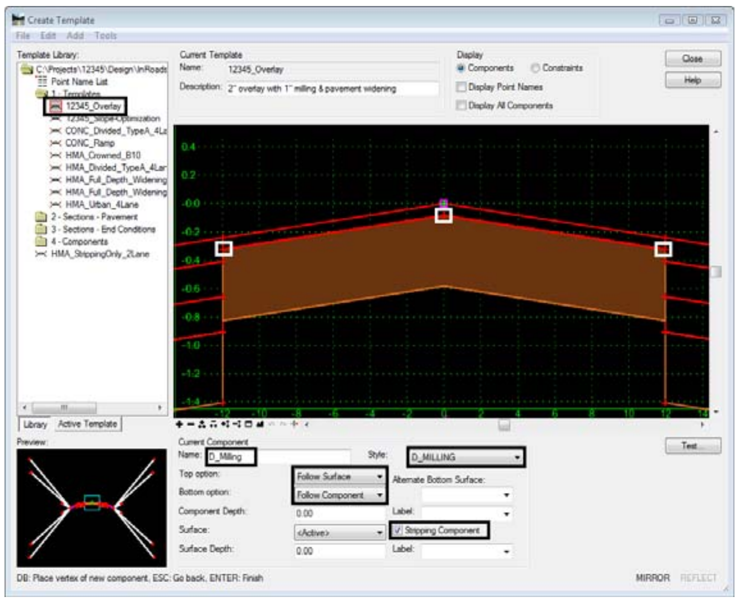
Review the overlay/leveling results



5. Open the template library ***12345DES_Templates-Overlay*** for editing.

6. **<D><D>** on template ***12345-Overlay*** to open it for editing.

7. **<D> Add > Overlay/Stripping** (component)



8. Key-in or Select the following:
   Name:* *D_Milling
   Top option: **Follow Surface**
   Bottom option: **Follow Component**
   Style: **D_LEVELING-Milling**

9. Create the component by selecting the three points representing the ***bottom*** of the 1" overlay component.

10. **<R>** ***Finish***

    Note: The component created has no depth however it's application is controlled by a combination of settings in roadway designer overlay tools and the existing surface. Testing the component may display results that appear suspect but will function correctly.

11. **File > Save** to save the template library.

12. **<D>** ***Close***

In Roadway Designer synchronize the revised template with the corridor.

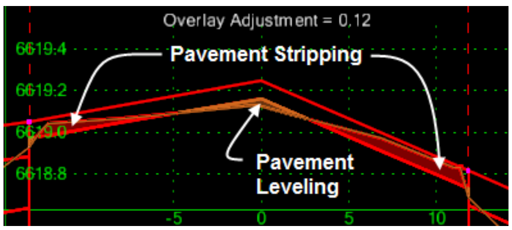
13. **<D> Corridor > Template Drops**.

14. **<D>** ***the single template drop***

15. **<D>** ***Synchronize with Library***

16. **<D>** ***Close***

17. ***Review*** the overlay adjustments which should depict both leveling and stripping components.



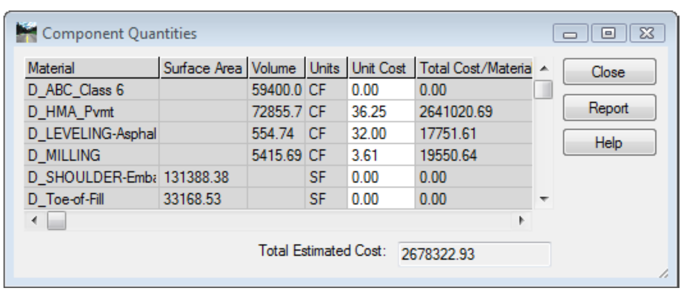
Make a final check on quantities and associated costs.

18. **<D>** ***Process All***, in Roadway Designer

19. Using the scroll buttons navigate to the ***last*** station.

20. From the Roadway Designer menu bar select **Tools > Component Quantities** to review quantities and cost.

21. For the ***D_Milling*** unit cost key in $***0.30***
Milling is reported in cubic feet. The cost of $2.70/S.Y. will be used as the basis. Therefore $0.30/S.F. divided by an average thickness of 1" (0.083') =$3.61/C.F.


Component Quantities

Material	Surface Area	Volume	Units	Unit Cost	Total Cost/Materia
D_ABC_Class 6		59400.0	CF	0.00	0.00
D_HMA_Pvmt		72855.7	CF	36.25	2641020.69
D_LEVELING-Asphal		554.74	CF	32.00	17751.61
D_MILLING		5415.69	CF	3.61	19550.64
D_SHOULDER-Emb:	131388.38		SF	0.00	0.00
D_Toe-of-Fill	33168.53		SF	0.00	0.00

Close
Report
Help

Total Estimated Cost: 2678322.93

The quantity for the leveling course has been reduced. This is offset by the less expensive cost of milling. The project cost has been reduced to approximately $2,678,000.

22. **<D> Close** the Component Quantities dialog.

23. To find the precise planner area of pavement milling select **Tools > Milling Report**

24. For the XML report Select folder ***Milling*** & Style Sheet ***RoadwayDesignMillingReport.xsl***

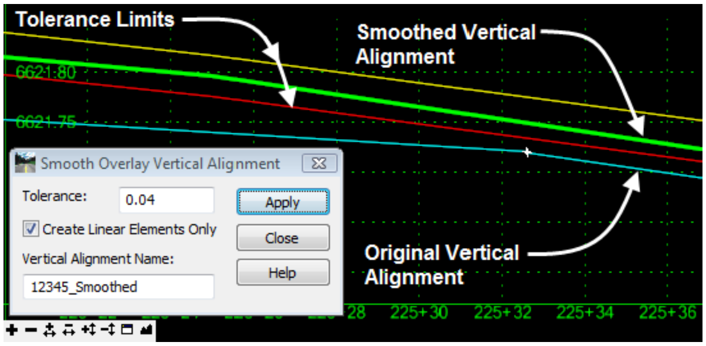
25. ***Close*** the ***XML report***, ***Close*** the ***Component Quantities*** dialog.

Lab 25.12 - Creating the Regressed Vertical Alignment

The adjustments made to the vertical alignment through the use of overlay tools are temporarily stored in memory until applied to the corridor.

In Roadway Designer (in overlay display mode) the upper-right quadrant of the dialog displays two lines. These lines represent the original vertical alignment used to define the corridor. A second line, shown in red, displays the ideal vertical alignment a defined by the settings defined as part of the overlay tools. This optimized alignment can be applied to the corridor as is or it can be smoothed, or regressed, within user defined tolerances to develop a ‘best fit’ alignment.

1. From the Roadway Designer menu bar, select **Overlay Tools > Smooth Adjusted Vertical Alignment**
2. Key in ***0.5"*** as the ***Tolerance***.
3. Key in ***12345_Smoothed*** for the ***Vertical Alignment Name***.
4. <D> Apply

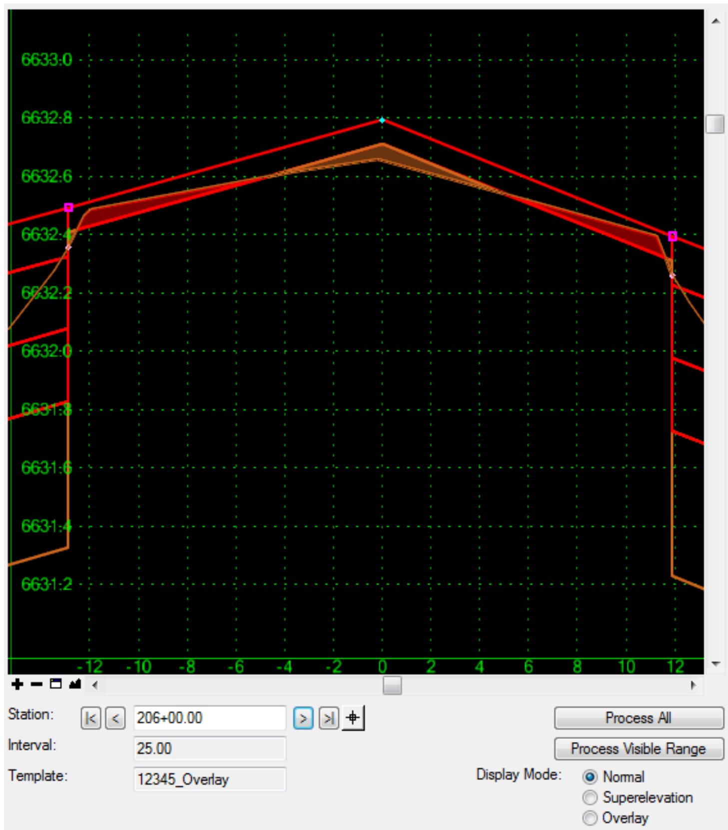


5. **<D>** ***Close***
6. **<D>** ***Overlay Tools > Apply Adjusted Vertical Alignment***
7. Toggle on **Apply Adjusted Vertical Alignment to Corridor**
8. Select Style: ***ALG_OTHER_Vert***
9. **<D>** ***Apply***

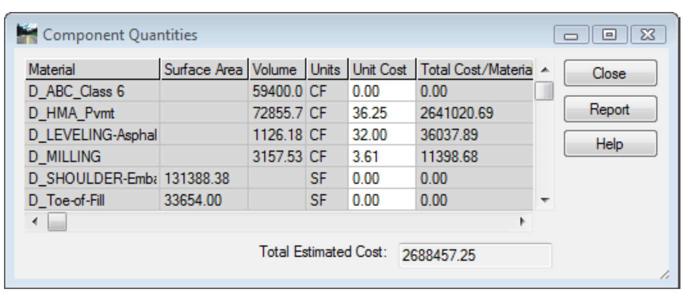
Verify the results

10. Select **Corridor > Manage Corridors**
11. **<D>** on corridor ***Overlay Project***, note the vertical alignment associated with the alignment.
12. **<D>** Close the Manage Corridor dialog.
13. In ***Roadway Designer*** toggle on ***Display Mode:*** **Normal.**

14. Using the scroll buttons navigate through the template application locations to review the design.



15. **<D> Tools > Component Quantities** to see the results using the smoothed vertical alignment.



16. Select **File > Save** to write the roadway definitions to ***12345_DES_Overlay.ird***

17. **<D> Save** then **<D> Cancel** to dismiss the dialog box.

18. **<D> Close** to dismiss the Roadway Designer dialog box.

19. Exit InRoads and MicroStation.

Chapter Summary:

- Point controls can be used to match the existing cross slope of the road.
- Slope optimization can also be used to develop a design relative to existing conditions.
- Surface features can be used to create point control alignments.
- Be aware that other features may reside inside of the edge of pavement which could cause problems when modeling the corridor.
- If the edge of pavement is to be saw cut prior to widening, a horizontal offset can be defined when point controls are created.
- Superelevation is used to develop a control line that can be overridden by cross slope optimization.
- Using cross slope optimization, the exercise can be used to rehabilitate existing pavement cross slopes.
- Vertical alignments can be adjusted to for overlay and/or milling requirements.
- There are new template components for overlay and milling (stripping).
- Component quantities can be calculated as a design progresses.

LAB 26 - Variable Median Ditch

When a divided highway has separate horizontal and vertical controls for each driving surface, the median can not have a fixed width. In this lab, an end condition section is developed for a variable width median.

Chapter Objectives:

- Build components for each median situation.
- Assemble the components into a single section.
- Add Display Rules to turn components on and off.
- Add the median ditch section to a template.
- Update a corridor to use the template and examine its behavior.

The Following files are used in this lab:

- C:\Projects\12345\Design\Drawings\Reference_Files\12345DES_Model_Median-Ditch.dgn
- C:\Projects\12345\Design\InRoads\12345DES_Median-Ditch.alg
- C:\Projects\12345\Design\InRoads\12345DES_Templates_Median-Ditch.itl
- C:\Projects\12345\Design\InRoads\12345DES_Median-Ditch.ird
- C:\Projects\12345\Design\InRoads\12345DES_Northbound.dtm
- C:\Projects\12345\DesignROW_Survey\InRoads\DTM\12345SURV_Existing_Ground_VMD.dtm

The median section attaches to the right side of the southbound template. There are four different situations that have to be accounted for on the median ditch. These are:

- ♦ 6:1 / 6:1 “V” Ditch - This option is used when the inside EOP points are less than 24’ apart.
- ♦ 6:1 - 10:1 / 6:1 - 10:1 Compound Ditch - This option is used when the inside EOP points are greater than 24’ apart.
- ♦ 6:1 - 10:1 / 6:1 Compound Ditch - This option is used when the southbound lanes are higher than the northbound lanes and the left 10:1 slope intercepts the right 6:1 slope.
- ♦ 6:1 / 6:1 - 10:1 Compound Ditch - This option is used when the northbound lanes are higher than the southbound lanes and the right 10:1 slope intercepts the left 6:1 slope.

A separate component will be built for each situation and tested to be sure it works.

Lab 26.1 - Create the 6:1 / 6:1 “V” Ditch Component

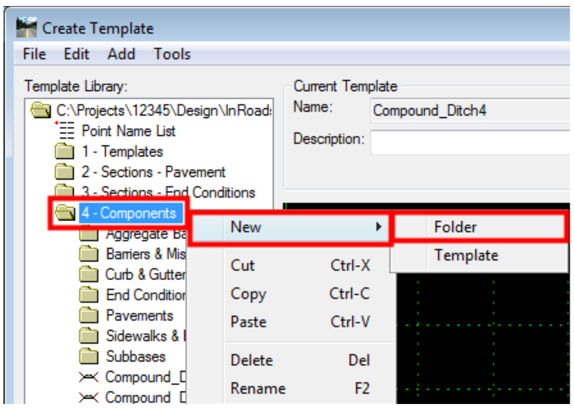
1. Open MicroStation and InRoads using the **C:\Projects\12345\Design\Drawings\Reference_Files\12345DES_Model_Median-Ditch.dgn** file.

2. Load the following files into InRoads:

   - ♦ **C:\Projects\12345\Design\InRoads\12345DES_Median-Lab.alg**
   - ♦ **C:\Projects\12345\ROW_Survey\InRoads\DTM\12345SURV_Existing_Ground_VMD.dtm**

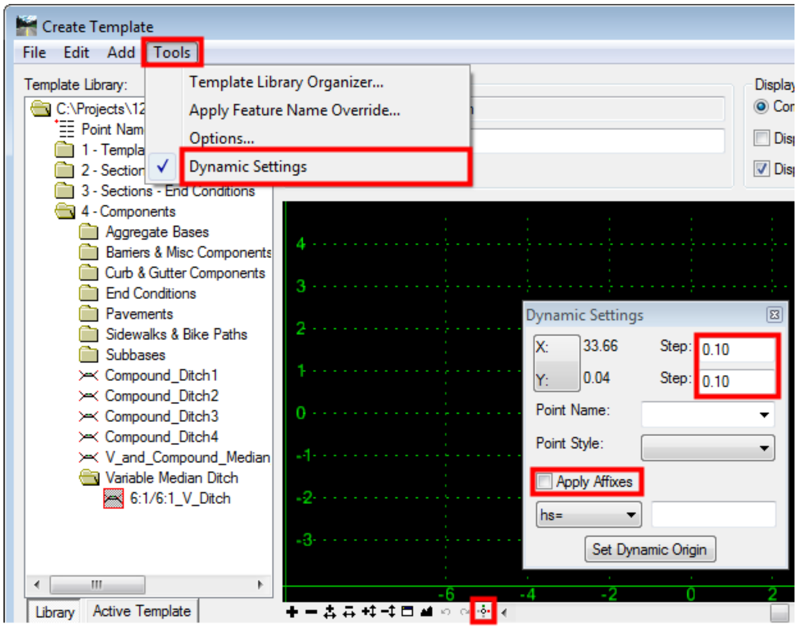
- **C:\Projects\12345\Design\InRoads\12345DES_Templates_Median-Ditch.itl**
- **C:\Projects\12345\Design\InRoads\12345DES_Median-Ditch.ird**
- **C:\Projects\12345\Design\InRoads\12345DES_Northbound.dtm**

3. Verify that the **C:\Workspace\Workspace-CDOT_V8i\Standards-Global\InRoads\ Preferences\CDOT_Civil.xin** file is loaded.
4. From the InRoads menu bar, select **Modeler > Create Template**.
5. Expand the **4 - Components** folder of the template library.
6. **<R>** on the **4 - Components** folder and select **New > Folder** from the right click menu.



7. Key in ***Variable Median Ditch*** for the folder name.
8. **<R>** on the **Variable Median Ditch** folder and select **New > Template** from the right click menu.
9. Key in ***6:1/6:1_V_Ditch*** for the template name. The new template is automatically opened for editing.
10. Display the **Dynamic Settings** dialog box.
11. Set both the ***X Step*** and ***Y Step*** to ***0.10***.

12. Verify that **Apply Affixes** is toggled off.



13. **<R>** in the template view and select **Add New Component > End Condition** from the right click menu.

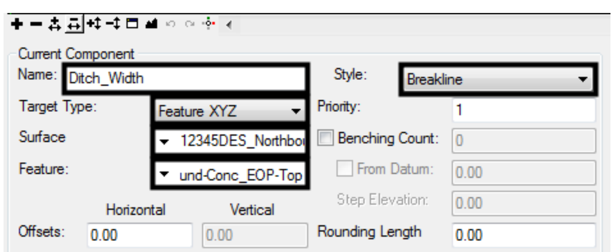
14. In the ***Current Component*** area, key in ***Ditch_ Width*** for the ***Name***.

15. Set the ***Style*** to **Breakline**.

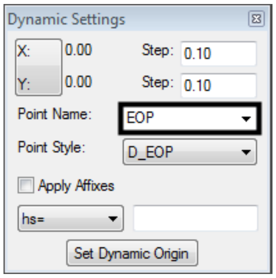
16. Set the ***Target Type*** to **Feature XYZ**.

17. Set the ***Surface*** to **12345DES_Northbound**.

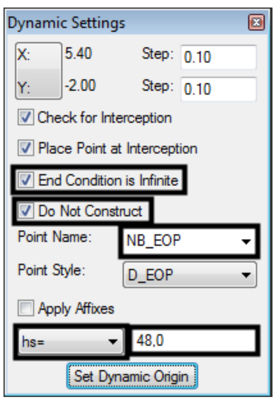
18. Set the ***Feature*** to **Northbound-Conc_EOP-Top**.



19. In the ***Dynamic Settings*** dialog box, select **EOP** for the ***Point Name***.



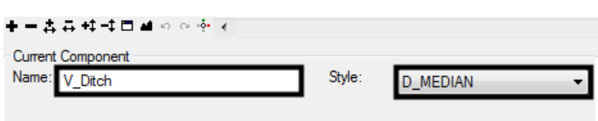
20. Move the cursor to the template origin (0.00,0.00) and **<D>** to place the point.
21. In the ***Dynamic Settings*** dialog box, key in ***NB_EOP*** for the ***Point Name***.
22. Toggle on **End Condition is Infinite** and **Do Not Construct**.
23. Set the key in mode to **hs=**.
24. Key in ***48,0*** in the precision key in field and press ***Enter***.



25. **<R>** and select **Finish** from the right click menu.

This end condition is used to determine the width of the median. Each of the four components used for this median ditch will contain this end condition. Next, the ditch component is added.

26. **<R>** in the template view and select **Add New Component > Unconstrained** from the right click menu.
27. In the ***Current Component*** area, key in ***V_Ditch*** for the ***Name***.
28. Set the ***Style*** to **D_Median**.

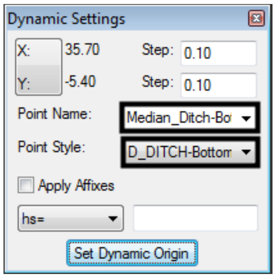


29. **<D>** on the **EOP** point to start the component at the origin.

Note: When the "+" symbol turns white, the cursor is snapped to the point and the points automatically merge.

30. In the ***Dynamic Settings*** dialog box, key in ***Median_Ditch-Bottom*** in the ***Point Name*** field.

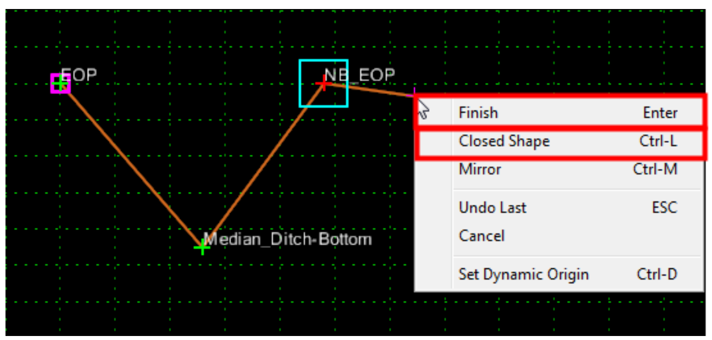
31. Select **D_DITCH-Bottom** for the ***Point Style***.



32. **<D>** between and below the ***EOP*** and ***NB_EOP*** points.

33. **<D>** on the **NB_EOP** point.

34. **<R>** in an open area. Verify that **Closed Shape** is toggled off, then select **Finish**.



35. **<D> <D>** on the **Median_Ditch-Bottom** point to display the ***Point Properties*** dialog box.

36. In the ***Point Properties*** dialog box, set both constraints to **Slope**.

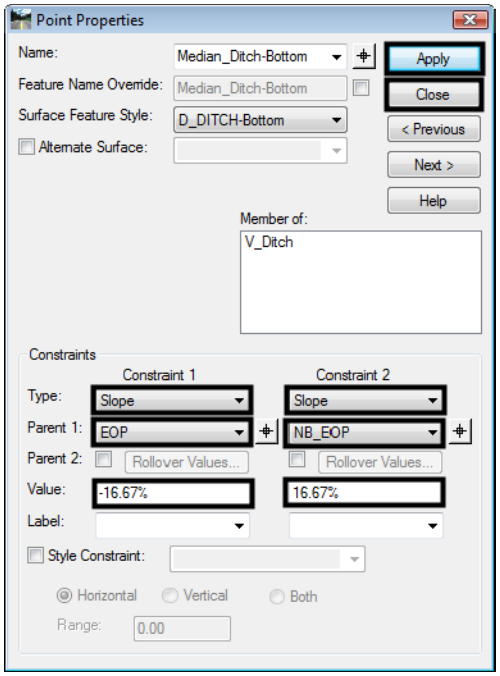
37. Set the ***Parent 1*** for ***Constraint 1*** to **EOP**.

38. Set the ***Parent 1*** for ***Constraint 2*** to **NB_EOP**.

39. Key in ***-16.67%*** for the ***Value*** of ***Constraint 1***.

40. Key in ***16.67%*** for the ***Value*** of ***Constraint 2***.

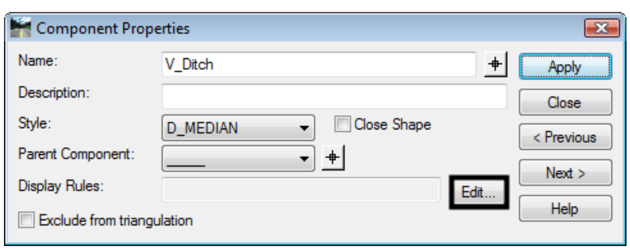
41. **<D> Apply** then **<D> Close** to dismiss the ***Point Properties*** dialog box.



This component will now construct a “V” ditch with 6:1 slopes on each side. Now it must be restricted to display only when the EOP and NB_EOP points are within 24’ horizontally of each other. This is accomplished using a Display Rule.

42. **<D> <D>** on the line forming the ditch to display the ***Component Properties*** for the ***V_Ditch*** component.

43. In the ***Component Properties*** dialog box, **<D>** the **Edit** button. This displays the ***Component Display Conditional Expression*** dialog box.



44. In the ***Component Display Conditional Expression*** dialog box, **<D>** the **Add** button. This displays the ***Display Rule*** dialog box.

45. In the ***Display Rule*** dialog box, key in ***V_DitchWidth*** for the ***Name***.

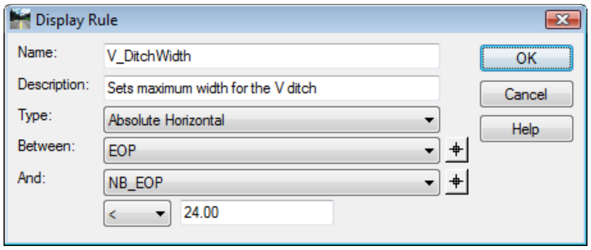
46. Key in ***Sets maximum width for the V ditch*** for the ***Description***.

47. Set the ***Type*** to **Absolute Horizontal**.

48. Set ***Between*** to **EOP**.

49. Set ***And*** to **NB_EOP**.

50. Set the operator to **<** and key in ***24.00*** for the value. The dialog box with completed entries is illustrated below:

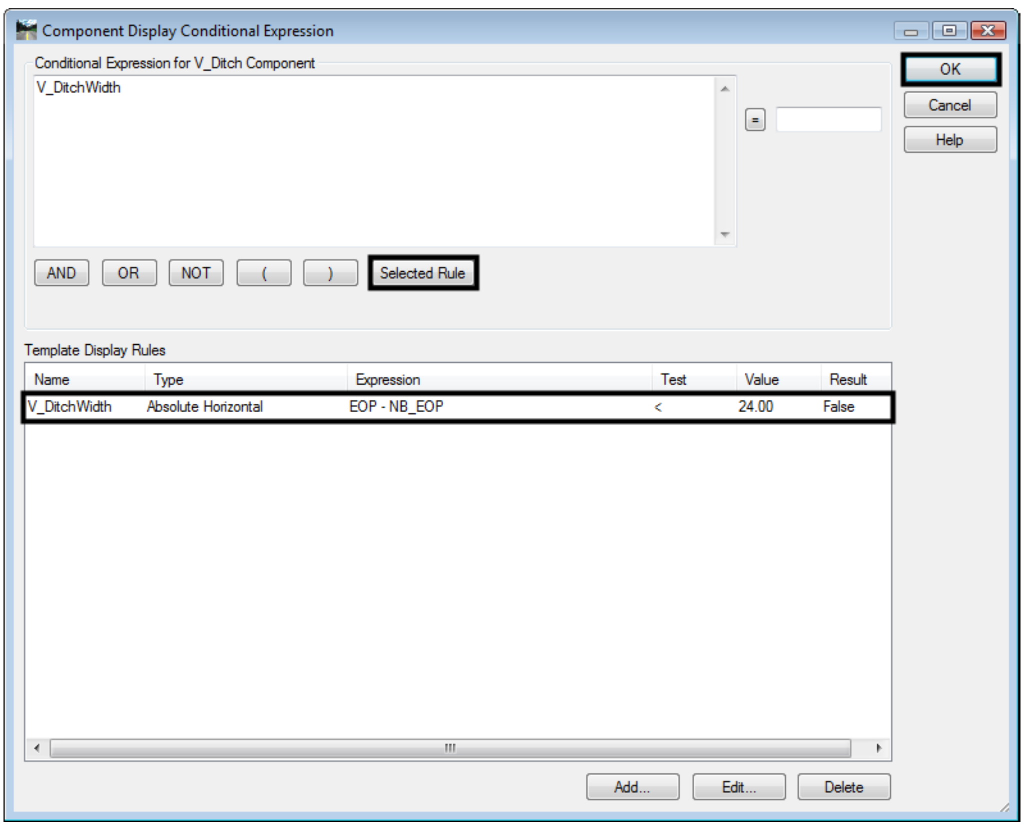


51. **<D> OK**. This dismisses the ***Display Rule*** dialog box.

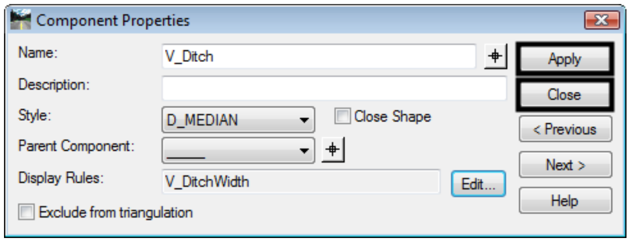
52. In the ***Component Display Conditional Expression*** dialog box, highlight **V_DitchWidth** in the ***Template Display Rules*** area.

53. **<D>** the **Selected Rule** button.

54. **<D> OK**. This dismisses the ***Component Display Conditional Expression*** dialog box and adds the rule to the component properties of ***V_Ditch***.



55. In the ***Component Properties*** dialog box, **<D> Apply** then **<D> Close** to dismiss the dialog box.



If the V_Ditch does not disappear right away, it will when you click in the template view. This is because the Display Rule returned a false value (EOP and NB_EOP are more than 24 feet apart). Because an end condition controls the NB_EOP point, the template can be tested to see if it works properly.

56. **<D>** the **Test** button.

57. In the ***Test End Conditions*** dialog box, **<D>** the **Draw** button.

58. Move the cursor slowly from right to left in the dialog box. Notice that once the cursor is moved left of the 25 grid line, the template displays.

59. **<D> Close** to dismiss the ***Test End Conditions*** dialog box.

60. Select **File > Save** from the ***Create Template*** menu bar.

Lab 26.2 - Create the 6:1 - 10:1 / 6:1 - 10:1 Compound Ditch Component

The next component to build is the 6:1 - 10:1 / 6:1 - 10:1 Compound Ditch. This component has a 12 foot 6:1 slope extending from each pavement edge. The slope changes to 10:1 at this point to form the ditch bottom.

1. Create a new template in the ***Variable Median Ditch*** folder as described in steps 6 through 9 above. Name the template ***Standard Compound Ditch***.

2. **<R>** in the template view and select **Add New Component > End Condition** from the right click menu.

3. In the ***Current Component*** area, key in ***Ditch_ Width*** for the ***Name***.

4. Set the ***Style*** to **Breakline**.

5. Set the ***Target Type*** to **Feature XYZ**.

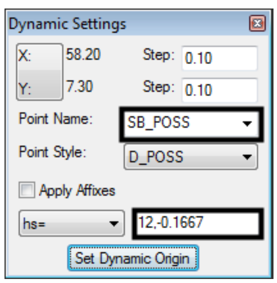
6. Set the ***Surface*** to **12345DES_Northbound**.

7. Set the ***Feature*** to **Northbound-Conc_EOP-Top**.

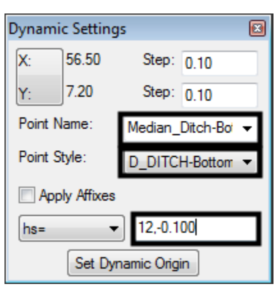
8. In the ***Dynamic Settings*** dialog box, select **EOP** for the ***Point Name***.

9. Move the cursor to the template origin (0.00,0.00) and **<D>** to place the point.

10. In the ***Dynamic Settings*** dialog box, key in ***NB_EOP*** for the ***Point Name***.
11. Toggle on **End Condition is Infinite** and **Do Not Construct**.
12. Set the key in mode to **hs=**.
13. Key in ***48,0*** in the precision key in field and press ***Enter***.
14. **<R>** and select **Finish** from the right click menu.
15. **<R>** in the template view and select **Add New Component > Unconstrained** from the right click menu.
16. In the ***Current Component*** area, key in ***Std_Compound_Ditch*** for the ***Name***.
17. Set the ***Style*** to **D_Top-of-Cut**. Using a different style for each ditch component will make it easier to troubleshoot the template if there is a problem
18. **<D>** on the **EOP** point to start the component at the origin.
19. In the ***Dynamic Settings*** dialog box, select **POSS** for the ***Point Name***. Then key in ***SB_POSS*** for the ***Point Name***. Selecting POSS first automatically sets the Point Style, then "SB_" can be appended to the name.
20. In the precision key in field, type ***12,-0.1667*** and press ***Enter***.

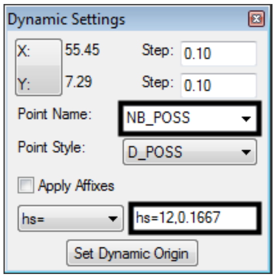


21. In the ***Dynamic Settings*** dialog box, key in ***Median_Ditch-Bottom*** in the ***Point Name*** field.
22. Select **D_DITCH-Bottom** for the ***Point Style***.
23. In the precision key in field, type ***12,-0.100*** and press ***Enter***.



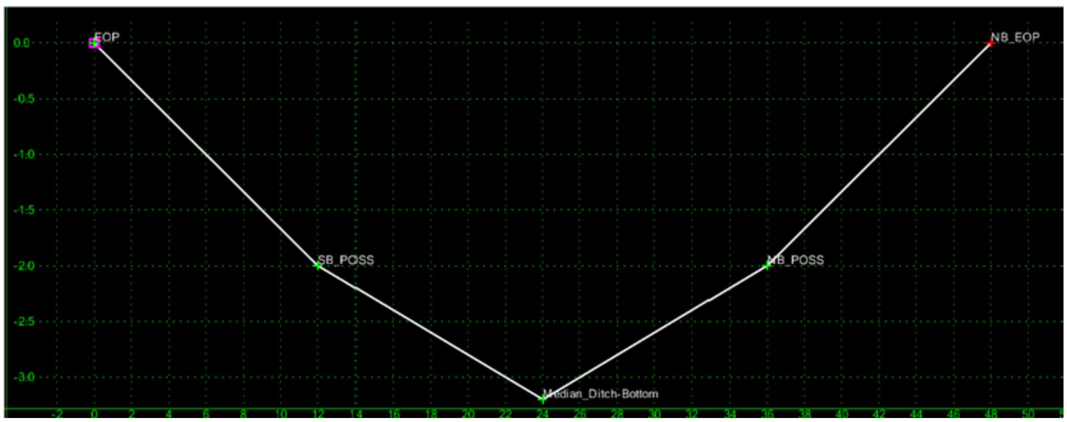
24. In the ***Dynamic Settings*** dialog box, select **POSS** for the ***Point Name***. Then key in ***NB_POSS*** for the ***Point Name***.

25. In the precision key in field, type ***12,0.100*** and press ***Enter***.



26. **<D>** on the **NB_EOP** point.

27. **<R>** and select **Finish** from the right click menu. The illustration below shows the component as it appears at this point.



The points on the component form the proper shape. Now they must be constrained to maintain that shape.

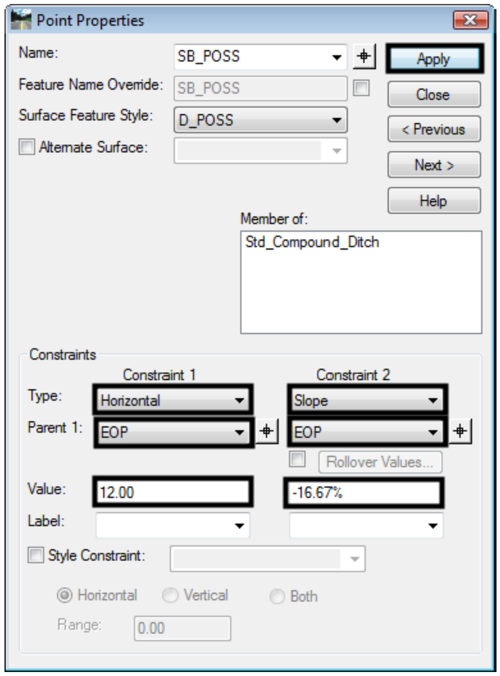
28. **<D> <D>** on the **SB_POSS** point.

29. In the ***Point Properties*** dialog box, set the ***Constraint 1 Type*** to **Horizontal**.

30. Set the ***Constraint 2 Type*** to **Slope**.

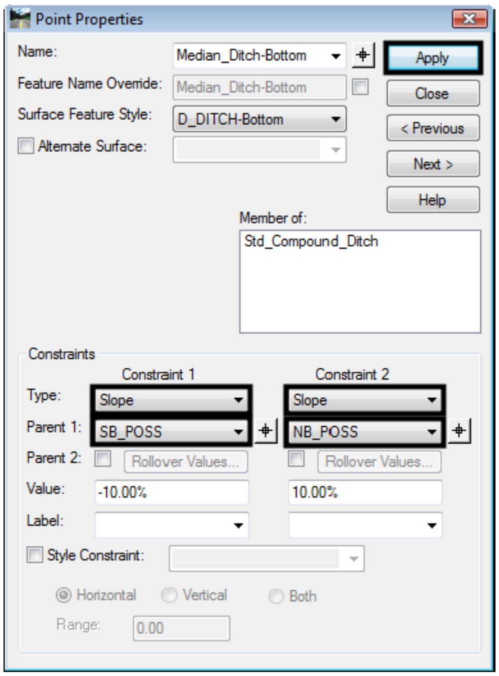
31. Set the ***Parent 1*** for both constraints to **EOP**.

32. **<D> Apply**.



33. **<D>** the **Next** button to select **Median_Ditch-Bottom**.
34. Set the ***Type*** of both constraints to **Slope**.
35. Set the ***Parent 1*** of ***Constraint 1*** to **SB_POSS**.
36. Set the ***Parent 1*** of ***Constraint 2*** to **NB_POSS**.

37. **<D> Apply**.



38. **<D>** the **Next** button to select **NB_POSS**.

39. Set the ***Constraint 1 Type*** to **Horizontal**.

40. Set the ***Constraint 2 Type*** to **Slope**.

41. Set the ***Parent 1*** for both constraints to **NB_EOP**.

42. **<D> Apply** then **<D> Close** to dismiss the ***Point Properties*** dialog box.

There are three situations where this component will not work correctly. These are 1) when the median is less than 24 feet wide 2) when the NB_POSS drops below the 10:1 slope from the SB_POSS and 3) when the Median_Ditch-Bottom is left of the SB_POSS (this can occur when the NB_EOP is higher than the SB_EOP). Display rules are used to test for each of these situations.

43. **<D> <D>** on the line forming the ditch to display the ***Component Properties*** for the ***Std_Compound_Ditch*** component.

44. In the ***Component Properties*** dialog box, **<D>** the **Edit** button. This displays the ***Component Display Conditional Expression*** dialog box.

45. In the ***Component Display Conditional Expression*** dialog box, **<D>** the **Add** button. This displays the ***Display Rule*** dialog box.

46. In the ***Display Rule*** dialog box, key in ***Std_Compound_DitchWidth*** for the ***Name***.

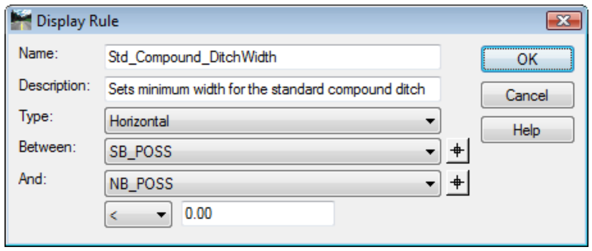
47. Key in ***Sets minimum width for the standard compound ditch*** for the ***Description***.

48. Set the ***Type*** to **Horizontal**.

49. Set ***Between*** to **SB_POSS**.

50. Set ***And*** to **NB_POSS**.

51. Set the operator to **<** and key in ***0.00*** for the value. The dialog box with completed entries is illustrated below:



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

53. In the ***Component Display Conditional Expression*** dialog box, **<D>** the **Add** button.

54. In the ***Display Rule*** dialog box, key in ***Std_Compound_DitchVertical1*** for the ***Name***.

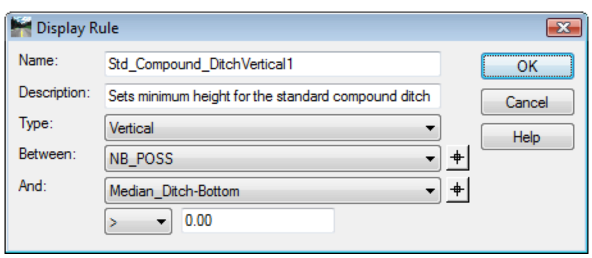
55. Key in ***Sets minimum height for the standard compound ditch*** for the ***Description***.

56. Set the ***Type*** to **Vertical**.

57. Set ***Between*** to **NB_POSS**.

58. Set ***And*** to **Median_Ditch-Bottom.**

59. Set the operator to **>** and key in ***0.00*** for the value. The dialog box with completed entries is illustrated below:



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

61. In the ***Component Display Conditional Expression*** dialog box, **<D>** the **Add** button.

62. In the ***Display Rule*** dialog box, key in ***Std_Compound_DitchVertical2*** for the ***Name***.

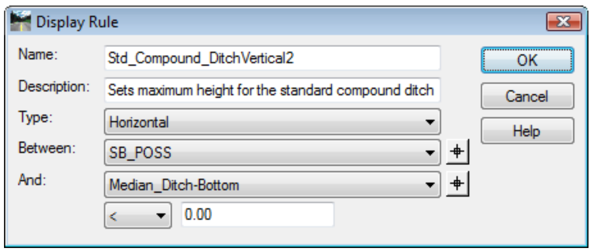
63. Key in ***Sets maximum height for the standard compound ditch*** for the ***Description***.

64. Set the ***Type*** to **Horizontal**.

65. Set ***Between*** to **SB_POSS**.

66. Set ***And*** to **Median_Ditch-Bottom.**

67. Set the operator to **<** and key in ***0.00*** for the value. The dialog box with completed entries is illustrated below:



68. **<D> OK** to accept the entries and dismiss the dialog box.

69. In the ***Component Display Conditional Expression*** dialog box, highlight **Std_Compound_DitchWidth** in the ***Template Display Rules*** area.

70. **<D>** the **Selected Rule** button.

71. **<D>** the **AND** button.

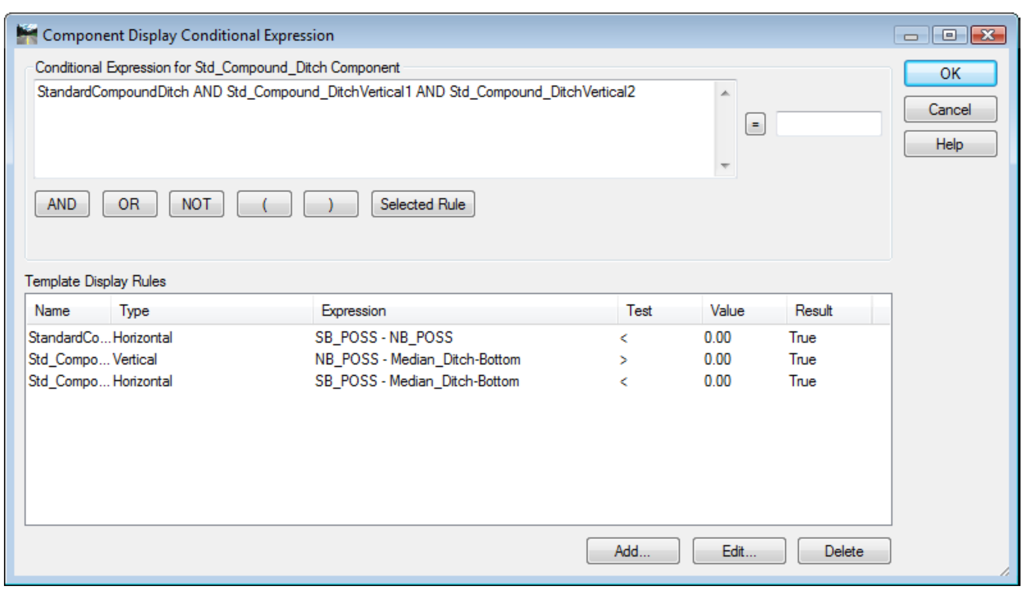
72. Highlight **Std_Compound_DitchVertical1** in the ***Template Display Rules*** area.

73. **<D>** the **Selected Rule** button.

74. **<D>** the **AND** button.

75. Highlight **Std_Compound_DitchVertical2** in the ***Template Display Rules*** area.

76. **<D>** the **Selected Rule** button. The dialog box with completed entries is illustrated below:



77. **<D> OK**. This dismisses the ***Component Display Conditional Expression*** dialog box and adds the rule to the component properties of ***Std_Compound_Ditch***.
78. **<D>** the **Apply** button then **<D>** the **Close** button to dismiss the ***Component Properties*** dialog box.

Using the three display rules with the AND operator means that all of the rules must return a True result in order for the component to be displayed.

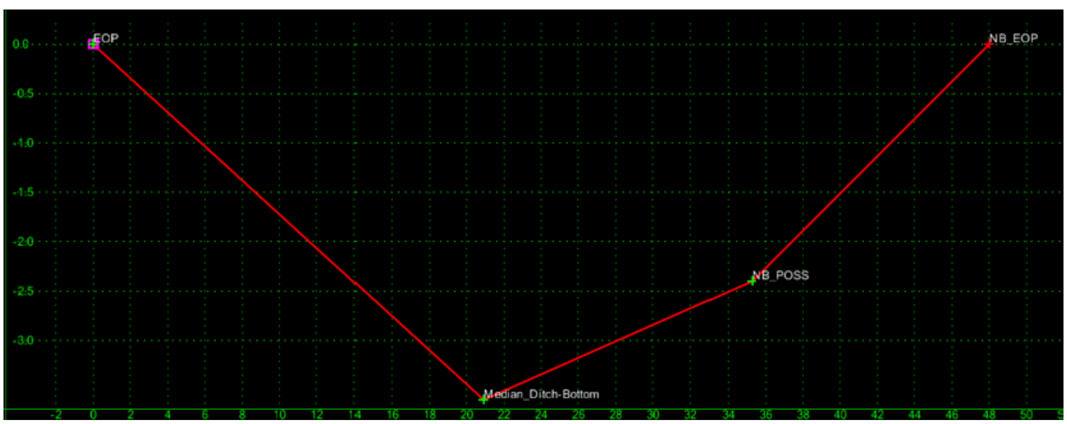
79. **<D>** the **Test** button.
80. In the ***Test End Conditions*** dialog box, **<D>** the **Draw** button.
81. Move the cursor slowly from right to left and up and down in the dialog box. Notice the different situations that cause the template to disappear.
82. **<D> Close** to dismiss the ***Test End Conditions*** dialog box.
83. Select **File > Save** from the ***Create Template*** menu bar.

Lab 26.3 - Create the 6:1 - 10:1 / 6:1 Compound Ditch Component

Two of the four components required for this template have been completed. The final two components define the ditch where the 10:1 slope from one side of the ditch intercepts the 6:1 slope on the other side.

1. Create a new template in the ***Variable Median Ditch*** folder as described in steps 6 through 9 above. Name the template ***Compound Ditch NB_EOP High***.
2. **<R>** in the template view and select **Add New Component > End Condition** from the right click menu.
3. In the ***Current Component*** area, key in ***Ditch_ Width*** for the ***Name***.
4. Set the ***Style*** to **Breakline**.
5. Set the ***Target Type*** to **Feature XYZ**.
6. Set the ***Surface*** to **12345DES_Northbound**.
7. Set the ***Feature*** to **Northbound-Conc_EOP-Top**.
8. In the ***Dynamic Settings*** dialog box, select **EOP** for the ***Point Name***.
9. Move the cursor to the template origin (0.00,0.00) and **<D>** to place the point.
10. In the ***Dynamic Settings*** dialog box, key in ***NB_EOP*** for the ***Point Name***.
11. Toggle on **End Condition is Infinite** and **Do Not Construct**.
12. Set the key in mode to **hs=**.
13. Key in ***48,0*** in the precision key in field and press ***Enter***.
14. **<R>** and select **Finish** from the right click menu.

15. Add a new unconstrained component.
16. Key in ***NB_EOP-High*** for the ***Name***.
17. Select **D_CONC_Sw** for the ***Style***.
18. **<D>** on the **EOP** point to start the component at the origin.
19. In the ***Dynamic Settings*** dialog box, key in ***Median_Ditch-Bottom*** in the ***Point Name*** field.
20. Select **D_DITCH-Bottom** for the ***Point Style***.
21. **<D>** between and below the ***EOP*** and ***NB_EOP*** points.
22. In the ***Dynamic Settings*** dialog box, key in ***NB_POSS*** in the ***Point Name*** field.
23. Select **D_POSS** for the ***Point Style***.
24. **<D>** to the right and above ***Median_Ditch-Bottom*** and to the left and below ***NB_EOP***.
25. **<D>** on the **NB_EOP** point.
26. **<R>** and select **Finish** from the right click menu. The illustration below shows the component as it appears at this point.

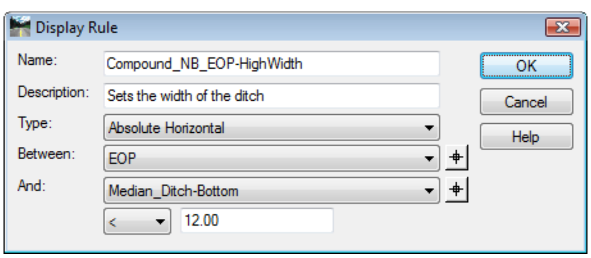


27. **<D> <D>** on the **Median_Ditch-Bottom** point.
28. In the ***Point Properties*** dialog box, set the ***Type*** to **Slope** on both constraints.
29. Set the ***Parent 1*** for ***Constraint 1*** to **EOP**.
30. Set the ***Parent 1*** for ***Constraint 2*** to **NB_POSS**.
31. Key in the ***-0.1667*** for the ***Value*** of ***Constraint 1***.
32. Key in the ***0.1000*** for the ***Value*** of ***Constraint 2***.
33. **<D> Apply**.
34. **<D> Next** to select the **NB_POSS** point.
35. Set the ***Constraint 1 Type*** to **Horizontal**.

36. Set the ***Constraint 2 Type*** to **Slope**.
37. Set the ***Parent 1*** for both constraints to **NB_EOP**.
38. Key in the ***12.00*** for the ***Value*** of ***Constraint 1***.
39. Key in the ***0.1667*** for the ***Value*** of ***Constraint 2***.
40. **<D> Apply** then **<D> Close** to dismiss the dialog box.

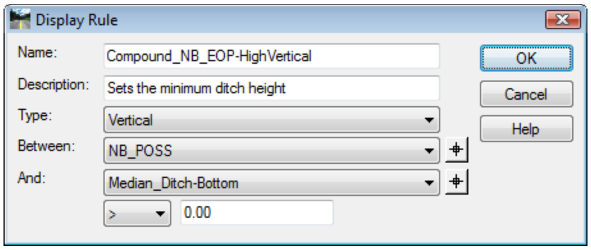
The shape of the ditch is now fixed. Now display Rules must be added to control when this component is displayed.

41. **<D> <D>** on the line forming the ditch to display the ***Component Properties*** for the ***NB_EOP_HIGH*** component.
42. In the ***Component Properties*** dialog box, **<D>** the **Edit** button. This displays the ***Component Display Conditional Expression*** dialog box.
43. In the ***Component Display Conditional Expression*** dialog box, **<D>** the **Add** button. This displays the ***Display Rule*** dialog box.
44. In the ***Display Rule*** dialog box, key in ***NB_EOP_HIGHWidth*** for the ***Name***.
45. Key in ***Sets width for ditch*** for the ***Description***.
46. Set the ***Type*** to **Absolute Horizontal**.
47. Set ***Between*** to **EOP**.
48. Set ***And*** to **Median_Ditch-Bottom**.
49. Set the operator to **<** and key in ***12.00*** for the value. The dialog box with completed entries is illustrated below:



50. **<D> OK**. This dismisses the ***Display Rule*** dialog box.
51. In the ***Component Display Conditional Expression*** dialog box, **<D>** the **Add** button.
52. In the ***Display Rule*** dialog box, key in ***NB_EOP_HIGHVertical*** for the ***Name***.
53. Key in ***Sets height for the ditch*** for the ***Description***.
54. Set the ***Type*** to **Vertical**.
55. Set ***Between*** to **NB_POSS**.
56. Set ***And*** to **Median_Ditch-Bottom.**

57. Set the operator to **>** and key in ***0.00*** for the value. The dialog box with completed entries is illustrated below:



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

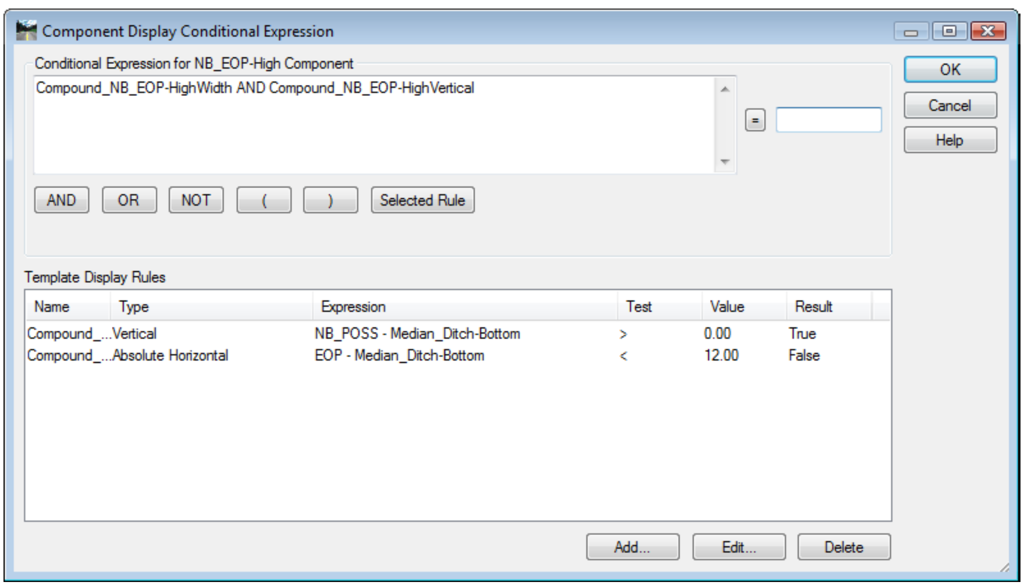
59. In the ***Component Display Conditional Expression*** dialog box, highlight **NB_EOP_HIGHWidth** in the ***Template Display Rules*** area.

60. **<D>** the **Selected Rule** button.

61. **<D>** the **AND** button.

62. Highlight **NB_EOP_HIGHVertical** in the ***Template Display Rules*** area.

63. **<D>** the **Selected Rule** button. The dialog box with completed entries is illustrated below:



64. **<D> OK**. This dismisses the ***Component Display Conditional Expression*** dialog box and adds the rule to the component properties of ***NB_EOP High***.

65. **<D>** the **Apply** button then **<D>** the **Close** button to dismiss the ***Component Properties*** dialog box.

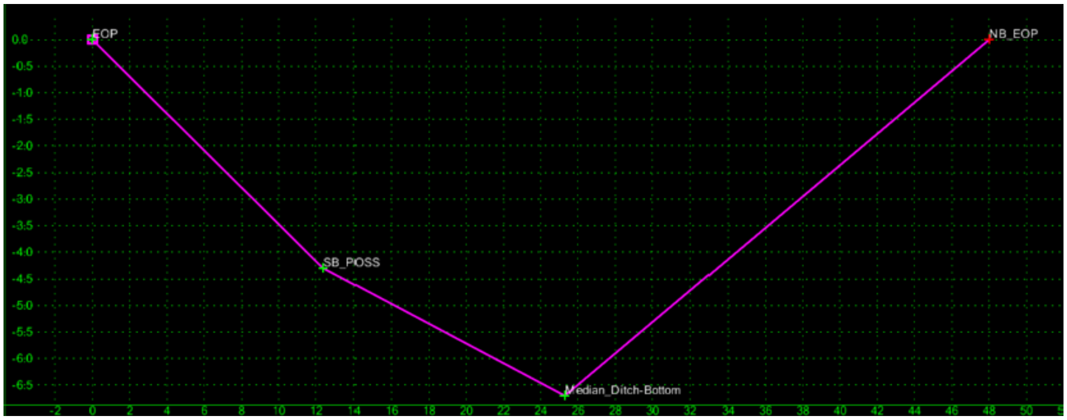
This completes the ***Compound Ditch NB_EOP High*** component.

Lab 26.4 - Create the 6:1 / 6:1 - 10:1 Compound Ditch Component

Next the final component is built.

1. Create a new template in the ***Variable Median Ditch*** folder as described in steps 6 through 9 above. Name the template ***Compound Ditch SB_EOP High***.
2. **<R>** in the template view and select **Add New Component > End Condition** from the right click menu.
3. In the ***Current Component*** area, key in ***Ditch_ Width*** for the ***Name***.
4. Set the ***Style*** to **Breakline**.
5. Set the ***Target Type*** to **Feature XYZ**.
6. Set the ***Surface*** to **12345DES_Northbound**.
7. Set the ***Feature*** to **Northbound-Conc_EOP-Top**.
8. In the ***Dynamic Settings*** dialog box, select **EOP** for the ***Point Name***.
9. Move the cursor to the template origin (0.00,0.00) and **<D>** to place the point.
10. In the ***Dynamic Settings*** dialog box, key in ***NB_EOP*** for the ***Point Name***.
11. Toggle on **End Condition is Infinite** and **Do Not Construct**.
12. Set the key in mode to **hs=**.
13. Key in ***48,0*** in the precision key in field and press ***Enter***.
14. **<R>** and select **Finish** from the right click menu.
15. Add a new unconstrained component.
16. Key in ***SB_EOP-High*** for the ***Name***.
17. Select **D_Shoulder** for the ***Style***.
18. **<D>** on the **EOP** point to start the component at the origin.
19. In the ***Dynamic Settings*** dialog box, key in ***SB_POSS*** in the ***Point Name*** field.
20. Select **D_POSS** for the ***Point Style***.
21. **<D>** between and below the ***EOP*** and ***NB_EOP*** points.
22. In the ***Dynamic Settings*** dialog box, key in ***Median_Ditch-Bottom*** in the ***Point Name*** field.
23. Select **D_DITCH-Bottom** for the ***Point Style***.
24. **<D>** between and below the ***SB_POSS*** and ***NB_EOP*** points.
25. **<D>** on the **NB_EOP** point.

26. **<R>** and select **Finish** from the right click menu. The illustration below shows the component as it appears at this point.



27. **<D> <D>** the **SB_POSS** point.

28. Set the ***Constraint 1 Type*** to **Horizontal**.

29. Set the ***Constraint 2 Type*** to **Slope**.

30. Set the ***Parent 1*** for both constraints to **EOP**.

31. Key in the ***12.00*** for the ***Value*** of ***Constraint 1***.

32. Key in the -***0.1667*** for the ***Value*** of ***Constraint 2***.

33. **<D> Apply** to accept the changes.

34. **<D> Next** to select the **Median_Ditch-Bottom** point.

35. In the ***Point Properties*** dialog box, set the ***Type*** to **Slope** on both constraints.

36. Set the ***Parent 1*** for ***Constraint 1*** to **SB_POSS**.

37. Set the ***Parent 1*** for ***Constraint 2*** to **NB_EOP**.

38. Key in the ***-0.1000*** for the ***Value*** of ***Constraint 1***.

39. Key in the ***0.1667*** for the ***Value*** of ***Constraint 2***.

40. **<D> Apply**.

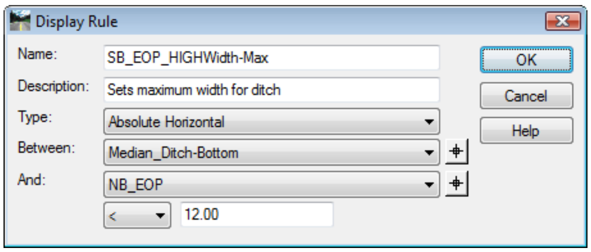
The shape of the ditch is now fixed. Now display Rules must be added to control when this component is displayed.

41. **<D> <D>** on the line forming the ditch to display the ***Component Properties*** for the ***SB_EOP-High*** component.

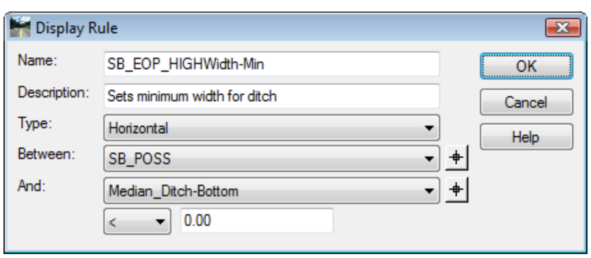
42. In the ***Component Properties*** dialog box, **<D>** the **Edit** button. This displays the ***Component Display Conditional Expression*** dialog box.

43. In the ***Component Display Conditional Expression*** dialog box, **<D>** the **Add** button. This displays the ***Display Rule*** dialog box.

44. In the ***Display Rule*** dialog box, key in ***SB_EOP_HIGHWidth-Max*** for the ***Name***.
45. Key in ***Sets maximum width for ditch*** for the ***Description***.
46. Set the ***Type*** to **Absolute Horizontal**.
47. Set ***Between*** to **Median_Ditch-Bottom**.
48. Set ***And*** to **NB_EOP**.
49. Set the operator to **<** and key in ***12.00*** for the value. The dialog box with completed entries is illustrated below:



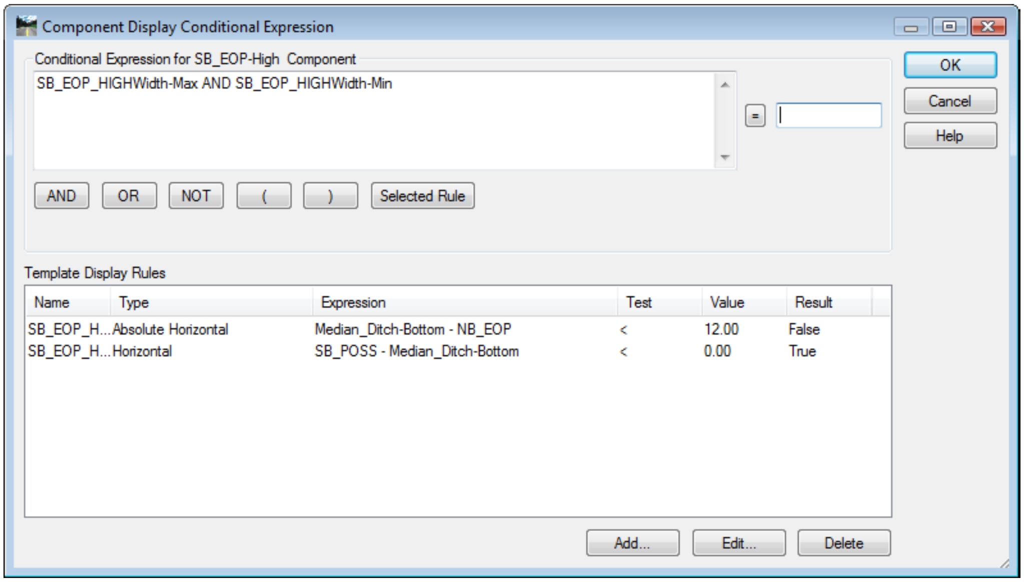
50. **<D> OK**. This dismisses the ***Display Rule*** dialog box.
51. In the ***Component Display Conditional Expression*** dialog box, **<D>** the **Add** button.
52. In the ***Display Rule*** dialog box, key in ***SB_EOP_HIGHWidth-Min*** for the ***Name***.
53. Key in ***Sets minimum width for ditch*** for the ***Description***.
54. Set the ***Type*** to **Horizontal**.
55. Set ***Between*** to **SB_POSS**.
56. Set ***And*** to **Median_Ditch-Bottom**.
57. Set the operator to **<** and key in ***0.00*** for the value. The dialog box with completed entries is illustrated below:



58. **<D> OK**. This dismisses the ***Display Rule*** dialog box.
59. In the ***Component Display Conditional Expression*** dialog box, highlight **SB_EOP_HIGHWidth-Max** in the ***Template Display Rules*** area.
60. **<D>** the **Selected Rule** button.
61. **<D>** the **AND** button.

62. Highlight **SB_EOP_HIGHWidth-Min** in the ***Template Display Rules*** area.

63. **<D>** the **Selected Rule** button. The dialog box with completed entries is illustrated below:



64. **<D> OK**. This dismisses the ***Component Display Conditional Expression*** dialog box and adds the rule to the component properties of ***SB_EOP High***.

65. **<D>** the **Apply** button the **<D>** the **Close** button to dismiss the ***Component Properties*** dialog box.

This completes the ***Compound Ditch SB_EOP High*** component. All of the variable median ditch components can be placed into a single section.

Section Summary:

- The components use an end condition to find the edge of the northbound pavement. This is so that the component can be tested before it is added to the template. The same results can be accomplished with a null point and a point control.
- Display rules are used to define when a component will be used.
- Different Styles are used for the ditch line in each component. This is done to facilitate troubleshooting. Once the components are assembled into a section and it is working properly, the styles will be set to match for each component.

Lab 26.5 - Assemble the Components into a Section

Now that the individual components for the variable median ditch are built, they can be assembled into a section.

Section Objectives:

- Create a new folder for the variable median ditch section.
- Create a new template for the variable median ditch section.
- Add the components to the section.

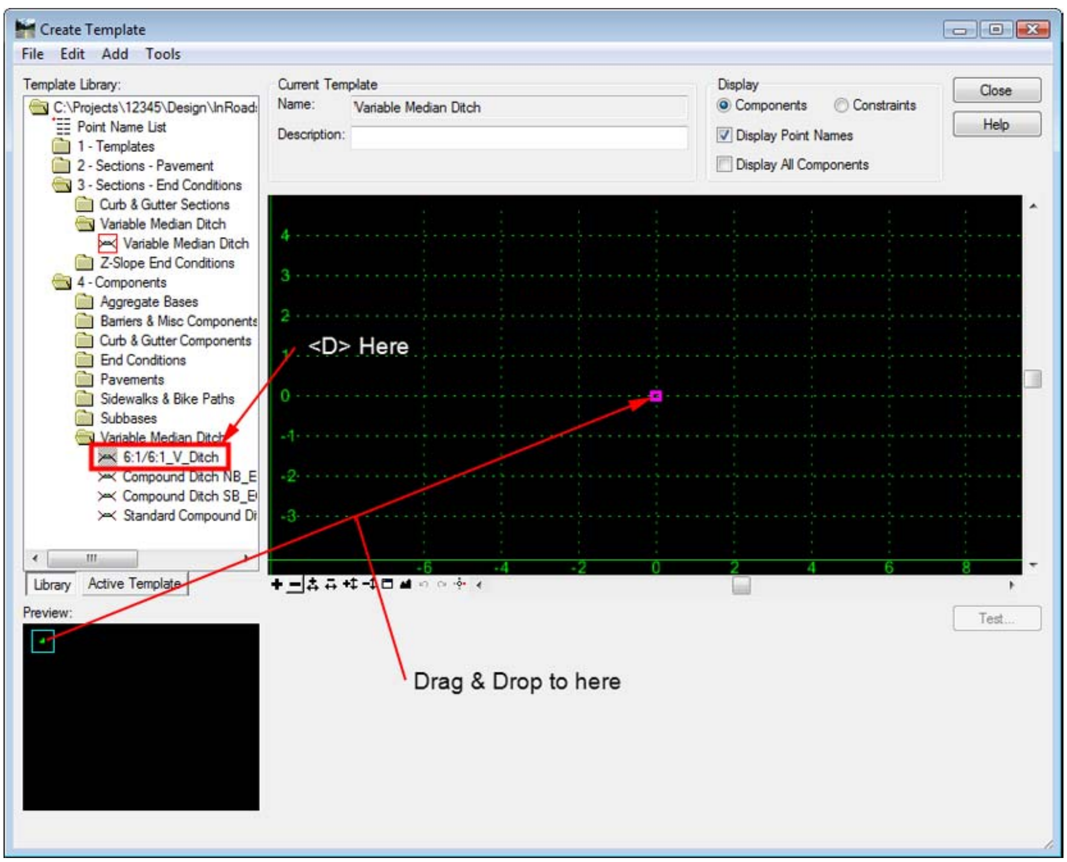
- ♦ Delete the redundant end condition components.
- ♦ Add additional display rules so that only one component is displayed at a time.

The first step is to create the folder and template for the variable median ditch section.

1. Expand the **3 - Sections - End Conditions** folder of the template library.
2. **<R>** on the **3 - Sections - End Conditions** folder and select **New > Folder** from the right click menu.
3. Key in ***Variable Median Ditch*** for the folder name.
4. **<R>** on the **Variable Median Ditch** folder and select **New > Template** from the right click menu.
5. Key in ***Variable Median Ditch*** for the template name. The new template is automatically opened for editing.

Now the components can be placed into the new template.

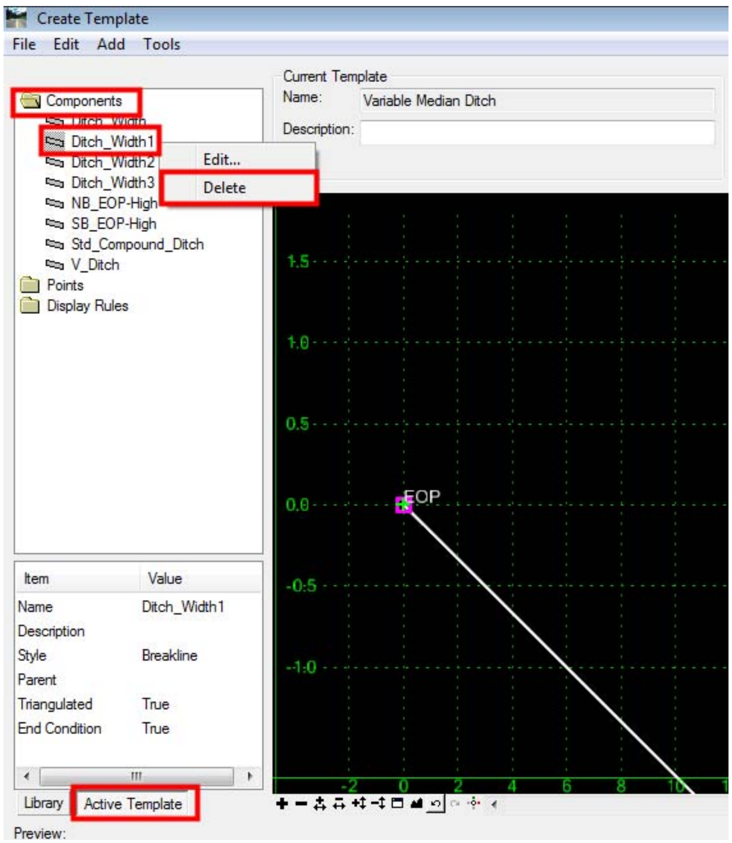
6. **<D>** on the **6:1/6:1_V_Ditch** component so that it is displayed in the ***Preview*** window.
7. Drag the component by its origin (the green dot in the upper left corner) and drop it on the origin in the template view.



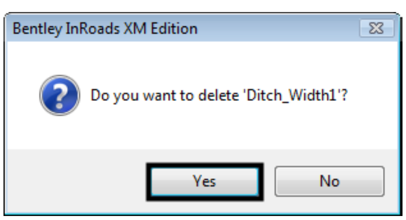
8. Repeat steps 6 and 7 with the **Compound Ditch NB_EOP High**, **Compound Ditch NB_EOP High**, and **Standard Compound Ditch**.

Because each component has the same end condition in it, the Variable Median Ditch section now has four identical end conditions. Three of these end conditions are deleted to remove redundancies in the template. Because the same point names are used in each component, deleting the extra end conditions will not affect how the individual components operate.

9. **<D>** the **Active Template** tab at the bottom of the Template Library tree view.
10. Expand the **Components** folder.
11. **<R>** on **Ditch_Width1** and select **Delete** from the right click menu.



12. **<D> Yes** on the delete warning message box.

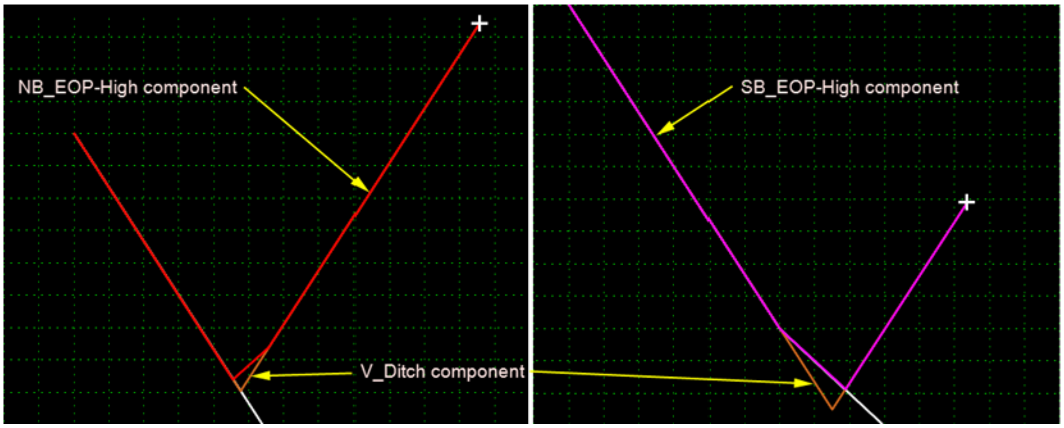


13. Repeat steps 10 through 12 for **Ditch_Width2** and **Ditch_Width3**.

Next, test the section and see how each of the components behave.

14. **<D>** the **Test** button.
15. In the ***Test End Conditions*** dialog box, **<D>** the **Draw** button.

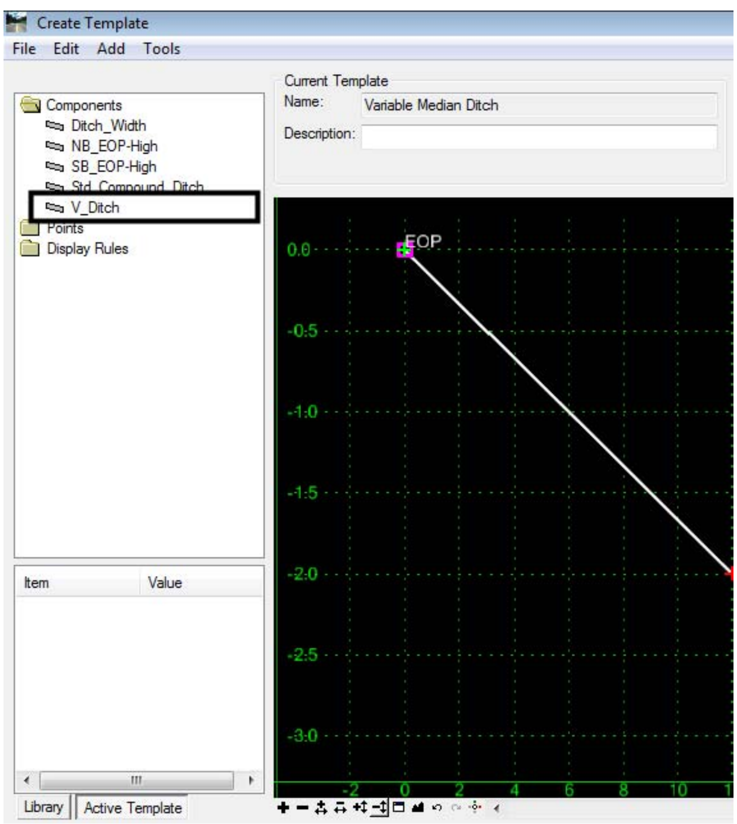
16. Move the cursor around slowly in the view area. Notice that there are two instances when two components are displayed at the same time. These occur when the horizontal distance between the EOP and NB_EOP is less than 24' and there is an elevation difference between the points.



This is fixed by adding two more display rules to the V_Ditch component.

17. **<D> Close** to dismiss the ***Test End Conditions*** dialog box.

18. In the ***Create Templates*** dialog box, **<D> <D>** on the **V_Ditch** component in the ***Active Template*** tree view. This opens the ***Component Properties*** dialog box.



19. **<D>** the **Edit** button to display the ***Component Display Conditional Expression*** dialog box.

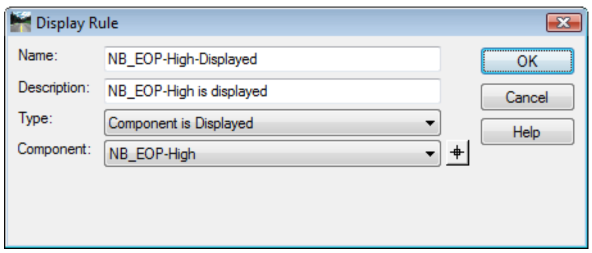
20. In the ***Component Display Conditional Expression*** dialog box, **<D>** the **Add** button to display the ***Display Rule*** dialog box.

21. In the ***Display Rule*** dialog box, key in ***NB_EOP-High-Displayed*** for the ***Name***.

22. Key in ***NB_EOP-High is displayed*** for the ***Description***.

23. Set the ***Type*** to **Component is Displayed**.

24. Set the ***Component*** to **NB_EOP-High**. The dialog box with completed entries is illustrated below:



25. **<D>** the **OK** button. This dismisses the ***Display Rule*** dialog box and adds the new rule to the Template Display Rules list on the ***Component Display Conditional Expression*** dialog box.

    Note: The Template Display Rules list contains all of the rules created thus far in the lab.

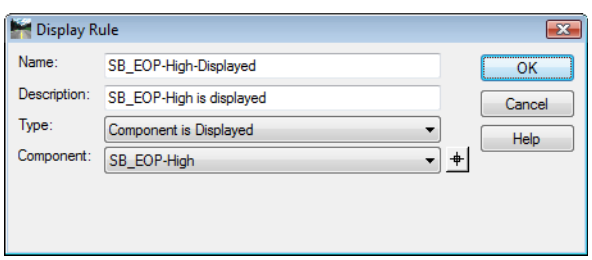
26. In the ***Component Display Conditional Expression*** dialog box, **<D>** the **Add** button to display the ***Display Rule*** dialog box.

27. In the ***Display Rule*** dialog box, key in ***SB_EOP-High-Displayed*** for the ***Name***.

28. Key in ***SB_EOP-High is displayed*** for the ***Description***.

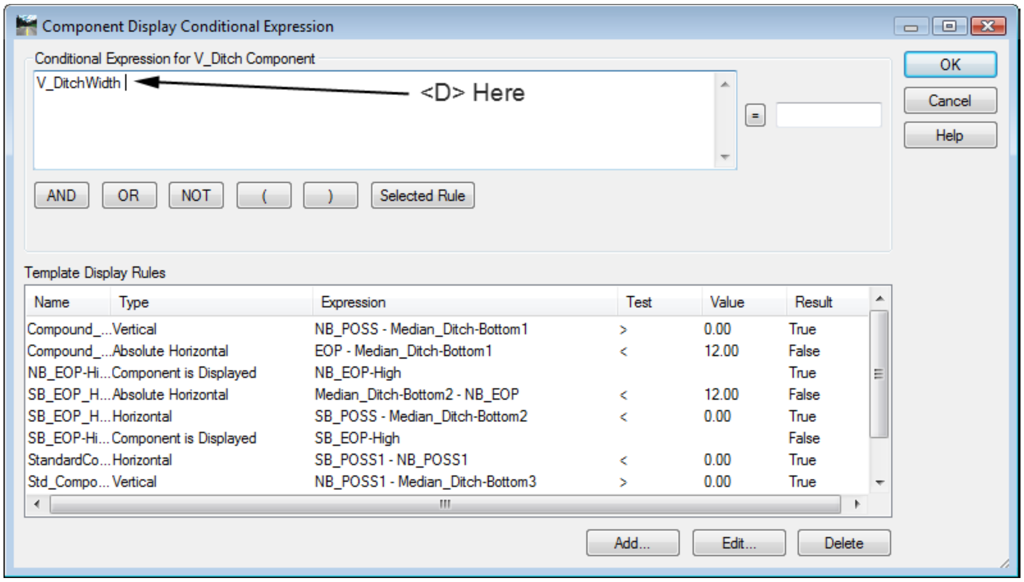
29. Set the ***Type*** to **Component is Displayed**.

30. Set the ***Component*** to **SB_EOP-High**. The dialog box with completed entries is illustrated below:



31. **<D>** the **OK** button.

32. In the ***Component Display Conditional Expression*** dialog box, **<D>** in the ***Conditional Expression for V_Ditch*** area to the right of the ***V_DitchWidth*** entry.



33. **<D>** the **AND** button.

34. **<D>** the **NOT** button.

35. Highlight the **NB_EOP-High-Displayed** rule in the ***Template Display Rules*** list.

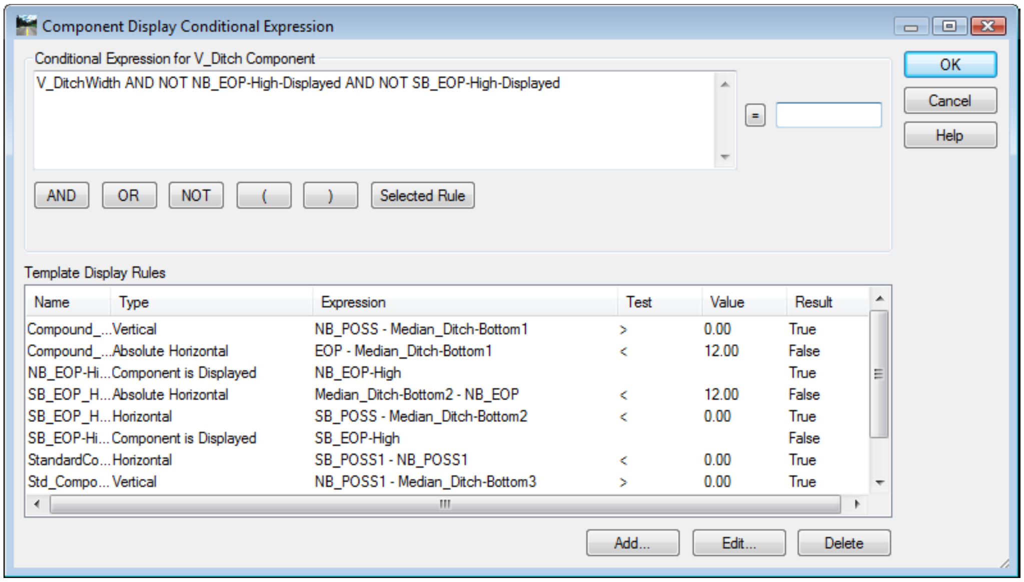
36. **<D>** the **Selected Rule** button.

37. **<D>** the **AND** button.

38. **<D>** the **NOT** button.

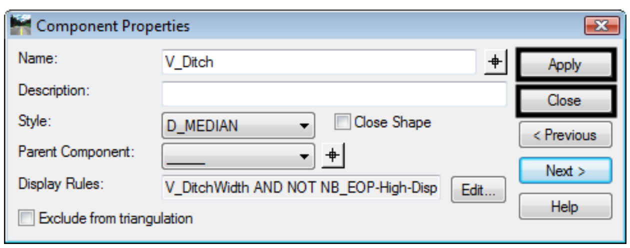
39. Highlight the **SB_EOP-High-Displayed rule** in the ***Template Display Rules*** list.

40. **<D>** the **Selected Rule** button. The dialog box with completed entries is illustrated below:



41. **<D>** the **OK** button to accept the changes and dismiss the dialog box.

42. On the ***Component Properties*** dialog box, **<D> Apply** then **<D> Close**.



43. Test the section again. Notice that only one component at a time is displayed.

44. **<D> Close** on the ***Test End Conditions*** dialog box.

45. Select **File > Save** from the ***Create Template*** menu bar.

The Variable Median Ditch section is ready to be used on a template.

Section Summary:

- As components were added to the section, common points were merged but common components (like the end conditions) are not.
- Use the Active Template tree view to access components that are not displayed.
- Additional display rules can be used to turn off a component when two are displayed at the same time.

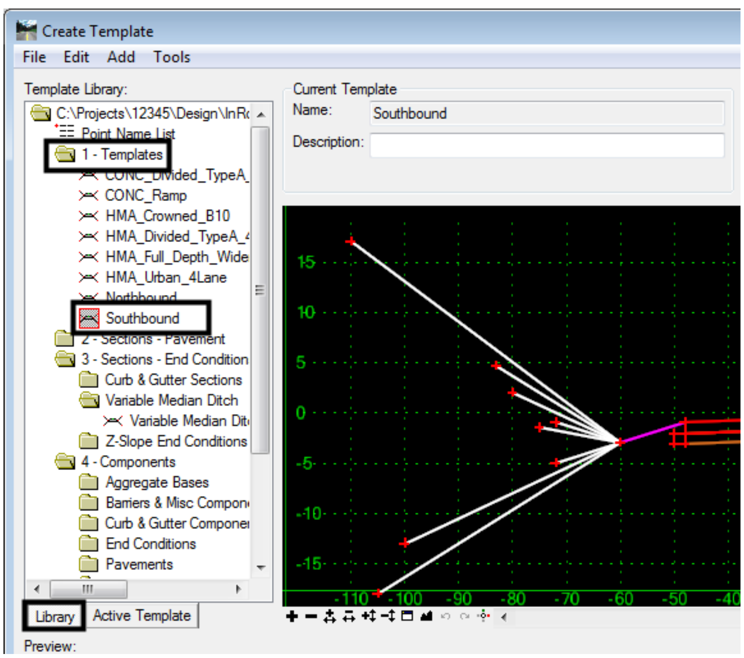
Lab 26.6 - Adding the Section to a Template and Reviewing the Corridor

The variable median ditch section can now be added to the template and used in the design corridor.

Section Objectives:

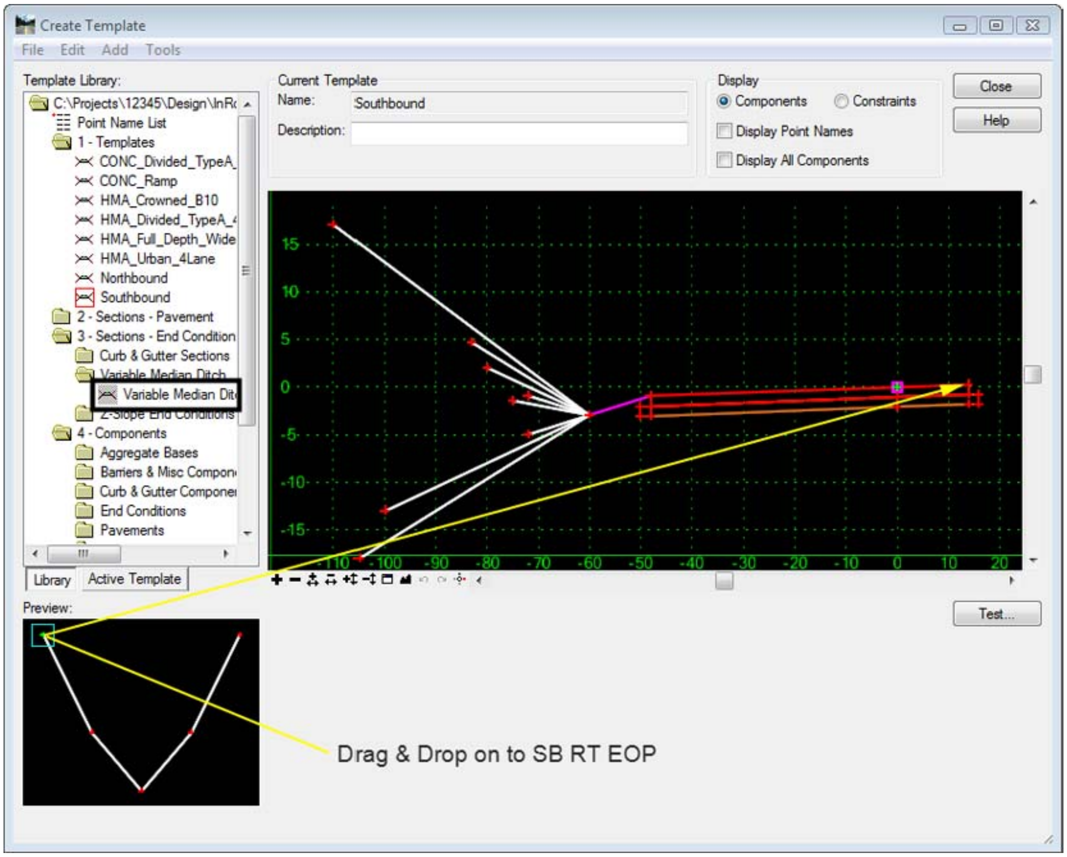
- ♦ Add the variable median ditch to the southbound backbone template.
- ♦ Update the corridor to use the modified template.
- ♦ Examine the results in the Roadway Designer dialog box.

1. **<D>** the **Library** tab to show the ***Template Library*** tree view.
2. Expand the **1 - Templates** folder.
3. **<D> <D>** on the **Southbound** template to make it active.



4. **<D>** on the **Variable Median Ditch** section (in the ***3 - Sections - End Conditions*** > ***Variable Median Ditch***) to display it in the ***Preview*** window.
5. In the ***Preview*** window, **<D> and hold** on the ***Variable Median Ditch*** origin.

6. **Drag** the section into the template view and **Drop** it on the **SB RT EOP** point.



7. Select **File > Save** from the ***Create Template*** menu bar.

8. **<D> Close** on the ***Create Template*** dialog box.

The template is now ready to use in the corridor.

9. From the InRoads main menu bar, select **Modeler > Roadway Designer**. This displays the ***Roadway Designer*** dialog box.

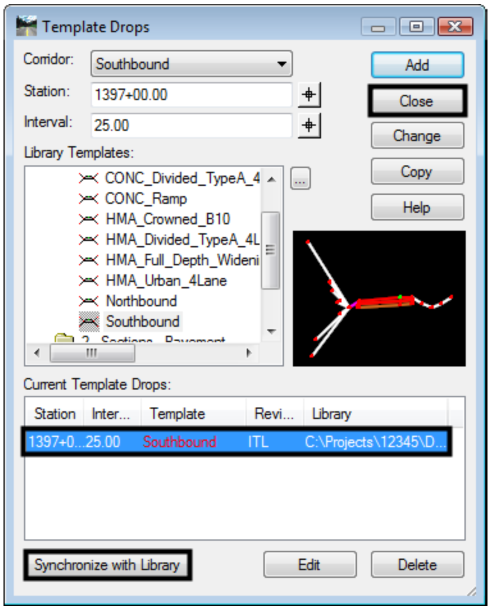
10. In the ***Roadway Designer*** dialog box, verify that the Southbound corridor is active.

11. Select **Corridor > Template Drops** from the Roadway Designer menu bar.

12. Highlight the entry in the ***Current Template Drops*** list.

13. **<D>** the **Synchronize with Library** button.

14. **<D> Close** to dismiss the ***Template Drops*** dialog box.



15. Scroll through the stations watching the template view. Notice the changes in the median ditch (especially around stations 1407+25 and 1415+75,). The different styles used on the median ditch components make it easy to spot when the component changes.

16. On the Roadway Designer menu bar, select **File > Save** to save the modified ird file.

17. **<D> Close** on the ***Roadway Designer*** dialog box.

18. Close InRoads and MicroStation.

Section Summary:

- ♦ The variable median ditch requires no further editing to be used in the template.
- ♦ Always check the Template Drops after editing templates.
- ♦ After examining the corridor, go back and change the styles of the median ditch components so they match.

Chapter Summary:

- Build complex sections in smaller components that can be tested prior to assembling the whole thing.
- Use display rules to select a single component when more than one can be displayed.
- Use different styles to facilitate trouble shooting.

LAB 27 - Using Walls in a Corridor Run

Walls Are used to reduce the width of sideslopes in areas restricted by right of way, roads or other structures, or natural obstacles. Other labs in this series describe the design of independent walls. In this lab, walls are used as part of the template in a corridor run.

Chapter Objectives:

- Modify an existing wall component for a specific situation.
- Add the modified wall component to a template.
- Construct a new wall component that targets a surface feature.

The Following files are used in this lab:

- C:\Projects\12345\Design\Drawings\Reference_Files\12345DES_Walls-Lab.dgn
- C:\Projects\12345\Design\InRoads\12345DES_Walls-Lab.alg
- C:\Projects\12345\Design\InRoads\12345DES_Walls-Lab.ird
- C:\Workspace\Workspace-CDOT_XM\Standards-Global\InRoads\Templates\ CDOT_Template-Library.itl
- C:\Projects\12345\DesignROW_Survey\InRoads\DTM\12345 Walls-Lab.dtm

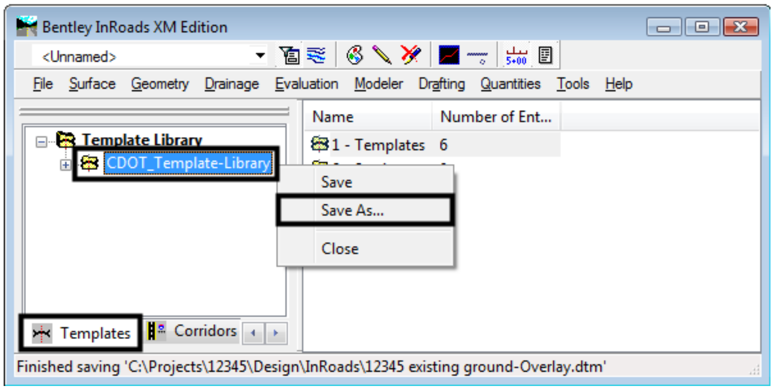
Each of these walls are applied to the same corridor. The wall component that is currently in the library is used on the right side of the template. The new wall component, that is built as part of the lab, is used on the left side.

Lab 27.1 - Add an Existing Wall Component to a Template

The existing wall component has the basic layout needed for this project. It just needs a couple of minor alterations to make it fit into the location where it is used. In this exercise, the wall component is added to the template and the minor changes are made.

1. Open MicroStation and InRoads using the **C:\Projects\12345\Design\Drawings\ Reference_Files\12345DES_Walls-Lab.dgn** file.
2. Load the following files into InRoads:
   - ♦ **C:\Projects\12345\Design\InRoads\12345DES_Walls-Lab.alg**
   - ♦ **C:\Projects\12345\Design\InRoads\12345DES_Walls-Lab.ird**
   - ♦ **C:\Projects\12345\ROW_Survey\InRoads\DTM\12345 Walls-Lab.dtm**
   - ♦ **C:\Workspace\Workspace-CDOT_XM\Standards-Global\InRoads\ Templates\CDOT_Template-Library.itl**
3. Verify that the **C:\Workspace\Workspace-CDOT_XM\Standards-Global\ InRoads\ Preferences\CDOT_Civil.xin** file is loaded.
4. In the InRoads explorer, **<D>** the **Template** tab.

5. **<R>** on the **CDOT_Template-Library** and select **Save As** from the right click menu.



6. In the **Save As** dialog box, verify that the **C:\Projects\12345\Design\InRoads** directory is selected.

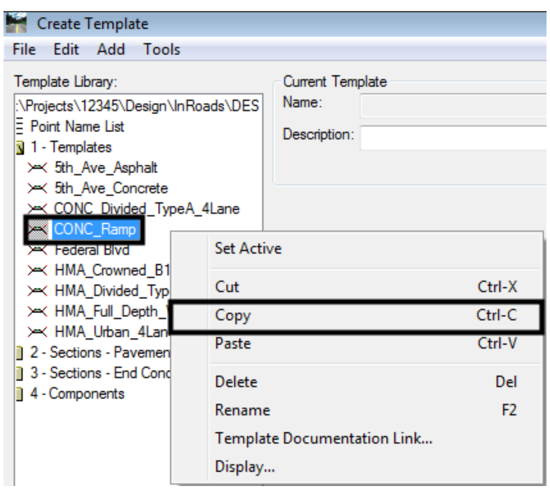
7. In the ***File name*** field, key in ***DES12345_ Walls-Lab***.

8. **<D> Save** then **<D> Cancel**.

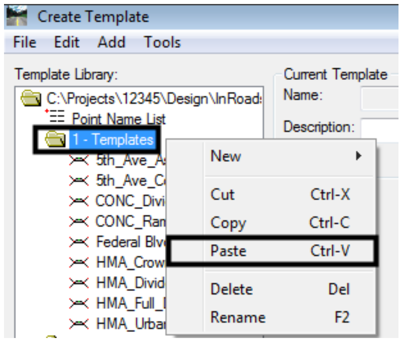
9. From the InRoads menu bar, select **Modeler > Create Template**.

10. In the ***Create Template*** dialog box, expand the **C:\Projects\12345\Design\InRoads\DES12345_Walls-Lab > 1 - Templates** folder.

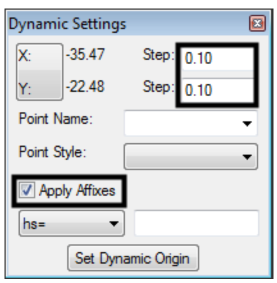
11. **<R>** on the **CONC_Ramp** template and select **Copy** from the right click menu.



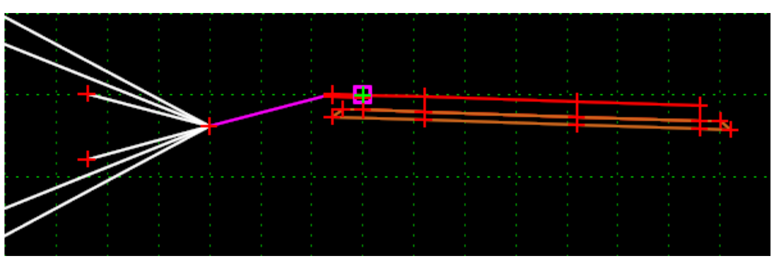
12. **<R>** on the **1 - Templates** folder and select **Paste** from the right click menu. This creates the ***CONC_Ramp1*** template.



13. **<R>** on the **CONC_Ramp1** template and select **Rename** from the right click menu.
14. Key in ***CONC_Ramp_with_Walls*** for the name.
15. **<D> <D>** on the **CONC_Ramp_with_Walls** template to make it active. Display the ***Dynamic Settings*** dialog box.
16. In the ***Dynamic Settings*** dialog box, set the ***Steps*** to ***0.10***.
17. Toggle on **Apply Affixes**.



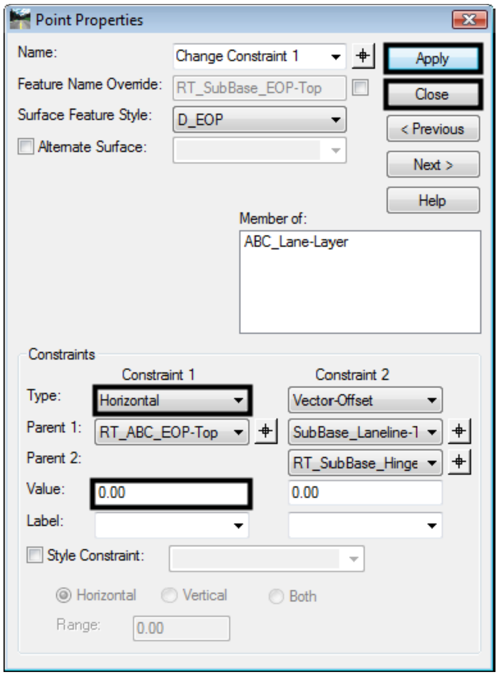
18. Delete the POSS and end condition components from the right side of the template. The illustration below shows the template with the components deleted.



Next, the RT_SubBase_EOP-Top point is moved to line up under the RT_ABC_EOP-Top point. This is so that it will not overlap into the wall base.

19. **<D> <D>** on the **RT_SubBase_EOP-Top** point to display the ***Point Properties*** dialog box.
20. Change the ***Constraint 1 Type*** from ***Slope*** to **Horizontal**.

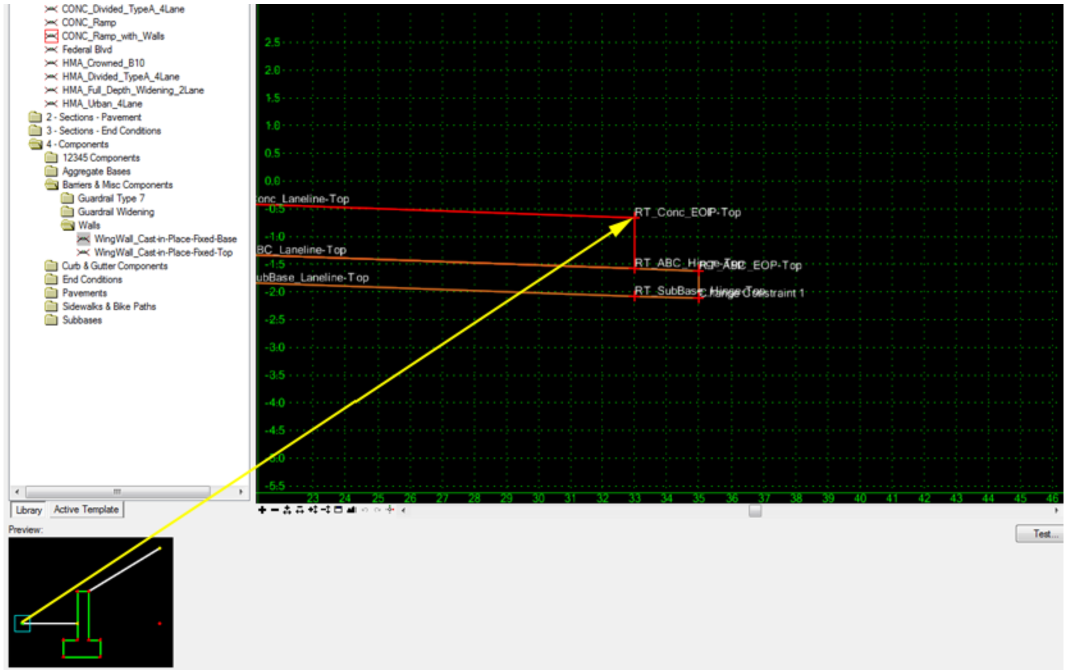
21. Key in ***0.00*** for the ***Value***.
22. **<D>** the **Apply** button then **<D> Close** to dismiss the dialog box.



Now the wall component can be added to the template.

23. In the Template Library explorer, expand the folders to show the contents of the **C:\Projects\12345\Design\InRoads\DES12345_Walls-Lab.itl > 4 - Components > Barriers & Misc Components > Walls** folder.
24. **<D>** on the **WingWall_Cast-in-Place-Fixed-Base** component to display it in the ***Preview*** window.
25. **<D> and hold** on the wall component's origin (the far left point).

26. **Drag and drop** it onto the ***RT_Conc_EOP-Top*** point.

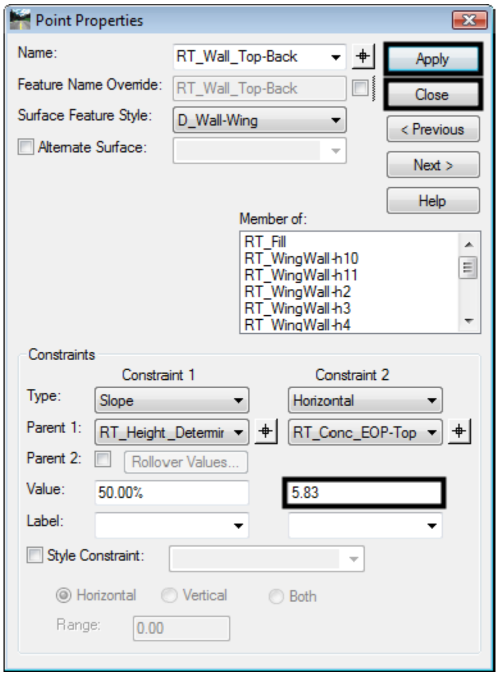


Currently, the wall is set 4 feet from the pavement edge. If the wall is extended to its full height, the footer of the wall will expand into the ABC material of the ramp. To correct this problem, the wall is moved 1 foot to the right.

27. **<D> <D>** on the **RT_Wall_Top-Back** point to display the ***Point Properties*** dialog box.

28. In the ***Point Properties*** dialog box, Change the ***Value*** of ***Constraint 2*** (the Horizontal constraint) to ***5.83***.

29. **<D> Apply** then **<D> Close** to dismiss the dialog box.



This has moved the wall 1 foot to the right. It has also left a gap between the wall and the segment that connects the wall to the rest of the template. Next this gap is closed and a shallow "V" ditch is created between the wall and pavement edge.

30. **<D> <D>** on the **RT_SwaleToe** point.

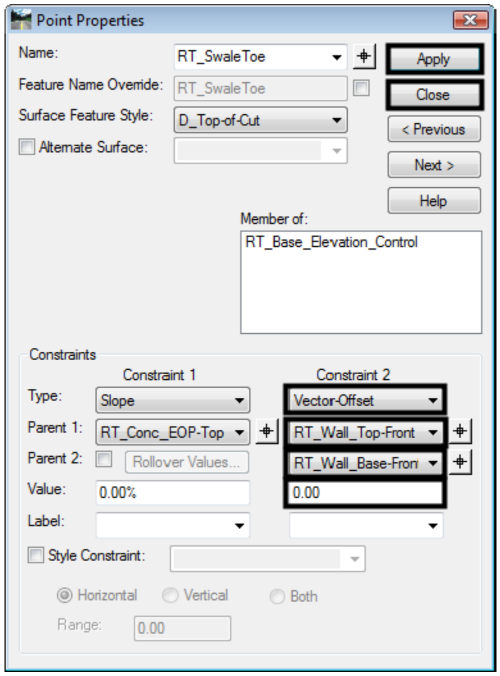
31. In the ***Point Properties*** dialog box, Set the ***Constraint 2 Type*** to **Vector-Offset**.

32. Set the ***Constraint 2 Parent 1*** to **RT_Wall_Top-Front**.

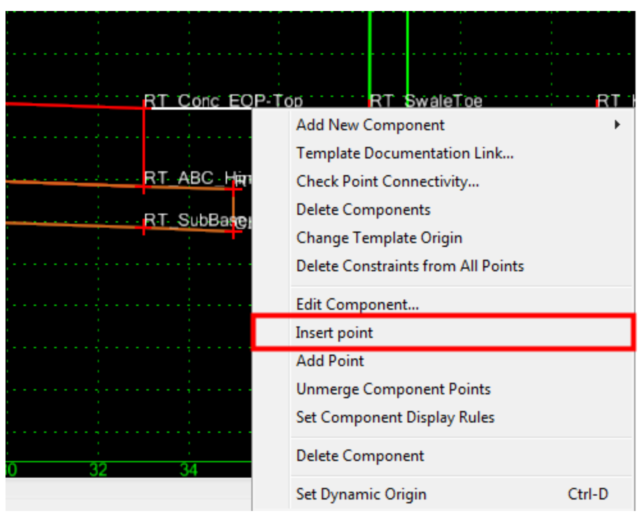
33. Set the ***Constraint 2 Parent 2*** to **RT_Wall_Base-Front**.

34. Key in ***0.00*** for the ***Constraint 2 Value***.

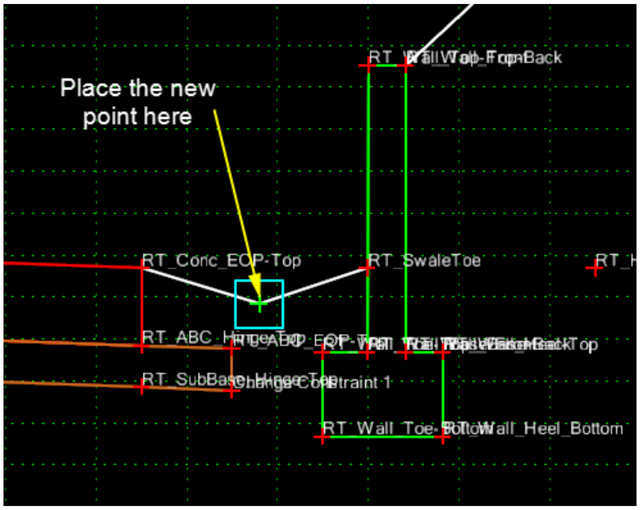
35. **<D> Apply** then **<D> Close** to dismiss the dialog box.



36. **<R>** on the **RT_Base_Elevation_Control** component (the line that connects the Wall with the pavement edge) and select **Insert Point** from the right click menu.



37. Place the point between and below the ***RT_Conc_EOP-Top*** and ***RT_SwaleToe*** points.



38. **<D> <D>** on the new point to display the ***Point Properties*** dialog box.

39. In the ***Point Properties*** dialog box ***Name*** field, key in **RT_Ditch-Bottom**.

40. Set the ***Surface Feature Style*** to **D_Ditch-Bottom**.

41. Set the ***Type*** for both constraints to **Slope**.

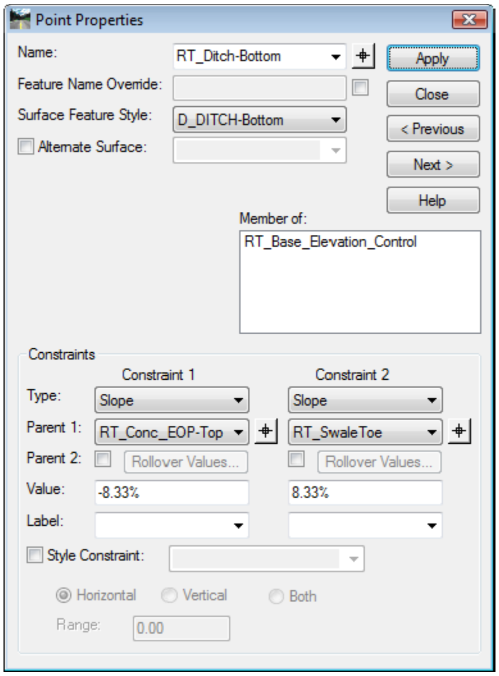
42. Set the ***Parent 1*** for ***Constraint 1*** to **RT_Conc_EOP-Top**.

43. Set the ***Parent 1*** for ***Constraint 2*** to **RT_SwaleToe**.

44. Key in ***-8.33%*** for the ***Value*** of ***Constraint 1***.

45. Key in **8.33%** for the ***Value*** of ***Constraint 2***.

46. **<D> Apply** then **<D> Close** to dismiss the dialog box. The illustration below shows the dialog box as completed



This completes the edits to the template.

47. Select **File > Save** from the ***Create Template*** menu bar.

48. **<D>** the **Close** button on the ***Create Template*** dialog box to dismiss it.

Now, examine how the template behaves in Roadway Designer.

49. Select **Modeler > Roadway Designer** from the InRoads menu bar.

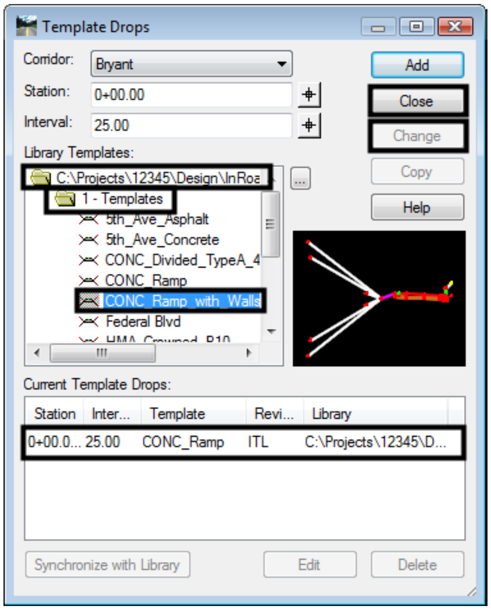
50. From the ***Roadway Designer*** menu bar, select **Corridor > Template Drops**.

51. In the ***Template Drops*** dialog box, highlight the entry in the ***Current Template Drops*** area.

52. Expand the Template library folder to show the contents of the ***1 - Templates*** folder.

53. **Highlight** the **CONC_Ramp_with_Walls** template from the ***Library Templates*** list.

54. **<D> Change** then **<D> Close** to dismiss the dialog box.



55. Scroll through the template drops in the Cross Section view of the Roadway Designer dialog box.

56. Verify that the wall is expanding and contracting to meet the existing ground.

57. Select **File > Save** from the ***Roadway Designer*** dialog box.

58. **<D> Close** to dismiss the dialog box.

Section Summary:

- The Wall_Top-Back point is the controlling point for the wall component's shape. Change its horizontal constraint to move the wall away from or closer to the template origin.
- Adjust the horizontal constraint on the Height Control Point to change the width of the Fill component that extends from the back of the wall to the existing ground.
- Aside from the Wall_Top-Back, SwaleToe, and Height _Control_Point try not to edit other points on the wall component as these can change the shape of the visible component but not the hidden components.

Lab 27.2 - Creating a Custom Wall

There are cases where the wall components in the template library are not suited for the situation under design. In the exercise below, a wall is required on the left side of the template from station 1+50 to the end of the project. The height of the wall is determined by running a 10 to 1 slope from a target feature in the existing ground dtm up to the base of the wall.

Section Objectives:

- ♦ Make a copy of the CONC_Ramp_with_Walls template.
- ♦ Add an end condition that seeks a surface feature.
- ♦ Build the slope component from the targeted feature to the base of the wall.
- ♦ Build the wall components.
- ♦ Update the corridor to use the templates.

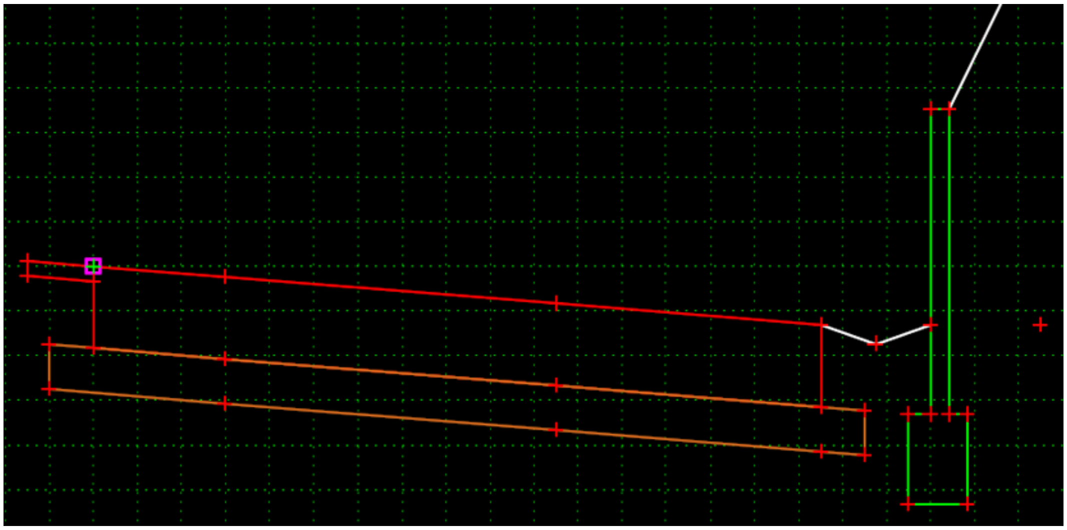
First, a copy of the CONC_Ramp_with_Walls template is made. This template is used for the first 150' of the project.

1. From the InRoads menu bar, select **Modeler > Create Template**.
2. In the Create Template dialog box, expand the **C:\Projects\12345\Design\InRoads\DES12345_Templates-Overlay.itl > 1 - Templates** folder.
3. **<R>** on the **CONC_Ramp_with_Walls** template and select **Copy** from the right click menu.
4. **<R>** on the **1 - Templates** folder and select **Paste** from the right click menu. This creates the ***CONC_Ramp_with_Walls1*** template.
5. **<R>** on the **CONC_Ramp_with_Walls1** template and select **Rename** from the right click menu.
6. Key in ***CONC_Ramp_with_Wall-Rt*** for the name.

The CONC_Ramp_with_Wall-Rt template is used for the first 150' of the project. The CONC_Ramp_with_Walls template will be modified with a wall on the left side and is used on the remainder of the project.

7. Verify that the **CONC_Ramp_with_Walls** template is active.

8. Delete the POSS and end condition components from the left side of the template. The illustration below shows the template with the left end conditions deleted:



9. Display the ***Dynamic Settings*** dialog box.

10. In the ***Dynamic Settings*** dialog box, verify that the ***Steps*** are set to ***0.10***.

11. Verify that **Apply Affixes** is toggled on.

12. **<R>** in a blank area of the template view and select **Add New Component > End Condition** from the right click menu.

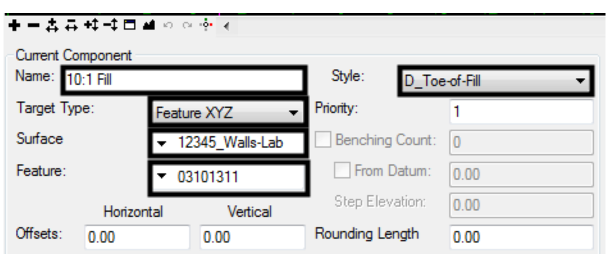
13. In the ***Current Component*** area, key in ***10:1 Fill*** for the ***Name***.

14. Set the ***Style*** to **D_Toe-of-Fill**.

15. Set the ***Target Type*** to **Feature XYZ**.

16. Set the ***Surface*** to **12345_Walls-Lab**.

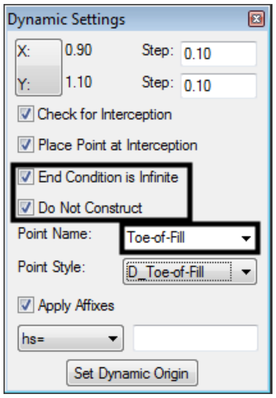
17. Select **03101311** for the ***Feature***.



18. **<D>** on the **HMA_GRAIL-Top** point.

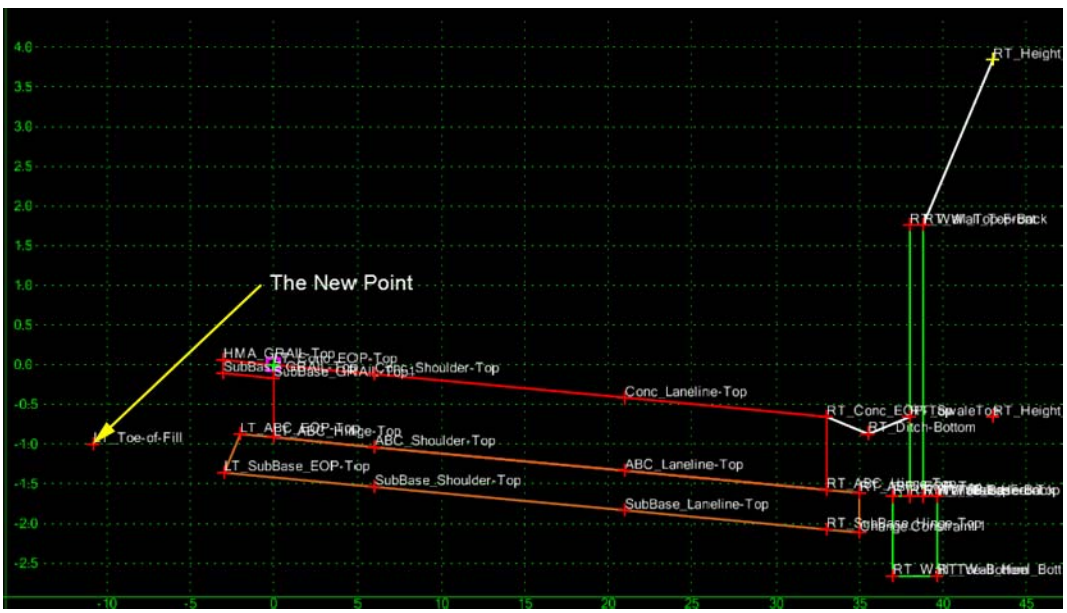
19. In the ***Dynamic Settings*** dialog box, toggle on **End Condition is Infinite** and **Do Not Construct**.

20. Select **Toe-of-Fill** for the **Point Name**.



21. **<D>** below and to the left of the **HMA_GRAIL-Top** point.

22. **<R>** and select **Finish** from the right click menu. The only thing that is displayed is a single point (LT_Toe-of-Fill).



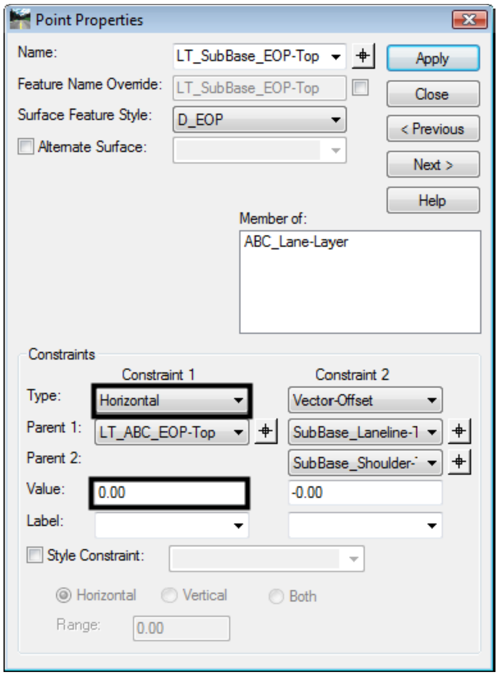
This component is only used to locate the feature. The slope and wall will be built back from this point to the rest of the template.

Next, the ABC component is modified on the left side and the Wall component is added.

23. **<D> <D>** the **LT_SubBase_EOP-Top** point to display the ***Point Properties*** dialog box.

24. In the ***Point Properties*** dialog box, change the ***Slope*** constraint to a **Horizontal** constraint (Constraint 1 in this example).

25. Key in ***0.00*** for the ***Value*** of the ***Horizontal*** constraint. This moves the point out of the way of the wall.



26. **<D> Apply** then **<D> Close** to dismiss the dialog box.

27. **<R>** in a blank area of the template view and select **Add New Component > Unconstrained** from the right click menu.

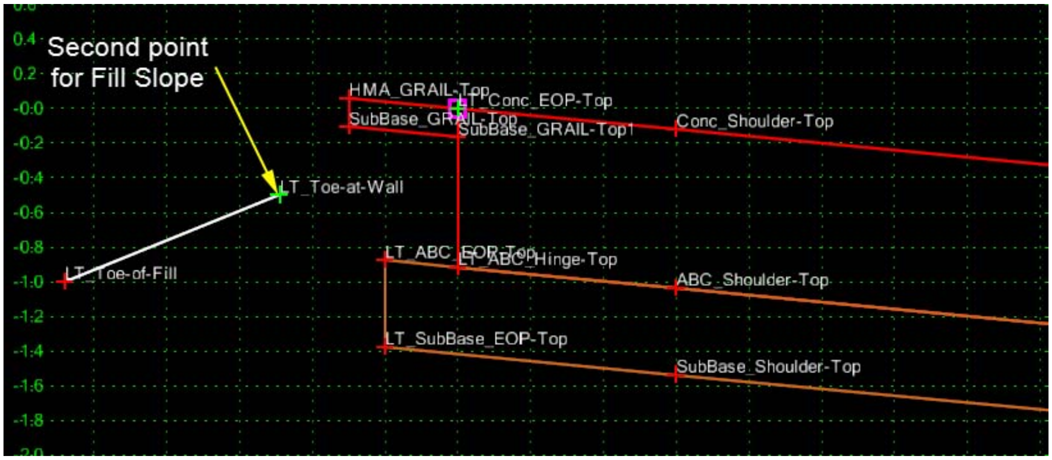
28. In the ***Current Component*** area, key in ***Fill Slope*** for the ***Name***.

29. **<D>** on the **LT_Toe-of-Fill** point.

30. In the ***Dynamic Settings*** dialog box, key in ***Toe-at-Wall*** for the ***Point Name***.

31. Verify that the ***Style*** is set to **D_Toe-of-Fill**.

32. **<D>** just to the left and below the guardrail asphalt component as shown in the illustration below:



33. **<R>** and select **Finish** from the right click menu. Constraints will be added to the ***LT_Toe-at-Wall*** point after the wall component is added.

34. **<R>** in a blank area of the template view and select **Add New Component > Unconstrained** from the right click menu.

35. In the ***Current Component*** area, key in ***Wall*** for the ***Name***.

36. Select **D_Wall-Retaining** for the ***Style***.

37. **<D>** on the **HMA_GRAIL-Top** point.

38. In the ***Dynamic Settings*** dialog box, key in ***Wall_Base-Back*** for the ***Point Name***.

39. Set the ***Style*** set to **D_Wall-Retaining**.

40. **<D>** directly below the **HMA_GRAIL-Top** point about half way through the ABC component.

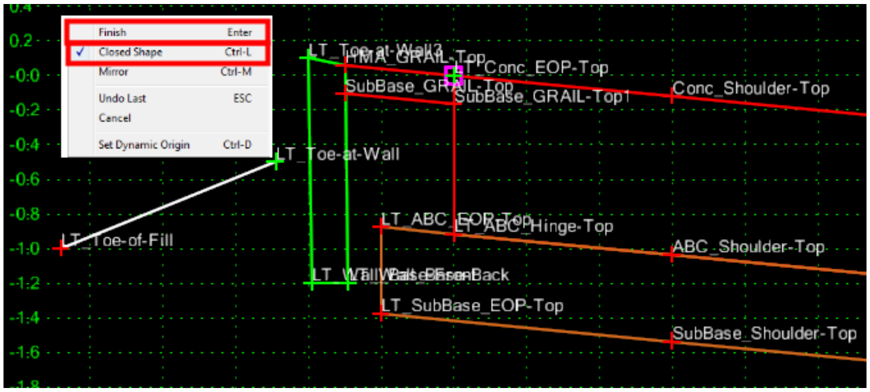
41. In the ***Dynamic Settings*** dialog box, key in ***Wall_Base-Front*** for the ***Point Name***.

42. Move the cursor to the left until the ***X*** coordinate reads ***-3.90*** in the ***Dynamic Settings*** dialog box then **<D>**.

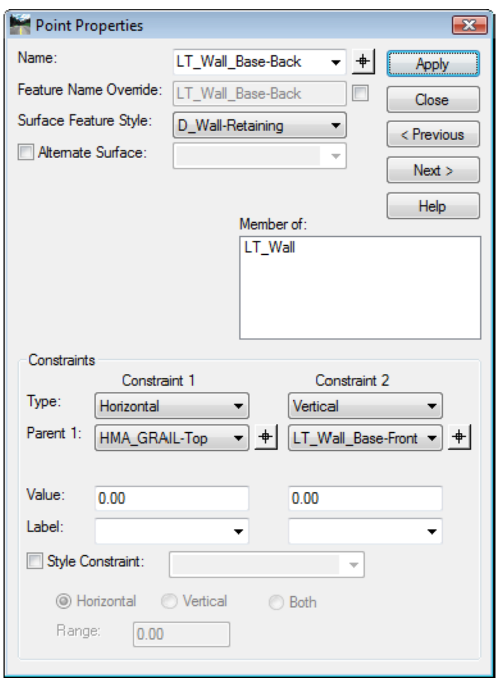
43. In the ***Dynamic Settings*** dialog box, key in ***Wall_Top-Front*** for the ***Point Name***.

44. Move the Cursor straight up and **<D>** near the level of the ***HMA_GRAIL-Top*** point.

45. **<R>** and verify that ***Closed Shape*** is toggled on, then select **Finish** to complete the component. The illustration below shows the new wall component.

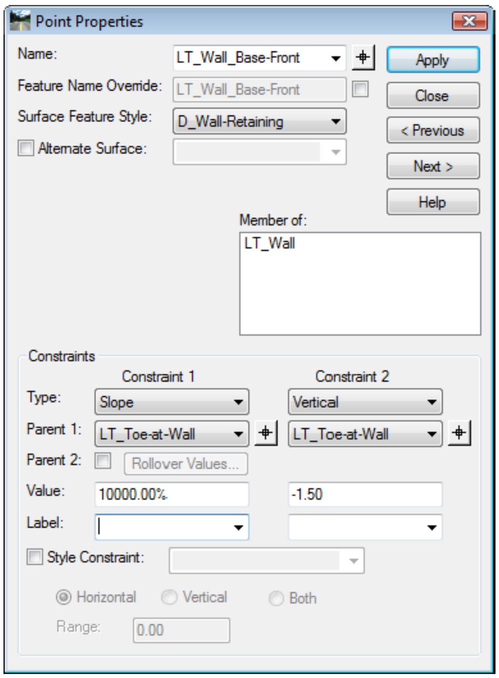


46. **<D> <D>** the **LT_Wall_Base-Back** point to display the ***Point Properties*** dialog box.
47. In the ***Point Properties*** dialog box, set the ***Constraint 1 Type*** to **Horizontal**.
48. Set the ***Constraint 2 Type*** to **Vertical**.
49. Set the ***Parent 1*** for ***Constraint 1*** to **HMA_GRAIL-Top.**
50. Set the ***Parent 1*** for ***Constraint 2*** to **LT_Wall_Base-Front.**
51. Key in ***0.00*** for the ***Value*** of both constraints. The illustration below shows the completed dialog box.



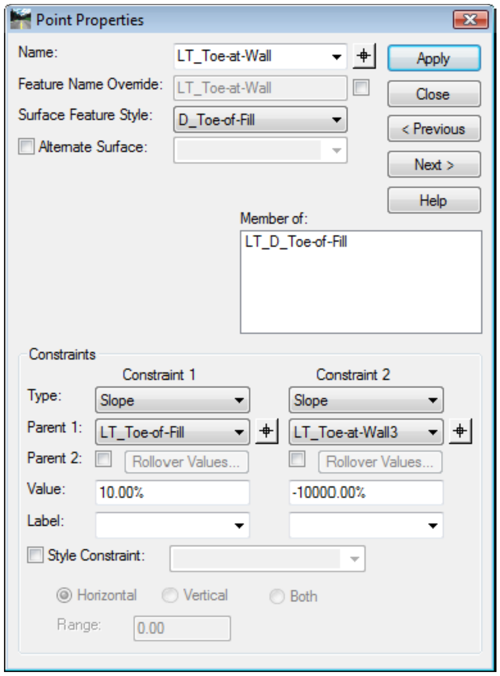
52. **<D> Apply** then **<D> Close** to dismiss the dialog box.
53. **<D> <D>** the **LT_Wall_Base-Front** point.

54. Set the ***Constraint 1 Type*** to **Slope**.
55. Set the ***Constraint 2 Type*** to **Vertical**.
56. Set the ***Parent 1*** for both constraints to **LT_Toe-at-Wall**.
57. Key in ***10000%*** for the ***Value*** of ***Constraint 1***.
58. Key in -***1.50*** for the ***Value*** of ***Constraint 2***. The illustration below shows the completed dialog box.



59. **<D> Apply** then **<D> Close** to dismiss the dialog box.
60. **<D> <D>** the **LT_Toe-at-Wall** point.
61. Set the ***Type*** of both constraints to **Slope.**
62. Set the ***Parent 1*** for ***Constraint 1*** to **LT_Toe-of-Fill.**
63. Set the ***Parent 1*** for ***Constraint 2*** to **LT_Wall_Top-Front.**
64. Key in ***10.00%*** for the ***Value*** of ***Constraint 1***.

65. Key in ***-10000%*** for the ***Value*** of ***Constraint 2***. The illustration below shows the completed dialog box.



66. **<D> Apply** then **<D> Close** to dismiss the dialog box.

67. **<D> <D>** the **LT_Wall_Top-Front** point.

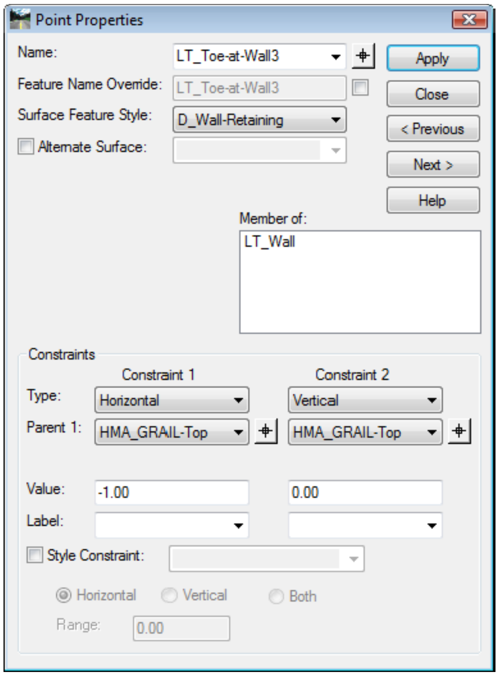
68. Set the ***Constraint 1 Type*** to **Horizontal**.

69. Set the ***Constraint 2 Type*** to **Vertical**.

70. Set the ***Parent 1*** for both constraints to **HMA_GRAIL-Top**.

71. Key in ***-1.00*** for the ***Value*** of ***Constraint 1***.

72. Key in ***0.00*** for the ***Value*** of ***Constraint 2***. The illustration below shows the completed dialog box.

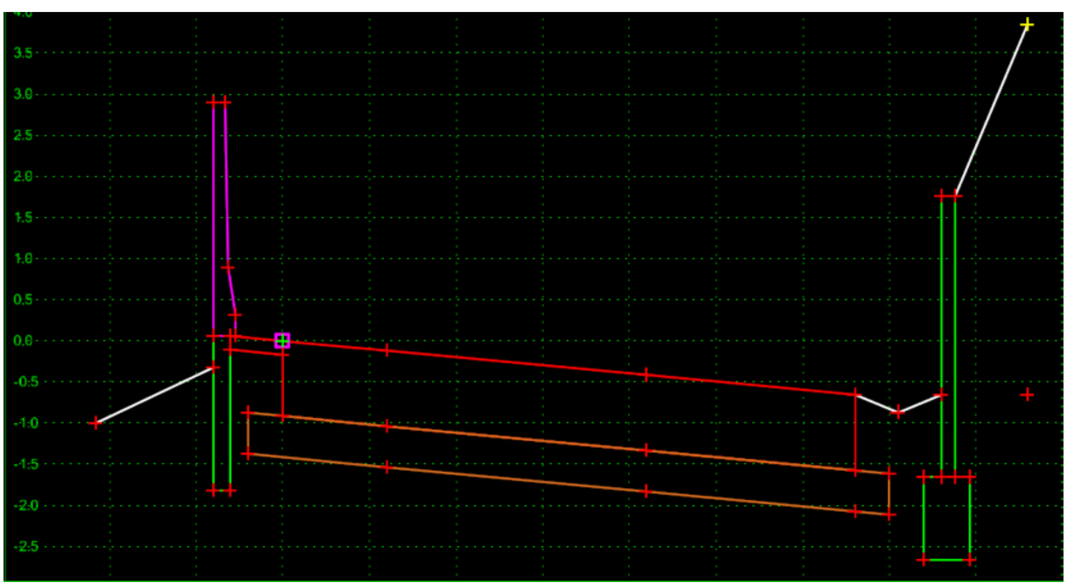


73. **<D> Apply** then **<D> Close** to dismiss the dialog box.

74. In the Template Library explorer, expand the folders to show the contents of the **C:\Projects\12345\Design\InRoads\DES12345_Walls-Lab.itl > 4 - Components > Barriers & Misc Components > Guardrail Type 7** folder.

75. **<D>** on the **Guardrail_Type 7-CD** component.

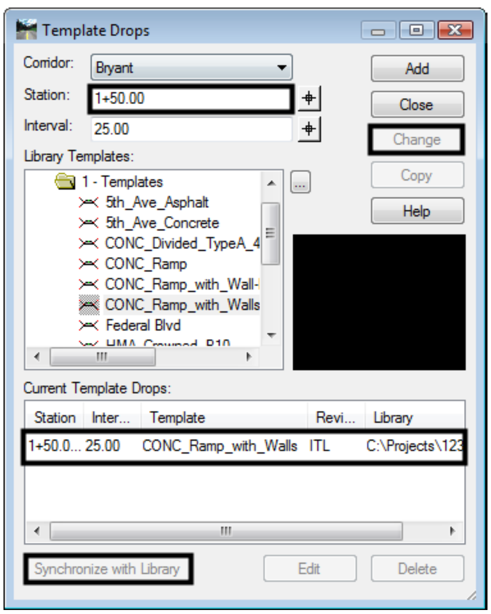
76. Drag the component by the origin (lower left corner) and drop it on to the LT_Wall_Top-Front point. The illustration below shows the completed template.



77. Select **File > Save** from the ***Create Template*** menu bar.
78. **<D>** the **Close** button on the ***Create Template*** dialog box to dismiss it.

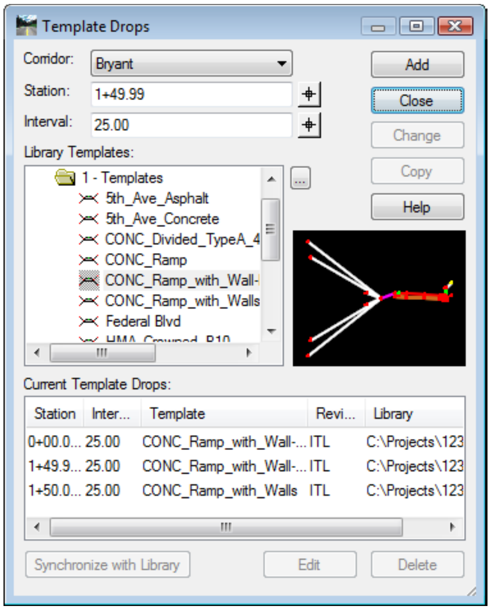
The template is now ready to use in the corridor.

79. Select **Modeler > Roadway Designer** from the InRoads menu bar.
80. From the ***Roadway Designer*** menu bar, select **Corridor > Template Drops**.
81. In the ***Template Drops*** dialog box, highlight the entry in the ***Current Template Drops*** area.
82. In the ***Station*** field, key in ***1+50.00***.
83. **<D>** the **Change** button.
84. Highlight the entry again and **<D>** the **Synchronize with Library** button.



85. In the ***Station*** field, key in ***0+00.00***.
86. Expand the Template library folder to show the contents of the ***1 - Templates*** folder.
87. **Highlight** the **CONC_Ramp_with_Wall-Rt** template from the ***Library Templates*** list.
88. **<D>** the **Add** button.
89. In the ***Station*** field, key in ***1+49.99***.

90. **<D>** the **Add** button then **<D> Close** to dismiss the dialog box. The completed dialog box is shown below.



91. Scroll through the template drops in the Cross Section view of the Roadway Designer dialog box.

    ♦ Verify that the wall is expanding and contracting to meet the existing ground.

92. Select **File > Save** from the ***Roadway Designer*** dialog box.

93. **<D> Close** to dismiss the dialog box.

94. Close InRoads and MicroStation.

Section Summary:

♦ An end condition was used to locate the feature to tie to. This can also be done with a Null point and a point control.

♦ A true vertical segment can not be used to create a triangulated surface, that is why the wall face has a 10000% slope.

Chapter Summary:

- Add walls to a corridor using dedicated templates and template drops. Using walls as part of an end condition solution may result in walls occurring in areas where they are not wanted or not occurring in areas where they are needed.
- Wall sections will contain either an end condition or point control to determine the height of the wall.
- Changes from the non-wall to the wall template should occur within 0.01 feet. This ensures a clean change from one template to the other.

LAB 28 - Create Raised Median

This lab demonstrates a procedure for modeling a roadway which includes a raised median and a median opening. The exercise below uses a single template which utilizes point controls and display rules to achieve the two different roadway sections. Additionally a second template is used to model the median openings.

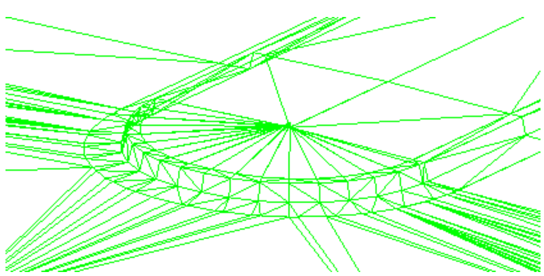
Chapter Objectives:

- Use a single template to model the mainline with and without a median
- Create display rules which determine when the raised median excluded
- Use point controls to define the location of the median nose
- Model multiple corridors
- Combine corridors in a single final surface

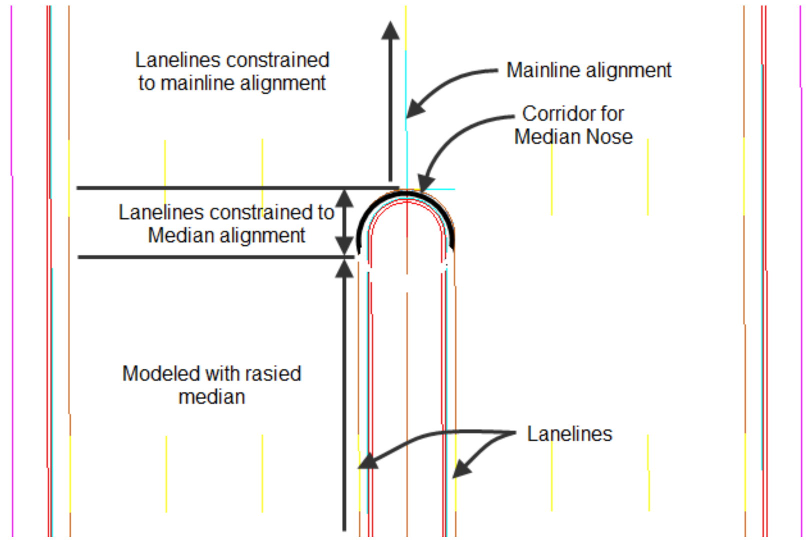
Lab 28.1 - Workflow

A summary of the overall process

1. In addition to the mainline horizontal and vertical alignments, create horizontal alignment(s) for the median nose.
2. Create a template for the crowned roadway - without the raised median.
3. Model the mainline using the crowned template.
4. Create the vertical alignments for the median noses by extracting their elevations from the surface created in the previous step.
5. Create a template for the median noses
6. Model the median noses
7. Create a template for the raised median
8. Add Display Rules to the components of the raised median.
9. Create a corridor definition for the raised median
10. Add point controls to constrain the raised median template to run as defined, constrained to the medians or to the mainline alignment.
11. Define key stations for template drops.
12. Create the final design surface by modeling the mainline and median openings simultaneously.



Modeling Schematic



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Lab 28.2 - Open Lab Files

An initial model of the roadway is crated using the roadway typical section without the median. This is done for the purposed of extracting the profile gradeline for the median noses.

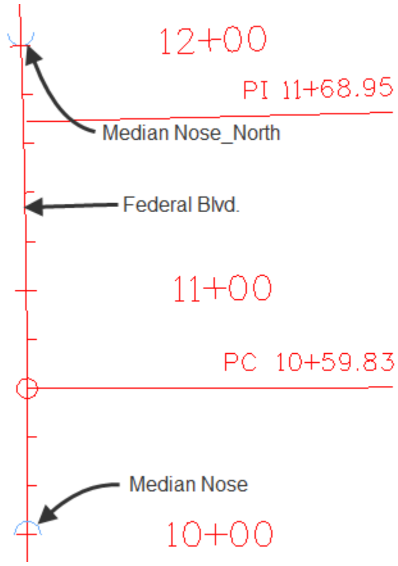
1. Open MicroStation and InRoads using the ***12345DES_Model-Create Raised Median.dgn*** file.
2. Verify that the file ***C:\Workspace\Workspace-CDOT_XM\Standards-Global\InRoads\Preferences\CDOT_Civil.xin***
3. Select **File> Open** from the InRoads menu bar.
4. Open the following files from ***C:\Projects\12345\Design\InRoads*** folder:
   - ♦ 12345DES_Existing-Create Raised Median.dtm
   - ♦ 12345DES_Geometry-Create Raised Median.alg
   - ♦ 12345DES_Templates-Create Raised Median.itl
   - ♦ 12345DES_Roadweay-Create Raised Median.ird
5. **<D> Cancel** the ***Open*** dialog box to close.

Lab 28.3 - Review The Alignments

In this exercise three alignments are used. ***Federal CL*** for the main corridor, ***Median Nose*** and ***Median Nose_North*** which define the median opening and termination.

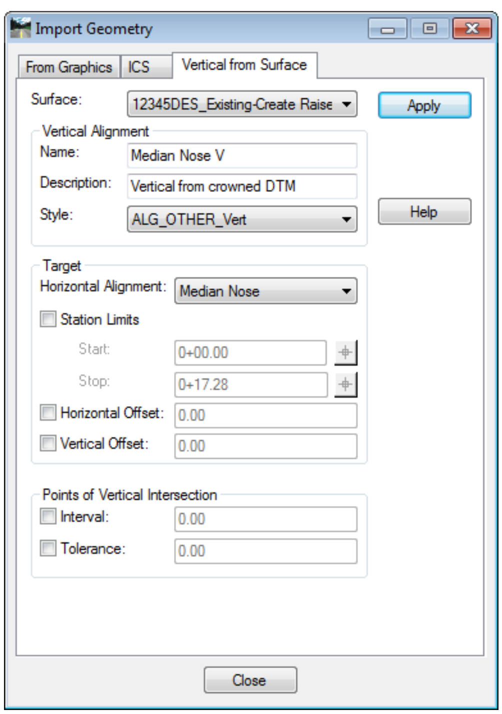
1. Select the **Geometry** tab in the ***InRoads Explorer***
2. View the horizontal alignments ***Federal CL***, ***Median Nose*** and ***Median Nose_North***

3. View stationing for horizontal alignment ***Federal CL***



Lab 28.4 - Review Data

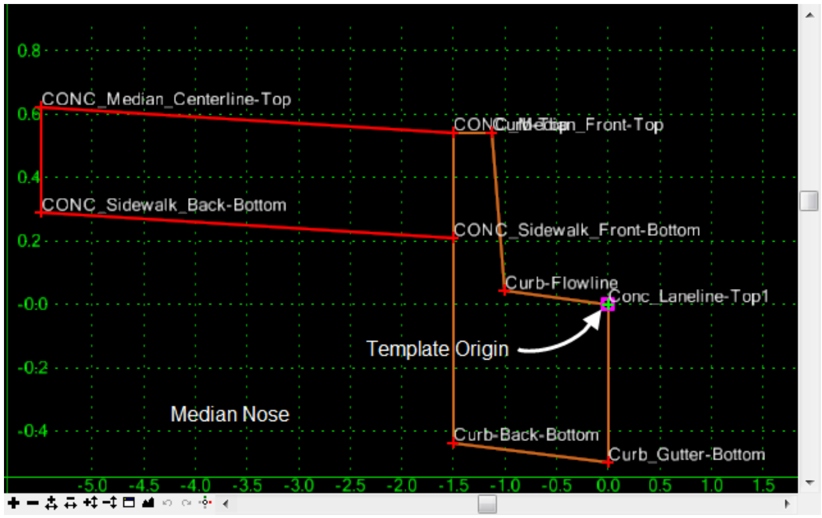
An initial model of the roadway was created using a crowned roadway section (without the raised median). This was done for the purpose of extracting the vertical profile of the median noses. This was accomplished by using the command **File > Import > Geometry [Vertical From Surface].**



Next, the templates used for the project are reviewed.

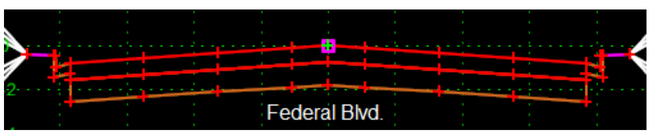
1. Select **Modeler > Create Template** from the InRoads menu bar.

2. In the ***Create Template*** dialog box review the template for ***Median Nose*** in the ***1-Templates*** folder.

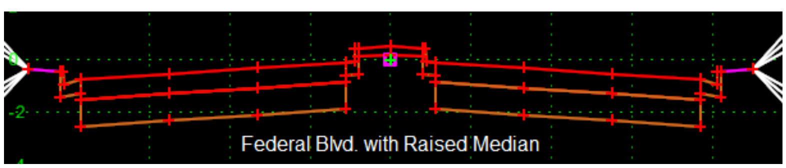


3. Also in the ***Create Template*** dialog box, review the templates for Federal Blvd. in the ***1-Templates*** folder.

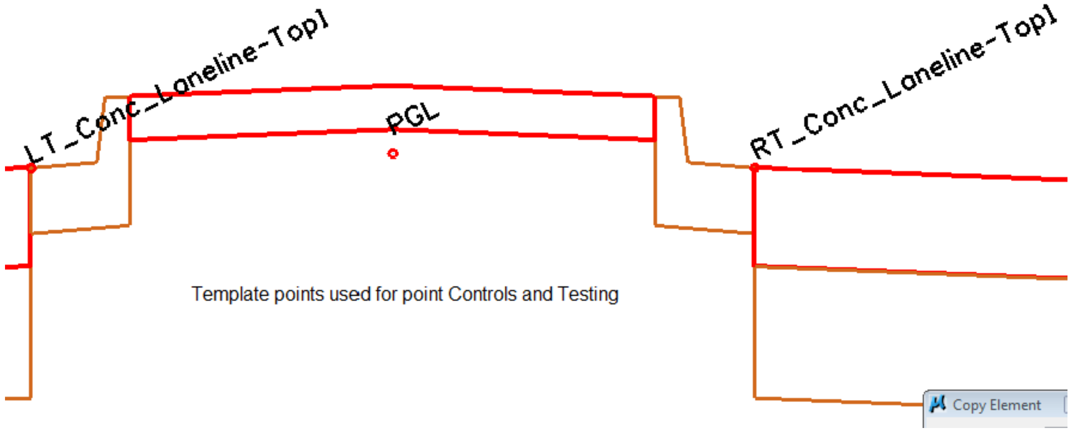
   The ***Federal Blvd*** template was use to create a preliminary model. This model was used to extract vertical alignments for the median alignments.



   The template ***Federal Blvd with Raised Median***. uses display rules control to determine when the median is modeled.



The illustration below shows an expanded view of the median. The 'Laneline' points will be controlled by both the Federal Blvd. and median alignments. Additionally the median components will be assigned display rules which will test the distance between the lanelines and the PGL.



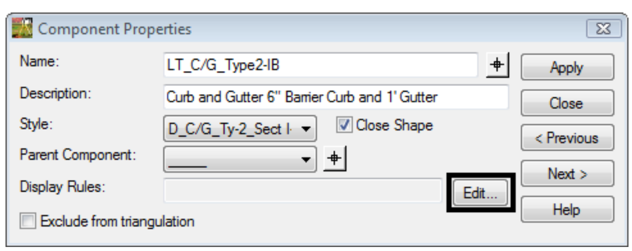
Lab 28.5 - Add Display Rules

Display rules are associated with components to test if the component should be displayed or not. The display rules turn off the median components if the distance between either lanelines and the PGL is less than 5.50'. This is the distance from the mainline alignment to the PC or PT of either median nose alignment.

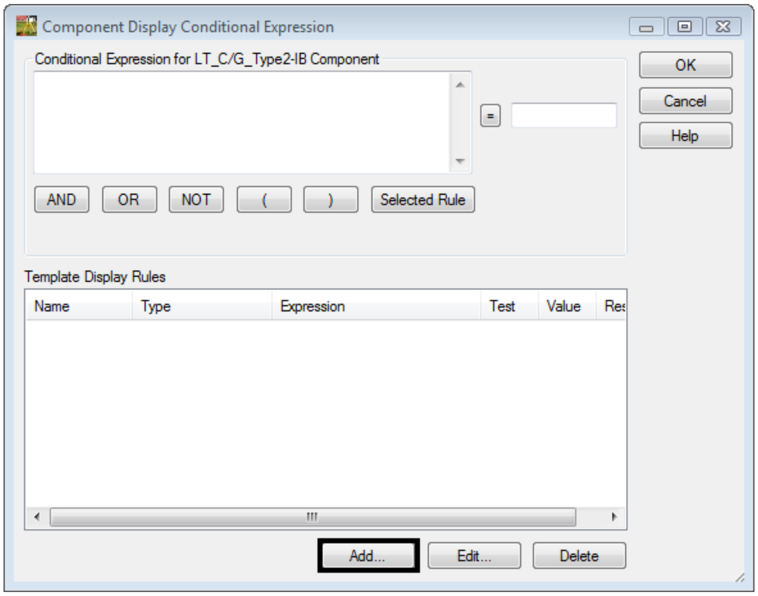
1. **Copy** the template ***Federal Blvd with Raised Median*** to ***Federal Blvd with Raised Median_DR.***

2. Open the ***Federal Blvd with Raised Median_DR*** template for editing.

3. Select the median curb and gutter component named ***LT_C/G_Type2-1B*** for editing. In the Component Properties dialog box, select the **Edit** button.

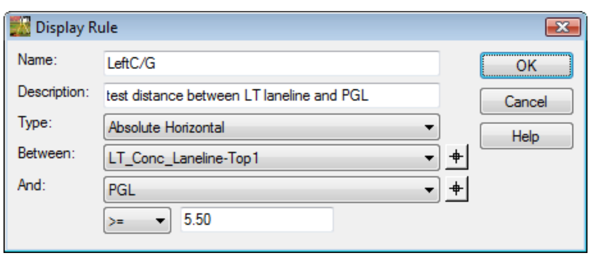


4. In the ***Component Display Conditional Expression*** dialog box, select the **Add** button.

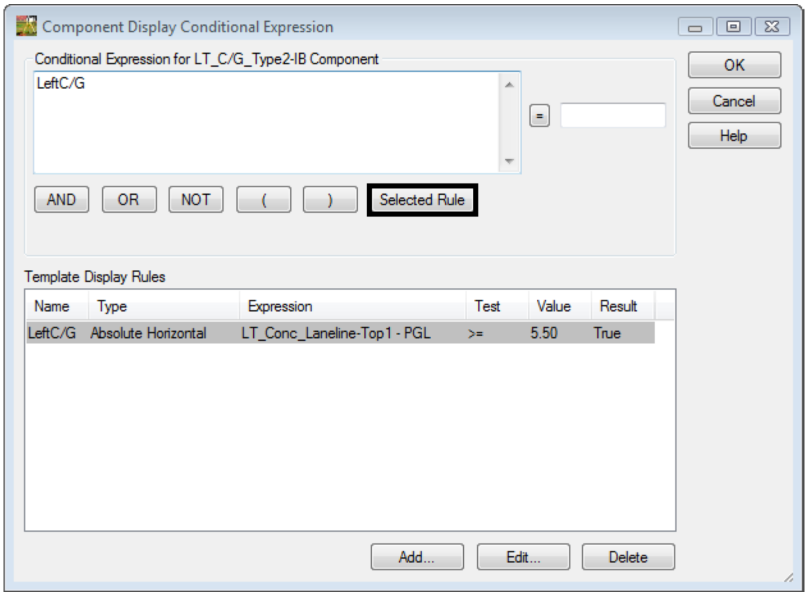


5. **Create** a Display Rule that tests the distance between the Left Laneline and the PGL using the following data:

- *Name:* ***LeftC/G***
- *Description:* ***test distance between LT laneline and PGL***
- *Type:* **Absolute Horizontal**
- *Between:* **LT_Conc_Laneline-Top1**
- *And:* **PGL**
- Test (button): **>=**
- Value (field): ***5.50***

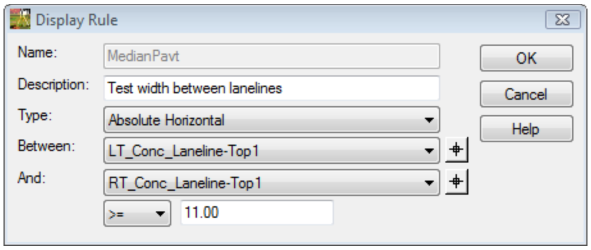


6. Highlight the rule and **<D>** the **Selected Rule** button.



7. **<D> OK** to use the rule and dismiss the dialog box.
8. In the ***Component Properties*** dialog box, **<D> Apply** then **Close**.
9. Select the component ***RT_C/G_Type2-1B*** for editing.
10. **Build** and **apply** a similar rule for the RT Laneline using the following data:
    - *Name:* ***RightC/G***
    - ***Between:*** **RT_Conc_Laneline-Top1**
    - ***And:*** **PGL**
    - All other fields are the same
11. **Edit** the component ***CONC_Sidewalk-4”***
12. ***Build*** and **Apply** a Display Rule to test for a minimum distance of 11.00 feet between the RT and LT Lanelines for the Median Cover (Conc_Sidewalk-4”) using the following data:
    - *Name:* ***MedianPavt***
    - ***Description:*** ***Test width between lanelines***
    - ***Type:*** **Absolute Horizontal**
    - ***Between:*** **LT_Conc_Laneline-Top1**
    - ***And:*** **RT_Conc_Laneline-Top1**
    - Test (button): **>=**

- ***Value:* 11.00**

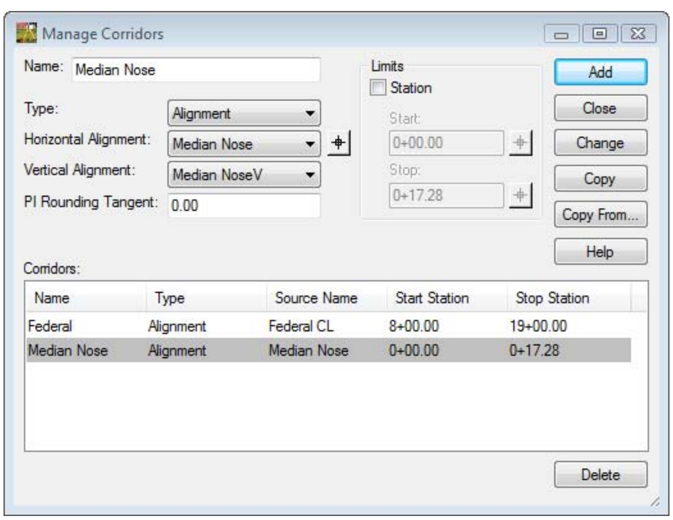


13. **Save** and **Close** the Create Template dialog box.

Lab 28.6 - Create Corridors

Corridors contain definitions for which alignments, templates, point controls, etc. are used to model the roadway. In this exercise, three corridors are defined, one for each median nose and a new one for the mainline.

1. Select **Modeler > Roadway Designer**
2. Select **Corridor > Corridor Management** from the Roadway Designer menu bar.
3. In the ***Manage Corridors*** dialog box, key in ***Median Nose*** for the ***Name***.
4. Set the ***Type*** to **Alignment**.
5. Set the ***Horizontal Alignment*** to **Median Nose**.
6. Set the ***Vertical Alignment*** to **Median NoseV**.
7. **<D>** the **Add** button to create the corridor.



8. Repeat the steps above to add a corridor for the ***Median Nose_North*** alignment using the following data:
    - ***Name:* Median Nose_North**
    - ***Type:*** **Alignment**

- ***Horizontal Alignment:*** **Median Nose_North**
- ***Vertical Alignment:*** **Median Nose_NorthV**

9. Create a corridor for the Mainline using the following data:

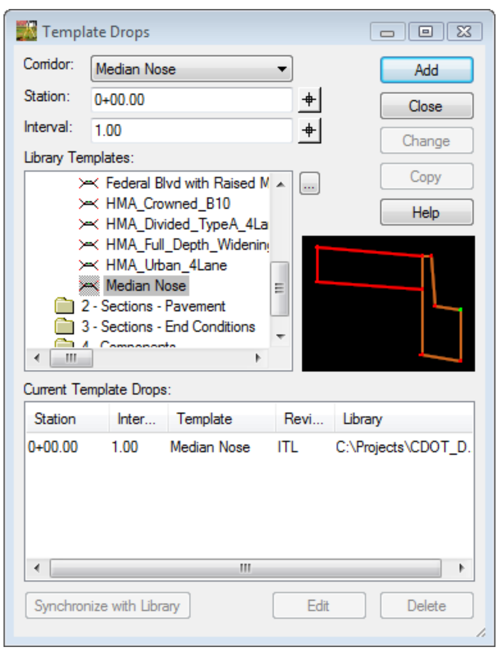
- ***Name:*** ***Federal_Display_Rule***
- ***Type:*** **Alignment**
- ***Horizontal Alignment:*** **Federal CL**
- ***Vertical Alignment:*** **Federal CL_V**
- ***Start Station:*** ***8+00***
- ***Stop Station:*** ***19+00***

10. **<D> Close** to dismiss the ***Manage Corridors*** dialog box.

Lab 28.7 - Add Template Drops

Templates define the cross section of the design model. They are assigned to the corridor through the Template Drops dialog box. The starting station defaults to the beginning of the corridor, so setting the interval and selecting the desired template is all of the input that is required.

1. Select **Corridor > Template Drops** from the Roadway Designer menu bar.
2. Highlight the **Median Nose** template from the ***Library Templates*** list.
3. Key in ***1*** for the ***Interval***.



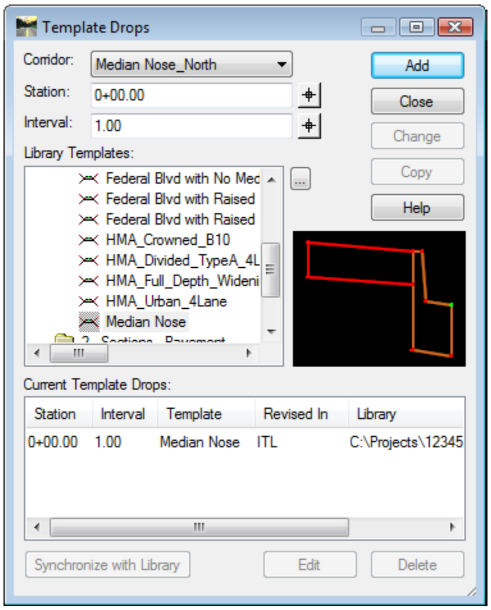
4. **<D> Add** to create the template drop.

Next, add a template drop to the Median Nose_North corridor.

5. Set the ***Corridor*** to **Median Nose_North.**

6. Highlight the **Median Nose** template from the ***Library Templates*** list.

7. Key in ***1*** for the ***Interval***.



8. **<D> Add**.

9. Set the ***Corridor*** to **Federal_Display_Rule**.

10. Key in ***8+00*** for the ***Station***.

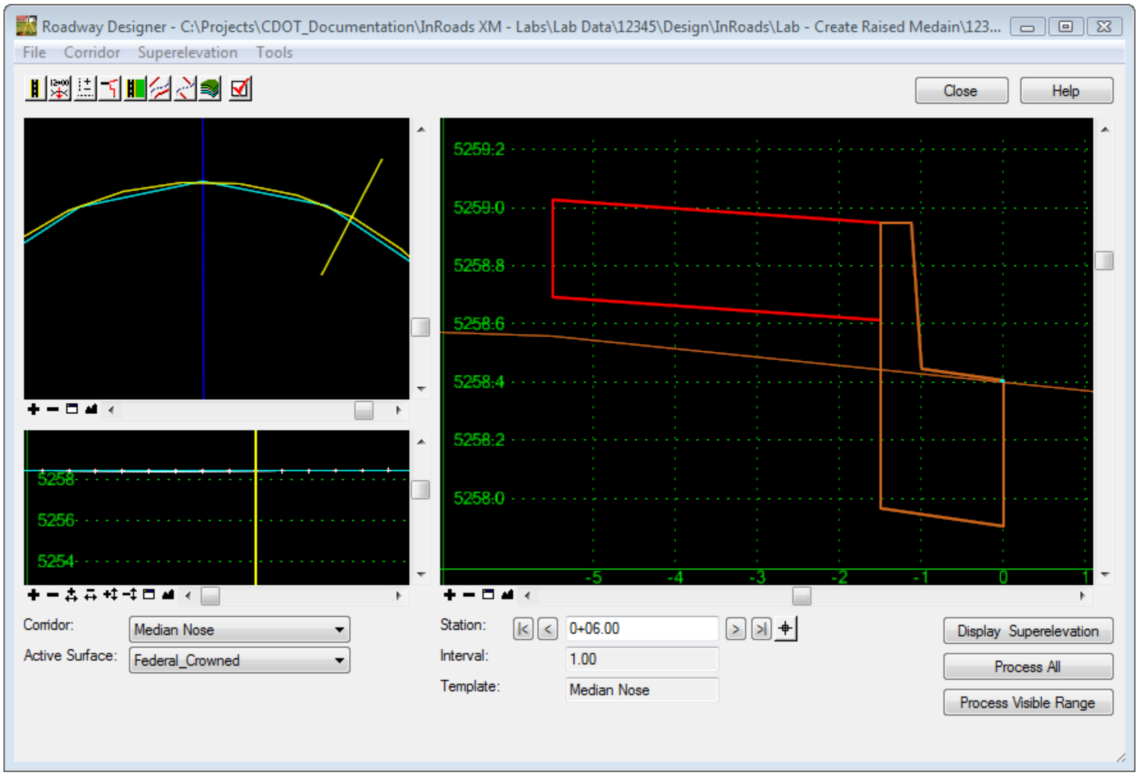
11. Key in ***10*** for the ***Interval***.

12. Highlight the **Federal Blvd with Raised Median_DR** template from the ***Library Templates*** list.

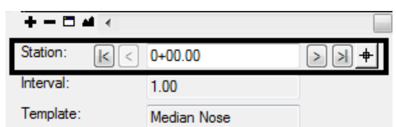
13. **<D> Add** then **Close** to dismiss the ***Template Drops*** dialog box.

Use Roadway Designer to evaluate the corridors. The template data is displayed in the cross section view of the Roadway Designer dialog box. There are two options for scrolling through the corridor; using the station arrows below the cross section view and using the station line in the plan view.

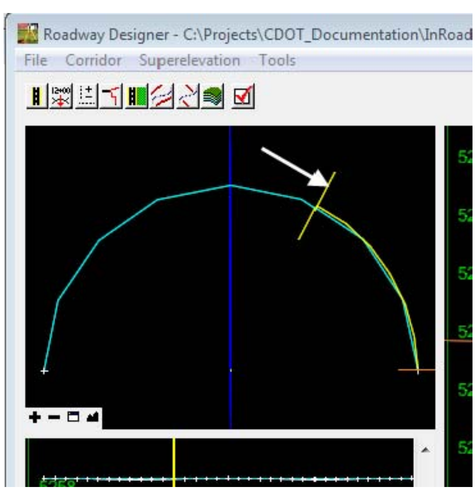
14. In the ***Roadway Designer*** dialog box, set the ***Corridor*** to **Median Nose**.



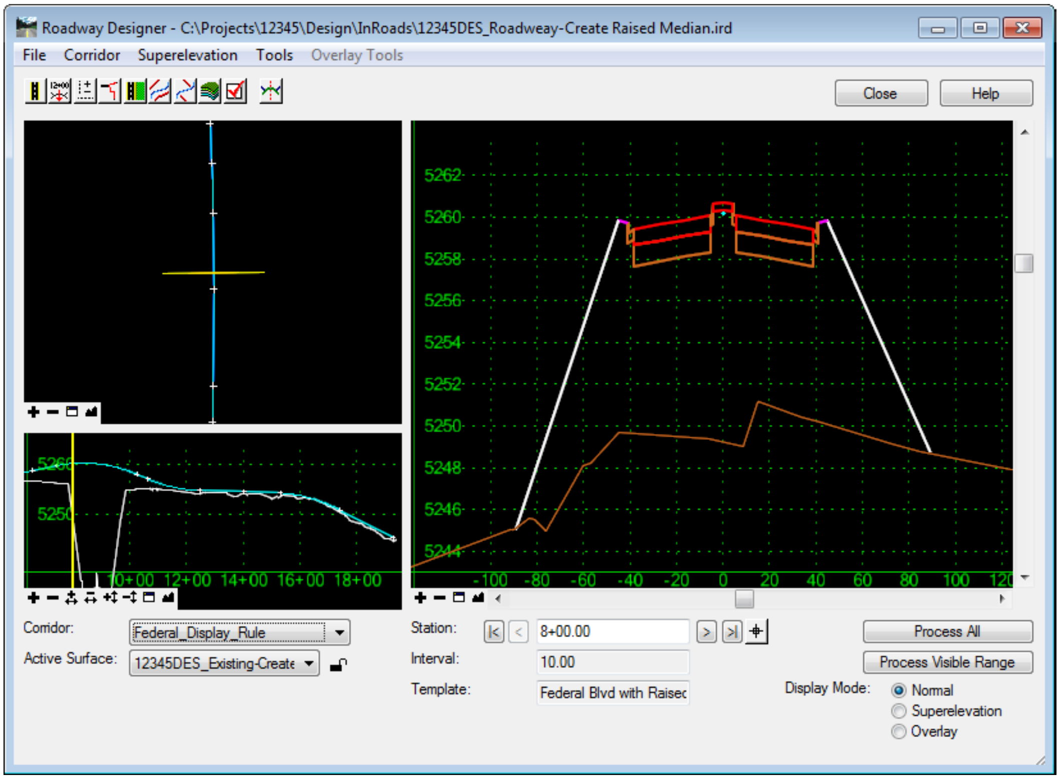
15. **<D>** on the station arrows to scroll through the design. Notice how the data in the cross section view is updated for each station.



16. **<D> and Hold** on the yellow station line. Move the pointer back and forth to scroll through the design. The data is now updated based upon the location of the station bar.



17. Evaluate the ***Federal_Display_Rule*** corridor.



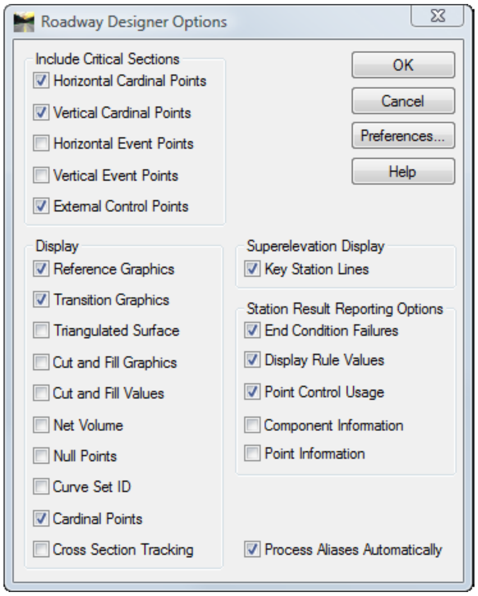
Lab 28.8 - Change Roadway Designer Settings

The Roadway Designer settings determine if additional stations are processed, what information is displayed in the views, and what information is included in the processing report. In this exercise, cardinal points are processed and component and point information is added to the processing report.

The first series of steps set Roadway Designer to process the horizontal cardinal and event points.

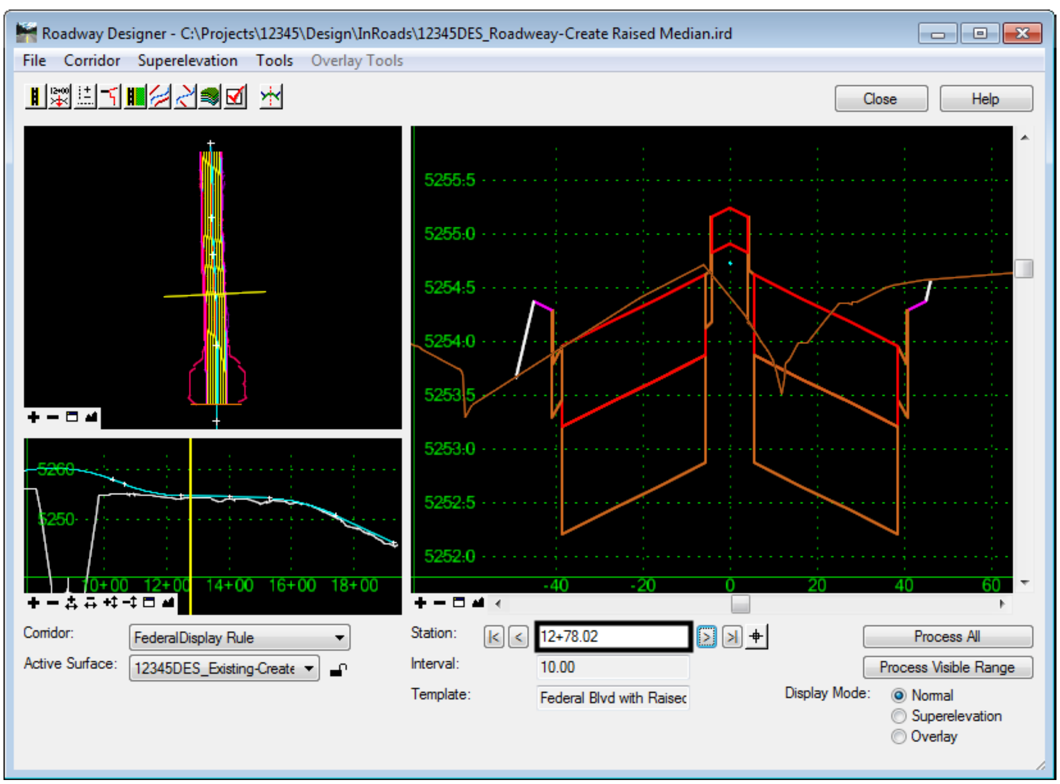
1. From the Roadway Designer menu bar, select **Tools > Options**.
2. In the ***Roadway Designer Options*** dialog box, toggle on the following options:
   - **Horizontal Cardinal Points**
   - **Vertical Cardinal Points**
   - **External Control Points**
   - **Reference Graphics**

- ♦ **Transition Graphics.**



3. **<D> OK**.

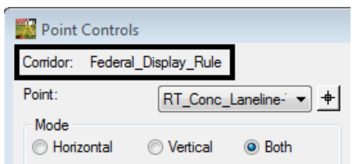
4. Scroll through the stations and notice that some stations do not fall on even intervals. These are the cardinal and event points.



Lab 28.9 - Point Controls

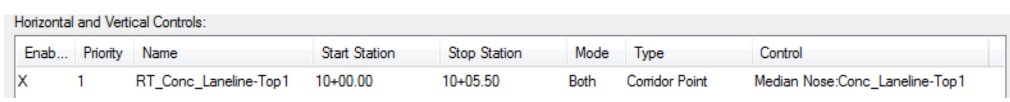
This series of steps adds Point Controls (overrides) to the Federal_Display_Rule corridor. The roadway is modeled as defined until it encounters a point control. For this design, three point controls are required for each side of the roadway (Left laneline and Right laneline) for 6 total point controls. The first control instructs the laneline to follow a feature created by the ***Median Nose*** corridor. The second control instructs the laneline to follow the ***mainline alignment***. The third control instructs the laneline to follow a feature created by the ***Median Nose_North*** corridor.

1. Verify the corridor **Federal_Display_Rule** is the active corridor.
2. Select **Corridor > Point Controls** from the Roadway Designer menu bar.



Next, create the following Point Control entries to instruct the RT_Conc_Laneline-Top1 template point to follow a feature (by the same name) created by the Median Nose corridor.

3. Select **RT_Conc_Laneline-Top1** from the ***Point*** drop-down menu.
4. Set the ***Mode*** to **Both**.
5. Set the ***Control Type*** to **Corridor Point**.
6. Select **Median Nose** for the ***Corridor***.
7. Select **Conc_Laneline-Top 1** for the ***Reference Point***.
8. Key in ***10+00.00*** (begin of median radius) for the ***Start*** station.
9. Key in ***10+05.50*** (end of median radius/nose) for the ***Stop*** station.
10. **<D> ADD** to create the point control.



Horizontal and Vertical Controls:

Enab...	Priority	Name	Start Station	Stop Station	Mode	Type	Control
X	1	RT_Conc_Laneline-Top1	10+00.00	10+05.50	Both	Corridor Point	Median Nose:Conc_Laneline-Top1

11. Repeat the steps above to add the other two point controls for this corridor, using the following data:
    - Second point control
        - ***Point:*** **RT_Conc_Laneline-Top1**
        - ***Mode:*** **Both**
        - ***Control Type:*** **Alignment**
        - ***Horizontal Alignment:*** **Federal CL**
        - ***Vertical Alignment:*** **Federal CL_V**

- ***Start Station:*** **10+05.51** (end of median radius/nose - beginning of median opening)
- ***Stop Station***: **12+00.00** (beginning of north median/radius nose)

Horizontal and Vertical Controls:

Enab...	Priority	Name	Start Station	Stop Station	Mode	Type	Control
X	1	RT_Conc_Laneline-Top1	10+00.00	10+05.50	Both	Corridor Point	Median Nose:Conc_Laneline-Top1
X	1	RT_Conc_Laneline-Top1	10+05.51	12+00.00	Both	Alignment	Federal CL:Federal CL_V

♦ Third point control
- ***Point:*** **RT_Conc_Laneline-Top1**
- ***Mode:*** **Both**
- ***Control Type:*** **Corridor Point**
- ***Corridor:*** **Median Nose_North**
- ***Reference Point:*** **Conc_Laneline-Top 1**
- ***Start Station:*** **12+00.00** (begin of median radius/nose)
- ***Stop Station:*** use the default station.

Horizontal and Vertical Controls:

Enab...	Priority	Name	Start Station	Stop Station	Mode	Type	Control
X	1	RT_Conc_Laneline-Top1	10+00.00	10+05.50	Both	Corridor Point	Median Nose:Conc_Laneline-Top1
X	1	RT_Conc_Laneline-Top1	10+05.51	12+00.00	Both	Alignment	Federal CL:Federal CL_V
X	1	RT_Conc_Laneline-Top1	12+00.00	12+05.00	Both	Corridor Point	Median Nose_North:Conc_Laneline-Top1

The fourth, fith, and sixth entry for the ***LT_Conc_Laneline-Top1*** point. The definitions mimic the definitions use for the RT_Conc_Laneline-Top1 point.

♦ Fourth point control
- ***Point:*** **LT_Conc_Laneline-Top1**
- ***Mode:*** **Both**.
- ***Control Type:*** **Corridor Point**
- ***Corridor:*** **Median Nose** for the ***Corridor***.
- ***Reference Point:*** **Conc_Laneline-Top 1** for the ***Reference Point***.
- ***Start Station:*** **10+00.00** (begin of median radius)
- ***Stop Station:*** **10+05.50** (end of median radius/nose)

♦ Fifth point control
- ***Point:*** **LT_Conc_Laneline-Top1**
- ***Mode:*** **Both**
- ***Control Type:*** **Alignment**
- ***Horizontal Alignment:*** **Federal CL**
- ***Vertical Alignment:*** **Federal CL_V**
- ***Start Station:*** **10+05.51** (end of median radius/nose - beginning of median opening)
- ***Stop Station***: **12+00.00** (beginning of north median/radius nose)

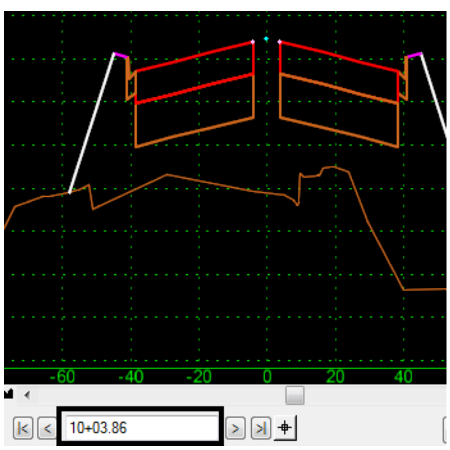
- Sixth point control
    - ***Point:*** **LT_Conc_Laneline-Top1**
    - ***Mode:*** **Both**
    - ***Control Type:*** **Corridor Point**
    - ***Corridor:*** **Median Nose_North**
    - ***Reference Point:*** **Conc_Laneline-Top 1**
    - ***Start Station:*** ***12+00.00*** (begin of median radius/nose)
    - ***Stop Station:*** use the default station.

Horizontal and Vertical Controls:

Enabled	Priority	Name	Start Sta...	Stop Station	Mode	Type	Control
X	1	RT_Conc_Laneline-Top1	10+00.00	10+05.50	Both	Corridor Point	Median Nose:Conc_Laneline-Top1
X	1	RT_Conc_Laneline-Top1	10+05.51	12+00.00	Both	Alignment	Federal CL:Federal CL_V
X	1	RT_Conc_Laneline-Top1	12+00.00	12+05.00	Both	Corridor Point	Median Nose_North:Conc_Laneline-Top1
X	1	LT_Conc_Laneline-Top1	10+00.00	10+05.50	Both	Corridor Point	Median Nose:Conc_Laneline-Top1
X	1	LT_Conc_Laneline-Top1	10+05.51	12+00.00	Both	Alignment	Federal CL:Federal CL_V
X	1	LT_Conc_Laneline-Top1	12+00.00	12+05.00	Both	Corridor Point	Median Nose_North:Conc_Laneline-Top1

12. **<D> Close** to dismiss the ***Point Controls*** dialog box.

13. Review the results graphically in Roadway Designer. Notice that the raised median disappears between stations 10+00.00 and 10+05.00 and again between 12+00.00 and 12+05.00. Between these station extents, the corridors for the medians will complete the model.

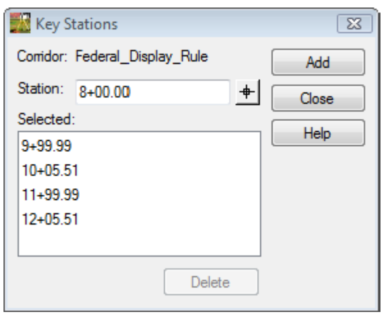


Also notice that the left and right pavement edges run together between stations 10+05.51 and 12+00.00. This represents the median opening.

Lab 28.10 - Adding Key Stations

Key Stations are specific locations you define relative to your design. At these locations an additional template is processed. You can also elect to create a cross section a locations defined by key stations. Examples of Key Stations may be at driveways, side roads, drainage structures or in the case of this exercise, just prior to and after the application of point controls. This ensures that the roadway is modeled as designed and eliminates transitions between point controls and the next corridor defined interval.

1. Select **Corridor > Key Stations** from the Roadway Designer menu bar or **<D>** the Key Station button  .
2. **Key-in** the station values as shown in the list below. Select **Add** after each entry.
   - ***9+99.99***
   - ***10+05.51***
   - ***11+99.99***
   - ***12+05.51***

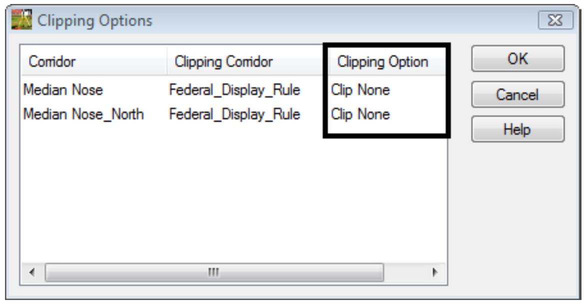
3. **<D> Close**
4. Select **File > Save** from the Roadway Designer menu.

Lab 28.11 - Creating the Model

With all the corridors, template drops point controls and key stations defined, the model is ready to be created.

1. Select **Corridor > Create Surface** from the Roadway Designer menu bar or **<D>** the Create Surface button 
2. Select the following corridors for modeling:
   - ***Federal_Display_Rule***
   - ***Median Nose***
   - ***Median Nose_North***

3. **<D>** on the ***Clipping Options*** button.



4. Under the ***Clipping Option*** column, **<D>** to cycle through the options and set both the ***Median Nose*** and ***Median Nose_North*** corridors to **Clip None**.

Also set:

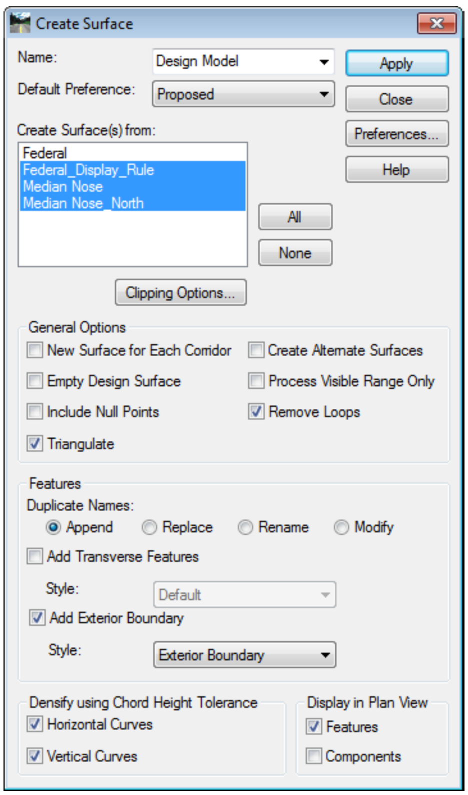
- Name: **Design Model**
- Default Preference: **Proposed**

And toggle on:

- **Densify Horizontal Curves using Chord Height Tolerance**
- **Densify Vertical Curves using Chord Height Tolerance**
- **Triangulate**
- **Remove Loops**
- **Display Features in Plan View**

And toggle off:

- **Add Exterior Boundary - Style:**

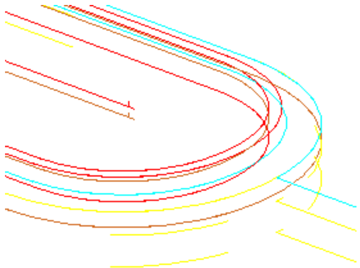


Lab 28.12 - Review the Design

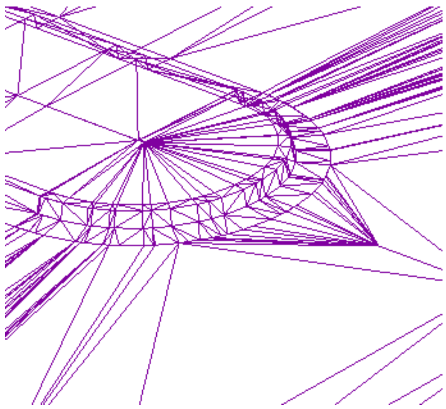
Use your knowledge of InRoads to review your model.

Some methods may include:

- A 3D isometric view of DTM features



- DTM triangles



Contours, profiles and cross sections are additional options.

Chapter Summary:

- Display Rules are used to turn on or off components based on the relationship between two points
- Point Controls are used to modify a template during processing. In this lab, the point controls were used to modify the relationship between points used in display rules to affect the display co the median components
- Key Stations and the settings under Options force the template to be processed at specific stations in addition to the processing that occurs at the normal template drop interval
- Clipping Options determine how template components are affected in areas where corridors overlap. The None option was used here, so that all of the components from each corridor would be retained.

LAB 29 - Create Ramp Model

This lab demonstrates the InRoads design process for creating a single lane freeway entrance ramp (tapered type) model and the infield, gore and taper area segment of the mainline model. The Vertical Gore Tool is used to create a guide for revise and tie the ramp vertical alignment into the edge of lane of the mainline taper. The corridors are created for both the ramp and mainline models. Display rules, Point controls, and end condition exceptions are used to tie the inside of the ramp model into the mainline corridor model in the gore and infield area. The outside lane of the mainline corridor is widened with a point control to create the ramp taper. After the ramp and mainline surfaces are created from the Roadway Designer, cross sections are displayed and examined to view the results.

Chapter Objectives:

- Revise the ramp vertical alignment to tie into the edge of lane of the mainline taper using the Vertical Gore Tool
- Create the freeway entrance ramp (tapered type) model
- Create the infield, gore and taper area segment of the mainline model
- Create a ramp and mainline surfaces from Roadway Designer, display cross sections and examine the results

The following files are used for this lab:

- C:\Projects\12345\Design\InRoads\12345DES_Geometry-Create Ramp Model.alg
- C:\Projects\12345\Design\InRoads\12345DES_Template-Create Ramp Model.itl
- C:\Projects\12345\Design\InRoads\12345DES_Roadway-Create Ramp Model.ird
- C:\Projects\12345\Design\InRoads\12345DES_Existing-Create Ramp Model.dtm
- C:\Projects\12345\Design\InRoads\CDOT_Civil-Create Ramp Model.xin

Lab 29.1 - Open InRoads Data Files

1. Open MicroStation and InRoads using the ***12345DES_Model-Create Ramp Model.dgn*** file.
2. Load **CDOT_Civil-Create Ramp Model.xin**.

   In the MicroStation drawing, notice the entrance ramp and mainline proposed linework displayed as a reference and the profile views for each alignment.
3. Open the following files from the ***C:\Projects\12345\Design\InRoads*** directory in InRoads:

   ♦ 12345DES_Geometry-Create Ramp Model.alg
   ♦ 12345DES_Template-Create Ramp Model.itl
   ♦ 12345DES_Roadway-Create Ramp Model.ird
   ♦ 12345DES_Existing-Create Ramp Model.dtm

Lab 29.2 - Set the Global Scale Factors

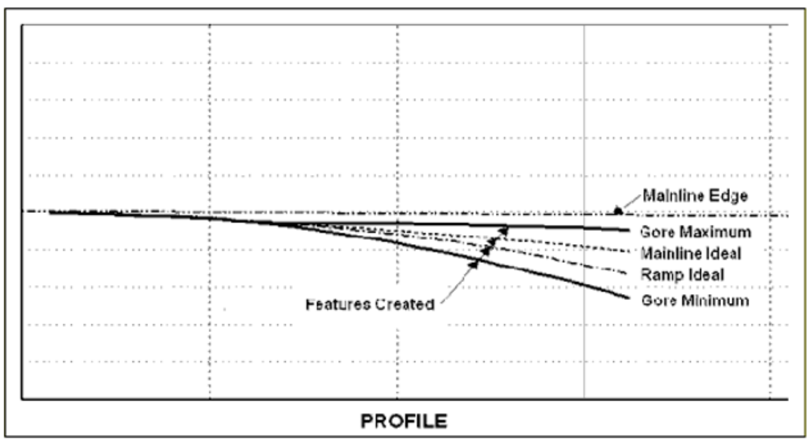
1. Select **Tools> Options** from the InRoads menu bar.

2. In the ***Options*** dialog box, Select ***Factors*** tab.
3. Key in ***200*** for the ***Text*** and ***Cell Scale Factor*** fields.
4. **<D> Apply** and **<D> Close.**

Lab 29.3 - Create Ramp Vertical Alignment Guide with Vertical Gore Tool

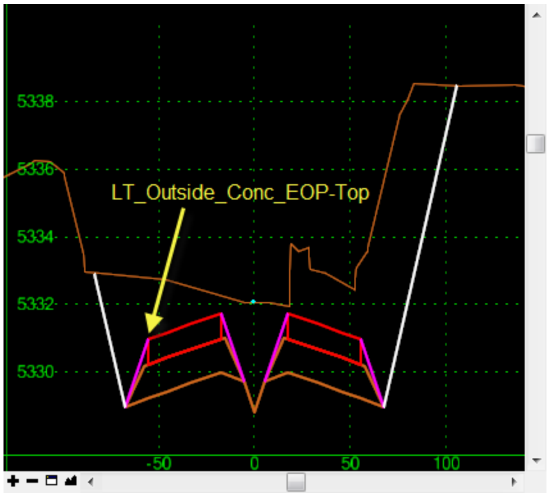
The Vertical Gore Tool is used to create a guide for revising the ramp vertical alignment. The output from this command is a surface with four linear features which are then displayed in the profile of the ramp alignment. These features specify the allowable maximum and minimum elevations of the ramp vertical alignment, as well as the ideal locations to make the gore cross slope match the mainline and ramp cross slopes.

The exercise will use the Mainline Ideal cross slope to set the ramp's vertical alignment. This is used because the mainline's cross slope extends out at a constant 2% from the crown in the 50:1 taper section. Note the Ramp Ideal cross slope feature is at the same location.

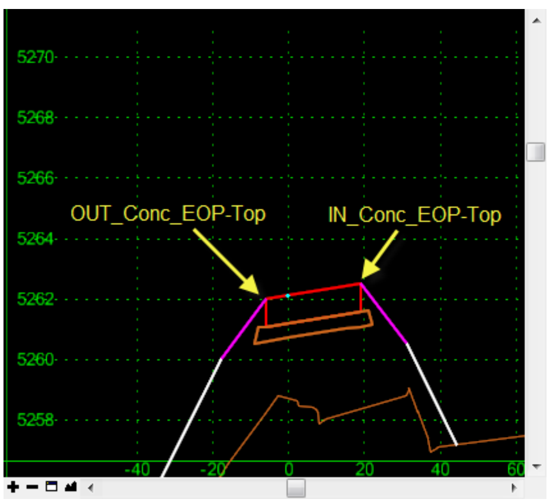


1. Select **Modeler> Roadway Designer** from the InRoads menu bar.
2. Select **Tools> Vertical Gore Tool** from the Roadway Designer menu bar.
3. In the ***Vertical Gore Design Tool*** dialog box, select **IH 39** in the ***Mainline Corridor*** field.

4. Select **LT_Outside_Conc_EOP-Top** for the ***Mainlined Edge*** field, using the drop-down list or the selector button.

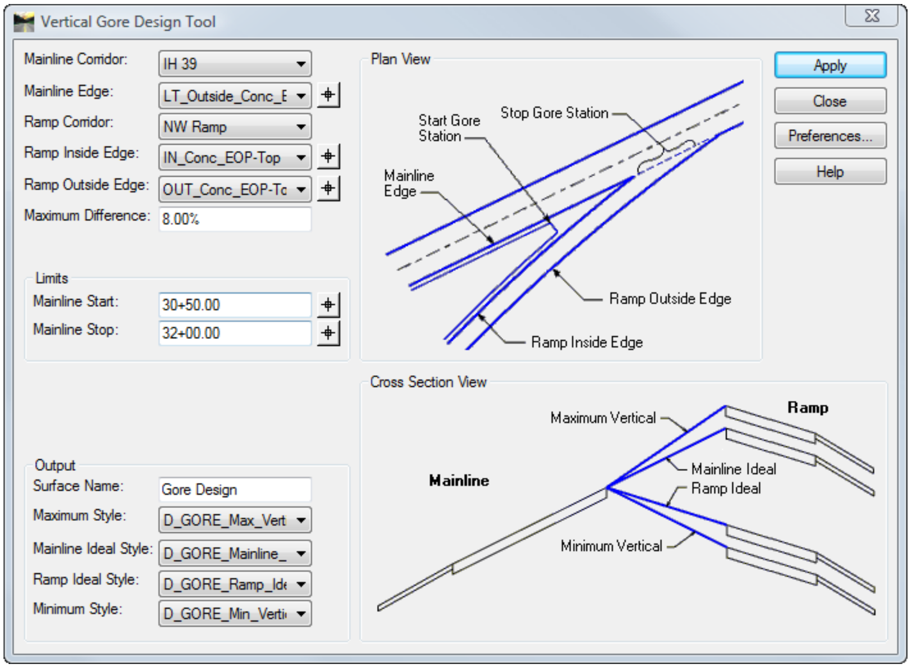


5. Select **NW Ramp** in the ***Ramp Corridor*** field.
6. Select **IN_Conc_EOP-Top** for the ***Ramp Inside Edge*** field.
7. Select **OUT_Conc_EOP-Top** for the ***Ramp Outside Edge*** field.



8. Key in ***8%*** in the ***Maximum Difference*** field.
9. Key in ***30+50*** in the ***Mainline Start*** field.
10. Key in ***32+00*** in the ***Mainline Stop*** field.
11. Key in ***Gore Design*** in the ***Surface Name*** field.
12. Select **D_GORE_Max_Vertical** for the ***Maximum Style***.
13. Select **D_GORE_Mainline_Ideal** for the ***Mainline Ideal Style***.
14. Select **D_GORE_Ramp_Ideal** for the ***Ramp Ideal Style***.

15. Select **D_GORE_Min_Vertical** for the ***Minimum Style***.



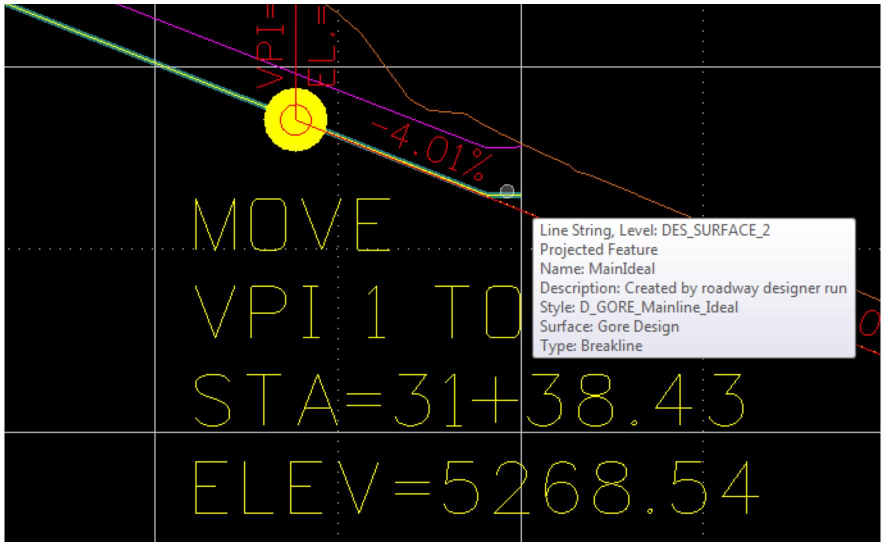
16. **<D> Apply** and **<D> Close** to dismiss the ***Vertical Gore Design Tool*** dialog box.

17. In the ***Roadway Designer*** dialog box, **<D> Close** and select **No** to save changes.

Lab 29.4 - Update NW Ramp profile and Modify the Vertical Alignment

1. Select **Evaluation> Profile> Update Profile** from the InRoads menu bar.
2. In the ***Update Profile*** dialog box, verify that **NW Ramp** is selected for the ***Profile Set***.
3. Select **Projected Features** from the ***Update Profile*** tree.
4. Select **Display On** for the ***Mode.***
5. Select **Gore Design** in the ***Surfaces*** area.
6. Select All features in the ***Projected Features*** area.

♦ **<D> Apply and <D> Close.**



The NW Ramp vertical alignment needs to be revised to tie to the edge of lane of the mainline taper and to better tie into the mainline ditch in the infield area.

7. Set alignment ***NW Ramp*** as the ***Active*** alignment
8. Select **Geometry> Vertical Curve Set> Move PI** from the InRoads menu bar.
9. **<D> Apply** on the ***Move Vertical PI*** dialog box then **<D>** on the first vertical PI.
10. In the MicroStation key in window, type ***se=31+38.43,5268.54*** and press ***Enter***.
11. **<D>** to accept the location then **<R>** to exit the command.
12. **<D> Apply** on the ***Move Vertical PI*** dialog box then **<D>** on the second vertical PI.
13. In the MicroStation key in window, type ***se=35+75.00,5251.04*** and press ***Enter***.
14. **<D>** to accept the location then **<R>** to exit the command.
15. **<D> Close** to dismiss the ***Move Vertical PI*** dialog box.
16. Select **Geometry> View Geometry> Vertical Annotation** from the InRoads menu bar.
17. **<D> Apply** and **<D> Close.**
18. Examine the changes in the vertical alignment.

Next, revise NW Ramp corridor to start at the beginning of the ramp's revised vertical alignment.

19. Select **Modeler> Roadway Designer** from the InRoads menu bar.
20. In the ***Roadway Designer*** dialog box, select **NW Ramp** from the ***Corridor*** drop down menu.

21. Select **Corridor > Corridor** Management from the Roadway Designer menu bar.
22. Highlight **NW Ramp** in the ***Corridors*** area.
23. Key in ***31+38.43*** in the ***Start*** field.
24. **<D> Change**.
25. **<D> Close** to dismiss the ***Manage Corridors*** dialog box.

Lab 29.5 - Define End Condition Exceptions

Next, end condition exceptions are added to right side of NW Ramp along the gore and infield area.

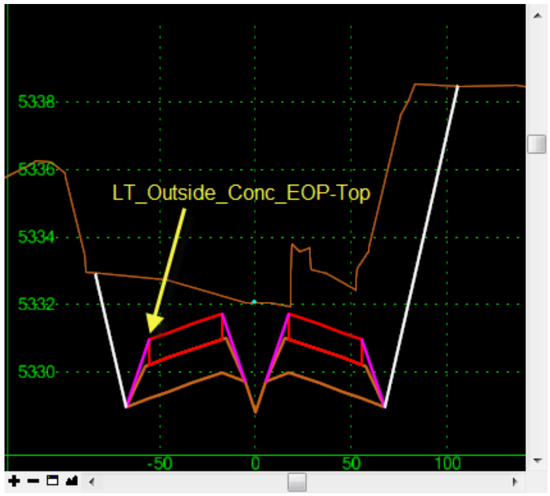
1. In the ***Roadway Designer*** dialog box, select ***NW Ramp*** from the ***Corridor*** drop down menu.
2. Select **Corridor> End Condition Exceptions** in the Roadway designer menu bar.
3. Key in ***31+38.43*** in the ***Start*** field.
4. Key in ***40+50*** in the ***Stop*** field.
5. Toggle on ***Right Override*** in the ***Apply To*** area.
6. Toggle on ***Backbone*** Only.
7. **<D> Add** and **<D> Close** to dismiss the ***End Condition Exceptions*** dialog box.

Lab 29.6 - Define Point Controls

Define Point Controls for the IH 39 corridor. Stretch westbound roadway's left edge of pavement to create the ramp taper.

1. In the ***Roadway Designer*** dialog box, select ***IH 39*** from the Corridor drop down menu.
2. Select **Corridor> Point Controls** in the Roadway Designer menu bar.

3. In the ***Point Controls*** dialog box, select **LT_Outside_Conc_EOP-Top** for the ***Point***.

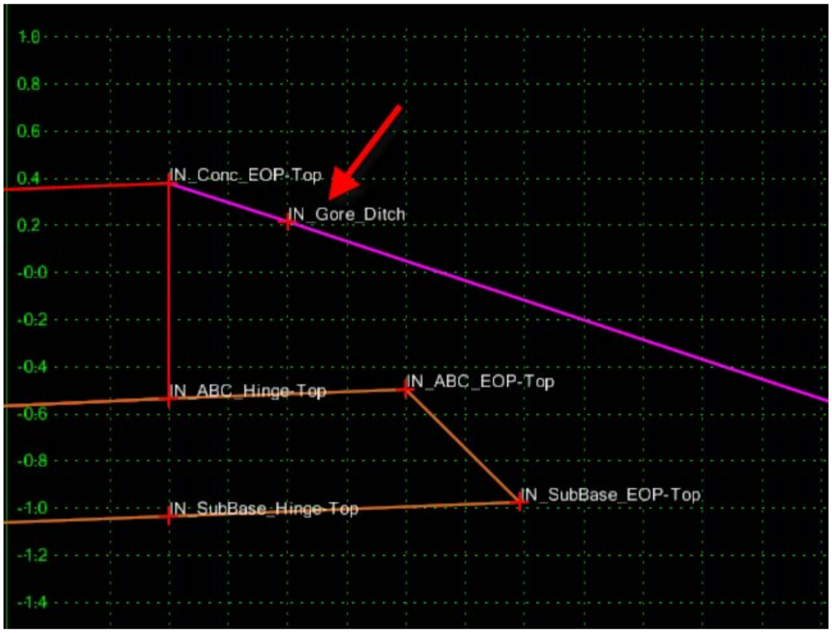


4. Toggle on **Horizontal** for the ***Mode***.
5. Select **Alignment** in the ***Control Type*** field.
6. Select **Outside Edge of Pavement** in the ***Horizontal Alignment*** field.
7. Toggle on **Use as a Secondary Alignment**.
8. Key in ***31+38.43*** in the ***Stop Station*** field.
9. **<D> Add** and **<D> Close** to dismiss the ***Point Controls*** dialog box.

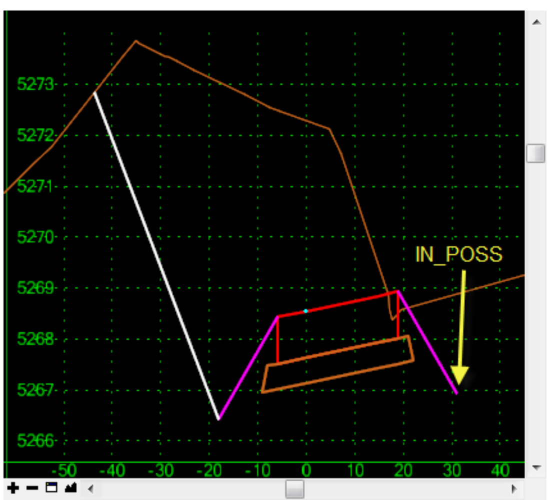
Create a special ditch between the ramp and mainline shoulder pavements from the gore nose to a station where the mainline ditch starts (when the ramp fore slope is flatter than the 3:1 maximum).

10. In the ***Roadway Designer*** dialog box, select ***NW Ramp*** from the Corridor field.
11. Select **Corridor> Point Controls** in the Roadway designer menu bar.

12. In the ***Point Controls*** dialog box, select **IN_Gore_Ditch** from the ***Point*** menu.

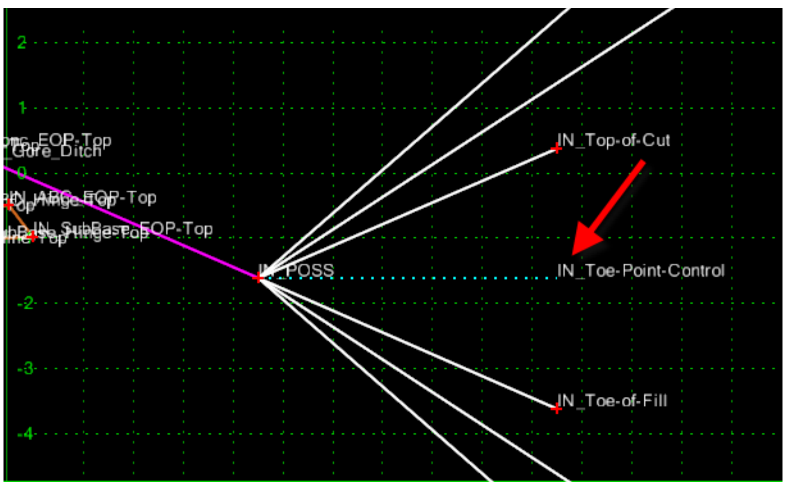


13. Toggle on **Both** for the ***Mode***.
14. Select **Alignment** in the ***Control Type*** field.
15. Select **Special_Ditch_NW_Ramp** in the ***Horizontal Alignment*** field.
16. Toggle off **Use as a Secondary Alignment.**
17. Key in ***31+38.43*** in the ***Start Station*** field.
18. Key in ***35+99.90*** in the ***Stop Station*** field.
19. **<D> Add**
20. Select **IN_POSS** from the ***Point*** menu.



21. Toggle on **Both** for the ***Mode***.
22. Select **Corridor Point** in the ***Control Type*** field.
23. Select **IH 39** in the ***Corridor*** field.
24. Select **LT_Outside_Conc_EOP-Top** in the ***Reference Point*** field.
25. Key in ***31+38.43*** in the ***Start Station*** field.
26. Key in ***35+99.90*** in the ***Stop Station*** field.
27. **<D> Add**
28. Select ***IN_Toe-Point-Control*** from the ***Point*** menu.

    Note: This component has a display rule.



29. Toggle on **Both** for the ***Mode***.
30. Select **Corridor Point** in the ***Control Type*** field.
31. Select **IH 39** in the ***Corridor*** field.
32. Select **LT_POSS** in the ***Reference Point*** field.
33. Key in ***36+00*** in the ***Start Station*** field.
34. Key in ***40+50*** in the ***Stop Station*** field.
35. **<D> Add** and **<D> Close** to dismiss the ***Point Controls*** dialog box.

Lab 29.7 - Define Key station for IH 39 corridor

1. Select ***IH 39*** from the ***Corridor*** drop down menu.
2. Select **Corridor> Key Stations** in the Roadway designer menu bar.
3. Key in ***31+38.42*** in the ***Station*** field.

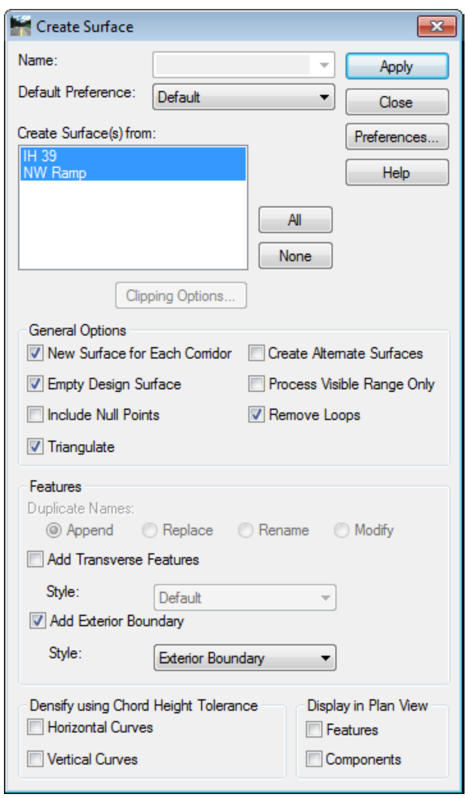
4. **<D> Add** and **<D> Close**

Next, define Key station for NW Ramp corridor.

5. In the ***Roadway Designer*** dialog box, select **NW Ramp** from the ***Corridor*** drop down menu.
6. Select **Corridor> Key Stations** in the Roadway Designer menu bar.
7. Key in ***3599.90*** in the ***Station*** field.
8. **<D> Add** and **<D> Close.**

Lab 29.8 - Create Surfaces to display in cross sections to examine design models

1. In the ***Roadway Designer*** dialog box, select ***Existing_Ground*** from the Active Surface drop down menu.
2. Select **Corridor> Create Surface** in the Roadway designer menu bar.
3. Select the following options as shown in the illustration below:

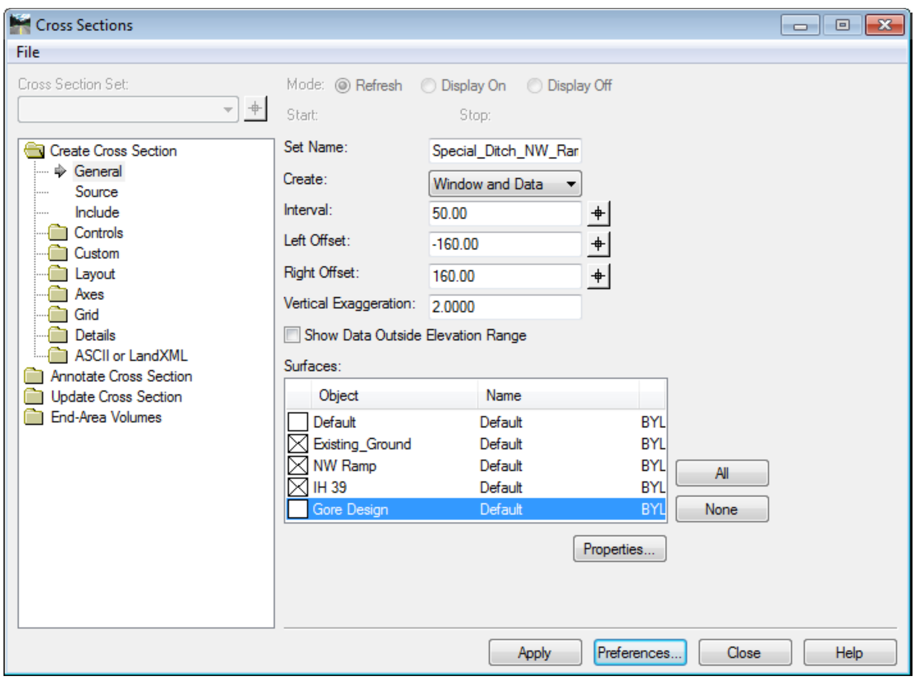


4. **<D> Apply** to create the surface.
5. Review and then close the ***Results*** dialog box.
6. **<D> Close** to dismiss the Create Surface dialog box.

7. In the ***Roadway Designer*** dialog box, select **File> Save** from the Roadway designer menu bar.
8. **<D> Close** to dismiss the ***Roadway Designer*** dialog box.

Lab 29.9 - Display and Review Cross Sections

9. Make **IH 39** the active alignment.
10. Select **Evaluation> Cross Section> Create Cross Sections** from the InRoads menu bar.
11. In the ***Create Cross Section*** dialog box, **<D> Preferences.**
12. Highlight **40H 20V 320' Wide**.
13. **<D> Load** then **Close**.
14. Toggle off **Gore Design** surface.



15. **<D> Apply** and **<D>** in the drawing view to display the cross section set.
16. **<D> Close** to dismiss the ***Create Cross Section*** dialog box.
17. Select **Evaluation> Cross Section> Cross section Viewer** from the InRoads menu bar.
18. Select **24+00.00** in the ***Cross Sections*** area and **<D> Run**.
19. Examine the ramp and westbound mainline sections as the viewer moves along the taper, gore, and infield areas.

Chapter Summary:

- The Vertical Gore Tool is used to create design guides for laying out vertical alignments on merging corridors
- End Condition Exceptions are used to modify or remove the sideslope within a defined station range
- A single design surface can be created from two or more corridors

LAB 30 - Forcing Toes Inside of the Right Of Way

There are numerous reasons why it may not be possible to acquire additional right of way on a project. In these situations, the end conditions must adjust to the location of the right of way where it is restrictive and follow the proper design criteria where it is not.

In this lab, an end condition section is constructed that determines the proper sideslope based on the criteria from the 2005 Roadway Design Guide and the location of the right of way. This end condition section is then attached to a template and used in a corridor to demonstrate its functionality.

Chapter Objectives:

- Modify an existing end condition section to account for the right of way.
- Add the modified section to a “backbone” template.
- Create a corridor that uses the modified template.
- Add point controls so that the template can locate the right if way line.

The following files are used with this lab:

- C:\Projects\12345\Design\Drawings\Reference_Files\12345DES_Model.dgn
- C:\Projects\12345\Design\InRoads\12345DES_Geometry-Toes.alg
- C:\Projects\12345\ROW_Survey\InRoads\DTM\12345 existing ground.dtm
- C:\Projects\12345\Design\InRoads\12345DES_Templates_Toes-Lab.itl

Lab 30.1 - Modifying the End Condition Section and Adding it to a Template

In this exercise, a standard end condition section is copied and modified to account for the right of way. This end condition is then added to a template.

Section Objectives:

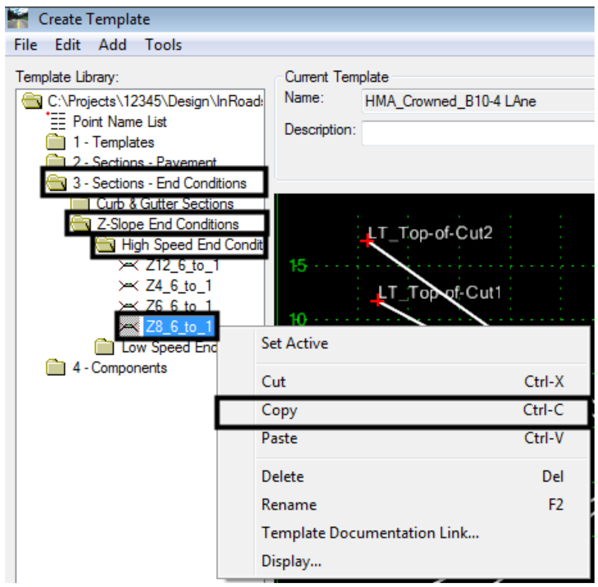
- ♦ Copy the end condition section.
- ♦ Add NULL points to control the maximum length of sideslopes and locate the right of way.
- ♦ Modify point constraints to place the toes in the proper location.
- ♦ Add the modified end condition section to a template.

Three NULL points are used to modify the end condition. Two are used to locate the maximum length of the 6 to 1 and 4 to 1 slopes. The third locates the right of way. The constraints are changed on the toe of slope points to extend to the NULL point closest to the centerline.

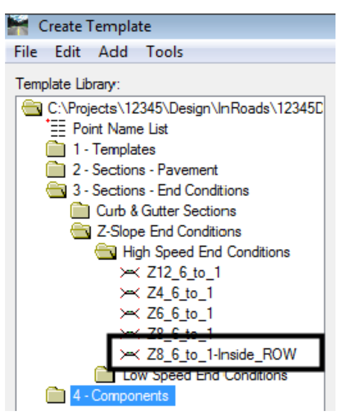
1. Open MicroStation and InRoads using the **C:\Projects\12345\Design\Drawings\Reference_Files\12345DES_Model.dgn** file.
2. Load the following files into InRoads:
    - ♦ **C:\Projects\12345\Design\InRoads\12345DES_Geometry-Toes.alg**

- **C:\Projects\12345\ROW_Survey\InRoads\DTM\12345 existing ground.dtm**
- **C:\Projects\12345\Design\InRoads\12345DES_Templates_Toes-Lab.itl**

3. Verify that the **C:\Workspace\Workspace-CDOT_XM\Standards-Global\InRoads\ Preferences\CDOT_Civil.xin** file is loaded.
4. From the InRoads menu bar, select **Modeler > Create Template**.
5. Expand the template library to show the **3 - Sections - End Conditions > Z-Slope End Condition - High Speed End Conditions**.
6. **<R>** on the **Z8_6_to_1** and select **Copy** from the right click menu.

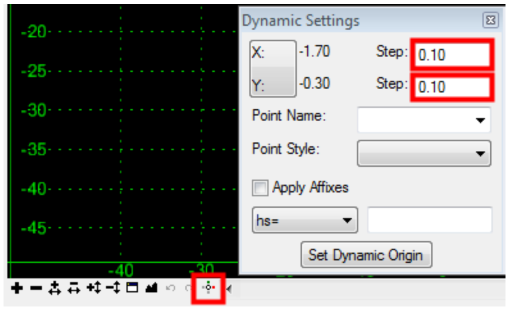


7. Paste the copy into the same folder.
8. Rename the copy **Z8_6_to_1-Inside_ROW.**

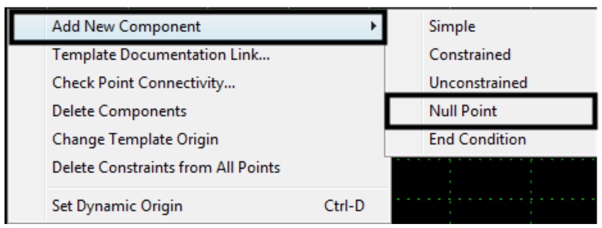


9. **<D> <D>** on the **Z8_6_to_1-Inside_ROW** to open it for editing.
10. Open the **Dynamic Settings** dialog box.

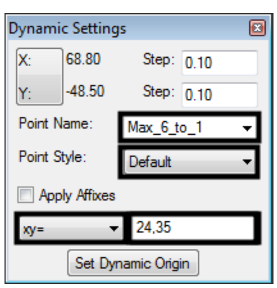
11. Key in ***0.10*** for the ***X*** and ***Y Step***.
12. Verify that **Apply Affixes** is toggled off.



13. **<R>** in the template view and select **Add New Component > Null Point** from the right click menu.

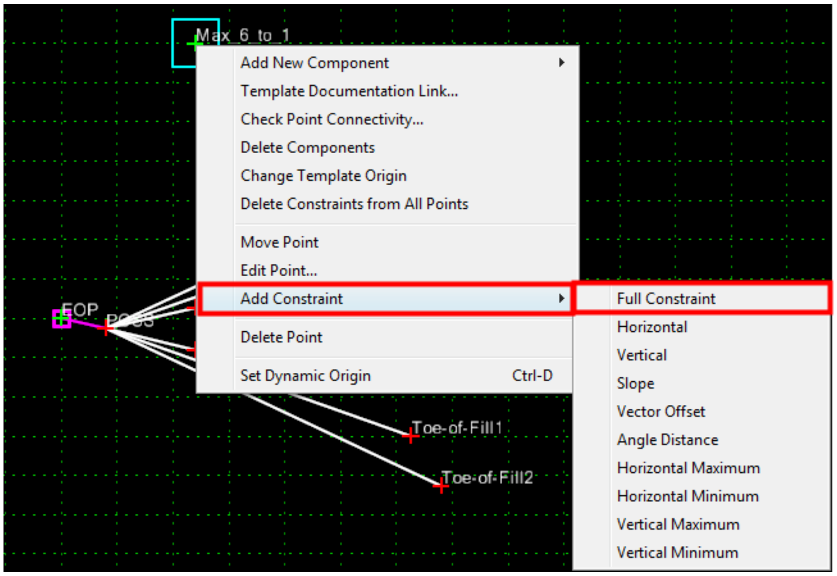


14. In the ***Dynamic Settings*** dialog box, key in ***Max_6_to_1*** in the ***Point Name*** field.
15. Set the ***Point Style*** to ***Default***.
16. Set the precision key in type to **xy=**.
17. In the precision key in field, key in ***24,35*** and press the ***Enter*** key. The 24 equals the maximum horizontal distance that a 6 to 1 toe can be from the pavement edge. The 35 represents the height above the pavement edge. The height for this point is irrelevant and can be set to any value. 35 is used here to place the point out of the way of other data while having the fit view at a reasonable scale.



The ***Max_6_to_1*** point is placed in the correct location, but it is not constrained. It should be constrained to the pavement edge sot that the proper distance is maintained if the pavement width is changed.

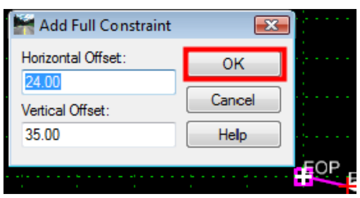
18. **<R>** on the ***Max_6_to_1*** point and select **Add Constraint > Full Constraint** from the right click menu.



19. **<D>** on the **EOP** point. This displays the ***Add Full Constraint*** dialog box.

The data in the dialog box is correct because the precision key in was used to place the point.

20. **<D> OK** to accept the constraints and dismiss the dialog box.



21. **<R>** in the template view and select **Add New Component > Null Point** from the right click menu.

22. In the ***Dynamic Settings*** dialog box, key in ***Max_4_to_1*** in the ***Point Name*** field.

23. In the precision key in field, key in ***62.67,35*** and press the ***Enter*** key.

24. **<R>** on the ***Max_4_to_1*** point and select **Add Constraint > Full Constraint** from the right click menu.

25. **<D>** on the **EOP** point. This displays the ***Add Full Constraint*** dialog box.

26. **<D> OK** to accept the constraints and dismiss the dialog box.

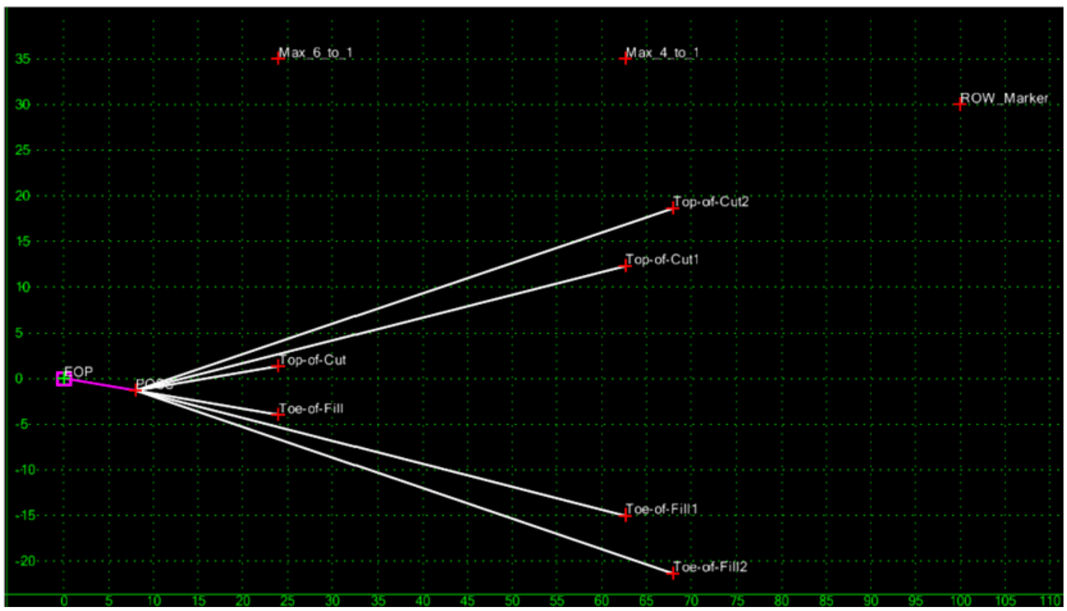
Next, a point to follow the right of way is added.

27. **<R>** in the template view and select **Add New Component > Null Point** from the right click menu.

28. In the ***Dynamic Settings*** dialog box, key in ***ROW_Marker*** in the ***Point Name*** field.

29. In the precision key in field, key in ***100,30*** and press the ***Enter*** key.
30. **<R>** on the ***ROW_Marker*** point and select **Add Constraint > Full Constraint** from the right click menu.
31. **<D>** on the **EOP** point. This displays the ***Add Full Constraint*** dialog box.
32. **<D> OK** to accept the constraints and dismiss the dialog box.
33. Select **File > Save** from the ***Create Template*** menu bar.

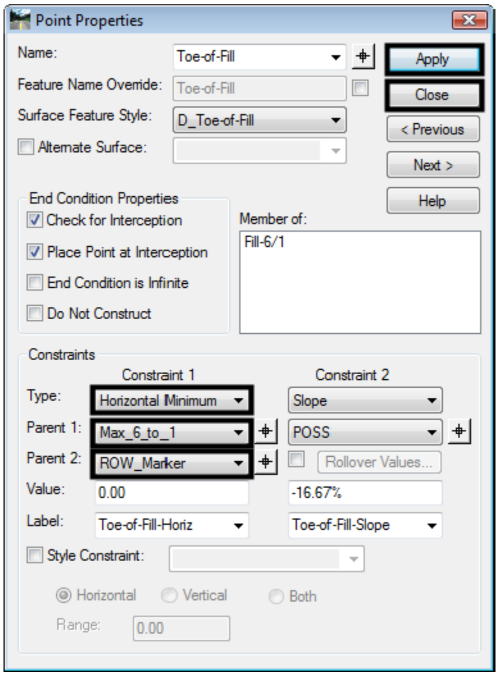
The illustration below shows the template completed to this point.



Next, the constraints on the toe points are changed to use the three Null points just added.

34. **<D> <D>** on the **Toe-of-Fill** point. This displays the ***Point Properties*** dialog box.
35. In the ***Point Properties*** dialog box, set the ***Constraint 1 Type*** to **Horizontal Minimum**.
36. Set the ***Parent 1*** to **Max_6_to_1**.
37. Set the ***Parent 2*** to **ROW_Marker**.
38. Verify that the ***Value*** is set to ***0.00***.

39. **<D> Apply** to accept the changes. **<D> Close** to dismiss the dialog box.



40. Repeat steps 34 through 39 for the **Top-of-Cut** point.

The Horizontal Minimum constraint uses the left most of the two Parent points as a Horizontal constraint. When the right of way is to the right of the two Max null points, the Max null point distance is used for the sideslope. When the right of way is to the left of a Max null point, the ROW_Marker sets the length of the sideslope.

41. **<D> <D>** on the **Toe-of-Fill1** point.

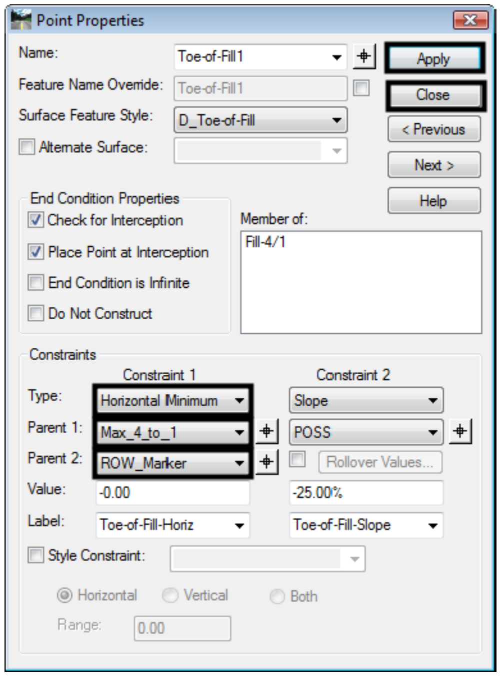
42. Set the ***Constraint 1 Type*** to **Horizontal Minimum**.

43. Set the ***Parent 1*** to **Max_4_to_1**.

44. Set the ***Parent 2*** to **ROW_Marker**.

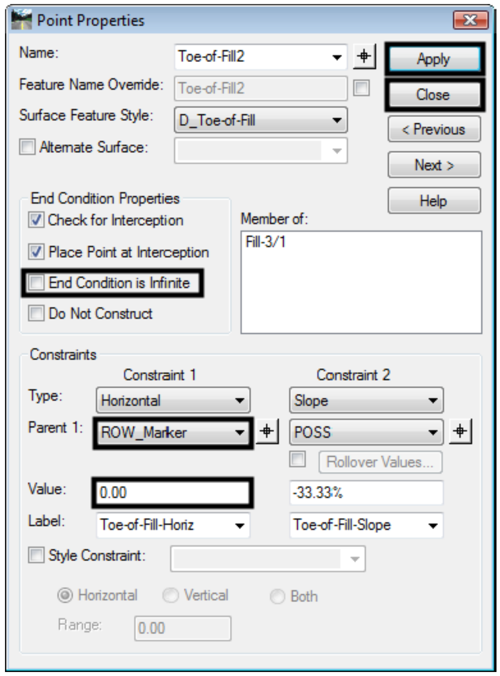
45. Verify that the ***Value*** is set to ***0.00***.

46. **<D> Apply** to accept the changes. **<D> Close** to dismiss the dialog box.



47. Repeat steps 41 through 46 for the **Top-of-Cut1** point.
48. **<D> <D>** on the **Toe-of-Fill2** point.
49. Toggle off **End Condition is Infinite**.
50. Set the ***Parent 1*** for the ***Horizontal*** constraint to **ROW_Marker**.
51. Key in ***0.00*** for the Value of the ***Horizontal*** constraint.

52. **<D> Apply** to accept the changes. **<D> Close** to dismiss the dialog box.



53. Repeat steps 48 through 52 for the **Top-of-Cut2** point.

54. Select **File > Save** from the ***Create Template*** menu bar.

This completes the section. It is now ready to be added to the template backbone.

55. Expand the **1 - Templates** folder in the Template Library area.

56. **<D> <D>** on the **HMA_B10-4 Lane** template to make it active.

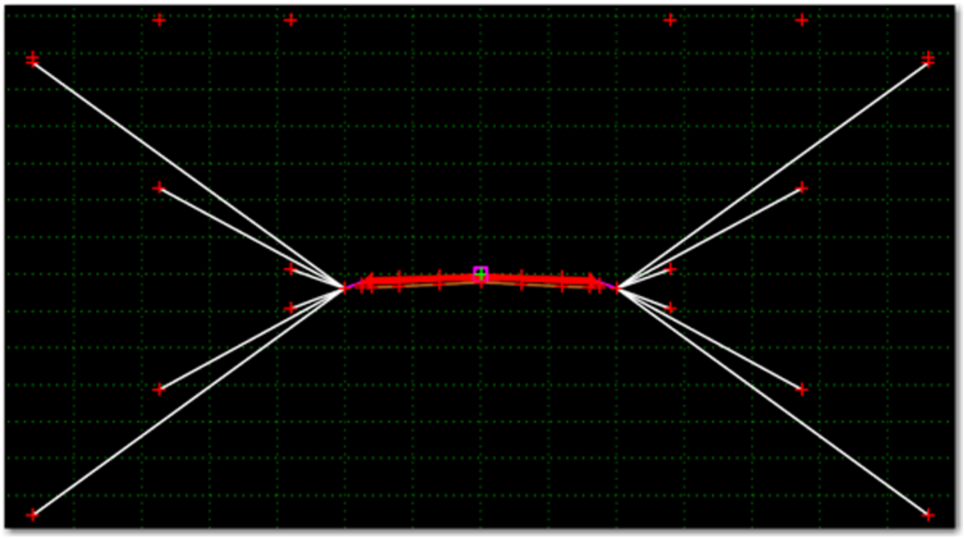
57. In the ***Dynamic Settings*** dialog box, toggle on **Apply Affixes**.

58. **<D>** on the **Z8_6_to_1-Inside_ROW** section to display it in the ***Preview*** window.

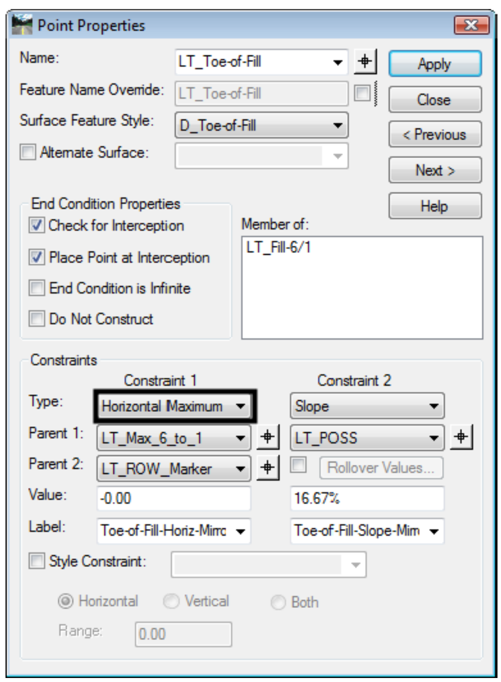
59. **<D> an hold** on the section's origin and drag it into the template view.

60. **<R>** and select **Mirror** from the right click menu.

61. **Drop** the section on the ***HMA_Lift1_EOP-Top*** point. Below is an illustration of the finished template.



62. **<D> <D>** on the **LT_Toe-of-Fill**. Notice that the ***Constraint 1*** has changed from ***Horizontal Minimum*** to ***Horizontal Maximum***. Horizontal Maximum uses the right most point of the two parents as a horizontal constraint.



63. Select **File > Save** from the ***Create Template*** menu bar.

64. Close the ***Create Template*** dialog box.

This completes the work done in the template library. Next, the template is used in a corridor.

Section Summary:

- ♦ The end condition sections in the standard template library can be easily modified to stop at the right of way.
- ♦ Null points are used to determine the maximum length of the sideslope.
- ♦ Horizontal Minimum constraints change to Horizontal Maximum constraints when the template is reflected (or on the reflected side when mirrored).

Lab 30.2 - Corridor Set up and Run

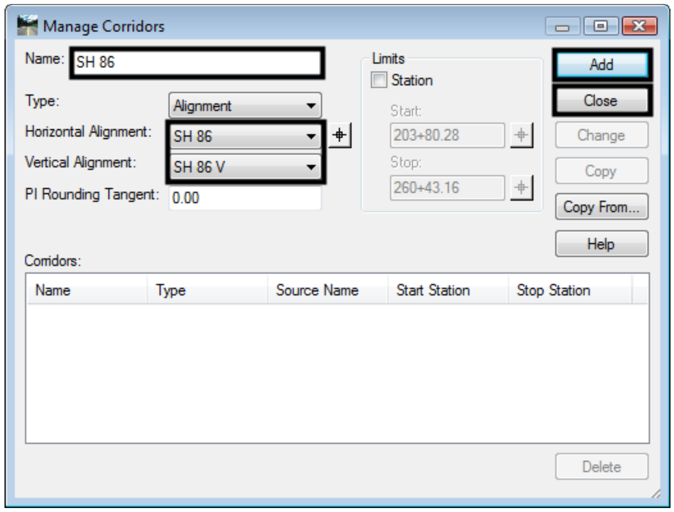
As designed, the template requires two point controls to follow the right of way lines. For this exercise, the right of way lines have already been chained together and imported as horizontal alignments.

Section Objectives:

- ♦ Create a corridor and template drop.
- ♦ Create point controls for the right of way.
- ♦ Add the right of way alignments as reference displays in the Roadway Designer views.

1. Select **Modeler > Roadway Designer** from the InRoads menu bar.
2. From the Roadway Designer menu bar, select **File > New**.
3. Verify the directory is ***C:\\12345\Design\InRoads***.
4. Key in ***12345DES_Toes-Lab.ird*** for the file name.
5. **<D> Save** to create the Roadway Designer file and dismiss the ***Save Roadway Design As*** dialog box.
6. Select **Corridor > Corridor Management** from the Roadway Designer menu bar.
7. Key in ***SH 86*** for the corridor ***Name***.
8. Verify that **SH 86** and **SH 86 V** are set as the ***Horizontal Alignment*** and ***Vertical Alignment***.

9. **<D> Add** to create the corridor then **<D> Close** to dismiss the ***Manage Corridors*** dialog box.



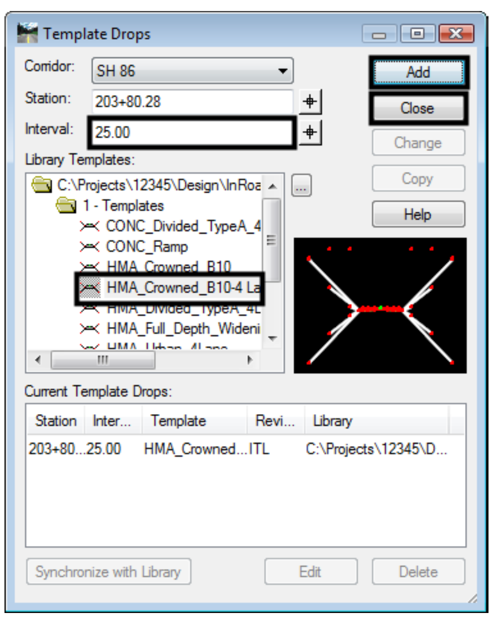
10. Select **Corridor > Template Drops** from the Roadway Designer menu bar.

11. Key in ***25*** for the ***Interval***.

12. In the ***Library Templates*** area, expand the **C:\Projects\12345\Design\InRoads\12345DES_Templates_Toes-Lab.itl > 1 - Templates** folder.

13. Highlight the **HMA_Crowned_B10-4 Lane** template.

14. **<D> Add** then **<D> Close** to dismiss the ***Template Drops*** dialog box.



15. Select **Corridor > Point Controls** from the Roadway Designer menu bar.

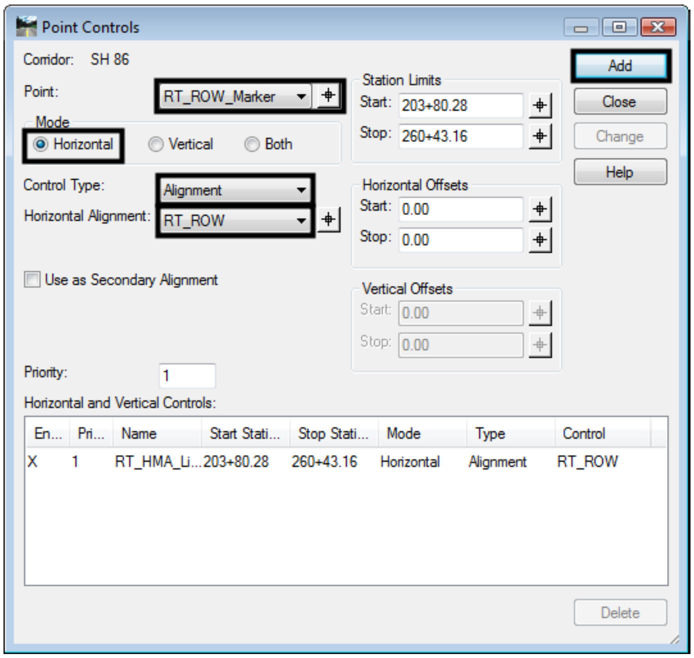
16. In the ***Point Controls*** dialog box, set the ***Point*** to **RT_ROW_Marker**.

17. Toggle on **Horizontal** for the ***Mode***.

18. Verify that the ***Control Type*** is set to **Alignment**.

19. Select **RT_ROW** for the ***Horizontal Alignment***.

20. **<D> Add** to create the point control.



21. Set the ***Point*** to **LT_ROW_Marker**.

22. Select **LT_ROW** for the ***Horizontal Alignment***.

23. **<D> Add** to create the point control. **<D> Close** to dismiss the ***Point Controls*** dialog box.

The toes will now remain inside the right of way. However, it is not apparent. To show the relationship between the toes and the right of way, The right of way alignments are displayed in the Roadway Designer window as references.

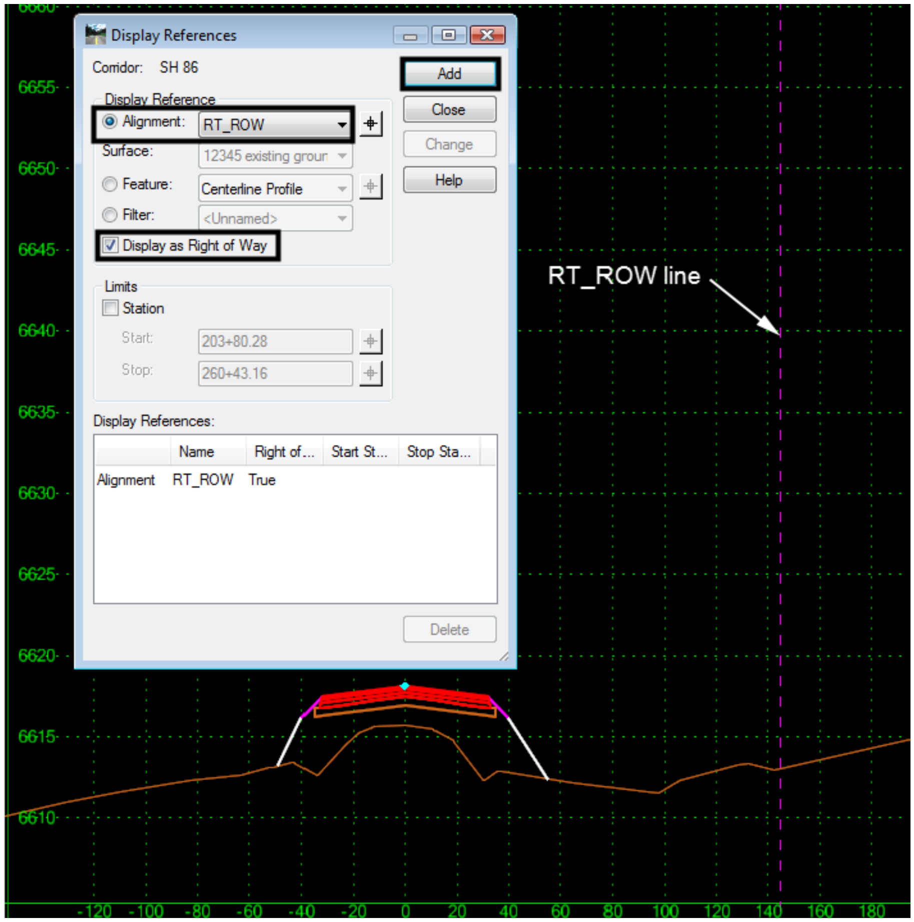
24. Select **Corridor > Display References** from the Roadway Designer menu bar.

25. Verify that **Alignment** is toggled on.

26. Select **RT_ROW** for the ***Alignment***.

27. Toggle on **Displays as Right of Way**.

28. **<D> Add**. Notice the line displayed on the right side of the template view. That line represents the offset distance to the right of way from the corridor alignment.



29. Repeat steps 26 through 28 using **LT_ROW** for the alignment.

30. **<D> Close** to dismiss the ***Display References*** dialog box.

31. Scroll through the stations. Notice two things, 1) the toes never go outside the right of way, and 2) If the toe can not tie before the right of way, it is omitted.

Note: This end condition will not solve every template drop. Those template drops that do not solve will have to be examined to determine the best solution for those areas. The solutions for those areas are not a part of this lab.

Section Summary:

- The ROW_Marker points are attached to the right of way horizontal alignments using point controls.
- Using Display References helps to show that the template is working properly.
- Design decisions have to be made in areas where the toes can not tie inside the right of way.

Chapter Summary:

- The right of way controls can be easily added to an existing template.

- This example uses a point control, however the same results can be achieved by making the ROW markers into end conditions.
- Developing these kinds of templates is an iterative process. Parts will be developed that show areas which need further consideration.

LAB 31 - End Conditions that Require Multiple Solutions

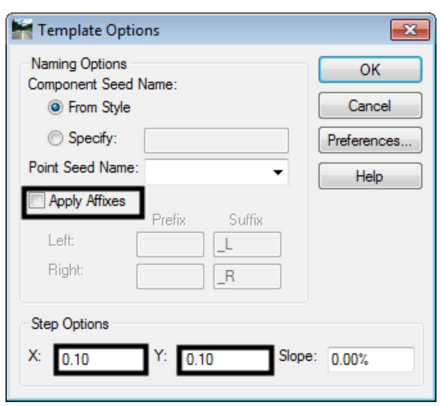
This lab demonstrates the construction of end conditions that require multiple solutions. The section will place a minimum 2-foot deep ditch, with a berm if necessary, when in cut. The section will also place a 4 to 1 fill slope when the embankment height is 10-feet or less and a 3 to 1 fill slope when over 10-feet in height. This section is constructed using the drag and drop method. Then, the end condition priorities are reset so that the section operates properly.

Chapter Objectives:

- Build an end condition section that tests for solutions based on priority
- Build an end condition section using existing components with the drag and drop method

Lab 31.1 - End Conditions that Require Multiple Solutions

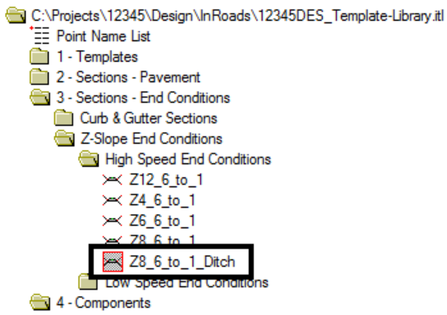
1. Open MicroStation and InRoads using the ***12345DES_Model-End Cond Mult Sol.dgn*** file.
2. Select **File> Open** from the InRoads menu bar.
3. Select the ***C:\Projects\12345\Design\InRoads\ 12345DES_Template-End Cond Mult Sol.itl*** from the available files.
4. **<D> Open** then **<D> Cancel** to dismiss the ***Open*** dialog box.
5. Select **Modeler> Create Template** from the InRoads menu bar.
6. Select ***Tools> Options*** from the ***Create Template*** menu bar.
7. Make sure that **Apply Affixes** is toggled off and the **X** and **Y Step Options** are set to ***0.10***.



8. **<D>** the **OK** button.
9. **<D> <D>** on the root folder in the Template Library pane to expand the folder structure.

10. Expand the ***3 - Sections - End Conditions> Z-Slope End Conditions> High Speed End Conditions*** folder.

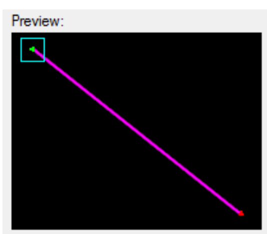
11. Create a new template in the ***High Speed End Conditions*** folder. Name it ***Z8_6_to_1_Ditch***.



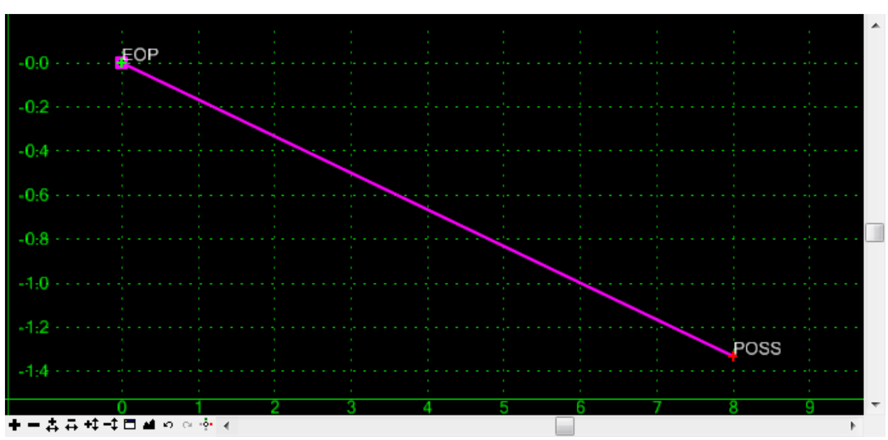
12. Expand ***4 - Components> End Conditions> Z-Slope Components > High Speed End Conditions*** folder.

13. **<D>** on the ***Z-Slope_8_6_to_1*** component. The component is displayed in the Preview window.

14. **<D> and hold** on component's origin (the green dot).



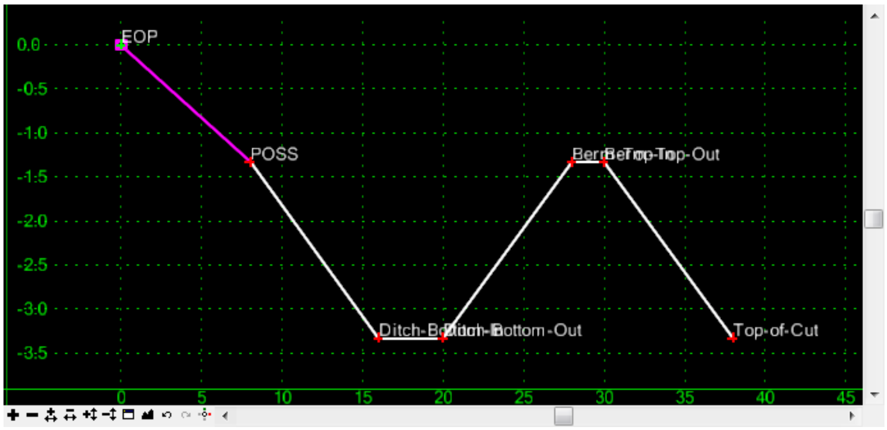
15. **Drag** the component into the Template View and **drop** (release the data button) it on the new section's origin.



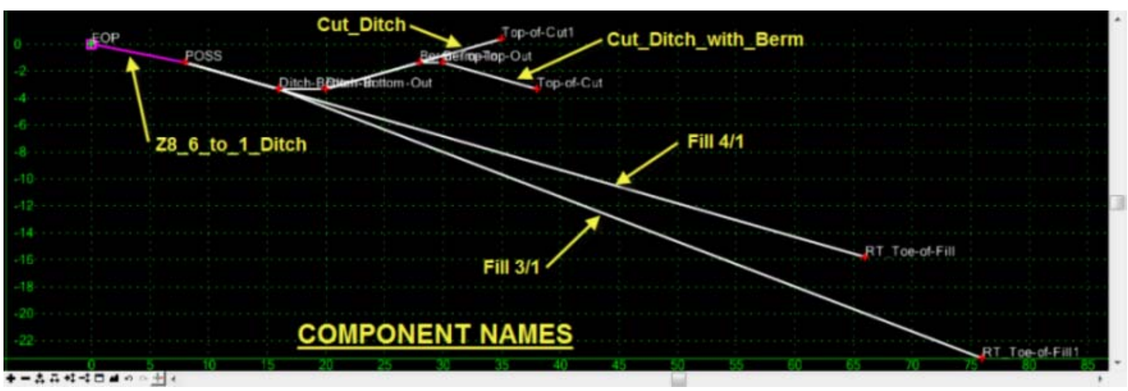
16. Expand ***4 - Components> End Conditions> Cut Slope Components*** folder.

17. **<D>** on the ***Cut_Ditch_with_Berm*** component.

18. **<D> and hold** on component's origin (the green dot).
19. **Drag** the component into the Template View and move the pointer on to the component point named ***POSS*** and **drop.** The "+" on the component point turns white when the pointer is on it.

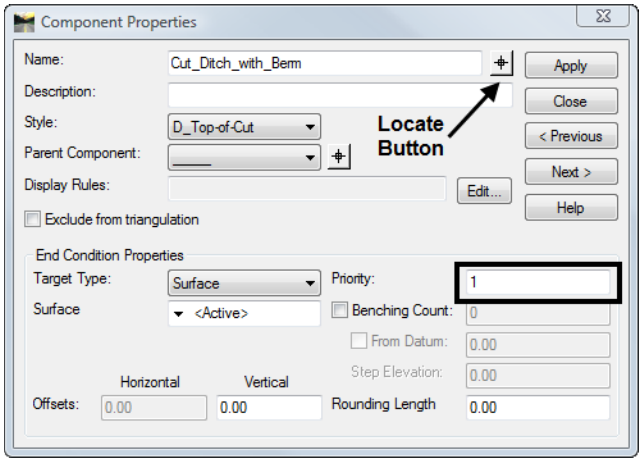


20. Repeat steps 16, 17 & 18 for the ***Cut_Ditch*** component.
21. Expand ***4 - Components> End Conditions> Fill Slope Components*** folder.Repeat steps 16, 17 & 18 for the ***Fill__4_to_1*** and ***Fill_3_to_1*** components.



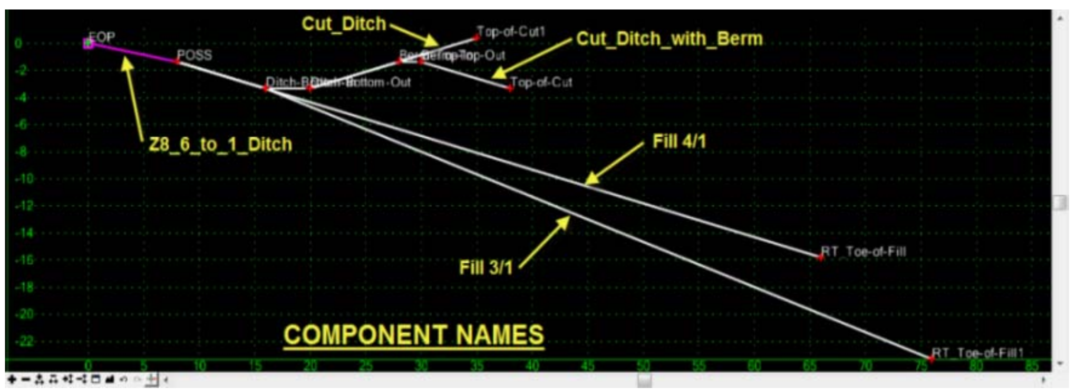
22. **<D> <D>** on the ***Cut_Ditch_with_Berm*** component.

23. Verify that the **Priority** is set to ***1***.



24. **<D>** on the ***Locate Button*** next to ***Name*** in the ***Component Properties*** dialog box.

25. **<D>** on the ***Cut_Ditch*** component in the Template View.



26. Verify that the **Priority** is set to ***2*** in the ***Component Properties*** dialog box.

27. Set the remaining End Condition Component priorities as follows:

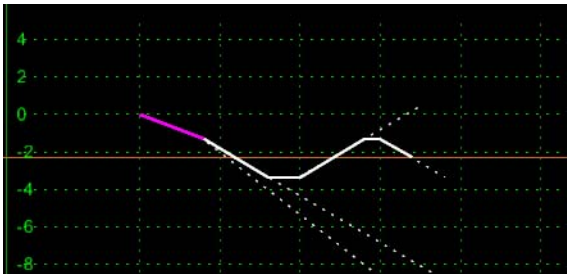
- ***Fill_4/1*** = ***3***
- ***Fill_3/1*** = ***4***

28. Be sure to **<D>** the **Apply** button if any Priority values were modified.

29. **<D>** the **Close** button in the Component Properties dialog box.

30. **<D>** the **Test** Button.

31. In the ***Test End Conditions*** dialog box, **<D> Draw** and notice how end conditions behave.



32. **<D> Close**.

Chapter Summary:

- When multiple end conditions are chained together, if one part of the chain fails then the whole chain fails.
- End condition components that share a common starting point are considered a single end condition.

LAB 32 - Create End Conditions to Search a Surface

This lab demonstrates the ability of an end condition to target multiple surfaces, using target aliasing. In this exercise, a template is edited and new corridor is defined to target multiple surfaces. The existing ground surface was divided into three separate segments along the length of the project. There is also a rock layer surface 10-feet below the existing ground, for the second and third segments, where there is a deep cut section in the profile. The template end conditions target the rock and active surfaces, so target aliasing is required to target all the existing ground and rock surfaces as the corridor extends along the three segments of the project.

Chapter Objectives:

- Modify a template end condition to target a rock layer when that surface is present.
- Build a corridor and use target aliasing to target multiple existing ground and rock layer surfaces along three segments of the project.
- View the corridor to examine the end condition's behavior and determine if templates and target aliasing are working properly

The following files are used in this lab:

- C:\Projects\12345\Design\InRoads\12345DES_Geometry-Create End Condit Search Surf.alg
- C:\Projects\12345\Design\InRoads\12345DES_Template-Create End Condit Search Surf.itl
- C:\Projects\12345\Design\InRoads\12345DES_Roadway-Create End Condit Search Surf.ird
- C:\Projects\12345\Design\InRoads\Exist_Ground_1-Create End Condit Search Surf.dtm
- C:\Projects\12345\Design\InRoads\Exist_Ground_2-Create End Condit Search Surf.dtm
- C:\Projects\12345\Design\InRoads\Exist_Ground_3-Create End Condit Search Surf.dtm
- C:\Projects\12345\Design\InRoads\Rock_Layer_2-Create End Condit Search Surf.dtm
- C:\Projects\12345\Design\InRoads\Rock_Layer_3-Create End Condit Search Surf.dtm

Lab 32.1 - Create End Conditions to Search a Surface

1. Open MicroStation and InRoads using the ***12345DES_Create End Cond Search Surf.dgn*** file.

   In the MicroStation drawing, notice the three perimeters displayed for each existing ground surface

2. Select **File> Open** from the InRoads menu bar.

3. Open the following files from ***C:\Projects\12345\Design\InRoads*** directory.

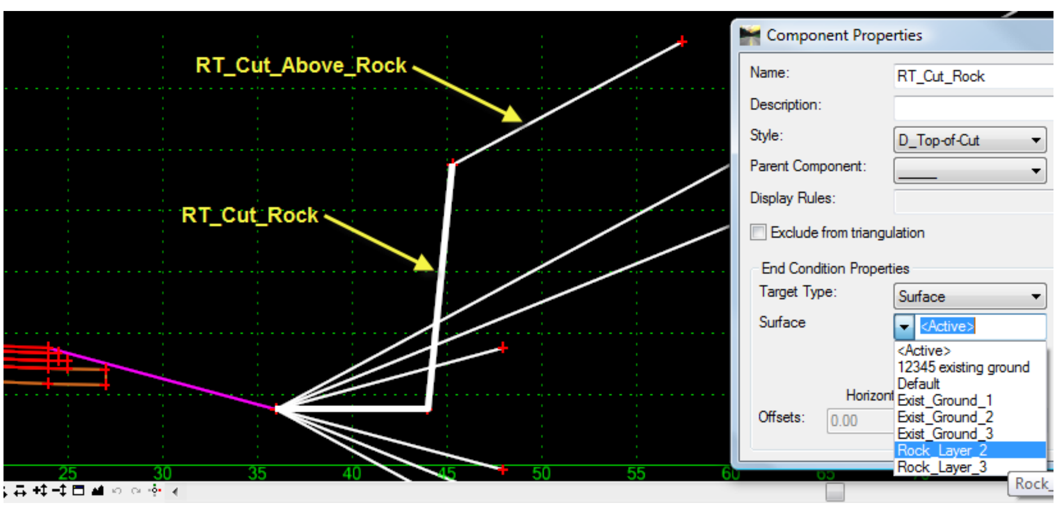
   - **CDOT_Civil.xin**
   - **12345DES_Geometry-Create End Condit Search Surf.alg**
   - **12345DES_Template-Create End Condit Search Surf.itl**

- **12345DES_Roadway-Create End Condit Search Surf.ird**
- **Exist_Ground_1-Create End Condit Search Surf.dtm**
- **Exist_Ground_2-Create End Condit Search Surf.dtm**
- **Exist_Ground_3-Create End Condit Search Surf.dtm**
- **Rock_Layer_2-Create End Condit Search Surf.dtm**
- **Rock_Layer_3-Create End Condit Search Surf.dtm**

4. **<D> Cancel** the to dismiss the ***Open*** dialog box.

Lab 32.2 - Edit template end condition components to target rock layer.

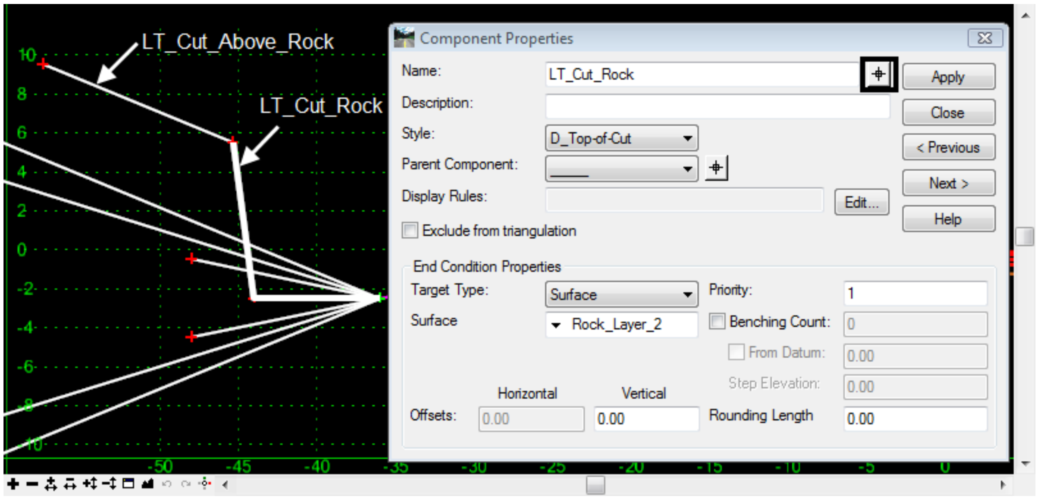
1. Select **Modeler> Create Template** from the InRoads menu bar.
2. **<D> <D>** on the root folder in the Template Library pane to expand the folder structure.
3. Expand the ***1 - Templates*** folder.
4. **<D> <D>** on the ***12345_HMA_2Lane_Rock*** template to open it for editing.
5. **<D> <D>** on the ***RT_Cut_Rock*** component.
6. In the ***Component Properties*** dialog box, change the **Surface** to ***Rock_Layer_2*** and **<D> Apply**



Note: This end condition has two components and is only placed when there is a rock surface above the ditch bottom. The first component, ***RT_Cut_Rock***, extends to intersect the rock layer surface. The second, ***RT_Cut_Above_Rock***, is a child of the first and extends to intersect the active surface (existing ground). All other end condition components in this template target the active surface (existing ground).

7. **<D>** on the ***Locate Button*** next to ***Name*** in the ***Component Properties*** dialog box

8. On the left side of the template, **<D>** on the ***LT_Cut_Rock*** component.



9. In the ***Component Properties*** dialog box, Change the **Surface** to ***Rock_Layer_2,*** then **<D> Apply** and **<D> Close**.

Lab 32.3 - Create a Corridor and Template Drop

Build a corridor that follows the centerline alignment and extends along all three segments of the project.

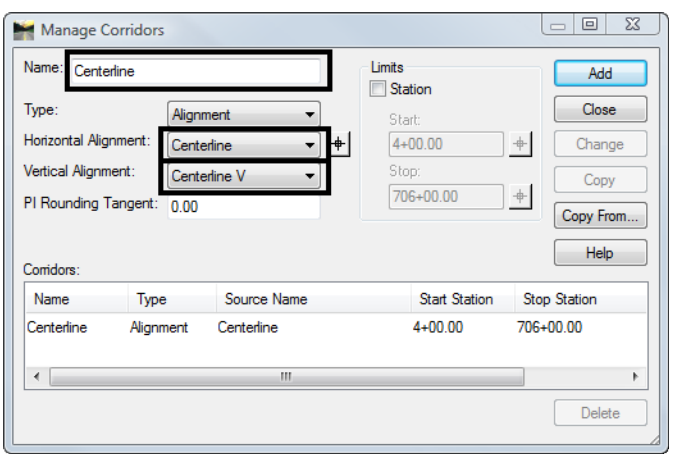
10. Select **Modeler> Roadway Designer** from the InRoads menu bar.

11. Select **Corridor> Corridor Management** from the Roadway Designer menu bar.

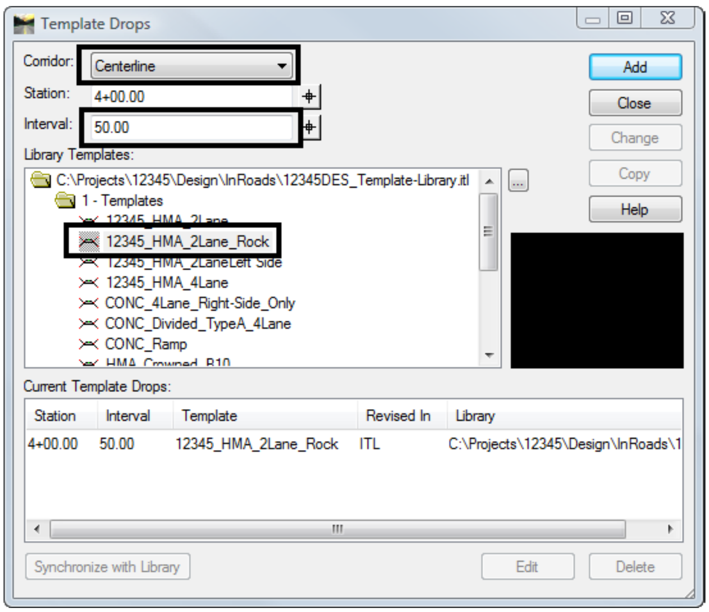
12. In the ***Manage Corridors*** dialog box:

   - Key in ***Centerline*** in the ***Name*** field.
   - Select **Centerline** for the ***Horizontal Alignment***.
   - Select **Centerline V** for the ***Vertical Alignment***.

13. **<D> Add** then **<D> Close**.



1. Select **Corridor> Template Drops** from the Roadway Designer menu bar.
2. In the ***Template Drops*** dialog box, select **Centerline** for the ***Corridor*** name.
3. Key in ***50*** for the ***Interval***.
4. Expand **1 - Templates** folder in ***Library Templates*** area.
5. **<D>** on the **12345_HMA_2Lane_Rock** template.
6. **<D> Add** then **Close**.

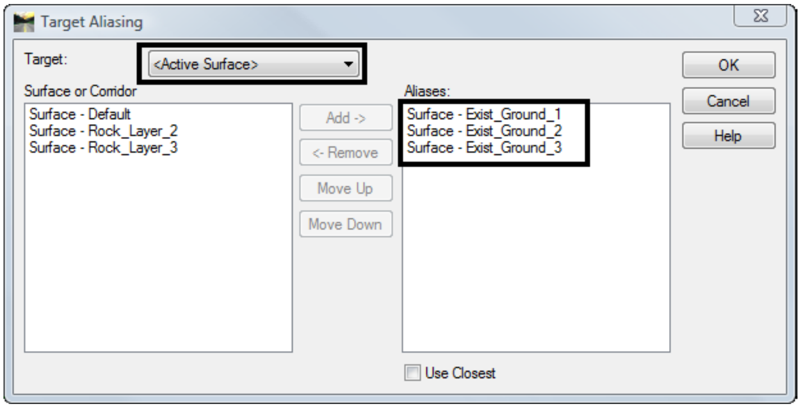


Lab 32.4 - Define target aliasing

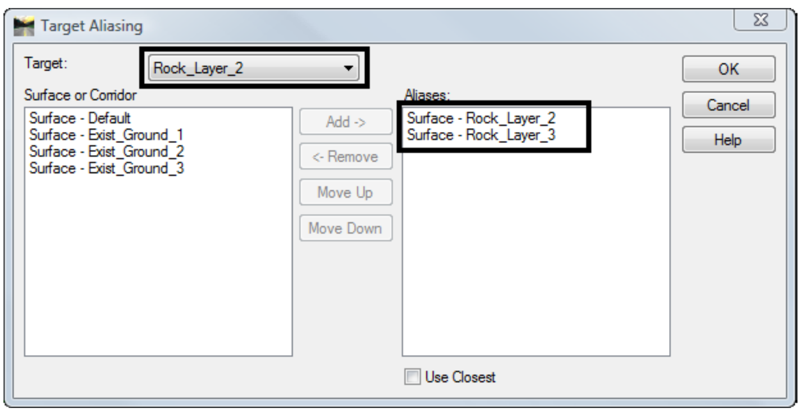
Target aliasing allows multiple targets to be specified for a single end condition. In this example, the existing ground for the project was contained in three separate dtms.

7. Select **Tools> Target Aliasing** from the Roadway Designer menu bar.
8. In the ***Target Aliasing*** dialog box, select **<Active Surface>** for the ***Target***.
9. Highlight **Surface - Exist_Ground_1**, **Surface - Exist_Ground_2** and **Surface - Exist_Ground_3** in the ***Surface or Corridor*** area.

10. **<D> Add**.



11. Select **Rock_Layer_2** for the ***Target***.
12. Highlight **Surface - Rock_Layer_2** and **Surface - Rock_Layer_3** in the ***Surface or Corridor*** area.
13. **<D> Add**.

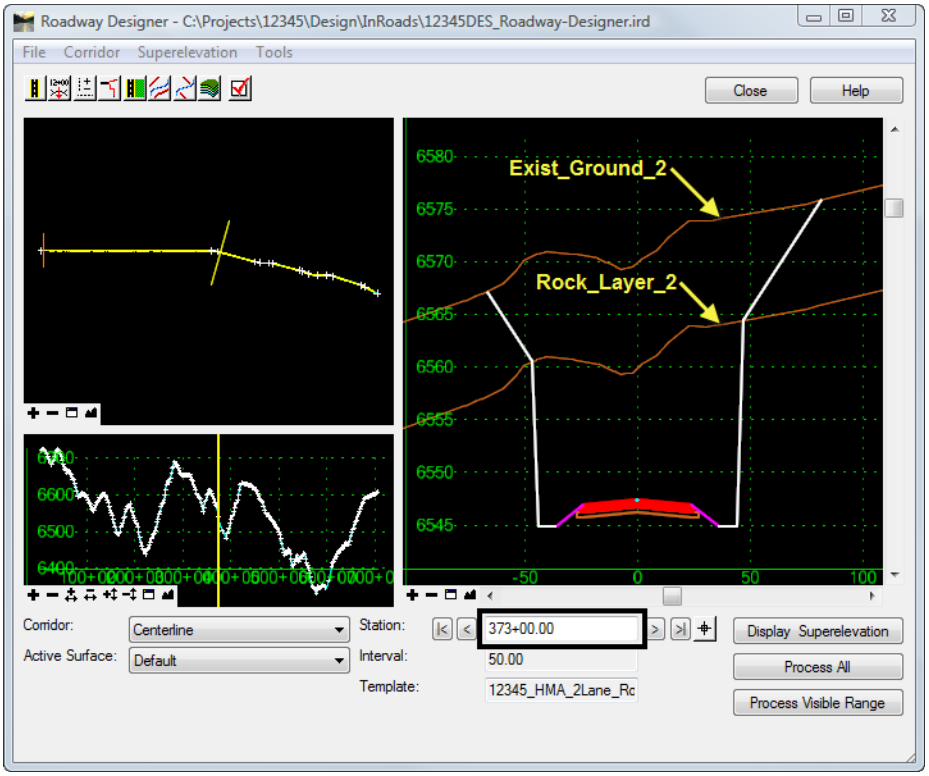


14. **<D> OK.**

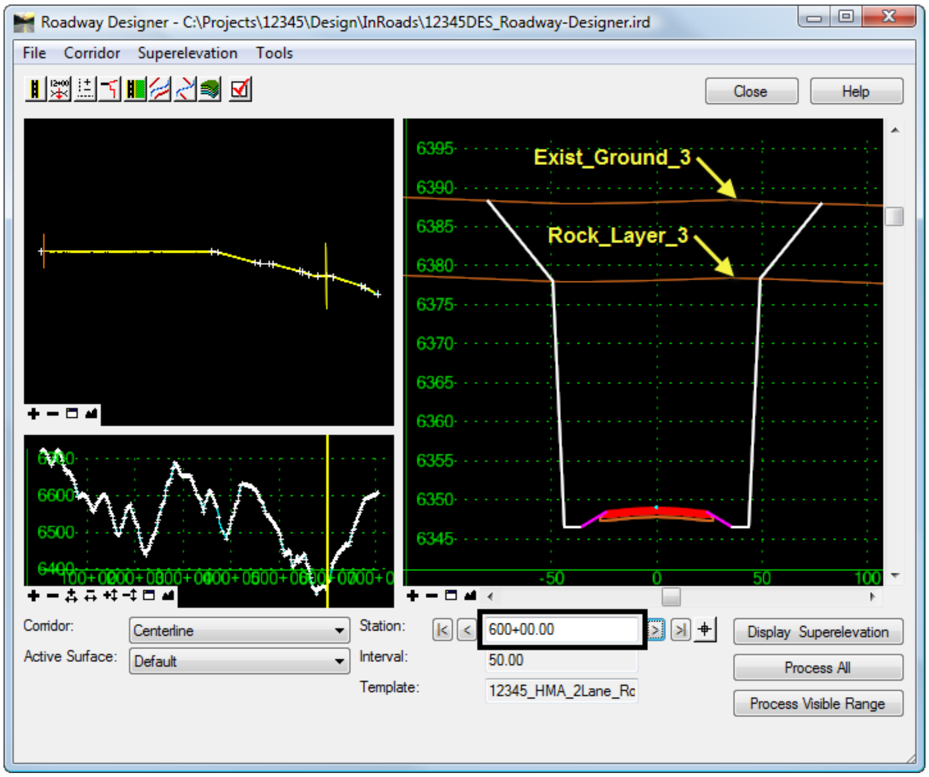
Lab 32.5 - Review Design Model

View the corridor to examine the end condition's behavior and determine if templates and target aliasing are working properly.

1. In the ***Roadway Designer*** dialog box, key in ***373+00*** for the ***Station***. Notice the end conditions target the existing ground and rock layer surfaces in Roadway Designer dialog's cross- section viewer.



2. Key in ***600+00*** for the ***Station***. Notice in the illustration below, that even though the surfaces are different, the end condition still solves. THis is because the Target Aliasing allows multiple surfaces to be specified for the end condition.



Chapter Summary:

- When end conditions are chained together (like the rock layer components used above), all parts of the chain must solve or the whole end condition fails.
- Use target aliasing to target multiple existing ground and rock layer surfaces.

Chapter 2 - Intersection Project

This intersection lab is based on the Federal Blvd. and 6th Ave. interchange reconstruction project. The lab focuses on the reconstruction of the intersection at Federal Blvd. and 5th Avenue. It describes the tools and techniques for modeling an intersection.

Chapter Objectives:

- Describe the procedures and techniques used to create an at-grade intersection
- Improve proficiency in creating corridors
- Practice creating design surfaces
- Introduce the student to the multi-centered curve tool used to develop geometry for curb returns
- Learn how to use point controls in typical sections to model curb returns
- Reinforce techniques for combining surfaces to create a final surface

Project Overview

The scope of work for the Federal Blvd. and 5th Ave. intersection project is a complete reconstruction. Key features of the reconstruction are:

- Federal Blvd. (the mainline) is being widened from 4 to 6 lanes
- 5th Ave. (the crossing street) is being realigned to accommodate the on ramp to 6th Ave.
- Federal Blvd. uses a concrete pavement design
- 5th Ave. uses an asphalt pavement design
- 5th Ave. switches to a concrete pavement prior to the intersection.
- 5th Ave has a taper on the south side to facilitate right turns.

Project Data

The following data is provided for this project:

- **Federal @ 5thAve.alg** - This file contains predefined horizontal and vertical alignments for Federal Blvd. and the horizontal alignment 5th Ave. The student will create a vertical alignment for 5th Ave. in addition to geometry for each of the curb returns.
- **16628_Existing.dtm** – This file represents the surveyed surface data of the existing intersection.
- **Federal_and_5th.itl** – This file contains predefined templates for Federal Blvd. and 5th Ave.

InRoads Design Process

Below is an outline of the InRoads procedures used to create the intersection design model:

1. Create the initial mainline design surface
2. Create the vertical alignment for crossing street and match the mainline design surface through the intersection
3. Create the initial crossing street design surface
4. Add geometry for each curb return
5. Update the crossing street corridor to include curb returns
6. Update mainline corridor to include curb returns and features from the crossing street.
7. Create the final intersection Surface

Initial Modeling

Section Objectives:

Federal Blvd. is considered the mainline and should be modeled first. Use this initial Federal Blvd. design surface to assist in defining the vertical alignment for 5^{th} Ave., the intersecting street. Using the new vertical alignment and the predefined template for 5^{th} Ave., create the initial design surface for the crossing street. At this point there will be two separate design surfaces, one for the mainline and one for the crossing street.

Create the Initial Federal Blvd. Design Surface

Use the following procedure to create the initial design surface for Federal Blvd.:

- Load project data
- Create the Federal Blvd. corridor
- Add template drops
- Generate the initial mainline design surface

Load Project Data

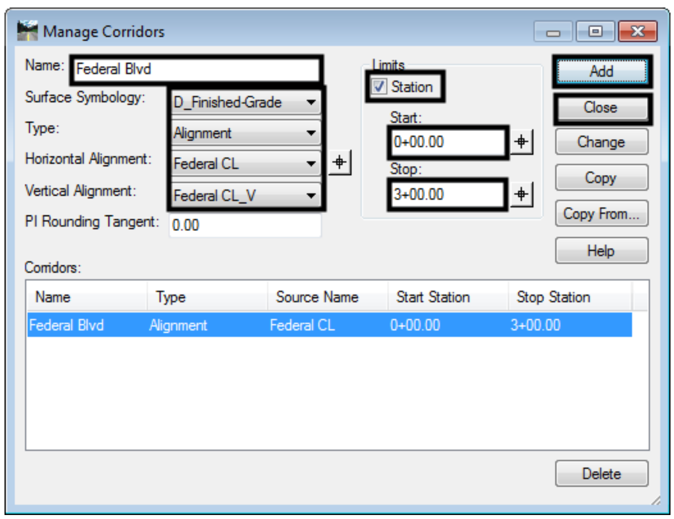
1. Open the **Federal @ 5thAve.alg** geometry file.
2. Open the **Federal_and_5th.itl** template library.
3. Open the **16628_Existing.dtm** surface.

Create the Federal Blvd. Corridor

The Federal Blvd. alignment runs from south of 5th Ave to north of the ramps for eastbound 6th Ave. Because this lab is concerned with the intersection at 5th Ave., the first 300 feet of the Federal Blvd. alignment is used.

1. Select **Modeler > Roadway Designer** from the InRoads menu bar. This displays the ***Roadway Designer*** dialog box.
2. In the ***Roadway Designer*** dialog box, select **Corridor > Corridor Management** or **<D>** the  button. This displays the ***Manage Corridors*** dialog box.

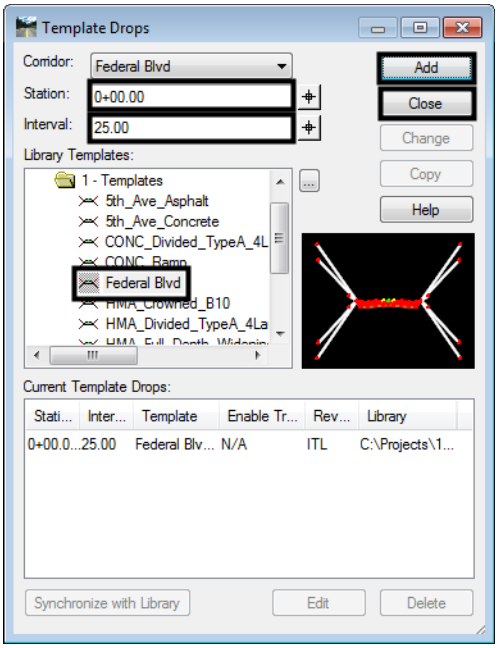
3. In the ***Manage Corridors*** dialog box, key in ***Federal Blvd*** for the ***Name***.
4. Set the ***Surface Symbology*** to **D_Finished-Grade.**
5. Set the ***Type*** to **Alignment**.
6. Select **Federal CL** as the ***Horizontal Alignment***.
7. Select **Federal CL_V** as the ***Vertical Alignment***.
8. Toggle on **Station** in the ***Limits*** area.
9. Key in ***0+00.00*** for the ***Start*** station.
10. Key in ***3+00.00*** for the ***Stop*** station.
11. **<D> Add** to complete the corridor.
12. **<D> Close** to dismiss the ***Manage Corridors*** dialog box.



Add Federal Blvd. Template Drops

1. In the ***Roadway Designer*** dialog box, select **Corridor > Template Drops** or **<D>** the  button. This displays the ***Template Drops*** dialog box.
2. In the ***Template Drops*** dialog box, Key in ***0+00.00*** for the ***Station***.
3. Key in ***25*** for the ***Interval***.
4. In the ***Library Templates*** area, expand the **1 – Templates** folder.

5. Highlight the **Federal Blvd** template.



6. **<D> Add** and **<D> Close**.

Create the Initial Federal Blvd. Design Surface

The surface created here will be used in conjunction with the existing ground to lay out the vertical alignment for 5th Ave. Having the Federal Blvd. surface makes it easier to match it's cross slope with the 5th Ave vertical alignment.

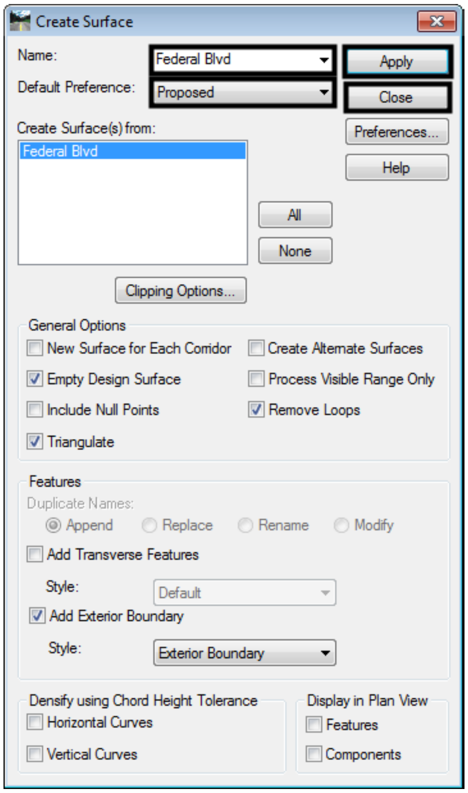
1. In the ***Roadway Designer*** dialog box, select **Corridor > Create Surface** or **<D>** the button. This displays the ***Create Surface*** dialog box.

2. Key in ***Federal Blvd*** for the ***Name***.

3. Select **Proposed** for the ***Default Preference***.

   Note: If Proposed is not found in the list, make sure the standard CDOT_Civil.xin file is loaded.

4. Verify the remaining settings match the illustration below.



5. **<D> Apply** and **<D> Close**.

   Note: If the ***Report Lock*** is ***On***, the ***Results*** dialog box will appear with information about the creation of the surface. This can be dismissed.

Roadway Designer is exited at this point. Save the ird file so that it can be used in later steps.

6. Select **File > Save** from the ***Roadway Designer*** menu bar.

7. Key in ***Federal_and_5th.ird*** for the ***file name***.

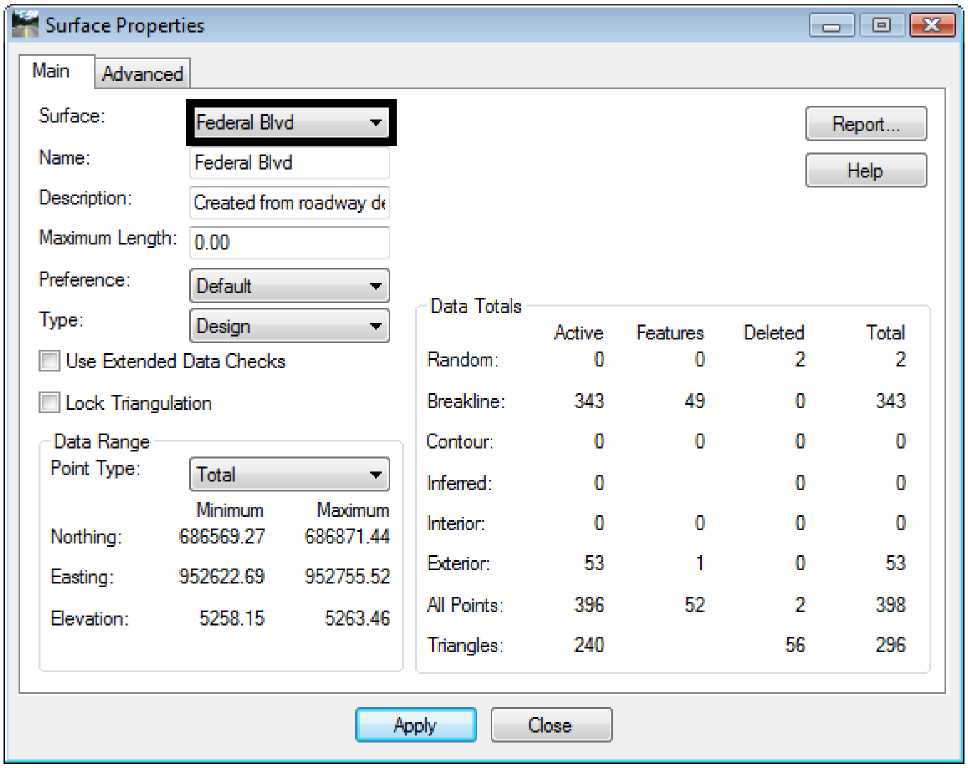
8. **<D> Save** then **<D> Cancel** in the ***Save As*** dialog box.

9. **Close** the ***Roadway Designer*** dialog box.

Changing the symbology for the cross sections and profiles makes it easier to differentiate between surfaces. To change the symbology:

10. From the InRoads menu bar, select **Surface > Surface Properties**. This displays the ***Surface Properties*** dialog box.

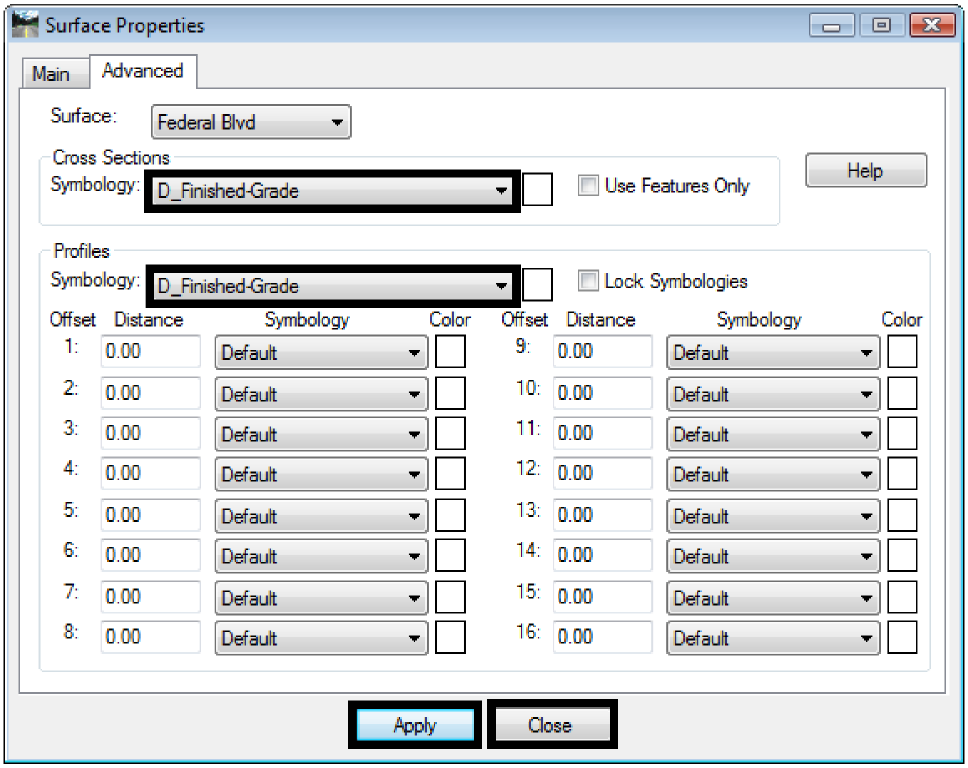
11. In the ***Surface Properties*** dialog box on the ***Main*** tab, select the **Federal Blvd** surface.



12. Select the ***Advanced*** tab.

13. Select **D_Finished-Grade** for ***Cross Sections Symbology***.

14. Select **D_Finished-Grade** for ***Profile Symbology***.



15. **<D> Apply**.

16. **<D> Close**.

This completes the initial design of Federal Blvd.

Create the 5th Ave Vertical Alignment

The vertical alignment for 5th Ave. is created at this point. Using the initial Federal Blvd surface and the existing ground surface, the vertical alignment for 5th Ave. can be tied into Federal Blvd. properly.

- ♦ Create the crossing street profile
- ♦ Define the crossing street vertical alignment

Create a Profile for 5th Ave.

In order to define a vertical alignment, a profile window is required. The existing surface along with the initial Federal Blvd. surface is displayed in this profile.

1. In MicroStation, move to an area to the right of the alignments.

2. Verify the ***5th_Ave*** horizontal alignment is active.

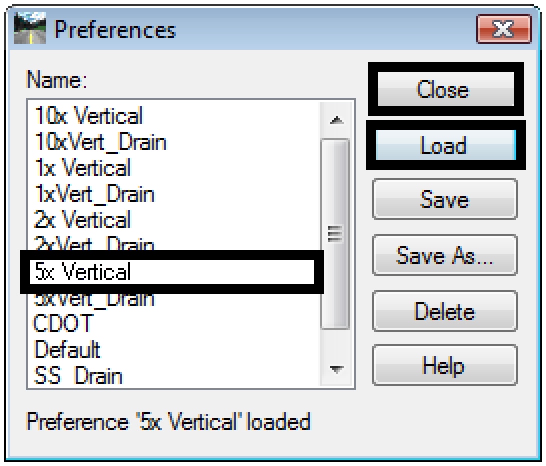
3. On the InRoads main menu, select **Evaluation > Profile > Create Profile**. This displays the ***Create Profile*** dialog box.

The 5x Vertical preference is used here so that the slopes are easier to see.

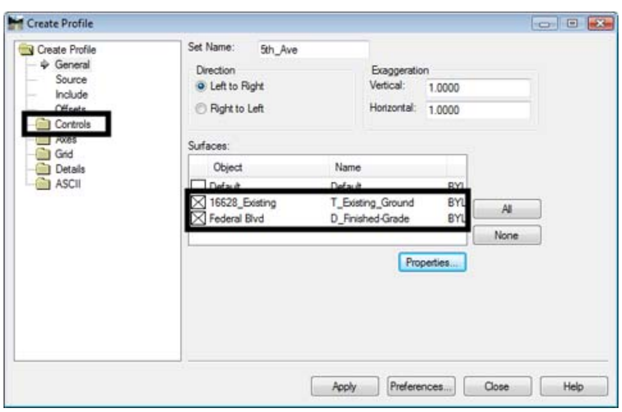
4. **<D> Preferences** and highlight the preference **5x Vertical** from the list.

   Note: Because there are so many settings that control the look and feel of a profile, several CDOT preferences have been created that can save the end user a significant amount of time setting up and creating a profile. Be sure to use a standard preference as much as possible.

5. **<D> Load** to load the preference and then **<D> Close**.



6. On the ***General*** leaf, enter **5th_Ave** for the ***Set Name***.
7. Toggle on **Right to Left** in the ***Direction*** area.
8. Toggle on the **16628_Existing** and **Federal Blvd** surfaces.
9. **<D>** on the **Controls** leaf.

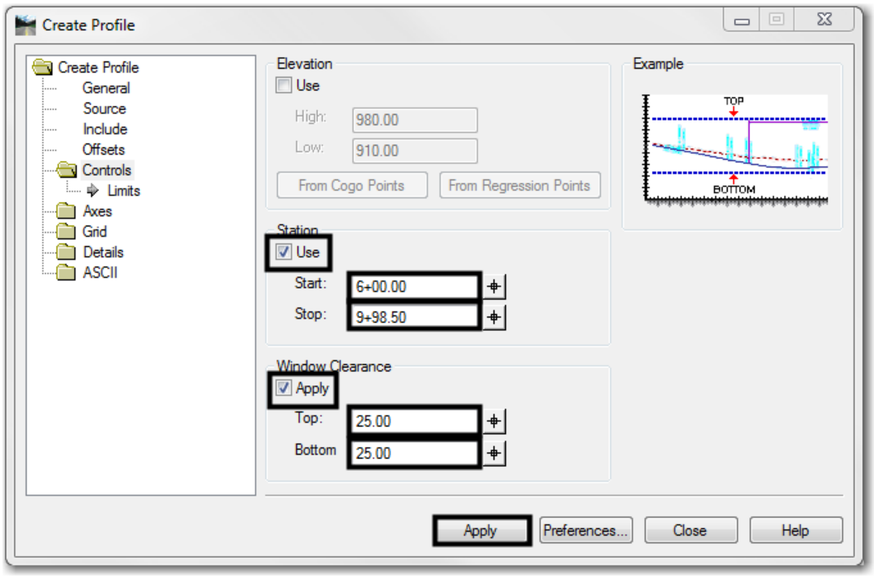


10. Toggle on **Use** in the ***Station*** area.

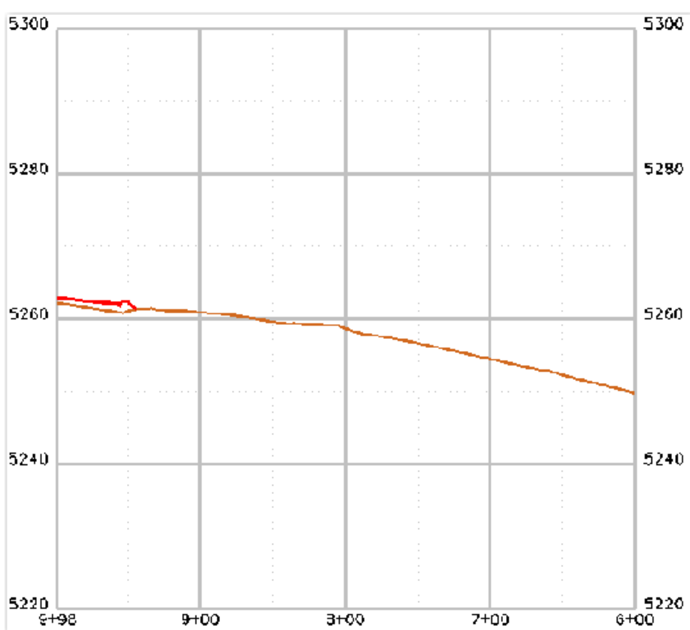
Because this lab is concerned with just the intersection, the vertical alignment (and the profile) is constructed to cover just the area of the intersection.

11. Key in ***6+00.00*** for the ***Start*** station.

12. Key in ***9+98.50*** for the ***Stop*** station.
13. Toggle on **Apply** in the ***Window Clearance*** area.
14. Key in ***25*** for both the T***op:*** and ***Bottom***.



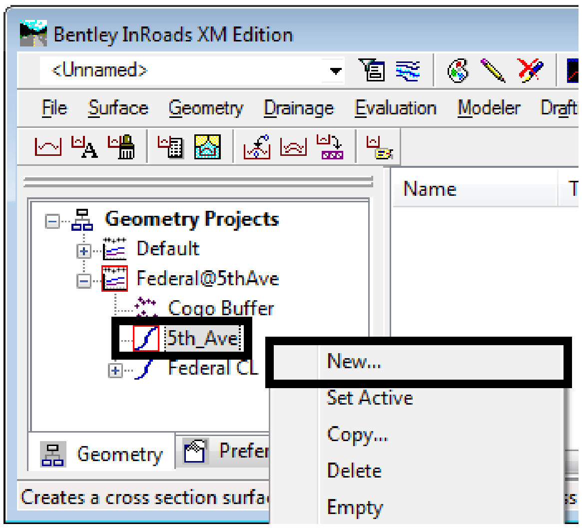
15. **<D> Apply**.
16. **<D>** in the MicroStation view window to identify the profile's location. Because the ***Direction*** was set to ***Right to Left***, the profile will be place to the right of the data point.
17. The profile should look similar to the following:



18. **<D> Close** on the ***Create Profile*** dialog box to dismiss it.

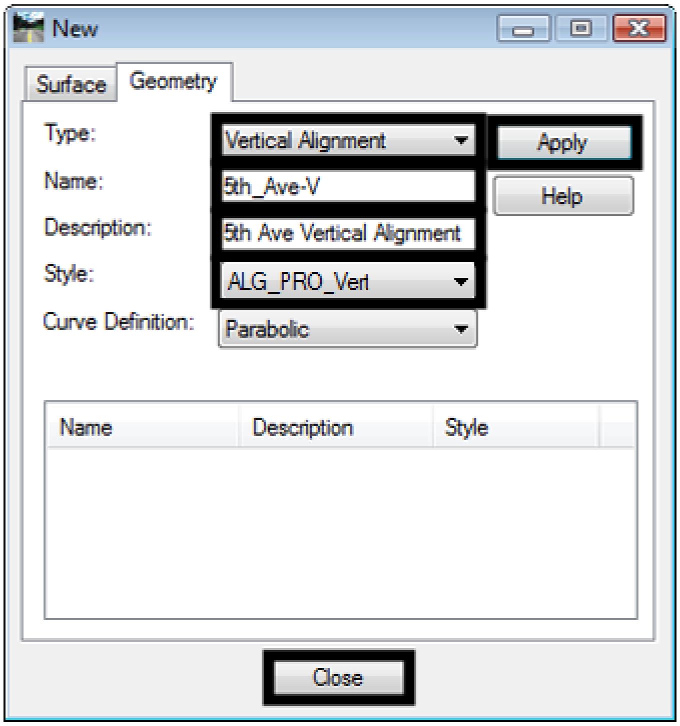
Define the 5th Ave Vertical Alignment

1. Select the **Geometry** bottom tab from the InRoads Explorer.
2. Expand the ***Federal@5thAve*** geometry project to show the **5th_Ave** horizontal alignment.
3. **<R>** on the **5th_Ave** horizontal alignment and select **New** from the menu.



4. In the ***New*** dialog Box, set the ***Type*** to **Vertical Alignment**.
5. In the ***Name*** field, key in ***5th_Ave-V***.
6. In the ***Description*** field, key in ***5th Ave Vertical Alignment***.
7. Set the ***Style*** to **ALG_PRO_Vert**. (This stands for Alignment Proposed Vertical)

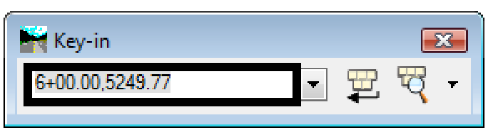
8. The dialog box should look like the following:



9. **<D> Apply** and **<D> Close**.

10. Select **Geometry > Vertical Curve Set > Add PI** from the InRoads main menu. There is no dialog box with this command.

11. In the MicroStation **Key in** window, key in ***se=6+00.00, 5249.77*** and press ***Enter***.



12. Key in ***se=7+87.03, 5258.98*** and press ***Enter***.

13. Key in ***se=9+57.46, 5261.99*** and press ***Enter***.

    Note: This is the station where the alignment of 5th Ave. ties into the cross slope of Federal Blvd. Make sure that this is a smooth transition by comparing the cross slope of Federal Blvd. to the slope of this tangent.

14. Key in ***se=9+98.49, 5262.82*** and press ***Enter***.

15. **<R>** to stop placing PI's.

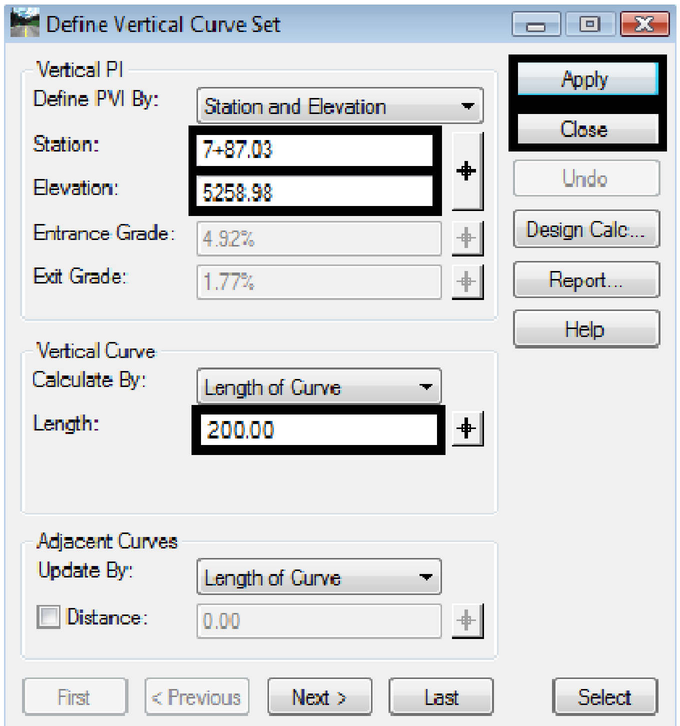
16. In the ***Add Vertical PI*** dialog box, **<D> Close** to dismiss the dialog box.

17. Select **Geometry > Vertical Curve Set > Define Curve** from the InRoads main menu.

18. In the ***Define Vertical Curve Set*** dialog box, verify that the ***Station*** is ***7+87.03***.

19. Verify that the ***Elevation*** is ***5258.98***.

20. In the ***Vertical Curve*** area, key in ***200.00*** in the ***Length*** field.



21. **<D> Apply** and **<D> Close**.

Create the Initial 5th Ave. Design Surface

- Define the corridor for the crossing street
- Add template drops
- Add point controls
- Create the initial crossing street design surface

Build the 5th Ave. Corridor

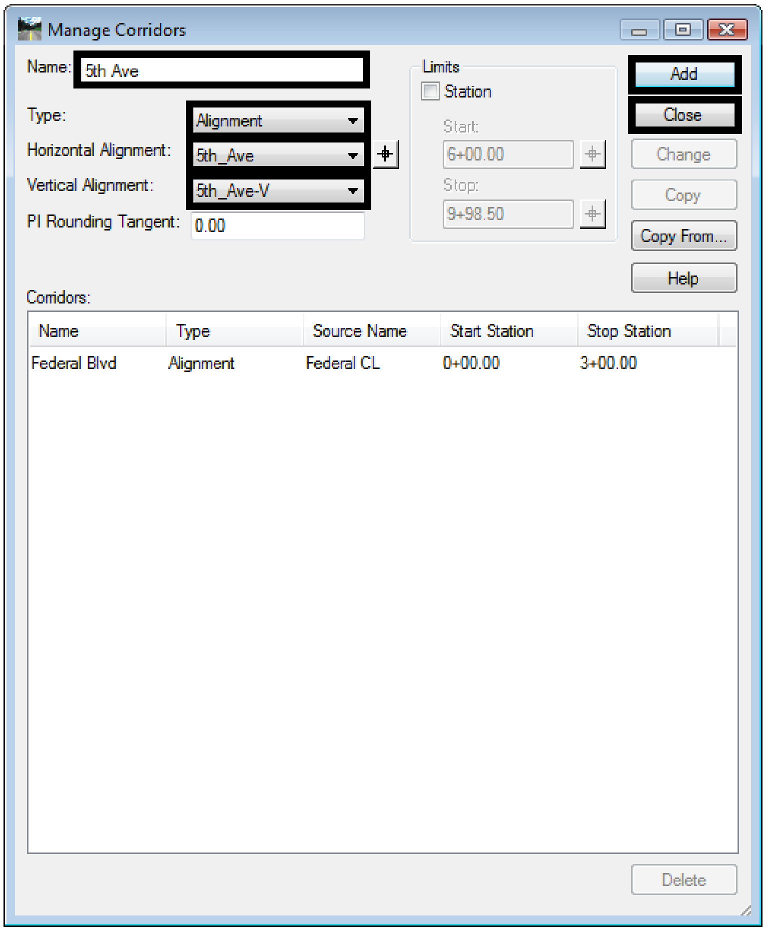
1. Select **Modeler > Roadway Designer** from the InRoads menu bar. This displays the ***Roadway Designer*** dialog box.

2. In the ***Roadway Designer*** dialog box, select **Corridor > Corridor Management** or **<D>** the  button. This displays the ***Manage Corridors*** dialog box.

3. In the ***Manage Corridors*** dialog box, key in ***5th Ave*** for the ***Name***.

4. Set the ***Type*** to **Alignment**.

5. Select **5th_Ave** as the ***Horizontal Alignment***.
6. Select **5th_Ave -V** as the ***Vertical Alignment***.
7. Toggle off **Station** in the ***Limits*** area.
8. **<D> Add** to complete the corridor.



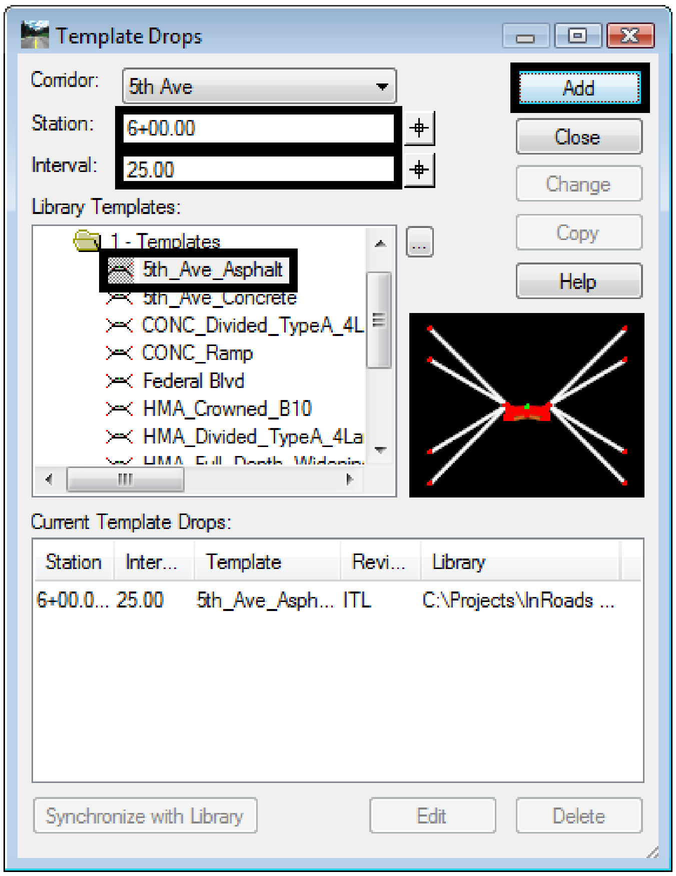
9. **<D> Close** to dismiss the ***Manage Corridors*** dialog box.

Add 5th Ave. Template Drops

The pavement for 5th Ave. needs to change from an asphalt pavement to a concrete pavement as it approaches Federal Blvd. This takes place at Sta. 8+30.00. Therefore, the asphalt template is used from the beginning of the 5th Ave. corridor to station 8+29.99. The concrete template is used from station 8+30.00 to the end of the project. Switching templates in 1/100 of a foot gives a clean change between templates.

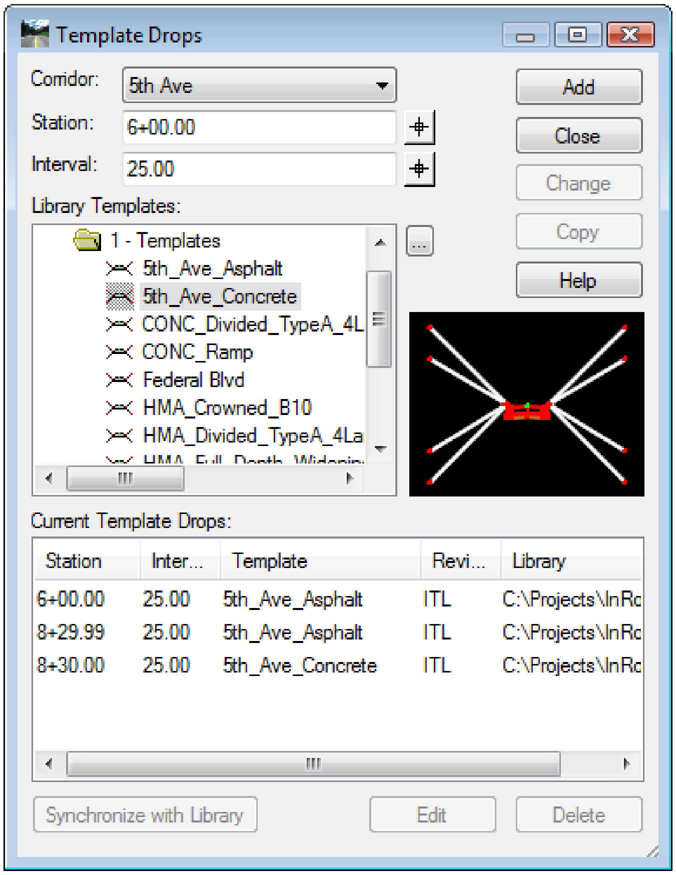
1. In the ***Roadway Designer*** dialog box, select **Corridor > Template Drops** or **<D>** the  button. This displays the **Template Drops** dialog box.
2. Verify the ***Corridor*** is set to **5th Ave.**
3. In the **Template Drops** dialog box, Key in ***6+00.00*** for the ***Station***.

4. Key in ***25*** for the ***Interval***.
5. In the ***Library Templates*** area, expand the **1 – Templates** folder.
6. Highlight the **5th_Ave_Asphalt** template.
7. **<D> Add**.



8. Key in ***8+29.99*** for the ***Station***.
9. Highlight the **5th_Ave_Asphalt** template.
10. **<D> Add**.
11. Key in ***8+30.00*** for the ***Station***.
12. Highlight the **5th_Ave_Concrete** template.
13. **<D> Add**.

14. The template drops appear in the dialog box as shown below:



15. **<D> Close**.

Add 5th Ave. Point Controls

The templates are defined to be used "as is" at the beginning of the alignment and are to widen out as Federal Blvd. is approached. The point controls used here reflect the area of widening where 5th Ave. approaches Federal Blvd.

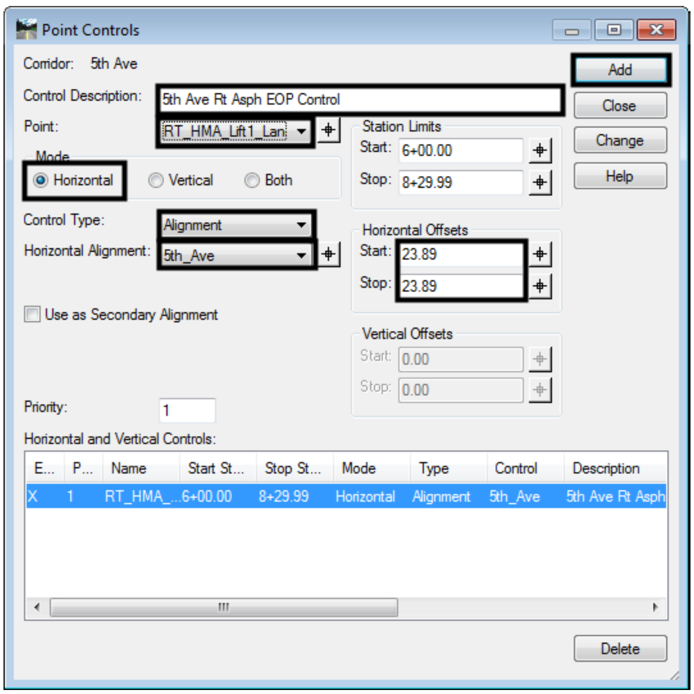
Because the asphalt template and the concrete template use different point names, point controls have to be defined for each template. This first set of point controls define the widening on the right side of 5th Ave. This widening is constant through the corridor.

1. In the ***Roadway Designer*** dialog box, select **Corridor > Point Controls** or **<D>** the button. This displays the ***Point Controls*** dialog box.
2. In the ***Control Description*** field, key in ***5th Ave Rt Asph EOP Control***.
3. In the ***Point Controls*** dialog box, set the ***Point*** to **RT_HMA_Lift1_Laneline-Top** using the drop down menu or the Button.
4. Toggle on **Horizontal** in the ***Mode*** area.
5. Set the ***Control Type*** to **Alignment**.

6. Set the ***Horizontal Alignment*** to **5th_Ave**.

   Note: The settings made in steps 3 through 5 are used for setting up all of the point controls that follow.

7. In the ***Station Limits*** area, key in ***6+00.00*** for the ***Start*** station.
8. Key in ***8+29.99*** for the ***Stop*** station.
9. In the ***Horizontal Offsets*** area, key in ***23.89*** for the ***Start*** and ***Stop*** offsets.
10. **<D> Add**.



11. Advance the ***Station*** to **8+30.00** in the Roadway Designer plan view window.
12. In the ***Control Description*** field, key in ***5th Ave Rt Conc EOP Control***.
13. In the ***Point Controls*** dialog box, set the ***Point*** to **RT_Conc_Laneline-Top** using the drop down menu or the  button.
14. In the ***Station Limits*** area, key in ***8+30.00*** for the ***Start*** station.
15. Key in ***9+98.50*** for the ***Stop*** station.
16. In the ***Horizontal Offsets*** area, key in ***23.89*** for the ***Start*** and ***Stop*** offsets.
17. **<D> Add**.

This set of point controls define the widening on the left side of 5th Ave. It is constant from the beginning of the corridor to station 8+30.00 (where the templates change). From here it transitions out to provide the additional width for right turns. The additional width is maintained to the end of the corridor.

18. In the ***Control Description*** field, key in ***5th Ave Lt Asph EOP Control***.
19. Set the Point to **LT_HMA_Lift1_Laneline-Top**.
20. In the ***Station Limits*** area, key in ***6+00.00*** for the ***Start*** station.
21. Key in ***8+29.99*** for the ***Stop*** station.
22. In the ***Horizontal Offsets*** area, key in ***-12.45*** for the ***Start*** and ***Stop*** offsets.
23. **<D> Add**.

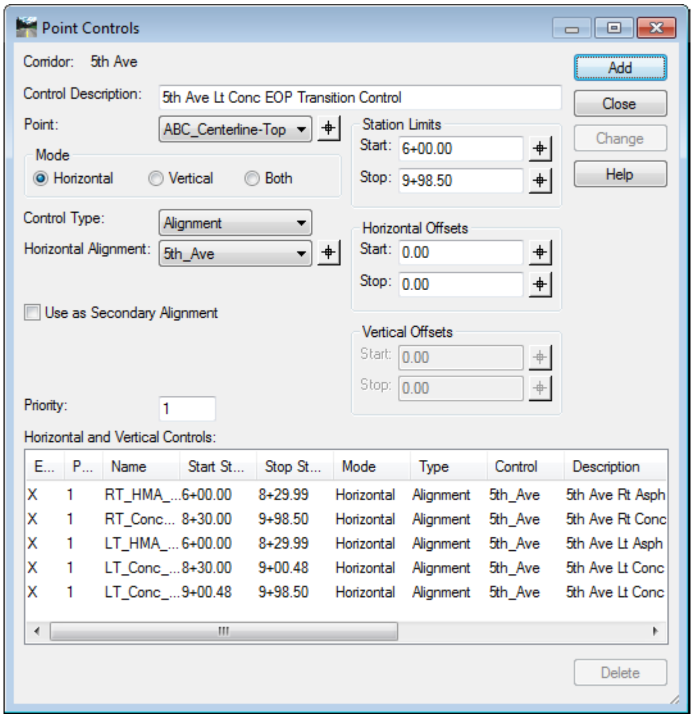
The next series of steps define the tapered area of the widening.

24. In the ***Control Description*** field, key in ***5th Ave Lt Conc EOP Transition Control***.
25. Set the Point to **LT_Conc_Laneline-Top**.
26. In the ***Station Limits*** area, key in ***8+30.00*** for the ***Start*** station.
27. Key in ***9+00.48*** for the ***Stop*** station.
28. In the ***Horizontal Offsets*** area, key in ***-12.45*** for the ***Start*** offset.
29. Key in ***-15.87*** for the ***Stop*** offset.
30. **<D> Add**.

For the final point control use the following steps:

31. In the ***Control Description*** field, key in ***5th Ave Lt Conc EOP Full Width Control***.
32. In the ***Station Limits*** area, key in ***9+00.48*** for the ***Start*** station.
33. Key in ***9+98.50*** for the ***Stop*** station.
34. In the ***Horizontal Offsets*** area, key in ***-15.87*** for the ***Start*** and ***Stop*** offsets.
35. **<D> Add**.

36. At this point there should be 5 point controls setup, 3 for the left side of 5th Ave. and 2 for the right side, as shown in the following image.



37. **<D> Close**.

Create the Initial 5th Ave. Design Surface

This surface, along with the initial Federal Blvd. surface, will be used to determine the vertical alignments for the curb returns.

1. In the ***Roadway Designer*** dialog box, on the InRoads ***Surfaces*** tab, verify that ***16628_Existing*** is the active surface.

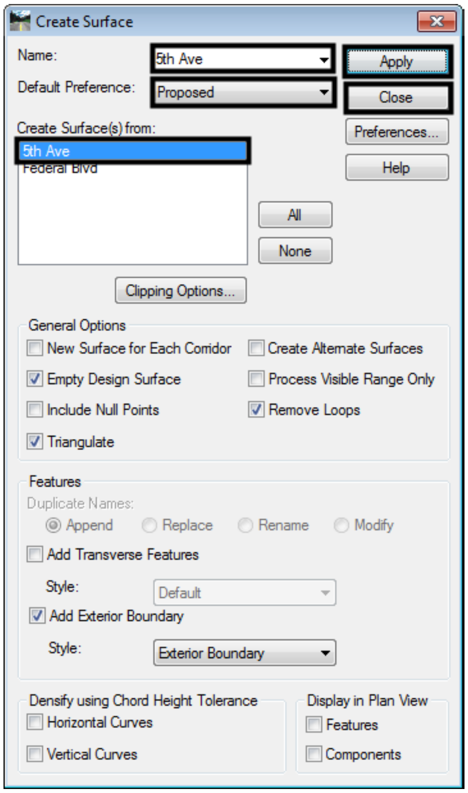
2. Select **Corridor > Create Surface** or **<D>** the  button. This displays the **Create Surface** dialog box.

3. Key in ***5th Ave*** for the ***Name***.

4. Select **Proposed** for the ***Default Preference***.

5. Highlight only **5th Ave** in the ***Create Surface(s) From*** list.

6. The remaining settings should be correct. If not, set them to match the illustration below.



7. **<D> Apply**.
8. **<D> Close**.
9. Select **File > Save** from the ***Roadway Designer*** menu bar.
10. **Close** the ***Roadway Designer*** dialog box.
11. From the InRoads menu bar, select **Surface > Surface Properties**. This displays the ***Surface Properties*** dialog box.
12. In the ***Surface Properties*** dialog box on the ***Main*** tab, select the **5th Ave** surface.
13. Select the ***Advanced*** tab.
14. Select **D_Finished-Grade** for ***Cross Sections Symbology***.
15. Select **D_Finished-Grade** for ***Profile Symbology***.
16. **<D> Apply** and **<D> Close**.

Section Summary:

At this point there are two initial design surfaces created; a mainline and the crossing street. In order for these surfaces to match up through the intersection additional, geometry will need to be created.

Additional Geometry

Section Objectives:

- Create horizontal and vertical geometry for curb returns

In this section the two initial design surfaces are used to create smooth vertical alignment transitions around the corners of the intersection. Horizontal and vertical geometry for each curb return is defined with the InRoads ***Create Multicenter Curves*** tool. The new geometry will be used to create the final design surface.

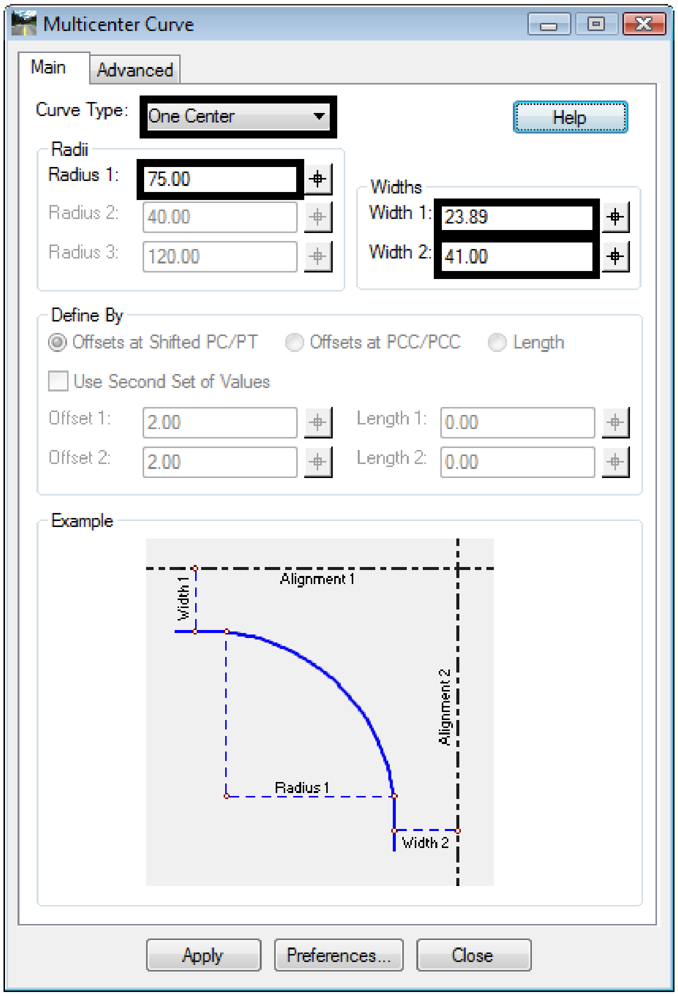
Curb Returns

Because this example is a T-intersection there are only two curb returns to model. In a typical intersection there are four returns to model. The steps shown below can also be used to develop curb returns for an intersection with more than one crossing street.

Create Northeast Curb Return

1. From the InRoads menu bar, select **Geometry > Utilities > Multicenter Curve…** This displays the ***Multicenter Curve*** dialog box.
2. On the ***Main*** tab of the ***Multicenter Curve*** dialog box, set the ***Curve Type*** to **One Center**.
3. In the ***Radii*** area, key in ***75*** for ***Radius 1***.
4. In the ***Widths*** area, key in ***23.89*** for ***Width 1***. This is the width of 5th Ave. from its centerline to the right edge of pavement.

5. Key in ***41*** for ***Width 2***. This is the width of Federal Blvd. from its centerline to the right edge of pavement.



Important! Use the graphic in the Example area to determine how to enter your curb data. This graphic changes according to the Curve Type:. As an example, when prompted by the software to choose the first alignment, choose the alignment that is associated with Width 1.

6. **<D>** the **Advanced** tab.

The steps below define the properties of the horizontal alignment representing the northeast curb return.

7. In the ***Name*** field of the ***Alignment*** area, key in ***5th_Ave_NE-Quadrant***.

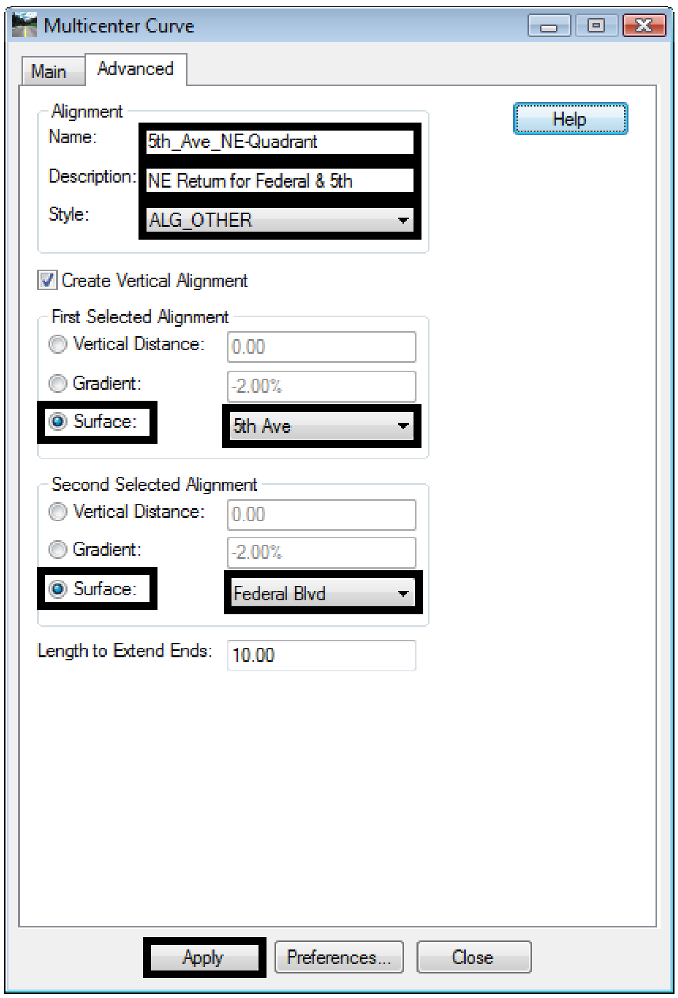
8. In the ***Description*** field, key in ***NE Return for Federal & 5th***.

9. Set the ***Style*** to **ALG_OTHER**.

The following steps define the vertical alignment for the curb return. Because the 5th Ave. width was entered in Width 1 previously, 5th Ave. data must be used in the First Selected Alignment fields here. The Federal Blvd. data is used in the Second Selected Alignment fields.

10. Toggle on **Create Vertical Alignment**.
11. In the ***First Selected Alignment*** area, toggle on **Surface**.
12. Select **5th Ave** for the surface.
13. In the ***Second Selected Alignment*** area, toggle on **Surface**.
14. Select **Federal Blvd** for the surface.

    The dialog box should now look like the image below.



15. **<D> Apply**.

    Important! Now you must select the alignments in the same order that they were defined in the dialog box.

    The following message is displayed in the lower left corner of the MicroStation window:

16. **<D>** on the **5th_Ave** alignment in the MicroStation view window. The following message is displayed:

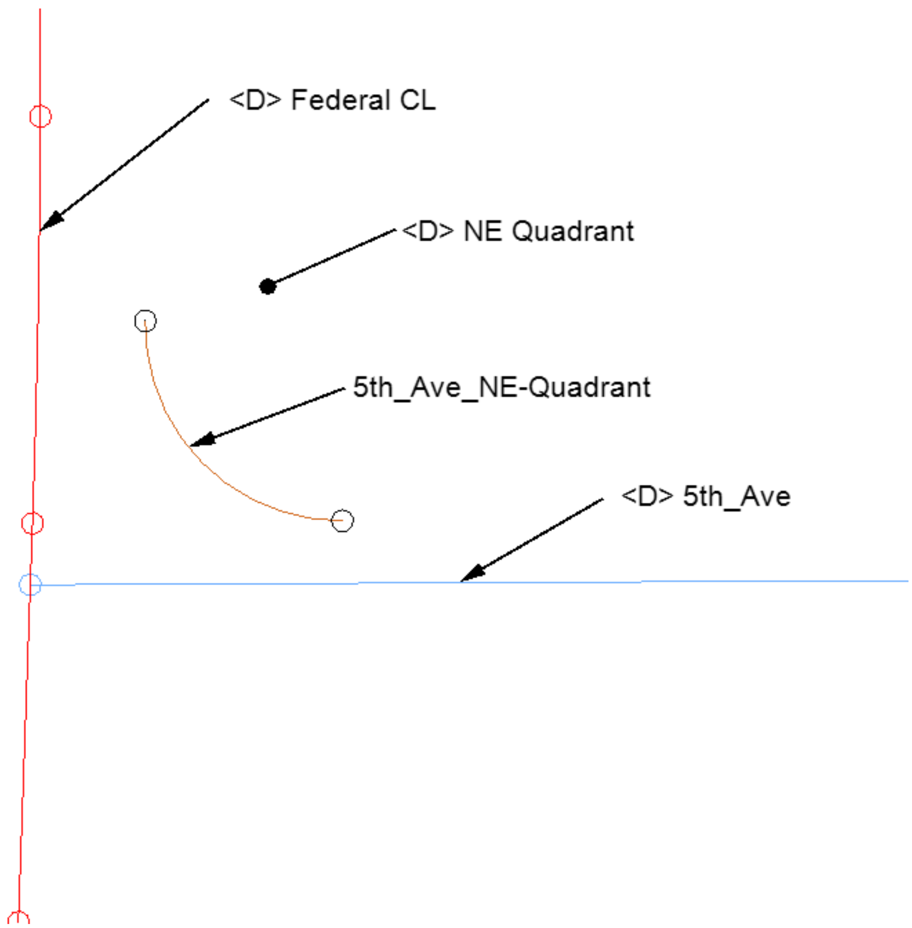
    > Identify second alignment/Reset for new first alignment

17. **<D>** on the **Federal CL** alignment. The following message is displayed:

    > Identify quadrant for return/Reset for new second alignment

18. **<D>** above the **5th_Ave** alignment and to the right of the **Federal CL** alignment. The curb return alignment is displayed.

19. **<D>** one more time to **Accept** the creation of the new alignment.

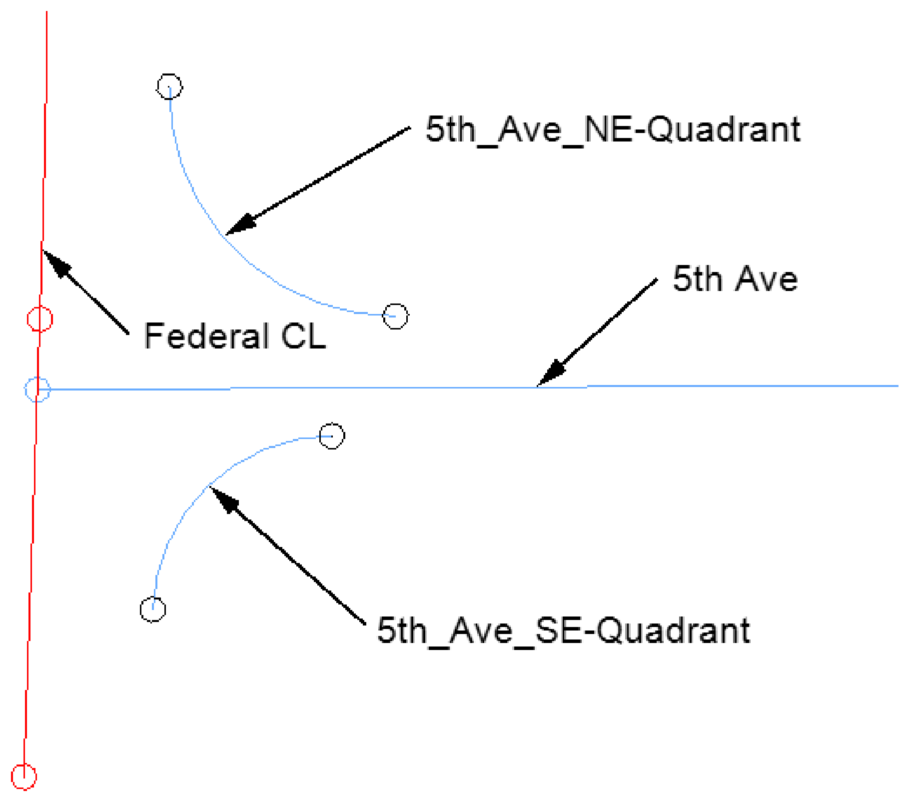


Create Southeast Curb Return

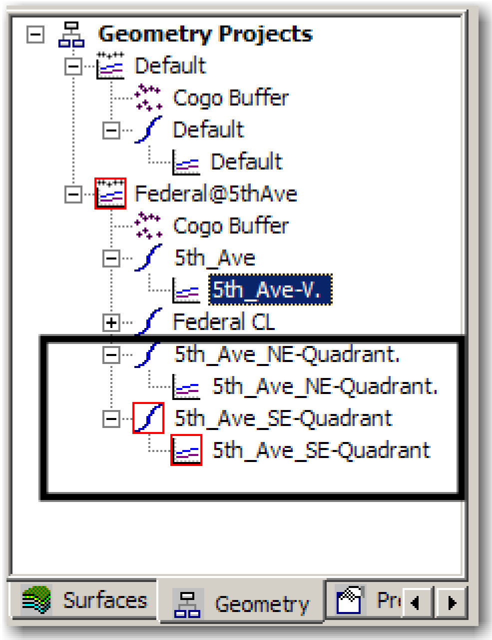
Again, the 5th Ave. data is used first to create the southeast curb return.

1. From the InRoads menu bar, select **Geometry > Utilities > Multicenter Curve…**
2. On the ***Main*** tab, in the ***Radii*** area, key in ***60*** for ***Radius 1***.
3. In the ***Widths*** area, key in ***15.87*** for ***Width 1***.

4. Key in ***41*** for ***Width 2***.
5. **<D>** the **Advanced** tab.
6. In the ***Name*** field of the ***Alignment*** area, key in ***5th_Ave_SE-Quadrant***.
7. In the ***Description*** field, key in ***SE Return for Federal & 5th***. The remaining data is the same as used on the northeast quadrant.
8. **<D> Apply**.
9. Follow the prompts, identifying **5th_Ave** first then **Federal CL.** Identify the quadrant below the **5th_Ave** alignment and to the right of the **Federal CL** alignment. The curb return alignment is displayed.



10. Verify that the new alignments show up in the ***Geometry*** tab of InRoads Explorer as shown below.



Section Summary:

The ***Multicenter Curve*** tool created smooth horizontal and vertical alignments from the surface of the cross street to the surface of the mainline. You may need to modify these alignments depending on the actual design needs for the flowline.

Final Design Modeling

Section Objectives:

- Revise the point controls and template drops for 5th Ave using new curb return alignments.
- Use Target Aliasing to match the surface of Federal Blvd to the surface of 5th Ave.
- Update the 5th Ave surface
- Update Federal Blvd. template drops and add point controls
- Create a complete final combined surface

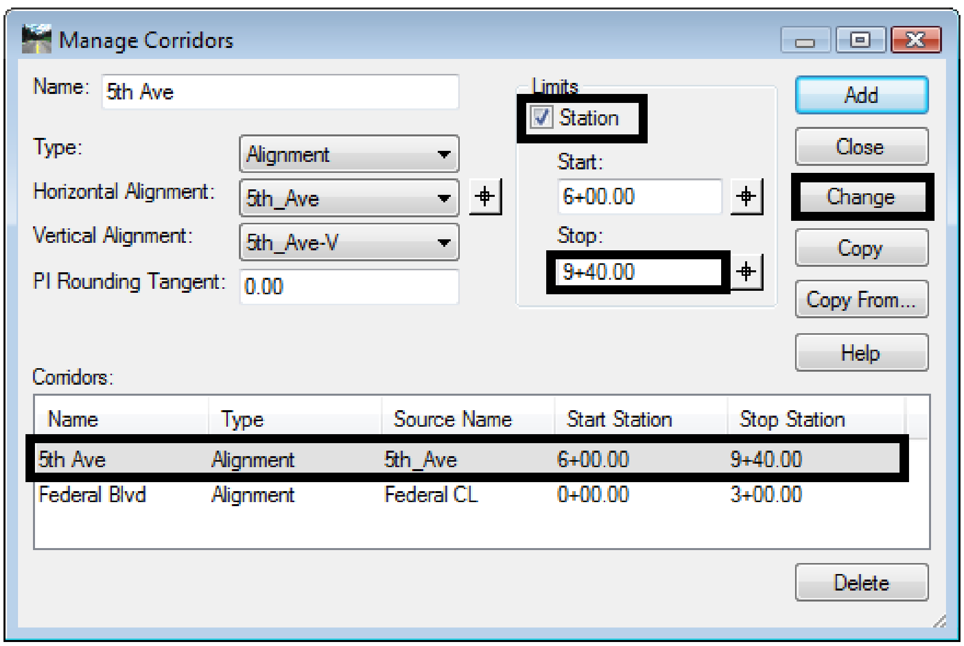
Create the Final 5th Ave. Corridor Surface

The 5th Ave. design surface is created first so that a feature in that surface can be used to control the edge of Federal Blvd. through the intersection. The 5th Ave. corridor is used to clip the Federal Blvd. corridor, removing the curb and gutter through the intersection that would normally be placed by the Federal Blvd. template.

Edit 5th Ave. Corridor Definition

The 5th Ave corridor is going to clip out portions of the Federal Blvd. corridor when the final surface is created. If the 5th Ave. corridor clips any of the driving lane components in the Federal Blvd. template, those components will be lost for calculating volumes. In order to prevent this from occurring, The corridor for 5th Ave. is stopped before it reaches the edge of the Federal Blvd. template.

1. Select **Modeler > Roadway Designer** from the InROads main menu.
2. In the ***Roadway Designer*** dialog box, select **Corridor > Corridor Management** or **<D>** the button. This displays the ***Manage Corridors*** dialog box.
3. Highlight **5th Ave** in the ***Corridors*** list.
4. Toggle on **Station** in the ***Limits*** area.
5. Key in ***9+40.00*** for the ***Stop*** station. This station was selected because it is about halfway through the curb returns and before the edge of Federal Blvd.
6. **<D> Change**.
7. **<D> Close**.



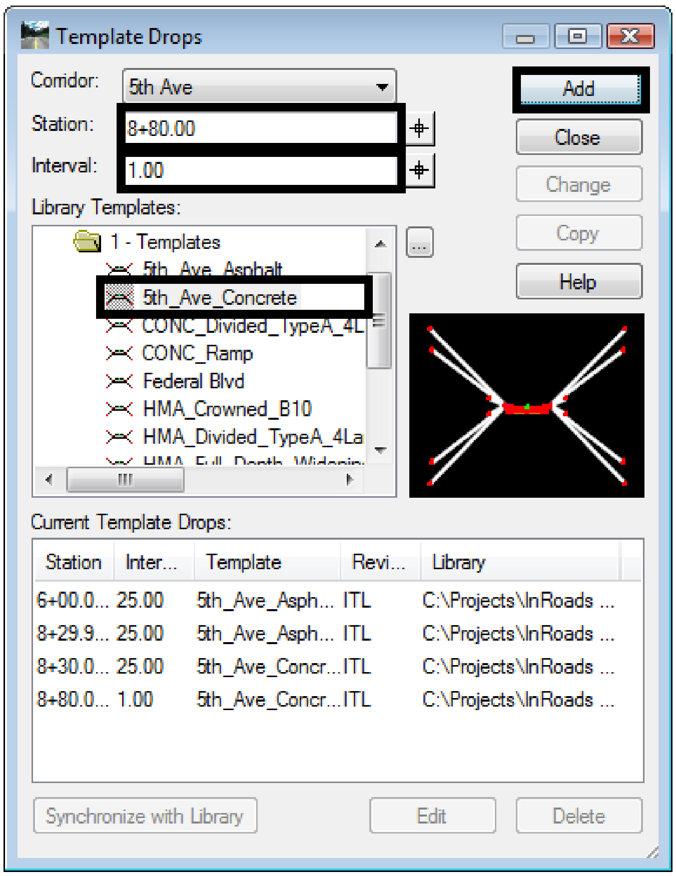
Edit 5th Ave. Template Drops

1. In the ***Roadway Designer*** dialog box, select **Corridor > Template Drops** or **<D>** the button. This displays the **Template Drops** dialog box.
2. Verify that the ***Corridor*** is set to ***5th Ave***.
3. In the **Template Drops** dialog box, Key in ***8+80.00*** for the ***Station***.

4. Key in ***1*** for the ***Interval***

   Note: An interval of 1 is used here in order to sufficiently model the surface around the curb returns.

5. In the ***Library Templates*** area, expand the **1 – Templates** folder.
6. Highlight the **5th_Ave_Concrete** template.
7. **<D> Add**.
8. **<D> Close**.



5^{th} Ave. Point Controls for Curb Returns

Additional point controls are added to the 5th Ave. corridor to use the curb return alignments. The existing point controls for the concrete pavement must also be modified so that they do not overlap the curb returns.

1. In the ***Roadway Designer*** dialog box, select **Corridor > Point Controls** or **<D>** the button.
2. In the ***Control Description*** field, key in ***5th Ave Rt Conc EOP Return Control***.
3. Set the ***Point*** to **RT_Conc_Laneline-Top** using the drop down menu or the button.

4. Toggle on **Both** in the ***Mode*** area.

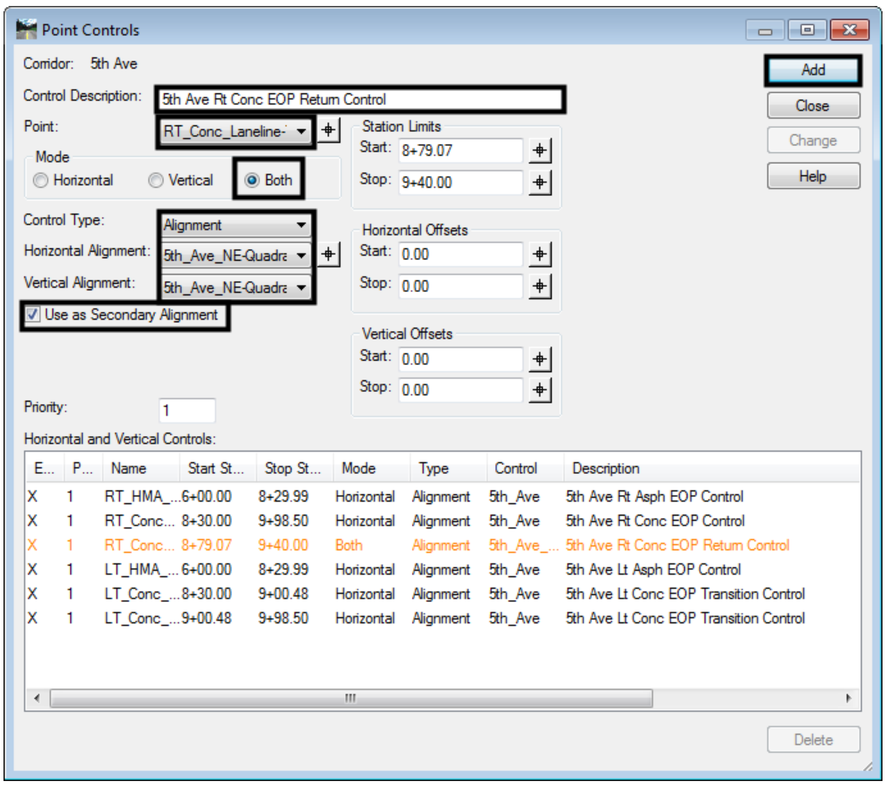
5. Set the ***Control Type*** to **Alignment**.

6. Set the ***Horizontal Alignment*** to **5th_Ave_NE-Quadrant**.

   Note: Selecting the 5th_Ave_NE-Quadrant alignment automatically sets the ***Station Limits*** to cover that alignment.

7. Toggle on **Use as Secondary Alignment.**

8. **<D> Add**.

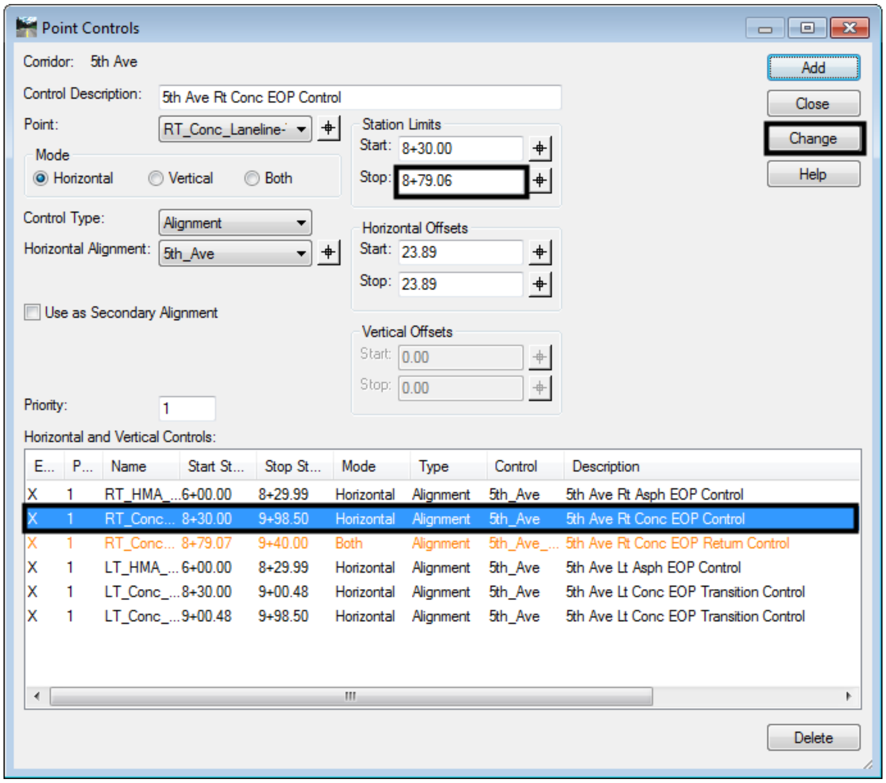


Important! The entry is displayed in orange, indicating that there is a conflict with another point control. The point control entered during the initial modeling is now too long, so its end station must be adjusted.

9. Highlight the **RT_Conc_Laneline-Top** control that runs from ***8+30.00*** to ***9+98.50***.

10. In the ***Station Limits*** area, key in ***8+79.06*** for the ***Stop*** station. This stops the point control where the curb return control starts.

11. **<D> Change**.



12. In the ***Control Description*** field, key in ***5th Ave Rt Conc EOP Return Control***.

13. Set the ***Point*** to **LT_Conc_Laneline-Top** using the drop down menu or the button.

14. Toggle on **Both** in the ***Mode*** area.

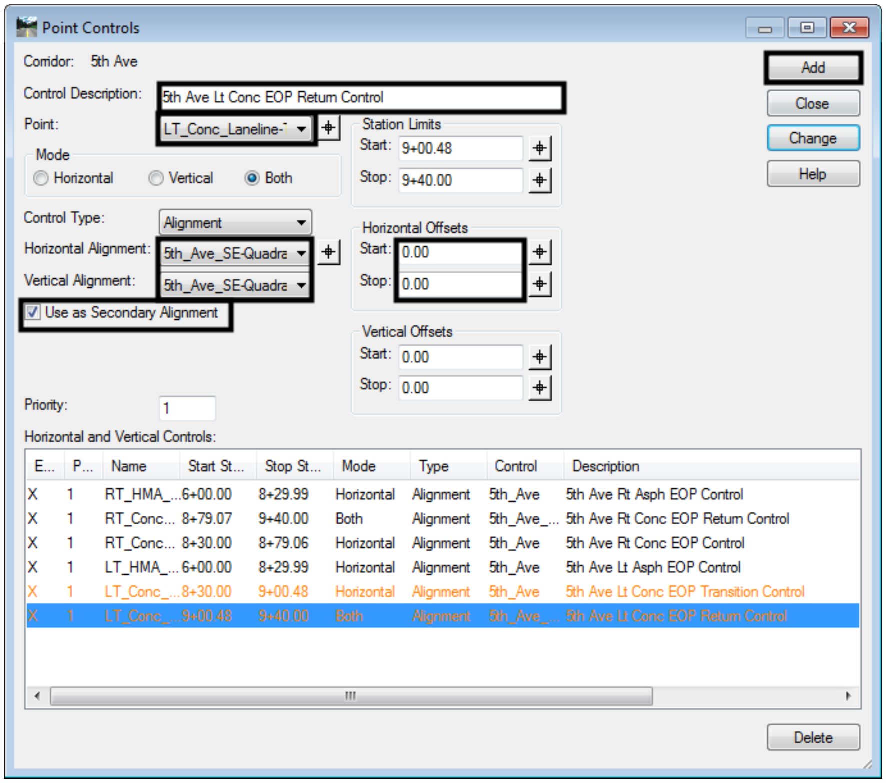
15. Set the ***Control Type*** to **Alignment**.

16. Set the ***Horizontal Alignment*** to **5th_Ave_SE-Quadrant**.

17. Toggle on **Use as Secondary Alignment.** This is so that the curb component is placed perpendicular to the curb return alignment.

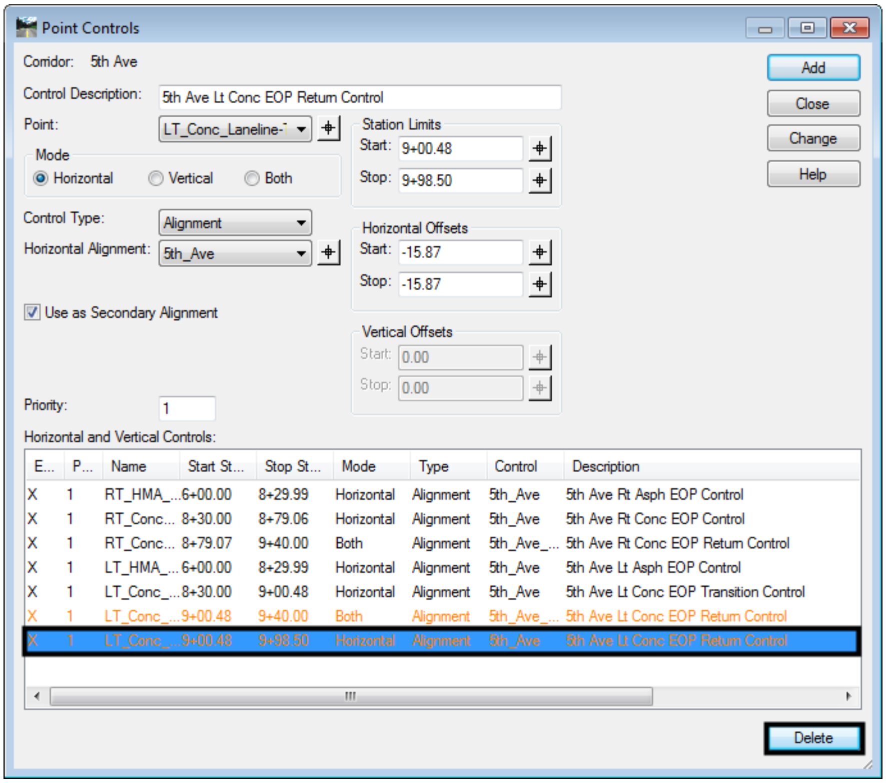
18. In the ***Horizontal Offsets*** area, key in ***0*** for the ***Start*** and ***Stop*** offsets.

19. **<D> Add**.

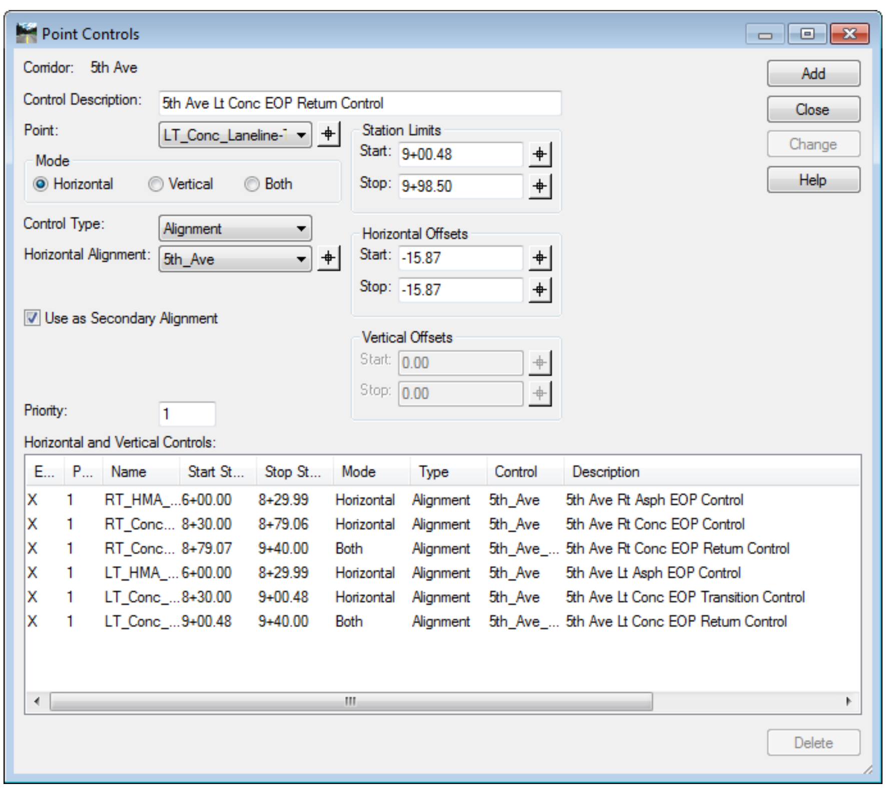


20. Highlight the **LT_Conc_Laneline-Top** control that runs from ***9+00.48*** to ***9+98.50.*** This entry is completely covered by the curb return, so it is deleted.

21. **<D> Delete**.



The illustration below shows the list of point controls used on the Final 5th Ave. corridor.



22. **Close** the ***Point Control*** dialog box.

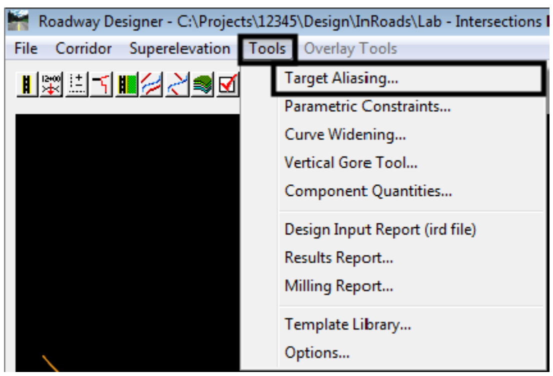
23. Select **File > Save** from the ***Roadway Designer*** menu bar.998

Create the Final 5th Ave. Design Surface

The 5th Ave. surface is remodeled to incorporate the corridor changes made above and to generate the feature that will control the edge of pavement for Federal Blvd.

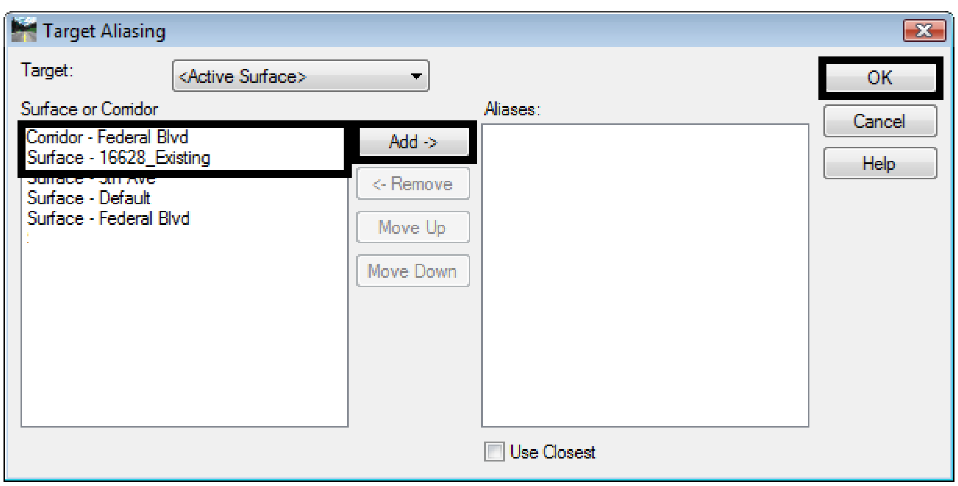
The target aliasing is set up so that the 5th Ave corridor will clip the Federal Blvd. corridor when the final surface is created.

1. In the ***Roadway Designer*** dialog box, select **Tools > Target Aliasing**.



2. In the ***Target Aliasing*** dialog box, highlight both the **Corridor – Federal Blvd** and **Surface – 16628_Existing** from the ***Surface or Corridor*** list.

3. **<D> Add**.



4. **<D> OK** to dismiss the ***Target Aliasing*** dialog box.

5. In the ***Roadway Designer*** dialog box, select **Corridor > Create Surface** or **<D>** the  button. This displays the **Create Surface** dialog box.

6. Key in ***5th Ave*** for the ***Name***.

7. Select **Proposed** for the ***Default Preference***.

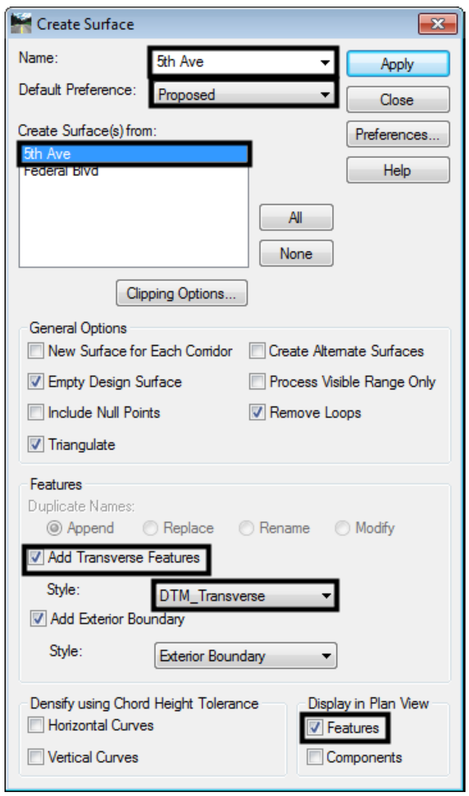
8. Highlight only **5th Ave** in the ***Create Surface(s) From*** list.

Transverse features run perpendicular to the corridor alignment and are placed at each template drop. The last transverse feature created on the 5th Ave. corridor will be used to control the edge of Federal Blvd. through the intersection.

9. Toggle on **Add Transverse Features**.

10. Set the transverse feature ***Style*** to **DTM_Transverse**.

11. Toggle on **Display Features in Plan View**. (These features will be used to identify important stationing for Federal Blvd. template drops.



12. **<D> Apply** and **<D> Close**.

13. If necessary, click **Fit View** to see the new graphics.

Final Federal Blvd. Corridor Surface

Additional template drops and point controls are required on Federal Blvd. as well. The template drops change the interval to model smoothly around the curb returns. The point controls are used to model the remaining parts of the curb returns and the intersection driving surface.

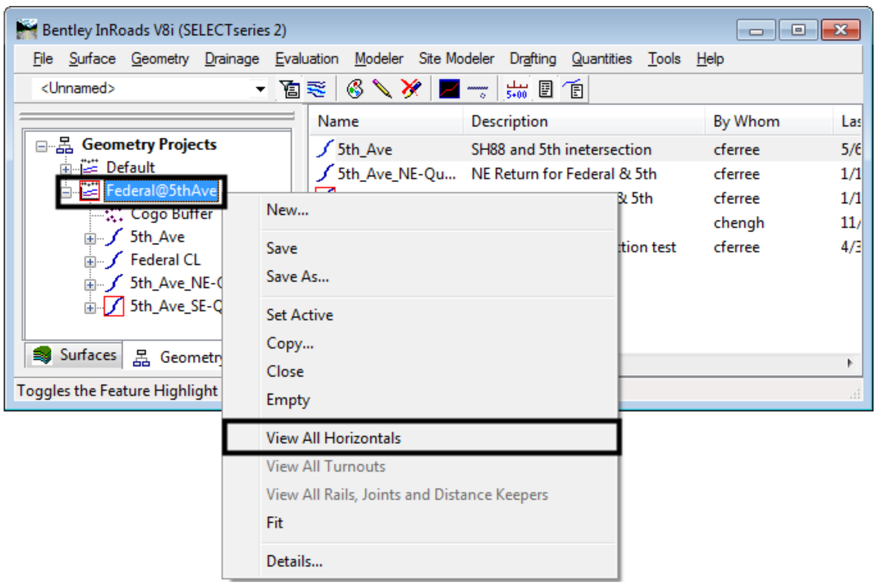
Section Objectives:

- ♦ Add template drops to tie into 5th Ave corridor
- ♦ Add point controls

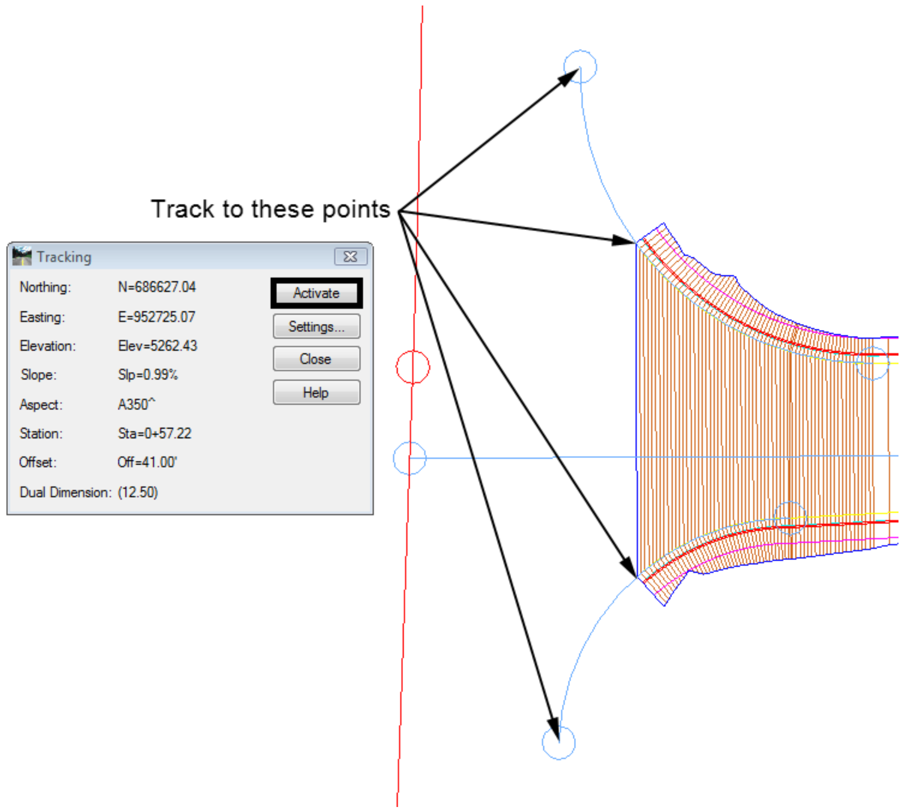
Collect Station Information for Template Drops

The locations for the template drops and point controls are determined using tracking.

1. In the InRoads main dialog box, set the InRoads Explorer to the **Geometry** tab.
2. Set the **Federal CL** as the active alignment.
3. **<R>** on the **Federal@5thAve** geometry project and select **View All Horizontals** from the menu.



4. In the MicroStation view window, zoom in around the intersection.
5. Select **Tools > Tracking > Tracking** from the InRoads menu bar.
6. In the ***Tracking*** dialog box, **<D>** the **Activate** button.
7. **<T>** to each of the points indicated in the illustration below and write down the Station for each.



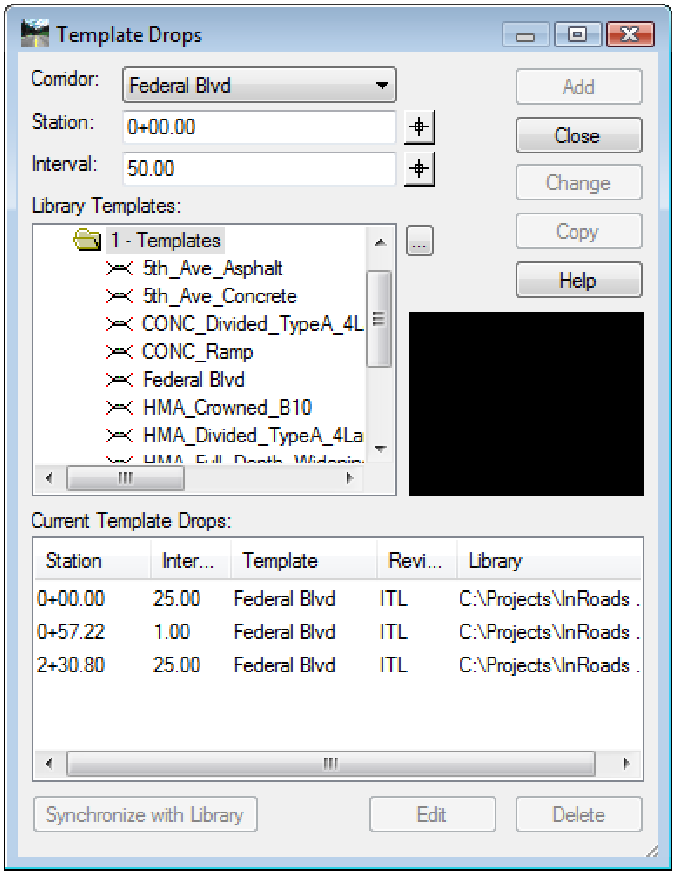
These stations are (from bottom to top):

- 0+57.22
- 1+00.73
- 1+86.15
- 2+30.80

Template drops are required at the first an last stations. The first station starts the one foot intervals around the SE curb return. The last station is at the end of the intersection and goes back to a 25 foot interval.

8. In the ***Roadway Designer*** dialog box, select **Corridor > Template Drops** or **<D>** the button. This displays the **Template Drops** dialog box.
9. Verify the ***Corridor*** is set to ***Federal Blvd***.
10. In the **Template Drops** dialog box, key in ***0+57.22*** for the ***Station***.
11. Key in ***1*** for the ***Interval***.
12. Highlight **Federal Blvd** in the ***Library Templates*** list.
13. **<D> Add**.
14. Key in ***2+30.80*** for the ***Station***.
15. Key in ***25*** for the ***Interval***.

16. **<D> Add**. The list of template drops is illustrated below.



17. **<D> Close**.

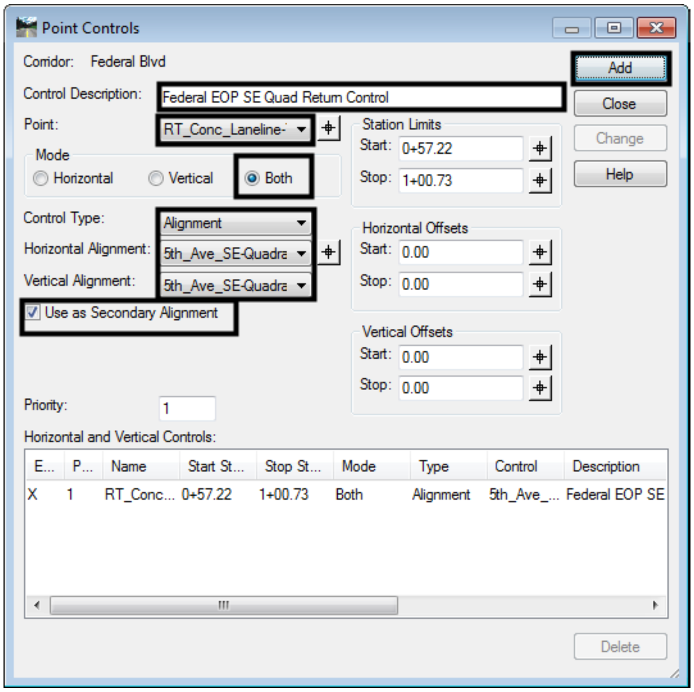
Federal Blvd. Point Controls for Curb Returns

All four of the stations located above are used for point controls. The first and second stations create a control for the SE curb return. The second and third stations create a point control that follows the last transverse feature in the 5th Ave. surface. The third and fourth stations create a control for the NE curb return.

1. In the ***Roadway Designer*** dialog box, select **Corridor > Point Controls** or **<D>** the button.
2. In the ***Control Description*** field, key in ***Federal EOP SE Quad Return Control***.
3. Set the ***Point*** to **RT_Conc_Laneline-Top6** using the drop down menu or the button.
4. Toggle on **Both** in the ***Mode*** area.
5. Set the ***Control Type*** to **Alignment**.
6. Set the ***Horizontal Alignment*** to **5th_Ave_SE-Quadrant**.
7. Toggle on **Use as Secondary Alignment.**

8. In the ***Station Limits*** area, the ***Start*** **s**tation is set by the specified alignment. Key in ***1+00.73*** for the ***Stop*** station.

9. **<D> Add**.

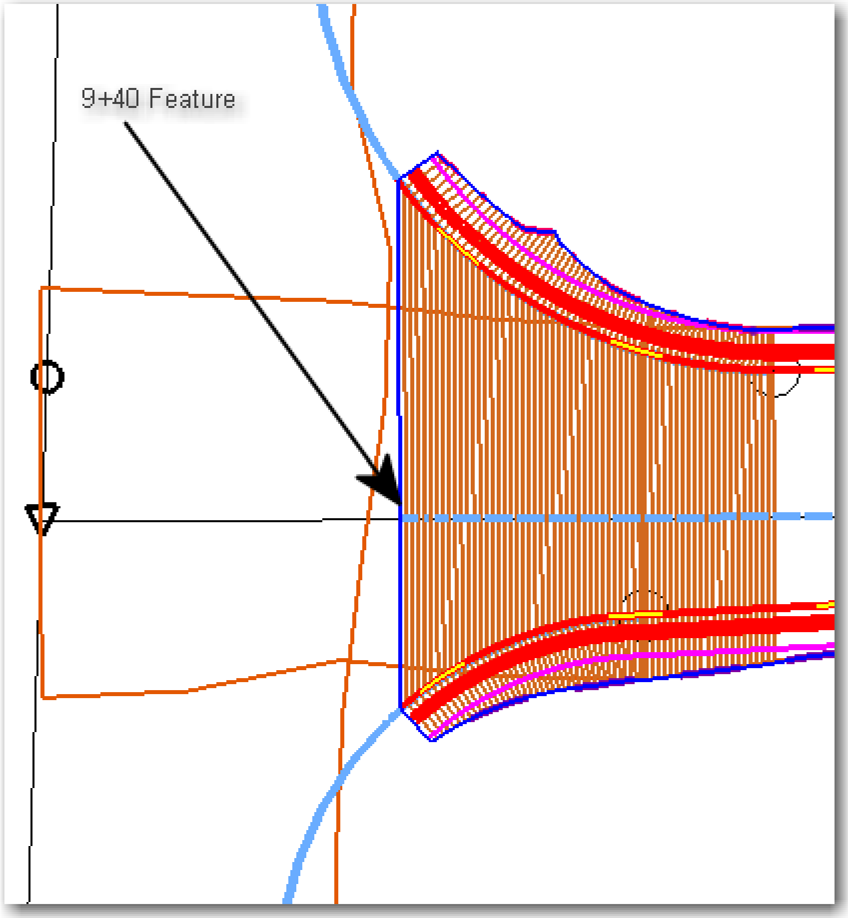


10. In the ***Control Description*** field, key in ***Federal EOP Feature Control.***

11. Set the ***Control Type*** to **Feature**.

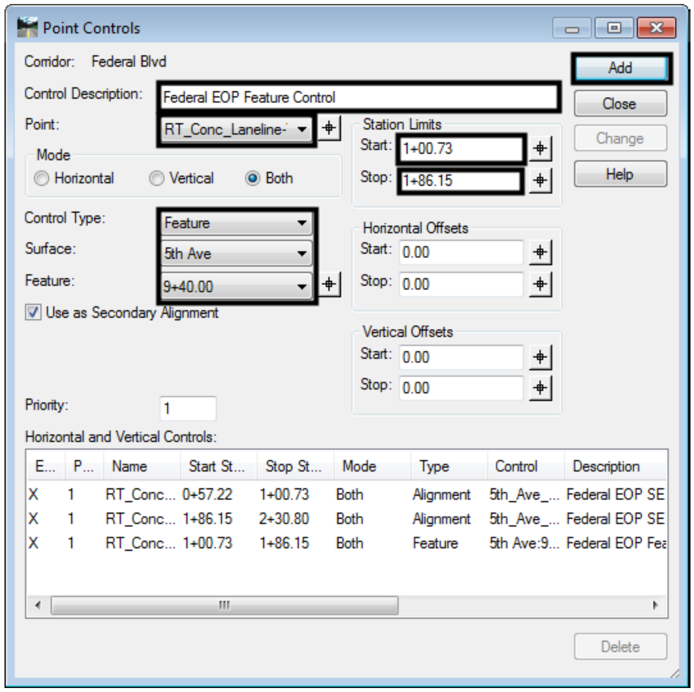
12. Select **5th Ave** for the ***Surface***.

13. Select **9+40.00** for the ***Feature***.



14. In the ***Station Limits*** area, key in ***1+00.73*** for the ***Start*** station.
15. Key in ***1+86.15*** for the ***Stop*** station.

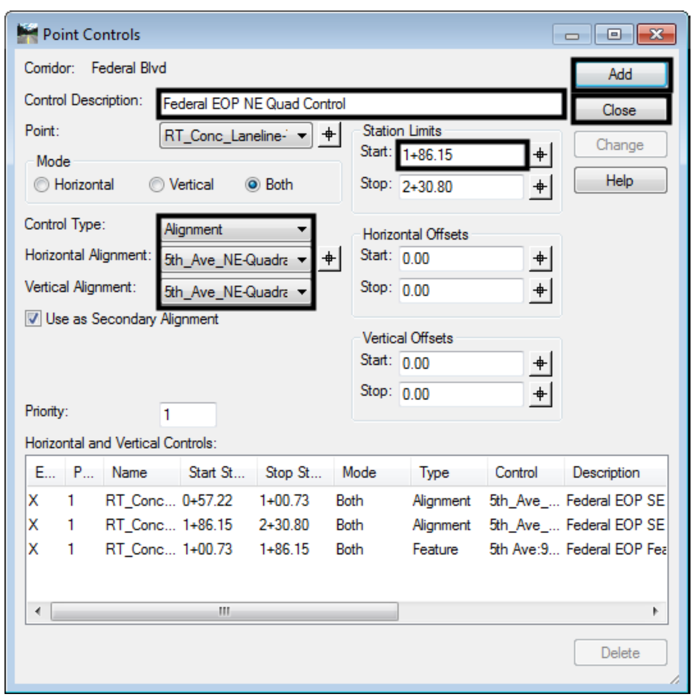
16. **<D> Add**.



17. In the ***Control Description*** field, key in ***Federal EOP NE Quad Control.***

18. Set the ***Control Type*** to **Alignment**.

19. Set the ***Horizontal Alignment*** to **5th_Ave_NE-Quadrant**.18In the ***Station Limits*** area, key in ***1+86.15*** for the ***Start*** station. The ***Stop*** station is set by the selected alignment.



20. **<D> Add**. and **<D> Close**.

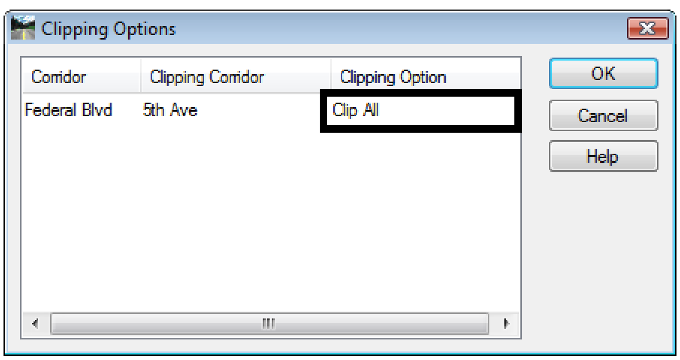
Create the Final Intersection Design Surface

After creating the point controls for Federal Blvd. (using features from the 5th Ave. design surface), both corridors are used to create the design surface of the entire intersection.

1. Verify that ***16628_Existing*** is the active surface.

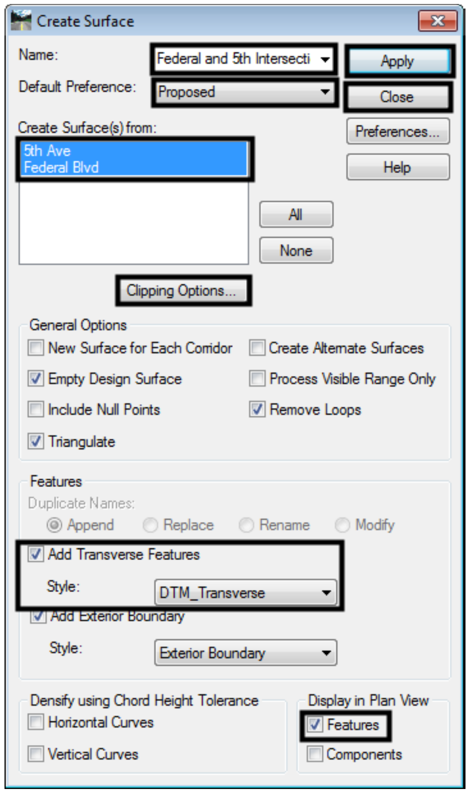
   Note: If the Existing surface is not the active surface several template drop errors will be listed in the Results dialog box indicating problems with the final surface.

2. In the ***Roadway Designer*** dialog box, select **Corridor > Create Surface** or **<D>** the button. This displays the **Create Surface** dialog box.
3. Key in ***Federal and 5th Intersection*** for the ***Name***.
4. Select **Proposed** for the ***Default Preference***.
5. Highlight both **5th Ave** and **Federal Blvd** in the ***Create Surface(s) From:*** list.
6. **<D>** the **Clipping Options** button.
7. Verify that the ***Clipping Option*** is set to **Clip All**.
8. **<D> OK** on the ***Clipping Options*** dialog box.



9. Toggle on **Add Transverse Features**.
10. Set the transverse feature ***Style*** to **DTM_Transverse**.

11. Toggle on **Display Features in Plan View**. This displays the surface features in the dgn file for review.

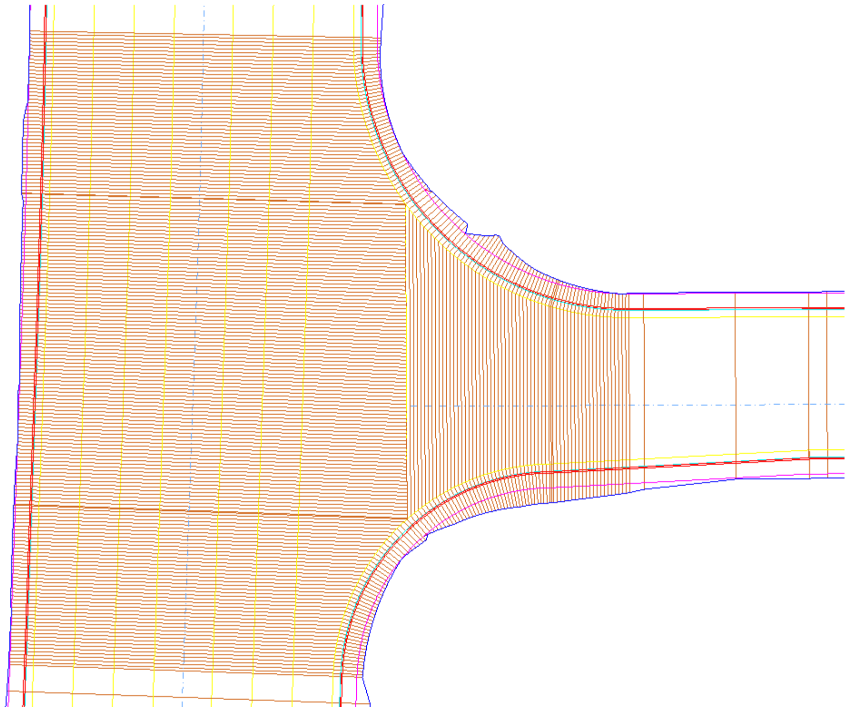


12. **<D> Apply** and **<D> Close**.

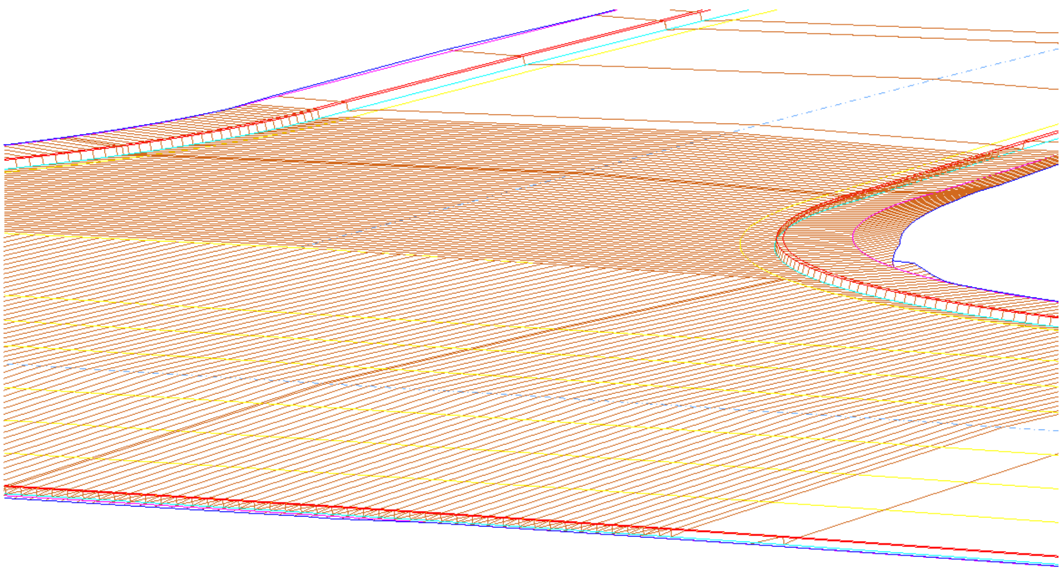
13. Select **File > Save** from the ***Roadway Designer*** menu bar.

14. **<D> Close** to dismiss the ***Roadway Designer*** dialog box.

15. Examine the features displayed in the MicroStation view window. The illustrations below show the finished intersection.



16. Use the rotate view command to see the features in 3D



Chapter 3 - Interchange Project

As part of the Federal Blvd. and 6th Ave. interchange reconstruction project, access from Federal Blvd. to 6th Ave. and Bryant Street is being added. The ramp from Federal Blvd. to 6th Ave (called the SE Ramp) splits to provide access to Bryant Street. This lab illustrates the InRoads design process for creating this interchange. This lab is concerned with the mergers of the SE Ramp with the 6th Ave. edge of pavement and the mergers of the Bryant Street ramp with the SE Ramp. Therefore, the intersections of the ramps at Bryant Street and Federal Blvd. will not be modeled.

Chapter Objectives:

- Give a project overview
- Create a corridor for the SE Ramp.
- Define Point Controls to tie to the existing 6th Ave. edge of pavement.
- Create a corridor for Bryant Ramp.
- Create initial design surfaces for SE Ramp and Bryant Ramp.
- Determine key stations for ramp mergers.
- Define Point Controls for street returns in both corridors
- Modify Bryant Ramp template for the area in the intersection.
- Create a combined surface of SE Ramp and Bryant Ramp.

Project Overview

Project Description

This project creates accesses to 6th Ave. and Bryant Street from Federal Blvd. The Ramp from Federal Blvd. merges into the existing edge of pavement of 6th Ave. The ramp from Bryant Street merges into the SE Ramp (from Federal to 6th).

Project Data

- **Existing_Ground.dtm** – This contains the survey data for the existing terrain.
- **Interchange.alg** – This contains all of the horizontal and vertical alignments used for this project.
- **Interchange.itl** – The initial templates are stored in this file.

InRoads Design Process

1. Open Data files.
2. Initial Modeling for SE Ramp and Bryant Ramp.
3. Determine Key Stations for ramp mergers.
4. Modify templates for merger areas.

5. Make changes to corridor data.
6. Create the combined design surface.
7. Review the results

Getting Started

1. Open the **Interchange.alg**.
2. Open the **Interchange.itl** template library.
3. Open the **Existing Ground.dtm**.

Initial Modeling

There are two areas of special importance on this project, where the SE Ramps merges with the existing 6th Ave. edge of pavement and where the Bryant Ramp merges with the SE Ramp. In these areas, the templates change to accommodate the narrowing pavement width. To determine the stations where template changes occur, initial design surfaces are created for the SE Ramp and the Bryant Ramp.

Initial SE Ramp Corridor Model

The initial run of the SE Ramp is primarily concerned with locating stations for template changes. Do not be concerned that the template crosses into the 6th Ave. driving lanes, as this will be corrected in the final modeling.

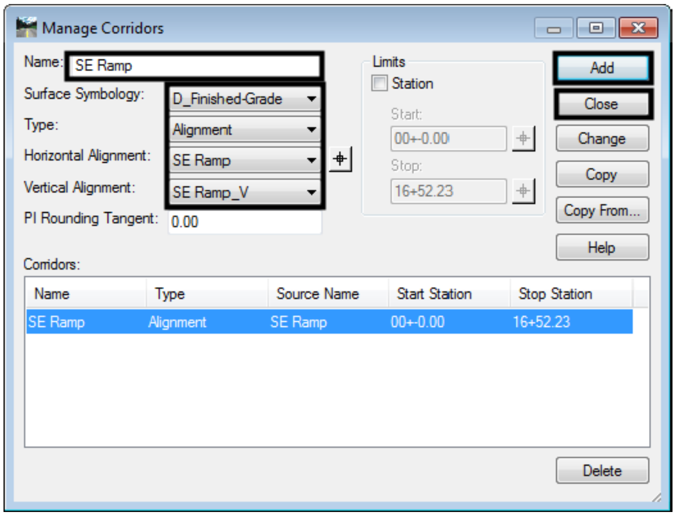
Section Objectives:

- ♦ Create a corridor for the SE Ramp alignment
- ♦ Add template drops to the corridor
- ♦ Create the initial SE Ramp surface

Build the SE Ramp Corridor

1. Select **Modeler > Roadway Designer** from the InRoads menu bar. This displays the ***Roadway Designer*** dialog box.
2. In the ***Roadway Designer*** dialog box, select **Corridor > Corridor Management** or **<D>** the  button. This displays the ***Manage Corridors*** dialog box.
3. In the ***Manage Corridors*** dialog box, key in ***SE Ramp*** for the ***Name***.
4. In the ***Surface Symbology*** field, select **D_Finished-Grade**.
5. Set the ***Type*** to **Alignment**.
6. Select **SE Ramp** as the ***Horizontal Alignment***.
7. Select **SE Ramp_V** as the ***Vertical Alignment***.
8. **<D> Add** to complete the corridor.

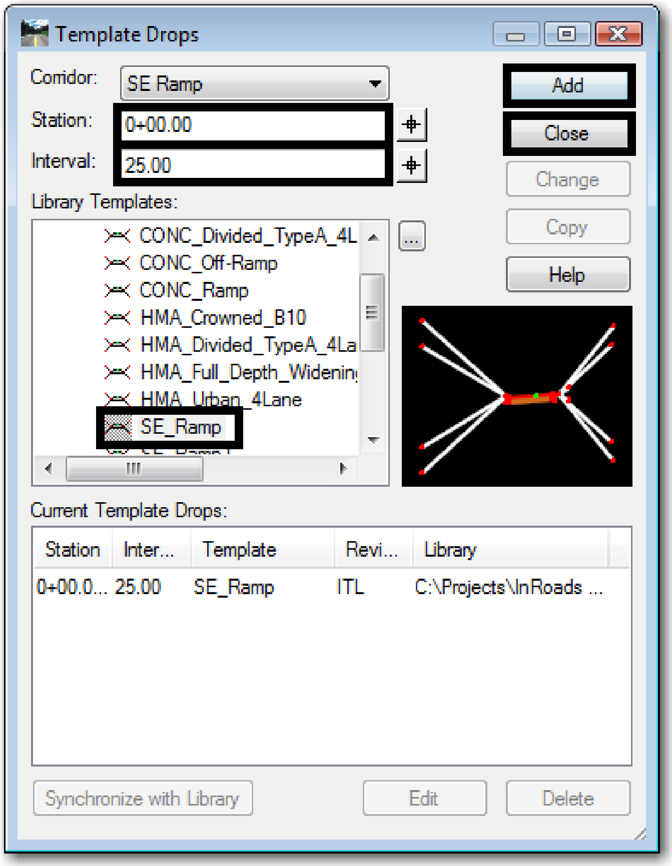
9. **<D> Close** to dismiss the ***Manage Corridors*** dialog box.



Add the SE Ramp Template Drops

1. In the ***Roadway Designer*** dialog box, select **Corridor > Template Drops** or **<D>** the  button. This displays the ***Template Drops*** dialog box.
2. In the **Template Drops** dialog box, Key in ***0+00.00*** for the ***Station***.
3. Key in ***25*** for the ***Interval***.
4. In the ***Library Templates*** area, expand the **1 – Templates** folder.
5. Highlight the **SE Ramp** template.
6. **<D> Add**.

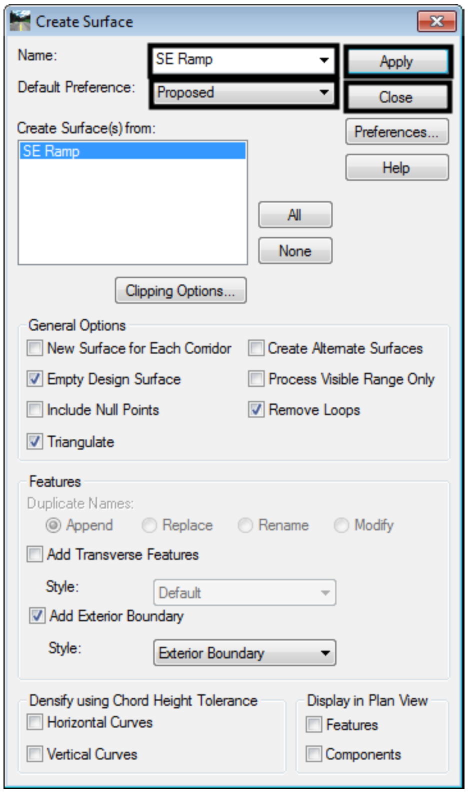
7. **<D> Close**.



Create the Initial SE Ramp Design Surface

1. In the ***Roadway Designer*** dialog box, select **Corridor > Create Surface** or **<D>** the  button. This displays the ***Create Surface*** dialog box.
2. Key in ***SE Ramp*** for the ***Name***.
3. Select **Proposed** for the ***Default Preference***.

4. The remaining settings should be correct. If not, set them to match the illustration below.



5. **<D> Apply**.

6. **<D> Close**.

Initial Bryant Ramp Corridor Model

As with the SE Ramp, do not worry about the Bryant Ramp crossing into the SE Ramp. In fact, this has to occur in order to determine the stations required for new template drops.

Section Objectives:

- Create a corridor for the Bryant Ramp alignment
- Add template drops to the corridor
- Create the initial Bryant Ramp surface

Build the Bryant Ramp Corridor

1. In the ***Roadway Designer*** dialog box, select **Corridor > Corridor Management** or **<D>** the  button.

2. In the ***Manage Corridors*** dialog box, key in ***Bryant Ramp*** for the ***Name***.

3. In the ***Surface Symbology*** field, select **D_Surface_2**.

4. Set the ***Type*** to **Alignment**.

5. Select **Bryant Ramp** as the ***Horizontal Alignment***.
6. Select **Bryant Ramp_V** as the ***Vertical Alignment***.
7. **<D> Add** to complete the corridor.
8. **<D> Close** to dismiss the ***Manage Corridors*** dialog box.

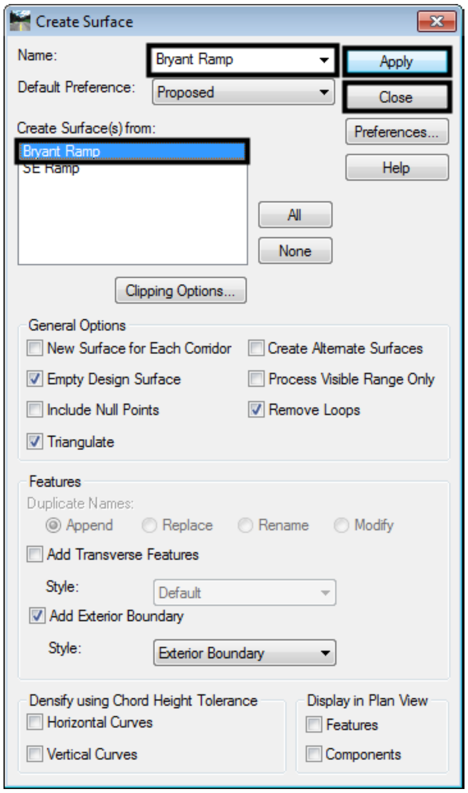
Add the Bryant Ramp Template Drops

1. In the ***Roadway Designer*** dialog box, select **Corridor > Template Drops** or **<D>** the  button.
2. In the ***Template Drops*** dialog box, Key in ***0+00.00*** for the ***Station***.
3. Key in ***25*** for the ***Interval***.
4. In the ***Library Templates*** area, expand the **1 – Templates** folder.
5. Highlight the **Bryant Ramp** template.
6. **<D> Add**.
7. **<D> Close**.

Create the Initial Bryant Ramp Design Surface

1. In the ***Roadway Designer*** dialog box, select **Corridor > Create Surface** or **<D>** the  button.
2. Key in ***Bryant Ramp*** for the ***Name***.
3. In the ***Create Surface(s***) from area, highlight **Bryant Ramp** only.
4. The remaining settings should be correct. If not, set them to match the illustration below.
5. **<D> Apply**.

6. **<D> Close**.



7. **<D> File > Save** from the Roadway Designer menu bar.
8. In the ***Save As*** dialog box, navigate to the InRoads folder.
9. Key in ***SE Ramp and Bryant Ramp*** for the ***File Name***.
10. **<D> Save**.
11. **<D> Cancel** to dismiss the ***Save As*** dialog box.
12. **<D> Close** to dismiss the ***Roadway Designer*** dialog box.

Determine Key Stations for Ramp Mergers

It was determined that the gore between the merger of SE Ramp and 6th Ave would end at the intersection of the RT_POSS and the existing edge of pavement of 6th Ave. the gore between the merger of SE Ramp and Bryant St ends at the intersection of SE Ramp's LT_POSS and Bryant Ramp's RT_POSS. The stations of these intersections, along with the intersection of the SE Ramp's LT_POSS and Bryant Ramp's LT_POSS, must be determined for the additional template drops needed in the final surface.

Display Design Data

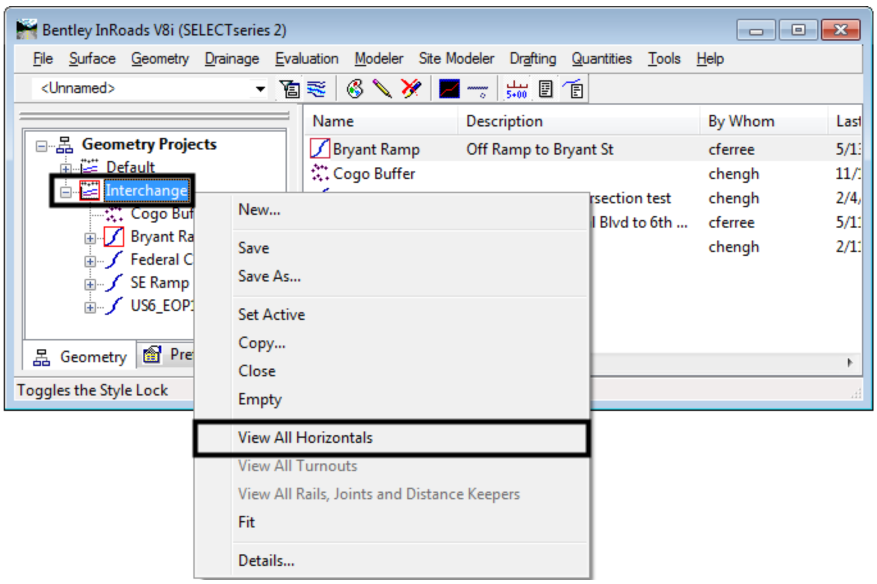
The relevant horizontal alignments are displayed in the dgn file to give a reference location when determining the key stations.

Section Objectives:

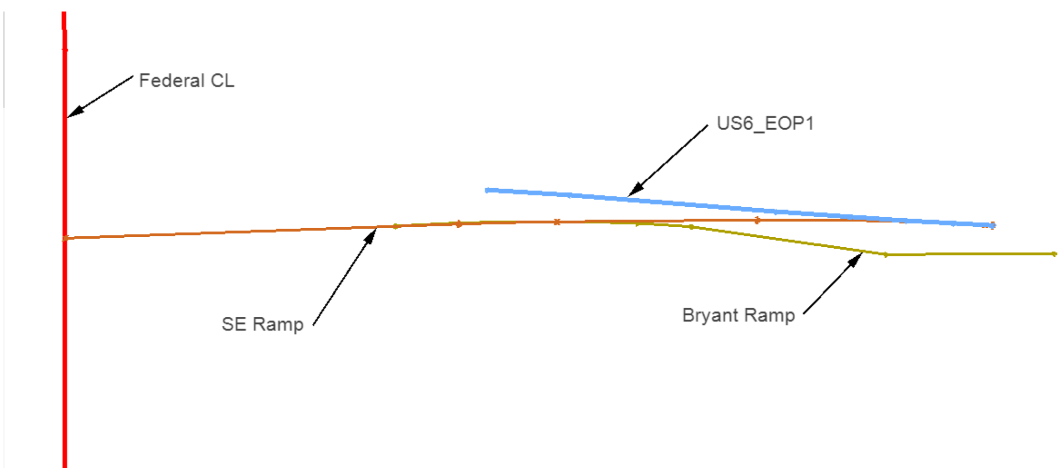
- Display the horizontal alignments

Display Horizontal Alignment Data

1. **<D>** the **Geometry** tab in the InRoads Explorer.
2. **<R>** on the **Interchange** geometry project.
3. Select **View All Horizontals** from the menu.



The illustration below identifies each of the alignments displayed



Key Station Locations

To determine the key stations, the POSS and EOP features of both initial design surfaces are displayed. Then tracking is used on both the SE Ramp alignment and the Bryant Ramp alignment. The stations are needed on each alignment so that template drops can be entered correctly.

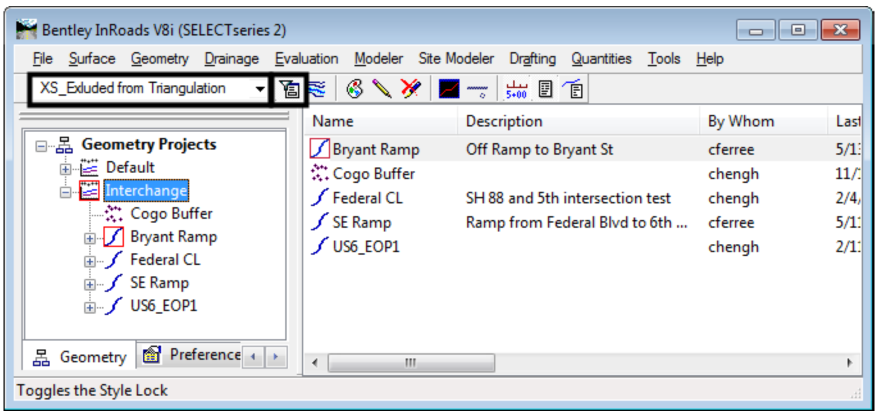
Section Objectives:

- Display the required surface features from the initial design surfaces
- Use Tracking to identify the key stations

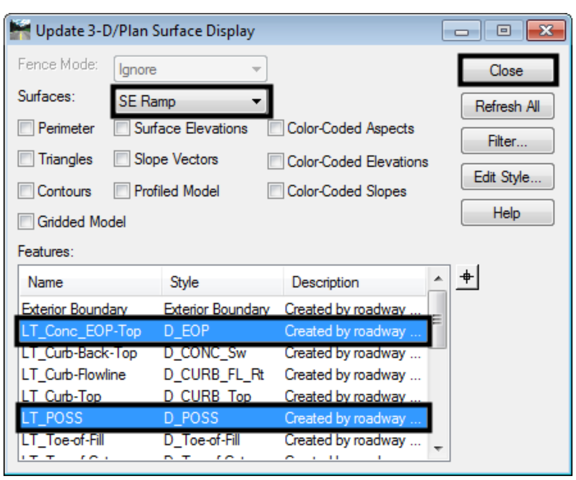
Locate Key Stations for SE Ramp at 6th Ave.

Each point on a template creates a feature in the design surface which can make it difficult to find the desired features for display. To reduce the number of features that have to be combed through, feature filters are used. There is a predefined filter that excludes untriangulated features. This is used reduce the number of features in the dialog box to a manageable number.

1. On the InRoads Locks toolbar, set the ***Feature Filter*** to **XS_Excluded from Triangulation**.
2. Toggle on the **Feature Filter Lock**.

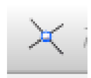


3. On the InRoads menu bar, select **Surface > Update 3d/Plan Surface Display**.
4. In the ***Update 3d/Plan Surface Display*** select the **SE Ramp** surface.
5. In the ***Features*** list, select the features with **EOP** or **POSS** in the name. Hold the ***Ctrl*** key to highlight each of the features. Highlighted features are automatically displayed.
6. **<D> Close**.

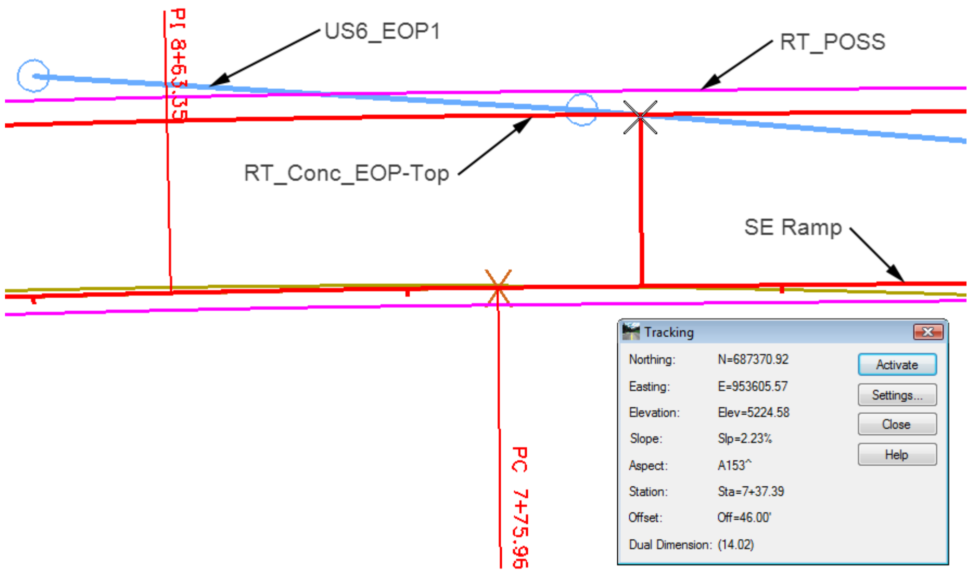


After the features are displayed, tracking is used to determine the key stations for the SE Ramp along the 6th Ave. edge of pavement.

7. Using the MicroStation view controls, zoom in on the left end of the 6th Ave alignment.
8. Set the **SE Ramp** alignment active.
9. From the InRoads menu bar, select **Tools > Tracking > Tracking**.
10. **<T>** where the feature **RT_Conc_EOP-Top** crosses the **US6_EOP1** alignment and note the station.

    Note: Use the ***Intersection*** snap  to locate the station

11. **<T>** where the feature **RT_POSS** crosses the **US6_EOP1** alignment and note the station.



The stations for the two points above are:

- ***RT_Conc_EOP-Top and US6_EOP1 – 7+37.39***
- ***RT_POSS and US6_EOP1 – 8+23.46***

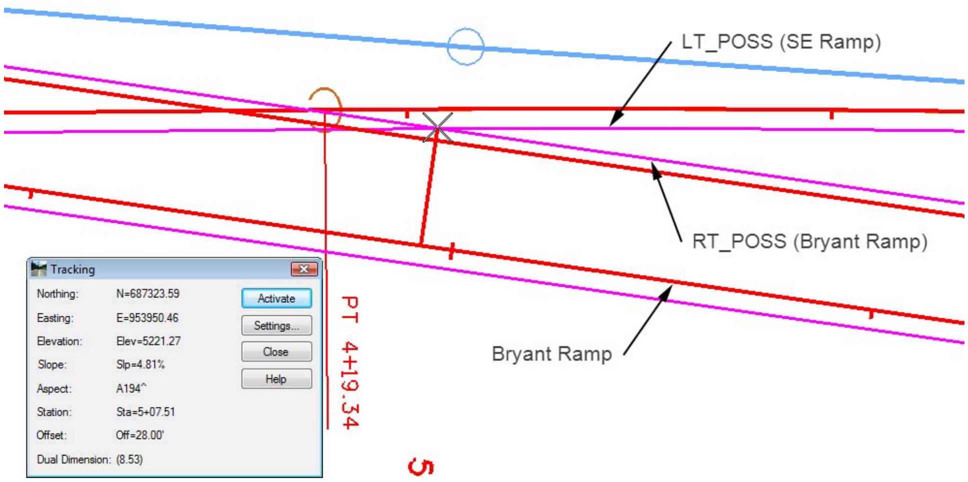
12. **<D> Close** on the ***Tracking*** dialog box.

Locate Key Stations for Bryant Ramp at SE Ramp

The same procedure is used for locating the key stations at the merger of the SE Ramp and the Bryant Ramp.

1. On the InRoads menu bar, select **Surface > Update 3d/Plan Surface Display**.
2. In the ***Update 3d/Plan Surface Display*** select the **Bryant Ramp** surface.
3. Toggle on the **Features** check box.
4. In the Features list, select the features with **EOP** or **POSS** in the name.

5. **<D> Apply** and **<D> Close**.
6. Using the MicroStation view controls, zoom in to the area where SE Ramp and Bryant Ramp intersect.
7. Set the **Bryant Ramp** alignment active.
8. From the InRoads menu bar, select **Tools > Tracking > Tracking**.
9. **<T>** where the feature **RT_POSS** from the ***Bryant Ramp*** crosses the **LT_POSS** from the ***SE Ramp*** and note the station.



- Intersection of **RT_POSS** and **LT_POSS** – ***5+07.51***

10. **<T>** where the feature **LT_POSS** from the ***Bryant Ramp*** crosses the **LT_POSS** from the ***SE Ramp*** and note the station.

- Intersection of **LT_POSS** and **LT_POSS** – ***8+39.60***

11. Set the **SE Ramp** alignment active and determine the stations for the locations in 9 and 10 above for this alignment also.

- Intersection of **RT_POSS** and **LT_POSS – *3+92.92***
- Intersection of **LT_POSS** and **LT_POSS – *7+27.40***

12. **<D> Close** on the ***Tracking*** dialog box.

Template Modifications

As designed, the SE Ramp and Bryant Ramp templates have curb and end conditions on both sides. Templates must be created for the merger areas that do not have the restrictive components.

SE Ramp Template at 6th Ave.

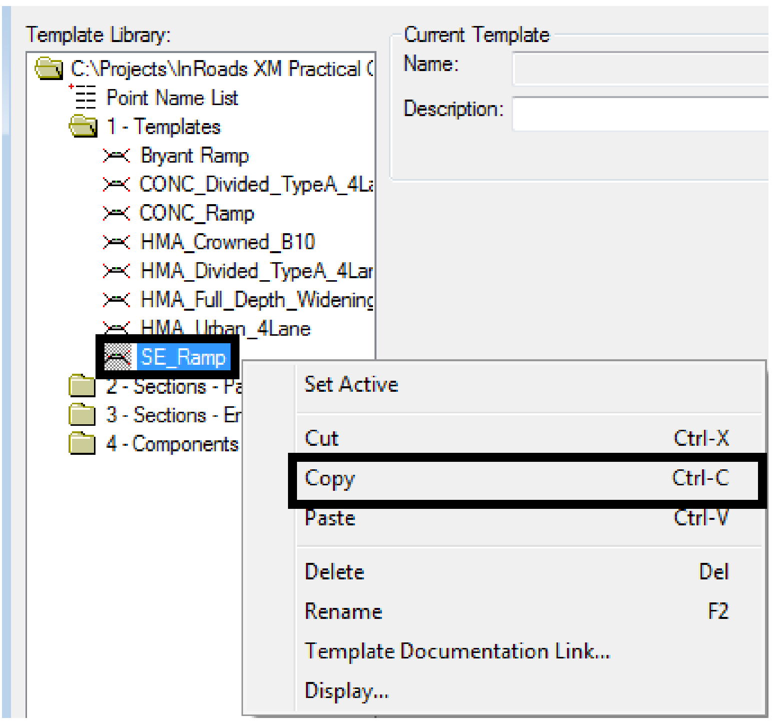
- Copy the SE Ramp template

- Modify the copy for the 6th Ave merger area

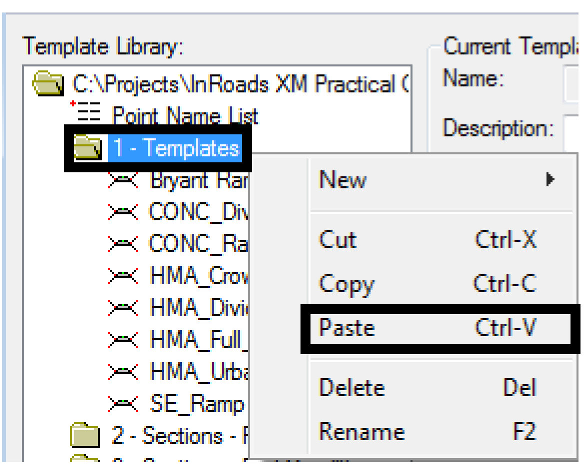
Copy the SE Ramp Template

The basic SE Ramp template is used once all of the merger areas are cleared. A copy of this template is made so that one can be modified and the other left intact.

1. On the InRoads menu bar, select **Modeler > Create Template**.
2. In the ***Create Template*** dialog box, expand the template library to show the contents of the ***1- Templates*** folder.
3. **<R>** on the **SE Ramp** template and select **Copy** from the menu.



4. **<R>** on the **1 – Template** folder and select **Paste**.



5. **<R>** on the **SE Ramp1** template and select **Rename**. Key in ***SE Ramp at 6th Ave*** for the name.

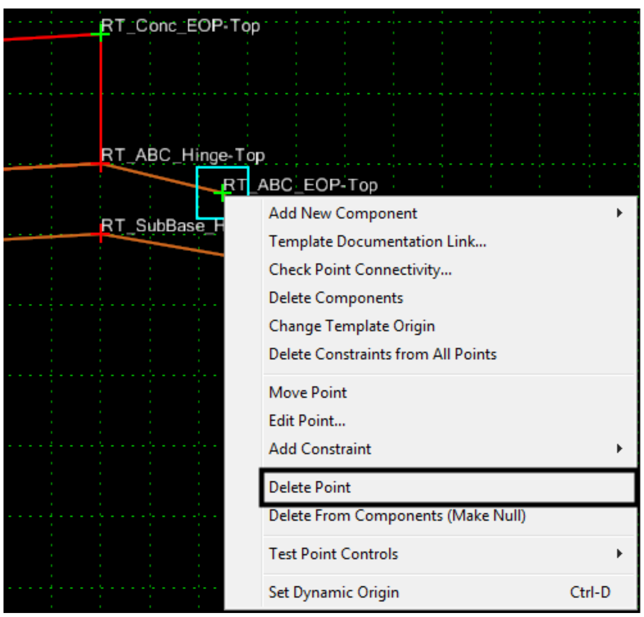
Modify the SE Ramp at 6th Template

This template needs to be modified on the right (6th Ave.) side only.

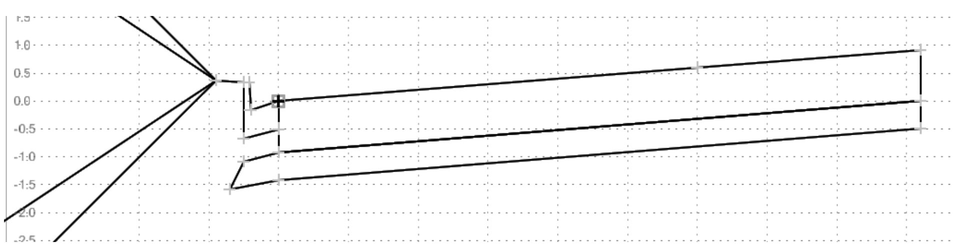
1. **<D> <D> SE Ramp at 6th** template to make it active.
2. Zoom in on the right side of the template.
3. **<R>** in the Template view and select **Delete Components** from the menu.
4. Drag a line through the **RT_C/G_Type2-IIB** and the **RT_Benching** components.

   Note: The end conditions are also deleted because of the parent/child relationship they have with RT_Benching.

5. **<R>** on the **RT_ABC_EOP-Top** and select **Delete Point** from the menu.



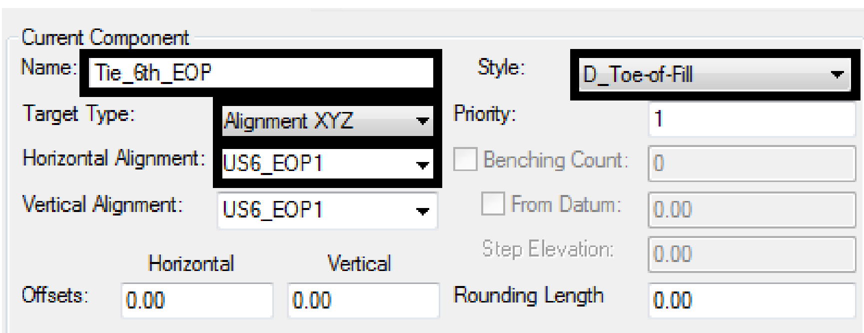
6. Delete the **RT_SubBase_EOP-Top** point also. The illustration below shows the template completed to this point.



Add an End condition to the SE Ramp at 6th Ave template

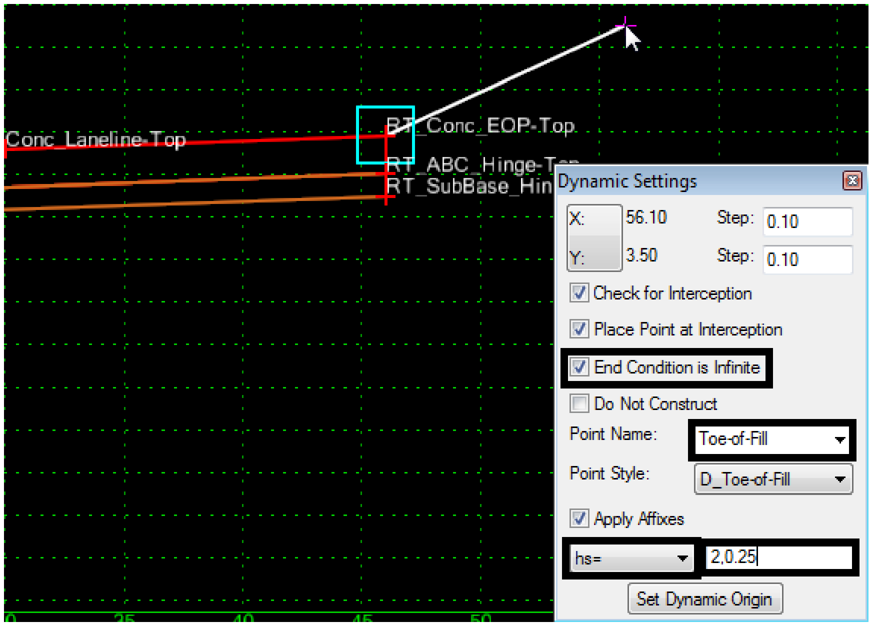
This end condition is used to create the gore after the SE Ramp edge of pavement separates from the 6th Ave. pavement edge.

1. **Select Tools > Dynamic Settings from the Create Template menu bar or <D> the Dynamic Settings** button.
2. Select **Tools > Options** from the ***Create Template*** menu bar.
3. Toggle on **Apply Affixes**.
4. Set the ***X*** and ***Y Step Options*** to ***0.1***.
5. **<D> OK.**
6. **<R>** in the Template view and select **Add New Component > End Condition**.
7. In the ***Component Properties*** area, key in ***Tie_6th_EOP*** for the ***Name.***
8. Set the ***Target Type*** to **Alignment XYZ**.
9. Select **US6_EOP1** for the ***Horizontal Alignment***. This automatically sets the vertical alignment.
10. Set the ***Style*** to **D_Toe-of-Fill**.



11. **<D>** on the **RT_Conc_EOP-Top** point to place the first point.
12. In the ***Dynamic Settings*** dialog box, toggle on **End Condition Is Infinite**.
13. Select **Toe-of-Fill** for the ***Point Name***. This automatically sets the ***Point Style***.
14. Select **hs=** for the key in type.

15. Key in ***2,0.25*** and press ***Enter***.



16. **<R>** and select **Finish**.

SE Ramp Template at Bryant St.

The merger areas for the SE Ramp at 6th Ave. and the SE Ramp at the Bryant ramp overlap. A copy of the SE Ramp at 6th Ave template is modified for use in this merger area. A separate template is used here because using target aliasing and clipping options would result in the loss of the ABC component in the clipped template.

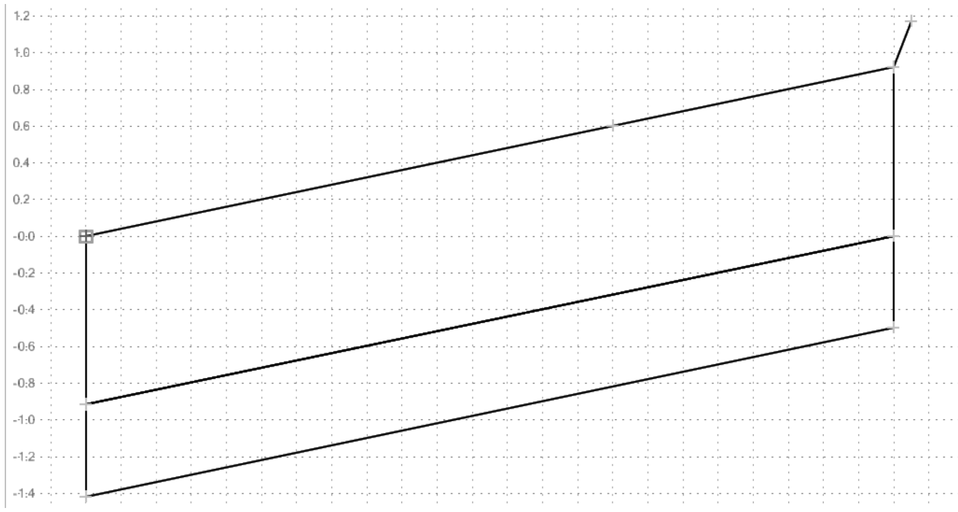
Section Objectives:

- Copy the SE Ramp at 6th Ave template
- Modify the copy for the Bryant Ramp merger area

Copy and Modify the SE Ramp at 6th Ave Template

1. Make a copy of the ***SE Ramp at 6th Ave*** and key in ***SE Ramp at Bryant*** for the name.

2. Modify the ***SE Ramp at Bryant*** template as described above deleting the curb and end condition components and sub base points on the left side of the template. The illustration below shows the completed template.



Bryant Ramp at the SE Ramp

A copy of the Bryant Ramp template is also modified to work in the merger area.

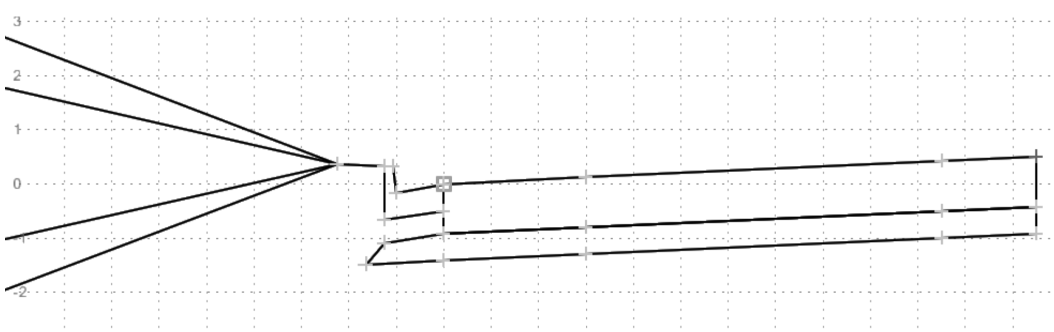
Section Objectives:

- ♦ Copy the Bryant Ramp template
- ♦ Modify the copy for the SE Ramp merger area

Copy and Modify the Bryant Ramp Template

1. Make copy of the **Bryant Ramp** template as described above. Name it ***Bryant Ramp at SE Ramp***.

2. Modify the ***Bryant Ramp at SE Ramp*** template as described above making the changes on the right side of the template. The illustration below shows the completed template.



Set Up For Final Modeling

With the key stations determined and the new templates created, the corridors are modified to use this data. Changes in corridor stations, additional template drops, point controls, and target aliasing are used to incorporate this data. Also, after reviewing the initial design surface data, some sideslopes require modification

Set Up for the SE Ramp

Section Objectives:

- Add template drops for the new SE Ramp templates
- Add point controls to match the template to the 6th Ave edge of pavement
- Modify sideslopes in the template view

Adding Template Drops

These are added to include the new templates into the corridor.

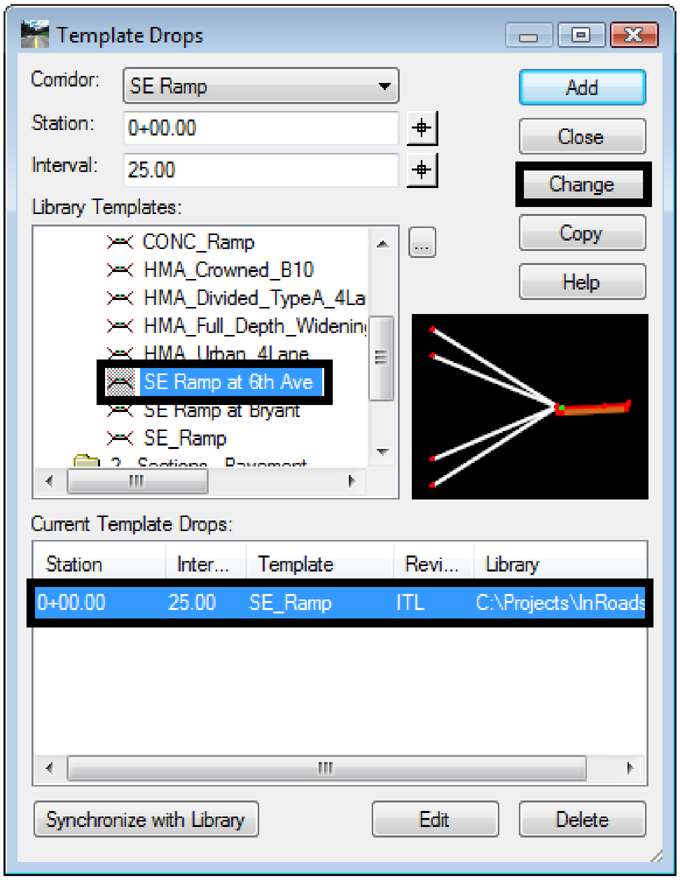
1. Open **Roadway Designer**.
2. Set the ***Corridor*** to **SE Ramp** and the ***Active Surface*** to **Existing_Ground**.

3. Open the **Template Drops** dialog box.

Because this alignment runs west to east, the first template drop is at the edge of 6th Ave. Therefore, the template for this drop is changed to use the SE Ramp at 6th Ave template.

4. Highlight the template drop in the ***Current Template Drops*** list.
5. In the ***Library Templates*** area, expand the **1 – Templates** folder and select the **SE Ramp at 6th Ave** template.

6. **<D> Change**.



The next two template drops define the change from the SE Ramp at 6th Ave to the SE Ramp at Bryant Ramp template. This change occurs in 0.01 feet so that there is an abrupt change from a template with a curb to a template without one.

7. Key in ***3+88.03*** for the ***Station***.
8. Key in ***25*** for the ***Interval***.

   Note: The interval for this template drop could be anything greater than 0.01.

9. In the ***Library Templates*** area, highlight the **SE Ramp at 6th Ave** template.
10. **<D> Add**.
11. Key in ***3+88.04*** for the ***Station***.
12. Key in ***25*** for the ***Interval***.
13. In the ***Library Templates*** area, highlight the **SE Ramp at Bryant Ramp** template.
14. **<D> Add**.

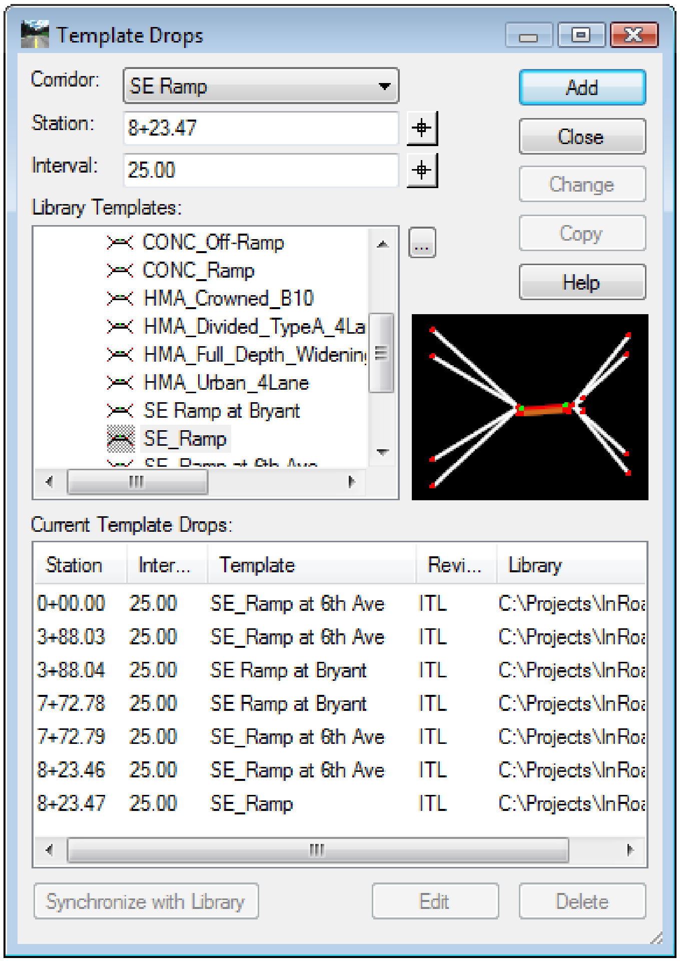
The next transitions define the end of the Bryant ramp merger. Again, an abrupt change between templates is needed so the transition occurs in 0.01 feet.

15. Key in ***7+72.78*** for the ***Station***.
16. Key in ***25*** for the ***Interval***.
17. In the ***Library Templates*** area, highlight the **SE Ramp at Bryant Ramp** template.
18. **<D> Add**.
19. Key in ***7+72.79*** for the ***Station***.
20. Key in ***25*** for the ***Interval***.
21. In the ***Library Templates*** area, highlight the **SE Ramp at 6th Ave** template.
22. **<D> Add**.

Finally the transition to an independent SE Ramp is defined.

23. Key in ***8+23.46*** for the ***Station***.
24. Key in ***25*** for the ***Interval***.
25. In the ***Library Templates*** area, highlight the **SE Ramp at 6th Ave** template.
26. **<D> Add**.
27. Key in ***8+23.47*** for the ***Station***.
28. Key in ***25*** for the ***Interval***.
29. In the ***Library Templates*** area, highlight the **SE Ramp** template.

30. **<D> Add**. The completed Template Drops dialog box is shown below.



31. **<D> Close**.

Add Point Controls for the SE Ramp

A point control is used to match the right edge of pavement of the SE Ramp templates to the existing pavement edge of 6th Ave. (defined by the US6_EOP1 alignment).

1. Select **Corridor > Point Controls** from the InRoads menu bar. This displays the ***Point Controls*** dialog box.

2. In the ***Control Description*** field, key in ***SE Ramp EOP RT at 6th Control***.

3. Select **RT_Conc_EOP-Top** for the ***Point***.

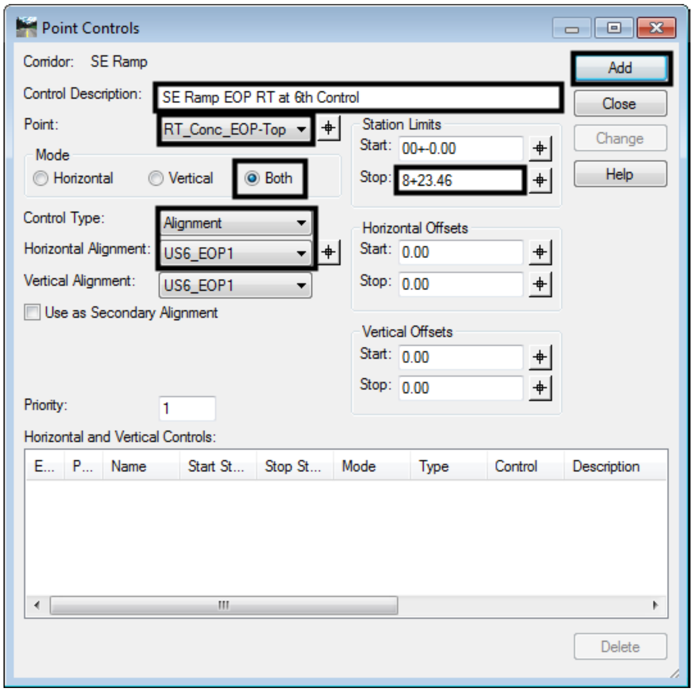
4. Toggle on **Both** for the ***Mode***.

5. Set the ***Control Type*** to **Alignment**.

6. Select **US6_EOP1** for the ***Horizontal Alignment***. The vertical alignment is automatically set.

7. In the ***Station Limits*** area, leave the ***Start*** at ***0+00.00*** and key in ***8+23.46*** for the ***Stop*** station.

8. **<D> Add** and **Close**.



Modify Side Slopes for SE Ramp

There is a area in this corridor where the computed end condition created an undesirable result. Because this area only covers two template drops, it is corrected by modifying the templates at those stations. If this area were larger, an end condition override or a new template should be used.

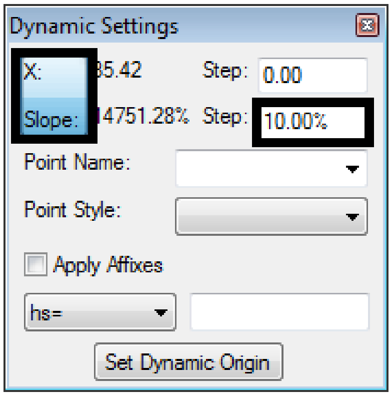
1. Set the ***Station Indicator*** to **7+72.79**.

2. **<D> <D>** in the Template View to open the ***Edit Template at Station 7+72.79 Only*** dialog box.

3. Open the ***Dynamic Settings*** dialog box.

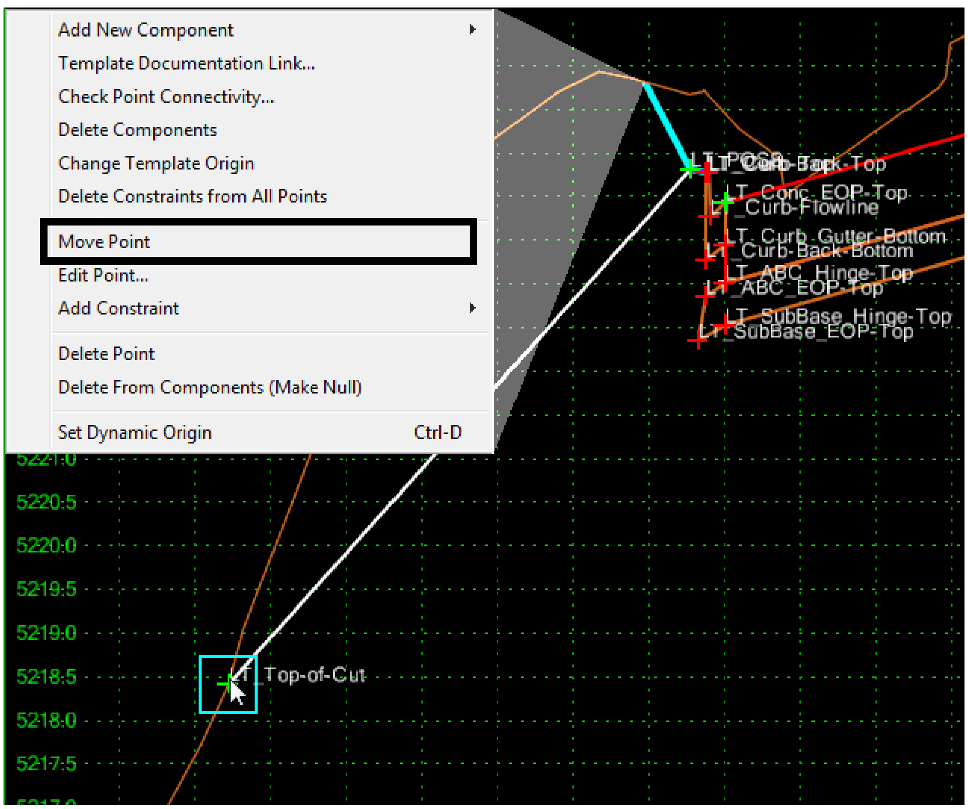
4. **<D>** on the Readout button to change it to ***X*** and ***Slope***.

5. Key in ***10.00 %*** for the slope ***Step***.



6. **<R>** on **the LT_Top-of-Cut** point and select **Move Point** from the menu.

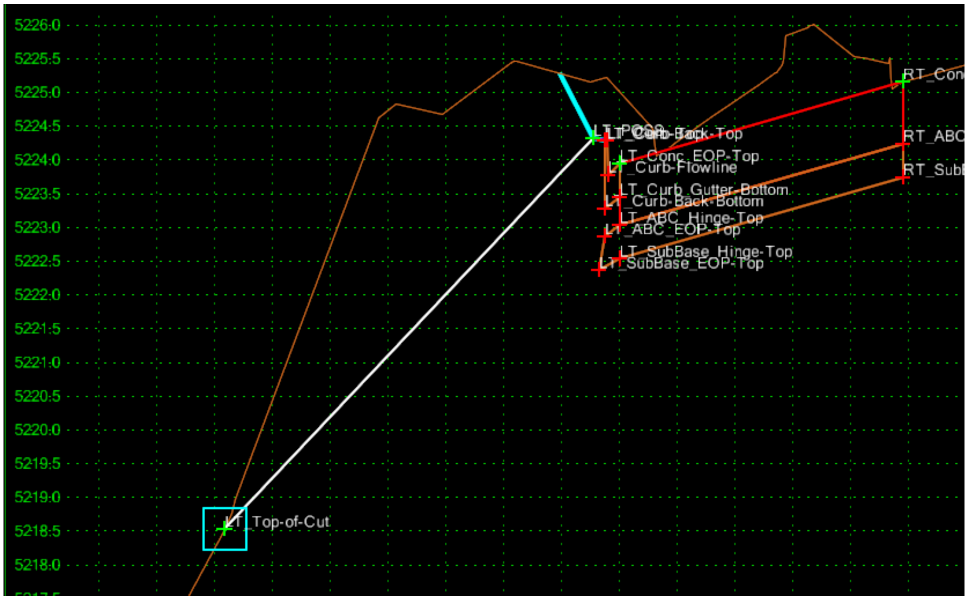
7. Move the point to the location shown in the illustration below. **<D>** to place it.



Note: The point will snap to the Existing Ground line when the cursor is moved next to the line.

8. **<D> OK** to accept the change and dismiss the dialog box.

9. Modify station **7+75.00** in a similar manner as shown in the illustration below.



Set Up for the Bryant Ramp

Section Objectives:

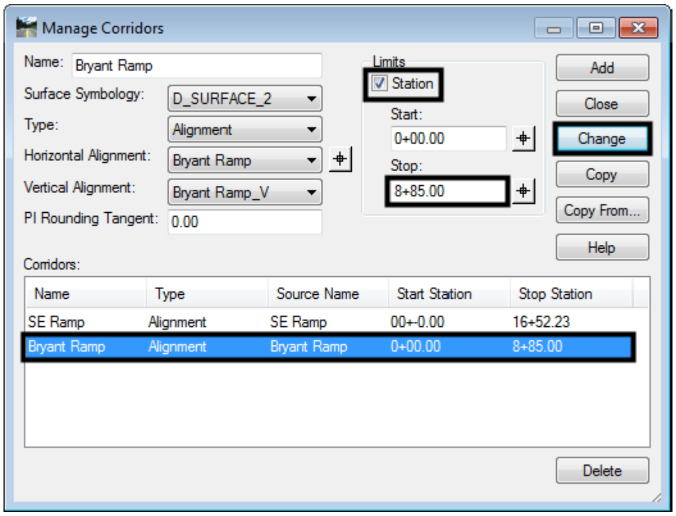
- Change the end station for the Bryant Ramp corridor
- Add template drops for the new Bryant Ramp templates
- Add point controls to match the template to the SE Ramp edge of pavement
- Define target aliasing to target the SE Ramp surface
- Modify sideslopes in the template view

Edit Corridor Stations

The Bryant Ramp alignment runs past the point where the Bryant Ramp template is no longer used. The corridor is modified to end at the same place where the template needs to end.

1. Set the ***Corridor*** to **Bryant Ramp**.
2. Select **Corridor > Corridor Management** from the InRoads menu bar. This displays the ***Manage Corridors*** dialog box.
3. In the ***Manage Corridors*** dialog box, highlight the **Bryant Ramp** entry from the ***Corridors*** list.
4. In the ***Limits*** area, toggle on **Station**.
5. Key in ***8+85.00*** for the ***Stop*** station.

6. **<D> Change** and **Close**.

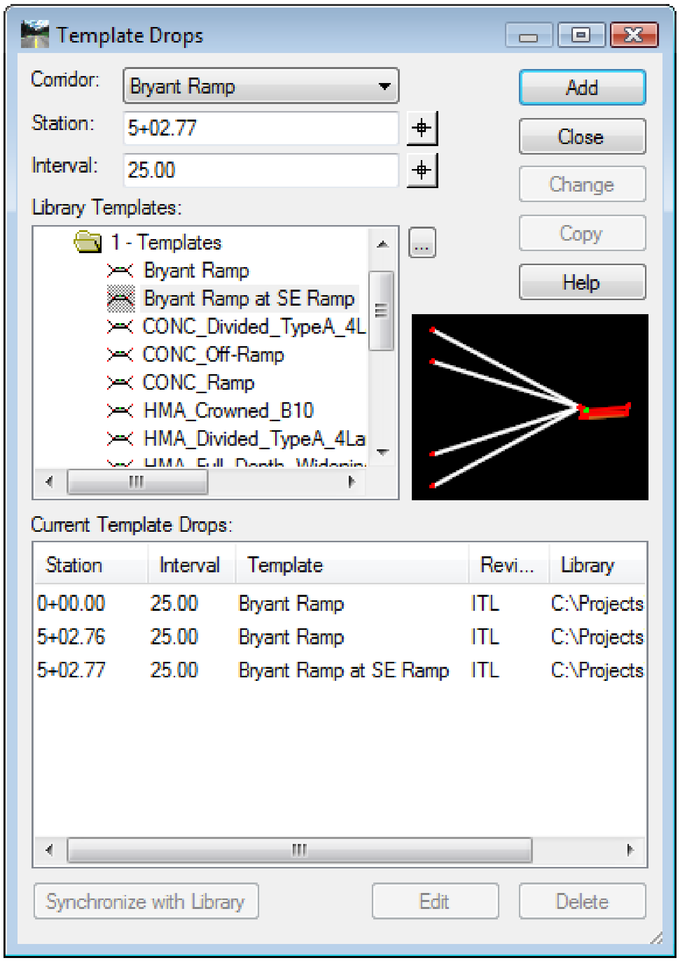


Adding Template Drops

The additional template drops are added to include the modified template properly as explained above.

1. Open the **Template Drops** dialog box.
2. Key in ***5+02.76*** for the ***Station***.
3. Key in ***25*** for the ***Interval***.
4. In the ***Library Templates*** area, highlight the **Bryant Ramp** template.
5. **<D> Add**.
6. Key in ***5+02.77*** for the ***Station***.
7. Key in ***25*** for the ***Interval***.
8. In the ***Library Templates*** area, highlight the **Bryant Ramp at SE Ramp** template.

9. **<D> Add** and **Close**. The completed Template Drops dialog box is shown below.



Add Point Controls for the Bryant Ramp

This point control matches the right edge of pavement of the Bryant Ramp to the left edge of pavement of the SE Ramp. It causes the Bryant ramp to transition to 0 by the end of the merger.

1. Select **Corridor > Point Controls** from the InRoads menu bar.

2. In the ***Control Description*** field, key in ***Bryant Ramp EOP RT at SE Ramp Control***.

3. Select **RT_Conc_EOP-Top** for the ***Point***.

4. Toggle on **Both** for the ***Mode***.

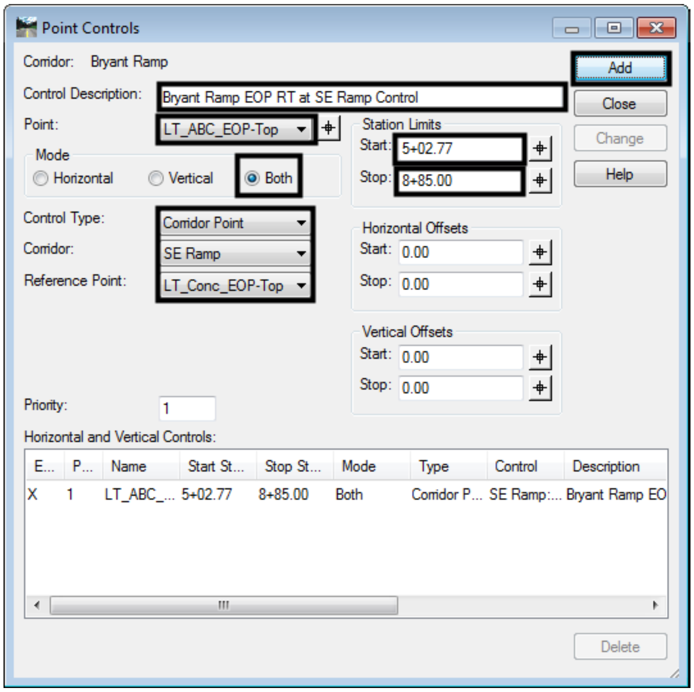
5. Set the ***Control Type*** to **Corridor Point**.

6. Select **SE Ramp** for the ***Corridor***.

7. Select **LT_Conc_EOP-Top** for the ***Reference Point***.

8. In the ***Station Limits*** area, key in ***5+02.77*** for the ***Start*** station and key in ***8+85.00*** for the ***Stop*** station.

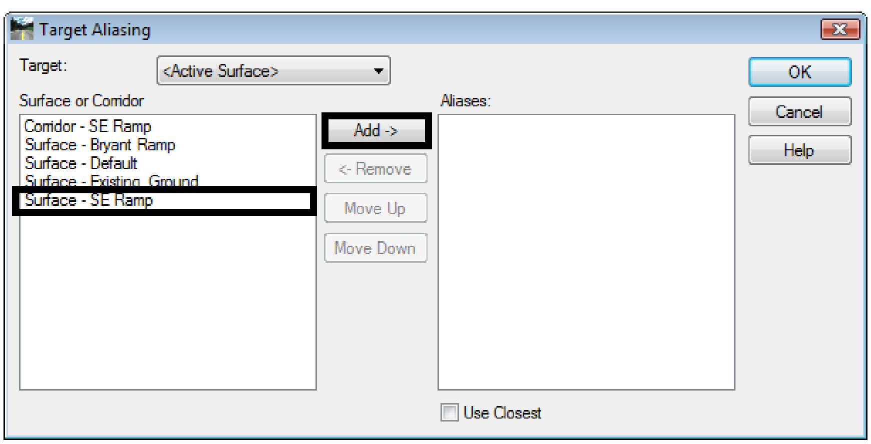
9. **<D> Add** and **Close**.



Create Target Aliasing for the Bryant Ramp

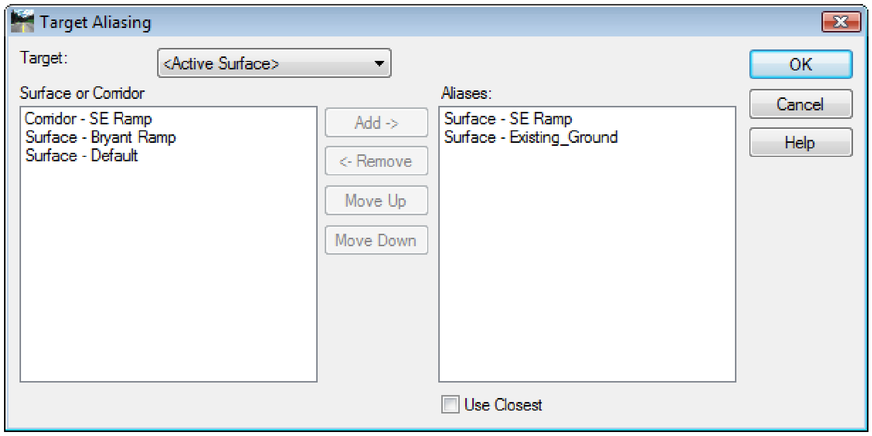
Target aliasing is used to tie the Bryant Ramp sideslope to the SE Ramp sideslope in the area before the merger. Without this, the combined surface will not triangulate properly in areas where the toes overlap.

1. Select **Tools > Target Aliasing** from the Roadway Designer menu bar.
2. Highlight **Surface – SE Ramp** in the ***Surface or Corridor*** list.
3. **<D> Add**.



4. Highlight **Surface – Existing_Ground** in the ***Surface or Corridor*** list.

5. **<D> Add**. The dialog box looks like the illustration below.

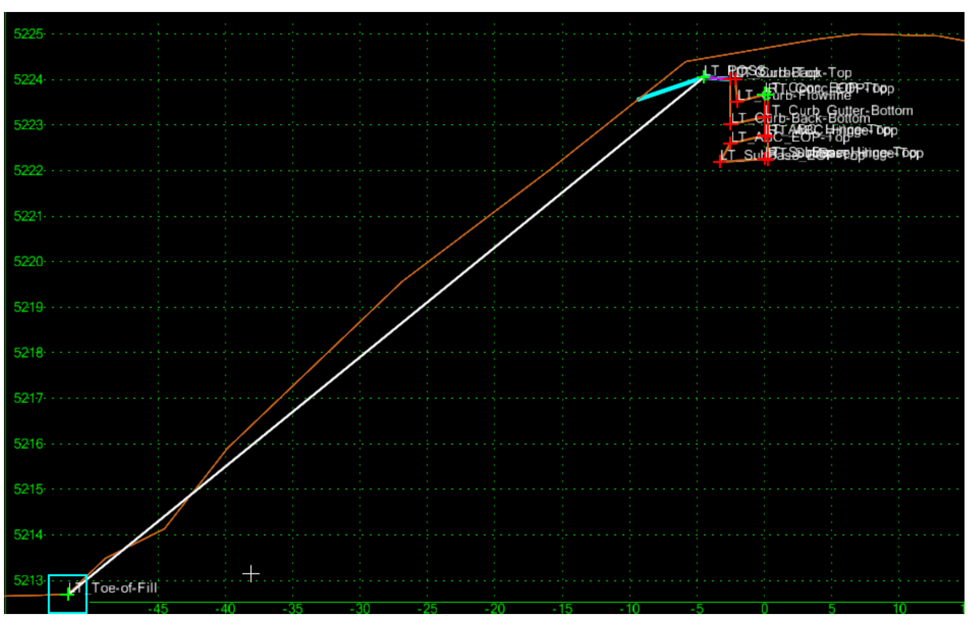


6. **<D> OK**.

Modify Side Slopes for Bryant Ramp

This corridor also has an undesirable result on a sideslope. Again, because this result occurred in a limited area, the template at the station is edited.

1. Set the ***Station Indicator*** to **8+50.00**.
2. **<D> <D>** in the Template View to open the ***Edit Template at Station 8+50.00 Only*** dialog box.
3. Move the point **LT_Toe-of-Fill** as shown in the illustration below.
4. **<D> OK** to accept the change and dismiss the dialog box



Create the Final Combined Design Surface

The two corridors are combined into one surface of the interchange.

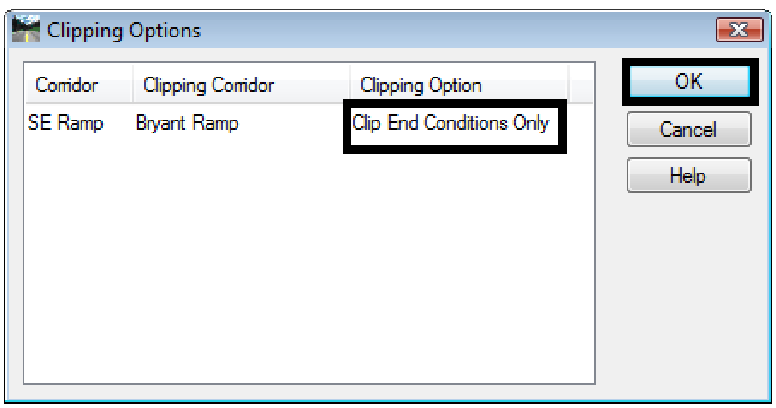
Section Objectives:

- Create a combined surface from the SE Ramp and Bryant Ramp corridors

1. Open the ***Create Surface*** dialog box.
2. In the ***Name*** field, key in ***SE-Bryant Ramps***.
3. Set the ***Default Preference*** to **Proposed**.
4. In the ***Create Surface(s) From*** list box, highlight both **Bryant Ramp** and **SE Ramp**.

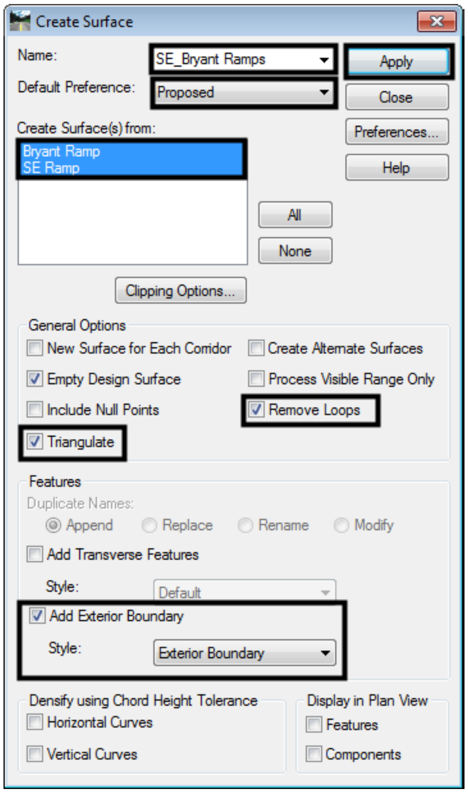
The clipping options are used to modify the combined surface where the end conditions overlap prior to the merger.

5. **<D>** the **Clipping Options** button.
6. Set the ***Clipping Option*** to **End Conditions Only**.
7. **<D> OK** to accept the change and close the ***Clipping Options*** dialog box.



8. Verify that **Add Exterior Boundary**, **Triangulate**, and **Remove Loops** are toggled on.

9. **<D> Apply** and **Close**. Also, close the ***Results*** window if it is displayed.



10. Select **File > Save** from the Roadway Designer menu bar.

11. **<D> Close** to dismiss the Roadway Designer dialog box.

Review the Results

Once the design surface is created a review of that surface will determine if additional work is required.

Cross Sections

Cross sections are one of the standard design surface review tools.

Section Objectives:

- Create a set of cross sections

Display Cross Sections with the SE Ramp Alignment

The SE Ramp alignment is the main alignment for this project, so it is used when reviewing the data.

1. Set the **SE Ramp** alignment active.

2. Open the **Create Cross Sections** dialog box.

3. Set the ***Left Offset*** to ***-150*** and the ***Right Offset*** to ***100***.

4. Select the **Existing_Ground** and **SE-Bryant Ramps** surfaces
5. **<D> Apply** and **<D>** to place the set.
6. Close the ***Create Cross Sections*** dialog box.
7. Review the cross sections paying particular attention to the merger areas.

View 3D Components

With the advent of template components, a new option has been added to the view surface commands. Viewing the design surface components in 3d is a new tool for reviewing surfaces.

Section Objectives:

- ♦ Display surface components into the MicroStation file

1. Select **Surface > View Surface > Components** from the InRoads Menu.
2. In the ***View Surface Components*** dialog box, select **SE-Bryant Ramps** for the S***urface***.
3. In the ***Component*** list, **<R>** and choose **Select All** from the menu.
4. Hold the ***Ctrl*** key and **<D>** on the ABC components to deselect them.
5. **<D> Apply** and **Close**.
6. Examine the components, rotating the view to see different perspectives.