Labs for InRoads XM

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 08.09.04.88
InRoads® version 08.09.02.16
0209 – Version 04.00 CDOT Configuration

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

Table of Contents

Chapter 2 - Intersection Project

Chapter 3 - Interchange Project

Chapter 1 - 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

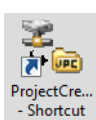
Lab 1.1 - Creating a Project Directory

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:

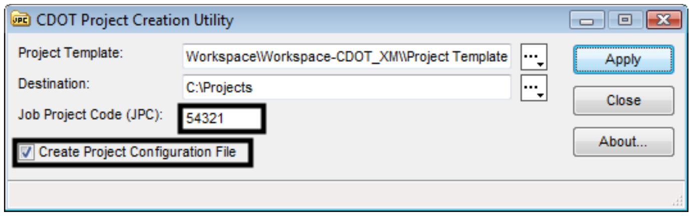
- ♦ Create a project directory.
- ♦ Explore the folder structure created.
- ♦ Demonstrate how the PCF file works

1. **<D>** the **Project Creation Utility** icon or select **Start > All Programs >_CDOT_CADD_Information > 8.9.xx – XM > Create XM Project Directory Structure** to open the ***CDOT Project Creation Utility*** dialog box.



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

3. 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.



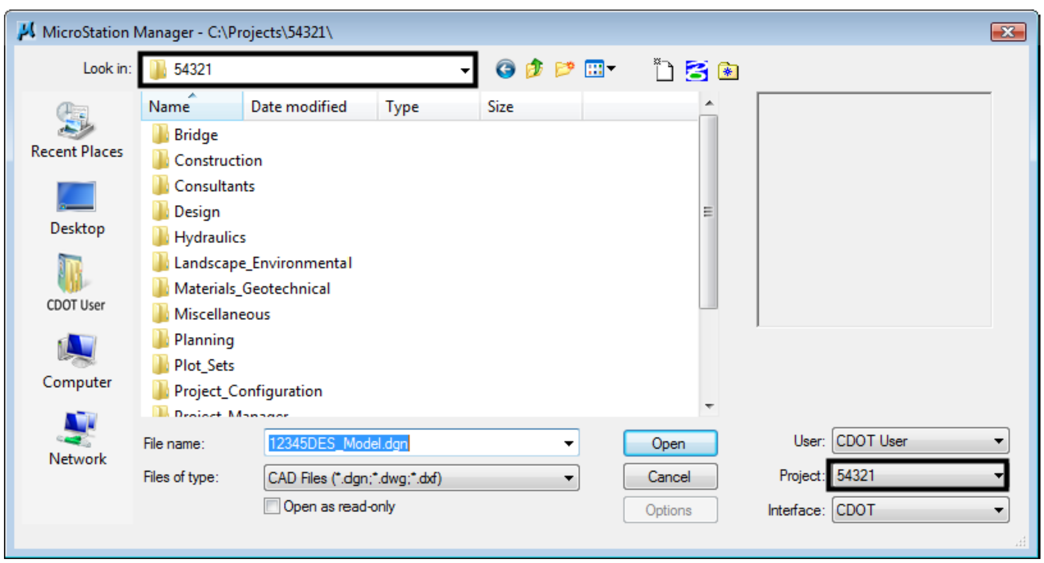
4. **<D> Apply** then **<D> Close** to dismiss the dialog box.

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

6. Close the Windows Explorer.

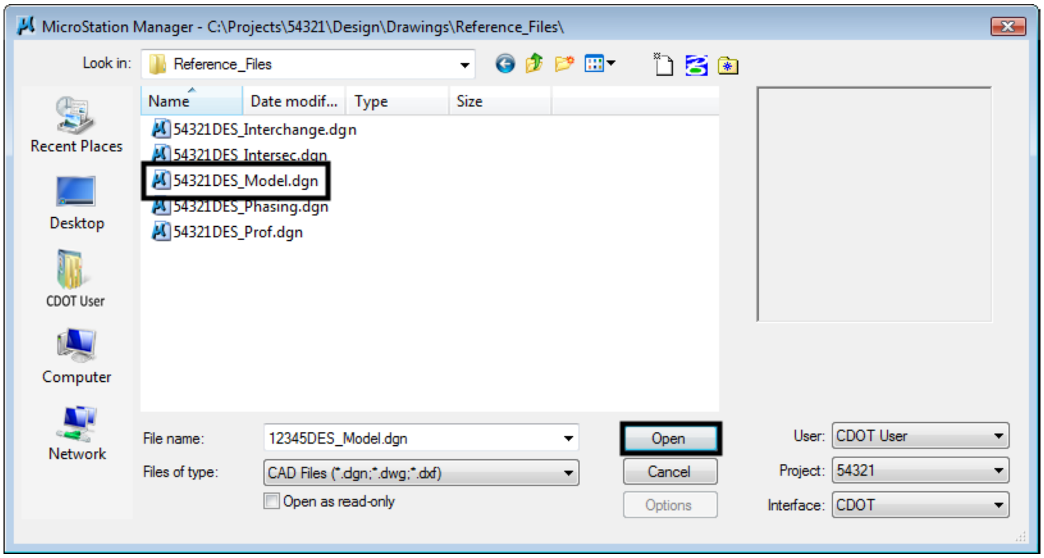
7. Start **MicroStation**.

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



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

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



11. 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_XM Disciplines.reg*** file supplied with the CDOT workspace, this job is very simple. The .reg file uses variables stored in the pcf to set the directory paths when opening or saving data InRoads related data files.

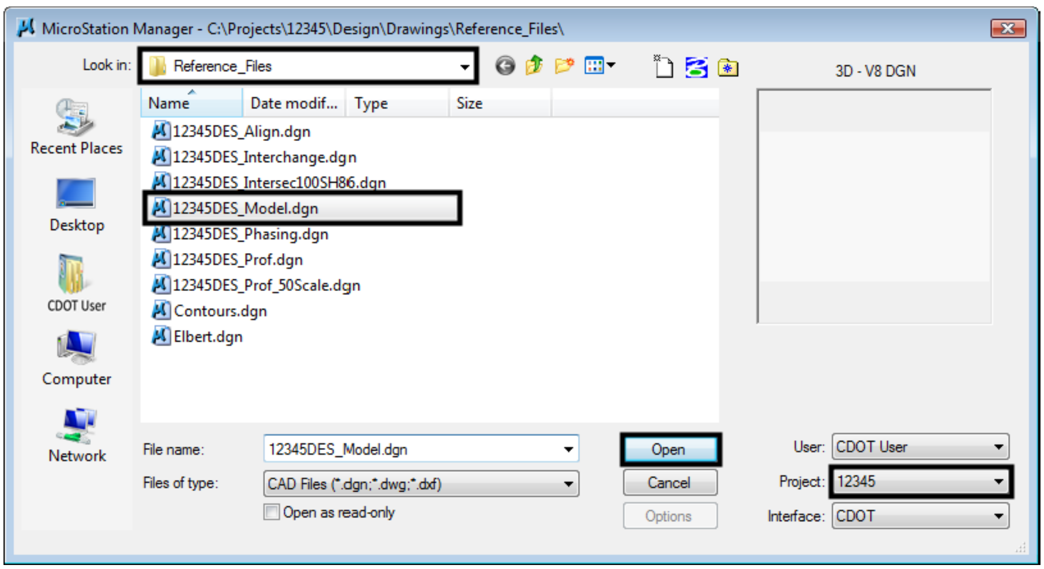
In addition to setting up the project defaults, students will learn how to create a project file which allows several data files to be loaded into InRoads simultaneously.

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

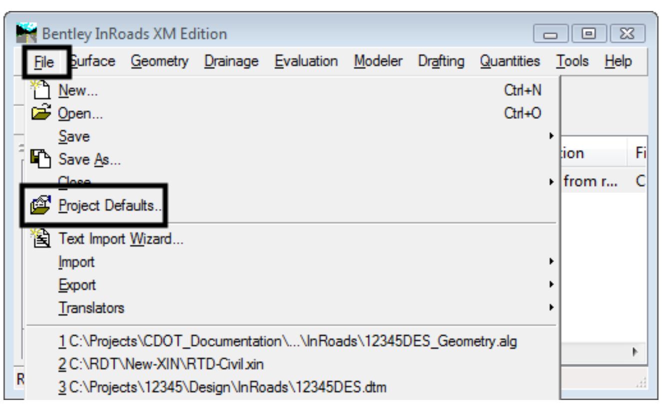
Section Objectives:

- Open MicroStation and InRoads using the 12345.pcf file.
- Import the CDOT_XM 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 XM > 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.



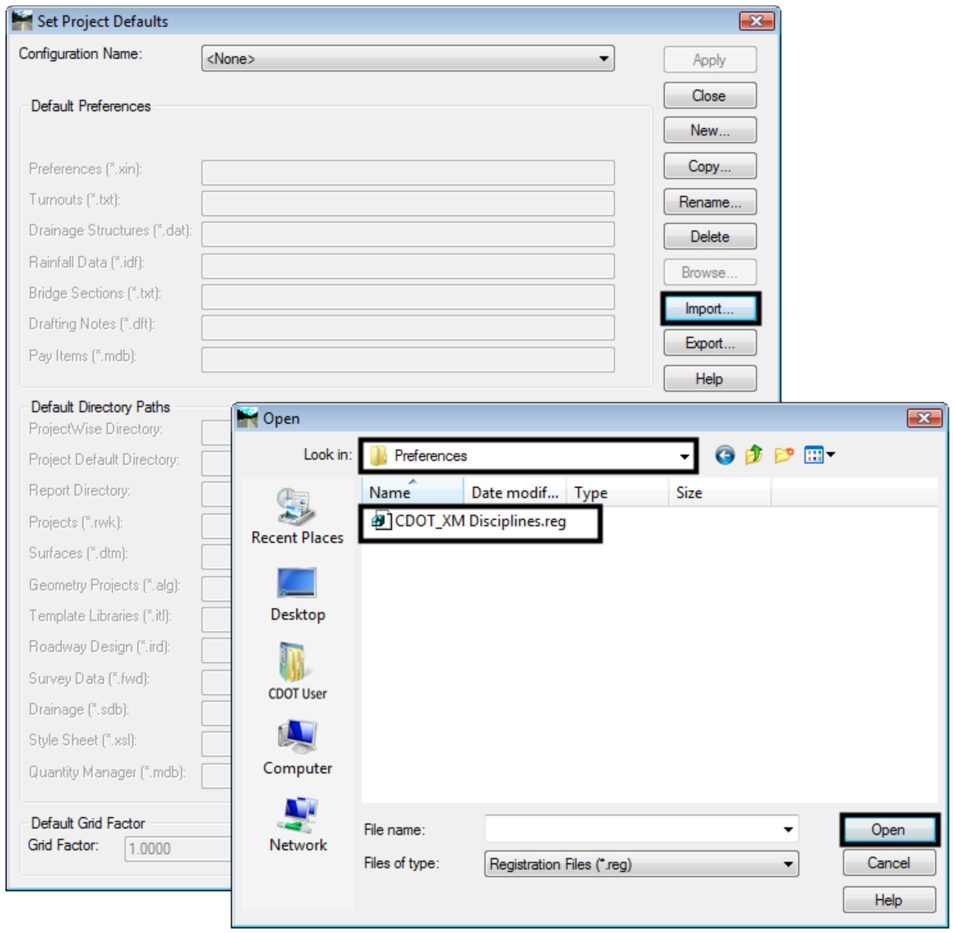
5. From the InRoads menu bar, select **File > Project Defaults**. This displays the ***Project Defaults*** dialog box.



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_XM\Standards-Global\InRoads\Preferences** and highlight the **CDOT_XM 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 InRoads.

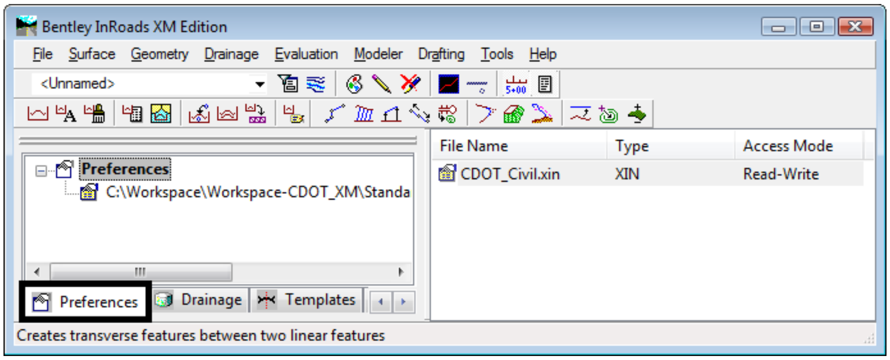
9. Back on the Set Project Defaults dialog box, set the ***Configuration Name*** to **CDOT Design Discipline**.

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 files are loaded.



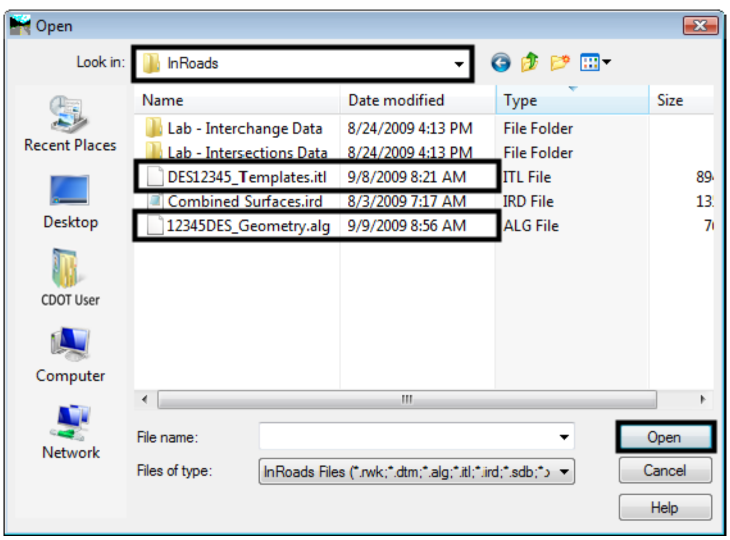
Next, the initial InRoads data files are loaded.

12. From the InRoads menu bar, select **File > Open**. This displays the Open dialog box.

13. The Open window defaults to the ***C:\Projects\12345\Design*** folder. **<D> <D>** on the **InRoads** folder.

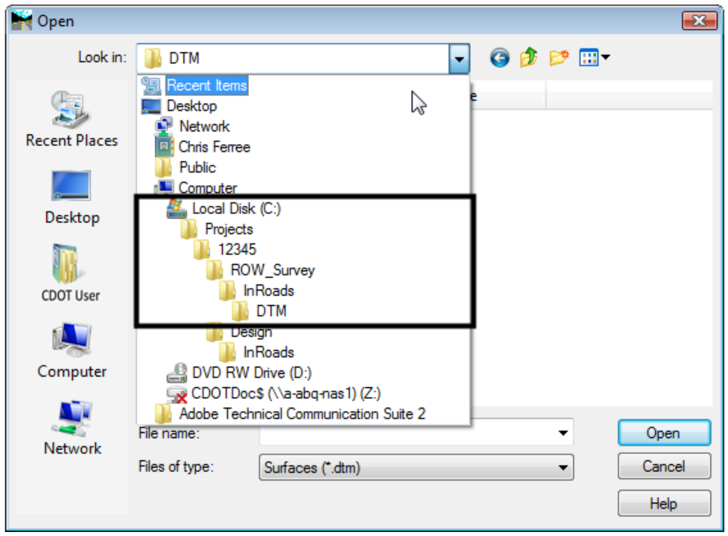
14. Highlight **12345DES_Geometry.alg** and **<D> Open**.

15. Highlight **DES12345_Templates.itl** and **<D> Open**.



Typically, the template library is copied from C:\Workspace\Workspace-CDOT_XM\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 window Look In drop down, navigate to ***C:\Projects\12345\ROW_Survey\InRoads\DTM*** folder.



17. Highlight **12345 Existing Ground.dtm** and **<D> Open**.

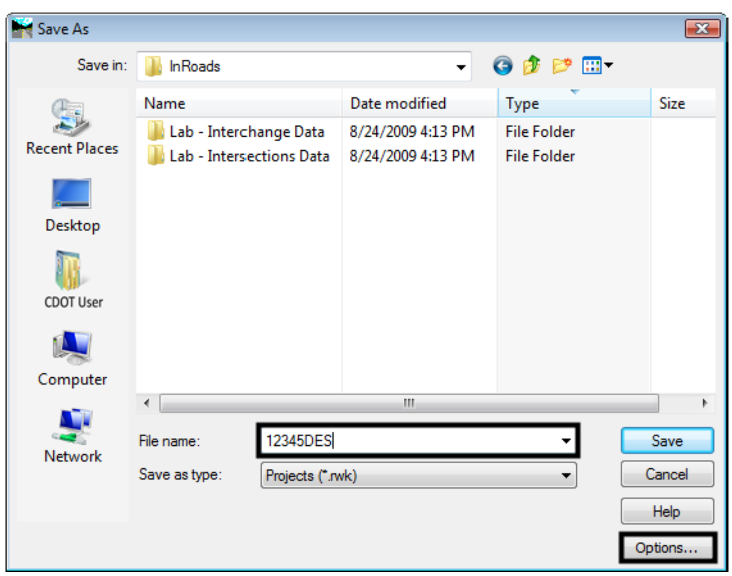
18. **<D> Cancel** to close the ***Open*** dialog box.

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.

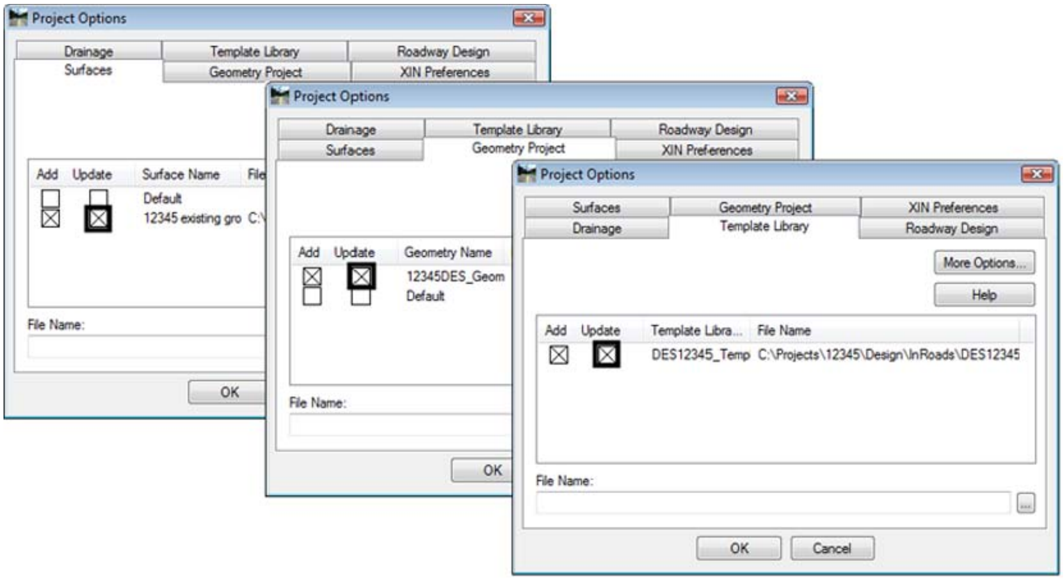
19. Select **File > Save > Project** from the InRoads menu bar. This displays the ***Save As*** dialog box.

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_XM 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

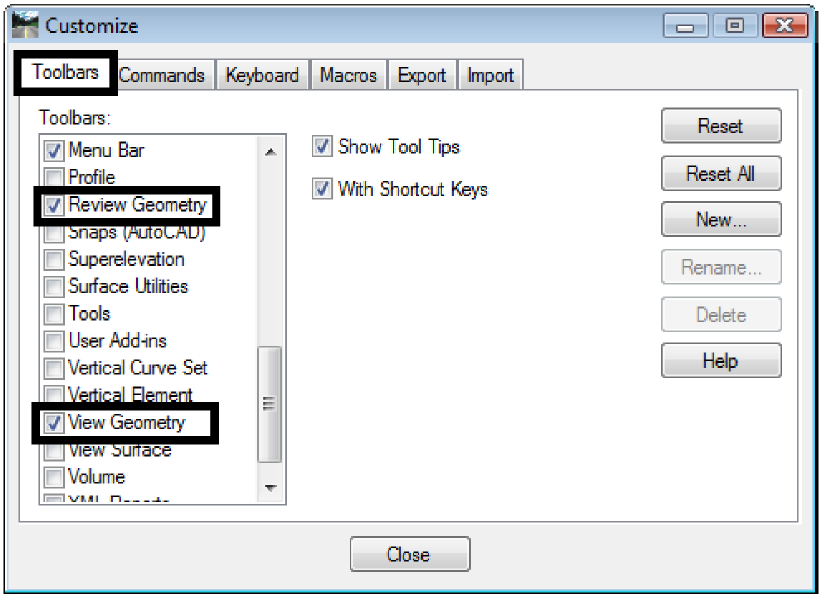
This lab demonstrates how the InRoads Interface can be populated with toolbars for easy access to commands. The pull-down menus can be used to select the correct tool, but it may be more convenient to use toolbar icons. All InRoads toolbars can be customized to fit your workflow or personal preferences.

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

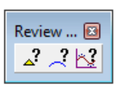
Opening Additional Toolbars

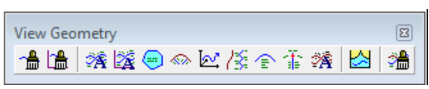
1. From the pull-down menu select **Tools > Customize**. The ***Customize*** dialog will appear.



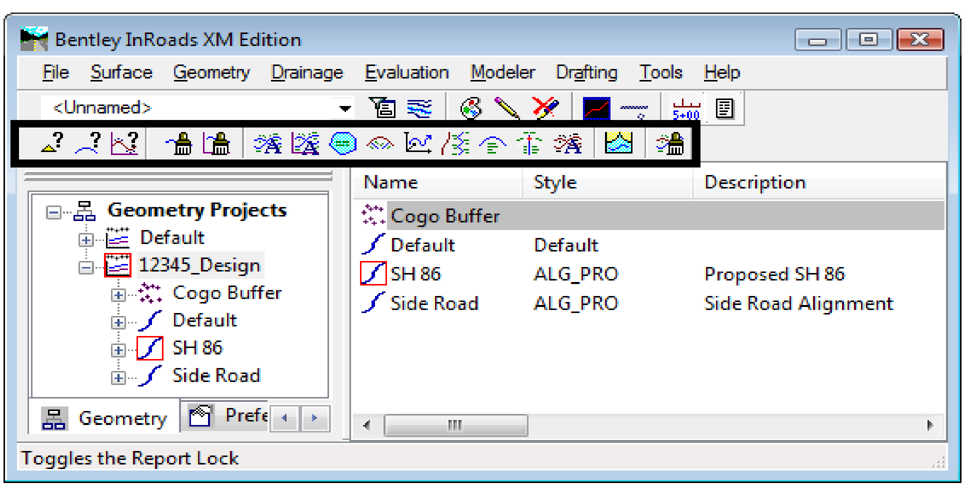
2. Under the **Toolbars** tab, check that the boxes for **Review Geometry** and **View Geometry** are selected. When checked on, the toolbars become active in the graphics file immediately.

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

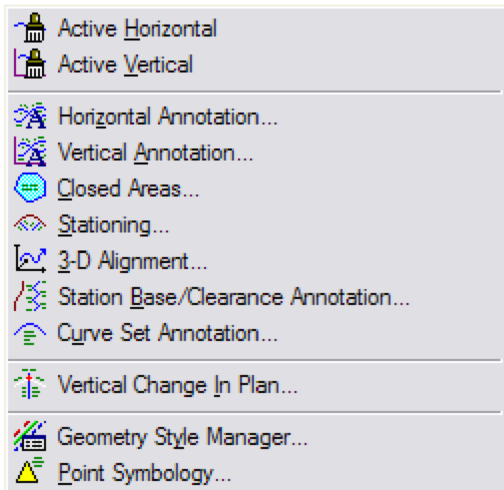


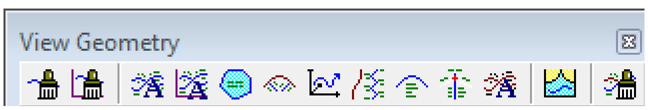


4. **Dock**, **Undock** and **Resize** the toolbars until you are comfortable repositioning them. Notice how toolbars can be docked in the InRoads interface but not MicroStation's.



5. From the pull-down menu, select **Geometry > View Geometry** look at each command and the associated image. Notice the correlation of the graphics between the pull-down menu and the toolbar.





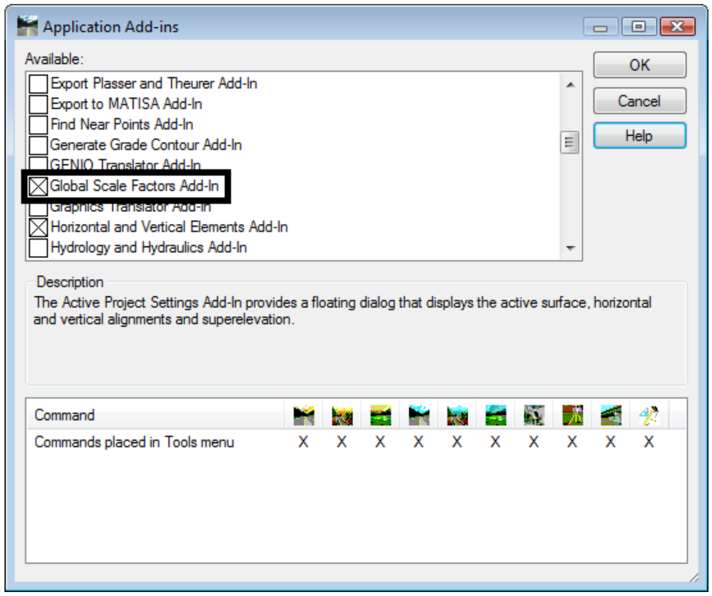
6. Place the cursor over an icon in any toolbar. A ***Tool Tip*** will appear at the lower right of the cursor, additionally a description of the command shows in the status field.

   - The tool tip feature is controlled in the ***Customize*** dialog (***Tools*** > ***Customize***) box via the ***Show Tool Tips*** checkbox 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 ***Tools*** > ***Options [Factors]*** tab. However, enabling the command directly from the menu bar is more efficient.

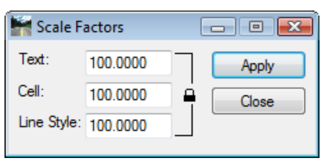
7. Select **Tools > Application Add-ins** to display a list of available InRoads commands and functions that can be added to the InRoads interface.



Selecting an item will display a description. 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.

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



10. Verify all three scale settings are set to ***100***.

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: Digital Terrain Models are not a core topic of this course. However, it is worth noting that Global Scale Factors apply to all InRoads data displayed. This includes the display of features from a DTM. While 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 Factor Add-in and how the global scale factor impacts grapics generate from InRoads commands.

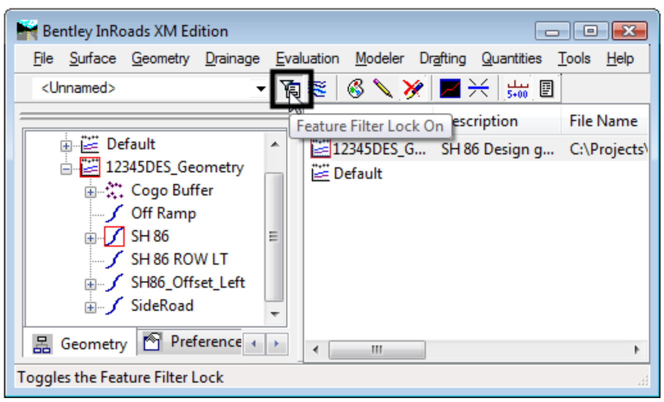
Lab 1.4 - Locks

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

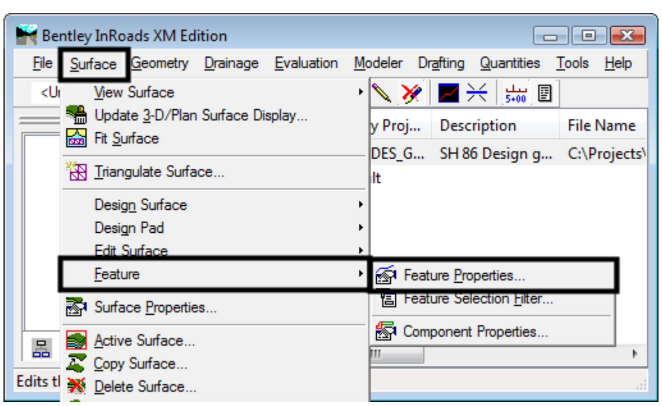
Section Objectives:

- ♦ 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.

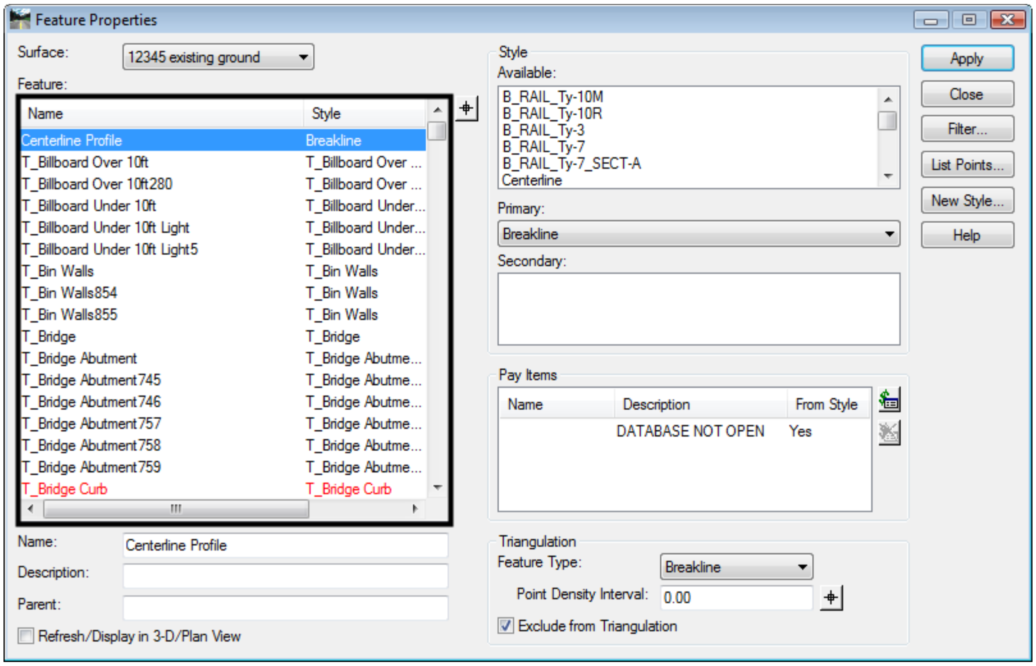
1. On the InRoads main dialog box, verify that the ***Feature Filter*** lock is ***on*** and the filter name is set to **<Unnamed>**. Unnamed is in effect no filter.



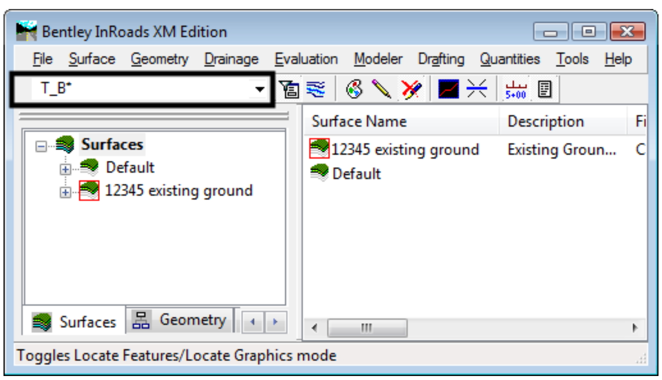
2. From the InRoads menu bar, select **Surface > Feature > Feature Properties**.



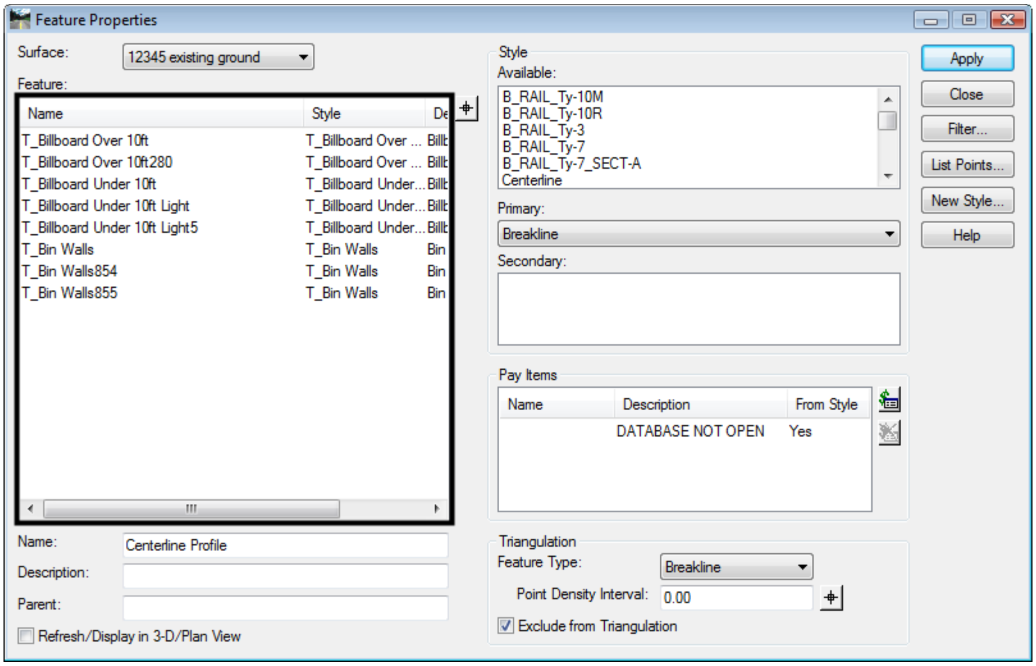
The illustration below shows the Feature Properties dialog box as displayed with no active feature filter.



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.



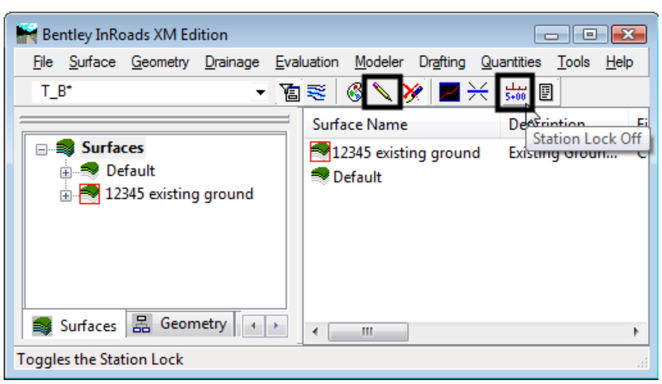
4. Close the ***Feature Properties*** dialog box.

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

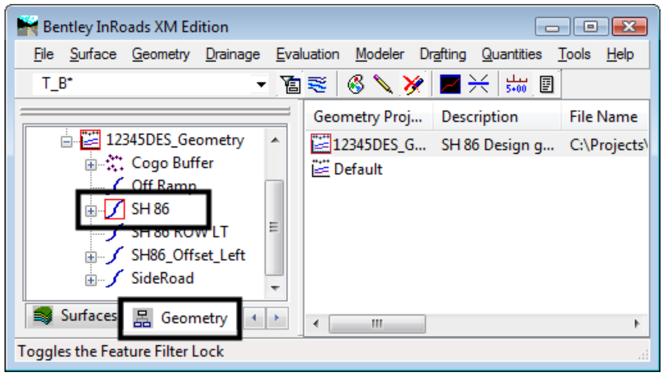
Next, the Pen/Pencil mode and the Station lock are demonstrated.

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

7. Turn the ***Station*** lock off.



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

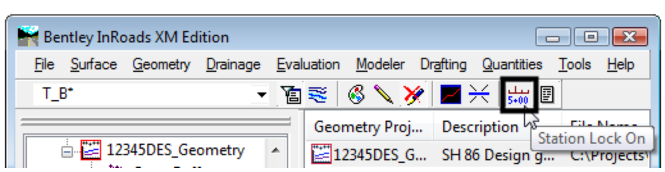


9. From the InRoads menu bar, select **Geometry > View Geometry > Stationing**.

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

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

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

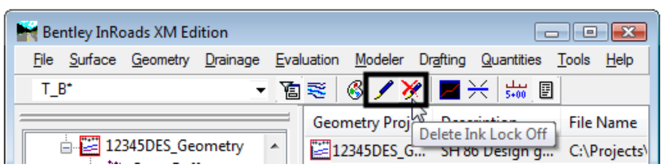


13. Redisplay the Stationing.

14. 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.

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

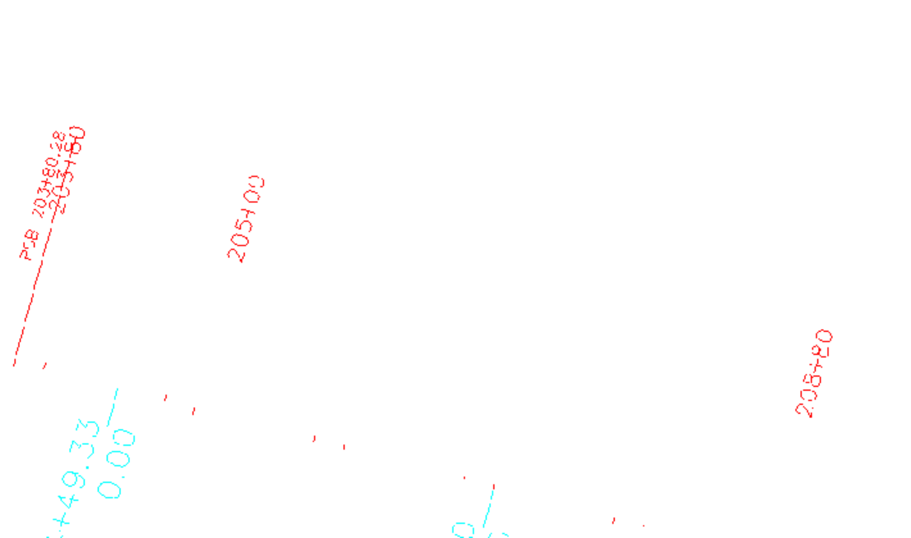
16. Turn **Delete Ink** off. ***Delete Ink*** makes ***Pen*** mode behave like ***Pencil*** mode. It is turned off here to illustrate ***Pen*** mode.



Next, Pen mode is demonstrated.

17. Redisplay the Stationing. The stationing will appear the same as it did in the previous step. This is done so that the stations are displayed with Pen mode. Stationing displayed in Pencil mode will always behave in Pencil mode.

18. 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.



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.

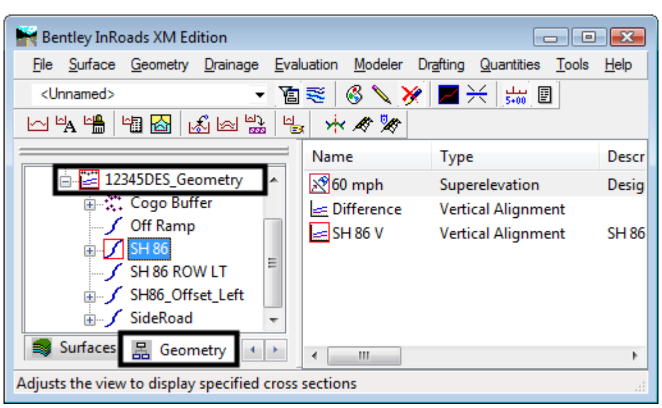
Lab 1.5 - Precision and Factors

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 **12345DES_Geometry** to show the ***SH 86*** alignment.

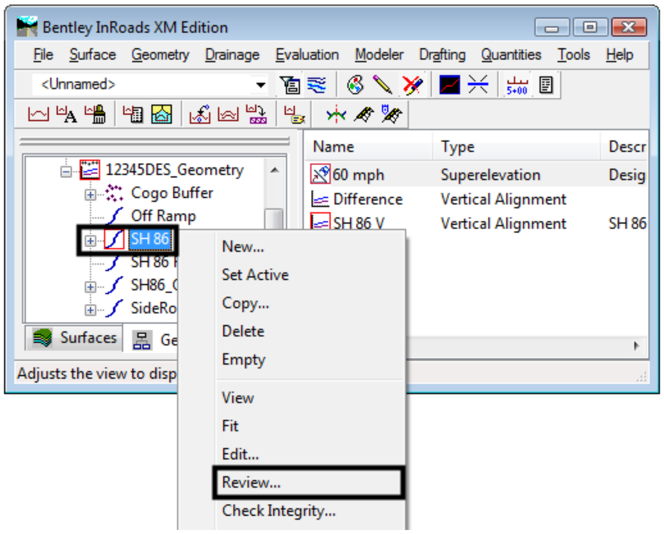


3. From the InRoads menu bar, select **Tools > Options**.

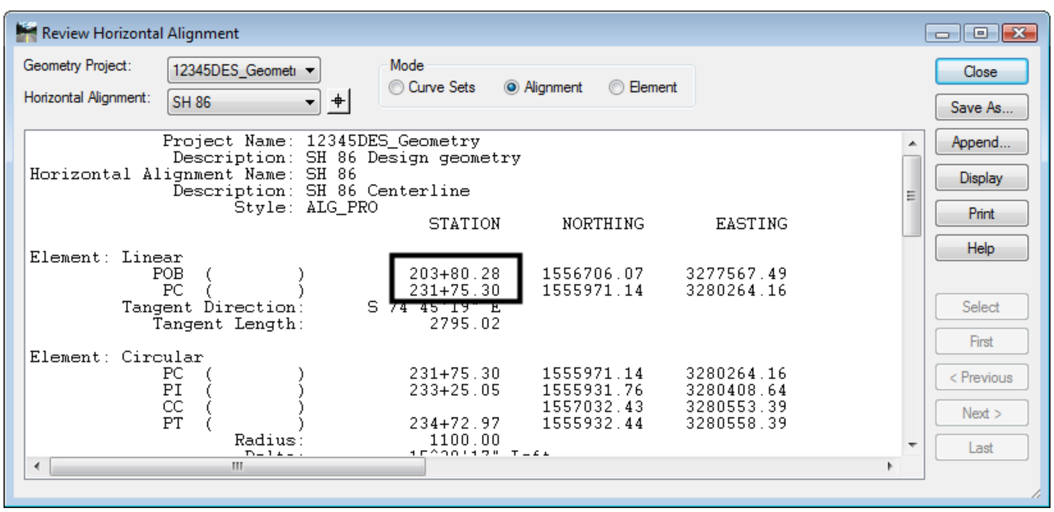
4. Verify that the ***Precision*** tab is active.

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.



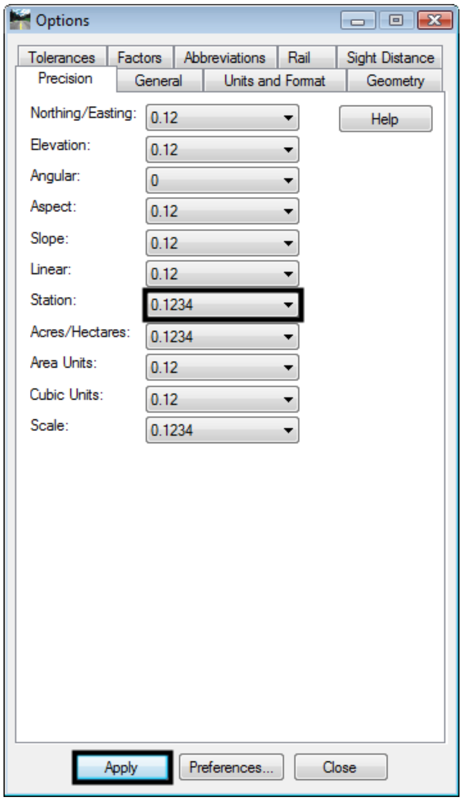
In the Review Horizontal Alignment dialog box, notice that the stations have 2 decimal places.



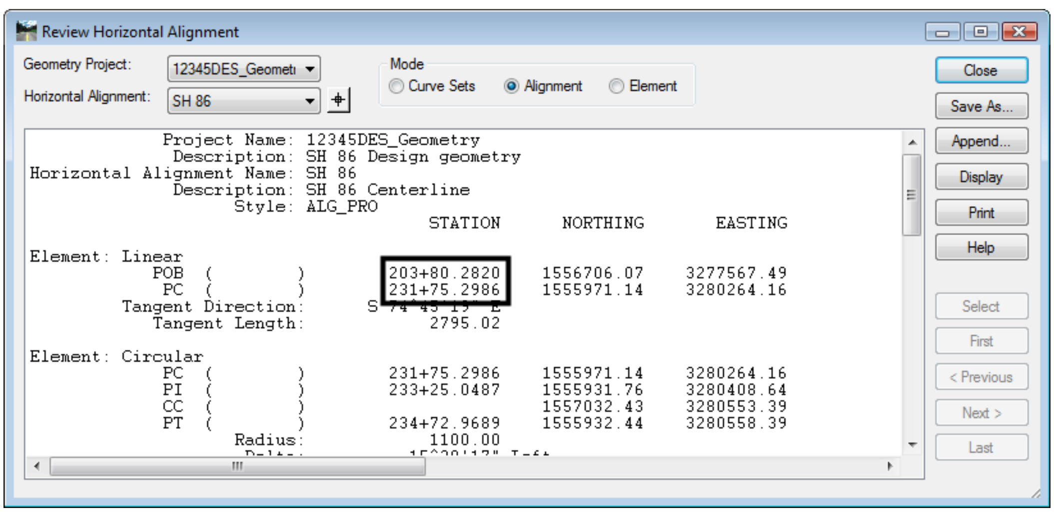
6. **Close** the ***Review Horizontal Alignment*** dialog box.

7. In the ***Options*** window, change the ***Station*** precision to **0.1234**.

8. **<D> Apply**.



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

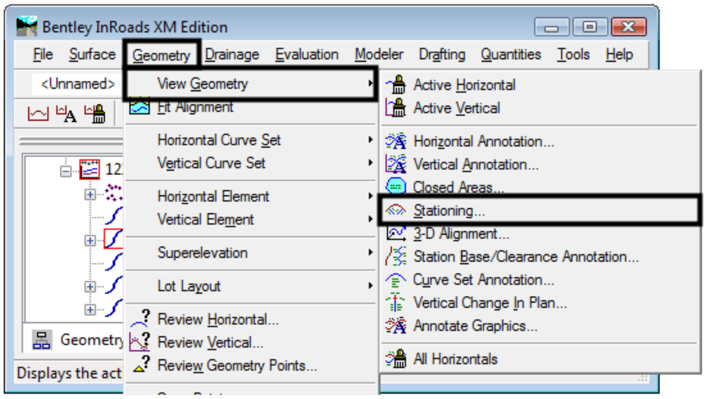


Notice that the stations now show 4 decimal places. Next the affects of factors is demonstrated.

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

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

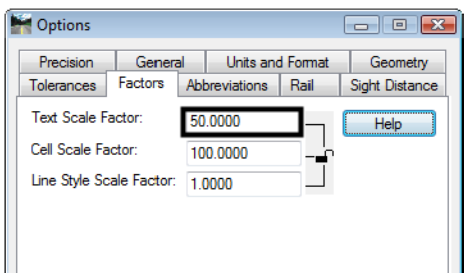
12. From the InRoads main menu, select **Geometry > View Geometry > Stationing**.



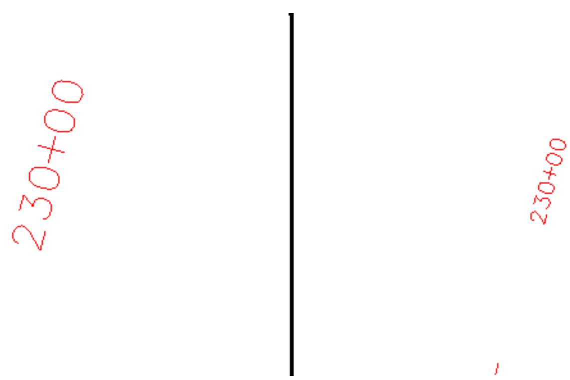
13. On the ***View Stationing*** dialog box, **<D> Apply**.

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

15. On the 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, 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 more detailed review of the contents of the ***12345DES_Geometry*** geometry project ***(12345DES_Geometry.alg)*** file used in the previous lab.

The ***12345DES_Geometry*** geometry project is a collection of all the data from the initial topographic survey. Existing linear objects such as pavement lines, breaklines, streamlines, etc are stored as horizontal alignments. Survey shots of singular features such as signs, utilities, ground shots, trees, etc. are written to the cogo buffer and stored as individual points.

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 exisisting 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
- C:\Projects\12345\Design\InRoads\12345 existing ground.dtm

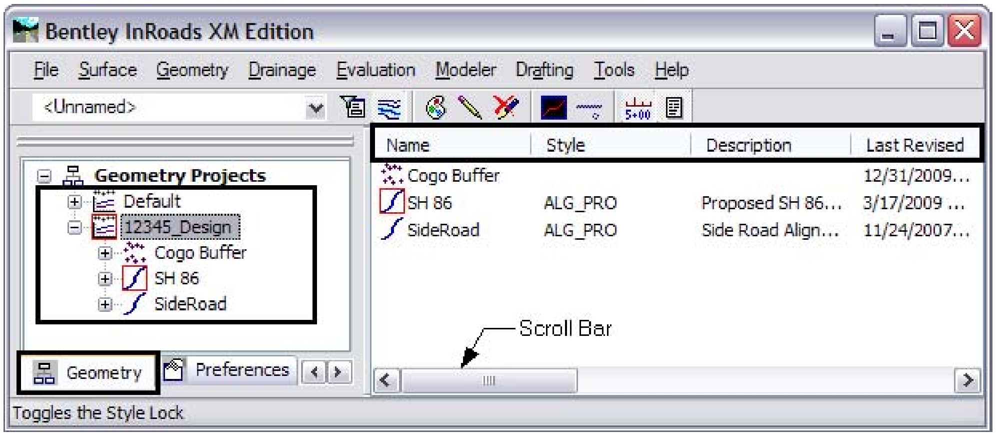
Lab 2.1 - Review Geometry Project

Section Objectives:

- ♦ Verify the correct geometry is loaded.
- ♦ 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 infomation.

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**. You should see something similar to the image below.



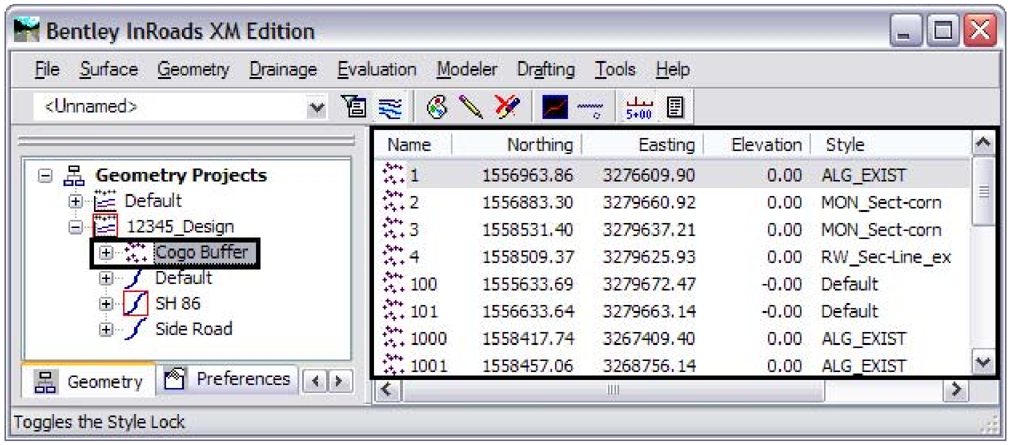
3. **Expand** the screen display of the geometry project by selecting the + (plus) symbol located to the left of the geometry project name.

4. Look to the right side of the InRoads pane. 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 should see but may be in a different order:

   - ***Name*** - The horizontal alignment name and the Cogo Buffer are shown here.
   - ***Style*** - The Style name attached the 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 alignmentis 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.

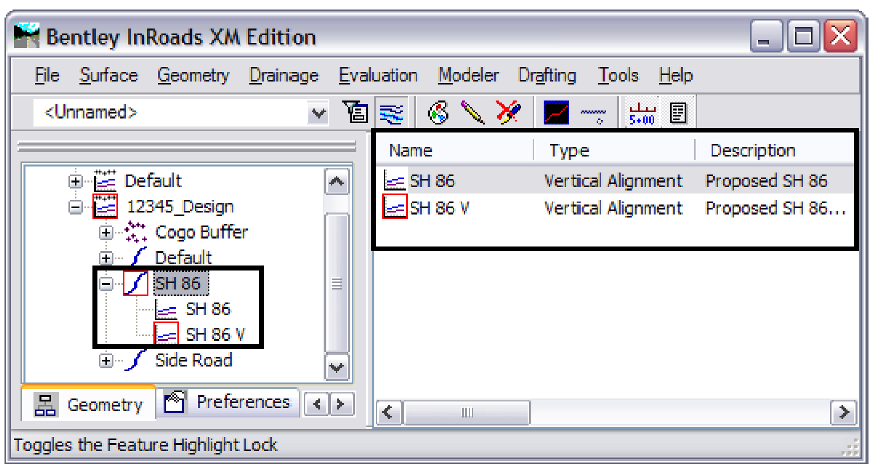
5. **<D>** on any of column headings to sort ascending or descending.

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.



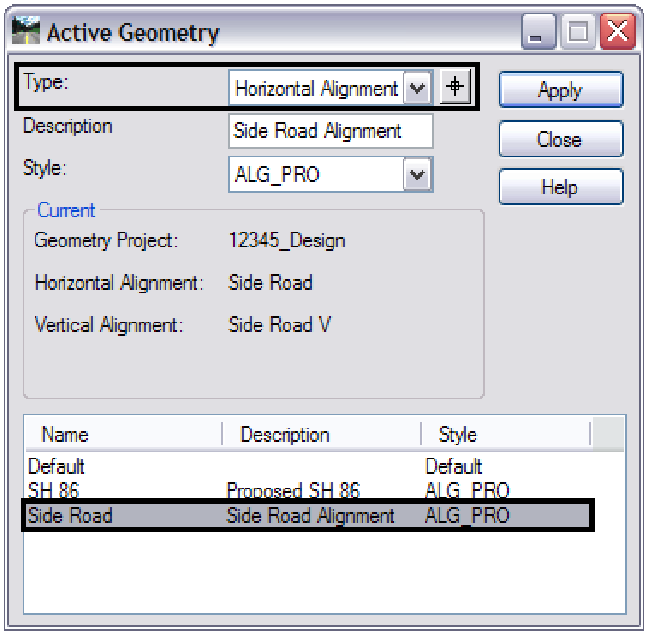
7. **<D>** on the Cogo Buffer. Notice the detail screen to the right showing the contents of the Cogo buffer. Also notice the columns showing Northing, Easting, and Elevation by adjusting the view pane.

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



Note: 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.

9. Select **Geometry > Active Geometry.** The ***Active Geometry*** dialog will appear.

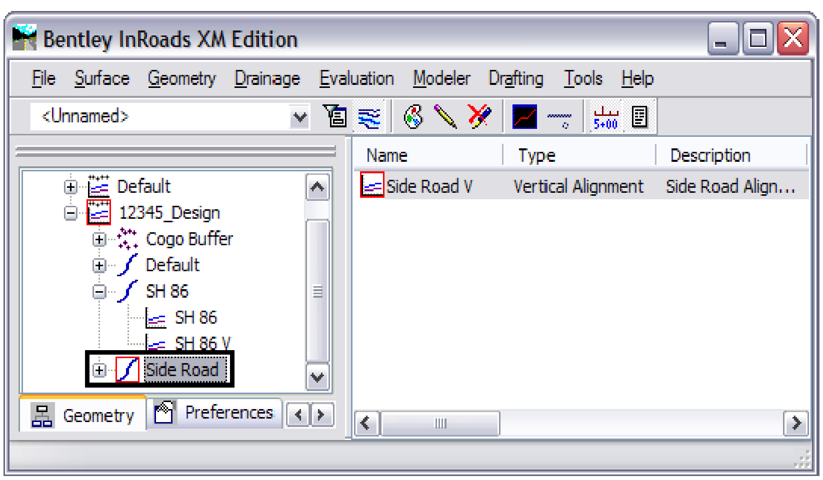


10. Set ***Type*** to **Horizontal Alignment.**

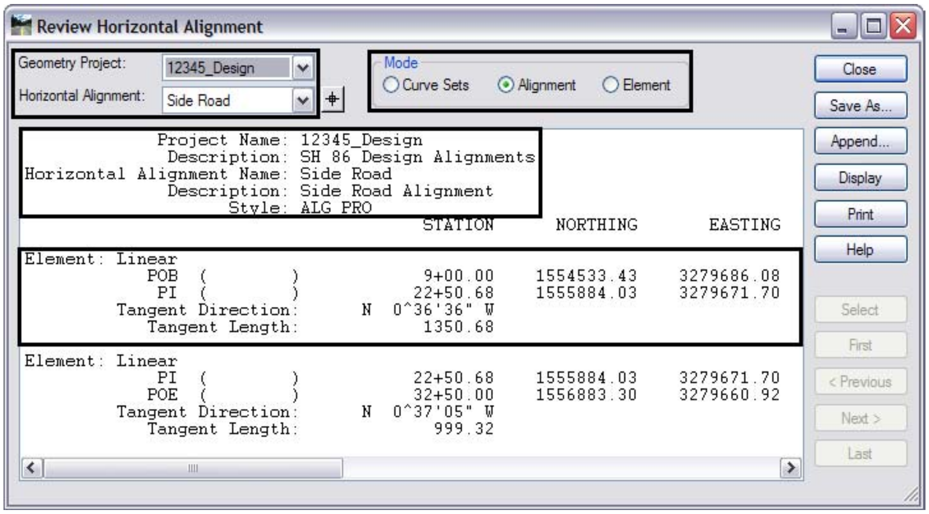
11. **<D>** on alignment **Side Road.**

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 infomation in the dialog box changes
- ***Geometry header (in the veiw port)***
  - Note the change to the **P*roject Name, Description, Alignment name***, ***Description, Geometry Style***
- ***Element Details (in the veiw port)***
  - Note how 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.

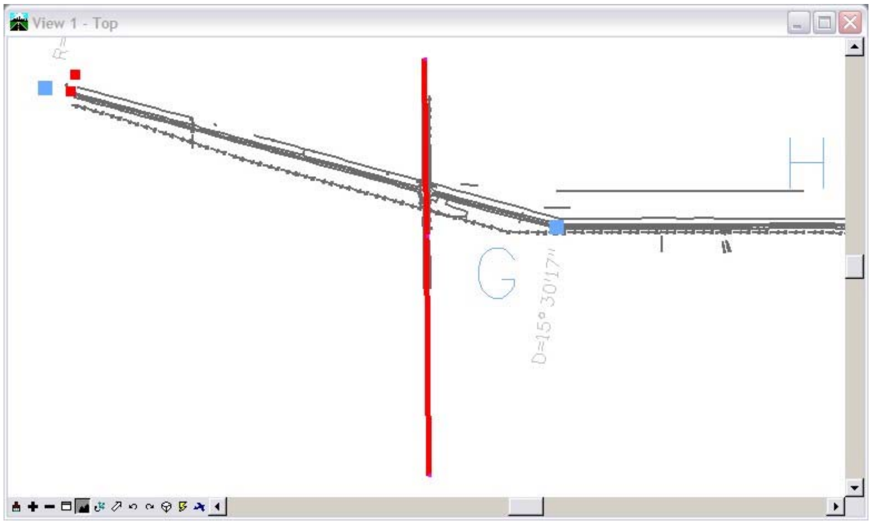
16. **<D>** the **Close** button**.**

17. Select **Geometry > View Geometry > Active Horizontal** to write the alignment to the MicroStation file**.**

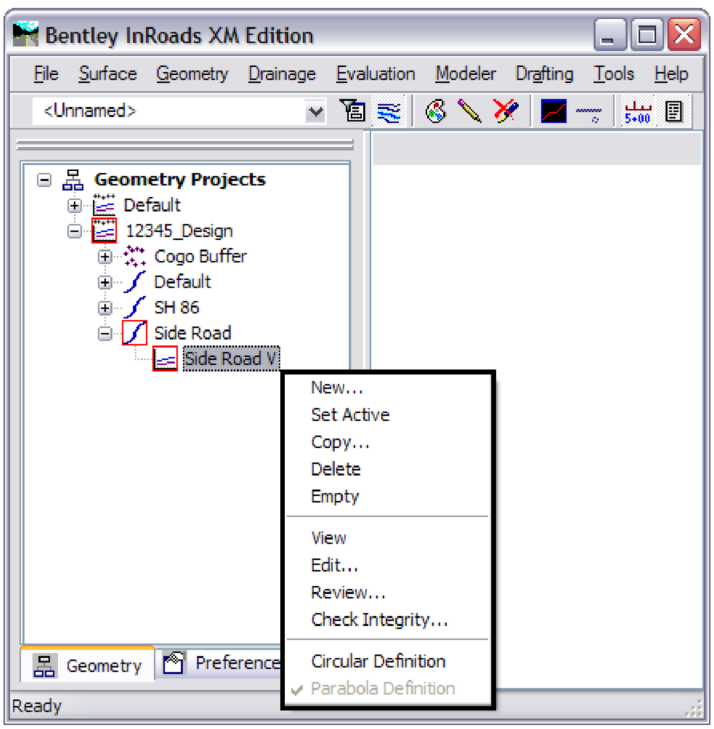
Note: It may appear that nothing happend. This is because the view window is not postioned correctly to see the data. The next step will resolve this.

18. 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, us the key in ***dp = -10000, 30000*** and left click in View 1 to expand the MicroStation clipping planes.

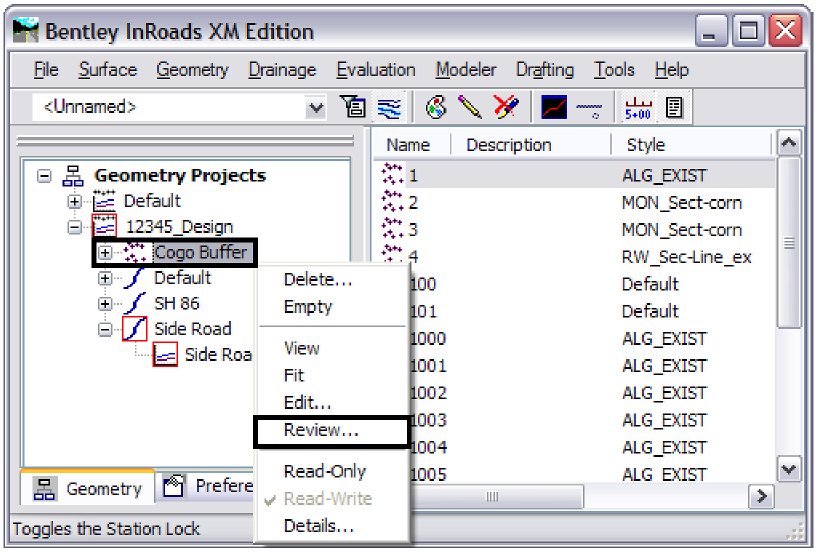


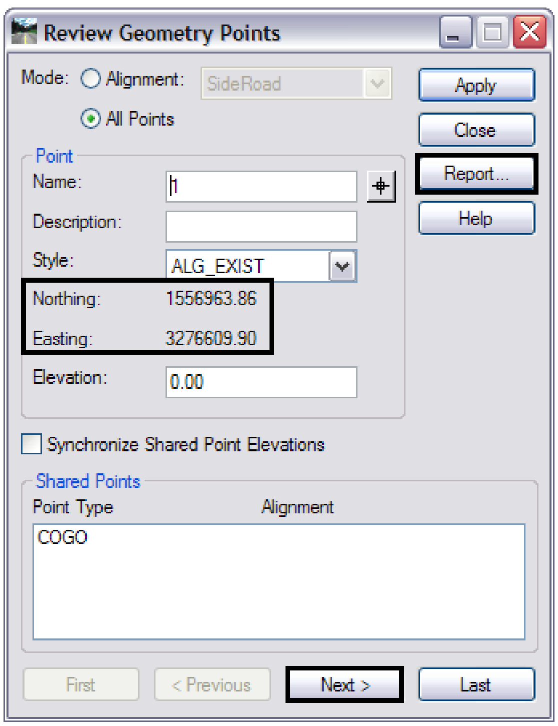
19. In the Workspace Bar **<R>** (right-click) on the active alignment name. Note the ***Active***, ***View***, ***Fit***, and ***Review*** commands are available from the short-cut fly-out menu.



20. Experiment using this fly-out menu with any alignment.

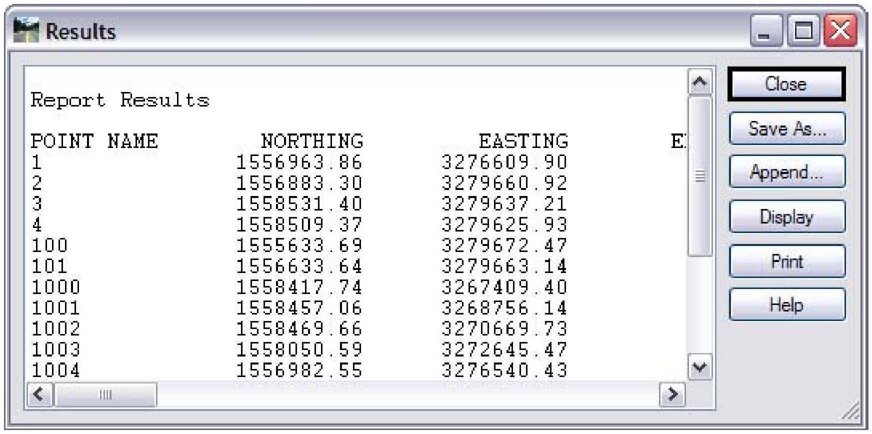
21. In the Workspace Bar **<R>** on the **Cogo Buffer** and select **Review…**. The ***Review Geometry Points*** dialog will appear.





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

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



Note: The buttons on the right side of the ***Results*** dialog allow you to save or display this report. These options exist in many InRoads dialogs.

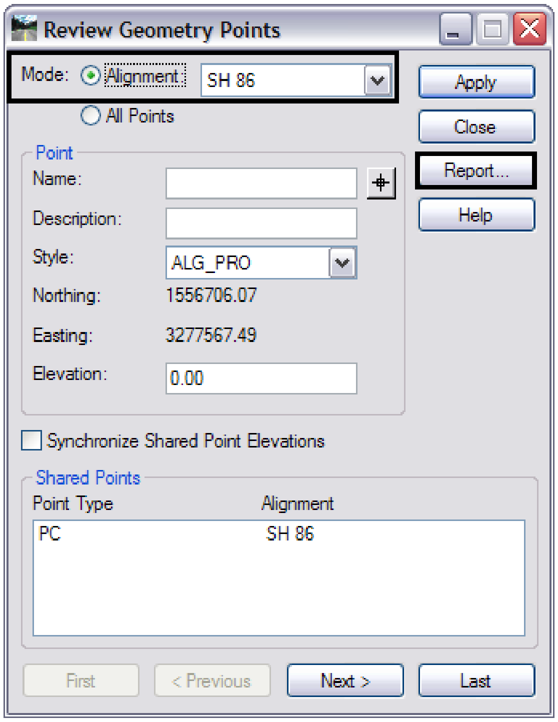
24. They are:

- ***Close*** - closes the ***Results*** dialog
- ***Save As*** - saves the contents of the dialog 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.

25. **<D>** the **Close** button in the ***Results*** dialog

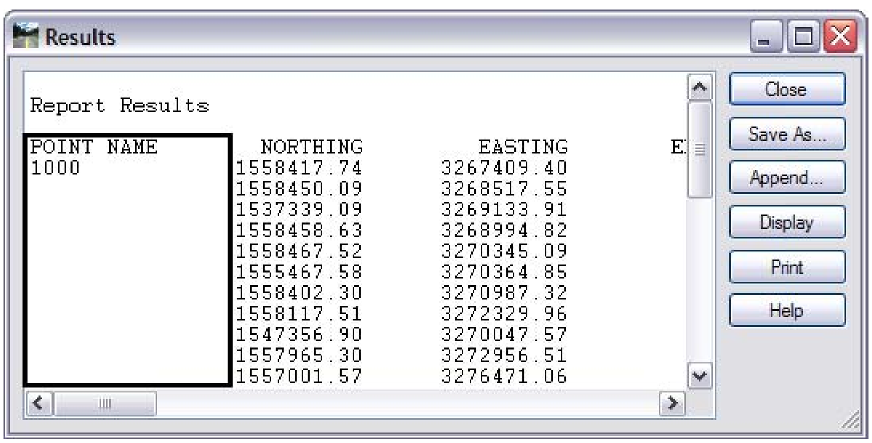
26. In the ***Mode*** section of the ***Review Geometry Points*** dialog, toggle the radio button to **Alignment**. Notice how the Alignment drop-down list is activated.

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



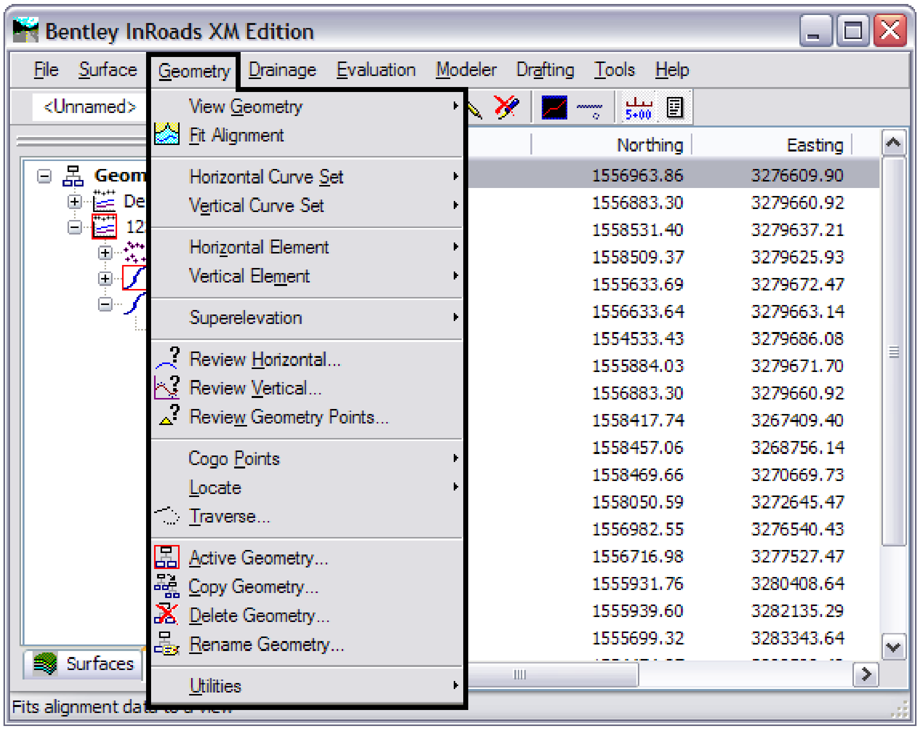
28. **<D>** the **Report** button again to review the vertices of the selected alignment.

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.



29. **<D>** the **Close** button in both the ***Results*** and ***Review Geometry Points*** dialogs.

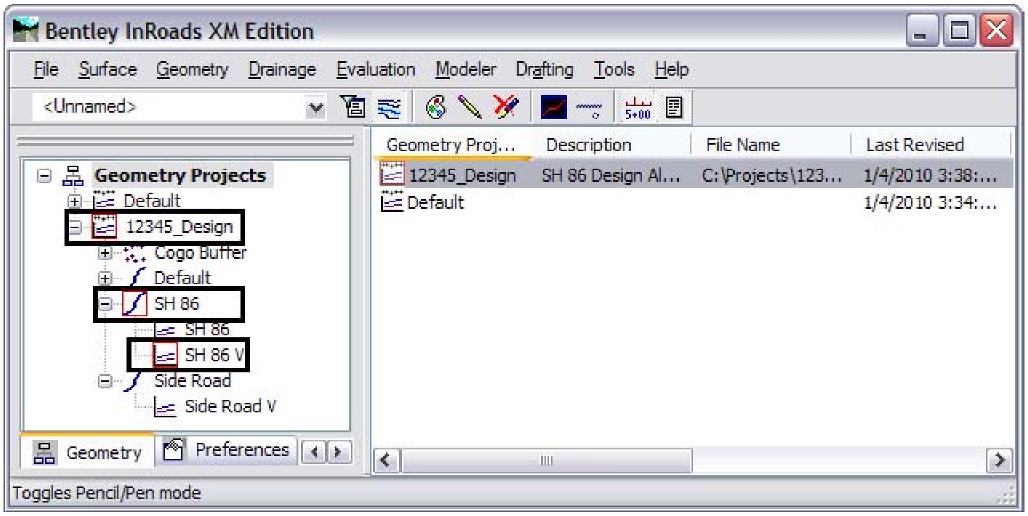
Note: The previous steps used the short-cut fly-out menus, all actions can also be found under the ***Geometry*** pull-down menus.



At anytime during these labs you can 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 can be redisplayed using the InRoads display commands shown in previous sections.

Note: The screened topography and the graphics used as training guides are either locked graphics or are attached as a reference file so they can not be deleted. These graphics will be used in future labs.

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.



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

31. 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.

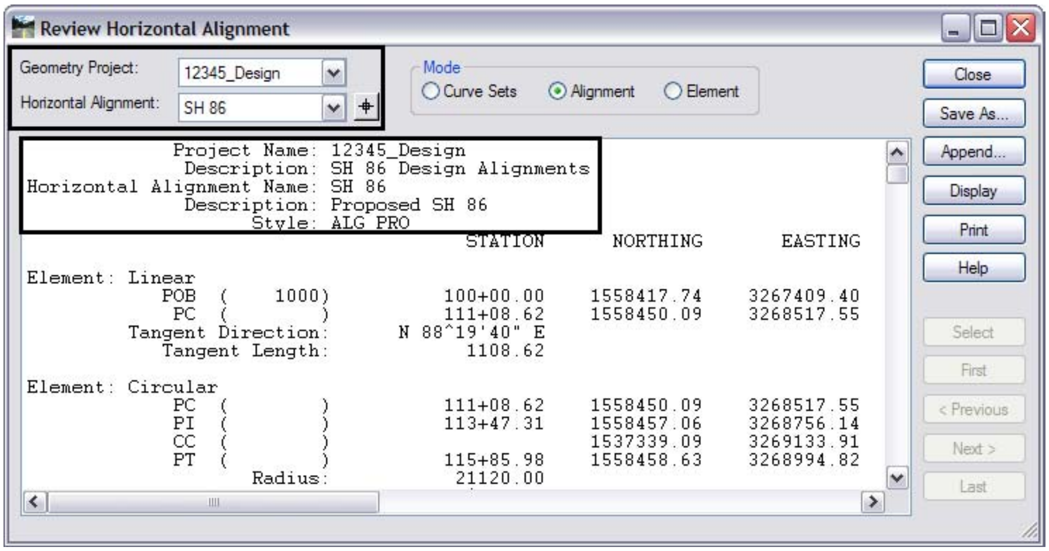
Lab 2.2 - Review Alignment Attributes

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

Section Objectives:

- Review Alignment Attributes
- Review Cogo Point Attributes

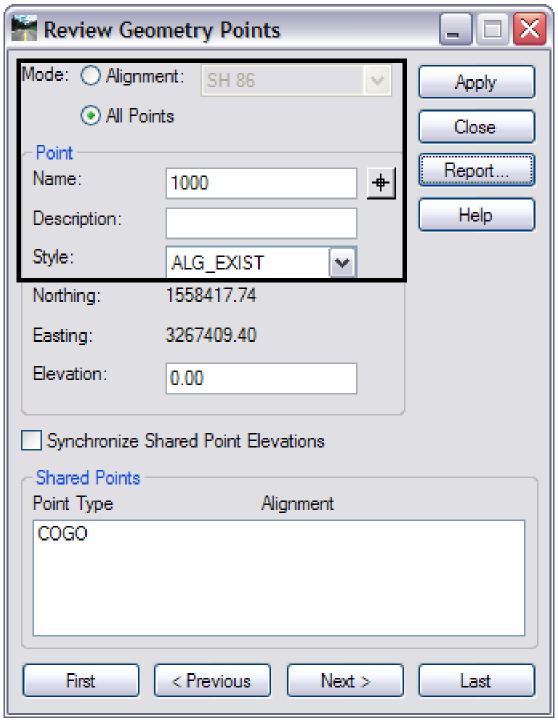
1. Select **Geometry > Review Horizontal…**



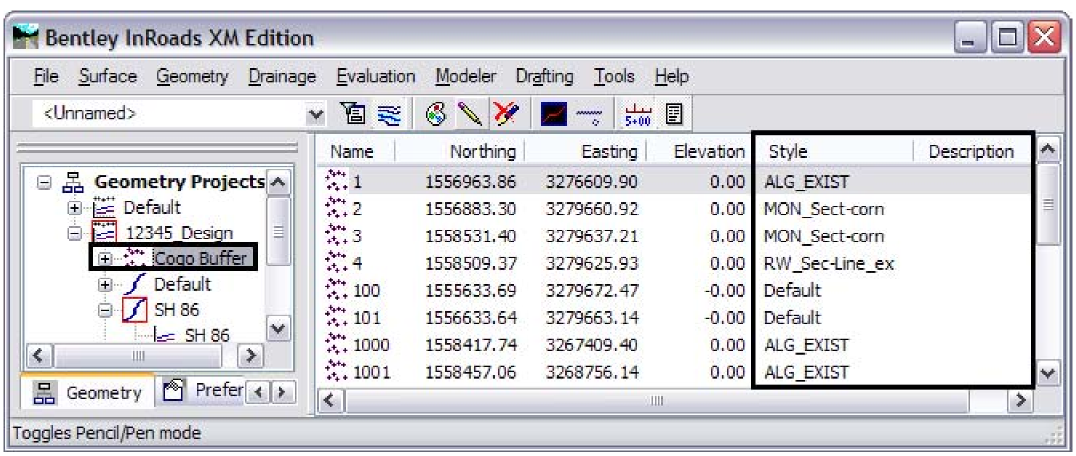
2. Using the selection box labeled ***Horizontal Alignment***, **Compare** the settings for alignment **SH 86** with the attributes for ***alignment*** **Side Road**. Note the changes in Description & Style.

3. Select **Geometry > Review Geometry Points…** to review Cogo point names, descriptions, and style assignments.

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



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



Note: If the ***Style*** assigned to the data is not a valid name when displaying an alignment or Cogo point (not existing in the Style Manager), a ***Style*** by the name ***Default*** will be used.

The ***Default*** CDOT Style for all geometry elements has the same properties as the defined style ***ALG_Proposed***.

Section Summary:

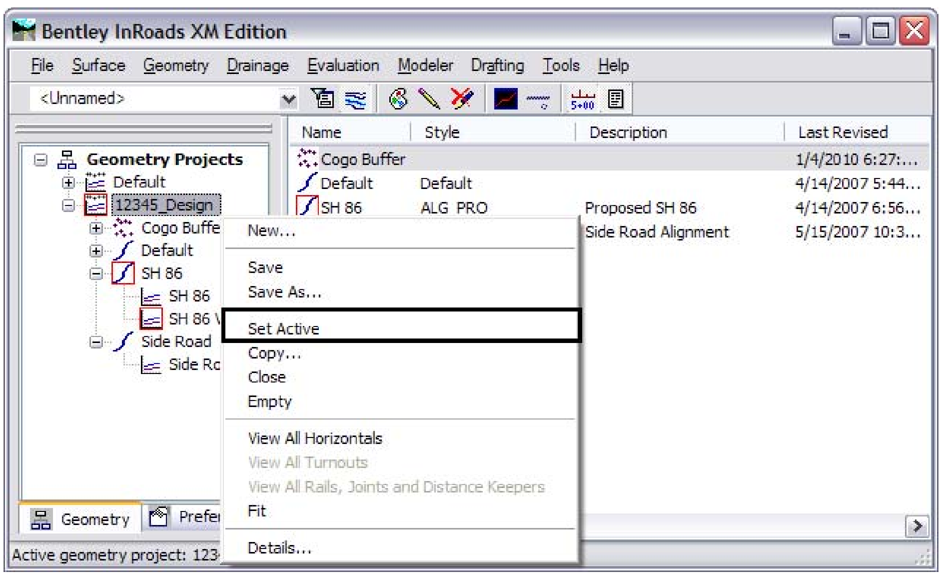
- ♦ Geometry styles are stored along with surface and survey styles in the CDOT_Civil.xin file.

Lab 2.3 - Review Alignment Stationing

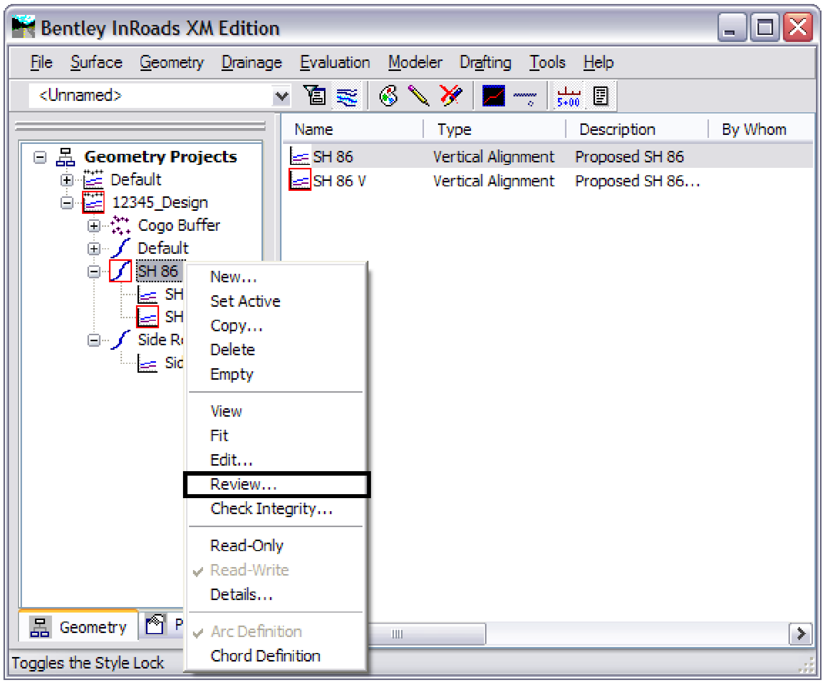
The default station at the beginning of a newly created horizontal or vertical alignment is 0+00. If the alignment previously existed, the beginning station may not be 0+00. Stationing values value can be changed to accomodate the needs of the project as shown in a later lab.

The first thing to do is to determine the existing assigned stationing values by using the alignment review commands.

1. Make **12345DES_Geometry** the active geometry project by **right-clicking** on the geometry name and selecting **Set Active** from the fly-out menu.

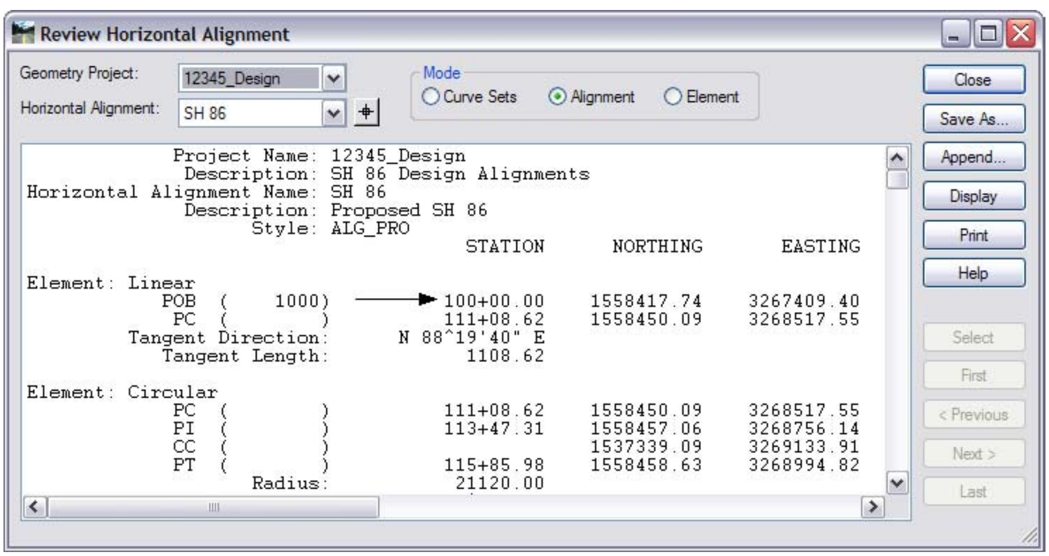


2. **Right-click** on the alignment **SH 86** and select ***Review*** from the Fly-out menu. The ***Review Horizontal Alignment*** dialog will appear.

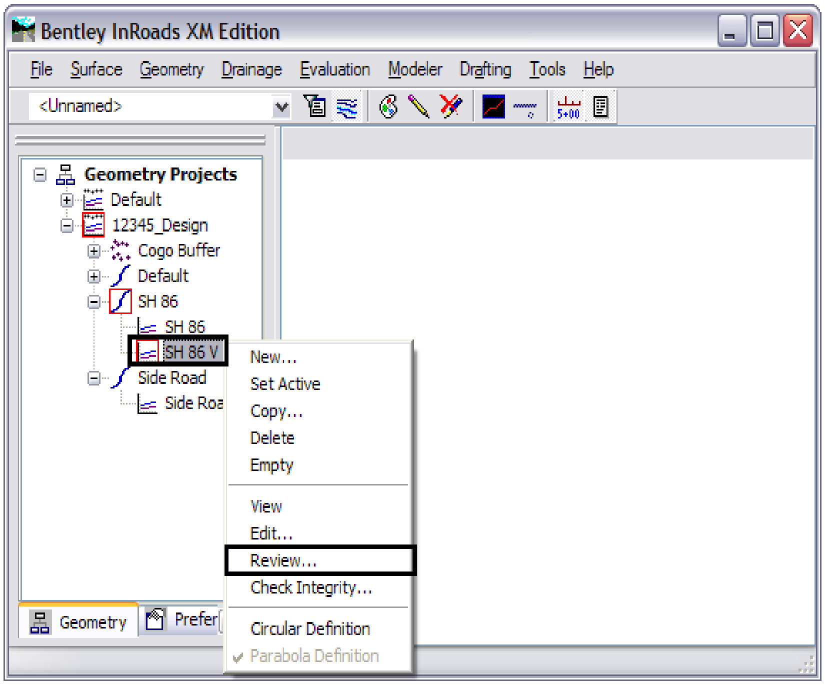


Note: Fly-out menus can be access from either the workspace or feedback panes. Also note that selecting an alignment for review switches it to being the ***active*** alignment.

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

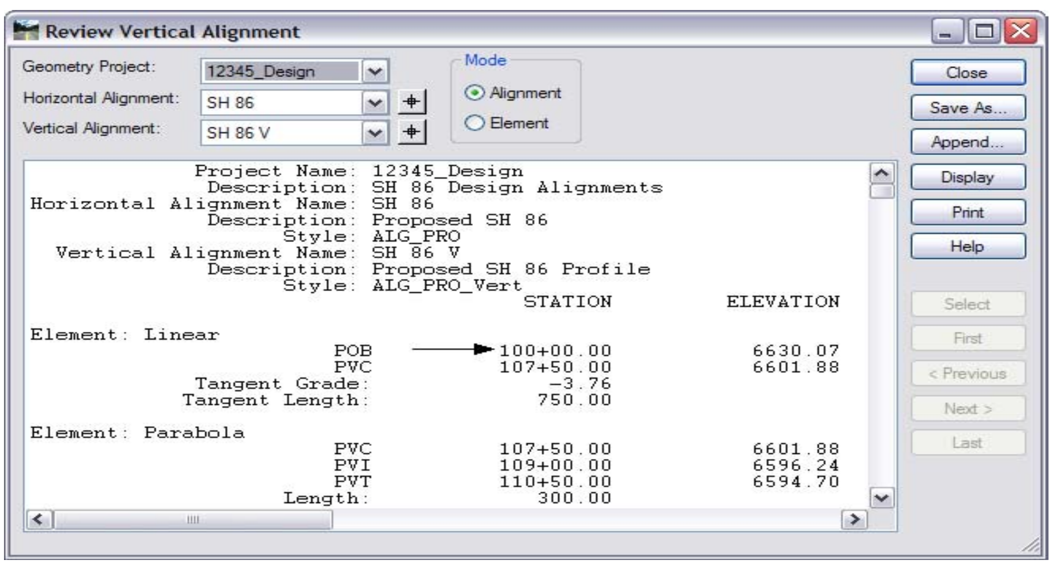


4. Review the ***Vertical*** alignment **SH 86 V** associated with horizontal alignment SH 86.



5. Write down the initial station value assigned to vertical alignment **SH 86 V:**

___________.



If the horizontal and vertical stationing are not sychronized it will cause confusion in the design and construction processes. Is the stationing for the horizontal and vertical alignments synchronized?

Section Summary:

- The beginning and ending stations cna be found in the feedback 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 th ereview dialog boxes to move through long reports.
- The attributes for geometry elements can be found in the feedback window 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_Model.dgn
- C:\Projects\12345\Design\InRoads\12345DES_Geometry.alg
- C:\Projects\12345\Design\InRoads\12345 existing ground.dtm

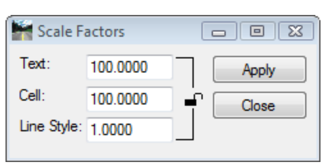
Lab 3.1 - Geometry Display

Section Objectives:

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

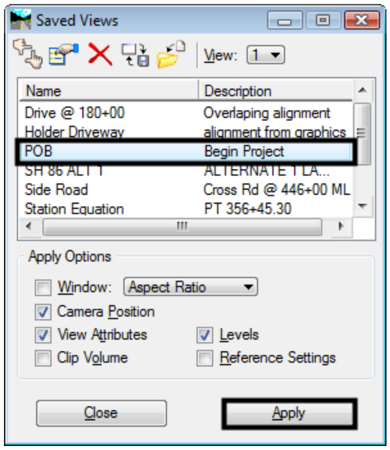
Options for displaying horizontal alignments are available when using the **Horizontal Annotation** dialog.

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

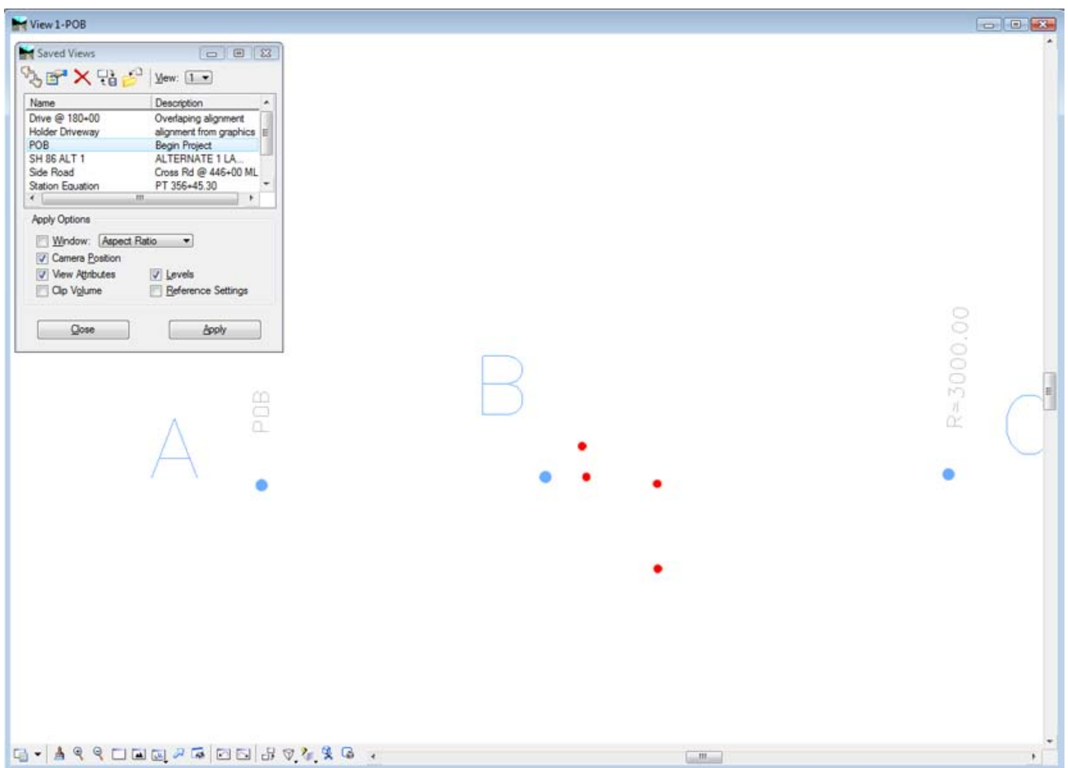


2. Using the ***MicroStation*** menus, select **Utilities > Saved Views** tools to open the saved views dialog.

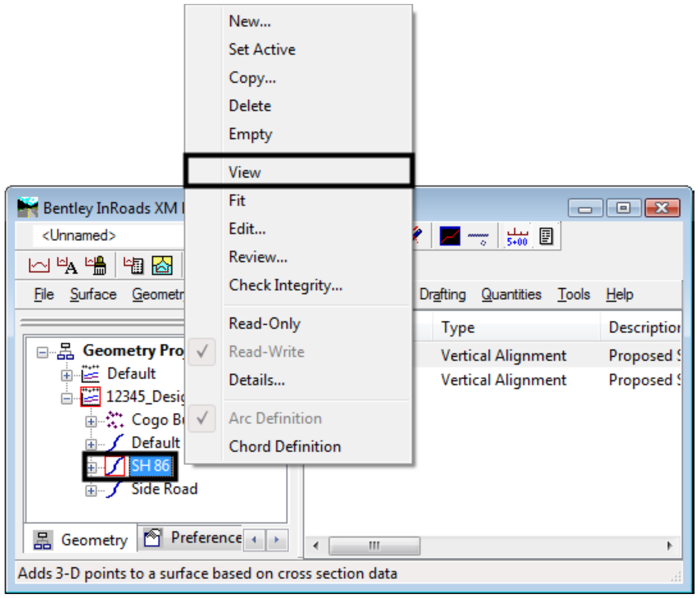
3. **<D>** on the name **POB**, **<D> Apply** for view **1**, and **<D> Close**.

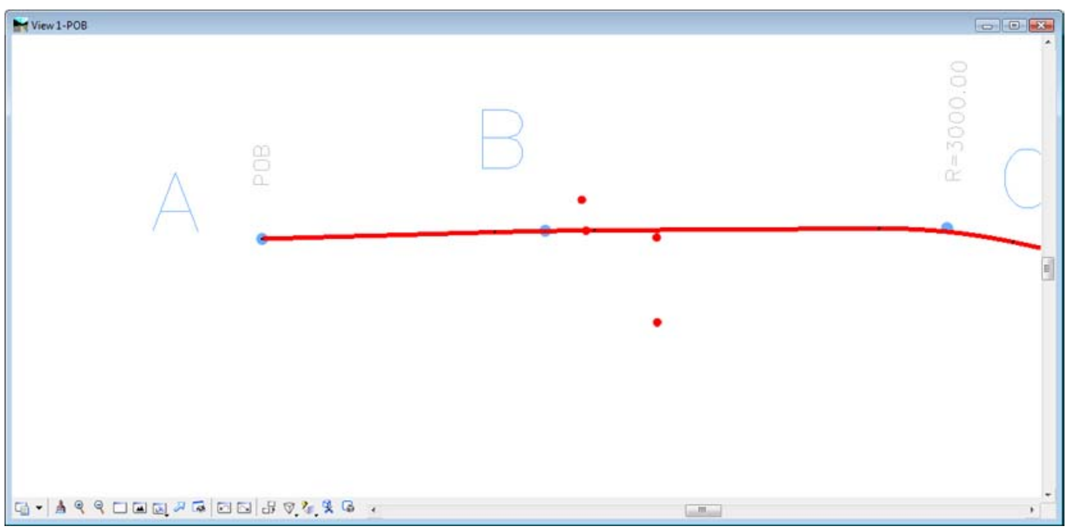


Below is an example of the saved view.



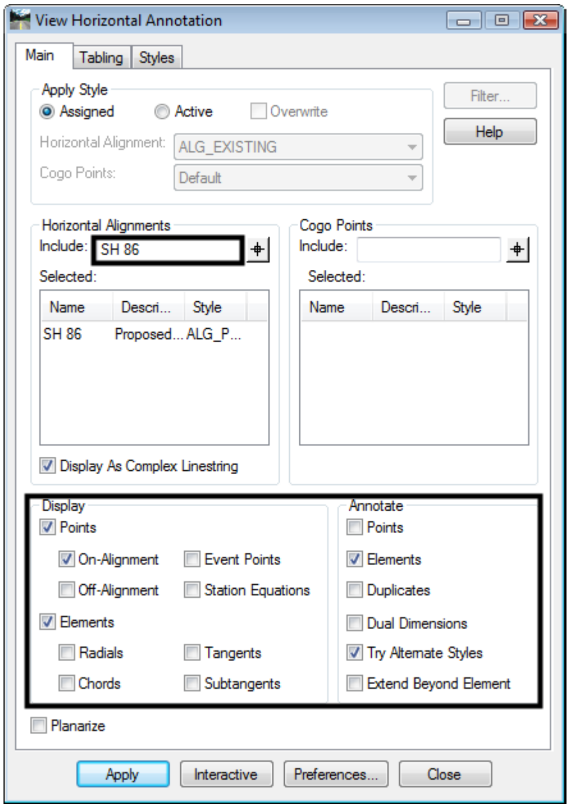
4. Display alignment **SH 86** from the Geometry Project ***12345_Design*** by right-clicking **<R>** on the alignment name and selecting **View** from the fly-out menu.





The alignment display is based on the geometry style assigned to the alignment. This display method is suitable but does not allow the user any options or allow annotation of the geometry. The next steps illustrate how to customize the graphics display for geometry elements.

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

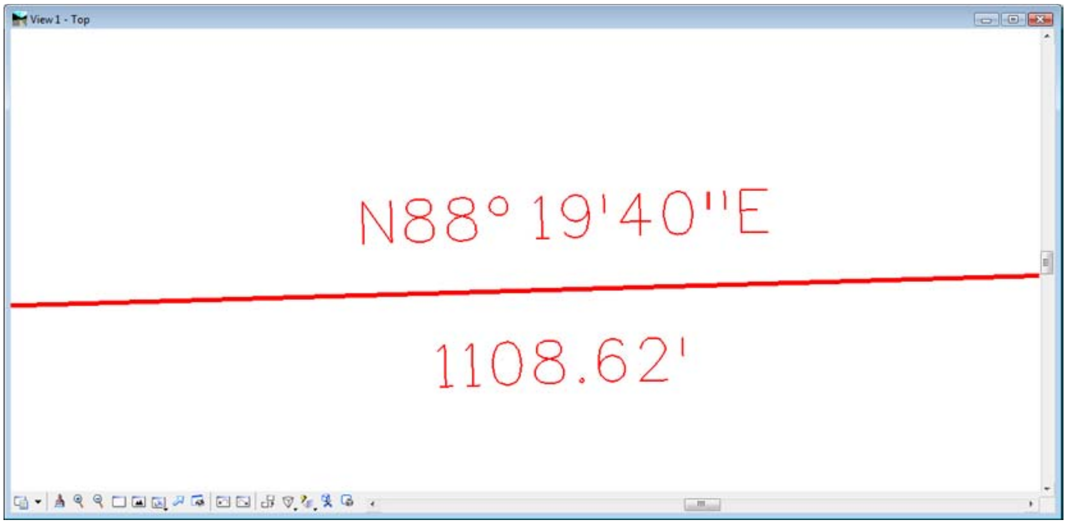


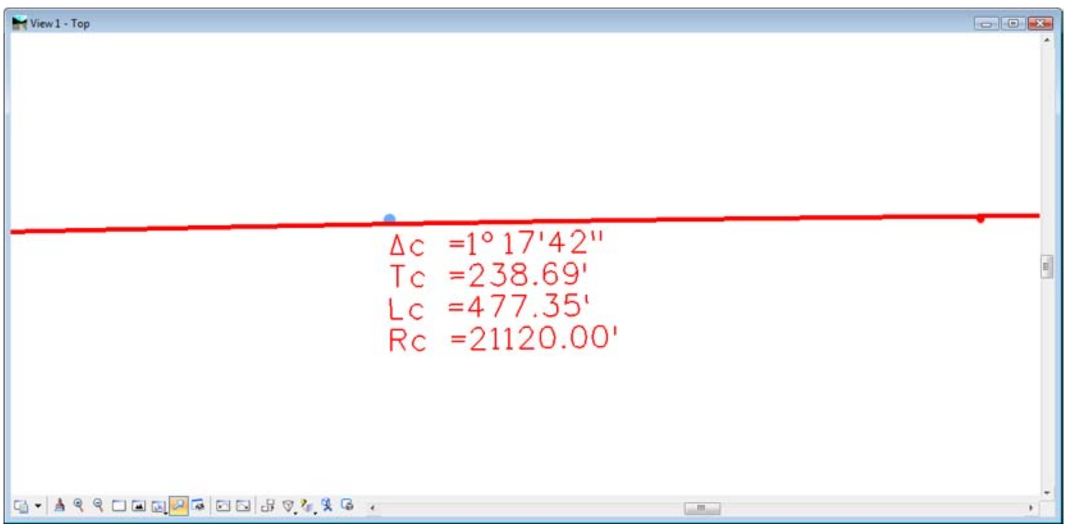
6. Key in ***SH 86*** in the ***Annotate*** field and ***Tab*** from the field.

7. Set options for the ***Display*** and ***Annotate*** sections of the dialog as shown in the above screen shot.

8. **<D>** the **Apply** button. This will write alignment ***SH 86*** to the MicroStation Screen and annotate the alignment.

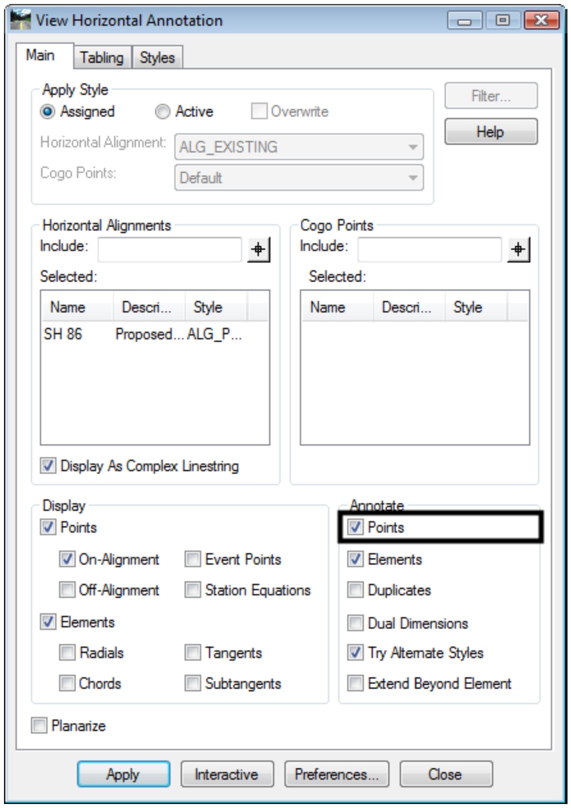
Note how ***Bearing*** and ***Distance*** annotation is displayed along the tangents. If the alignment contains horizontal curves, curve data will be displayed.



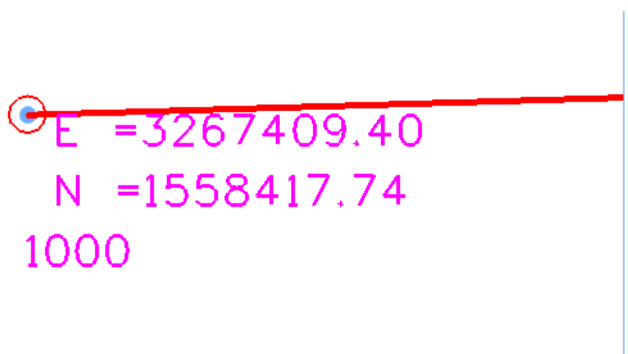


9. Return to the **View Horizontal Annotation** dialog.

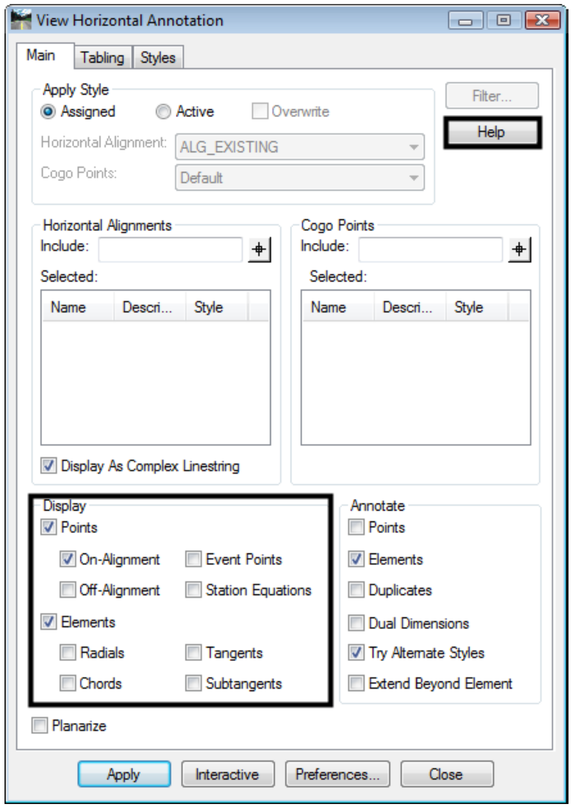
10. In the ***Annotate*** area of the ***Main*** tab, Toggle on ***Points***, **<D> Apply**



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



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



12. Experiment displaying an alignment with ***Points*** and ***Elements*** turned on or off on both the ***Display*** tab and the ***Annotate*** tab.

13. Experiment displaying the various components available in the display portion of the dialog.

Section Summary:

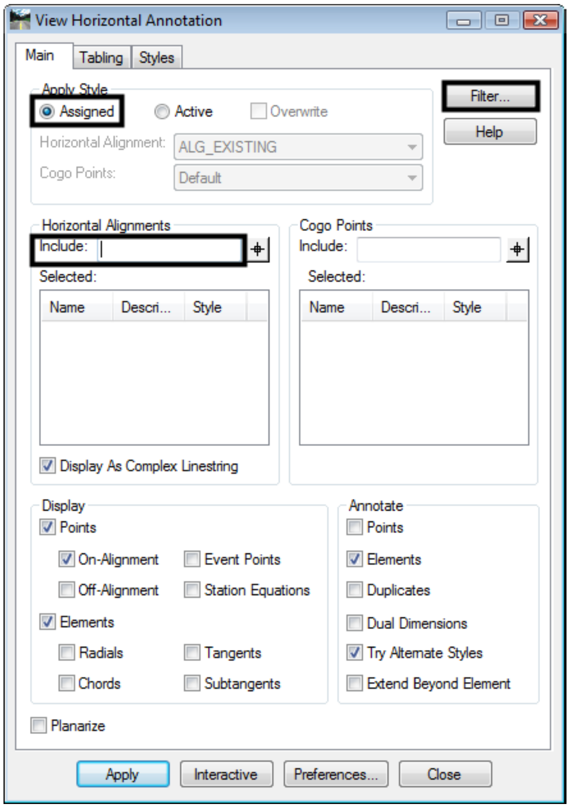
- InRoads displayed graphics are governed by the Global Scale Factor in InRoads. THe MicroStation Annotation Scale has no affect on these elements.
- The view alignment commands (from the right click menu of from Geometry > View Geometry > Active Horizontal) only display the lines and arcs that make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

Lab 3.2 - Selection of Geometry for display and/or Annotation

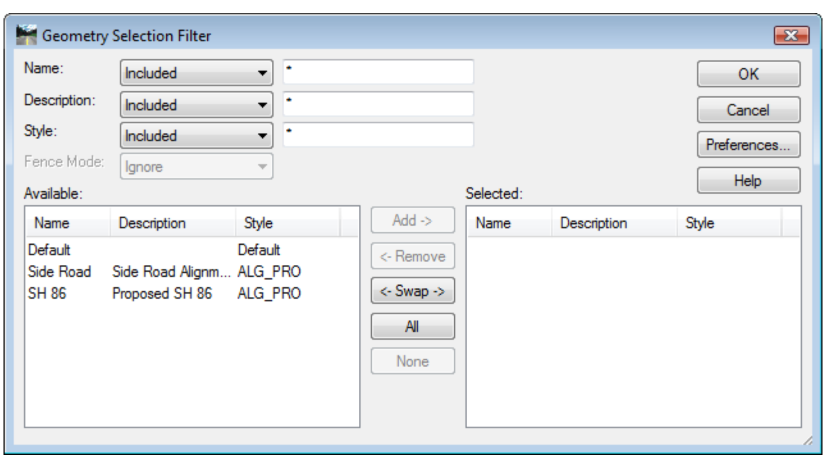
Section Objectives:

- Illustrate methods for defining horizontal alignment elements for display and/or annotation.

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.



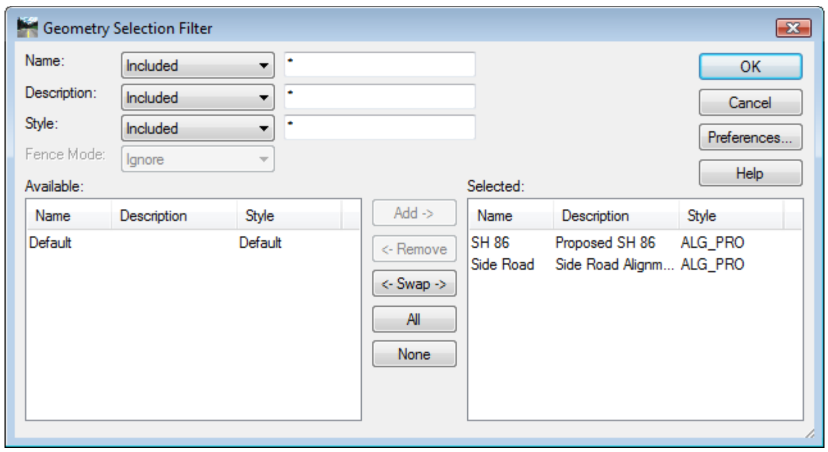
5. **<D>** the **Filter** button. The ***Geometry Selection Filter*** dialog will appear.



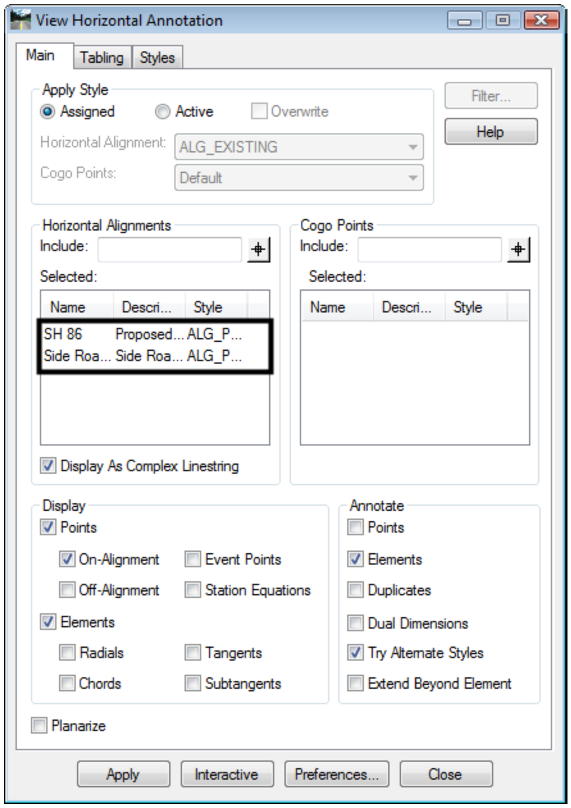
Note: ***Available*** alignments are shown on the left, ***Selected*** (for display or annotation) alignments are shown on the right. This makes it possible to select multiple alignments for display or annotation.

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

Note: The data in this dialog can be sorted by clicking **<D>** on the column headers. Multiple selections of alignments can be made through the use of the <CTRL> or <Shift> keys.

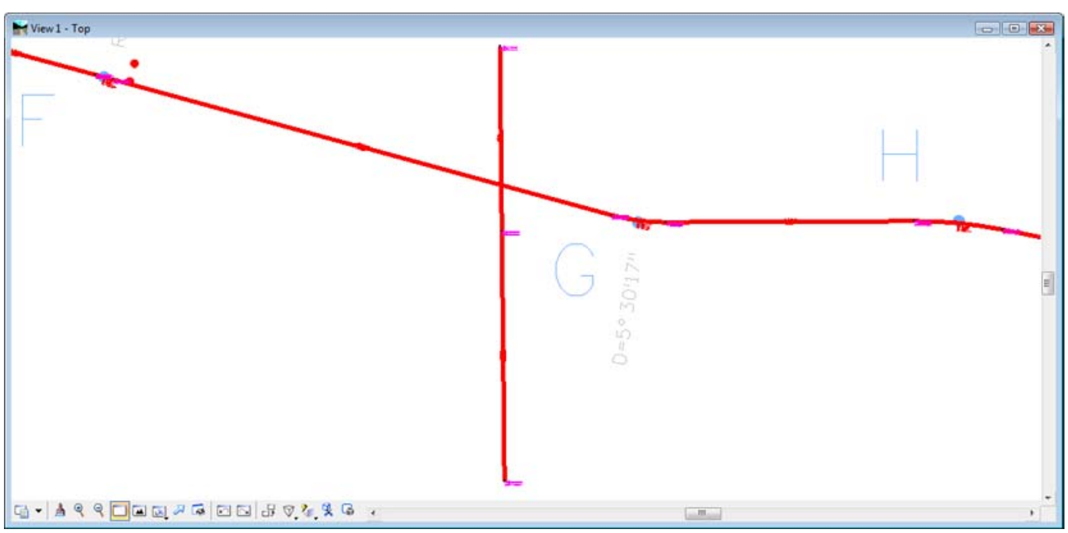


7. When done identifying the desired alignments in the Filter dialog, **<D> OK** – the Selected geometry is populated in the ***Selected*** field



8. **<D> Apply** and the selected alignments will display 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.

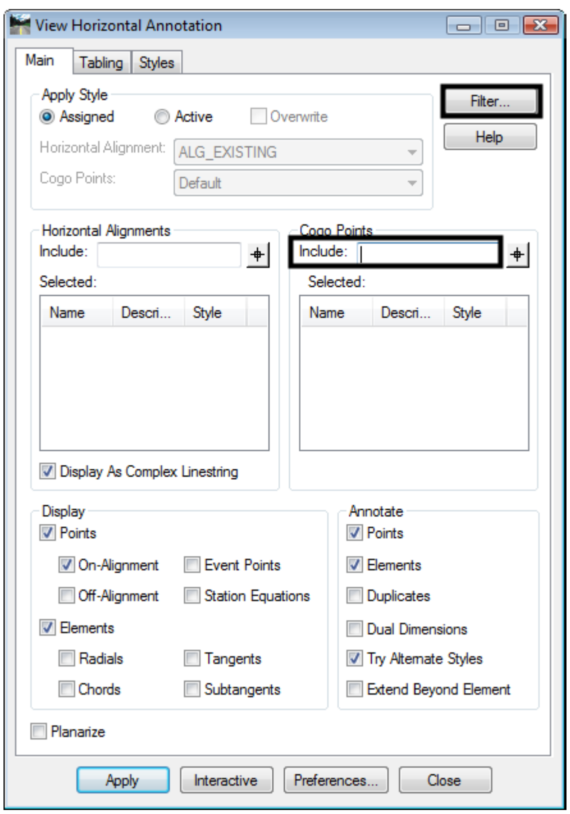
Lab 3.3 - Display or Annotation of Cogo Points

Section Objectives:

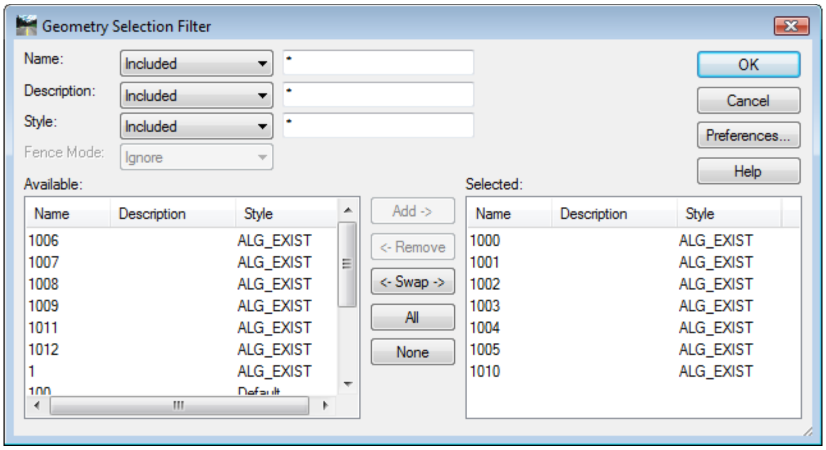
- Illustrate methods for defining cogo points for display and/or annotation.

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 will appear.

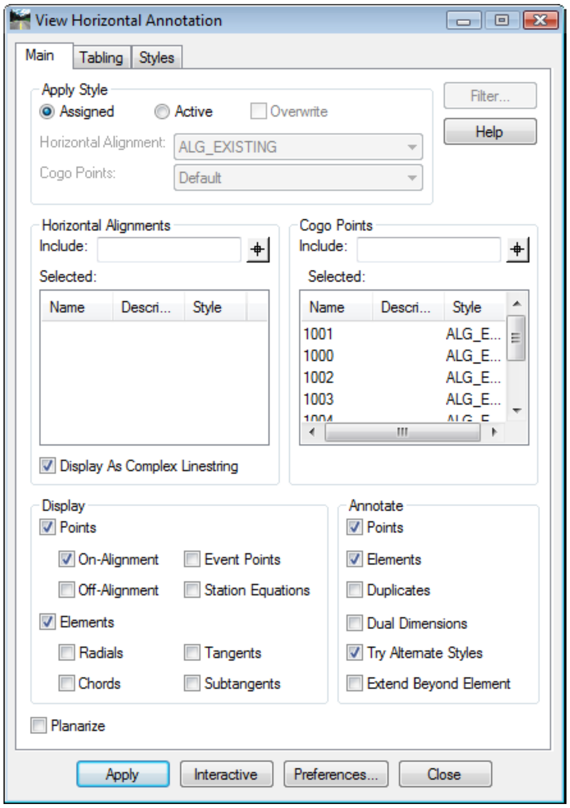


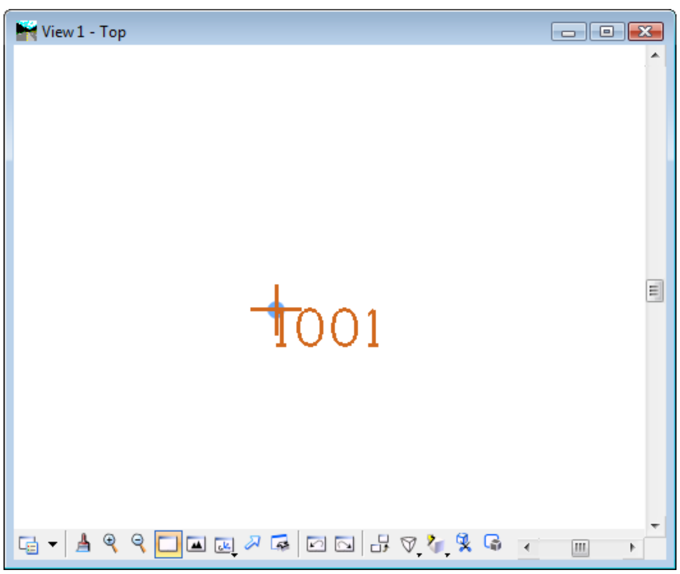
12. Select points **1001-1005 & 1010** from the ***Available*** field and add them to the ***Selected*** field.



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

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





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

> ***Note:*** Remember to toggle on ***Points*** in the ***Annotation*** tab if you need to see Cogo Point numbers, Northing, and Easting. Keep in mind annotation settings are derived from the Geometry Style Manager Type: Points for the assigned Geometry Style.

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 elements.
- The Annotate area is used to turn on and off the text data associated with the geometry elements.

Lab 3.4 - Review Alignment Stationing

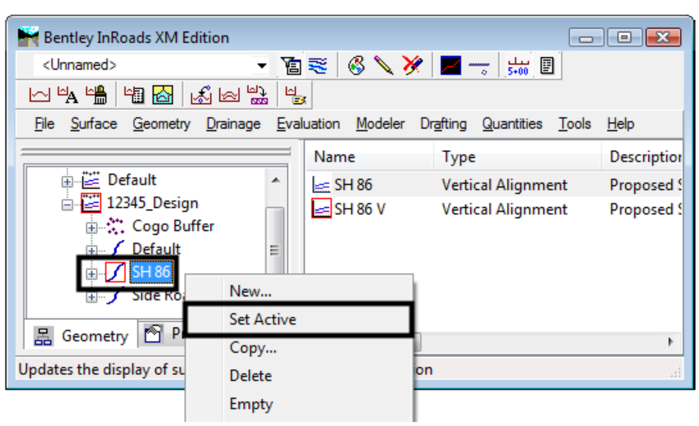
Section Objectives:

- Review the alignmet to determine its current stationing.

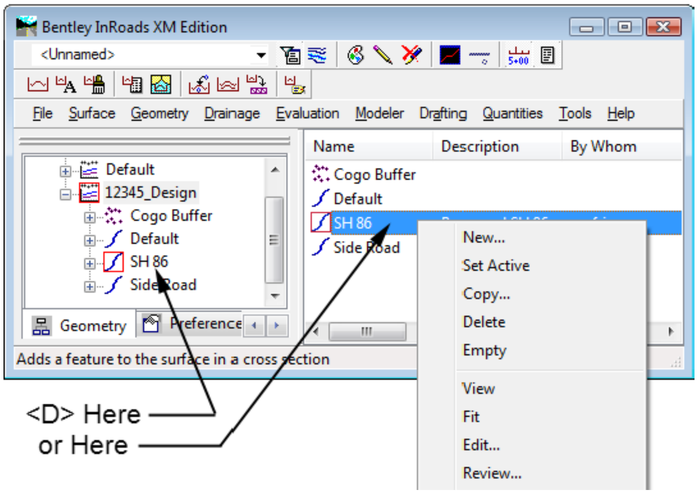
The default station at the beginning of a newly created horizontal or vertical alignment is 0+00. This value can be changed as shown later in this lab.

One of the easiest methods for determining assigned stationing values is through the alignment review commands.

1. Make **12345_Design** the active geometry project by **right-clicking** on this geometry name and selecting **Set Active** from the fly-out menu.



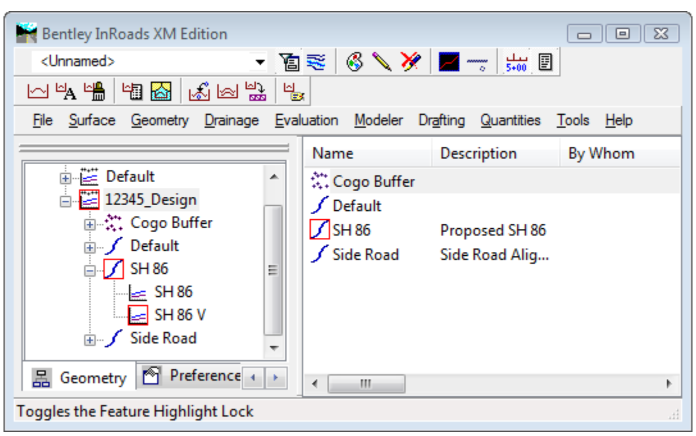
2. **Right-click** on the alignment **SH 86** and select ***Review*** from the Fly-out menu. The ***Review Horizontal Alignment*** dialog will appear.



Note: Fly-out menus can be access from either the workspace or feedback panes. Also note that selecting an alignment for review switches it to being the ***active*** alignment.

3. Investigate the stationing assigned to horizontal Alignment **SH 86**.

   Initial station value is: ______________________________.



4. Review the ***Vertical*** alignment **SH 86 V** associated with horizontal alignment SH 86.

   ♦ Is the stationing for the horizontal and vertical alignments synchronized?

Section Summary:

- Use the Review command to find out information about the alignment, like stationing, without having to display it graphically.

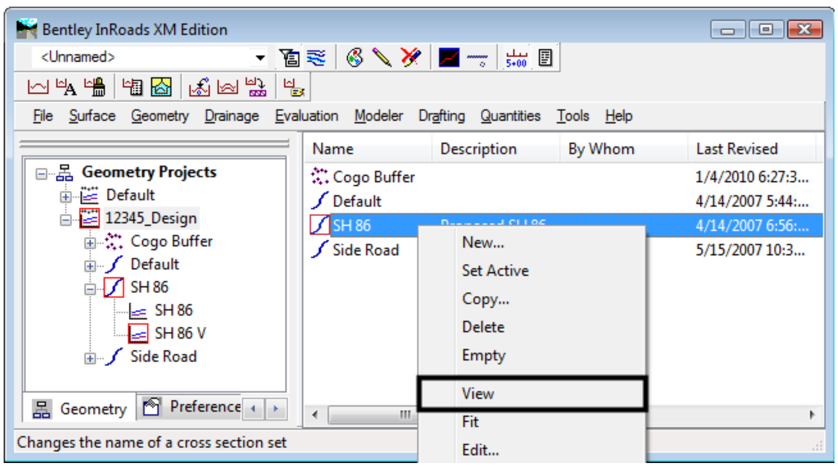
Lab 3.5 - Displaying Stationing

Section Objectives:

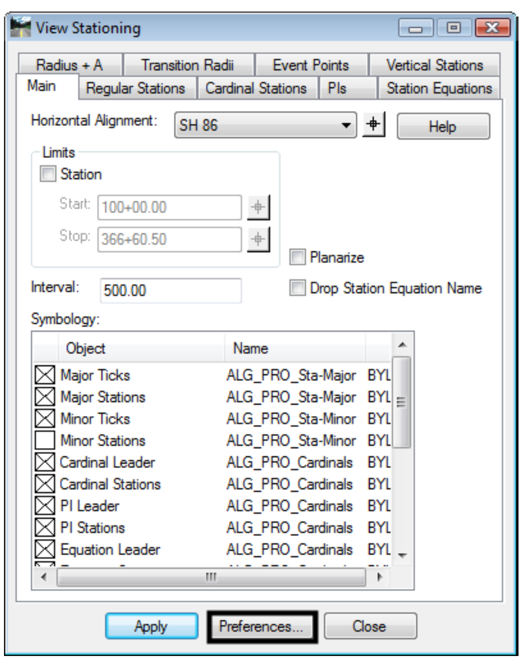
- Display stationing and alignment keypoints.
- Use the Symbology toggles to turn on and off various items.

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

   Right-click on the alignment name in the InRoads explorer window and select ***View*** from the fly-out menu.



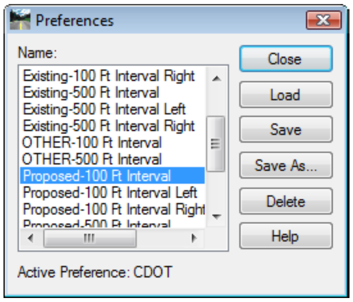
2. Select **Geometry > View Geometry > Stationing.** The ***View Stationing*** dialog will appear.



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

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

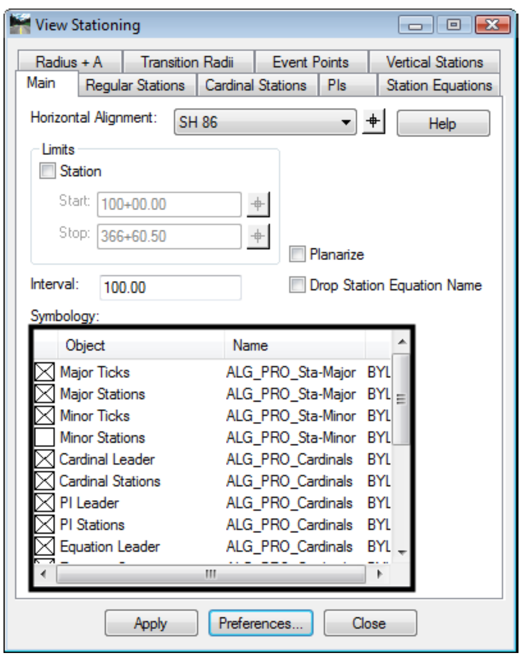
The following steps load the Preference Proposed–100 Ft Interval as the active symbology.



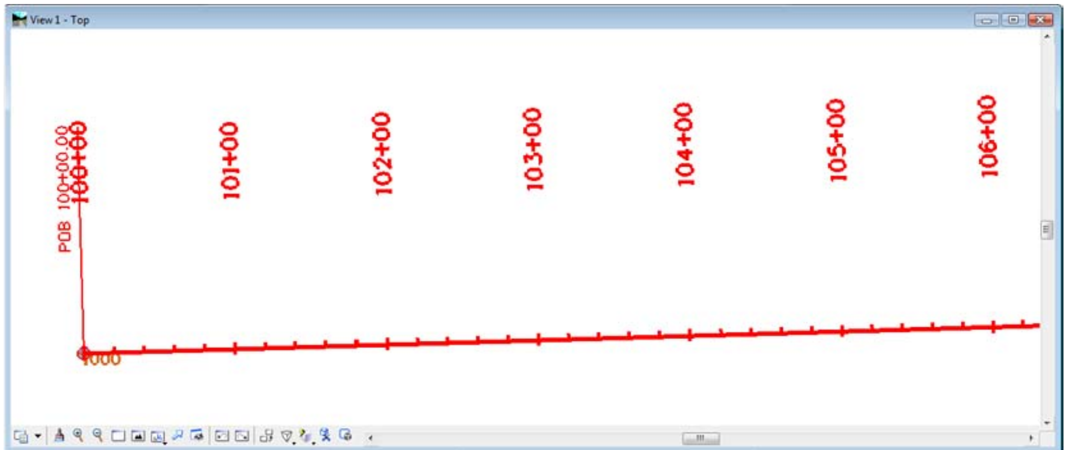
4. **<D> Proposed-100 Ft Interval**.

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

6. In the ***Symbology*** portion of the dialog, select or de-select the alignment components for display. Loading the preference sets the default interval for major stations.



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



The ***View Stationing*** dialog is populated with the predefined settings from the stored preferences. Notice the ***interval*** field and settings under the ***symbology*** section. The display toggles define what will display; the name column reflects the InRoads named symbology defining graphical attributes for displayed items.

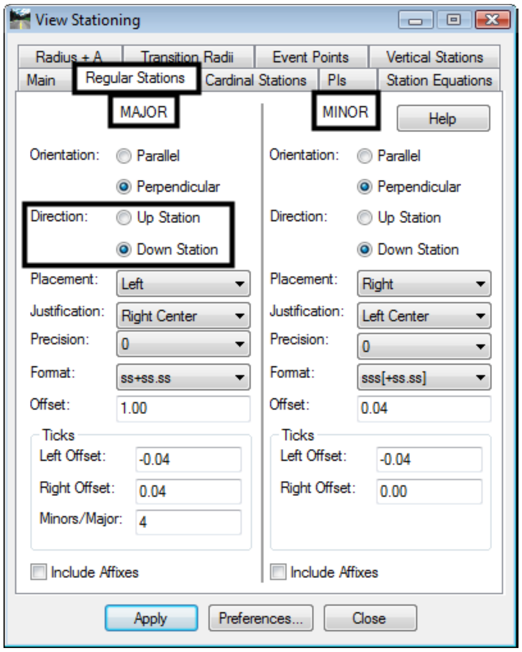
There are several standard CDOT preferences to choose from, depending upon the type of alignment stationed and station interval. Choose the appropriate **Preference** and **<D> Apply** to see the stationing.

Keep in mind that text size is dependent on the active ***Global Scale Factor*** at time of display. If necessary, select **Tools > 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 until presets becomes familiar.

10. **Experiment** with the various tabs and settings in the ***View Stationing*** dialog 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.

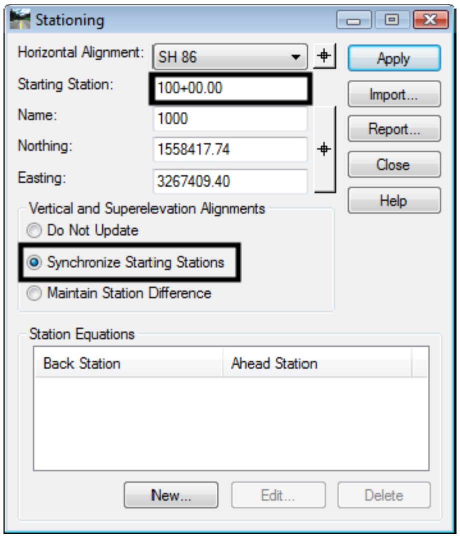
Lab 3.6 - Defining Stationing

Section Objectives:

- Change the biginning 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. Additionally, station equations can be incorporated.

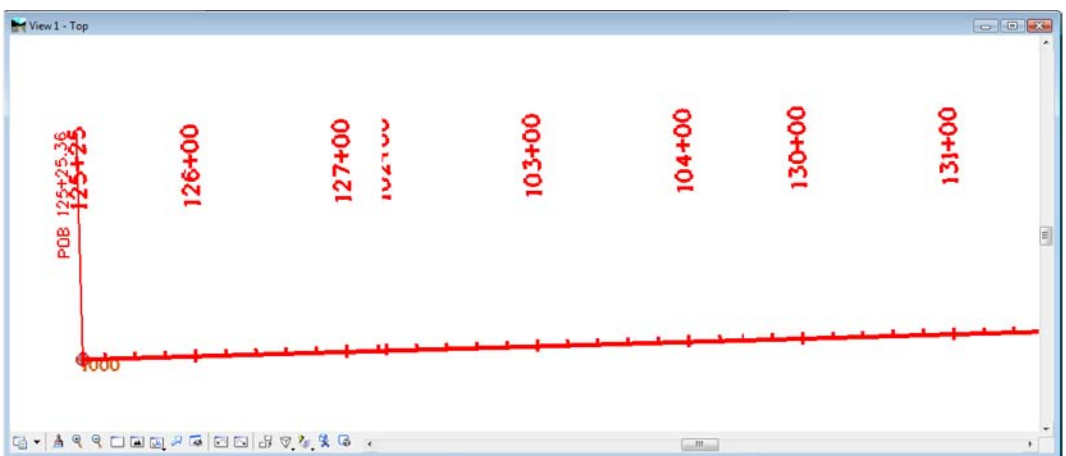
1. Select **Geometry > Horizontal Curve Set > Stationing**. By default, this dialog displays the beginning station value of the active alignment.



2. Select **Synchronize Starting Stations** in the ***Vertical and Superelevation Alignments*** section.

3. Set the beginning station of alignment ***SH 86*** by keying in ***125+25.36*** and choosing **Apply**.

4. **Verify** the change has been applied by redisplaying the stationing using **Geometry > View Geometry > Stationing** and clicking **Apply**. Also, check the beginning station value of any associated vertical alignments by using the review command.

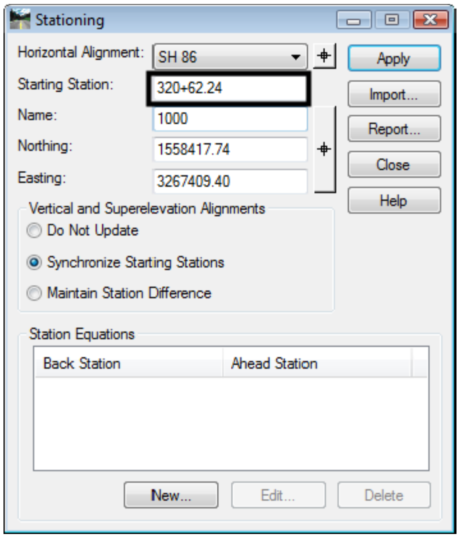


Note: The options for ***Vertical Alignments*** should be considered carefully. **Do Not Update** will leave the stationing of vertical application stations as is, **Synchronize Starting Stations** will update their stationing to match that of the horizontal and **Maintain Station Difference** will keep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

- Any point along the alignment can be specified as the location for the input stationing value. The alignment location defined by either ***name*** or the ***northing*** and ***easting*** fields is the location the input stationing will propagate from.

5. Set the beginning station of alignment ***SH 86*** by keying in ***32062.24*** and choosing **Apply**.



6. **Verify** the change has been applied by redisplaying the stationing. Select **Geometry > View Geometry > Stationing** then click **Apply**.

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.

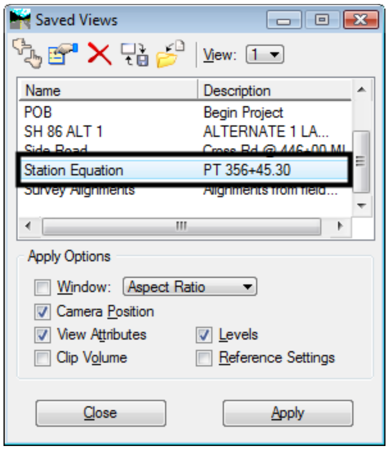
Lab 3.7 - Station Equations

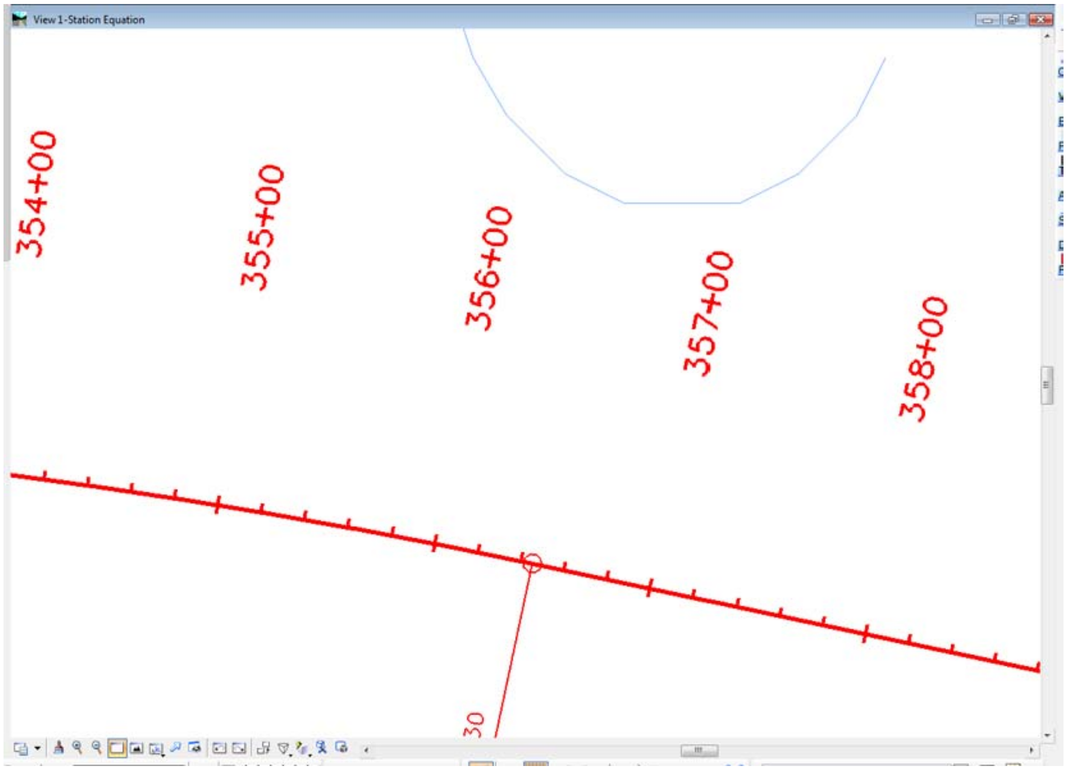
If there are inequalities in the alignment, station equations may be required. These equations can be either gap or overlap equations.

Section Objectives:

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

1. From MicroStation, select **Utilities > Saved Views. Apply** saved view **Station Equation.** Once applied, **Close** the ***Saved View*** dialog.



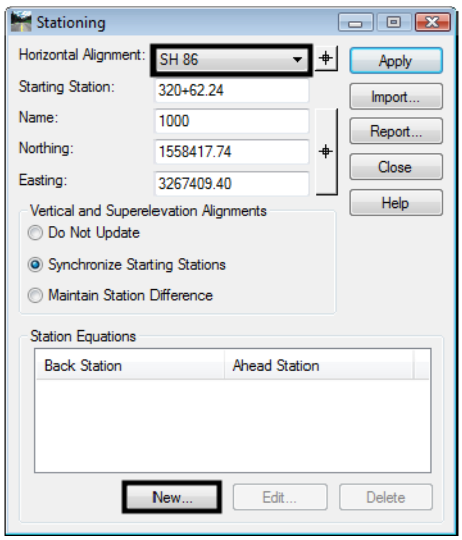


At the PT of the curve a station equation is necessary to tie to previous work. The values are:
Back = 356+45.30
Ahead = 356+40.30

2. Select **Geometry > Horizontal Curve Sets > Stationing.** The ***Stationing*** dialog will appear.

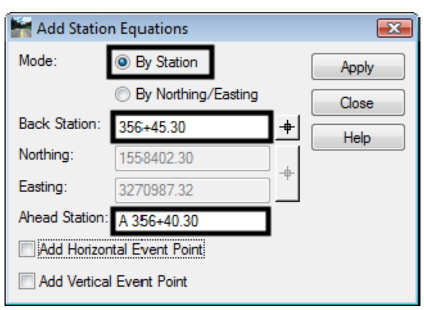
3. Verify **SH 86** is the horizontal alignment.

4. At the bottom of the dialog, choose **New**.



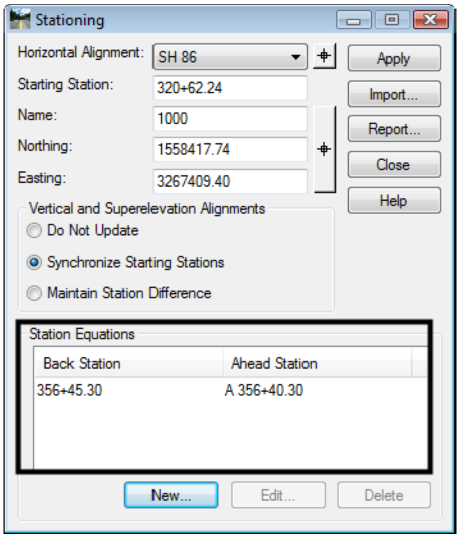
5. In the resulting box, set the ***Mode*** to **By Station**.

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



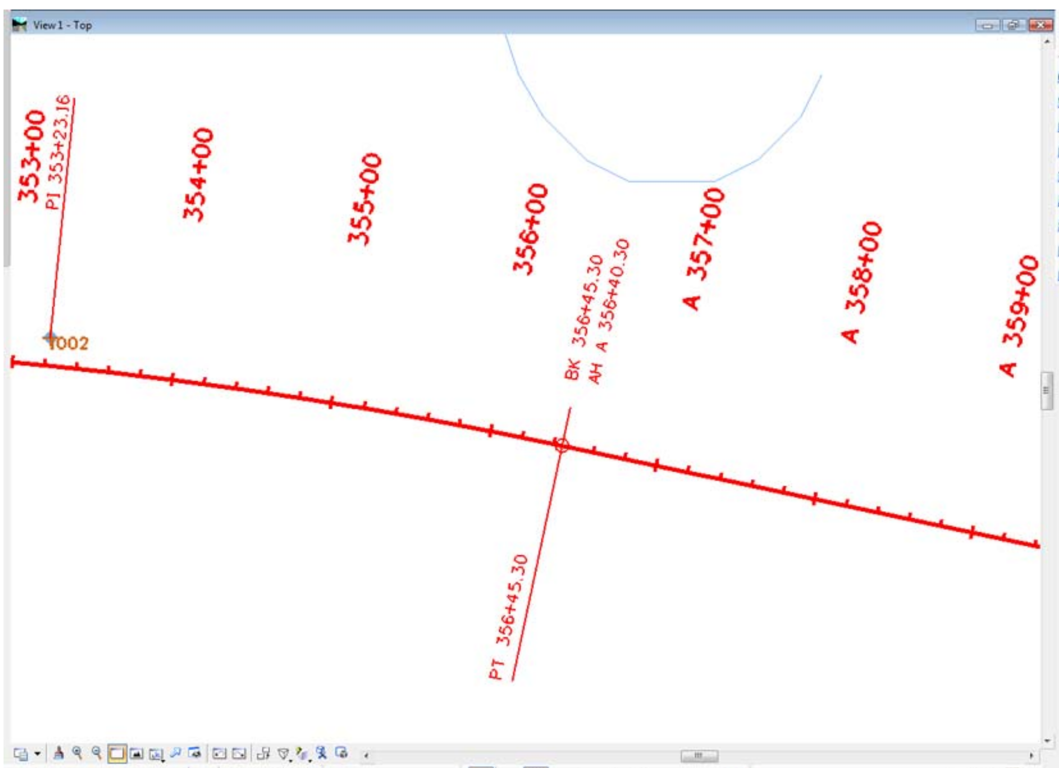
7. **<D> Apply**.

8. **<D> Cancel** to close the ***Add Station Equation*** dialog. The station equation will be shown in the parent dialog.



9. **<D> Close** in the ***Stationing*** dialog.

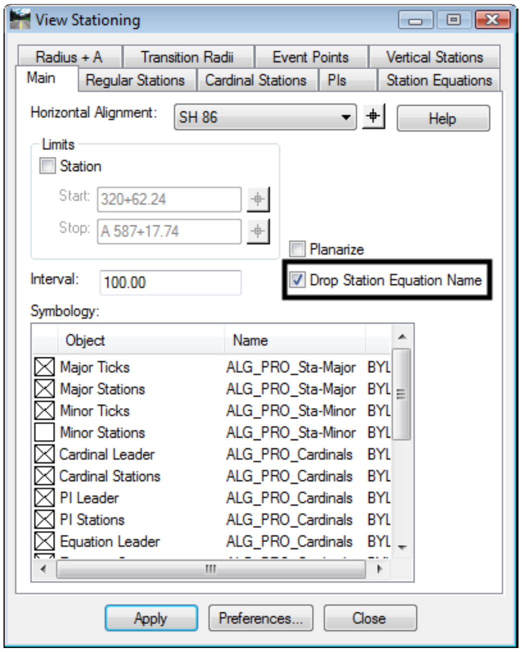
10. Redisplay the stationing for alignment **SH 86**.

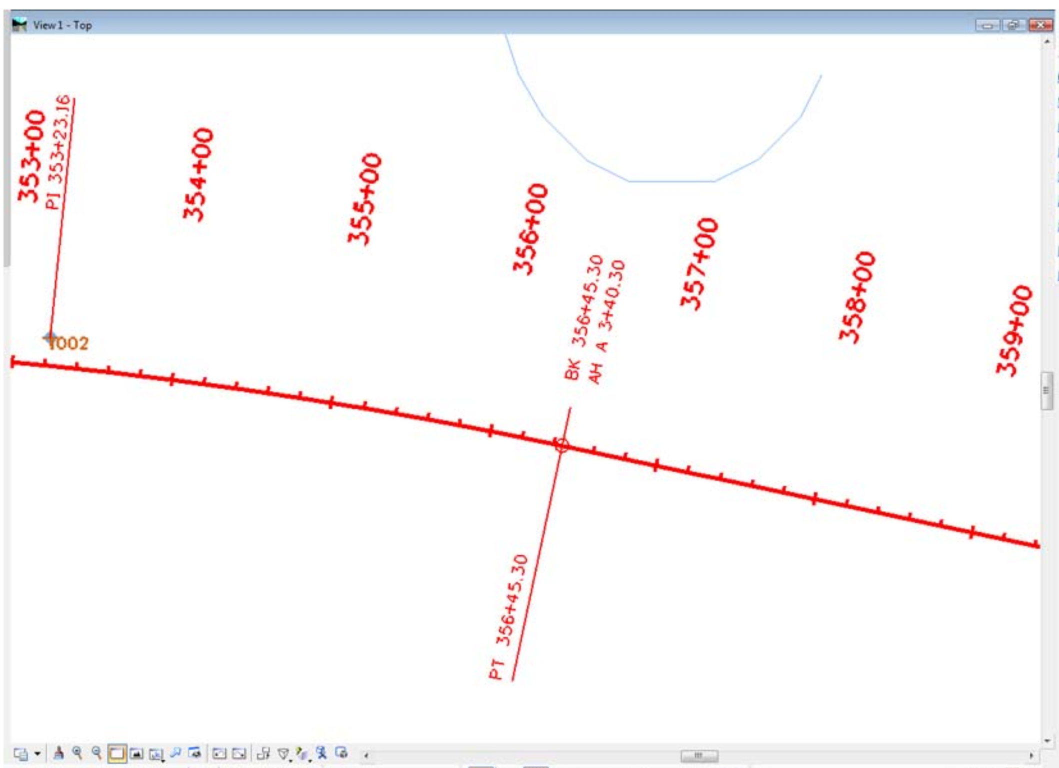


Note: The ahead station must be prefixed with an equation name. The name must consist of at least one alpha character.

- 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. If the prefix is undesirable, toggle on ***Drop Station Equation Name*** in the **View Stationing** dialog and redisplay the stationing.





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 atleast 1 letter, followed by the new station number.

Lab 3.8 - Horizontal Alignment Tracking

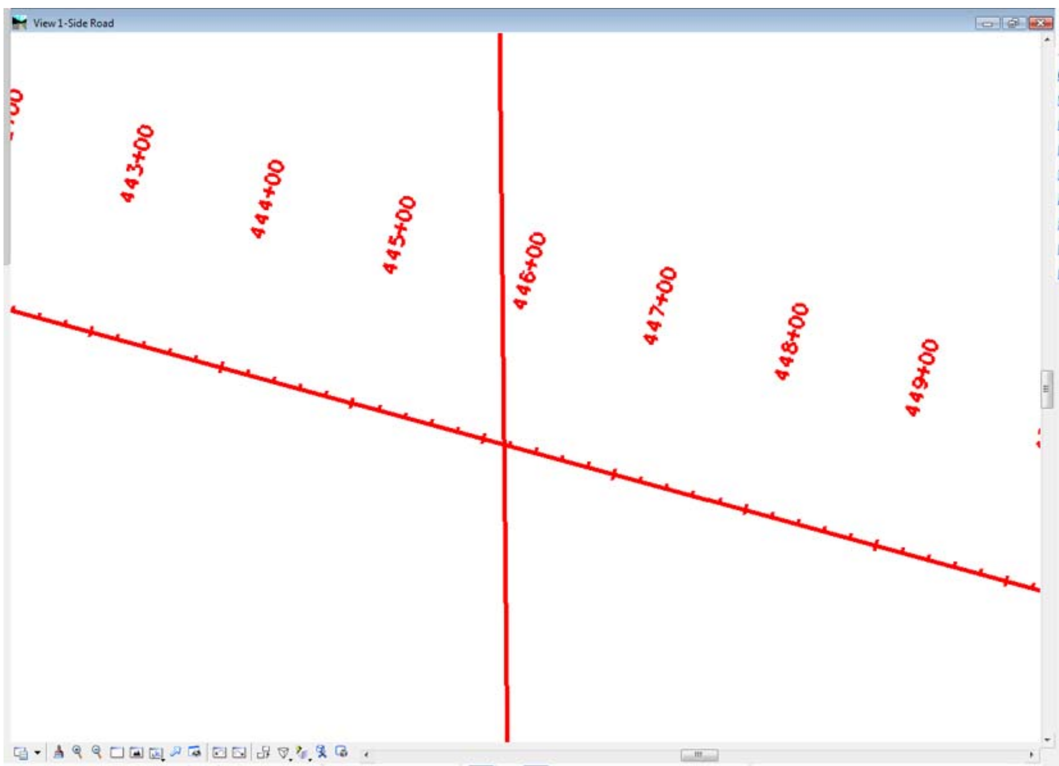
Two methods exist for receiving interactive information relative to a horizontal alignment. Both methods report on stationing, offset, elevation, etc. One method reports the elevation of the active surface, the other reports the elevation of the active vertical alignment.

Section Objectives:

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

Horizontal Alignment & Surface Elevation Tracking

1. **Recall** Saved View **Side Road**.

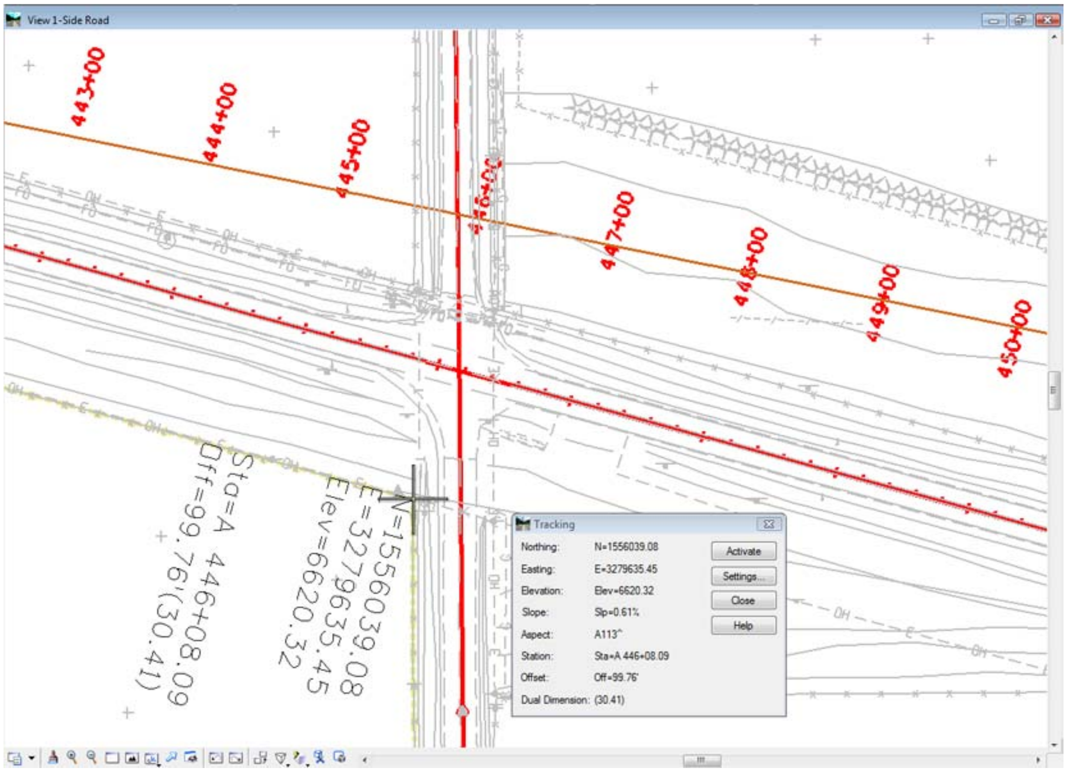


In addition to reporting on station and offset information relative to the active alignment, the following method will report on information relative to the active surface.

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

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

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

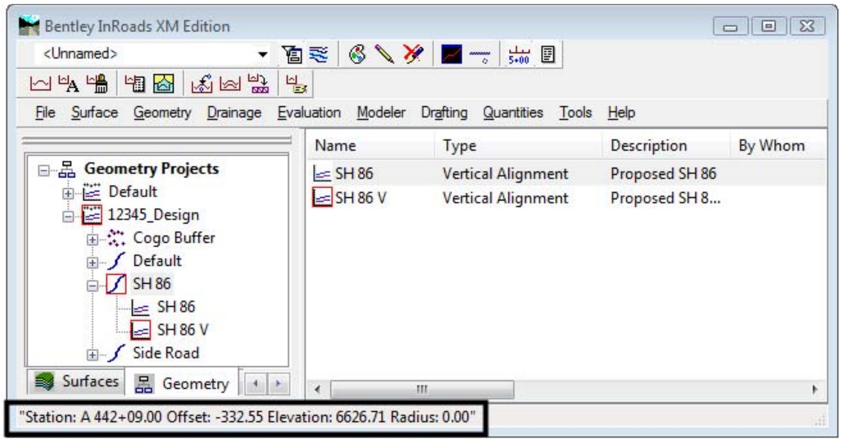


Note: Select the **Settings** button in the ***Tracking*** dialog to examine the attributes assigned to annotation placed in the MicroStation design file.

Horizontal & Vertical Alignment Tracking

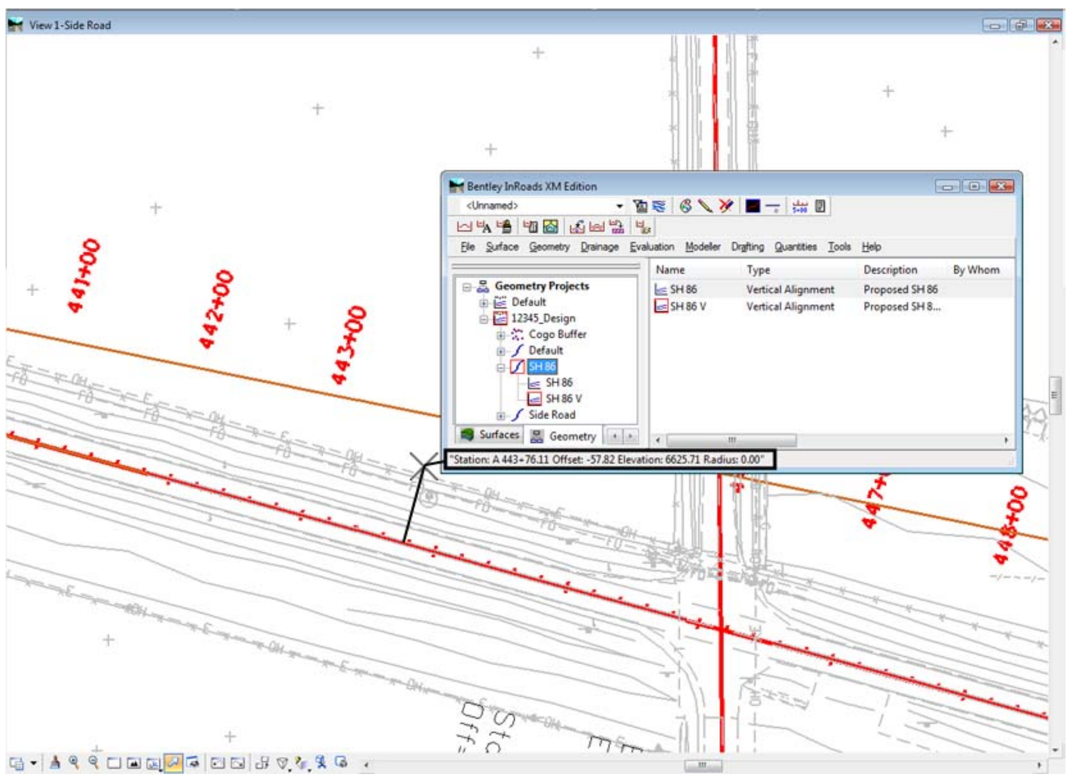
The second method tracks the station and offset relative to the active horizontal alignment along with the elevation of the active vertical alignment. Station, Offset, and Elevation information is displayed in the message field of the InRoads interface.

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



2. The results display 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, **<D>** the offset displayed will be relative to the two alignments perpendicular to the active alignment.



Section Summary:

- Use the Tracking command to get surface information in relation the 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 disable the graphic display of items in the Tracking dialog box.
- Use the Horizontal Alignments tracking to get vertical alignment information in relation the the horizontal alignment.
- Horizontal Alignments tracking can not be displayed graphically.

Chapter Summary:

- 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. Items in the Stationing dialog box should only be changes 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 sufrace 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.
- Transpose alignments.

The following files are used in this lab:

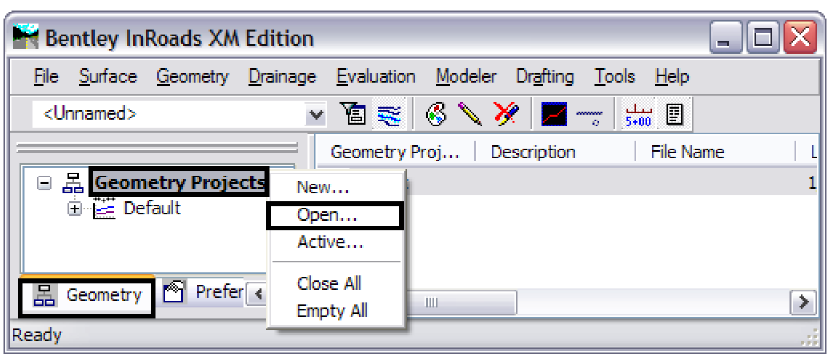
- C:\Projects\12345\Design\Drawings\Reference_Files\12345DES_Model.dgn
- C:\Projects\12345\ROW_Survey\InRoads\InRoads\12345SURV_Fieldbook.alg

Lab 4.1 - Copy a Geometry Project

Section Objectives:

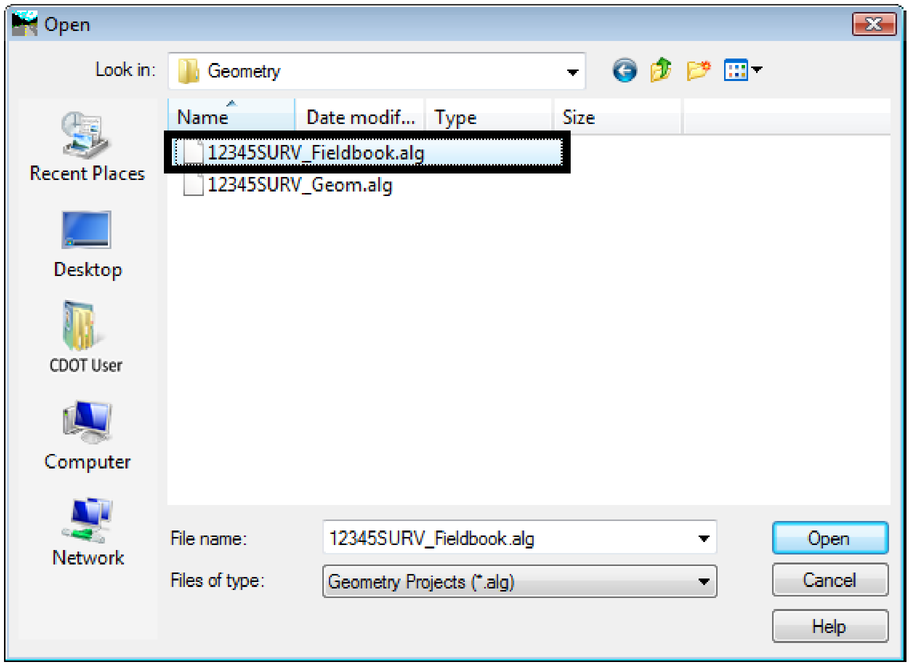
- ♦ Access a Geometry Project created by the Survey/ROW discipline.
- ♦ Save the renamed Geometry Project in the Design project folder (vs. the Survey folder).
- ♦ Rename horizontal alignment names, add/modify descriptions, and review the geometry styles assigned to the alignments.

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

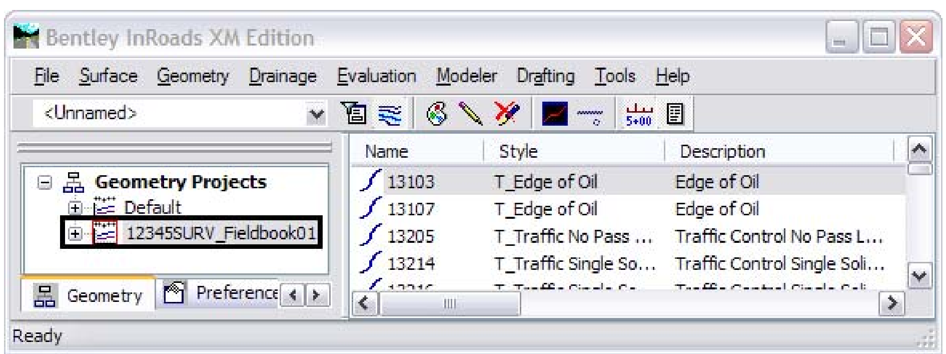


2. Navigate to the directory **C:\Projects\12345\ROW_Survey\InRoads\Geometry**.

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



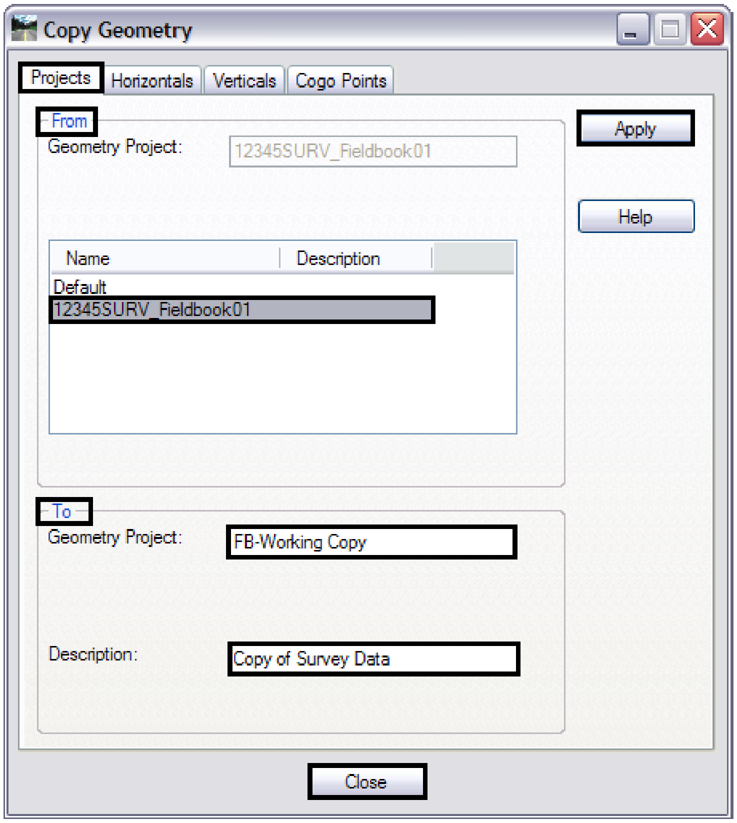
4. **<D> Open** then **Cancel** button. The ***Open*** dialog will close.



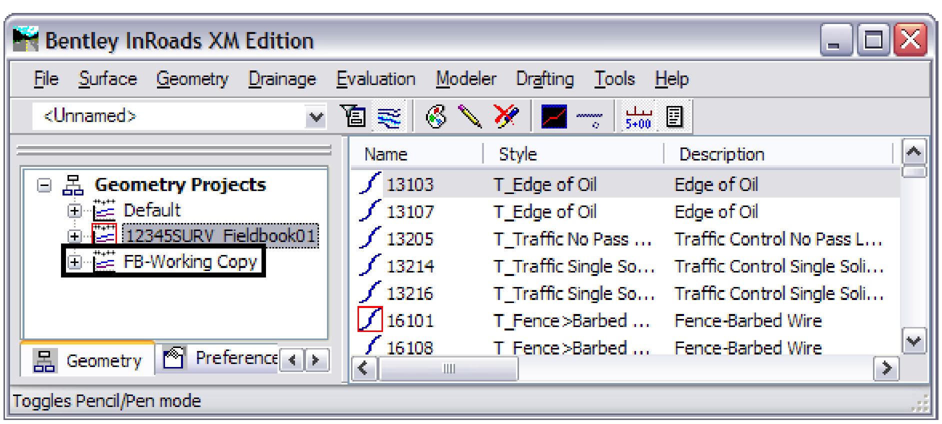
At this point, a ‘copy’ of the survey geometry project is loaded into memory. The following steps will rename the geometry project and save this copy in the Design discipline folder.

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

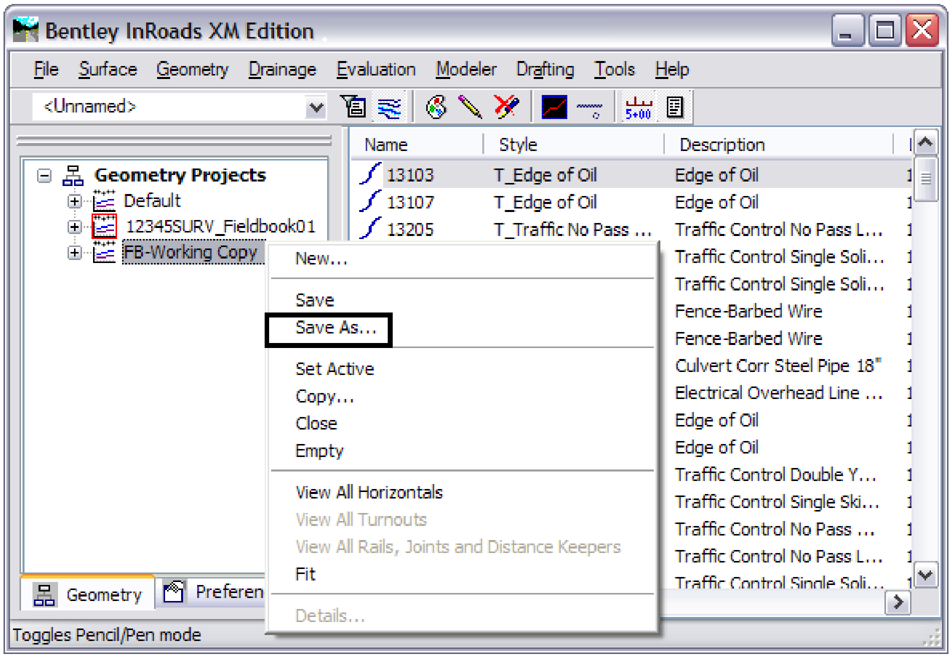
5. Select **Geometry > Copy Geometry**.

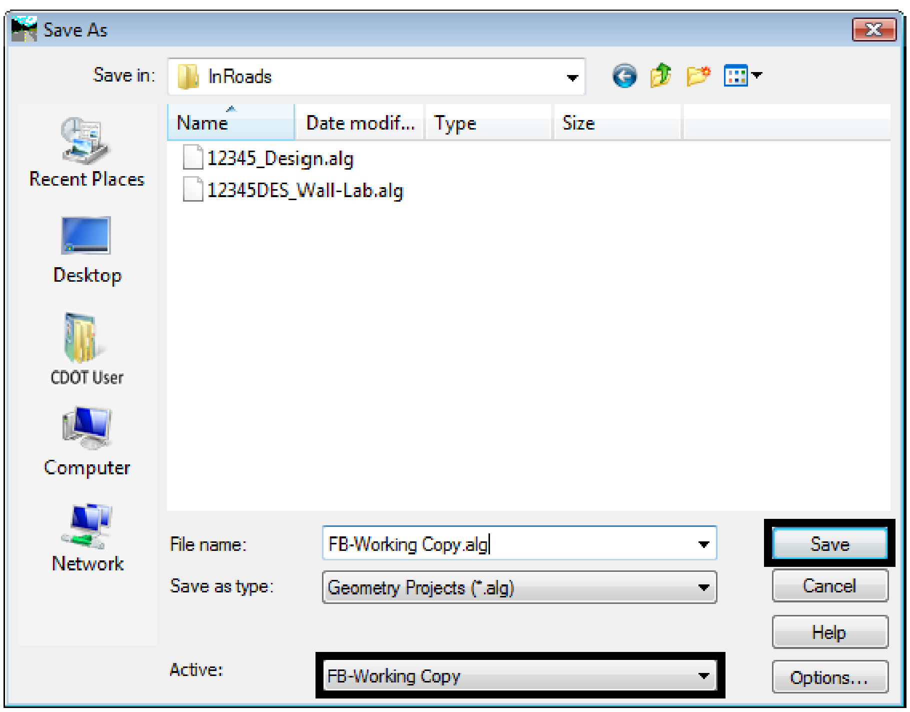


6. On the ***Projects*** tab, in the ***From*** section select **12345SURV_Fieldbook01**.
7. In the ***To:*** field key in ***FB-Working Copy***.
8. In the ***Description:*** field key in ***Copy of Survey data***.
9. **<D>** the **Apply** then **Close** buttons.
10. Verify the copy is created by checking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



11. In the InRoads explorer window, **<R>** on the **FB-Working Copy** geometry project and select **Save As…** from the shortcut list. The ***Save As*** dialog will appear.



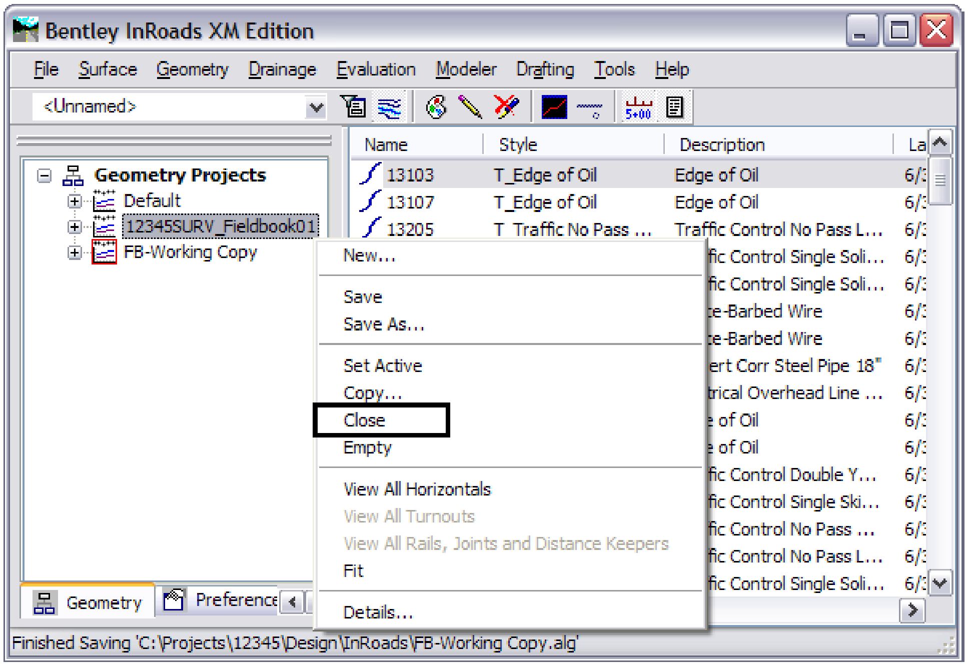


12. Navigate to the **C:\Projects\12345\Design\InRoads** folder. If necessary, use the drop-down arrow in the ***Active*** field and reselect the desired name to ensure the saved file name will match the active surface name.

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

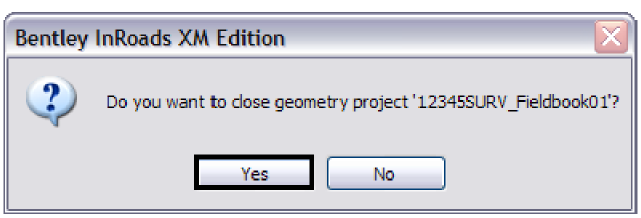
Note: Ensuring that the saved Geometry name in the project folder matches the Geometry name displayed in InRoads explorer will minimizes confusion.

14. The original geometry project generated by the survey staff is no longer required. In the InRoads explorer window, **<R>** on the geometry project name **12345SURV_Fieldbook** and select **Close** from the fly-out 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 assigned to some the roadway centerline shots, add descriptions, and assign appropriate Geometry Styles.

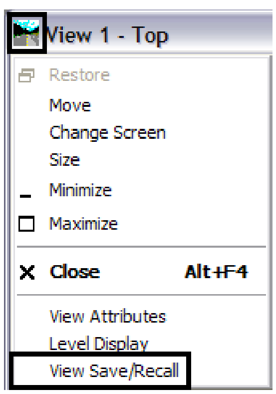
Graphics clean-up

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.

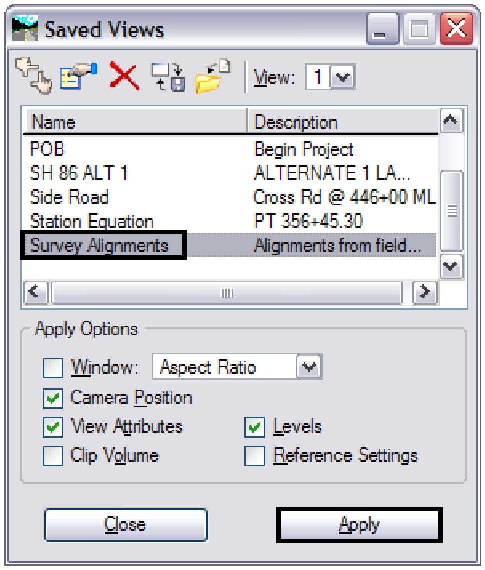
Renaming Horizontal Alignments

1. Right click on the InRoads icon in the top left corner of the view window and choose **View Save/Recall** from the shortcut menu.

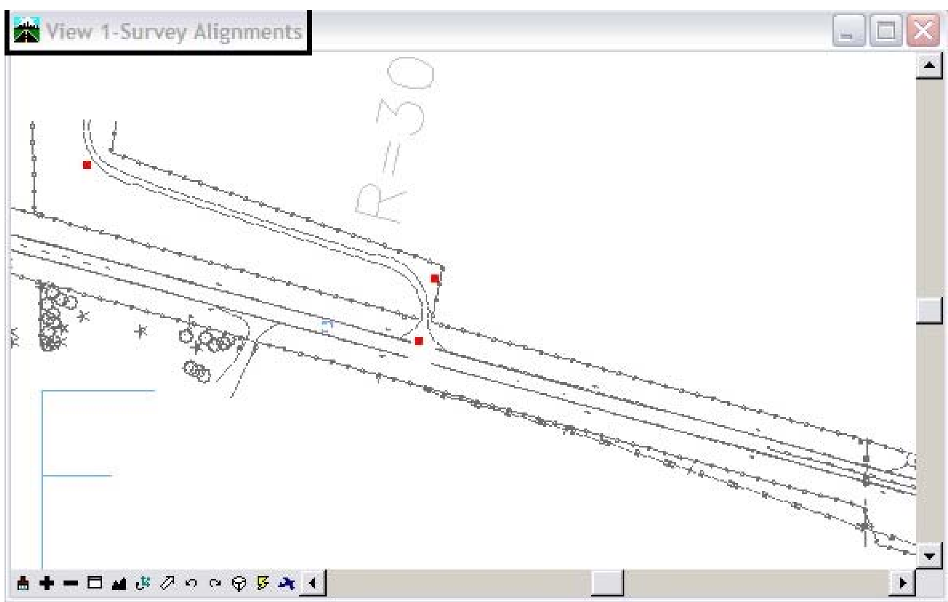


2. From the ***Saved View*** dialog box click on **Survey Alignments**.

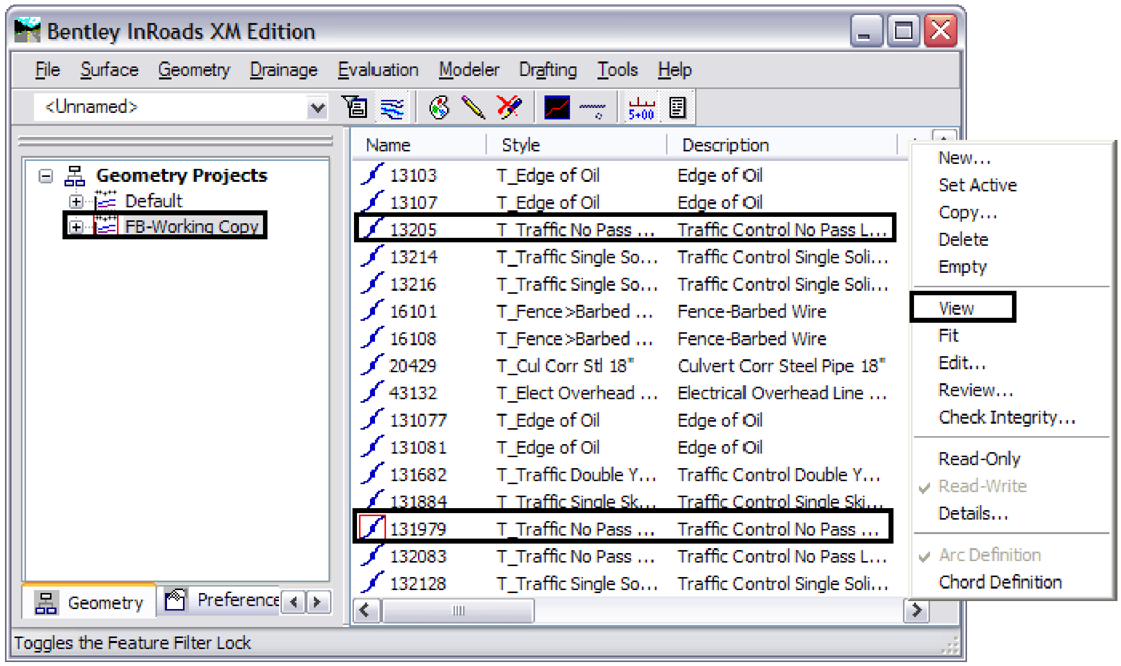
3. Click on **Apply** and then **Close**.



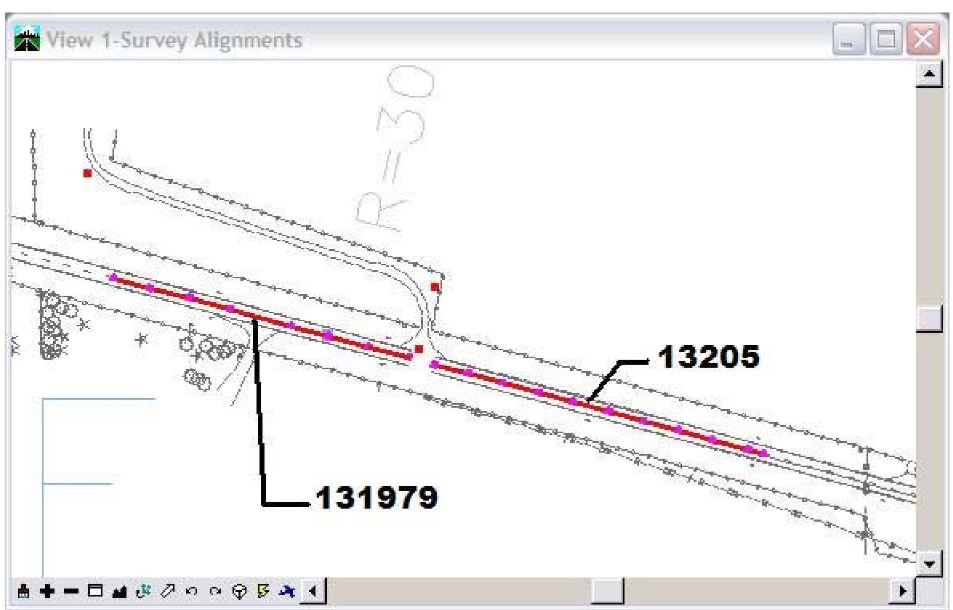
4. Verify that the view name includes Survey Alignments. The view window should look similar to the following image.



5. **Display** alignments **13205 & 131979** by righ clicking on the alignment and choosing **View** from the shortcut window.

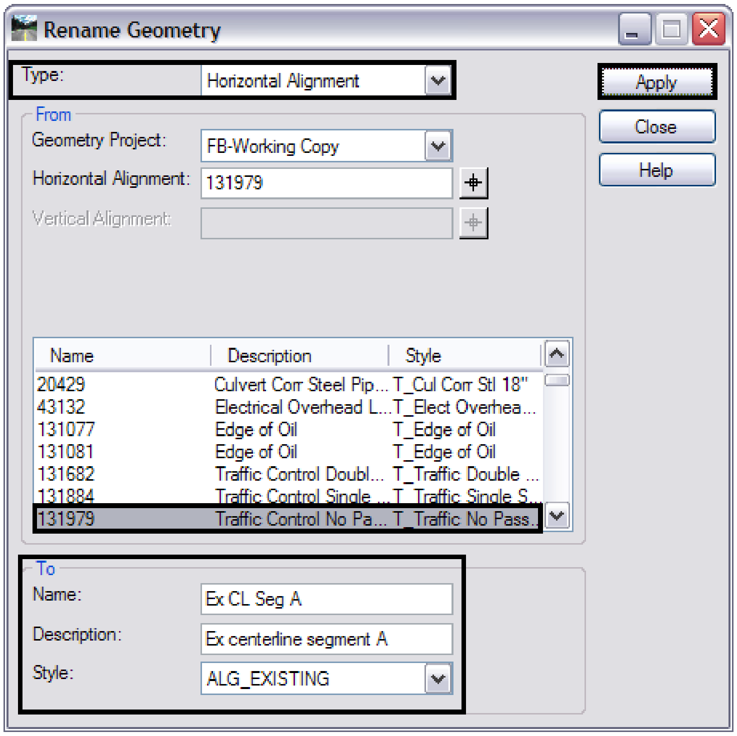


The the alignments should show up in the view window as shown below.



6. Select **Geometry > Rename Geometry**. The ***Rename Geometry*** dialog will appear.

7. From the ***Type:*** drop-down list select **Horizontal Alignment**.



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

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

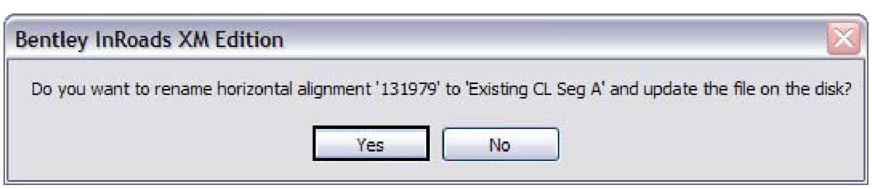
   Note: This alignment represents the centerline of existing pavement.

10. In the ***To*** section key in the ***Name: Ex CL Seg A***.

11. In the ***To*** section key in the ***Description: Ex centerline segment A***.

12. In the ***To*** section set the ***Style: ALG_EXISTING***

13. **<D>** the **Apply** button a confirmation dialog will appear.



14. **<D>** the **Yes** button.

15. **Rename** the centerline alignment 13205 as follows:

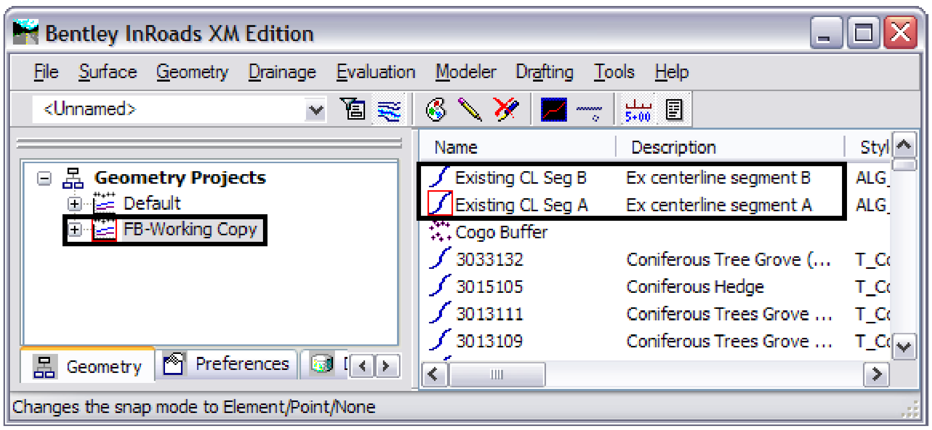
    Note: You can use the dialog selection icon to graphically identify the alignments for renaming.

    - 13205

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

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 accomplished prior to the generation of Profile or Cross Section sets.

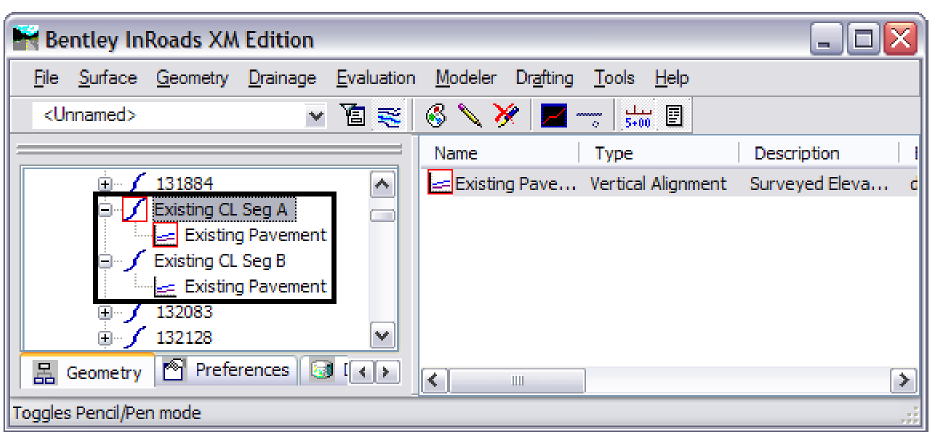
16. When done renaming the alignments **Close** the ***Rename*** dialog and check the InRoads explorer window to verify the results.



Renaming Vertical Alignments

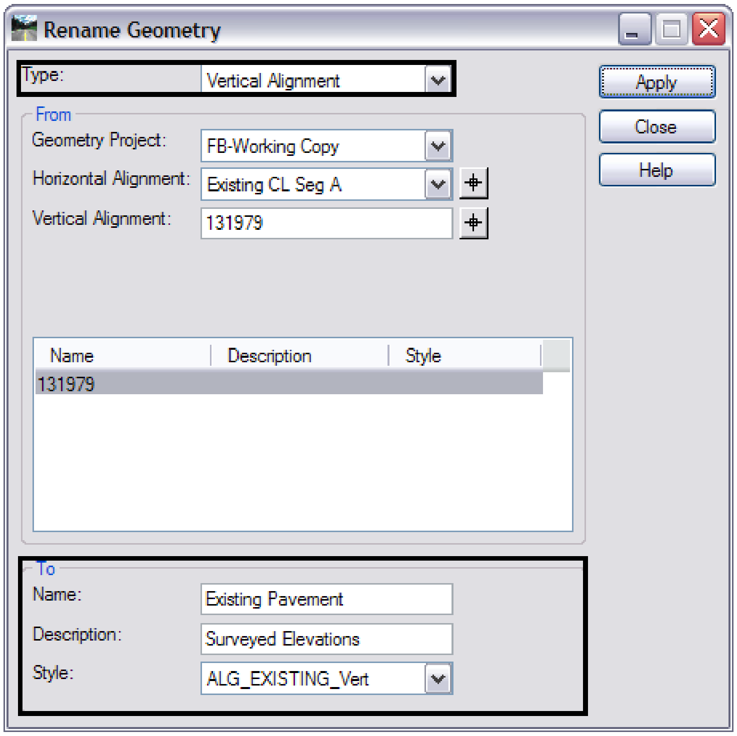
Two horizontal alignments have been renamed, a description has been added and the alignments are assigned an appropriate geometry style. Horizontal alignments are 'parent' alignments which can contain 'child' vertical alignments.

17. In the Workspace bar under the **Geometry** tab check the horizontal alignments for associated vertical alignments by expanding the **+** icon.



18. Select **Geometry > Rename Geometry**. The ***Rename Geometry*** dialog will appear.

19. From the ***Type:*** drop-down list select **Vertical Alignment**.



20. In the ***From*** section verify the ***Geometry Project*** is set to **FB-Working Copy**.
21. In the ***From*** section verify the active ***Horizontal Alignment*** is set to **Existing CL Seg A**.
22. In the ***From*** section ***Vertical Alignment*** list locate and **<D>** on alignment **131979**.

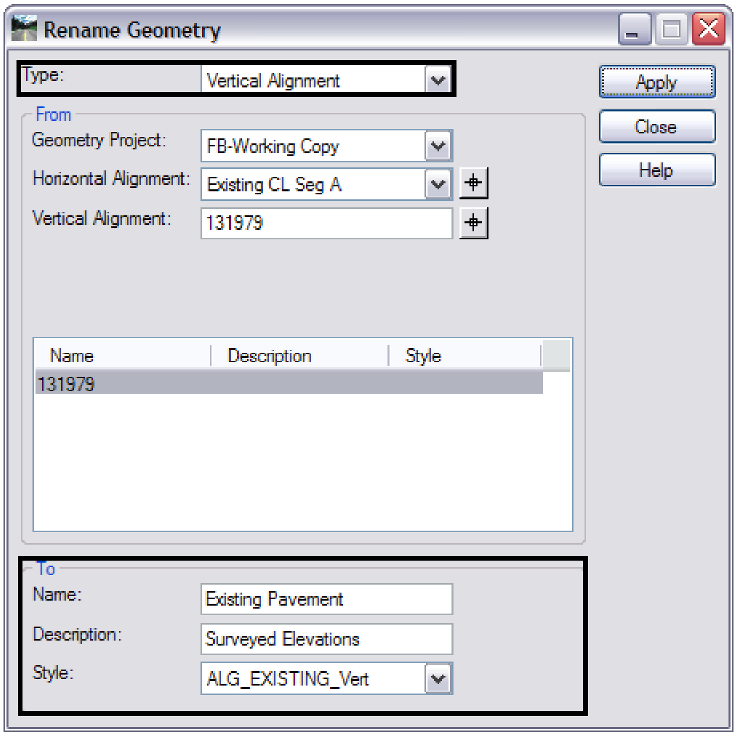
    Note: This alignment represents the vertical elevations of existing pavement.

23. In the ***To*** section **key in** the ***Name: Existing Pavement***.
24. In the ***To*** section **key in** the ***Description: Surveyed elevations***.
25. In the ***To*** section set the ***Style:*** **ALG_EXISTING_Vert.**
26. **<D> Apply** then **<D> Yes** button.
27. Now set the active ***Horizontal Alignment*** to **Existing CL Seg B** to rename the vertical alignment associated with the horizontal alignment Existing CL Seg B.

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

28. In the ***To*** section **key in** the ***Name: Existing Pavement***.
29. In the ***To*** section **key in** the ***Description: Surveyed elevations***.

30. In the ***To*** section set the ***Style:*** **ALG_EXISTING_Vert**.



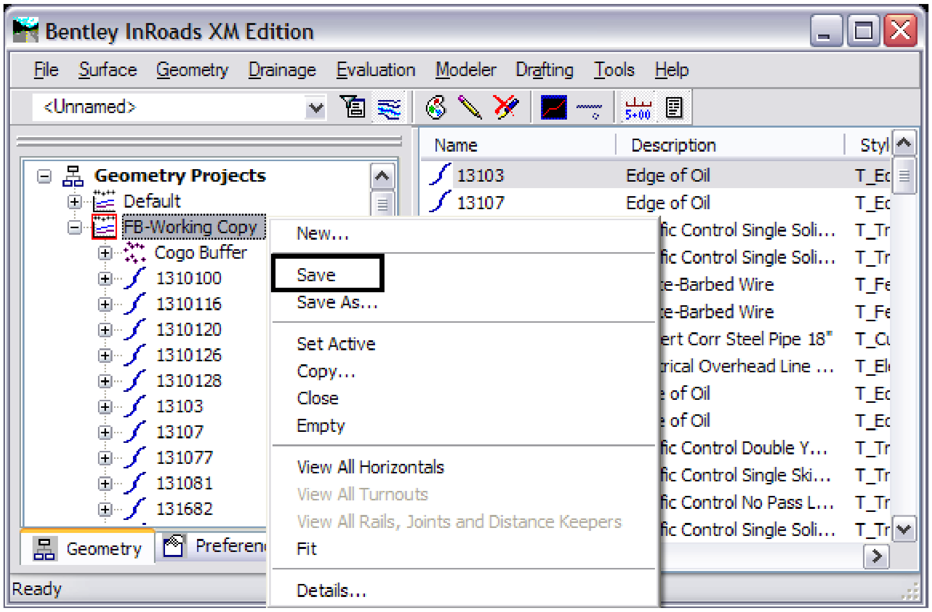
31. **<D> Apply** then **<D> Yes** button.

32. **<D> Close** the ***Rename Geometry*** dialog.

These changes have been made in a copy of the geometry project that was exported from the survey fieldbook. In this copy, some key horizontal and vertical alignments have been renamed, described, and assigned appropriate geometry styles to conform to CDOT standards with a naming convention that is more intuitive.

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

33. **<R>** on the geometry project **FB-Working copy** and select **Save As** from the fly-out menu.



34. 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.

Lab 4.3 - Transposing Alignments

Transposing an alignment reverses the direction of that alignment. Tangent sections are reversed and left-hand curves become right-hand curves. The beginning stationing value is retained; however, any station equations previously defined are deleted. Associated vertical alignments are also reversed.

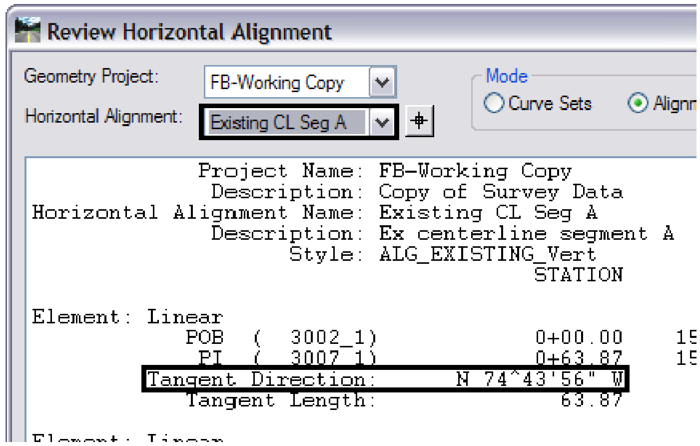
You may find the need to transpose an alignment if it was surveyed in a direction opposite from the direction you wish to design (up-stream vs. down stream). Other instances may be if you create an alignment by importing from graphics. InRoads will generate the alignment in the direction the MicroStation graphic was drawn which is not necessarily in the direction of ‘up-station’. Or you may simply create an alignment in the wrong direction using any of the InRoads geometry commands.

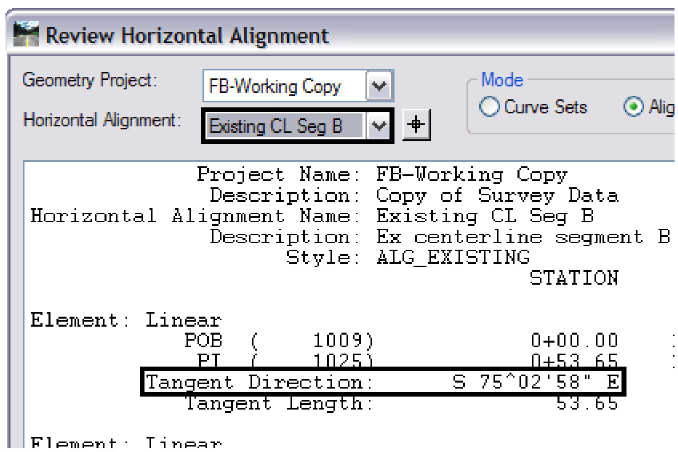
Section Summary:

- ♦ Change the stationing direction using the Transpose command.

1. Use the review tools to evaluate both of the renamed horizontal alignments. What direction are the tangents running?

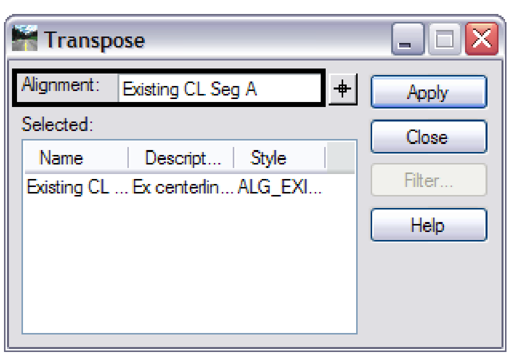
- You should notice that the alignment **Existing CL Seg A** runs northwest and that alignment **Existing CL Seg B** runs southeast.





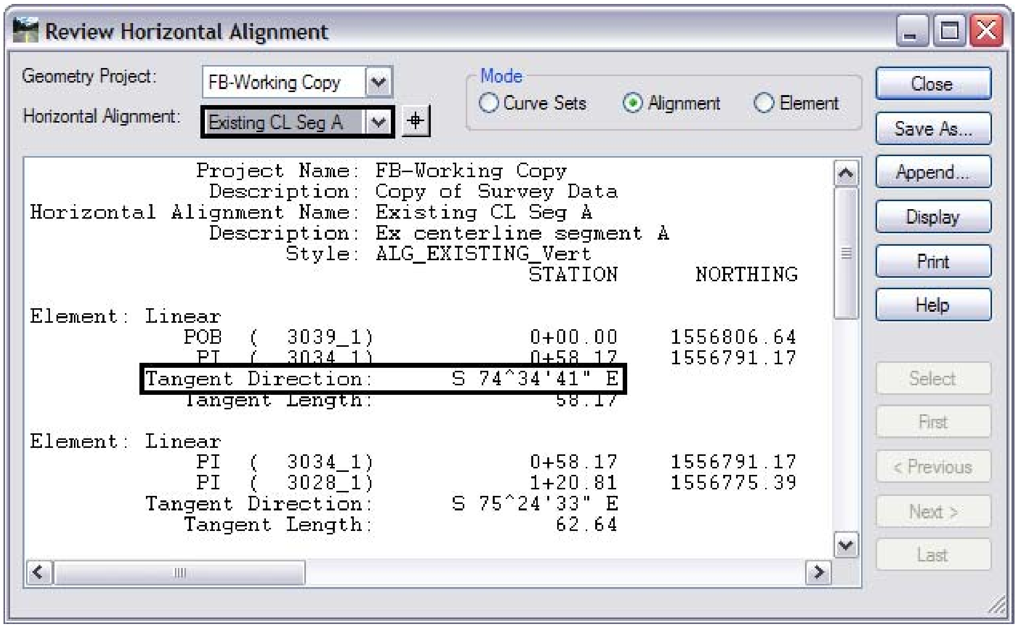
- Alignments created by exporting an electronic fieldbook assume the direction of the data collection.
- Both alignments should run in a Southeasterly direction.

2. Select **Geometry > Utilities > Transpose**.



3. Select alignment **Existing CL Seg A** for transposing **<D> Apply**.

4. **Review** the alignment to verify the transposition.



5. **Save** the geometry project **FB-Working Copy**.

Section Summary:

- ♦ Always review geometry after making changes like Transpose to ensure that the command was completed as desired.

Chapter Summary:

- Take care not to inadvertently edit or delete other group's work. Communication is the key to reducing data loss.
- Survey geometry has name meaningful to them, but possibly not to other groups. Rename your copy of survey's geometry data.
- The direction of an alignment can be changed using the transpose command. Set the alignment to the direction that makes the most sense for the design.

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 joining cogo points together and the traversing commands.

Another aspect of this lab is to learn how to modify or create new geometry from geometry features that exist in a geometry project. An example of this would be to create parallel/offset alignment such as a centerline to represent the edge of road or other feature that parallels the centerline.

Chapter Objectives:

- Create a new geometry.
- Create alignment tangents.
- Define alignment curves.
- Learn how to define and modify alignment stationing.
- Annotate an alignment.
- Create a horizontal alignment form graphics.
- Modify an existing alignment.
- Create parallel horizontal alignments.

The following files are used in this lab:

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

A predefined workflow for creating geometry is not dictated by InRoads. However, a typical workflow might be:

1. Create or open an existing geometry project
2. Create horizontal alignments (or Cogo points)
3. Assign stationing for alignments
4. Define alignment 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

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.

Lab 5.1 - Review Geometry from Survey

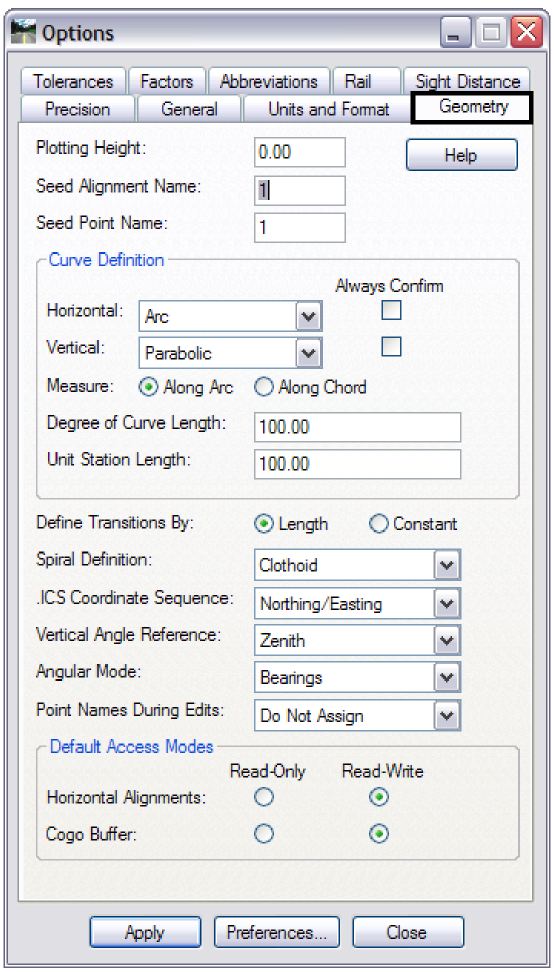
Section Objectives:

- Understand the difference between Named and Unnamed cogo points and how to apply cogo point names

1. Start InRoads using your desktop icon and opening the file **12345DES_Model.dgn** from the **C:\Projects\12345\Design\Drawings\Reference_Files** directory.

2. Open up the InRoads ***Options*** dialog box from the menu bar under **Tools > Options** and review the settings in the **Geometry** tab.

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

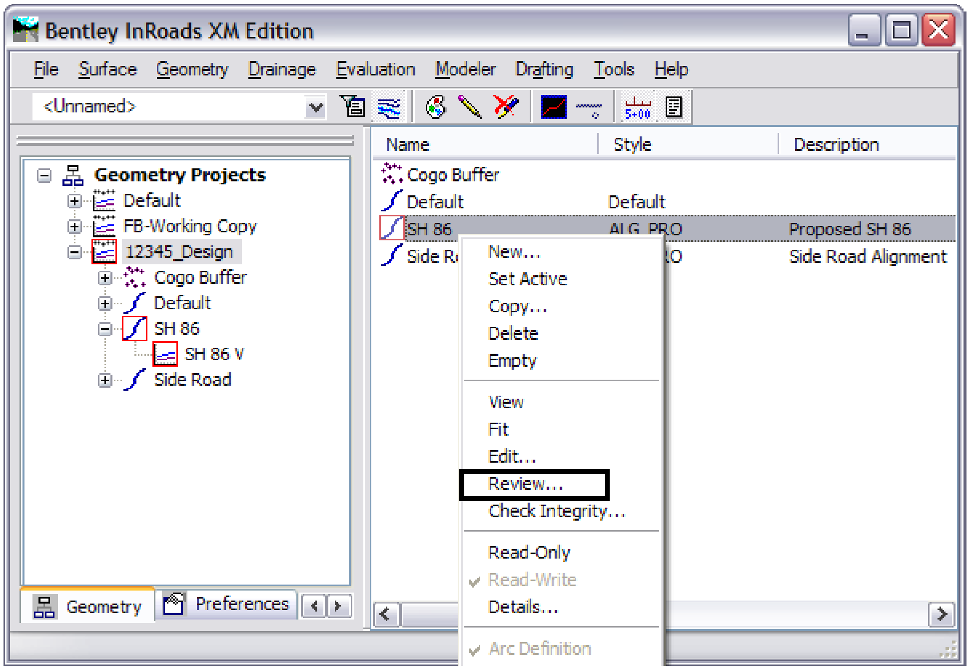


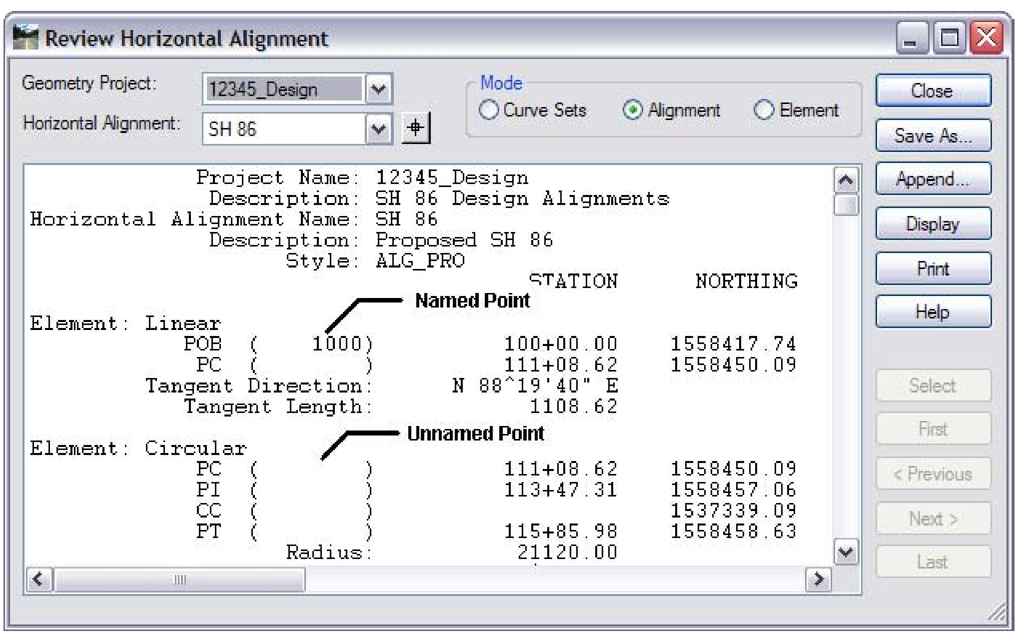
3. Load the geometry project **12345DES_Design.alg** from the folder **C:\Projects\12345\Design\InRoads**.

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.





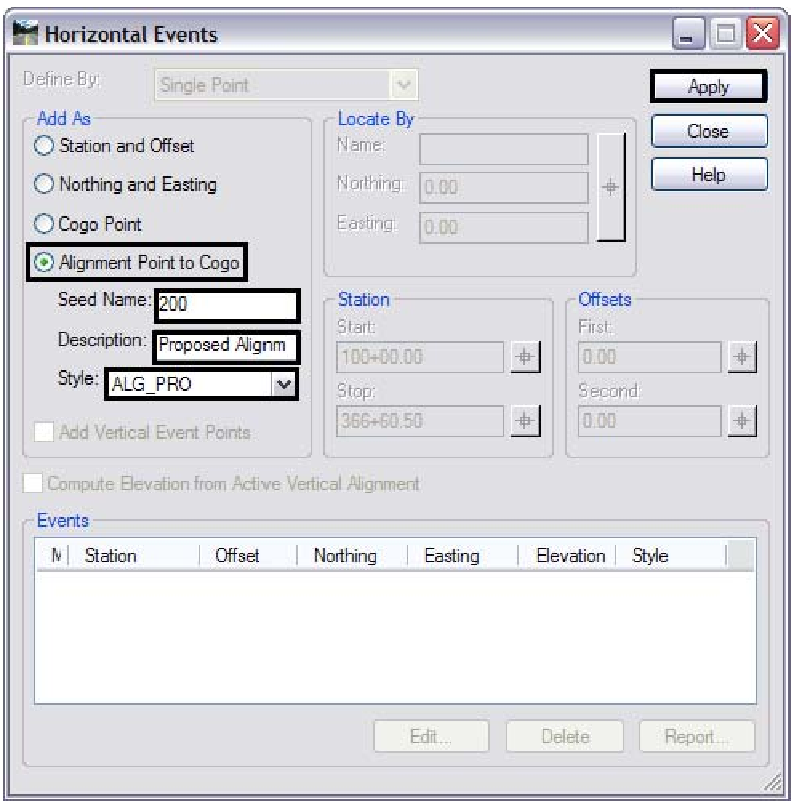
Note: If ***Point Name During Edits*** is set to **Named** on the ***Geometry*** tab of the ***Options*** dialog box, alignment key-points are generated with a name based on the next available ID as specified in the ***Seed Point Name*** field. The specified seed point name can be alpha, numeric, or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

5. To create point names for all alignment key points and add them to the Cogo Buffer, select **Geometry > Horizontal Curve Set > Events**.

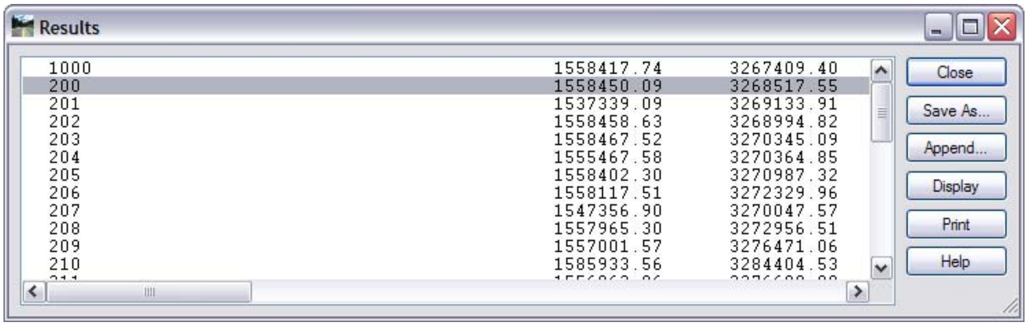
6. In the Horizontal Events dialog box, toggle on Alignment Point to Cogo in the Add As section.

7. Key in ***200*** for the ***Seed Name:***, ***Proposed Alignment*** for ***Description:***, and select **ALG_PRO** for the ***Style:***.

8. Click **Apply**.



A Results dialog box will appear 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.

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

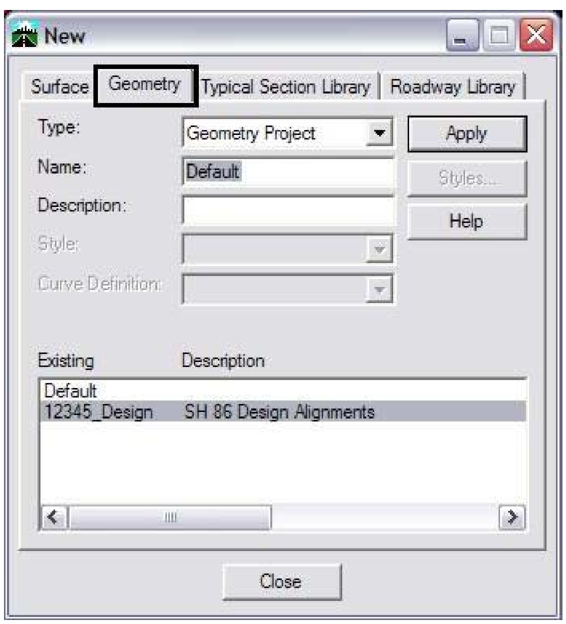
Lab 5.2 - Create New Geometry

Section Objectives:

- Learn how to create a geometry project and place holders for horizontal geometry data.

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

1. From the pull-down menu **File > New**.

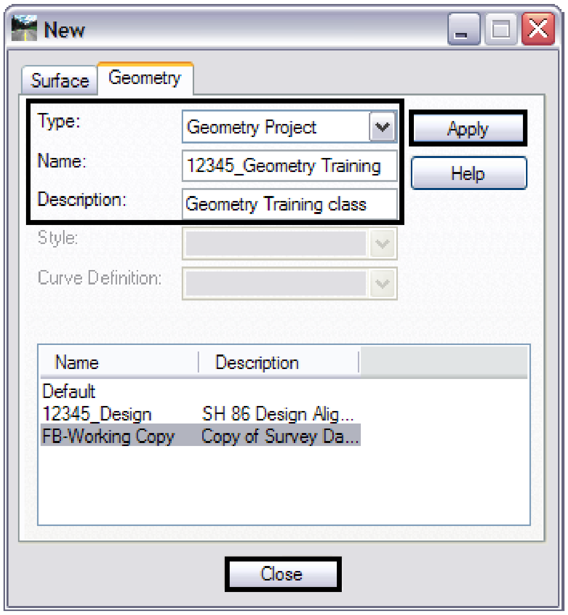


2. **<D>** the **Geometry** tab.

3. For the ***Type***, choose **Geometry Project**.

4. In the ***Name*** field, key in ***12345_Geometry Training***.

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

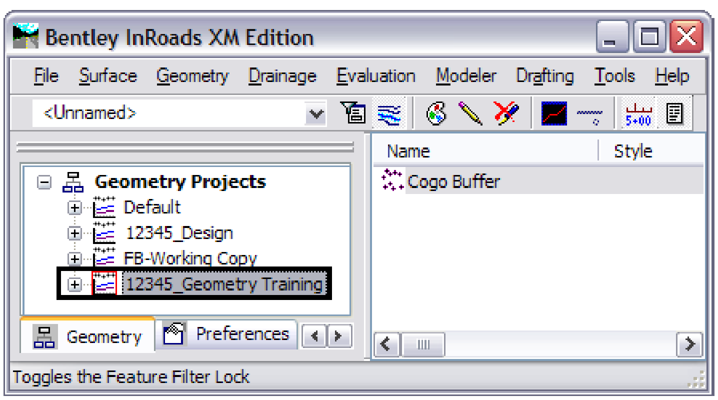


Note: The lower portion of the ***New*** dialog displays geometry projects that are currently loaded into memory.

6. **<D> Apply** (Do not Close the New dialog box yet).

Note: InRoads created the geometry project and made it the active geometry project. Any horizontal alignments created will be placed in the active geometry project.

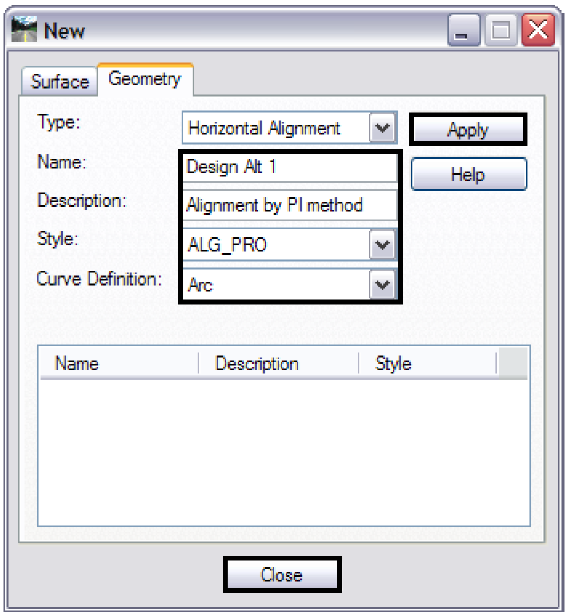
7. **Verify** that the new geometry project was created.



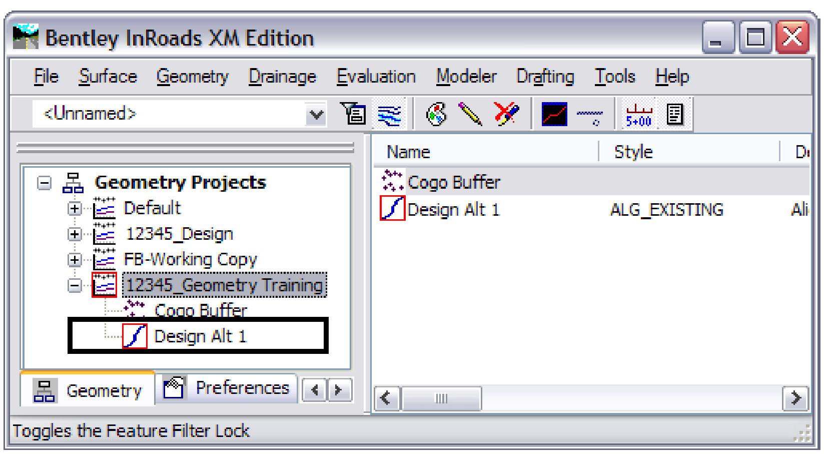
Note: This creates the geometry project where all new alignment data will be stored. At this point, it is held in RAM (Random Access Memory). When saved to the hard drive, the default extension will be *.alg, as was assigned to previous geometry projects.

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**



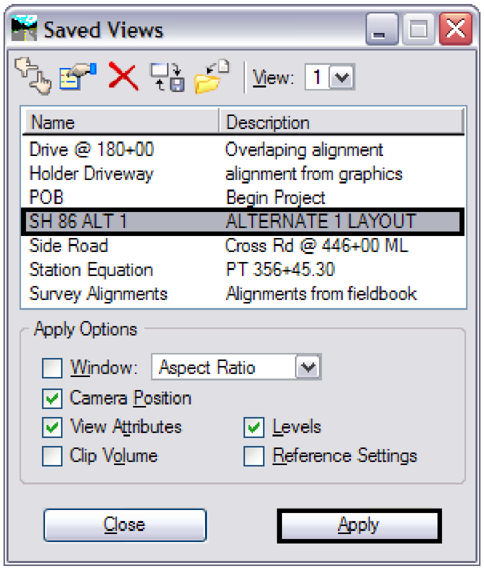
9. **<D>** the **Apply** then **Close** buttons.



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

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

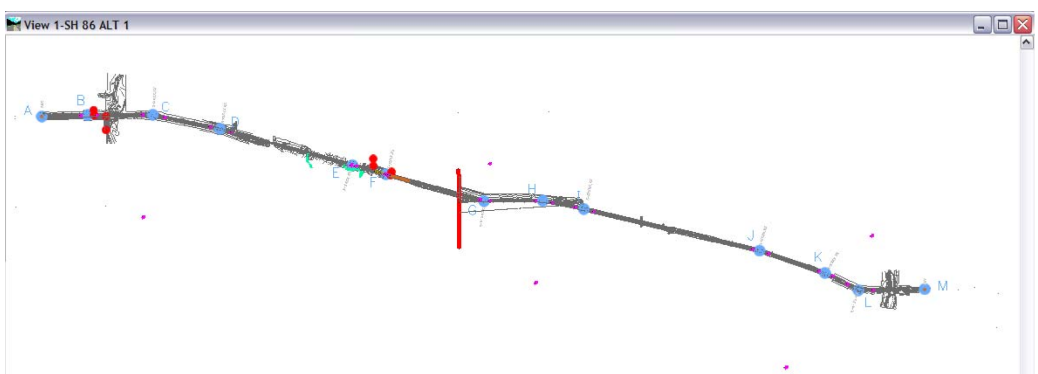
12. From the ***Saved Views*** dialog **<D>** saved view name **SH 86 ALT 1**.



13. **<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 steps will be used to construct the tangents, then insert curves between the tangents once constructed.



Note: The following labs 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.

Note: For orientation screened graphics and curve radius values are shown for the alignment that will be created.

Lab 5.3 - Create Alignment Tangents

Section Objectives:

- ♦ Learn how to create horizontal alignments from PI to PI.

The first toolbox that we will use is the ***Horizontal Curve Set*** commands. These commands present an easy way to create alignments. They consist of five primary commands described below and may be accessed from a toolbar (shown) or from the pull-down menu under ***Geometry*** > ***Horizontal Curve Set***.

Add PI is used to create a PI that begins a new alignment, or to add a PI onto either end of an existing alignment thereby extending it.

Insert PI is used to add a PI to an existing alignment between two existing PIs.

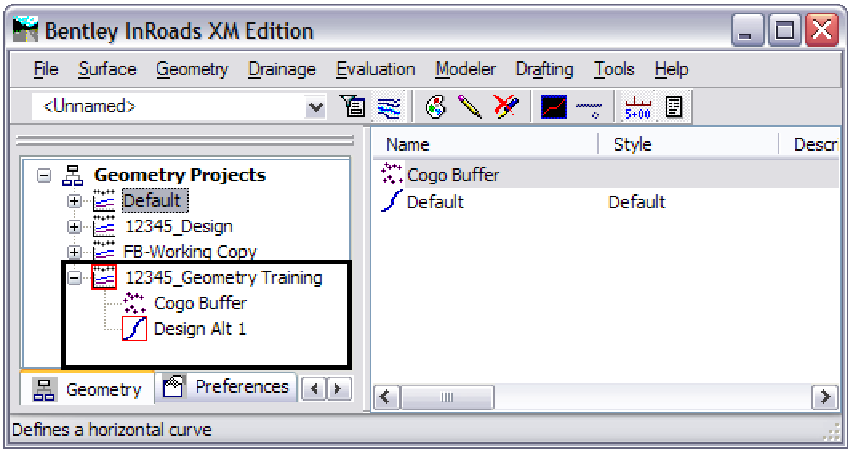
Move PI is used to change the location of a PI previously established.

Delete PI is used to remove a PI from an existing alignment. For removing more than one PI, you must choose and ***Accept*** each one individually. To remove all PIs associated with an alignment, but leave the alignment name, right-click on the alignment name in the Explorer menu and choose ***Empty***.

> ***Define Curve*** is used to either establish curves or to edit curves previously defined.
>
> ***Stationing*** for establishing stationing or station equations along an alignment
>
> ***Events*** are used to establish unique locations relative to an alignment, Cogo points, or the assignment of Cogo points along an alignments keypoints.

In this lab you will create an alignment using the Horizontal Curve Set, or PI method. First input the tangent sections of the alignment by selecting locations graphically. This is accomplished by **<D>** at the desired location. Once the tangents are in place, curves between these tangents will be defined.

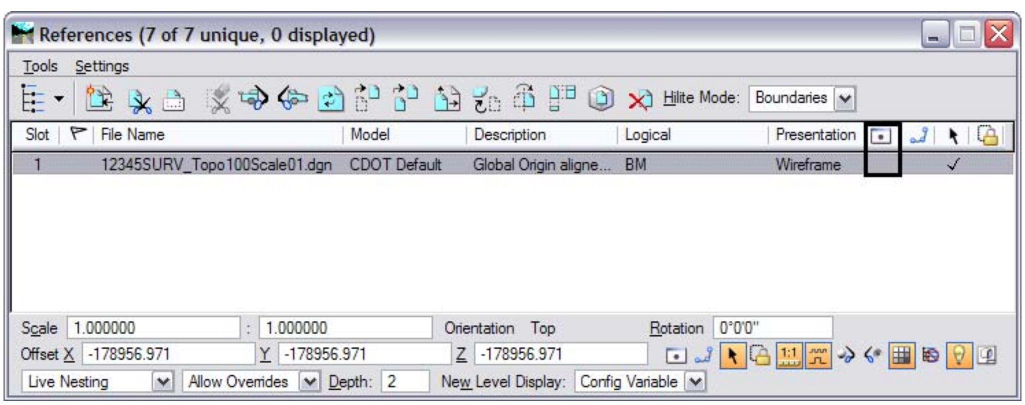
1. Before beginning, verify the proper alignment is ***Active***. This is necessary as any geometry entered will be populated in the active alignment.



Design Alt 1 should be the active alignment. If not, several options exist to define it as the active alignment.

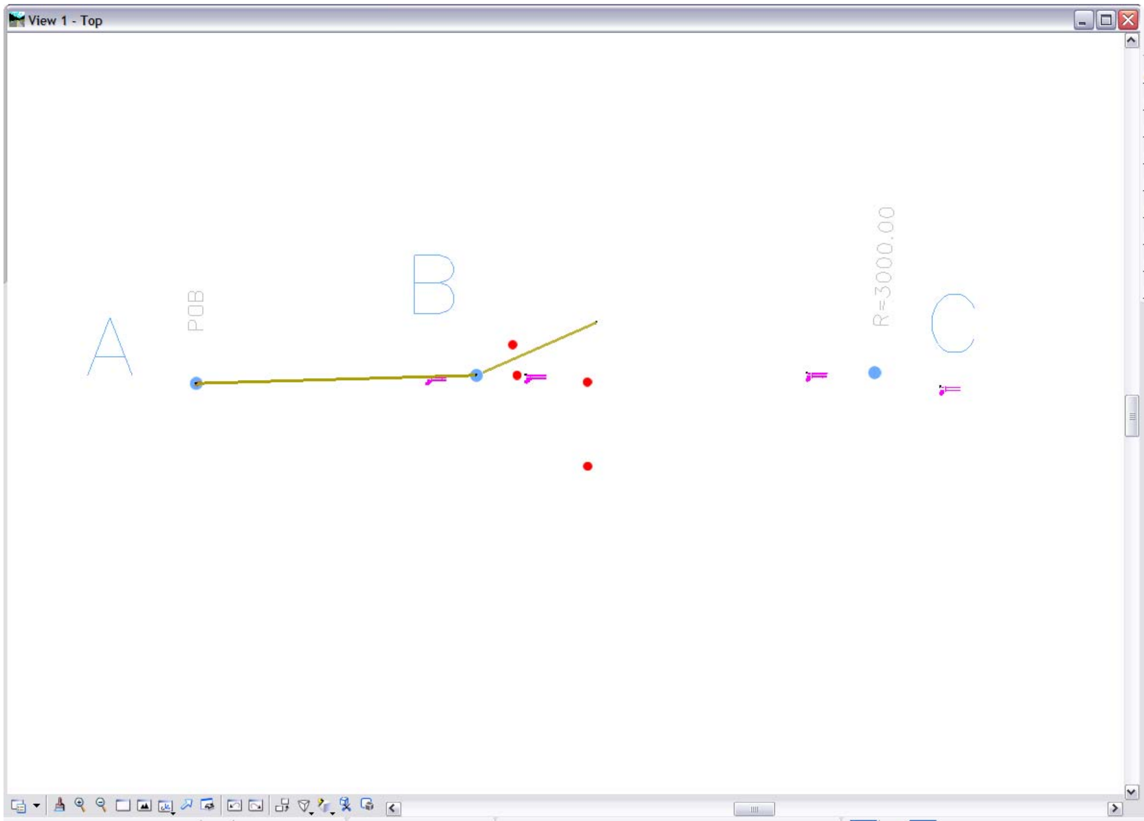
- Right-click **<R>** on the horizontal alignment name and select ***Set Active*** from the fly-out menu.
- From the pull-down menu, select **Geometry > Active Geometry** and use the resulting dialog to set the active alignment.

2. To clear the MicroStation view turn **Off** the Reference Display for the **12345SURV_Topo100Scale01.dgn** in the ***References*** dialog box.



3. Select **Geometry > Horizontal Curve Set > Add PI.** You are prompted in the MicroStation status bar to ***Identify Alignment End***.

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

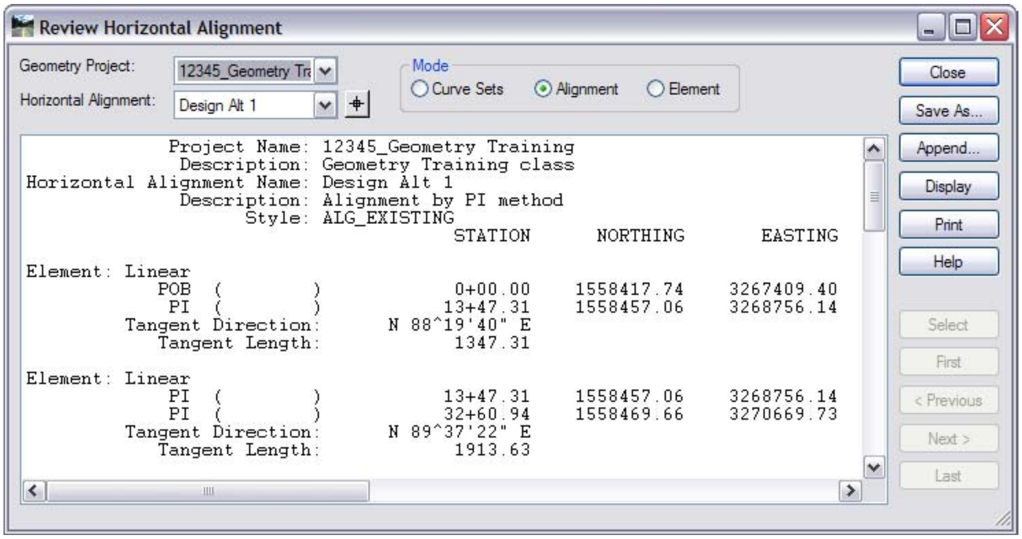


5. Continue to issue a series of points **<T>** and **<D>** through points **B-M**.

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

7. 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.

8. 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.

The next lab teaches how to define the horizontal curves.

Lab 5.4 - Define Alignment Curves

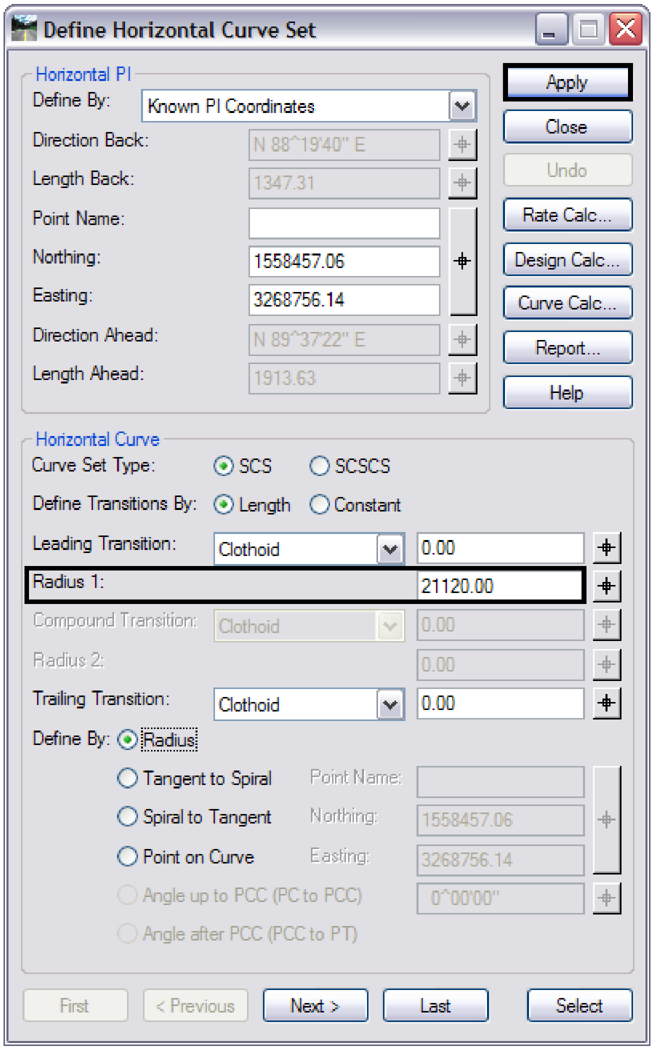
Section Objectives:

- Learn how to add curves to horizontal alignments using various methods
- Learn how the Curve Calculator is useful in calculating an unknown curve radius

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 can 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.

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). Use the Curve Calc…. button to solve the curve data.

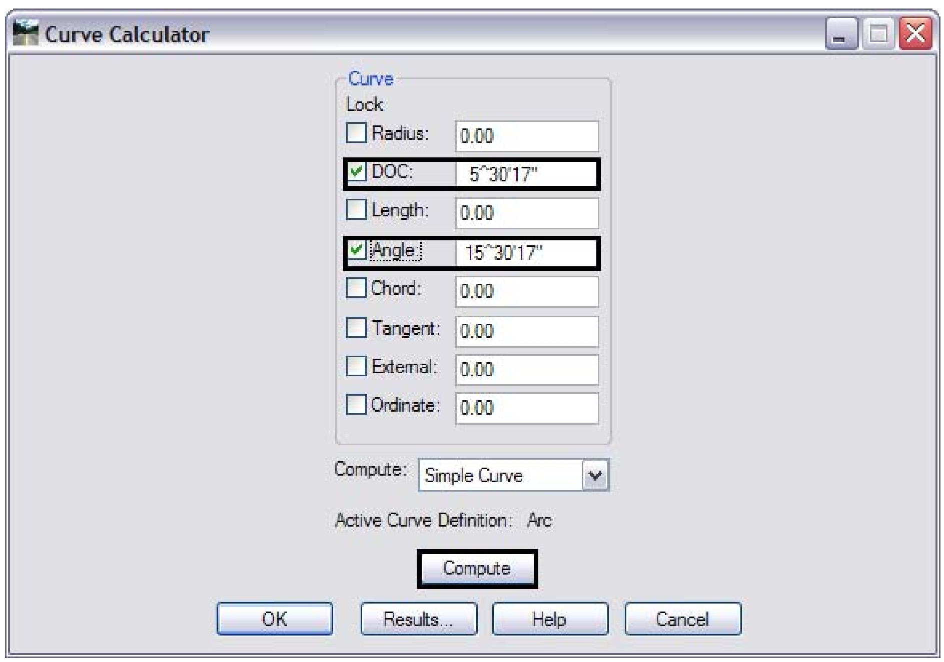
8. **<D>** the **Next** button to define the curve at point G.

9. **<D>** the **Curve Calc…** button.

10. **Set** Compute: to **Simple Curve**.

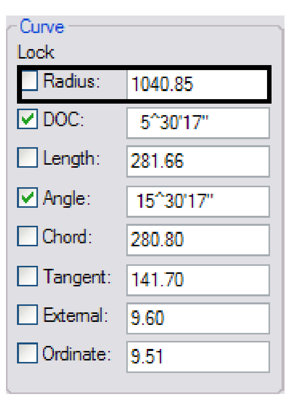
11. Calculate based on a **5 degree 30 minute 17 second** curve.

12. Key in ***5 30 07*** for the ***DOC:*** the field and verify that the ***Lock*** field is **Checked On**. (Verify the Radius option is unlocked and that only 2 fields shown below are locked).

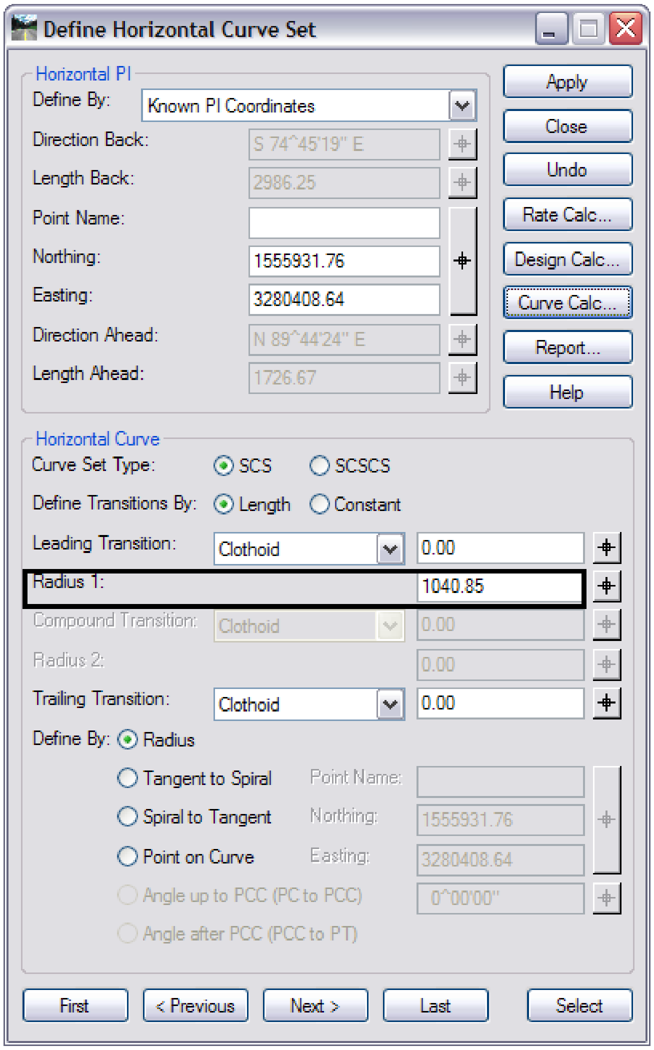


13. **<D> Compute**.

Notice the changes that occur in the dialog.



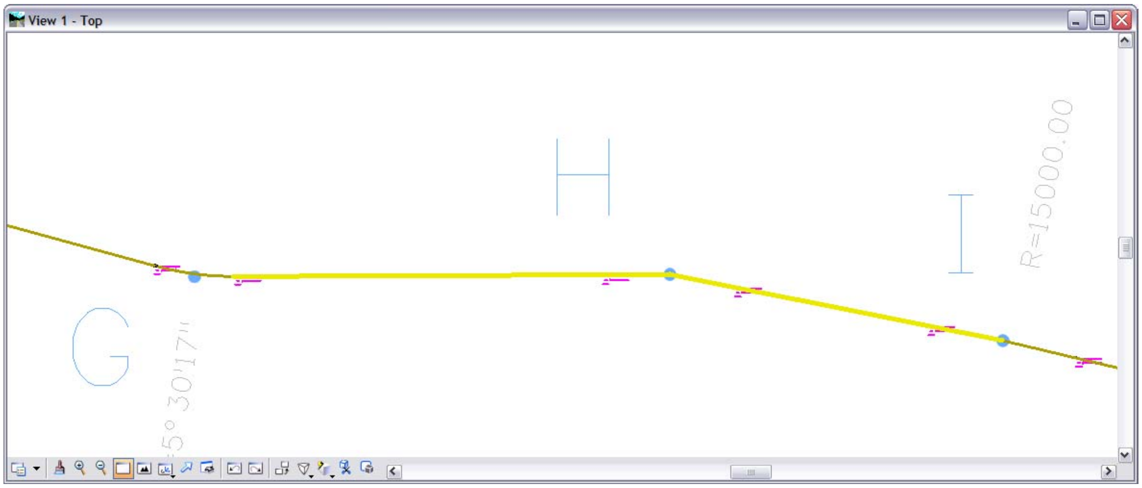
14. **<D> OK**. The ***Curve Calculator*** dialog will close and the calculated radius will be populated in the ***Radius 1*** field in the parent dialog.



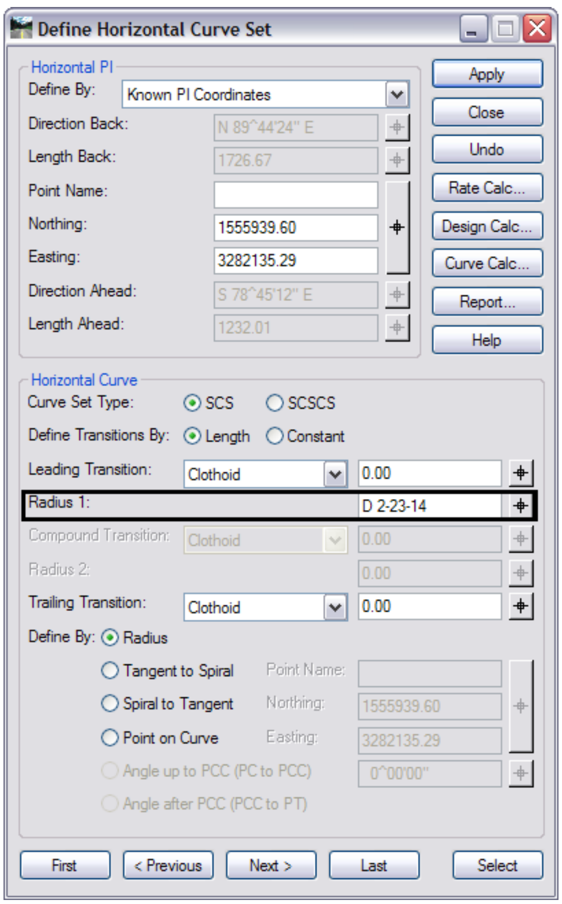
15. **<D> Apply** and the curve will be created.

The next curve (location H) will also be developed 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***.



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 as noted in the drawing and 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**.

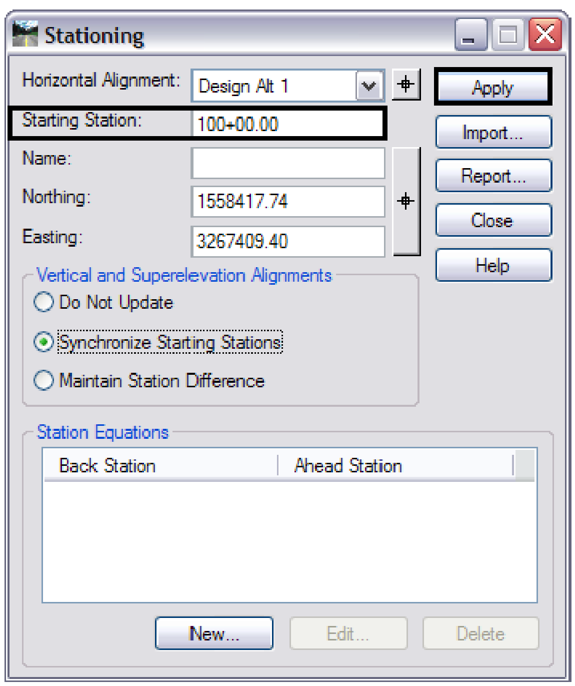
Lab 5.5 - Alignment Stationing

Section Objectives:

- Understand how to 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

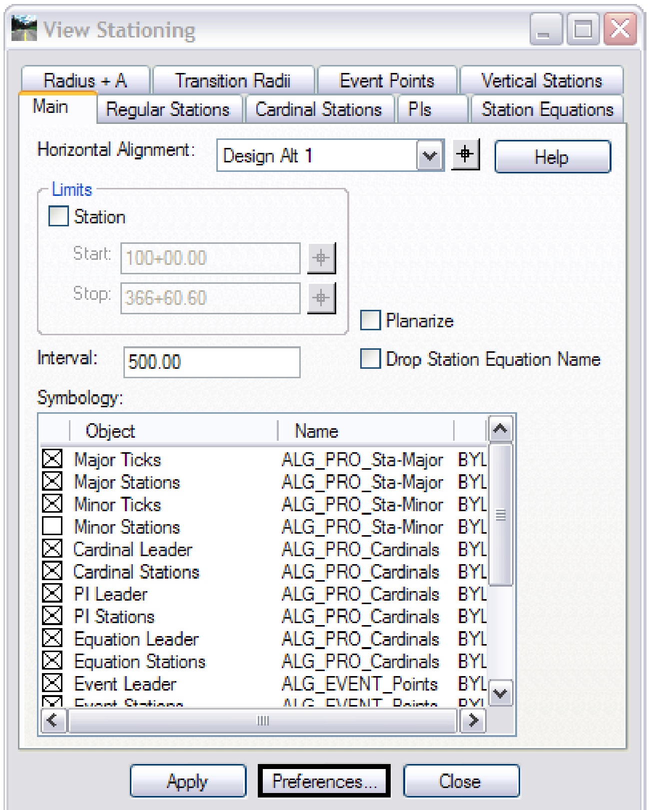
1. Select **Geometry > Horizontal Curve Set > Stationing**.
2. Key in ***Starting Station: 100+00***. (Can be entered as 10000 and then tab out of the field)
3. **<D>** the **Apply** button.



4. Verify your results using both of these methods:

- **Geometry > Review Horizontal**
- **Tools > Tracking > Horizontal Alignments**

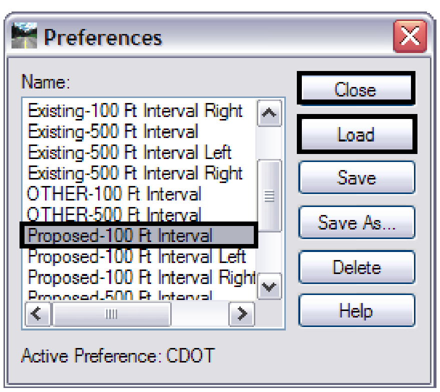
5. Select **Geometry > View Geometry > Stationing**.



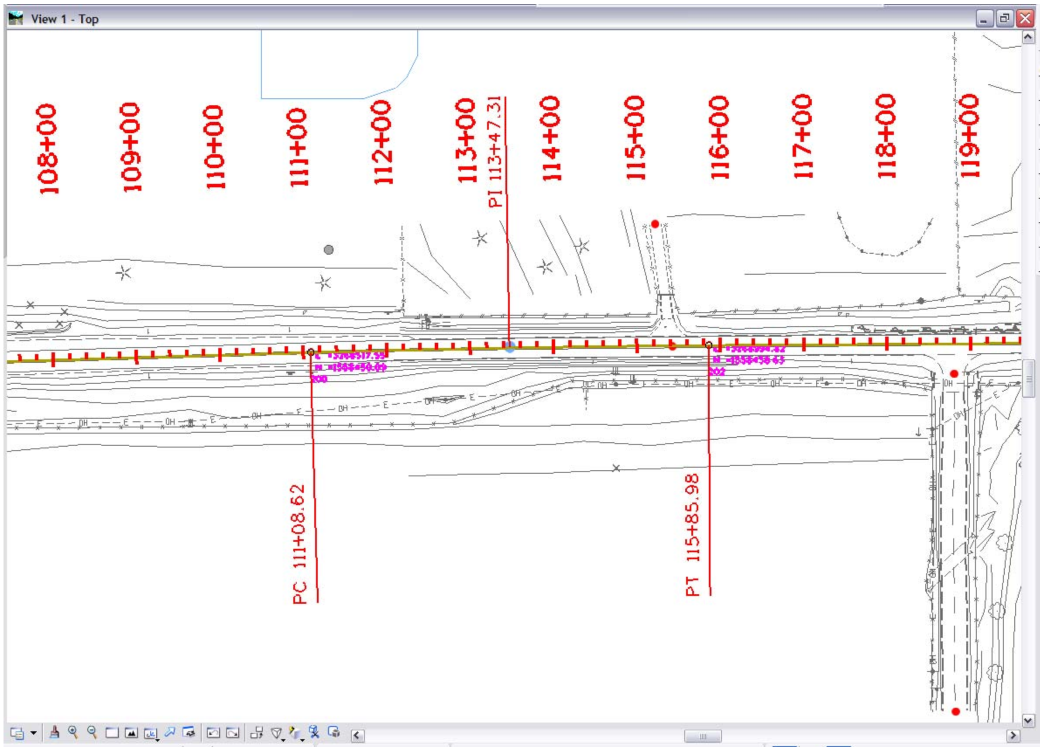
6. **<D>** the **Preferences** button.

7. **<D>** the saved preference name **Proposed-100 Ft Interval**.

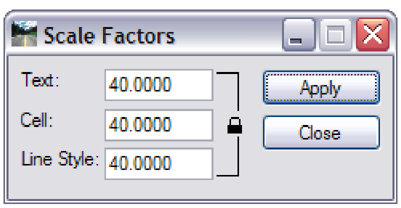
8. **<D> Load** and **Close**.



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



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



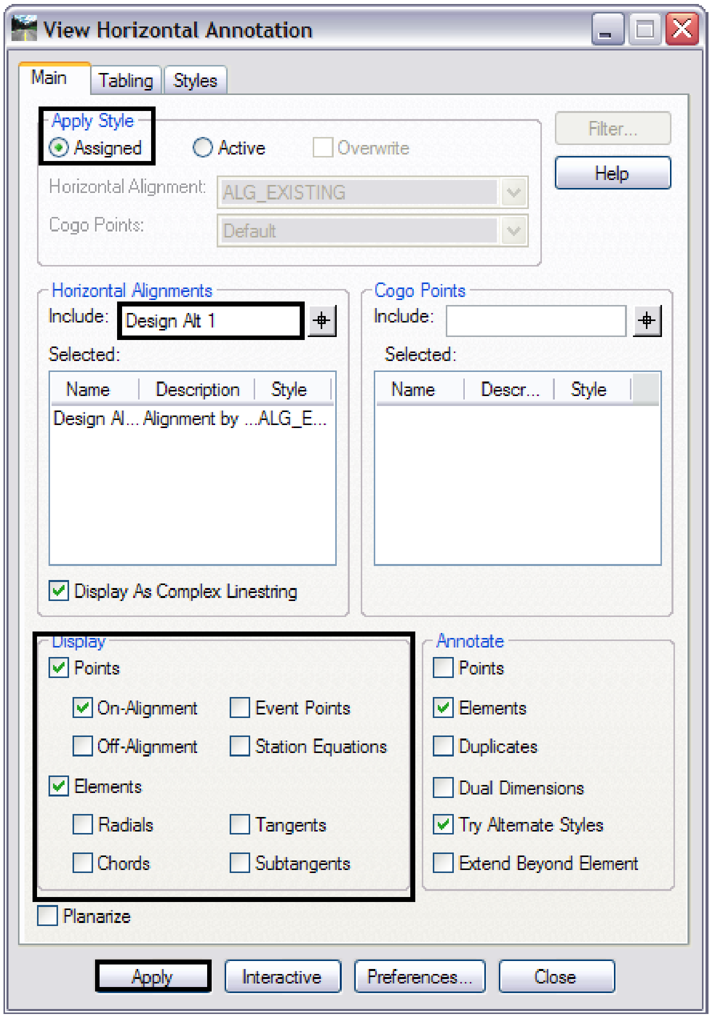
Lab 5.6 - Annotating an Alignment

Section Objectives:

Understand the difference between Named and Unnamed cogo points and how to apply cogo point names.

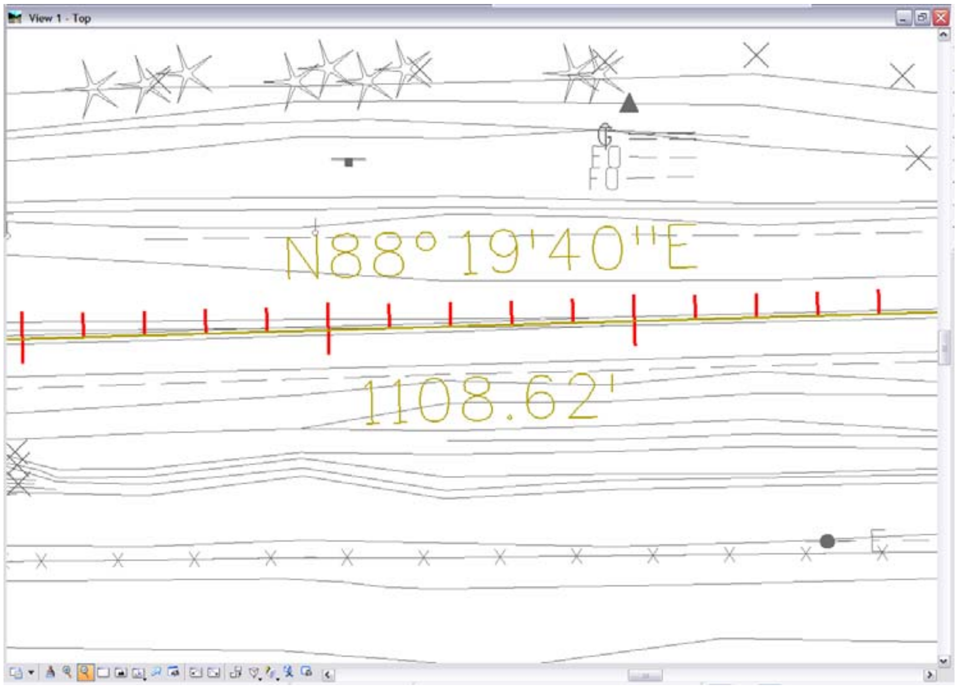
- ♦ Learn how to annotate an alignment.

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



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

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 an alignment PI
   - Redefine one or more horizontal curves
   - Define alignment stationing as ending 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
   - Create a profile showing the existing ground profile along the copied alignment with a 2x vertical exaggeration

Lab 5.7 - Horizontal Alignment from Graphics

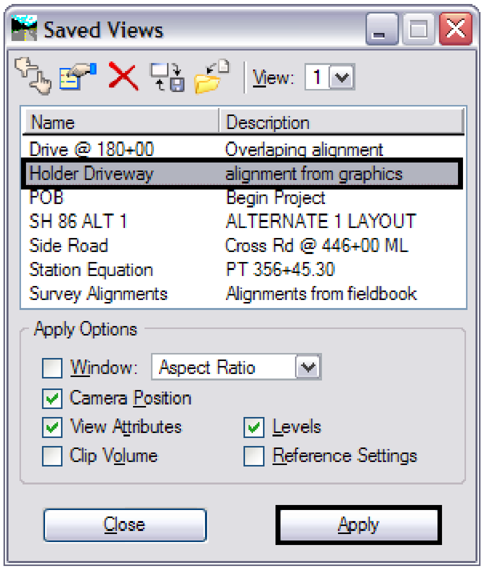
Section Objectives:

- Learn how to create a new horizontal alignment from MicroStation graphics.

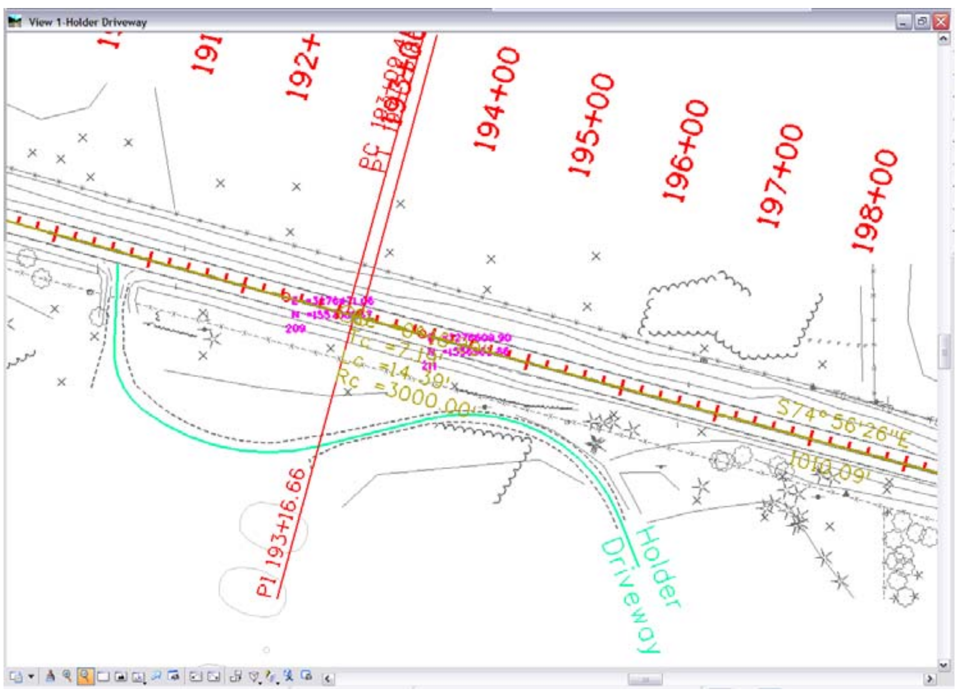
Alignments can be created from existing MicroStation graphics. In this exercise a chained MicroStation element will be used to create an alignment.

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

2. From the ***Saved Views*** dialog **<D>** saved view name **Holder Driveway**.



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



4. Select **File > Import > Geometry.** The ***Import Geometry*** dialog will open.

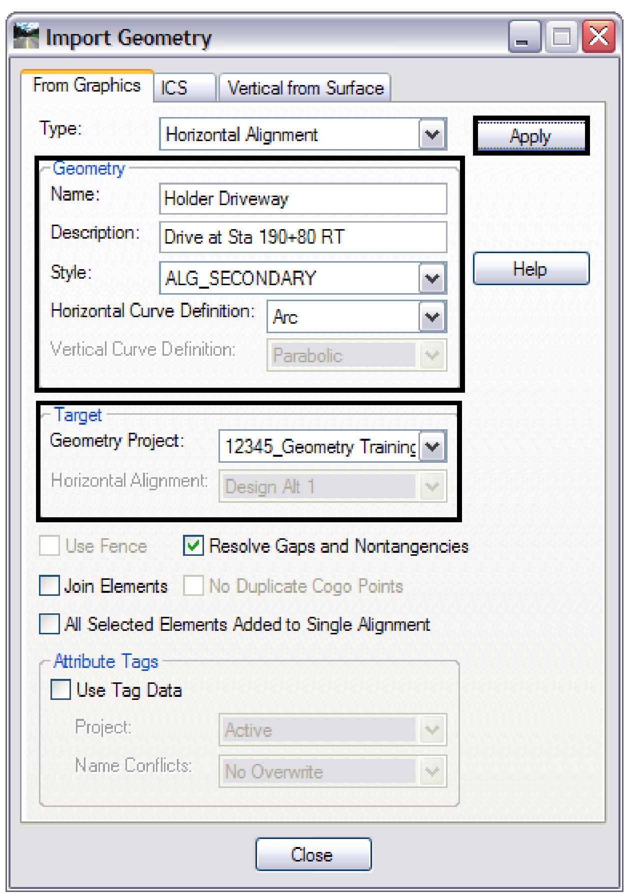
Horizontal Alignments, Horizontal and Vertical Alignments, Cogo Points or Event Points can be imported from MicroStation graphics. If the alignment has curves, it is recommended to toggle on **Resolve Gaps and Nontangencies**. If the alignment was drawn as a series of lines and/or arcs that have not been chained together as complex elements toggle on **All Selected Elements Added to Single Alignment** (you must define a Fence or Selection Set of the elements).

After specifying the ***Name***, the ***Description*** and the ***Style***, choose **Apply**. If you created a Selection Set or defined a fence prior to initializing the command, you will be asked to Accept the contents. If this was not done, you'll be asked to identify the element. In either case, after accepting, an alignment or alignments will be added to the geometry project specified in the ***Target*** section.

5. Fill in the following information on the **From Graphics** tab:

- ♦ Type: **Horizontal Alignment**
- ♦ Name: ***Holder Driveway***
- ♦ Description: ***Driveway at Sta 190+80 RT***
- ♦ Style: ***ALG_SECONDARY***
- ♦ Geometry Project: **1234_Geometry Training**

6. **<D>** the **Apply** button. The ***Import Geometry*** dialog will minimize allowing you to see more of your MicroStation view.



7. When prompted to Identify Element **<D>** on the MicroStation graphic drawn in the center of the driveway.

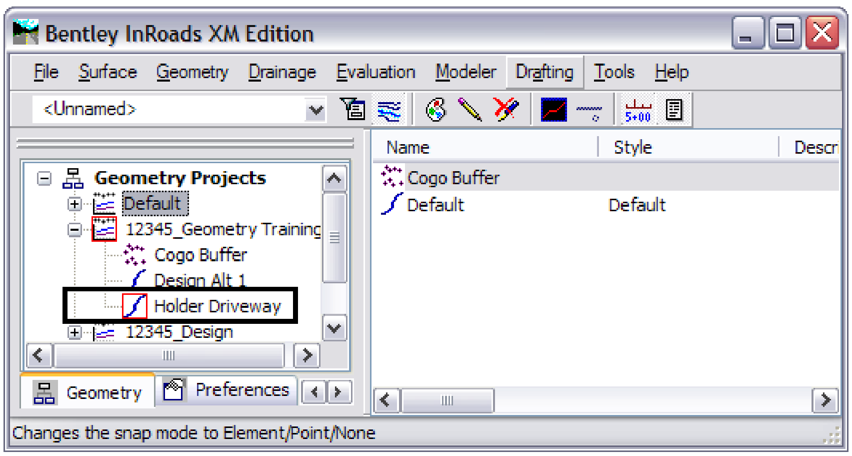
8. **<D>** again to accept the highlighted graphics in the MicroStation view.

9. **<R>** in the MicroStation view to terminate the command. The ***Import Geometry*** dialog will restore. The MicroStation graphics have been imported as an alignment.

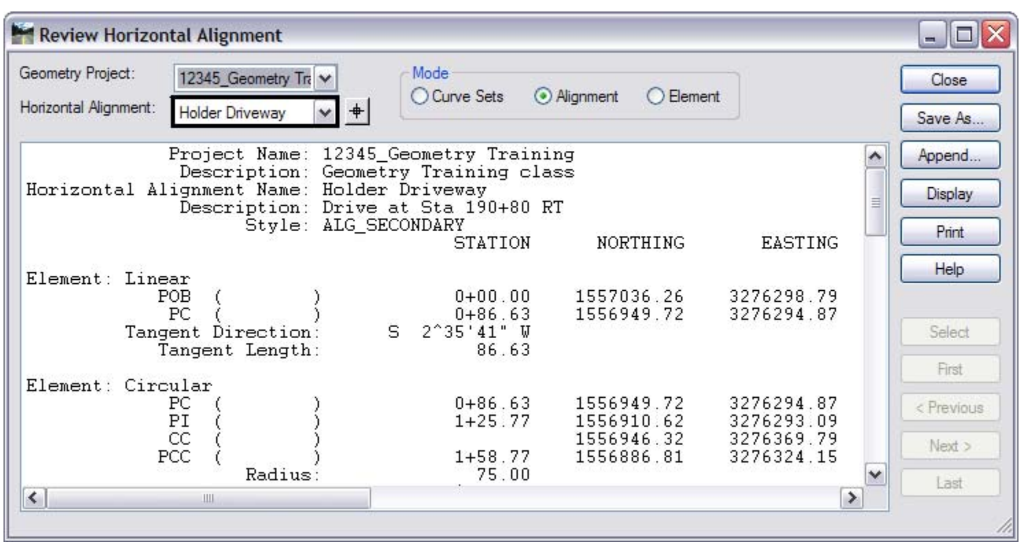
   Note: The geometry name field increments for additional selection(s).

10. **<D>** the **Close** button to close the ***Import Geometry*** dialog.

11. **Verify** the alignment was created.



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



13. When finished Close the dialog box.

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

Lab 5.8 - Extend Alignment

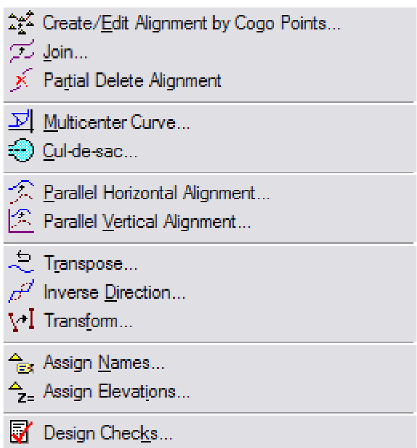
Section Objectives:

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

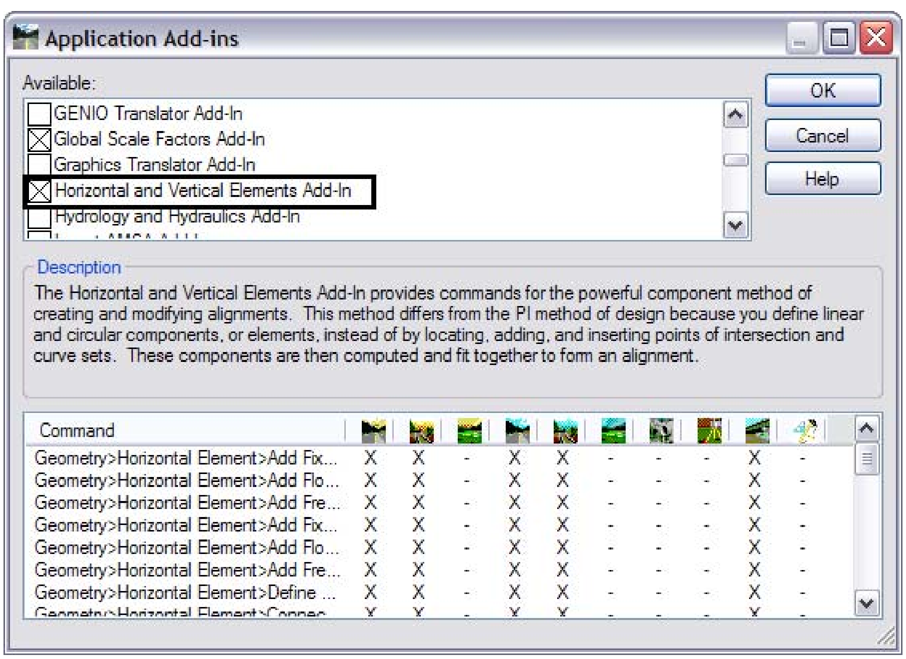
The alignment ***Holder Driveway*** does not intersect the reference line alignment ***Design Alt 1***. Standard practice necessitates the driveway alignment to commence at the main-line reference line.

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

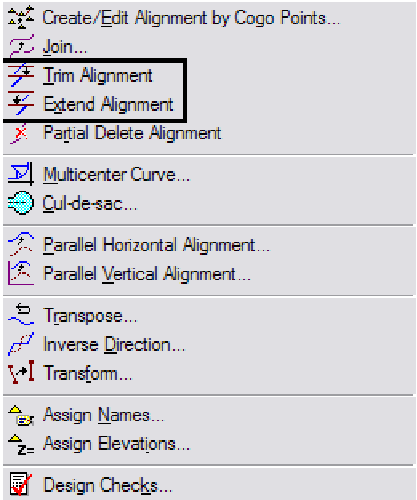
Note: If the commands for Trim and Extend Alignment are not listed in the menu, this means that they are not enabled. These 2 commands are an extension of the Horizontal & Vertical Elements command set which must be enabled.



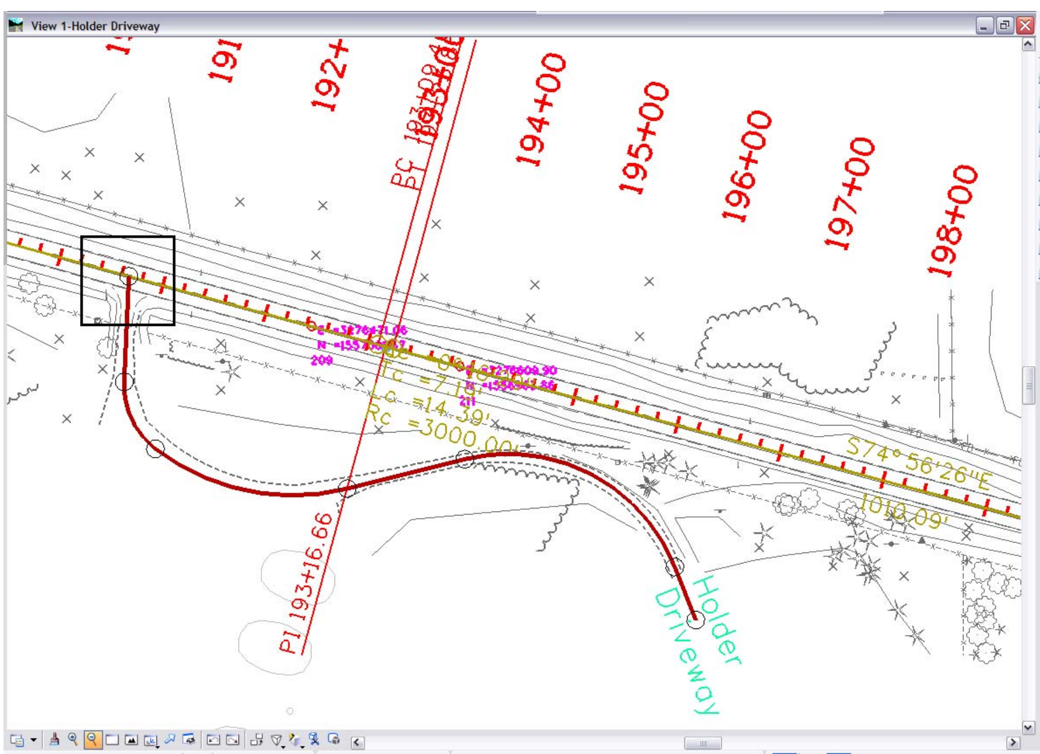
2. Select **Tools > Application ADD-Ins**.



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 and is assigned a station value of -0+12.41. The negative value is due to the original points in the alignment retaining their assigned station locations.

8. From the pull-down menu **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 and are prompted to select alignments. However, the location of the data point in response to ***Identify portion to clip*** will determine both the alignment and the portion that will be eliminated.

Lab 5.9 - Saving Geometry

Section Objectives:

- Understand the importance of frequently saving InRoads design data.

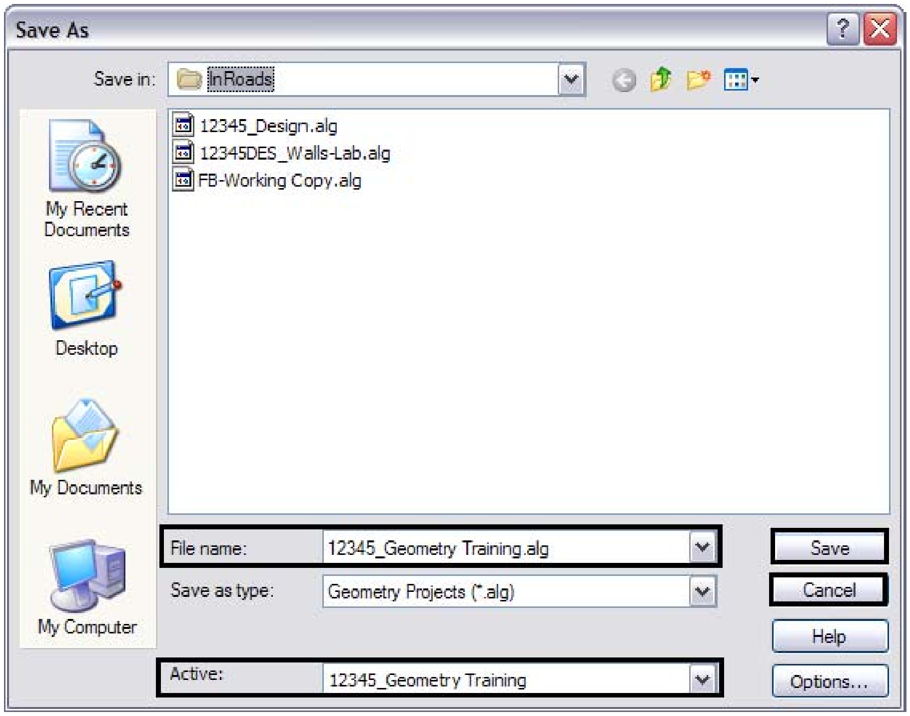
Alignments cannot be saved individually. They are saved when the geometry project is saved. Due to the fact InRoads works on geometry that is loaded in memory, the geometry project must be saved at appropriate times.

Geometry projects can be saved using several methods including:

1. From the pull-down **File > Save > Geometry Project**. The ***Save As*** dialog will appear with the ***Save as type:*** set to **Geometry (*.alg)**.

2. Verify you are in the correct project directory **C:\Projects\12345\Design\InRoads**.

Note: If the geometry project is already saved, then perform a **Save** operation instead of a **Save As** (see below).



3. The file name should match the ***Active:*** name at the bottom of the ***Save As*** dialog. If necessary, use the drop-down arrow in the ***Active:*** field and reselect the desired name to ensure the saved file name will match the surface 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 will close.

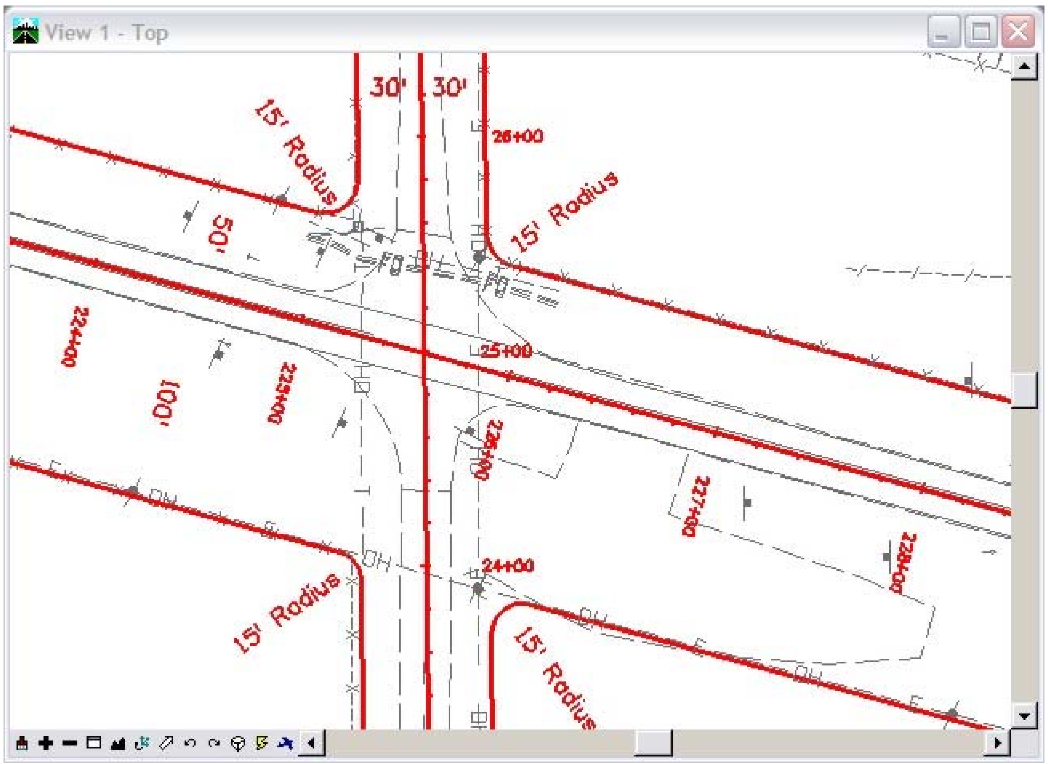
Lab 5.10 - Creating Parallel Horizontal Alignments

Section Objectives:

- Learn additional tools for creating 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.

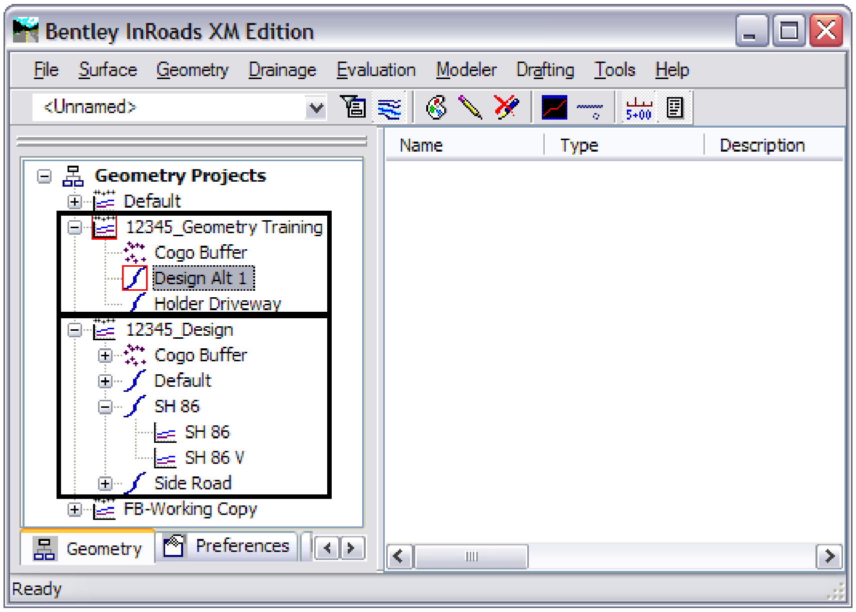
In this lab we will generate right-of-way limits for the mainline road and the side road. The Side Road has a right-of-way width of 60’ (30’ on each side of centerline). The mainline alignment has a total right-of-way width of 150’ being 50’ feet north of the reference line and 100’ south. At the intersection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



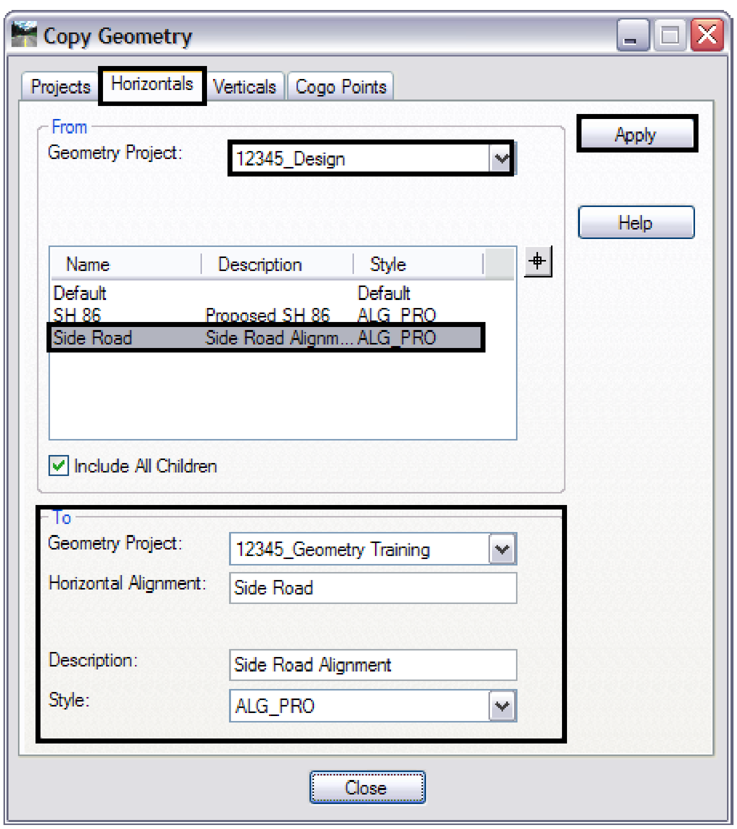
The workflow will consist of using an assortment of geometry commands:

- **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.



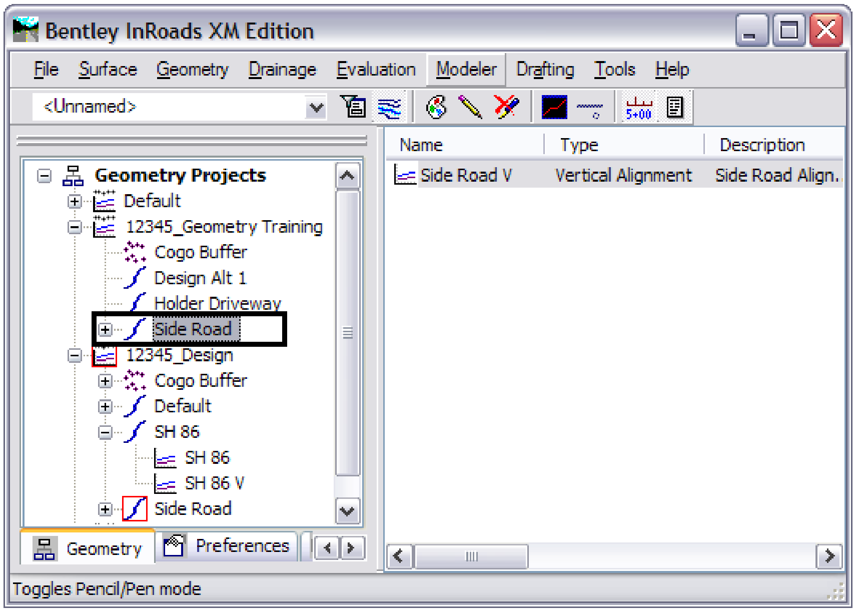
1. Select **Geometry>Copy Geometry**.



2. **Copy** the alignment **Side Road** from geometry project **12345_Design** to the geometry project **12345_Geometry Training**.

   Note: Also copy alignment **SH 86** as **SH 86 ALT 1** if you feel the mainline alignment created by an earlier lab exercise may be problematic.

3. Verify the alignment was copied.



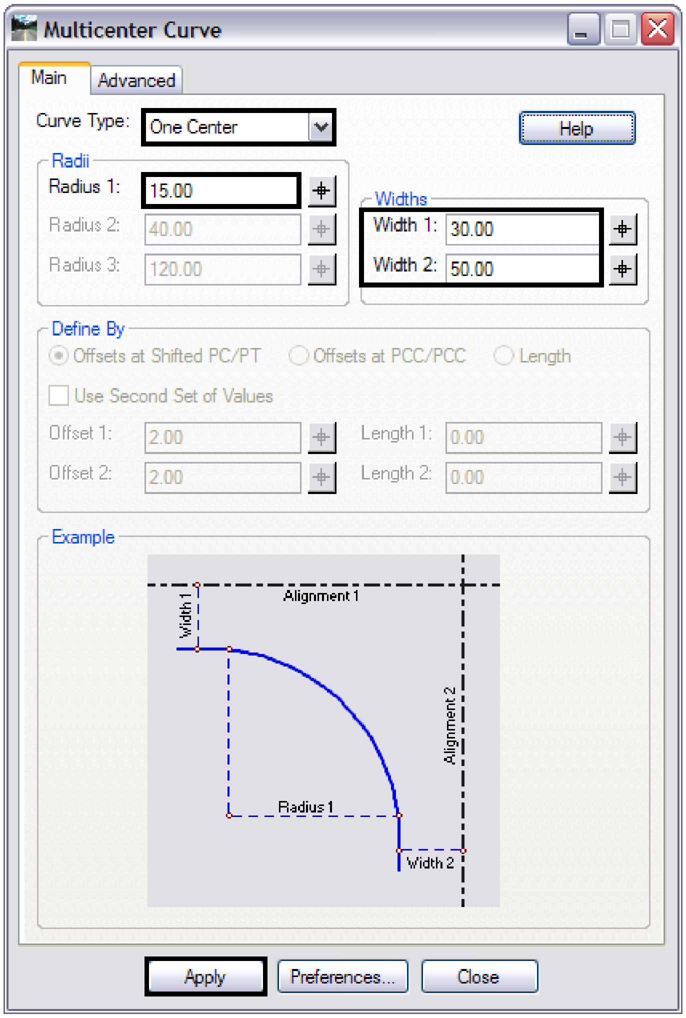
4. Set the geometry project **12345_Geometry Training** as ***Active*** causing newly created geometry to populate this project.

The next step is to generate the radius returns. This is done by using the ***Multi-Center Curves*** command. Begin by creating the radius returns north of the mainline alignment.

5. From the ***Saved Views*** dialog **<D>** saved view name **Side Road**.

6. Click **Apply**.

7. Select **Geometry > Utilities > MultiCenter Curve**.



8. Choose **One Center**.

9. Input the following values:

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

10. **<D>** the Apply button. Follow the prompts.

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

12. **<D>** on the **SH 86** alignment.

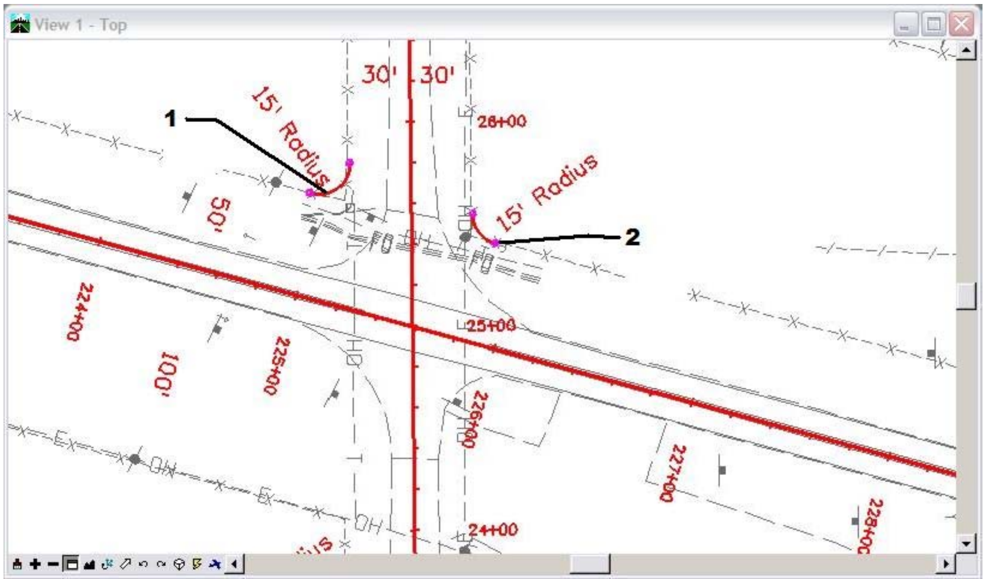
13. **<D>** in the ***Northwest*** quadrant

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

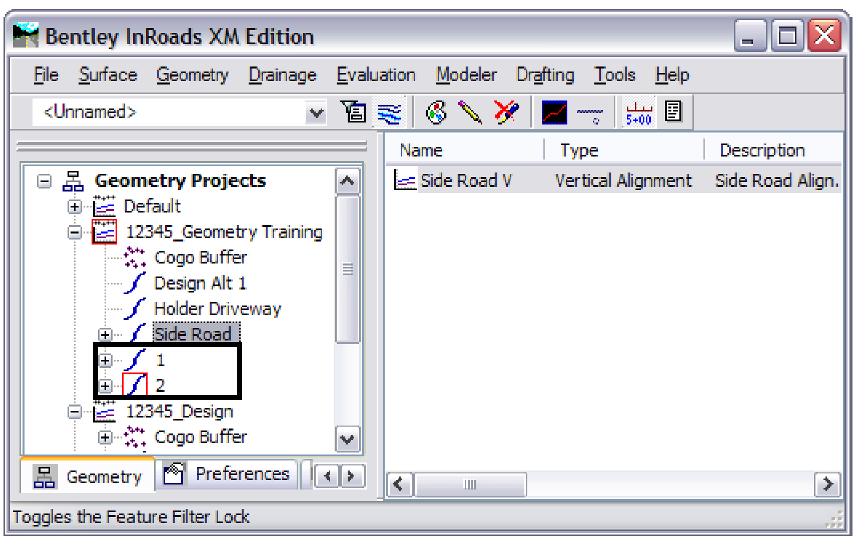
15. **Repeat** steps 7-12 and **<D>** in the ***Northeast*** quadrant.

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

Two new alignments are created, 1and 2.

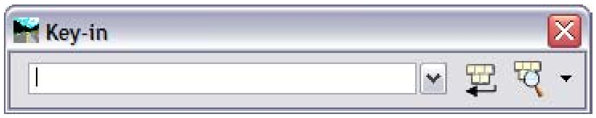


Note: Your stationing graphics may appear at a different location than shown above.



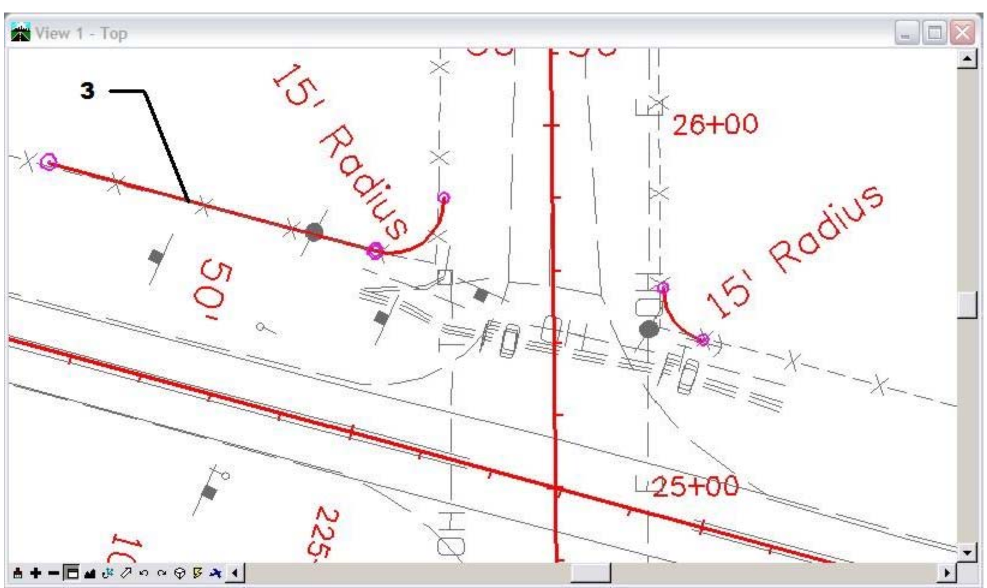
The next steps will be to offset the mainline and side road alignments so they match up with the returns that were just created. This is done using the ***Offset Alignments by Station*** command.

16. From the MicroStation pull-down menu, select **Utilities > Keyin**. The key in browser is needed to input the desired station limits and offset distances. Without this, they could be defined graphically.



17. From the InRoads pull-down menu **Geometry > Utilities > Parallel Horizontal Alignment...**.
18. In the ***Parallel Horizontal Alignment*** dialog box toggle on **Interactive By Station** and then click **Apply**.
19. In the MicroStation view **<D>** on the mainline alignment.
20. At the prompt ***Identify First Station/Key in Station***, key in ***224+00***.
21. **<D>** the **Run** button or press the Enter key.

22. At the prompt ***Identify Second Station/Key in Station***, key in ***224+93.20***.
23. **<D>** the **Run** button.
24. For ***Identify Location:*** key in ***-50*** (50' to the left).
25. **<D>** the in the view window to accept the solution and alignment 3 is created and displayed.

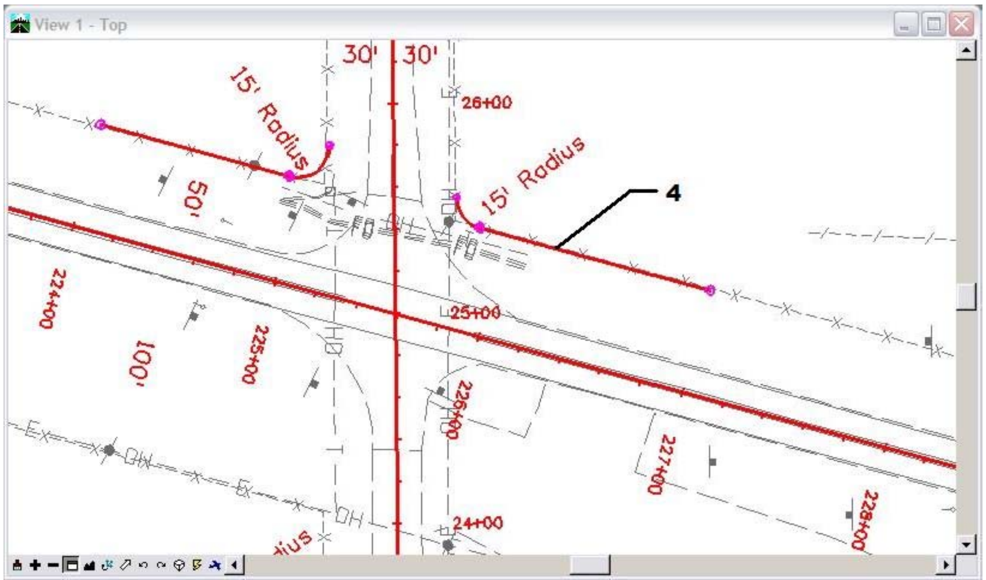


26. Repeat the **Geometry > Utilities > Parallel Horizontal by Station** command to the east of the sideroad using the following data:

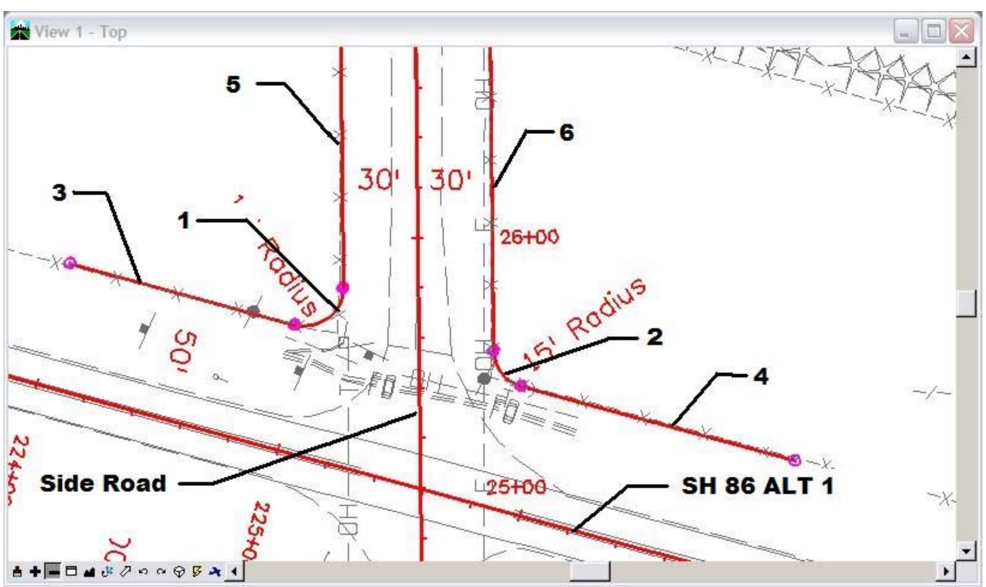
    ♦ Station limits of: **225+86.76** to **227+00, 50'** left of US 86 Alt 1

    Note: The station limits can be graphically selected by issuing a data **<D>** point in the MicroStation view. The offset distance can also be graphically selected but using the key in field allows a specific distance to be input.

    Alignment 4 is created and displayed.



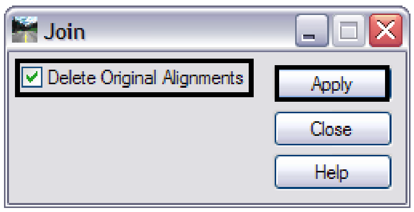
27. Re-execute the command to create the alignments along the Side Road north of the radius returns.



Next we will use the Join Alignment command to connect the alignments created in the previous steps single alignments for each quadrant. This command operates by either connecting the components with a straight line segment or by paralleling an alignment to define the configuration of the created geometry.

Join alignments 3, 1, & 5 to create the Northwesterly right-of-way limits.

28. Select **Geometry > Utilities > Join**.



29. Check **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.

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

31. ***Identify Initial Alignment:*** **<D>** on alignment **3**.

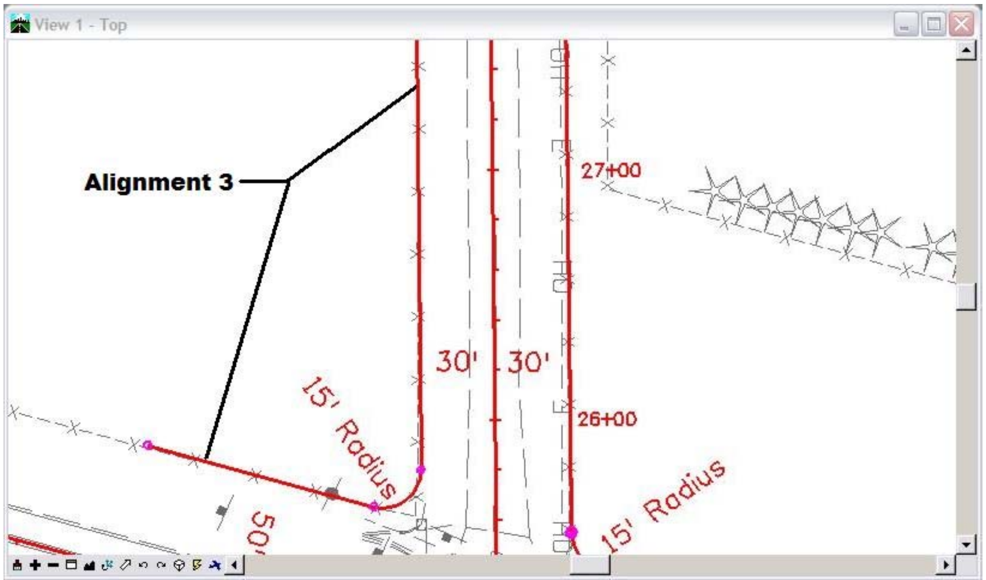
32. ***Identify Alignment to Parallel/Skip:*** **<D>** alignment **1** to parallel (overlay) this alignment.

    Note: If a reset **<R>** is issued in the above step, a tangent line would be created from the end of alignment 3 to the beginning of alignment 5. By selecting the alignment representing the radius return, a curved section is generated at a zero offset to alignment 1.

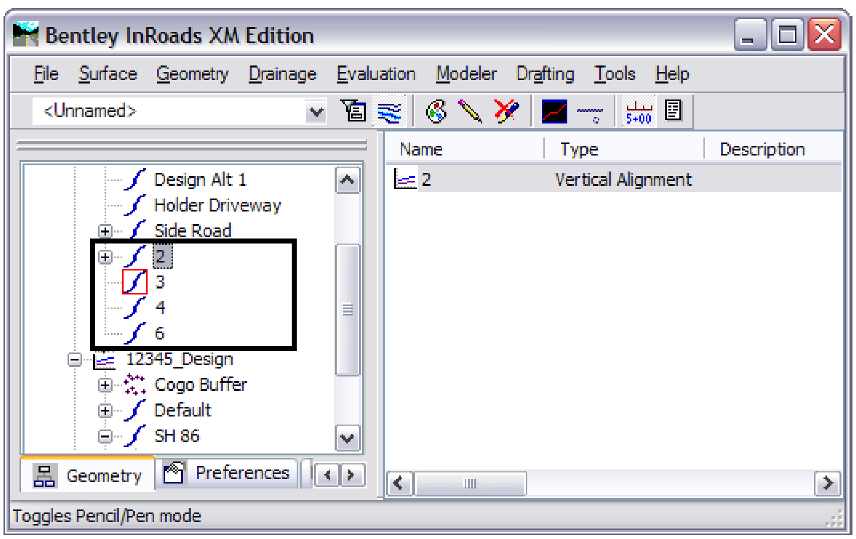
33. ***Identify Next Alignment:*** **<D>** on alignment **5**.

34. ***Accept or Reject:*** **<D>** to accept the dynamic display.

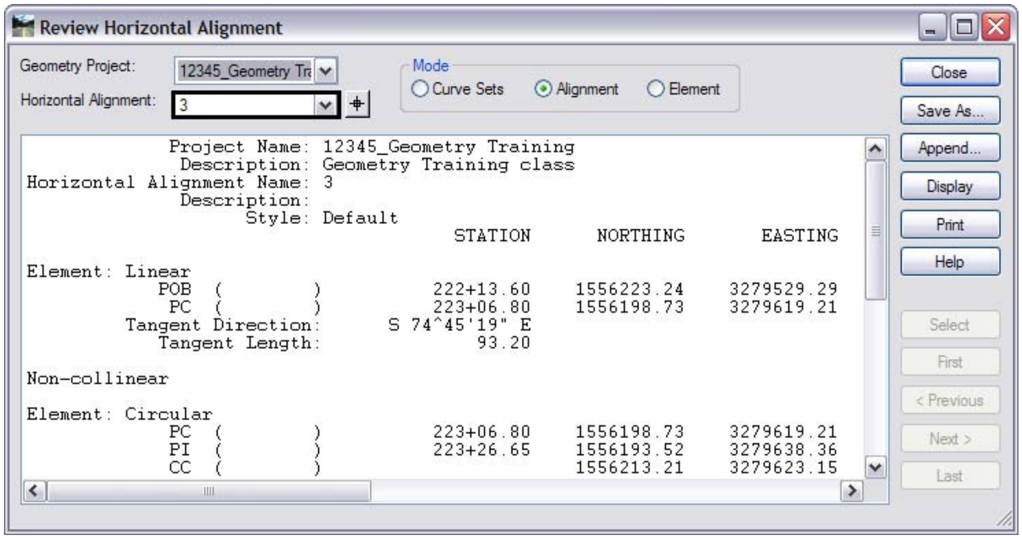
35. Reset **<R> <R>** twice to terminate the command.



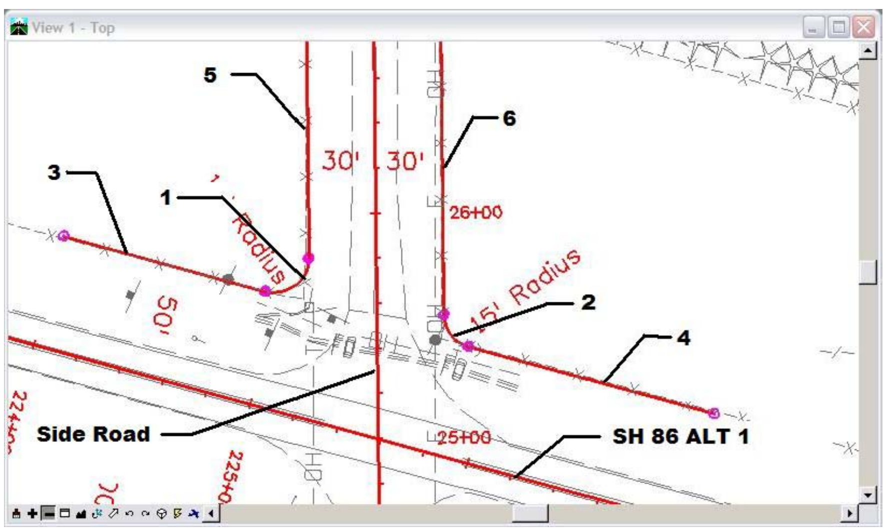
Alignment 3 is now the combination of the alignments 3, 1, and 5. Alignments 1 and 5 are removed from the geometry project.



36. **Review** alignment **3**.



37. Using the same steps above, join alignments 6, 2, and 4 to create the northeasterly right-of-way limits; begin with alignment **6**.

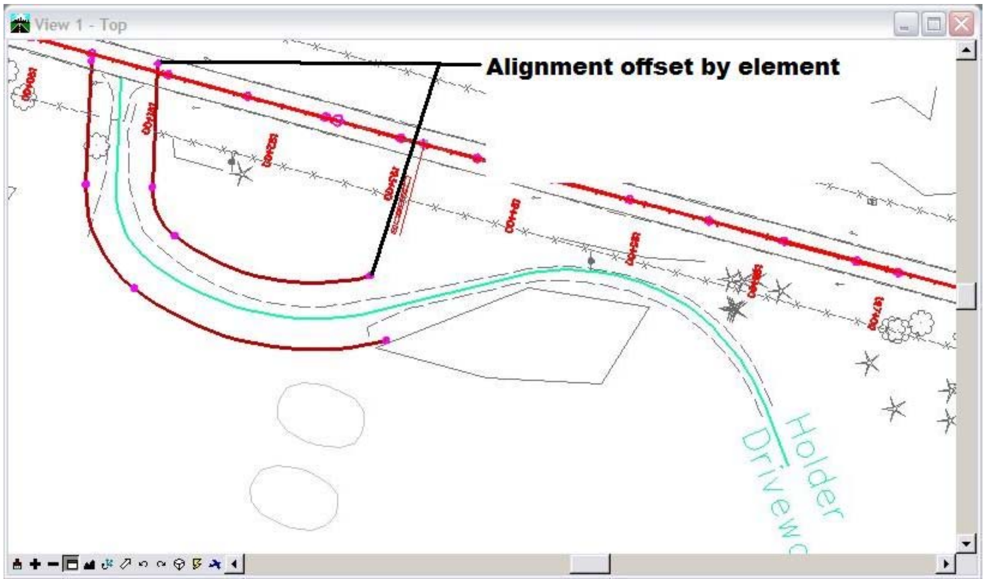


Once the above step is completed, alignments 3 and 6 define the right-of-way limits on the north side of the intersection.

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

38. Choose **Geometry > Utilities > Parallel Horizontal by Element**.

Parallel ***by Element*** differs from by Station in that you can select the limits of the alignment to offset by selecting, **<D>**, alignment components (tangent or curve) 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 the path of the horizontal alignment. 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

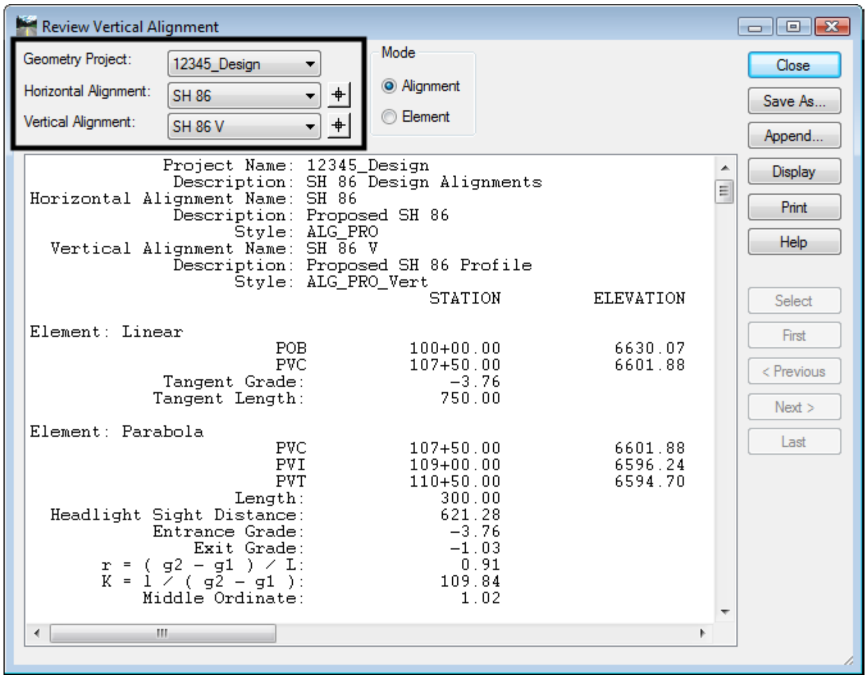
Lab 6.1 - Reviewing Vertical Alignments

Section Objectives:

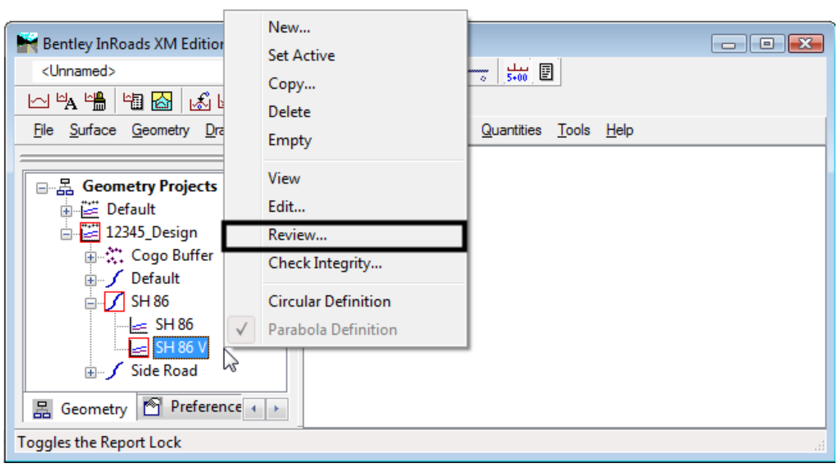
- ♦ Examine the Review Vertical Geometry window.
- ♦ Explore the functionality of the dialog box.

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

1. Select **Geometry > Review Vertical**.



2. The review dialog can also be opened with the right-click fly-out menus.



Section Summary:

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

Lab 6.2 - Creating Profiles

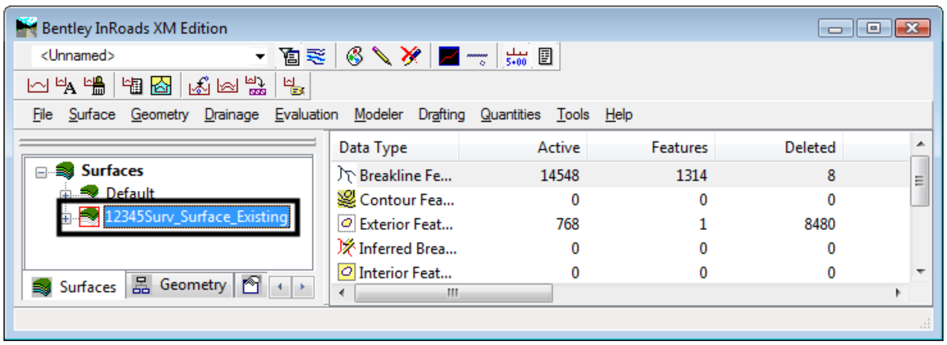
Prior to graphically displaying a vertical alignment a profile must be created. These are referred to as profile sets in InRoads. A profile set can be created using a horizontal alignment, a MicroStation element, or interactively to define the horizontal (plan) location the vertical information is extracted from. Upon creation, a profile can display DTM surfaces, vertical alignments and DTM features. Once created, a profile set can be refreshed to display additional data, turn the display or data off, or to redraw the graphics based on current DTM information.

Section Objectives:

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

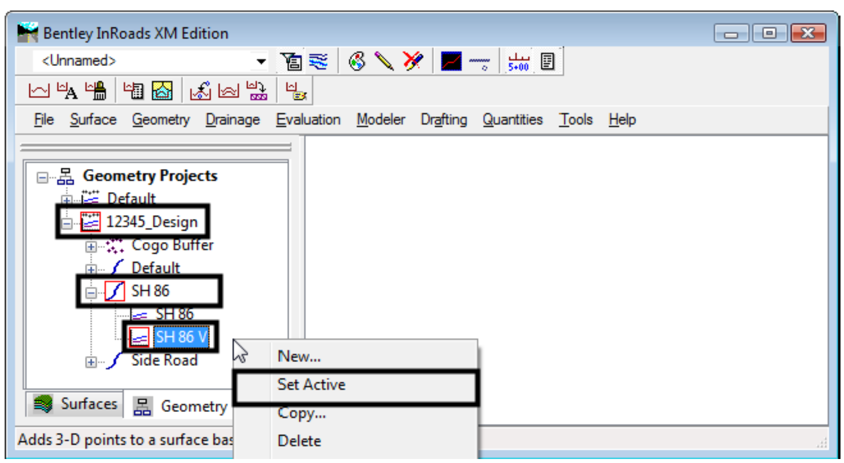
Prior to creating a profile set, load the DTM **12345Surv_Surface_Existing** if not already loaded. This surface will be used to display an existing ground-line.

1. Select **File > Open**.

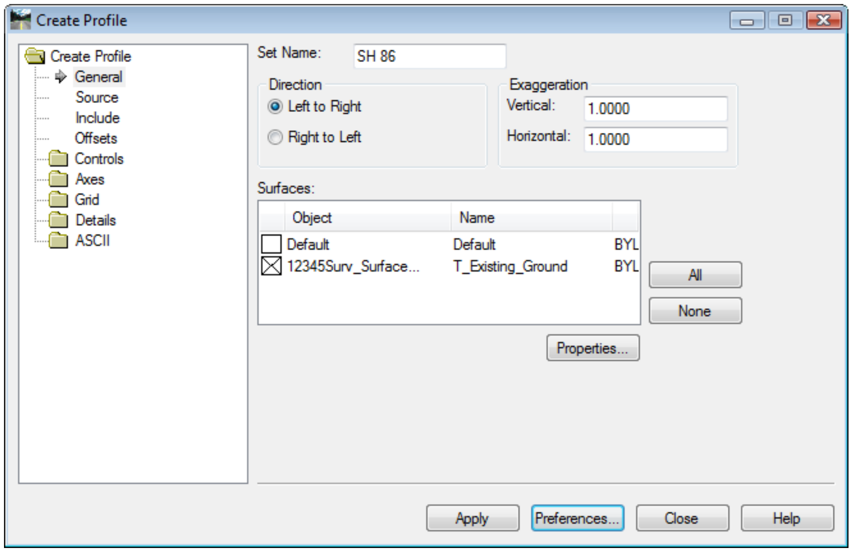


2. In the workspace bar under the **Geometry** tab, verify that **12345_Design** is the ***active*** geometry project and that the horizontal alignment **SH86** is the ***active*** alignment.

Note: To make something active, **<R>** on the name and select ***Set Active*** from the fly-out menu.

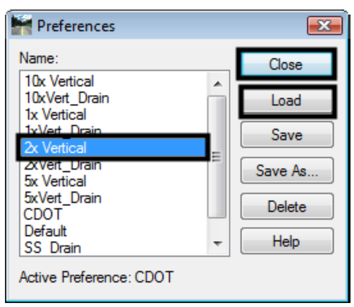


3. Select **Evaluation > Profile > Create Profile** the ***Create Profile*** dialog will appear.



4. **<D>** the **Preferences** button. The ***Preferences*** dialog will appear.

5. **<D>** the predefined settings for **2x vertical**.

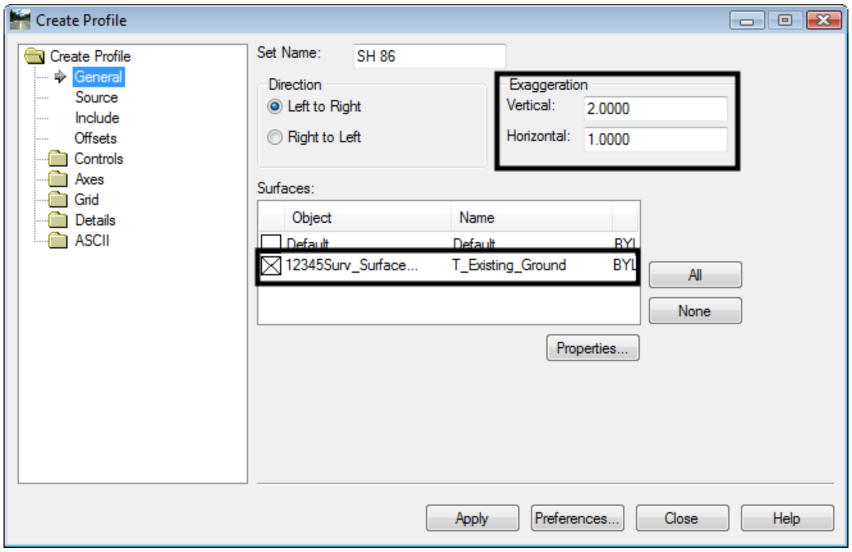


6. **<D>** the **Load** then **Close** buttons.

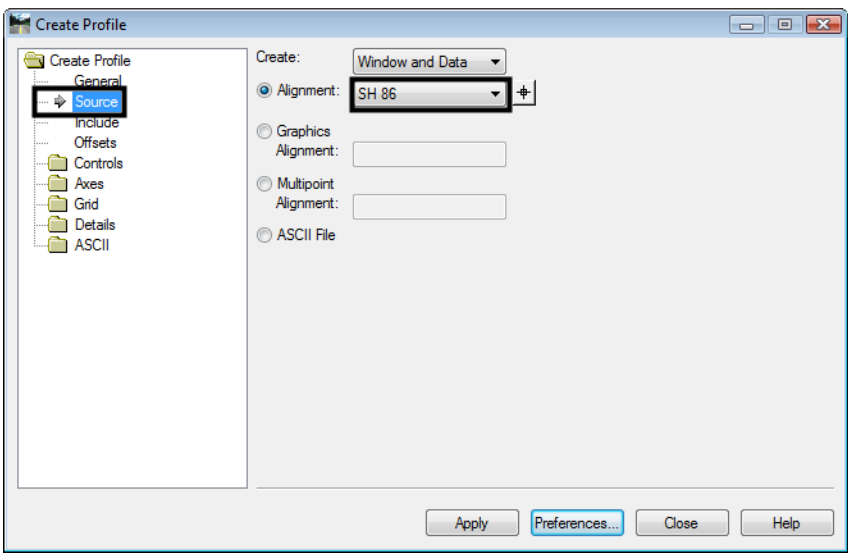
Note: Load preferences before making any other menu settings. Loading Preferences resets all menu settings to those predefined in the preference.

7. Note the ***Exaggeration*** specified.

8. Verify that in the ***Surfaces*** portion of the dialog, the ***Display*** box is checked for surface **12345SURV_Surface_Existing**.

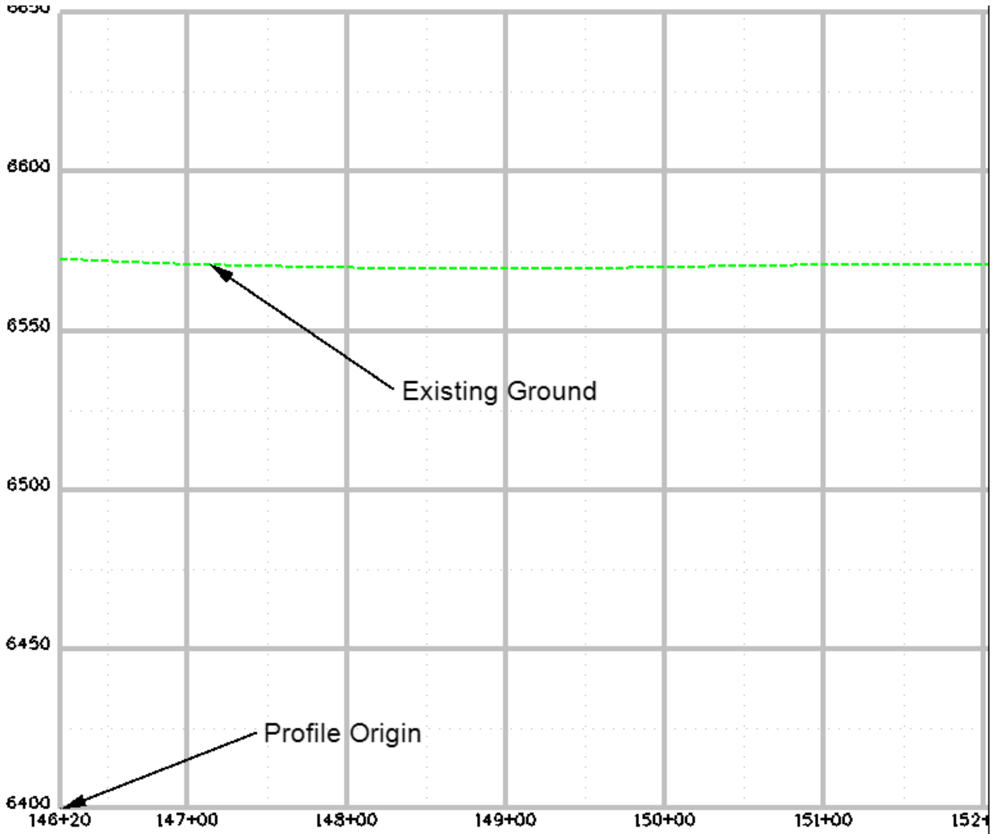


9. **<D>** the **Source** leaf. Verify that the **SH 86** alignment is selected.



10. **<D>** the **Apply** button. The ***Create Profile*** dialog will temporarily minimize.

11. You are prompted by MicroStation to ‘Identify location’. **<D>** in the MicroStation view. The Profile window will be placed and the ***Create Profiles*** dialog will restore.

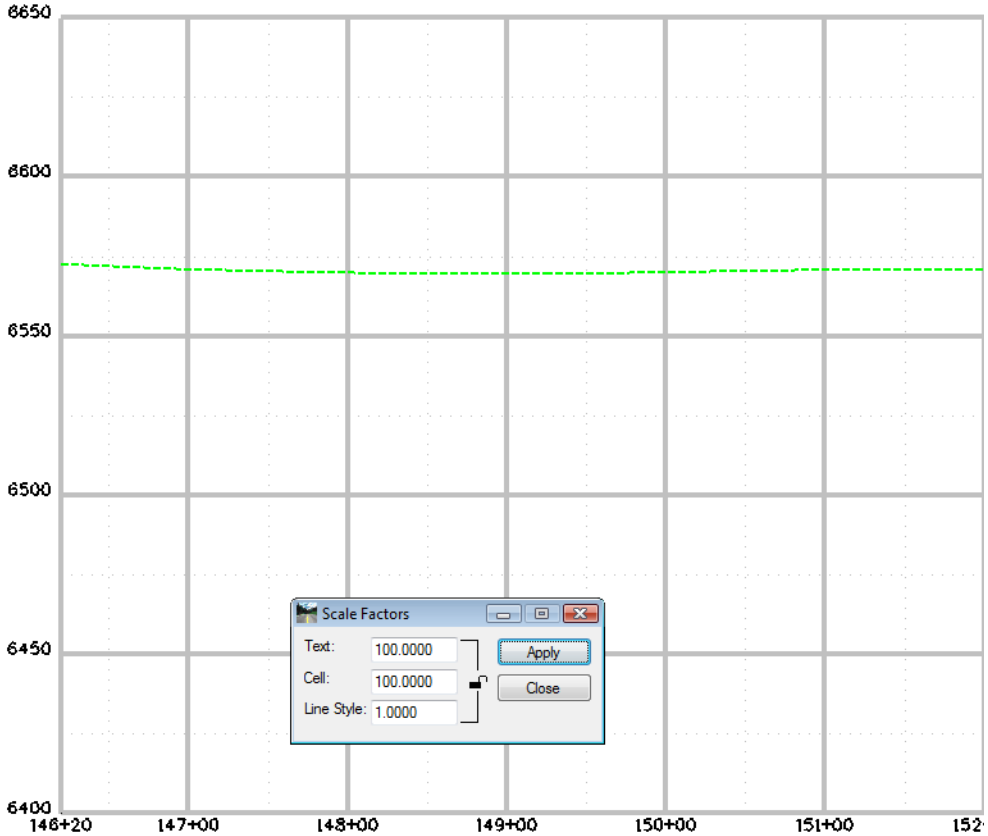


> ***Note:*** For convenience, we are displaying the profile in our current drawing. Standard practice dictates that separate drawings should be created for profile and cross section display. Consult the directory structure and file naming convention for your specific discipline to determine standards relating to profile display.

Viewing Vertical Alignments

12. 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.

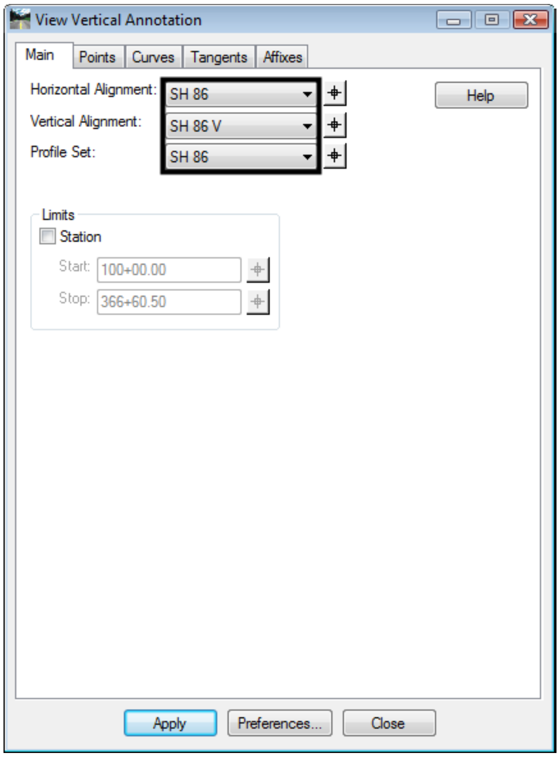


Note: Annotation size for the index elevations and stationing text is generated based on the global scale factor defined for text. The text size specified should be set based on the ultimate plotting scale. To change text size on a profile, delete the displayed profile, change the global scale factor, and regenerate the profile display.

Annotating Vertical Alignments

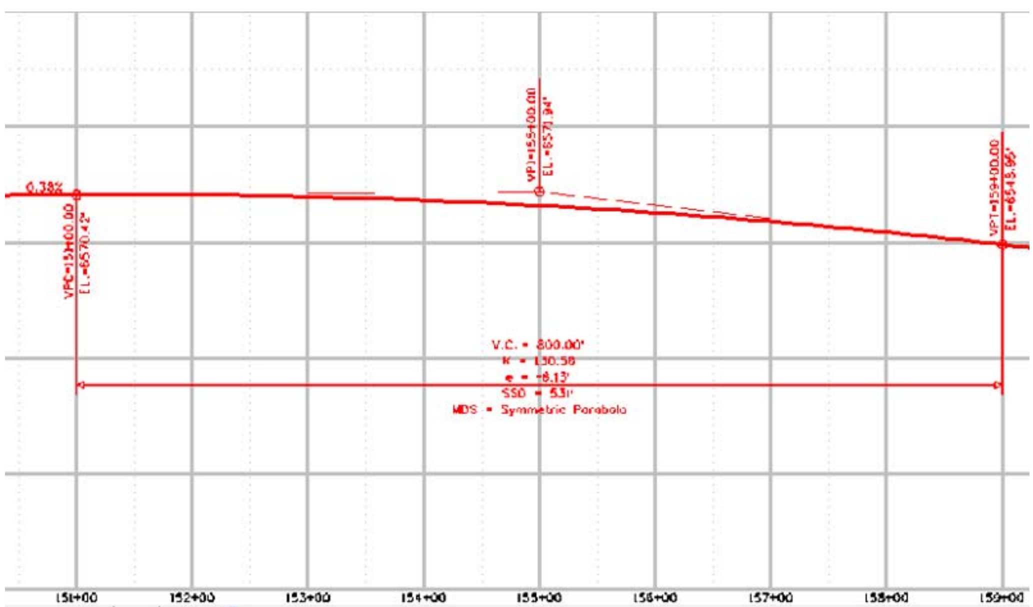
Similar to horizontal stationing, annotation of vertical alignments is accomplished much the same way.

13. Select **Geometry > View Geometry > Vertical Annotation** to view vertical alignment annotation.



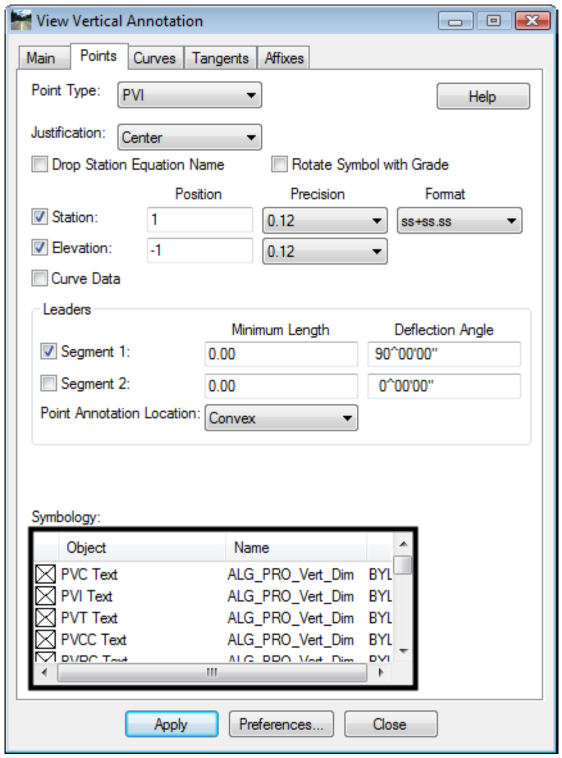
14. **Verify** the appropriate ***Horizontal***, ***Vertical Alignments***, and ***Profile Set*** are correctly identified.

15. Click **Apply**.

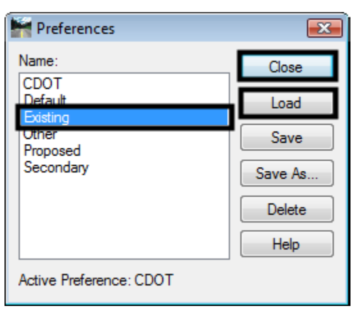


16. Take some time and investigate the remaining tabs along the top of the ***View Vertical Annotation*** dialog and the individual settings for each.

17. **<D>** the **Points** tab. Note the settings in the ***Symbology*** portion of the dialog. By default, ***Symbology*** for a ***Proposed*** alignment loads.



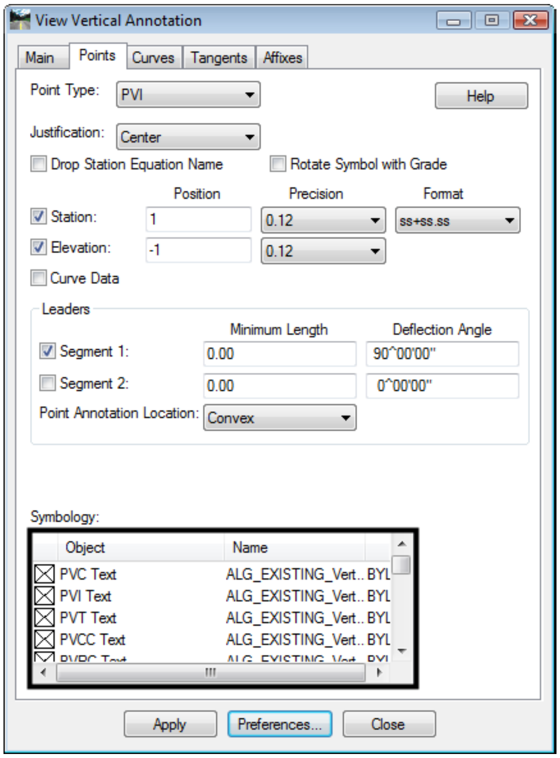
18. **<D>** the **Preferences** button.



19. **<D>** the name **Existing**.

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

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



22. **<D>** the **Apply** button from the ***View Vertical Annotation*** dialog. Review the results in the MicroStation drawing. The content of the graphics should remain the same, however, different levels, color, style, and weight are utilized.

23. For practice, continue to ***Load*** and ***Display*** additional preferences.

24. 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 6.3 - Updating Profiles

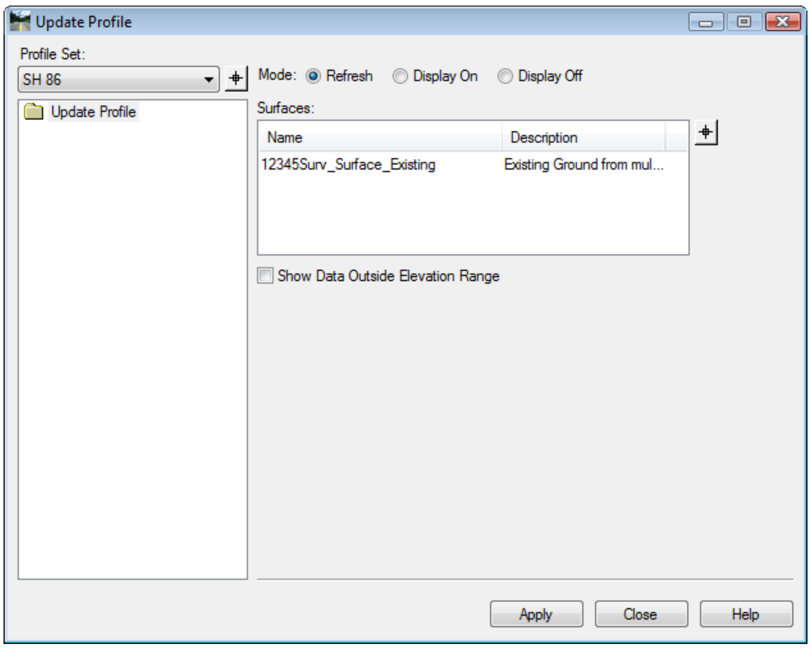
When a profile is created the user has the option to display items such as: multiple surfaces, profile lines offset from the horizontal alignment, and features such as underground utilities and pipes. However, the Create Profile command does not allow the user to specify which features are displayed.

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:

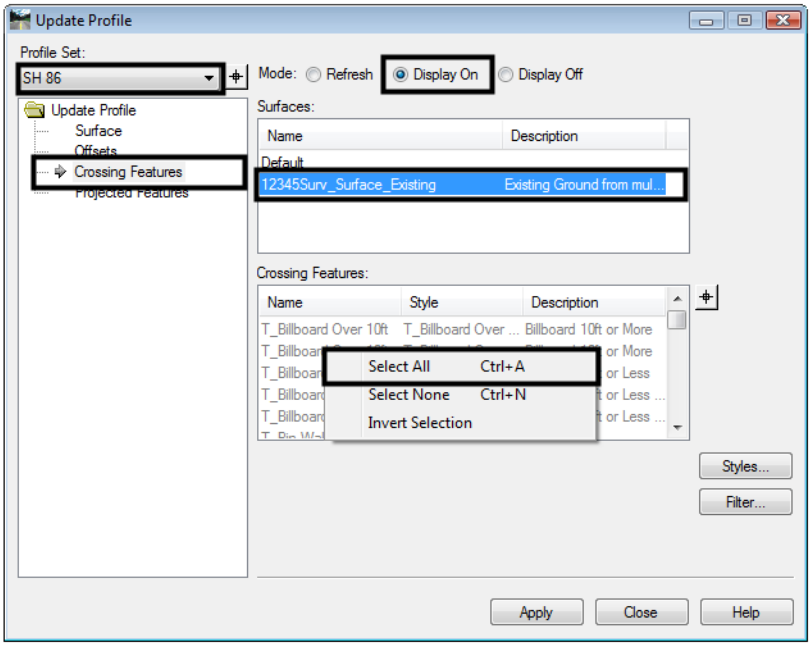
- Use the Update Profile command to add features to the display.
- Illustrate how Global Scale Factors affect cell size.
- Examine how Feature Filters affect dialog box lists.

1. From the pull down menu **Evaluation > Profile > Update Profile.** The ***Update Profile*** dialog will appear.

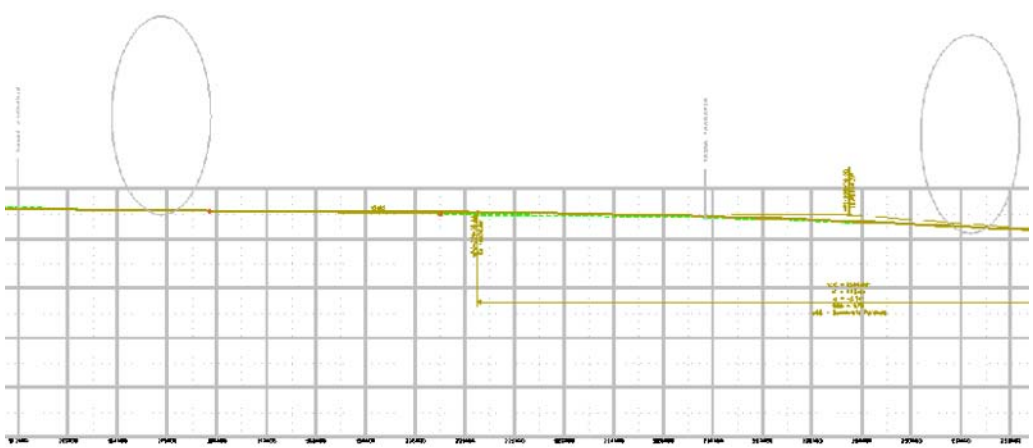


2. **<D>** the **Crossing Features** leaf.
3. Verify **SH 86** is the active ***Profile Set***.
4. In the ***Mode*** section toggle the radio button **Display On**.
5. In the ***Surfaces*** section **<D> 12345SUR_Surface.**

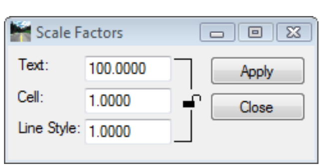
6. **<R>** in the ***Crossing Features*** list and select **All** from the menu.



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



Note: Profile and cross section displays are drawn at true horizontal scale. A vertical distortion will be applied to cells displayed in profiles or cross section views based on the vertical scale applied to the grid. Some DTM features displayed in these graphics are configured to display at their true horizontal (x-direction) sizes. Therefore, prior to displaying features in either profiles or cross sections the global scale factor for cells should be set to 1.



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 item 1:

The global scale factor for cells should be set to 1 and a subset of the dtm crossing features should be displayed (or refreshed in this case). This is accomplished with the use of feature filters.

For Item 2:

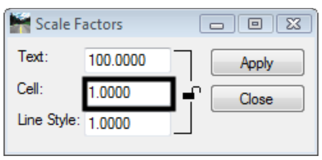
The global scale factor should be set equal to the plot scale.

Note: See the following page for information on updating a profile to refresh the graphics.

Refreshing a Profile Display

First, take care of refreshing the display of the true-scale items such as the culverts.

8. Select **Tools > Global Scale Factors**.

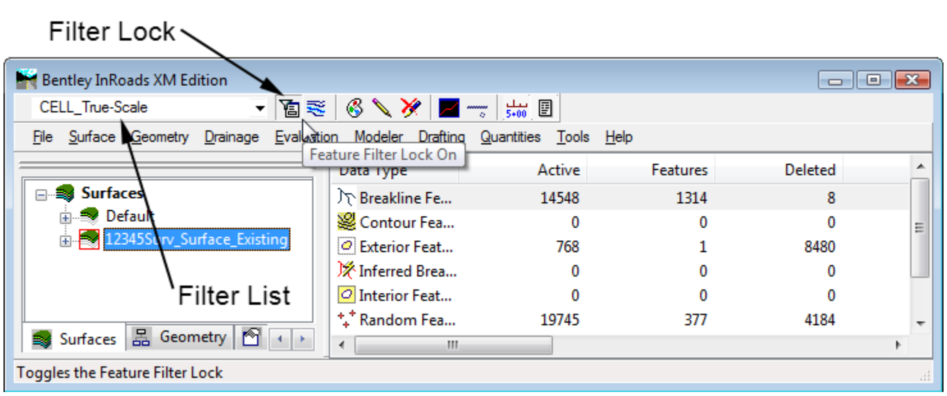


9. Key in the field ***Cell:*** ***1***.

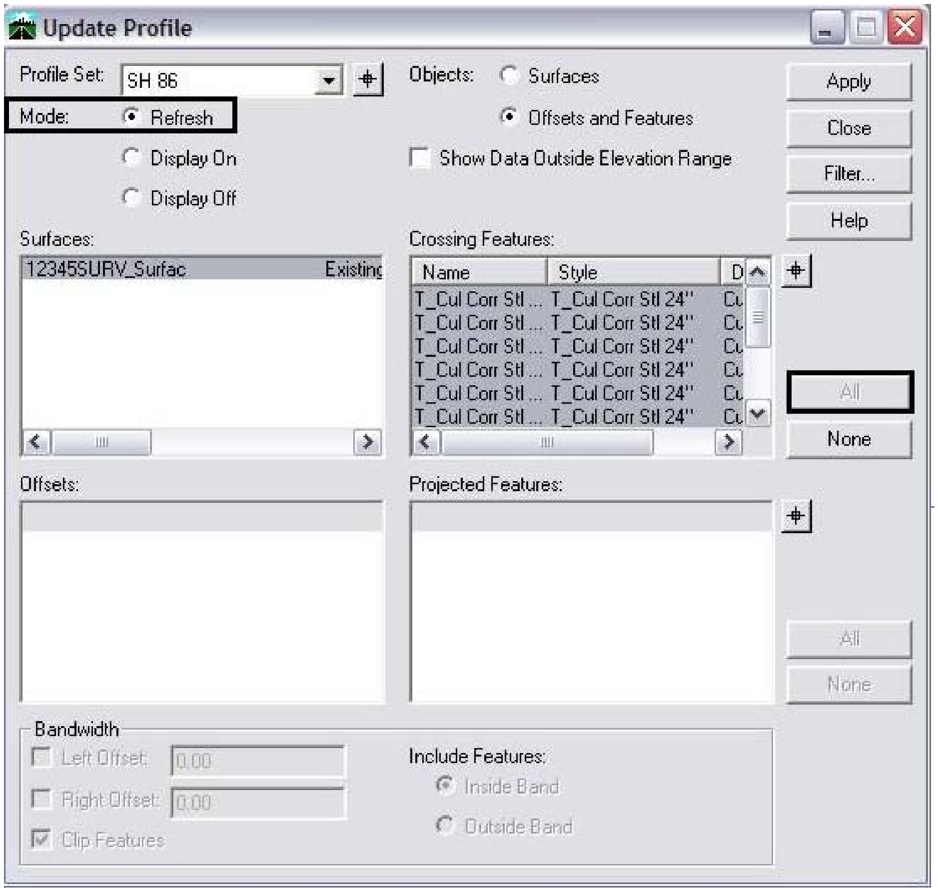
Note: You may need to ***Unlock*** the icon to allow modification to the cell scale only. By doing so, when you update the profile, the cells will draw at their true sizes. Leaving the Text field at 100 and Line Style field set to 1. This allows annotation and other commands to remain unaffected by the scale factor that was input specific for cells.

10. **<D>** the **Apply** then **Close** buttons in the ***Scale Factor*** dialog

11. In the main InRoads interface, select the filter **CELL_True-Scale** from the drop-down list. Also toggle **On** the ***Feature Filter*** lock.



12. Close and reopen the ***Update Profile*** dialog.



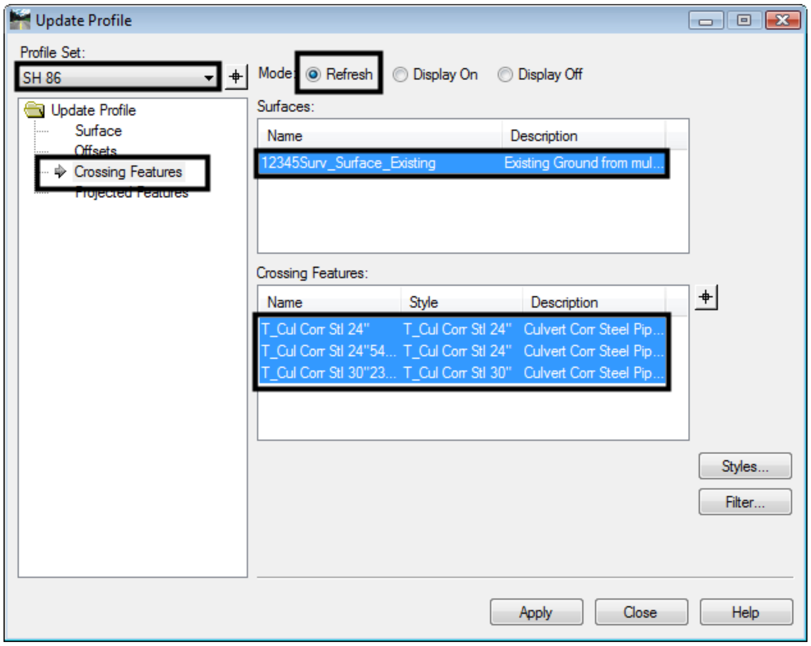
13. Verify **SH 86** is still the active ***Profile Set***. Use the target button next to the Profile Set to graphically change the active profile set.

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

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

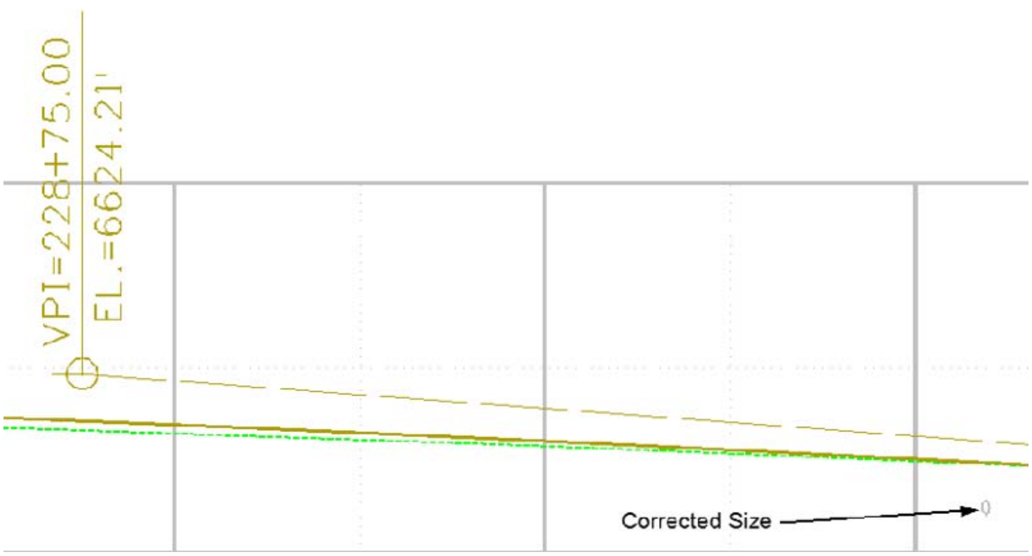
16. **<D>** the surface name **12345SURV_Surface.**

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



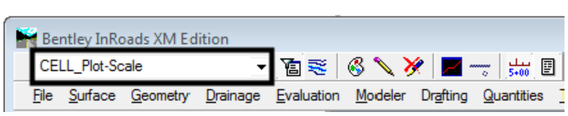
18. **<D>** the **Apply** button.

19. Using MicroStation viewing tools, locate a crossing culvert and review the results.



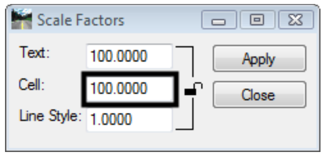
20. Use MicroStation Measuring tools to verify pipe size(s).

21. From the ***Locks*** toolbar select **CELL_Plot-Scale** filter from the pull down list.



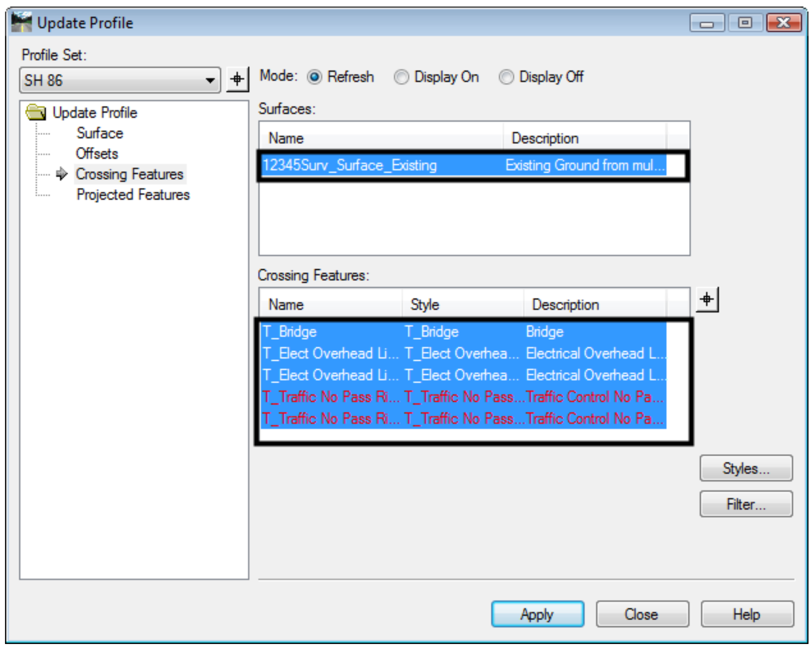
Note: Verify that the feature filter is toggled on.

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



Note: This is the desired plot scale change accordingly.

23. **Close** and reopen the ***Update Profile*** dialog.



24. 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.

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

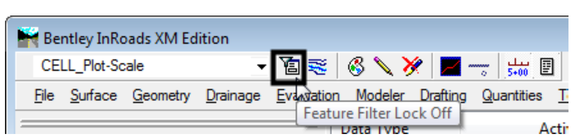
26. **<D>** the **Crossing Features** leaf.

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

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

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

30. 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.

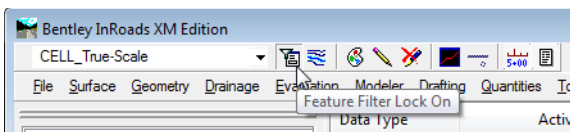
Lab 6.4 - Annotating a Feature in a Profile

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

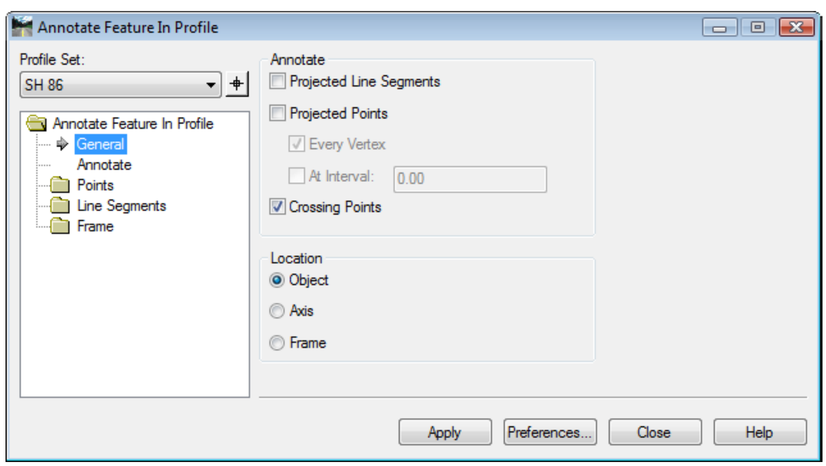
Section Objectives:

- Annotate the true scale features in the profile.

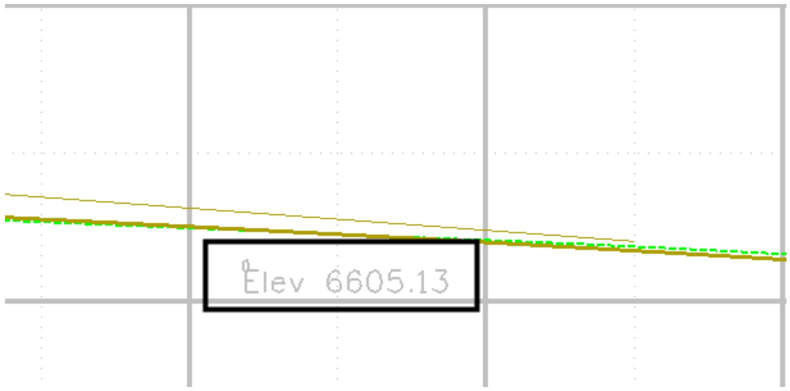
1. Using MicroStation commands, window into any culvert displayed in the profile created in the previous lab.
2. From the ***Locks*** toolbar select **CELL_PLOT-Scale** filter and verify the feature filter is toggled **On**.



3. Select **Evaluation > Profile > Annotate Feature** in Profile. The ***Annotate Feature In Profile*** dialog will appear.

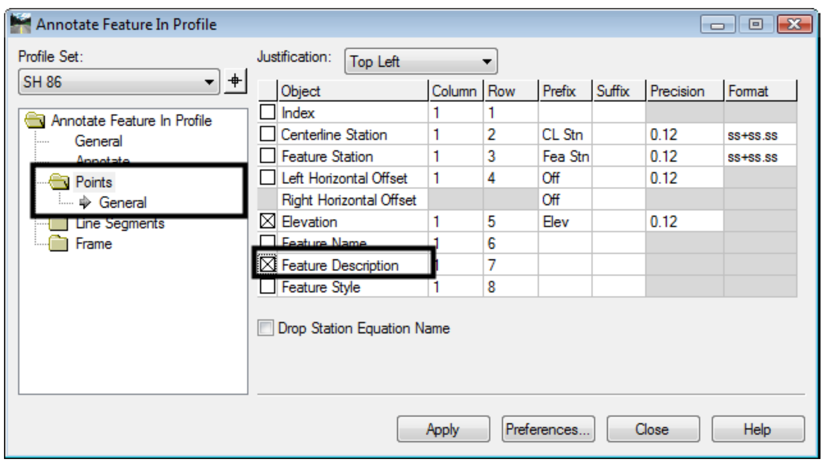


4. **<D>** the **Apply** button and review the results.

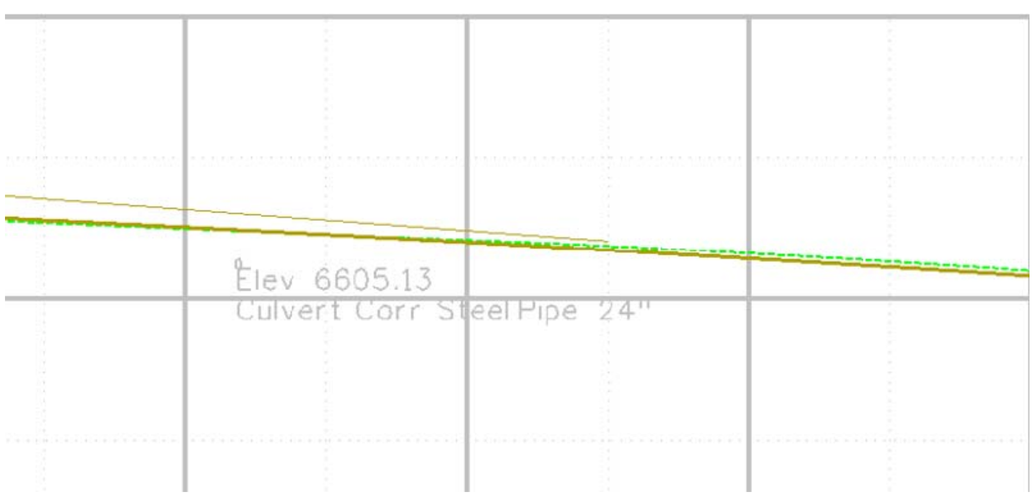


5. **<D>** the **Points** branch.

6. Check **On** the **Feature Description**.



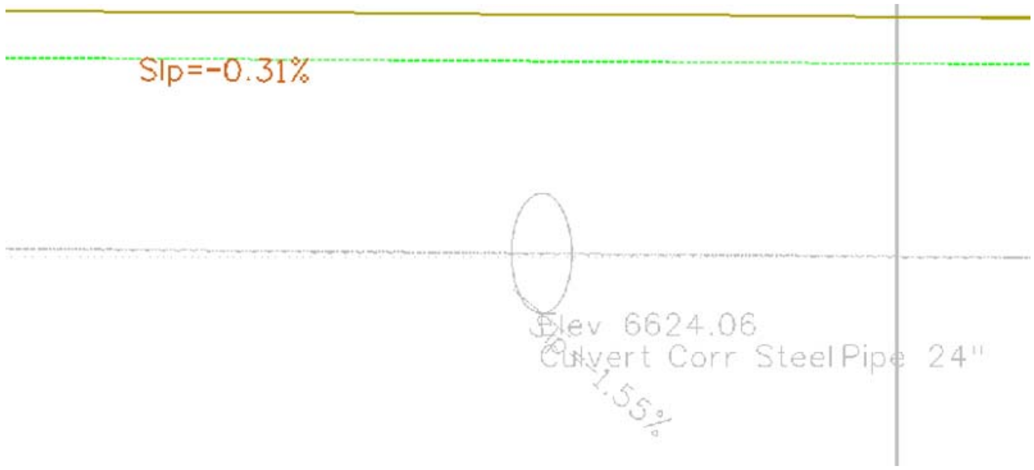
7. **<D>** the **Apply** button and review the results in your profile.



8. Experiment with enabling other options in the ***Point*** tab 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.

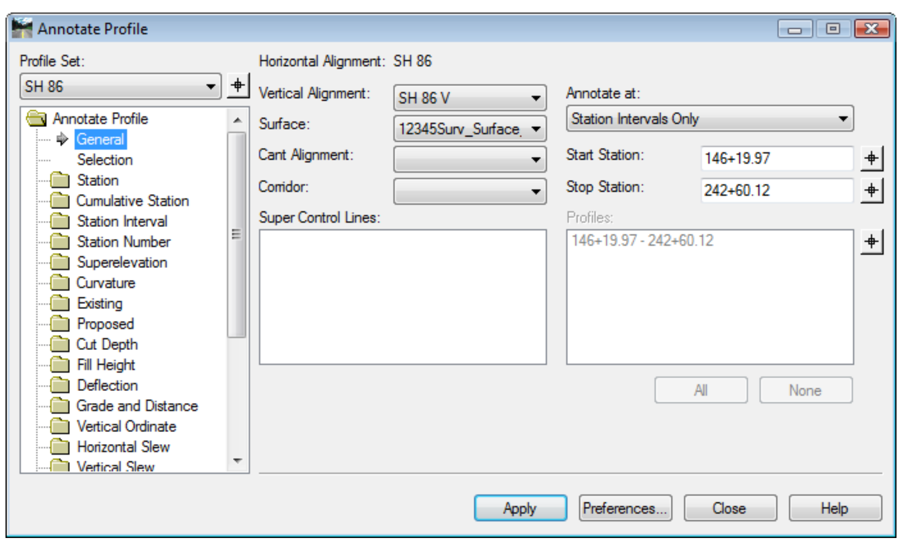
Lab 6.5 - Annotating a Profile

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

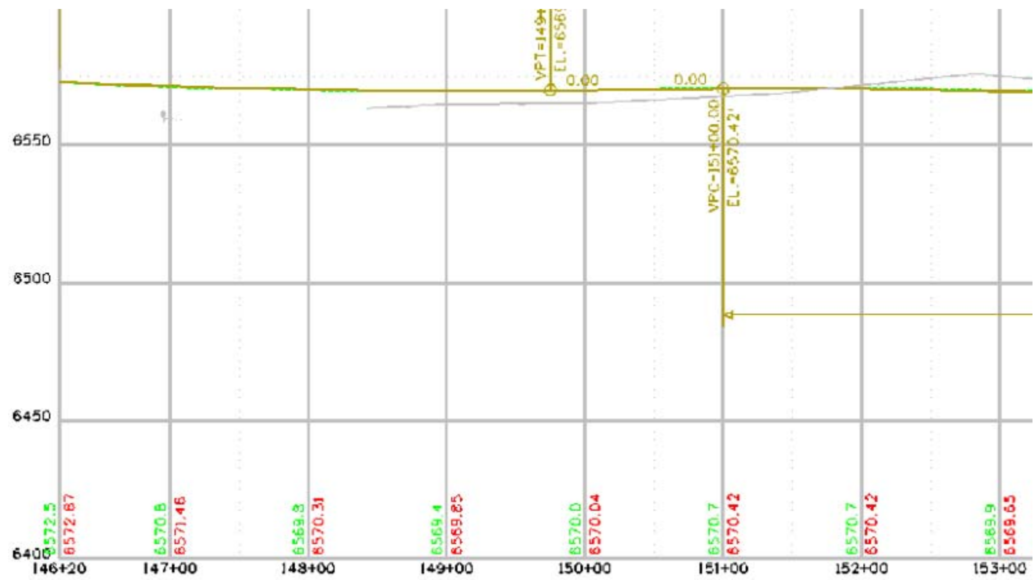
Section Objectives:

- ♦ 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**.

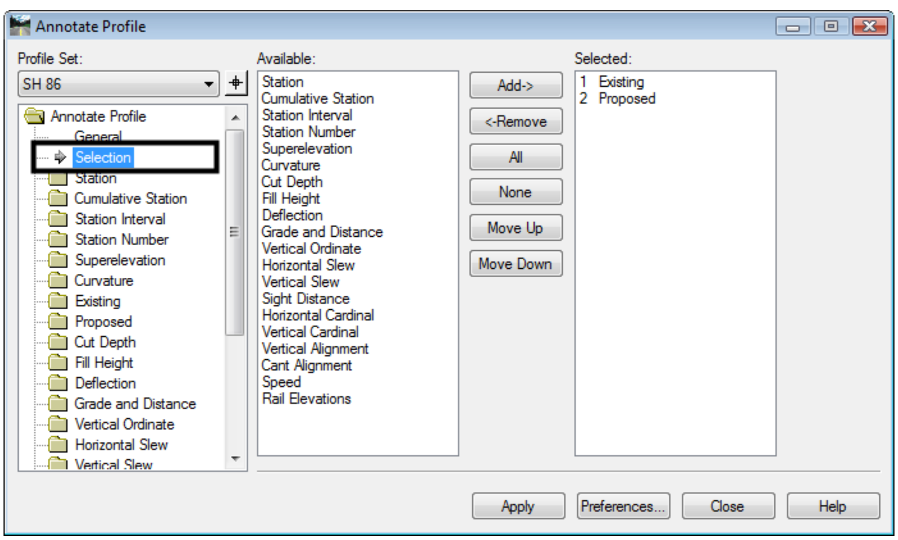


2. **<D> Apply**. The existing and proposed grades annotate the profile.



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

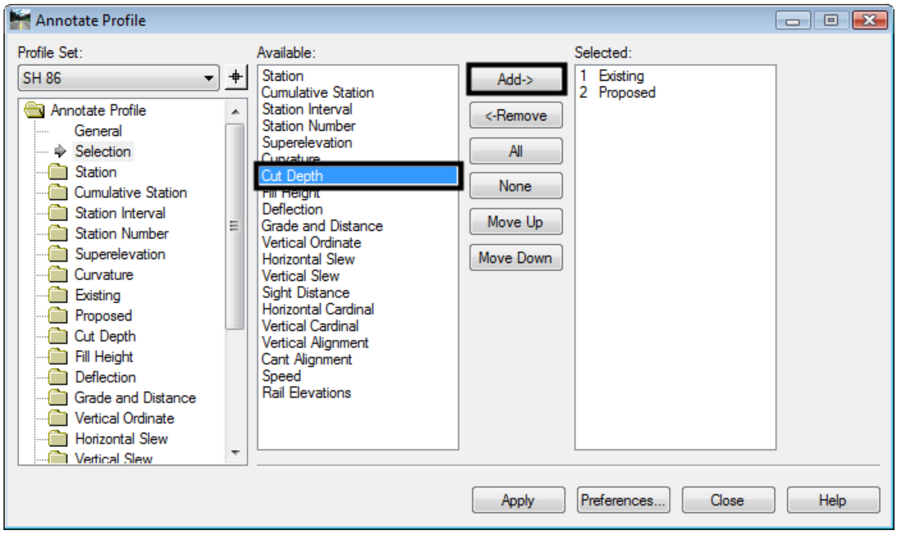
4. Now go back and **<D>** the **Selection** leaf.



Note: The dialog 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.



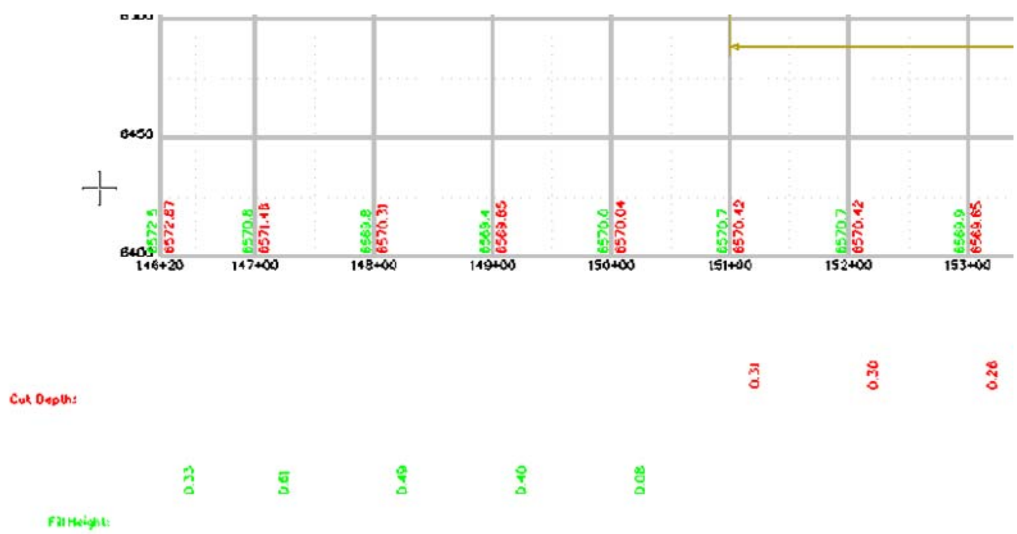
7. **<D>** the item **Fill Height** from the Available list.

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 6.6 - Vertical Alignment Tracking

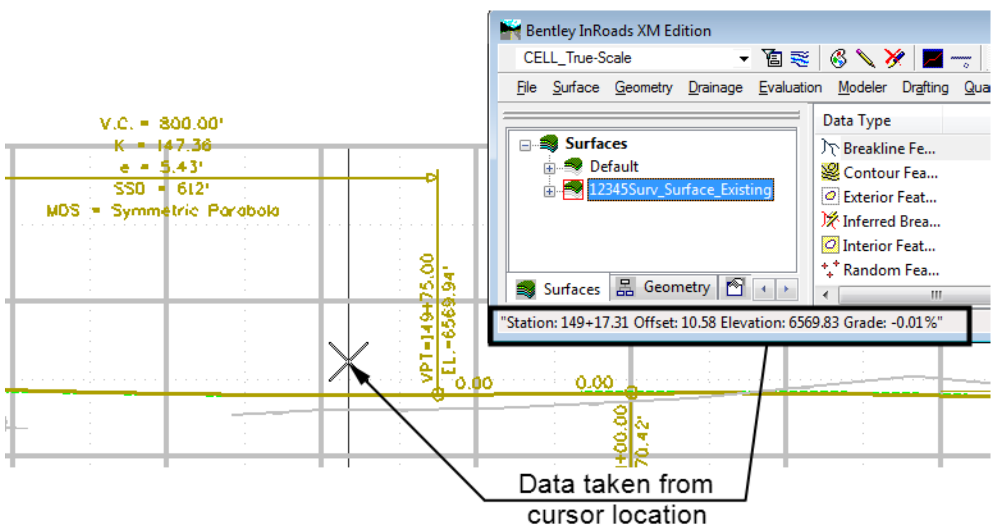
Vertical alignments can be interactively queried similar to horizontal alignments.

Section Objectives:

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

Tracking Vertical Alignments in Profile View

1. Select **Tools > Tracking > Vertical Alignments**.
2. Move the cursor inside the Profile Set window and review the output in the InRoads Status bar.

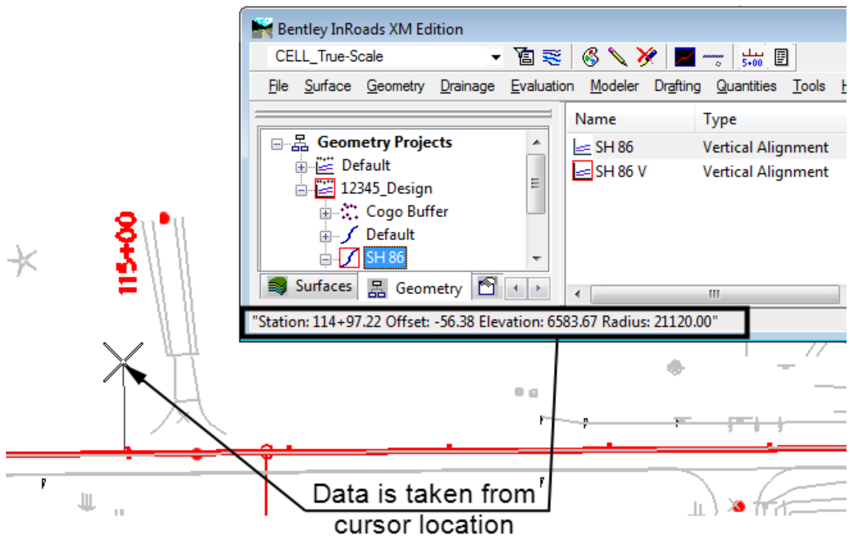


Note: As you move your cursor in the profile view InRoads displays vertical alignment information in the status field. There is ***not*** an option to write this information to the MicroStation file.

Tracking Vertical Grades in Plan View - Review

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 6.7 - 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.

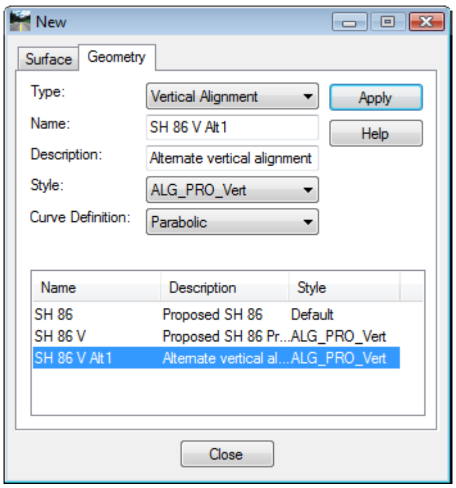
1. Select **File > New.**

2. Choose the **Geometry** tab.

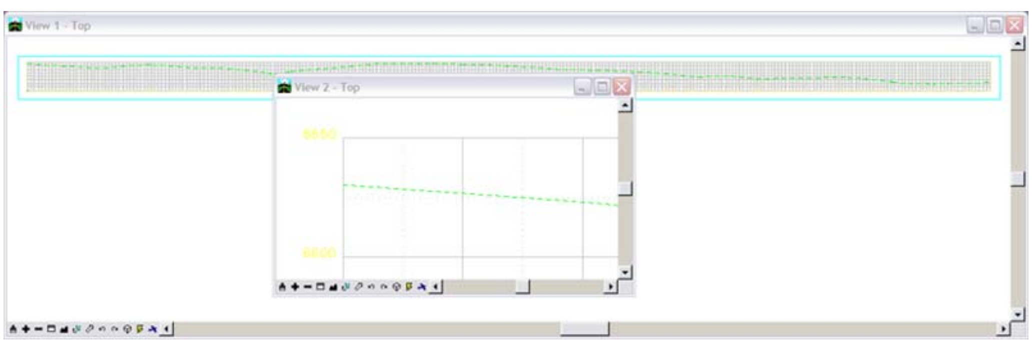
3. Toggle the Type to Vertical Alignment and set the following:

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**

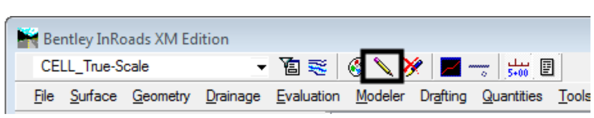


9. Set up your MicroStation windows so the entire profile is visible in one window, then open another MicroStation window and Zoom in to the beginning of the profile as shown.

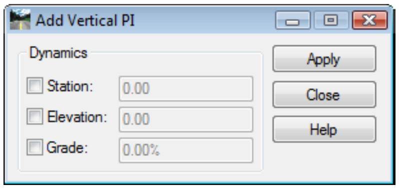


Next, add PVIs to the Vertical Alignment.

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



11. Select **Geometry > Vertical Curve Set > Add PI**.

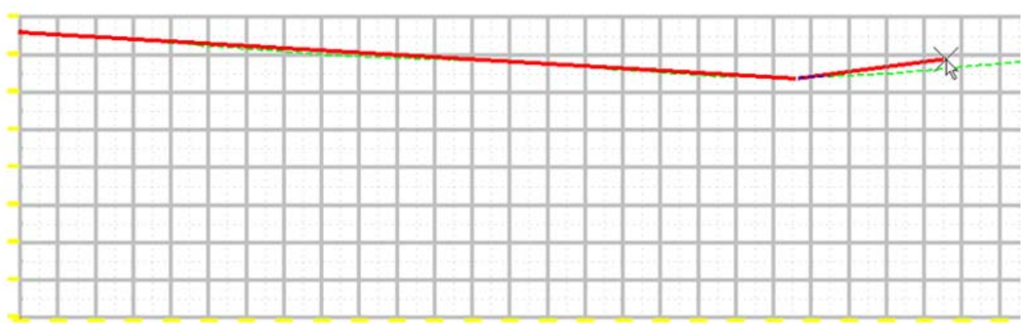


12. Select **Apply**.

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 your key-in.)

    ♦ ***dg=900,-3.76%***



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

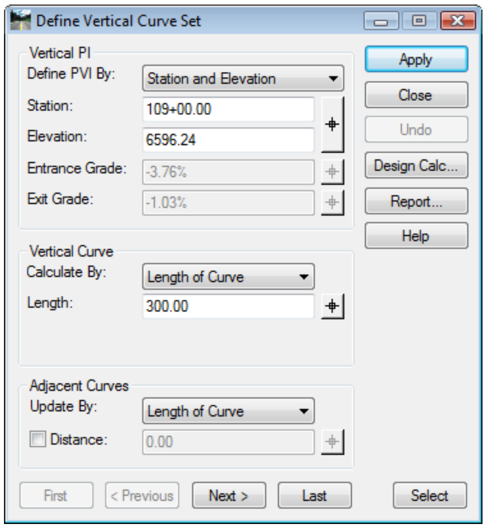
    The ***dg=*** key-ins place additional vertical PIs at the specified distance and grade. The last one again places a vertical PI at the station and elevation specified.

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**.

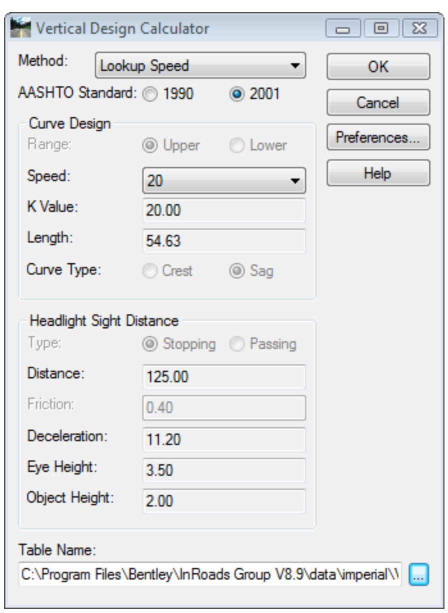


The Define Vertical Curve dialog box is automatically displayed ready to accept input for the first curve on the vertical alignment. To step to other curve sets, you can use ***Previous*** and ***Next***, or ***First*** and ***Last***.

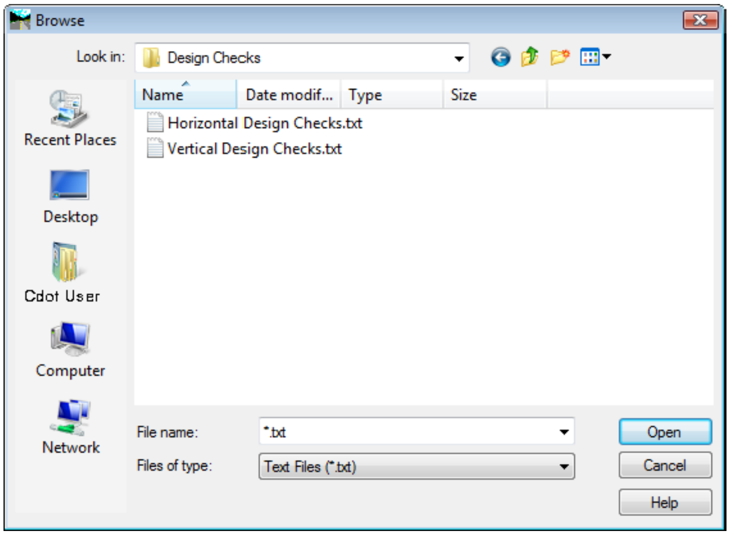
18. Under the ***Vertical Curve*** category,

- Set ***Calculate By*** to **Length of Curve**.
- Key in ***300*** for the ***Length***.

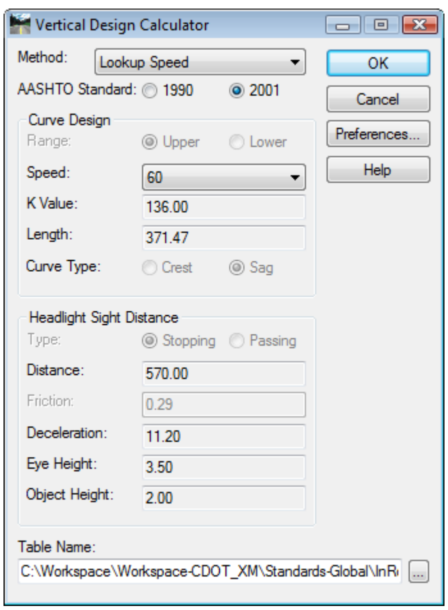
19. Select **Design Calc**.



20. Click in the Table Name and Browse to the **C:\Program Files\Workspace-CDOT\Standards-Global \ InRoads\Design Checks** folder and choose the file Vertical Design Checks.txt.

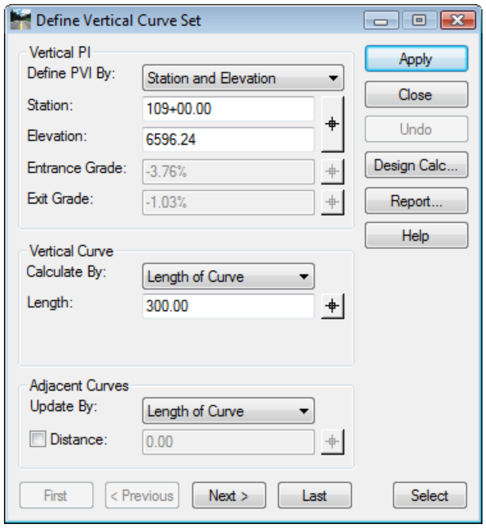


21. Verify that the length of curve meets your design criteria.

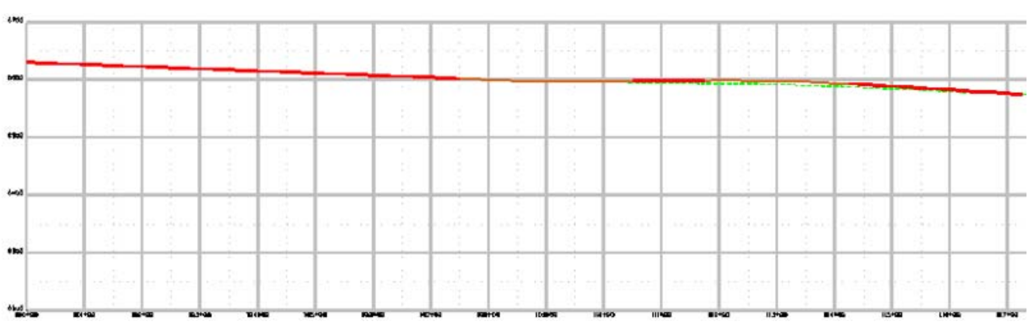


22. Choose **Cancel** when done. You do not want to accept the minimum curve, just verify that yours meets the criteria.

23. Select **Apply**



24. Select **Next** to move to the second intersection of tangents.
    - Set ***Calculate By:*** to **Length of Curve**.
    - Key in ***250*** for the ***Length***.
25. Select **Design Calc**.
26. Verify that the length of curve meets your design criteria.
27. Choose **Cancel** when done.
28. Select **Apply**.
29. Close the **Define Vertical Curve Set** dialog.



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 - 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_XM\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

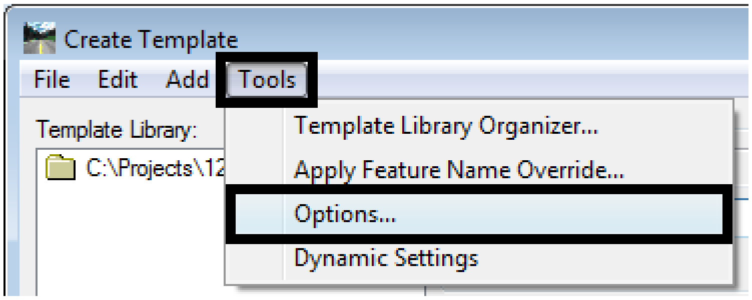
Lab 7.1 - Build A Simple Component

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.

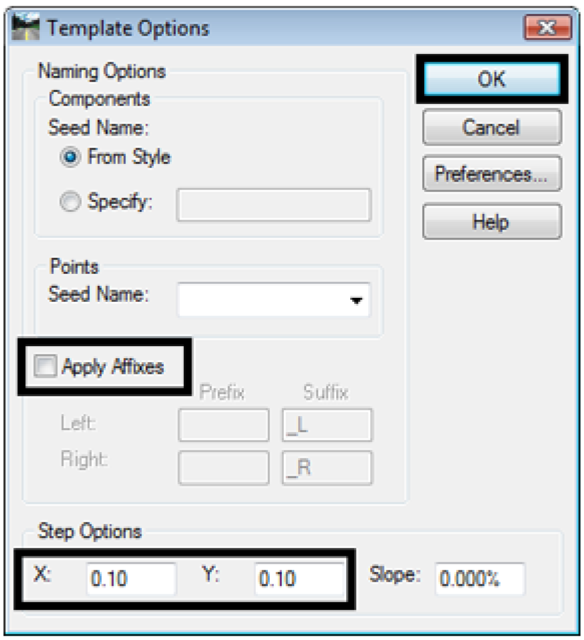
6. Select **Tools > Options** from the ***Create Template*** menu bar.



7. Toggle off ***Apply Affixes***.

8. Set the ***X*** and ***Y Step Options*** to ***0.10***.

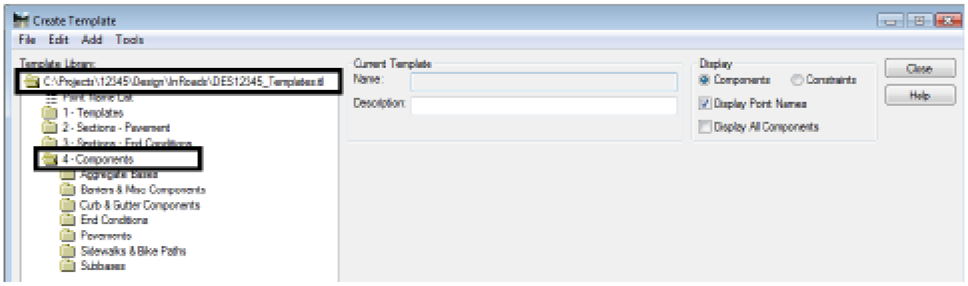
9. **<D> OK**.



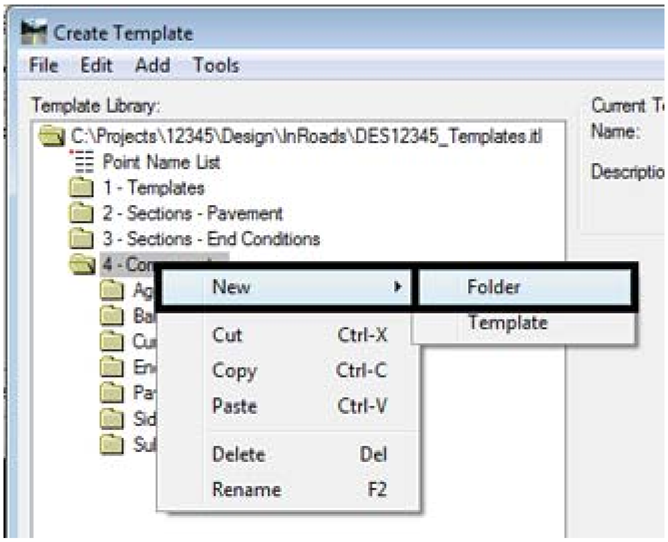
The next series of steps creates a new project specific folder to store the components that will be created in the lab. Creating project specific folders in the template library makes easier to find project specific components.

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.

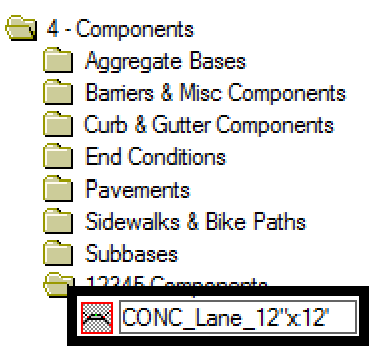


13. Key in ***12345 Components*** for the folder name.

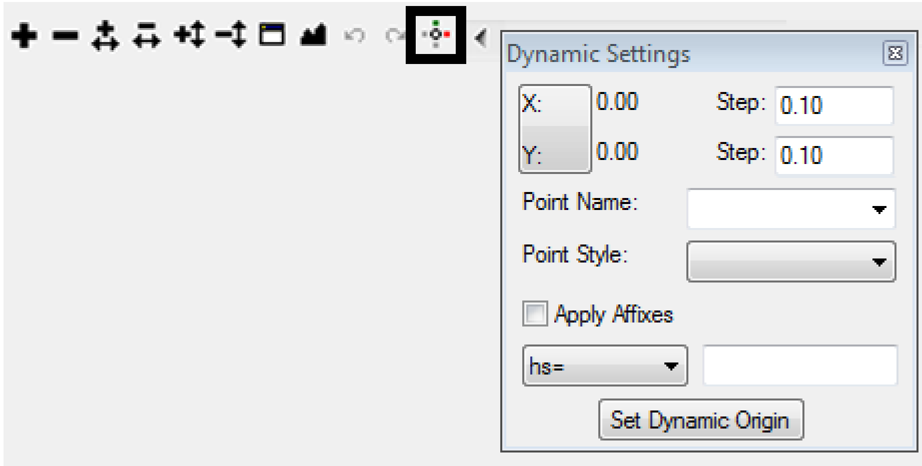
Components are the building blocks of templates. Create a pavement component using the ***Simple*** option. This option is used because it automatically sets up the constraints of the component.

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

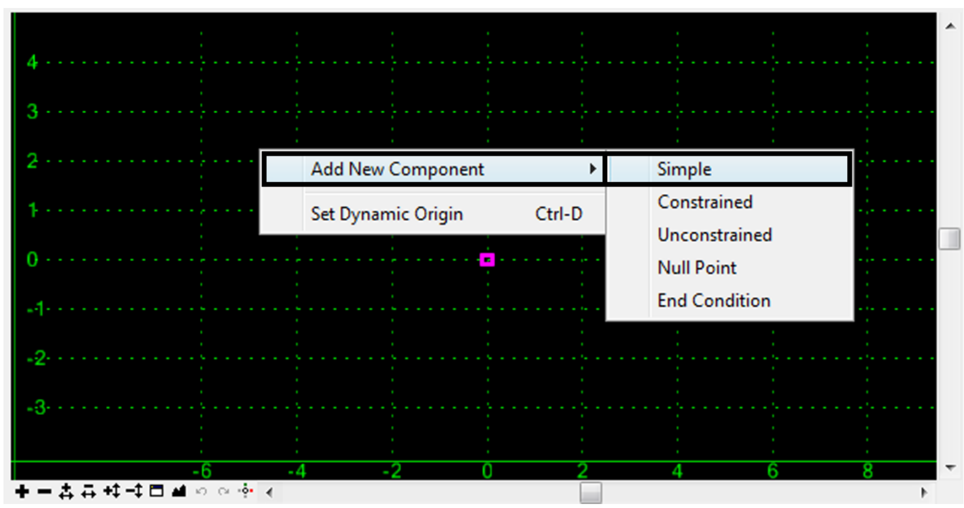
15. Key in ***CONC_Lane_12"x12'*** for the component name.



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.



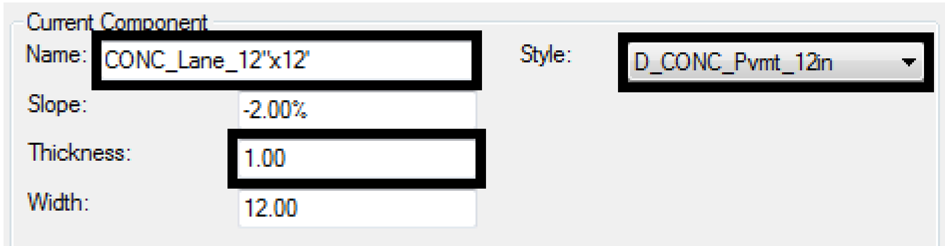
The next steps define the style that the component will use, the point names, and the origin of the component.

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.

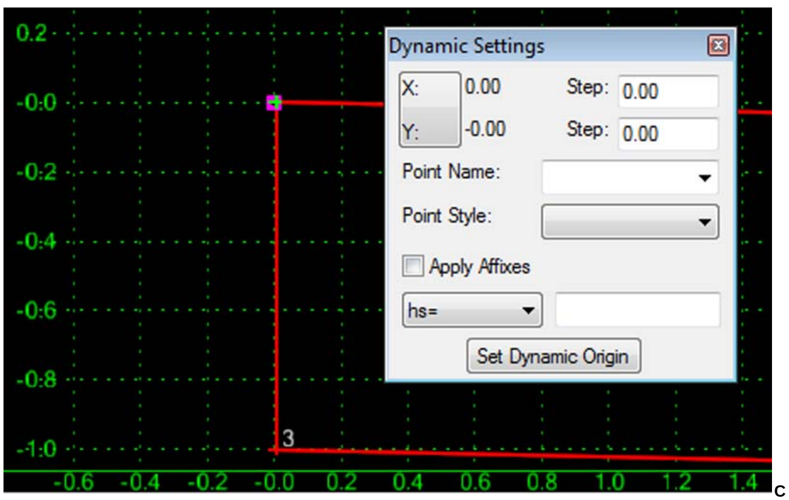
20. Key in ***1*** for the ***Thickness.***

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***.

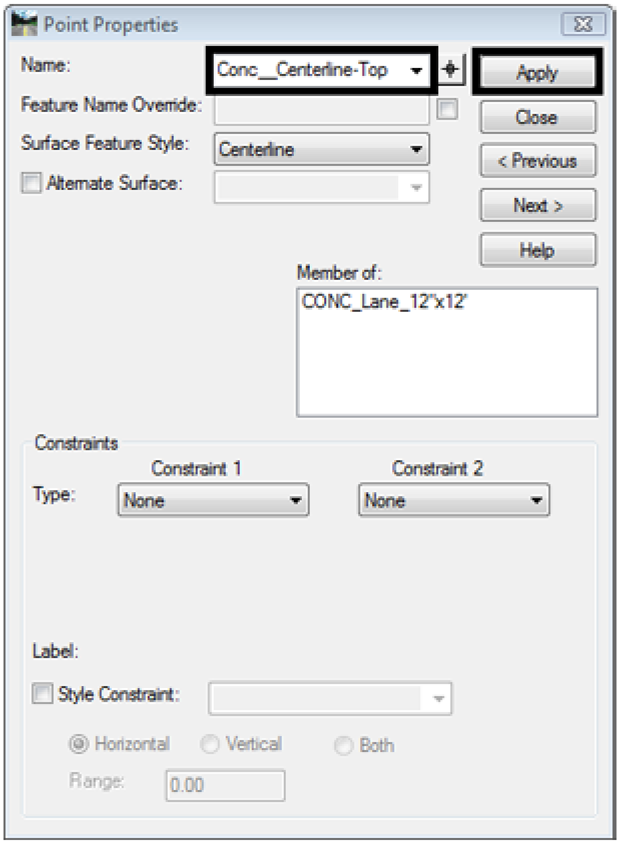
22. **<D>** to place the element.



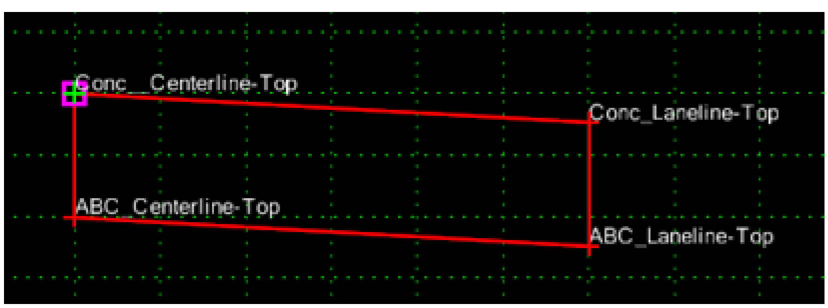
23. **<D> <D>** on the origin.

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.

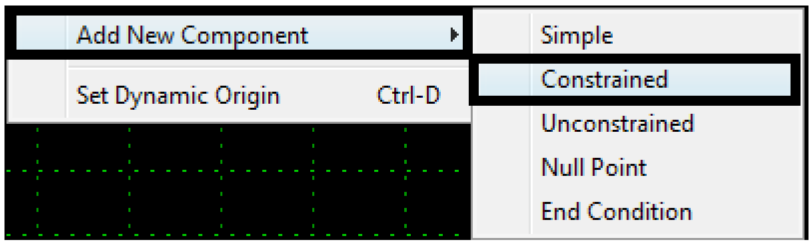


This completes the creation of a simple, closed shaped component with horizontal and slope constraints.

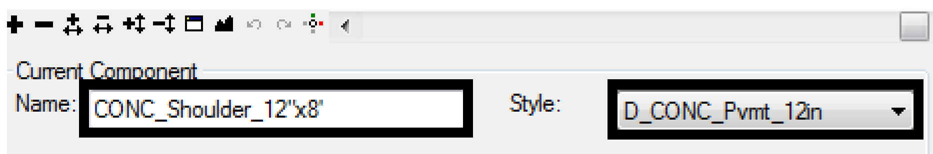
Lab 7.2 - Build a Constrained Component

In addition to building regular closed shape components, irregular and/or open shaped components can be created using the contrained 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.

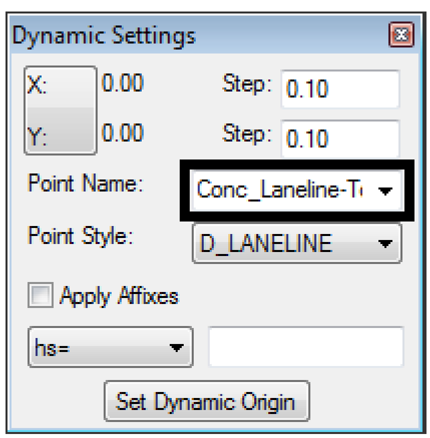


4. In the ***Current Component*** area, key in ***CONC_Shoulder_12"x8'*** into the ***Name*** field.
5. Set the Style to **D_CONC_Pvmt_12in** using the drop down menu.



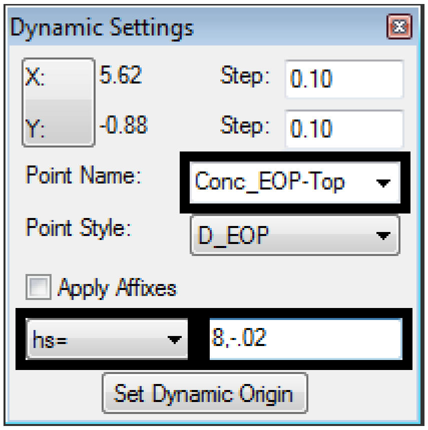
When placing constrained or unconstrained components, each point of the component must be placed individually. Use the ***Dynamic Settings*** dialog box is to enter point names, styles, and locations.

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

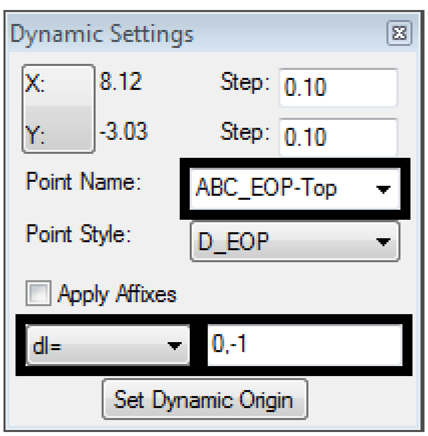


7. Move the pointer on to the template origin and **<D>**.
8. ***Dynamic Settings*** dialog box, Select ***Conc_EOP-Top*** from the ***Point Name*** drop down menu.
9. Change the key in mode to ***hs=*** (horizontal distance and slope).

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

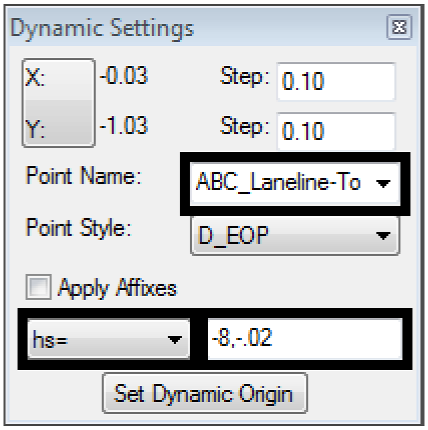


11. Press the ***Enter*** key to place the point.
12. Select ***ABC_EOP-Top*** from the ***Point Name*** drop down menu.
13. Change the key in mode to ***dl=*** (horizontal and vertical distance from the last entered point).
14. Key in ***0,-1*** in the key in field. This is the horizontal distance and vertical distance from the previously placed point.

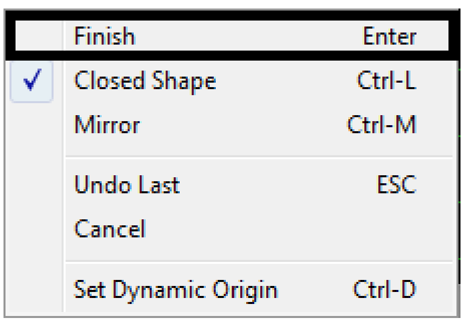


15. Press the ***Enter*** key to place the point.
16. Select ***ABC_Laneline-Top*** from the ***Point Name*** drop down menu.
17. Change the key in mode back to ***hs=*** (horizontal distance and slope).

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.



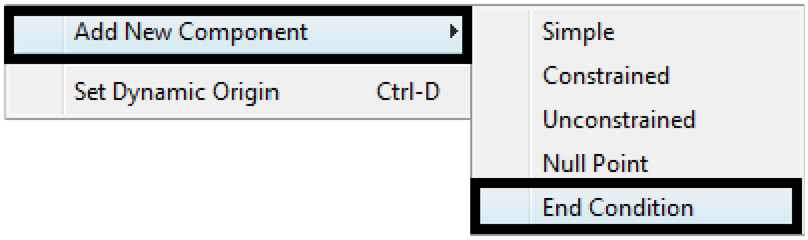
You should now understand how to create a constrained, closed shaped component. By reviewing the steps above, now you should also be able to also create unconstrained and open shaped components simply by choosing different options from the dialog boxes that were introduced.

Lab 7.3 - 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.

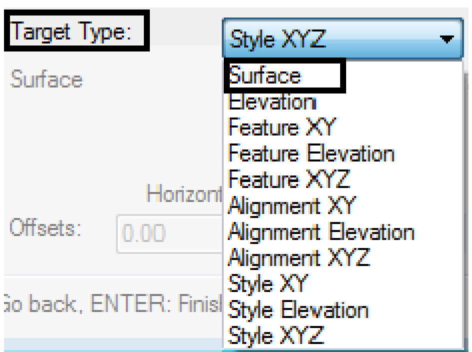


3. Key in ***6 to 1 Fill*** for the ***Name***.

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.

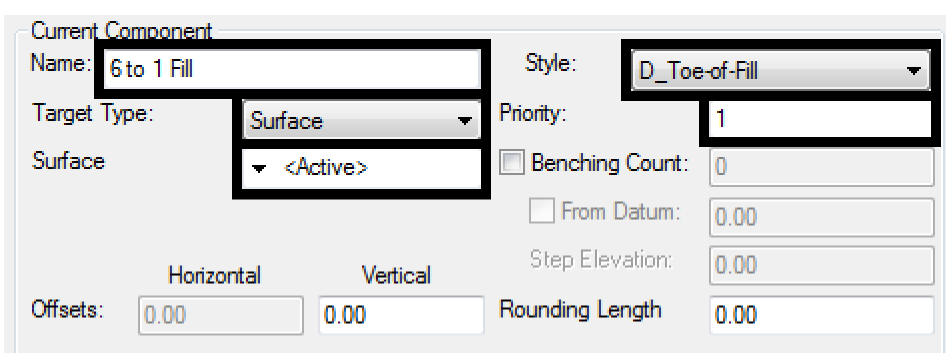


6. Select ***Surface*** from the ***Target Type*** drop down menu.

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.

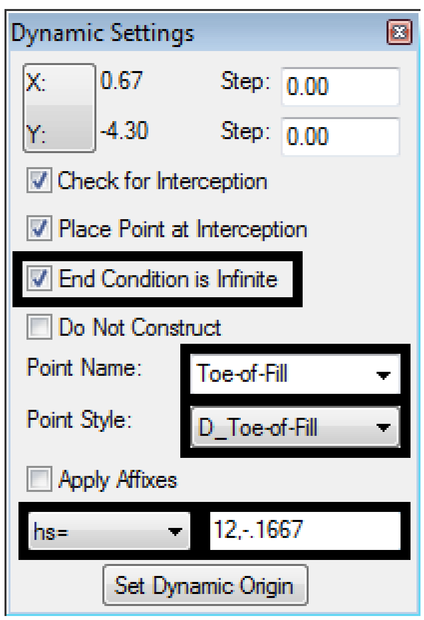
9. Key in ***1*** for the ***Priority***.



> **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***).

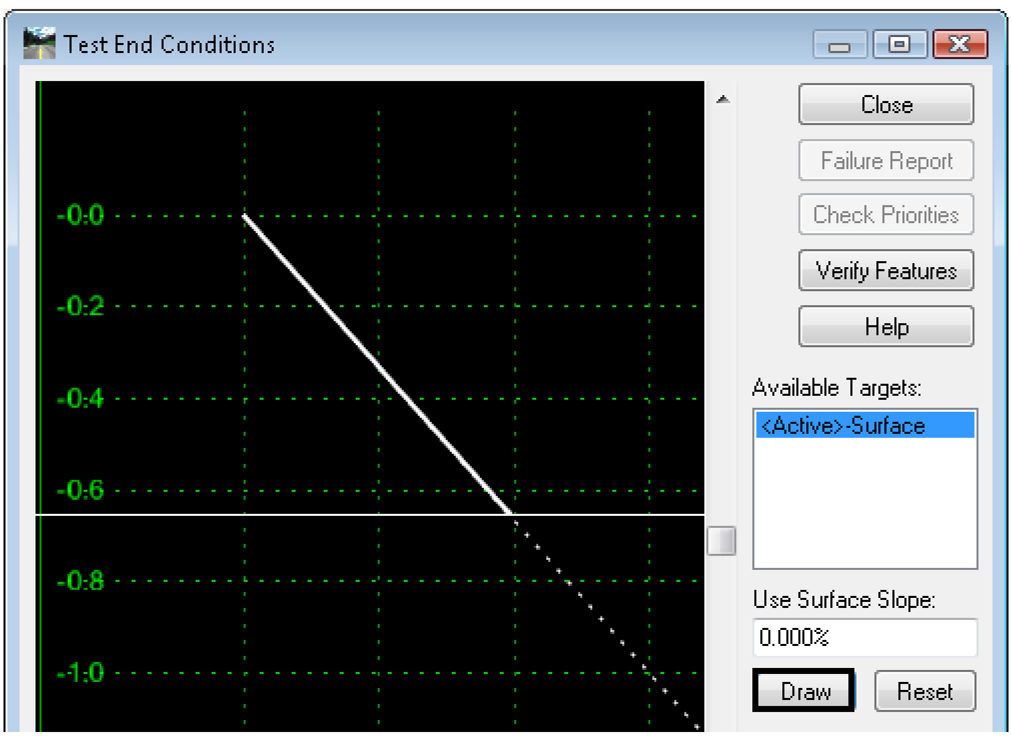


16. **<R>** and select ***Finish*** from the right click menu.

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.

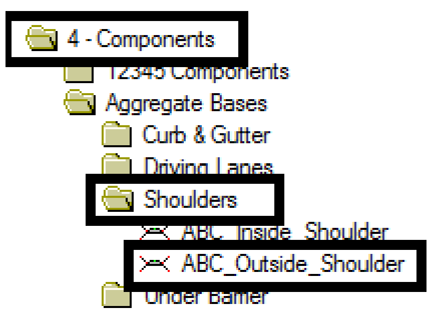
Lab 7.4 - How Point Constraints Work

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***.

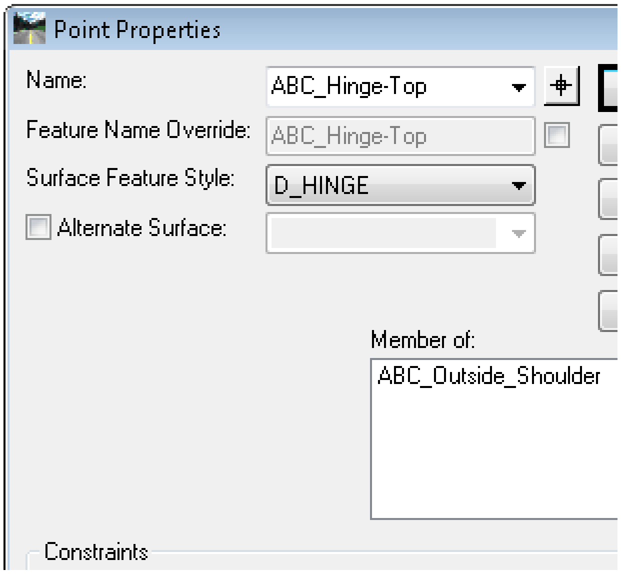
3. **<D> <D>** on the **ABC_Outside_Shoulder** component.



4. **<D> <D>** on the **ABC_Hinge-Top** point.

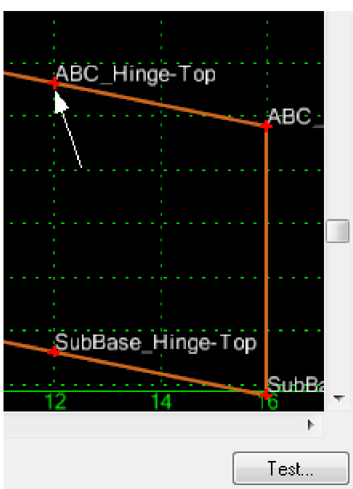
5. In the **Point Properties** dialog box, notice that this point has both a ***Horizontal*** and ***Slope*** constraint.

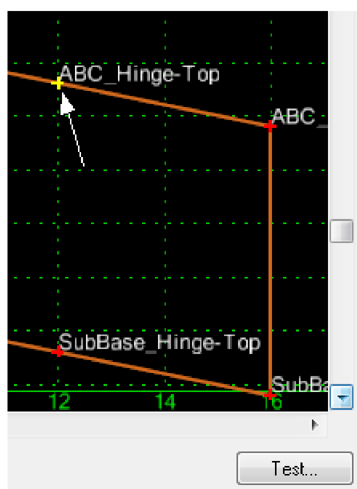
6. Change the ***Slope*** constraint to **None** and **<D> Apply**. This will allow the point to move up and down independent of any other point.



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.

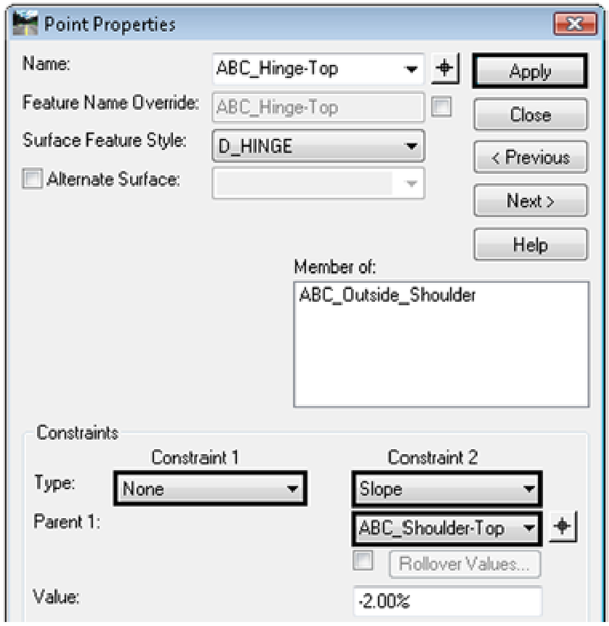
12. **<D> <D>** on the **Subbase_Hinge-Top** point.
13. Notice that ***Subbase_Hinge-Top*** is constrained both horizontally and vertically to ***ABC_Hinge-Top***. Therfore, if ABC_Hinge-Top moves, Subbase_Hinge-Top will follow according to what is entered in the constraint ***Value:*** field. The next 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 teh 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 7.1 -Build A Simple Component* showed how to modify point names in using the Point Properties dialog.
- The next lab, *Lab 7.2 -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 7.3 -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 7.4 -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 8 - 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

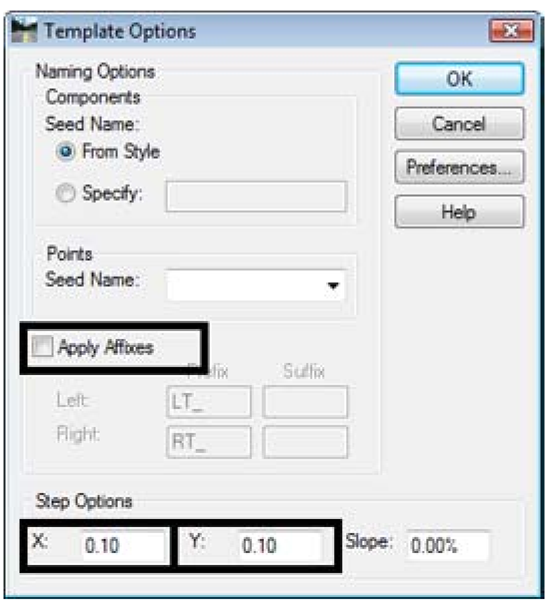
Before beginning this lab, verify that the following files are loaded:

- C:\Projects\12345\Design\Drawings\Reference_Files\12345DES_Model.dgn
- C:\Workspace\Workspace-CDOT_XM\Standards-Global\InRoads\Preferences\CDOT_Civil.xin
- C:\Projects\12345\12345\Design\InRoads\DES12345_Templates.itl (This file was modified in Lab 1)

Lab 8.1 - 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.

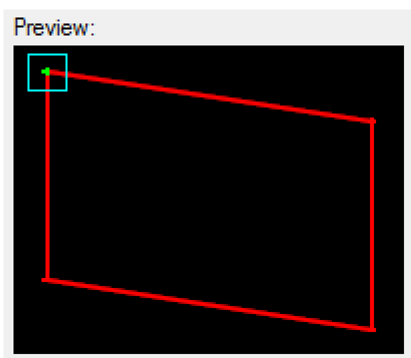
5. Create a new folder under ***2 – Sections – Pavement*** called ***12345 Sections***.

6. Create a new template in the ***12345 Sections*** folder. Name it ***Conc_Driving_Lane***.

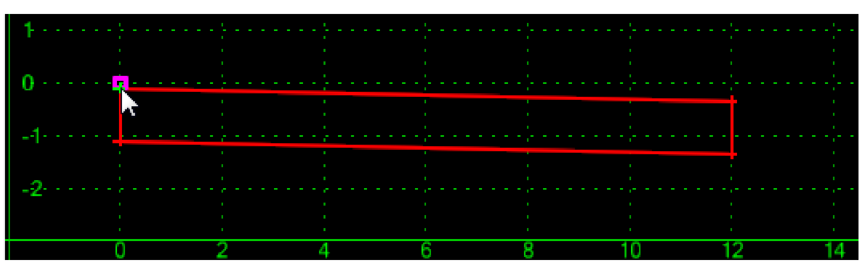
7. Expand the ***4 – Components*** folder. Also expand the ***12345 Components*** folder created in Lab 1.

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).



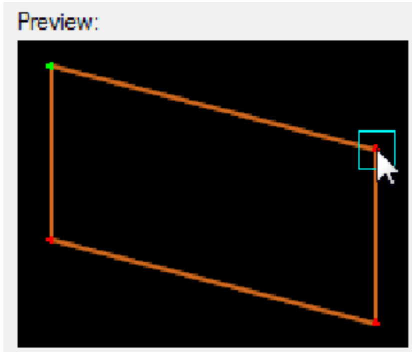
10. **Drag** the component into the template view and **drop** (release the data button) it on the new section's origin.



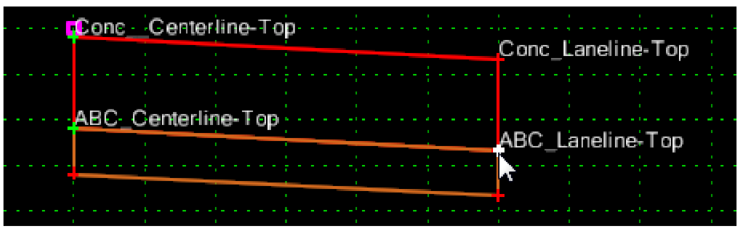
11. Expand the ***4 – Components >Aggregate Bases > Driving Lanes*** folder.

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 points 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 th e component.

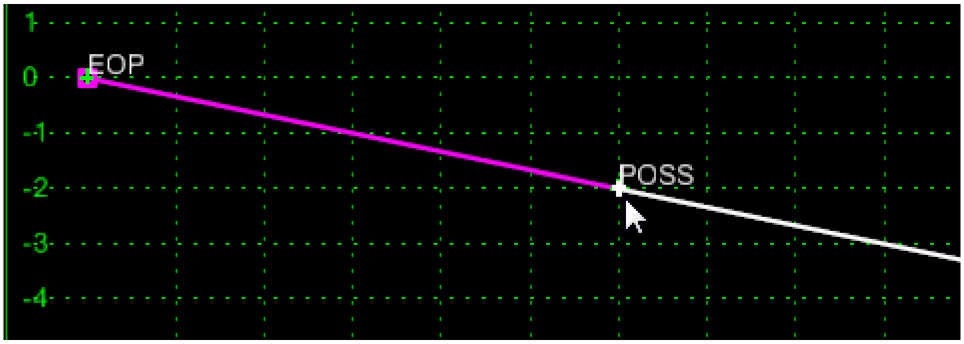
Lab 8.2 - Build an End Condition Section

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.

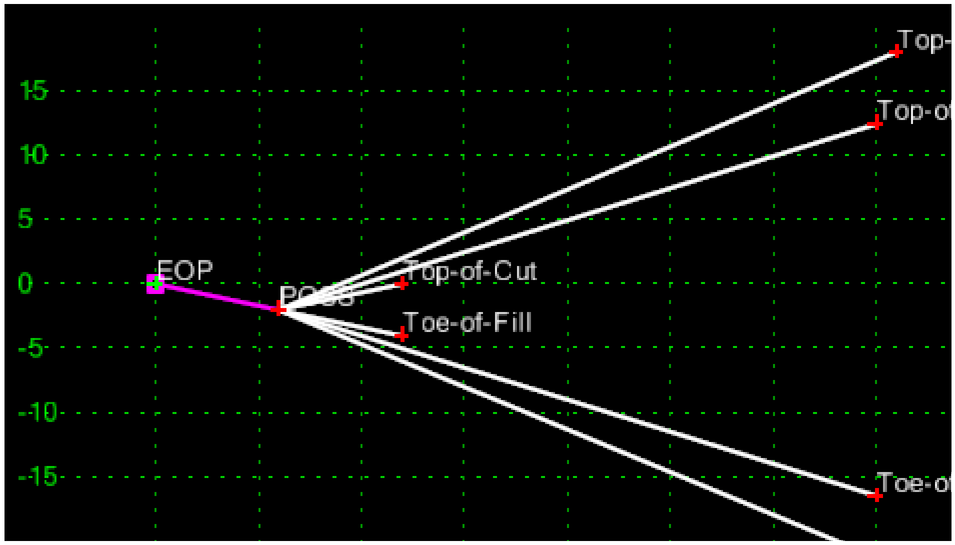
6. Expand the ***4 – Components >End Condition > Fill Slope Components*** folder.
7. **<D>** on the ***Fill_6_to_1*** component.
8. **Drag and Drop** the component on to the ***POSS*** point.



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.

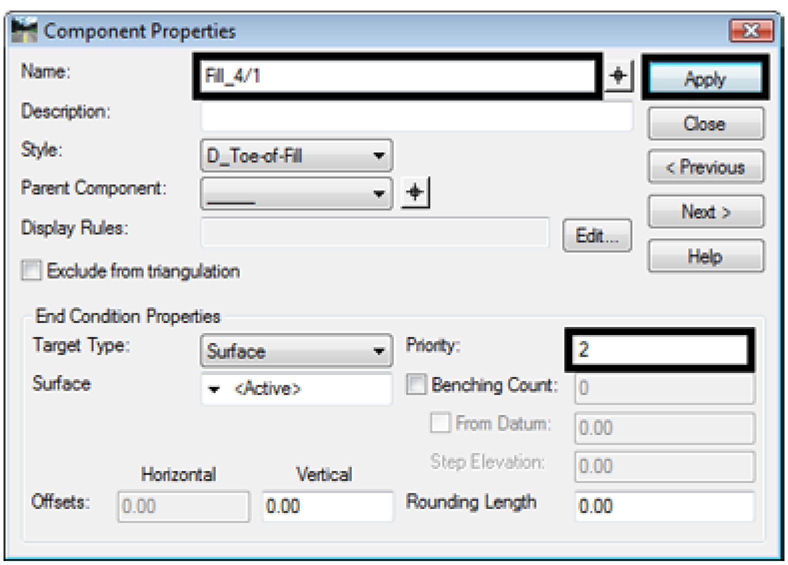


12. **<D> <D>** on the ***Fill 6/1*** component.

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.**



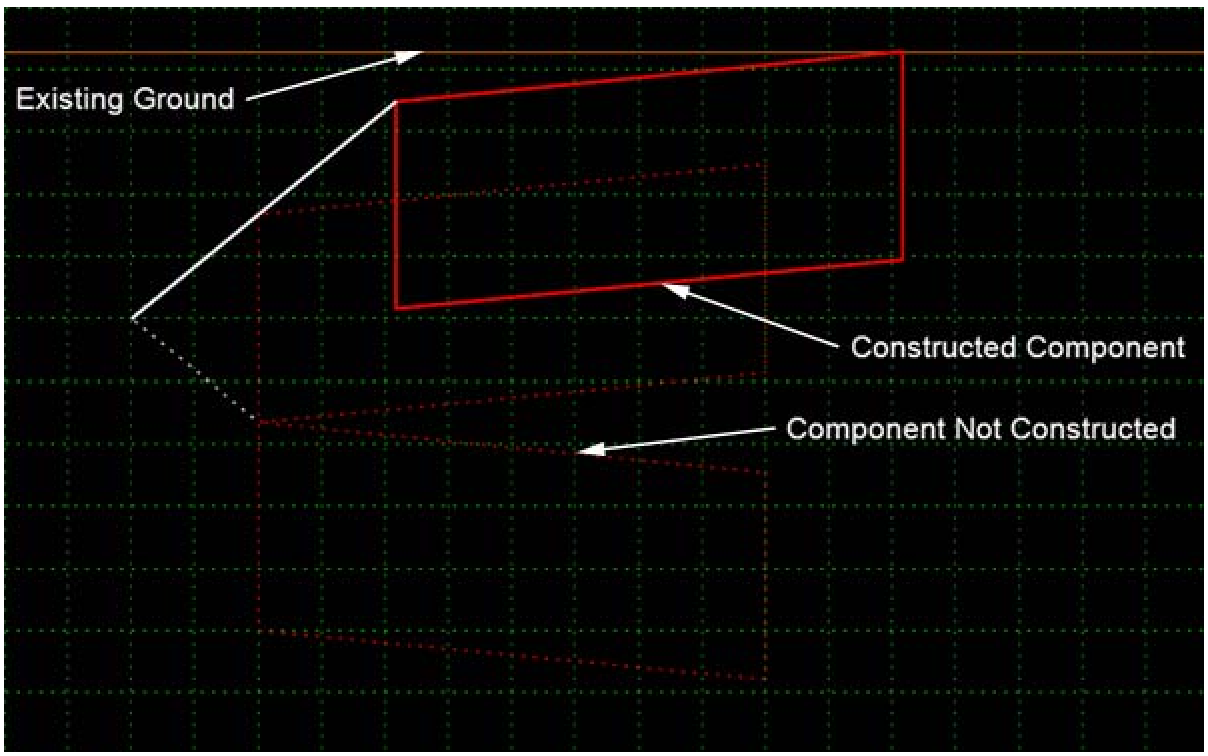
16. Set the remaining priorities as follows

- **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 8.3 - Using Parent Components

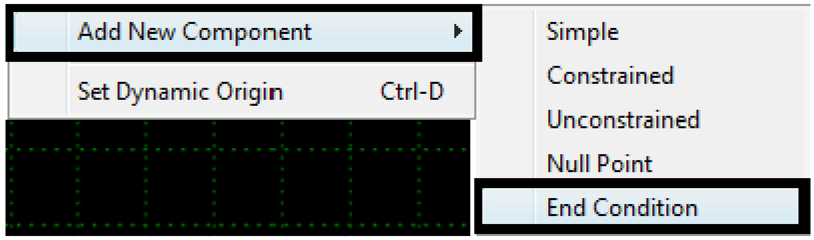
This example places a sidewalk at the end of a cut or fill slope. It illustrates how the parent/child relationship between components can be used. The sidewalk position end conditions are parents to the sidewalk components. This “turns off” the sidewalk when its parent end condition does not intercept the target surface.



1. Create a new template in the ***12345 Sections*** folder named named ***Parent Component Example***.

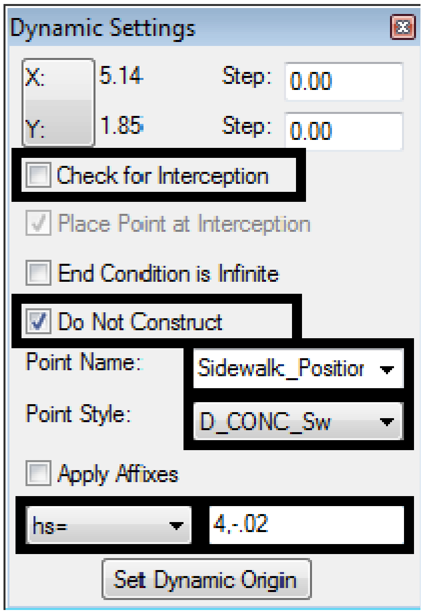
The end condition component is used to locate the position of the sidewalk. It contains two segments. The first segment matches the sidewalk’s width and slope. The second segment intercepts the target surface where the actual sidewalk goes. The Do Not Construct point property is used so that the points 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**.

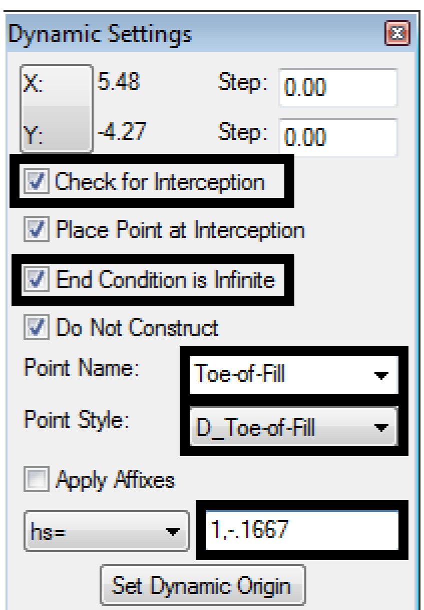


3. Key in ***Fill*** for the component ***Name***.
4. Select ***D_Toe-of-Fill*** for the ***Style***.
5. Key in ***1*** for the ***Priority***.
6. In the ***Dynamic Settings*** dialog box, set the ***Point Name*** to **POSS**.
7. Place the point on the template origin.
8. In the ***Dynamic Settings*** 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 Positon is not created.



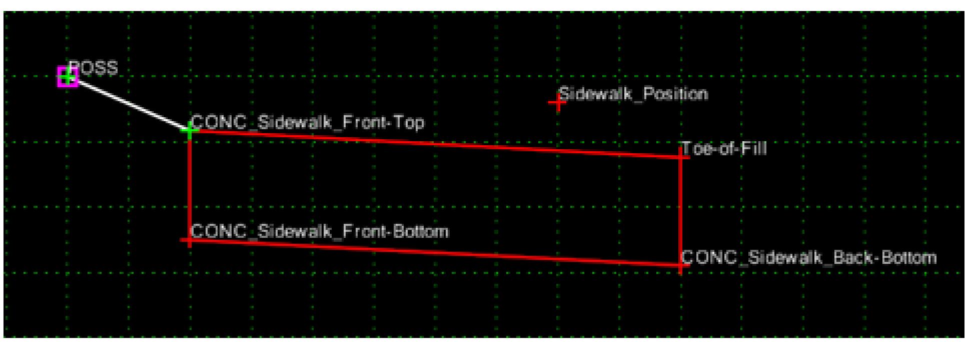
15. In the ***Dynamic Settings*** dialog box, toggle on ***Check for Interception***.
16. Toggle on ***End Condition is Infinite***.
17. Set the ***Point Name*** to **Toe-of-Fill**.
18. Key in ***1,-.1667*** and press ***Enter***.



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.

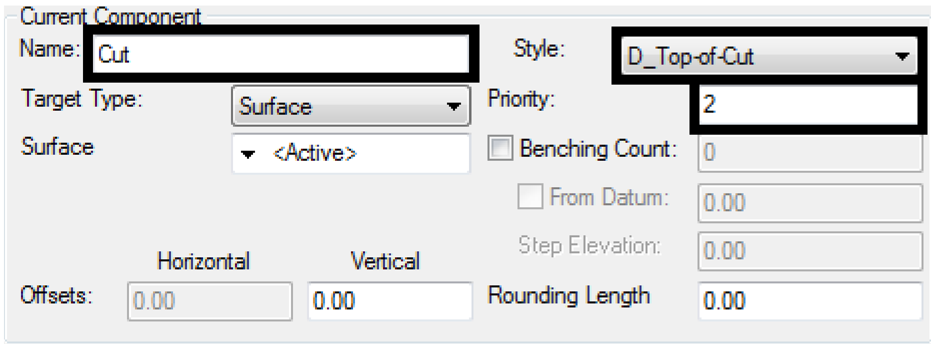
20. Expand the ***4 – Components >Sidewalks & Bike Paths > Sidewalks*** folder.
21. **<D>** on the ***4"_CONC_Sidewalk*** component.
22. **<D> and hold** on the upper right point in the Preview.
23. **Drag and Drop** the component on the ***Toe-of-Fill*** point.
24. **<D> <D>** on the ***CONC_Sidewalk_Front-Top*** 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 Contraint 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***.

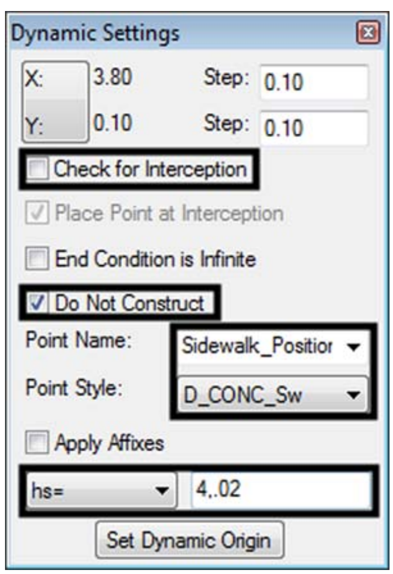
40. In the ***Dynamic Settings*** dialog box, toggle off ***Check for Interception***.

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***.

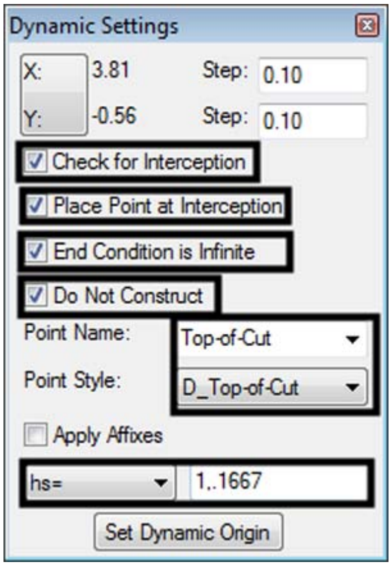


45. In the ***Dynamic Settings*** dialog box, toggle on ***Check for Interception***.

46. Toggle on ***End Condition is Infinite***.

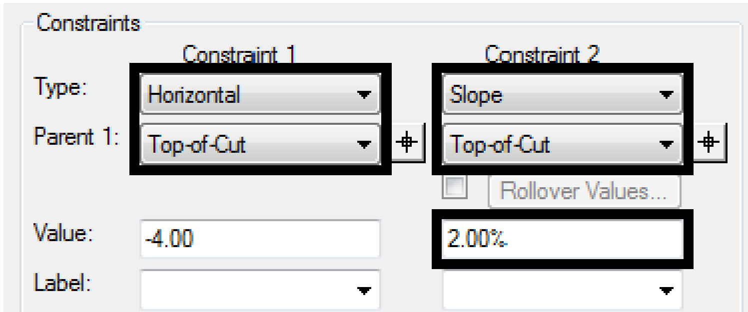
47. Set the ***Point Name*** to **Top-of-Cut**.

48. Key in ***1,.1667*** and press ***Enter***.

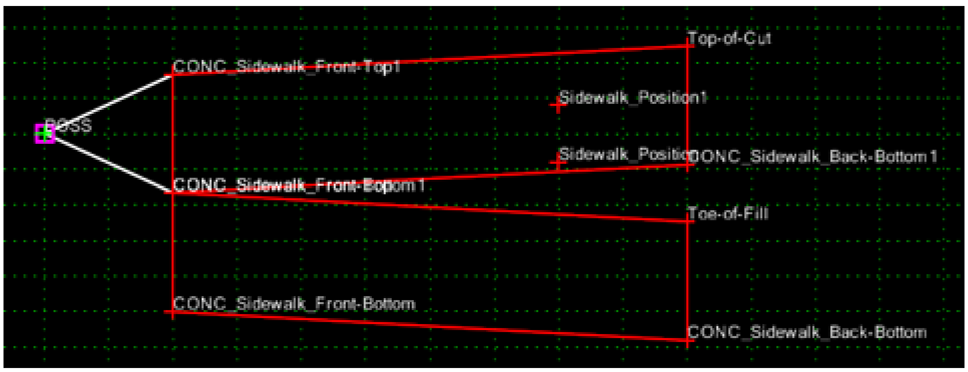


49. **<R>** and select **Finish**.
50. **<D>** on the ***4"_CONC_Sidewalk*** component.
51. **<D> and hold** on the upper right point in the Preview.
52. **Drag and Drop** the component on the ***Top-of-Cut*** point**.**
53. **<R>** and select **Finish**.
54. **<D> <D>** on the **CONC_Sidewalk_Front-Top1** 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.

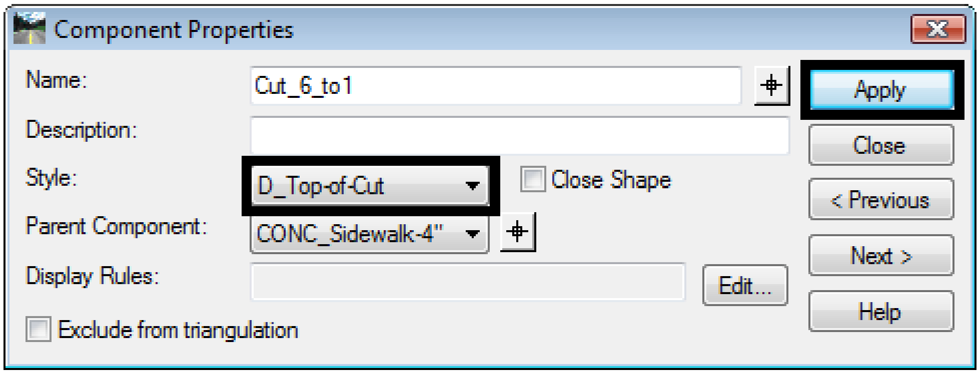
67. **<D> Close**.

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 8.4 - 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 seperate 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 excedes the maximum value the guardrail end condition is used.

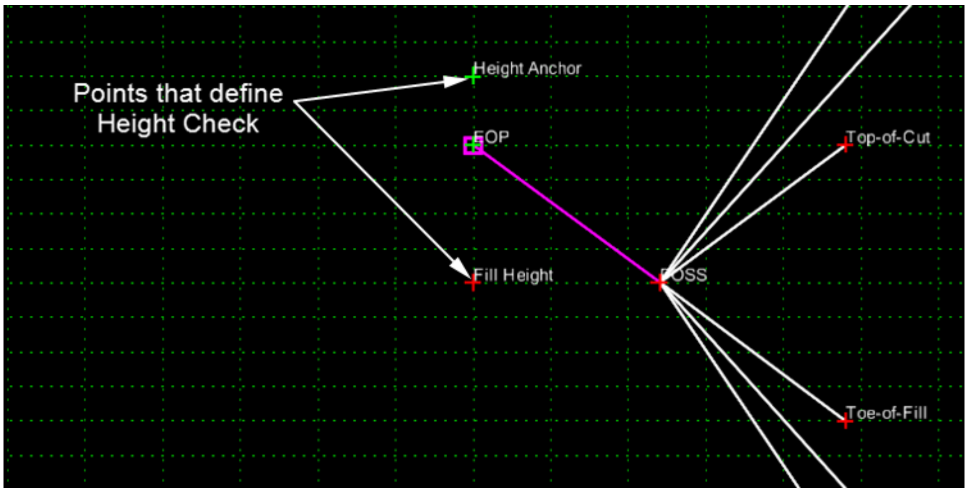
The standard end condition section is added to the template.

1. Create a new template in the ***12345 Sections*** folder. named ***Display Rules Example***.

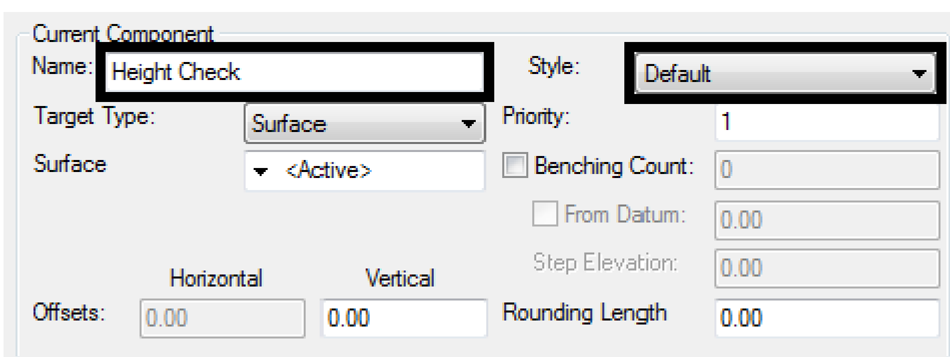
2. Expand the ***3 – Sections - End Sections > Z-Slope End Conditions > High Speed End Conditions*** folder.

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.

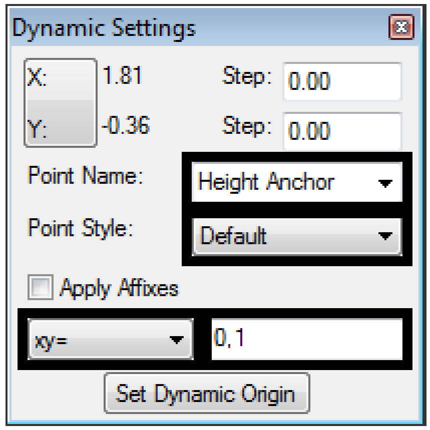


6. **<R>** in the Template View and select **Add New Component > End Condition**.
7. Key in ***Height Check*** for the ***Name***.
8. Select **Default** for the ***Style***.



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***.

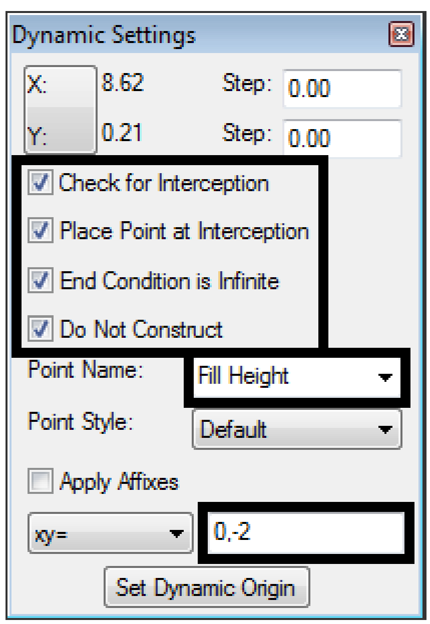


This pointsets the Height Check end condition over the EOP so that the fill height can be checked vertically at this point.

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***.



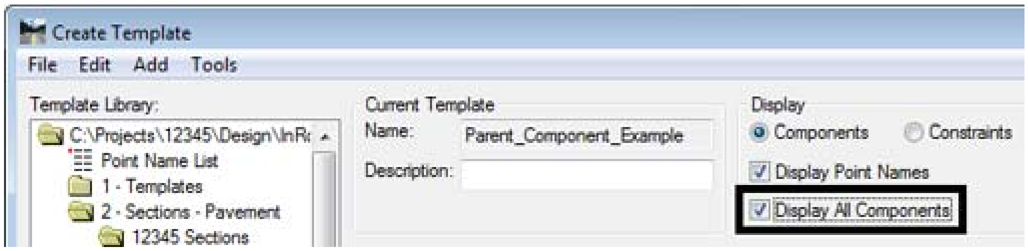
This sets the starting location for the Fill Height point. This point intercepts the existing ground directly under the EOP to determine the fill height. The 2 foot distance below the template origin is an arbitrary value, so long as the Fill Height point is placed below the Height Anchor point the template will work properly.

16. **<R>** and select **Finish**.

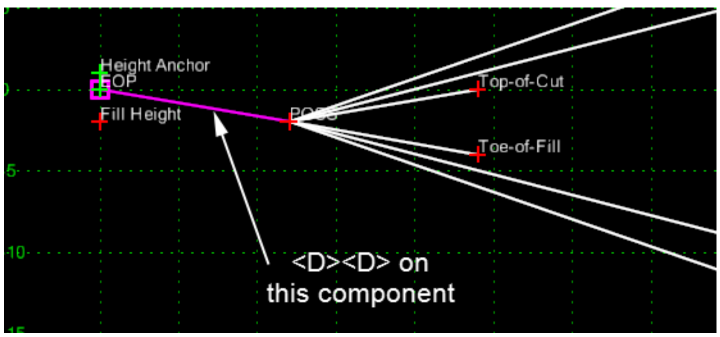
17. Select **File > Save**. (This is an intermediate save to prevent loss of information.)

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***.



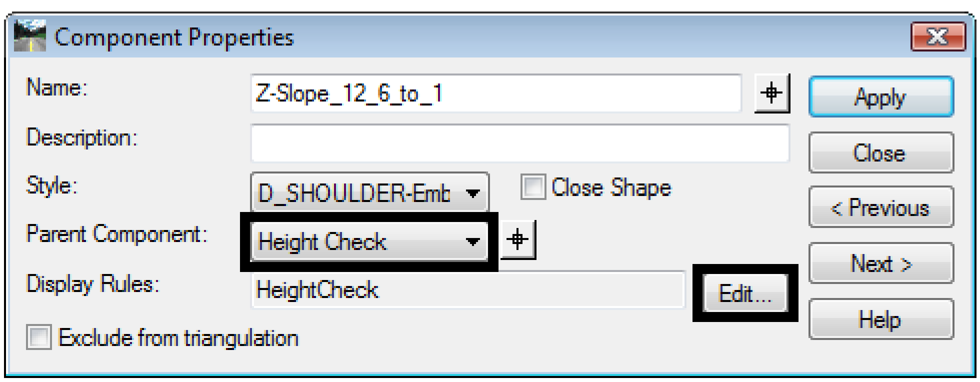
19. **<D> <D>** on the **Z-Slope_12_6_to_1** component.



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.

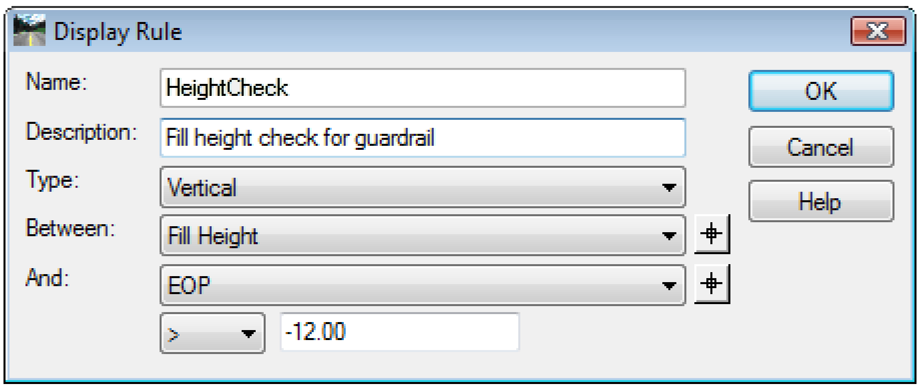


22. In the ***Component Display Conditional Expression*** dialog box, **<D> Add**. The ***Display Rule*** dialog box is displayed.

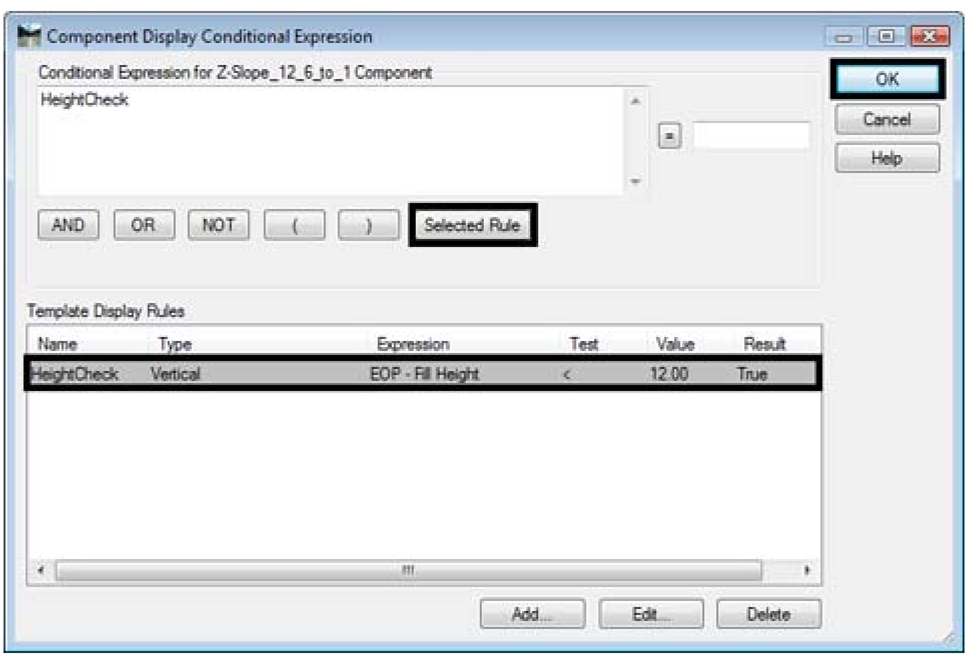
The Display Rule determines when the Z-Slope_12_6_to_1 component is displayed. It is set so that when the fill height at the edge of pavement is more than 12 feet, the normal end condition is turned off.

23. In the ***Display Rule*** dialog box , key in ***Height Check*** for the ***Name***.

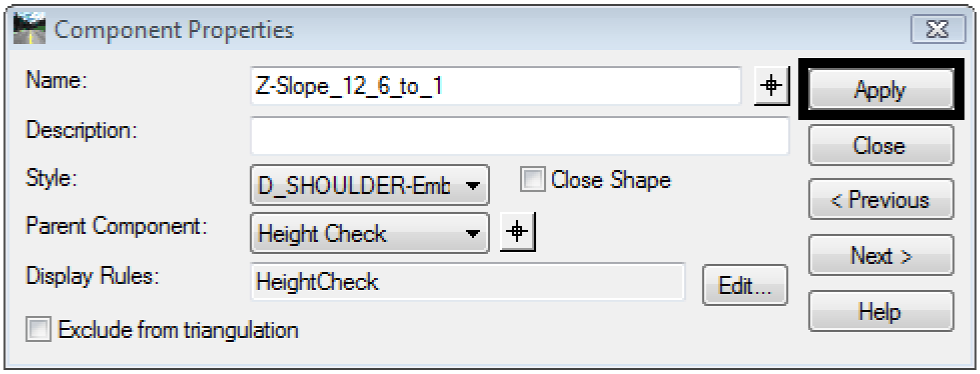
24. Key in ***Fill height check for guardrail*** in the ***Description*** field.
25. Set the ***Type*** to **Vertical**.
26. Set ***Between*** to **Fill Height**.
27. Set ***And*** to **EOP**.
28. Set the expression to **>.**
29. Key in **-12** in the value field.
30. **<D> OK**.



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**.

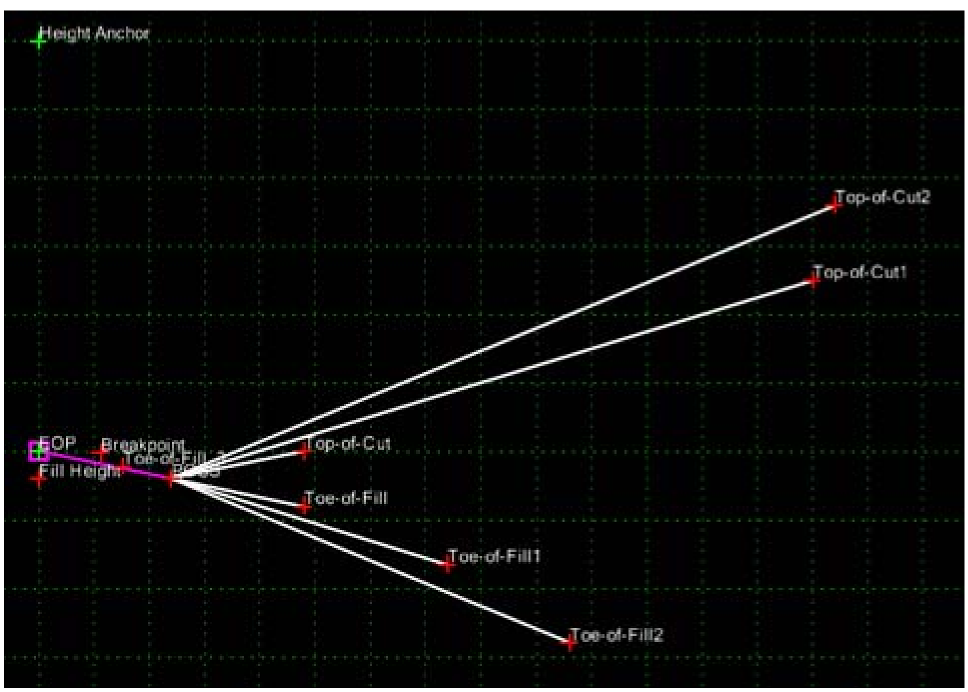
As defined in the Z12_6_to_1 Section, the 3 to 1 fill slope will never be used. This is because the guardrail component is activated before the 4 to 1 option reaches its maximum distance. By changing the value on the horizontal constraint to 32 on the 4 to 1 slope, it will reach its maximum length before 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.

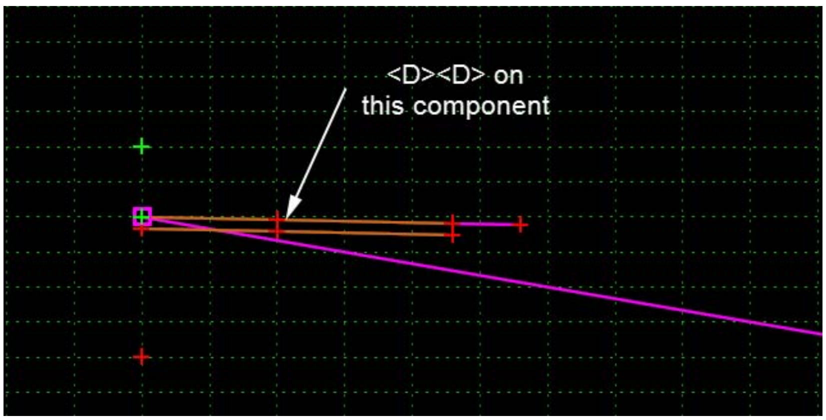
43. Expand the ***4 – Components > Barriers & Misc Components > Guardrail Widening*** folder.

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.

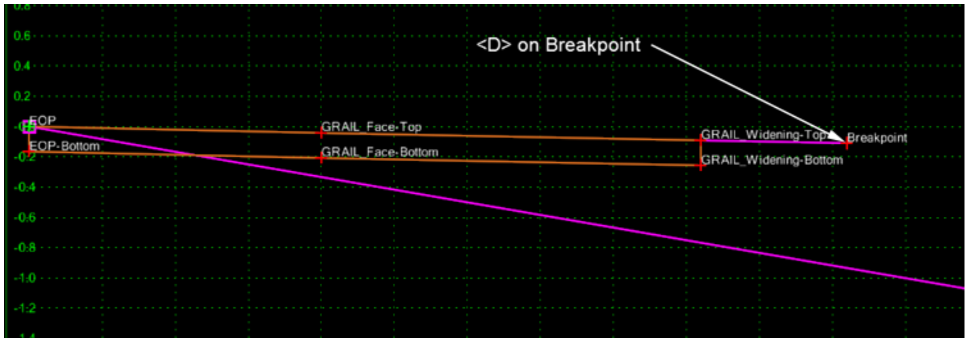
53. Zoom in around the guardrail widening component placed above.

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.

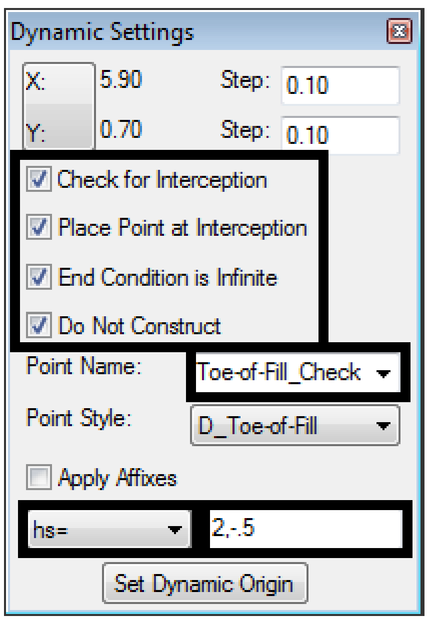


58. In the ***Dynamic Settings*** dialog box, Key in ***Toe-of-Fill_3*** for the ***Point Name***.

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 8.2 -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 8.3 -Using Parent Components* and *Lab 8.4 -Using Display Rules* built sections from new and existing components. A variety of methods can be used to put data into a template.
- *Lab 8.3 -Using Parent Components* and *Lab 8.4 -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 8.4 -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 9 - 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.

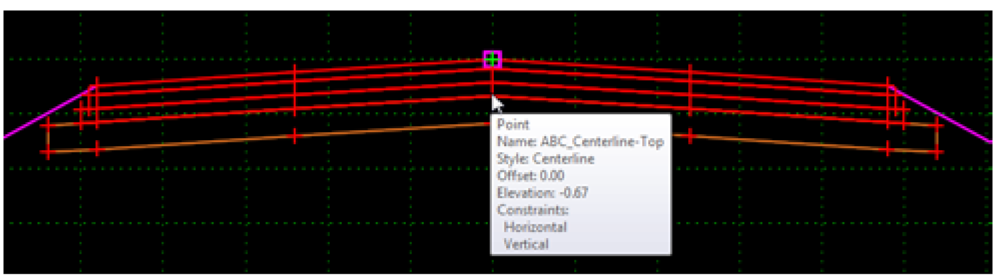
Before beginning this lab, verify that the following files are loaded:

- C:\Projects\12345\Design\Drawings\Reference_Files\12345DES_Model.dgn
- C:\Workspace\Workspace-CDOT_XM\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\Combined Surfaces.ird
- C:\Projects\12345\Design\InRoads\DES12345_Templates.itl (This file was modified in Lab 1)

Lab 9.1 - Modify pavement lift thickness

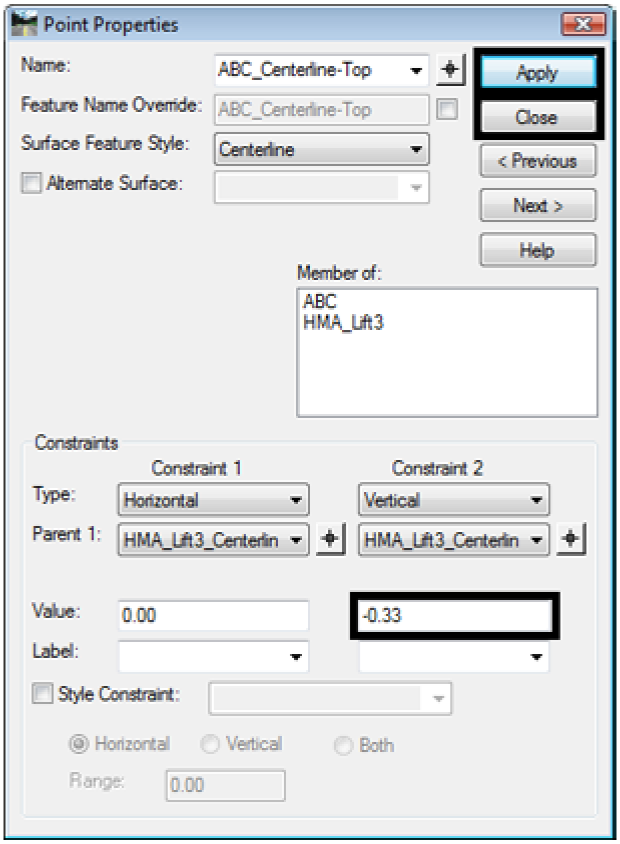
This exercise demonstrates how to modify point constraints in order to change the lift thickness on an existing template. The HMA_Crowned_B10 template from the template library will be modified so that the bottom lift of asphalt will be 4 inches thick.

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.



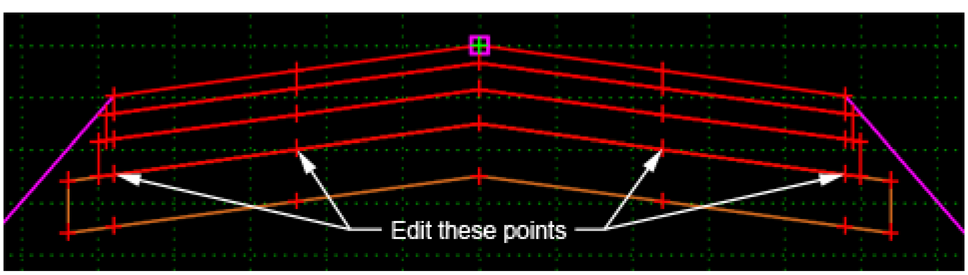
5. Key in **-0.33** for the ***Value*** of the ***Vertical*** constraint**.**
6. **<D> Apply.**

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

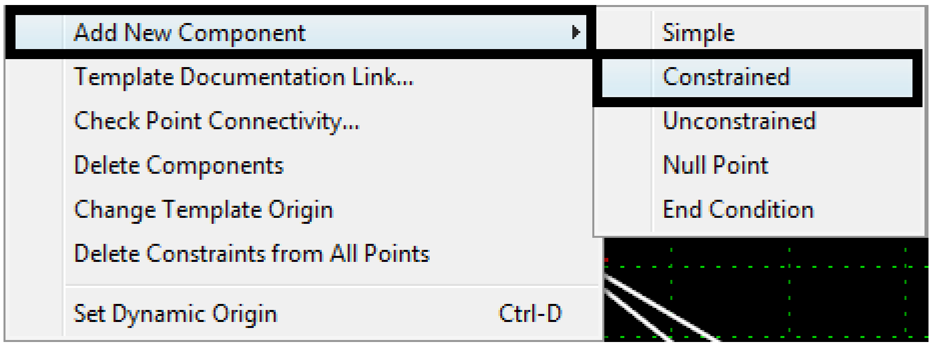


Note: The two outside points (HMA_Lift3_EOP-Bottom and ABC_EOP-Top) do not need to be modified. This is because they are built with Vector/Offset constraints which keeps them in line with the other points on that row.

Lab 9.2 - Add a sub-base component to the template

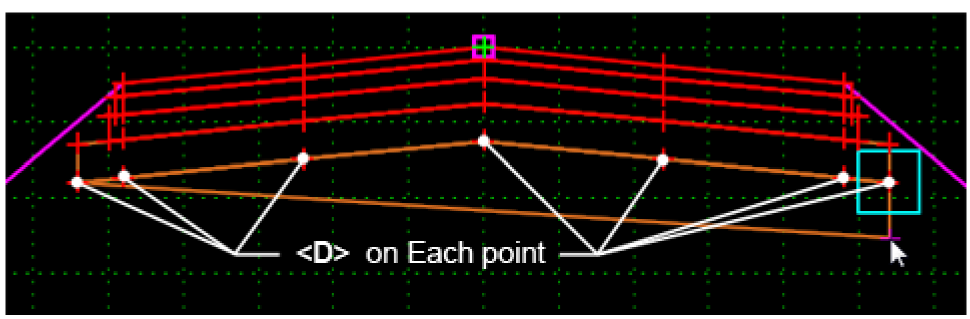
This exercise show how to add and modify a component to an existing template in order to add a sub-base component to the bottom of the HMA_Crowned_B10 template used above. The sub-base will be added as a new component instead of using one from the libraryin order to minimize the amount of editing.

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 verfiy that ***Closed Shape*** is checked on.



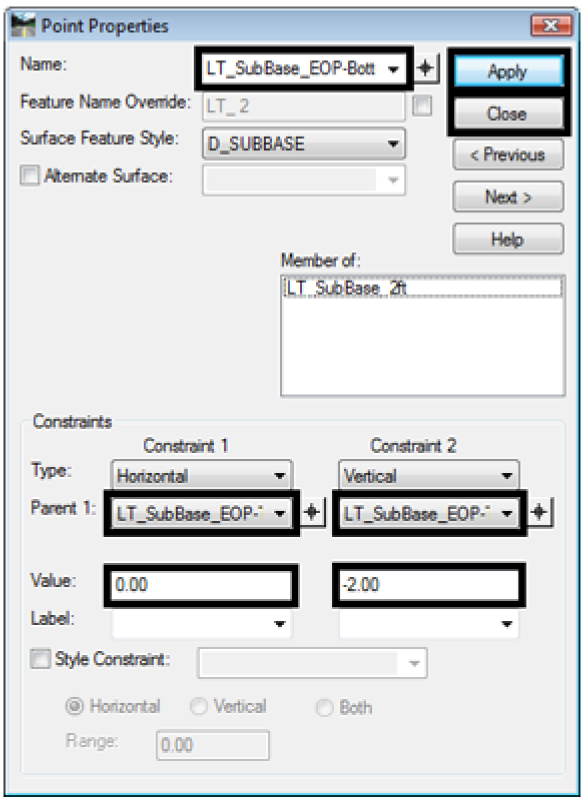
The next steps build the bottom of the subbase. The points are placed in the approximate location. There final position is set by editing the point constraints.

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***.

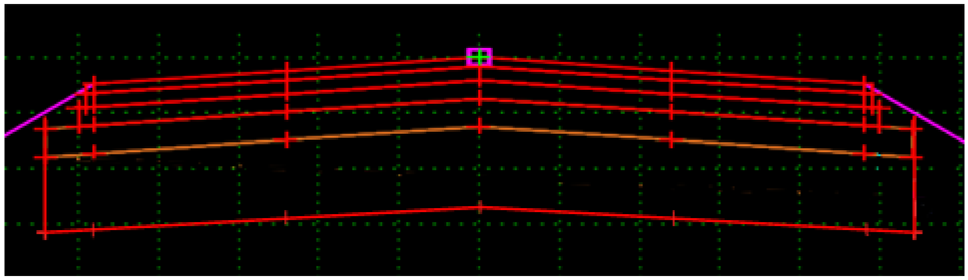
    Note: The name is the same as the point above it, except that the word Top is replaced with the word Bottom.

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:

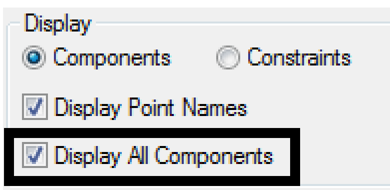


Lab 9.3 - Add an Additional Lane to One Side of a Template

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***.

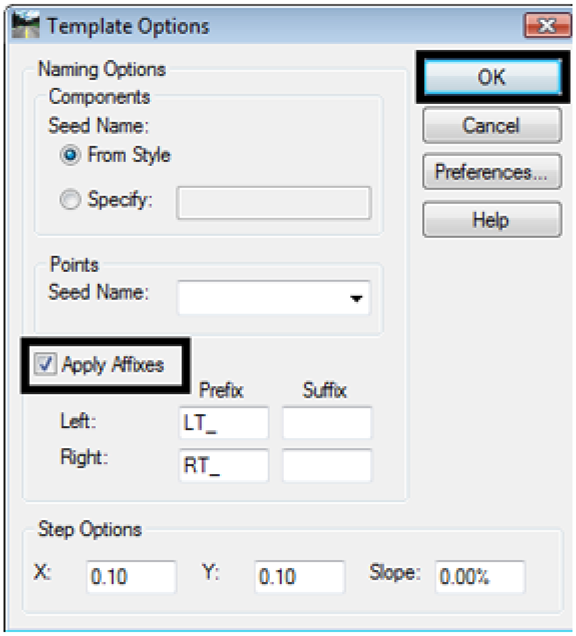


Affixes are used so that point names added to the template are updated to reflect their location with respect to the control line.

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

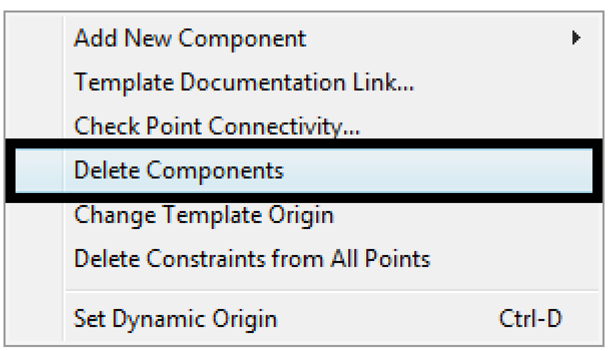
4. Toggle on **Apply Affixes**.

5. **<D> OK**.

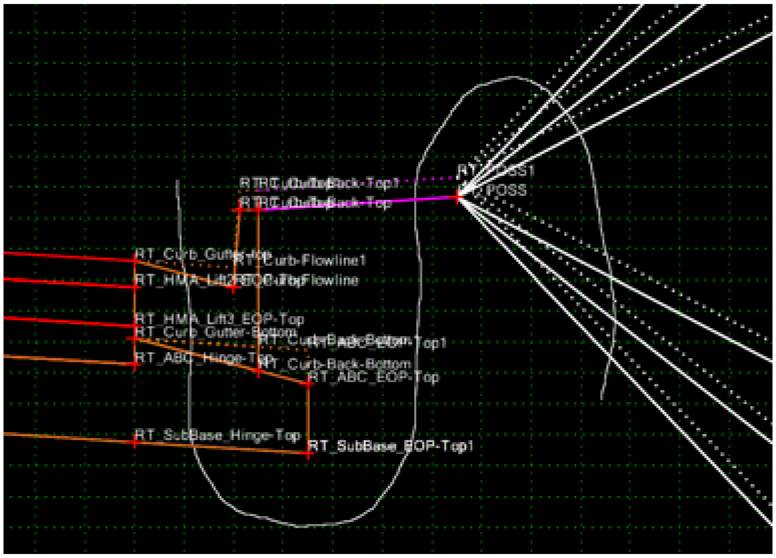


The existing curb and gutter on the right side of the template and its ABC component must be removed from the template to make room for the new lane.

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

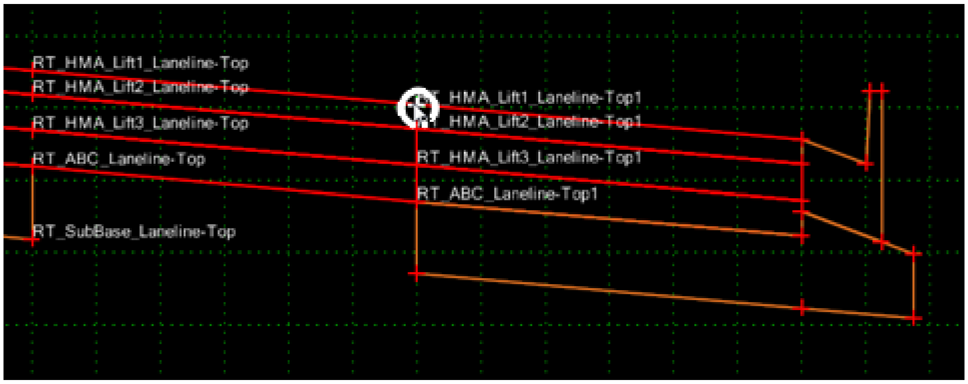
The template library contains a three lift asphalt driving lane section with curb and gutter attached. Use this section to complete the backbone of the template.

9. Expand the ***2 – Sections - Pavement > Curb & Gutter Sections*** folder in the template library explorer.

10. **<D>** on the **C/G_Type2-IIB** section.

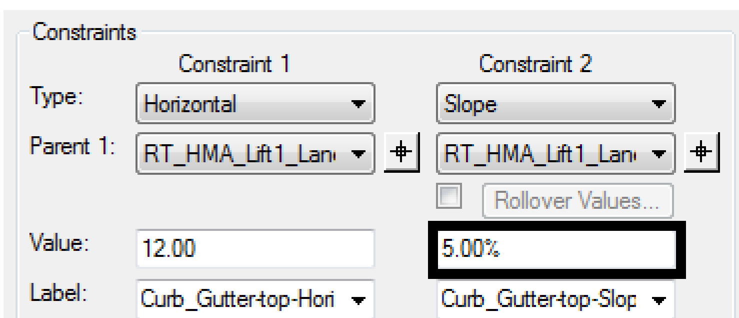
11. **<D> and Hold** on the section's origin in the ***Preview*** window.

12. Drag and Drop the section onto the ***RT_HMA_Lift1_Laneline-Top1*** point.



The new section that was added accomodates 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.

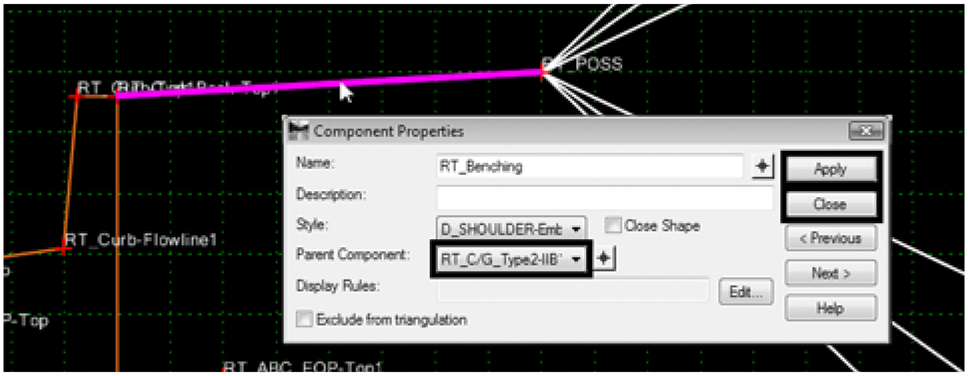
13. Zoom in on the right curb components, there are two (one is shown with dotted lines).
14. **<D> <D>** on the **RT_Curb_Gutter-top** point.
15. Change the ***Slope*** constraint ***Value*** to ***5.00%.*** This is done so that hidden (dotted) curb component is displayed. It will also allow the points to merge as desired in the following steps.



16. **<D> Apply**.

Labs for InRoads XM LAB 9 - Modifying Templates

25. **<D> Close**.



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

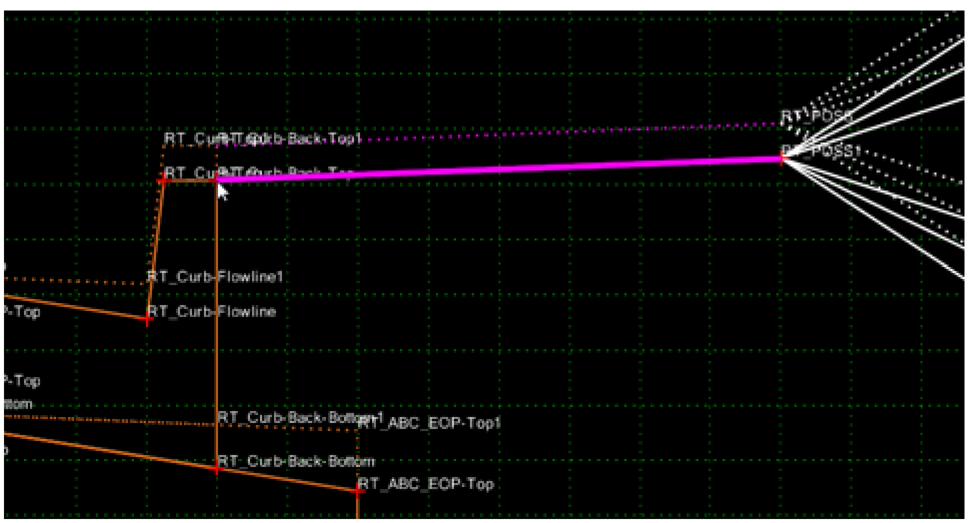
27. Change the ***Slope*** constraint ***Value*** to ***-2.00%.*** This is done so that the hidden (dotted) curb component is displayed. It will also allow the points to merge as desired in the following steps.

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**.

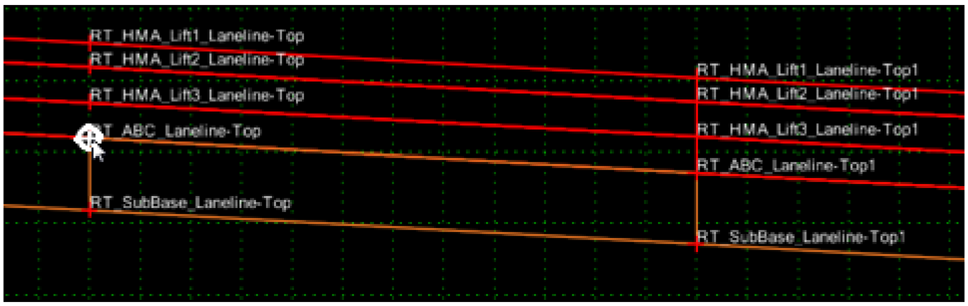
34. **<D> Apply**.

35. **<D> Close**.

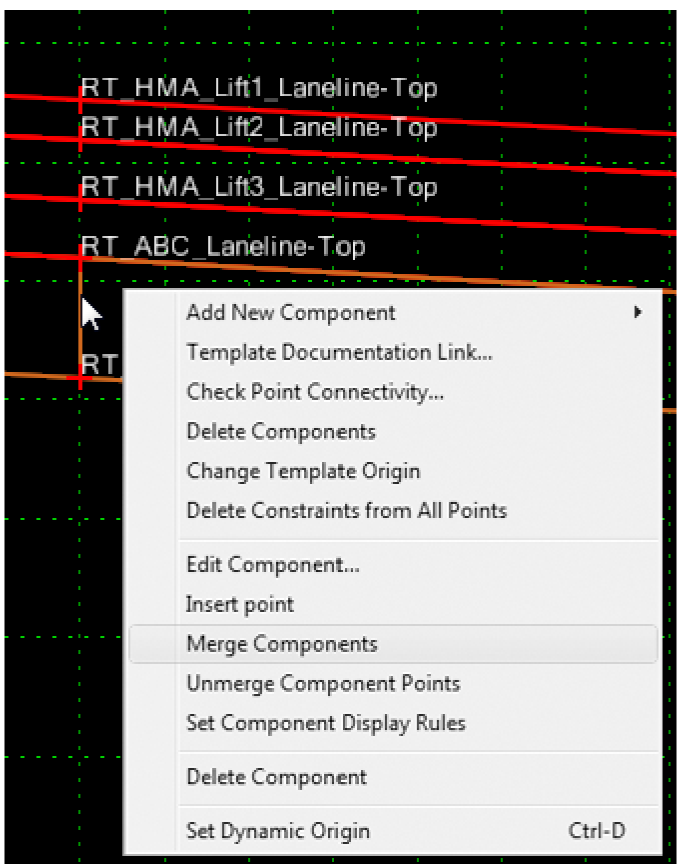
Note: Applying the Parent Component settings to the Benching components will make the proper end condition display based on the pavement cross slope.

Finally, the missing ABC component is added under the new driving lane.

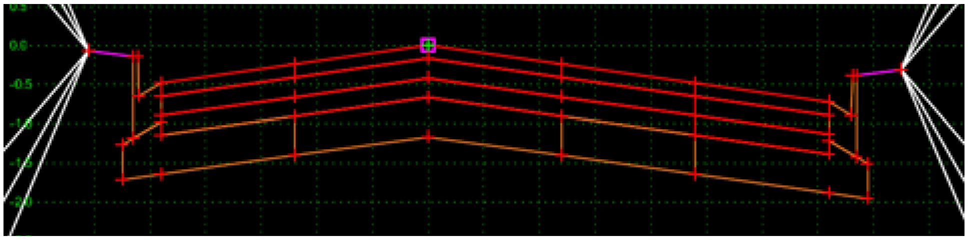
36. Expand the ***4 - Components > Aggtegate Bases > Driving Lanes*** folder in the template library explorer.
37. **<D>** on the **ABC_Lane** component to display it in the Preview window.
38. **<D> and Hold** on the section's origin in the ***Preview*** window.
39. Drag and Drop the section on to the ***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:

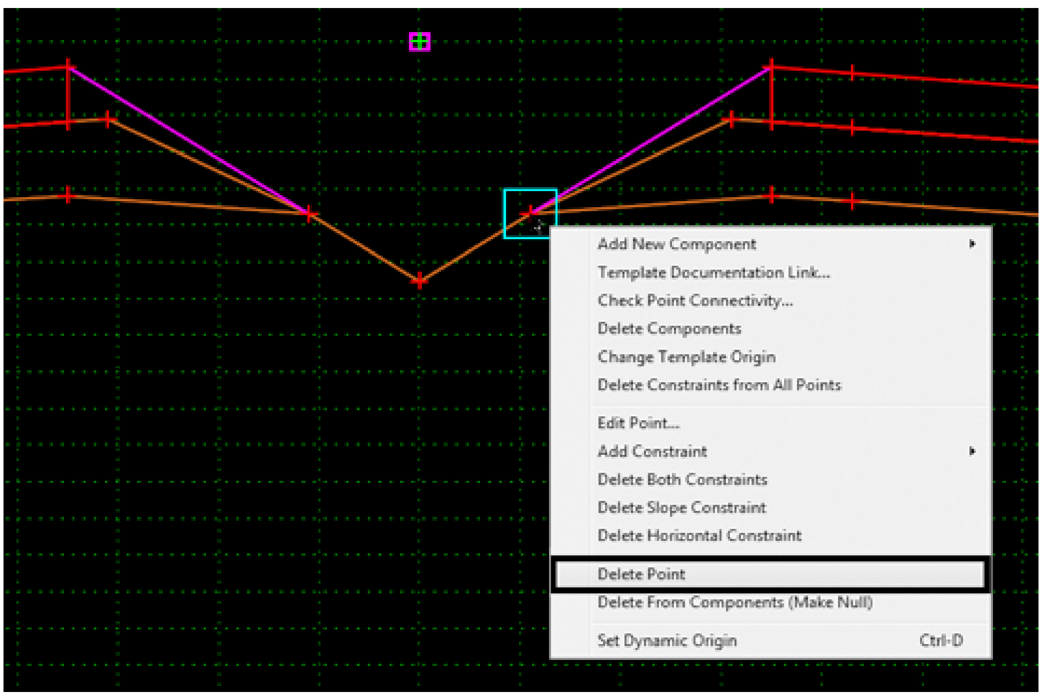


Lab 9.4 - Add a Median Barrier to a Divided Highway Template

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.

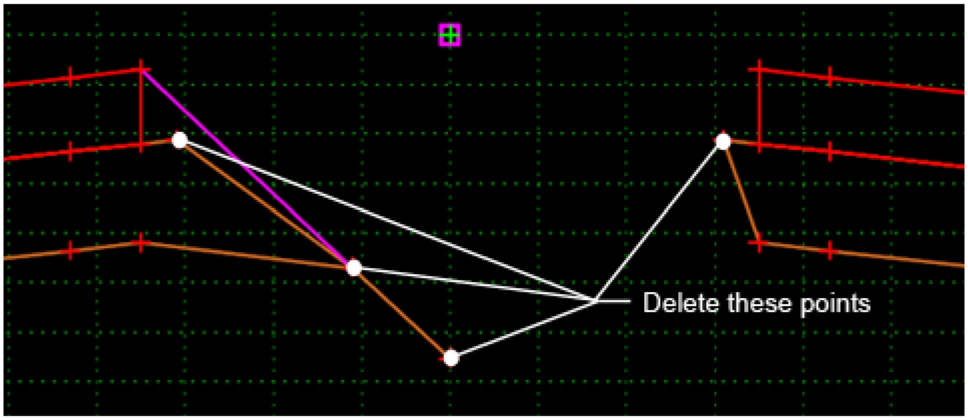
1. **<D> <D>** on the **CONC_Divided_TypeA_4Lane** template.
2. **<R>** on the **RT_Median_POSS point** and select **Delete Point.**



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:

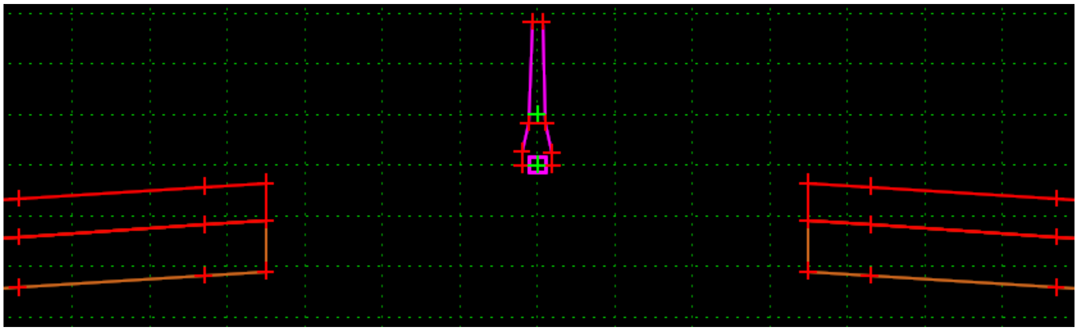
   ♦ LT_Median_POSS

- 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.

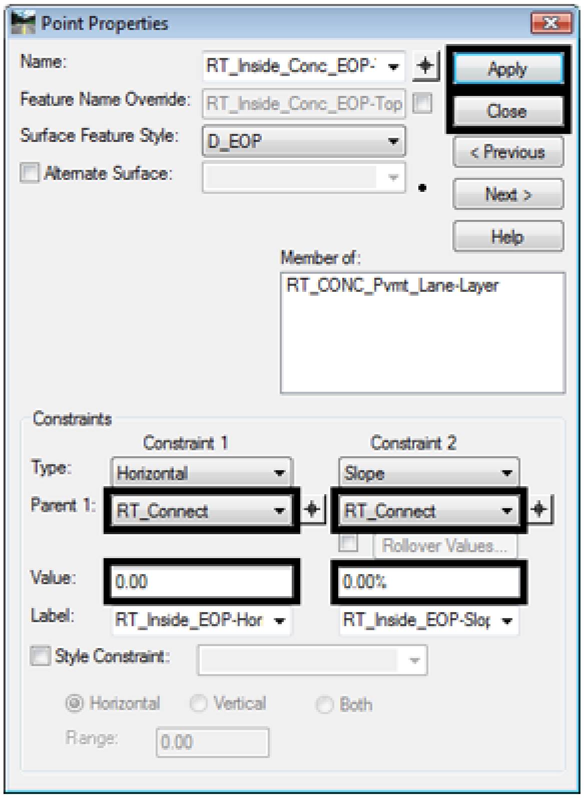
7. Toggle off **Apply Affixes** (either on the ***Dynamic Settings*** dialog or from ***Tools*** > ***Options***).
8. Expand the ***4 – Components > Barriers & Misc Components > Guardrail Type 7*** folder in the template library explorer.
9. **<D>** on the **Guardrail_Type 7-CE** component to highlight 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.



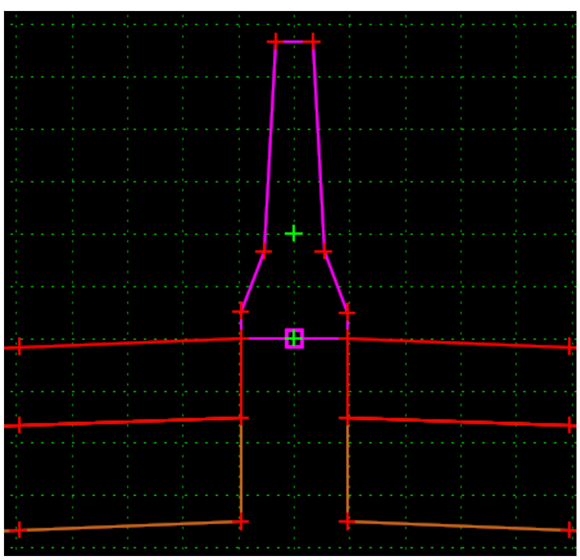
Now the pavement edges need to be attached to the barrier. This is done by modifying the constraints for the those points.

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**.



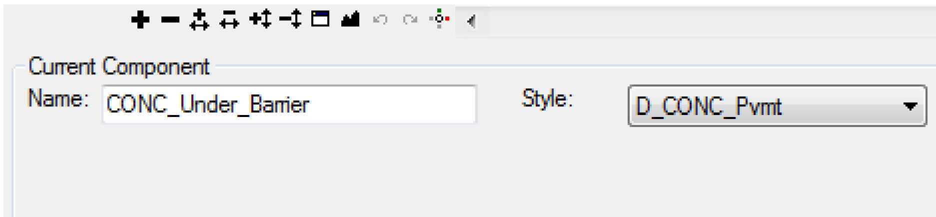
17. Repeat steps 12 through 15 for point **LT_Inside_Conc_EOP-Top** using **LT_Connect** as the ***Parent 1*** point.



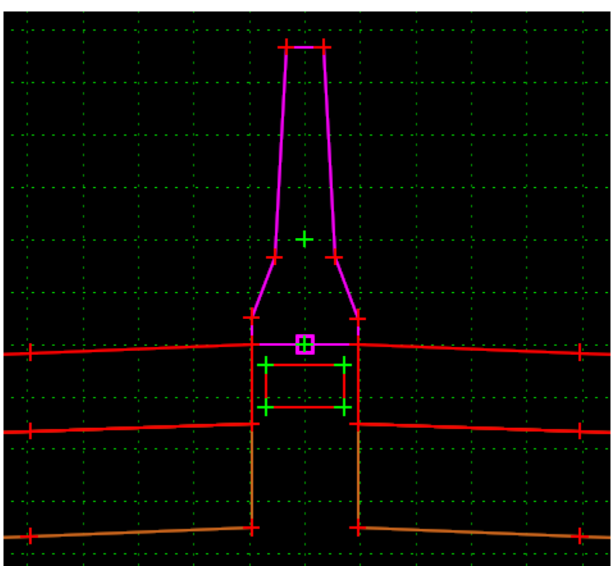
18. Zoom in to the area under the barrier.

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***.

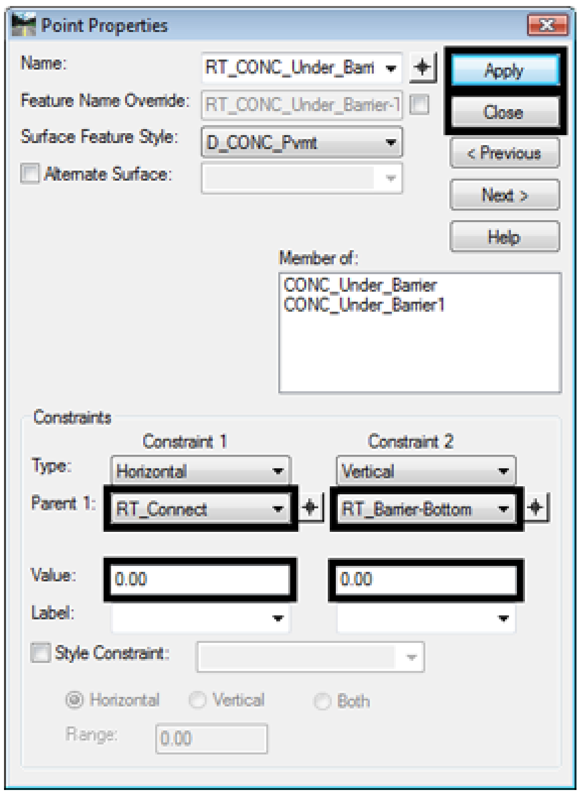


22. In the Dynamic Settings dialog box, key in ***RT_ CONC_Under_Barrier-Top*** for the ***Point Name.***
23. **<D>** under the right edge of the barrier but not on any existing point or component.
24. In the Dynamic Settings dialog box, key in ***RT_ ABC_Under_Barrier-Top*** for the ***Point Name.***
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**.



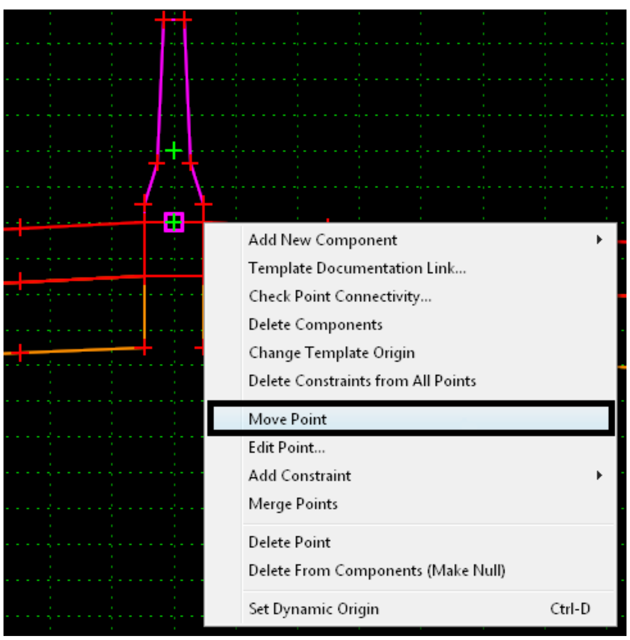
31. **<D> <D>** on the **RT_ CONC_Under_Barrier-Top** point.

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**.



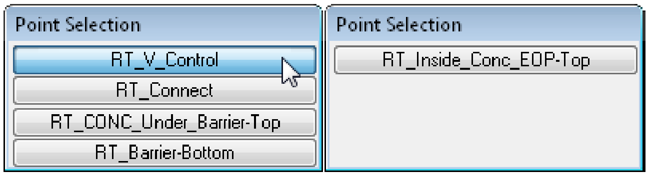
39. **<D> <D>** on the **LT_ CONC_Under_Barrier-Top** point.
40. Set the ***Constraint 1 Type*** to **Horizontal**.
41. Set the ***Constraint 2 Type*** to **Vertical**.
42. Set the ***Constraint 1 Parent 1*** to **LT_Barrier-Bottom**.
43. Set the ***Constraint 2 Parent 1*** to **LT_Barrier-Bottom**.
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**.

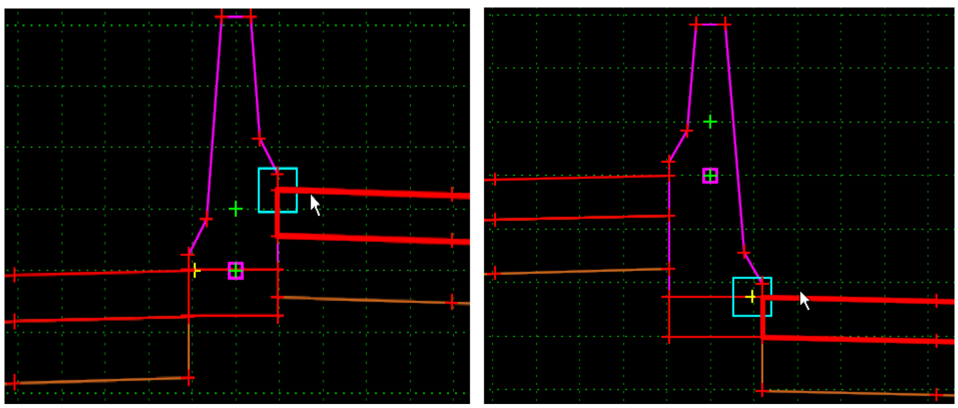
64. **<D>** on **RT_V_Control** in the box that pops up listing all available points at this location.



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”.

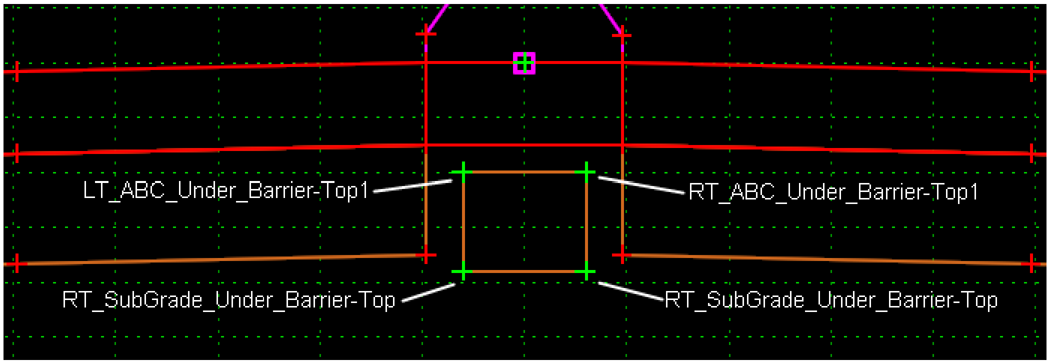
Important! Since the barrier width is variable, the adjacent shoulder, lanes, etc. are ‘pushed out’ as the barrier widens. A decision must be made if this is acceptable, or if you want another solution, such as varying the width of the shoulder to accomodate the widened barrier. If so, change the Parent 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**.

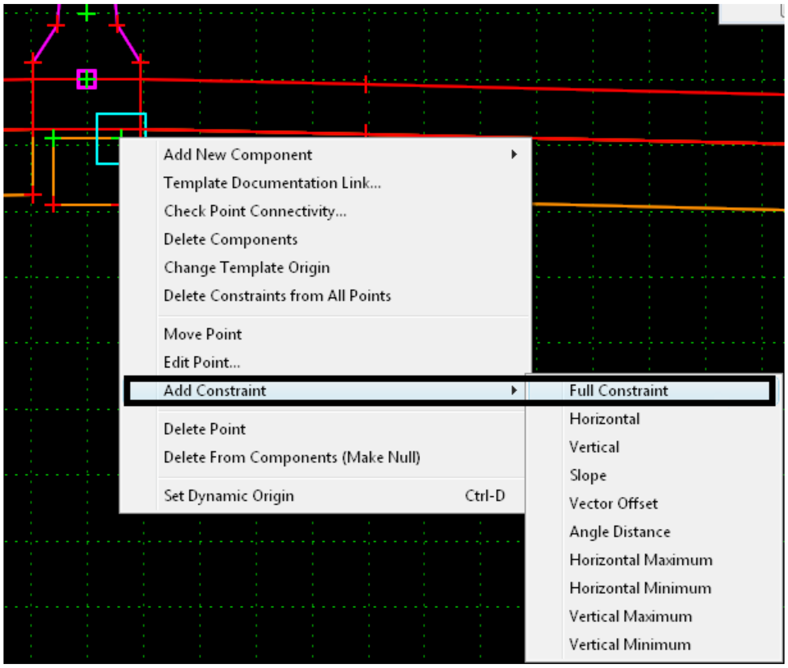
68. Key in ***ABC_Under_ Barrier*** for the component ***Name***.

69. Select **D_ABC_Class 6** for the ***Style***.



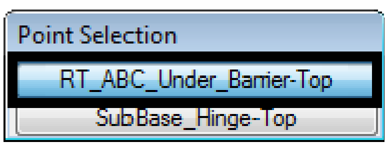
70. In the Dynamic Settings dialog box, key in ***RT_ ABC_Under_Barrier-Top1*** for the ***Point Name.***
71. **<D>** under the right edge of the component just added but not on any existing point or component.
72. Continue adding the other three points (as was done with the concrete component) Naming 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**.



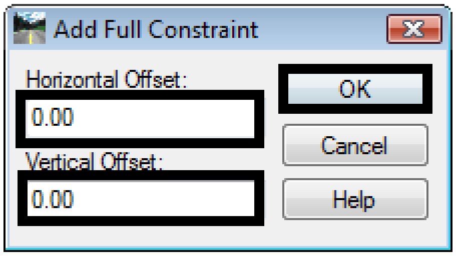
82. **<D>** on the **RT_ ABC_Under_Barrier-Top.**

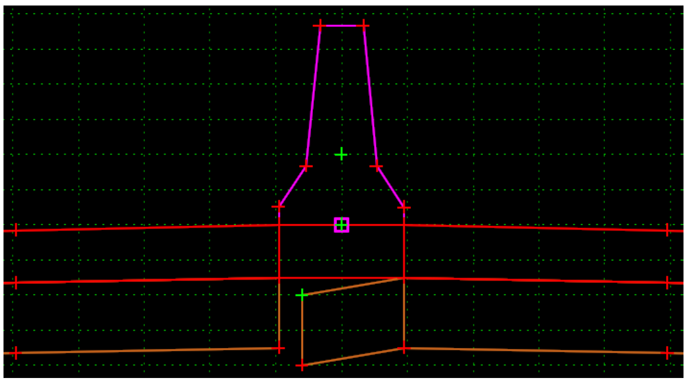
83. **<D>** on **RT_ ABC_Under_Barrier-Top** on the ***Point Selection*** dialog box.



84. In the ***Add Full Constraint*** dialog box, key in ***0*** for both offsets.

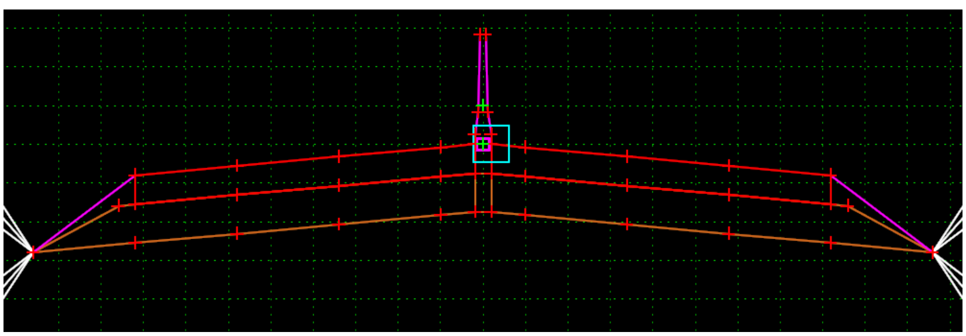
85. **<D> OK**.





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 9.1 -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 9.2 -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 9.3 -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 reaults can be achieved working with the points on components. In *Lab 9.4 -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 10 - 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

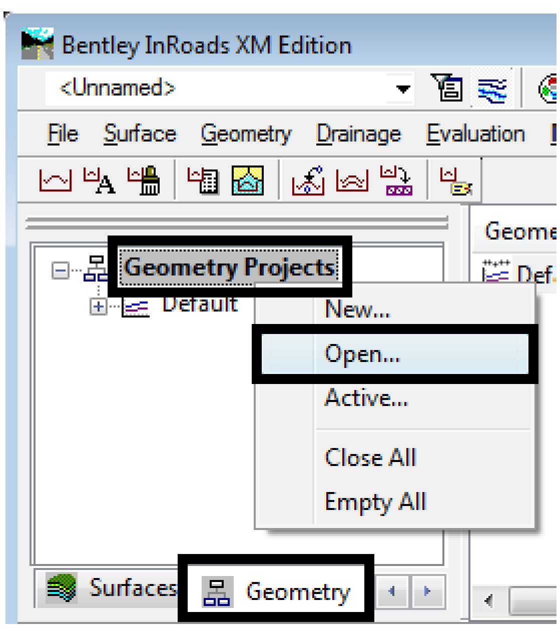
Before beginning this lab, verify that the following files are loaded:

- C:\Projects\12345\Design\Drawings\Reference_Files\12345DES_Model.dgn
- C:\Workspace\Workspace-CDOT_XM\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 10.1 - 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.

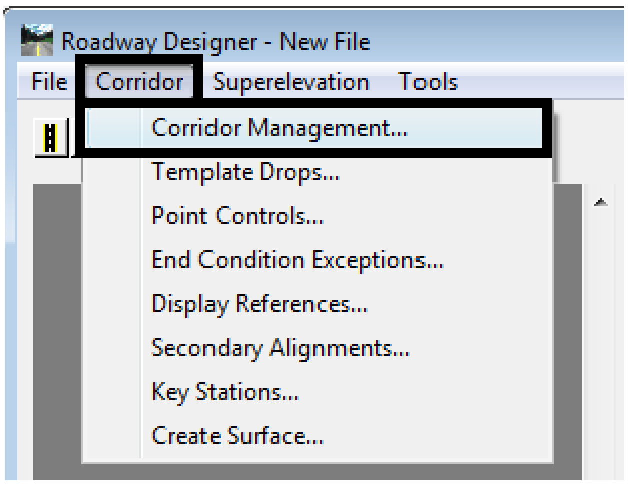
1. Select the **Geometry** tab in the ***InRoads Explorer***.
2. **<R> Geometry Projects**, select **Open**, and select the **12345DES_Geometry.alg** file from the ***\12345\Design\InRoads*** directory.



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.

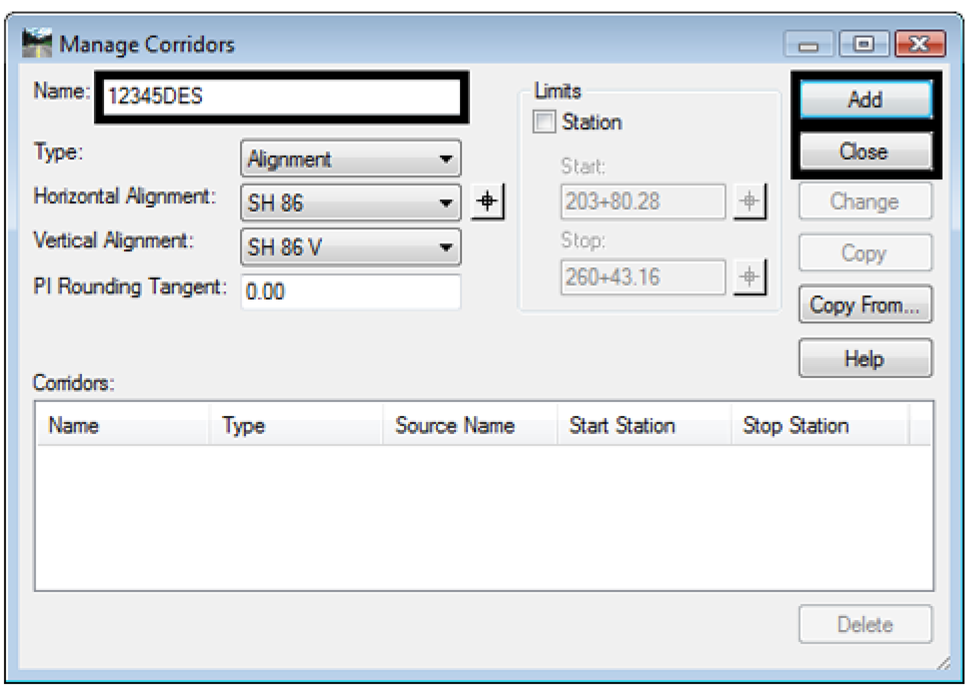
5. Select **Corridor > Corridor Management** from the Roadway Designer menu bar or **<D>** the corridor management button .



6. In the ***Manage Corridors*** dialog box, key in ***12345DES*** in the ***Name*** field.

7. **<D> Add**.

8. **<D> Close**.

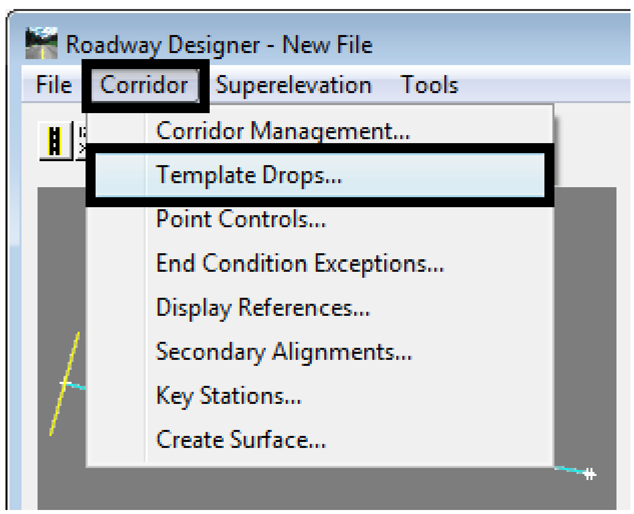


Note: By default, the ***Type*** is set to ***Alignment*** and the ***Horizontal Alignment*** and ***Vertical Alignment*** are set to the active alignments, though any alignment can be selected. Notice that data is now displayed in the Roadway Designer views.

Lab 10.2 - Devlop Initial Template Drops

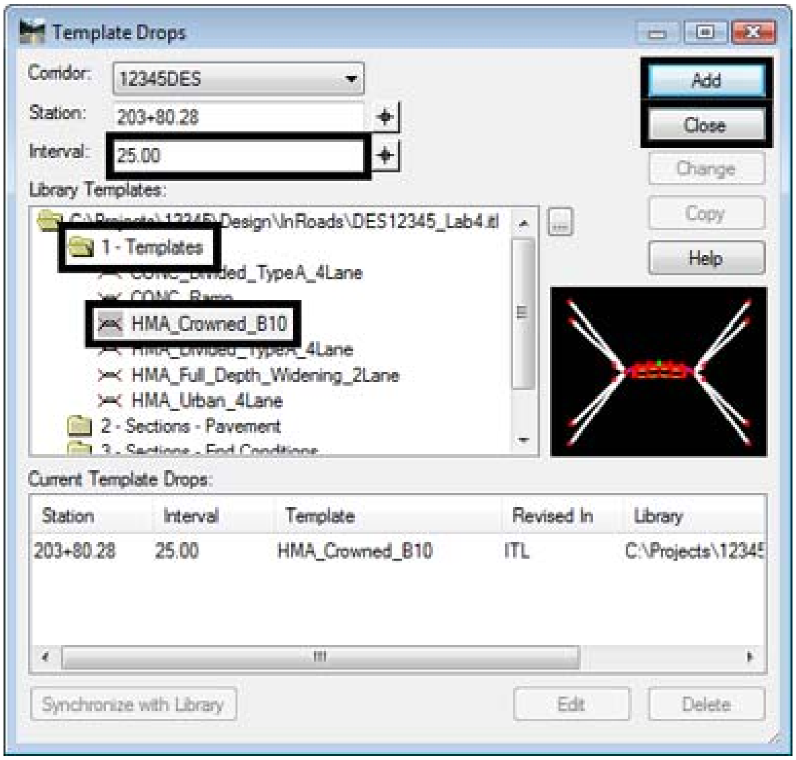
Design model cross sections are developed by applying templates along a corridor. A template drop needs to be defined at any location where the cross section of the corridor changes. Template drops are assigned to the corridor through the Template Drops dialog box. This exercise uses a single template drop that runse 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 .



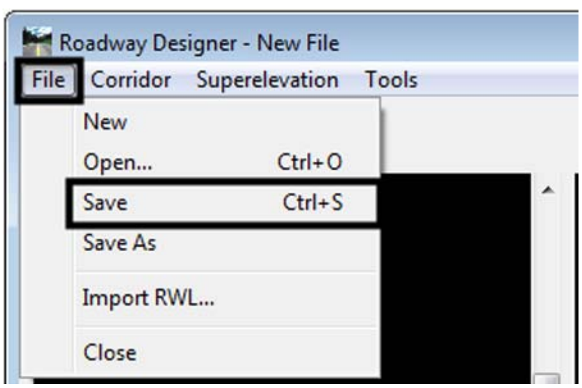
2. In the ***Template Drops*** dialog box, key in ***25*** for the ***Interval***.
3. Expand the **1- Templates** folder in the ***Library Templates*** area. of the ***Template Drops*** dialog box.
4. **<D>** on the **HMA_Crowned_B10** template.
5. **<D> Add**.

6. **<D> Close**.



This is a good spot to save the roadway designer (IRD) file.

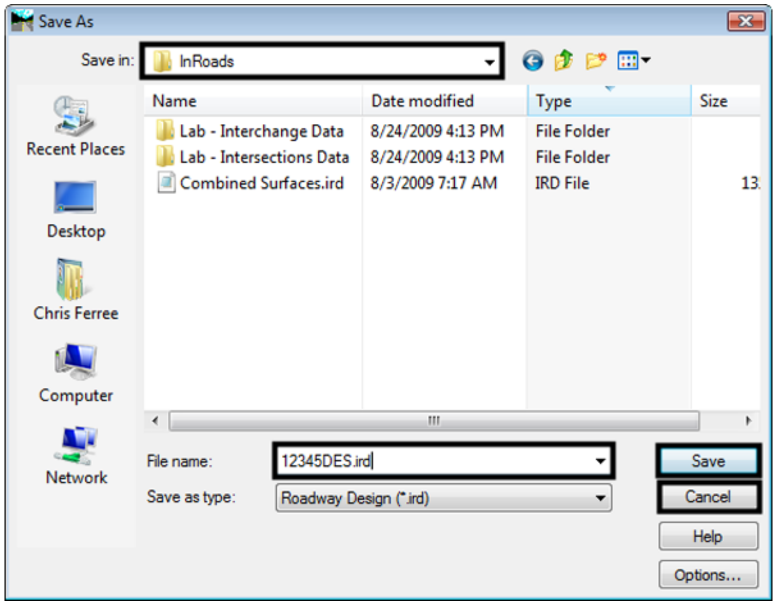
7. Select **File > Save** from the Roadway Designer menu bar.



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***.

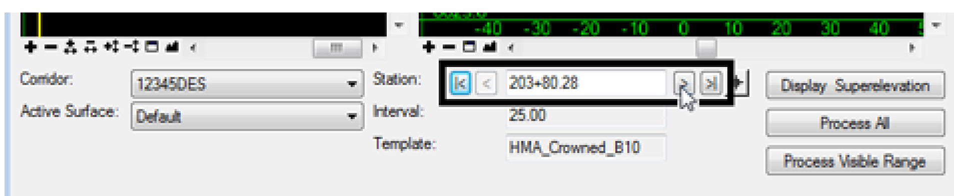
10. **<D> Save** then **<D> Cancel**.



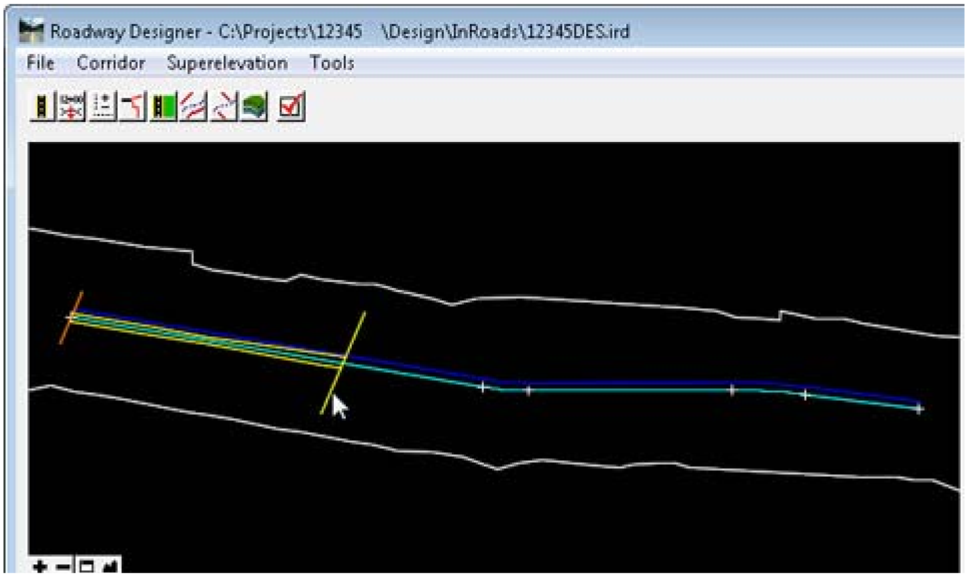
The template data is displayed in the cross section view of the Roadway Design. Notice, in the template view of the Roadway Designer, that the end conditions have already been solved.

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 throught the cooridor, **<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 10.3 - Generate Additional Details for Template Drops

Between the regular station intervals defined by a template drop, design data is generated using straing 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 regulare 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.

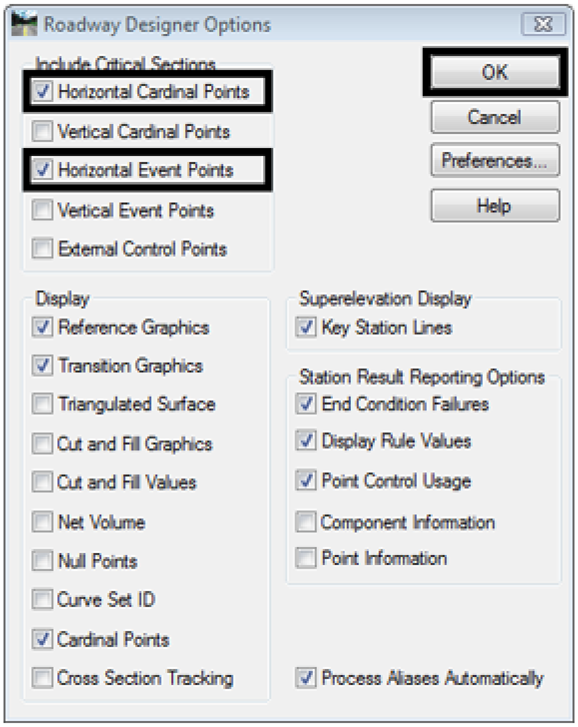
This exercise will demonstrate several of the options including:

- Processing cardinal and event points
- Displaying cut and fill information
- and Generating a report of component and point information.

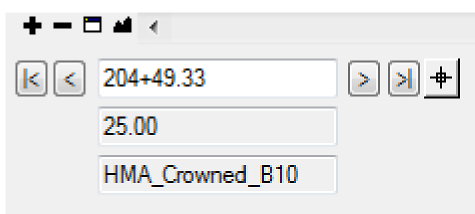
The first series of steps tell the Roadway Designer to process the horizontal cardinal and event points.

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.

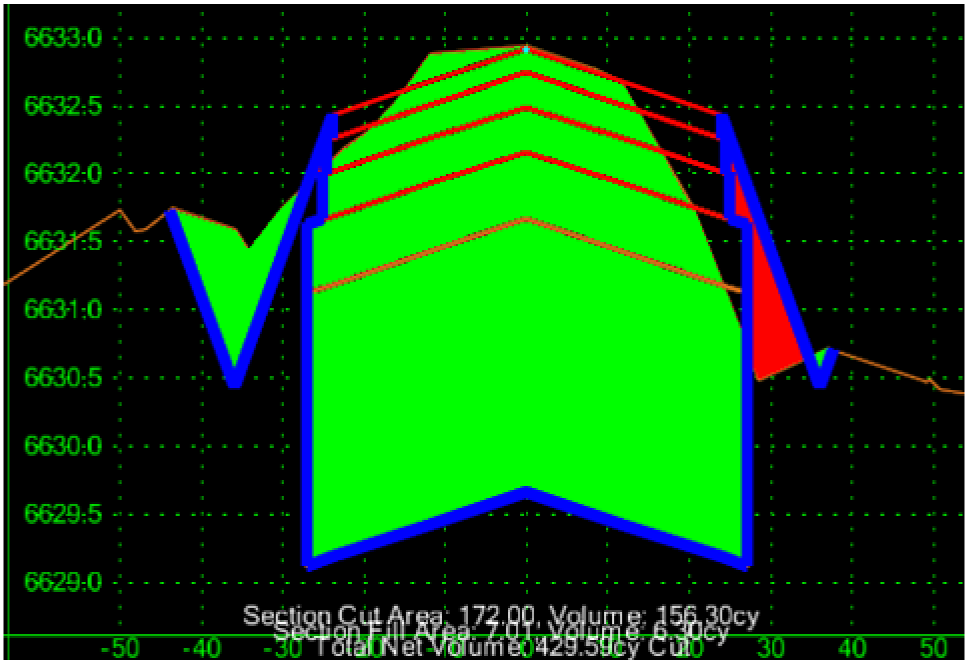


The following series of steps adds volume information to the template view of the Roadway Designer.

5. Open the ***Roadway Designer Options*** dialog box again.

6. Toggle on **Cut and Fill Graphics**, **Cut and Fill Values**, and **Net Volume**.

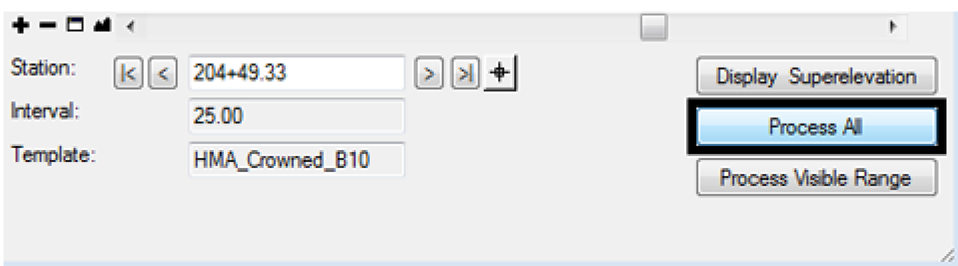
7. **<D> OK**.



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.

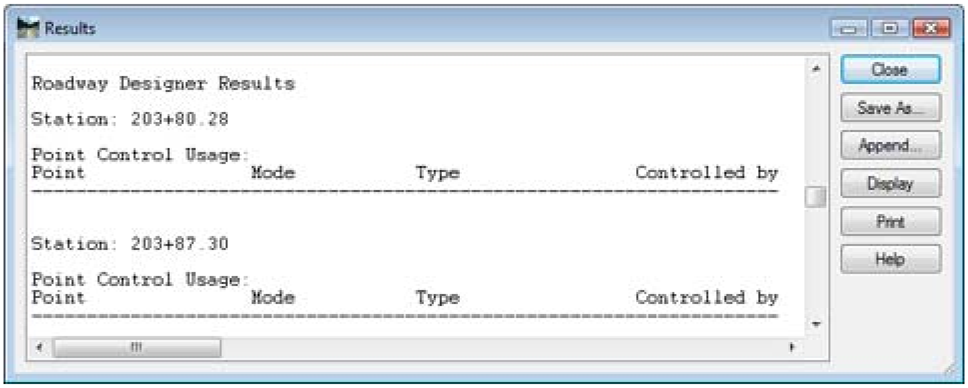
9. **<D>** the **Process All** button.



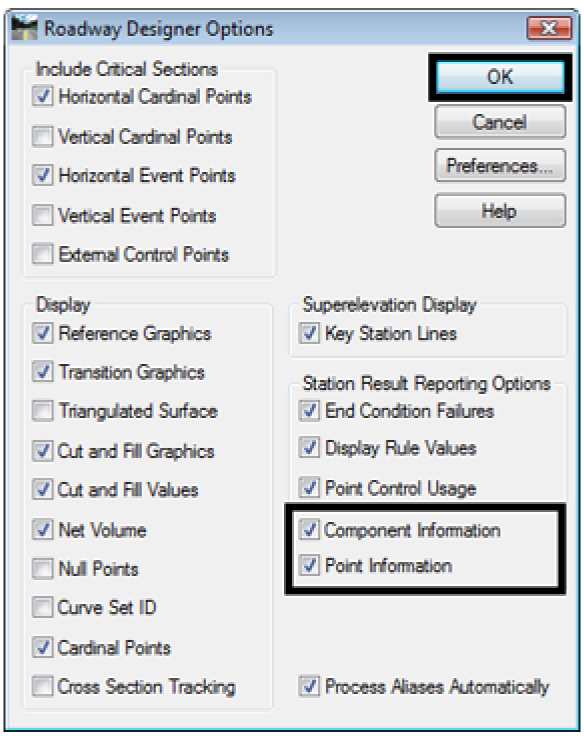
10. This displays the ***Results*** dialog box. Some of the information displayed includes:

- ♦ 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.

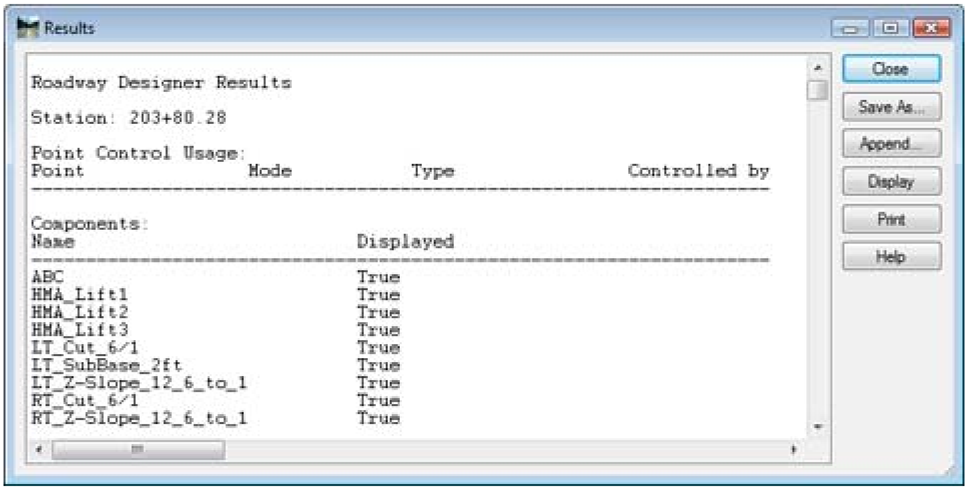


11. **<D> Close** on the ***Result*** dialog box.
12. Open the ***Roadway Designer Options*** dialog box again.
13. Toggle on **Component Information** and **Point Information**.
14. **<D> OK**.



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.



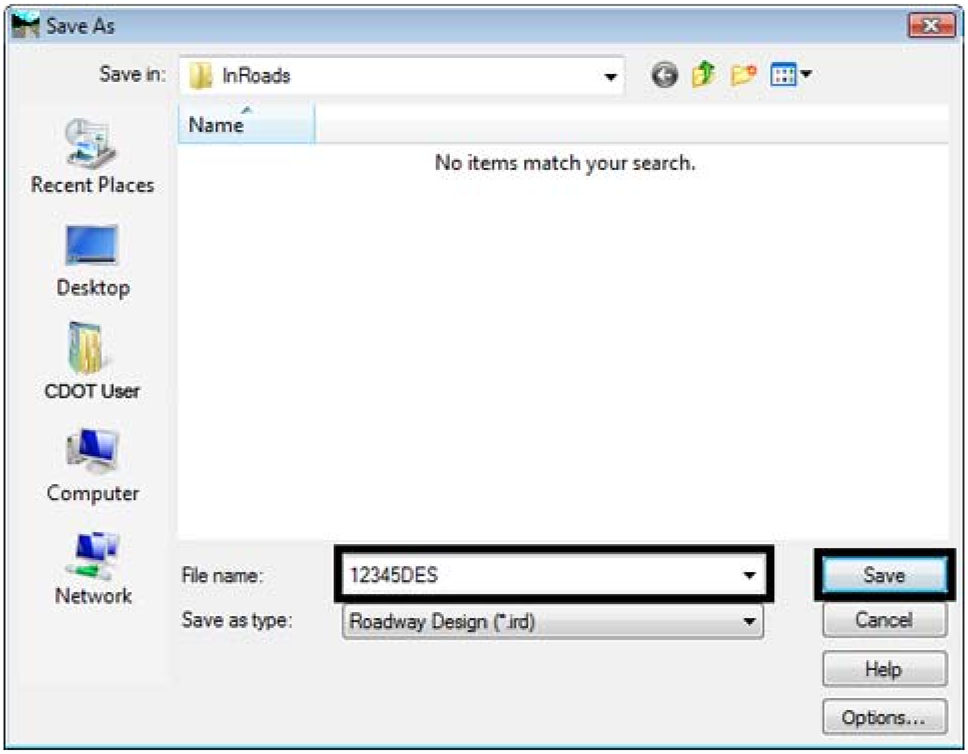
Note: The Results dialog box is limited to a report of up to approximately 16,000 lines. This equals about 220 template drops (about a mile at a 25' interval) when using the HMA_Crowned_B10 template.

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 10.1 -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 10.2 -Devlop 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 10.3 -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 11 - 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:

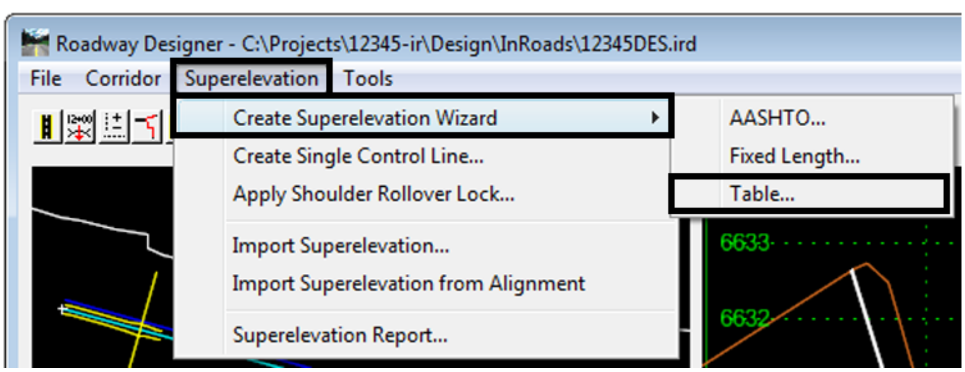
- C:\Projects\12345\Design\Drawings\Reference_Files\12345DES_Model.dgn
- C:\Workspace\Workspace-CDOT_XM\Standards-Global\InRoads\Preferences\CDOT_Civil.xin
- C:\Projects\12345\Design\InRoads\12345 existing ground.dtm
- C:\Projects\12345\Design\InRoads\12345DES_Geometry.alg
- C:\Projects\12345\Design\InRoads\DES12345_Templates.itl

Lab 11.1 - 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.

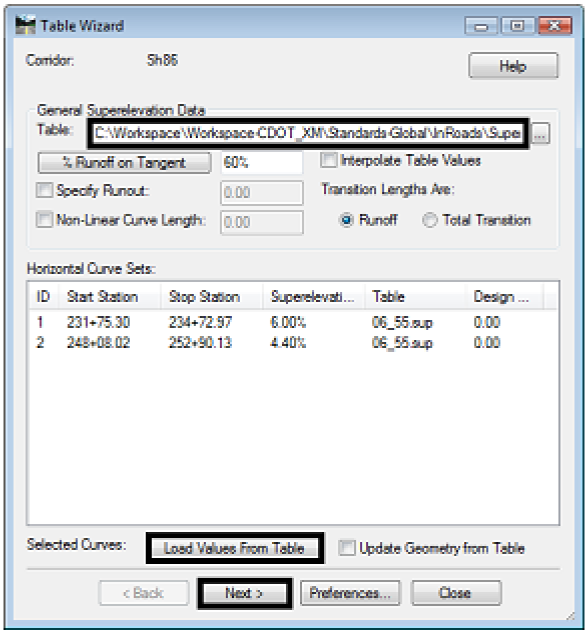


3. **<D>** the **Browse** button and select:

   C:\Workspace\Workspace-CDOT_XM\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.

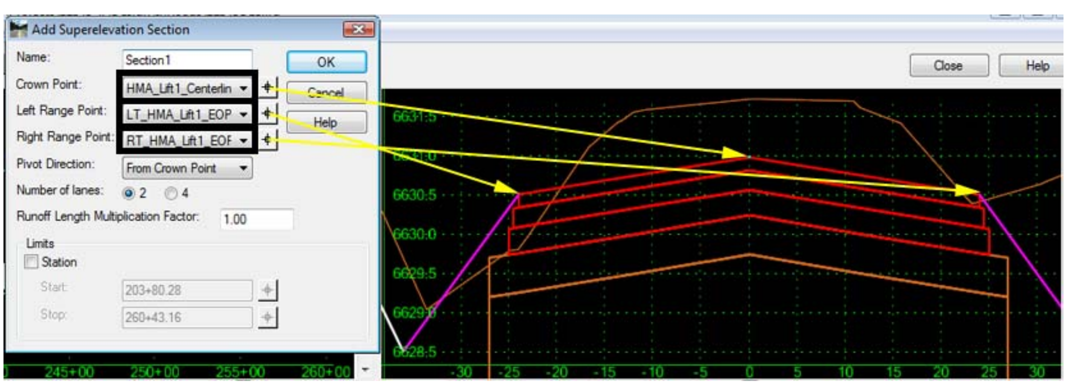
6. On the ***Superelevation Section Definitions*** dialog box, **<D> Add**. This displays the ***Add Superelevation Section*** dialog box.

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 superelvation control line properties can be reviewed/updated before they are applied.

12. **<D>** the **Finish** button to complete the superelevation entry.

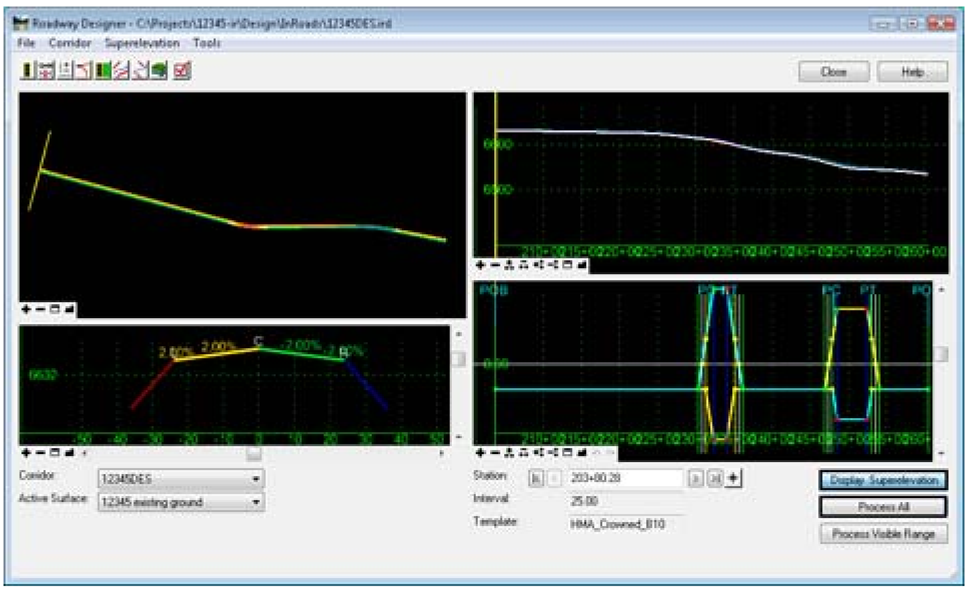
13. **<D>** the **Display Superelevation** button on the ***Roadway Designer*** dialog box.

This adds the superelevation view window to the Roadway Desiner 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%

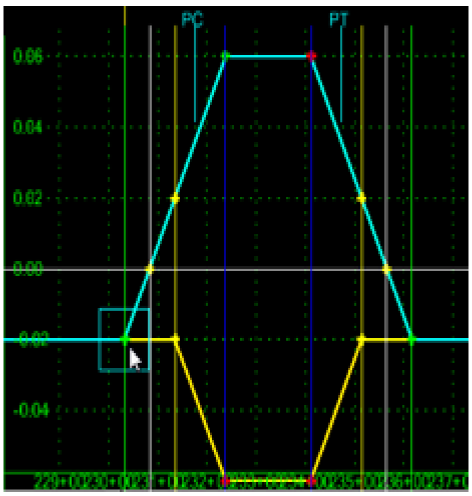
16. Select **File > Save** from the Roadway Designer menu bar.

Lab 11.2 - Edit a Superelevation Control Line

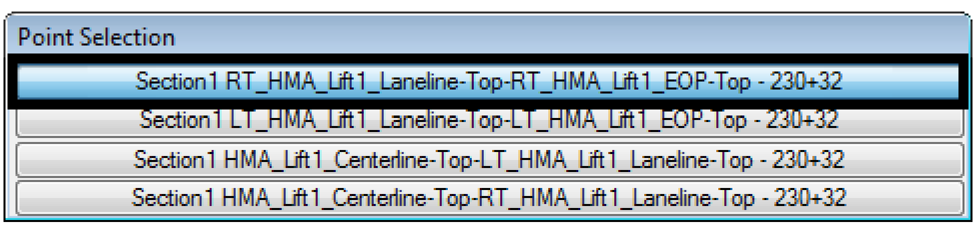
In this exercise the superelevation stations for the first curve are edited to even stations. This illustrates the procedure for editing superelevation. There are a couple of methods for editing superelvation stations:

- Edit the superelevation points from the superelvation 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.



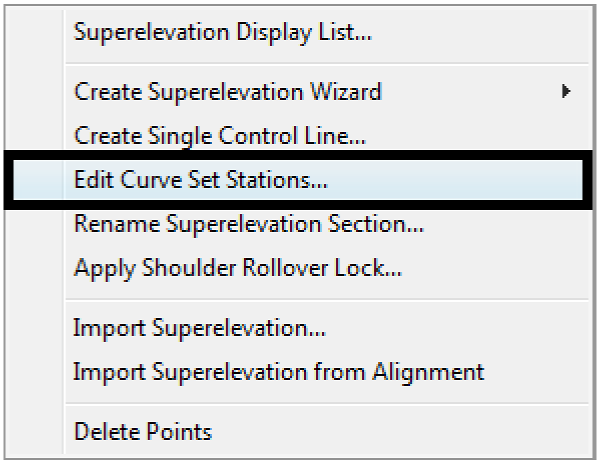
2. The ***Point Selection*** dialog box is displayed. **<D> <D>** on the **Section1 RT_HMA_Lift1_Laneline-Top-RT_HMA_Lift1_EOP-Top - 230+32.50.**



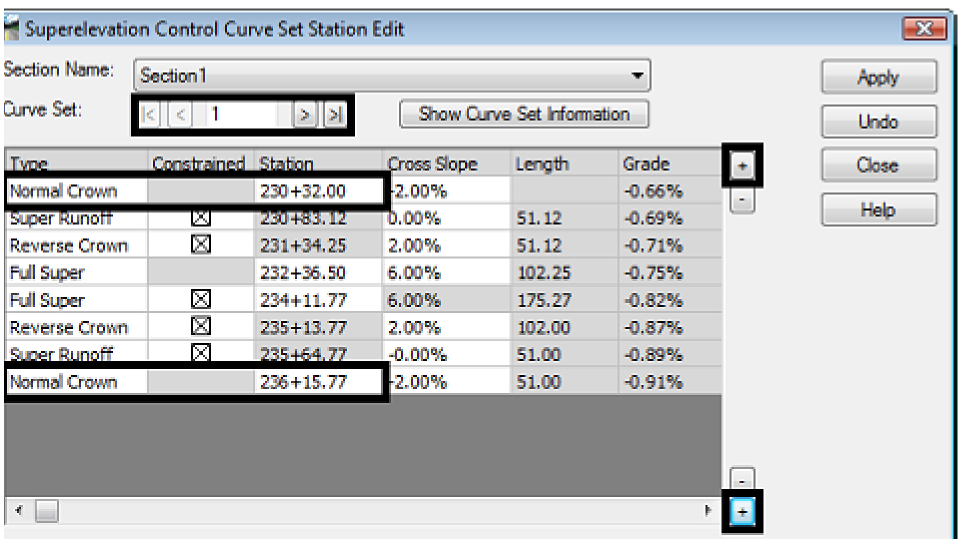
3. The ***Superelevation Point Properties*** dialog box is displayed. Key in ***230+32.00*** in the ***Station*** field.
4. **<D> Apply**.
5. **<D> Close**.

The other method is to use the Edit Curve Set Stations command. The dialog box may be more use since it uses common terminolgy used to define superlevation 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.



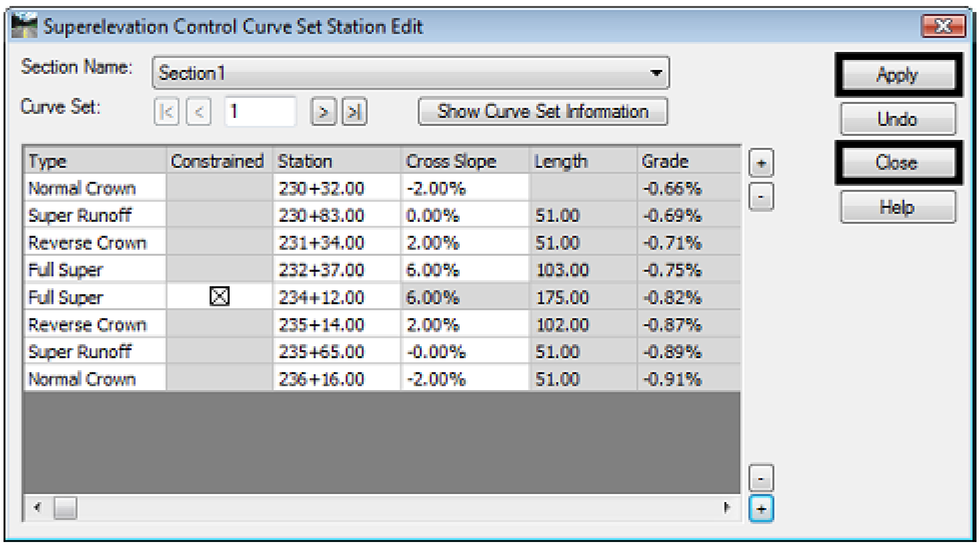
10. **Toggle off** the ***Constrained*** toggle for Super Runoff at station **230+83.12**. Superelevation station that have a ***Grey*** background cannot be changed without turning off the ***Constrained*** toggle.
11. Round the Station value from **230+83.12** to ***230+83.00***. Be sure to use the 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 11.1 -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 11.2 -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 rember that editing superelevation stations is a design decision based on standard design criteria from the AASHTO manual and project specific conditions.

LAB 12 - 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:

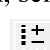
- C:\Projects\12345\Design\Drawings\Reference_Files\12345DES_Model.dgn
- C:\Workspace\Workspace-CDOT_XM\Standards-Global\InRoads\Preferences\CDOT_Civil.xin
- C:\Projects\12345\Design\InRoads\12345DES_Geometry.alg
- C:\Projects\12345\Design\InRoads\12345 existing ground.dtm
- C:\Projects\12345\Design\InRoads\12345DES.ird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

Lab 12.1 - Adding an Additional Lane with Offset Point Controls

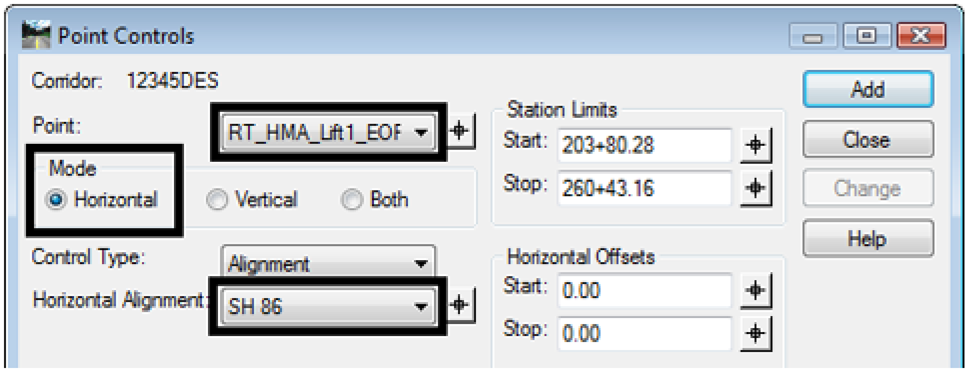
In this exercise the corridor created in the previous lab is modified by adding an additional lane to the right side of the template using a standard point control. This control is based on the centerline (SH 86) alignment and uses offset distances from this alignment to modify the template. Three control 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.

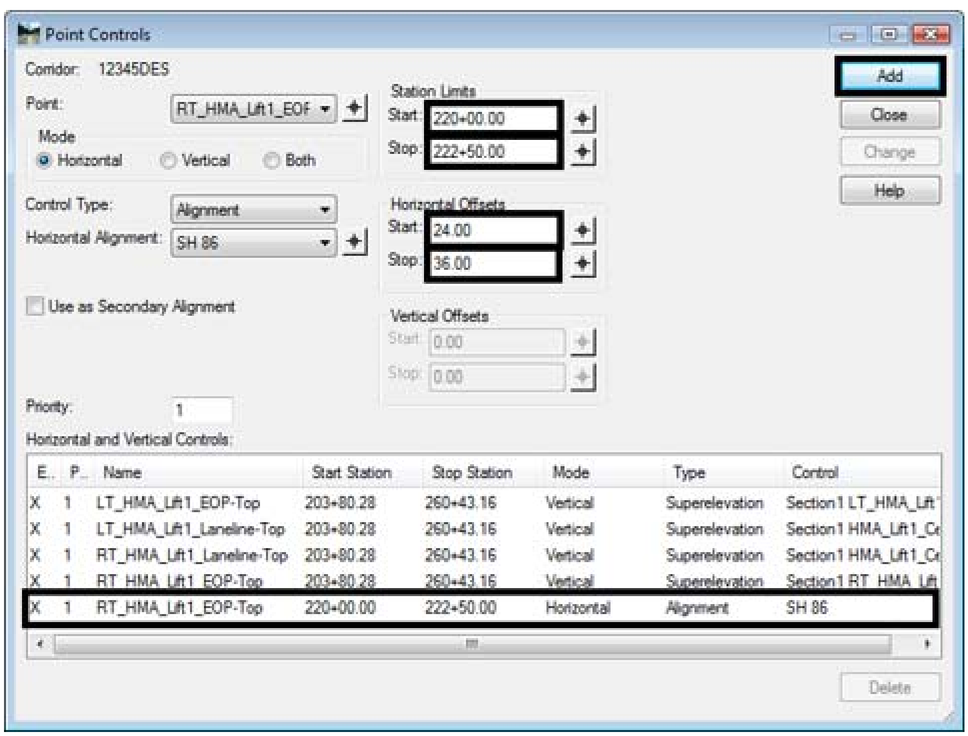
3. In the Roadway Designer dialog box, select **Corridor > Point Controls** from the menu bar or **<D>** the point controls button .
4. In the ***Point Controls*** dialog box, select **RT_HMA_Lift1_EOP-Top** for the point. Use the drop down menu or **<D>** the “target”  button and then **<D>** the point 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.

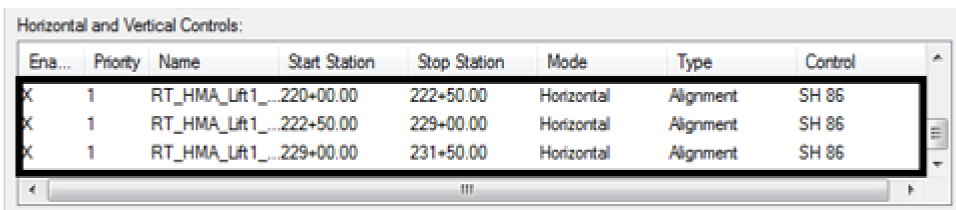
18. Key in ***231+50.00*** in the ***Station Limits Stop*** field.

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.


Horizontal and Vertical Controls:

Ena...	Priority	Name	Start Station	Stop Station	Mode	Type	Control
X	1	RT_HMA_Lift1_...	220+00.00	222+50.00	Horizontal	Alignment	SH 86
X	1	RT_HMA_Lift1_...	222+50.00	229+00.00	Horizontal	Alignment	SH 86
X	1	RT_HMA_Lift1_...	229+00.00	231+50.00	Horizontal	Alignment	SH 86

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.

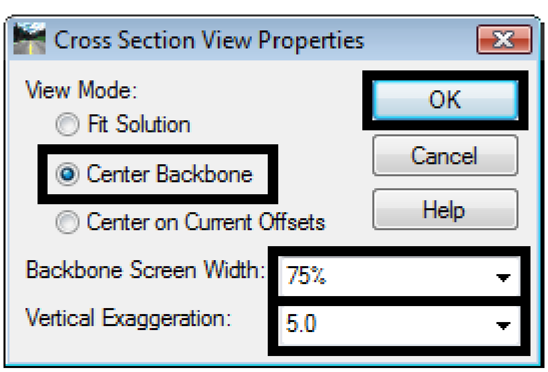
23. **<R>** in the template view of the Roadway Designer dialog box and select **Display Properties** from the menu.

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 12.2 - 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***.

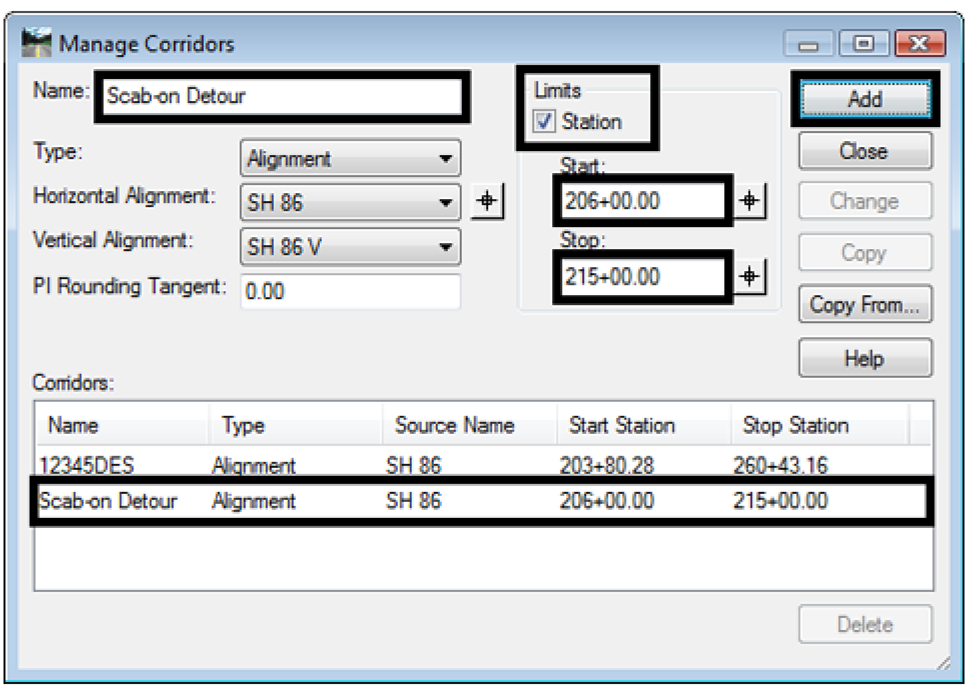
3. Toggle on the ***Station Limits***.

4. Key in ***206+00.00*** for the ***Start*** station.

5. Key in ***215+00.00*** for the ***Stop*** station.

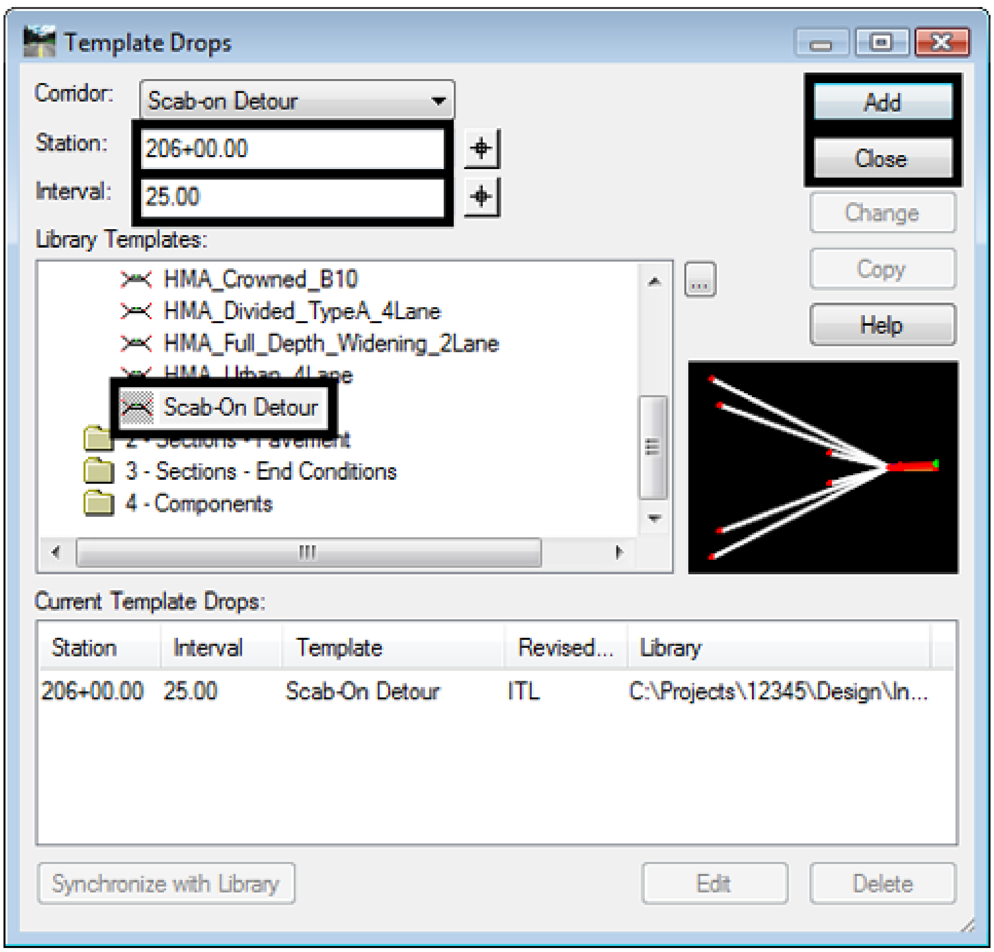
6. **<D> Add**.

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***.

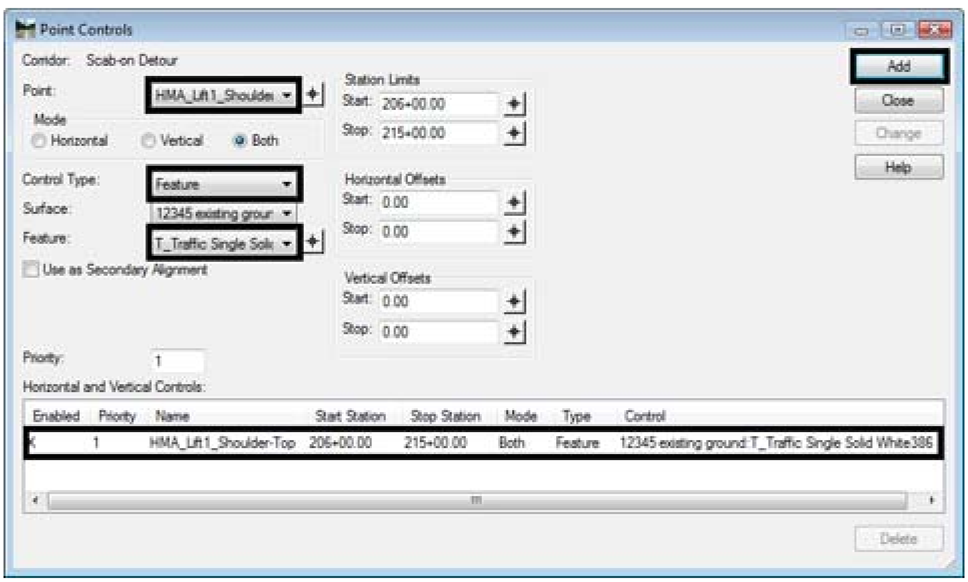
17. Select **Feature** for the ***Control Type***.

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 XM"* 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.

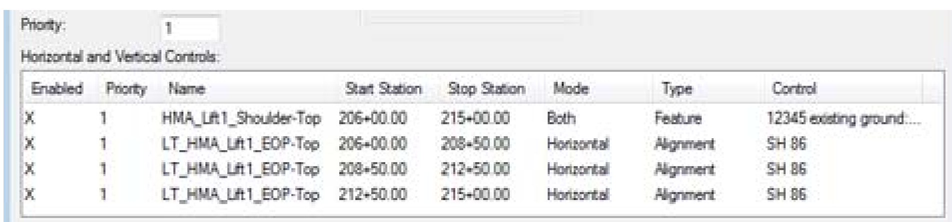
35. Key in ***215+00.00*** in the ***Station Limits Stop*** field.

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_Lft1_Shoulder-Top	206+00.00	215+00.00	Both	Feature	12345 existing ground:...
X	1	LT_HMA_Lft1_EOP-Top	206+00.00	208+50.00	Horizontal	Alignment	SH 86
X	1	LT_HMA_Lft1_EOP-Top	208+50.00	212+50.00	Horizontal	Alignment	SH 86
X	1	LT_HMA_Lft1_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.

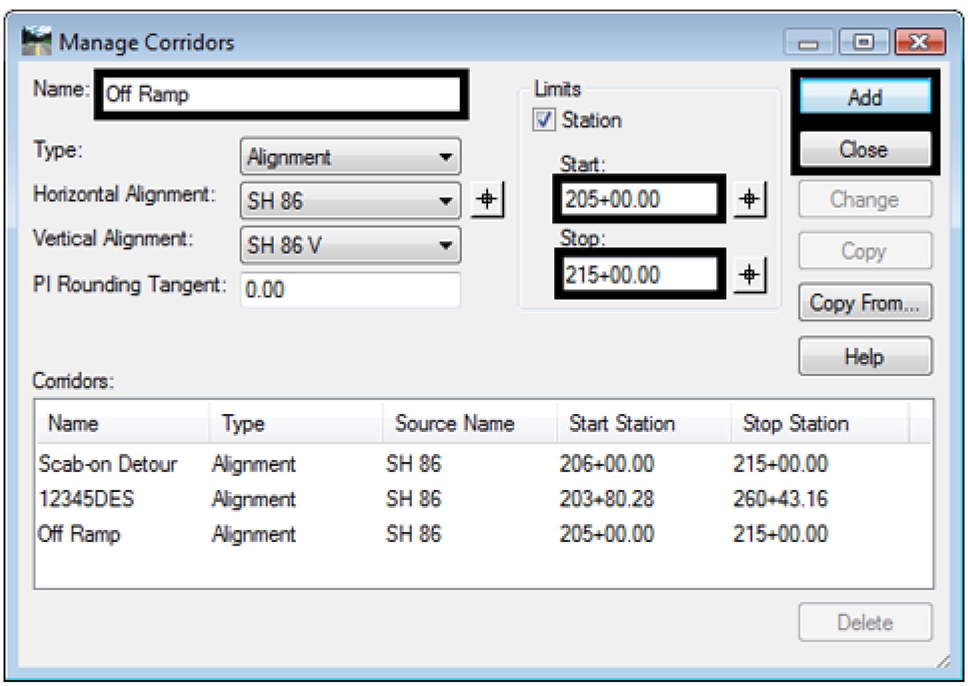
40. Select **File > Save** from the Roadway Designer menu bar.

Lab 12.3 - 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.

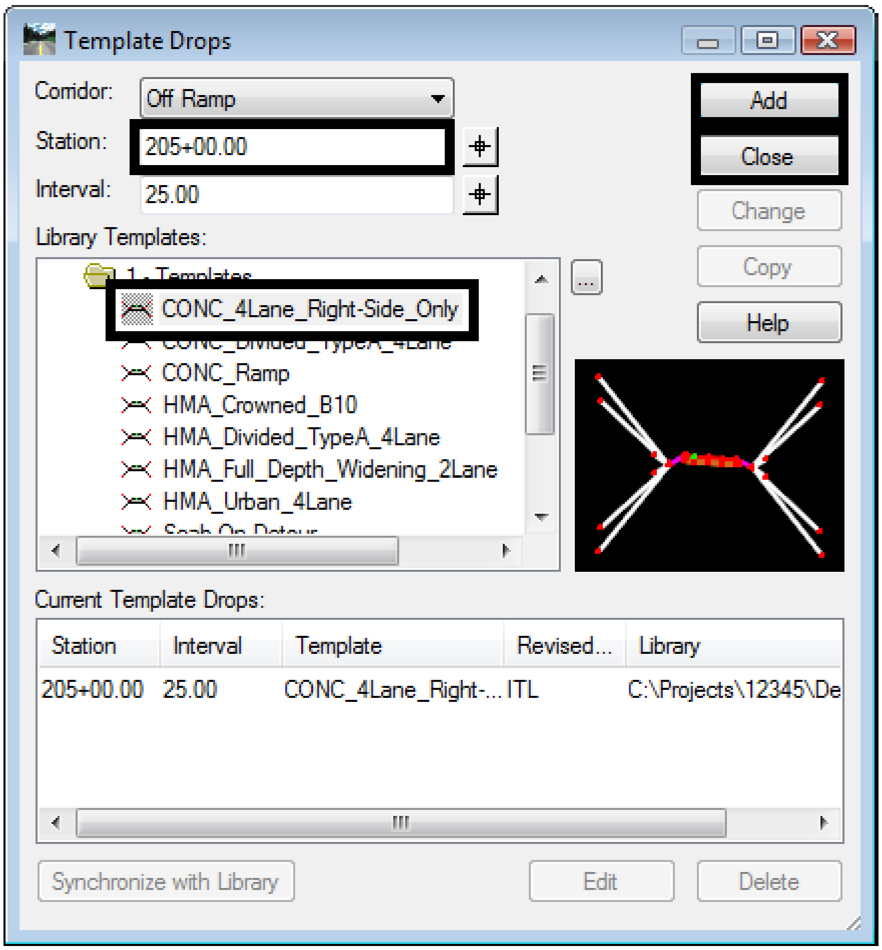
1. Select **Corridor > Corridor Management** from the Roadway Designer menu bar or **<D>** the **Corridor Management** button.
2. In the ***Manage Corridors*** dialog box, key in ***Off Ramp*** for the ***Name***.
3. Toggle on the ***Station Limits***.
4. Key in ***205+00.00*** for the ***Start*** station.
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.

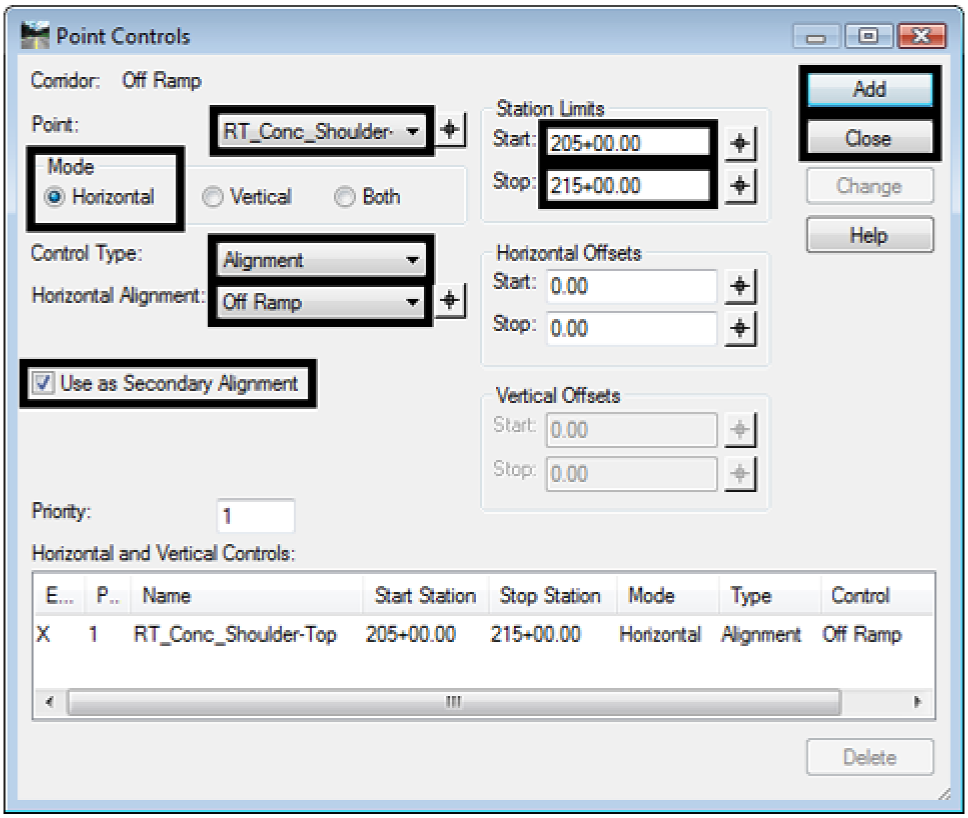
10. Key in ***25*** for the ***Interval***.
11. Expand the **C:\Projects\12345\Design\InRoads\DES12345-Templates.itl > 1- Templates** folder in the ***Library Templates*** area and highlight the **CONC_4Lane_Right-Side_Only** template.
12. **<D> Add**.
13. **<D> Close**.



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**.



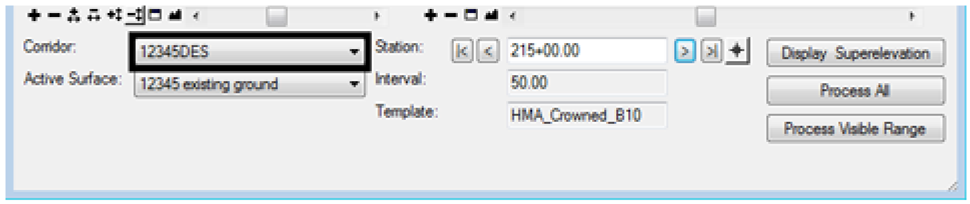
25. Scroll through the stations between ***205+00.00*** and ***215+00.00*** and notice how the template behaves. The orange line in the plan view and the template view represents the Off Ramp alignment. Notice how the template line (the yellow line in the plan view) outside the Off Ramp alignment changes so that it is perpendicular to the Off Ramp alignment.
26. Select **File > Save** from the ***Roadway Designer*** menu bar.

Lab 12.4 - Using Parametric Constraints to Widen the Road Surface

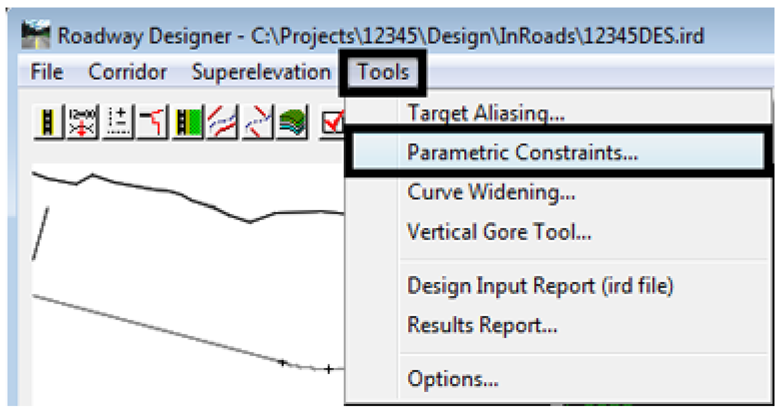
Parametric Constraints are used to modify the value of the constraint. This option allows greater flexibility of what can be modified during processing as slopes and vector/offsets can be modified in addition to the usual horizontal and vertical controls. In this exercise, the ***Horizontal Constraint*** of a template point is modified to widen the template on the left side. This is done in a similar maner 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.

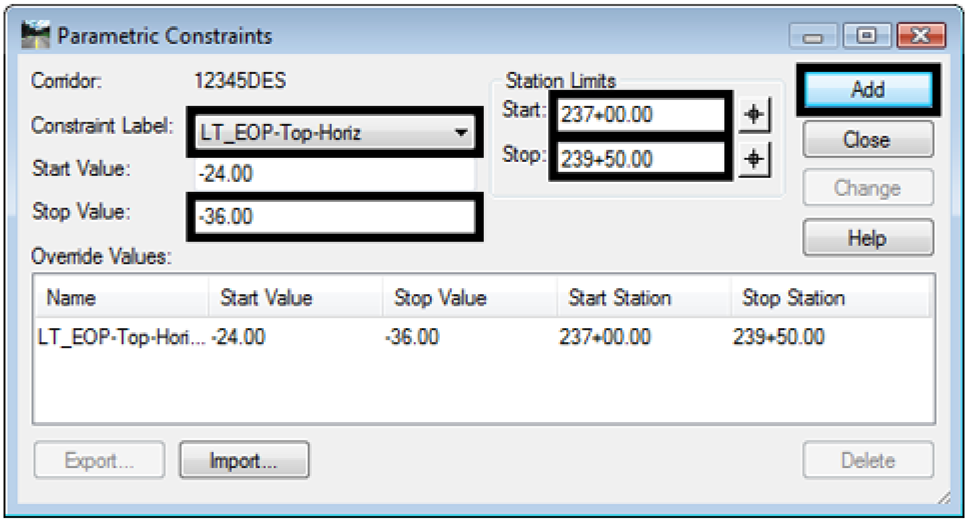


2. Select **Tools > Parametric Constraints** from the Roadway Designer menu bar.



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**.

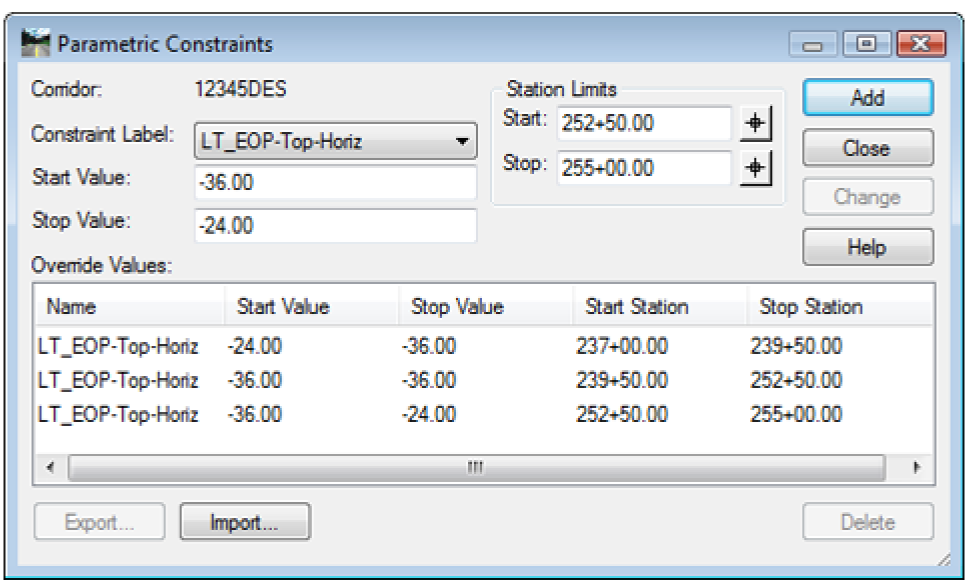
12. Key in ***-24*** for the ***Stop Value*** (the ***Start Value*** stays at -36).

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 12.1 -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 12.2 -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 12.3 -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 12.4 -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 13 - 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:

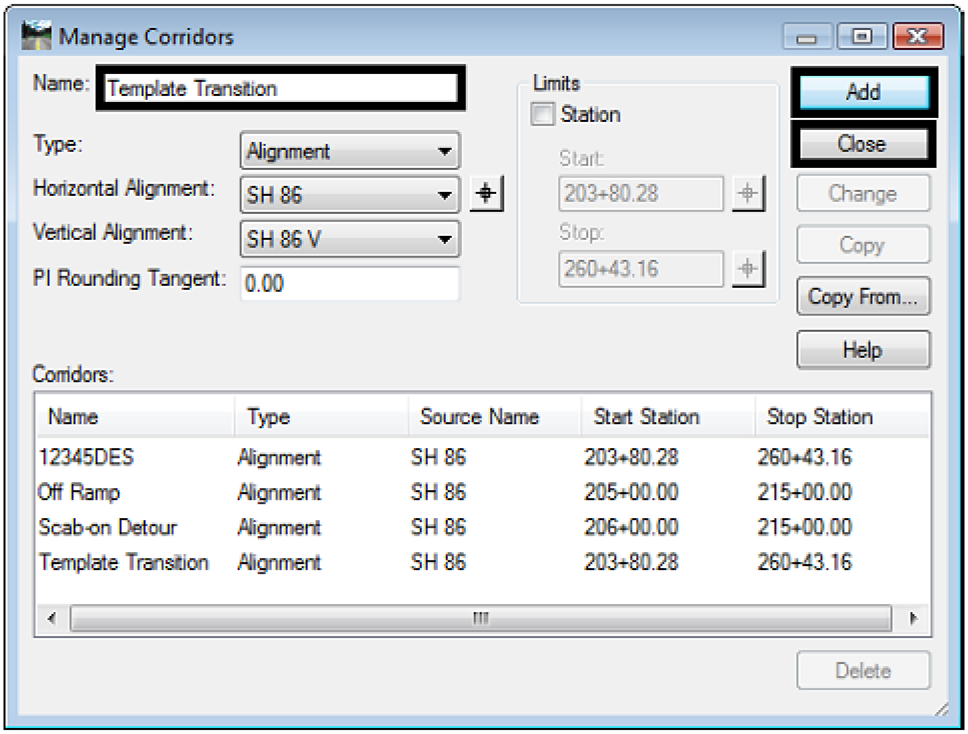
- C:\Projects\12345\Design\Drawings\Reference_Files\12345DES_Model.dgn
- C:\Workspace\Workspace-CDOT_XM\Standards-Global\InRoads\Preferences\CDOT_Civil.xin
- C:\Projects\12345\Design\InRoads\12345DES_Geometry.alg
- C:\Projects\12345\Design\InRoads\12345 existing ground.dtm
- C:\Projects\12345\Design\InRoads\12345DES.ird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

Lab 13.1 - 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**.

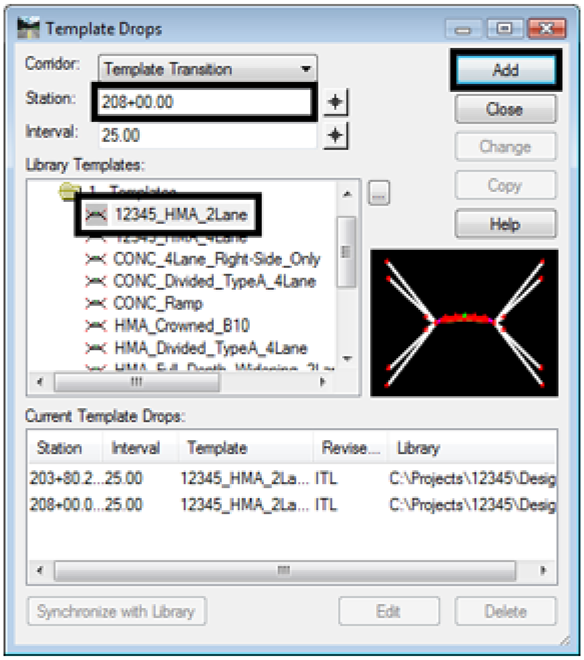
5. **<D> Close**.



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**.



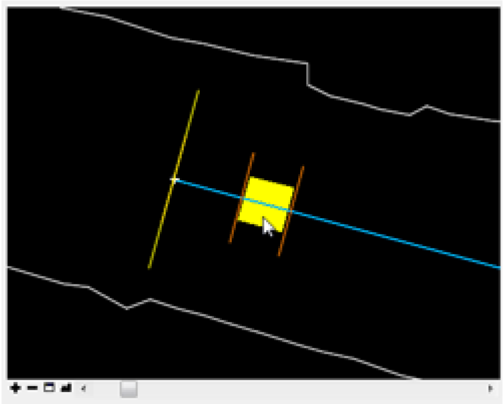
The final template drop is used from the end of the transition to the end of the project.

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**.

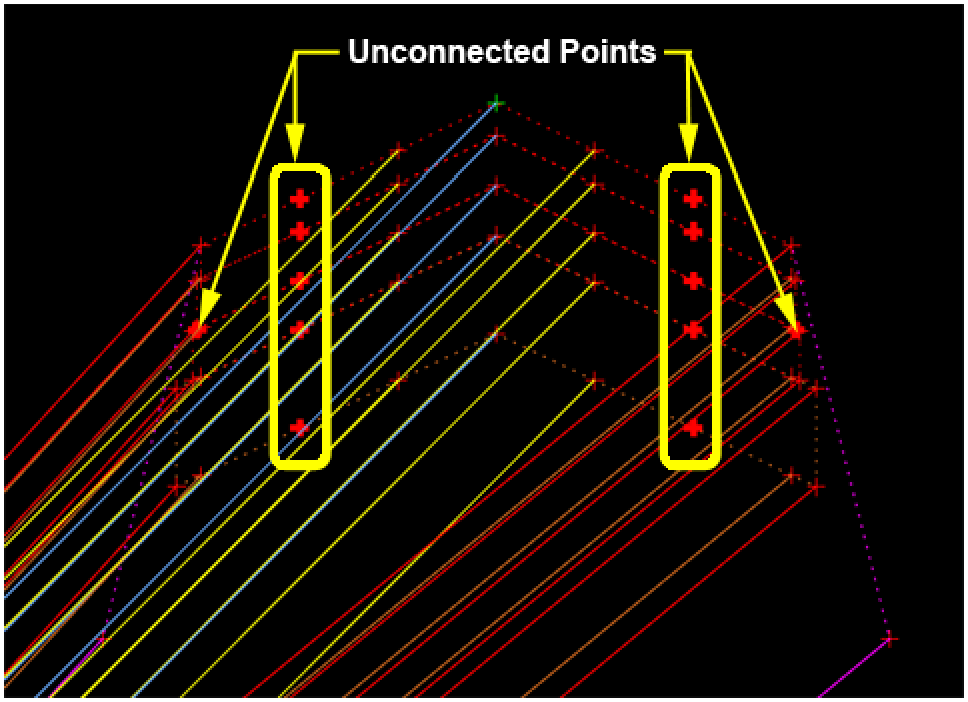
Note: Notice in the Plan view a yellow box has been displayed. This is the area of the transition. The yellow indicates that some of the points have been connected between the templates. Next, the remainder of the points are connected.

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.

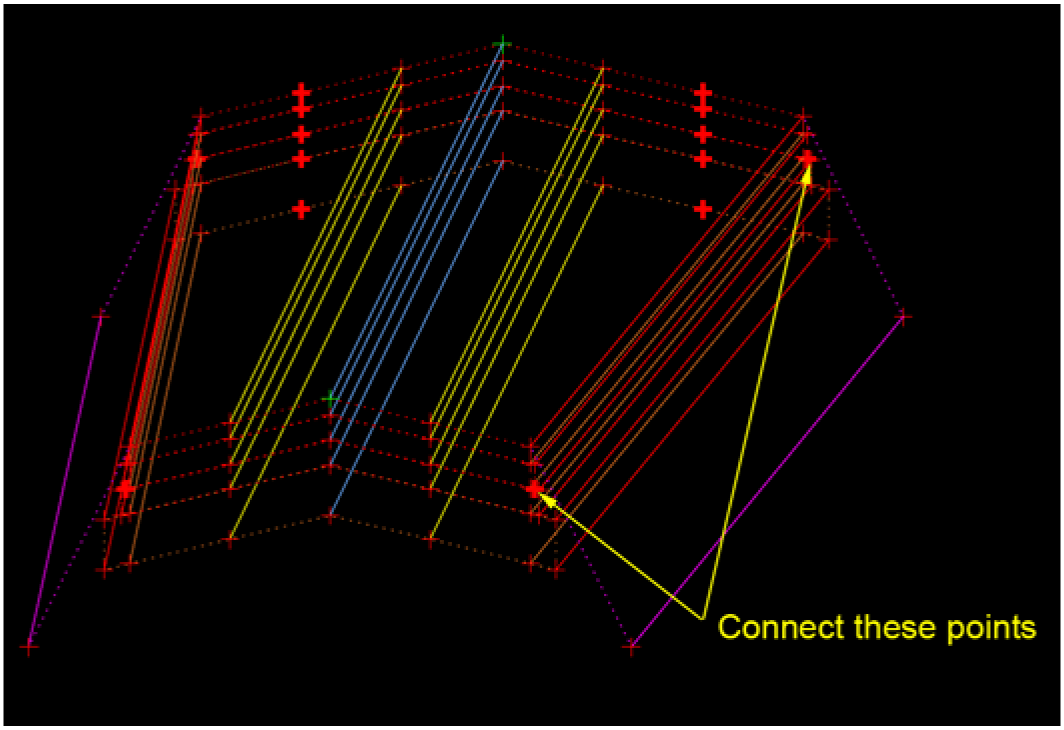


20. Zoom in on the bold "+" on the right side of the bottom template.

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.

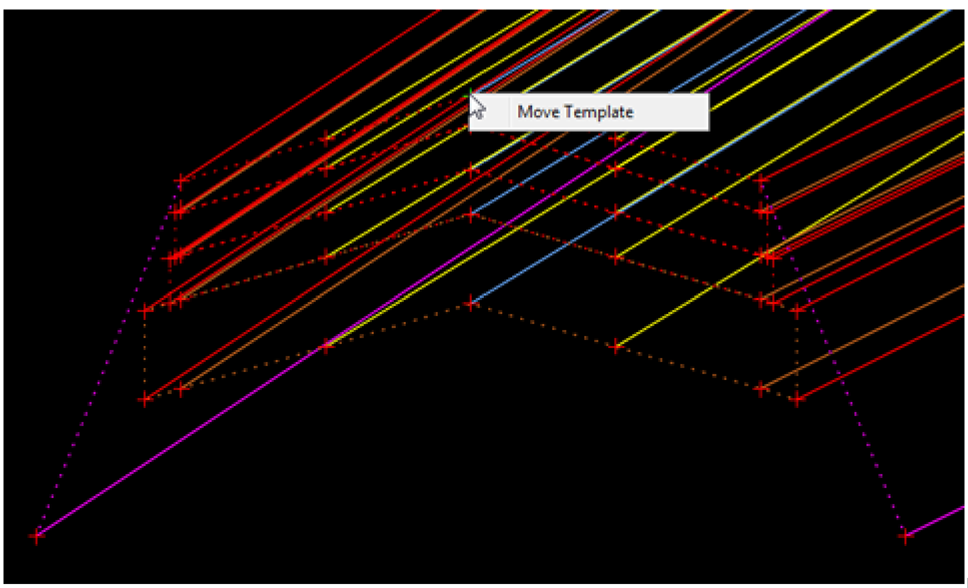
23. **<D>** on the "**+**". The line is now attached to the "+" and it is unbolded.



24. Repeat steps 19 through 22 on the left side.

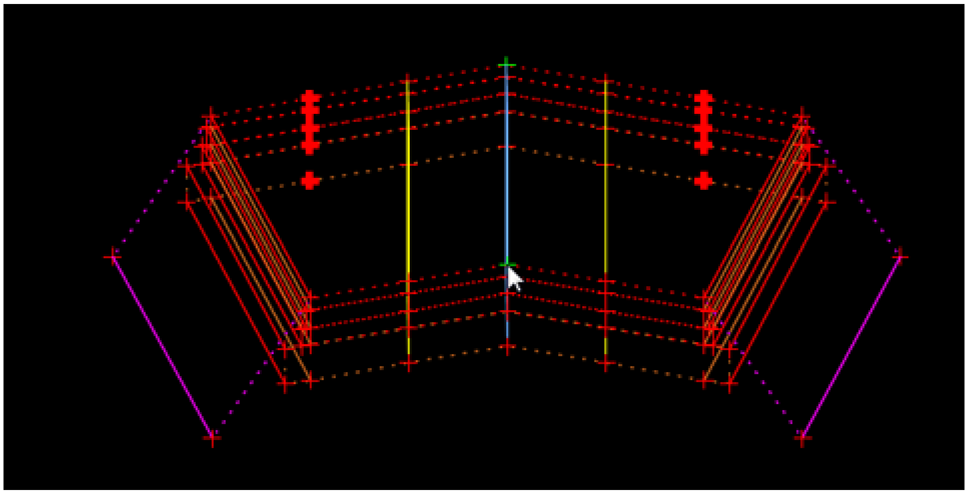
    All of the points on the bottom template have been attached to points on the top template. However, points on the top template remain unconnected. These are connected to the appropriate laneline points of the bottom template.

25. **<R>** on the green "**+**" on the bottom template and select **Move Template**.

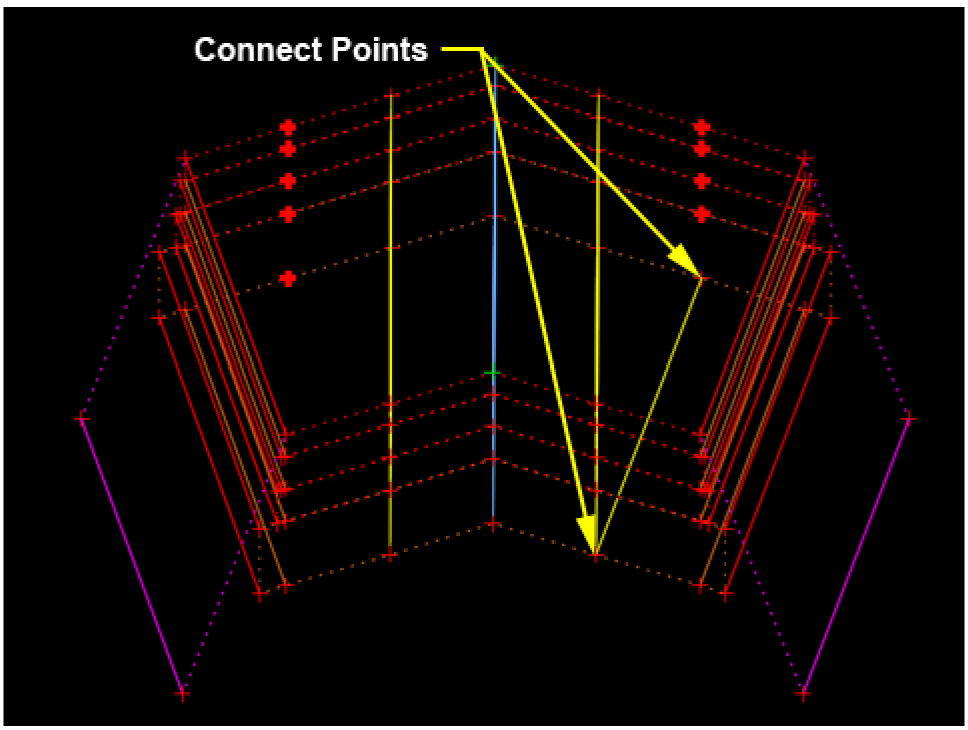


26. Move the bottom template so that it is easier to see the points to be connected.

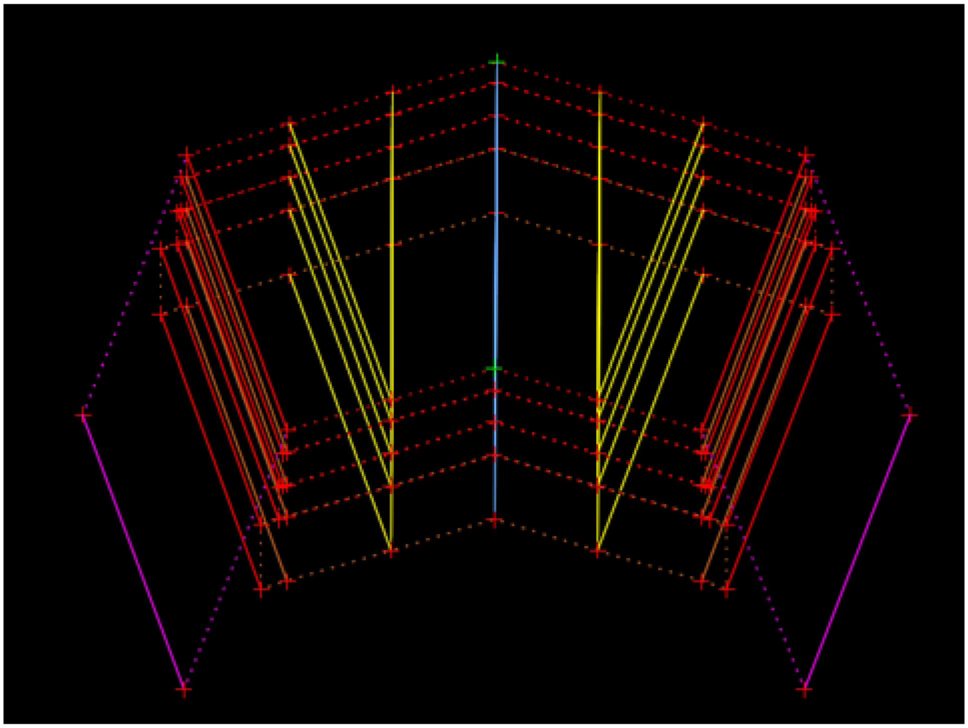
27. **<D>** to complete the move.



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.



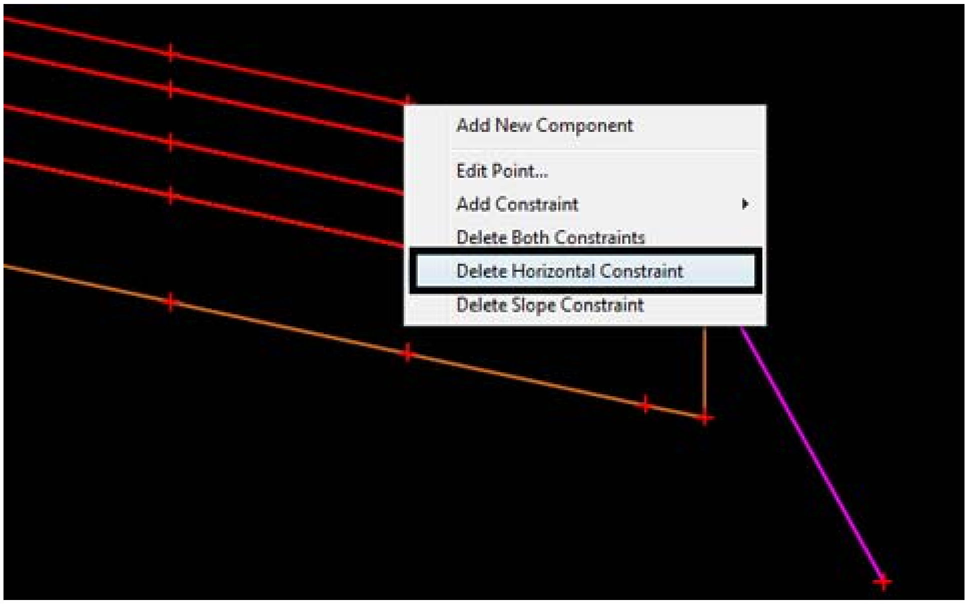
29. Connect the remaining points as shown below.



30. **<D> OK**. This displays the ***Edit Transition Midpoint – 208+00.00 to 211+00.00*** dialog box.

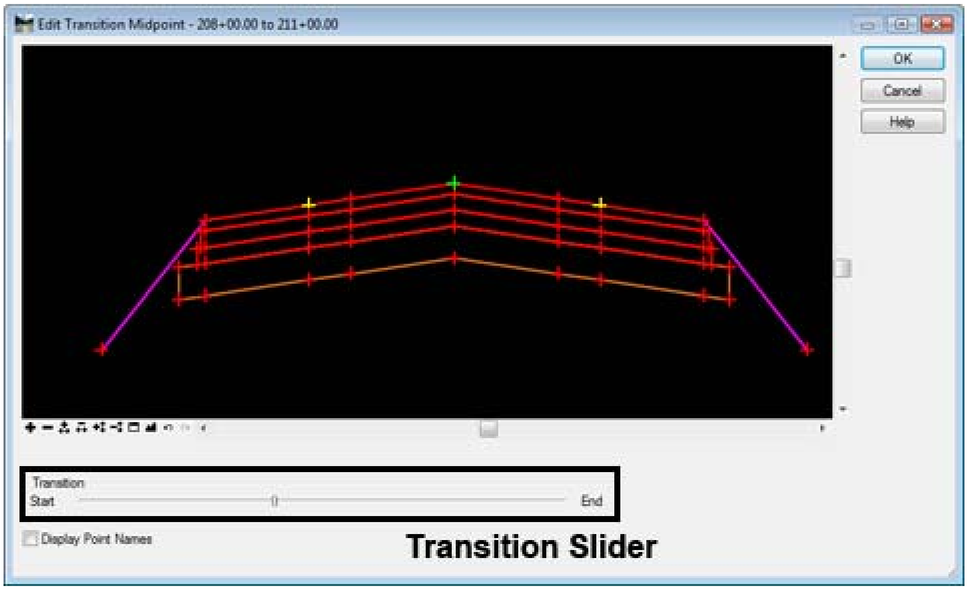
    In order for the transition to function properly, the horizontal constraints on the lanelines must be deleted.

31. **<R>** on the **RT_HMA_Lift1_Laneline-Top1** point and select **Delete Horizontal Constraint** from the menu.



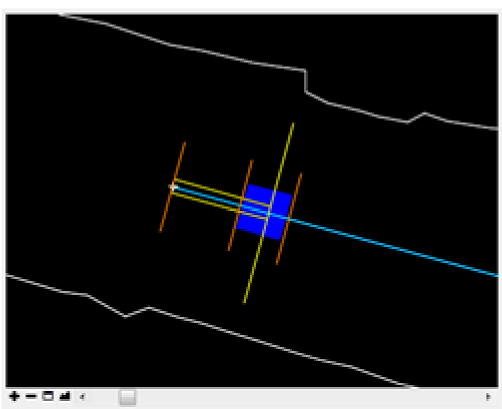
32. **<R>** on the **LT_HMA_Lift1_Laneline-Top1** point and select **Delete Horizontal Constraint** from the menu.

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.

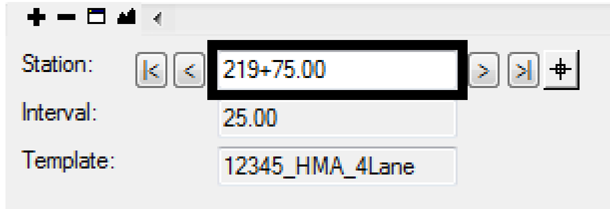


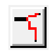
35. Select **File > Save** from the Roadway Designer menu bar.

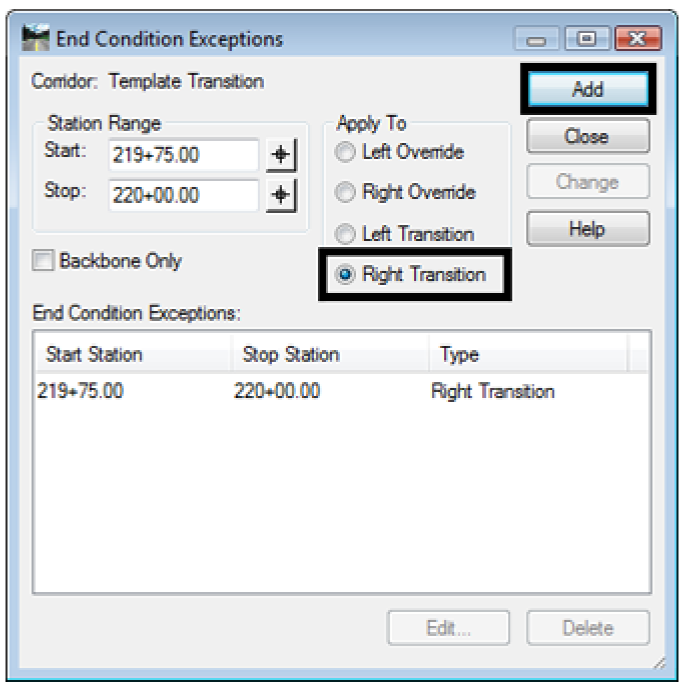
Lab 13.2 - Set Up an End Condition Transition

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**.

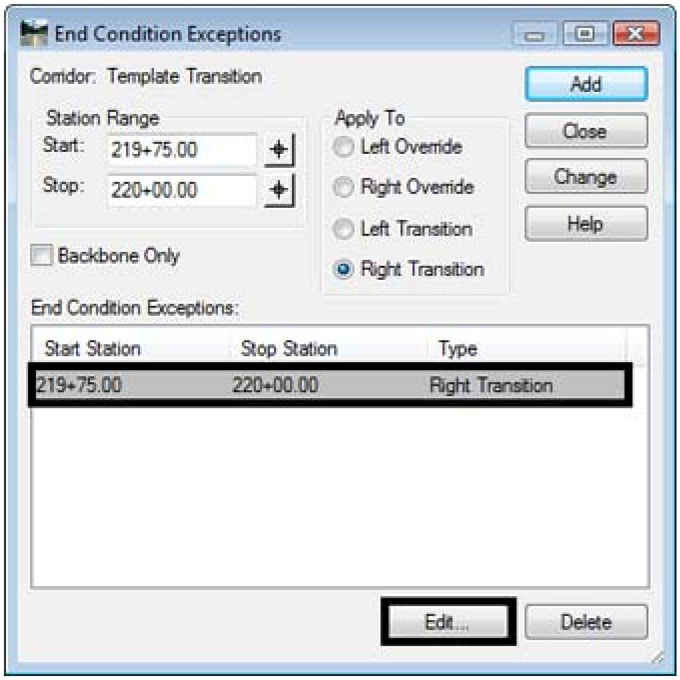


2. Select **Corridor > End Condition Exceptions** from the Roadway Designer menu bar or **<D>** the **End Condition Exceptions** button .
3. In the ***End Condition*** Exceptions dialog box, note that the desired stations are already selected.
4. Toggle on ***Right Transition***.
5. **<D> Add**. This 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.

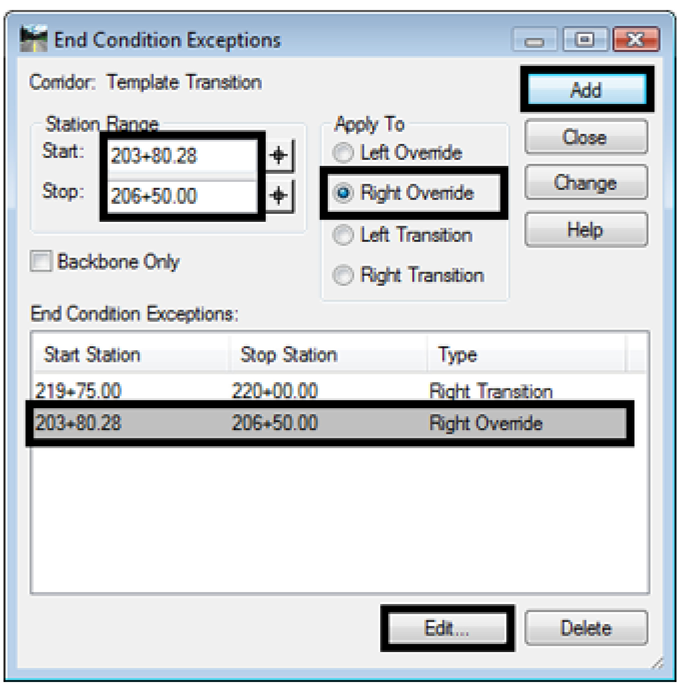
Lab 13.3 - Set Up an End Condition Exception

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.

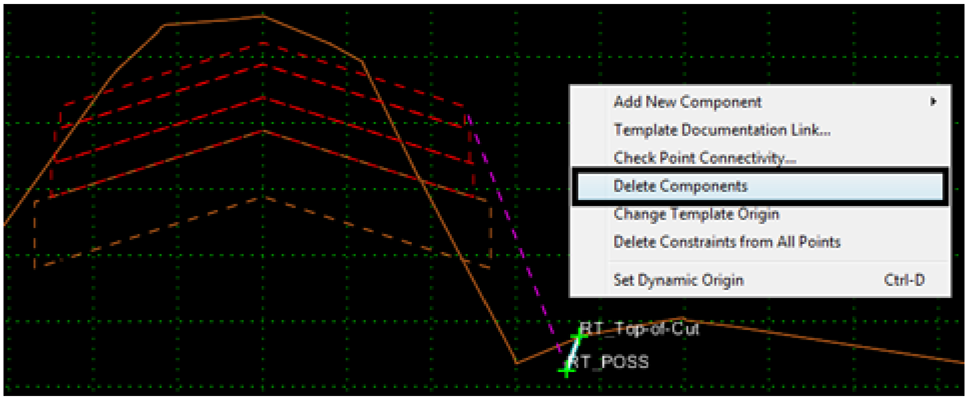
The steps below are used to actually modify the end condition data.

6. Highlight the entry.
7. **<D> Edit**. This displays the ***Right Override – 203+80.28 to 206+50.00*** dialog box.



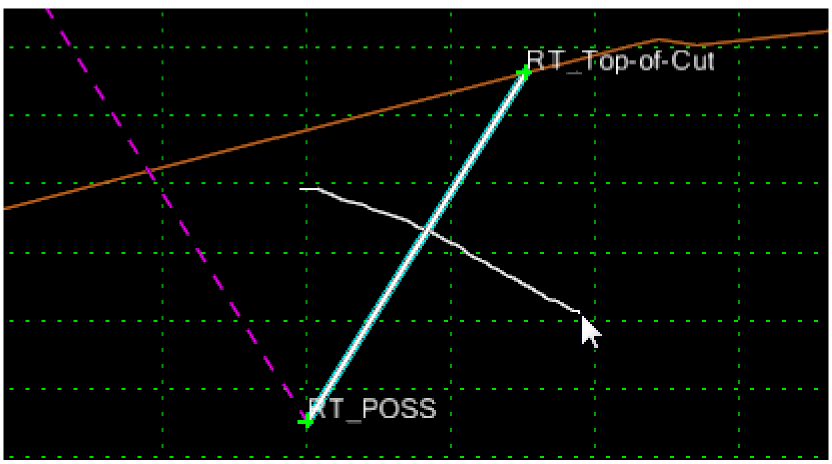
The existing end condition components are deleted from the right side of the template. Deleting the existing components is done in the same way as in the Create Template dialog box. However, when using an end condition override, the backbone components can not be deleted.

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.

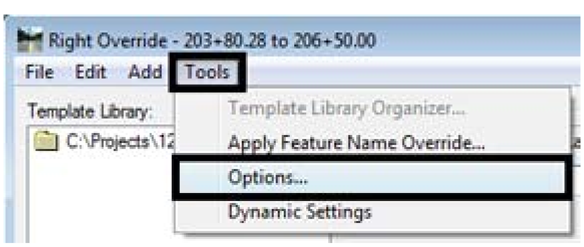
10. **<D> and hold**, then drag a line through the existing cut slope component. Release the mouse button to complete the delete.



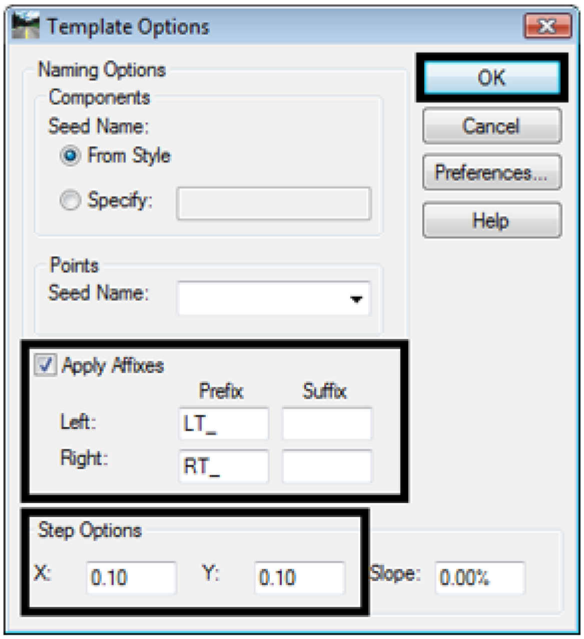
Note: The deleted component remains visible shown in light blue. However it is not incorporated into the model.

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.

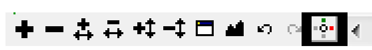
11. Select **Tools > Options** from the menu bar.



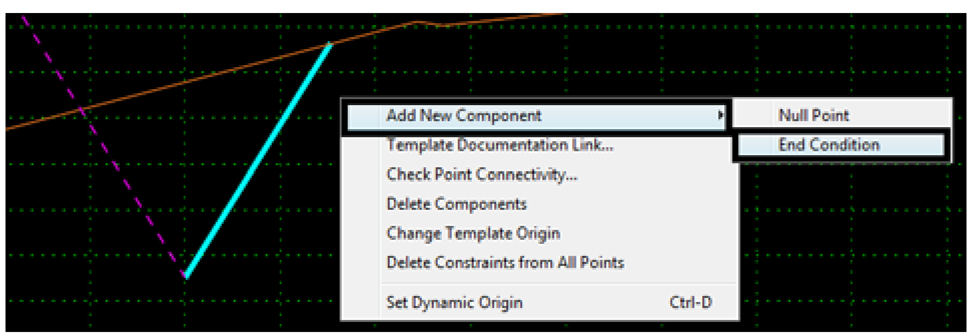
12. Toggle on **Apply Affixes**.
13. Key in ***0.10*** for the ***X*** and ***Y Step Options***.
14. **<D> OK**.



15. **<D>** the **Dynamic Setting button** on the view control button bar. This displays the ***Dynamic Settings*** dialog box.

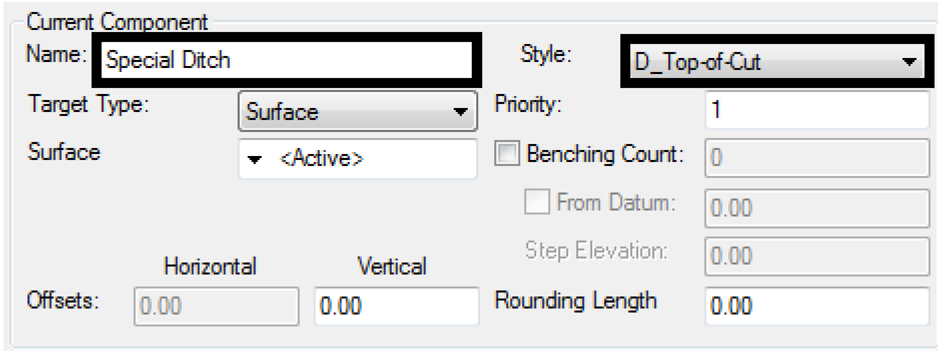


16. **<R>** in the template view and select **New Component > End Condition** from the menu.

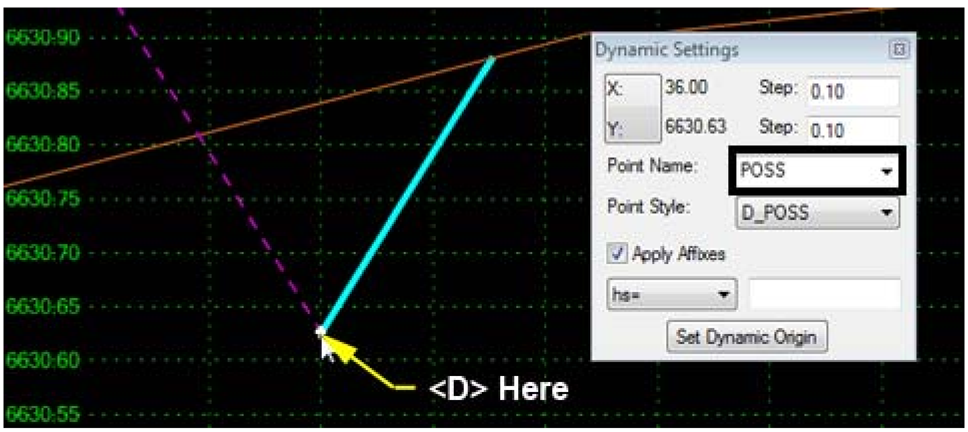


17. In the Current Component area, key in ***Special Ditch*** for the ***Name***.

18. Select **D_Top-of-Cut** for the ***Style***.

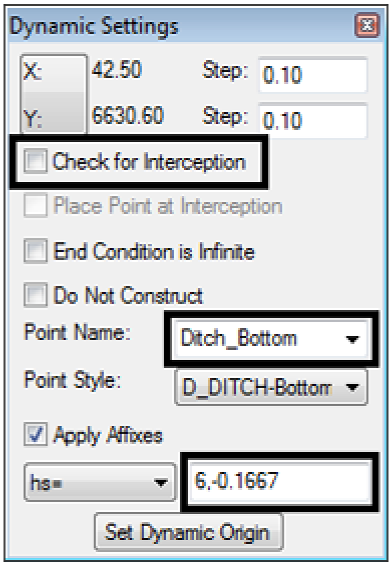


19. In the ***Dynamic Settings*** dialog box, select **POSS** for the ***Point Name***.
20. **<D>** on the ***RT_POSS*** point.

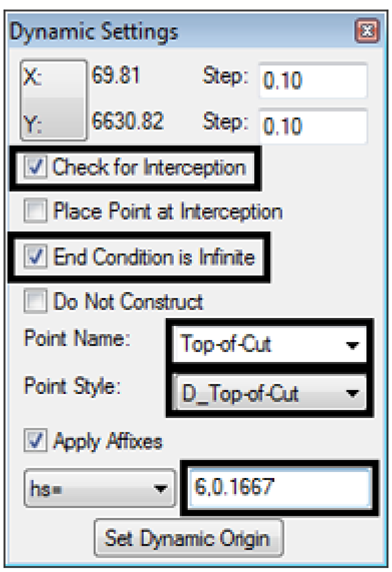


21. In the ***Dynamic Settings*** dialog box, toggle off **Check for Interception**.
22. Key in ***Ditch_Bottom*** for the ***Point Name***.
23. Set the ***Point Style*** to **D_DITCH-Bottom.**

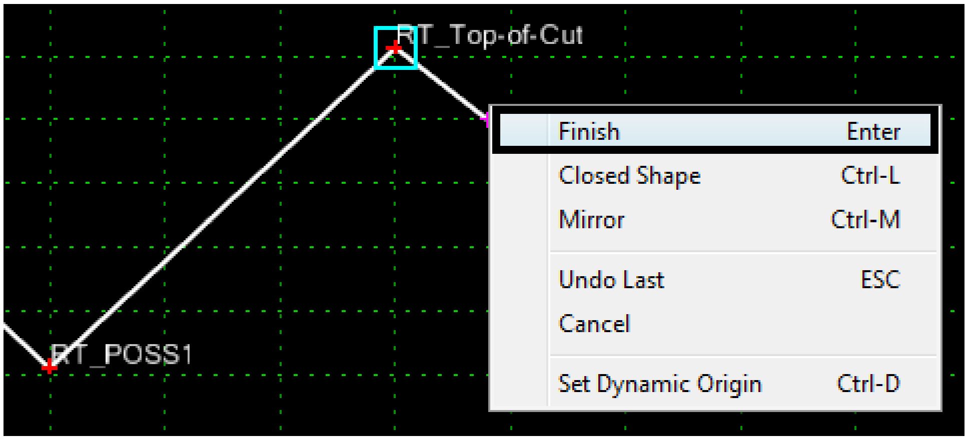
24. In the precision key-in field, key in ***6,-0.1667.***



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 13.1 -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 13.2 -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 13.3 -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 14 - 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:

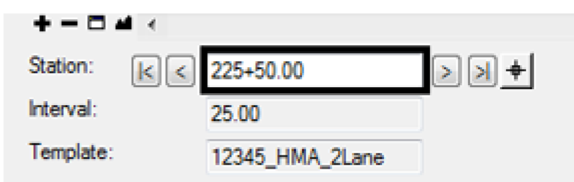
- C:\Projects\12345\Design\Drawings\Reference_Files\12345DES_Model.dgn
- C:\Workspace\Workspace-CDOT_XM\Standards-Global\InRoads\Preferences\CDOT_Civil.xin
- C:\Projects\12345\Design\InRoads\12345DES_Geometry.alg
- C:\Projects\12345\Design\InRoads\12345 existing ground.dtm
- C:\Projects\12345\Design\InRoads\12345DES.ird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

Lab 14.1 - Modifying a Single Template Drop

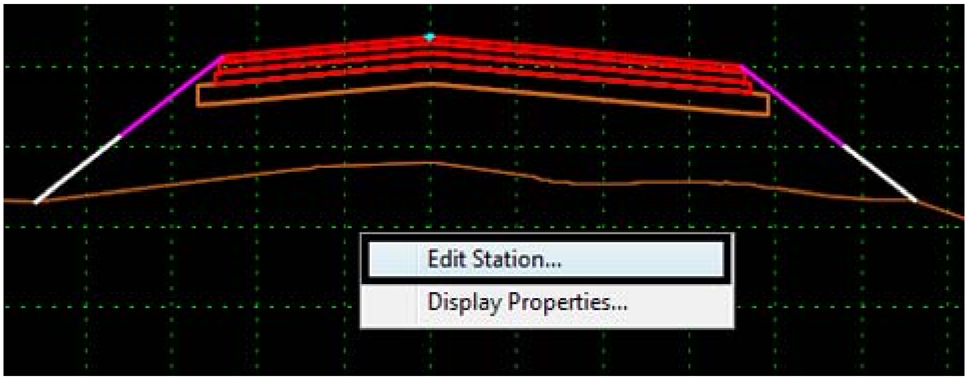
At station ***225+50.00*** the design toe falls inside a small rise in the natural ground creating an area that pools water. This station is edited to move the toe to the top of that rise.

1. Select **Modeler > Roadway Designer** from the InRoads menu bar.
2. Select **12345DES** for the corridor (created in lab 4).

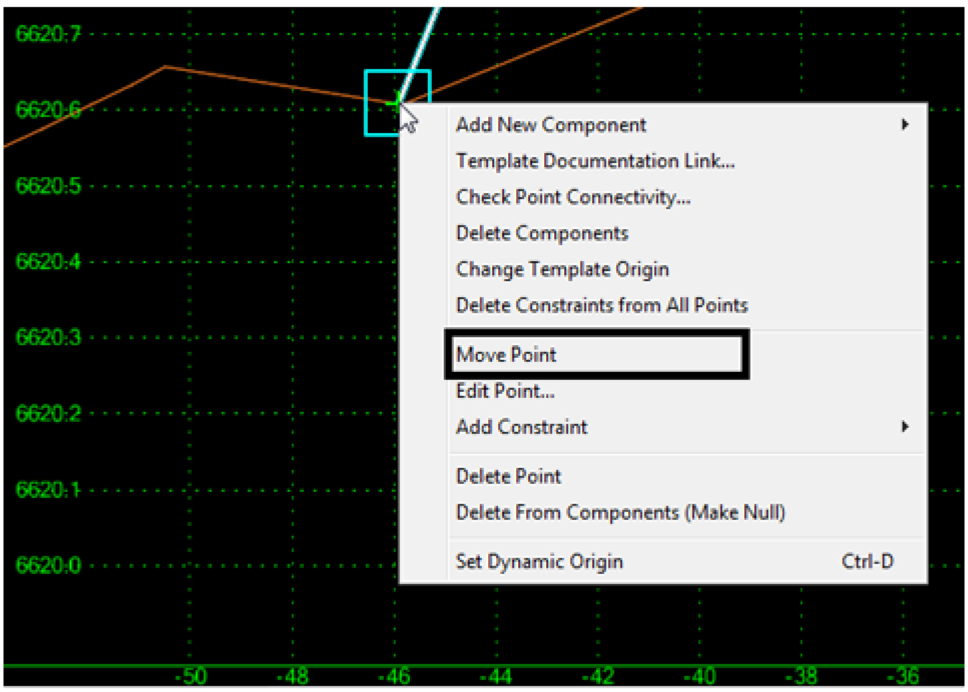
3. Key in **225+50.00** in the Station indicator and press the Tab key.



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 14.2 - 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.

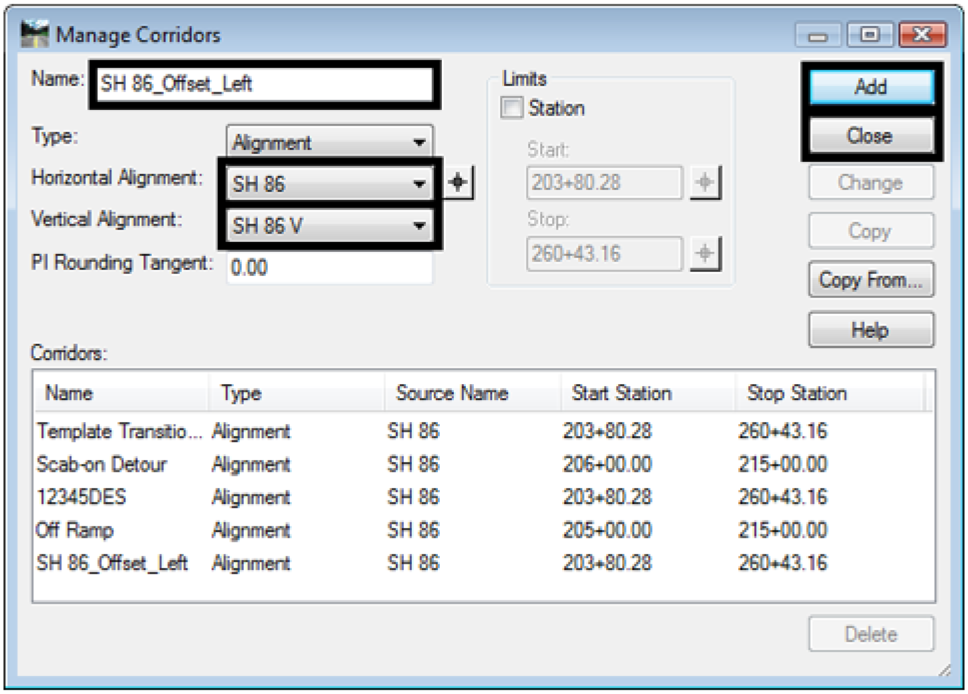
1. Select **Corridor > Corridor Management** from the Roadway Designer menu bar or **<D>** the Corridor Management button.

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**.

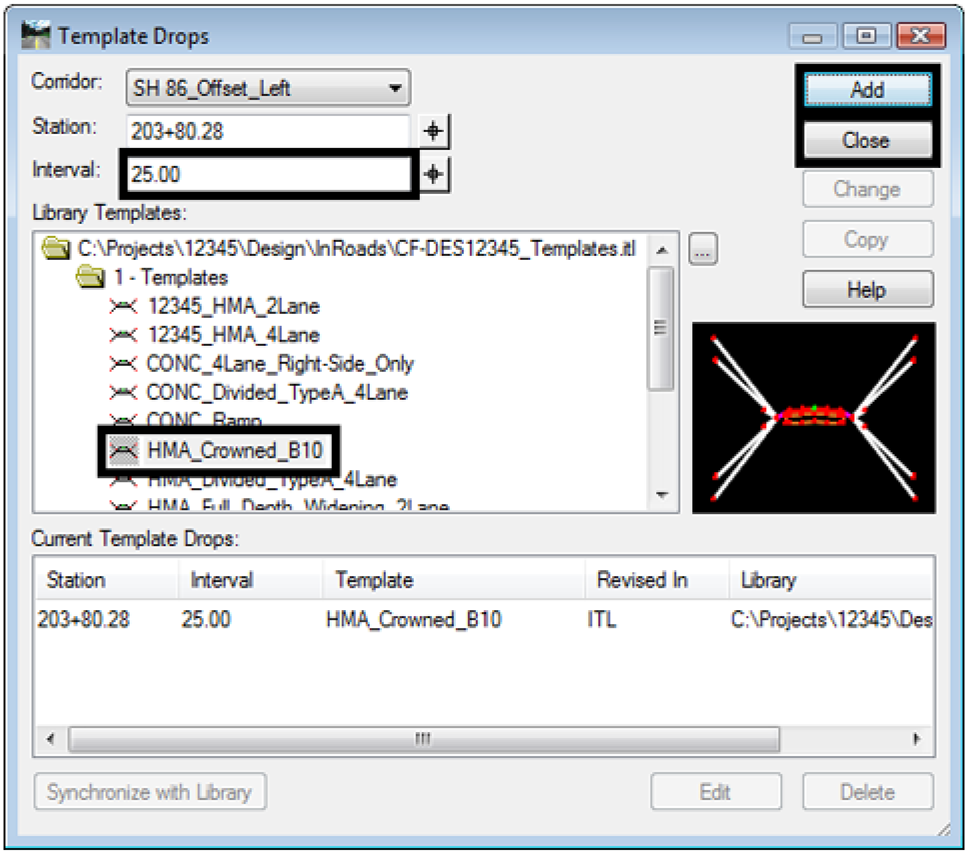
5. **<D> Close**.



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.

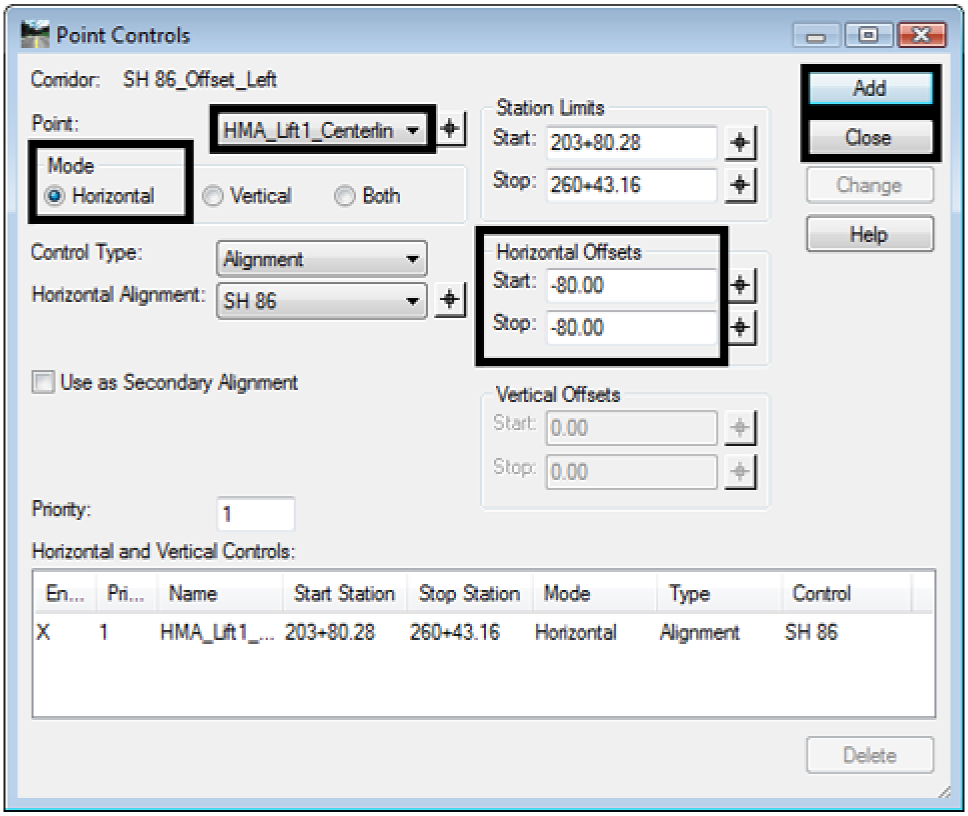
13. In the ***Point Controls*** dialog box, select **HMA_Lift1_Centerline-Top** for the ***Point***.

14. Toggle on **Horizontal** for the Mode.

15. In the ***Horizontal Offsets*** area, key in ***-80*** for both the ***Start*** and ***Stop*** offsets.

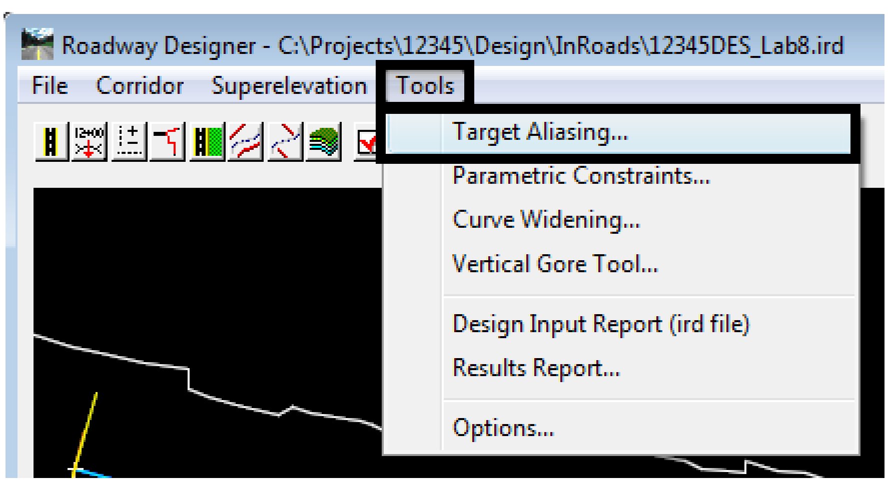
16. **<D> Add**.

17. **<D> Close**.



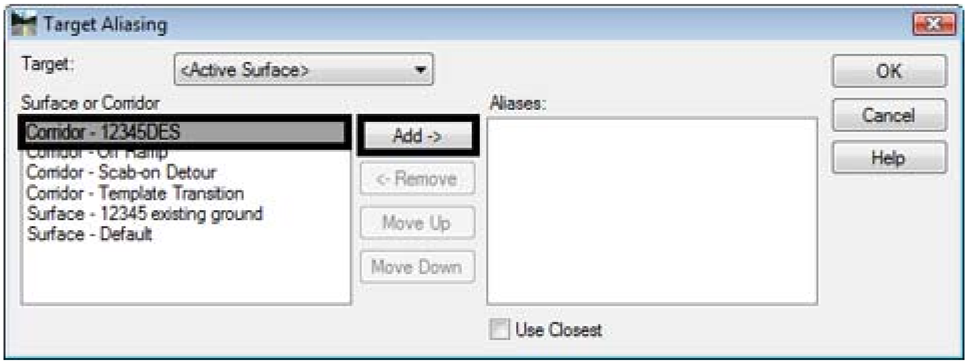
The final step is to add the target aliasing.

18. Select **Tools > Target Aliasing** from the Roadway Designer menu. The ***Target Aliasing*** dialog box is displayed.



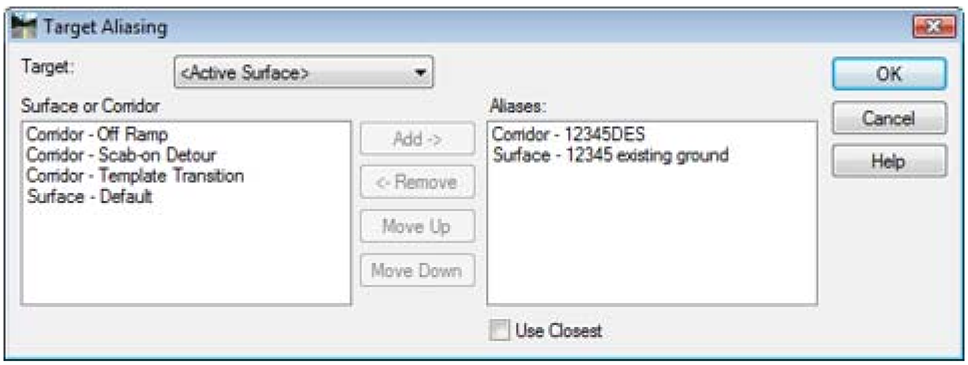
19. In the ***Target Aliasing*** dialog box, Highlight **Corridor – 12345DES** from the ***Surface or Corridor*** list.

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 14.1 -Modifying a Single Template Drop* a single template drop was modified by moving a point.
- In*Lab 14.2 -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 15 - 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:

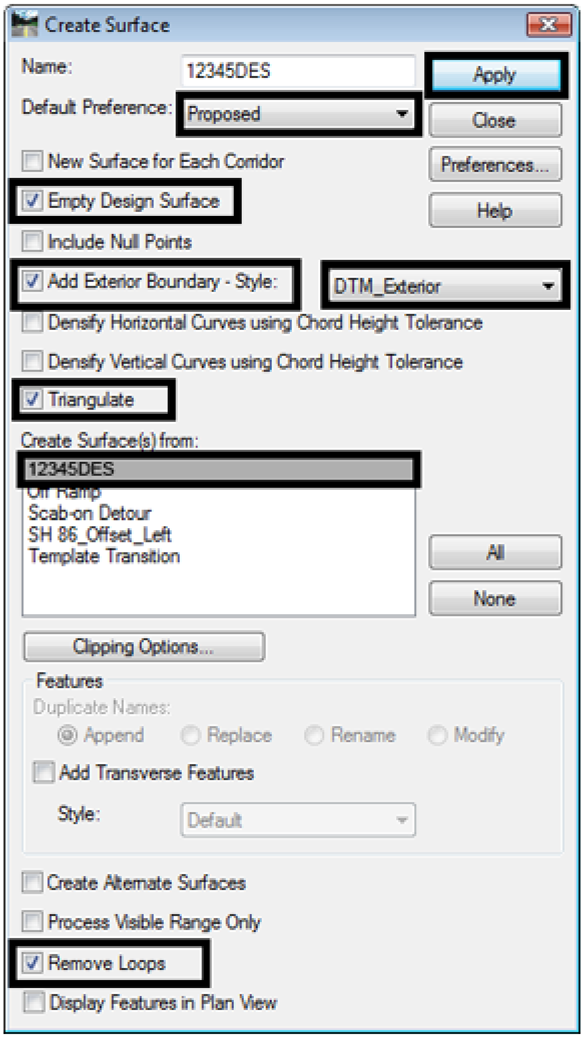
- C:\Projects\12345\Design\InRoads\12345DES_Geometry.alg
- C:\Projects\12345\Design\InRoads\12345 existing ground.dtm
- C:\Projects\12345\Design\InRoads\12345DES.ird (created in lab 4)
- C:\Projects\12345\Design\InRoads\DES12345_Templates.itl
- C:\Projects\12345\Design\InRoads\Combine Surfaces.ird

Lab 15.1 - 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)
   - **Add Exterior Boundary** (to eliminate erroneous triangles in concave areas of the design model)
   - **Triangulate** (to create the triangulated model)
   - **Remove Loops** (to correct areas where template drops cross)
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.

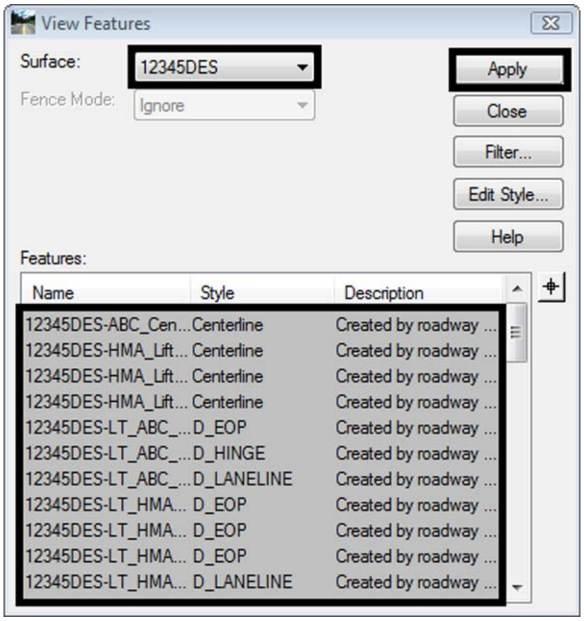
One method of reviewing the dtm is to display the features into the MicroStation file. Follow the steps below to display the features from the newly created surface.

12. From the ***InRoads*** menu bar, select **Surface > View Surface > Features**.

13. In the ***View Features*** dialog box, select **12345DES** for the ***Surface***.

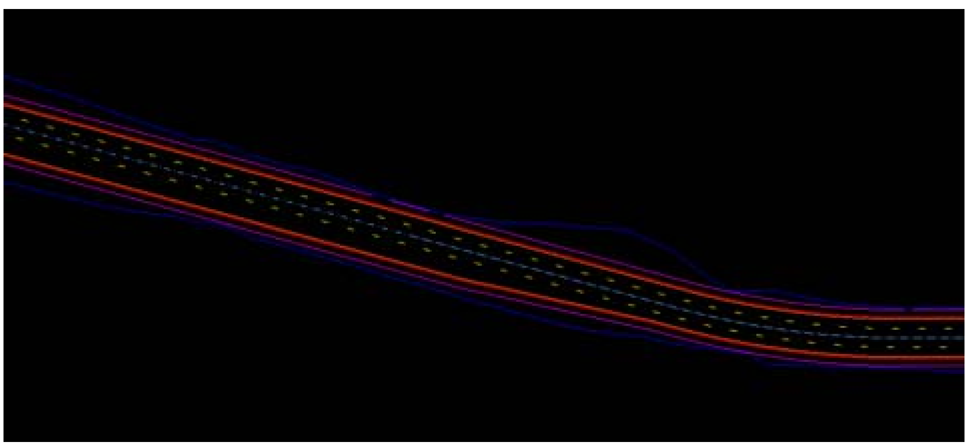
14. Verify that all features are highlighted in the ***Features*** list.

15. **<D> Apply**.



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

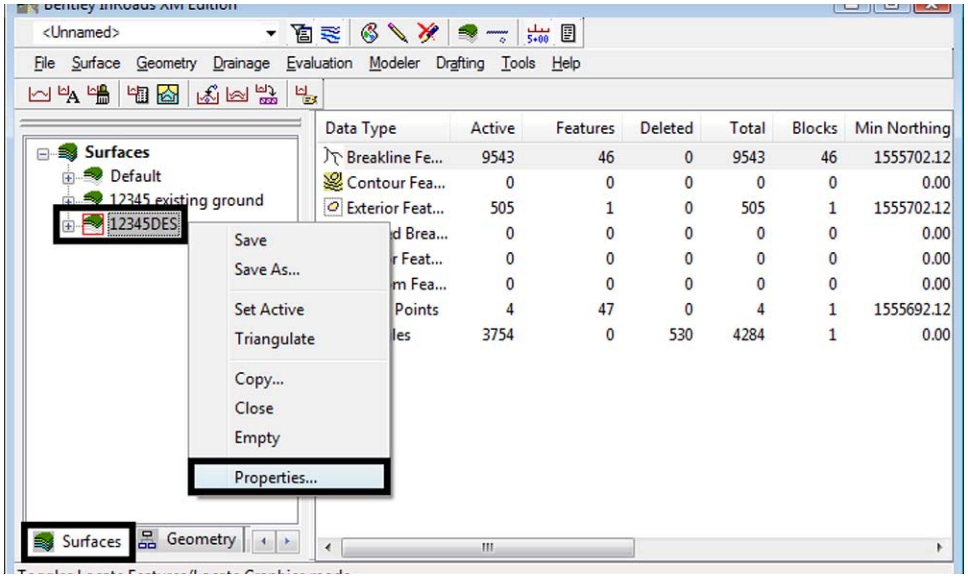
17. Examine the displayed features.



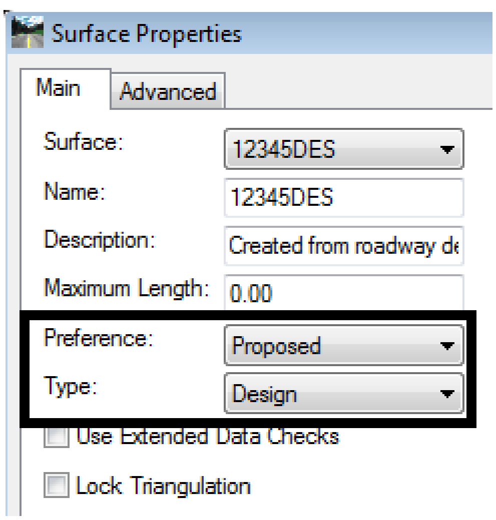
DTMs created with the Roadway Designer have some properties that need to be set. These control how the surface is displayed and how it is used in volume calculations. Follow the steps below to make the settings changes.

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.



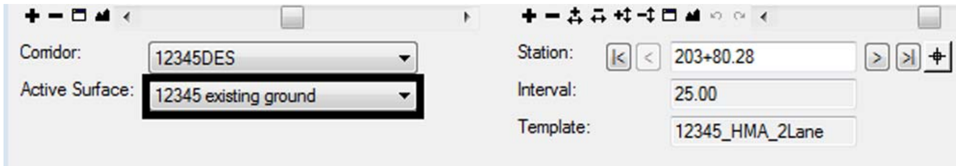
21. **<D>** the **Advanced Tab**.
22. In both the ***Cross Sections*** and ***Profiles*** areas, set the ***Symbology*** to **D_Finished-Grade**.
23. **<D> Apply** to accept the changes.
24. **<D> Close** to dismiss the ***Surface Properties*** dialog box.

Lab 15.2 - Creating Multiple Surfaces from Multiple Corridors.

This exercise illustrates the process of creating multiple surfaces at one time.

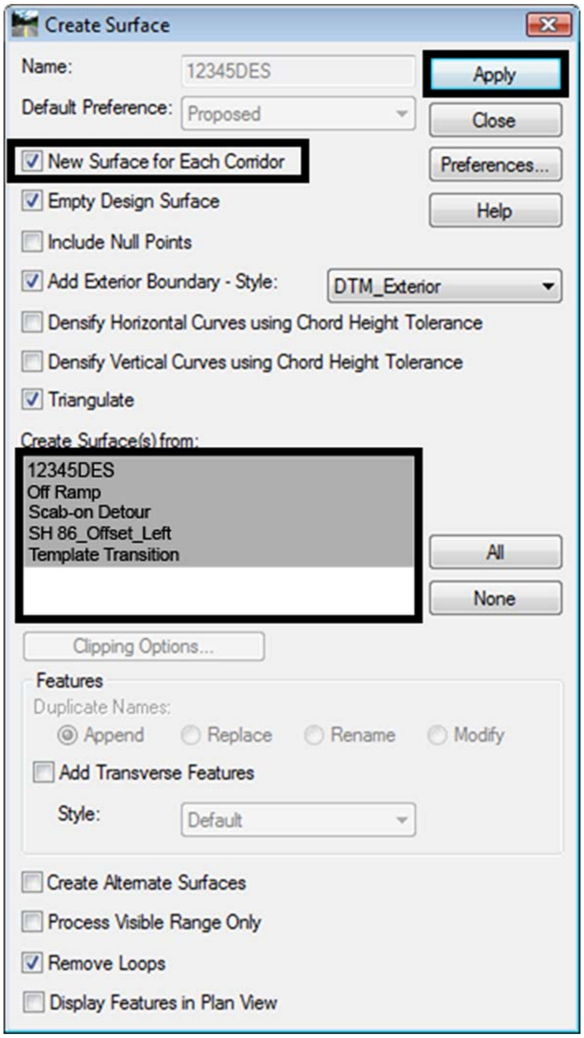
When the surface properties were accessed in the previous lab, the active surface was set to the 12345DES surface. The active surface needs to be set to the 12345_Existing Ground surface in order for the corridors to process correctly.

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*** winow.

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.

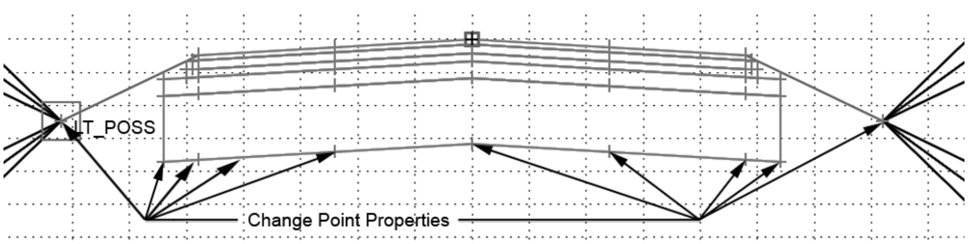
13. **<D> Close** to Dismiss the Roadway Designer dialog box.

Lab 15.3 - 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.

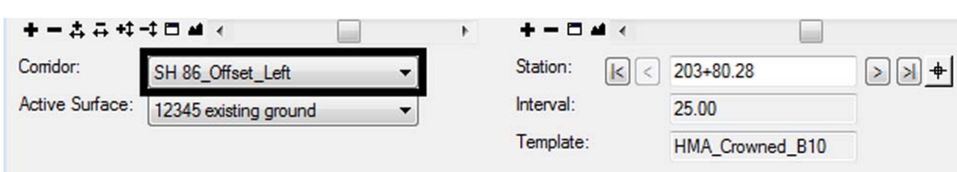
1. From the ***InRoads*** menu bar, select **Modeler > Create Templates**.
2. In the ***Template Library*** area, expand the ***C:\Projects\12345\Design\InRoads\DES12345_Templates.itl*** folder.
3. Expand the **1 – Templates** folder.
4. **<D> <D>** on the **HMA_Crowned_B10** template.
5. **<D> <D>** 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**.

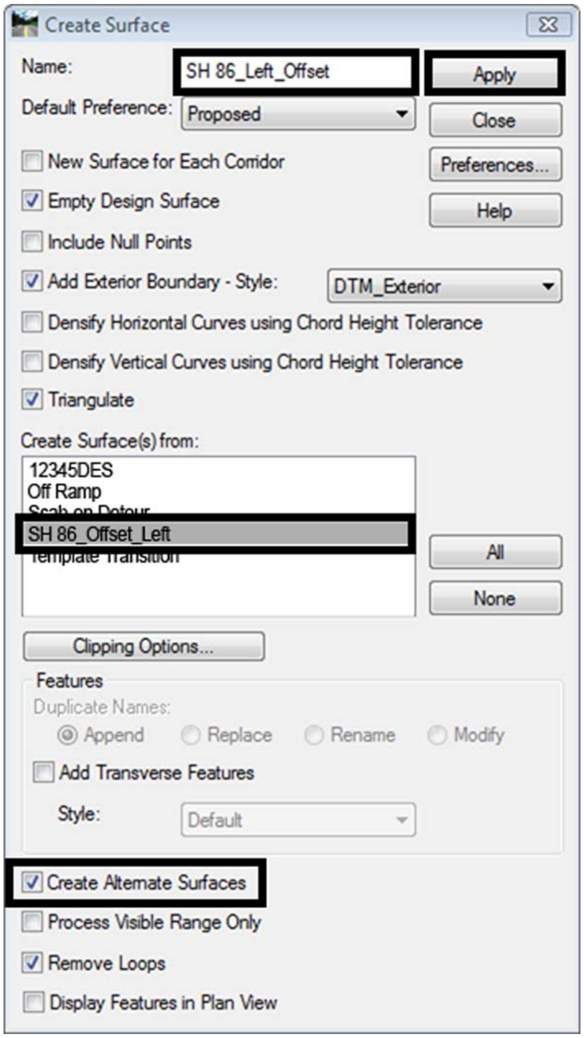


15. Select **Corridor > Template Drops** from the ***Roadway Designer*** dialog box, or **<D>** the **Template Drops** button.
16. In the ***Template Drops*** dialog box, highlight the entry in the ***Current Template Drops*** list.
17. **<D> Synchronize With Library** button.
18. **<D> Close**.

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**.



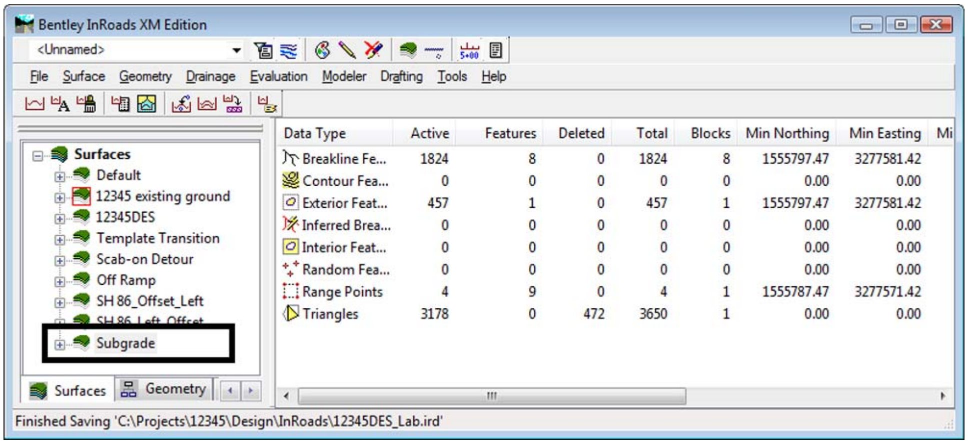
25. Review the report displayed in the Results dialog box, then **<D> Close** the ***Results*** dialog box.

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.

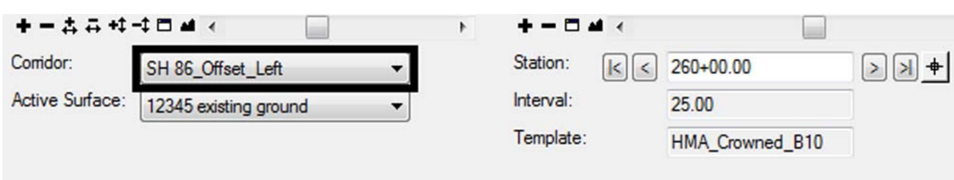


Lab 15.4 - Create a single surface from two corridors

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.

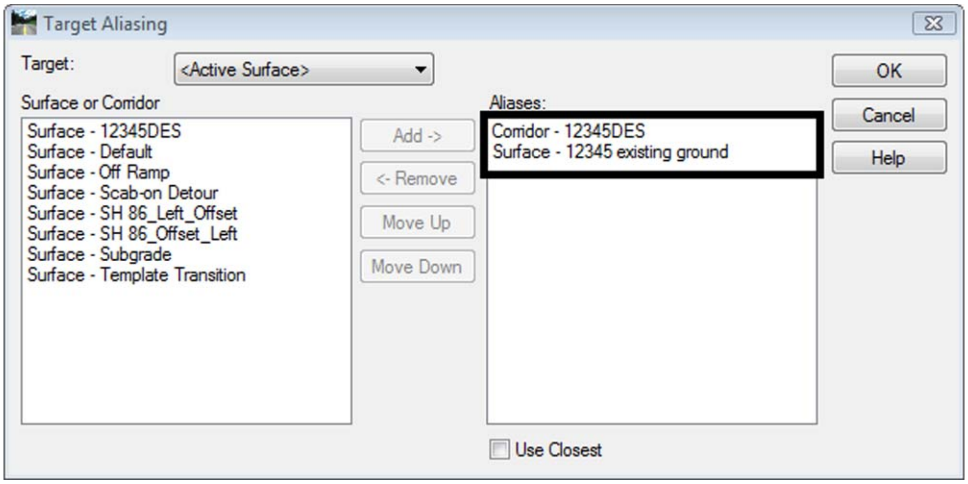
This exercise uses a different corridor than the previous exercises. The first steps load the Combine Surfaces.ird file.

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**.

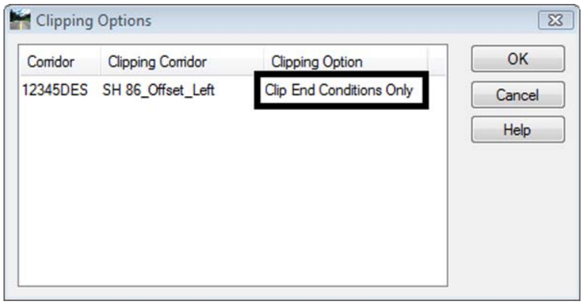
14. Highlight the **12345DES** and the **SH86_Offset_Left** corridors from the ***Create Surface(s) From*** list. Hold the **Ctrl** key and **<D>** on each corridor.

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.

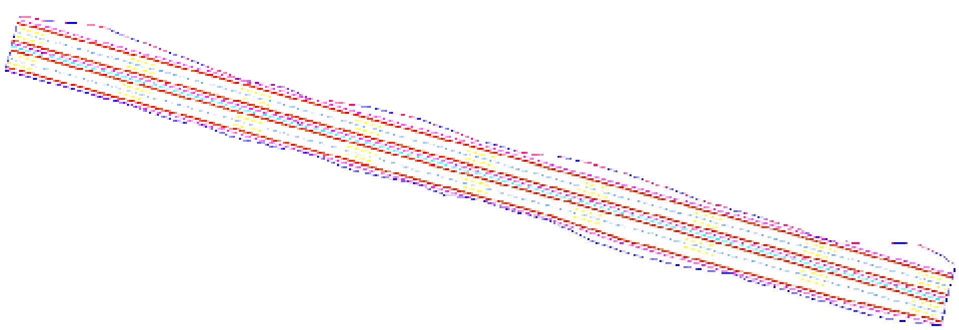
17. **<D> OK**. This dismisses the Clipping Options dialog box.



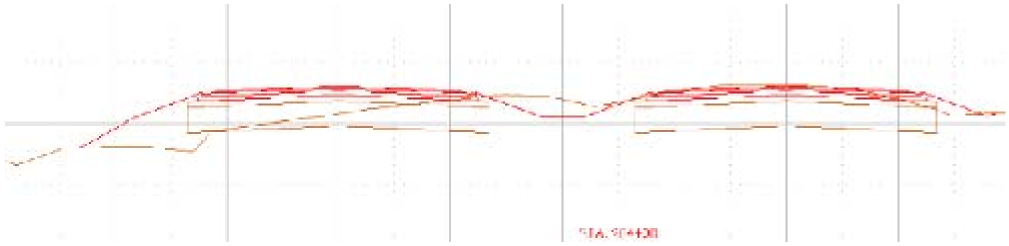
18. In the ***Create Surface*** dialog box, verify that **New Surface for Each Corridor** and **Create Alternate Surfaces** are toggle off .
19. **<D> Apply** to create the combined surface.
20. Review then **<D> Close** on the ***Results*** dialog box.
21. **<D> Close** to dismiss the ***Create Surface*** 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.

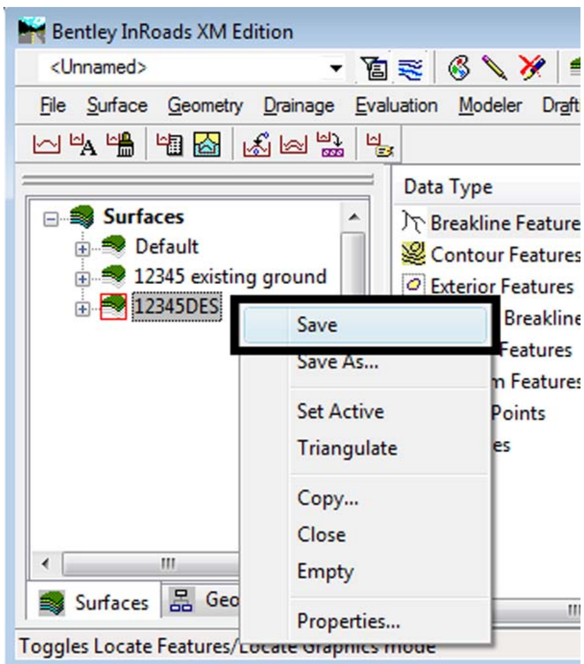
24. Delete any graphics displayed in the drawing.
25. From the InRoads Menu bar, select **Surface > View Surface > Features**.
26. In the ***View Features*** dialog box, select **SH 86_Combined** for the ***Surface***.
27. Verify that all features are highlighted in the ***Features*** list.
28. **<D> 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 15.1 -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 15.2 -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 15.3 -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 15.4 -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 16 - Cross Sections, Volumes, and Reports

This lab illustrates the changes in cross sections, volumes, and reporting from InRoads 2004 to InRoads XM. 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_XM\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 16.1 - 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 XM edition of InRoads.

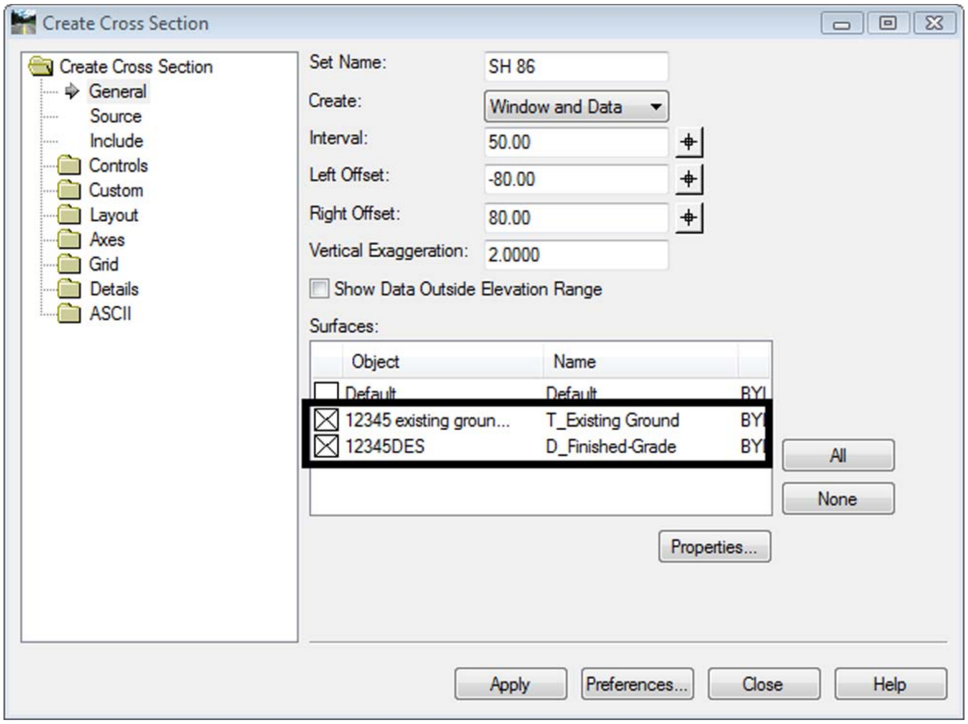
Step 1 resets the text scale factor for InRoads so that the cross sections will display correctly.

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 trinagulated design surface only. This is to illustrate what features (template points) are used to create the triangulated surface model.

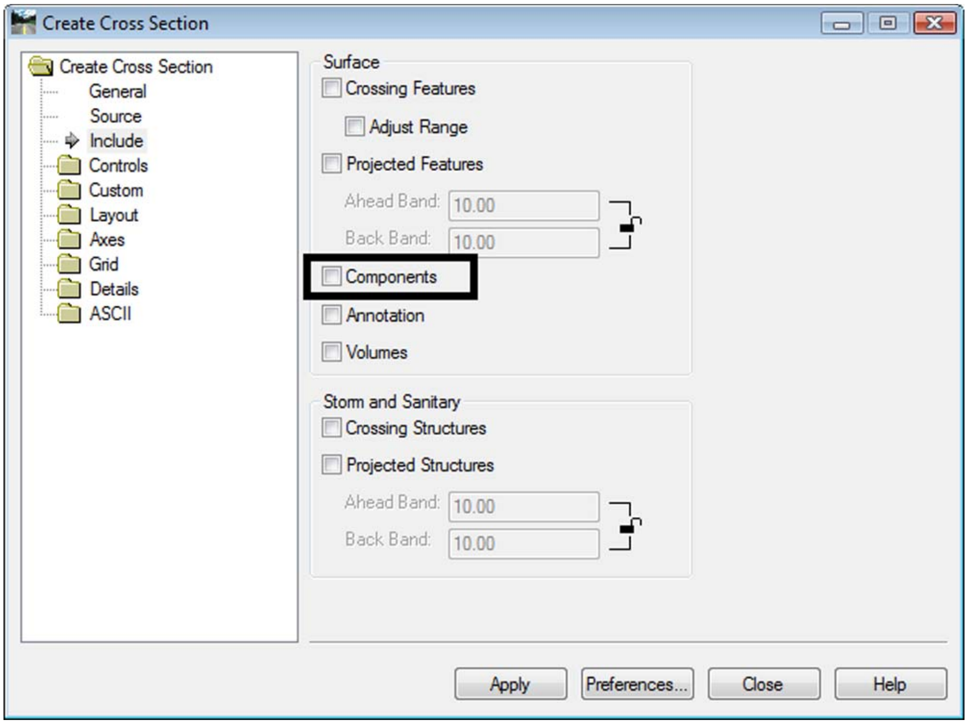
4. Select **Evaluation > Cross Section > Create Cross Section** from the InRoads menu bar.

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.

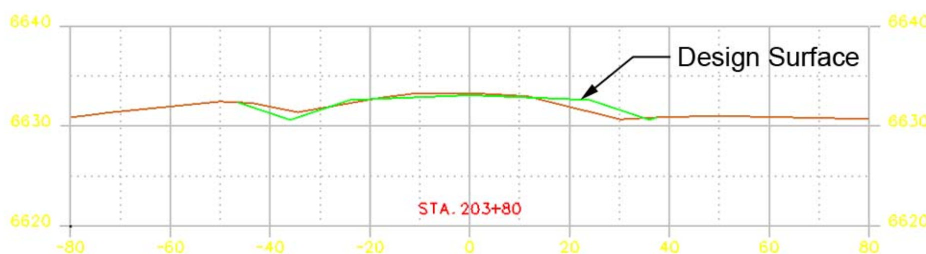
7. Toggle off **Components**. This is done to illustrate what is stored as a surface. Normally, this toggle is left on. The components will be added to the cross sections in later steps.



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.



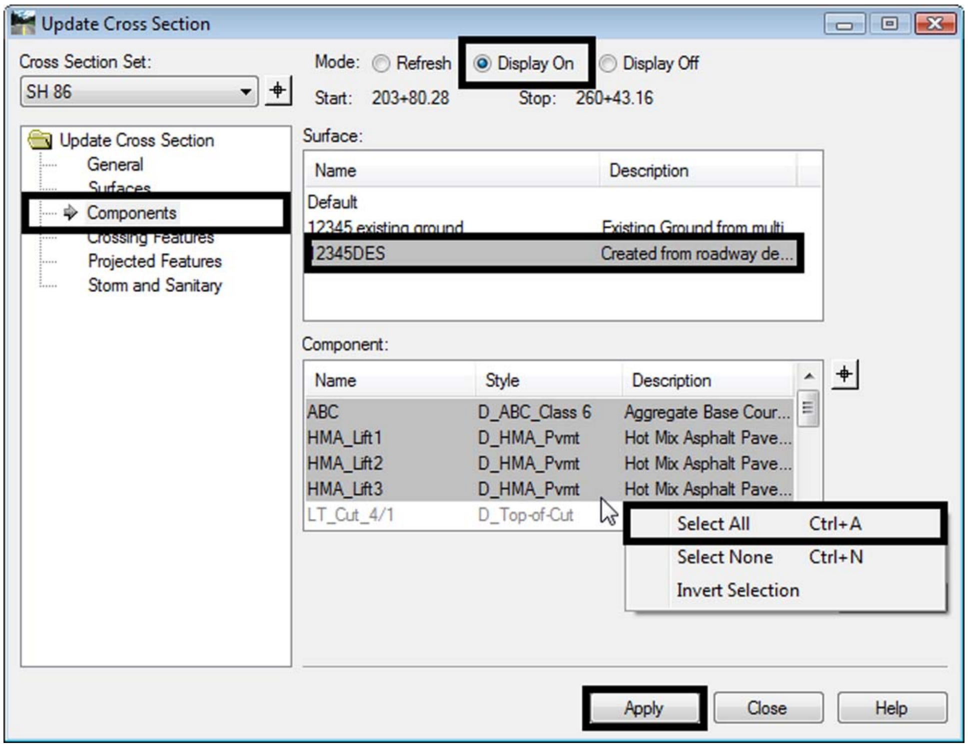
Next, the components are added to the cross sections using the Update Cross Section command.

11. Select **Evaluation > Cross Section > Update Cross Section** from the InRoads menu bar.

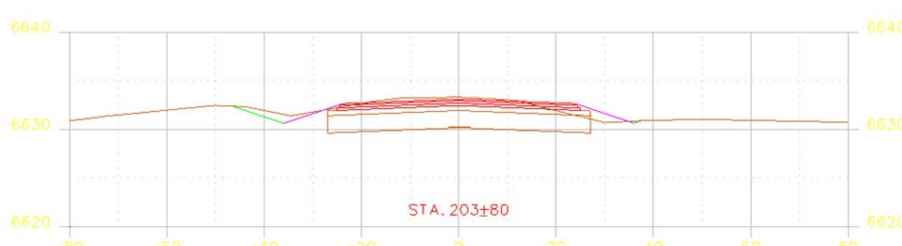
12. Toggle on the **Display On** radio button.

13. **<D> Components** in the ***Update Cross Section*** explorer.

14. Highlight **12345DES** in the ***Surface*** area.
15. **<R>** in the ***Component*** area and select **Select All** from the menu.
16. **<D> Apply**.



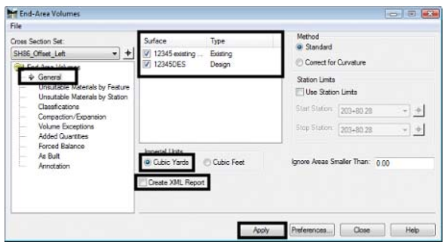
17. **<D> Close** to dismiss the ***Update Cross Section*** dialog box.
18. Examine the first cross section. The surfacing components are shown. End condition components are not shown in the cross sections because they are also part of the surface.



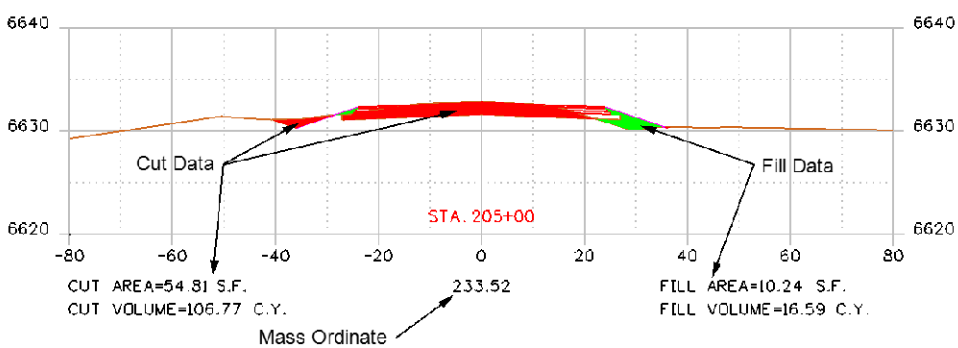
Lab 16.2 - Calculate End Area Volumes

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 >Volume > End Area Volume** from the InRoads menu bar.
2. On the ***General*** leaf, notice the Surfaces selected. Surface 12345 Existing Ground has the Type of Existing and 12345DES has the type of Design.
3. Toggle off **Create XML Report**.
4. Toggle on **Cubic Yards**.
5. **<D> Apply.**



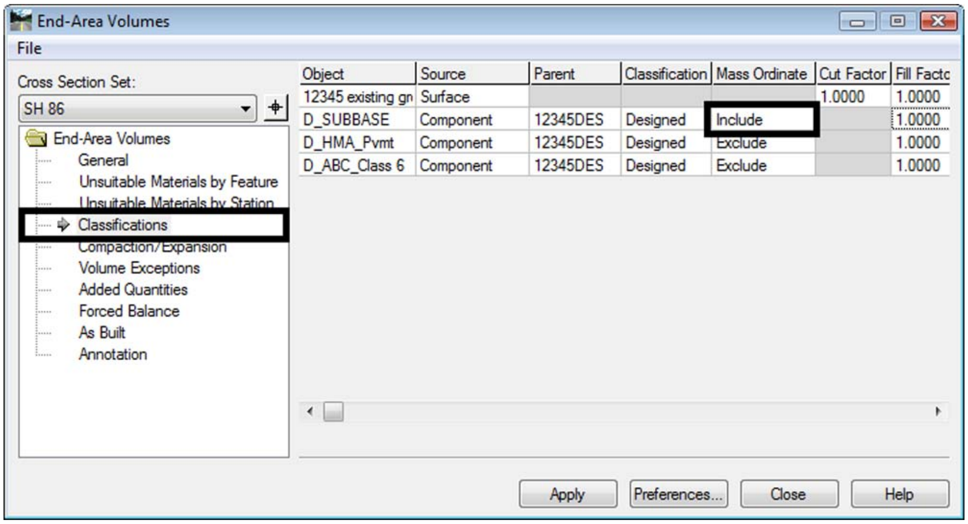
6. Examine the cross sections. Notice the various types of data shown in the illustration below.



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.

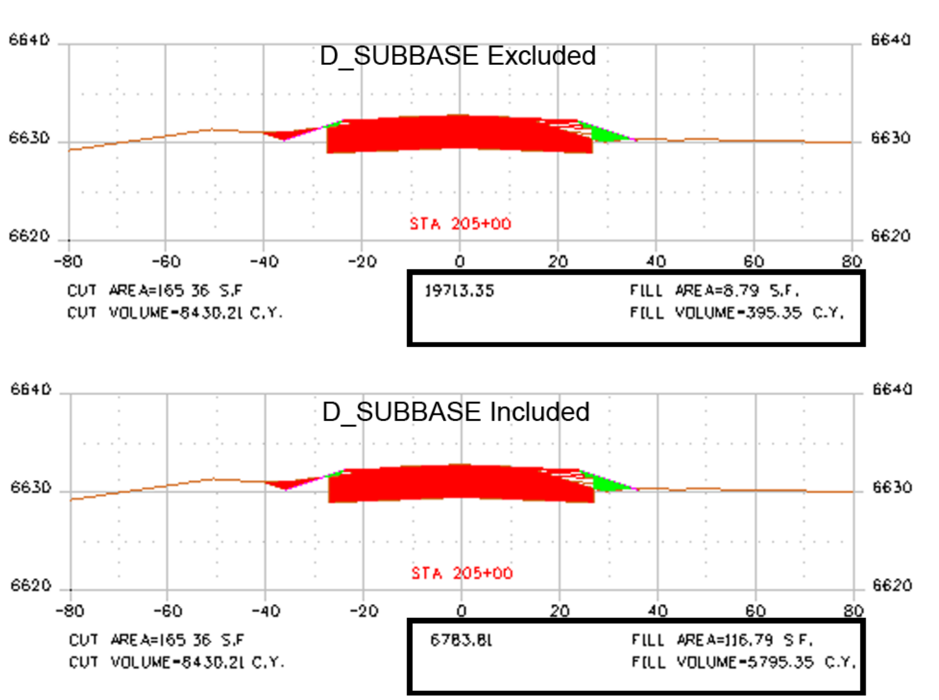
7. In the ***End Area Volumes*** dialog box, **<D>** on **Classifications** in the End Area Volumes explorer.

8. **<D>** in the cell of the ***D_SUBBASE*** row and the ***Mass Ordinate*** column so that it reads **Include.**



9. **<D> Apply**.

10. Examine the cross sections. Notice the change in the data.



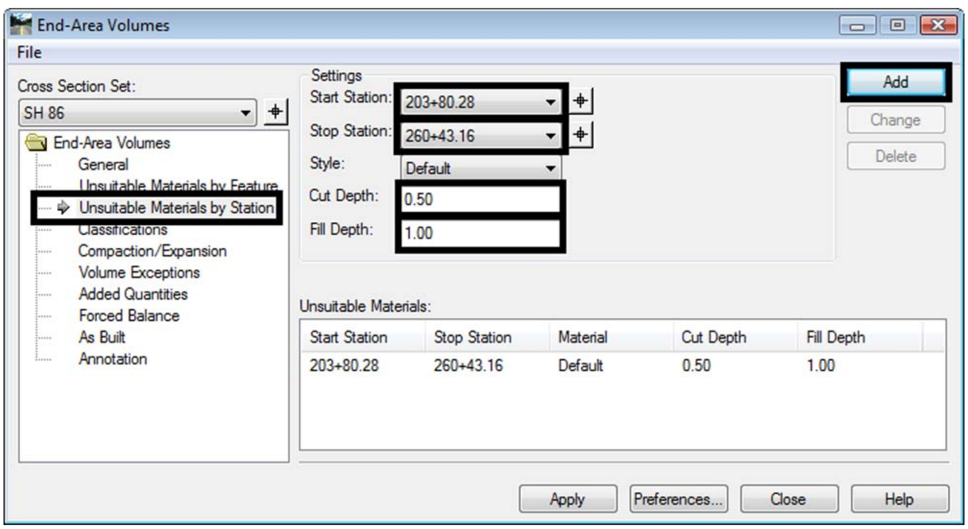
Lab 16.3 - Unsuitable Material

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.

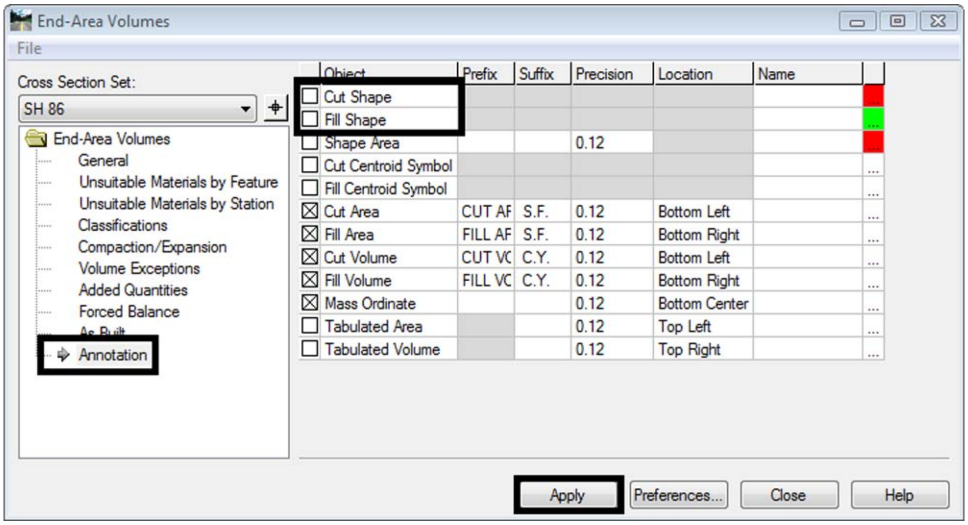
1. In the ***End Area Volumes*** dialog box, **<D> Unsuitable Materials by Station** in the End Area Volumes explorer.
2. Select **203+80.28** for the ***Start Station***.
3. Select **260+43.16** for the ***Stop Station***.
4. Key in ***0.50*** for the ***Cut Depth***.
5. Key in ***1.00*** for the ***Fill 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.

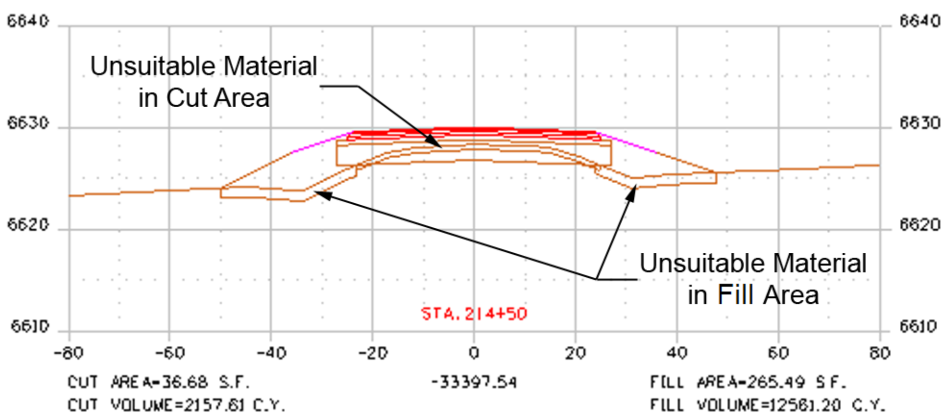


7. **<D> Annotation** in the in the End Area Volumes explorer.
8. ***Toggle off*** **Cut Shape** and **Fill Shape.** fThis is so that the unsuitable material shapes can be seen.

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 16.4 - 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. 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.***

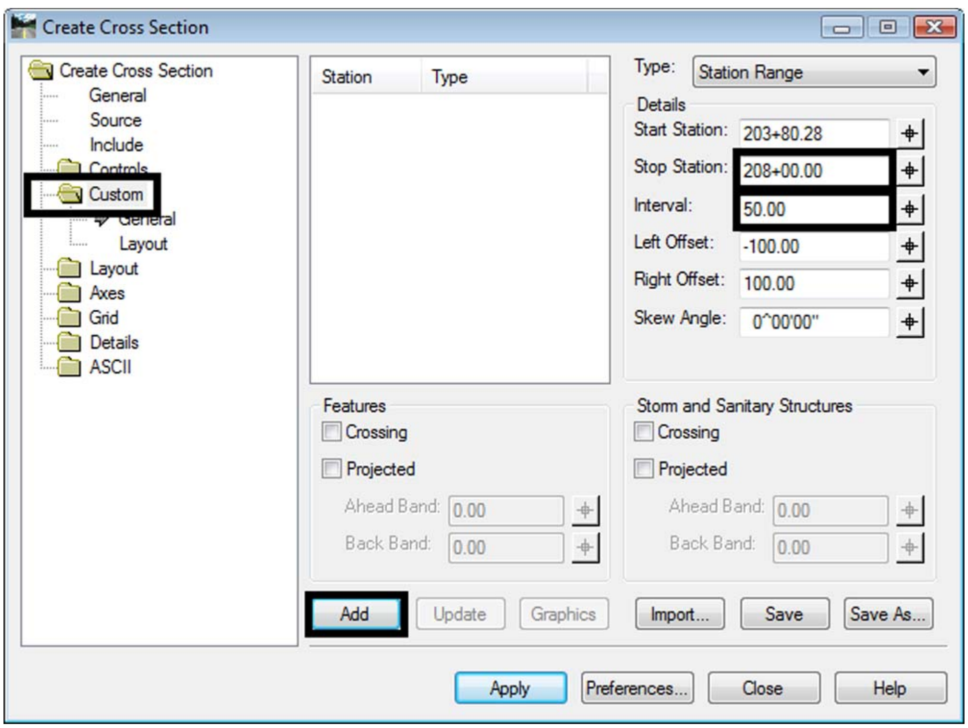
The first series of steps is used to set up the custom cross section set.

1. Select **Cross Section > Create Cross Section** from the InRoads menu bar.

2. In the ***Create Cross Section*** dialog box, on the ***General*** leaf, verify that the **12345 Existing Ground** and **12345DES** surfaces are selected.
3. **<D> Include** in the Create Cross section explorer.
4. Toggle on **Components**.
5. **<D> Custom** in the Create Cross section explorer.

The steps below are used to display cross sections normally, from the beginning of the project to station 208+00.

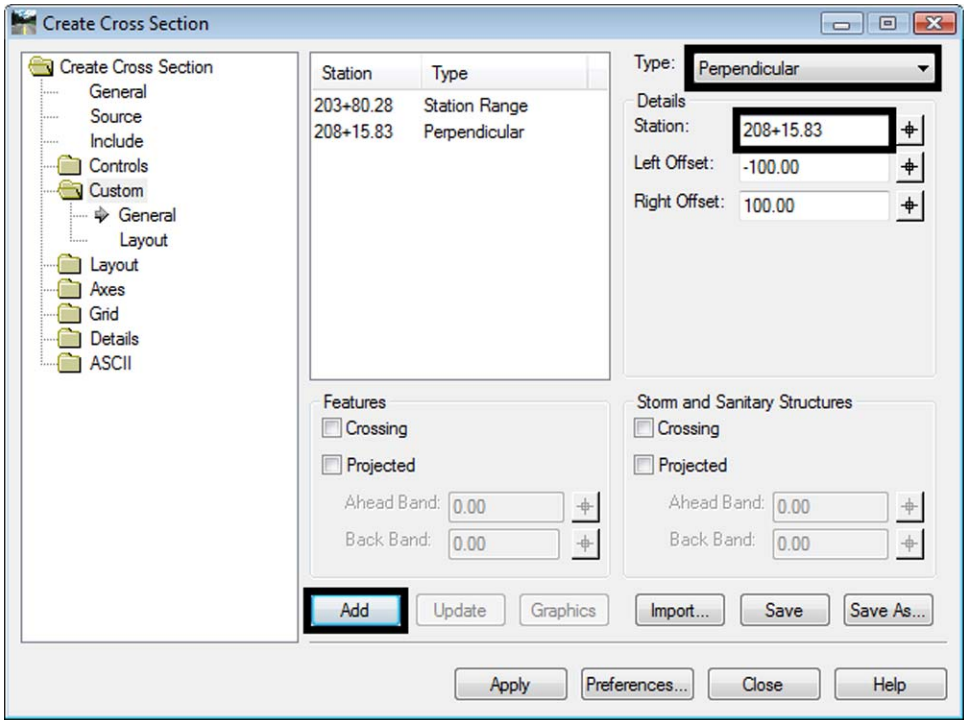
6. Key in ***208+00.00*** for the ***Stop Station*** (the Start Station is set to the beginning station by default).
7. Key in ***50.00*** for the ***Interval***.
8. **<D> Add**.



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**.

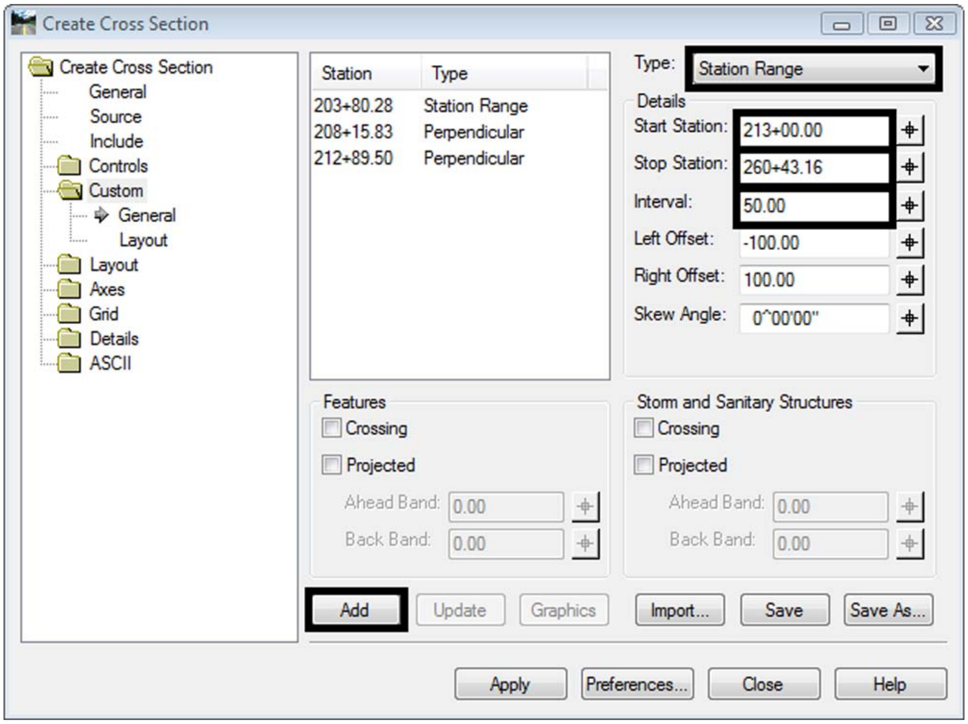


12. Key in ***212+89.50*** for the ***Station***. (all other settings remain the same)
13. **<D> Add**.

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.

20. **<D> Close** to dismiss the ***Create Cross Sections*** dialog box.

The data used for the custom cross section set can be saved for use at a later time. The steps below save the data.

21. **<D> Yes** for the message to save the data for the custom cross sections.

22. In the ***Save AS*** dialog box, navigate to ***C:/Projects/12345/Design/InRoads/*** directory.

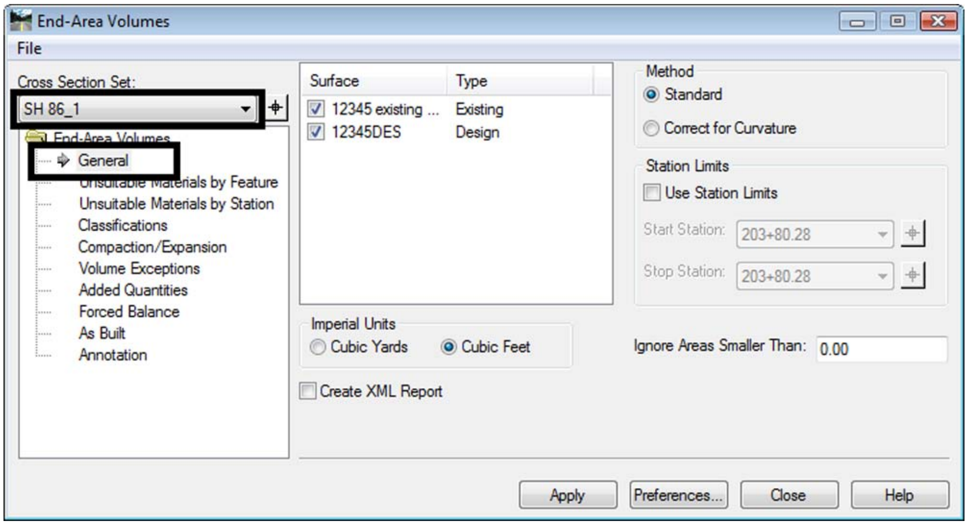
23. Key in ***SH 86.xsc*** for the file name and **<D> Save**.

To exclude the material within the volume exception, end area volumes must be recalculated. The following steps create the the volume exception and recalculate the volumes.

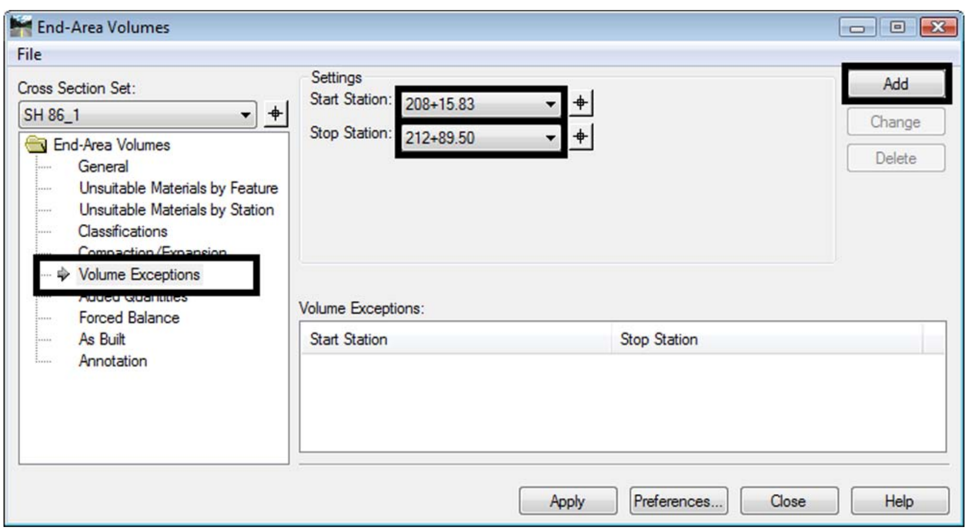
24. Select **Evaluation >Volume > End Area Volume** from the InRoads menu bar.

25. **<D> General** in the End Area Volume explorer.

26. Select **SH 86_1** for the ***Cross Section Set***. The other settings are correct.

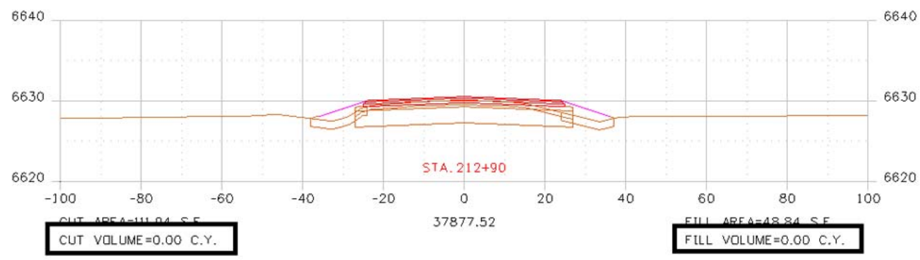


27. **<D> Volume Exceptions** in the End Area Volume explorer.
28. Select **208+15.83** for the ***Start Station***.
29. Select **212+89.50** for the Stop Station.
30. **<D> Add**.



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 16.5 - Volume Reports

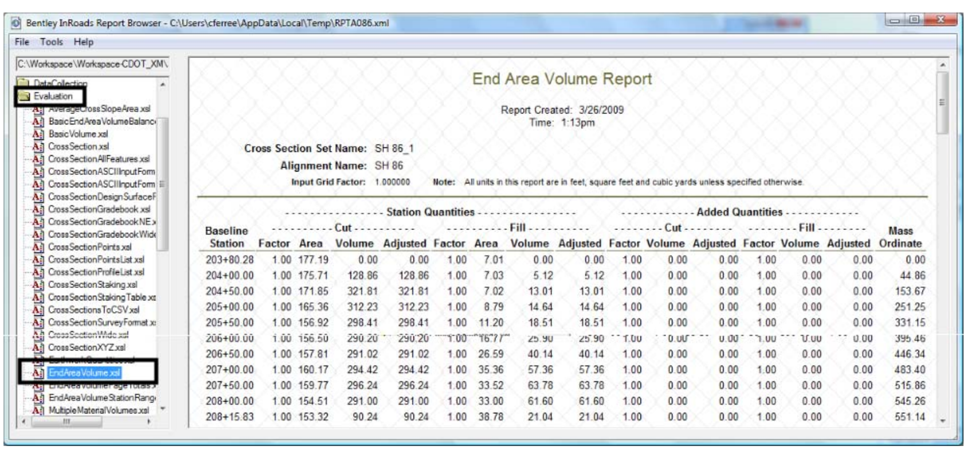
In addition to having volume information displayed on the cross sections, it can also be written to a tabular report. This exercise demonstrates how to create the report and the various templates used with the report.

The steps below create the XML data used for the report.

1. In the ***End Area Volumes*** dialog box, **<D> General** in the End Area Volume explorer.
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.

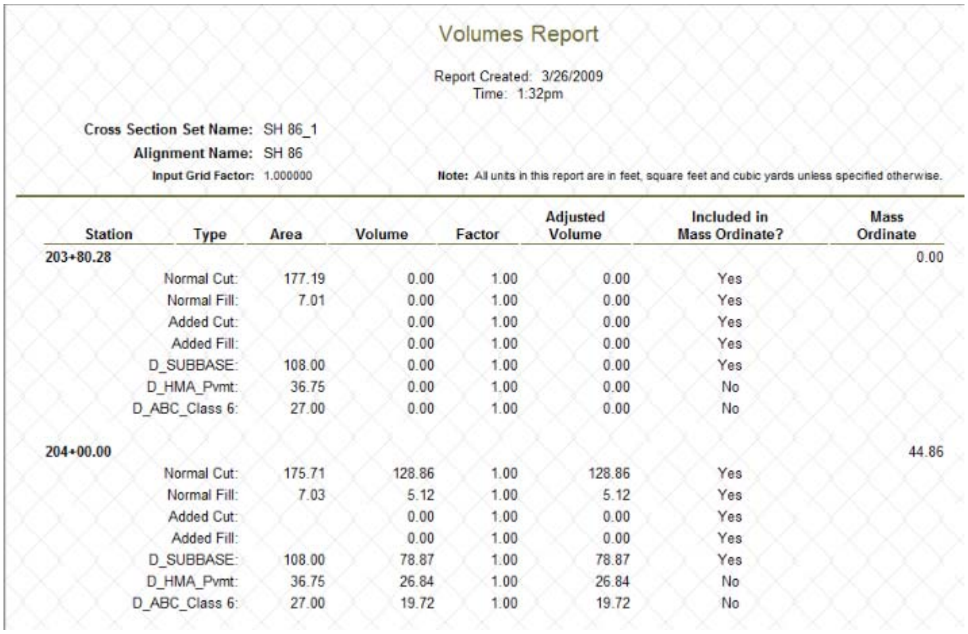


7. Examine the report in the right pane of the browser. This report only has a grand total line.
8. **<D>** on the **EndAreaVolumePageTotals.xsl** template.

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	

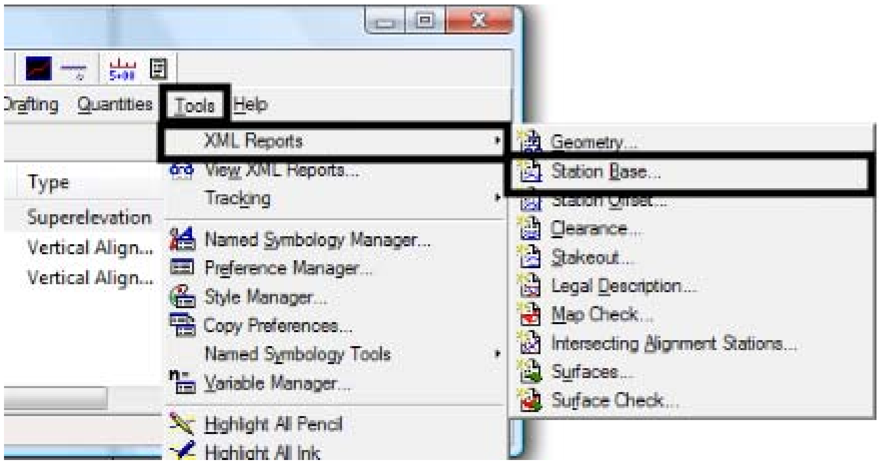
12. Close the ***Bentley InRoads Report Browser*** and all open dialog boxes (except the main InRoads dialog box).

Lab 16.6 - Station Base Reports

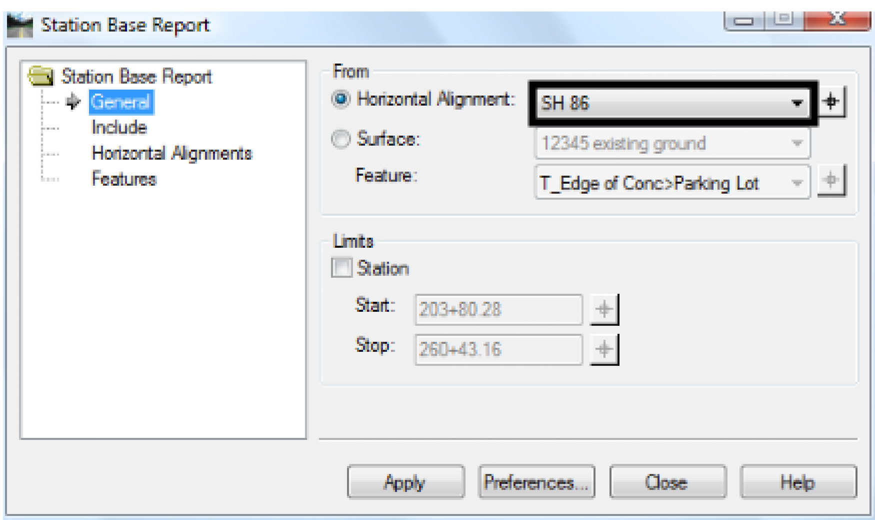
There are numerous other reports that can be generated from InRoads. they all function in a similar manner. This lab demonstrates the process of creating reports. The Geometry Station Base report is used for an example.

The Station Base report measures the offste distance from the active alignment to a specified alignment at given intervals along the active alignment. 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**.

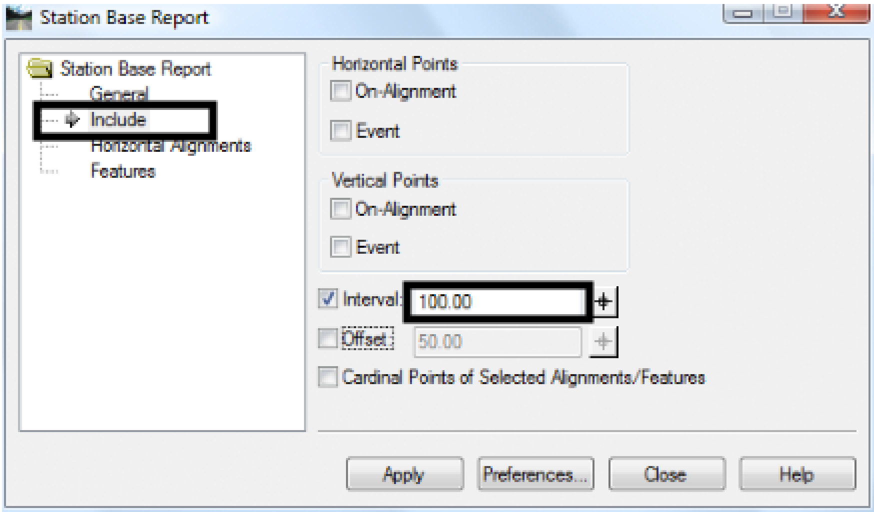


2. In the ***From*** area of the ***Station Base Report*** dialog box, note that the alignment ***SH 86*** is selected. Measurements are made perpendicular to this alignment.

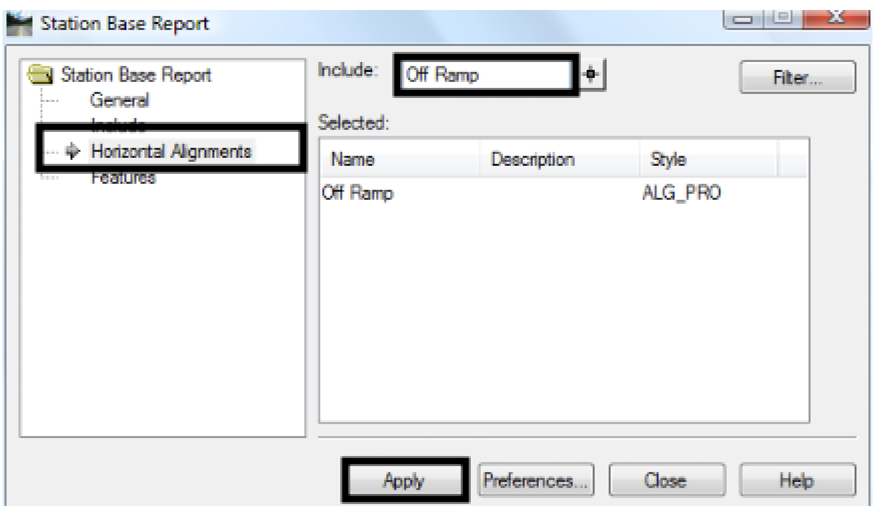


3. **<D> Include** from the ***Station Base Report*** explorer.

4. In the ***Interval*** field, key in **100**.

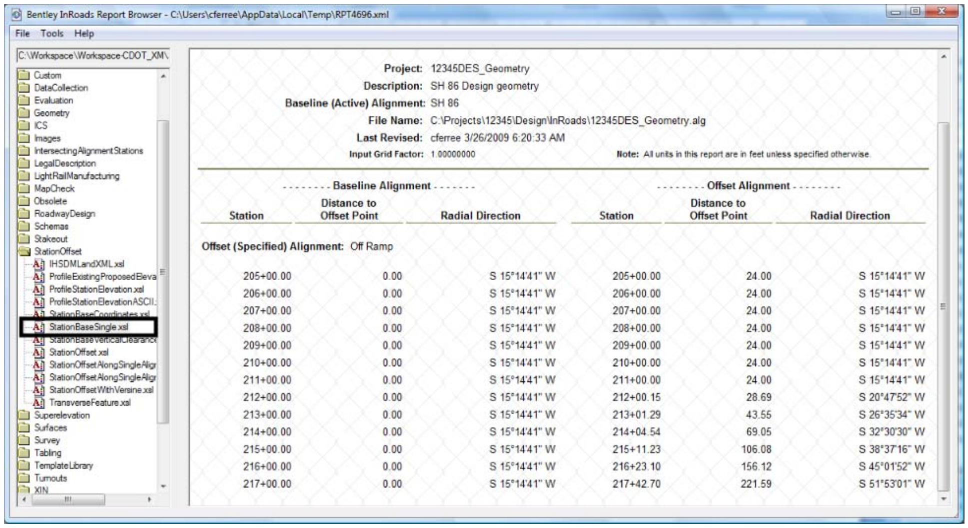


5. **<D> Horizontal Alignments** from the ***Station Base Report*** explorer.
6. In the ***Include*** field, key in ***Off Ramp***. Press the ***Tab*** key to accept the entry.
7. **<D> Apply**. This displays the ***Bentley InRoads Report Browser.***



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.

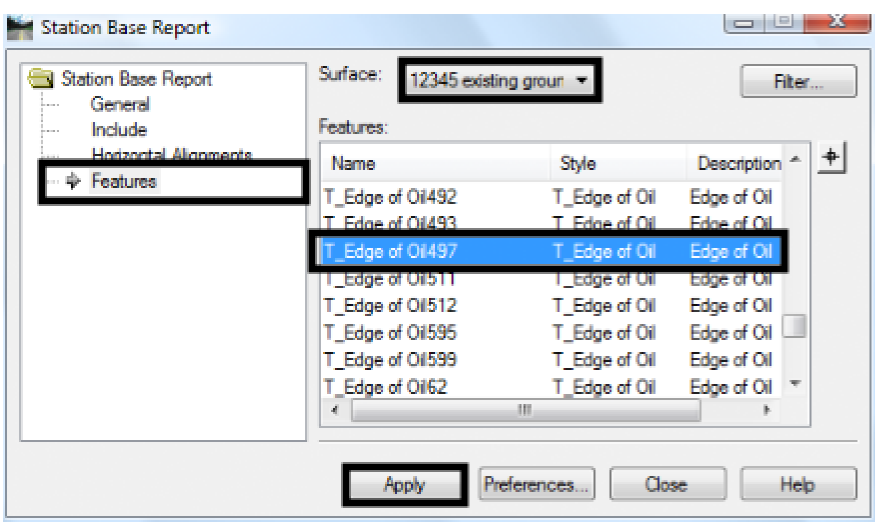
12. In the ***Include*** field, key in a space and press the ***Tab*** key to accept the entry. This clears the ***Selected*** list.

13. **<D> Features** in the explorer.

14. Select **12345 Existing Ground** for the ***Surface***.

15. In the ***Features*** list, Highlight **T_Edge of Oil497**.

16. **<D> Apply**.



17. In the ***Bentley InRoads Report Browser,* <D>** the **StationBaseSingle.xls**.

18. 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

19. Close the ***Bentley InRoads Report Browser*** and all open dialog boxes (except the main InRoads dialog box).

20. Save the InRoads project then close InRoads.

Chapter Summary:

- In *Lab 16.1 -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 16.2 -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 16.3 -Unsuitable Material* an area of unsuitable material was defined using the station method. This was used to modify the volume calculation.
- In *Lab 16.4 -Volume Exceptions* A set of custom cross sections was created, then a volume exception was defined.
- In *Lab 16.5 -Volume Reports* the various templates for End Area Volume reports were examined.
- In *Lab 16.6 -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 17 - 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\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 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.

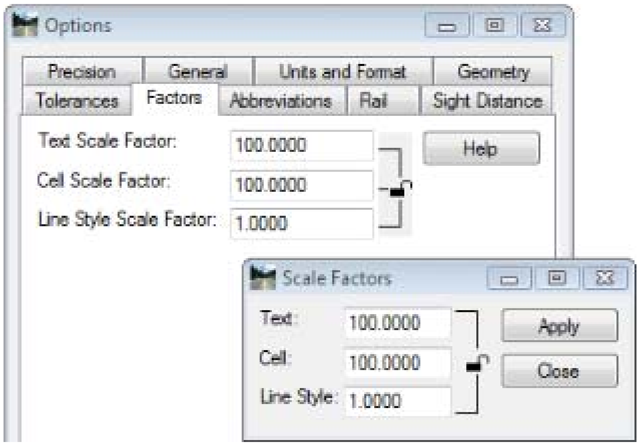
Lab 17.1 - Creating 100 Scale P and P Sheets

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 **Tools > 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.

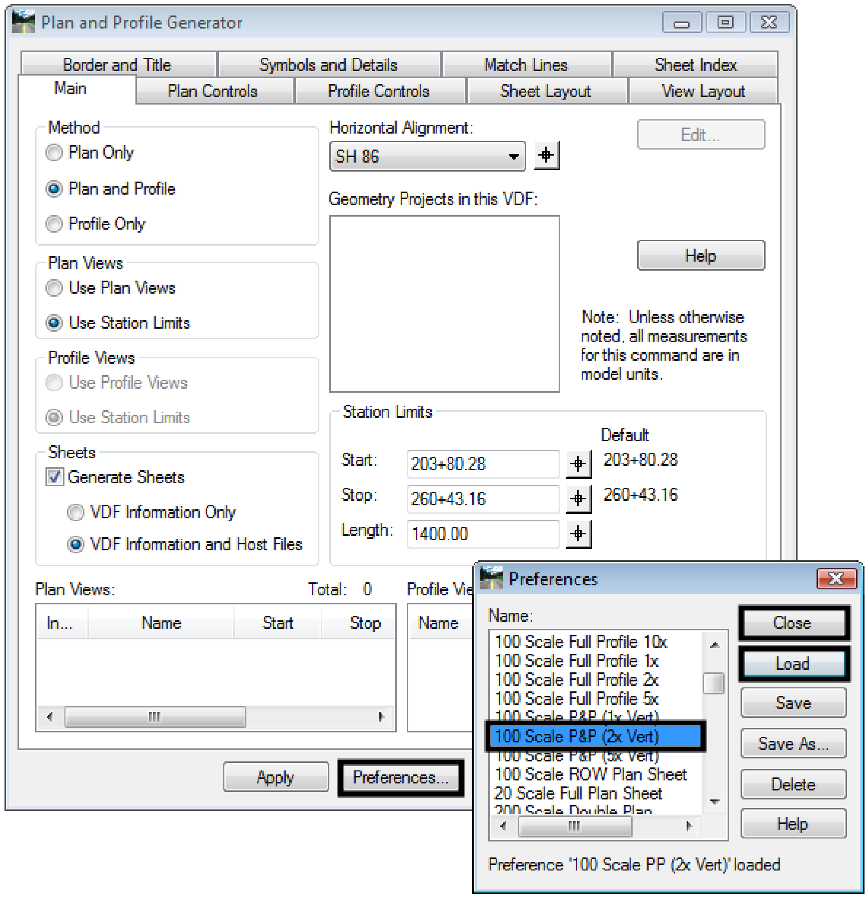


3. **<D> Apply** then **Close**.

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.**

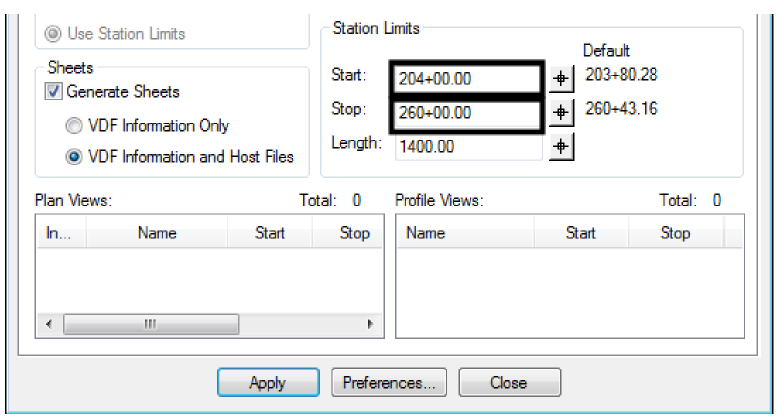
8. **<D> Close.** This dismisses the Preferences dialog box.



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.

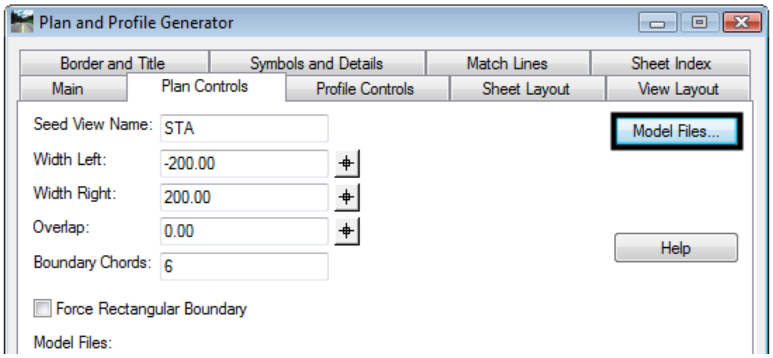
9. Back on the ***Main*** tab, in the Station Limits area, key in ***204+00.00*** for the ***Start*** station.

10. key in ***260+00.00*** for the ***Stop*** station.

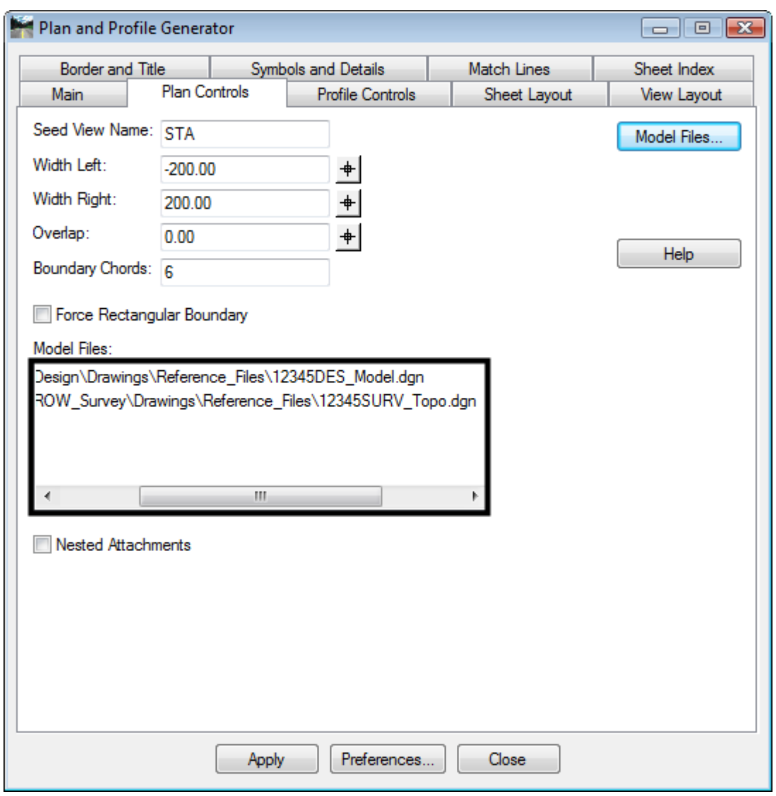


Reference files that make up the plan portion of the sheets are selected from the Plan Controls tab. The following steps are used to select the desired files.

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.

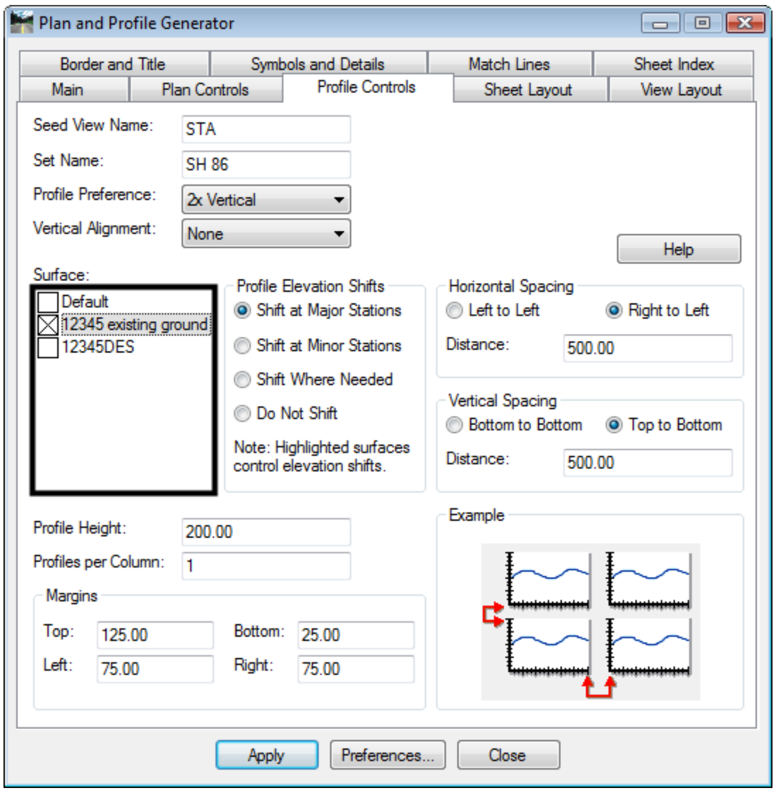


The Profile controls tab determines how the profiles will be displayed. Most of the settings are by the selected preference, however, it is a good idea to check the Surface area and make sure it is set up as desired. In this exercise, only the existing ground is to be displayed in the profile so it is 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. In the ***Surface*** area, toggle off all surfaces except ***12345 existing ground***.

20. Verify that the surface ***12345 existing ground*** is toggled on and highlighted. The illustration below shows the tab as completed.



With the exception of the Host File, the Sheet Layout tab is set by the prererence 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.

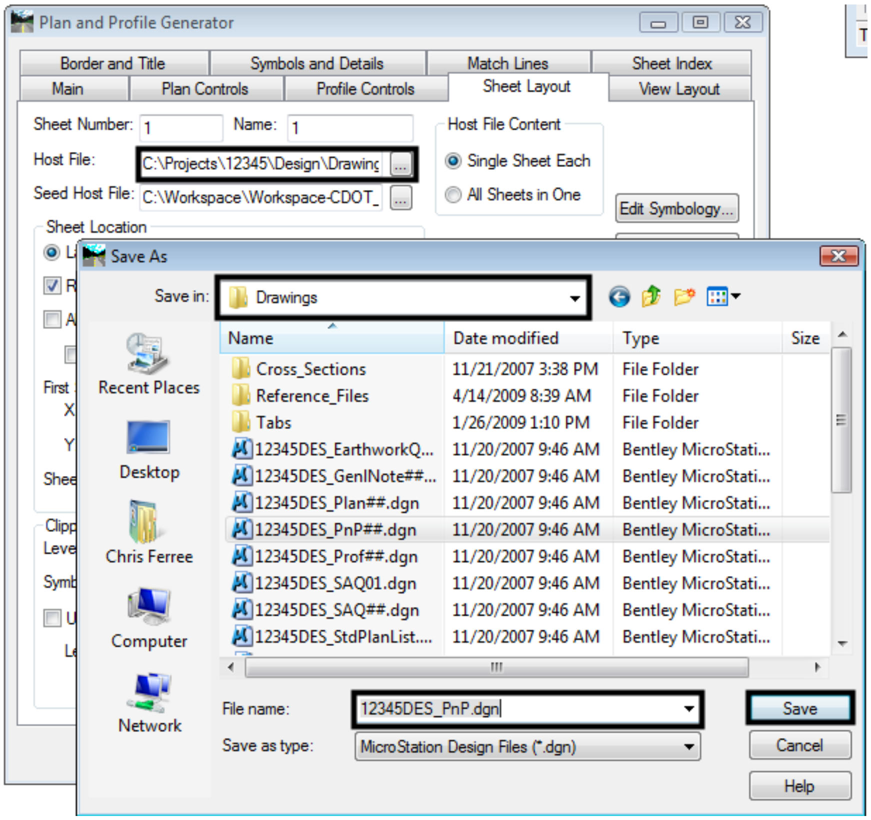
21. **<D>** the **Sheet Layout** tab.

22. **<D>** in the ***Host File*** field, then **<D>** the  button. This displays the ***Save As*** dialog box.

23. In the ***Save As*** dialog box, navigate to the ***C:\Projects\12345\Design\Drawings*** folder.

24. In the ***File Name*** field, key in ***12345DES_PnP.dgn***.

25. **<D>** the **Save** button. This dismisses the ***Save As*** dialog box adds the file name to the ***Host file*** field.

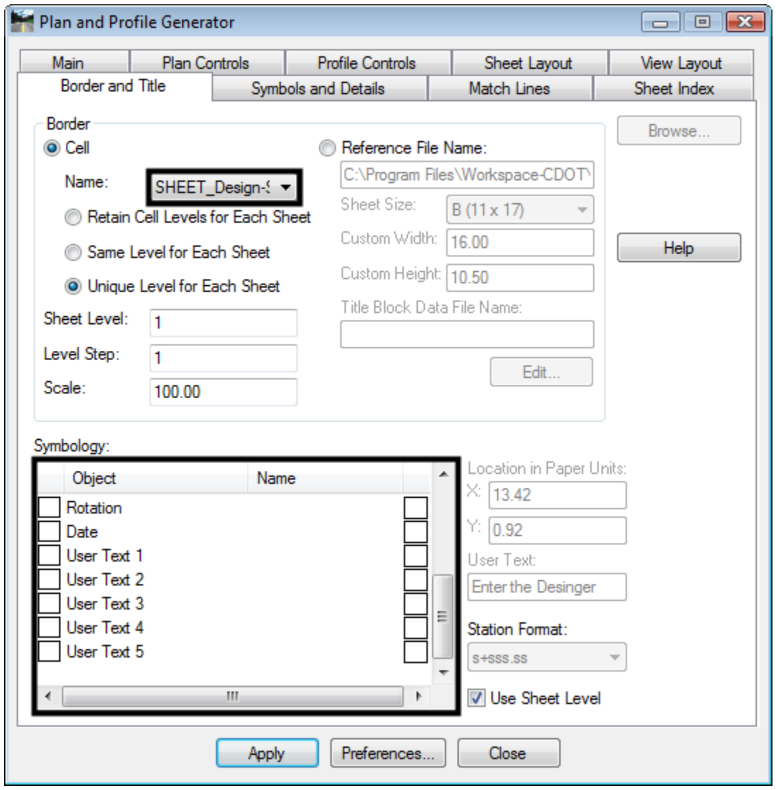


The Border and Title tab identifies the cell used for the sheet border. This tab should be checked to ensure that the proper border cell is being used. Also check to make sure that all of the toggles in the symbology area are turned off. If left on, erroneous data could be displayed on the sheets.

26. **<D>** the **Border and Title** tab.

27. Verify that the **Sheet_Design-Sheet** cell is selected for the cell ***Name***.

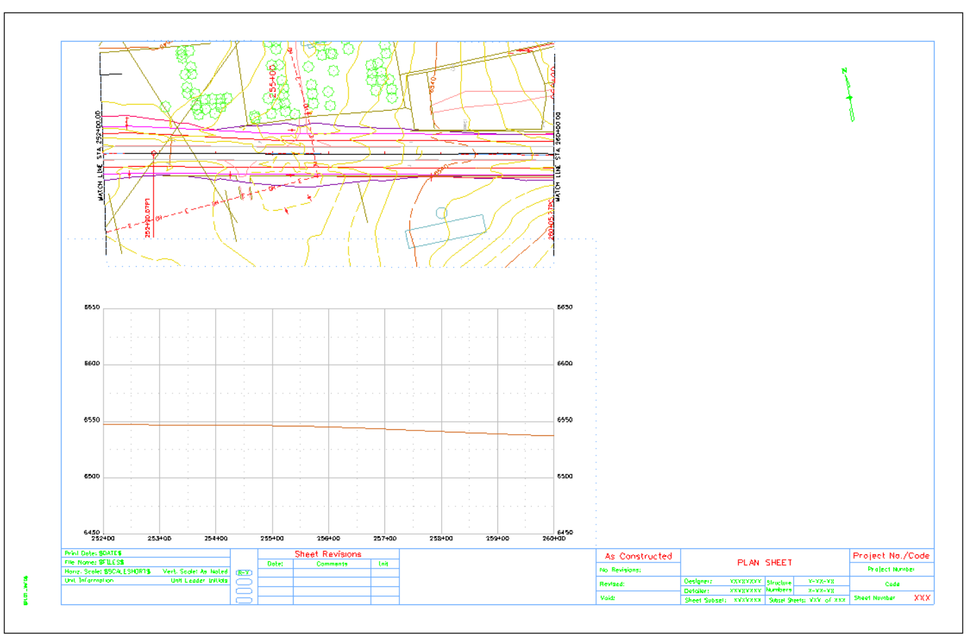
28. Verify that all of the check boxes in the ***Symbology*** area are toggled off.



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

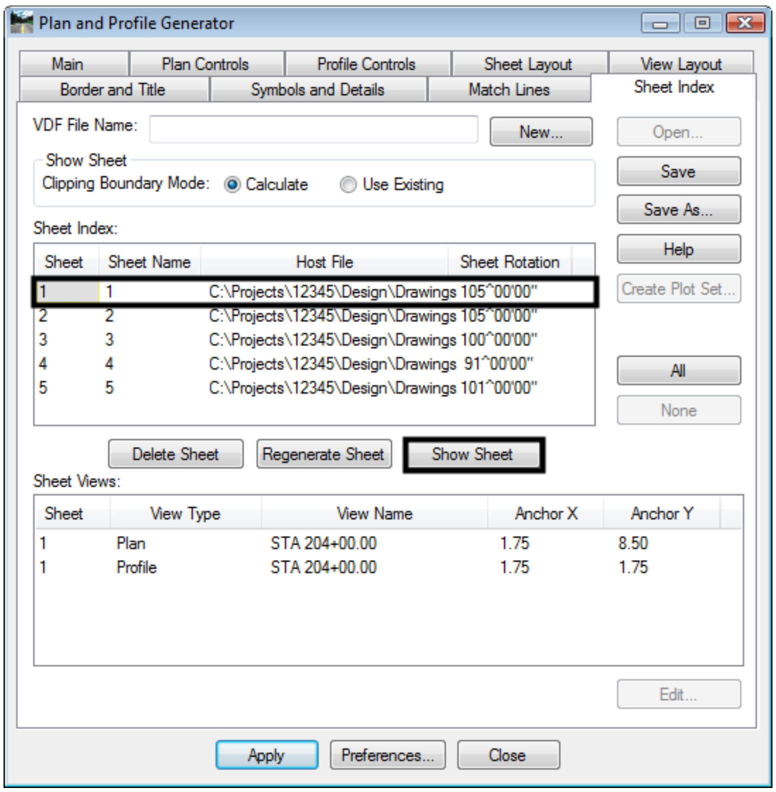
30. **<D>** in the MicroStation view window.

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.

31. **<D>** the **Sheet Index** tab.
32. Highlight sheet **1** in the ***Sheet Index*** list.
33. **<D>** the **Show Sheet** button.



34. Repeat steps 31 and 32 for the remaining sheets.

Lab 17.2 - 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:

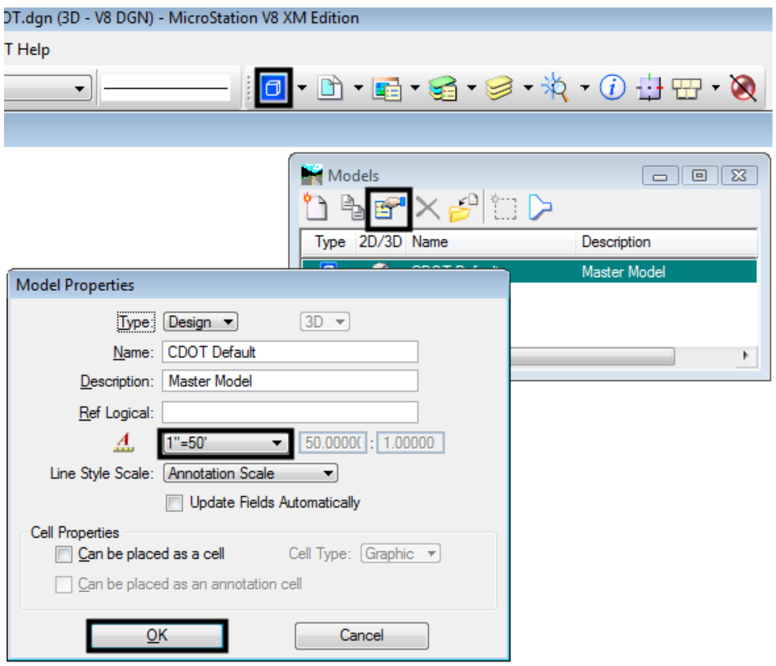
C:\Workspace\Workspace-CDOT_XM\Standards-Global\MicroStation\Seed\3D-Seed_CDOT.dgn

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.

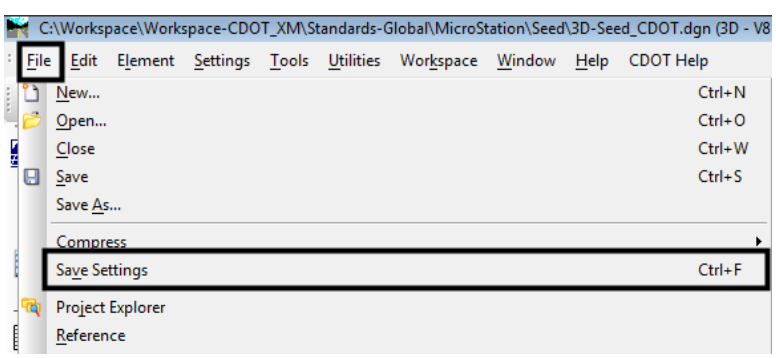
5. **<D> OK**. This dismisses the ***Model Properties*** dialog box.



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**.



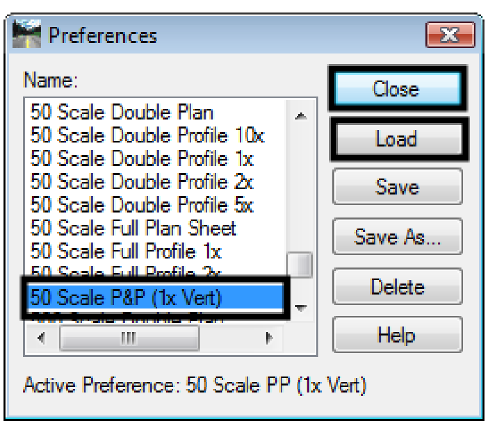
Note: The changes to the seed file only last until the computer is logged off. At the next log in, the settings revert back their original state. The sheets created from the seed file maintain the changes.

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.

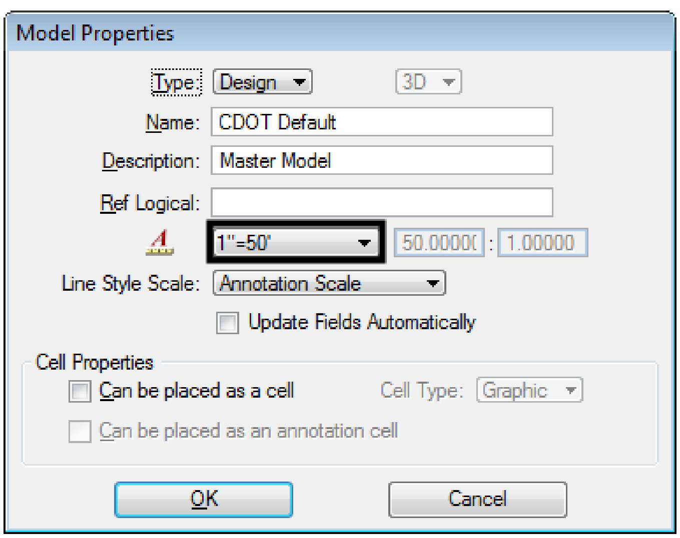


Except for the Host File name, the user defined settings are still active and are used for this lab. To set the Host File name:

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 ProfileViews?"*** 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.

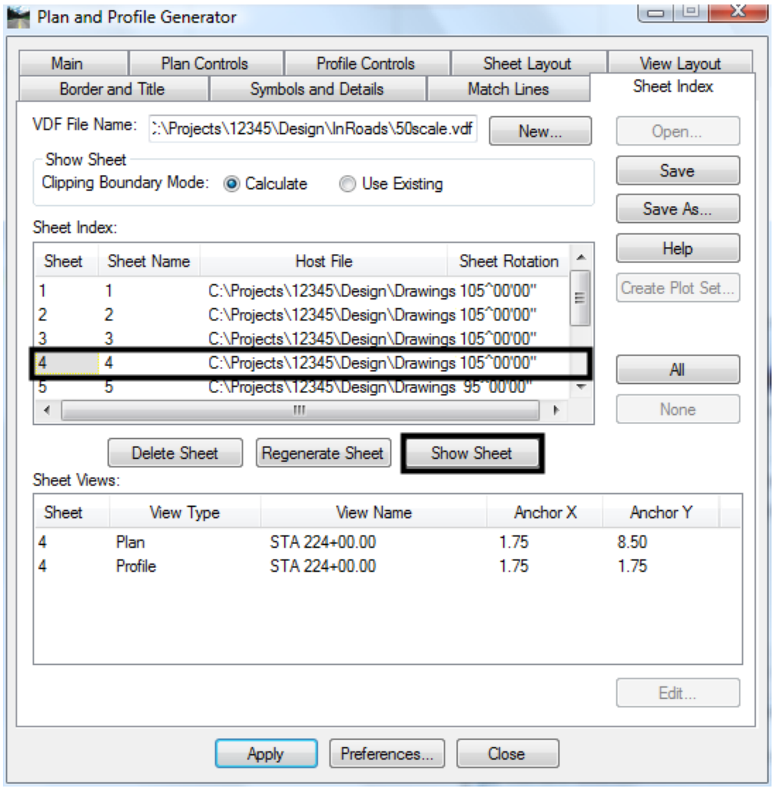
Lab 17.3 - Edit Sheet Extents

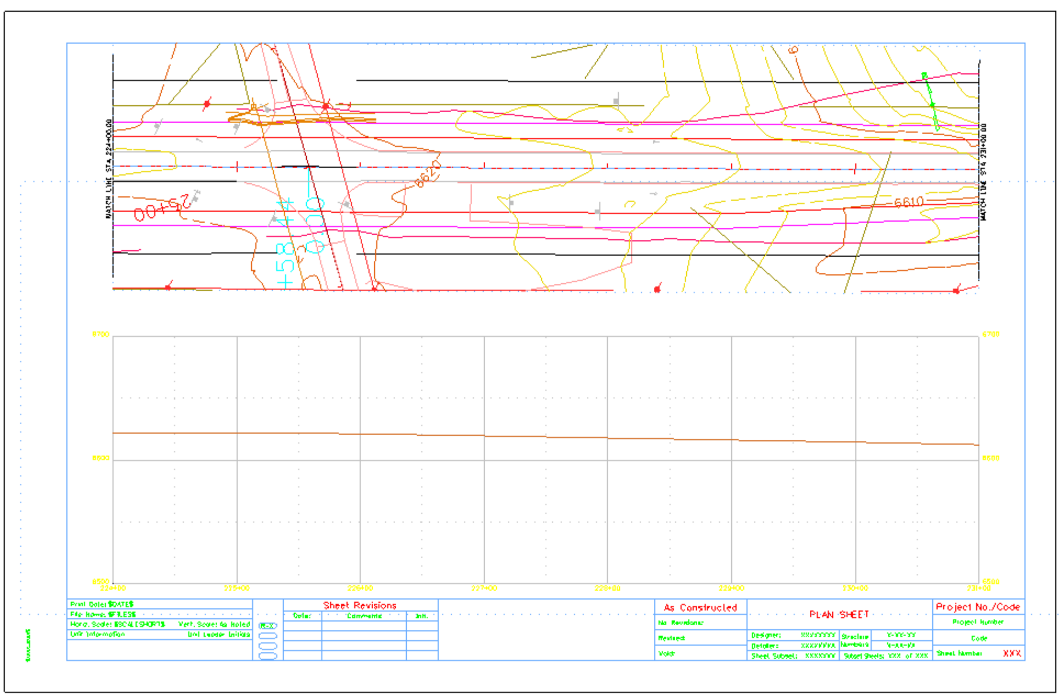
After examining the sheets created in the last lab, the intersection on sheet 4 should be centered on the sheet. In this lab, the sheet extents are changed to center the intersection.

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.



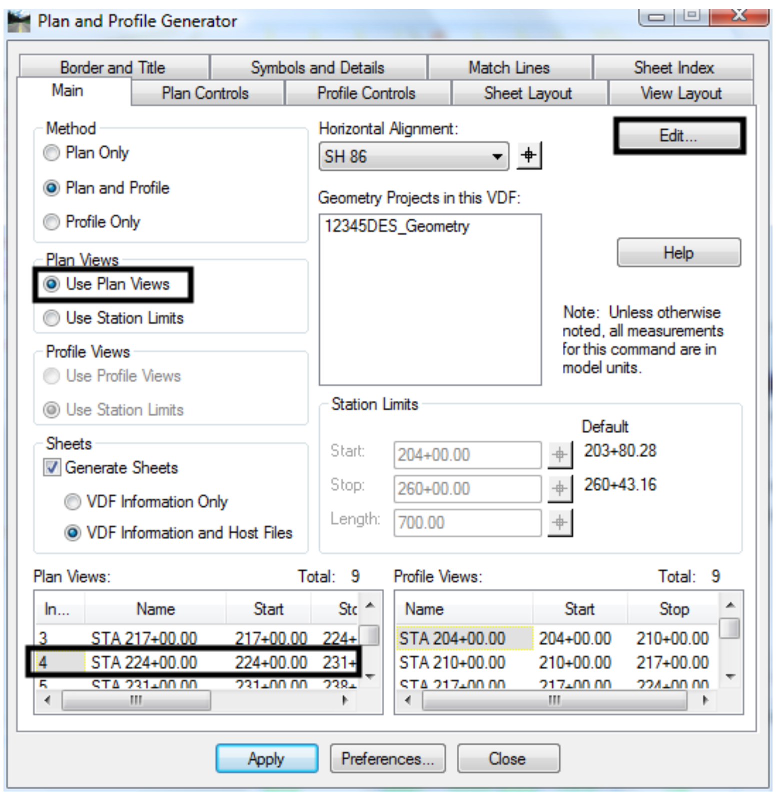


Examining sheet 4 shifting two stations (200 feet) to the left centers the intersection.

4. Open the ***C:\Projects\12345\Design\Drawing\Reference Files\12345DES_Prof.dgn*** file.
5. Delete the previously displayed profiles.

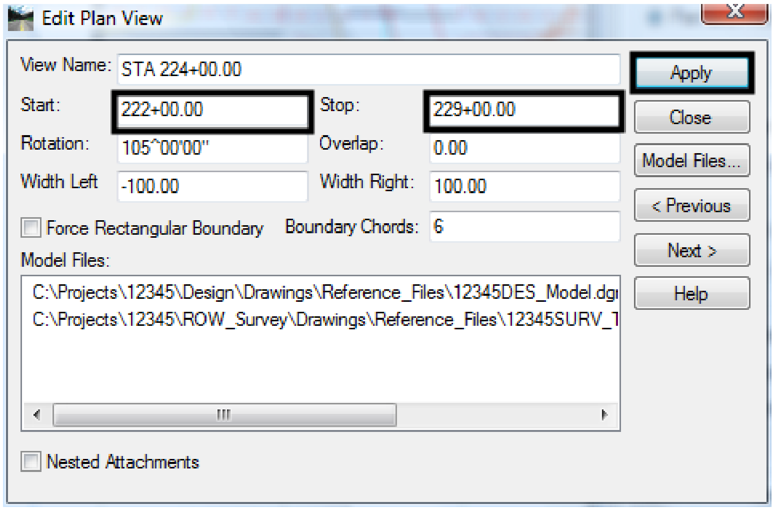
Plan and Profile Generator can be used to specify the station extents of any sheet. Here, sheet 4 is adjusted to center the intersection and the other sheets will automatically be changed to match. The steps below update the station extents on sheet 4.

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.

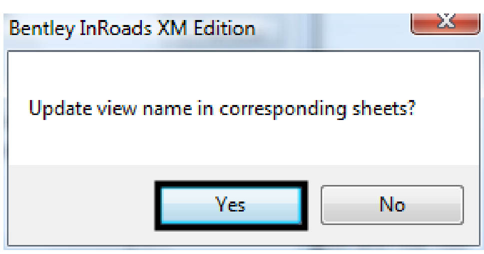


The next steps update the remaining sheets to match the changes made to sheet 4.

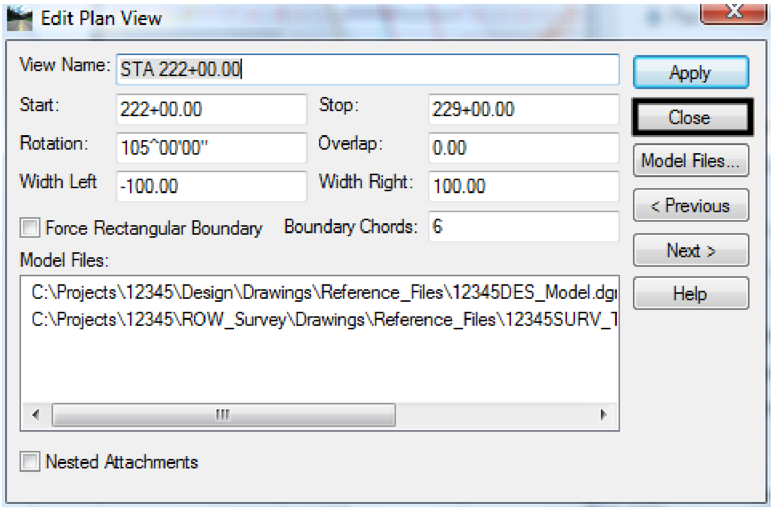
13. In the ***Adjust Plan Views*** dialog box, toggle on **Adjust all views to maintain view lengths**.

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.

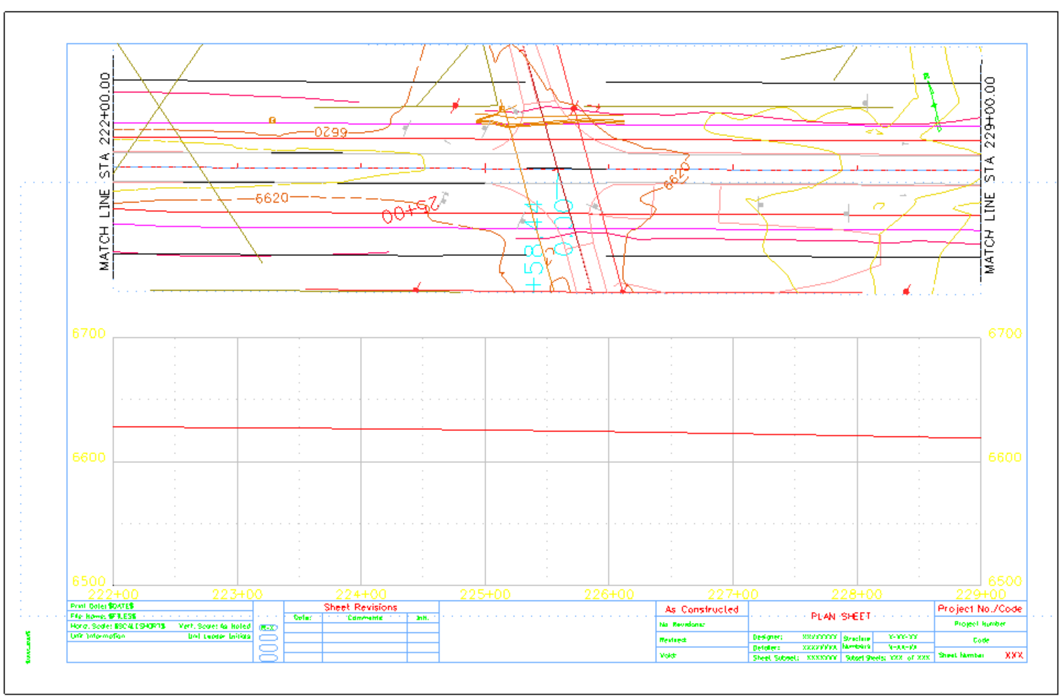
Finally, the steps below regenerate the sheets.

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.

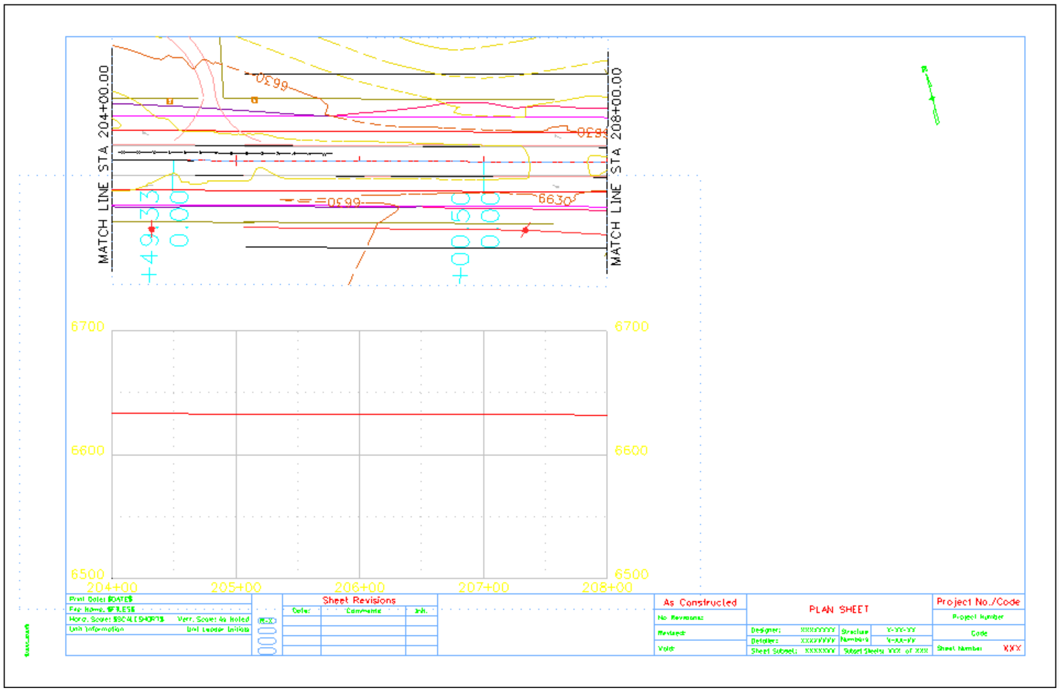


Lab 17.4 - Moving Reference Files Within the Sheet Border

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.

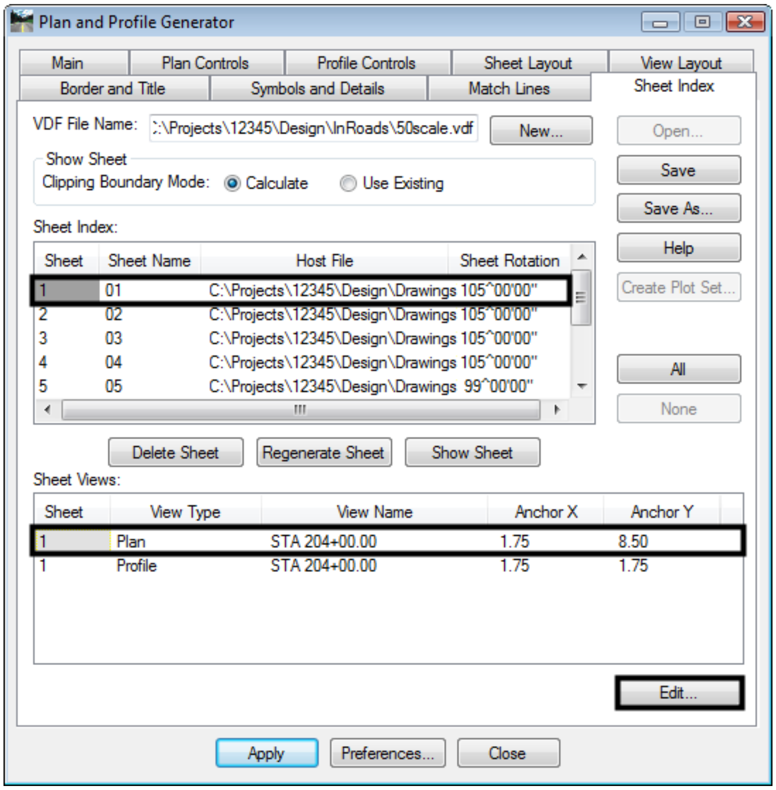
1. Examine sheet 1, as described at the first of the lab. The illustration below shows sheet 1. The reference files for the plan and profile need to be shifted 300 feet or 6" (paper scale) to the right.



2. On the Plan and Profile Generator's ***Sheet Index*** tab, highlight sheet **1** in the ***Sheet Index*** list.

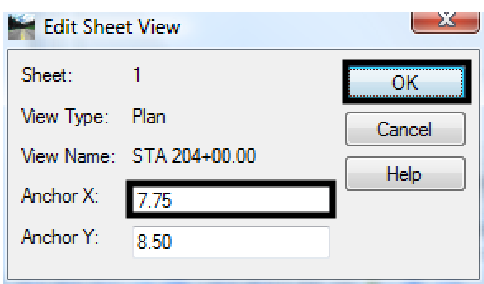
3. In the ***Sheet Views*** list, highlight sheet **1 Plan.**

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.

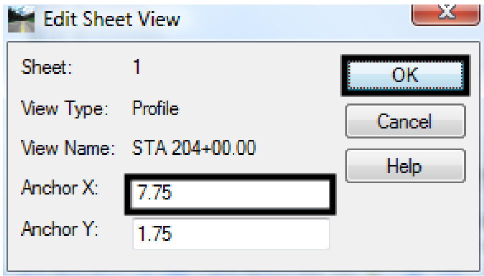


7. In the ***Sheet Views*** list, highlight sheet **1 Profile.**

8. **<D> Edit**. This displays the ***Edit Sheet View*** dialog box.

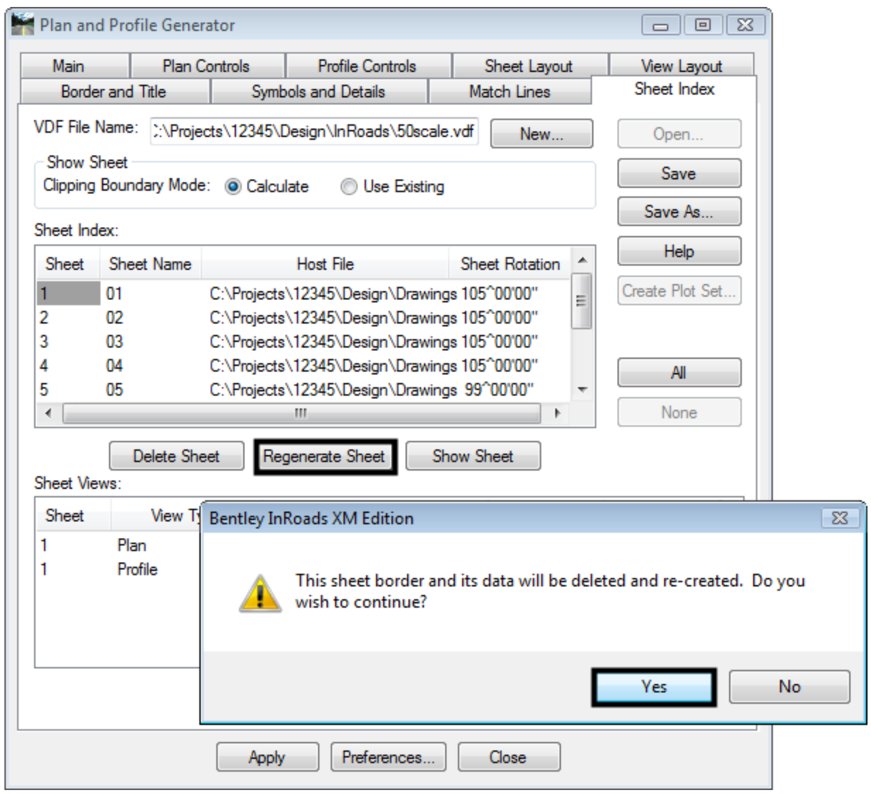
9. **In the *Anchor X* field, key in *7.75*.**

10. **<D> OK**.

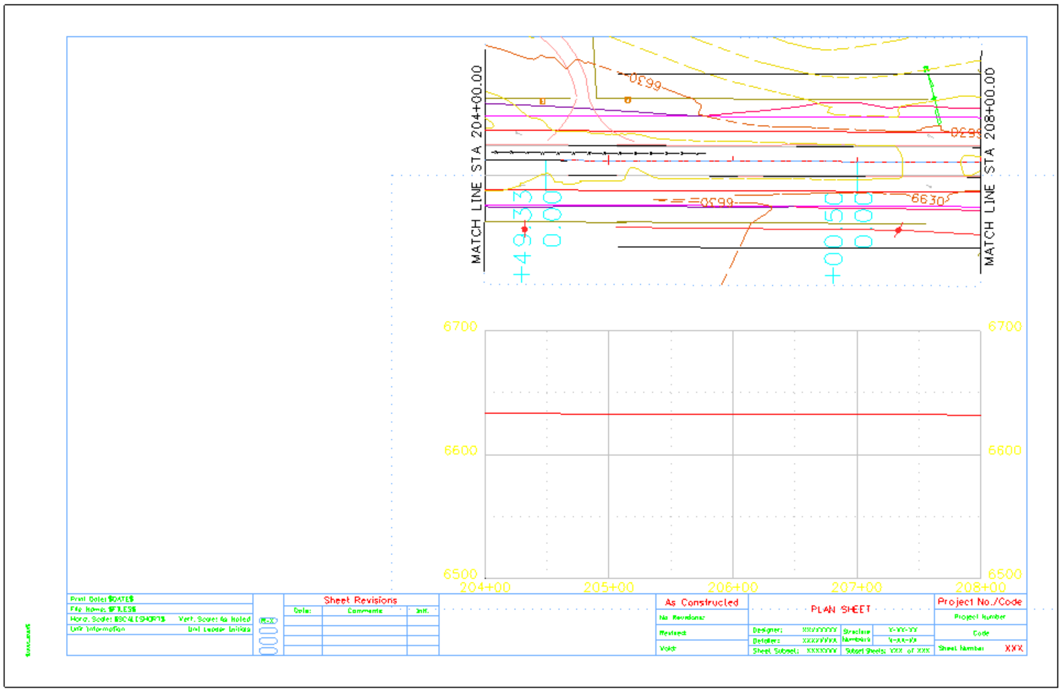


11. **<D>** the **Regenerate Sheet** button.

12. **<D> Yes** on the message box that is displayed.



The sheet now looks like the illustration below.

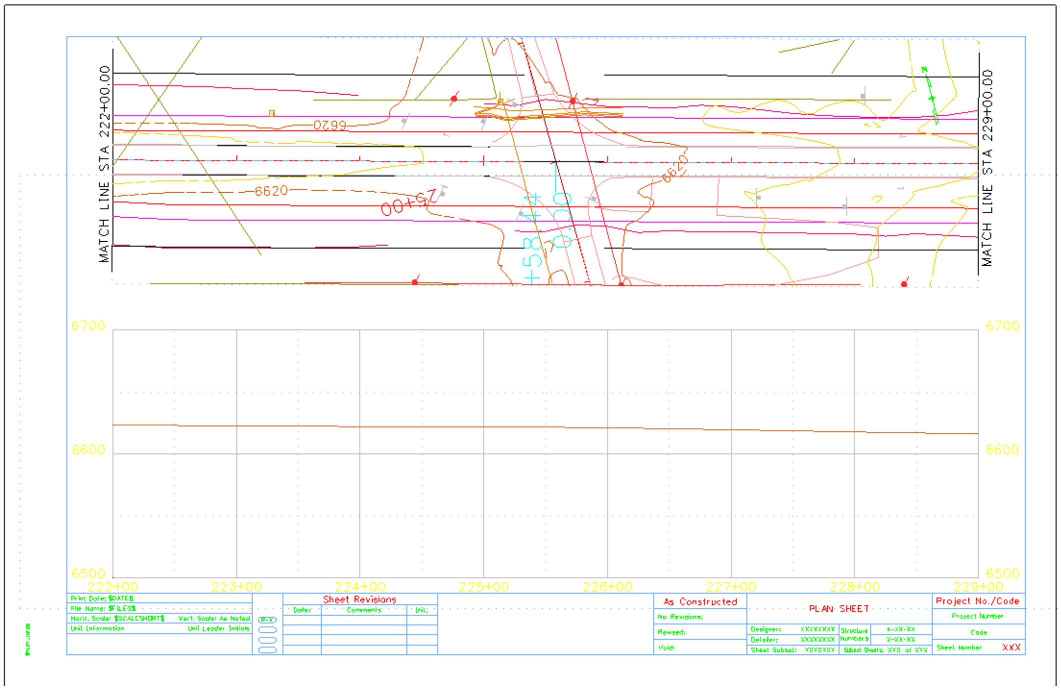


Lab 17.5 - Adding a Model File to a Single Sheet

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.

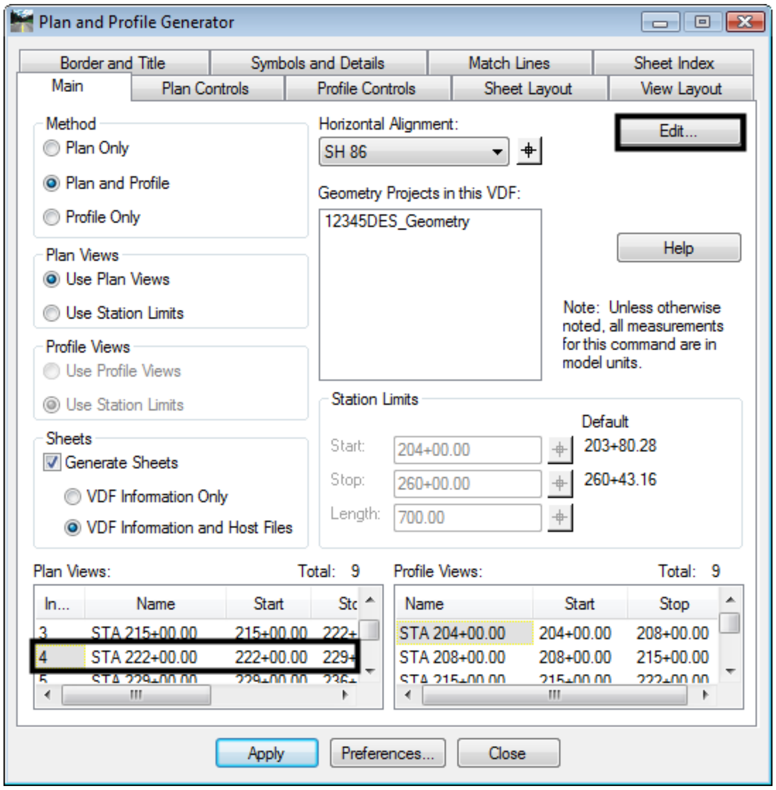
1. Examine sheet 4, as described at the first of the lab. The illustration below shows sheet 4.



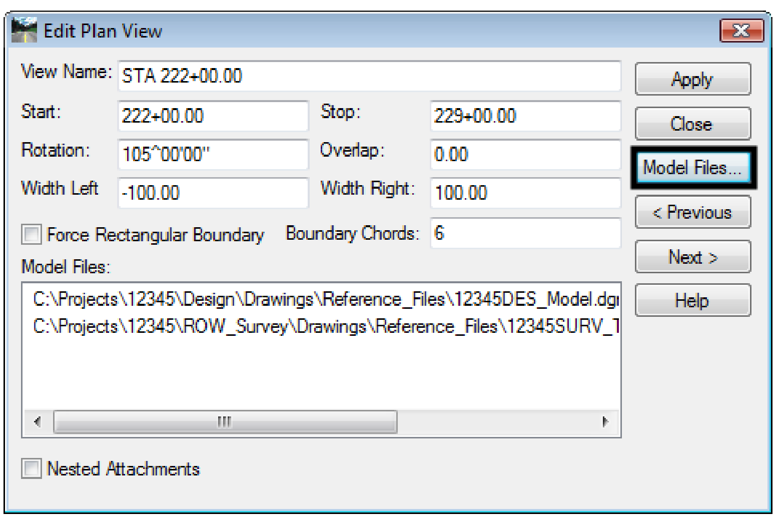
Additional models are added from the Edit options on the Main tab of the Plan and Profile Generator dialog box. The steps below illustrate this process.

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.



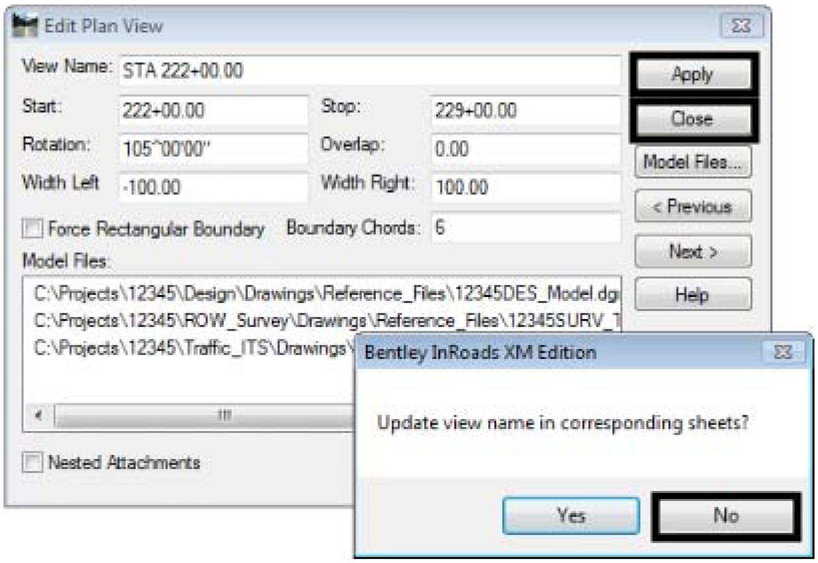
5. In the ***Edit Plan Views*** dialog box, **<D>** the **Model Files** button.



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.

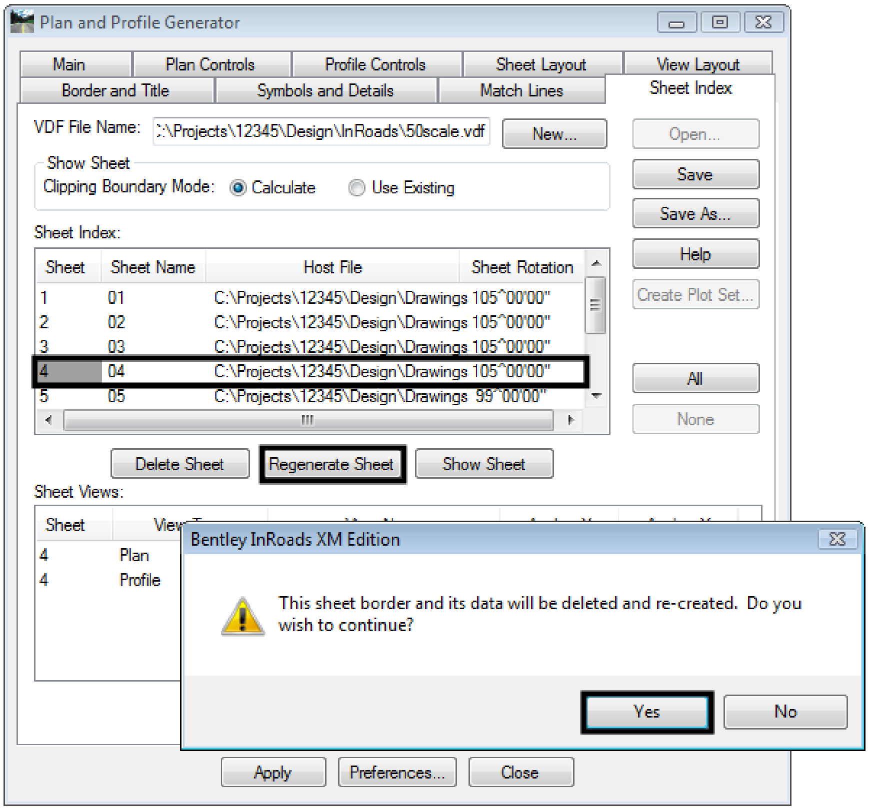
10. **<D> No** in the message box that is displayed.
11. **<D> Close** to dismiss the ***Edit Plan View*** dialog box.



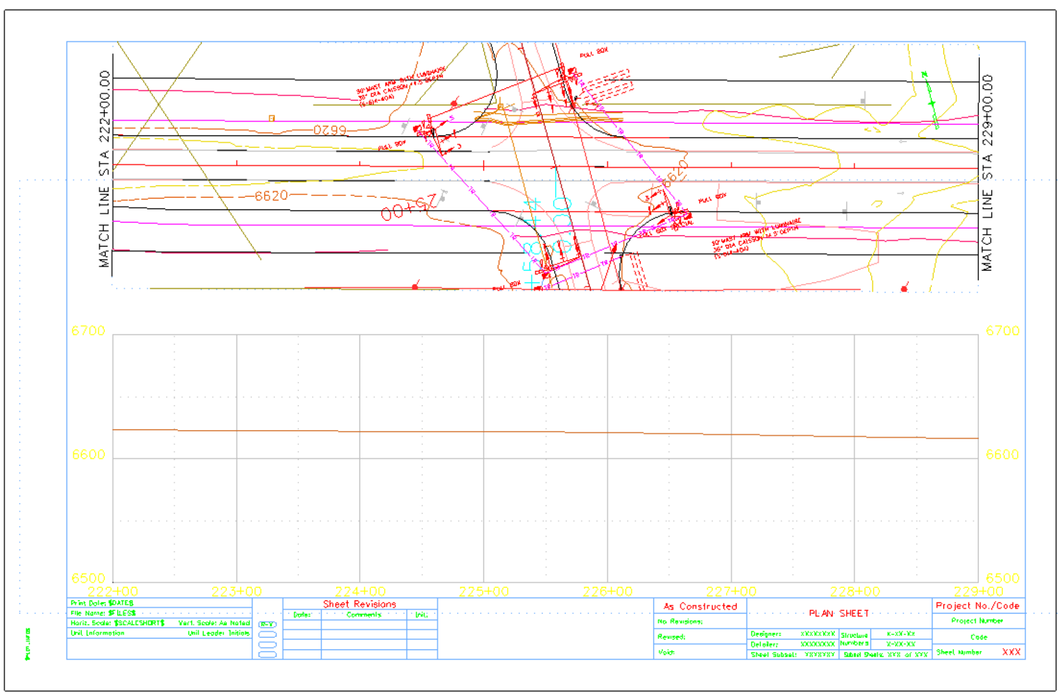
Since the added model file only affects on sheet (sheet 4), there is no need to generate a new complete set. Instead, only sheet 4 is updated. The steps below are used to update the sheet.

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.

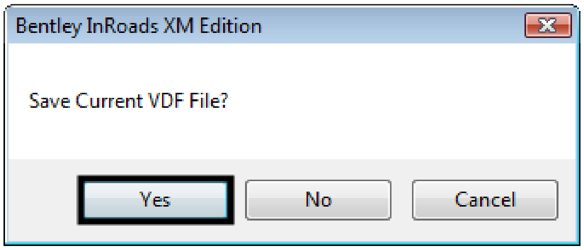


The sheet now looks like the illustration below.



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 17.1 -Creating 100 Scale P and P Sheets* the input data for the initial 100 scale Plan and Profile Generator run was described
- In *Lab 17.2 -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 17.3 -Edit Sheet Extents* the sheet extents for the 50 scale plans were modified to center the intersection and the sheets were regenerated
- In *Lab 17.4 -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 17.5 -Adding a Model File to a Single Sheet* a traffic signal plan model file was added to sheet 4 only

LAB 18 - Tab Sheets

This lab demonstrates the functionality build 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:

- 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.

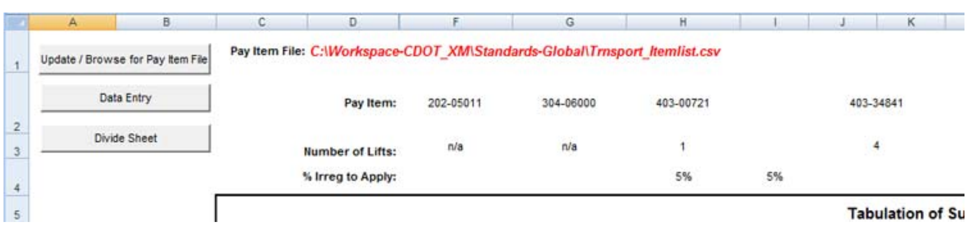
The files used in this lab are:

- C:\Projects\12345\Design\Drawings\Tabs\12345DES_Tabulation of Surfacing.xls
- C:\Projects\12345\Design\Drawings\12345DES_TabMisc##.dgn

Lab 18.1 - Update the Pay Item File location

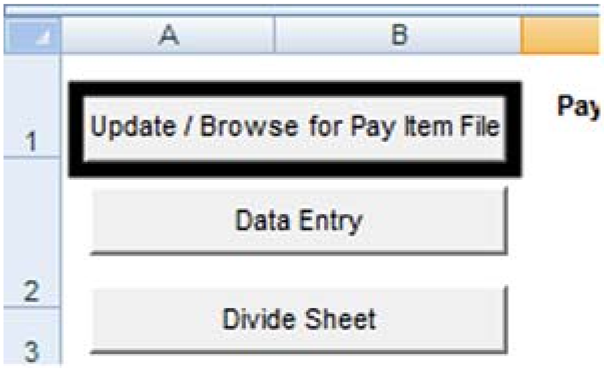
In order for the tab sheet to function properly, it must access the Trnsport_Itemlist.csv file. The location of this file is specified in cell D1 of the Surfacing Sheet worksheet. This exercise demonstrates how to select the the Trnsport_Itemlist.csv file's location.

1. Start Excel and select **File > Open**.
2. In the ***Open*** dialog box, navigate to ***C:\Projects\12345\Design\Drawings\Tabs***.
3. Highlight the **12345DES_Tabulation of Surfacing.xls** file and **<D> Open**.

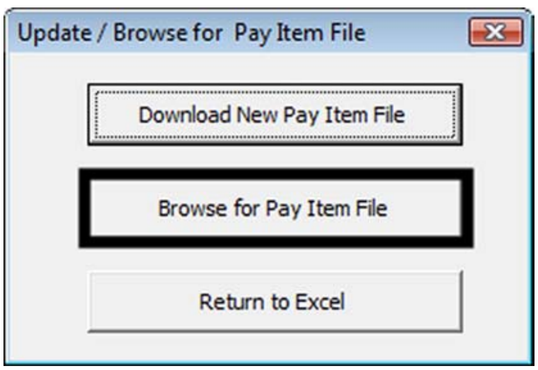


Notice that the text for the Pay Item File is red. This indicates that the file is not found. Without this file, additional pay items cannot be added. To locate the Trnsport_Itemlist.csv file:

4. **<D>** the **Update / Browse for Pay Item File** button. This displays the ***Update / Browse for Pay Item File*** dialog box.

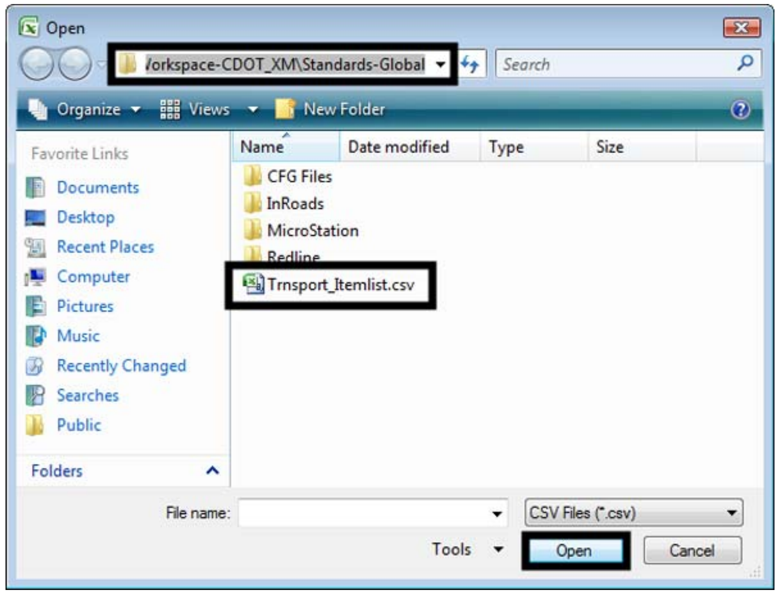


5. **<D>** The **Browse for Pay Item File** button. This displays the ***Open*** dialog box.

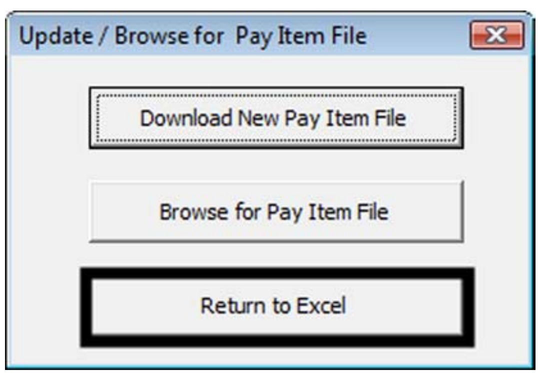


6. Navigate to the ***C:\Workspace\Workspace-CDOT_XM\Standards-Global*** directory.

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.

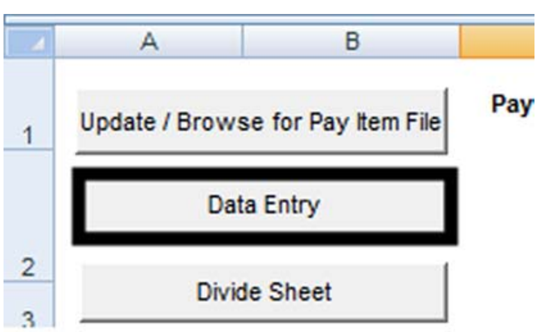
Lab 18.2 - Adding a Pay Item

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.

	Pay Item:	202-05011	304-06000	403-00721	403-34841			
	Number of Lifts:	n/a	n/a	1	4			
	% Irreg to Apply:			5%	5%			
Tabulation of Surfacing								
Station		Sawing Concrete (10.5 Inch)	Aggregate Base Course (Class 6)	Hot Mix Asphalt (Patching) (Asphalt)	Hot Mix Asphalt (Grading SX) (100) (PG 64-22)			
		LF	TON	SY	TON			
From	To			Bottom	Bottom	Lift 2	Lift 3	Top
1+00	5+00							
5+00	12+00							
12+00	19+00							
19+00	26+00							
26+00	31+00							
31+00	38+00							
38+00	45+00							
45+00	52+00							
52+00	59+00							
59+00	66+00							
66+00	73+00							
73+00	80+00							
80+00	87+00	24	890		488	366	366	366
87+00	94+00		890		488	366	366	366

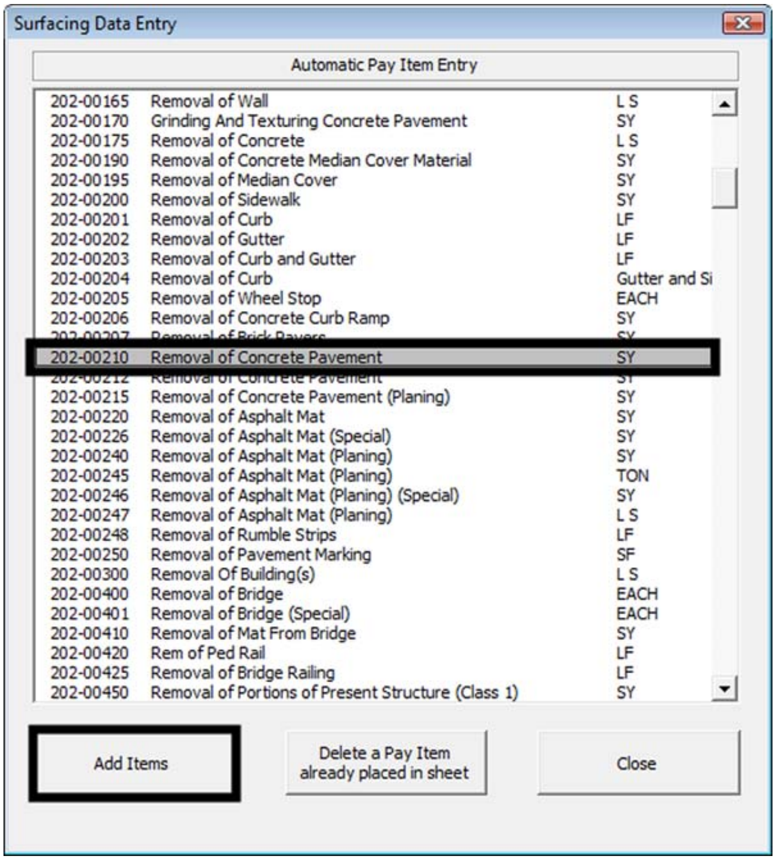
The illustration above shows the sheet before adding the column.

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.

	Pay Item:	202-00210	202-05011	304-06000	403-00721	403-34841			
	Number of Lifts:	n/a	n/a	n/a	1	4			
	% Irreg to Apply:				5%	5%			
						Tabulation of Surfacing			
Station		Removal of Concrete Pavement	Sawing Concrete (10.5 Inch)	Aggregate Base Course (Class 6)	Hot Mix Asphalt (Patching) (Asphalt)	Hot Mix Asphalt (Grading SX) (100) (PG 64-22)			
		SY	LF	TON	SY	TON			
From	To				Bottom	Bottom	Lift 2	Lift 3	Top
1+00	5+00								
5+00	12+00								
12+00	19+00								
19+00	26+00								
26+00	31+00								
31+00	38+00								
38+00	45+00								
45+00	52+00								
52+00	59+00								
59+00	66+00								
66+00	73+00								
73+00	80+00								
80+00	87+00		24	890		488	366	366	366
87+00	94+00			890		488	366	366	366

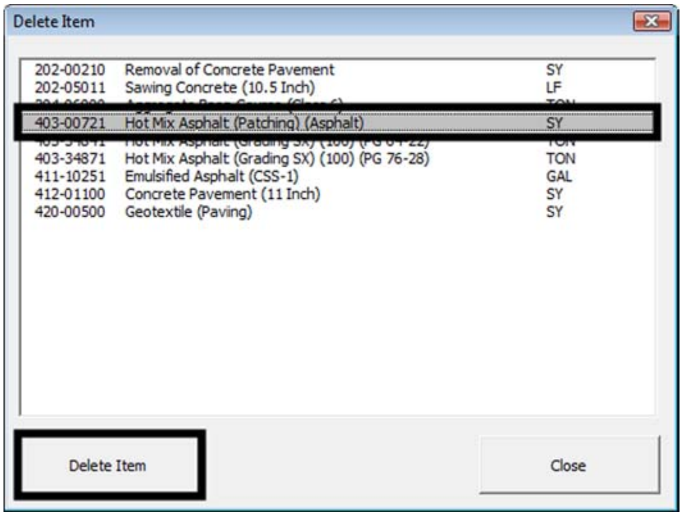
The illustration above shows the sheet after the new column is added.

Lab 18.3 - 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.

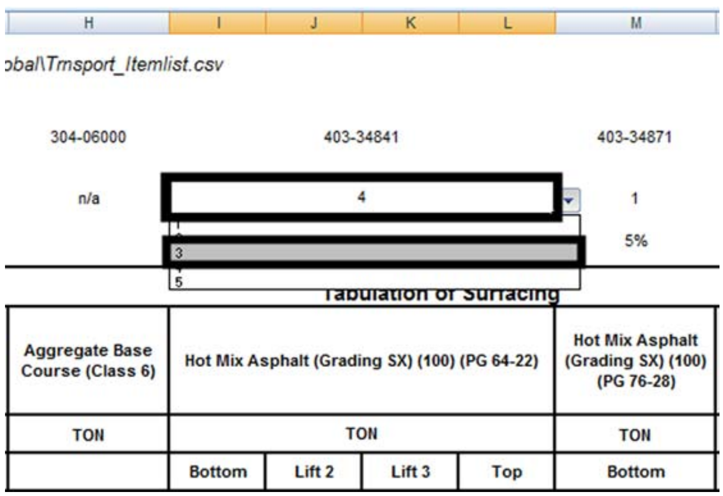
Notice that the patching asphalt column is gone and the columns to the right have shifted over. The illustration below shows the final layout.

	Pay Item:	202-00210	202-05011	304-06000		403-34841		
	Number of Lifts:	n/a	n/a	n/a		4		
	% Irreg to Apply:				5%			
Tabulation of Surfacing								
Station		**Removal of Concrete Pavement**	**Sawing Concrete (10.5 Inch)**	**Aggregate Base Course (Class 6)**	**Hot Mix Asphalt (Grading SX) (100) (PG 64-22)**			
		SY	**LF**	**TON**	**TON**			
From	**To**				**Bottom**	**Lift 2**	**Lift 3**	**Top**
1+00	5+00							
5+00	12+00							
12+00	19+00							
19+00	26+00							
26+00	31+00							
31+00	38+00							
38+00	45+00							
45+00	52+00							
52+00	59+00							
59+00	66+00							
66+00	73+00							
73+00	80+00							
80+00	87+00		24	890	488	366	366	366

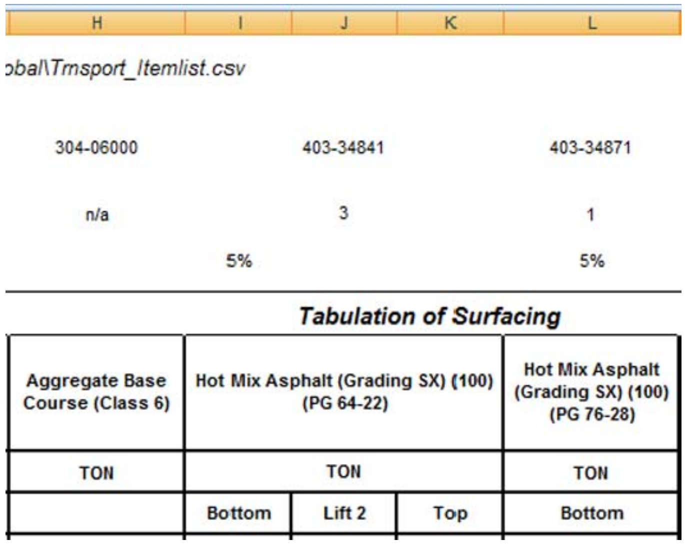
Lab 18.4 - Additional Fields Associated with HMA Pay Items

Unlike concrete, asphalt pavement is laid down in a series of lifts. Each lift making up the total pavement thickness could be a different thickness and/or a different grade (which uses a different pay item code). The DES_Tabulation of Surfacing.xls In addition, extra material is often added to the first (Bottom) lift of asphalt to account for irregularities in the ground surface. These items are accounted for in the tabulation sheet with two fields outside of the table and a heading row within the table. For the exercise below, the pavement contains three lifts of PG 64-22 asphalt and one lift (the top lift) of PG 76-28 asphalt. The sheet shows four lifts of PG 64-22 asphalt and one lift of PG 76-28 asphalt listed as a bottom lift. It will also use an irregularity factor of 2% where the sheet currently shows 5%. The sheet will be modified to match the pavement description given above.

1. **<D>** in the Number of Lifts cell for the ***403-34841 Hot Mix Asphalt (Grading SX) (100) (PG 64-22)*** pay item. (cell I4 in this exercise)
2. Use the drop down menu and select **3** from the list.



The original Lift 2 row was deleted (including the data). The Lift 3 and Top rows were shifted over and renamed. The illustration below shows the results.



Next, the lift headings for the Top lift of the PG 64-22 asphalt and the lift of PG 76-28 are modified.

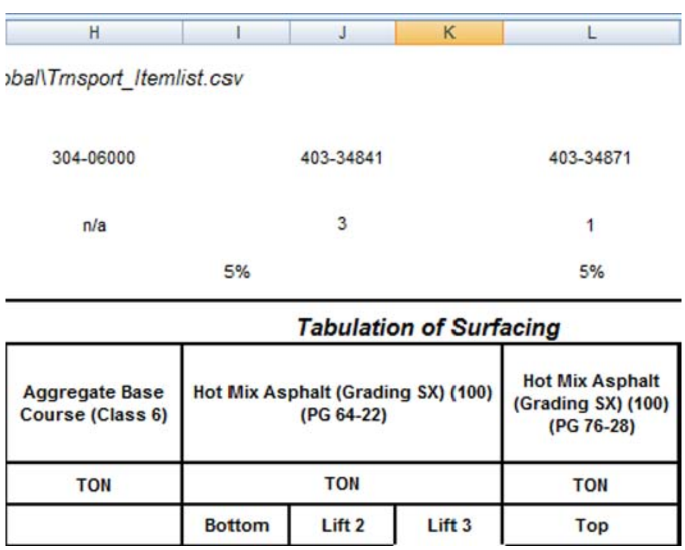
3. **<D>** in cell **K9** (it reads Top under the PG 64-22 main heading).

4. Key in ***Lift 3*** and press the Enter key.

5. **<D>** in cell **K10**.

6. Key in ***Top*** and press the Enter key.

This changes the lift headings for the two asphalt items. The spreadsheet looks at these headings to determine if the irregularity factor is applied. The irregularity factor is applied to the Bottom lift only and if the PG 76-28 lift heading was not changed it would result in an erroneous total. The illustration below shows the changes made.



Finally, the irregularity factor for the PG 64-22 is changed. The irregularity factor for the PG 76-28 does not have to be changed because it is not a Bottom lift.

7. **<D>** in cell **I4**. This is the ***% Irreg to Apply:*** cell for the 4***03-34841 Hot Mix Asphalt (Grading SX) (100) (PG 64-22)*** pay item.

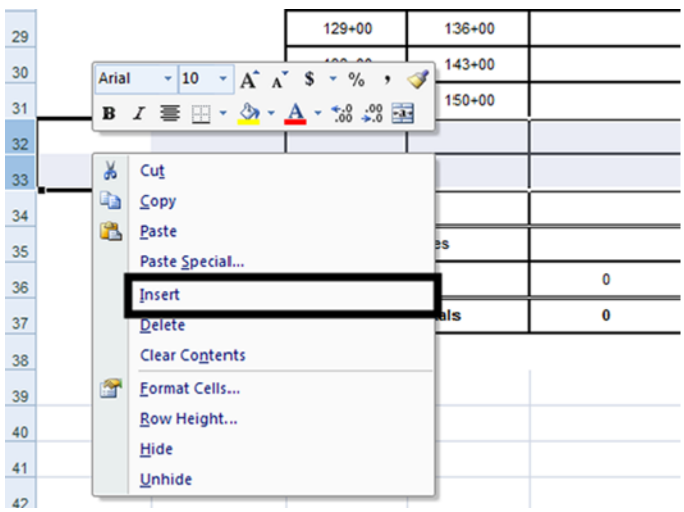
8. Key in ***2*** and press the Enter key. The change is made in cell I4. This value is used to determine the total amount of material used for irregularities at the bottom of the sheet.

Lab 18.5 - Adding Additional Rows

It is possible that additional rows for data are required. These can be added using the functionality built into Excel. In this exercise, two additional rows are needed.

1. Highlight rows **32** and **33**. To do this, **<D>** and hold on the row number 32 and drag through number 33 and release.

2. **<R>** in the highlighted area and select **Insert** from the menu.



The additional rows are added above row 32.

Lab 18.6 - Add Additional Data to the Sheet

Now that the sheet is set up, the quantities for the new columns and rows can be added. Station extents for the last five rows are needed. At the top of the sheet, quantities for removal of concrete pavement are added. At the bottom, the quantities associated with the asphalt pavement are added. (Note: on an actual project the quantity values are calculated based on design data prior to creating this sheet. Here we are inserting an arbitrary value to demonstrate the functionality of the sheet.)

1. **<D>** in cell **F10**. This is the first quantity cell of the removal of concrete pavement pay item.

2. Key in ***132*** and press the **Enter** key. This represents the number of square yards of concrete pavement removed between station 1+00 and 5+00.

3. Press **Enter** twice more. The cursor is in cell I13.
4. Key in ***247*** and press **Enter**.
5. Key in ***316*** and press **Enter**. This is in cell I14.
6. Scroll so that the **Project Totals** line is visible. The total for removal of concrete pavement is 695.

Next enter the station numbers for the last three lines. The stations are in 700 foot intervals.

7. **<D>** in field **C32**. This is the first empty cell in the ***From*** station field.
8. Key in ***15000*** and press the **Enter** key. This is 700 more the value in the cell above.
9. Continuing entering stations (adding 700 each time) down to cell C36.
10. Repeat this process in the To station column. The illustration below shows the completed station columns.

136+00	143+00	
143+00	150+00	
150+00	157+00	
157+00	164+00	
164+00	171+00	
171+00	178+00	
178+00	185+00	
Irregularities		
SubTotals		695
Project Totals		**695**

11. To finish the data entry, copy the data from row 31 – columns H through O into rows 32 through 36. The illustration below shows the completed data entry.

Tabulation of Surfacing												
Station		Removal of Concrete Pavement	Sawing Concrete (10.5 Inch)	Aggregate Base Course (Class 6)	Hot Mix Asphalt (Grading SX) (100) (PG 64-22)			Hot Mix Asphalt (Grading SX) (100) (PG 76-28)	Emulsified Asphalt (CSS-1)	Concrete Pavement (11 Inch)	Geotextile (Paving)	Notes
		SY	LF	TON	TON			TON	GAL	SY	SY	
From	To				Bottom	Lift 2	Lift 3	Top				
1+00	5+00	132								1334		
5+00	12+00									1867		
12+00	19+00									1867		
19+00	26+00	247								1867		
26+00	31+00	316								1867		
31+00	38+00									1867		
38+00	45+00									1867		
45+00	52+00									1867		
52+00	59+00									1867		
59+00	66+00									1867		
66+00	73+00									1867		
73+00	80+00									1867		
80+00	87+00		24	890	488	366	366	245	176		2667	
87+00	94+00			890	488	366	366	245	176		2667	
94+00	101+00			890	488	366	366	245	176		2667	
101+00	108+00			890	488	366	366	245	176		2667	
108+00	115+00			890	488	366	366	245	176		2667	
115+00	122+00			890	488	366	366	245	176		2667	
122+00	129+00			890	488	366	366	245	176		2667	
129+00	136+00			890	488	366	366	245	176		2667	
136+00	143+00			890	488	366	366	245	176		2667	
143+00	150+00			890	488	366	366	245	176		2667	
150+00	157+00			890	488	366	366	245	176		2667	
157+00	164+00			890	488	366	366	245	176		2667	
164+00	171+00			890	488	366	366	245	176		2667	
171+00	178+00			890	488	366	366	245	176		2667	
178+00	185+00			890	488	366	366	245	176		2667	
Irregularities					146.4							
SubTotals		695	24	13350	7466.4	5490	5490	3675	2640	21871	40005	
Project Totals		**695**	**24**	**13350**	**18446.4**			**3675**	**2640**	**21871**	**40005**	

12. Examine the totals for the Asphalt pay items. Note:

♦ An irregularities total only for the bottom lift of asphalt
♦ Sub totals for each lift of PG 64-22
♦ A grand total for PG 64-22

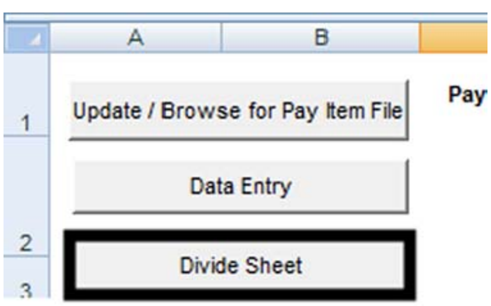
Tabulation of Surfacing

Aggregate Base Course (Class 6)	Hot Mix Asphalt (Grading SX) (100) (PG 64-22)			Hot Mix Asphalt (Grading SX) (100) (PG 76-28)	Emulsified Asphalt (CSS-1)
TON	TON			TON	GAL
	Bottom	Lift 2	Lift 3	Top	
890	488	366	366	245	176
890	488	366	366	245	176
890	488	366	366	245	176
	146.4				
13350	7466.4	5490	5490	3675	2640
13350	**18446.4**			**3675**	**2640**

Lab 18.7 - Dividing the Surfacing Sheet into Sub Sheets

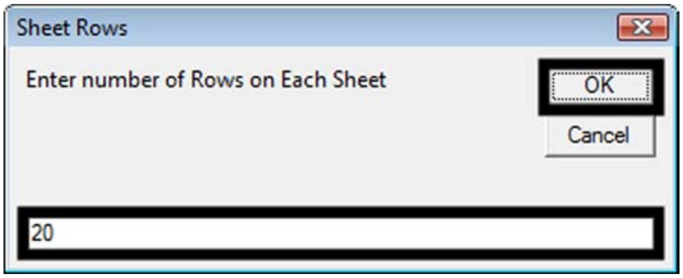
It the sheet is too long to fit inside the sheet border, there is a option to divide the master sheet into sub sheets of a specified number of data rows. When this option is selected, additional worksheets are added to the file that contain a part of the master sheet along with a sheet totals table. In this exercise, it was decided the 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. Scroll to the top of the sheet (if it is not there already).
2. **<D>** the **Divide Sheet** button. This displays the ***Sheet Rows*** dialog box.

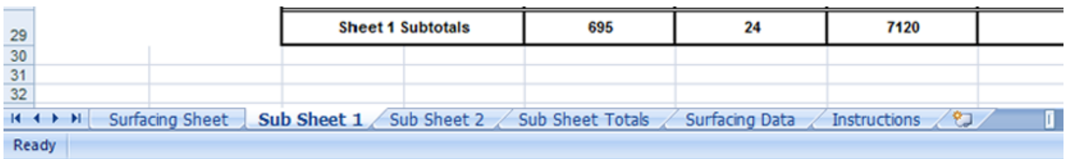


3. Key in ***20***. This is the number of data rows used on each sub sheet.

4. **<D> OK**.



Two sub sheets (Sub Sheet 1 and Sub Sheet 2) were 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 the sub sheets and run through the process again.

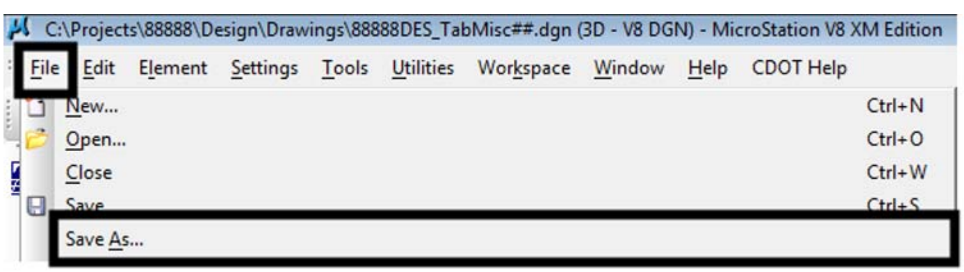
5. **Save** but do not close the file.

Lab 18.8 - 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.

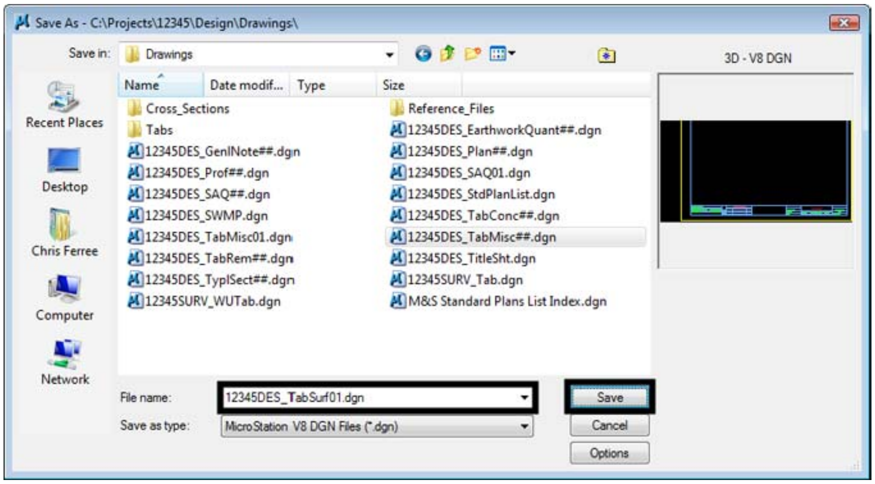
The first step in linking the spreadsheet is to prepare the MicroStation file. The miscellaneous tab sheet border is copied and renamed to be the surfacing tab sheet.

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.



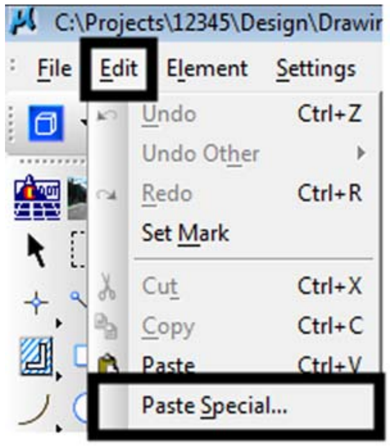
5. Bring Excel to the front.
6. Select the **Sub Sheet 1** worksheet.
7. Highlight cells **C2** through **P29**. This is the entire table.

Tabulation of Surfacing

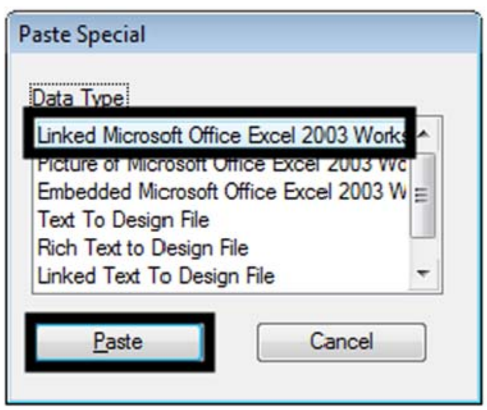
Station		Removal of Concrete Pavement	Saving Concrete (10.5 Inch)	Aggregate Base Course (Class 6)	Hot Mix Asphalt (Grading SX) (100) (PG 64-22)			Hot Mix Asphalt (Grading SX) (100) (PG 76-28)	Emulsified Asphalt (CSS-1)	Concrete Pavement (11 Inch)	Geotextile (Paving)	Notes
		SY	LF	TON	TON			TON	GAL	SY	SY	
From	To				Bottom	Lift 2	Lift 3	Top				
1+00	5+00	132								1334		
5+00	12+00									1867		
12+00	19+00									1867		
19+00	26+00	247								1867		
26+00	31+00	316								1867		
31+00	38+00									1867		
38+00	45+00									1867		
45+00	52+00									1867		
52+00	59+00									1867		
59+00	66+00									1867		
66+00	73+00									1867		
73+00	80+00									1867		
80+00	87+00		24	890	488	366	366	245	176		2667	
87+00	94+00			890	488	366	366	245	176		2667	
94+00	101+00			890	488	366	366	245	176		2667	
101+00	108+00			890	488	366	366	245	176		2667	
108+00	115+00			890	488	366	366	245	176		2667	
115+00	122+00			890	488	366	366	245	176		2667	
122+00	129+00			890	488	366	366	245	176		2667	
129+00	136+00			890	488	366	366	245	176		2667	
Irregularities					78.08							
SubTotals		695	24	7120	3982.08	2928	2928	1960	1408	21871	21336	
Sheet 1 Subtotals		**695**	**24**	**7120**	**9838.08**			**1960**	**1408**	**21871**	**21336**	

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.

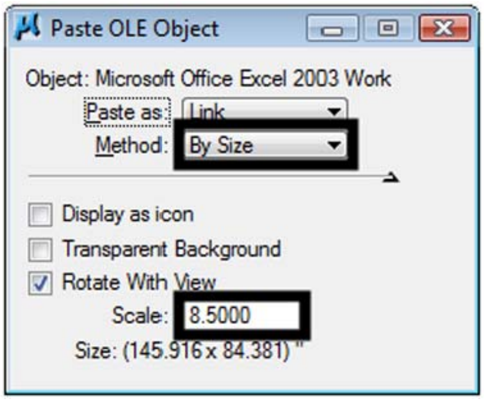


11. In the ***Paste Special*** dialog box, highlight **Linked Microsoft Office Excel 2003 Worksheet**.



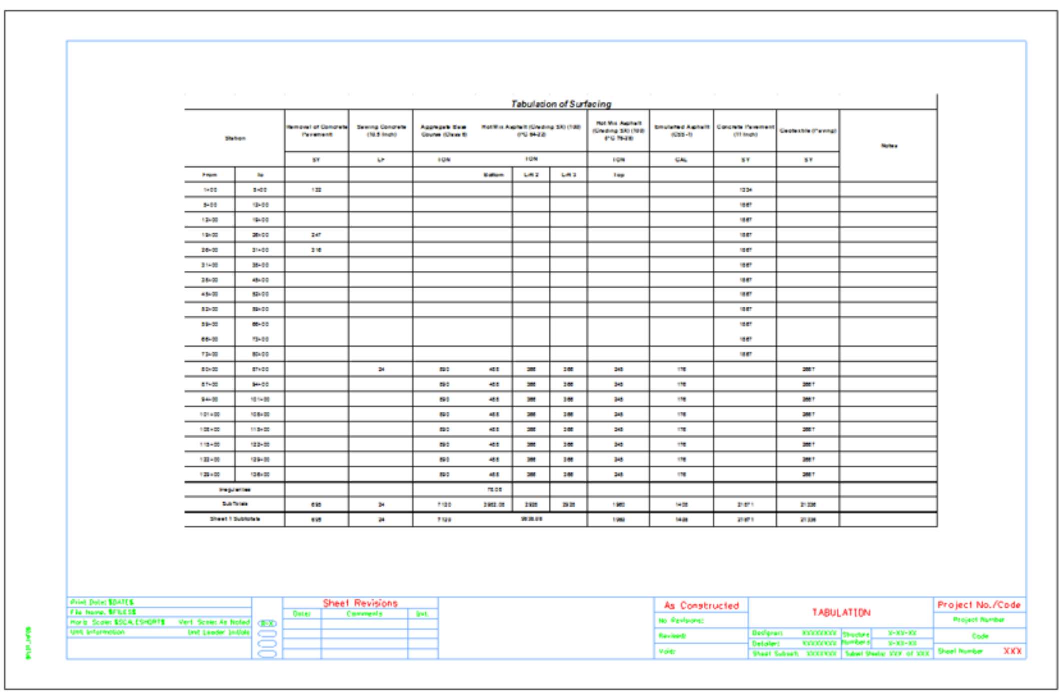
12. **<D> Paste**. This displays the ***Paste OLE Object*** tool settings box.
13. In the ***Paste OLE Object*** tool settings box, set the ***Method*** to **By Size**.

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 dashed 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.



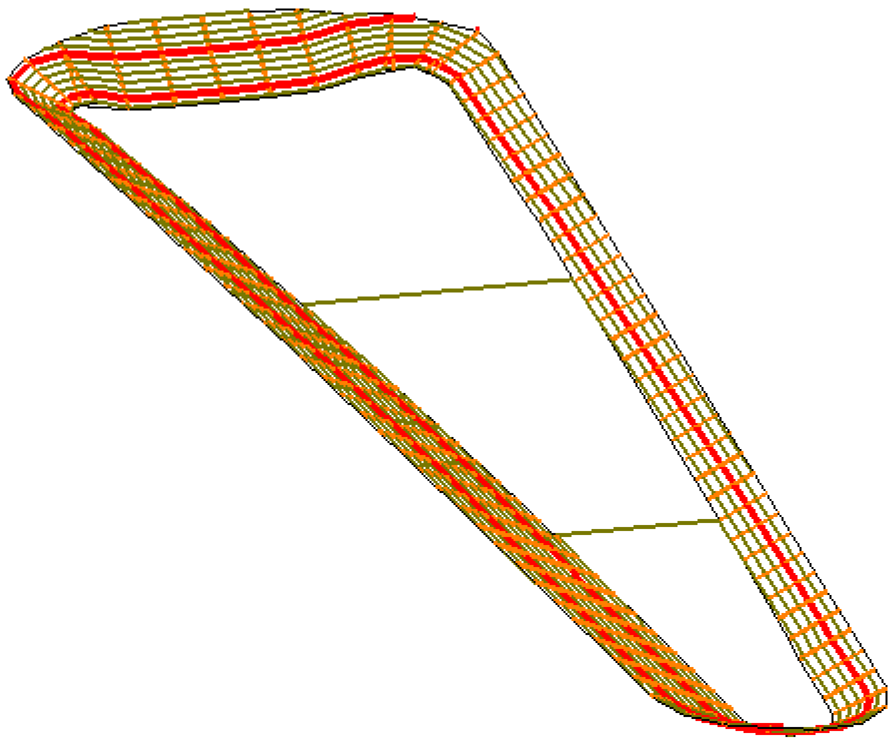
17. **Close** MicroStation.

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 19 - 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.

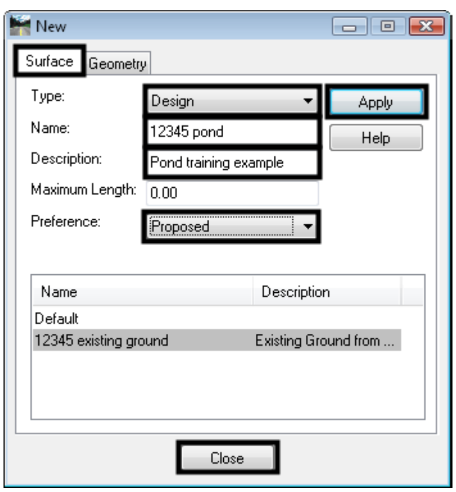


Chapter Objectives:

- To learn the process of using the combination of several feature tools to create a proposed design.
- To understand the concept of creating a surface of features solely for use as a target.
- To realize the value of using **Generate Longitudinal Feature** and **Generate Sloped Surface** in creating proposed designs.

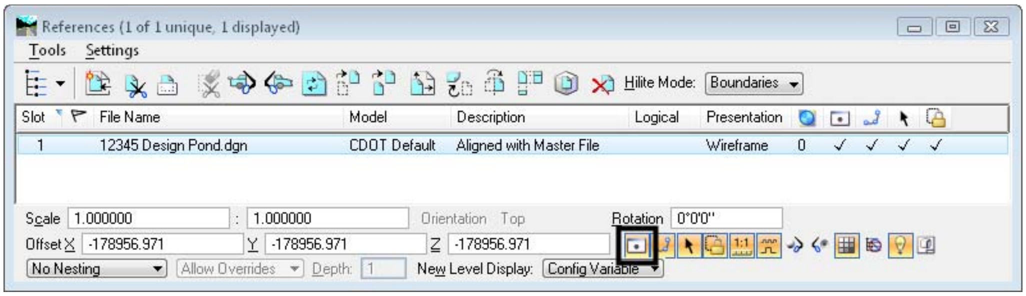
Lab 19.1 - Load and Create Surfaces

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 ground.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 the ***Name*** ***12345 pond***.
13. Key in the ***Description*** ***Pond training example***
14. Set the ***Preference*** to ***Proposed***
15. **<D> Apply** and **Close** the ***New*** dialog.

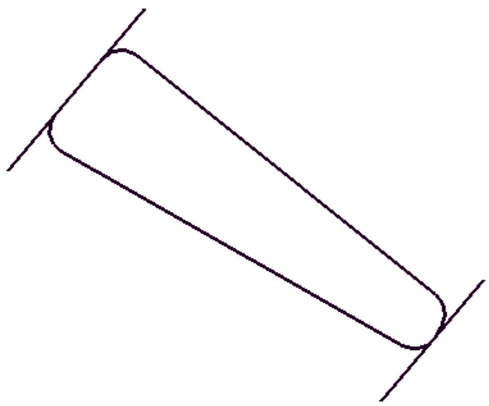


Lab 19.2 - Display the Pond Graphics

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.

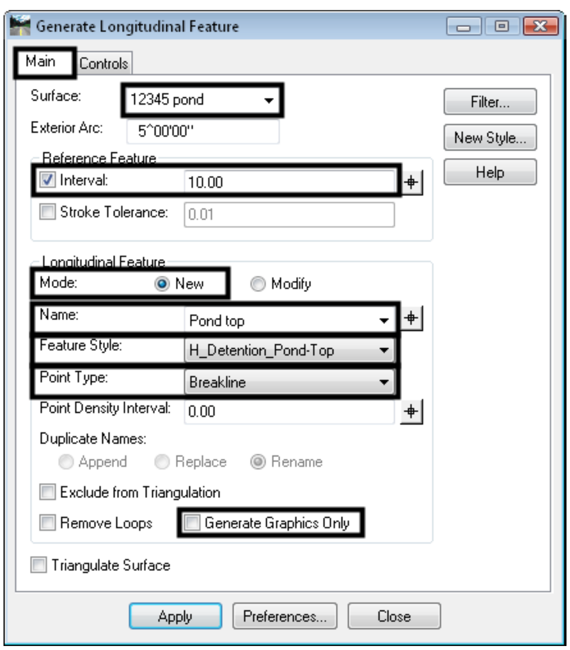
Lab 19.3 - Creating a feature for the top of pond

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**.

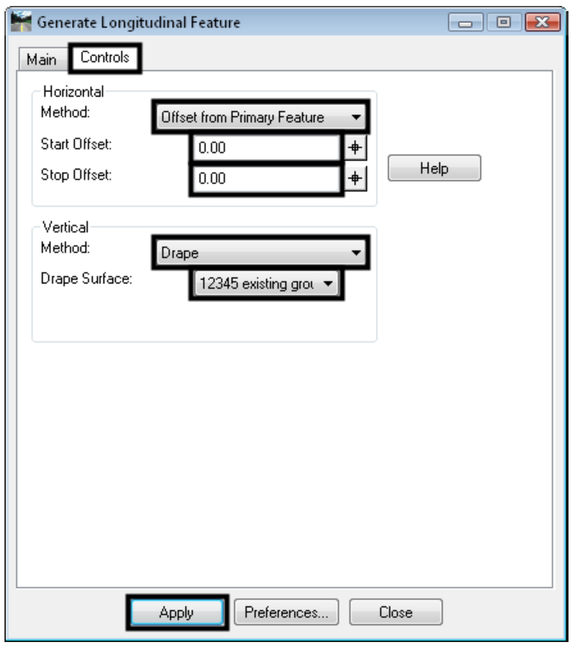
On the ***Main*** tab:

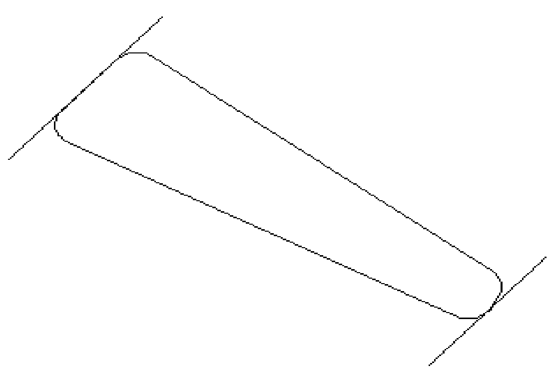
2. Toggle off ***Generate Graphics Only***
3. Select ***12345 pond*** as the ***Surface***.
4. Toggle on ***Interval*** and set it to ***10***.
5. Toggle on ***New*** for the ***Mode***.
6. Key in the feature ***Name*** ***Pond top***.
7. Set the ***Feature Style*** to ***H_Detention_Pond-Top***.
8. 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 ground***.
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***.

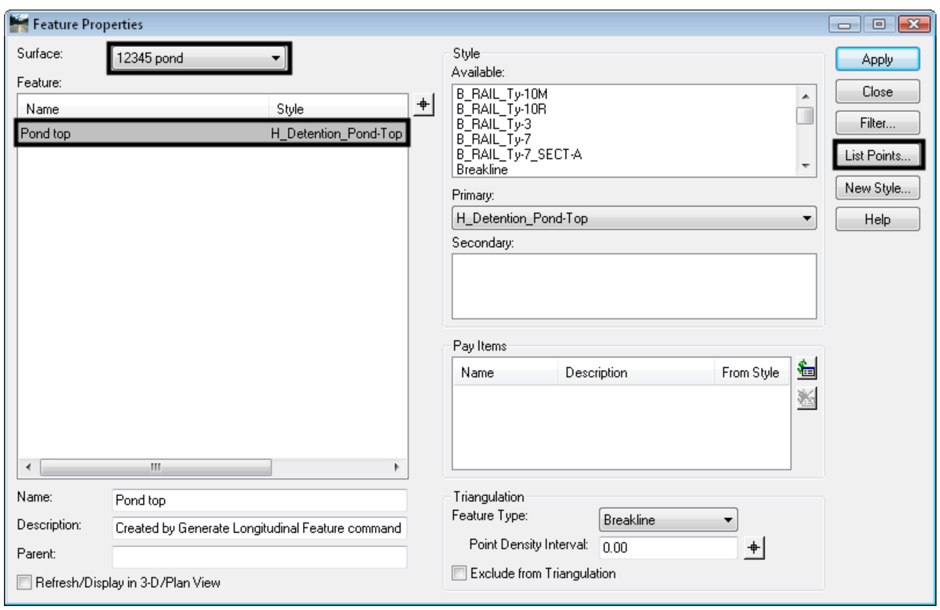
Note: If your ***Horizontal Offsets*** were not 0, you would be telling InRoads which side to offset by moving your cursor to that location before **<D>**; since they are both 0, it does not matter where you identify the location.

The shape is draped on the existing model, but placed in the new surface.

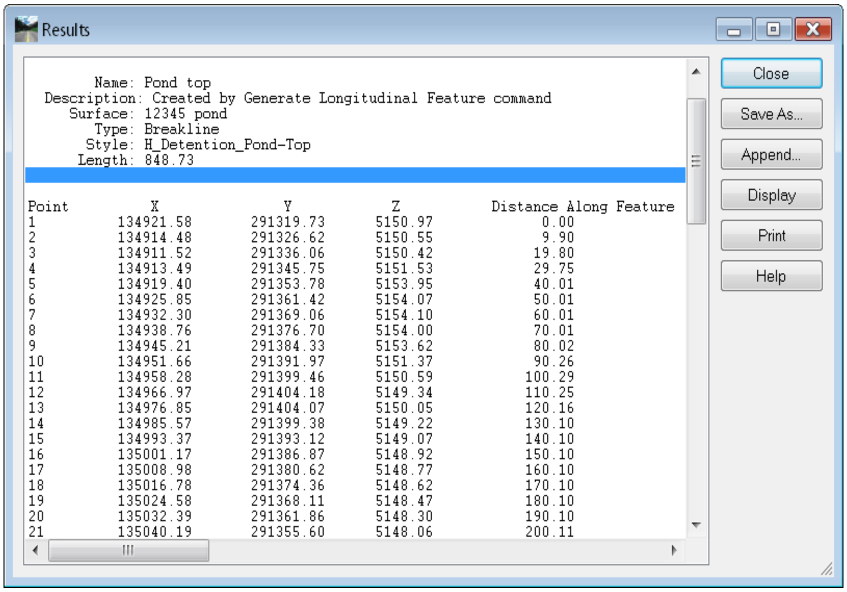
18. **<D> Close** on the ***Generate Longitudinal Feature*** dialog.

Lab 19.4 - Review the feature

1. Select **Surface > Feature > Feature Properties**.
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*** box and again on ***Feature Properties***.

Lab 19.5 - 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**.

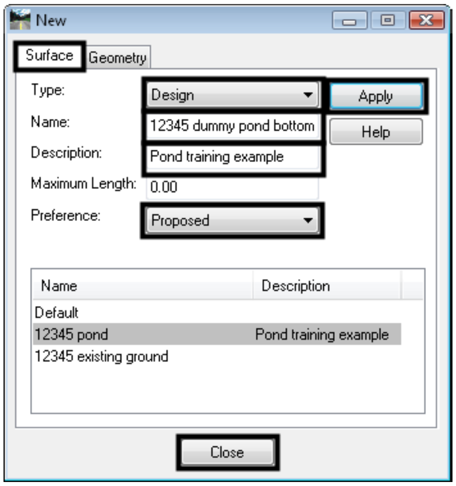
2. Set the ***Type*** to ***Design***.

3. Key in the ***Name***: ***12345 dummy pond bottom***.

4. Key in the ***Description***: ***Pond training example***.

5. Set the ***Preference*** to ***Proposed***.

6. **<D> Apply** and **Close** the ***New*** dialog.

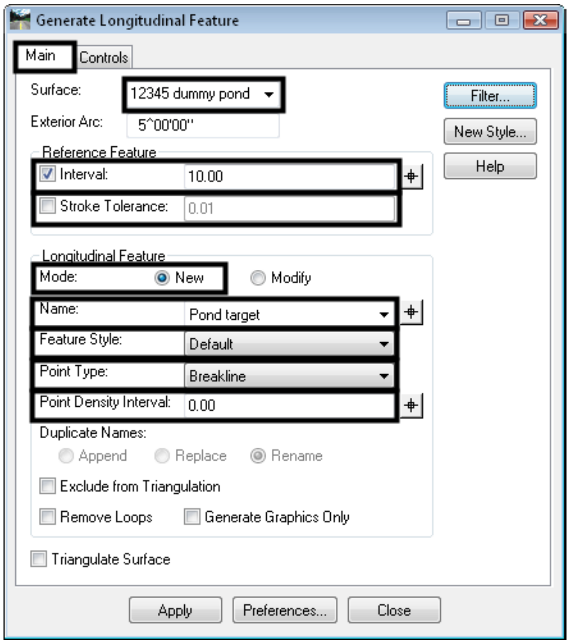


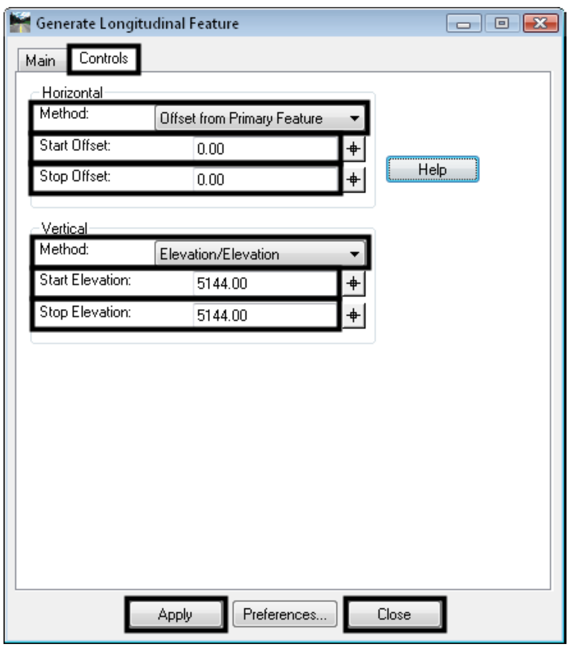
On the ***Surface*** tab:

Select **Surface > Design Surface > Generate Longitudinal Feature** (**GLF**).

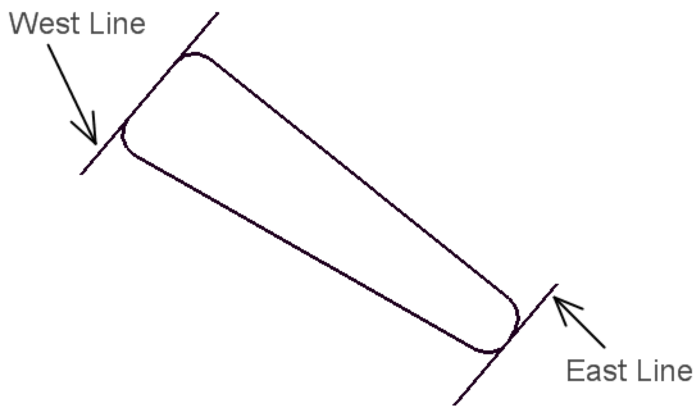
7. Set the ***Surface*** to ***12345 dummy pond bottom***.

8. Set the other criteria as shown to create a new feature.





9. **<D> Apply**.
10. Select the West linestring with a data point **<D>**.



The linestring highlights and you are prompted to ***Accept/Reject***.

11. **<D>** to accept.

You are prompted to ***Identify Reference Element***.

12. 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)***.

13. **<R>** Reset to copy the entire element.
14. **<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 shape is made into a feature at elevation 5144 in the surface dummy pond bottom.

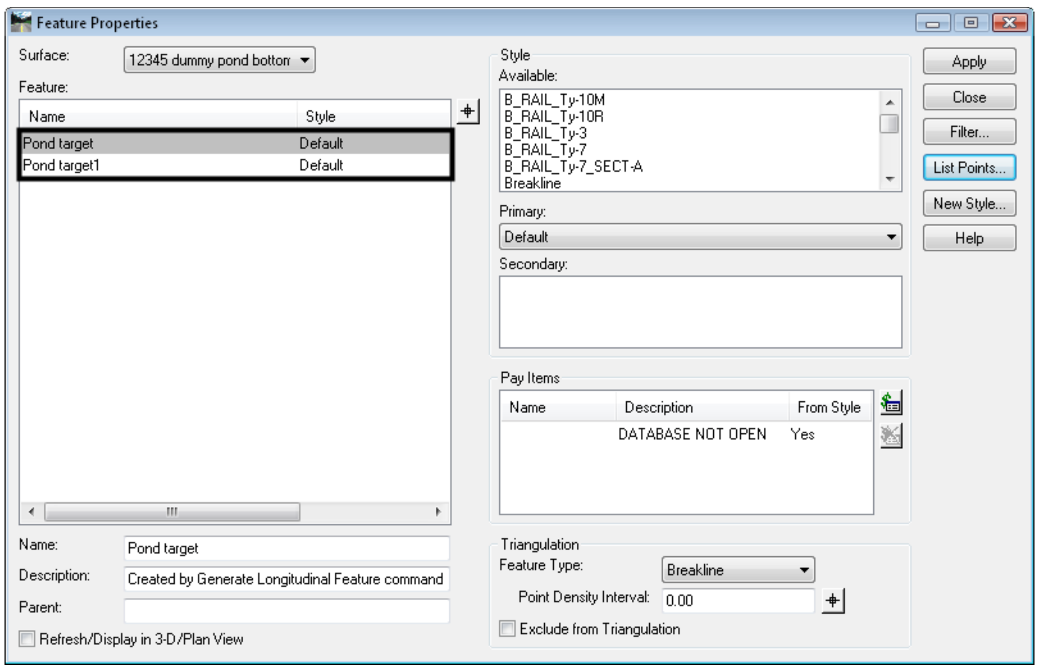
Lab 19.6 - Review the feature

1. Select **Surface > Feature > Feature Properties**.
2. Set the ***Surface*** to ***12345 dummy pond bottom***.
3. Highlight the ***Pond target*** (5144 elevation) feature and choose ***List Points***.

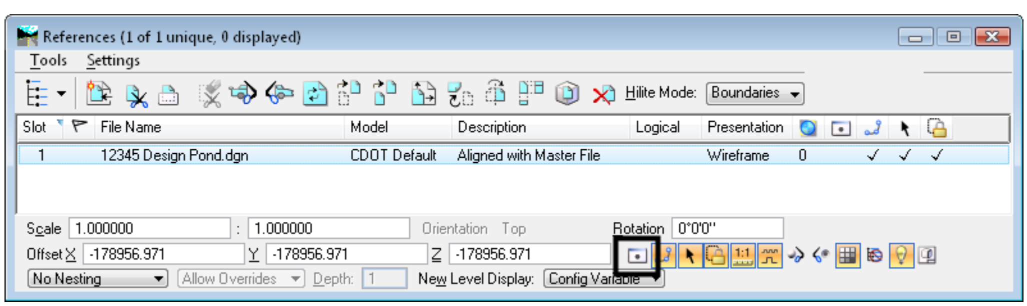
   You should see all 5144 elevations for the feature.

4. Repeat section 1.5 steps 7-13 to create a feature in the same surface for the East line, which should be set to an elevation of ***5141***.

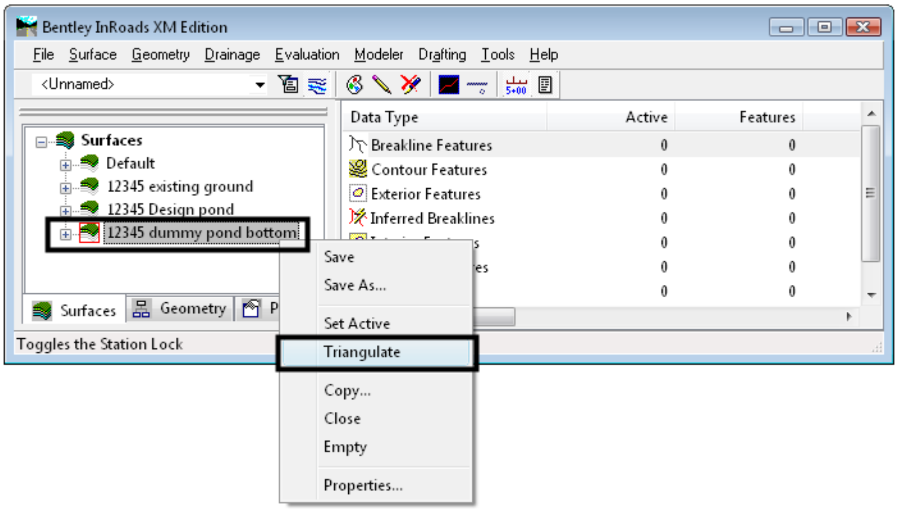
   You should now have two features in ***12345 dummy pond bottom***.



5. Select **Close** to dismiss the ***GLF*** dialog box.
6. Turn off the reference with the original pond graphics.



7. **Triangulate** the dummy pond bottom surface.



Lab 19.7 - 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 bottom of the pond, you must first change the ***Locate*** mode.

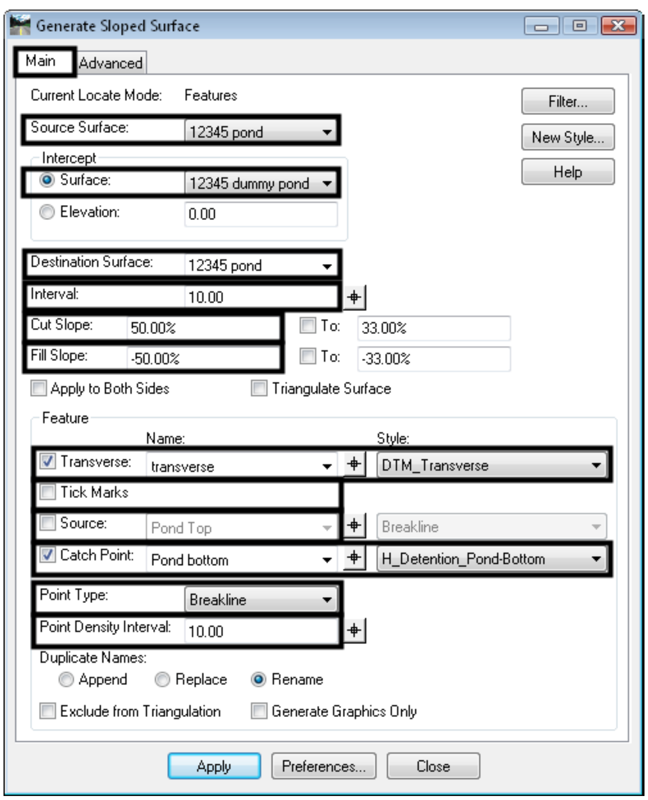
2. Select the **Surface > Design Surface > Generate Sloped Surface** (**GSS**).

On the ***Main*** tab:

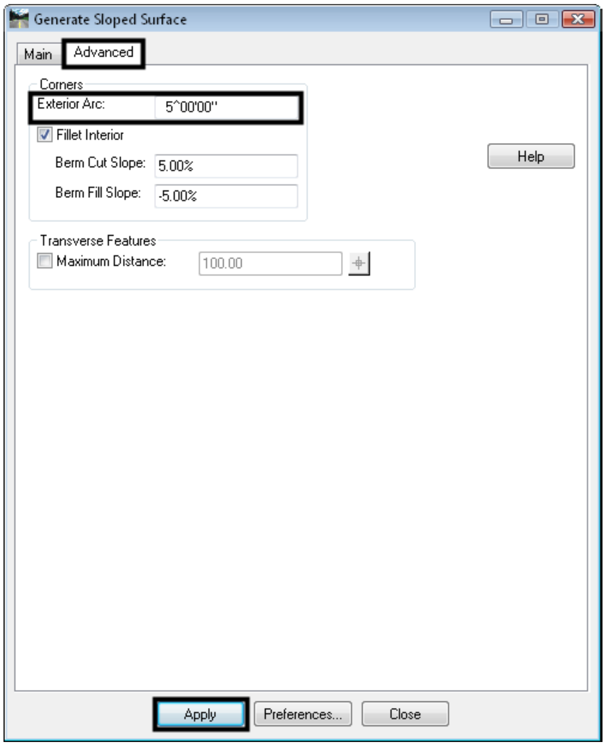
3. Set ***Source Surface*** to ***12345 pond***.
4. Set ***Intercept Surface*** to ***12345 dummy pond bottom***.
5. Set ***Destination Surface*** to ***12345 pond***.
6. For ***Interval*** key in ***10***.
7. For ***Cut Slope*** key in ***50%***.
8. For ***Fill Slope*** key in ***-50%***.

In the ***Feature*** category:

9. Turn 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***.



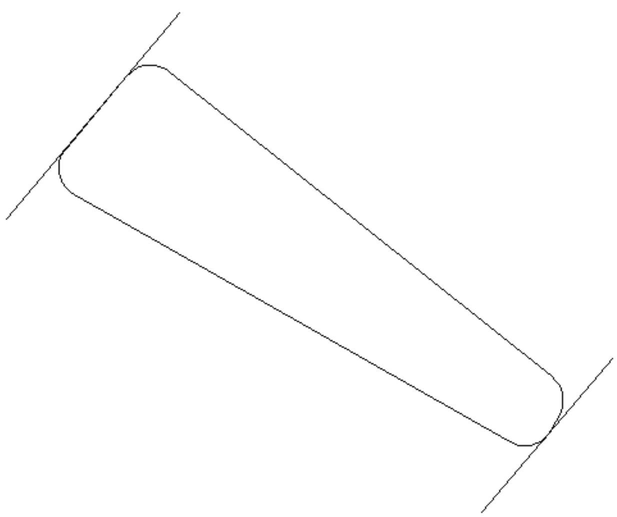
15. On the ***Advanced*** tab, key in ***5^00'00.00"*** for ***Exterior Arc***.



16. **<D> Apply** to run the **GSS** command.

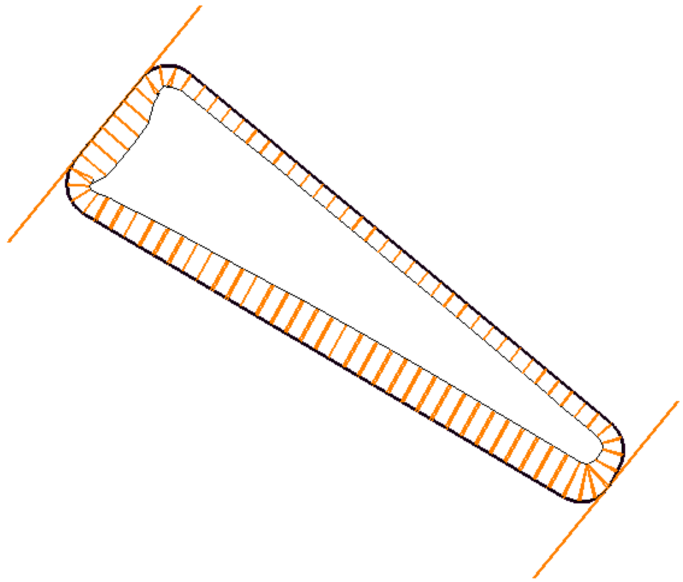
    You will be prompted to ***Identify Feature***.

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.

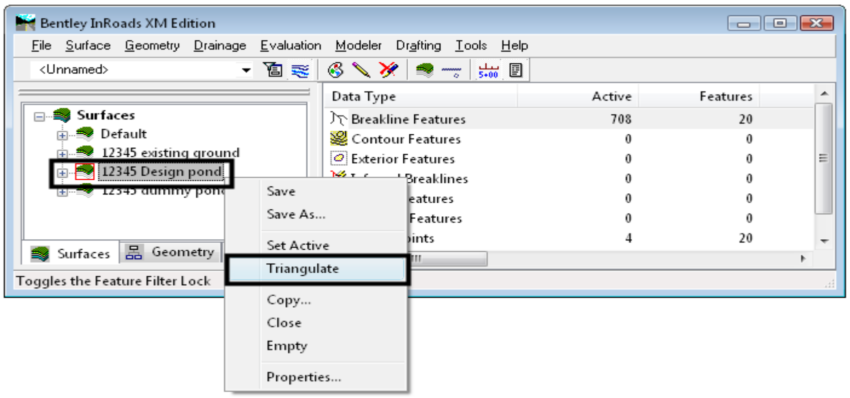


Graphics will appear as shown.

21. **<R>** and then select **Close** to dismiss the dialog box.

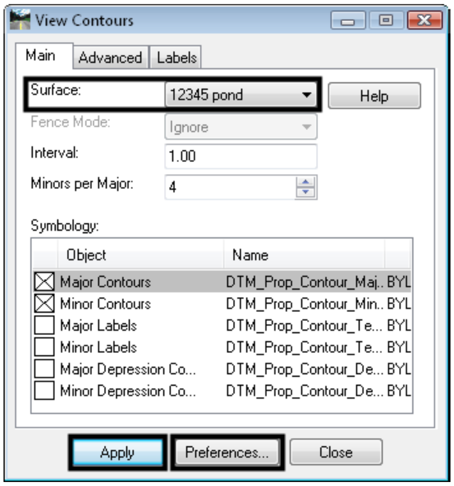
Lab 19.8 - Evaluate the pond surface

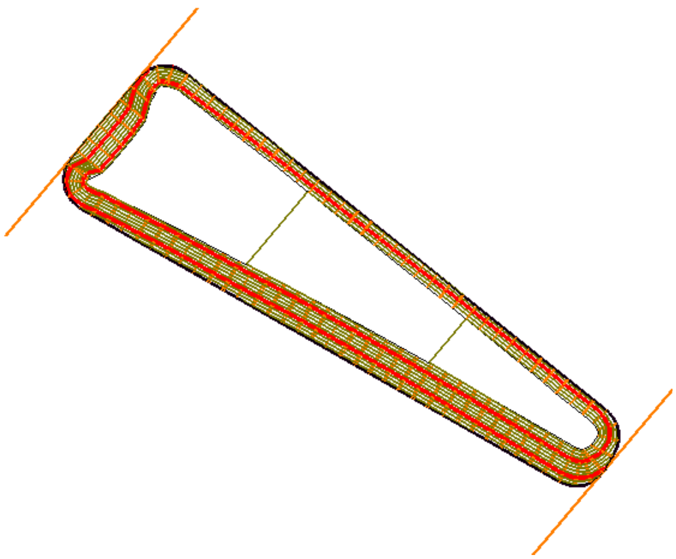
1. Right-click on the pond surface in the Explorer portion of the InRoads menu and select **Tri-angulate**.



2. Select **Surface > View Surface > Contours**.
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

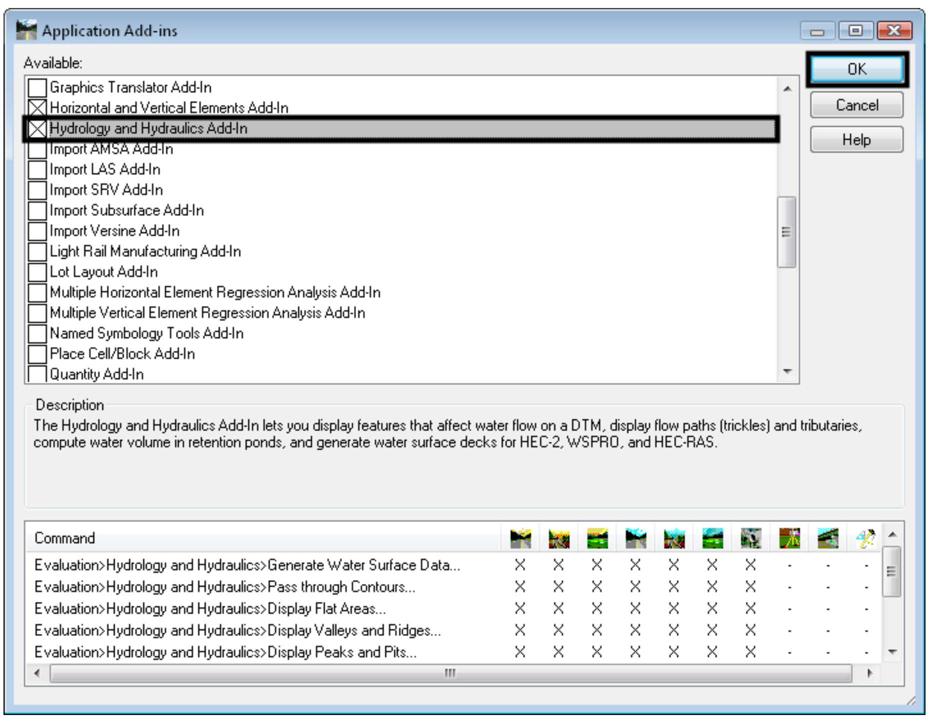


Lab 19.9 - Save the pond surface to the hard disk

1. Select **File > Save As**.
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*** box.

Lab 19.10 - Calculate the pond's capacity

1. Select **Tools > Application Add-ins**, toggle on ***Hydrology and Hydraulics Add-in*** (if it's not already on) and choose **OK**.



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.

2. Select **Evaluation > Hydrology and Hydraulics > Compute Pond Volumes**.

3. Set the ***Surface*** to ***12345 pond***.

4. Set the ***Method*** to ***Incremental***.

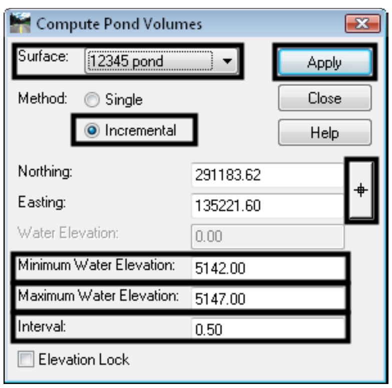
5. For the ***Minimum Water Elevation*** key in ***5142***.

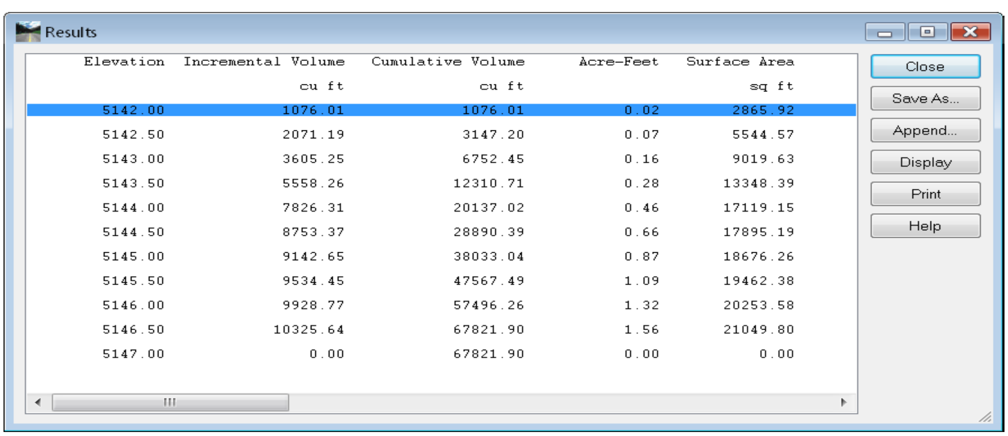
6. For the Maximum Water Elevation key in ***5147***.

7. For the ***Interval*** key in ***0.5***.

8. 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.

9. **<D> Apply** and the volume is calculated for the range of elevations you entered. A report is shown with the incremental volumes.



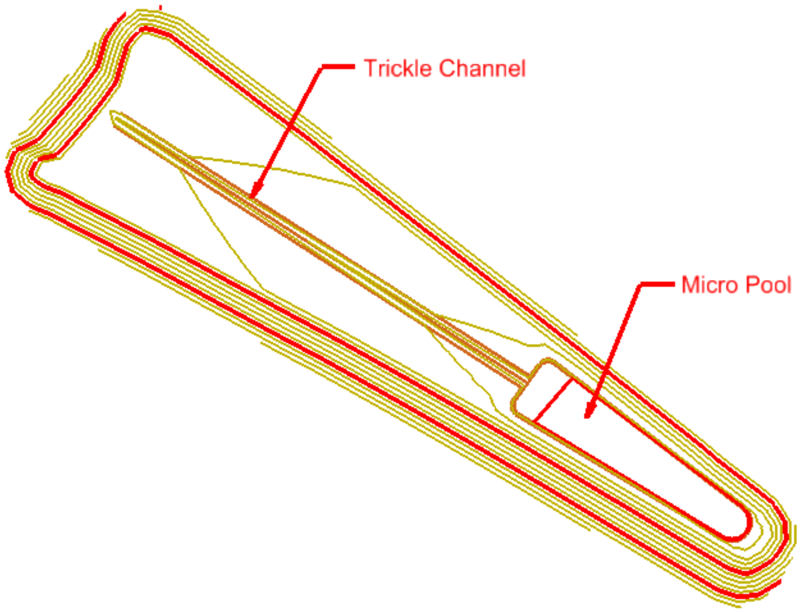


10. **Save** the report to your hard drive if desired.

11. **Close** the ***Compute Pond Volumes*** dialog.

Lab 19.11 - 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 proficient tool for creating 3D features.
- Simple sideslopes can be formed with GSS.
- Staged water volumes can be computed for DTMs using the **Pond Volumes** command on the **Hydrology and Hydraulics Add-in**.

LAB 20 - 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:

- Use Tracking to determine the location of the ramp.
- Use Generate Longitudinal Feature to construct the centerline and edge features of the ramp.
- Use Drape Surface to create the end of the drive.
- Use Import Surface to create features from MicroStation graphics.
- Use Fillet Feature to construct the drive returns.
- Use Join Features to create a continous feature from the driveway edges and returns.
- Use 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 20.1 - 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.

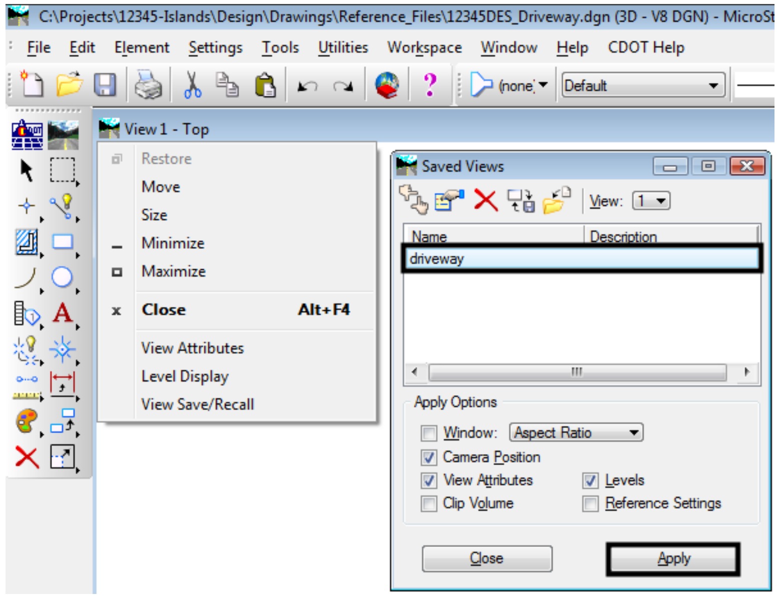
1. Open InRoads using the ***12345DES_Driveway.dgn*** file.

   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, highlignt **driveway**.

c. **<D> Apply** and then **<D> Close** to dismiss the ***Saved Views*** dialog box.

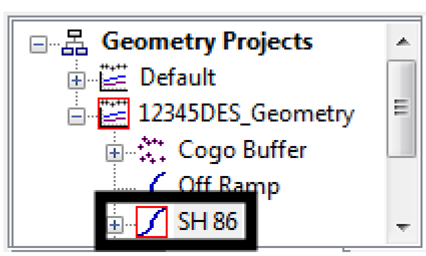


2. Open the following InRoads data files:

   - 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

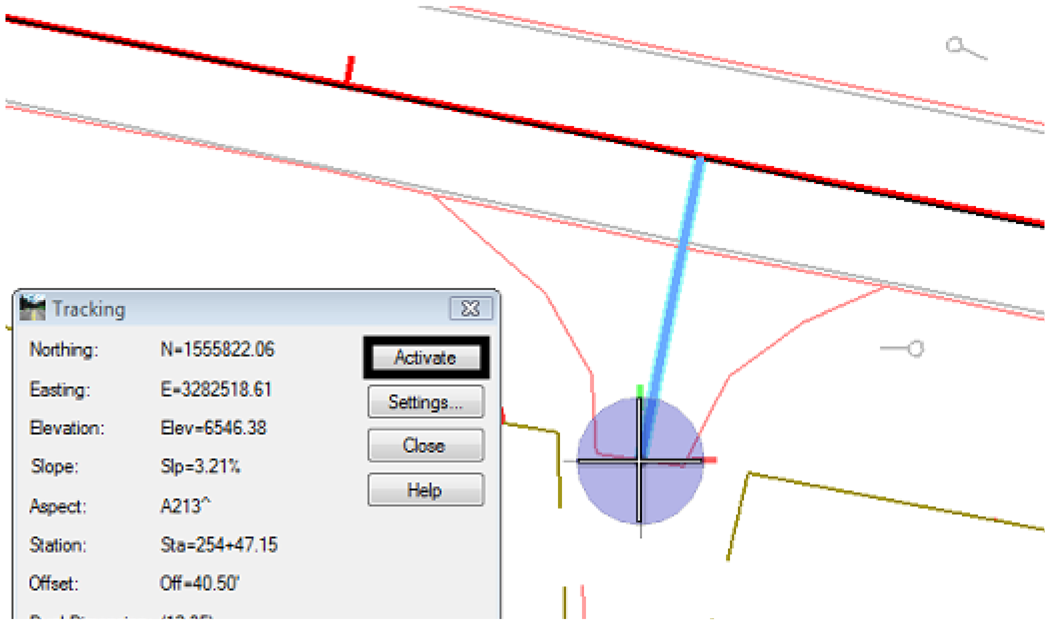
3. Verify that the **C:\Workspace\Workspace-CDOT_XM\Standards-Global\InRoads\Preferences\CDOT_Civil.xin** file is loaded.

4. Verify that the SH 86 alignment is active.

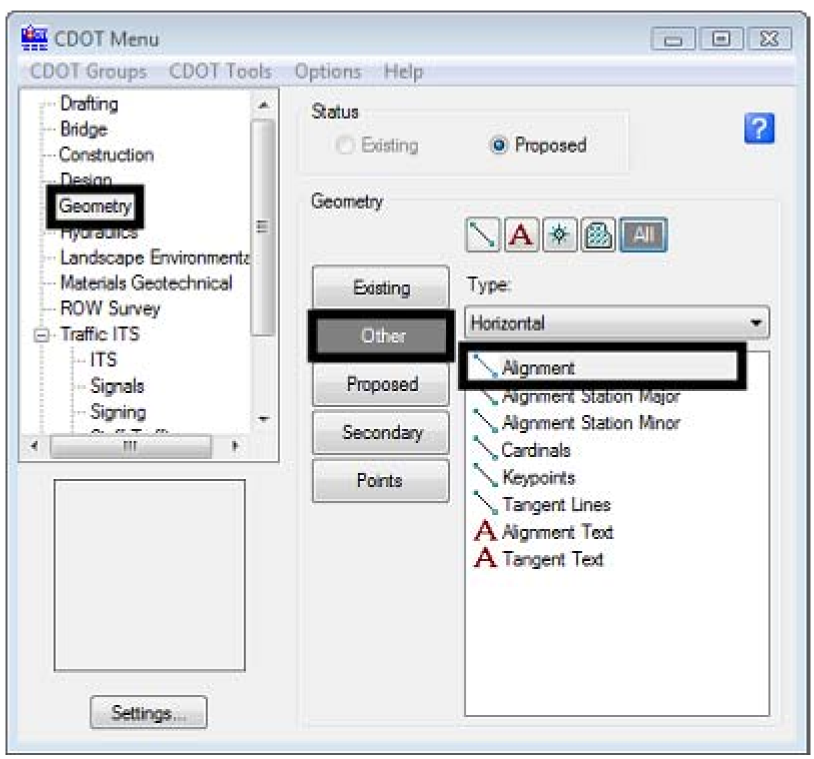


5. Select **Tools > Tracking > Tracking** from the InRoads menu bar.

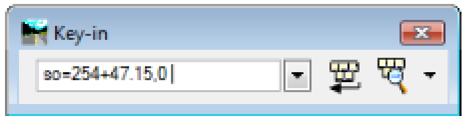
6. **Activate** the tracking and **<T>** to the center of the back of the driveway.



7. Write down the **Station** listed in the ***Tracking*** dialog box.
8. From the ***CDOT Menu***, highlight the **Geometry** group.
9. **<D>** the **Other** button and select **Alignment** from the item list.



10. In the MicroStation key-in window, type ***so=254+47.15,0*** and ***Enter***.



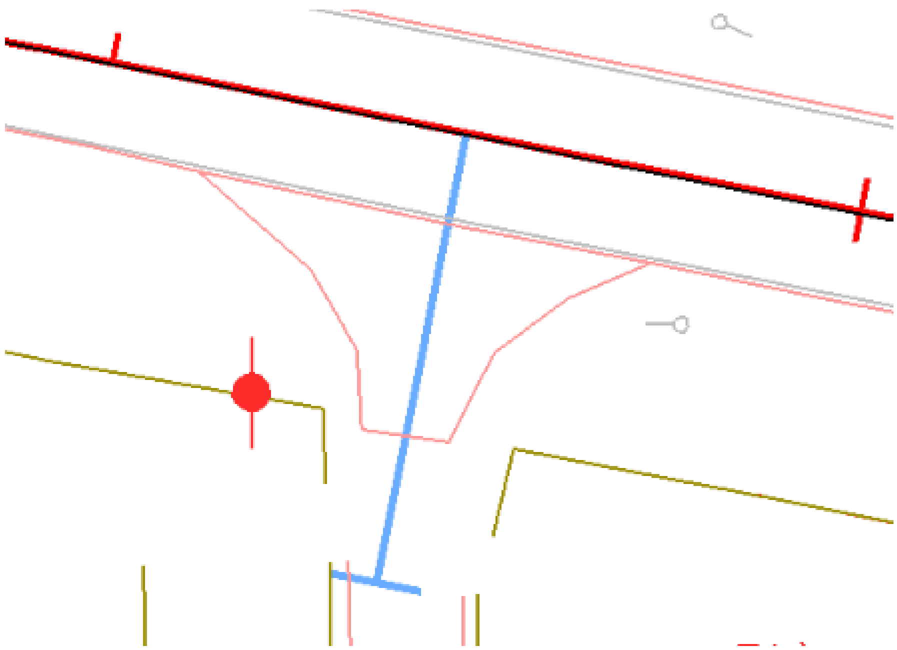
Note: Use the station that you wrote down in step 6.

11. 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.

12. Key in ***so=254+41.15,60*** and ***Enter***.

13. 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.

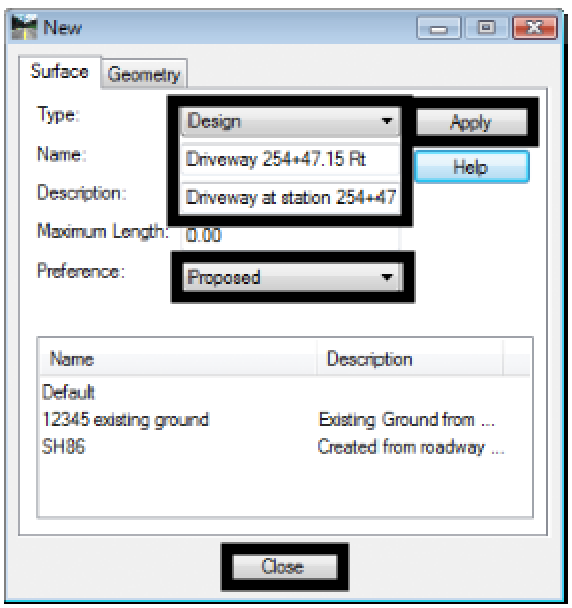
Lab 20.2 - Setting Elevations

In this section, the driveway end line is draped to the existing surface to aquire 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:

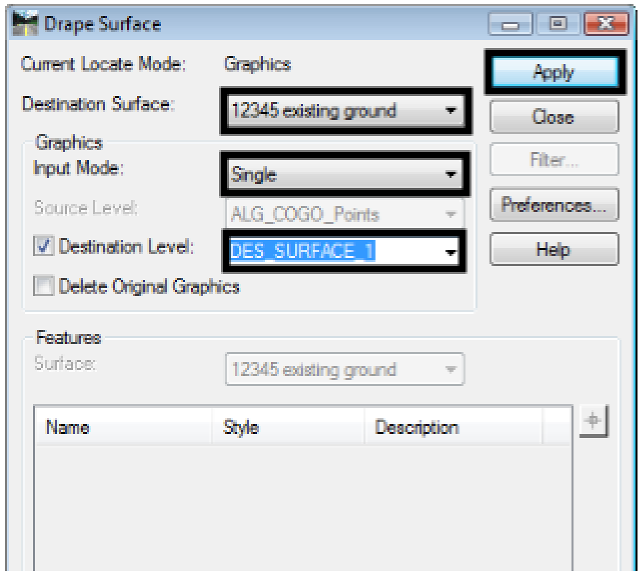
- Create a surface for the driveway.
- Use Drape Surface to create the driveway end line feature.
- Display the design surface (SH 86) triangulated features.
- Move the driveway centerline to its proper location (horizontally and vertically).
- Create a centerline feature with the proper slopes using 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).

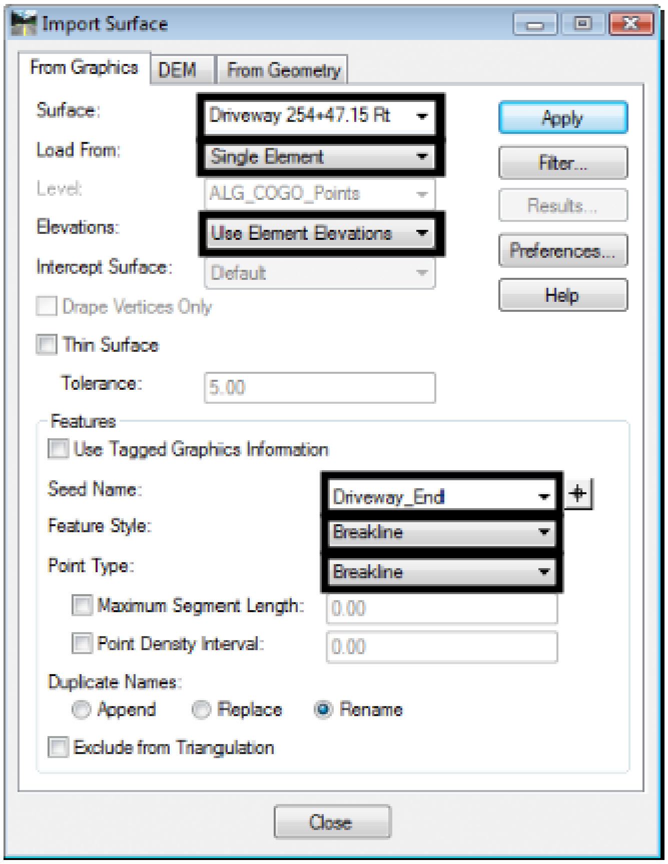


12. **Close** the Drape Surface dialog box.

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.

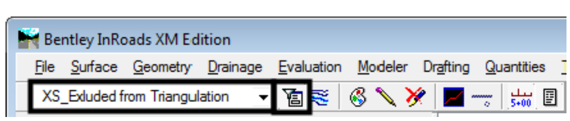
20. **<D>** the element created by the Drape Surface command. **<D>** in a blank area to accept the element.

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**.

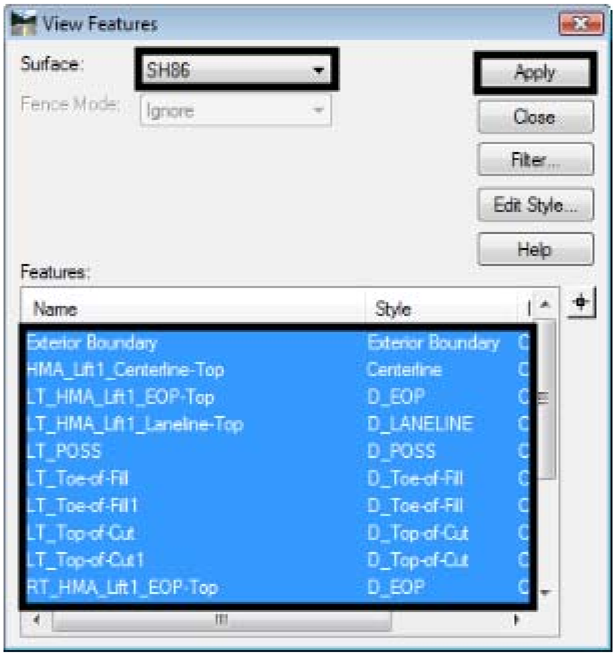
23. Toggle on the **Feature Filter Lock**.



24. Select **Surface > View Surface > Features** from the InRoads menu bar.

25. Select **SH86** for the ***Surface***.

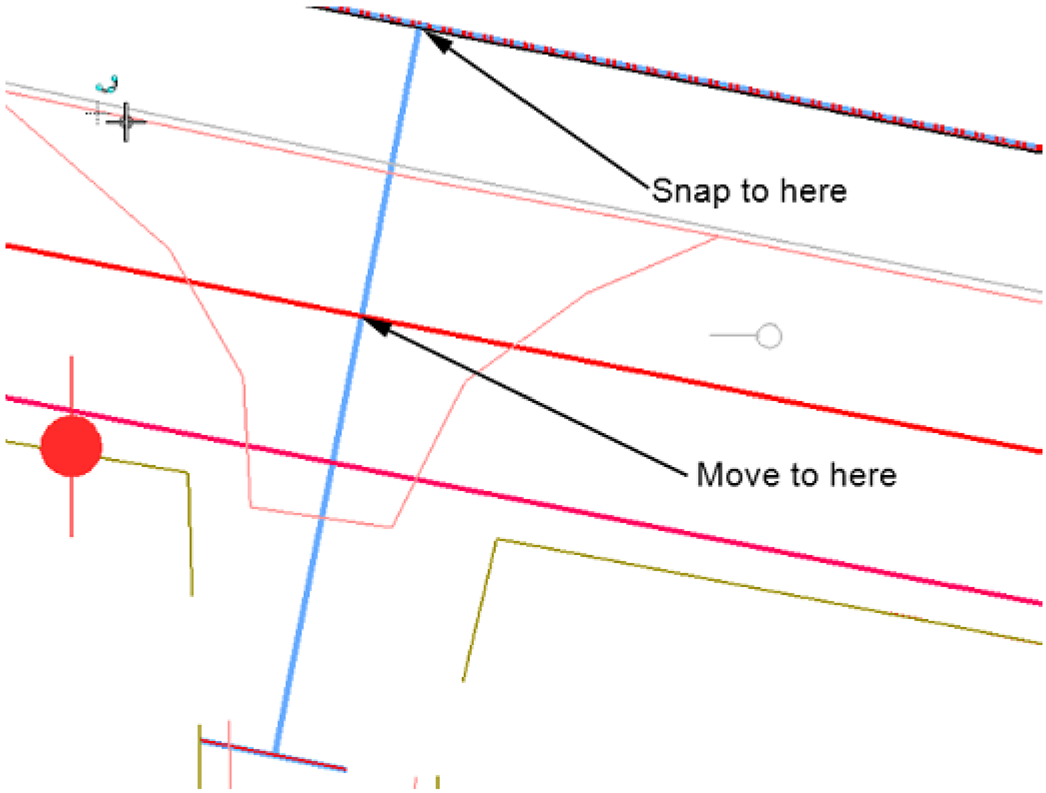
26. Highlight all of the features in the ***Features*** list.
27. **<D> Apply** then **Close** the ***View Features*** dialog box.



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.



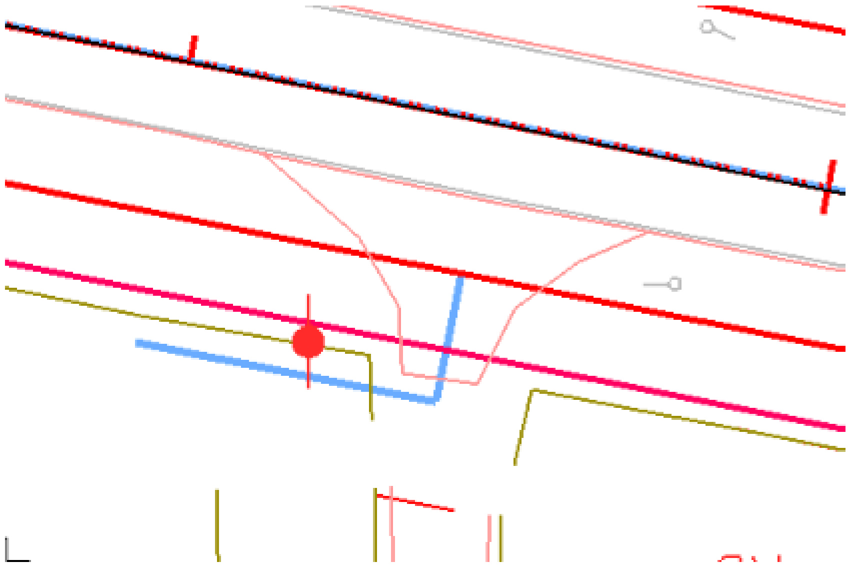
Next, the point of the "breakover" from the 12 to 1 slope must be located. This point is 20' from the proposed edge of pavement, or 44' from the mainline centerline.

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.



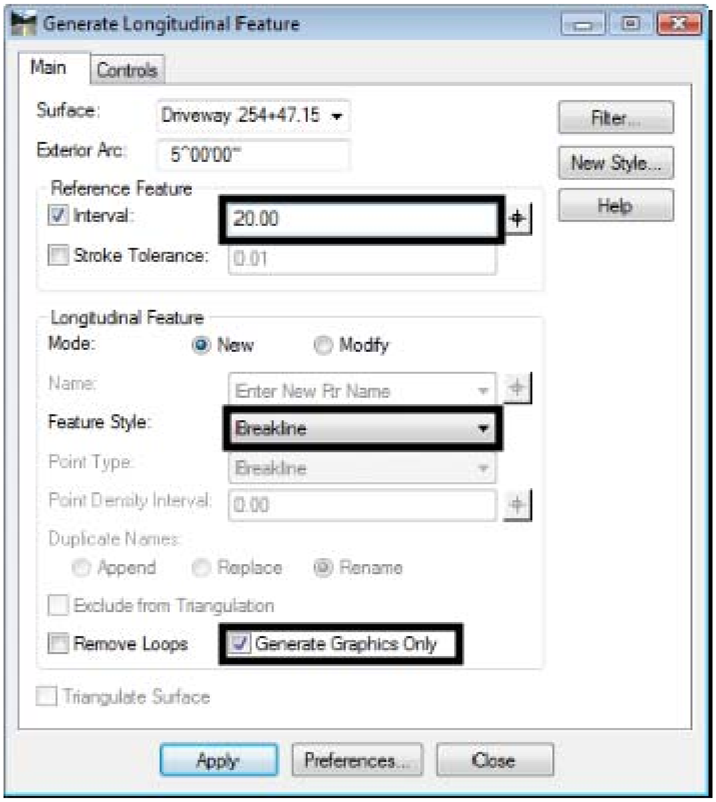
Now the 12 to 1 slope is added to the line. The Generate Longitudinal Feature command is used to create the sloped element. The Generate Graphic Only option is used because additional editing is required.

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**.



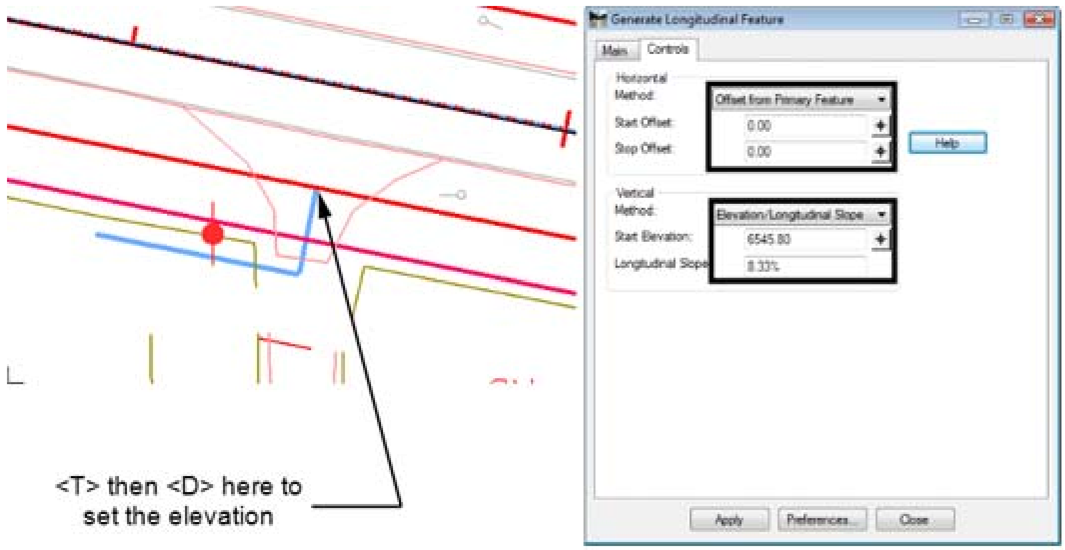
38. Select the **Controls** tab.

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 ***Logitudinal Slope***. The result will be 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.

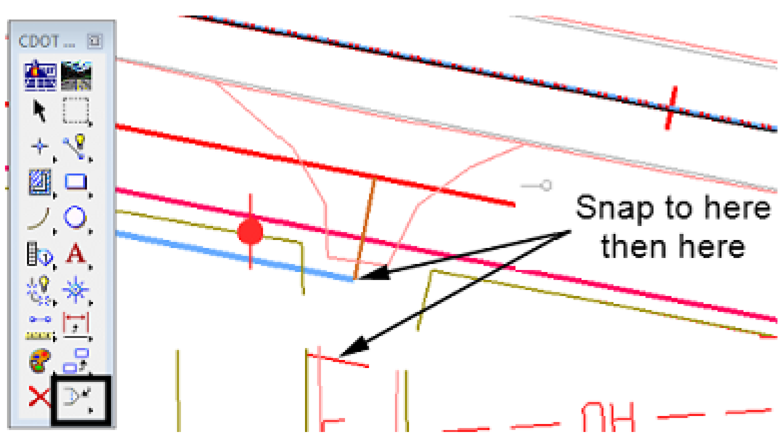
45. **<R>** to use the entire line, the **<D>** to finish the command.

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 lane, 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 Longitudunal Feature command. Finally. the elevation at the end of the drive was set by snapping the new vertex to the driveway end line created eariler. 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 ramp. The driveway end line was draped to the existing ground and stored in the diveway surface. A 3D centerline was created with the desired slopes.

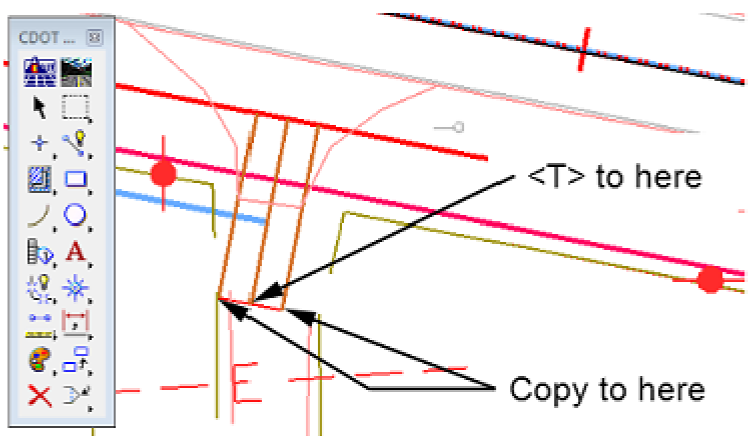
Lab 20.3 - Create Driveway Edges

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.

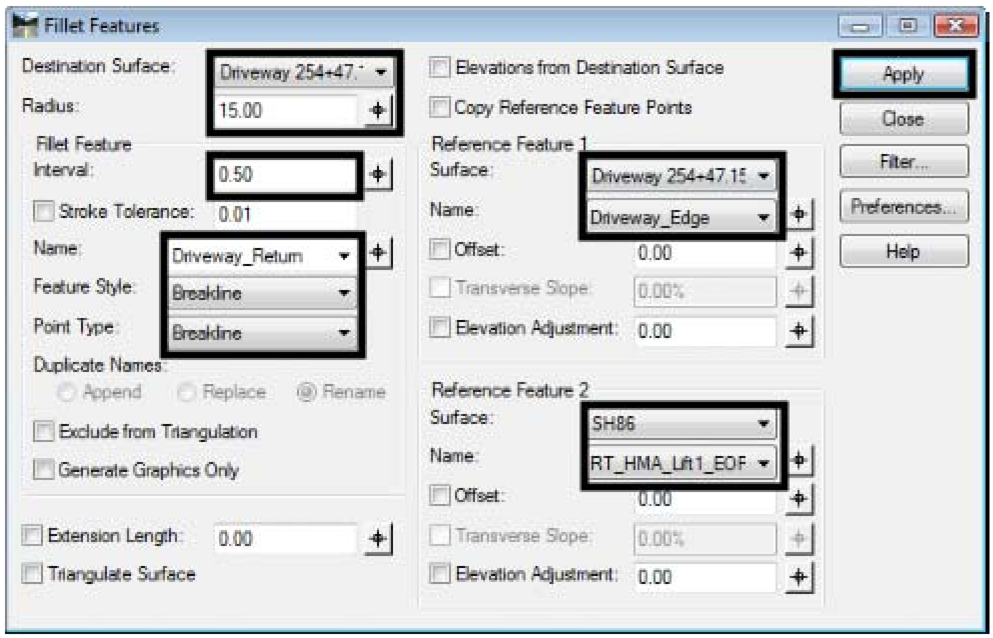


4. From the InRoads menu bar, Select **File > Import > Surface**.
5. Set up the ***Import Surface*** dialog box as in the ***Setting Elevations (pg. 145)*** section above, using ***Driveway Edge*** as the ***Seed Name***.

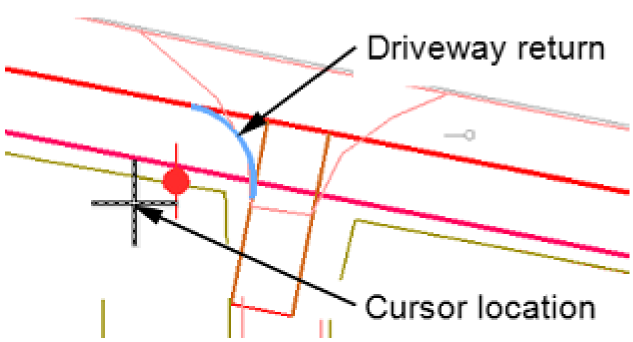
6. **<D> Apply** the **<D>** on one of the edge lines. Repeat the process with the other edge line.
7. **Close** the Import Surface dialog box.

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.

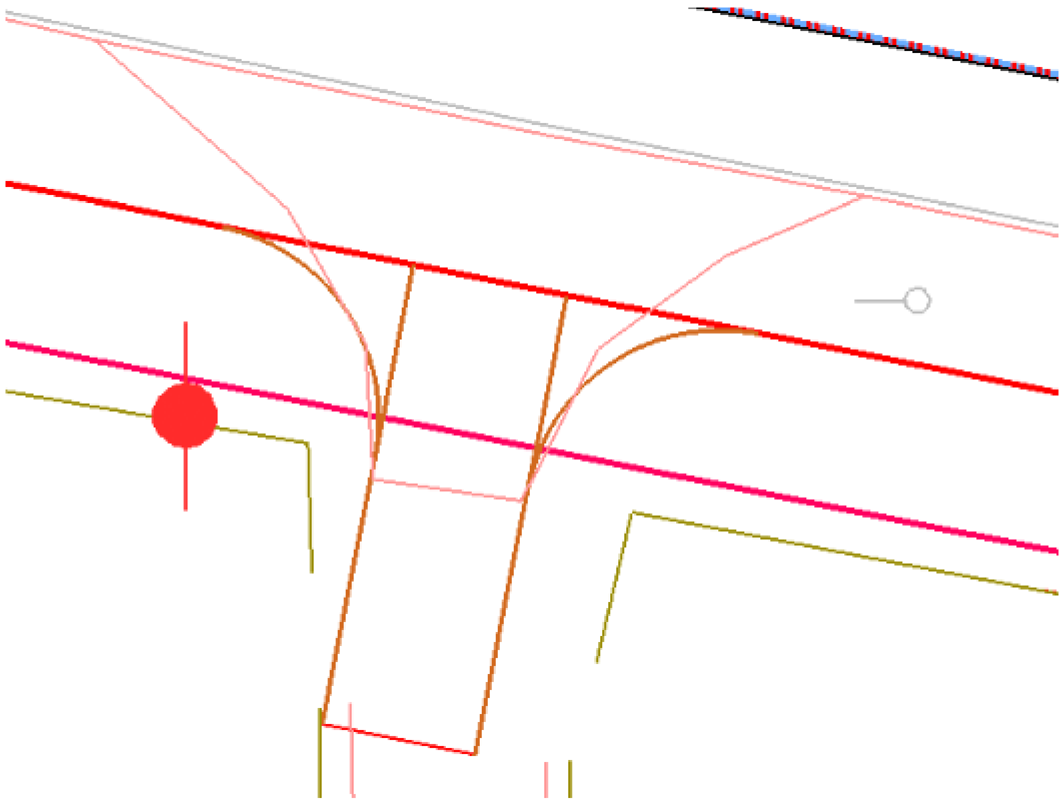


10. **<D> Apply**, then move the cursor into the quadrant for the return and <D>. The return is added to the driveway surface.



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.

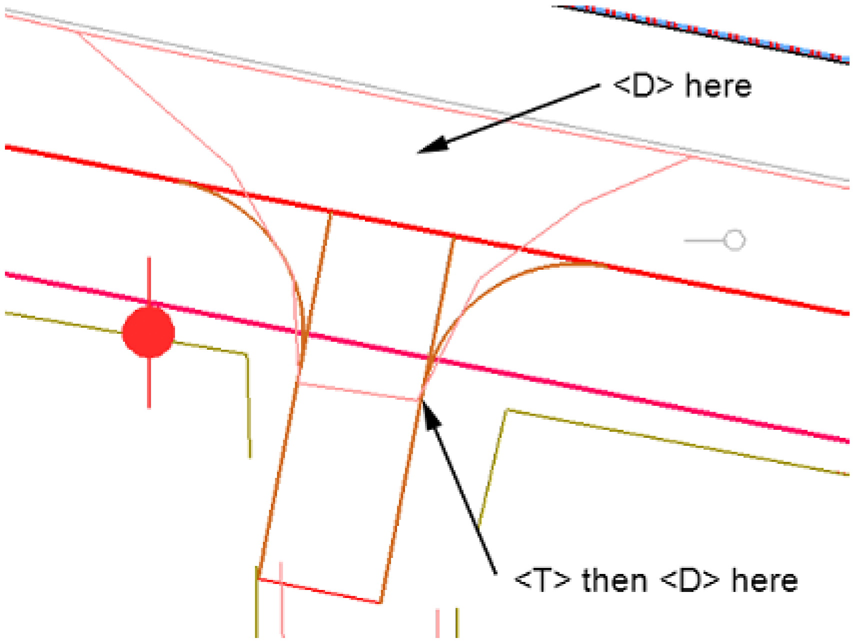
15. Verify that the ***Driveway 254+47.15 Rt*** surface is active.

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.

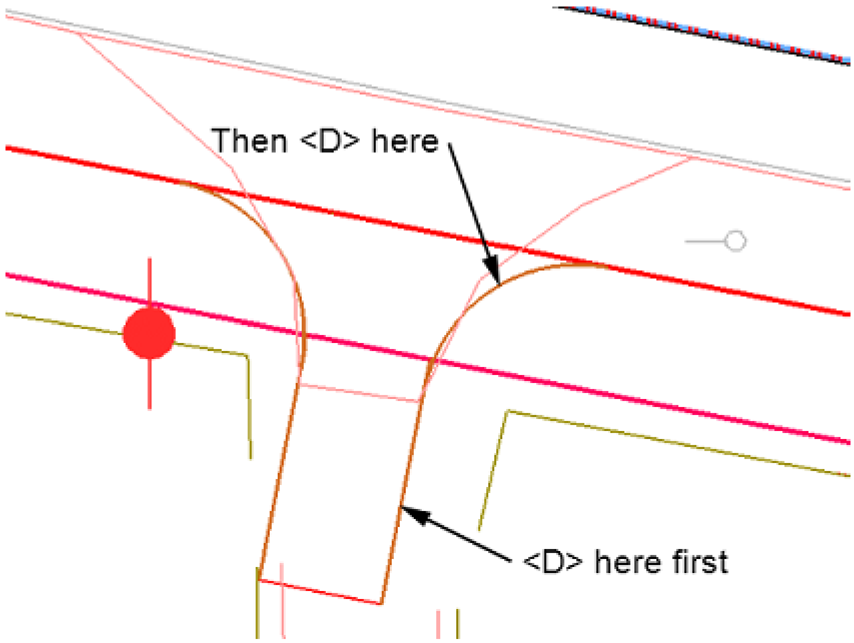
The final step in creating the driveway edge lines is to join the line and return features to form a single feature. This will make it easier to construct the side slopes for the drive way.

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 20.4 - Sideslopes and the Exterior Boundary

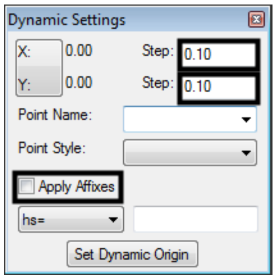
With the backbone of the driveway complete, the sideslopes and exterior boundary can be added to finish the driveway model.

Section Objectives:

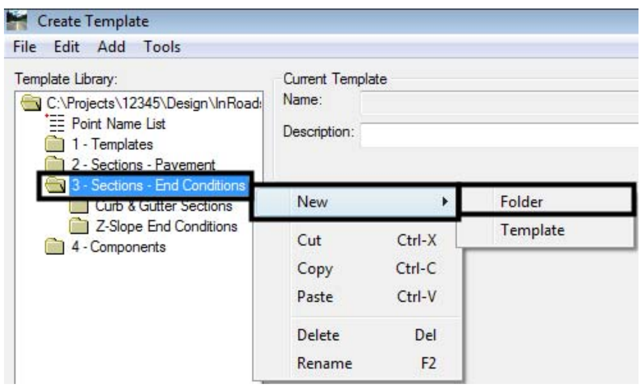
- Modify an end condition section to search for a specific surface.
- Use Apply Template to create driveway sideslopes.
- Create an exterior boundary from graphic elements.

The sideslopes for the driveway must tie to two different surfaces, the proposed (SH86) surface ot 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**.



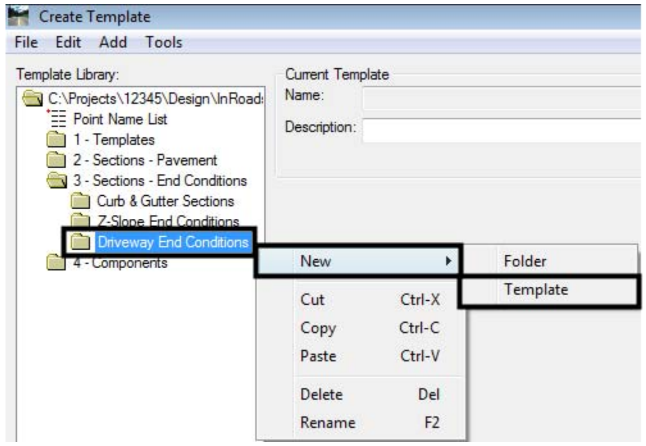
5. Navigate to the **3 - Sections - End Conditions** folder in the template library explorer.
6. **<R>** on the ***3 - Sections - End Conditions*** folder and select **New > Folder**.



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***.

12. Drag the component from the ***Preview*** into the ***4_to_1-Existing*** section by its origin and place it on the origin on the new section.

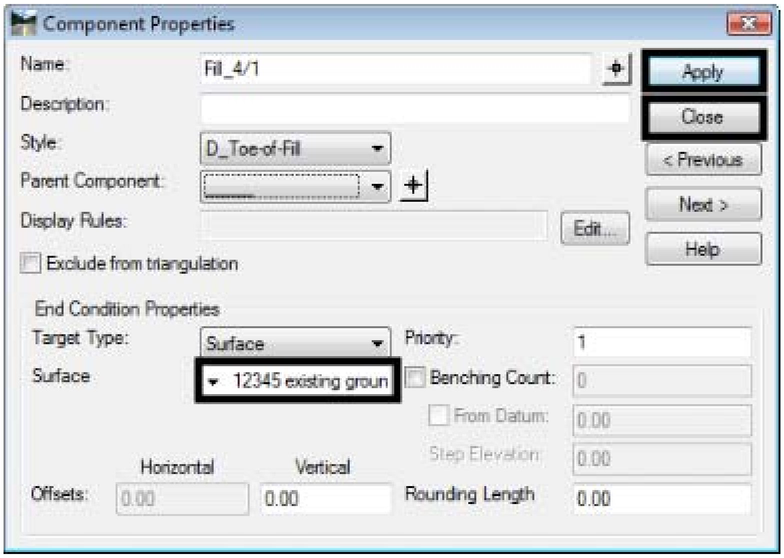
13. Expand the ***Cut Slope Components*** folder and **<D>** on the **Cut_4_to_1** component.

14. Drag and drop this component into the new setion 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.

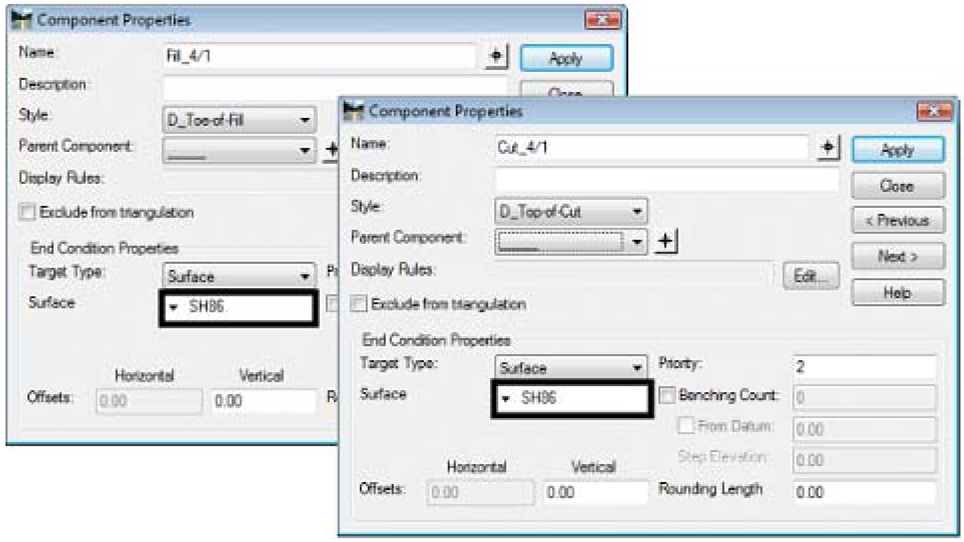
22. **<R>** on the **4_to_1-Existing** section and select **Copy**.

23. **<R>** on the ***Driveway End Conditions*** folder and select **Paste**.

24. Rename the section to ***4_to_1-Proposed***.

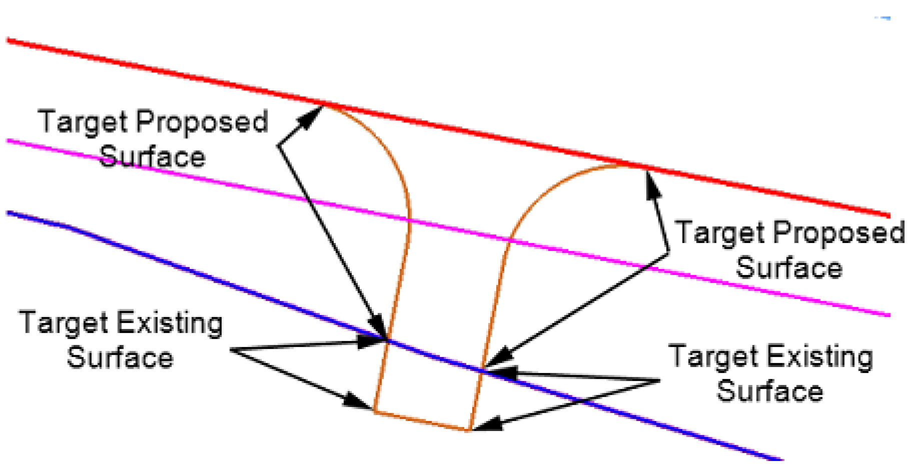
25. **<D> <D>** on the ***4_to_1-Proposed*** section to make it active.

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.

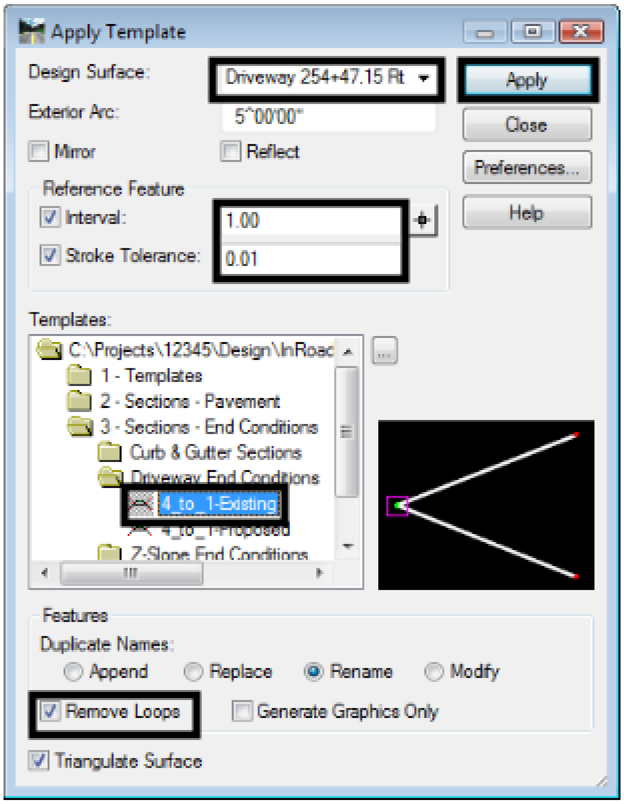
32. Navigate to ***3 - Sections - End Conditions*** > ***Driveway End Conditions*** in the template library.

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**.

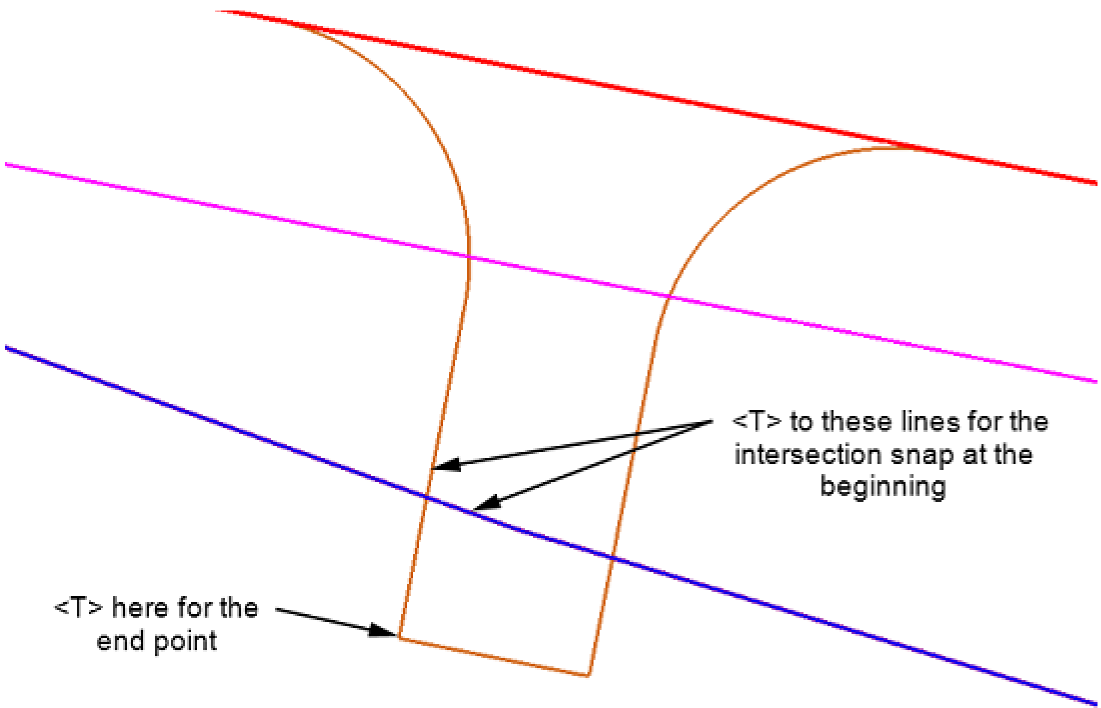
36. **<D> Apply**.



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.

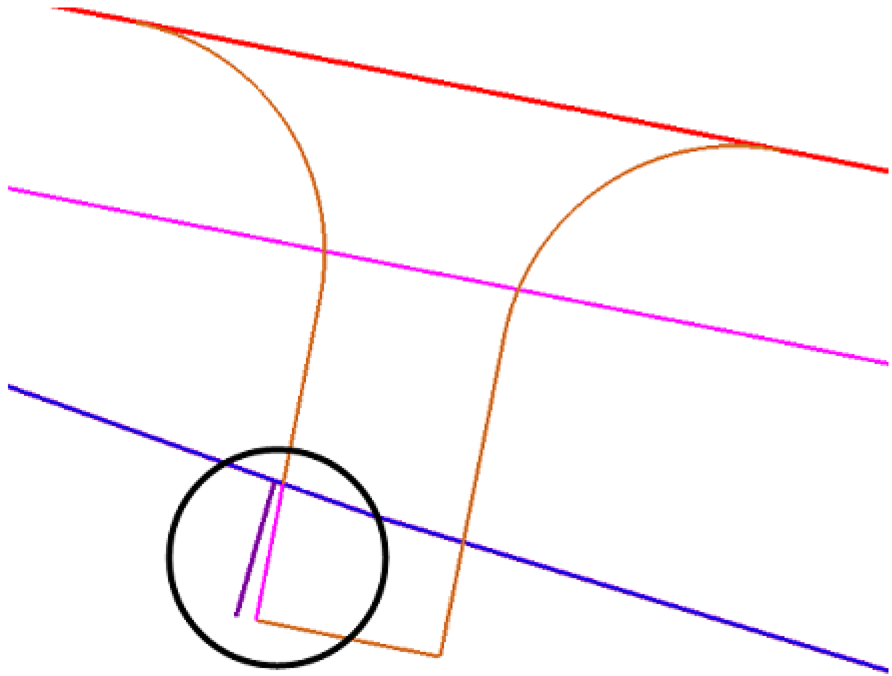


40. **<T>** on the mainline top of cut feature then **<T>** on the driveway edge feature.

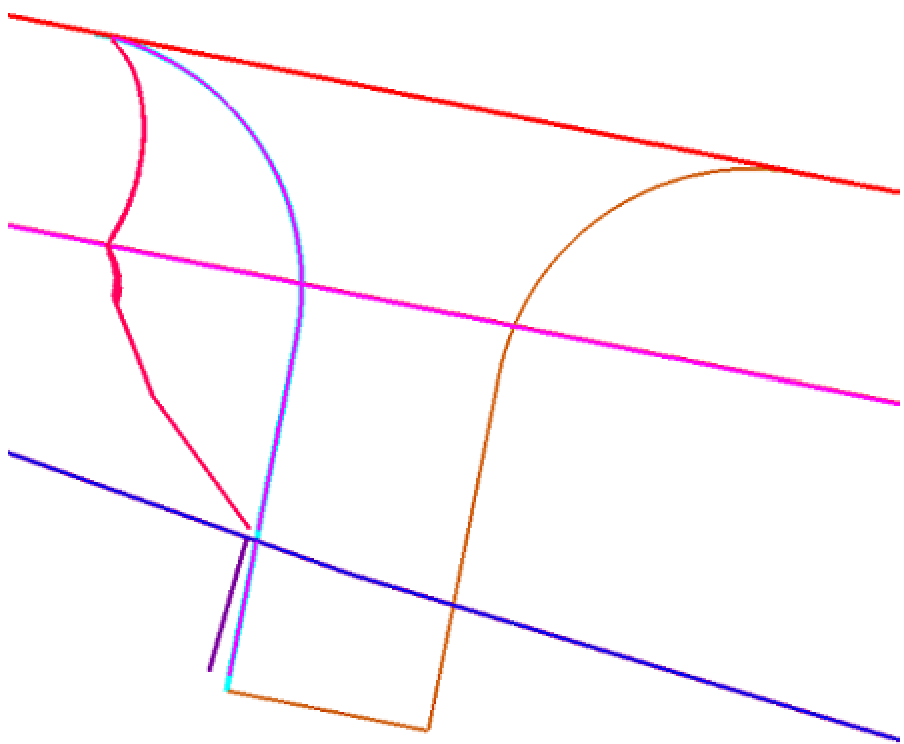
41. Use the keypoint snap to select the end point.

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.

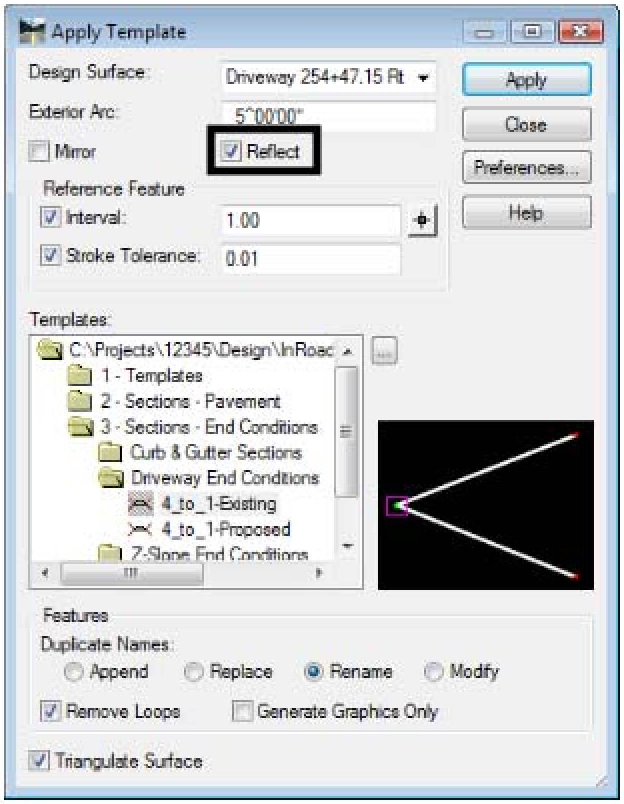
The result of the Apply Template is shown below (shown inside the circle).



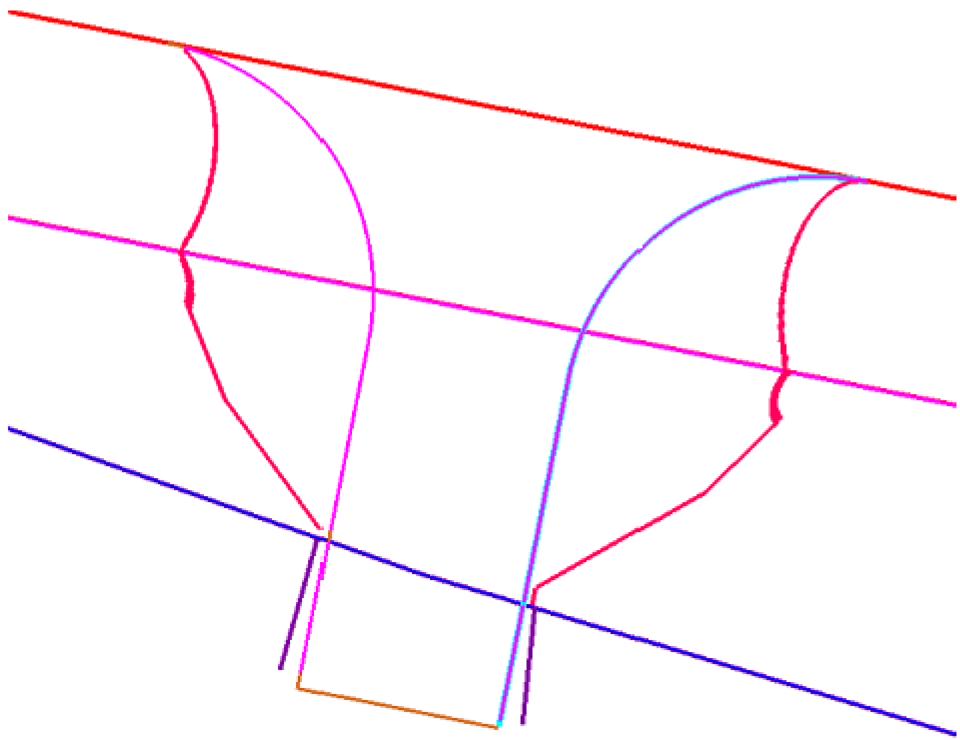
42. Repeat the Apply Template process, using the ***4_to_1-Proposed*** section, to model the sideslope to the (proposed) SH86 surface. The illustration below shows the results after applying both sections to the left side.



43. In the Apply Template dialog box, toggle on Reflect.



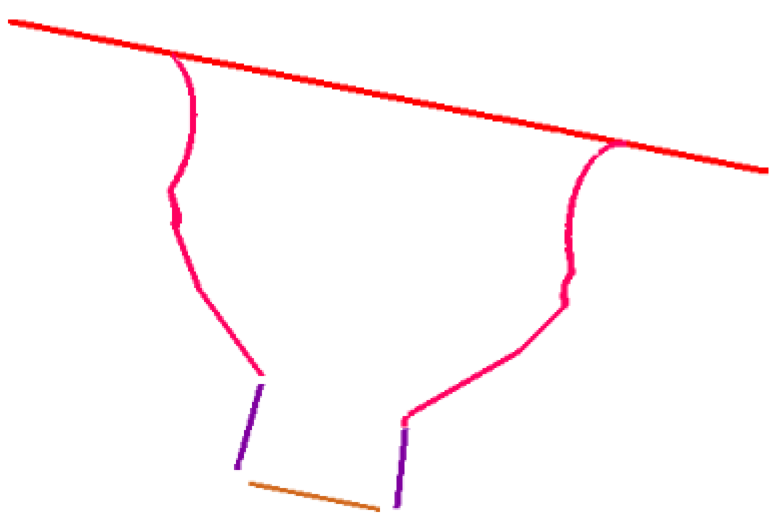
44. Apply both sections to the right side of the driveway as described above. The results of all of the Apply Template commands are shown below.



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.

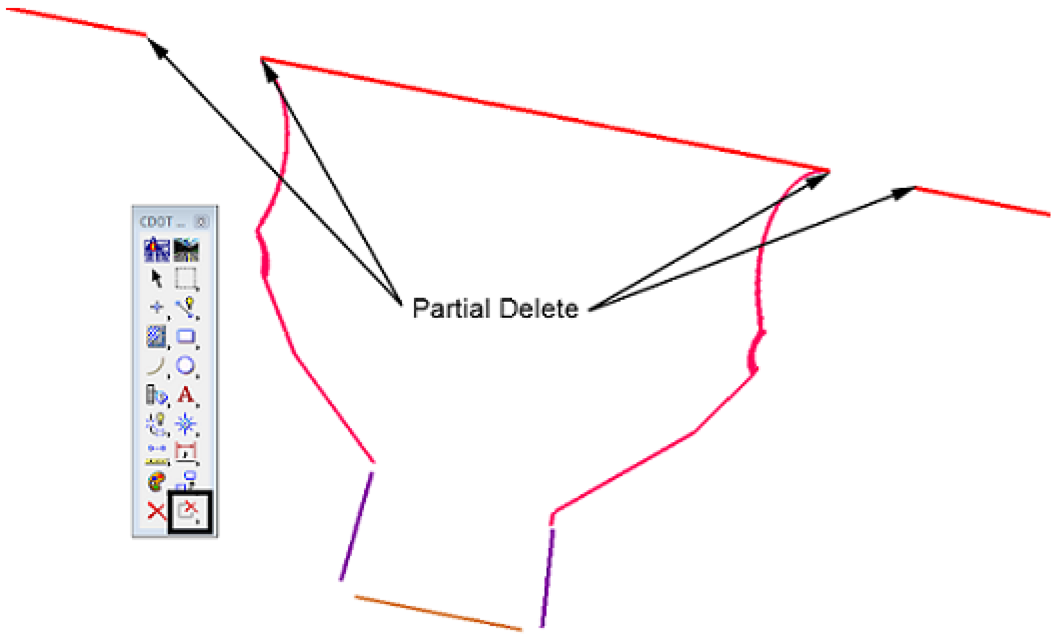
45. Select the MicroStation Delete command from the Main toolbar.

46. Delete the graphic elements that will not be used for the exterior boundary. The illustration below shows the elements needed.

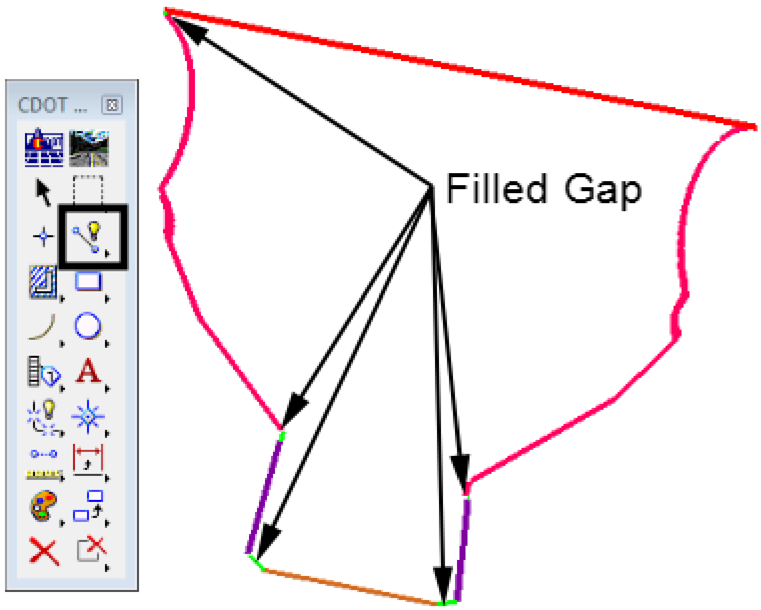


To create the boundary, the edge of pavement line needs to be trimmed and the gaps between elements need to be filled.

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.

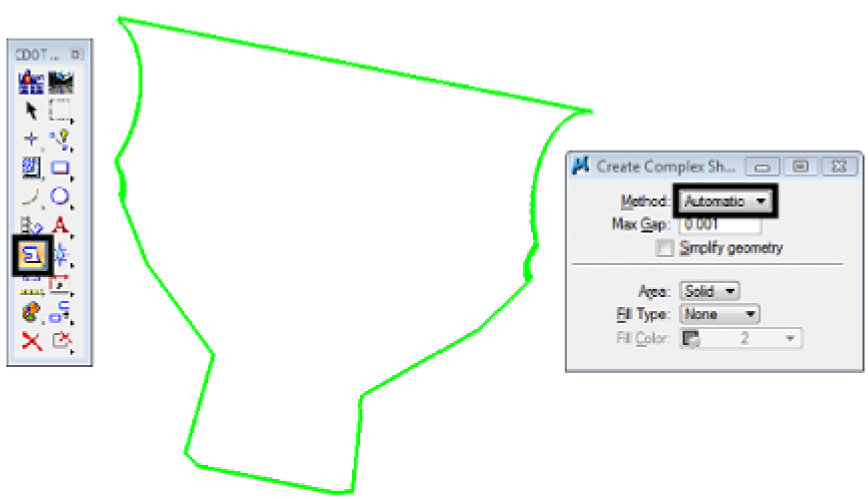


A closed shape element is created from the linework defining the exterior boundary

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**.

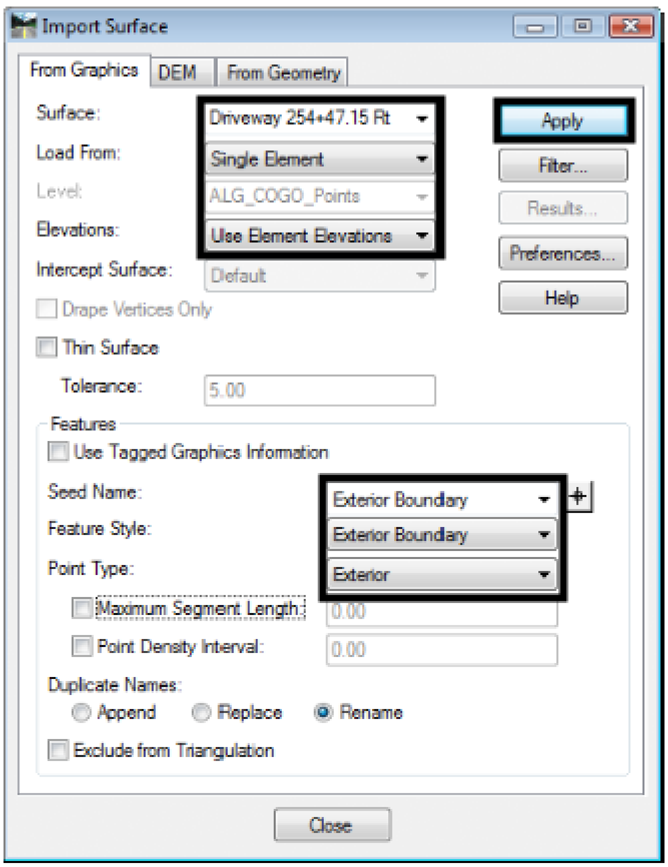
57. Set ***Elevations*** to **Use Element Elevations**.

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**.

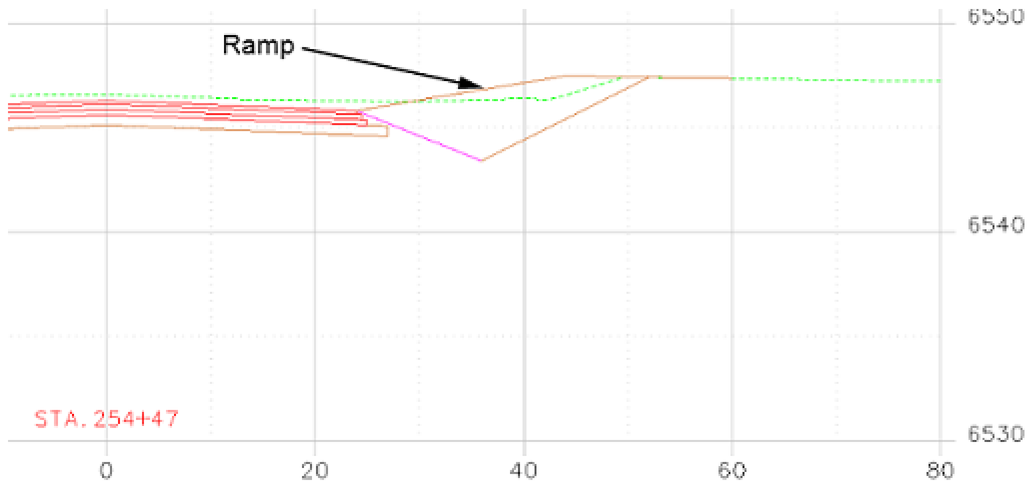
61. **<D> Apply** then **<D>** on the boundary graphic element.



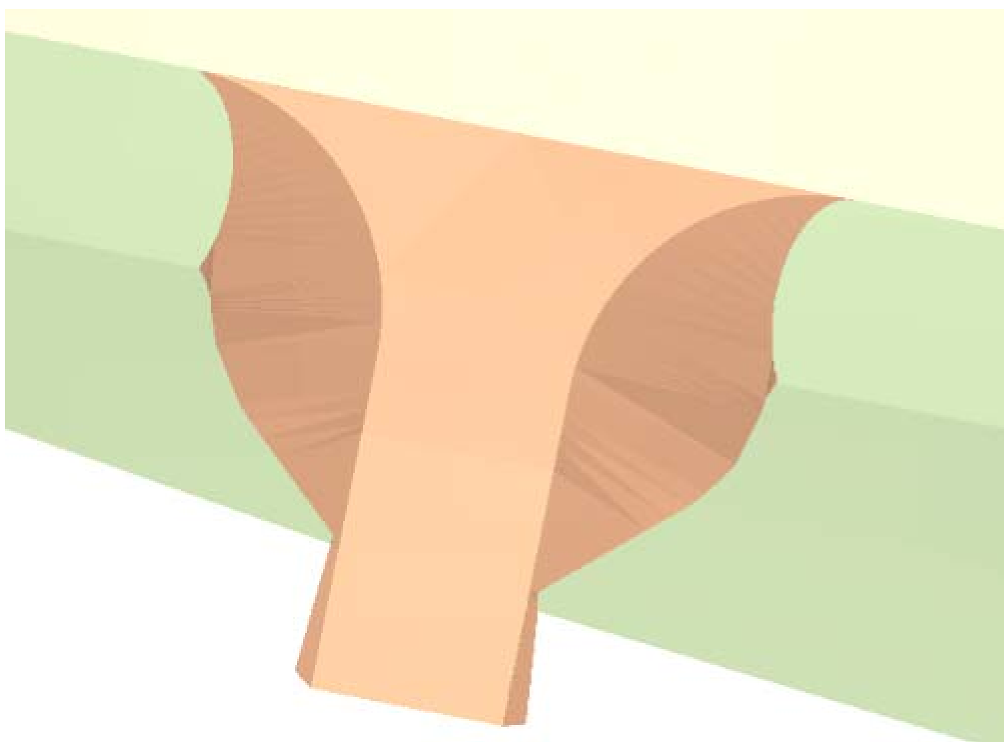
62. Close the Import Surface dialog box.

63. From the InRoads explorer, **<R>** on the **Driveway 254+47.15 Rt** surface and select **Triangulate**.

64. To evaluate the ramp, creat 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 21 - 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 21.1 - 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 laidout 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.

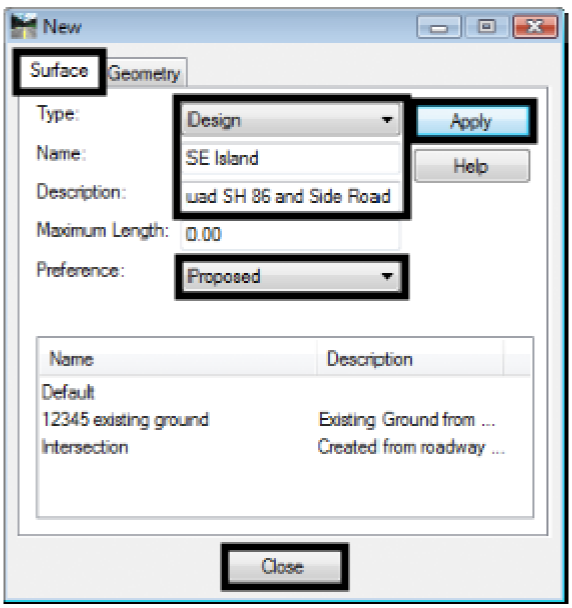
6. Set the ***Type*** to **Design**.

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 ***Preferance*** 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.

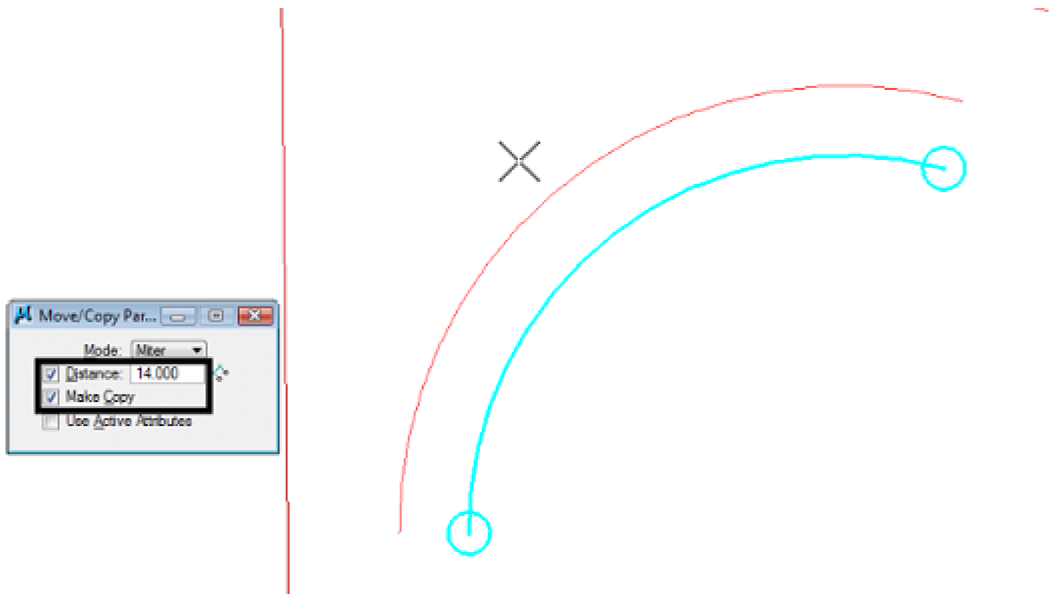
11. In the InRoads Explorer, expand the **12345DES_Geometry** geometry project.

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

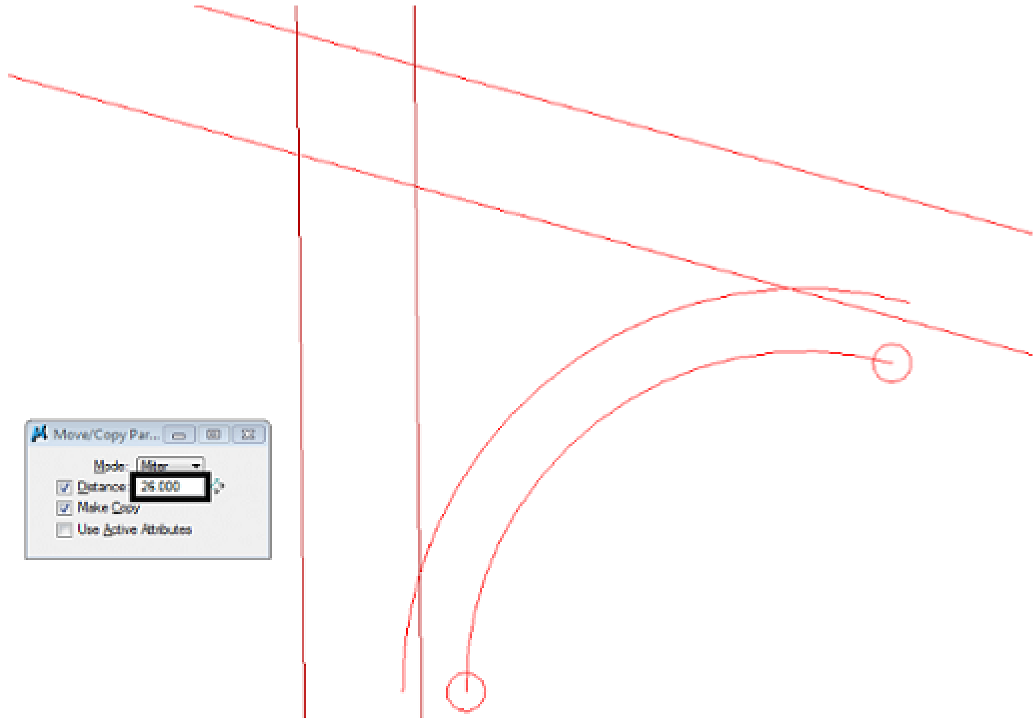
The MicroStation Move Parallel command is used to offset these lines. The SE Curb Return line is offset 14' (12' for the driving lane and 2' for the gutter) to the left to form one side of the island. The SH 86 and SideRoad lines are offset 26' (24' for the driving lane and 2' for the gutter) to the 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 the **<D>** to the right of the line. **<R>** to exit the command.

22. **<D>** on the **SideRoad** line the **<D>** to the right of the line. **<R>** to exit the command. The illustration below shows the results.



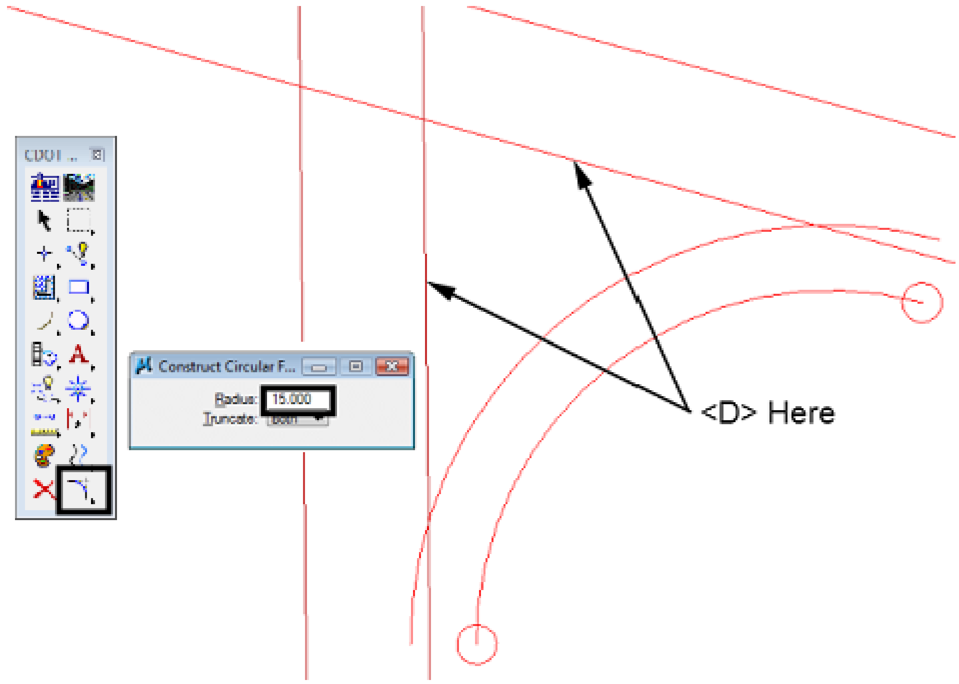
Next the radii for the island corners are added. The corner facing into the intersection has a 15' radius. The other two have a radius of 5'. These are placed using the Construct Circular Fillet command.

23. Select the **Construct Circular Fillet** command from the MicroStation Main toolbar.

24. In the tool settings box, key in ***15*** for the ***Radius***.

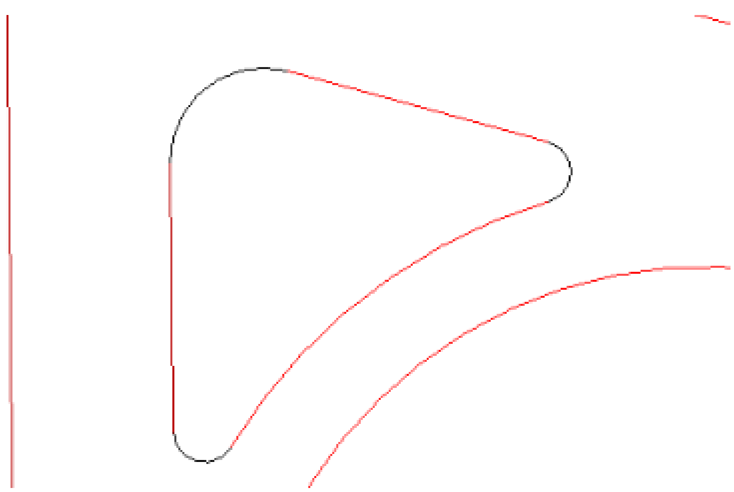
25. Set ***Truncate*** to **Both**.

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.

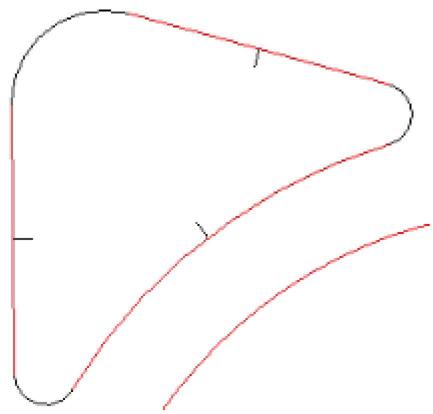


With the outline of the island in place, the pedestrain ramps can be located. These are placed in the center of each side of the island. The MicroStation Construct Line At Active Angle command is used to place the ramp centerline perpendicular to the island side.

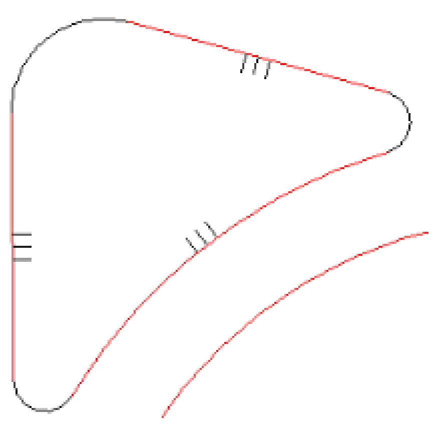
Note: The dimensions for the pedestrain ramp are taken from the M-608-1 Curb Ramps standard, page 104 of the M & S Standards July 2006 edition.

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 32 for the other two sides. The illustration shows the results.

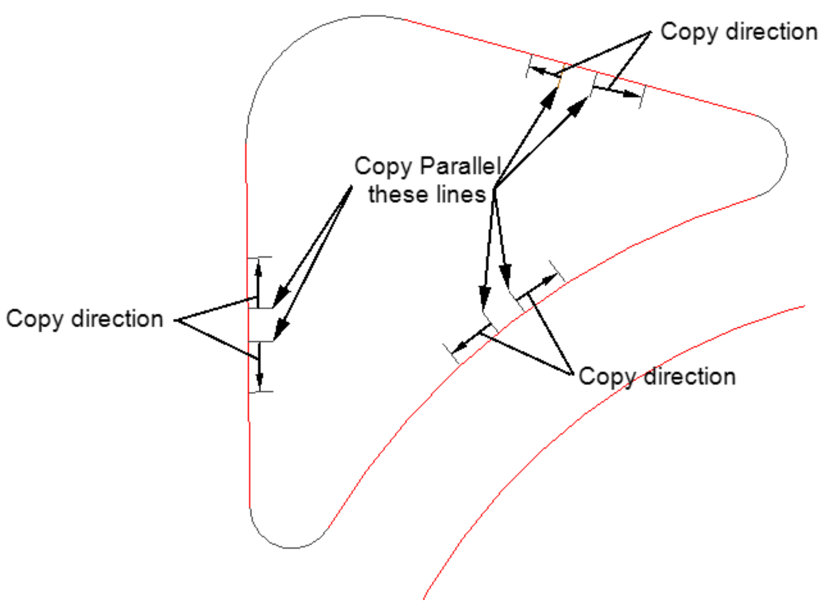


35. From the MicroStation ***Main*** toolbar, select **Move Parallel**.
36. In the ***Move/Copy Parallel*** tool settings box, toggle on ***Distance***.
37. Key in ***2*** for the value.
38. Copy each of the ramp centerlines to either side of itself. These will make up the edges of the ramp tread. The 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 pedestrain ramps were added using the Construct Line At Active Angle command.

Lab 21.2 - 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.

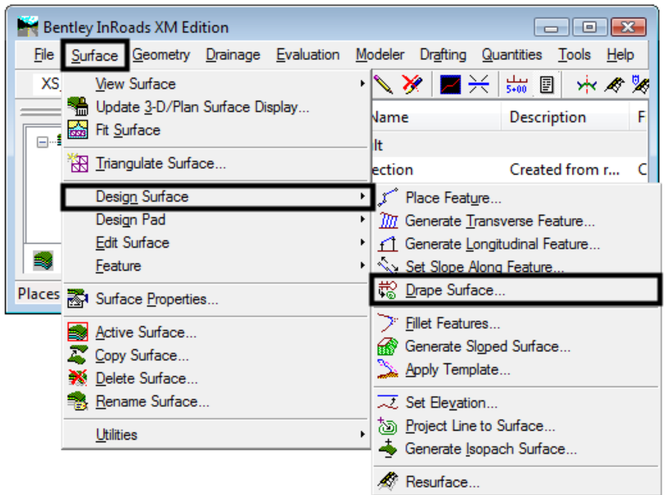
Section Objectives:

- 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.

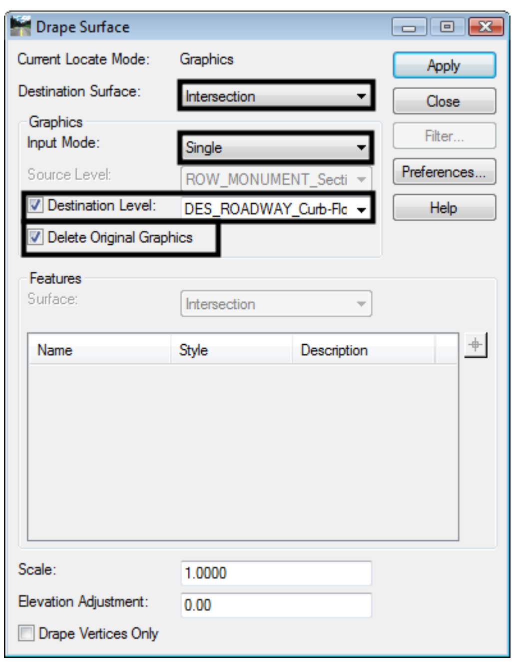


3. In the ***Drape Surface*** dialog box, set the ***Destination Surface*** to **Intersection** (this is the surface whose elevations are going to be matched).

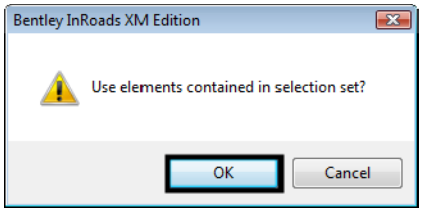
4. Set the ***Input Mode*** to **Single**.

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.

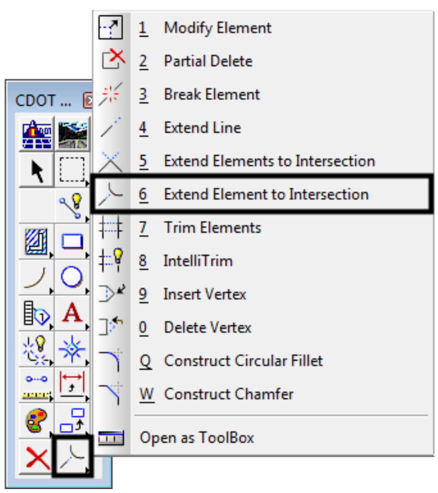


8. **<D> Close** to dismiss the ***Drape Surface*** dialog box.

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.

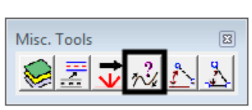
10. Select **Extend Element to Intersection** from the MicroStation main menu.



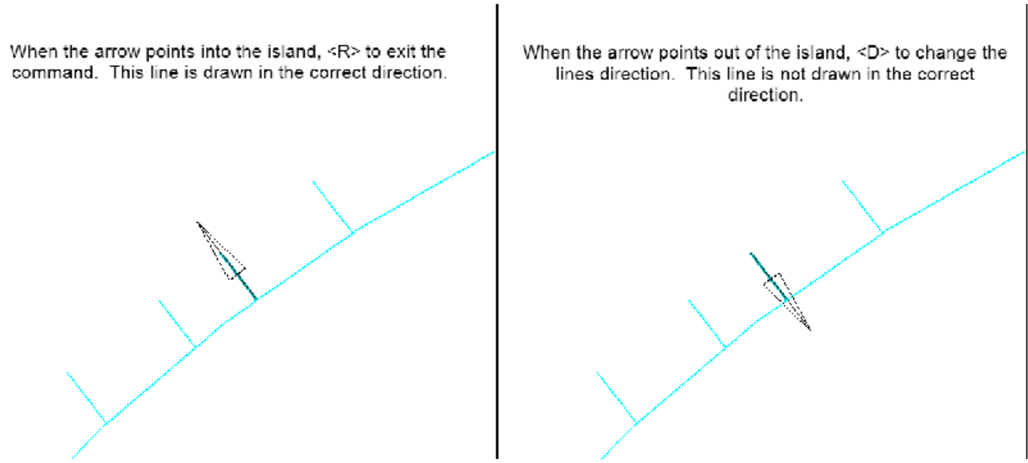
11. Extend the outside ramp line to meet the Island line.

Next, check the direction of the lines. This will affect how the Generate Longitudinal Feature command operates.

12. **<D>** the **Change Element Direction** tool from the Misc. Tools bar. The toolbar is usually docked at the top of the MicroStation window. If it is not docked, select **CDOT Tools > Misc. Tools** from the CDOT Menu menu bar.

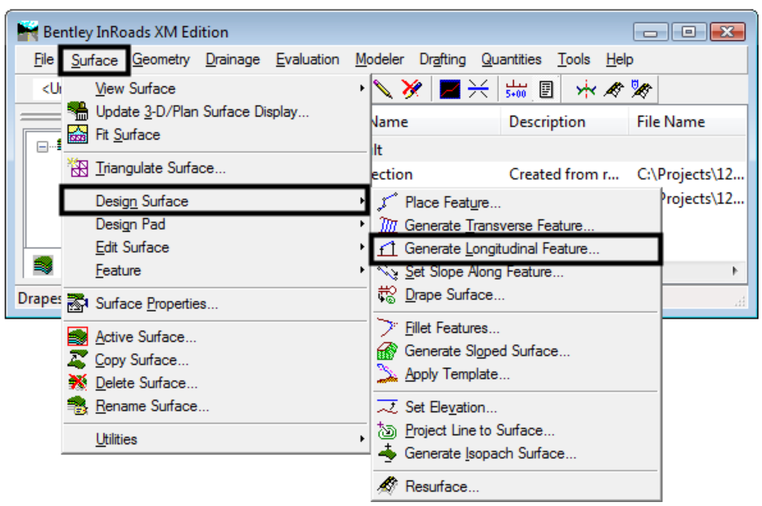


13. **<D>** on one of the ramp landing edge lines. An arrow appears on the line.



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.

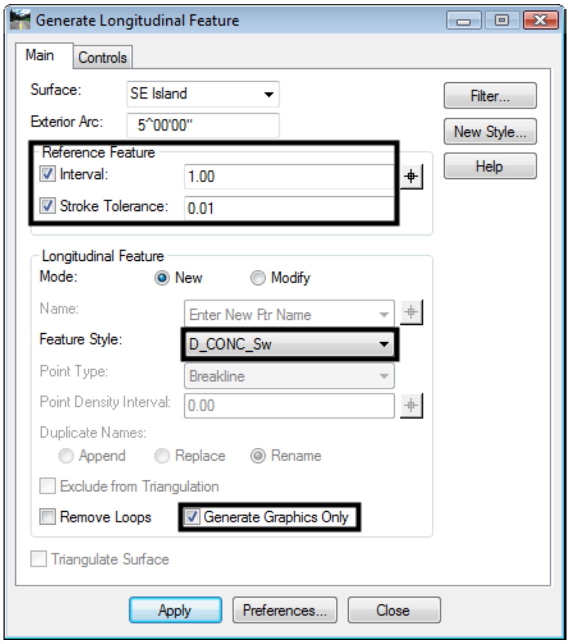


16. On the ***Generate Longitudinal Feature*** dialog box ***Main*** tab, Toggle on **Interval** and set the value to ***1.00***.

17. Toggle on **Stroke Tolerance** and set the value to ***0.01.***

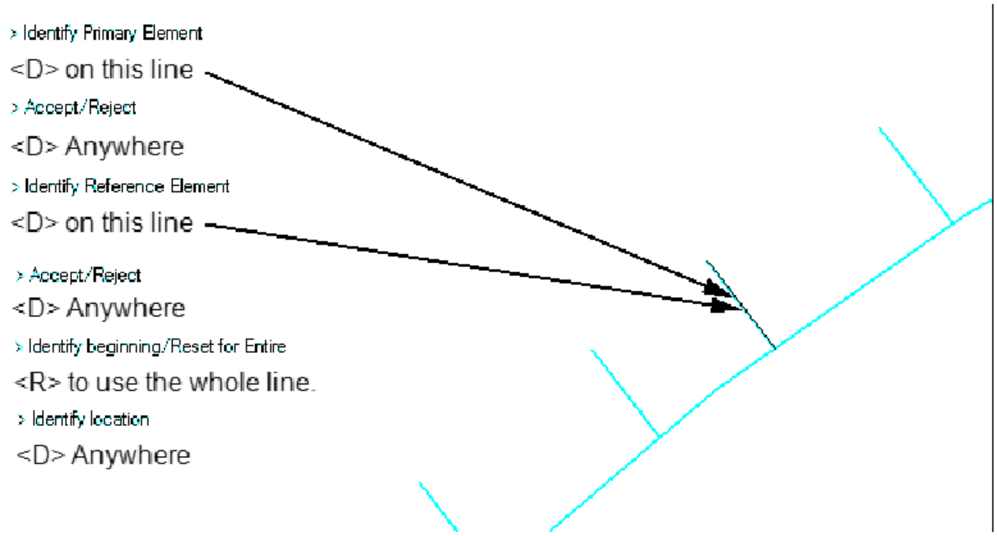
18. Use the ***Feature Style*** drop down menu and select **D_CONC_Sw**.

19. Toggle on **Generate Graphics Only**.

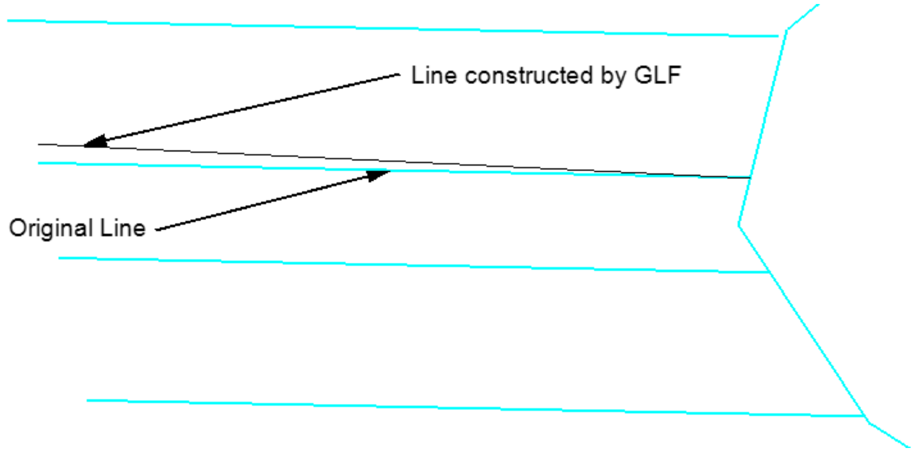


20. **<D>** the **Controls** tab.
21. Set the ***Horizontal Method*** to **Offset From Primary Feature**. Leave the ***Start*** and ***Stop*** values at ***0.00***.
22. Set the ***Vertical Method*** to **Elevation/Longitudinal Slope**.
23. **<D>** the ‘target” button for ***Start Elevation***, then **<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.



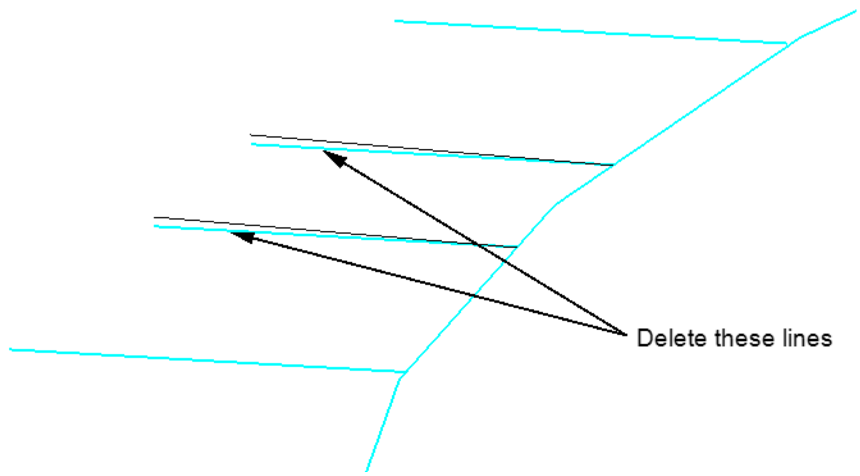
The illustration below shows the results of the ***Generate Longitudinal Feature*** command in a rotated view.



26. Repeat steps 23 through 25 for the remaining ramp landing lines (there are 5 more).

27. Rotate the view so the the originl ramp tread lines can be seen under the new lines.

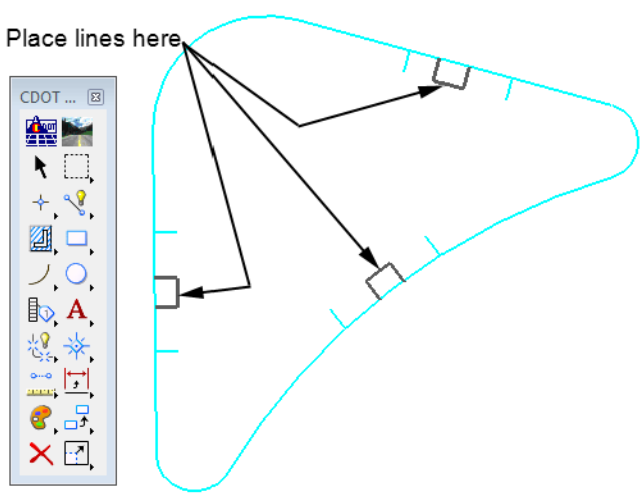
28. Delete the original ramp tread lines from each ramp.



29. Rotate the view back to a ***Top*** view.

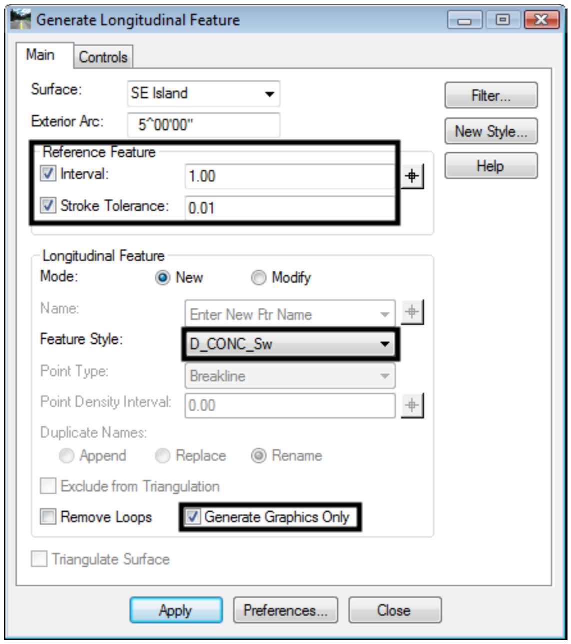
30. Select the MicroStation **Place Smartline** command.

31. Place a line connecting the back of each ramp tread line. Be sure to **<T>** to the end of 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.



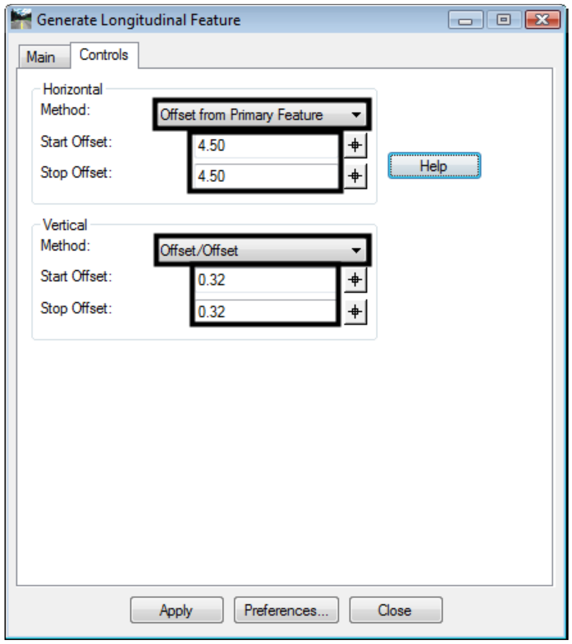
33. **<D>** the **Controls** tab.

34. In the ***Horizontal*** area, set the ***Method*** to **Offset from Primary Feature**.

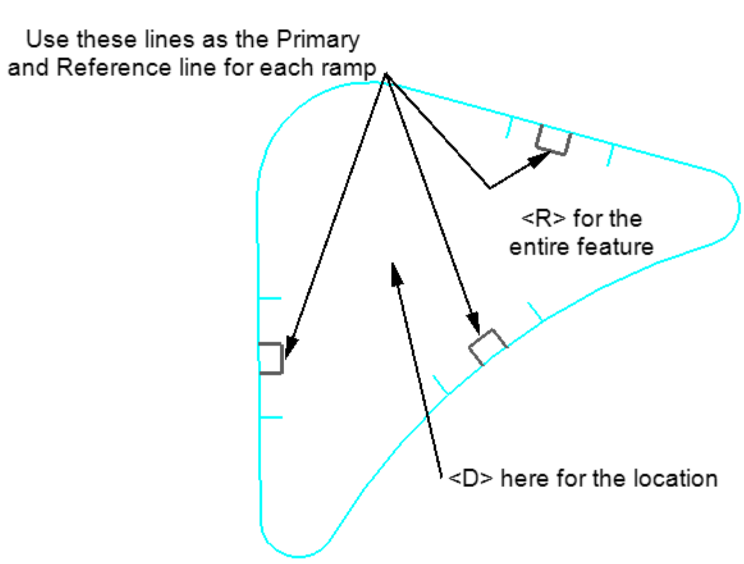
35. Key in ***4.50*** for the ***Start Offset*** and ***Stop Offset***. This is the minimum length for this section of the ramp according to the M & S Standard.

36. In the ***Vertical*** area, set the ***Method*** to **Offset/Offset**.

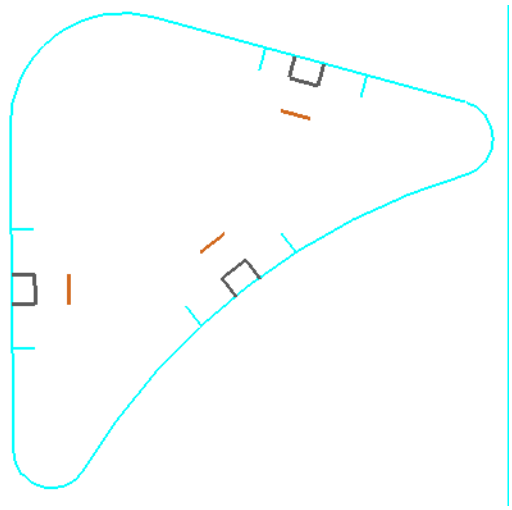
37. Key in ***0.32*** for the ***Start Offset*** and ***Stop Offset***. This is the difference in height from the end of the 20 to 1 tread slope to the top of the curb.



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.

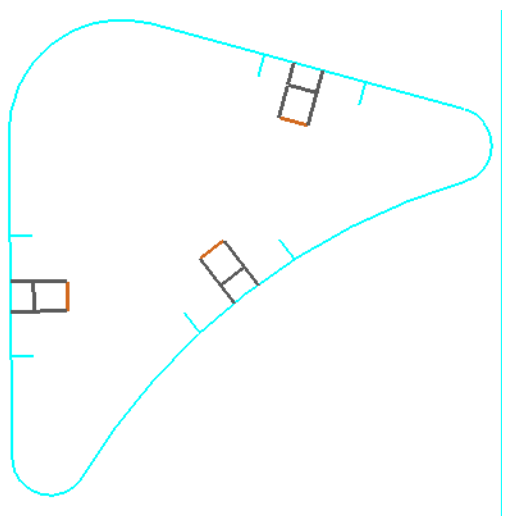


39. Repeat step 38 for each ramp. The illustration below shows the results. Dismiss the ***Generate Longitudinal Feature*** dialog box when finished.



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 of each line so that the elevation of the new line will be correct. The illustration below shows the results.

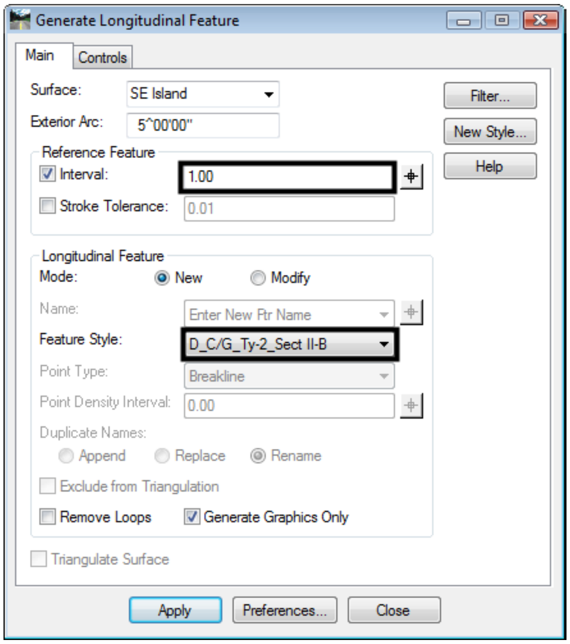


Next, elements defining the curb are added. The Generate Longitudinal Feature command is used for this.

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.



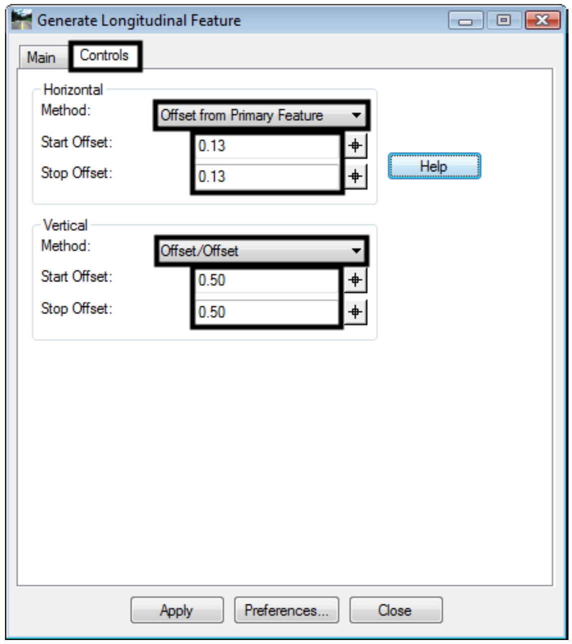
45. **<D>** the **Controls** tab.

46. Verify that the ***Horizontal Method*** is set to **Offset from Primary Feature**.

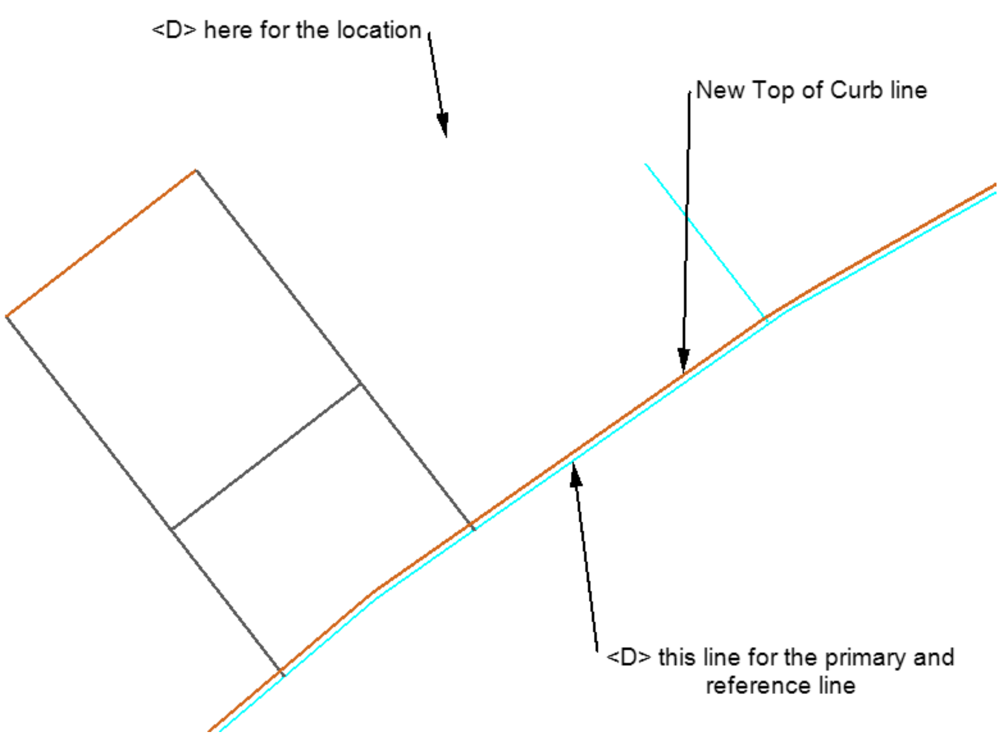
47. Key in ***0.125*** for the ***Start Offset*** and ***Stop Offset***. This is the horizontal distance from the gutter flowline to the top front of the curb according to the M & S Standard. Note: the entry will be rounded to 0.13 in the dialog box.

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.



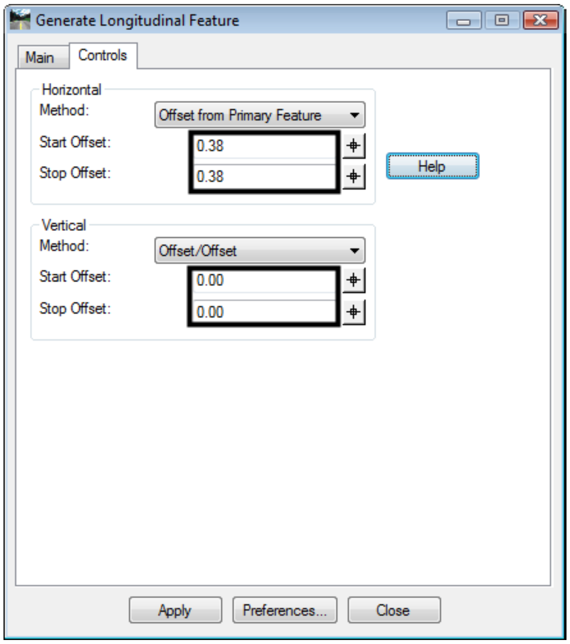
50. **<D> Apply**. Then follow the prompts. <D> an island outline element for the primary feature and use the same one for the reference feature. **<D>** in the middle of the Island for the location. The illustration shows an example of the results.



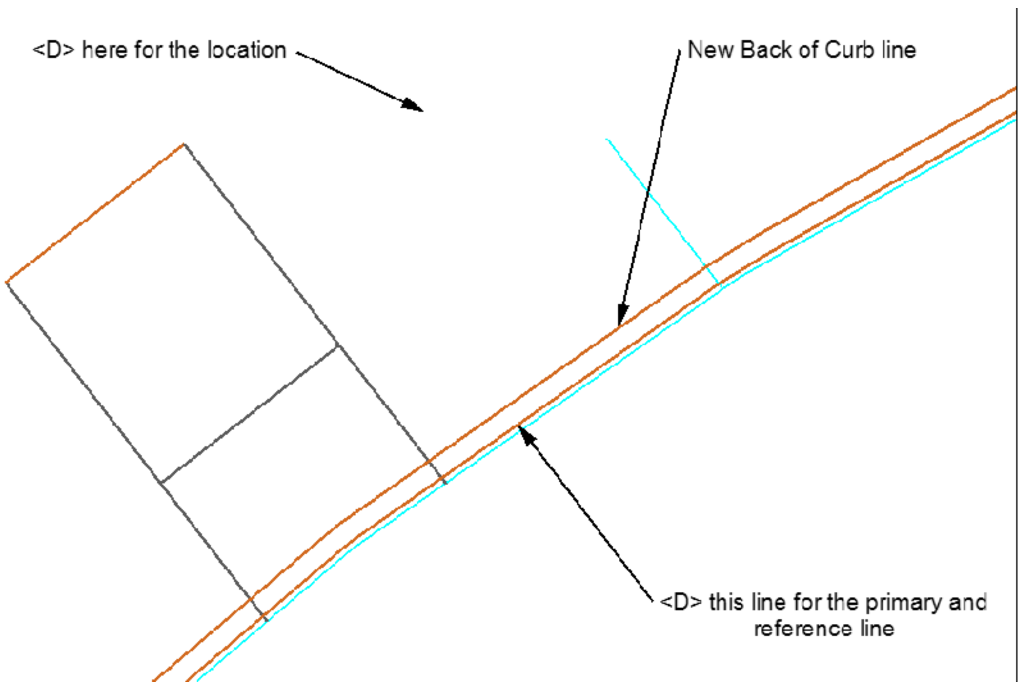
51. Repeat step 49 for each element in the island outline.

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***.



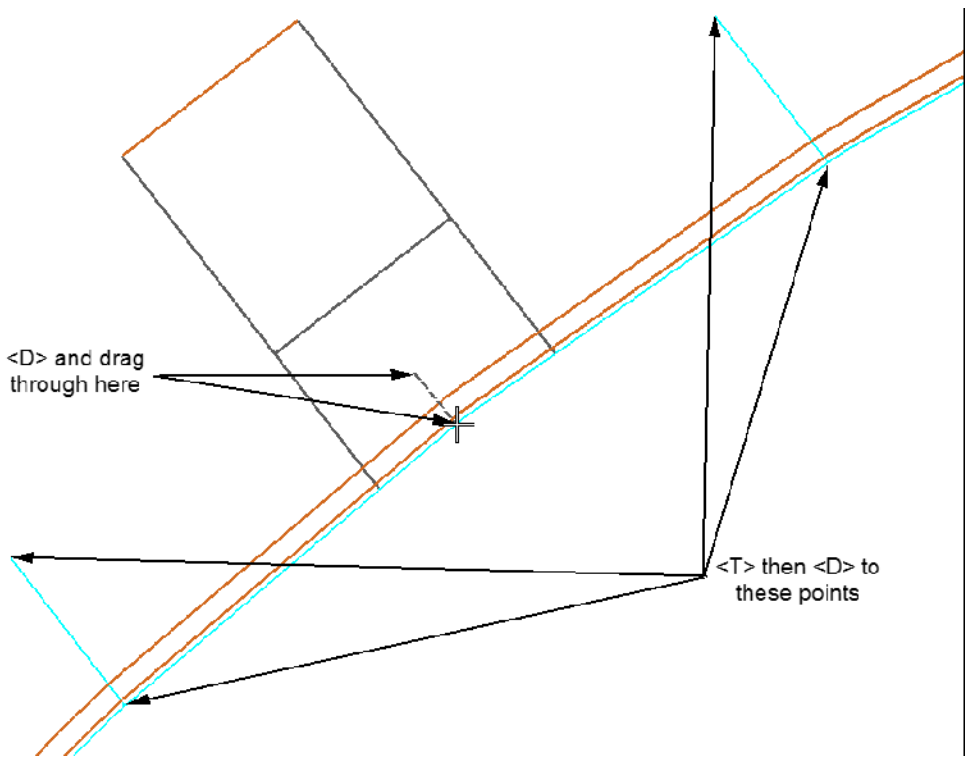
54. **<D> Apply**. Then follow the prompts. <D> a top of curb element for the primary feature and use the same one for the reference feature. **<D>** in the middle of the Island for the location. The illustration shows an example of the results.



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>** the **<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.



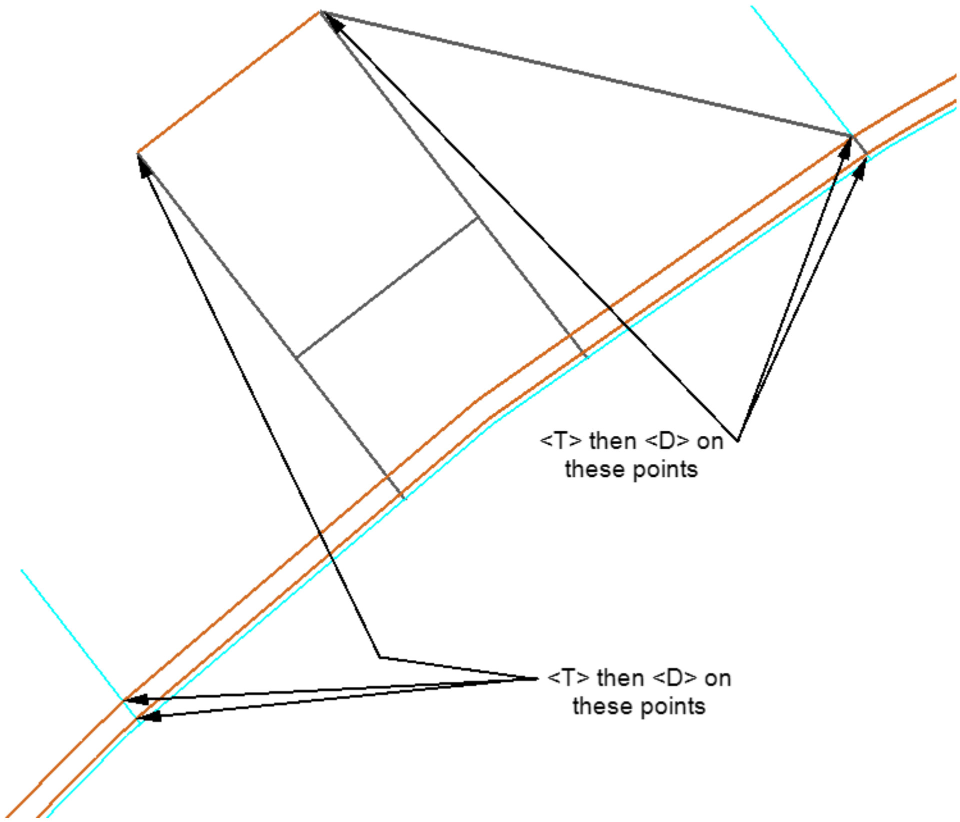
This has broken each of the curb top lines into four sections. The sections inside the ramp area will be modified after they are imported into the surface. Those outside will be left as is.

Next the lines representing the ramp wings are drawn.

62. From the MicroStation main toolbar, select the Place SmartLine command.

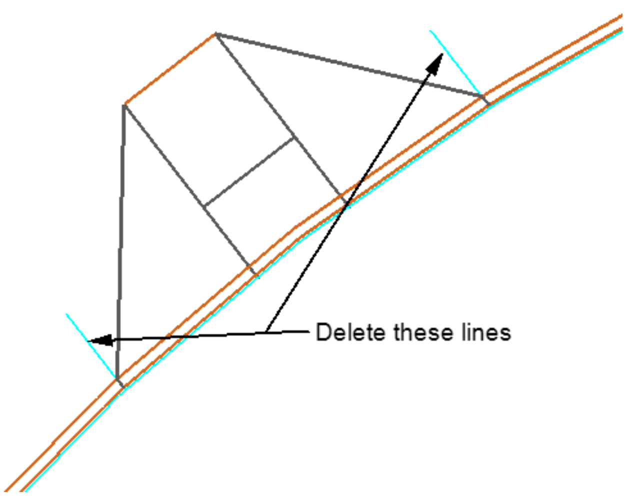
63. **<T>** then **<D>** to the points indicated in the illustration below.

Important! Be sure to snap to the curb top lines. Snapping to any othe line in this area will result in the wing being placed at the wrong elevation.

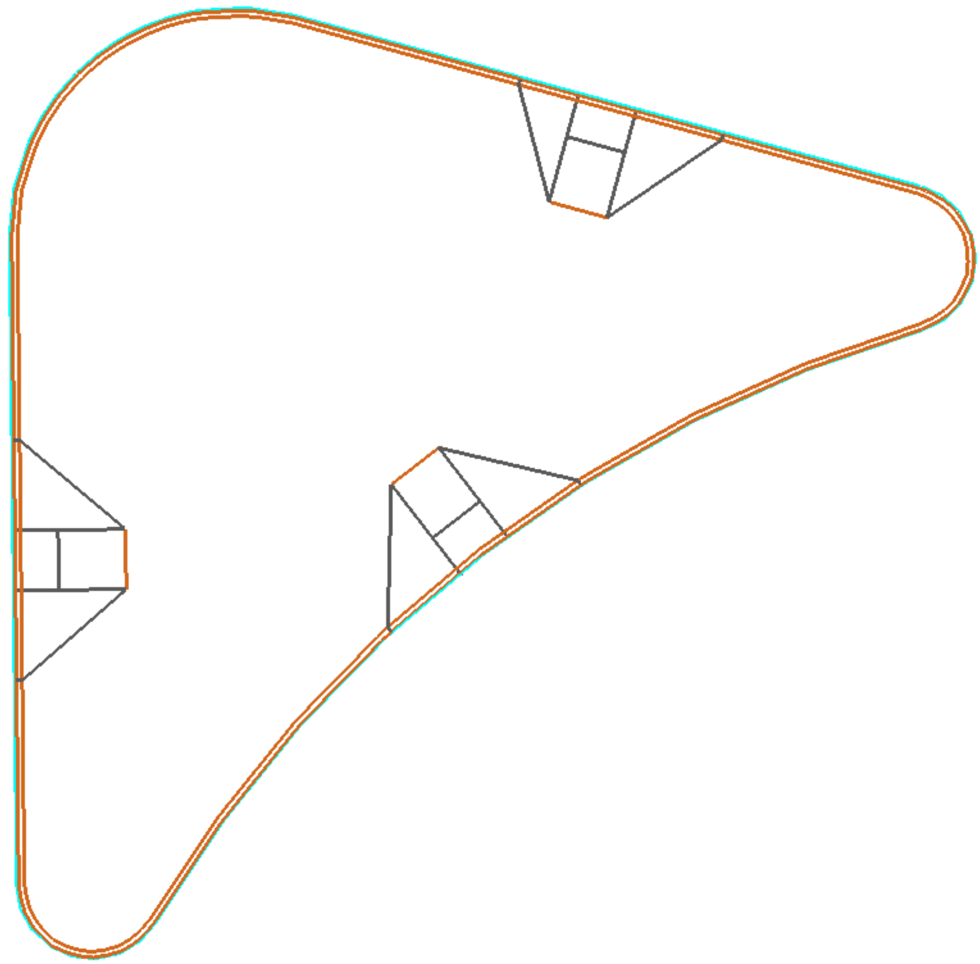


64. Select the MicroStation Delete command.

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.

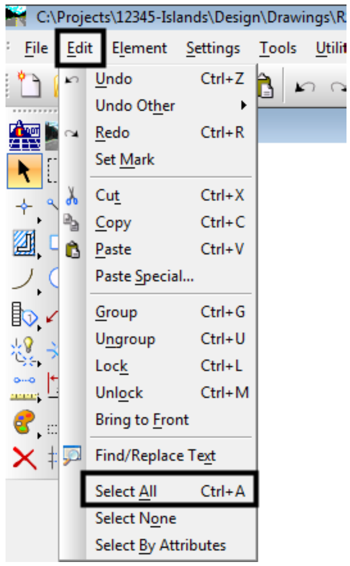
Lab 21.3 - Importing Graphics to Surface and Modifying Features

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:

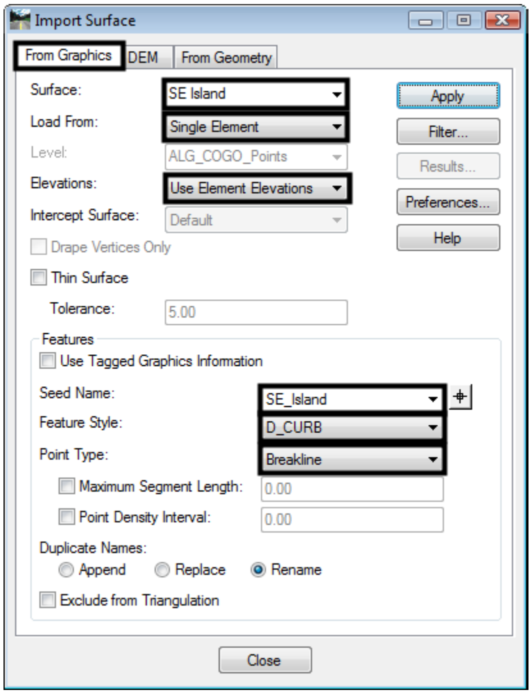
- Import Graphics to create a surface.
- Use Trim Feature to modify curb top features in the ramp areas.
- Use Edit Feature Point for the final cleanup of the curb top features.

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.

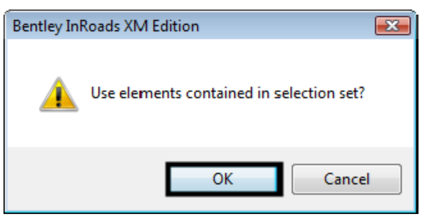


3. From the InRoads menu bar, select **File > Import > Surface**.
4. In the ***Import Surface*** dialog box, verify that the **From Graphics** tab is selected.
5. Select **SE Island** for the ***Surface***.
6. Verify that ***Load From*** is set to **Single Element**.
7. Verify that ***Elevations*** is 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.

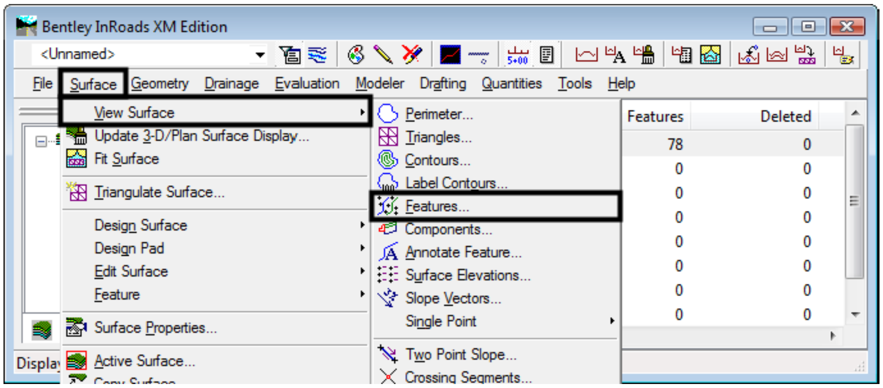


13. **<D> Close** to dismiss the ***Import Surface*** dialog box.

All of the graphic elements have been save 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.

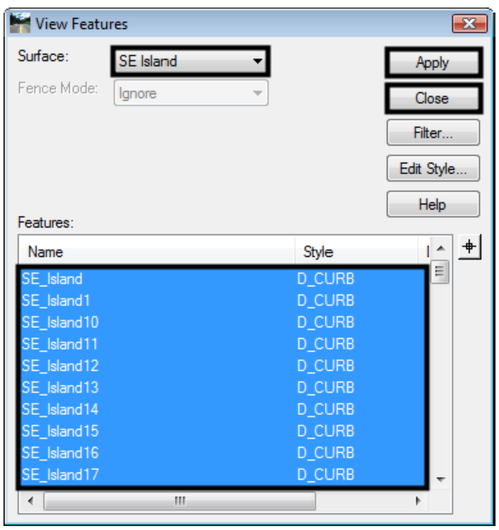
15. Select **Surface > View Surface > Features** from the InRoads menu bar.



16. In the ***View Features*** dialog box, verify that the ***Surface*** is set to **SE Island**.

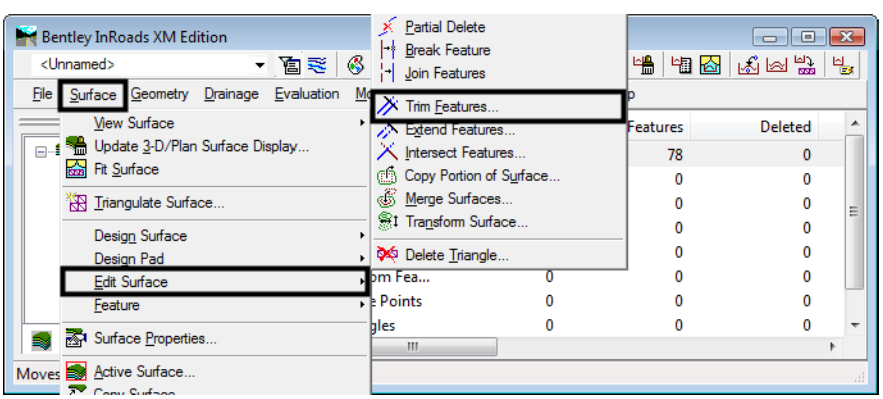
17. Verify that all of the features are highlighted.

18. **<D> Apply** then **<D> Close** to dismiss the View Features dialog box.

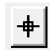


19. In the MicroStation view, zoom in on one of the ramps.

20. From the InRoads menu bar select **Surface > Edit Surface > Trim Features**.



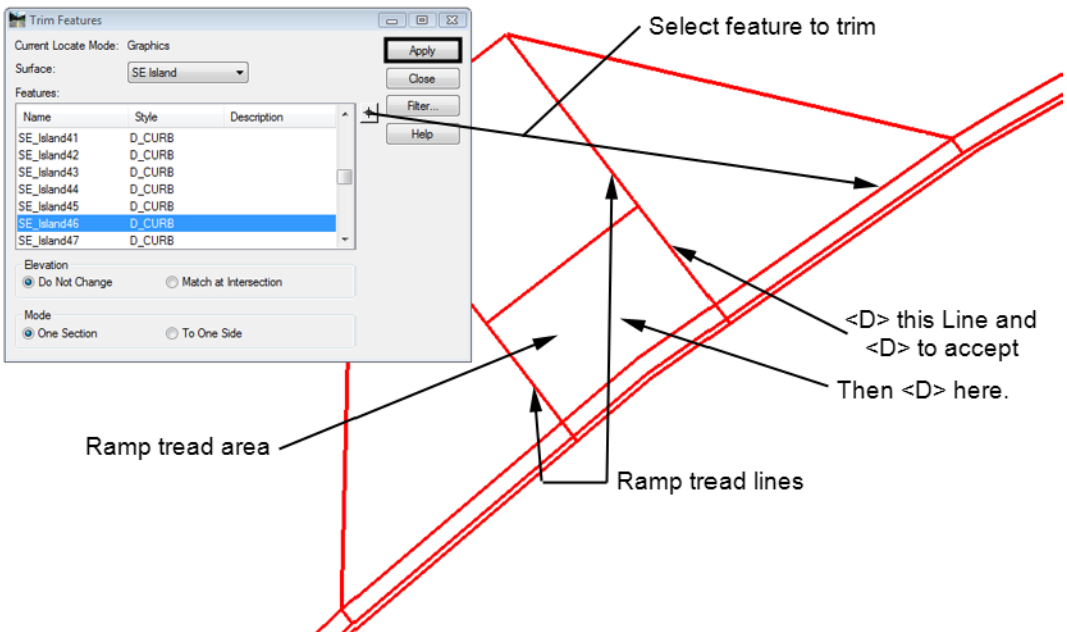
21. In the ***Trim Features*** dialog box, in the ***Elevation*** area, toggle on **Match at Intersection**.

22. **<D>** the target button  Then **<D>** the curb back line. This highlights that feature in the list.

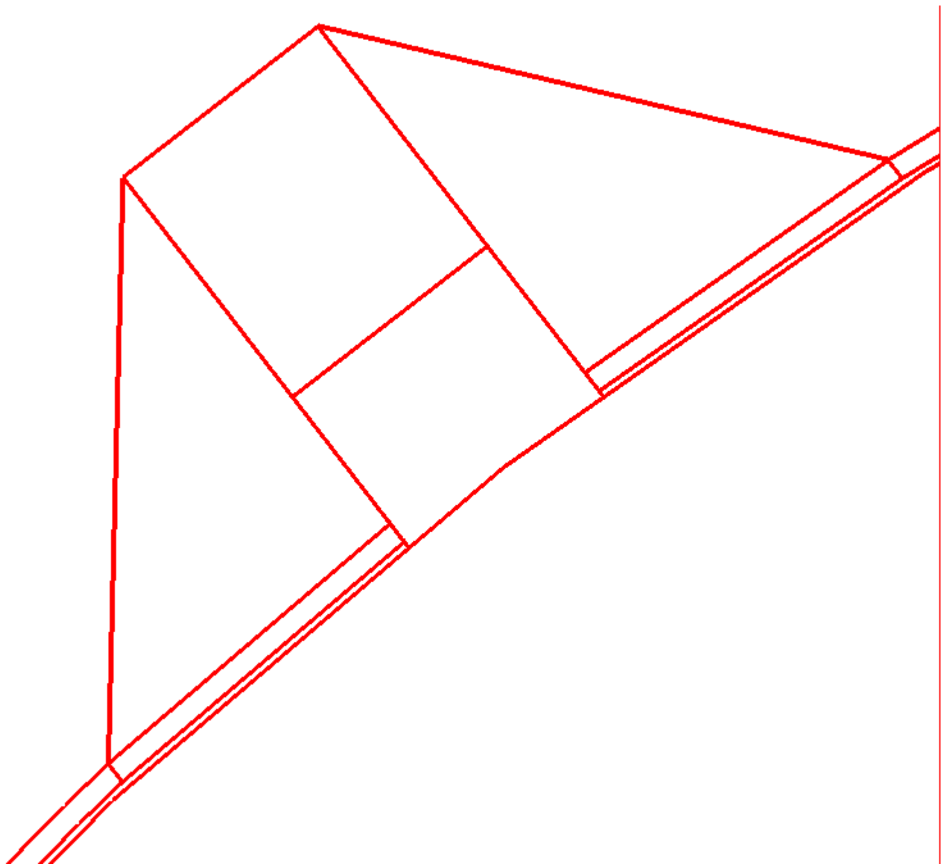
23. **<D> Apply** then **<D> to Accept**.

24. **<D>** the ramp tread line then **<D>** again to accept it.

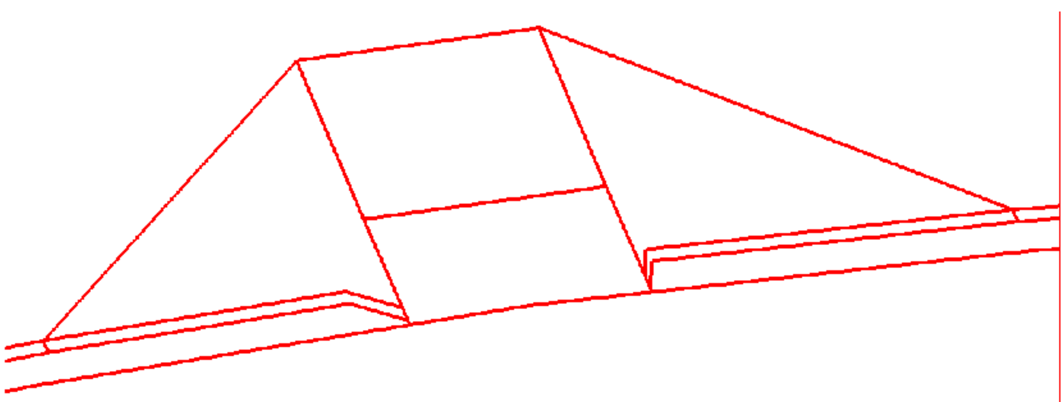
25. **<D>** inside the tread area to accept the command and trim the curb feature.



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 consistantly 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.



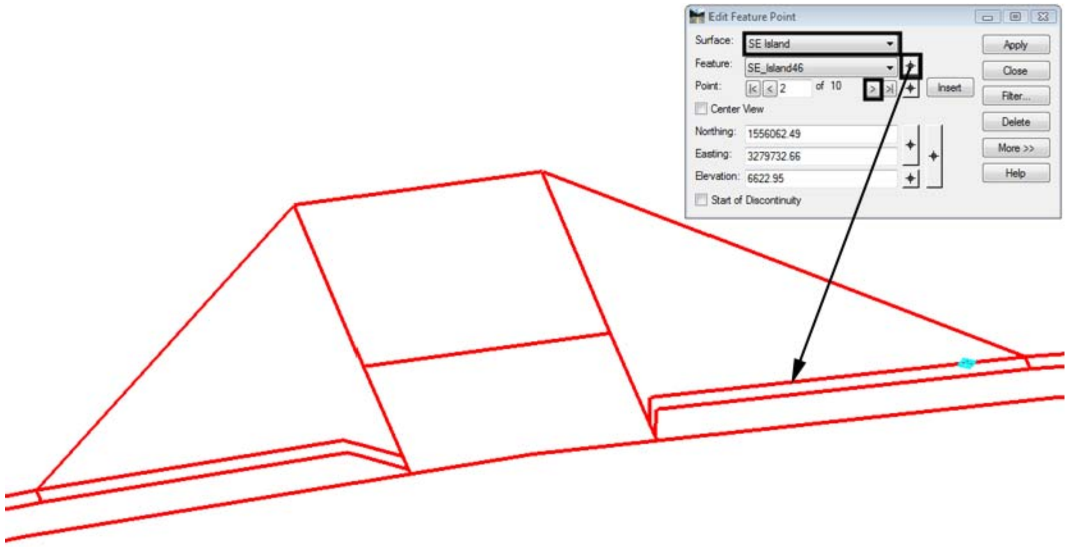
To correct this, the feature points between the beginning and end point are deleted.

27. From the InRoads menu bar, select **Surface > Edit Surface > Edit Feature Point**.

28. Verify that the ***Surface*** is set to **SE Island**.

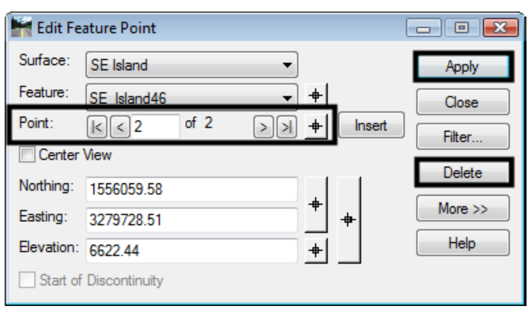
29. **<D>** the target button for ***Feature***, then **<D>** on the curb back line.

30. **<D>** the advance point button  to select point **2** on the feature.

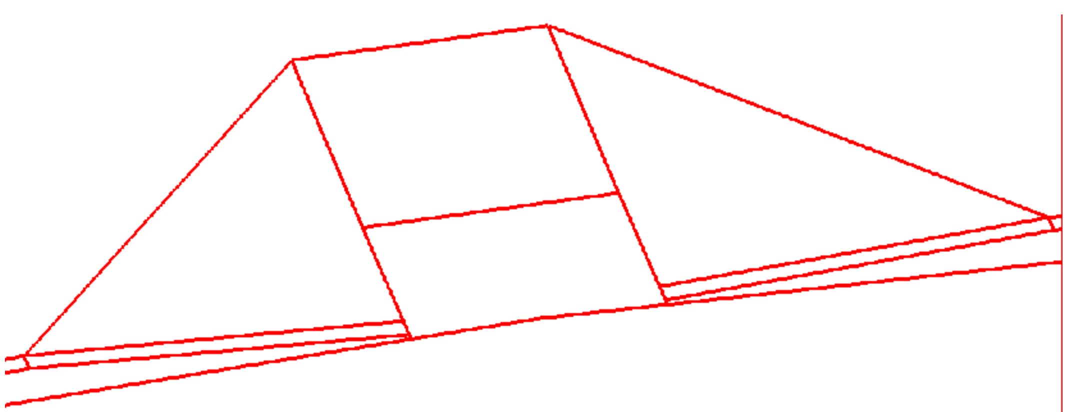


31. **<D>** the **Delete** button then **<D> Apply**.

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.

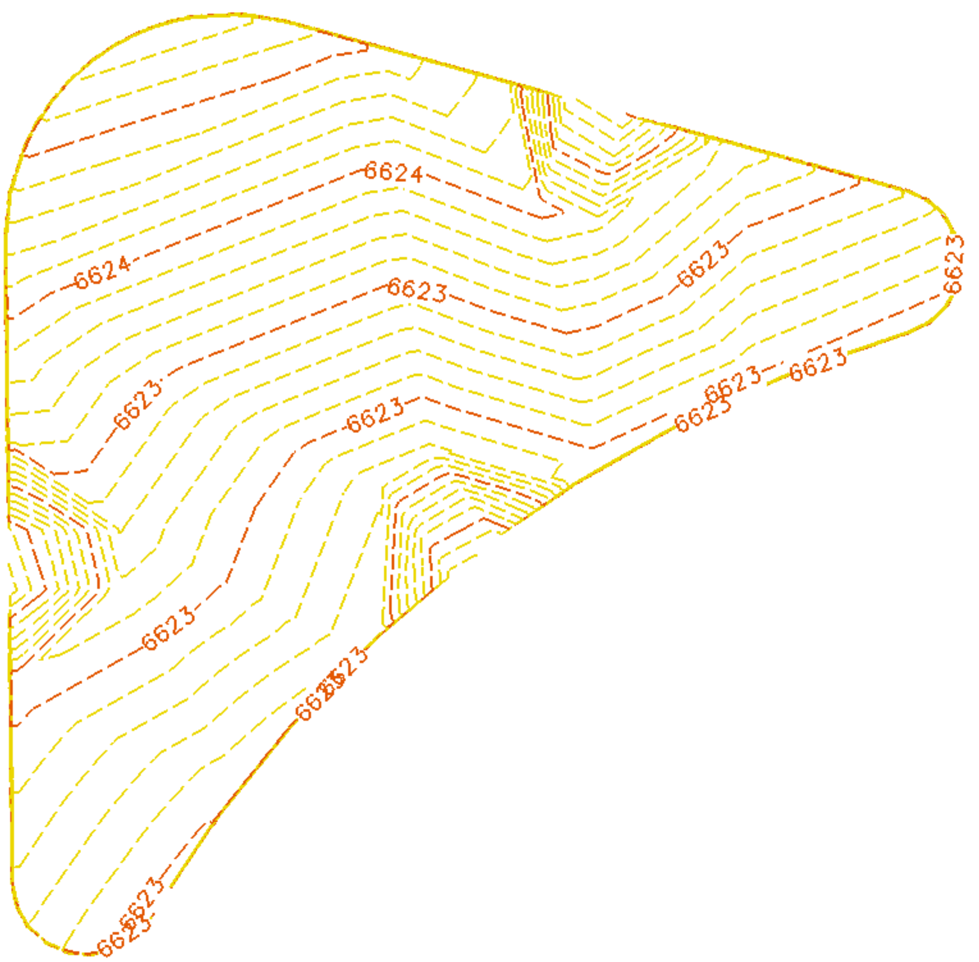
    Important! Be sure to rotate to a Top view when performing the Trim Feature command. This will make it easier to identify the trim location.

35. In the InRoads Explorer, **<R>** on **SE Surface** and select **Triangulate** from the right click menu.

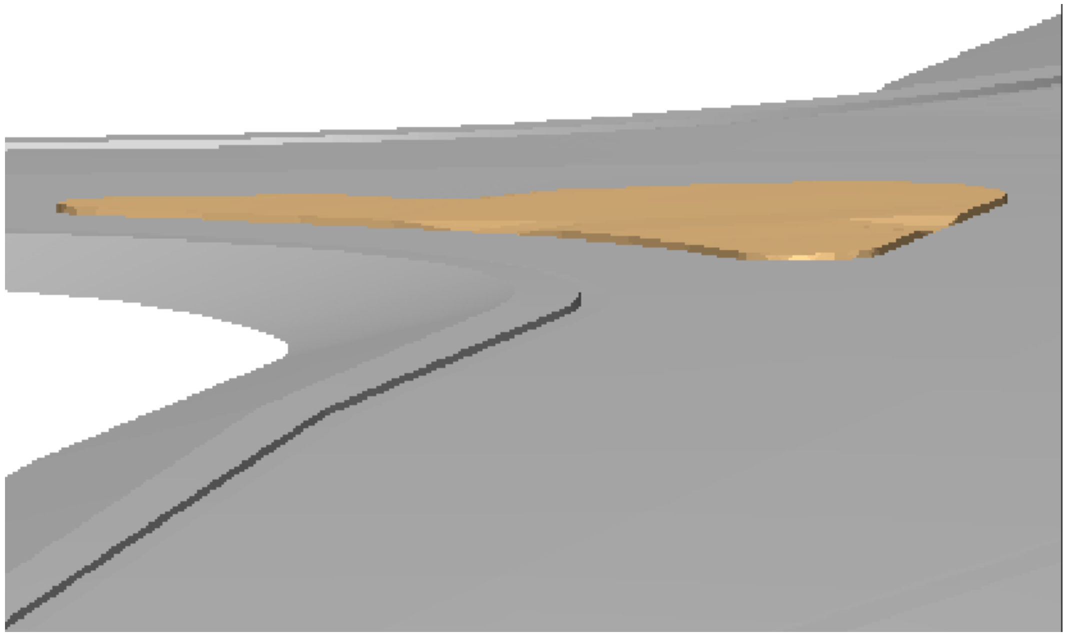
36. **<R>** on **SE Surface** and select **Save**.

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 22 - 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::

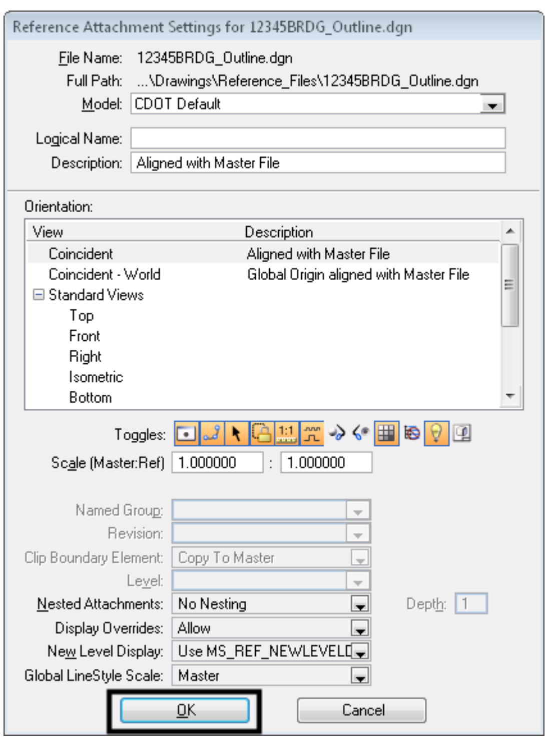
- To develop an understanding of modeling surfaces without templates.
- To learn how some of InRoads' Surface tools can create breaklines necessary for modeling surfaces at the ends of a bridge.

Lab 22.1 - Create the Surface East of the Bridge

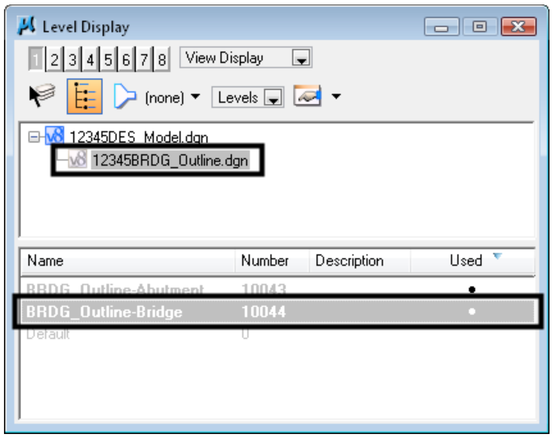
In this section, the design surface is used to create a smaller surface for the portion of the roadway East of the bridge. This surface will subsequently be used as the basis for the grading around the bridge abutment.

Open MicroStation and InRoads using the ***12345DES_Model.dgn*** file.

1. Select **File > Open** from the InRoads menu.
2. Open ***12345 SH52 71st intersection.dtm***, ***12345 SH119 SH52 interchange.alg***, and ***12345 existing ground for interchange.dtm***.
3. Select **File > Reference** from the MicroStation menu.
4. Select **Tools > Attach**.
5. Select ***C:\Projects\12345\Bridge\Drawings\Reference_Files\12345BRDG_Outline.dgn***.

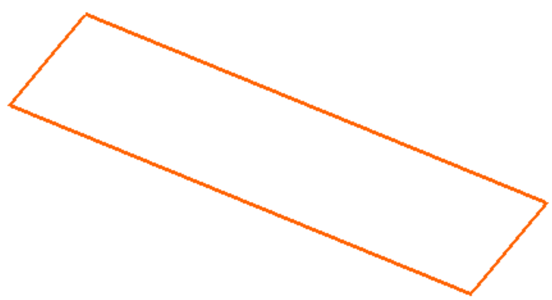


6. **<D> OK** to accept the default reference settings.
7. In the ***Level Display*** dialog, toggle on the reference file level ***BRDG_Outline-Bridge.***



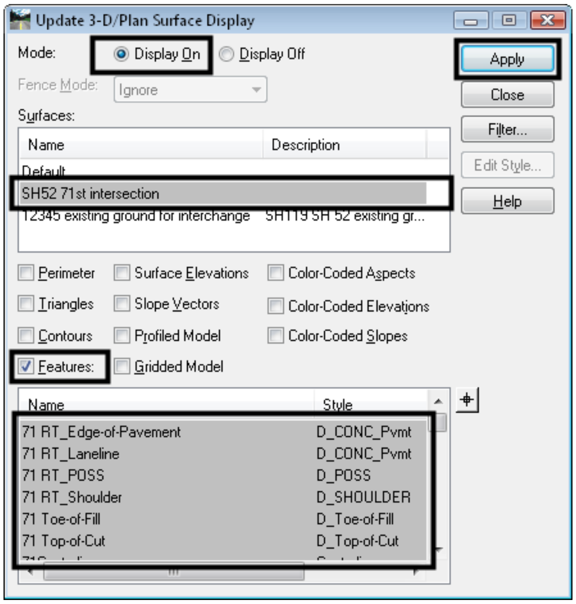
8. ***Fit*** the view.

   An outline of the proposed bridge is shown in the file.

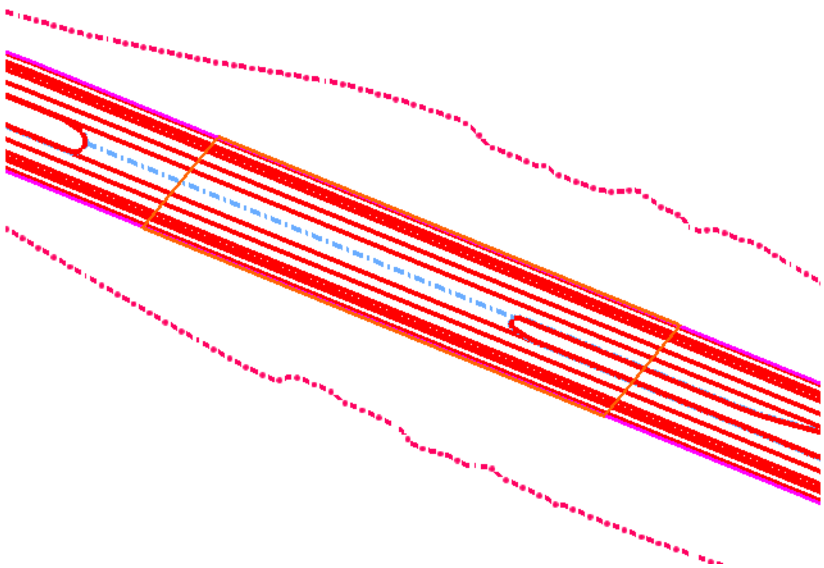


9. Set the ***Pen/Pencil*** lock to ***Pencil***
10. Select **Surface > Update 3D/Plan Surface Display**.
11. Toggle ***Display On*** and highlight the intersection surface.
12. Toggle on ***Features***.

13. Right-click in the feature list and choose ***Select All***.



14. **<D> Apply**.

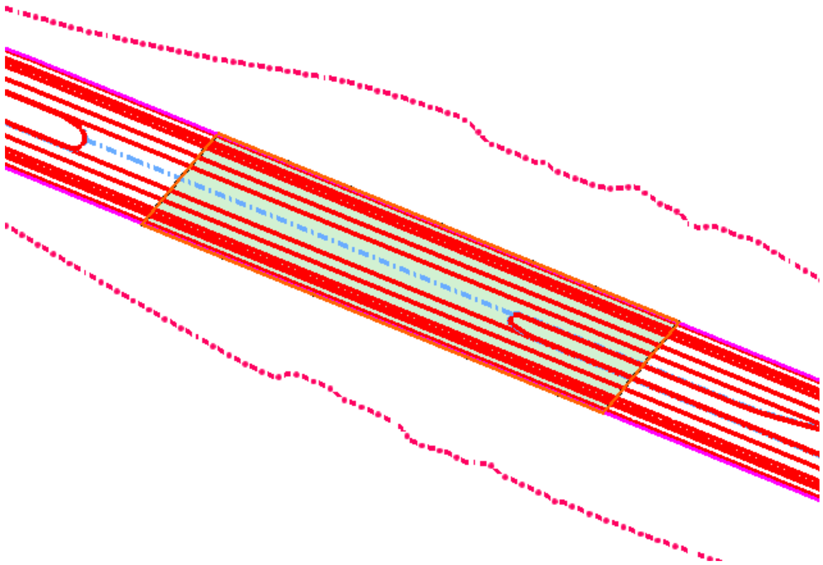


All of the features are shown in the file.

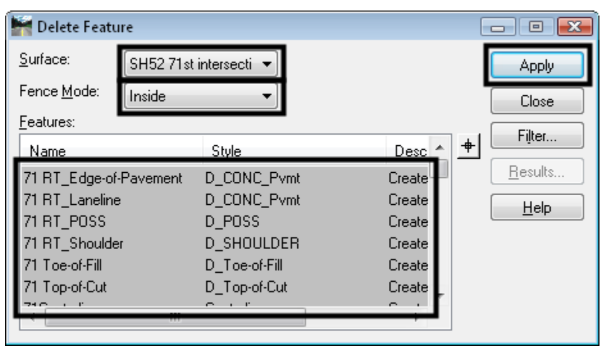
15. On the MicroStation menu, choose **Place Fence**.

16. In the ***Tool Settings*** box, change the ***Fence Type*** to ***Element***.

17. **<D>** on the bridge outline in the design file.

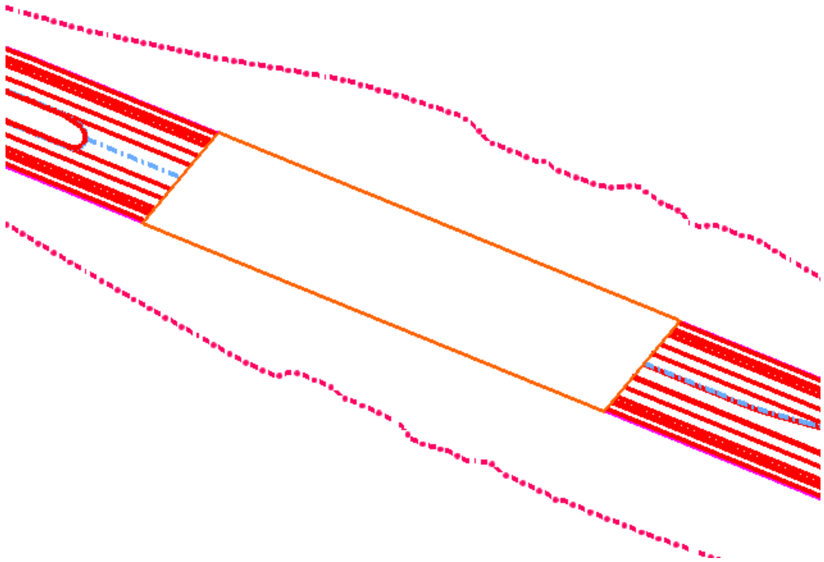


18. Choose **Surface > Edit Surface > Delete Feature**.
19. Set the ***Surface*** to ***SH5271st Intersection***.
20. Set the ***Fence Mode*** to ***Inside***.
21. Right-click in the feature list and choose ***Select All***.

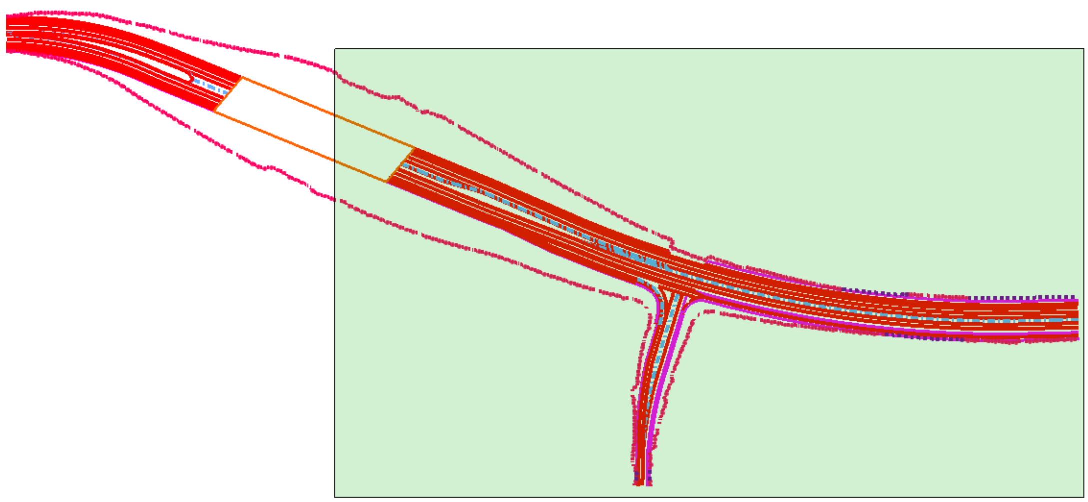


22. **<D> Apply**.
23. When prompted to ***Delete selected feature(s)***, select **OK**.
24. **Close** the dialog box.
25. Clear the fence.

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.

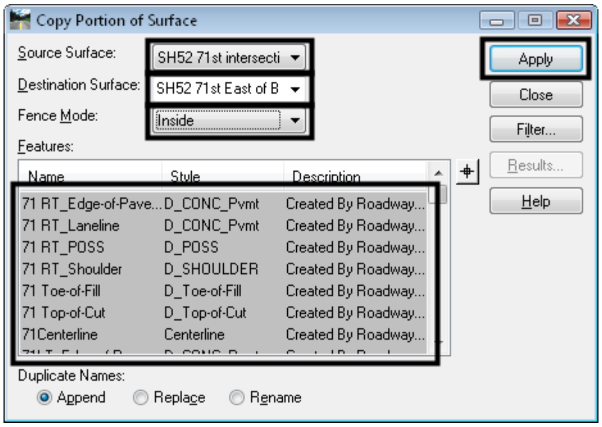


26. Choose **Place Fence**.
27. In the ***Tool Settings*** box, change the ***Fence Type*** to ***Block***.
28. Place a fence that encompasses all features East of the bridge as shown.



29. Select **Surface > Edit Surface > Copy Portion of Surface**.
30. Set the ***Surface*** to ***SH52 71st intersection***.
31. Key in the ***Destination Surface*** ***SH52 71st East of Bridge***.
32. Set the ***Fence Mode*** to ***Inside***.

33. If all Features are not highlighted, Right-Click in the feature list and choose ***Select All***.



34. **<D> Apply**, then **Close** the dialog box.

35. Choose **File > Save As**.

36. Set the ***Save As Type*** to ***Surfaces (*.dtm)***.

37. 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.

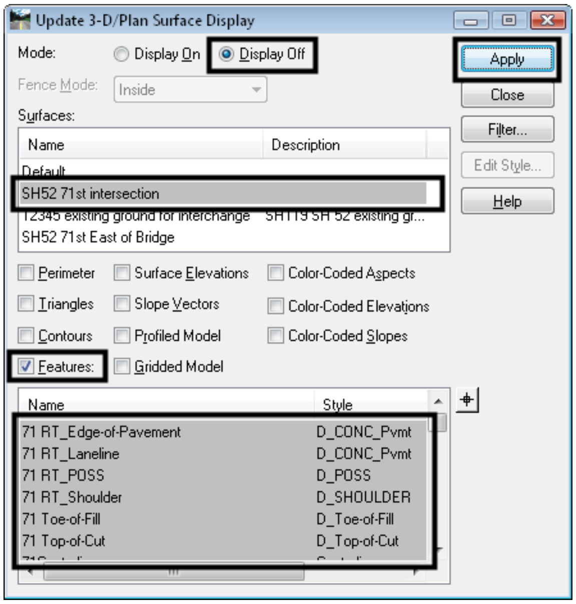
38. **<D> Save**.

39. Select **Surface > Update 3D/Plan Surface Display**.

40. Toggle ***Display Off*** and highlight the intersection surface.

41. Toggle on ***Features***.

42. Right-click in the feature list and choose ***Select All***.

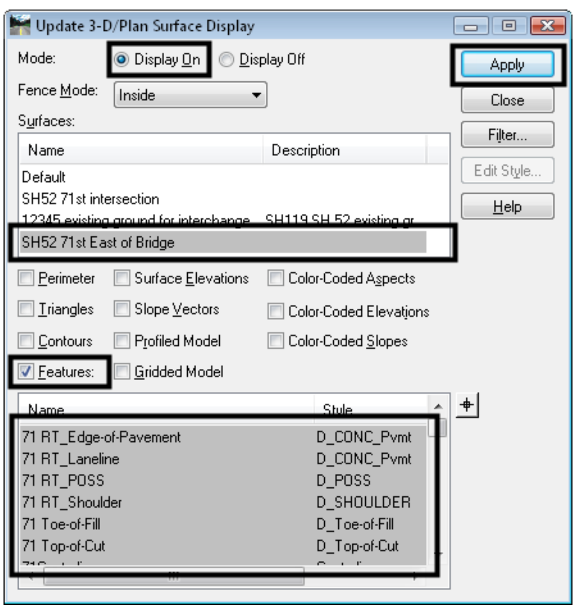


43. **<D> Apply**.

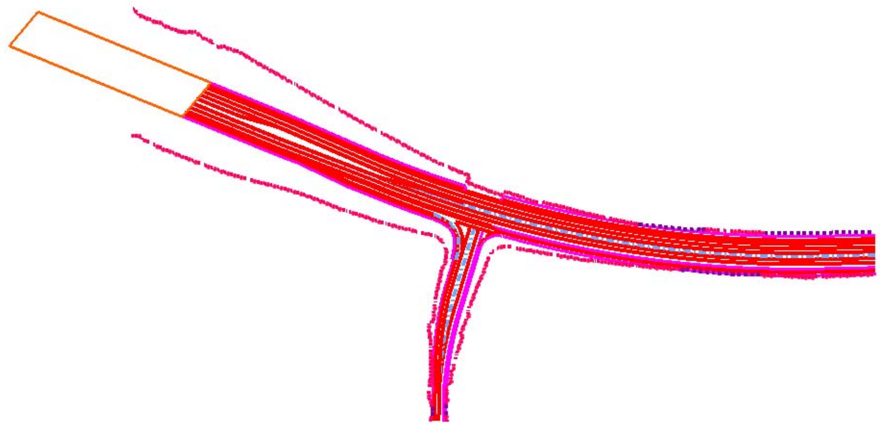
44. Toggle ***Display On*** and highlight the ***SH52 71st East of Bridge*** surface.

45. Toggle on ***Features***.

46. Right-click in the feature list and choose ***Select All***.



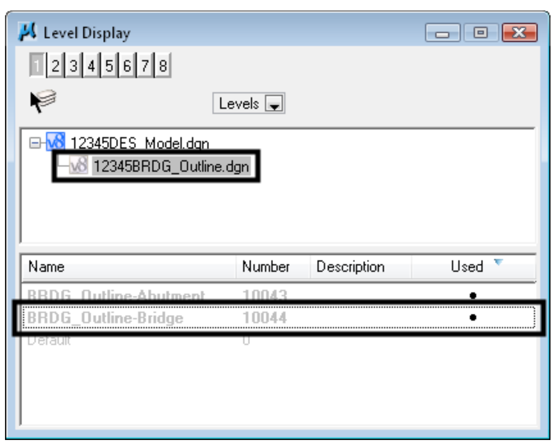
47. **<D> Apply**.



Lab 22.2 - Create a Feature at the Bridge

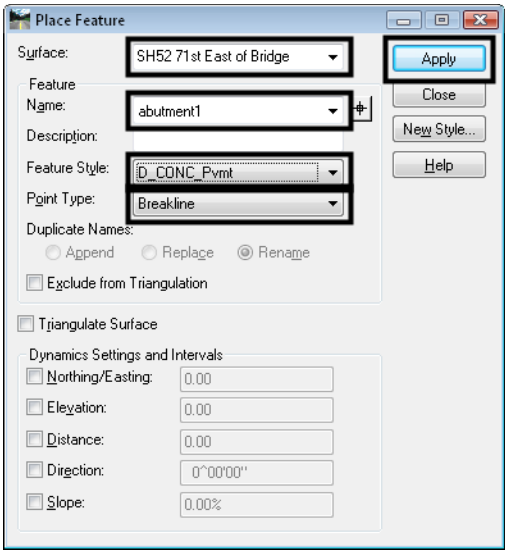
In this section, a breakline feature is created to ‘cap’ the end of the roadway features where the bridge starts.

1. In the ***Level Display*** dialog, toggle off the reference file level ***BRDG_Outline-Bridge***.



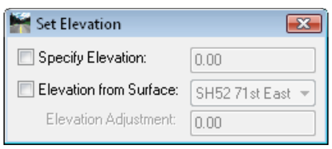
2. Select **Surface > Design Surface > Place Feature**.
3. Set the ***Surface*** to ***SH52 71st East of Bridge***.
4. Type in ***abutment1*** for the ***Feature Name***.
5. Type in a description if desired.
6. Set the ***Feature Style*** to ***D_CONC_Pvmt***.

7. Set the ***Point Type*** to ***Breakline***.

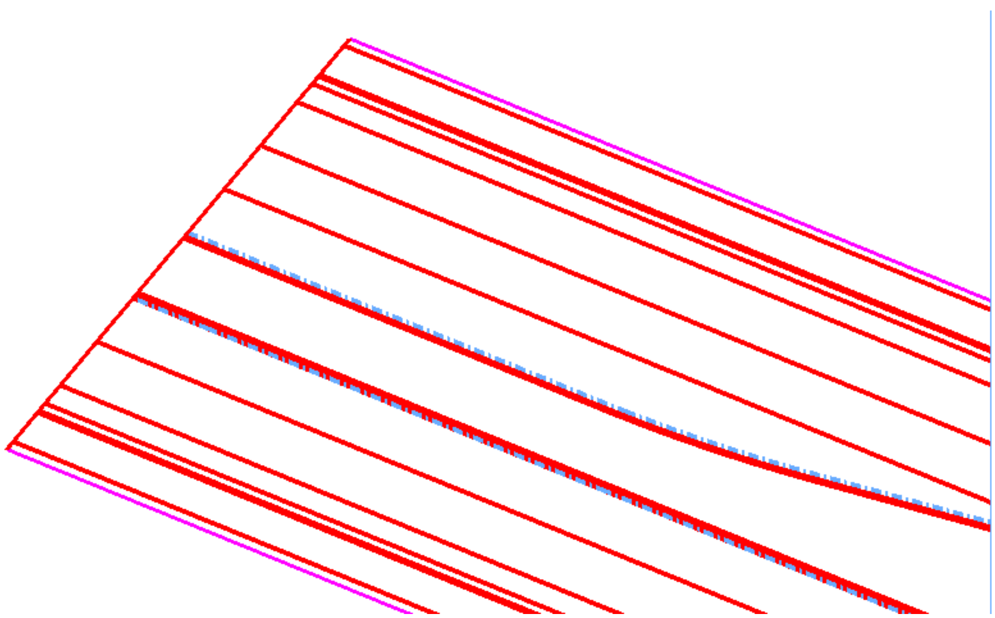


8. **<D> Apply**.

9. ***Do not*** toggle on either option on the ***Set Elevation*** dialog that appears.



10. Snap to the end of each of the roadway features from POSS to POSS as shown.



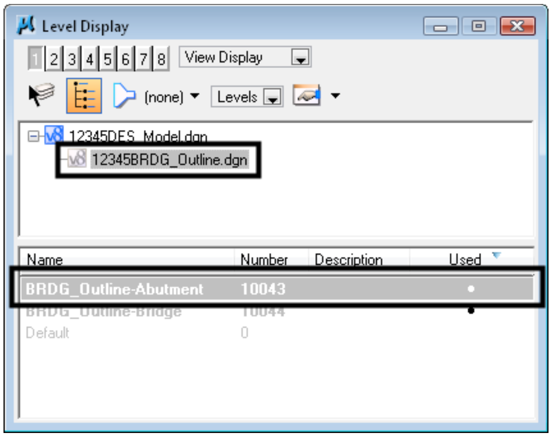
Note: If you want to use ***AccuSnap***, hold down your ***<Ctrl>*** and ***<Shift>*** keys and MicroStation's AccuSnap works while using InRoads commands.

11. **<R>** when done.

Lab 22.3 - 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.

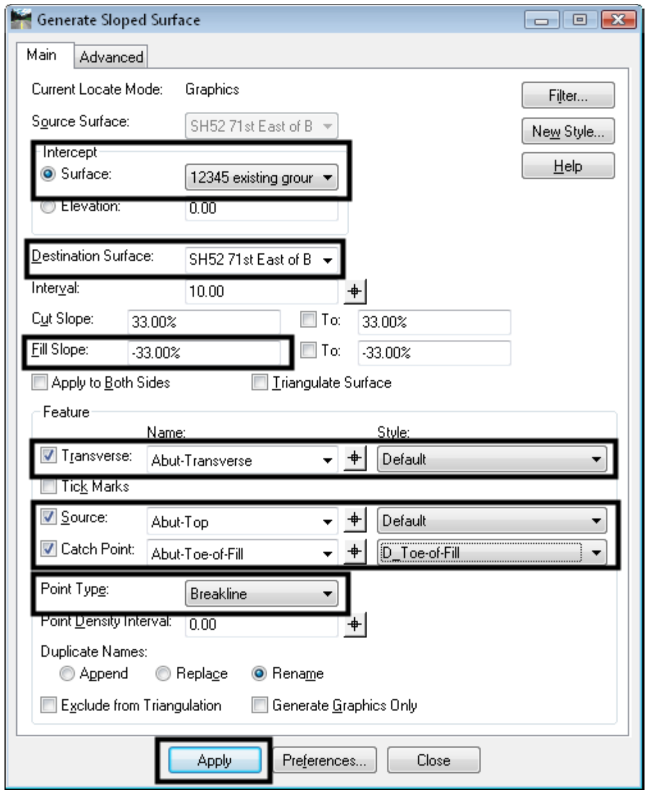
1. In the ***Level Display*** dialog, toggle on the reference file level ***BRDG_Outline-Abutment***.



Note: A green line displays that wraps around the edge of the roadway. This is the line from which the sloped surface is generated.

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***.

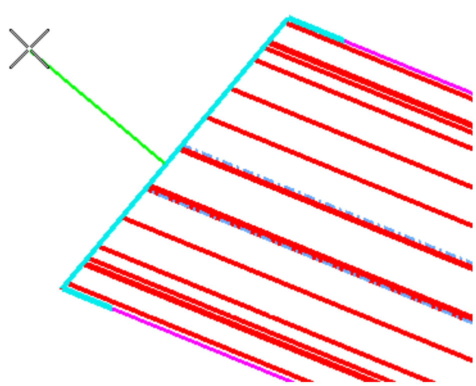
6. Set the other options as shown in the dialog. Be sure to toggle on and key in the feature names for ***Transverse***, ***Source*** and ***Catch Point***.



7. **<D> Apply**.

8. **<D>** to select the green line at the edge of the roadway.

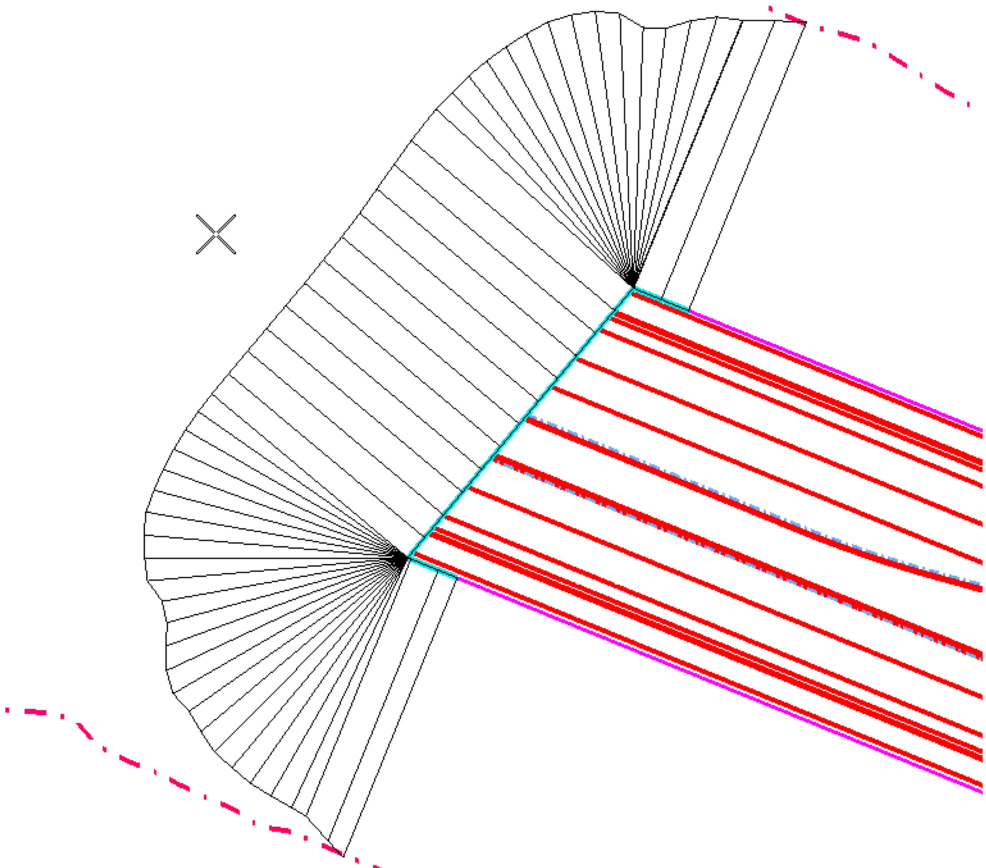
9. **<D>** again to accept the line.



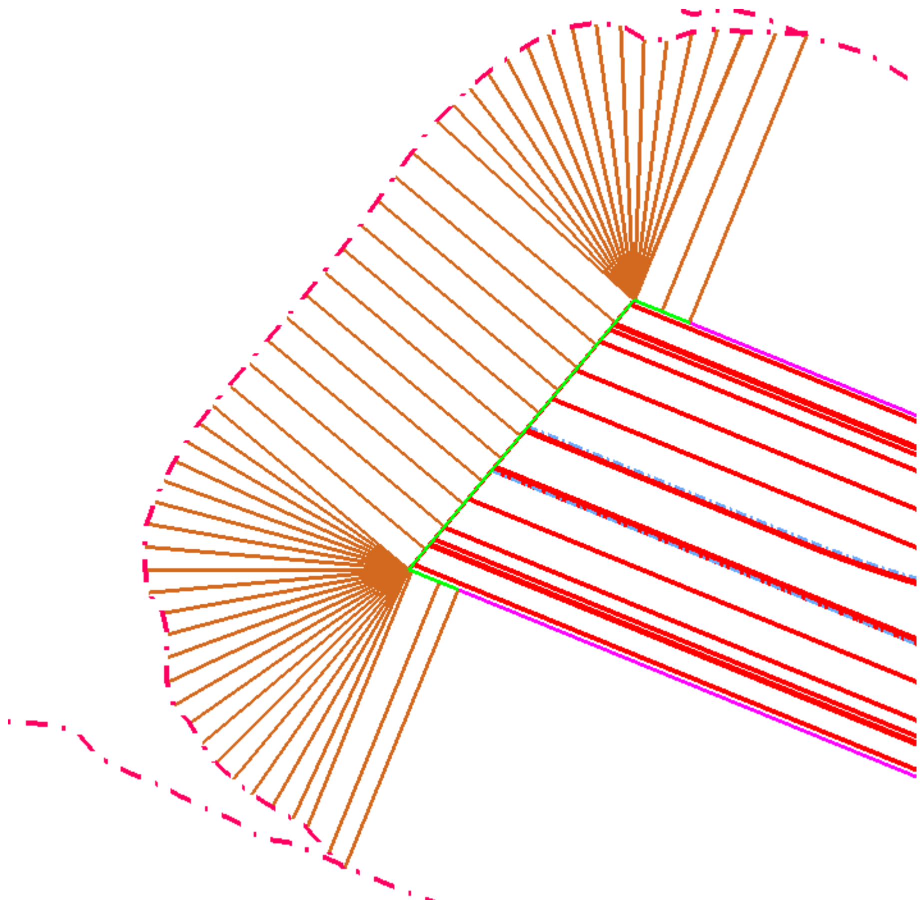
10. **<R>** to Reset for Entire Line.

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 close the dialog.

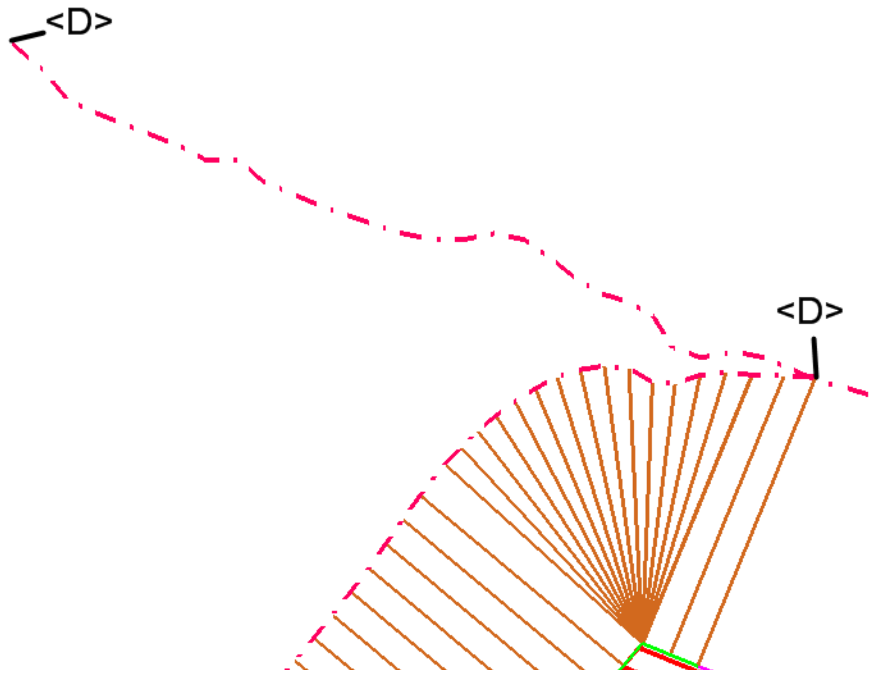
15. Save the Surface.

16. Select **Surface > Edit Surface > Partial Delete**.

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***.

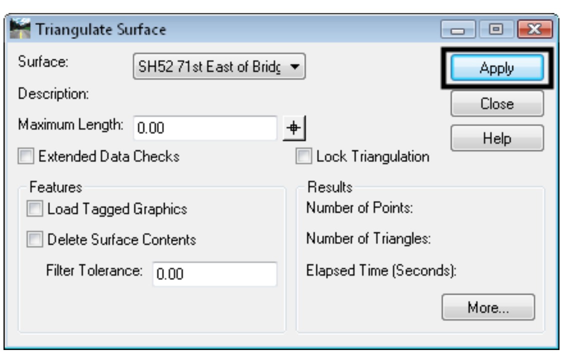


19. Repeat for the Toe-of-Fill on the South side of the roadway.

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.

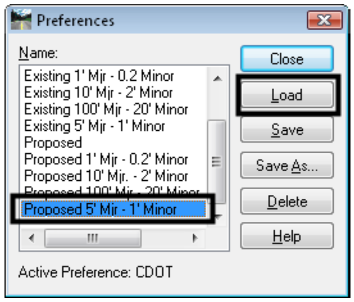
21. Choose **Surface > Triangulate Surface**.



22. **<D> Apply**.

23. Select **Surface > View Surface > Contours**.

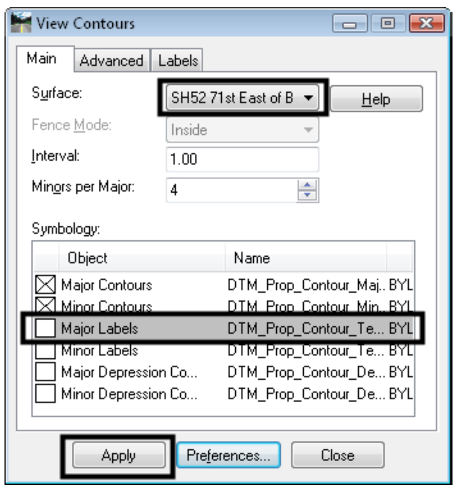
24. **<D> Preferences** and highlight ***Proposed 5' Mjr – 1' Minor***.



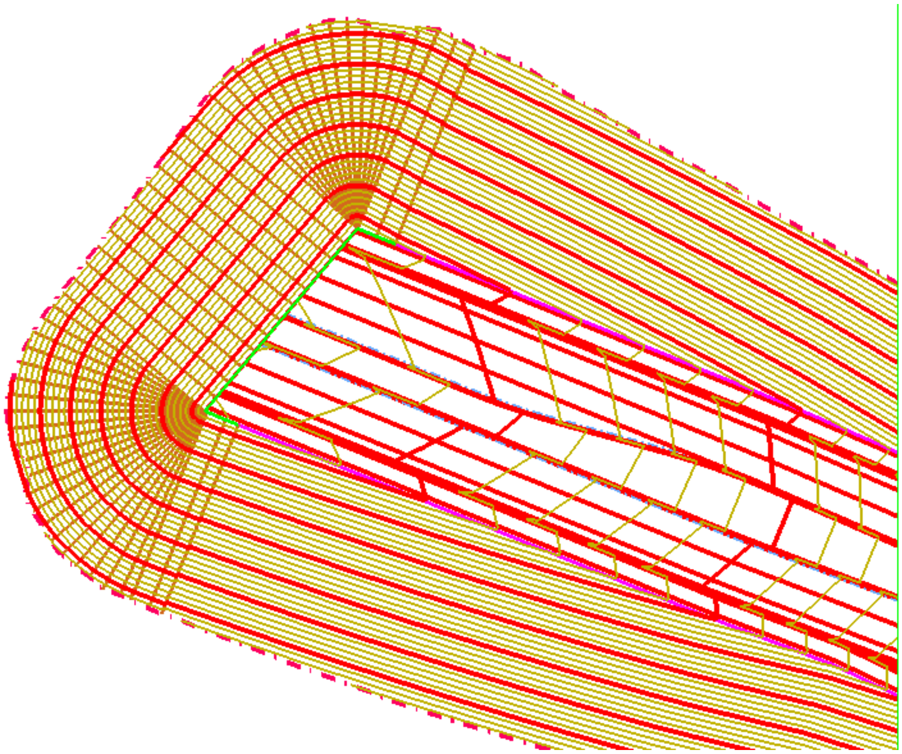
25. **<D> Load**, then **Close**.

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**.

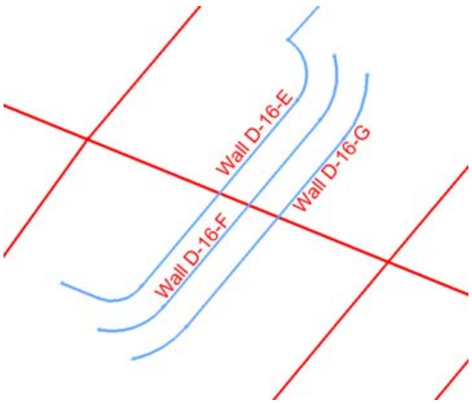
Chapter Summary:

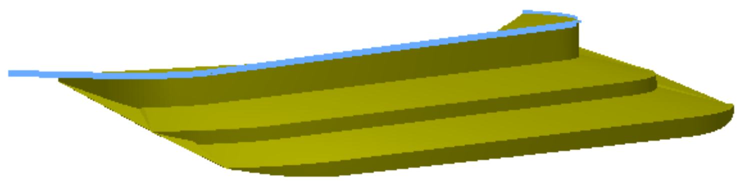
- The ***Design Surface*** and ***Edit Surface*** tools can be used to modify existing surfaces and add to them as necessary to accomplish your design model.
- Modeling the ends of a bridge can be accomplished using a base model of the roadway, and adding features to define the desired surface.

LAB 23 - 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 XM***.

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.

Lab 23.1 - Open Data Files

If you have not exited since the last lab, you can skip this section.

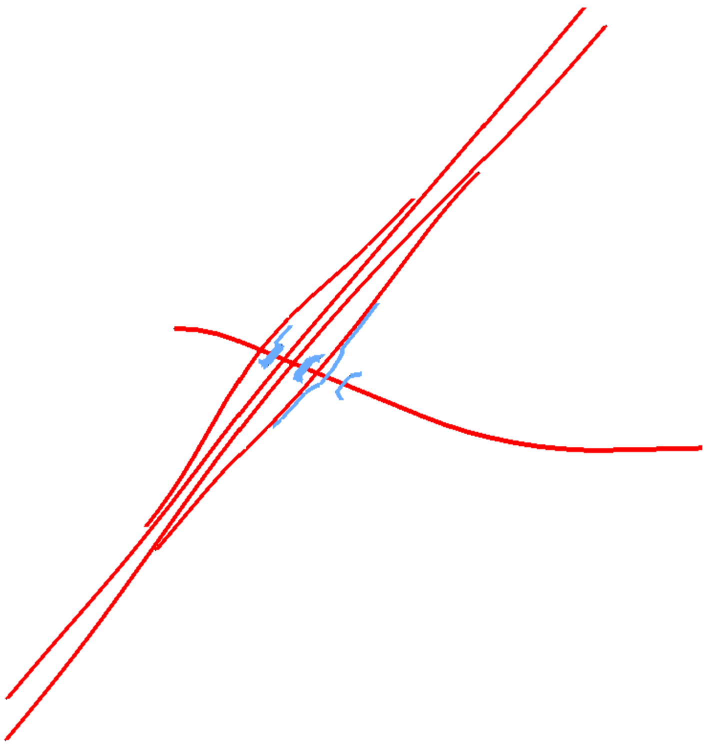
1. Open MicroStation and InRoads using the ***C:\Projects\12345\Design\Working\CU12345DES_Model.dgn*** file.
2. Verify the correct ***XIN*** file is loaded.
3. Select File > Open from the InRoads menu.
4. Open ***C:\Projects\12345\Design\InRoads\12345 SH119.dtm***, ***12345 SH52.dtm***, ***12345DES_Templates.itl*** and ***12345 SH119 SH52 interchange.alg***.
5. Open ***C:\Projects\12345\ROW_Survey\InRoads\DTM\12345 existing ground for interchange.dtm***.

Lab 23.2 - 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.

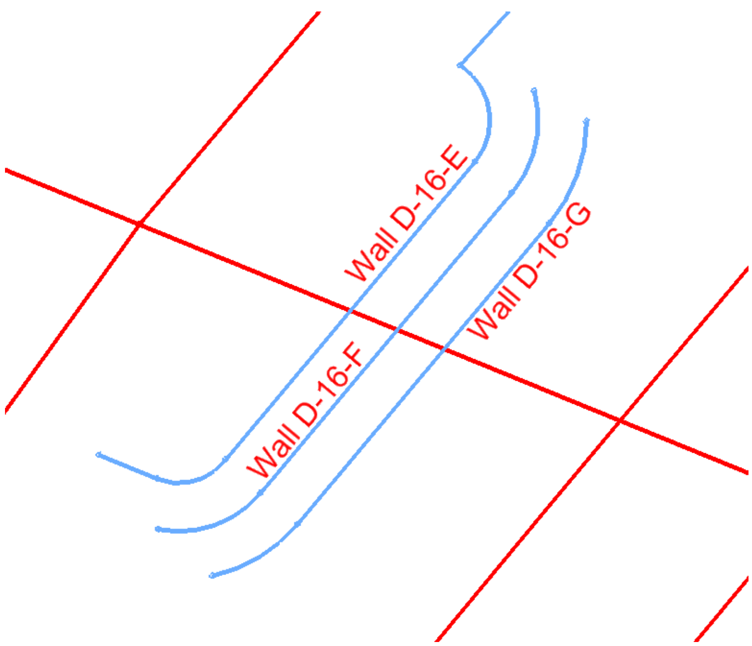
1. **Delete** any MicroStation graphics currently in the design file.

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.

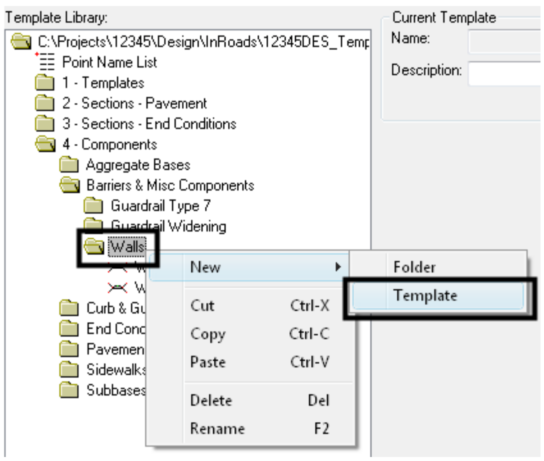
5. Select **Modeler > Create Template**.

6. Verify the template library is ***12345DES_Templates.itl***.

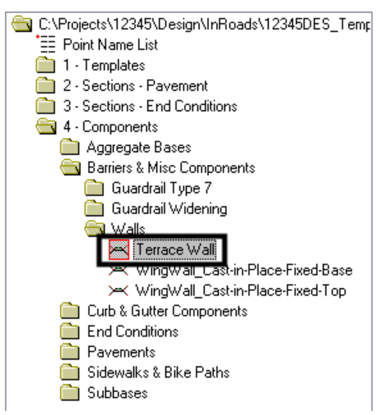
Note: Since there are no similar template to the one needed, a new one is created.

7. Expand the library folder structure for ***Components*** > ***Barriers & Misc Components*** > ***Walls***.

8. Right-click on the ***Walls*** folder and select **New > Template**.



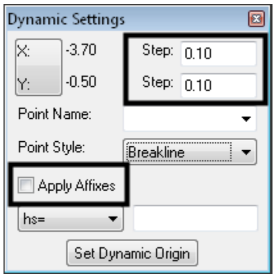
9. While the name is highlighted, type over it with ***Terrace_Wall***.



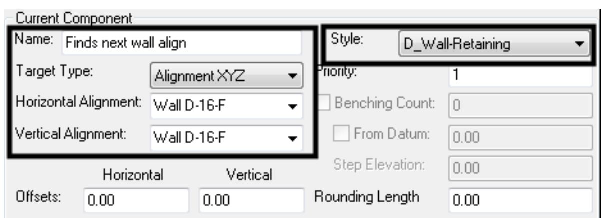
10. Select **Tools > Dynamic Settings**.

11. Toggle ***Apply Affixes*** off.

12. For **X** and **Y Step**, key in ***0.1***.

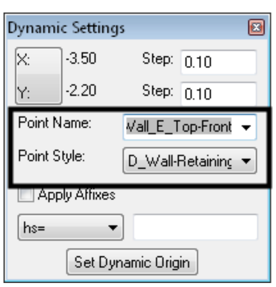


13. Right-click in the template view and select **Add New Component > End Condition**.
14. Under ***Current Component***, key in ***Finds next wall align*** for the ***Name***.
15. Set the ***Style*** to ***D_Wall-Retaining***.
16. Set the ***Target Type*** to ***Alignment XYZ***.
17. Set the ***Horizontal Alignment*** to ***Wall D-16-F***.
18. Set the ***Vertical Alignment*** to ***Wall D-16-F***.



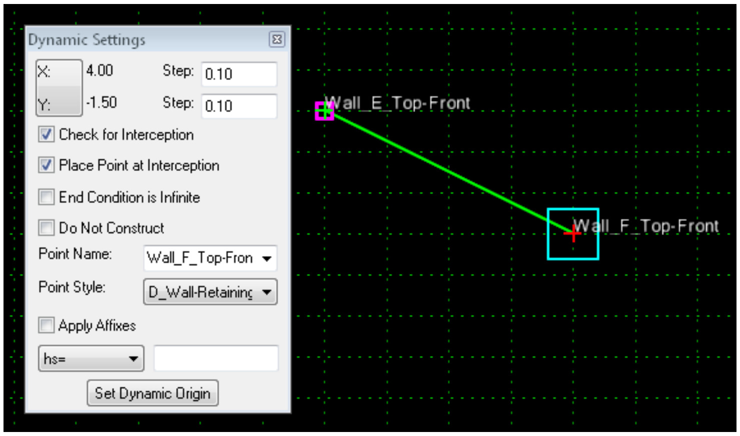
Note: Since the template will start at ***Wall D-16-E***, ***Wall D-16-F*** is the next wall alignment. With a target of ***Alignment XYZ***, the component will use a variable slope to 'find' the horizontal and vertical alignment.

19. In the ***Dynamic Settings*** 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*** 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.



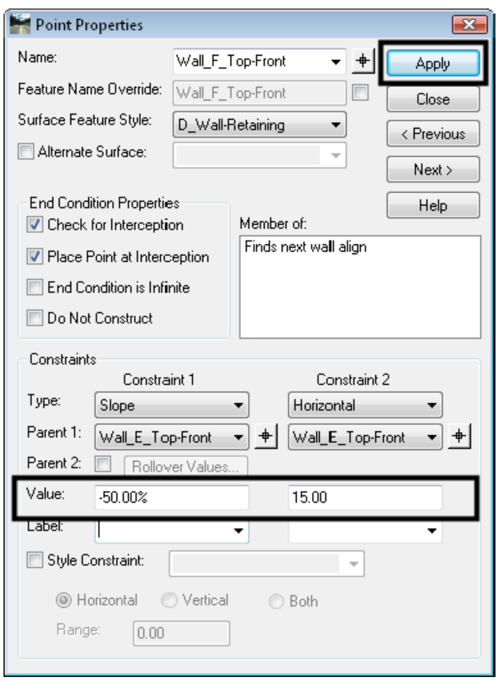
24. **<R>** and **<D> Finish** to complete the component.

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%***.

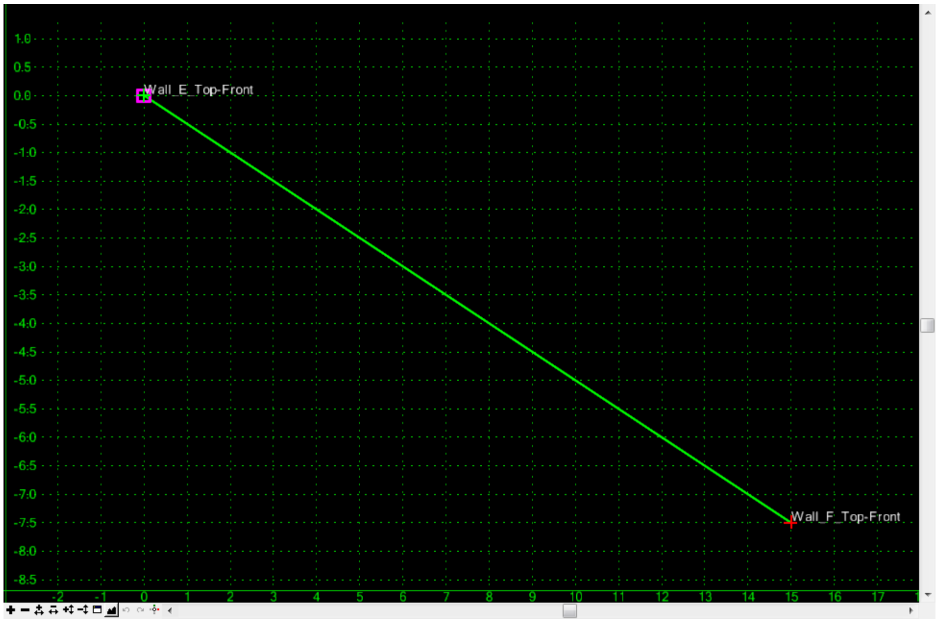
27. For the ***Horizontal Constraint***, set the ***Value*** to ***15.00***.

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**.

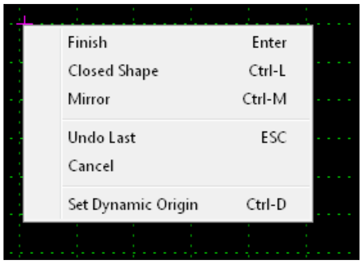
29. **Fit** the template.



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**.

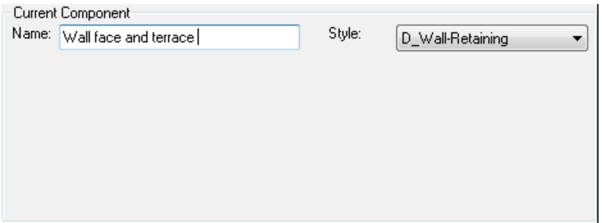
31. Right-click again and make certain all options are toggled off.



32. **<Esc>** to dismiss the menu if everything was already off.

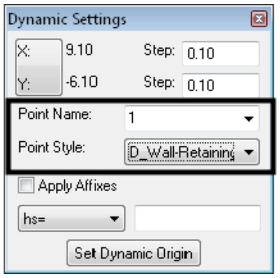
33. Under ***Current Component***, key in ***Wall face and terrace*** for the ***Name***.

34. Set the ***Style*** to ***D_Wall-Retaining***.



35. In the ***Dynamic Settings*** box, select ***D_Wall-Retaining*** for the ***Style***.

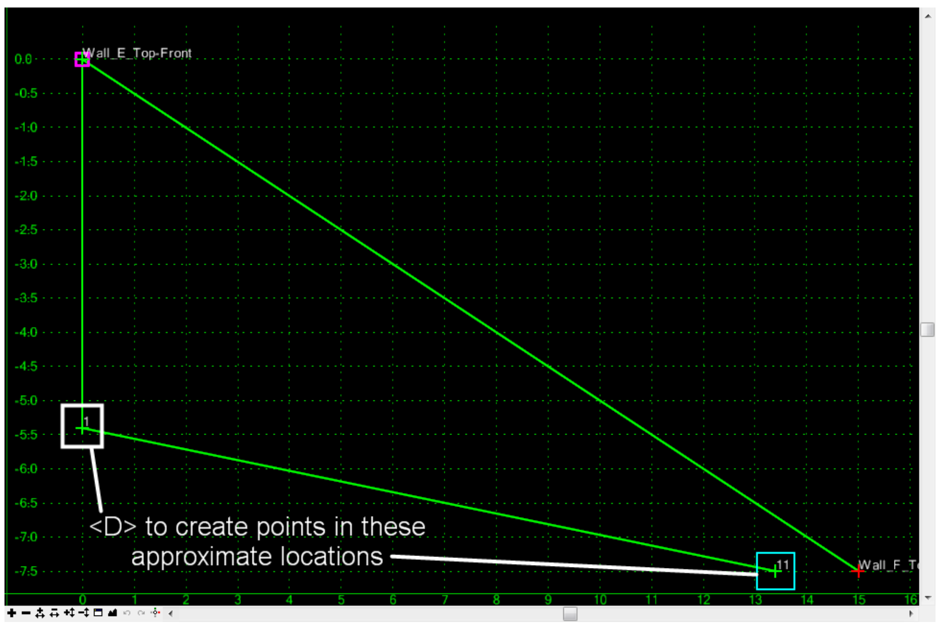
36. Key in ***1*** for the ***Point Name***.



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.

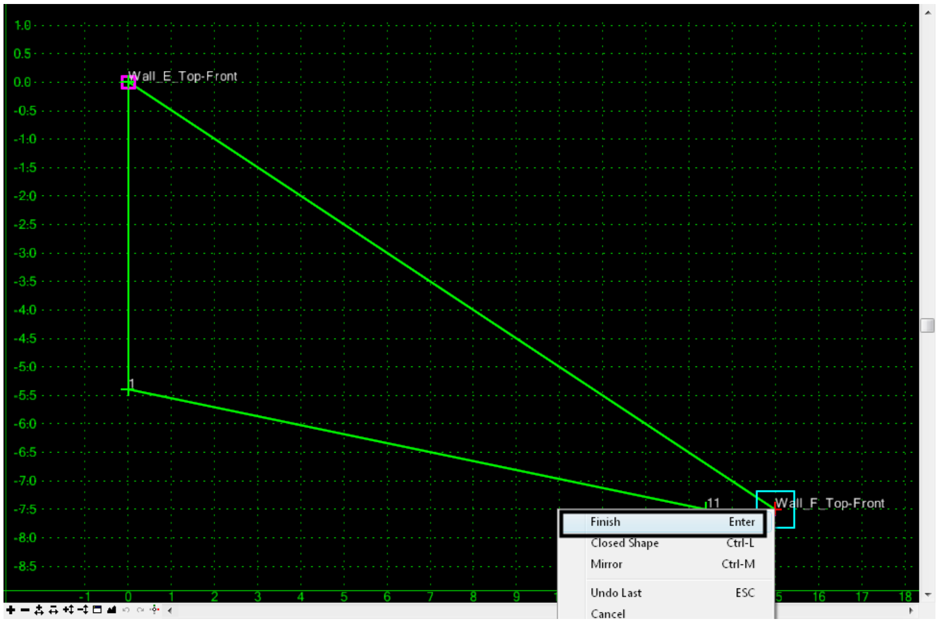
38. **<D>** to create two additional points similar to what is shown.



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**.

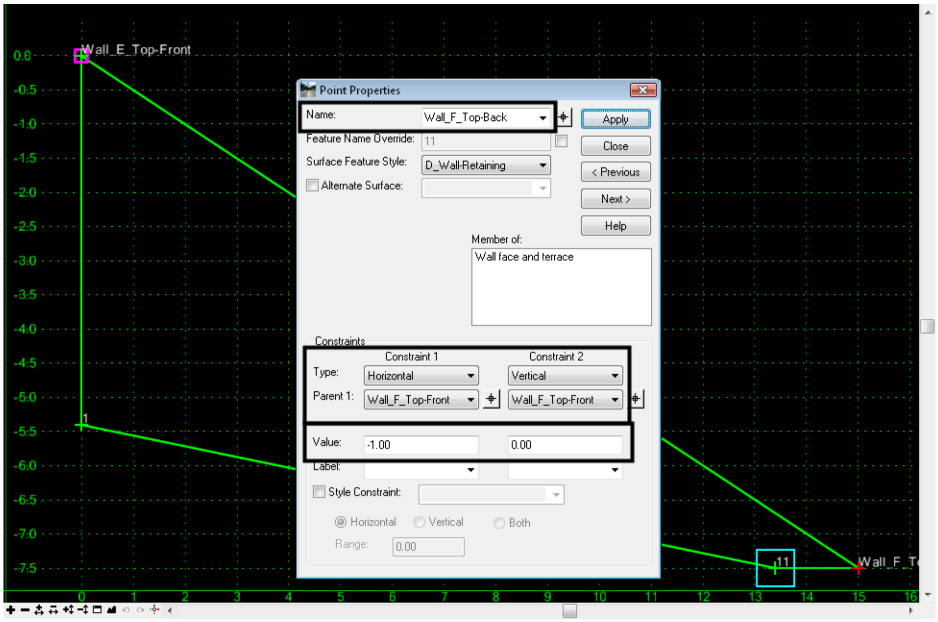


41. **Edit** the point ***11*** just inside the ***Wall_F_Top-Front*** point.

    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***.

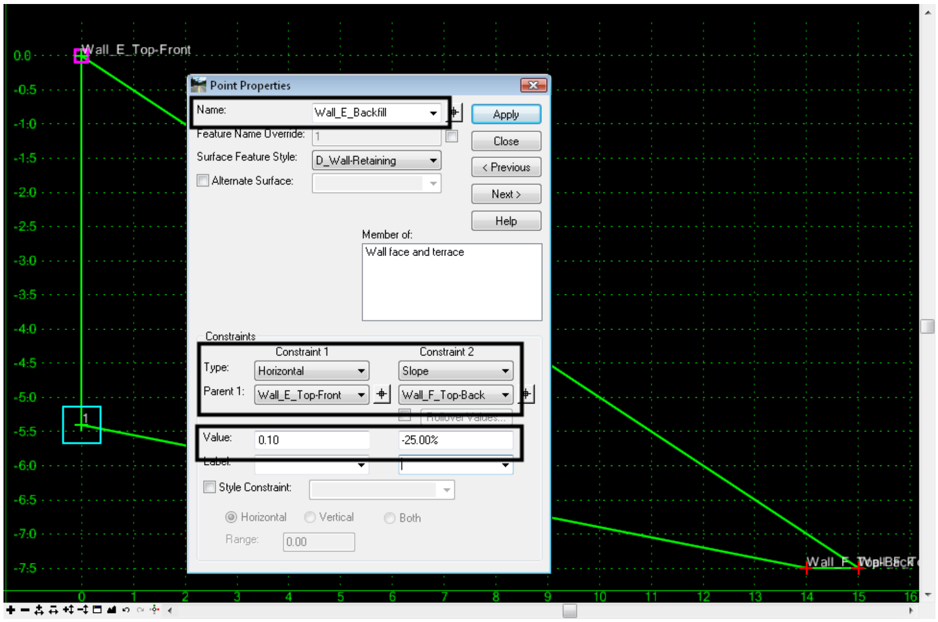
54. Key in a ***Value*** of ***0.1***.

    Note: This will force a small slope on the front face of the wall to allow triangulation.

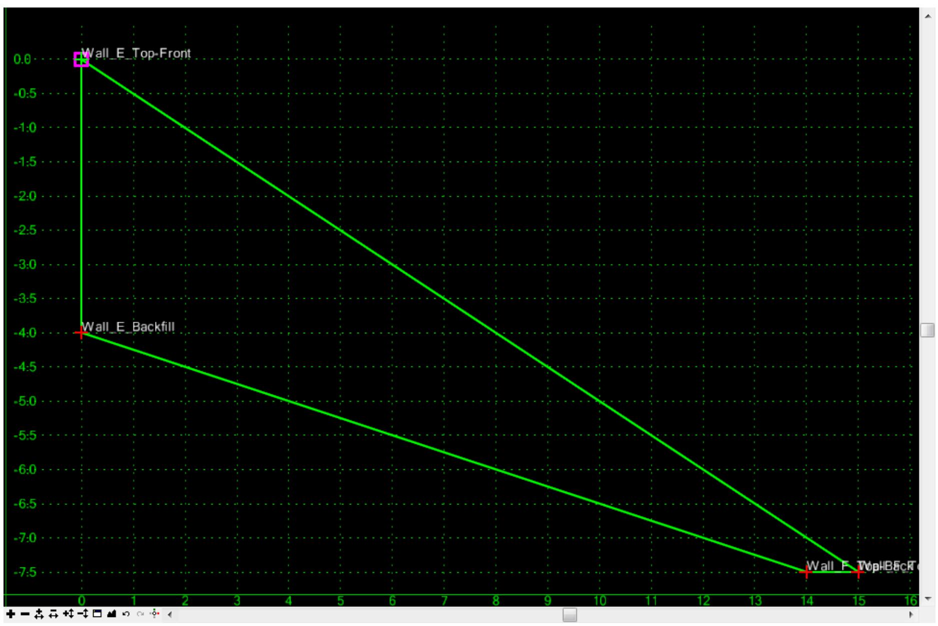
55. Set ***Constraint 2*** to ***Slope***.

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**.

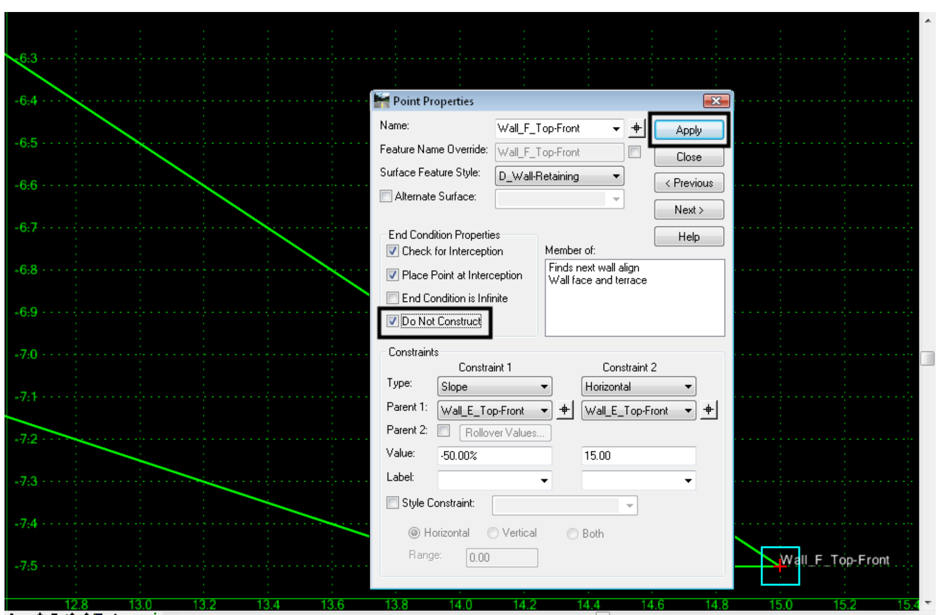
62. Move your cursor into the template view to see how the components react.

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*** box.

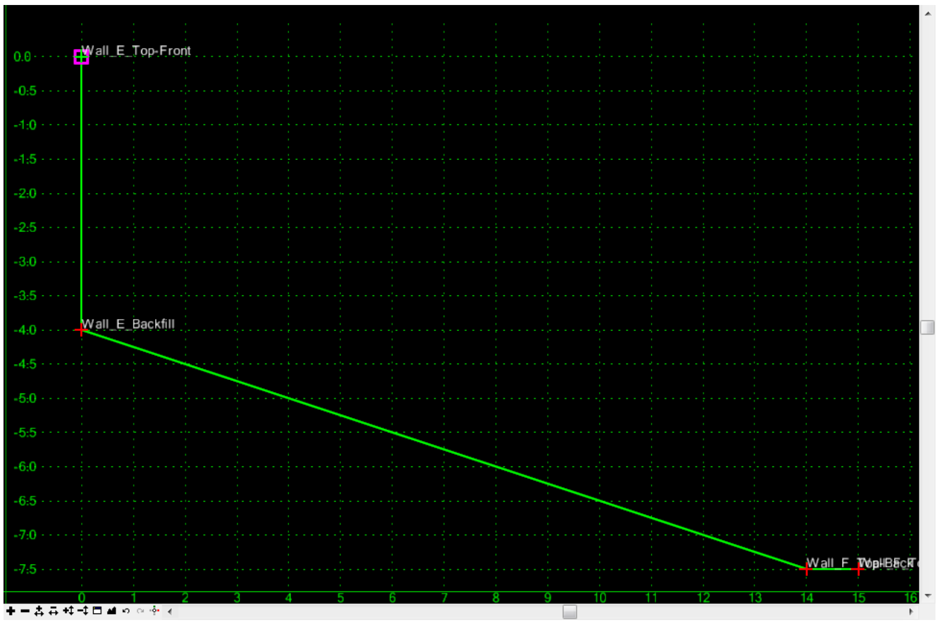
64. **Edit** the ***Wall_F_Top-Front*** point.

65. Toggle on ***Do Not Construct***.



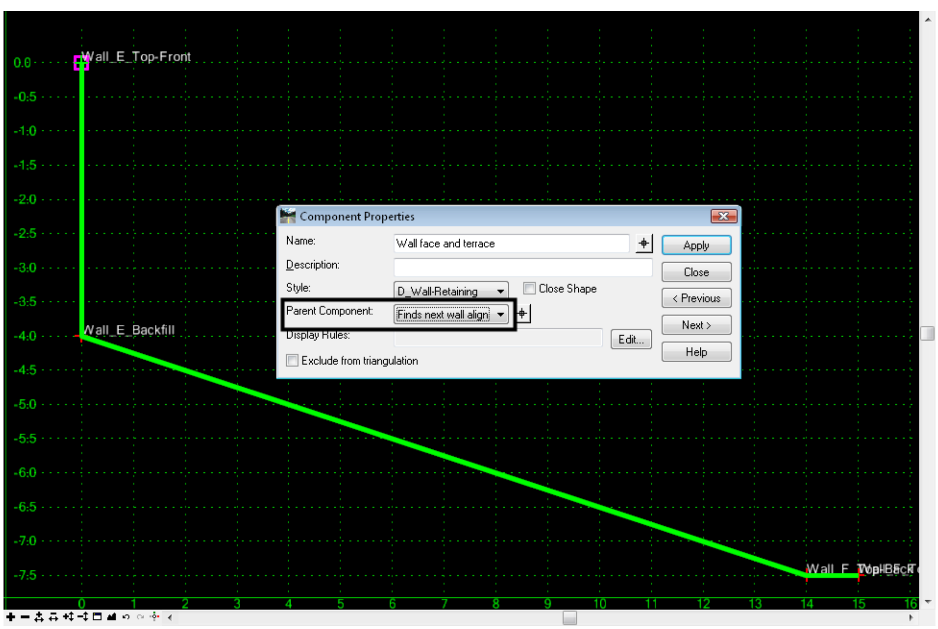
66. **<D> Apply**, then **Close**.

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.

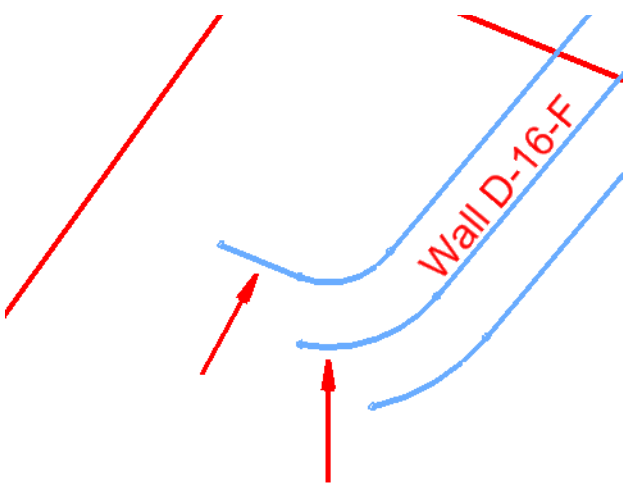
Note: Now, only a dashed line is shown initially, indicating when the end condition fails, nothing is displayed. When the end condition succeeds, only the ***Wall face and terrace*** is displayed.

71. **<D> Close** on the ***Test End Conditions*** box.

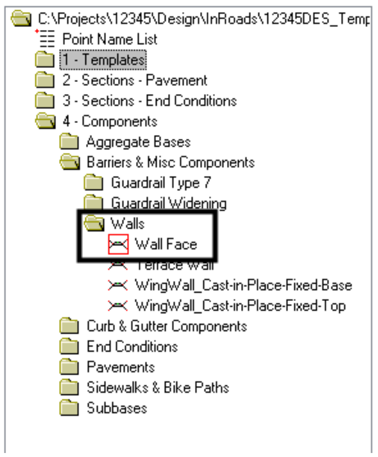
72. **Save** the template library.

Lab 23.3 - 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.



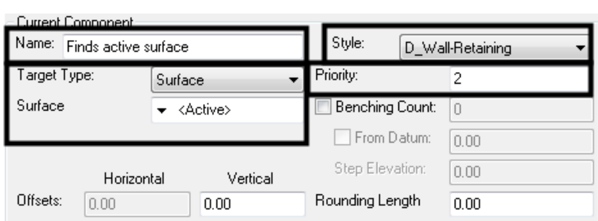
1. Right-click on ***Walls*** folder again in the library and select **New > Template**.
2. While the name is highlighted, type over it with ***Wall_Face***.



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.

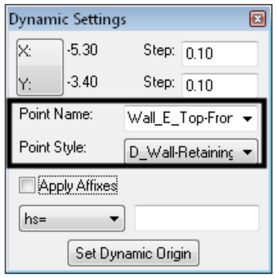
3. Right-click and select **Add New Component > End Condition**.
4. Under ***Current Component***, key in ***Finds active surface*** for the ***Name***.
5. Set the ***Style*** to ***D_Wall-Retaining***.
6. Set the ***Target Type*** to ***Surface***.
7. Set the ***Surface*** to ***<Active>***.
8. Set 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.

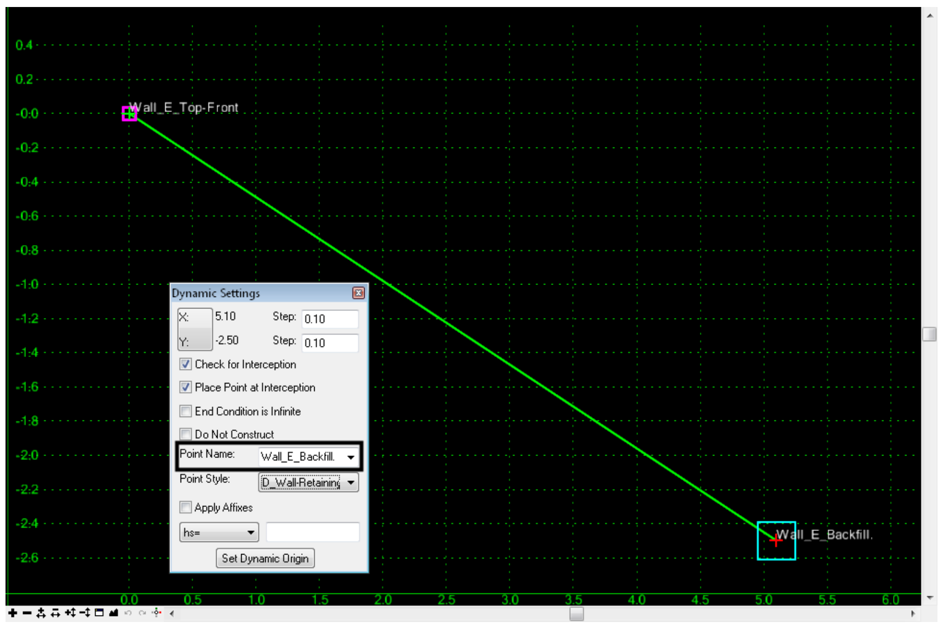


9. In the ***Dynamic Settings*** box, key in ***Wall_E_Top-Front*** for the ***Name***.

10. Select ***D_Wall-Retaining*** for the ***Style***.

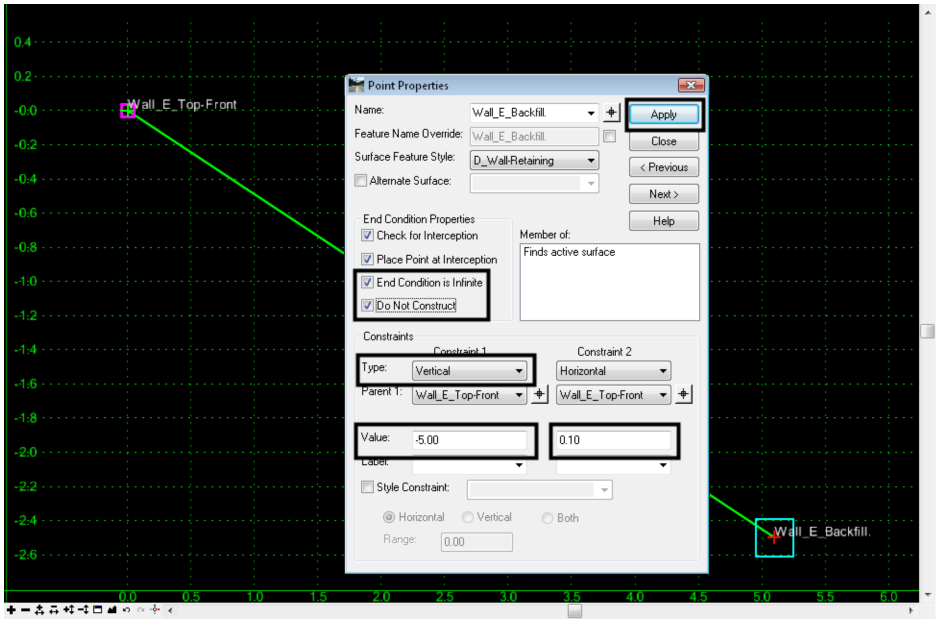


11. **<D>** on the origin point (0,0).
12. Back in the ***Dynamic Settings*** box, change the name to ***Wall_E_Backfill***.
13. **<D>** on a point down and to the right of the first point as shown.



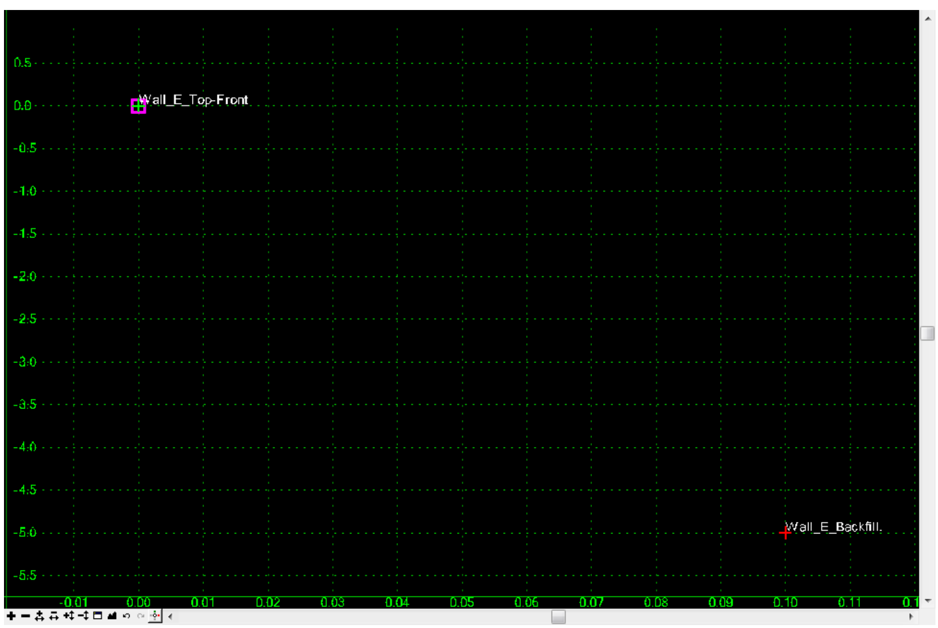
14. Right click and select **Finish**.
15. **Edit** the second point, ***Wall_E_Backfill***.
16. Change the ***Slope Constraint*** to ***Vertical*** and set the ***Value*** to ***-5.00***
17. For the ***Horizontal Constraint***, set the ***Value*** to ***0.1***.
18. Toggle on ***End Condition is Infinite***.

19. Toggle on ***Do No Construct***.



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

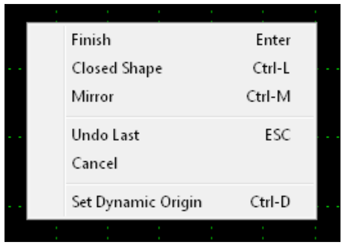
21. **Fit** the template.



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**.

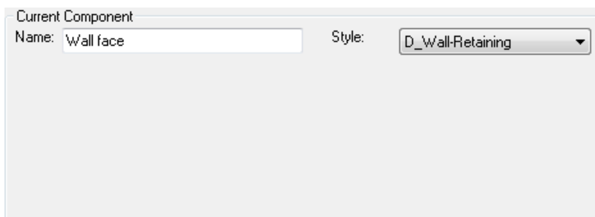
23. Right-click again and make certain all options are toggled off.



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***.



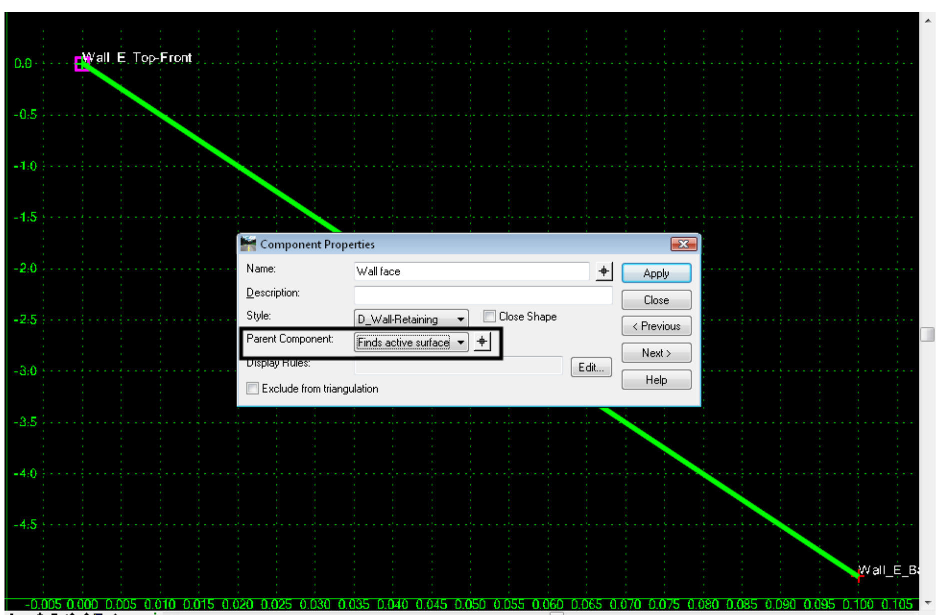
27. **<D>** on the ***Wall_E_Top-Front*** point to start the component.

28. **<D>** on the ***Wall_E_Backfill*** point.

29. Right click and select **Finish**.

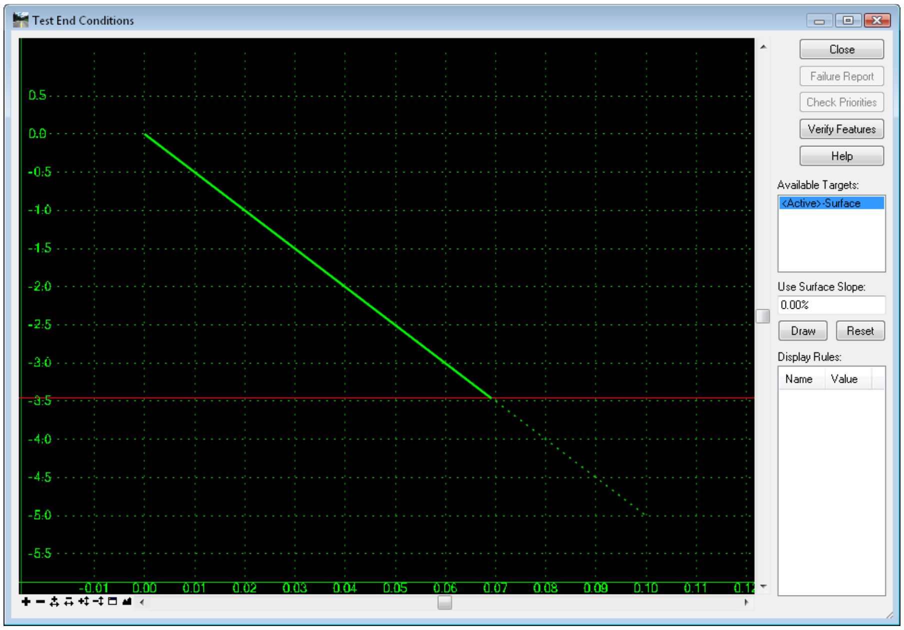
30. **Edit** the ***Wall face*** component.

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*** box.

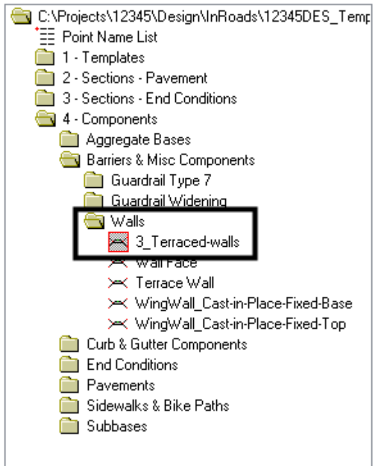
34. **Save** the template library.

Lab 23.4 - 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***.

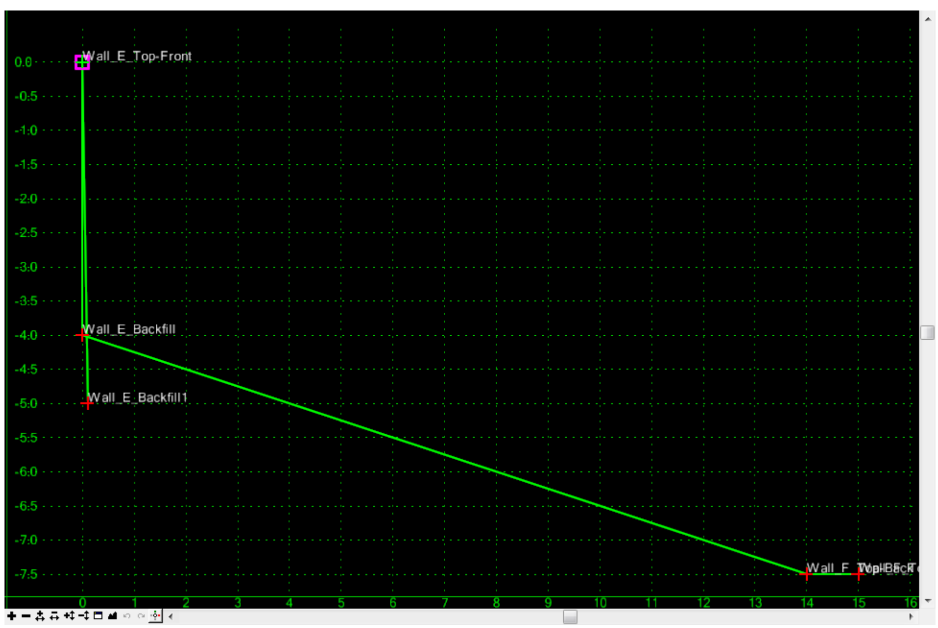


3. Highlight, but do not make active, ***Terrace_Wall***.

4. Drag the ***Terrace_Wall*** template from the preview 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 and drop it on the origin, making certain the ***Wall_E_Top-Front*** point turns white.

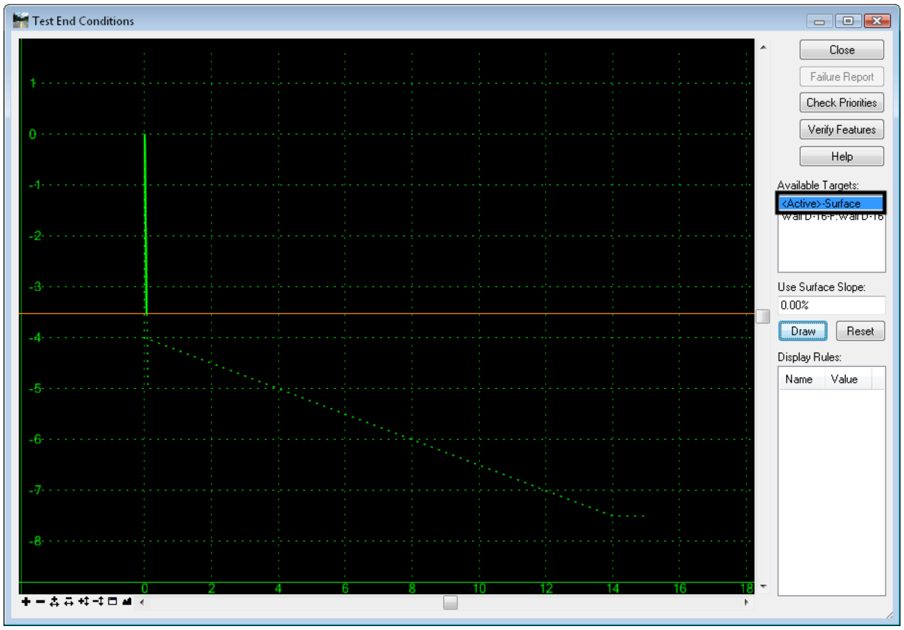


7. **<D> Test**.

8. **<D>** on the ***<Active>-Surface*** under ***Available Targets***.

9. **<D>** on **Draw**.

10. Move your cursor into the template view.

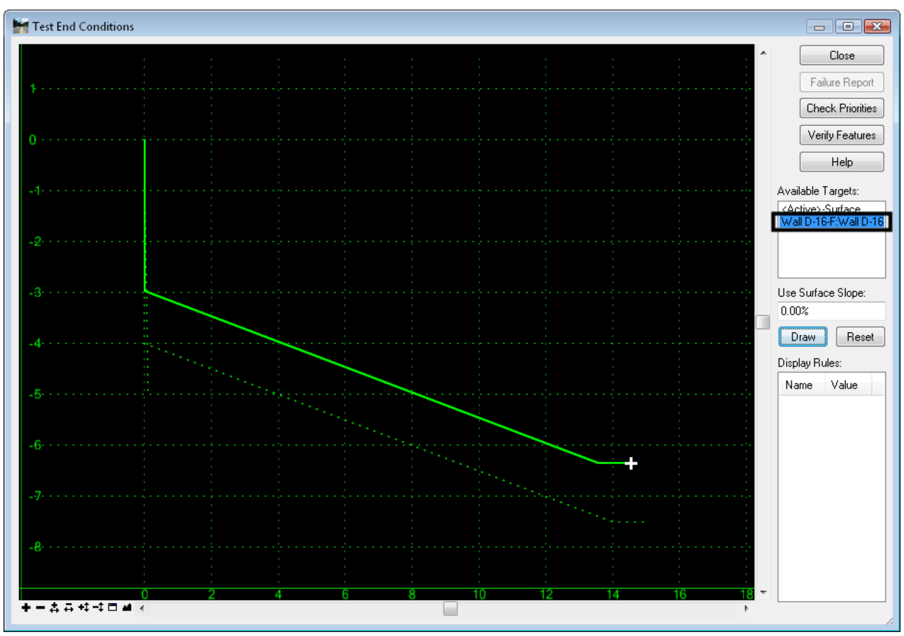


Note: The wall face appears, indicating that when the first option, the ***Wall face and terrace***, fails, the wall face alone will be created.

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.

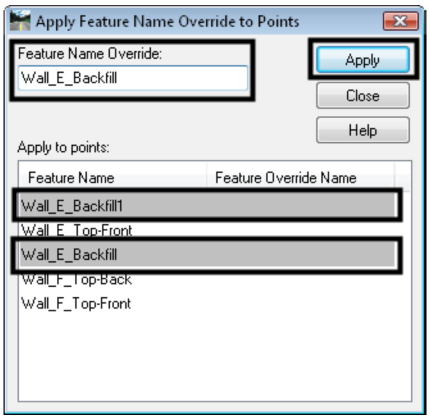
14. **<D> Close** on the ***Test End Conditions*** dialog.

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***.

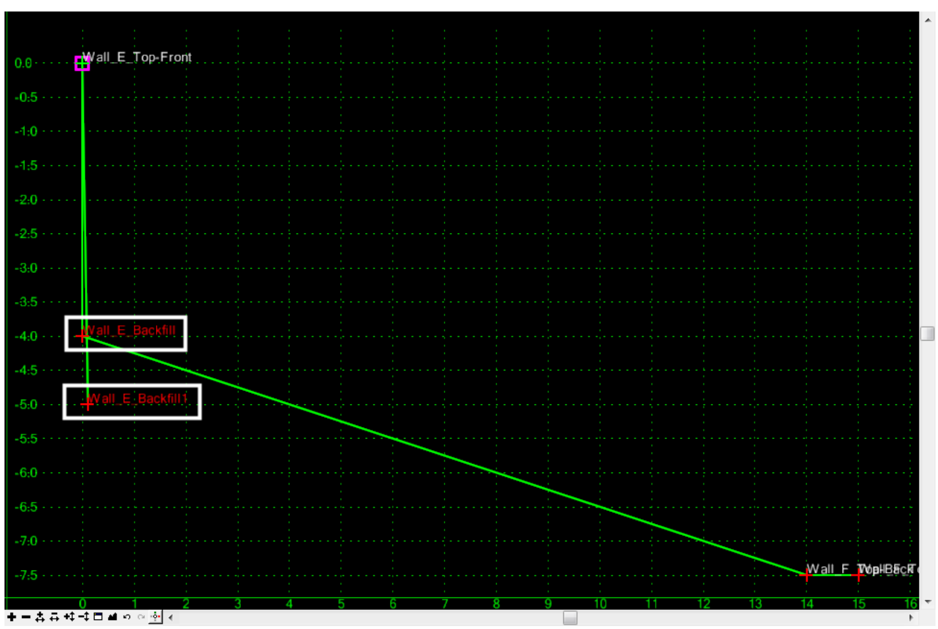
15. Select **Tools > Apply Feature Name Override**.

16. Highlight the two ***Wall_E_Backfill*** points

17. Key in ***Wall_E_Backfill*** for the ***Feature Name Override***.



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

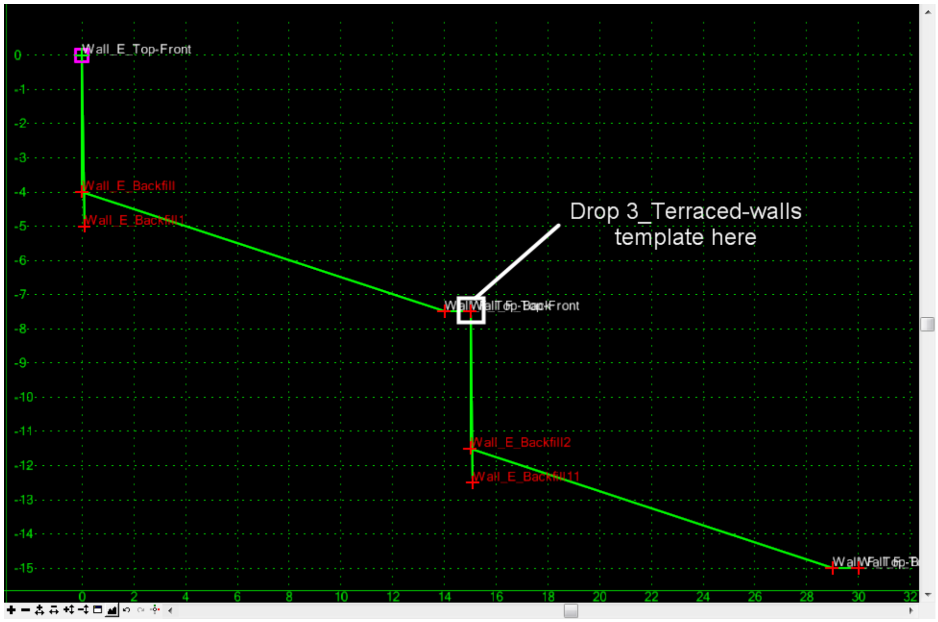


Note: The names turn red in the template view, indicating the names have been overridden.

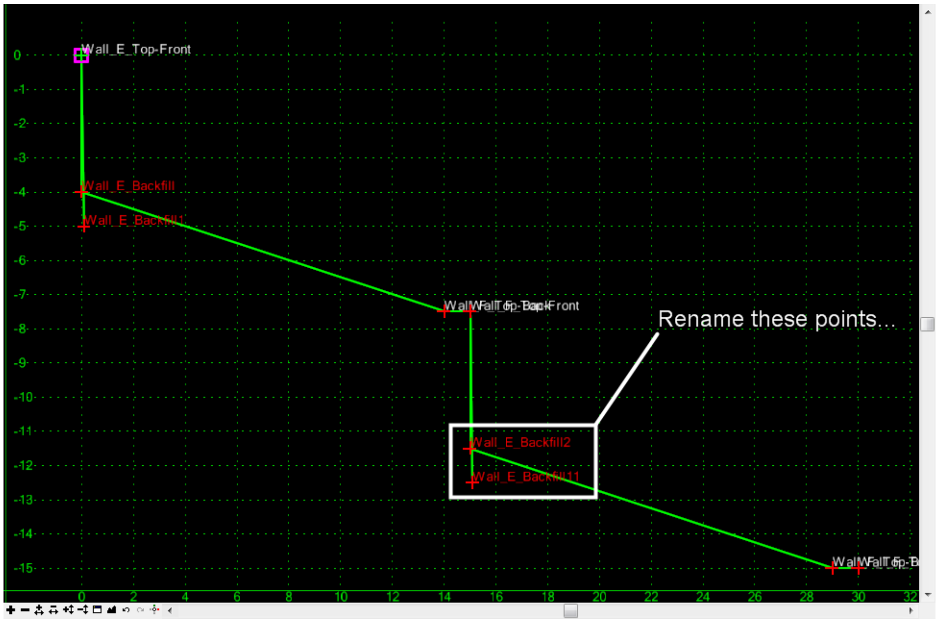
19. **Save** the template library.

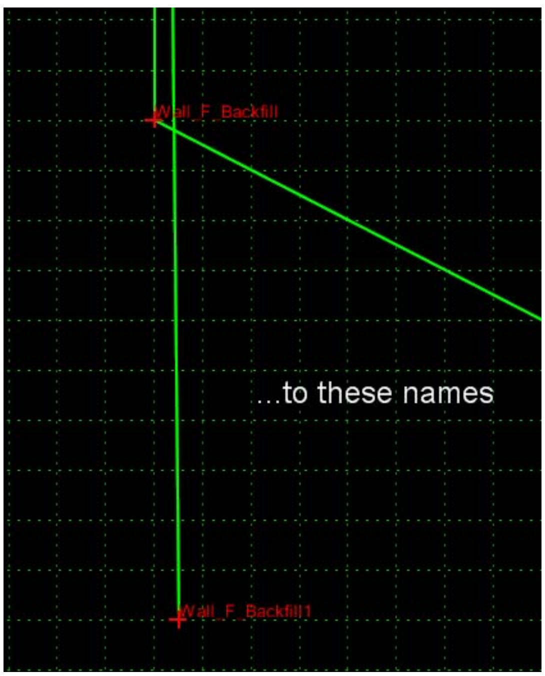
20. Highlight the ***3_Terraced-walls*** template in the list at left.

21. Drag and drop the template from the preview onto the ***Wall_F_Top-Front*** point, making certain the point turns white.



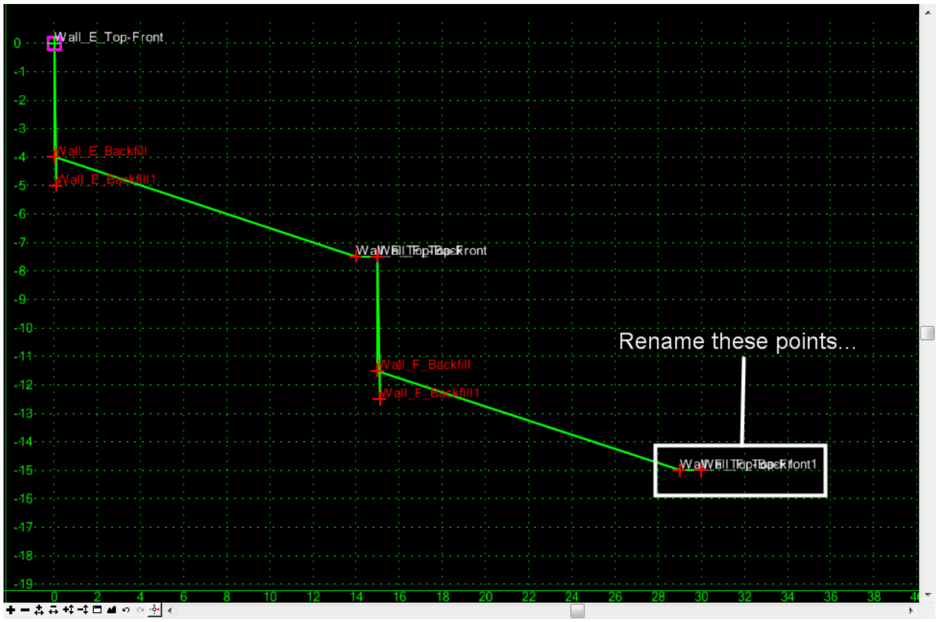
22. **Edit** the two backfill points for ***Wall F*** and rename the points to ***Wall_F_Backfill*** and ***Wall_F_Backfill1.***

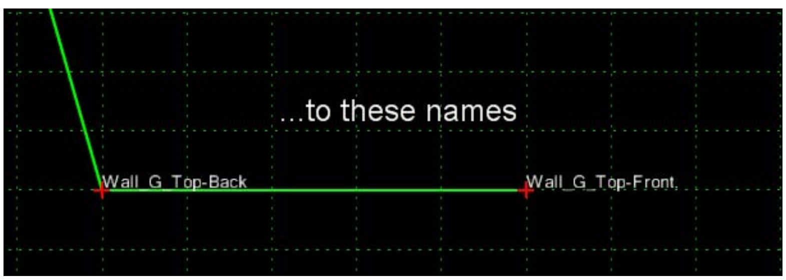




23. Rename the ***Wall_F_Top-Front1*** point to ***Wall_G_Top-Front***.

24. Rename the ***Wall_F_Top-Back1*** point to ***Wall_G_Top-Back***.

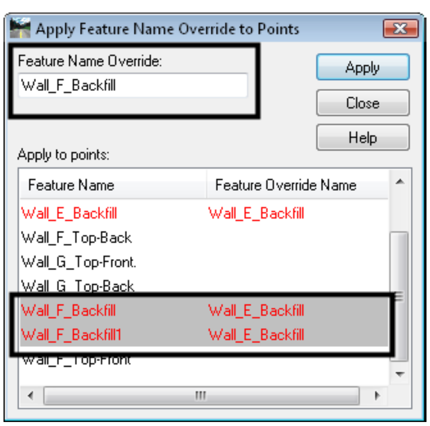




25. Select **Tools > Apply Feature Name Override**.

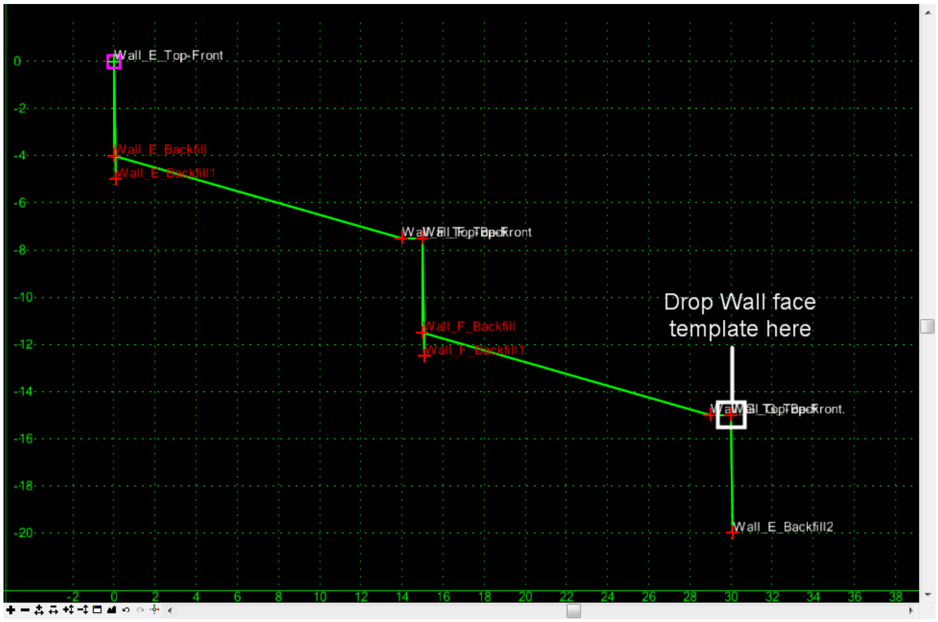
26. Highlight the two ***Wall_F_Backfill*** points

27. Key in ***Wall_F_Backfill*** for the ***Feature Name Override***.

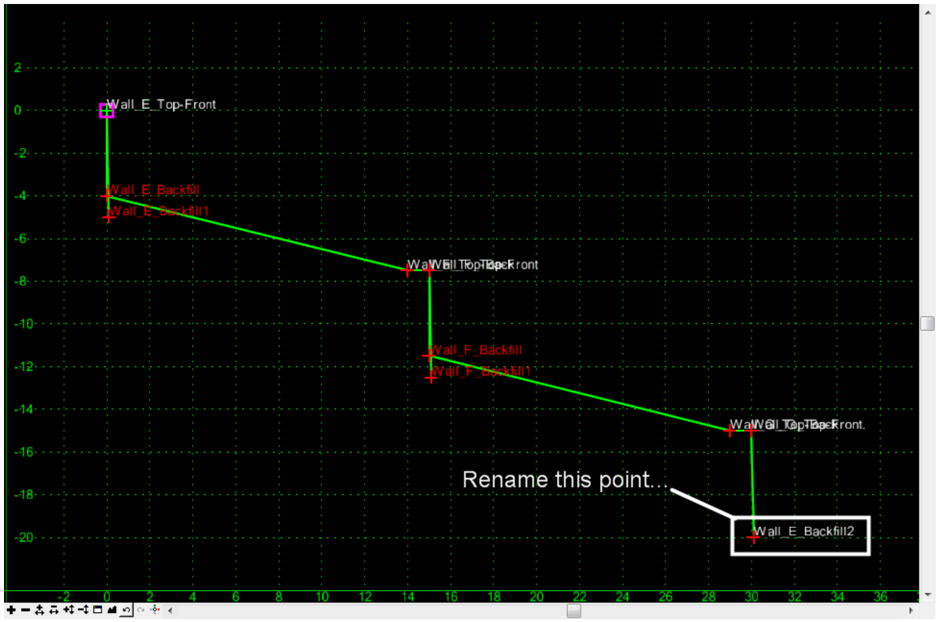


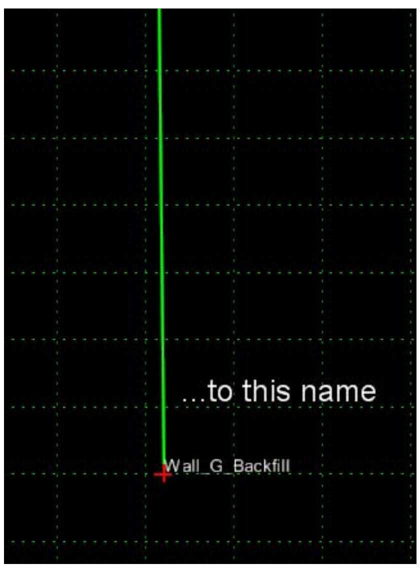
28. **<D> Apply**, then **Close**.

29. Highlight, but do not make active, ***Wall_Face***.
30. Drag the ***Wall_Face*** template from the preview 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***.

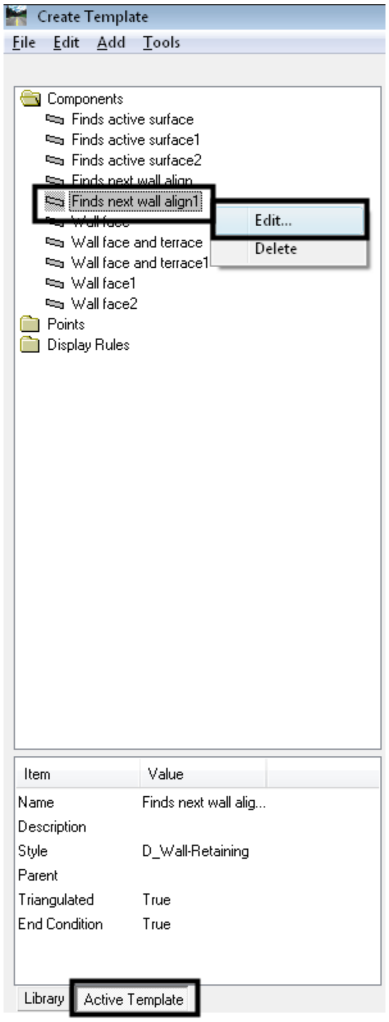




32. At the bottom of the Template Library list at left, select the ***Active Template*** tab.

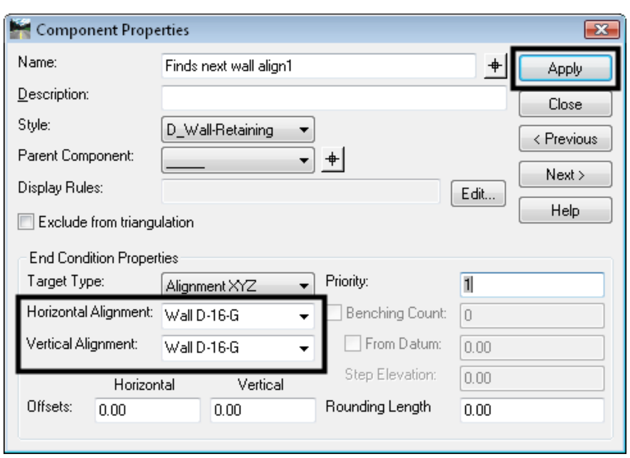
33. Expand the ***Components*** list.

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.
41. **<D> Close** on the ***Create Template*** dialog.

Lab 23.5 - 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***.

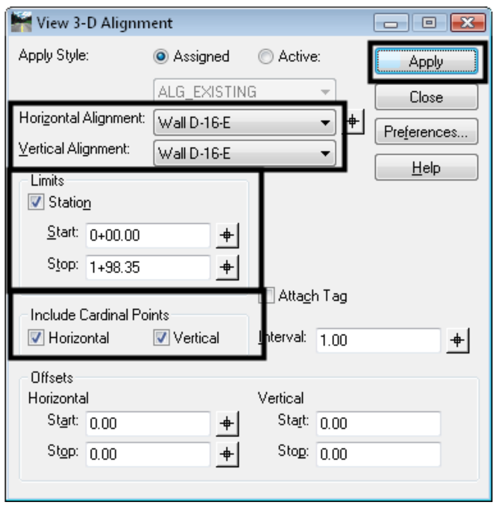
6. Key in ***1+98.35*** for the ***Stop Station***.

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.

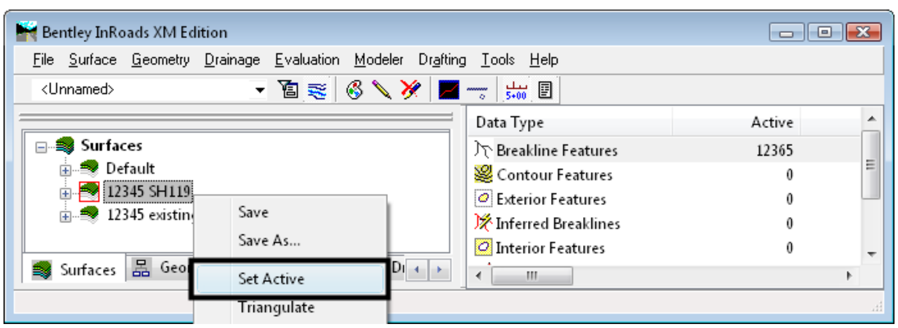


9. **<D> Apply**, then **Close**.

10. **Fit** the view.

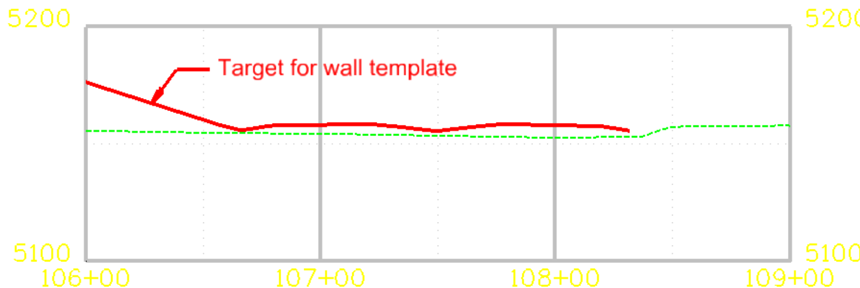
Note: The 3D linestring is shown here in plan and in a rotated view. It forms the origin point for the wall template.

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***.

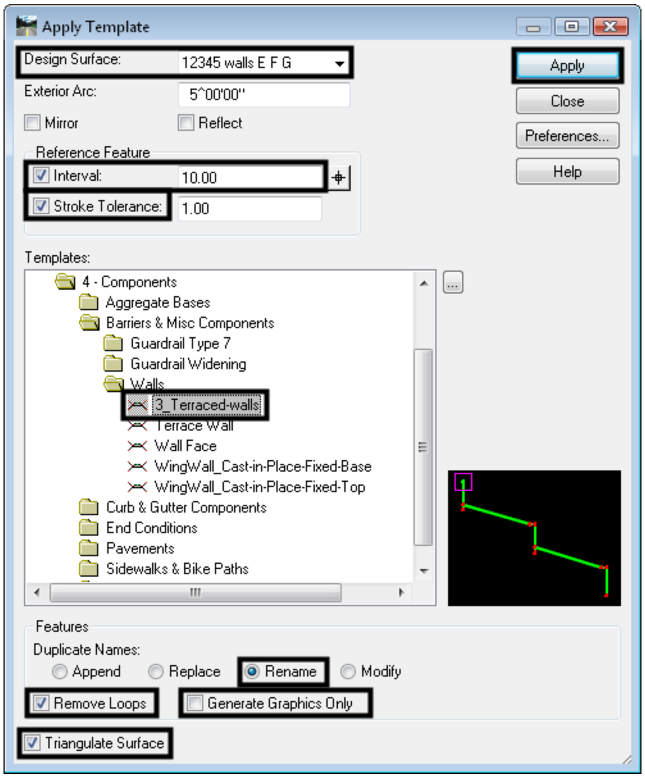
    Note: The design surface does not have to exist. It is created when the command is applied.

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 ***Replace***.
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***.

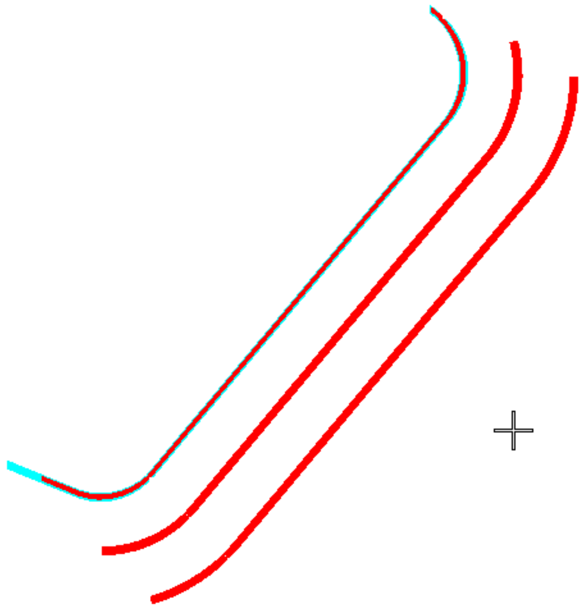
24. **<D>** anywhere in the view to accept.

25. **<D>** on the 3D alignment graphic again to identify the ***Reference Element***.

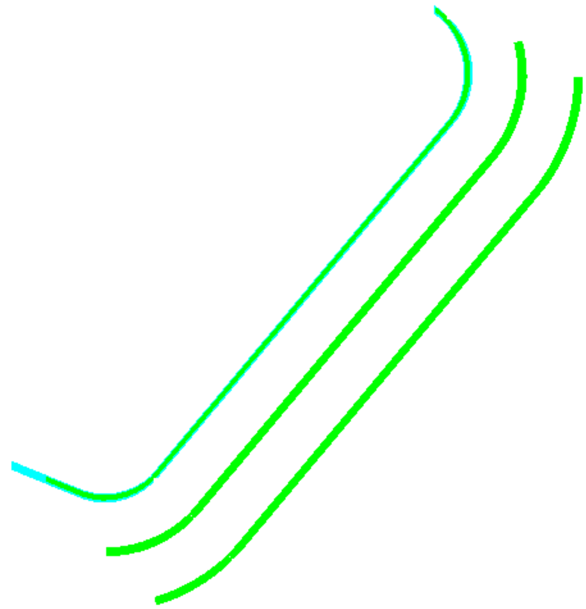
26. **<D>** anywhere in the view to accept.

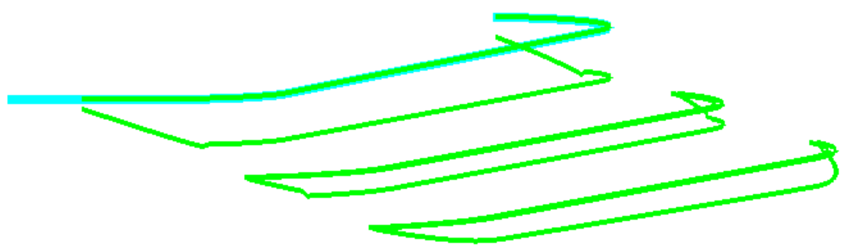
27. **<R>** to apply the template to the entire element.

Note: Temporary graphics appear showing the resulting feature locations.



28. **<D>** anywhere in the view for the location.

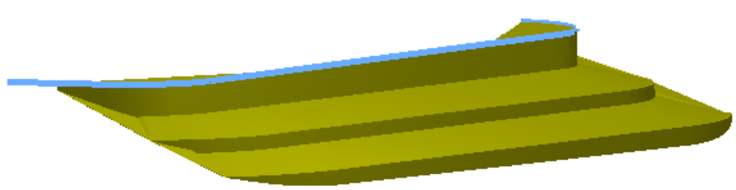




> ***Note:*** The ***Results*** dialog appears showing any end condition failures. Above, you see the plan and rotated views of the graphics. There may be failures at either end of the graphics, since the alignment actually begins slightly underground.

29. **Save** the wall surface to the ***c:\Projects\12345\Design\InRoads*** folder.

30. Review the surface by displaying triangles and/or contours.

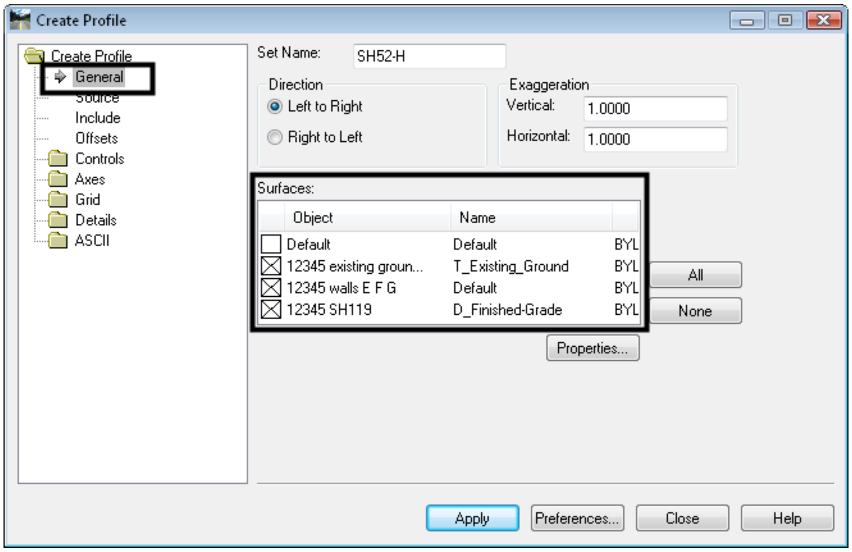


> ***Note:*** If the view is rotated, return to a top view when done.

31. Set the active alignment to ***SH52-H***.

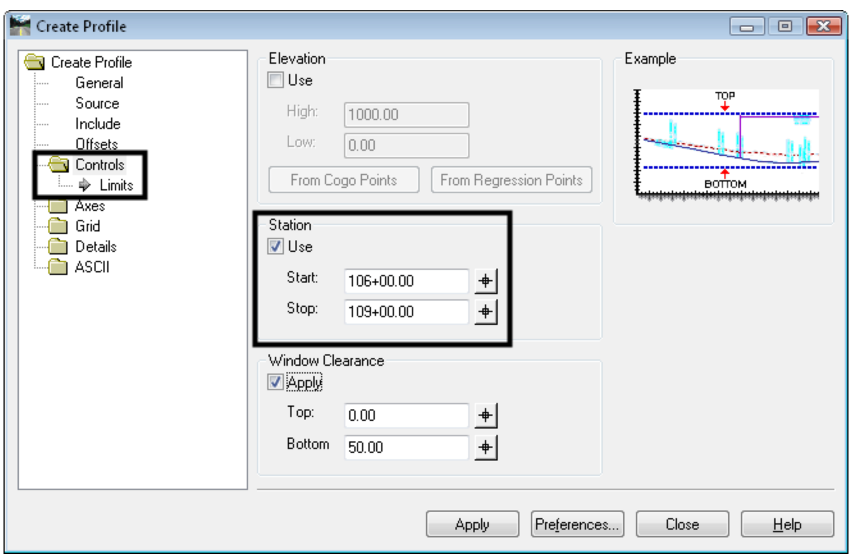
32. Select **Evaluation > Profile > Create Profile**.

33. Toggle on ***12345 existing ground for interchange***, ***12345 SH52***, ***12345 SH119*** and ***12345 walls E F G***.



34. Select the ***Controls*** branch.

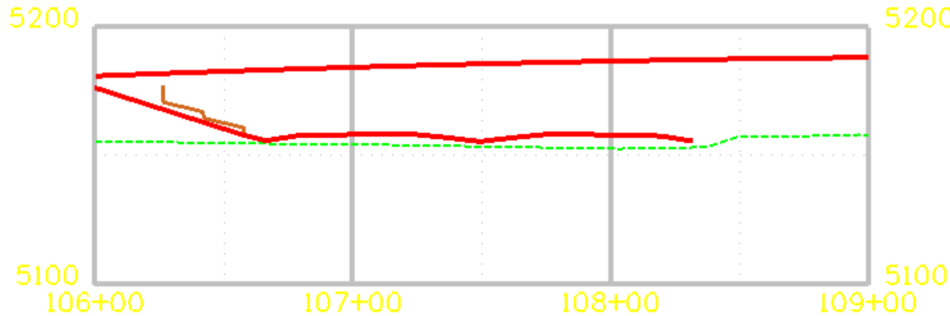
35. Set the ***Station Limits*** to ***106+00*** to ***109+00***.

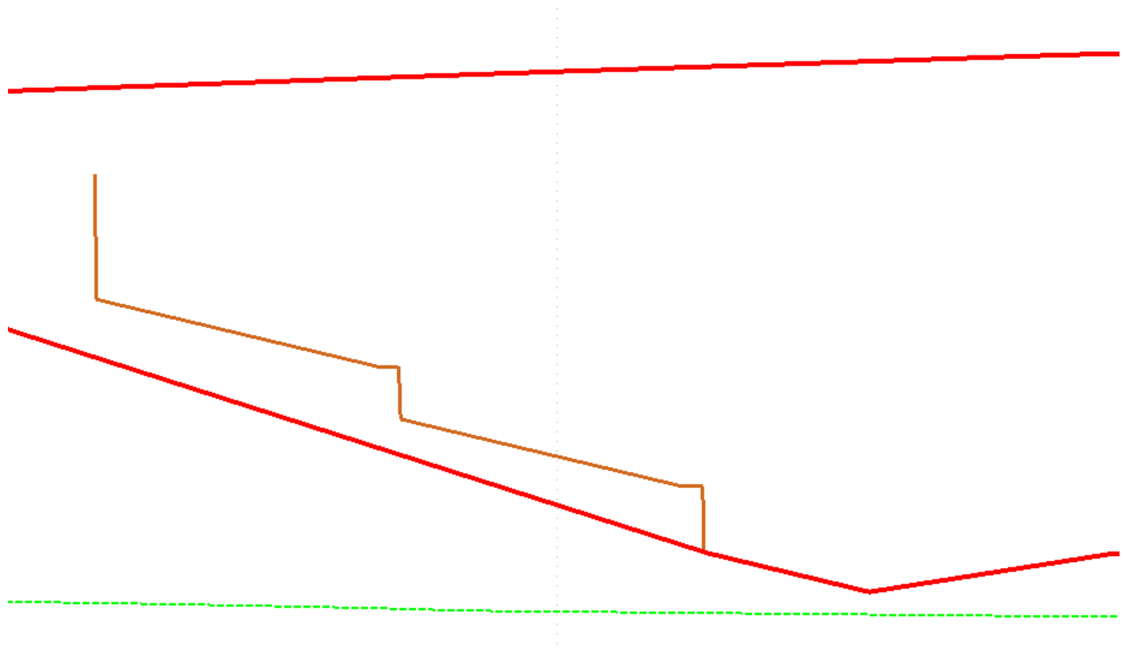


36. **<D> Apply**.

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 24 - Widening and Overlay

Widening and overlay projects are and increasingly large part of the CDOT workload. This lab illustrates the MicroStation and InRoads tools used for this type of project.

Chapter Objectives:

- Create a complex chains for the pavement edges from existing ground features.
- Import the chains as horizontal and vertical alignments.
- Develop a widening and overlay template.
- Define a corridor for the project.

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_XM\Standards-Global\InRoads\Templates\CDOT_Template-Library.itl
- C:\Projects\12345\DesignROW_Survey\InRoads\DTM\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.

Lab 24.1 - Chain Pavement Edge Features

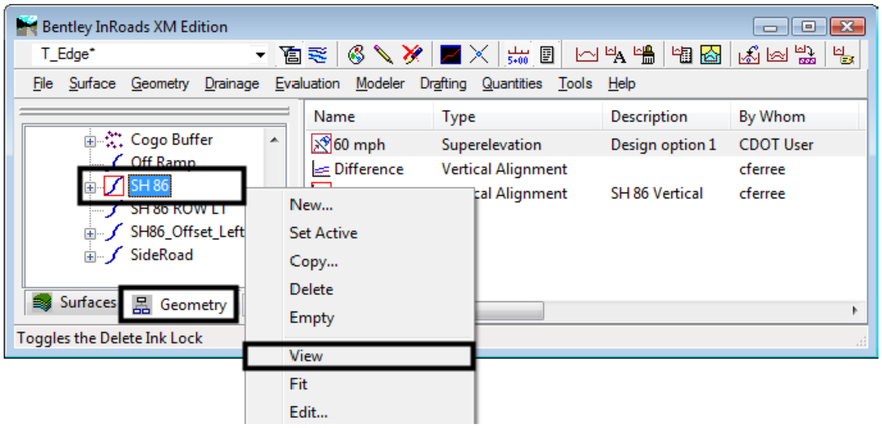
As single continuous lines are easier to use for point controls than a number of unconnected lines. Creating the complex chain also provides the opportunity to close gaps in the pavement edge features.

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_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.

   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.

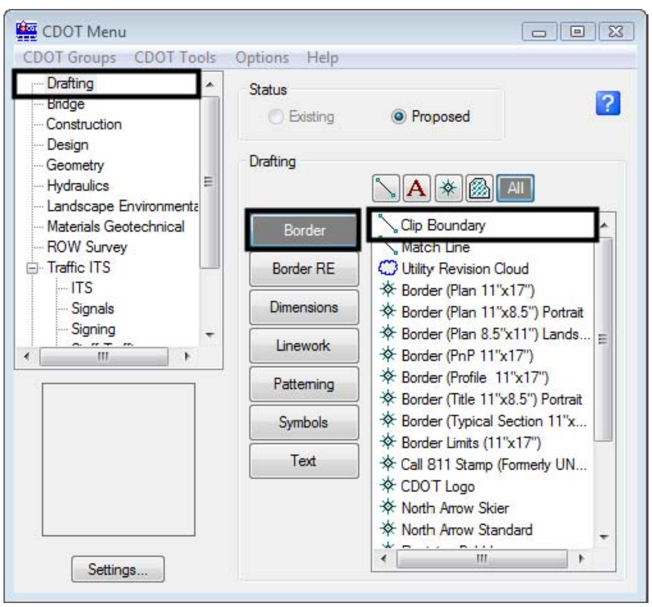


6. Select **Fit View** from the MicroStation view controls.

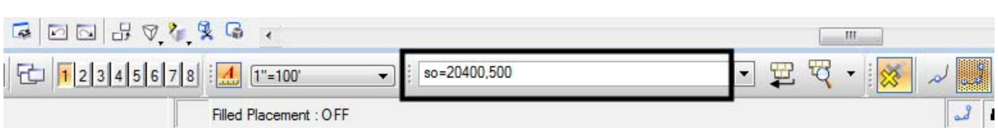
7. From the ***CDOT Menu***, select the **Drafting** group.

8. **<D>** the **Border** button.

9. Highlight **Clip Boundary** from the item list. This activates the ***Place SmartLine*** command.



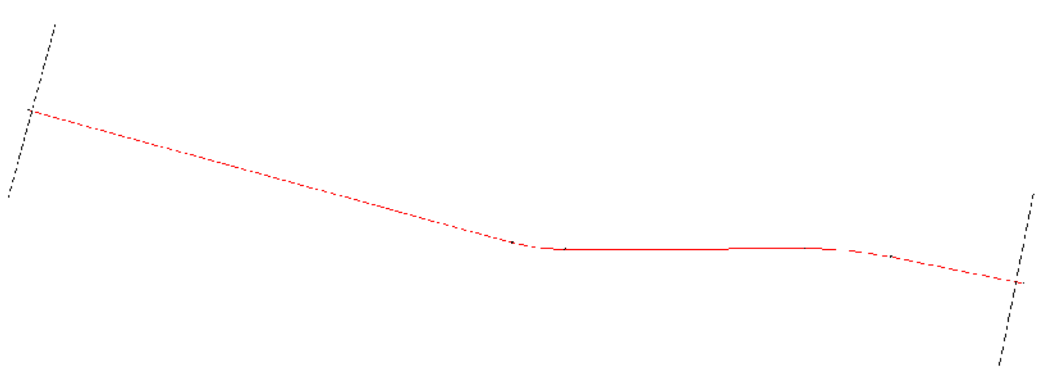
10. In the MicroStation key-in window, key in ***so=204+00,500*** and press ***Enter***.



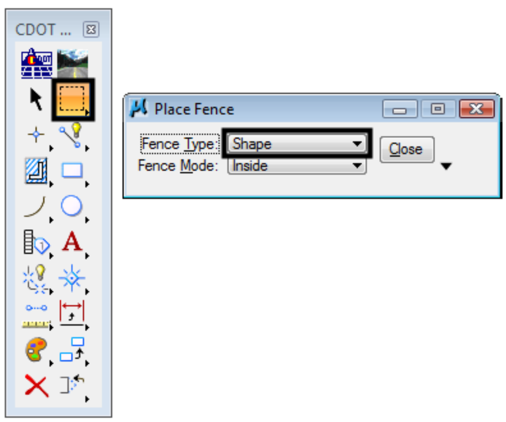
11. Key in ***so=204+00,-500*** and press ***Enter***. **<R>** to finish the line.

This places a line perpendicular to the alignment at the beginning of the project.

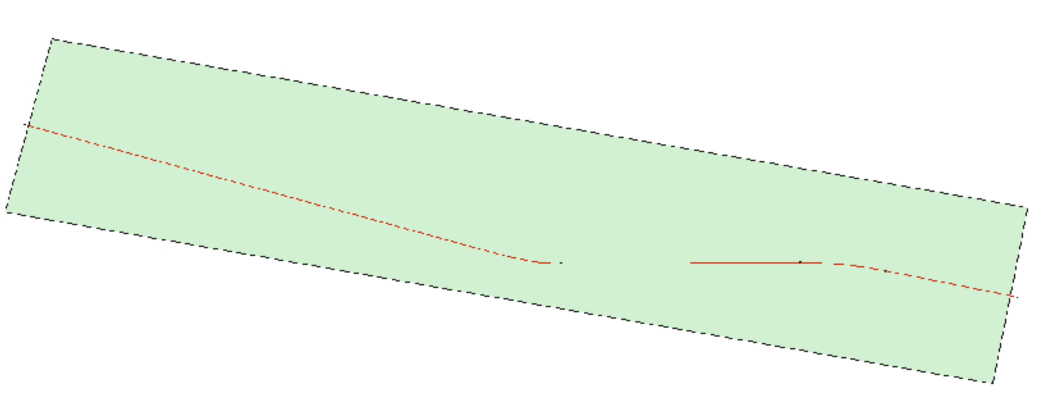
12. The Place SmartLine command is still active. Key in ***so=260+00,500*** and press ***Enter***.
13. Key in ***so=260+00,-500*** and press ***Enter***. **<R>** to finish the line.



14. From the MicroStation Main toolbar, **<D> Place Fence**.
15. In the Tool Settings dialog box, set the ***Fence Type*** to **Shape**.

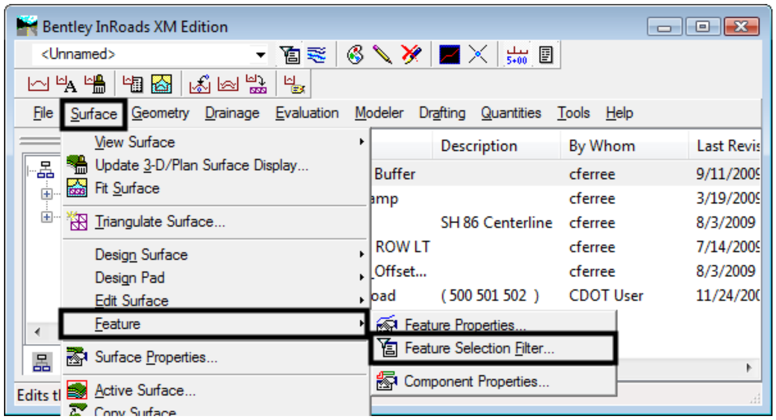


16. **<T>** then **<D>** to the ends of the lines. The fence is shown in the illustration below.



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.

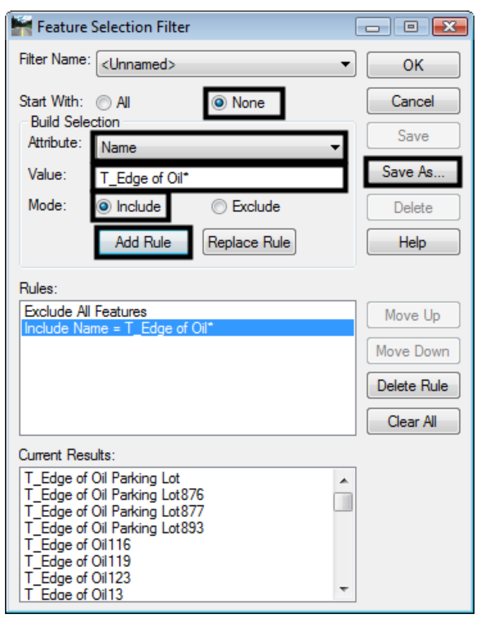
19. Verify that the ***Attribute*** is set to **Name**.

20. Key in ***T_Edge of Oil**** for the ***Value***.

21. Toggle on **Include** for the ***Mode***.

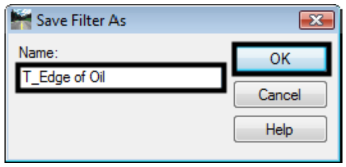
22. **<D>** the **Add Rule** button.

23. **<D>** the **Save As** button.



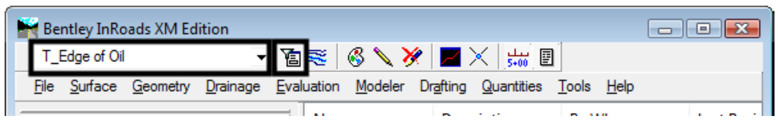
24. In the Save Filter As dialog box, key in ***T_Edge of Oil.***

25. **<D>** The **OK** button. This creates the filter and dismisses the ***Save Filter As*** dialog box.



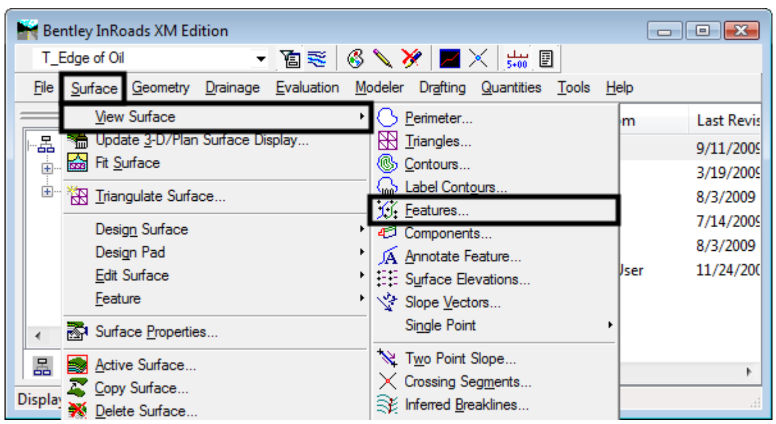
26. **<D>** the **OK** button to dismiss the ***Feature Selection Filter*** dialog box.

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.

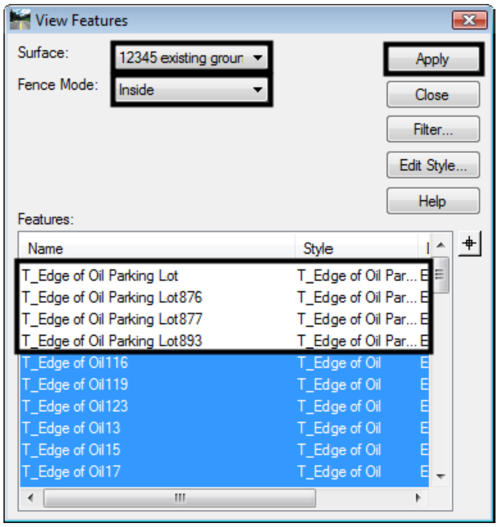


29. In the ***View Features*** dialog box, verify that **12345 existing ground-Overlay** is set as the ***Surface***.

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.

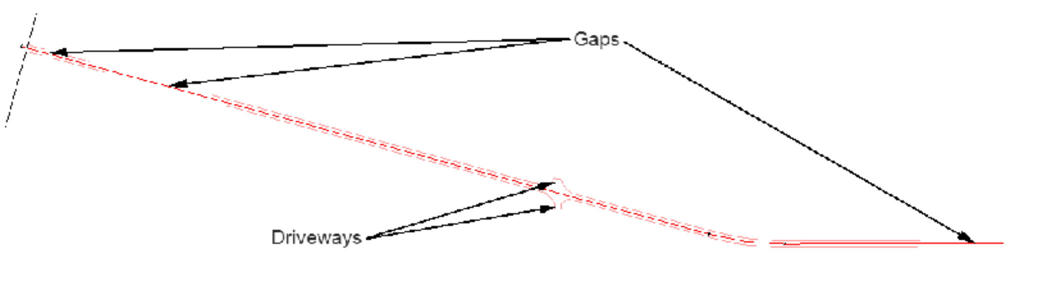


33. **<D> Close** to dismiss the ***View Features*** dialog box.

Note: If the features do not appear in the MicroStation window, **<D>** the **Fit View** from the view controls button bar.

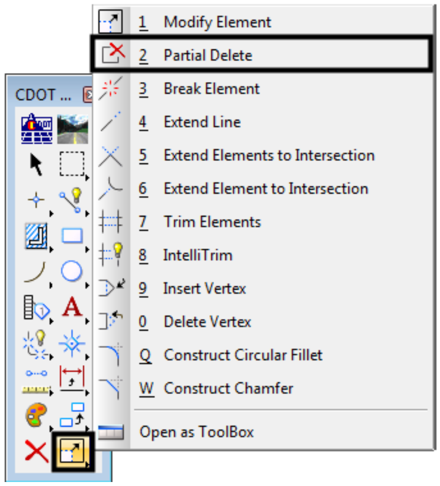
34. From the MicroStation Main toolbar, **<D> Place Fence** to dismiss the fence that was placed earlier.

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.

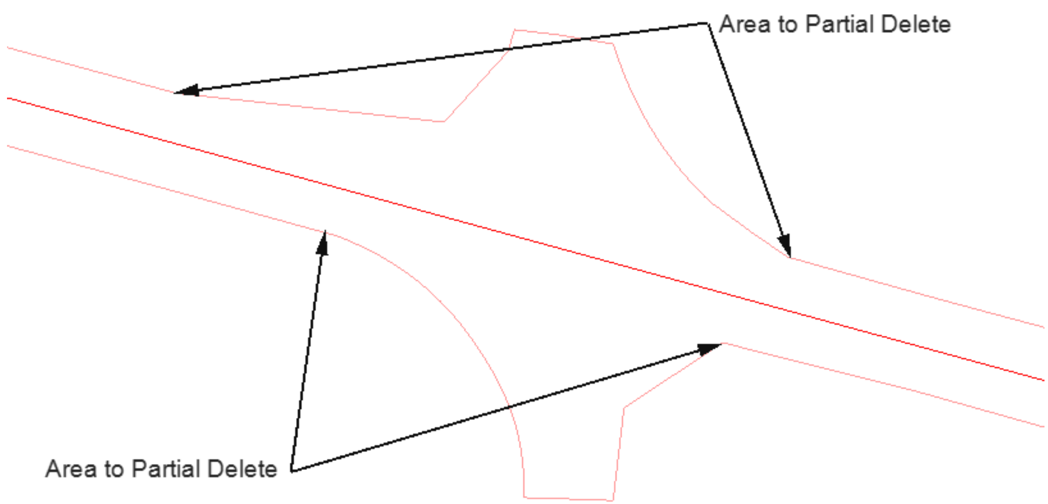


35. Use the MicroStation view controls to zoom in on the area with the driveways.

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.

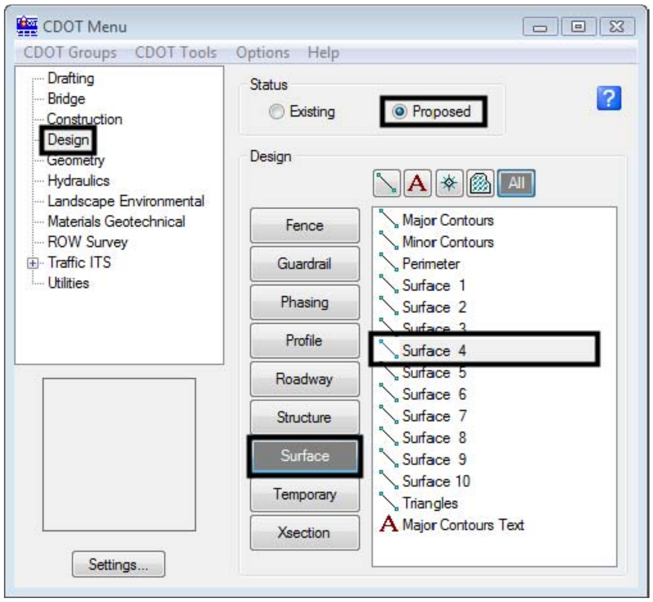


38. On the ***CDOT Menu***, select the **Design** group.

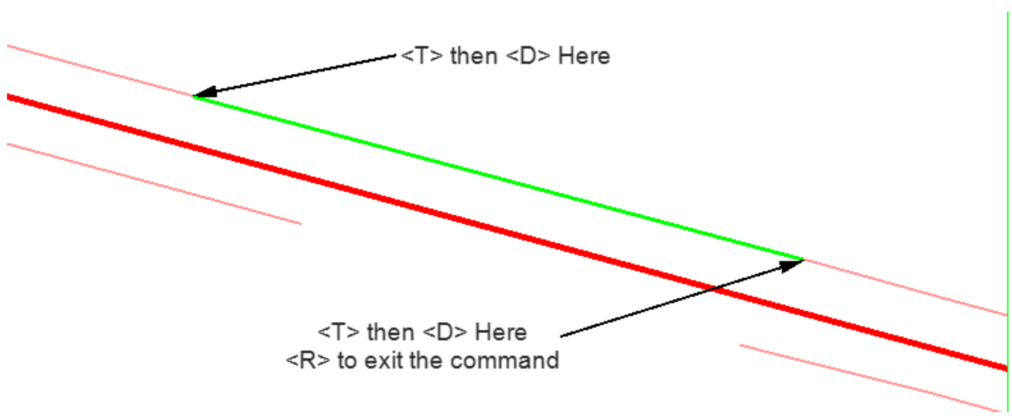
39. Verify that the ***Status*** is set to **Proposed**.

40. **<D>** the **Surface** button.

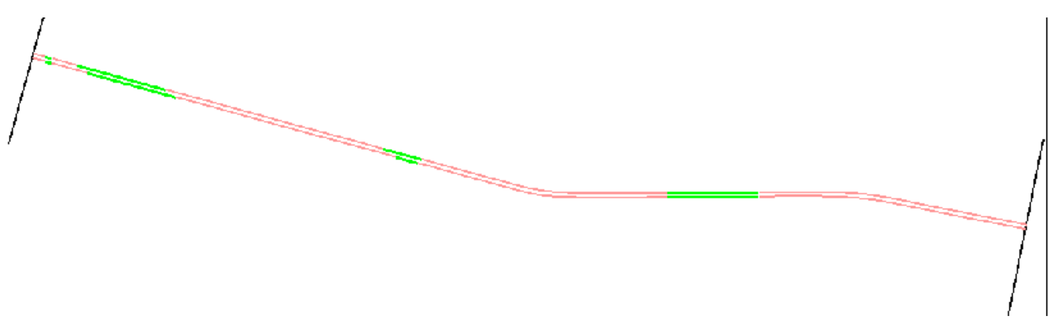
41. Highlight **Surface 4** from the item list. This level was selected because of the contrast to the features displayed.



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.

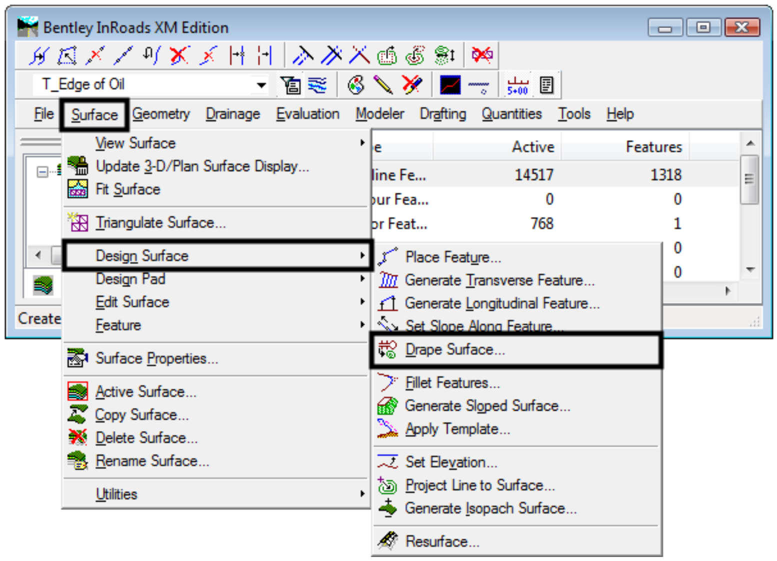


43. Repeat step 41 for each gap in the pavement edge lines. The illustration below shows all of the gaps closed.



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**.



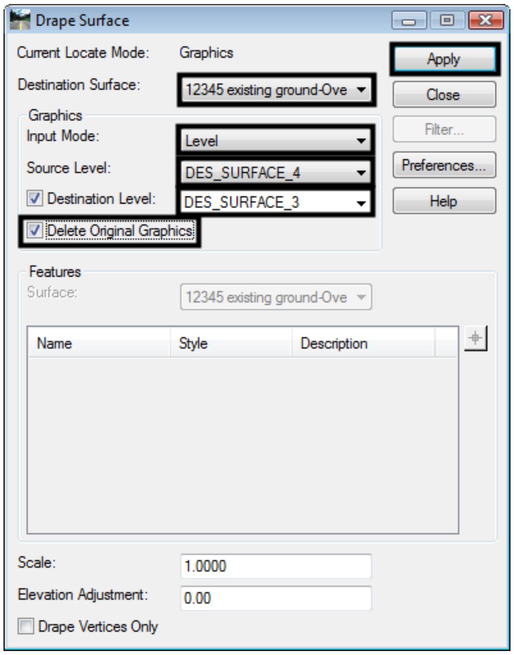
45. In the Drape Surface dialog box, verify that the Destination Surface is set to **12345 existing ground-Overlay**.

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**.



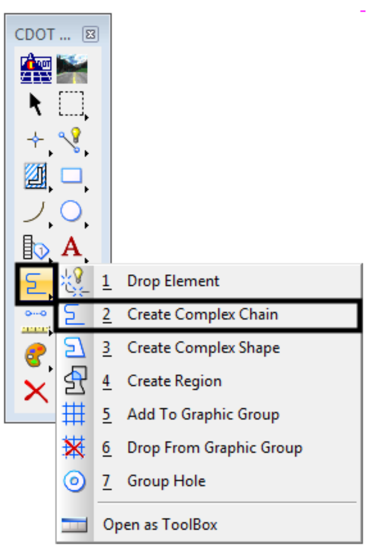
50. **<D> Apply**. The original lines are deleted and replaced with linestrings on the destination level, DES_SURFACE_3. The new linestrings contain a vertex at each point where the original line crossed a triangle in the destination surface.

Now the edge of oil lines can be chained into a single element.

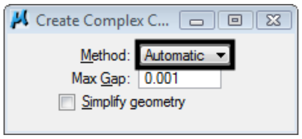
51. Select **Fit View** from the MicroStation ***View Controls***.

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 is 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.

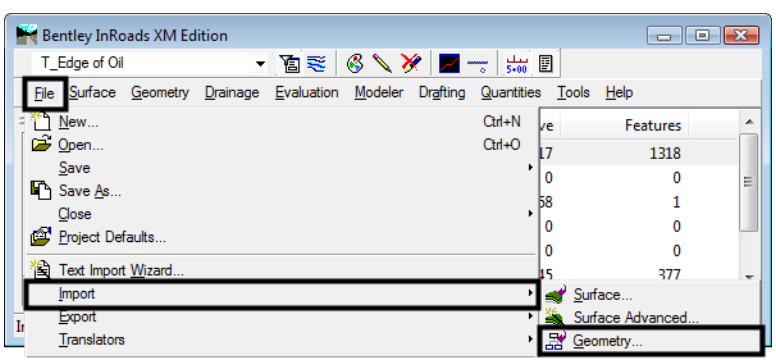
Lab 24.2 - Creating Alignments from Graphic Chains

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:

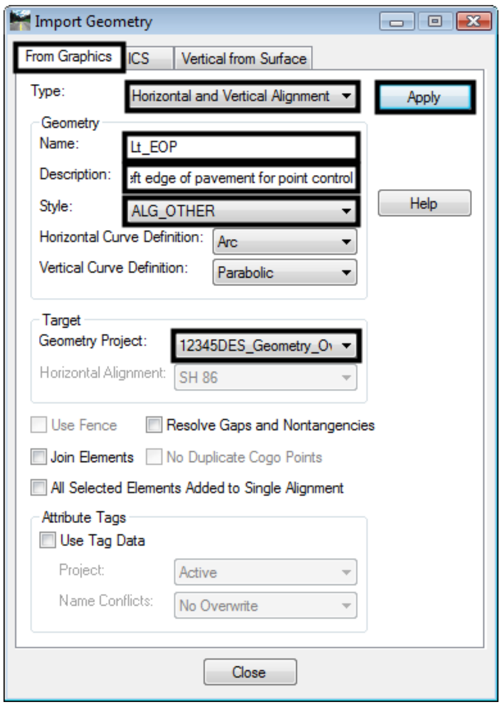
- ♦ Import the graphic elements created in the previous exercise as horizontal and vertical alignments.

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 24.3 - Creating a Widening and Overlay template

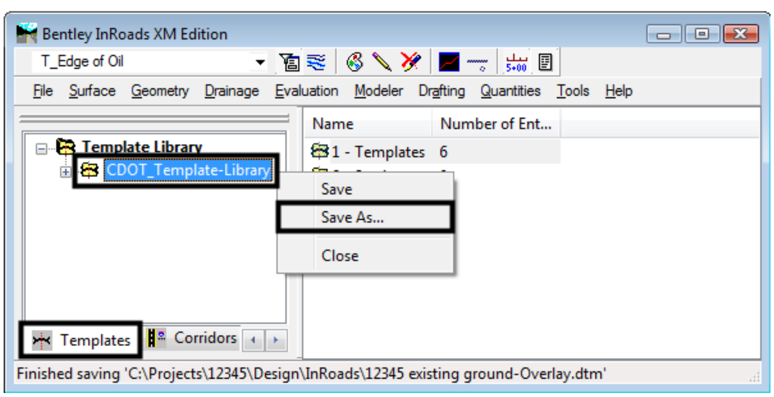
Now that the geometry required for the project is completed, the template and then the corridor can be defined. The template for this project has a 2" overlay of the existing pavement and 8' paved shoulders added to the existing pavement width.

Section Objectives:

- Copy the standard template library into the project folder
- Create a new template placeholder
- Add simple components to define the overlay.
- Change the constraints on the overlay to Project to Surface.
- Add shoulder and end condition sections.

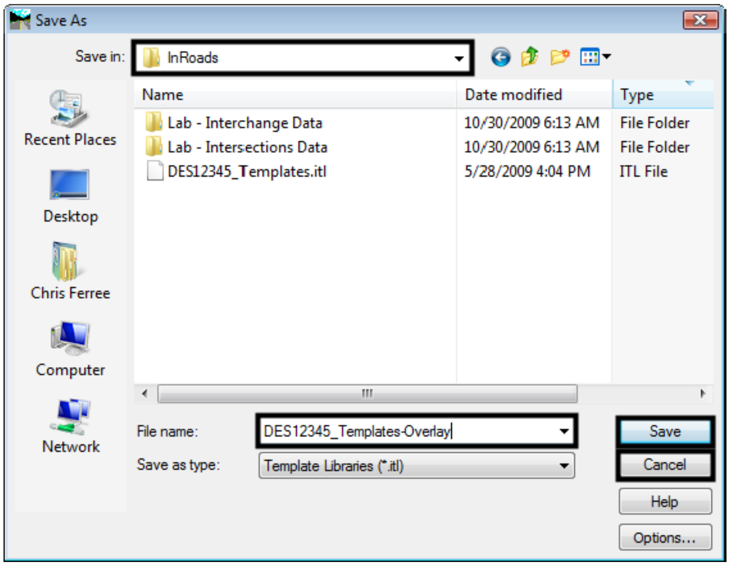
First, the standard template library is copied into the project directory.

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.

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.

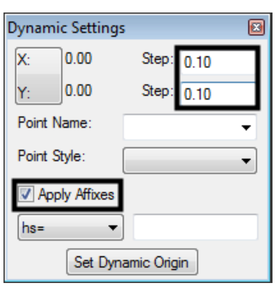
8. **<R>** on the **1 - Templates** folder and select **New > Template** from the right click menu.

9. Key in ***12345_Overlay*** for the template name.

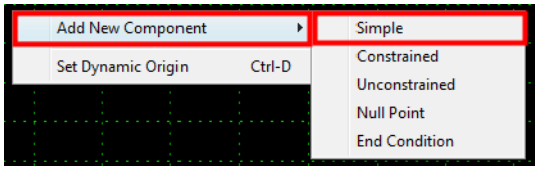
10. Display the **Dynamic Settings** dialog box.

11. Key in ***0.10*** for the ***X*** and ***Y Steps***.

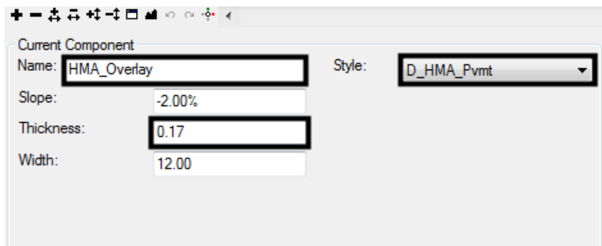
12. Toggle on **Apply Affixes**.



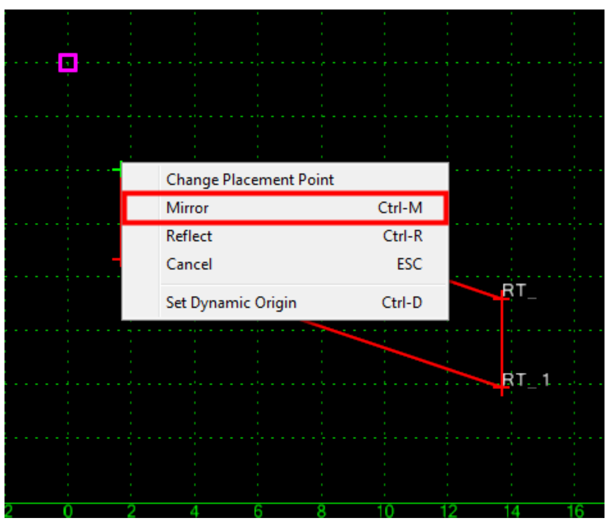
13. **<R>** in the template view and select **Add New Component > Simple** from the right click menu.



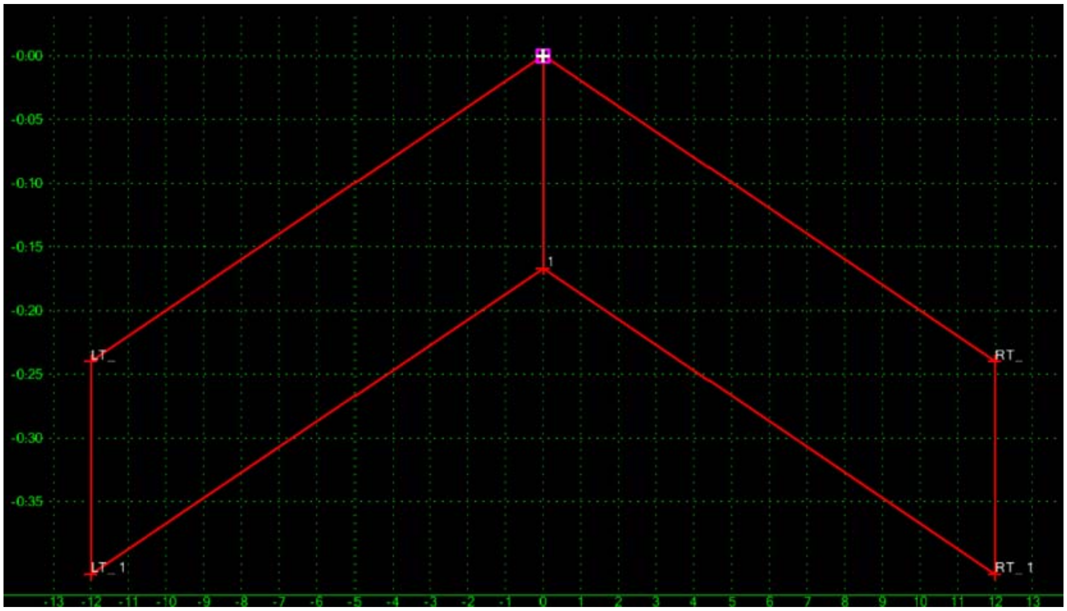
14. In the ***Current Component*** area, key in ***HMA_Overlay*** for the ***Name***.
15. Select **D_HMA_Pvmt** for the ***Style***.
16. Key in ***0.1667*** for the ***Thickness***. Note: this will round to 0.17 in the dialog box.



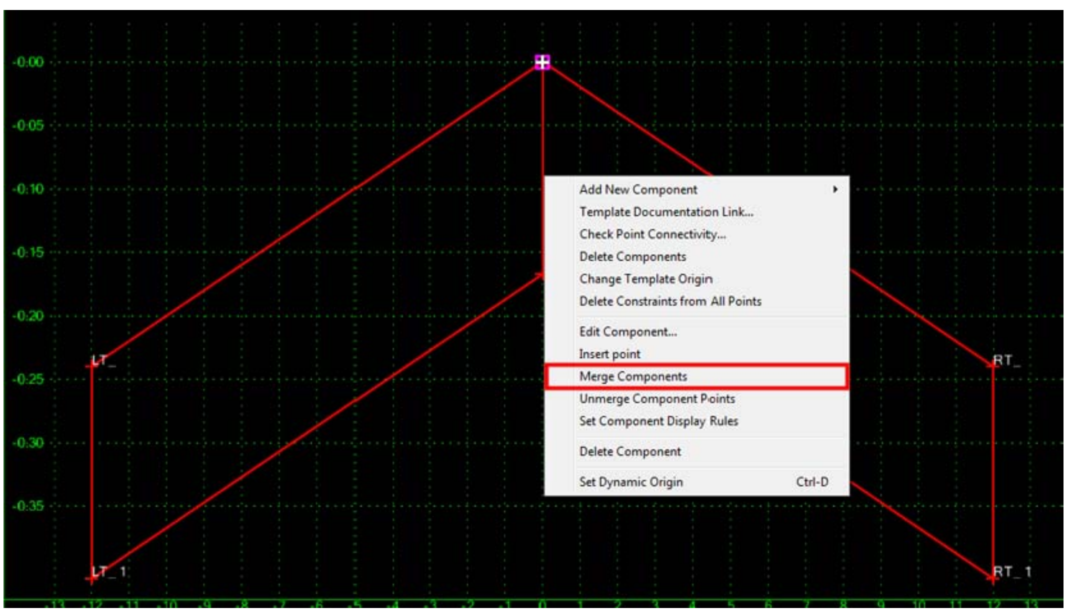
17. **<R>** in the template view and select **Mirror** from the right click menu.



18. **<D>** on the template origin. This creates the two components shown in the illustration below.



19. **<R>** on the vertical line in the center of the template and select **Merge Components** from the right click menu.

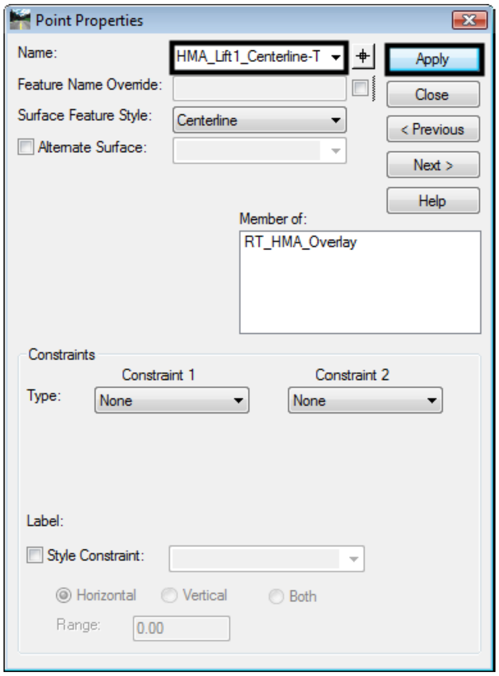


20. **<D> <D>** on the centerline point of the template to display the ***Point Properties*** dialog box.

21. In the ***Point Properties*** dialog box, select **HMA_Liftx_Centerline-Top** in the ***Name*** field. This also sets the ***Surface Feature Style*** to **Centerline**.

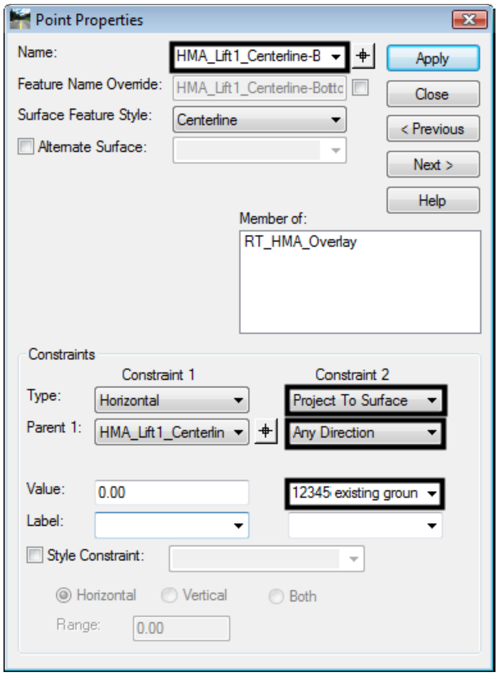
22. Change the ***x*** to a ***1*** in the ***liftx*** part of the name.

23. **<D> Apply** to accept the change.



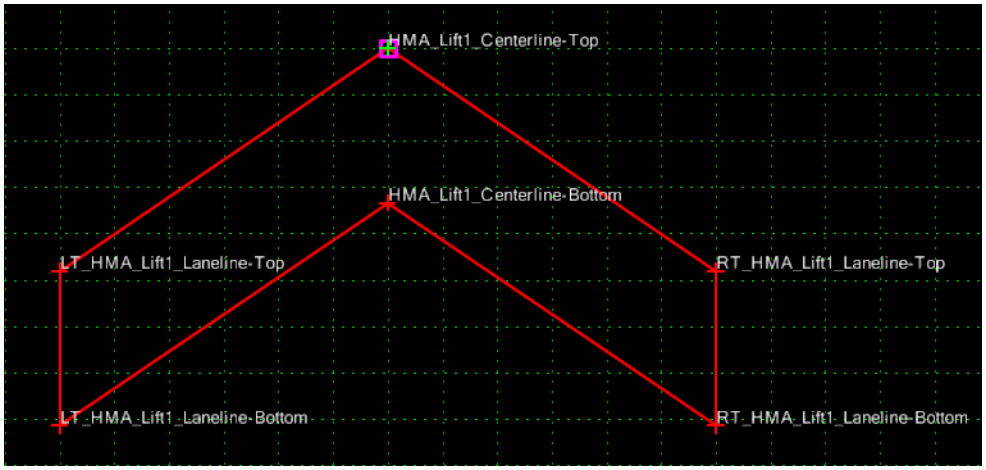
24. **<D>** the **Next** button to select the center bottom point (*1*).
25. Select **HMA_Liftx_Centerline-Top** in the *Name* field.
26. Change the ***x*** to a ***1*** in the ***liftx*** part of the name and change ***Top*** to ***Bottom***.
27. Change the **Vertical** constraint (Constraint 2 in this example) to **Project To Surface**.
28. Set the ***Parent 1*** of the above constraint to **Any Direction**.

29. Verify that the ***Value*** for the ***Project To Surface*** constraint is set to **12345 existing ground-Overlay**.



30. **<D> Apply** to accept the change.
31. **<D>** the **Next** button to select the right top point (***RT_***).
32. In the same manner as done in steps 22 and 26, change the name of the point to ***RT_HMA_Lift1_Laneline-Top***.
33. **<D> Apply** to accept the change.
34. **<D>** the **Next** button to select the right bottom point (***RT_1***).
35. Change the name of the point to ***RT_HMA_Lift1_Laneline-Bottom***.
36. Change the **Vertical** constraint (Constraint 2 in this example) to **Project To Surface**.
37. Set the ***Parent 1*** of the above constraint to **Any Direction**.
38. Verify that the ***Value*** for the ***Project To Surface*** constraint is set to **12345 existing ground-Overlay**.
39. **<D> Apply** to accept the change.
40. **<D>** the **Next** button to select the right top point (***LT_***).
41. In the same manner as done in steps 22 and 26, change the name of the point to ***LT_HMA_Lift1_Laneline-Top***.
42. **<D> Apply** to accept the change.
43. **<D>** the **Next** button to select the right bottom point (***LT_1***).

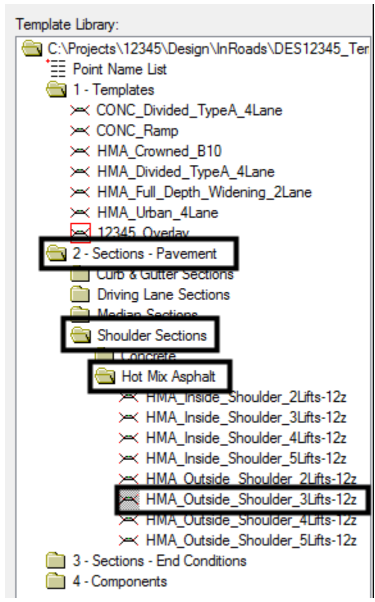
44. Change the name of the point to ***LT_HMA_Lift1_Laneline-Bottom***.
45. Change the **Vertical** constraint (Constraint 2 in this example) to **Project To Surface**.
46. Set the ***Parent 1*** of the above constraint to **Any Direction**.
47. Verify that the ***Value*** for the ***Project To Surface*** constraint is set to **12345 existing ground-Overlay**.
48. **<D> Apply** to accept the change.
49. **<D> Close** to dismiss the ***Point Properties*** dialog box. The template looks like the illustration below:



Now the shoulders and end conditions are added.

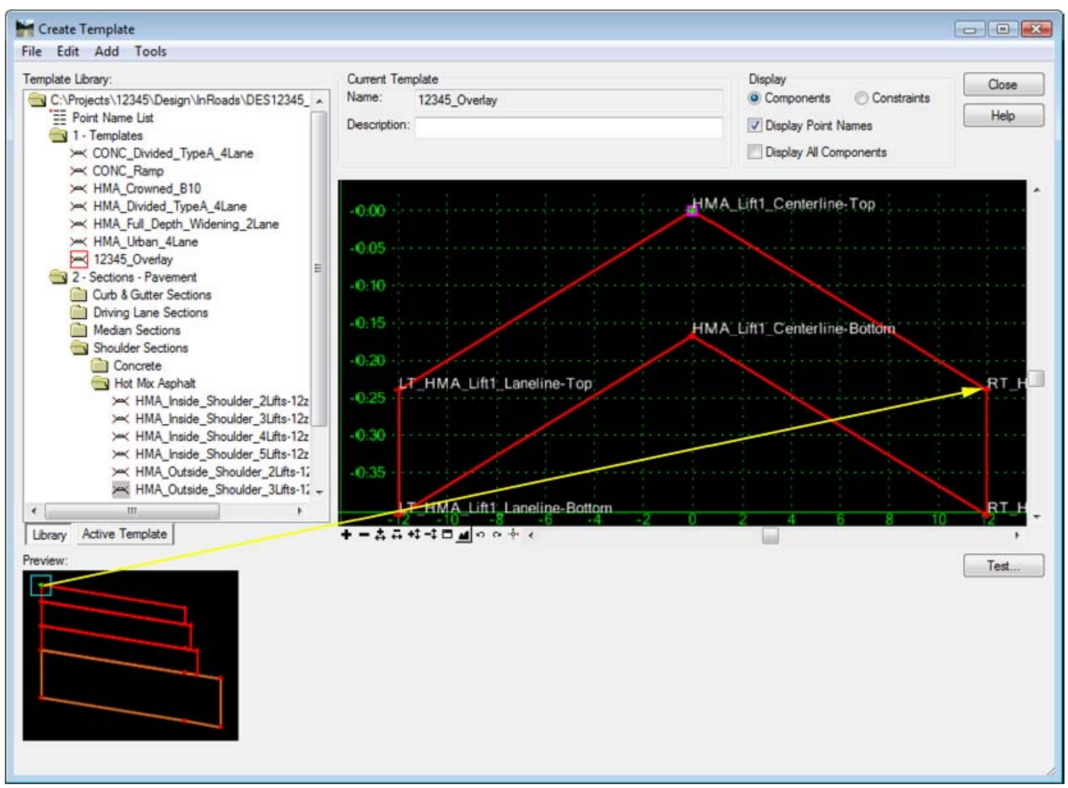
50. Expand the template library to show the contents of the **2 - Sections - Pavement > Shoulder Sections > Hot Mix Asphalt** folder.

51. **<D>** on the **HMA_Outside_Shoulder_3Lifts-12z** section.



52. In the Preview window, **<D>** and hold on the shoulder's origin (the upper left point).

53. 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.

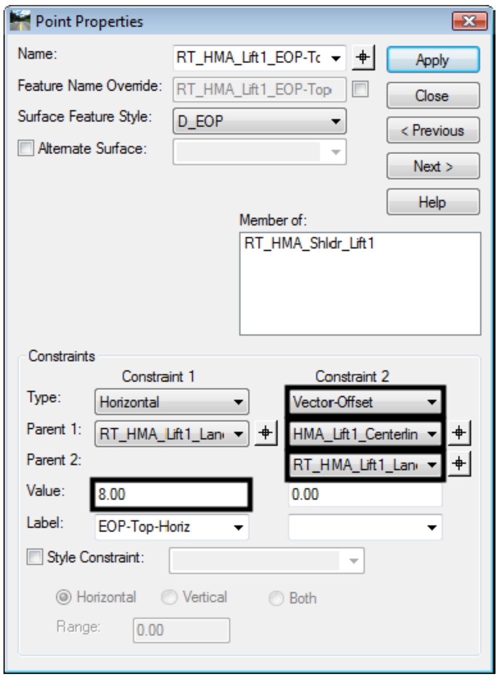
54. **<D> <D>** on the **RT_HMA_Lift1_EOP-Top** point to display the ***Point Properties*** dialog box.

55. Change the ***Value*** of the ***Horizontal*** constraint (***Constraint 1*** in this example) to ***8.00***.

56. Change the ***Slope*** constraint (***Constraint 2*** in this example) to a **Vector-Offset** ***Type***.

57. Set the ***Parent 1*** to **HMA_Lift1_Centerline-Top**.

58. Set the ***Parent 2*** to **RT_HMA_Lift1_Laneline-Top**.



59. **<D> Apply** and then **<D> Close** to dismiss the ***Point Properties*** dialog box.

60. Repeat steps 54 through 59 on 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 in step 55.

61. Expand the template library to show the contents of the **3 - Sections - End Conditions > Z-Slope End Conditions > High Speed End Conditions** folder.

62. **<D>** on the **Z12_6_to_1** section.

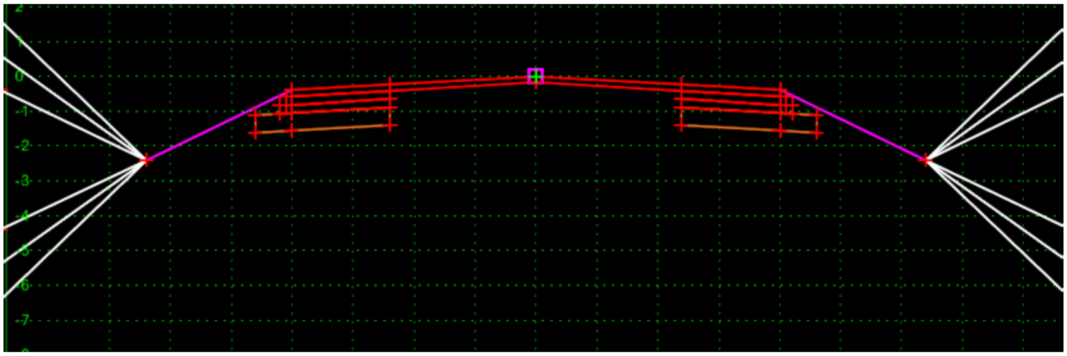
63. In the Preview window, **<D>** and hold on the section's origin (the upper left point).

64. Drag and drop the section onto the **RT_HMA_Lift1_EOP-Top** point.

65. This completes the template. Select **File > Save** from the ***Create Template*** menu bar.

66. **<D> Close** to dismiss the ***Create Template*** dialog box.

The illustration below shows the completed template:



Section Summary:

- Using the Project to Surface point constraint will cause the bottom of the overlay to match the existing ground exactly.
- Once the right click options of Mirror and Reflect are turned on, they remain active until they are turned off.

Lab 24.4 - Creating the Overlay Corridor

Finally, a corridor is constructed using the alignments and template developed earlier.

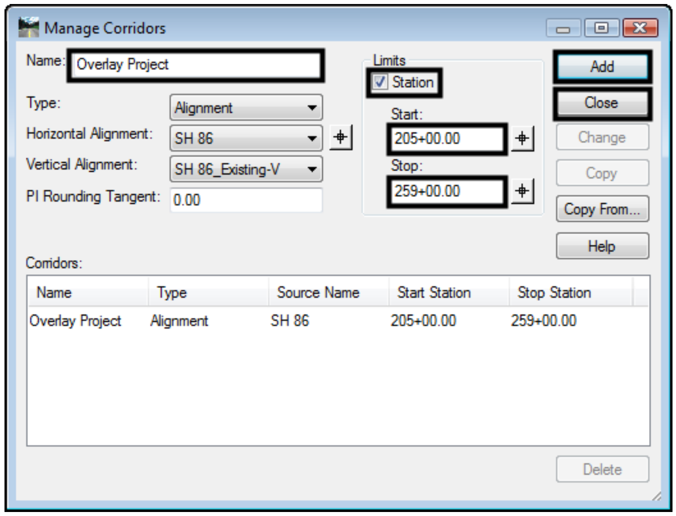
Section Objectives:

- 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.

This corridor contains a single template drop and three point controls. These control the two laneline points with a horizontal and vertical control and the centerline with a vertical control. Superelevation is not required for this corridor because the laneline point controls will cause the template to match the existing superelevation.

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 ***Overlay Project*** for the ***Name***.
4. Toggle on **Station Limits**.
5. Key in ***205+00.00*** for the ***Start*** station.
6. Key in ***259+00.00*** for the ***Stop*** station.

7. **<D>Add** then **<D> Close** to dismiss the dialog box.



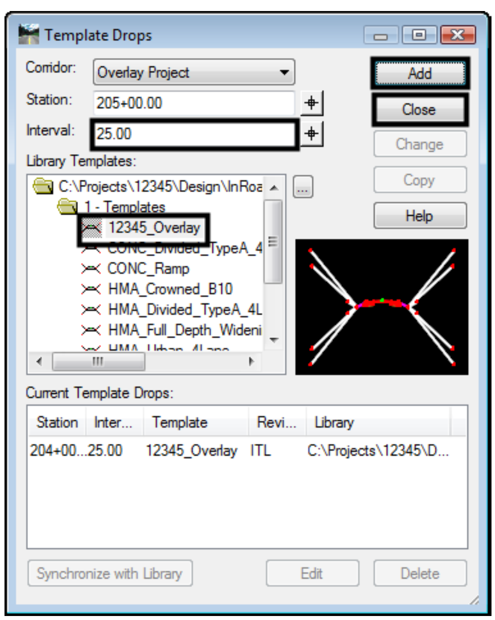
8. In the ***Roadway Designer*** dialog box, select **Corridor > Template Drops** from the menu bar.

9. In the ***Template Drops*** dialog box, key in ***25.00*** for the ***Interval***.

10. Expand the **C:\Projects\12345\Design\InRoads\DES12345_Templates-Overlay** template library to show the contents of the **1 - Templates** folder.

11. Highlight the **12345_Overlay** template.

12. **<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 raise the template up 2” and match the existing cross slopes of the original surface.

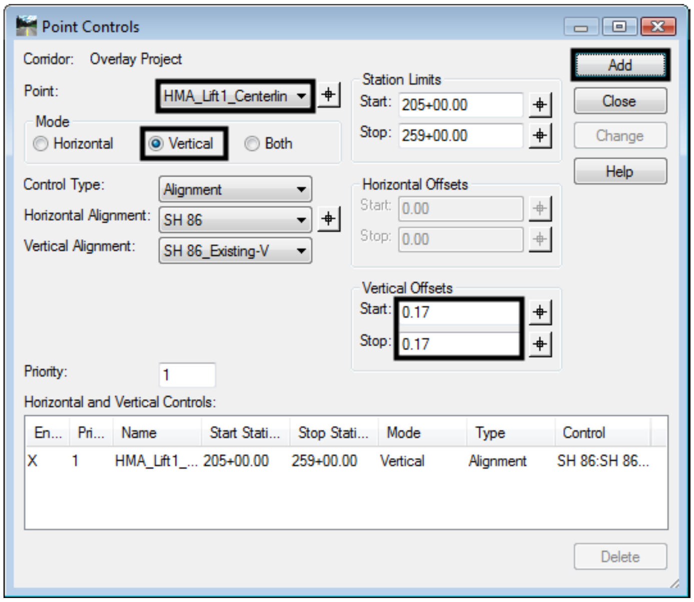
13. In the ***Roadway Designer*** dialog box, select **Corridor > Point Controls** from the menu bar.

14. In the ***Point Controls*** dialog box, set the Point to **HMA_Lift1_Centerline-Top**.

15. Toggle on **Vertical** for the ***Mode***.

16. In the ***Vertical Offsets*** area, key in ***0.1667*** for the ***Start*** and ***Stop*** offset. Note: these will be rounded to 0.17.

17. **<D>** the **Add** button.



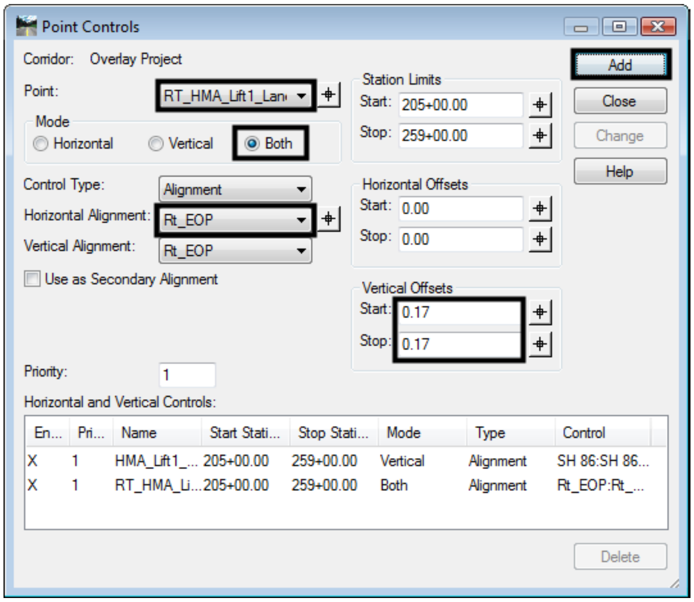
18. In the ***Point Controls*** dialog box, set the Point to **RT_HMA_Lift1_Laneline-Top**.

19. Toggle on **Both** for the ***Mode***.

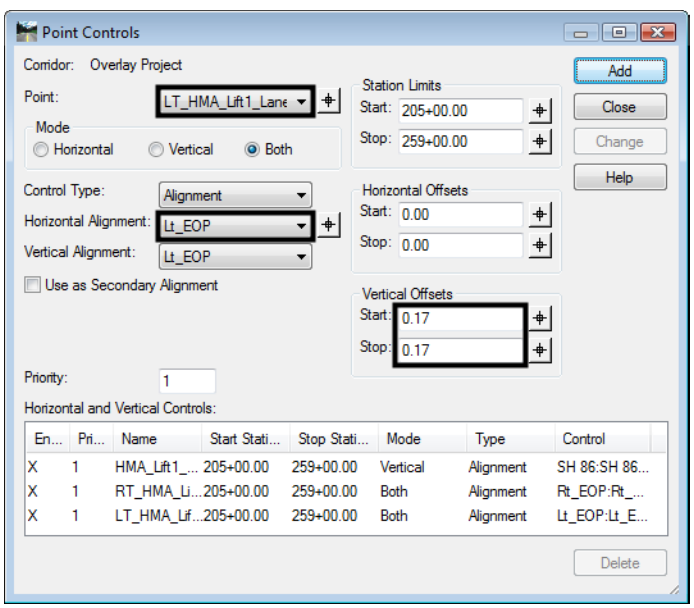
20. Select **Rt_EOP** for the ***Horizontal Alignment***. This automatically sets the vertical alignment.

21. In the ***Vertical Offsets*** area, key in ***0.1667*** for the ***Start*** and ***Stop*** offset.

22. **<D>** the **Add** button.



23. In the ***Point Controls*** dialog box, set the Point to **LT_HMA_Lift1_Laneline-Top**.
24. Select **Lt_EOP** for the ***Horizontal Alignment***. This automatically sets the vertical alignment.
25. In the ***Vertical Offsets*** area, key in ***0.1667*** for the ***Start*** and ***Stop*** offset.
26. **<D>** the **Add** button the **<D> Close** to dismiss the Point Controls dialog box.

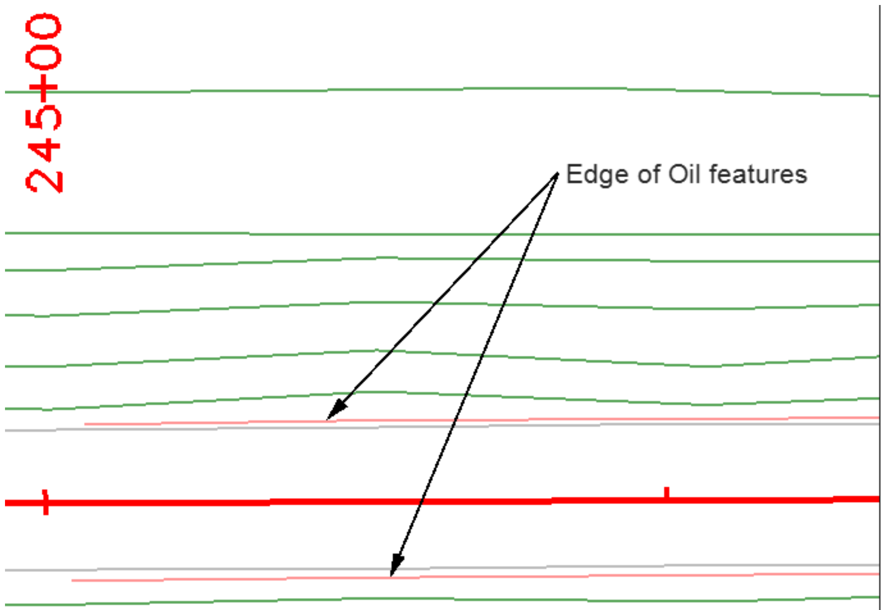


This completes the corridor definition. Now the corridor can be reviewed in Roadway Designer.

27. Scroll through the template drops using the station controls under the cross section view. Notice that the template top in the backbone of the template maintains a constant slope from the centerline to the edge of pavement.

28. Also notice that some areas did not appear to work properly. This is especially noticeable in the area between station 240+00 and 250+00. There are two causes for these anomalies. The first is the existence of additional features inside the Edge of Oil features used for point control alignments.

    The illustration below shows the area where other features are inside the edge of oil features.



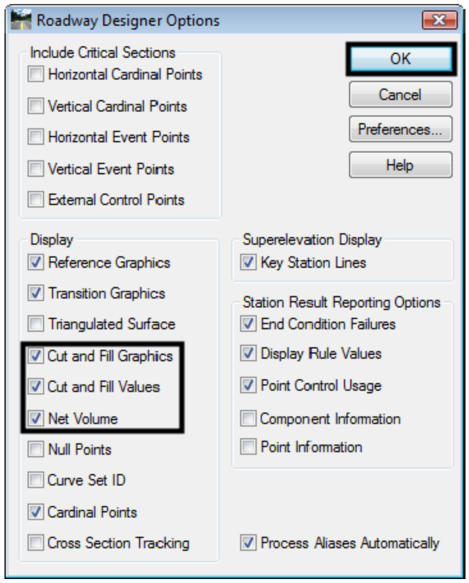
    In the example above the grey lines are pavement striping features.

    The other situation is similar and occurs where there were gaps in the edge of oil feature. Again features may occur inside where the lines were drawn to fill in these gaps.

29. From the Roadway Designer menu bar select **Tool > Options**.

30. In the ***Roadway Designer Options*** dialog box, toggle on **Cut and Fill Graphics**, **Cut and Fill Values**, and **Net Volumes**.

31. **<D> OK** to accept the changes and dismiss the dialog box.



32. Scroll through the template drops again.

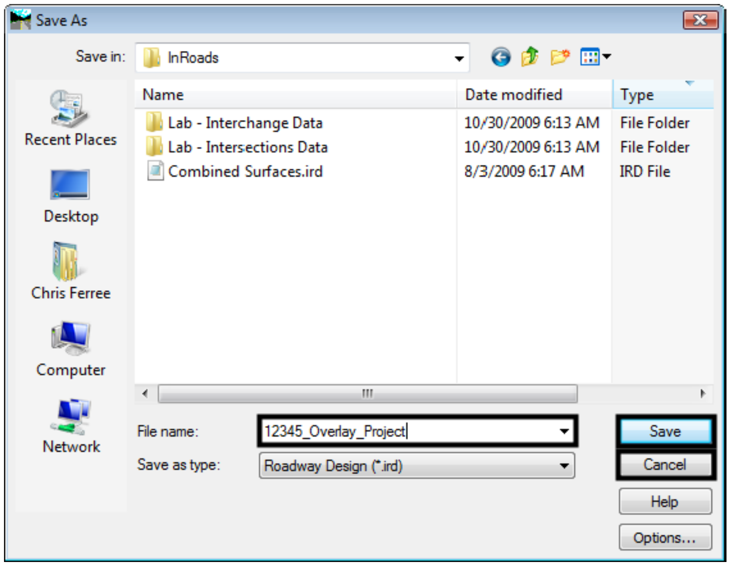
33. Notice the heavy blue line in the cross section display. This represents the design surface used to compute volumes.Under the overlay component, this line exactly matches the existing ground line. This is a result of the Project to Surface constraint defining each end of a segment. When a Project to Surface constraint is used on each end of a template segment the line between the points follows the target surface.

34. Also notice that there are no cut or fill areas in the overlay area.

35. From the Roadway Designer menu bar, select **File > Save**.

36. In the ***File name*** field of the ***Save As*** dialog box, key in ***12345_Overlay_Project***.

37. **<D> Save** then **<D> Cancel** to dismiss the dialog box.



38. **<D> Close** to dismiss the Roadway Designer dialog box.

39. Exit InRoads and MicroStation.

Section Summary:

- ♦ Point controls can be used to match the existing cross slope of the road.
- ♦ Displaying Cut and Fill graphics shows the design surface line used to compute volumes.

Chapter Summary:

- 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, Copy Parallel the edge of pavement chain the distance of the saw cut before importing the alignment. Also, in this case, the vertical alignment should be created separately, using the Vertical from Surface command.
- The Project to surface command is used to make a template segment match the existing ground.
- Because the point controls force the template to match the existing cross slope, superelevation is not used.
- With minor modification to the template and adjustments in point controls, the exercise can be use to rehabilitate existing cross slopes.

LAB 25 - 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-Lab.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

Lab 25.1 - Create Median Ditch Components

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.

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**

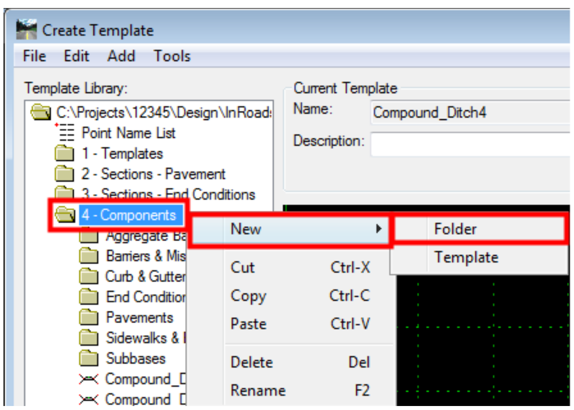
- **C:\Projects\12345\Design\InRoads\12345DES_Templates_Median-Ditch.itl**
- **C:\Projects\12345\Design\InRoads\12345DES_Median-Ditch.ird**
- **C:\Projects\12345\Design\InRoads\12345DES_Northbound.dtm**

3. Verify that the **C:\Workspace\Workspace-CDOT_XM\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.

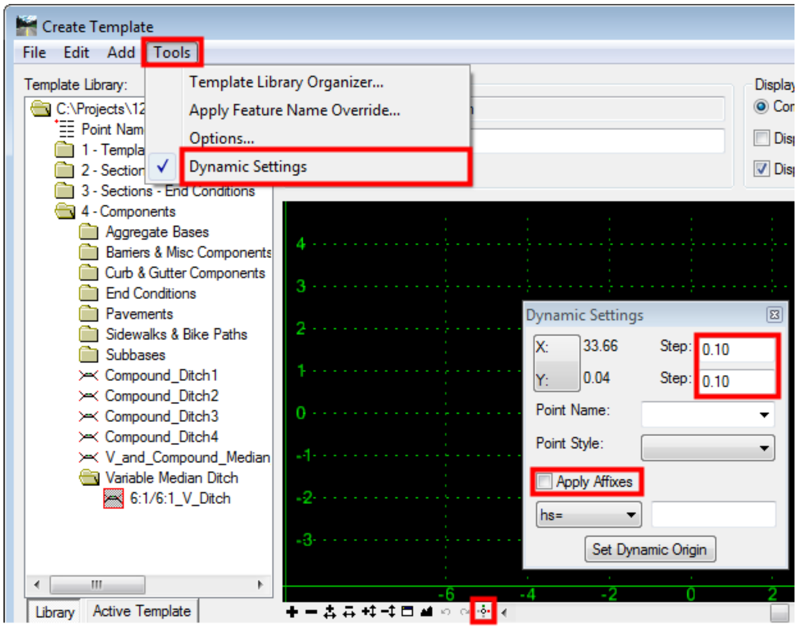
8. **<R>** on the **Variable Median Ditch** folder and select **New > Template** from the right click menu.

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.

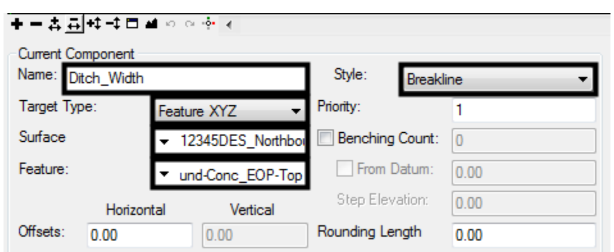
14. In the ***Current Component*** area, key in ***Ditch_ Width*** for the ***Name***.

15. Set the ***Style*** to **Breakline**.

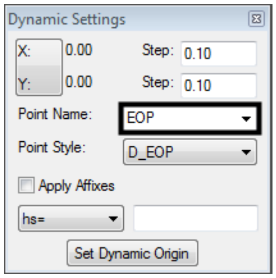
16. Set the ***Target Type*** to **Feature XYZ**.

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***.



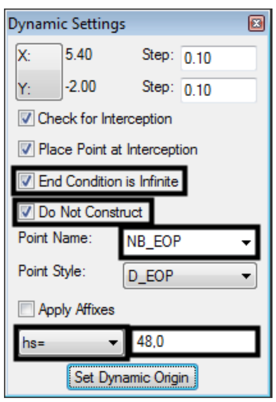
20. Move the cursor to the template origin (0.00,0.00) and **<D>** to place the point.

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***.



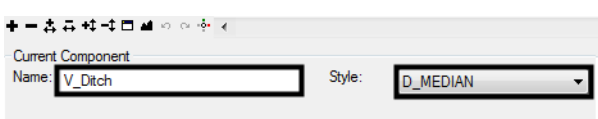
25. **<R>** and select **Finish** from the right click menu.

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***.

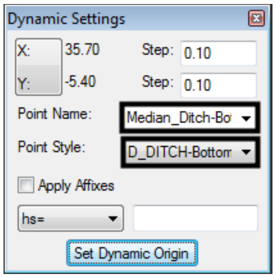
28. Set the ***Style*** to **D_Median**.



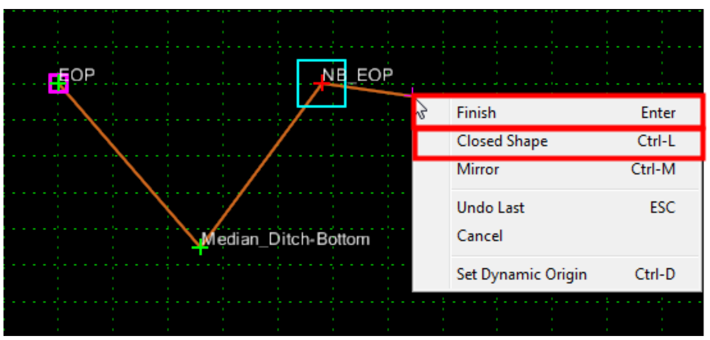
29. **<D>** on the **EOP** point to start the component at the origin.

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***.

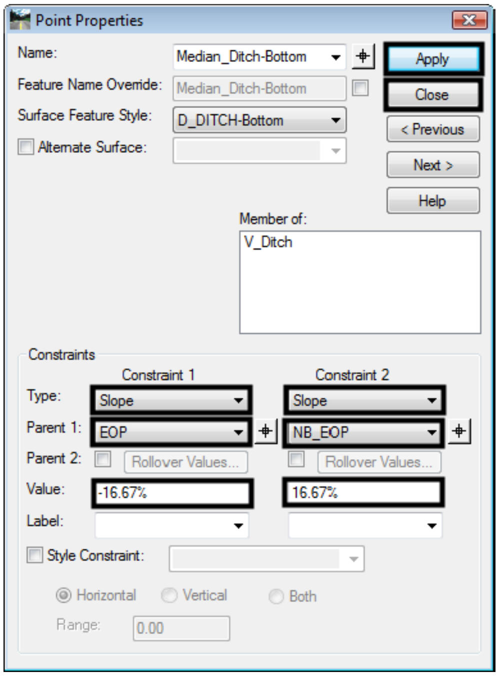


32. **<D>** between and below the ***EOP*** and ***NB_EOP*** points.
33. **<D>** on the **NB_EOP** point.
34. **<R>** in an open area. Verify that **Closed Shape** is toggled off, then select **Finish**.



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***.

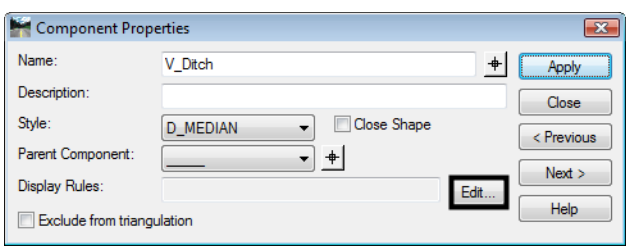
41. **<D> Apply** then **<D> Close** to dismiss the ***Point Properties*** dialog box.



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***.

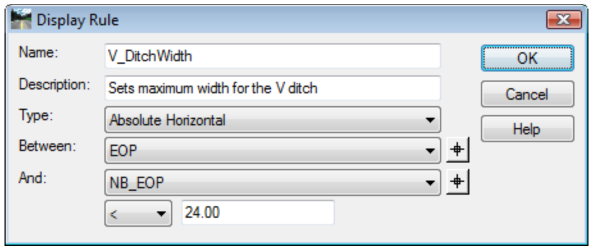
46. Key in ***Sets maximum width for the V ditch*** for the ***Description***.

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:

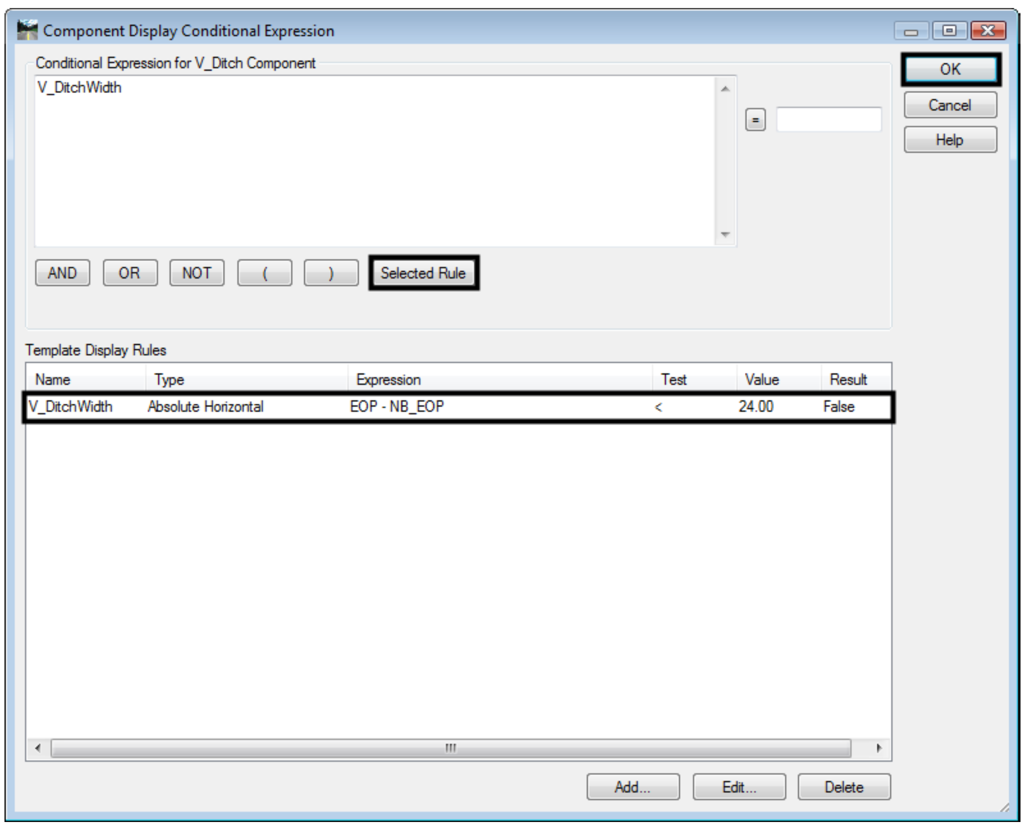


51. **<D> OK**. This dismisses the ***Display Rule*** dialog box.

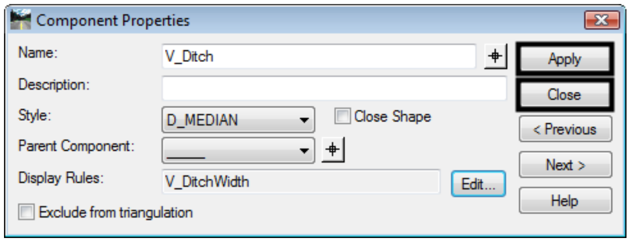
52. In the ***Component Display Conditional Expression*** dialog box, highlight **V_DitchWidth** in the ***Template Display Rules*** area.

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.

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.

61. Create a new template in the ***Variable Median Ditch*** folder as described in steps 6 through 9 above. Name the template ***Standard Compound Ditch***.

62. **<R>** in the template view and select **Add New Component > End Condition** from the right click menu.

63. In the ***Current Component*** area, key in ***Ditch_ Width*** for the ***Name***.

64. Set the ***Style*** to **Breakline**.

65. Set the ***Target Type*** to **Feature XYZ**.

66. Set the ***Surface*** to **12345DES_Northbound**.

67. Set the ***Feature*** to **Northbound-Conc_EOP-Top**.

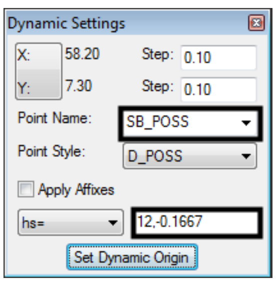
68. In the ***Dynamic Settings*** dialog box, select **EOP** for the ***Point Name***.

69. Move the cursor to the template origin (0.00,0.00) and **<D>** to place the point.

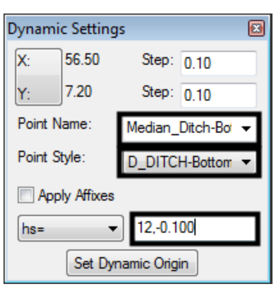
70. In the ***Dynamic Settings*** dialog box, key in ***NB_EOP*** for the ***Point Name***.

71. Toggle on **End Condition is Infinite** and **Do Not Construct**.

72. Set the key in mode to **hs=**.
73. Key in ***48,0*** in the precision key in field and press ***Enter***.
74. **<R>** and select **Finish** from the right click menu.
75. **<R>** in the template view and select **Add New Component > Unconstrained** from the right click menu.
76. In the ***Current Component*** area, key in ***Std_Compound_Ditch*** for the ***Name***.
77. 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
78. **<D>** on the **EOP** point to start the component at the origin.
79. 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.
80. In the precision key in field, type ***12,-0.1667*** and press ***Enter***.

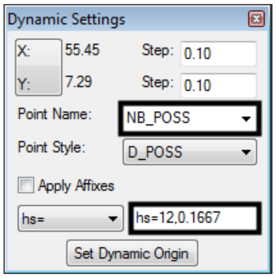


81. In the ***Dynamic Settings*** dialog box, key in ***Median_Ditch-Bottom*** in the ***Point Name*** field.
82. Select **D_DITCH-Bottom** for the ***Point Style***.
83. In the precision key in field, type ***12,-0.100*** and press ***Enter***.



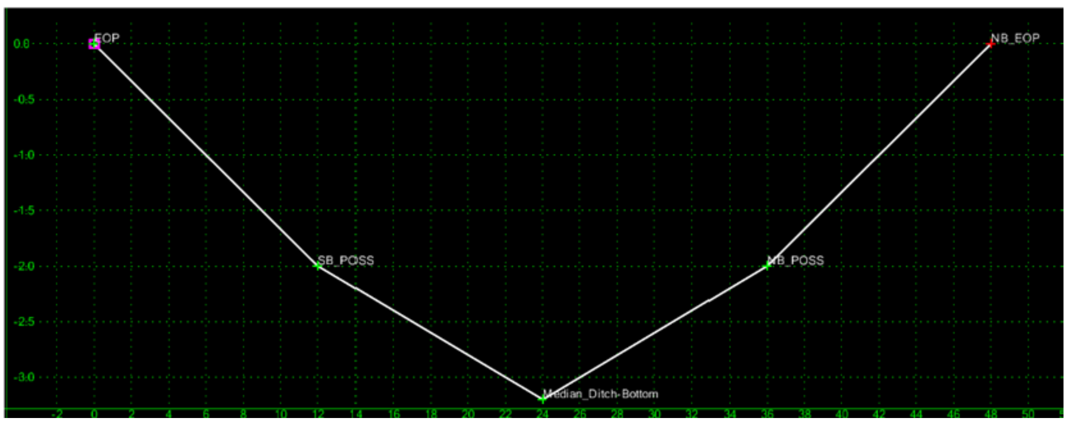
84. In the ***Dynamic Settings*** dialog box, select **POSS** for the ***Point Name***. Then key in ***NB_POSS*** for the ***Point Name***.

85. In the precision key in field, type ***12,0.100*** and press ***Enter***.



86. **<D>** on the **NB_EOP** point.

87. **<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.

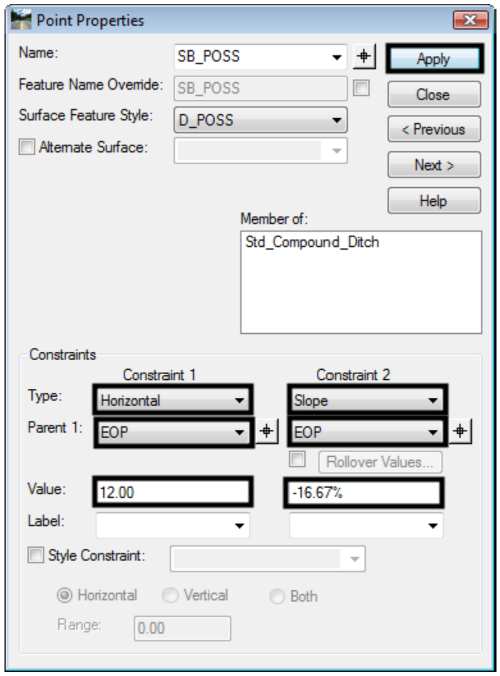
88. **<D> <D>** on the **SB_POSS** point.

89. In the ***Point Properties*** dialog box, set the ***Constraint 1 Type*** to **Horizontal**.

90. Set the ***Constraint 2 Type*** to **Slope**.

91. Set the ***Parent 1*** for both constraints to **EOP**.

92. **<D> Apply**.



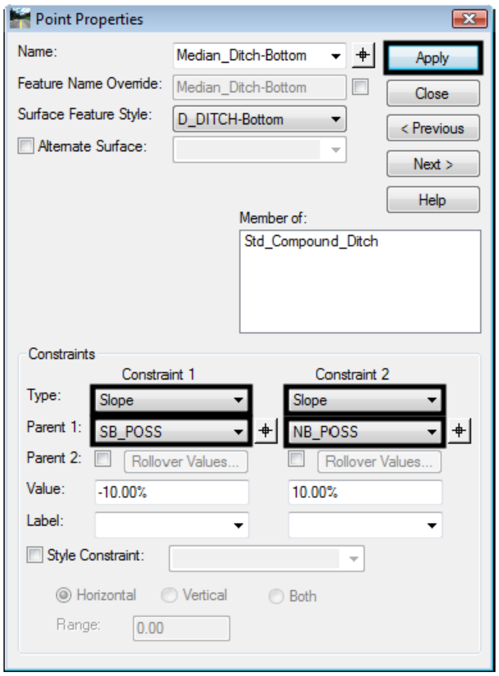
93. **<D>** the **Next** button to select **Median_Ditch-Bottom**.

94. Set the ***Type*** of both constraints to **Slope**.

95. Set the ***Parent 1*** of ***Constraint 1*** to **SB_POSS**.

96. Set the ***Parent 1*** of ***Constraint 2*** to **NB_POSS**.

97. **<D> Apply**.



98. **<D>** the **Next** button to select **NB_POSS**.

99. Set the ***Constraint 1 Type*** to **Horizontal**.

100. Set the ***Constraint 2 Type*** to **Slope**.

101. Set the ***Parent 1*** for both constraints to **NB_EOP**.

102. **<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.

103. **<D> <D>** on the line forming the ditch to display the ***Component Properties*** for the ***Std_Compound_Ditch*** component.

104. In the ***Component Properties*** dialog box, **<D>** the **Edit** button. This displays the ***Component Display Conditional Expression*** dialog box.

105. In the ***Component Display Conditional Expression*** dialog box, **<D>** the **Add** button. This displays the ***Display Rule*** dialog box.

106. In the ***Display Rule*** dialog box, key in ***Std_Compound_DitchWidth*** for the ***Name***.

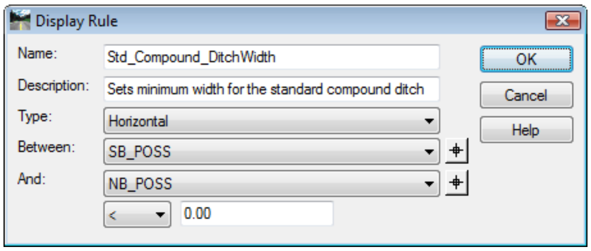
107. Key in ***Sets minimum width for the standard compound ditch*** for the ***Description***.

108. Set the ***Type*** to **Horizontal**.

109.Set ***Between*** to **SB_POSS**.

110.Set ***And*** to **NB_POSS**.

111.Set the operator to **<** and key in ***0.00*** for the value. The dialog box with completed entries is illustrated below:



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

113.In the ***Component Display Conditional Expression*** dialog box, **<D>** the **Add** button.

114.In the ***Display Rule*** dialog box, key in ***Std_Compound_DitchVertical1*** for the ***Name***.

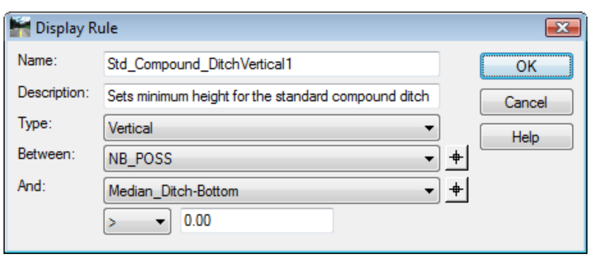
115.Key in ***Sets minimum height for the standard compound ditch*** for the ***Description***.

116.Set the ***Type*** to **Vertical**.

117.Set ***Between*** to **NB_POSS**.

118.Set ***And*** to **Median_Ditch-Bottom.**

119.Set the operator to **<** and key in ***0.00*** for the value. The dialog box with completed entries is illustrated below:



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

121.In the ***Component Display Conditional Expression*** dialog box, **<D>** the **Add** button.

122.In the ***Display Rule*** dialog box, key in ***Std_Compound_DitchVertical2*** for the ***Name***.

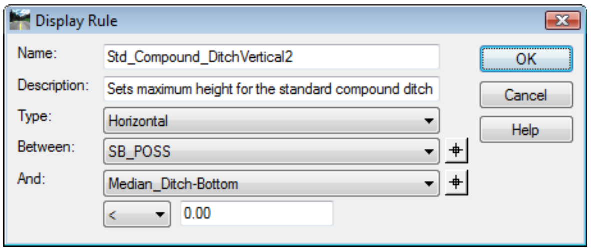
123.Key in ***Sets maximum height for the standard compound ditch*** for the ***Description***.

124.Set the ***Type*** to **Horizontal**.

125.Set ***Between*** to **SB_POSS**.

126.Set ***And*** to **Median_Ditch-Bottom.**

127.Set the operator to **<** and key in ***0.00*** for the value. The dialog box with completed entries is illustrated below:



128.**<D> OK** to accept the entries and dismiss the dialog box.

129.In the ***Component Display Conditional Expression*** dialog box, highlight **Std_Compound_DitchWidth** in the ***Template Display Rules*** area.

130. **<D>** the **Selected Rule** button.

131.**<D>** the **AND** button.

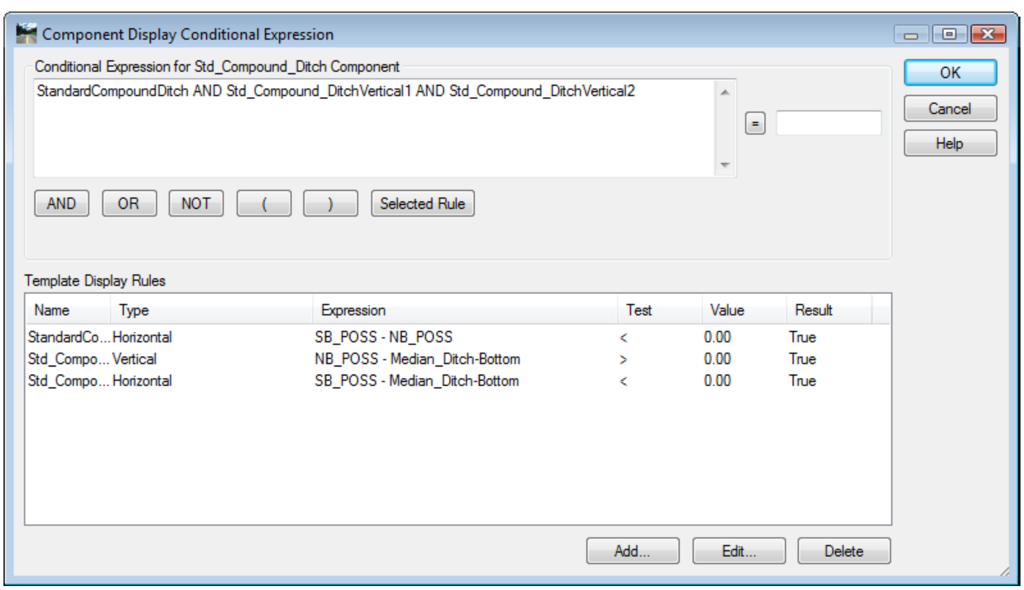
132.Highlight **Std_Compound_DitchVertical1** in the ***Template Display Rules*** area.

133.**<D>** the **Selected Rule** button.

134.**<D>** the **AND** button.

135.Highlight **Std_Compound_DitchVertical2** in the ***Template Display Rules*** area.

136.**<D>** the **Selected Rule** button. The dialog box with completed entries is illustrated below:



137.**<D> OK**. This dismisses the ***Component Display Conditional Expression*** dialog box and adds the rule to the component properties of ***Std_Compound_Ditch***.

138.**<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.

139.**<D>** the **Test** button.

140.In the ***Test End Conditions*** dialog box, **<D>** the **Draw** button.

141.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.

142.**<D> Close** to dismiss the ***Test End Conditions*** dialog box.

143.Select **File > Save** from the ***Create Template*** menu bar.

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.

144.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***.

145.**<R>** in the template view and select **Add New Component > End Condition** from the right click menu.

146.In the ***Current Component*** area, key in ***Ditch_ Width*** for the ***Name***.

147.Set the ***Style*** to **Breakline**.

148.Set the ***Target Type*** to **Feature XYZ**.

149.Set the ***Surface*** to **12345DES_Northbound**.

150.Set the ***Feature*** to **Northbound-Conc_EOP-Top**.

151.In the ***Dynamic Settings*** dialog box, select **EOP** for the ***Point Name***.

152.Move the cursor to the template origin (0.00,0.00) and **<D>** to place the point.

153.In the ***Dynamic Settings*** dialog box, key in ***NB_EOP*** for the ***Point Name***.

154.Toggle on **End Condition is Infinite** and **Do Not Construct**.

155.Set the key in mode to **hs=**.

156.Key in ***48,0*** in the precision key in field and press ***Enter***.

157.**<R>** and select **Finish** from the right click menu.

158.Add a new unconstrained component.

159.Key in ***NB_EOP-High*** for the ***Name***.

160.Select **D_CONC_Sw** for the ***Style***.

161.**<D>** on the **EOP** point to start the component at the origin.

162.In the ***Dynamic Settings*** dialog box, key in ***Median_Ditch-Bottom*** in the ***Point Name*** field.

163.Select **D_DITCH-Bottom** for the ***Point Style***.

164.**<D>** between and below the ***EOP*** and ***NB_EOP*** points.

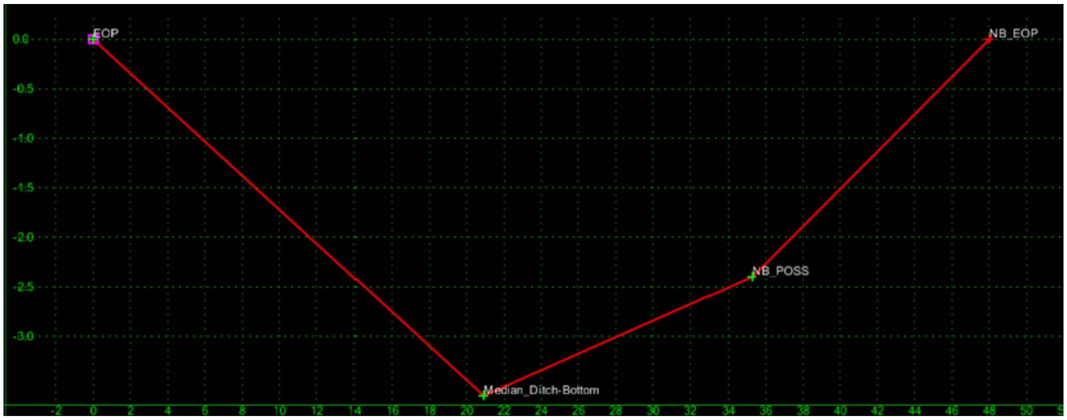
165.In the ***Dynamic Settings*** dialog box, key in ***NB_POSS*** in the ***Point Name*** field.

166.Select **D_POSS** for the ***Point Style***.

167.**<D>** to the right and above ***Median_Ditch-Bottom*** and to the left and below ***NB_EOP***.

168.**<D>** on the **NB_EOP** point.

169.**<R>** and select **Finish** from the right click menu. The illustration below shows the component as it appears at this point.



170.**<D> <D>** on the **Median_Ditch-Bottom** point.

171.In the ***Point Properties*** dialog box, set the ***Type*** to **Slope** on both constraints.

172.Set the ***Parent 1*** for ***Constraint 1*** to **EOP**.

173.Set the ***Parent 1*** for ***Constraint 2*** to **NB_POSS**.

174.Key in the ***-0.1667*** for the ***Value*** of ***Constraint 1***.

175.Key in the ***0.1000*** for the ***Value*** of ***Constraint 2***.

176.**<D> Apply**.

177.**<D> Next** to select the **NB_POSS** point.

178.Set the ***Constraint 1 Type*** to **Horizontal**.

179.Set the ***Constraint 2 Type*** to **Slope**.

180.Set the ***Parent 1*** for both constraints to **NB_EOP**.

181. Key in the ***12.00*** for the ***Value*** of ***Constraint 1***.

182. Key in the ***0.1667*** for the ***Value*** of ***Constraint 2***.

183. **<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.

184. **<D> <D>** on the line forming the ditch to display the ***Component Properties*** for the ***NB_EOP_HIGH*** component.

185. In the ***Component Properties*** dialog box, **<D>** the **Edit** button. This displays the ***Component Display Conditional Expression*** dialog box.

186. In the ***Component Display Conditional Expression*** dialog box, **<D>** the **Add** button. This displays the ***Display Rule*** dialog box.

187. In the ***Display Rule*** dialog box, key in ***NB_EOP_HIGHWidth*** for the ***Name***.

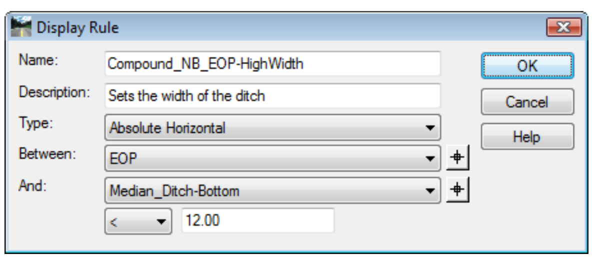
188. Key in ***Sets width for ditch*** for the ***Description***.

189. Set the ***Type*** to **Absolute Horizontal**.

190. Set ***Between*** to **EOP**.

191. Set ***And*** to **Median_Ditch-Bottom**.

192. Set the operator to **<** and key in ***12.00*** for the value. The dialog box with completed entries is illustrated below:



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

194. In the ***Component Display Conditional Expression*** dialog box, **<D>** the **Add** button.

195. In the ***Display Rule*** dialog box, key in ***NB_EOP_HIGHVertical*** for the ***Name***.

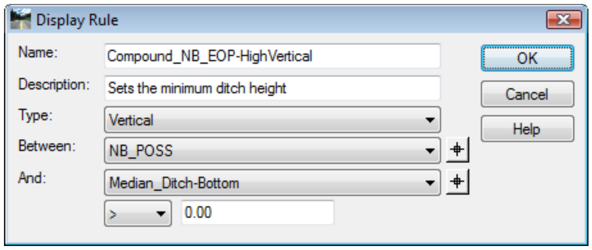
196. Key in ***Sets height for the ditch*** for the ***Description***.

197. Set the ***Type*** to **Vertical**.

198. Set ***Between*** to **NB_POSS**.

199. Set ***And*** to **Median_Ditch-Bottom.**

200.Set the operator to **<** and key in ***0.00*** for the value. The dialog box with completed entries is illustrated below:



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

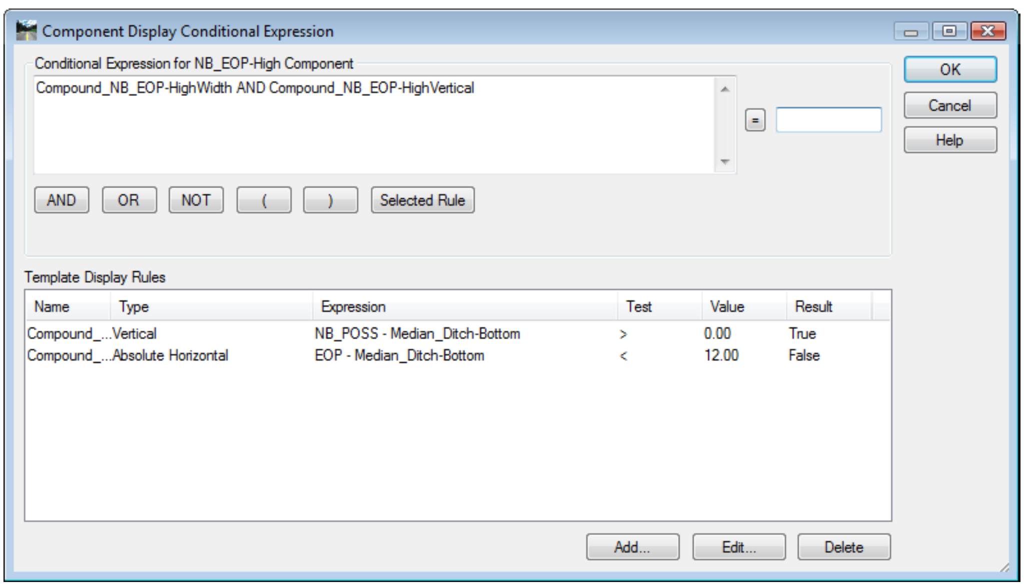
202.In the ***Component Display Conditional Expression*** dialog box, highlight **NB_EOP_HIGHWidth** in the ***Template Display Rules*** area.

203. **<D>** the **Selected Rule** button.

204.**<D>** the **AND** button.

205.Highlight **NB_EOP_HIGHVertical** in the ***Template Display Rules*** area.

206.**<D>** the **Selected Rule** button. The dialog box with completed entries is illustrated below:



207.**<D> OK**. This dismisses the ***Component Display Conditional Expression*** dialog box and adds the rule to the component properties of ***NB_EOP High***.

208.**<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. Next the final component is built.

209. 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***.

210. **<R>** in the template view and select **Add New Component > End Condition** from the right click menu.

211. In the ***Current Component*** area, key in ***Ditch_ Width*** for the ***Name***.

212. Set the ***Style*** to **Breakline**.

213. Set the ***Target Type*** to **Feature XYZ**.

214. Set the ***Surface*** to **12345DES_Northbound**.

215. Set the ***Feature*** to **Northbound-Conc_EOP-Top**.

216. In the ***Dynamic Settings*** dialog box, select **EOP** for the ***Point Name***.

217. Move the cursor to the template origin (0.00,0.00) and **<D>** to place the point.

218. In the ***Dynamic Settings*** dialog box, key in ***NB_EOP*** for the ***Point Name***.

219. Toggle on **End Condition is Infinite** and **Do Not Construct**.

220. Set the key in mode to **hs=**.

221. Key in ***48,0*** in the precision key in field and press ***Enter***.

222. **<R>** and select **Finish** from the right click menu.

223. Add a new unconstrained component.

224. Key in ***SB_EOP-High*** for the ***Name***.

225. Select **D_Shoulder** for the ***Style***.

226. **<D>** on the **EOP** point to start the component at the origin.

227. In the ***Dynamic Settings*** dialog box, key in ***SB_POSS*** in the ***Point Name*** field.

228. Select **D_POSS** for the ***Point Style***.

229. **<D>** between and below the ***EOP*** and ***NB_EOP*** points.

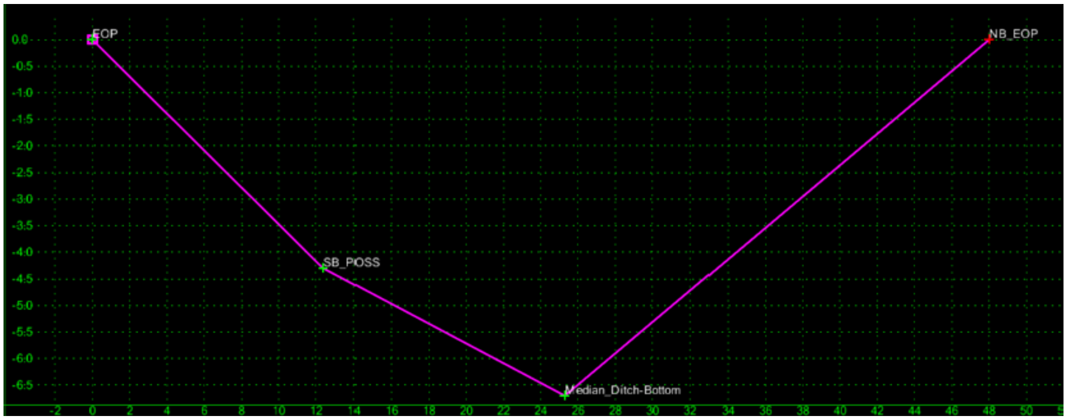
230. In the ***Dynamic Settings*** dialog box, key in ***Median_Ditch-Bottom*** in the ***Point Name*** field.

231. Select **D_DITCH-Bottom** for the ***Point Style***.

232. **<D>** between and below the ***SB_POSS*** and ***NB_EOP*** points.

233. **<D>** on the **NB_EOP** point.

234.**<R>** and select **Finish** from the right click menu. The illustration below shows the component as it appears at this point.



235.**<D> <D>** the **SB_POSS** point.

236.Set the ***Constraint 1 Type*** to **Horizontal**.

237.Set the ***Constraint 2 Type*** to **Slope**.

238.Set the ***Parent 1*** for both constraints to **EOP**.

239.Key in the ***12.00*** for the ***Value*** of ***Constraint 1***.

240.Key in the -***0.1667*** for the ***Value*** of ***Constraint 2***.

241.**<D> Apply** to accept the changes.

242.**<D> Next** to select the **Median_Ditch-Bottom** point.

243.In the ***Point Properties*** dialog box, set the ***Type*** to **Slope** on both constraints.

244.Set the ***Parent 1*** for ***Constraint 1*** to **SB_POSS**.

245.Set the ***Parent 1*** for ***Constraint 2*** to **NB_EOP**.

246.Key in the ***-0.1000*** for the ***Value*** of ***Constraint 1***.

247.Key in the ***0.1667*** for the ***Value*** of ***Constraint 2***.

248.**<D> Apply**.

The shape of the ditch is now fixed. Now display Rules must be added to control when this component is displayed.

249.**<D> <D>** on the line forming the ditch to display the ***Component Properties*** for the ***SB_EOP-High*** component.

250.In the ***Component Properties*** dialog box, **<D>** the **Edit** button. This displays the ***Component Display Conditional Expression*** dialog box.

251.In the ***Component Display Conditional Expression*** dialog box, **<D>** the **Add** button. This displays the ***Display Rule*** dialog box.

252.In the ***Display Rule*** dialog box, key in ***SB_EOP_HIGHWidth-Max*** for the ***Name***.

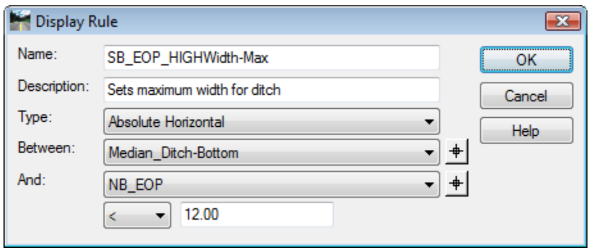
253.Key in ***Sets maximum width for ditch*** for the ***Description***.

254.Set the ***Type*** to **Absolute Horizontal**.

255.Set ***Between*** to **Median_Ditch-Bottom**.

256.Set ***And*** to **NB_EOP**.

257.Set the operator to **<** and key in ***12.00*** for the value. The dialog box with completed entries is illustrated below:



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

259.In the ***Component Display Conditional Expression*** dialog box, **<D>** the **Add** button.

260.In the ***Display Rule*** dialog box, key in ***SB_EOP_HIGHWidth-Min*** for the ***Name***.

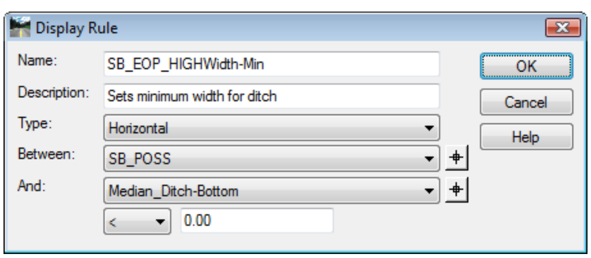
261.Key in ***Sets minimum width for ditch*** for the ***Description***.

262.Set the ***Type*** to **Horizontal**.

263.Set ***Between*** to **SB_POSS**.

264.Set ***And*** to **Median_Ditch-Bottom**.

265.Set the operator to **<** and key in ***0.00*** for the value. The dialog box with completed entries is illustrated below:



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

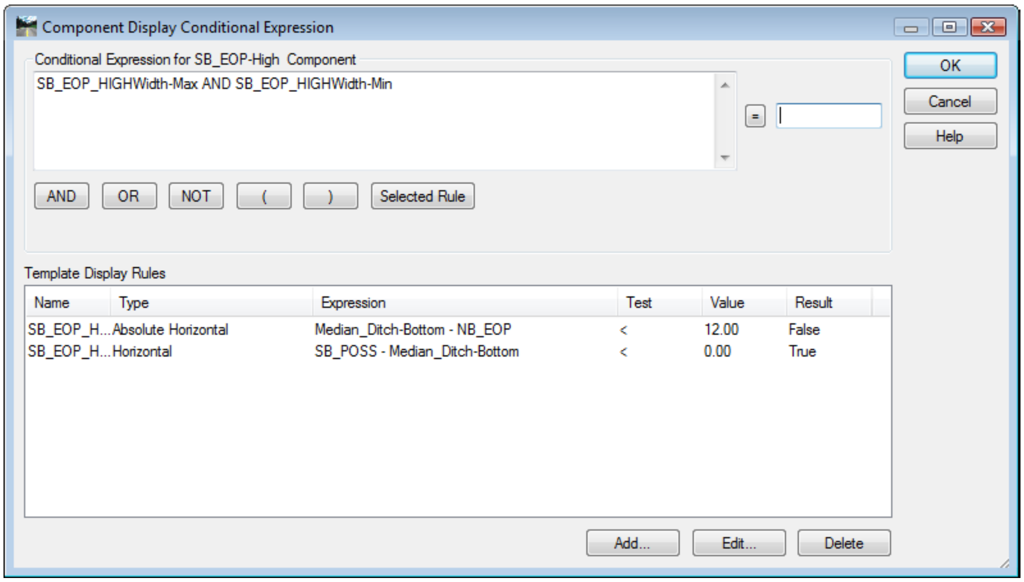
267.In the ***Component Display Conditional Expression*** dialog box, highlight **SB_EOP_HIGHWidth-Max** in the ***Template Display Rules*** area.

268. **<D>** the **Selected Rule** button.

269.**<D>** the **AND** button.

270.Highlight **SB_EOP_HIGHWidth-Min** in the ***Template Display Rules*** area.

271.**<D>** the **Selected Rule** button. The dialog box with completed entries is illustrated below:



272.**<D> OK**. This dismisses the ***Component Display Conditional Expression*** dialog box and adds the rule to the component properties of ***SB_EOP High***.

273.**<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 25.2 - 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.

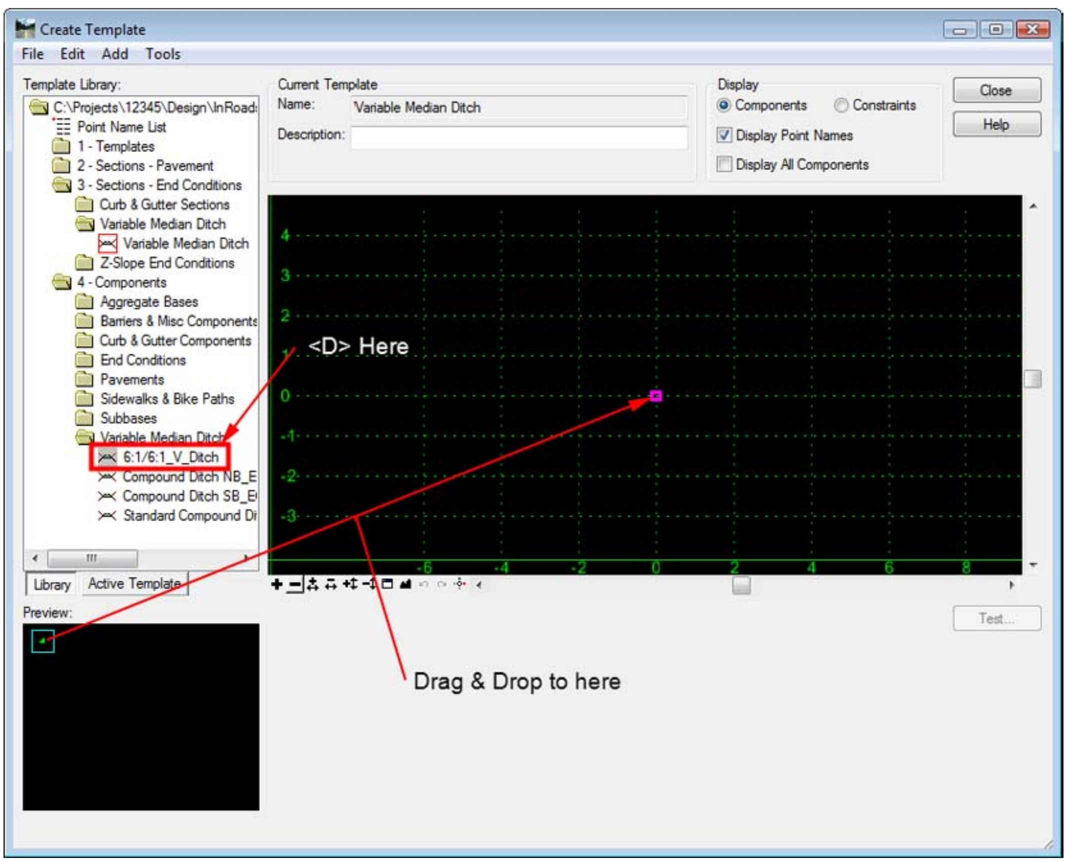
- Delete the redundant end condition components.
- Add additional display rules so that only one component is displayed at a time.

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.



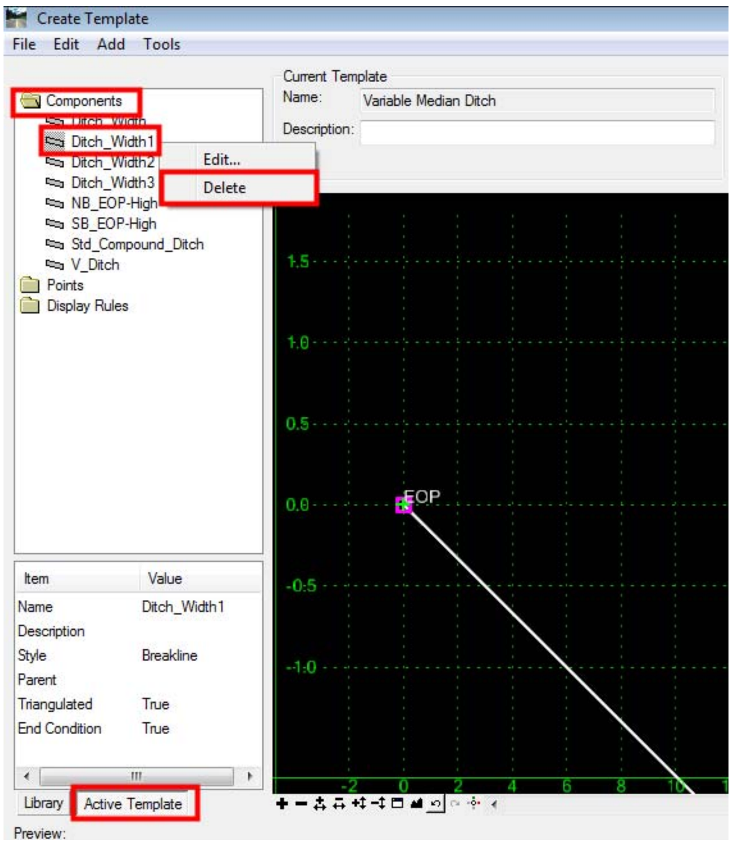
8. Repeat steps 6 and 7 with the **Compound Ditch NB_EOP High**, **Compound Ditch NB_EOP High**, and **Standard Compound Ditch**.

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.

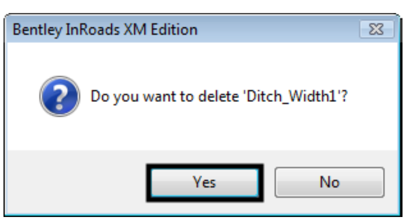
9. **<D>** the **Active Template** tab at the bottom of the Template Library tree view.

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.



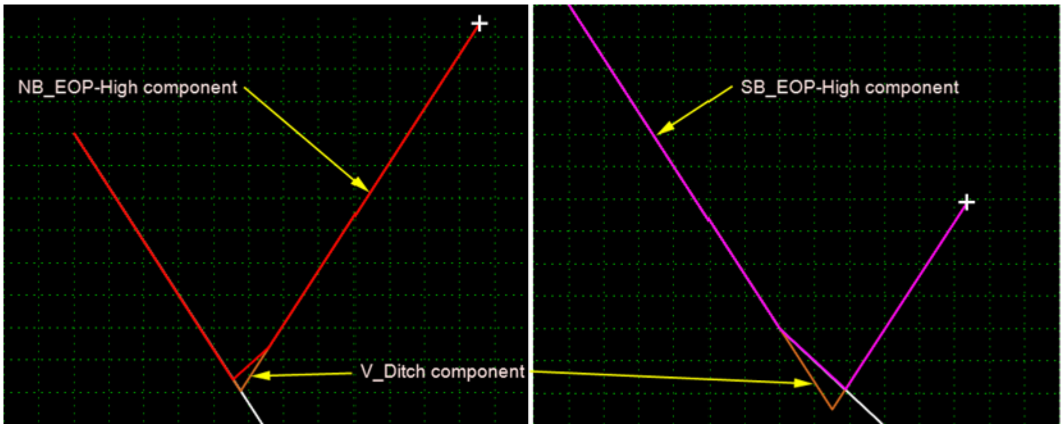
13. Repeat steps 10 through 12 for **Ditch_Width2** and **Ditch_Width3**.

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.

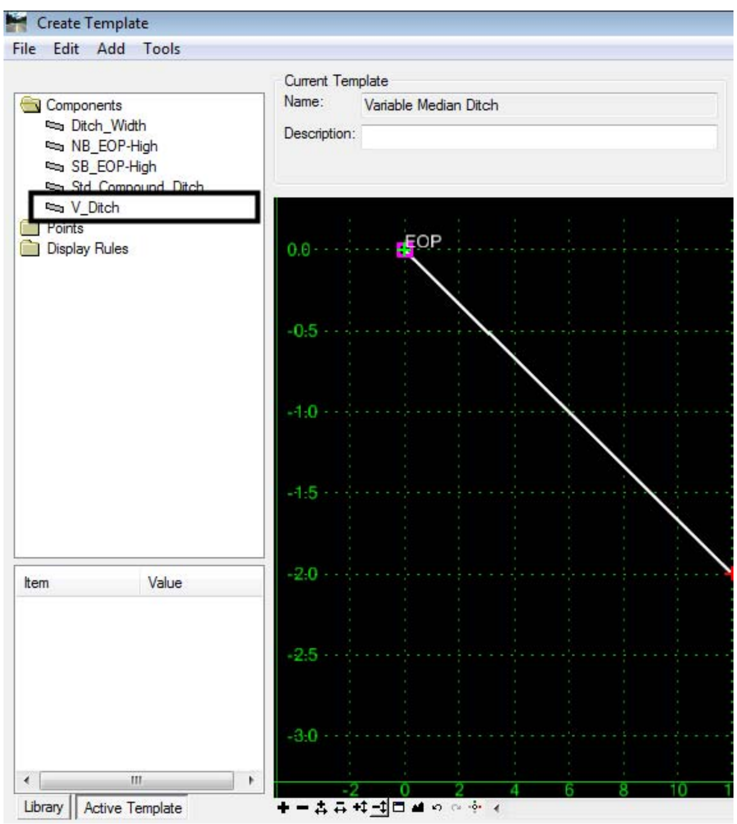
16. Move the cursor around slowly in the view area. Notice that there are two instances when two components are displayed at the same time. These occur when the horizontal distance between the EOP and NB_EOP is less than 24' and there is an elevation difference between the points.



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.

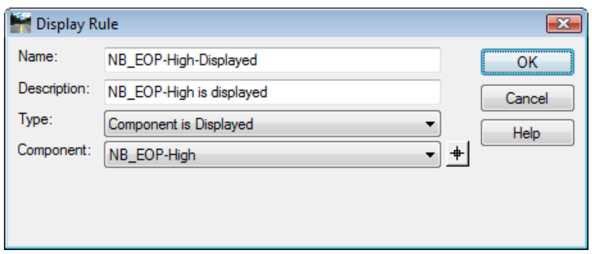
20. In the ***Component Display Conditional Expression*** dialog box, **<D>** the **Add** button to display the ***Display Rule*** dialog box.

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.

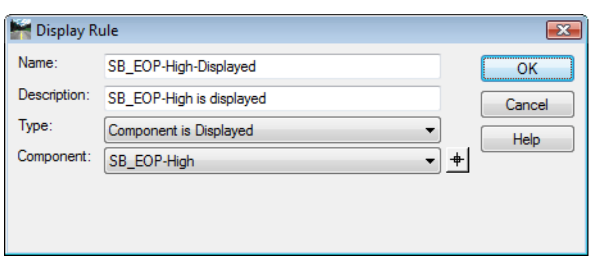
26. In the ***Component Display Conditional Expression*** dialog box, **<D>** the **Add** button to display the ***Display Rule*** dialog box.

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***.

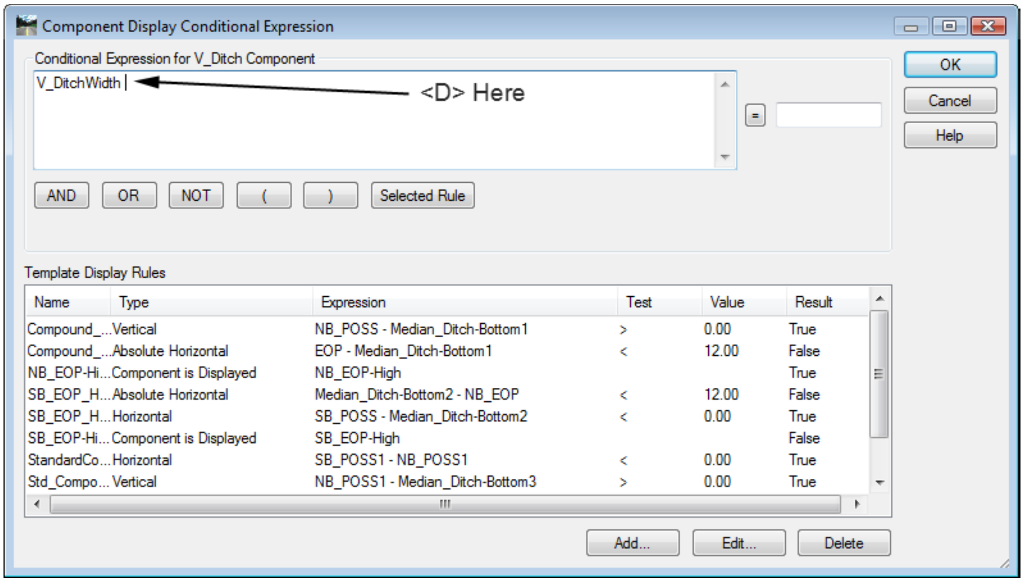
29. Set the ***Type*** to **Component is Displayed**.

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.

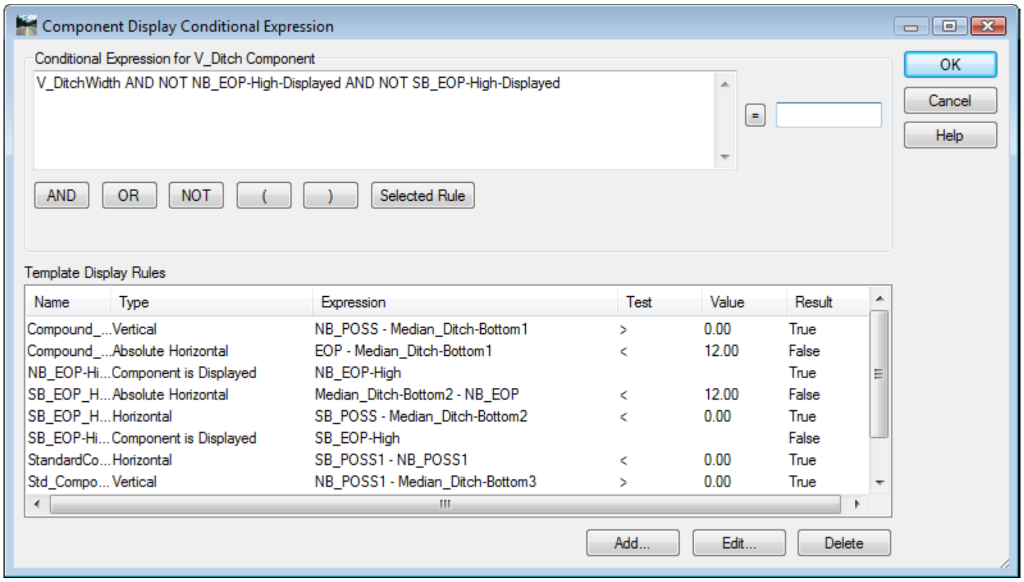
36. **<D>** the Selected Rule button.

37. **<D>** the **AND** button.

38. **<D>** the **NOT** button.

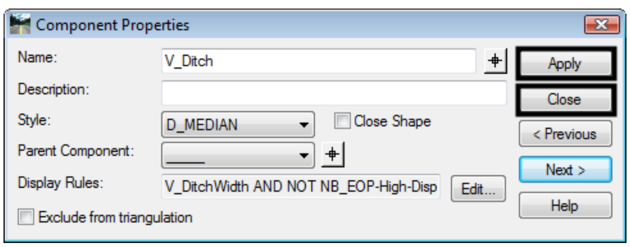
39. Highlight the **SB_EOP-High-Displayed rule** in the ***Template Display Rules*** list.

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.

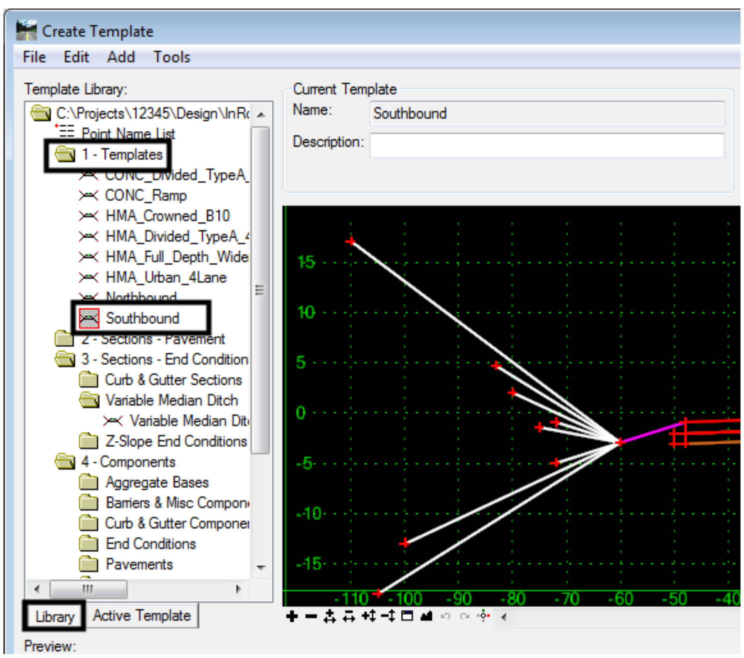
Lab 25.3 - Adding the Section to a Template and Reviewing the Corridor

The variable median ditch section can now be added to the template and used in the design corridor.

Section Objectives:

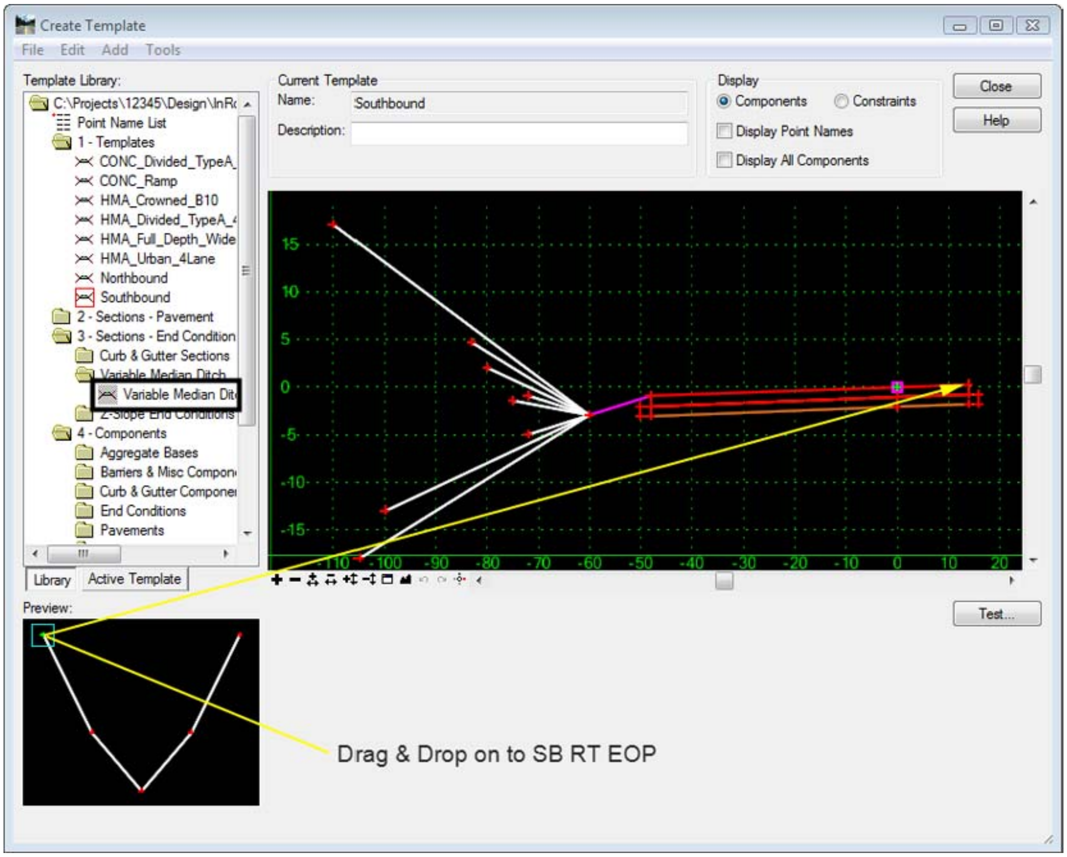
- Add the variable median ditch to the southbound backbone template.
- Update the corridor to use the modified template.
- Examine the results in the Roadway Designer dialog box.

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 area.
5. In the Preview area, **<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.

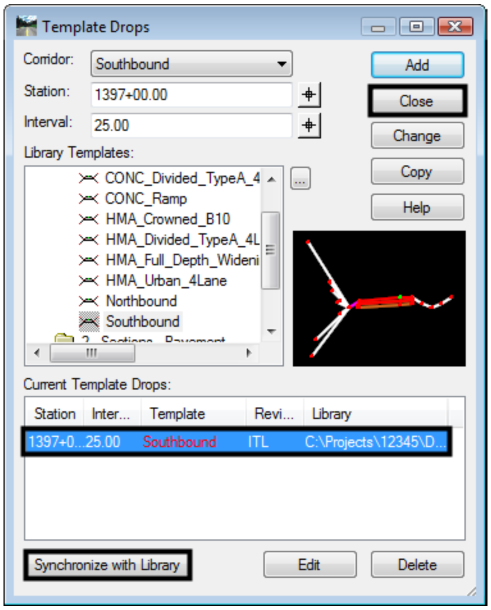
10. In the ***Roadway Designer*** dialog box, verify that the Southbound corridor is active.

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 26 - 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.

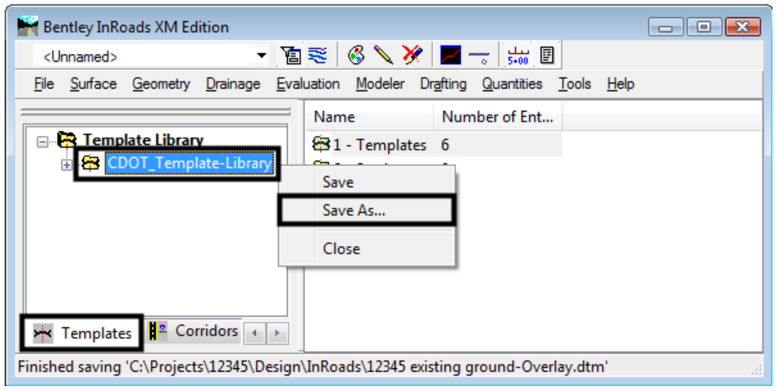
Lab 26.1 - Add an Existing Wall Component to a Template

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.

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.

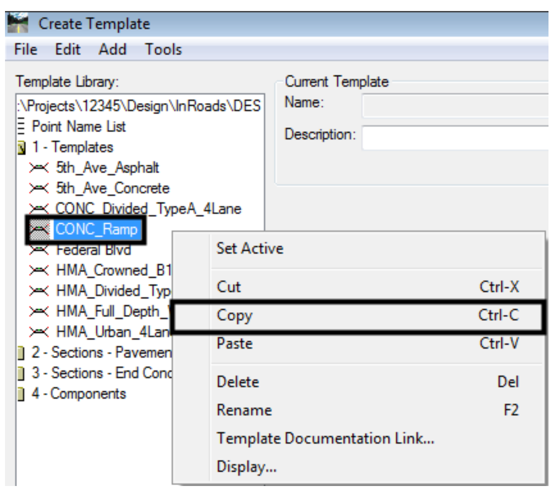
4. In the ***File name*** field, key in ***DES12345_ Walls-Lab***.

5. **<D> Save** then **<D> Cancel**.

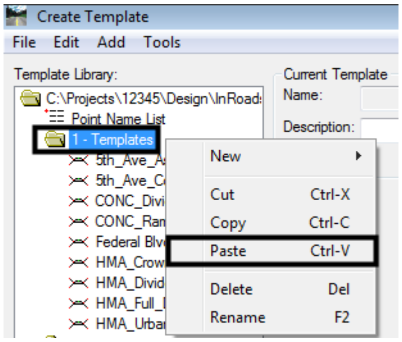
6. From the InRoads menu bar, select **Modeler > Create Template**.

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 **CONC_Ramp** template and select **Copy** from the right click menu.



9. **<R>** on the **1 - Templates** folder and select **Paste** from the right click menu. This creates the ***CONC_Ramp1*** template.



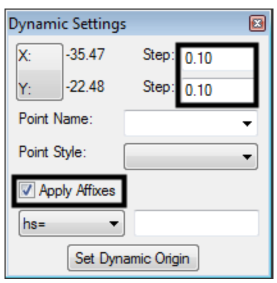
10. **<R>** on the **CONC_Ramp1** template and select **Rename** from the right click menu.

11. Key in ***CONC_Ramp_with_Walls*** for the name.

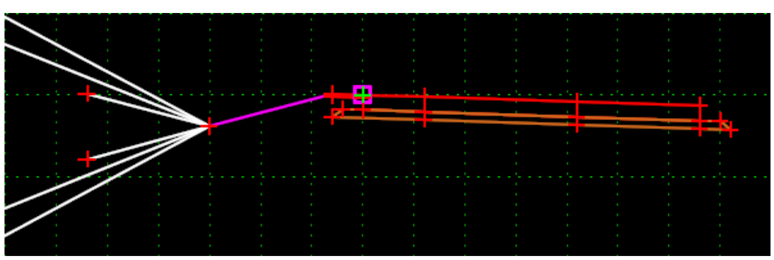
12. **<D> <D>** on the **CONC_Ramp_with_Walls** template to make it active. Display the ***Dynamic Settings*** dialog box.

13. In the ***Dynamic Settings*** dialog box, set the ***Steps*** to ***0.10***.

14. Toggle on **Apply Affixes**.



15. Delete the POSS and end condition components from the right side of the template. The illustration below show the template with the components deleted.



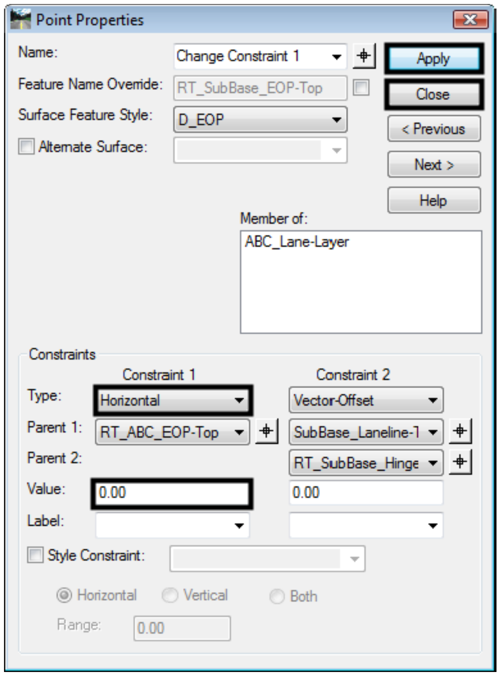
Next, the RT_SubBase_EOP-Top point is moved to line up under the RT_ABC_EOP-Top point. This is so that it will not overlay into the wall base.

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

17. Change the ***Constraint 1 Type*** from ***Slope*** to **Horizontal**.

18. Key in ***0.00*** for the ***Value***.

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



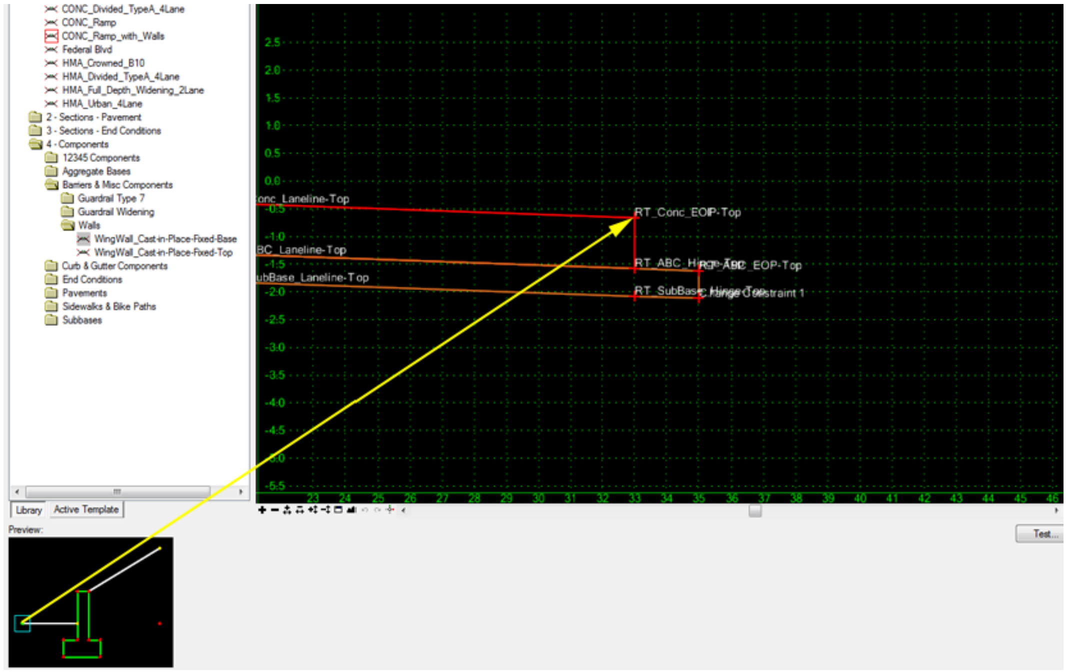
Now the wall component can be added to the template.

20. 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.

21. **<D>** on the **WingWall_Cast-in-Place-Fixed-Base** component to display it in the ***Preview*** window.

22. **<D> and hold** on the wall component's origin (the far left point).

23. **Drag and drop** it onto the ***RT_Conc_EOP-Top*** point.

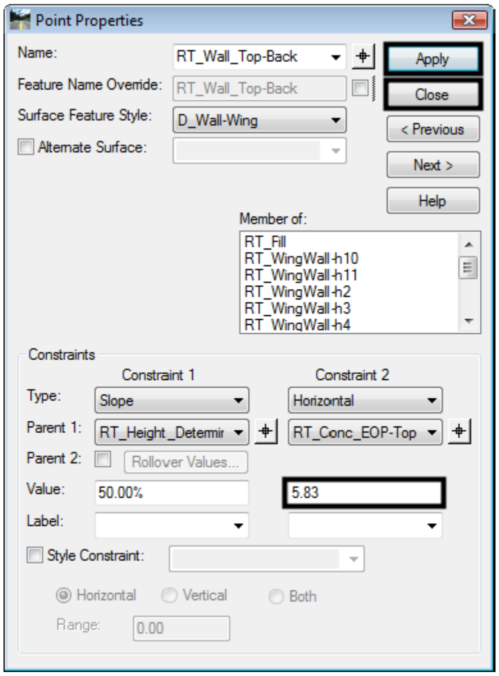


Currently, the wall is set 4 feet from the pavement edge. If the wall is extended to its full height, the footer of the wall will expand into the ABC material of the ramp. To correct this problem, the wall is moved 1 foot to the right.

24. **<D> <D>** on the **RT_Wall_Top-Back** point to display the Point Properties dialog box.

25. In the ***Point Properties*** dialog box, Change the ***Value*** of ***Constraint 2*** (the Horizontal constraint) to ***5.83***.

26. **<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.

27. **<D> <D>** on the **RT_SwaleToe** point.

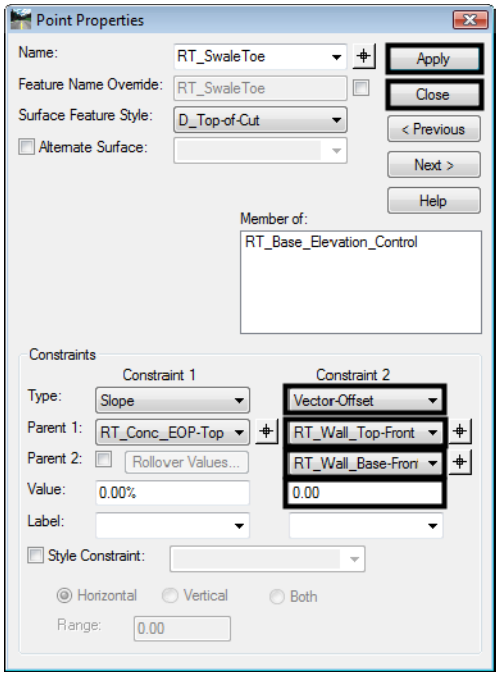
28. In the ***Point Properties*** dialog box, Set the ***Constraint 2 Type*** to **Vector-Offset**.

29. Set the ***Constraint 2 Parent 1*** to **RT_Wall_Top-Front**.

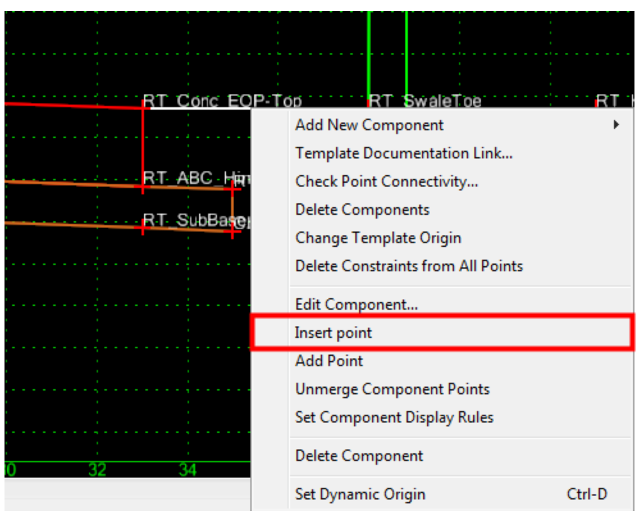
30. Set the ***Constraint 2 Parent 2*** to **RT_Wall_Base-Front**.

31. Key in ***0.00*** for the ***Constraint 2 Value***.

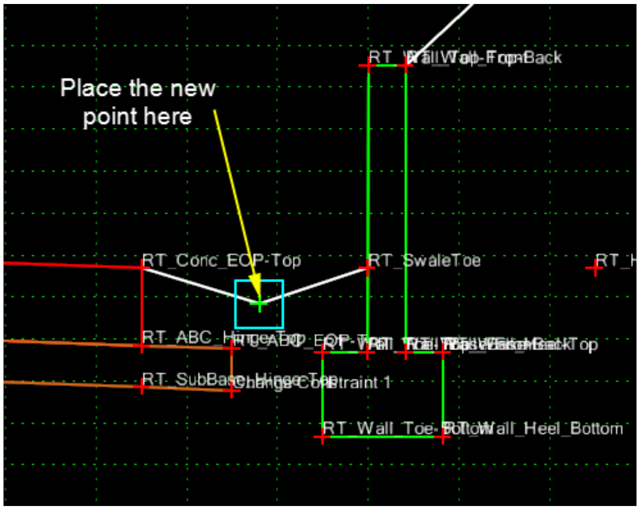
32. **<D> Apply** then **<D> Close** to dismiss the dialog box.



33. **<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.



34. Place the point between and below the ***RT_Conc_EOP-Top*** and ***RT_SwaleToe*** points.



35. **<D> <D>** on the new point to display the ***Point Properties*** dialog box.

36. In the ***Point Properties*** dialog box ***Name*** field, key in **RT_Ditch-Bottom**.

37. Set the ***Surface Feature Style*** to **D_Ditch-Bottom**.

38. Set the ***Type*** for both constraints to **Slope**.

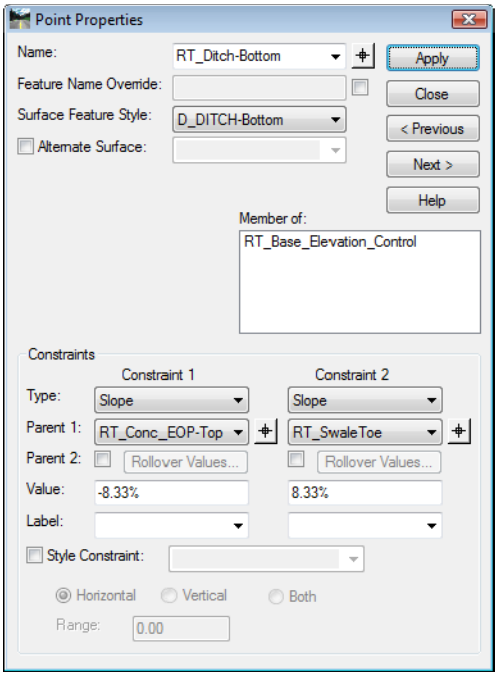
39. Set the ***Parent 1*** for ***Constraint 1*** to **RT_Conc_EOP-Top**.

40. Set the ***Parent 1*** for ***Constraint 2*** to **RT_SwaleToe**.

41. Key in ***-8.33%*** for the ***Value*** of ***Constraint 1***.

42. Key in **8.33%** for the ***Value*** of ***Constraint 2***.

43. **<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.

44. Select **File > Save** from the ***Create Template*** menu bar.

45. **<D>** the **Close** button on the ***Create Template*** dialog box to dismiss it.

Now, examine how the template behaves in Roadway Designer.

46. Select **Modeler > Roadway Designer** from the InRoads menu bar.

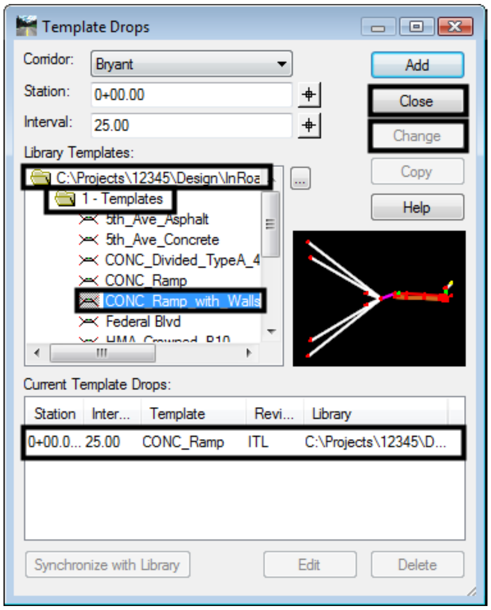
47. From the ***Roadway Designer*** menu bar, select **Corridor > Template Drops**.

48. In the ***Template Drops*** dialog box, highlight the entry in the ***Current Template Drops*** area.

49. Expand the Template library folder to show the contents of the ***1 - Templates*** folder.

50. **Highlight** the **CONC_Ramp_with_Walls** template from the ***Library Templates*** list.

51. **<D> Change** then **<D> Close** to dismiss the dialog box.



52. Scroll through the template drops in the Cross Section view of the Roadway Designer dialog box.

53. Verify that the wall is expanding and contracting to meet the existing ground.

54. Select **File > Save** from the ***Roadway Desgner*** dialog box.

55. **<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 26.2 - 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.

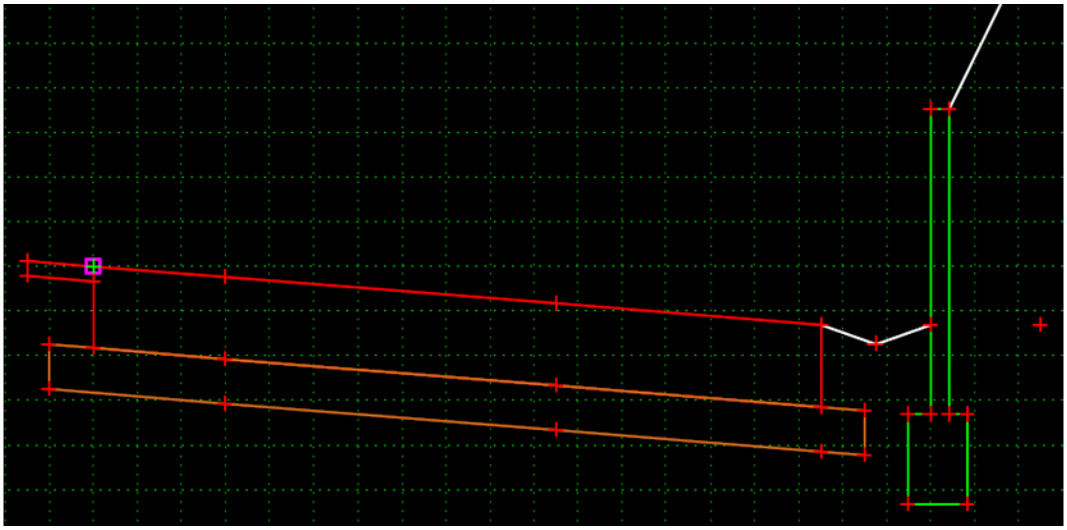
First, a copy of the CONC_Ramp_with_Walls template is made. This template is used for the first 150' of the project.

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.

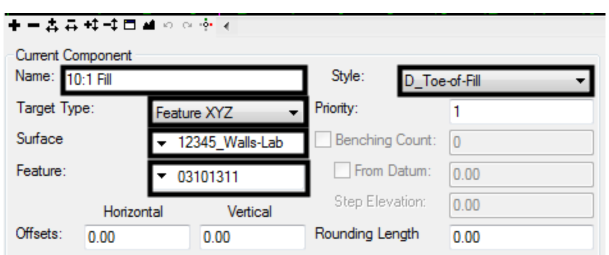
The CONC_Ramp_with_Wall-Lt template is used for the first 150' of the project. The CONC_Ramp_with_Walls template will be modified with a wall on the left side and is used on the remainder of the project.

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:

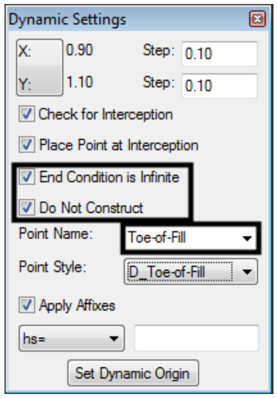


9. Display the ***Dynamic Settings*** dialog box.
10. In the ***Dynamic Settings*** dialog box, verify that the ***Steps*** are set to ***0.10***.
11. Verify that **Apply Affixes** is toggled on.
12. **<R>** in a blank area of the template view and select **Add New Component > End Condition** from the 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***.



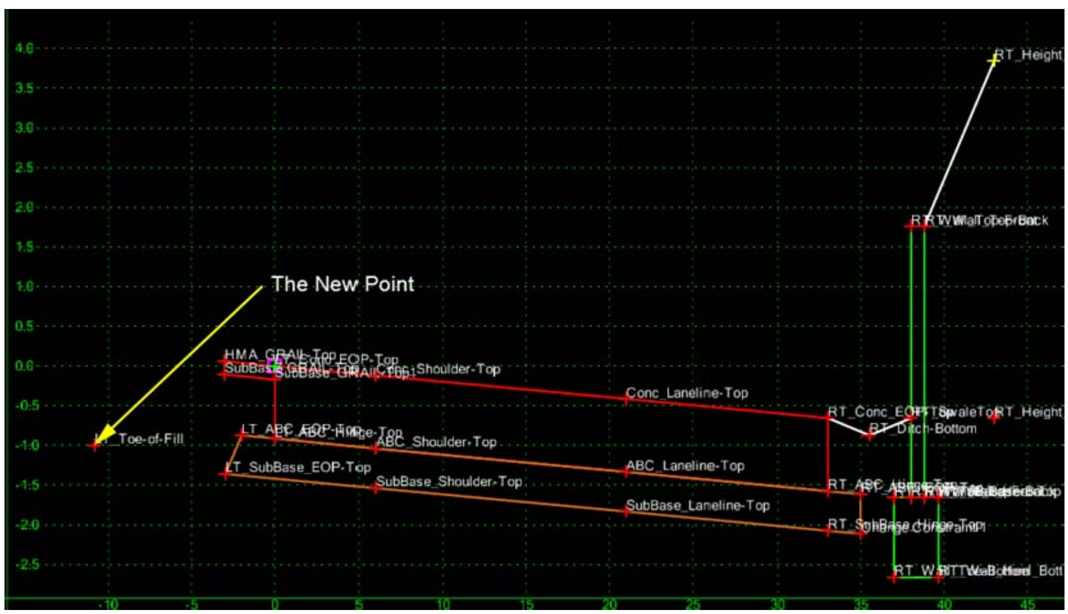
18. **<D>** on the **HMA_GRAIL-Top** point.
19. In the ***Dynamic Settings*** dialog box, toggle on **End Condition is Infinite** and **Do Not Construct**.

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).



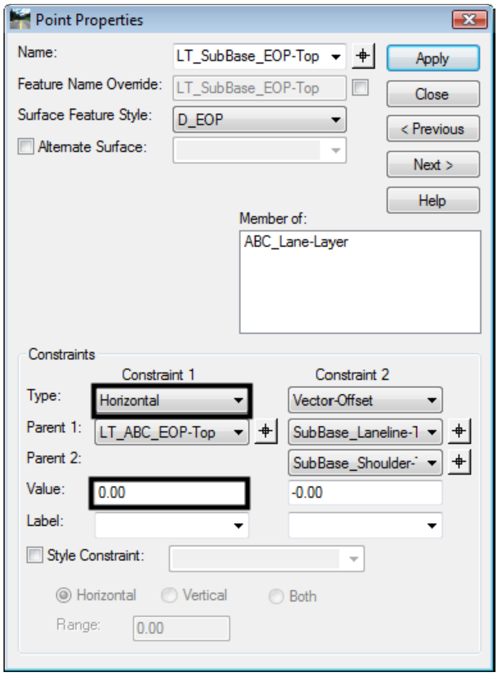
This component is only used to locate the feature. The slope and wall will be built back from this point to the rest of the template.

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.

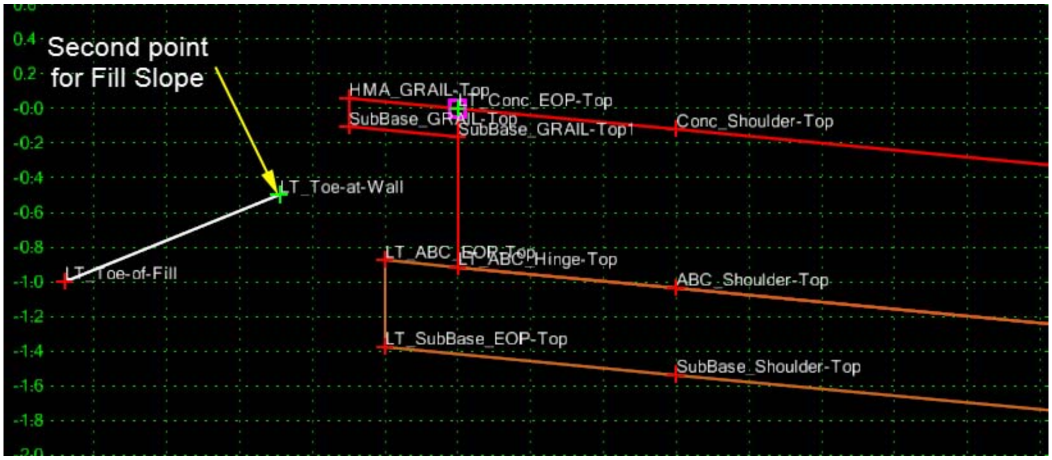
28. In the ***Current Component*** area, key in ***Fill Slope*** for the ***Name***.

29. **<D>** on 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.

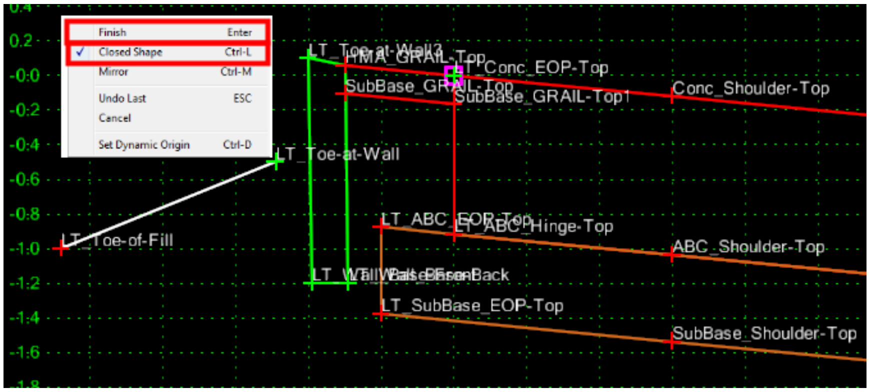
41. In the ***Dynamic Settings*** dialog box, key in ***Wall_Base-Front*** for the ***Point Name***.

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.

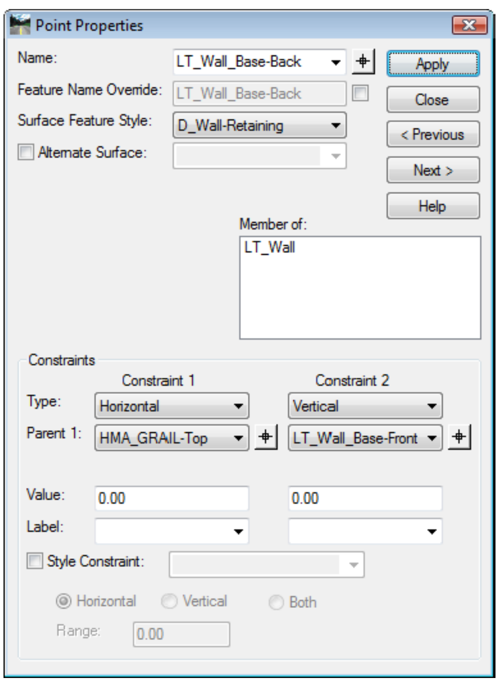
47. In the ***Point Properties*** dialog box, set the ***Constraint 1 Type*** to **Horizontal**.

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.**

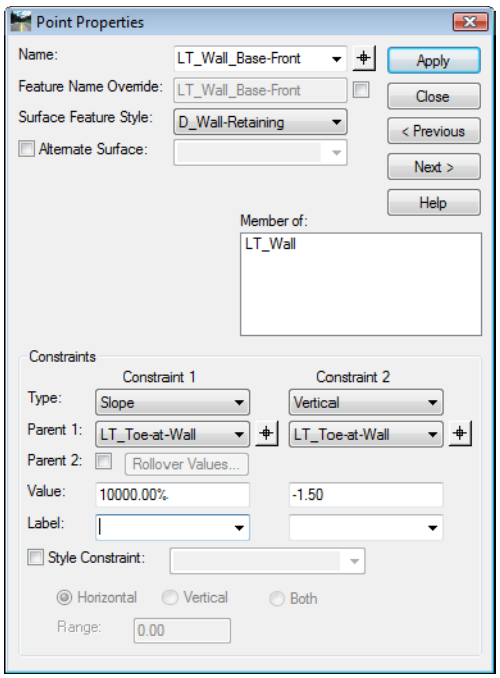
51. Key in ***0.00*** for the ***Value*** of both constraints. The illustration below shows the completed dialog box.



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

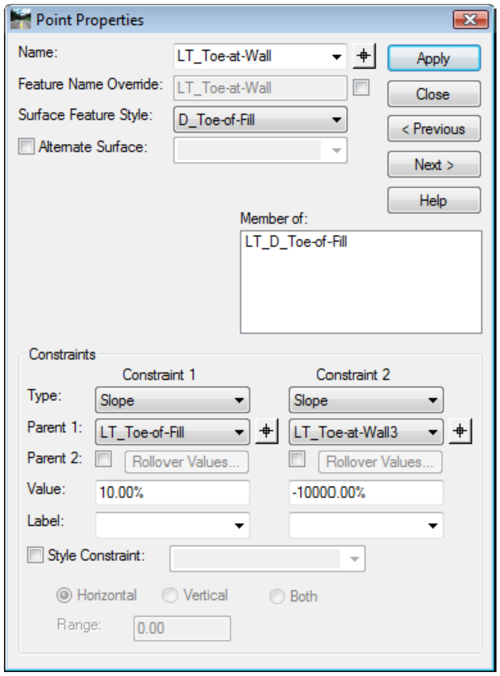
53. **<D> <D>** the **LT_Wall_Base-Front** point.

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.

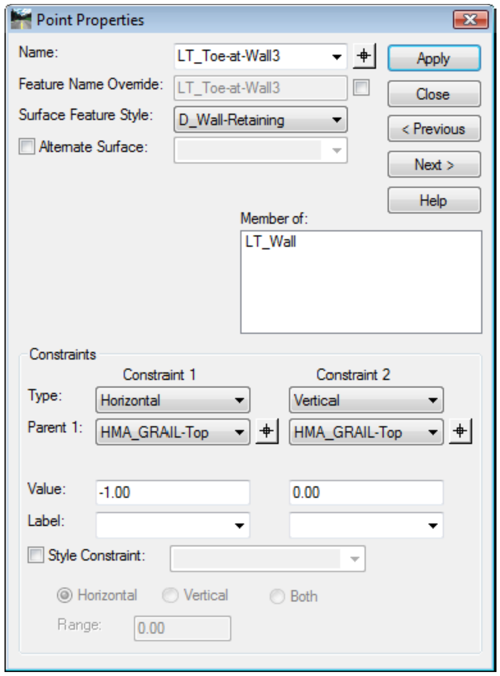
68. Set the ***Constraint 1 Type*** to **Horizontal**.

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.

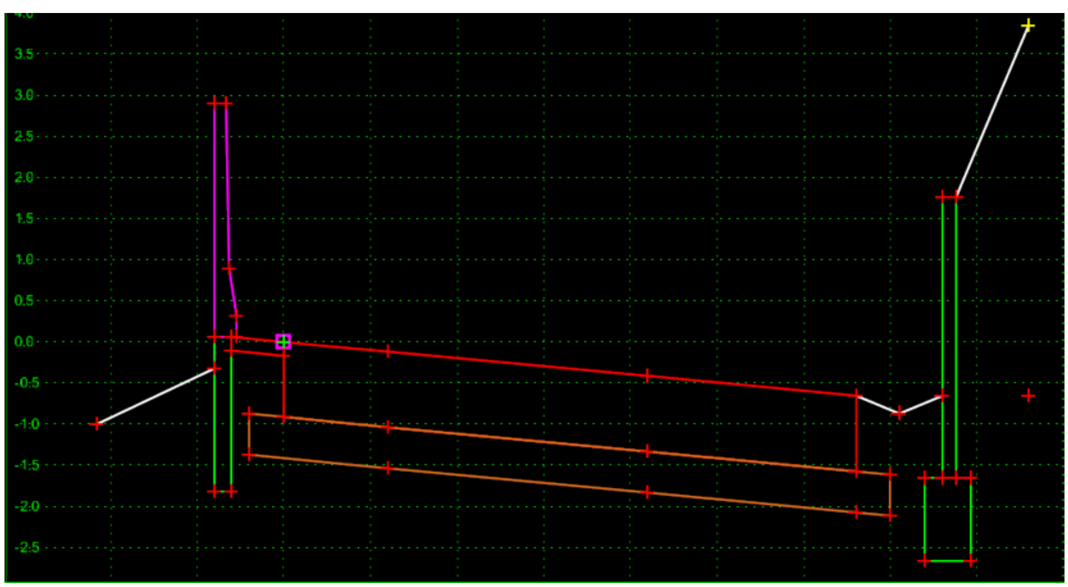


73. **<D> Apply** then **<D> Close** to dismiss the dialog box.

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.

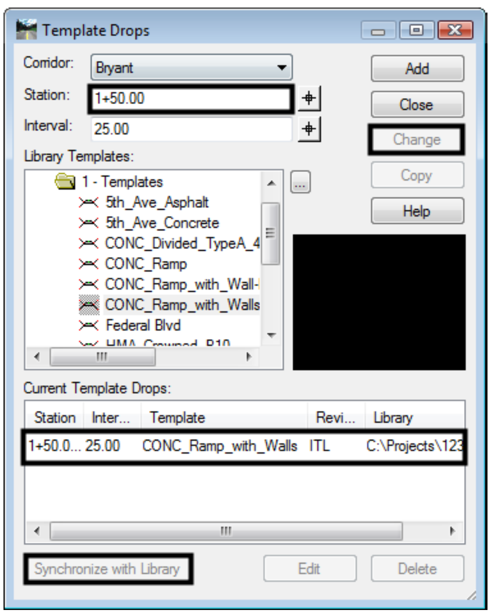
76. Drag the component by the origin (lower left corner) and drop it on to the LT_Wall_Top-Front point. The illustration below shows the completed template.



77. Select **File > Save** from the ***Create Template*** menu bar.
78. **<D>** the **Close** button on the ***Create Template*** dialog box to dismiss it.

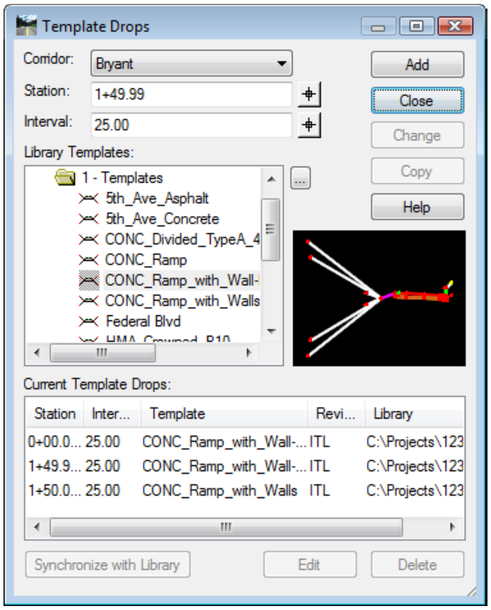
The template is now ready to use in the corridor.

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 Desgner*** 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 occuring in areas where they are not wanted or not occuring 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 27 - 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 27.1 - 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.

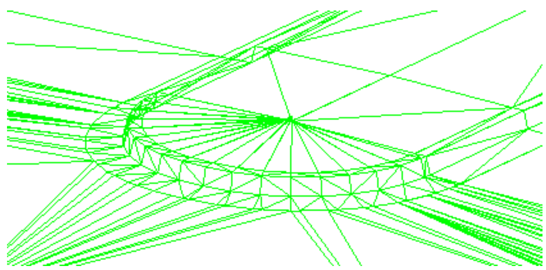
1. Open MicroStation and InRoads using the ***12345DES_Model-Create Raised Median.dgn*** file.
2. Select **File> Open** from the InRoads menu bar.
3. Select the file ***C:\Workspace\Workspace-CDOT_XM\Standards-Global\InRoads\Preferences\CDOT_Civil.xin***
4. Continue to select the following files from ***C:\Projects\12345\Design\InRoads*** and the **<D> Open** button.
   - ♦ 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 27.2 - Workflow

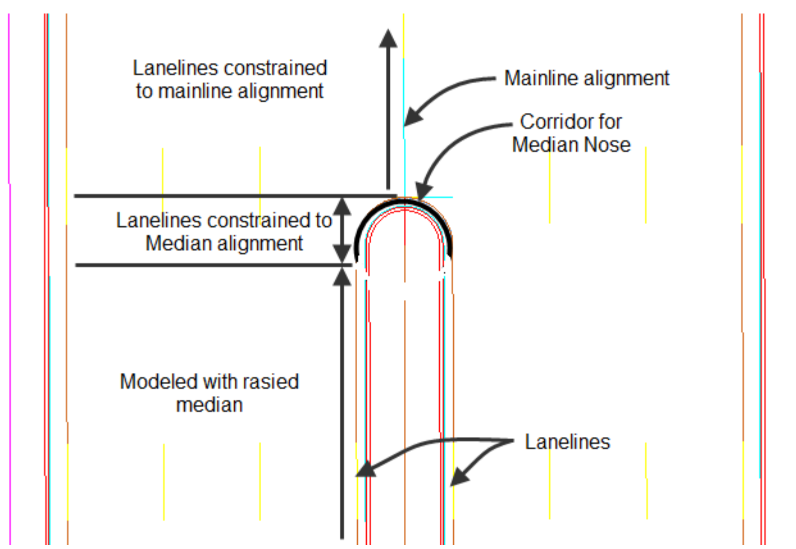
A summary of the overall process

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.



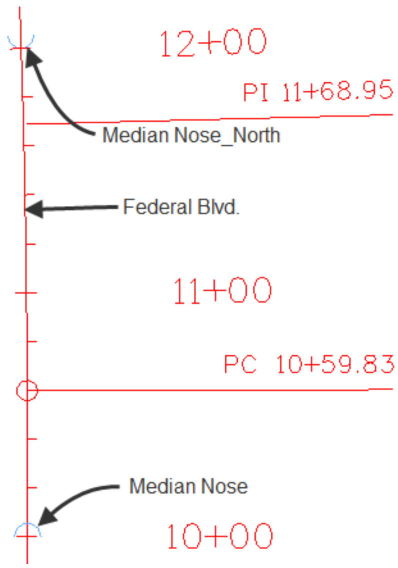
Modeling Schematic



Lab 27.3 - Review The Alignments

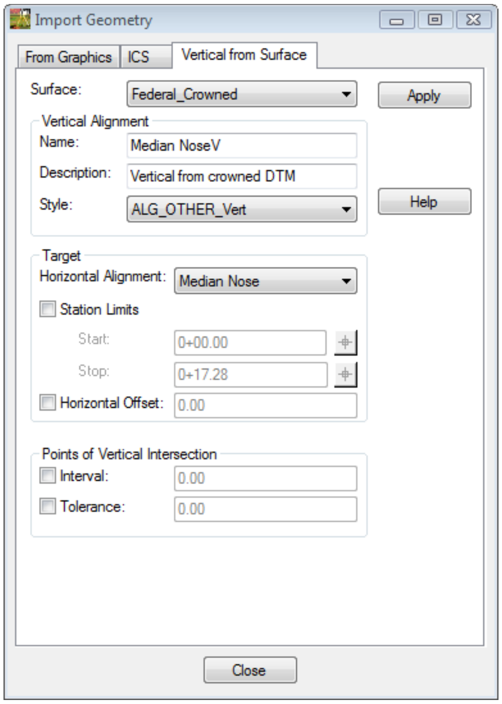
In this exercise three alignments are used. ***Federal CL*** for the main corridor and ***Median Nose*** & ***Median Nose_North*** which define the median opening and termination.

1. Select the **Geometry** tab in the ***InRoads Explorer***
2. View the horizontal alignments ***Federal CL***, ***Median Nose*** & ***Median Nose_North***
3. View stationing for horizontal alignment ***Federal CL***



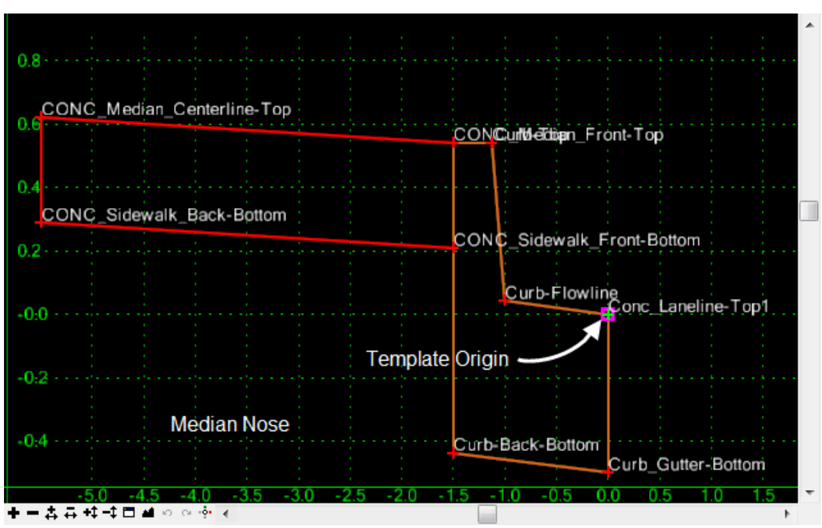
Lab 27.4 - Review Data

An initial model of the roadway was created using a crowned roadway section (without the raised median). This is done for the purpose of extracting the vertical profile of the median noses which is accomplished by using the command **File > Import > Geometry [Vertical From Surface].** This step has already been completed.

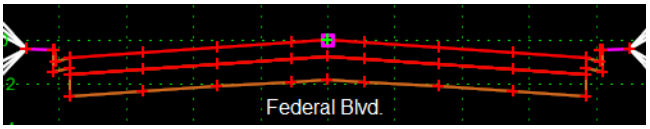


1. Select **Modeler > Create Template** from the InRoads menu bar.

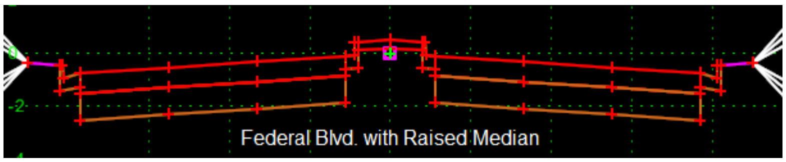
2. In the ***Create Template*** dialog review the template for ***Median Nose*** in the ***1-Templates*** folder.



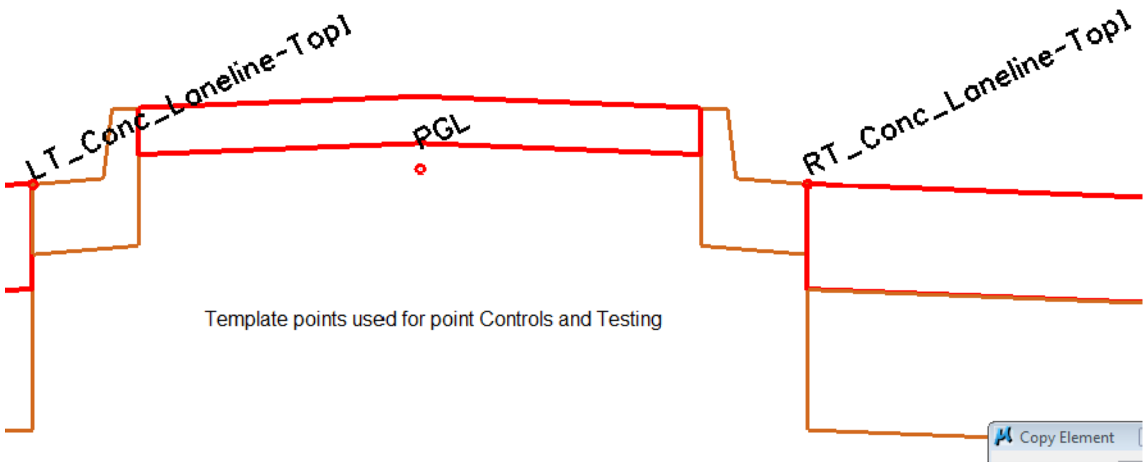
3. Also in the ***Create Template*** dialog review the template for ***Federal Blvd*** in the ***1-Templates*** folder. This template was use to create a preliminary model. This model was used to extract vertical alignments for the median alignments.



4. The template ***Federal Blvd with Raised Median***. Display rules control if the median is modeled.



5. 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.



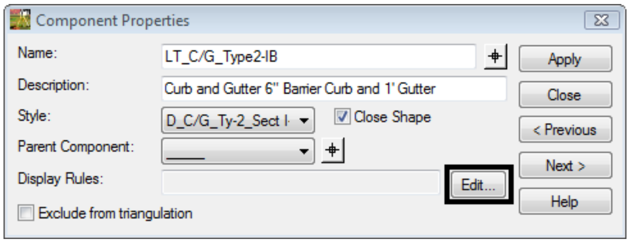
Lab 27.5 - Add Display Rules

Display rules can be associated with components to test if the component should be displayed or not.

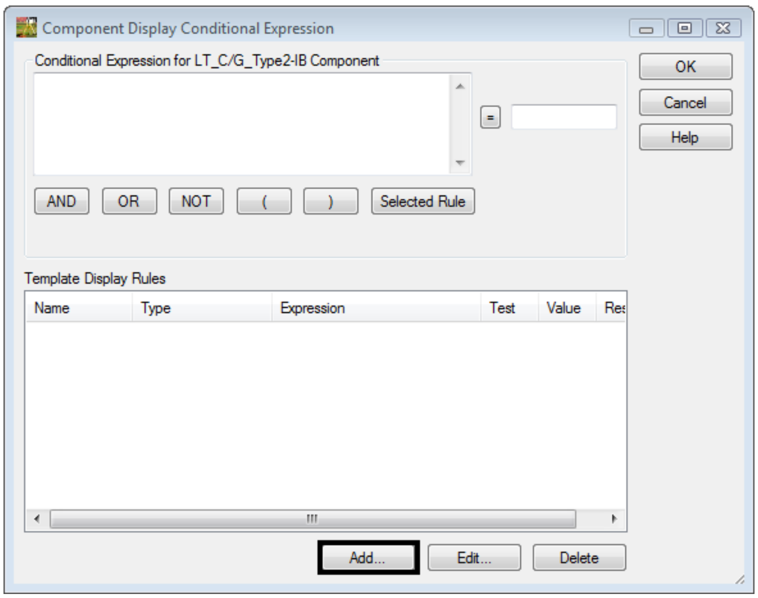
1. **Copy** the template ***Federal Blvd with Raised Median*** to ***Federal Blvd with Raised Median_DR***
2. **Open** ***Federal Blvd with Raised Median_DR*** for editing
3. The goal is to eliminate the construction of the median components if the distance between either lanelines and the PGL is less than 5.50'.

   Note: 5.50 feet represents the distance from the mainline alignment to the PC or PT of the alignments for the median noses.

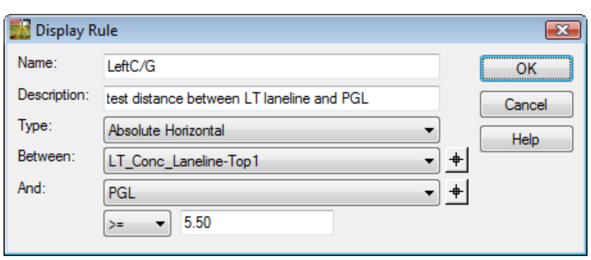
4. Select the median curb and gutter component named ***LT_C/G_Type2-1B*** for editing.



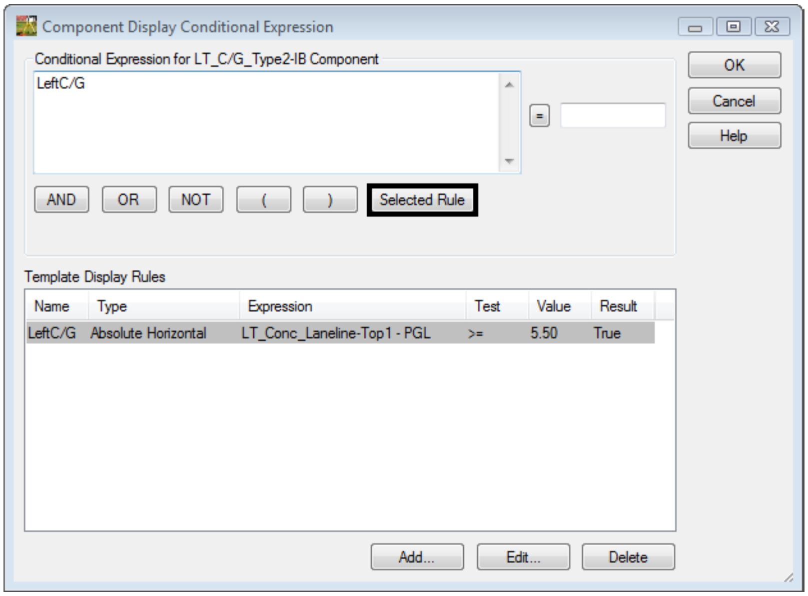
5. Select **Edit**



6. Select **Add**
7. **Create** a Display Rule that tests the distance between the Left Laneline and the PGL.
   - Name: LeftC/G
   - Description: test distance between LT laneline and PGL
   - Type: Absolute Horizontal
   - Between: LT_Conc_Laneline-Top1 and PGL
   - Test: >=
   - Value: 5.50



8. Select **Rule** for the LT Laneline, **OK** & **Apply**



9. Select the component ***RT_C/G_Type2-1B*** for editing.

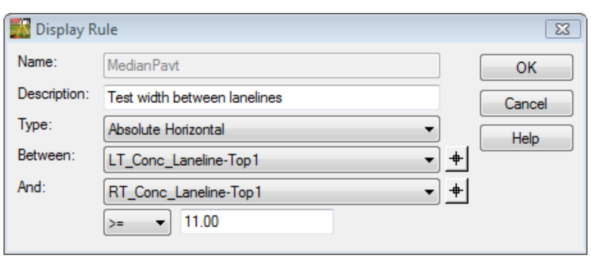
10. **Build** and **apply** a similar rule for the RT Laneline.

- Name: RightC/G
- Test 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")

- Name: MedianPavt
- Description: Test width between lanelines
- Type: Absolute Horizontal
- Between: LT_Conc_Laneline-Top1 and RT_Conc_Laneline-Top1
- Test: >=
- Value: 11.00

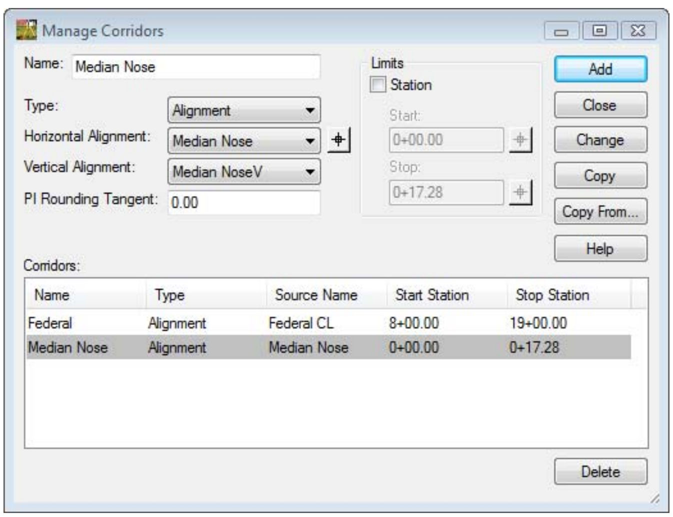


13. **Save** and **Close** the Create Template dialog.

Lab 27.6 - Create Corridors

Corridors contain definitions for which alignments, templates, point controls, etc. to incorporate when modeling the roadway. In this exercise, three corridors are defined, one for each median nose and one for the mainline.

1. Select **Modeler > Roadway Designer**
2. Select **Corridor > Corridor Management** from the Roadway Designer menu bar or **<D>** the Manage Corridors button .
3. **Add** corridors for both median openings.
   - Name: Median Nose
   - Type: Alignment
   - Horizontal Alignment: Median Nose
   - Vertical Alignment: Median NoseV



4. **Add** corridor definition for corridor Median Nose_North
   - Name: Median Nose_North
   - Type: Alignment
   - Horizontal Alignment: Median Nose_North
   - Vertical Alignment: Median Nose_NorthV
5. **Add** and **Close**

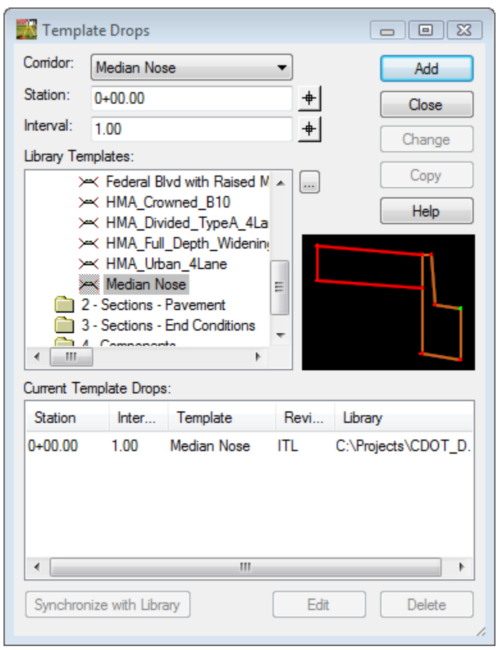
Lab 27.7 - Add Template Assignments

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 alignment 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 or **<D>** the template drops button .

2. **Add** template assignment to ***Median Nose***

   - Template: Median Nose
   - Interval of 1'

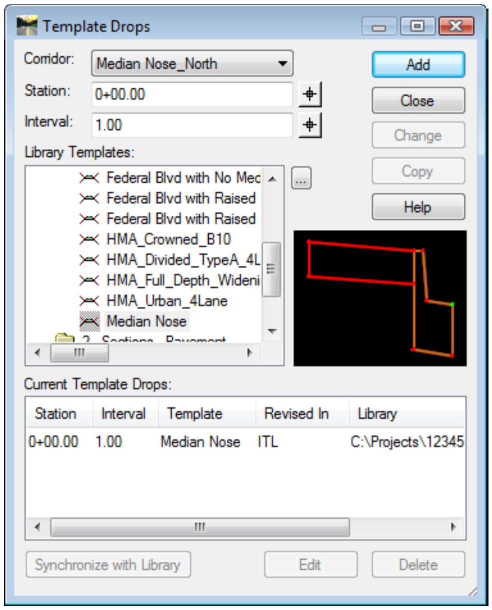


3. **<D> Add** then **Close**.

4. **Add** template assignment to ***Median Nose_North***

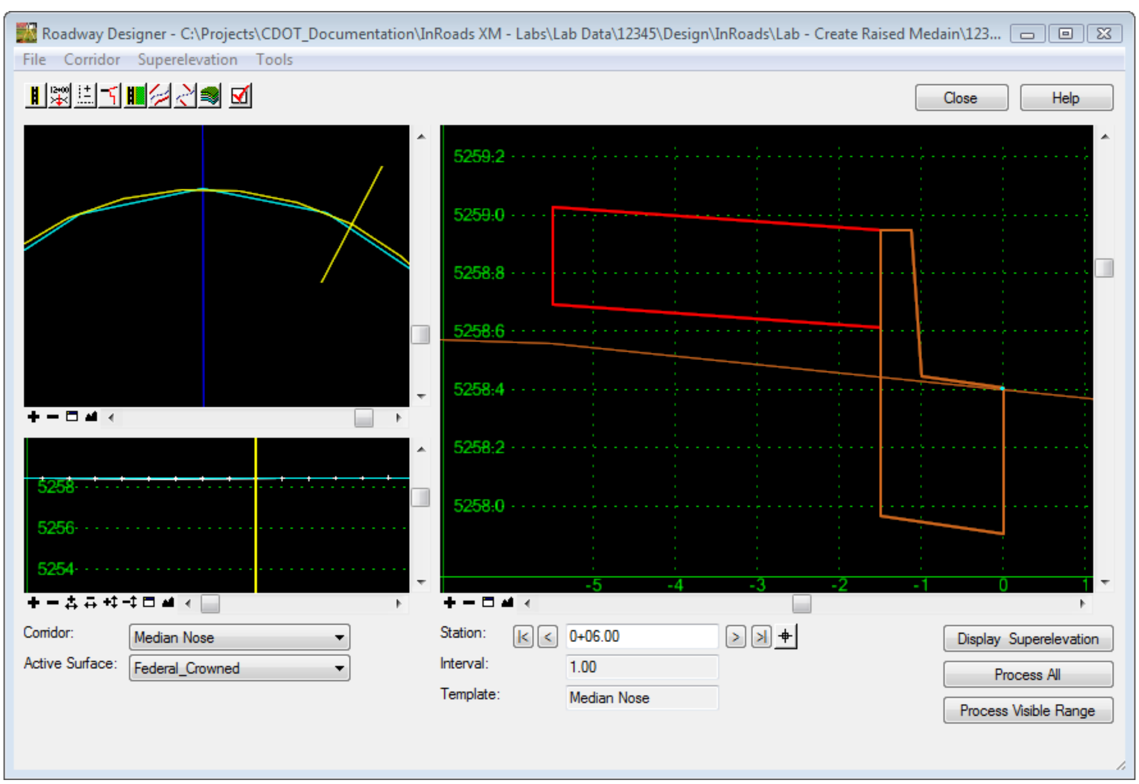
   ♦ Template: Median Nose_North

   ♦ Interval of 1’



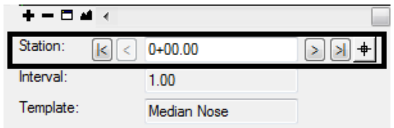
5. **<D> Add** then **Close**.

6. Roadway Designer can be used to evaluate the two median corridors.

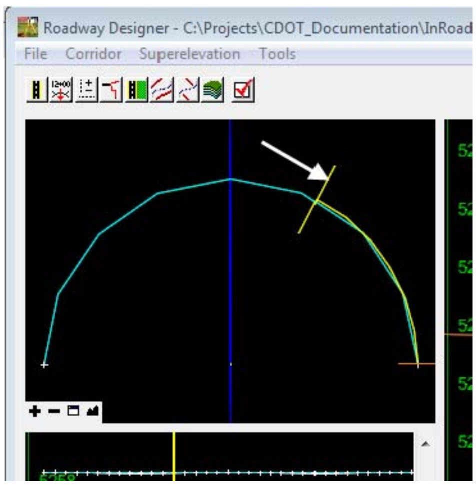


Note: The template data is displayed in the template view. There are two options for scrolling through the design, using the station arrows below the template view and using the station line in the plan view.

7. **<D>** on the station arrows to scroll through the design.



8. **<D> and Hold** on the yellow station line. Move the pointer back and forth to scroll through the design.



The median models are now ready to be evaluated.

9. From the pull down menu in the Roadway Designer dialog **Corridor > Corridor Management**.

10. **Create** a corridor for the Mainline.

    - Name: Federal_Display_Rule
    - Type: Alignment
    - Horizontal Alignment: Federal CL
    - Vertical Alignment: Federal CL_V
    - Start Station: 8+00
    - Stop Station: 19+00

11. **<D> Add**

12. **<D> Close**

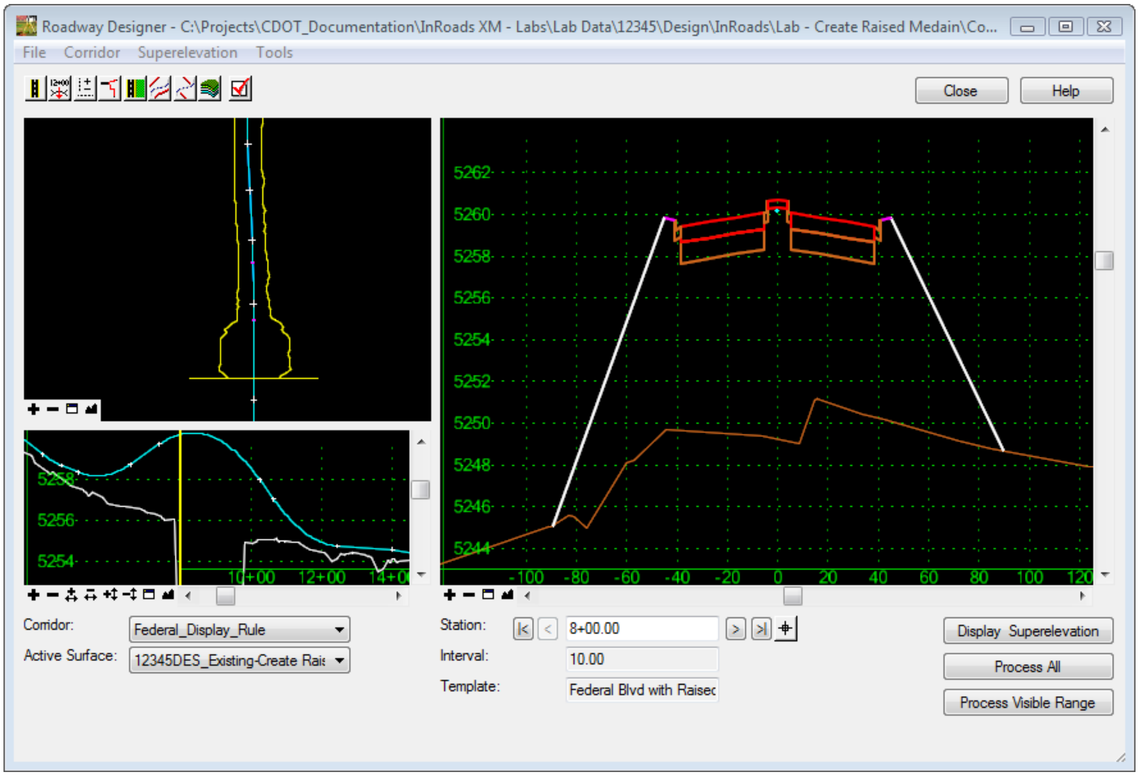
13. From the Roadway Designer dialog **Corridor > Template Drops**

14. **Add** template assignments to the corridor Federal_Display_Rule.

    - Station: 8+00

- Interval of 10’
- Template:Federal Blvd with Raised Median_DR

15. **<D> Add**
16. **<D> Close**
17. Evaluate the ***Federal_Display_Rule*** corridor.



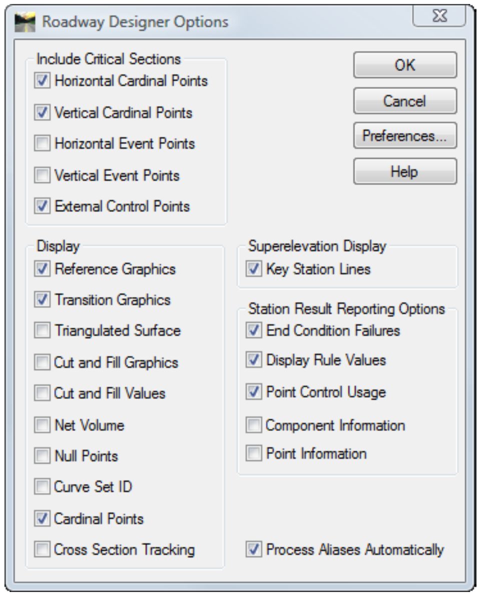
Lab 27.8 - Change Roadway Designer Settings

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, horizontal cardinal and event points are processed, cut and fill information is added to the template view, and component and point information is added to the processing report.

The first series of steps tell the Roadway Designer to process the horizontal cardinal and event points.

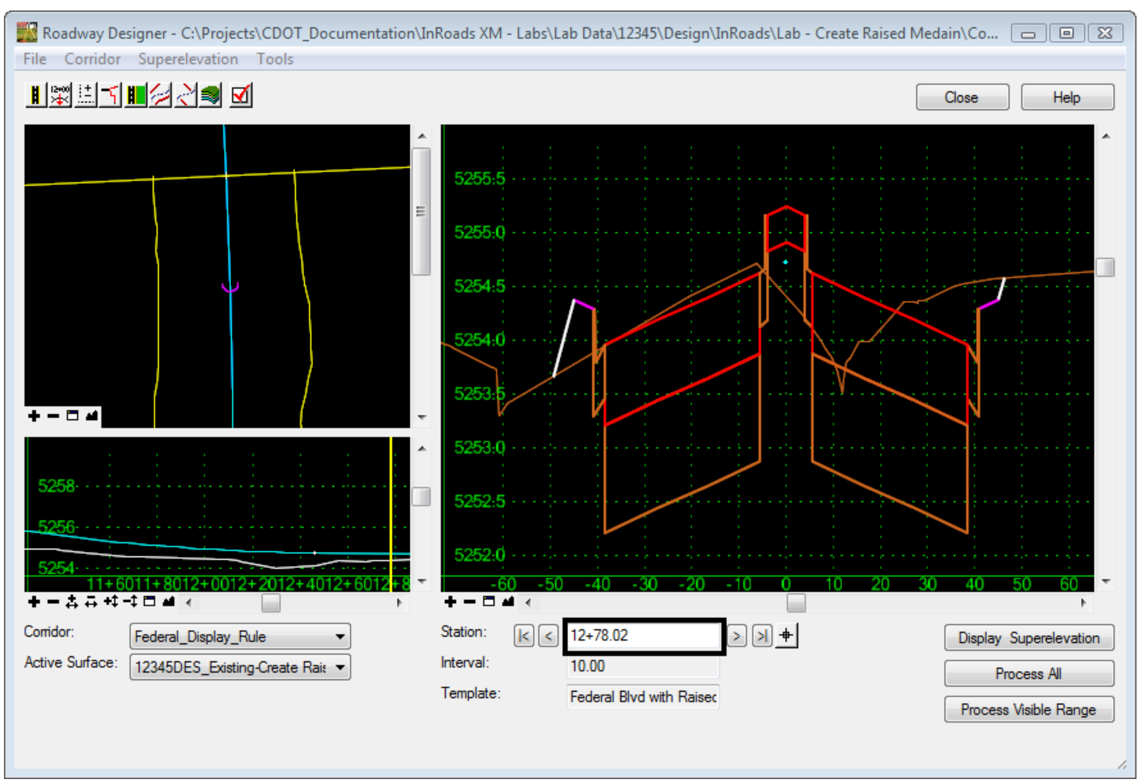
1. From the Roadway Designer menu bar, select **Tools > Options**.

2. In the ***Roadway Designer Options*** dialog box, toggle on **Horizontal Cardinal Points, Vertical Cardinal Points**, **External Control Points, Reference Graphics, and Transition Graphics.**



3. **<D> OK**.

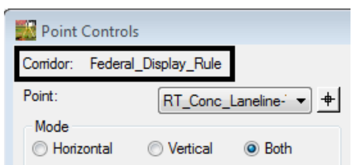
4. Scroll through the stations and notice that some stations do not fall on even intervals. These are the cardinal and event points.



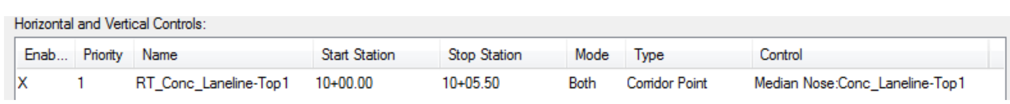
Lab 27.9 - Point Controls

This series of steps adds Point Controls (overrides) to the corridor definition previously defined in Roadway Designer.

1. Select **Corridor > Point Controls** from the Roadway Designer menu bar or **<D>** the Point Control button  .
2. The roadway will model 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). 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.
3. Verify the corridor **Federal_Display_Rule** is the active corridor.



4. Create the following Point Control entries to instruct the template point RT_Conc_Laneline-Top1 to follow a feature (by the same name) created by the Median Nose corridor.
5. ***First*** Point Control
   - Point: RT_Conc_Laneline-Top1
   - Mode: Both
   - Control Type: Corridor Point
   - Corridor: Median Nose
   - Reference Point: Conc_Laneline-Top 1
   - Station Start: 10+00.00 (begin of median radius)
   - Station Stop: 10+05.50 (end of median radius/nose)
6. **<D> ADD**



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

7. ***Second*** Point Control
   - Point: RT_Conc_Laneline-Top1
   - Mode: Both
   - Control Type: Alignment

- Horizontal Alignment: Federal CL
- Vertical Alignment: Federal CL_V
- Station Start: 10+05.51 (end of median radius/nose - beginning of median opening)
- Station Stop: 12+00.00 (beginning of north median/radius nose)

8. **<D> ADD**

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

9. ***Third*** Point Control

- Point: RT_Conc_Laneline-Top1
- Mode: Both
- Control Type: Corridor Point
- Corridor: Median Nose_North
- Reference Point: Conc_Laneline-Top 1
- Station Start: 12+00.00 (begin of median radius/nose)
- Station Stop: 12+05.00 (end of median radius)

10. **<D> ADD**

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

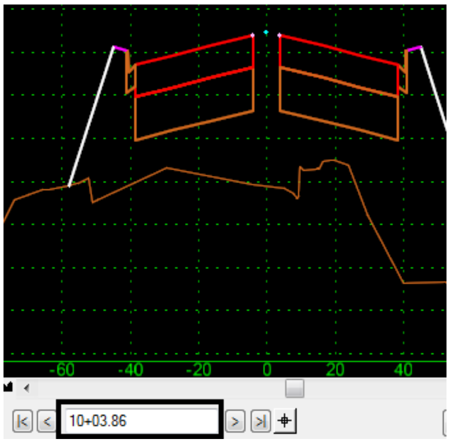
11. Add the fourth, fith, and sixth entry for the ***LT_Conc_Laneline-Top1*** point. The definitions mimic the definitions use for the RT_Conc_Laneline-Top1 point.

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> ADD**
13. **<D> Close**

14. Review the results graphically in Roadway Designer. You should see the raised median disappear between stations 10+00.00 and 10+05.00 and again between 12+00.00 and 12+05.00. Between these station limits, the corridors for the medians will complete the model.



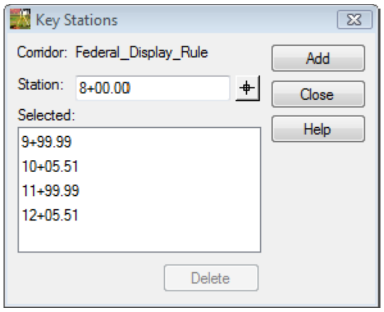
15. You should also see the left and right pavement edges running together between stations 10+05.51 and 12+00.00. This represents the median opening.

Lab 27.10 - 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 or in the case of this exercise, just prior to and after the application of point controls. This ensures the roadway models 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 Point Control button  .
2. **Key-in** the station values immediately before and after the point controls. Select **Add** after each entry.
   - ***9+99.99***
   - ***10+05.51***
   - ***11+99.99***

- ***12+05.51***

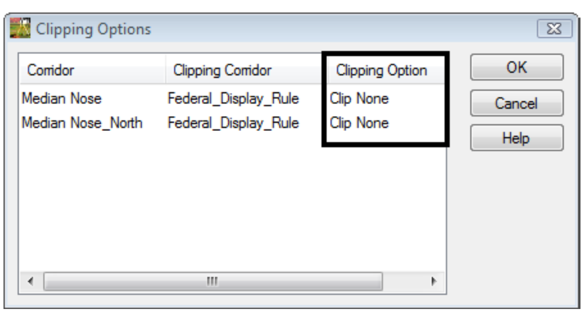


3. D **> Close**
4. Select **File > Save** from the Roadway Designer menu.

Lab 27.11 - Creating the Model

With all the corridors, template applications, 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 Point Control button 
2. Select the following corridors for modeling:
   - ***Federal_Display_Rule***
   - ***Median Nose***
   - ***Median Nose_North***
3. **<D>** on ***Clipping Options***



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:

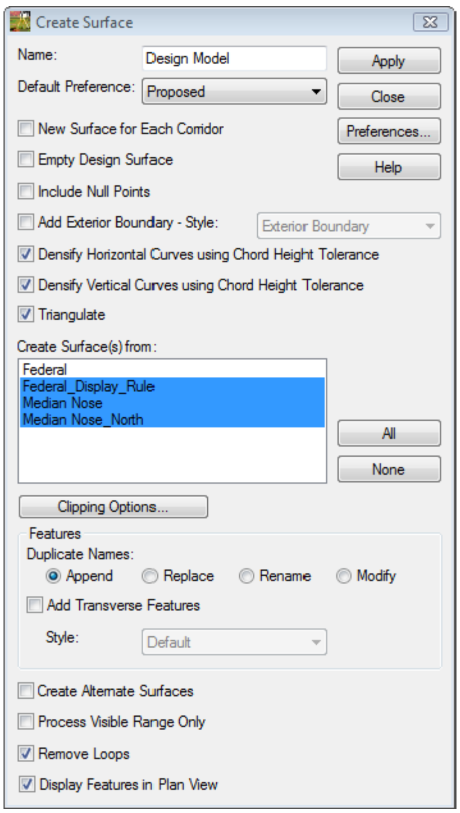
- Name: ***Design Model***
- Default Preference: ***Proposed***

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:***

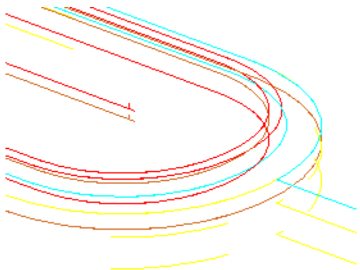


Lab 27.12 - Review the Design

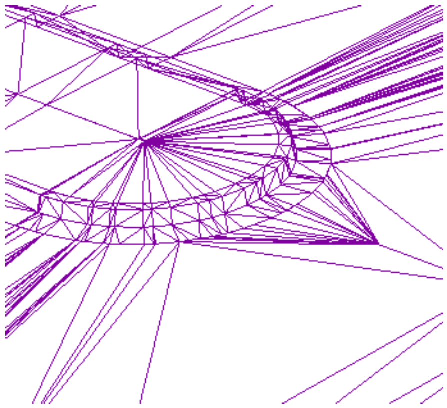
Use you knowledge of InRoads to review your model.

Some methods may include:

- A 3D isometric view of DTM features



- DTM triangles



Contours, profiles and cross sections are additional options.

Chapter Summary:

- In *Lab 27.5 -Add Display Rules* were created and associated with template components.
- In *Lab 27.9 -Point Controls* were defined to modify the application of the defined template
- In *Lab 27.10 -Adding Key Stations* are used to define supplemental template application stations.
- In *Lab 27.11 -Creating the Model* multiple corridors are modeled simultaneously and corridor clipping option are defined.

LAB 28 - 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 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 and tie a ramp vertical alignment into the edge of lane of the mainline taper using the Vertical Gore Tool.
- Create a freeway entrance ramp (tapered type) model and the infield, gore and taper area segment of the the mainline model.
- Create a ramp and mainline surfaces from the Roadway Designer, display cross sections and examine the results.

Lab 28.1 - Open InRoads Data Files

1. Open MicroStation and InRoads uing the ***12345DES_Model-Create Ramp Model.dgn*** file.
2. Load CDOT_Civil-Create Ramp Model.xin

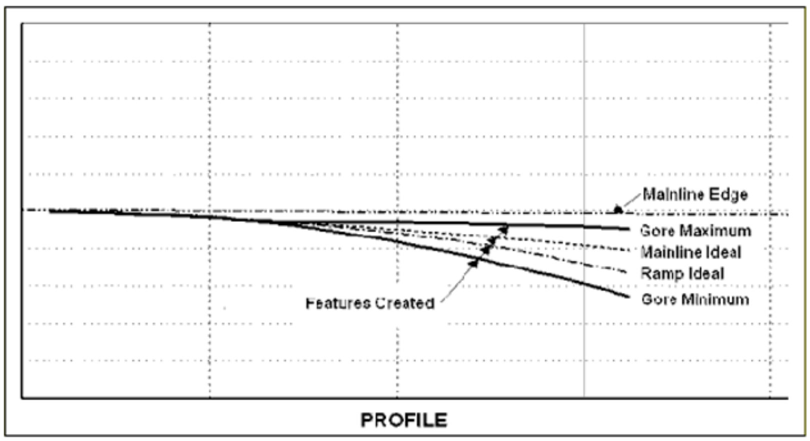
   In the MicroStation drawing, notice the entrance ramp and mainline proposed linework displayed as a reference and the profile views for each alignment.
3. Select **File> Open** from the InRoads menu bar.
4. Select the following files from ***C:\Projects\12345\Design\InRoads*** and **<D> Open** them.
   - 12345DES_Geometry-Create Ramp Model.alg
   - 12345DES_Template-Create Ramp Model.itl
   - 12345DES_Roadway-Create Ramp Model.ird
   - 12345DES_Existing-Create Ramp Model.dtm
5. **<D> Cancel** the ***Open*** dialog box to close.

Lab 28.2 - Set the Global Scale Factors

1. Select **Tools> Options** from the InRoads menu bar.
2. In the ***Options*** dialog box:
   - Select ***Factors*** tab.
   - Key in ***200*** in the Factor fields.
   - **<D> Apply and <D> Close.**

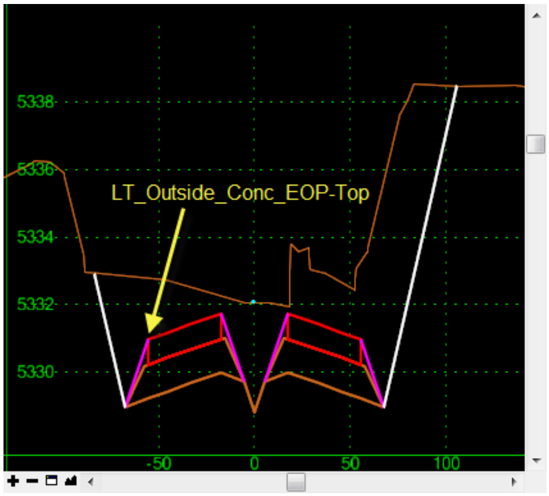
Lab 28.3 - Create Ramp Vertical Alignment Guide with Vertical Gore Tool

Use the Vertical Gore Tool to create a guide for revising the ramp vertical alignment. This command is used to create a surface feature envelope of a ramp that merges into a mainline corridor. The output from this command includes a surface with four linear features which are designed to be plotted on 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

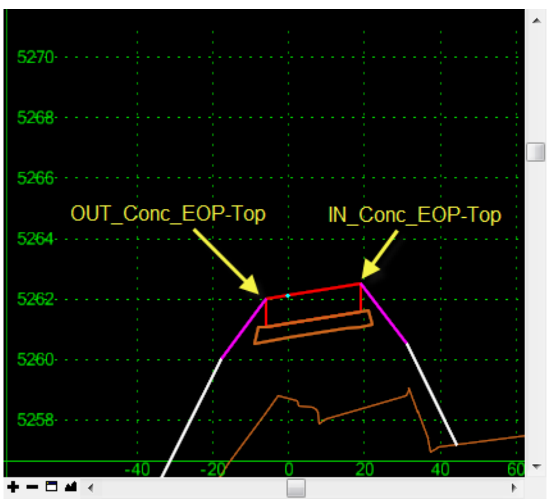
♦ Select ***LT_Outside_Conc_EOP-Top*** for the Mainlined Edge field, using the drop-down list or the selector button and **<D>** on the template point in the Roadway Designer dialog box.



4. Set ***NW Ramp*** as the ramp corridor field.

5. Select ***IN_Conc_EOP-Top*** for the Ramp Inside Edge field, using the selector button and **<D>** on the template point in the Roadway Designer dialog box.

♦ Select ***OUT_Conc_EOP-Top*** for the Ramp Outside Edge field, using the selector button and **<D>** on the template point in the Roadway Designer dialog box.



♦ Key in ***8%*** in the Maximum Difference field.

♦ Key in ***30+50*** in the Mainline Start field.

♦ Key in ***32+00*** in the Mainline Stop field.

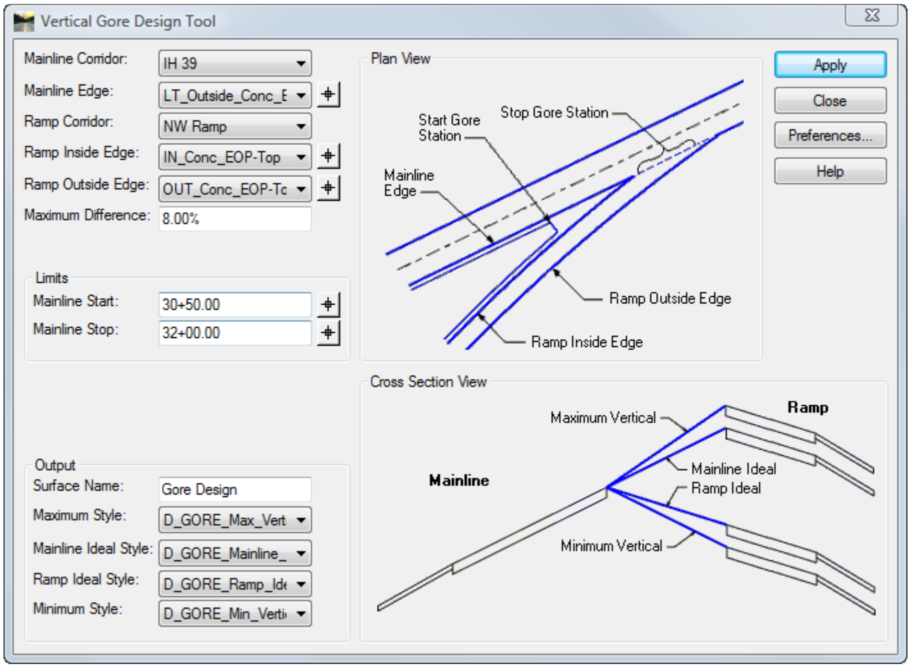
♦ Key in ***Gore Design*** in the Surface Name field.

♦ Select ***D_GORE_Max_Vertical*** for the Maximum Style.

♦ Select ***D_GORE_Mainline_Ideal*** for the Mainline Ideal Style.

♦ Select ***D_GORE_Ramp_Ideal*** for the Ramp Ideal Style.

- Select ***D_GORE_Min_Vertical*** for the Mimimum Style.



- **<D> Apply and <D> Close**

6. In the ***Roadway Designer*** dialog box:

   - **<D> Close** and select ***No*** to save changes

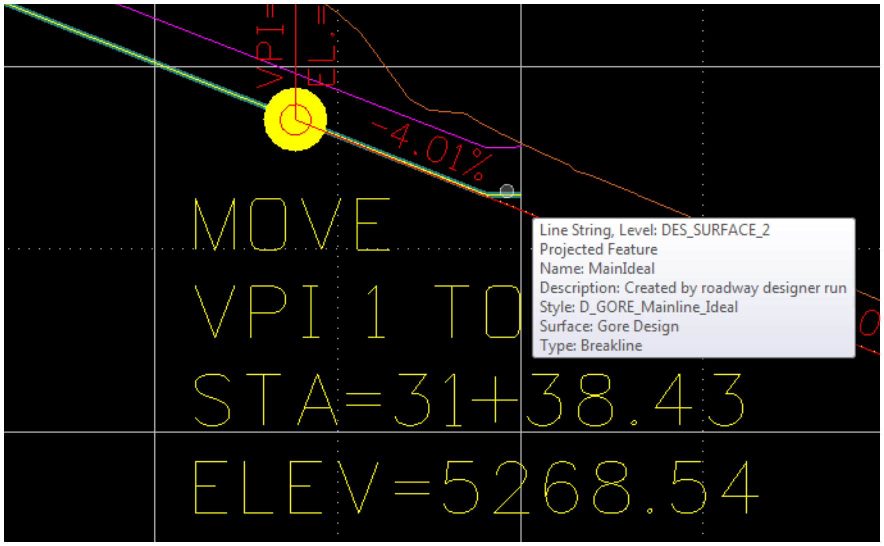
Lab 28.4 - Update NW Ramp profile view to display Projected Features from the Gore Design surface

1. Select **Evaluation> Profile> Update Profile** from the InRoads menu bar.

2. In the ***Update Profile*** dialog box:

   - Verify ***NW Ramp*** for the Profile Set.
   - Select ***Projected Features*** in the Update Profile area.
   - Select ***Display On*** for the Mode**.**
   - Select ***Gore Design*** in the Surfaces area.
   - Select All features in the Projected Features area.

- **<D> Apply and <D> Close.**



The vertical alignment displayed in the profile view does not tie into the mainline and was created to model the NW Ramp corridor for use in the Vertical Gore design Tool. The NW Ramp vertical alignment needs to be revised to tie into the edge of lane of the mainline taper. Revise VPI #1 to begin at Sta. 31+38.43 and the slope of feature D_GORE_Mainline Ideal is extended to the revised VPI #2 location of the proposed sag vertical curve at Sta. 35+75.00. The ramp vertical alignment is lowered to better tie into the mainline ditch in the infield area.

3. Set alignment ***NW Ramp*** as the ***Active*** alignment
4. Select **Geometry> Vertical Curve Set> Move PI** from the InRoads menu bar.
5. **Move** VPI #1 to Station 31+38.43, Elev. 5268.54
6. **Move** VPI #2 to Station 35+75.00, Elev. 5251.04

   Note: The keyin ***se=station,elevation*** can be used to move the PI's

7. Select **Geometry> View Geometry> Vertical Annotation** from the InRoads menu bar.
   - **<D> Apply and <D> Close.**

     Revise NW Ramp corridor to start at the beginning of the ramp's revised vertical alignment.

8. Select **Modeler> Roadway Designer** from the InRoads menu bar.
9. In the ***Roadway Designer*** dialog box:
   - Select ***NW Ramp*** in the Coordiors field.
   - Select **Corridor > Corridor** Management from the Roadway Designer menu bar.
   - **<D>** on cooridor NW Ramp
   - Key in ***31+38.43*** in the Start field.

- **<D> Change**.

  Define End Condition Exceptions for the IH 39 corridor. Apply Left Override, Backbone Only to left side of IH 39 along the NW Ramp gore and infield area.

10. In the ***Roadway Designer*** dialog box:
11. Select ***IH 39*** in the Corridor field and select **Corridor> End Condition Exceptions** in the Roadway designer menu bar.

- Key in ***31+38.43*** in the Start field.
- Key in ***40+50*** in the Stop field.
- Select ***Left Override*** in the Apply To area.
- Select ***Backbone*** Only
- **<D> Add and <D> Close**

Lab 28.5 - Define End Condition Exceptions for NW Ramp corridor

Apply Right Override, Backbone Only to right side of NW Ramp along the gore and infield area.

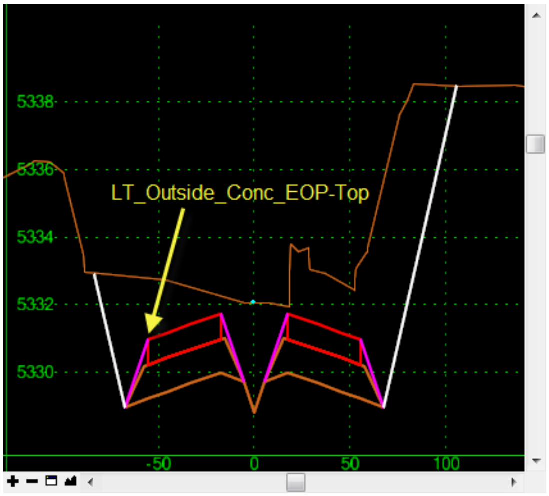
1. In the ***Roadway Designer*** dialog box:
2. Select ***NW Ramp*** in the Corridor field and select **Corridor> End Condition Exceptions** in the Roadway designer menu bar.

- Key in ***31+38.43*** in the Start field.
- Key in ***40+50*** in the Stop field.
- Select ***Right Override*** in the Apply To area.
- Select ***Backbone*** Only
- **<D> Add and <D> Close**

  Define Point Controls for the IH 39 corridor. Stretch westbound roadway's left edge of pavement to create the ramp taper.

3. In the ***Roadway Designer*** dialog box:
4. Select ***IH 39*** in the Corridor field and select **Corridor> Point Controls** in the Roadway designer menu bar.
5. In the ***Point Controls*** dialog box:

- Select ***LT_Outside_Conc_EOP-Top*** for the Point field, using the selector button and **<D>** on the template point in the Roadway Designer dialog box.



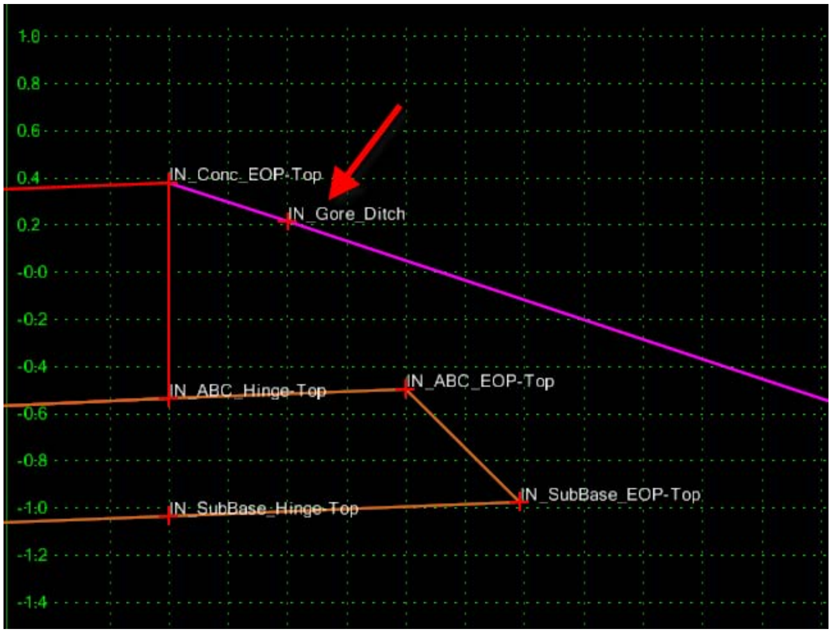
- Select ***Horizontal*** for the Mode.
- Select ***Alignment*** in the Control Type field.
- Select ***Outside Edge of Pavement*** in the Horizontal Alignment field.
- Select ***Use as a Secondary Alignment.***
- Key in ***31+38.43*** in the Stop field.
- **<D> Add and <D> Close**

Lab 28.6 - Define Point Controls for the NW Ramp corridor

Create a special ditch between the ramp and mainline shoulders 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) and tie the inside (right) fore slope of the ramp to the mainline ditch along the infield area when the mainline ditch starts.

1. In the ***Roadway Designer*** dialog box:
2. Select ***NW Ramp*** in the Corridor field and select **Corridor> Point Controls** in the Roadway designer menu bar.
3. In the ***Point Controls*** dialog box:

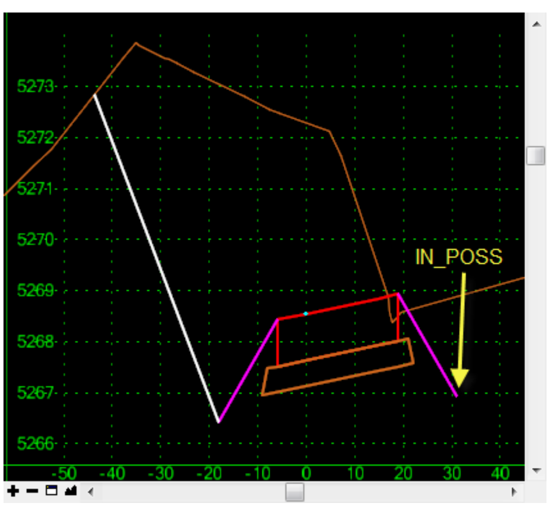
- Select ***IN_Gore_Ditch*** for the Point field, from the drop-down list..



- Select ***Both*** for the Mode.
- Select ***Alignment*** in the Control Type field.
- Select ***Special_Ditch_NW_Ramp*** in the Horizontal Alignment field.
- Unselect ***Use as a Secondary Alignment.***
- Key in ***31+38.43*** in the Start field.
- Key in ***35+99.90*** in the Stop field.
- **<D> Add**

4. In the ***Point Controls*** dialog box:

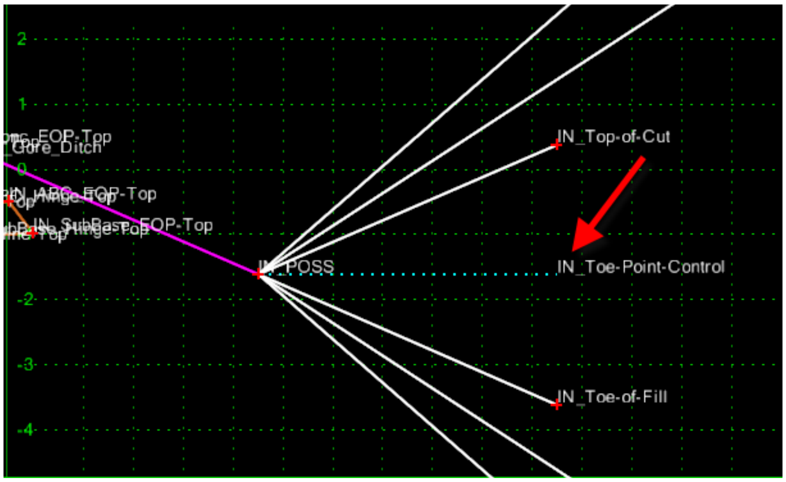
- Select ***IN_POSS*** for the Point field, using the selector button and **<D>** on the template point in the Roadway Designer dialog box.



- Select ***Both*** for the Mode.
- Select ***Corridor Point*** in the Control Type field.
- Select ***IH 39*** in the Corridor field.
- Select ***LT_Outside_Conc_EOP-Top*** in the Reference Point field.
- Key in ***31+38.43*** in the Start field.
- Key in ***35+99.90*** in the Stop field.
- **<D> Add**

5. In the ***Point Controls*** dialog box:

- Select ***IN_Toe-Point-Control*** for the Point field, from the drop-down list.. Note: This component has a display rule.



- Select ***Both*** for the Mode.
- Select ***Corridor Point*** in the Control Type field.
- Select ***IH 39*** in the Corridor field.
- Select ***LT_POSS*** in the Reference Point field.
- Key in ***36+00*** in the Start field.
- Key in ***40+50*** in the Stop field.
- **<D> Add and <D> Close**

Lab 28.7 - Define Key station for IH 39 corridor

1. In the ***Roadway Designer*** dialog box:
2. Select ***IH 39*** in the Corridor field and select **Corridor> Key Stations** in the Roadway designer menu bar.

- Key in ***31+38.42*** in the Station field.
- **<D> Add and <D> Close**

Define Key station for NW Ramp corridor.

3. In the ***Roadway Designer*** dialog box:

4. Select ***NW Ramp*** in the Corridor field and select **Corridor> Key Stations** in the Roadway designer menu bar.

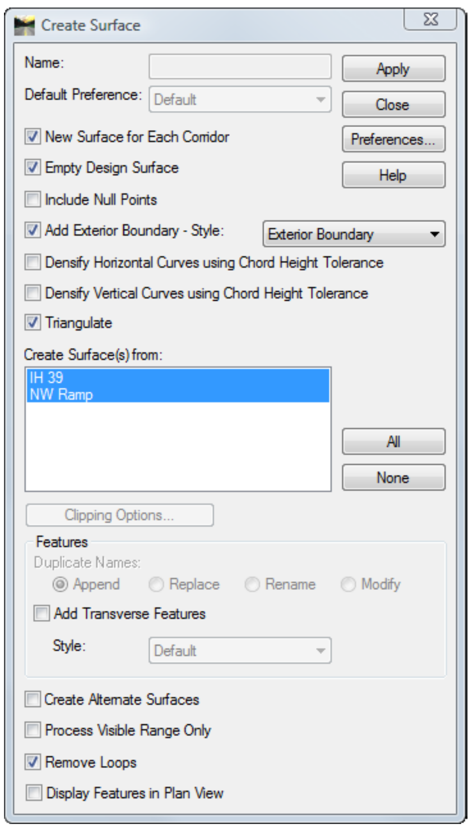
   - Key in ***3599.90*** in the Station field.
   - **<D> Add and <D> Close**

Lab 28.8 - Create Surfaces to display in cross sections to examine design models

1. In the ***Roadway Designer*** dialog box:

2. Select ***Existing_Ground*** in the Active Surface field and select **Corridor> Create Surface** in the Roadway designer menu bar.

   - Select the following options and **<D> Appy** and **<D> Close**



3. In the ***Roadway Designer*** dialog box:

   - Select **File> Save** in the Roadway designer menu bar.

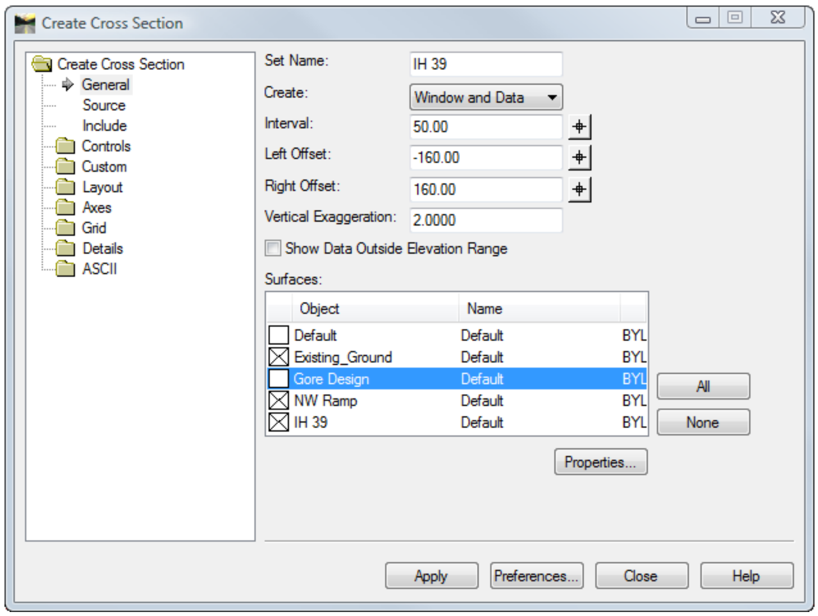
Lab 28.9 - Display cross sections and use cross section viewer to examine mainline and ramp design models together

1. Make ***IH 39*** the active alignment

2. Select **Evaluation> Cross Section> Create Cross Sections** from the InRoads menu bar.

3. **<D> Preferences** and select 40H 20V 320’ Wide

4. Uncheck Gore design surface



- ♦ Display cross sections in an area to the right of the design data.

5. **<D> Apply** and **<D>** in the drawing view to display the cross section set

6. **<D> Close** and

7. Select **Evaluation> Cross Section> Cross section Viewer** from the InRoads menu bar.

8. Select 24+00.00 in the Cross Sections area and **<D> Run**.

9. Examine the ramp and westbound mainline sections as the viewer moves along the taper, gore, and infield areas.

LAB 29 - Forcing Toes Inside of the Right Of Way

There are numerous reasons why it may not be possible to aquire 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 29.1 - 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. 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**

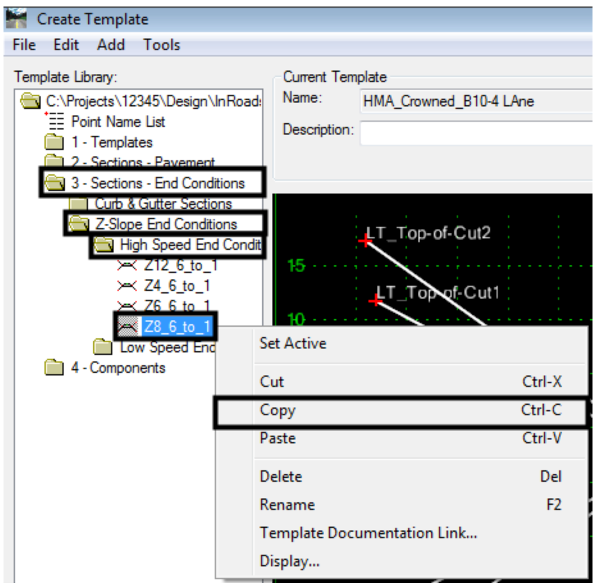
- **C:\Projects\12345\ROW_Survey\InRoads\DTM\12345 existing ground.dtm**
- **C:\Projects\12345\Design\InRoads\12345DES_Templates_Toes-Lab.itl**

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**.

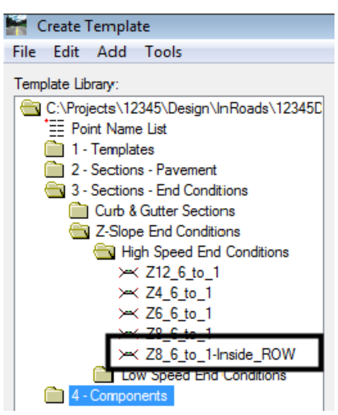
5. Expand the template library to show the **3 - Sections - End Conditions > Z-Slope End Condition - High Speed End Conditions**.

6. **<R>** on the **Z8_6_to_1** and select **Copy** from the right click menu.



7. Paste the copy into the same folder.

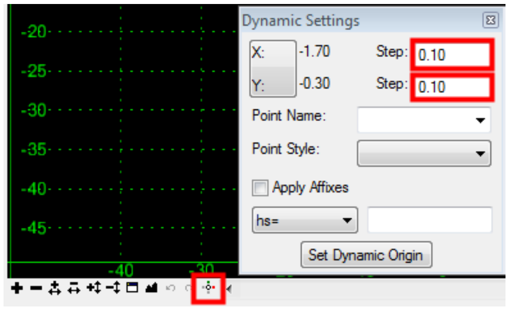
8. Rename the copy **Z8_6_to_1-Inside_ROW.**



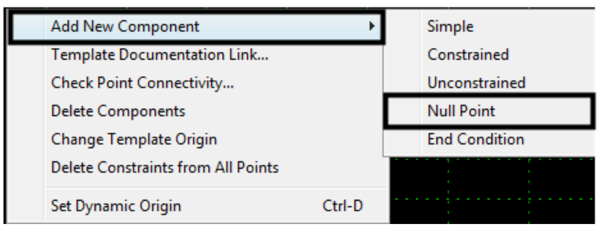
9. **<D> <D>** on the **Z8_6_to_1-Inside_ROW** to open it for editing.

10. Open the Dynamic Settings dialog box.

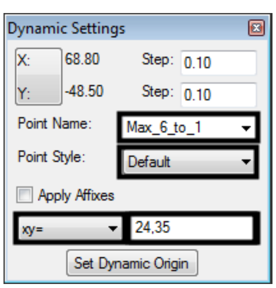
11. Key in ***0.10*** for the ***X*** and ***Y Step***.
12. Verify that **Apply Affixes** is toggled off.



13. **<R>** in the template view and select **Add New Component > Null Point** from the right click menu.

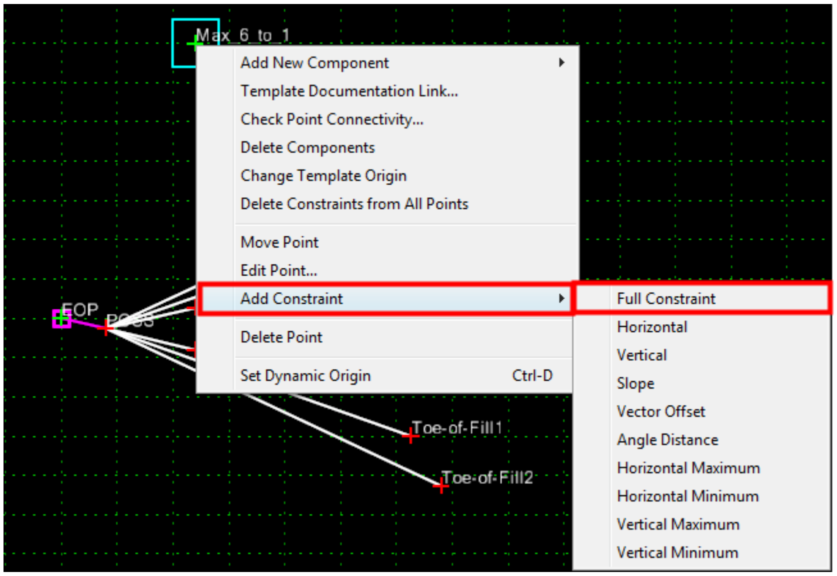


14. In the ***Dynamic Settings*** dialog box, key in ***Max_6_to_1*** in the ***Point Name*** field.
15. Set the ***Point Style*** to ***Default***.
16. Set the precision key in type to **xy=**.
17. In the precision key in field, key in ***24,35*** and press the ***Enter*** key. The 24 equals the maximum 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.

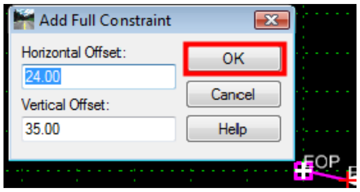
18. **<R>** on the ***Max_6_to_1*** point and select **Add Constraint > Full Constraint** from the right click menu.



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.

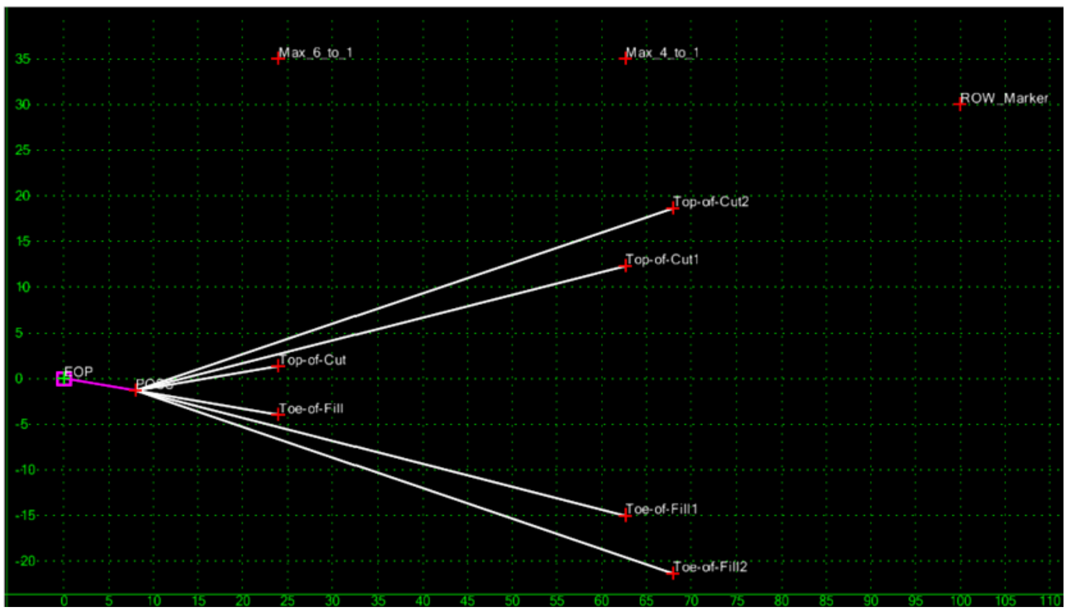
Next, a point to follow the right of way is added.

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.

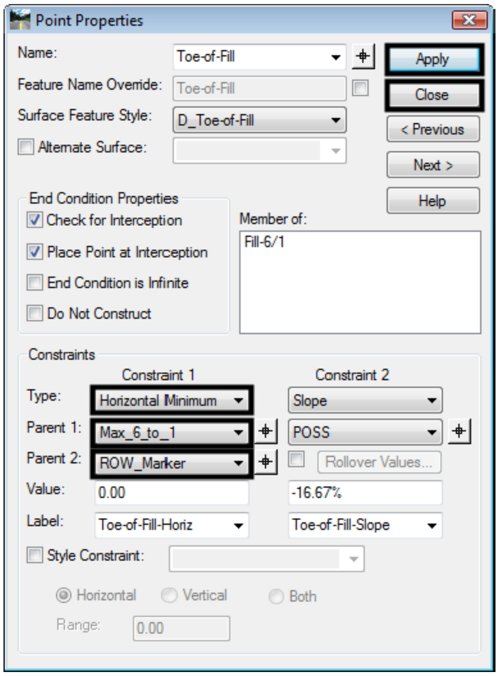
The illustration below shows the template completed to this point.



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 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.

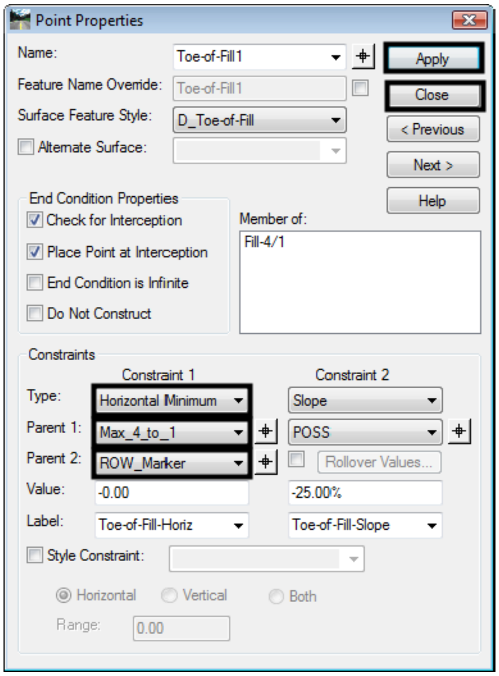
42. Set the ***Constraint 1 Type*** to **Horizontal Minimum**.

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.

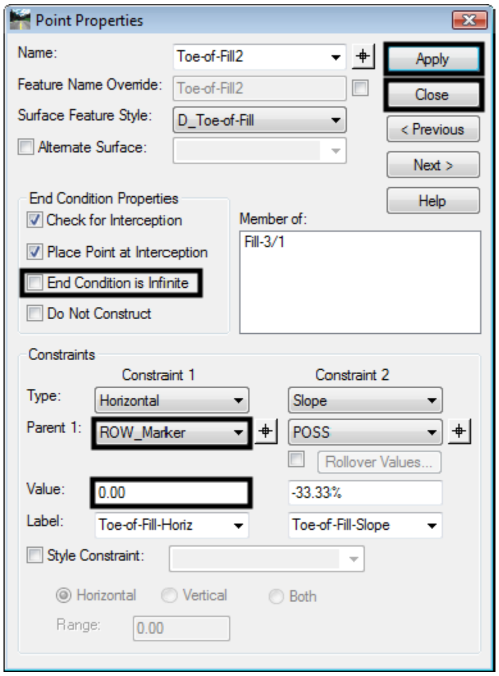
48. **<D> <D>** on the **Toe-of-Fill2** point.

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**.

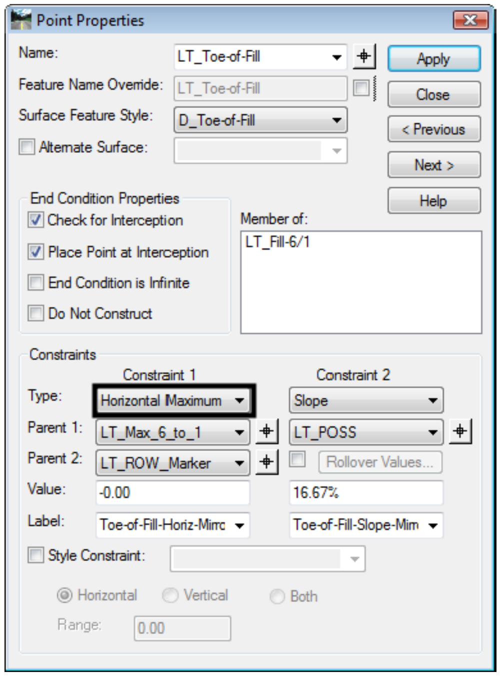
58. **<D>** on the **Z8_6_to_1-Inside_ROW** section to display it in the Preview window.

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.

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 workdone 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 29.2 - Corridor Set up and Run

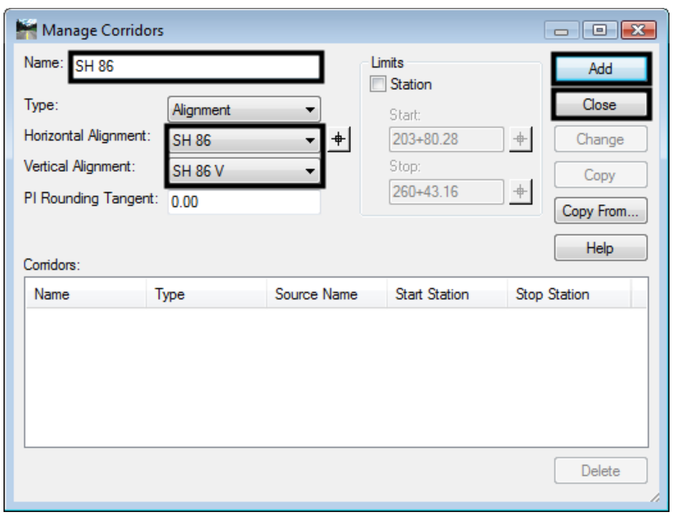
As designed, the template requires two point controls to follow the right of way lines. For this exercise, the right of way lines have already been chained together and imported as horizontal alignments.

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.

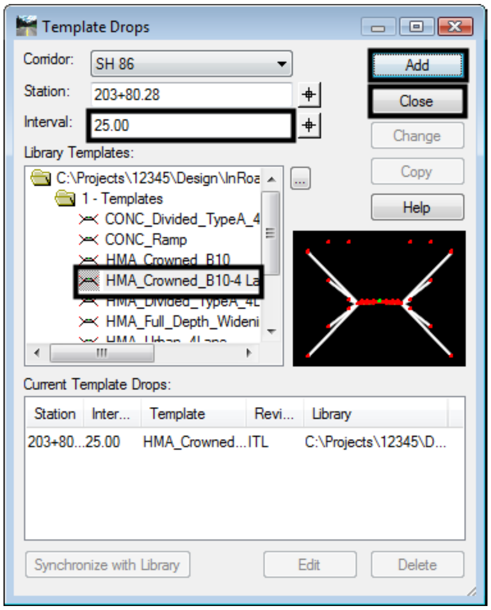
1. Select **Modeler > Roadway Designer** from the InRoads menu bar.

2. From the Roadway Designer menu bar, select **File > New**.
3. Verify the 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.

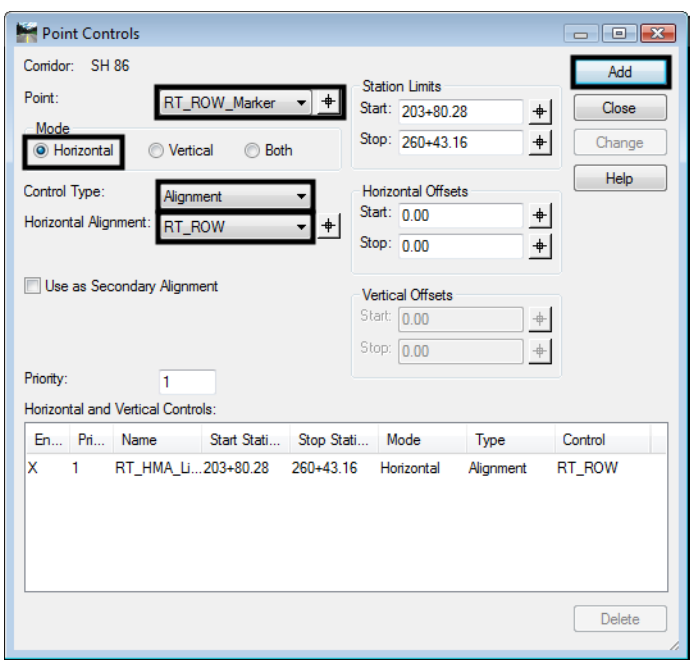
16. In the ***Point Controls*** dialog box, set the ***Point*** to **RT_ROW_Marker**.

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.

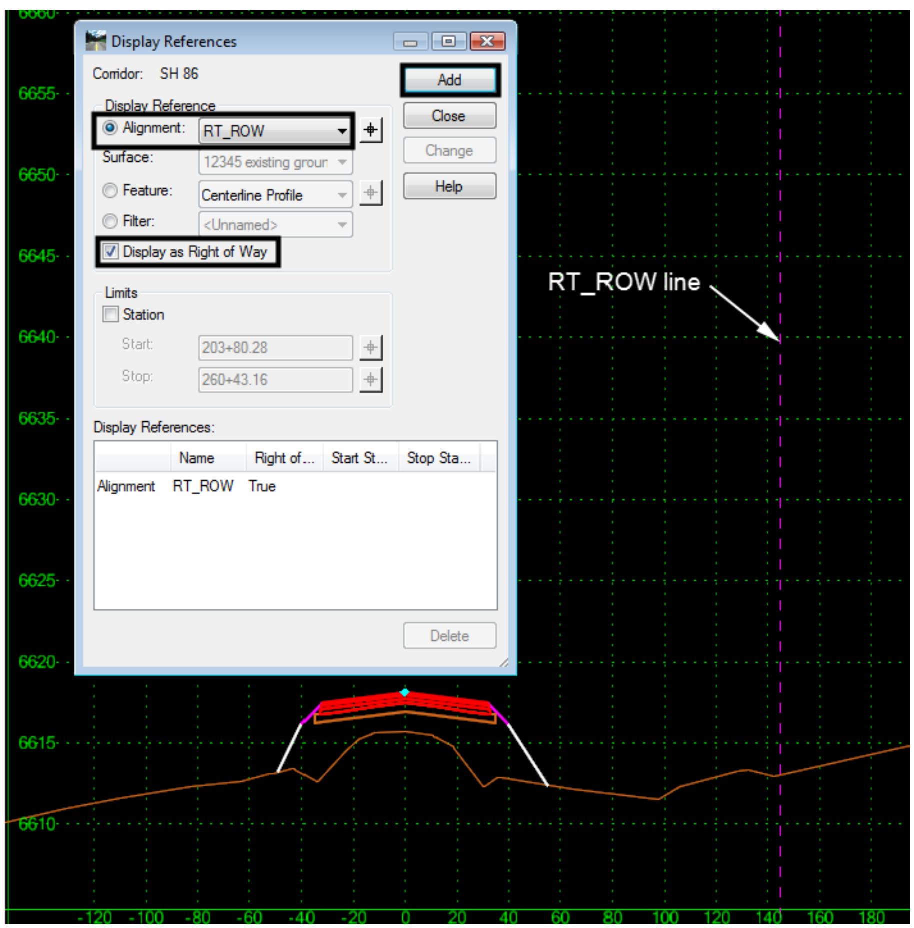
24. Select **Corridor > Display References** from the Roadway Designer menu bar.

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 hekps 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 then show areas that need further consideration.

LAB 30 - End Conditions that Require Multiple Solutions

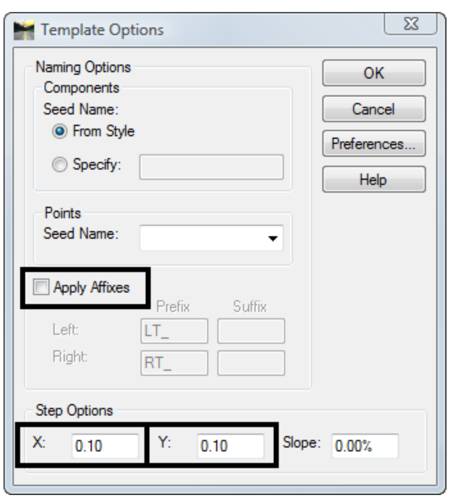
This lab demonstrates the construction of end conditions that require multiple solutions. The section will place a minimum 2-foot depth ditch, with a berm if necessary, when in cut. The section will also place a 4 to 1 fill slope when the embankment height is 10-feet or less and a 3 to 1 fill slope when 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 30.1 - End Conditions that Require Multiple Solutions

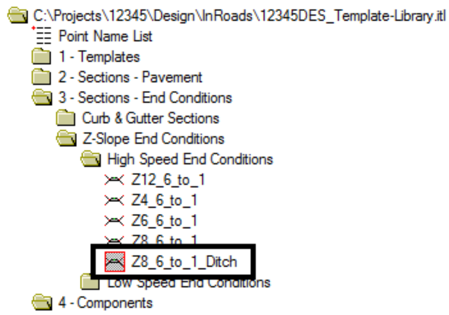
1. Open MicroStation and InRoads using the ***12345DES_Model-End Cond Mult Sol.dgn*** file.
2. Select **File> Open** from the InRoads menu bar.
3. Select the ***C:\Projects\12345\Design\InRoads\ 12345DES_Template-End Cond Mult Sol.itl*** from the available files.
4. **<D> Open** then **<D> Cancel** the ***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.

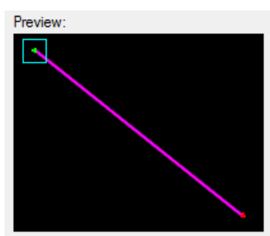
11. Create a new template in the ***High Speed End Conditions*** folder. Name it ***Z8_6_to_1_Ditch***.



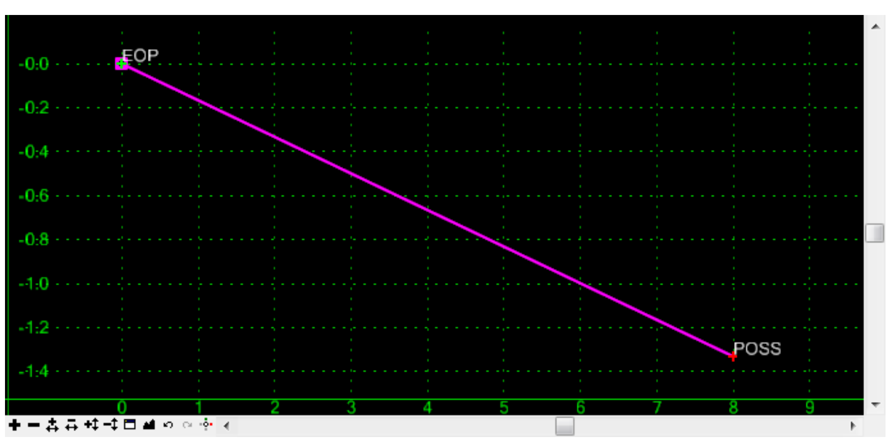
12. Expand ***4 - Components**>* ***End Conditions**>* ***Z-Slope Components*** > ***High Speed End Conditions*** folder.

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.

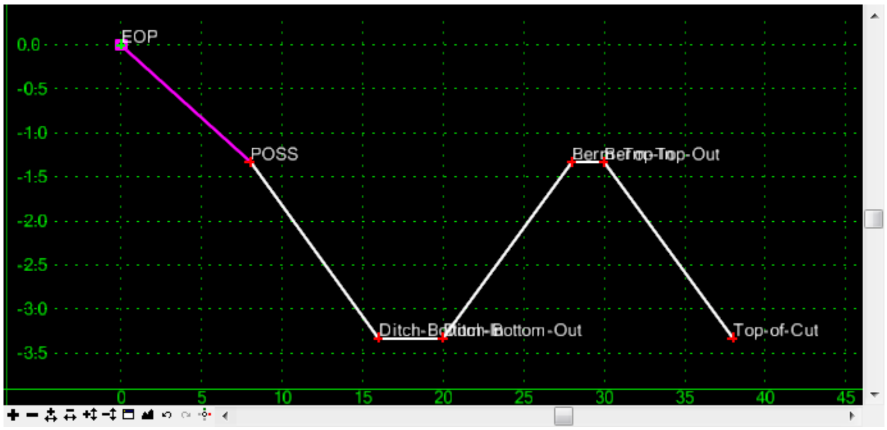


16. Expand ***4 - Components**>* ***End Conditions**>* ***Cut Slope Components*** folder.

17. **<D>** on the ***Cut_Ditch_with_Berm*** component.

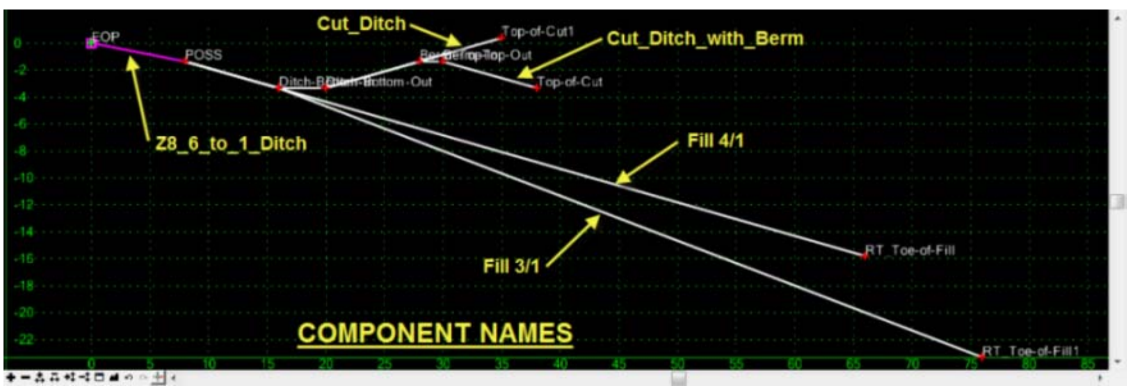
18. **<D> and hold** on component's origin (the green dot).

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.



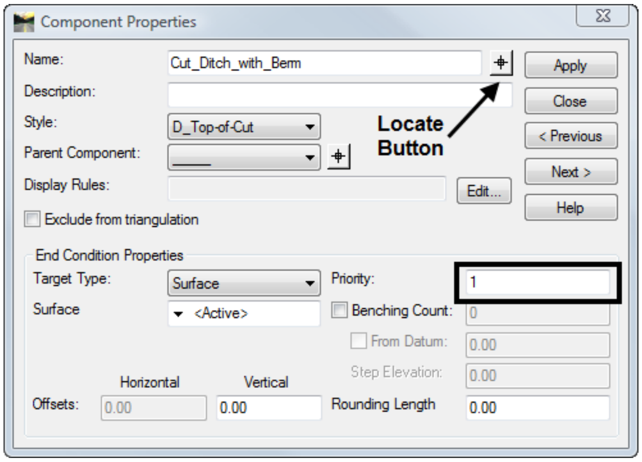
20. Repeat steps 16, 17 & 18 for the ***Cut_Ditch*** component.

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.



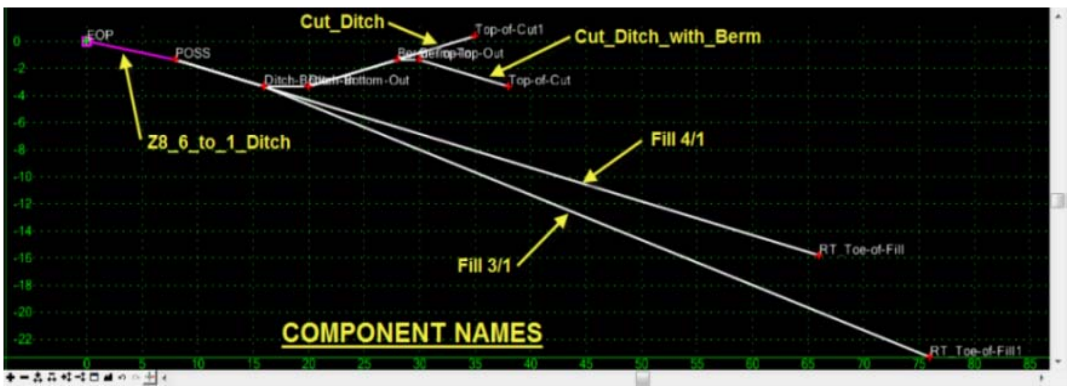
22. **<D> <D>** on the ***Cut_Ditch_with_Berm*** component.

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:

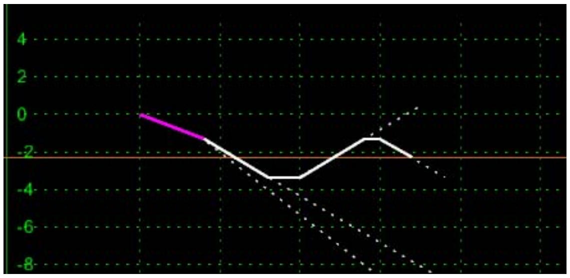
- ***Fill_4/1*** = ***3***
- ***Fill_3/1*** = ***4***

28. Be sure to **<D>** the **Apply** button if any Priority values were modified.

29. **<D>** the **Close** button in the Component Properties dialog.

30. **<D>** the **Test** Button.

31. In the ***Test End Conditions*** dialog box, **<D> Draw** and notice how end conditions behave.



32. **<D> Close**.

LAB 31 - 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

Lab 31.1 - 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

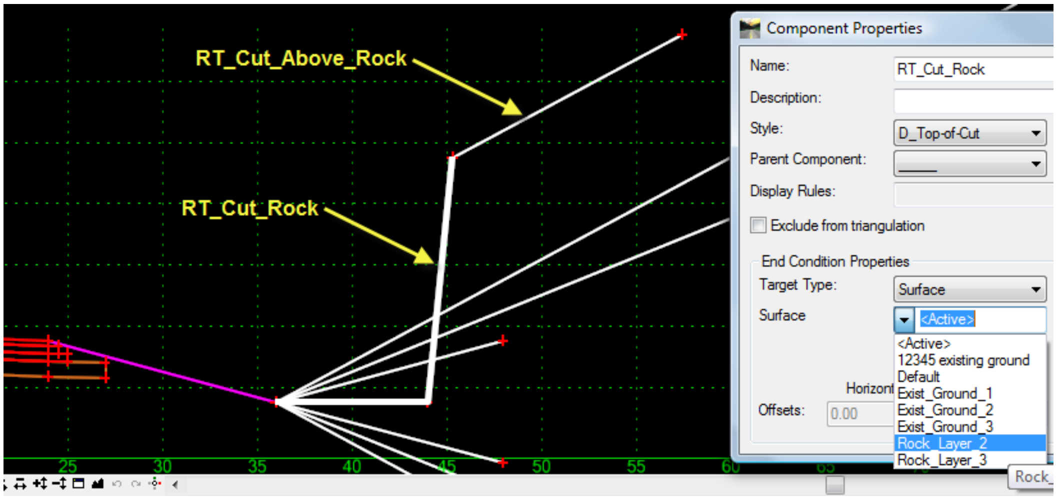
2. Select **File> Open** from the InRoads menu bar.
3. Select the following files from ***C:\Projects\12345\Design\InRoads*** and **<D> Open** them.
   - ♦ CDOT_Civil.xin
   - ♦ 12345DES_Geometry-Create End Condit Search Surf.alg
   - ♦ 12345DES_Template-Create End Condit Search Surf.itl
   - ♦ 12345DES_Roadway-Create 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 ***Open*** dialog box to close.

Lab 31.2 - 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



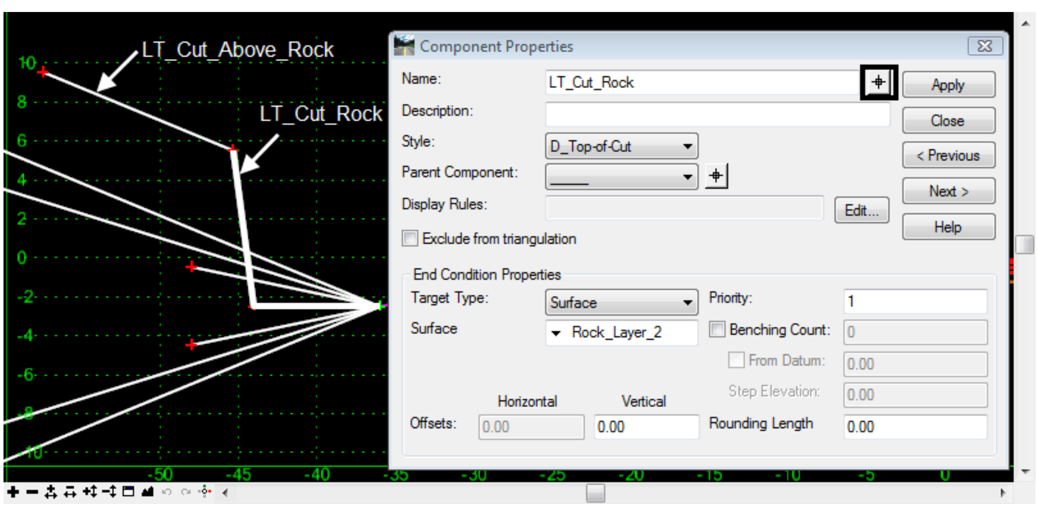
5. **<D> <D>** on the ***RT_Cut_Rock*** component.

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**.

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 or **<D>** the corridor management button .

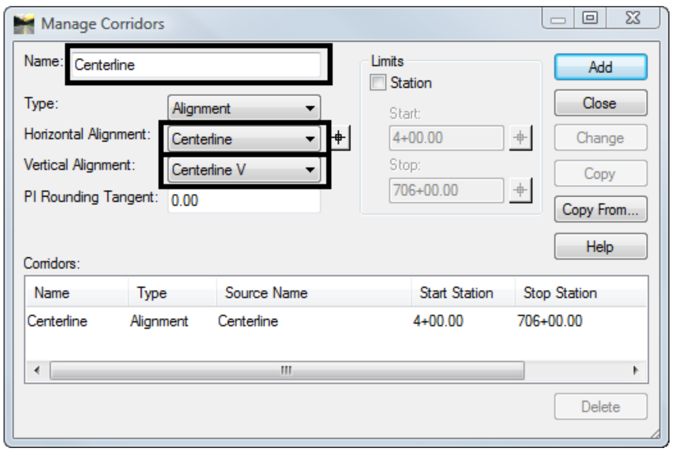
12. In the ***Manage Corridors*** dialog box:

   ♦ Key in ***Centerline*** in the Name field.

   ♦ Select **Centerline** Horizontal Alignment.

   ♦ Select **Centerline V** Vertical Alignment.

13. **<D> Add** then **<D> Close**.



Lab 31.3 - Define template drop for the corridor

1. Select **Corridor> Template Drops** from the Roadway Designer menu bar or **<D>** the template drops button  .

2. In the ***Template Drops*** dialog box:

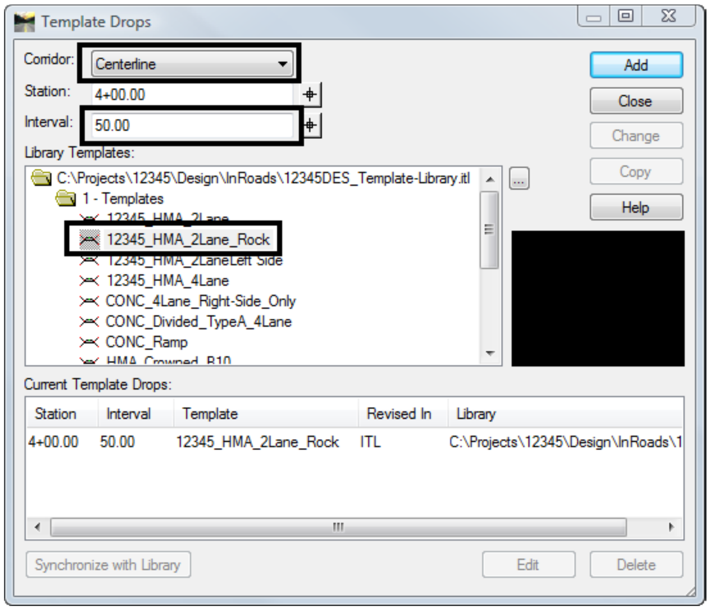
   ♦ Select ***Centerline*** for the ***Corridor*** name.

   ♦ Key in ***50*** for the ***Interval***.

   ♦ Expand ***1 - Templates*** folder in ***Library Templates*** area.

   ♦ **<D>** on the **12345_HMA_2Lane_Rock** template.

- **<D> Add**.



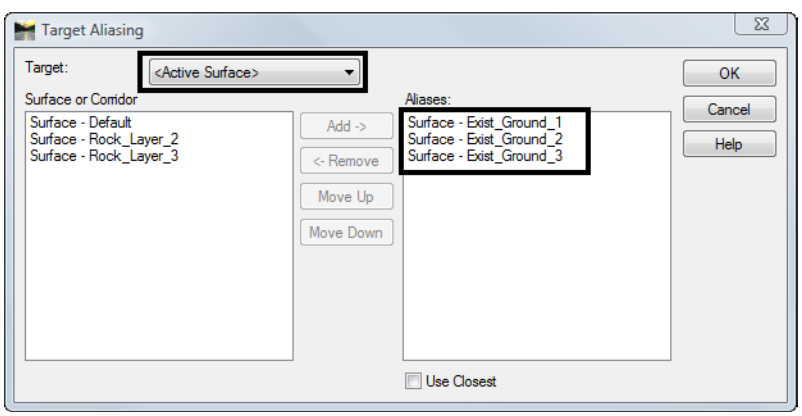
- **<D> Close**

Lab 31.4 - Define target aliasing

3. Select **Tools> Target Aliasing** from the Roadway Designer menu bar.

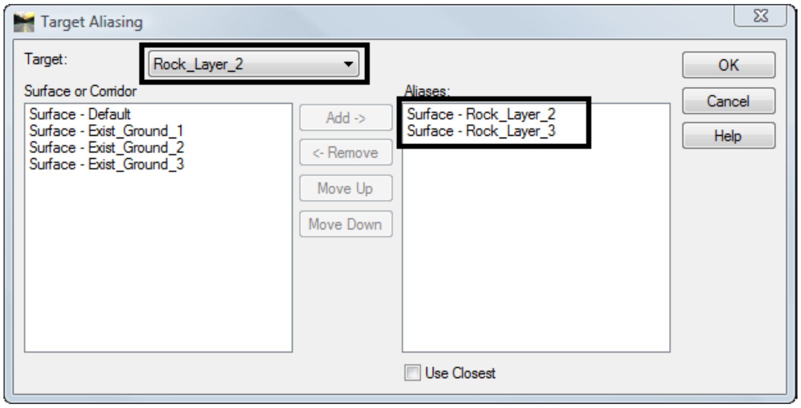
4. In the ***Target Aliasing*** dialog box:

   - Select ***<Active Surface>*** for the ***Target***.
   - Select ***Surface - Exist_Ground_1***, ***Surface - Exist_Ground_2*** and ***Surface - Exist_Ground_3*** in the ***Surface or Corridor*** area.
   - **<D> Add ->**.



   - Select ***Rock_Layer_2*** for the ***Target***.
   - Select ***Surface - Rock_Layer_2*** and ***Surface - Rock_Layer_3*** in the ***Surface or Corridor*** area.

- **<D> Add ->**.

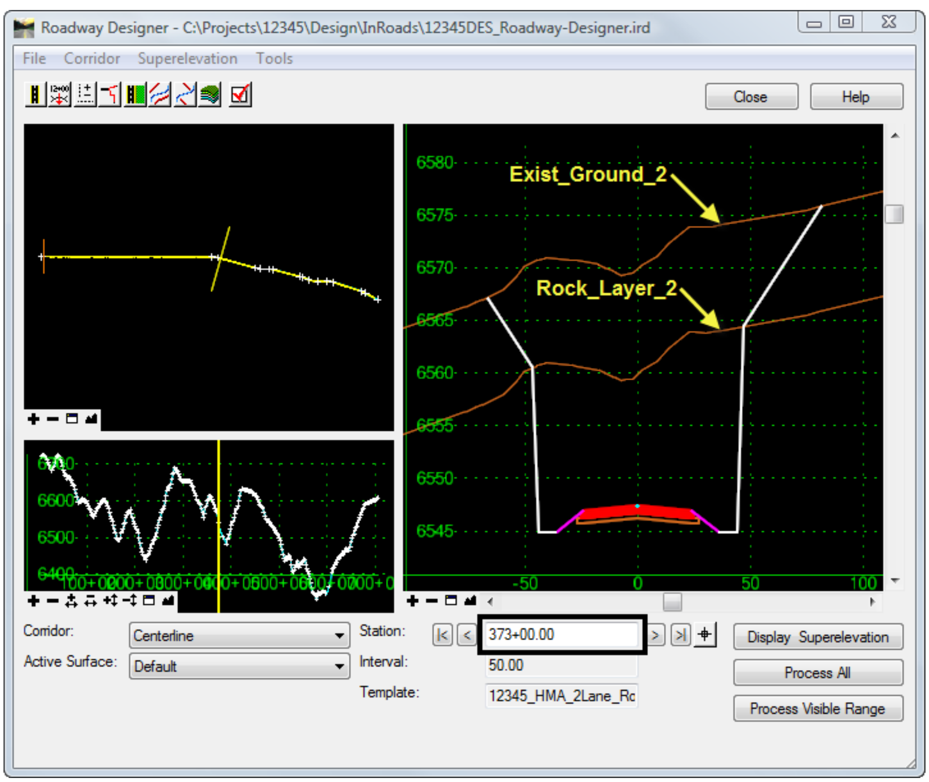


5. **<D> OK**

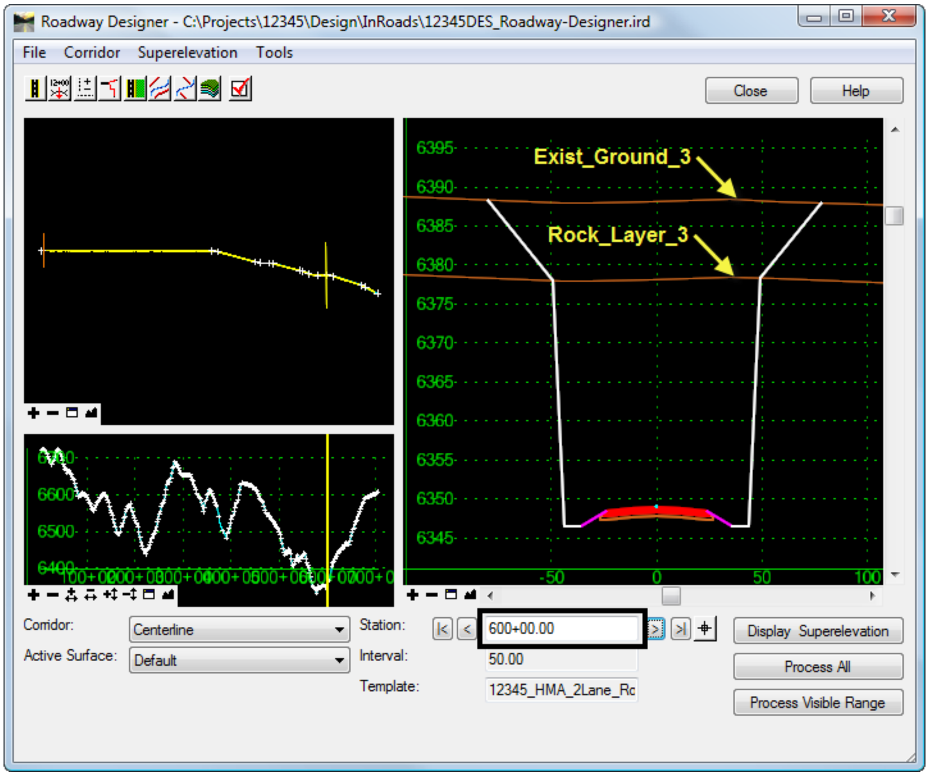
Lab 31.5 - View the corridor to examine the end condition's behavior and determine if templates and target aliasing are working properly.

1. In the ***Roadway Designer*** dialog box:

- Key in ***373+00*** for the ***Station***.



♦ Key in ***600+00*** for the ***Station***.



Note: Notice the end conditions target the multiple existing ground and rock layer surfaces in both of the above Roadway Designer dialog's cross- section viewer. Both of the station locations shown are in deep rock cut sections in the profile.

Chapter Summary:

- In this lab an existing template was modified to target a rock layer.
- In this lab a corridor was built to use target aliasing to target multiple existing ground and rock layer surfaces along three segments of the project.
- In this lab the corridor was examined at the end condition to determine if templates and target aliasing were working properly.

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 Ave. 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 template 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.
- **16628**.xin – This file controls the preferences

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 mainline design surface to include curb returns
6. Update corridor
7. Create the final intersection Surface

Initial Modeling

Chapter 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 5th Ave., the intersecting street. Using the new vertical alignment and the predefined template for 5th 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

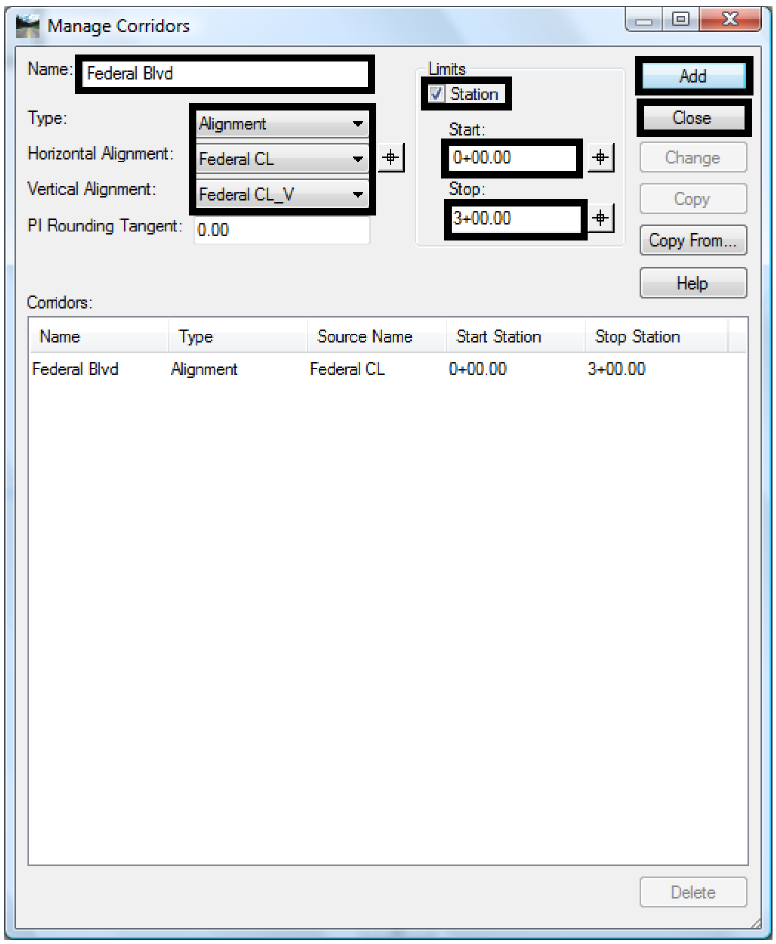
1. Open the **Federal @ 5thAve.alg** geometry file.
2. Open the **Federal_and_5th.itl** template library.
3. Open the **16628_Existing.dtm** surface.

Create the Federal Blvd. Corridor

The Federal Blvd. alignment runs from north of 5th Ave to south 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 ***Type*** to **Alignment**.
5. Select **Federal CL** as the ***Horizontal Alignment***.
6. Select **Federal CL_V** as the ***Vertical Alignment***.
7. Toggle on **Station** in the ***Limits*** area.
8. Key in ***0+00.00*** for the ***Start*** station.
9. Key in ***3+00.00*** for the ***Stop*** station.
10. **<D> Add** to complete the corridor.
11. **<D> Close** to dismiss the ***Manage Corridors*** dialog box.



Add Federal Blvd. Template Drops

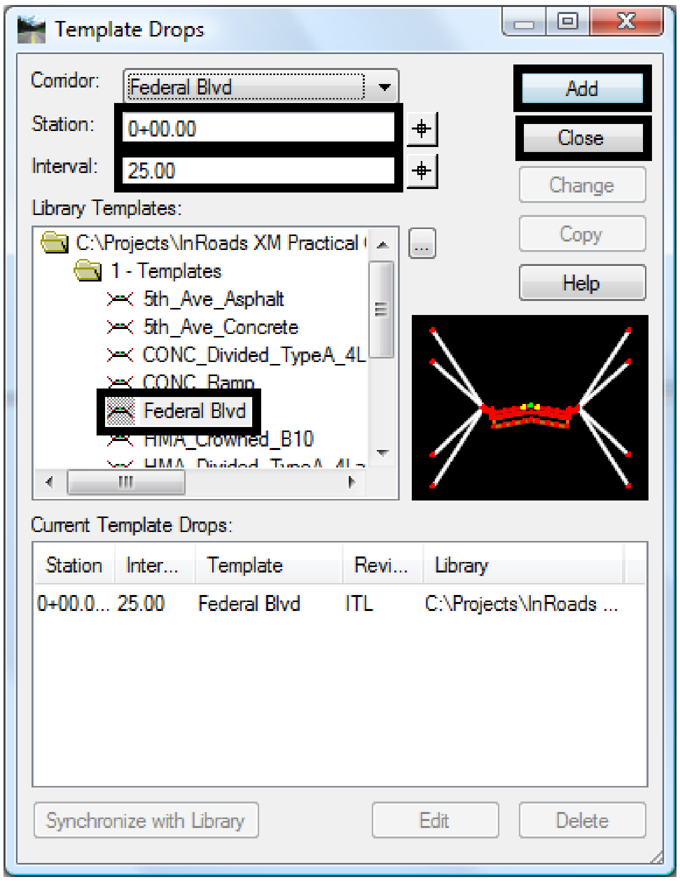
1. In the ***Roadway Designer*** dialog box, select **Corridor > Template Drops** or **<D>** the  button. This displays the ***Template Drops*** dialog box.

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 slopewith the 5th Ave vertical alignment.

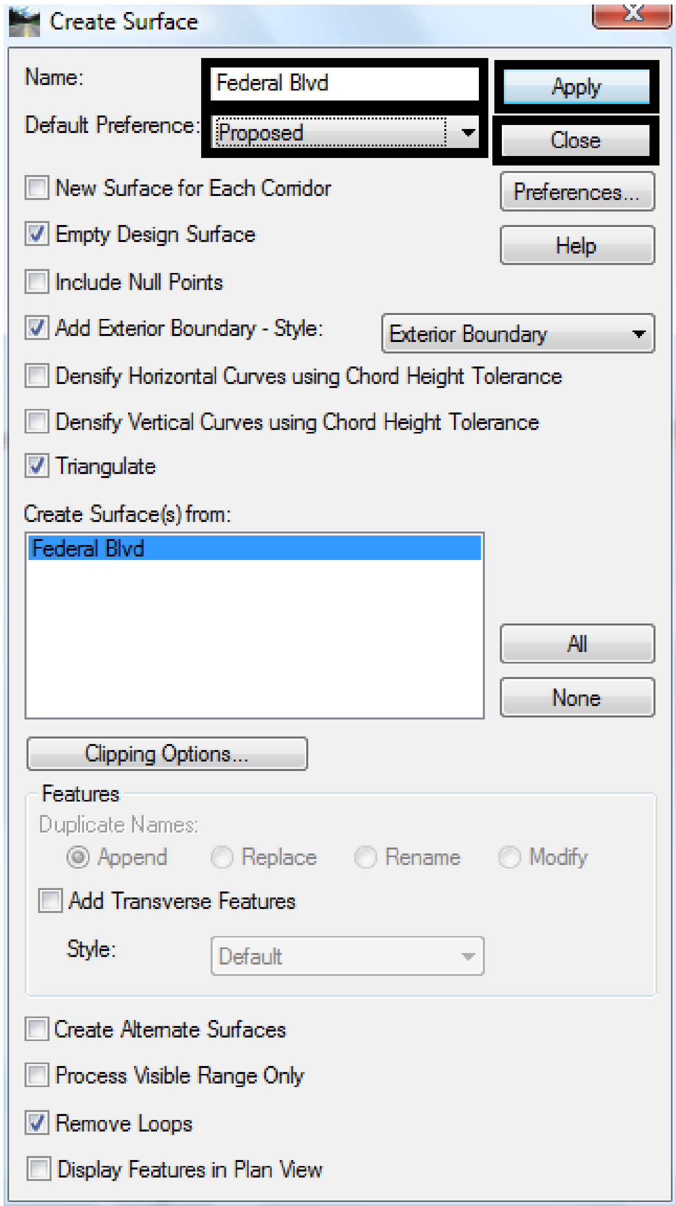
1. In the ***Roadway Designer*** dialog box, select **Corridor > Create Surface** or **<D>** the  button. This displays the ***Create Surface*** dialog box.

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.

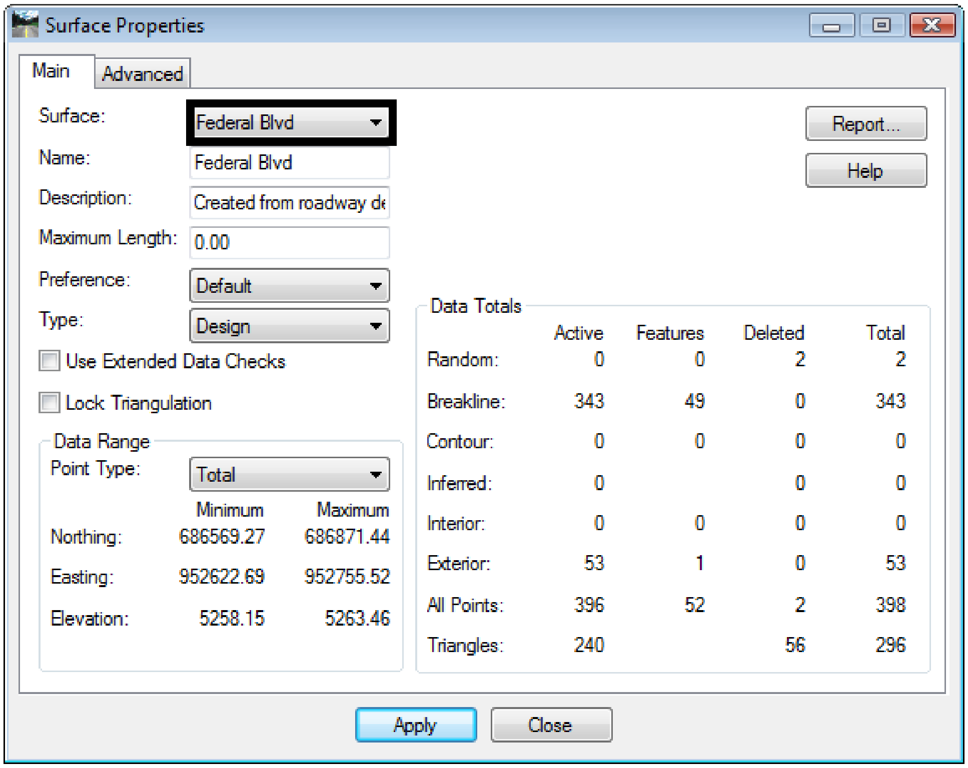
7. Key in ***Federal_and_5th.ird*** for the file name.

8. **<D> Save** then **<D> Cancel** in the ***Save As*** dialog box.

9. **Close** the Roadway Designer dialog box.

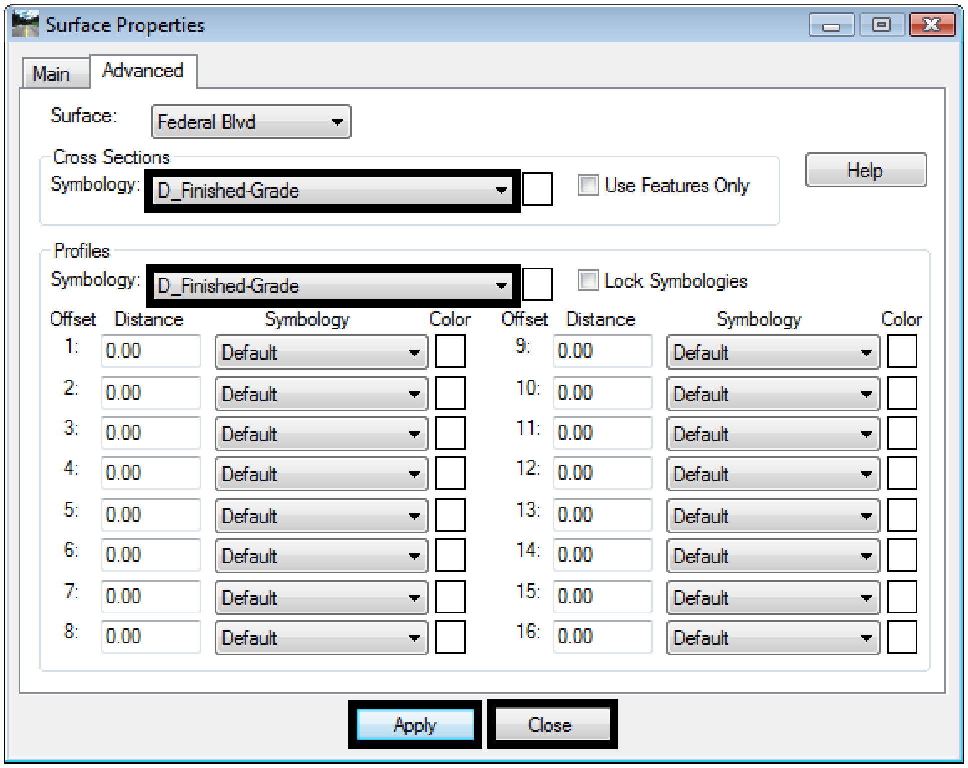
Changing the symbology for the cross sections and profiles makes it easier to deferintiate between surfaces.

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.

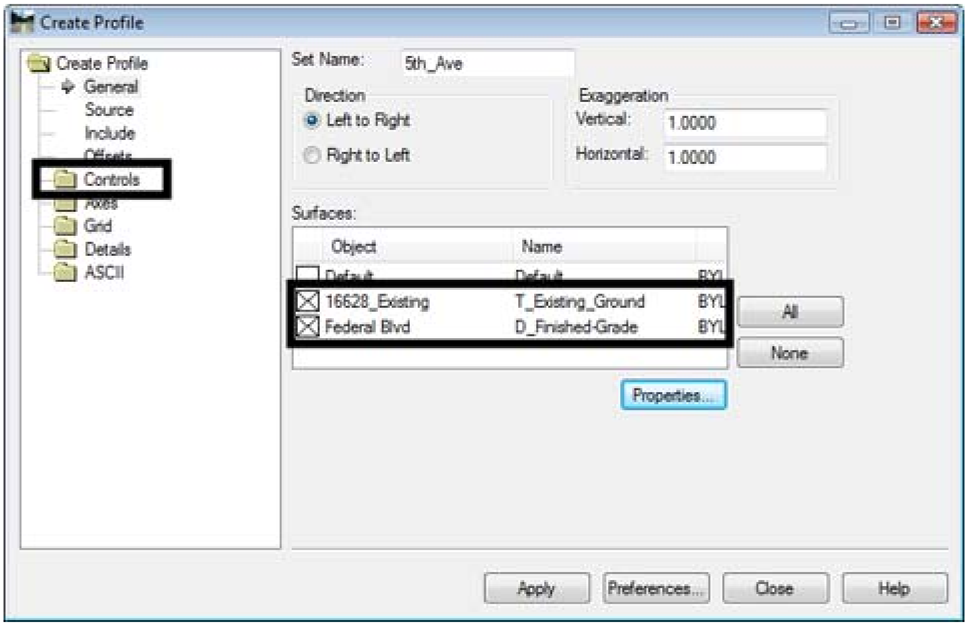
In order to define a vertical alignment, a profile window is required. The existing surface along with the initial federal Blvd. surfaceare displayed in this profile.

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.

4. On the ***General*** leaf, enter **5th_Ave** for the ***Set Name***.



The 5x Vertical preference is used here so that the slopes are easier to see.

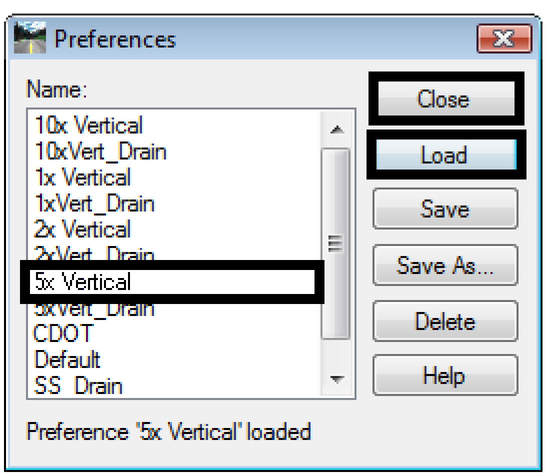
5. **<D> Preferences** and highlight the preference **5x Vertical** from the list.

Note: Because there are so many settings that control the look and feel of a profile, several CDOT preferences have been created that can be used to 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.

6. Toggle on Right to Left in the Direction area.

Important! Stationing of alignments normally increase from left to right. In this case, the 5th Ave. alignment increases in stationing from Right to Left so the direction of the profile needs to be changed to fit this circumstance.

7. **<D> Load** to load the preference and then **<D> Close**.

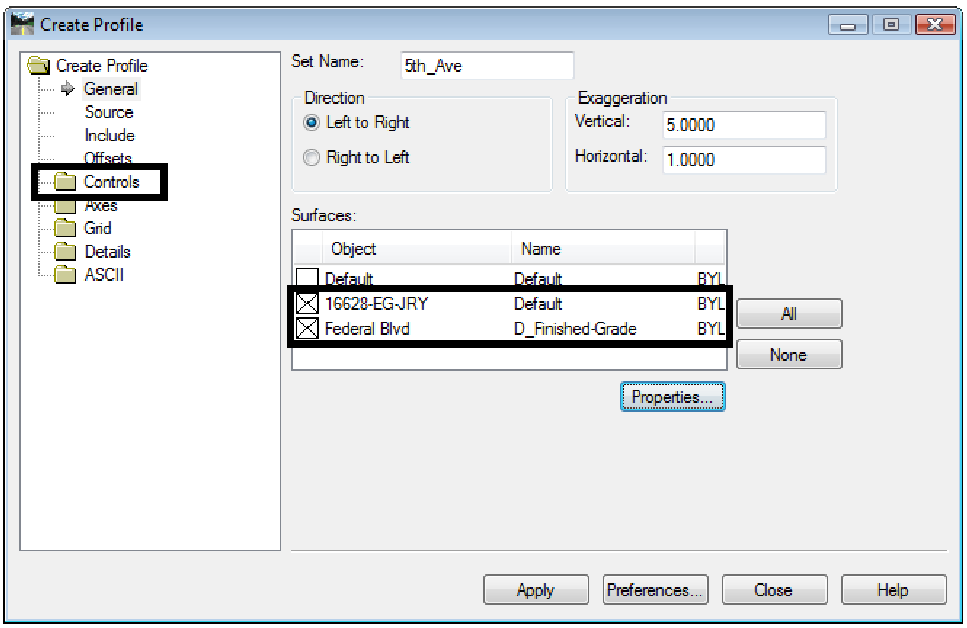


8. Toggle on Right to Left in the Direction area.

Important! Stationing of alignments normally increase from left to right. In this case, the 5th Ave. alignment increases in stationing from Right to Left so the direction of the profile needs to be changed to fit this circumstance. The direction should be set after loading a preference; otherwise it will be overwritten by the setting in the preference.

9. Toggle on the **16628_Existing** and **Federal Blvd** surfaces.

10. **<D>** on the **Controls** leaf.



11. Toggle on **Use** in the ***Station*** area.

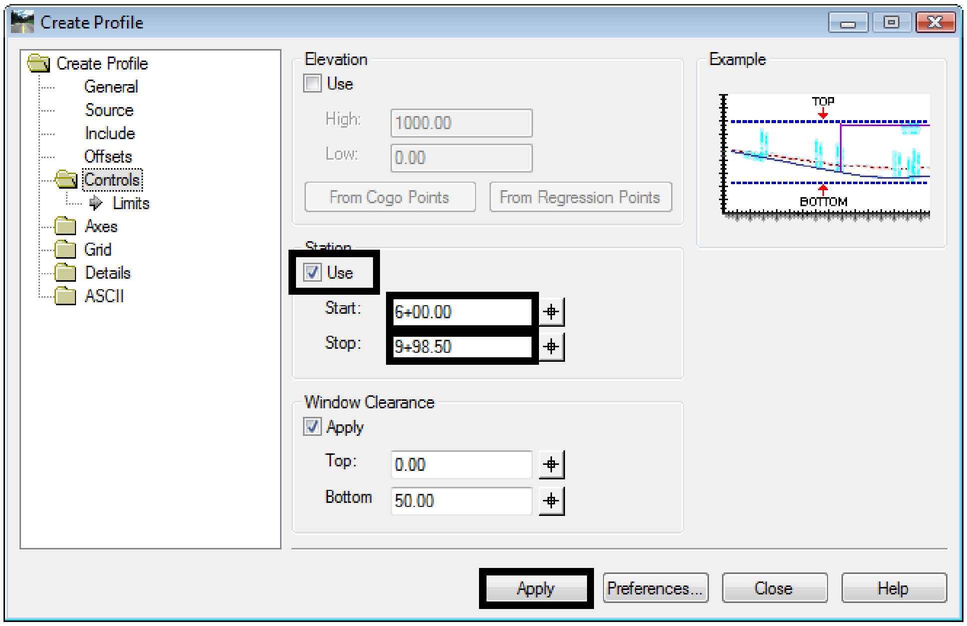
Because this lab is concerned with just the intersection, the vertical alignment (and the profile) is constructed to cover just the area of the intersection.

12. Key in ***6+00.00*** for the ***Start*** station.

13. Key in ***9+98.50*** for the ***Stop*** station.

14. Toggle on **Apply** in the ***Window Clearance*** area.

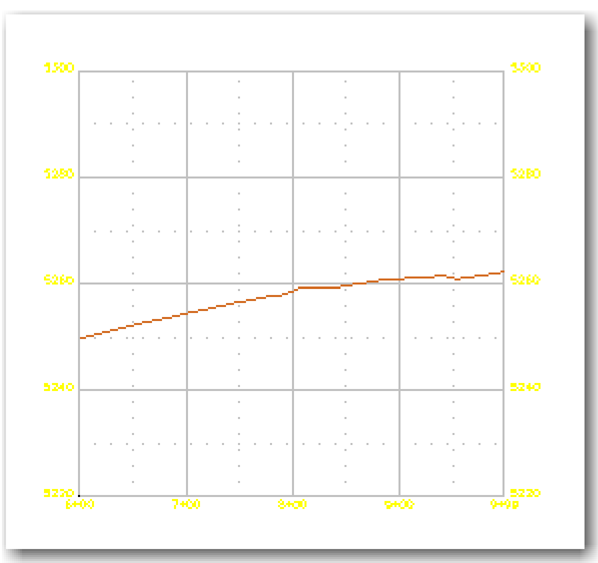
15. Key in ***25*** for both the T***op:*** and ***Bottom***.



16. **<D> Apply**.

17. **<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.

18. The profile should look similar to the following:

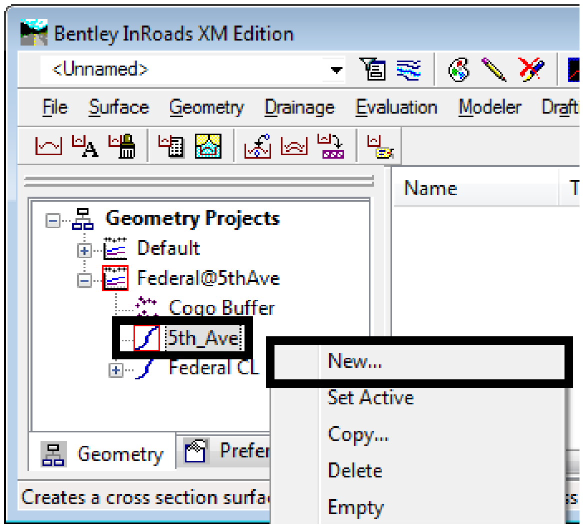


19. **<D> Close** on the ***Create Profile*** dialog box to dismiss it.

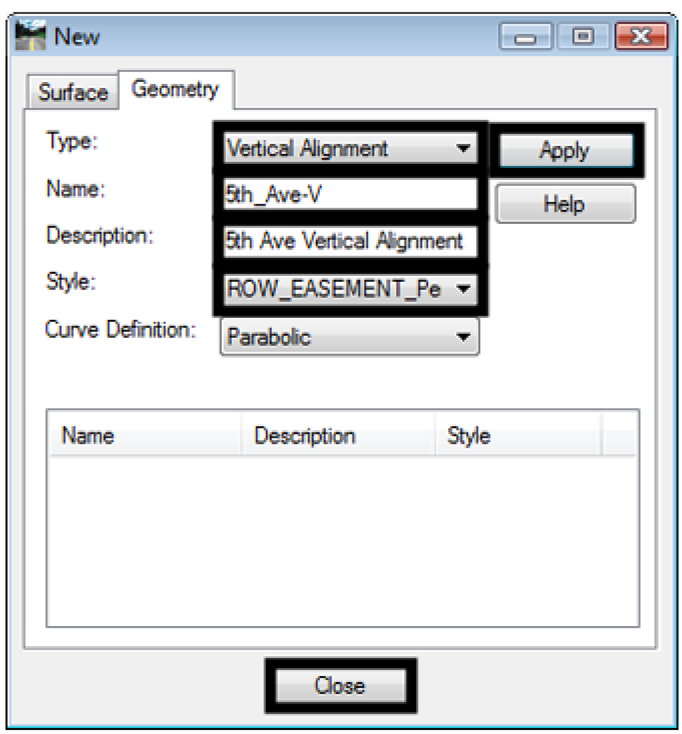
Define the 5th Ave Vertical Alignment

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.



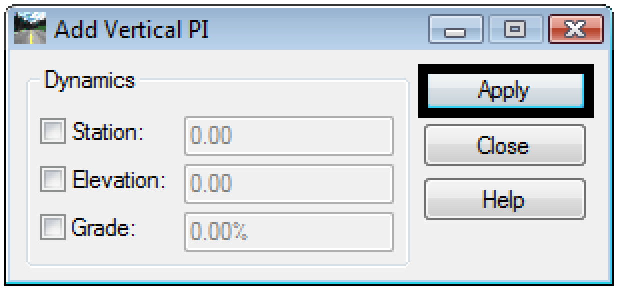
4. In the ***New*** dialog Box, set the ***Type*** to **Vertical Alignment**.
5. In the ***Name*** field, key in ***5th_Ave-V***.
6. In the ***Description*** field, key in ***5th Ave Vertical Alignment***.
7. Set the ***Style*** to **ALG_PRO_Vert**. (This stands for Alignment Proposed)
8. The dialog box should look like the following:



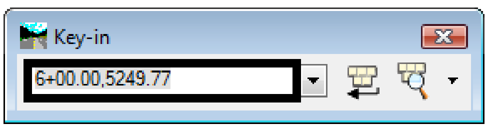
9. **<D> Apply** and **<D> Close**.

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

11. In the ***Add Vertical PI*** dialog box, **<D> Apply**.



12. In the MicroStation **Key in** window, key in ***se=6+00.00, 5249.77*** and press **Enter**.



13. Key in ***se=7+87.03, 5258.98*** and press Enter.

14. Key in ***se=9+57.06, 5262.00*** 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.

15. Key in ***se=9+98.49, 5262.82*** and press Enter.

16. **<R>** to stop placing PI's.

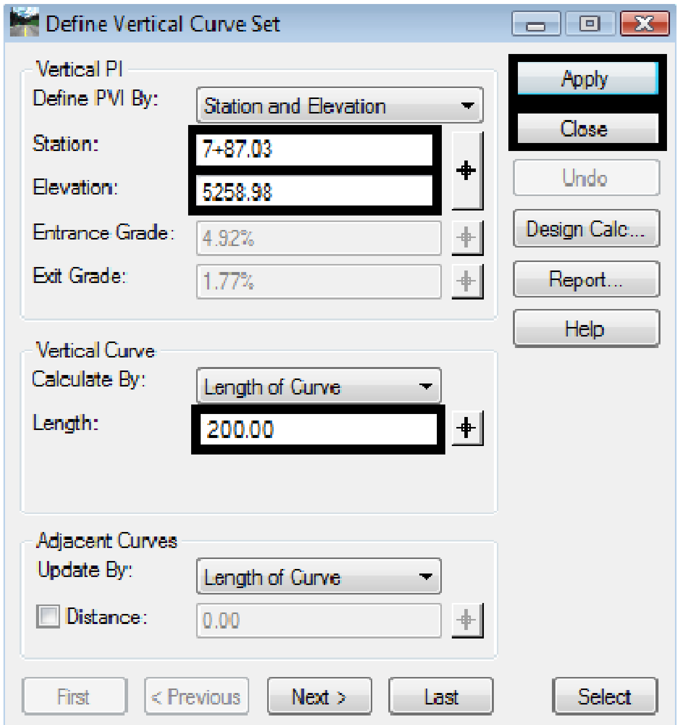
17. In the ***Add Vertical PI*** dialog box, **<D> Close** to dismiss the dialog box.

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

19. In the ***Define Vertical Curve Set*** dialog box, verify that the ***Station*** is ***7+87.03***.

20. Verify that the ***Elevation*** is ***5258.98***.

21. In the ***Vertical Curve*** area, key in ***200.00*** in the ***Length*** field.



22. **<D> Apply** and **<D> Close**.

Create the Initial 5th Ave. Design Surface

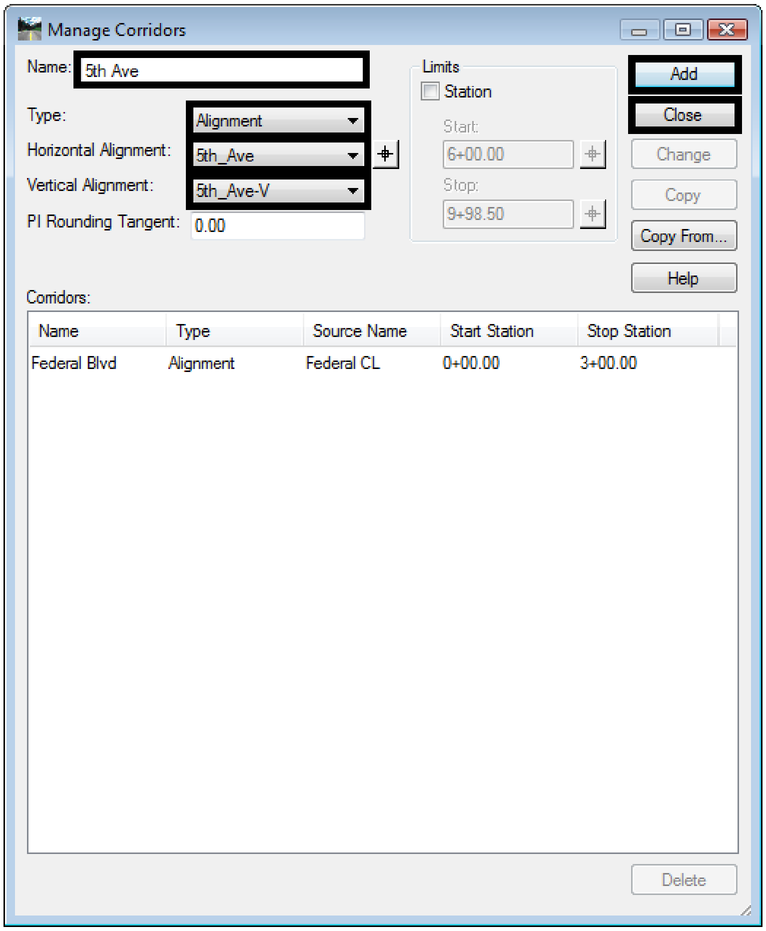
- Define the corridor for the crossing street
- Add template drops
- Add point controls
- Create the initial crossing street design surface

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 tmplate 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.

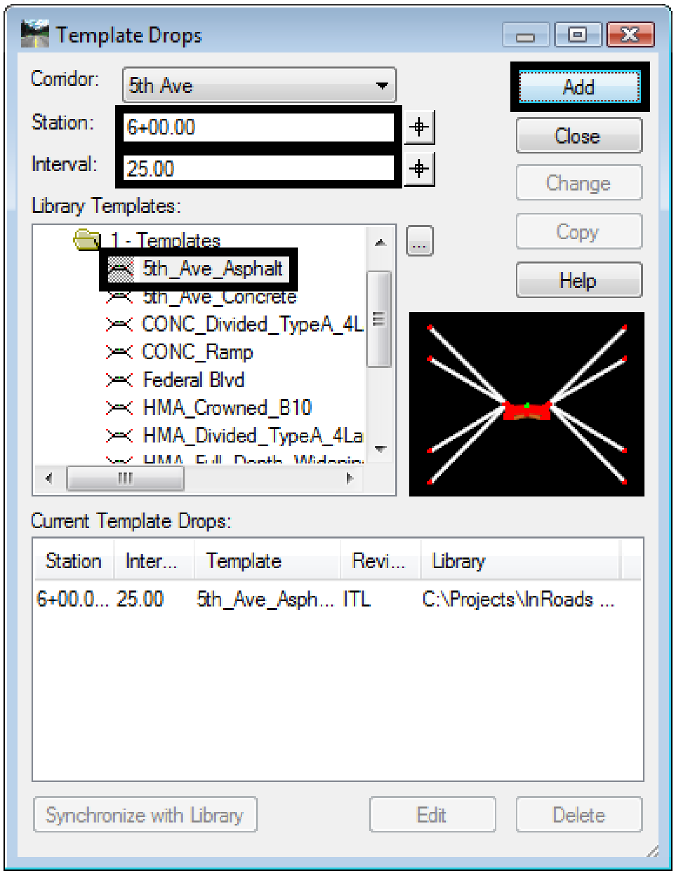
2. Verify the ***Corridor*** is set to **5th Ave**

3. In the **Template Drops** dialog box, Key in ***6+00.00*** for the ***Station***.

4. Key in ***25*** for the ***Interval***.

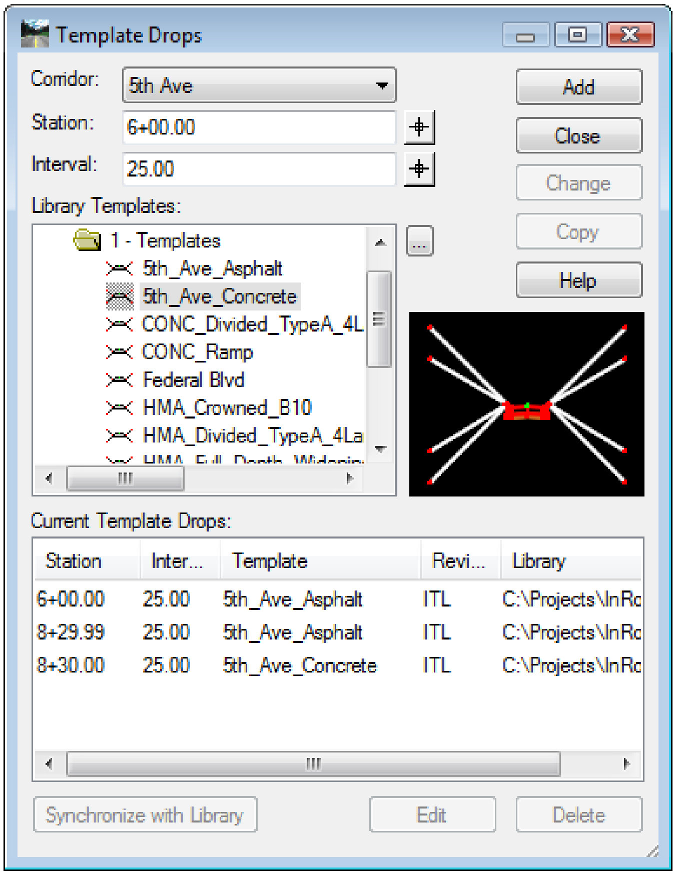
5. In the Library Templates area, expand the **1 – Templates** folder.

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 should appear in the dialog box as follows:



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 throught 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 ***Point Controls*** dialog box, set the ***Point*** to **RT_HMA_Lift1_Laneline-Top** using the drop down menu or the Button.

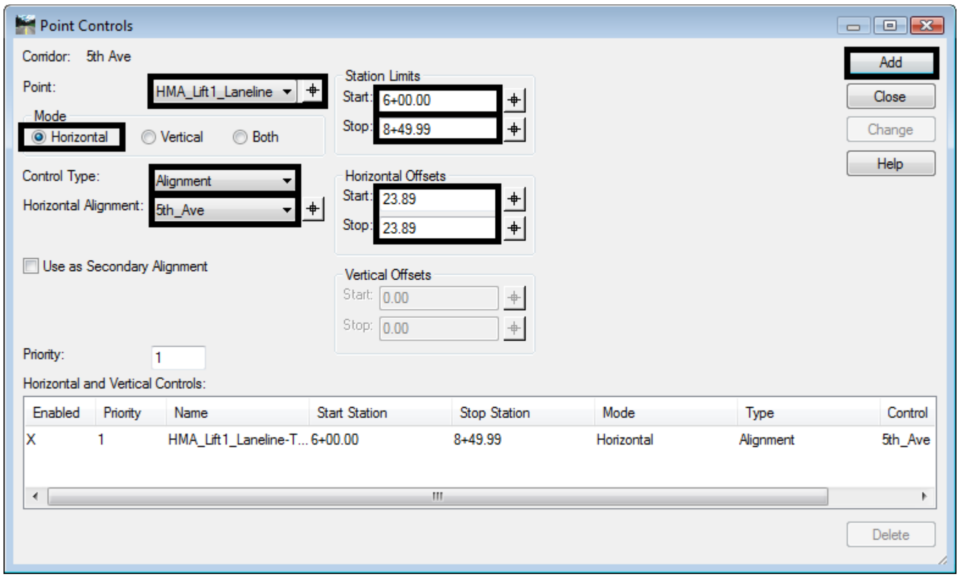
3. Toggle on **Horizontal** in the ***Mode*** area.

4. Set the ***Control Type*** to **Alignment**.

5. 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.

6. In the ***Station Limits*** area, key in ***6+00.00*** for the ***Start*** station.
7. Key in ***8+29.99*** for the ***Stop*** station.
8. In the ***Horizontal Offsets*** area, key in ***23.89*** for the ***Start*** and ***Stop*** offsets.
9. **<D> Add**.



10. Advance the Station to 8+30.00 in the Roadway Designer plan view window.
11. Set the Point to **RT_Conc_Laneline-Top** using the drop down menu or the  button.
12. In the ***Station Limits*** area, key in ***8+30.00*** for the ***Start*** station.
13. Key in ***9+98.50*** for the ***Stop*** station.
14. In the ***Horizontal Offsets*** area, key in ***23.89*** for the ***Start*** and ***Stop*** offsets.
15. **<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.

16. Set the Point to **LT_HMA_Lift1_Laneline-Top**.
17. In the ***Station Limits*** area, key in ***6+00.00*** for the ***Start*** station.
18. Key in ***8+29.99*** for the ***Stop*** station.
19. In the ***Horizontal Offsets*** area, key in ***-12.45*** for the ***Start*** and ***Stop*** offsets.

20. **<D> Add**.

21. Set the Point to **LT_Conc_Laneline-Top**.

22. In the ***Station Limits*** area, key in ***8+30.00*** for the ***Start*** station.

23. Key in ***9+00.48*** for the ***Stop*** station.

24. In the ***Horizontal Offsets*** area, key in ***-12.45*** for the ***Start*** offset.

25. Key in ***-15.87*** for the ***Stop*** offset.

26. **<D> Add**.

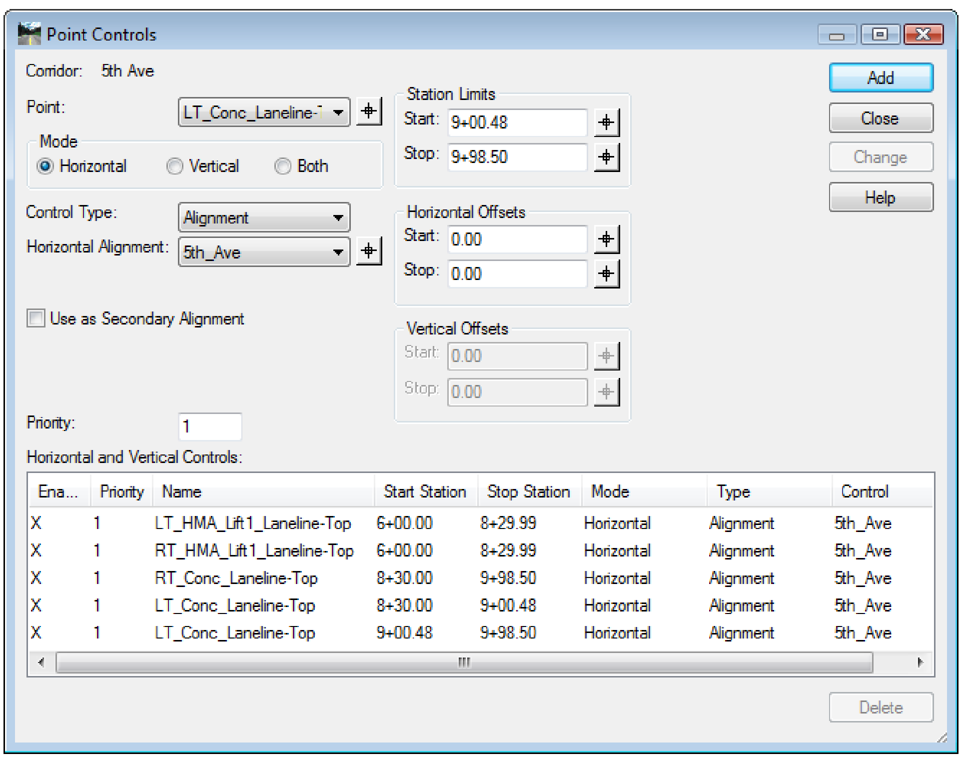
27. In the ***Station Limits*** area, key in ***9+00.48*** for the ***Start*** station.

28. Key in ***9+98.50*** for the ***Stop*** station.

29. In the ***Horizontal Offsets*** area, key in ***-15.87*** for the ***Start*** and ***Stop*** offsets.

30. **<D> Add**.

31. 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.

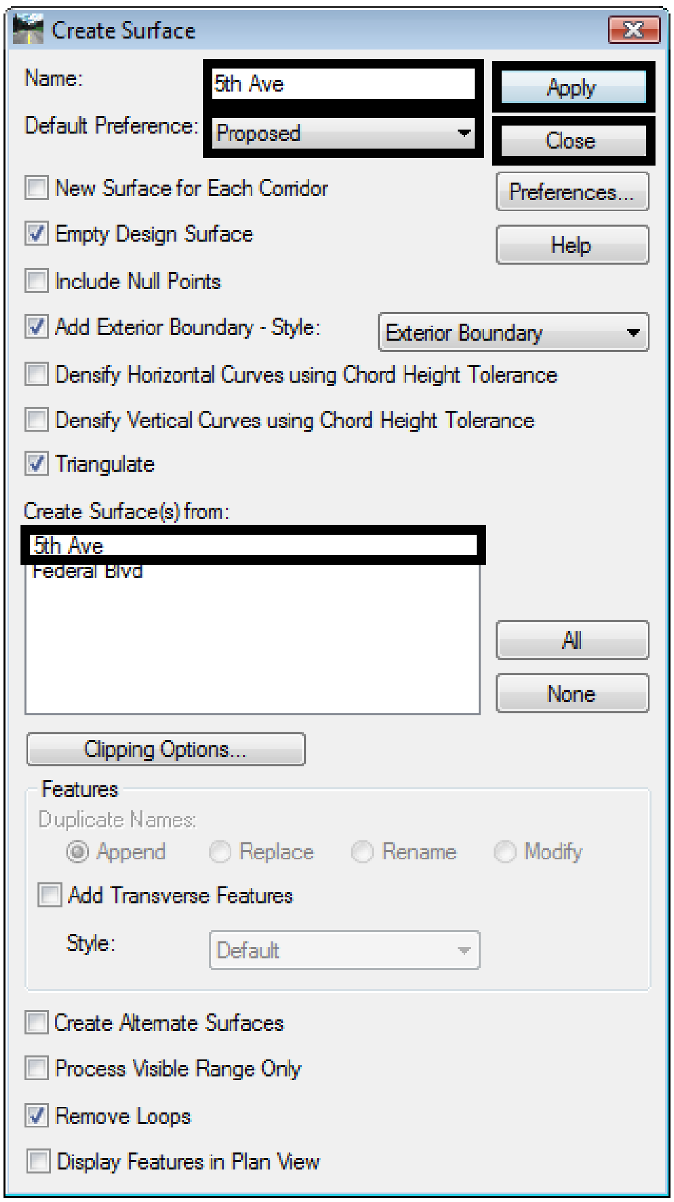


32. **<D> Close**.

Create the Initial 5th Ave. Design Surface

This surface, along with the initinal Federal Blvd. surface, we be used to determine the vertical alignments for the curb returns.

1. On the InRoads Surfaces tab, verify that ***16628_Existing*** is the active 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 ***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**.

Chapter 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

Chapter Objectives:

- Create horizontal and vertical geometry for curb retuns.

In this section the two initial design surfaces are used to create a smooth vertical alignment transitions around the corners of the intersection. Horizontal and vertical geometry for each curb return is defined the InRoads ***Create Multicenter Curves*** tool, offset distances from the two corridor alignments, and the initial design surfaces. The new geometry will be used to create the final design surface

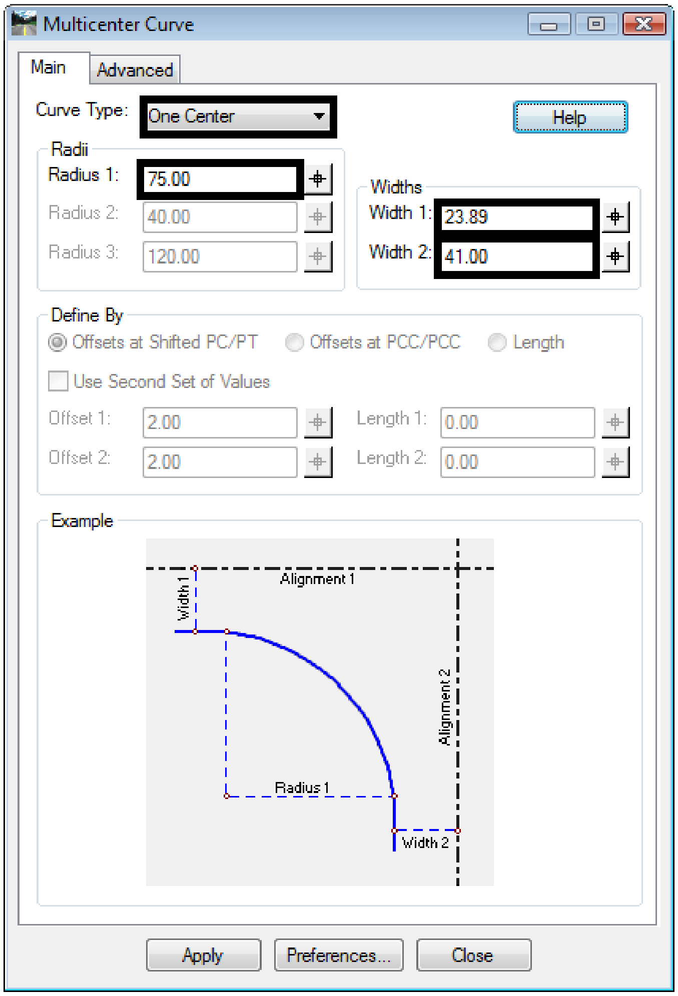
Curb Returns

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***.

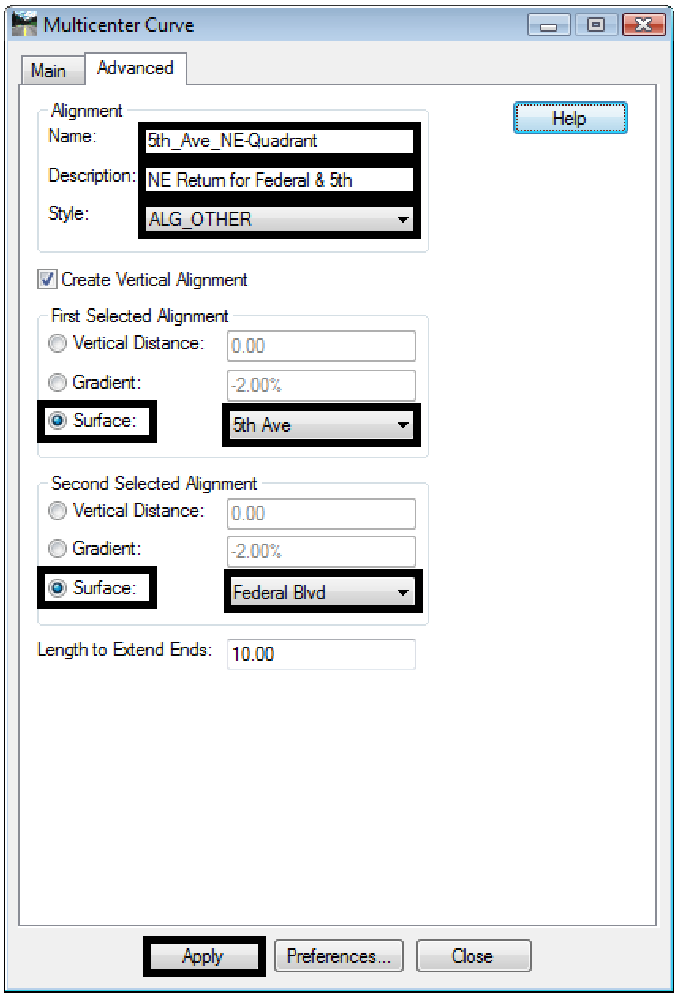
9. Set the ***Style*** to **ALG_OTHER**.

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.



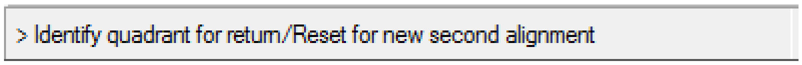
15. **<D> Apply**.

    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:

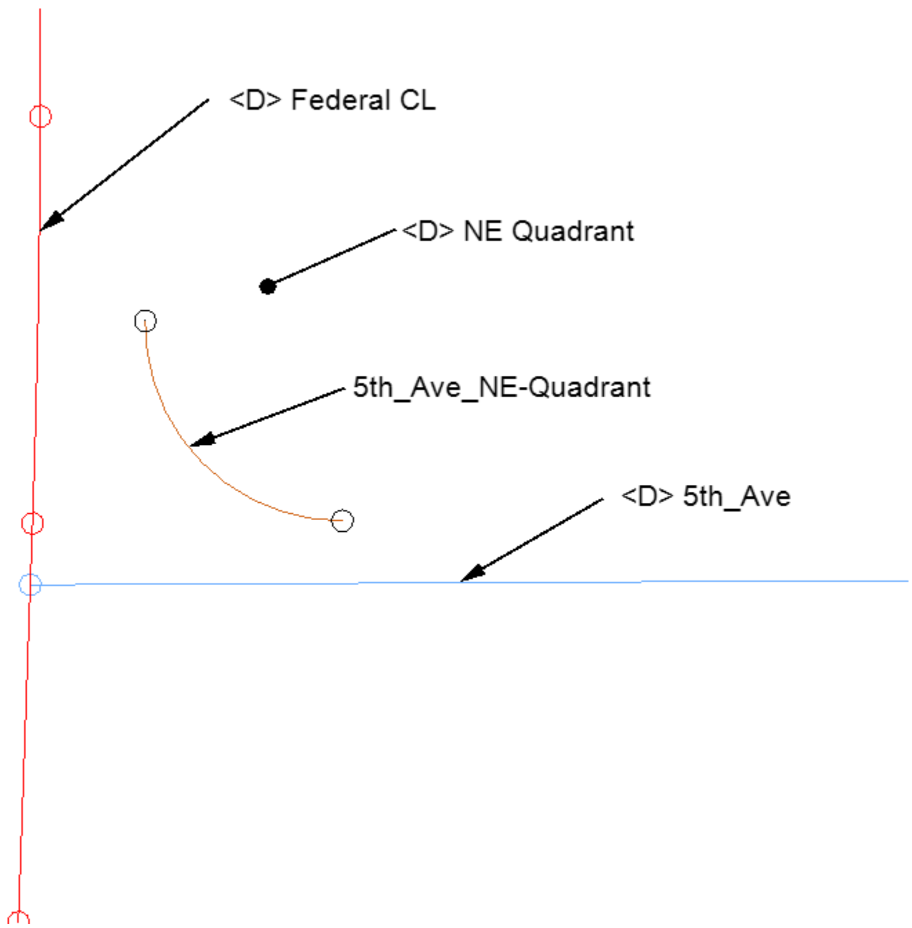
16. **<D>** on the **5th_Ave** alignment in the MicroStation view window. The following message is displayed:

17. **<D>** on the **Federal CL** alignment. The following message is displayed:



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.

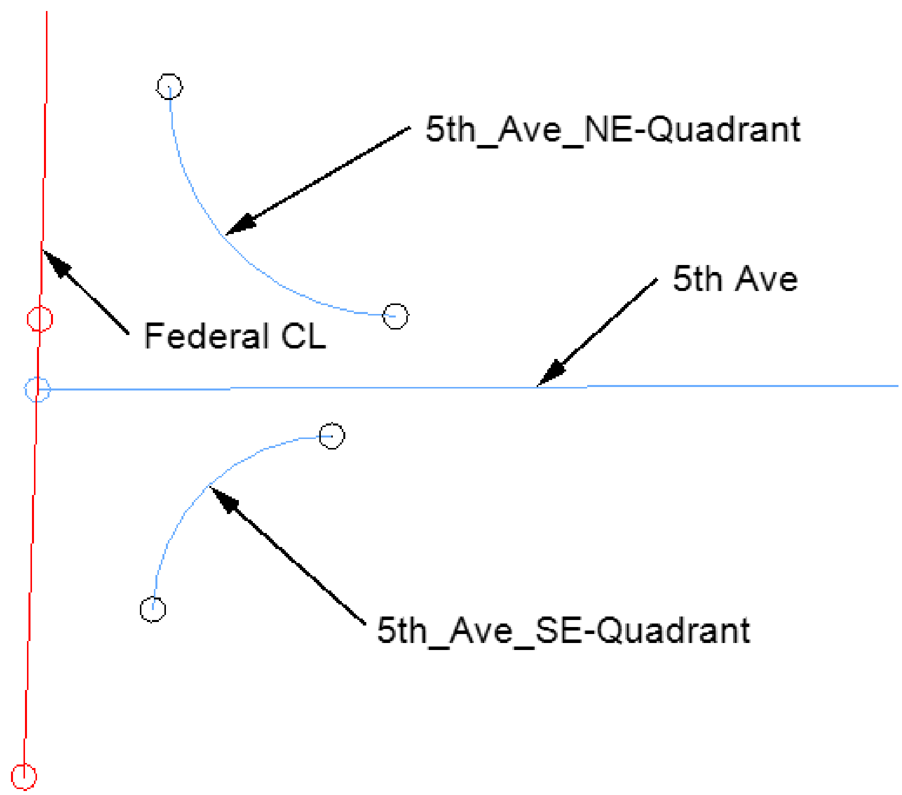


Create Southeast Curb Return

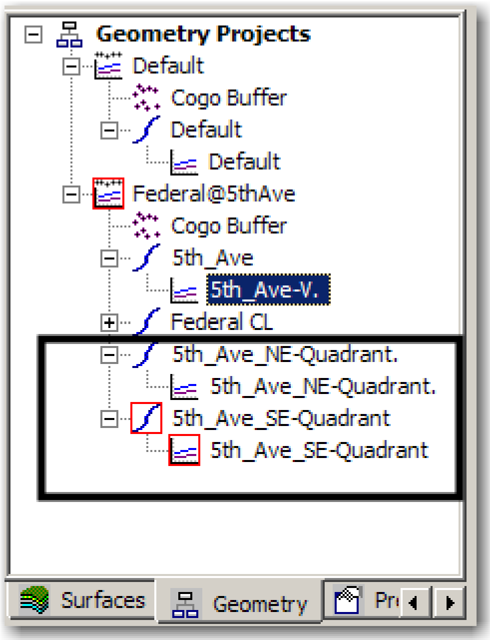
Again, the 5th Ave. data is used first to create the southeast curb return.

1. From the InRoads menu bar, select **Geometry > Utilities > Multicenter Curve…**.
2. 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 as shown below.



Chapter 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 needed for the flowline.

Final Design Modeling

Chapter Objectives:

- Revise the point controls and template drops for 5^{th} Ave using new curb return alignments.
- Use Target Aliasing to match the surface of Federal Blvd to the surface fo 5^{th} Ave.
- Update the 5^{th} Ave surface
- Update Federal Blvd. template drops and add point controls
- Create a complete final combined surface

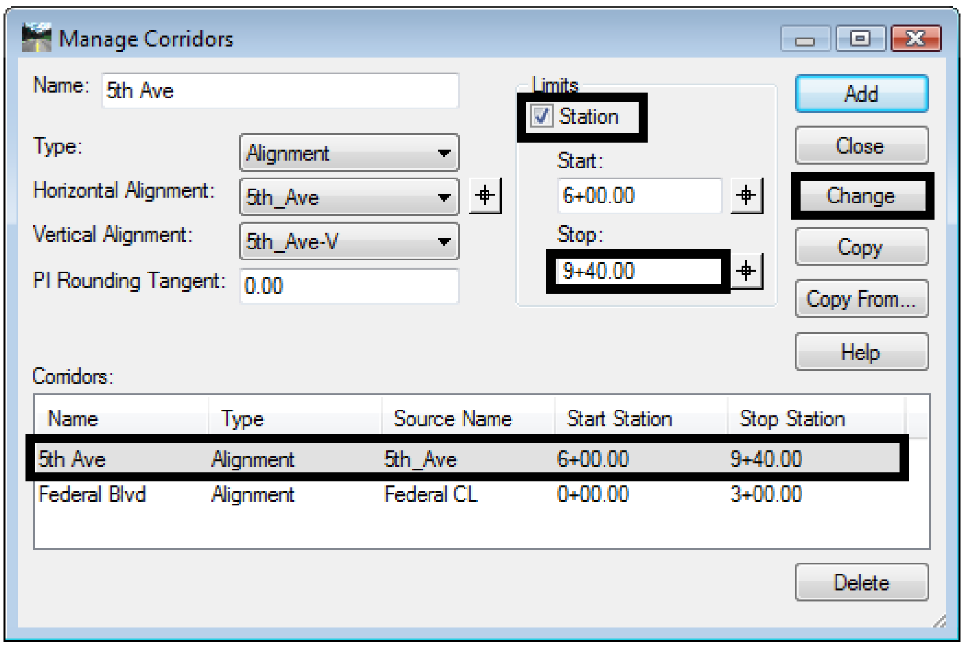
Create the Finial 5^{th} Ave. Corridor Surface

The 5^{th} 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 5^{th} 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 occuring, The corridor for 5th Ave. is stopped before it reaches the edge of the Federal Blvd. template.

1. In the ***Roadway Designer*** dialog box, select **Corridor > Corridor Management** or **<D>** the button. This displays the ***Manage Corridors*** dialog box.
2. Highlight **5th Ave** in the Corridors list.
3. Toggle on **Station** in the ***Limits*** area.
4. Key in ***9+40.00*** for the ***Stop*** station. This station was selected because it od about halfway through the curb returns and befor the edge of Federal Blvd.
5. **<D> Change**.
6. **<D> Close**.

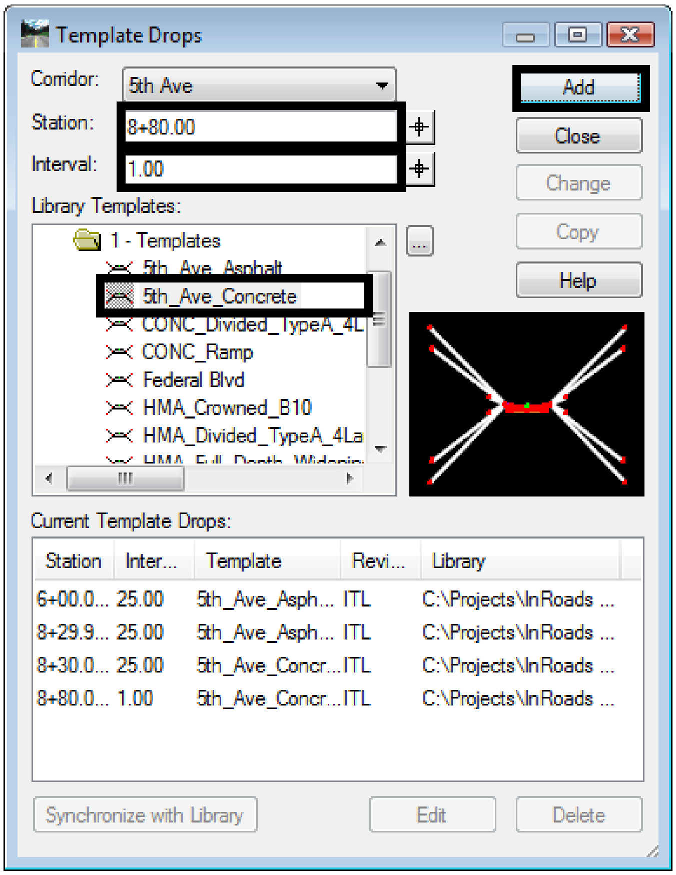


Edit 5th Ave. Template Drops

1. In the ***Roadway Designer*** dialog box, select **Corridor > Template Drops** or **<D>** the button. This displays the **Template Drops** dialog box.
2. Verify 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 retuns.

5. In the Library Templates area, expand the **1 – Templates** folder.
6. Highlight the **5th_Ave_Concrete** template.
7. **<D> Add**.
8. **<D> Close**.



5th 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. Select **Modeler > Roadway Designer** from the InRoads menu bar.
2. In the ***Roadway Designer*** dialog box, select **Corridor > Point Controls** or **<D>** the button.
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.

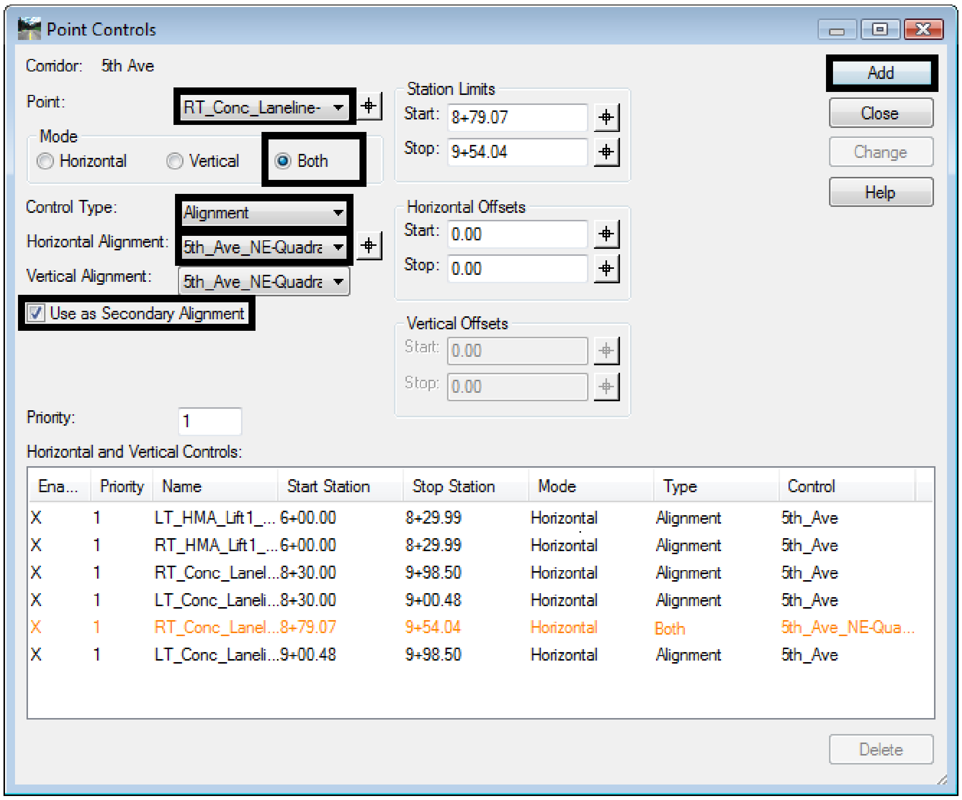
5. Set the ***Control Type*** to **Alignment**.

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**.

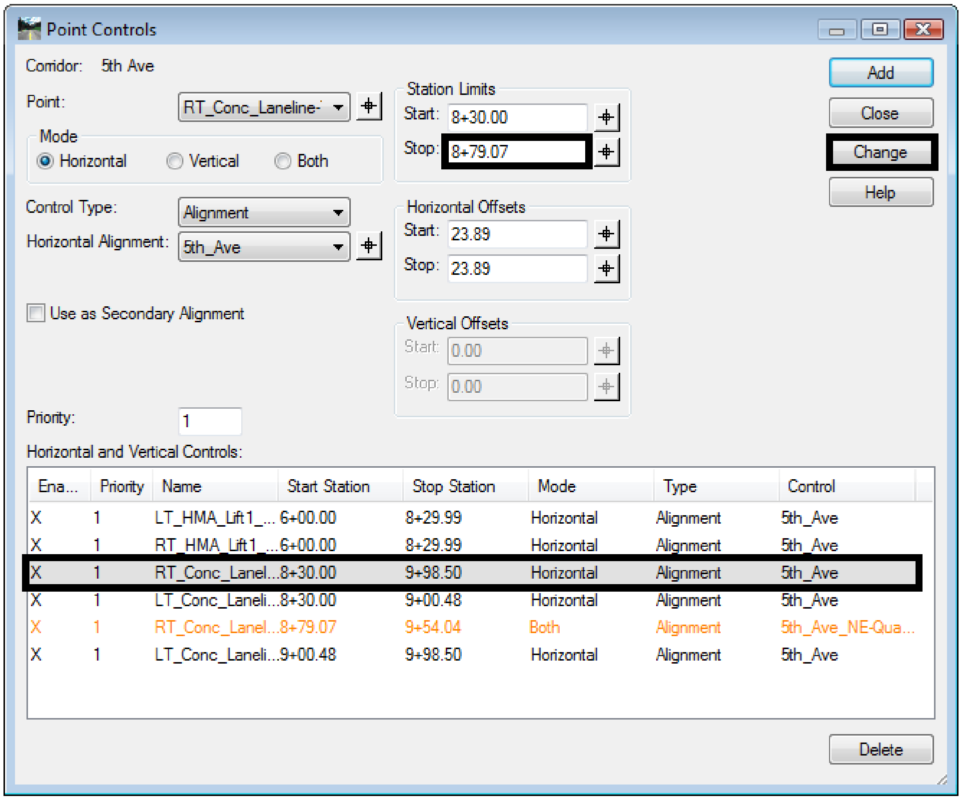


Important! The entry is displayed in orange, indicating that there is a conflict with another point control. The point control entered during the initial modeling is now too long, so its end station must be adjusted.

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. Set the Point to **LT_Conc_Laneline-Top** using the drop down menu or the button.

13. Toggle on **Both** in the ***Mode*** area.

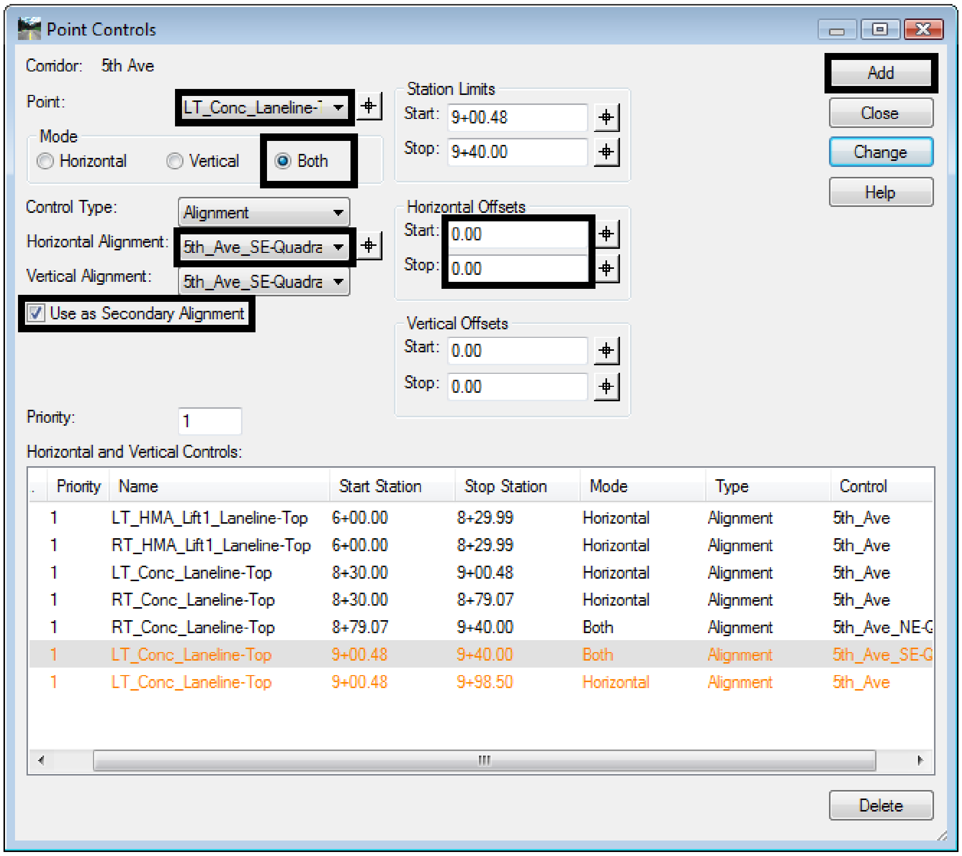
14. Set the ***Control Type*** to **Alignment**.

15. Set the ***Horizontal Alignment*** to **5th_Ave_SE-Quadrant**.

16. Toggle on **Use as Secondary Alignment.** This is so that the curb component is placed perpendicular to the curb return alignment.

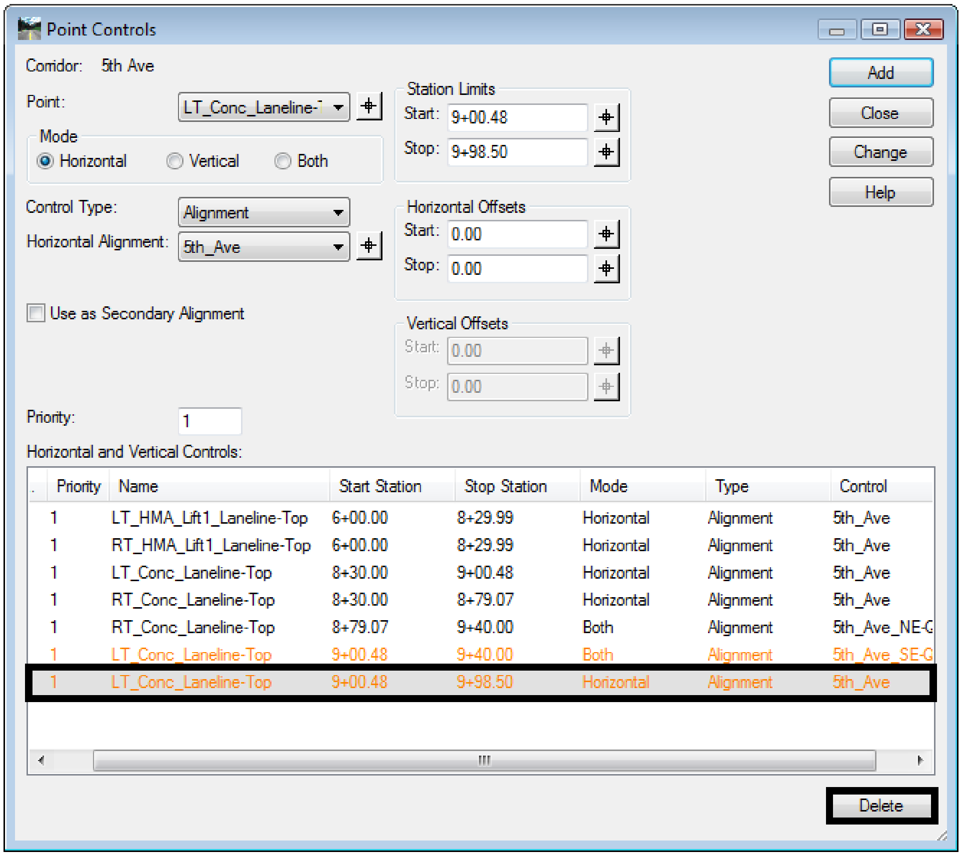
17. In the ***Horizontal Offsets*** area, key in ***0*** for the ***Start*** and ***Stop*** offsets.

18. **<D> Add**.

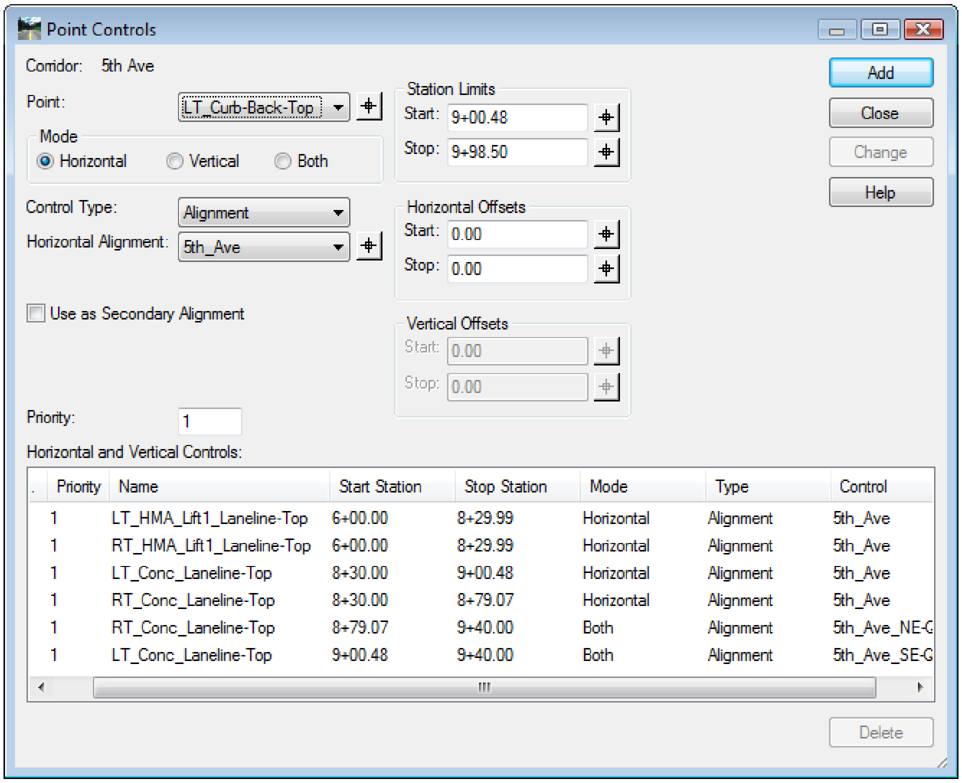


19. Highlight the **LT_Conc_Laneline-Top** control that runs from ***9+00.48*** to ***9+98.50.*** This entry is completely covered by the curb return, so it is deleted.

20. **<D> Delete**.


Point Controls
Corridor: 5th Ave
Point: LT_Conc_Laneline-T
Mode
Horizontal
Vertical
Both
Station Limits
Start: 9+00.48
Stop: 9+98.50
Add
Close
Change
Help
Control Type: Alignment
Horizontal Alignment: 5th_Ave
Horizontal Offsets
Start: 0.00
Stop: 0.00
Use as Secondary Alignment
Vertical Offsets
Start: 0.00
Stop: 0.00
Priority: 1
Horizontal and Vertical Controls:
Priority Name Start Station Stop Station Mode Type Control
1 LT_HMA_Lift1_Laneline-Top 6+00.00 8+29.99 Horizontal Alignment 5th_Ave
1 RT_HMA_Lift1_Laneline-Top 6+00.00 8+29.99 Horizontal Alignment 5th_Ave
1 LT_Conc_Laneline-Top 8+30.00 9+00.48 Horizontal Alignment 5th_Ave
1 RT_Conc_Laneline-Top 8+30.00 8+79.07 Horizontal Alignment 5th_Ave
1 RT_Conc_Laneline-Top 8+79.07 9+40.00 Both Alignment 5th_Ave_NE-C
1 LT_Conc_Laneline-Top 9+00.48 9+40.00 Both Alignment 5th_Ave_SE-C
1 LT_Conc_Laneline-Top 9+00.48 9+98.50 Horizontal Alignment 5th_Ave
Delete

The illustration below shows the list of point controls used on the Final 5^{th} Ave. corridor.



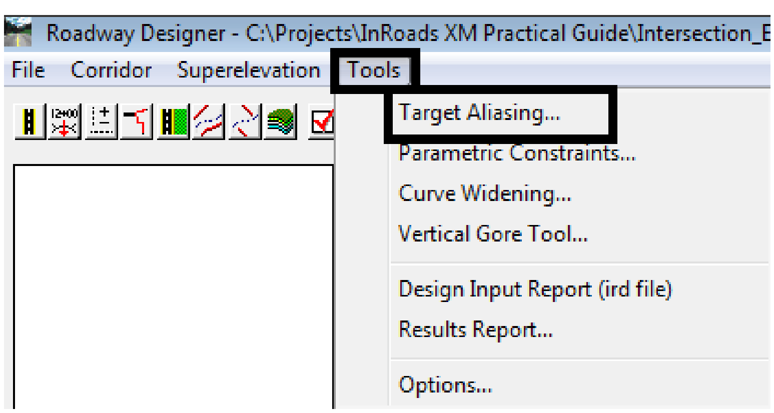
21. Close the Point Control dialog box.
22. Select **File > Save** from the ***Roadway Designer*** menu bar.

Create the Final 5^{th} Ave. Design Surface

The 5th Ave. surface is remodeled to incorperate the corridor changes made above and to generate the feature that will control the edge of pavement for Federal Blvd.

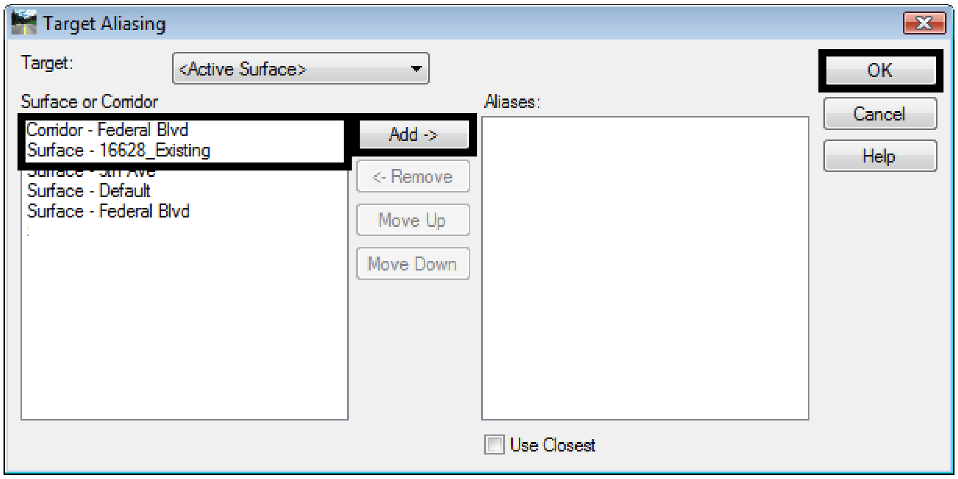
The target aliasing is set up so that the 5th Ave corridor will clip the Federal Blvd. corridor when the final surface is created.

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***.

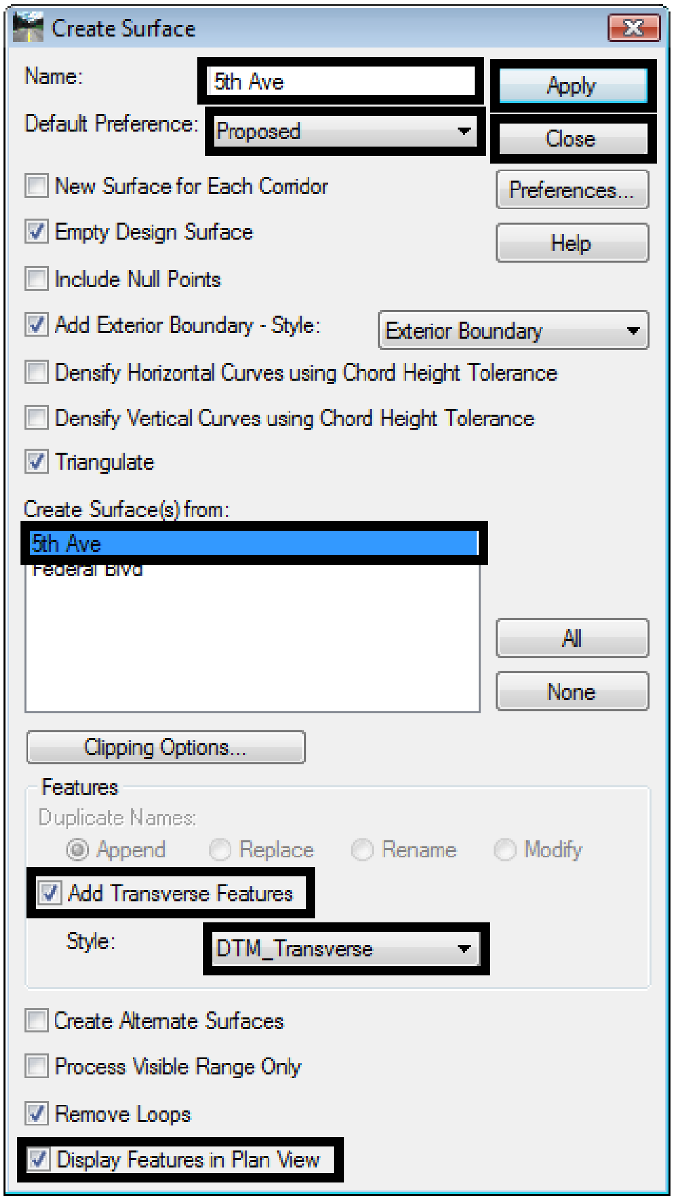
8. Highlight only **5th Ave** in the ***Create Surface(s) From*** list.

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 remainig parts of the curb returns and the intersection driving surface.

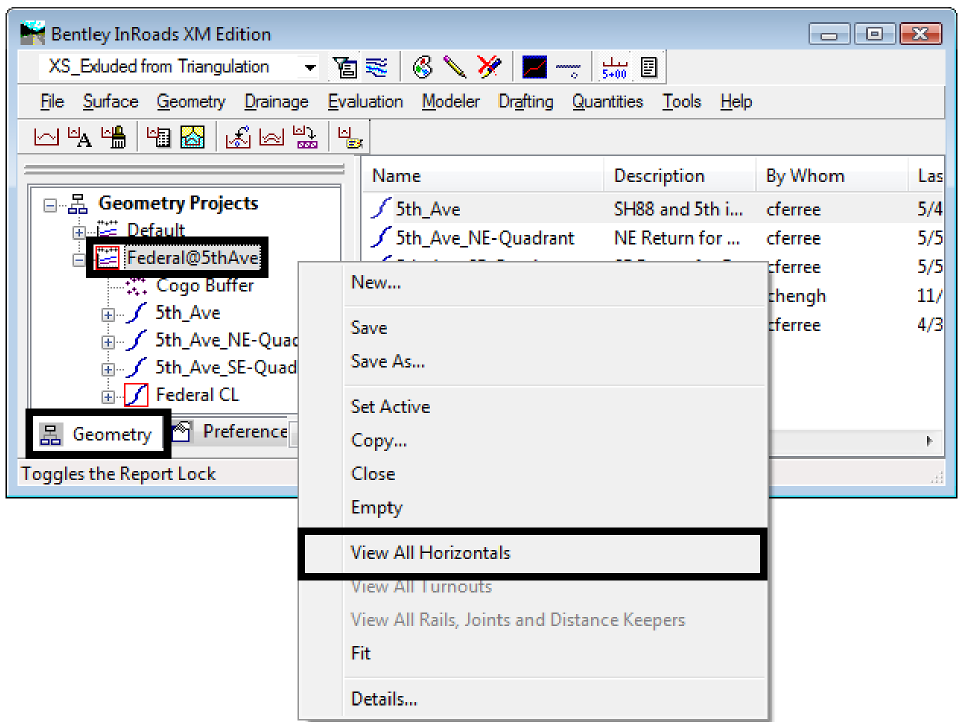
- Add template drops to tie into 5th Ave corridor

- Add point controls

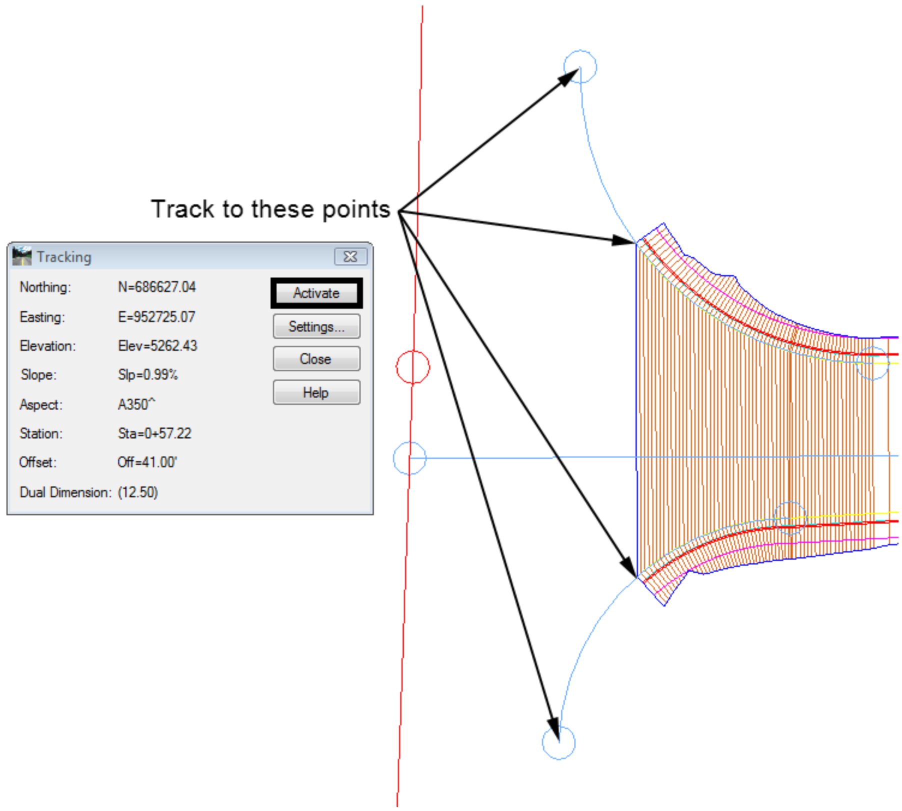
Collect Station Information for Template Drops

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 **Geometry**.
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. **<D>** the **Activate** button.
7. **<T>** to each of the points indicated in the illustration below and write down the Station for each.



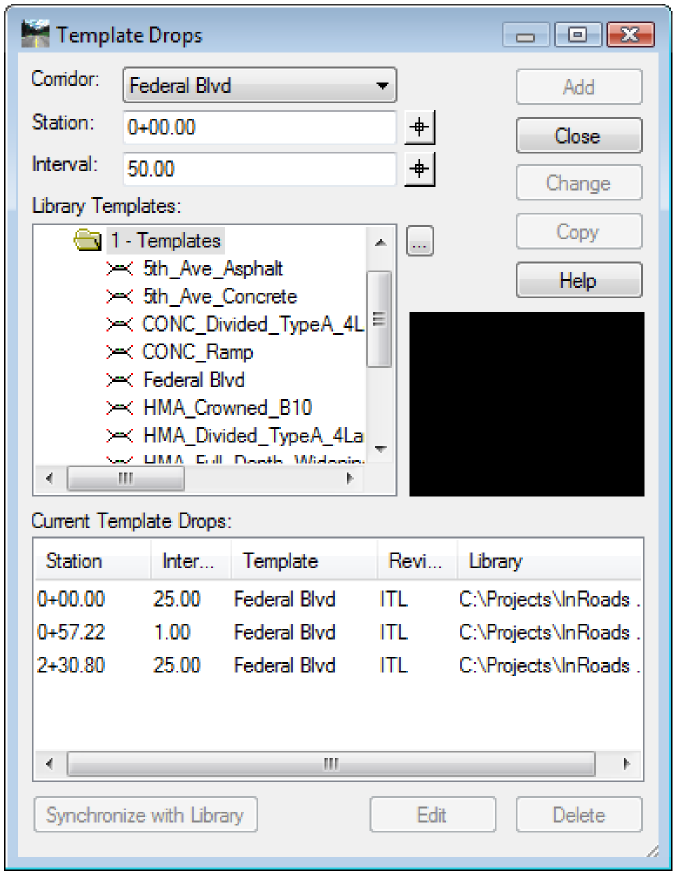
These stations are (from bottom to top):

- 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 arond 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. Set the Point to **RT_Conc_Laneline-Top6** using the drop down menu or the button.

3. Toggle on **Both** in the ***Mode*** area.

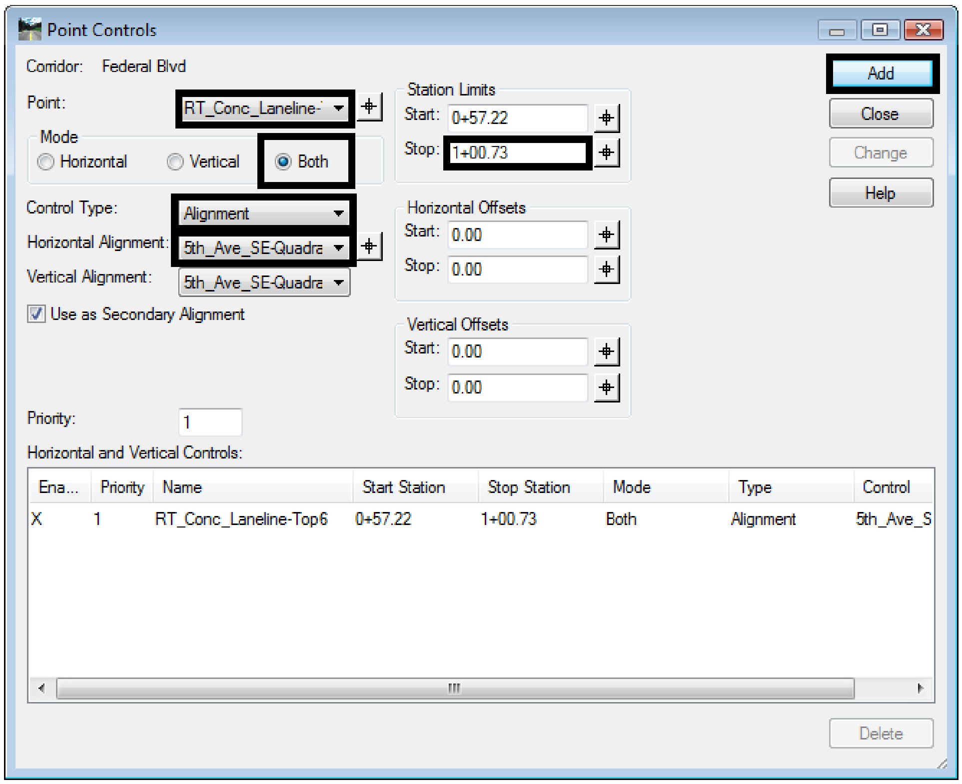
4. Set the ***Control Type*** to **Alignment**.

5. Set the ***Horizontal Alignment*** to **5th_Ave_SE-Quadrant**.

6. Toggle on **Use as Secondary Alignment.**

7. **In the *Station Limits* area, the *Start* station is set by the specified alignment. Key in *1+00.73* for the *Stop* station**

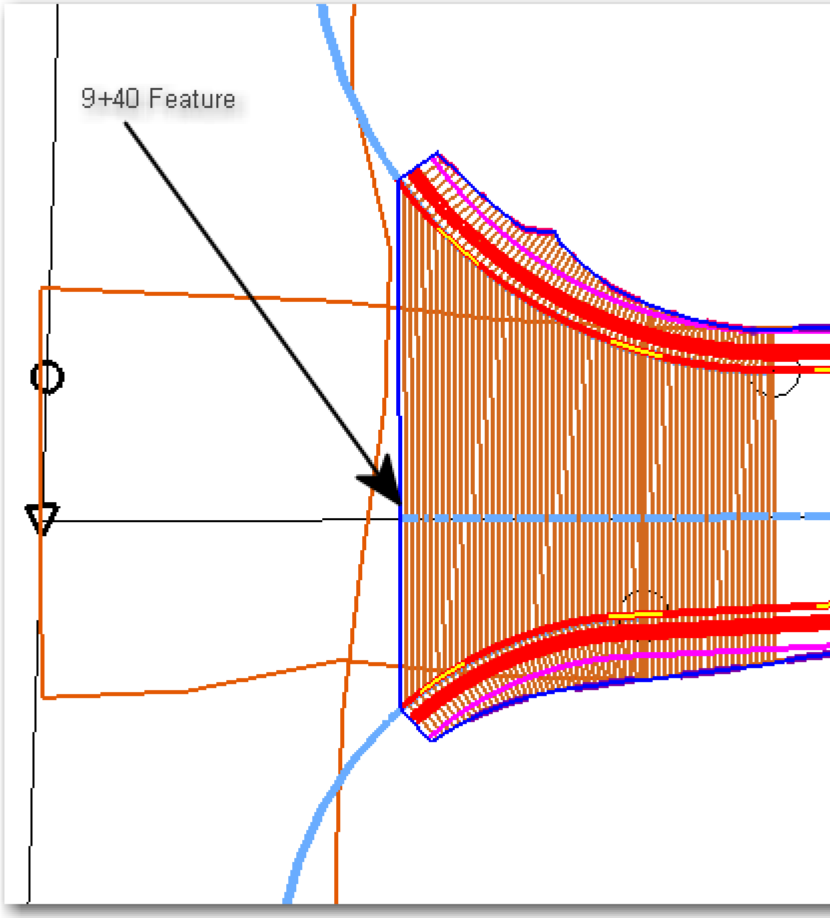
8. **<D> Add**.



9. Set the ***Control Type*** to **Feature**.

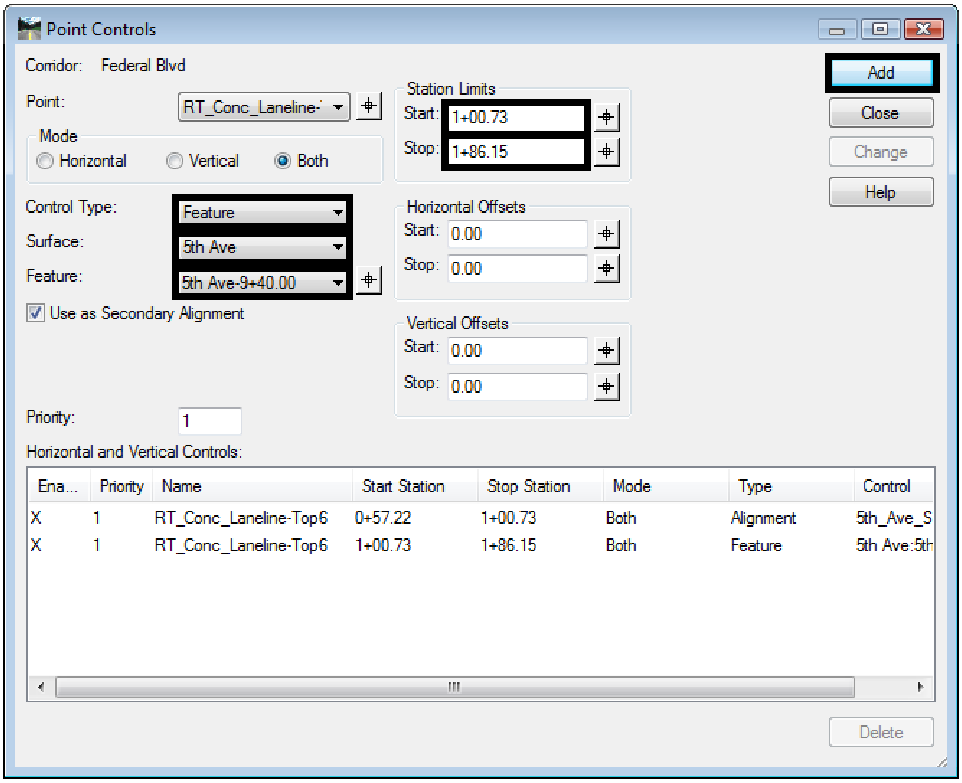
10. Select **5th Ave** for the ***Surface***.

11. Select **5th Ave-9+40.00** for the ***Feature***.



12. In the ***Station Limits*** area, key in ***1+00.73*** for the ***Start*** station.
13. Key in ***1+86.15*** for the ***Stop*** station.

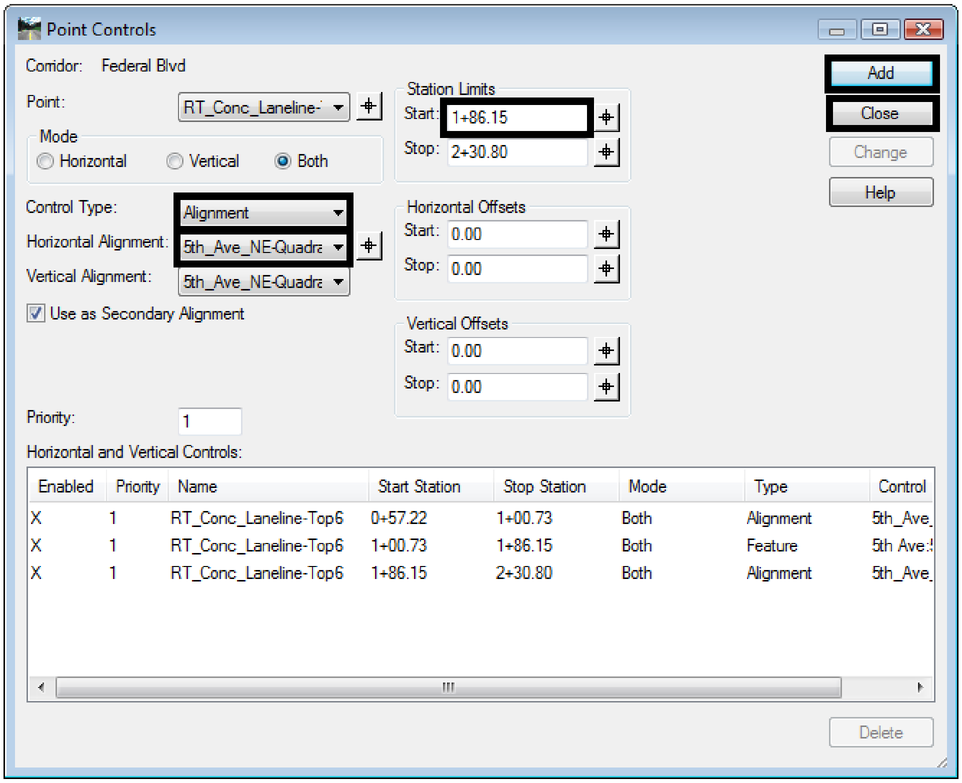
14. **<D> Add**.



15. Set the ***Control Type*** to **Alignment**.

16. Set the ***Horizontal Alignment*** to **5th_Ave_NE-Quadrant**.

17. In the ***Station Limits*** area, key in ***1+86.15*** for the ***Start*** station. The ***Stop*** station is set by the selected alignment.



18. **<D> Add**. and **<D> Close**.

Create the Final Intersection Design Surface

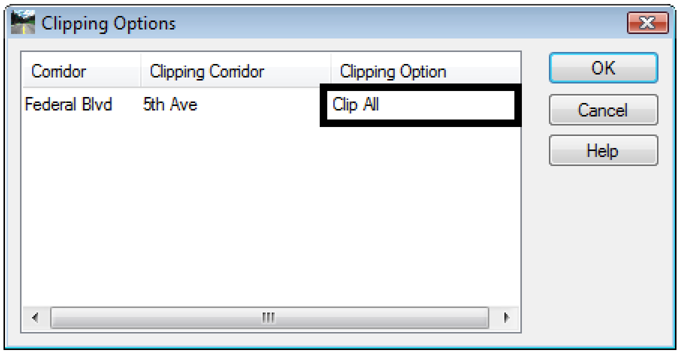
After creating the point controls for Federal Blvd. (using features from the 5th Ave. design surface), both corridors are used to create the design surface of the entire intersection.

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.

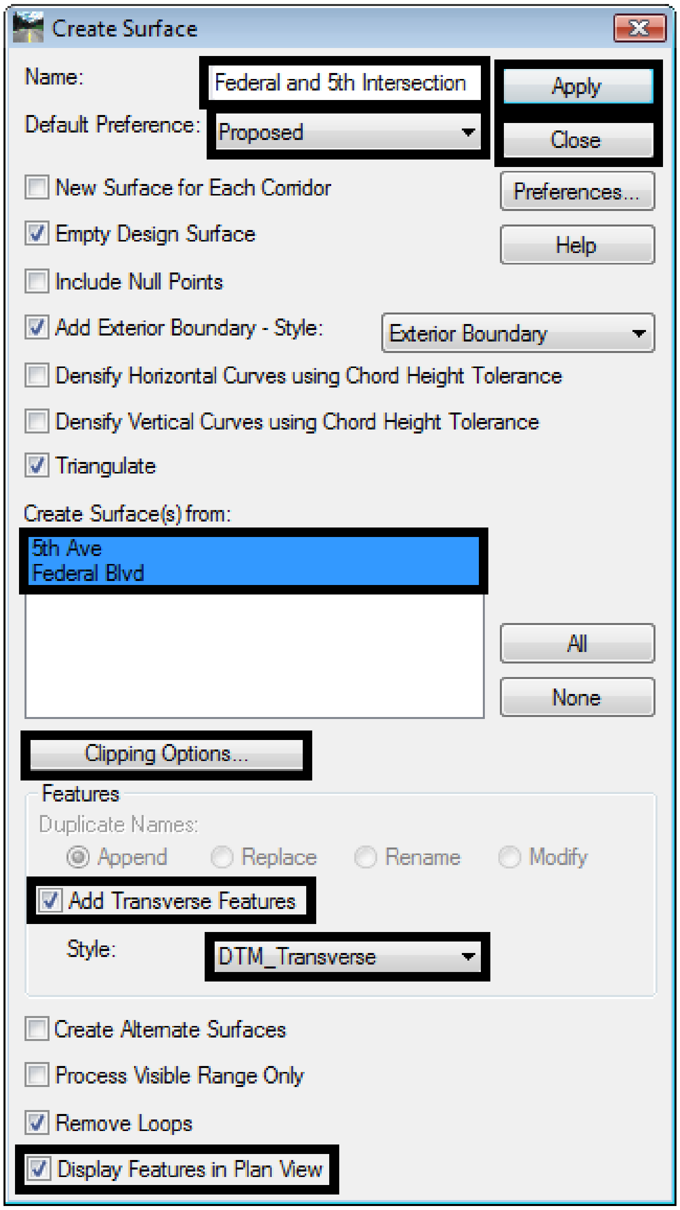
2. In the ***Roadway Designer*** dialog box, select **Corridor > Create Surface** or **<D>** the  button. This displays the **Create Surface** dialog box.
3. Key in ***Federal and 5th Intersection*** for the ***Name***.
4. Select **Proposed** for the ***Default Preference***.
5. Highlight both **5th 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.



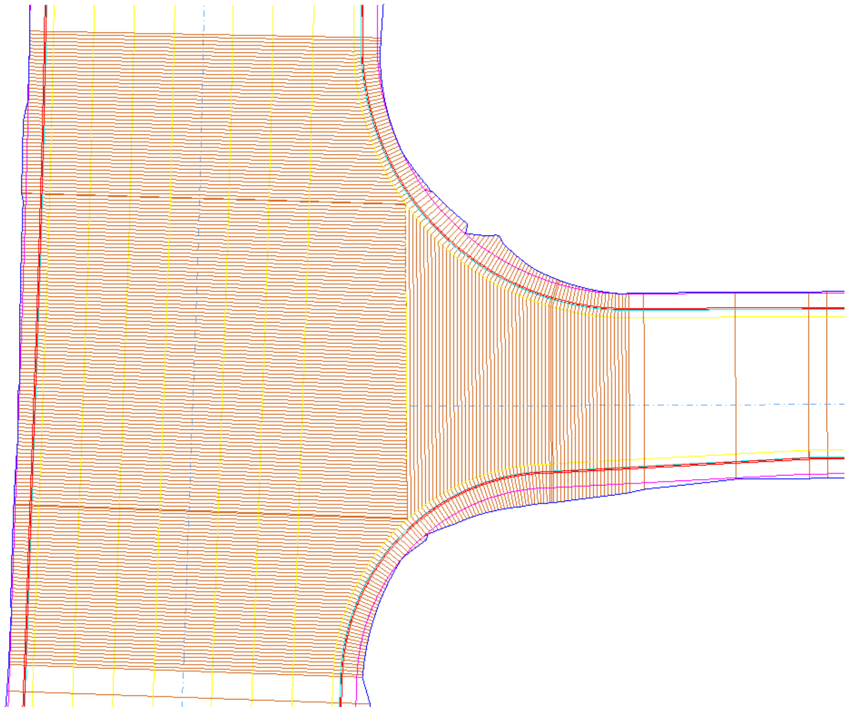
9. Toggle on **Add Transverse Features**.
10. Set the transverse feature ***Style*** to **DTM_Transverse**.

11. Toggle on **Display Features in Plan View**. This displays the surface features in the dgn file for review.

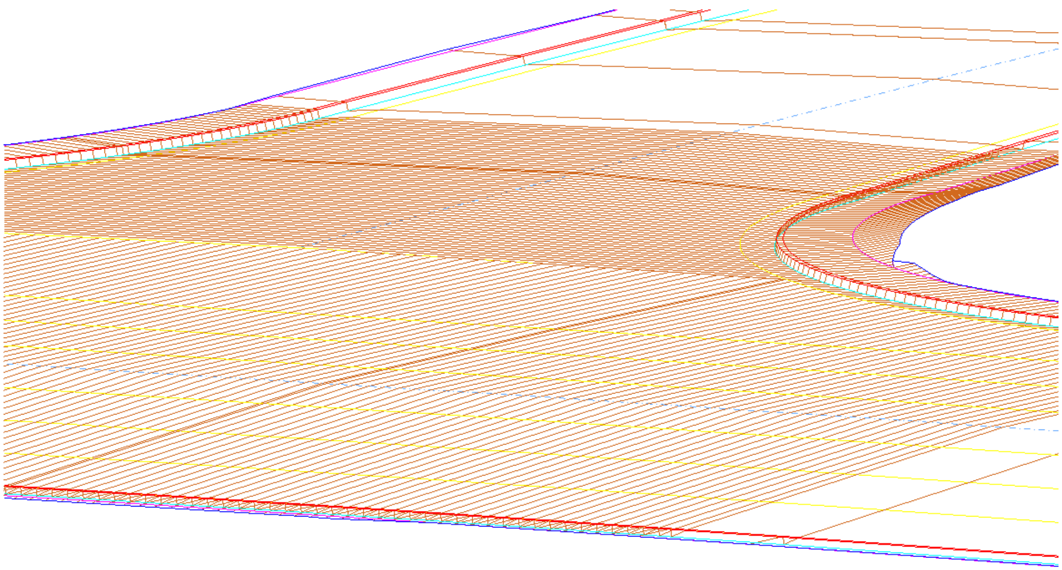


12. **<D> Apply** and **<D> Close**.
13. Select **File > Save** from the Roadway Designer menu bar.
14. **<D> Close** to dismiss the ***Roadway Designer*** dialog box.

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 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 Bivd. 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.

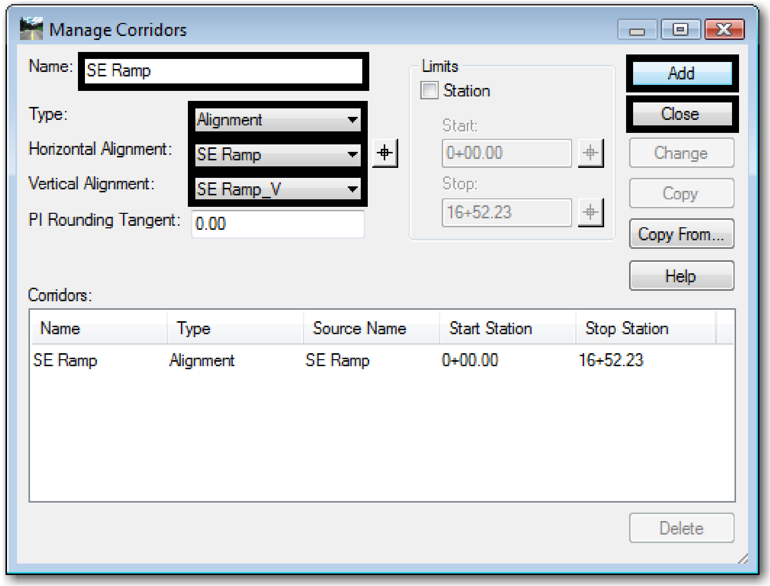
Section Objectives:

- ♦ 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. Set the ***Type*** to **Alignment**.
5. Select **SE Ramp** as the ***Horizontal Alignment***.
6. Select **SE Ramp_V** as the ***Vertical Alignment***.
7. **<D> Add** to complete the corridor.

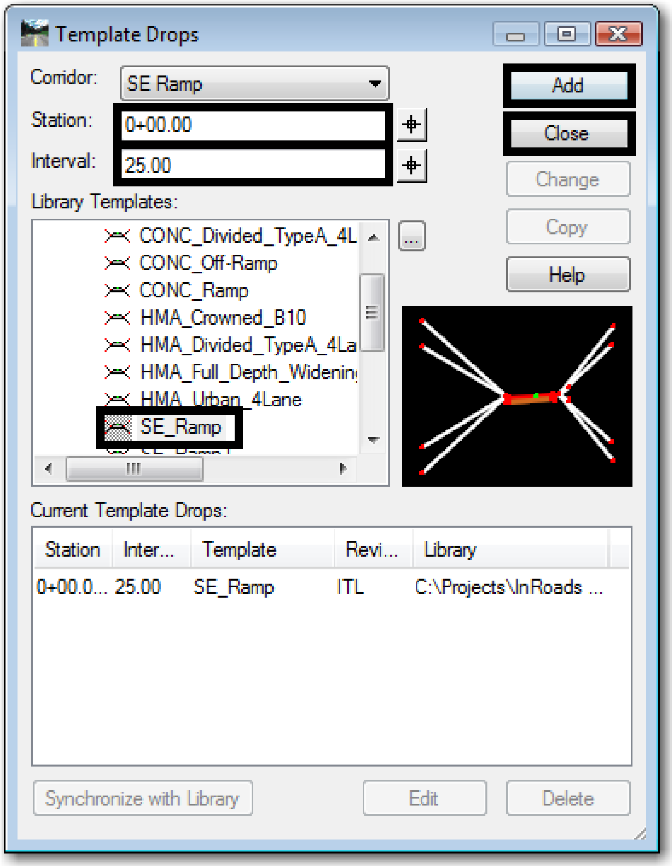
8. **<D> Close** to dismiss the ***Manage Corridors*** dialog box.



Add the 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**.

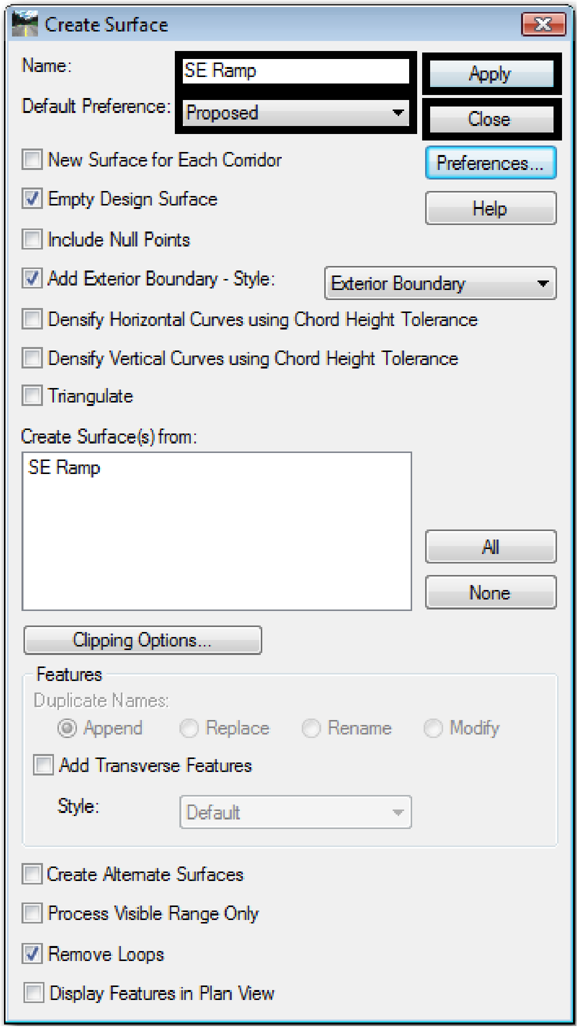
7. **<D> Close**.



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. Set the ***Type*** to **Alignment**.
4. Select **Bryant Ramp** as the ***Horizontal Alignment***.
5. Select **Bryant Ramp_V** as the ***Vertical Alignment***.
6. **<D> Add** to complete the corridor.
7. **<D> Close** to dismiss the ***Manage Corridors*** dialog box.

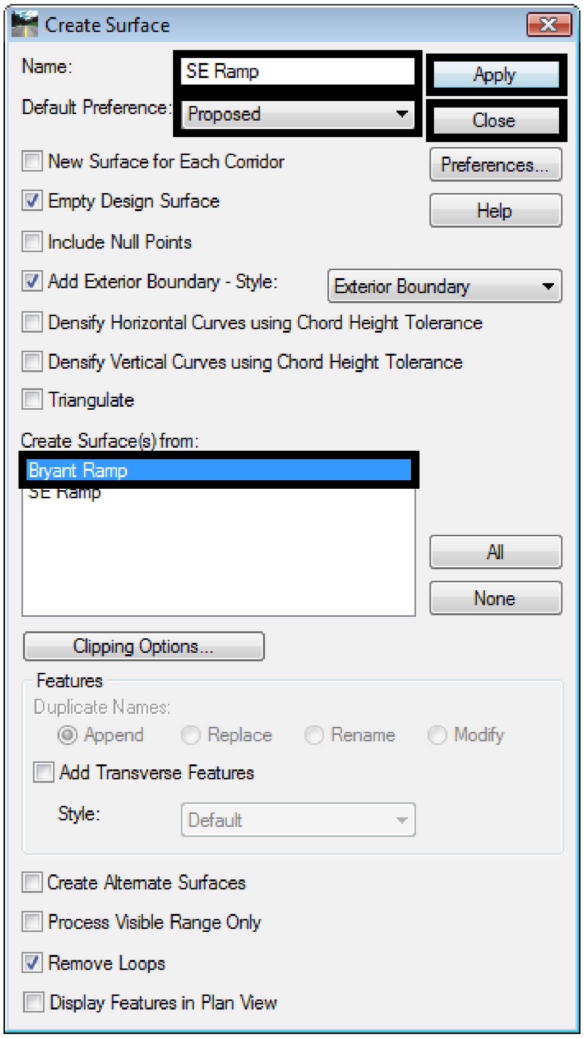
Add the Bryant Ramp Template Drops

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 ??? 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

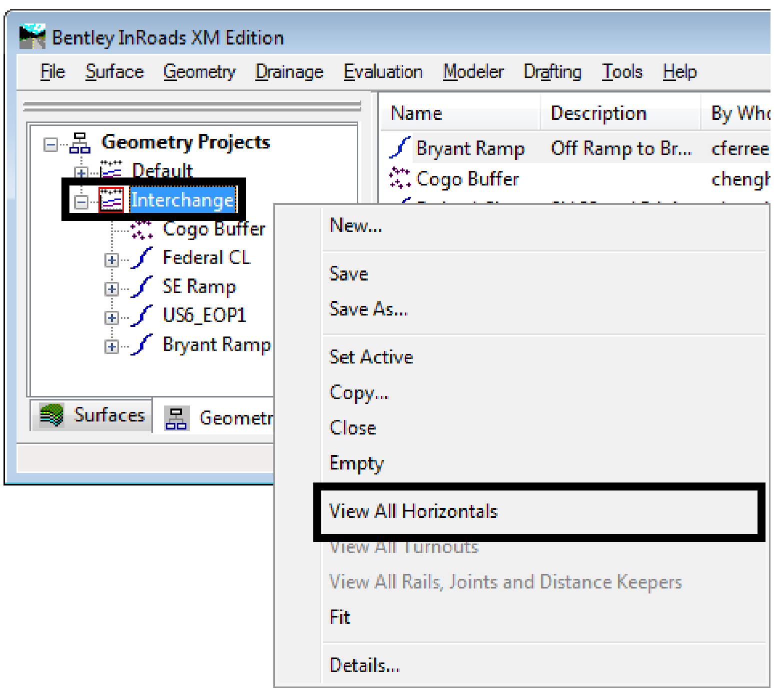
The relevant horizontal alignments are displayed in the dgn file give a reference location when determining the key stations.

Section Objectives:

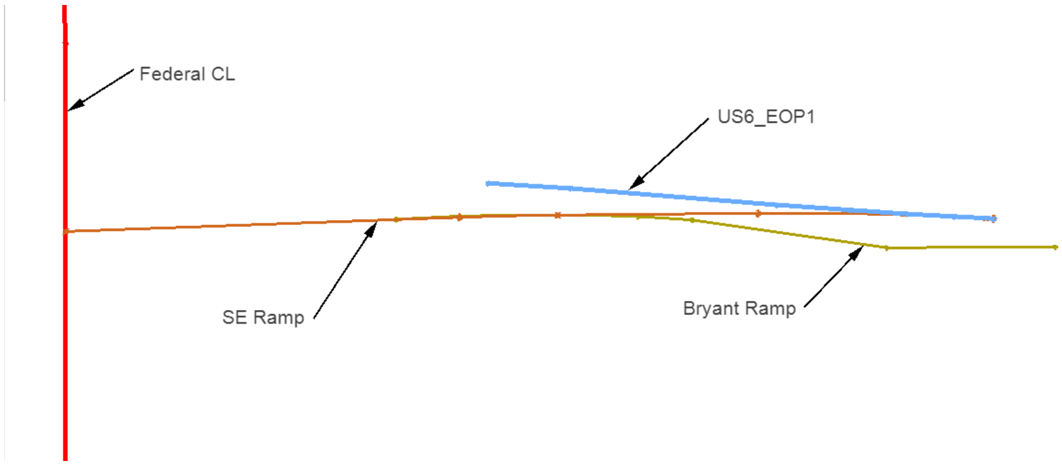
- Display the horizontal alignments

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:

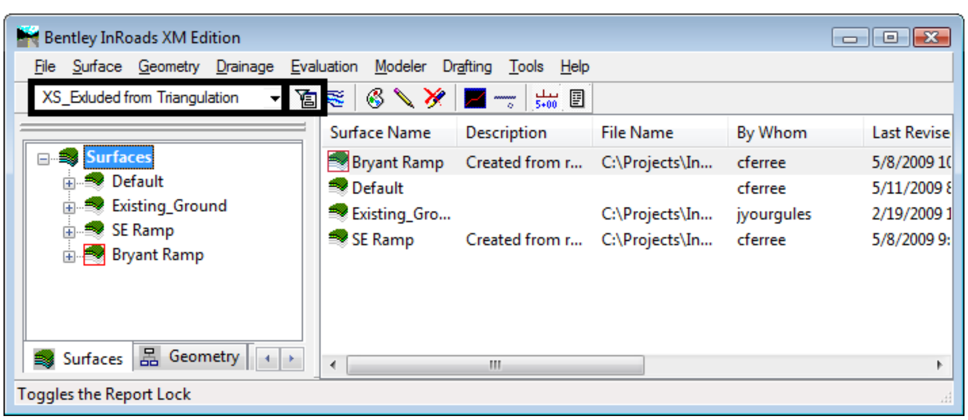
- Display the required surface features from the initial design surfaces
- Use Tracking to identify the key stations

Locate Key Stations for SE Ramp at 6th Ave.

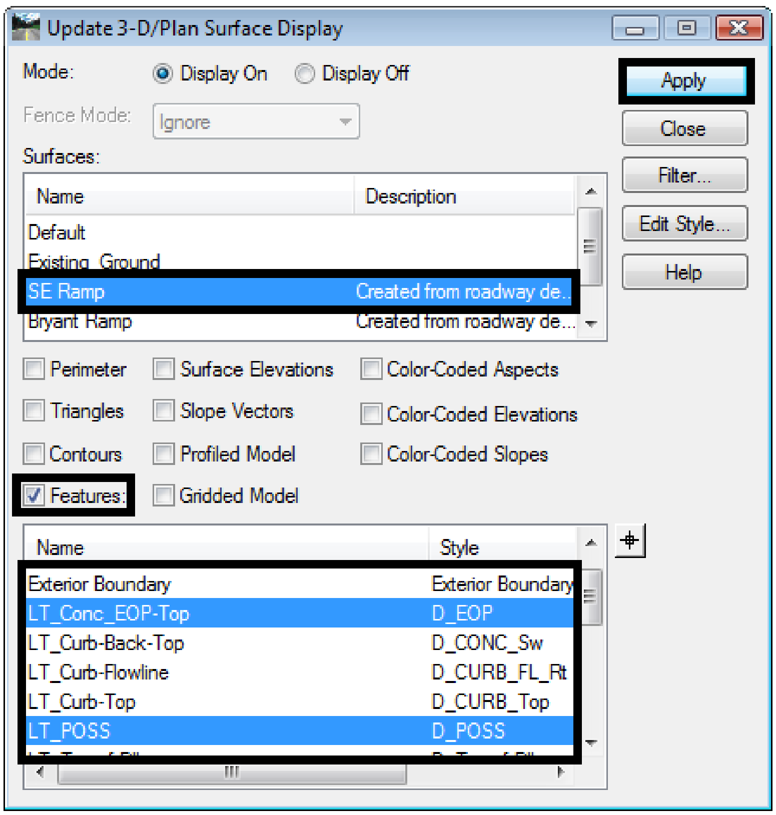
Each point on a template creates a feature in the design surface which can make it difficult to find the desired features for display. To reduce the number of features that have to be combed through, feature filters are used. There is a predefined filter that excludes untriangulated features. This is used reduce the number of features in the dialog box to a managible number.

1. On the InRoads Locks toolbar, set the ***Feature Filter*** to **XS_Excluded from Triangulation**.

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



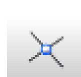
3. On the InRoads menu bar, select **Surface > Update 3d/Plan Surface Display**.
4. In the ***Update 3d/Plan Surface Display*** highlight the **SE Ramp** surface.
5. Toggle on the **Features** check box.
6. In the Features list, select the features with **EOP** or ***POSS*** in the name.
7. **<D> Apply**.



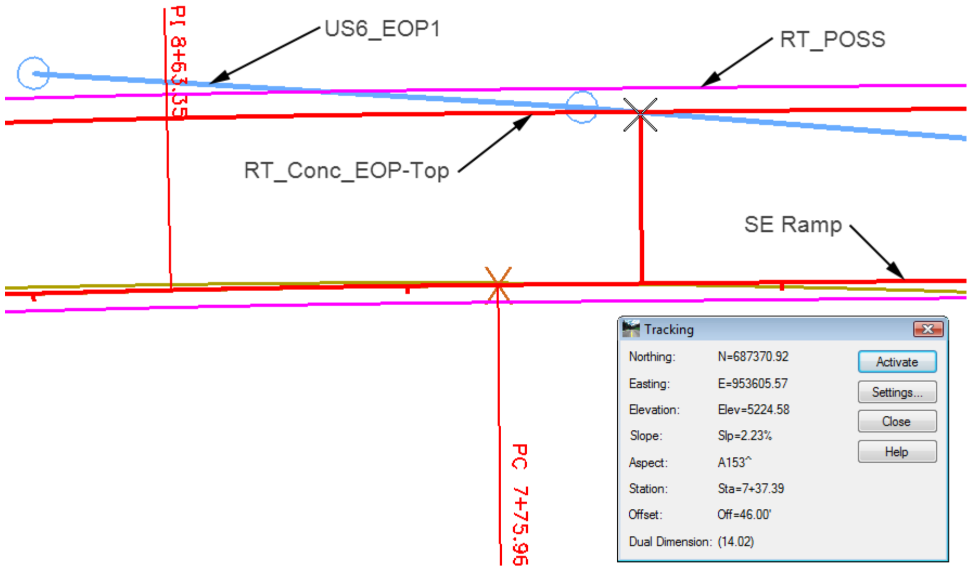
8. **<D> Close**.

After the features are displayed, tracking is used to determine the key stations for the SE Ramp along the 6th Ave. edge of pavement.

9. Using the MicroStation view controls, zoom in on the left end of the 6^{th} Ave alignment.
10. Set the **SE Ramp** alignment active.
11. From the InRoads menu bar, select **Tools > Tracking > Tracking**.
12. **<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

13. **<T>** where the feature **RT_POSS** crosses the **US6_EOP1** alignment and note the station.



- ***RT_Conc_EOP-Top and US6_EOP1* – *7+37.39***
- ***RT_POSS and US6_EOP1 – 8+23.46***

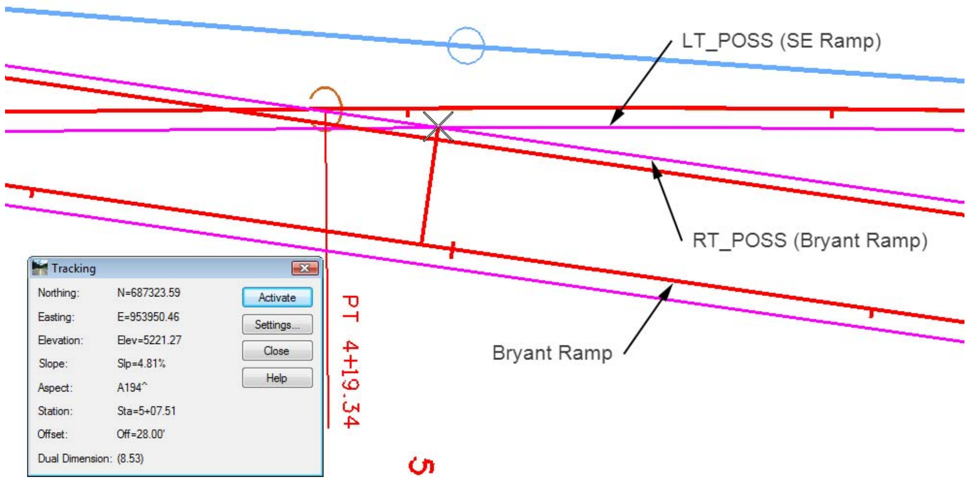
14. **<D> Close** on the ***Tracking*** dialog box.

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*** highlight 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 ***Bryant 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 ***Bryant 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

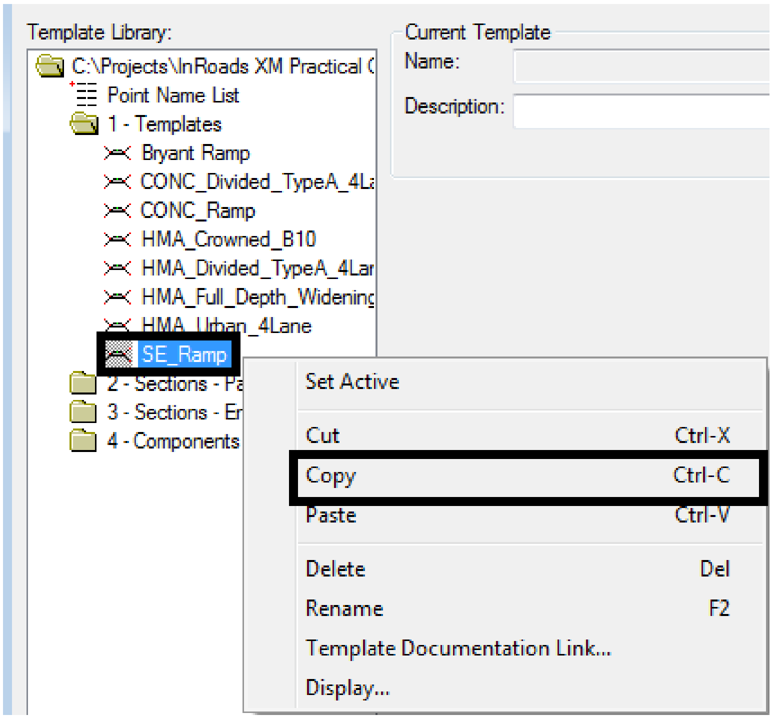
Copy the SE Ramp Template

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.

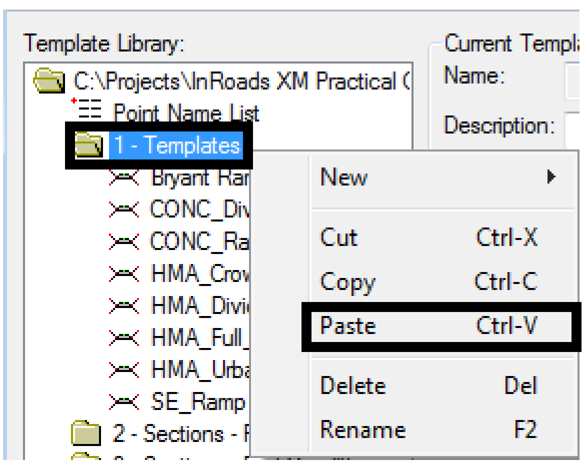
1. On the InRoads menu bar, select **Modeler > Create Template**.

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

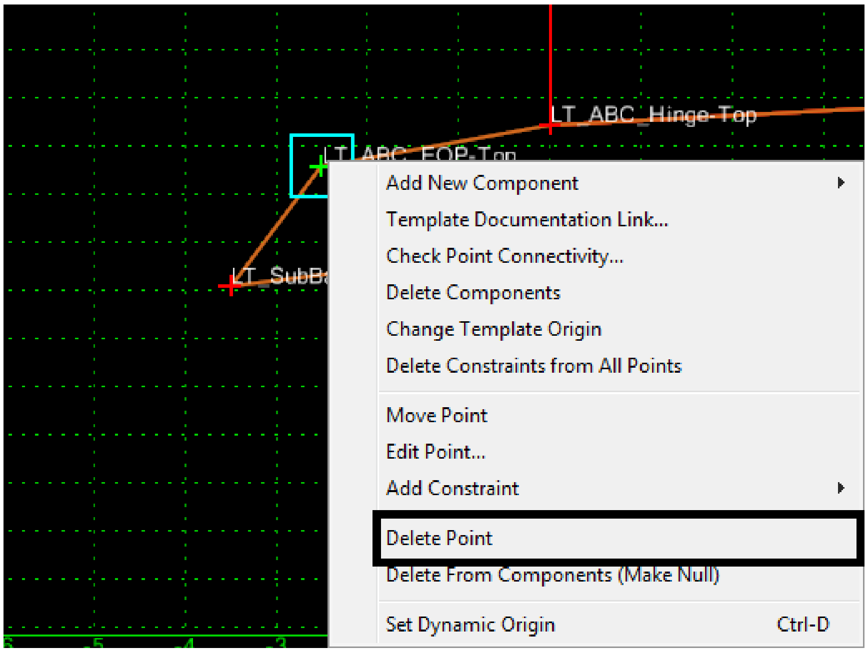
This template needs to be modified on the right (6th Ave.) side only.

1. **<D> <D> SE Ramp at 6th** template to make it active.

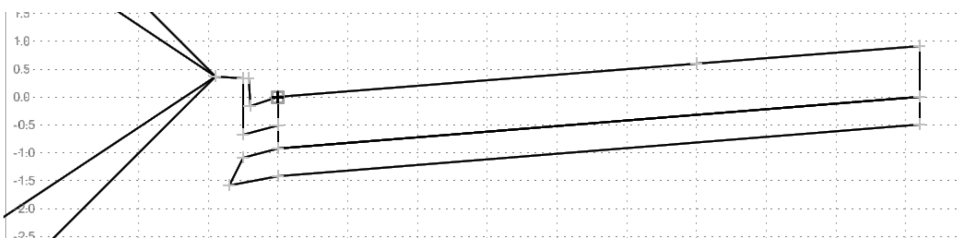
2. Zoom in on the right side of the template.
3. **<R>** in the Template view and select **Delete Components** from the menu.
4. Drag a line through the **RT_C/G_Type2-IIB** and the **RT_Benching** components.

   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.

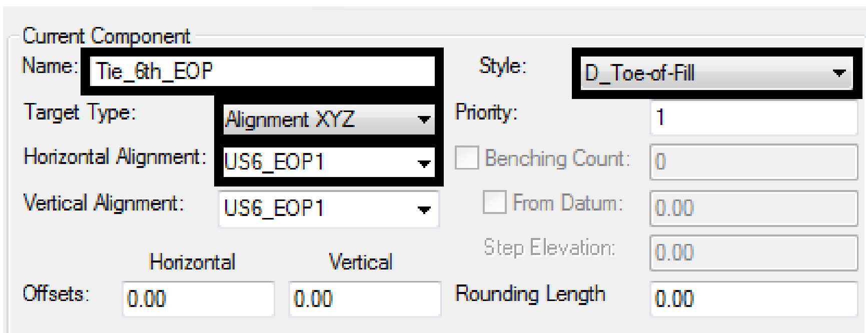


Add an End condition to the SE Ramp at 6th Ave template

This end condition is used to create the gore after the SE Ramp edge of pavement seperates from the 6th Ave. pavement edge.

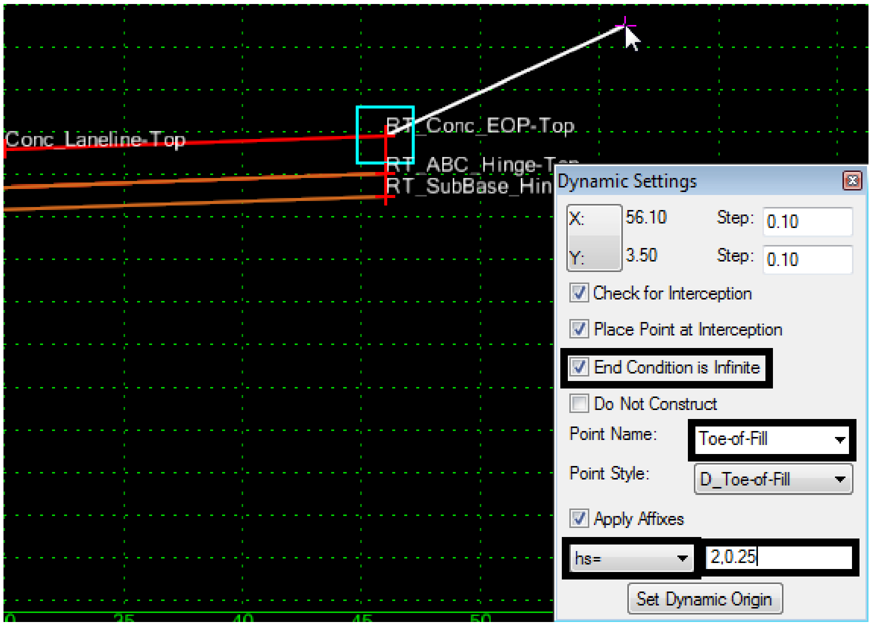
1. **Select Tools > Dynamic Settings from the Create Template menu bar or <D> the Dynamic Settings** button.
2. **Select Tools > Options from the Create Template menu bar.**
3. **Toggle on Apply Affixes.**

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 seperate template is used here because using target aliasing and clipping options would resuld in the loss of the ABC component in the clipped template.

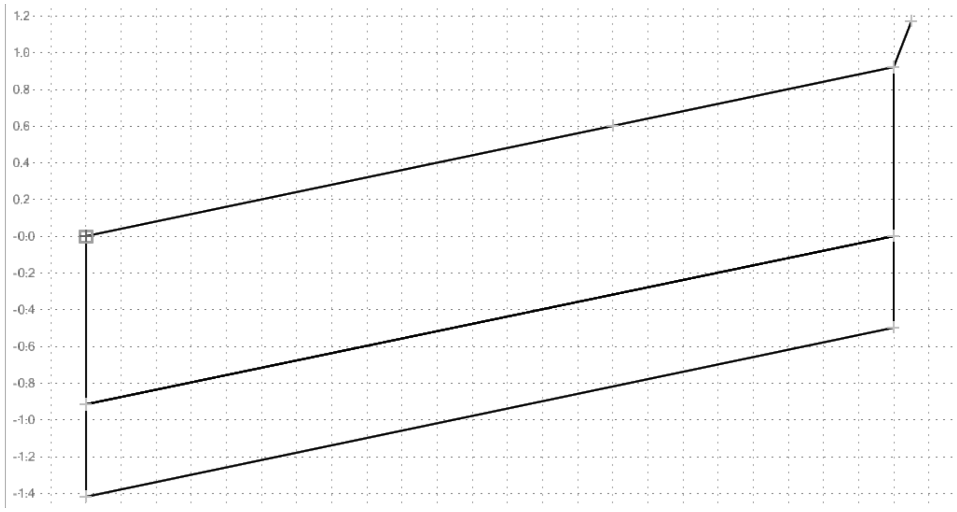
Section Objectives:

- 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 components an 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.

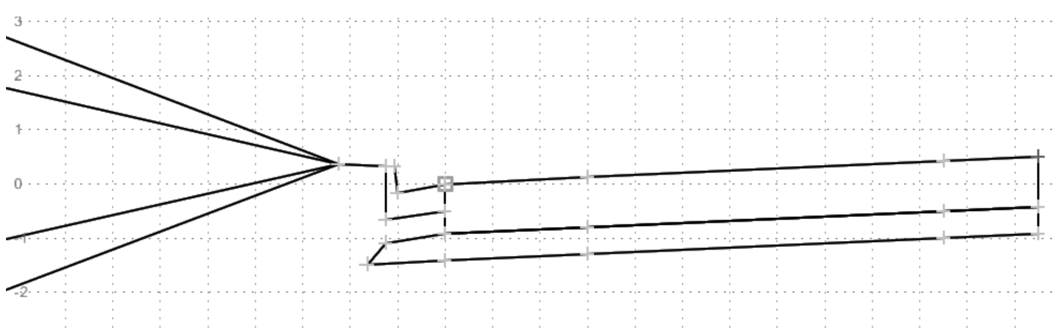
Section Objectives:

- ♦ 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 6^{th} Ave edge of pavement
- ♦ Modify sideslopes in the template view

Adding Template Drops

These are added to include the new templates into teh corridor.

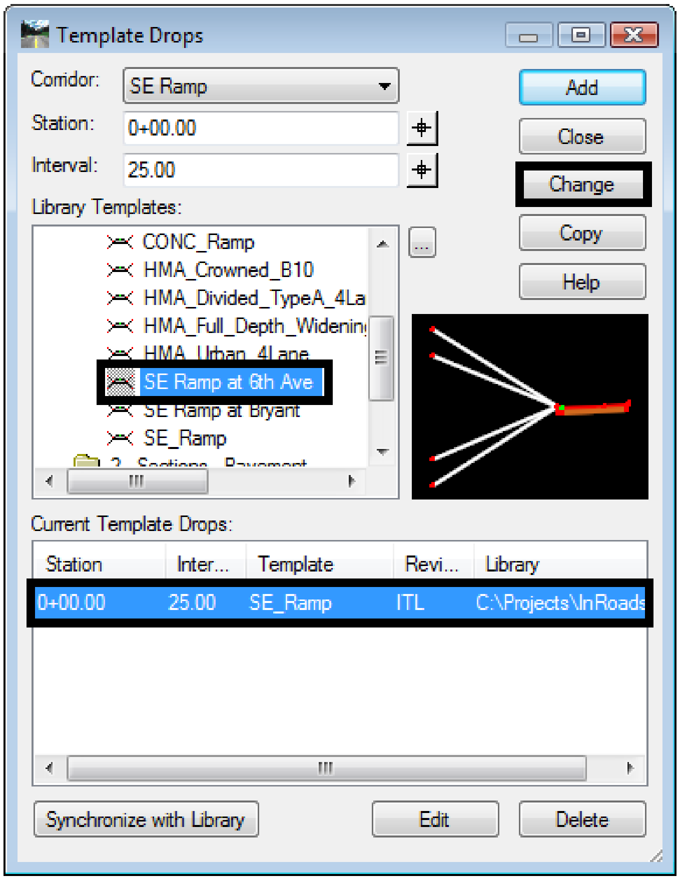
1. Open Roadway Designer.
2. Set the ***Corridor*** to **SE Ramp** and the ***Active Surface*** to **Existing_Ground**.

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***.

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**.

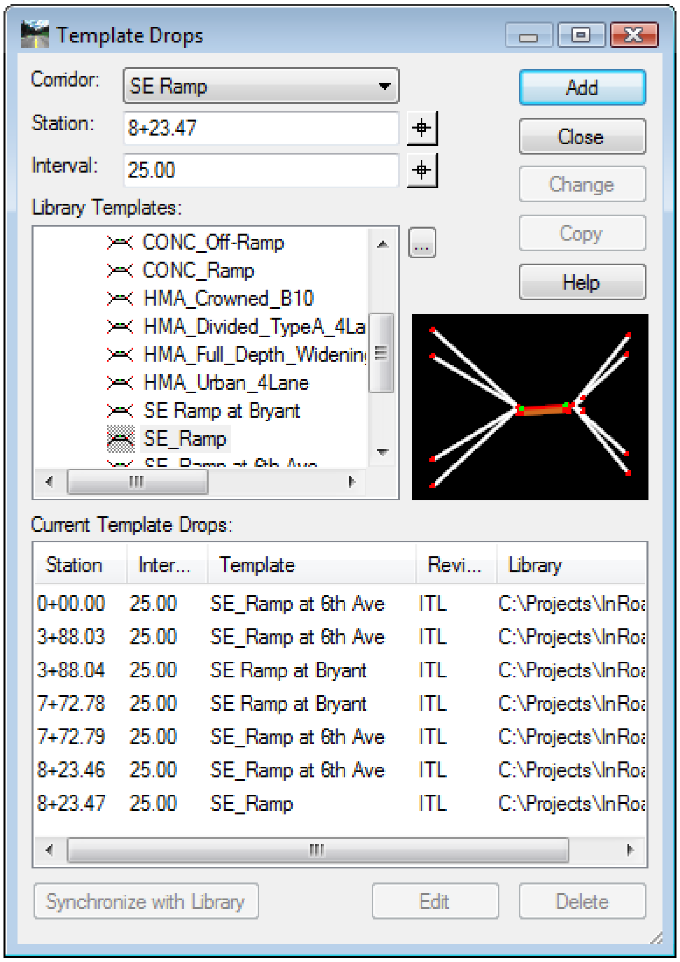
Again, an abrupt change between templates is needed so the transition occurs in 0.01 feet.

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**.
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. Select **RT_Conc_EOP-Top** for the ***Point***.

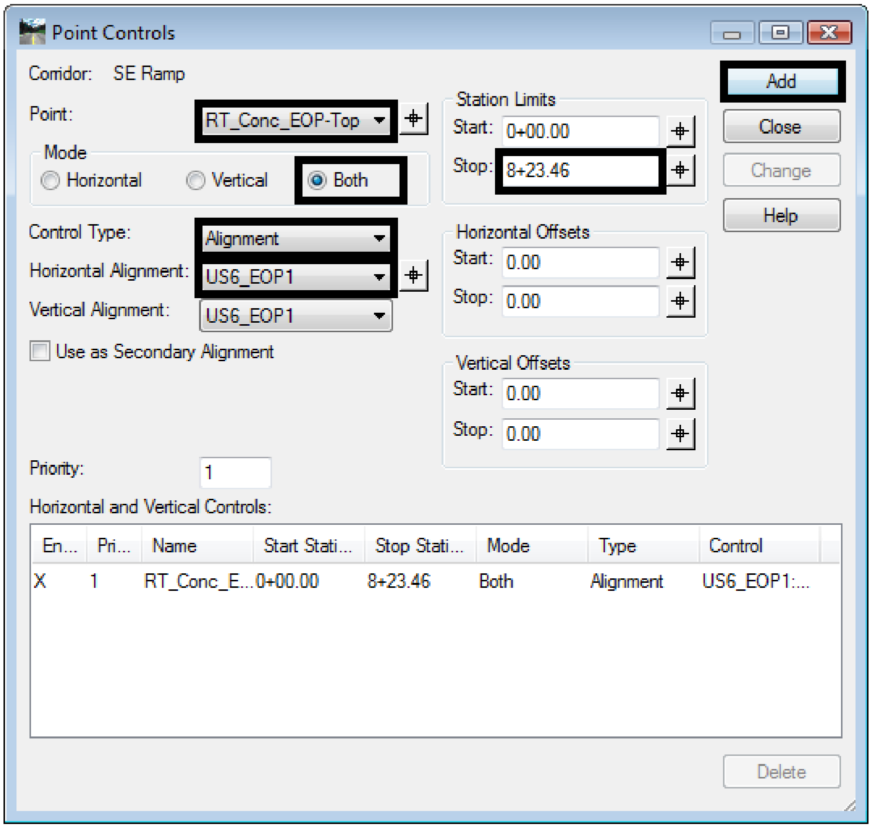
3. Toggle on **Both** for the ***Mode***.

4. Set the ***Control Type*** to **Alignment**.

5. Select **US6_EOP1** for the ***Horizontal Alignment***. The vertical alignment is automatically set.

6. In the ***Station Limits*** area, leave the ***Start*** at ***0+00.00*** and key in ***8+23.46*** for the ***Stop*** station.

7. **<D> Add** and **Close**.

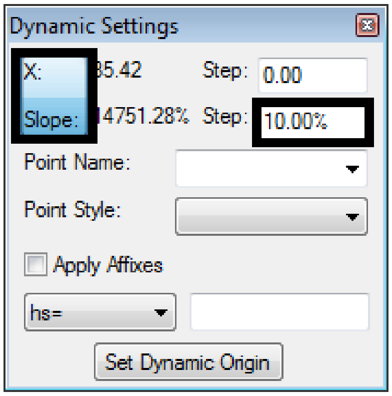


Modify Side Slopes for SE Ramp

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.

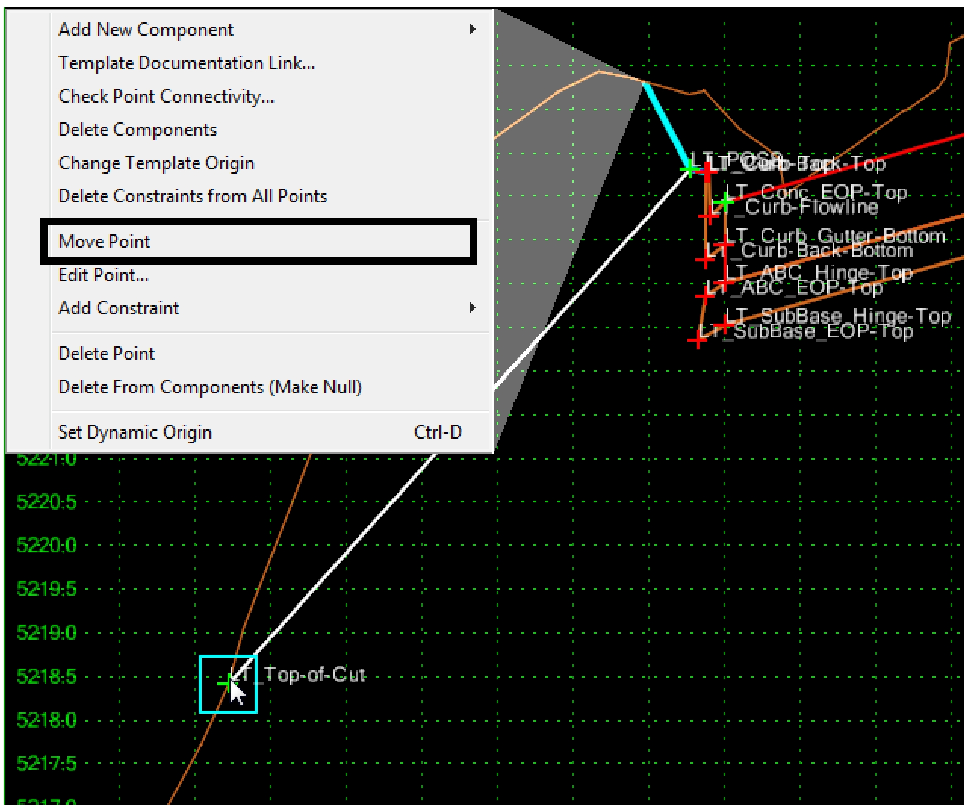
1. Set the ***Station Indicator*** to **7+72.79**.
2. **<D> <D>** in the Template View to open the ***Edit Template at Station 7+72.79 Only*** dialog box.
3. Open the ***Dynamic Settings*** dialog box.
4. **<D>** on the Readout button to change it to ***X*** and ***Slope***.

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.

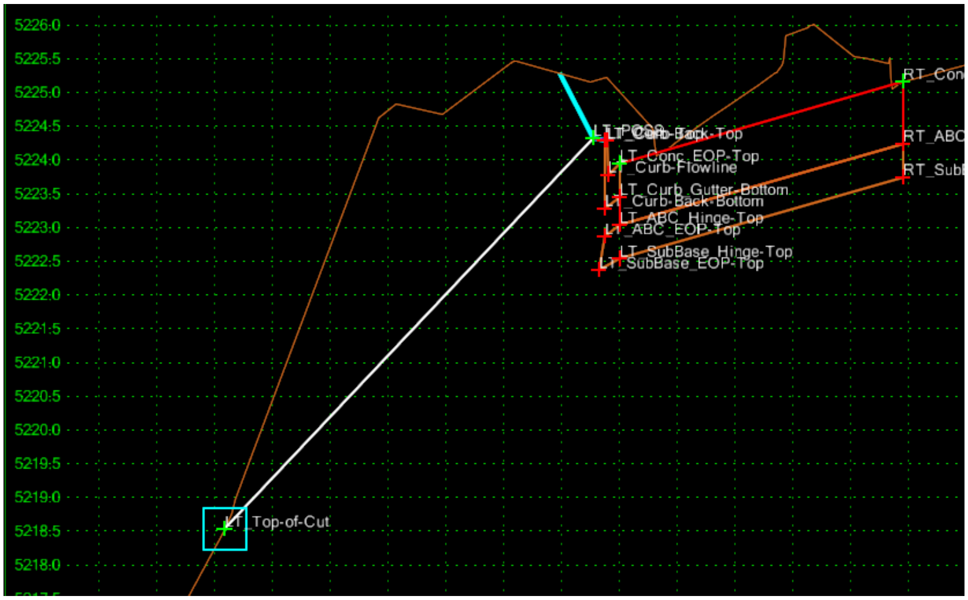
7. Move the point to the location shown in the illustration below. **<D>** to place it.



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:

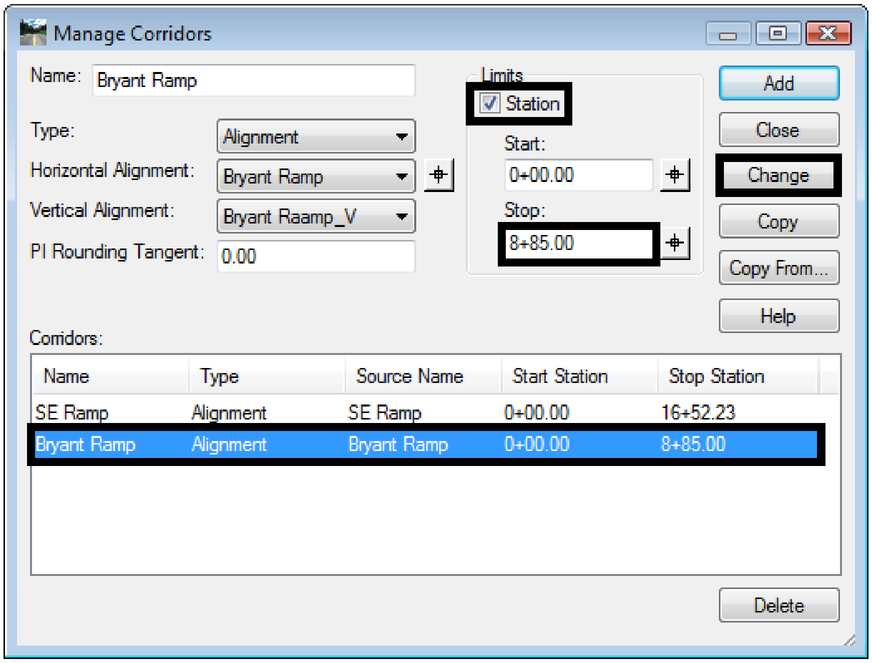
- Change the end station for the Bryant Ramp corridor
- Add template drops for the new Bryant Ramp templates
- Add point controls to match the template to the SE Ramp edge of pavement
- Define target aliasing to target the SE Ramp surface
- Modify sideslopes in the template view

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 as 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**.

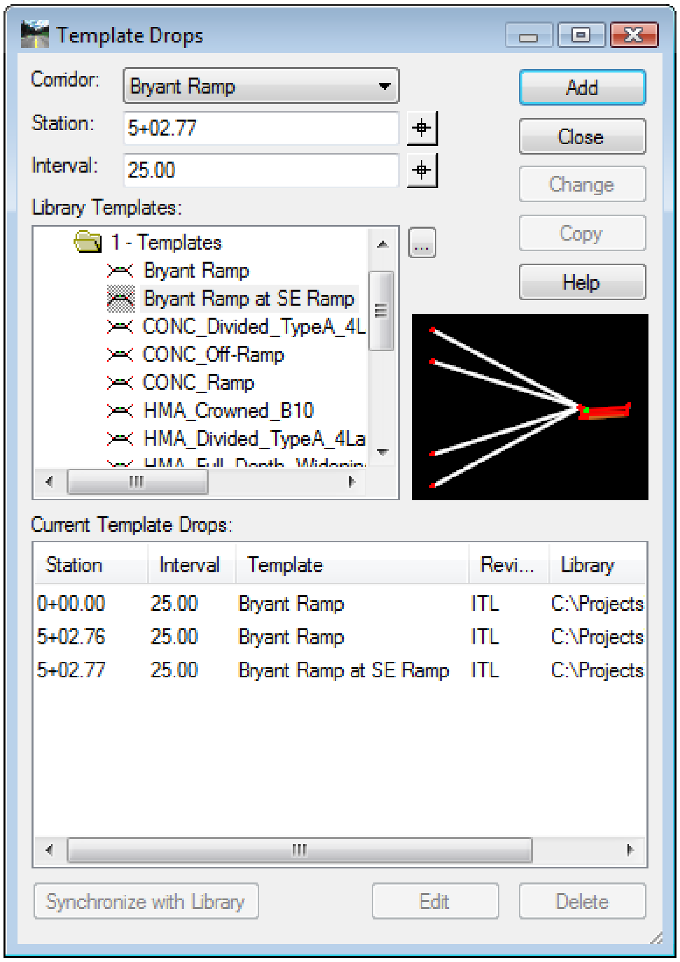


Adding Template Drops

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.

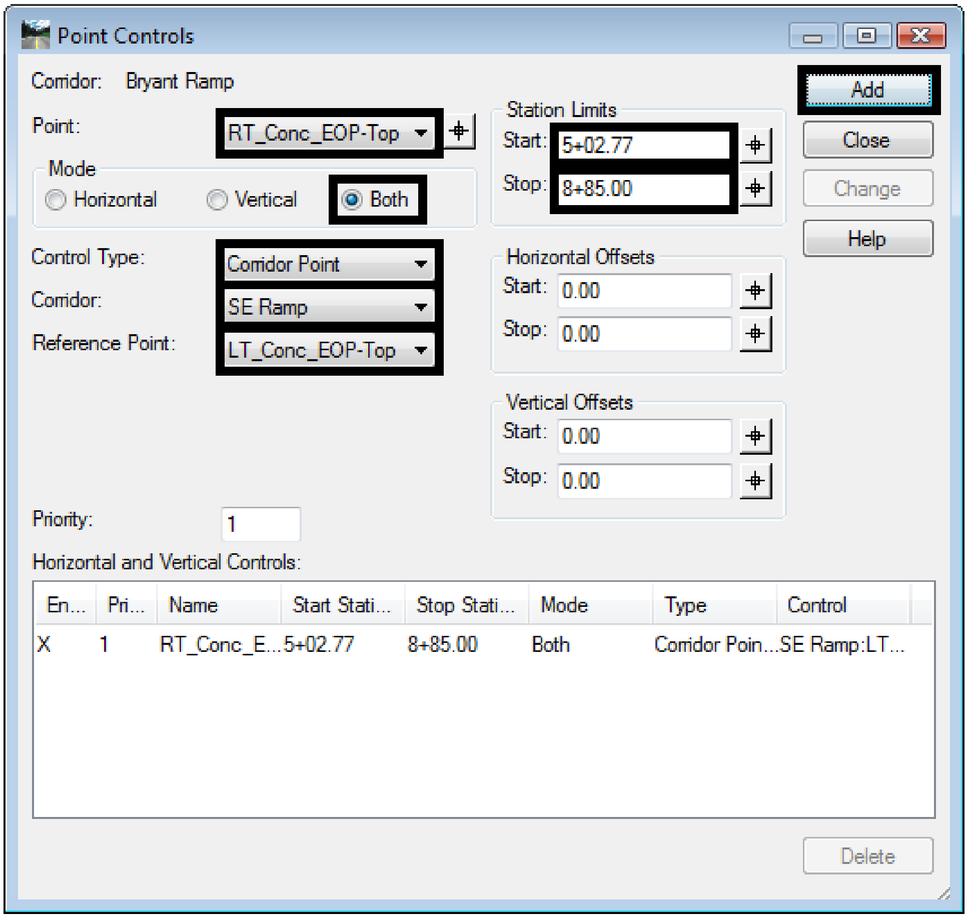


Add Point Controls for the Bryant Ramp

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. Select **RT_Conc_EOP-Top** for the ***Point***.
3. Toggle on **Both** for the ***Mode***.
4. Set the ***Control Type*** to **Corridor Point**.
5. Select **SE Ramp** for the ***Corridor***.
6. Select **LT_Conc_EOP-Top** for the ***Reference Point***.
7. In the ***Station Limits*** area, key in ***5+02.77*** for the Start station and key in ***8+85.00*** for the ***Stop*** station.

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

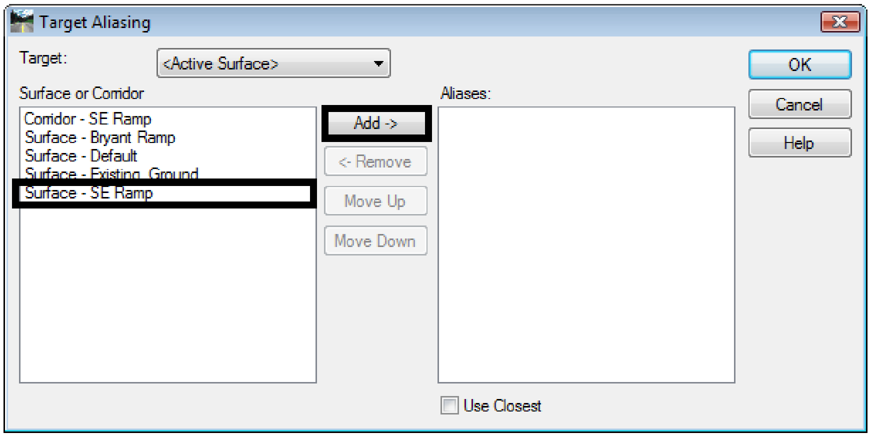


Create Target Aliasing for the Bryant Ramp

Target aliasing is used to tie the Bryant Ramp sideslope to the SE Ramp sideslope in the area befor the merger. Without this, the combined surface will not triangulate properly in areas where the toes overlap.

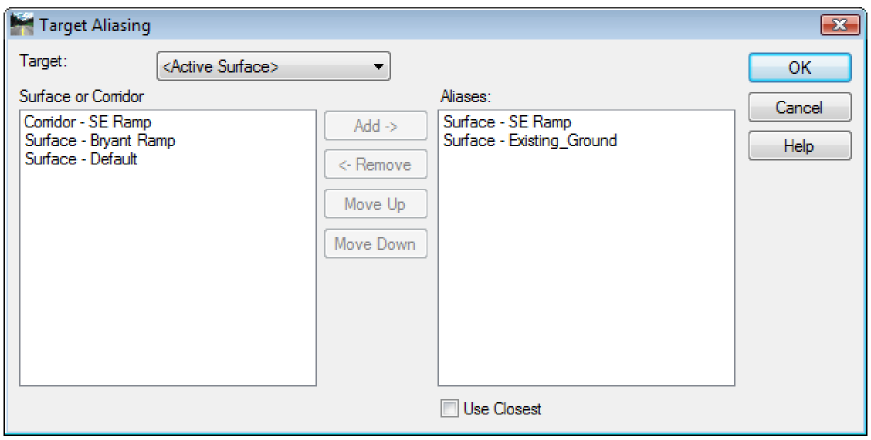
1. Select Tools > Target Aliasing from the Roadway Designer menu bar.
2. Highlight **Surface – SE Ramp** in the ***Surface or Corridor*** list.

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

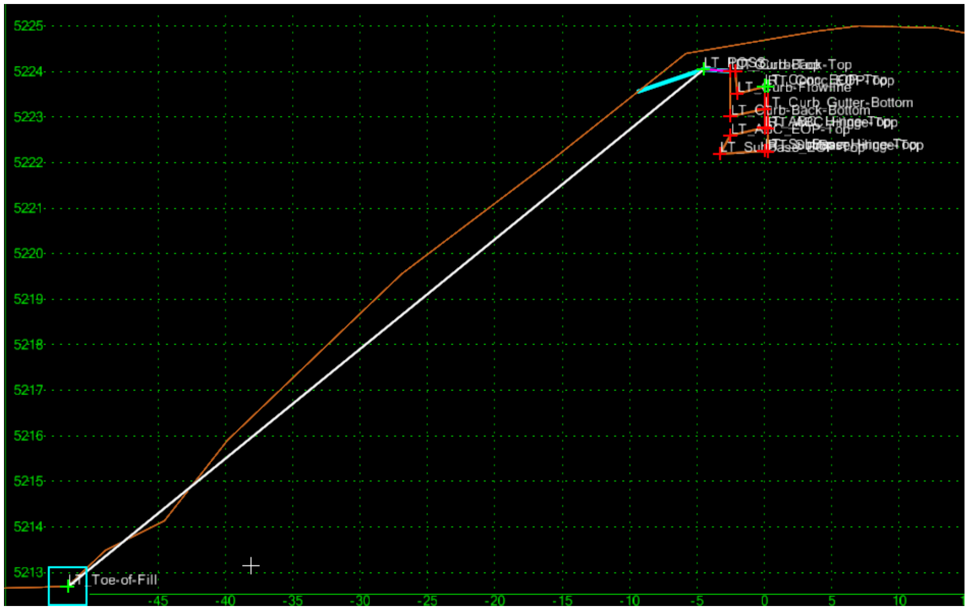
This corridor also has an undesirable result on a sideslope. Again, because this result occured in a limited area, the template at the station is edited.

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:

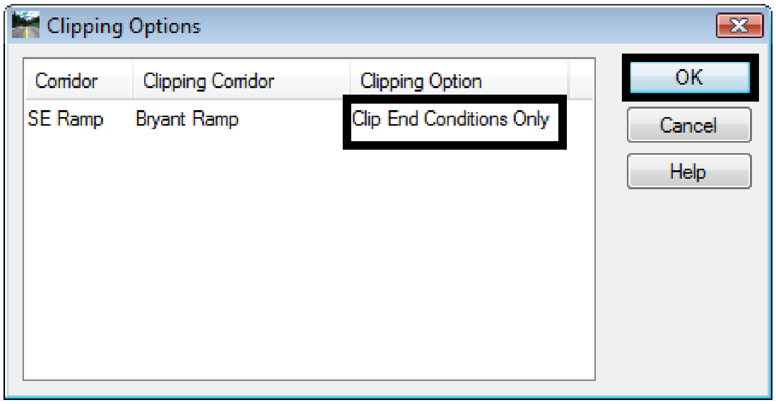
- Create a combines surface from the SE Ramp and Bryant Ramp corridors

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 in end conditions overlap prior to the merger.

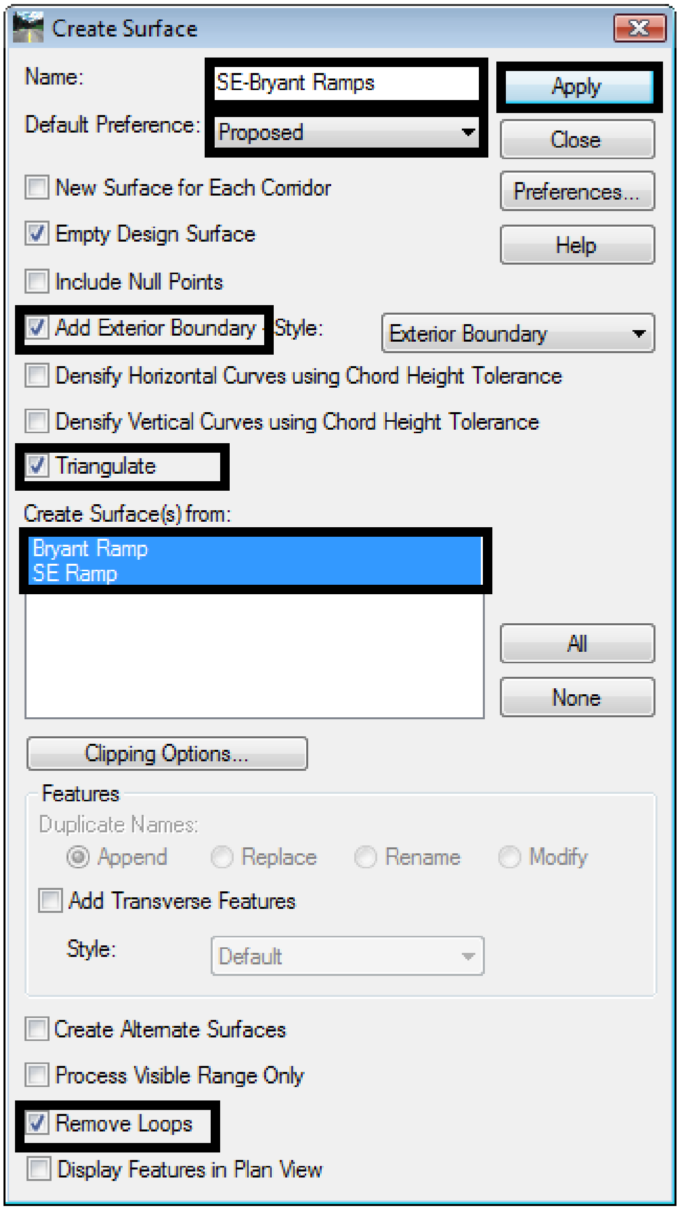
5. **<D>** the **Clipping Options** button.
6. Set the ***Clipping Option*** to **End Conditions Only**.

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**. 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.

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. **FM_BD_Body2**