Labs for Bridge Essential Using 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 08.09.04.51
InRoads® version 08.09.02.16
0209 – Version 04.00.00 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 hyper linked
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

LAB 1 - Getting Started in InRoads for Bridge

Chapter Objectives:

- Setup a project with the correct resources including the creation and maintenance of an InRoads project file
- Identify and load the correct resources and files needed for bridge design
- Develop an understanding of what InRoads tools to use as they relate to real world design processes

Note: The *.zip file of the data set for these labs can be downloaded from the website Labs for Bridge Essentials. The zip file should be extracted to the C:\Projects\ directory. If the labs will not be worked through sequentially, the data for each lab is also found in the Miscellaneous directory of the data set. To use the files from theMiscellaneous directory, copy the files in each specific lab folder following the instructions found in the *.doc file.

Lab 1.1 - Purpose of Bridge Essentials Labs

The Bridge Essential labs have been developed to demonstrate how InRoads tools can be used to facilitate the design and detailing processes of bridges and structures. These labs are intended as a supplement to the reference material and labs developed for the standard MicroStation and InRoads courses.

The labs are based on students having a basic understanding of MicroStation. A basic understanding of InRoads is preferable, but not required. Some of the basic InRoads concepts are covered in these labs only to explain more specific details as they relate to the Bridge workflow. However, for concepts that are not specific to the Bridge workflow, refer to the reference material for MicroStation and InRoads to gain a fundamental understanding of the CDOT engineering software environment.

For those with little or no experience with InRoads, use the links below to access standard MicroStation and InRoads reference material related to this lab.

From ***A Practical Guide for Using MicroStation XM***

- Chapter 1 - Introduction to CDOT - This chapter documents helpful CADD resources available to the student and links to those resources.
- Chapter 2 - Getting Started in MicroStation- This chapter documents the basics of the MicroStation interface including mouse mechanics, the MicroStation Manager window, and description of the toolbars.
- Another important chapter for the student to understand is Chapter 3 - Levels. Use this link if you are not familiar with how levels are organized and how to use them.

From ***A Practical Guide for Using InRoads XM***

- Chapter 1 - Getting Started in InRoads describes where to find and store files used in InRoads, how to setup a project directory, and best practices for setting up InRoads to automatically use the correct InRoads files and point to the correct InRoads folders.
- Chapter 2 - InRoads Options provides instruction on what Locks are and how to use them in addition to setting up the display precision for reports and setting the scale factors for how InRoads displays text, cells, and line styles.

1. Use the following link to see what other training material, including reference material and labs, is available for your use: Manuals, Training Materials, and Resources.

Lab 1.2 - Review of the Project Directory Structure

Project Setup

Setting up a project directory is generally performed by the Project Manager. However, a standard project directory structure can also be used to store data that is not part of a formal project. Benefits of setting up a standard project directory in these cases include:

- Ensures that predictable MicroStation and InRoads resources are being used to develop the data
- Facilitates the transfer of data to/from other project participants, entities, or storage areas
- Reduces need for support and associated downtime

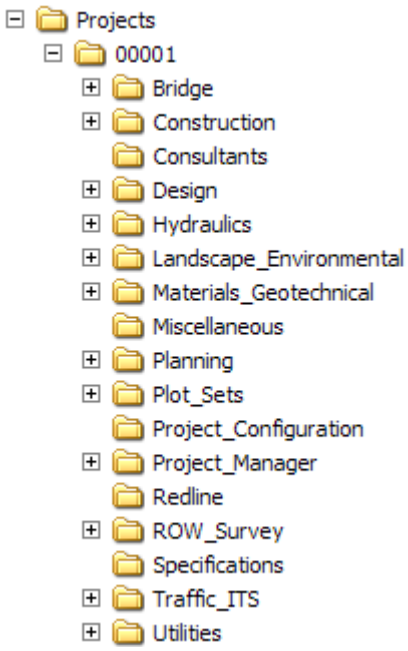
The standard project directory structure is suitable for small and large projects, projects in a network environment or stand alone projects, and even projects in the ProjectWise environment. By using this standard directory structure, Bridge users will be able to find the data they need from other specialty groups and in return specialty groups will be able to find the data supplied by bridge.

The next few steps will illustrate how to create a project directory for a stand alone project.

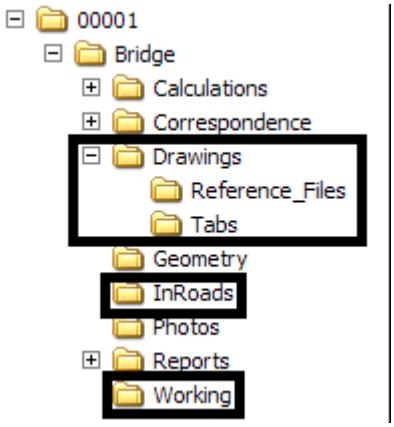
Note: Because a stand alone project does not have a project code use a project code of ***00001*** as the project number.

1. Follow the steps outlined in the section ***"Creating the Project Directory"*** found in Chapter 1 - Getting Started in InRoads of ***A Practical Guide for Using InRoads XM*** to create the project folder.

2. Open ***Windows Explorer*** and navigate to the new 00001 project folder.



3. Expand the ***Bridge*** folder.



The folders highlighted in the image above are the folders that will be most often used during this course and the normal design process.

In addition to these folders, files in the ***ROW_Survey\InRoads*** and ***Design\InRoads*** folders will be used as a basis for bridge and structure design.

- The topographic survey file will be found in the ROW_Survey\InRoads folder.
- The proposed roadway alignment and surfaces will be found in the Design\InRoads folder.

Lab 1.3 - InRoads Terminology

The following steps will show how the user how to use the Help system that comes with the product to find definitions to unfamiliar terminology.

1. Launch ***InRoads Help*** by going to **Help > Contents** in the InRoads application window.
2. On the ***Contents*** tab, click on **Supplemental Information > Glossary**.
3. Look up the following terms in the **Glossary**:
   a. Original Surface and Design Surface
   b. Digital Terrain Model
   c. Perimeter
   d. Geometry Project
   e. Alignment
   f. Corridor
   g. Project and RWK

Lab 1.4 - Understanding How Project Design Data is Stored

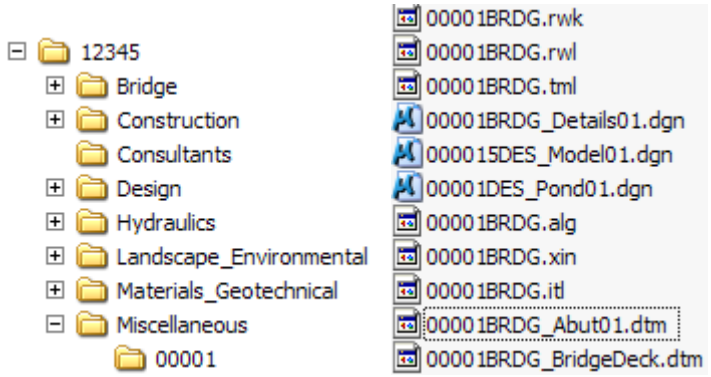
This section will help you understand how the different design features, such as surfaces, alignments, and typical sections, relate to InRoads file types. Managing InRoads data will be a lot easier if you have a good understanding of this relationship. The following table shows how InRoads file types relate to design elements.

Design Element	InRoads File
Surfaces - Topographic (existing) or proposed design	*
Alignments	*.alg
Typical sections (templates)	*.itl
Modeling (corridors)	*.ird
Control how graphics look (preferences)	*.xin
InRoads project	*.rwk

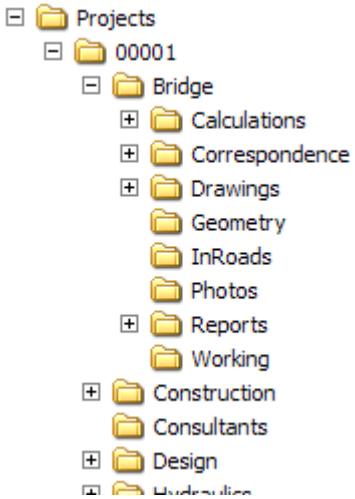
Additional information on how these file types in the section ***"InRoads XM Resource Locations"*** found in Chapter 1 - Getting Started in InRoads of ***A Practical Guide for Using InRoads XM.***

The next few steps illustrate a practical application of how to manage InRoads data in the project directory structure. There are several files located in the \Miscellaneous directory of project 12345 that need to be moved to the project 00001.

4. Open ***Window Explorer*** and navigate to the directory **\12345\Miscellaneous**.



5. Move all the files that begin with ***00001*** to the correct folders in the \00001 project directory.



Note: Each discipline has a standard acronym. Use this acronym to determine the folder the file should be placed in (e.g. BRDG is the acronym used for the bridge group).

Note: The contents of these files are irrelevant. Only the filenames are important in this exercise.

6. Identify the one file that should not be used from the project directory structure because it is not a standard file.

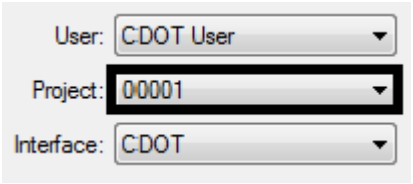
Note: Notice that there is only one geometry (*.alg) file for bridge. A good practice is to store all alignments in one geometry file. There are only a few situations that would require using more than one geometry file.

Using Project Defaults

InRoads ***Project Defaults*** are a way to improve the process of loading and saving InRoads files by setting a default path to the project folder where the resource should be located. This is accomplish by using another file type with the extension *.reg.

1. Launch MicroStation and set the ***Project Workspace*** to **00001**.

Note: You will need to revisit the MicroStation Manager window to set the project workspace to 12345 for subsequent labs.

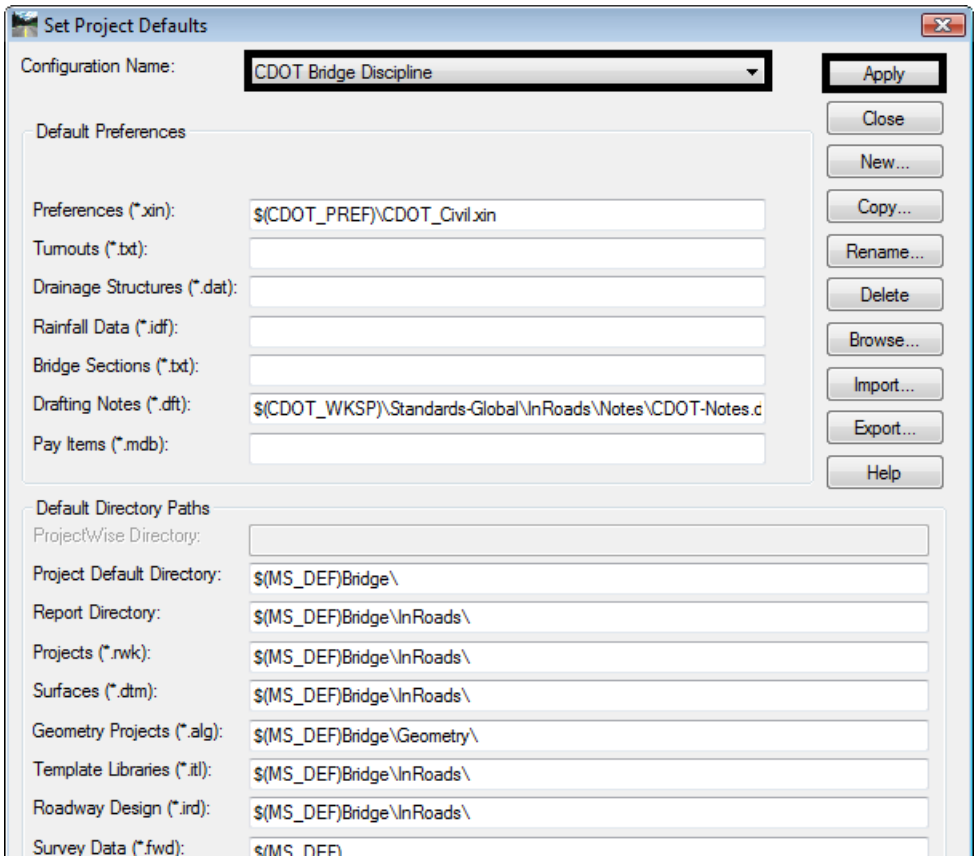


2. Open the file **00001BRDG_Model.dgn** from the directory ***C:\Projects\00001\Bridge\Drawings\Reference_Files***.

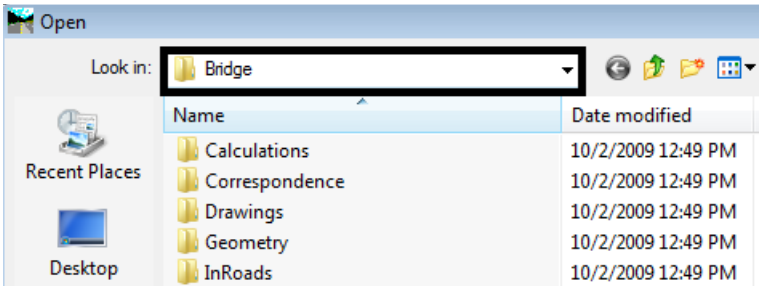
3. Launch InRoads by clicking on the  icon.

4. Follow the steps in the workflow CDOT InRoads XM Project Defaults Management to import the standard CDOT project defaults and set the ***Configuration Name*** to **CDOT Bridge Discipline**.

5. Click **Apply** and then **Close** the Project Defaults dialog box.



6. From the InRoads interface, select **File > Open.** Notice how InRoads now defaults to the Bridge folder of the project.



There are two keys to getting project defaults to work correctly:

- Load the correct pcf file by choosing the correct project workspace in the MicroStation Manager window
- Set the project default configuration name to ***CDOT Bridge Discipline***

Lab 1.5 - Requesting InRoads Design Data

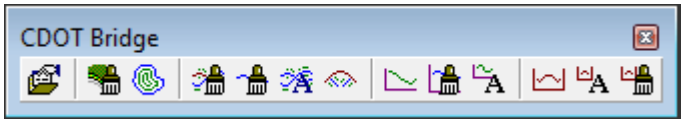
Before starting a Bridge project, you will need to load InRoads data files that have been created by other groups. The following is a list of these InRoads data files. Request the files from the appropriate contact person in each group.

Design Element	InRoads File	Responsible Group
Existing surface	*	Survey
Proposed (design) surface	*	Roadway Design
Proposed (design) alignments	*.alg	Roadway Design
Roadway Typical Sections (if needed)	*.itl	Roadway Design

The files should be copied into the ***Bridge\InRoads*** folder. The responsible group should update the Bridge group if any changes are made to these files, including:

- Additional/new survey data
- Revised alignments (horizontal and vertical)
- Revised typical sections
- Additional work at approach to structures

Lab 1.6 - Using the Bridge Toolbar to follow a Workflow

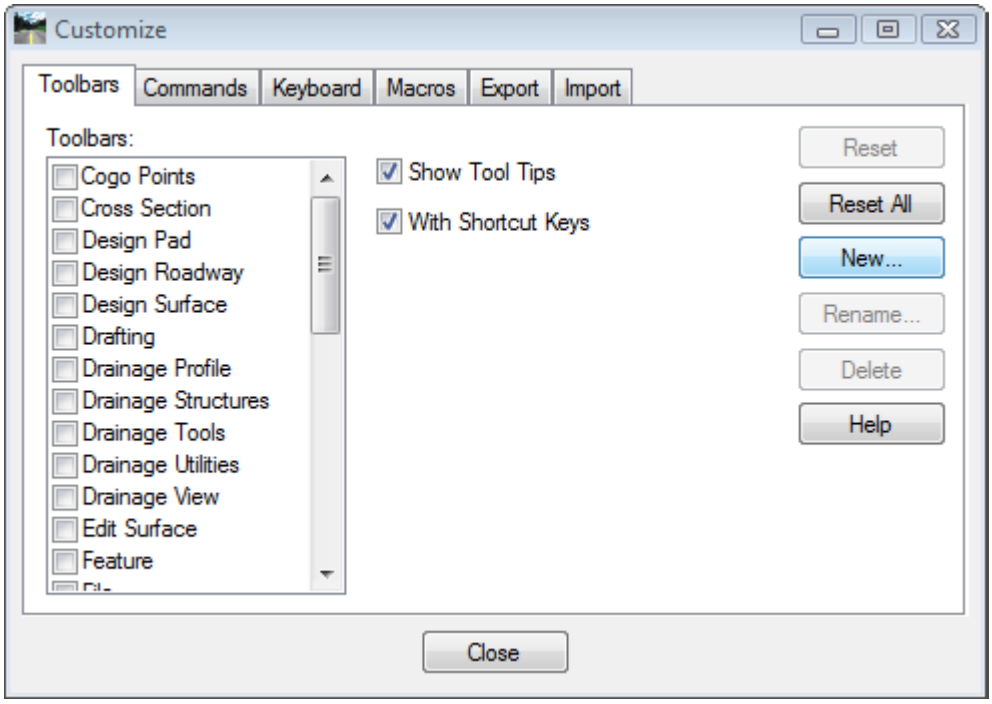


Not all InRoads tools are relevant to Bridge design and detailing processes. In addition, some tools are used more often than others. The purpose of the Bridge toolbar is to organize the most commonly used InRoads tools in a concise, sequential order and make them easily accessible.

The toolbar is not intended to be complete at this time but has been created to introduce bridge designers to the toolbar concept. With input from the bridge group, it is expected that the toolbar will change over time according to the needs of the group.

The toolbar needs to be loaded manually. Once loaded, the toolbar resides in the registry of the computer and only needs to be loaded again if it changes.

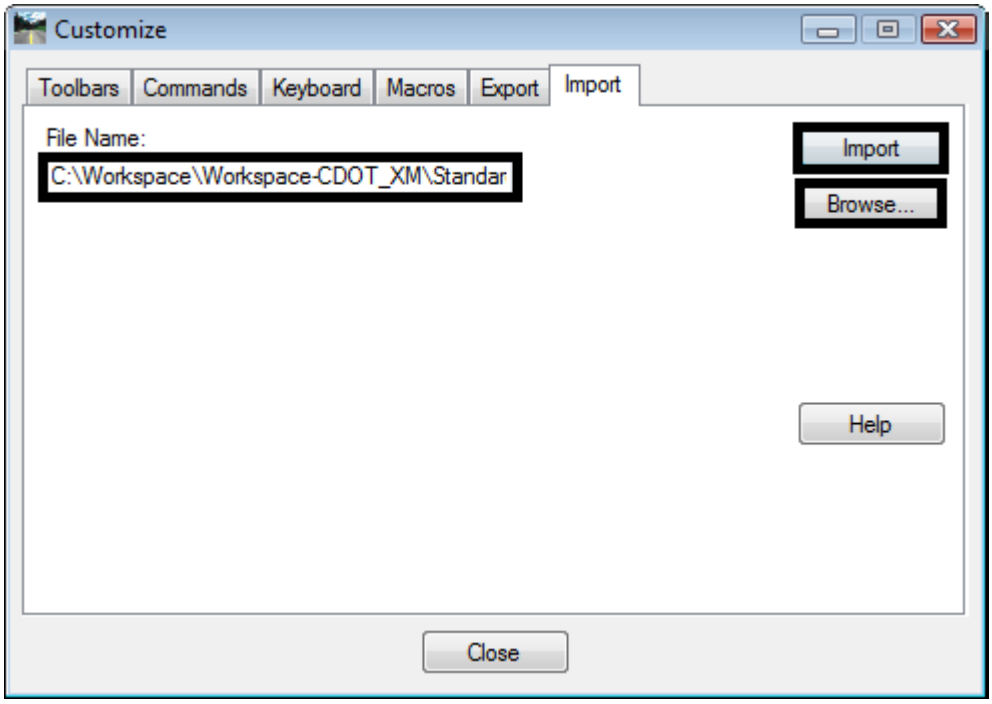
1. Load the ***Bridge Design*** toolbar by selecting **Tools > Customize.** The ***Customize*** dialog box will appear.



2. Click n the ***Import*** tab and choose Browse.

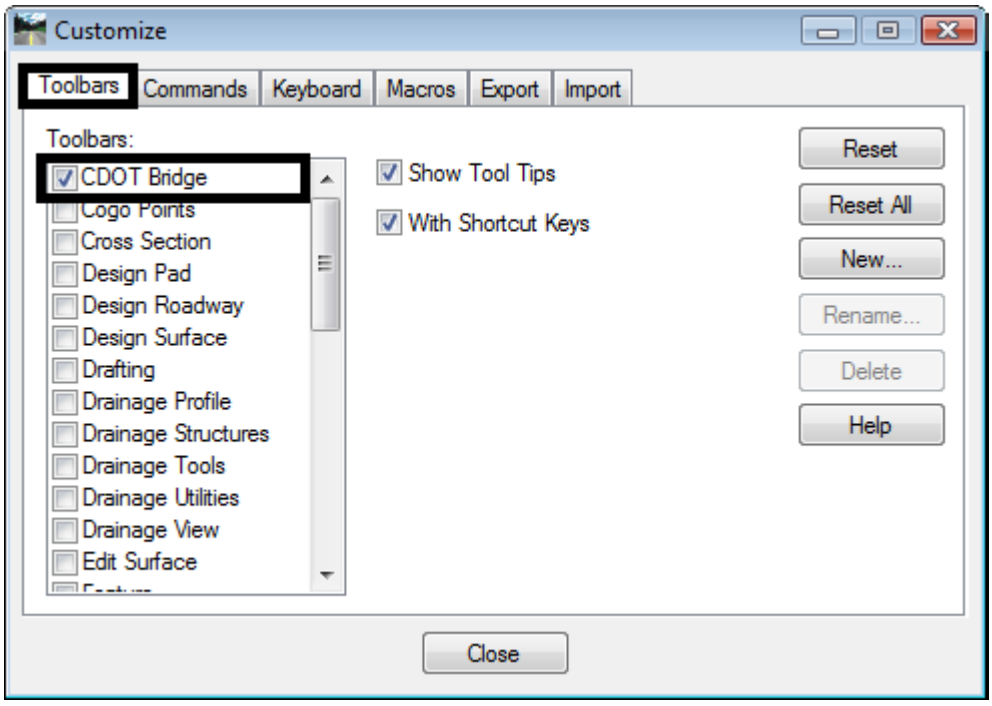
3. Select the **CDOT Bridge.tbr** file from the ***C:\Workspace\Workspace-CDOT_XM\Standards-Global\InRoads\Interface*** directory.

4. Click on **Import**.



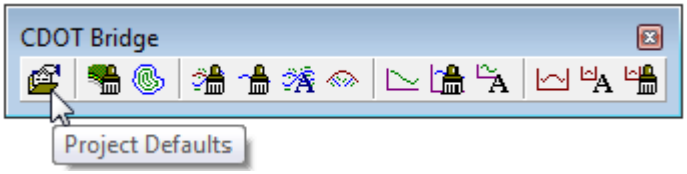
5. Click on the ***Toolbars*** tab

6. Check on **CDOT Bridge** in the ***Toolbars:*** area. The CDOT Bridge toolbar will appear on the screen

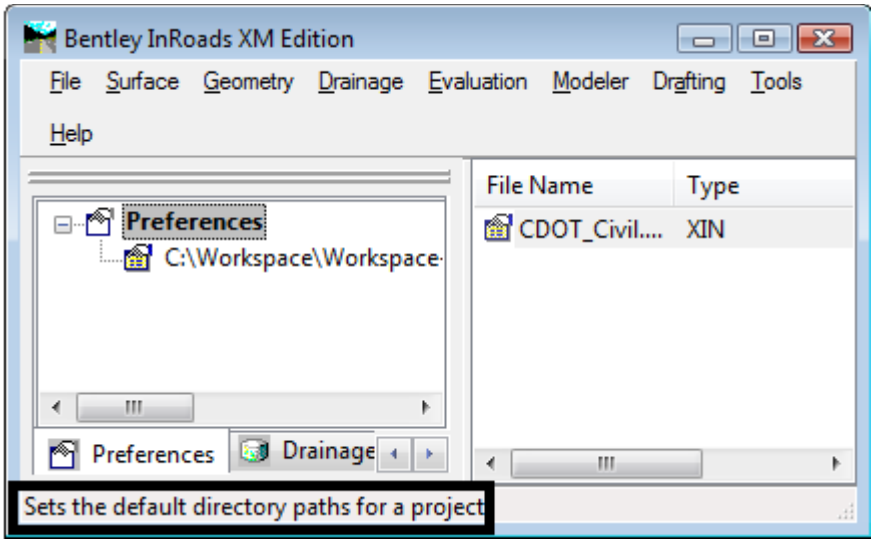


7. Close the Customize dialog box.

8. Click on the title bar of the CDOT Bridge menu to make it active.
9. Hover over the ***Project Defaults*** icon. A ***tool tip*** appears to indicate what tool the icon represents.



10. An explanation of what the tool does also appears in the lower left of the InRoads application window.



For now, the toolbar is divided into the following sections:

a. Project Defaults - Used to set the default paths to InRoads files
b. View Surface - Used to evaluate a surface including displaying the contours or surface features
c. Review Horizontal Alignments - Used to display and annotate horizontal alignments and generate alignment reports
d. Profiles and Vertical Alignments - Used to generate and annotate profiles
e. Cross Sections - Used to generate and annotate cross sections

The Project Defaults tool was explained in this lab. The other tools on this toolbar will be explained in the next lab.

11. Now that you understand how to create a project and manage the data within a project directory structure, **Delete** the project ***00001***.

Chapter Summary:

- Using the standard project directory structure will make it easier to manage project data and facilitate the correct usage of InRoads resources.
- Using Project Defaults will make it easier to save and retrieve InRoads files to/from the correct project folders.
- Using the Bridge Toolbar will reduce the amount of time looking for the correct InRoads tool. In addition, the toolbar is workflow based, allowing the user to quickly find the correct tool based on the design stage being worked on.

LAB 2 - Reviewing Roadway Design Data

Chapter Objectives:

- Develop an understanding of the roadway design data.
- Learn InRoads' tools that are used to display and evaluate surfaces.
- Learn InRoads' tools that are used to display and evaluate alignments.

The following files are used in this lab:

- C:\Workspace\Workspace-CDOT_XM\Standards-Global\InRoads\Preferences\CDOT_Civil.xin
- C:\Projects\12345\Bridge\Working\12345BRDG_Model-Drain.dgn
- C:\Projects\12345\Design\InRoads\12345 SH52
- C:\Projects\12345\Design\InRoads\12345 SH119 SH52 interchange.alg
- C:\Projects\12345\ROW_Survey\InRoads\DTM\12345 existing ground for interchange

Lab 2.1 - Requesting InRoads Design Data

See Section 1.5 ***Requesting InRoads Design Data*** to determine which InRoads data files are needed to start your work. The labs assume that you have been provided the appropriate InRoads data files from the responsible groups noted in Section 1.5.

Lab 2.2 - Using InRoads Surface and Geometry Tools

This section covers how to use surface and geometry viewing, annotation, tracking, and reporting tools to review InRoads data that is provided to the Bridge group by the Roadway Design group. A "working" file will be used to view geometry, cross sections, and profiles.

1. Open MicroStation and InRoads using the ***C:\Projects\12345\Bridge\Working\CU12345BRDG_Model.dgn*** file.

   Note: The standard filename for working files includes the user's initials in front of the filename. In this case, "CU" stands for CDOT User.

2. Delete any MicroStation graphics currently in the design file.

3. Verify the correct ***.xin*** file is loaded.

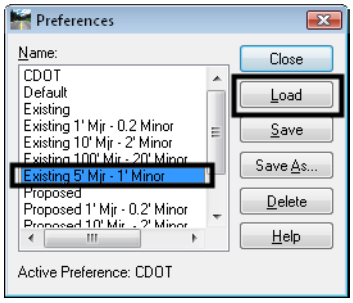
4. Select **File > Open** from the InRoads menu.

5. Open ***C:\Projects\12345\Design\InRoads\12345 SH52*** and ***12345 SH119 SH52 interchange.alg***.

6. Open ***C:\Projects\12345\ROW_Survey\InRoads\DTM\12345 existing ground for interchange***.

Review the surfaces

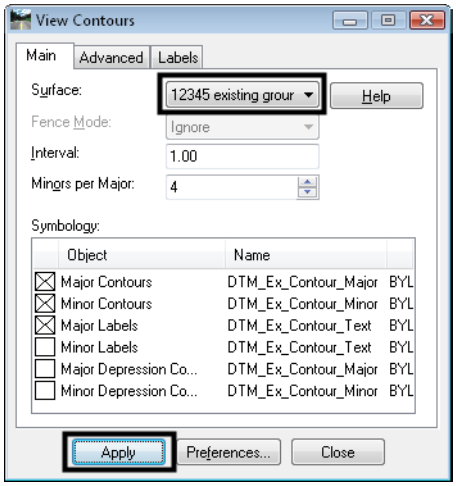
1. Select **Surface > View Surface > Contours**.
2. Select **Preferences**.



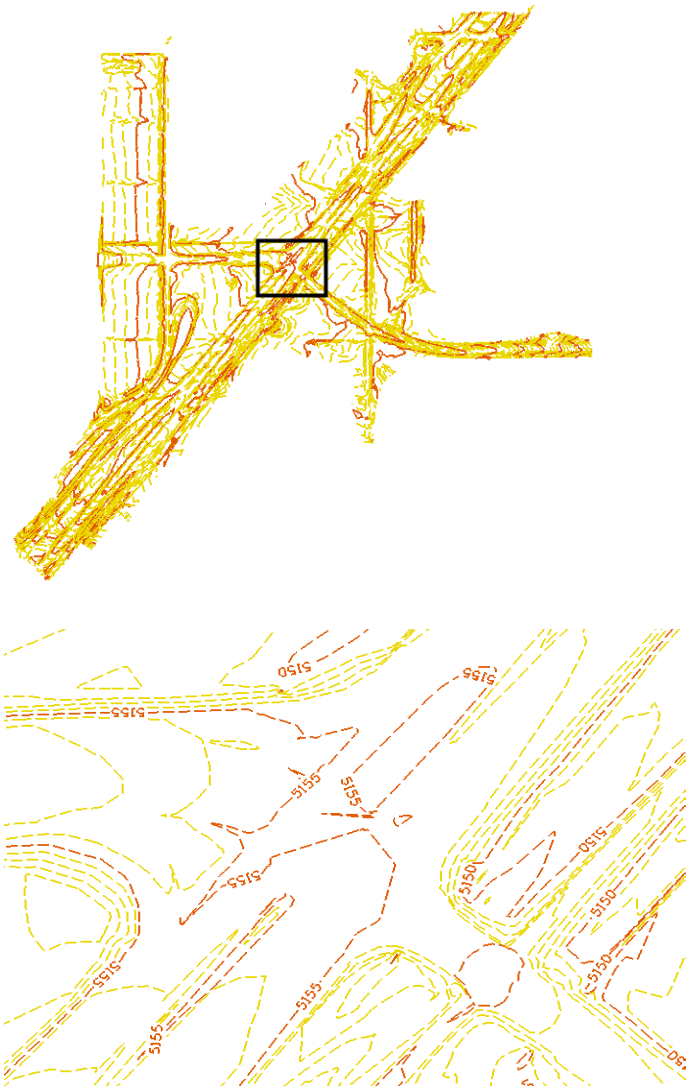
3. Highlight the ***Existing 5' Mjr – 1' Minor*** preference.

   Note: The ***Preference*** controls the interval of the contours, number of minors per major contour, labeling, levels the contours are displayed on, etc.

4. **<D> Load**, then **Close**.
5. Set the ***Surface*** to ***12345 existing ground for interchange***.
6. **<D> Apply**.



7. Review the contours and zoom into the proposed bridge area.

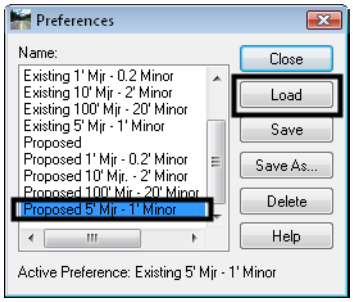


8. Use MicroStation to **Delete** the contours when done reviewing.

   Note: The contours are a graphic group, so make certain graphic group lock is on.

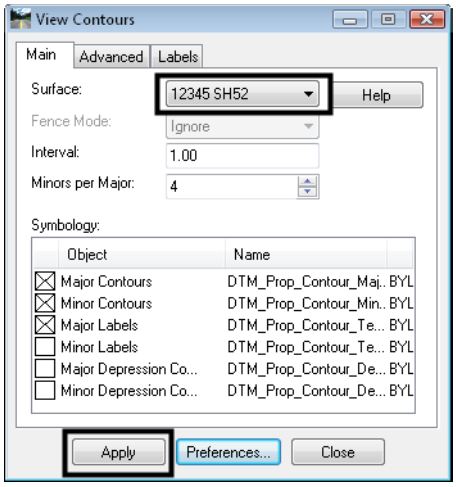
9. Select **Preferences** from the **View > Contours** dialog.

10. Highlight the ***Proposed 5' Mjr – 1' Minor*** preference.



11. **<D> Load.**

12. Switch the surface to ***12345 SH52***.

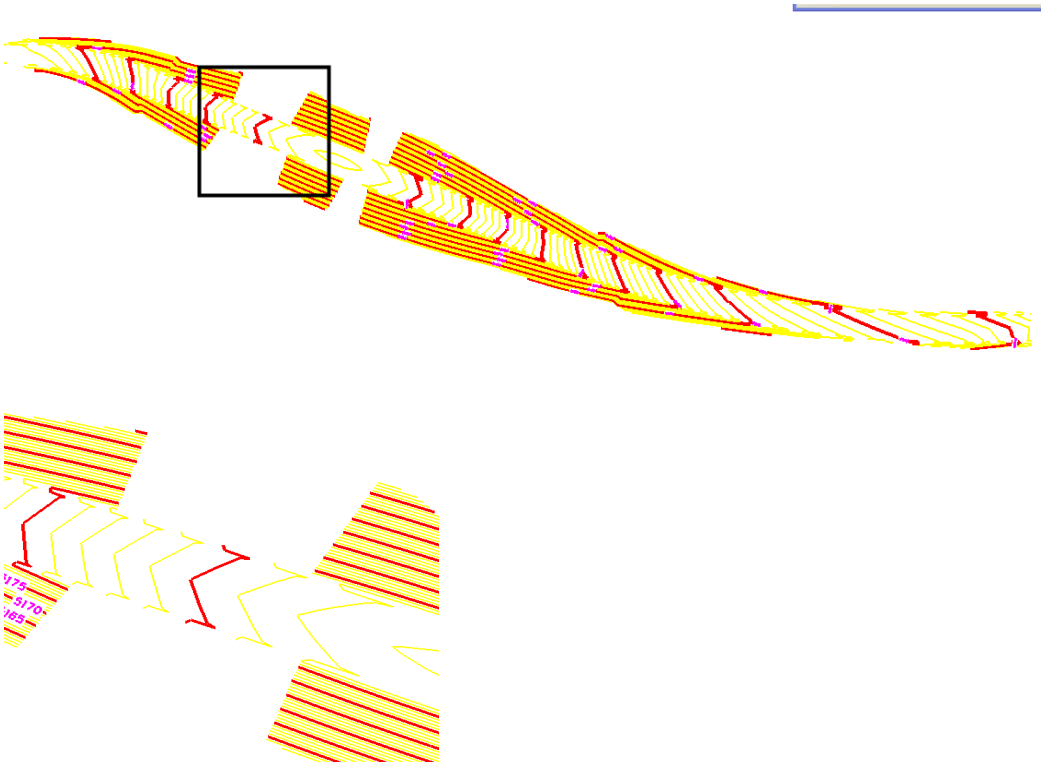


13. **<D> Apply**.

14. **Close** the ***Preferences*** dialog.

    Note: Loading the preference changes the contour settings so this display uses the proposed symbology.

15. Review the contours and window in as shown.

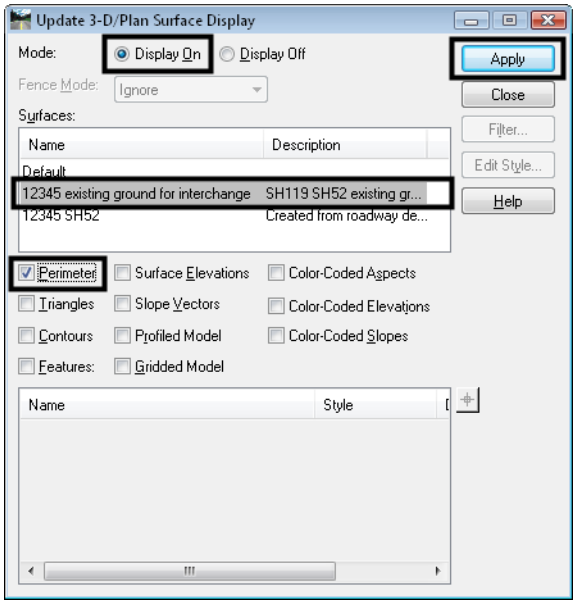


Note: In this case, the design model does not have sideslopes in the area where the proposed bridge will be located.

16. **Close** the ***View Contours*** dialog.
17. Use MicroStation to **Delete** the contours when done reviewing.
18. Select **Surface > Update 3D/Plan Surface Display**.

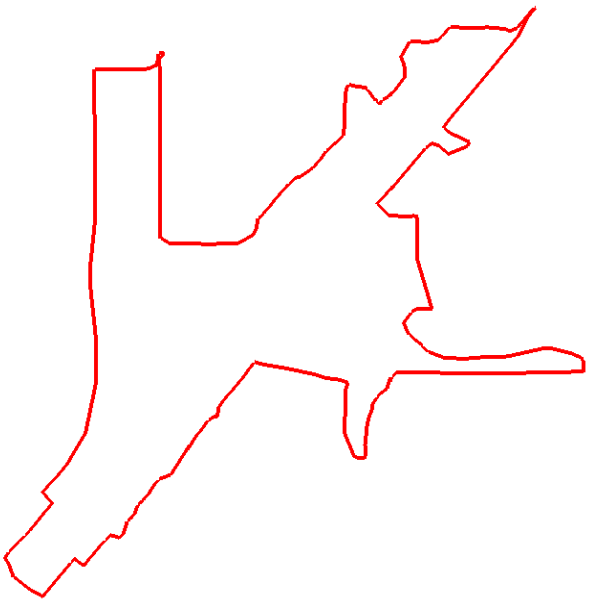
    Note: This command is useful since it provides access to most surface viewing commands in one dialog, and it allows you do delete the displays without using the MicroStation Delete command.

19. Toggle ***Display On*** and highlight the ***existing ground*** surface.
20. Toggle on ***Perimeter***.



21. **<D> Apply**.
22. **Fit** the MicroStation view to see the perimeter of the surface.

Note: The perimeter of the existing ground is useful to review the limits of the survey.

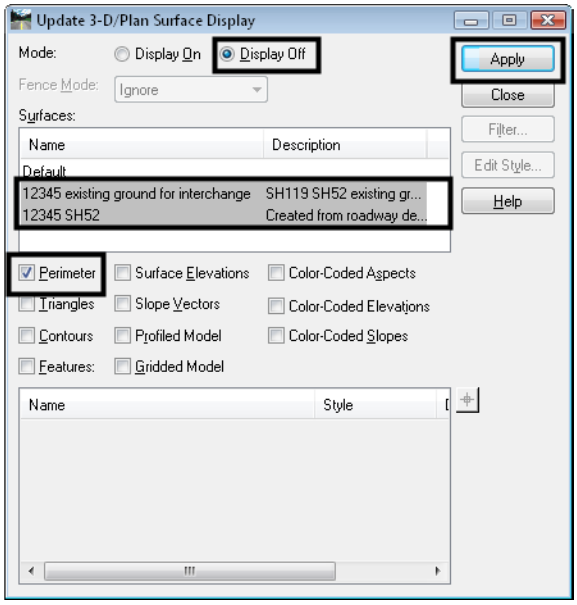


23. Repeat for the ***SH52 surface***.

Note: You can highlight more than one surface at a time. These were done separately to more easily tell which surface is which.

24. Toggle ***Display Off***.

25. Highlight both surfaces.



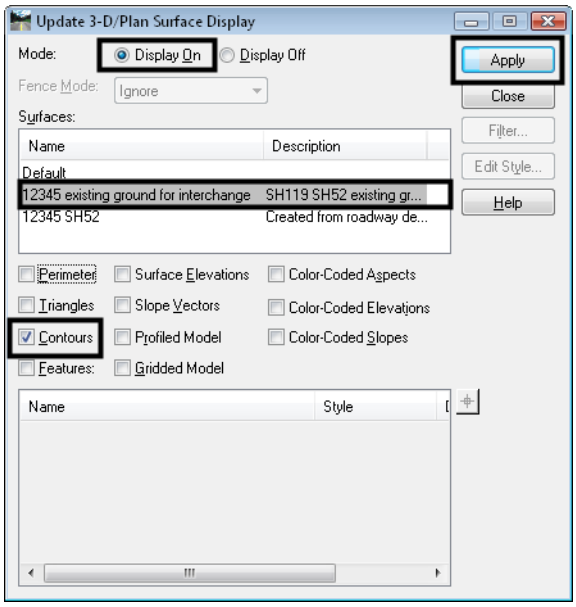
26. **<D> Apply**.

27. Toggle ***Display On***.

28. Toggle on ***Contours***.

29. Toggle off ***Perimeter***.

30. Highlight the ***existing ground*** surface.



31. **<D> Apply**.

32. Review the contour display.

33. Toggle Display Off.
34. **<D> Apply**.

    Note: You are not given a choice on the preference when using this command for displays, but you were able to delete the perimeter and contours without using the MicroStation delete command.

35. **<D> Close**.

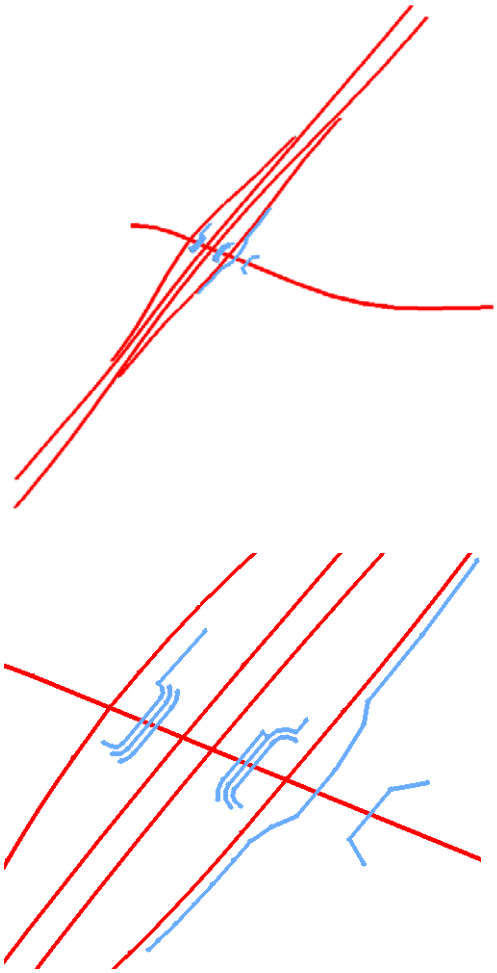
Review alignments using Viewing, Tracking and Stationing

The following InRoads tools will be used in this lab to review alignments that are created by the Roadway Design group.

- **Geometry > View Geometry > All Horizontals** which displays all horizontal alignments in the active geometry project with no annotation.
- **Tools > Tracking > Tracking** which displays the Station and Offset for a specific point, along with surface data.
- **Tools > Tracking > Horizontal Alignments** which provides a readout of the Station, Offset and Curve radius (if applicable) for a specific point, along with elevation of the active vertical alignment.
- **Geometry > View Geometry > Active Horizontal** which displays only the active horizontal with no annotation.
- **Geometry > View Geometry > Horizontal Annotation** which displays the specified alignment or alignments along with annotation of the tangent and curve data.
- **Geometry > View Geometry > Stationing** which displays station for the specified horizontal alignment.

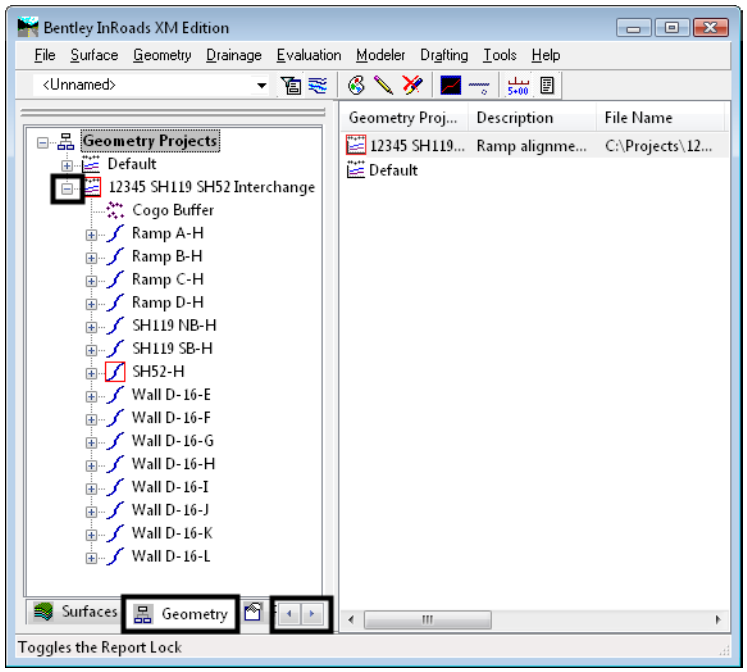
1. Select **Geometry > View Geometry > All Horizontals**.
2. Fit the MicroStation view.

Note: This geometry file contains horizontal and vertical alignments for ***SH119 NB*** and ***SB***, ***SH52***, ***Ramps A-D***, and several walls.

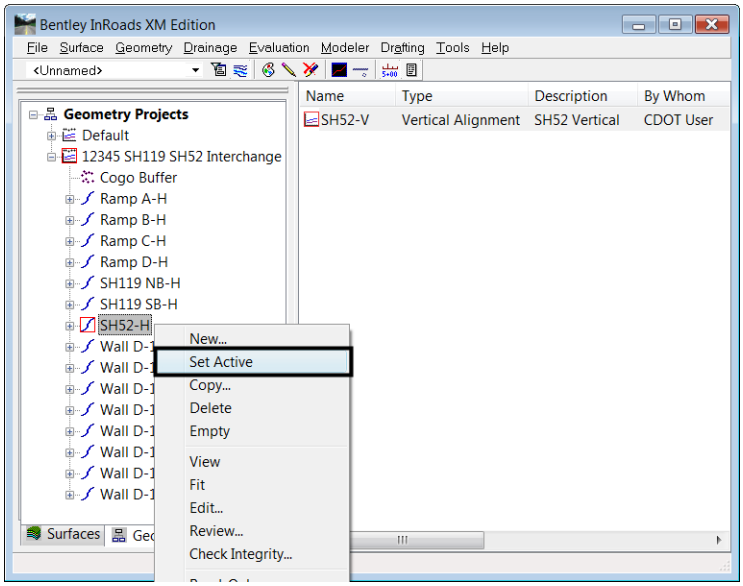


3. In the ***Explorer*** part of the InRoads menu, **<D>** on the ***Geometry*** tab and **<D>** on the '+' next to the geometry project to expand the list of alignments.

Note: You may need to use the arrows to scroll across to see the Geometry tab.

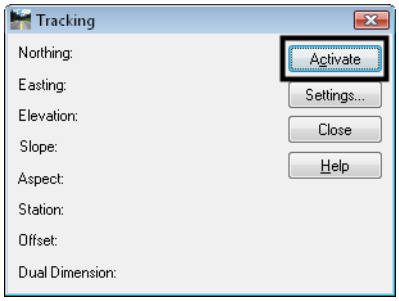


4. Right-click on ***SH52-H*** and select ***Set Active*** if it's not already.



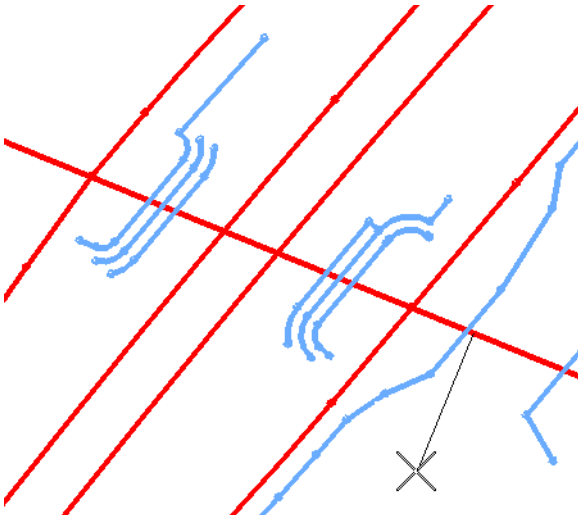
Note: The active alignment has a red box around its icon.

5. Select **Tools > Tracking > Tracking**.



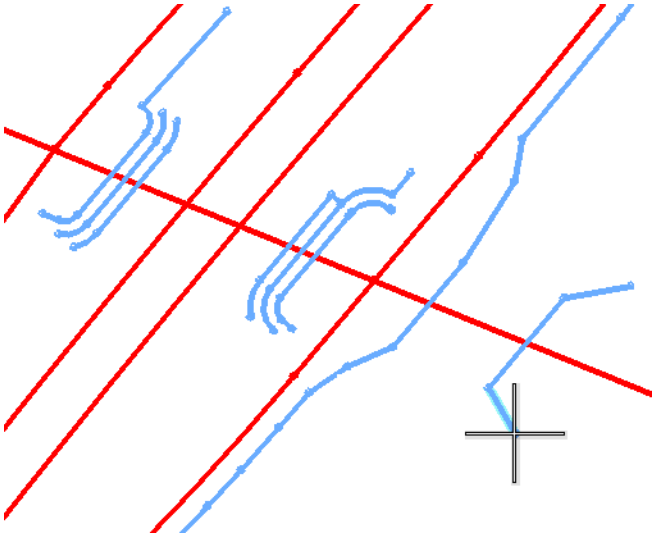
6. **<D> Activate**.

7. Move your cursor in the vicinity of the wall alignments as shown.

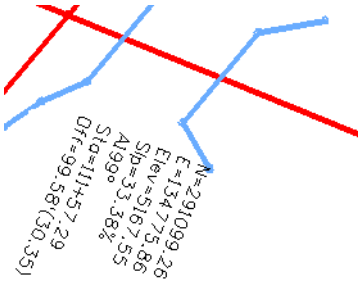


Note: The readout of ***Station***, ***Offset***, etc is shown in the dialog box. Using this command gives you a readout of the stationing on the alignment, the perpendicular offset to your cursor location the coordinates of your cursor location, and the ***Elevation*** (along with other data) of the ***active surface*** at your cursor location.

8. Snap to the end point of the wall alignment as shown.



Note: You may snap using **<T> <D>** just as you would in MicroStation or if you want to use ***AccuSnap***, hold down your **<Ctrl>** and **<Shift>** keys on your keyboard. This is true whenever you need to use ***AccuSnap*** within an InRoads command.



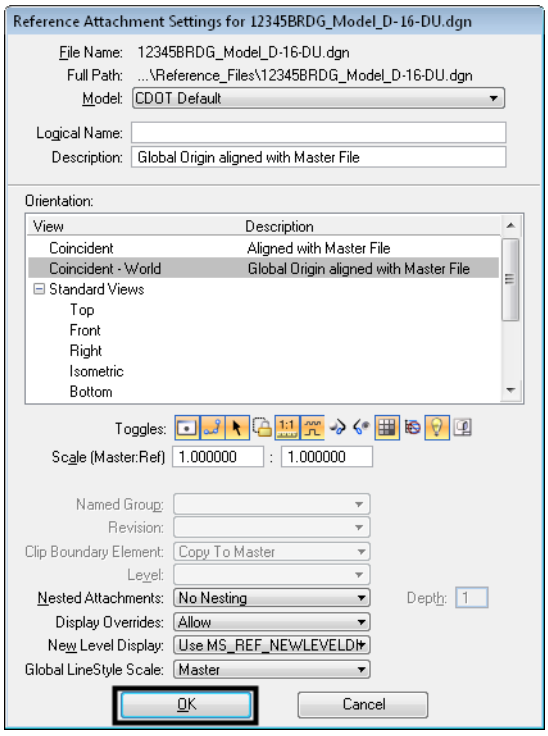
Note: The readouts are written to the design file. The text is written perpendicular to the alignment being tracked and is top-left justified on the point where you snapped.

In the next series of steps you'll attach a reference file containing the SH52 bridge pier and abutment graphics and then use these graphics to obtain additional tracking information.

9. Select **File > Reference** from the MicroStation menu.

10. Select **Tools > Attach**.

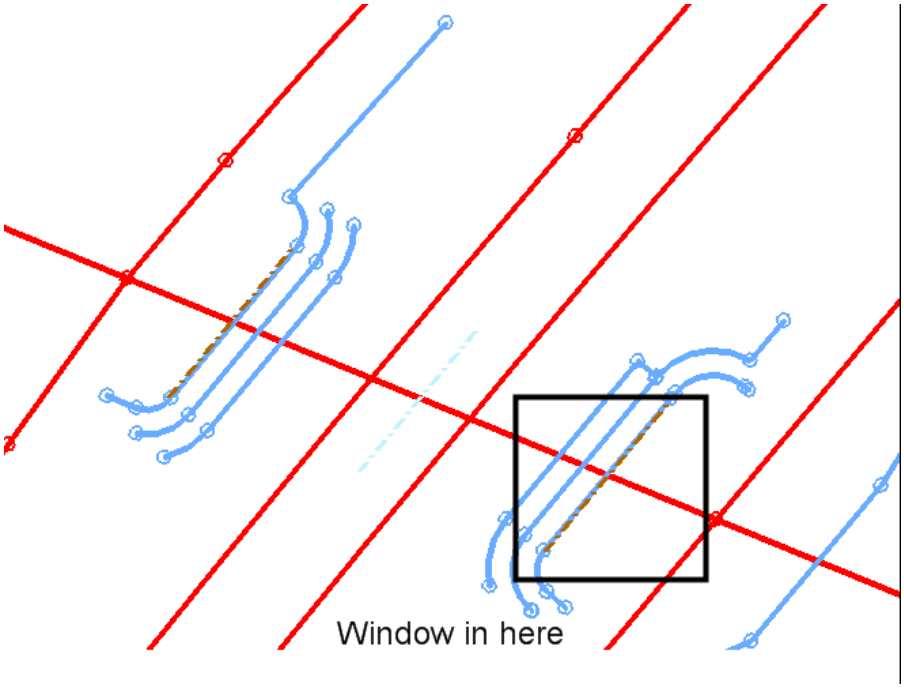
11. Select ***C:\Projects\12345\Bridge\Drawings\Reference_Files\12345BRDG_Model_D-16-DU.dgn***.



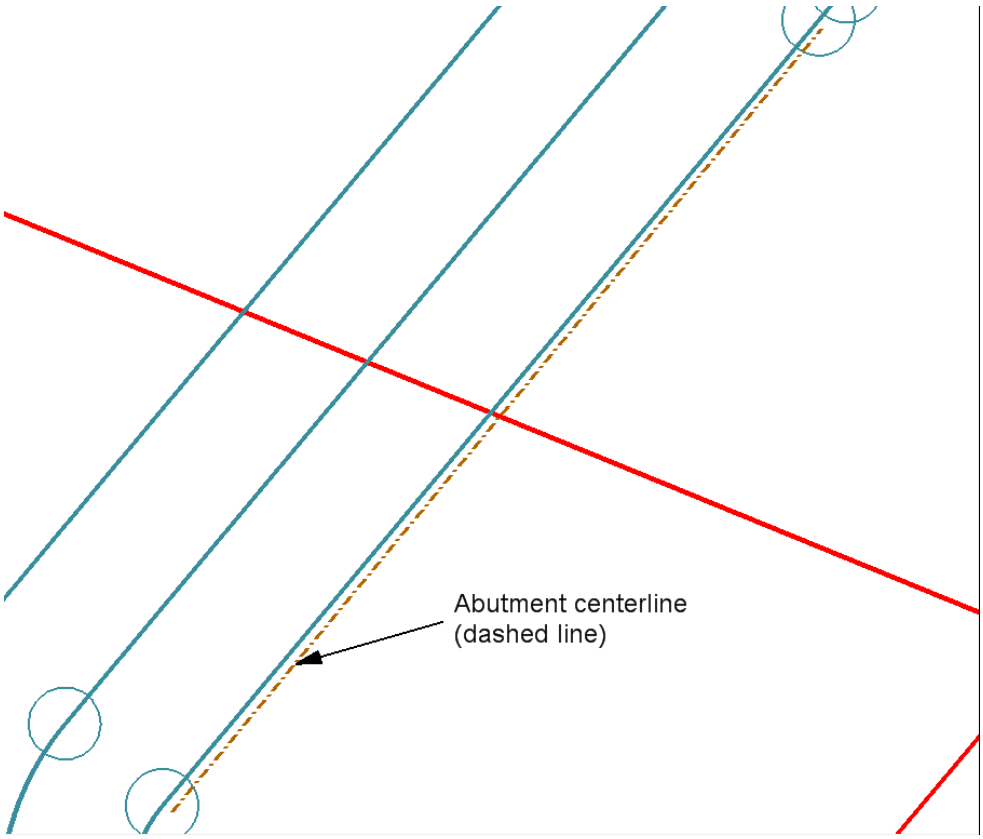
12. **<D> OK** to accept the default reference settings.

13. **Close** the ***Reference*** dialog box.

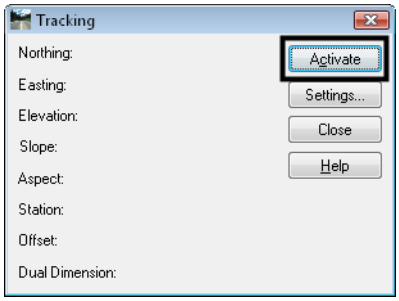
Note: Abutment and Pier centerlines are shown in the file.



14. Window in on the area shown to see the abutment centerline.

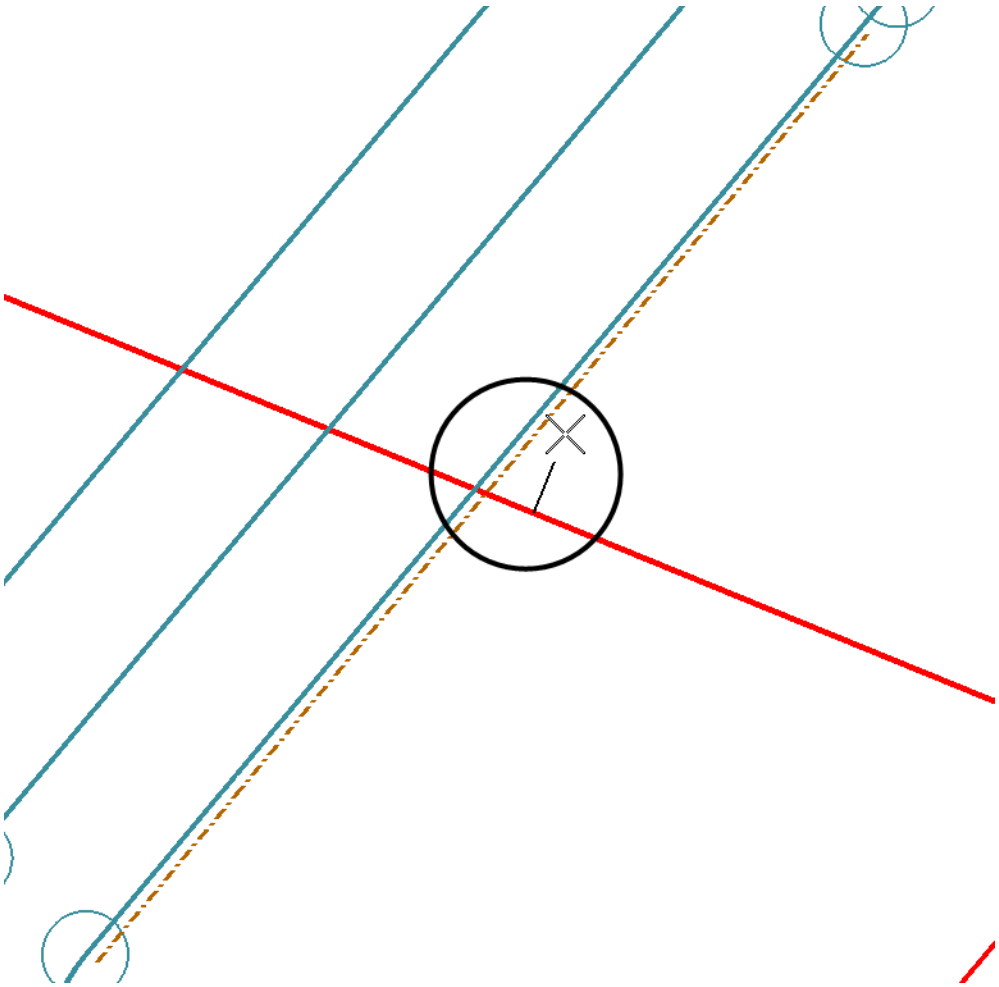


15. Select **Tools > Tracking > Tracking**.

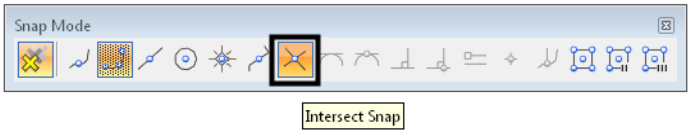


16. **<D> Activate**.

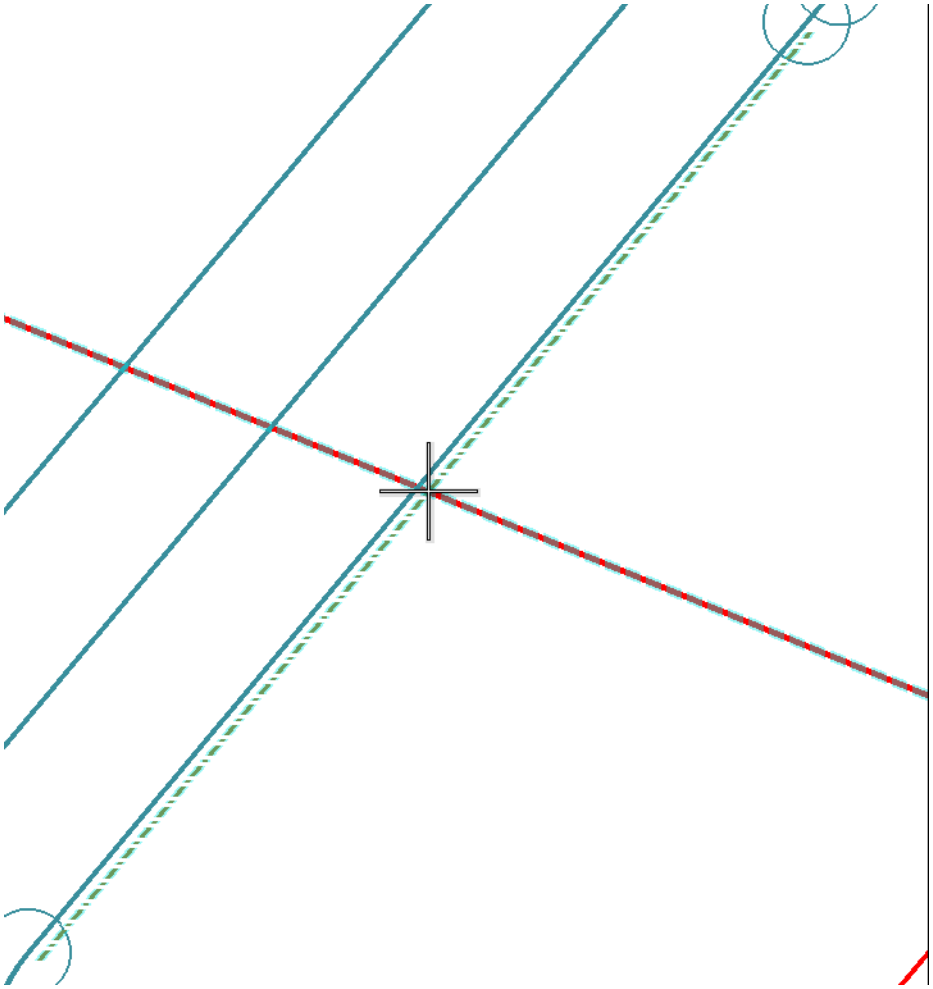
17. Move your cursor in the vicinity of the abutment graphic as shown.



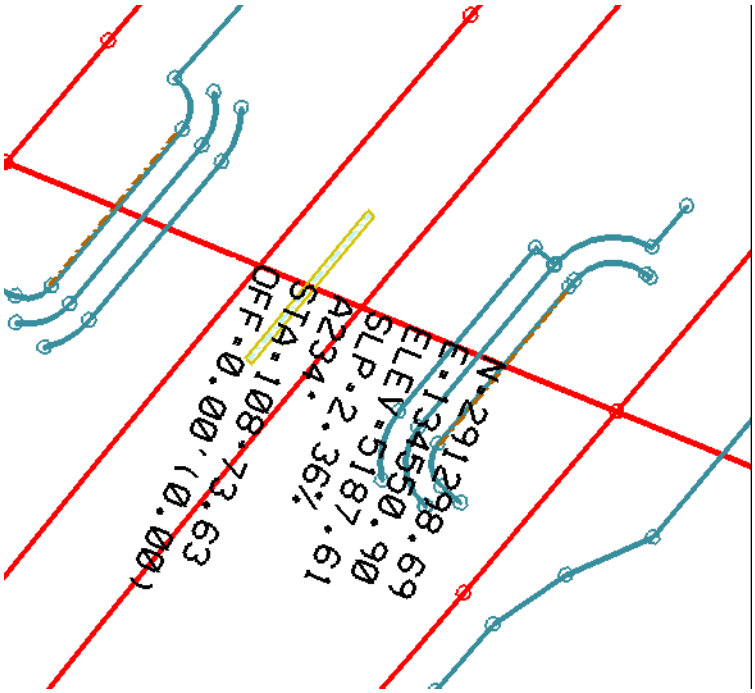
18. Select MicroStation's Intersection snap mode.



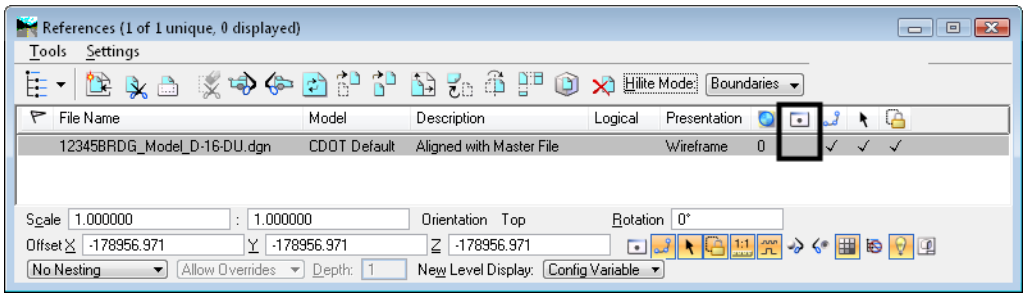
19. Snap to the intersection of the abutment centerline and the SH52 centerline alignment.



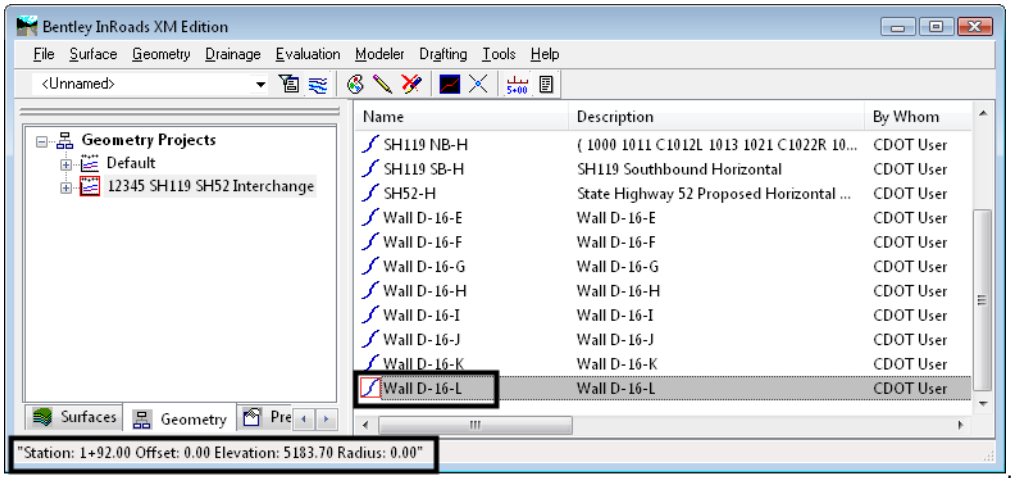
Note: The readouts are written to the design file. Note that the abutment centerline is located at station 108+73.63 on the SH52 alignment. Tracking is a convenient tool for obtaining station locations of abutment centerlines or backfaces.

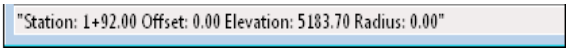


20. **<D> Close** to exit the ***Tracking*** command.
21. **Delete** the readout with MicroStation.
22. Turn off the display of the bridge reference file.



23. Select **Tools > Tracking > Horizontal Alignments**.





Note: The ***Station***, ***Offset***, ***Elevation*** and curve ***Radius*** is shown in both the InRoads and MicroStation message fields. Using this command gives you a readout of the stationing on the alignment, the perpendicular offset to your cursor location and the elevation of the ***active vertical alignment*** associated with the horizontal you're tracking (as opposed to the DTM elevation in the Tracking command).

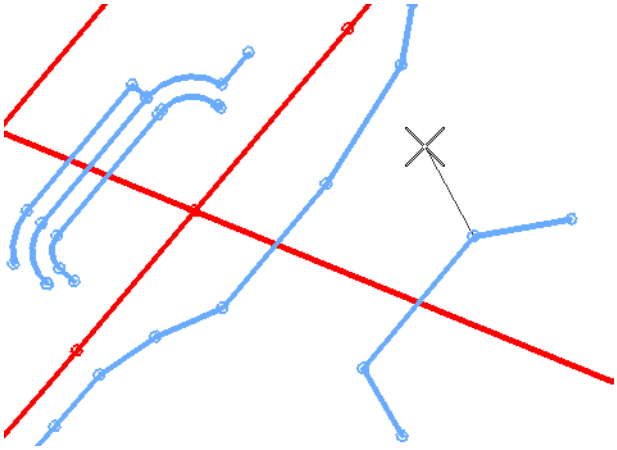
24. Make ***Wall D-16-L*** active.

25. Track the Alignment with ***Horizontal Alignment Tracking***.

26. Toggle ***Point Snap*** on.

27. Track the alignment and note that the cursor only tracks from the beginning, ending and angle points or PIs of the alignment.

Note: This can be used to easily check the stationing of the angle points for the wall to see if the wall segments are of even lengths.



28. Toggle ***Point Snap*** back to ***No Snap***.

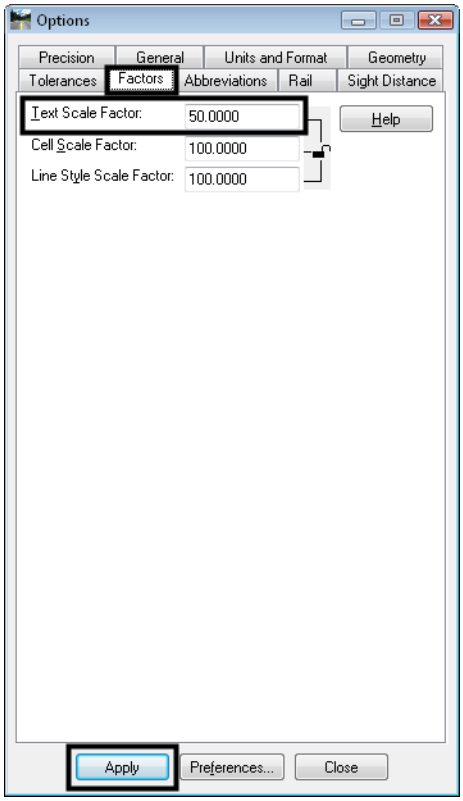
Next, you will station an alignment. The ***Text Scale Factor*** is applied to all text, ticks and offsets created by InRoads and may be changed at any time.

29. Choose **Tools > Options > Factors**.

    Note the default settings.

30. **<D>** the lock icon to unlock the three settings so they can be set individually.

31. Change the ***Text Scale Factor*** to ***50***.



32. **<D> Apply**.

33. **<D> Close**.

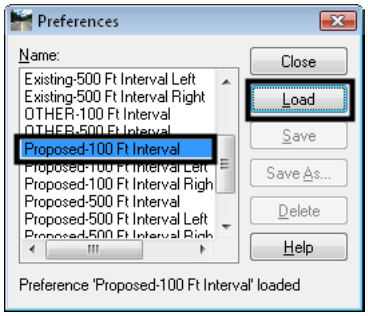
Note: If you **Apply** without saving a preference, the change only remains active until you exit InRoads.

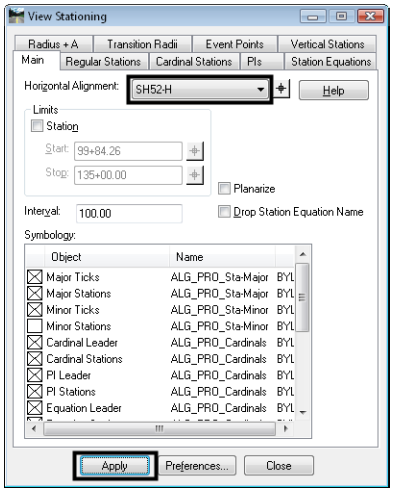
34. Select **Geometry > View Geometry > Stationing**.

35. Toggle the ***Horizontal Alignment*** to ***SH52-H***.

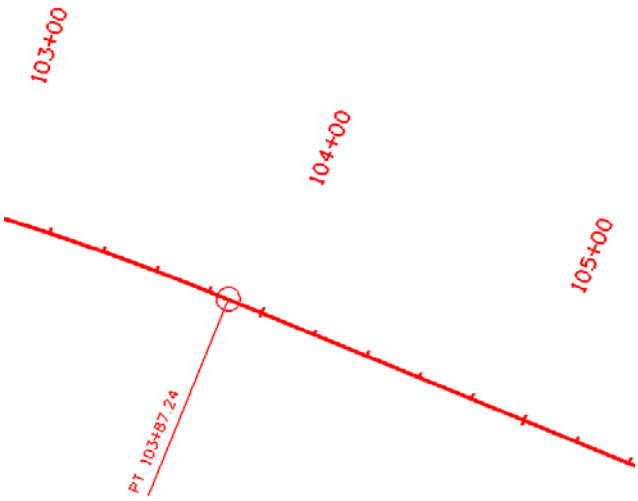
Note: The Horizontal Alignment defaults to the active alignment. Changing it here also changes the active alignment.

36. Load the preference ***PROPOSED-100 Ft Interval***.



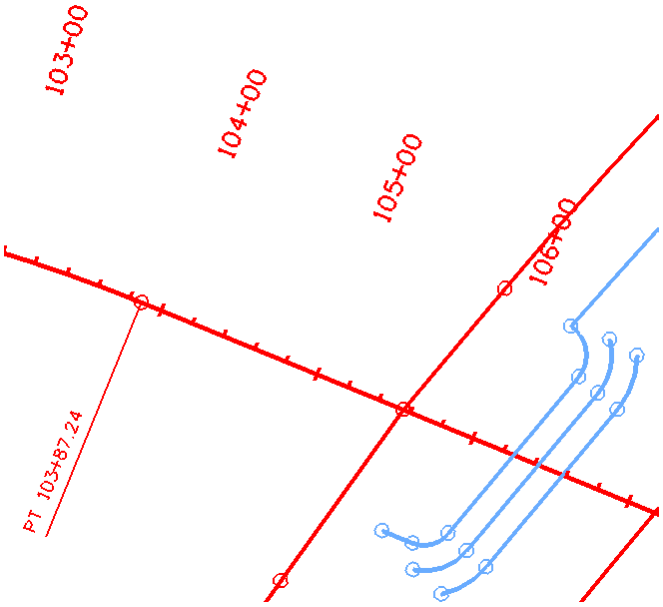


37. **<D> Apply**.



38. Select **Tools > Options > Factors** and set the **Text Scale Factor** to ***100***. (Don't forget to **Apply**.)

39. **<D> Apply** on the ***Stationing*** dialog, then **Close**.



Note: Since you are in Pencil mode, the second set of stationing replaces the first set.

Note: The display of the stationing on the alignment honors the ***Text Factor*** as you can see. In general, you use a text factor equal to the scale you plan to plot. When reviewing data that you do not plan to plot, as you are here, you may choose a different text scale to make the text more legible in the file.

40. Use MicroStation to **Delete** the Stationing.

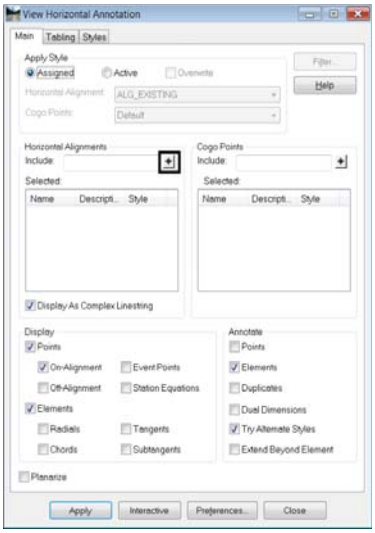
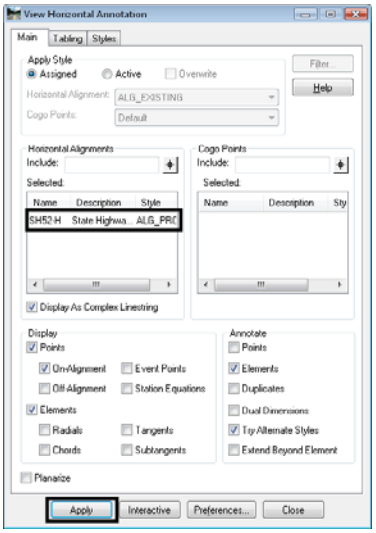
Note: The stationing is made up of graphic groups, making it easier to delete.

41. Choose **Geometry > View Geometry> Horizontal Annotation**.

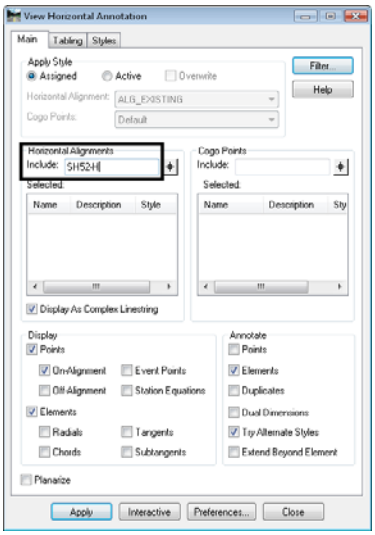
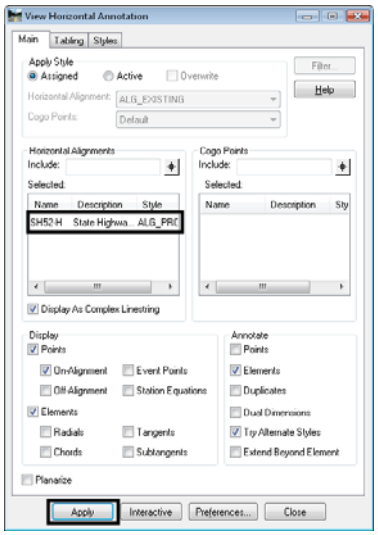
42. In the ***Horizontal Alignments Include*** field, select the ***SH52-H*** alignment.

You may either:

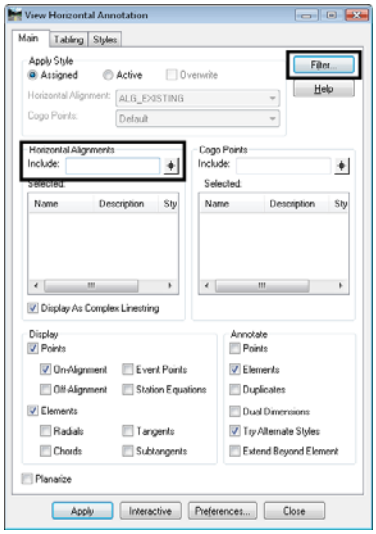
- Use the target button next to the ***Include*** field and graphically pick the alignment,

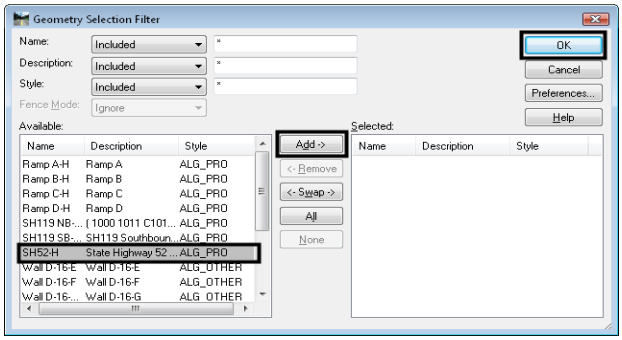



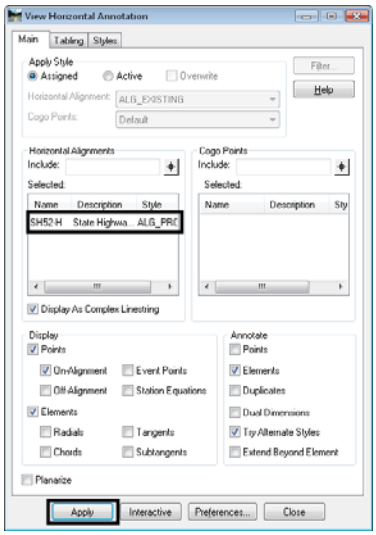
- Type the alignment name in the ***Include*** field (wildcards are allowed), or

- **<D>** in the ***Include*** field and choose ***Filter*** to pick the alignment from a list and select **Add** and then **OK**.

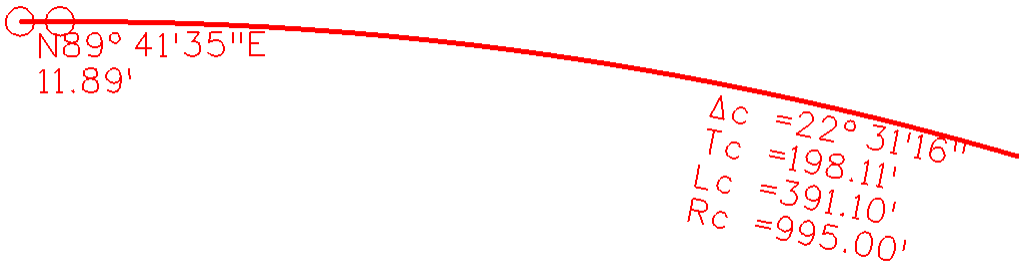






43. **<D> Apply** and the alignment is annotated.

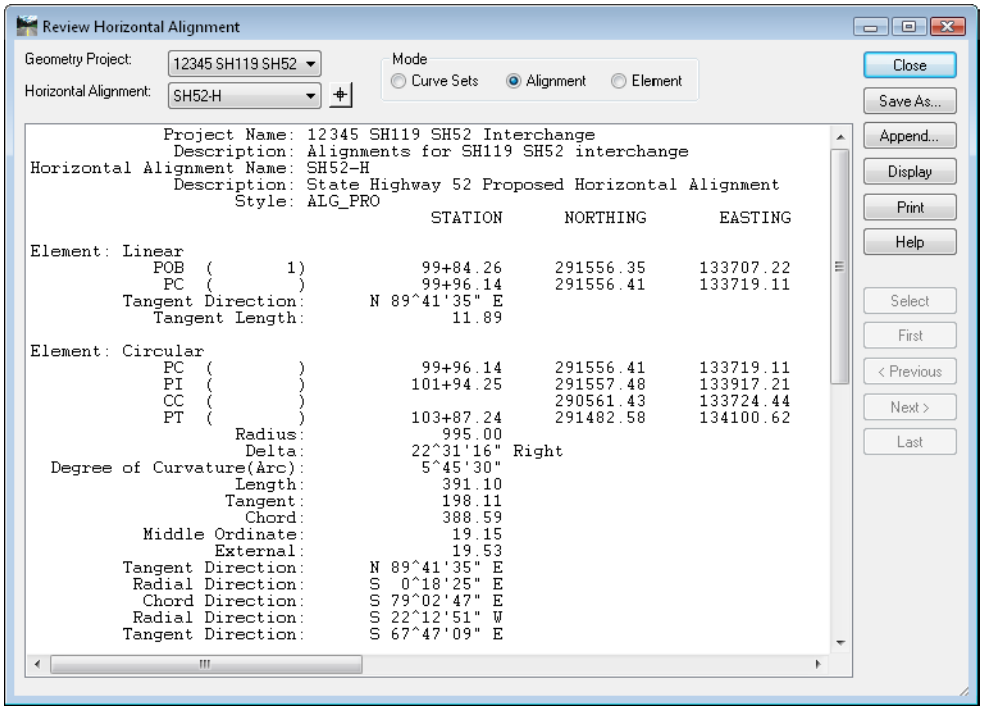
44. Window in and review the annotation.



Note: You may also **<D> Interactive** and then choose one piece of any alignment at a time to annotate (whether or not it is currently active or displayed).

45. Choose **Geometry > Review Horizontal**.

Note: You can also right-click on the horizontal in the ***Explorer*** portion of the menu and choose **Review**.



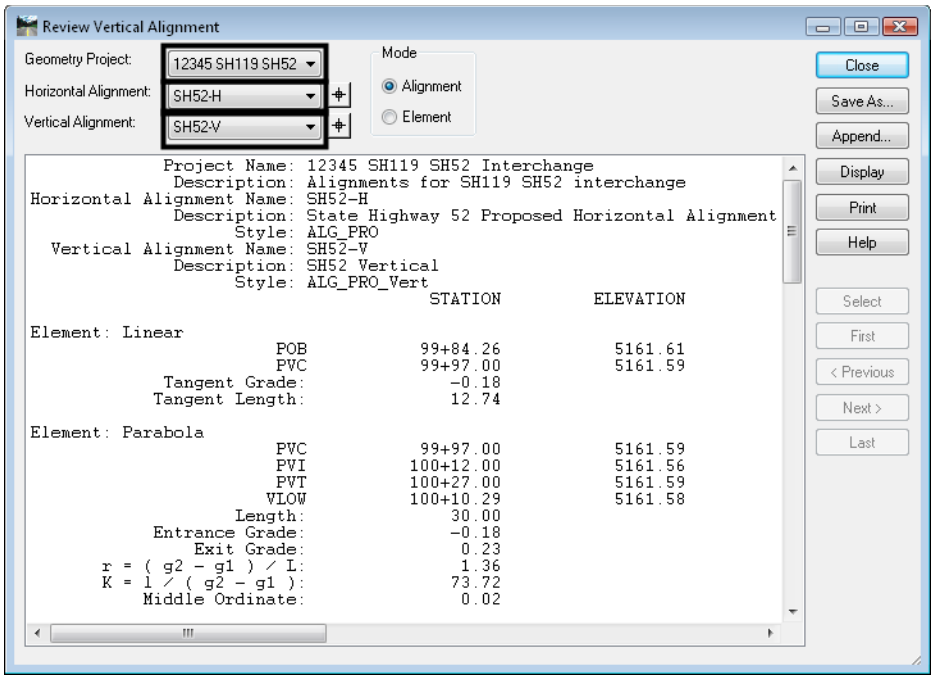
Note: The ***Review*** lists all the information about the ***active*** horizontal alignment. This report can be saved as a text file, displayed in the design file or printed if necessary. You can also switch to a different alignment using the drop-down list at the top of the dialog.

Important! The ***Print*** command allows the report to be printed to any printer that can be accessed on the current machine.

46. **<D> Close** when you are finished evaluating the alignment.

47. Choose **Geometry > Review Vertical**.

Note: You can change Geometry Projects, Horizontal Alignments, or Vertical Alignments using the drop-down list at the top of the ***Review*** dialog. You can also use the target buttons to graphically identify alignments.



Note: The ***Review*** lists all the information about the active vertical alignment. In this case, the vertical is the top of wall elevation.

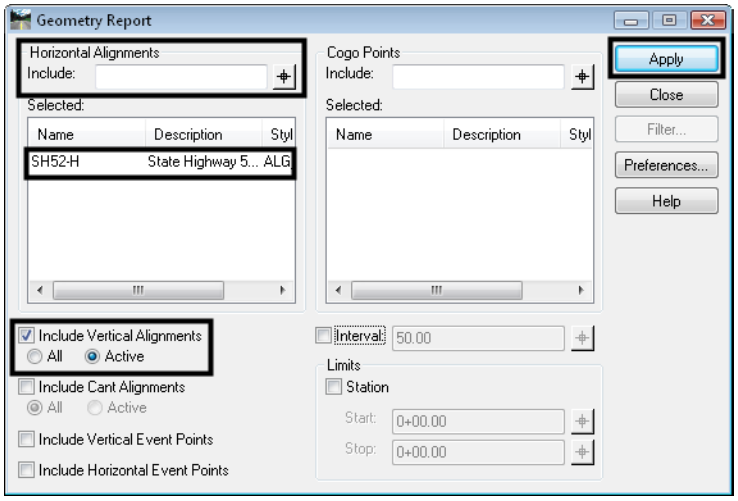
48. **<D> Close** when you are finished evaluating the alignment.
49. Continue to review other alignments as desired.
50. Select **Tools > XML Reports > Geometry**.
51. Select the ***SH52-H*** alignment.

    As described earlier, you may either:

    - Use the target button next to the ***Include*** field and graphically pick the alignment,
    - Type the alignment name in the ***Include*** field (wildcards are allowed), or
    - **<D>** in the ***Include*** field and choose ***Filter*** to pick the alignment from a list.

52. Toggle on ***Include Vertical Alignments***.
53. Toggle on ***Active***.

54. Toggle all other options off.



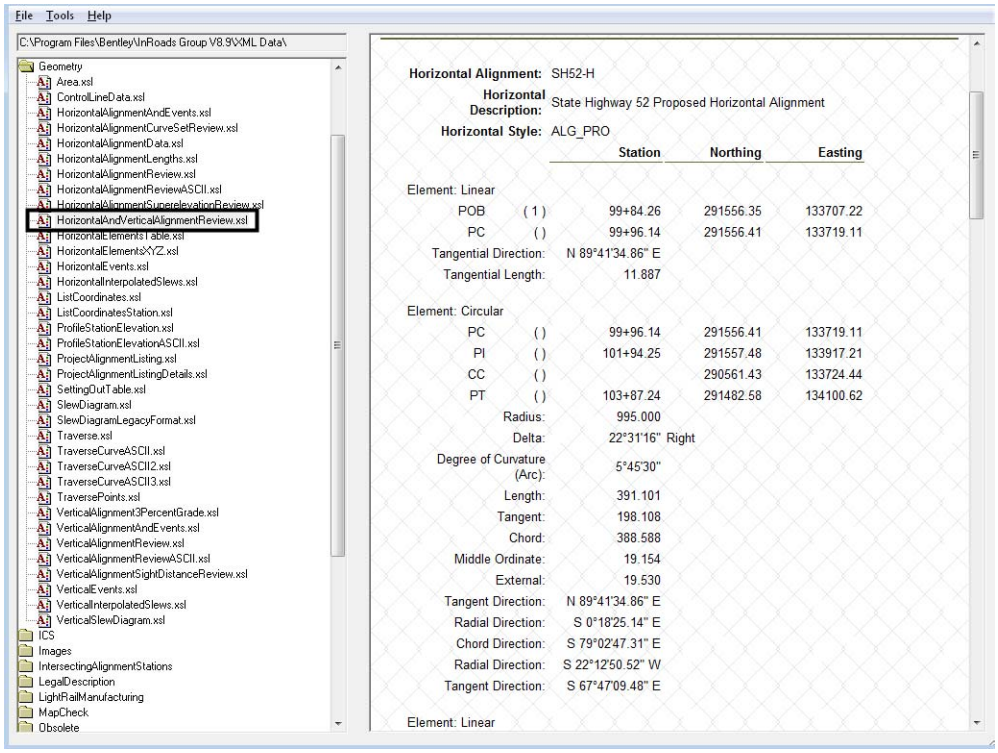
55. **<D> Apply**.

Note: When you create a report using one of the **XML Report** commands, an ****.xml*** data file with the results is created in the user's ***Local Settings\Temp*** folder. This XML file is formatted in the Report Browser using an XSL style sheet, or format. Most reports have a default format, but you can choose between other formats as desired.

56. In the ***Report Browser*** that appears, available formats are listed on the left side. Choose the format: ***Geometry > HorizontalAndVerticalAlignmentReview.xsl***.

Note: All XML reports use this same browser, so the folder structure at left lists all different types of reports. Here, you are looking at an alignment, so you choose a report format from the ***Geometry*** folder. If you are reporting on Stations and Offset, you would use formats from the ***StationOffsets*** folder, and so on.

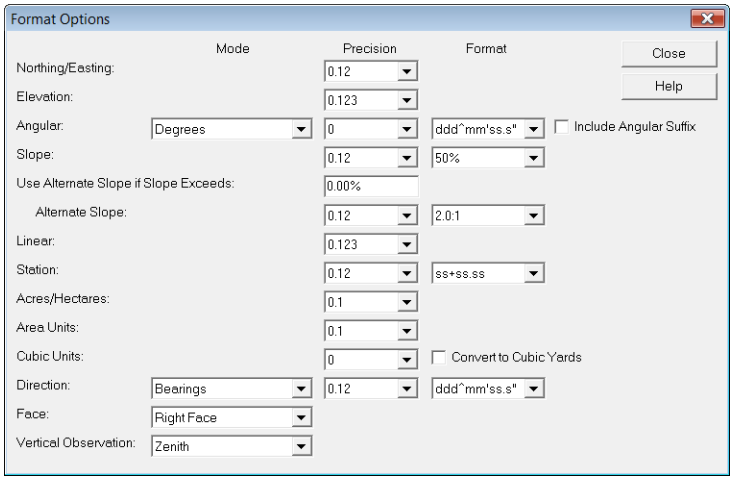
57. Review the report.



Note: If you right-click a format and choose ***Style Sheet Help***, a dialog will pop up describing the data required to complete that particular format.

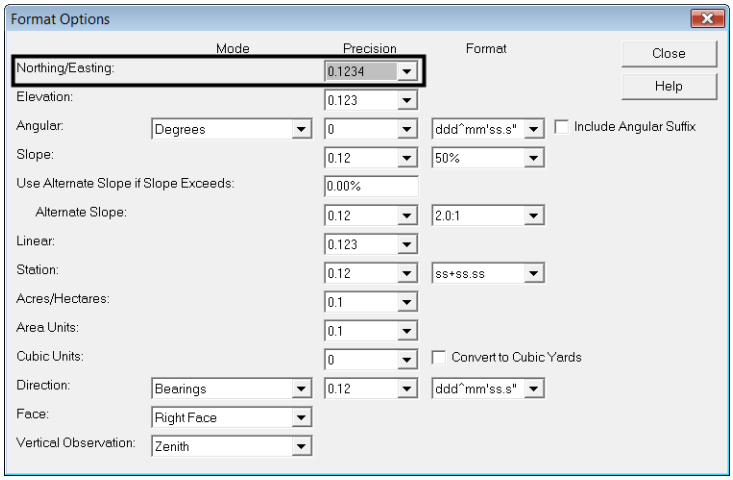
Important! Just like in the ***Review*** command, reports may be printed directly from this dialog. Select **File > Print** to access this function.

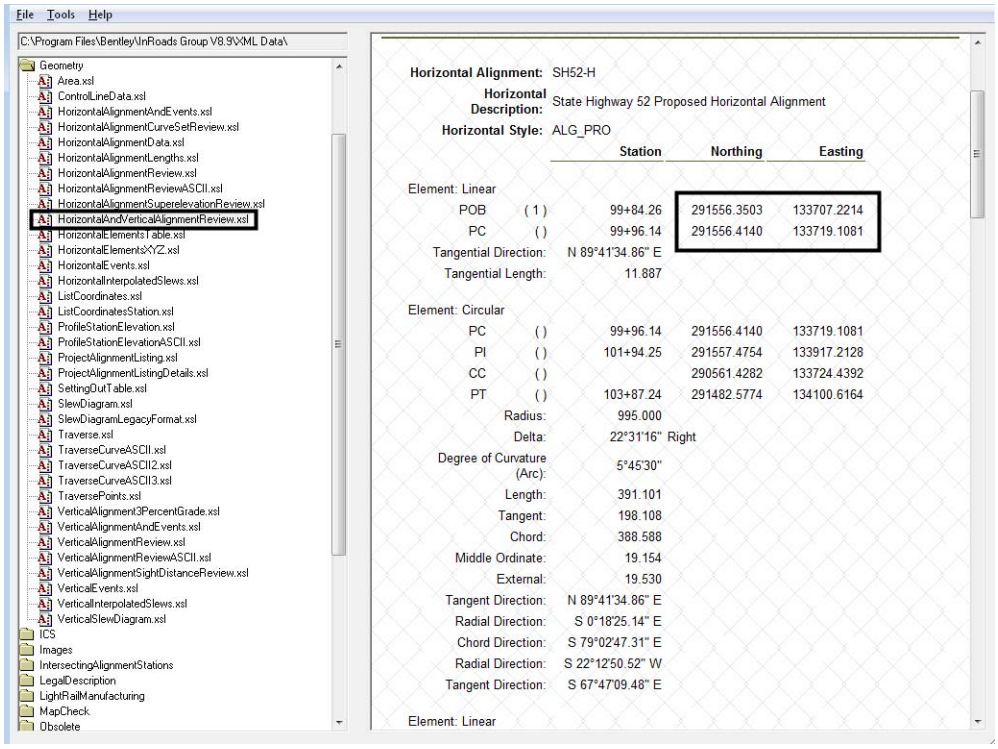
58. Choose **Tools > Format Options**.



Note: Much of the formatting of the report can be modified on the fly by changing the settings in this dialog box.

59. Change the ***Northing Easting Precision*** to show four decimals.

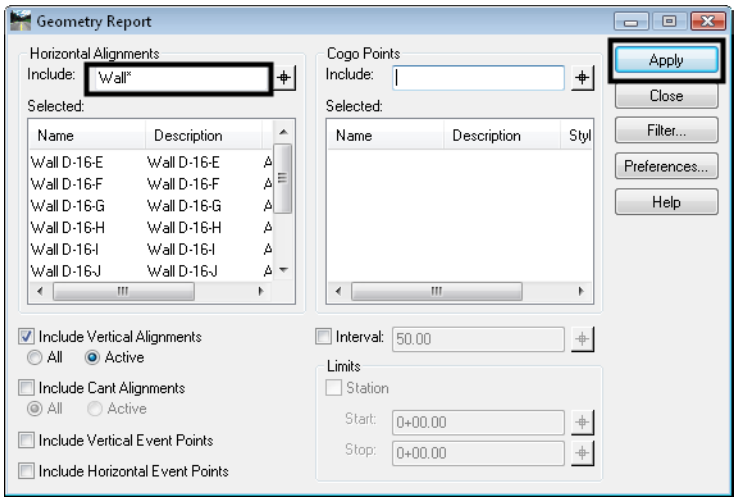




60. **<D> Close** on the ***Format Options*** dialog.

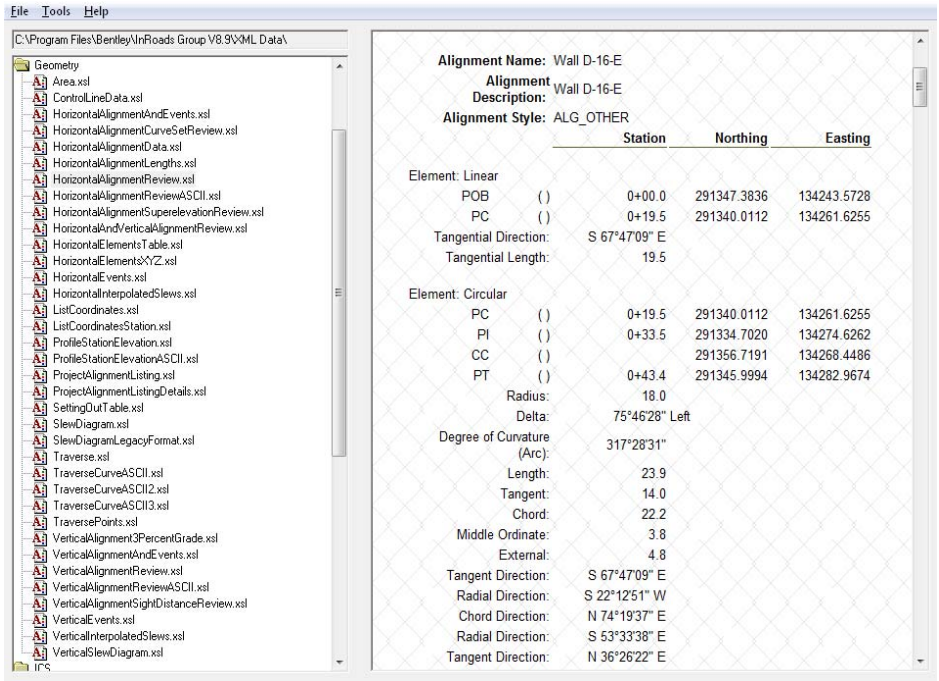
61. **Close** the Report.

62. Back in the ***Geometry Report*** dialog, **<D>** in the ***Include*** field and key in ***Wall**** to select all the Wall alignments.



63. **<D> Apply**.

In the Report Browser, note the reports now shows each of the wall alignments.



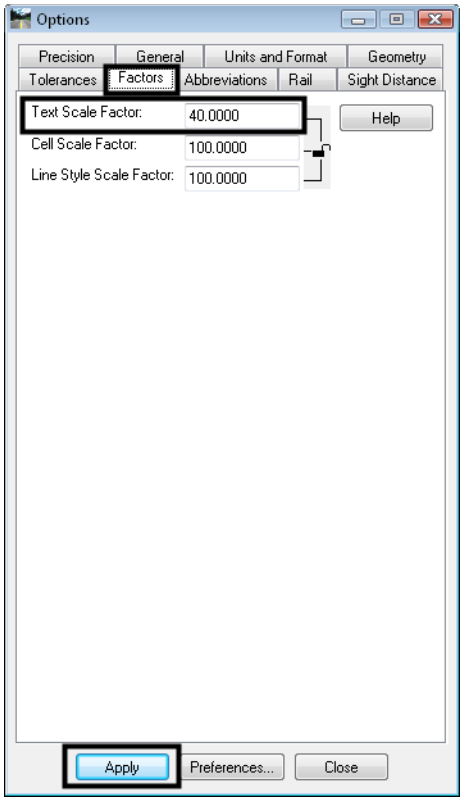
64. **Close** the Report Browser when you're done reviewing the report.

Lab 2.3 - Using InRoads Evaluation Tools

Next, you will be creating profiles and cross sections to analyze geometry and surface data provided by Roadway Design. This includes annotating information on the profiles and cross sections. For this annotation the text scale factor is applied to all the text, ticks and offsets for the cross sections as well as profiles.

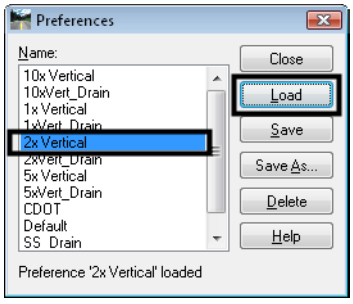
Note: Each time you create profiles or cross sections, you create a new set and it is given a name, which by default is derived from the alignment name with a counter on the end. Later, you will use this set name when identifying the profile or section set to view, annotate, etc.

1. For this example, set the ***Text Scale Factor*** to ***40***.



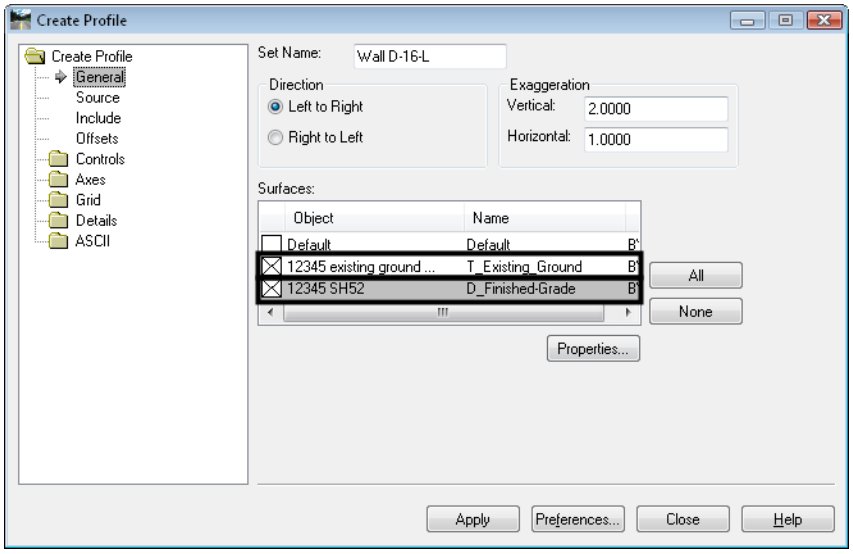
2. Choose **Evaluation > Profile > Create Profile**.

3. **<D> Preferences** and **Load** the ***2x Vertical*** preference.



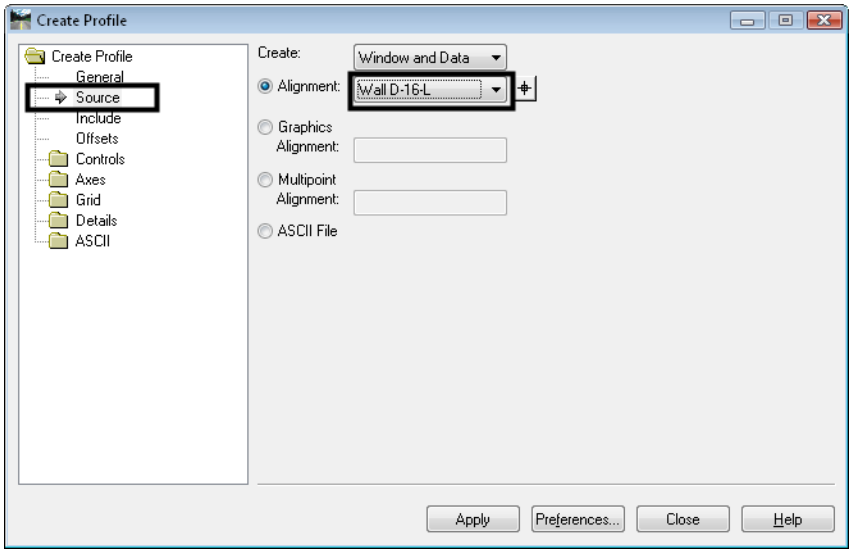
4. **<D> Close** on the ***Preferences*** dialog.

5. In the ***Surfaces*** area, toggle on both the ***existing ground*** and ***SH52***.

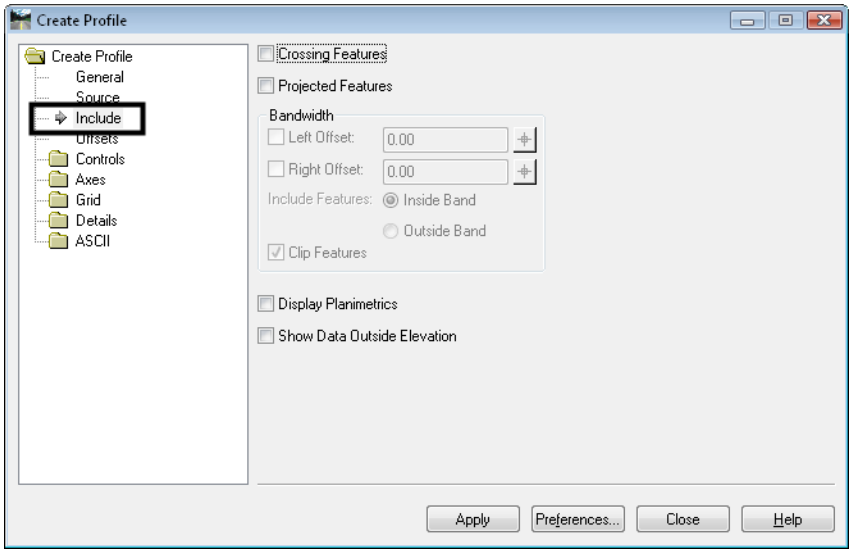


6. **<D>** on the ***Source*** branch on the left of the dialog.

7. Make certain Alignment is toggled on and set to ***Wall D-16-L***.



8. **<D>** on the ***Include*** branch.

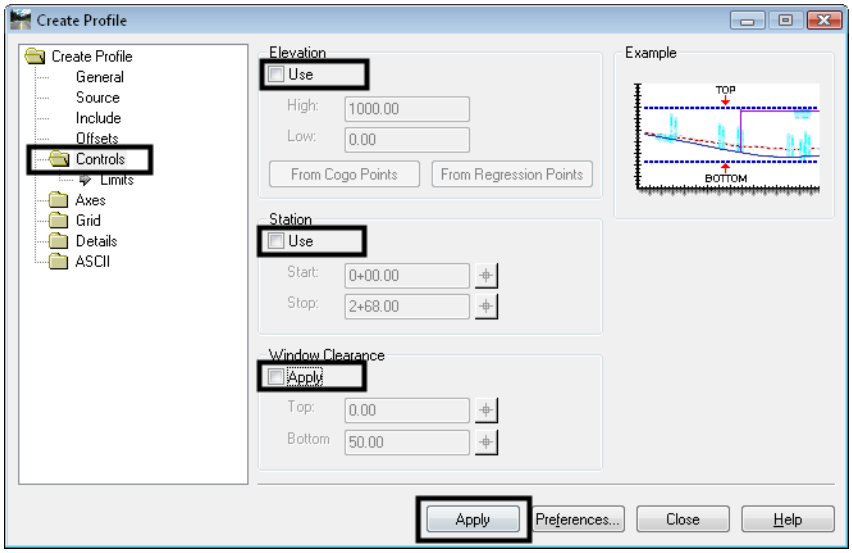


Note: If you want to display crossing features on your profile like pipes or utilities, toggle on ***Crossing Features.*** These features must first exist in the surface(s) you're profiling. The feature's style controls if the feature can be shown on the profile.

Note: If you want to show features that fall outside the profile window, toggle on ***Projected Features***. This will show the orthogonal projection of the features onto the profile. You also have the option of specifying a ***Bandwidth*** to either side of the profile to project the features.

9. For this exercise, leave these options toggled off.

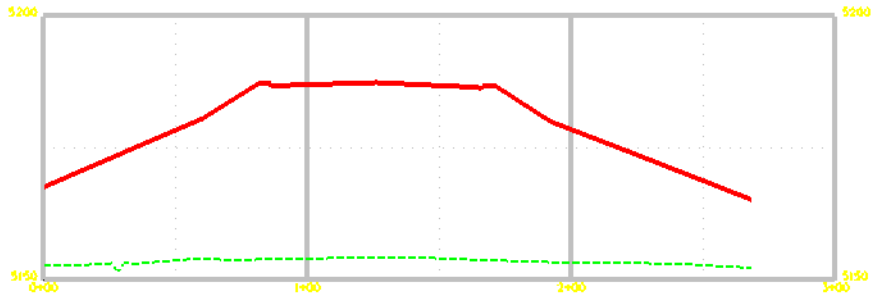
10. **<D>** on the ***Controls*** branch and toggle off all Controls.



Note: The ***Elevation*** option is used to set absolute values for the left axis. With it off, the left axis elevations are determined by the high and low elevations of the surfaces. The ***Station*** option allows you to create a partial profile. With it off, the entire alignment is profiled. The ***Window Clearance*** option is used when you want to add grid to the top or bottom of the profile for annotation, which we do not need here.

11. **<D> Apply** and **<D>** a clear area in your design file when prompted to ***Identify Location***.

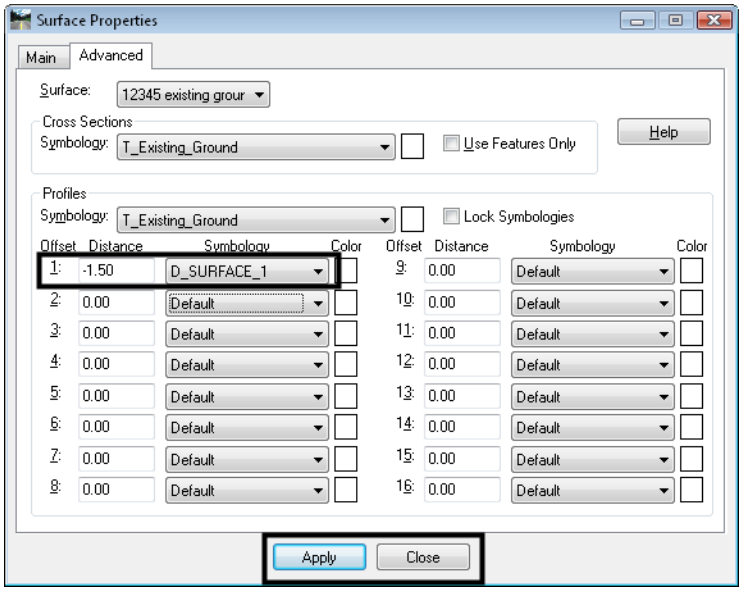
    Note: This is the location of the lower left corner of the profile grid, so make certain there is room above and to the right of the point you select. You do not need to click near the horizontal alignment.



The profile is displayed with the two surfaces showing. Offsets can also be shown on the profile.

12. Use MicroStation to delete the profile.

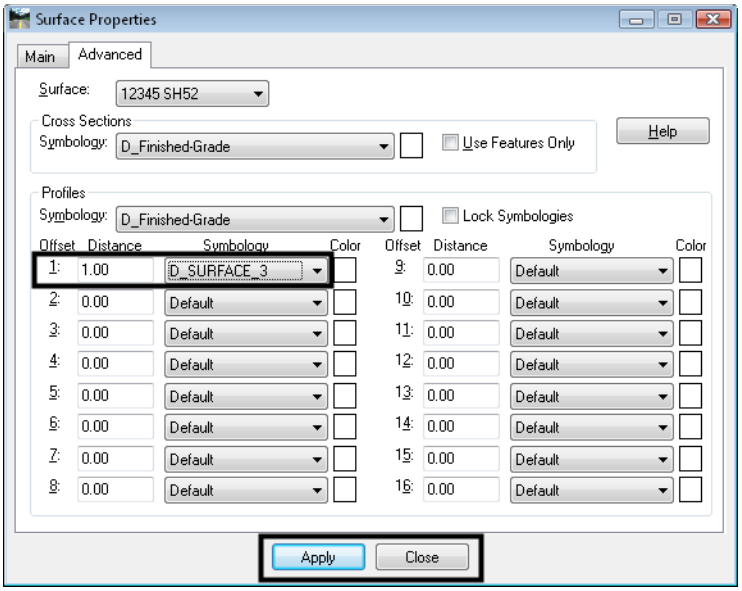
13. Under ***General***, highlight the existing ground surface and choose **Properties**.



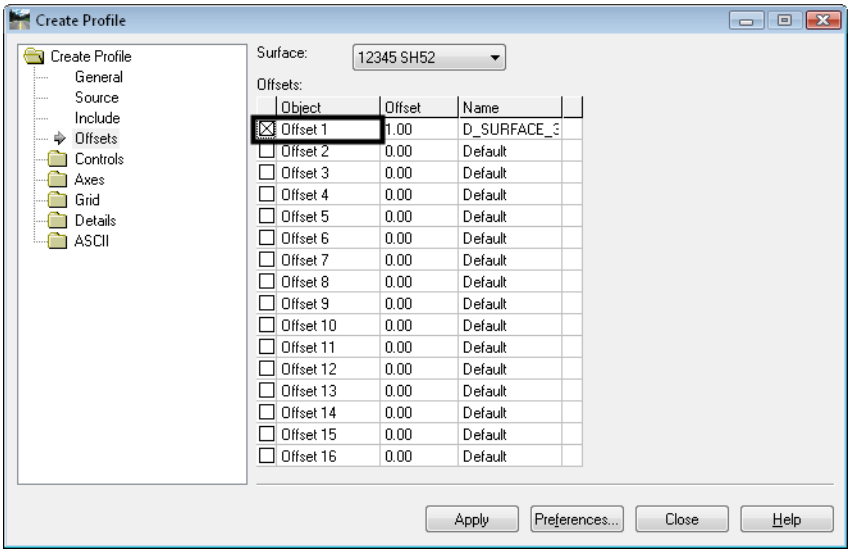
14. On the ***Advanced*** tab of ***Surface Properties***, set ***Offset 1*** to ***-1.50*** and the ***Symbology*** to ***D_Surface1***.

    Note: A negative offset is to the left of the alignment.

15. **<D> Apply**.
16. Toggle the ***Surface*** to ***12345 SH52*** and select ***Properties***.

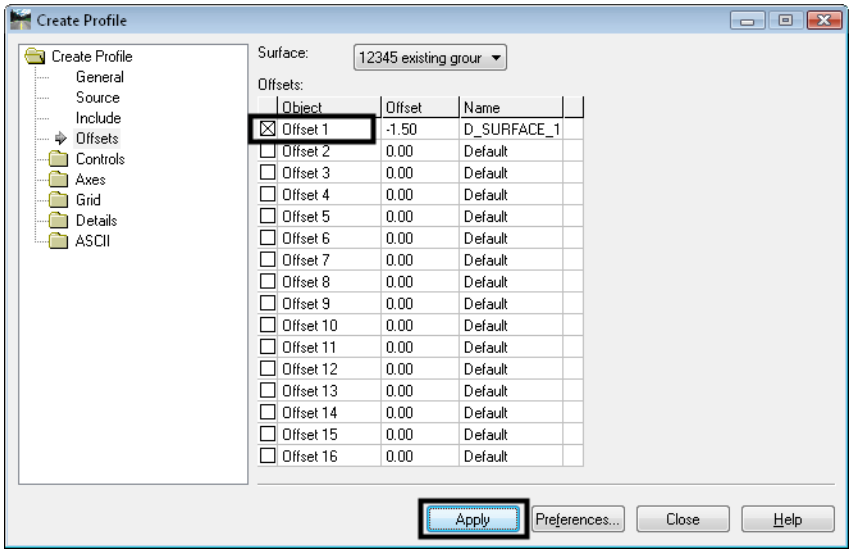


17. On the ***Advanced*** tab, Set ***Offset 1*** to ***1.00*** and the ***Symbology*** to ***D-Surface3***.
18. **<D> Apply** then **Close**.
19. Choose ***Offsets*** on the ***Profile*** dialog.

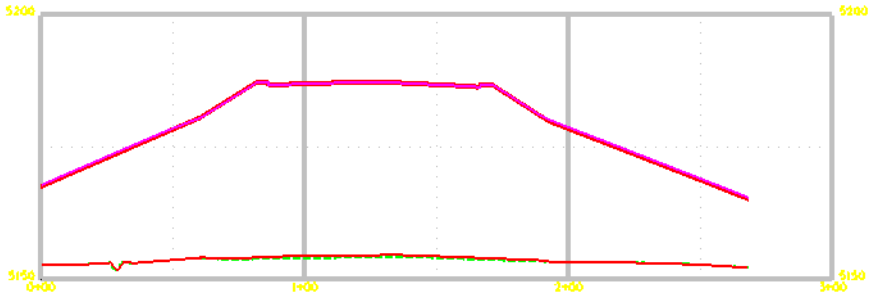


20. Set the ***Surface*** to ***12345 SH52*** and toggle on ***Offset 1***.

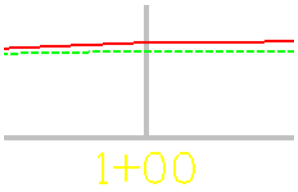
21. Set the ***Surface*** to ***12345 existing ground for interchange*** and toggle on ***Offset 1***.



22. **<D> Apply** and **<D>** a clear area in your design file when prompted to ***Identify Location***.



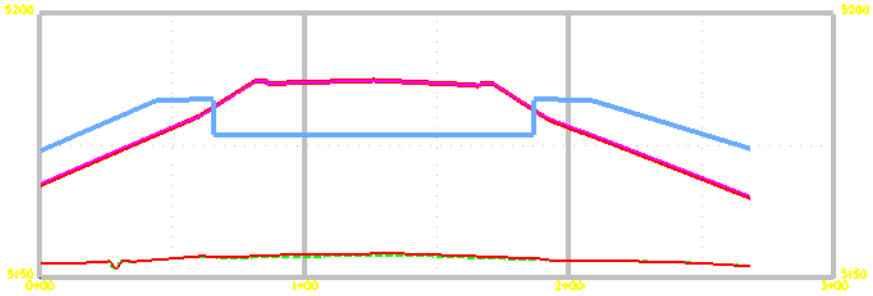
23. Window in close to the ground surface on the profile.



Note: The profile now shows two lines for the existing ground and two lines for the proposed. The existing ground is shown at the wall centerline and 1.5' in front of the wall. The proposed ground is shown at the wall centerline and 1.0' behind the wall. You can use profile offsets to set the bottom of wall elevations (e.g. if the toe of wall is 1.5 feet in front of the wall face, you can copy that offset line down by 1.5' (or whatever the vertical exaggeration requires) to get the top of the footing. Dropping it 3 feet will provide the minimum bottom of footing).

24. **<D> Close** on the ***Profile*** dialog.

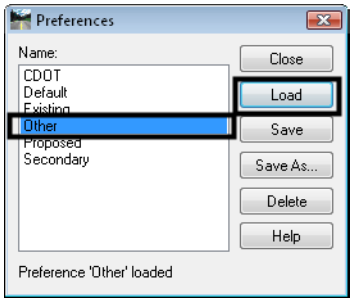
25. Select **Geometry > View Geometry > Active Vertical**.

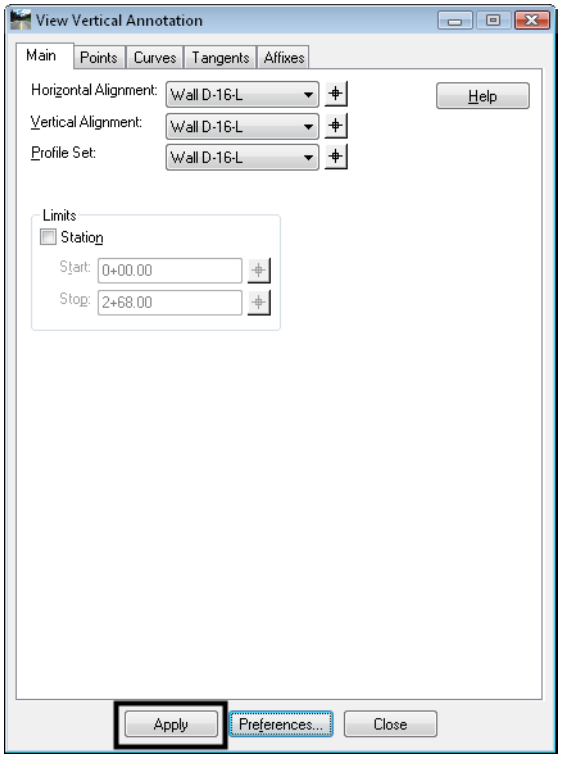


You may instead want to display and annotate the vertical alignment.

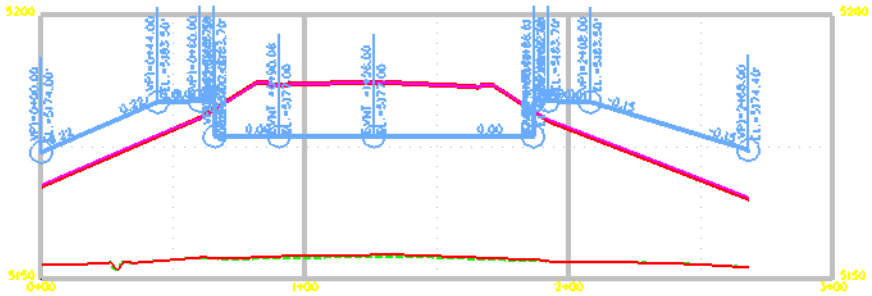
26. Select **Geometry > View Geometry > Vertical Annotation**.

27. **Load** the ***Other*** preference.





28. **<D> Apply**.



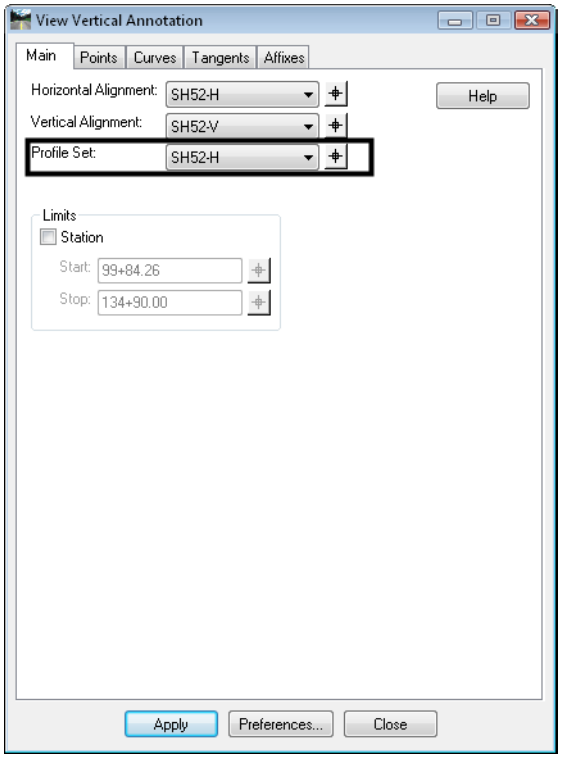
29. Review the annotation on the profile. You may need to change the ***Text Scale Factor*** using **Tools > Options > Factors**. If you **<D>** Apply again, the original annotation is deleted and the new annotation is placed.

30. **<D> Close** when done.

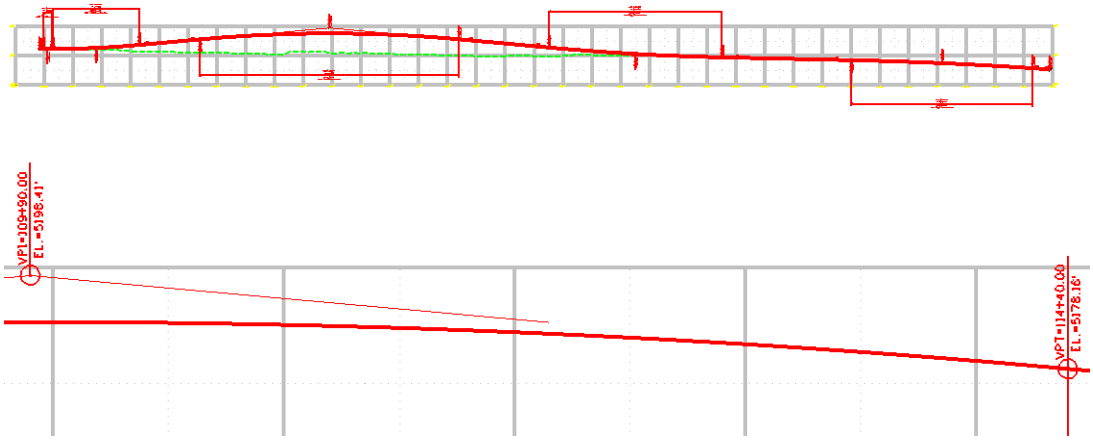
31. Right-click on the ***SH52-H*** alignment in the ***Explorer*** part of the InRoads menu and choose ***Set Active***.

32. Create a profile for this alignment using the same steps as shown above, except only toggle on the ***existing ground*** surface.

33. View the vertical annotation, using the ***Proposed*** preference.



Note: When more than one profile exist in the MicroStation file, you can tell InRoads which one to use for annotation by selecting it from the drop-down list or by using the target button and selecting it graphically.

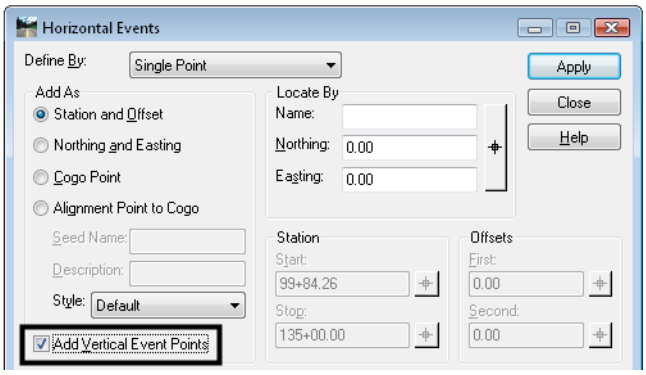


The vertical alignment for ***SH52*** does not currently show the location of the bridges. This can be accomplished using ***Event Points*** as shown below.

34. Verify ***SH52-H*** is still active.

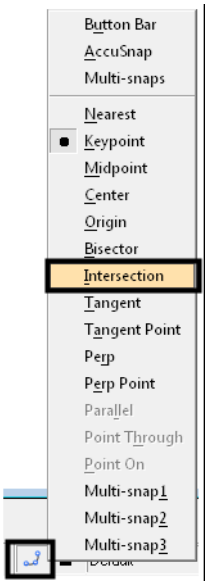
35. Select **Geometry > Horizontal Curve Set > Events**.

36. Toggle on ***Add Vertical Event Points***.

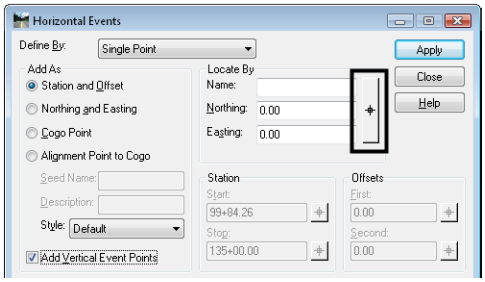


Important! Adding event points results in a modification to the *.alg file. In order to make this type of edit, you will need write access to the alignment file being used in the geometry project. This file is typically located in the Design group's InRoads folder and often has restricted access. If direct access is not granted, someone fron the Design group will need to add the event points for you. Either way, communication with the Design group is critical.

37. **<D>** the Snap icon on the MicroStation Status bar and choose ***Intersection***.

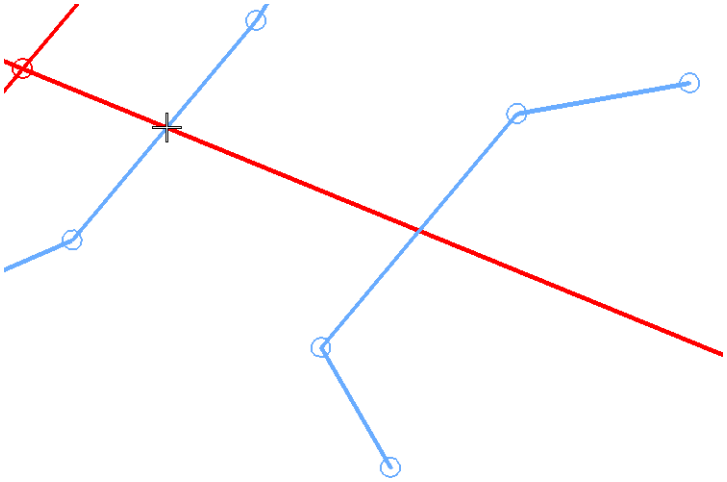


38. **<D>** the Target button in the ***Locate By*** field on the dialog.



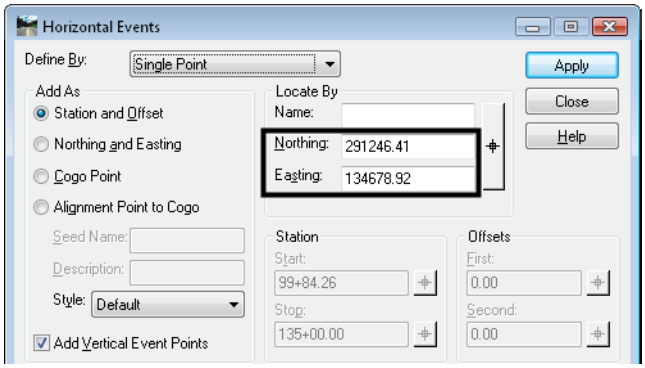
39. Hold down your <***Ctrl***> and <***Shift***> keys on your keyboard and move your cursor to the intersection of the ***SH52*** and ***Wall D-16-K*** alignment.

Note: <***Ctrl***> and <***Shift***> can be held down any time you want to use ***AccuSnap*** within an InRoads command.

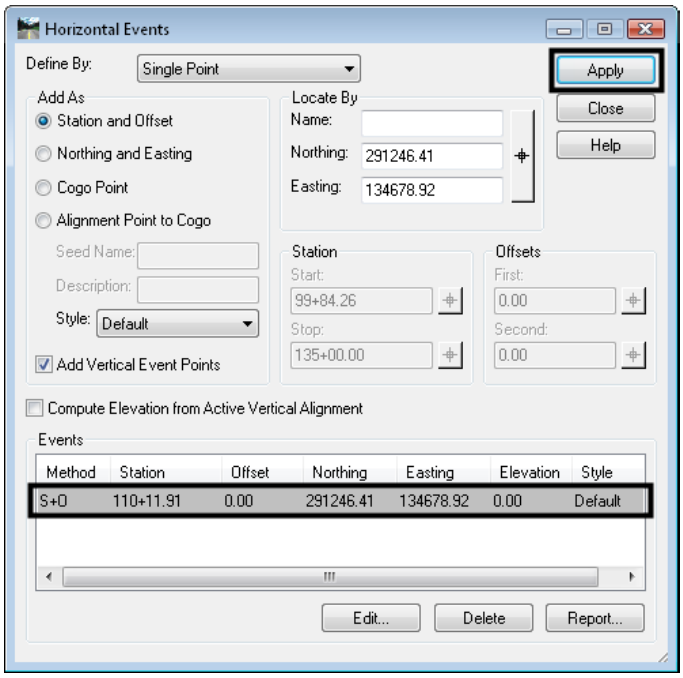


40. When the two alignments highlight with a yellow X at the intersection, **<D>** to select the location.

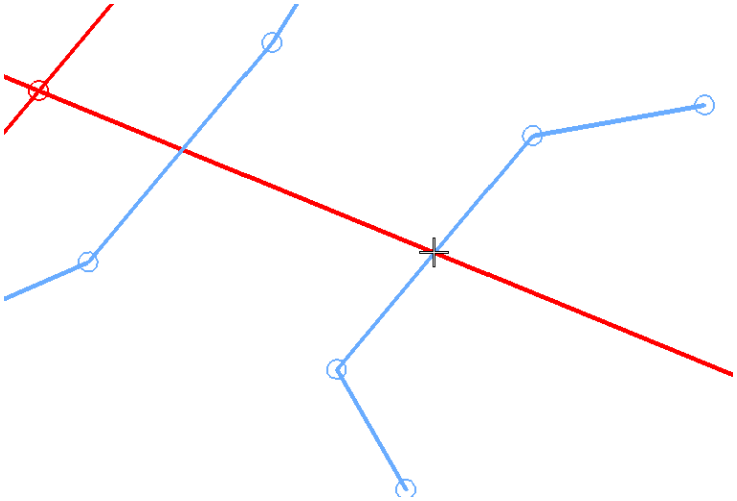
    The coordinates of the intersection are entered in the dialog.

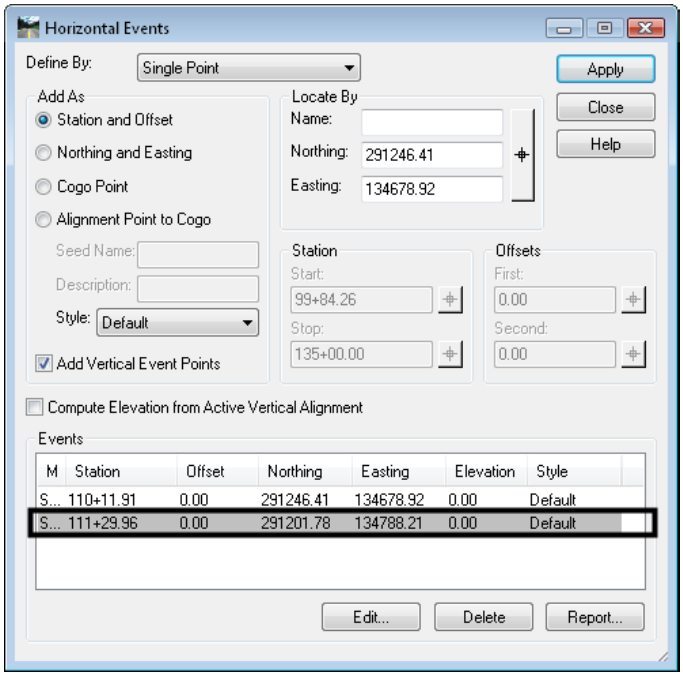


41. **<D> Apply** to add the event point.



42. Repeat this process for the location of the intersection of ***SH52*** and ***Wall D-16-L***.



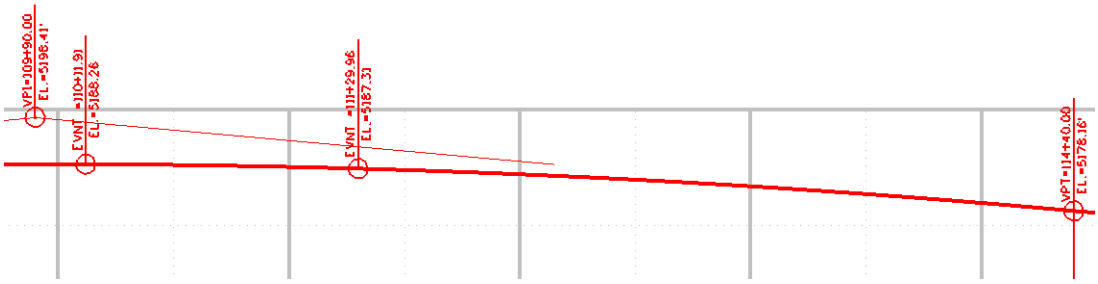


43. **<D> Close** when you have both Event Points located.

44. View the vertical annotation for ***SH52***, again using the ***Proposed*** preference.

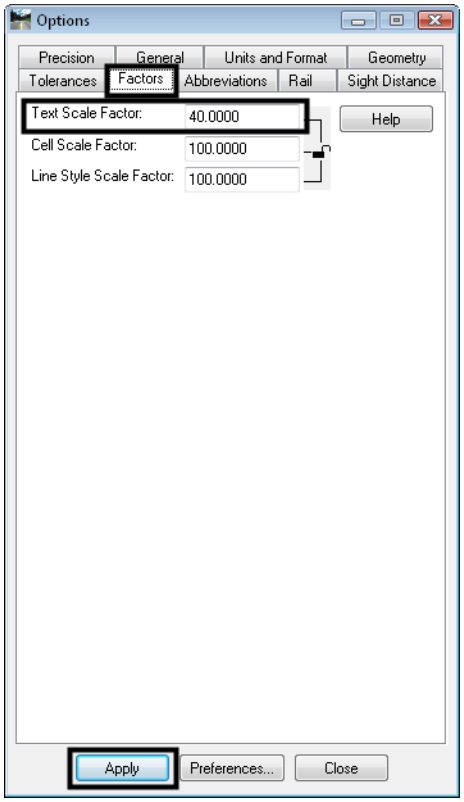
Note: The last used preference remains active in a dialog until another one is selected or you close InRoads, so you should not need to load it this time.

The locations of the intersecting alignments are annotated on the profile as Event Points.



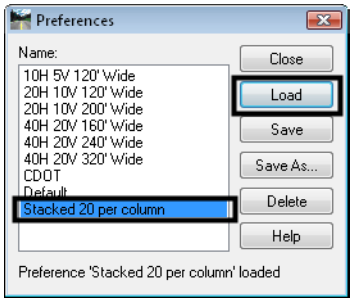
Next, you will create cross sections.

45. For this example, set the ***Text Scale Factor*** to ***40***.



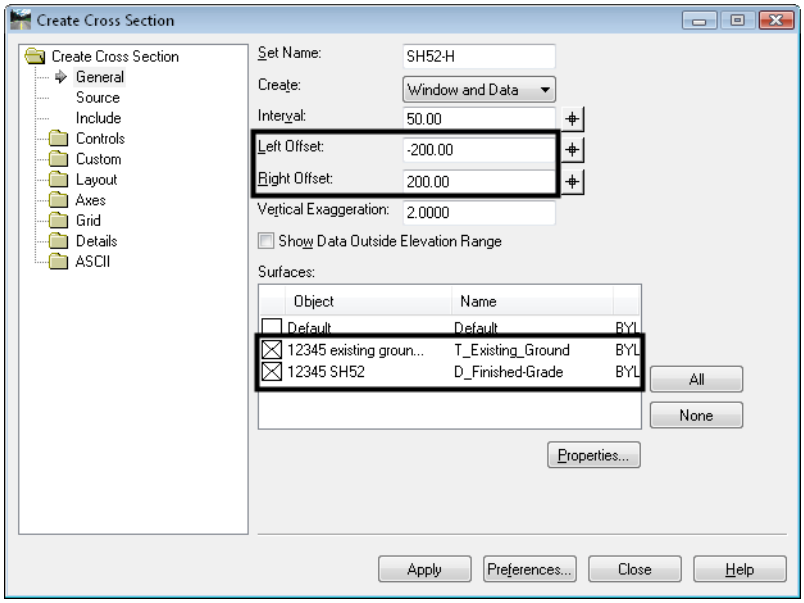
46. Choose **Evaluation > Cross Section > Create Cross Section**.

47. Load the ***Stacked 20 per column*** preference.



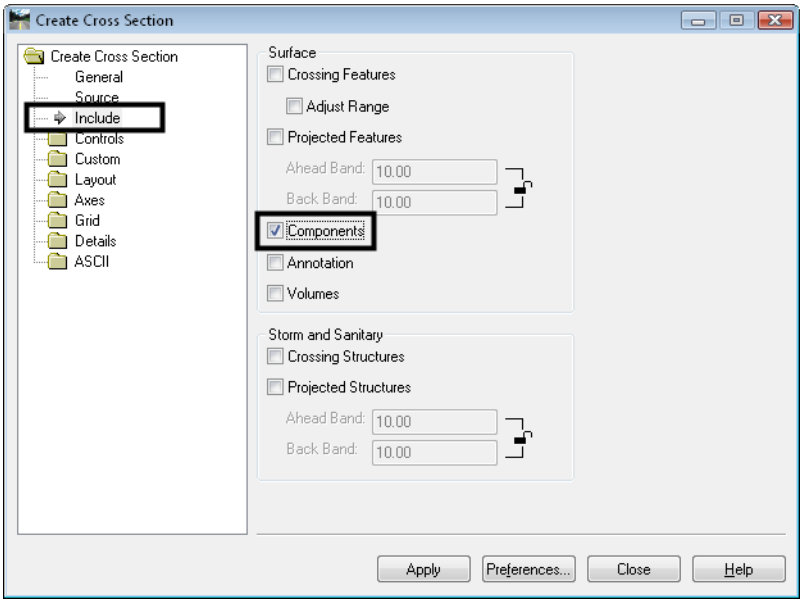
48. Set the ***Offsets*** to ***-200 and 200***.

49. Toggle on both surfaces.



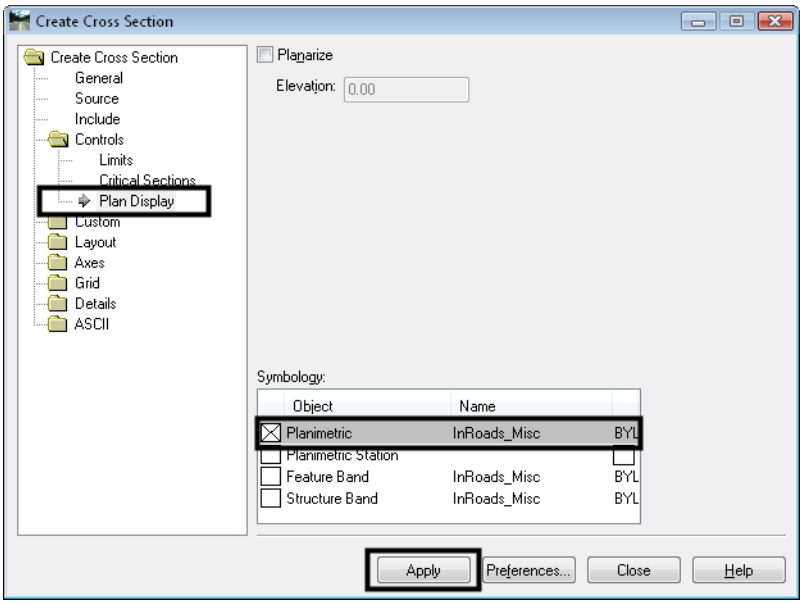
50. **<D>** on the ***Include*** branch at left.

51. Toggle on ***Components***.



52. **<D>** on ***Controls*** > ***Plan Display***.

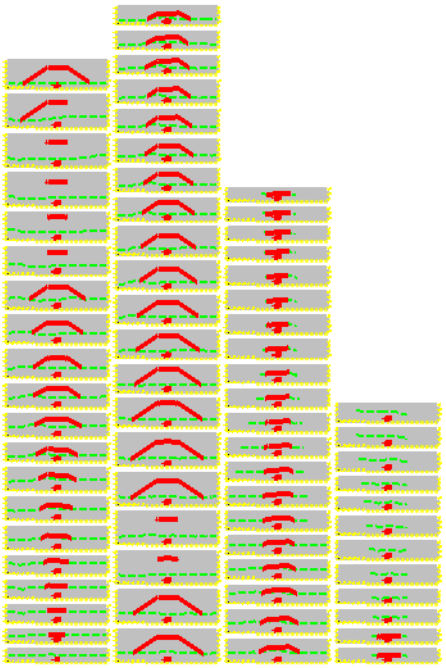
53. Toggle on the ***Planimetric*** option in the ***Symbology*** branch.



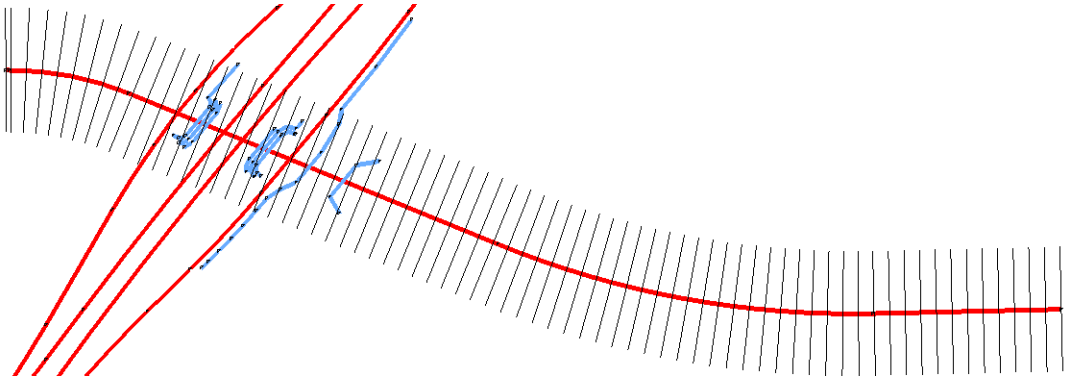
Note: The planimetric option displays a MicroStation element showing where each cross section is cut.

54. **<D> Apply**.

55. **<D>** in a clear area in the design file. Like the profile, you are identifying the lower left corner for the display, so make certain you are in an area that is clear above and to the right of your <D>.

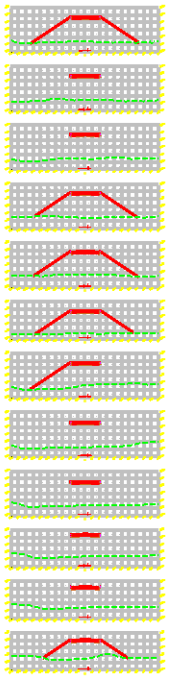


56. **Fit** your MicroStation view and notice the planimetric lines. You can see that by default, cross sections are cut perpendicular to the active alignment. In a later section, you will learn to cut the cross sections on a skew.

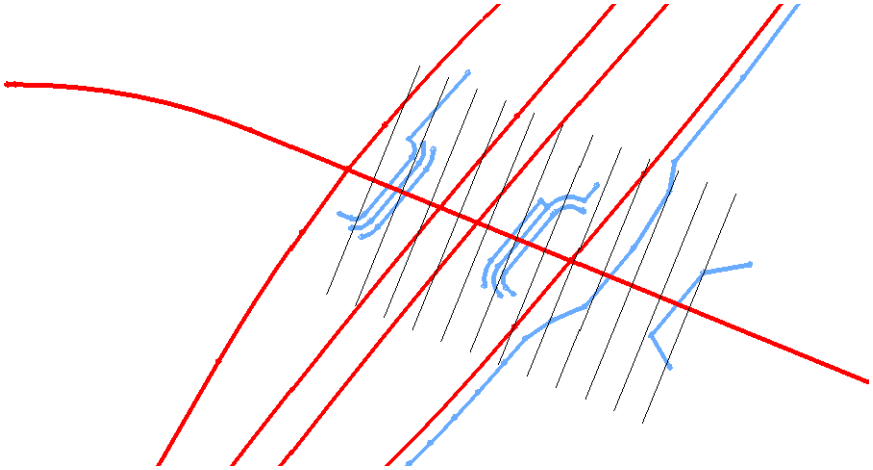


57. Use MicroStation to delete the cross sections and the planimetric lines in the plan view.
58. **<D>** on ***Controls*** > ***Limits***.
59. Toggle on ***Station***.
60. Set the ***Start Station*** to ***116+00.00***.
61. Set the ***End Station*** to ***111+50.00***.
62. **<D> Apply**.

63. **<D>** in a clear area in the design file.



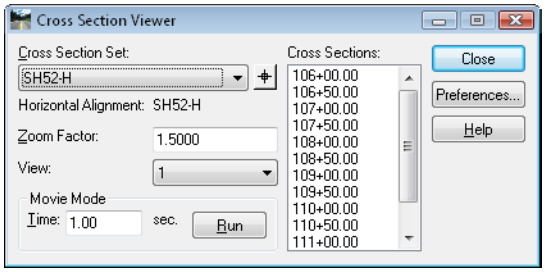
64. **Fit** your MicroStation view and notice the planimetric lines.



Note: Using the Station Limits allows you to cut sections for just a portion of the alignment.

You can zoom in and out of the cross sections to review them, or you can use a viewer that will automatically zoom into a selected cross section.

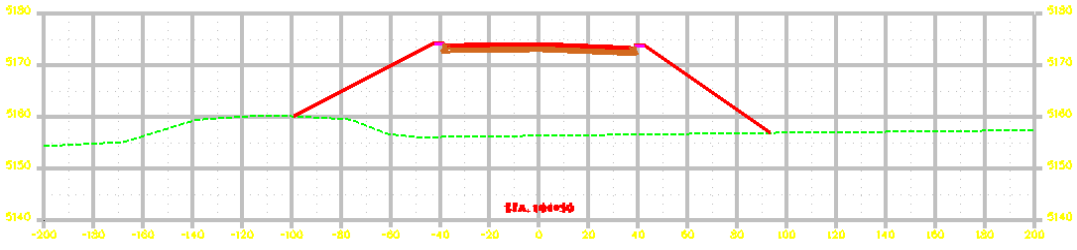
65. Choose **Evaluation > Cross Section > Cross Section Viewer**.



The viewer allows you to view cross sections by set. If you have more than one set of sections in the file, you can use the drop-down to choose the set you want to view, or you can use the target and **<D>** inside one of the sections. If you are zoomed out far enough, you will see a box drawn around the set of sections currently shown in the Viewer.

66. **<D>** on any one of the sections in the list.

67. With only one MicroStation view open, the Viewer automatically uses it to zoom into the section selected. If you have more than one MicroStation view open, you are prompted to select the view with a **<D>**.



68. Change the ***Zoom factor*** to ***1.0000*** and choose another section.

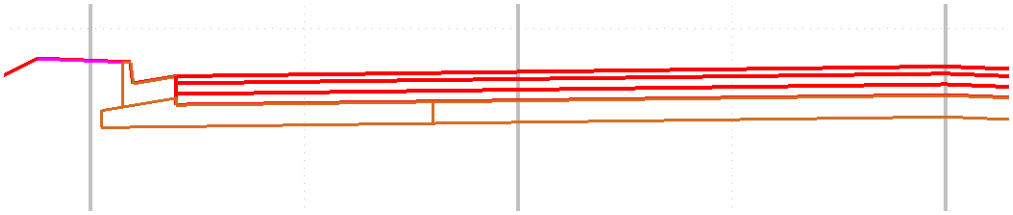
69. **<D> Run**.

Just as before, with only one MicroStation view open, the Viewer automatically uses it to zoom into the sections, but this time it automatically scrolls through the entire set. If you have more than one MicroStation view open, you are prompted to select the view with a **<D>**.

Note: <***Esc***> on your keyboard stops the viewing process.

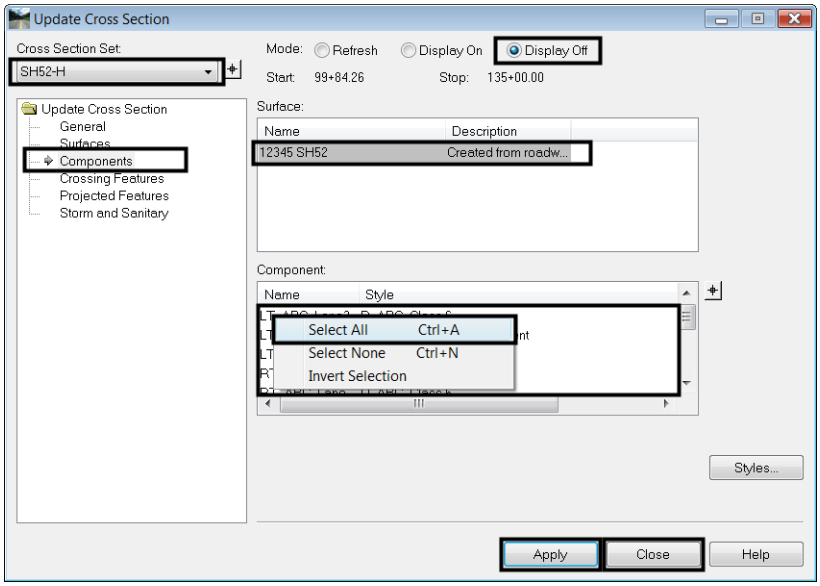
70. **<D> Close** on the **Cross Section Viewer**.

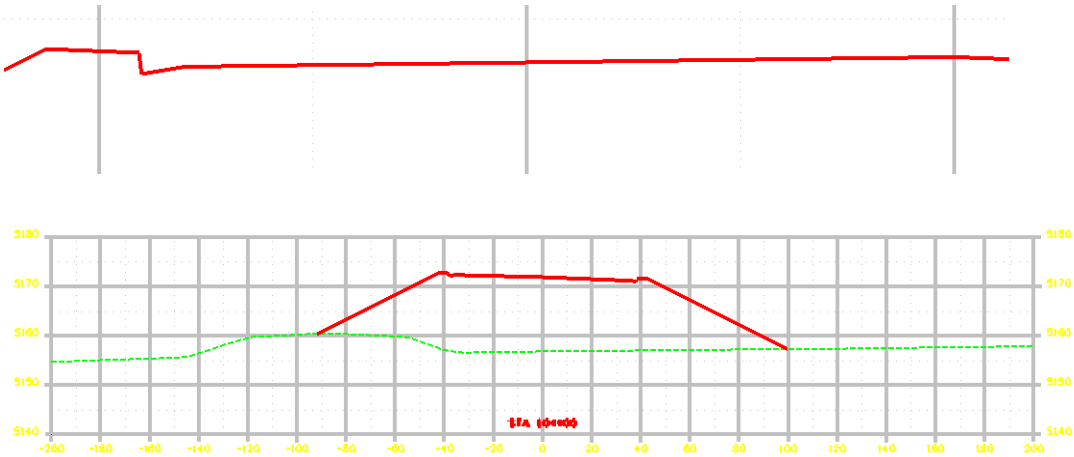
71. Window in to any one of the sections.



Note: The lifts, curb and gutter, etc. are ***components***, which were turned on before cutting sections. Design surfaces are made up of these components, as well as features and triangles.

72. Select **Evaluation > Cross Section > Update Cross Section**.
73. Set the ***Cross Section Set*** to ***SH52-H***.
74. Set the ***Mode*** to ***Display Off***.
75. Select the ***Components*** branch at left.
76. Highlight the ***12345 SH52*** surface.
77. Right-click in the component list and **<D>** ***Select All***.
78. **<D> Apply**, then **Close**.



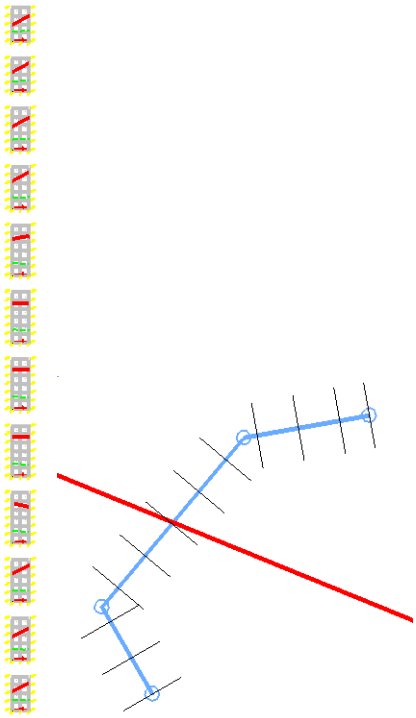


Note: The cross sections now show only the triangulated surface for SH52. Components may be turned on and off as desired using this procedure.

79. Use MicroStation to **Delete** the cross section set and the planimetric lines.

    Note: Sections can be cut along any alignment, not just a highway alignment.

80. Using what you have learned, cut 25' sections along Wall-16-L that are 20' wide on either side.



81. Review the sections.

82. Use MicroStation to **Delete** the cross section set and the planimetric lines.

Chapter Summary::

- Surfaces may be reviewed graphically by viewing the perimeter, triangles and/or contours among other surface displays.
- Horizontal alignments may be viewed graphically along with their stationing and annotation.
- Horizontal alignments may also be tracked as a review tool.
- Reports for horizontal alignment can be generated with the Review commands or with the XML Report command.
- With a horizontal alignment and surface, you can generate a profile and annotate a vertical alignment.
- With a horizontal alignment and surface, you can generate a set of cross sections to review the data.

LAB 3 - Working With Alignments

Alignments are reference points that are used to relate the design world to the real world. The coordinates that make up the alignment are located at the construction site and measurements for design elements are taken from these coordinates.

In this lab, a horizontal and vertical alignment is created that represents the new flowline for a drainage channel. The new flowline must match the existing flowline horizontally and vertically at the beginning and end of the alignment as well as at an inlet structure in the middle.

Chapter Objectives:

- Import a horizontal alignment from a graphic element.
- Add a horizontal curve to the alignment.
- Create a profile.
- Define a vertical alignment.

The following files are used in this lab:

- C:\Workspace\Workspace-CDOT_XM\Standards-Global\InRoads\Preferences\ CDOT_Civil.xin
- C:\Projects\12345\Bridge\Drawings\Reference Files\12345BRDG_Model-Drain.dgn
- C:\Projects\12345\Bridge\Drawings\Reference Files\12345BRDG_Prof.dgn
- C:\Projects\12345\ROW_Survey\InRoads\DTM\12345_Drain

Lab 3.1 - Draw Graphic Elements for the Horizontal Alignment

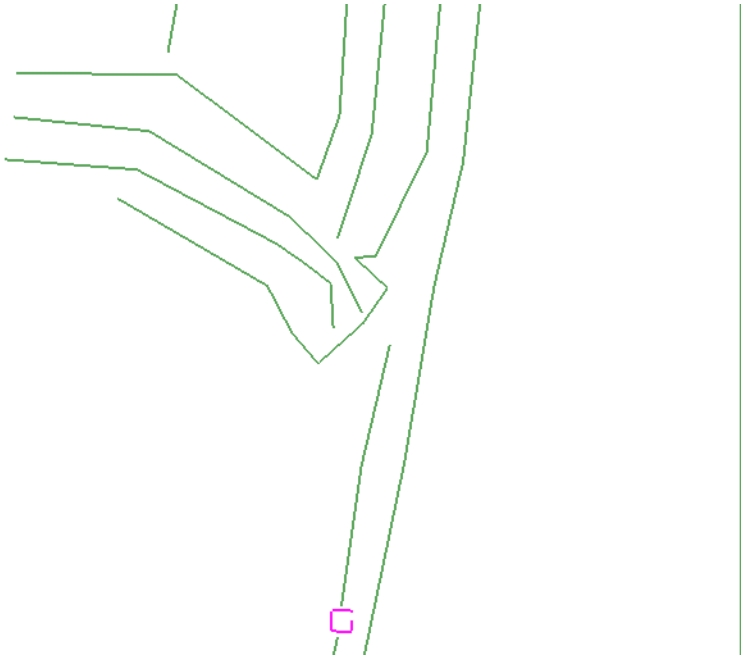
There are numerous methods for entering horizontal alignment data into InRoads. Most of these methods are designed for survey and roadway geometry. Because this lab is not concerned with roadway geometric design criteria, the alignment can be laid out graphically then imported into inRoads.

Section Objectives:

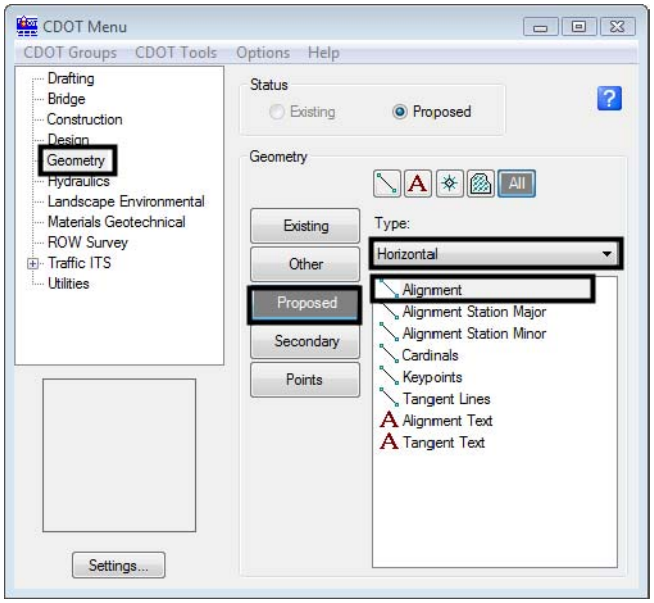
- Create MicroStation graphic elements that represent the alignment.
- Create a complex chain from those elements.
- Import the graphic as a horizontal alignment.
- Change the direction of the alignment, if needed.

1. Start MicroStation and InRoads using the **12345BRDG_Model-Drain.dgn** file.
2. In the main InRoads dialog box, verify that the ***CDOT_Civil.xin*** is loaded.
3. From the InRoads menu bar, select **File > Open**.
4. Navigate to the **C:\Projects\12345\ROW_Survey\InRoads\DTM** directory and open the **12345_Drain** file

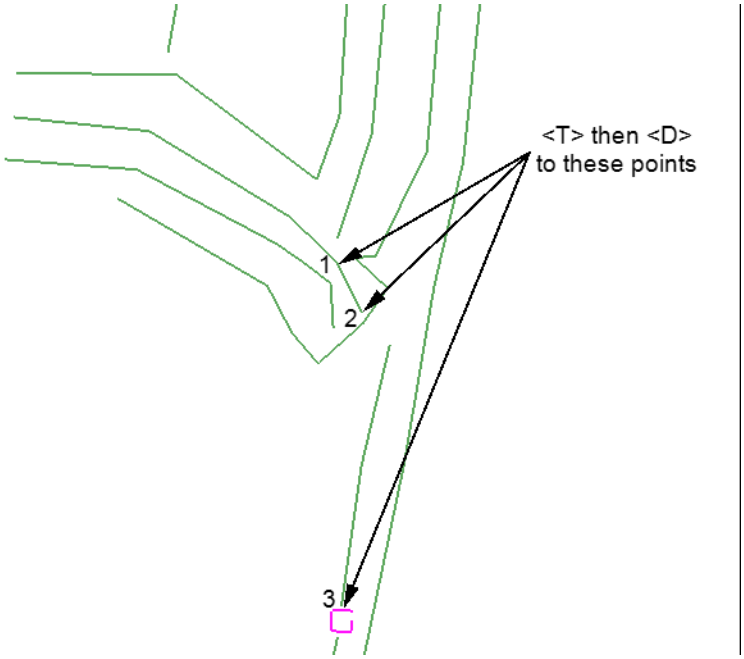
5. Using the MicroStation view controls, zoom into the area shown in the illustration below.



6. From the ***CDOT Menu***, select the **Geometry** group.
7. **<D>** the **Proposed** button.
8. Verify that the ***Type*** is set to **Horizontal**.
9. Highlight **Alignment** from the item list. This activates the Place SmartLine command.

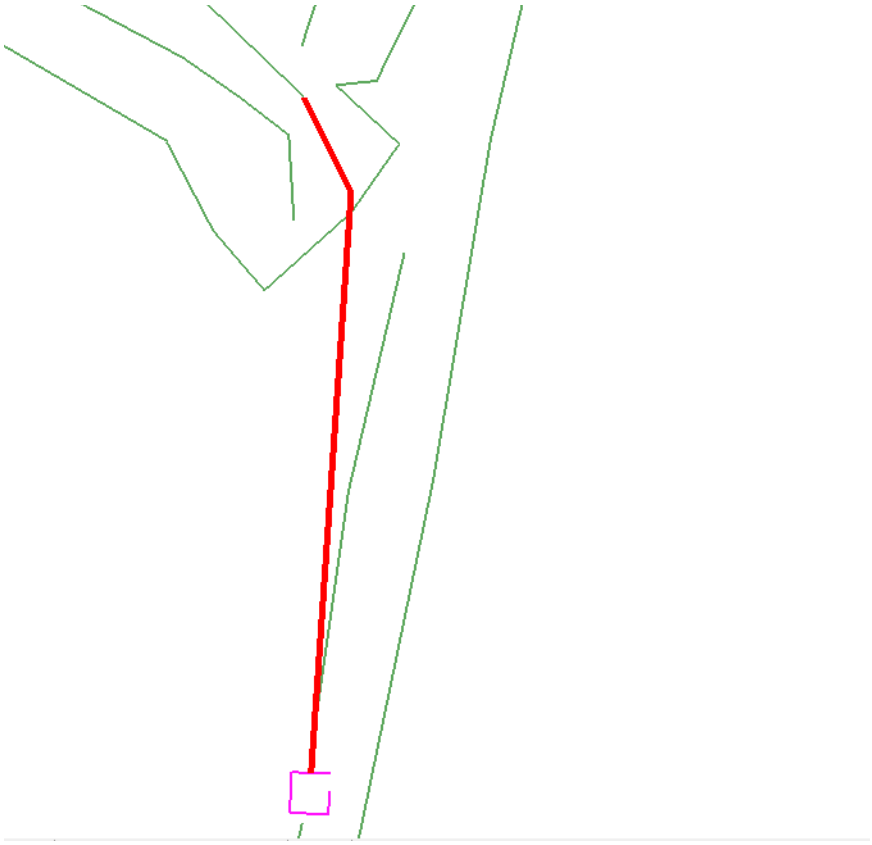


10. **<T>** then **<D>** on the points shown in the illustration below.



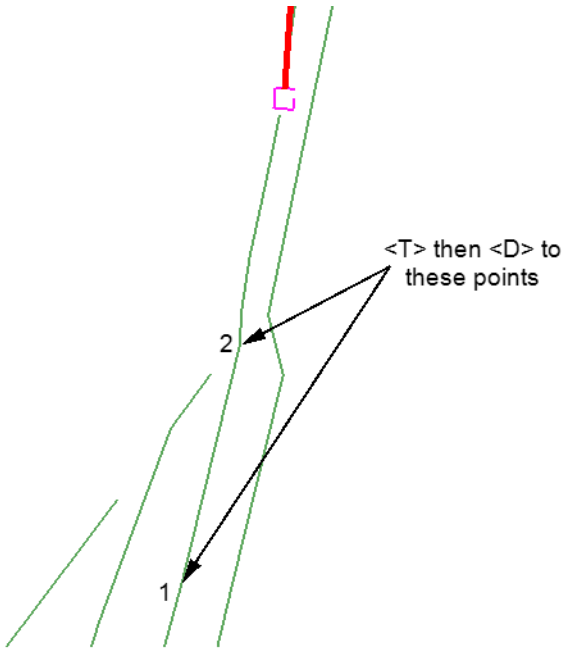
Points 1 and 2 are on the flowline of the existing channel. Point 3 is in the center of the top side of the inlet structure.

11. **<R>** to exit the **Place SmartLine** command. The result is a linestring placed as shown below.



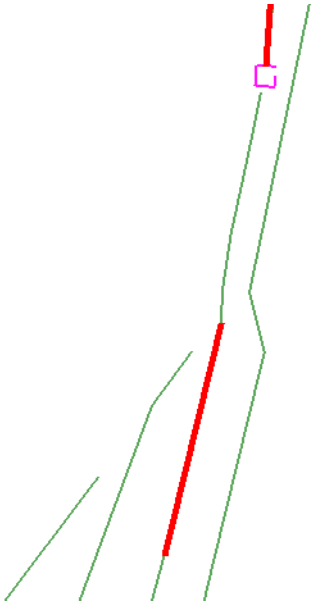
12. Zoom out to see the channel below the inlet.

13. **<T>** then **<D>** on the points shown in the illustration below.



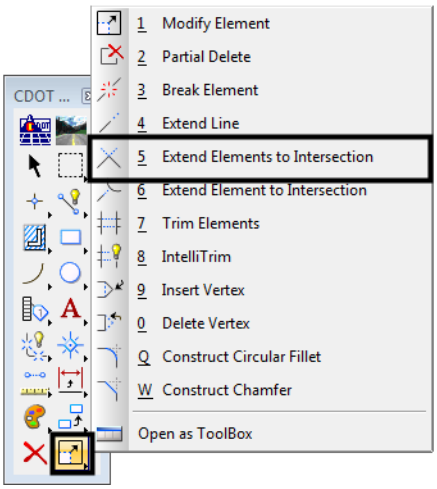
This line will match the new channel to the existing channel below the inlet.

14. **<R>** to exit the **Place SmartLine** command. The result is a linestring placed as shown below.



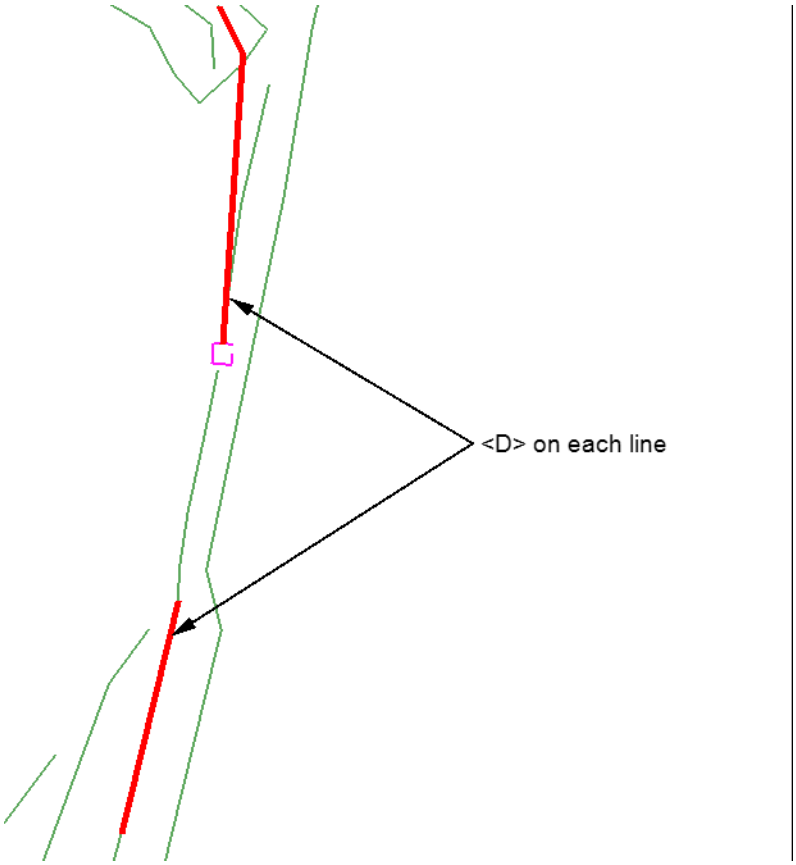
In order to create an alignment from these elements must match up end to end. The MicroStation Extend Elements to Intersection is used to accomplish this.

15. From the MicroStation Main toolbar select the **Extend Elements to Intersection** command.



16. **<D>** on the first linestring near the inlet.

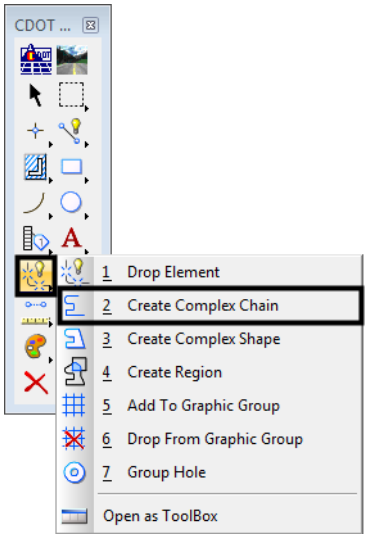
17. **<D>** the second linestring near the end closest to the inlet.



Note: If you are having trouble selecting the correct lines, the green terrain lines can be deleted to get them out of the way.

The MicroStation Create Complex Chain command is used to join the two linestrings into a single element which can be imported into InRoads as a horizontal alignment.

18. From the MicroStation Main toolbar select the **Create Complex Chain** command.



19. **<D>** on each line, then **<D>** in a blank area to accept the elements.

20. **<R>** to exit the **Create Complex Chain** command.

This completes the linestring that will be used for the alignment. Next, the linestring is imported into InRoads.

Section Summary:

- MicroStation graphic elements can be used to create InRoads alignments.
- Multiple elements can be joined to create a single element which is easier to import into a single alignment.

Lab 3.2 - Create a Geometry Project and Import a Horizontal Alignment

Section Objectives:

- Create a new InRoads geometry project.
- Import the chain into InRoads.

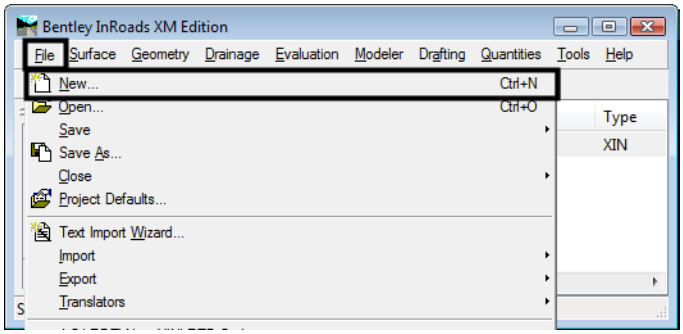
The first step is to create a Geometry Project. This is the file that holds the horizontal and vertical alignment data.

1. Start MicroStation and InRoads (if they are not already started) and open the ***12345BRDG_Model-Drain.dgn*** file.

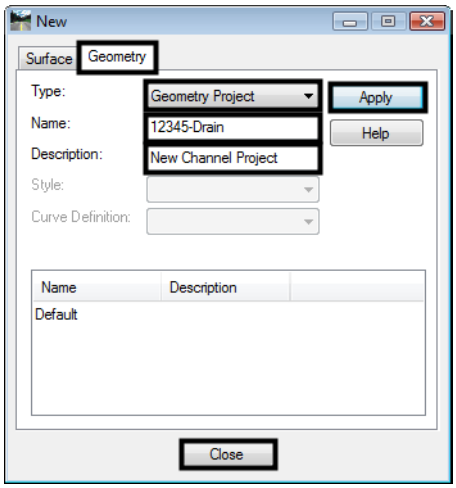
2. If InRoads was already opened, save and close any InRoads data files that are open.

3. From the inRoads menu, open the ***C:\Projects\12345\ROW_Survey\InRoads\DTM\12345_Drain*** file.

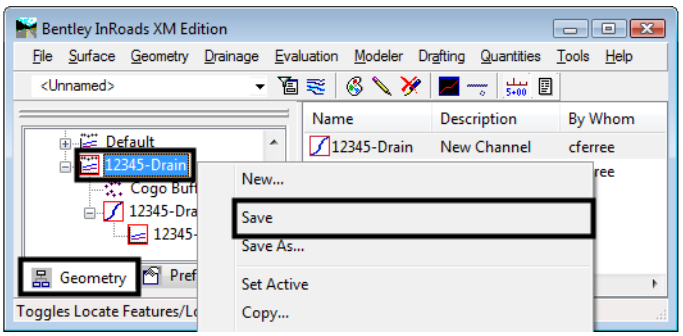
4. From the InRoads main menu, select **File > New**.



5. In the ***New*** dialog box, **<D>** the **Geometry** tab.
6. Set the ***Type*** to **Geometry Project**.
7. Key in ***12345-Drain*** for the ***Name***.
8. Key in ***New channel project*** for the ***Description***.
9. **<D> Apply** then **<D> Close** to dismiss the dialog box.



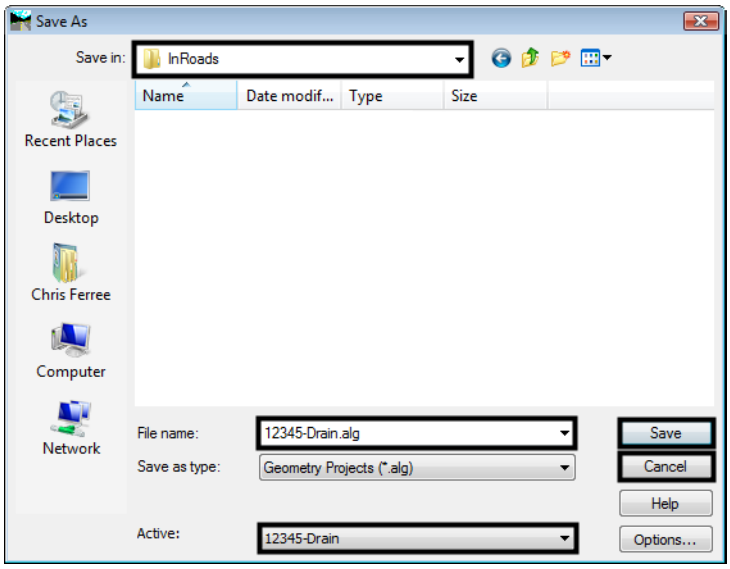
10. On the InRoads Explorer, **<D>** the **Geometry** tab.
11. **<R>** on the **12345-Drain** geometry project and select **Save** from the right click menu.



12. In the ***Save As*** dialog box, navigate to the **C:\Projects\12345\Bridge\InRoads** folder.

13. At the bottom of the dialog box, use the ***Active*** drop down menu to reselect the **12345-Drain** geometry project. This will automatically fill in the name field so that the name on the hard drive matches what is shown in InRoads.

14. **<D> Save** then **<D> Cancel** to dismiss the dialog box.



Next, the horizontal alignment is created from the graphic element drawn above.

15. From the InRoads menu bar, select **File > Import > Geometry**.

16. In the ***Import Geometry*** dialog box, verify that the **From Graphics** tab is selected.

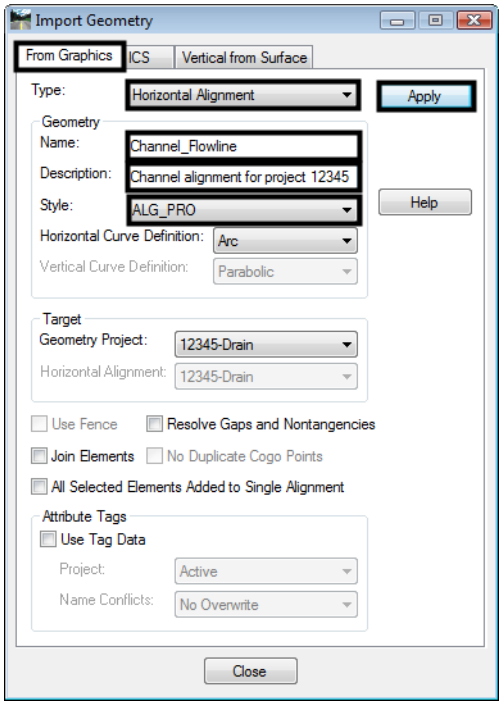
17. Set the ***Type*** to **Horizontal Alignment**.

18. Key in ***Channel_Flowline*** for the ***Name***.

19. Key in ***Channel alignment for project 12345*** for the ***Description***.

20. Set the ***Style*** to **ALG_PRO**.

21. **<D> Apply**. The ***Import Geometry*** dialog box minimizes.



22. **<D>** on the linestring then **<D>** in a blank area to accept the element.

23. **<R>** to end the command. The ***Import Geometry*** dialog box is redisplayed.

24. **<D>** the **Close** button to dismiss the dialog box.

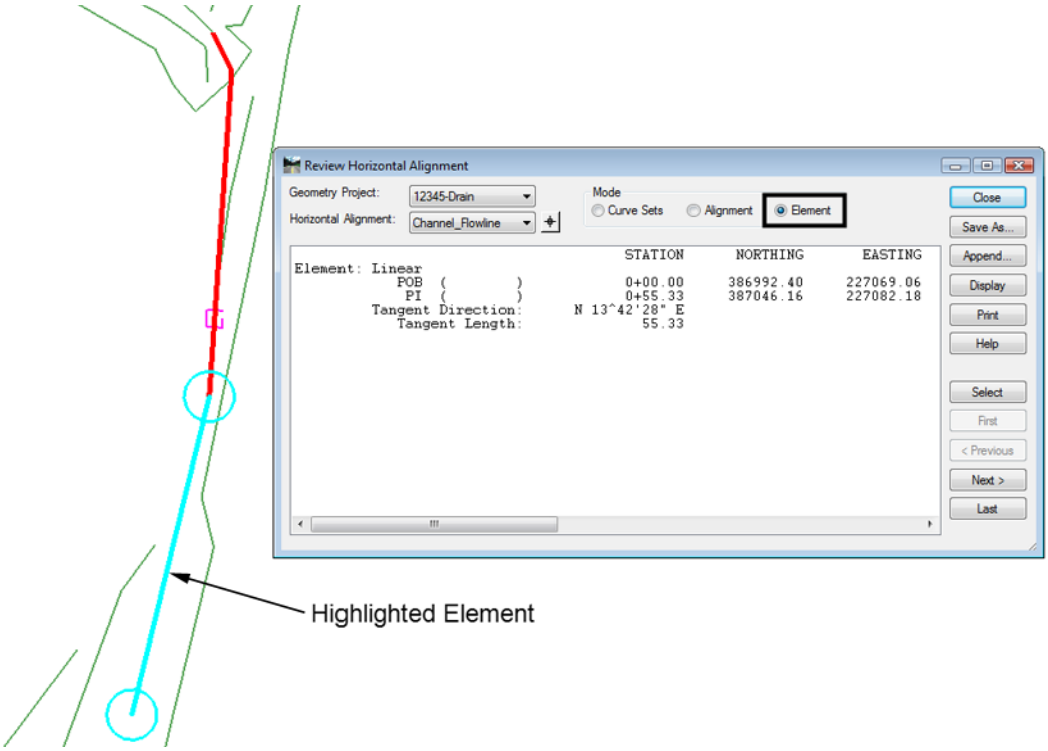
The linestring has now been added to the 12345-Drain geometry project. Next, the direction of the alignment must be determined. The alignment should run from north to south. The direction of the alignment is determined by the direction of the linestring (or complex chain). To check the direction of the alignment use the review command.

25. In the InRoads explorer, expand the **12345-Drain** geometry project to show the **Channel_Flowline** alignment.

26. **<R>** on the **Channel_Flowline** alignment and select **Review** from the right click menu.

27. Move the **Review Horizontal Alignment** dialog box so that the **Channel_Flowline** alignment is visible.

28. In the ***Review Horizontal Alignment*** dialog box, toggle the mode to Element. This causes the first element of the alignment to highlight.



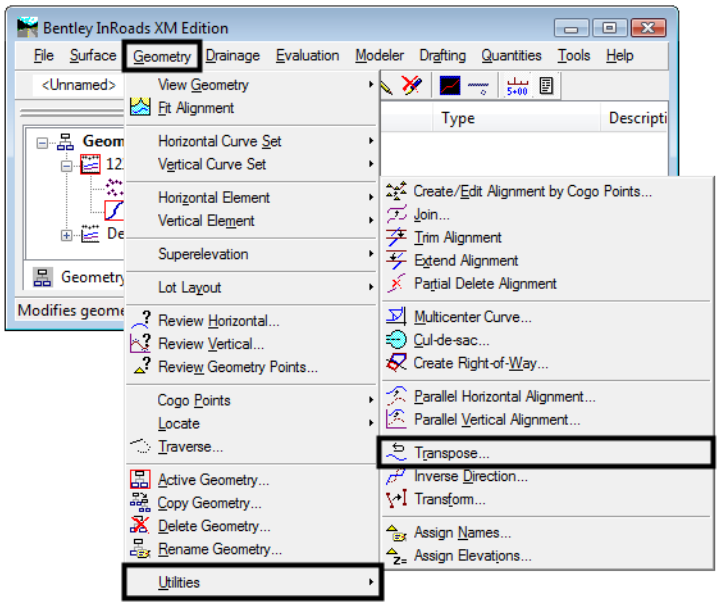
29. **<D> Close** to dismiss the Review Horizontal Alignment dialog box.

If the element highlights as shown in the image above, the alignment is running the wrong way.

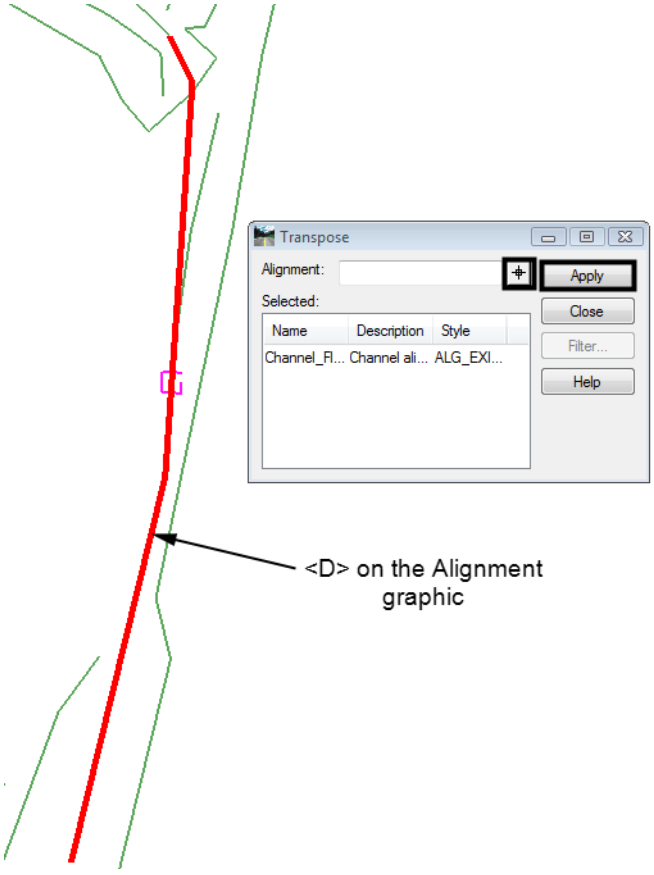
To change the direction of the alignment:

Important! Complete steps 30 through 33 only if your alignment starts at the south end, as illustrated above.

30. From the InRoads main menu bar, select **Geometry > Utilities > Transpose**.

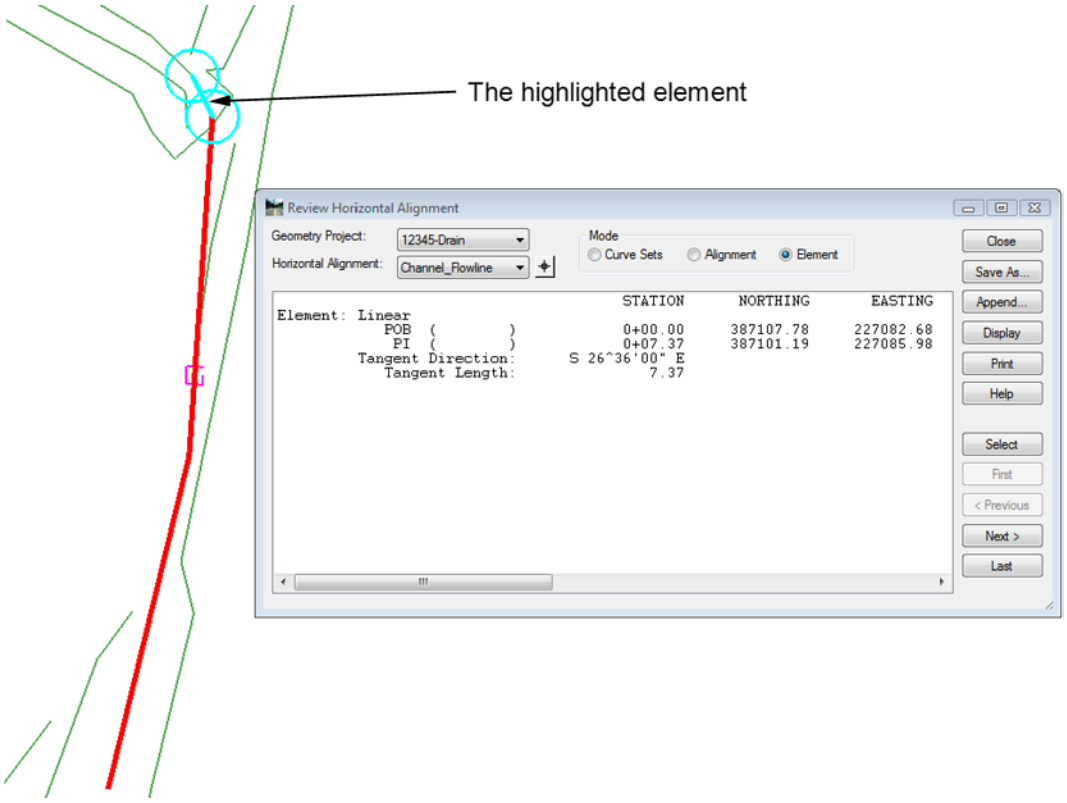


31. In the Transpose dialog box, **<D>** the "target" button then **<D>** on the alignment. **<D>** in a blank area to accept.



32. The alignment name appears in the Selected list. **<D>** the **Apply** button. **<D> Close** to dismiss the ***Transpose*** dialog box.

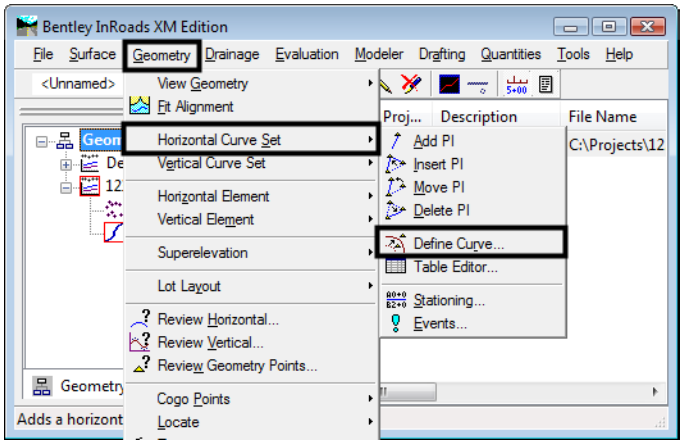
33. Review the alignment again. The north most element highlights indicating the alignment now runs in the desired direction.



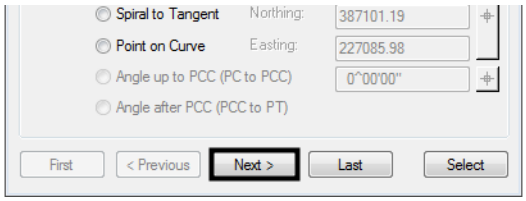
34. **<D> Close** to dismiss the Review Horizontal Alignment dialog box.

To smooth the intersection between the last two segments of the alignment, a horizontal curve is added to the alignment.

35. From the InRoads menu bar, select **Geometry > Horizontal Curve Set > Define Curve**.

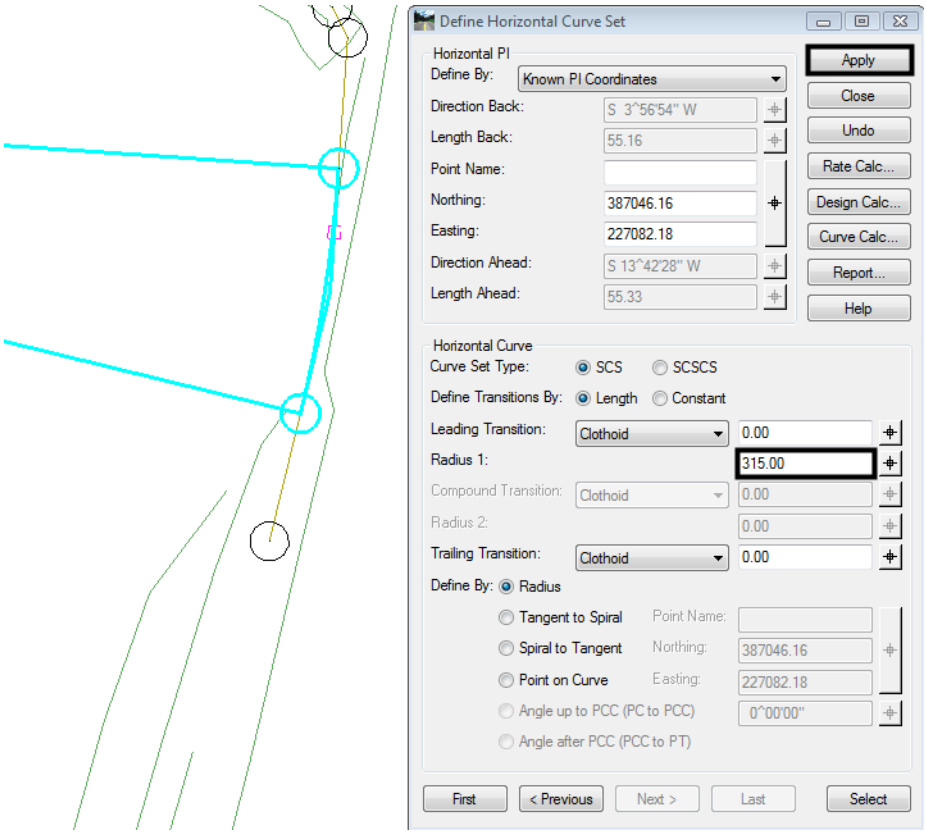


36. The first PI highlighted does not need a curve because that segment of the alignment is there to match the existing flowline. **<D>** the **Next** button to move to the next PI.



37. In the ***Radius 1*** field, key in ***315***. This radius is a design decision made by the engineer.

38. **<D> Apply**. The MicroStation graphics are updated to show the radius.



39. **<D> Close** to dismiss the ***Define Horizontal Curve Set*** dialog box.

40. **In the InRoads explorer, <R>** on the **12345-Drain** geometry project and select **Save** from the right click menu.

Section Summary:

- The Geometry project holds horizontal and vertical alignment data.
- Use the same name for the geometry project when saving it as used when it was created.
- When importing a horizontal alignment from graphics, the direction of the element determines the direction of the alignment.

Lab 3.3 - Creating a Vertical Alignment

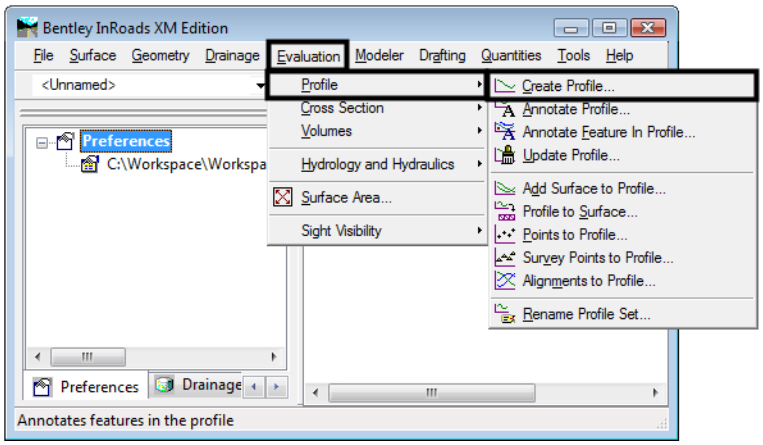
A vertical alignment controls the elevation of the template as it is placed along the corridor. Vertical alignments are typically built in a profile window.

Section Objectives:

- Create a profile along the new horizontal alignment.
- Create a vertical alignment placeholder.
- Add data to the vertical alignment

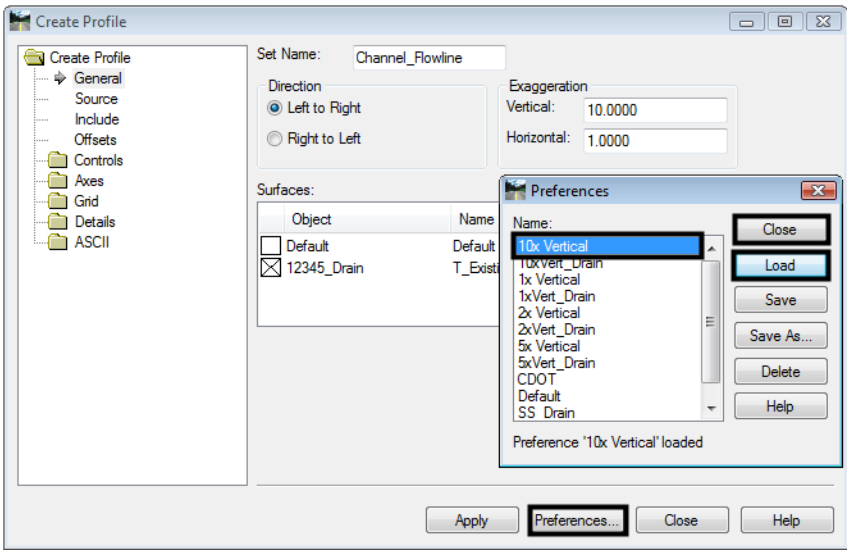
In order to add data to a vertical alignment, a profile window is required.

1. From the MicroStation menu bar, select **File > Open.**
2. Navigate to the **C:\Projects\12345\Bridge\Drawings\Reference Files** folder and select the **12345BRDG_Prof.dgn** file.
3. From the InRoads menu bar, select **Evaluation > Profile > Create Profile**.



4. In the ***Create Profile*** dialog box, **<D>** the **Preferences** button.
5. In the ***Preferences*** dialog box, select **10x Vertical**.

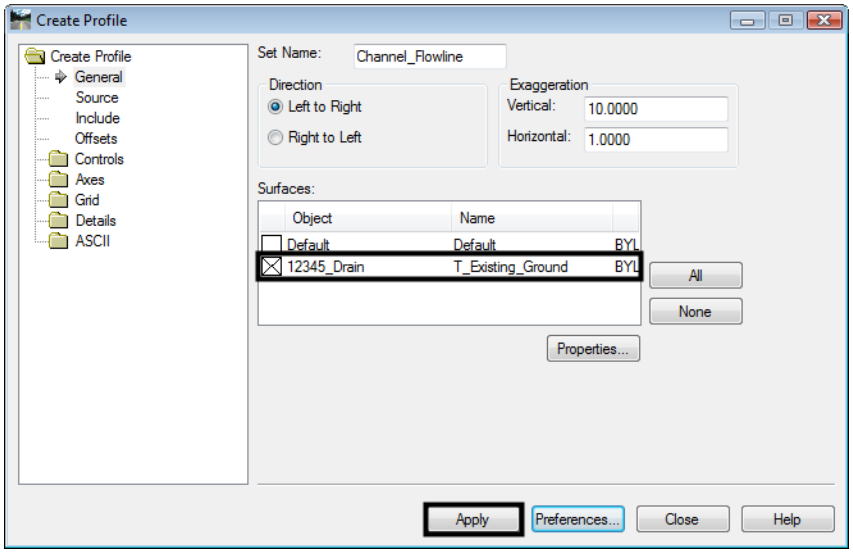
6. **<D> Load** then **<D> Close** to dismiss the ***Preferences*** dialog box.



Using the 10x vertical exaggeration makes it easier to see elevation changes in relatively flat terrain.

7. Verify that the **12345_Drain** surface is the only selected surface.

8. **<D> Apply** then **<D>** in the MicroStation view window. The profile is drawn in the dgn.

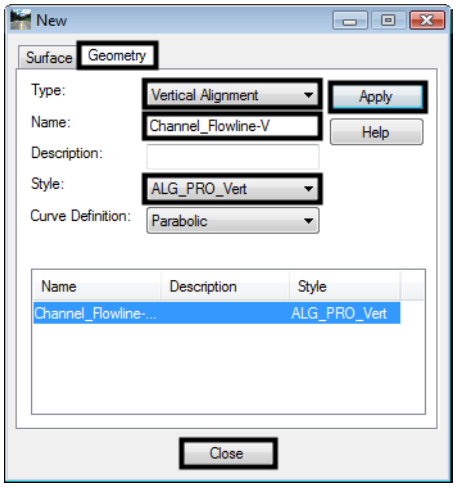


9. **<D> Close** to dismiss the ***Create Profile*** dialog box.

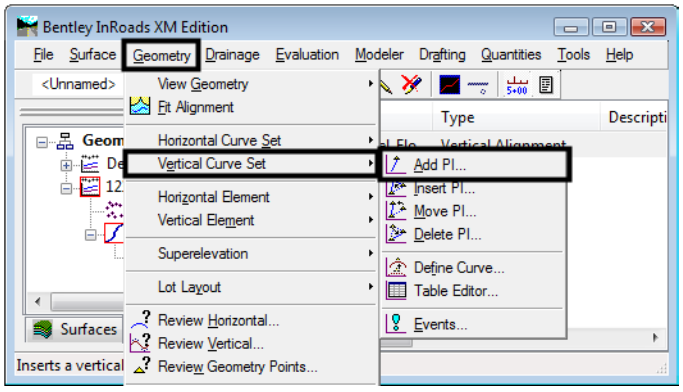
10. In MicroStation, zoom in on the profile so that the elevations between ***4680*** and ***4700*** are visible.

With the profile window created, the vertical alignment data can be entered. The first step in this process is to create a vertical alignment placeholder for the Channel_Flowline horizontal alignment.

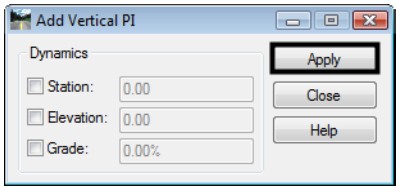
11. On the InRoads menu bar, select **File > New**.
12. In the ***New*** dialog box, **<D>** the **Geometry** tab.
13. Set the ***Type*** to **Vertical Alignment**.
14. Key in ***Channel_Flowline-V*** for the ***Name***.
15. Set the ***Style*** to **ALG_PRO_Vert**.
16. **<D> Apply** then **<D> Close** to dismiss the ***New*** dialog box.



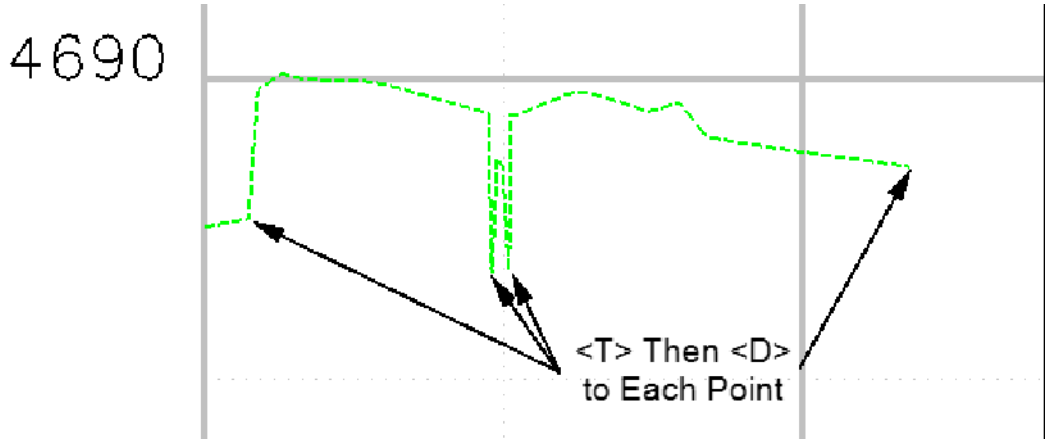
17. On the InRoads menu bar, select **Geometry > Vertical Curve Set > Add PI**.



18. In the ***Add Vertical PI*** dialog box, **<D>** the **Add** button.

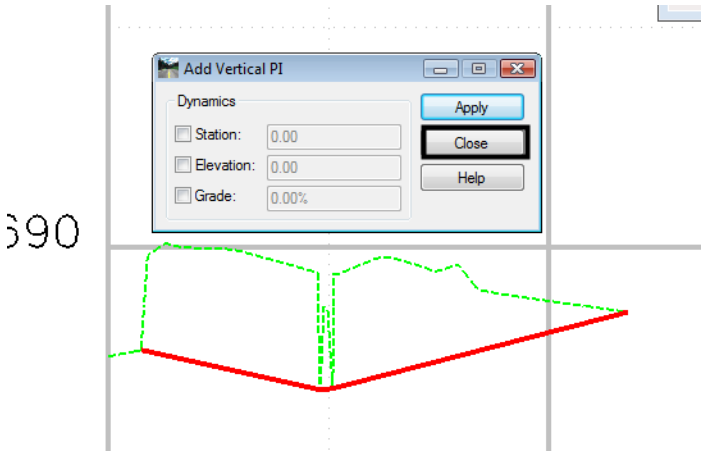


19. **<T>** then **<D>** on each of the points indicated in the illustration below.



20. **<R> <R>** to exit the **Add Vertical PI** command. **<D>** the **Close** button to dismiss the ***Add Vertical PI*** dialog box.

The illustration below shows the completed vertical alignment.



21. **In the InRoads explorer, <R>** on the **12345-Drain** geometry project and select **Save** from the right click menu.

Section Summary:

- A vertical alignments is a child of a horizontal alignment.
- Vertical alignment data is entered within a profile window.
- A profile window can be exaggerated vertically to emphasize elevation changes.
- Vertical PIs can be placed by tentative snapping to elements within the profile window. The SE=*station,elevation* key in can also be used to place vertical PIs.

Chapter Summary:

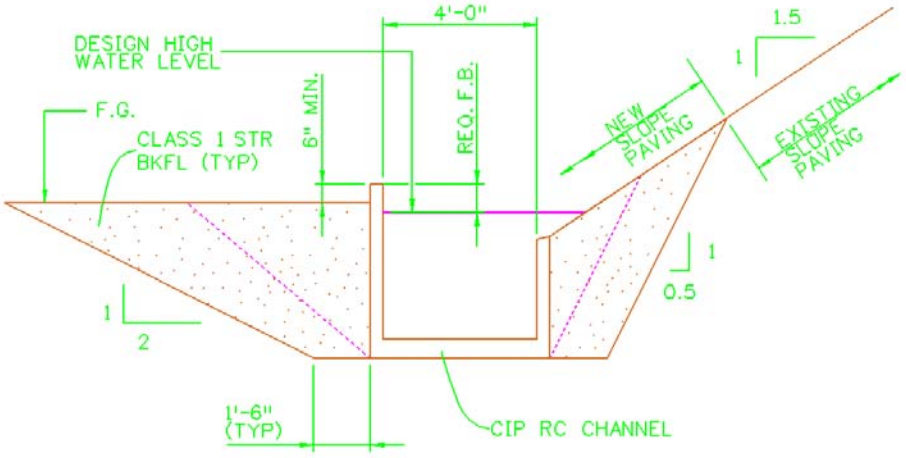
- Horizontal and vertical alignments are used to define the location or path of construction.
- Horizontal PIs can be placed by tentative snapping to elements within the drawing window. The xy=*easting coordinate,northing coordinate,elevation(optional)* key in can also be used to place horizontal PIs.

- A profile window displays the elevations of the existing ground under the horizontal alignment.
- Profiled are the entry point for vertical alignment data.
- Save the geometry project after data is entered. This file does not save automatically.

LAB 4 - Templates and Corridors

This lab demonstrates the use of templates and corridors to create a surface model (dtm) that can then be used to calculate earthwork and other quantities. This method of design is well suited for linear construction sites such as ditches/channels and walls.

In this exercise, a template is created that contains a cast-in-place reinforced concrete channel liner, the excavation required to build the liner, and backfill to complete the construction. Below is a sketch of the template.



TYPICAL SECTION

Note: The slope paving shown in the illustration above has been omitted for this lab.

Chapter Objectives:

- Build a template showing the excavation, channel liner, and slope paving.
- Create a corridor that follows an alignment.
- Review design data in Roadway Designer.
- Generate design surfaces from the template and corridor.

The following files are used in this lab:

- C:\Projects\12345\Bridge\Drawings\Reference Files\12345BRDG_Model-Drain.dgn
- C:\Workspace\Workspace-CDOT_XM\Standards-Global\InRoads\Preferences\CDOT_Civil.xin
- C:\Projects\12345\ROW_Survey\InRoads\DTM\12345_Drain
- C:\Projects\12345\Bridge\InRoads\12345_Drain.alg
- C:\Workspace\Workspace-CDOT_XM\Standards-Global\InRoads\Templates\CDOT_Template-Library.itl

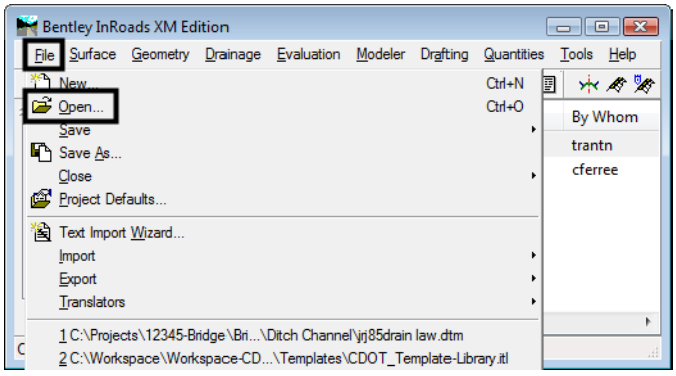
Lab 4.1 - Construct the Channel Liner

The ditch liner is a closed shape component that defines the design channel. The wall of the channel liner are 4 inches thick and the bottom is 6 inches thick. The left side rises 6 inches above the existing ground, while the right side is flush with the existing ground. This component is not included as part of the triangulated surface model because it does not define the area of excavation.

Section Objectives:

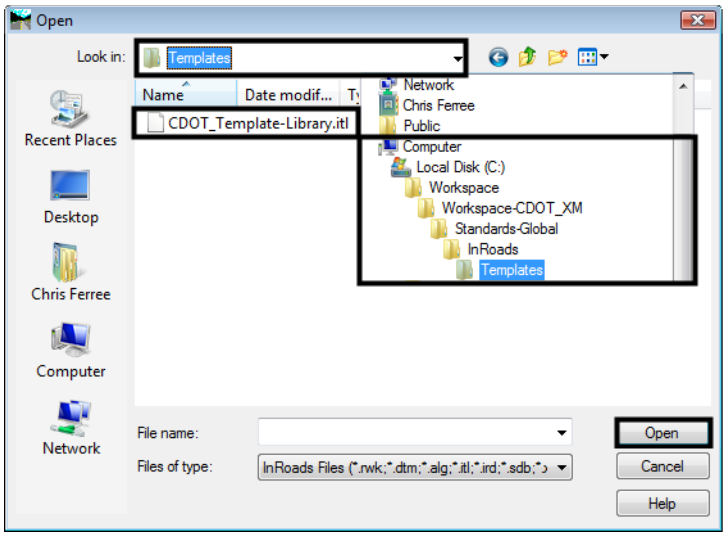
- Copy the standard template library into the project folder.
- Create a new template in the project template library.
- Construct a new channel liner component for the template.
- Edit point properties to define the shape of the liner.
- Edit the component properties to exclude the line from triangluation.

1. Start MicroStation and InRoads opening the ***12345BRDG_Model-Drain.dgn*** file.
2. In the main InRoads dialog box, verify that the ***CDOT_Civil.xin*** is loaded.
3. From the InRoads menu bar, select **File > Open**.



4. Navigate to the **C:\Projects\12345\ROW_Survey\InRoads\DTM** directory and open the **12345_Drain** file
5. Navigate to the **C:\Projects\12345\Bridge\InRoads** directory and open the **12345_Drain.alg** file.

6. Navigate to ***C:\Workspace\Workspace-CDOT_XM\Standards-Global\InRoads\Templates*** and open the **CDOT_Template-Library.itl** file.

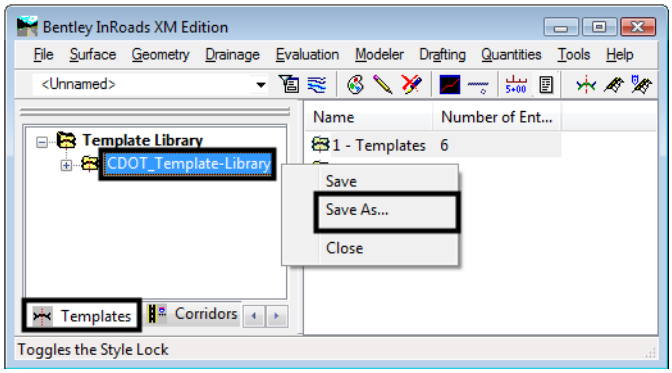


7. Navigate to ***C:\12345\ROW_Survey\InRoads\DTM*** and open **12345_Drain.**

8. **<D> Cancel** to dismiss the Open dialog box.

9. In the InRoads Explorer pane, **<D>** the **Templates** tab.

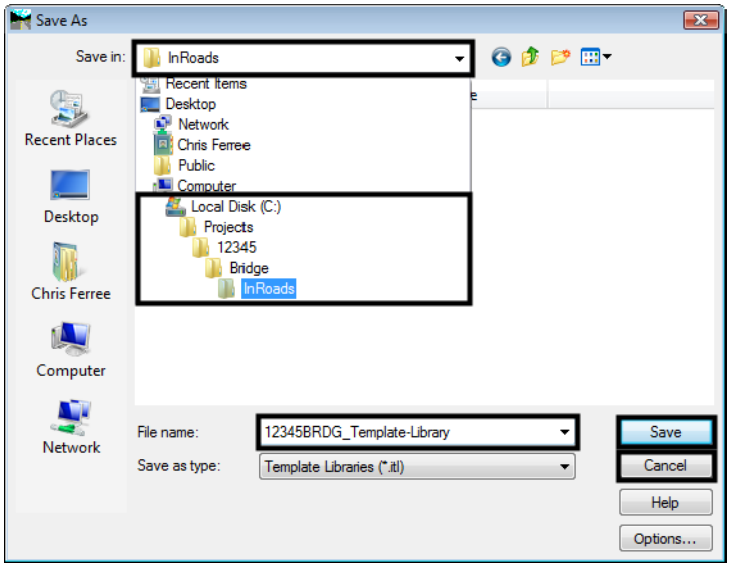
10. **<R>** on **CDOT _Template-Library** and select **Save As** from the right click menu.



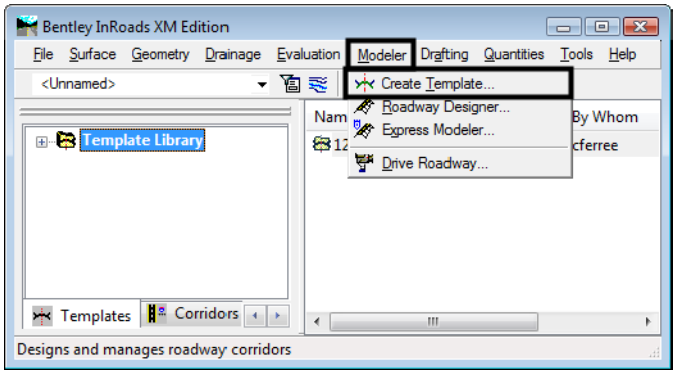
11. In the ***Save As*** dialog box, navigate to the ***C:\Projects\12345\Bridge\InRoads*** folder.

12. Key in ***12345BDRG_Templates.itl*** for the file name.

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



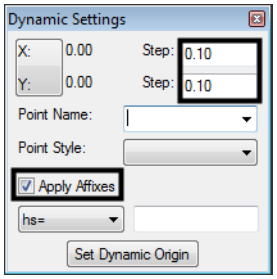
14. From the InRoads menu bar, select **Modeler > Create Templates**. This displays the Create Template dialog box.



15. From the Create Template menu bar, select **Tools > Dynamic Settings**.

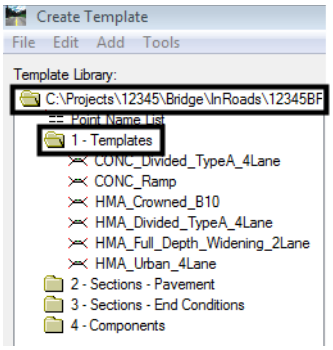
16. In the ***Dynamic Settings*** dialog box, key in ***0.10*** for both the "***X***" and "***Y***" ***Step***.

17. Toggle on **Apply Affixes**.

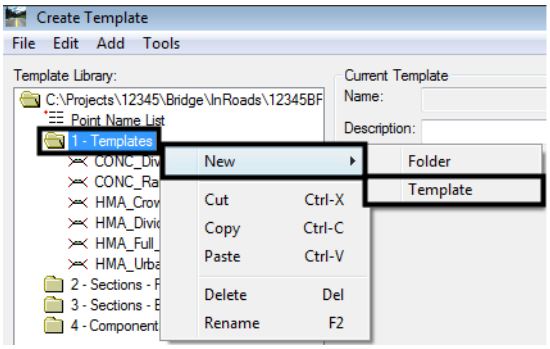


The Dynamic Settings dialog box is used to enter data while constructing a component.

18. In the Template Library Explorer area of the ***Create Template*** dialog box, expand the folders to show the contents of the ***1-Templates*** folder.



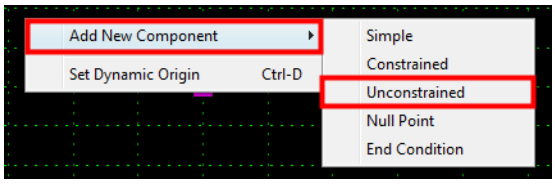
19. **<R>** on the **1-Templates** folder and select **New > Template** from the right click menu.



20. Key in ***12345_Channel-Liner*** for the template name.

Because the channel liner is a unique shape, there are no components in the library that can be used. Therefore, it will be built as a new component. The channel liner is first "sketched in" as an Unconstrained component. Then constraints are applied to the component points to define the proper shape.

21. **<R>** in the Template view and select **Add New Component > Unconstrained** from the right click menu.

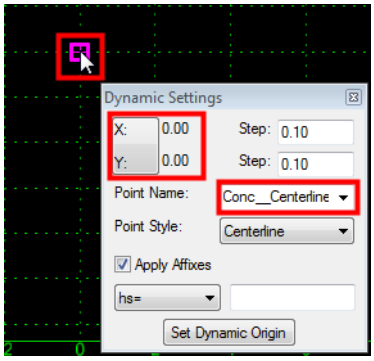


22. In the lower center of the dialog box, data fields are displayed that apply to the new component. In the ***Name*** field, key in ***Channel Liner***.

23. Select **D_CONC_Pvmt** from the ***Style*** drop down menu.

24. In the ***Dynamic Settings*** dialog box, **<D>** on the ***Point Name*** drop down arrow, and select **Conc_Centerline-Top** from the menu. This automatically sets the ***Point Style*** as well.

25. Move the cursor onto the ***Template Origin*** (the magenta square) so that the readout in the ***Dynamic Settings*** dialog box is ***X: 0.00 Y: 0.00***, then **<D>**.



26. In the ***Dynamic Settings*** dialog box, **<D>** in the ***Point Name*** field and key in ***Ditch-Bottom***.

27. Set the ***Point Style*** to **D-DITCH-Bottom**.

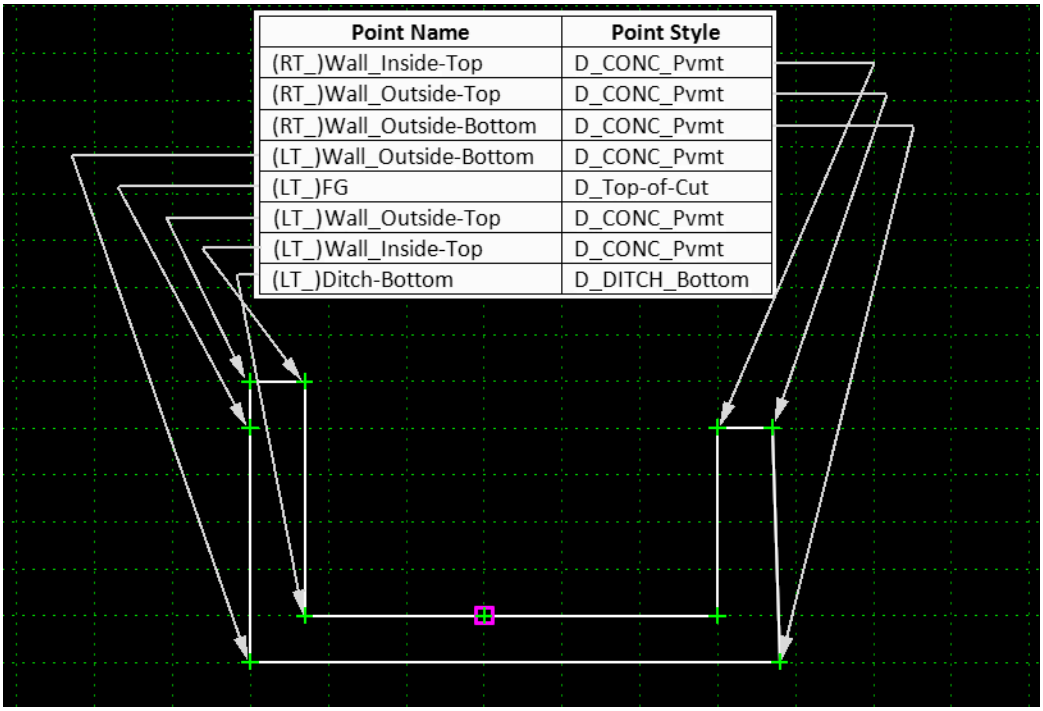
28. Move the cursor into the Template View to the right of the origin and **<D>** to place the ***RT_Ditch-Bottom*** point. The "***RT_***" is added to the name because ***Apply Affixes*** is on.

29. Key in ***Wall_Inside-Top*** for the next point.

30. Set the ***Point Style*** to **D_CONC_Pvmt**.

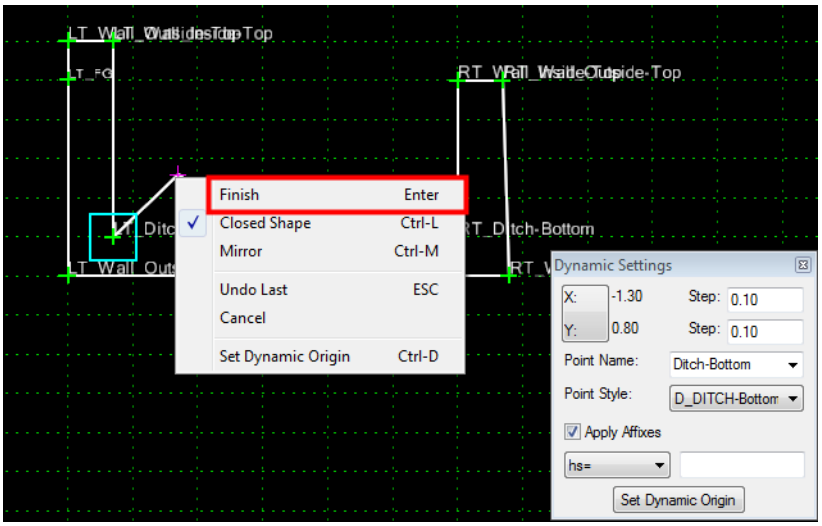
31. **<D>** above the ***RT_Ditch-Bottom*** point.

32. Use the diagram below to name and place the remaining points.



Point Name	Point Style
(RT_)Wall_Inside-Top	D_CONC_Pvmt
(RT_)Wall_Outside-Top	D_CONC_Pvmt
(RT_)Wall_Outside-Bottom	D_CONC_Pvmt
(LT_)Wall_Outside-Bottom	D_CONC_Pvmt
(LT_)FG	D_Top-of-Cut
(LT_)Wall_Outside-Top	D_CONC_Pvmt
(LT_)Wall_Inside-Top	D_CONC_Pvmt
(LT_)Ditch-Bottom	D_DITCH_Bottom

33. After the last point is placed, **<R>** in the Template View and select **Finish** from the right click menu.



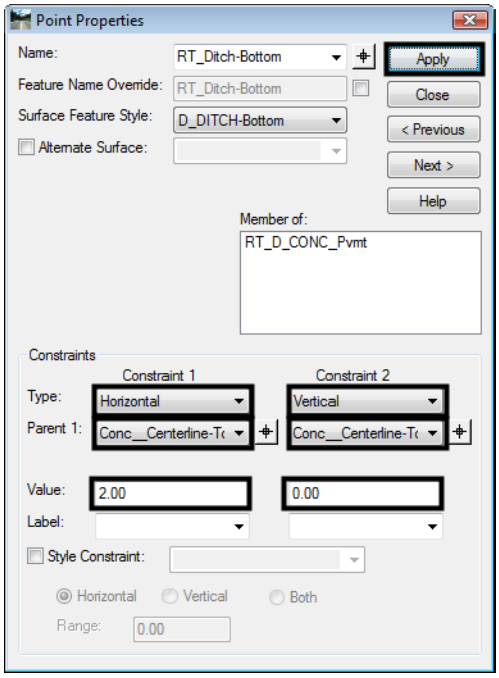
This completes the basic outline of the channel liner. Next, constraints are assigned to the point to form the exact shape desired.

34. **<D><D>** on the **RT_Ditch-Bottom** point. This displays the Point Properties dialog box.

35. In the ***Point Properties*** dialog box, set the ***Constraint 1 Type*** to **Horizontal**.

36. Set the ***Constraint 2 Type*** to **Vertical**.

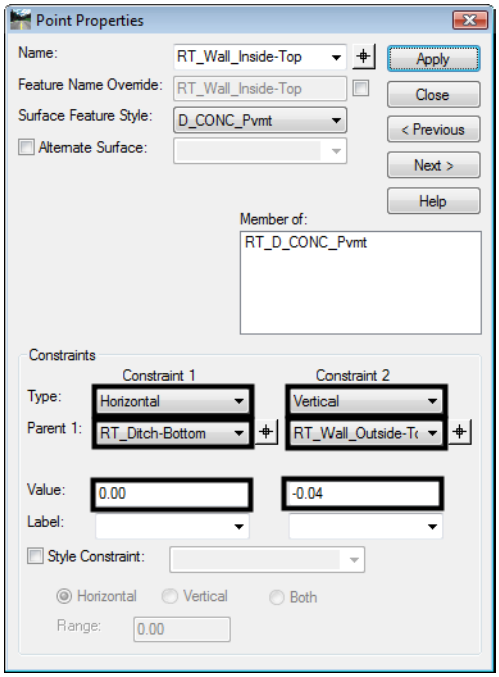
37. Set the ***Parent 1*** for both constraints to **Conc_Centerline-Top**.
38. Key in ***2.00*** for the ***Constraint 1 Value***.
39. Key in ***0.00*** for the ***Constraint 2 Value***.
40. **<D> Apply**.



The RT_Ditch-Bottom point symbol changes to red and the point move to be 2 feet to the right of the Conc_Centerline-Top point.

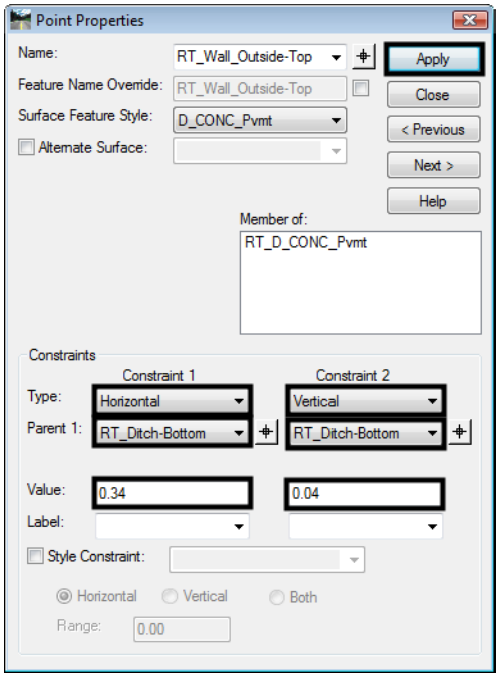
41. **<D> Next>** to move to the ***RT_Wall_Inside-Top*** point.
42. Set the ***Constraint 1 Type*** to **Horizontal**.
43. Set the ***Constraint 2 Type*** to **Vertical**.
44. Set the ***Parent 1*** for ***Constraint 1*** to ***RT_Ditch-Bottom***.
45. Set the ***Parent 2*** for ***Constraint 1*** to ***RT_Wall_Outside-Top***.
46. Key in ***0.00*** for the ***Constraint 1 Value***.
47. Key in ***-0.04*** for the ***Constraint 2 Value***.

48. **<D> Apply**.



49. **<D> Next>** to move to the ***RT_Wall_Outside-Top*** point.
50. Set the ***Constraint 1 Type*** to **Horizontal**.
51. Set the ***Constraint 2 Type*** to **Vertical**.
52. Set the ***Parent 1*** for both constraints to **RT_Ditch-Bottom**.
53. Key in ***0.34*** for the ***Constraint 1 Value***.
54. Key in ***0.04*** for the ***Constraint 2 Value***.

55. **<D> Apply**.



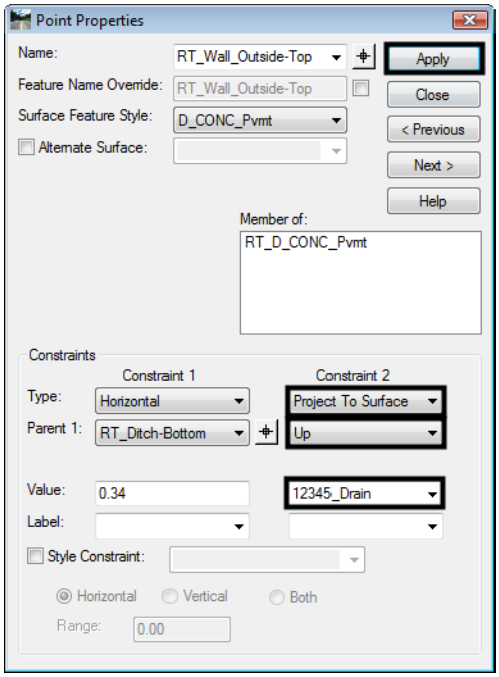
The Vertical constraint is temporary, in order to position the point. The final Constraint 2 is now set.

56. Set the ***Constraint 2 Type*** to **Project to Surface**.

57. Set the ***Parent 1*** for ***Constraint 2*** to **Up**.

58. Select **12345_Drain** for the ***Constraint 2 Value***.

59. **<D> Apply**.



60. **<D> Next>** to constrain the ***RT_Outside-Bottom*** point.
61. Set the ***Constraint 1 Type*** to **Horizontal**.
62. Set the ***Constraint 2 Type*** to **Vertical**.
63. Set the ***Parent 1*** for ***Constraint 1*** to **RT_Wall_Outside-Top**.
64. Set the ***Parent 1*** for ***Constraint 2*** to **RT_Ditch-Bottom**.
65. Key in ***0.00*** for the ***Constraint 1 Value***.
66. Key in ***-0.50*** for the ***Constraint 2 Value***.
67. **<D> Apply** then **<D> Next>** to constrain the ***LT_Outside-Bottom*** 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 **LT_Ditch-Bottom**.
71. Key in -***0.34*** for the ***Constraint 1 Value***.
72. Key in ***-0.50*** for the ***Constraint 2 Value***.
73. **<D> Apply** then **<D> Next>** to constrain the ***LT_FG*** point.

This point will also have a temporary vertical constraint to position the point then it will be changed to a Project to Surface constraint.

74. Set the ***Constraint 1 Type*** to **Horizontal**.

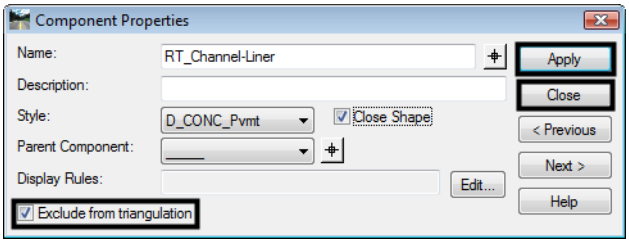
75. Set the ***Constraint 2 Type*** to **Vertical**.
76. Set the ***Parent 1*** for ***Constraint 1*** to **LT_Wall_Outside-Bottom**.
77. Set the ***Parent 1*** for ***Constraint 2*** to **LT_Ditch-Bottom.**
78. Key in ***0.00*** for the ***Constraint 1 Value***.
79. Key in ***0.00*** for the ***Constraint 2 Value***.
80. **<D> Apply**
81. Set the ***Constraint 2 Type*** to **Project to Surface**.
82. Set the ***Parent 1*** for ***Constraint 2*** to **Up**.
83. Select **12345_Drain** for the ***Constraint 2 Value***.
84. **<D> Apply** then **<D> Next>** to constrain the ***LT_Wall_Outside-Top*** point.
85. Set the ***Constraint 1 Type*** to **Horizontal**.
86. Set the ***Constraint 2 Type*** to **Vertical**.
87. Set the ***Parent 1*** for both constraints to **LT_FG**.
88. Key in ***0.00*** for the ***Constraint 1 Value***.
89. Key in ***0.50*** for the ***Constraint 2 Value***.
90. **<D> Apply** then **<D> Next>** to constrain the ***LT_Wall_Inside-Top*** point.
91. Set the ***Constraint 1 Type*** to **Horizontal**.
92. Set the ***Constraint 2 Type*** to **Vertical**.
93. Set the ***Parent 1*** for ***Constraint 1*** to **LT_Ditch-Bottom**.
94. Set the ***Parent 1*** for ***Constraint 2*** to **LT_Wall_Outside-Top.**
95. Key in ***0.00*** for the ***Constraint 1 Value***.
96. Key in -***0.04*** for the ***Constraint 2 Value***.
97. **<D> Apply** then **<D> Next>** to constrain the ***LT_Ditch-Bottom*** point.
98. In the ***Point Properties*** dialog box, set the ***Constraint 1 Type*** to **Horizontal**.
99. Set the ***Constraint 2 Type*** to **Vertical**.
100. Set the ***Parent 1*** for both constraints to **Conc_Centerline-Top**.
101. Key in -***2.00*** for the ***Constraint 1 Value***.
102. Key in ***0.00*** for the ***Constraint 2 Value***.
103. **<D> Apply**.

This completes the point editing for the channel liner component. To complete the component properties are edited. The component property to exclude the channel liner from triangulation will be turned on. This will allow the design surface to triangulate properly so that it represents the actual area of excavation on this project.

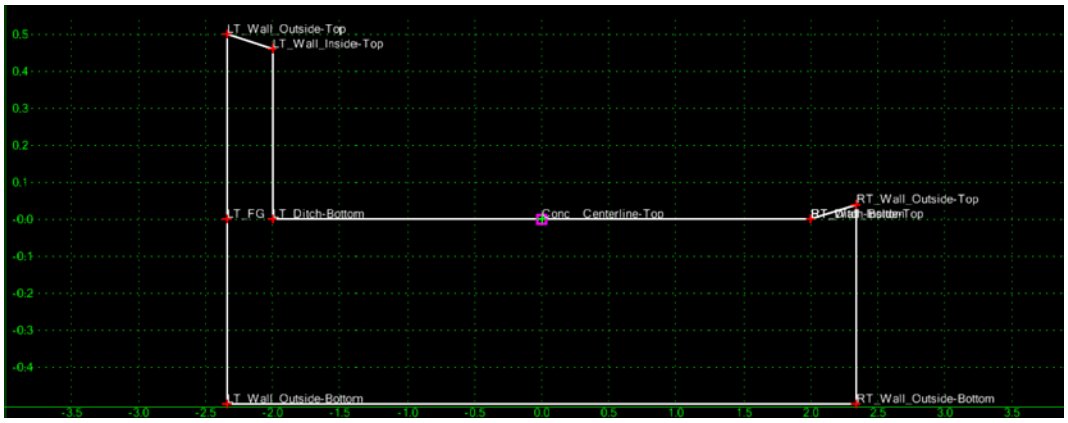
104. **<D><D>** on the line that makes up the channel liner. This displays the ***Component Properties*** dialog box for the channel liner.

105. In the ***Component Properties*** dialog box, toggle on **Exclude from triangulation**.

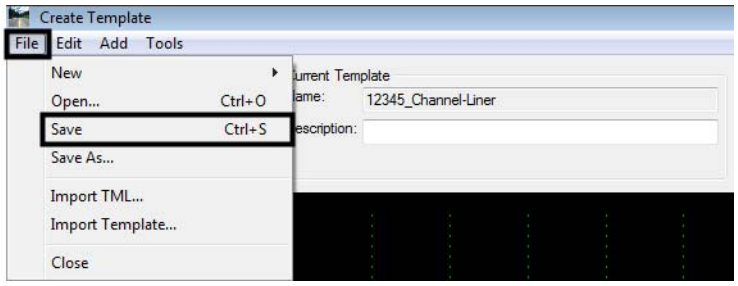
106. **<D> Apply** then **<D> Close**.



The channel liner points and component is still included in the dtm created later. They can still be included in the cross section display and have volume data calculated. However, the channel liner component will not affect the earthwork volume calculations.



107. Select **File > Save** from the Create Template menu bar.



Section Summary:

- Copying the standard template library is necessary because the standard template library is overwritten at login if it has been changed.

- Templates store the information used to create design dtms.
- A dtm can contain triangulated and untriangulated data.
- Point constraints locate points in relation to other points.
- The Project to Surface constraint is used to make the point follow the "target" surface.

Lab 4.2 - Create the Excavation Components

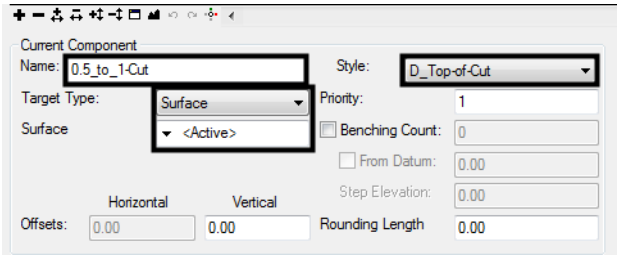
The Excavation components comprise the triangulated part of the template which will be used to compute earthwork volumes in a later lab. Two end condition components are used, the left one has a 2 to1 slope, the right one has a 0.5 to 1 slope.

Section Objectives:

- Build the two end condition components.
- Move a component to a new location.
- Test the template.

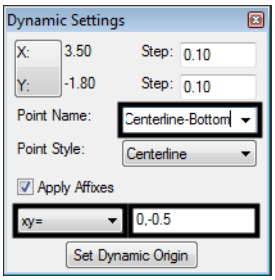
The first end condition component to be added is the right side end condition. It begins at the center bottom of the channel liner, runs to the RT_Wall_Outside-Bottom point, then up at a 0.5 to 1 slope to intercept the existing ground surface (12345_Drain).

1. **<R>** in the Template View of the Create Template dialog box and select **Add New Component > End Condition** from the right click menu.
2. In the ***Current Component*** area, Key in ***0.5_to_1-Cut*** in the ***Name*** field.
3. Set the ***Style*** to **D_Top-of-Cut**.
4. Verify that the ***Target Type*** is set to **Surface** and set the ***Surface*** to **12345_Drain**.



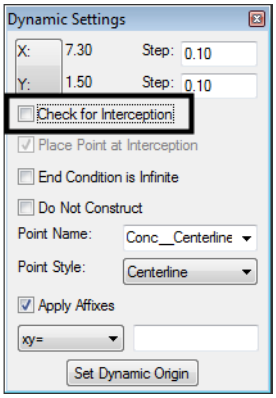
5. In the ***Dynamic Settings*** dialog box ***Point Name*** field, select **Conc_Centerline-Top**. Then edit the name to read ***Conc_Centerline-Bottom***.

6. Set the key in type to **XY=** and key in ***0,-0.5*** in the key in field. Then press the **Enter** key. This places the first point at the center bottom of the ditch liner.



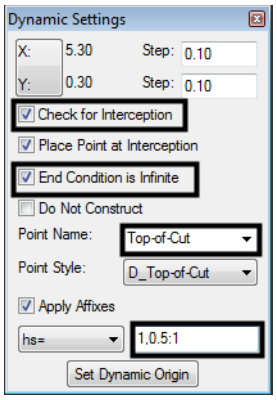
The next point is placed on top of the RT_Wall_Outside-Bottom point. The new point is merged with the existing point retaining the existing point's properties.

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



8. Move the cursor into the Template View and place it over the ***RT_Wall_Outside-Bottom*** point.
9. When the point symbol turns white, **<D>** to place the new point.
10. In the ***Dynamic Settings*** dialog box, toggle on **Check fo Interception**.
11. Toggle on **End Condition is Infinite**.
12. In the ***Point Name*** field, select **Top-of-Cut** from the drop down menu.

13. Set the key in type to **HS=** (horizontal distance and slope)and key in ***1,1:0.5*** in the key in field. Then press the **Enter** key.



14. **<R>** in the Template view and select **Finish** from the right click menu.

15. This completes the right end condition.

The left side end condition is added similarly to the right side. However, it cannot be placed directly on top of the existing points. If it were placed on to the existing points, the software would interpret them as part of a single end condition and the template would not function properly.

Therefore, the left end condition will be built in an open area then moved to its proper location.

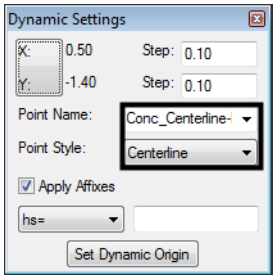
16. **<R>** in the Template View of the Create Template dialog box and select **Add New Component > End Condition** from the right click menu.

17. In the ***Current Component*** area, Key in ***2_to_1-Cut*** in the ***Name*** field.

18. Set the ***Style*** to **D_Top-of-Cut**.

19. Verify that the ***Target Type*** is set to **Surface** and set the ***Surface*** to **12345_Drain**.

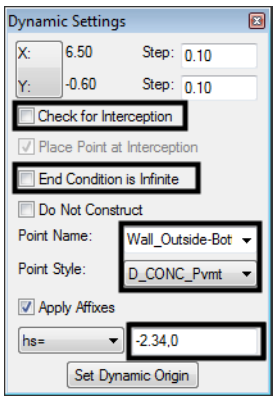
20. In the ***Dynamic Settings*** dialog box ***Point Name*** field, select **Conc_Centerline-Top**. Then edit the name to read ***Conc_Centerline-Bottom***.



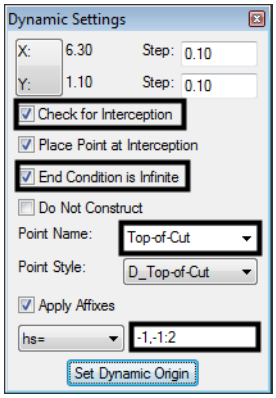
21. Move the cursor into an open area of the Template View, to the left of the origin, and **<D>** to place the new point.

22. In the ***Dynamic Settings*** dialog box, toggle off **Check for Interception** and **End Condition is Infinite**.

23. Key in ***Wall_Outside-Bottom*** for the ***Point Name***.
24. Select **D_Conc-Pvmt** for the ***Point Style***.
25. Verify that the key in type is set to **HS=** and key in ***-2.34,0*** in the key in field. Then press the **Enter** key. This creates the bottom under the channel liner.



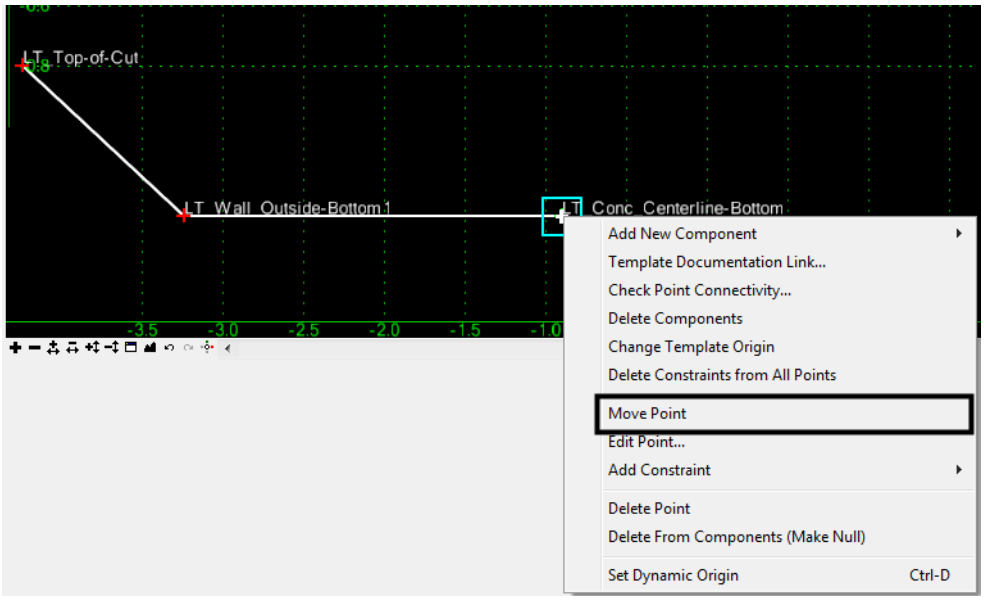
26. In the ***Dynamic Settings*** dialog box, toggle on **Check for Interception**.
27. Toggle on **End Condition is Infinite**.
28. In the ***Point Name*** field, select **Top-of-Cut** from the drop down menu.
29. Key in ***-1,-1:2*** in the key in field. Then press the **Enter** key.



30. **<R>** in the Template view and select **Finish** from the right click menu.

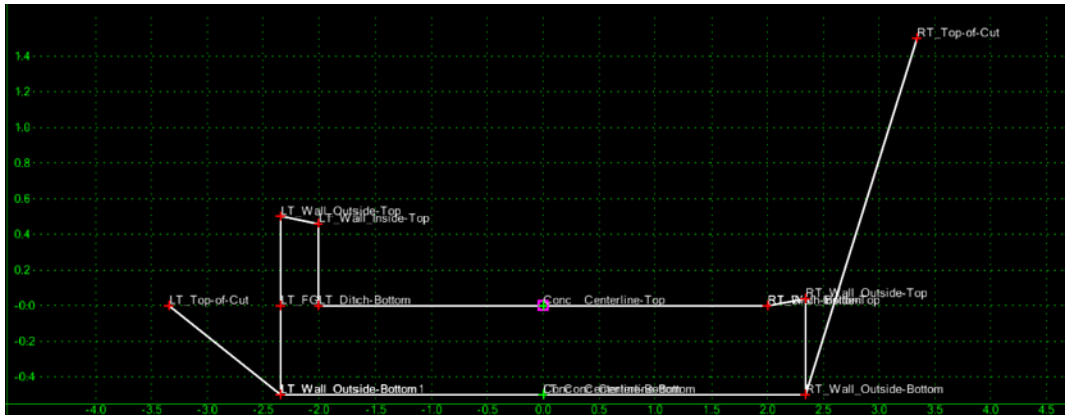
This completes the left end condition. Now it is moved to its proper location.

31. **<R>** on the **LT_Conc_Centerline-Bottom** point and select **Move Point** from the right click menu.



32. Move the cursor (and the component) on to the ***Conc_Centerline-Bottom*** point and **<D>** to move the left end condition to its proper location.

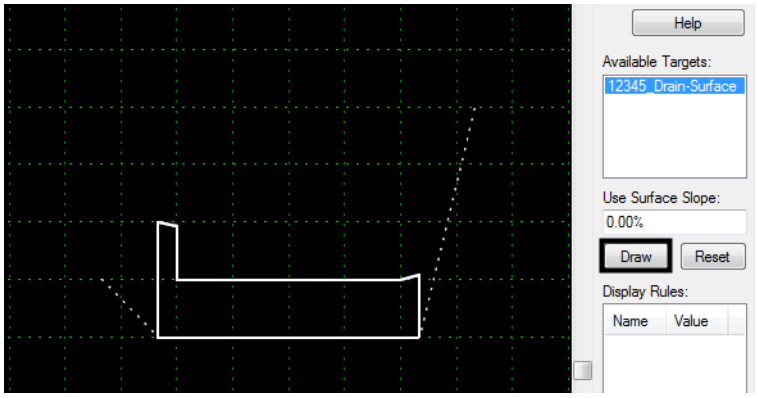
This completes this portion of the template. The illustration below shows the template at this stage.



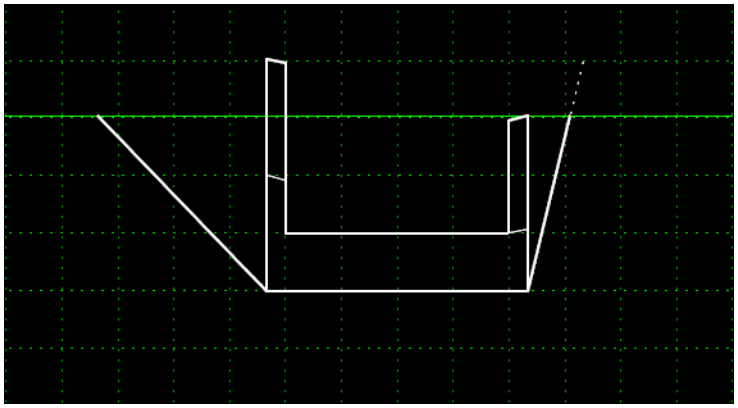
The template can now be tested to see how it will perform in a corridor.

33. **<D>** the **Test** button under the right corner of the Template View. This displays the ***Test End Conditions*** dialog box.

34. **<D>** the **Draw** button.



35. Move the cursor up and down in the view area. Notice that the walls of the liner and the cut slopes extend up to meet the ground line so long as it is above the inside bottom of the liner.



36. **<D> Close** to dismiss the ***Test End Conditions*** dialog box.

37. Select **File > Save** from the Create Template menu bar.

Section Summary:

- End conditions are special components that do not use a constraint to intercept a surface.
- End conditions that share a common starting point are considered a single component and only one of the lines will be used.
- To create two end conditions that start at the same point, the second component must be created in a different location then moved to the correct spot.
- Test templates with end conditions to be sure they behave as expected prior to using them in a corridor.

Lab 4.3 - Adding Backfill Components

The final components for the template are the backfill components. These are used to calculate the the volume of embankment material used to fill in the trench excavation behind the channel liner. These components will not be used to create the triangulated surface, but can still be displayed in cross sections and have volumes calculated for them.

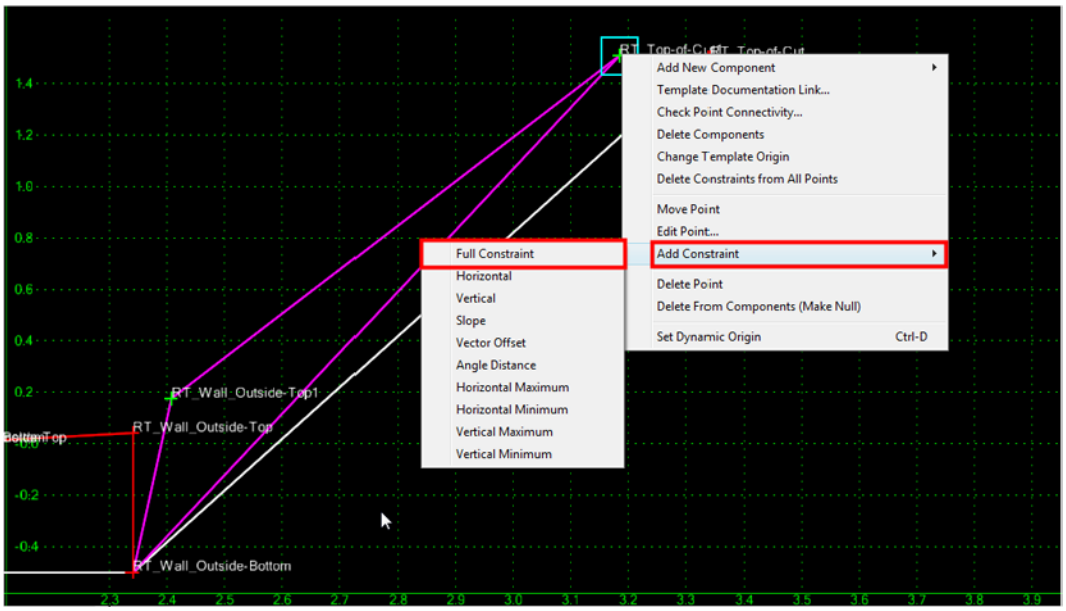
Section Objectives:

- Add Backfill components

1. **<R>** in the Template View of the Create Template dialog box and select **Add New Component > Unconstrained** from the right click menu.
2. In the ***Current Component*** area, key in ***Backfill*** for the ***Name***.
3. Select **D_SHOULDER-Embankment** for the ***Style***.

4. **<D>** on the ***RT_Wall_Outside-Bottom*** point.
5. In the ***Dynamic Settings*** dialog box, select **Top-of-Cut** for the ***Point Name***.
6. **<D>** in an open area near the ***RT_Top-of-Cut*** point.
7. In the ***Dynamic Settings*** dialog box, key in ***Wall_Outside-Top***.
8. Set the ***Point Style*** to **D_CONC_Pvmt**.
9. **<D>** in an open area near the ***RT_Wall_Outside-Top*** point.
10. **<R>** and select **Finish** from the right click menu.

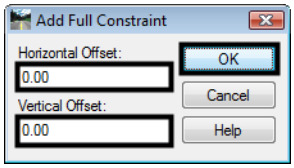
11. **<R>** on the **RT_Top-of-Cut1** point and select **Add Constraint > Full Constraint** from the right click menu.



12. **<D>** on the **RT_Top-of-Cut** point to identify it as the parent.

13. In the ***Add Full Constraint*** dialog box, key in ***0.00*** for the values of both the ***Horizontal Offset*** and ***Vertical Offset***.

14. **<D> OK**.



15. Repeat steps 11 through 14 for the **RT_Wall_Outside-Top1** point, using ***RT_Wall_Outside-Top*** as the parent.

Placing the backfill points directly on top of the existing points would cause the line between RT_Wall_Outside-Top and RT_Top-of-Cut to match the existing ground instead of creating a single segment between the two points.

The steps to create the left side backfill are the same as those above.

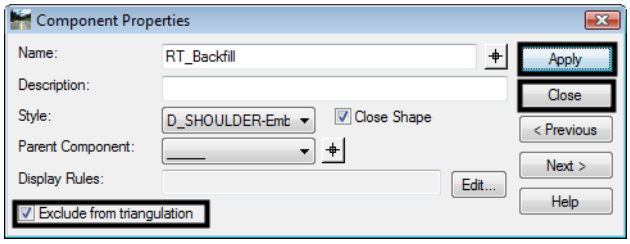
16. Repeat steps 1 through 15 for the left side, using the corresponding points from the left of the existing template.

The final step to complete the template is to exclude the backfill components from triangulation.

17. **<D><D>** on the **RT_Backfill** component line. This displays the ***Component Properties*** dialog box.

18. Toggle on **Exclude from triangulation**.

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



20. Repeat steps 11 through 13 for the **LT_Backfill** component.
21. Select **File > Save** from the Create Template menu bar.
22. **<D> Close** on the Create Template dialog dox to dismiss the window.

This completes the template. It is now ready to use to create a design surface model (dtm).

Section Summary:

- Points added on top of other points do not have to be defined in the dynamic Settings dialog box.
- Points added on top of other points are merged with the existing points and take on the properties already defined.

Lab 4.4 - Creating the Corridor for the Channel

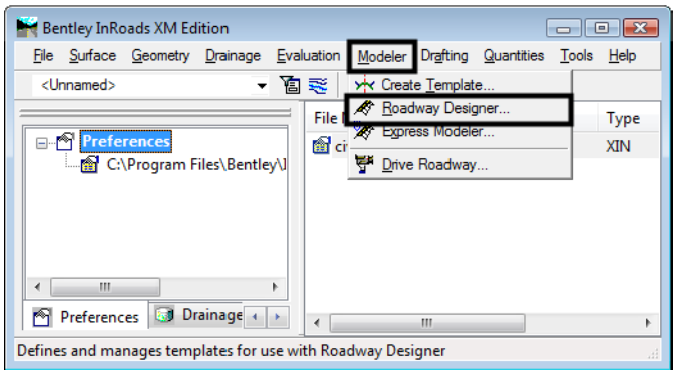
With the completed template and the horizontal and vertical alignments from a previous lab, a corridor can be defined that is used to create the design surface model. A corridor contains two basic parts: a path over the existing terrain, and a typical section of the design. In this example, a horizontal and vertical alignment define the path of the corridor and the template built above defines the typical section.

Section Objectives:

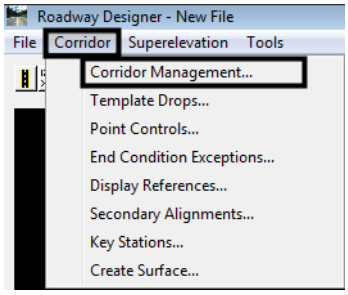
- Create a corridor base on a horizontal and vertical alignment.
- Add a template drop to the corridor.
- Review the corridor in Roadway Designer.
- Create a design surface from the corridor.

The first step in creating a design surface is to create the corridor.

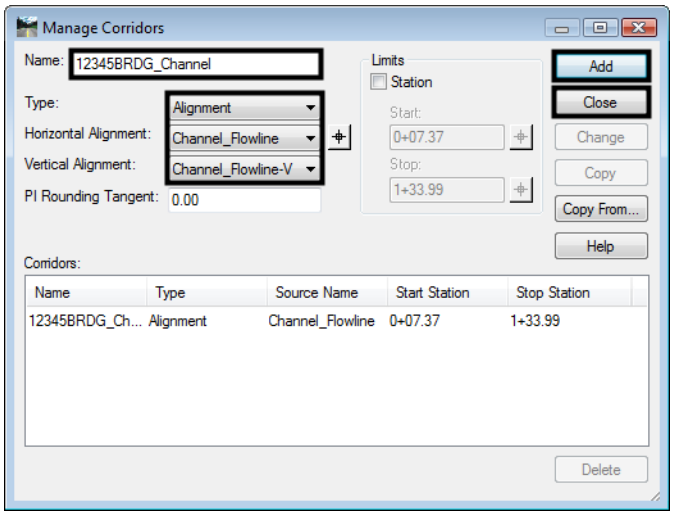
1. Select **Modeler > Roadway Designer** from the InRoads menu bar. This displays the ***Roadway Designer*** dialog box.



2. From the ***Roadway Designer*** menu bar, select **Corridor > Corridor Management** or select the corridor management button from the button bar.

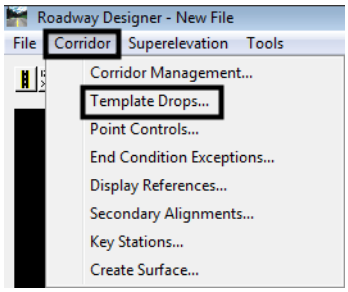


3. In the ***Manage Corridors*** dislog box, key in ***12345BRDG_Channel*** for the ***Name***.
4. Verify that the ***Type*** is set to **Alignment**.
5. Verify that **Channel _Flowline** is set for the ***Horizontal Alignment***.
6. **<D> Add** the **<D> Close** to dismiss the ***Manage Corridors*** dialog box.

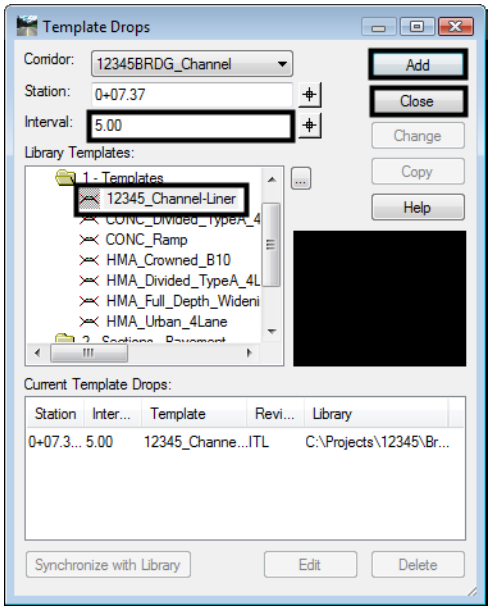


Next, the template drop is added to the corridor.

7. Select **Corridor > Template Drops** from the ***Roadway Designer*** menu bar of **<D>** the Template Drops button from the button bar.

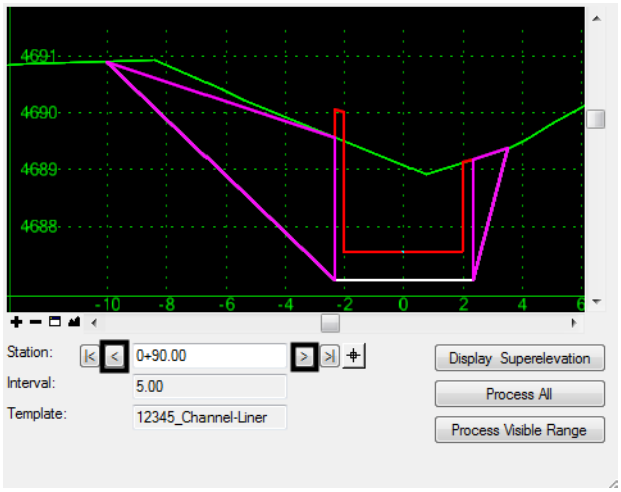


8. In the Template Drops dialog box, key in 5.00 for the Interval.
9. Expand the folder in the ***Library Templates*** area to show the contents of the **1-Templates** folder.
10. Highlight the **12345_Channel-Liner** template then **<D> Add**.
11. **<D> Close** to dismiss the ***Template Drops*** dialog box.



Notice that the template is now displayed in the template view of the Roadway Designer dialog box. The design can now be reviewed in Roadway Designer.

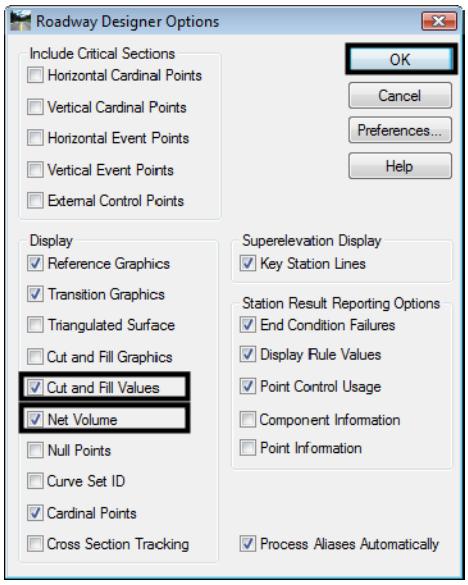
12. Use the station indicator arrows to move back and forth through the design corridor. The sideslopes should tie to the existing ground and the design channel flowline should be at or very near the existing flowline athe the beginning and end of the corridor.



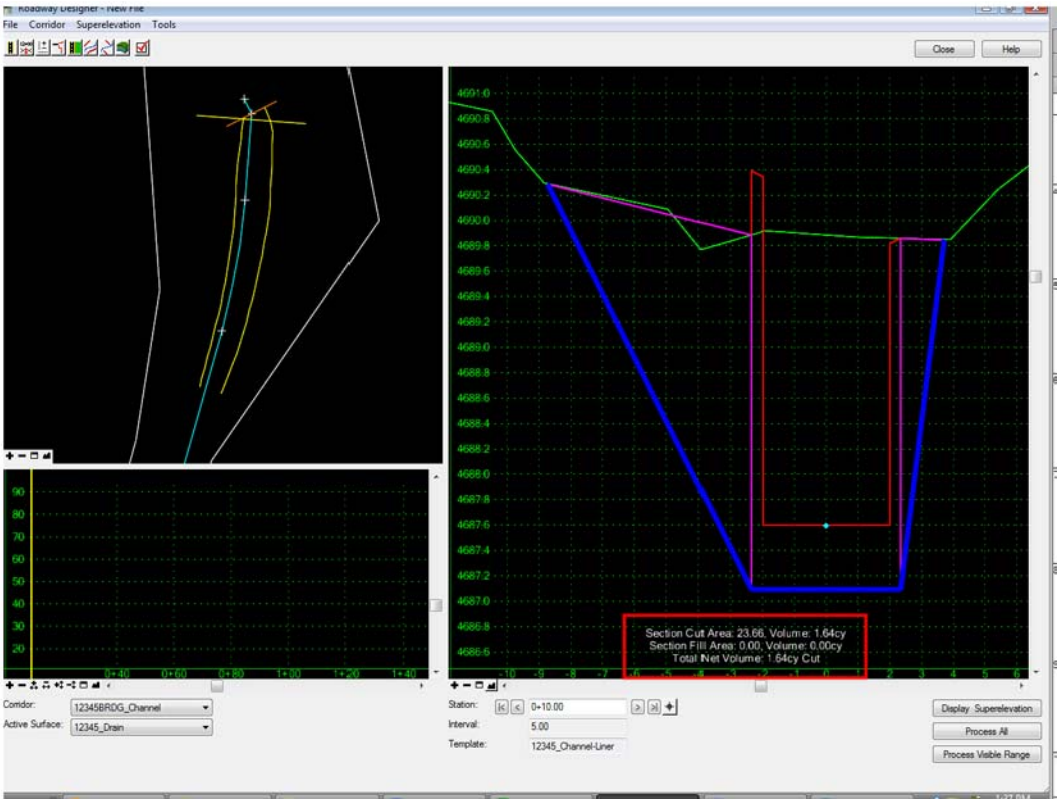
13. Select **Tool > Options** from the Roadway Designer menu bar. The Roadway Designer Options dialog box is used to turn on or off various design data displays.

14. Toggle on **Cut and Fill Values** and **Net Volume**.

15. **<D> OK**.

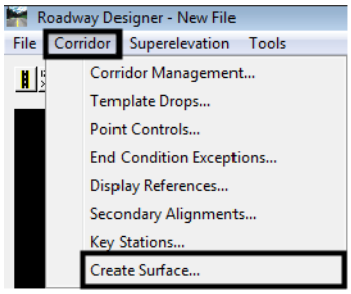


16. Scroll through the corridor again. Notice the cut and fill volume data displayed at the bottom of the template view.



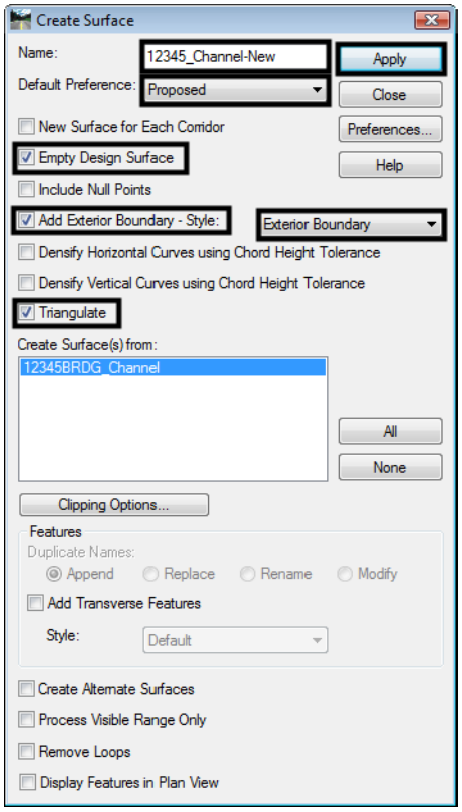
Finally, a surface (dtm) is created from the corridor. With a design surface, annotated cross sections can be created for plan sets and various volume reports can be generated.

17. Select **Corridor > Create Surface** from the Roadway Designer menu bar of **<D>** the create surface button from the button bar.



18. In the ***Create Surface*** dialog box, key in ***12345_Channel-New*** for the ***Name***.
19. Select **Proposed** for the ***Default Preference***.
20. Toggle on **Empty Design Surface**, **Add Exterior Boundary**, and **Triangulate**.
21. Select **Exterior Boundary** for the boundary's ***Style***.

22. **<D> Apply**. This creates the design surface.

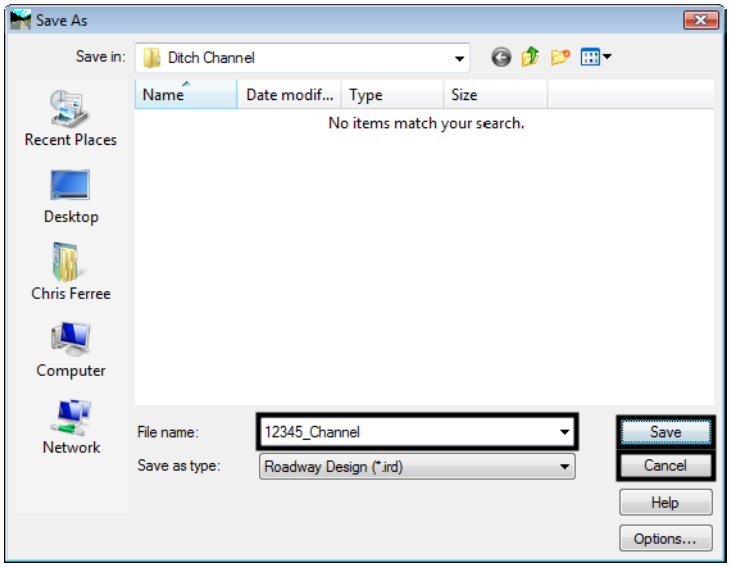


23. **<D> Close** to dismiss the ***Create Surface*** dialog bix.

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

25. In the ***Save As*** dialog box, navigate to the **C:\Projects\12345\Bridge\InRoads** directory.

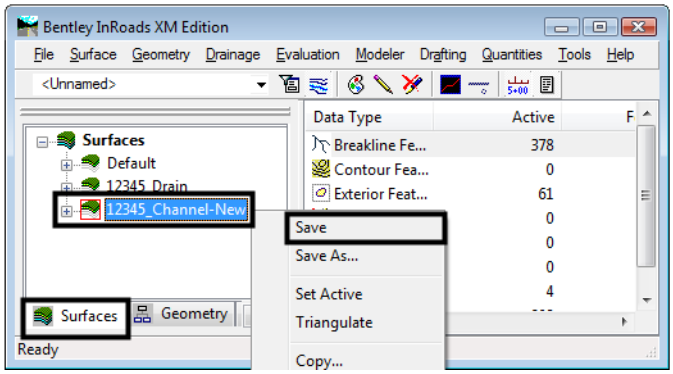
26. Key in ***12345_Channel*** for the ***File name***.



27. **<D> Close** on the ***Roadway Designer*** dialog dox to dismiss the window.

28. In the InRoads Explorer, **<D>** the **Surfaces** tab at the bottom.

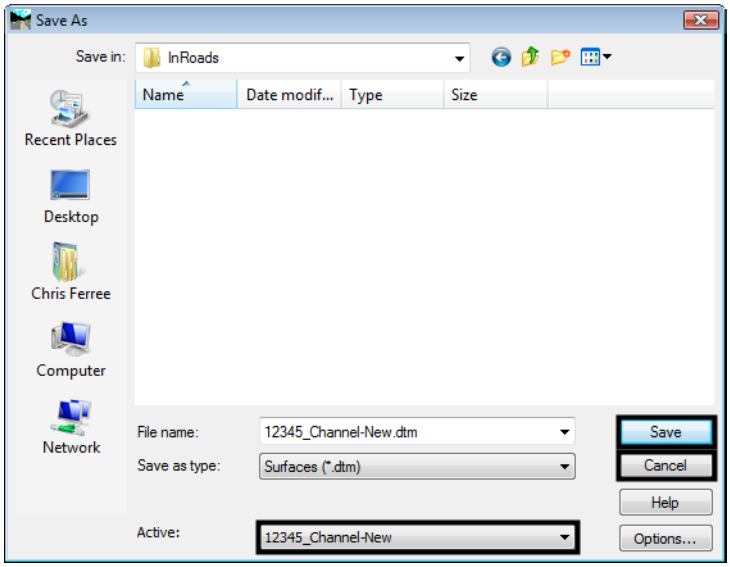
29. **<R>** on the **12345_Channel-New** surface and select **Save** from the menu.



30. In the ***Save As*** dialog box, navigate to the **C:\Projects\12345\Bridge\InRoads** directory.

31. Use the ***Active*** drop down menu and select **12345_Channel-New**. This places the surface's name in the ***File name*** field.

32. **<D> Save** then **<D> Cancel** to dismiss the dialog box.



The design surface is now ready for use generating cross sections, volumes, and reports.

Section Summary:

- Corridors are most commonly created along horizontal and vertical alignments.
- The origin of the template follows the corridor path (horizontal and vertical alignment or surface feature).
- Template Drops define which template is used and how often it is applied.
- Once the corridor and templated drops are defined, the design can be reviewed and edited in the Roadway Designer dialog box.
- A design surface (dtm), based on the corridor and templated drops, can be created from Roadway Designer.

Chapter Summary:

- Templates and corridors are used to create a design surface (dtm) of roughly parallel features.
- Templates define the “typical section” of the design surface.
- Templates are defined by points. Points are located using offsets from other points known as constraints.
- Acomponent is a series of related points that define the area of a specific material.
- Components are included in the design dtm, but do not have to make up the triangulated model.
- Corridors define the path, in relation to the existing ground, that the template will follow.
- The design model can be reviewed and edited in the Roadway Designer dialog box prior to creating a dtm.

LAB 5 - Evaluating Clearances and Conflicts

This section covers how to evaluate design data for minimum clearances. Alignments, Surfaces and Features will be used in the evaluation. Since the alignments and surfaces represent finished grade elevation, the depth of the bridge structure must be taken into account as well.

Chapter Objectives:

- Learn to find the minimum clearance between crossing vertical alignments.
- Learn some of the tools available for finding areas with potential clearance issues.
- Learn how to use MicroStation along with feature graphics to check clearances.

The following files are used in this lab:

- C:\Projects\12345\Bridge\Working \CU12345BRDG_Model.dgn
- C:\Workspace\Workspace-CDOT_XM\Standards-Global\InRoads\Preferences\ CDOT_Civil.xin
- C:\Projects\12345\Design\InRoads\12345 SH119
- C:\Projects\12345\Design\InRoads\12345 SH52
- C:\Projects\12345\Design\InRoads\12345 SH119 SH52 Interchange.alg
- C:\Workspace\Workspace-CDOT_XM\Standards-Global\InRoads\Templates\ CDOT_Template-Library.itl

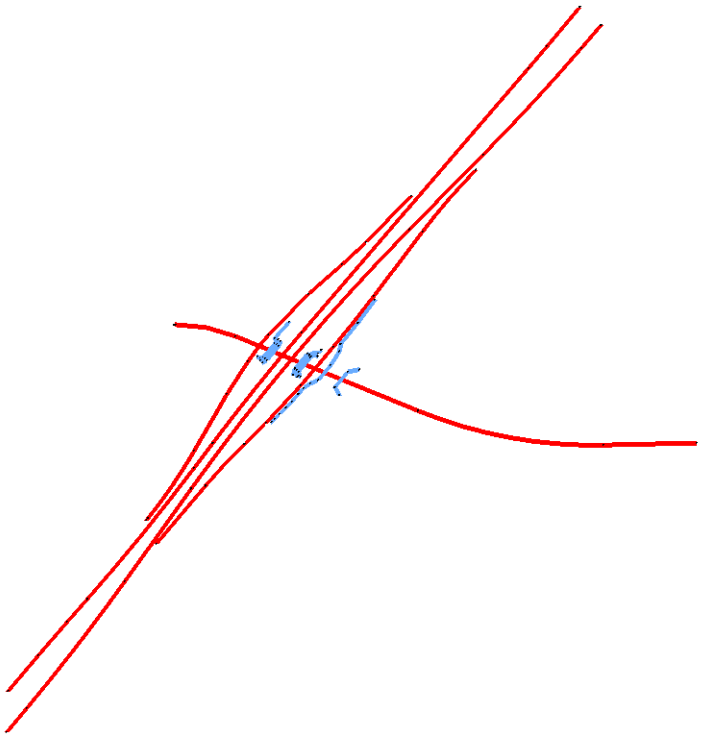
Lab 5.1 - Open Data Files

1. Open MicroStation and InRoads using the ***C:\Projects\12345\Bridge\Working \CU12345BRDG_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***, ***12345 SH52*** and ***12345 SH119 SH52 Interchange.alg***.

Lab 5.2 - Intersecting Alignment Reports

1. Delete any MicroStation graphics currently in the design file.

2. Select **Geometry > View Geometry > All Horizontals**.

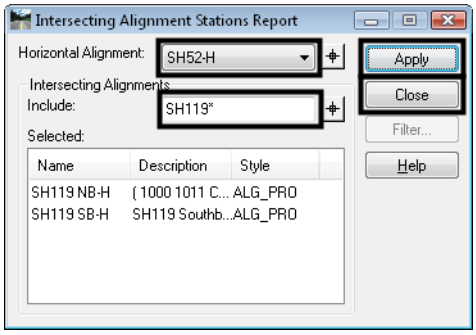


3. Select **Tools > XML Reports > Intersecting Alignment Stations**.

   Note: This report returns the stationing of both intersecting alignments, along with the coordinates of the intersection and the elevation difference between the two active verticals.

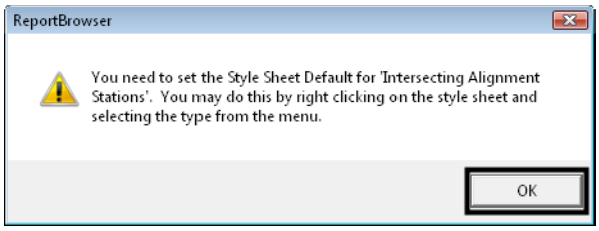
4. For the ***Horizontal Alignment***, select ***SH52-H***.

5. For the ***Intersecting Alignments***, key in ***SH119**** to select both NB and SB.

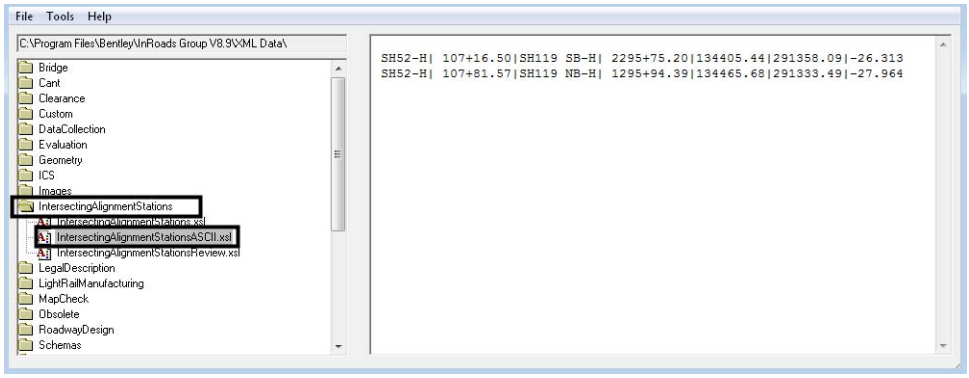


6. Select **Apply**.

7. If the default style sheet has not been set for this report, a Report Browser message will appear. Select **OK** if it does.



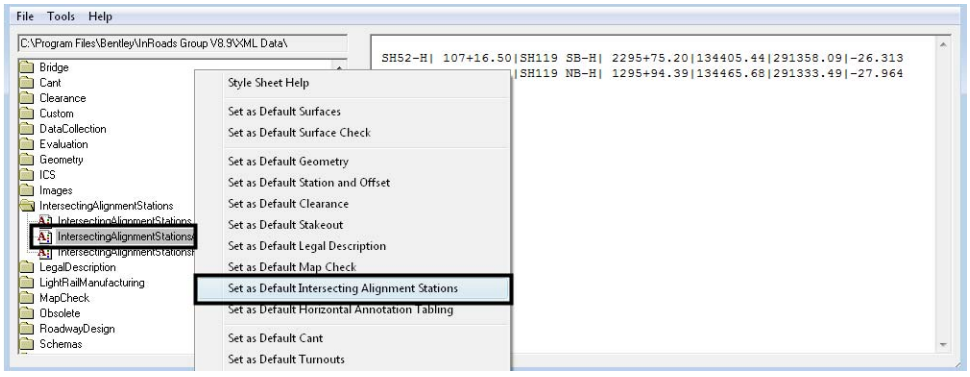
8. Select the ***IntersectingAlignmentStations*** > ***IntersectingAlignmentStationsASCII*** report format.



Note: This report lists the stationing of each of the crossing alignments, along with the coordinates of the crossing point and the elevation difference. The report can be printed or saved as a text file if desired.

Important! The last active vertical alignment under each horizontal is used to determine the vertical clearance. In this case, each horizontal has only one vertical, so it is not a concern.

9. Right-click on the format and select ***Set as Default Intersecting Alignment Stations***.



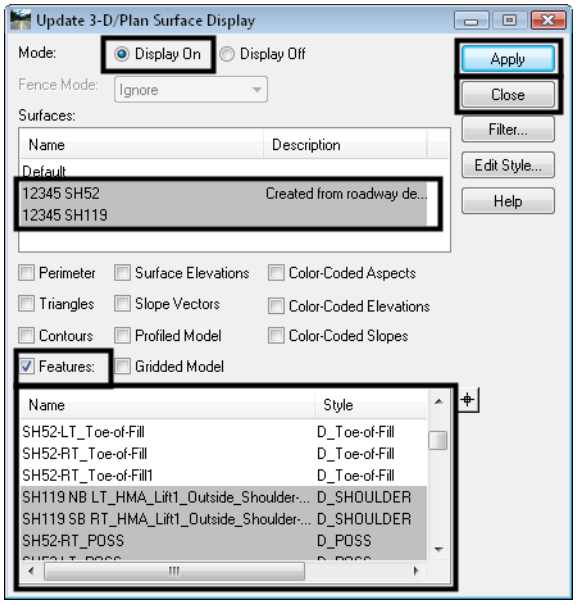
10. Close the ***Report*** dialog.

If this report is needed at all feature intersections rather than only at the centerline intersections, the following steps may be used.

11. **Close** the ***Intersection Alignment Stations Report*** dialog.
12. **Delete** all the alignment graphics.
13. Toggle on the **Feature Filter Lock**.
14. Set the ***Feature Filter*** to ***XS_Excluded from Triangulation***.

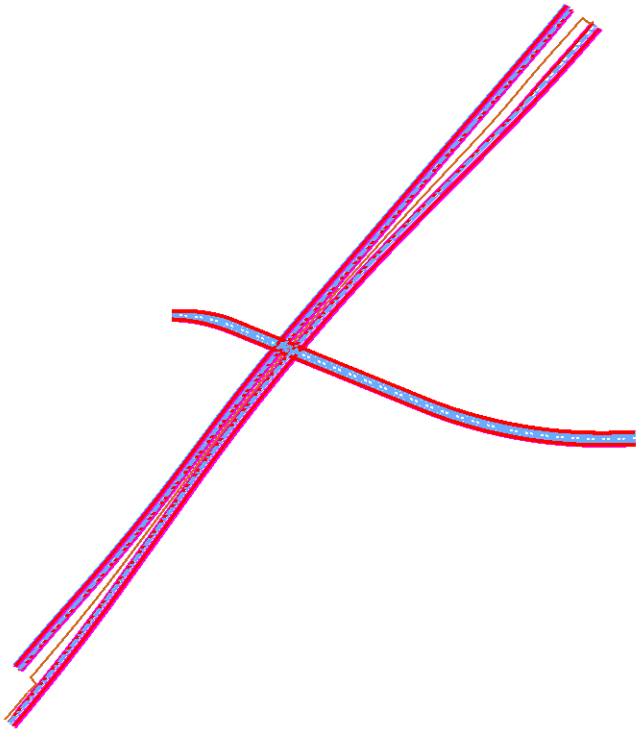
Note: This filter allows only triangulated features to show in dialog boxes. In the next step, the features for SH52 are displayed and the non-triangulated features are not needed.

15. Select **Surface > Update 3D Plan/Surface Display**.
16. Toggle ***Display On***.
17. Highlight the surfaces ***12345 SH52*** and ***12345 SH119***.
18. Toggle on ***Features***.
19. In the feature list, right-click and ***Select All***.
20. **<D>** on the ***Style*** header to sort by style name.
21. Holding down your <***Ctrl***> key, **<D>** on all the ***Cut*** and ***Fill*** Features, the ***Exterior*** and the ***3:1 Slope*** features to de-select them. All other features should be highlighted.



Note: Some of the features are de-selected because for the next series of steps, you only want the backbone features displayed.

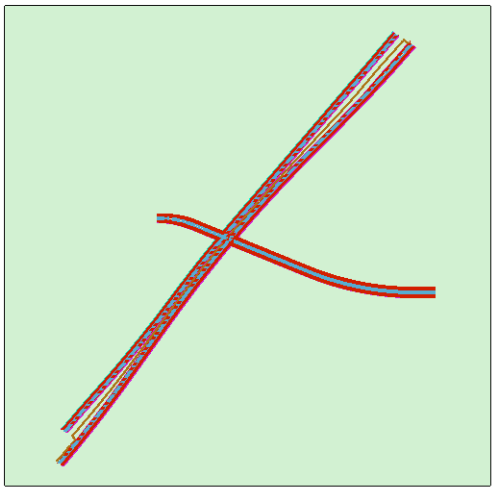
22. **<D> Apply**.



Note: The features should be displayed in the file as shown. If not, try the previous steps again.

23. **Close Update 3D Plan/Surface Display**.

24. Select MicroStation **Place Fence** and place a fence around all of the features.



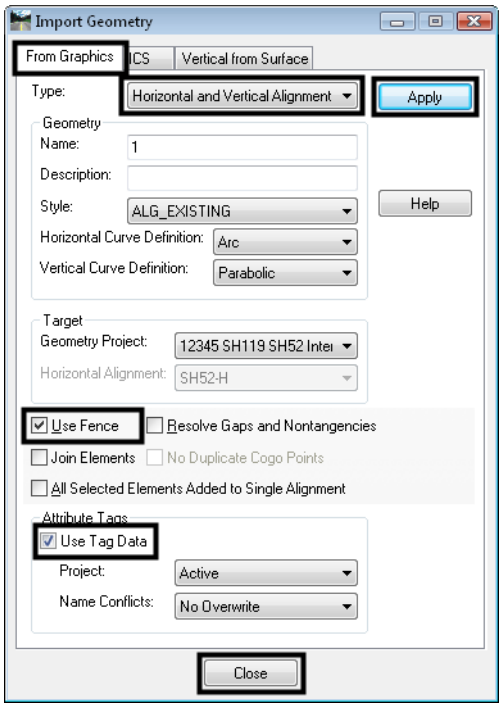
25. Select **File > Import > Geometry**.

26. On the ***From Graphics*** tab, select ***Horizontal and Vertical Alignment*** for the ***Type***.

27. Verify the ***Target Geometry Project*** is ***12345 SH119 SH52 Interchange***.

28. Toggle on ***Use Fence***.

29. Toggle on ***Use Tag Data***.



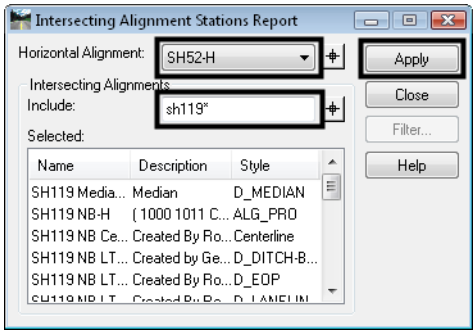
30. **<D> Apply**.

Note: All of the graphics in the fence are imported as alignment. Since they were displayed as features and have tags, the alignments are named the same as the feature names.

31. Select **Tools > XML Reports > Intersection Alignment Stations**.

32. For the ***Horizontal Alignment***, select ***SH52-H***.

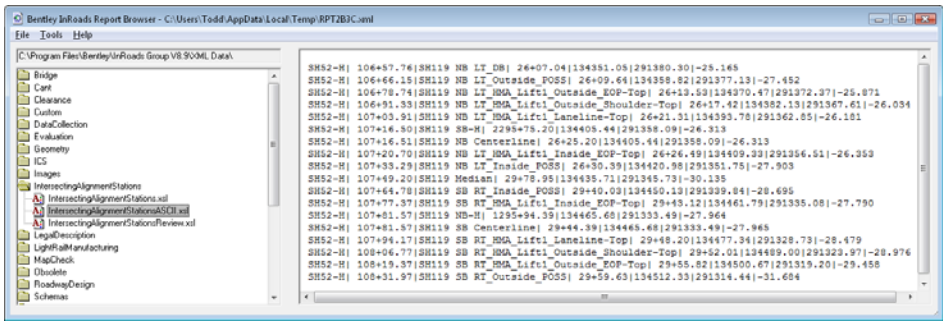
33. For the ***Intersecting Alignments***, key in ***SH119**** to select all of the crossing alignments.



34. **<D> Apply**.

Note: When an alignment is imported from graphics, the default stationing begins with 0+00.00, so the stations shown for the imported alignments do not correspond with the actual stationing.

35. **Close** the ***Report*** dialog when finished reviewing the data.

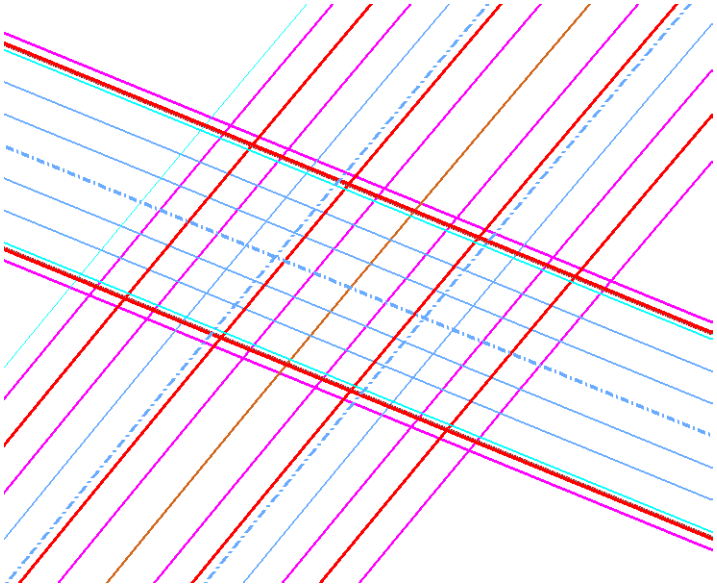


36. **Close** the ***Intersection Alignment Stations Report*** dialog.

37. Select the MicroStation **Place Fence** command to clear the fence.

Lab 5.3 - MicroStation Measurements

1. Zoom into the bridge area.



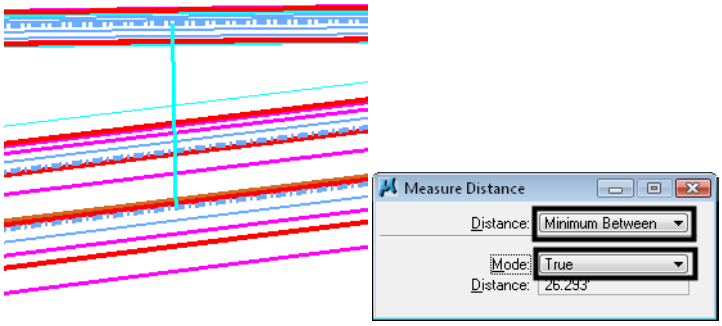
2. On the MicroStation menu, select **Measure Distance**.

3. Set the ***Distance*** to ***Minimum Between***.

4. Set the ***Mode*** to ***True***.

5. **<D>** on one of the SH52 Features.

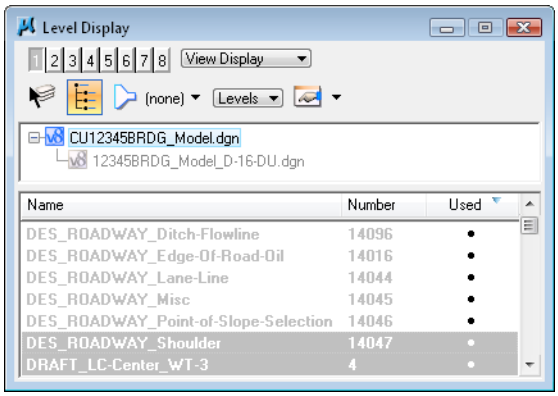
6. **<D>** on one of the SH119 Features.

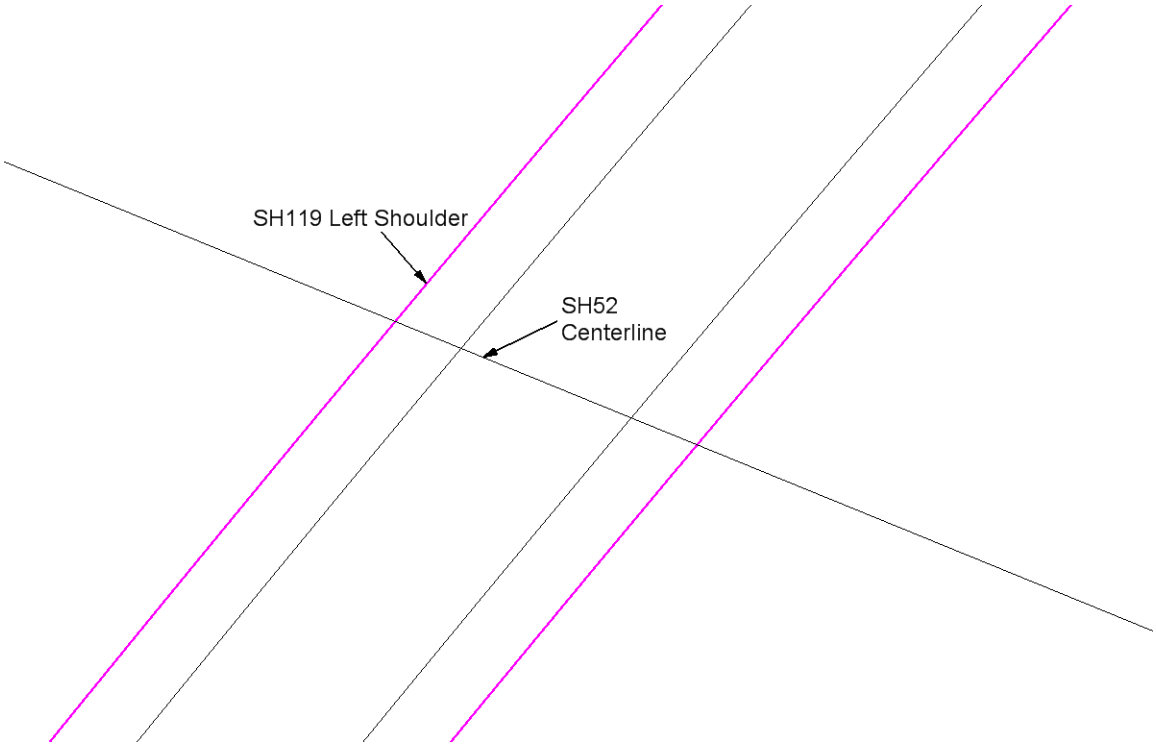


Note: The ***Minimum Distance*** between the features is the vertical clearance.

If you want to check the minimum clearance between the shoulder and the edge of girder, you will need a MicroStation graphic representing the girder placed at the correct 3D location in the file. There are several methods for obtaining the girder element. One method is to use the ***View 3D Alignment*** command in InRoads. This command combines the horizontal and vertical alignment to create a 3D MicroStation element. You can use this command to view the centerline of SH52 and apply the correct offsets for any of the girders.

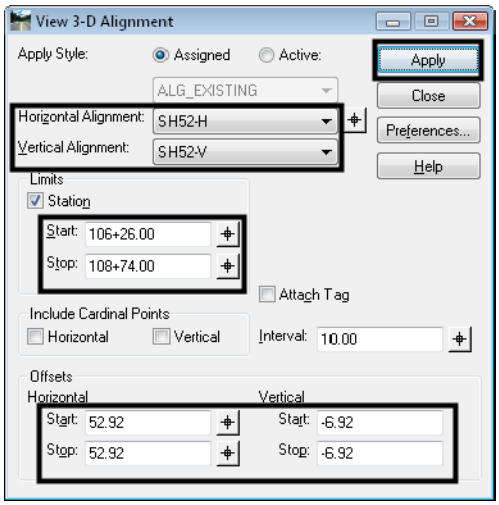
7. Turn off all levels except ***DES_Roadway_Shoulder*** (the SH119 shoulder lines) and ***DRAFT_LC-Center_WT-3*** (roadway centerlines).





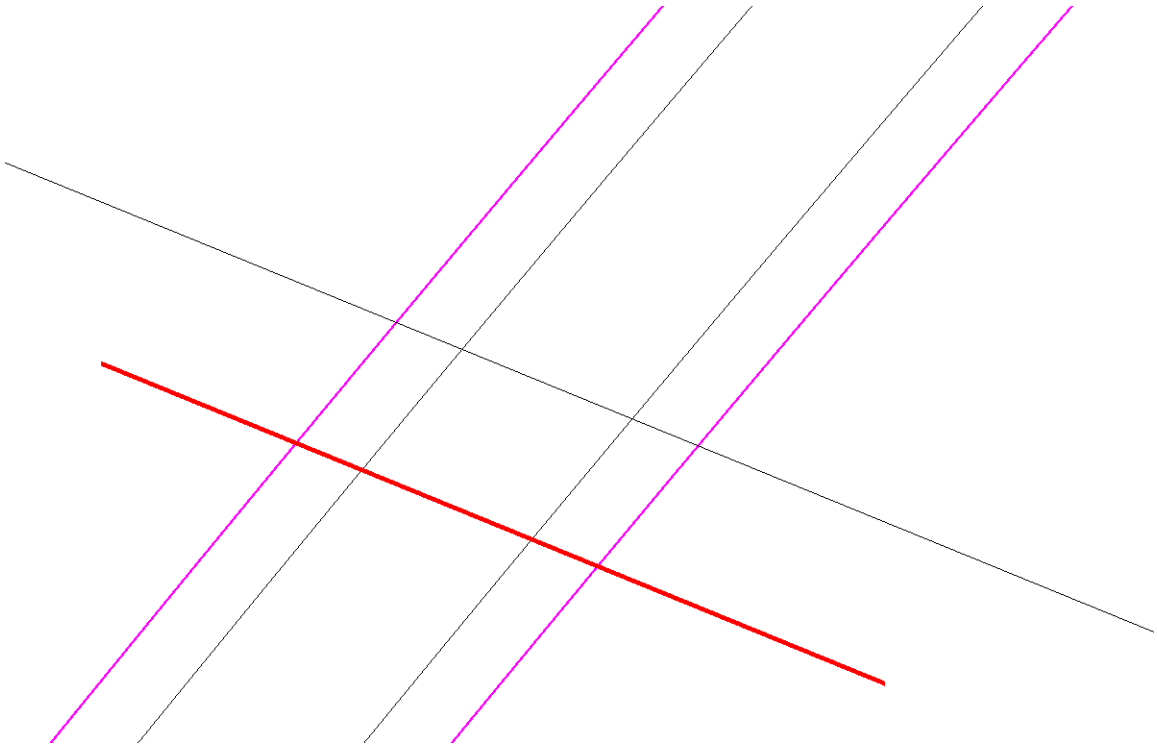
8. Select **Geometry > View Geometry > 3D Alignment**.
9. Set ***Horizontal Alignment*** to ***SH52-H*** and ***Vertical Alignment*** to ***SH52-V***.
10. In the ***Limits*** section, key in ***106+00*** for the ***Start*** station limit and ***109+00*** for the ***Stop*** station limit.

11. In the ***Offsets*** section, key in ***52.92*** for ***Horizontal Start*** and ***Stop***. Key in ***-6.92*** for the ***Vertical Start*** and ***Stop***.



Note: For this bridge, there are 5 girders on each side of the centerline spaced at 10'-7" on center, making the outmost girder a horizontal offset of 52.92 feet from the centerline. The vertical offset to the bottom of the girder is 6.92 feet.

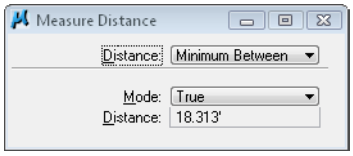
12. **<D> Apply**, then **Close**.



Note: The red line represents the outermost girder on the right side of the SH52 and placed in the file at the correct horizontal and vertical offset from the centerline.

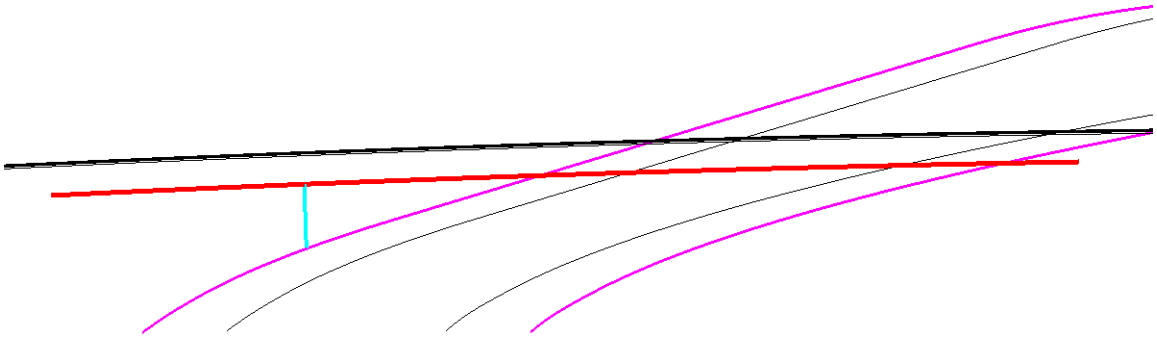
13. On the MicroStation menu, select **Measure Distance**.

14. Set the ***Distance*** to ***Minimum Between***.
15. Set the ***Mode*** to ***True***.
16. **<D>** on one of the SH52 girder (red line).
17. **<D>** on one of the SH119 left shoulder (left purple line).



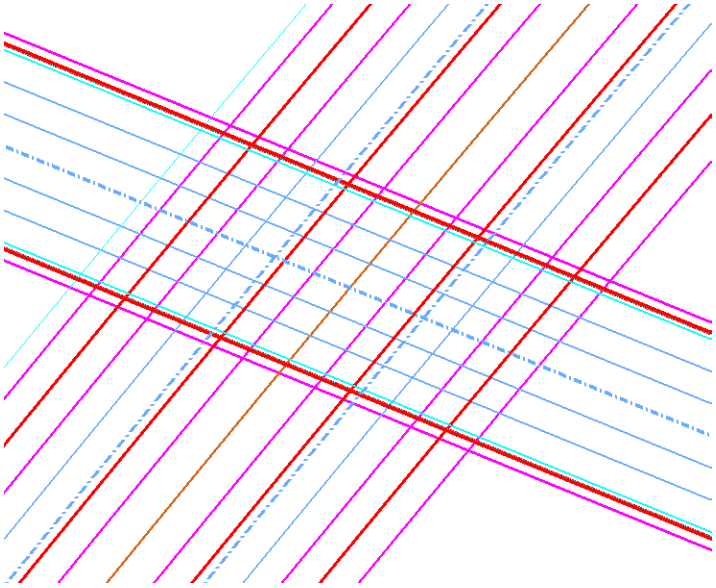
Note: The minimum vertical distance from the girder to the shoulder is displayed in the tool settings box.

18. If you like, you can dynamically rotate your view to get a dynamic display (blue line) of where the minimum distance occurs.



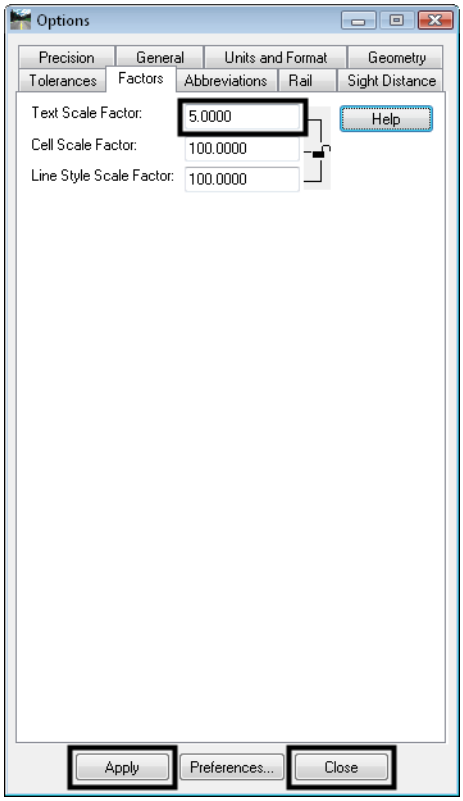
19. If you rotated your view, rotate the view back to ***Top***.
20. **Delete** the girder element (red line).

21. Turn on all levels to view all SH52 and SH119 roadway features.

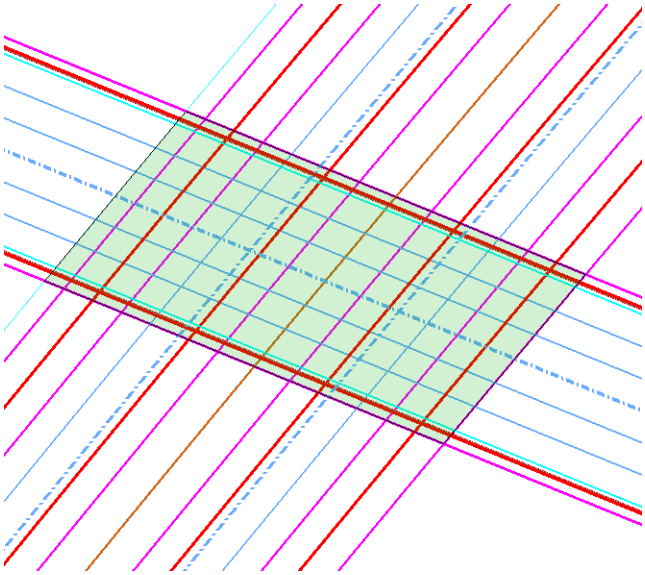


Lab 5.4 - Isopach Surface

1. The surfaces can also be used for a more visual look at the clearances.
2. Select **Tools > Options > Factors** and set the ***Text Scale Factor*** to ***5***.

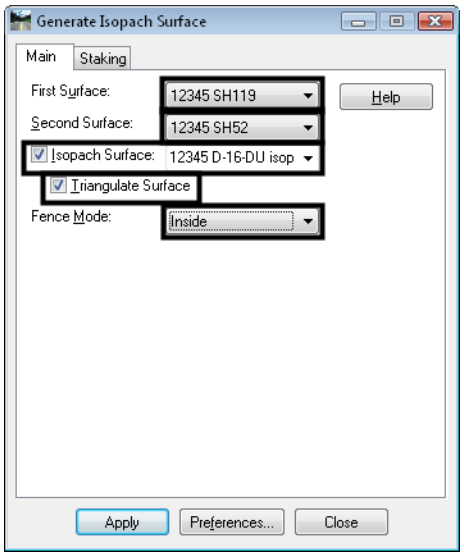


3. Place a MicroStation fence around the area where the bridge will be as shown.



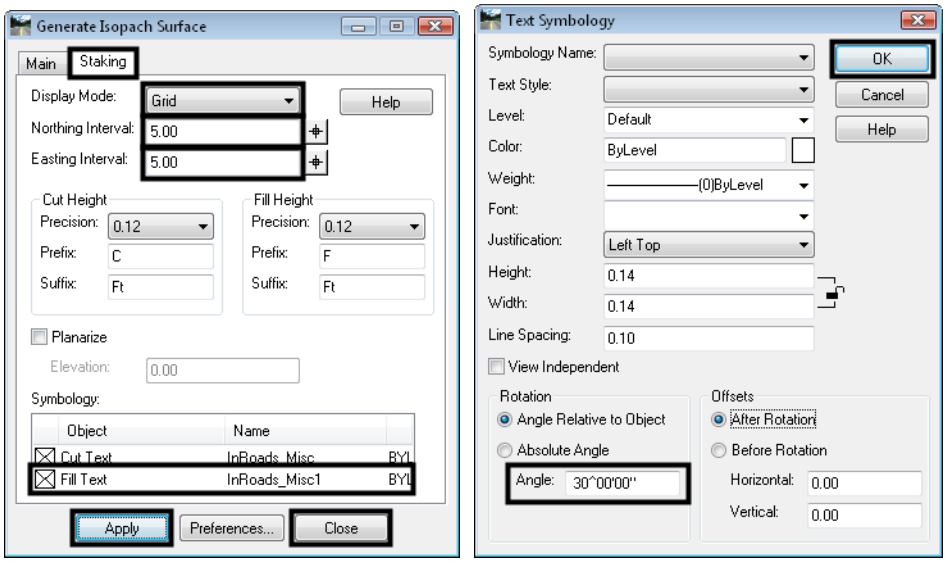
4. Select **Surface > Design Surface > Generate Isopach Surface**.
5. Set the ***First Surface*** to ***SH119***.
6. Set the ***Second Surface*** to ***SH52***.
7. Toggle on ***Isopach Surface*** and key in ***12345 D-16-DU isopach*** for the surface name.

   Note: This surface will be created when the command is applied.
8. Toggle on ***Triangulate Surface***.
9. Set the **Fence Mode** to **Inside**.

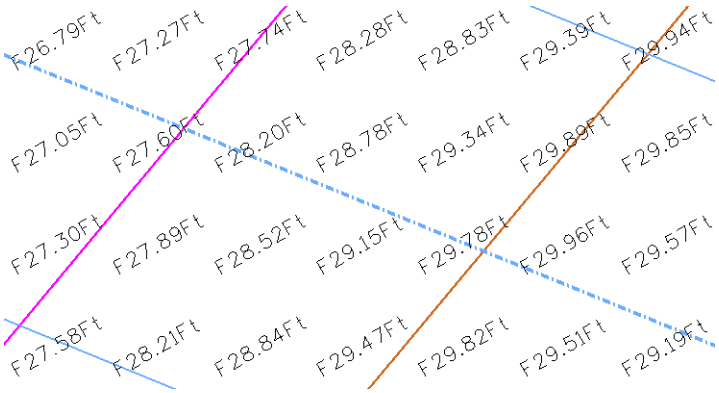


10. Select the ***Staking Tab***.

11. Set the ***Display Mode*** to ***Grid***.
12. Set the ***Northing*** and ***Easting Intervals*** to ***5.00***.
13. **<D> <D>** on the ***Fill Text Symbology*** and set the ***Rotation Angle*** to ***30^00'00"***, then **<D> OK**.



14. **<D> Apply**, then **Close**.
15. Clear the fence.
16. **Fit** the MicroStation view, then window into the bridge area.



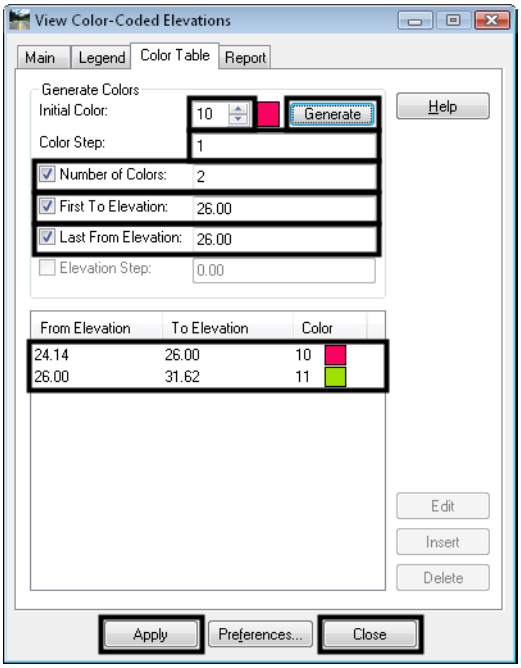
Note: The text in the file denotes the difference between the two surfaces on a 5' grid interval. In addition, a surface was generated with points on a 5' grid, with each point's elevation being the difference. This surface can be used to help visualize any potential conflicts.

17. Delete all the graphics in the design file.
18. Select **Surface > View Surface > Color Coded Elevations**.
19. Set the ***Surface*** to ***12345 D-16-DU isopach***.

20. Set the ***Color Mode*** to ***Automatic***.
21. Select the ***Color Table*** tab.
22. Set the ***Initial Color*** to ***10***.
23. Key in ***1*** for the ***Color Step***.
24. Toggle on ***Number of Colors*** and key in ***2***.
25. Toggle on ***First*** and ***Last Elevation Options*** and set each to ***26.00***.

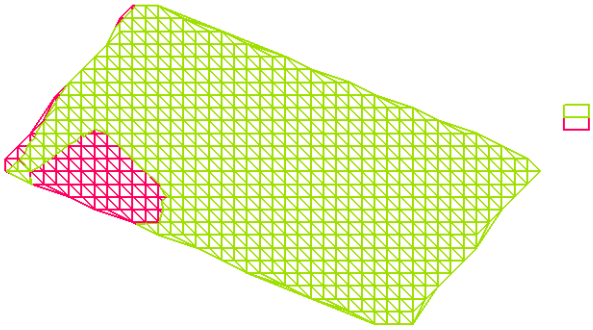
    Note: The elevation is where the color will change on the display from color 10 to color 11, indicating that everything color 10 has a clearance of less than 26 feet, while everything color 11 has a clearance of more than 26 feet.

26. **<D> Generate**.

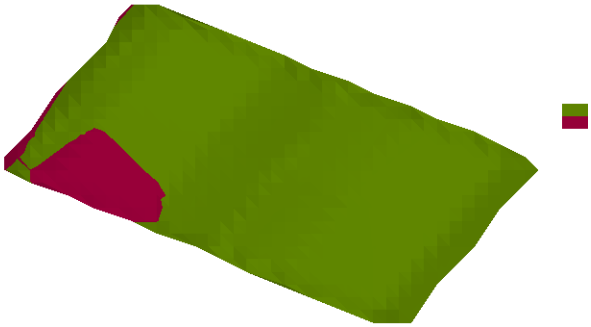


27. **<D> Apply**.

28. **<D>** in the design file for the location of the legend.



29. **<D> Close**
30. On the MicroStation menu, select **Utilities > Render > Smooth**.
31. **<D>** in the view.



32. Try other elevations to isolate potential areas of conflict.

Chapter Summary:

- The vertical clearance between InRoads alignments can be checked easily with an ***XML Report***.
- Surface Features can be imported as alignments to run the same report.
- MicroStation measure commands are used to check the minimum distance between graphic elements.
- An ***isopach*** surface generated between two design surfaces will help determine areas of potential clearance issues.

LAB 6 - Working with Surfaces

This lab covers how to use additional cross section and profile tools to review surface data.

Chapter Objectives:

- Learn how to use cross section tools to cut sections on a skew to the alignment.
- Learn how to cut sections at specific locations based on graphic elements.
- Learn how to use level filters to find specific levels or groups of levels to turn on or off.
- Learn how to update components, features or surfaces on cross sections.
- Learn how to annotate points or features on cross sections.
- Learn how to use feature filters to find specific features for displaying or annotating.
- Learn how to cut profiles along graphic elements.

The following files are used in this lab:

- C:\Projects\12345\Bridge\Working \CU12345BRDG_Model.dgn
- C:\Workspace\Workspace-CDOT_XM\Standards-Global\InRoads\Preferences\ CDOT_Civil.xin
- C:\Projects\12345\ROW_Survey\InRoads\DTM\12345 existing ground for interchange
- C:\Projects\12345\Design\InRoads\12345 SH52
- C:\Projects\12345\Design\InRoads\12345 SH119 SH52 Interchange.alg
- C:\Projects\12345\Bridge\Drawings\Reference_Files\12345BRDG_Model_D-16-DU.dgn
- C:\Workspace\Workspace-CDOT_XM\Standards-Global\InRoads\Templates\ CDOT_Template-Library.itl

Lab 6.1 - Open Project Data

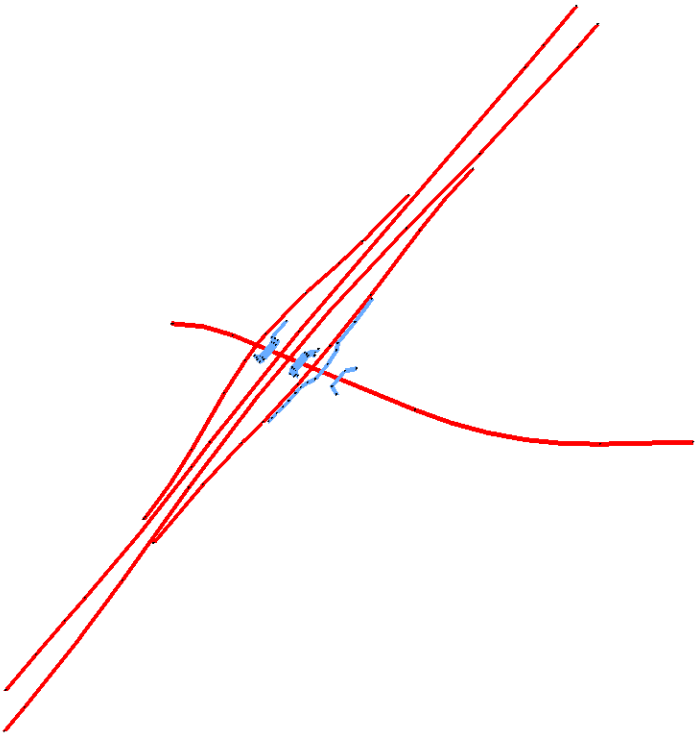
1. Open MicroStation and InRoads using the ***C:\Projects\12345\Bridge\Working \CU12345BRDG_Model.dgn*** file.
2. Verify the correct ***XIN*** file is loaded.
3. Select **File > Open** from the InRoads menu.
4. Open ***C:\Projects\12345\Design\InRoads\12345 SH52*** and ***12345 SH119 SH52 interchange.alg***.
5. Open ***C:\Projects\12345\ROW_Survey\InRoads\DTM\12345 existing ground for interchange***.

Lab 6.2 - Create Skewed Cross Sections from Graphics

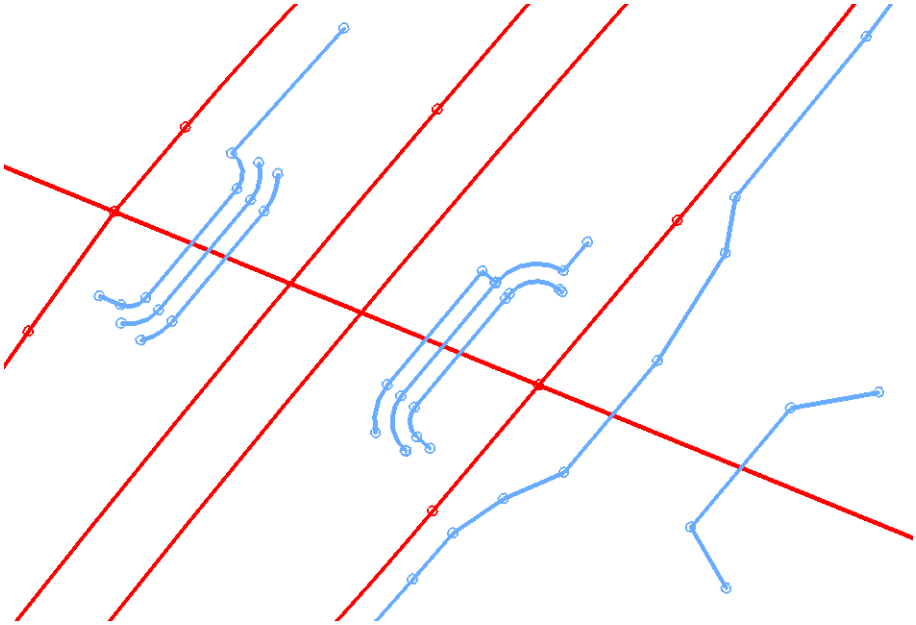
In the previous lab, a cross section set was created based on SH52 at an even interval along the alignment and all sections were perpendicular. In this section, cross sections are created on a skew to the alignment for review purposes.

1. **Delete** any MicroStation graphics currently in the design file.

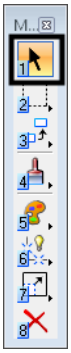
2. Select **Geometry > View Geometry > All Horizontals**.
3. **Fit** the MicroStation view.



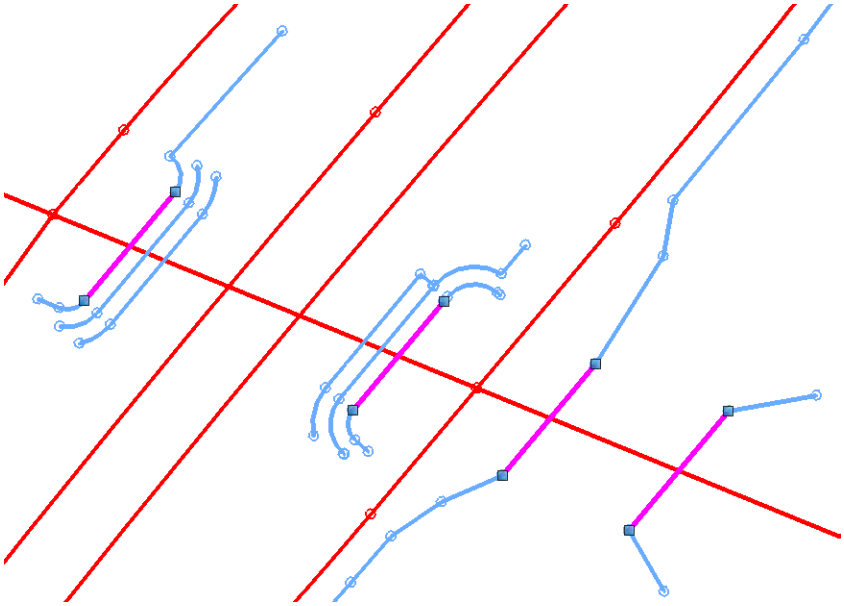
4. **Zoom in** to the approximate area shown.



5. In MicroStation, select the **Element Selection** tool.



6. While holding down the <***Ctrl***> key on your keyboard, **<D>** on the four elements shown here.

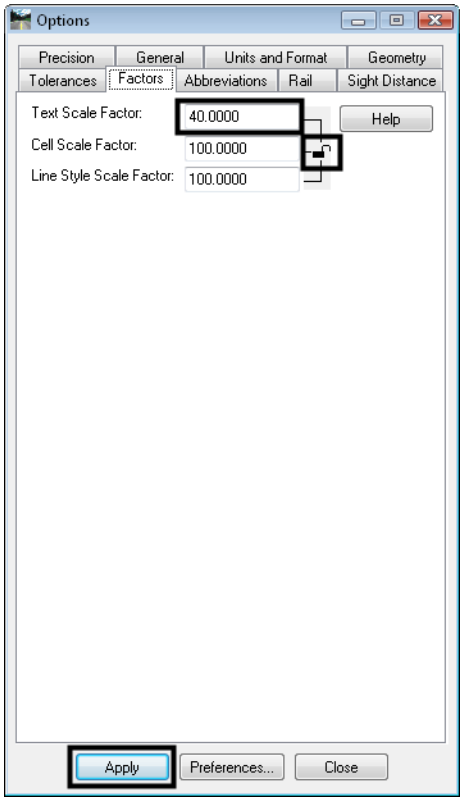


Note: This makes a MicroStation selection set from the wall alignment graphics.

7. Select **Tools > Options > Factors**.

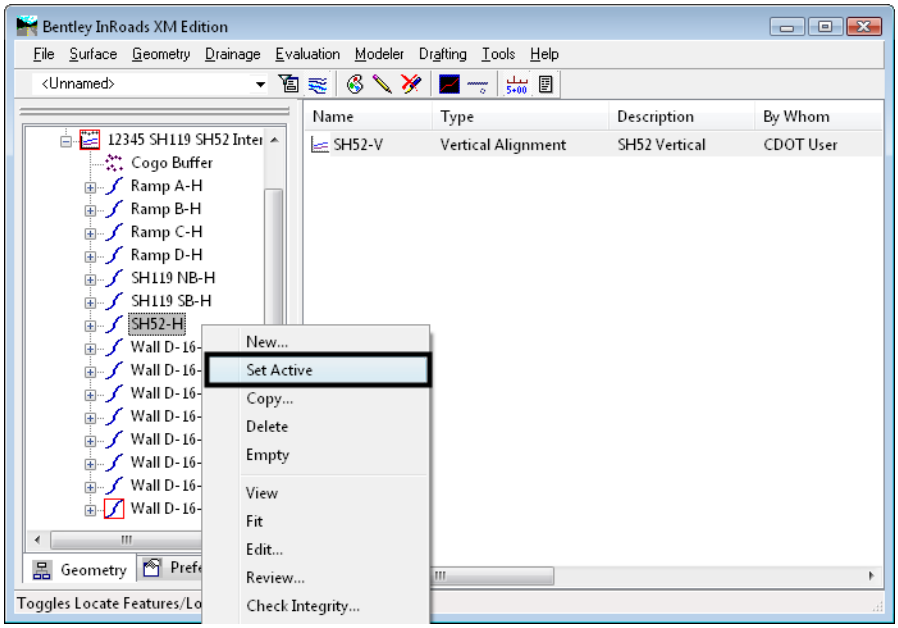
8. **<D>** the lock icon.

9. Set the ***Text Scale Factor*** to ***40.***

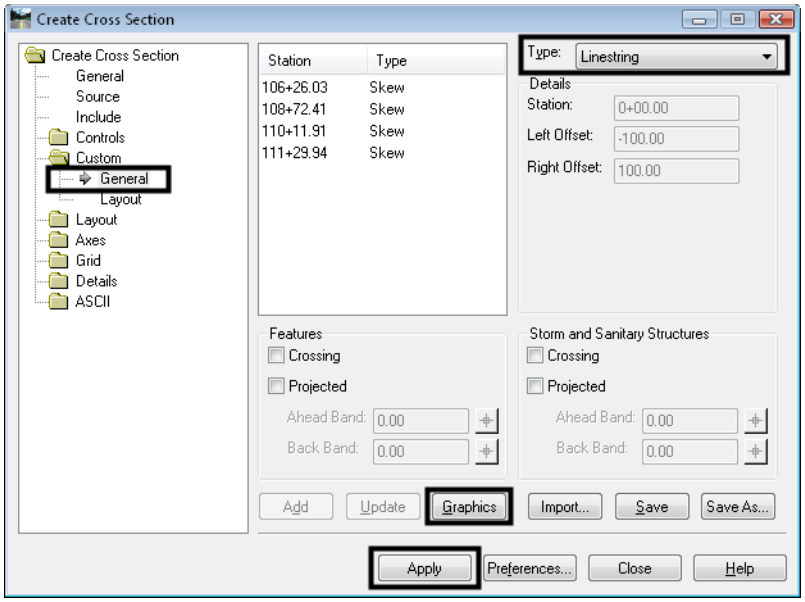


10. **<D> Apply**, then **Close**.

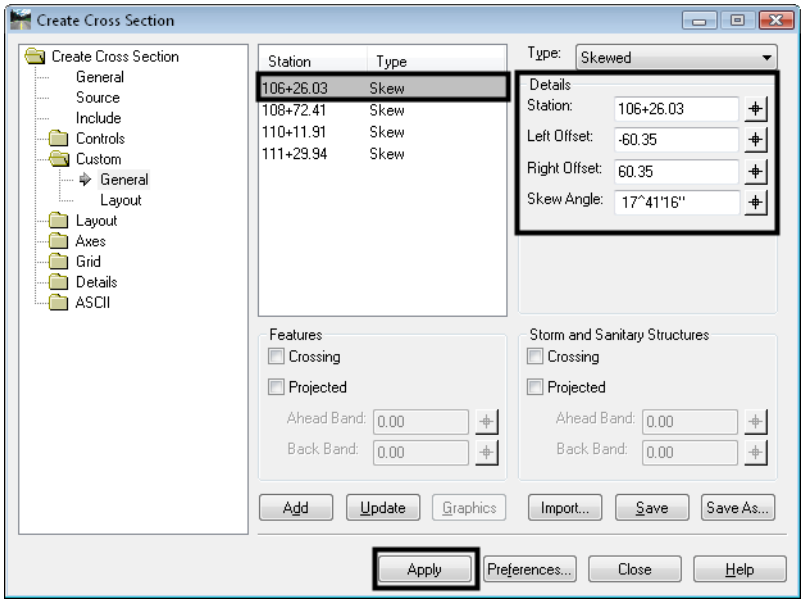
11. Make ***SH52-H*** the active alignment.



12. Select **Evaluation > Cross Sections > Create Cross Sections**.
13. Toggle on the two surfaces.
14. Select the **Custom > General** branch.
15. Set the ***Type*** to ***Linestring***.
16. **<D> Graphics**.

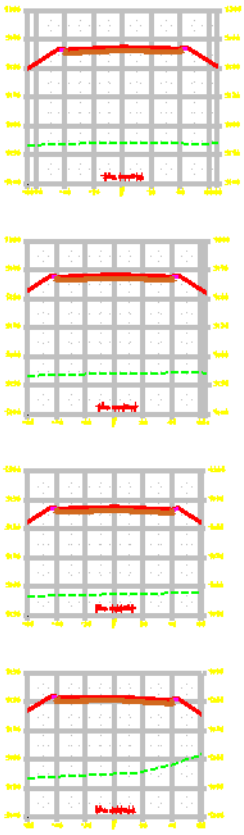


Note: The list of stations where the graphics cross the alignment is shown in the dialog. If an entry is highlighted, the information on the right shows the offsets and the skew angle also.



17. **<D> Apply**.

18. **<D>** a clear area in the design file for the bottom left corner of the cross section set.



19. Review sections by zooming in or by using the **Cross Section Viewer**.

    Note: The cross sections are created based on the graphic elements. In this case, they are graphical displays of alignments, but they can be graphics drawn in MicroStation as well. Next, elements representing bearing lines and the pier centerline are used to create sections.

20. Back in the ***Cross Section*** dialog, highlight the list of custom stations and choose **Delete** on the keyboard.

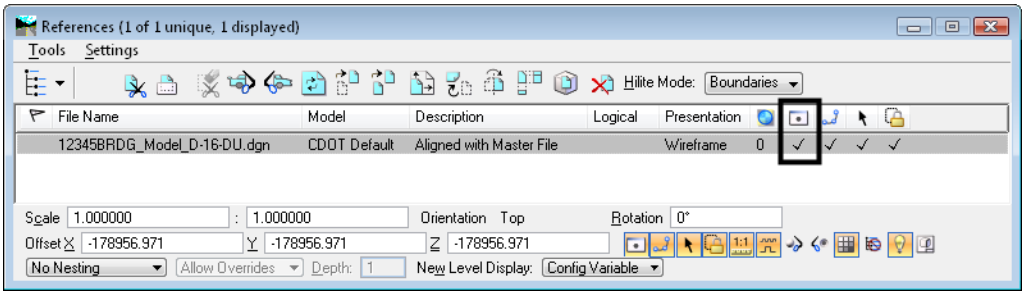
21. **<D> Close**.

22. Clear the selection set of graphics by selecting the **Element Select** tool and **<D>** in a clear area of your file.

    Note: The graphics representing the centerline and bearing lines are currently in a reference file and on a level that is turned off.

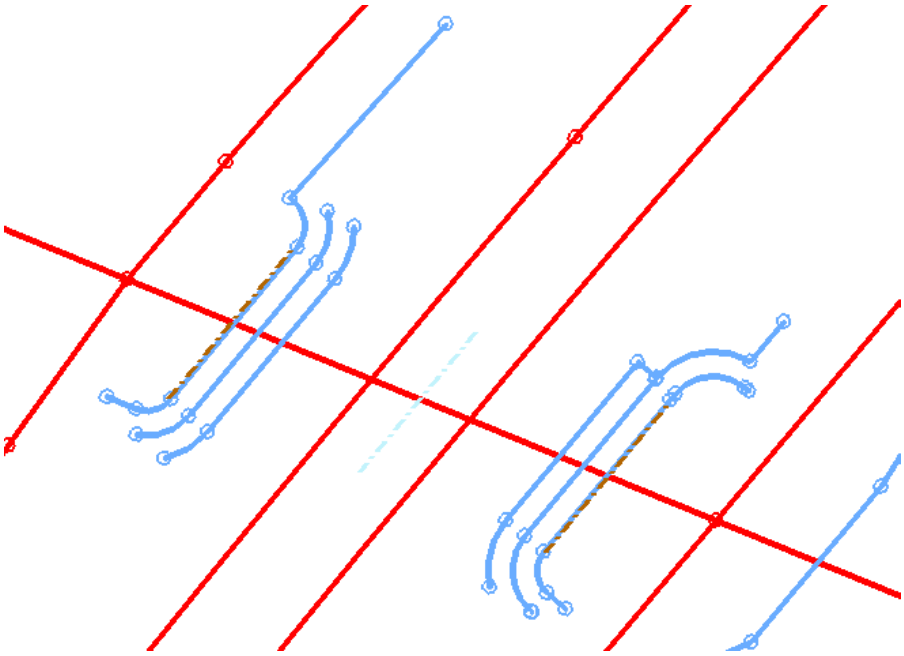
23. Select **File > Reference** from the MicroStation menu.

24. Turn on the display of the ***BRDG_Model_D_16-DU.dgn*** reference.



25. **Close** the ***Reference*** dialog box.

Note: Bearing and Pier centerlines are shown in the file. This reference was attached in the previous lab.



Note: It will be easier to see the new elements if the alignment levels are turned off. To facilitate finding the appropriate levels, level filters are used. Level filters allow the segregation of levels based on predefined criteria, such as all alignment levels, all bridge levels, etc. When a level filter is active, the dialogs listing levels only show those that pass the filter, making it easier to find specific ones.

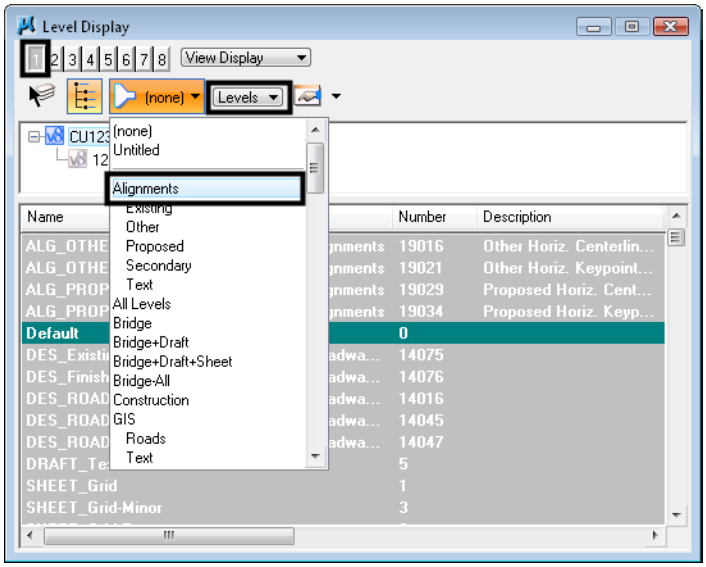
26. In MicroStation, select **Settings > Level > Display**.

27. Toggle ***View Index 1*** on and all others off.

28. Set the ***Active Level*** to ***Default***.

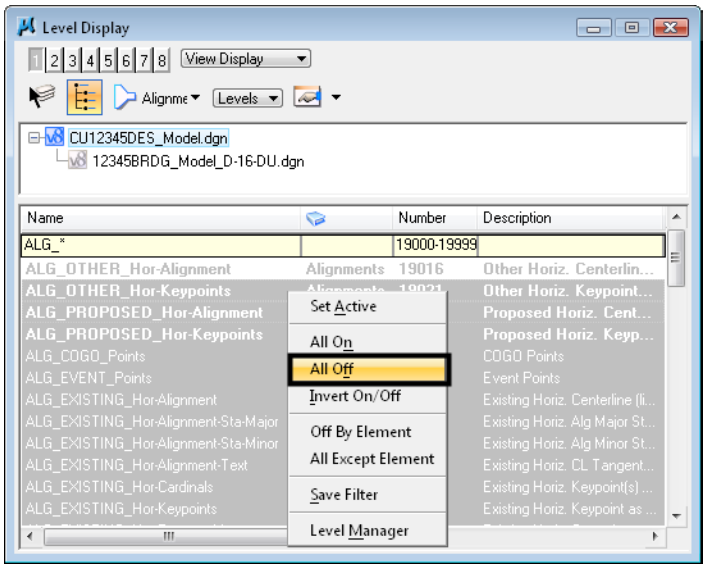
29. Toggle ***Show Level Name or Filters*** to ***Levels***.

30. Set the ***List Filter*** to ***Alignment***

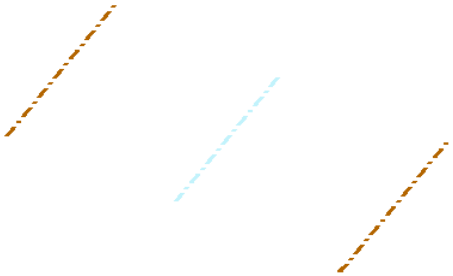


31. Scroll through the list and notice only alignment levels are displayed.

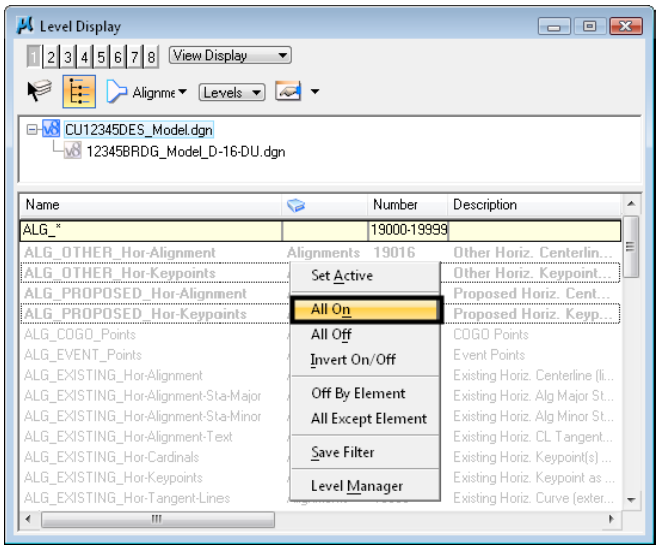
32. Right-click in the level list and choose ***All Off***.

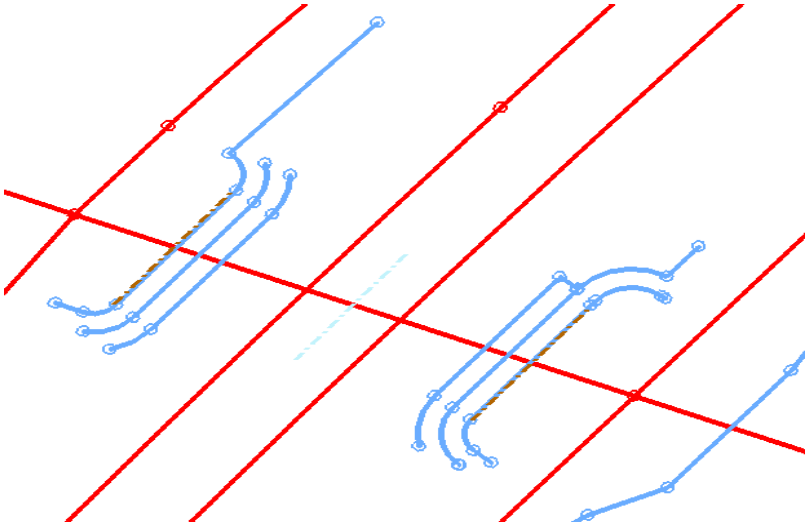


Note: In the MicroStation view, notice the alignments levels are now off and the bridge levels are still on.



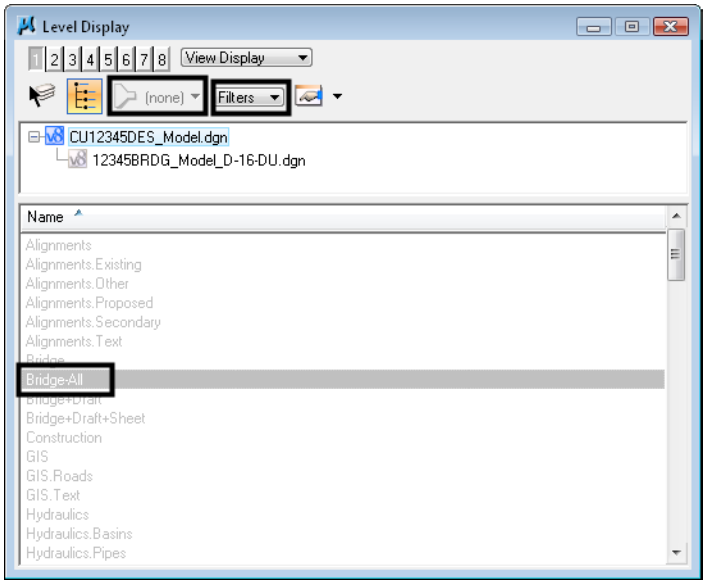
33. Right-click in the level list and choose ***All On***.



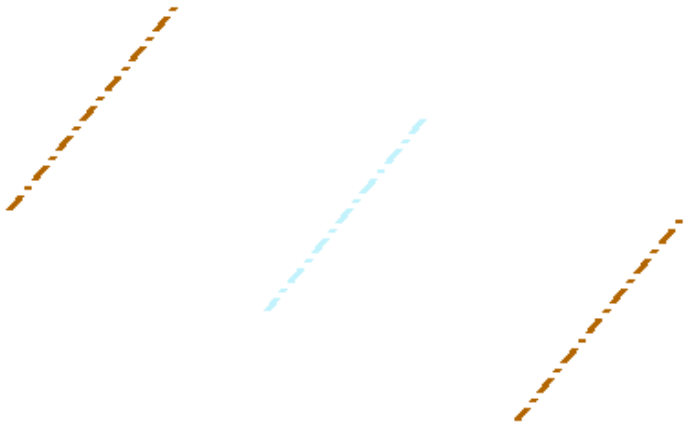


Note: Level filter are used in two ways. One, as described above, they are used to segregate the level lists to make it easier to find the necessary levels. They can also be used to turn on or off all associated levels.

34. Toggle the ***Filter*** to ***(none)***.
35. Toggle ***Show Level Name or Filters*** to ***Filters***
36. Highlight ***Bridge-All***.



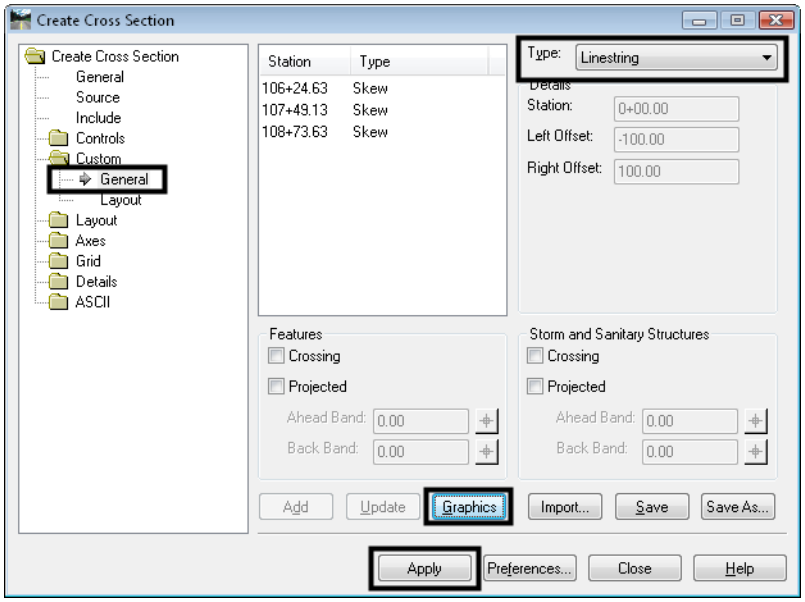
37. **Fit** the MicroStation view and notice that the alignment levels are now off and only bridge levels are on.



38. Clear any previous selection set.

39. Make a selection set from the Pier and Bearing MicroStation graphics.

40. Select **Evaluation > Cross Section > Create Cross Section**.
41. In the ***Cross Section*** dialog on the ***Custom*** > ***General*** branch, set the ***Type*** to ***Linestring***.
42. **<D> Graphics**.



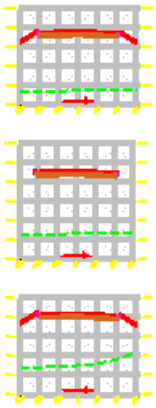
43. In the ***Level Display*** box, toggle off the ***Bridge-All*** filter to turn all levels back on.
44. In the ***Create Cross Section*** command, **<D> Apply** and then **<D>** in a clear area of the file.
45. **<D> Close**.

    Note: Three cross sections are created for the three lines in the selection set.

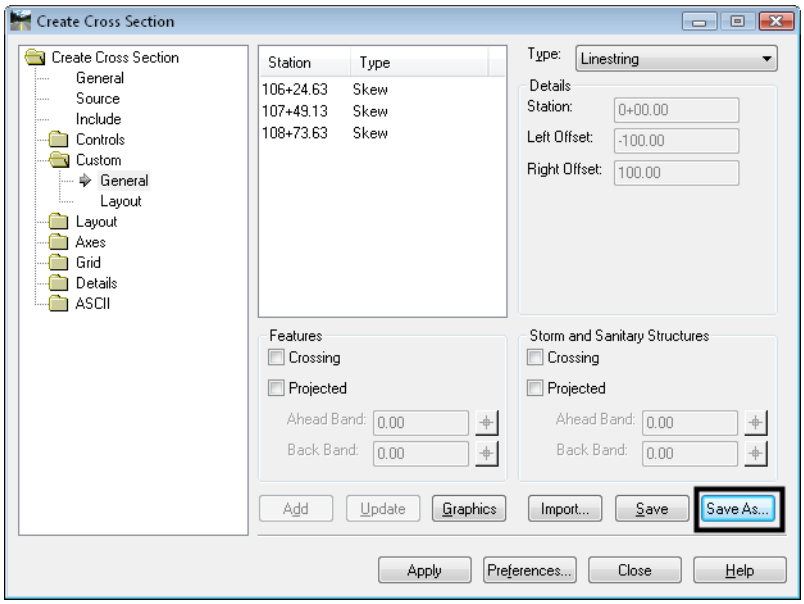
46. ***Do not*** close out of the ***Create Cross Section*** command.

47. Close the ***Level Display*** box.

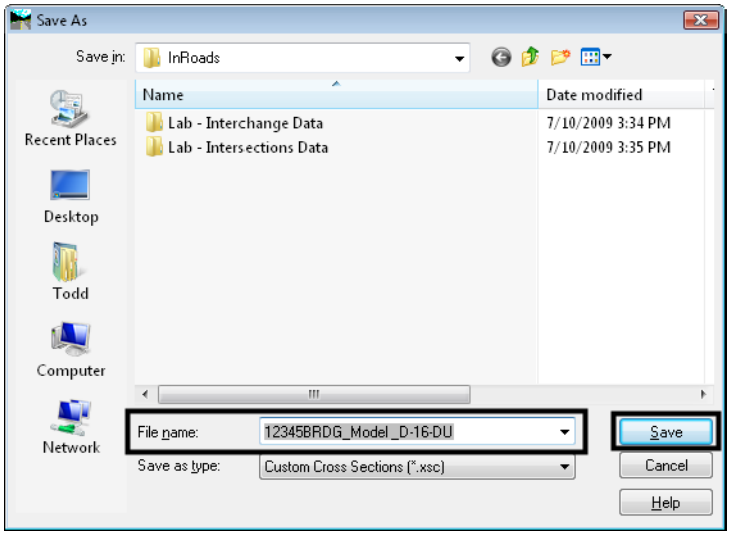
48. Review your new custom cross section set.



49. In the Cr***eate Cross Section*** dialog box, select **Save As**.



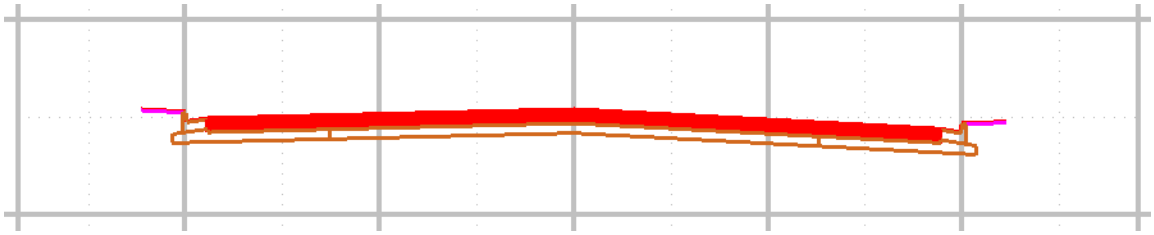
50. Key in ***12345BRDG_Model _D-16-DU*** for the file name.



51. Select **Save**.

Note: In the future, these sections can be re-created by loading this text (****.xsc***) file rather than selecting the graphic elements.

52. **Zoom in** to the second cross section.



Lab 6.3 - Update and Annotate Cross Sections

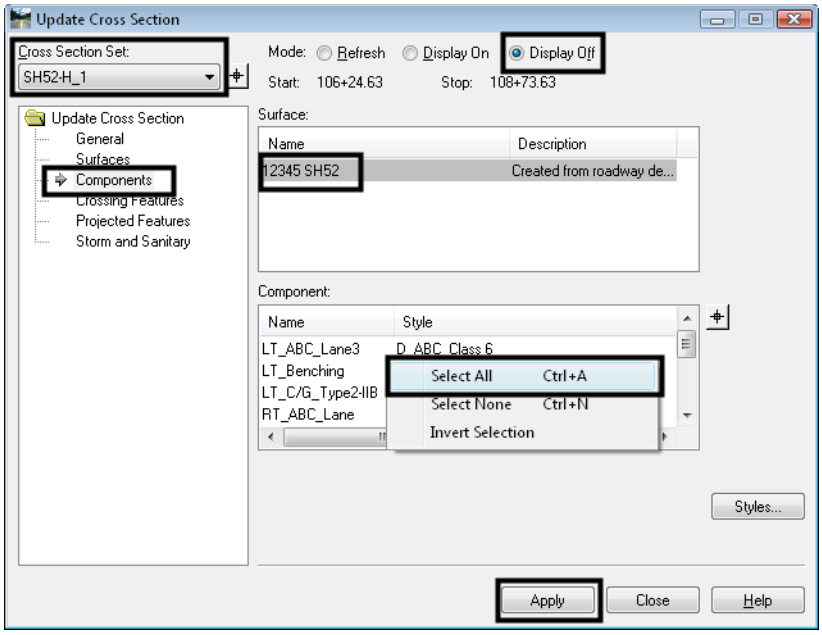
You can update a cross section set to turn on or off the display of components, crossing features, projected features or surfaces. You can also refresh the display of these items if changes have been after creating the cross sections.

Cross section points and segments can be annotated as well. If you want to annotate specific points, you can choose the corresponding features for annotation. However, the features must first be displayed on the cross section before they can be annotated.

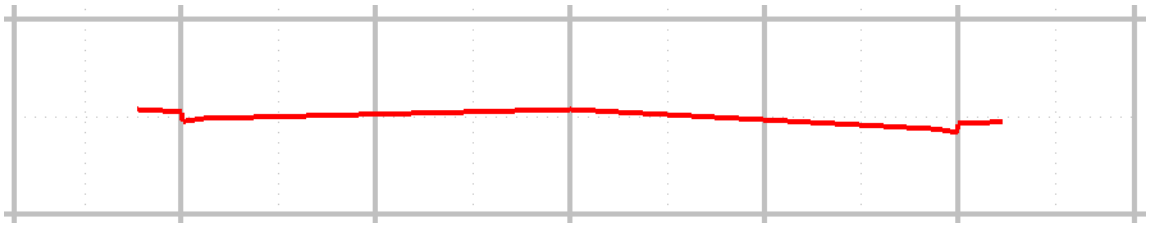
In this section, you will use both the ***Update Cross Section*** and ***Annotate Cross Section*** commands. First, to more easily see the design surface, you will toggle off the components.

1. Select **Evaluation > Cross Section > Update Cross Section**.
2. Verify the ***Section Set*** is the current one.
3. Set the ***Mode*** to ***Display Off***.
4. Highlight ***Components*** at left.

5. Highlight the ***SH52*** Surface.
6. Right-click in the component list and **<D> *Select All***.

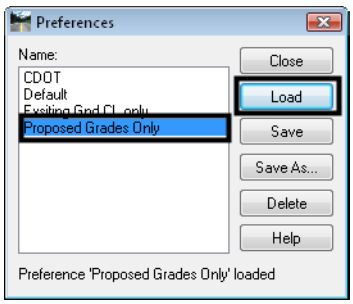


7. **<D> Apply**, then **Close**.
8. Review the cross section to see that components have been turned off.

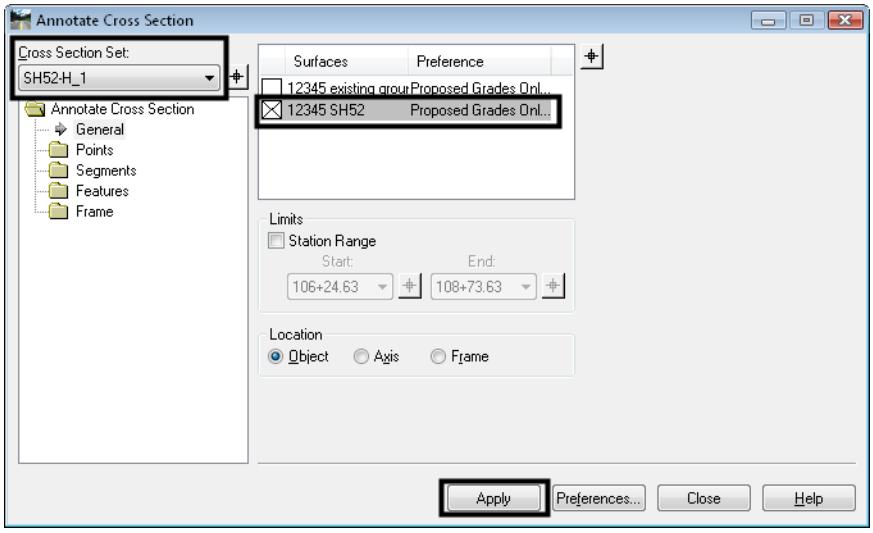


Note: To assist in evaluating the cross sections, it is often helpful to see the elevations, which can be annotated using ***Annotate Cross Sections***.

9. Select **Evaluation > Cross Section > Annotate Cross Section**.
10. Load the preference ***Proposed Grades Only***.

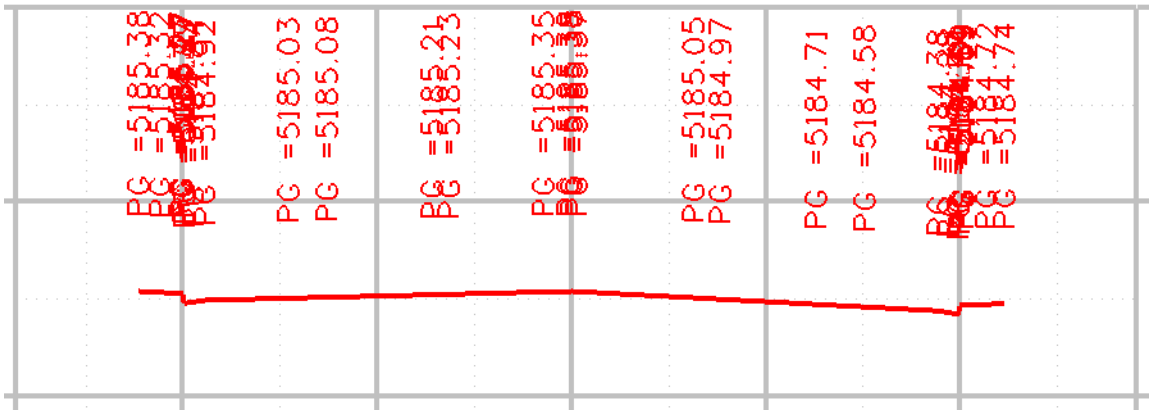


11. Select the Set of skewed sections.
12. Toggle on the ***SH52*** surface.



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

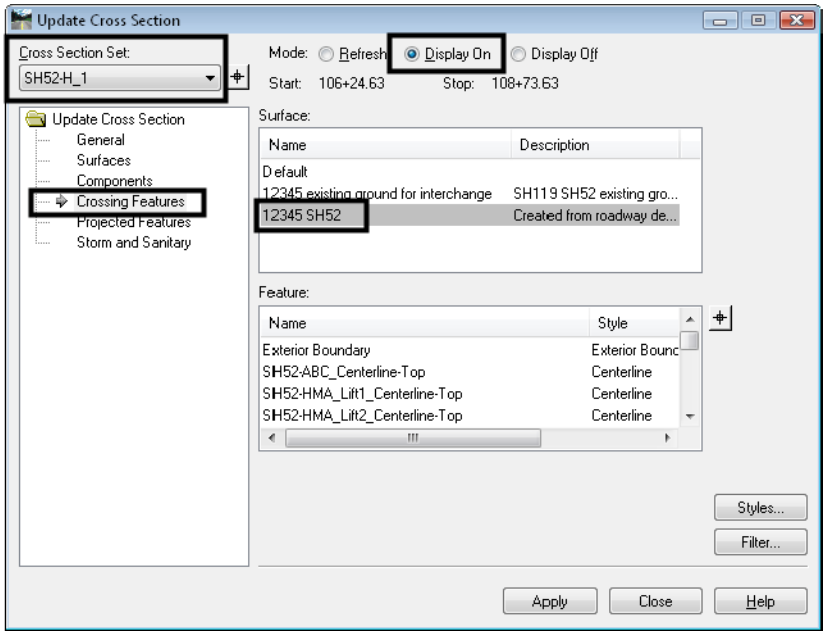
Note: The elevations are annotated for every point on the proposed grade.



Note: Often, a more useful option is to annotate the elevations of only certain points. This is accomplished by first displaying the features in the proposed model on the cross sections.

14. Select **Evaluation > Cross Sections > Update Cross Sections**.
15. Select the set of skewed sections.
16. Set the ***Mode*** to ***Display On***.
17. Select ***Crossing Features***.

18. Highlight the ***SH52*** Surface.

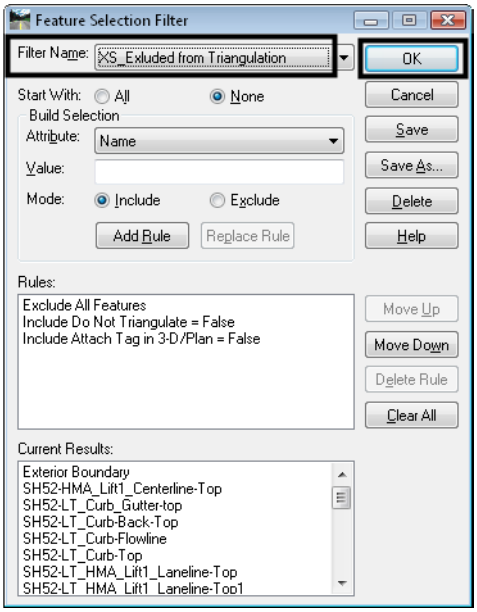


Note: Look in the feature list and notice that there are several features. The surface contains features for each of the lifts seen on the cross sections earlier. The features on the finished grade, which are triangulated, are the ones typically annotated in this case. Rather than scrolling through this list and highlighting just those, a feature filter is used.

19. Select **Tools > Locks > Toolbar** to toggle on the locks toolbar if it is not on already.

20. On the ***Update Cross Section*** box, select Filter...

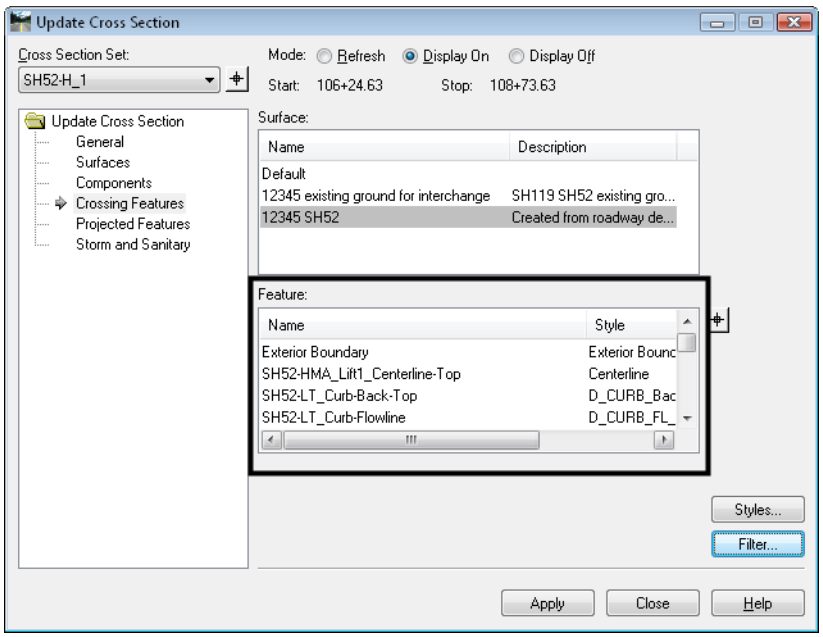
21. In the feature filter list, select ***XS_Excluded from Triangulation*** and select **OK**.



22. Toggle on the ***Feature Filter*** lock.

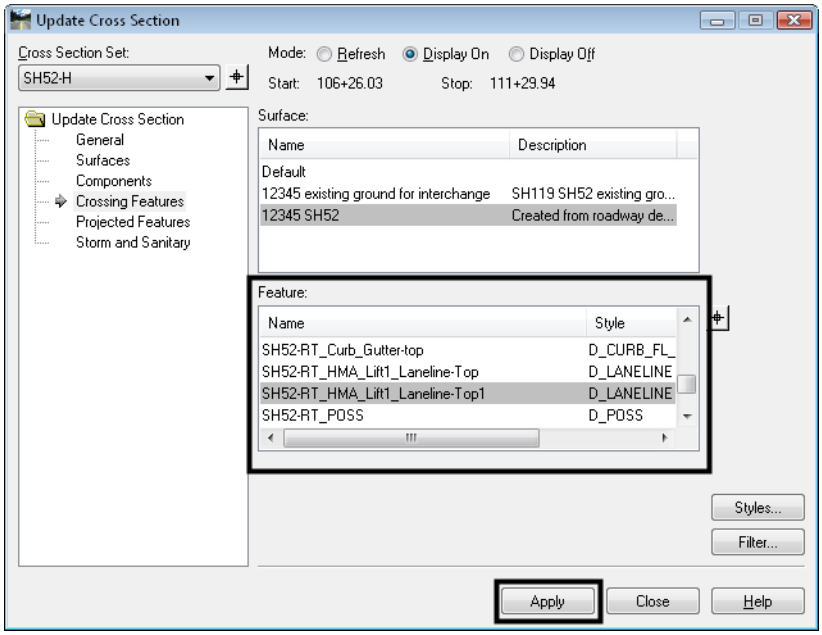
Note: The feature filter has no effect unless the lock is on.

23. In the ***Update Cross Section*** box, scroll through the list of features and note the number is greatly reduced.

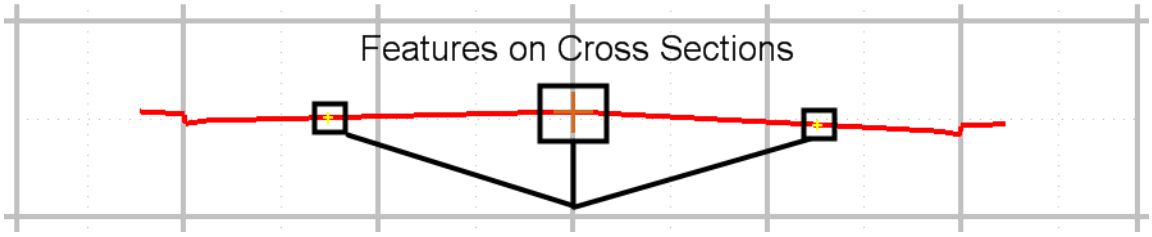


Note: The filter chosen, ***XS_ Excluded from Triangulation*** eliminates non-triangulating features from any dialog box that lists features. While it is very handy, it can also be confusing when features that exist do not show up in the list. For that reason, the lock is toggled off after use. There are several pre-defined filters that can be used to segregate features. These filters are stored in the ***XIN*** file.

24. Highlight the ***Centerline Top*** and the ***left*** and ***right Laneline-Top1*** features.



25. **<D> Apply**.



Note: Small '+' signs are shown on the cross sections. These mark the location of the features and can now be annotated.

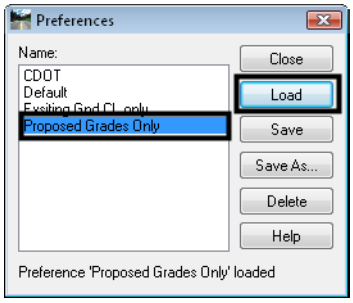
26. **<D> Close**.

27. Toggle off ***Feature Filter*** lock.

Note: It is best to leave this lock off unless you need it.

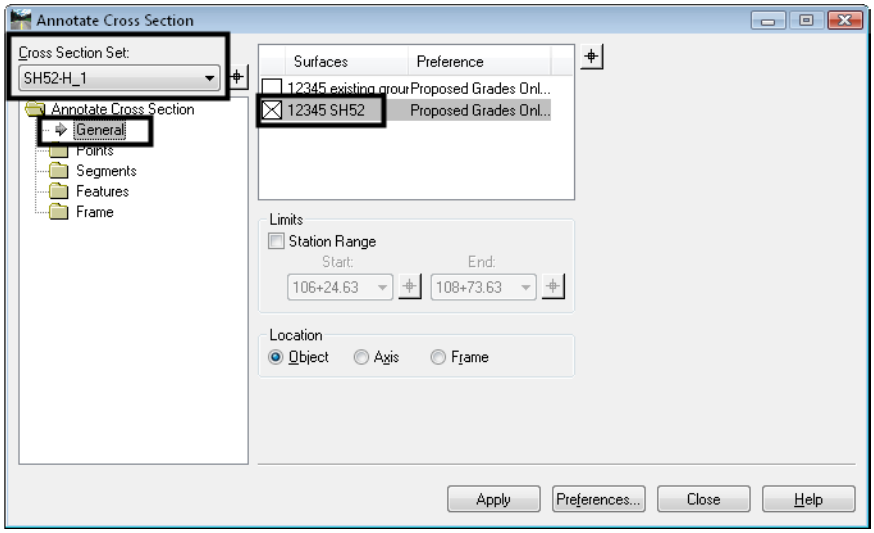
28. Select **Evaluation > Cross Section > Annotate Cross Section**.

29. Load the preference ***Proposed Grades Only***.

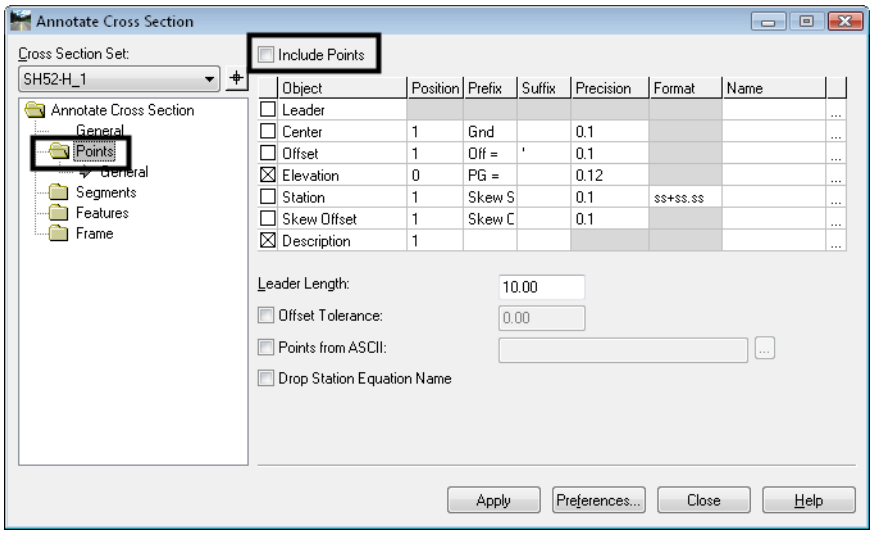


30. Select the set of skewed sections.

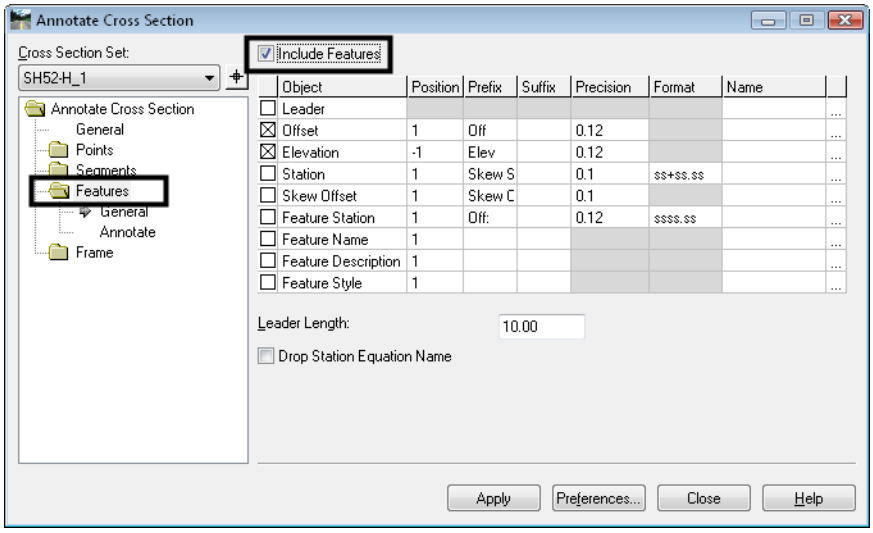
31. Toggle on the ***SH52*** surface.



32. Select ***Points*** and toggle off ***Include Points***.

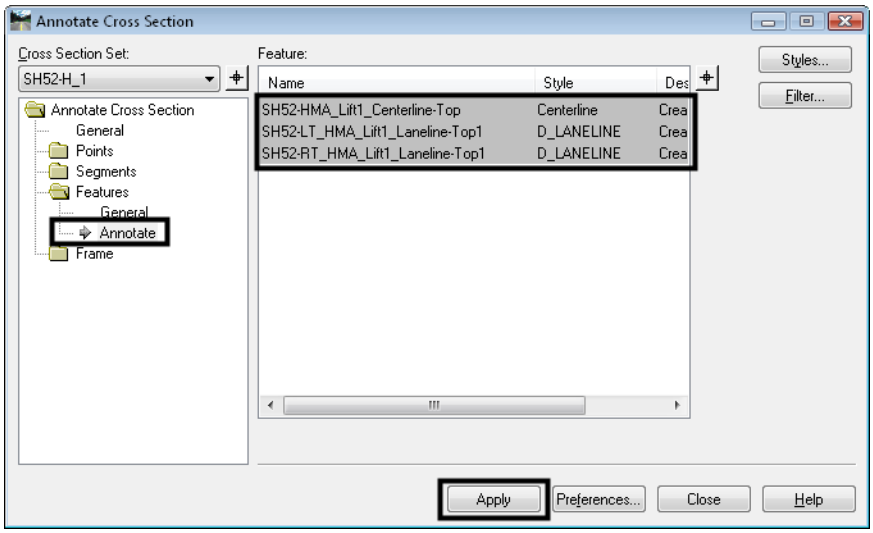


33. Select ***Features*** and toggle on ***Include Features***.

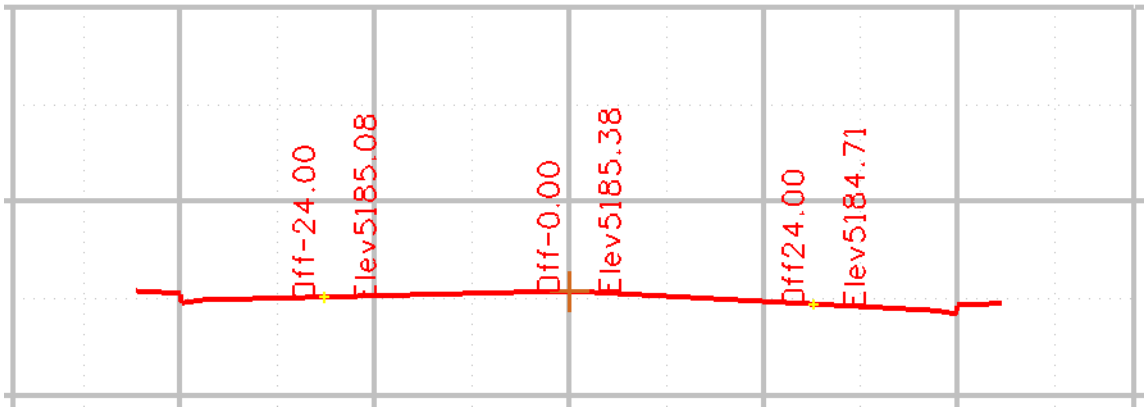


34. Select ***Annotate*** under ***Features***.

35. Highlight the three features listed.



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



Note: Offsets and elevations are annotated for only the three features on the proposed grade. The previous annotation was deleted since you displayed these graphics in ***Pencil*** mode.

Lab 6.4 - Creating Profiles from Graphics

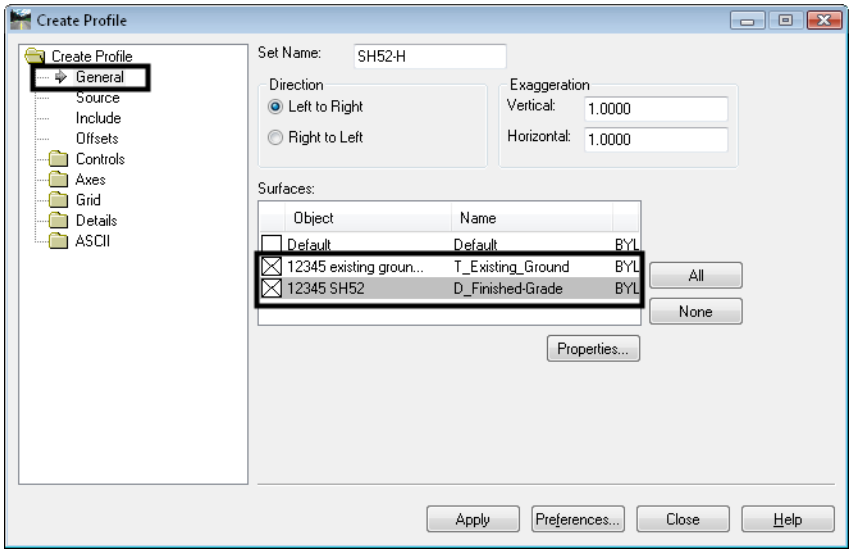
In addition to cutting skewed sections based on graphic elements, profiles can also be generated from graphics. The main differences between the two options include:

- The bottom axis of Cross Sections list offsets from the reference line along which they are created (alignment, graphic, or multi-point).
- The bottom axis of a Profile lists stationing, even if the profile is cut from a graphic. For profiles cut from graphics or multi-points, the stationing begins at 0+00.

In this section, you will generate a profile showing existing and proposed surfaces along a the pier centerline graphic. Since the graphic is in a reference, you will first draw a new line the active file to use for profiling.

1. In MicroStation select the **Place Line** command.
2. Place a new line by snapping to the two end points of the pier centerline.
3. Select **Evaluation > Profile > Create Profile**.
4. Select ***General***.

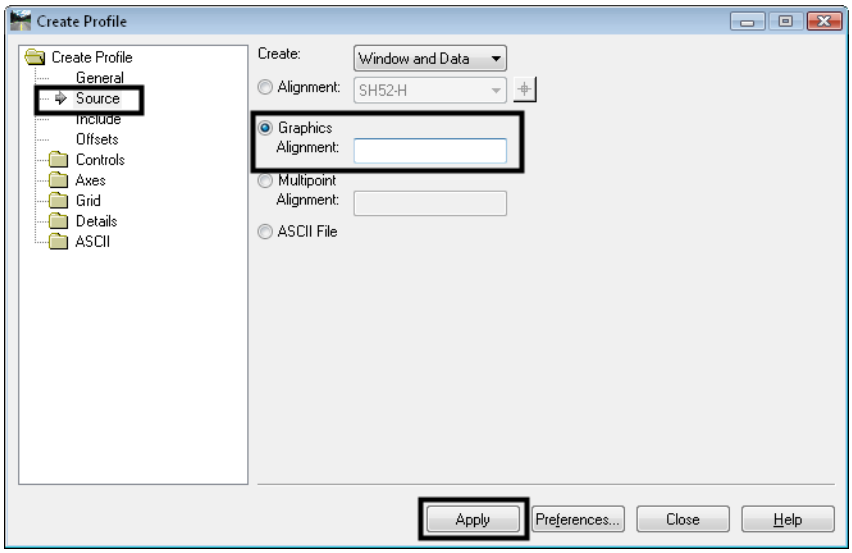
5. Toggle on both surfaces.



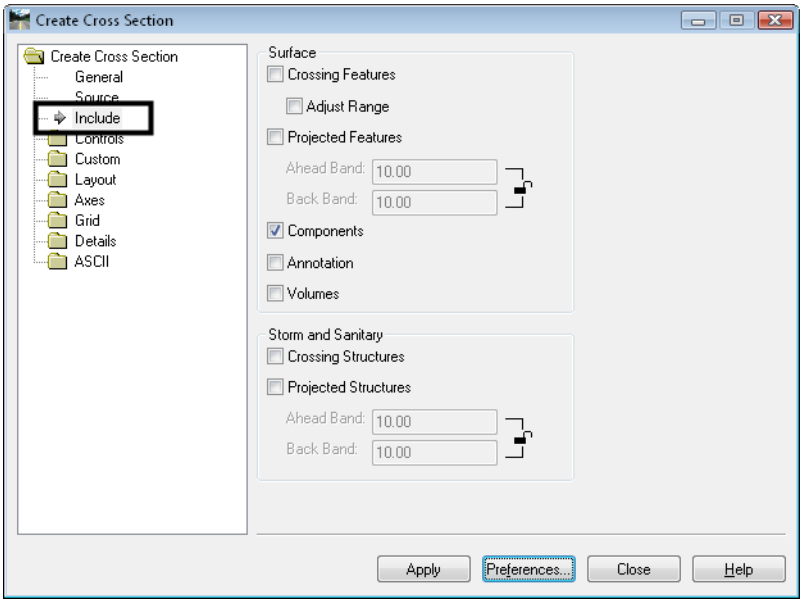
6. Select ***Source***.

7. Toggle on ***Graphics Alignment***.

8. If you key in a name in the ***Graphics Alignment*** field, an alignment is created for the graphic element selected after choosing Apply.



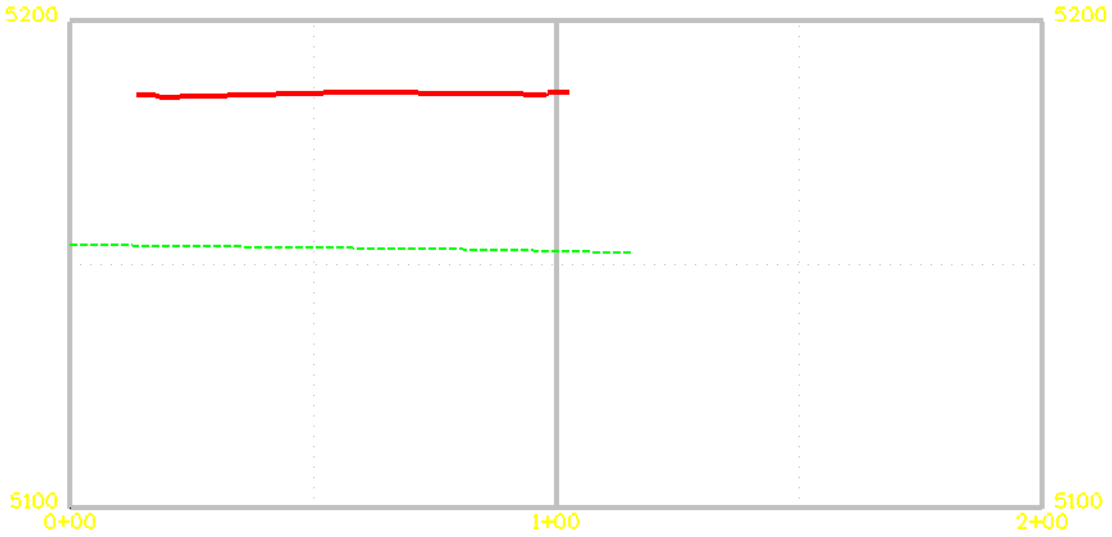
9. **<D>** on the Include Branch.



Note: If you want to display crossing features on your cross section like pipes or utilities, toggle on ***Crossing Features.*** These features must first exist in the surface(s) you're showing on the sections. The feature's style controls if the feature can be shown on the cross section.

Note: If you want to show features that fall outside the cross section, toggle on ***Projected Features***. This will show the orthogonal projection of the features onto the cross section. You also have the option of specifying a ***Bandwidth*** to either side of the section to project the features.

10. For this exercise, leave ***Crossing Features*** and ***Projected Features*** turned off.
11. <**<D> Apply**.
12. **<D>** on the line you drew over the pier centerline element.
13. **<D>** to accept the element.
14. **<D>** a clear area in the file.



Note: The profile is created showing both surfaces. Since there is not an alignment associated with this review profile, some of the post-processing commands for profiles, such as annotating and updating are not available. Profiles that need to be annotated and/or updates should be cut using an alignment, or an alignment should be created when the profile is cut by specifying an alignment name as noted above.

Chapter Summary:

- Custom cross sections are used to create sections that are not based on an interval or perpendicular to an alignment.
- The setup for custom cross section sets may be saved to a text file and loaded later to cut sections at the same location.
- Level filters can create a subset or group of levels to easily turn an entire group of levels on or off. They can also help you find individual levels more easily.
- Feature filters create a subset or group of surface features for displaying in plan, profile or cross section. They can also help you find individual features more easily.
- Profiles can be cut based on alignments or graphics.

LAB 7 - Feature Based Modeling

This section covers how to use Surface Modeling tools for excavation and backfills. You will also use these tools to create pier features.

Chapter Objectives:

- Learn how to create excavation and backfill surfaces for footers (piers, walls, etc.).
- Learn how to use the ***Generate Sloped Surface*** command to create proposed surfaces by intercepting existing or design surfaces.
- Learn how to profile excavation and backfill surfaces.
- Learn how to set the elevation of elements or features.
- Learn how to import MicroStation graphics into a surface.
- Learn how to create pier features and a pier surface for volume computations.

The following files are used in this lab:

- C:\Projects\12345\Bridge\Working \CU12345BRDG_Model.dgn
- C:\Workspace\Workspace-CDOT_XM\Standards-Global\InRoads\Preferences\ CDOT_Civil.xin
- C:\Projects\12345\ROW_Survey\InRoads\DTM\12345 existing ground for interchange
- C:\Projects\12345\Design\InRoads\12345 SH119
- C:\Projects\12345\Design\InRoads\12345 SH119 SH52 Interchange.alg
- C:\Projects\12345\Bridge\Drawings\Reference_Files\12345BRDG_Model_D-16-DU.dgn
- C:\Workspace\Workspace-CDOT_XM\Standards-Global\InRoads\Templates\ CDOT_Template-Library.itl

Lab 7.1 - Open Project Data

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. Select **File > Open** from the InRoads menu.
5. Open ***C:\Projects\12345\Design\InRoads\12345 SH119*** and ***12345 SH119 SH52 Interchange.alg.***
6. Open ***C:\Projects\12345\ROW_Survey\InRoads\DTM\12345 existing ground for interchange***.

Lab 7.2 - Create an Excavation Surface for a Pier Footer

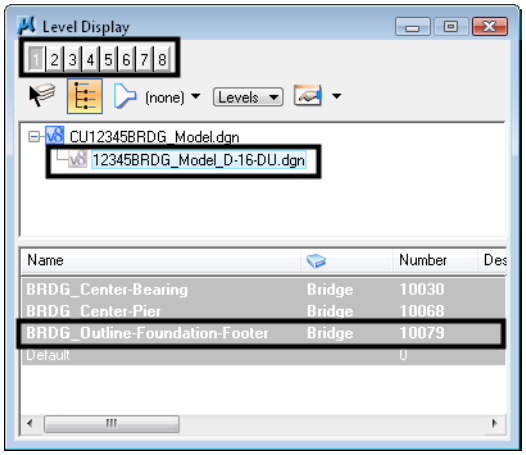
In this section, surfaces are created for the excavation and backfill for a pier footer for bridge D-16-DU. The primary commands used are ***Generate Sloped Surface*** and ***Generate Longitudinal Feature***. For more information on either of these commands, please see the ***Surface Editing*** chapter of ***A Practical Guide for Using InRoads XM.***

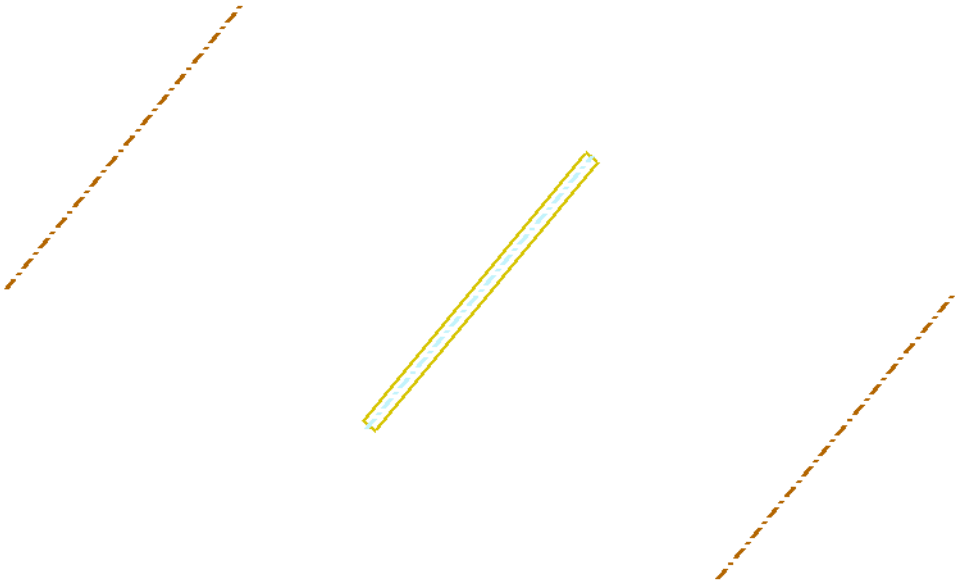
In a later lab, these surfaces will be used to calculate volumes.

1. In MicroStation, select **Settings > Level > Display**.
2. Toggle ***View Index 1*** on and all others off.
3. Toggle ***Show Level Name or Filters*** to ***Levels***.
4. Highlight the ***12345BRDG_Model_D-16-DU.dgn*** file.

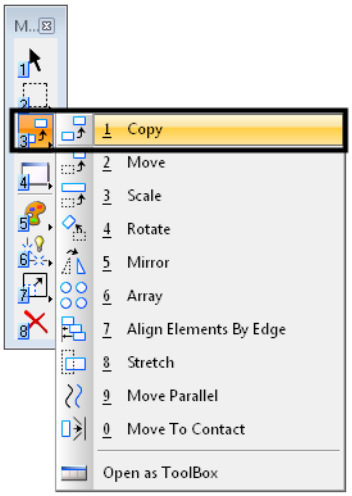
   Note: This is the reference file that was attached in Lab 2. If it is not listed in this dialog, re-attach the reference file now.

5. Turn on the ***BRDG_Outline-Foundation-Footer*** level.

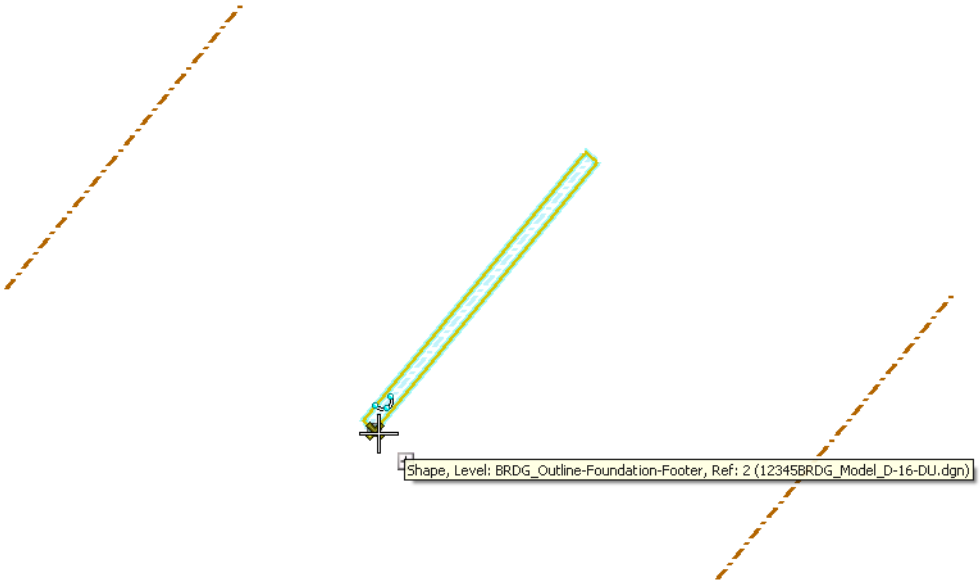




6. Select MicroStation's **Copy** tool.

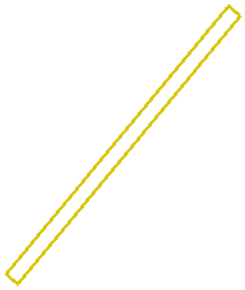


7. Snap to a corner of the outline to choose it to copy.



8. Snap to the same corner to place it at the same location in the current working file.
9. In MicroStation, select **File > Reference**.
10. Highlight the ***12345BRDG_Model_D-16-DU.dgn*** file and toggle the ***Display*** off.

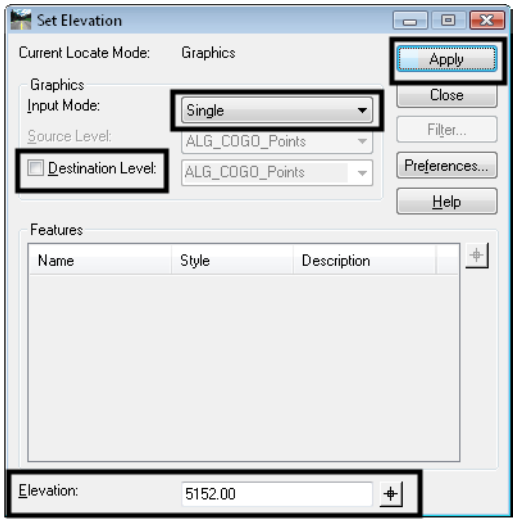
The new copy of the outline should still be showing in the current file.



Note: The outline is currently at elevation 0. Next, the outline must be moved to the appropriate elevation.

11. Select **Surface > Design Surface > Set Elevation**.
12. Make certain the current ***Locate Mode*** is ***Graphics***. If not, toggle it on your ***Locks*** toolbar.

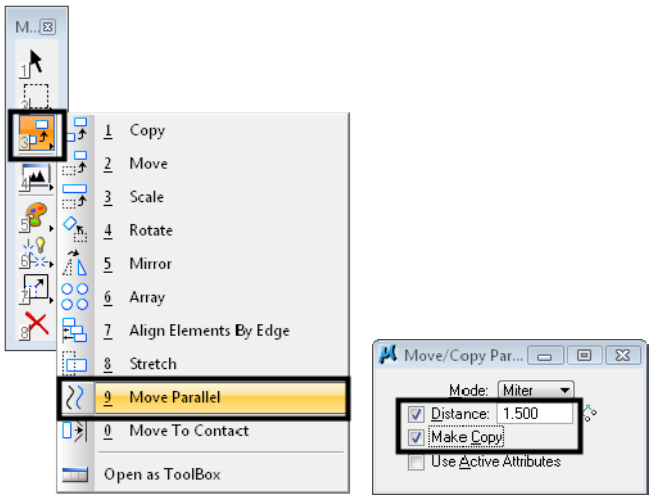
13. In the ***Set Elevation*** dialog box, set the ***Input Mode*** to ***Single***.
14. Toggle off the ***Destination Level***.
15. Key in ***5152*** for the ***Elevation***.



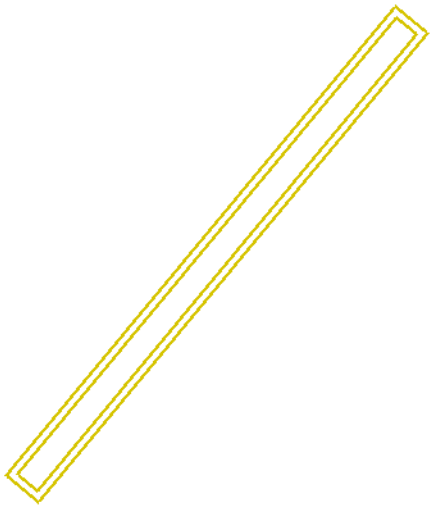
16. **<D> Apply**.
17. **<D>** the outline.
18. **<D>** to Accept.

    Note: The outline may disappear because elevation 5152 is not within your display depth. If it does, Fit your view with MicroStation.

19. Select MicroStation's **Move Parallel** tool.

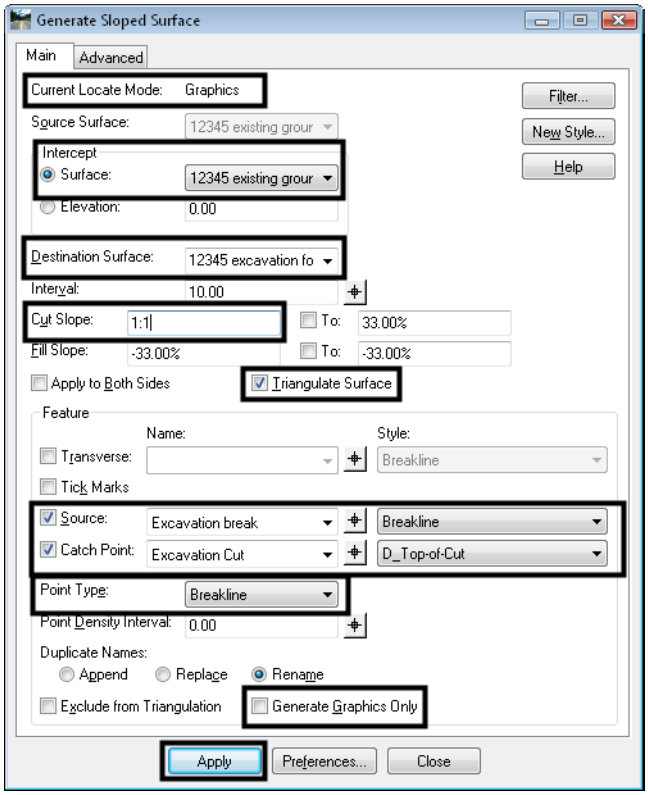


20. Toggle on ***Distance*** and key in ***1.5***.
21. Toggle on ***Make Copy***.
22. **<D>** on the outline.
23. **<D>** to Accept on the outside of the footer outline.



24. **<R>** to stop copying.
25. Select **Surface > Design Surface > Generate Sloped Surface**.
26. Verify that the current ***Locate Mode*** is ***Graphics***. If not, toggle ***Locate Feature / Locate Graphics*** to ***Locate Graphics*** on the ***Locks*** toolbar.
27. Verify that ***Generate Graphics Only*** is toggled off.
28. Set the ***Intercept Surface*** to ***12345 existing ground for interchange***.
29. Key in ***12345 excavation for pier footer*** as the ***Destination Surface***.
30. Set the ***Cut Slope*** to ***1:1***.

    Note: The ratio is automatically converted into a percentage.
31. Toggle on ***Triangulate Surface***.
32. Toggle on ***Source*** and key in ***Excavation break***.
33. Set the ***Style*** to ***Breakline***.
34. Toggle on ***Catch Point*** and key in ***Excavation Cut***.
35. Set the ***Style*** to ***D_Top-of-Cut***.
36. Set the ***Point Type*** to ***Breakline***.

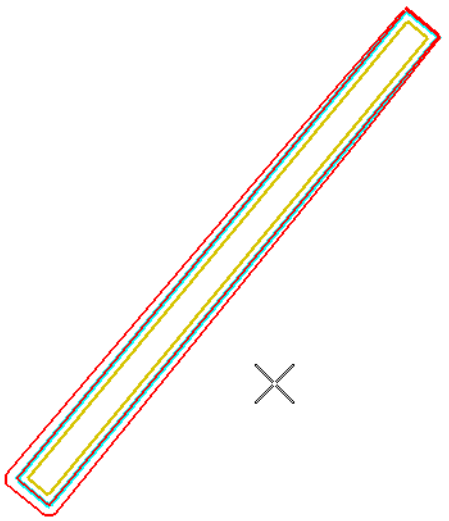


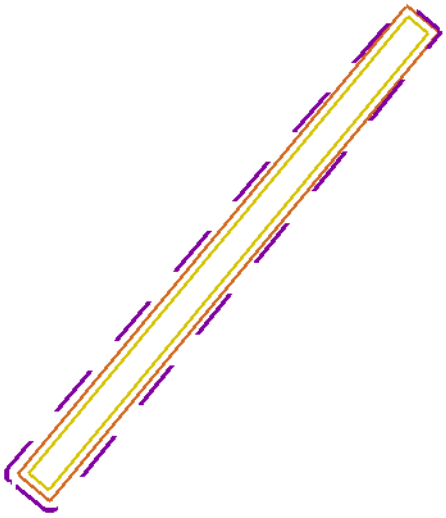
37. **<D> Apply**.

38. **<D>** on the outer pier outline.
39. **<D>** to Accept.
40. **<R>** for Entire (the entire element).

    Important! If you **<D>** again instead of **<R>**, that location is the starting point for the slope and the excavation will not be completed around the pier.

41. Move your cursor to the ***outside*** until the temporary graphic looks like shown here, then **<D>** to Accept the location.





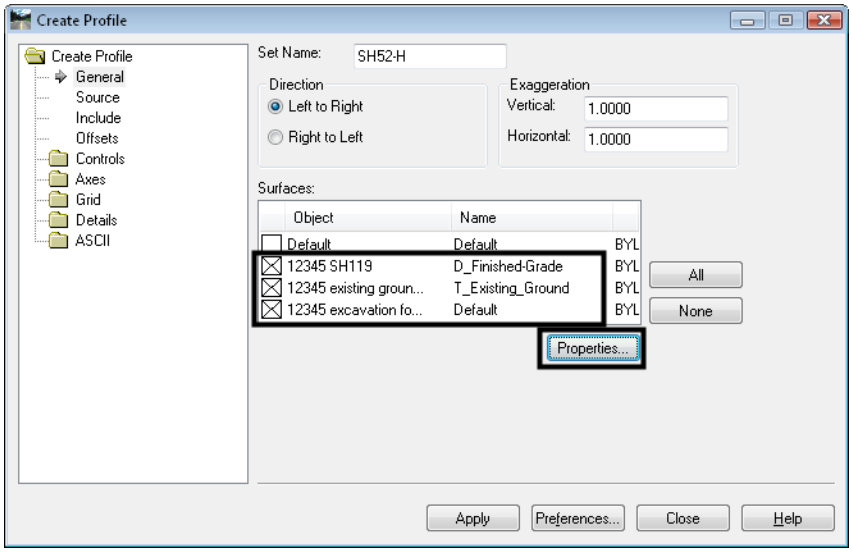
<R> out of the command.

Note: The ***Generate Sloped Surface*** command is very useful for creating sloped surfaces from features or graphical elements that intercept other surfaces. The intercepts can be existing ground surfaces, design surfaces or even surfaces previously created with this command.

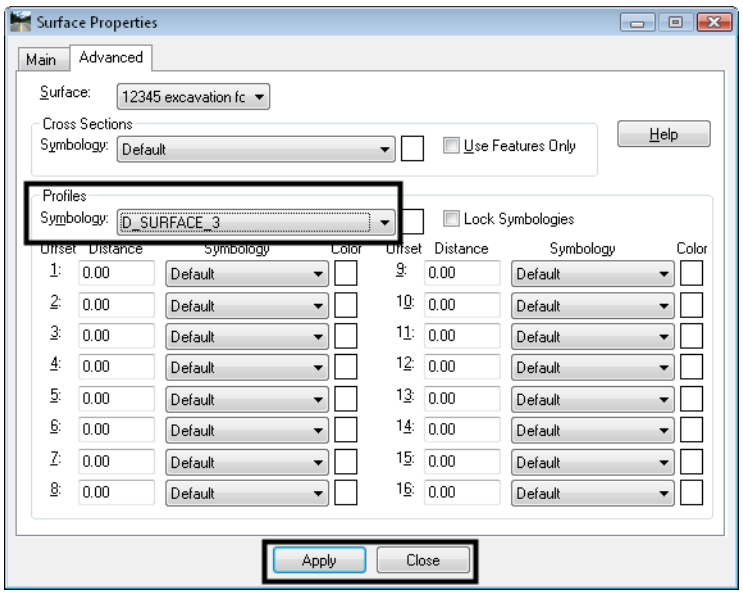
42. Select **Evaluation > Profile > Create Profile**.

43. Toggle on ***12345 existing ground for interchange***, ***12345 SH119*** and ***12345 excavation for pier footer***.

44. Highlight ***12345 excavation for pier footer*** and choose ***Properties***.



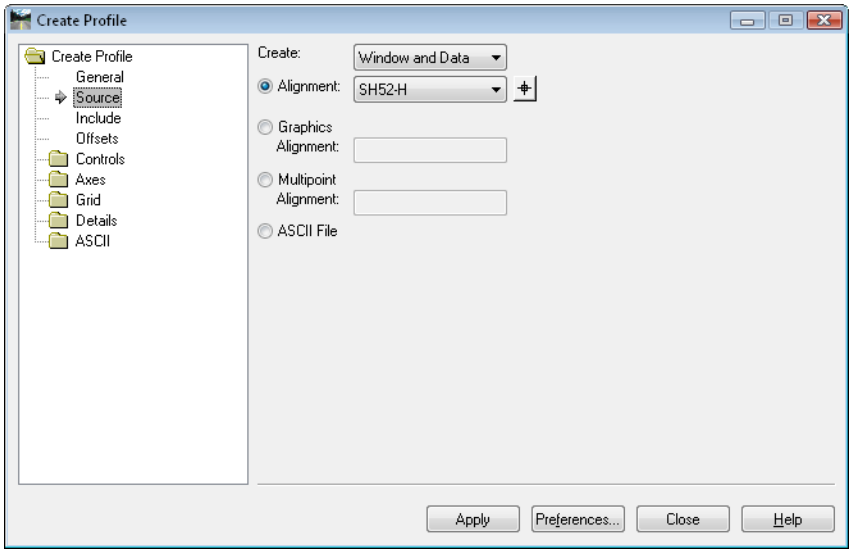
45. Set the ***Profile Symbology*** to ***D_SURFACE_3***.



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

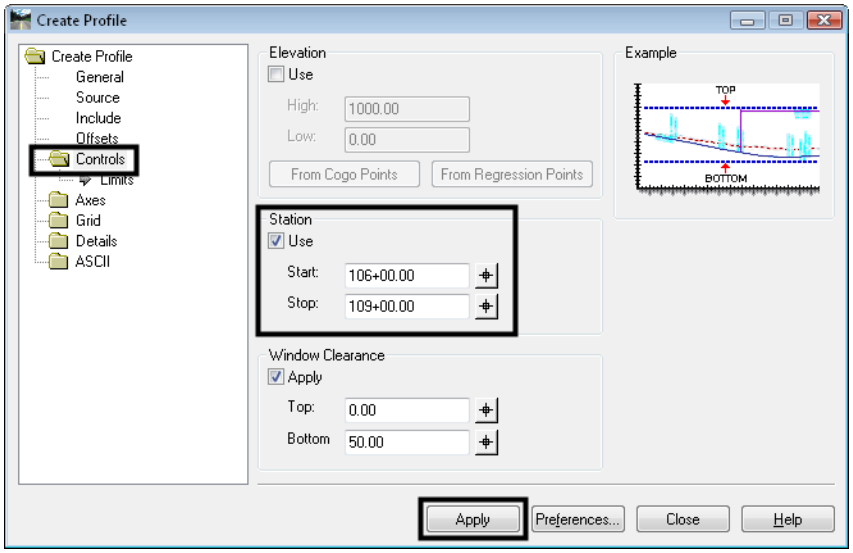
47. Back on the ***Create Profile*** dialog box, select the ***Source*** branch

48. Set ***Alignment*** to ***SH52-H***



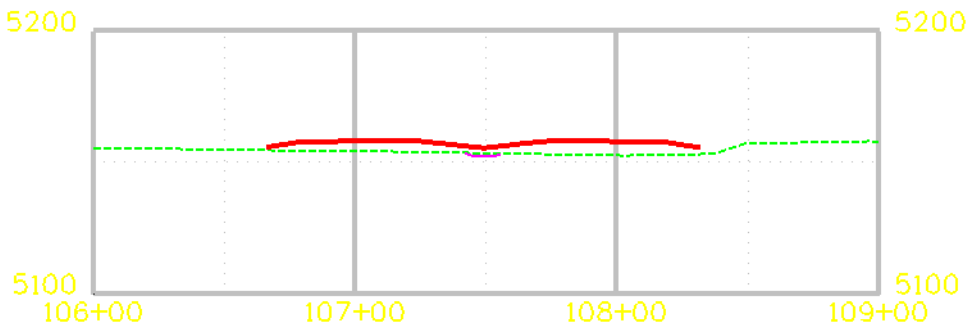
49. Select the ***Controls*** branch.

50. Set the ***Station Limits*** to ***106+00*** to ***109+00***.

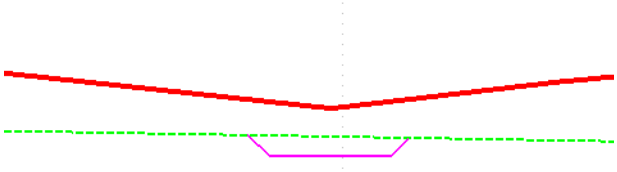


51. **<D> Apply**.

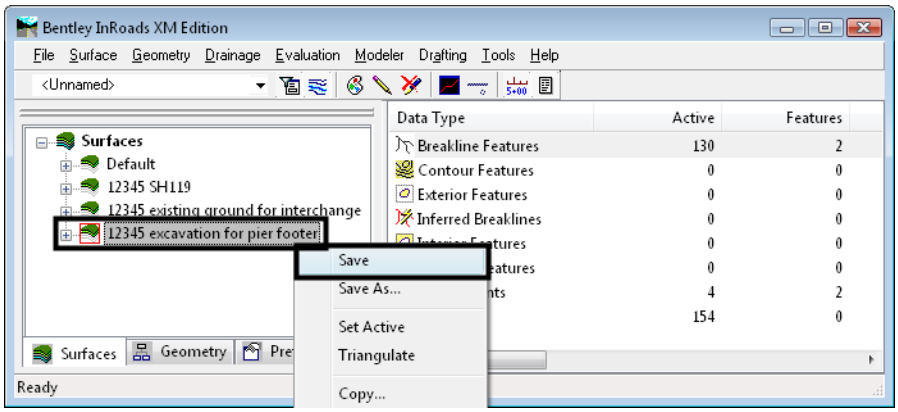
52. **<D>** a clear area in the design file for the location of the profile.



53. Window in to see the excavation surface.

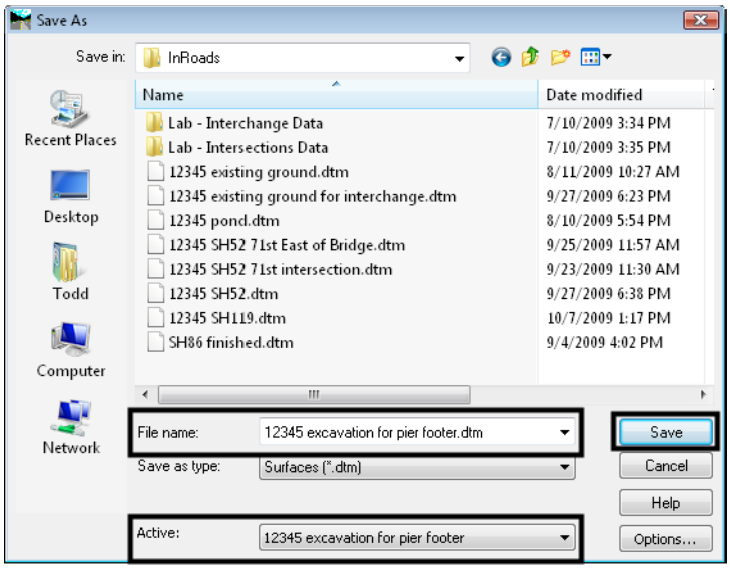


54. Right-click on the ***12345 excavation for pier footer*** surface in the ***Explorer*** part of the menu and choose ***Save***.



Note: Verify the ***Active Surface*** is ***12345 excavation for pier footer***

55. If the ***File name*** is blank, use the ***Active*** drop-down to again choose ***12345excavation for pier footer*** and the name appears in the ***File name*** field as well.



56. Verify the ***Save In*** path is ***C:\Projects\12345\Bridge\InRoads***.

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

Lab 7.3 - Create a Backfill surface for a Pier

Next, the surface for the backfill is created, using the same procedure.

1. Select **Surface > Design Surface > Generate Sloped Surface** if you previously closed it.

2. Verify that the current ***Locate Mode*** is ***Graphics***. If not, toggle ***Locate Feature / Locate Graphics*** to ***Locate Graphics*** on the ***Locks*** toolbar.

3. Verify that ***Generate Graphics Only*** is toggled off.

4. Set the ***Intercept Surface*** to ***12345 SH119***.

5. Key in ***12345 backfill for pier footer*** as the ***Destination Surface***.

6. Set the ***Cut Slope*** to ***1:1***.

   Note: The ratio is automatically converted into a percentage.

7. Toggle on ***Triangulate Surface***.

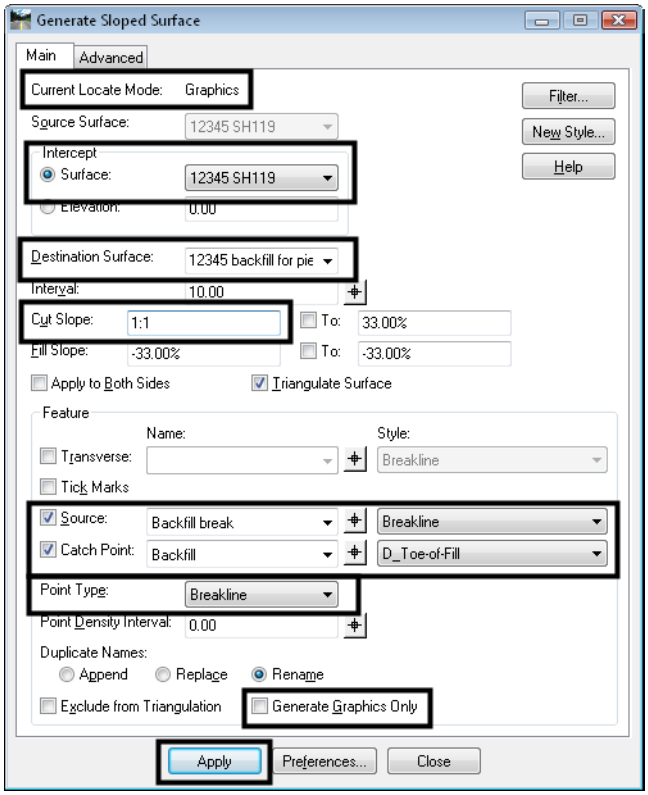
8. Toggle on ***Source*** and key in ***Backfill break***.

9. Set the ***Style*** to ***Breakline***.

10. Toggle on ***Catch Point*** and key in ***Backfill***.

11. Set the ***Style*** to ***D_Top-of-Fill***.

12. Set the ***Point Type*** to ***Breakline***.



13. **<D> Apply**.

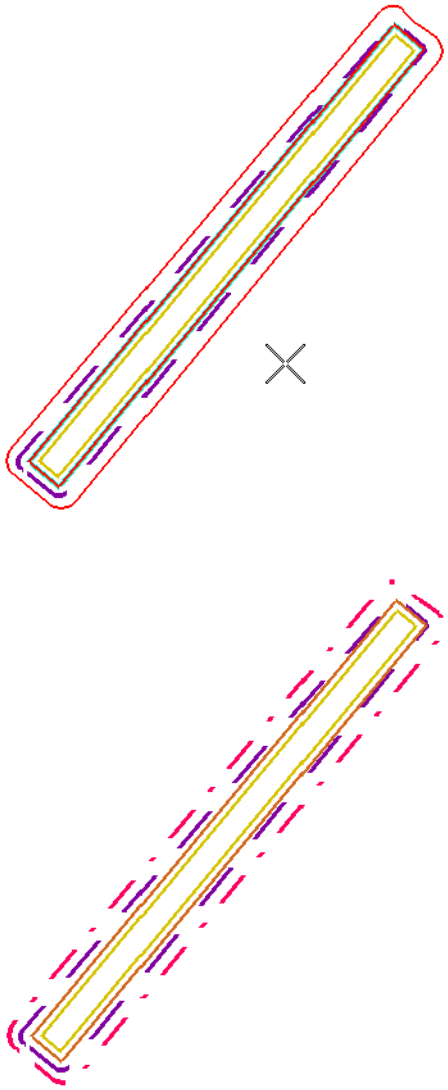
14. **<D>** on the outer pier outline.

15. **<D>** to Accept.

16. **<R>** for Entire (the entire element).

Important! If you **<D>** again instead of **<R>**, that location is the starting point for the slope and the backfill will not be completed around the pier.

17. Move your cursor to the ***outside*** until the temporary graphic looks like shown here, then **<D>** to Accept the location.



18. **<R>**.

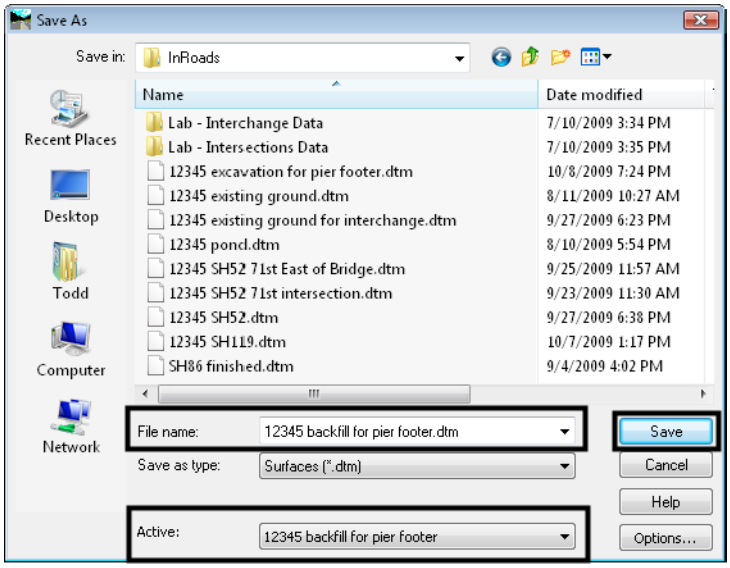
19. **<D> Close** on the ***Generate Sloped Surface*** dialog.

20. Right-click on the ***12345 backfill for pier footer*** surface in the ***Explorer*** part of the menu and choose ***Save***.

    Note: Verify the ***Active Surface*** is ***12345 backfill for pier footer***

21. If the ***File name*** is blank, use the ***Active*** drop-down to again choose ***12345 backfill for pier footer*** and the name appears in the ***File name*** field as well.

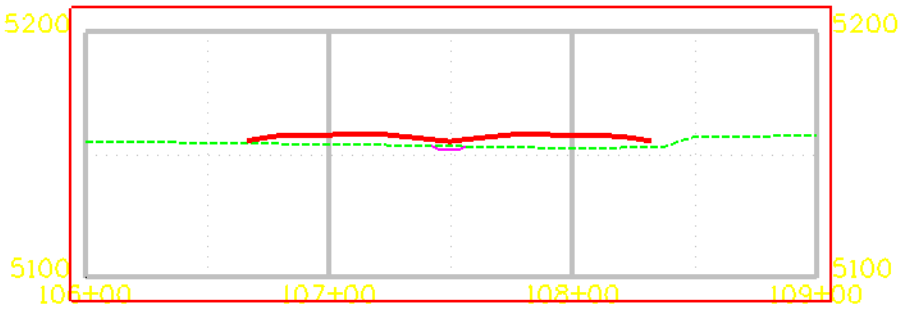
22. Verify the ***Save In*** path is ***C:\Projects\12345\Design\InRoads***.



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

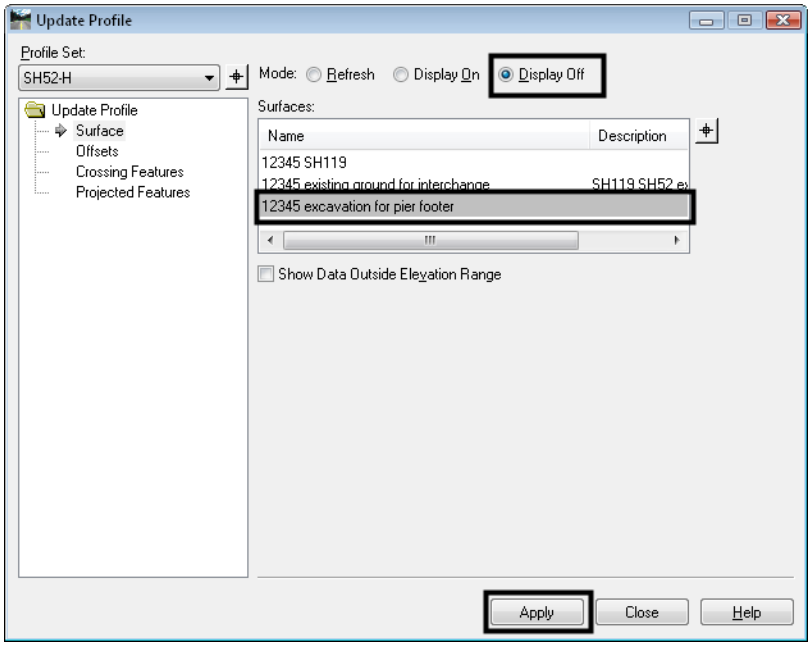
24. Select **Evaluation > Profile > Update Profile**.

25. Verify the ***Profile Set*** is the one used in the previous section if you have more than one in your file. A box is drawn around the Profile Set listed.

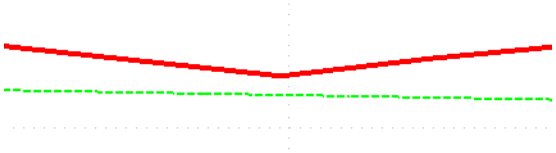


26. Toggle ***Mode*** to ***Display Off***.

27. Highlight the ***12345 excavation for pier footer***.



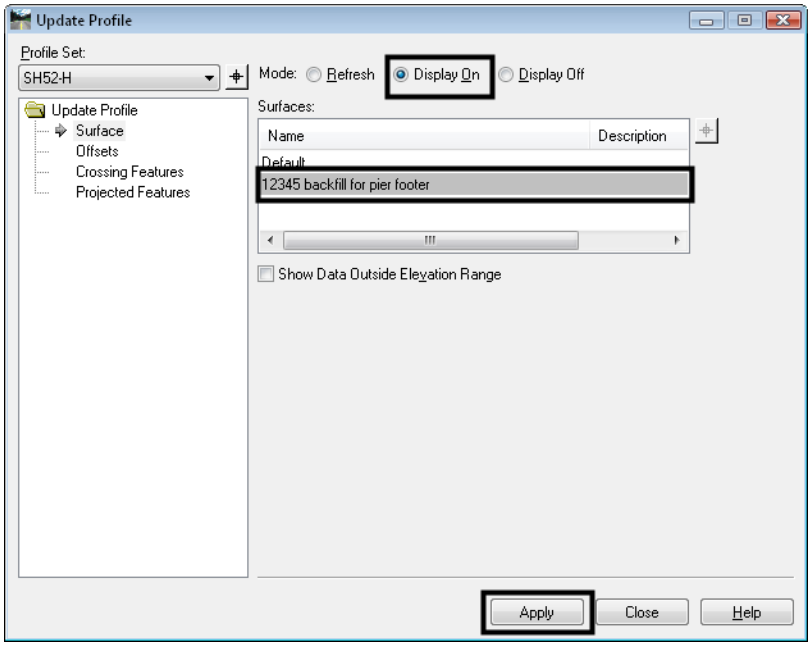
28. **<D> Apply**.



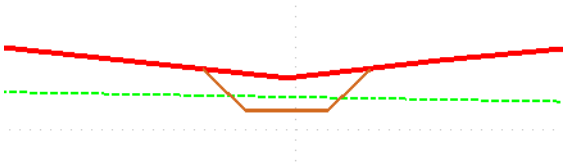
Note: The excavation surface is no longer shown on the profile.

29. Toggle ***Mode*** to ***Display On***.

30. Highlight the ***12345 backfill for pier footer***.



31. **<D> Apply**.



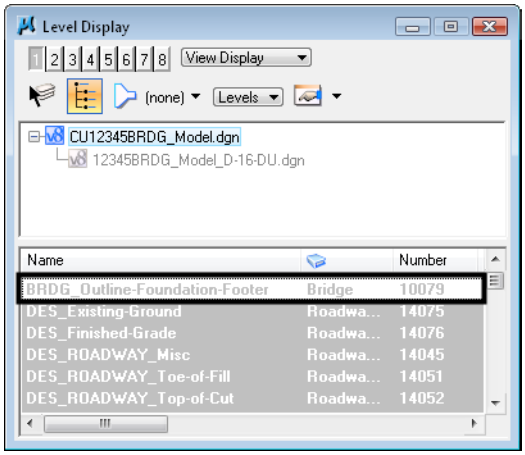
Note: The backfill surface is now shown on the profile.

32. **<D> Close** on the ***Update Profile*** dialog.

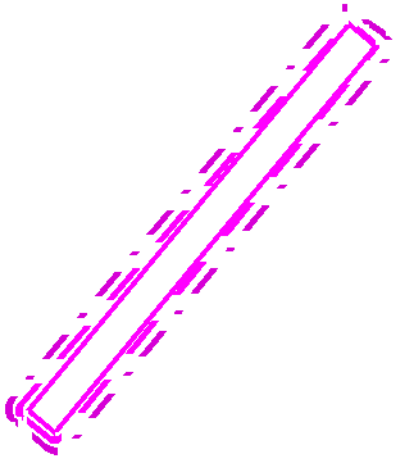
Lab 7.4 - Create Pier Features

The footer and pier must be excluded from the backfill quantities. This can be accomplished by manually calculating the quantity and deducting it from what will be calculated from the surface as it exists now. Or, features may be added to the surface that take the footer and pier into account when InRoads computes the quantity. In the next series of steps, the second option is shown, creating four breaklines: ***bottom of footer***, ***top of footer***, ***bottom of pier***, and ***top of pier***. Since DTMs do not support overhangs or true verticals, the footer and pier are represented as 'near' verticals.

1. Turn off the ***BRDG_Outline-Foundation-Footer level***.

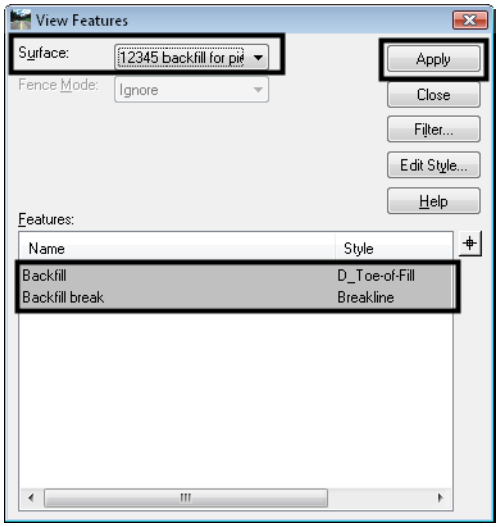


2. **Delete** all of the remaining plan graphics to make it easier to see the features as they are developed (do not delete the profile graphics).

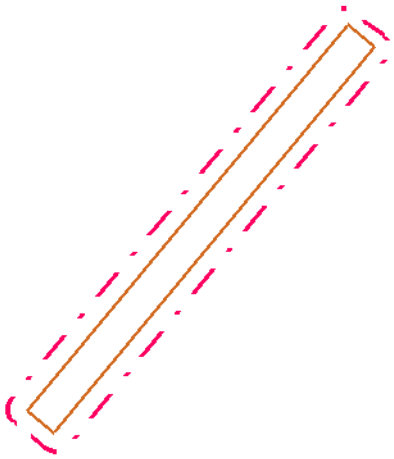


3. Select **Surface > View Surface > Features**.
4. Set the ***Surface*** to ***12345 backfill for pier footer***.

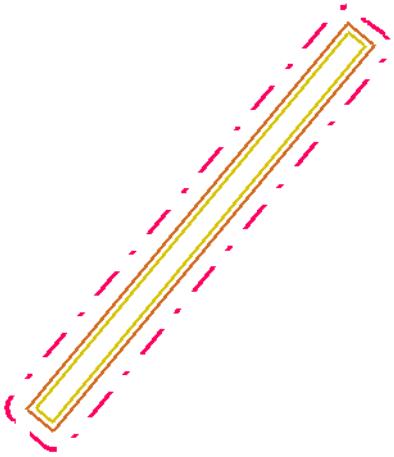
5. Highlight both features.



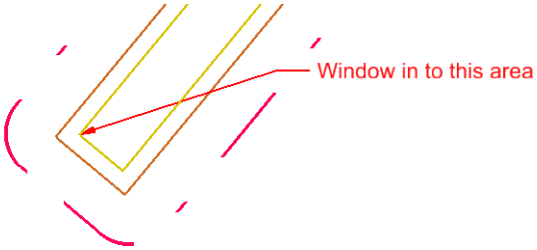
6. **<D> Apply**, then **Close**.

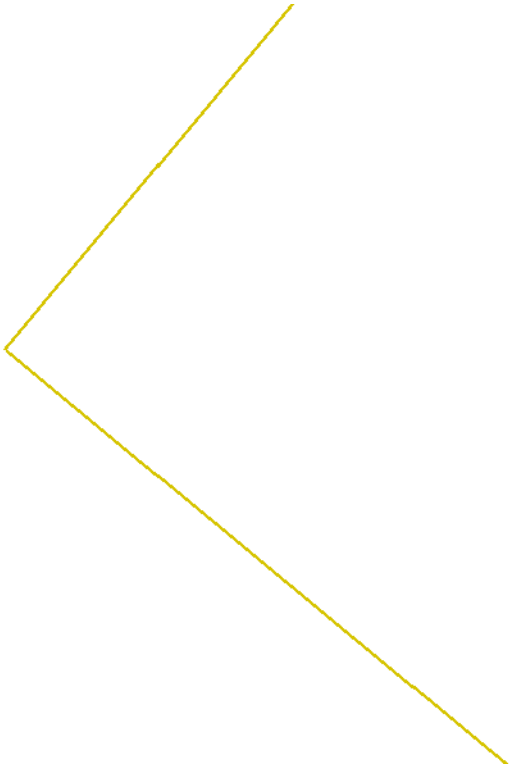


7. Turn on the ***BRDG_Outline-Foundation-Footer level***.

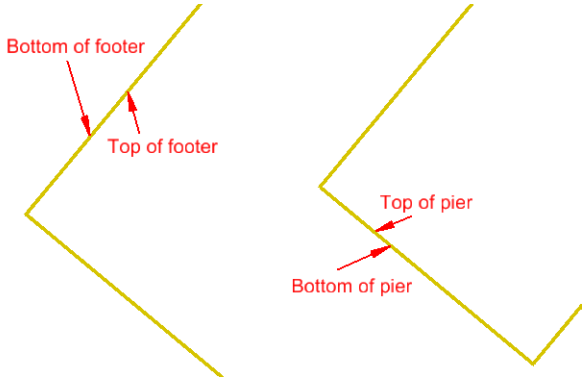


8. Window in to the corner of the footer.

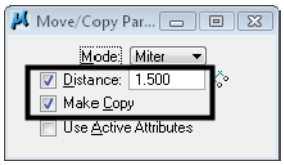




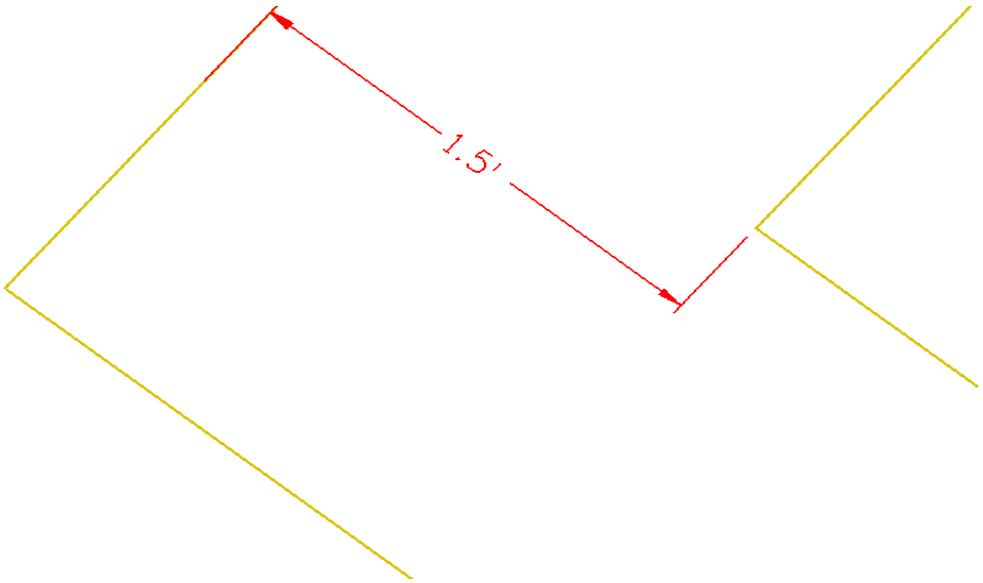
Note: This element represents the bottom of the footer. In the next series of steps, MicroStation is used to create 3 parallel copies of this element.



9. Select MicroStation's **Move Parallel** tool.
10. Toggle on ***Distance*** and key in ***1.50***.
11. Toggle on ***Make Copy***.

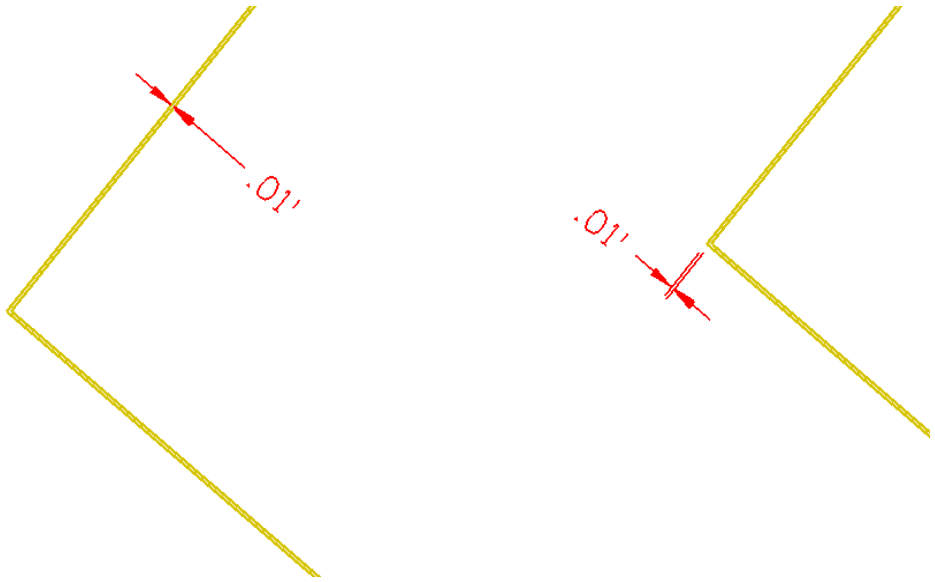


12. **<D>** on the footer outline.
13. **<D>** to Accept ***inside*** the footer outline.
14. **<R>** to end the copy.



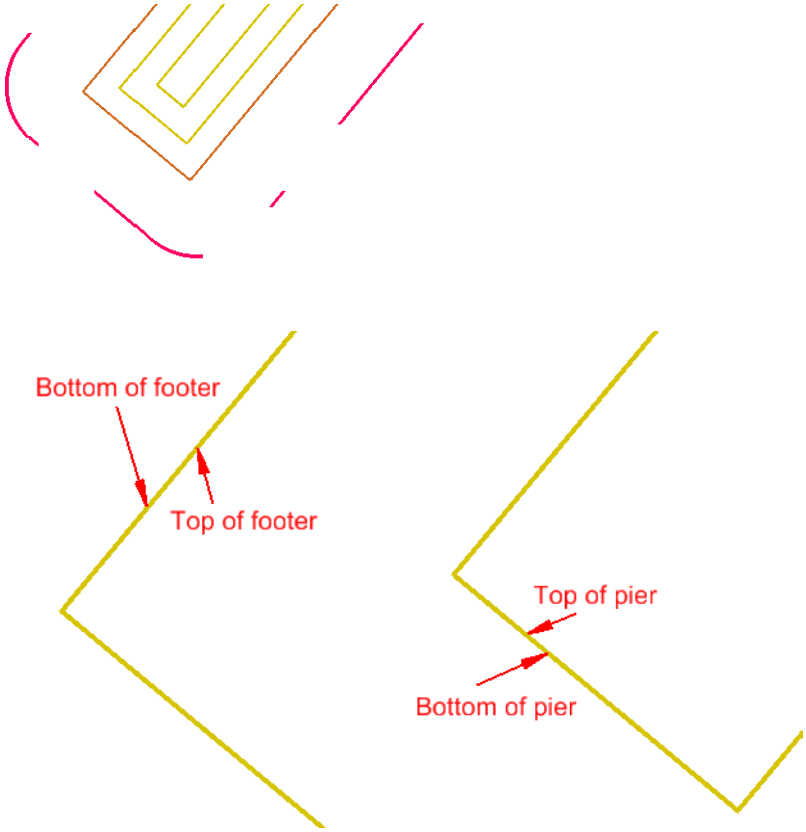
Note: This is the bottom of the pier.

15. In the **Move Parallel** command, change the ***Distance*** to ***0.01***.
16. Make a copy of each line, to the inside.



Note: These lines represent the top of the footer and the top of pier.

Note: There are now four concentric rectangles representing the footer and pier. In this case, one monolithic pier is being used; for multiple piers this procedure would be repeated for each.



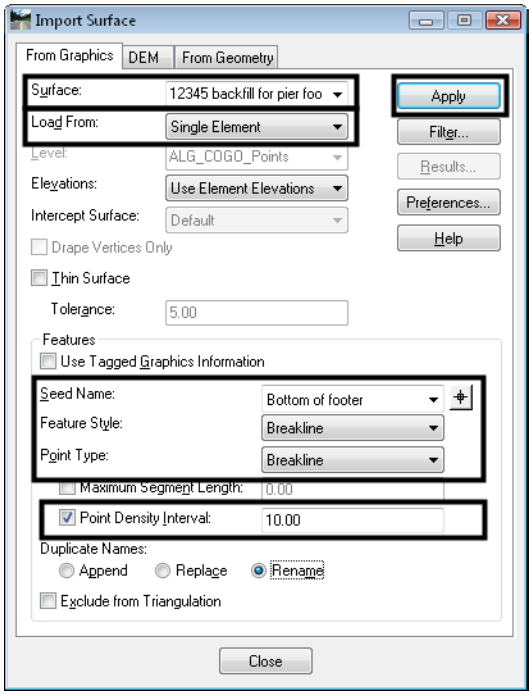
Each of these MicroStation shapes must now be made into a feature, then moved to the correct elevation.

17. Select **File > Import > Surface**.
18. Select the ***From Graphics*** tab.
19. Set the ***Surface*** to ***12345 backfill for pier footer***.
20. Set ***Load From*** to ***Single Element***.
21. Set ***Elevations*** to ***Use Element Elevations***.

    Note: All of these shapes are at the same elevations. After importing them, the proper elevations will be set.

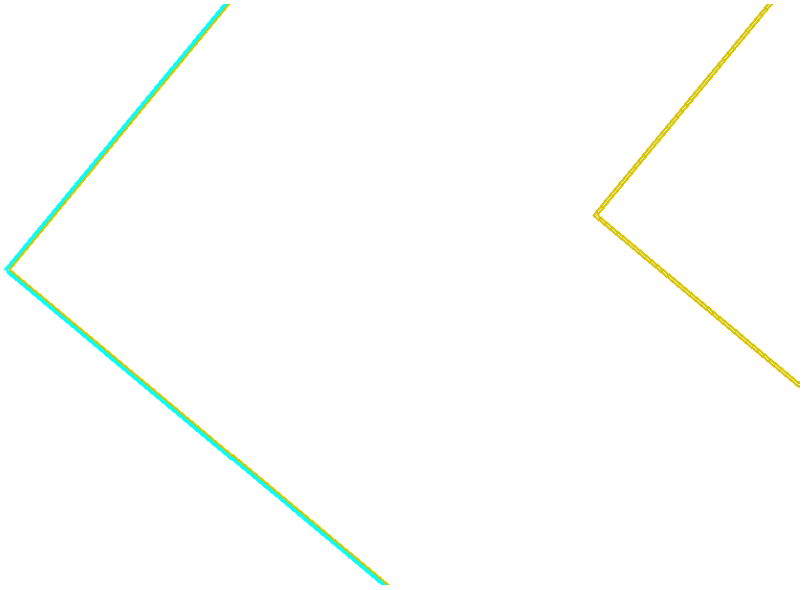
22. Key in ***Bottom of footer*** for the ***Seed Name***.
23. Set the ***Feature Style*** to ***Breakline***.
24. Set the ***Point Type*** to ***Breakline***.

25. Toggle on ***Point Density Interval*** and key in ***10.00*** for the value.



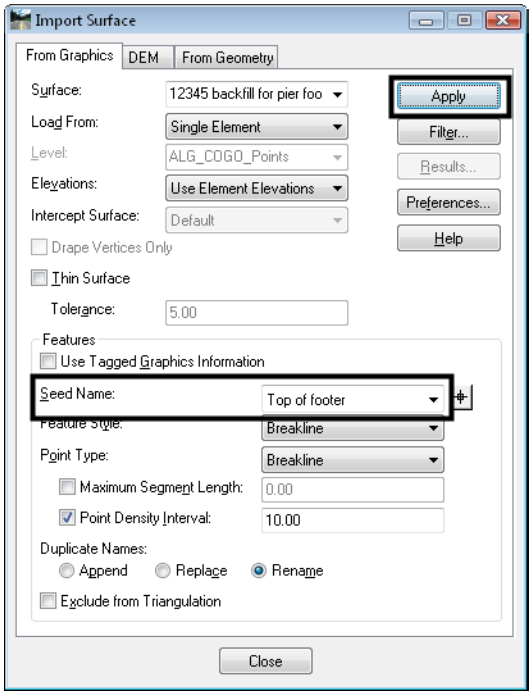
26. **<D> Apply**.

27. **<D>** on the bottom of footer line.



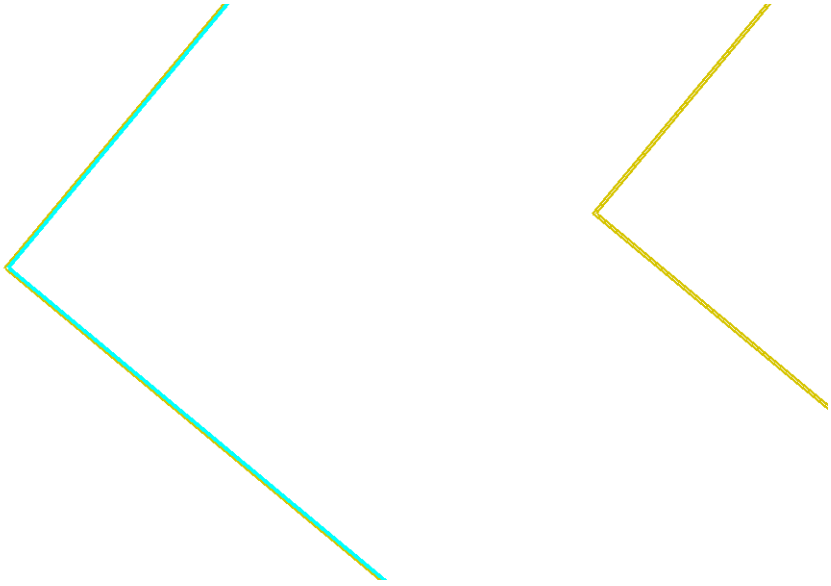
28. **<D>** to Accept.

29. Key in ***Top of footer*** for the ***Seed Name***



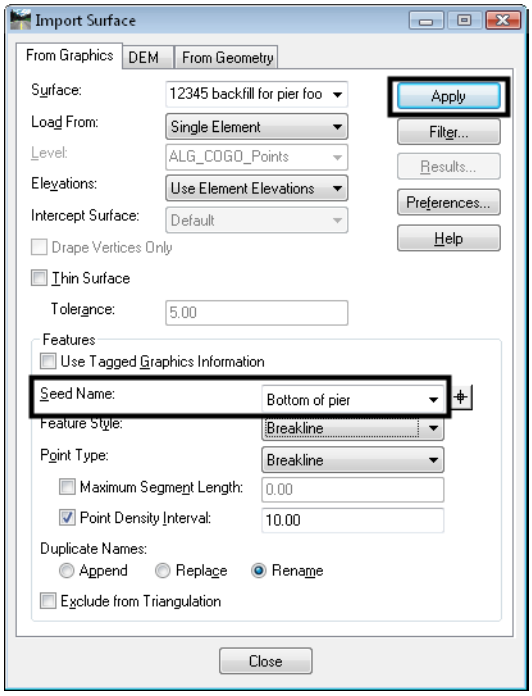
30. **<D> Apply**.

31. **<D>** on the top of footer line.



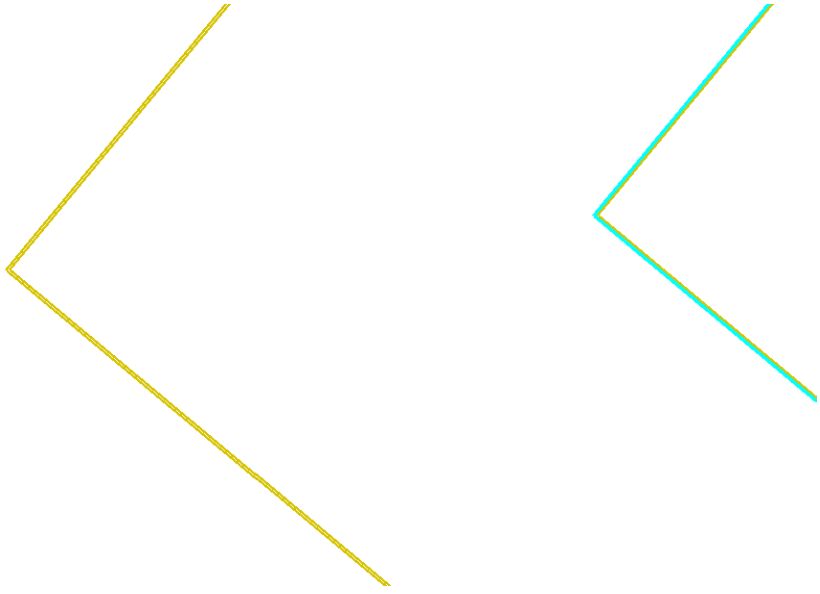
32. **<D>** to Accept.

33. Key in ***Bottom of pier*** for the ***Seed Name***.



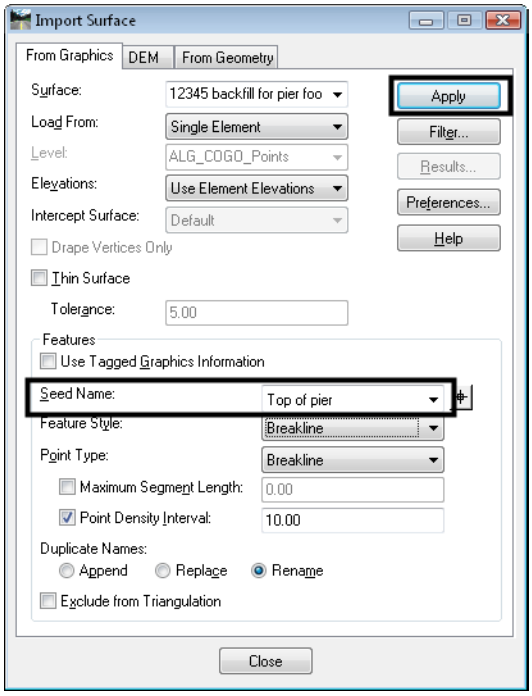
34. **<D> Apply**.

35. **<D>** on the bottom of pier line.



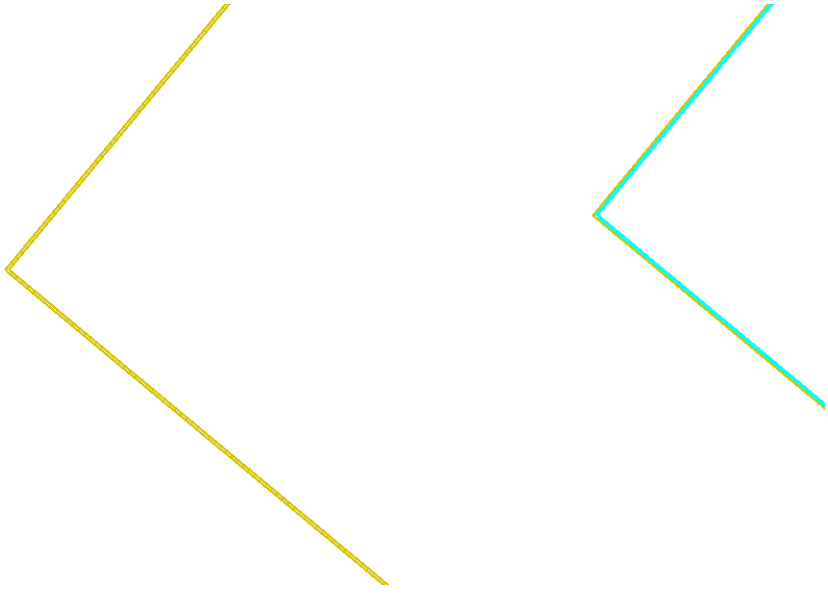
36. **<D>** to Accept.

37. Key in ***Top of pier*** for the ***Seed Name***.



38. **<D> Apply**.

39. **<D>** on the top of pier line.



40. **<D>** to Accept.

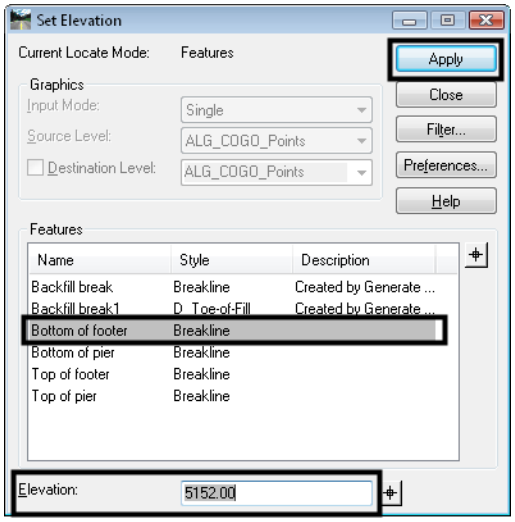
41. Select **Surface > Design Surface > Set Elevation**.

42. If the current ***Locate Mode*** is not set to ***Features***, toggle ***Locate Graphics/Locate Features*** on the locks toolbar to ***Locate Features***.

Note: This command can set the elevation of either graphical elements or features. Since the shapes have already been loaded into the surface, they are already features.

43. Highlight the ***Bottom of footer*** feature.

44. Key in an ***Elevation*** of ***5152***.



45. **<D> Apply**.

46. Highlight the ***Top of footer*** feature.

47. Key in an ***Elevation*** of ***5153.5***.

48. **<D> Apply**.

49. Highlight the ***Bottom of pier*** feature.

50. Leave the ***Elevation*** set to ***5153.5***.

51. **<D> Apply**.

52. Highlight the ***Top of pier*** feature.

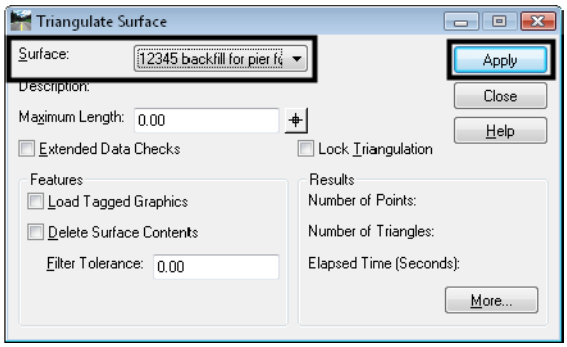
53. Key in an ***Elevation*** of ***5180***.

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

Note: Alternately, you can set the MicroStation graphics to the correct elevation using the ***Set Elevation*** command prior to importing the graphics as features into InRoads.The ***Set Elevation*** command works on either graphics or features based on the ***Locate mode***.

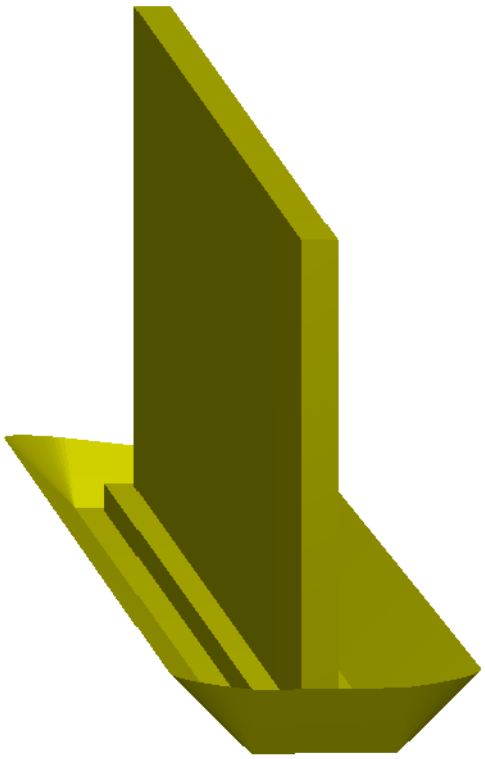
55. Select **Surface > Triangulate Surface**.

56. Verify the ***Surface*** is ***12345 backfill for pier***.



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

Note: This has basically created a footer and pier sitting in a trough. The triangles and/or contours may be displayed to review the surface if desired. This image shows a rotated view of the triangles that has been shaded using MicroStation's **Utilities > Render > Smooth**.



58. ***Save*** the ***12345 backfill for pier footer*** surface to the directory C:\Projects\12345\Bridge\InRoads.

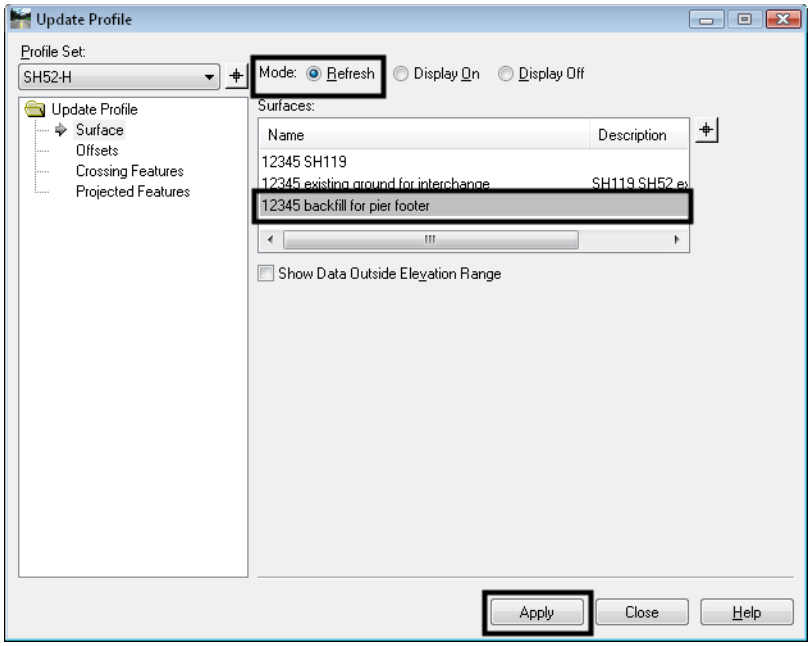
59. Window in to the previously displayed profile.

60. Select **Evaluation > Profile > Update Profile**.

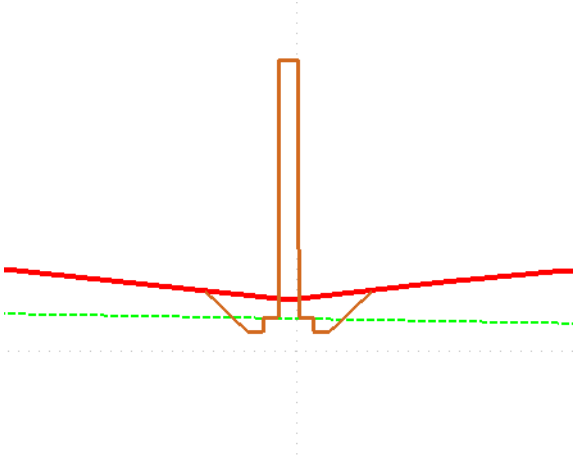
    Note: If there is more than one profile in the design file, make certain the correct ***Profile Set*** is listed.

61. Set the ***Mode*** to ***Refresh***.

62. Highlight the ***12345 backfill for pier surface***.



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



Note: This surface, along with the excavation surface will be used in a later lab to calculate volumes.

Chapter Summary:

- The ***Generate Sloped Surface*** command is very useful for creating sloped surfaces from features or graphical elements that intercept other surfaces.
- The intercepts can be existing ground surfaces, design surfaces or even surfaces previously created with this command.
- Features can be added to a proposed surface representing footers, piers, walls, etc.), which can be used for volume computations.
- MicroStation elements or surface features can be placed at the correct elevation using the ***Set Elevation*** command in InRoads.
- MicroStation elements can be imported as surface features using the ***Import Surface*** command in InRoads; if they are not at the correct elevation, the elevation can be set using the InRoads ***Set Elevation*** command.

LAB 8 - Evaluating Bridge Design Surfaces

In this lab you will evaluate the excavation and backfill surfaces you created in the previous lab by computing cut and fill volumes. InRoads provides different methods for computing volumes. In this lab, you will work with three different methods.

Chapter Objectives:

- Learn how to compute Triangle volumes.
- Learn how to set default XSL style sheets to format InRoads reports.
- Learn how to compute Grid volumes as a check for the triangle volumes.
- Learn how the grid interval affects grid volume results.
- Learn how to compute End Area Volumes from cross section graphics.

The following files are used in this lab:

- C:\Projects\12345\Bridge\Working \CU12345BRDG_Model.dgn
- C:\Workspace\Workspace-CDOT_XM\Standards-Global\InRoads\Preferences\ CDOT_Civil.xin
- C:\Projects\12345\Design\InRoads\12345 SH119
- C:\Projects\12345\Design\InRoads\12345 SH119 SH52 Interchange.alg
- C:\Projects\12345\ROW_Survey\InRoads\DTM\12345 existing ground for interchange

Note: The following files were created in the previous lab ***"Feature Based Modeling."*** If these files don't exist in the location identified below then they can also be copied from the directory ***C:\Projects\12345\Miscellaneous\BRDG-08***

- C:\Projects\12345\Bridge\InRoads\12345 backfill for pier footer
- C:\Projects\12345\Bridge\InRoads\ 12345 excavation for pier footer

Lab 8.1 - Open Data Files

1. Open MicroStation and InRoads using the ***C:\Projects\12345\Bridge\Working \CU12345BRDG_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***, ***12345 backfill for pier footer***, ***12345 excavation for pier footer***, and ***12345 SH119 SH52 interchange.alg***.
5. Open ***C:\Projects\12345\ROW_Survey\InRoads\DTM\12345 existing ground for interchange***.

Lab 8.2 - Compute the Pier Excavation Volume

The triangle is the most accurate method of computing volumes in InRoads. It compares existing and design surfaces to compute cut, fill and net volume between the surfaces. Since you have created an excavation surface for the pier footer, you can use the triangle method to compare this surface to the existing ground surface and compute the amount of cut needed for the excavation of the footer.

The grid method provides a quick check against other volume methods to ensure volume accuracy. The smaller you set the grid interval, the more accurate the volume results. You'll use the grid method to check your triangle volume.

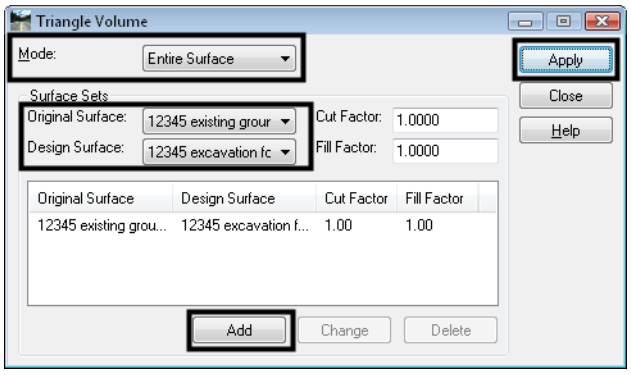
1. **Delete** any MicroStation graphics currently in the design file.
2. Select **Evaluation > Volumes > Triangle Volume**.
3. Set ***Mode*** to ***Entire Surface***.

   Note: You have the option to compute volumes on a portion of the surface using a MicroStation fence or shape. Areas outside of the smaller of the two surfaces are ignored.

4. Set ***Original Surface*** to ***12345 existing ground for interchange***.
5. Set ***Design Surface*** to ***12345 excavation for pier footer***.

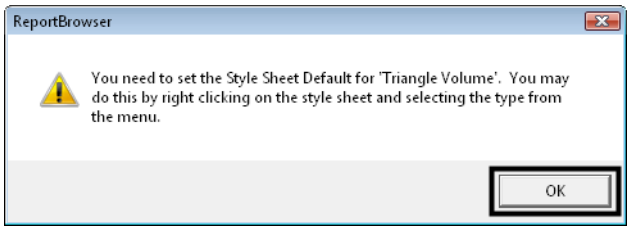
Note: ***Cut*** and ***Fill Factors*** are swell and shrinkage factors that you can apply to the volumes depending on the classification of material.

6. **<D> Add**.

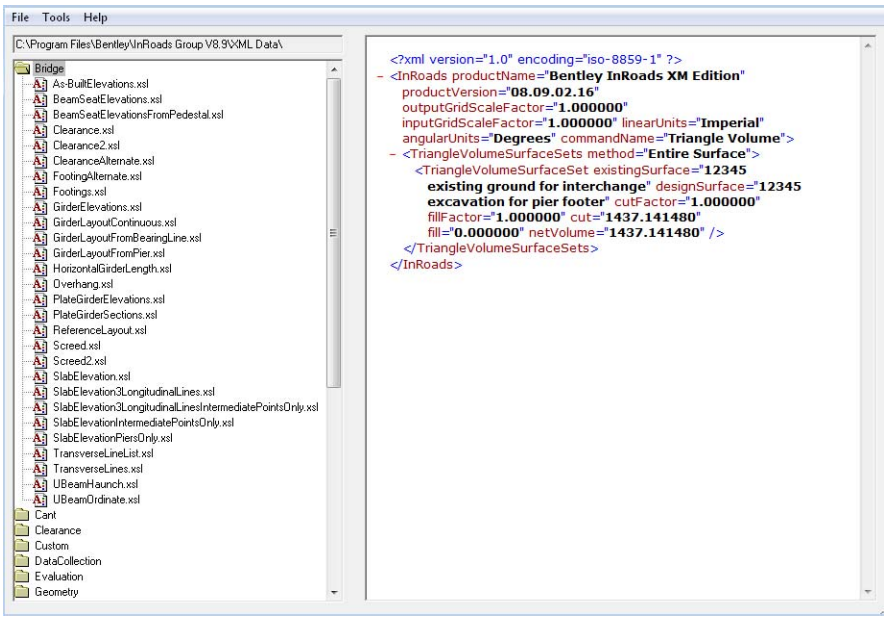


7. **<D> Apply**.

8. If you receive a warning message that a default style sheet has not been selected for the ***Triangle Volume*** report, select **OK** after receiving this message. You will set a default style sheet in this lab.

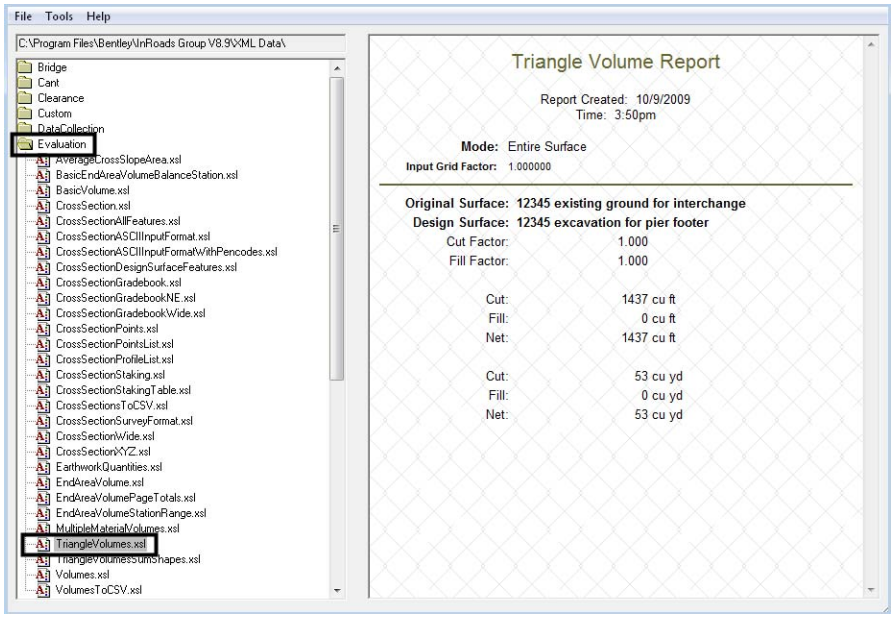


Note: The ***Bentley InRoads Report Browser*** automatically starts, allowing you to select a style sheet (i.e. a report template) to format the report. All available report style sheets are organized in folders and listed on the left-hand side of the report browser. The right-hand side shows the report ***XML*** data.



9. In the ***Report Browser***, select the ***Evaluation*** folder.

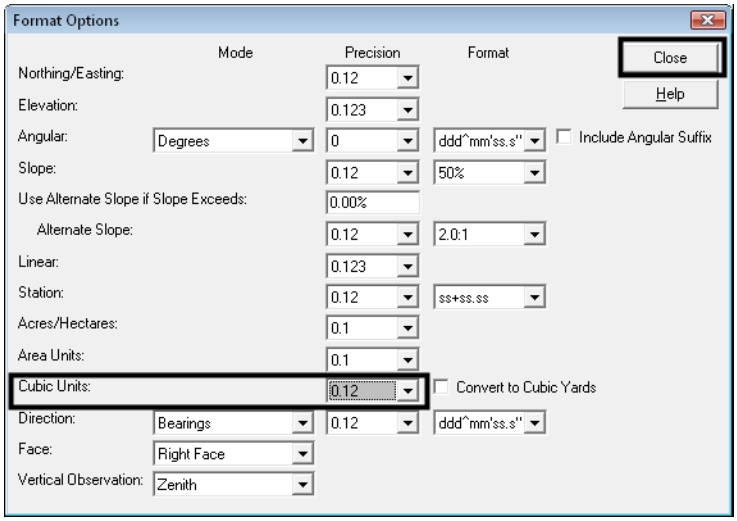
10. Select the ***TriangleVolumes.xsl*** style sheet.



Note: The ***XML*** data is formatted using this report style sheet.

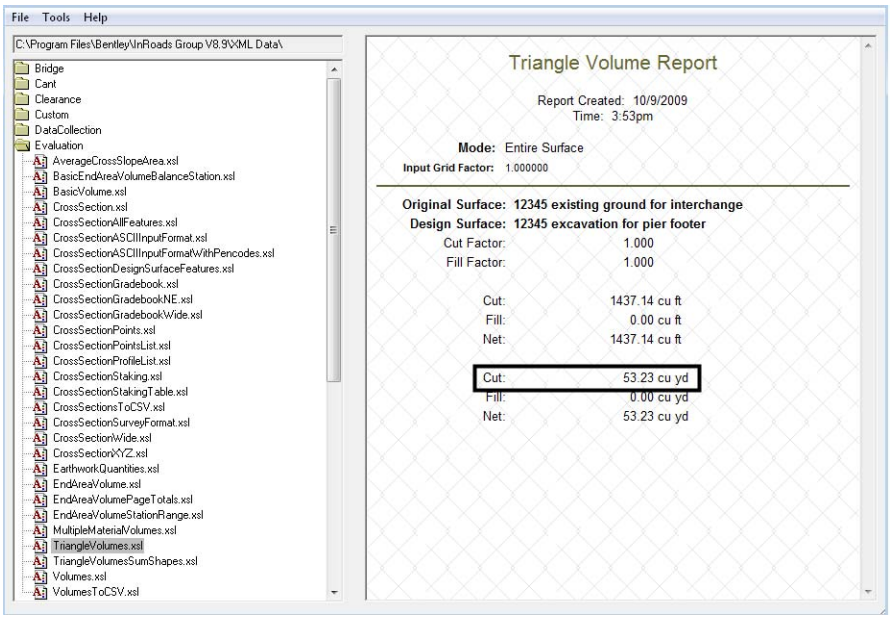
11. In the ***Report Browser*** window, select **Tools > Format Options**.

12. In the ***Format Options*** dialog box, set ***Cubic Units*** to ***0.12*** precision.



13. **<D> Close**.

Note: The report automatically updates with the new formatting.



14. Record your results:

Cut: _____ cu yd.

Note: Any fill that is listed should be negligible.

15. Right-click on the ***TriangleVolumes.xsl*** style sheet and select ***Set Default Triangle Volume***.

Note: The next time you run the ***Triangle Volume*** command, InRoads will automatically use this style sheet without you having to select it. You can always select another style sheet from the ***Report Browser*** to change the report formatting at any time.

16. **Close** the ***Triangle Volume Report*** by select the ***X*** in the upper right corner of the ***Report Browser***.

17. In the ***Triangle Volume*** command, **<D> Close**.

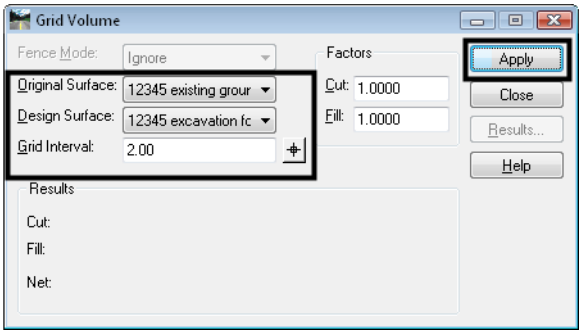
Next, you will check your triangle volumes by computing grid volumes.

18. Select **Evaluation > Volumes > Grid Volume**.

19. Set ***Original Surface*** to ***12345 existing ground for interchange***.

20. Set ***Design Surface*** to ***12345 excavation for pier footer***.

21. For ***Grid Interval*** Key in ***2.0***.



22. **<D> Apply**.

    Note: For this command, the volume results appear in the dialog box instead of a report.

23. Record your results in the table below.

24. For ***Grid Interval*** Key in ***1.0***.

25. **<D> Apply**.

26. Record your results in the table below.

27. For ***Grid Interval*** Key in ***0.5***.

28. **<D> Apply**.

29. Record your results in the table below.

	Interval = 2.0	**Interval = 1.0**	**Interval = 0.5**
Cut Volume	cu yd.	cu yd.	cu yd.

    Note: As you decrease the size of the grid interval, your grid volume should approach the triangle volume results with increased accuracy. If your ***0.5*** grid interval volume does not compare favorably to your triangle volume, see your instructor.

30. **<D> Close** on the ***Grid Volume*** dialog box.

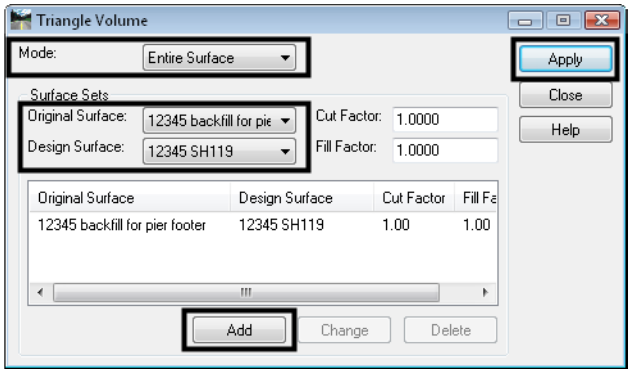
Lab 8.3 - Compute the Pier Backfill Volume

In this section, you will use the same volume commands to compute your backfill quantities.

1. Select **Evaluation > Volumes > Triangle Volume**.
2. Set ***Mode*** to ***Entire Surface***.
3. Set ***Original Surface*** to ***12345 backfill for pier footer***.
4. Set ***Design Surface*** to ***12345 SH119***.

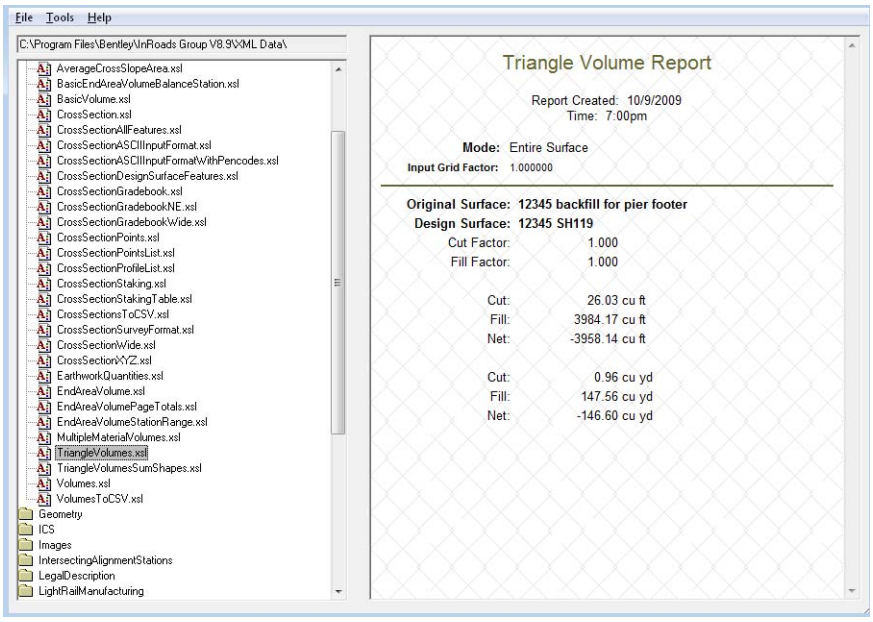
Note: The backfill surface is set as the ***original surface*** in order for the results to display as a "fill" volume.

5. **<D> Add**.



6. **<D> Apply**.

Note: Since you previously selected a default style sheet for this command, you do not get the warning message and the report is automatically generated using the ***TriangleVolumes.xsl*** style sheet.



7. Record your results:

Fill: _____ cu yd.

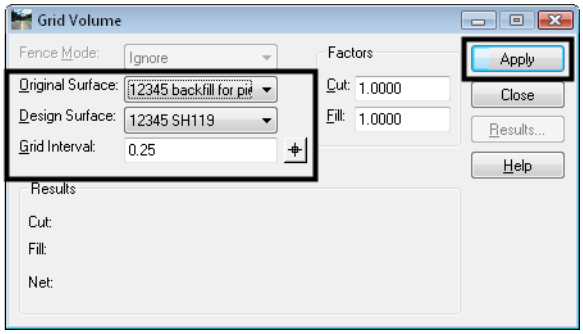
8. **Close** the ***Triangle Volume Report*** by select the ***X*** in the upper right corner of the ***Report Browser***.

9. In the ***Triangle Volume*** dialog box, **<D> Close**.

Next, you will check your triangle volumes by computing grid volumes.

10. Select **Evaluation > Volumes > Grid Volume**.
11. Set ***Original Surface*** to ***12345 backfill for pier footer***.
12. Set ***Design Surface*** to ***12345 SH119***.
13. For ***Grid Interval*** key in ***0.25***.

Note: An acceptable grid interval depends on the size of your surfaces, the variation and relief in your surfaces, whether or not your surfaces were surveyed, how they were surveyed, etc. You may need to try a few grid intervals based on these variables before converging on a good net number. For our two surfaces, an interval of ***0.25*** should provide accurate results.



14. **<D> Apply**.
15. Record your results:

Fill: _____ cu yd.

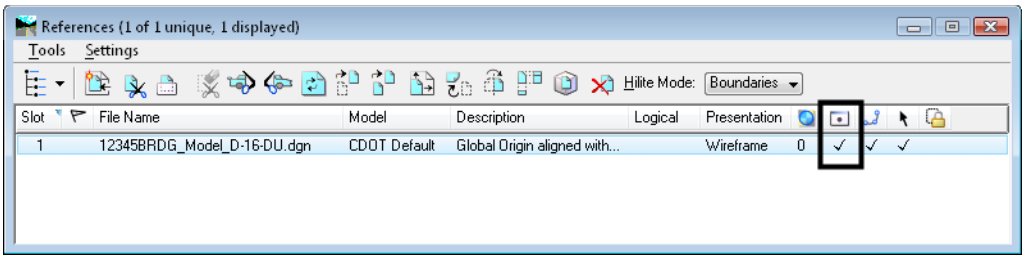
Note: Your grid volume results should compare favorably to your triangle volume results. If not, see your instructor.

Lab 8.4 - Compute End Area Volumes

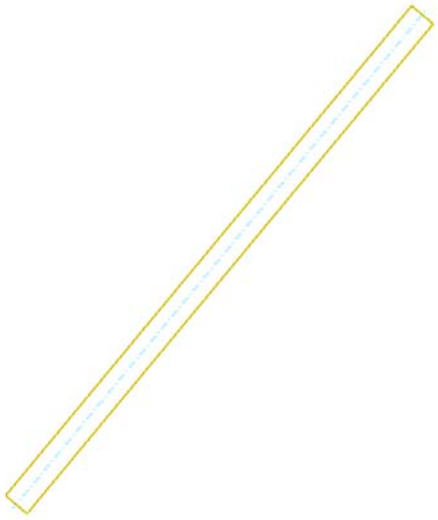
You may also want to use the ***End Area Volumes*** command as another check of your triangle volumes or if your contractor requires end area volumes for his work. The ***End Area*** method requires that you have a set of cross sections cut showing the surfaces from which you want to compute volumes. The volumes are calculated from the cross section graphics instead of comparing DTM data, as with the ***Triangle*** and ***Grid*** methods.

In this section you will compute the end area volume for your pier footer backfill. In order to do so, you must first cut a set of cross sections along the pier. You can either cut cross sections on a graphic or an alignment, so you will copy the pier centerline element from the reference file into the active bridge model file.

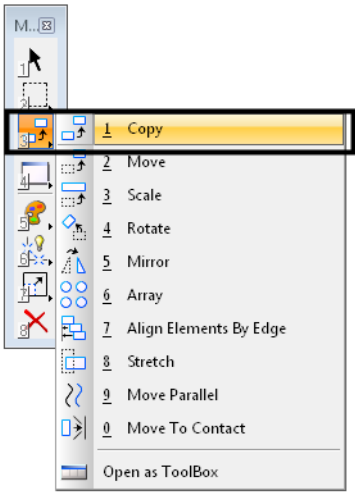
1. If your reference file is not turned on, select **File > Reference** and toggle on the display of the ***12345BRDG_Model_D-16-DU*** file.



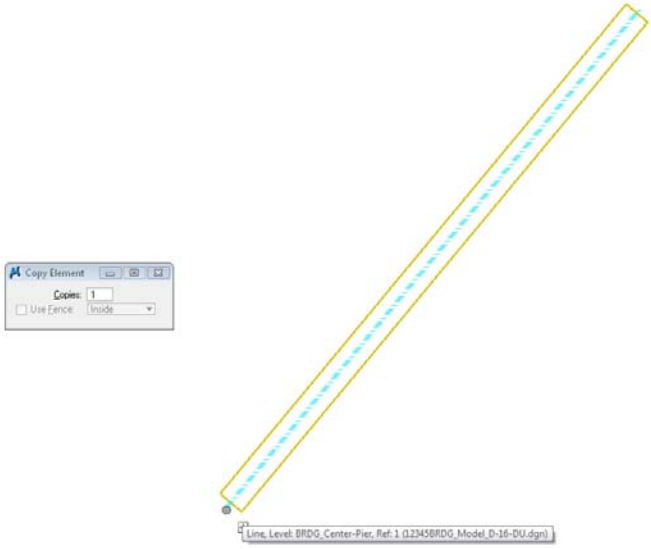
2. Window in on the pier centerline.



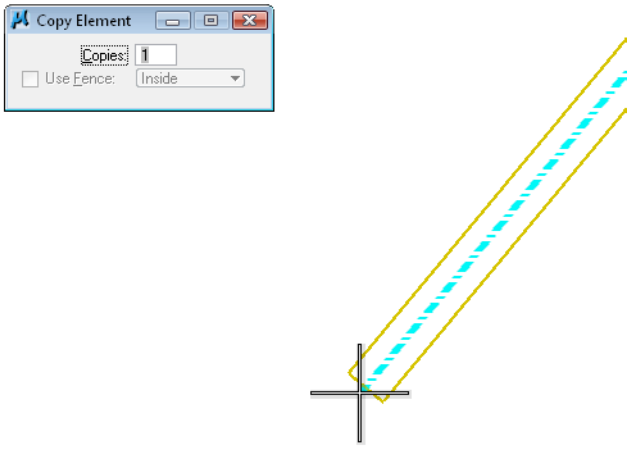
3. Select MicroStation's **Copy** command.



4. Snap to the end of the line to identify it to copy.



5. Snap to the same end to copy it to the active file in the exact same location.



6. Turn off the display of the reference file.

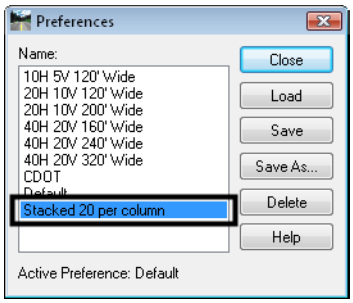
   Note: Only the pier centerline element is now shown in the view.

7. Before cutting cross sections, set the text scale factor to be used for the cross section text. Select **Tools > Options**.

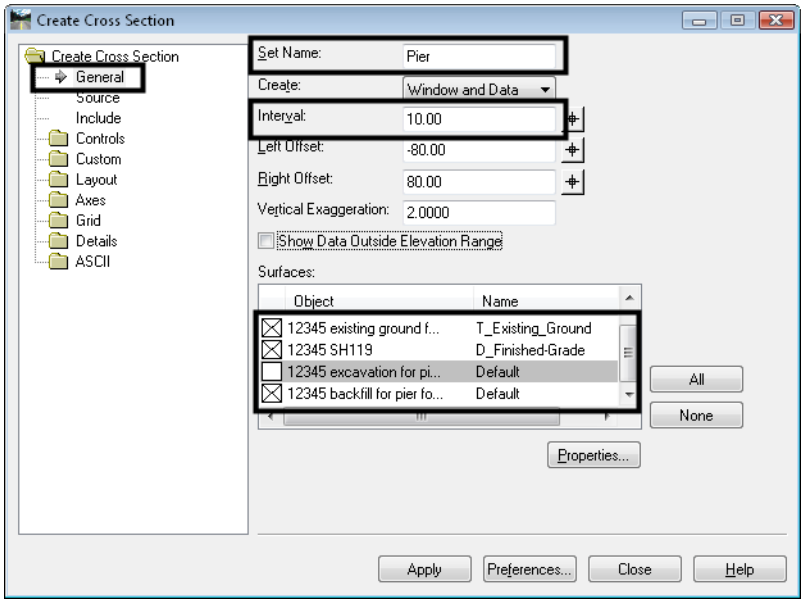
8. Select the ***Factors*** tab.

9. Unlock the three factors and for ***Text Scale Factor*** key in ***40***.

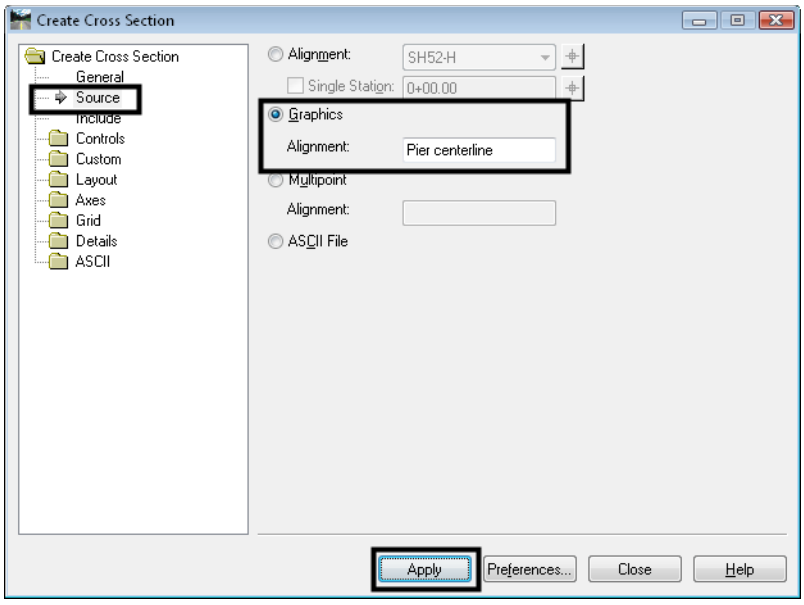
10. **<D> Apply**, then **<D> Close**.
11. Select **Evaluation > Cross Section > Create Cross Section**.
12. Select ***Preferences*** and select the ***Stacked 20 per column*** preference.



13. **<D> Load**, then **<D> Close**.
14. On the ***General*** branch, toggle off the ***12345 excavation for pier footer*** and ***Default*** surfaces. Make sure all other surfaces are toggled on.
15. For ***Set Name***, key in ***Pier***.
16. For ***Interval***, key in ***10***.



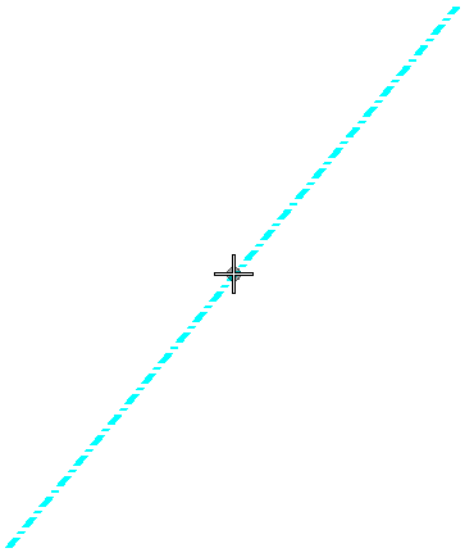
17. On the ***Source*** branch, toggle on ***Graphics*** and in the ***Alignment*** field, key in ***Pier centerline***.



Note: The ***End Area Volume*** command requires an alignment in order to compute volumes. Specifying a name here will automatically create an alignment along the pier centerline element.

18. <**D> Apply**.

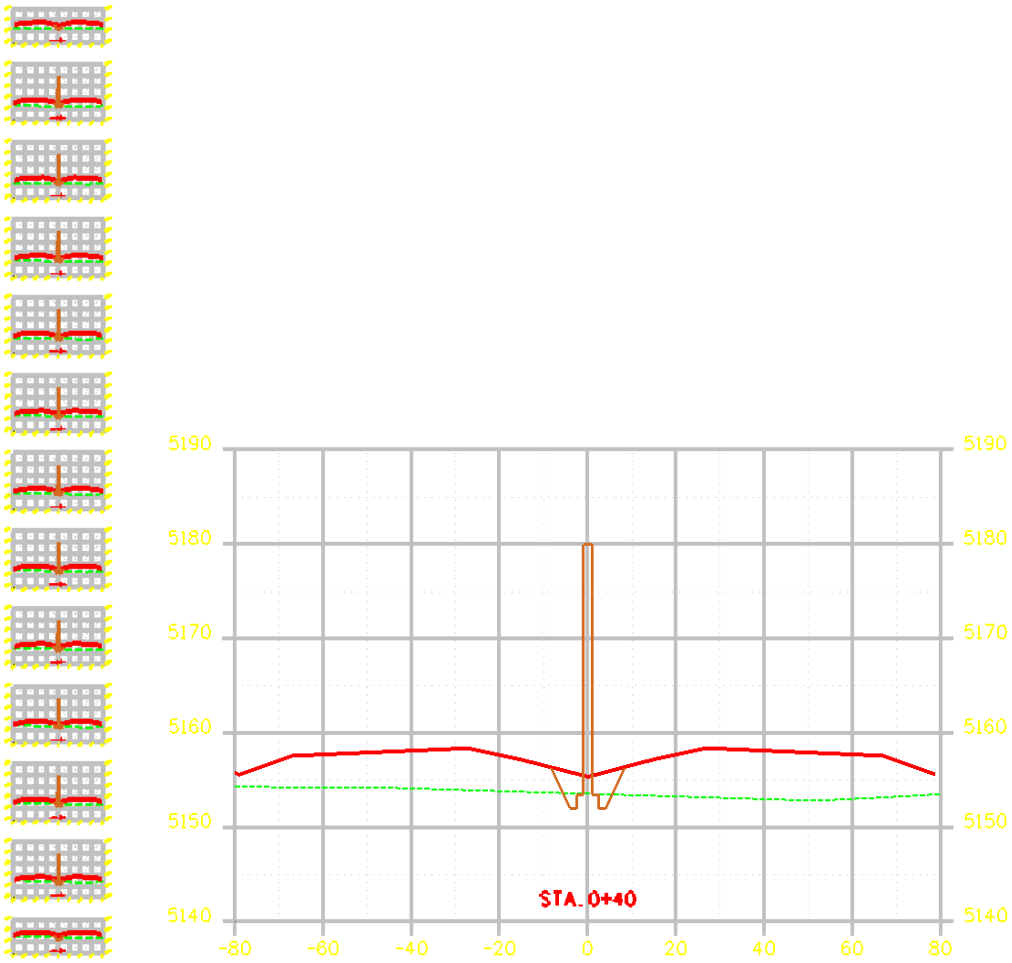
19. **<D>** the pier centerline.



20. **<D>** to Accept.

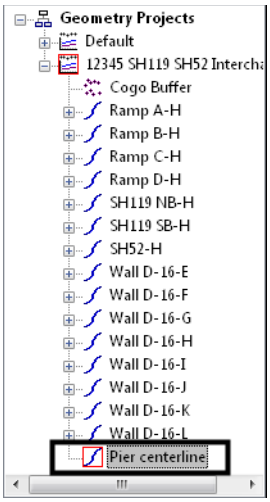
21. **<D>** in a clear area for the lower left corner of the cross section set.

22. Window in on one of the cross sections to see the three surfaces.



Note: Since you added the pier features to the backfill surface in the last lab, the pier and footer will be excluded from the backfill quantities, but the area of the pier that falls above the SH119 surface will be shown as cut and should be ignored.

23. Select the ***InRoads Explorer Geometry*** tab and note that you now have an active ***Pier centerline*** alignment created by the ***Cross Section*** command.



You're now ready to compute the end area volumes from the cross section graphics and new pier centerline alignment.

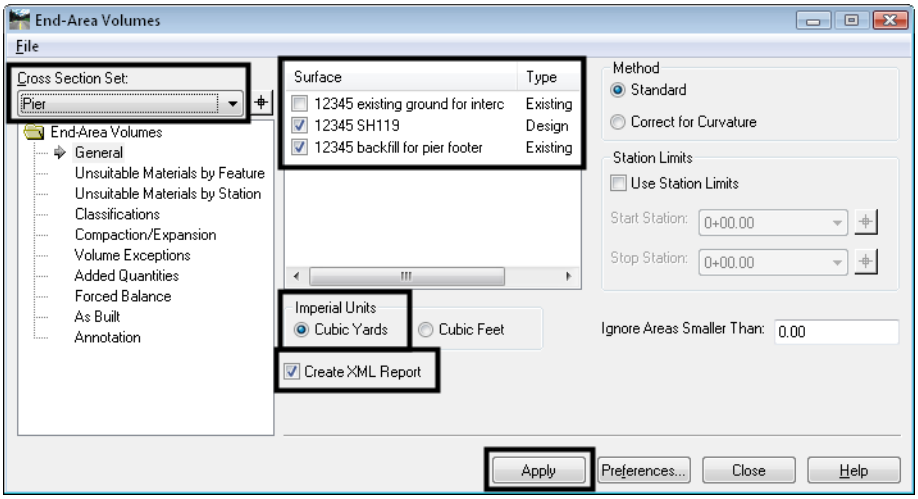
24. Select **Evaluation > Volumes > End Area Volumes**.

25. On the ***General*** branch, toggle off the ***12345 existing ground for interchange surface*** and make sure the ***12345 SH119*** and ***12345 backfill for pier footer surfaces*** are toggled on.

26. Set ***Cross Section*** Set to ***Pier***.

27. Set ***Imperial Units*** to ***Cubic Yards***.

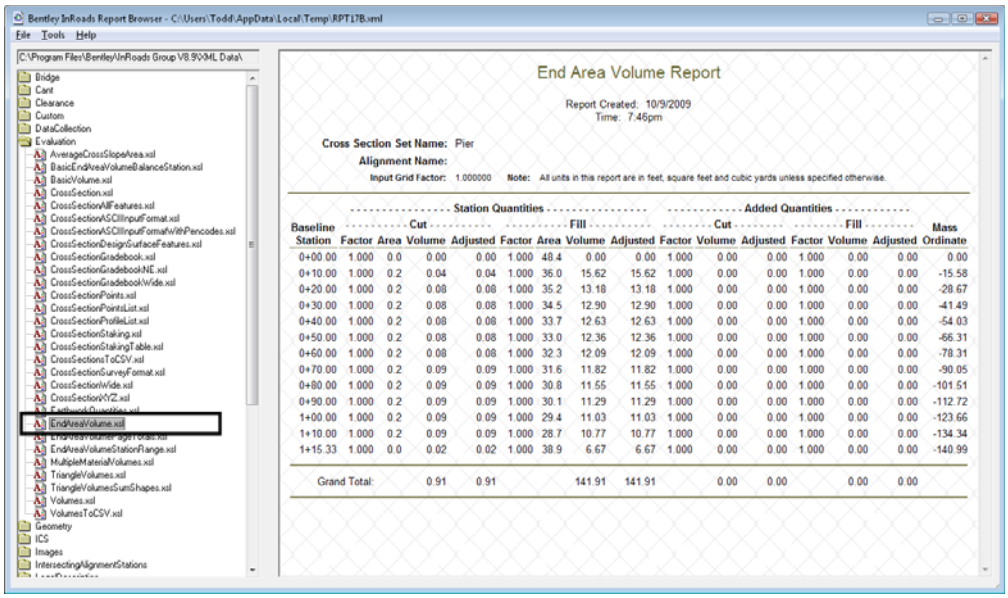
28. Toggle on ***Create XML Report***.



29. **<D>** Apply.

30. If you receive the ***Report Browser*** warning message, select **OK** since the ***End Area Volume*** command does not yet have a default style sheet set.

31. In the ***Report Browser***, select the ***EndAreaVolume.xsl*** style sheet under the ***Evaluation*** folder to format the report.



Note: If your report lists cubic feet, select **Tools > Format** options and toggle on ***Convert to Cubic Yards***.

32. Read your fill volume from the Grand Total line of the report and record your results:

    Fill: _____ cu yd.

Note: The ***End Area Volume*** results should compare favorably to your ***Triangle Volume*** results for backfill (within a few cubic yards). If not, see your instructor.

33. **Close** the ***End Area Volume*** report (click the ***X*** in the upper right corner).

34. **<D> Close** on the ***End Area Volume*** dialog box.

Chapter Summary:

- ***Triangle*** volumes provide accurate cut and fill quantities.
- The ***Triangle Volumes*** command compares surfaces to compute volumes.
- The ***Grid*** method is useful to check triangle volumes.
- The accuracy of the ***Grid Volumes*** is controlled by the grid interval.
- Many factors affect the selection of an appropriate grid interval. Select an interval that converges on a net number favorable to the triangle results.
- The smaller the grid interval, the more accurate the grid volumes.
- ***End Area Volumes*** are computed from cross section graphics instead of comparing DTMs.
- The ***End Area Volume*** results should compare favorably to the ***Triangle*** volume results.

LAB 9 - Plan Production for Bridge

Chapter Objectives:

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Lab 9.1 - Under Development

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