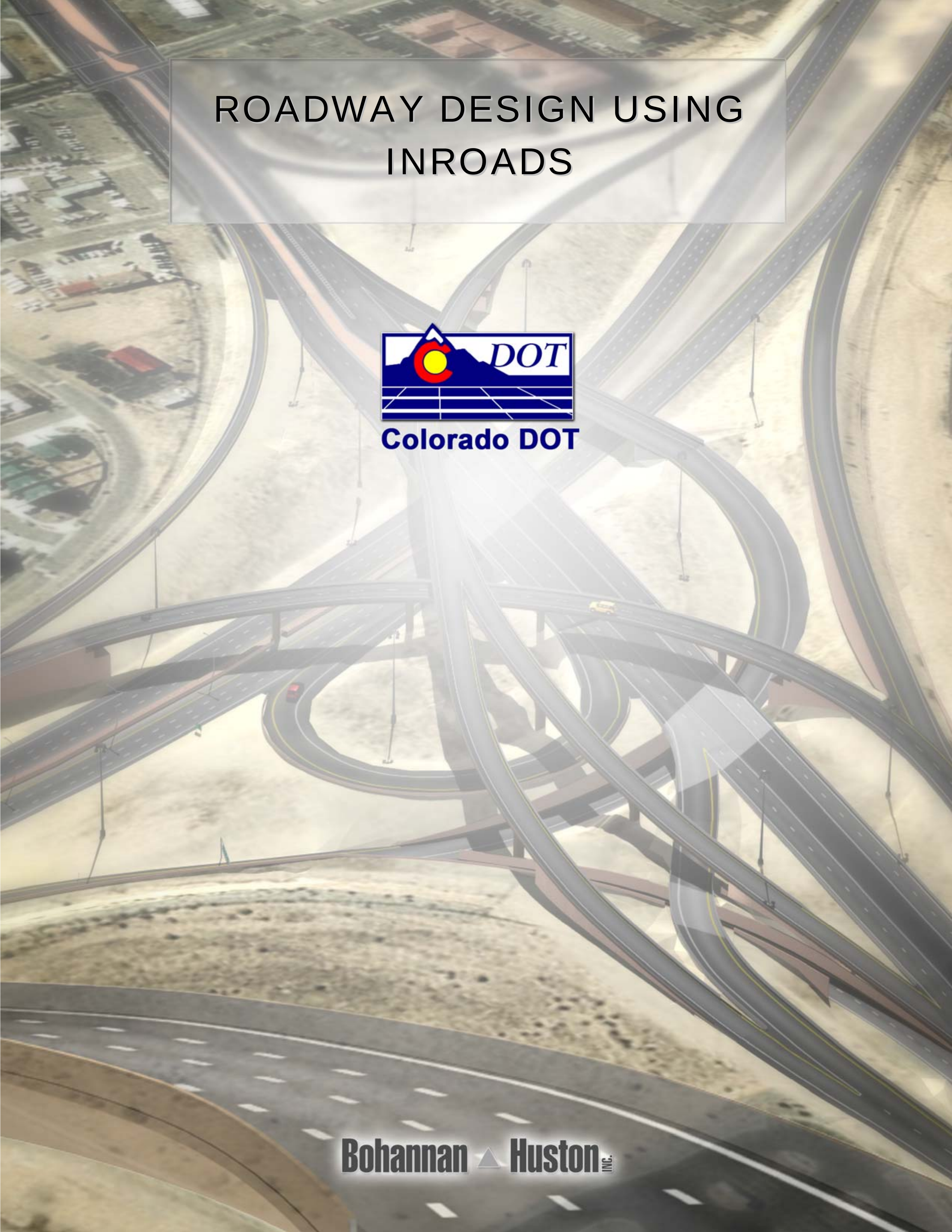
ROADWAY DESIGN USING INROADS



Colorado DOT

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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 08.05.02.55
InRoads® version 08.05.00.00 – Service Pack 5

1107 – Version 03.02 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
Key in	entering data with the keyboard
Document name	style used when referring to another document
Note: text	information about a command or process that you should pay particular attention to
Emphasis	an important word or phrase
1. Numbered Steps	actions that you are to perform as part of the lab activities
<D> or **Data**	press the data button on the mouse
<R> or **Reset**	press the reset button on the mouse
<T> or **Tentative**	press the tentative button on the mouse

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1. Getting Started

Introduction

This course was developed to introduce the basics of using Bentley's InRoads roadway design software package in the CDOT Design Process. InRoads is a civil engineering design package that automates many of the tasks performed in the CDOT Process. It runs on top of a CAD platform, which in this case is Bentley's MicroStation.

InRoads is used throughout the process for developing and evaluating the design. The primary goals of the course are to use InRoads to generate all of the components of the design such as: plan/profile sheets, cross section sheets, quantities and a 3D model of the proposed roadway. Also covered is the development of a 3D model for a basic intersection.

The document is designed for use in an instructor-led classroom environment, but will be useful for new users to refer back to as they begin applying the learned techniques to their projects. However, it is not meant to be a software reference guide or to replace the on-line help available through InRoads.

The lab activities are written to provide the students with step-by-step instructions for the main focus of the chapter, with additional challenge labs in many of the chapters for those who finish early or want to dig deeper into the topics.

Prerequisites

This course is designed for students that already have a working knowledge of MicroStation and a familiarity with civil engineering terms and concepts. This is not a course on how to design, but rather on how to utilize InRoads in the design and modeling process.

CDOT CADD Resources

There are many resources available to assist you when working on your CDOT CADD project. These resources can be found on the CDOT CADD & Engineering Innovation Web site.

CDOT CADD & Engineering Innovation Web Site

The CDOT CADD & Engineering Innovation web page is available at:

http://internal/cadd/ It can also be found on the internal CDOT website:

Organizations > Project Development > CADD and Engineering Innovation.

The website (presently only available to CDOT) provides CDOT users with up to date information, tools, and resources related to CADD and the Colorado Engineering Software Transition (CEST) project.

This website is a valuable resource for CADD users and includes links to:

CADD Library -- provides links to manuals, newsletters, standard details, Tips and Tricks *etc*.

CADD Manual -- documents standardized procedures for the exchange of information. The Manual also addresses software issues, tools, techniques, standards and procedures, etc. which will aid the user in the efficient production of CDOT plan sets.

CDOT Workflows -- step-by-step CDOT-specific procedures for certain tasks that you may encounter when working in MicroStation or InRoads on a CDOT project.

Issues Logs -- to determine the status of submitted requests.

Requests and Support -- provides CADD help solutions where you can submit questions or requests, obtain InRoads, InRoads Survey and MicroStation support, and link to IT Services for support.

Training -- sign up for training classes or review online computer-based training (CBT) for MicroStation, InRoads and InRoads Survey.

Project design files

The CDOT workflow requires that graphic and design data is created in multiple design files during the course of project development. These design files need standard, informative, and unique file names.

CDOT file naming convention

Model files and Sheet files need standard, informative, and unique names to allow easy identification of the specialty group responsible for the file and the type of information contained within the file. All CDOT CADD drawings created should follow the CDOT standard naming convention so the data can be easily identified and shared by all users.

The CDOT file naming convention contains the Job Project Code (JPC), a short standardized file name, and file extension.

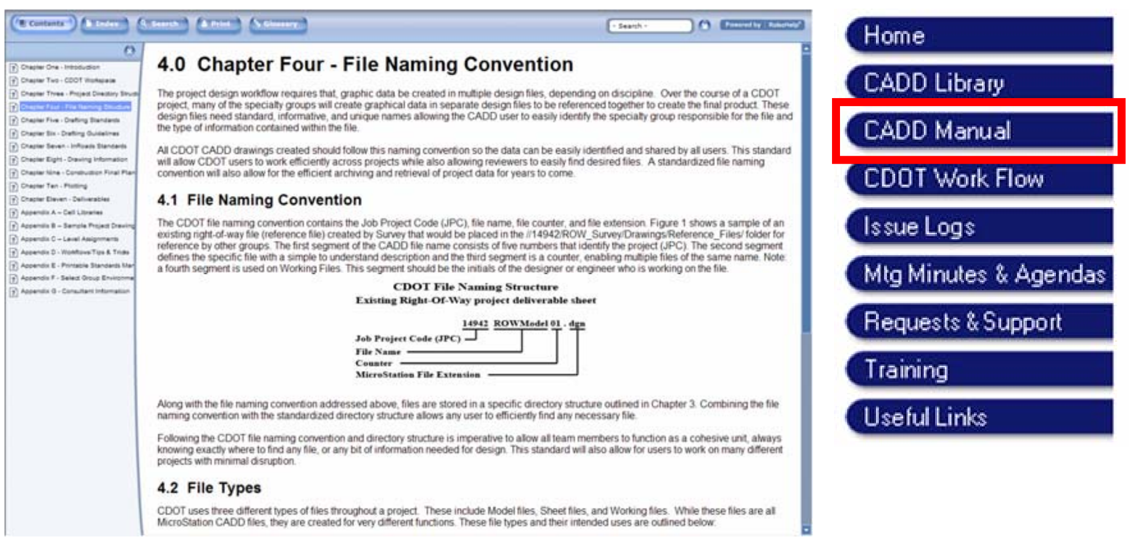
An example of a MicroStation design file would look like the following.

12345DES_Model.dgn

12345 indicating the CDOT Project Number, **DES_Model** indicates it is Roadway Design's model file. **DGN** is the default extension for MicroStation design files.

> **Note**: Working Files contain another identifier. This segment should be the initials of the designer or engineer who is working on the file.
> Example: **CU12345DES_Model.dgn** where CU are the initials of the designer or engineer (in this example, CU stands for "CDOT User").

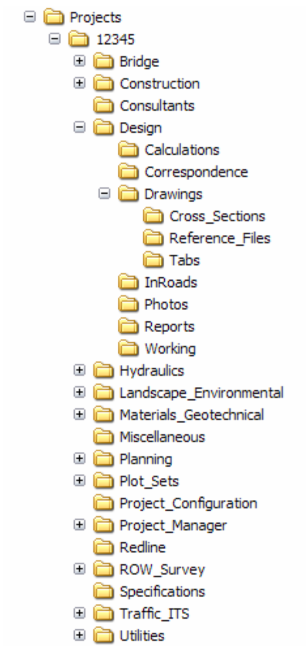
For more information about the CDOT project directory structure, see the **CDOT CADD Manual**, ***Chapter Four – File Naming Convention.***



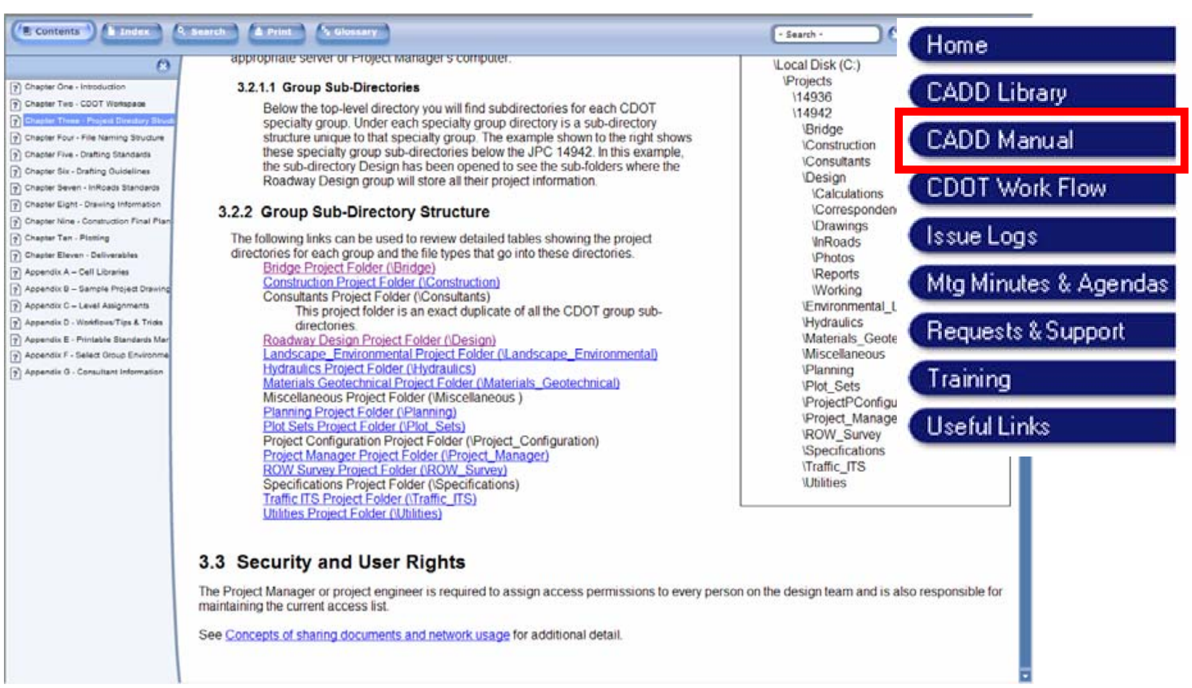
Project File Structure

All files related to this course are stored in the ***C:\Projects\12345*** folder, where **12345** is the CDOT project code. Subfolders under the project contain the discipline-specific files.

Project files follow a standardized scheme. This section describes the location of project files and the standard directory structure for each group within CDOT.



For more information, including what files go where, search the **CDOT CADD Manual** for ***Group Sub-Directory Structure.***



Training files

The training lab files for this course will be available after you complete the training. Your computer will have a training files icon in **CDOT Customization** Group accessed from the **Windows Start** menu. A link is also available in **IT Services** on the **CADD & Engineering Innovation** website. The icon and link perform the same self extracting zip process to install the training files on your machine.

It is highly recommended that you install the training files and continue practicing with MicroStation and InRoads by completing the lab exercises contained in this course guide, especially if you do not plan to start work on a MicroStation/InRoads project soon.

Files used by InRoads

InRoads uses several different files to store parameters driving the design and display of InRoads graphics, as well as to store the design data. These files are loaded into memory during a design session and with some exceptions must be saved if they have been modified. The typical files used in a project are shown below.

File	Ext.	Format	Comes From	*	Contains	Method of Saving
Preferences (CDOT-preferences.ini)	.ini	ASCII	CDOT Standard	M	Units Precision Readout Command preferences	**
Styles (CDOT-styles.ini)	.ini	ASCII	CDOT Standard	M	Geometry Styles Controls symbology of alignments and cogo points.	**
Digital Terrain Models	.dtm	Binary	Existing - from Survey Design - created by InRoads	S	Topographic information for ground surface. Used for contouring, profiles, cross section, etc.	Must be saved before exiting. May use File>Save As>*.dtm
Geometry Project	.alg	Binary	Survey Copied and added to during design	S	Horizontal alignments Vertical alignments Superelevation Cogo points	Must be saved before exiting. May use File>Save As>*.alg
Typical Section Library	.tml	Binary	CDOT Standard** Make copy for project use so you can edit	M	Templates Tables: Decision, Cut/Fill, Material TC (transition control) Names	Must be saved before exiting. May use File>Save As>*.tml
Roadway Library	.rwl	Binary	Created for each project	M	Roadway Definitions (Station & Template setups, etc.)	Must be saved before exiting. May use File>Save As>*.rwl
Project	.rwk	ASCII	Created for each project	S	List of files used in project.	The project file saves all the individual files using File>Save or Save As. NOTE: Files saved are only those listed in the .rwk.

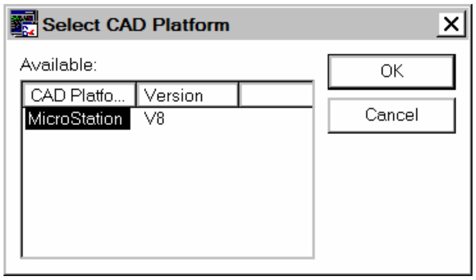
* M=Multiple Project Use, S=Single Project Use

** CDOT configuration does not allow modification of standards, preferences or styles.

Starting InRoads

If you are using a machine that has both MicroStation and AutoCAD loaded, or more than one version of MicroStation, you must tell InRoads which CAD platform to use before starting InRoads.

Choose **Start > All Programs > Bentley Civil Engineering > Select CAD Platform** and select MicroStation V8, then choose **OK**.

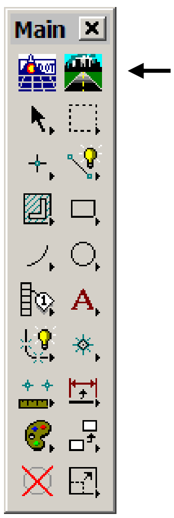


There are three main methods of starting InRoads:

a. Choose **Start > All Programs > Bentley Civil Engineering > Bentley InRoads** and MicroStation will start and allow you to choose the design file, then InRoads will start.

b. Choose the Desktop icon for InRoads if one is available on your machine. MicroStation will start and allow you to choose the design file, then InRoads will start.

c. If you already have MicroStation open, you can choose the InRoads icon from the MicroStation main toolbar.



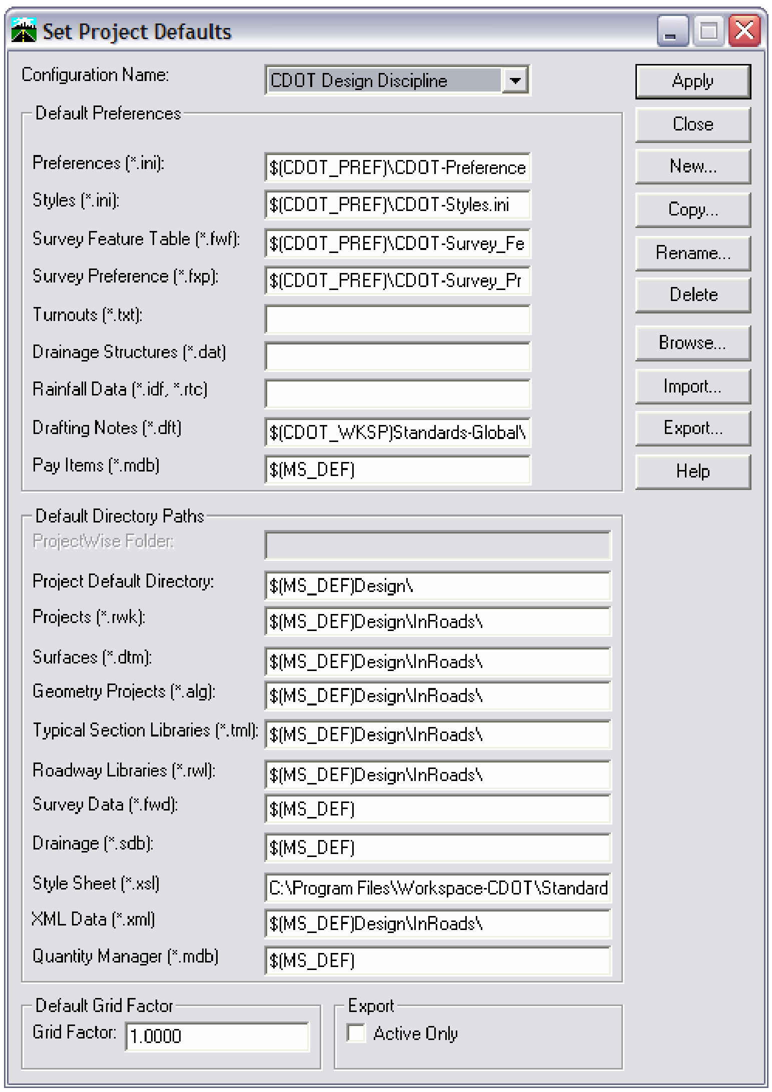
Project Defaults

InRoads loads a preferences file and a styles file when it starts. You may create **Project Defaults** to have InRoads load your CDOT customized files automatically. If you do not, it will load the default files out of the InRoads product directory and you will have to load yours (**CDOT-preferences.ini** and a **CDOT-styles.ini**) through a project file (**.rwk**) or individually.

The **Project Defaults** also set the path that InRoads will use to open or store data files that you load or save. These paths are not absolute; they are just the starting point to which InRoads defaults.

Multiple **Project Defaults** may be created and stored on a machine, and you can switch between them when switching between projects.

The **Project Defaults** are found on the InRoads menu under **File > Project Defaults** as shown below. (This figure shows a variable configured in the path so you do not need as many configurations.)



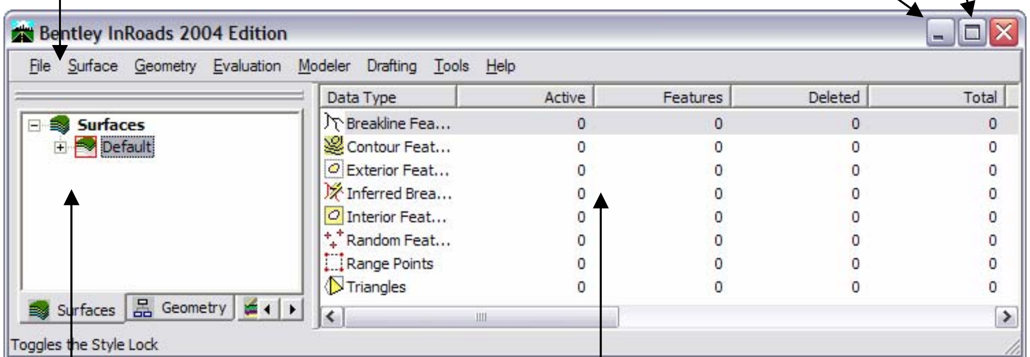
The InRoads Menu

The InRoads menu consists of several parts as shown below, the Workspace and Menu bars can be undocked and placed at separate positions. The menu may be resized as needed and also minimized or contracted.

Menu Bar
This is the Primary menu system for InRoads commands. Toolbar menus are also available under **Tools>Customize**.

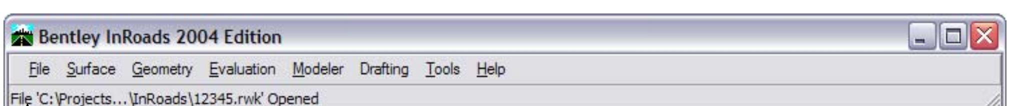
Minimize

Maximize



Workspace toolbar (InRoads Explorer)
This toolbar has a tab for each of the data types that may be loaded into InRoads, where you can see what files are loaded and what they contain. There are several “right-click” options that can be used to load, save, delete, *etc*.

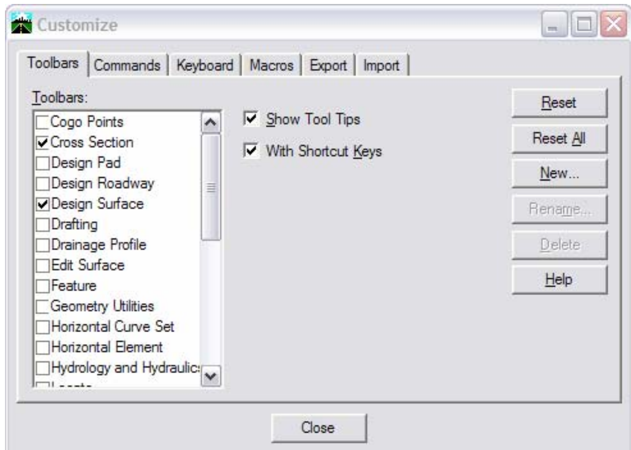
Information window
When an item is selected in the Workspace toolbar, this area displays information about the selection



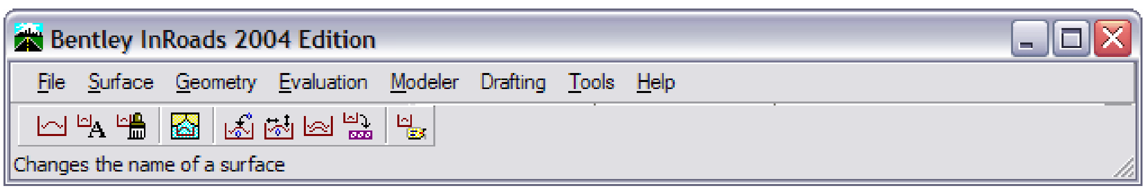
Messages appear in the space at the bottom of the menu, as well as in the MicroStation prompt and message fields.

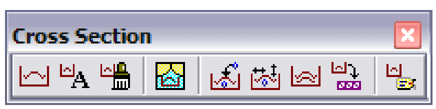
InRoads Toolbars

Most of the InRoads commands are located on toolbars as well as on the pulldown menus. These toolbars as accessed through the **Tools > Customize** dialog. Toolbars can be turned on and off at will. You can also create your own toolbars using the customize dialog.



Initially, toolbars are docked on the InRoads menu, but may be pulled off of it and will remember their last location when they are closed and reopened.



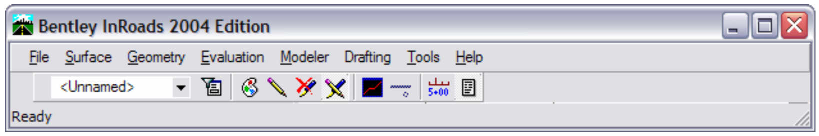


InRoads Locks

There are several locks that are used by InRoads in addition to the MicroStation locks that are available. These locks will be used throughout the course.

The locks toolbar is shown below.

Docked



And **Undocked**

Filter Name – Lists the name of the **Feature Filter** that is currently active. It has no affect if the **Feature Filter** lock is ***off***. If the **Feature Filter** lock is ***on***, it will limit dialog boxes to showing only the features that are within the filter. Feature Filters are stored in the **CDOT-preferences.ini** file and are accessed by using the drop-down arrow next to the name.

Feature Filter lock – If on, activates the current filter. If off, has no affect and all surface features are shown in boxes that list features. Shown here in the off position.

Style lock – The **Style lock**, if on, forces many of the **Surface View** commands to display the requested data (triangles, contours, etc.) without bringing up the dialog box. The preference used is the one associated with the surface under **Surface > Surface Properties**. **Style** lock also forces the **Cross Section Annotation** command to use the named symbology associated with the feature for the annotation properties. If ***off***, the **Style lock** has no affect. Shown here in the off position.

Pen/Pencil (shown in ***Pencil***) ***Delete Ink*** (shown off) ***Write*** lock (shown on)

These three locks work together.

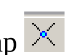
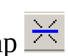
Write lock – If **Write lock** is ***off***, the displays will be temporary. Zooming in or out, updating the view, etc. will cause the graphics to disappear.

If **Write lock** is ***on***, there are two modes – **Pen** and **Pencil**.

If the **Pencil** mode is selected, the graphics are updated whenever the same display command is selected again. For example, if you display the contours, then change to a different preference and display again, the old contours are deleted and the new contours are displayed.

If **Pen** mode is selected there are two options. If **Delete Ink** is ***off***, the graphics are ***not*** updated when the same display command is selected again. Instead, another copy is placed in the design file. If **Delete Ink** is ***on***, the graphics are treated like **Pencil** mode and the old one removed before the new ones are placed.

Locate Features/Locate Graphics – There are several commands in InRoads that will work on either Features out of the DTM or on MicroStation graphical elements (**Drape Surface**, for example). These commands will “look” for features if this lock is toggled to **Locate Features** and for MicroStation elements if it is set to **Locate Graphics**. It is shown here in **Locate Graphics** mode.

Point Snap has three modes: Off  Point Snap  and Element Snap 

Off – No affect

Point Snap – Some geometry commands (especially cogo commands) will lock onto the nearest geometry point’s coordinates when you select something graphically. This is useful when you need to identify a PC or PT, for example. Also, some DTM editing commands, such as **Partial Delete Feature** will lock onto the vertices or points that make up the feature.

Element Snap – In geometry commands requiring a distance or a bearing, you can set the **Element Snap** and then identify an existing geometry element, such as part of an existing alignment and it will read the elements length or bearing (whichever is required).

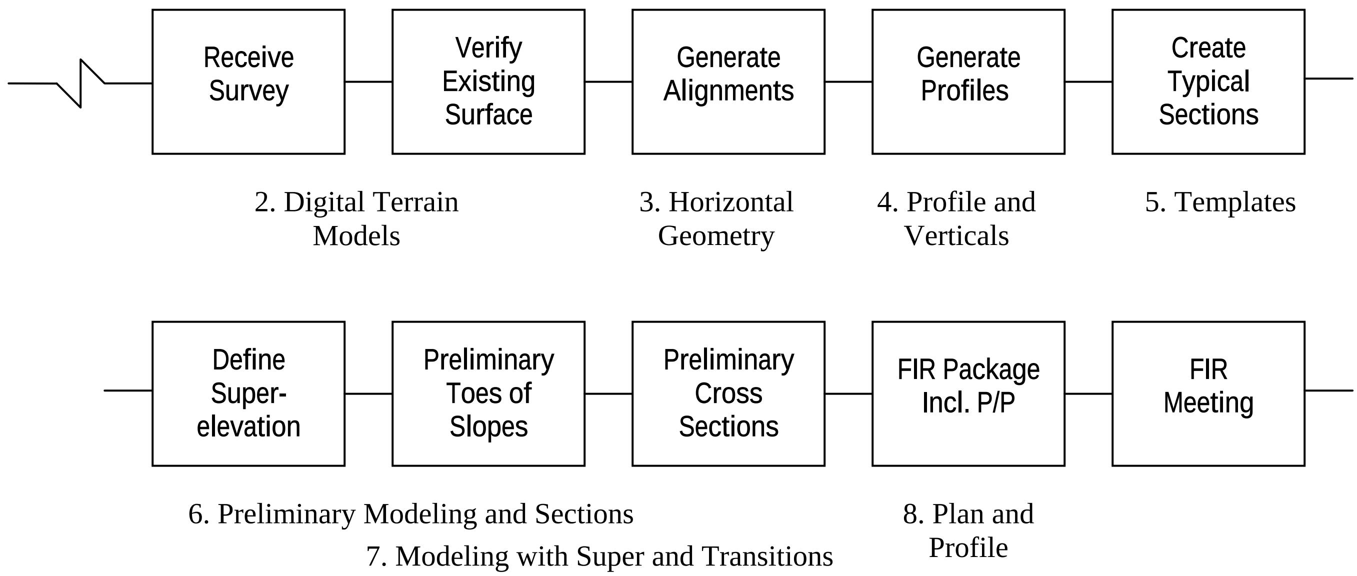
Station lock – Locks you onto even stations in the event that the alignment you are using does not start on an even station. The station will be determined by the interval you are using. For example, if you are stationing an alignment at 100 ft. intervals, the displays will show even 100 ft. stations. This affects not only station displays but virtually everything that using a stationing interval, such as cross sections, profiles and modeling.

Report lock – Some commands will return information to you if this lock is ***on***. For example, if you store a cogo point and the **Report** lock is ***on***, a Results box will pop open showing the coordinate and point number of the new point. The box can be moved out of the way, then it will keep a running list of messages, which can be saved to a text file if desired.

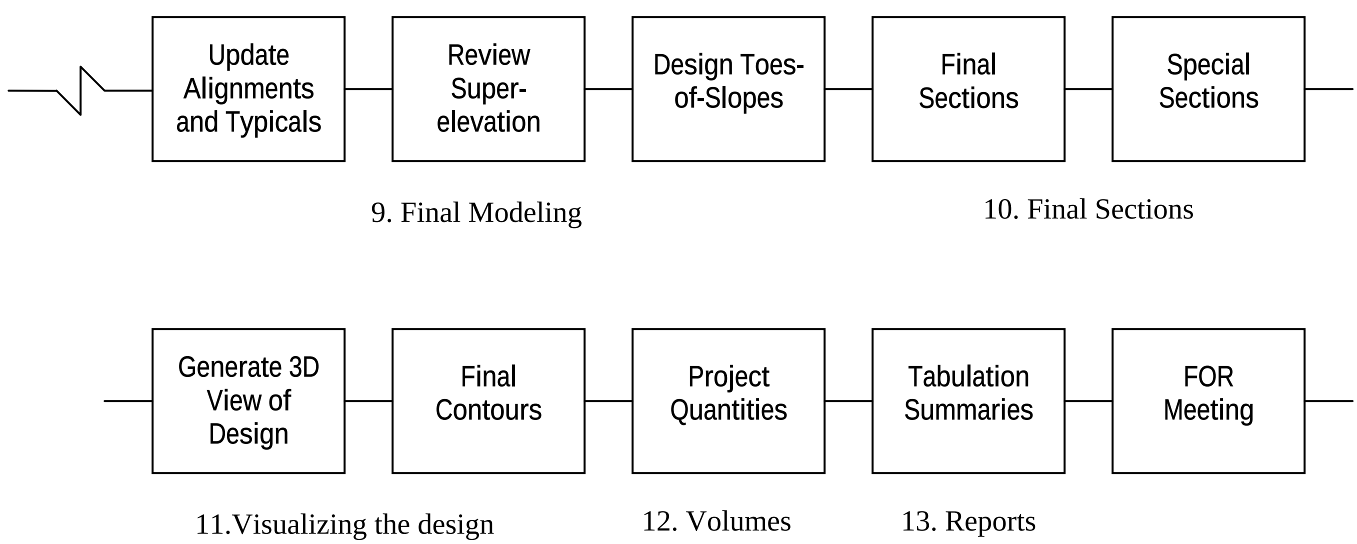
CDOT Design Process/InRoads Workflow

The following diagram shows the CDOT Design Process and the chapter each item relates to in this book.

Field Inspection Review (FIR)



Final Office Review (FOR)



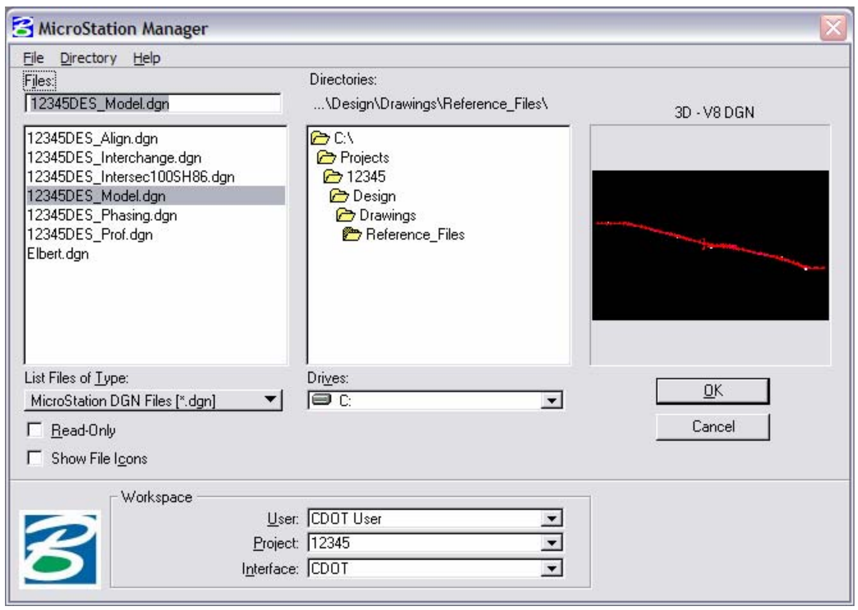
Lab 1 – Getting Started

The CDOT training data set is used by several different classes, some of which require a model file that has already been setup. For this class, we need to start with a new model file, so you will first delete the current one, then create the new one.

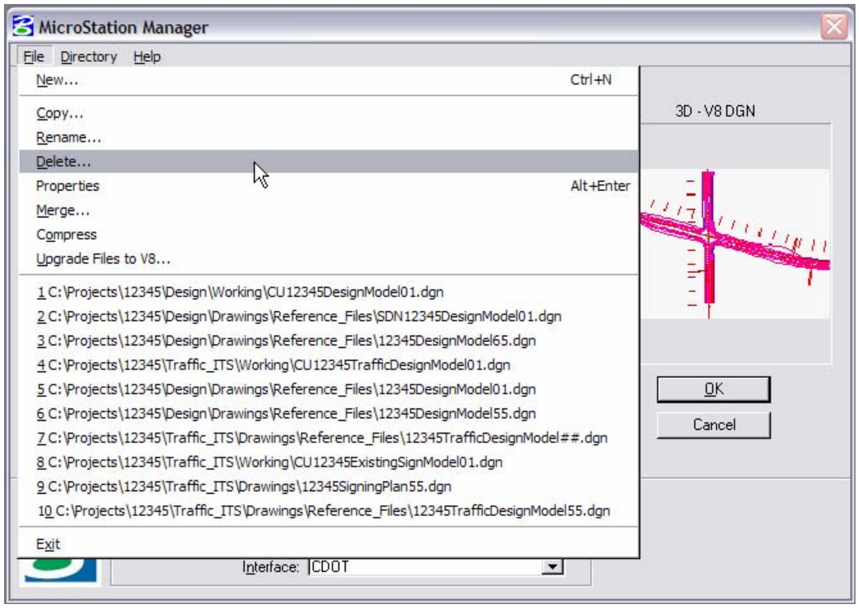
Start MicroStation

1. Double-click the InRoads icon on your desktop (or use the Start menu).

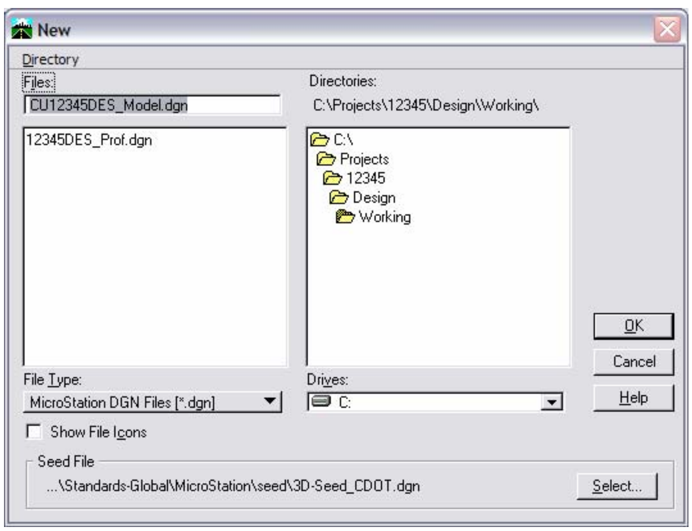
2. On the MicroStation Manager dialog, select the **Project** ***12345***, then highlight the file **12345DES_Model.dgn** in the **\Design\Drawings\Reference_Files** folder.



3. Choose **File > Delete.**



4. On the Alert box, choose **OK**.
5. Choose **File > New.**
6. Set the folder is **\Design\Working**
7. Key in the name **CU12345DES_Model.dgn**



8. Choose **OK** to create the new file, then **OK** on the MicroStation Manager.

   This file is typically prefixed with your initials while you are working on it. When it is ready for other disciplines to reference, you will take your initial off and move it to the **Reference_Files** folder.

9. Choose **OK**.

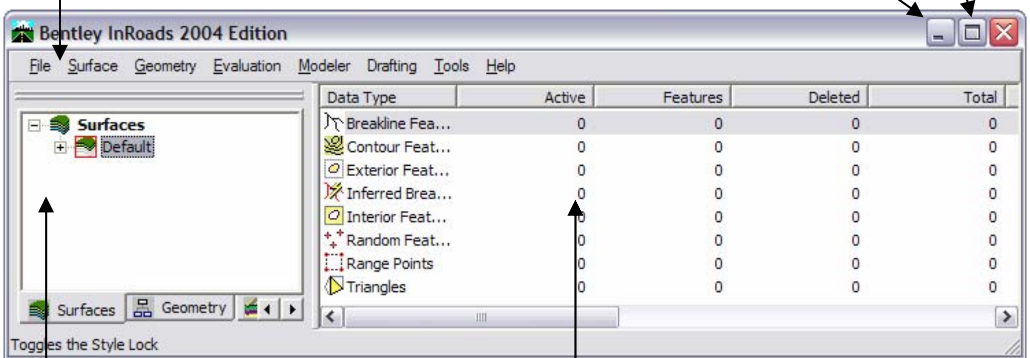
   The design file is saved into the **Working** folder, using the **CU12345DES_Model.dgn** name. You are automatically switched into this design file, and InRoads starts.

Review the different parts of the InRoads menu.

Menu Bar
This is the Primary menu system for InRoads commands. Toolbar menus are also available under **Tools>Customize**.

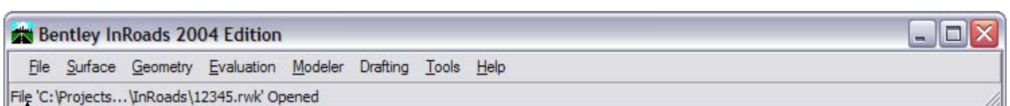
Minimize

Maximize



Workspace toolbar (InRoads Explorer)
This toolbar has a tab for each of the data types that may be loaded into InRoads, where you can see what files are loaded and what they contain. There are several "right-click" options that can be used to load, save, delete, *etc*.

Information window
When an item is selected in the Workspace toolbar, this area displays information about the selection



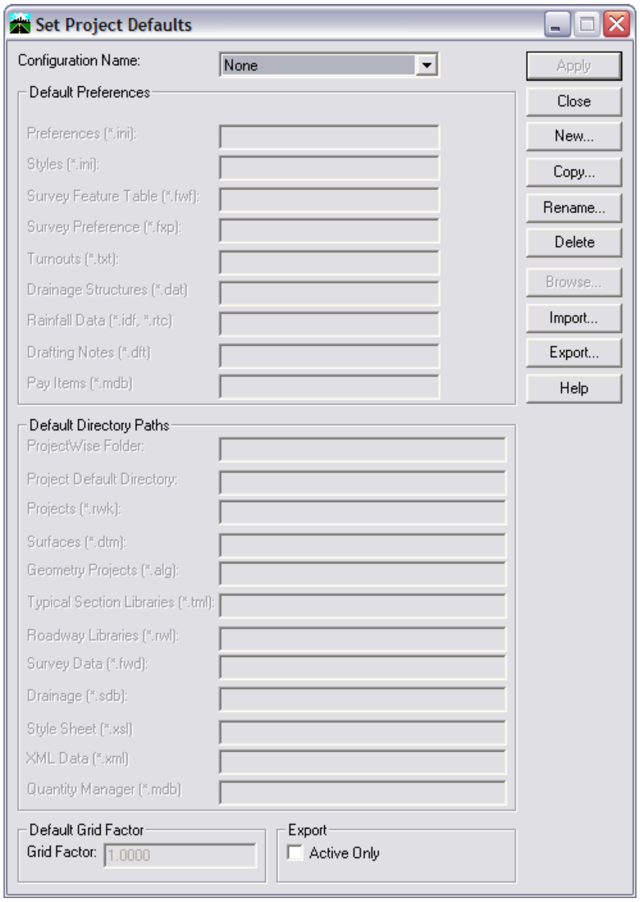
Messages appear in the space at the bottom of the menu, as well as in the MicroStation prompt and message fields.

Project Defaults

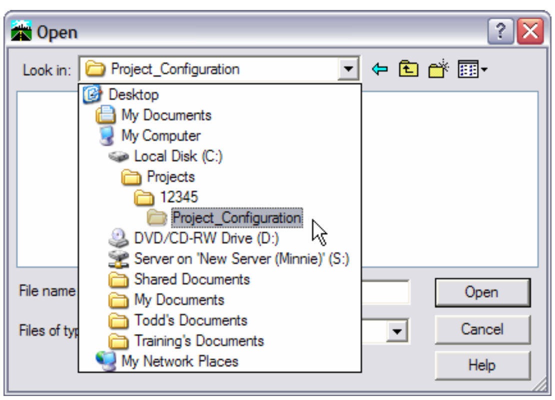
Project defaults define which preference and style files to open with each design session. They also set the default folders for opening and saving your InRoads data files. **If the machine you're on has been used for a previous training class**, you will not need to complete the first few steps. Skip to 5; if the configuration is in your list, start there.

Create a new Project Default

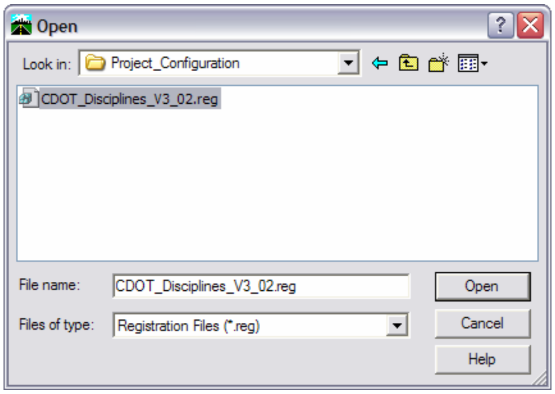
1. Choose **File > Project Defaults**.



2. Choose **Import**.

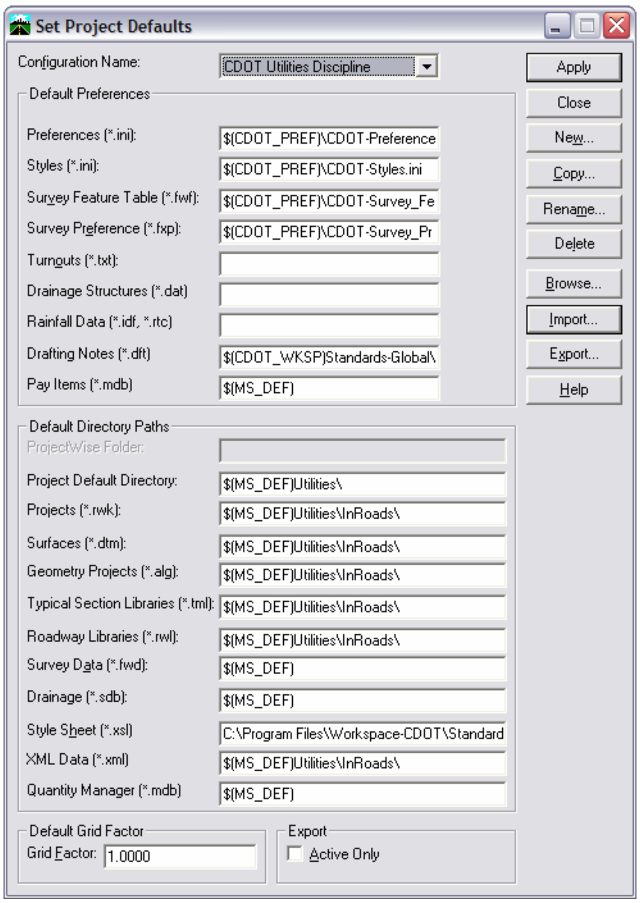


3. Set the **Look In** folder to **C:\Projects\12345\Project_Configuration**.

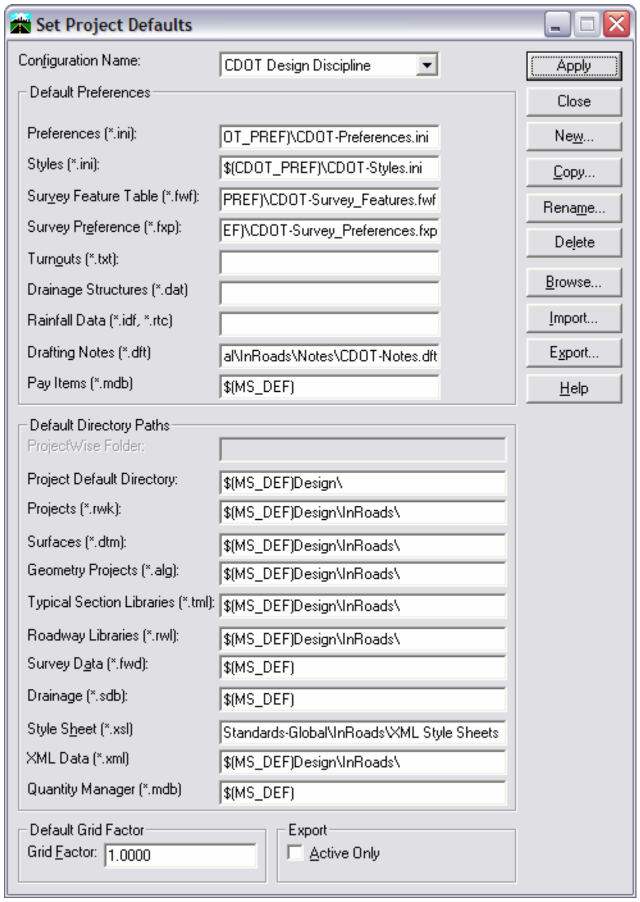


4. Highlight **CDOT_Disciplines_V3_02.reg** and choose **Open**.

The **.reg** file contains project defaults that have already been configured for CDOT disciplines. In addition, they use variables in place of hard-coding the folder structure so different projects can use the same configuration.



5. Click the drop-down next to the **Configuration Name** and choose **CDOT Design Discipline**.

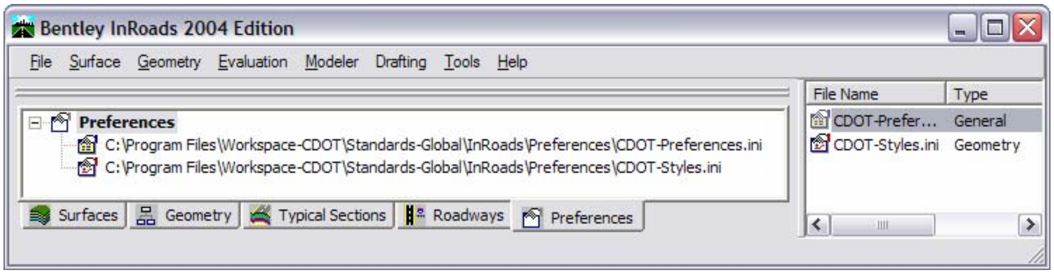


6. **Apply**, then **Close** the **Options** dialog – ***do NOT*** use the **X** in the upper right corner or the **Project Defaults** will not be activated.

   This will be the active configuration each time you enter InRoads unless you change it.

Check your .ini files.

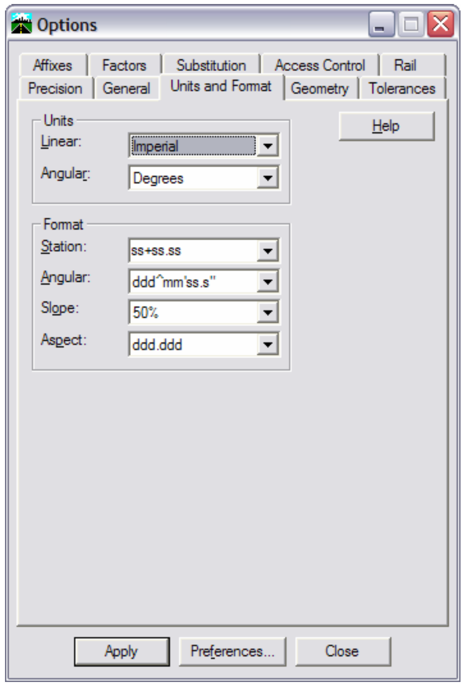
7. In the Explorer window, choose the **Preferences** tab in the left side of the window and make certain the correct .ini files are loaded. If not, review your **Project Defaults** or ask for assistance.



Review design parameters for InRoads

1. From the InRoads menu, select **Tools > Options**.

2. Select the **Units** and **Format** tab.



3. Review the parameters.

4. Select the other tabs and review the CDOT default project parameters.

5. **Close** the **Preferences** dialog.

   If changes are made to the preferences, then you must **Apply** to make the active in this design session. They will be automatically reset when you next start InRoads.

Open the locks toolbar.

6. From the InRoads pull-down menu, select **Tools > Locks > Toolbar**.

   The **Locks** toolbar may already be open when you start InRoads. It can be docked on the **Explorer** window or floated on-screen.

7. Review each lock by placing your cursor over the icon.

8. Leave the **Locks** toolbar open for future use.

Challenge lab: Preview the InRoads Workflow

You'll be going through each of the following topics in detail during this course. If you finished the previous lab early, you may want to try your hand at a quick run-through similar to the demo your instructor just presented.

Load InRoads data into memory

1. From the InRoads toolbar, select **File > Open**.
2. Set **Files of type** to **Projects (*.rwk).**
3. Open **12345Preview.rwk** from the **\Miscellaneous** folder and

   This loads the different types of previously created data files. These include the geometry project, the existing dtm, the template library and the roadway library.

Review the existing surface data

1. Right-click on **12345 existing ground** under **Surfaces** in the left-hand portion of the InRoads menu (called the **Explorer** portion of the menu). You may have to expand the menu by dragging one of the edges.
2. Choose **Set Active**.
3. Right click again on exist and choose **Properties**.
4. Review the surface information, then **Close** the **Surface Properties** dialog.
5. Highlight **12345 existing ground** and review the DTM data that make up the surface in the right-hand section of the Explorer window.

Review geometry data

1. Click on the **Geometry** tab, then double-click on **12345Preview** and review the geometry information in the right-hand side.
2. Right-click on alignment **SH86** in the geometry project **12345Preview**.
3. Select **Review** and scroll through the alignment data.
4. **Close** the **Review** box when finished.
5. Double-click on **SH86** to see its vertical alignment, **SH86 V**.
6. Review **SH86 V**.

Review typical sections for this project

1. Click on the **Typical Sections** tab.
2. Double-click on **Templates**.
3. Double-click on **SH 86 1L-1L Rural**.
4. Double-click on **D_SH 86 Finished-Grade**.
5. Click on **Right Backbone**.

   Review the right backbone segments for the finished grade surface in the right-hand side of the Explorer window.
6. Review other template zones as desired.

   Note: You can also edit the typical section directly from the Explorer with a right mouse click.

7. Use the same method in the previous step to review the decision table **Plains_Z=12'@6:1** entries.

   Note: You can also edit the decision table directly from the Explorer with a right mouse click.
8. Use the same method as above to review the station and template setups for the roadway definition **SH 86 with dec table**.

   Note: You can also edit the roadway definition directly from the Explorer with a right mouse click.

View contours

1. Turn **Write** lock on.
2. Set the mode to **Pencil**.
3. Turn **Style** lock on.
4. Select **Surface > View Surface > Contours**.

   The **View Contours** dialog box does not display since **Style** lock is on. The active preference is used to display the contours.

View the proposed bypass alignment, SH 86.

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

   Alternately, you can right-click on **SH 86** from the Explorer window and select **View**.

Station the SH 86 alignment

1. Select **Geometry > View Geometry > Stationing**.
2. **Apply** to use the default preference to station the alignment.
3. Window in and take a look at the stationing.

   Remain in the **View Stationing** command.
4. Under the **Regular Stations** tab, change the stationing preference to **Parallel** orientation with **Center Center** justification.
5. **Apply** the command again – do not delete the original stationing.

   With **Write** lock on in **Pencil** mode, the old stationing is automatically deleted and the new stationing displays.
6. Close the **View Stationing** dialog. Since you did not save the preference, your changes will not be saved.

Create a Profile of the existing ground

1. Select **Evaluation > Profile > Create Profile**.

   Notice in the **Symbology** category, the **12345 existing ground** surface is set to use a named symbology of **Existing Ground**.
2. Keep the **Profile** command open.
3. Choose **Surface > Surface Properties**.

4. Set the **Surface** to **12345 existing ground**.

5. Choose the **Advanced** tab

   Note the **Profile Symbology** and **Cross Section Symbology** are set to **T_ Existing Ground**. This is where the symbology a surface will use on profiles and cross sections is assigned.

6. Close the **Surface Properties** dialog.

7. Choose **Apply**.

8. You will be prompted to Identify Location. **<D>** for the lower left corner of the profile in a clear area of your design file.

9. **Zoom** in and review the profile information.

View and annotate the proposed vertical alignment

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

2. Select **Apply** and the vertical alignment is annotated in the profile window you just created.

Review the typical sections for this project.

1. Select **Modeler > Define Typical Sections**.

2. Select the **Template** tab.

3. Double-click on the **SH 86 1L-1L Rural** template.

4. Use the **Layer** and **Segment** tabs to review the template.

5. Use the **Next** button on the **Segment** tab to **Review** the template segments.

6. Close the **Edit Template** dialog and repeat for template **SH 86 2L-2L Rural**.

7. While still in the **Define Typical Section** dialog, review the decision table used to develop sideslopes for this project.

8. Select the **Decision Tables** tab.

9. Double-click on **Variable Cut and Fill**.

10. Review the decision table entries.

11. **Close** all dialogs when done

Review the roadway definitions

1. Select **Modeler > Define Roadway**.
2. Double-click on the roadway definition **SH 86 with dec table**.
3. Review the transition entries, and notice the transition between 2 lane and 4 lane typicals. Double-click on the first station. Each entry has a dialog behind it that controls the transitioning and other criteria for modeling the roadway.
4. **Close** all dialogs when done

Model the road with the given data

1. Select **Modeler > Roadway Modeler**.
2. Review the default preference setup on the **Advanced** and **Main** tabs.
3. **Apply** the command to model the road.
4. Review the results of your **Roadway Modeler** run.

Cut a set of cross sections

Cut cross sections along SH 86 showing surfaces 12345 existing ground (existing ground), D_SH 86 Finished-Grade (finished grade of the proposed road) and the three additional layers, D_SH 86 Base-Course-Top, D_SH 86 Subbase-Top and D_SH 86 Subgrade-Top

1. Select **Tools > Options > Factors** and set the **Text Scale Factor** to ***40***. **Apply**, then **Close** the dialog box.
2. Select **Evaluation > Cross Sections > Create Cross Sections**.
3. Select **Apply** on the **Cross Section** dialog
4. Place a **<D>** in a clear area of your file to define the location of the lower left corner of a cross section set.
5. Select **Close**.
6. Window in to see the information contained on the sections.
7. Select **Evaluation > Cross Sections > Cross Section Viewer**.
8. Set the **Zoom Factor** to ***1*** and the **Time** to ***0.5***, then choose **Run**.
9. If you have more than one view open, you must **<D>** in the view to start the run.

Compute end area volumes

1. Select **Evaluation > Volumes > End Area Volumes**.
2. Set the **Existing** surface to **12345 existing ground** and the **Design** surface to **D_SH 86 Finished-Grade**.
3. **Apply** and view the results, then **Close** all dialog boxes.

Visualize the new roadway

1. Choose **Tools > Application Add-Ins**.
2. Toggle on **Drive Roadway** and choose **OK**.
3. Select **Modeler > Drive Roadway**.
4. Highlight the Horizontal Alignment **SH 86**.
5. Highlight the Vertical Alignment **SH 86 V**.
6. Choose **Run**.

   If you have multiple windows open, you must **<D>** where you want to see the drive-through; if you only have one window open, it automatically uses it.

7. Close the **Drive Roadway** dialog.

   During the rest of the course, you will be re-creating this roadway, learning the components and how they relate together to model the roadway.

8. Select **File > Exit** on the MicroStation menu. When prompted to save your changes, choose **No to All**.

2. Digital Terrain Models (DTMs)

A digital terrain model (DTM) is a mathematical representation of topography that includes points and triangles and is often referred to as a surface. The triangles allow the DTM to provide elevation information at any location by interpolating the elevations of the three points making up the triangle in question.

Using Delauney's criteria, InRoads calculates the smallest triangles possible for a given set of point data. Delauney's criteria states that any triangle formed may be circumscribed and no other point will fall within the circle. Linear features must sometimes violate Delauney's criteria in order to hold a constant slope between points. In other words, linear features will not allow triangles to cross them.

You may load as many DTMs as you need into memory when using InRoads. It is typical to have several DTMs loaded, since you will have an original and several design surfaces (such as a finished grade and one or more subgrades). At any given time, only one surface is active, meaning it will be the default when using any command requiring a surface.

When a digital terrain model is saved to the hard drive, it takes on an extension of **.dtm**.

DTM Point Types

Random

- Normal topo shots
- Often used for spot shots, local highs and lows

Breakline

- Used to represent linear features such as ditches, ridges, and edges of pavement, and named accordingly
- No triangles cross breaklines — they take precedence over random points
- Must have at least two points to form a breakline (lines, linestrings, curvestrings and complex chains are acceptable for import)
- Can be densified or thinned

Contour Points

- Use when data comes from contours, *e.g.*, digitized from aerial maps
- Work much like breaklines with a constant elevation
- Converts lines, linestrings, curvestrings and complex chains into DTM points
- Can be densified or thinned

Inferred breaklines

- Only used with contour points
- Generated by the software
- Eliminate flat spots by forcing a slope on every triangle
- Add overhead to your surface

Interior

- Used to model holes in your surface where there is unknown survey data or areas you do not want considered in the DTM
- Requires at least three points to model a closed shape
- No triangles are formed inside an interior boundary
- You can have more than one interior boundary per surface, but they can not overlap

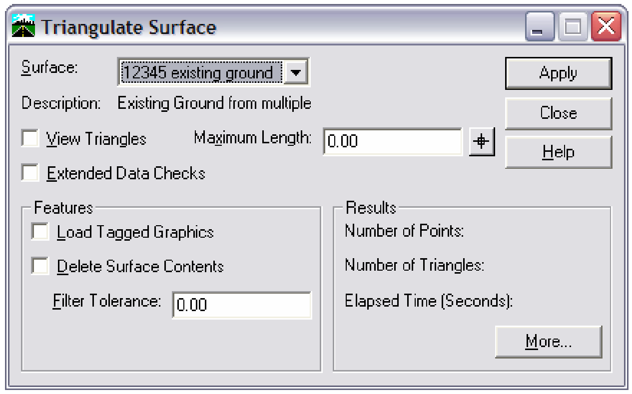
Exterior

- Define limits of triangulation
- Requires at least three points to model a closed shape
- There is only one exterior boundary per surface

Surface Triangulation

In order for a surface to be used for contouring, modeling, etc., it must have been triangulated. The original ground surface received from Survey will already be triangulated, however, if any changes or edits are made to a surface it will have to be triangulated again before the changes will show up in displays of the surface either in Plan, Profile or Cross Section.

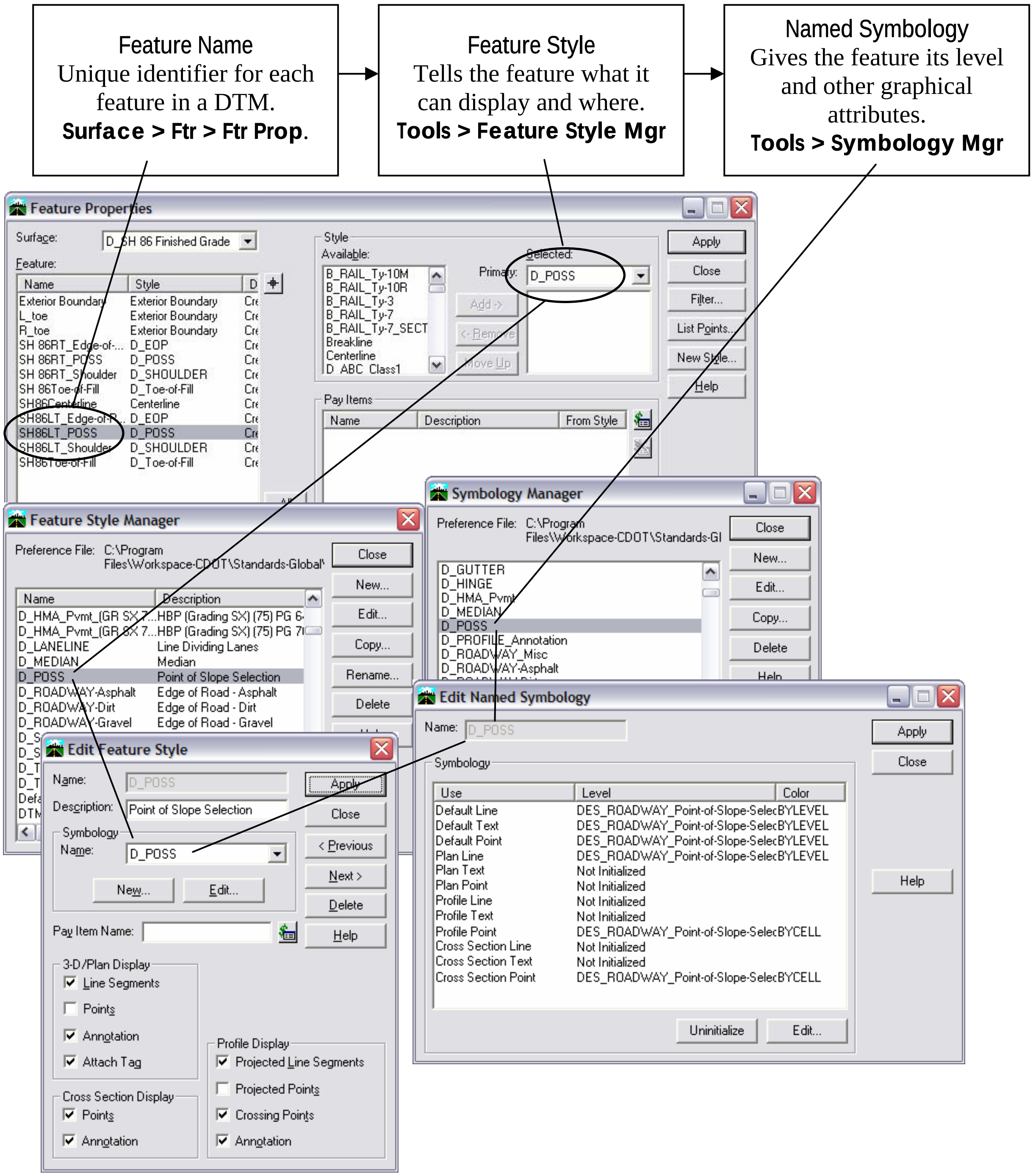
Surface > Triangulate Surface



A surface may also be triangulated by right-clicking it in the InRoads Explorer menu and selecting **Triangulate** from the list of available commands.

Intelligent DTMs

InRoads' digital terrain models are intelligent models. By using Feature Names, Feature Styles and Named Symbologies as described below, the models will know what types of features can be displayed in which views as well as the symbology they will use to display.



Feature Names

Everything in a DTM is a feature and every feature must have a unique name. Often, when creating new features, you will be asked to supply a **Seed Name**. This seed name is used as the base for a unique feature name. For example, if you use creek as the **Seed Name**, and you load more than one (with a level or selection set, for example) the second will be named creek1, third creek2, *etc*.

A feature can be either triangulating, such as breaklines representing ditches, centerlines, etc. or it can be non-triangulating, such as utilities that are below or above the ground surface. These types of non-triangulating features can be shown on cross section, profiles and in plan view without affecting the triangulated network.

Feature names are stored within the DTM.

Feature Styles

Feature Styles are assigned to features in the DTM. They control where and what the features is “allowed” to display, as well as assigning a named symbology. For example, when you assign a feature style to a feature, you are determining if it can be displayed in plan using lines, points and/or annotation; if it can be displayed in sections using points and/or annotation, etc.

Feature Styles are stored in **CDOT-Preferences.ini**.

Named Symbology

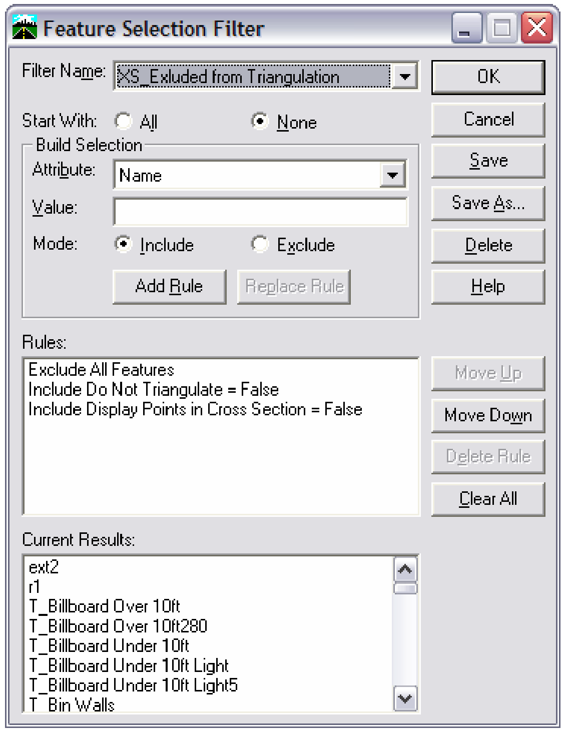
Named Symbologies are just what they sound like — setups, such as color, weight, line style, font that can be saved by name. They even go one step farther allowing these setups to share a name while establishing different symbologies for plan, cross sections and profiles. This way, one entity that uses a named symbology can still display using different setups in plan vs. cross section vs. profile. Just about anywhere you assign symbology, you can use a named symbology instead.

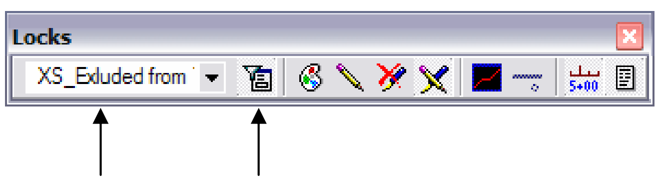
Named Symbologies are stored in **CDOT-Preferences.ini**.

Feature Selection Filters

Feature Selection Filters allow a method of segregating features for use in other commands. For example, if you are working with the breaklines that form a ditch, you can use a selection filter containing just those breaklines, then turn on the **Feature Filter Lock**. Future commands that use features will show only those specified by the filter as being available.

Feature Filters are stored in **CDOT-Preferences.ini**, and therefore cannot be created by users. The CDOT configuration contains predefined filters.





Creating a DTM

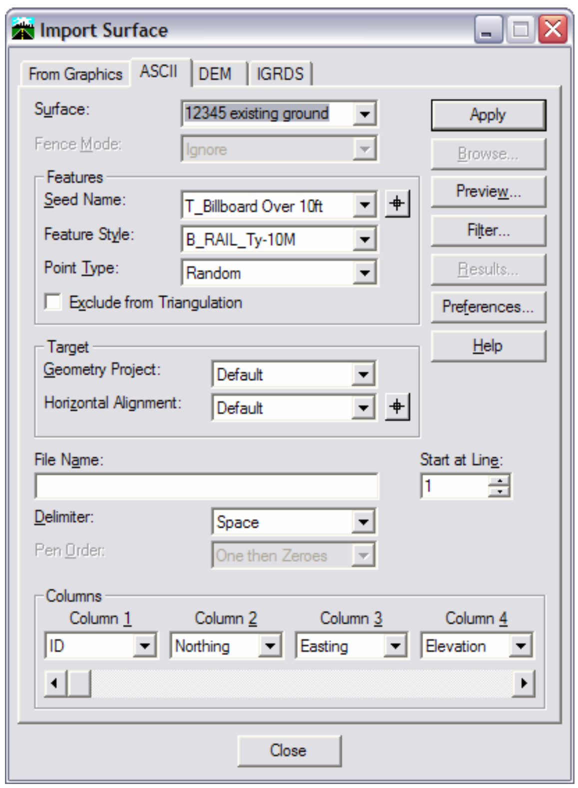
The existing ground DTM will be provided by Survey and proposed DTMs will be created by InRoads tools such as **Roadway Modeler**. However, there may be times when you may have to create or supplement one of these DTMs. If so, the data used to create the DTM may be in one of several formats. The most common formats are described below.

ASCII (text) Files

ASCII data can be loaded from several different formats. Using the **File > Import > Surface > ASCII** command, you can specify the format for your data. Some commonly used formats include:

- x,y,z*
- northing,easting,elevation*
- station,offset,elevation (baseline alignment required)*

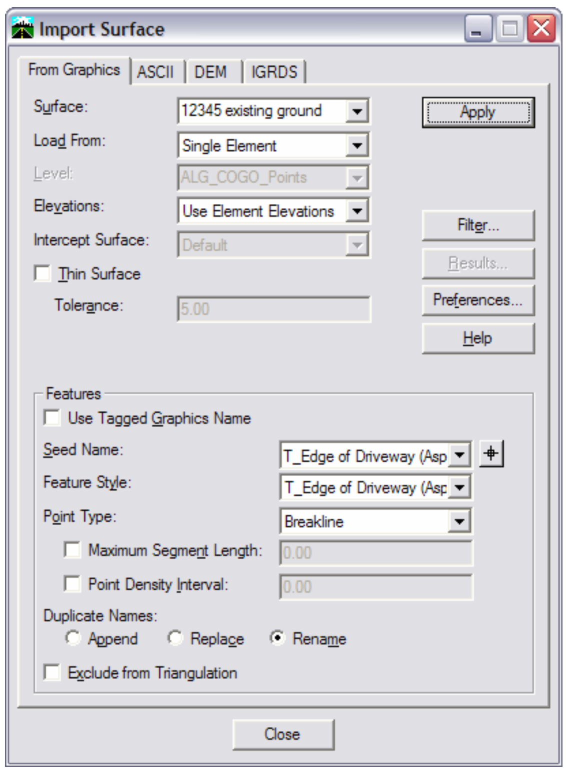
*Can have additional columns for "pen-up, pen-down" to define separate linear elements in one file, for feature names, features styles, etc.



Surface from graphics

Graphical data is sometimes used to generate existing or proposed surfaces using **File > Import > Surface > From Graphics**. When using graphics, some key points are listed below.

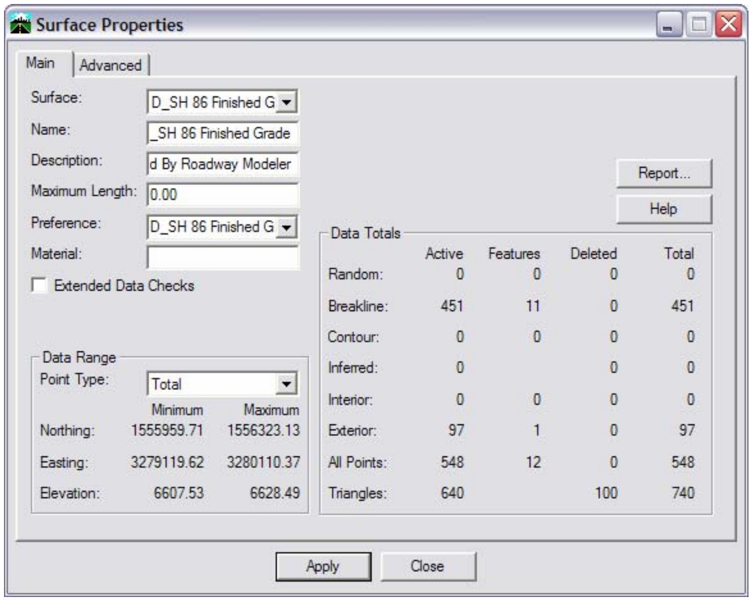
- Elevations may be taken from the element or from surface (if the surface has been triangulated already).
- Elevations may be taken from text if you're loading random points that are graphically displayed in the correct location, with text listing the elevations.
- Linear features that contain curves can be densified using the chord height tolerance (set under **Tools>Options>Tolerances**).
- Linear elements can be densified by setting a maximum segment length or a point density interval.
- Points on linear elements can be thinned upon input using the **Thin** (and **Tolerance**) option.

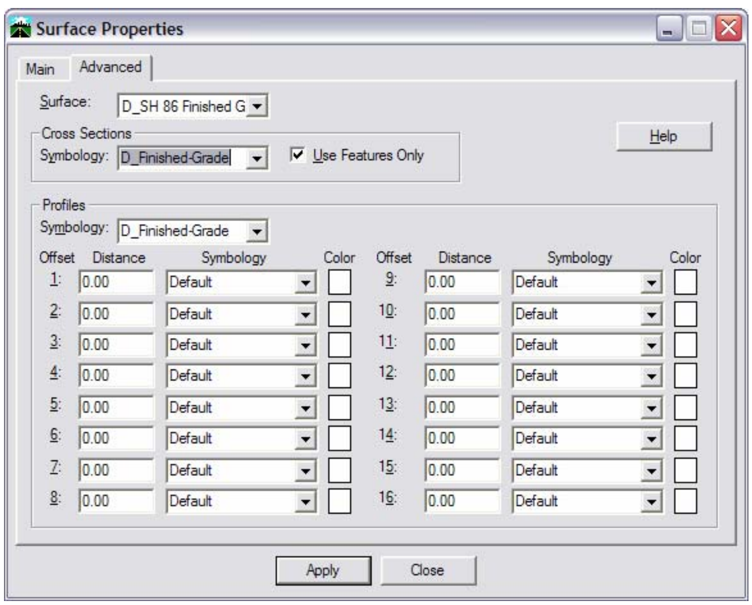


Reviewing a Surface

After a surface is created, you may review the data it contains using **Surface Properties** or **Feature Properties**.

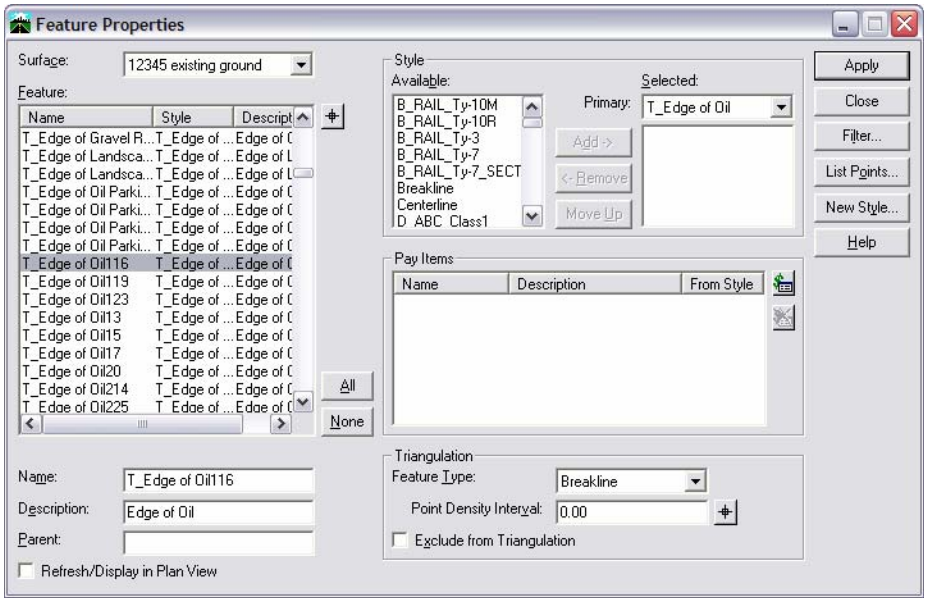
Surface > Surface Properties

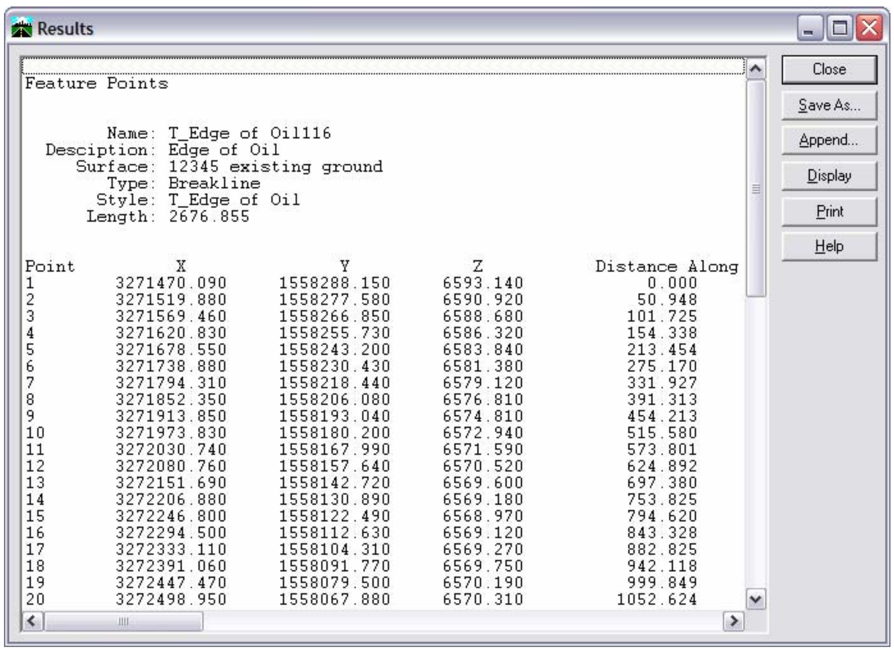




The **Surface Properties** dialog allows you to change the name, description or preference associated with the surface. By accessing the **Advanced** tab, you can also set the named symbology to be used when displaying the surface ground line in profiles and cross sections. The **Advanced** tab also allows the establishment of **Offsets** that can later be displayed when creating or updating a profile.

Surface > Feature > Feature Properties

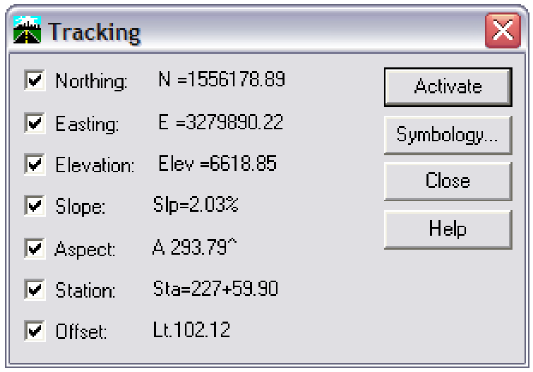




The **Feature Properties** dialog allows you to change the name, description and style of an individual feature. You can also get a listing of all the points that make up the feature by highlighting the feature in the list (or using the target button to graphically identify it) and then choosing **List Points**.

Tracking the Surface

The **Tools > Tracking > Tracking** command allows you to move your cursor and get a readout of the coordinate location and the interpolated elevation, as long as you are in a triangulated area. By toggling on the information you want, then choosing **Apply**, you can also Data point at any location and have the information written into the design file.



Note that the station and offset are also available for tracking when a geometry project is loaded and has an active alignment.

Combining DTMs

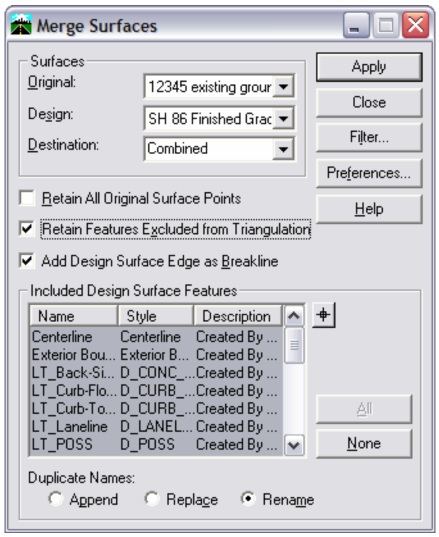
Merge Surfaces

The **Merge Surfaces** command (**Surface > Edit Surface > Merge Surfaces**) is typically used to combine a design surface, such as a roadway with an existing ground surface. By turning off the option to **Retain All Original Surface Points**, everything from the original surface that falls inside the design surface's perimeter is removed, the design surface added and the new surface triangulated.

Other options include retaining any non-triangulating features and creating a breakline from the design surface's edge (exterior).

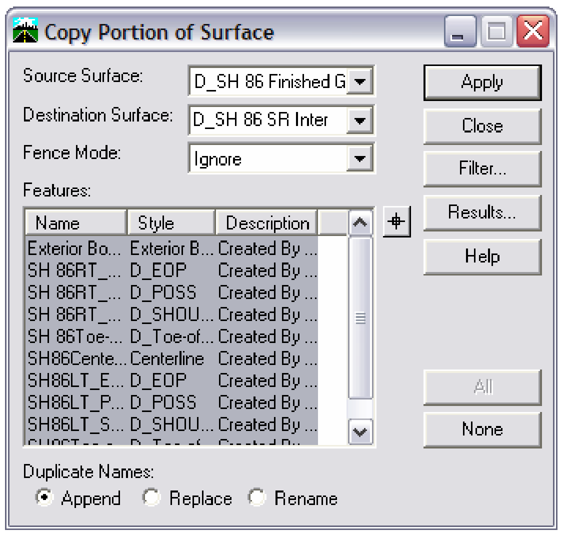
This command will not allow the destination surface to go outside of the exterior boundary contained in the original surface, so the original surface's exterior would need to be removed if this command is used to combine adjacent surfaces.

<u>Note:</u> It is a good idea to use a new surface name for the **Destination** surface. This ensures your original and design surfaces will remain intact. (Just type in a new name and is will be created upon execution of the command.)



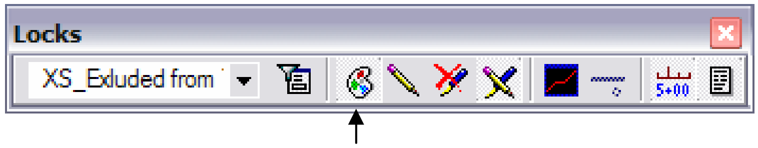
Copy Portion of Surface

The **Copy Portion of Surface** command (**Surface > Edit Surface > Copy Portion of Surface**) allows you to copy features from one surface into another surface. This can be used to combine two adjacent surfaces when the desire is to keep the features from both. Care must be taken not to use either exterior boundary in this case. The recommended method is to copy one of the surfaces and remove the exterior using **Surface > Edit Surface > Delete Features**. Use this as the **Destination** surface, then do not select the exterior boundary feature when selecting the features from the **Source** surface to copy into the **Destination**.



Locks affecting Surface Displays

Two locks affect surface displays.



Style lock – If **Style** lock is on, the dialog box for the view command will not be displayed. Instead, the display will be executed using the active surface and the preference assigned to the surface in the **Surface > Surface Properties** dialog.

Write lock – If **Write** lock is off, the displays will be temporary. Zooming in or out, updating the view, etc. will cause the graphics to disappear.

If **Write** lock is on, there are two modes – Pen and Pencil.

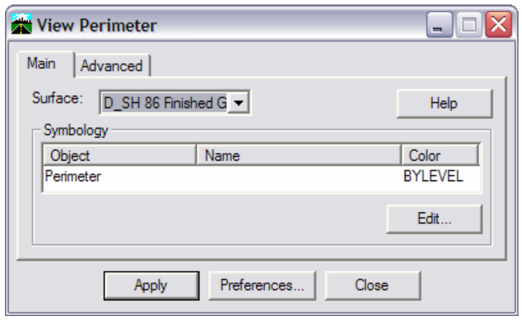
If the **Pencil** mode is selected (as shown here), the graphics are updated whenever the same display command is selected again. For example, if you display the contours, then change to a different preference and display again, the old contours are deleted and the new contours are displayed.

If **Pen** mode is selected there are two options. If **Delete Ink** is off, the graphics are not updated when the same display command is selected again. Instead, another copy is placed in the design file. If **Delete Ink** is on, the graphics are treated like **Pencil** mode and the old one removed before the new ones are placed.

Viewing the DTM Perimeter

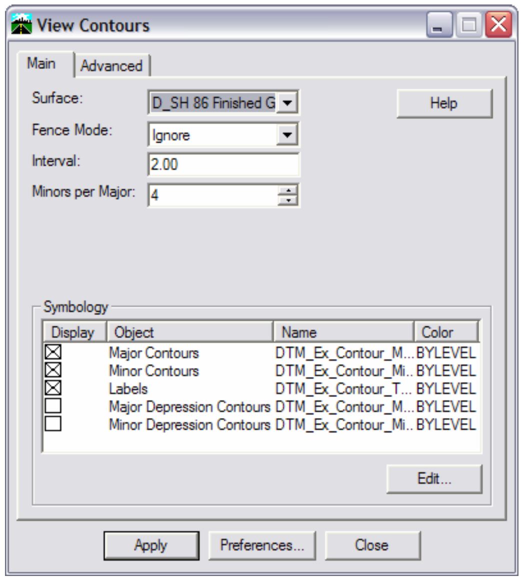
The perimeter of a DTM is an outline of the current triangles, and therefore can only be displayed after a surface is triangulated. It should not be confused with an exterior boundary, which actually limits the triangulation. If there is an exterior boundary on the surface, the perimeter will be in the same location.

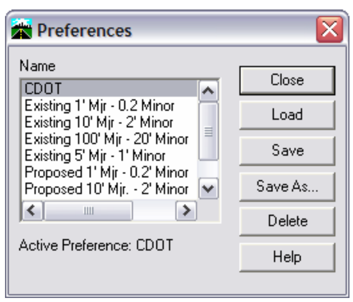
Surface > View Surface > Perimeter



Viewing Contours

The contours for a model may be displayed using the **Surface > View Surface > Contours** command. There are several preferences available in this command, depending upon the type of surface and contours you want to display. Select **Preferences** and choose the appropriate one for your application before choosing **Apply**.





The CDOT preferences, as shown above, relate to the type of surface, existing or proposed, and to the interval for major and minor contours. The preferences also set the level for displaying the contours, which in turn sets the **ByLevel** symbology.

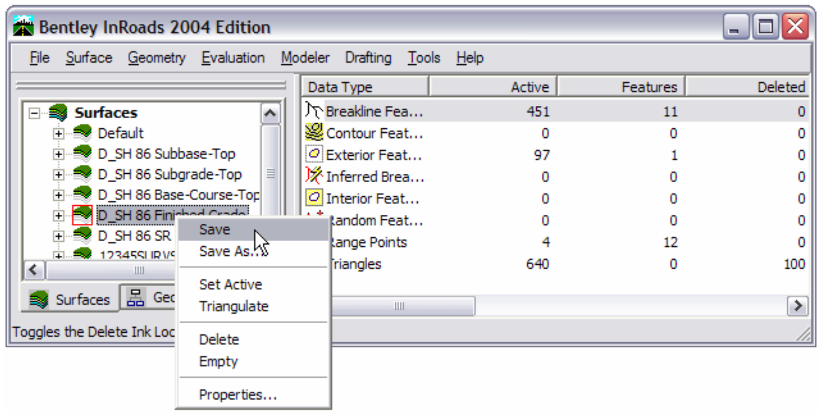
Saving a Surface

Surfaces can be saved using several methods including:

- Choose **File > Save > Surface**

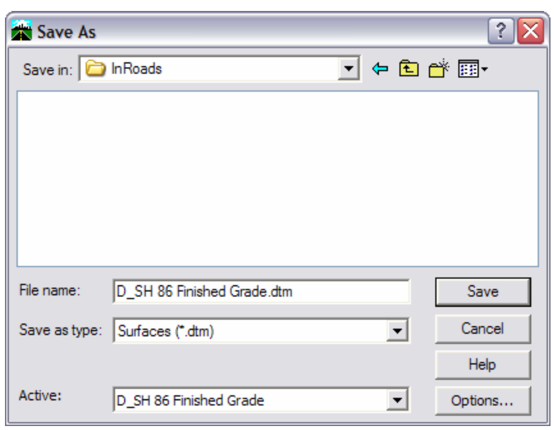
The active surface is saved.

- Right-click on the Surface in the **Explorer** menu and chose **Save**



The surface you highlighted is saved.

If the surface has never been saved, either of the above methods will bring up the **Save > As** box as shown below.



- Choose **File > Save As**
- Set the **Files of Type** to ***.dtm**
- Choose the surface you want to save
- Key in the file name (or use the default)
- Choose **Apply**.

Note: Surfaces have both an internal name that appears in the dialog boxes in InRoads and a name on the hard drive that has a **.dtm** extension. It is recommended that these names be the same, and care should be taken to make certain you have chosen the correct surface name to match the file name you specify. Otherwise, you could accidentally save over a file on the hard drive with the wrong surface.

The surface may also be saved as part of the project or **.rwk** file, which you will be using in your lab activities.

Lab 2 – Digital Terrain Models

Start InRoads

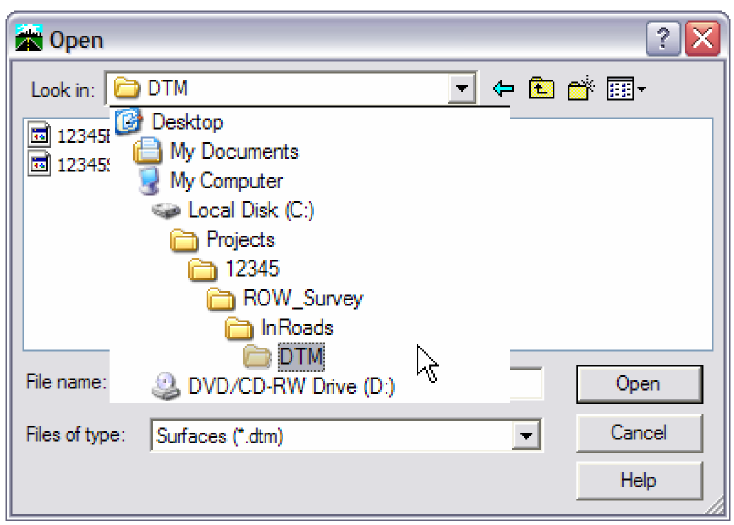
1. Double-click the InRoads icon from your desktop.

2. Select the design file **CU12345DES_Model.dgn** from the **\Design\Working** folder.

   InRoads automatically starts with MicroStation, using the design file specified.

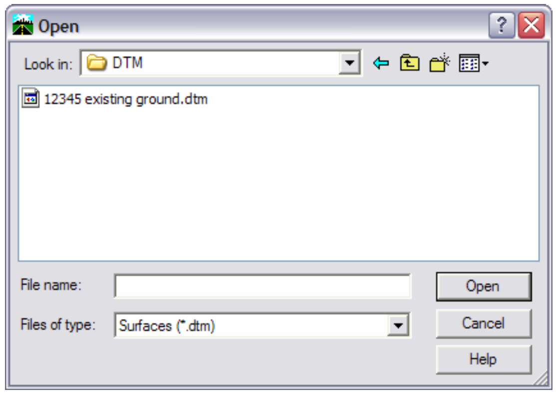
Load the digital terrain model (DTM) provided by Survey

1. Select **File > Open** From the InRoads menu.



2. Set the **Files of type** to **Surfaces (*.dtm)**.
3. Navigate to the **\ROW_Survey\InRoads\DTM** folder.

4. Double-click **12345 existing ground.dtm** or highlight it and select **Open**.

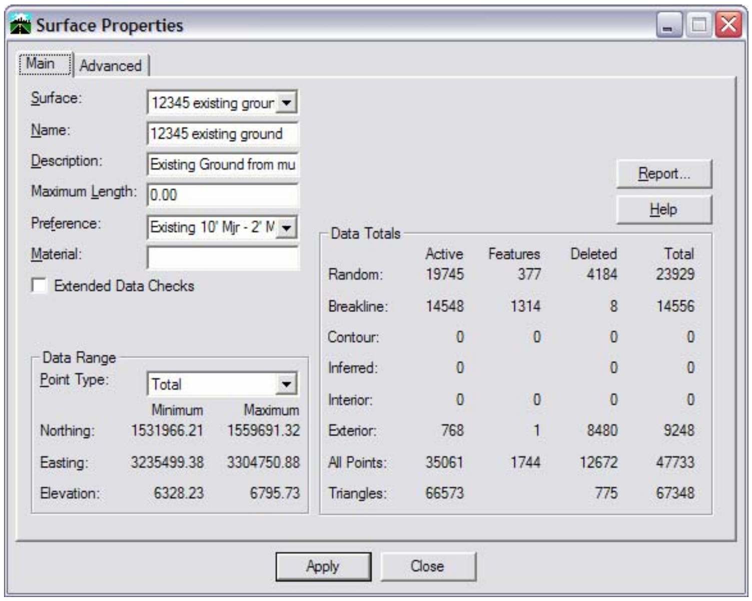


5. **Cancel** the **Open** dialog box.

Review the DTM

1. Select **Surface > Surface Properties**.

   This opens a review dialog where you can change the surface name, description, maximum triangle length and the preference associated with the surface. You can also review the coordinate and elevation ranges for the different point types.



2. In the **Data Range** category, review the coordinate range.

3. Change the **Point Type** to **Breakline** and review the range again.

   You can review any of the point type's ranges to look for discrepancies.

4. **Close** the dialog when you are through reviewing the data.

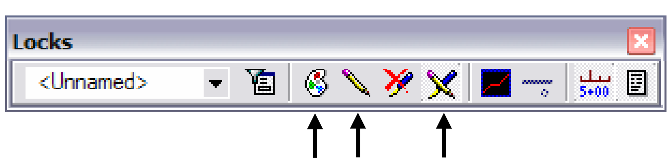
Display a perimeter

1. Select **Surface > Fit Surface**.

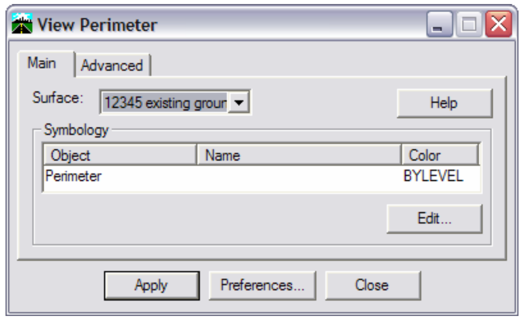
   This sets the MicroStation view to show the entire surface, even though nothing from the surface has been displayed. If you have more than one view open, you must **<D>** in the view you want to use after selecting the command.

2. Turn on **Write** lock and set the mode to **Pencil**.

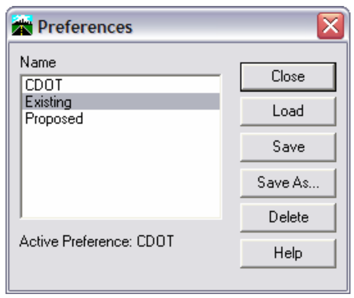
3. Ensure **Style** lock is off, or the perimeter will be displayed without the dialog box appearing.



4. Select **Surface > View Surface > Perimeter**.



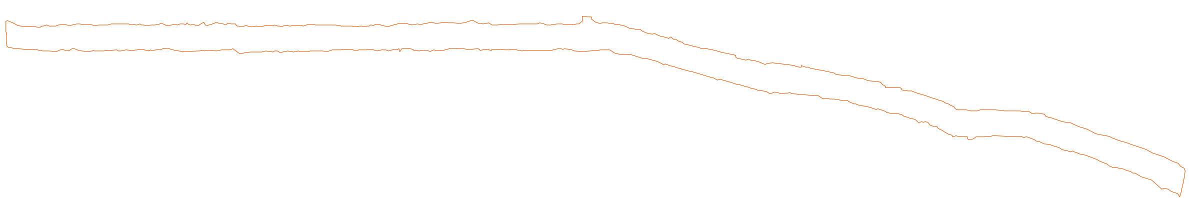
5. Select **Preferences**, then highlight **Existing** and choose **Load**.



6. **Close** the **Preferences** dialog, then **Apply** and **Close** the **View Perimeter** dialog.

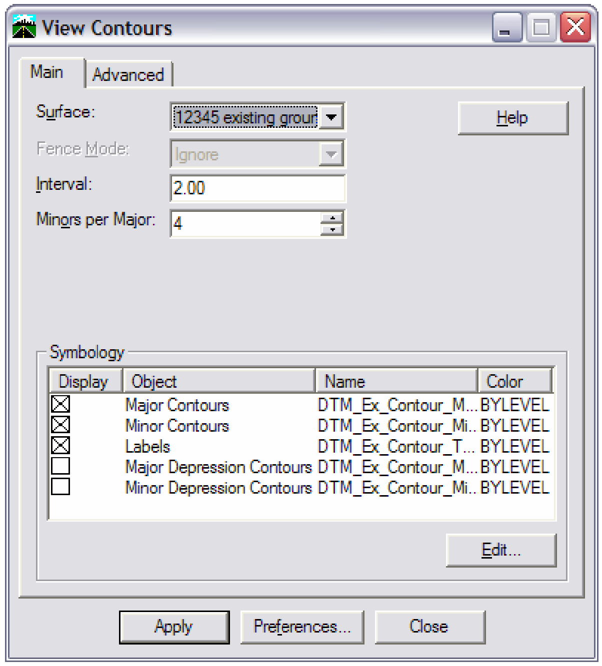
   Use the MicroStation **Fit** command to fit the view if you do not see the perimeter.

   Your display should now show the perimeter of the existing surface.



Display Contours

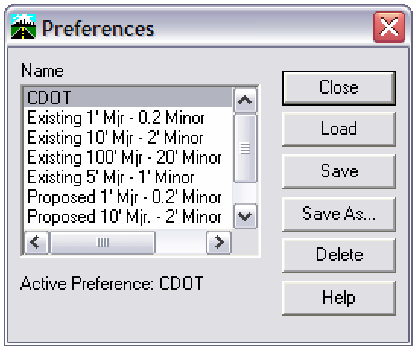
1. Select **Surface > View Surface > Contours**.



Note that the existing ground surface is already listed in the dialog. This is because the existing ground surface is your ***Active*** surface.

2. Select **Apply** and the contours are displayed in your design file. If you do not see them, **Fit** the view.

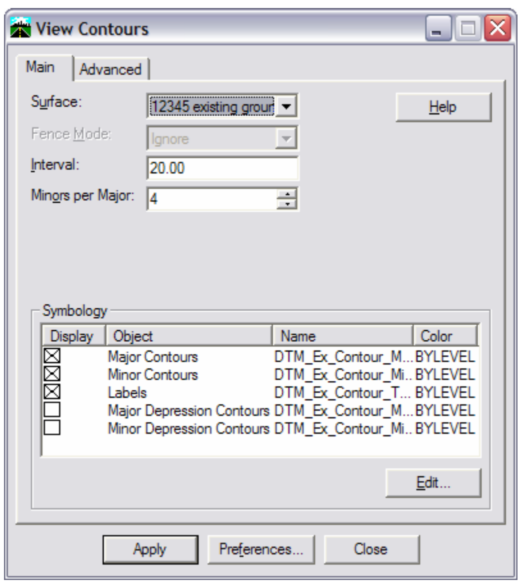
3. Select **Preferences** from the **View Contours** dialog.



The CDOT standard preferences for contours are listed in the dialog. As you can see, they correspond to different contours setups for both existing and proposed surface models.

4. Highlight the **Existing 100' Mjr – 20' Minor** preference and choose **Load**.

5. Close the **Preferences** dialog.



Notice in the **Symbology** category, this preference is set up to display **Majors**, **Minors** and **Labels**.

6. Select the **Advanced** tab and review the settings. These are all controlled by the preference as well.

7. **Apply** to generate the contours with the new preference.

Note: Since you were in **Pencil** mode the first time you generated contours, this time the original display was deleted and replaced with the new display.

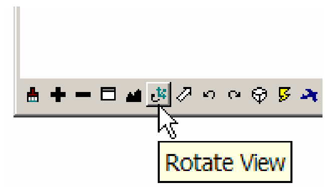
8. Select **Preferences** from the **View Contours** dialog and load the **Existing 10' Mjr – 2' Minor** preference.

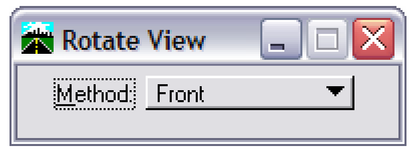
9. **Apply** to generate the contours with the new preference.

10. **Close** the Contour dialog.

Use Rotate View to look at the contours from different angles.

11. Select the MicroStation **Rotate View** command and set the **Method** to **Front**.





Note: If you have more than one view open, you will need to **<D>** in the view to execute the rotation.

12. **Fit** the view and look for any spikes in the contours.

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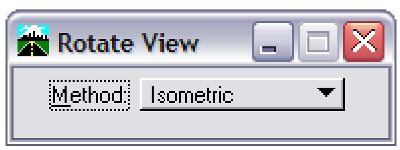
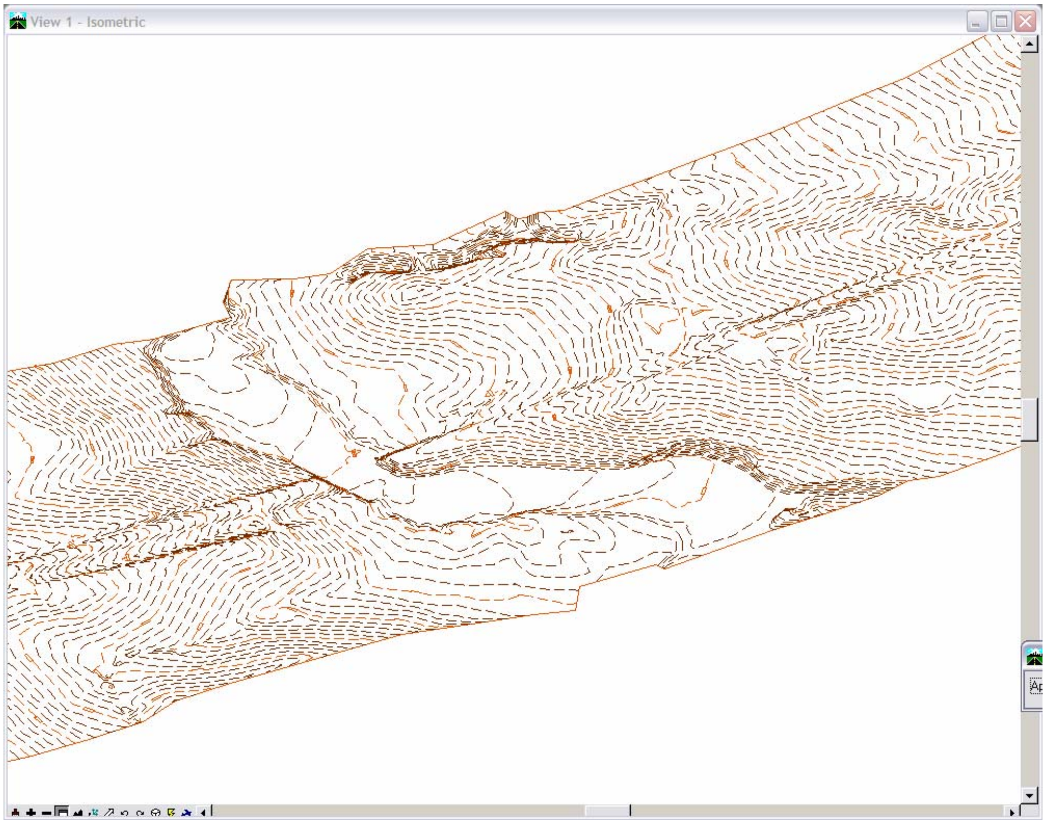
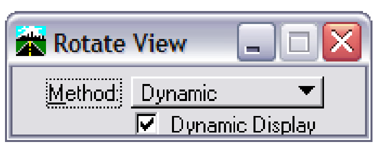
13. Select **Rotate View** again and set the **Method** to **Isometric**.



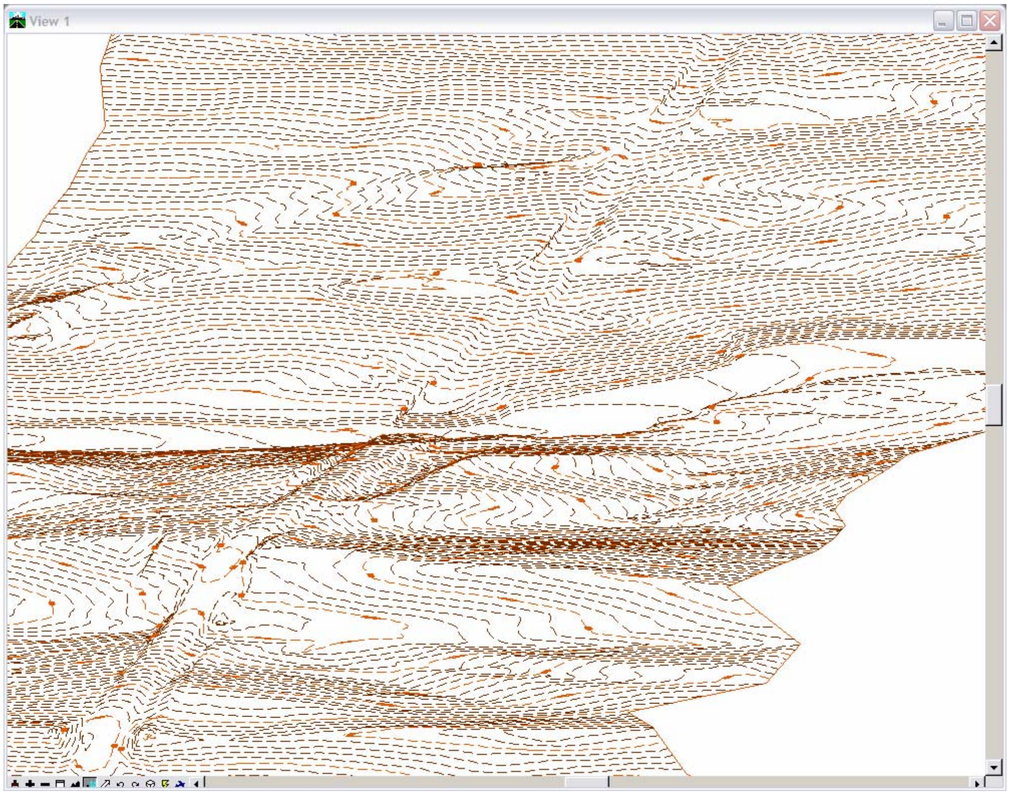
14. **Fit** the view.



15. Select **Rotate View**, set the **Method** to **Dynamic** and toggle on **Dynamic Display**.



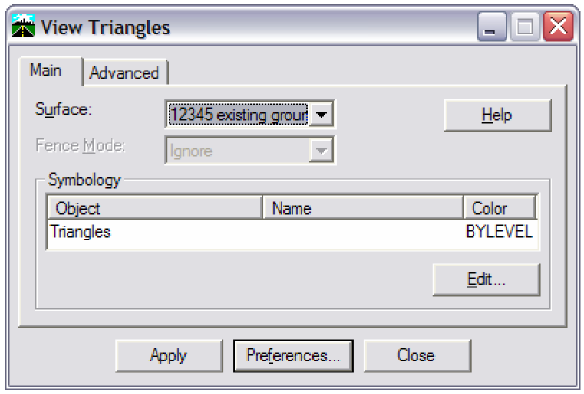
16. Snap (**<T>**, then **<D>** or **AccuSnap**) to one of the contours near the center of the surface, then move your cursor to review the surface from different angles.



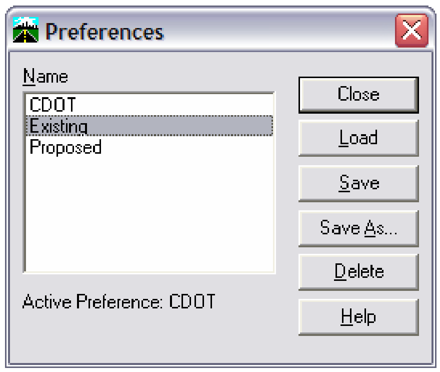
17. If you are out of the **Rotate View** command, select it again.
18. Set the **Method** to **Top**.
19. **Fit** the view.
20. Use MicroStation to delete the contour display. The contours are a graphic group, so one delete will delete them all if **Graphic Group** lock is on.
21. Use MicroStation to delete the perimeter display.

Display triangles

1. Select **Surface > View Surface > Triangles**.

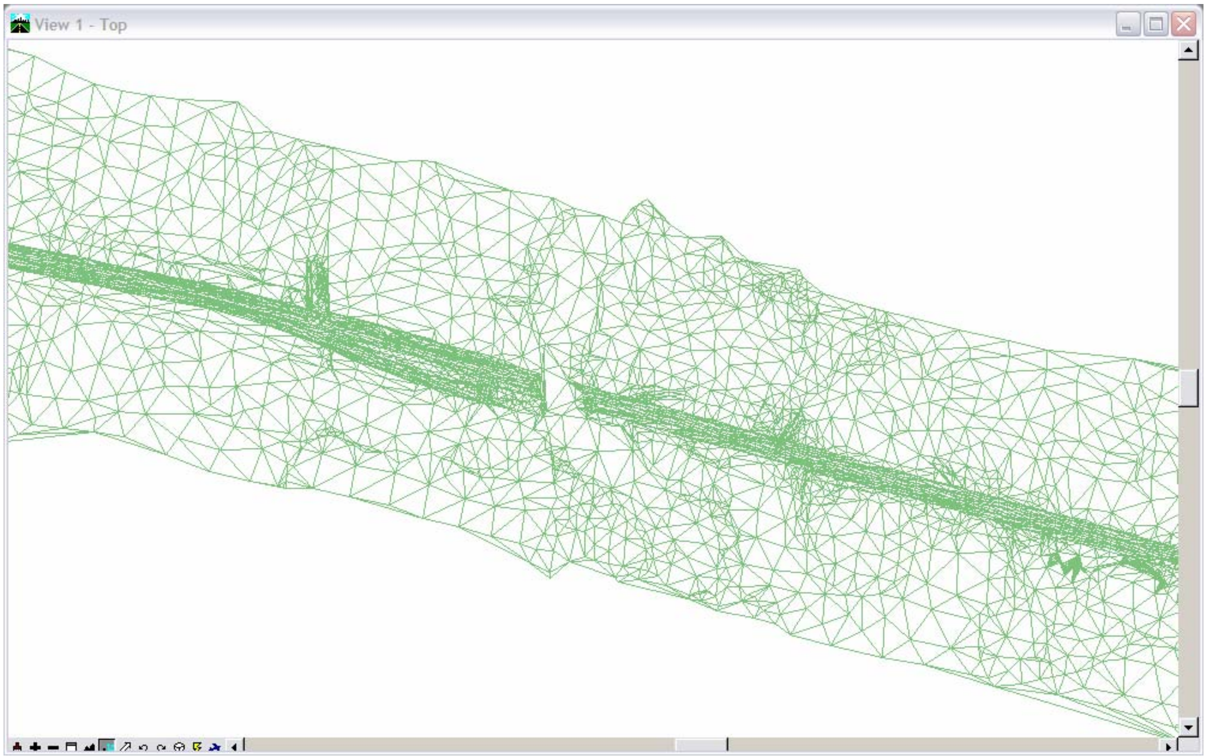


2. Select **Preferences**.

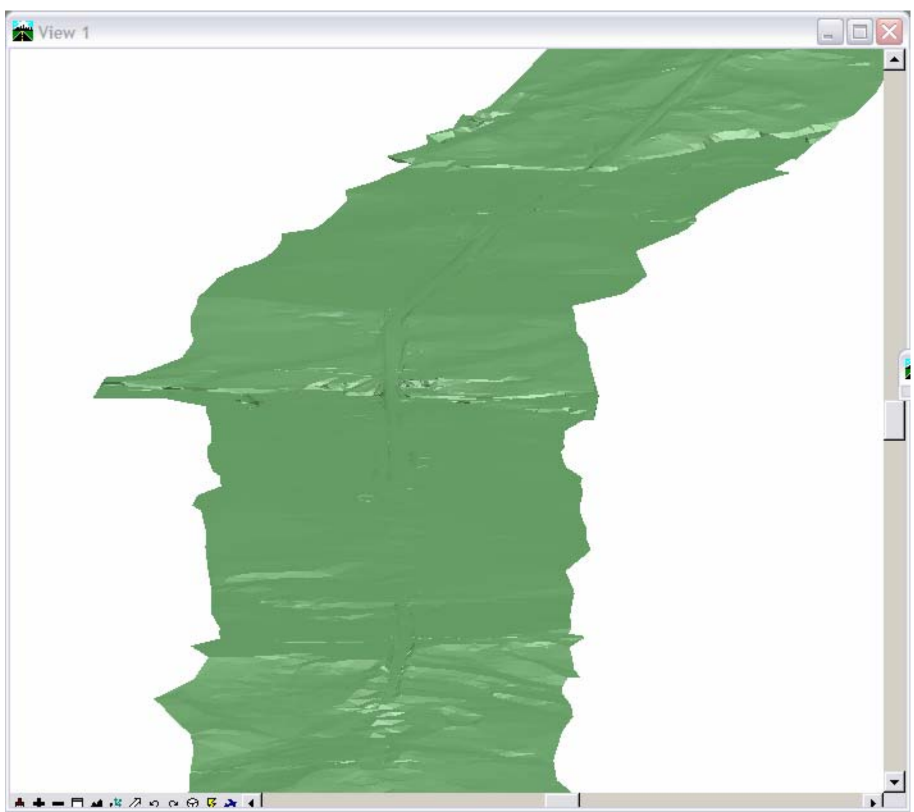


The CDOT standard preferences for triangles are listed in the dialog.

3. Highlight **Existing** and choose **Load**.
4. **Close** the **Preferences** dialog.
5. **Apply** to view the triangles.



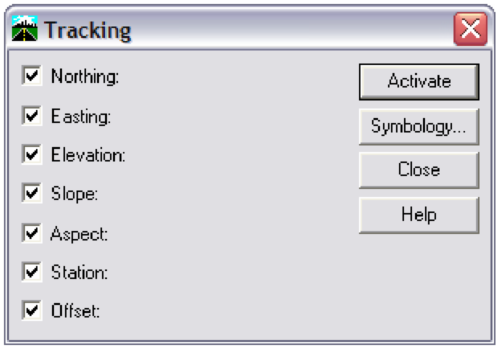
6. Use **Rotate View** to look at the triangles from different angles.
7. Select MicroStation **Utilities > Render > Phong** to see a shaded view of the DTM.



8. Return to a top view when finished.
9. **Delete** the triangle display.
10. View the perimeter of the model.

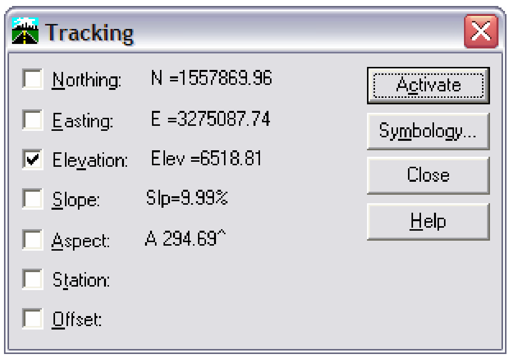
Track the surface and display elevations

1. Select **Tools > Tracking > Tracking**.



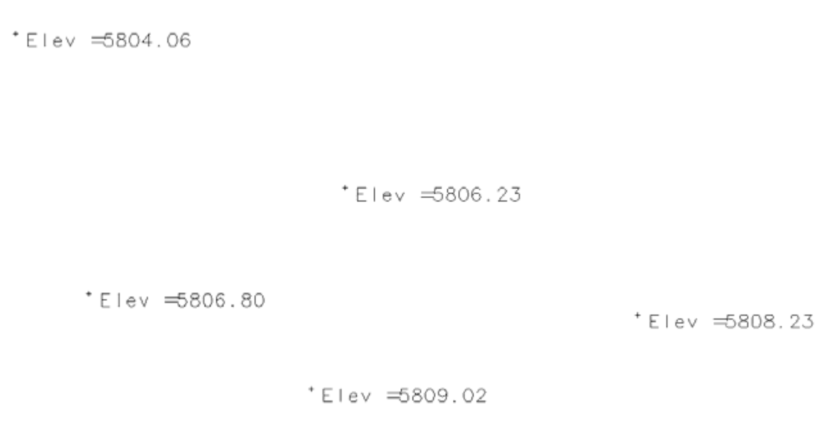
2. Toggle off all options except **Elevation**, then choose **Activate**.

3. Move your cursor around the view and note that the coordinates, elevations, *etc.* are 'tracked' in the dialog.



4. Move your cursor outside the perimeter and notice that only the Northing and Easting coordinates are tracked when you're outside the surface.

5. **<D>** inside the perimeter to display the elevation at the cursor location.

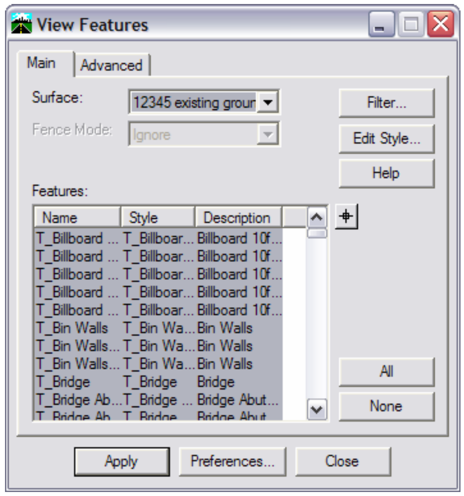


6. Try several locations, then **Close** the dialog.

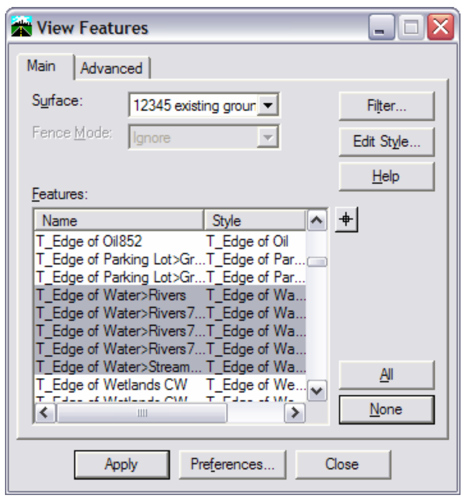
7. Use MicroStation to zoom in and review, then **Delete** the elevation displays.

Display the surface features

1. Select **Surface > View Surface > Features**.



2. Select **None**, then highlight the **Edge of Water ...** features.

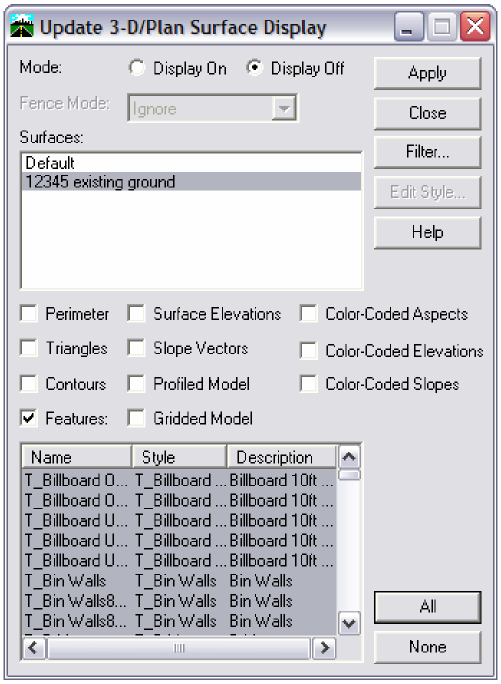


3. **Apply** and **Close** the **View Features** dialog.

4. **Zoom** in to see some of the features.

   The features do not display as a graphic group, but as individual entities. As such, they must be deleted individually. While a fence or a selection set could be used to make the task easier, you are going to use a new command, **Update 3D/Plan Surface Display**. This command allows you to view or delete many of the surface displays from one dialog.

5. Select **Surface > Update 3D/Plan Surface Display**.



6. Set the **Mode** to **Display Off**.

7. Select the **12345 existing ground** surface.

8. Toggle on **Features**.

9. Next to the feature window, select **All** to highlight all the features.

   You do not have to find the Water features and highlight them individually, unless there are more features displayed and you only want to turn off the Water ones.

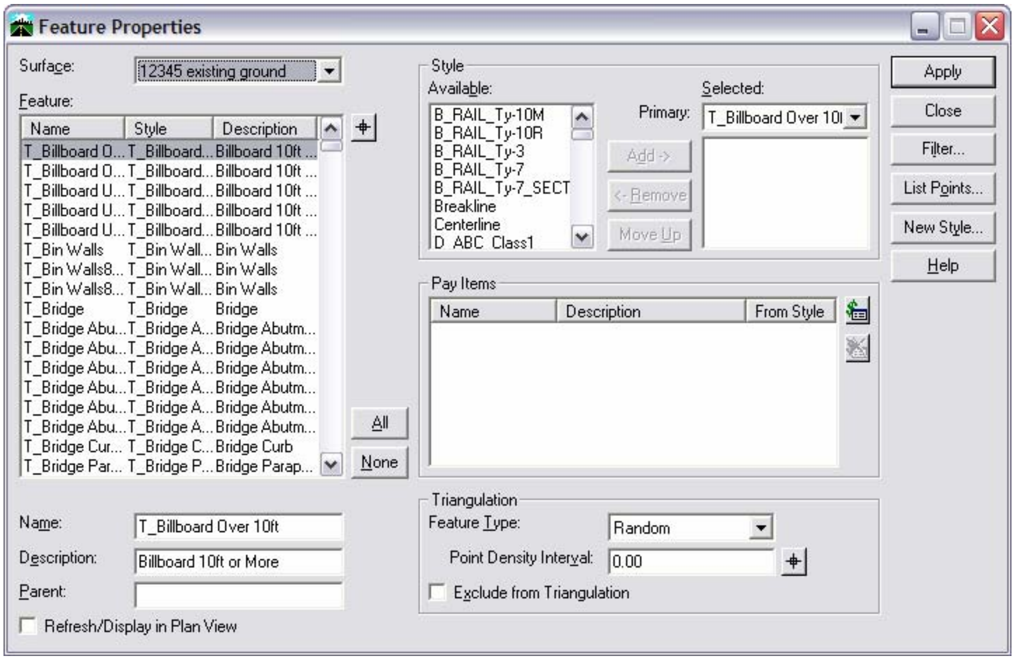
10. Select **Apply**.

11. Experiment with some of the other displays, turning them on and off as desired.

12. When you are comfortable with this dialog, toggle all of the displays off and then **Close** the dialog.

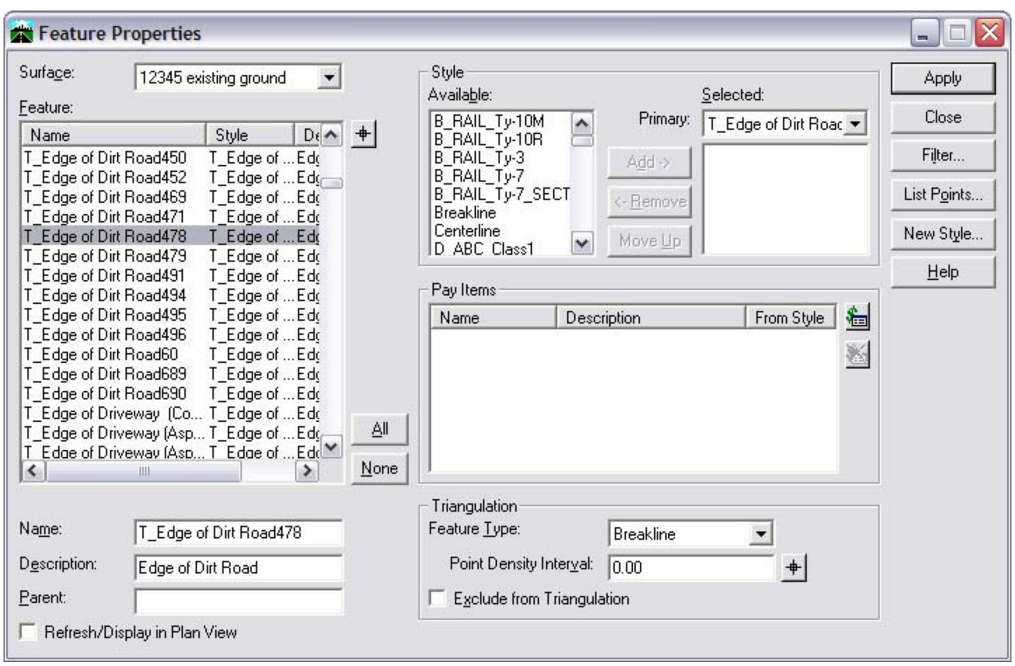
Review features

1. Select **Surface > Feature > Feature Properties**.

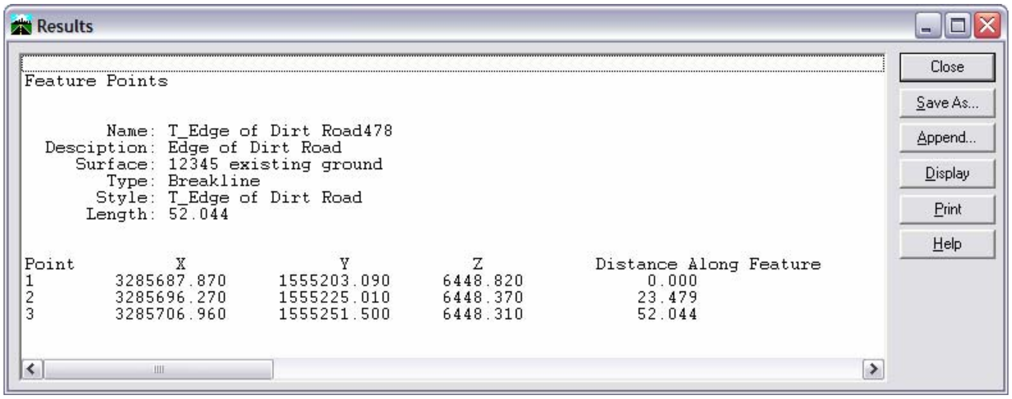


2. This dialog allows you to change any of the properties of the feature. Note that one of these properties is the **Exclude from Triangulation** option.

3. Highlight one of the **Edge of Dirt Road** features.



4. Select **List Points**.



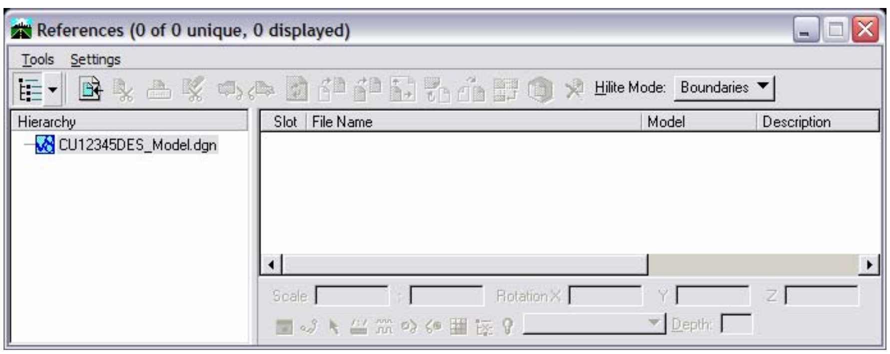
The **Results** dialog appears, listing the coordinates of each vertex of the feature, as well as the distance along the feature where the vertex occurs. This report can be printed, displayed in the design file, saved as a text file or appended to an existing text file.

5. **Close** the **Results** box and the **Feature Properties** box.

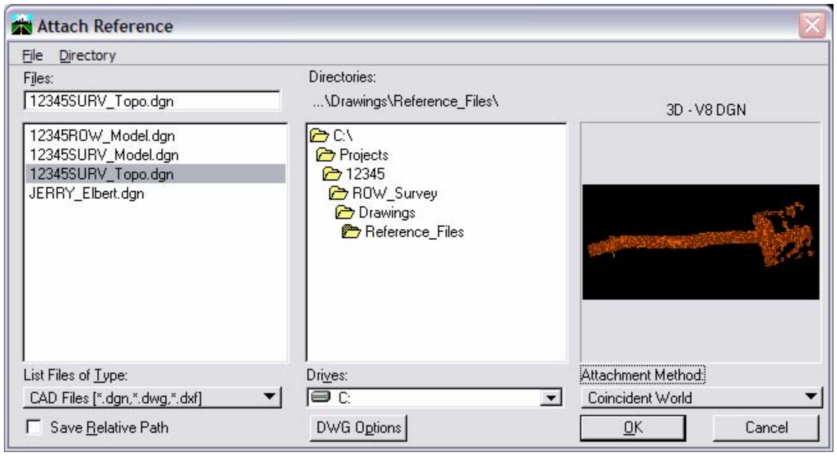
Attach the Survey file as a reference

Survey provides several design files, using different scales, that can be referenced to your design. This is why you turned off the previous feature displays, as these displays are contained in the design files from survey and were displayed previously for practice, since the same techniques are used for proposed models.

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



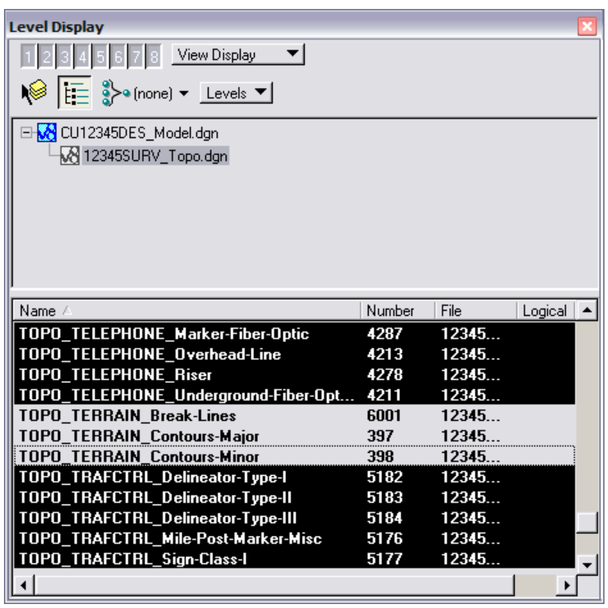
2. Select **Tools > Attach**.
3. Highlight **12345SURV_Topo.dgn** from the **ROW_Survey\Drawings\Reference_Files** folder.

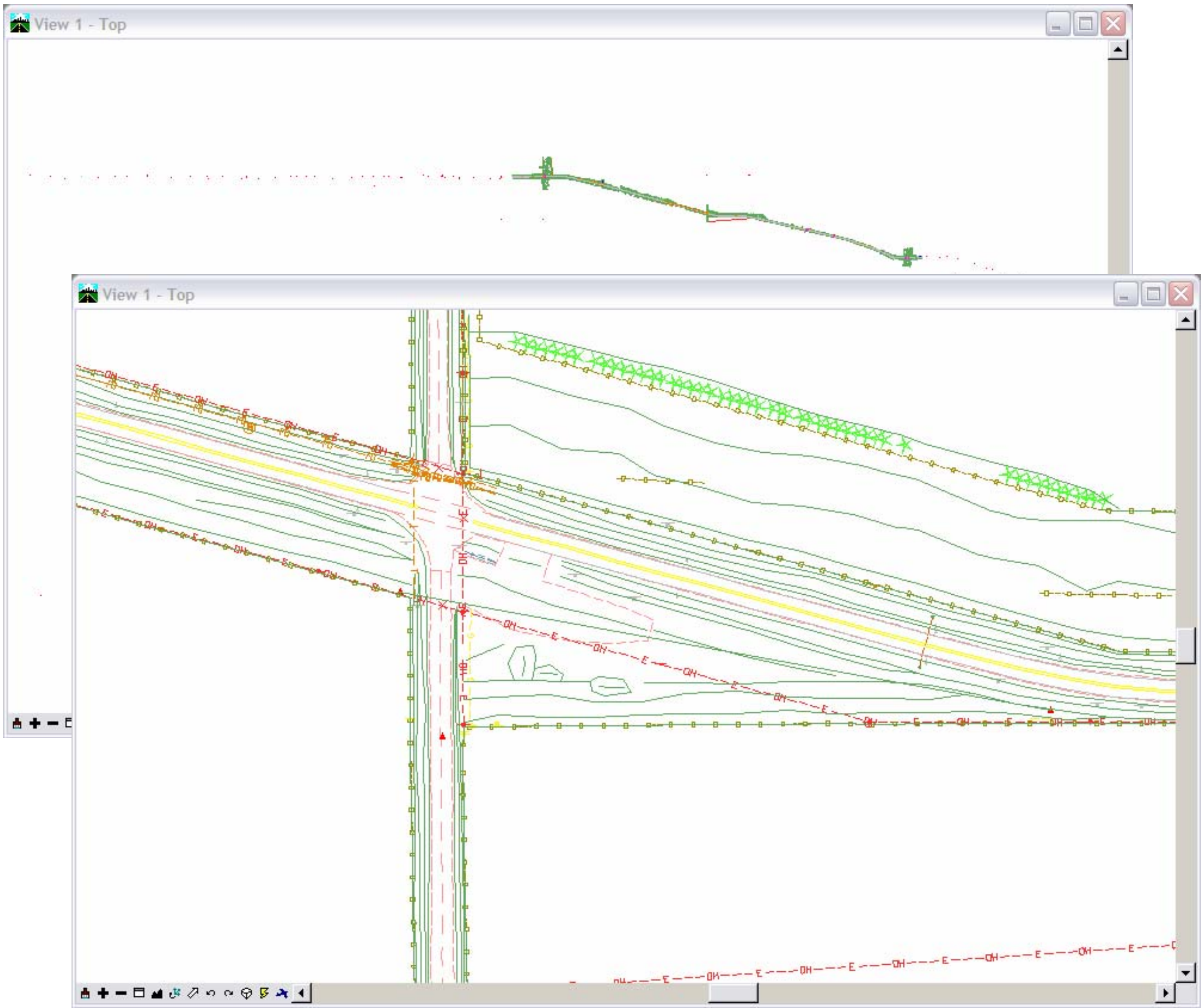


4. Set the parameters as shown on the dialog and choose **OK**.

   By setting **Coincident World** on the dialog, you do not have to specify the name, description, model or view you want to reference. These are set automatically and the Default model is referenced to the active design file model.

5. **Fit** the view.
6. Turn off the contour levels to better see the features.





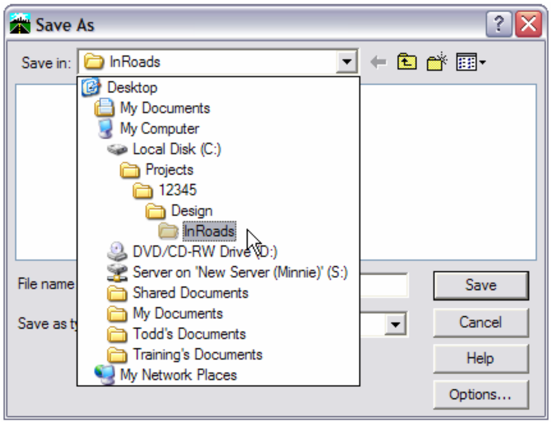
7. Select **File > Save Settings** from the MicroStation menu.

8. Select **File > Compress > Design** from the MicroStation menu.

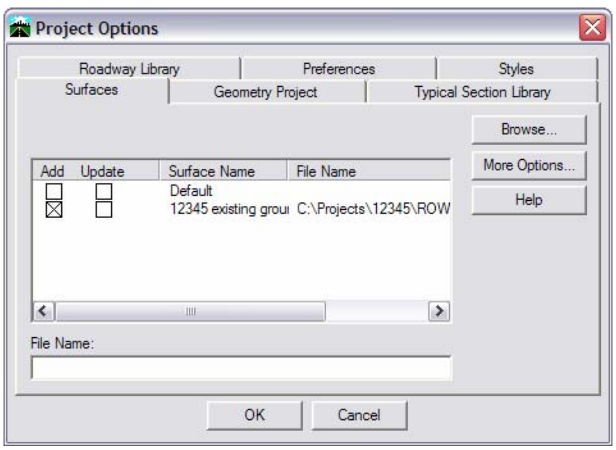
Create a project file (rwk)

When using InRoads, there are several data files that must be loaded into memory each time you start to work. These files can be loaded in one step by creating a project file. A project file is just a text file that lists the different data files you need to load. It can be created with a text editor, or with the InRoads menu as you will do here.

1. Select **File > Save As** from the InRoads menu and ensure the **Files of Type** is set to **Projects (*.rwk)** and the folder is C:\Projects\12345\Design\InRoads.



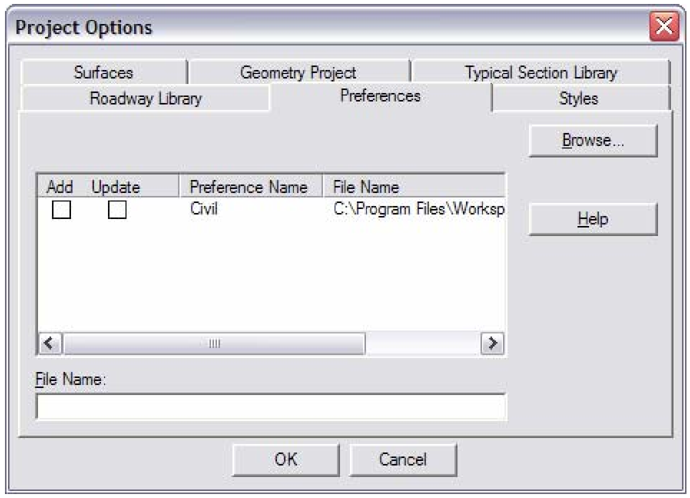
2. Choose **Options**.



3. On the **Surfaces** tab, toggle on **Add** for **12345 existing ground**.

   Add will load the surface each time the project is loaded. **Update** would save the surface, but since this surface is set you do not need to save it each time.

4. On the **Preferences** tab, toggle off **CDOT-Preferences.ini**.

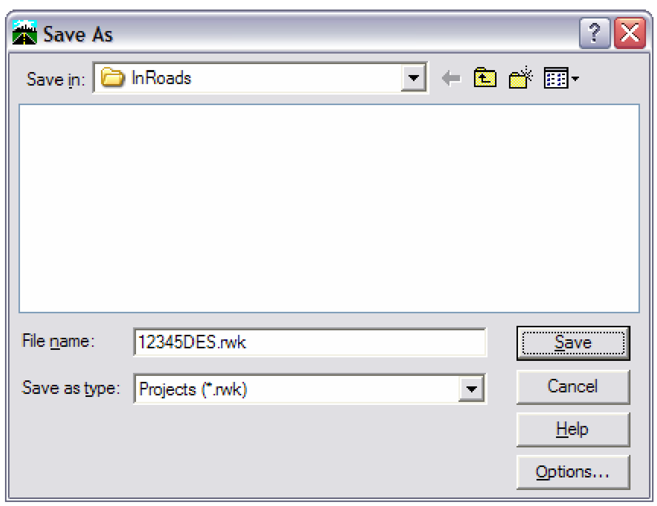


5. On the **Styles** tab, toggle off **CDOT-Styles.ini**.

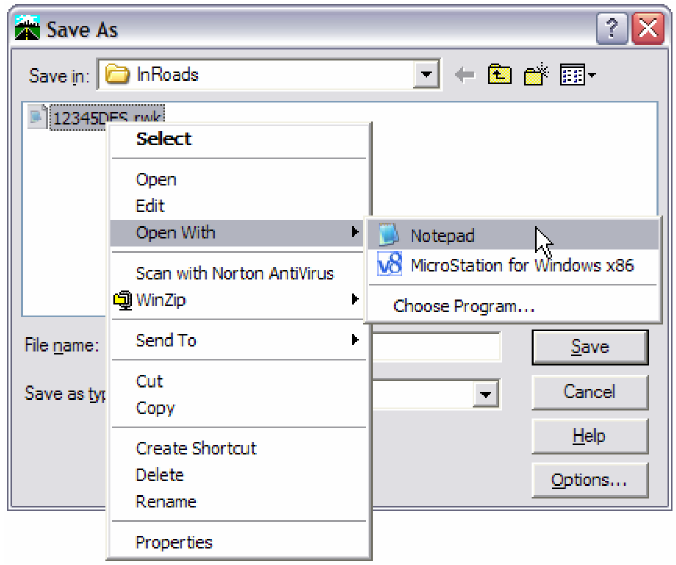
   These files are automatically loaded with the project defaults, so you do not need to load them with the project. If you do not use project defaults, then you can toggle these on.

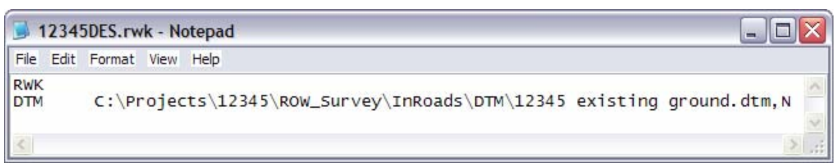
6. Choose **OK**.

7. Back on the **Save As** dialog, key in the name **12345DES.rwk** and choose **Save**.



8. Right-click on the file when it appears in the dialog and choose **Edit** or **Open With** or **Open** and then choose Notepad.





Note: If you do not have the option for **Edit**, **Open** or **Open With** options, Use Notepad to open the file from the **C:\Projects\12345\Design\InRoads** folder.

9. Notice that the file is a text file that currently lists just the DTM. If you do not see the file as shown here, try this section again or ask for assistance.

10. **Close** the Notepad report and **Cancel** the **Save As** dialog box.

Exit

1. **Exit** MicroStation; do not save any changes to the surface.

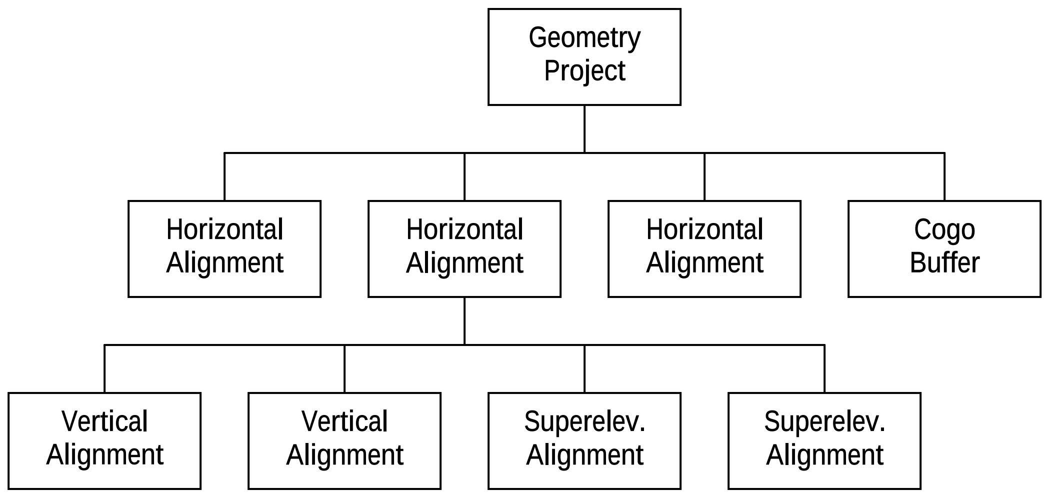
   By now, you are aware that with each lab you will start MicroStation and InRoads again. The temptation is to leave them open to save the step next time. However, when you exit MicroStation and InRoads it clears the memory on your machine and your files will process faster, so you are encouraged to exit at the end of each lab.

3. Defining Horizontal Alignments

The Geometry Project

The geometry project is the data file that stores horizontal and vertical alignments, superelevation alignments (stations where the super transitions occur and the corresponding slopes) and cogo points (called the cogo buffer).

There is a hierarchical relationship between the data stored in the geometry project, as illustrated below.



You may load as many geometry projects into memory as you need at a given time. However, only one project is active at a time, with one Horizontal Alignment, one Vertical and one Superelevation active. The active Superelevation and Vertical must fall under the active Horizontal, and the active horizontal must fall under the active project.

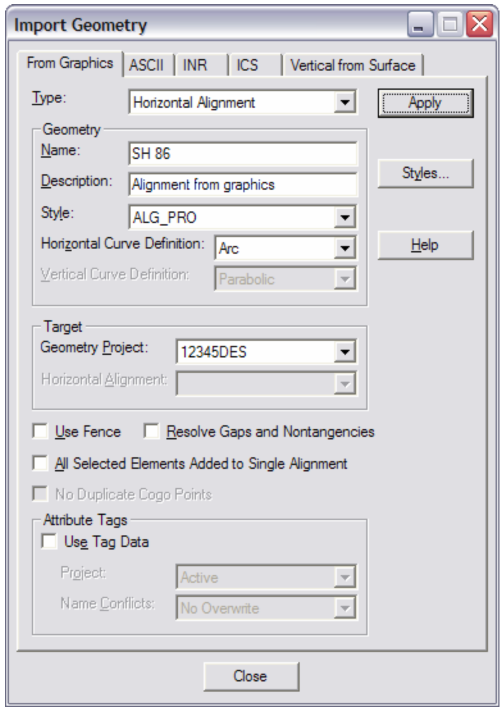
When the geometry project is saved to the hard drive, it takes on an extension of **.alg**.

Importing alignments

If alignments are already defined graphically or in an electronic text file, they may be imported into InRoads without having to re-enter the data.

From graphics

Alignments that has already been drawn graphically may be imported using **File > Import > Geometry > From Graphics**.



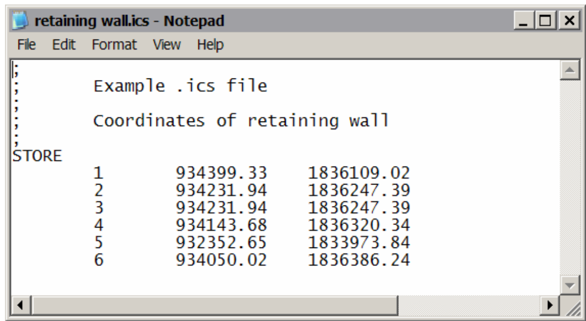
You can import Horizontal Alignments, Horizontal and Vertical Alignments, Cogo Points or Event Points. If the alignment has curves, it is typically best to toggle on **Resolve Gaps and Nontangencies**. If the alignment was drawn as a series of lines and/or arcs that have not been complexed, toggle on **All Selected Elements Added to Single Alignment** (you must first define a Fence or Selection Set of the elements, and the elements will import in the order of creation, even though they're added to the same alignment).

After specifying the **Name** (which defaults if you don't supply one), the **Description** and the **Style**, choose **Apply**. If you have first created a Selection Set or defined a fence, you will be asked to Accept the contents. If you have not, you'll be asked to identify the element. In either case, after accepting, an alignment or alignments will be added to the geometry project listed in the **Target** section.

From text files

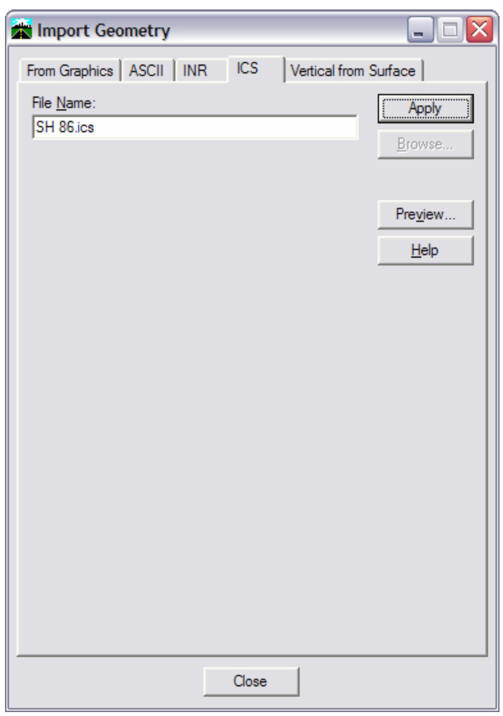
Text files may be imported from several formats, the easiest of which to create is an **.ics** file. (Interactive Coordinate geometry Subsystem) This file type was first used with a product of the same name many years ago, but is still in use with InRoads today. It is basically a list of cogo commands along with the input for those commands.

If you have a text file of coordinates, you can create an .ics file by adding a **Store** command at the top and formatting the file similar to the one shown below.




```
;
;       Example .ics file
;
;       Coordinates of retaining wall
;
STORE
        1       934399.33     1836109.02
        2       934231.94     1836247.39
        3       934231.94     1836247.39
        4       934143.68     1836320.34
        5       932352.65     1833973.84
        6       934050.02     1836386.24
```

Choose **File > Import > Geometry > ICS**. **Browse** to find the file, then choose **Apply**.

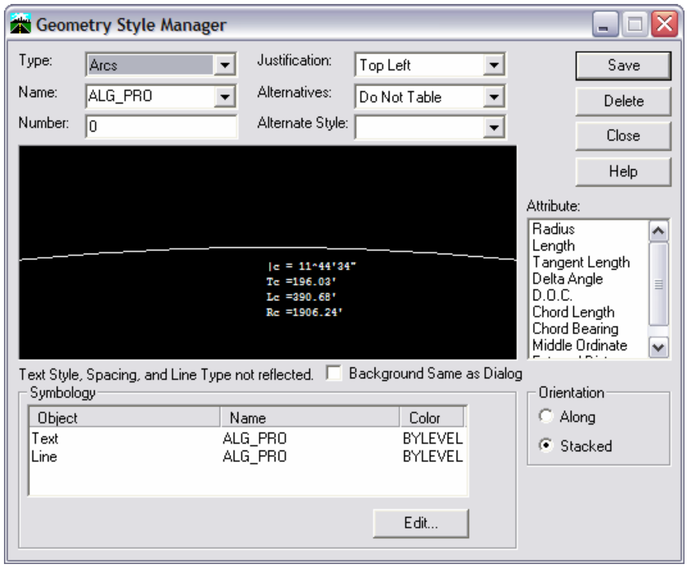


The cogo points will be added to the active geometry project. You may then use **Geometry > Utilities > Create/Edit Alignment** to join the points, forming an Alignment and **Geometry > Horizontal Curve Sets > Define Curves** to add curves to the alignment. You can also accomplish these same tasks within the **.ics** file. See the Bentley Help topic ***Alpha Cogo***.

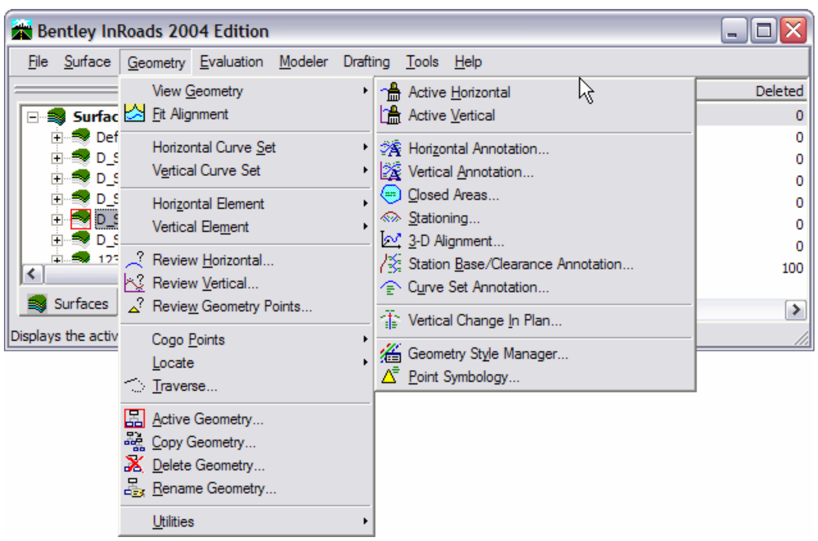
Displaying Alignments

There are several methods for displaying alignments in InRoads. The method you choose is based on the desired display.

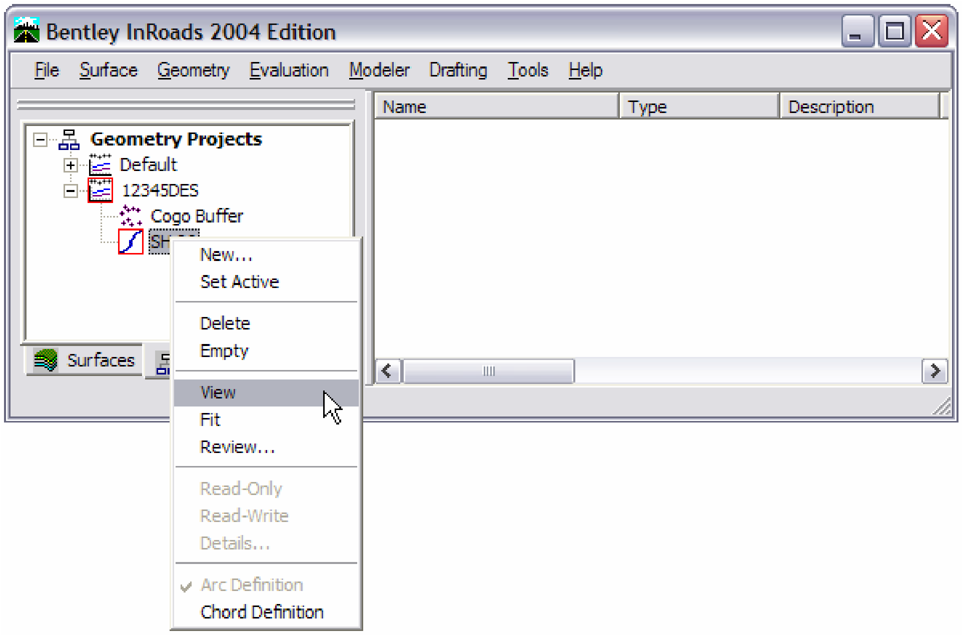
Whichever method you choose, a geometry style controls the level and therefore the symbology of the display. Geometry styles are associated with individual alignments when they are created. The CDOT standard styles have been pre-defined and are stored in the **CDOT-styles.ini** file, accessed through the **Geometry > View Geometry > Geometry Style Manager** dialog. Each style is really made up of one style in each of up to four categories: **Points**, **Lines**, **Arcs**, and **Spirals**.



To display the active alignment, choose **Geometry > View Geometry > Active Horizontal** and the active alignment displays in the design file showing points and linework (no annotation is displayed).

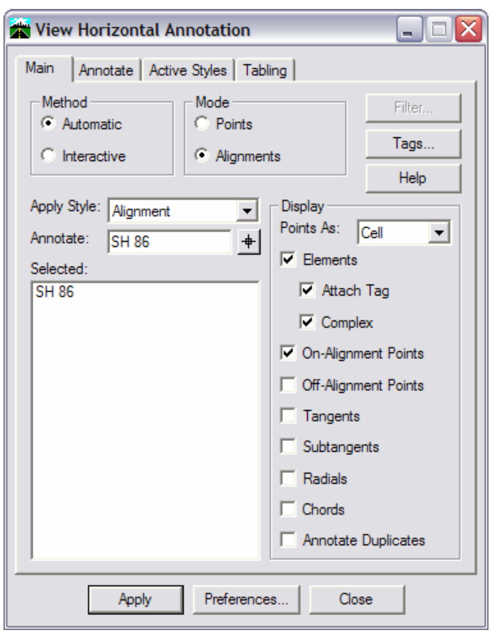


To display any alignment, right-click on the alignment name in the **Explorer** menu and choose **View**. The chosen alignment displays in the design file showing points and linework (no annotation is displayed).



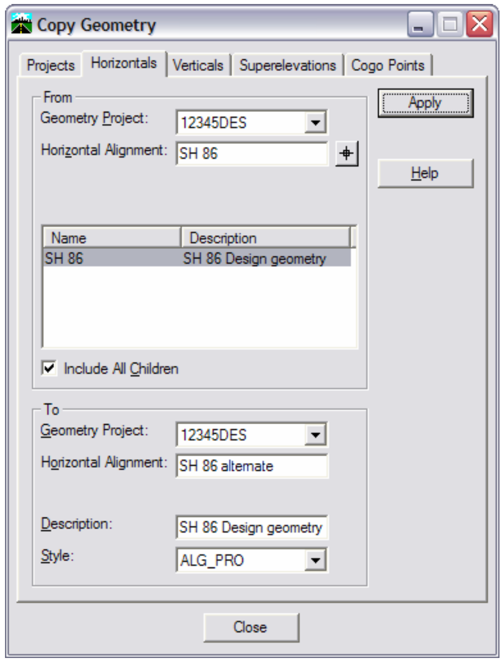
To display the alignment and annotate it at the same time, choose **Geometry > View Geometry > Horizontal Annotation**. The alignment you want to annotate can be selected graphically by picking the target button first, it can be keyed in, or it can be selected from a list by clicking in the **Annotate** field and choosing **Filter**. Multiple alignments may be annotated at one time with this command, each will display using its associated style.

The resulting display is a MicroStation graphic group. Therefore if you want to move the annotation (individual curve data, for example) you must first turn off the **Graphic Group** lock.



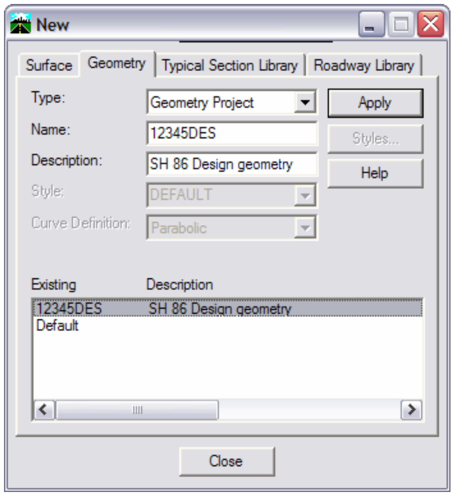
Copy Geometry

Copy Geometry can be used to copy geometry from within the same geometry project, or from project to project.



Creating Alignments

In order to create a new alignment, you must first have a geometry project loaded. If you need to create a new one, choose **File > New > Geometry** set the **Type** to **Geometry Project** and enter a **Name** and **Description**.

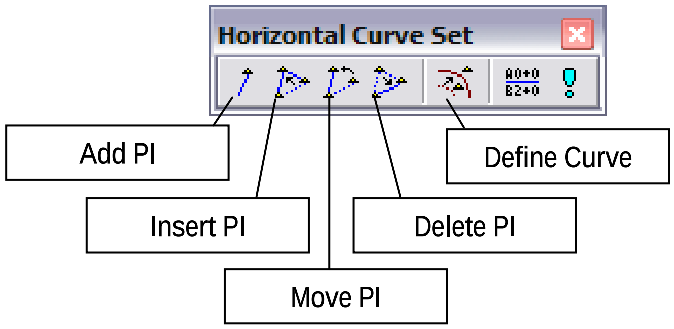


Once the geometry project is loaded (and active), you may create a new alignment name. Select **File > New > Geometry** (if you have closed the dialog) and set the Type to **Horizontal Alignment**. Enter the ***Name***, ***Description*** and select a ***Style***.

Apply after filling in the appropriate information, then you may proceed with either the **Horizontal Curve Set** or **Horizontal Element** tools to enter the alignment data.

Horizontal Curve Set commands

The **Horizontal Curve Set** commands make up an easy way to create alignments. They consist of five primary commands described below, and may be access from a toolbar (shown) or from the pulldown under **Geometry > Horizontal Curve Set**.



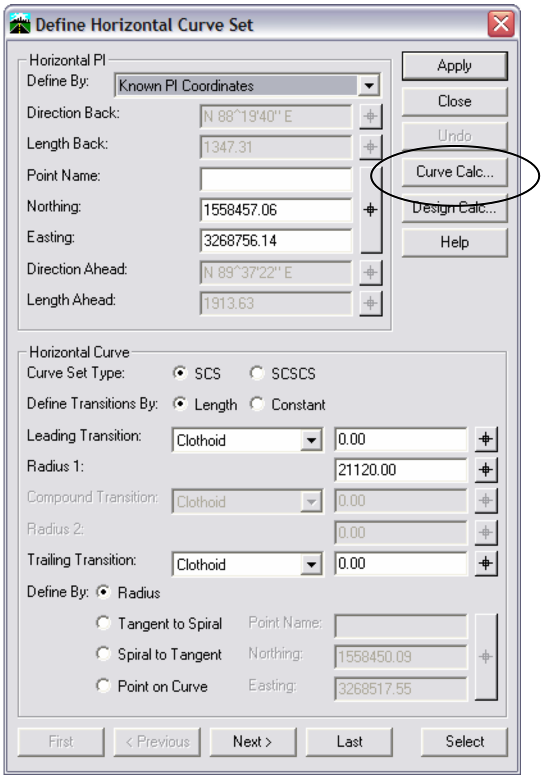
Add PI – **Add PI** is used to create a PI that begins a new alignment, or to add a PI onto either end of an existing alignment.

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

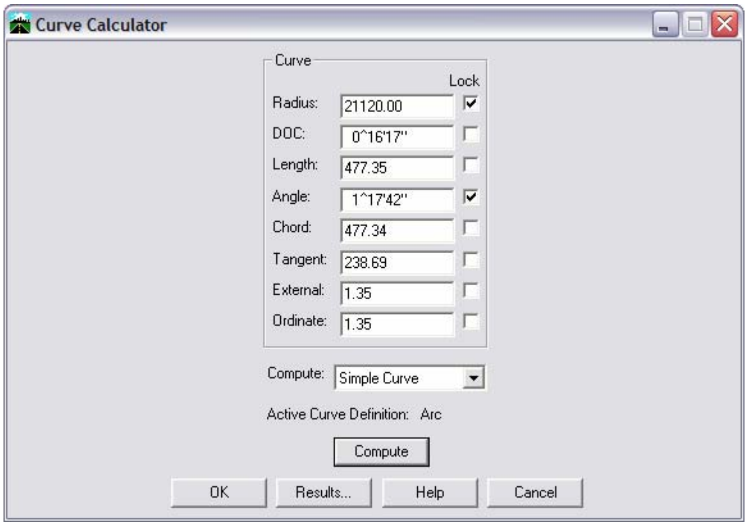
Move PI – **Move PI** is used to change the location of an existing PI.

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

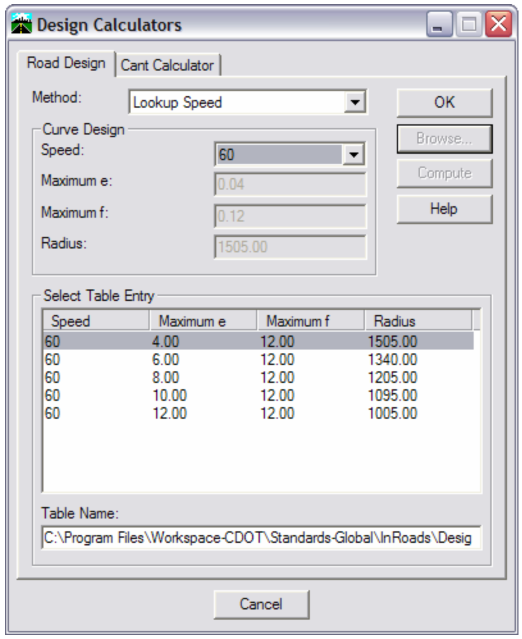
Define Curve – **Define Curve** is used to create a curve at a PI on an alignment, or to revise an existing curve on an alignment. The **Previous** and **Next** buttons are used to step through the alignment. The tangents forming the PI where the curve is to be defined are highlighted graphically.



The **Curve Calculator** is used to generate curve data for different curves without having to accept the curve. This way, you can review the results before the curve is created.



The **Design Calculator** is used to compute or look up curve data to ensure your design criteria are met.



Keyins

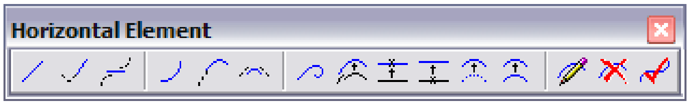
In addition to the standard MicroStation keyins (like xy= and di=), there are keyins available only when InRoads is running. Two of these are useful when creating alignments, but are available for other function as well.

NE=northing,easting (***NE=935587.5418,1835192.1205***)

SO=station,offset (***SO=34500,-125***) stationing references active alignment

SO=station,offset,elevation,alignment
(***SO=34500,-125,0,CL US 100***) stationing references named alignment

Horizontal Elements



The **Horizontal Element** tools allow you to create alignments without knowing the PI information. They may be accessed from the toolbar shown above, or from the pulldown under **Geometry > Horizontal Elements**.

There are several advantages to this method. One of the greatest advantages of the horizontal element alignments is that they do not have to be continuous. For example, you can create elements that have the most constraints, leaving gaps between them, and then join them together with unconstrained tangents and curves.

Another advantage is the ease with which reverse and compound curves can be created, as well as curves greater than 180 degrees.

When creating elements, you have three basic placement options for linear elements and the same three options for circular elements. These options are just for placement; once an element is placed and accepted, it is treated the same as any other element no matter the placement method.

Fixed placement is used when you know exactly where the element is going to be located and you, in effect, lock it in place using a combination of coordinates, pass-through points, bearings or radii. When using the fixed placement options, the resulting elements are not tangent or coincident with any existing elements. This placement option is used to place standalone elements.

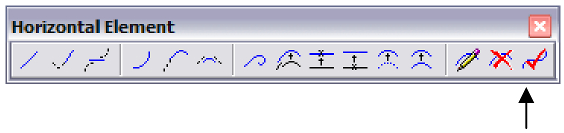
Floating placement is used to establish elements coincident and tangent to an existing element with a pass-through point and a radius (for curves) and with a pass-through point or a bearing for lines. They force the alignment to be coincident and tangent at the end where they join and will lengthen or shorten the element they are being attached to as necessary to meet the criteria specified. They will only ensure tangency and coincidence at the end where they are attached to an existing element. The floating placement options will not connect two existing elements.

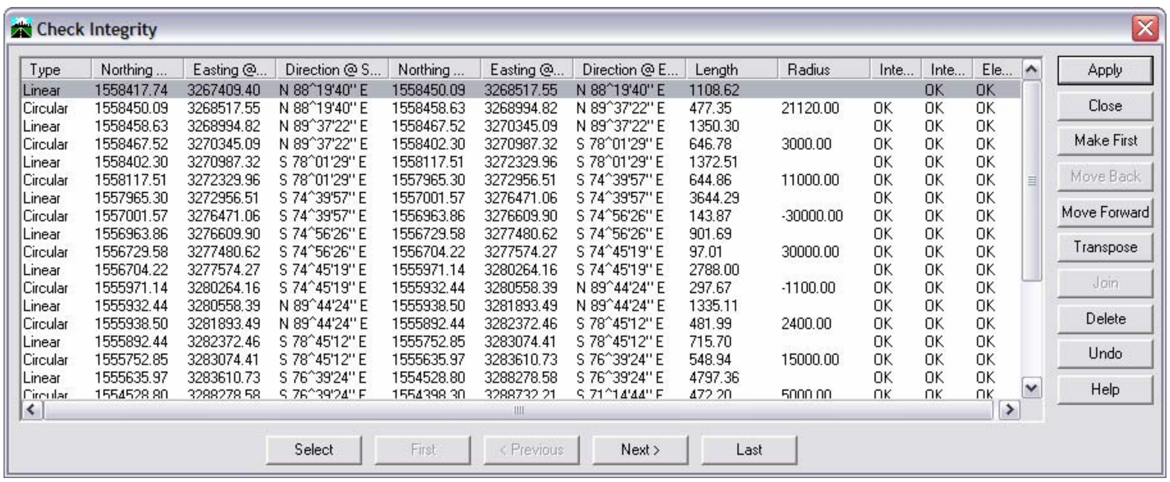
Free placement is used to connect two existing elements. It ensures coincidence and tangency at both ends where it connects to the existing elements. The existing elements may lengthen or shorten as necessary, but will not change locations.

To create a horizontal element alignment, first give the alignment a name description and style, then use a combination of the fourteen commands to define the alignment. (The fifteenth command is for checking and correcting problems with the integrity of the alignment, described below.)

Check Integrity

The **Check Integrity** command on the **Horizontal Element** toolbar allows you to check the coincidence and tangency of horizontal alignments. The **Element** tools allow you to place the different components of the alignment in whatever order you wish, therefore it is not uncommon for the elements to be "out of order". This is one of the situations where **Check Integrity** can help, since you cannot only check the integrity, but make changes to the elements to correct integrity problems.





Cogo commands

InRoads has a series of coordinate geometry commands built into the software. There is no need to exit and start another product in order to use them. These commands provide an alternative method for creating horizontal alignments. One of the main differences in creating the cogo alignments (sometimes referred to as figures) and other alignments is that cogo alignments require that the points be established first, then joined together to form the alignments.

Once created, cogo points and alignments are, in most cases, interchangeable with other horizontal points and alignments. There are a few key differences, however:

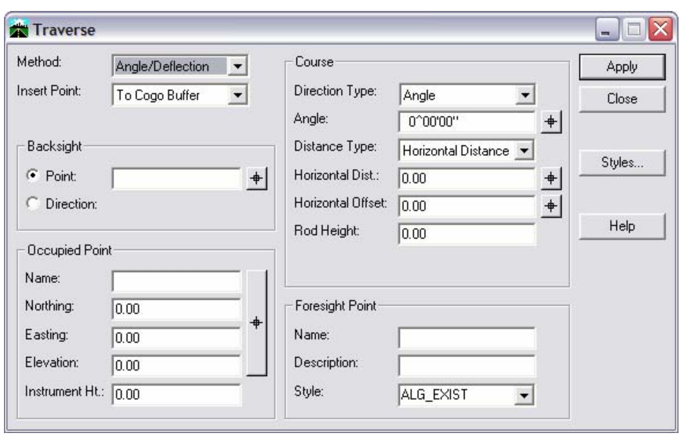
- Cogo points are always numbered as you go (beginning with the seed number established in **Tools > Options > Geometry** or with the next available number above the seed.
- Cogo points can stand alone, such as when locating a fire hydrant or signs.

There are several toolbars devoted to coordinate geometry described here. These same commands may be found under the Geometry heading on the pulldown menu.

Cogo Point commands

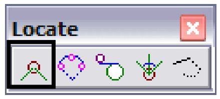
Use the **Cogo Points** commands to create, edit or delete cogo points.

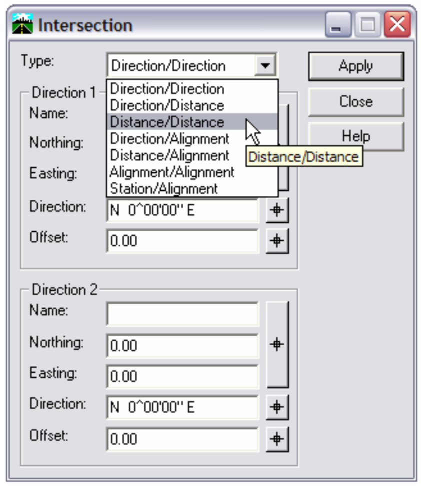
Cogo Traverse commands



The **Traverse** commands are used to input cogo points when you know an occupied point number or location and a distance and bearing to the point you're locating (Direction Traverse). It may also be used when you know an occupied point or location, a backsight point or bearing and a distance and angle or deflection angle to the point you're locating (**Angle/Deflection Traverse**).

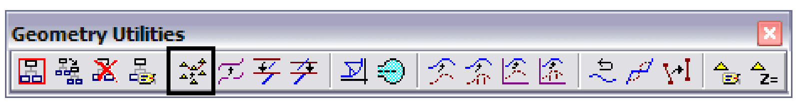
Cogo Intersection commands





The **Intersection** commands are used when you want to locate a new cogo point based on two known points, two known alignments or a combination of a known point and a known alignment along with and distances and or bearings between them and the desired point. For example, you may know two cogo points and the bearings from each to the desired new point.

Create/Edit Alignment by Cogo Points



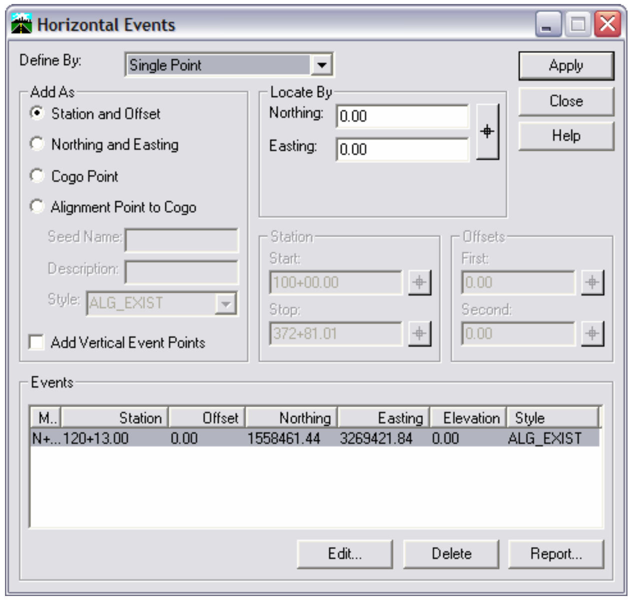
Alignments are created from cogo points using the **Create/Edit Alignment** command. It is not necessary to create the alignment name prior to using this command; it may be entered here, along with a **Description** and **Style**. The points you want to make up the alignment are listed as the **Alignment Definition**. Once you choose **Apply**, the alignment is created by chaining together the listed points. Dashes may be used when a range of consecutively numbered cogo points are selected.

See the Bentley Help or InRoads Reference Guide for additional information on InRoads cogo.

Horizontal Event Points

Horizontal Event points are points associated with an alignment that are not actually a part of the geometry of the alignment the way a PC, PT or PI are, for example. They are used for points that need to be annotated with stations and offsets, for points where you need special sections cut or for points where you want to be certain **Roadway Modeler** drops a template.

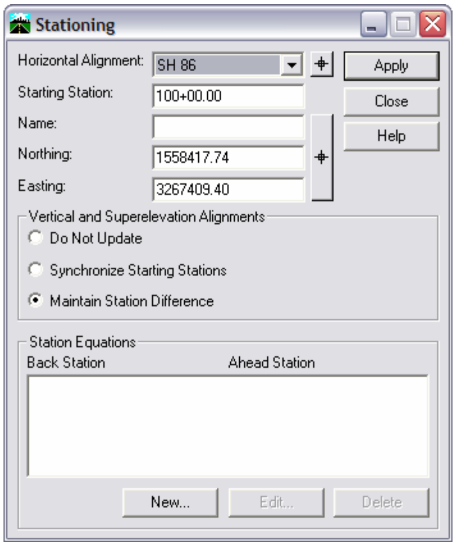
Select **Geometry > Horizontal Curve Sets > Events**.



Event points may be added as either **Station and Offset** (so they move with the alignment if it moves) or as **Northing and Easting** (so they remain stationary if the alignment moves). Whichever way they are stored, they can be initially defined by either coordinates or stations and offsets.

Setting the Beginning Station

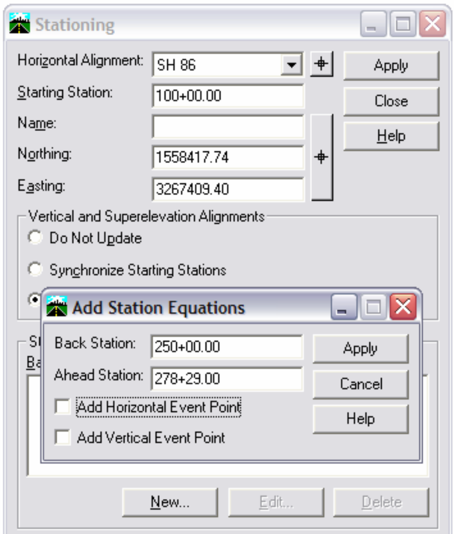
The default station at the beginning of a newly created alignment is 0+00. To change it, select **Geometry > Horizontal Curve Sets > Stationing**. Set the beginning station of the active alignment by keying in the desired new station and choosing **Apply**. The options for **Vertical and Superelevation Alignments** should be considered carefully. **Do Not Update** will leave there stationing as is, **Synchronize Starting Stations** will update their stationing to match that of the horizontal and **Maintain Station Difference** will keep any difference in the current starting stations, such as when the vertical alignment does not start at the beginning of the horizontal.



<u>Note:</u> InRoads does not require you to key in the '+' when entering a station. It will add the plus sign for you based on your preferences.

Equations

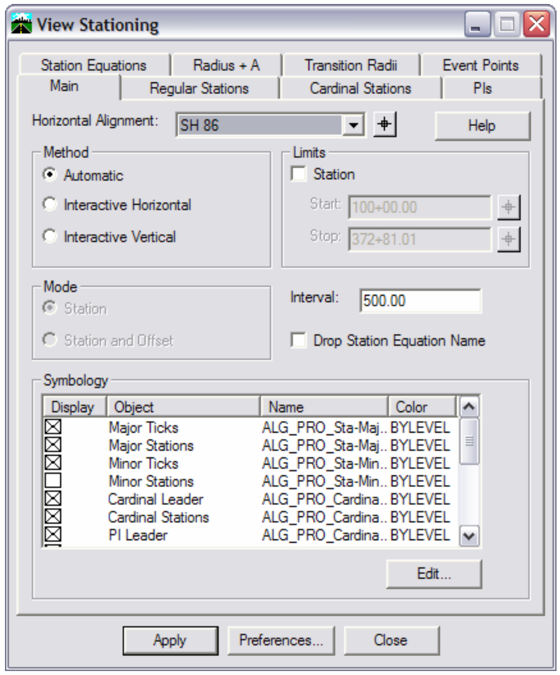
If there are inequalities in your alignment, you may assign station equations. These equations can be either gap or overlap equations. To assign an equation, select **Geometry > Horizontal Curve Sets > Stationing**. At the bottom of the dialog, choose **New**. In the resulting box, enter the **Back Station** and the **Ahead Station**, with the ahead station prefixed with an equation name. When choosing a name for the equation, remember that from this point in the alignment forward, stationing will be referred to by this name preceding the station so the shorter the name, the easier it will be for key-ins, *etc*.



You can have multiple equations in one alignment if necessary.

Displaying Stationing

To display the stationing of an alignment in the design file, select **Geometry > View Geometry > Stationing**. There are several standard CDOT preferences to choose from, depending upon the type of alignment you're stationing as well as the station interval. Choose the appropriate preference, then **Apply** to see the stationing.

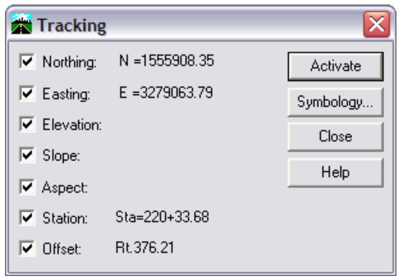


The **Station** lock, if on, will force the display to even stations.

Tracking

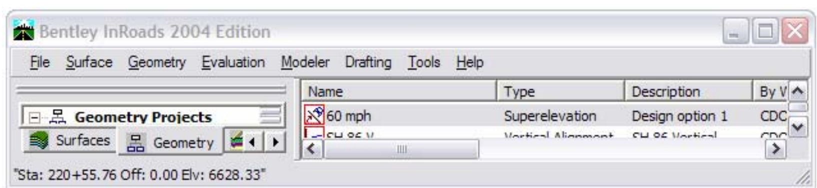
There are two methods of tracking a horizontal alignment.

Tools > Tracking > Tracking – Tracks both the active horizontal alignment and the active surface. After applying the command, data point a location in the design file and the requested information is displayed graphically. The listed elevation is read from the surface at the cursor location, not at the alignment.



Tools > Tracking > Horizontal Alignment – Tracks the horizontal alignment with a perpendicular line to your cursor. Gives a Station, Offset, Elevation readout in the message field, where the elevation is read from the active vertical alignment at the given station, not from the DTM.

If a second horizontal alignment is selected, the offset will be between the two alignments, perpendicular to the first.



Saving an Alignment

Alignments are not saved individually. Instead, they are saved when the geometry project is saved. Since you are working on a copy of the geometry project that is loaded in memory, saving is a good idea whenever you make changes to your alignment, and mandatory before exiting – assuming you want to save your changes.

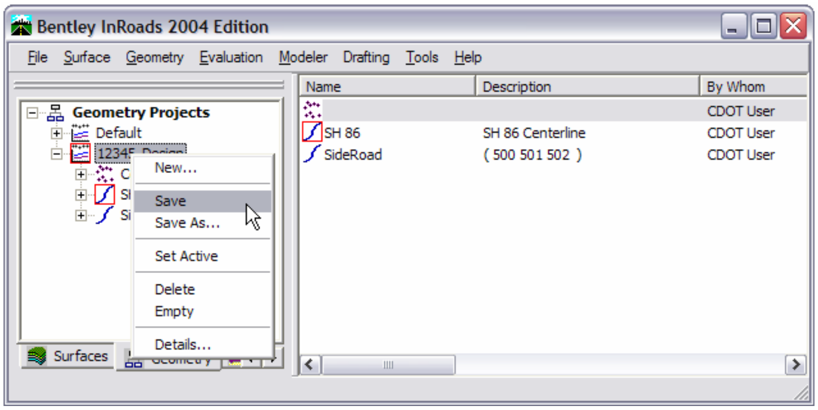
Geometry projects can be saved using several methods including:

Choose **File > Save > Geometry Project**

The active geometry project is saved.

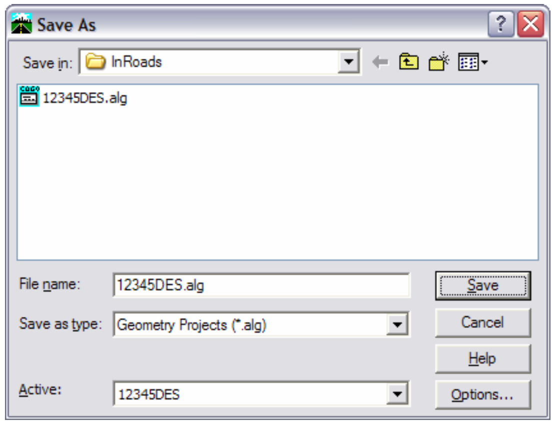
Right-click on the **Geometry Project** in the Explorer menu and chose **Save**

The geometry project you highlighted is saved.



If the geometry project has never been saved, either of the previous methods will bring up the **Save > As** box shown below.

Choose **File>Save** As



Set the **Files of Type** to (***.alg)**

Choose the geometry project you want to save (in the **Active** category)

Key in the file name (or use the default)

Choose **Apply** and the file is saved.

Note: Geometry projects have both an internal name that appears in the dialog boxes in InRoads and a name on the hard drive that has an **.alg** extension. Care should be taken to make certain you have chosen the correct geometry project name to match the file name you specify. Otherwise, you could accidentally save over a file on the hard drive with the wrong geometry project.

The geometry project may also be saved as part of the project file or **.rwk**, which you will be using in your lab activity.

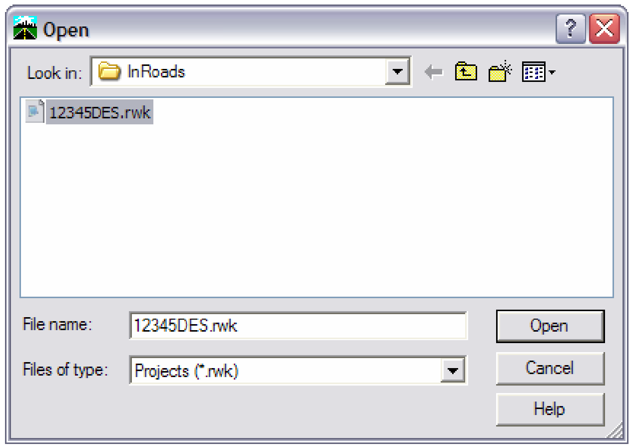
Lab 3 – Defining Horizontal Alignments

Starting InRoads

1. Start InRoads using your desktop icon.
2. Open **CU12345DES_Model.dgn** from the **\Design\Working** folder.

Open your InRoads data file

1. Select **File > Open**.



2. Ensure the **Files of Type** option is set to **Projects (*.rwk)**.
3. Double-click on **12345DES.rwk**.

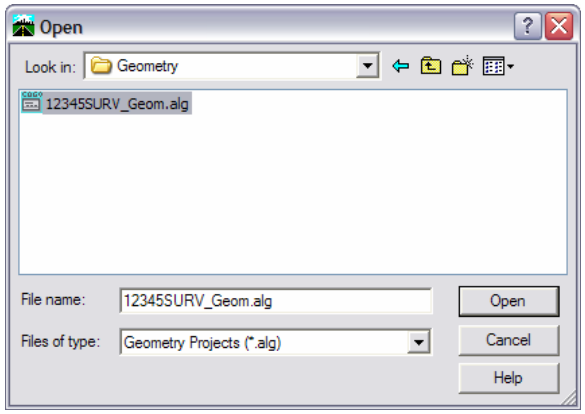
   Double-clicking is the equivalent of highlighting the file and choosing **Open**.
4. **Cancel** the dialog.

Review geometry from Survey

Survey provides a geometry project in addition to the DTM and design files. You will first open and review the alignment from survey.

Open geometry project from Survey

1. Select **File > Open**.

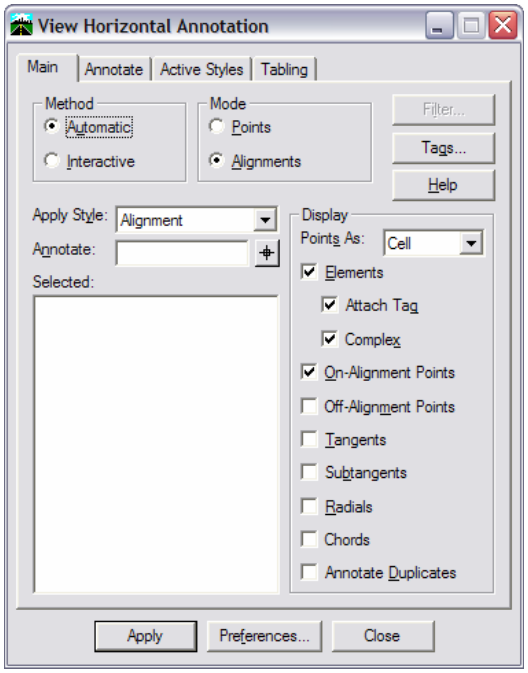


- Set the **File of Type** to **Geometry Projects (*.alg)**.
- Navigate to the folder **ROW_Survey\InRoads\Geometry**.

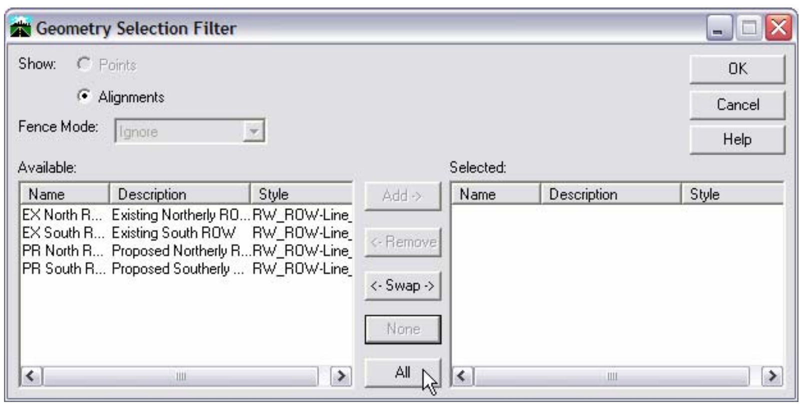
2. Highlight **12345SURV_Geom.alg** and select **Open**, then **Cancel** the dialog.

Display and review the existing geometry

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



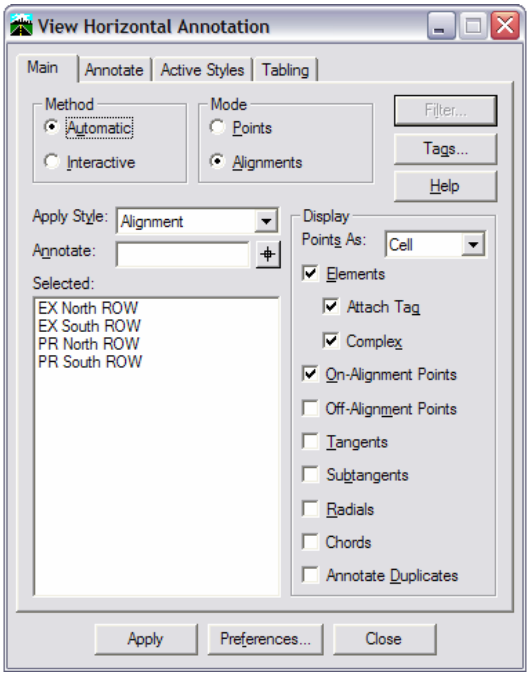
- **<D>** in the **Annotate** field and select **Filter**.



- Select **All**, then **OK** to add all of the alignments to the **Selected** field.

Alternately, you could key in an asterisk in the **Annotate** field to select all of the alignments in the geometry project.

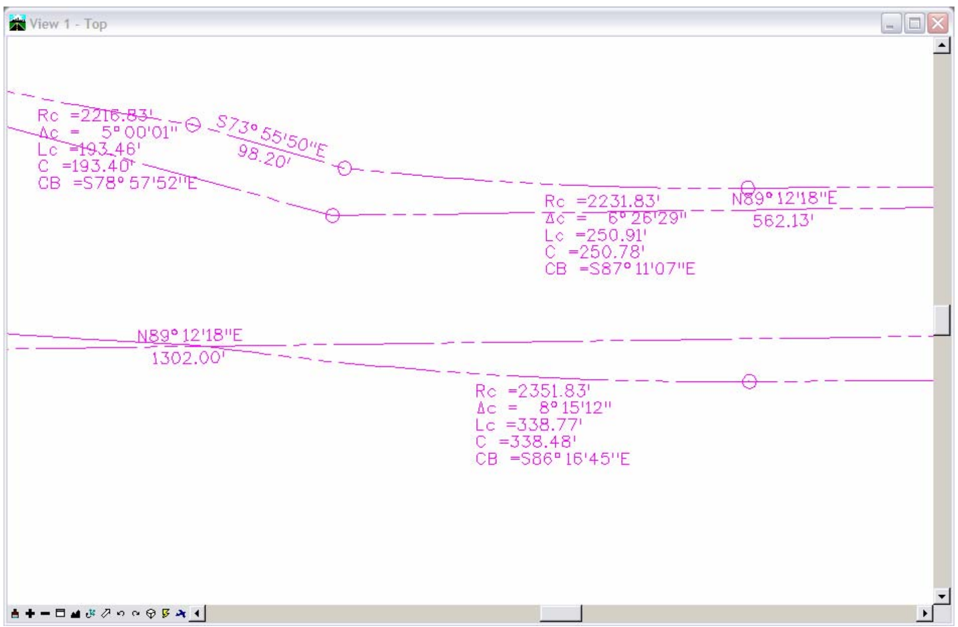
4. Select **Apply** to view the alignments (Window in, if necessary to see the annotation).



5. Close the **Horizontal Annotation** dialog.

6. Window to see the ROW annotated.

   You can toggle off the Reference Display (as shown here) if you like.



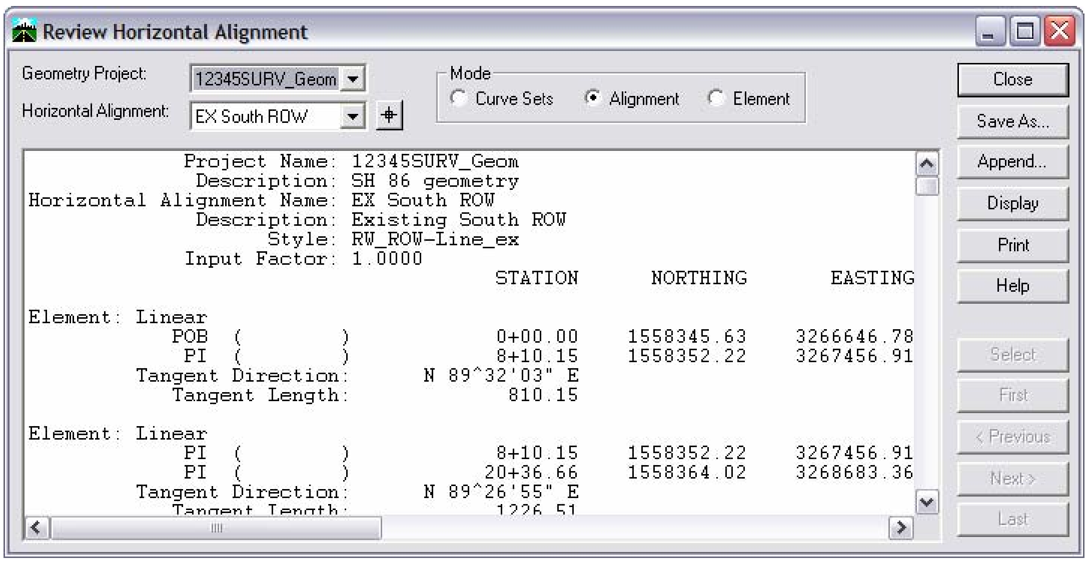
7. Use MicroStation to **Move** the curve data for one of the curves.

   Note: The curve data is graphic grouped not only together, but with all the other annotation. To move individual pieces, toggle of the **Graphic Group** lock.

8. After you take a look at the ROW graphics, use MicroStation to **Delete** them all. You can use **Undo** if you prefer. Or, since they are the only graphics in this file, you can **Edit > Select All** to make a selection set, and then choose **Delete** on the MicroStation menu.

9. Select **Geometry > Review Horizontal** to review the alignment data.

10. Select the drop-down for **Horizontal Alignment** and notice you can review any of the available alignments.

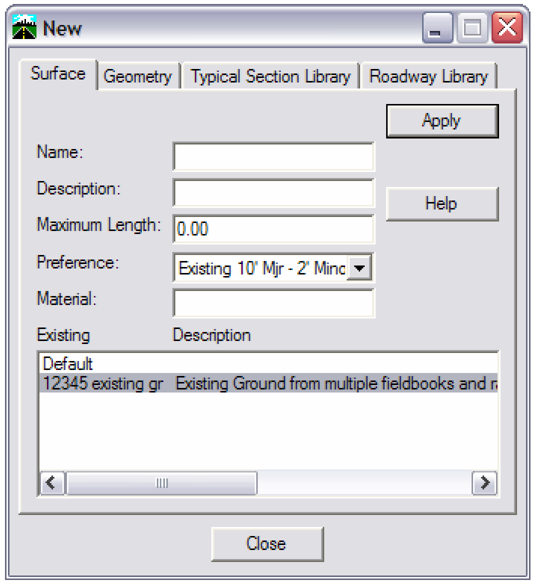


11. **Close** the Results dialog when you're through reviewing the alignments.

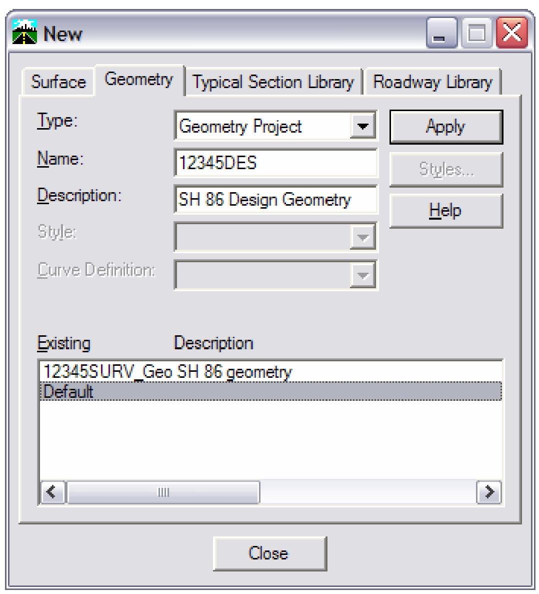
Create a new geometry project

Create a new geometry project to hold your coordinate geometry and alignment information.

1. Select **File > New**.



2. Select the **Geometry** tab.
3. For the **Type**, choose **Geometry Project**.



- In the **Name** field, enter ***12345DES***
- In the **Description** field, enter ***SH86 Design Geometry***

4. Select **Apply**

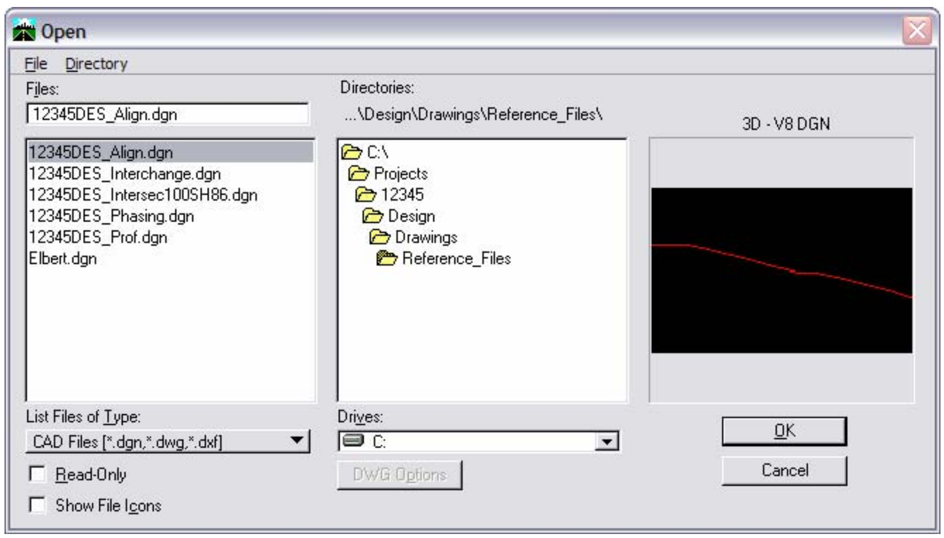
   This creates the Geometry Project where all the new alignment data will be stored. At this point, it is held in RAM (Random Access Memory). When saved to the hard drive, the default extension will be .alg, just like the geometry project from survey.

5. **Close** the **New** dialog box.

Import an alignment into the new geometry project

There are several methods of creating an alignment in InRoads, including keying in the coordinates for each PI. The method you will use first is to import the alignment from graphics. To save time, the alignment for this project has already been drawn in another file.

1. Choose **File > Open** on the MicroStation menu.

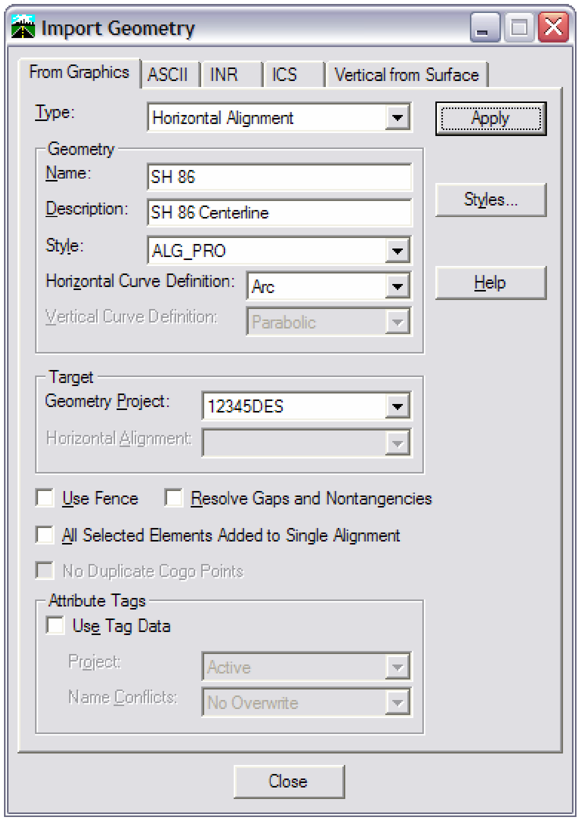


2. Highlight the file **12345DES_Align.dgn** in the **\Design\Drawings\Reference_Files** folder.

   The file opens and you will see a graphic for the alignment.

3. Select **File > Import > Geometry.**

4. Select the **Graphics** tab.



5. In the **Geometry** category,

   - Set the **Type** to **Horizontal Alignment**.
   - For the **Name**, key in ***SH 86***.
   - For the **Description**, key in ***SH 86 Centerline***.
   - Set the **Style** to **ALG_PRO**.

6. In the **Target** category,

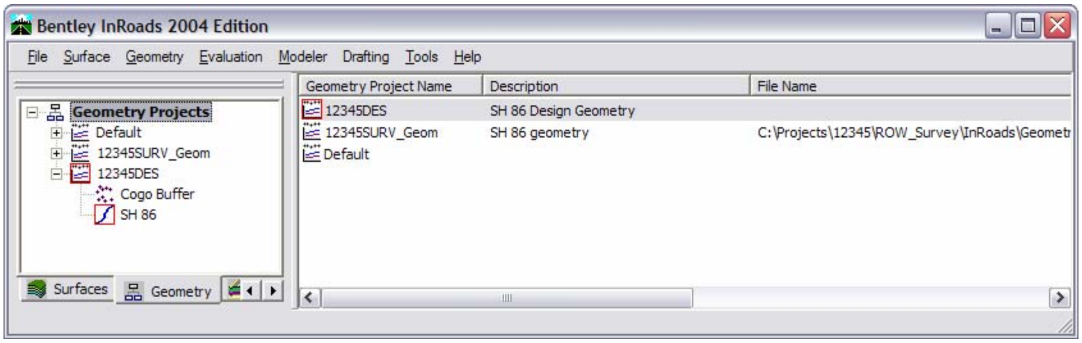
   - Ensure the **Geometry Project** is **12345DES**.
   - Make certain all other options are toggled off.

7. Choose **Apply**.

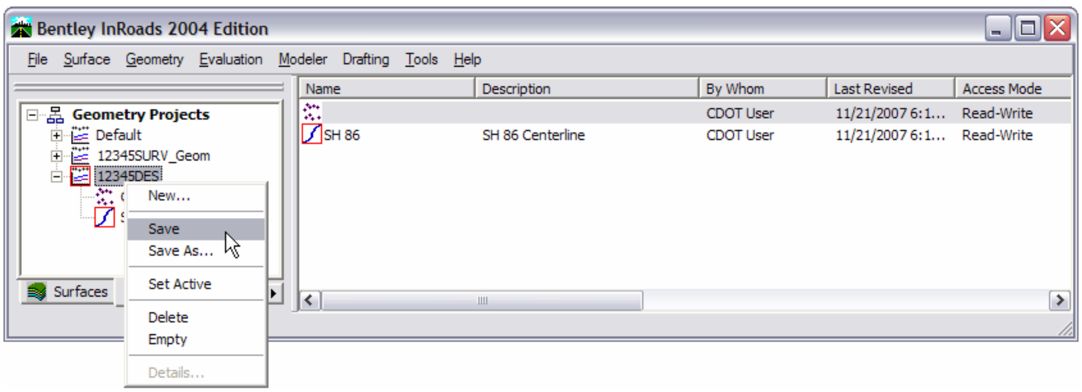
8. **<D>** (Identify) the graphical alignment when prompted and **<D>** again to accept it when it highlights.

9. **<R>** and **Close** the dialog.

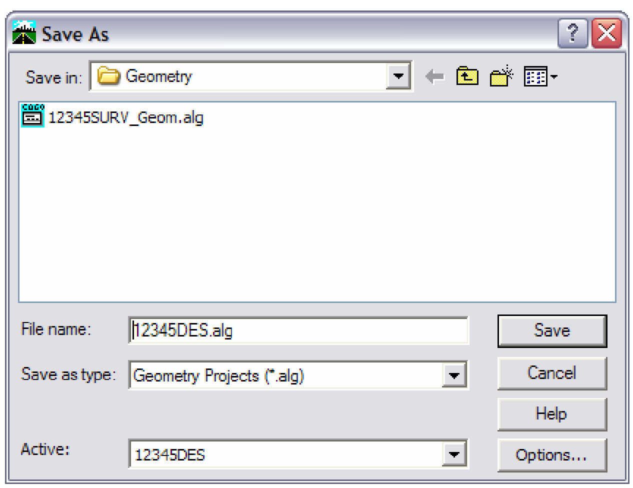
10. Look in the InRoads workspace bar menu and see that both your new and old geometry projects are loaded, and that the new alignment is listed in the **12345DES** project.



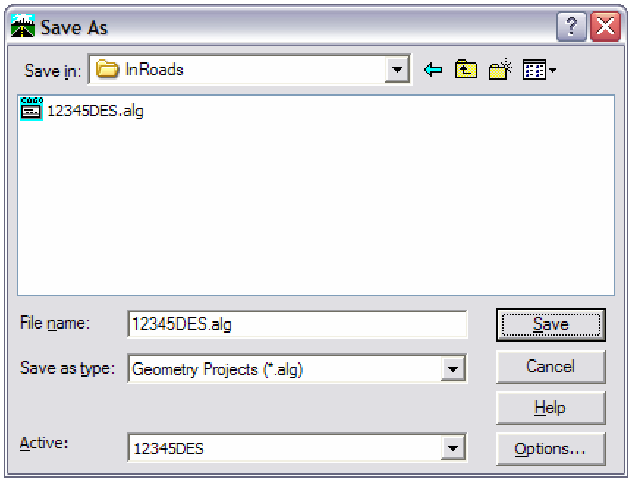
11. Right-click on the **12345DES** project and choose **Save**.



Since the project has never been saved, you are taken to the **Save As** dialog.



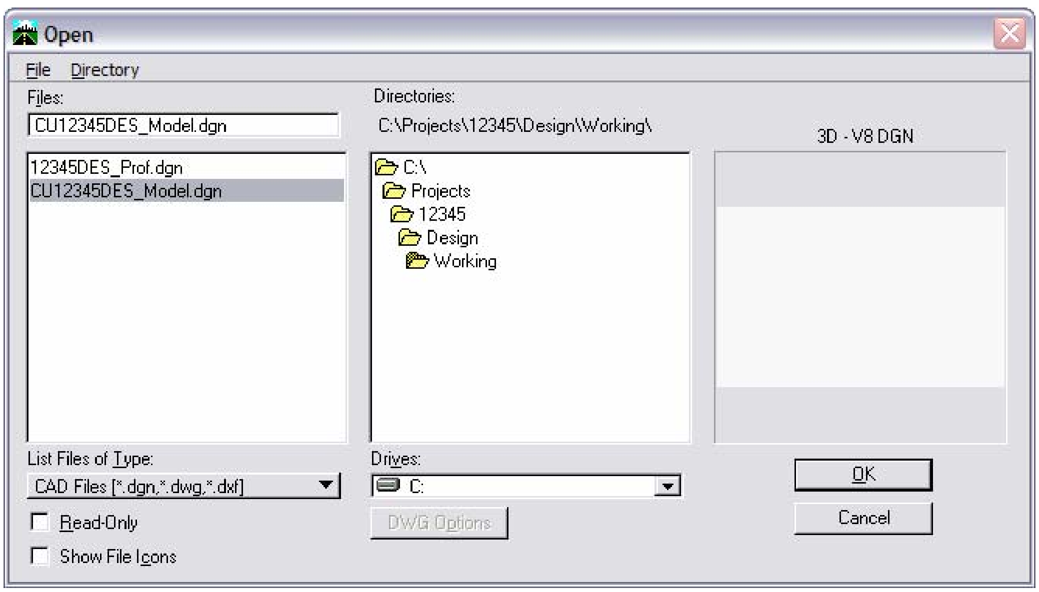
12. Change the **Save in** folder to **/Design/InRoads**.



13. Choose **Save**, then **Cancel** the dialog.

Return to your MicroStation working file.

14. Choose **File > Open** on the MicroStation menu.

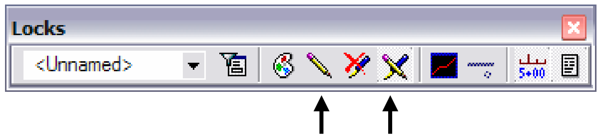


15. Highlight the file **CU12345DES_Model.dgn** in the **\Design\Working** folder.

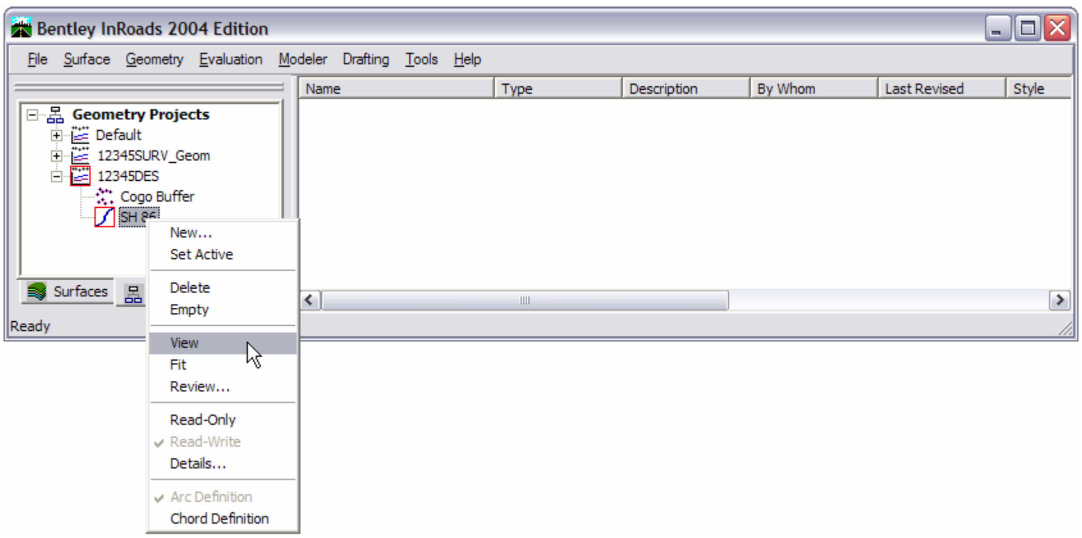
16. Choose **OK**.

17. Make lock settings

- Turn the **Write** lock on.
- Toggle to **Pencil** mode.

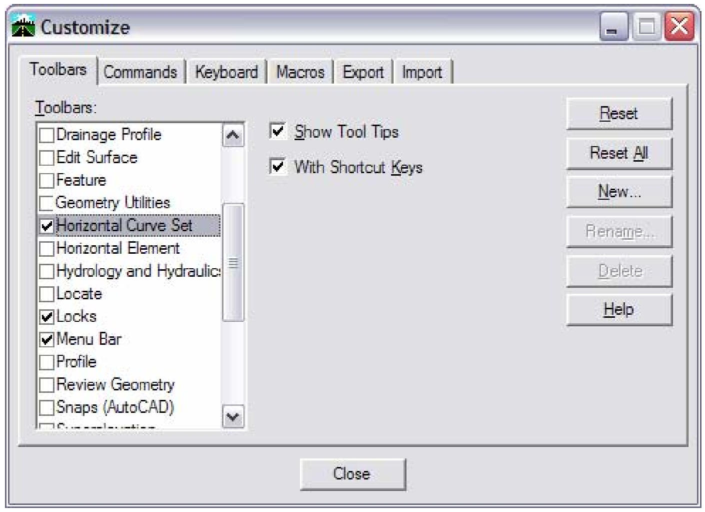


18. Right-click on the new alignment name and choose **View**.

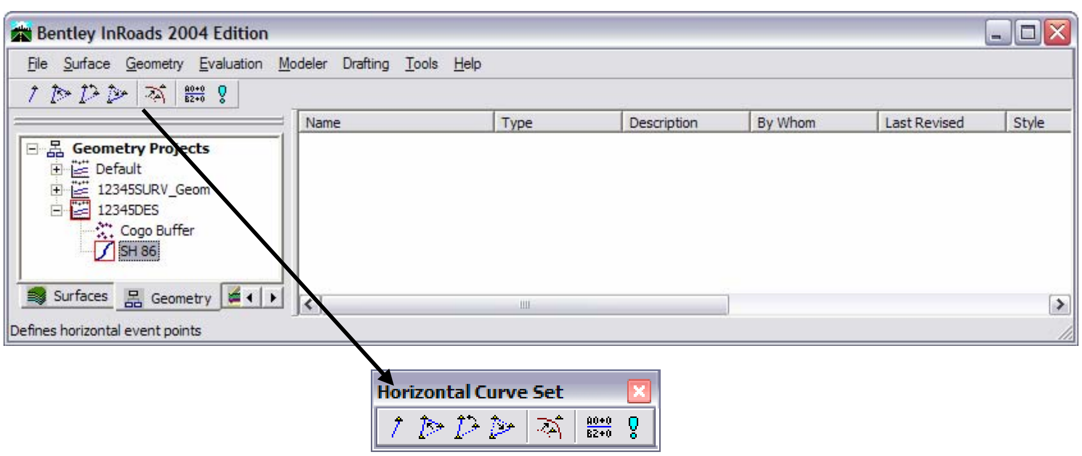


Add a new POE to the end of the alignment.

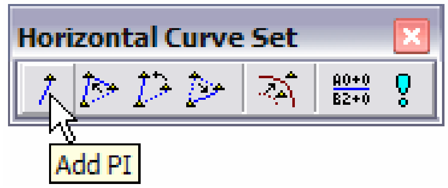
1. Window Area around the right end of the alignment
2. Choose **Tools > Customize**.



3. Toggle on the toolbar for **Horizontal Curve Sets**.
4. **Close** the **Customize** dialog.
5. The toolbar may be docked initially. You can use it docked, or float it to any location you choose. (It's easiest to float the toolbar by 'grabbing' one of the vertical lines between buttons.)

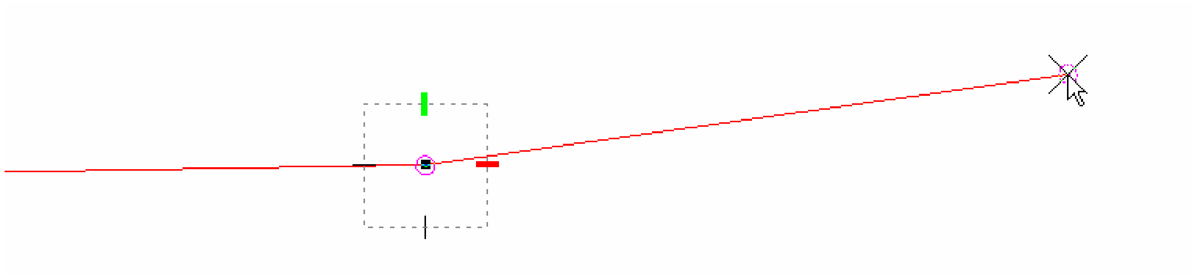


6. Select **Add PI**.



7. You are prompted: ***Identify Alignment End***;

   - **<D>** near the end of the alignment to tell InRoads which end you're adding on to.



The alignment starts tracking with your cursor. Don't **<D>**, instead:

   - Key in ***ne=1553346.5,3293694.7***

     as the coordinate for the new POE alignment.

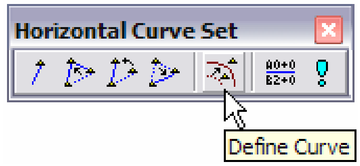
A point is placed at the specified coordinates and you are prompted to identify the next point in the alignment. The tangent follows your cursor, so **do not data point** or a PI will be placed at the data point location.

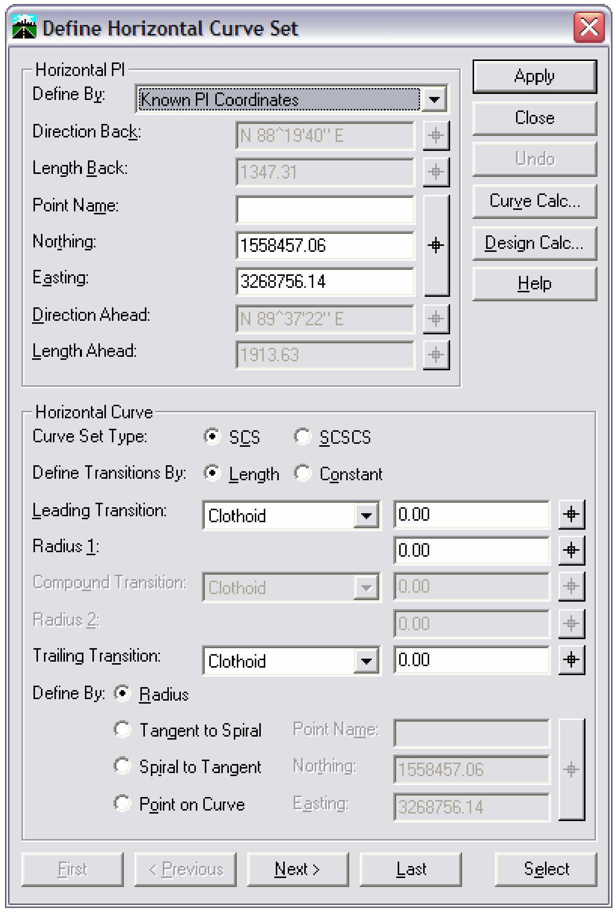
8. After the point is defined, **<R> Reset** twice out of the command.

9. **Fit** your view

Define Curves

1. Select the **Define Curve** command.



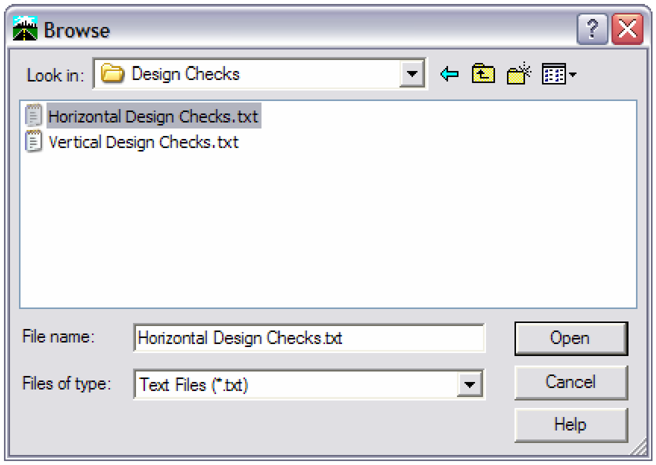


The **Horizontal Curve Set Editor** dialog box is displayed. The first center PI is automatically selected for the curve.

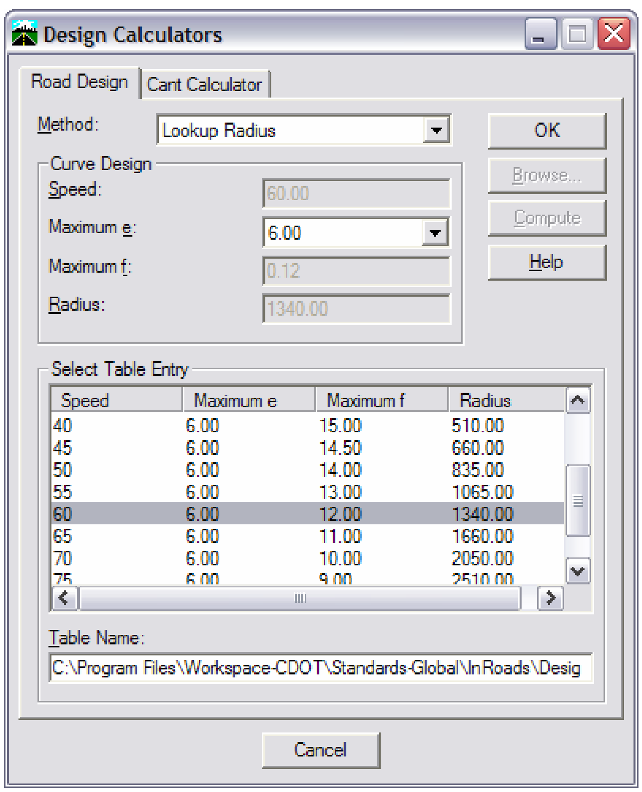
2. Ensure the **Curve Set Type** is set to **SCS**.

3. Choose **Design Calc** to open the **Design Calculator**.

- **<D>** in the **Table Name** field and select **Browse**.
- Navigate to the **C:\Program Files\Workspace-CDOT\Standards-Global\InRoads\Design Checks** folder and choose the file **Horizontal Design Checks.txt**.

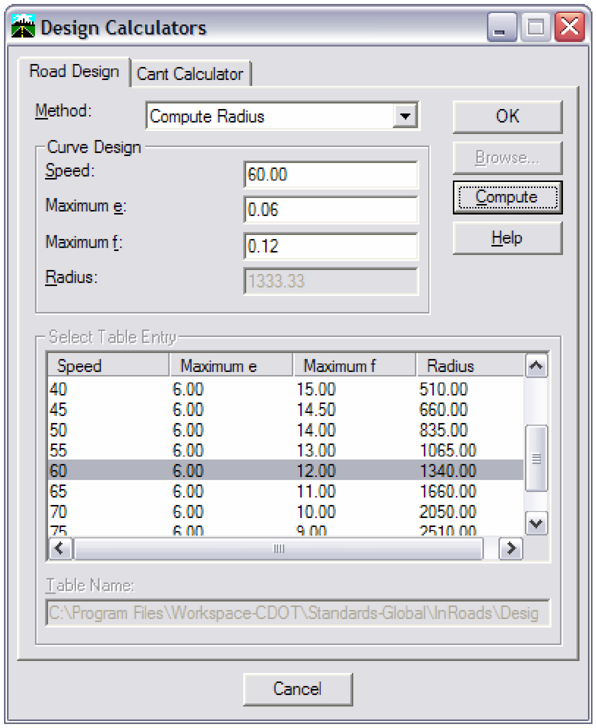


- Choose **Open**.
- Set the **Method** to **Lookup Radius**.
- Set the **Maximum e** to ***6.0***



Notice the minimum Radius is listed for various design speeds.

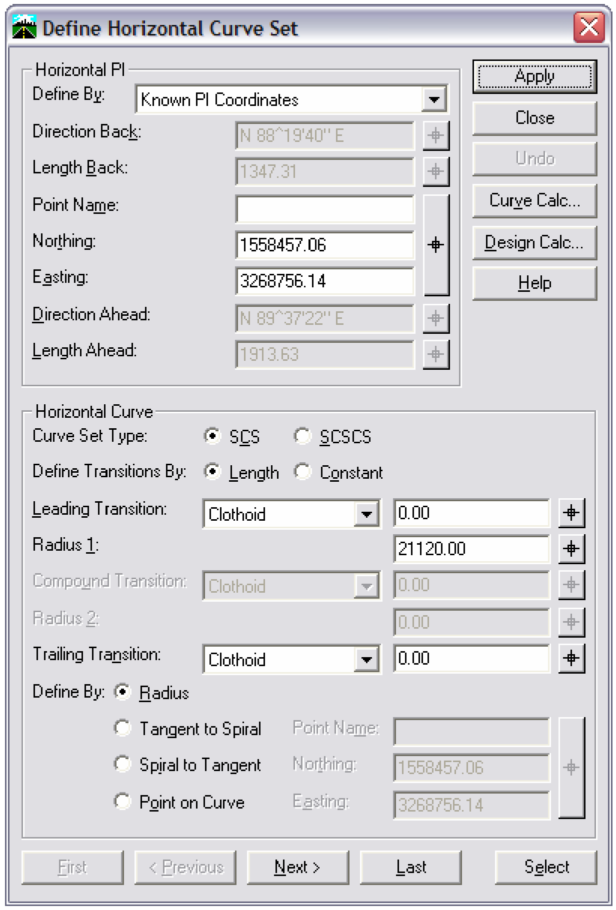
- Set the **Method** to **Compute Radius**.
- Set the **Speed** to ***60***
- Set the **Maximum e** to ***0.06***
- Choose **Compute**.



- Choose **Cancel**.

The Design Checks can be very handy to lookup or compute the radius or design speed for curves on your alignment. If you choose OK when you have computed or highlighted a radius, that value is placed in the radius field. Here, we are going to key in the radii.

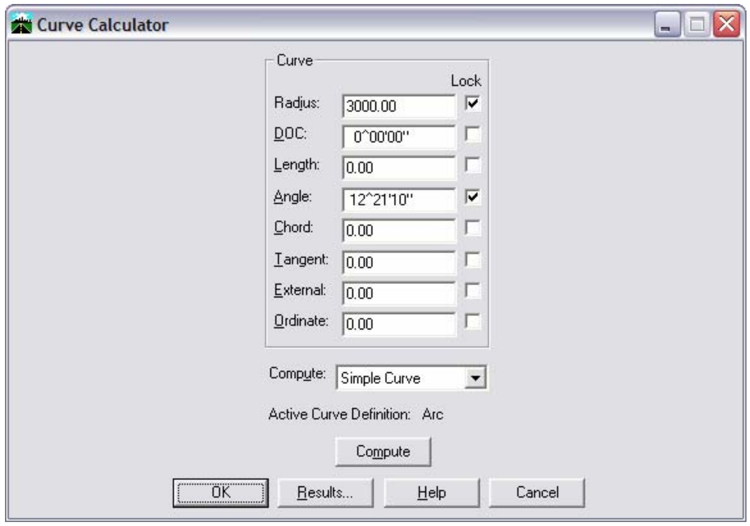
4. Key in ***21120*** for **Radius 1**.



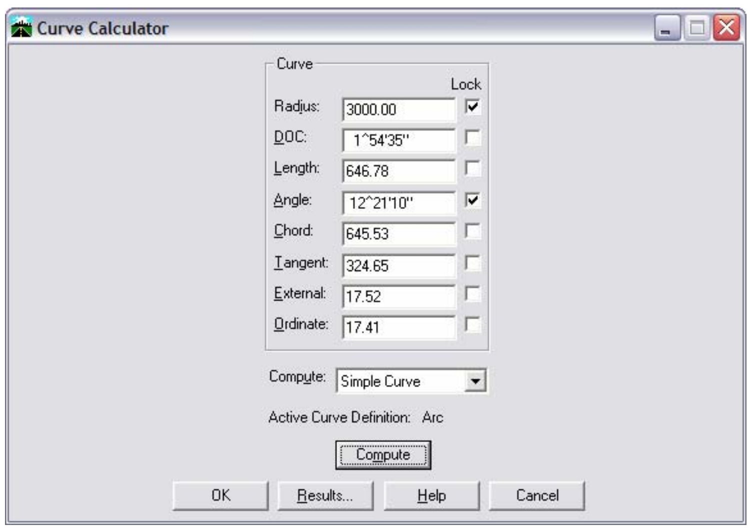
5. Choose **Apply** to add the curve to the alignment.

6. Select **Next** to move to the next PI in the horizontal alignment.

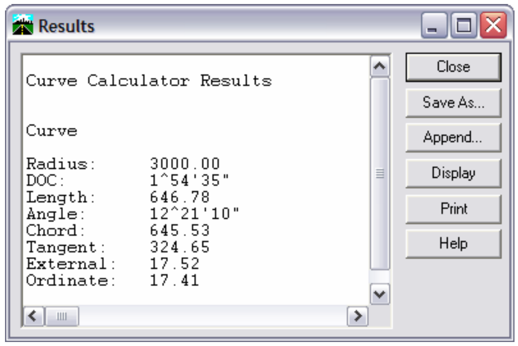
7. Select **Curve Calc** to activate the **Curve Calculator**.



- Set the **Compute** option to **Simple Curve**.
- In the **Curve** column, set the **Radius** to ***3000*** and **Lock** the value.
- Choose **Compute**.

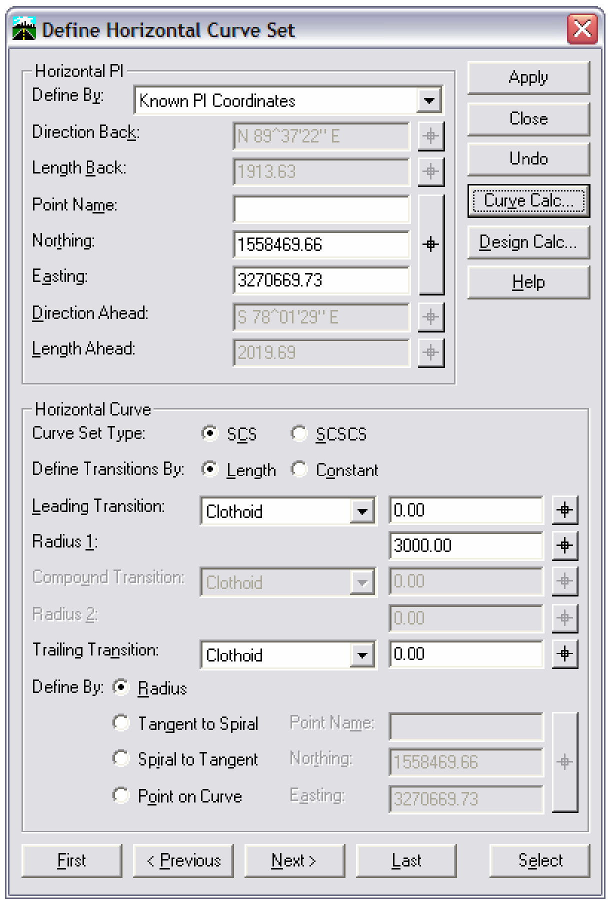


- Choose **Results** to generate a report of the computed curve data. You may save this to your hard drive if you would like. Note that it can also be printed directly from the results dialog.



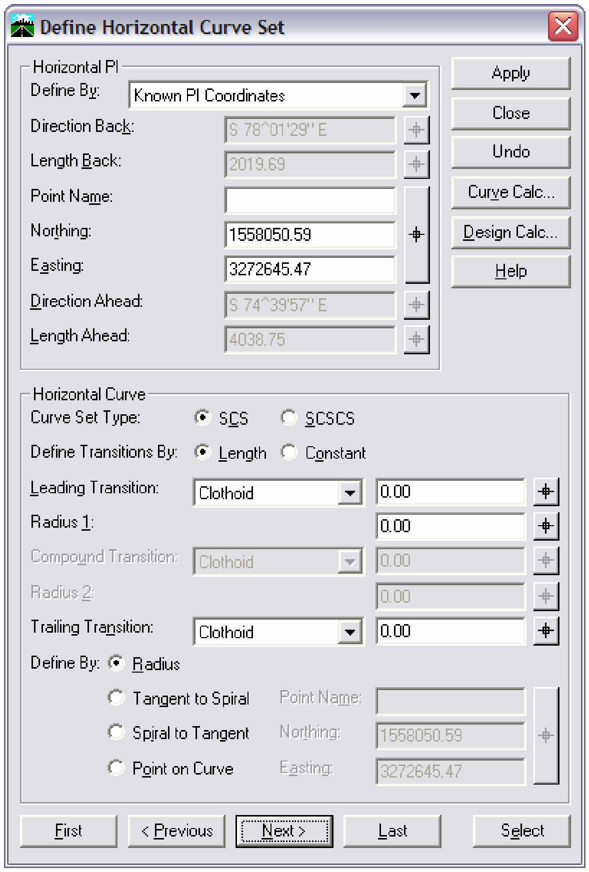
- Close the **Results** dialog.
- Choose **OK** on the **Curve Calculator**.

The **Curve Calculator** is closed and the entered **Radius** is transferred to the appropriate fields in the **Define Horizontal Curve Set** dialog.



8. Verify the curve is set as shown, then select **Apply** and the curve is added to the alignment and displayed in the design file.

9. Choose **Next** to step along the alignment and input curve 3.



10. Set the **Radius** to ***11000***.
11. Choose **Apply**.
12. Choose **Next** to step along the alignment to curve 4.
13. Set the **Radius** to ***30000***.
14. Choose **Apply**.
15. Continue stepping along the alignment set setting the other curves as follows: Be sure to **Apply** and choose **Next** between the curves.
16. Curve 5 **Radius** = ***30000***.
17. Curve 6 **Radius** = ***1100***.
18. Curve 7 **Radius** = ***2400***.
19. Curve 8 **Radius** = ***15000***.
20. Curve 9 **Radius** = ***5000***.
21. Curve 10 **Radius** = ***3000***.
22. Curve 11 **Radius** to ***1600***.
23. Curve 12 **Radius** to ***15000***.

24. After Applying Curve 12, choose **First** to return to the first curve, then step back through the curves using **Next** to verify their radii.

25. **Close** the **Define Horizontal Curve Set** dialog box when done.

The reference file display has been turned off in the picture so you can better see the alignment.

Save your geometry

Save the geometry project that now includes the new horizontal alignment.

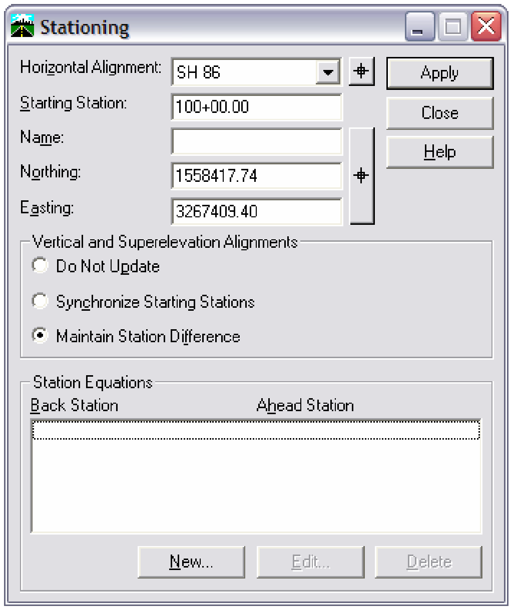
1. Select **File> Save > Geometry Project**.

   Since the file has been saved before, you do not have to enter a name. When you choose **Save > Geometry**, the active geometry project is saved.

Define the beginning station

Set the beginning station of the new horizontal alignment.

1. Select **Geometry > Horizontal Curve Set > Stationing**.



2. Key in a **Starting Station** of ***100+00.00***
3. Select **Apply**.

Note: You do not have to key in the “+” when you key in stationing in InRoads. Nor do you have to key in a leading or trailing “0”.

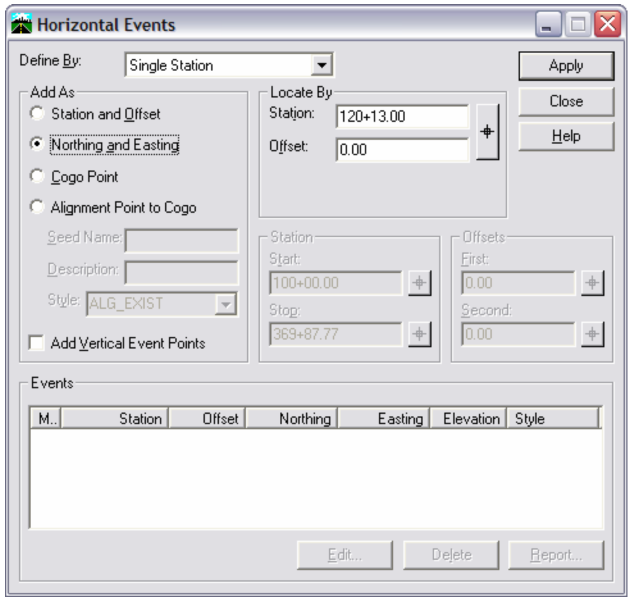
4. Select **Close** to dismiss the dialog box.

This defines the beginning station on the proposed alignment to correspond with the stationing on the existing alignment at the point where they coincide.

Add a Horizontal Event Point

Add an event point for a culvert that crosses under the proposed roadway.

1. Select the **Geometry > Horizontal Curve Sets > Events** command.



- Set **Define By** to **Single Station**.
- Set **Add As** to **Northing & Easting**.
- In the **Station** field, key in ***120+13***.
- The **offset** field should be ***0.00***.

2. Select **Apply** then **Close**.

Save the changes to your alignment

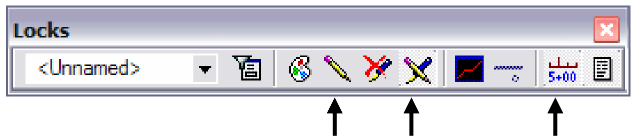
The alignment information has changed and should be saved to your hard drive. It is part of the geometry project.

1. Select **File > Save > Geometry Project**.

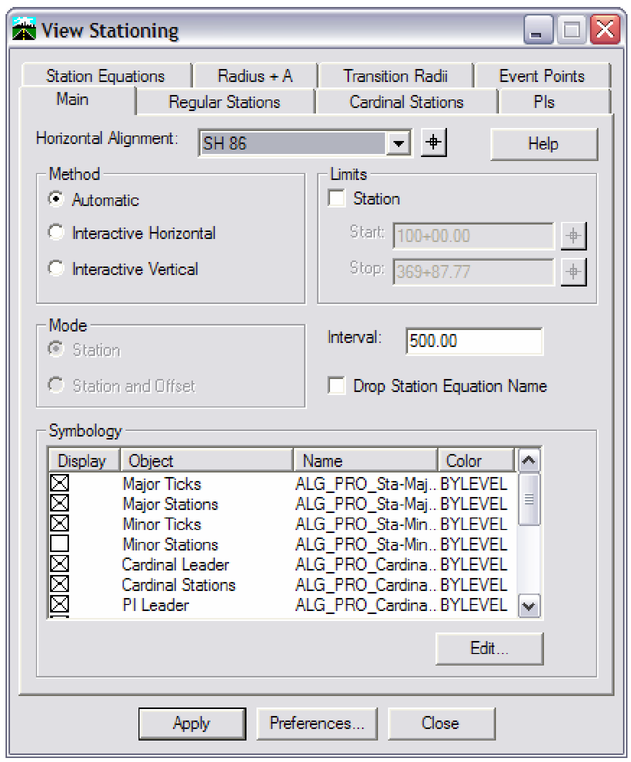
<u>**Note**</u>: Using the Undo and Redo commands in MicroStation only affect the graphics – they do not change the InRoads data.

Station the alignment

1. Make lock settings before proceeding.
   - Toggle on the **Station** and **Write** locks.
   - Set the **Pen/Pencil** mode to **Pencil**.



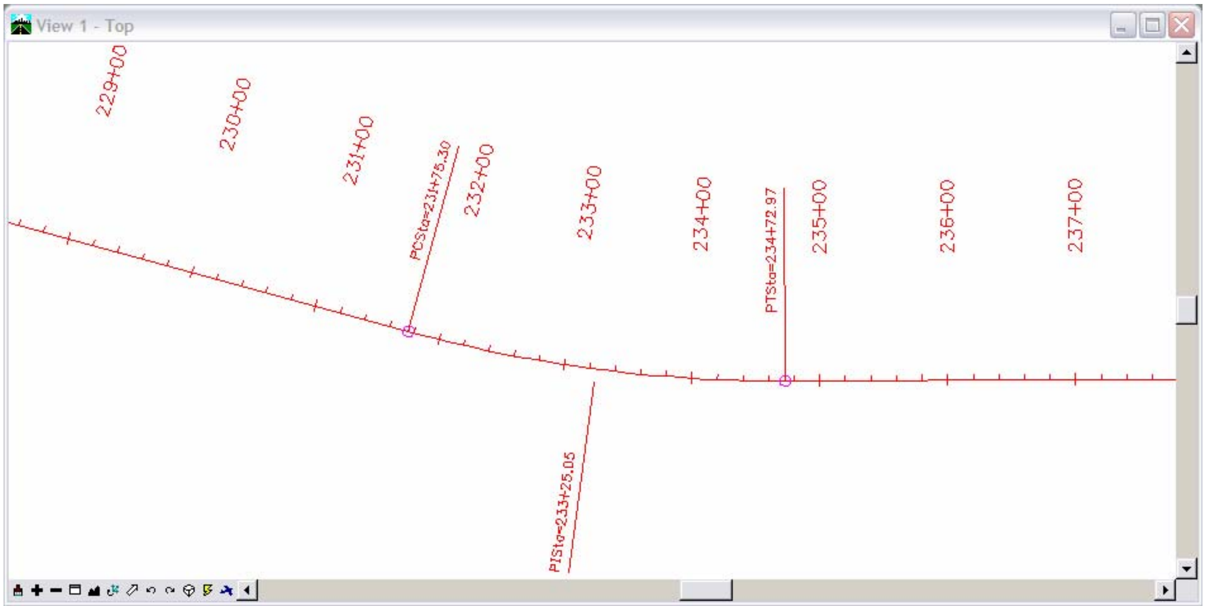
2. Select **Geometry > View Geometry > Stationing**.



   - Make certain the **Horizontal Alignment** is set to **SH 86**.
   - Select **Preferences**.
   - Highlight **Proposed-100 Ft Interval** and choose **Load**.
   - **Close** the **Preferences** dialog.

3. Select **Apply**.

   The alignment is stationed at 100-foot intervals, the curve points, and the event points. Use MicroStation view commands to take a closer look at what was displayed.

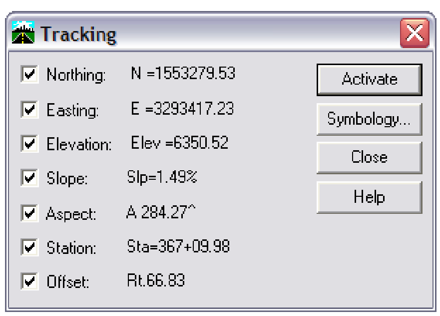


4. **Zoom** in to the alignment and review the stationing display.
5. Review each of the tabs on the **View Stationing** box to see the setup. Try displaying the stationing with other preferences.
6. Select **Close** to close the **Stationing** dialog when you're done.

Review the alignment data

Use General tracking

1. Select **Tools > Tracking > Tracking**, then choose **Activate**.
2. Move the cursor along the alignment and note that the Elevation, Slope and Aspect fields are populated as long as you're in the area of the DTM.



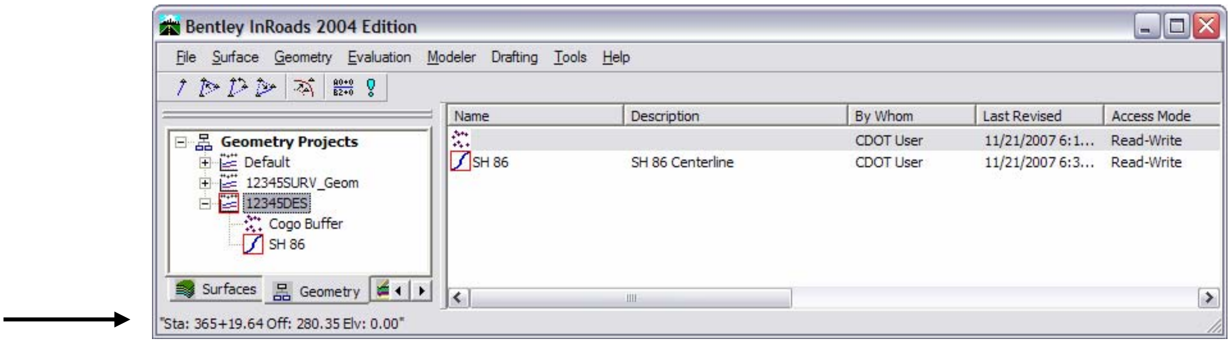
The information in the dialog box can be displayed into the design file by placing a **<D>** at the desired location. All of the annotation fields that are toggled on will be annotated in the design file.

3. **<D>** in the file to see the annotation display.
4. **Close** the **Tracking** dialog.

Use Alignment tracking

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

   Move the cursor along the alignment and watch the data change in the InRoads command window. As the cursor moves, the station and offset from the active alignment is displayed.

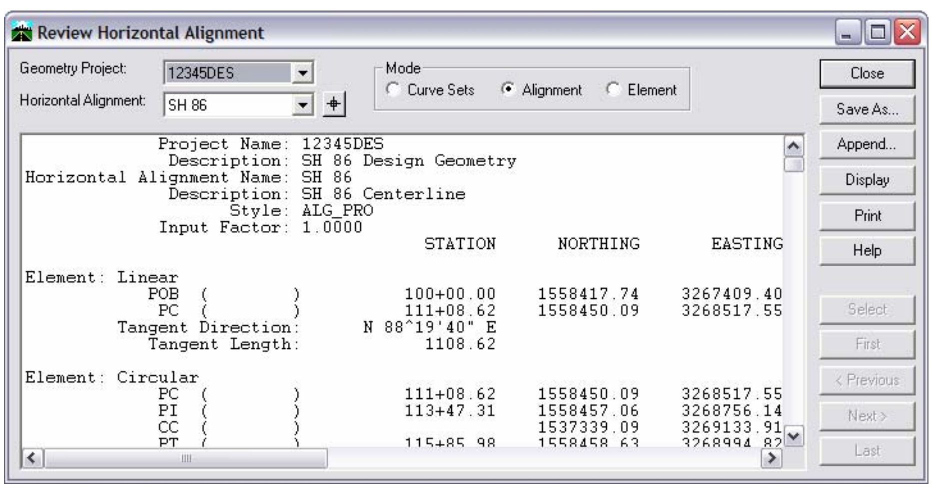


   As you move your cursor, you will see the line tracking between the proposed horizontal alignment and your cursor. The offset listed is the perpendicular distance from the alignment to your cursor.

6. **Reset** twice to exit the tracking mode

Use the Review command

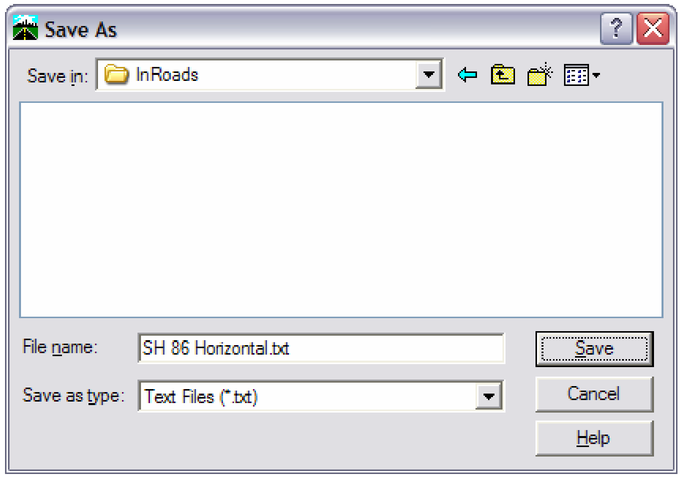
7. Select **Geometry > Review Horizontal**.



   A window is displayed showing all the alignment data for the selected alignment.

8. Scroll through the report to review the information it contains.

9. From the **Review Horizontal Alignment** window, select **Save As**.



10. Set the folder to **C:\Projects\12345\Design\InRoads** and in the name field, key in ***SH 86 Horizontal.txt***

11. Select **Save**.

12. Close the **Review** dialog box.

An ASCII file has been created in the **C:\Projects\12345\Design\InRoads** directory that can be reviewed and printed.

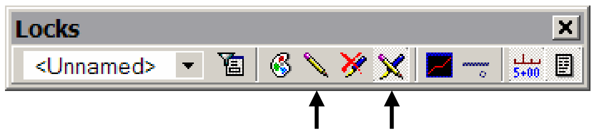
Note: If you have a default printer set in Windows, you can use the **Print** option on the **Review** dialog to print directly to your printer.

Move a horizontal PI

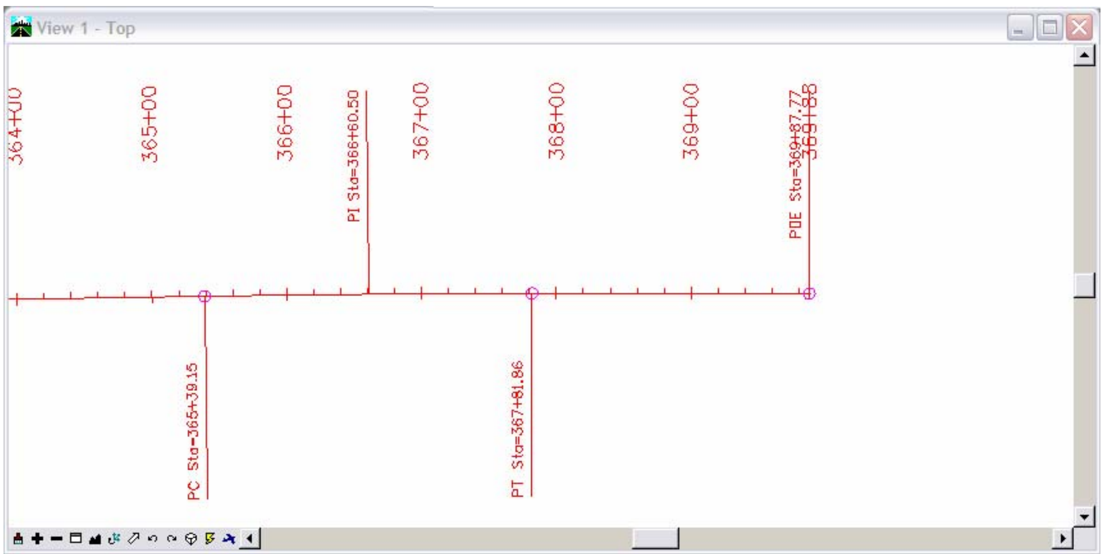
Often in the process of defining an alignment or in making modifications to an alignment it is necessary to move a horizontal PI. InRoads provides several tools for accomplishing this task. You will use the Edit Horizontal Element command to extend the last tangent.

1. Make lock settings.

    - Toggle **Write** lock on
    - Set the mode to **Pencil**

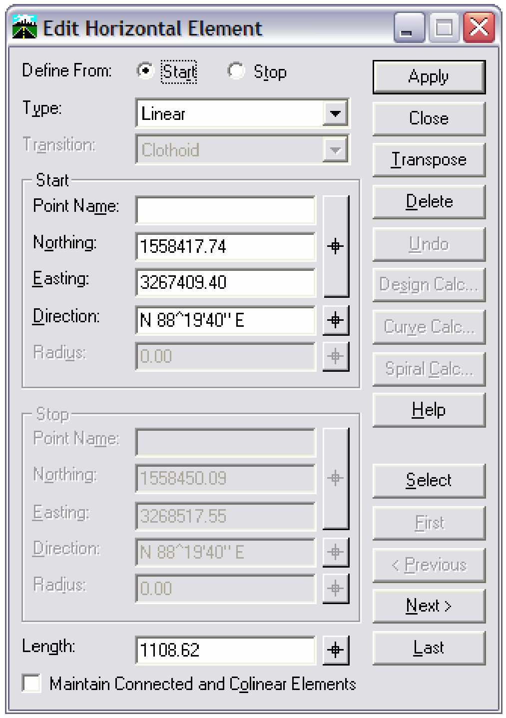


Move the POE using Edit Horizontal Element.



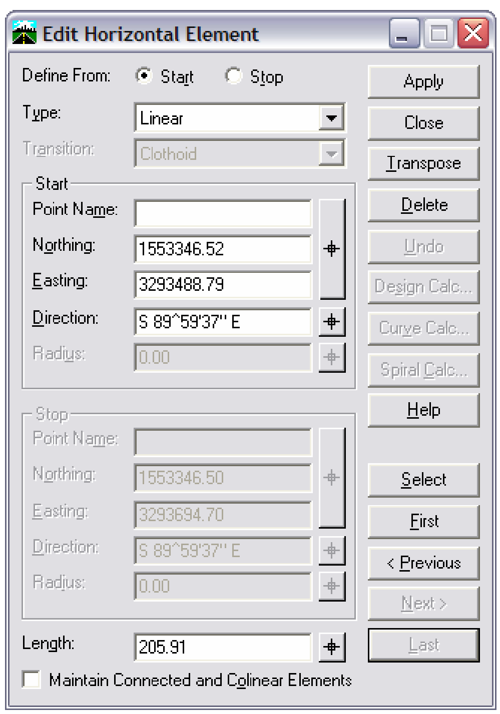
2. Window Area around the end of the alignment as shown.

3. Select **Geometry > Horizontal Element > Edit Element**.



4. Select **Last** on the dialog to move to the last element in the alignment.

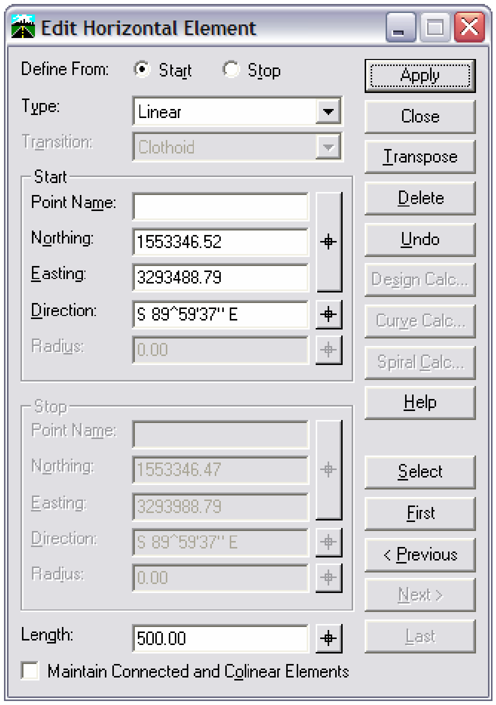
Do not miss the step to choose Last or you will edit the wrong point !



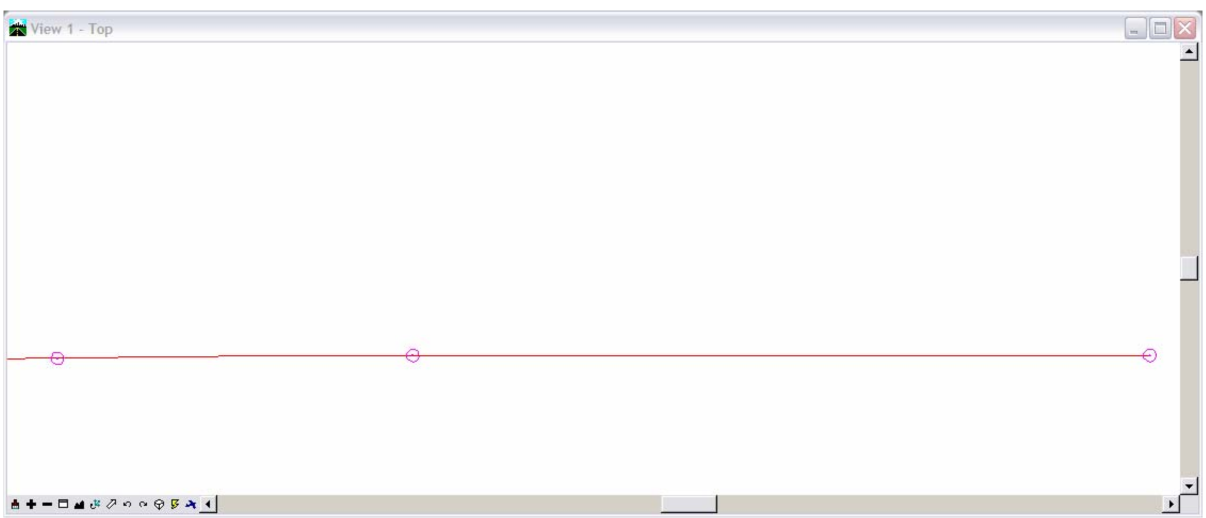
- At the top of the dialog, set the **Define From** option to **Start**.

This holds the starting point of the element and allows you to edit the ending point.

- In the **Length** field, change the entry to ***500***.



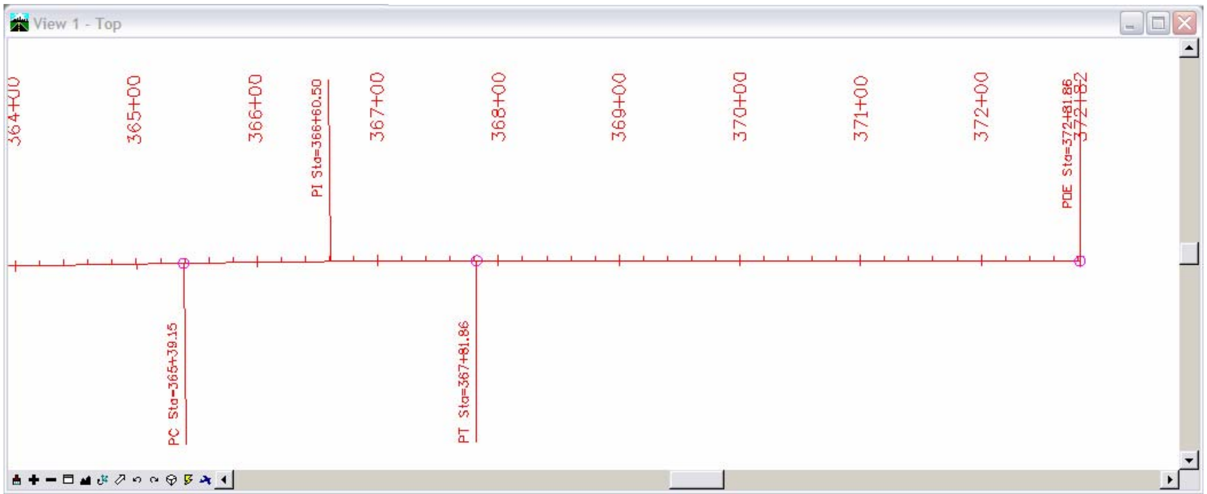
5. Choose **Apply**.



6. Close the **Edit Horizontal Element** dialog.

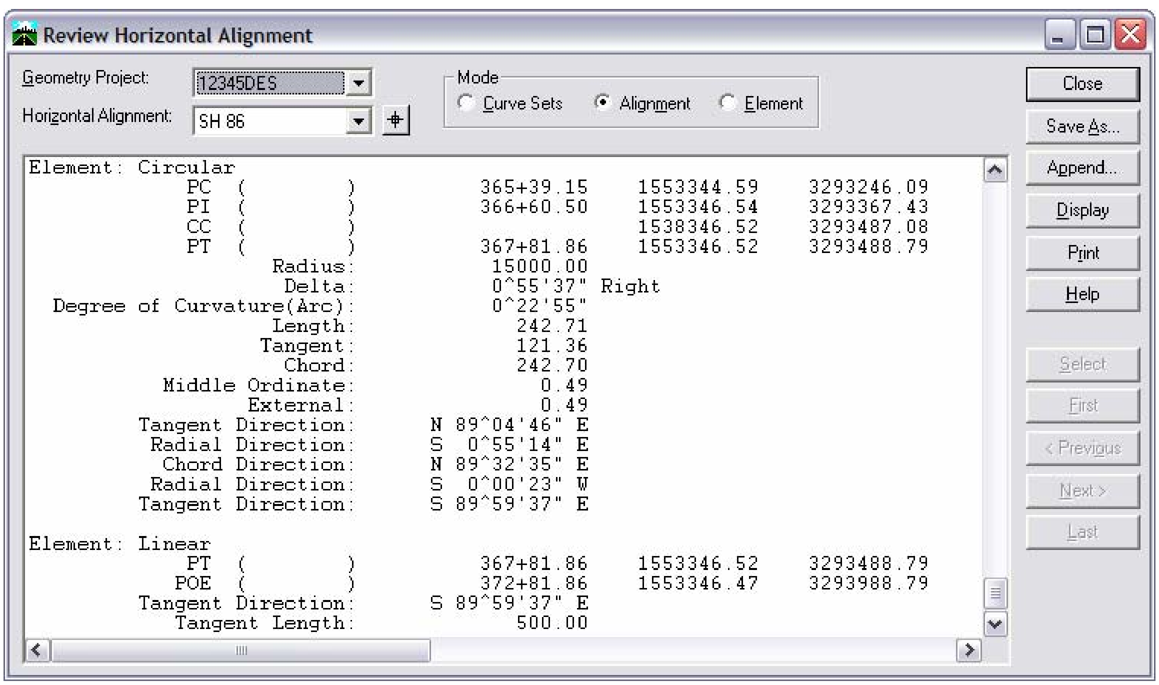
7. Using what you previously learned, view the stationing for the updated alignment. (**Geometry > View Geometry**)

   Since the stationing was originally placed in **Pencil** mode, it was deleted when the alignment was updated.



8. Review the alignment again (**Geometry > Review Horizontal**).

9. Compare the alignment to the Review dialogs shown below. Be certain to scroll to the bottom and check your alignment's ending tangent length, which should now be ***500*** because of the change you just made.



10. If your alignment doesn't match, you can:

- Modify the ending tangent like you did above to set the length to 500, if the edit didn't work,
- Modify it using the **Move PI** command if a PI is in the wrong location,
- Modify a curve using the **Define Curve** command if a curve is wrong, or if necessary,
- Right-click the alignment in the Explorer portion of the menu and choose **Empty**, then start over with the alignment.

11. If your alignment matches this printout, save your report again, over-writing the one you saved earlier.

Save your updated alignment

1. Select **File > Save > Geometry Project**.

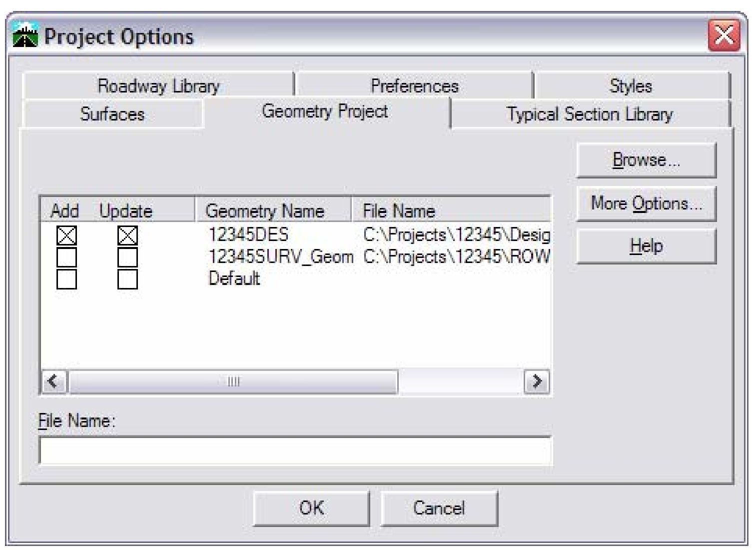
   This saves the active geometry project.

Add the geometry project to your project (rwk) file

2. Select **File > Save As**.

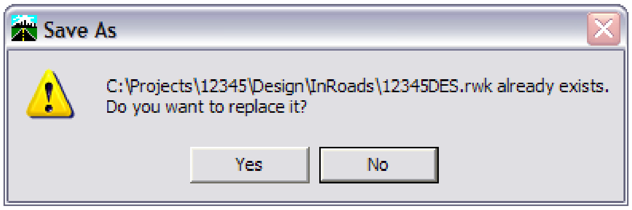
   - Set the **Save as Type** to **Projects *.rwk**.
   - Highlight **12345DES.rwk**.
   - Choose **Options**.

3. On the **Geometry Projects** tab, click on **Add** and **Update** for the **12345DES** geometry project.



Add loads the file when the project is loaded and **Update** saves the file when the project is saved. You do not need to load the Survey geometry project for future use, so you can leave it toggled off.

4. Choose **OK**.
5. Choose **Save** on the **Save As** dialog.
6. When prompted to overwrite the current .rwk, choose **Yes**.



This adds the geometry project **12345DES.alg** to the previously created **12345DES.rwk** file.

7. Exit InRoads and MicroStation.

If prompted, "Do you want to save changes to the Geometry Project **12345DES.alg**?" choose **Yes**. This obviously means the geometry project was not saved with the project file. Open InRoads and try saving your project again. If you have trouble, ask for assistance.

If prompted to save the survey geometry file, choose **No**.

Challenge lab

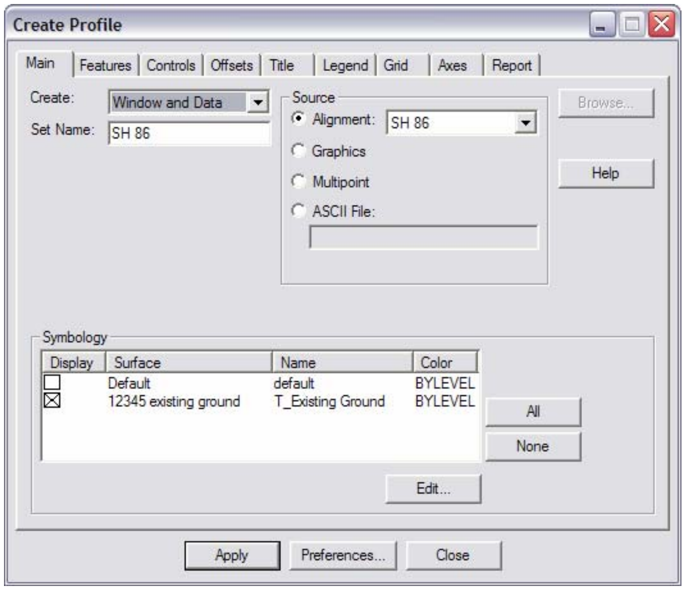
Create an alignment of your choosing using the **Horizontal Element** commands.

4. Creating Profiles and Vertical Alignments

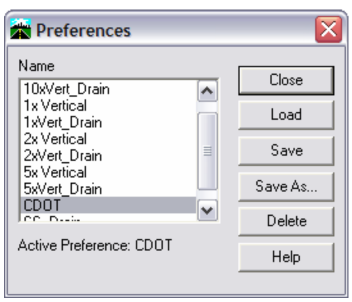
Creating Profiles

A profile of the horizontal alignment showing the existing surface groundline is required before creating the design profile, known in InRoads as the vertical alignment.

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



There are several CDOT preferences for the different vertical exaggerations. Choose the appropriate one under **Preferences** and **Load** it to establish the settings in the dialog.

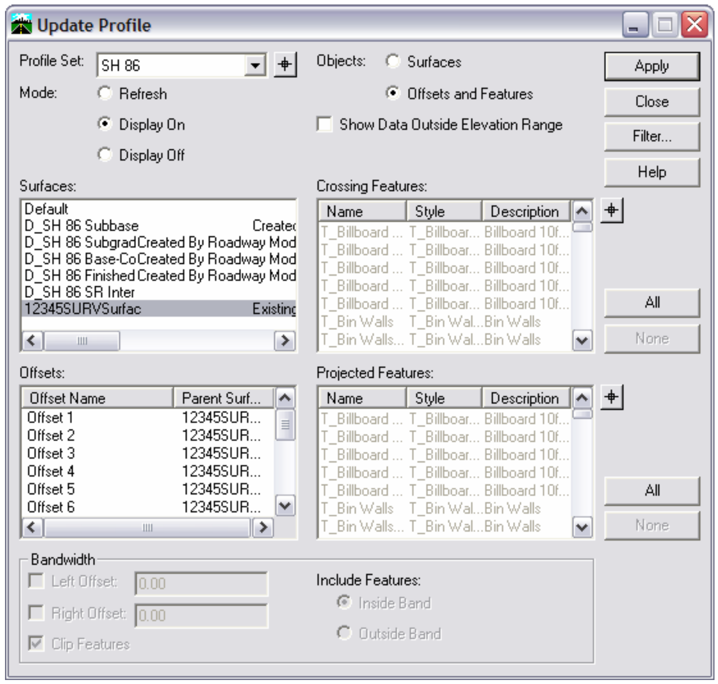


Multiple surfaces may be shown on one profile by selecting them in the **Symbology** category. You may also show features that cross the alignment and projected features on the profile. These may be toggled on from the **Features** tab before creating the profile.

Updating Profiles

If there are changes that need to be made to the profile after it is cut, such as turning on or off a surface or features, or updating surfaces or features that have been modified, you can update the profile.

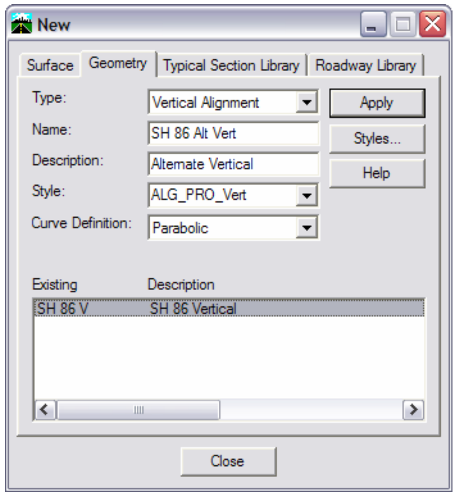
Select **Evaluation > Profile > Update Profile**.



Creating Vertical Alignments (Design Profiles)

In order to create a new design profile or vertical alignment, you must first have a geometry project loaded, with a horizontal alignment active.

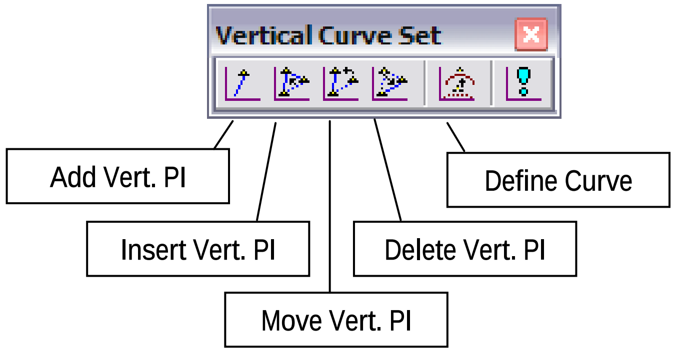
Once the geometry project is loaded (and correct horizontal is active), you may create a new alignment name. Choose **File > New > Geometry** and set the **Type** to **Vertical Alignment**. Enter the **Name**, **Description** and select a **Style**.



Apply after filling in the appropriate information. If you have already created a profile of the horizontal, then you may proceed with either the **Vertical Curve Set** or **Vertical Element** tools to enter the alignment data.

Vertical Curve Set Commands

The **Vertical Curve Set** commands make up an easy way to create alignments. They consist of five primary commands described below.



Add Vertical PI – **Add Vertical PI** is used to create a PI that begins a new alignment, or to add a PI onto either end of an existing alignment.

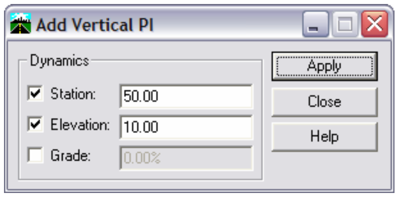
Insert Vertical PI – **Insert Vertical PI** is used to add a PI to an existing alignment between two existing PIs.

Move Vertical PI – **Move Vertical PI** is used to change the location of an existing vertical PI.

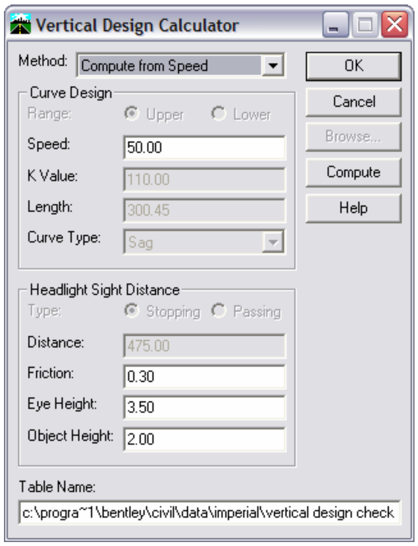
Delete Vertical PI – **Delete Vertical PI** is used to remove a PI from an existing alignment. For removing more than one PI, you must choose and accept each one individually. To remove all PIs associated with an alignment, but leave the alignment name, right-click on the alignment name in the Explorer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

Define Vertical Curve – **Define curve** is used to create a curve at a PI on an alignment, or to revise an existing curve on an alignment. The **Previous** and **Next** buttons are used to step through the alignment. The tangents forming the PI where the curve is to be defined will be highlighted graphically.

Dynamics – The **Dynamics** dialog allows you to set intervals for placement of the vertical PIs. It locks your cursor into the desired station, elevation and/or grade intervals.



The **Design Calculator** is used to compute or look up curve data to ensure your design criteria are met.



Keyins – There are additional keyins that can be useful when creating a vertical alignment, including:

SE=station,elevation (***SE=34500,8421***)

DG=distance,grade (***DG=1500,-2.5%*** or ***DG=1500,-.025***)

Displaying Alignments

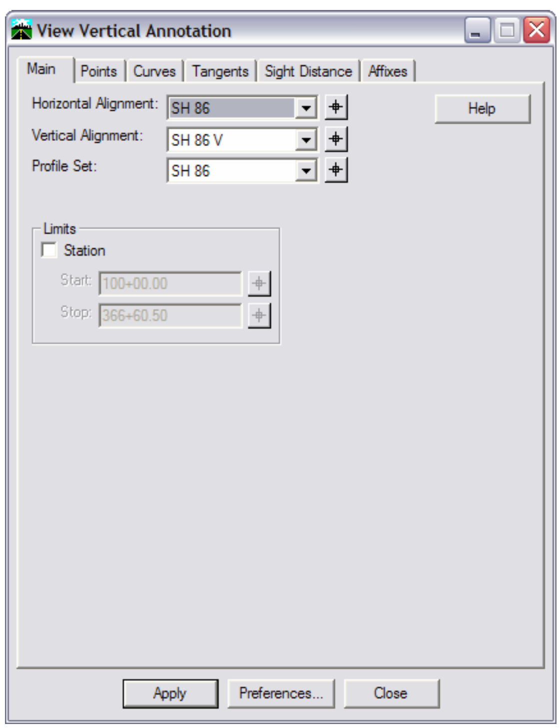
There are several methods for displaying vertical alignments in InRoads. The method you choose is based on the desired display.

If you choose one of the methods other than **Vertical Annotation**, a geometry style controls the level and therefore the symbology of the display. Geometry styles are associated with individual alignments when they are created. The CDOT standard styles have been pre-defined and are stored in the **CDOT-styles.ini** file, accessed through the **Geometry > View Geometry > Geometry Style Manager** dialog. (See ***Horizontal Alignment Annotation***.)

To display the active alignment, choose **Geometry > View Geometry > Active Vertical** and the active alignment will display on every profile (created from the vertical's parent horizontal) in the design file showing points and linework (no annotation).

To display any alignment, right-click on the alignment name in the Explorer menu and choose **View**. The chosen alignment will display on every profile (created from the vertical's parent horizontal) in the design file showing points and linework (no annotation).

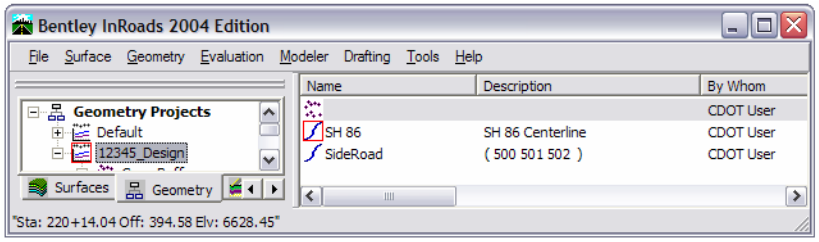
To display the alignment and annotate it at the same time, choose **Geometry > View Geometry > Vertical Annotation**. This command uses a preference to define the symbology of the vertical alignment and to define what and how the alignment is annotated. There are several CDOT preferences available for different types of vertical alignments.



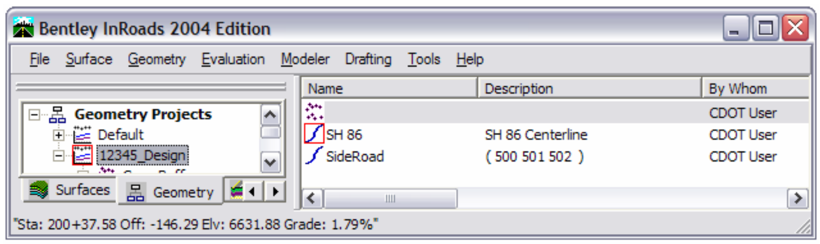
Tracking

The Vertical Alignment can be tracked using one of two methods.

Tools > Tracking > Horizontal Alignment – Tracks the horizontal alignment with a perpendicular line to your cursor. It gives a Station, Offset, Elevation readout in the message field, where the elevation shown is that of the active vertical alignment at the given station.



Tools > Tracking > Vertical Alignment – Tracks the vertical alignment on the profile grid with a vertical line to your cursor. It gives a Station, vertical Offset, Elevation and vertical alignment Grade readout at the location of your cursor.



If a second vertical alignment is selected, the offset is between the two alignments.

Saving an Alignment

Alignments are not saved individually. Instead, they are saved when the geometry project is saved. Since you are working on a copy of the geometry project that is loaded in memory, saving is a good idea whenever you make changes to your alignment, and mandatory before exiting – assuming you want to save your changes.

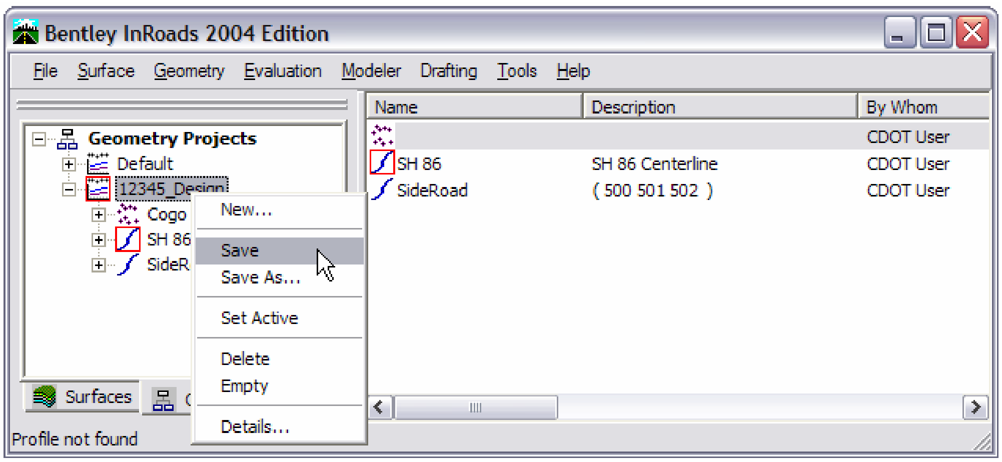
Geometry projects can be saved using several methods including:

Choose **File > Save > Geometry Project**

The active geometry project is saved.

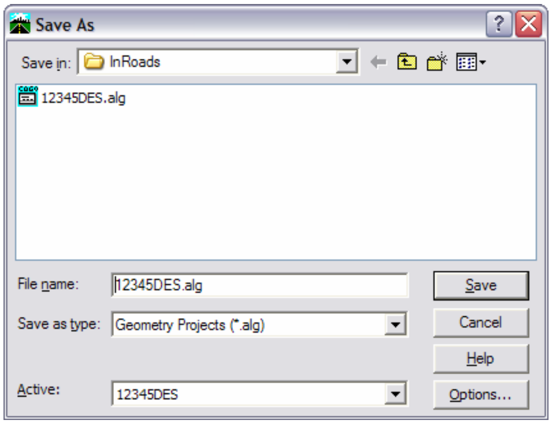
Right-click on the **Geometry Project** in the Explorer menu and chose **Save**

The geometry project you highlighted is saved.



If the geometry project has never been saved, either of the previous methods will bring up the **Save > As** box shown below.

Choose **File>Save** As



Set the **Files of Type** to (***.alg)**

Choose the geometry project you want to save (in the **Active** category)

Key in the file name (or use the default)

Choose **Apply** and the file is saved.

Note: Geometry projects have both an internal name that appears in the dialog boxes in InRoads and a name on the hard drive that has an .alg extension. Care should be taken to make certain you have chosen the correct geometry project name to match the file name you specify. Otherwise, you could accidentally save over a file on the hard drive with the wrong geometry project.

The geometry project may also be saved as part of the project file or **.rwk**, which you will be using in your lab activity.

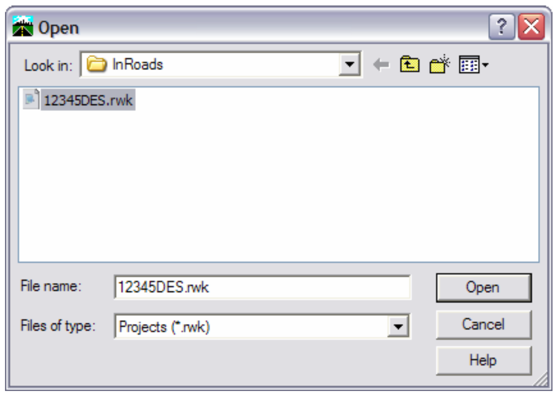
Lab 4 – Creating Profiles and Vertical Alignments

Starting InRoads

1. Start InRoads and open **CU12345DES_Model.dgn** from the **Design\Working folder.**

Open your InRoads data files

1. Select **File > Open**.



2. Ensure the **Files of Type** option is set to **Projects (*.rwk)**.

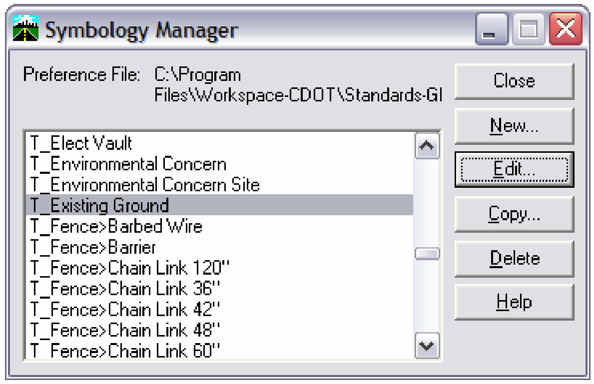
3. Double-click on **12345DES.rwk**.

   Double-clicking is the equivalent of highlighting the file and choosing **Open**.

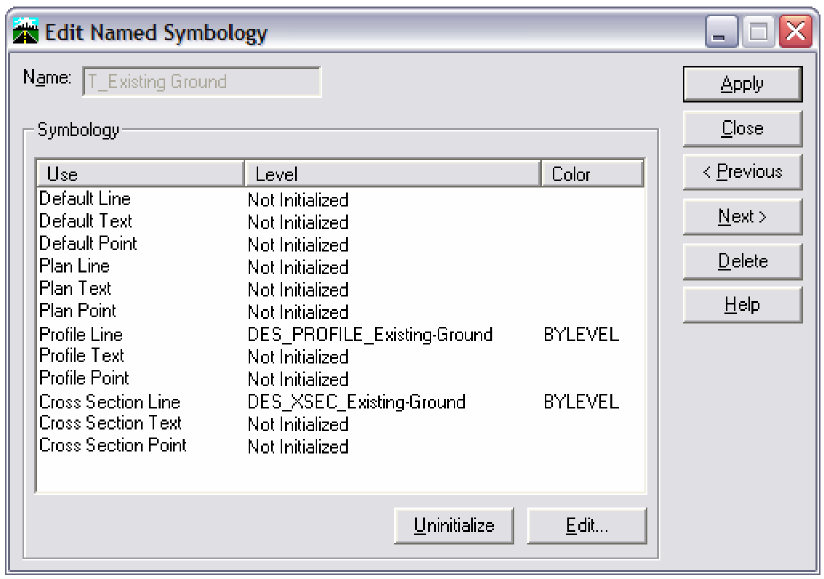
4. **Cancel** the dialog.

Review Profile symbologies

1. Select **Tools > Symbology Manager**.



2. Choose **T_Existing Ground** from the list and select **Edit**.

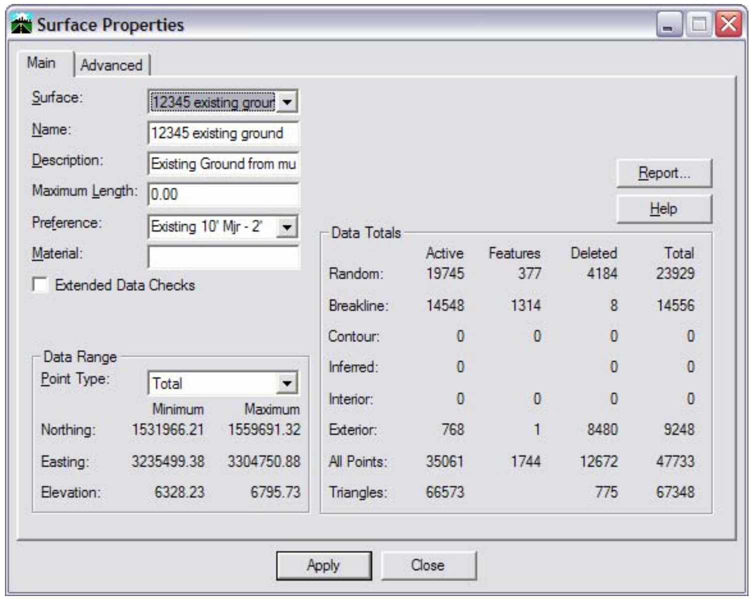


Notice that the Profile line is set to display on the level ***DES_PROFILE_Existing-Ground*** and to use ***By_Level*** symbology.

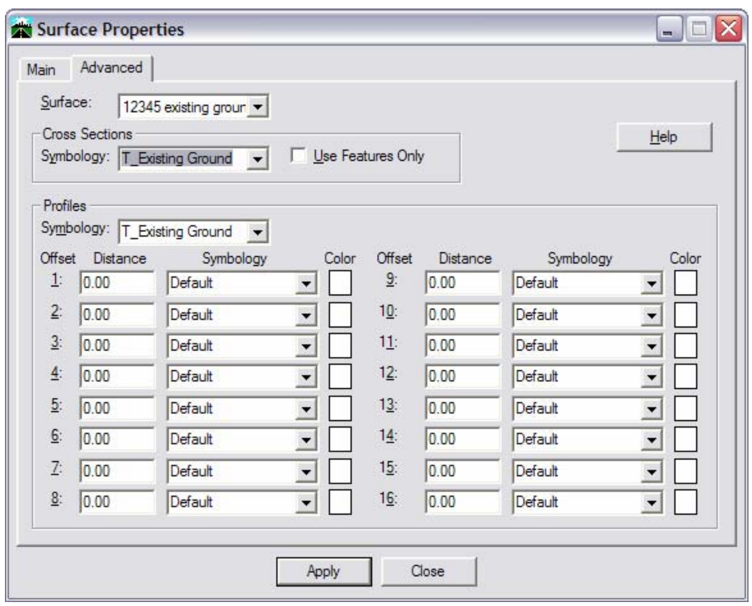
3. Close the **Symbology Manager** dialogs.

4. Select **Surface > Surface Properties**.

5. Set the **Surface** to **12345 existing ground**.



6. Select the **Advanced** tab.



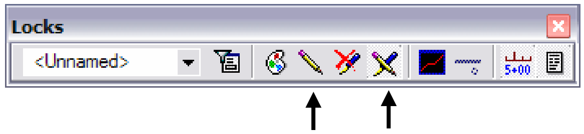
Note: The **Profile Symbology** is set to **T_Existing Ground**. This means that when the profile is displayed, the ground line will use this named symbology, will be placed on the ***DES_PROFILE_Existing-Ground*** level and will use ***By_Level*** color, weight and line style.

Create a multi-point profile

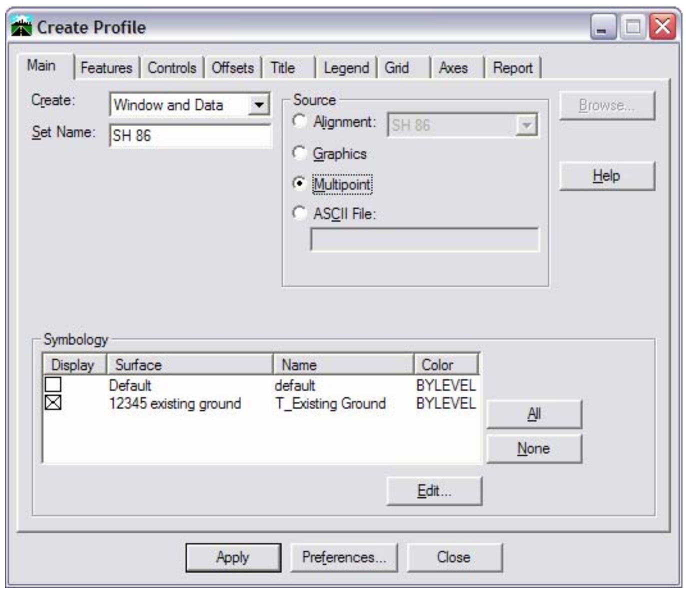
Multi-point profiles display a profile of the existing ground surface between points defined graphically.

1. Ensure **Write** lock is on.

2. Set the **Mode** to Pencil.



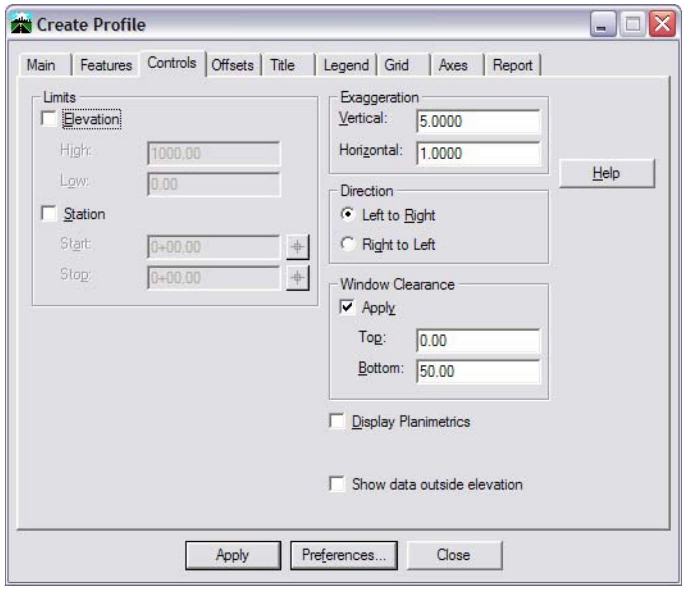
3. Select **Evaluation > Profile > Create Profile**.



4. Choose **Preferences** and **Load** ***5xVertical***.

   - Toggle the **Create** option to **Window and Data**.
   - Key in a **Set Name** of **Existing Road**.
   - Select **Multi-Point** as the **Source**.
   - Under **Symbology**, toggle on **12345 existing ground** in the list of surfaces.

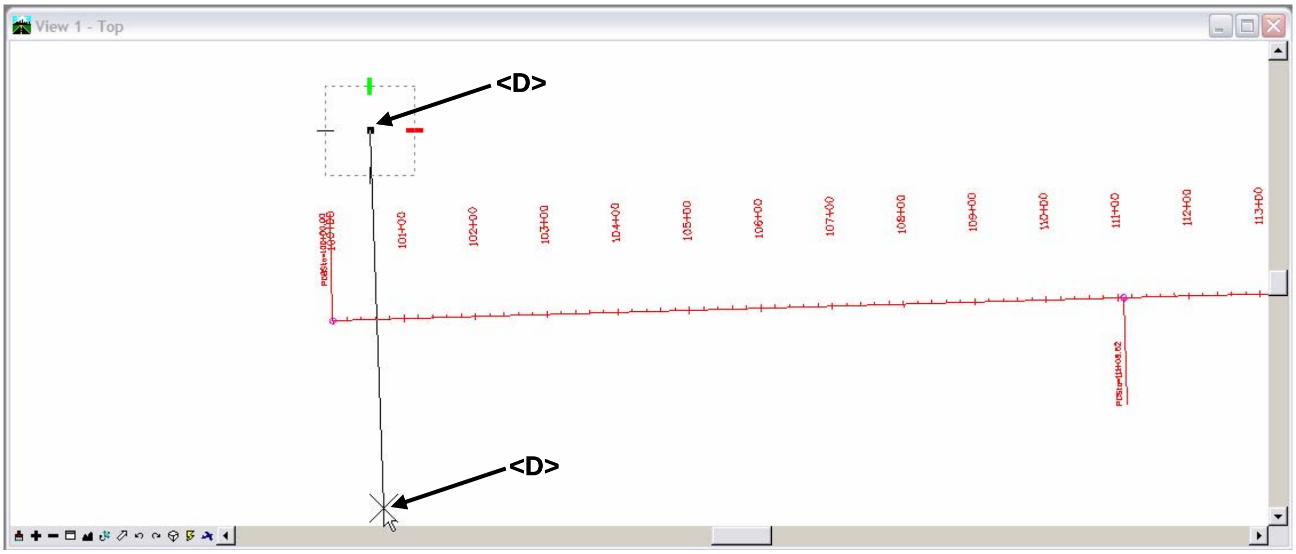
5. Choose the **Features** tab.
   - Verify the both options are off.
6. Choose the **Controls** tab.



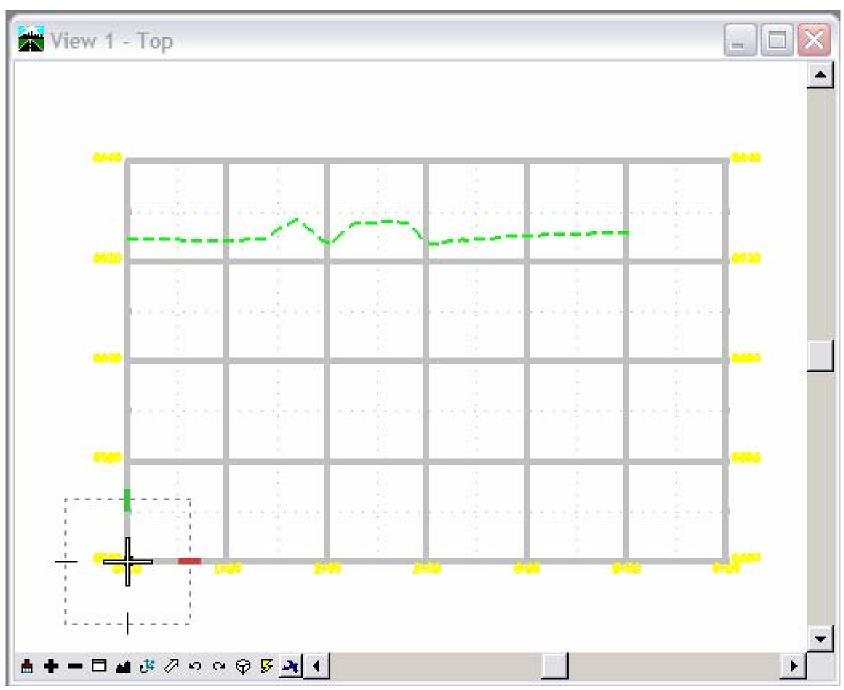
   - Verify the **Vertical Exaggeration** is ***5.0***.
   - Verify the **Horizontal Exaggeration** is ***1.0***.
   - Note the **Window Clearance Bottom** is ***50***. The profile command uses the ground elevations to determine the elevation range of the profile, then adds enough to the low and high elevations to start and stop on an even interval. The **Window Clearance** is an opportunity to increase the size of the grid by adding 'blank' space at the top or bottom. This is especially helpful if you have vertical alignment data that will fall outside the elevation range of the existing topo. As you can see, the CDOT preference you loaded has a clearance at the bottom. If you need more room at the top, add a **Top** clearance.

7. Select **Apply**.

   - When prompted to **Identify Point**, place a **<D>** north of the beginning (POB) of the proposed alignment.
   - Place a second **<D>** south of the beginning (POB) of the proposed alignment.
   - **<R>** to stop selecting points.



8. When prompted to **Identify Location**, place a **<D>** in a clear area above the alignment. This will be the location of the lower left corner of the profile grid.



9. Close the **Create Profile** dialog.

   A profile is displayed that shows the ground surface between the first two data points. The third data point determined the location of the bottom left corner of the profile grid.

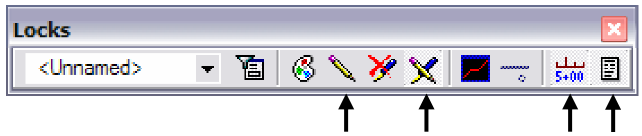
   The height of the profile is determined by the height of grid needed for the ground line, plus the 50 extra feet of bottom clearance (set by the preference and found on the **Controls** tab).

10. Use the MicroStation window commands to take a closer look at the two-point profile.

11. When done, **Fit** your MicroStation view before continuing.

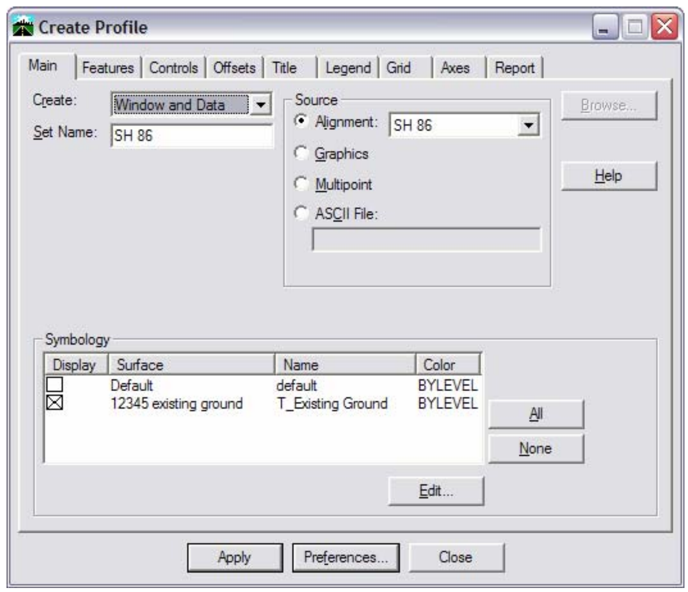
Create alignment profiles

1. Ensure **Station** and **Report** locks are on.



Create a profile for the active horizontal alignment

2. Select **Evaluation > Profile > Create Profile**.

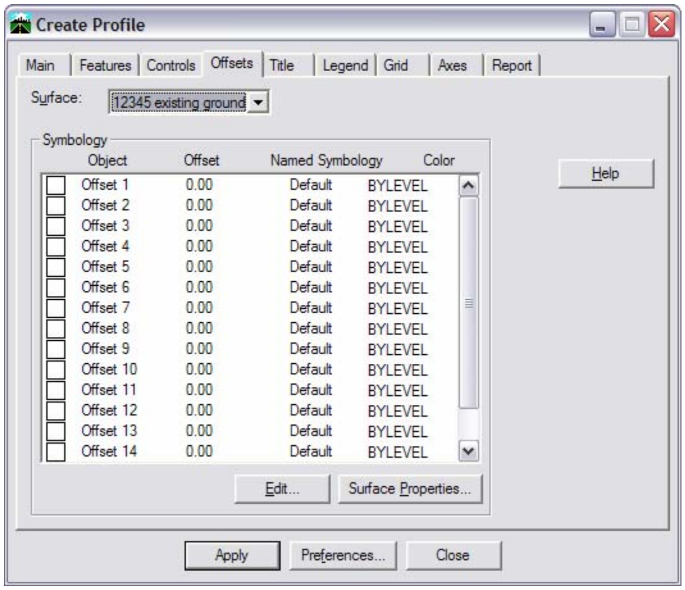


3. Choose **Preferences** and load **2x Vertical**.

4. Set the following parameters in the **Main** tab if they don't default:

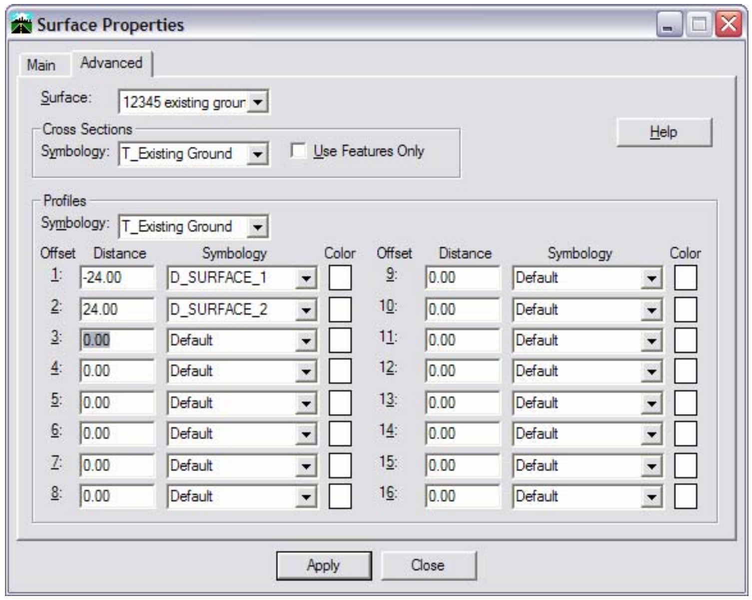
   - **Create**: *Window and Data*.
   - **Set Name**: *SH 86*.
   - **Source**: **Alignment:** *SH86*.
   - Under **Symbology**, toggle on **Surface** *12345 existing ground*.

5. Choose the **Features** tab.
   - Toggle off **Crossing Features**.
   - Toggle off **Projected Features**.
6. Choose the **Offsets** tab.



   - Set the **Surface** to ***12345 existing ground***.
   - Highlight **Offset 1** and choose **Surface Properties**.

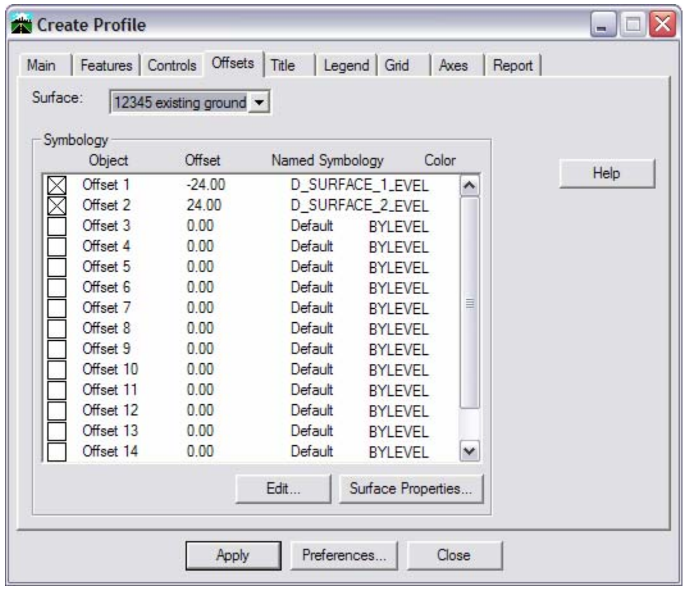
7. On the **Surface Properties' Advanced** tab,



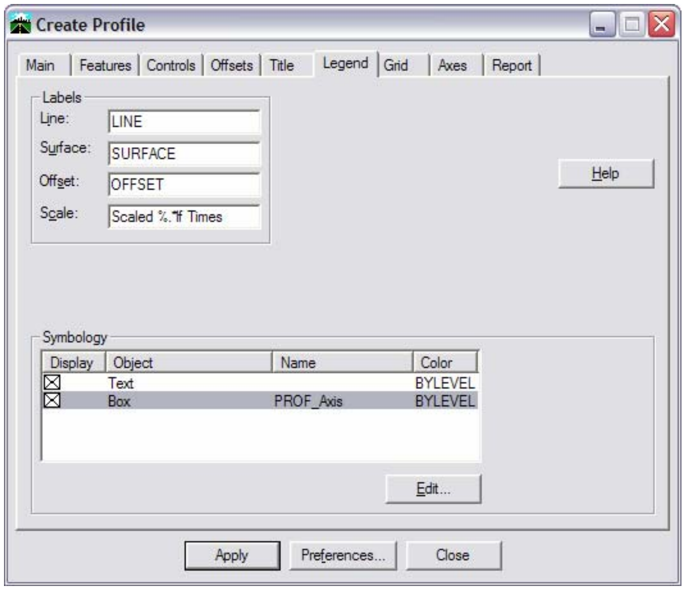
- Key in ***-24*** for **Offset 1** and choose the **Symbology** ***D_ SURFACE_1***.
- Key in ***24*** for **Offset 2** and choose the **Symbology** ***D_ SURFACE _2***.
- **Apply** then **Close** the **Surface Properties** dialog.

Note: ***D_ SURFACE _1*** through ***10*** can be used to show additional surfaces on either cross sections or profiles. You can also use them here to show offset lines using different symbologies from the centerline. They each have different **ByLevel** symbologies that do not preview in the **Surface Properties** dialog box, but will display on the profile.

8. Back on the **Offsets** tab, toggle on **Offsets 1** and **2**.



9. Choose the **Legend** tab and toggle on **Text** and **Box** in the **Symbology** area.

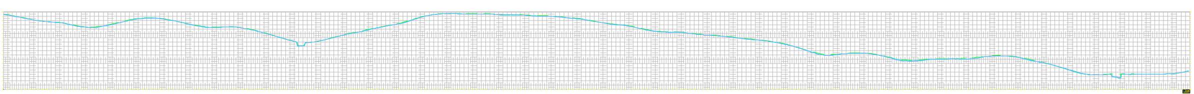


10. Look at the other tabs to see how the CDOT preferences are set up.

11. Select **Apply**.

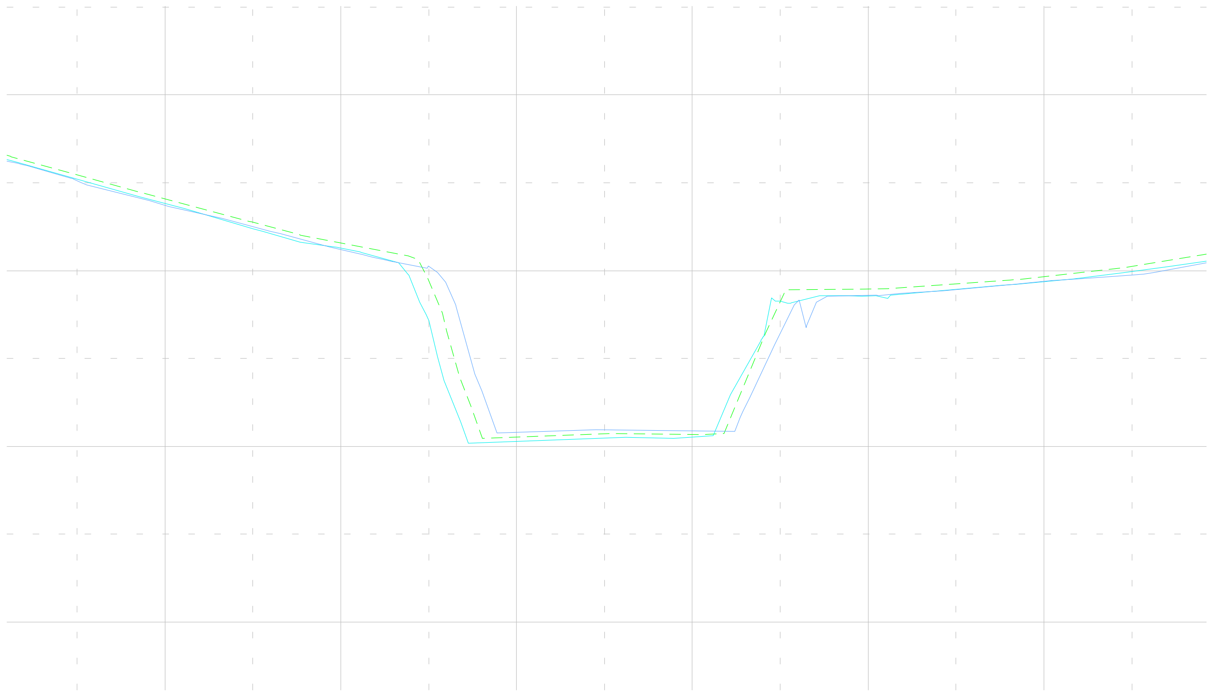
    - When prompted **Identify Location**, place a **<D>** in a clear area below the surface.

    The data point defines the lower left corner of the profile window. The profile is plotted showing the surface elevations along the active alignment SH86.



12. **Close** the **Profile** dialog.

13. Use your MicroStation **View** commands to take a closer look at the profile.

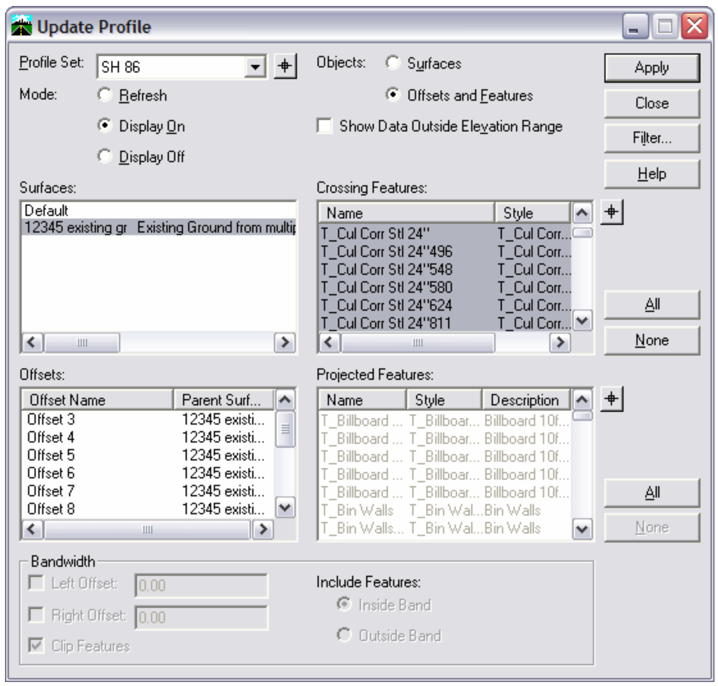


Note the centerline (green-dashed) offsets and the legend noting the different lines and symbologies.

Update your profile

You have been requested to show culverts on your profile. The utility information has been provided in your survey topo.

1. Choose **Tools > Options > Factors**.
2. Unlock the three factors.
3. Set the **Cell Scale Factor** to ***1***.
4. Choose **Apply**, then **Close**.
5. Select **Evaluation > Profile > Update Profile**.
6. Choose the **Profile Set** for last profile.



- Set the **Mode** to **Display On**.
- Set the **Objects** to **Offsets and Features**.
- Under **Surfaces** highlight **12345 existing ground**.
- Under **Crossing Features**, highlight the features that start with **T_Cul Corr Stl 24"**

7. Choose **Apply**.
8. Window into the profile (near station 215+00) to see one of the crossings.

Clean up your design file before plotting the final profile.

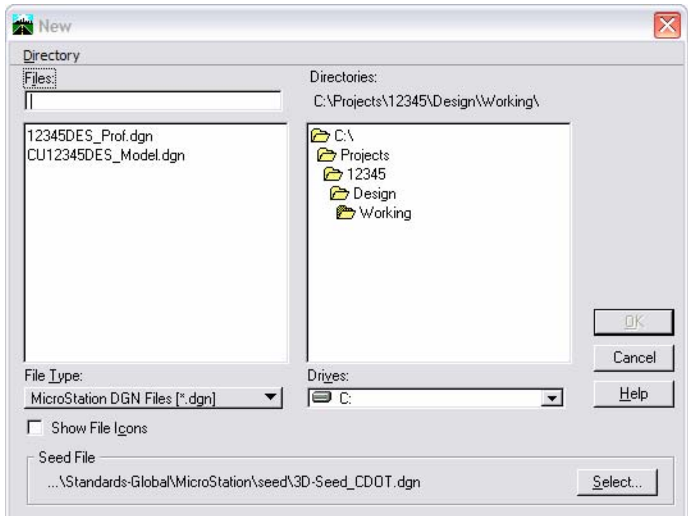
1. Delete all the profile windows that are displayed in the design file.

   Note: Turn on **Graphic Group** lock and use MicroStation **Delete**.

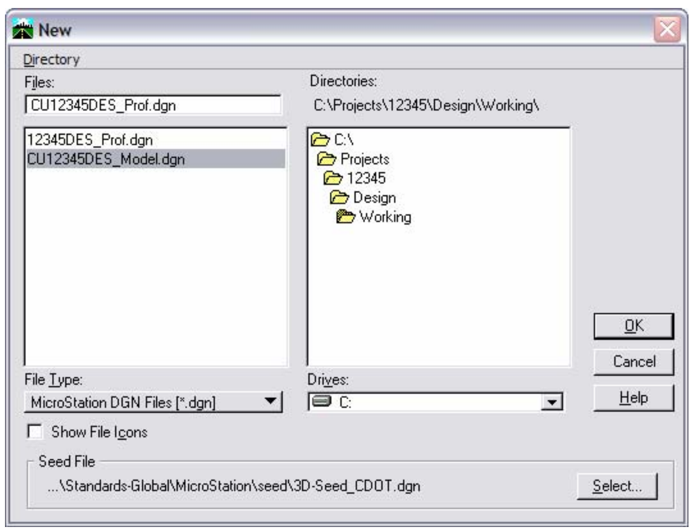
2. Select MicroStation **File > Compress > Design** to compress the design file.

Create a MicroStation design file for the final profile

1. On the MicroStation menu, select **File > New**.



- Key in **CU12345DES_Prof.dgn** and set the folder to **12345 \ Design \ Working**.

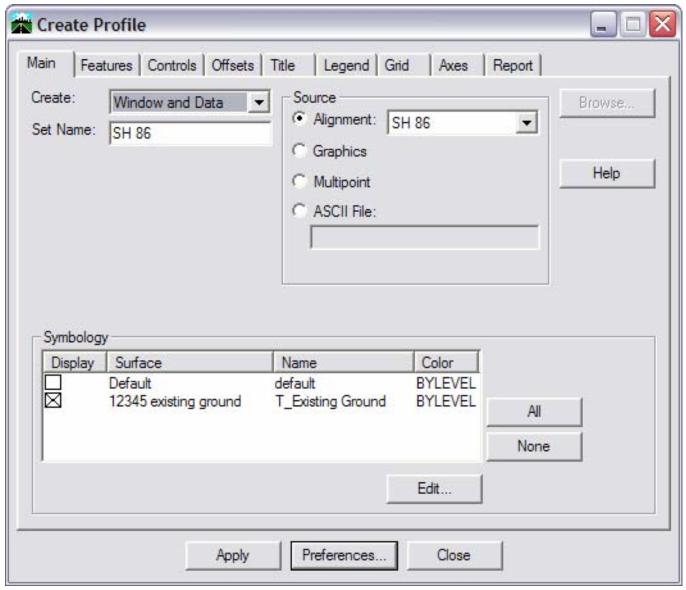


2. Choose **OK**.

   You are now in the **CU12345DES_Prof.dgn** file, ready to create the final profile.

Create the final profile

1. Select **Evaluation > Profile > Create Profile**.



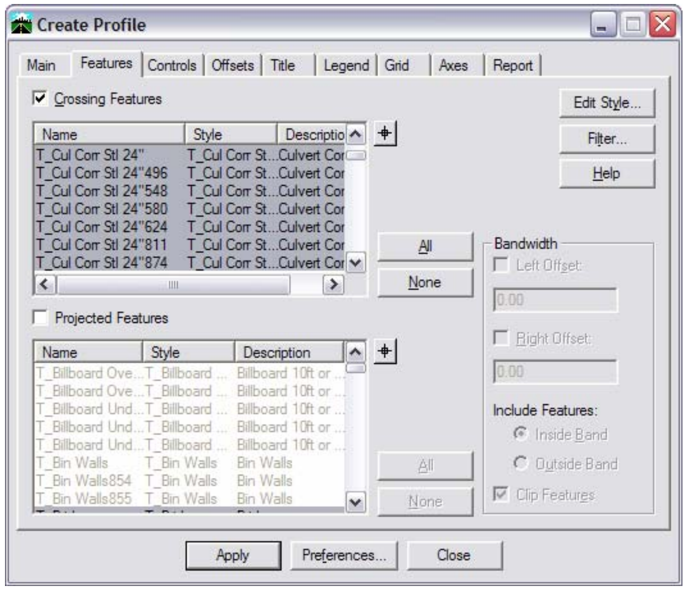
2. Choose **Preferences** and load **2x Vertical**.

   This will reset all of your previous changes back to the CDOT defaults.

3. Set or verify the following parameters in the **Main** tab:

   - **Create**: *Window and Data*.
   - **Set Name**: *SH 86*.
   - **Source**: *Alignment SH 86*.
   - Under **Symbology**, toggle on ***12345 existing ground***.

4. On the **Features** tab, toggle on **Crossing Features** and select the 24” culverts you used before.



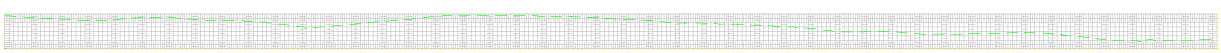
5. Select **Apply** on the **Profile** dialog box.

6. Place a **<D>** in the design file to plot the profile window.

7. **Close** the profile dialog box.

   Since **Write** lock is on, the profile is now permanent in the design file.

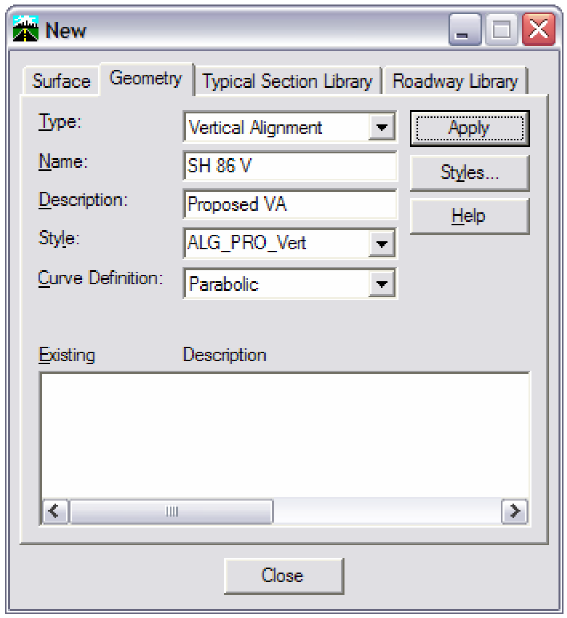
8. Use MicroStation view commands to take a closer look at your final profile, noting that the utilities are displayed.



Create a vertical alignment

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

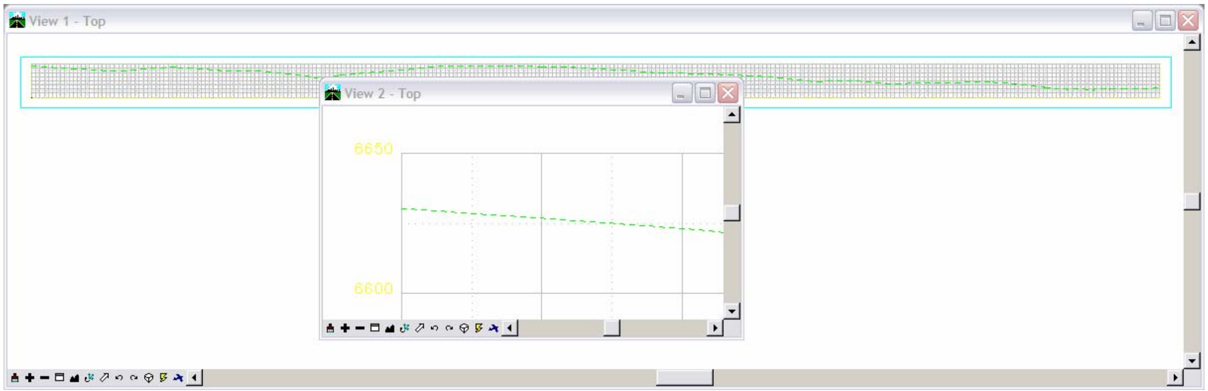
1. Select **File > New.**
2. Choose the **Geometry** tab.



- Toggle the **Type** to **Vertical Alignment** and set the following:
- **Name**: ***SH 86 V***
- **Description**: ***Proposed VA***
- **Style**: *ALG_PRO_Vert*
- **Curve Definition**: *Parabolic*

3. Select **Apply** then **Close**

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

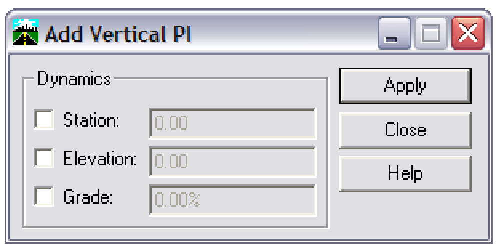


Add PVIs to the Vertical Alignment

5. Ensure **Write** lock is on.

6. Set the mode to **Pencil**.

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

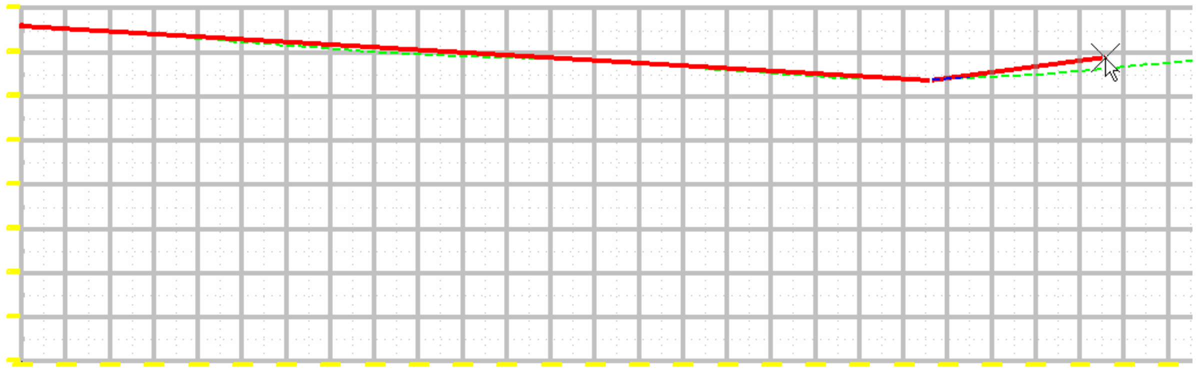


8. Select **Apply**.

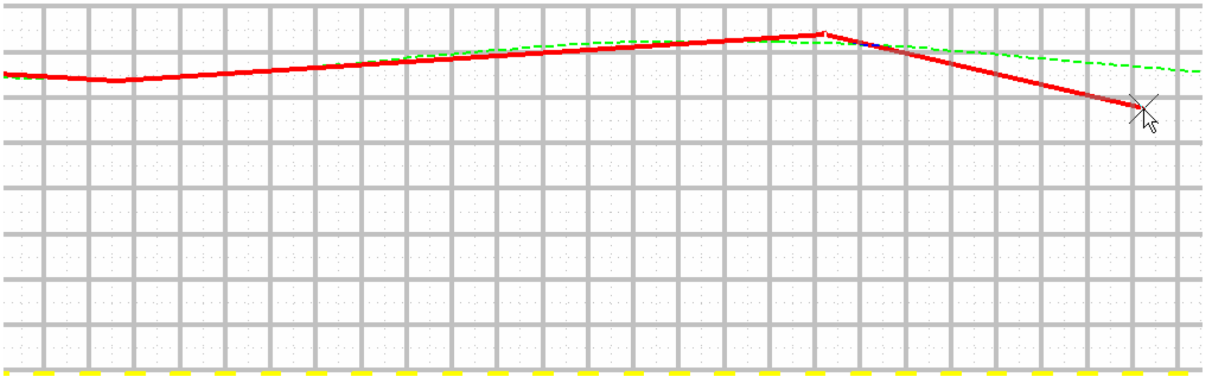
9. For the first PVI, snap to the beginning of the ground line in the window where you are zoomed in.

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

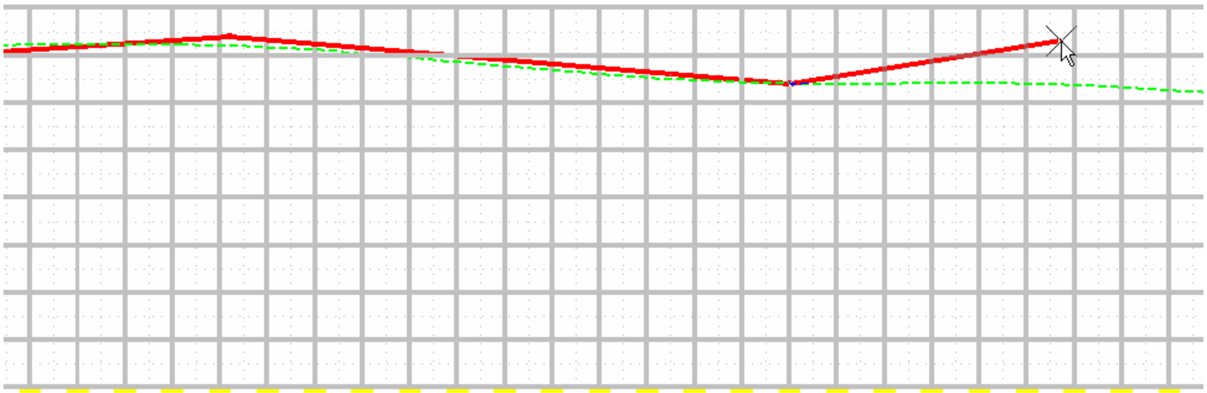
    - ***dg=2060,-3%***



    - ***dg=1560,3.3%***



    - ***se=14800,6570***



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

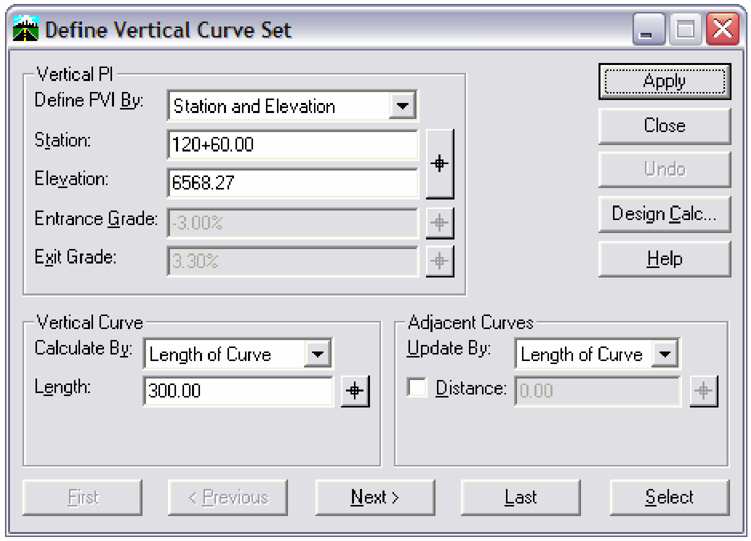
11. **<R>** twice to exit, then **Close** the **Add Vertical PI** command.

12. **Update** the view.

The vertical alignment is displayed permanently in the design file since **Write** lock is on. Because **Pencil** mode is active, the tangents will automatically update when the curves are added. If you forgot to turn Write lock on and the vertical alignment disappears, re-display it by choosing **Geometry > View Geometry > Active Vertical**.

Creating vertical curves

13. Select **Geometry > Vertical Curve Set > Define Curve**.

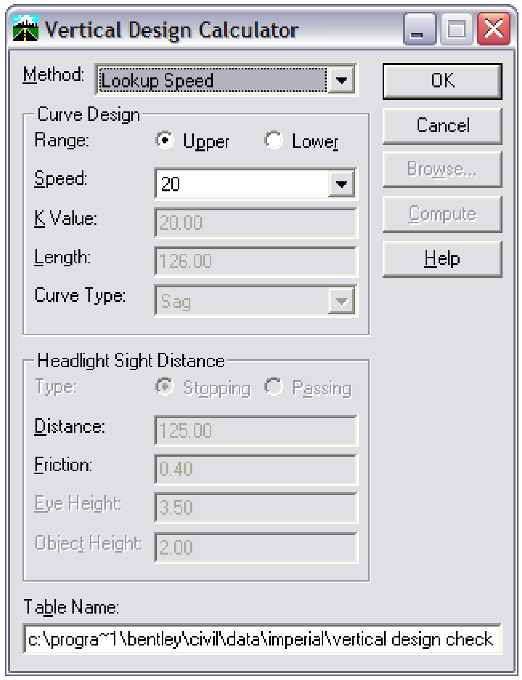


The **Define Vertical Curve** dialog box is automatically displayed ready to accept input for the first curve on the vertical alignment. To step to other curve sets, you can use **Previous** and **Next**, or **First** and **Last**.

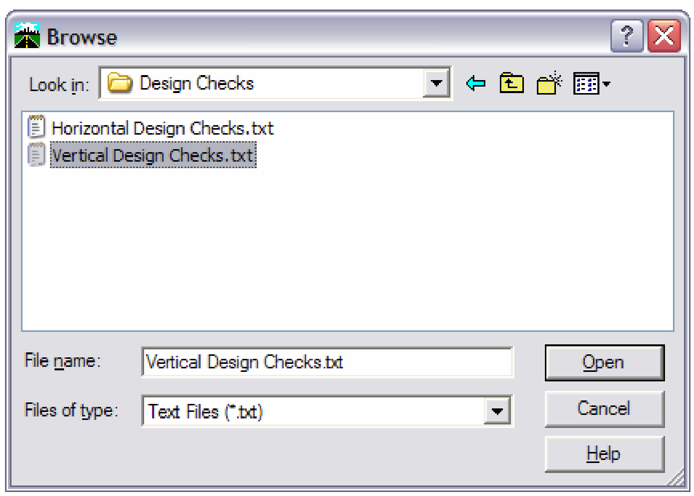
14. Under the **Vertical Curve** category,

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

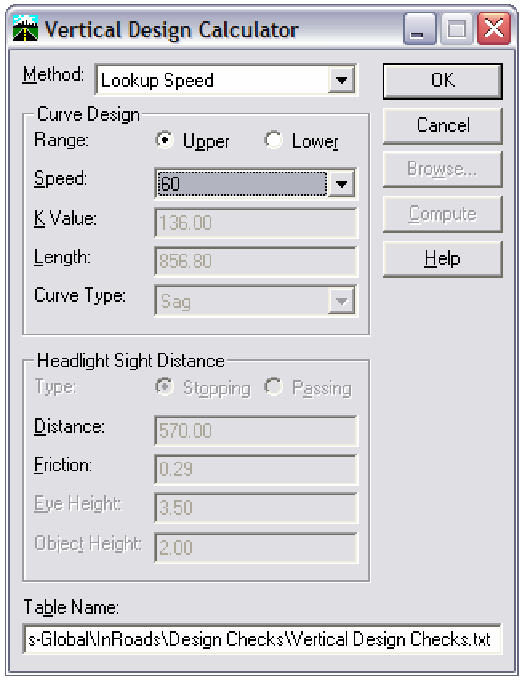
15. Select **Design Calc**.



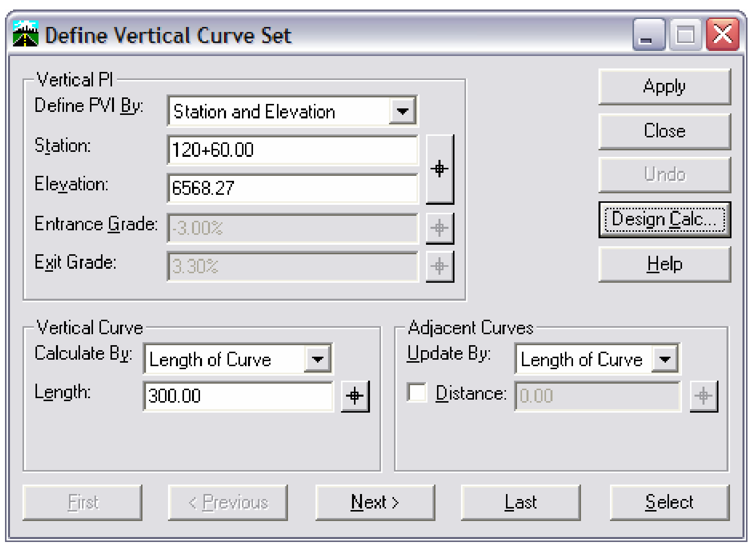
- Click in the Table Name and Browse to the **C:\Program Files\Workspace-CDOT\ Standards-Global \ InRoads\Design Checks** folder and choose the file **Vertical Design Checks.txt**.



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

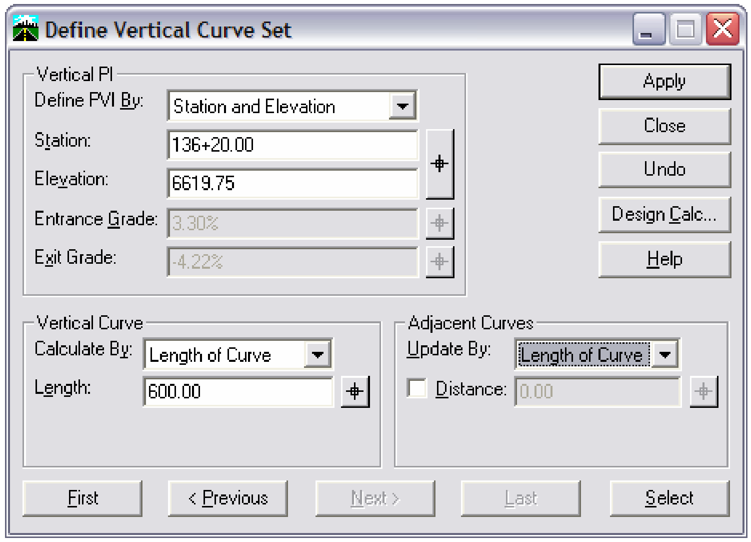


16. Choose **Cancel** when done. You do not want to accept the minimum curve, just verify that yours meets the criteria.



17. Select **Apply**

18. Select **Next** to move to the second intersection of tangents

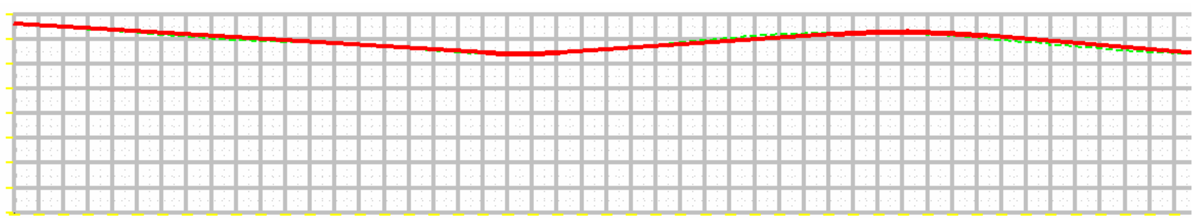


- Set **Calculate By**: to ***Length of Curve***
- Set the **Length** to ***600***
- Select **Design Calc**.
- Verify that the length of curve meets your design criteria.

19. Choose **Cancel** when done.

20. Select **Apply**.

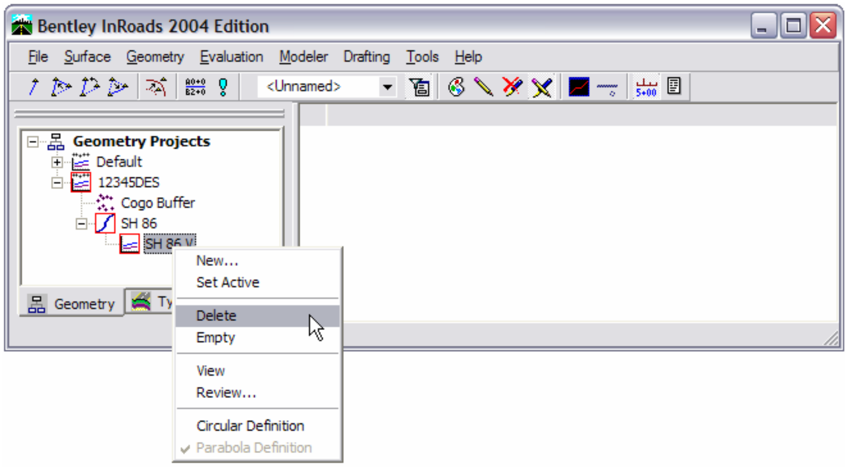
21. **Close** the **Define Vertical Curve Set** dialog.



Import final vertical alignment.

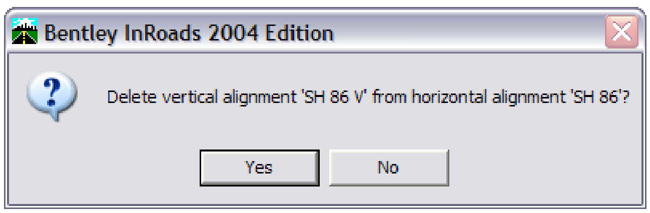
The vertical alignment for this project actually has more than 20 PVIs and vertical curves. To save time, you will delete the vertical alignment you just started and import the vertical from an .ics file.

1. Right-click on the vertical alignment in the explorer and choose **Delete**.

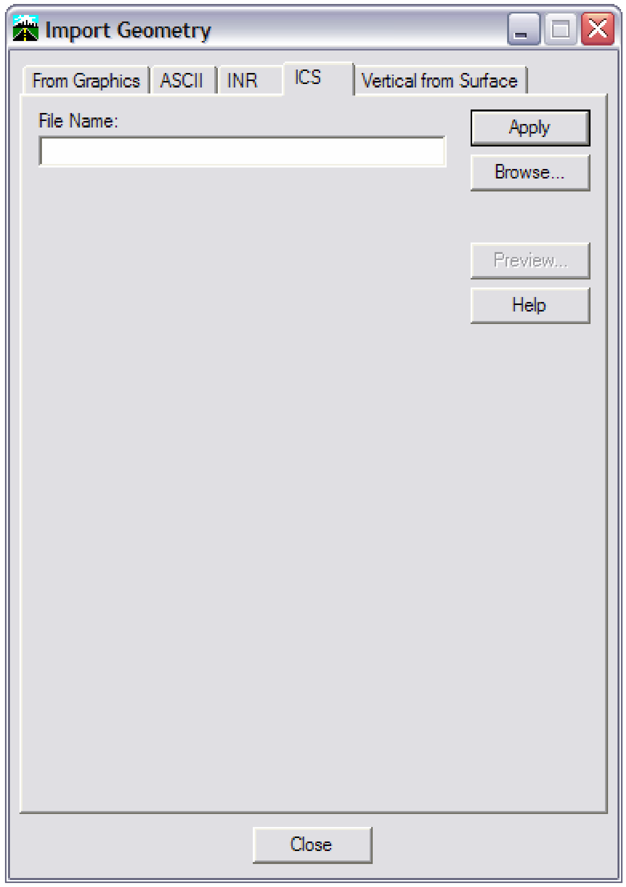


Be sure you right-click on the ***vertical*** alignment!

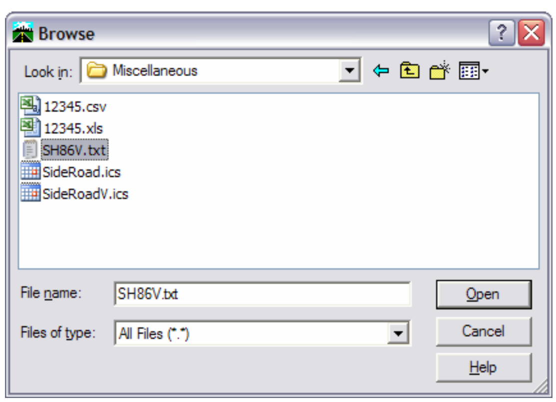
2. Choose **Yes** when asked to confirm the **Delete**.



3. Choose **File > Import > Geometry**.



4. Choose the **ICS** tab.

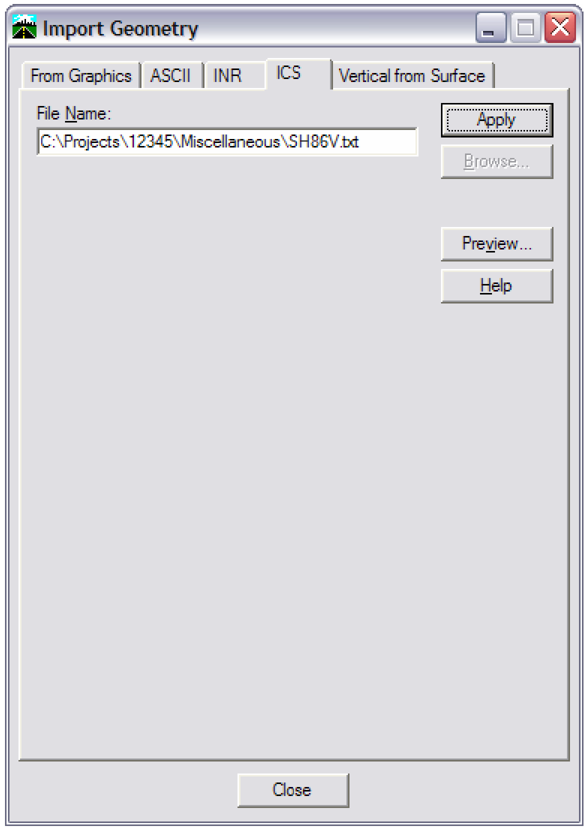


5. Browse to **C:\Projects\12345\Miscellaneous**.

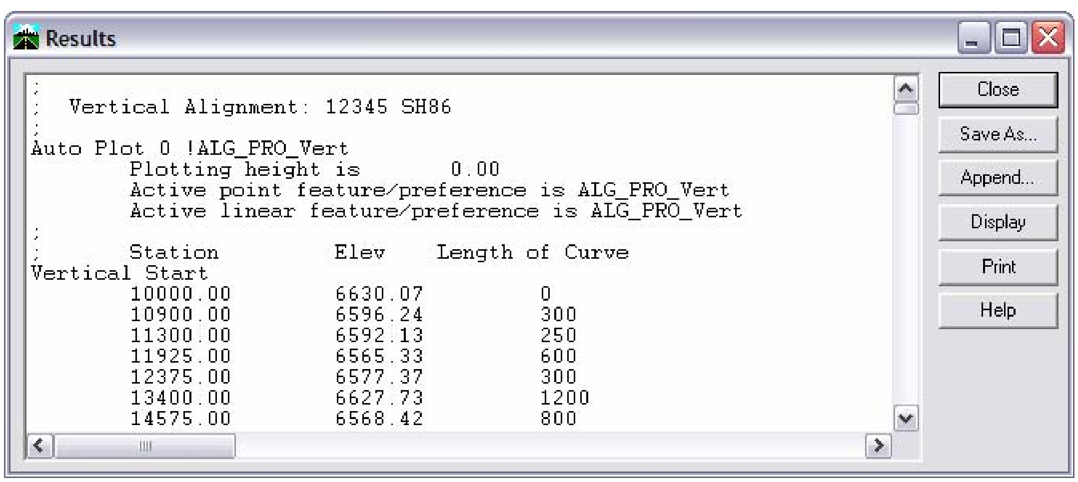
6. Set the **Files of Type** to **All Files**.

7. Select **SH86V.txt**.

8. Choose **Open**.



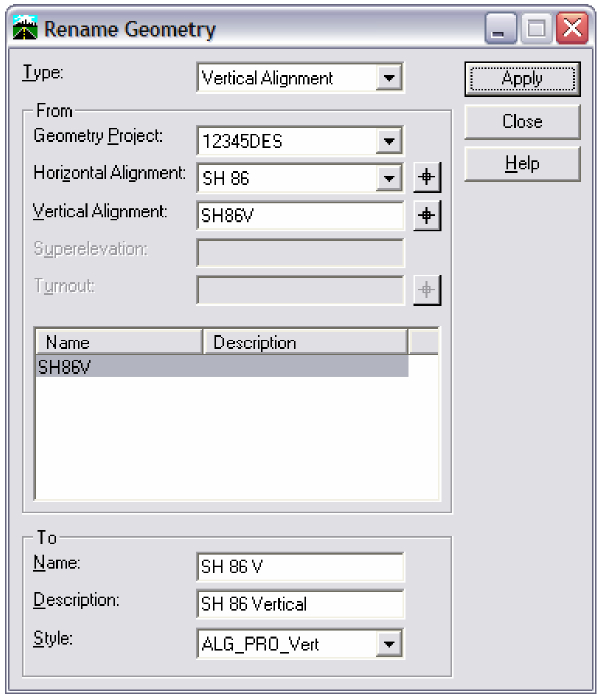
9. Choose **Apply**.



Since **Report** lock is on, you get a Results box showing what was imported.

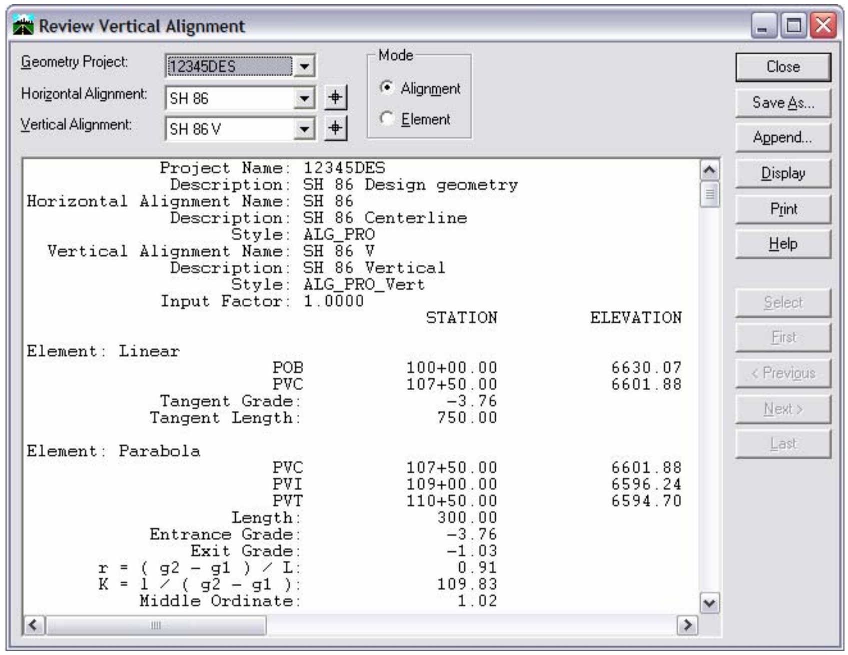
10. **Close** the **Import Geometry** dialog.

11. The .ics import will not allow spaces in the alignment name, so you can add them as well as setting the description and Style using **Geometry > Rename Geometry** as shown.



Evaluate the alignment and create an ASCII report

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



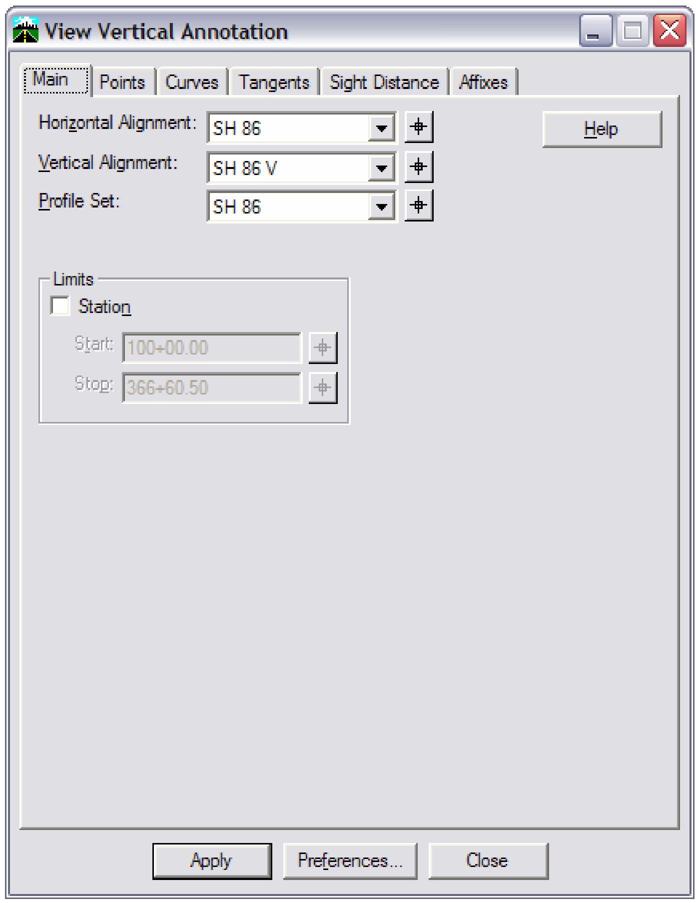
- Use the scroll bar on the right to view the vertical data.
- Select **Save As**.
- Ensure that the **Save in** folder is set to **C:\Projects\12345\Design\InRoads**.
- Enter ***SH 86 Vertical.txt*** for the file name.
- Select **Save**.

2. **Close** the dialog box.

   This creates an ASCII report of the information shown in the dialog box.

Annotate the vertical alignment

1. **Update** the view
2. Ensure the **Write** lock is on.
3. Set the **Mode** to **Pencil**.
4. Select **Geometry > View Geometry > Vertical Annotation**.



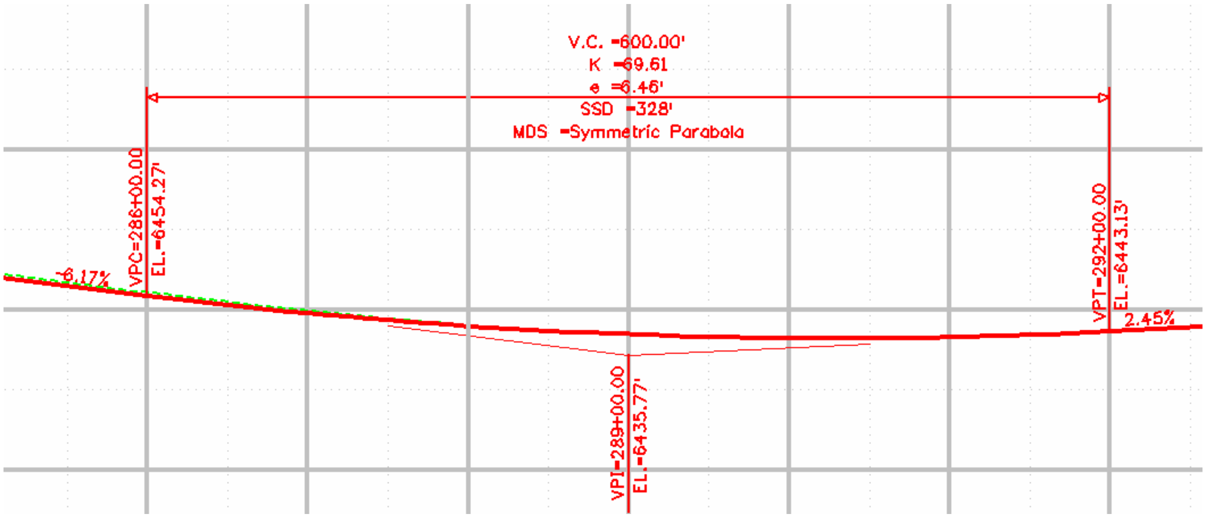
5. On the **Main** tab,
   - Select ***SH 86*** and ***SH 86 V*** as the horizontal and vertical alignments.
   - Select the **Profile Set** ***SH 86***.

If you do not specify a name, profile sets are sequentially numbered as they are created using the alignment name. If you created more than one profile, select the last one you created (SH 86_1 or SH 86_2, etc.). You can also select the profile set using the target button next to the set name and choosing the profile graphically.

The tangents and curves are already displayed on the profile, however, since the original alignment was created in **Pencil** mode, it will be deleted and replaced when you **Apply** and **Accept** this display.

6. Choose **Preferences** and load the **Proposed** preference.
7. Select **Apply** to annotate, then **Close** to dismiss the dialog.

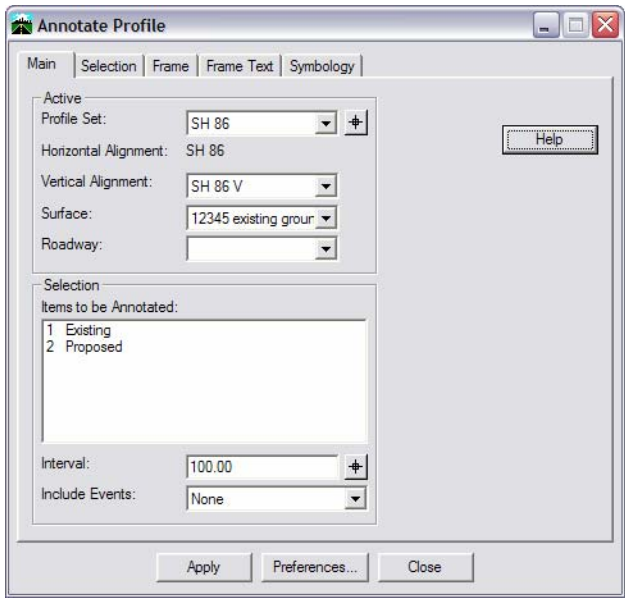
   The vertical alignment is displayed and each curve is annotated.
8. **Zoom** in to see the curve information.



Annotate the profile

Next, you will annotate your profile to show the existing and proposed elevations and the grades and distances for the tangents.

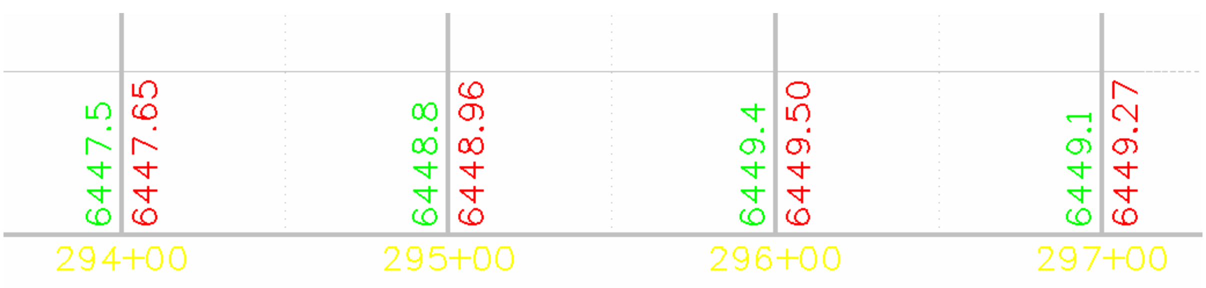
1. Select **Evaluation > Profile > Annotate Profile**.



- Set **Profile Set** to ***SH 86*** (or the last one you created).
- Set the **Surface** to **12345 existing ground**.

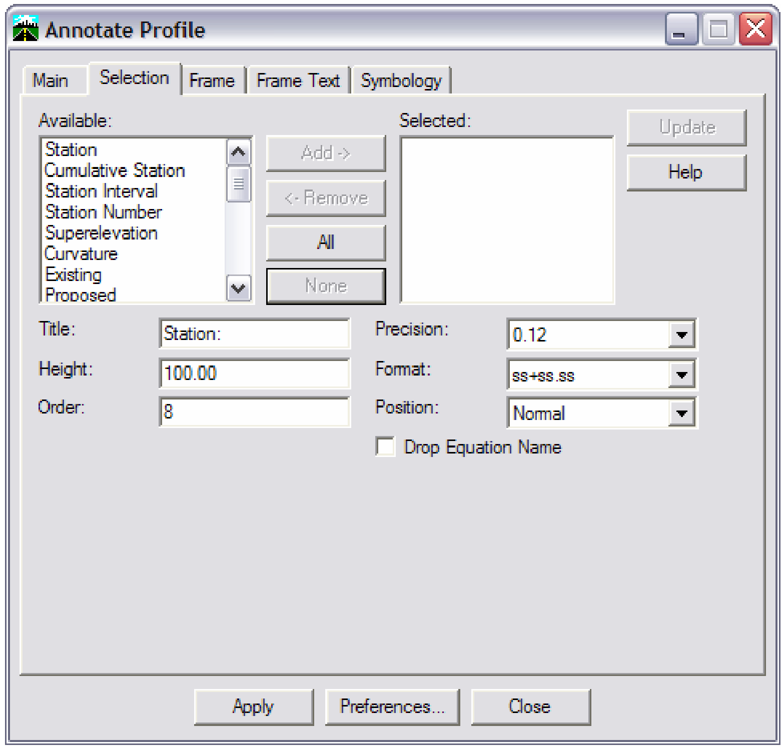
2. Select **Apply.**

The existing and proposed elevation annotations are placed on the bottom axis of the profile.

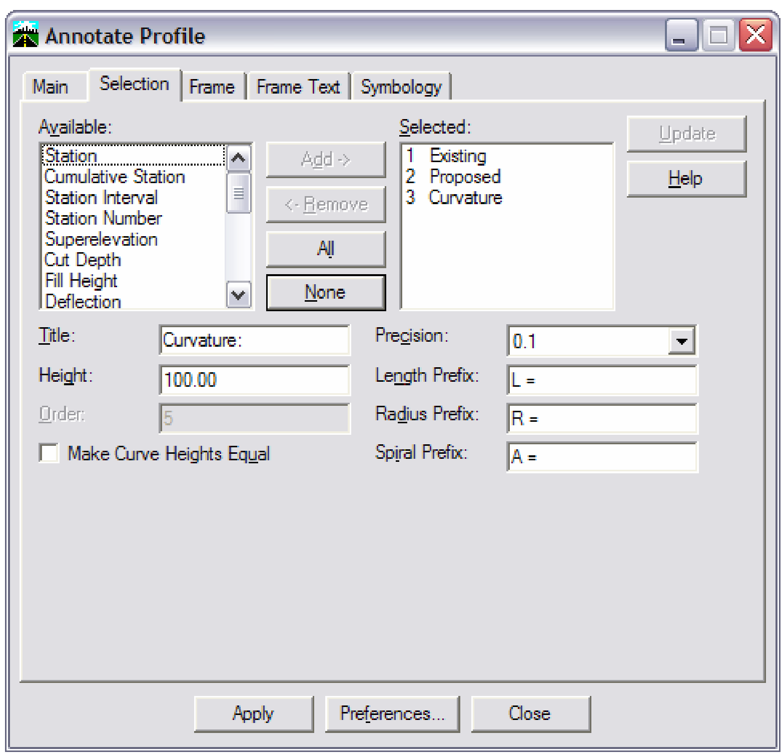


Customize your annotation

3. Go to the **Selection** tab and choose **None**.



4. Toggle any displays you want to see by double-clicking them in the **Available** window.



5. **Apply** and note that since the original display was in **Pencil** mode, it is updated with the new display.

   Note that some of the information is not available yet (*e.g.* superelevation). You'll redisplay the profile annotation in a later lab, after these items are available.

6. Select **Close** to dismiss the **Profile Annotation** dialog box.

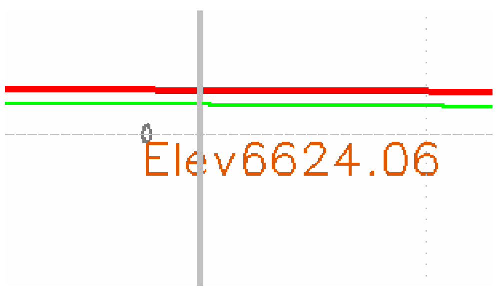
7. Use the MicroStation **View** commands to take a closer look at the profile annotation.

Exit MicroStation

1. Select **File > Exit** from the MicroStation menu. If prompted to save changes to surface **12345 existing ground**, or Geometry Project **12345DES** choose **Yes**.

Challenge lab

Use **Annotate Features on Profile** to show stations and elevations for your utility features.



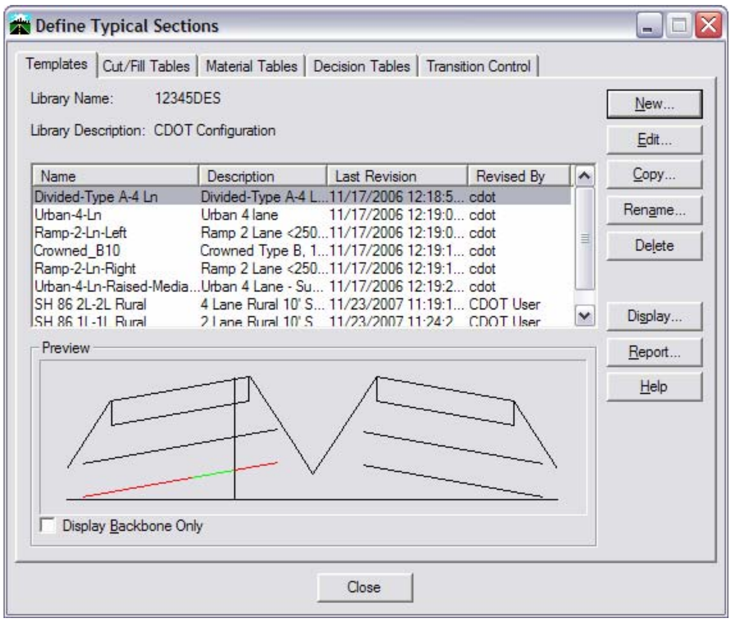
This display is near station 215+00

5. Typical Sections

Whether you work on roadways or retaining walls, templates provide the tools necessary for creating 3D models for your proposed designs. Anything that can be defined by a typical cross section and horizontal and vertical alignments can be designed with templates and their counterparts for sideslopes, decision tables. Templates can be thought of as typical sections, but not just for roadways.

The Library

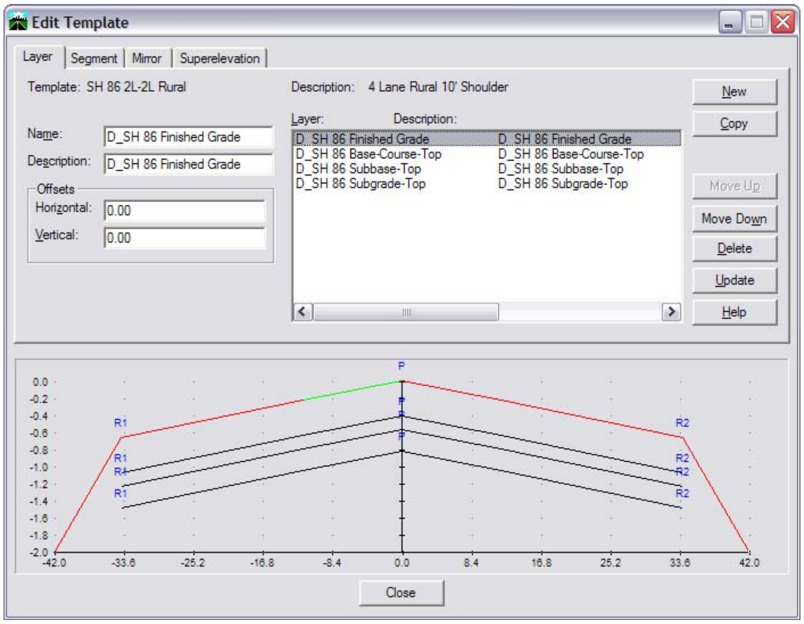
Templates are stored in a typical section library along with cut/fill tables, material tables, and decision tables. CDOT has a standard typical section library that has been populated with several typical sections. These typicals may be copied and modified as needed for a particular project or design situation.



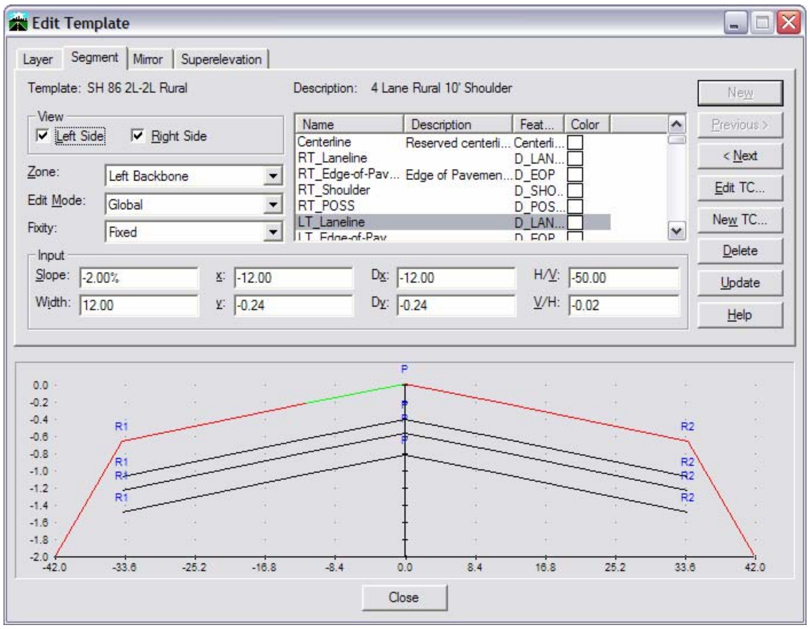
Only one typical section library can be open at a time, so all templates used to create one roadway must reside in the same library. You can, however, copy typicals from library to library using **Modeler > Copy Typical Sections**. This command only affects libraries currently on the hard drive, so it should be used prior to loading.

Template Editor

The template editor is your interface for creating new or modifying existing typical sections. It is accessed by selecting **Modeler > Define Typical Sections**. On the **Templates** tab, highlight the template you wish to modify and choose **Edit**. You may also copy a template or create a new one from this tab.



The **Edit Template** dialog is where you will add, modify or delete layers in the template, or select one of the other tabs for modifying the active layer. Active layers show up in red and green, with green representing the active segment within the active layer.



You will be using this interface to create and modify templates in the lab activities.

Template Zones

A template consists of a left and right side, each containing a backbone, cut and fill. Each of these portions or zones of the template contains up to 255 segments, as long as the last fill section is negative and the last cut section is positive.

Note: If you are strictly using tables for sideslope calculations, the templates itself does not have to have any cut and fill definitions.

The hinge point is the point between the backbone and the cut and fill segments, and is the point the software uses to decide if, upon dropping the template, it needs to use the cut or the fill section. This is also known as the POSS (Point Of Slope Selection). If a decision table is specified for the particular template drop, it is used regardless of the hinge point location.

Template Layers

Multiple layers can be used in a single template to define finished grade, and several subgrades. When **Modeler** is run, each layer in the template creates a separate DTM named the same as the layer name.

In order for the template to transition properly, the layers must be built in the same order in every template, and identical names must be used for like layers in different templates.

Note: The first template in the roadway definition must contain all layers used through the model. Subsequent templates cannot introduce new layers.

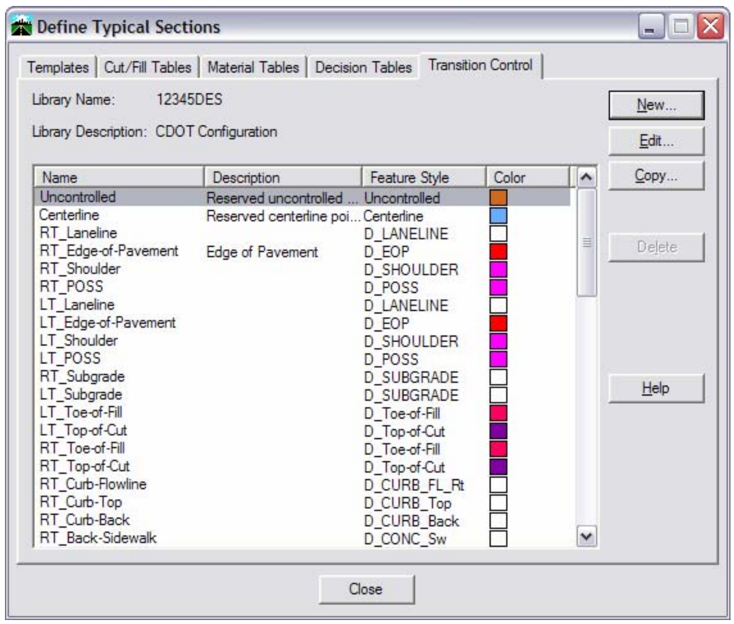
Layers other than the main one do not project to intersection with the existing terrain. Instead, the subgrades project into either the main layer, or the layer processed just previous to the current one.

Note: When editing a template, use **Global** edit to change the template segment and have all subsequent segments keep their slope and width, shifting closer or further from the center as necessary. Use **Local** edit to change a template segment and have the adjacent segment change slope and width to accommodate, while all other segments maintain their relationship to the center.

Transition Control

Transition control names are names created in the template library and assigned to the end-point of template segments. They are used for several purposes: the TC name becomes the feature name and by assigning a feature style, it controls the placement and symbology of the resulting feature (known as transition control lines when displayed by **Roadway Modeler**), controlling template transitioning, reporting and independent control. If you do not assign a name to a point in the template, it will be name **Uncontrolled**.

CDOT has standard TC names that are located in the seed typical section library. For any pre-defined templates, these names have already been assigned to the appropriate points on the templates.



Transition control lines are features in the DTM created by **Roadway Modeler**. They represent the template points as they are transitioned longitudinally along the corridor. They provide planimetrics of your design surface, such as edges of pavement, shoulder points and centerline.

Controlling Template Transitioning

Assigning identical TC names on adjacent templates forces those points on the two templates to be joined when the TC lines are drawn. Triangulation itself is affected, since the TC lines are breaklines in the model. The like TC names must reside in the same zone of the template.

Independent Control

By assigning a unique TC name to a point on the template, you can control the point's path. To do so, independent control is established for the point in question. Setting up and using independent control is discussed in a later chapter.

Saving a Typical Section

Typical sections are not saved individually. Instead, they are saved when the typical section library is saved. Since you are working on a copy of the library that is loaded in memory, saving is a good idea whenever you make changes, and mandatory before exiting – assuming you want to save your changes.

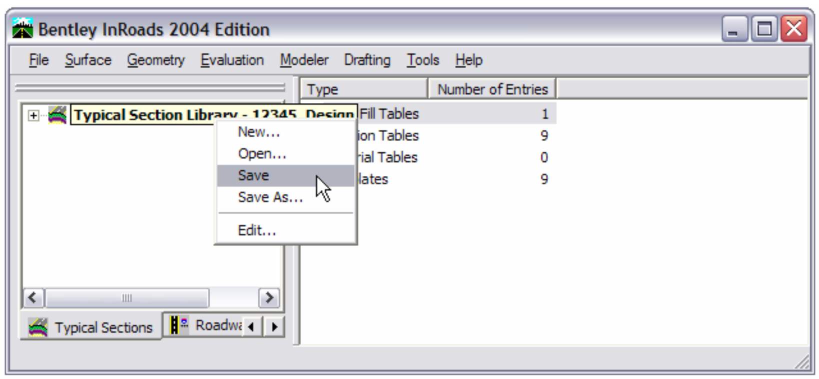
Typical section libraries can be saved using several methods including:

Choose **File > Save > Typical Section Library**

The loaded typical section library is saved.

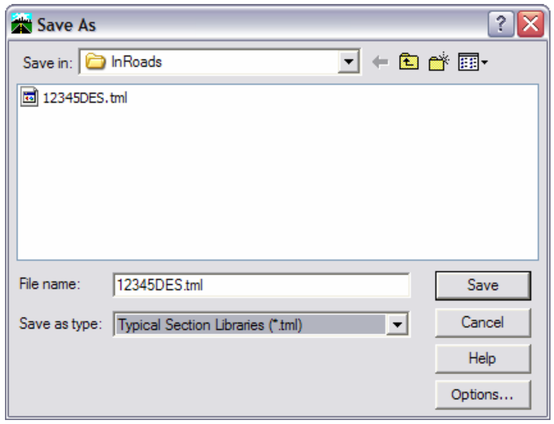
Right-click on the **Typical Section Library** in the Explorer menu and chose **Save**

The loaded typical section library is saved.



If the typical section library has never been saved, either of the above methods will bring up the **Save > As** dialog as shown below.

Choose **File > Save As**



Set the Files of Type to ***.tml**

Key in the file name (or use the default)

Choose **Apply** and the file is saved.

Note: Typical section libraries have both an internal name that appears in the dialog boxes in InRoads and a name on the hard drive that has a **.tml** extension.

The typical section library may also be saved as part of the project file or **.rwk**, which you will be using in your lab activity.

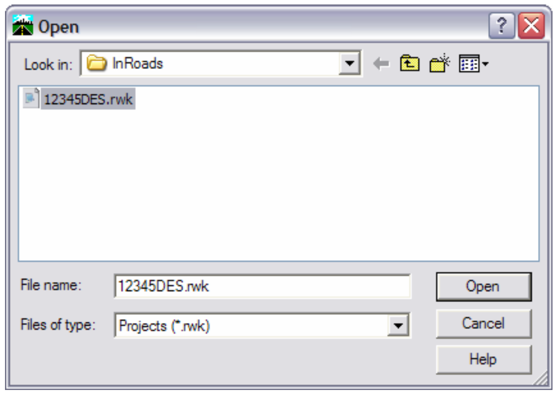
Lab 5 – Typical Sections

Start InRoads

1. Start InRoads and open **CU12345DES_Model** from the **\Design\Working** folder.

Open your InRoads data files

1. Select **File > Open**.



2. Ensure the **Files of Type** option is set to **Projects (*.rwk)**.

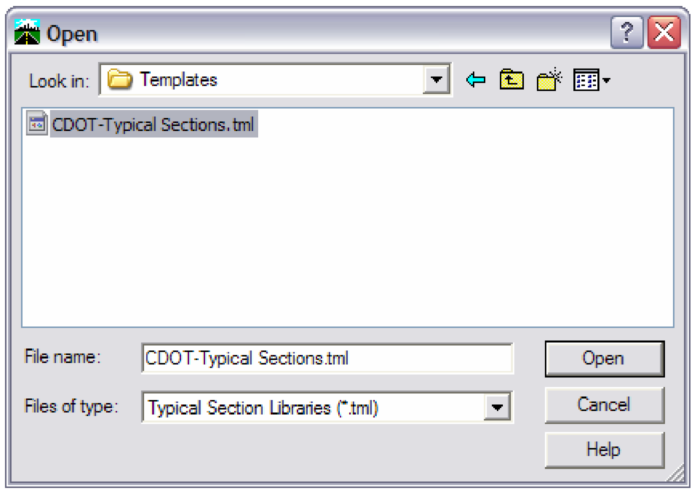
3. Double-click on **12345DES.rwk**.

   Double-clicking is the equivalent of highlighting the file and choosing **Open**.

Open the CDOT standard typical library and save a project copy

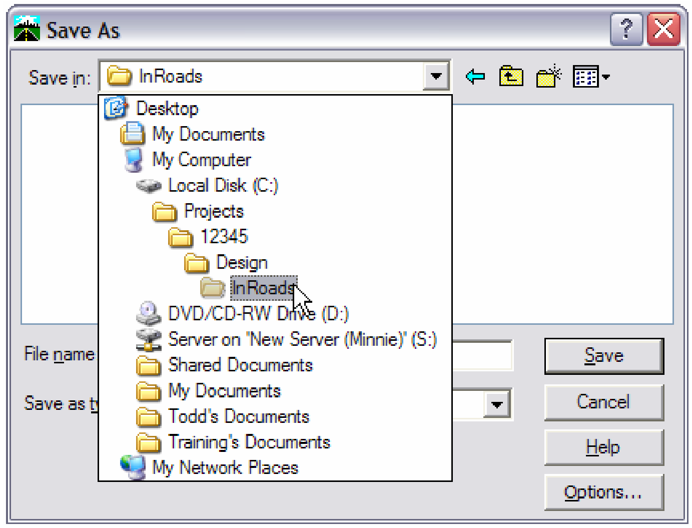
The standard CDOT typical sections are found in the CDOT Workspace and called **CDOT-Typical Sections.tml.** Here, you will be using a copy of the standards that has been modified for the training exercises.

1. Select **File > Open** if you've canceled the dialog.
   - Toggle the **Files of type** option to **Typical Section Libraries (*.tml)**.
   - Navigate to the **C:\Program Files\Workspace-CDOT\Standards-Global\InRoads\Templates** folder and Highlight the file **CDOT-Typical Sections.tml** and choose **Open**.

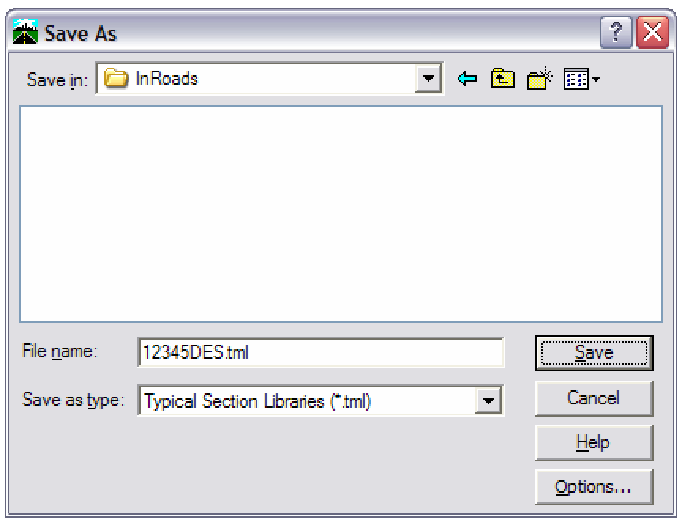


2. **Cancel** the dialog.

3. Select **File > Save As** and toggle the **Files of type** option to **Typical Section Libraries (*.tml)**.



4. Navigate back to the **C:\Projects\12345\Design\InRoads** folder.

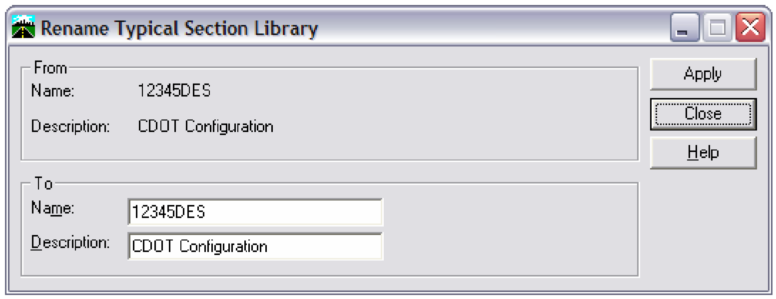


5. In the **File Name** field, key in ***12345DES.tml*** and select **Save**, then **Cancel** the dialog.

Reset the typical section library's internal name

Rename the internal InRoads name of your typical section library to match the hard drive name from the previous step.

1. Select **Modeler > Rename Typical Section Library**.
2. In the To Name field, key in ***12345DES***.
3. Key in a **Description** of ***CDOT configuration*** to note where the template library originated.
4. Select **Apply**, then **Close** the dialog.



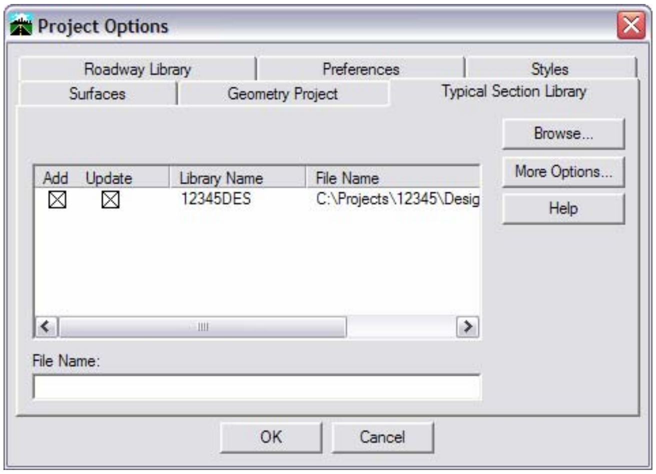
Add the typical section library to your project file

1. Select **File > Save As**.

   - Set the **Save as type** to **Projects (*.rwk)**.
   - Highlight **12345DES.rwk**.

2. Choose **Options**.

   - On the **Typical Section Library** tab, click on **Add** and **Update** for the new library.



Remember, **Add** loads the file when the project is loaded and **Update** saves the file when the project is saved.

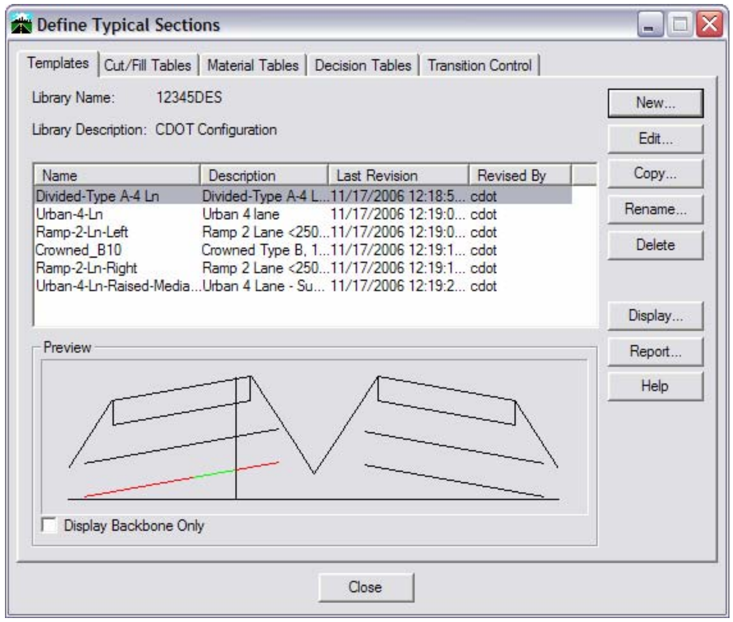
   - Choose **OK**.

3. Choose **Save** on the **Save As** dialog and overwrite the existing .rwk, then **Cancel** the dialog.

This adds the typical section library **12345DES.tml** to the previously created **12345DES.rwk** file. Now, anytime the project is loaded or saved, the typical section library will be also.

Review the project library with CDOT standards

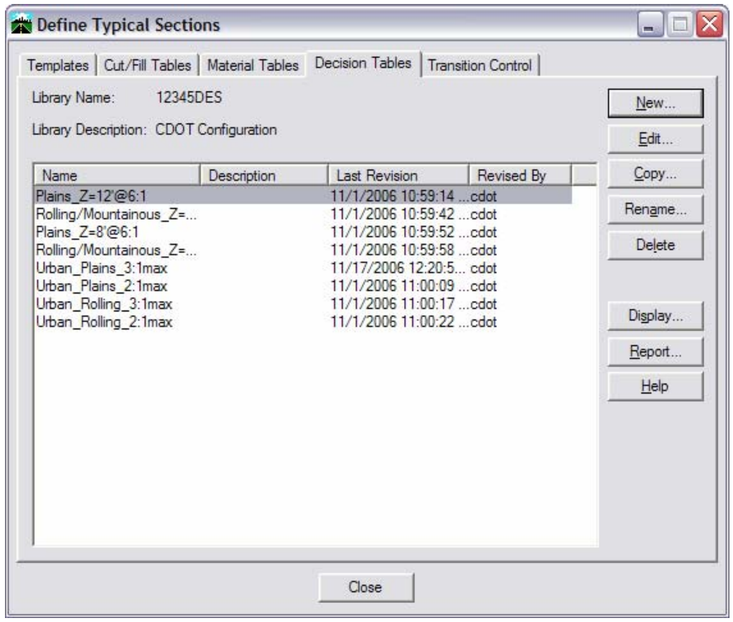
1. Select **Modeler > Define Typical Sections**.



Notice there are a few standard templates already created with CDOT standards. You can use these templates, copy and modify them for specific project purposes, or create new templates for your project.

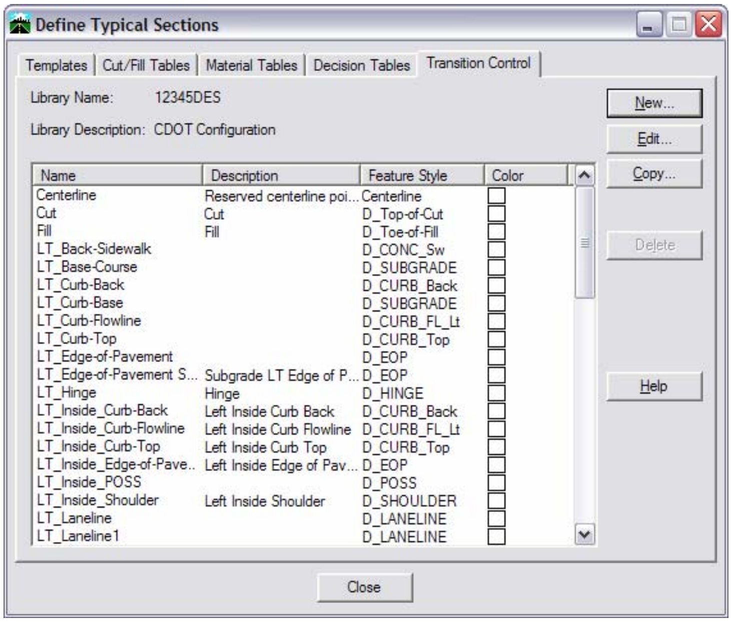
You will be creating new templates from scratch to better learn the **Template Editor**.

2. Select the **Decision Table** tab and note there are several decision tables created as well. You'll be using the decision table later.



3. Select the **Transition Control** tab and note there are several pre-defined TC names for use in your templates.

4. Click the **Name** heading to sort them as shown.



Name	Description	Feature Style	Color
Centerline	Reserved centerline poi...	Centerline	
Cut	Cut	D_Top-of-Cut	
Fill	Fill	D_Toe-of-Fill	
LT_Back-Sidewalk		D_CONC_Sw	
LT_Base-Course		D_SUBGRADE	
LT_Curb-Back		D_CURB_Back	
LT_Curb-Base		D_SUBGRADE	
LT_Curb-Flowline		D_CURB_FL_Lt	
LT_Curb-Top		D_CURB_Top	
LT_Edge-of-Pavement		D_EOP	
LT_Edge-of-Pavement S...	Subgrade LT Edge of P...	D_EOP	
LT_Hinge	Hinge	D_HINGE	
LT_Inside_Curb-Back	Left Inside Curb Back	D_CURB_Back	
LT_Inside_Curb-Flowline	Left Inside Curb Flowline	D_CURB_FL_Lt	
LT_Inside_Curb-Top	Left Inside Curb Top	D_CURB_Top	
LT_Inside_Edge-of-Pave..	Left Inside Edge of Pav...	D_EOP	
LT_Inside_POSS		D_POSS	
LT_Inside_Shoulder	Left Inside Shoulder	D_SHOULDER	
LT_Laneline		D_LANELINE	
LT_Laneline1		D_LANELINE	

These Transition Control (TC) names are the standard CDOT names and can be used on your templates to maintain consistency with the feature names resulting from using the template to model a roadway.

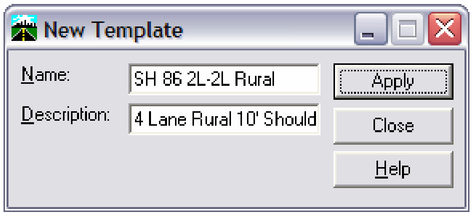
Notice that they are assigned a feature style, which controls what and where the feature can be displayed. The feature style is also assigned a named symbology that controls the graphical attributes of the displays.

Create a 4-lane rural template

In general, you will start your template creation by copying an existing template and then modifying it to meet your criteria. However, for the purposes of learning the template editor, you will create a 4-lane template, then copy and modify it to create a 2-lane template.

1. Choose the **Template** tab.

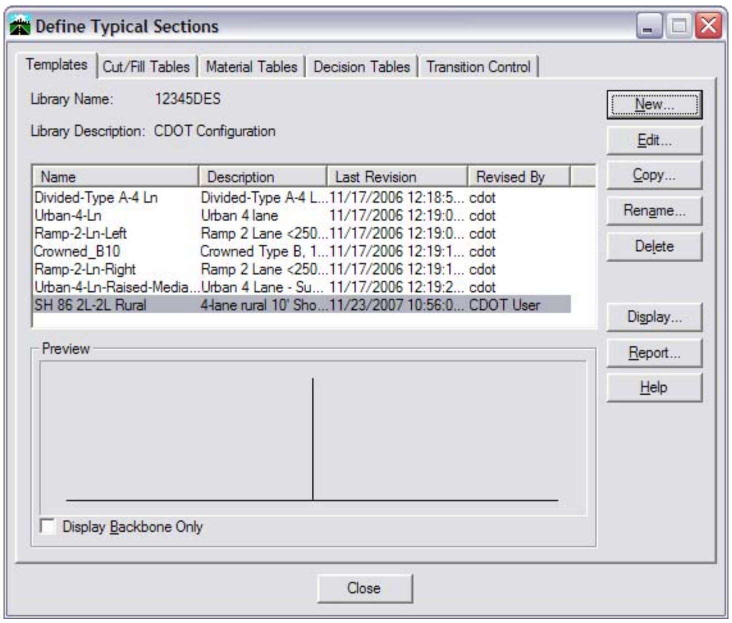
2. Choose **New**.



- For the new **Name**, key in ***SH 86 2L-2L Rural***
- **Description**: ***4 Lane Rural 10' Shoulder***

The name indicates first the corridor the typical is created for, the number of lanes on either side of the centerline, then an indicator of the type of template – i.e Rural, Urban, Ramp, etc.

3. Choose **Apply**, then **Close**.

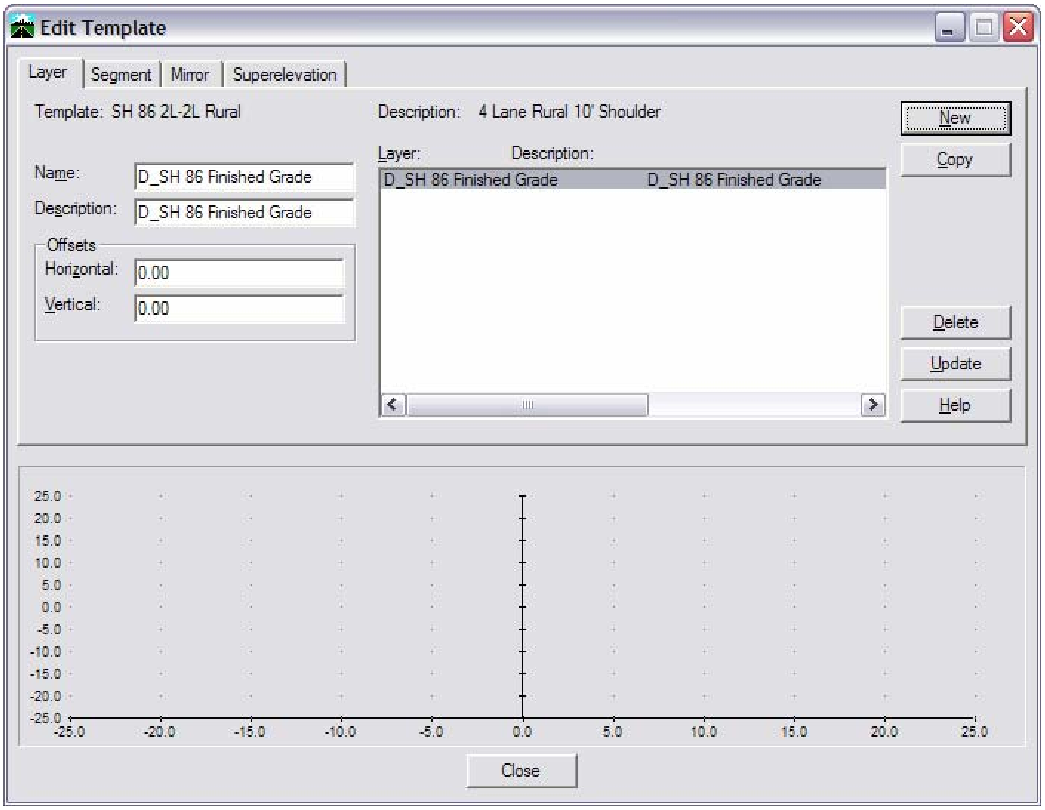


4. While the new template is highlighted, choose **Edit**.

   - Type in ***D_SH 86 Finished-Grade*** for the layer **Name** and also for the **Description**.

Hint: You can right-click to copy/paste.

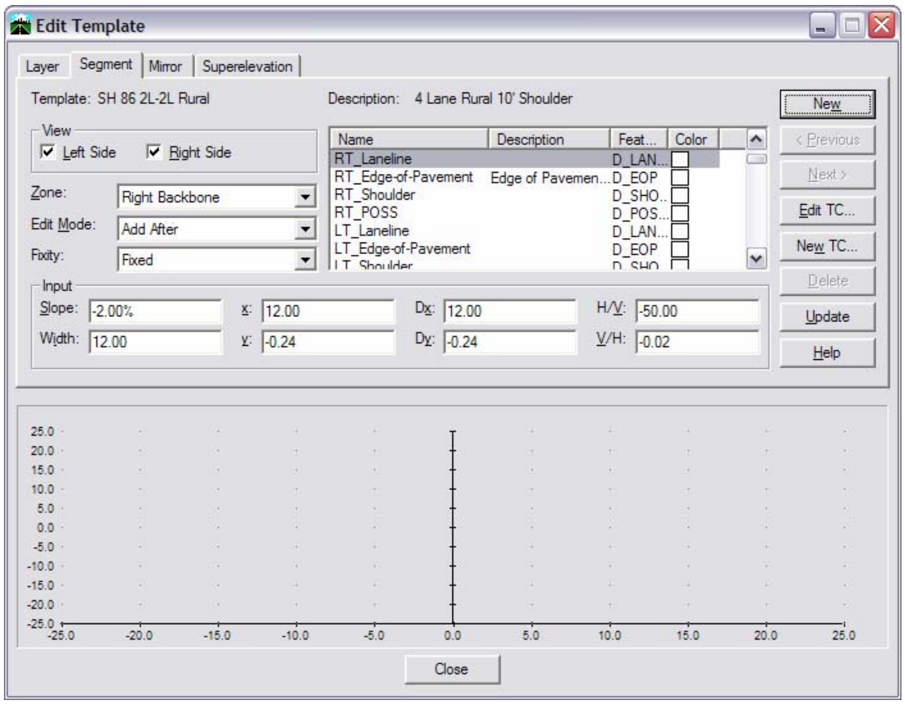
   - Choose **New**.



Note: The D prefix designates that this is a Design layer, which will later become Design surface after modeling.

Define the pavement segments on the right

5. With the layer **D_SH 86 Finished Grade** highlighted, select the **Segment** tab.
    - Toggle on both **Left Side** and **Right Side** under **View**.
    - Set **Zone** to: **Right Backbone**.
    - Set **Edit Mode** to **Add After**.
6. Under **Input**,



- Enter the **Slope: *–2%***

You must either use the % sign or key in -0.02

- Enter the **Width**: ***12,*** then **<Tab>** on your keyboard.

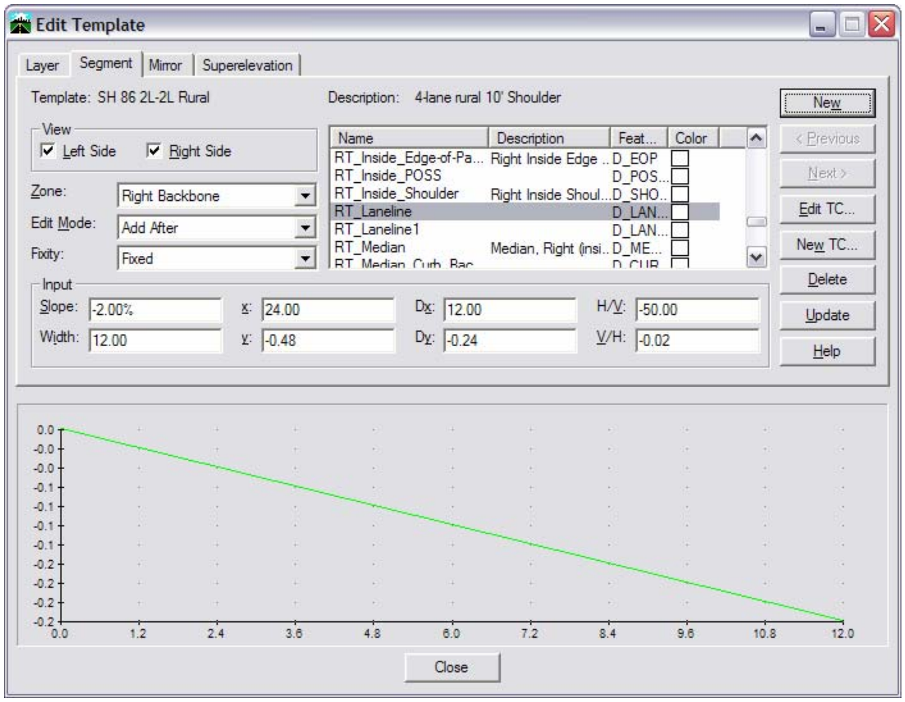
You do not need to key in any other values. Two values under input will allow all the others to be calculated.

- Highlight **RT_Laneline** in the list of transition control names.

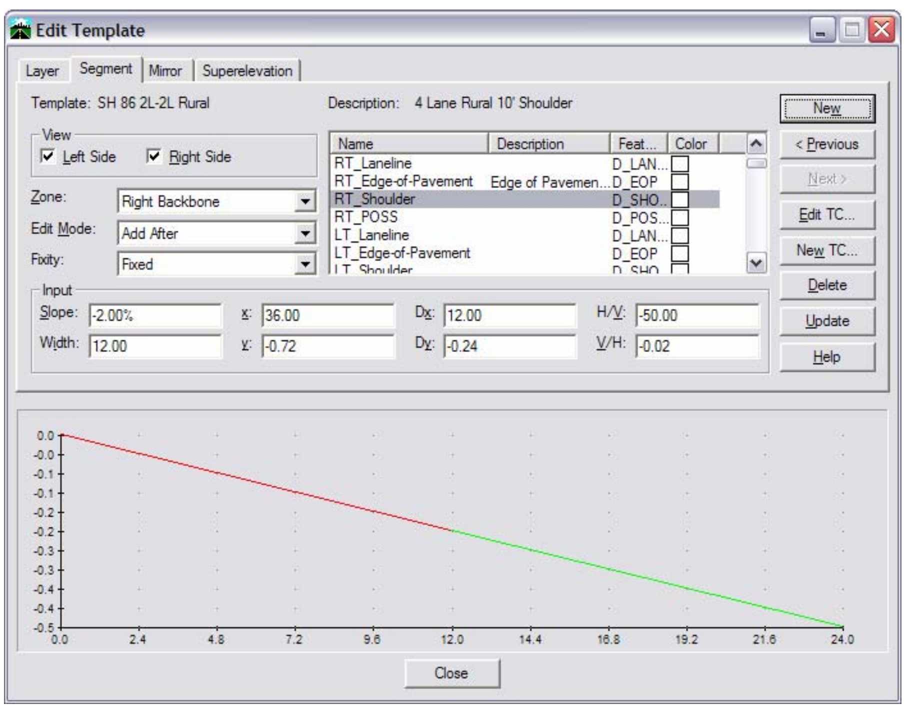
Note: You can **<D>** on any column to sort the TCs.

7. Select **New**.

   The first segment is added to the template backbone and the display window updates.



8. Highlight **RT_Shoulder** in the list of transition control names.
9. Select **New**.



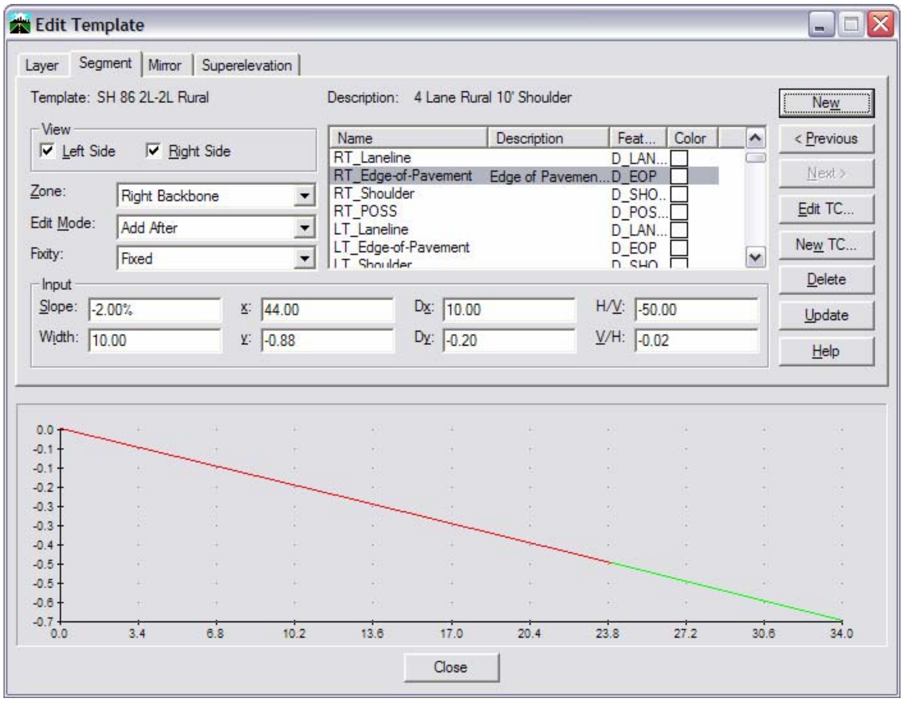
The second segment is added to the template backbone with the same slope and width.

Define the shoulder segment on the right side.

10. Under **Input**,

    - Enter the **Slope**: ***–2***%
    - Enter the **Width**: ***10***
    - Select the **T.C. Name RT_Edge-of-Pavement**.

11. Select **New**.



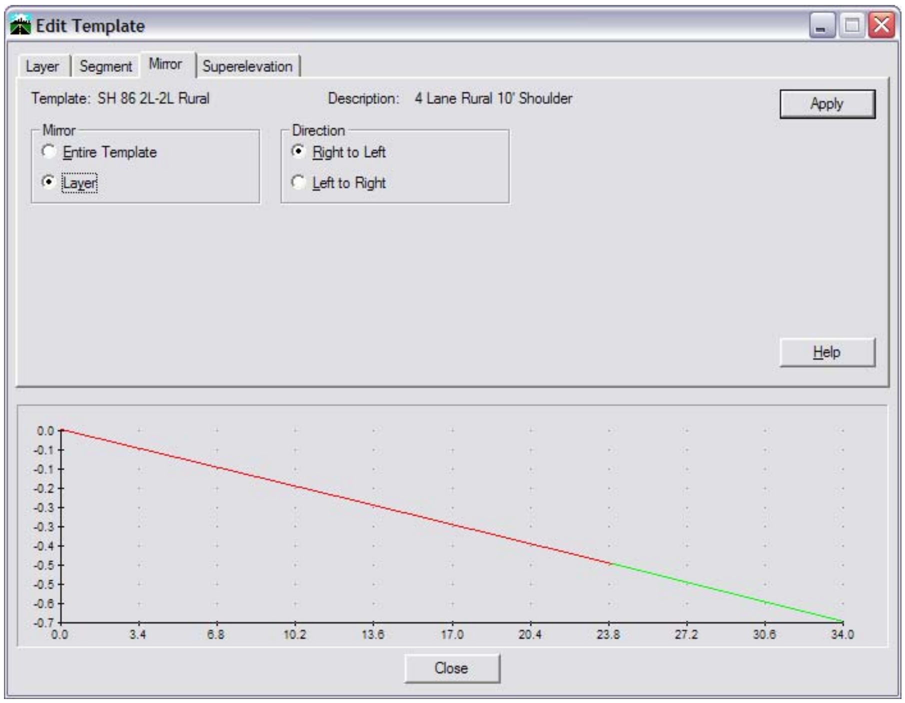
The third segment is added to the template backbone.

Create the left side from the right

The portion of the template you have just created is the same for all the layers of the template. Therefore, we will finish the other side of the layer, then copy it to create the additional layers before coming back and completing it.

Since this is a symmetrical template, you have two options for creating the other side. First, you can repeat the steps above. However, you can also mirror the template, which you will do here. Since your TC names will be incorrect on the left side, you will **Update** them after the mirror.

12. Choose the **Mirror** tab.

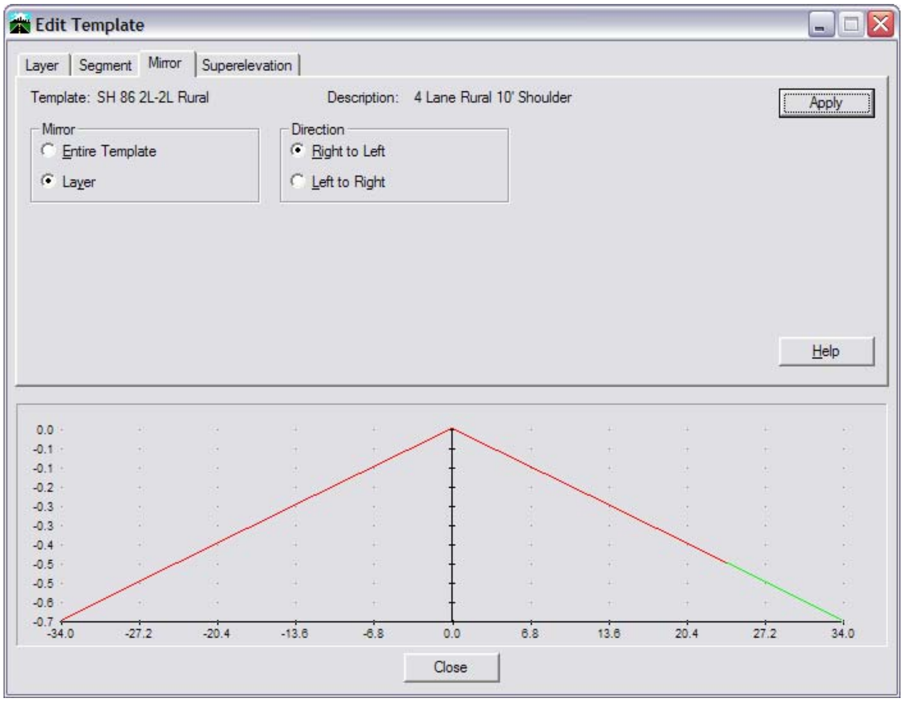


- Set the **Mirror** option to **Layer**.

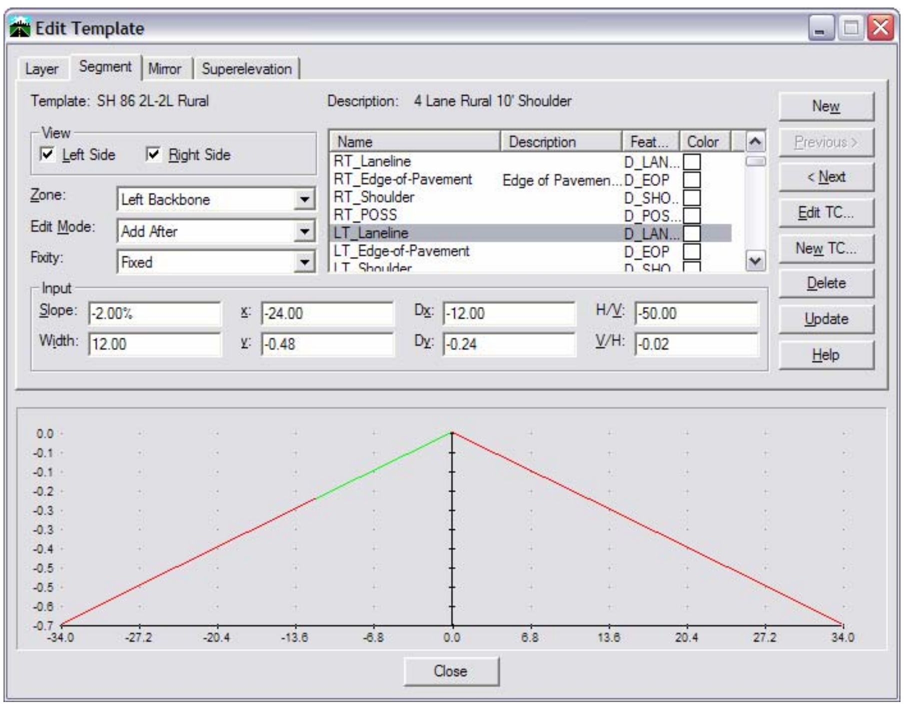
This is inconsequential since the template has only one layer defined at this point.

- Set the **Direction** to **Right to Left**.

13. Choose **Apply**, then **OK** to confirm the mirror.



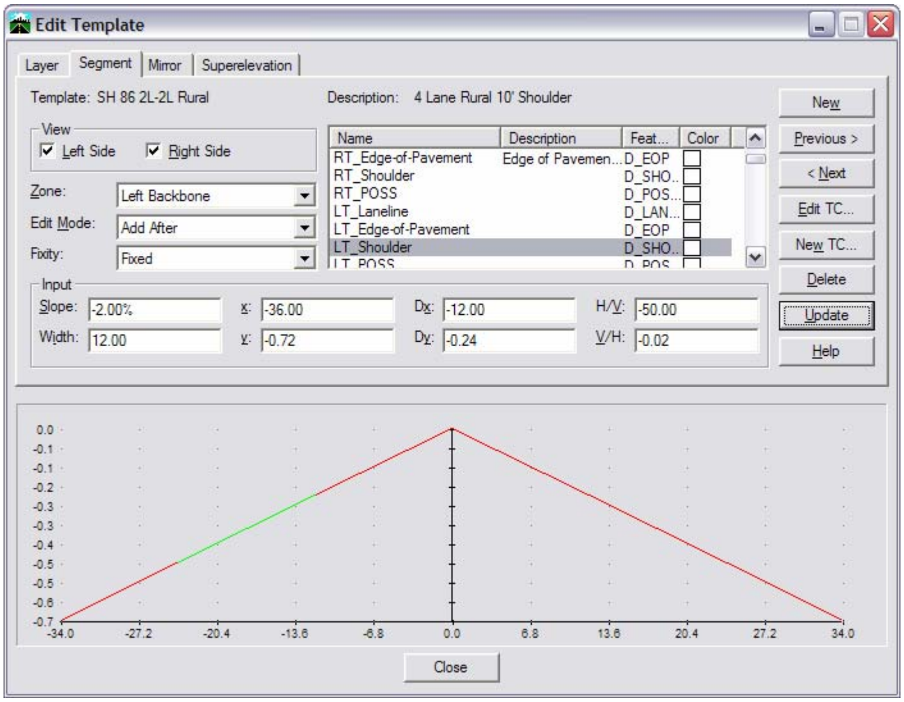
14. Back on the **Segments** tab, set the **Zone** to **Left Backbone**.



- Make certain the segment closest to the centerline is highlighted (green). Use **Previous** and **Next** to step between the segments if necessary.
- Highlight **LT_Laneline** in the list of transition control names.

15. Choose **Update**.

    - Choose **Next** to move to the second pavement segment.



    - Highlight **LT_ Shoulder** in the list of transition control names.

16. Choose **Update**.

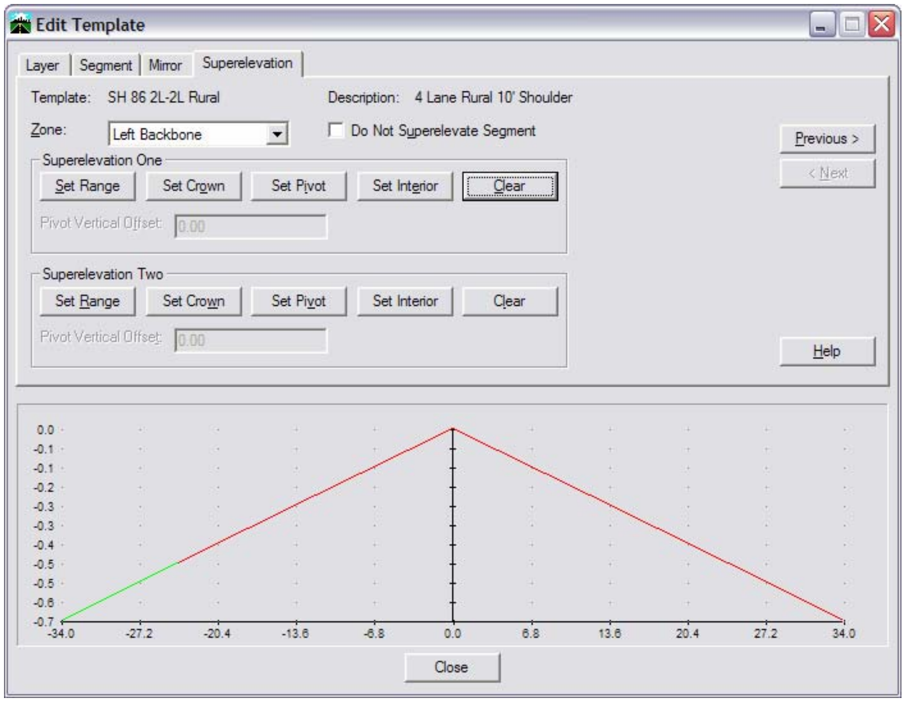
    - Choose **Next** to move to the shoulder.
    - Highlight **LT_Edge-of-Pavement** in the list of transition control names.

17. Choose **Update**.

Set the Superelevation Range and Pivot Points

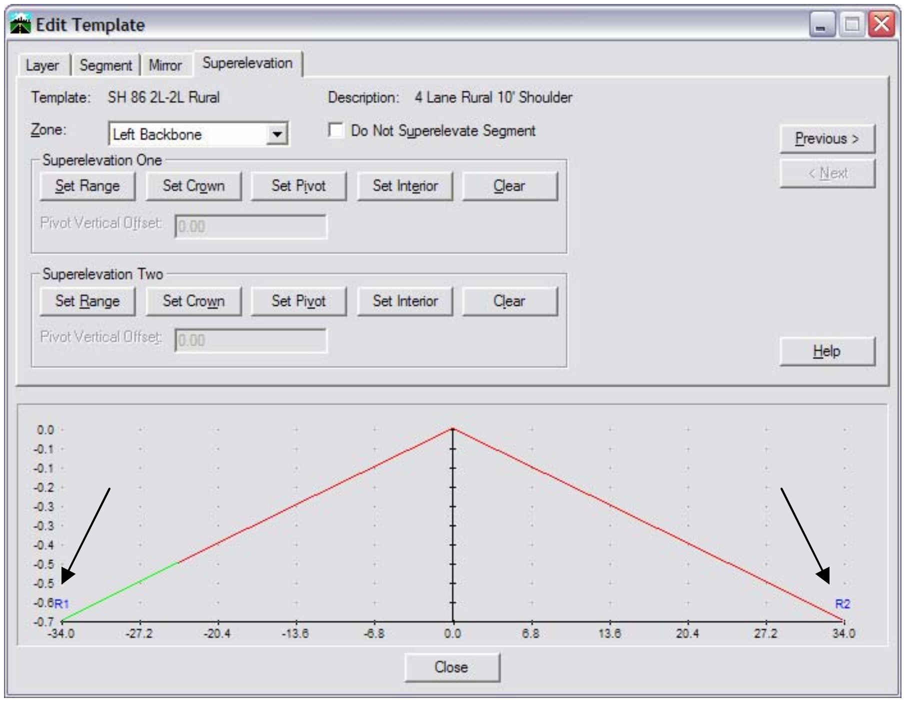
Since the entire paved width will later be superelevated, you can go ahead and assign Superelevation Points.

18. Choose the **Superelevation** tab.



19. In the **Superelevation One** category, choose **Set Range**.

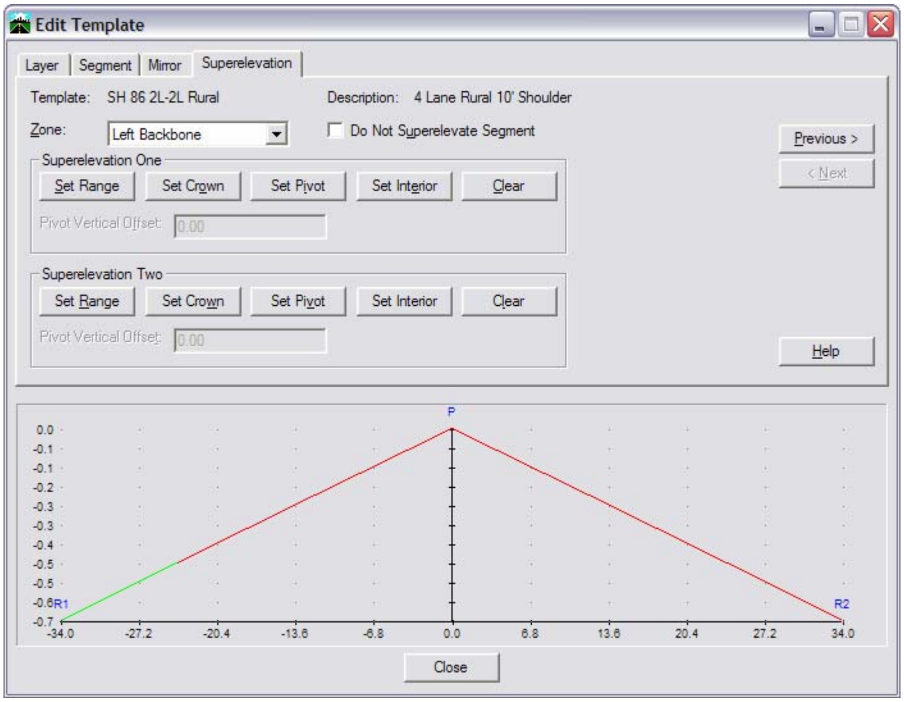
20. Using your cursor, click on the diagram at the point where the shoulder segment ends on the left side, then again on the right side.



A blue **R1** will appear on the first point and a blue **R2** will appear on the second point as shown in the diagram. If you get any points in the wrong location, choose **Clear** and start over. If your points are red, you accidentally chose **Superelevation Two** instead of **One**. **Clear** the points and start over.

21. In the **Superelevation One** category, choose **Set Pivot**.

22. Using your cursor, click on the diagram at the centerline.

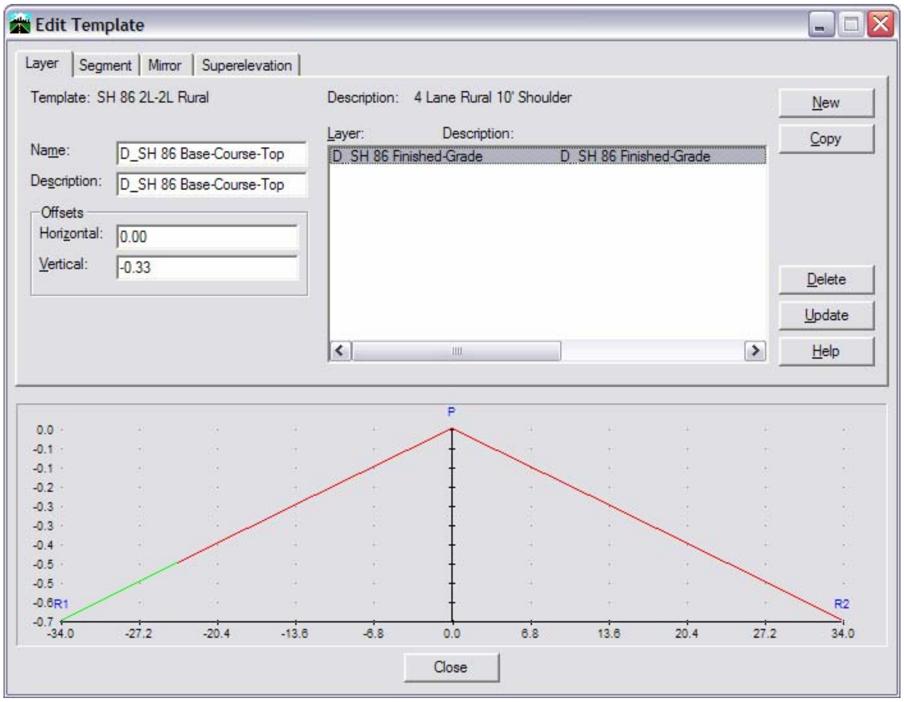


Notice there is also a **Set Crown** option. While it will not hurt anything to set the crown point, there is no need when the **Pivot** point is set at the crown point of the template.

Create additional layers in the 4-lane template

Now that the main part of the template backbone is created, you will copy it to create the additional layers. This saves much time in the creation of templates. At this point, you probably won't know pavement depths, etc., but you will modify them later.

1. Choose the **Layer** tab.



2. Highlight **D_SH 86 Finished-Grade.**

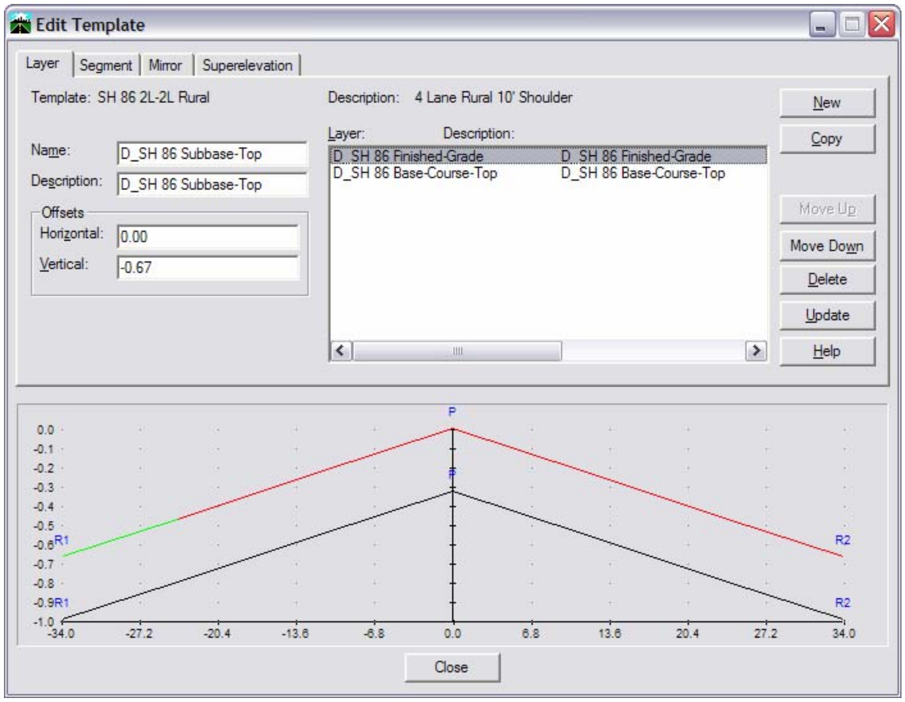
3. Type over the **Name** with ***D_SH 86 Base-Course-Top***.

4. Key in a **Vertical Offset** of ***– 4"***

   Don't forget the negative sign or the inches quote.

5. Choose **Copy**.

6. Highlight **D_SH 86 Finished-Grade.**



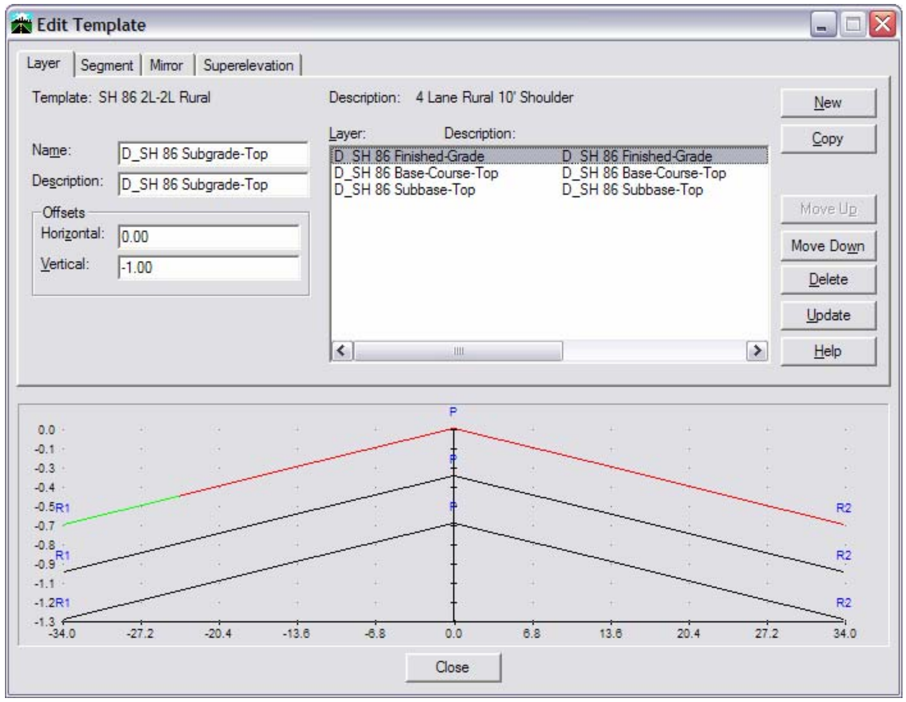
7. Type over the **Name** with ***D_SH 86 Subbase-Top***.

8. Key in a **Vertical Offset** of ***– 8”***

   Don’t forget the negative sign or the inches quote. The vertical offset is from the vertical alignment, not the previous layer or the layer you are copying.

9. Choose **Copy**.

10. Highlight **D_SH 86 Finished-Grade.**

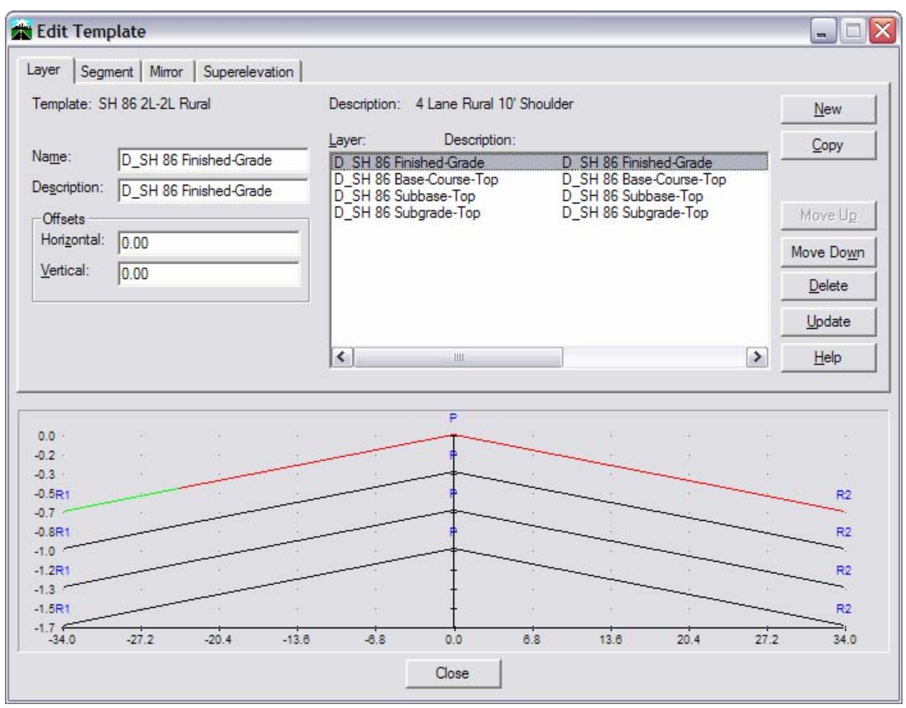


11. Type over the **Name** with ***D_SH 86 Subgrade-Top***.

12. Key in a **Vertical Offset** of ***– 12”***

    Don’t forget the negative sign or the inches quote.

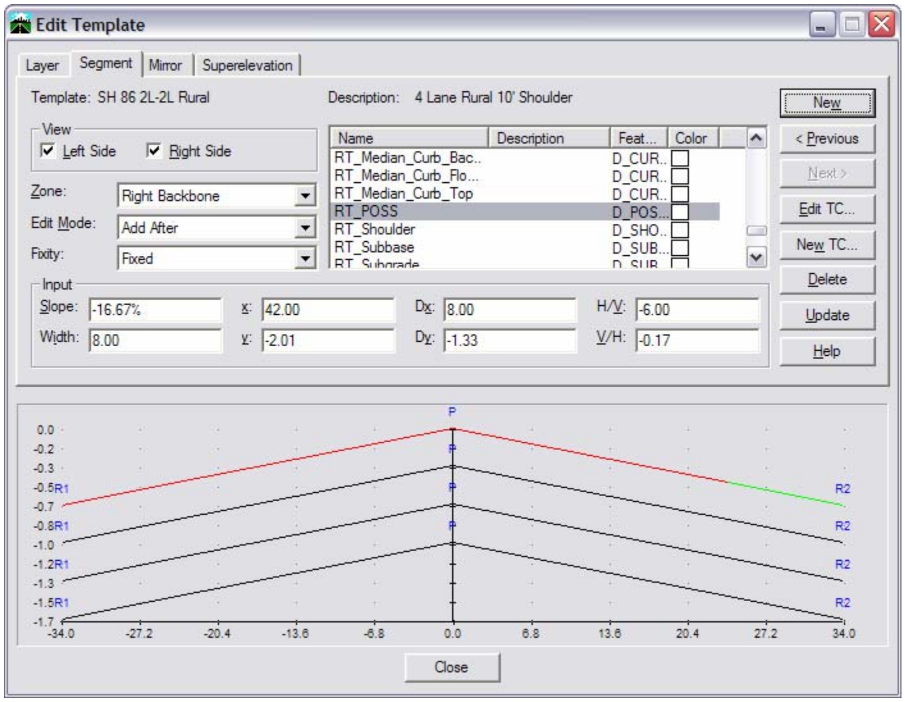
13. Choose **Copy**.



Complete the finished grade layer

You now have four layers in your template. Next, you'll go back to the finished grade layer and add the Z-slopes and cut and fill.

1. Highlight **D_SH 86 Finished-Grade.**
2. Choose the **Segment** tab.

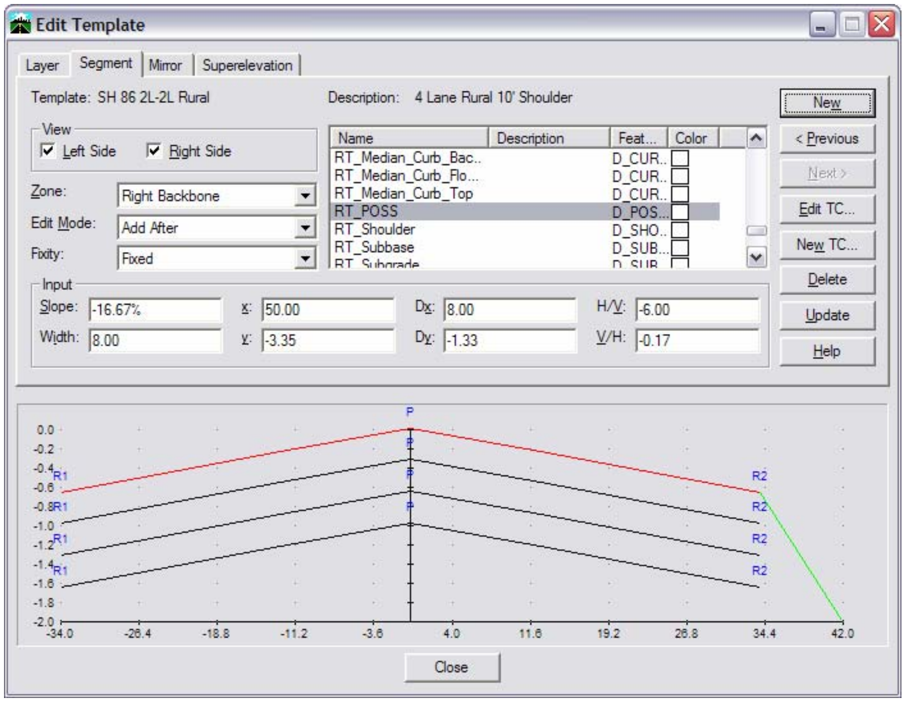


- Verify that the **Zone** is **Right Backbone**,
    - The **Edit Mode** is **Add After,**
    - Choose **Next** until the last segment on the right is active (green)
- Enter the **H/V**: ***–6***

H/V is another method of specifying a slope. Be certain to enter it into the H/V field and not the Slope field.

- Enter the **Width**: ***8***
- Select the **T.C. Name: RT_POSS**.

3. Select **New**.

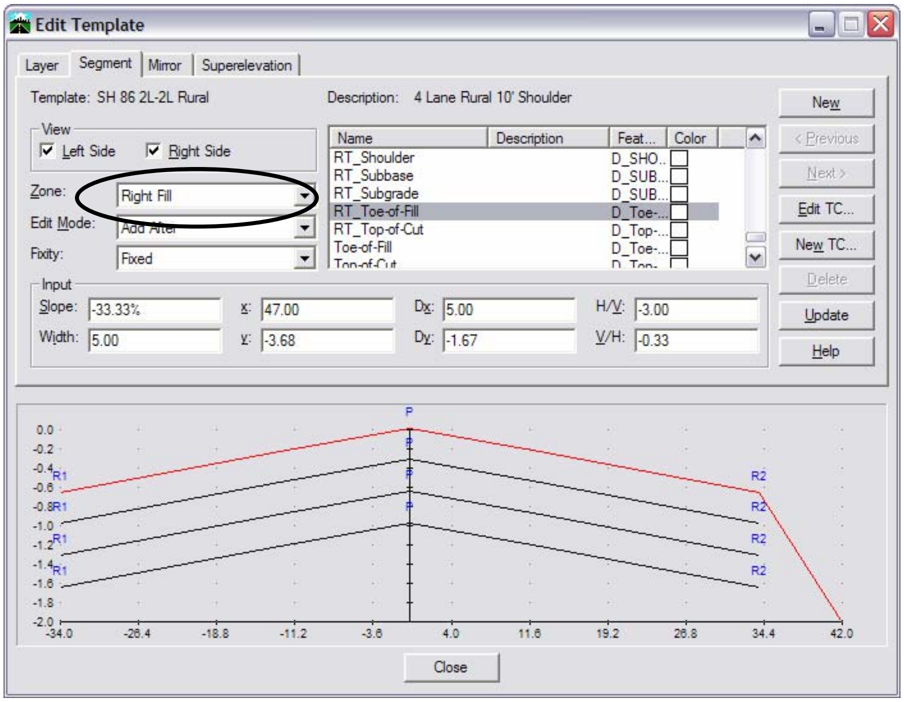


The fourth segment on the right is added to the template backbone and your template should look like the one above.

Define the sideslope segments

The point at the end of the fourth segment, the point of sideslope selection, is the *hinge* point in the template. From this point, you will establish the cut and fill slopes. Later, you will use decision tables for the sideslopes, but for preliminary runs, you'll use cut and fill segments on the templates.

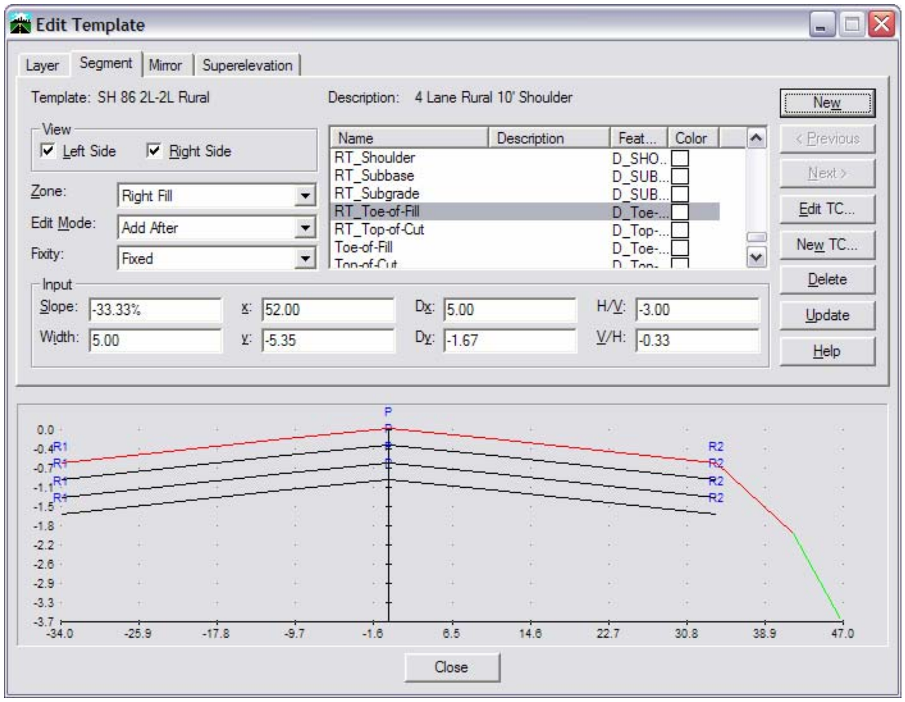
4. Set the **Zone** to **Right Fill**.



5. Under **Input**,

   - Enter the **H/V**: ***–3***
   - Enter the **Width**: ***5***
   - Select the **T.C. Name**: **RT_Toe-of-Fill**.

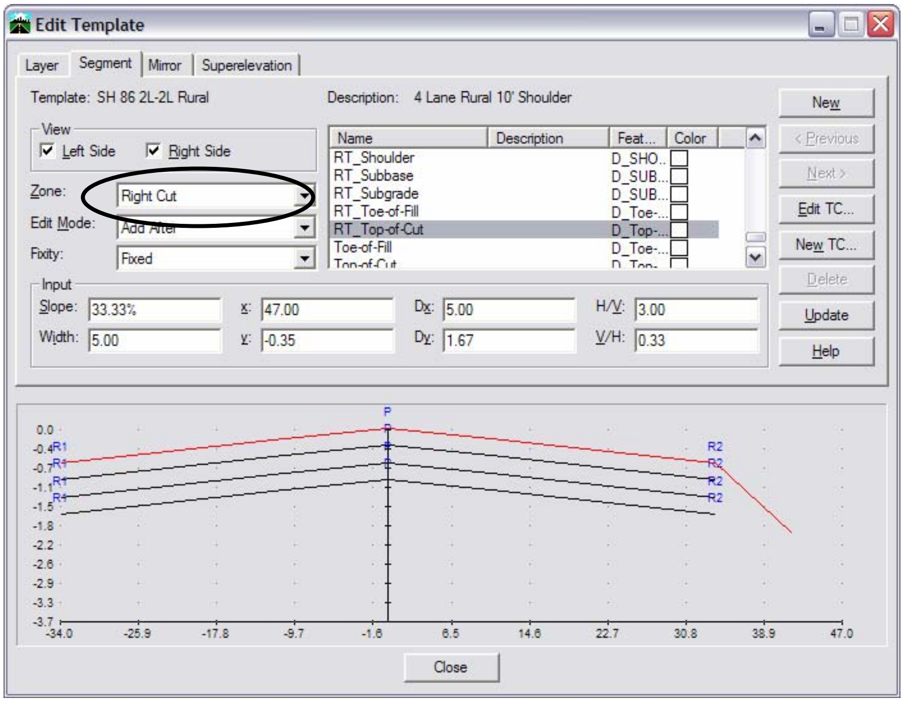
6. Select **New**.



The fill segment is added to the template.

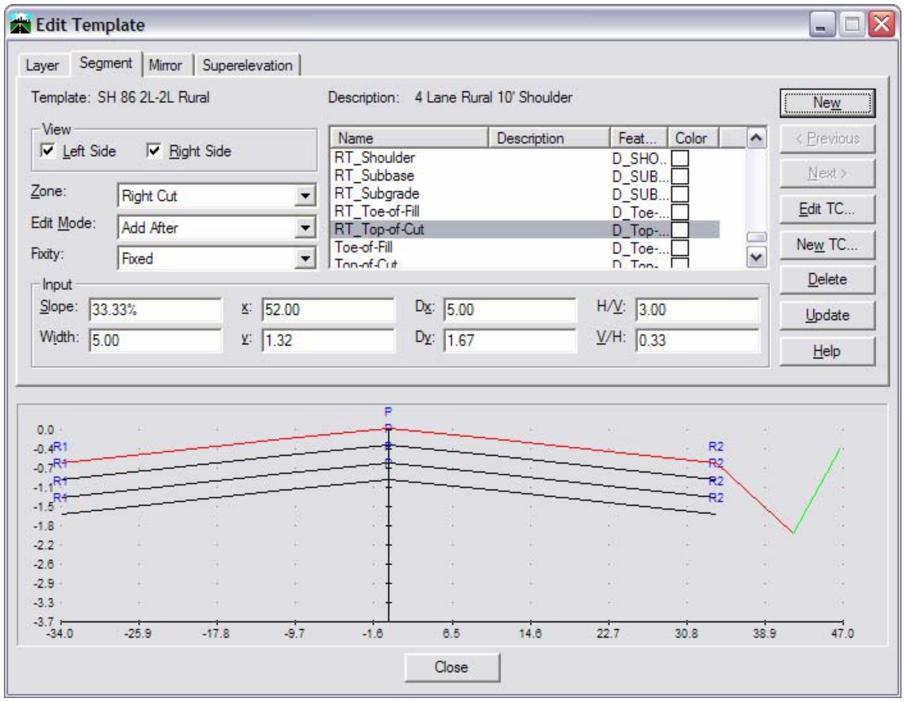
7. Set the **Zone** to **Right Cut**.

8. Under **Input**,



- Enter the **H/V**: ***3***
- Enter the **Width**: ***5***
- Select the **T.C. Name: RT_Top-of-Cut**.

9. Select **New**.

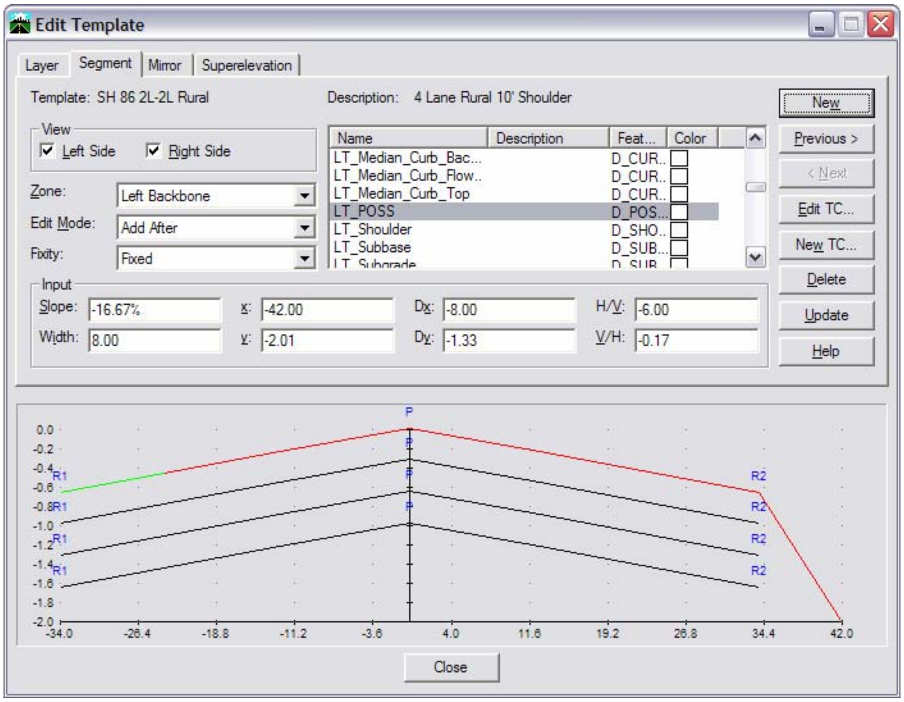


The cut segment is added to the template.

Complete the left side finished grade layer

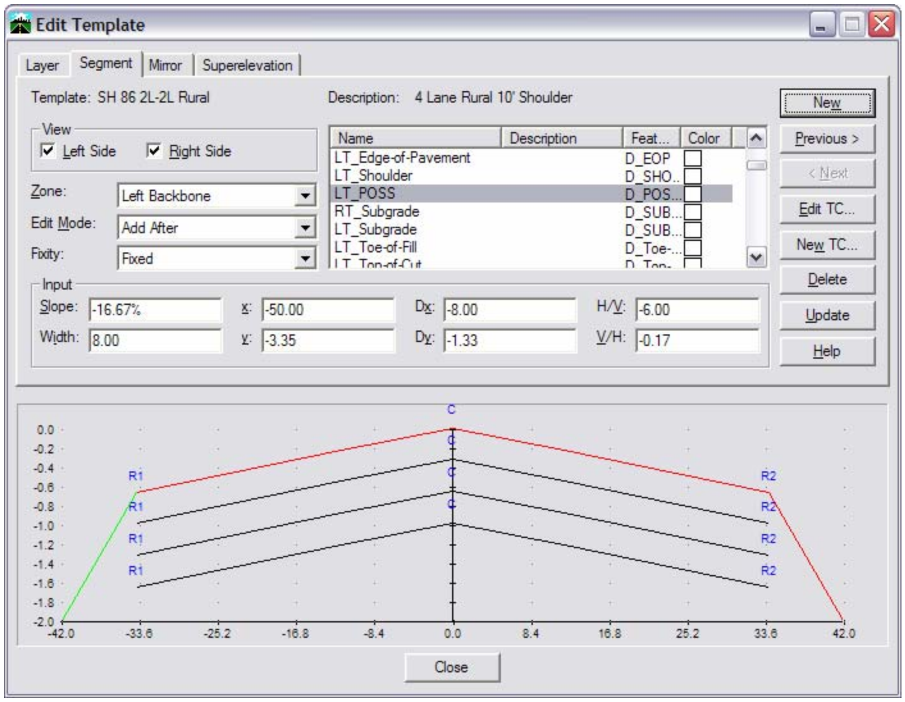
You will now repeat the steps for the left side.

10. Add the POSS **Segment**.



- Verify that the **Zone** is **Left Backbone**,
  - The **Edit Mode** is **Add After,**
  - The last segment on the right is active (green)
- Enter the **H/V**: ***–6***
- Enter the **Width**: ***8***
- Select the **T.C. Name: LT_POSS**.

11. Select **New**.

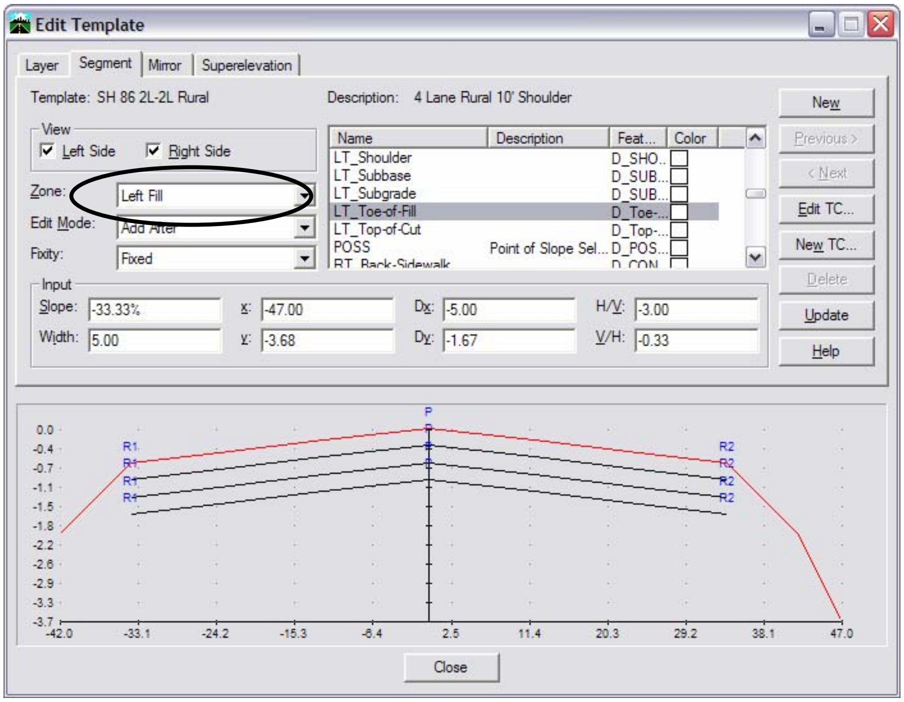


The fourth segment is added to the template backbone and your template should look like the one above.

Define the sideslope segments

The point at the end of the fourth segment, the point of sideslope selection, is the *hinge* point in the template. From this point, you will establish the cut and fill slopes.

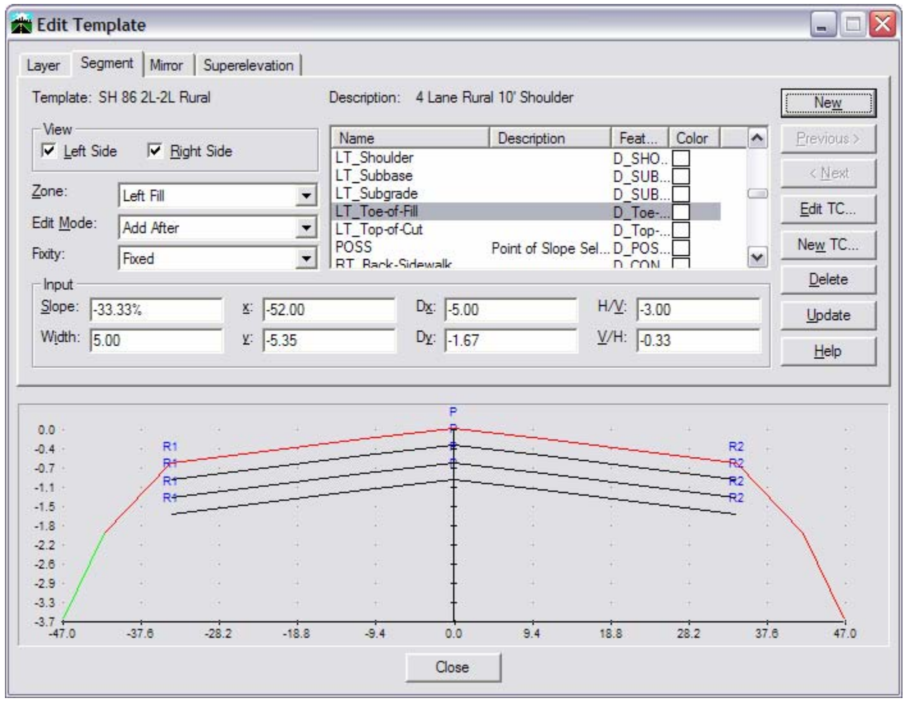
12. Set the **Zone** to **Left Fill**.



13. Under **Input**,

- Enter the **H/V**: ***–3***
- Enter the **Width**: ***5***
- Select the **T.C. Name**: **LT_Toe-of-Fill**.

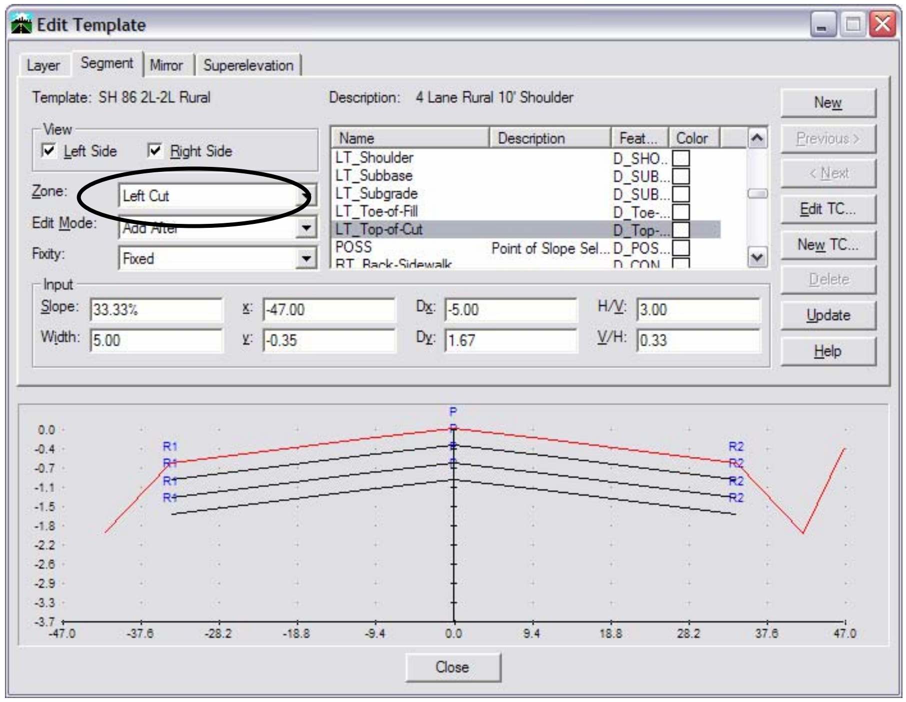
14. Select **New**.



The fill segment is added to the template.

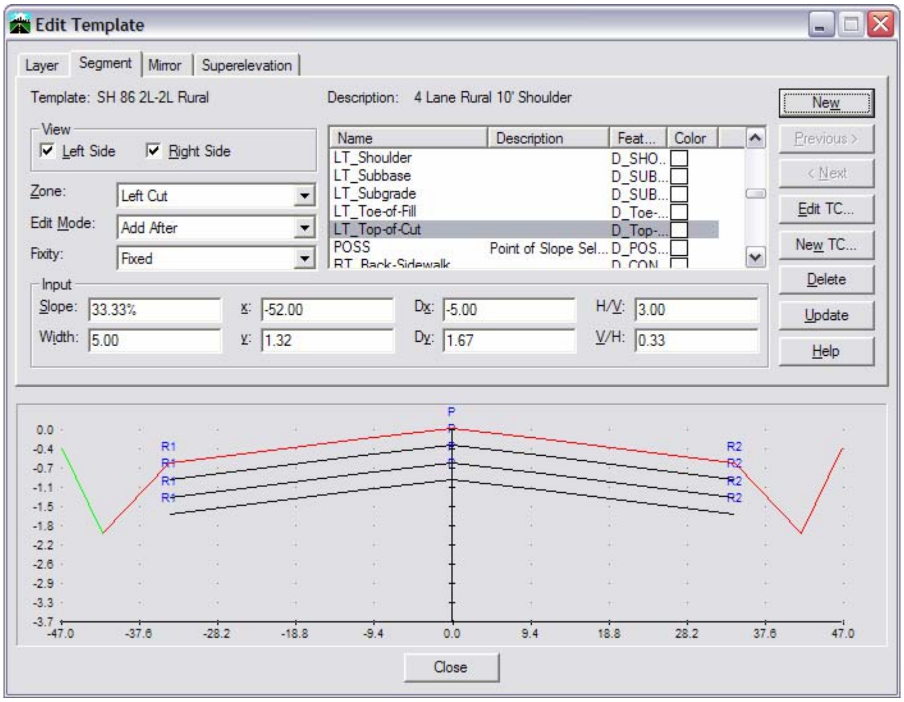
15. Set the **Zone** to **Left Cut**.

16. Under **Input**,



- Enter the **H/V**: ***3***
- Enter the **Width**: ***5***
- Select the **T.C. Name: LT_Top-of-Cut**.

17. Select **New**.



18. The cut segment is added to the template.

19. Close the **Edit Template** dialog.

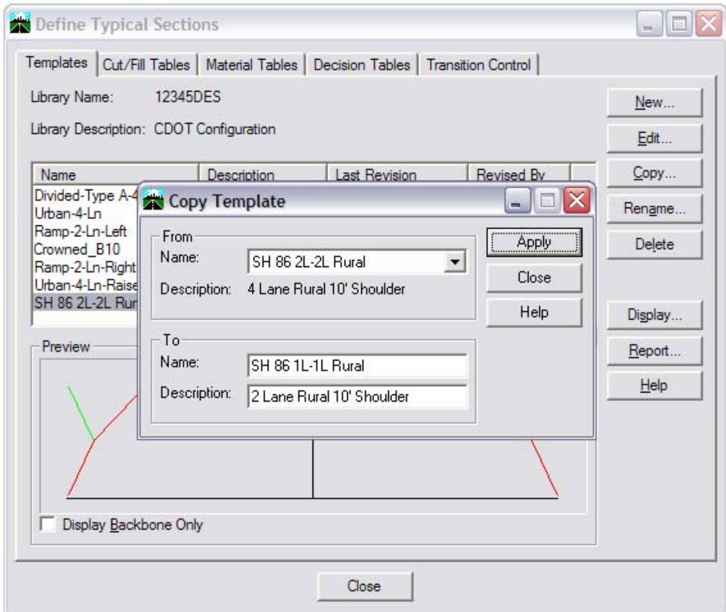
20. Close the **Define Typical Section** dialog.

Save the Typical Section Library

1. Select **File > Save > Typical Section Library**.

Copy the four-lane template to create a two-lane

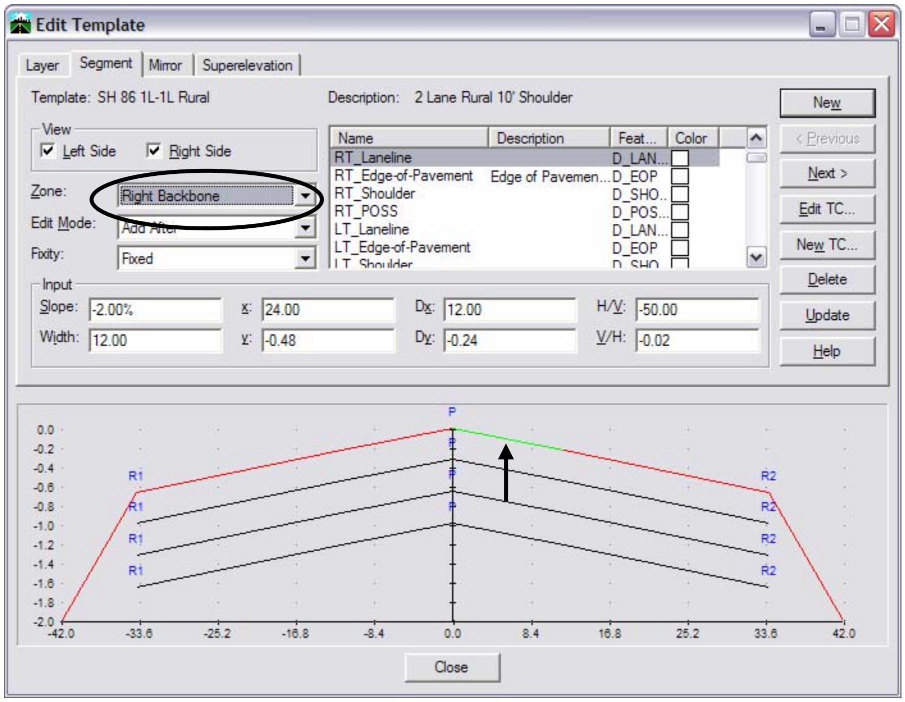
1. Choose **Modeler > Define Typical Section**.
2. Highlight the **SH 86 2L-2L Rural** template and choose **Copy**.



- Change the **To** name to ***SH 86 1L–1L Rural***
- Change the description to ***2-lane rural typical 10' Shoulder***
- Choose **Apply**.
- **Close** the **Copy Template** box.

3. With the **SH 86 1L-1L Rural** template highlighted, choose **Edit**.

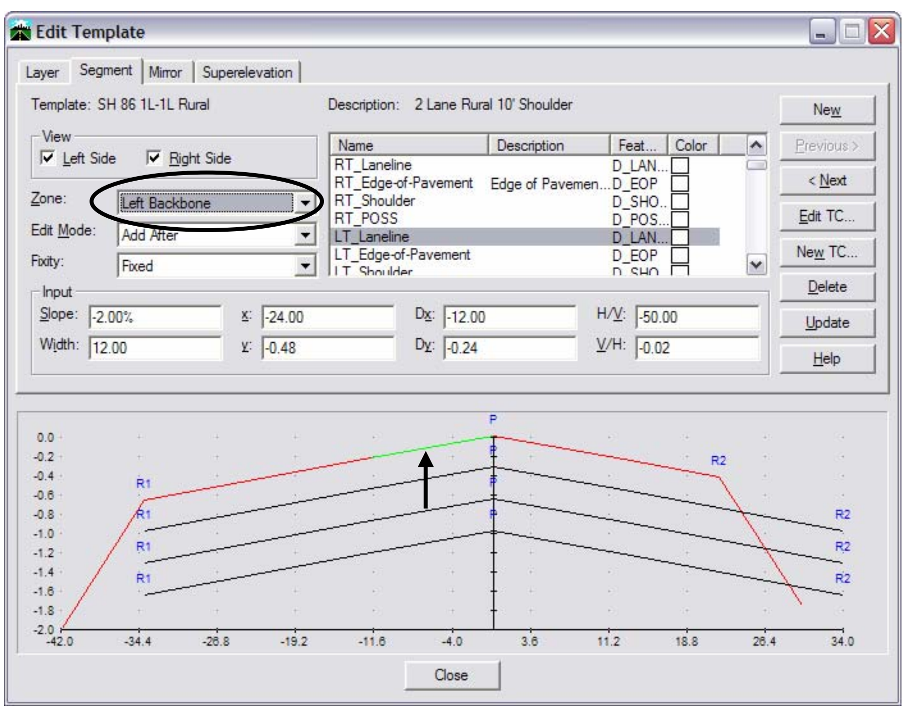
4. On the **Layer** tab, highlight **D_SH 86 Finished-Grade.**
5. Choose the **Segment** tab.

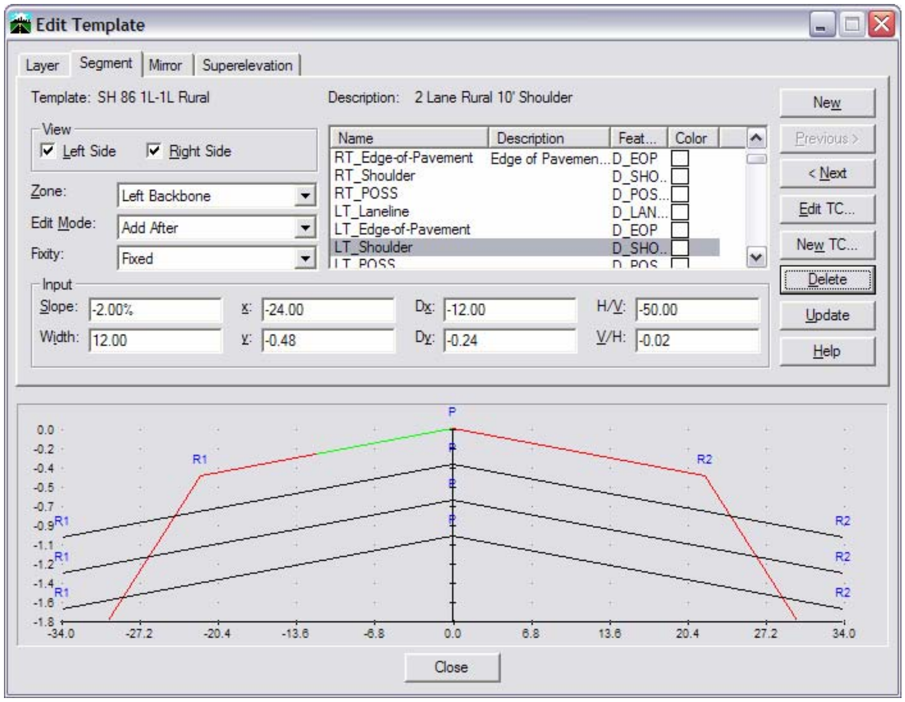


- With the first segment on the **Right Backbone** highlighted (the RT_Laneline segment), choose **Delete**.

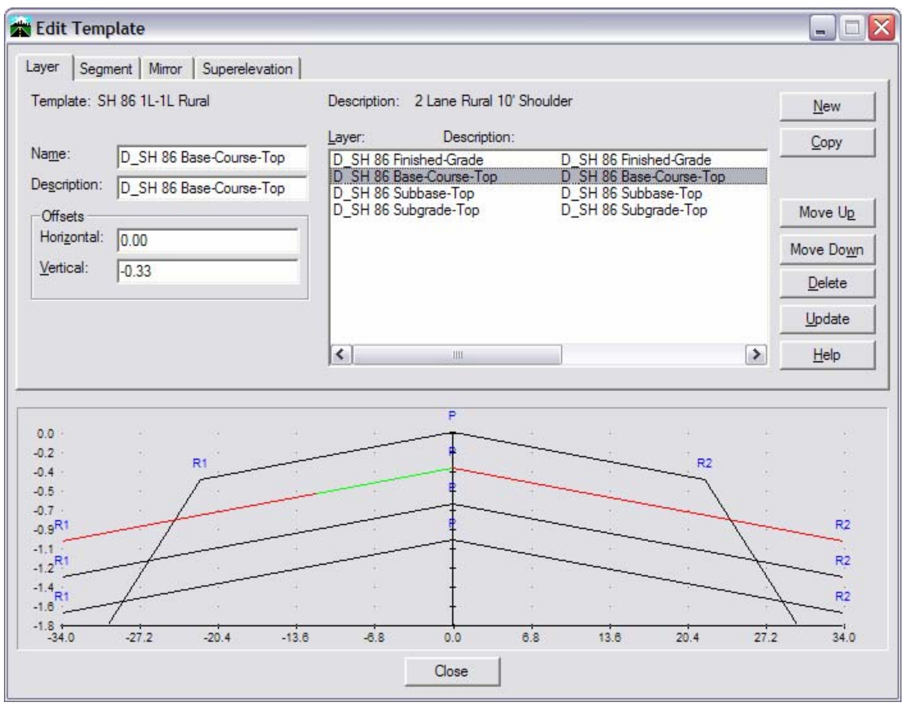
Remember, use **<Previous** and **Next>** to highlight the appropriate segment.

- Repeat for the **Left Backbone**.

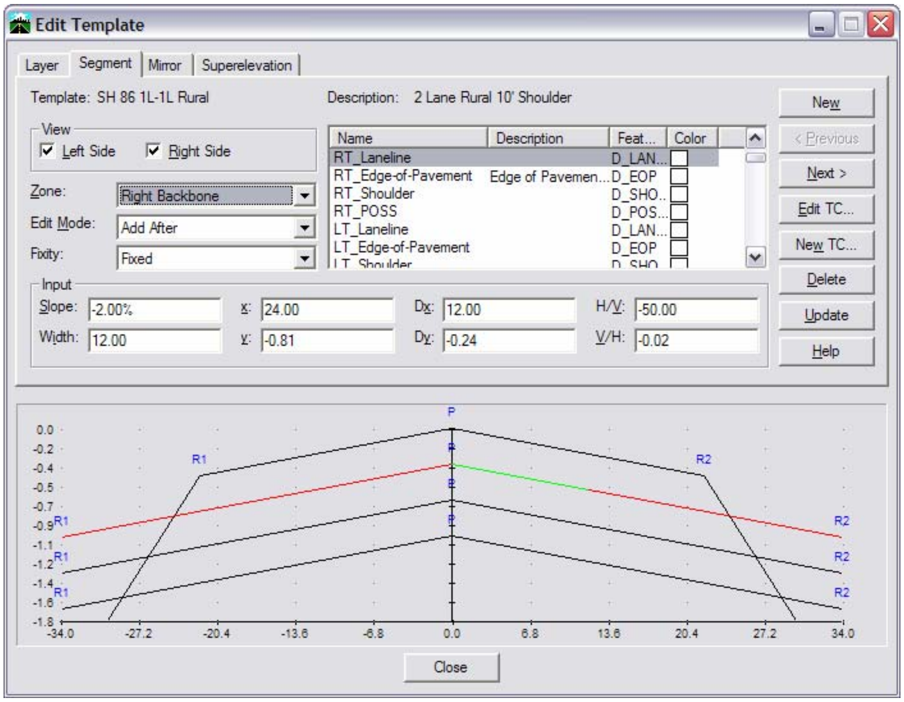




6. On the **Layer** tab, highlight **D_SH 86 Base-Course-Top.**

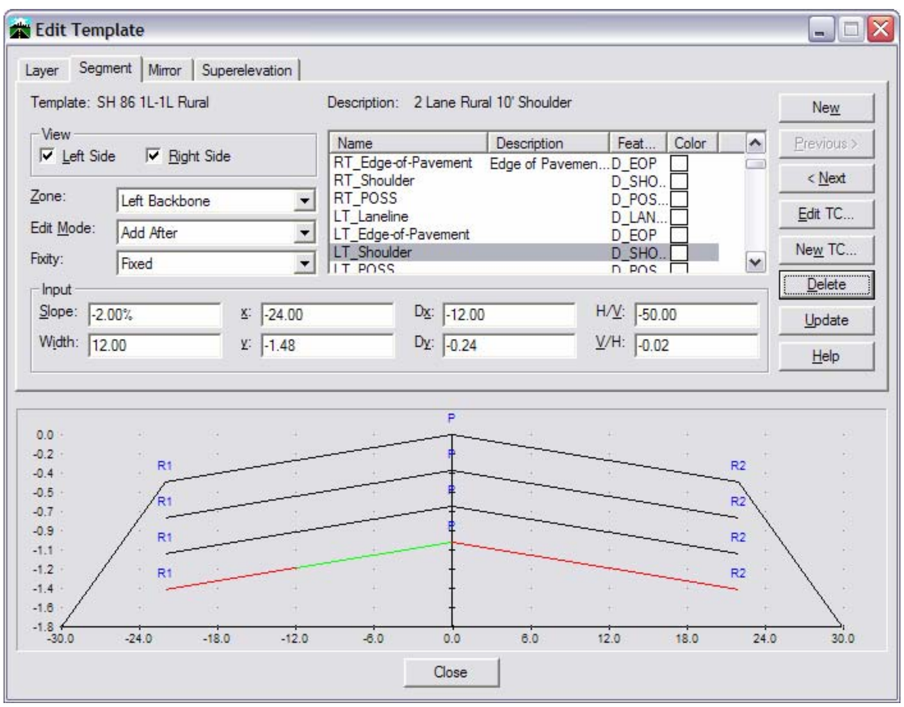


7. Choose the **Segment** tab.



- With the first segment on the **Right Backbone** highlighted (the RT_Laneline segment), choose **Delete**.
- Repeat for the **Left Backbone**.

8. Repeat this process of deleting the two inside lanes on the other two layers. When done, you template should look like the one shown here.



9. **Close** all open template dialog boxes.

10. Save the typical section library (**File > Save > Typical Section Library**).

Test one of the templates

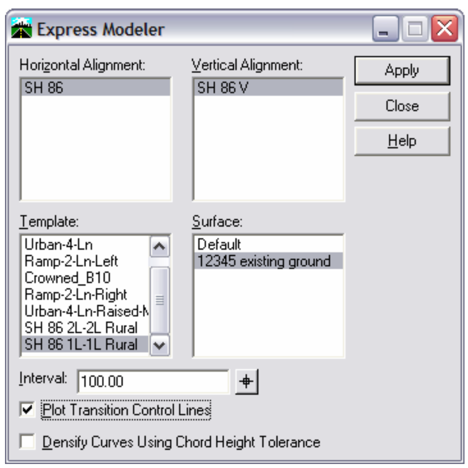
In the next series of steps, you will test the template you just created by using it to model the roadway. This will not be the final design, but just a test of the one template using **Express Modeler**. **Express Modeler** does not allow the use of multiple templates, decision tables, or superelevation, but is a good, quick test.

Create a model of the roadway using the 1L-1L template

1. Ensure **Write** lock is on.

2. Ensure **Station** lock is on.

3. Select **Modeler > Express Modeler**.

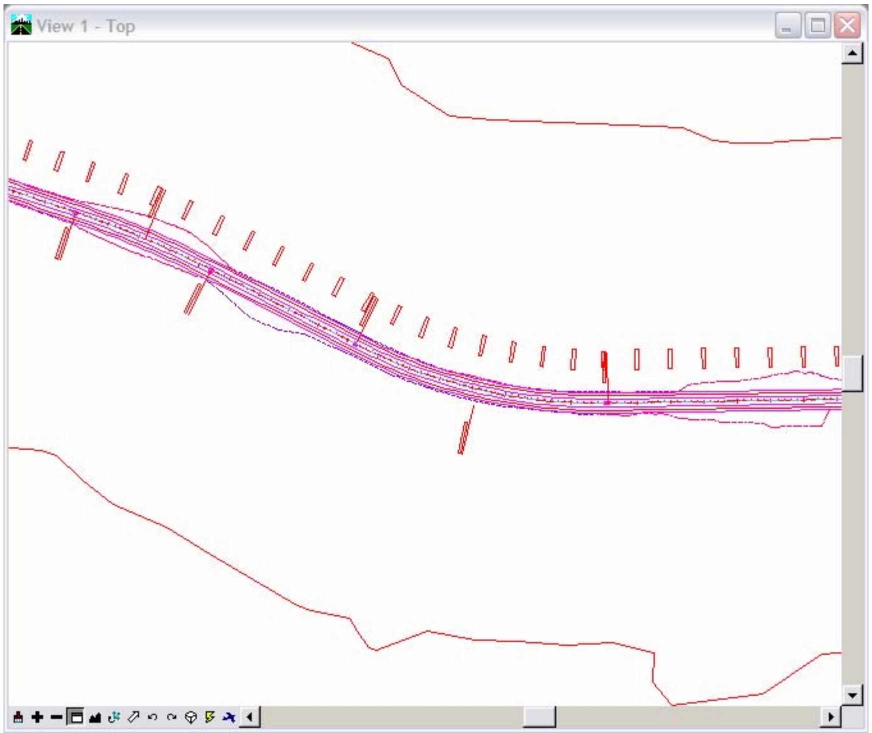


- Select **SH 86** for the **Horizontal**.
- Select **SH 86 V** for the **Vertical**.
- Select **SH 86 1L-1L Rural** for the **Template**.
- Select **12345 existing ground** for the **Surface**.
- Set the **Interval** to ***25***.
- Toggle on **Plot Transition Control Lines**.

Template **SH 86 1L-1L Rural** will be applied along the alignment every 25 feet.

4. Select **Apply**.

5. **Close** the **Express Modeler** dialog box.

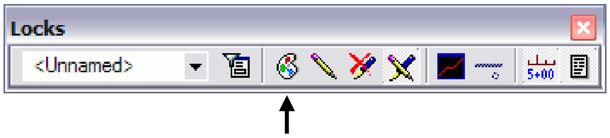


View the results

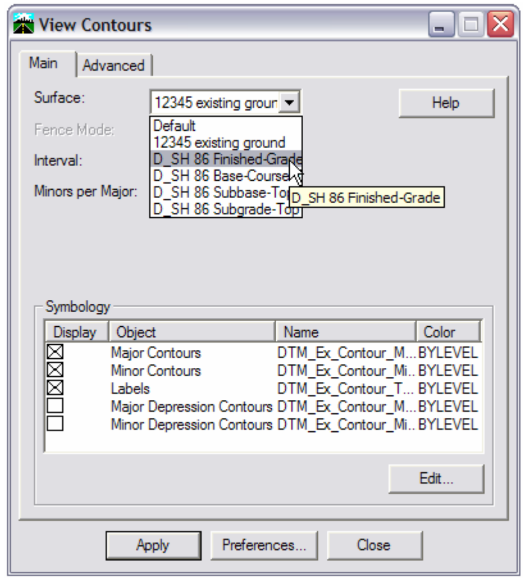
1. **Zoom in** to see the features created by **Modeler**.

View the contours for the finished surface created by Express Modeler.

2. Ensure the **Style** lock is off.



3. Select **Surface > View Surface > Contours**.



- Set the **Surface** to **D_SH 86 Finished-Grade**.
- Select **Preferences** and load **Proposed 10' Mjr. – 2' Minor**.

4. Select **Apply**.

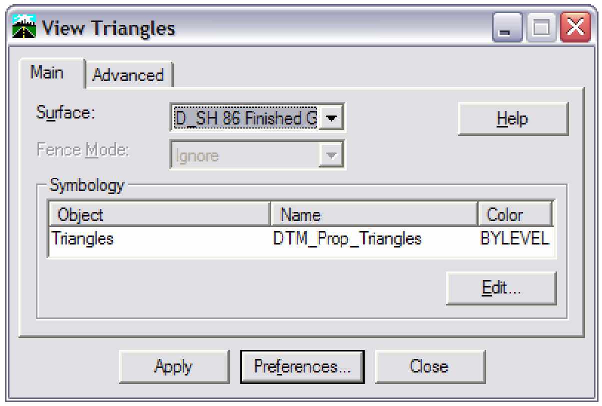
5. Use MicroStation **View** commands to take a closer look at the contours.

6. Use MicroStation **Delete Element** command to delete the contour display.

   Remember that the contour display is a graphic group.

View the triangles for the finished surface created by Express Modeler.

7. Select **Surface > View Surface > Triangles**.



- Set the **Surface** to **D_SH 86 Finished-Grade**.
- Choose **Preferences** and load the preference **Proposed**.

8. Select **Apply**.

9. Close the **View Triangles** box.

10. Use MicroStation **View** commands to take a closer look at the triangles.

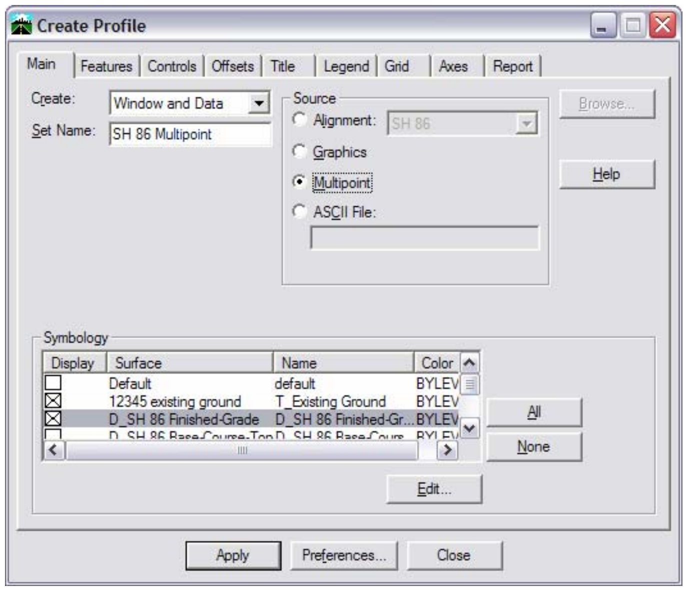
11. Use MicroStation **Delete Element** command to delete the triangle display.

    The triangle display is also a graphic group.

Create a profile

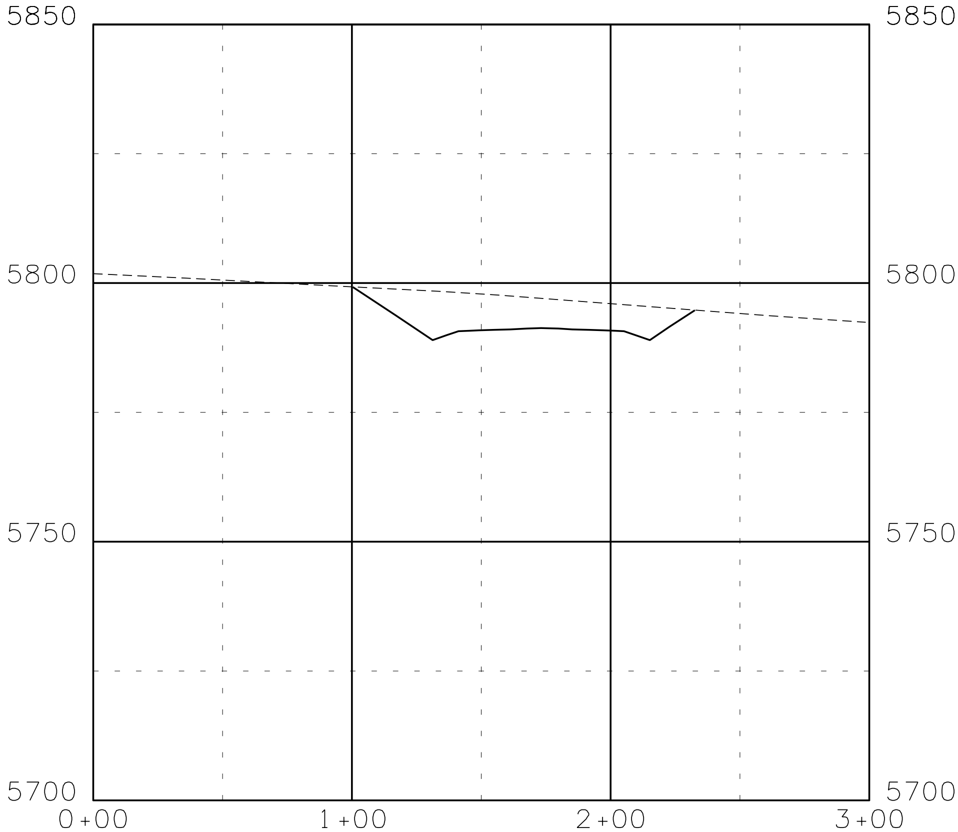
12. Select **Evaluation > Profile > Create Profile** to create multi-point profiles as you previously learned.

    - Load the preference **2x Vertical**.
    - On the **Main** tab key in a set name ***SH 86 Multipoint***
    - Set the source to **Multipoint**. Under the **Symbology** section, toggle on **Display** for **12345 existing ground** and **D_SH 86 Finished-Grade**.



13. **Apply** and be sure to cut the profile across your proposed road surface.

14. Use MicroStation **View** commands to take a closer look at the profile.
15. Delete the profile when you're finished reviewing it.



Exit InRoads

1. Exit MicroStation and InRoads by selecting **File>Exit** first from InRoads, then from the MicroStation command window. When prompted, do not save the surfaces just created; we will be modeling again in the next lab and will save the surfaces then. If you are prompted to save the typical section library, choose **Yes**.

Challenge lab

Model with **SH 86 2L-2L Rural** template and review the results as above

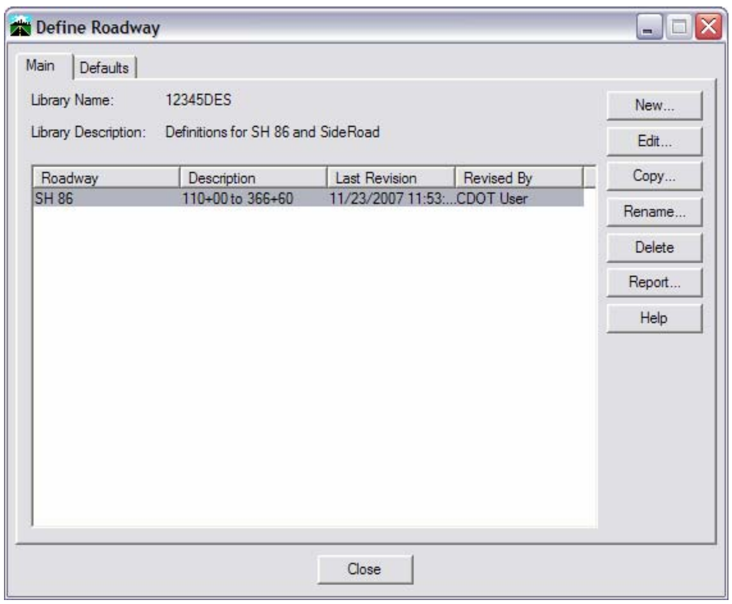
6. Preliminary Modeling and Sections

Roadway Libraries

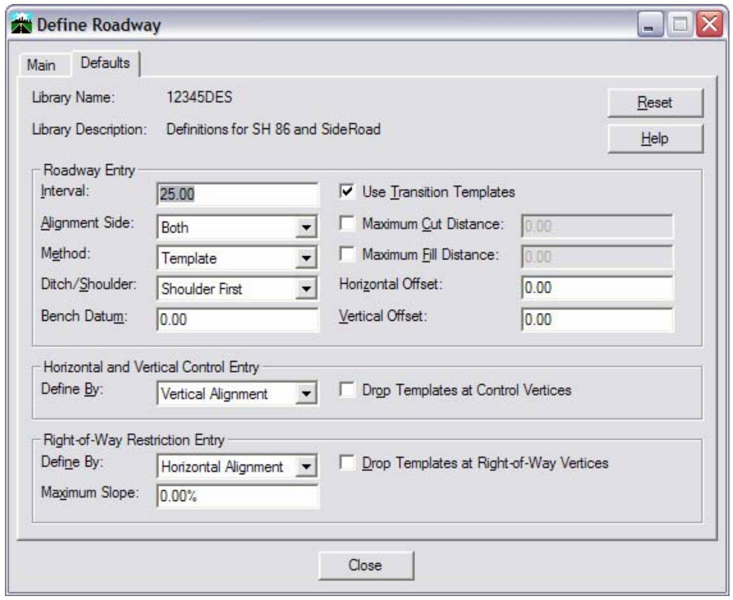
Roadway libraries store station and template setups, called ***roadway definitions***. Only one library can be loaded at any given time, but each library can contain multiple definitions. In addition to setting which template is used where, the roadway definition establishes other modeling criteria like how the sideslopes are calculated, what the template interval is and how the transitioning between templates occurs. Independent control is established in the roadway library as part of the roadway definition.

Creating Roadway Definitions

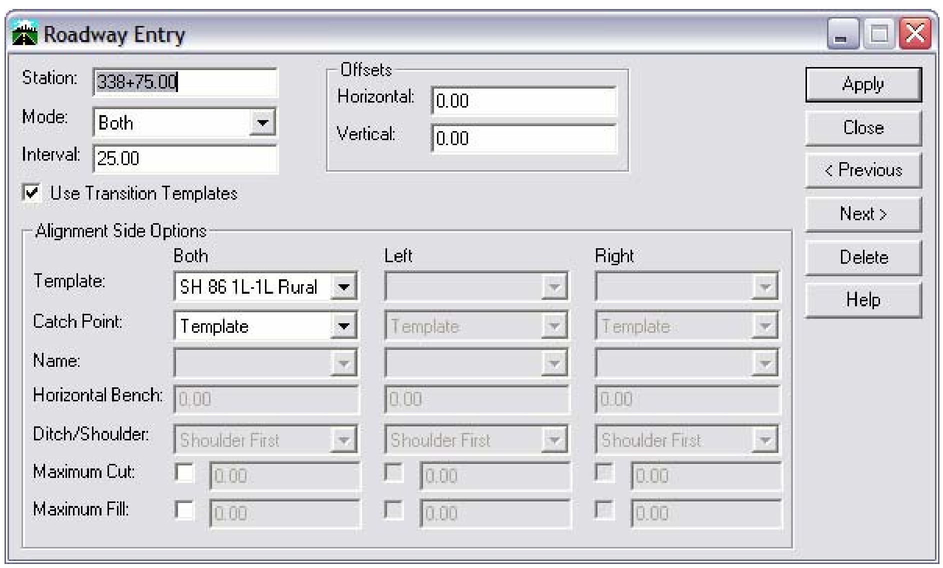
Roadway definitions are created from the main roadway library dialog, accessed by selecting **Modeler > Define Roadway**.



When the definitions are created, they are given a name and description. Before adding the actual entries, default setups can be established so they do not have to be repeated with every station and template in the definition. To set these defaults, choose the **Defaults** tab on the main **Define Roadway** dialog.

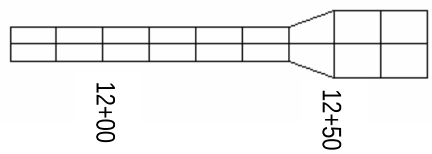


Once the defaults are established, they are copied for each entry created in the roadway definition. When added or edited, any of entries' default setups can be overridden.

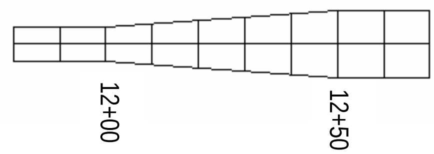


Template Transitions

Roadway definitions determine the transition lengths between two templates by the **Use Transition Template** toggle in the roadway entry. If it is toggled ***on***, the transition will occur between the two stations listed for the template in each roadway entry. If the toggle is ***off***, the transition will occur between the last drop of the first template and the first drop of the second template.



Transition Template ***off***



Transition Template ***on***

The example above shows the effect of the **Transition Template** toggle. In both diagrams, the template interval is 10; at station 12+00, the narrower template was dropped. At 12+50, the wider template was dropped. With **Transition Template** off, the transition occurred in the last 10 ft (left diagram). With **Transition Template** on, the transition occurred over the full 50 ft (right diagram).

During the transitioning of templates, transition control lines are drawn by connecting like-named points on each template. These lines become breaklines in the DTM, and have a feature name that corresponds to their TC name. The transition control lines that are joined must be in the same zone of the template. In other words, TC lines cannot cross the centerline or hinges.

Saving a Roadway Definition

Roadway definitions are not saved individually. Instead, they are saved when the roadway library is saved. Since you are working on a copy of the library that is loaded in memory, saving is a good idea whenever you make changes, and mandatory before exiting – assuming you want to save your changes.

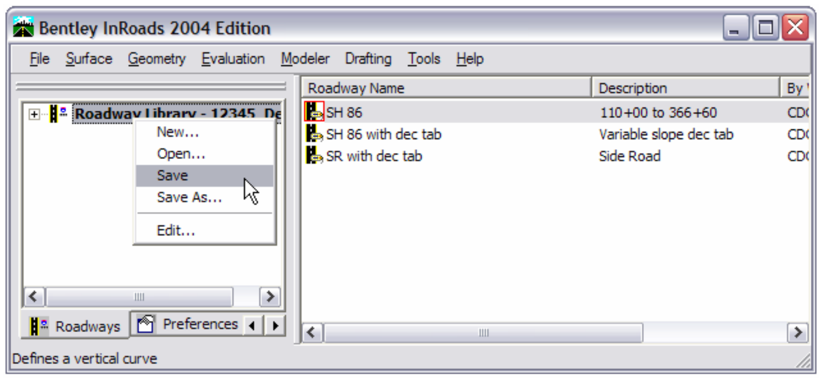
Roadway libraries can be saved using several methods including:

Choose **File > Save > Roadway Library**

The loaded roadway library is saved.

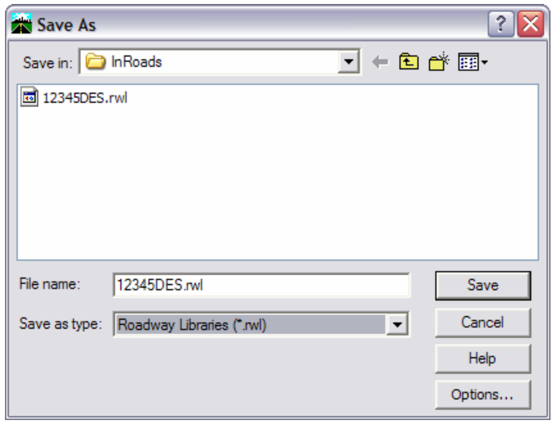
Right-click on the **Roadway Library** in the Explorer menu and chose **Save**

The loaded roadway library is saved.



If the roadway library has never been saved, either of the above methods will bring up the **Save > As** box as shown below.

Choose **File>Save As**



Set the **Files of Type** to ***.rwl***

Key in the file name (or use the default if it's set)

Choose **Apply** and the file is saved.

Note: Roadway libraries have both an internal name that appears in the dialog boxes in InRoads and a name on the hard drive that has an .rwl extension.

The roadway library may also be saved as part of the project file or .rwk, which you will be using in your lab activity.

Reports

A report of **Roadway Modeler** conditions is accomplished from the **Define Roadway** dialog. Edit the roadway definition to report on, then choose **Report**.

A report box is displayed on-screen, and can be saved by selecting **Save As** from the dialog. The report lists any Right-of-Way controls, Horizontal and Vertical Controls, and Stations and Templates setups.

Roadway Modeler

Roadway Modeler is the culmination of the process of defining a proposed corridor. Prior to running **Modeler**, you must have an existing digital terrain model (DTM), proposed horizontal and vertical alignments, template(s) and a roadway definition. **Roadway Modeler** combines these inputs to create a 3D proposed model of the corridor they define.

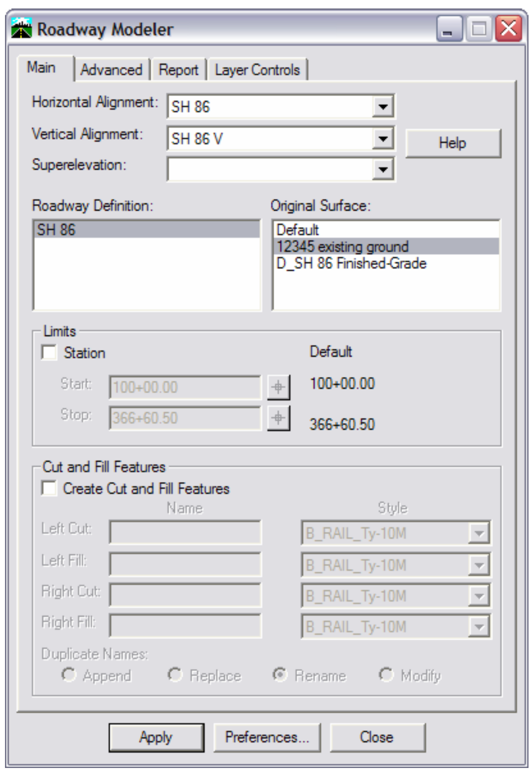
Three locks affect results of **Roadway Modeler**:

Write lock – Turn on if you are using any of the following options and want the graphics to be permanent MicroStation elements: display of TC lines or display of cut/fill features.

Station lock – Turn on if you want the templates to fall on even stations, even if the alignment starts with an odd station.

Report lock – Turn on if you want a report dialog to appear after **Modeler** is run listing resulting error messages (or blank if there are no errors). If this lock is off, errors will result in abbreviated messages, and you will not get the empty box with every **Modeler** run that doesn't generate an error.

After ensuring that all data is available to complete the corridor (as listed previously), select the **Roadway Modeler** command from the **Design Roadway** toolbar.

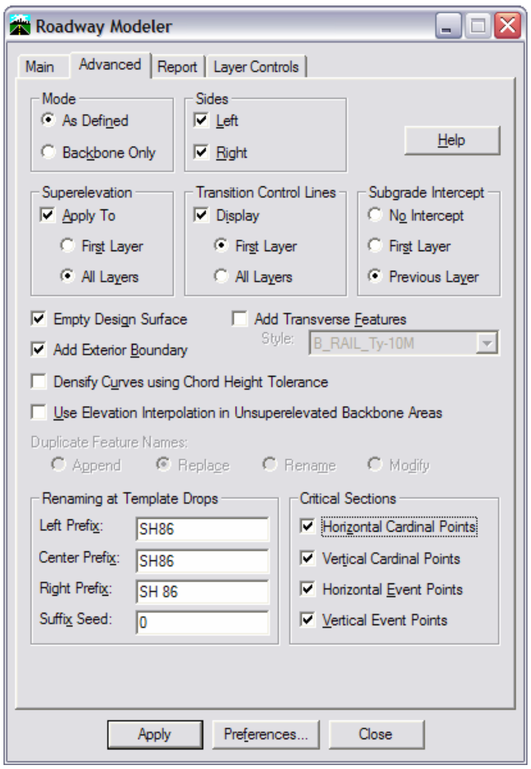


Several options are available when using **Modeler** and can be set under the various tabs.

On the Main tab:

Cut and Fill Features —When toggled on, non-triangulated features are created in the DTM for cut and fill on either side of the road, using the **Name** and **Style** specified. If the surface is not emptied, then you have several options for what to do with duplicate names: **Append** makes one feature from this and any previous features with the same name; **Replace** replaces previous features of the same name; **Rename** changes the new feature's name by adding an incrementing number to the end if another feature of the same name is encountered; **Modify** changes an existing feature of the same name.

On the Advanced tab:



Mode — Mode overrides the settings in the individual roadway definition entries, if desired. The options are **As Defined** (no overrides) or **Backbone Only**.

Backbone only is useful when running checks on the corridor, such as testing superelevation. It prevents having to wait on the sideslope calculations at times when you are only interested in the backbone.

Sides — Side overrides the settings in the individual roadway definition entries, if desired.

Superelevation — This toggle tells Roadway Modeler to look at the super application stations table to determine rotational values for accomplishing super. The options allow you to decide whether to apply super to only the main layer or all layers.

Transition Control Lines — In order for a TC line to be displayed , this toggle must be on, and the **3D/Plan Display Line Segment** toggle must be on in the feature style.

Subgrade Intercept — This option sets the intersection point of the subgrade surfaces. The subgrade can either extend until it hits the **First Layer**, or extend until it hits the **Previous Layer**. If no intercepts are desired, toggle the option to **None**.

Empty Design Surface — When toggled on, **Modeler** empties any data in the surfaces defined by the layer names on the template.

Add Transverse Features – Toggle on and specify a **Feature Style** if you want features placed following every template drop, perpendicular to the alignment.

Add Exterior Boundary — With **Add Exterior Boundary** turned on, the toe-of-slope points are connected and added to the DTM as an exterior to form the limits of triangulation.

Densify Curves Using Chord Height Tolerance — The chord height tolerance to segments curves in the horizontal alignment, densifying the template drops. The tolerance is set under **Tools>Options>Tolerances**.

Use Elevation Interpolation in Unsuperelevated Backbone Areas — Segments being transitioned a great difference in width and slope do not form a smooth linear transition. Using this toggle, you can force the elevation transition to be linear, rather than the slope transition.

Duplicate Feature Names —When **Empty Design Surface** is toggled off, you have several options for what to do with features that would cause duplicate names in the DTM: **Append** makes one feature from this and any previous features with the same name; **Replace** replaces previous features of the same name; **Rename** changes the new feature's name by adding an incrementing number to the end if another feature of the same name is encountered; **Modify** changes an existing feature of the same name.

Renaming at Template Drops — If you use the same TC names on both sides of your template, then the software will rename the features created from them to avoid duplicate names. The features on the left side will use the original name and on the right, they will be prefixed with **Right_**. If you do not want these prefixes, you can use this category to create your own prefixes and seed suffix. You may want to use this to prefix the corridor name onto the features. However, the Left and Right prefixes cannot be identical, so a space for example, must be used in one of the entries.

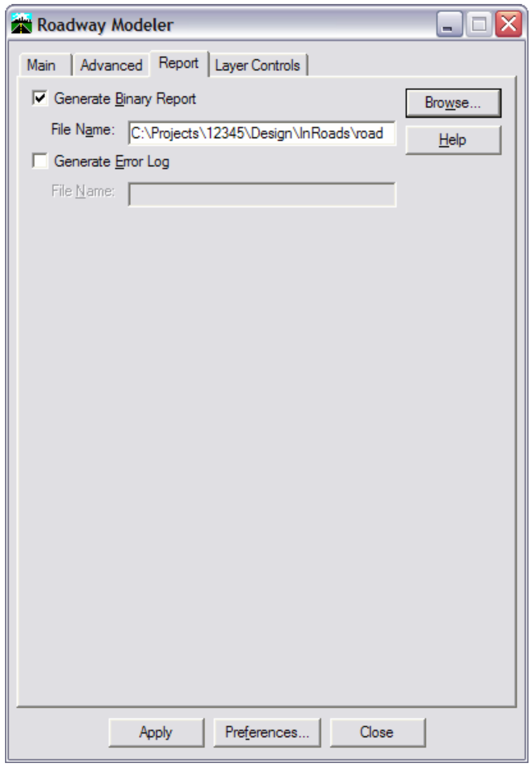
Critical Sections — Choose the locations of your cross sections in addition to the even interval specified on the **Main** tab.

Add Transverse Features – Toggle this option on when you want transverse as well as longitudinal features created when modeling.

On the Report tab

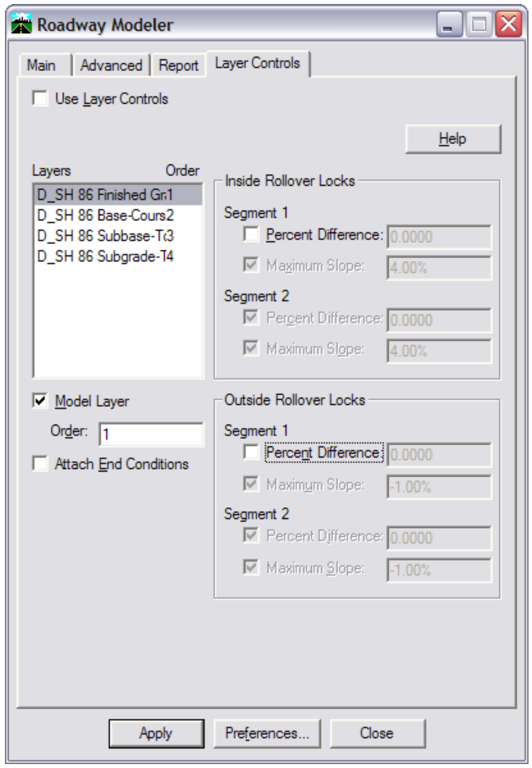
Generate Binary Report —With this option toggled on, a binary file is created containing all of the data from the cross section command. It can later be formatted with the **General Reports** command.

Generate Error Log — Creates a text file containing any errors that occur during processing.



Layer Controls tab

These options allow you to change the order in which the layers are processed, which layer will attach to the cut and fill, as well as specify rollover locks for superelevation per layer.



Saving Surfaces created by Roadway Modeler

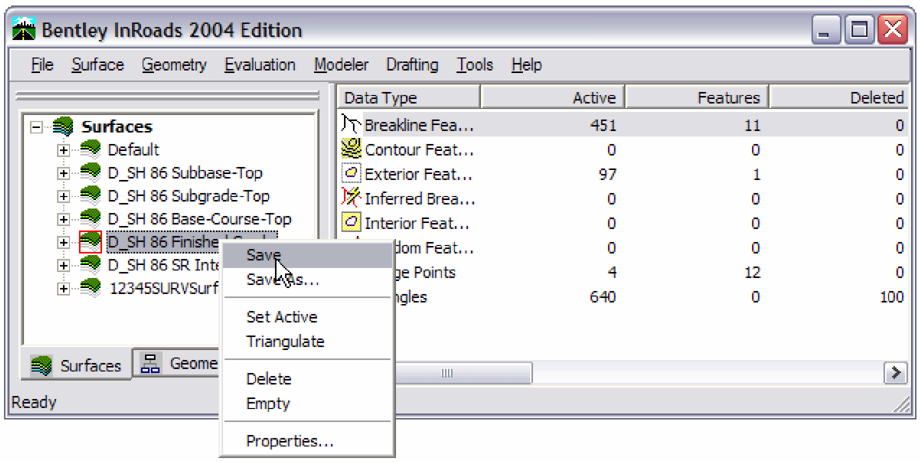
Since **Roadway Modeler** creates new surfaces from each of the layers of the template used, these surfaces must be saved to the hard drive using one of several methods including:

Choose **File > Save > Surface**

The active surface is saved.

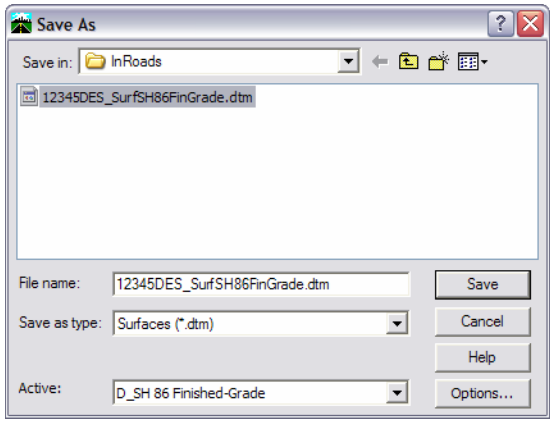
Right-click on the **Surface** in the Explorer menu and chose **Save**

The surface you clicked on is saved.



If the surface has never been saved (as is the case when **Modeler** is run for the first time for a particular roadway), either of the above methods will bring up the **Save > As** box which is shown below.

Choose **File > Save As**



Set the Files of Type to ***.dtm**

Choose the surface you want to save from the **Active** pulldown list

Key in the file name (or use the default)

Choose **Apply**.

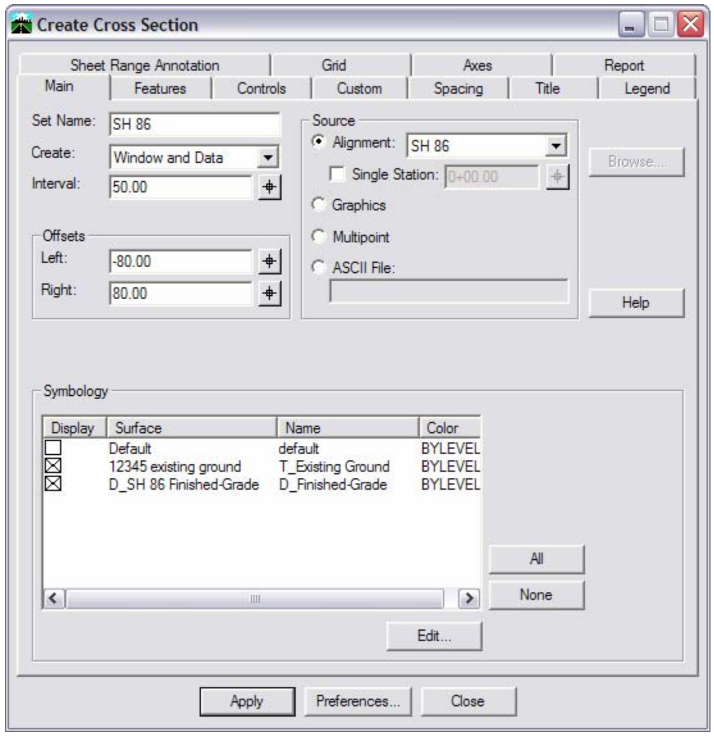
Note: Surfaces have both an internal name that appears in the dialog boxes in InRoads and a name on the hard drive that has a **.dtm** extension. Care should be taken to make certain you have chosen the correct surface name to match the file name you specify. Otherwise, you could accidentally save over a file on the hard drive with the wrong surface.

This process must be repeated for each of the surfaces **Roadway Modeler** creates. (One for each layer in the templates used.)

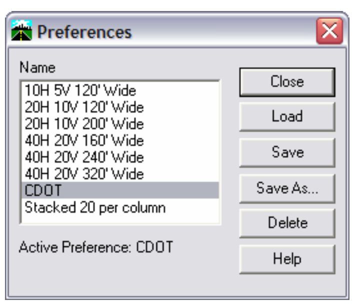
The surface may also be saved as part of the project or **.rwk** file, which you will be using in your lab activities.

Cutting Cross Sections

Cross sections are created based on a horizontal alignment and DTM information. More than one DTM can be shown on a cross section, such as an existing and several design surfaces. Select **Evaluation > Cross Section > Create Cross Section**.



There are CDOT preferences for different width and scale cross sections. Each of the preferences other than the one named CDOT places the cross sections inside a CDOT border, placed as a cell. All other parameters for cutting the cross sections are established by these preferences as well.



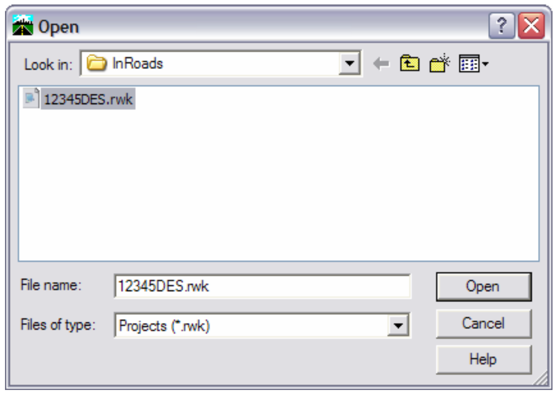
Lab 6 – Preliminary Modeling and Sections

Start InRoads

1. Start InRoads and open **CU12345DES_Model.dgn** from the **Design\Working** folder.

Open your InRoads data files

1. Select **File > Open**.



2. Ensure the **Files of Type** option is set to **Projects (*.rwk)**.

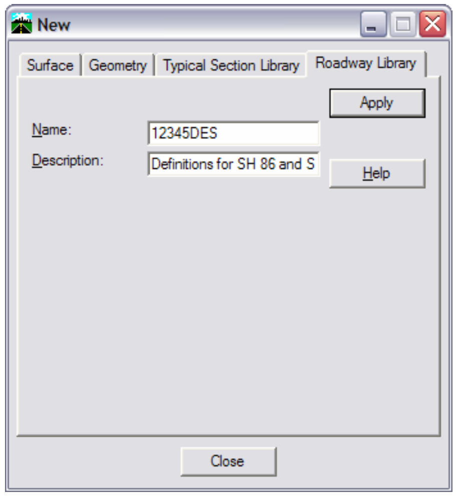
3. Double-click on **12345DES.rwk**.

   Double-clicking is the equivalent of highlighting the file and choosing **Open**.

4. **Cancel** the dialog.

Create a roadway library

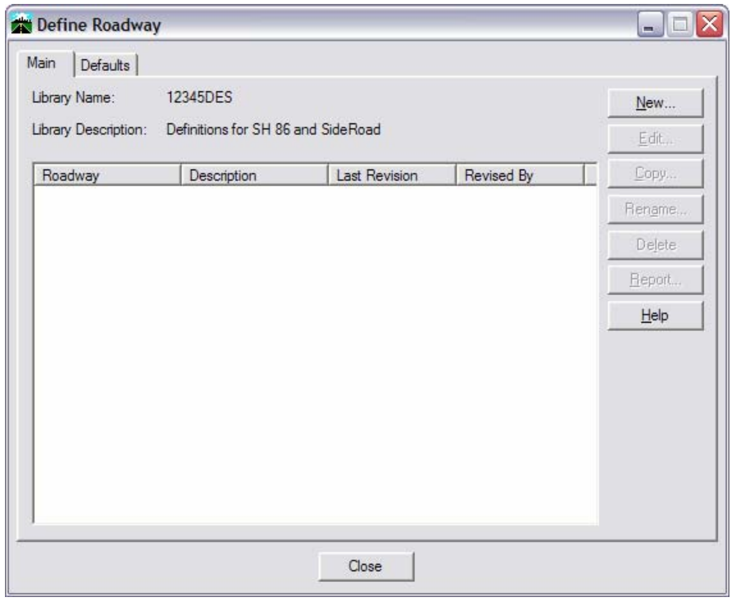
1. Select **File > New**.



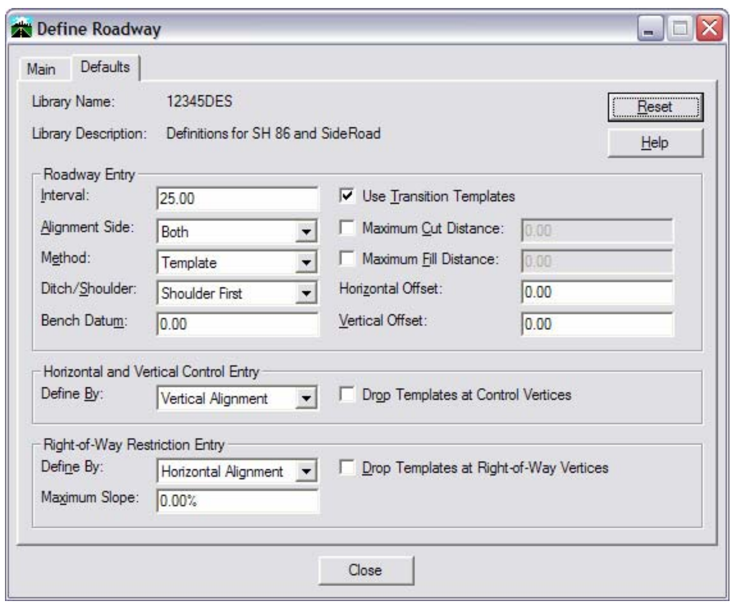
2. Select the **Roadway Library** tab and:
   - Enter the **Name**: ***12345DES***
   - Enter the **Description**: ***Definitions for SH 86 and SideRoad***
3. Select **Apply**.
4. Select **Close**.

Establish the default settings for the roadway definitions.

5. Select **Modeler > Define Roadway**.



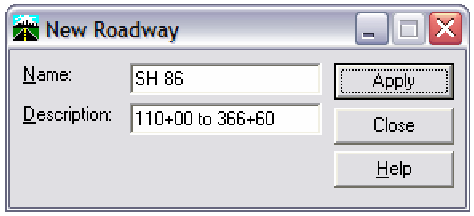
6. Select the **Defaults** tab.



- Enter the **Interval:** ***25***
- Set **Alignment Side**: **Both**.
- Set **Method**: **Template**.
- Toggle on **Use Transition Templates**.

Name the roadway definition in the Roadway Library.

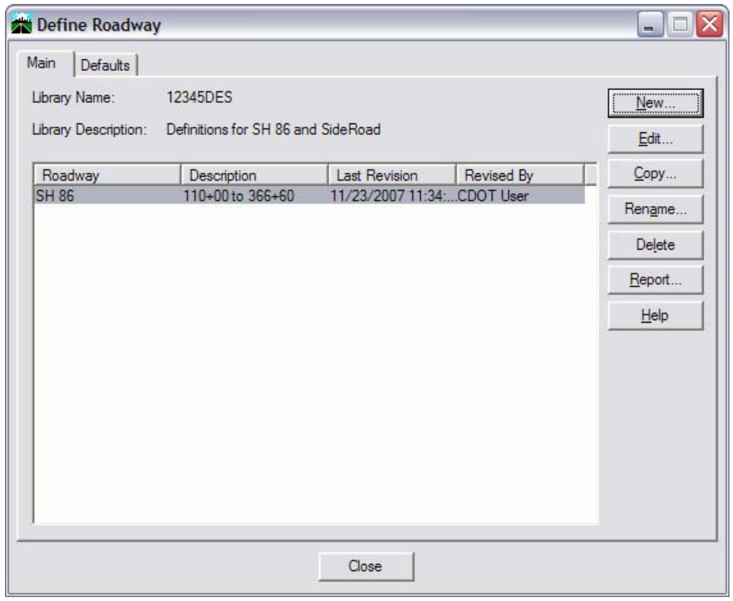
7. From the **Define Roadway** dialog box, **Main** tab, select **New**.
   - Enter the **Name**: ***SH 86***
   - Enter the **Description**: ***110+00 to 366+60***



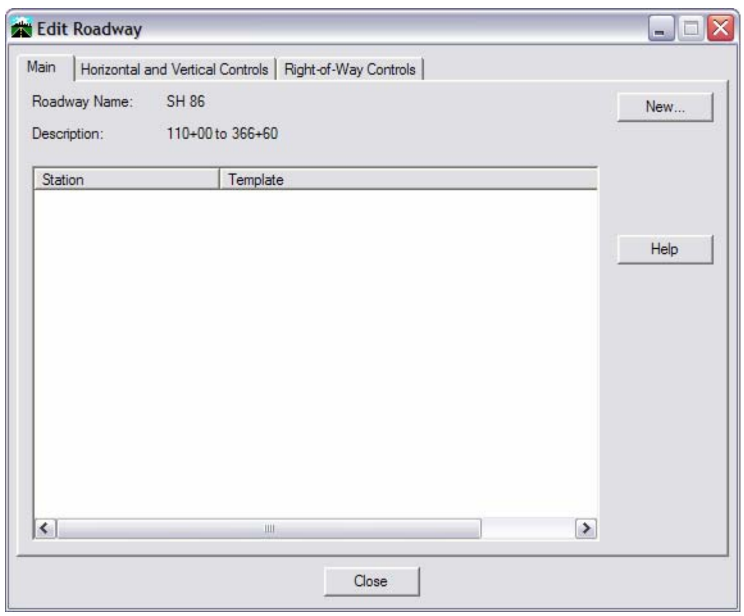
8. Select **Apply**, then **Close**.

Add station and templates entries to the new roadway definition.

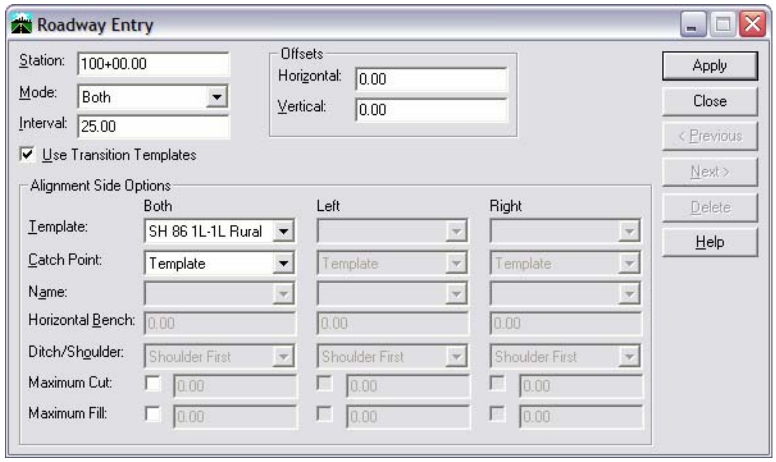
9. From the **Define Roadway** dialog box highlight the roadway definition, **SH 86** just added.



10. Select **Edit**.



11. Select **New** on the **Edit Roadway Main** tab.



Note the default settings made previously are set in this dialog box. Note also that the station defaults to the beginning station of the active alignment.

- The **Interval** should be ***25***.
- The **Alignment Side** should be set to ***Both***.

12. Select the **Template** drop-down under the **Both** column.

- Select **SH 86 1L-1L Rural** from the list.

The Template field populates with the template name.

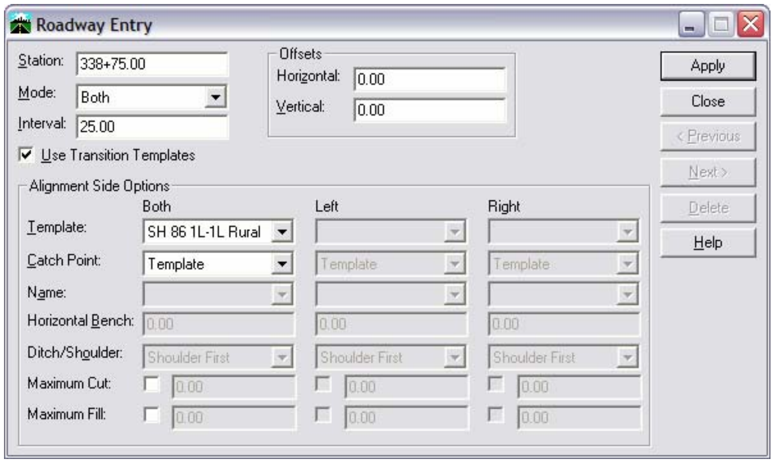
- The **Catch Point** should be set to **Template**

13. Select **Apply**.

You have now added the first station/ template to the roadway definition.

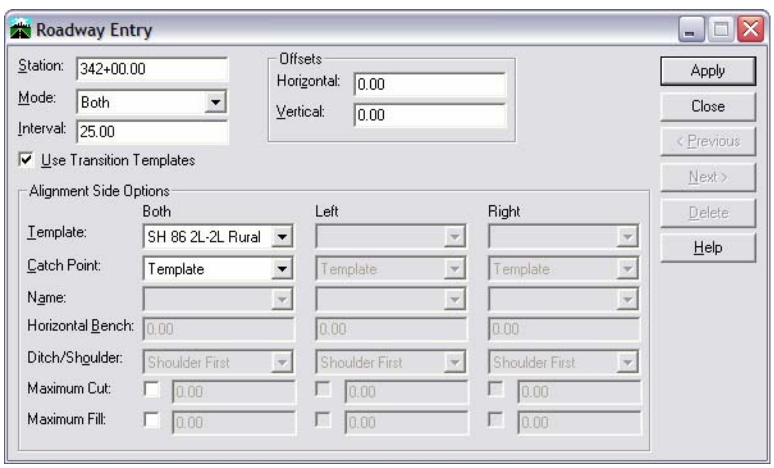
14. Enter the Station: ***338+75***

15. Set the **Template** to **SH 86 1L-1L Rural**.



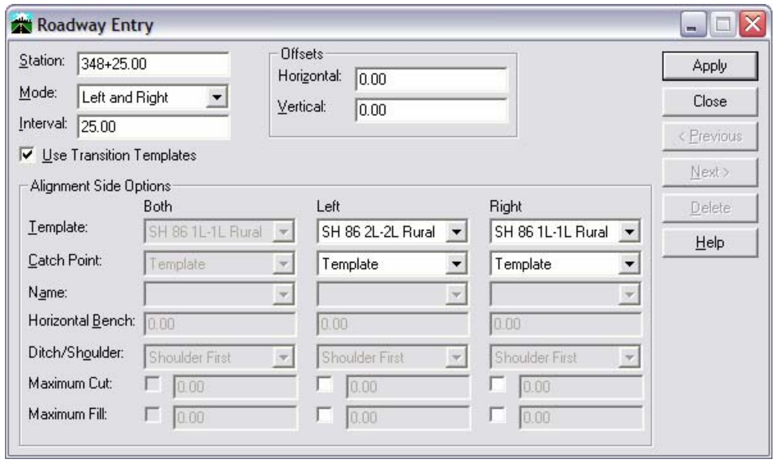
16. Select **Apply.**

17. Continue adding the entries for the roadway definition in the **Roadway Entry** box. If you make a mistake, close the dialog, highlight the erroneous entry in the **Edit Roadway** box and choose **Edit**. When done correcting the mistake, choose **Apply**, and then **Close** the dialog. Choose **New** to continue adding new entries.



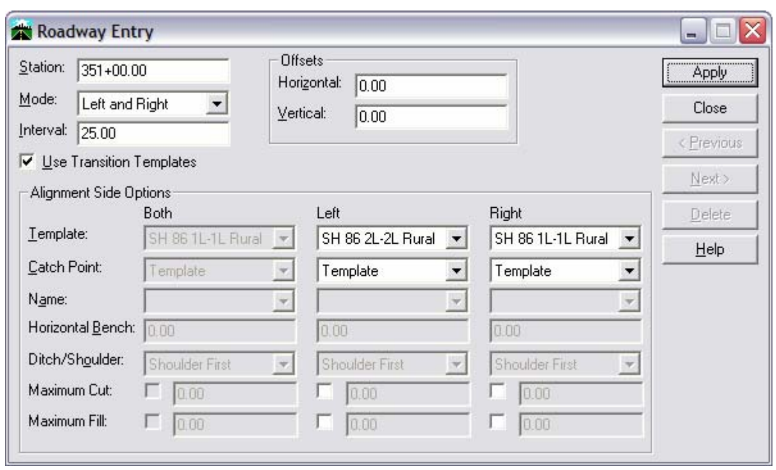
- Station: ***342+00*** Template: **SH 86 2L-2L Rural**

18. At station 348+25, the design calls for two lanes on the left side of the alignment and one lane on the right. You can accomplish this by changing the **Mode** to **Left and Right**, then using the four-lane template on the Left and the two-lane template on the Right.



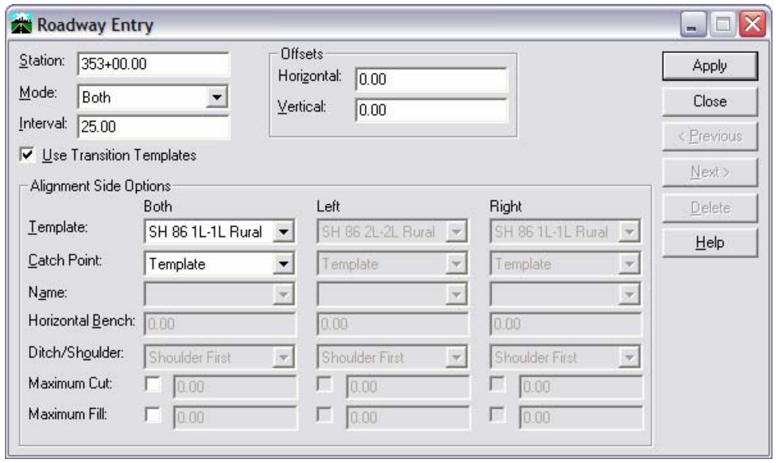
- Enter the **Station *348+25***.
- Set the **Mode** to **Left and Right**.
- In the **Left** column, select **SH 86 2L – 2L Rural.**
- Make certain the **Catch Point** is set to **Template**.
- In the **Right** column, select **SH 86 1L – 1L Rural.**
- Make certain the **Catch Point** is set to **Template**.
- Choose **Apply**.

19. Create an entry for 351+00.



- Enter the **Station *351+00***
- Choose **Apply**.

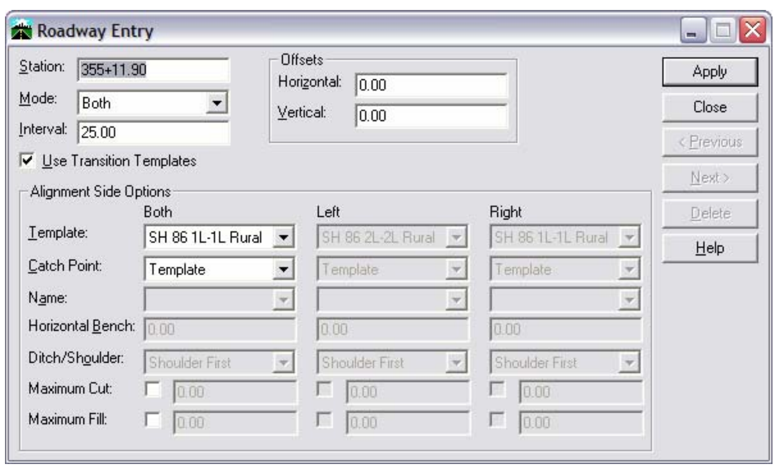
20. Create an entry for 353+00.



- Enter the **Station *353+00***
- Set the **Mode** to **Both**
- In the **Both** column, select the **Template SH 86 1L – 1L Rural.**
- Choose **Apply**.

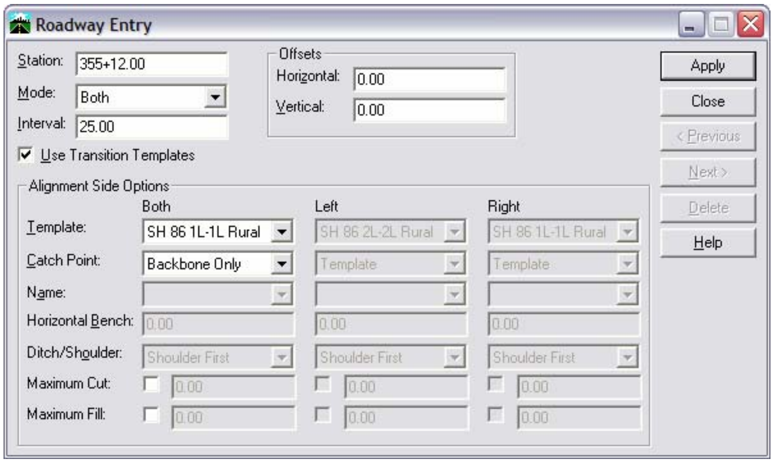
The next four entries define an abrupt transition from using templates for sideslopes to using no sideslopes (Backbone Only) through the bridge area.

21. Create an entry for the last station to create a sideslope prior to the bridge.



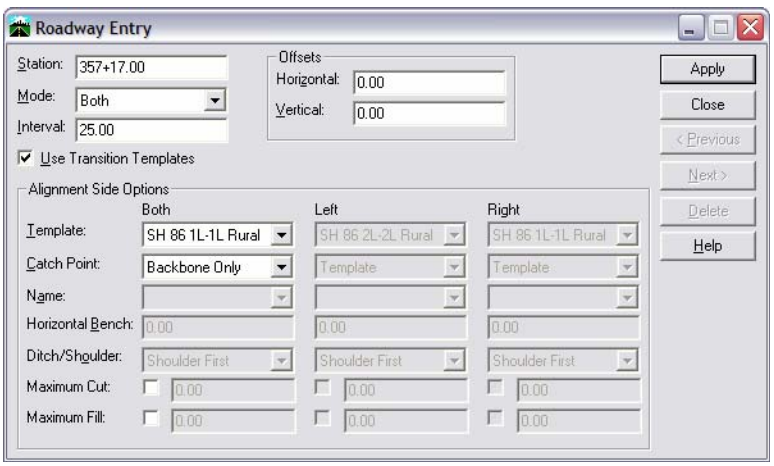
- Enter the **Station *355+11.9***
- Select the **Template SH 86 1L – 1L Rural.**
- Choose **Apply**.

22. Create an entry for the first station of the bridge area which is backbone only.



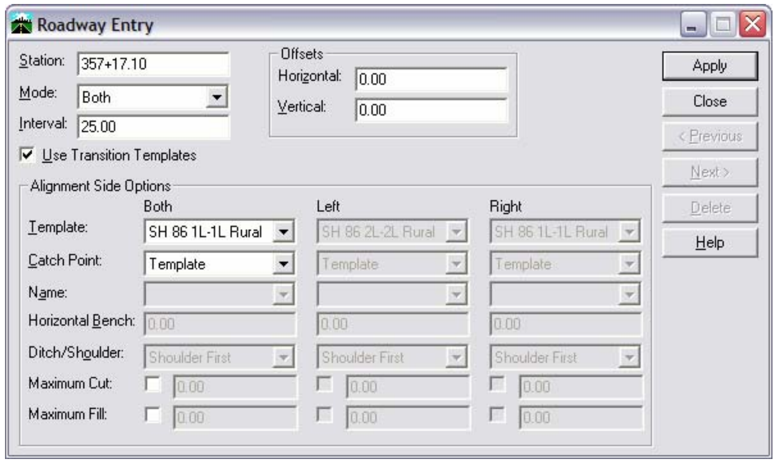
- Enter the **Station *355+12***
- Select the **Template SH 86 1L – 1L Rural.**
- Select **Backbone Only** for the **Catch Point**.
- Choose **Apply**.

23. Create an entry for the last station of the bridge area which is backbone only.



- Enter the **Station *357+17***
- Choose **Apply**.

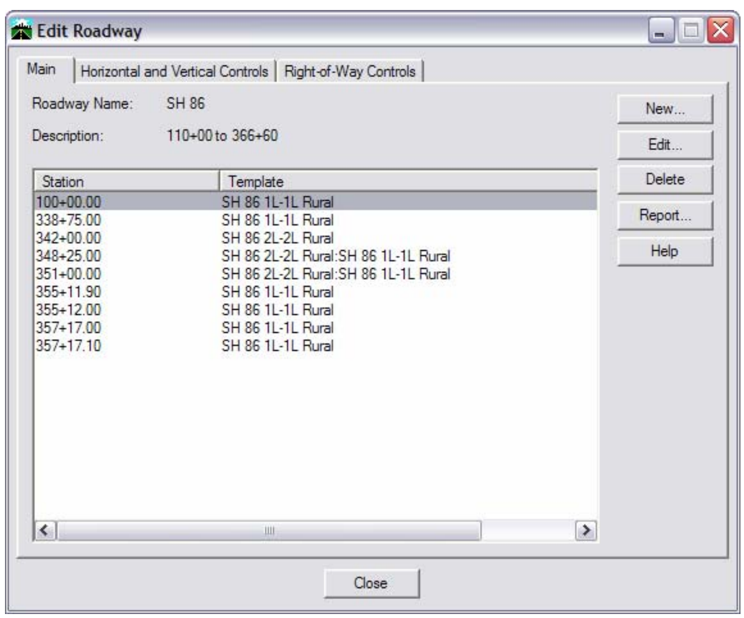
24. Create an entry for the first station on the other side of the bridge area which returns to normal cuts and fills.



- Enter the **Station** ***357+17.10***
- Select **Template** for the **Catch Point**.
- Choose **Apply**
- Choose **Close**

25. Review your entries. When complete, the entries should look like the dialog below.

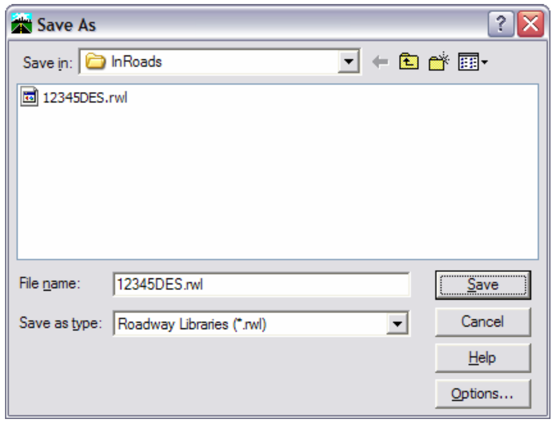
    You do not have to enter the ending station. The last entry will be used until the end of the model.



26. Select **Close** to dismiss the **Roadway Entry** box.
27. Select **Close** to dismiss the **Edit Roadway Table** box.
28. **Close** the **Define Roadway** box.

Save the roadway library.

1. Select **File > Save As**.



- Ensure the **Save in** folder is set to **Design\InRoads**
- Toggle the **Save as Type** field to: **Roadway Libraries (*.rwl)**.
- Verify the **Name** is: ***12345DES.rwl***

2. Select **Save**

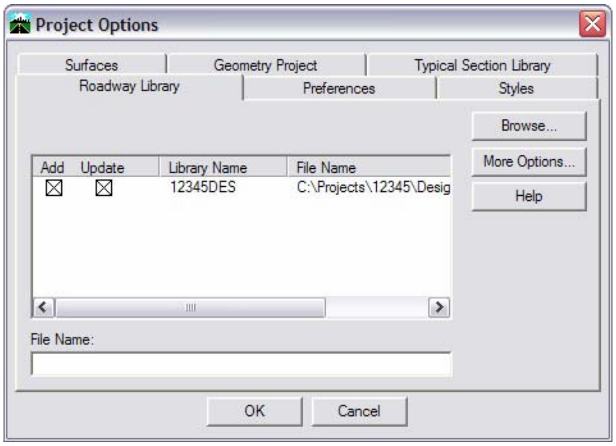
   The file **12345DES.rwl** is saved to the hard disk.

3. Select **Cancel**.

Add the roadway library to your project file

1. Select **File > Save As**.

    - Set the **Save as type** to **Projects *.rwk**.
    - Click on **12345DES.rwk**.
    - Choose **Options**.
    - On the **Roadway Library** tab, click on **Add** and **Update** for the new library.



Remember, **Add** loads the file when the project is loaded and **Update** saves the file when the project is saved.

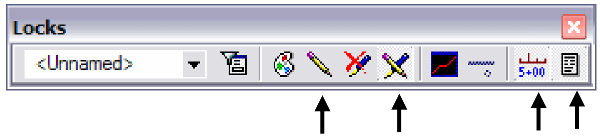
2. Choose **OK**.

3. Choose **Save** on the **Save As** dialog and overwrite the current .rwk.

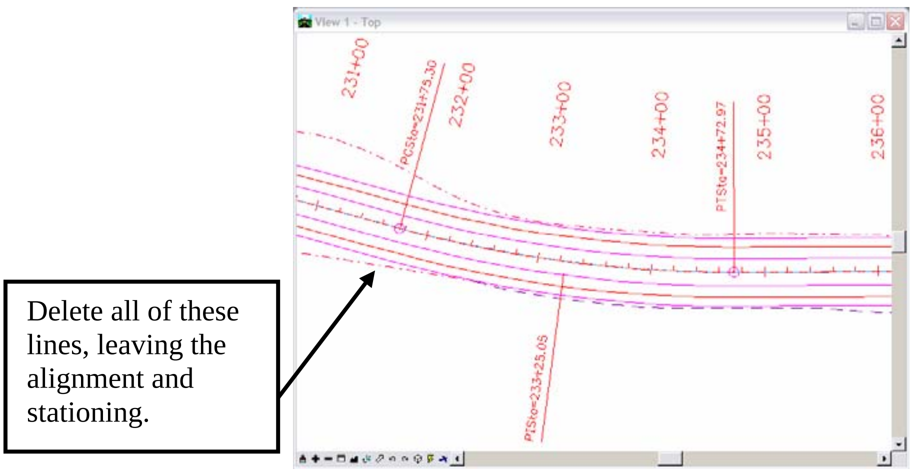
This adds the roadway library **12345DES.rwl** to the previously created **12345DES.rwk** file. Now, anytime the project is loaded or saved, the roadway library will be also.

Model the roadway

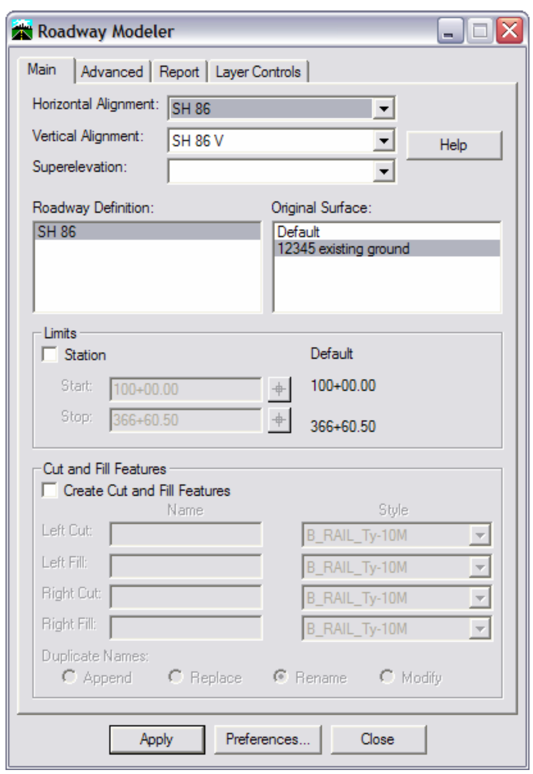
1. Toggle **Write, Report and Station** locks on.
2. Set the mode to **Pencil**.



3. Using MicroStation, delete all TC lines (features in plan) and any other leftover surface displays from the previous **Modeler** run.

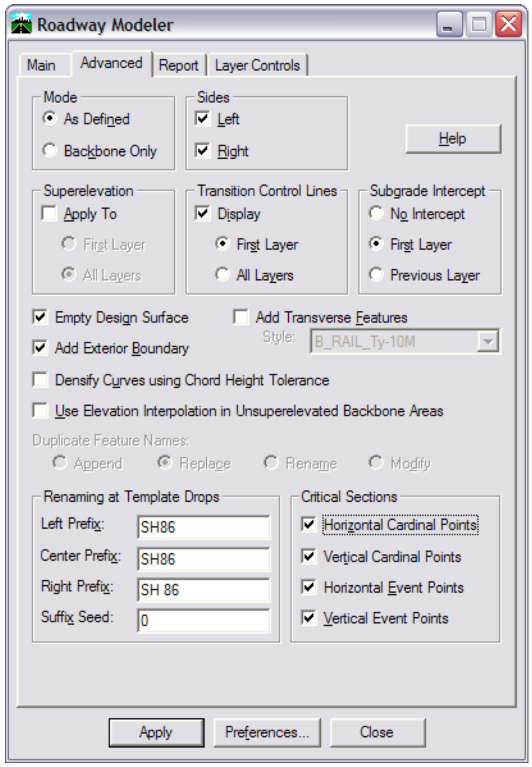


4. Select **Modeler > Roadway Modeler**.



Confirm and set additional design parameters.

5. Select the **Advanced** tab.



- Set the **Mode** to **As Defined**.
- Toggle the **Side** to **Left and Right**.
- Toggle off **Superelevation**.
- Toggle on the **Display Transition Control Lines** for the **First Layer**.
- Set the **Subgrade Intercept** to **First Layer**.
- Toggle on **Empty Design Surface**.
- Toggle on **Add Exterior Boundary**.
- Key in a prefix of ***SH86*** for **Left** and **Center**.

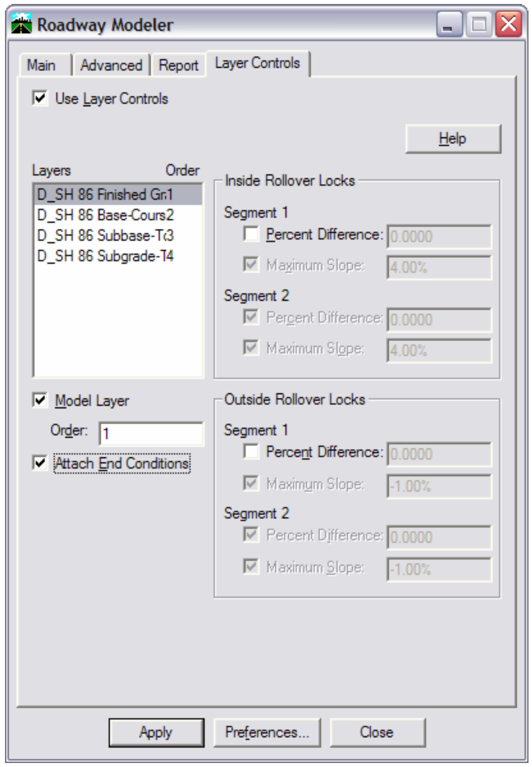
The prefixes cannot be the same for Left and Right, so be sure you use the space in the Right prefix.

- Key in a prefix of ***SH 86*** for **Right**.
- Ensure the **Suffix** Seed is ***0***.

6. Select the **Report** tab.

    - Toggle off **Generate Binary Report**.

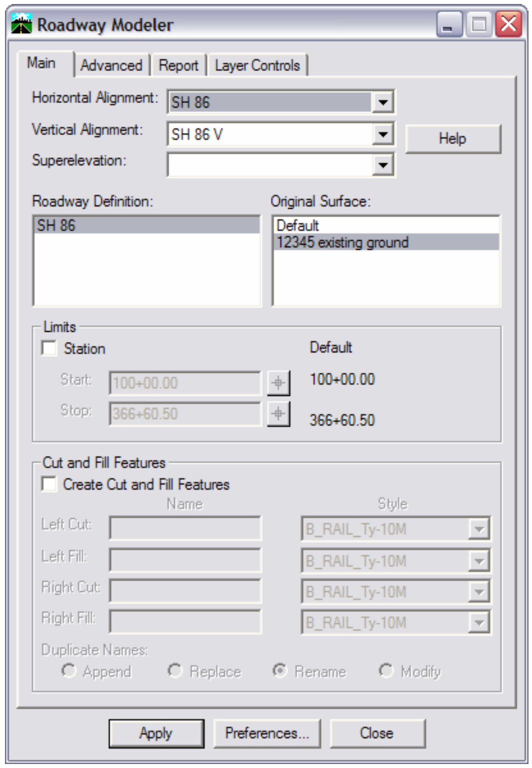
7. Select the **Layer Controls** tab.



- Toggle on **Use Layer Controls**.
- Toggle off **Segment 1** under both **Inside** and **Outside Rollover Locks** categories.
- Under **Layers**,
- Highlight **Finished Grade** and make certain **Model Layer** is checked.
- Also check **Attach End Conditions**.
- Highlight each of the other listed layers (one at a time) and toggle ***off*** **Model Layer**.

This sets the model to only process the **D_SH 86 Finished-Grade** layer from the template.

8. Back on the **Main** tab, make certain the:



- **Horizontal Alignment** is set to **SH 86**.
- **Vertical** is **SH 86 V**.
- Highlight the **Roadway Definition SH 86**.
- Under the **Original Surface** list, select **12345 existing ground**.
- Toggle off **Create Cut and Fill Features**.

9. Select **Apply**.

   The templates are applied along the alignment as defined in the roadway definition. A new surface is created for the **D_SH 86 Finished-Grade** layer in the templates.

10. Select **Close** to dismiss the **Roadway Modeler** box.

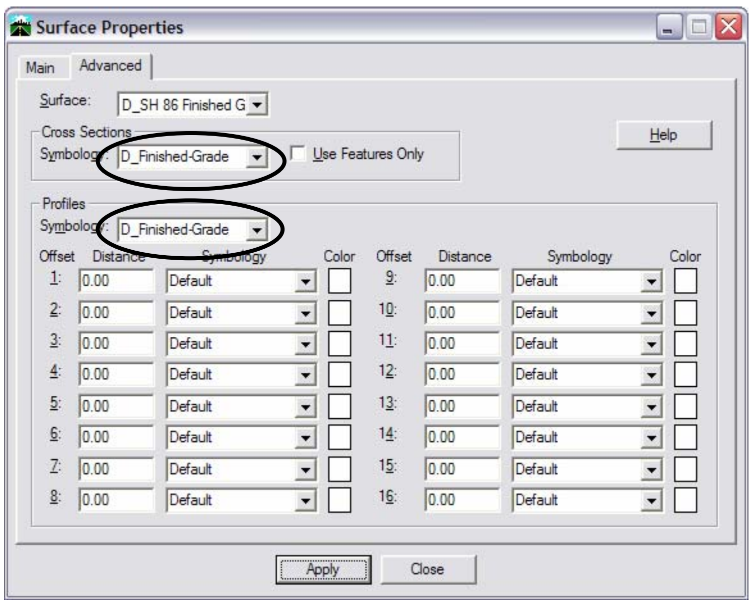
Assign a named symbology to the surface

Roadway Modeler automatically assigns named symbologies to the surfaces based on the surface name. Since you prefixed the alignment name to the front, these symbologies are not found in the configuration. You can change them to the desired symbology by selecting a new one on the **Advanced** tab of **Surface>Surface Properties**.

1. Select **Surface>Surface Properties.**

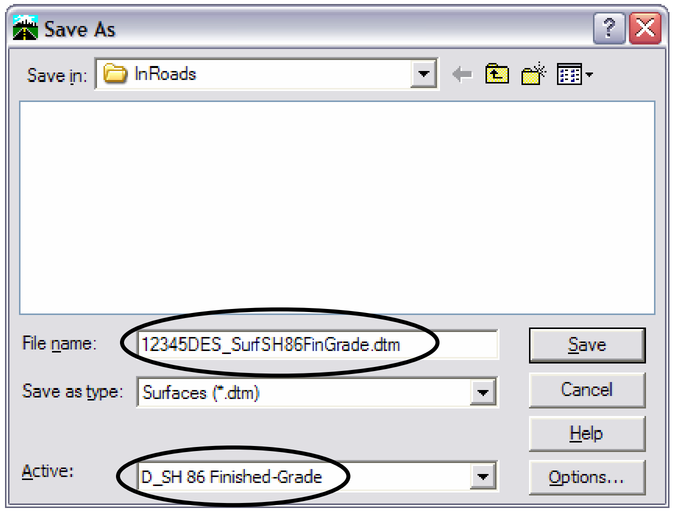
2. On the **Advanced** tab,

   - Set the **Surface** to ***D_SH 86 Finished-Grade***
   - Set the **Cross Section Symbology** to ***D_Finished Grade***
   - Set the **Profile Symbology** to ***D_Finished Grade***
   - **Apply**, then **Close** the dialog.



Save the new surface

1. Select **File > Save As.**



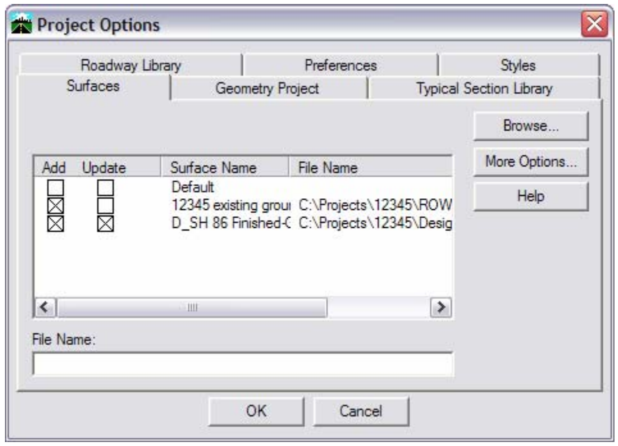
- Set the **Save As Type** to **Surfaces (*.dtm)**
- Set the **Active** surface to **D_SH 86 Finished-Grade**
- Key in the file name:
  12345DES_SurfSH86FinGrade.dtm
- Verify that the current **Save in** folder is **Design\InRoads**.

2. Select **Save**.

3. If prompted, ***'The file ... already exists. Replace'***, select **Yes**

Add the new surface to your project file

1. Select **File > Save As**.



- Set the **Save as type** to **Projects *.rwk**.
- Click on **12345DES.rwk**.
- Choose **Options**.
- On the **Surfaces** tab, click on **Add** and **Update** for the new surface.

Remember, **Add** loads the file when the project is loaded and **Update** saves the file when the project is saved.

2. Choose **OK**.

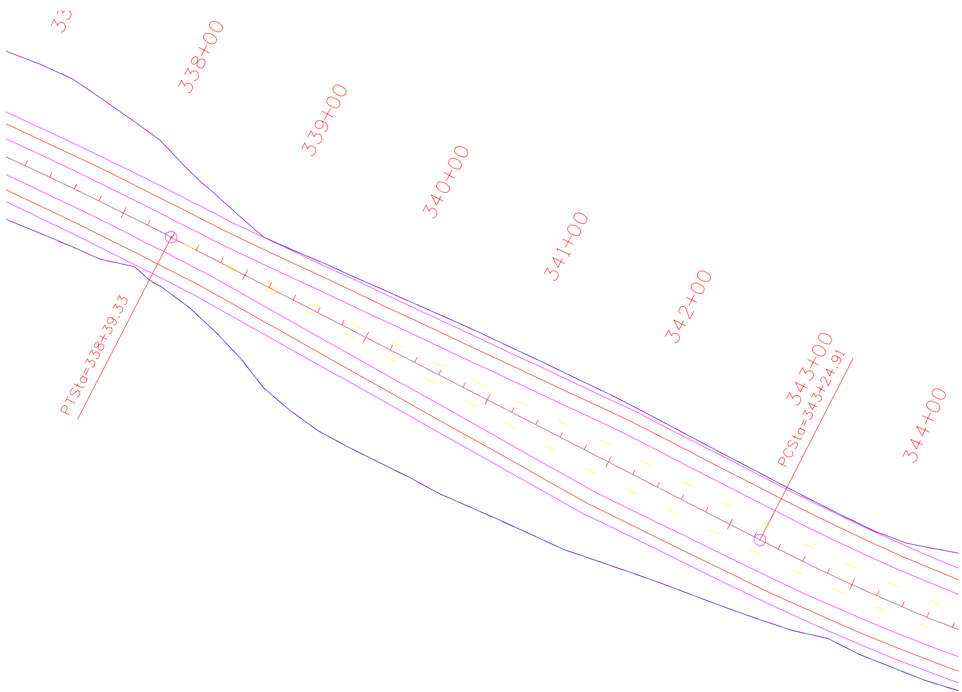
3. Choose **Save** on the **Save As** dialog and overwrite the current .rwk.

This adds the **D_SH 86 Finished-Grade** surface to the previously created **12345DES.rwk** file. Now, anytime the project is loaded or saved, this surface will be also.

View the results of Roadway Modeler

1. **Zoom in** or **out** as needed with MicroStation to visually review the display of the Transition Control (TC) lines.

   Note: **Zoom in** on station 340+00 to see the transition from 2 lanes to 4 lanes. **Zoom in** on station 345+00 to see the transition from 4 lanes to 3 lanes.



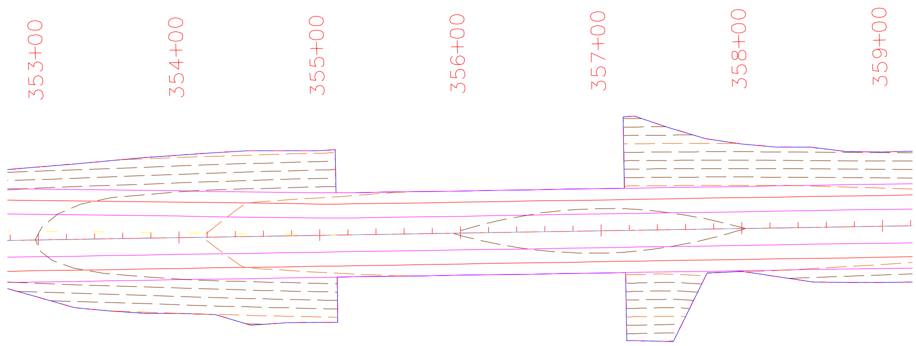
   You might want to try zooming with precision by picking the Window Area command and keying in: ***so=35100*** **<Enter>** and ***so=35500*** **<Enter>**. When prompted, pick the view you want and it will window between the two stations.

Display the triangles for the proposed surface.

1. Select **Surface > View Surface > Triangles**.
   - Set the **Surface** to **D_SH 86 Finished-Grade**.
2. Select **Apply** then **Close**.
3. Use the MicroStation **View Control** commands to take a closer look at the display.
4. Use MicroStation **Delete Element** to delete the triangle display (**Graphic Group** lock on).

View contours for the proposed surface

1. Select **Surface > View Surface > Contours**.
   - Set the **Surface** to **D_SH 86 Finished-Grade**.
   - Select **Preferences** and load **Proposed 10' Mjr. – 2' Minor**.
2. Select **Apply**.



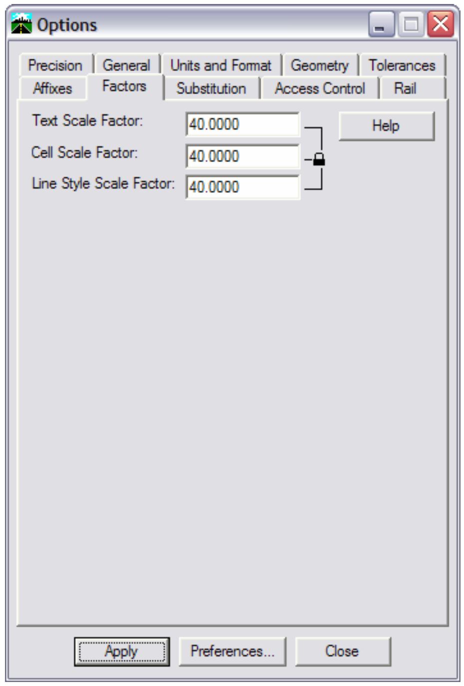
3. Use MicroStation **View** commands to take a closer look at the contours.
4. Use MicroStation **Delete Element** command to delete the contour display.

   Remember that the contour display is a graphic group.

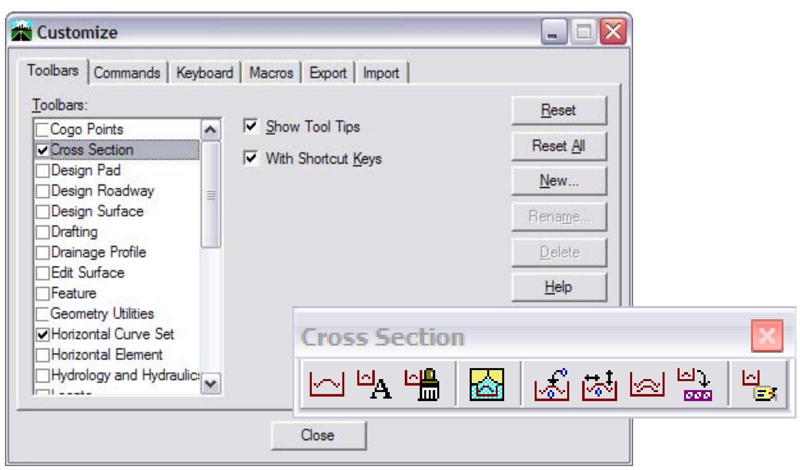
Cut Cross Sections for the proposed roadway

1. Make certain **Write** and **Station** locks are on, and that you are in **Pencil** mode.

2. Select **Tools > Options > Factors** and key in a **Text Scale Factor** of ***40*** then **Apply**. By Applying but not saving the preference, the factor will revert back to 100 when you next start InRoads.

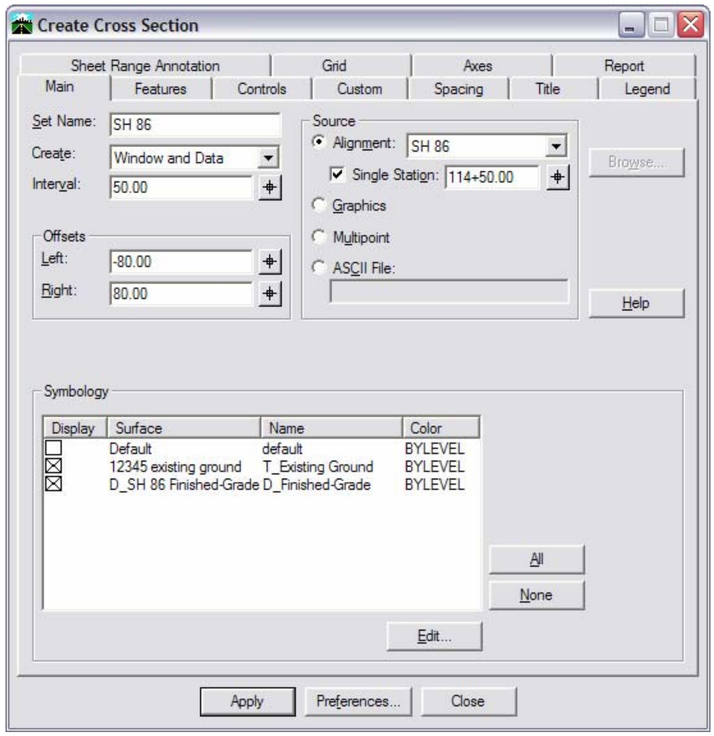


3. Select **Tools > Customize > Cross Section**, then **Close** the **Toolbars** dialog.



Up to this point, we have been using mainly the pull-down menus. Toolbars like this one are also available for selecting most commands.

4. On the **Cross Section** toolbar, select **Create Cross Sections**.



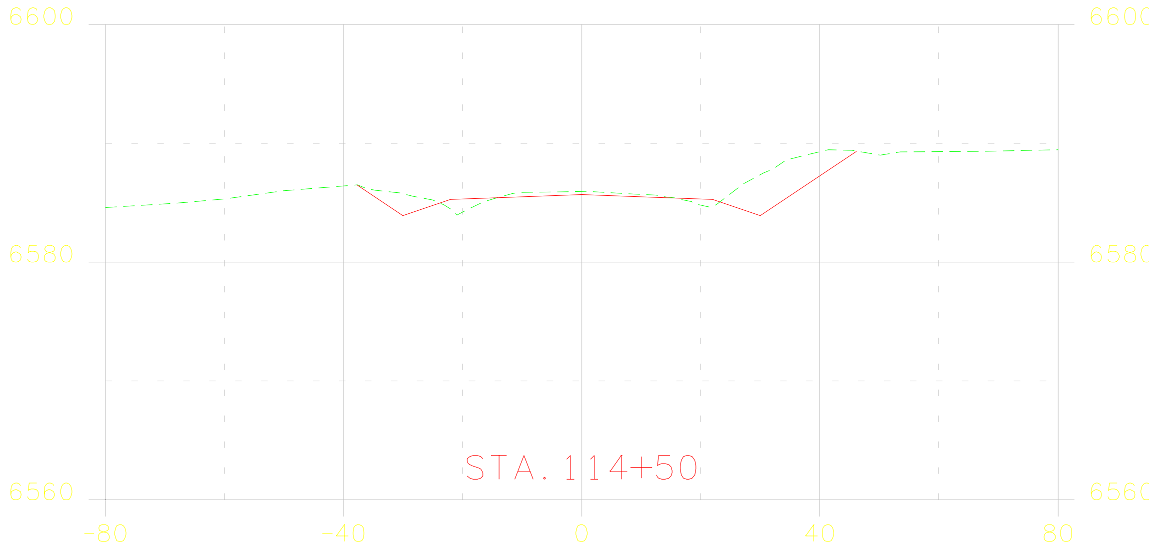
5. Choose **Preferences** and load **40H 20V 160' Wide**.

6. On the **Main** tab,

   - Set the **Source** to **Alignment** and select **SH 86**.
   - Toggle on **Single Station**.
   - Key in ***114+50*** .
   - Toggle on only **12345 existing ground** and **D_SH 86 Finished-Grade**.

7. **Apply** and **<D>** for the lower left corner of the single cross section.

8. **Zoom** in to the section.

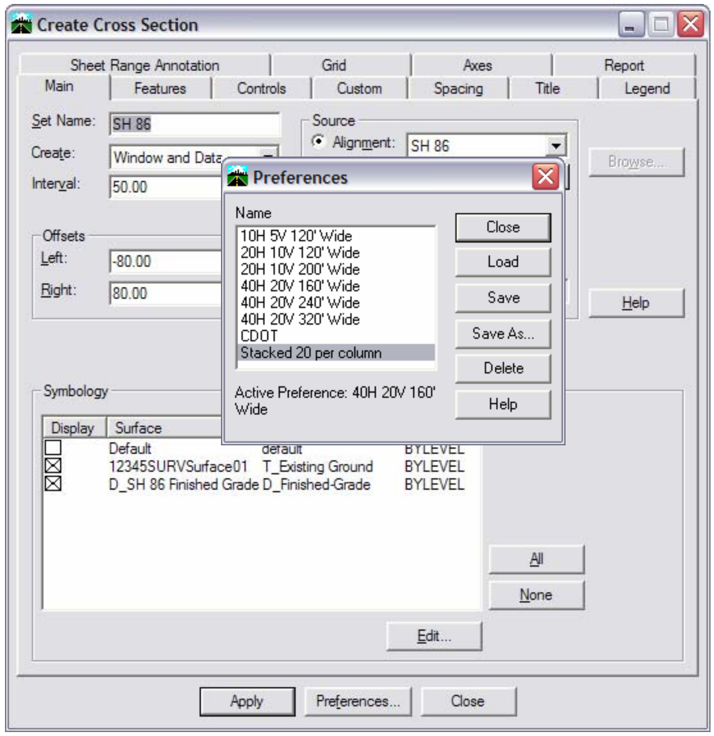


Note that the section appears inside a border. This is the default preference – next, you'll load a preference that does not use a border so you can create a working or check set of sections. Later, when you create the final sections, you'll modify a border for this job and use it to cut section on sheets.

9. **Delete** the cross section display with MicroStation when you are through reviewing.

10. On the **Create Cross Section** dialog.

    - Select **Preferences**.
    - Highlight the preference **Stacked 20 per column** and choose **Load**.
    - **Close** the **Preferences** dialog.



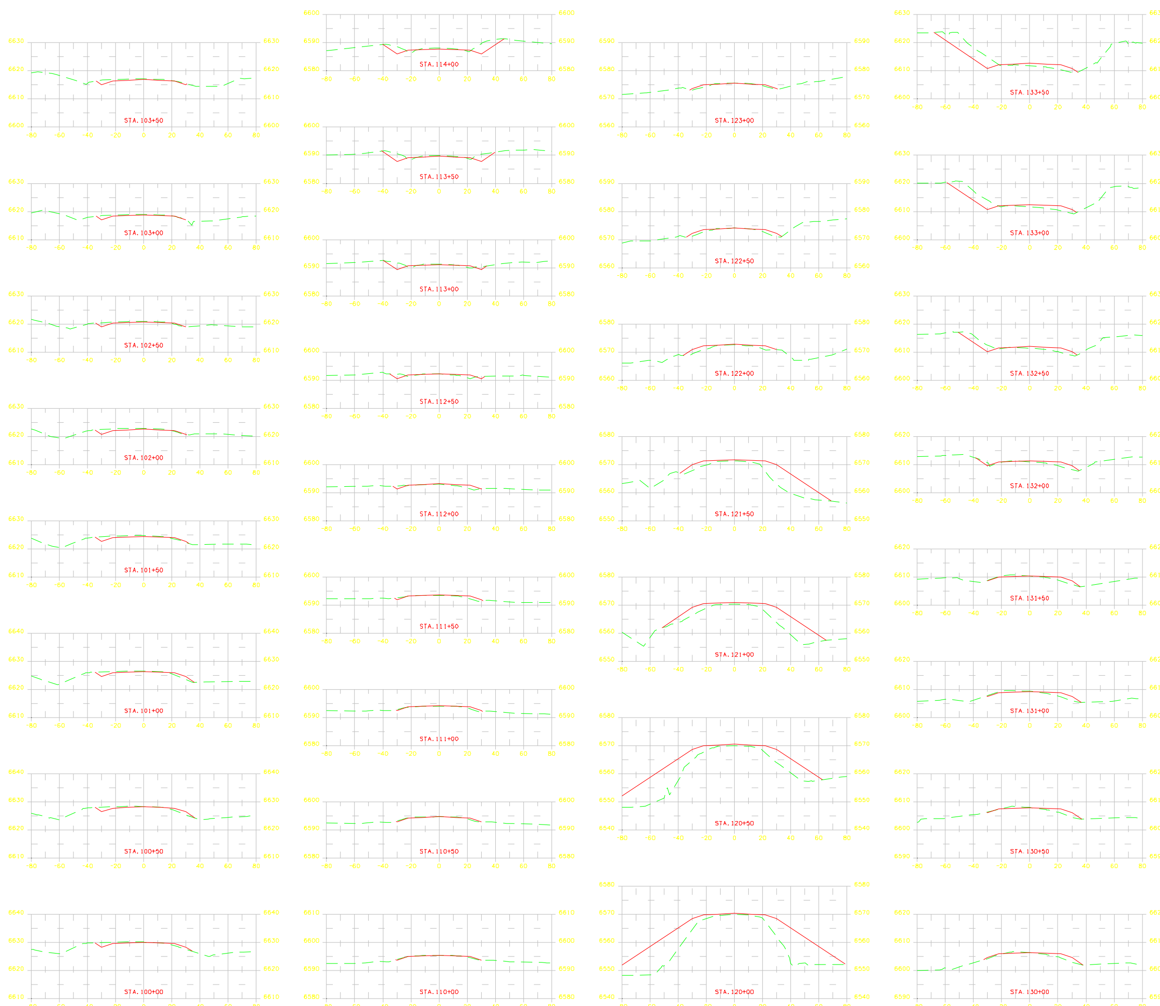
11. Toggle off **Single Station**.

12. Select **Apply**.

    Before you complete the next step, remember that the location you identify is the lower left corner of the entire cross section set, so be certain to select a clear area in your file.

    If you place the cross sections in the wrong location, make sure **Graphic Group** lock is on, then **Delete** the set and re-create it. Do not move the cross sections.

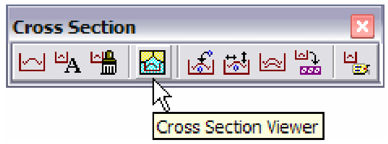
13. Place a **<D>** in the design file to specify the lower left corner of the cross section plot.

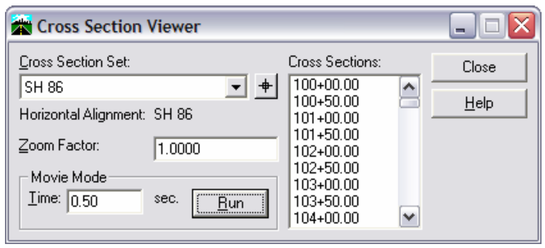


14. Select **Close** on the **Cross Section** dialog.

View the cross sections that are plotted in the design file.

1. On the **Cross Section** toolbar, select the **Cross Section Viewer** command.





- Set the **Cross Section Set** option to **SH 86** (or the last section set in the list if you haven't deleted all of your previous sets).
- Set the **Zoom Factor** to ***1.0***.
- Set the **Time** to ***0.5*** sec.

2. Select **Run**.
3. You can hit **<ESC>** on your keyboard to stop the run if you would like.
4. You can choose individual sections to look at from the **Viewer** as well. If you have only one MicroStation view open, you can use your keyboard arrow keys to step between the sections.
5. Close the **Cross Section Viewer** dialog when you are finished looking at the sections.
6. **Exit** MicroStation.

7. Modeling with Superelevation and Transitions

Superelevation

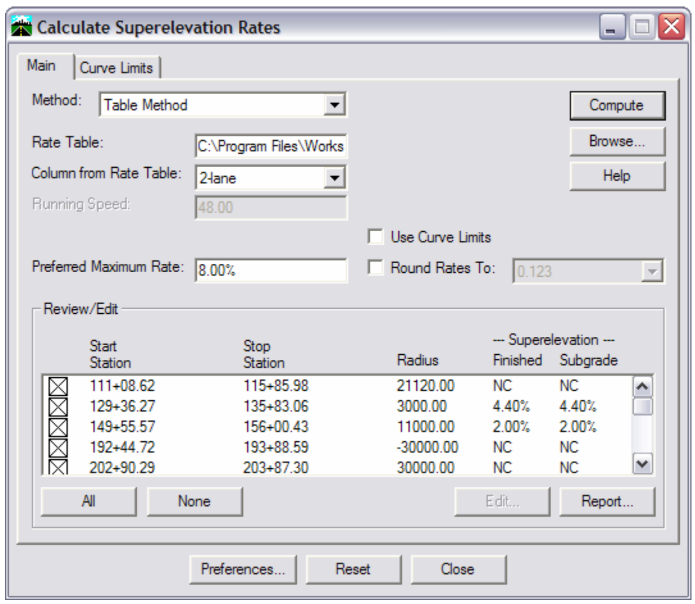
Calculating the superelevation transitions requires that the horizontal alignment, vertical alignment and roadway definitions be set. Superelevation points must also be defined in the template. After that, there are three main steps to setting up superelevation.

Calculate the rates

Select **Modeler > Superelevation > Rate Calculator**. There is a preference established for CDOT, but you will still need to **Browse** and select the appropriate superelevation table. The tables are named according to the design criteria as shown below:

08_65.sup

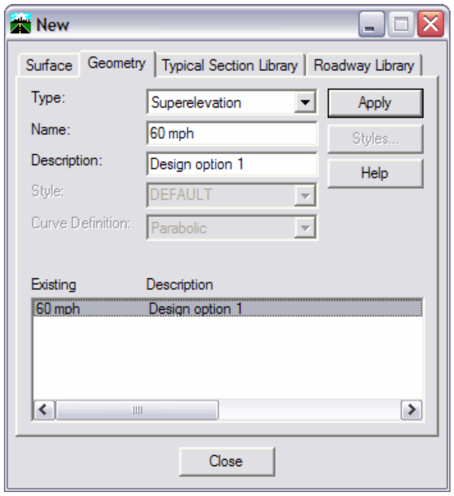
08 = max super rate in table; **65** = design speed in mph.



The CDOT superelevation tables are found in the folder **C:\Program Files\Workspace-CDOT\Standards-Global\InRoads\Superelevation Tables**. There are two subfolders – AASHTO 2001 and AASHTO 2004 – which contain their respective rate tables.

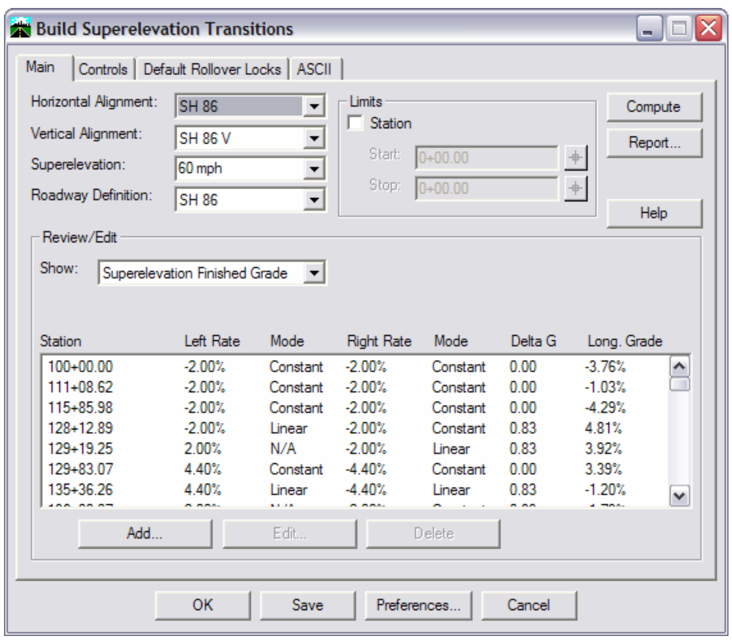
Create a superelevation alignment, which stores the stationing and rates for superelevation transitions.

Select **File > Geometry > New** and specify a name and description for your superelevation alignment.



Calculate or Build the Transitions.

Select **Modeler > Superelevation > Build Transitions.**



The CDOT standard **Controls** and **Rollover Locks** (which are turned off) are stored in the **Preferences** for the command.

Horizontal and Vertical (Independent) Control

Independent control can greatly enhance the use of templates by allowing you to vary widths and slopes of backbone segments during **Roadway Modeler** runs without using a second template.

> **Note:** Independently controlled points in the template must be in the backbone of the template.

Independent Control is setup and stored in the roadway library, with the individual roadway definitions. In order to define the controls, you must have the geometry file loaded with the alignment active that is to be used with **Roadway Modeler**, the template library loaded and the roadway library must also be loaded. The geometry file should also contain any alignments you plan to assign to different points on the template.

There are two types of controls – horizontal and vertical. They can be used individually, or in combination.

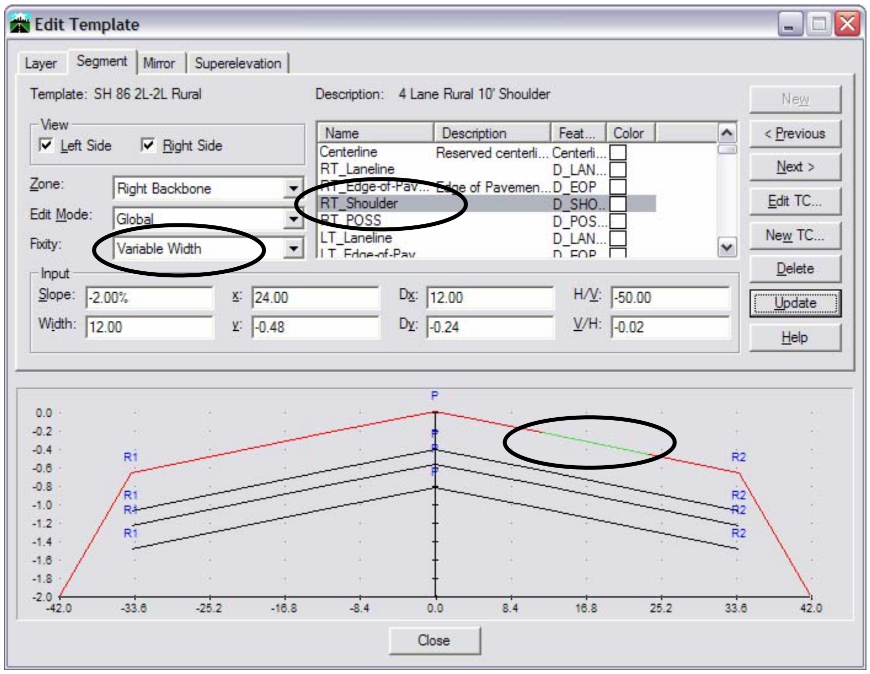
Use ***Horizontal controls*** when the independent control path is defined by a separate horizontal alignment or by stations and offsets from the mainline. Horizontal controls are used in conjunction with variable width template segments, typically for items such as lane widenings or turn lanes.

Use ***Vertical controls*** when the separate path is defined by a separate vertical alignment, a vertical difference alignment, or by vertical offsets from the mainline vertical.

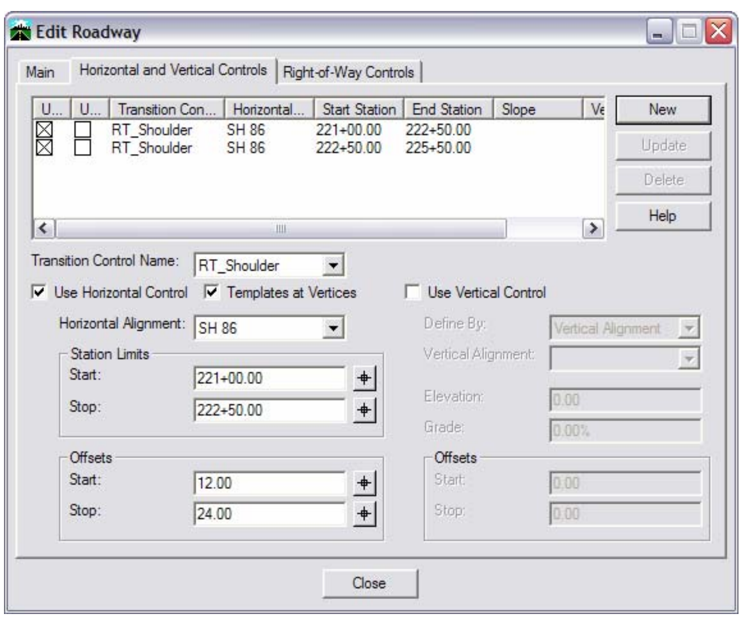
Workflow for H&V Controls

There are four basic steps.

1. Assign a unique TC name to the point on the template you want to control.
2. Set the segment you want to vary in the template to **Variable Slope**, **Variable Width** or **Variable Slope and Width**.

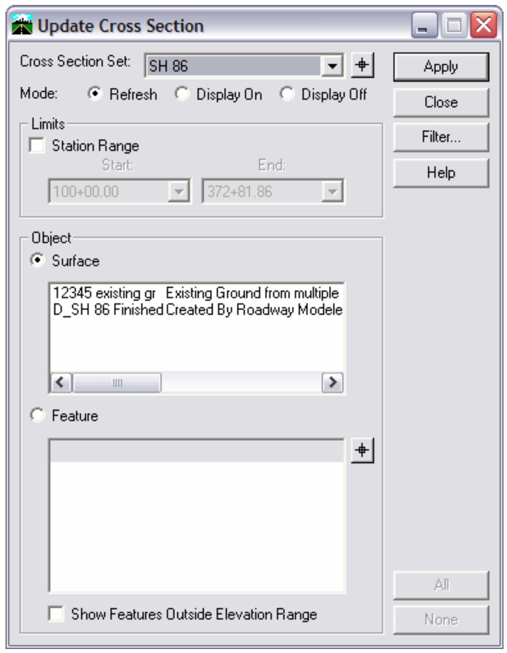


3. Make the horizontal alignment active that you're going to use for **Modeler**.
4. Establish the controls in the roadway definition.



Updating Existing Sections

Cross sections retain their association with the surfaces and features they display and therefore you can update the sections when any new information is available. For example, you may realize that you need to add a utility line into the DTM. Rather than cutting a new set of sections to show the addition, select **Evaluation > Cross Section > Update Cross Section**. From this dialog, you can either update the entire set of sections or a range of sections. The update can involve refreshing items that have already been displayed on the sections, turning those items off, or turning on items not currently displayed.



Always use this command to turn off features displayed from a design surface before running **Roadway Modeler** and creating the same surface. Otherwise, the features will not be recognized by the new surface so you will not be able to turn them off or update them later.

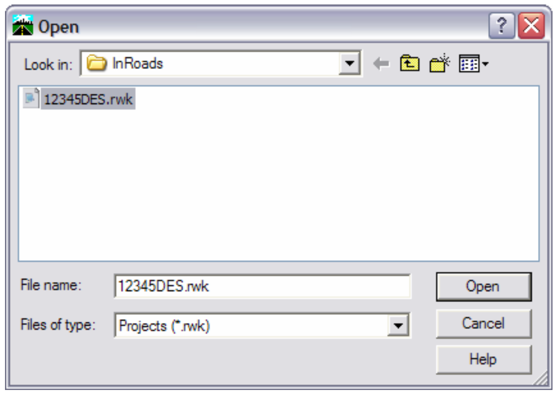
Lab 7 –Modeling with Superelevation and Transitions

Start InRoads

1. Start InRoads and open **CU12345DES_Model.dgn** from the **Design\Working** folder.

Open your InRoads data files

1. Select **File > Open**.

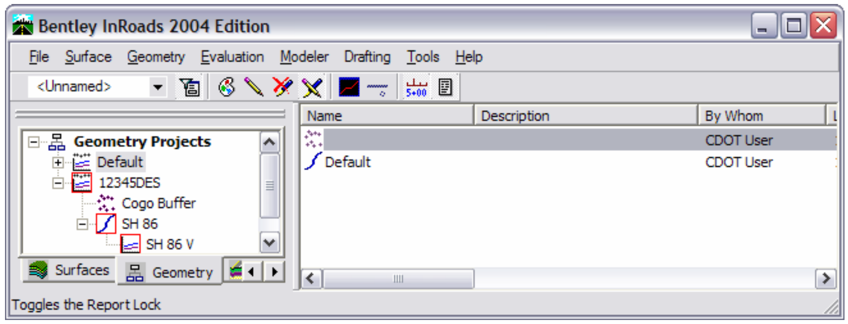


2. Ensure the **Files of Type** option is set to **Projects (*.rwk)**.
3. Double-click on **12345DES.rwk**.

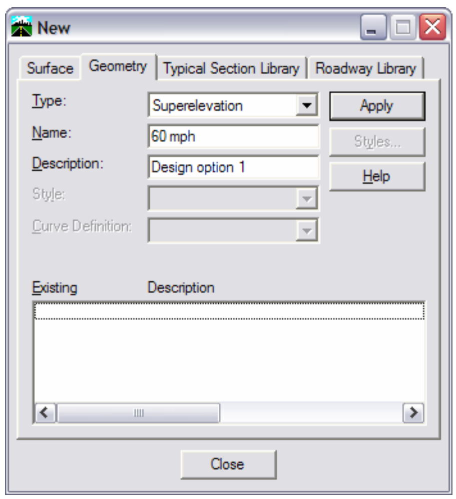
   Double-clicking is the equivalent of highlighting the file and choosing **Open**.
4. **Cancel** the dialog.

Create a superelevation alignment

1. Make certain the active alignment is **SH 86**.



2. Select **File > New**.
3. Select the **Geometry** tab.



- Set the **Type** field to **Superelevation**.
- Enter the **Name**: ***60 mph***
- Enter the **Description**: ***Design option 1***

4. Select **Apply** then **Close**.

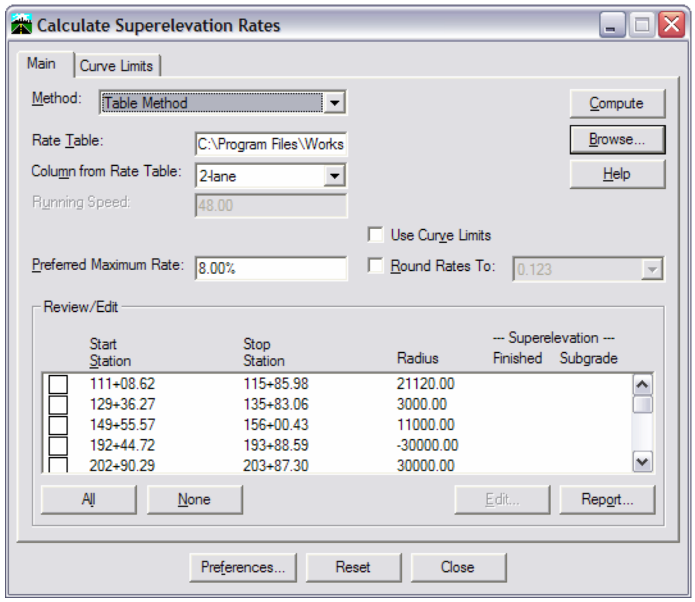
Calculate the superelevation rates

Since you are have two design speeds for the alignment, you will calculate the rates for each separately.

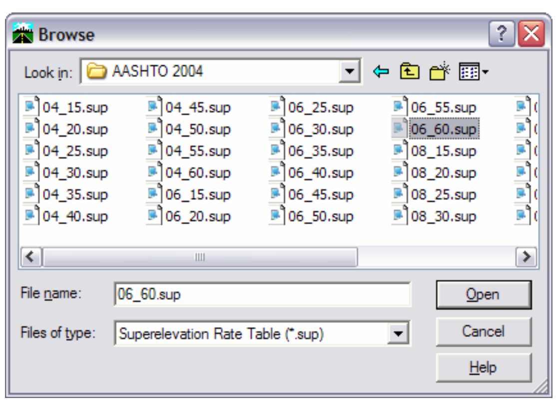
Set the superelevation rate parameters for 60 mph curves

In this example, you'll use a 6% maximum super and a design speed of 60 mph.

1. Select **Modeler > Superelevation > Rate Calculator**.



- Set the **Rate Calculation Method** to **Table Method**.
- Click in the **Rate Table** field and delete the text.
- Select **Browse** and choose **06_60.sup** from the **C:\Program Files\Workspace-CDOT\Standards-Global\InRoads\Superelevation Tables\AASHTO 2004** folder.



- Set **Column from Rate Table** to: **2-lane**.
- Enter the **Preferred Max Super Rate**: ***5.5%***

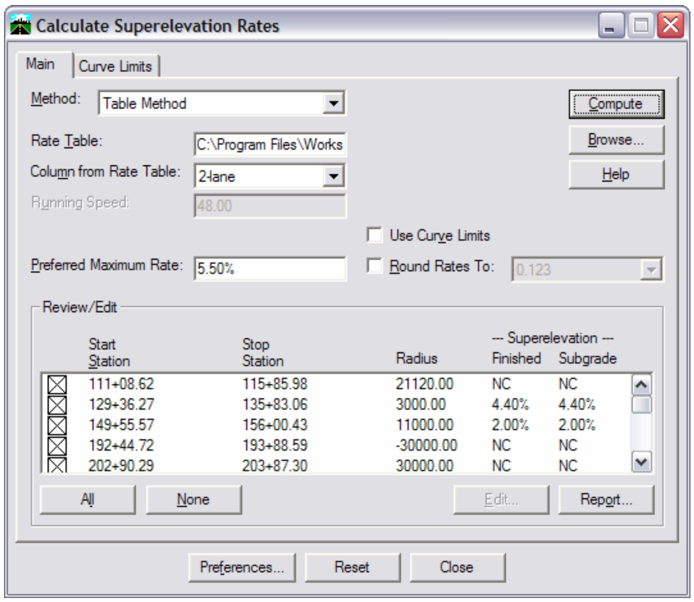
This does not limit the super that can be used – it just warns you if this rate is exceeded by the table.

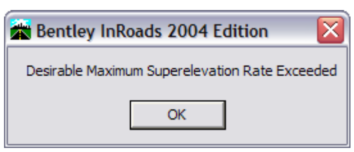
- Toggle off **Use Curve Limits**.
- Toggle on **Round Rates** to and select **0.123**.

Calculate rates

2. On the **Main** tab, select **All** to toggle on all the curves in the **Review/Edit** area.

3. Select **Compute**.





Select **OK** when you get the **Desirable Maximum Superelevation Rate Exceeded** message. This message just warns you so you can check the curves to see if it's what you want.

The superelevation rates are calculated for the curves and displayed in the **Review/Edit** category.

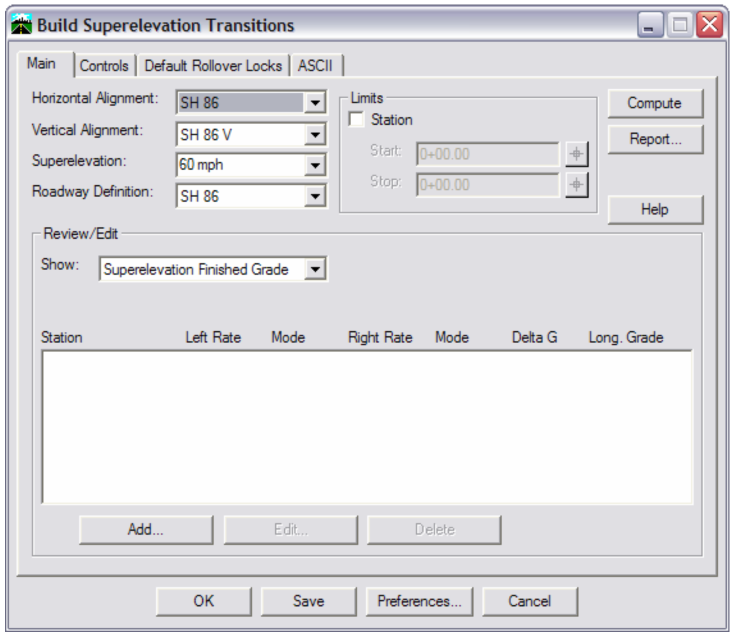
Notice the superelevation rate exceeded your preferred maximum rate. You can choose to accept this, override the calculation or redefine the curves and/or design speed. For class purposes, choose **OK**.

4. Select **Close** to dismiss the **Superelevation Rate Calculator** dialog box

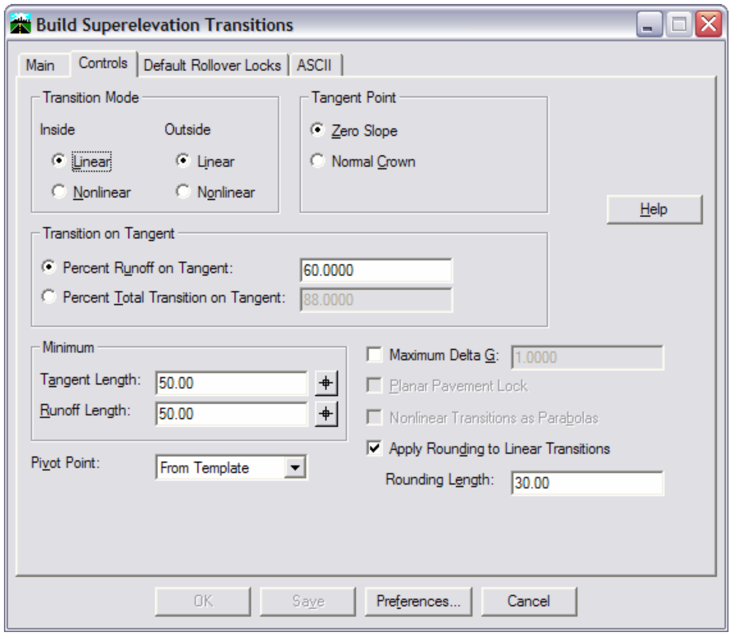
Calculate the superelevation transitions

Set the application station design parameters.

1. Make certain **Report** lock is on.
2. Select **Modeler > Superelevation > Build Transitions**.

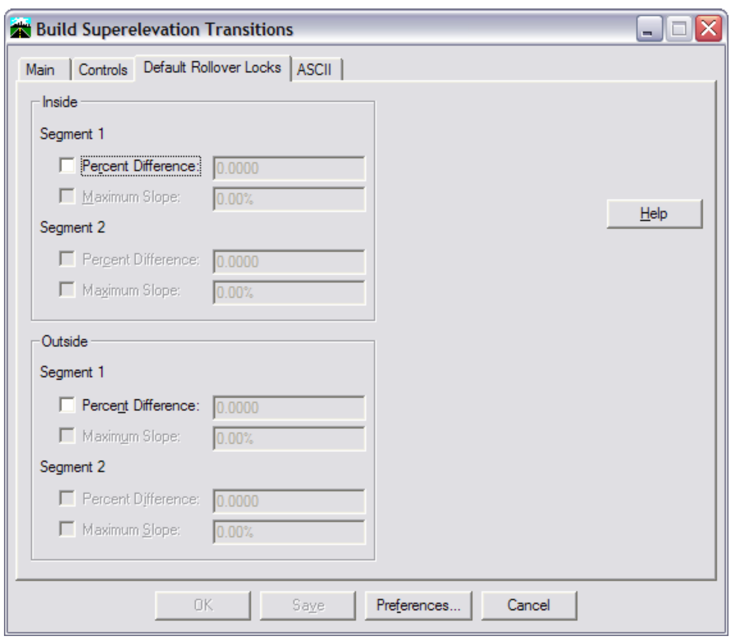


3. From the **Controls** tab,



- Review the standard CDOT superelevation controls.

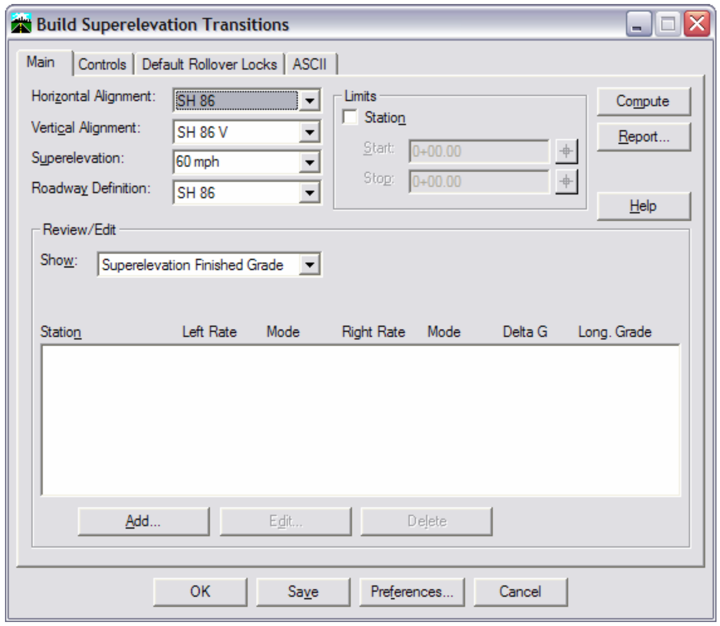
4. Choose the **Default Rollover Locks** tab.



- Notice that CDOT's superelevation criteria does not require rollover locks.

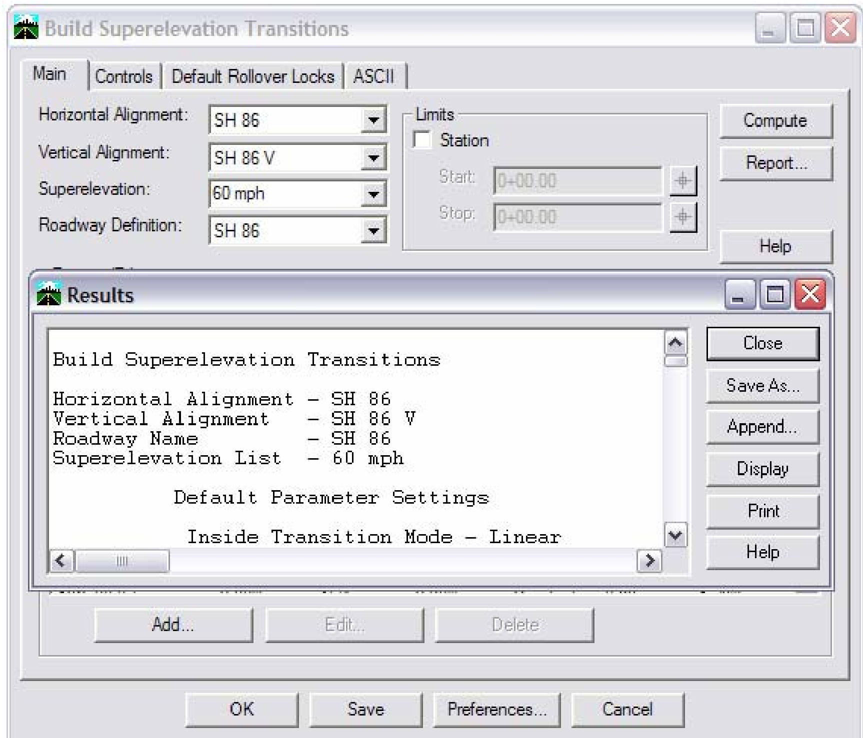
Calculate the application stations for the transitions

5. Back on the **Main** tab, make certain the:



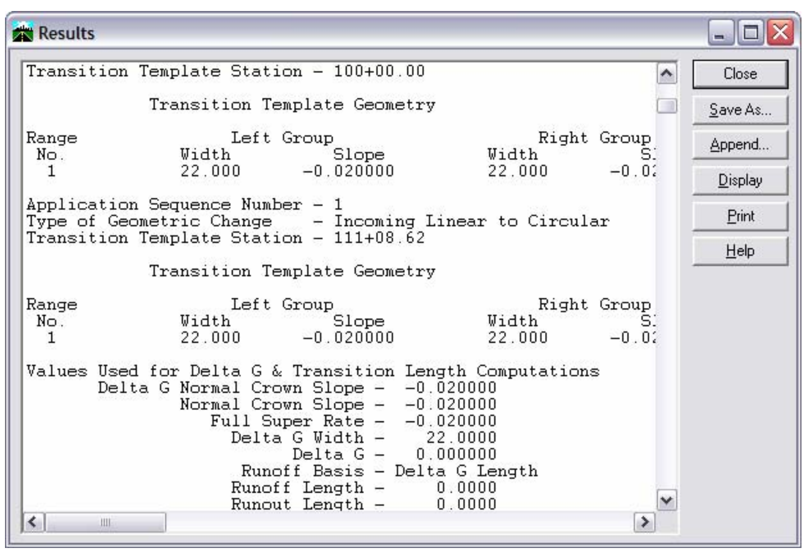
- **Horizontal Alignment** is set to **SH 86.**
- **Vertical Alignment** is **SH 86 V.**
- **Superelevation** is **60 mph.**
- **Roadway Definition** is **SH 86**.

6. Select **Compute**.

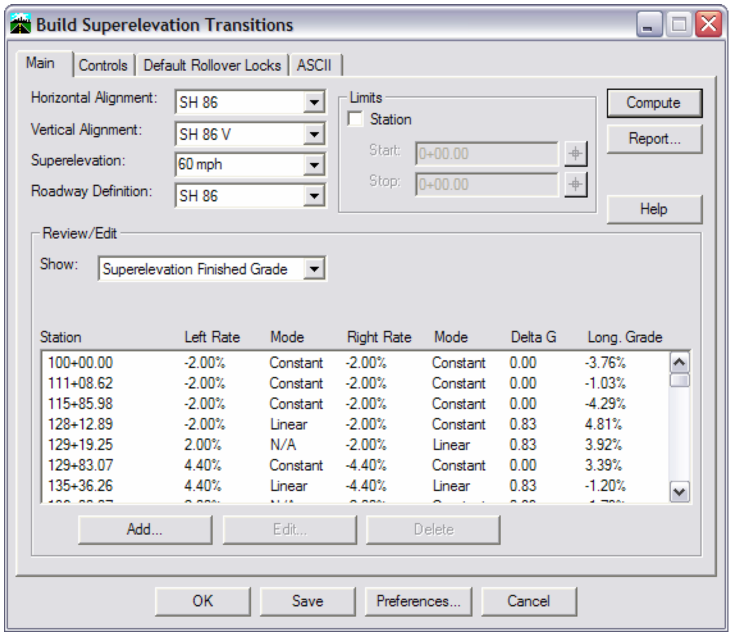


The application stations are built and displayed in the **Review / Edit Application Stations** category. The **Results** window is also displayed because the **Report** lock is on. This window shows super parameters and calculations. The **Save As** command can be used to save this information into an ASCII file on disk.

7. Review the **Results** box.



8. Choose **Save As** on the **Results** box.
    - Ensure the **Save in** folder is **C:\Projects\12345\Design\InRoads**.
    - Key in the filename **SH 86 super.txt** and choose **Save**.
9. Select **Close** on the **Results** dialog.
10. Scroll through the application stations list and review the results.



11. Select **Save** on the main dialog.
12. Select **OK**.

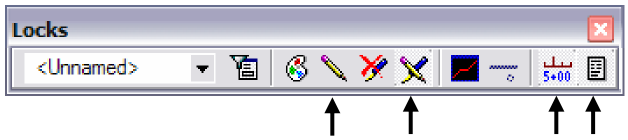
Save the application stations

The superelevation rates and application stations have all been calculated. Now save the results in the **.alg** on the disk.

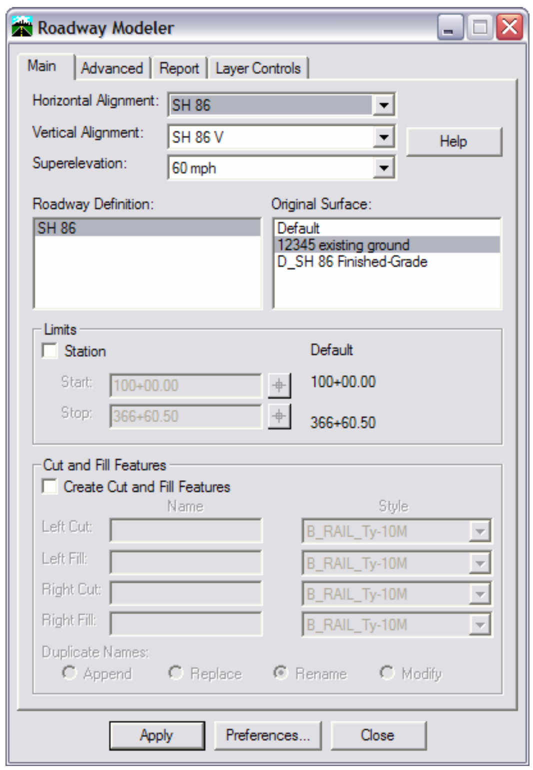
13. Select **File > Save > Geometry Project**.

Model the roadway

1. Toggle **Write** lock on.
2. Toggle **Report** lock on.
3. Set the mode to **Pencil**.
4. Toggle **Station** lock on.

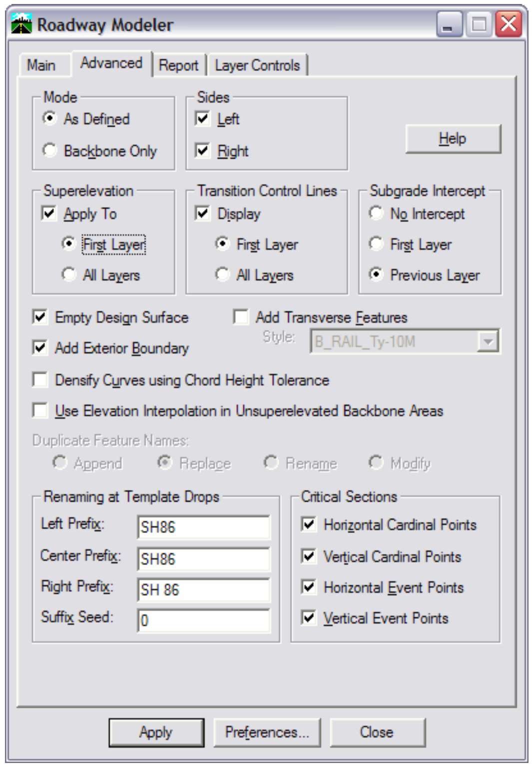


5. **Delete** all TC lines (features in plan) from the previous **Modeler** runs.
6. Select **Modeler > Roadway Modeler**.



Confirm and set additional design parameters.

7. Select the **Advanced** tab.

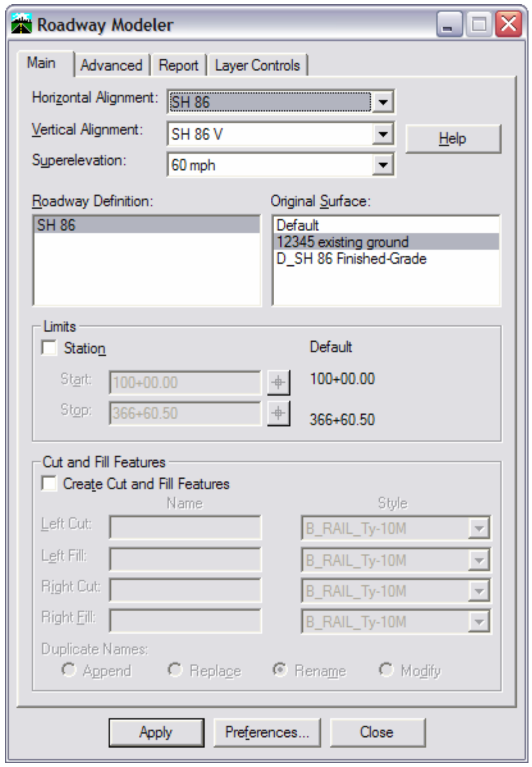


- Toggle on **Superelevation Apply to First Layer**.
- Other options should still be set as shown.

8. Select the **Layer Controls** tab.

- Toggle on **Use Layer Controls**.
- Highlight **Finished Grade** and make certain **Model Layer** is checked
- Toggle all **Rollovers** off.
- Highlight each of the other listed layers (one at a time) and toggle off **Model Layer** and **Rollovers**

9. Back on the **Main** tab, make certain the:



- **Horizontal Alignment** is set to **SH 86**.
- **Vertical** is **SH 86 V**.
- Highlight the Roadway Definition **SH 86**.
- Under the **Original Surface** list, highlight only **12345 existing ground**.
- Toggle off **Create Cut and Fill Features**.

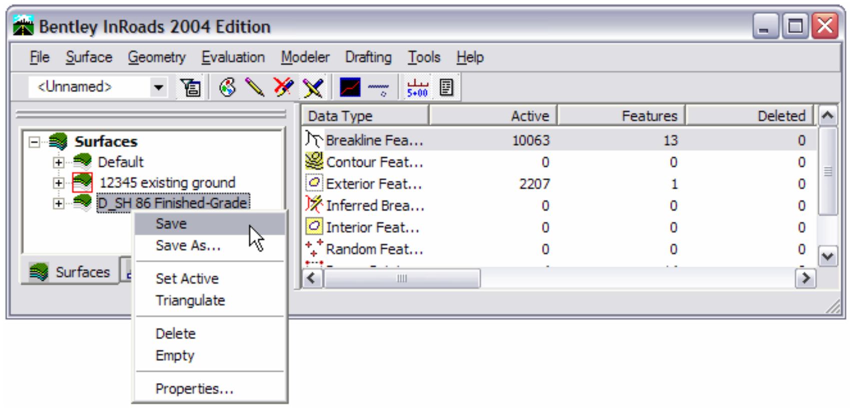
10. Select **Apply**.

    The templates are applied along the alignment as defined in the roadway definition and superelevation is applied as it was calculated. A new surface is created for **D_SH 86 Finished-Grade**. Since **Empty Design Surface** was toggled on, the previously modeled surface is emptied and the new model with superelevation takes its place.

11. Select **Close** to dismiss the **Roadway Modeler** box.

Save the new surface

1. Right-click on **D_SH 86 Finished-Grade** in the **Workspace** (Explorer) portion of the InRoads menu and select **Save**.



View the results of Roadway Modeler

1. **Zoom** in or out as needed with MicroStation to visually review the display of the Transition Control (TC) lines.

Display the triangles for the proposed surface.

2. Select **Surface > View Surface > Triangles**.
3. Set the **Surface** to **D_SH 86 Finished-Grade**.
4. Select **Apply** then **Close**.
5. Use the MicroStation **View Control** commands to take a closer look at the display. (Try rotating a view to see the super.)
6. Use MicroStation **Delete Element** to delete the triangle display (graphic group lock on).

View contours for the proposed surface

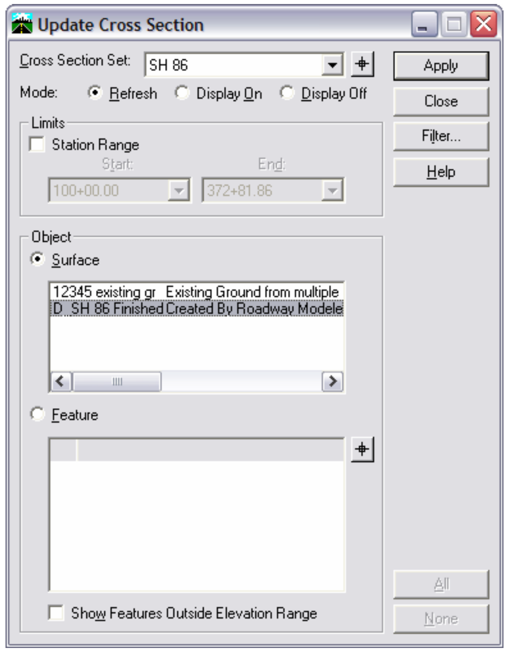
7. Select **Surface > View Surface > Contours**.
8. Set the **Surface** to **D_SH 86 Finished-Grade**.
9. Select **Preferences** and load **Proposed 10’ Mjr. – 2’ Minor**.
10. Select **Apply**.
11. Use MicroStation **View** commands to take a closer look at the contours.
12. Use MicroStation **Delete Element** command to delete the contour display.
13. Remember that the contour display is a graphic group.

Update the Cross Sections

Since you already have a set of section for the roadway, you can just update them with the new surface instead of creating a whole new set.

1. Make sure you're in a top view, then **Fit**.

2. Choose **Evaluation > Cross Section > Update Cross Section**.



- Choose the **Cross Section Set** that contains your previously cut full set of section. You can tell which one you select by the box that's drawn around the set.
- Set the **Mode** to **Refresh**.

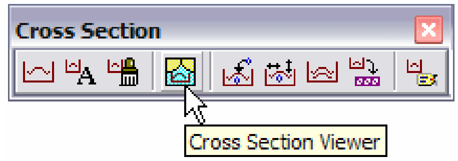
You can **Refresh** or toggle **Off** items that are currently displayed on the sections. You can toggle **On** items that are not currently displayed.

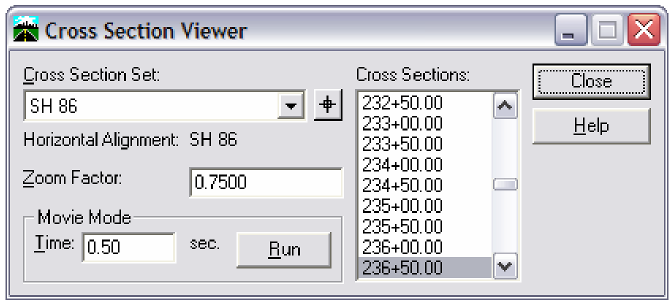
- Toggle on **Surface** in the **Object** category.
- Highlight **D_SH 86 Finished-Grade**.

3. Choose **Apply**.

The surface displayed in the cross sections is replaced with the newly modeled surface.

4. On the **Cross Section** toolbar, select the **Cross Section Viewer** command.





- Set the **Cross Section Set** option to the cross section set you just updated.
- Set the **Time** to ***0.5*** sec.
- Select **Run**.

Watch for the sections through the curve to see the superelevation.

5. Close the **Cross Section Viewer** dialog.

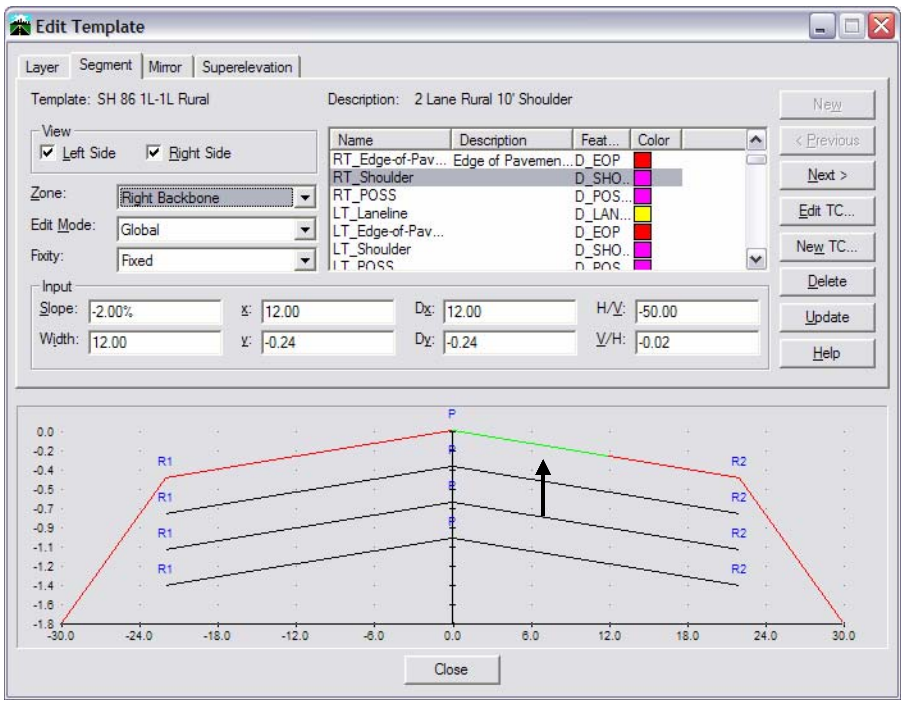
Using Independent Control

In this section, you will add an independent control setup for creating a turn lane.

Update the template for independent control

In the template, you must have a unique TC name assigned to the point you want to control.

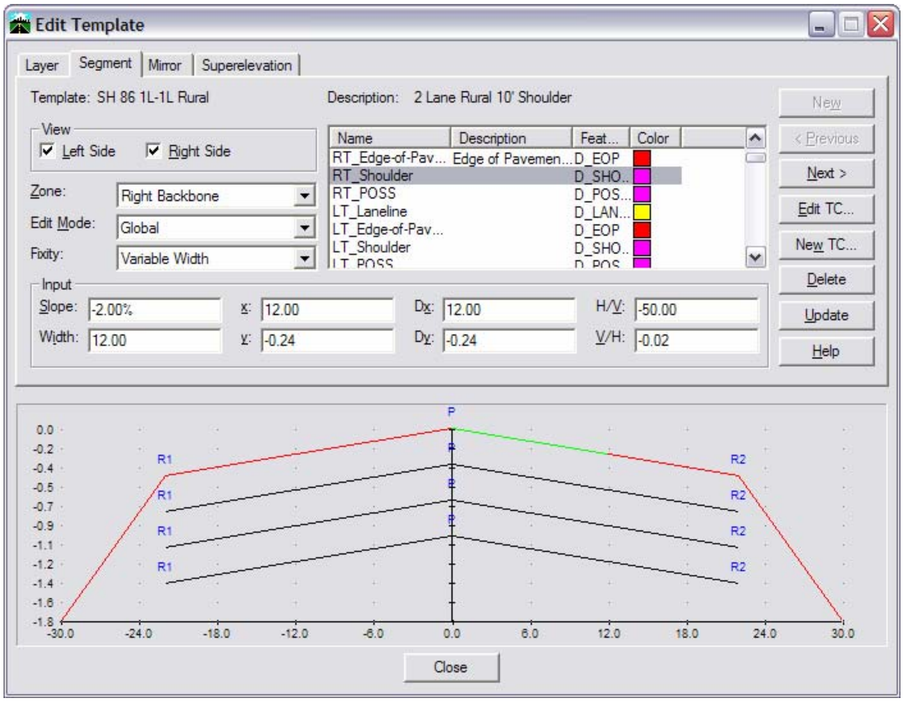
1. Select **Modeler > Define Typical Section**.
2. On the **Templates** tab, highlight **SH 86 1L-1L Rural** and choose **Edit**.
3. Highlight the **D_SH 86 Finished-Grade** layer and choose the **Segment** tab.



- Set the **Zone** to **Right Backbone**.
- Choose **Previous** or **Next** as necessary to make the active segment (green) the right driving lane.

Since we want this segment to widen for the turn lane, we must tell InRoads that the segment may vary in width, but hold the slope constant.

In this particular example, since we are only going to use Horizontal Control to widen one segment next the TC name you're controlling, you could actually leave the Fixity set to Fixed and the lane would widen. However, it's much safer to get in the habit of always changing the fixity of segment you want to vary.



- Under **Fixity**, choose **Variable Width**.
- Choose **Update** to confirm the change.

Notice the TC name that is highlighted. It should be **RT_Shoulder**.

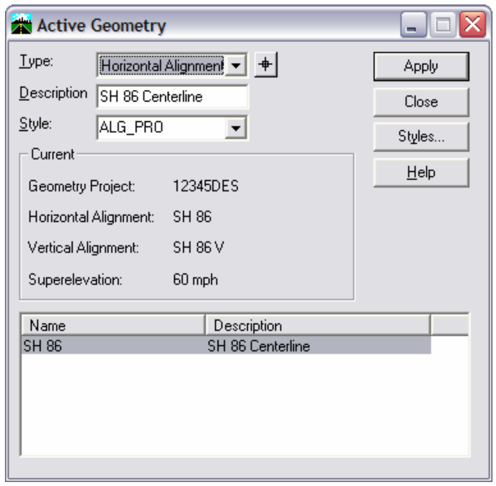
This is a unique name, since there should be only one **RT_Shoulder** on the template. You can step back and forth to other segments to verify they have different names.

4. Close the **Edit Template** dialog.
5. Close the **Define Typical Section** dialog.

Assign the controls in the roadway definition

When you assign the controls in the roadway definition, the stationing it uses is based on the active alignment. Since we'll be using **SH 86** to run **Modeler**, you must make it active before proceeding.

6. Choose **Geometry > Active Geometry**.



- Set the **Type** to **Horizontal Alignment**.
- From the list at the bottom, select **SH 86**.

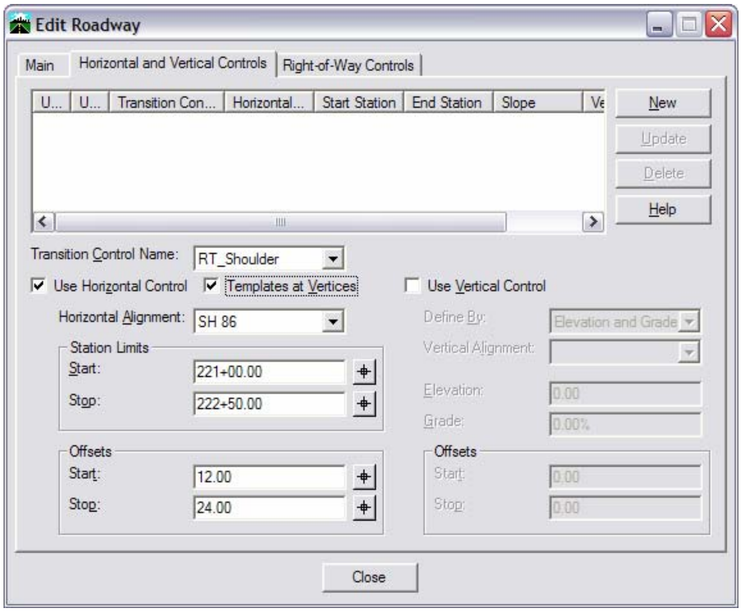
7. Choose **Apply**.

8. **Close** the **Active Geometry** dialog.

Alternately, you can right-click the alignment in the InRoads Explorer menu and choose **Set Active**.

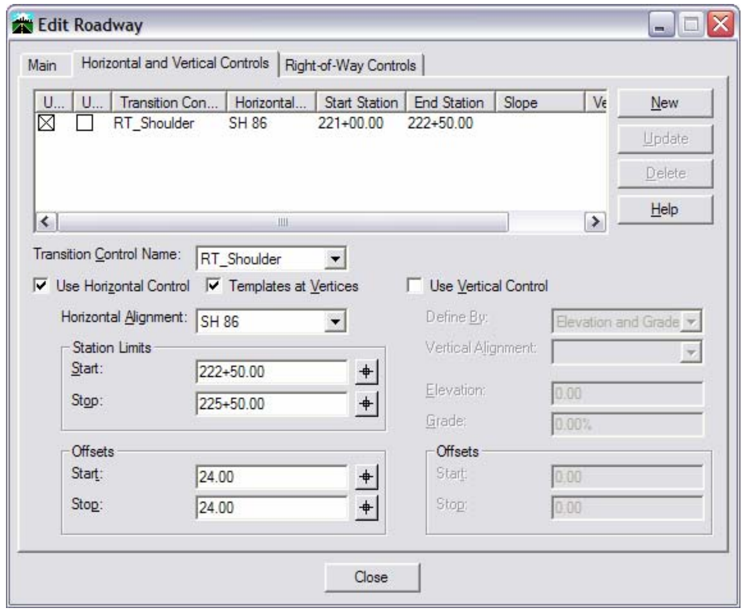
9. Verify the active alignment by looking in the InRoads Explorer menu to ensure the red box is indicating **SH 86**.

10. Select **Modeler > Define Roadway**.
11. Highlight **SH 86** and choose **Edit**.
12. On the **Edit Roadway** dialog, choose the **Horizontal and Vertical Controls** tab.



- Set the **Transition Control Name** to **RT_Shoulder**.
- Toggle on **Use Horizontal Controls** and **Templates at Vertices**.
- Toggle off **Use Vertical Controls**.
- Choose the **Horizontal Alignment SH 86**.
- Key in a **Start Station** of ***221+00***
- Key in a **Stop Station** of ***222+50***
- Key in a **Start Offset** of ***12.0***
- Key in a **Stop Offset** of ***24.0***

13. Choose **New** to add the independent control.



This takes care of the taper to widen out for the turn lane. Next, you'll add an entry to carry the widening for 300' up to the intersection.

- Leave the setting as they are, except:
- Key in a **Start Station** of ***222+50***
- Key in a **Stop Station** of ***225+50***
- Key in a **Start Offset** of ***24.0***
- Key in a **Stop Offset** of ***24.0***

14. Choose **New**

15. **Close** both of the open dialogs.

Save the new setup

Since we have modified both the typical section library and the roadway library, we can save them in one step by saving the project.

16. Choose **File > Save > Project**.

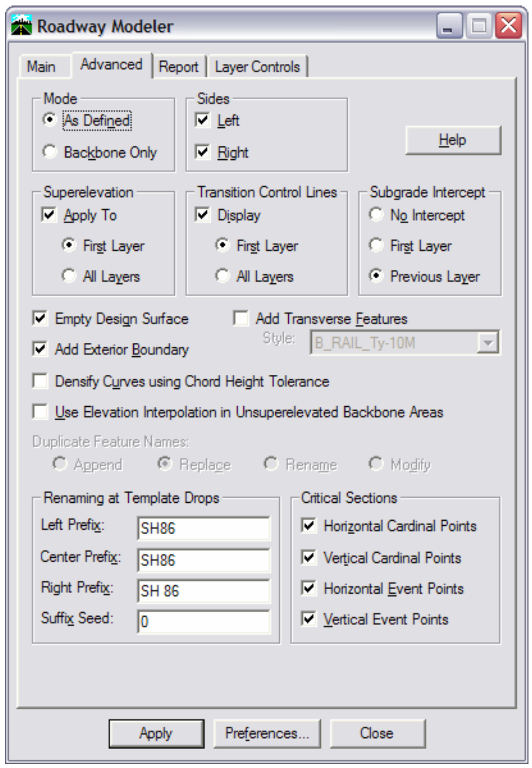
Model the roadway

1. **Delete** all TC lines (features in plan) from the previous **Modeler** runs.
2. Select **Modeler > Roadway Modeler**.

Confirm the design parameters.

These should all still be set if you haven't exited InRoads, but it's always a good idea to double-check, especially the alignments and existing surface, since they reflect the actives.

3. Select the **Advanced** tab.

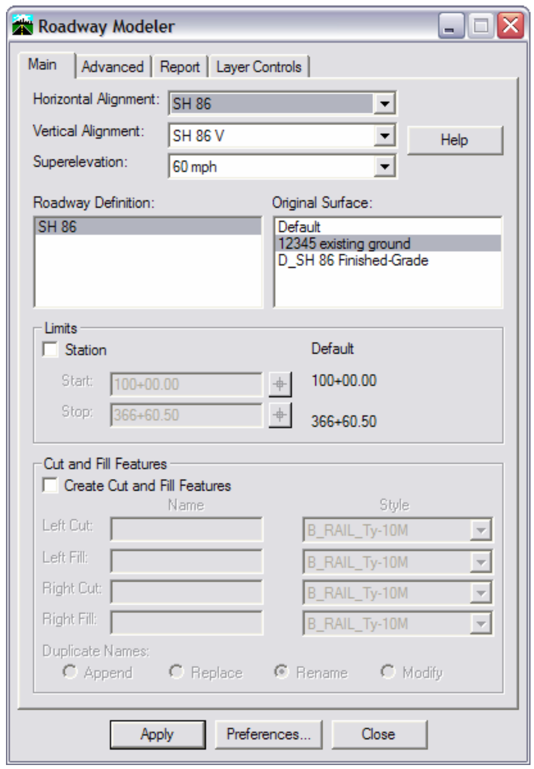


- Verify the settings you previously made.

4. Select the **Layer Controls** tab.

    - Toggle on **Use Layer Controls**.
    - Toggle off **Segment 1** under both **Inside** and **Outside Rollover Locks** categories.
    - Under **Layers**,
    - Highlight **Finished Grade** and make certain **Model Layer** is checked.
    - Highlight each of the other listed layers (one at a time) and toggle off **Model Layer**.

5. Back on the **Main** tab, make certain the:



- **Horizontal Alignment** is set to **SH 86**.
- **Vertical** is **SH 86 V**.
- Highlight the Roadway Definition **SH 86**.
- Under the **Original Surface** list, highlight only **12345 existing ground**.
- Toggle off **Create Cut and Fill Features**.

6. Select **Apply**.

   The templates are applied along the alignment as defined in the roadway definition, superelevation is applied as it was calculated, and the independent control is applied as it was defined. A new surface is created for **D_SH 86 Finished-Grade**.

7. Select **Close** to dismiss the **Roadway Modeler** box.

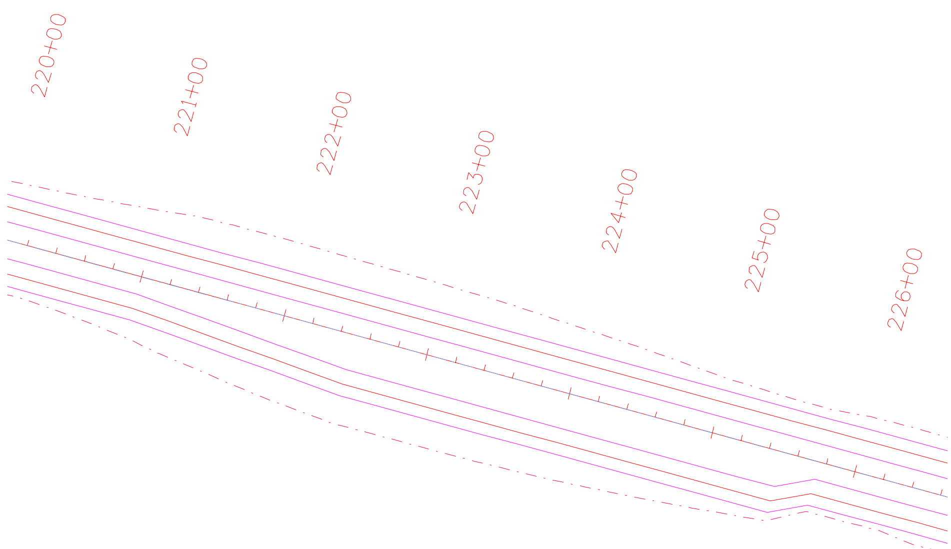
Save the new surface

1. Right-click on **D_SH 86 Finished-Grade** in the **Workspace** (Explorer) portion of the InRoads menu.

2. Select **Save**.

View the results of Roadway Modeler

1. **Zoom** in or out as needed with MicroStation to visually review the display of the Transition Control (TC) lines. Be sure to look at the turn lane area to see how the model widens.



Display the triangles for the proposed surface.

1. Select **Surface > View Surface > Triangles**.
2. Set the **Surface** to **D_SH 86 Finished-Grade**.
3. Select **Apply** then **Close**.
4. Use the MicroStation **View Control** commands to take a closer look at the display. (Try rotating a view to see the super.)
5. Use MicroStation **Delete Element** to delete the triangle display (graphic group lock on).

View contours for the proposed surface

1. Select **Surface > View Surface > Contours**.
2. Set the **Surface** to **D_SH 86 Finished-Grade**.
3. Select **Preferences** and load **Proposed 10' Mjr. – 2' Minor**.
4. Select **Apply**.
5. Use MicroStation **View** commands to take a closer look at the contours.
6. Use MicroStation **Delete Element** command to delete the contour display.

   Remember that the contour display is a graphic group.

Update the Cross Sections

Since you already have a set of section for the roadway, you can just update them with the new surface instead of creating a whole new set.

1. Make sure you're in a top view, then **Fit**.
2. Choose **Evaluation > Cross Section > Update Cross Section**.
    - Choose the Cross Section Set that contains your previously cut full set of section. You can tell which one you select by the box that's drawn around the set.
    - Set the **Mode** to **Refresh**.

    You can **Refresh** or toggle **Off** items that are currently displayed on the sections. You can toggle **On** items that are not currently displayed.

    - Toggle on **Surface** in the **Object** category.
    - Highlight **D_SH 86 Finished-Grade**.
3. Choose **Apply**.

    The surface displayed in the cross sections is replaced with the newly modeled surface.

4. On the **Cross Section** toolbar, select the **Cross Section Viewer** command.
    - Set the **Cross Section Set** option to the cross section set you just updated.
    - Set the Time to ***0.5*** sec.
5. Select **Run**.

    Watch for the sections through the curve to see the superelevation and through the turn lane are to see the widening.

6. Select a cross section in the turn lane area to better see the widening without the viewer running.
7. Close the **Cross Section Viewer** dialog.

Drive the roadway

1. Select **Modeler > Drive Roadway**.
    - Highlight the **Horizontal Alignment SH 86**.
    - Highlight the **Vertical Alignment SH 86 V**.
2. Choose **Run**.

   If you have multiple windows open, you must **<D>** where you want to see the drive-through; if you only have one window open, it automatically uses it.
3. Close the **Drive Roadway** dialog.
4. Set your view back to **Top**.

Exit

1. **Exit** MicroStation. If prompted to save the geometry project, choose **Yes**.

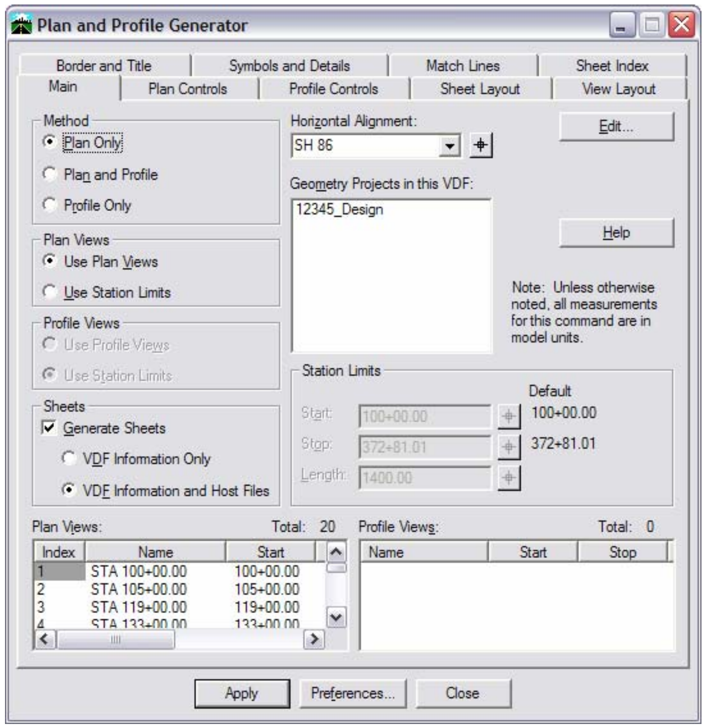
Challenge lab

Create right turn lane at the intersection for the East-bound lanes. You may create an alignment or use Stations and Offsets from the CL.

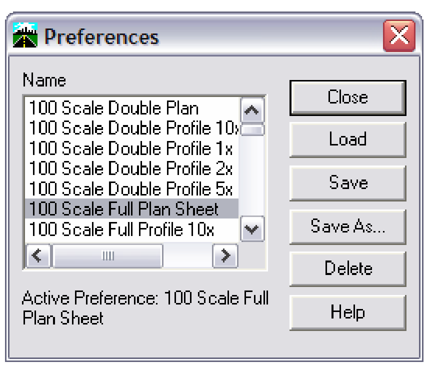
8. Plan and Profile

Concept

The **Plan and Profile Generator** automates the process of putting together sheets. It uses MicroStation's reference file utilities so that when done, you have a MicroStation sheet file with the border, plan view, associate profile view and any references to the plan attached and the view rotated to the proper angle.



Select **Drafting > Plan and Profile Generator**. There are CDOT preferences for this command: a CDOT default, one for Plan Sheets only, one for Profile Sheets only and one for Plan and Profile Sheets.



The **Plan and Profile Generator** uses three main types of files:

- ***Model Files***, which are MicroStation design files containing your plan and profile along with any references to those files.
- A ***Border File***, which is a MicroStation file containing the CDOT border you wish to use for your sheets. The Border can be referenced in or used as a cell.
- A ***Seed File***, which is a MicroStation design file that will be copied to form the design files when sheets are created.

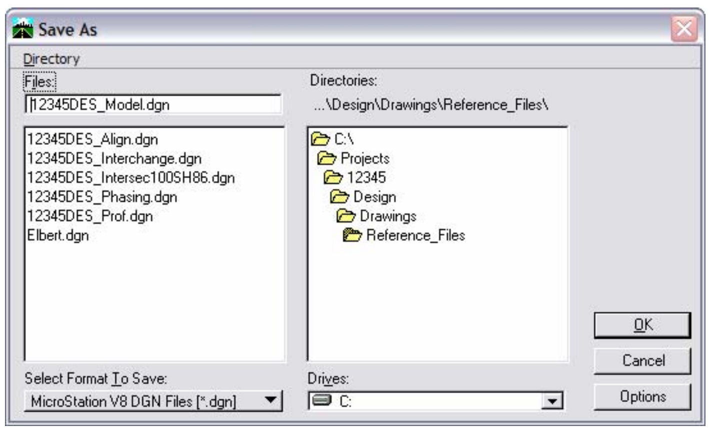
Host files are created, which are actually the sheet files containing the plan, profile or plan and profiles along with a border. Also created is a view definition file (**.vdf**) that stores all of the information about the sheets and can be retrieved later if you need to modify a sheet or sheets. Without the **.vdf** file, you can still modify the sheets using MicroStation referencing commands.

Lab 8 – Plan and Profile

The InRoads Plan and Profile Generator uses several different files to put together your Plan and Profile sheets. Here, you will create a border file to be used in each plan and profile. You will also create a profile design file, a seed file to be used for creating the individual sheets and a host file to use as the starting point for your sheets.

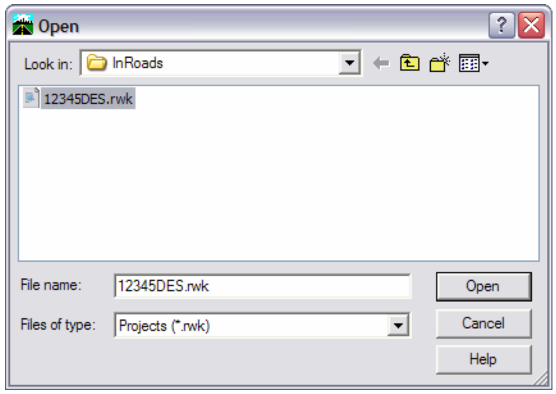
Start InRoads

1. Start InRoads and open **CU12345DES_Model.dgn** from the **Design\Working** folder.
2. Select **File > Save As** from the MicroStation menu
3. Change the folder to **Design\Drawings\Reference_Files**
4. Take the **CU** off the file name.
5. Choose **OK**.



Open your InRoads data files

1. Select **File > Open**.



2. Ensure the **Files of Type** option is set to **Projects (*.rwk)**.
3. Double-click on **12345DES.rwk**.

   Double-clicking is the equivalent of highlighting the file and choosing **Open**.
4. **Cancel** the dialog.
5. Make certain **Write** lock is on.
6. Make certain **Station** lock is on.

Create a project specific border

In order to use the **Plan and Profile Generator**, you need to have a border.

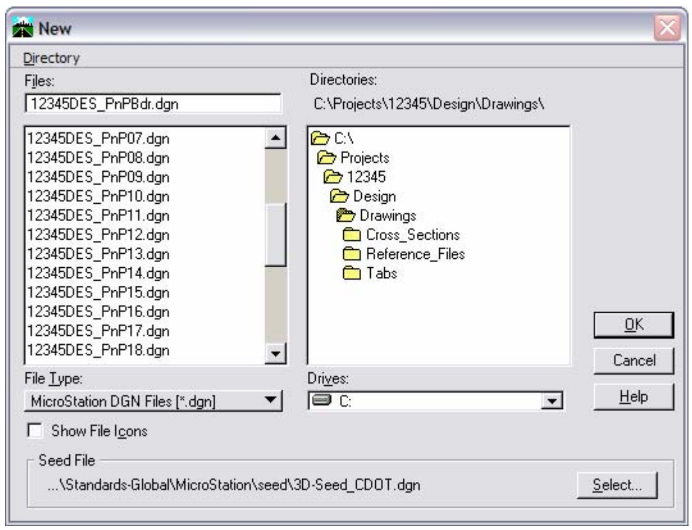
You can use the following method to create a project-specific border cell. This method uses the CDOT menu to place the border, and then edit it for your situations. After it is edited, you will use it as a cell to replace the border in the copied plan sheets.

Alternately, you can keep the Design borders and edit them individually. The method you choose should depend on the amount of edits you need to do to each and the number of sheets to edit.

Create the border file

Since you will use this border for multiple sheets, create one project border to avoid editing multiple borders later.

1. From MicroStation, select **File > New.**



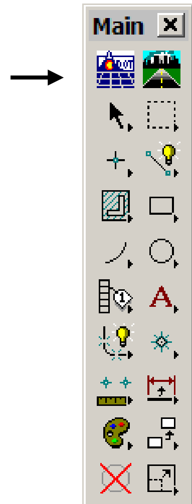
2. Set the directory to **\Design\Drawings**.

3. In the **Name** field, key in a drawing file name ***12345DES_PnPBdr.dgn***

4. In the **New** dialog box, select **OK**.

Use the CDOT Menu to create the border

1. To start the CDOT Menu if it has been closed, select the CDOT icon on the Main tool palette.

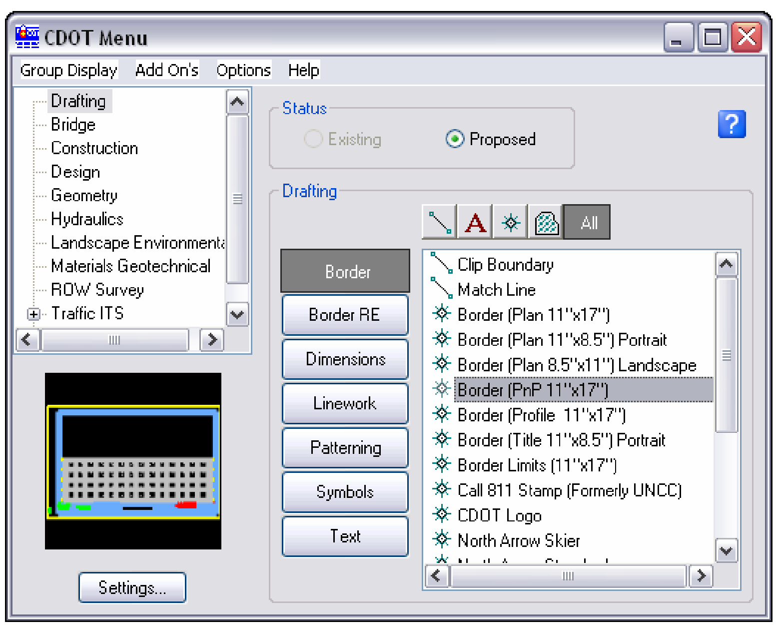


2. Select **Settings** and set **Active Scale** to ***1*** and **Active Angle** to ***0***.

Note: You will create the generic project border cell at a scale of 1 (11 x 17 master units). You'll actually scale the border, according to your plot scale, later when the cell is placed in the sheet file.

3. Select **Apply** and **Close** in the **Active Settings** box.

4. From the CDOT Menu Explorer, select **Drafting**, then select the Category **Border**. From the Selection Window, pick **Border (PnP 11"x17")**



5. When prompted to enter cell origin, key in ***xy=0,0,0***

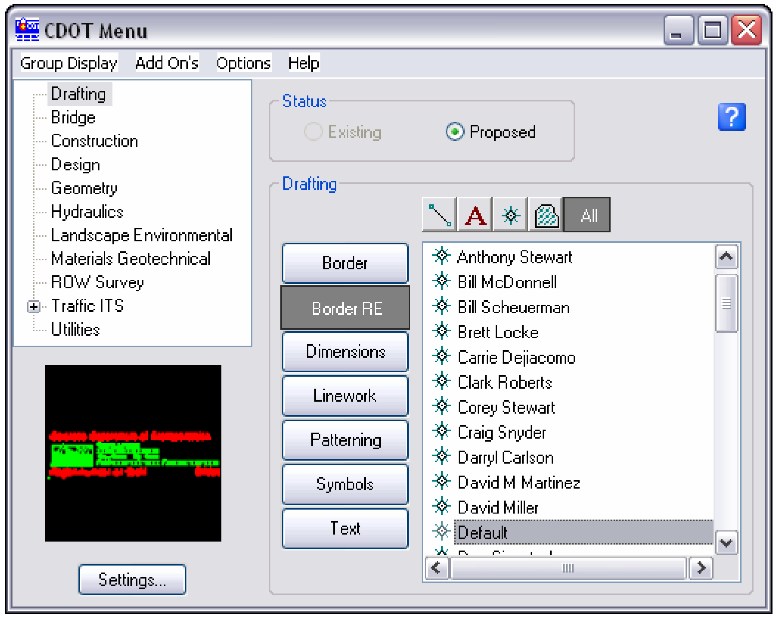
   Note: The lower left corner of the border must be located at the 0,0 coordinate in the file since this will be the origin of the cell.

   The sheet border cell is not anchored to your cursor but will be visible after you place it.

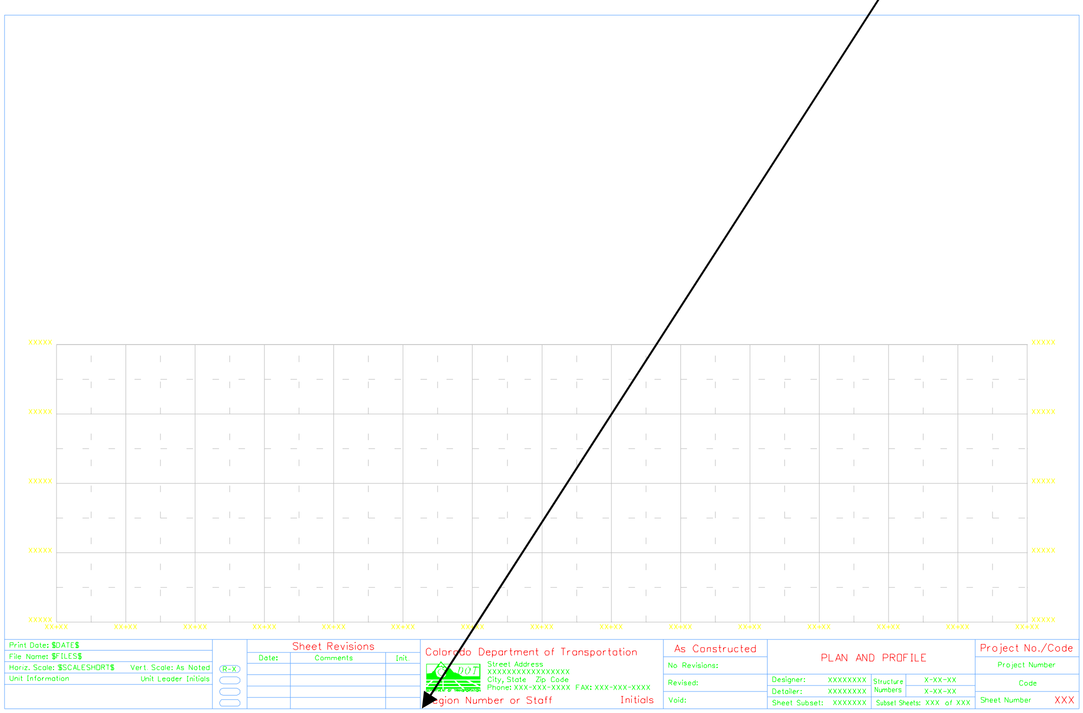
   You will place the bar scale and north arrow cell in each sheet.

6. **Fit** your view.

7. Back on the CDOT Menu, set the Category to **Border RE** and select your RE's Name.



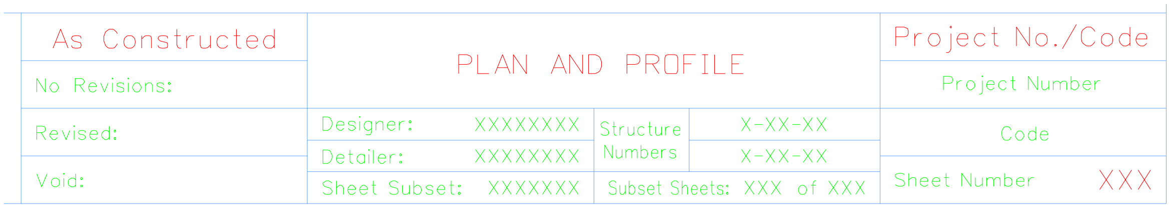
8. When prompted to enter cell origin of the **Region Engineer** cell, **Zoom in** as necessary on the bottom portion of the border and **<T>** to the location shown and then **<D>** to accept.



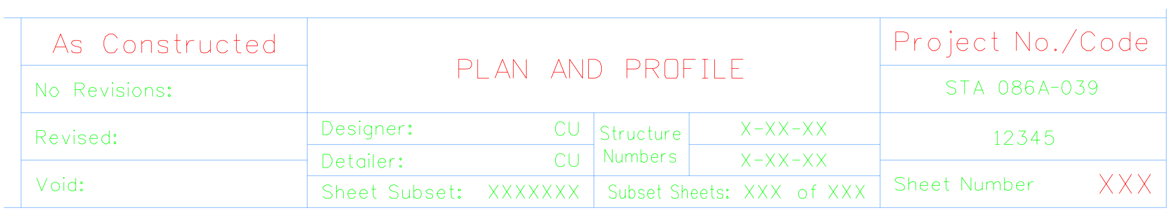
9. **Fit** the view.

Edit the border text with project specific information

1. **Zoom in** on the lower-right corner of the border as shown.



2. Select the **Edit Text** command from the **Text** toolbar.
3. **<D>** on the **Project Number** text.
4. In the **Text Editor**, replace this with ***STA 086A-039***.
5. **<D>** anywhere to accept.
6. **<D>** on the **Code** text.
7. In the **Text Editor**, replace this with ***12345*** and **<D>** to accept.
8. Edit the **X**'s beside Designer and replace with your initials.
9. Edit the **X**'s beside Detailer and replace with your initials.



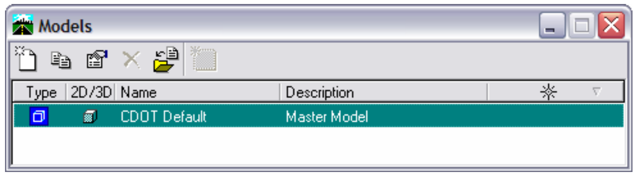
10. **Fit** the view.
11. Choose MicroStation **Drop Element** and select the border to drop

    The border must be dropped because you need to delete the profile grid. InRoads will generate it's own grid for the profile.

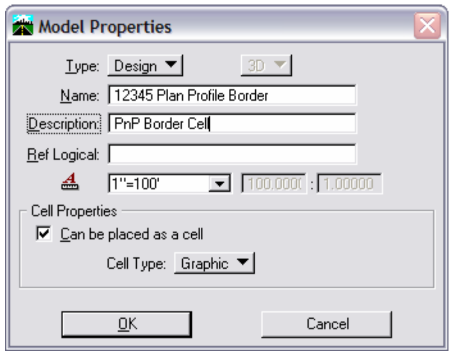
12. **Delete** the profile grid using MicroStation.

Make the border a cell

1. Select **Models** from the **Primary** toolbar.



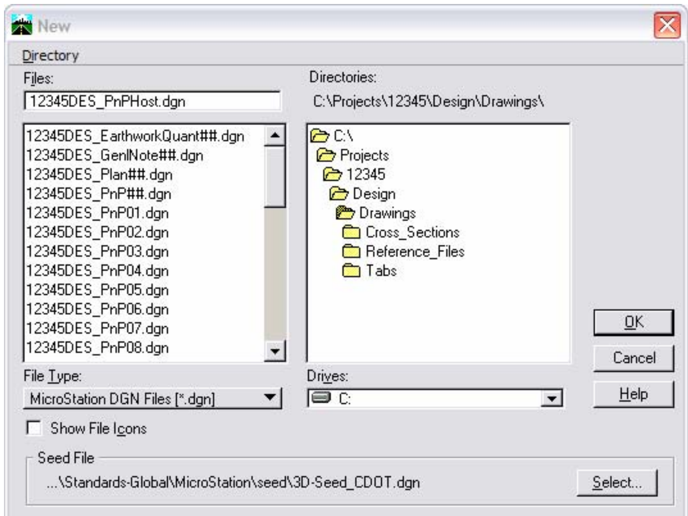
2. In the **Models** dialog box, select **Edit Model Properties**.



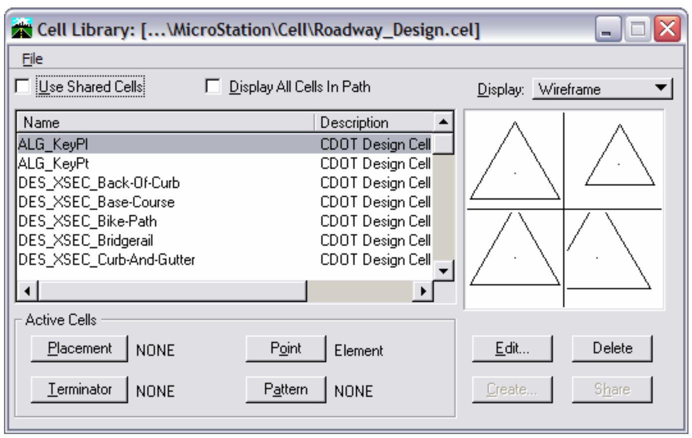
3. In the **Model Properties** box:
    - Toggle on **Can be placed as cell**
    - Change the **Name** to ***12345 Plan Profile Border***
    - Change the **Description** to ***PnP Border Cell***
    - Leave all other options as shown.
4. Select **OK**.
5. **Close** the **Models** box.
6. **Save Settings** (**File > Save Settings**).

Create a host seed file for the plan and profile sheets

1. Select MicroStation **File > New.**
2. Key in ***12345DES_PnPHost.dgn.***

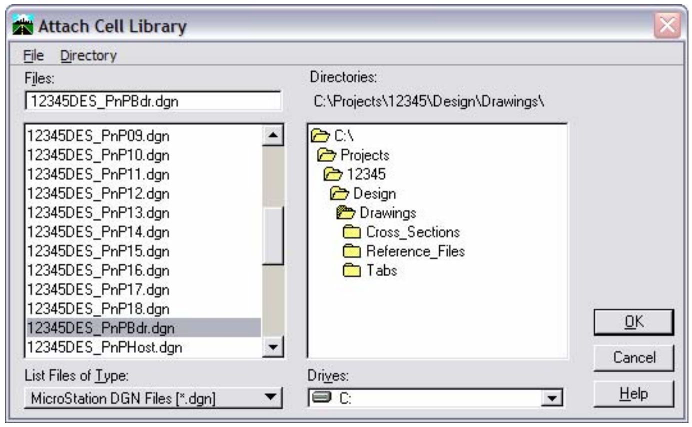


3. Choose **OK**.
4. Select MicroStation **Element > Cells**.



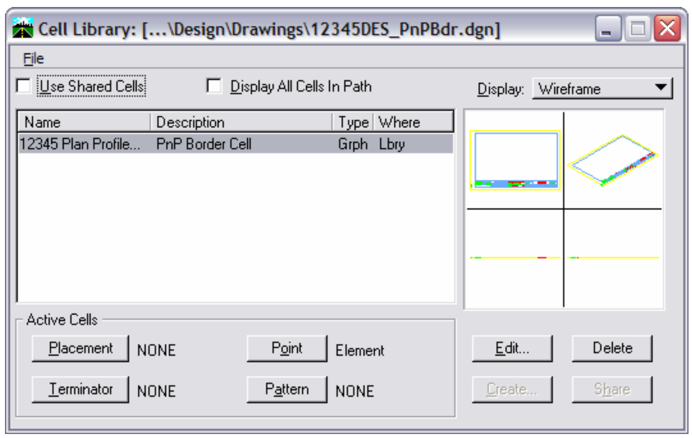
5. Select **File > Attach**.

6. Set the **List Files of Type** to **MicroStation DGN Files**.



7. Ensure the directory is **\Design\Drawings**.

8. Select **12345DES_PnPBdr.dgn** and then select **OK**.

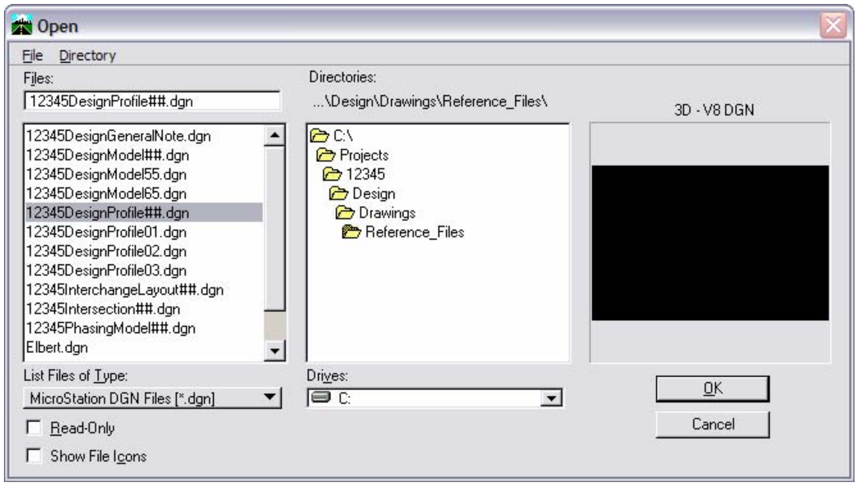


9. **Close** the **Cell Library** dialog.

10. Select **File > Save Settings**.

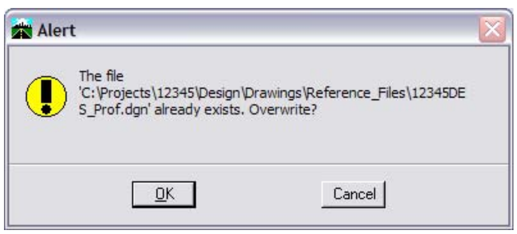
Prepare a profile design file

1. Select MicroStation **File > New**.



2. Navigate to the **\Drawings\Reference_Files** folder and key in **12345DES_Prof.dgn**.

3. Choose **OK**.

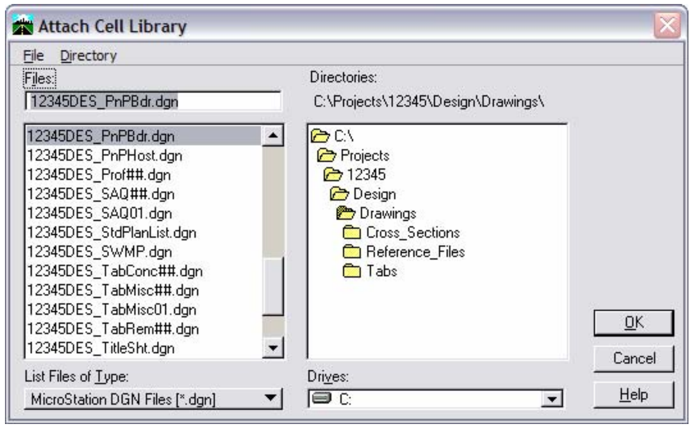


4. If you get a message that the file exists, choose **OK** to **Overwrite**.

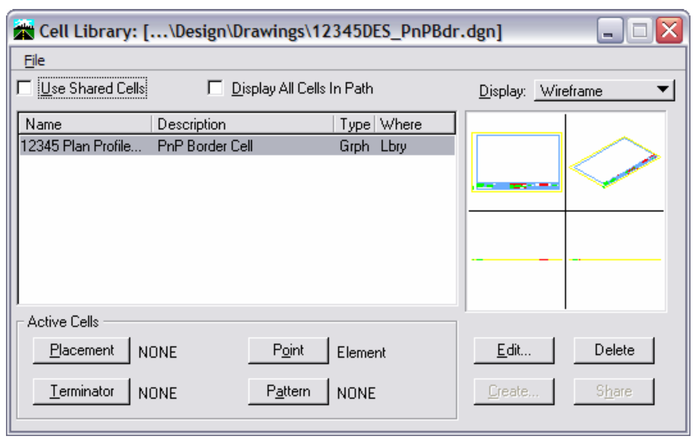
Attach the border file as a cell library

1. Select **Element>Cells.**

   - Select **File>Attach.**
   - Navigate to the **\Design\Drawings** folder and double-click **12345DES_PnPBdr.dgn**.



This established the design file containing the border you previously placed and edited as a cell library, with the border as the only cell.

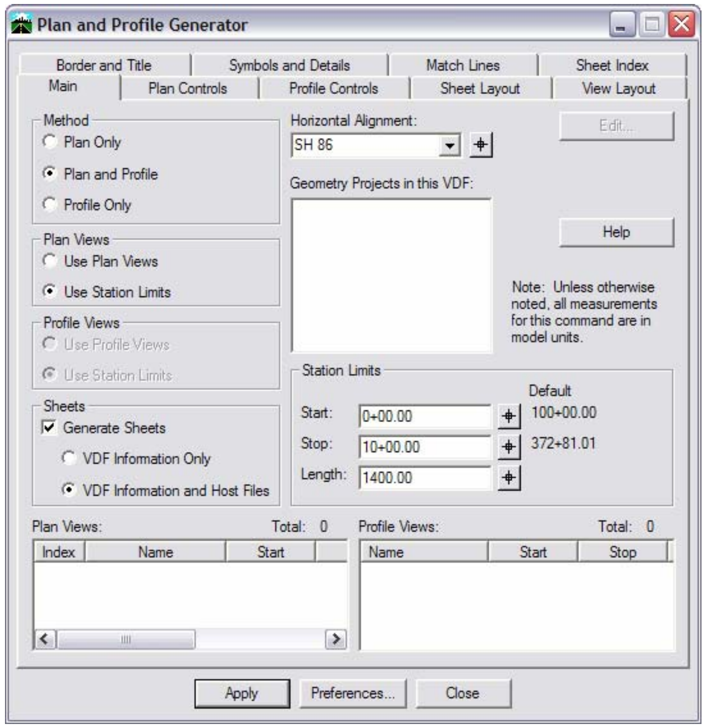


2. Close the **Cell Library** dialog.

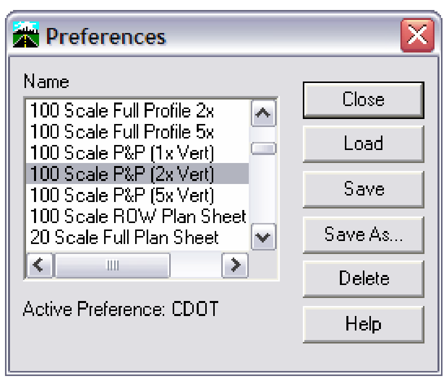
3. **Save Settings**.

Set up the Plan and Profile Generator options

1. Select **Drafting>Plan and Profile Generator**



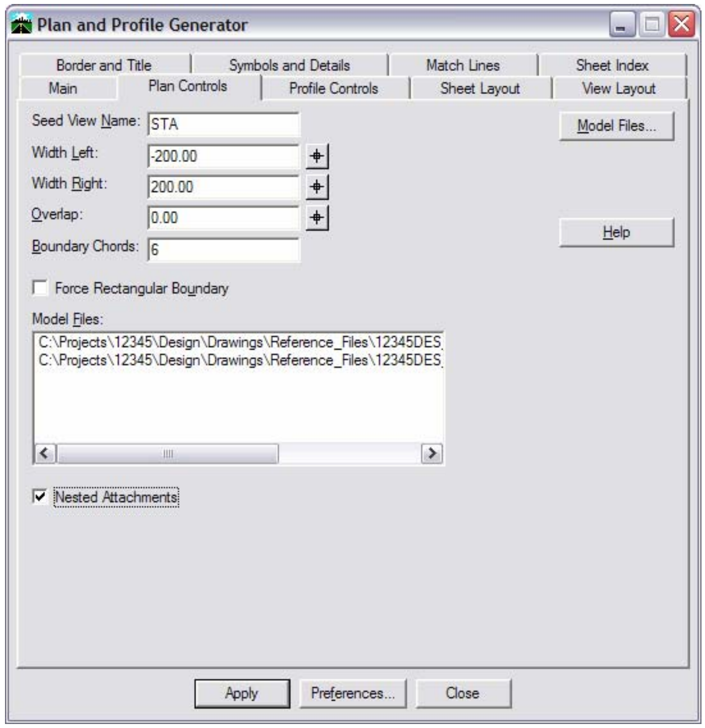
2. Choose **Preference** and load **100Scale P&P (2x Vert)**.



First, you will set up and review the different tabs.

Many of the following parameters are set by the preference you loaded, but continue reviewing the tabs to enter additional data and to see what settings have been made for you.

3. On the **Plan Controls** tab:



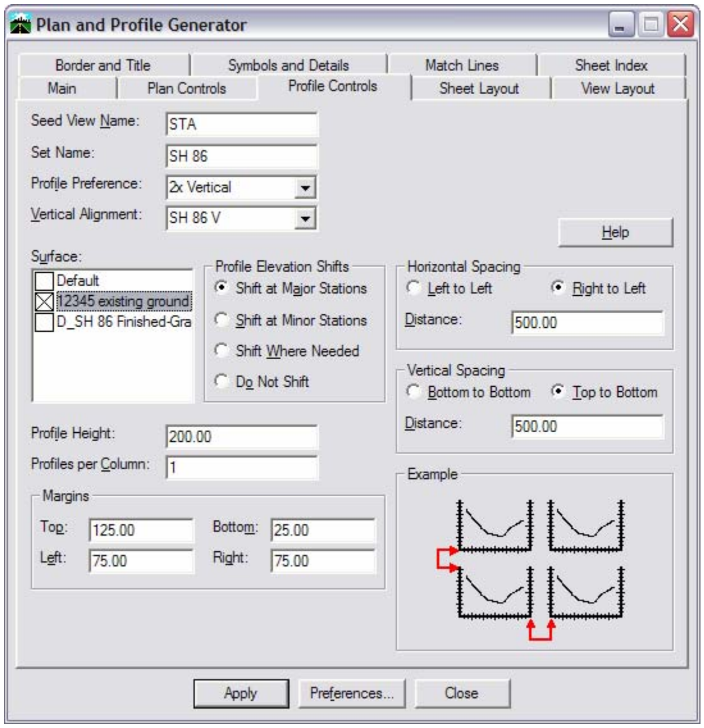
Notice the **Width Left** and **Right** are set to ***–200*** and ***200***. This indicates the plan view will span 400 feet in total width.

Notice the **Overlap** is set to ***0***, indicating there will be no overlap between the sheets.

- Select the **Model Files** button. In the **Open Model File** dialog box, double-click on **12345DES_Model.dgn** file from the **\Design\ Drawings\Reference_Files** folder.
- If your profile file is not already listed, select the **Model Files** button again. In the **Open Model File** dialog box, double-click on **12345DES_Prof.dgn** file from the **\Design\Drawings\Reference_Files** folder.
- Toggle on **Nested Attachments**.

With **Nested Attachments**, you will see not only the **12345DES_Model.dgn** graphics referenced to your plan, but also any files referenced to it. In this case, it means your survey graphics file.

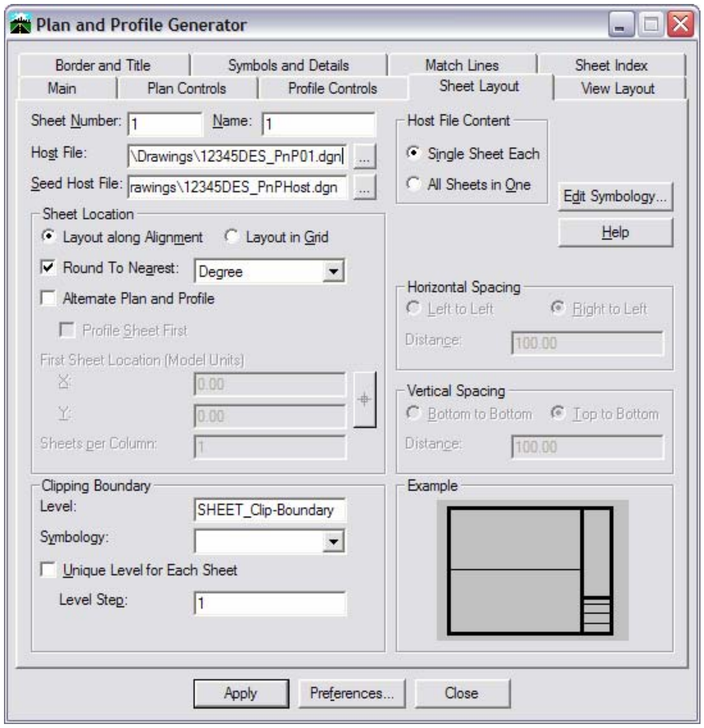
4. On the **Profile Controls** tab:



- Set **Vertical Alignment** to **SH 86 V**.
- Toggle on the surface **12345 existing ground** and toggle all other surfaces off.
- Double-check that **12345 existing ground** is highlighted.

12345 existing ground ***must*** be ***highlighted*** and ***toggled on***. Toggling it on is to have it shown on the profile. Highlighting it is to make certain the grid elevations encompass the entire surface.

5. On the **Sheet Layout** tab:

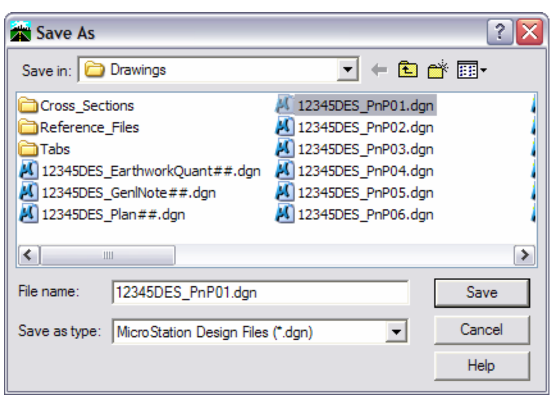


- Verify that **Sheet Number** and **Name** are set to ***1***
- In the **Host File Content** section, select **Single Sheet Each**.

This will place each plan/profile sheet in a separate MicroStation design file, starting with **PnP1.dgn**, then incrementing by one (**PnP2.dgn**, **PnP3.dgn**, etc.).

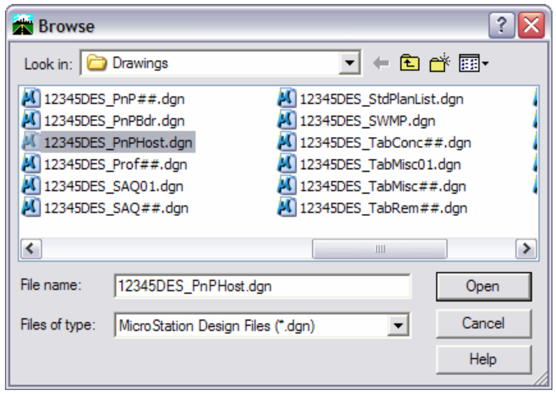
- Click inside the **Host File** field, and choose the **...** button to Browse.

When the **Save As** dialog appears, navigate to the **\Design\Drawings** folder and key in a name of ***12345DES_PnP01.dgn***. Note that the files already exist for Plan and Profile sheets. Here, we'll overwrite them with our new ones.

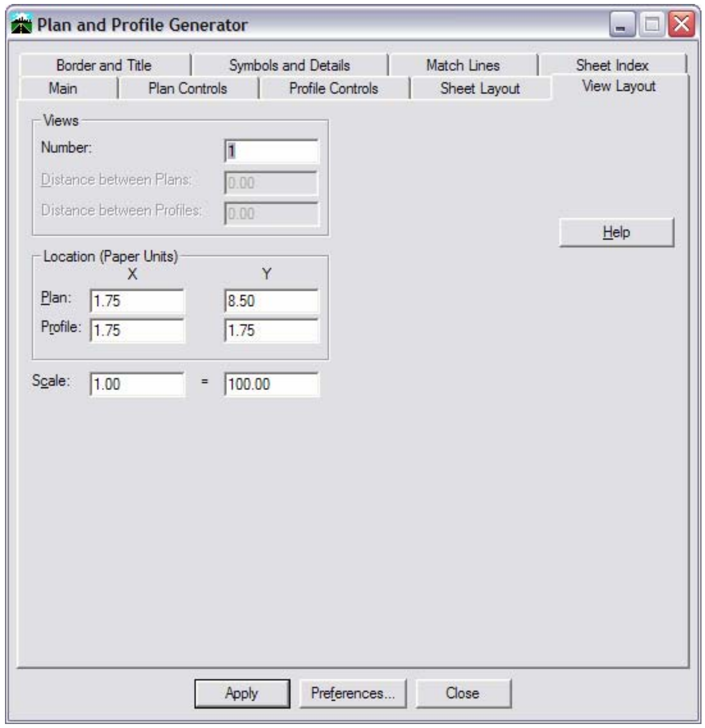


- Choose **Save**.

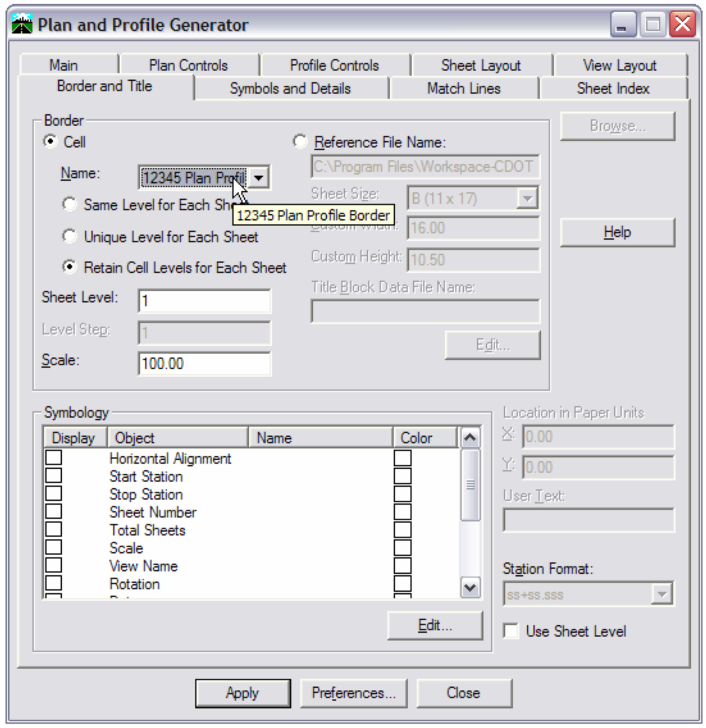
- Click inside the **Seed Host File** field, and choose the **…** button to Browse.
- Navigate to the **\Design\Drawings** folder, select the file **12345DES_PnPHost.dgn** and then select **Open**.



6. On the **View Layout** tab, notice the location of the Plan and Profile. These values are measured from the lower left corner of the border with a starting coordinate of 0,0 and are listed in paper units, which in this case is inches.



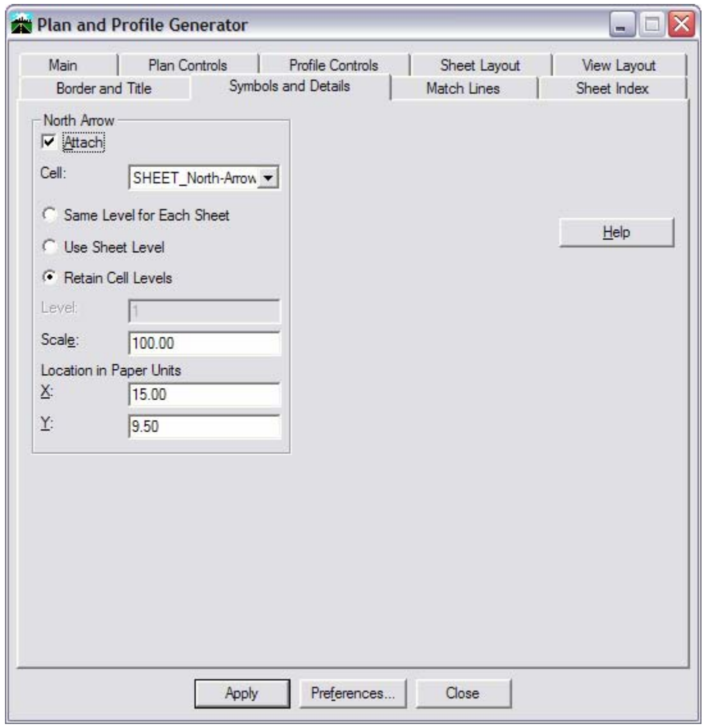
7. On the **Border and Title** tab:



- Notice the **Cell** option is toggled on.
- Use the drop-down list to choose **12345 Plan Profile Border**.
- The Scale is set to **100**.

Your border will be scaled up 100 times around your graphics.

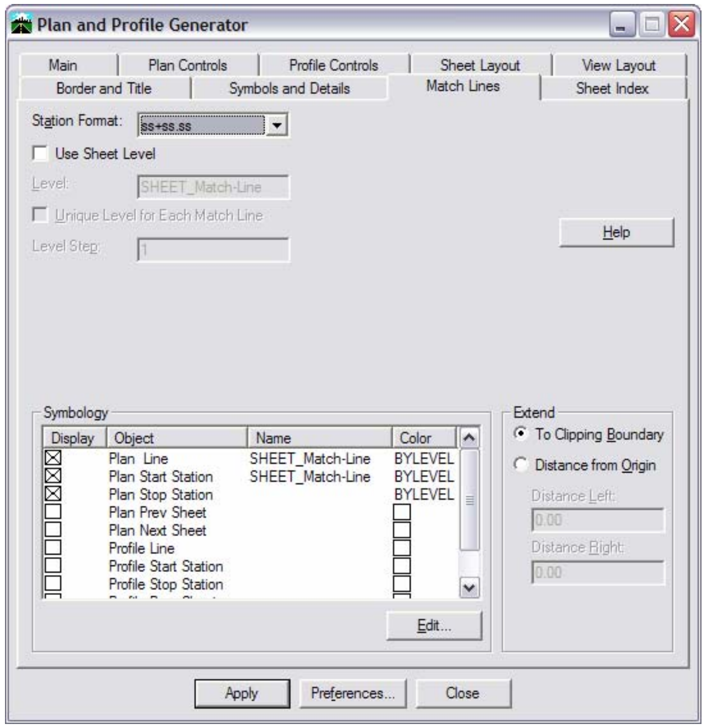
8. On the **Symbols and Details** tab:



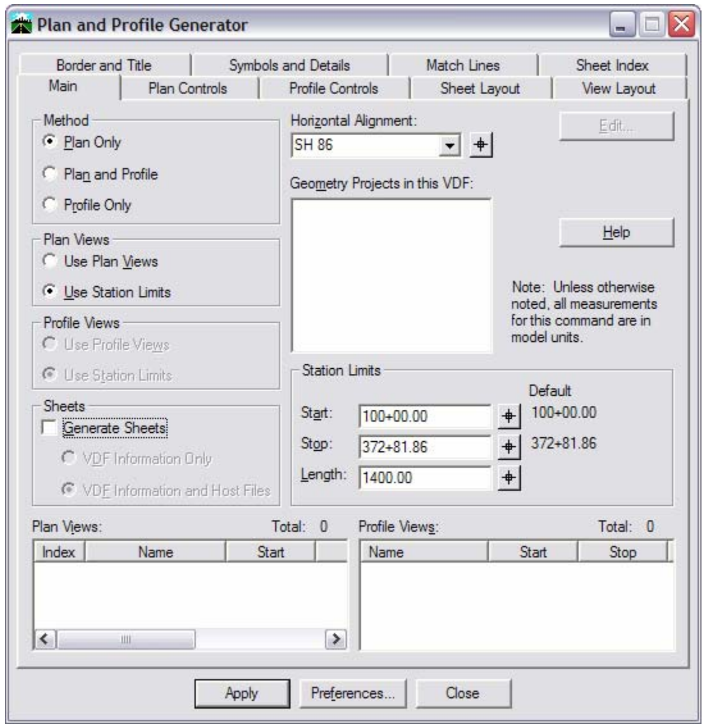
Note that a North arrow is automatically set. It will be displayed 15 inches over and 9.5 inches up from the lower left corner of the border.

9. On the **Match Lines** tab:

   - In the **Symbology** section, note the **Plan Line**, **Plan Start Station** and **Plan Stop Station** are already toggled on.



10. On the **Main** tab:



- Set the **Method** to **Plan Only**.
- Set the **Plan Views** to **Use Station Limits**.

This will compute each plan view based on the station limits set on this tab.

- Turn off **Generate Sheets**.

This will allow you to set up the plan view first, then you can generate the sheets.

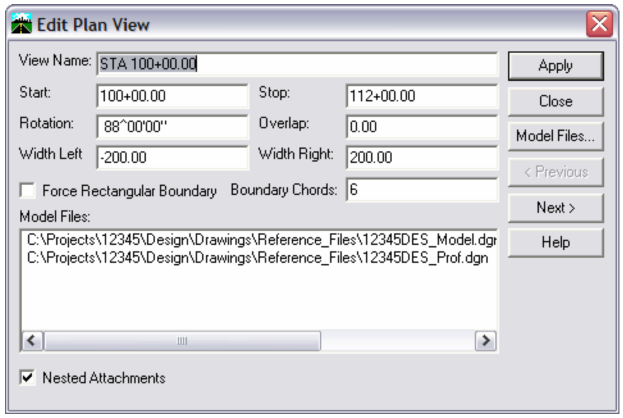
- Set the **Alignment** to **SH 86**.

The **Start and Stop Station Limits** should default to those of your alignment. If they do not, use the drop-down under the Horizontal Alignment and actually **<D>** on the alignment name.

The length is set by the preference at 1400 feet per sheet.

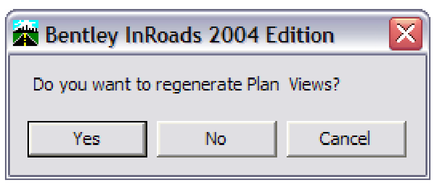
11. **Apply** and the Plan Views are generated.

- **Double-click** on the first plan view in the list.

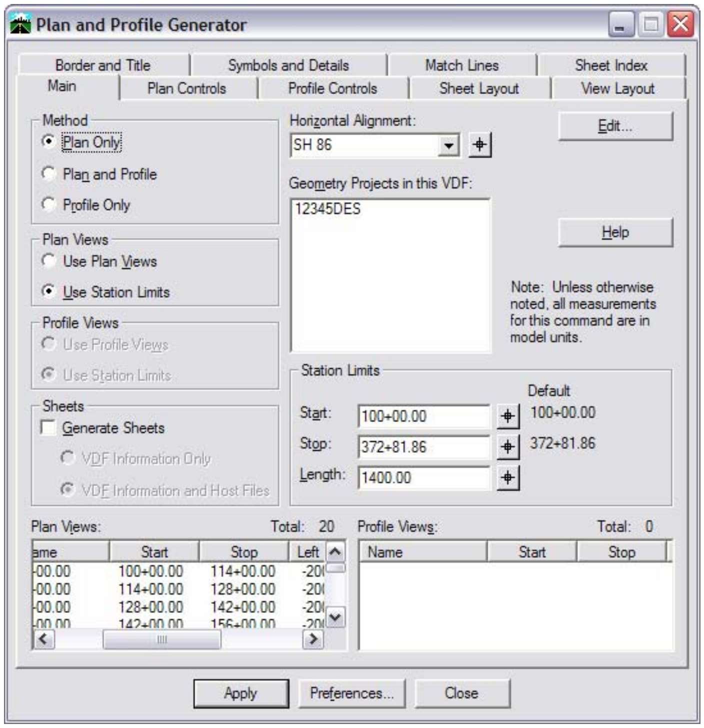


Notice that its Stop Station is only 112+00, which is not the desired 1400 feet. The **Station** lock has forced it to an even multiple of 1400, in this case 112+00. Next, you'll turn off Station lock and recompute.

- Close the **Edit Plan View** dialog.
- Toggle off **Station** lock.
- Apply again and choose **Yes** when prompted to overwrite the current plan views.

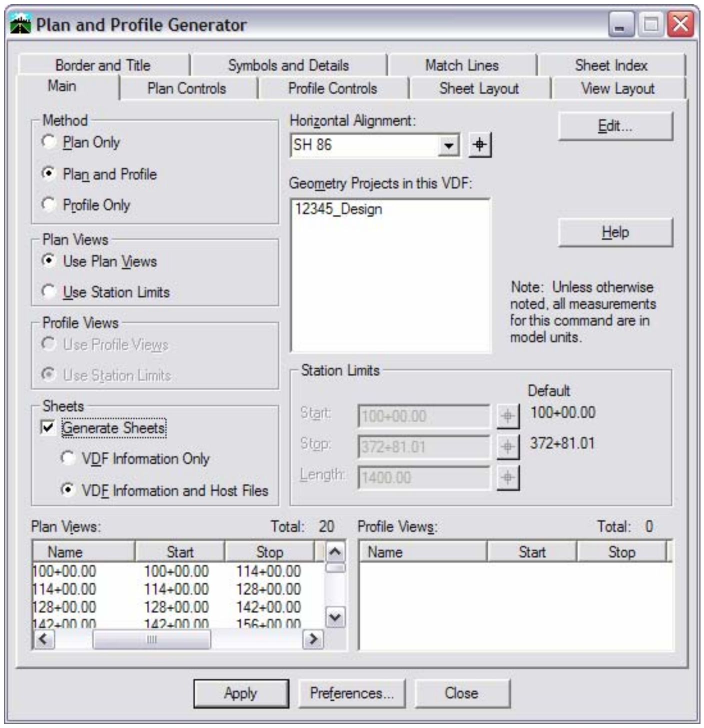


- Notice the first plan view is now 100+00 to 114+00.



12. Still on the **Main** tab.

    Now that the plan views are set the way you want, you can proceed with setting up and verifying other parameters on this tab.



- Set the **Method** to **Plan and Profile**.
- Set **Plan View** to **Use Plan Views**.

This tells it to use the views as listed. If you left it set to **Use Station Limits**, the edits to the plan views you just made would be wiped out. As it stands here, you would get the same results either way. If you had edited the stations manually, you would definitely want to **Use Plan Views**.

- Toggle on **Generate Sheets**.
- Toggle on **VDF Information and Host Files**.

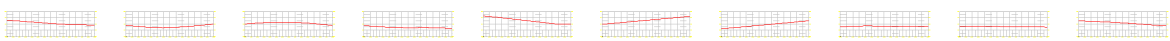
The VDF Information is found on the **Sheet Index** tab. It lists each of the plan and profile sheets, their station range, plan rotation, etc.

The **Host Files** are your actual plan and profile sheets.

Generate the plan and profile sheets

Since profiles will be generated with the execution of this command, you are currently in a profile design **12345DES_Prof.dgn**. Double-check before continuing.

1. In the **Plan and Profile Generator** dialog box, select **Apply**
2. **<D>** anywhere in the design file (**12345DES_Prof.dgn**) to identify a location to plot the profile views.

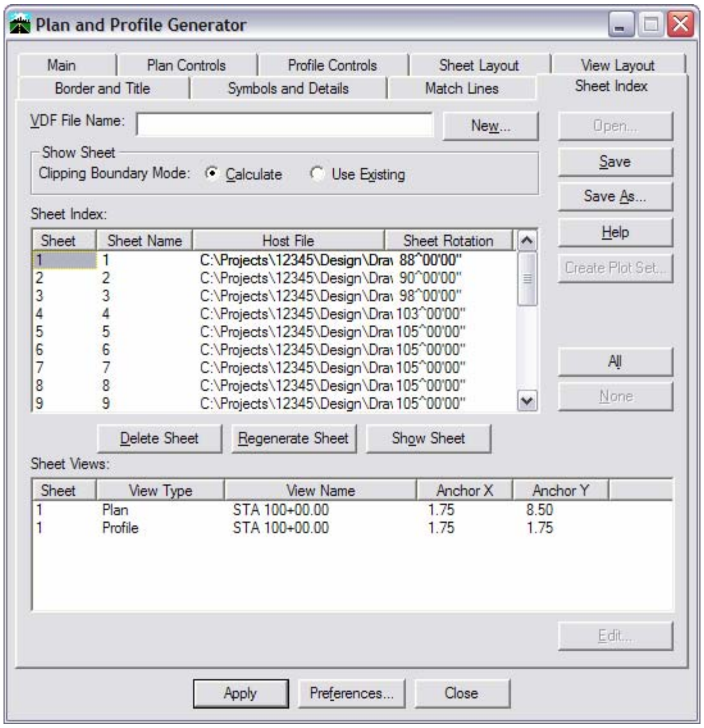


The profile views are plotted for each 1400’ of the proposed road and the plan and profile sheets are generated. You should see them as they are composed. In each sheet file the view is automatically rotated to horizontal, and the border and corresponding profile referenced.

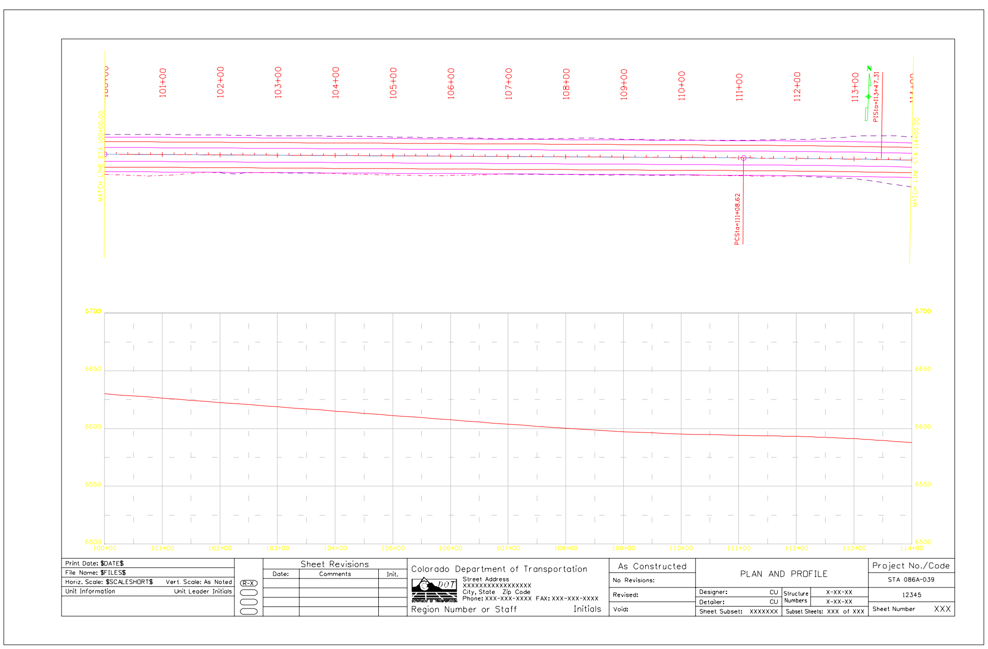
View the plan and profile sheets

Use the **Plan/Profile Generator** to view the sheet index and individual sheets.

1. Select the **Sheet Index** tab on the **Plan and Profile Generator** box.



- Highlight sheet number 1, then select **Show Sheet**.



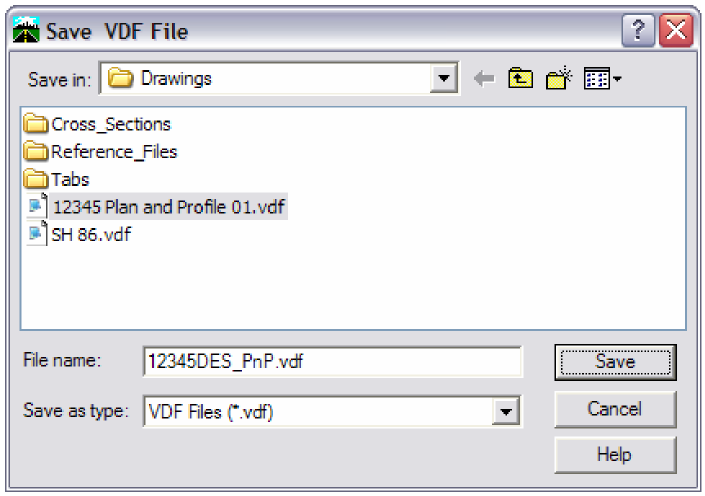
The **12345DES_PnP01.dgn** file is automatically opened.

- View other sheet files as desired.

Note: The clipping boundary can be modified with MicroStation to show more of the design. After modifying it, choose **Use Existing**, then **Show Sheet** again and it will be 're-clipped'.

2. **Close the Plan and Profile Generator** dialog box.

3. When prompted "**Save Current VDF file**?", choose **Yes**. Type in ***12345DES_PnP.vdf*** as the filename (do not choose a file from the list) and set the Save in folder to **\ Design\Drawings** and select **Save**.

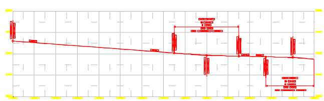
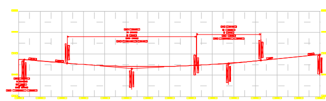
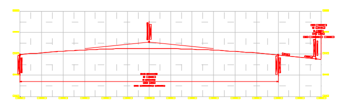


Display proposed graphics

1. Change the active design file back to the **12345DES_Prof.dgn** file in the **References** folder. (**File > Open** in MicroStation)

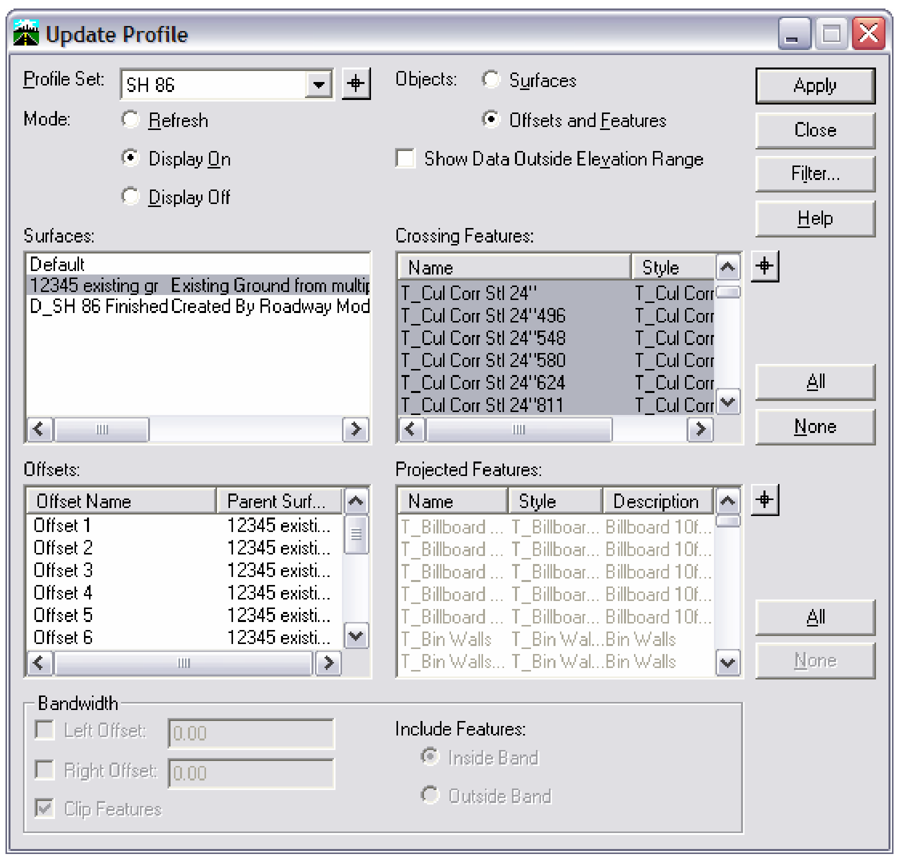
2. Display the proposed vertical alignment on the "mini" profile views created by the **Plan and Profile Generator**.

    - Select **Geometry > View Geometry > Vertical Annotation**.
    - Load the **Proposed** preference.
    - Choose **Apply**.

Display Utilities on the profile

Use the **Update Profile** command to view the culvert crossing information on the profiles.



Display the proposed contours for the new road surface

1. Change the active design file to the **12345DES_Model.dgn** file in the **References** folder.

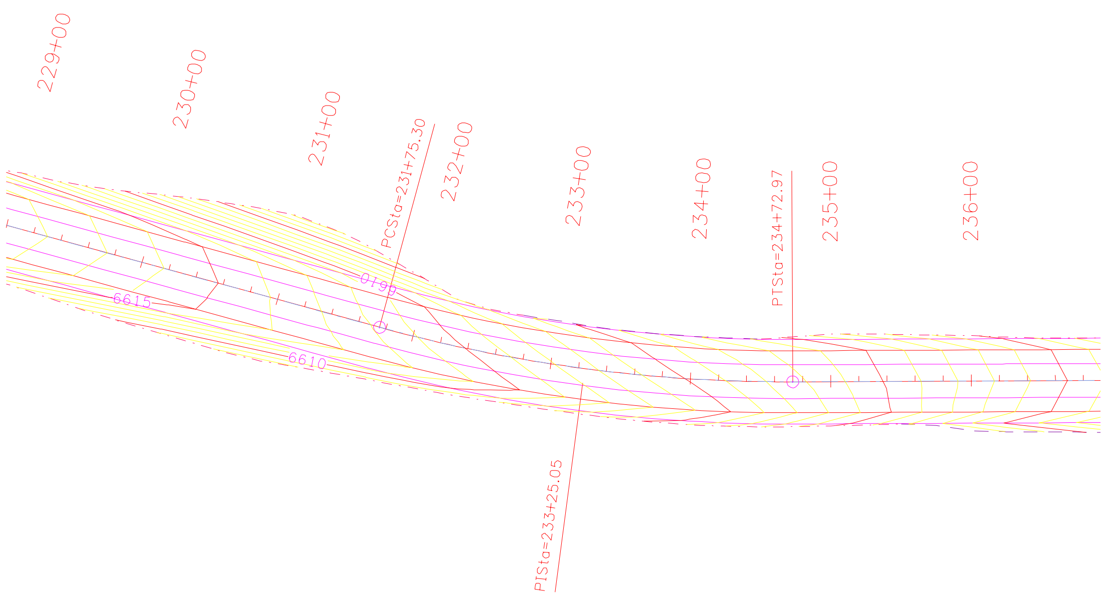
2. Make certain **Style** lock is off.

3. Select **Surface > View Surface > Contours**.

    - Set **Surface** to **D_SH 86 Finished-Grade**.
    - Load the preference **Proposed 10' Mjr. 2' Minor**.

4. **Apply**.

5. Select **Close**.

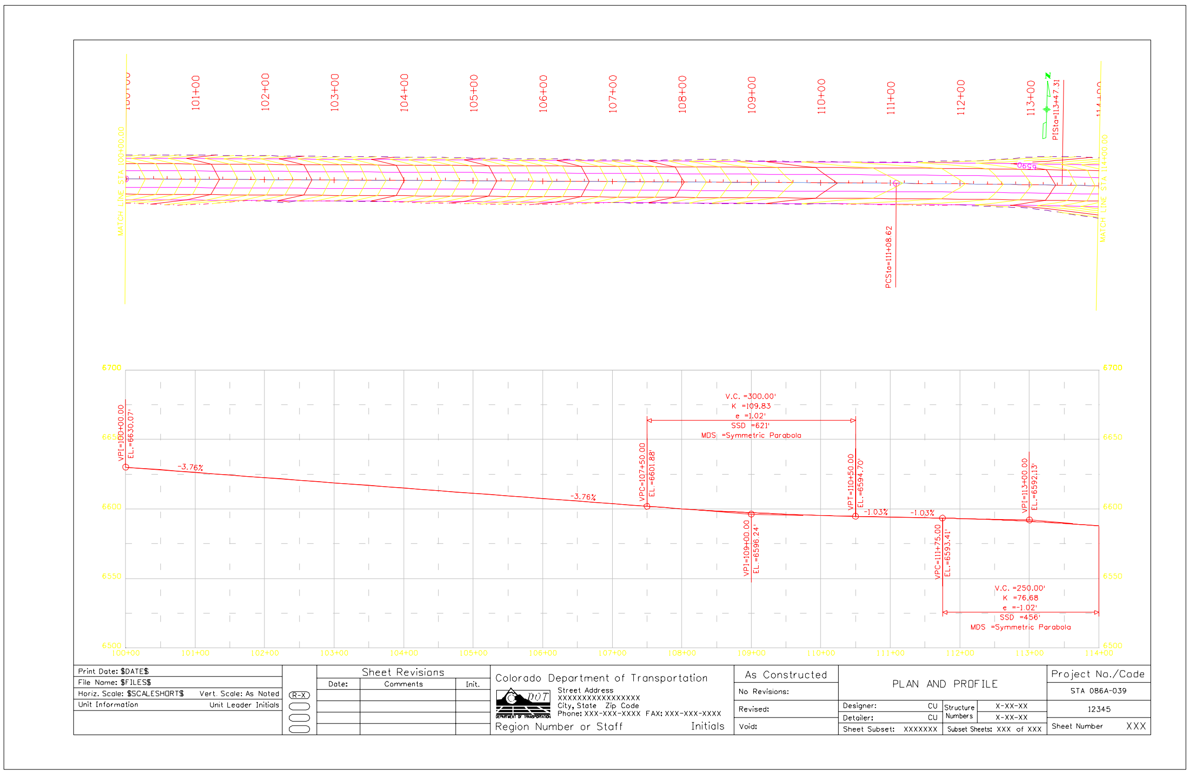


Revisit the plan and profile sheets

Use the **Plan/Profile Generator** to return to the sheet and view the updated graphics.

1. Select **Drafting > Plan and Profile Generator**.
2. Select the **Sheet Index** tab.
    - Select Sheet 1 from the list and select **Show Sheet**.

   The **12345DES_PnP01.dgn** file is automatically opened.



- View other sheets as desired

3. To remove the clipping boundary, toggle off **Constructions** under MicroStation **Settings > View Attributes**.

   The clipping boundary does not plot, so turning it off is not necessary for plotting.

4. Plot one of your plan and profile sheets.
5. **Exit** MicroStation and InRoads. If prompted to save geometry project, select **No**.

Challenge labs:

1. Create an alternating set of plan and profile sheets for the same alignment.
2. Change the clipping paths for one of your plans and plot the modified plan and profile sheet.

9. Final Modeling

In the final modeling phase, you re-visit some familiar concepts. Additional templates are included as needed, the template layers are adjusted as needed (with information from the Materials Engineer), and the Superelevation is reviewed and updated as needed.

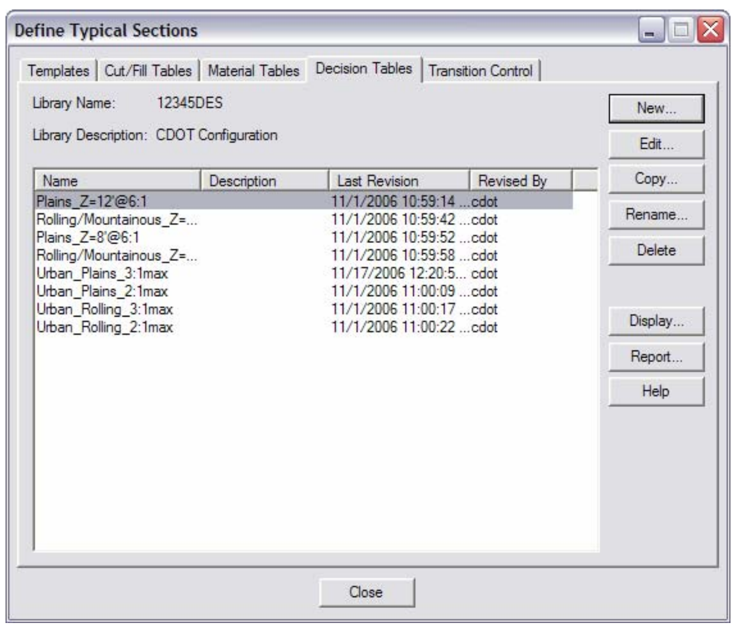
The main new concept that is introduced in this section is the use of decision tables for sideslope determination.

Overview of Decision Tables

Decision tables are made up of a series of records, each similar to a segment of a template, that defines a sideslope. A table can have more than one definition, and can have multiple targets — making it a very powerful tool in defining complex sideslopes.

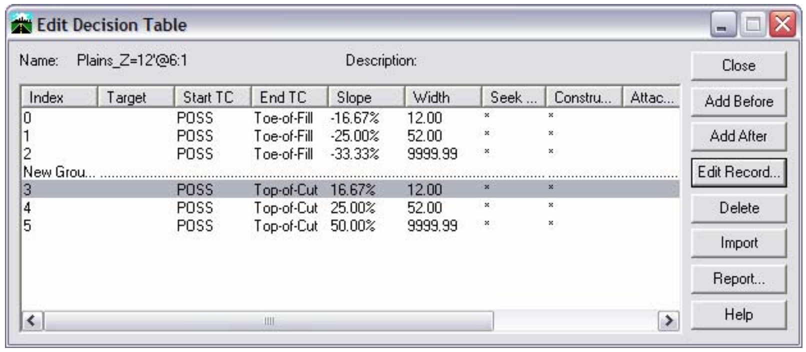
Template backbones are still used, but the decision tables take over at the hinge points to calculate sideslopes. The tables can also used with 3D graphical elements or features to calculate sideslopes, such as from ditch bottoms and ramps in gore areas. This can be especially useful when creating models for intersections and interchanges.

Decision tables are stored in the typical section library. CDOT has one default decision table stored in **CDOT-Typical Sections.tml**. When this file is copied into the project directory, the decision table may be copied and modified as needed.



Parts of a Table

There are three main parts of a decision table.



Records

A record is a single line in a decision table made up of a starting TC name, an ending TC name, a slope and a width (along with other criteria discussed later). The TC names have several purposes, including: they become the feature names of the longitudinal breaklines resulting from running the table, and they also provide a method for the table to back-track to a previous location in the sideslope.

Target Blocks

A target block is a series of records that, together, seek one 'hit' of a target. For example, you can create several records that make up cut and fill scenarios, but all seek the same existing ground surface, or target. Within the target block, you can backtrack if one solution, such as a shallow fill slope, fails, and the next solution will be attempted.

Processing occurs from the top down, evaluating each record in turn. The target block continues processing until one segment meets the target. Once a segment meets the target, the block is successful and no other records within that target block are evaluated. Any records that were not lost to backtracking prior to hitting are placed along with the successful record.

Note: A target block is successful and therefore stops if one of the records in the block meets its target.

If no records in a target block meet the target, the block is unsuccessful and all records in the block are discarded. If a record in the target block meets the target, the block is successful. In either case, the table looks to see if any other target blocks exist in the group (see below). If so, the next target block in line is processed (unless it is marked **Attach After**).

Groups

One or more target blocks making up a mutually exclusive sideslope condition form a group. Only one group in a decision table can be successful, since all processing stops when a group is successful.

An example of mutually exclusive sideslopes broken into groups includes: testing with one group to see if a design surface is met, and with another group to see if the original ground surface is met, such as the case of a divided highway run at separate times.

> **Note:** A group is successful ***ONLY*** if its last target block is successful. (Previous target blocks may also be successful.)

Other previous target blocks may be successful also, but the last one must be. Once a group is successful, the processing ends at the current location.

If the last target block in a group is unsuccessful, all previously successful records are discarded and the processing starts over again with the next group in the table. If there are no more groups, the decision table fails and no sideslope is created at this location.

Building a Decision Table

After creating several decision tables you will no doubt come up with your own methods for developing them. Many times, existing tables are copied and modified to fit new conditions, saving time in the creation and testing process. The following steps define a good path to follow when starting out with decision tables, and one that you can modify to fit your needs as your proficiency increases.

The building of a decision table is an iterative process and may require trial and error. When starting with the path outlined, keep in mind your initial division of target blocks and groups may need to be amended as additional variables are uncovered in the design process.

1. The best method of starting a decision table is to ***sketch the desired sideslope results***. When completing the sketch or sketches, try to think of as many existing conditions as possible, and the sideslopes that will best fit the conditions. Typically, you will need sideslopes for both cut and fill (at a minimum).

2. The next step in building the table is ***to break the sideslope conditions into groups***, or mutually exclusive designs. In a very simple table only one group may be necessary, since both cut and fill can be addressed in the same group and the same target block.

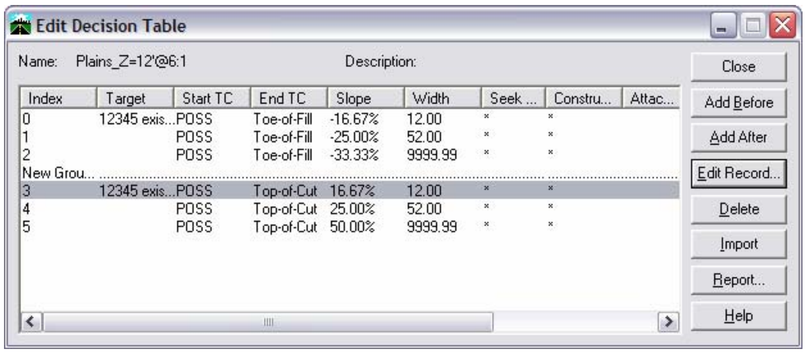
> **Note:** When breaking sideslopes into groups, keep in mind only one group is successful at any given location, so a group must contain a complete sideslope definition.

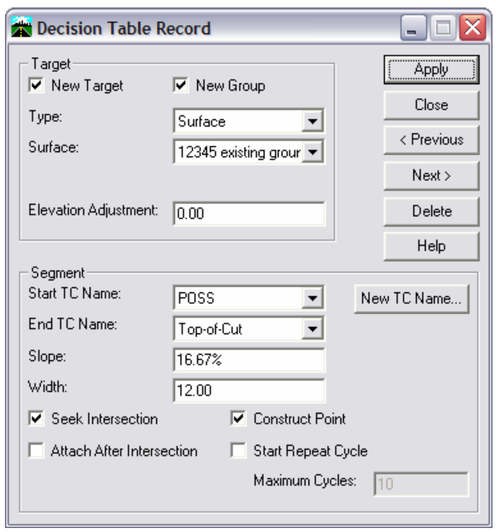
3. After determining the different groups required, ***each group must be broken into target blocks***. A target block is allowed only 1 “hit”, or interception with a target, so one must be developed for each instance a target is reached in a sideslope. For example, you may have a fill slope extend to the existing ground (target 1), then continue and place a ditch at the toe of slope, coming back and intercepting the same existing ground again (target 2).

4. With the preliminary work done, the next step involves ***creating the table***. Since decision tables may be very complex, it’s always a good idea to test the table as you go. Build one group (or even one target block) and display the table or test it on a small section of roadway where you know it should work. This will help spot problems when it’s easier to determine the cause.

The Decision Table Interface

Decision tables are stored in typical section libraries. They are built record by record through a dialog interface, which can also be used to edit the table later. When developing each record, criteria are used to determine how the record will react under certain conditions.





Each of the criteria is described below.

New Target – The record starts a target block; new target is turned on once per target block, in the first record of the block.

New Group – Indicates the beginning of a new sideslope definition.

Target Type – What the target block is seeking; options are: **DTM**, **Align Elevation** (vertical alignment), **Align XYZ** (horizontal and vertical alignment), **Align XY** (horizontal alignment), **Feature Elevation**, **Feature XY**, **Feature XYZ**, and **Elevation**.

Target – The name of the target being sought by the target block (*e.g.* the DTM name).

Elevation Adjustment – An offset for the target; *i.e.*, For a DTM, it has the effect of transforming the ground surface by the specified vertical offset.

Start TC – Transition control name for feature name, symbology and backtracking.

End TC – Transition control name for feature name and symbology.

Slope – Slope of the line defined by the record.

Width – Horizontal distance the record will extend if no target is met.

Seek Intersection – Indicates the record will stop if it meets the specified target.

Attach After – The record is only used if the previous target block in the same group is successful.

Construct Point – The point found at the end of the record will be used in the resulting DTM.

Start Repeat Cycle – The record is the beginning of a repetitive series.

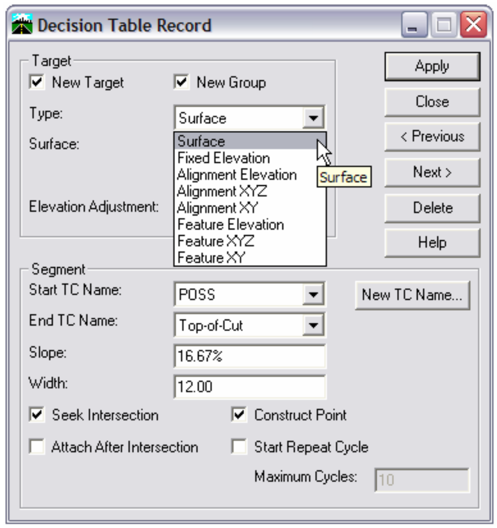
It is beneficial to display the decision table during the building process to check the records for problems with slopes and connectivity. Display a decision table using **Display** from the main decision table dialog.

> **Note:** The display uses the attached color table and beginning with color 1, changes colors with each target block. Within the target block, if there is backtracking, each record displays with a different line style, beginning with line style 0.

Target Options

One of the most powerful functions of a decision table is the ability to seek an intersection with targets other than DTMs. With this benefit, you can accomplish the equivalent of independent control outside the backbone of your template, along with other equally complex sideslopes.

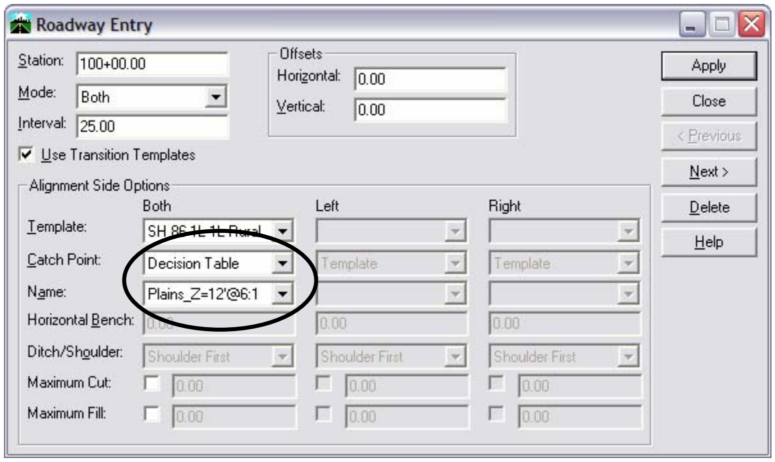
The eight available targets are: **Surface**, **Fixed Elevation**, **Align Elevation** (vertical alignment), **Align XYZ** (horizontal and vertical alignment), **Align XY** (horizontal alignment), **Feature Elevation**, **Feature XYZ** and **Feature XY**.



The **New Target** option is toggled on whenever you are changing targets and/or when the previous target block has already hit its target. For example, when creating berms at the top of cut, or toe-of-slope ditches, your initial DTM target may be the same as the DTM intercepted with the ditch or berm. In instances where the additional target is only used if the previous one is successful, the **Attach After Intersection** option is also toggled on.

Running a Decision Table with Roadway Modeler

The most common use of decision tables is to define sideslopes along a roadway corridor. This is done using **Roadway Modeler**, just like using template, cut/fill table or material table sideslopes.



In the roadway definition, the **Catch Point** is set to **Decision Table** and a decision table selected from the drop-down list. When the roadway is modeled, the decision table picks up at the hinge point with its calculations and the cut and fill portions of the template are ignored.

In some situations, a different decision table is needed on each side of the roadway. For these times, the roadway definition mode is set to **Left and Right** and a different decision table listed for each. You can also specify a decision table for one side and one of the other sideslope alternatives (cut/fill or material table, or template) for the other.

The results of running decision tables with **Roadway Modeler** are twofold. First, a DTM is created just like when the sideslopes are calculated with templates. Second, graphical elements are created longitudinally by connecting like TC points in the tables from template drop to template drop. These longitudinal lines are actually the features that are part of the resulting DTM, and are named according to the TC names in the table, just as they are with the template.

Note: In order to see the features created by **Roadway Modeler**, the TC name's **Feature Style** must have the **3D Plan/Display** toggled on and the **Transition Control Lines Display** option must be turned on in **Roadway Modeler** (on the **Advanced** tab).

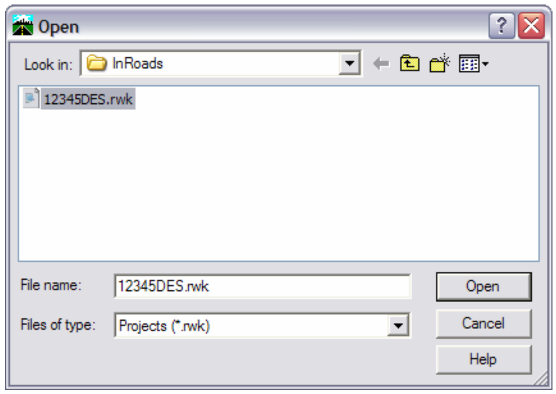
Lab 9 – Final Modeling

Start InRoads

1. Start InRoads and open **CU12345DES_Model.dgn** from the **\Design\Working** folder.

Open your InRoads data files

1. Select **File > Open**.



2. Ensure the **Files of Type** option is set to **Projects (*.rwk)**.

3. Double-click on **12345DES.rwk**.

   Double-clicking is the equivalent of highlighting the file and choosing **Open**.

4. **Cancel** the dialog.

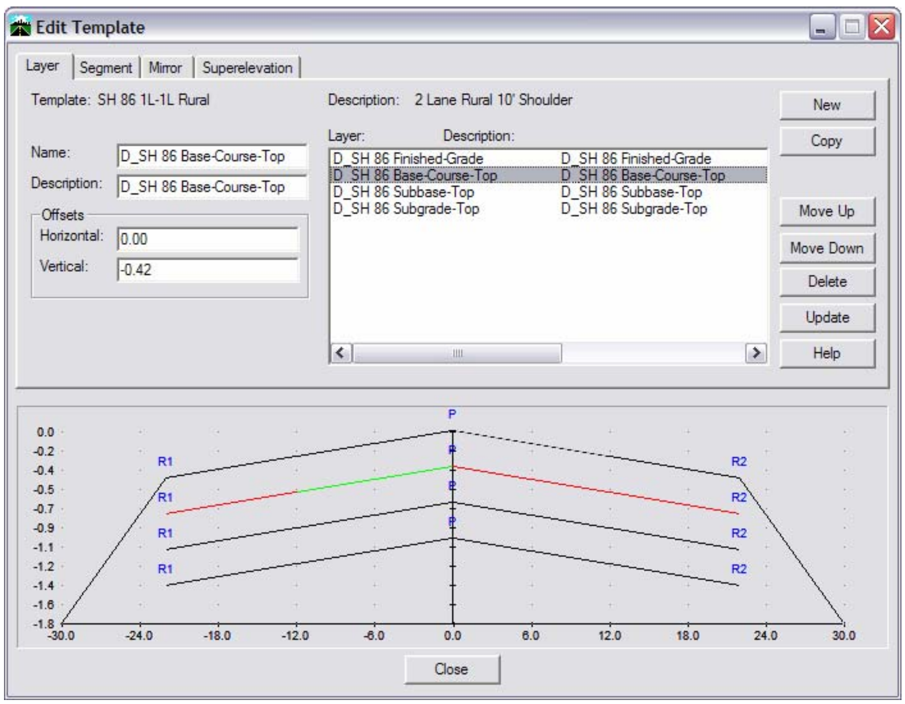
Update your typicals

In the next series of steps, you will update the 2 and 4-lane typicals you created earlier. Since the templates were originally defined with multiple layers, you can adjust the layers for the desired pavement and subgrade depths.

1. Select **Modeler > Define Typical Sections**.
2. On the **Templates** tab, choose **SH 86 1L-1L Rural** and **Edit**.
3. On the **Layer** tab,
   - Select **D_SH 86 Base-Course-Top**.

You have learned that the Base Course Top needs to be a depth of 5".

- Key in a vertical offset of ***-5"*** and **Tab** on your keyboard. (If you use the " it will automatically be converted to feet.)
- Select **Update** to have the change take affect.



4. Also on the **Layer** tab,

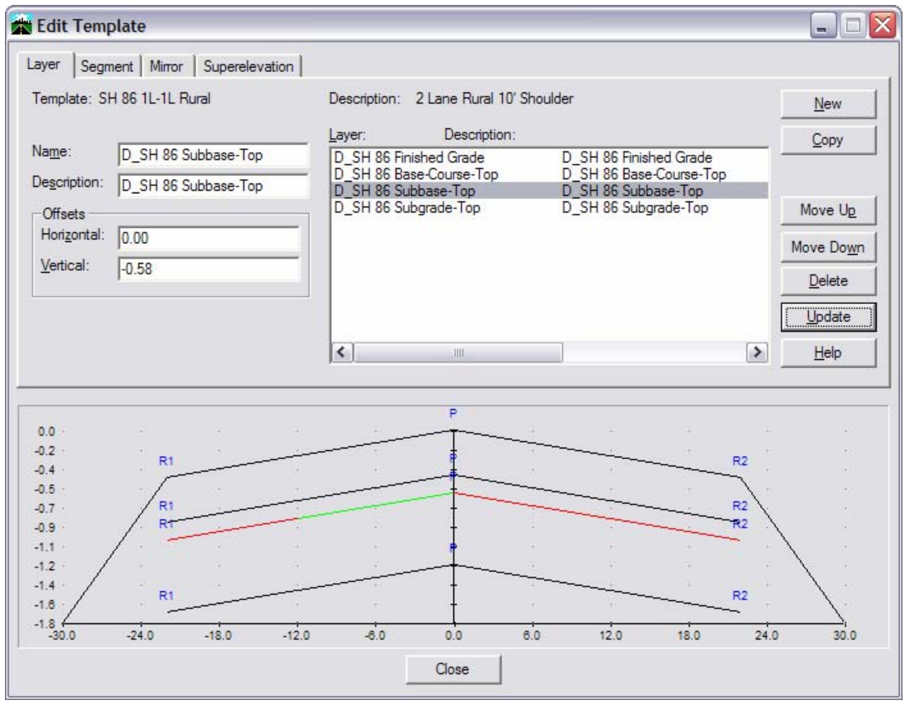
   - Select **D_SH 86 Subbase-Top**

   You have learned that the Subbase-Top needs to be a depth of 7”.

   - Key in a vertical offset of ***-7”*** and **Tab** on your keyboard. (If you use the ” it will automatically be converted to feet.)

   Notice the depths you key in are from the vertical alignment – not from the previous layer.

   - Select **Update** to have the change take affect.

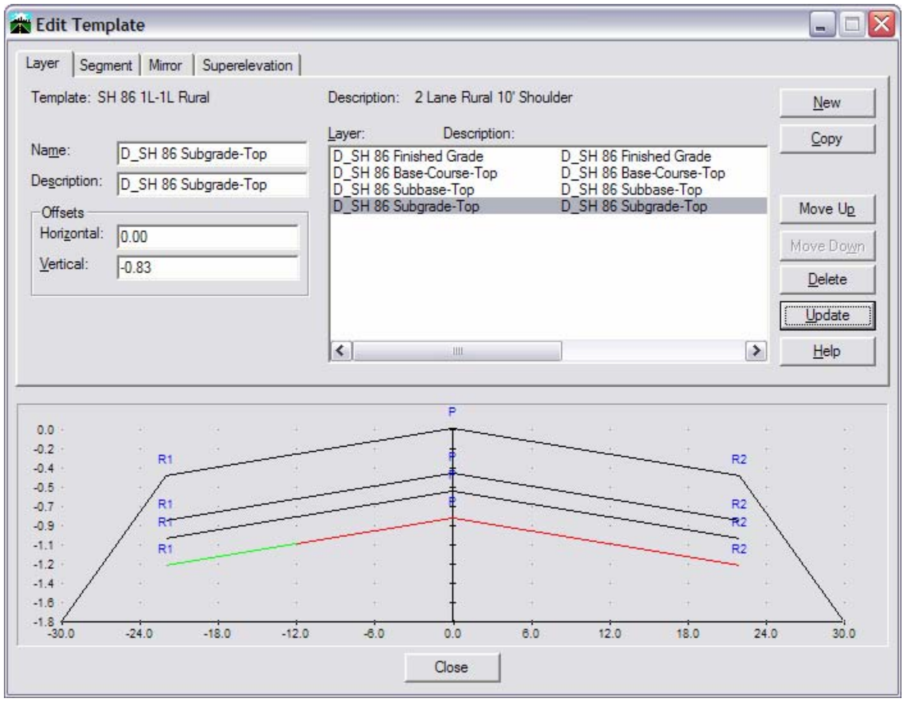


5. Also on the **Layer** tab,

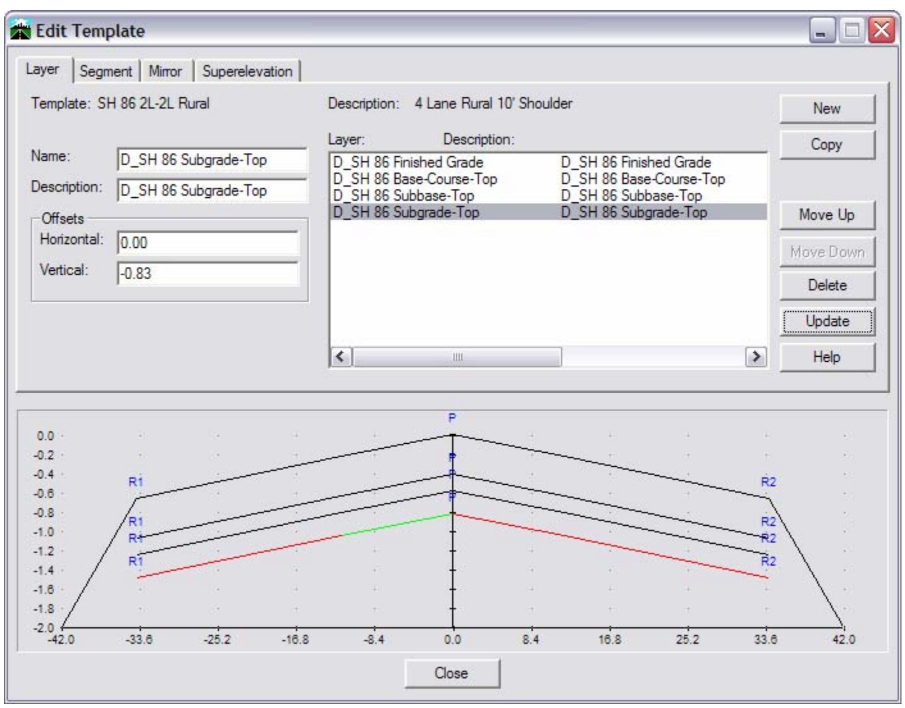
   - Select **D_SH 86 Subgrade-Top**

   You have learned that the Subgrade-Top needs to be a depth of 10”.

   - Key in a vertical offset of ***-10”*** and **Tab** on your keyboard. (If you use the ” it will automatically be converted to feet.)
   - Select **Update** to have the change take affect.

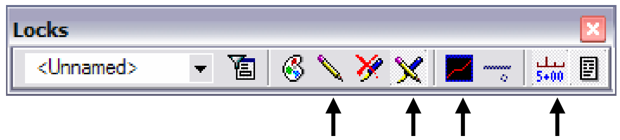


6. Repeat these steps for the 4 lane template, **SH 86 2L-2L Rural**.

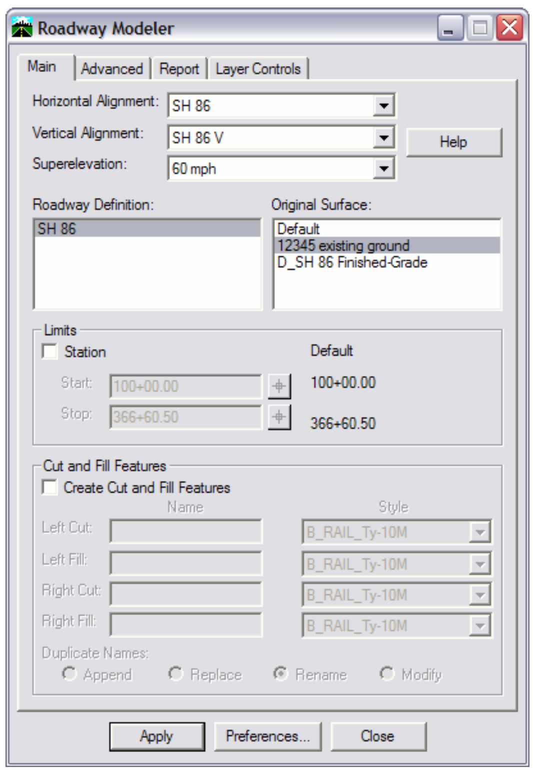


Model the roadway

1. Ensure **Write** lock is on.
2. Ensure **Report lock** is on.
3. Set the mode to **Pencil**.
4. Ensure **Station** lock is on.

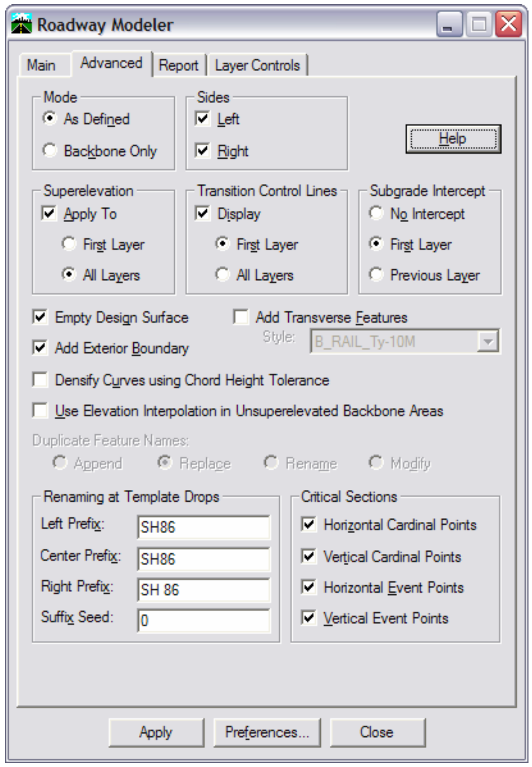


5. **Delete** all TC lines (features in plan) from the previous **Modeler** runs.
6. Select **Modeler > Roadway Modeler**.



Confirm and set additional design parameters.

7. Select the **Advanced** tab.



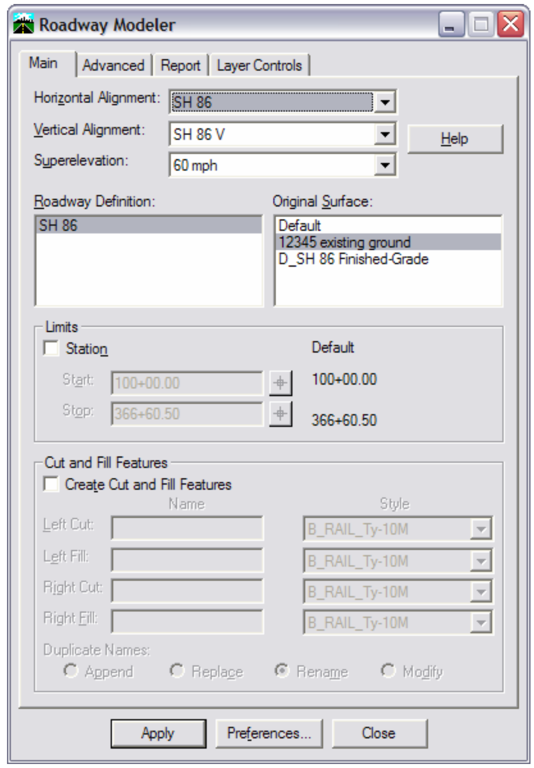
- Verify the design parameters – be certain to set the **Superelevation** to **All Layers**.
- Set the **Subgrade Intercept** to **First Layer**.

8. Select the **Layers** tab.

- Toggle off **Use Layer Controls**.

Now that you have established the additional layers, you'll model all.

9. Back on the **Main** tab, make certain the:



- **Horizontal Alignment** is set to **SH 86**.
- **Vertical Alignment** is **SH 86 V**.
- Highlight the **Roadway Definition SH 86** transition.
- Under the **Original Surface** list, highlight only **12345 existing ground**.
- Toggle off **Create Cut and Fill Features**.

10. Select **Apply**.

    The templates are applied along the alignment as defined in the roadway definition and superelevation is applied as it was calculated. This time, new surfaces are created for the Finished Grade, Base-Course-Top, Subbase Top and Subgrade Top.

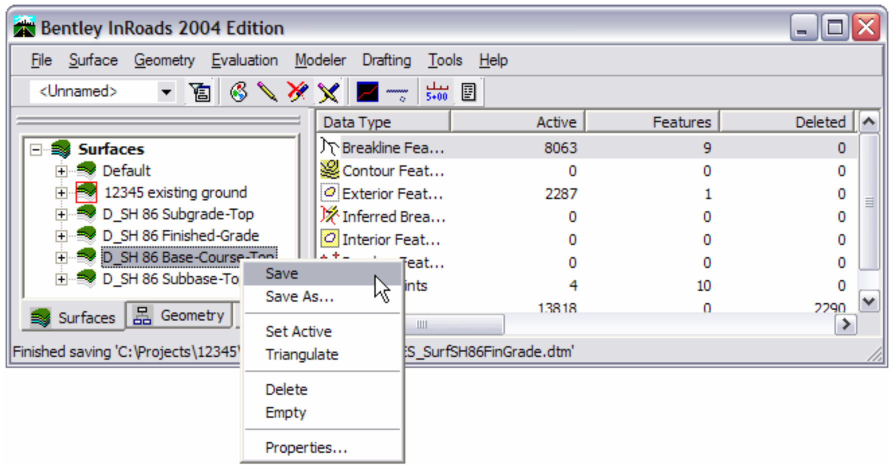
11. Select **Close** to dismiss the **Roadway Modeler** box.

Save the new surfaces

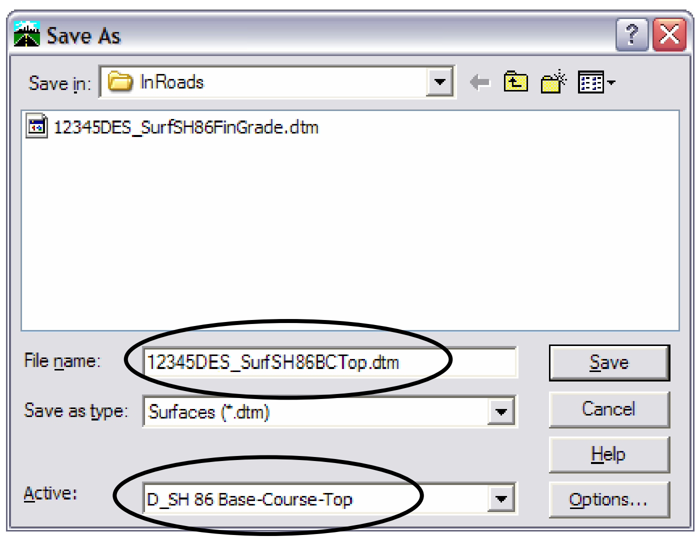
1. Right-click on **D_SH 86 Finished-Grade** in the Workspace (Explorer) portion of the InRoads menu.

2. Select **Save**.

3. Right-click on **D_SH 86 Base-Course-Top** in the Workspace (Explorer) portion of the InRoads menu.

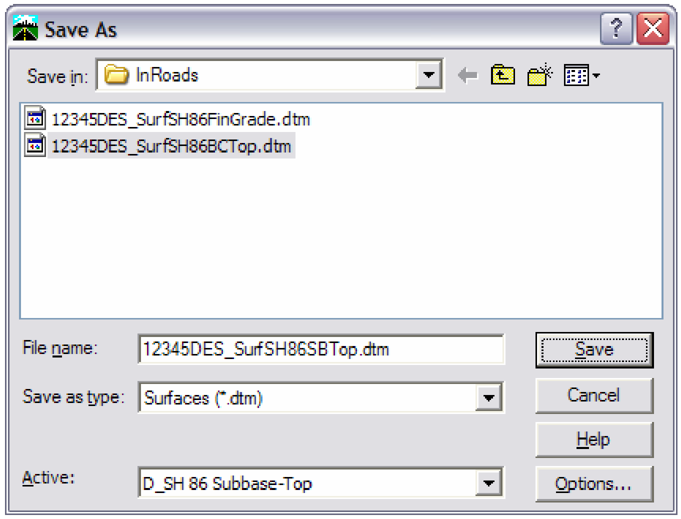


Since this surface has never been saved, the **Save As** dialog appears.

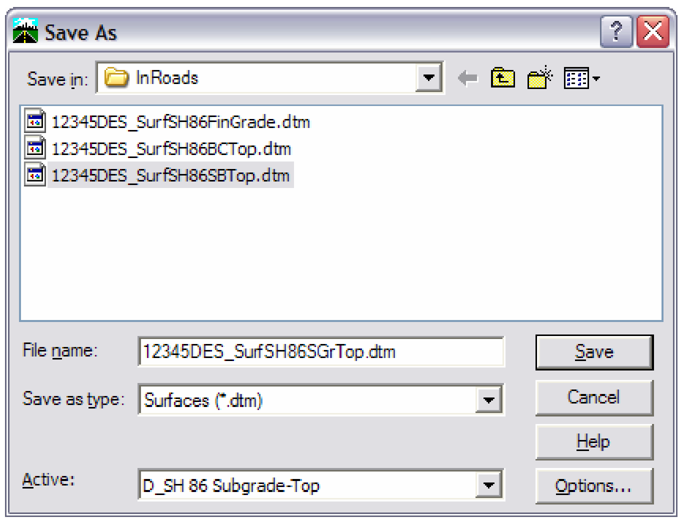


4. ***DO NOT*** choose **Save** until you verify that the **Active Surface** is set to ***D_SH 86 Base-Course-Top*** and the file name is correct! (Remember to add the ***12345*** project code to the File name).

5. Repeat for the **D_SH 86 Subbase-Top** surface,

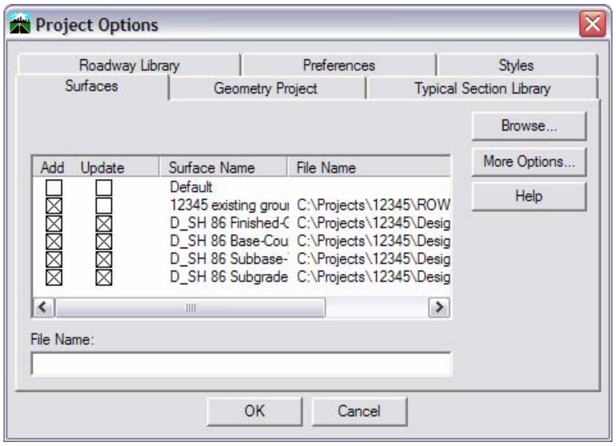


and **D_SH 86 Subgrade-Top**



6. Choose **File > Save As** if you closed it.

   - Set the **Save as type** to **Projects *.rwk**.
   - Click on **12345DES.rwk**.
   - Choose **Options**.
   - On the **Surfaces** tab, click on **Add** and **Update** for the three new surfaces (Base-Course-Top, Subbase-Top and Subgrade-Top).



7. Choose **OK**

8. Choose **Save** on the **Save As** dialog and overwrite the current .rwk.

Update the Cross Sections.

Since you already have a set of section for the roadway, you can just update them with the new surfaces instead of creating a whole new set.

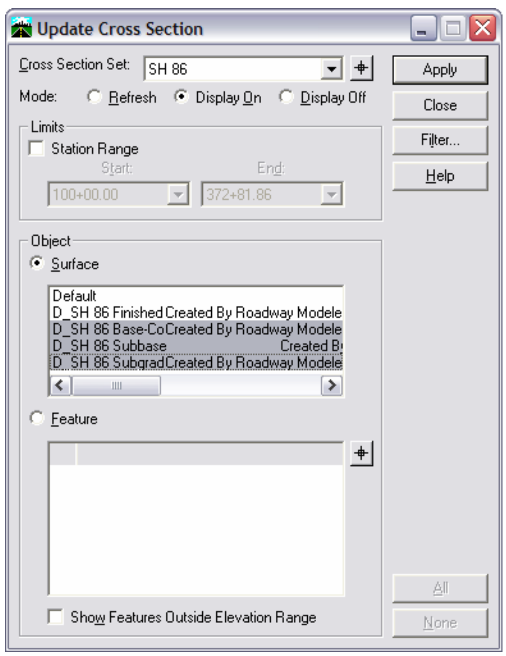
1. Make sure you're in a top view, then **Fit**.

2. Choose **Evaluation > Cross Section > Update Cross Section**.

Choose the Cross Section Set that contains your previously cut full set of section. You can tell which one you select by the box that's drawn around the set.

You can **Refresh** or toggle **Off** items that are currently displayed on the sections. You can toggle **On** items that are not currently displayed.

- Set the **Mode** to **Refresh**.
- Toggle on **Surface** in the **Object** category.
- Highlight **Finished Grade.**
- Choose **Apply.**
- Set the **Mode** to **Display On**.
- Toggle on **Surface** in the **Object** category.
- Highlight **Base-Course-Top**, **Subbase-Top** and **Subgrade-Top**

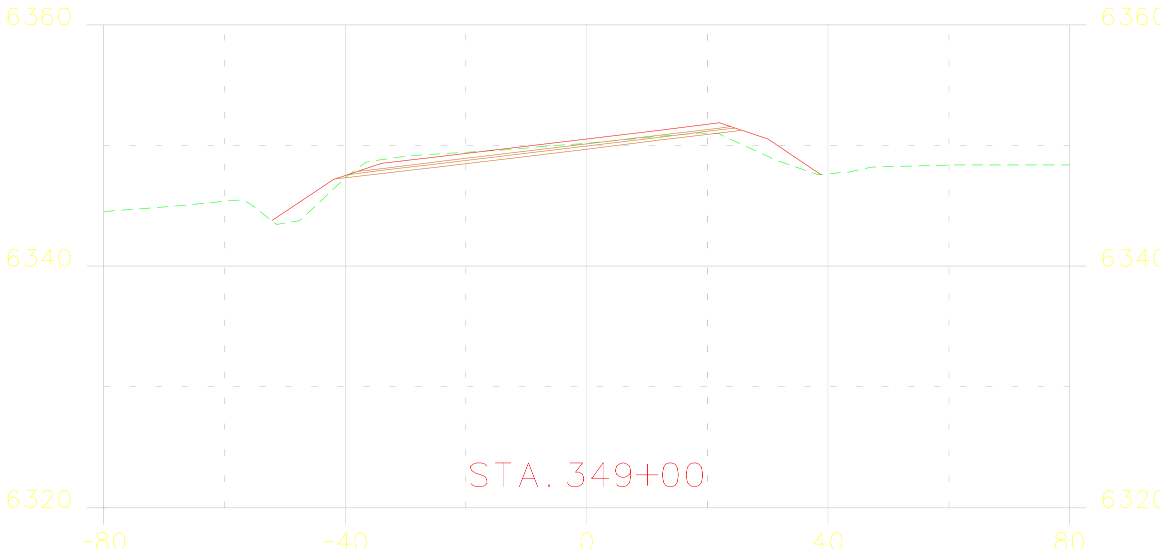


- Choose **Apply**.

The new surfaces are displayed in the cross sections.

3. On the **Cross Section** toolbar, select the **Cross Section Viewer** command.
   - Set the **Cross Section Sets** option to the cross section set you just updated.
   - Set the **Time** to ***0.5*** sec.
4. Select **Run**.

   Watch for the sections through the curve to see the subgrade surfaces superelevate.



5. **Close** the **Cross Section Viewer** dialog.

Create a decision table

There are often times when the simple cut and fill slopes created by using the template do not meet all of the necessary design criteria. Often, to meet the criteria, you must use a decision table. There are several decision table in the CDOT standard typical section library that you can copy and modify. However, to promote learning of the decision table concepts, you are going to create one from scratch.

1. The following criteria must be met for your sideslopes:

   Cut Slopes

   Slope 6:1 where Cut is 5’ or less

   Slope 4:1 where Cut is 5’ to 10’

   Slope 3:1 where Cut is 10’ to 15’

   Slope 2:1 where Cut is over 15’

   Fill Slopes

   Slope 6:1 where Fill is 5’ or less

   Slope 4:1 where Fill is 5’ to 10’

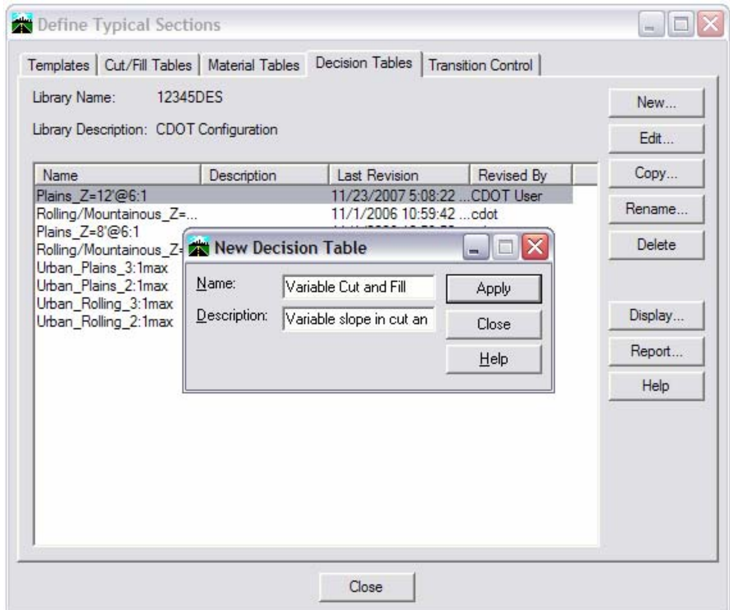
   Slope 3:1 where Fill is 10’ to 15’

   Slope 2:1 where Fill is over 15’

2. Sketch the decision table before proceeding.

Create a name for the decision table.

1. On the **Design Roadway** toolbar, select **Define Typical Sections**.
2. Select the **Decision Tables** tab.

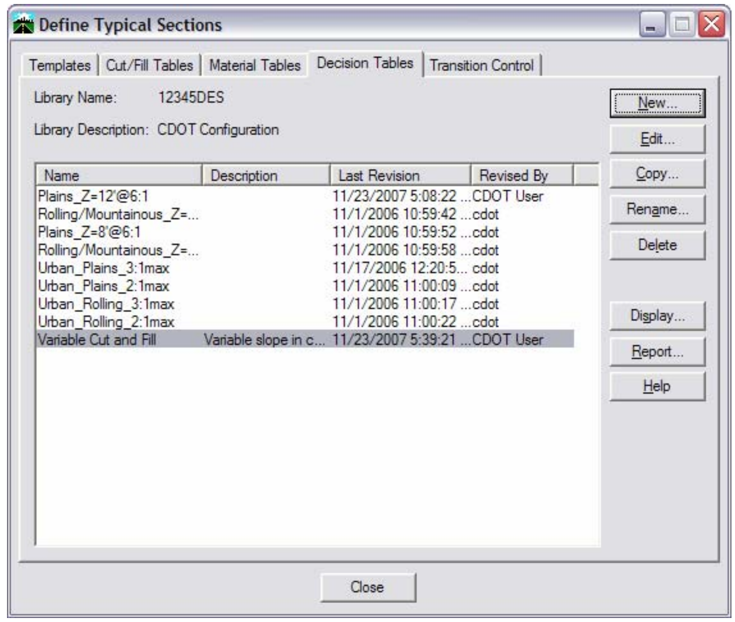


- Select **New**.
- Enter the **Name**: **Variable Cut and Fill**
- Enter the **Description**: **Variable slope in cut and fill**

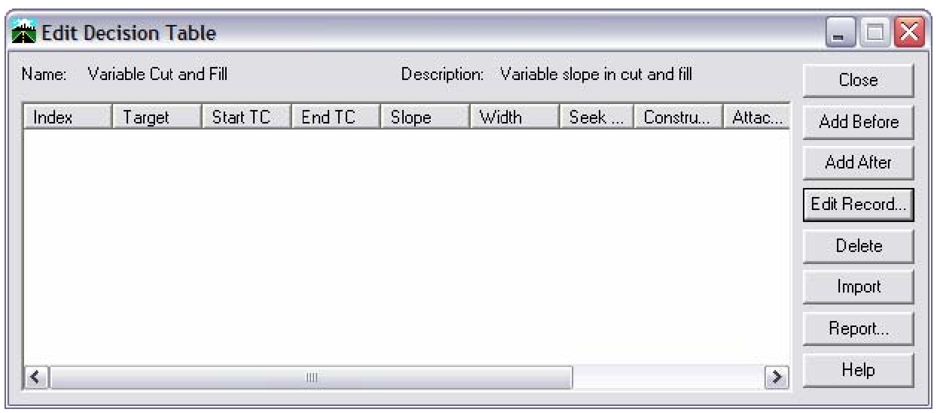
3. Select **Apply**, then **Close**.

Define the cut slopes.

1. Select **Variable Cut and Fill** from the available list.

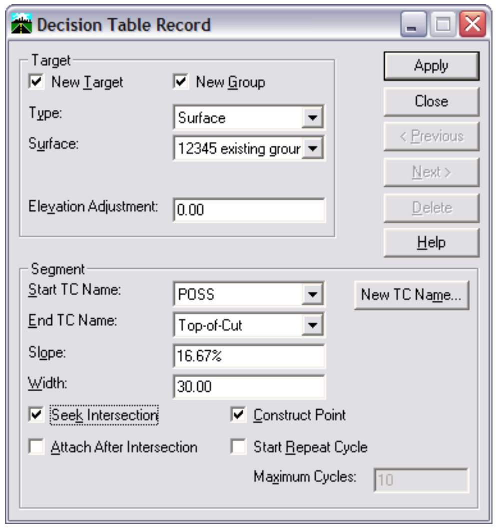


2. Select **Edit**.



Define the first record

3. Select **Add After**.



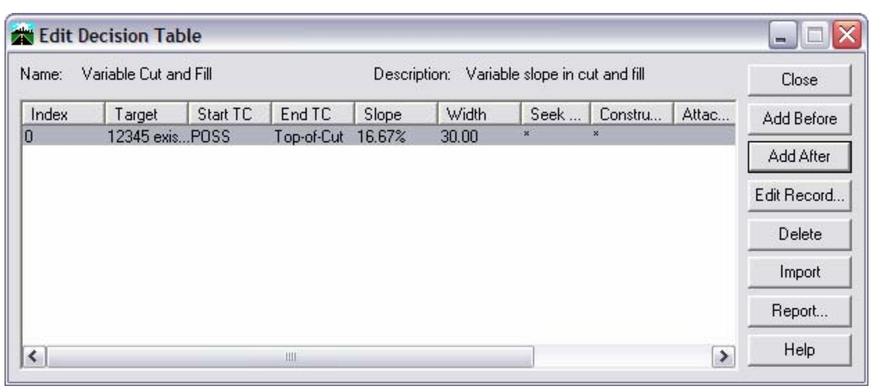
4. First, set the **Target** information:

   - Toggle on **New Target**
   - Toggle on **New Group**
   - Toggle the **Target Type** to **Surface**
   - Toggle the **Surface** to **12345 existing ground**

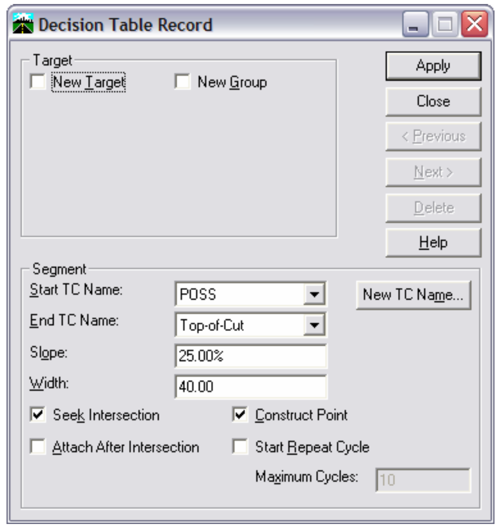
5. Next, set the Segment Information:

   - Start TC Name: **POSS**
   - End TC Name: **Top-of-Cut**
   - Slope: ***1:6***
   - Width: ***30*** (which corresponds to a 5' depth)
   - Toggle on: **Construct Point** and **Seek Intersection**
   - Toggle off: **Attach After** … and **Start Repeat Cycle**

6. Choose **Apply**



Define the second record while in the Decision Table Record dialog



7. First, set the Target information:

   - Toggle off **New Target**
   - Toggle off **New Group**

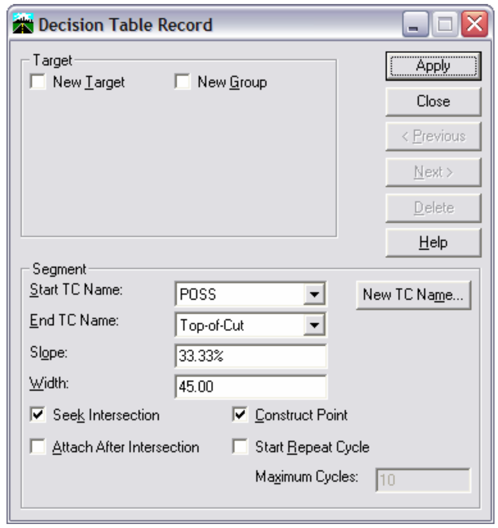
   This segment is part of the same target block and therefore must not have either of these toggled on.

8. Next, set the Segment Information:

   - Start TC Name: **POSS**
   - End TC Name: **Top-of-Cut**
   - Slope: ***1:4***
   - Width: ***40*** (which corresponds to a 10' depth)
   - Toggle on: **Construct Point** and **Seek Intersection**
   - Toggle off: **Attach After** … and **Start Repeat Cycle**

9. Choose **Apply**.

Define the third record



10. First, set the **Target** information:

    - Toggle off **New Target**
    - Toggle off **New Group**

    This segment is part of the same target block and therefore must not have either of these toggled on.

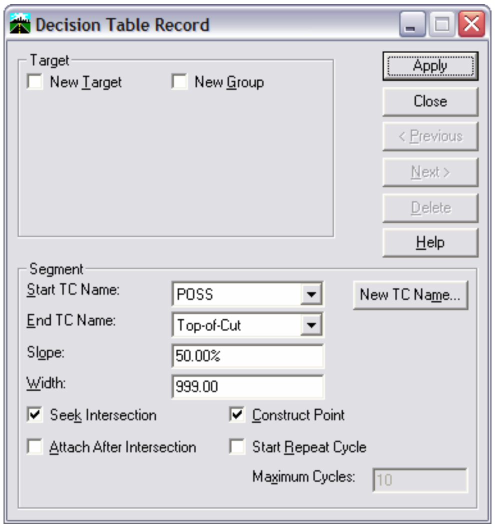
11. Next, set the **Segment** Information:

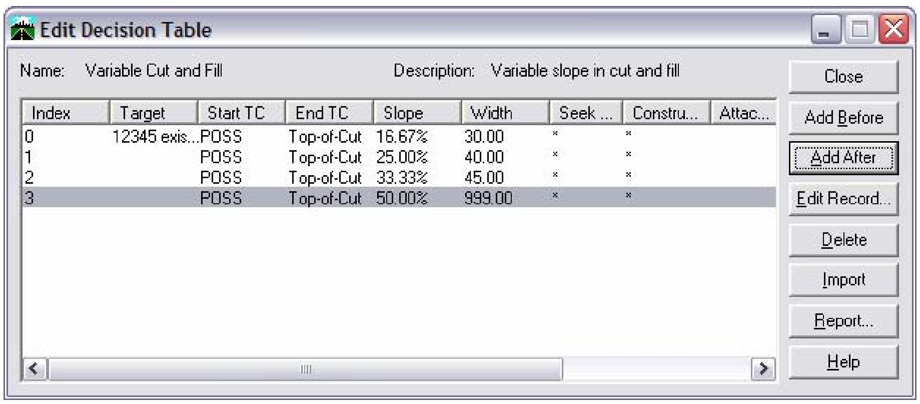
    - Start TC Name: **POSS**
    - End TC Name: **Top-of-Cut**
    - Slope: ***1:3***
    - Width: ***45*** (which corresponds to a 15' depth)
    - Toggle on: **Construct Point** and **Seek Intersection**
    - Toggle off: **Attach After** … and **Start Repeat Cycle**

12. Choose **Apply**.

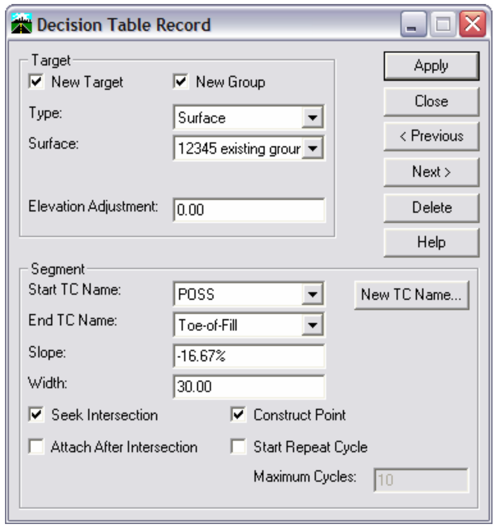
Define the fourth and final record in the cut group

Be certain to use a large width, since the last record must be able to catch when all previous records have failed.





Define the first record in the fill group



13. First, set the **Target** information:

    - Toggle on **New Target**
    - Toggle on **New Group**
    - Toggle the **Target Type** to **Surface**
    - Toggle the **Surface** to **12345 existing ground**

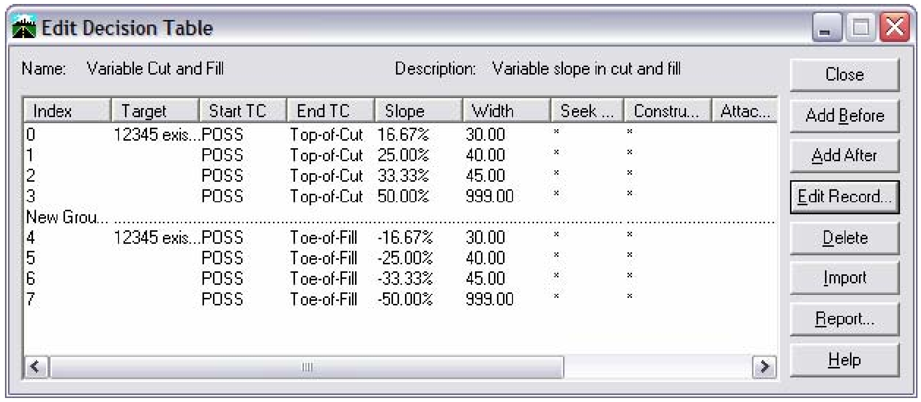
14. Next, set the Segment Information:

    - Start TC Name: **POSS**
    - End TC Name: **Toe-of-Fill**
    - Slope: ***-1:6***
    - Width: ***30*** (which corresponds to a 5' height)
    - Toggle on: **Construct Point** and **Seek Intersection**
    - Toggle off: **Attach After** … and **Start Repeat Cycle**

15. Choose **Apply**.

Define the other fill records from the table

Don’t forget, the fill slopes must be negative.



16. Choose **Close** on the **Edit Decision Table** dialog.

    Note: The cut and fill are in separate groups so they can easily be distinguished when editing or reviewing the table. However, they could also be in the same group as long as they are in the same target block.

17. **Close** the **Define Typical Section** dialog.

Save the decision table

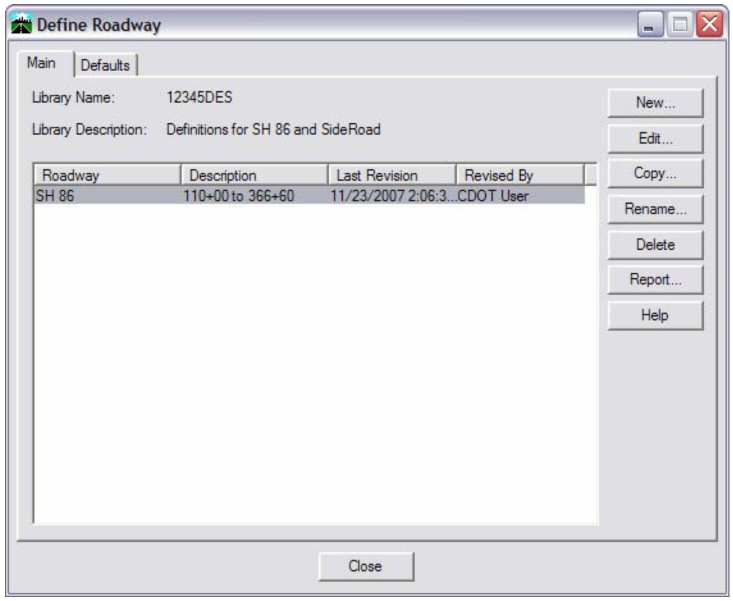
The decision table is stored in the typical section library.

1. Choose **File > Save > Typical Section Library**.

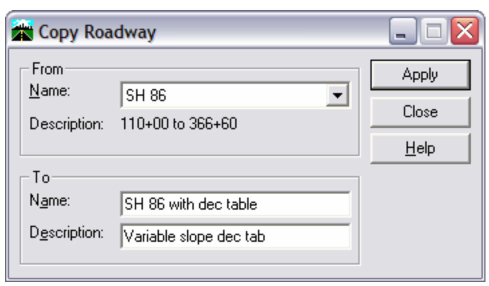
Create a new roadway library entry

You will copy the existing roadway definition file and then modify the copy to use the decision table created in the previous steps.

1. Select **Modeler > Define Roadway**.
2. Highlight the roadway definition **SH 86**.

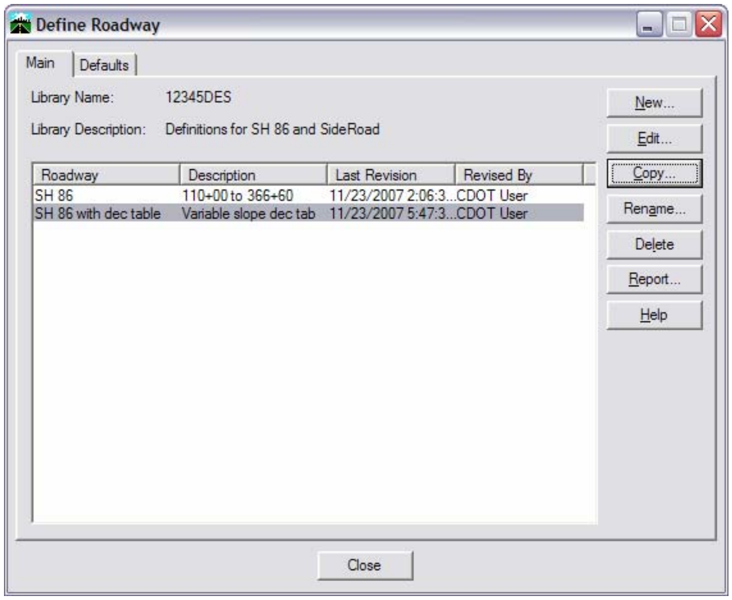


3. Select **Copy**.



- In the **To** category, enter the ***Name: SH 86 with dec table***.
- Enter the **Description**: ***Variable slope dec tab***.

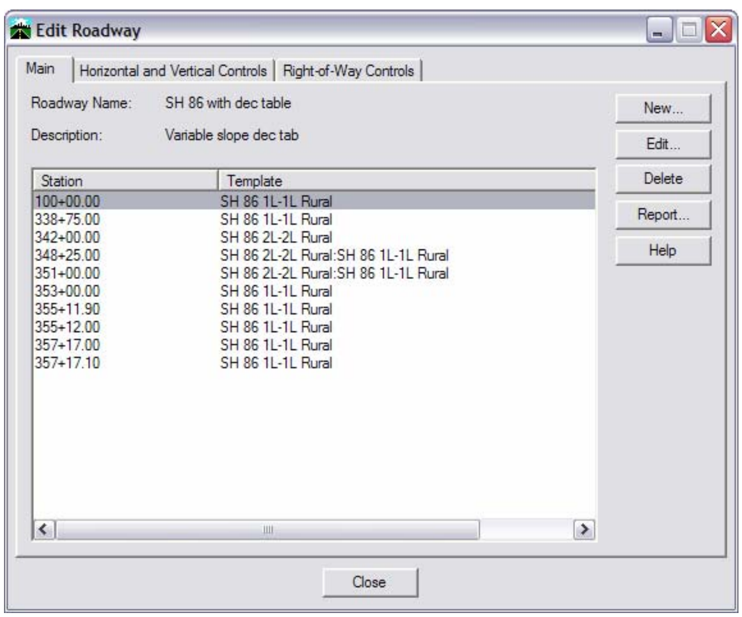
4. Select **Apply**, then **Close**.



Edit the copied roadway definition entry to use the decision table

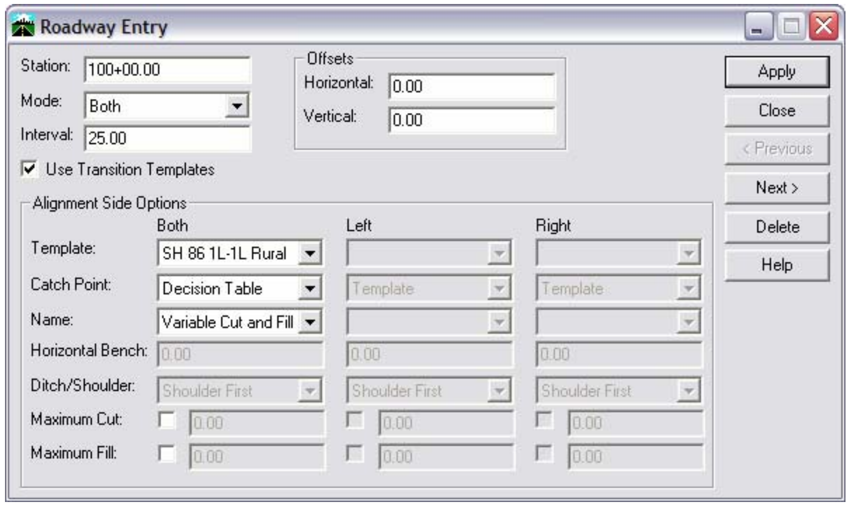
5. From the **Define Roadway** dialog box,

   - Highlight the new roadway definition, **SH 86 with dec table**.
   - Select **Edit**.



6. Select the first station in the list and select **Edit**.

    - Set the **Catch Point** to **Decision Table**.
    - In the **Name** field and select **Variable Cut and Fill** from the drop-down list.



7. Select **Apply**.

8. Select **Next** to move to the next station entry in the list.

9. Continue for all the stations that have a **Catch Point** of **Template**, setting:

    - **Catch Point** to **Decision Table** and **Name** to **Variable Cut and Fill** – **Apply** after each, then choose **Next**.
    - ***WARNING: Don't change the Catch Point for the sections that are Backbone Only!***

10. When complete, select **Close** to dismiss the **Roadway Entry** dialog box.

11. Select **Close** to dismiss the **Edit Roadway** dialog box.

12. Select **Close** to exit the **Define Roadway** box.

Save the roadway definition

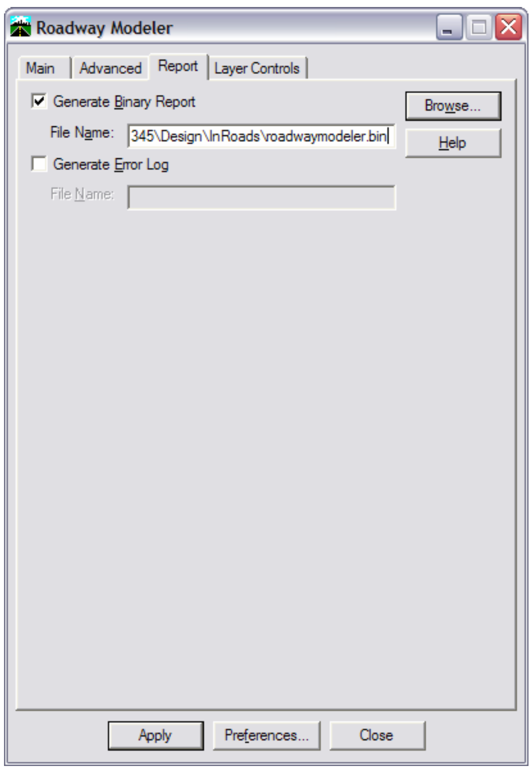
1. Select **File > Save > Roadway Library**.

2. The file **12345DES.rwl** is saved to the hard drive.

Run Roadway Modeler

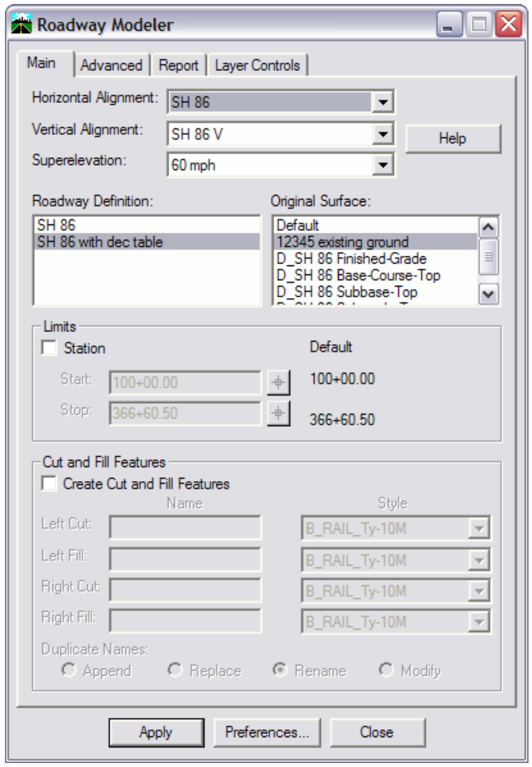
Before processing **Roadway Modeler** again, clean up the design file and make your lock settings.

1. **Delete** any contours from the previous **Roadway Modeler** run.
2. **Delete** any Transition Control lines from the previous run.
3. Ensure **Write** lock is on.
4. Ensure **Station** lock is on.
5. Select **Roadway Modeler** and choose the **Report** tab to set the report options.
   - Toggle on **Generate Binary Report**.
   - Select **Browse,** navigate to the **\Design\InRoads** and key in ***roadwaymodeler.bin***.
   - Select **Save**.



6. Choose the **Advanced** tab and make certain **Empty Design Surface** is toggled on.

7. Back on the **Main** tab, select the data to be used by **Roadway Modeler**.



- Under the **Roadway** list select **SH 86 with dec table**.
- Under the **Original Surface** list highlight only **12345 existing ground**.

8. Select **Apply**.

   The templates are applied along the alignment using the decision table to determine the sideslopes. A new surface is created for each layer in the templates applied to the design.

9. Select **Close** to dismiss the **Roadway Modeler** dialog box.

Save your new surfaces

1. Save the finished grade surface created with **Roadway Modeler** to the hard disk.

2. Select **File > Save > Project**.

   The surfaces are part of the project now, so they are saved and the old finished and subgrades are overwritten. The surfaces could also have been saved individually using the **File > Save As** command, or by right-clicking them in the InRoads Explorer menu.

View the results of Roadway Modeler

1. **Zoom in** or **out** as needed with MicroStation to visually review the display of the Transition Control (TC) lines.

Display the triangles for the proposed surface

1. Select **Surface > View Surface > Triangles**.

2. Set the **Surface** to **D_ SH 86 Finished-Grade**.

3. Select **Apply** then **Close**.

4. Use the MicroStation **View Control** commands to take a closer look at the display. (Try rotating a view to see the variable slopes.)

5. Use MicroStation **Delete Element** to delete the triangle display (graphic group lock on).

View contours for the proposed surface

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

   - Set the **Surface** to **D_ SH 86 Finished-Grade**.
   - Select **Preferences** and load **Proposed 10’ Mjr. – 2’ Minor**.

2. Select **Apply**.

3. Use MicroStation **View** commands to take a closer look at the contours.

4. Use MicroStation **Delete Element** command to delete the contour display.

   Remember that the contour display is a graphic group.

Update the Cross Sections

1. Using what you have previously learned, **Update** the sections with the new surface information.

2. Run the **Cross Section Viewer**.

   Watch for the sections through the curve to see the superelevation and through the turn lane are to see the widening. Also watch for the sideslopes to change as defined by the decision table.

3. **Close** the **Cross Section Viewer** dialog.

Drive the roadway

1. Select **Modeler > Drive Roadway**.
2. Highlight the Horizontal Alignment **SH 86**.
3. Highlight the Vertical Alignment **SH 86 V**.
4. Choose **Run**.
5. **Close** the **Drive Roadway** dialog.
6. Set your view back to **Top**.
7. **Exit** MicroStation.

Challenge labs:

1. Use the **Urban-4-Ln** template to create **SH 86 1L-1L Urban**.
   - Copy your roadway definition
   - Transition to the Urban section between 353+54.99 and 353+55.00
   - Keeping the bridge as backbone only, carry the Urban section through the end of the project.

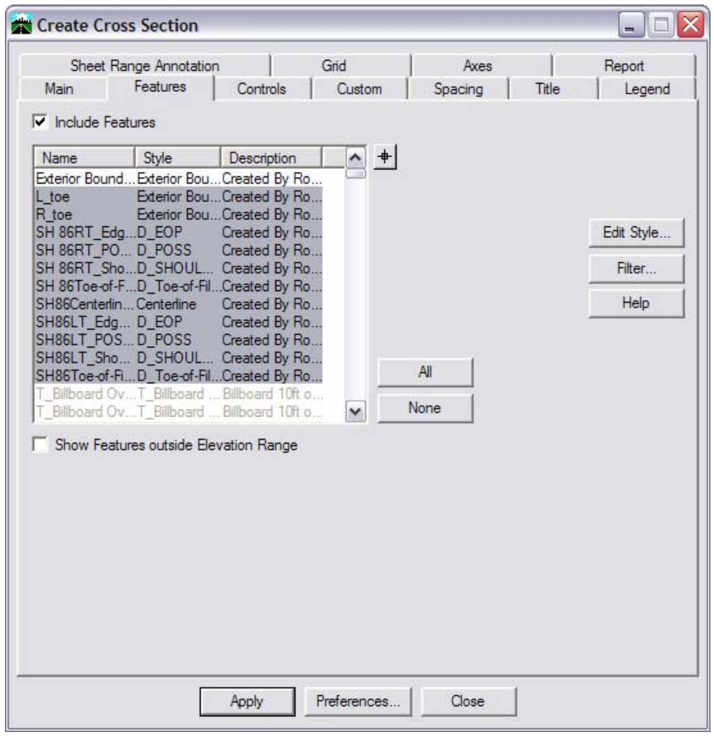
2. Create a decision table that uses a vertical alignment to define a ditch.

3. Create another decision table of your choosing.

10. Final Sections

Features on Sections

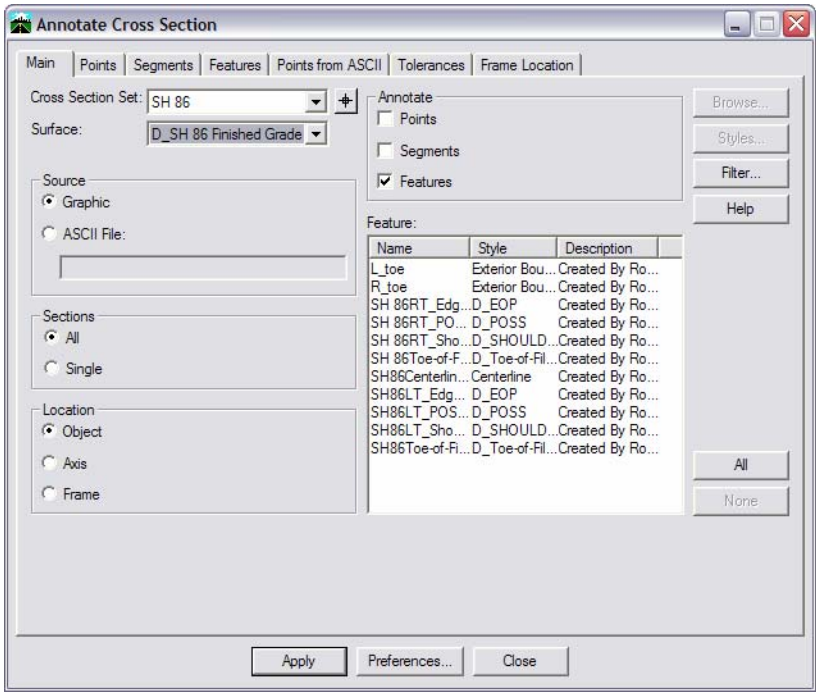
Both triangulating features and non-triangulating features can be shown on the cross sections. On the **Features** tab, toggle on **Include Features** and choose the features you want to show. The feature's style must allow **Cross Section Point** display.



Features that are shown on cross sections are available for annotation and editing.

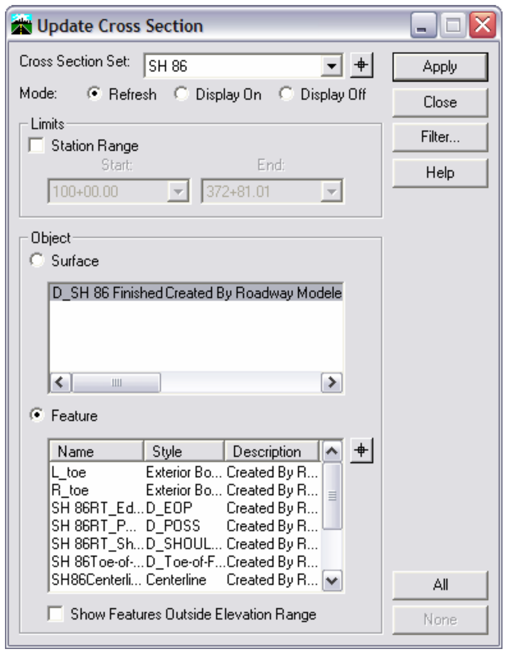
Annotating Cross Sections

Several annotation options are available for cross sections. **Points** can be annotated with offsets and elevations, **Segments** can be annotated with slopes, slope length and/or horizontal widths, and **Features** can be annotated with offset, elevations, and you choice of feature name, description or style.



Updating Existing Sections

Cross sections retain their association with the surfaces and features they display and therefore you can update the sections when any new information is available. For example, you may realize that you need to add a utility line into the DTM. Rather than cutting a new set of sections to show the addition, select **Evaluation > Cross Section > Update Cross Section**. From this dialog, you can either update the entire set of sections or a range of sections. The update can involve refreshing items that have already been displayed on the sections, turning those items off, or turning on items not currently displayed.



Always use this command to turn off features displayed from a design surface before running **Roadway Modeler** and creating the same surface. Otherwise, the features will not be recognized by the new surface so you will not be able to turn them off or update them later.

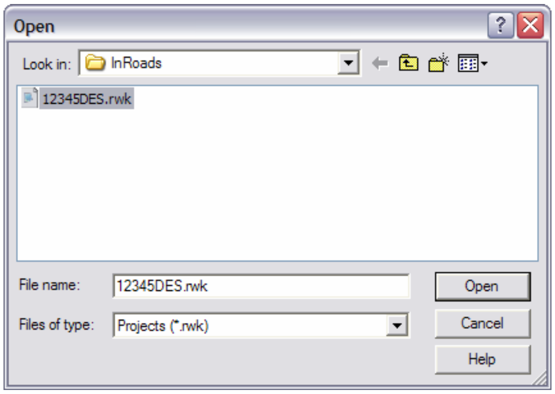
Lab 10 – Final Sections

Start InRoads

1. Start InRoads and open **CU12345DES_Model.dgn** from the **\Design\Working** folder.

Open your InRoads data files

1. Select **File > Open**.



2. Ensure the **Files of Type** option is set to **Projects (*.rwk)**.

3. Double-click on **12345DES.rwk**.

   Double-clicking is the equivalent of highlighting the file and choosing **Open**.

4. **Cancel** the dialog.

Create a new design file for your cross sections

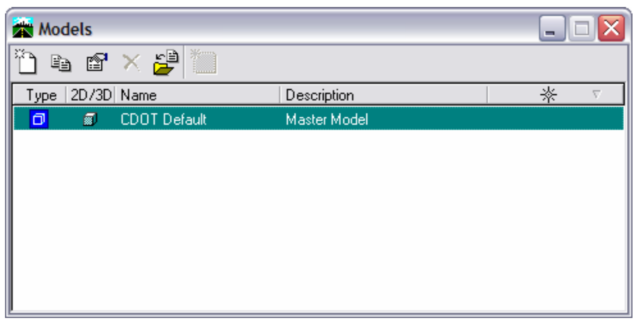
1. Select **File > New**.
2. Navigate to the **\Design\Drawings\Cross_Sections** folder.
3. Key in the Name ***12345DES_XSec.dgn***
4. Choose **OK**.

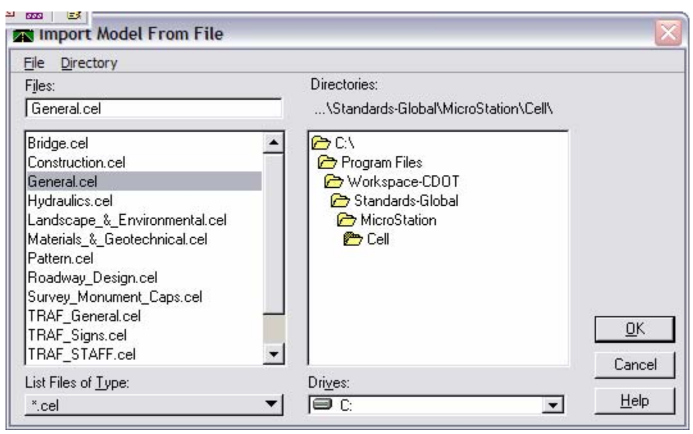
This creates the new design file and automatically opens it for you.

Prepare a cross section border

There is a generic border in your cell library. In the next series of steps, you will import that cell as a model into your cross section design file and modify it with project-specific information.

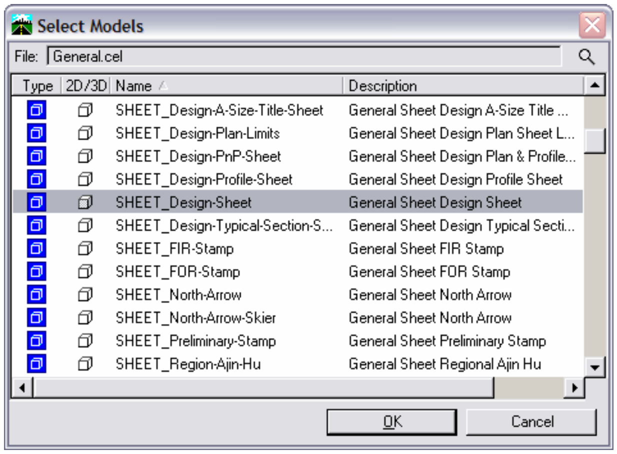
1. On the MicroStation menu, select **File > Models**.
2. On the **Models** dialog, select **Import Models**.



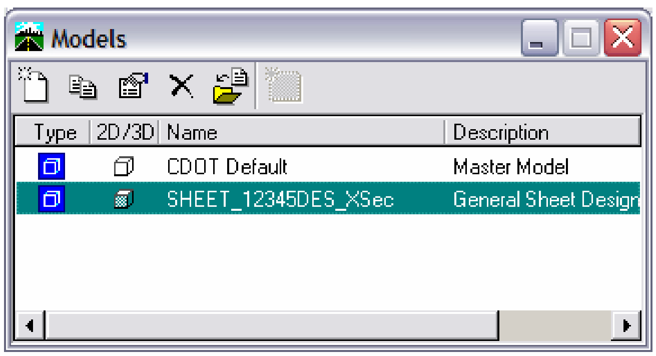


- Change the **List Files of Type** to **All Files (*.*)**.
- Navigate to the **C:\Program Files\Workspace-CDOT\Standards-Global\MicroStation\Cell** folder.
- Choose **General.cell** and then select **OK**.

- On the Select **Models** dialog, choose **SHEET_Design-Sheet** then **OK**.



The cell is imported into your active design file, **12345DES_XSec.dgn** and shows up in your **Models** dialog.

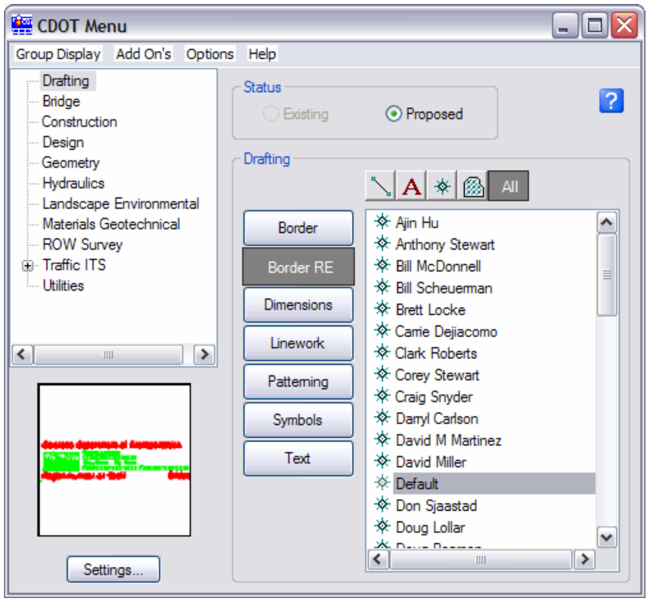


- Right-click on **SHEET_Design-Sheet** and change the name to **SHEET_12345DES_XSec.**

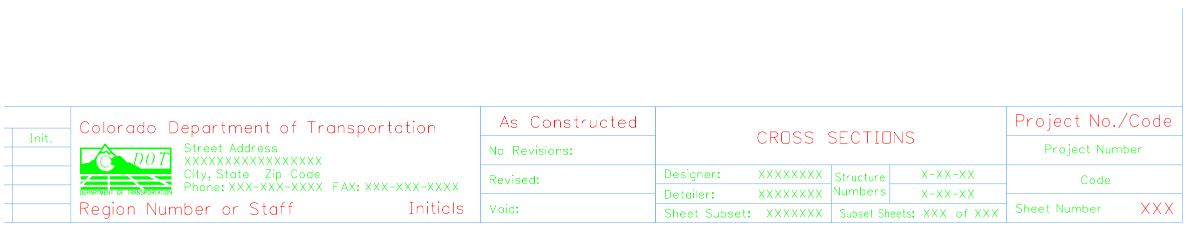
3. **Close** the **Models** dialog.

4. **Window** into the title block and use MicroStation **Edit Text** to change any of the generic information you want.

5. Use the CDOT Menu to add the Resident Engineer's cell to the border like you learned in the previous Plan and Profile chapter.

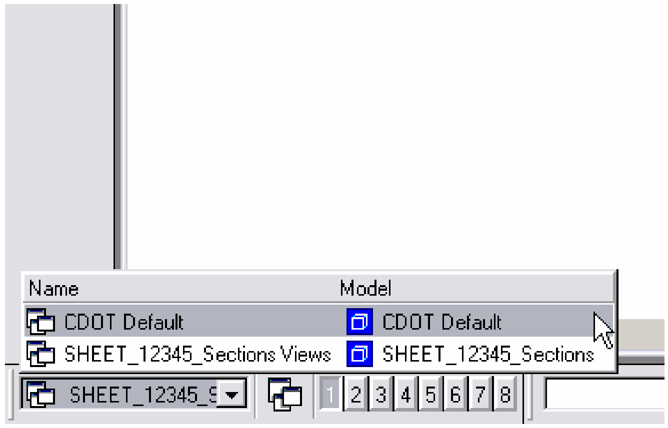


Hint: Set the Scale to 1 before Applying.



6. Return to the **CDOT Default** Model using the View Groups in the lower left of your screen.

   This is ***very*** important! If you do not have the **View Groups** in the lower left of your screen, ask your instructor for assistance!

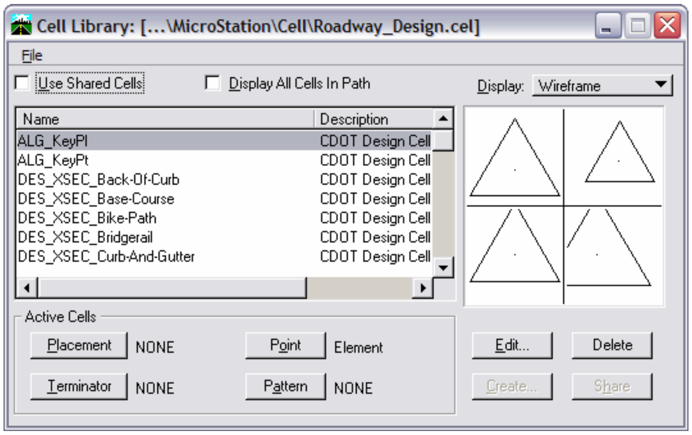


Verify you are in the CDOT Default model by checking the top left of the View window. It should look like the one pictured above.

Attach the design file as a cell library

Since any design file can be used as a library, you will now attach the file you just placed and customized the border cell in as a cell library itself. This allows you to use the customized cell as the border for your cross sections.

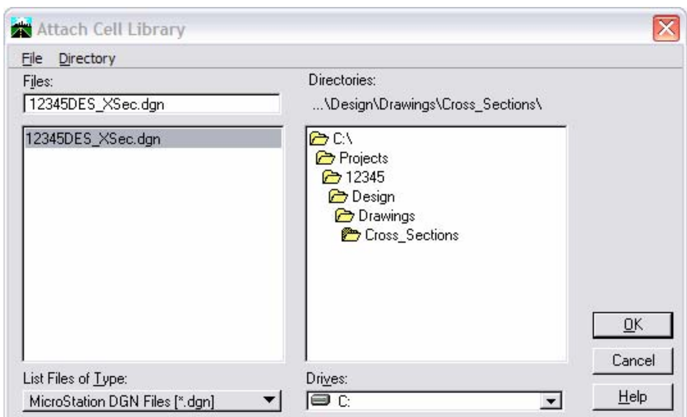
1. On the MicroStation menu, select **Element > Cells**.



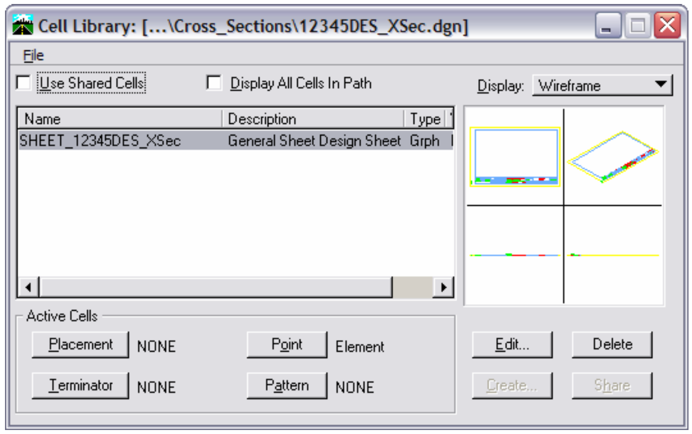
2. Toggle off **Display All Cells in Path**.

3. Select **File > Attach** and navigate to the **C:\Projects\12345\Design\Drawings\Cross_Sections** folder.

4. Change the **Files of Type** to **MicroStation DGN Files (*.dgn)**.



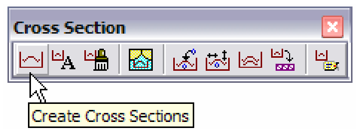
5. Choose **12345DES_XSec.dgn** and **OK**.

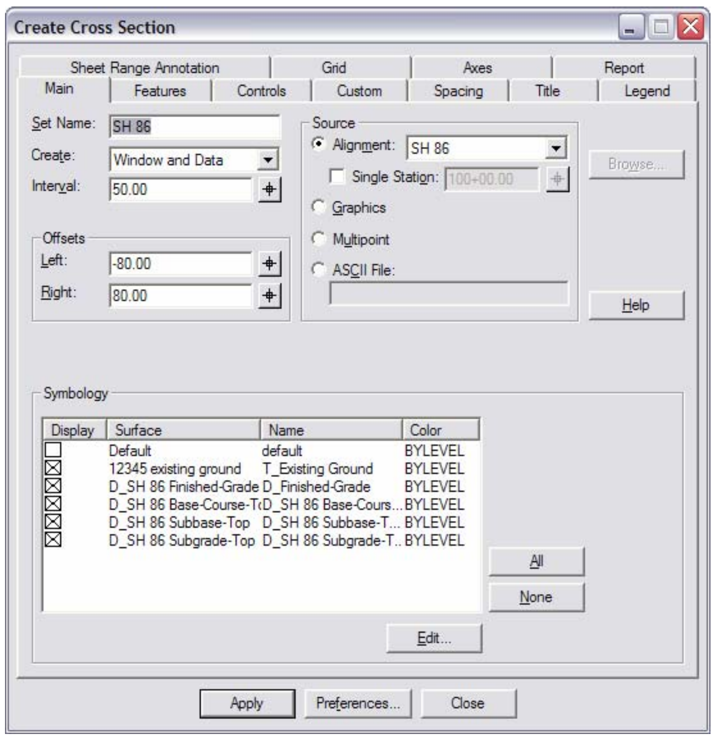


Your design file is now attached as a cell library, allowing you to place the modified border as a cell when creating cross sections in the next series of steps.

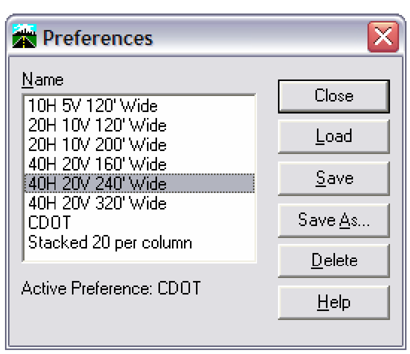
Cut Cross Sections

1. Make certain **Write** and **Station** locks are on, and that you are in **Pencil** mode.
2. Choose **Tools > Options > Factors** and set the **Text Scale Factor** to ***40***, then **Apply**.
3. If you have closed your **Cross Section** toolbar, then select **Tools > Customize > Cross Section**, then **Close** the **Toolbars** dialog.
4. On the **Cross Section** toolbar, select **Create Cross Sections**.

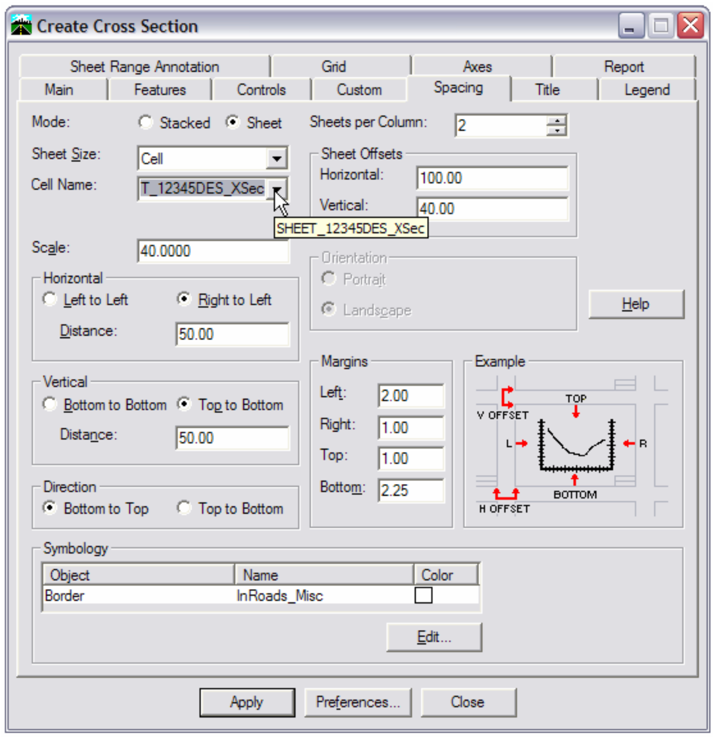




5. Choose **Preferences** and load **40H 20V 240' Wide**.

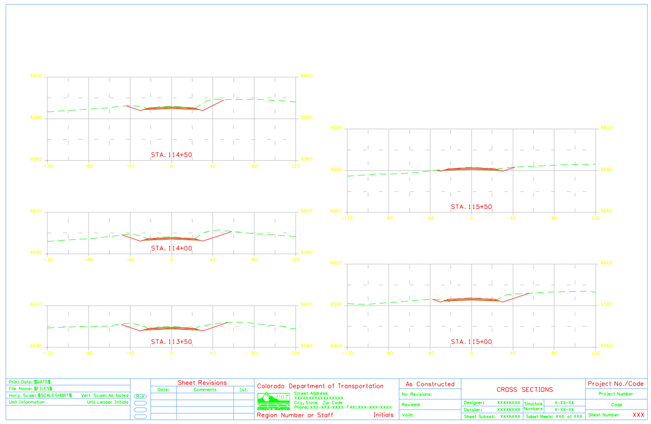


6. On the **Main** tab,
   - Set the **Source** to **Alignment** and select **SH 86**.
7. On the **Controls** tab,
   - Notice the **Vertical Exaggeration** is ***2***.
8. On the **Spacing** tab,
   - Set the **Cell Name** to **SHEET_12345DES_XSec**.



9. On the **Report** tab,
   - Turn on **Generate Binary Report**
   - Click in the **Name** field and **Browse**.
   - Set the folder to \12345\Design\InRoads
   - Key in ***section.bin*** and **Save**.

10. **Apply** and **<D>** for the lower left corner of the first cross section.



11. **Zoom in** to the section set.

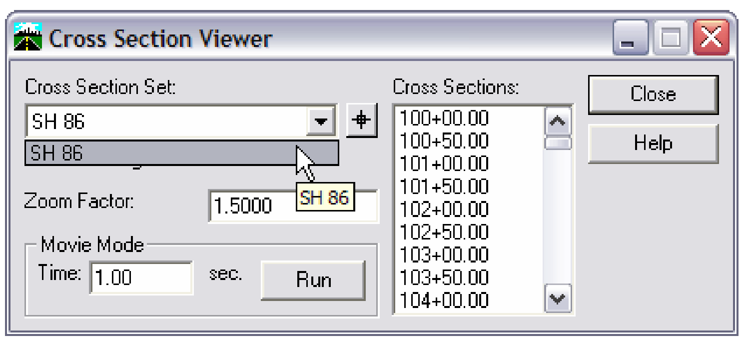
    Notice that the sections are placed inside sheets and the cell you modified is used as the border.

12. **Fit** your MicroStation view and make certain you have only one set of cross sections.

View the cross sections that are plotted in the design file

1. On the **Cross Section** toolbar, select the **Cross Section Viewer** command.

   The **Cross Section Sets** option should list only one set of sections.



2. Set the **Time** to **0.5 sec**.

3. Select **Run**.

   - You can stop the viewer by pressing the **<ESC>** key on your keyboard.

4. **Close** the **Cross Section Viewer** dialog.

5. On the MicroStation menu, select **File > Save Settings**.

Annotate sections

1. **Window in** to the 131+00 cross section. Hint: Use the **Cross Section Viewer**.

   Using the following command, you can annotate all of your sections with the desired information at one time. However, you will first annotate one section to ensure you are satisfied with the results before annotating the complete set.

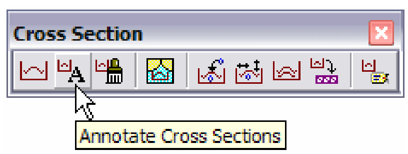
2. Ensure the **Write** lock is on.

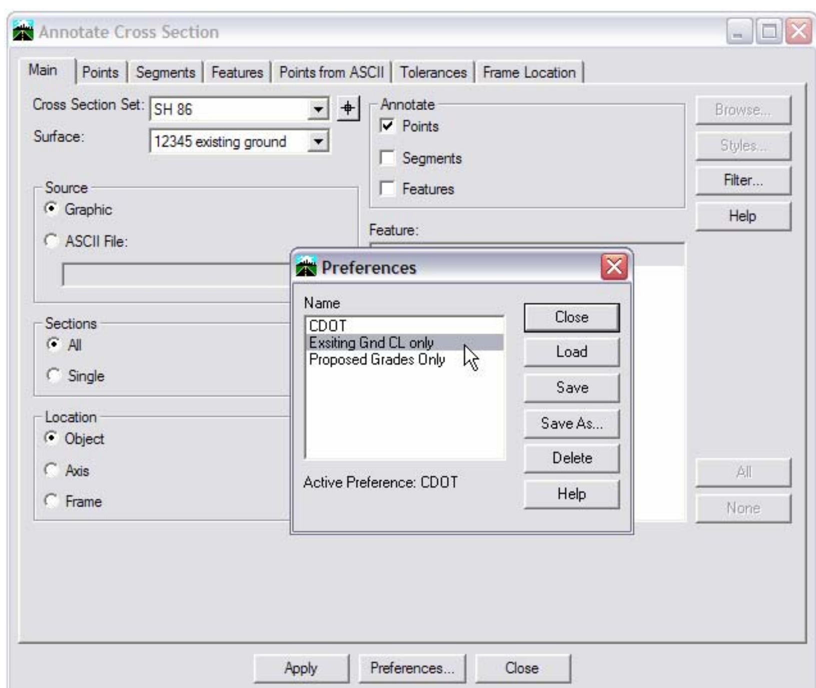
3. Ensure you are in **Pencil** mode.

4. Ensure the **Style** lock is off.

   If the Style lock is on, it will control the symbology of the annotation when annotating features, forcing them to use the **Named Symbology** assigned to each features. With it off, you will be able to control the symbology directly from the **Annotate Cross Section** dialog.

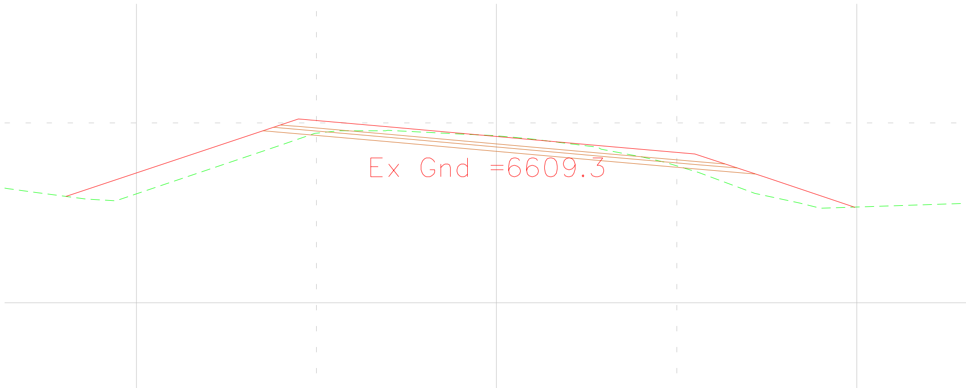
5. Select **Annotate Cross Sections**.





- Select **Preferences** and **Load** the **Existing Gnd CL only** preference.
- Set the **Surface** to **12345 existing ground**.
- Toggle on **Points**.
- Toggle on **Single** in the **Sections** area.

6. **Apply**, then **<D>** on the cross section in your view.

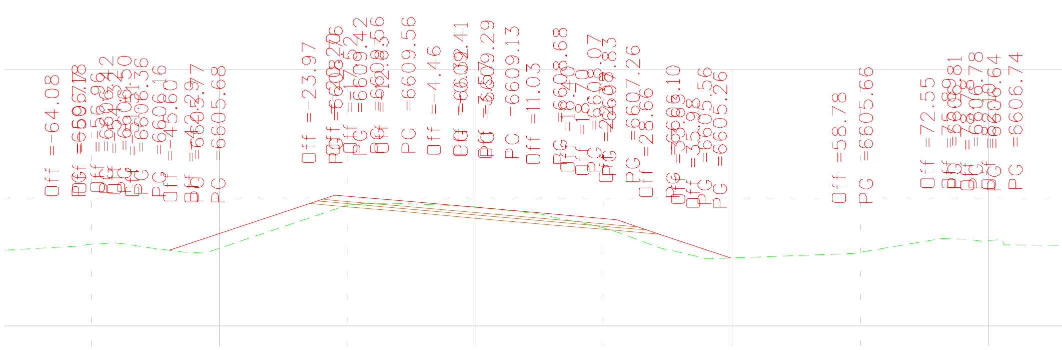


Notice only the CL elevation is annotated.

7. Select **Preferences** and **Load** the **CDOT preference**.

- Set the **Surface** to **12345 existing ground**.
- Toggle on **Points**.
- Toggle on **Single** in the **Sections** area.

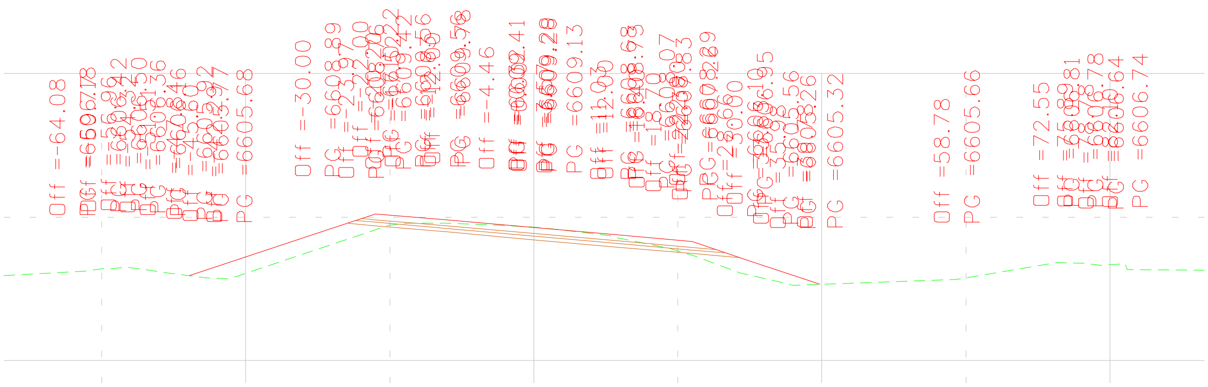
8. **Apply**, then **<D>** on the cross section in your view.



Notice the CL elevation is deleted (if you are still set to 12345 existing ground as the surface) and all points on the existing ground are annotated. The original annotation is deleted because it was placed in **Pencil** mode. If you wanted to keep it and annotate all other point, you could have switched to **Pen** mode first, then if desired, back to **Pencil** for subsequent annotations.

9. Set the **Surface** to **D_SH 86 Finished-Grade**.

10. **Apply**, then **<D>** on the cross section.

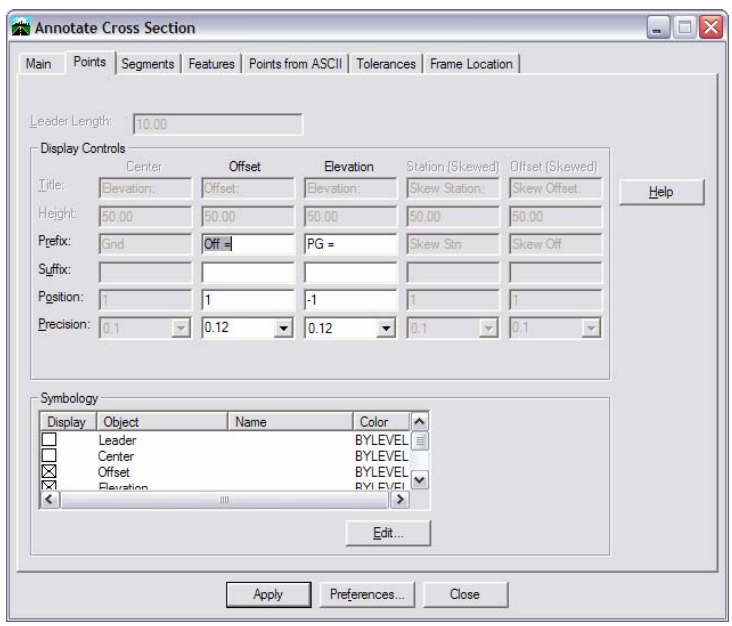


Notice the Finished Grade annotation is added to the existing annotation. Since you are annotating two different surfaces, it does not erase the first display, even though it was created in **Pencil** mode.

11. **Delete** the annotation.

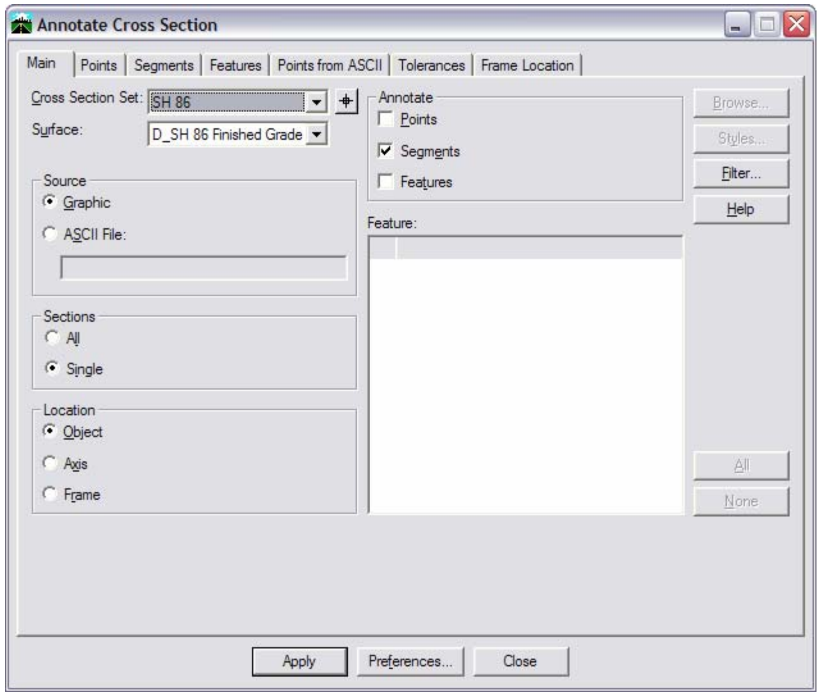
Since the annotation is just graphical, you can use MicroStation delete (with Graphic Group lock On) or you can use the MicroStation **Undo** command.

12. Select the **Points** tab.



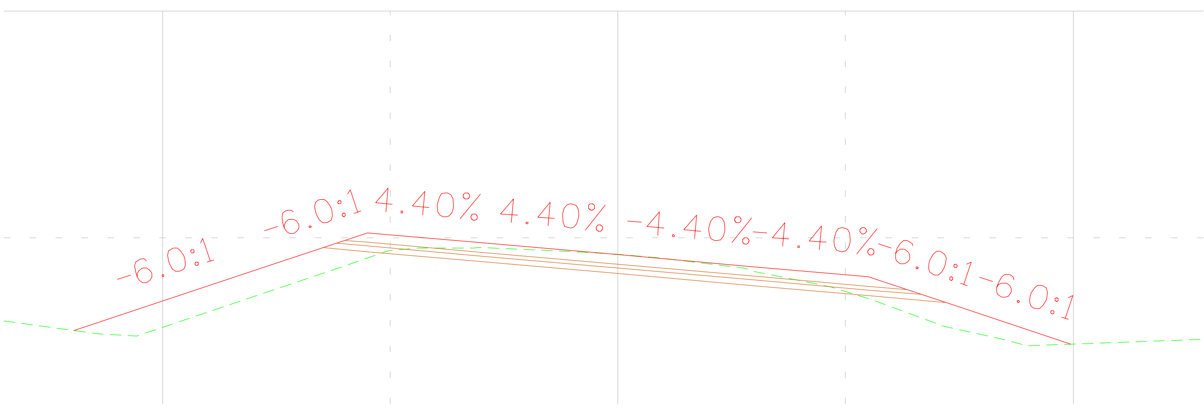
- This tab controls the annotation when you are in **Point** mode. Experiment with the different options and re-annotate to see the results.

13. **Delete** the annotation when you are done.
14. Select the **Main** tab.



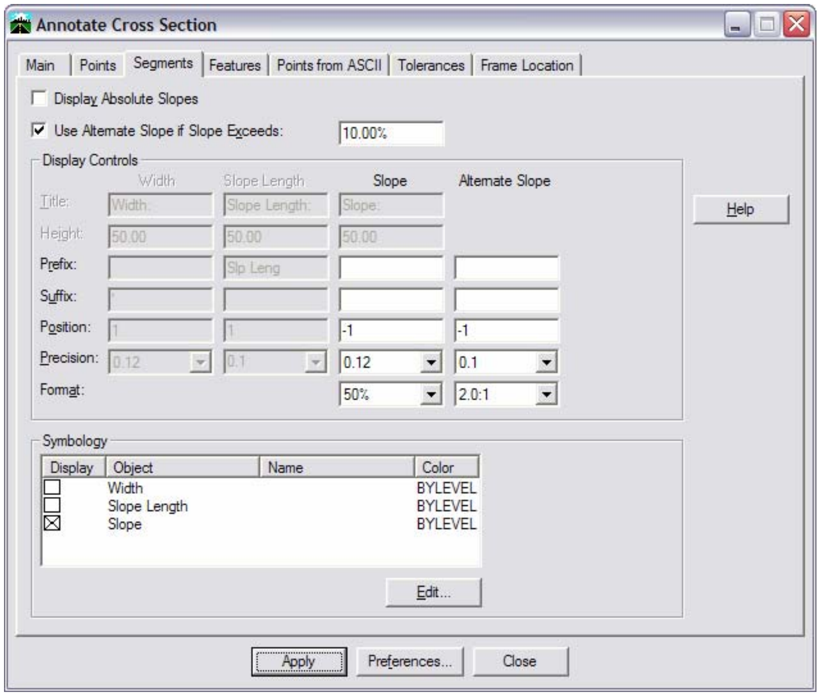
- Toggle off **Points** and toggle on **Segments**.

15. **Apply**, then **<D>** on the cross section.



Notice that the segments are annotated with the slope. This annotation is controlled by the **Segments** tab.

16. Select the **Segments** tab and experiment with some of the options.



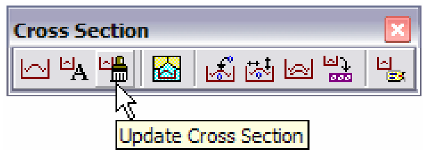
17. **Delete** the annotation when you are done.

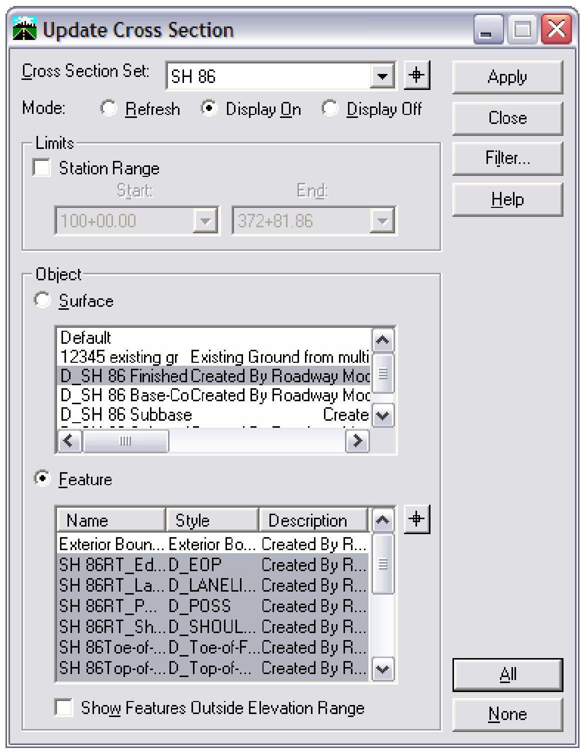
18. **Close** the Annotate dialog.

Using features with cross section annotation

The display of features on the cross sections can greatly enhance the ability to annotate sections.

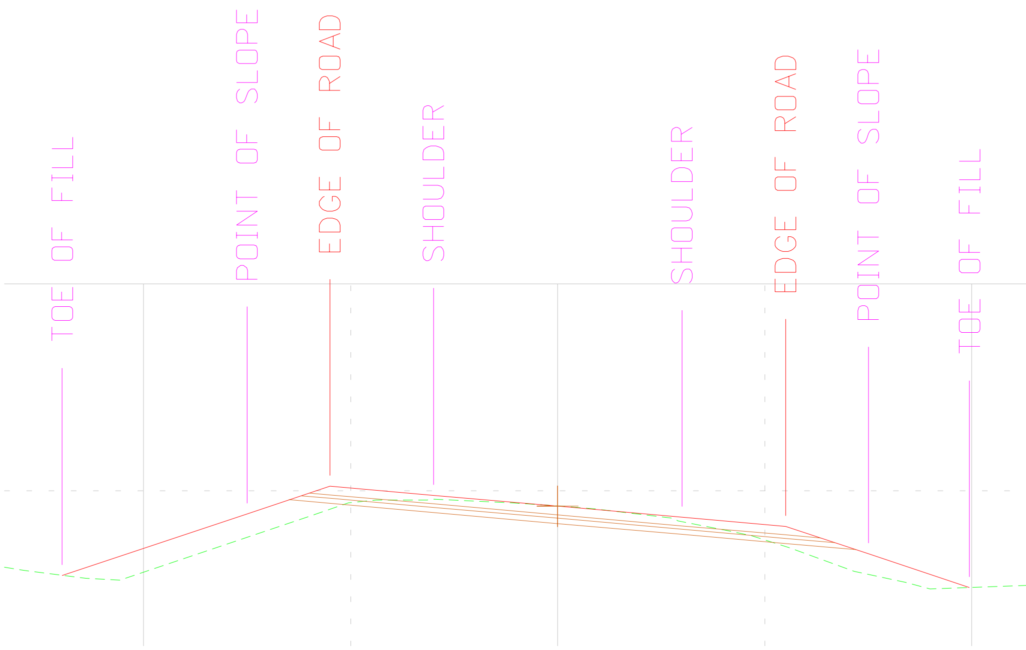
1. Select **Update Cross Section**.





- Set the **Mode** to **Display On**.
- Toggle on the **Object Feature**.
- Highlight the Surface **D_SH 86 Finished-Grade**.
- Select **All**.
- Hold your **<CTRL>** key down and select the Exterior Boundary to 'un-highlight' it.

2. **Apply**, then **Close**.



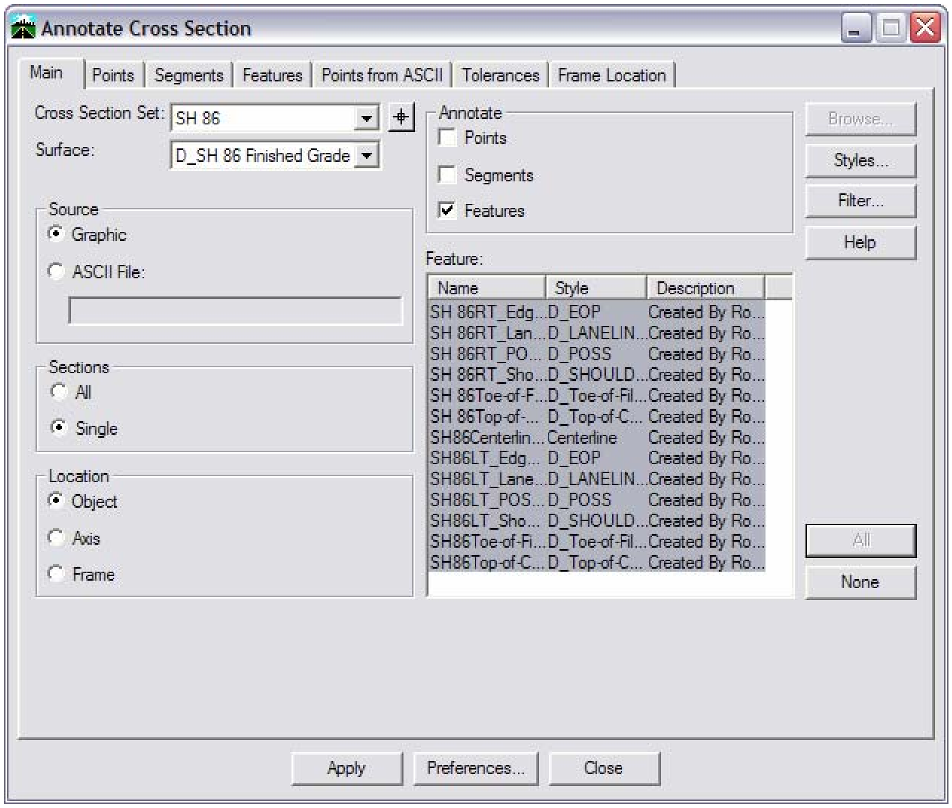
The cross section set is updated with location cells for each of the features in the proposed Finished Grade DTM.

3. Select **Annotate Cross Section**.

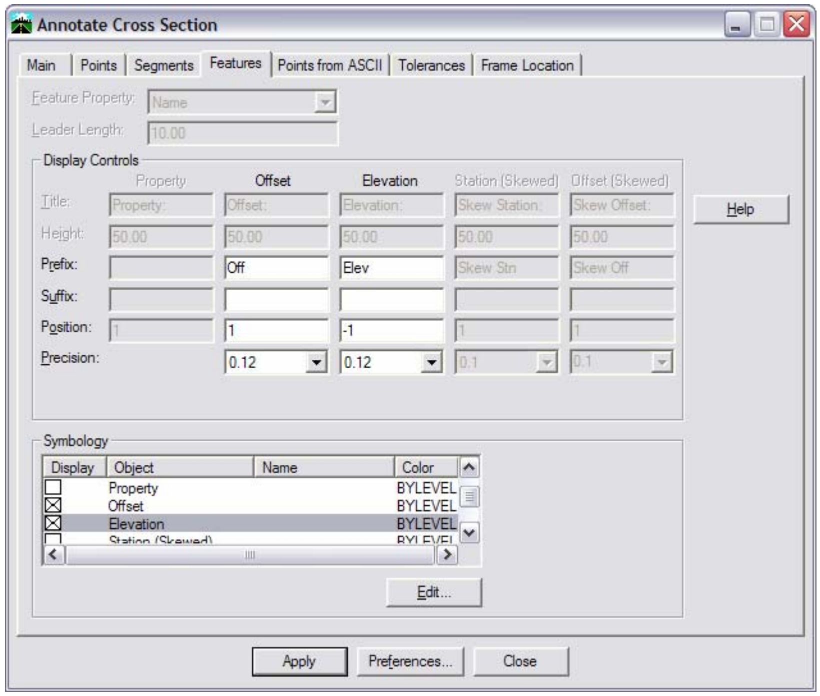
   - Set the **Surface** to **SH 86 Finished-Grade**.
   - Toggle off **Segments** and toggle on **Features**.

   Note that all of the features you just displayed on the cross sections now show up in the **Features** area.

   - Select **All** next to the **Feature** list.

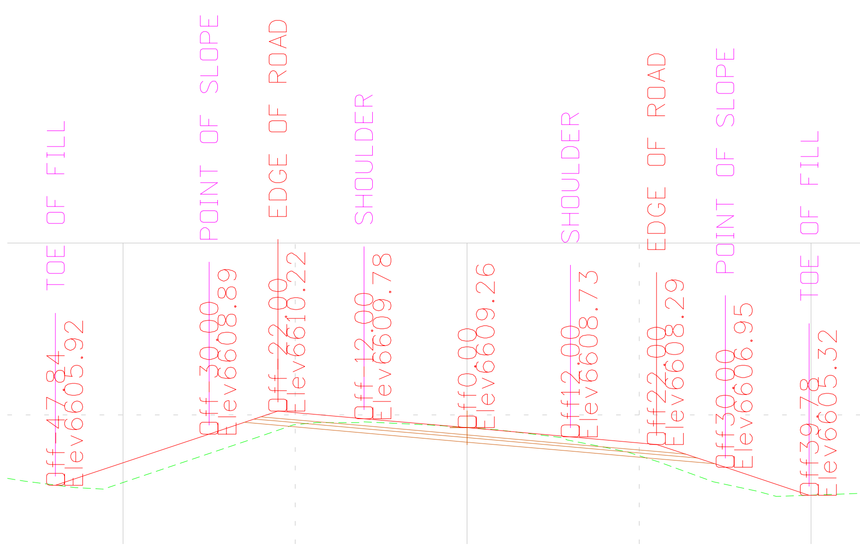


4. Select the **Features** tab.



- Toggle on **Offset** and **Elevation**.
- Toggle off **Property**.

5. **Apply** and **<D>** on the cross section.

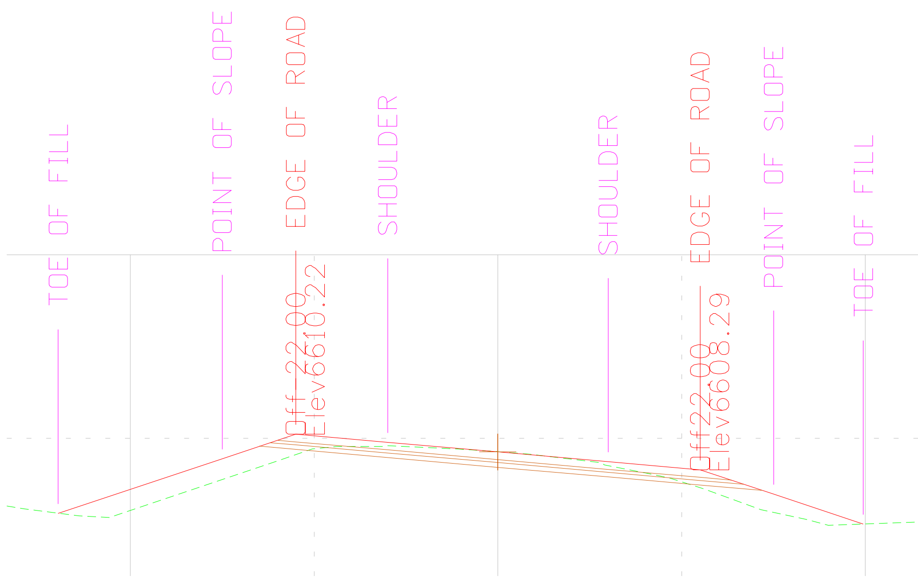


6. Review the annotation, then use MicroStation to delete it (do not delete the location cells (names) – just the offset and elevation annotation).

7. Select the **Main** tab.

    - Highlight just the edges of pavement.

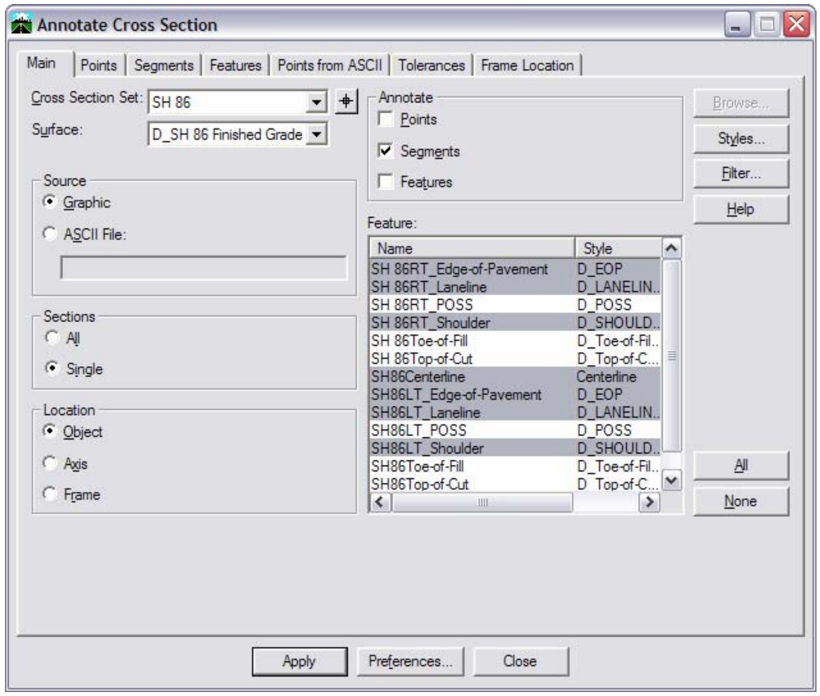
8. **Apply** and **<D>** on the cross section.



Note that this time, only the edges of pavement are annotated. Annotating features allows you to control which points are annotated and only annotate those you need, rather than all.

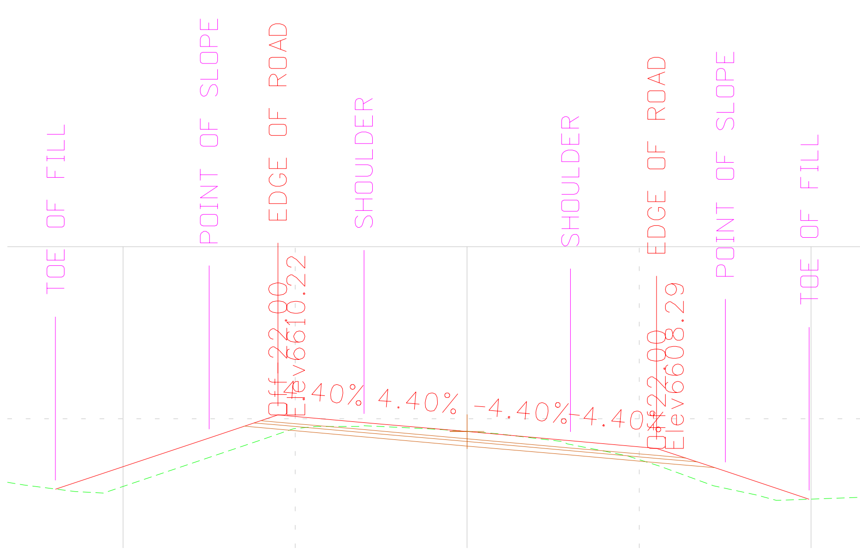
Features also allow you to annotate just the segments you want. For example, if you only need to annotate the sideslope segments, you can.

9. Select the **Main** tab.



- Toggle off **Features** and on **Segments**
- Highlight the features for the backbone as shown. (**Centerline**, **LT_Laneline**, **LT_Edge-of-Pavement**, **RT_Laneline**, **RT_Edge-of-Pavement**)

10. **Apply** and **<D>** on the cross section.



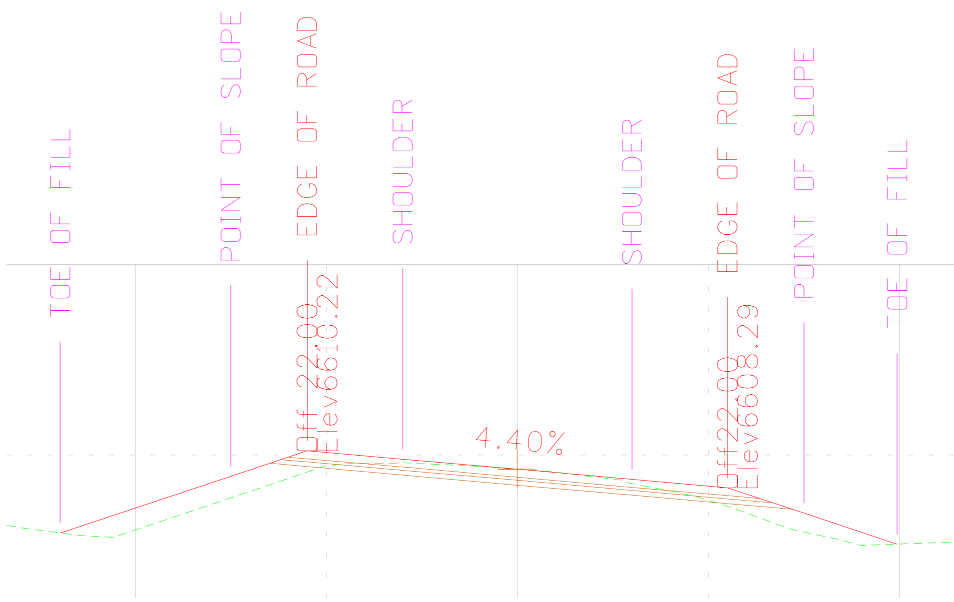
11. Select the **Tolerances** tab.

    - Change the Slope setting to 0.01%.

    This will annotate adjacent slopes that are identical only once.

12. **Apply** and **<D>** on the cross section.

    Notice that the adjacent segments are annotated once.

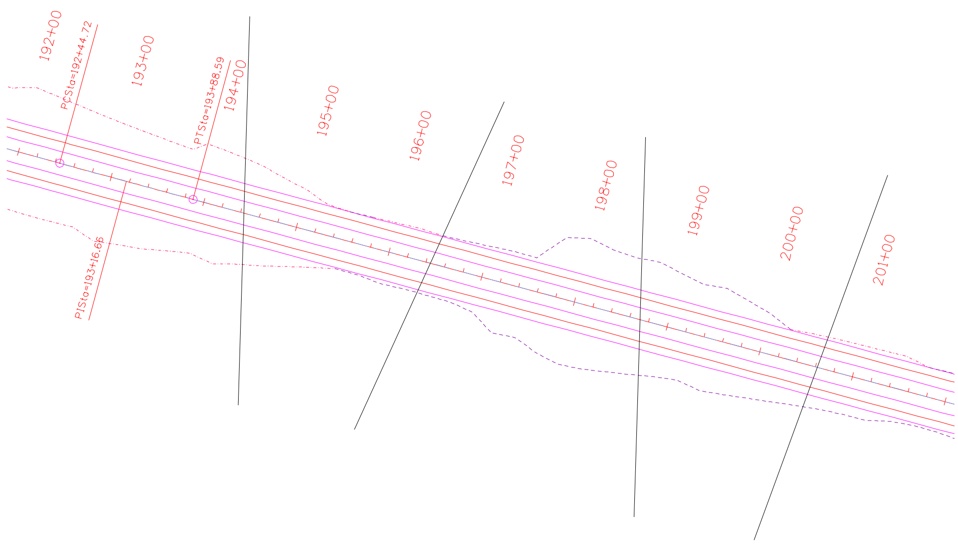


13. **Close** the **Annotate Cross** Section dialog.

Cutting skewed sections

1. Return to your working design **file 12345DES_Model.dgn**.

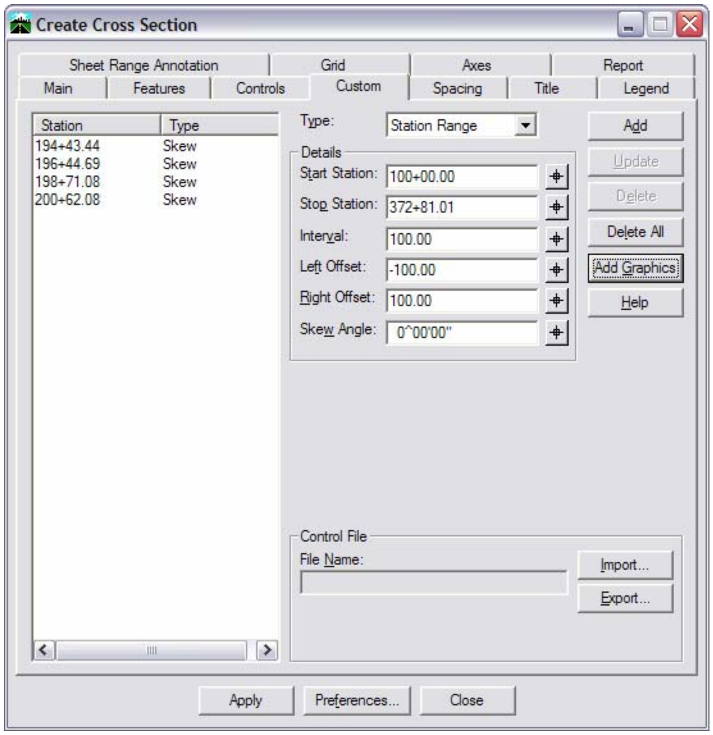
2. Draw a few lines that cross the roadway similar to those shown.



3. Make a selection set out of the MicroStation lines by using the **Element Selection** tool, holding down your **<CTRL>** key and choosing each of the elements. Make certain you do not get additional lines.

4. Select **Evaluation > Cross Section > Create Cross Section**.

   - Choose **Preference** and **load** the **Stacked 20 per column** preference.
   - On the **Custom** tab, choose **Add Graphics**.



This adds the graphic lines from the selection set as locations to cut sections.

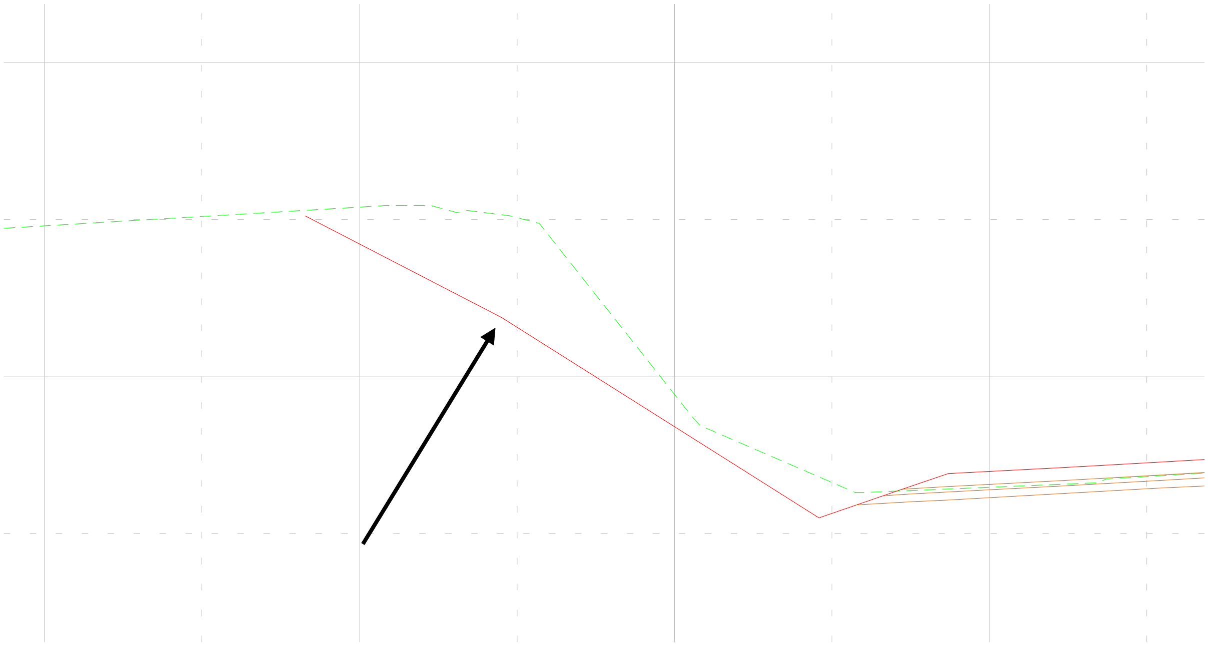
5. Select **Export**.

6. Key in a name of ***12345DES_SkewSec.xsc***

   This will save the skewed cross section setup to an ASCII file that can be Imported later to re-create the section set without the original MicroStation lines. Do not close the **Create Cross Section** dialog yet.

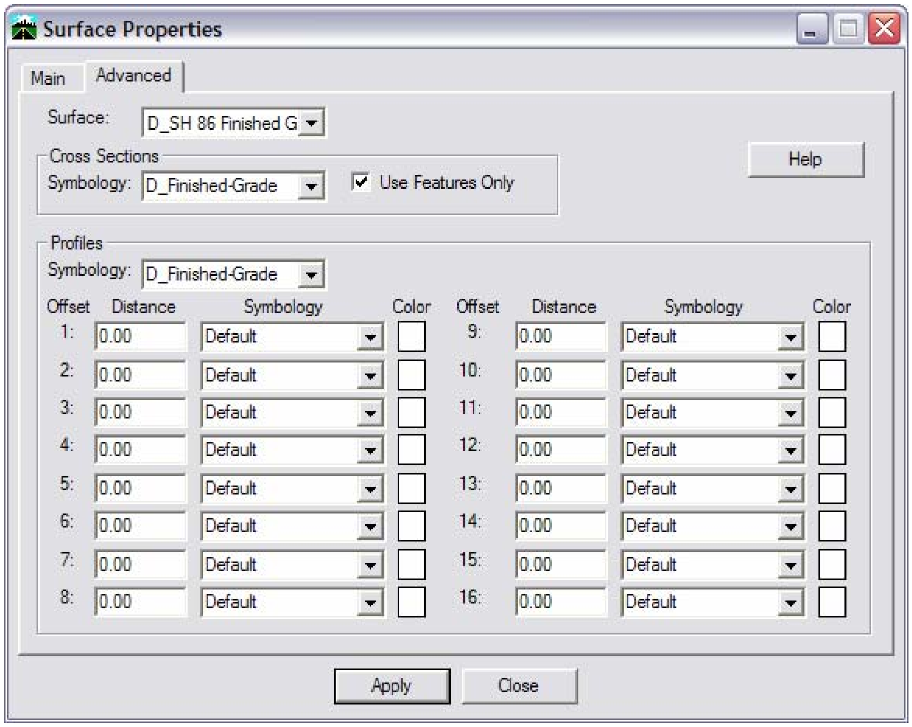
7. Choose **Apply** and **<D>** for the location of the lower left corner of the cross section set.

8. **Close** the **Cross Section** dialog.



Notice this cross section's sideslopes do not appear correct – it has a break in the slope. This is because the cross sections were cut based on triangles and therefore show the slope of individual triangles. You may or may not see this in any of your skewed sections. If you do, you can remedy this problem by using only the features to create the sections. This option can be used on all cross section sets, not just these skewed sections. Just remember, the cross sections will no longer reflect exactly what the DTM triangles define.

9. Select **Surface > Surface Properties**.



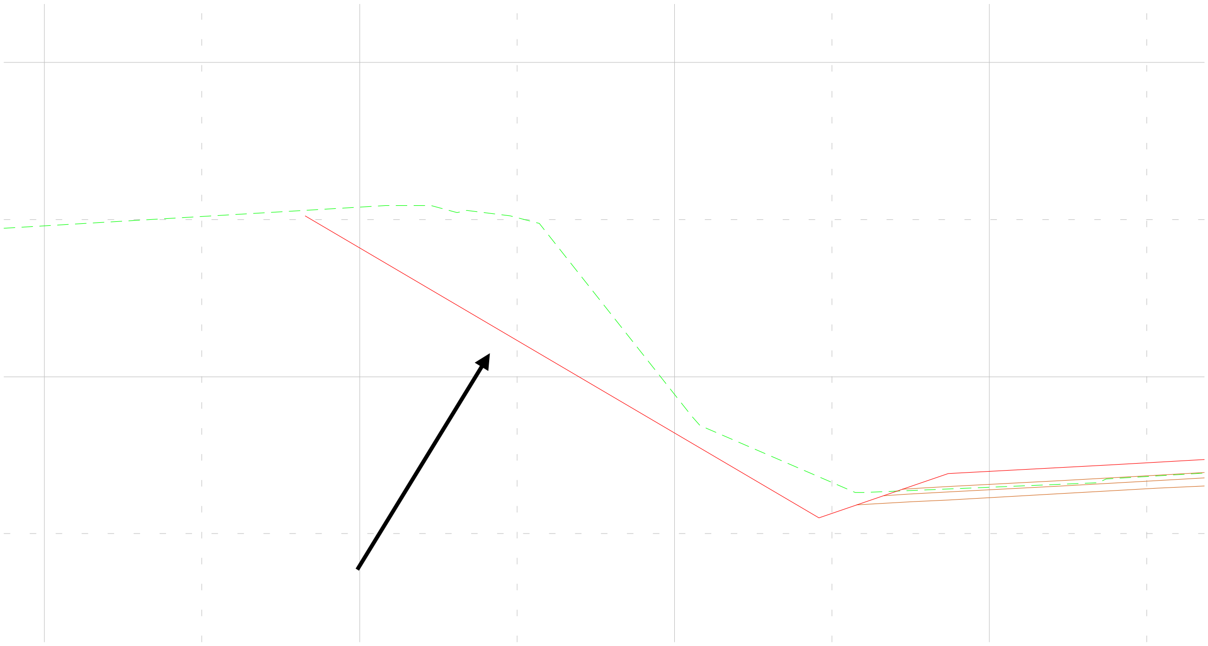
- Set the **Surface** to **D_SH 86 Finished-Grade**.
- On the **Advanced** tab, toggle on **Use Feature Only**.

10. **Apply**.

11. You may want to repeat for each of the proposed surfaces.

    You typically **do not** want to turn this on for existing surfaces!

12. **Update** the surfaces on your skewed cross sections and review the results.



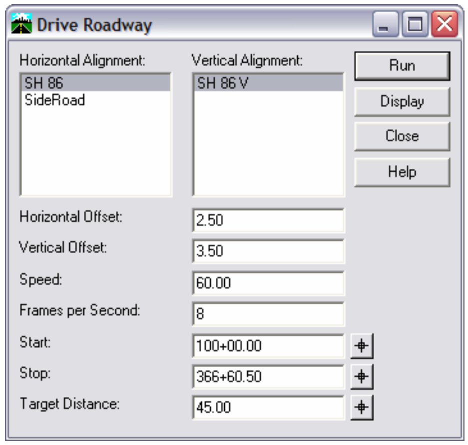
Challenge labs

1. Plot one of your cross section sheets if a plotter is available.
2. Show the utility lines on the cross sections and annotate them.
3. Create additional custom sets of sections.

11. Visualizing the Project in 3D

Drive Roadway

The **Drive Roadway** command is an **Application Add-in** with InRoads. After toggling it on under **Tools > Application Add-ins**, it becomes an option on the **Roadway Modeler** pulldown and toolbar.



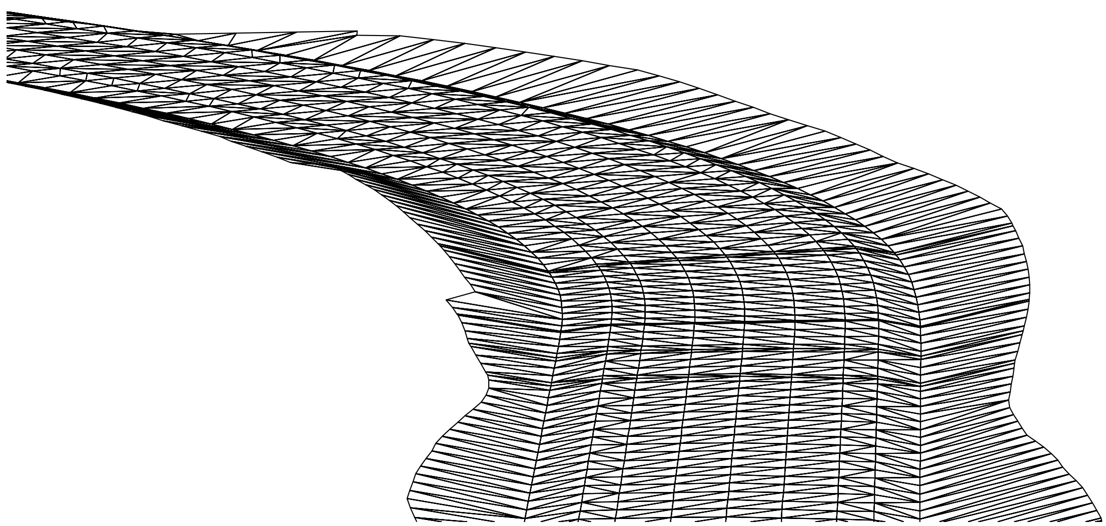
Drive Roadway has two primary functions. First it can be used to draw a 3D linestring along the alignment (using the **Display** option). This display can be used with MicroStation **Fly-through** or other rendering software to define a camera path for creating a movie. The vertices on the linestring represent camera positions to achieve the desired frames per second and travel speed.

Second, the **Drive Roadway** can be used as a visualization tool itself (using the **Run** option). It does not provide a rendered image, but a wireframe ride down the road. (The exception is if the view is set to display a rendered image and triangles or shapes are displayed. However, the drive is not a smooth, movie-like image such as you would get from a MicroStation **Fly-through**.) The more frames per second and the slower the speed, the smoother the resulting image during the drive, but the more likely your hardware will not be able to display it adequately.

Rotated Views

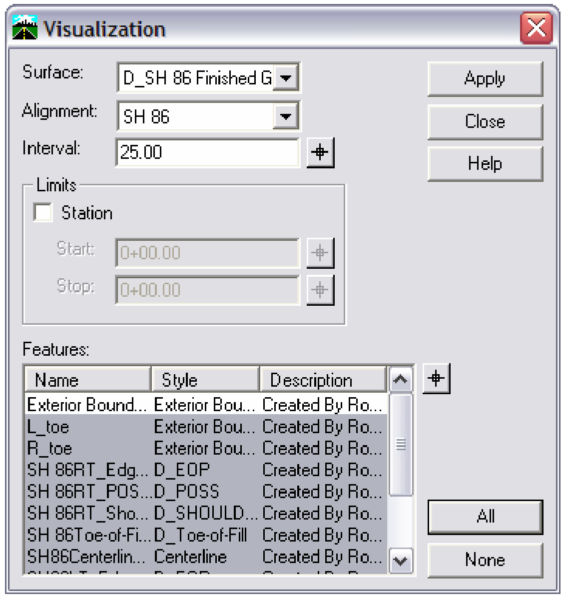
MicroStation 3D allows a view to be rotate to any position, which can be used to evaluate the design model. Select the **View Rotation** command at the bottom of the MicroStation view. If you snap to a point before beginning the rotation, that point will stay centered in the view.

If there are triangles displayed, the view may be rendered using one of the MicroStation rendering commands. To create more realistic rendered images, you can assign materials to the triangles (or shapes, see **Visualization** tool section), assign lighting characteristics, and even match the model to a photo of the site. See the rendering section of **MicroStation Help** for additional information.



InRoads Visualization

The **Visualization** command in InRoads – also an **Application Add-in** – simplifies the rendering process by creating color-coded shapes for the design model based on the features. Since the shapes are colored based on the symbology assigned to the feature styles, you may need to modify the colors in order to get the desired look for the model.



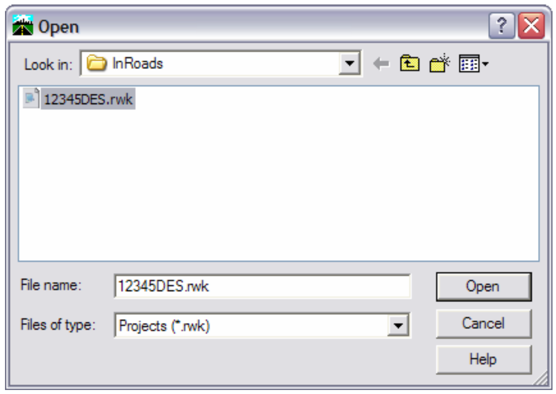
Lab 11 – Visualizing the Project in 3D

Start InRoads

1. Start InRoads and open **CU12345DES_Model.dgn** from the **\Design\Working** folder.

Open your InRoads data files

1. Select **File > Open**.



2. Ensure the **Files of Type** option is set to **Projects (*.rwk)**.

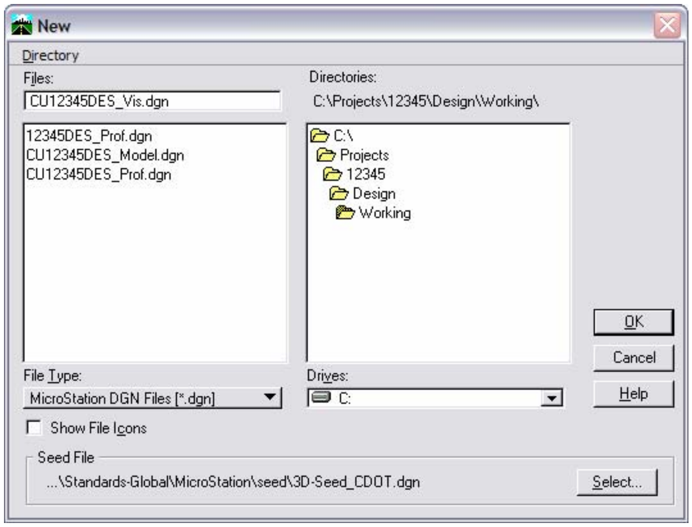
3. Double-click on **12345DES.rwk**.

   Double-clicking is the equivalent of highlighting the file and choosing **Open**.

4. **Cancel** the dialog.

Create a new design file for your visualization displays

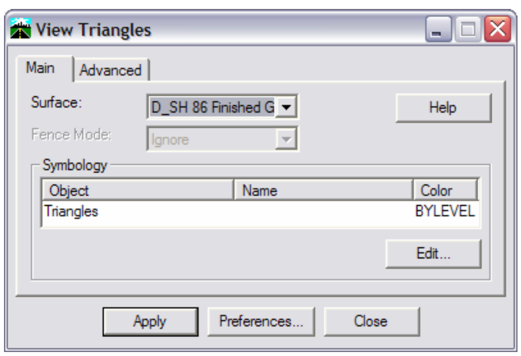
1. Select **File > New** on the MicroStation menu.



   - Navigate to the **\ Design\Working** folder.
   - Key in a name of ***CU12345DES_Vis.dgn***.

2. Choose **OK**.

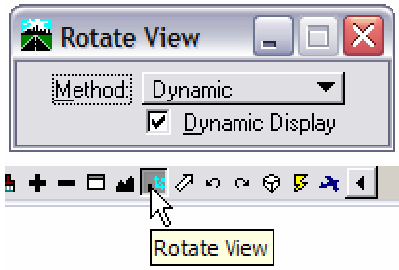
3. View the triangles for **D_SH 86 Finished-Grade.**



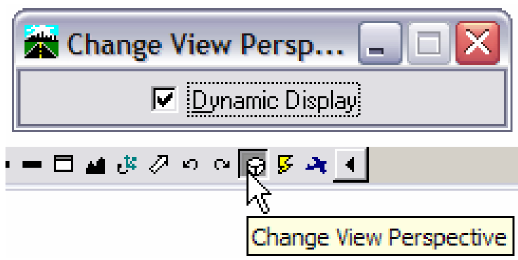
Rotate the View

1. Select the MicroStation **View Rotation** command and rotate the view.

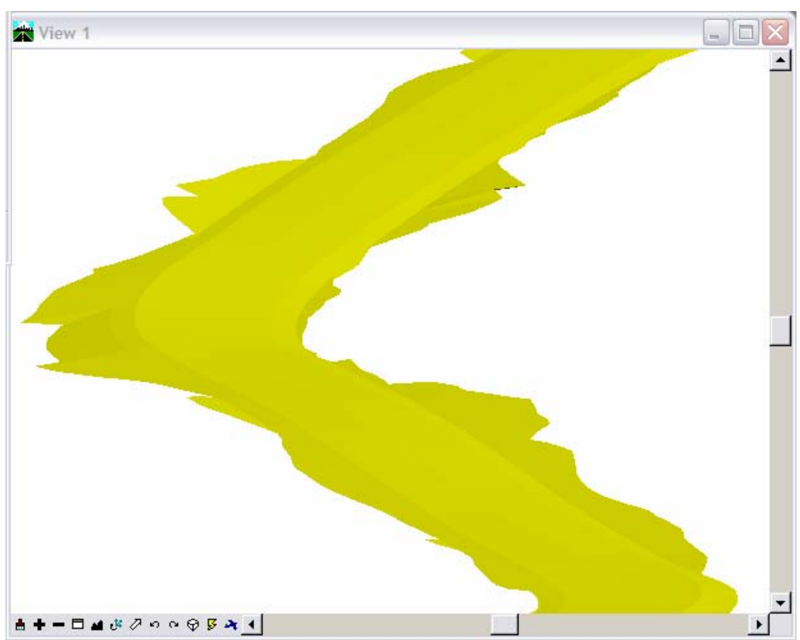
   Hint: It is easier if you start from an ISO view, and remember, if you snap to a point after picking the command, that is the point you'll be rotating about.

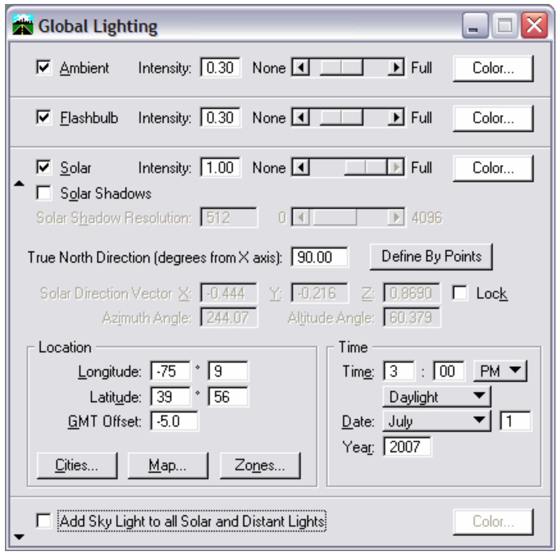
   You can also use **Change View Perspective**.

2. When you've rotated to a view you are satisfied with, choose **Utilities > Render > Phong** on the MicroStation menu, then **<D>** in the view.

3. If the rendering appears too dark, choose **Settings > Rendering > Global Lighting**.

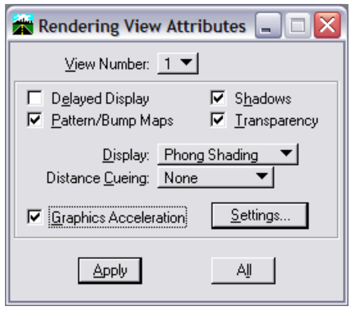


- Toggle on **Solar** and choose the drop-down arrow next to the toggle.
- Toggle off the **Solar Direction Vector lock**.
- Choose **Map** under **Location** and click on a location on the map.
- Set the time you would like.

4. Close the **Global Lighting** dialog and Render the view again.

Note: If you would like to see more definition of the roadway, you can display the features with the exception of the exterior. If you display the exterior, since it is a closed shape, it will be rendered as a whole.

5. Select **Settings > Rendering > View Attributes**.



- Set the **Display** to **Pong Shading**.
- Toggle on **Graphics Acceleration**.

6. Choose **Apply**.

7. Choose **View Rotation** again and this time make sure **Dynamic Display** is on.

8. Snap to a point in the road, then move your cursor to rotate the view. When you accept the rotation, it will be shaded.

Drive the Roadway

1. Use **Modeler > Drive Roadway** to see the rendered image as you drive.

Hint: If you don't have **Drive Roadway** on your menu, toggle it on first with **Tools > Application Add-ins**.

2. Experiment with different vertical offsets to see the difference in the **Drive Roadway** command.

3. **Delete** the triangle display.

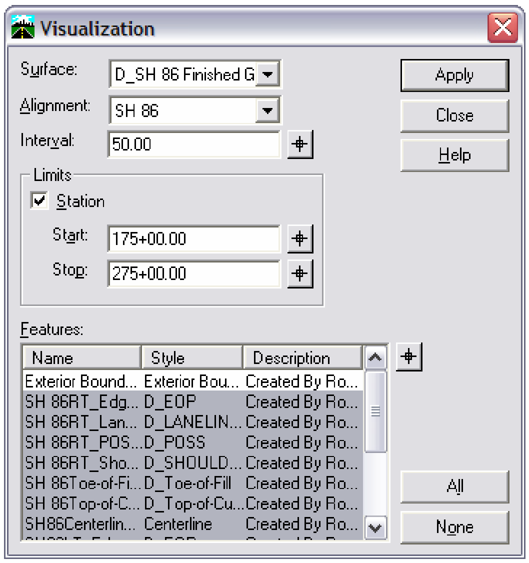
Display the surface with InRoads Visualization

1. This command uses the surfaces features to create a color-coded display of the roadway. The segments from the template are color-coded based on the color of the feature. Using the CDOT standard preference (.ini) file, this results in a purple, red and yellow roadway.

2. Use **Surface > View Surface > Features** to view the features (except the Exterior Boundary).

3. Choose **Tools > Application Add-ins** and ensure **Visualization** is toggled on.

4. Select **Surface > View Surface > Visualization**.



   - Choose the Surface **D_SH 86 Finished-Grade**.
   - Choose the Alignment **SH 86**.
   - Key in an interval of ***50***.
   - Toggle on **Station Limits** and set the **Start** to ***175+00*** and the **Stop** to ***275+00***.
   - Highlight all of the features except Exterior Boundary.

5. Choose **Apply**.

6. When the processing is done, **Drive Roadway** again to see its new colors.

Challenge lab

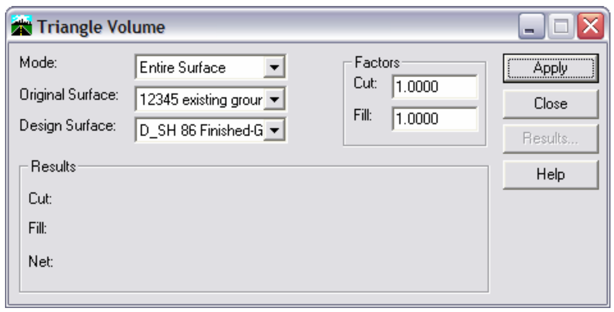
1. Use the perimeter of the proposed finished grade as an interior on a copy of the existing surface. Then display triangles for the existing, visualize the finished grade and render the combination. You can also drive the roadway with this display.

12. Generating Project Quantities

The surfaces generated by **Roadway Modeler** (or other design methods – see the intersection modeling chapter) are used to calculate volumes. There are four methods of volume calculations in InRoads: **Triangle**, **Triangle by Station**, **Grid**, and **End-area**, with the latter being the standard for CDOT highway design and the other methods being used where conditions warrant, or as checks.

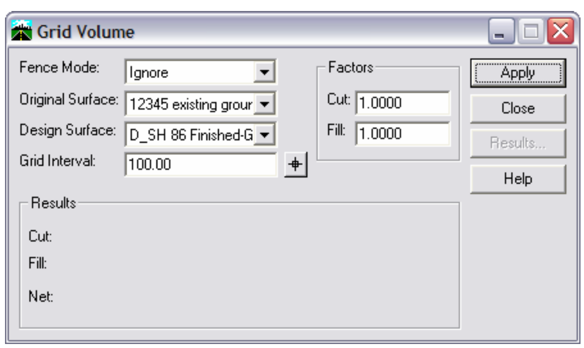
Triangle

The **Triangle** volume command compares two surfaces, listed as original and design surfaces. The **Cut** and **Fill Factors** are applied to the totals of cut and fill and the results consist of overall cut, overall fill and cumulative volumes.



Grid

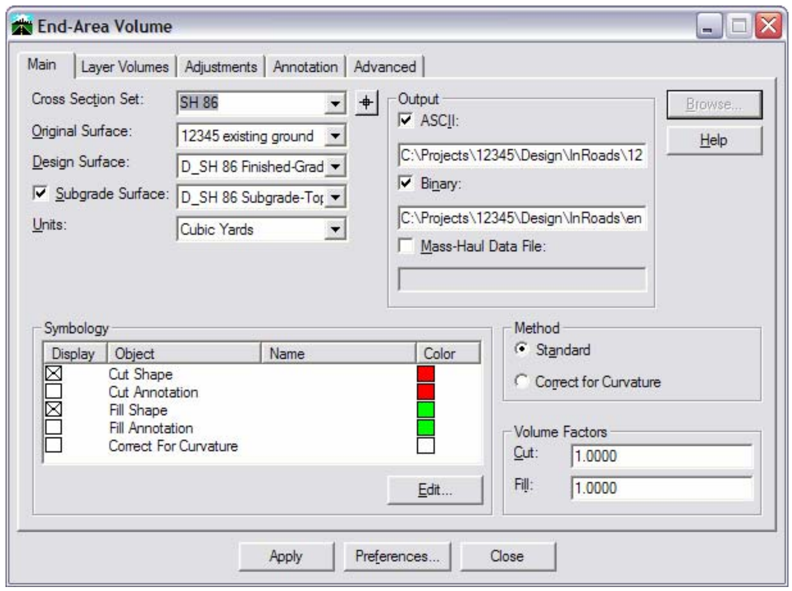
The **Grid** volume command compares the two surfaces, listed as original and design, based on an interval specified. The accuracy of the grid volume is dependent upon the size of the **Grid Interval**.



End Area

The CDOT standard for computing volumes is the End Area method. Prior to using the **End Area Volume** command, a set of cross sections containing at least two surfaces must be created in the active design file. If additional surfaces are shown on the sections, they can be used for volume calculations as well. Select **Evaluation > Volumes > End Area** to access the command (or choose it from the toolbar).

Main tab



On the **Main** tab, choose the set of sections to use for volumes, and specify the **Original** and **Design** Surfaces by choosing them from the list of surfaces on the drop-down.

Note: The **Subgrade Surface** defined in the dialog is the surface used to determine the depth of cut and height of fill. In effect, the volume accounts for cutting down to the subgrade in cut situations and filling up to the subgrade in fill situations.

If **Cut** and **Fill Volume Factors** are applied to the entire corridor, they are entered on the main dialog. If not, see **Adjustments**.

When the volumes are calculated, the MicroStation elements forming the cross section surfaces are used to determine the area of cut and fill on each section. The areas are outlined with MicroStation shapes if the **Objects** are toggled on under **Symbology**. If so, you also have the choice of annotating these areas on the sections.

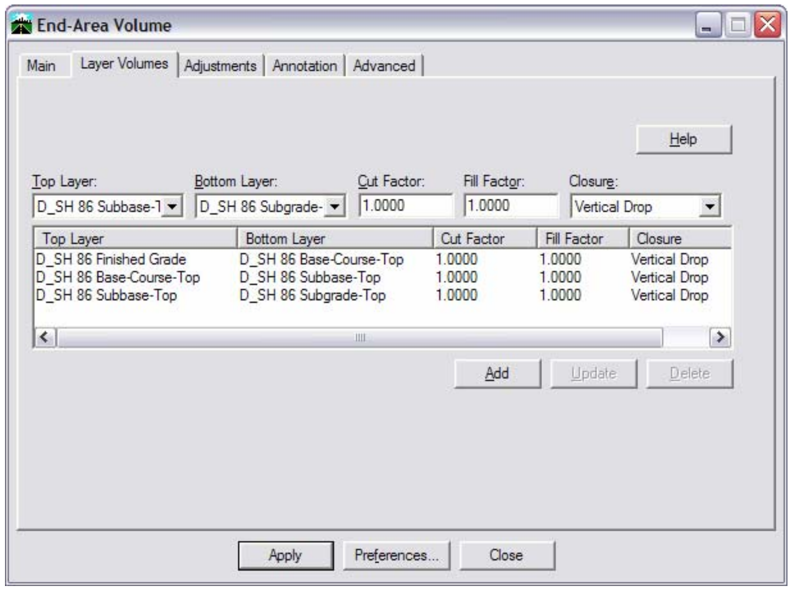
In addition, when the areas are used to calculate the volumes, they can be used in the standard end-area method, or they can be corrected for curvature — whichever is toggled under **Method**.

Under **Reports**, you have two options. The **Binary** option creates a binary file with all the data from the volume calculations. This data can be formatted into one of a number of reports using the **Tools > Reports > General** command.

The **ASCII** report file is not as flexible as the binary file, since the format is hard-coded, but you get an immediate report.

Several other options are available. They are found under the different tabs at the top of the main end-area dialog, and described in the following sections.

Layer Volumes tab

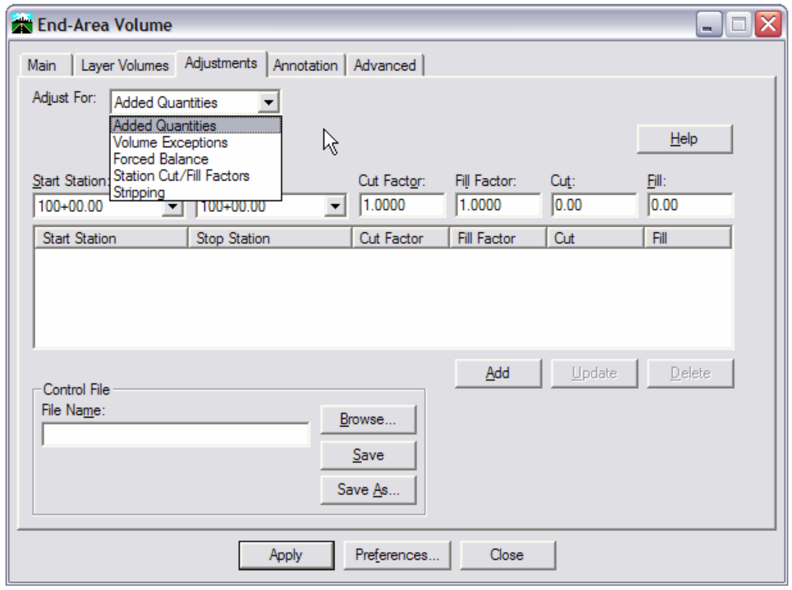


The **Layer Volumes** tab is used to specify additional surfaces for volume calculations.

Listed are the **Bottom Layer**, **Top Layer**, **Cut** and **Fill Factors** and **Closure**. The closure options allows you to determine how the two surfaces are to be joined together.

- **Vertical Drop** projects a vertical from the end points of the narrower surface to the other surface in the set.
- **Connect Ends** connects the ends of the two surfaces using a straight line.
- **Design Surface** connects the two ends of the surfaces by joining them along the layer defined in the dialog as the **Design Surface**.

Adjustments tab



The **Adjustments** tab is used to define various adjustments made to the volume computations. These options are listed below:

***Added Quantities* —** This option is used for adding quantities that are calculated from other sources into the end-area volume report. For example, you may have a volume from a side road or drive that needs to be shown in the overall end-area report.

The volume of added quantities is averaged over the range specified.

***Volume Exceptions* —** Volume exceptions are used to define areas where no cut and fill is calculated. A good example would be a bridge area.

In order to use this command, cross sections must be cut at the station where the first zero volume is desired, and at the station for the last zero volume.

> **Note:** Add event points to the alignment at each station where you want to cut a section.

***Forced Balance* —** The forced balance option allows you to specify stations at which the volumes must balance.

How does it balance? It determines a factor that must be applied to each station's volume of cut or fill (your choice) in order for the volume to balance at the requested station. It is then an iterative process of changing either templates or alignments to reduce the factors necessary to balance.

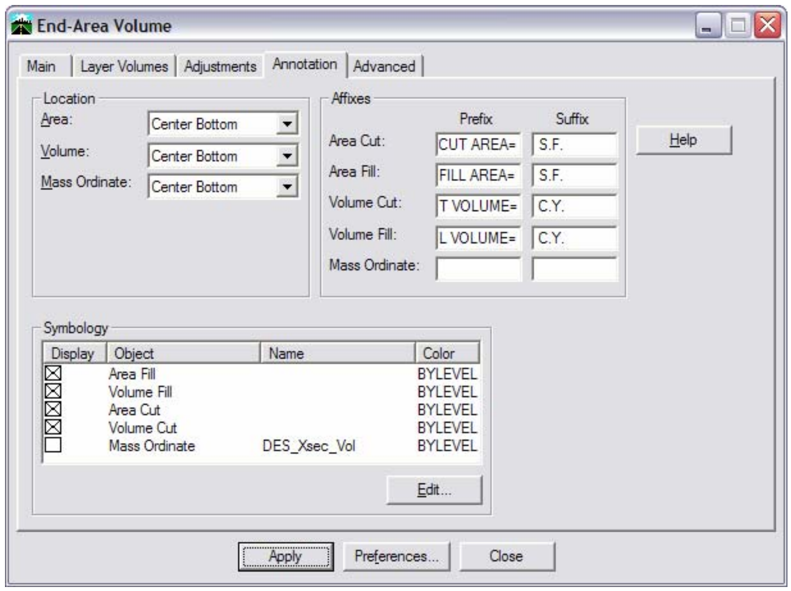
***Cut / Fill Factors* —** If you need to specify different cut and fill factors along the alignment rather than using the same one for the entire length, select this option and specify the different factors needed along with the ranges to which they apply.

***Stripping* —** Calculates the quantities for stripping material under a design. Specify the depth of stripping and the station where the stripping begins.

This amount of stripping remains in effect until the next entry in the table is reached or until the end of the alignment if no other entries are included in the table.

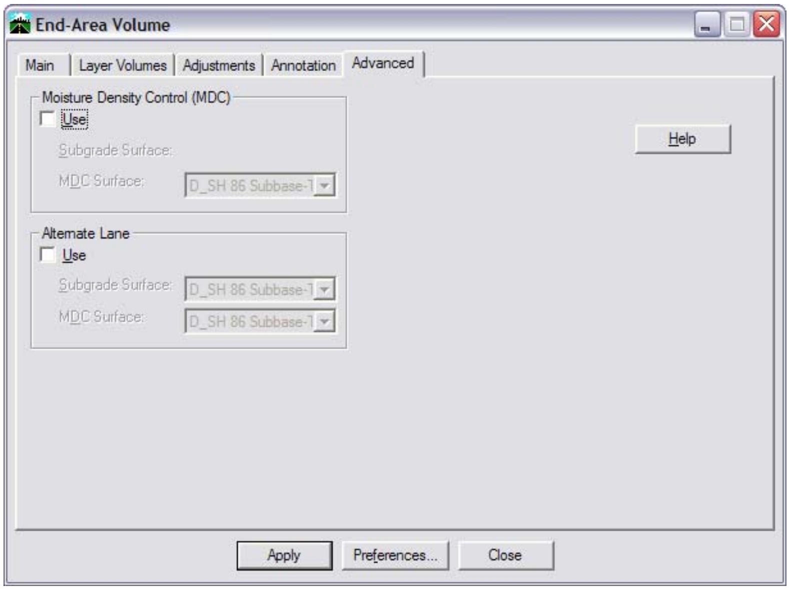
Note: The volumes in the **Results** box do not reflect stripping quantities. These quantities are only available from generating a report after the volumes are calculated.

Annotation tab



The area of cut and fill on each section is annotated, along with the volume between the current and previous stations and the cumulative volume. In this option, specify the location and symbology of the information to be placed on the sections upon triangulation.

Advanced tab



The **Advanced** tab is used for two things: First, you can specify **Moisture Density Control** surface(s). These **MDC** surfaces are additional layers on your template used only in cut.

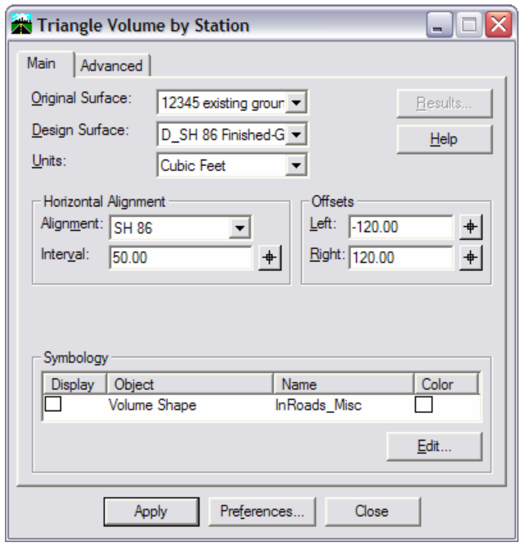
Second, you can specify **Alternate Lane** information. This is for divided highways where you have a separate subgrade on the other side of the median. (Use one side's subgrade on the main dialog, the other one here.) This is used to define overall cut/fill volumes.

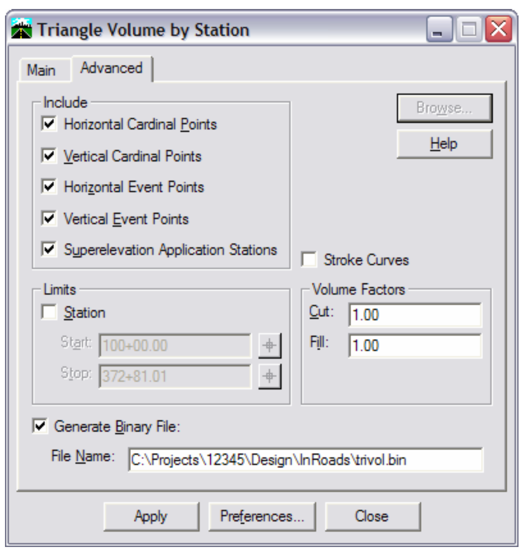
When all of the desired options are selected, both on the main dialog and under Setup, execute the volume command by choosing **Apply**. Volumes are calculated according the surfaces shown on the cross sections and the criteria specified in the options.

If specified, report files are created and the cross sections are annotated.

Triangle by Station

An extension of the **Triangle** volume command, **Triangle by Station** computes the volumes in the same manner – comparing triangles to triangles – however, it does so in between stations at a specified interval. This results in an optional report that is similar to an end-area report listing volumes by station and a cumulative volume up to each station.





In order to get the station by station report, you must generate a binary file and then apply a format using **Tools > Reports**.

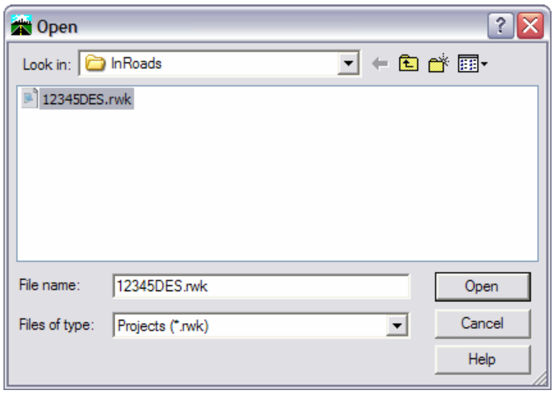
Lab 12 – Generating Project Quantities

Start InRoads

1. Start InRoads and open **12345DES_XSec.dgn** from the **\Design\Drawings\Cross_Sections** folder.

Open your InRoads data files

1. Select **File > Open**.



2. Ensure the **Files of Type** option is set to **Projects (*.rwk)**.
3. Double-click on **12345DES.rwk**.
4. **Cancel** the dialog.

Volume Comparison			
Grid			
50’	**C:**	**F:**	**N:**
10’	**C:**	**F:**	**N:**
5’	**C:**	**F:**	**N:**
Triangle			
	C:	**F:**	**N:**
End Area without subgrade considered			
	C:	**F:**	**N:**
End Area with subgrade considered			
	C:	**F:**	**N:**

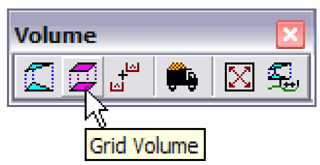
Make Lock Settings

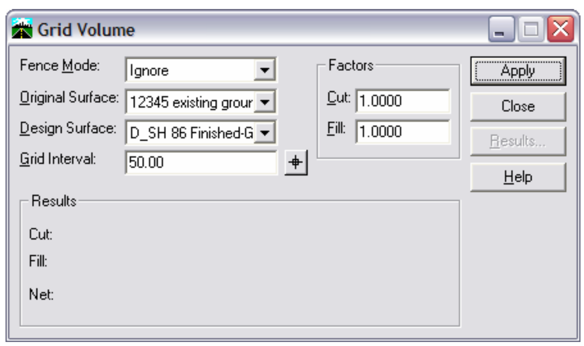
1. Toggle **Write** lock on
2. Toggle **Station** lock on
3. Set the mode to **Pencil**

Calculating Grid Volumes

Calculate the volume between the existing surface and the proposed surface using the grid volume method.

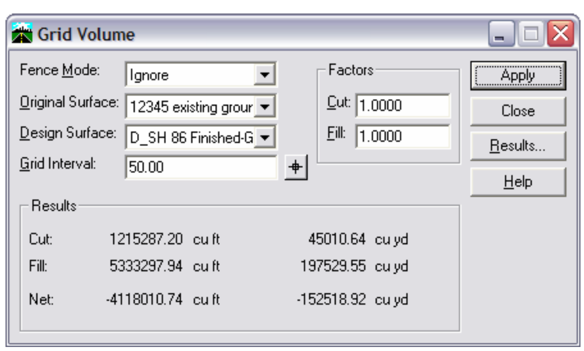
1. Select **Tool > Customize > Volume**, then **Close** the **Customize** dialog.
2. Select the **Grid Volume** command.





- Set the **Original Surface** to: **12345 existing ground.**
- Set the **Design Surface** to: **D_SH 86 Finished-Grade**.
- Enter the **Grid Interval**: ***50*** and **Tab** to accept.
- Leave the **Cut Factor** and **Fill Factor** set to **1.0**.

3. Select **Apply**.



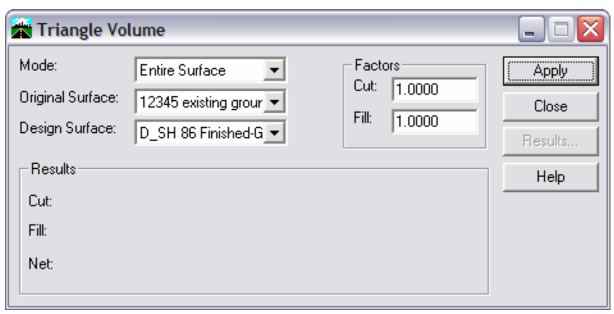
4. Record the results in the table provided. (You may not get the exact numbers shown.)

5. Enter the **Grid Interval**: ***10*** and **Tab** to accept.
6. Select **Apply**.
7. Record the results in the table provided.
8. Enter the **Grid Interval**: ***5*** and **Tab** to accept.
9. Select **Apply**.
10. Record the results in the table provided.
11. Select **Close** to dismiss the **Grid Volume** command.

Calculating Triangle Volumes

Calculate the volume between the existing surface and the proposed surface using the triangle volume method.

1. From the **Volumes** toolbar select the **Triangle Volume**.



- Set the **Mode** to **Entire Surface**.
- Set the **Original Surface** to: **12345 existing ground**.
- Set the **Design Surface** to: **D_SH 86 Finished-Grade**.
- Leave the **Cut Factor** and **Fill Factor** set to **1.0**.

2. Select **Apply**.

   This method will take longer to process than the grid method.

3. Record the results in the table provided.
4. Select **Close** to dismiss the **Triangle Volume** command.

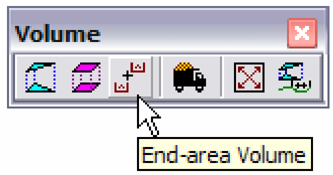
Calculating End-Area Volumes

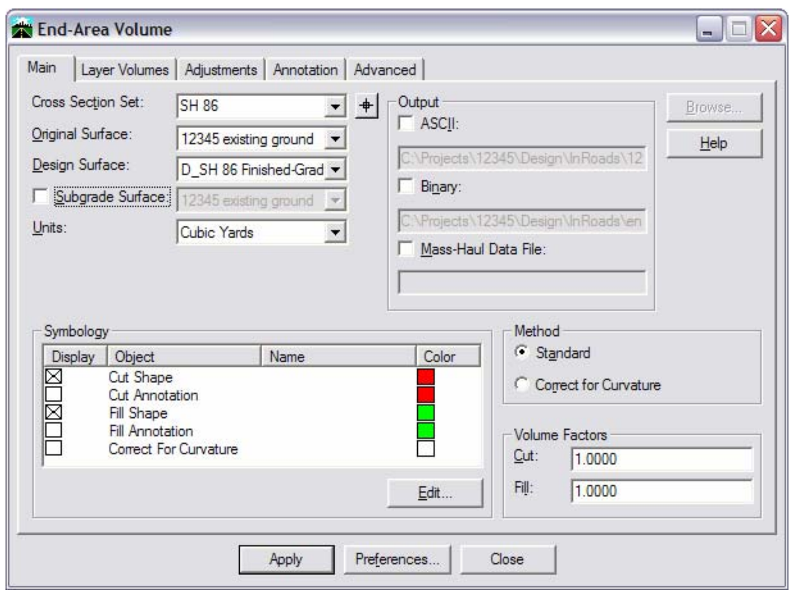
Calculate the volume between the existing surface and the proposed surface using the end-area volume method. With the first run, you will not take the subgrade into account.

End Area w/o subgrade

The sections are annotated with end areas during this process, so start by changing the Scale factor to 40.

1. From the **Volumes** toolbar, select the **End-Area Volume** command.





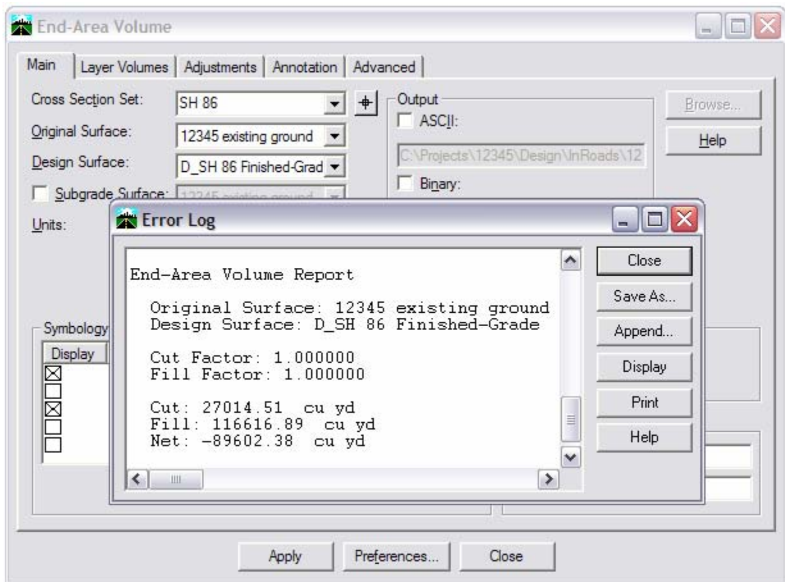
2. Define the cross sections and surfaces to be used for the volume calculations.

    - Select the ***final section*** set from the **Cross Section Set** list.

    This should be a full set of cross sections generated along the alignment. A box is drawn around the set to show which one you've picked.

    - Set the **Original Surface** to **12345 existing ground**.
    - Set the **Design Surface** to **D_SH 86 Finished-Grade**.
    - Set **Units** to **Cubic Yards**.
    - Leave the **Cut Factor** and **Fill Volume Factors** set to **1.0**.

3. Select **Apply**.



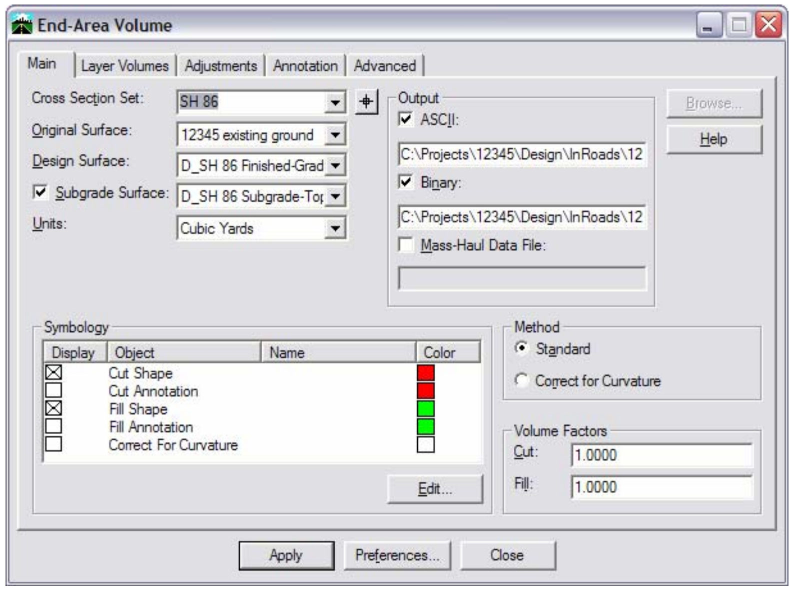
Results appear in a separate dialog box.

4. Record the results in the table provided, then **Close** the **Results** dialog.

End Area w/subgrade considered

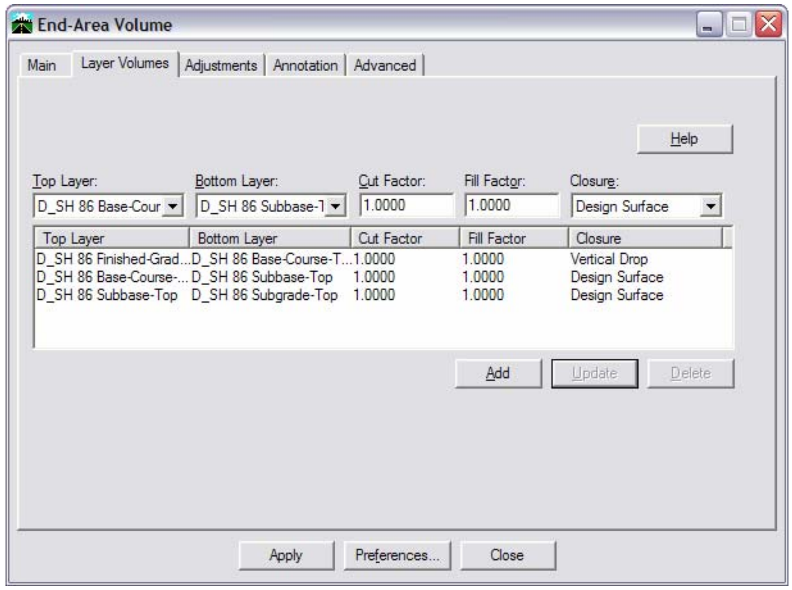
Calculate the volume between the existing surface and the proposed surface including the subgrade-top surface using the end-area volume method and generate an ASCII report and binary file to be formatted into an ASCII report in a later exercise. You will also calculate the additional material volumes.

5. In the **End Area** Volume dialog.



- Toggle on **Subgrade Surface** and set to **D_SH 86 Subgrade-Top**.
- Toggle on **ASCII Report**.
- Browse, set the folder to **InRoads** and enter a File Name of ***12345DES_EndVol.txt.***
- Toggle on **Binary Report**.
- Browse and enter a File Name of ***12345DES_Endvol.bin***.

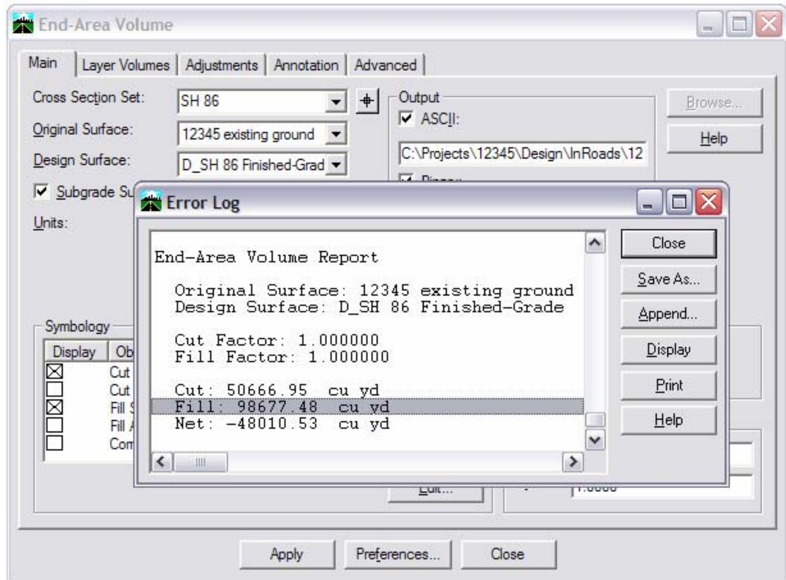
6. To calculate additional sublayer volumes, select the **Layer Volumes** tab.



- Set the **Top layer** to **D_SH 86 Finished-Grade**.
- Set the **Bottom layer** to **D_SH 86 Base-Course-Top**.
- Set the **Closure** to **Vertical Drop**.
- Select **Add**.
- Set the **Top layer** to **D_SH 86 Base-Course Top**.
- Set the **Bottom layer** to **D_SH 86 Subbase-Top**.
- Set the **Closure** to **Design Surface.**
- Select **Add.**
- Set the **Top layer** to **D_SH 86 Subbase-Top**.
- Set the **Bottom layer** to **D_SH 86 Subgrade-Top**.
- Set the **Closure** to **Design Surface.**
- Select **Add.**

7. Review the other tabs and make any changes you would like.

8. Select **Apply** on the **End-Area Volume** dialog box



9. Record the results in the table provided
10. **Close** the **Results** box
11. Select **Close** to dismiss the **End-Area Volume** command

Note the difference in the volumes as the Subgrade-Top is removed from fill volumes and added to the cut volumes.

In the next chapter, we will look at the reports just created. They will show a station by station list of the overall volumes as well as the Base-Course, Subbase and Subgrade materials.

12. Window in to your cross sections and review the shapes that were created when you calculated volumes.
13. **Exit** MicroStation and InRoads.

13. Creating Reports

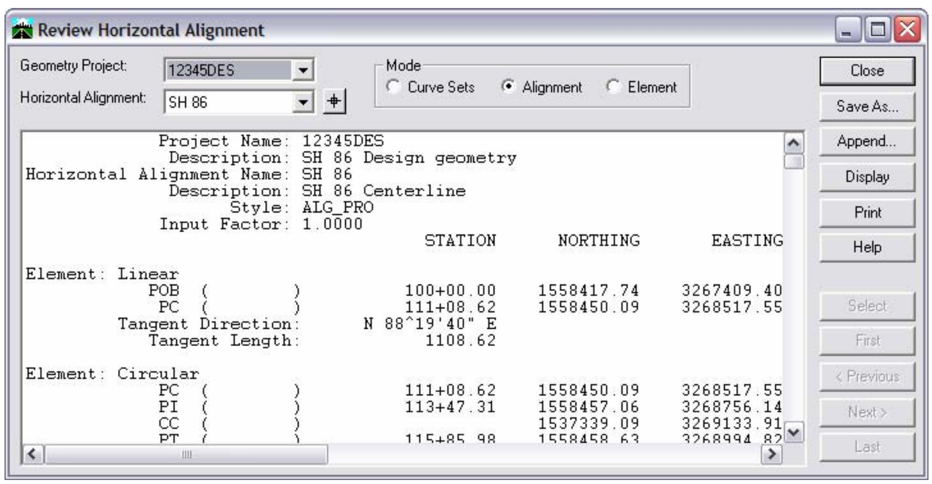
Automatic

There are several reports in InRoads that can be generated automatically, with the user having no (or very little) choice on the format of those reports. Some examples are shown below.

The results from these reports can be: Saved to the hard drive by selecting **Save As** and specifying a name; Appended to an existing text file by selecting **Append** and choosing the file; Displayed in the design file by selecting **Display** and identifying a location; or Printed by selecting **Print**.

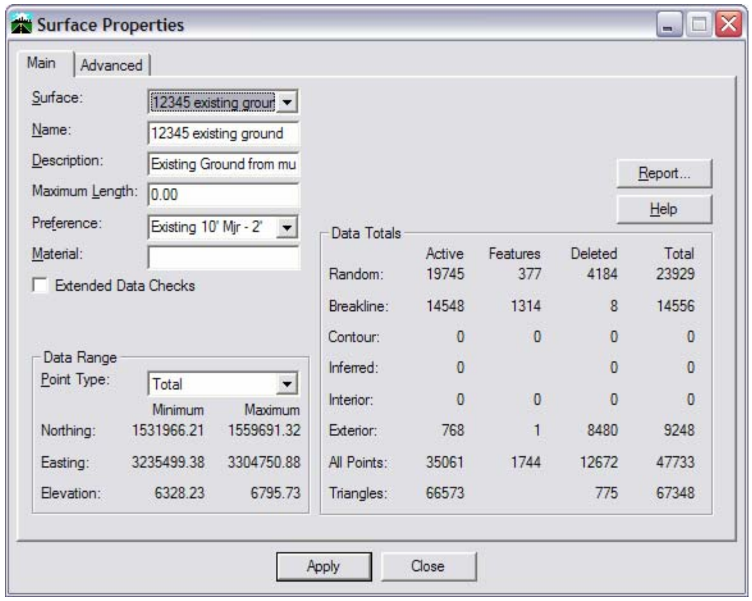
Alignments

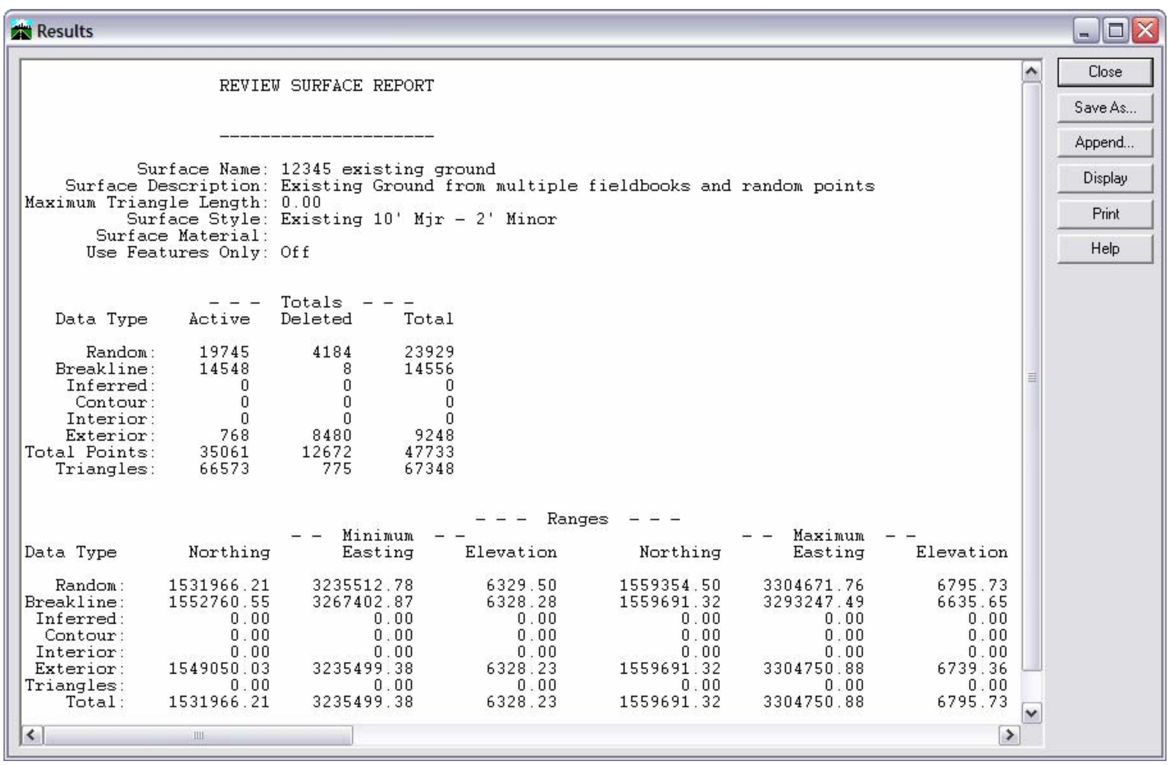
The quickest and easiest method of generating an alignment report is to use one of the **Review** commands. This can be accomplished by right-clicking the alignment in the Explorer menu and selecting **Review**, or by choosing it from the pulldown menu or from the toolbar.



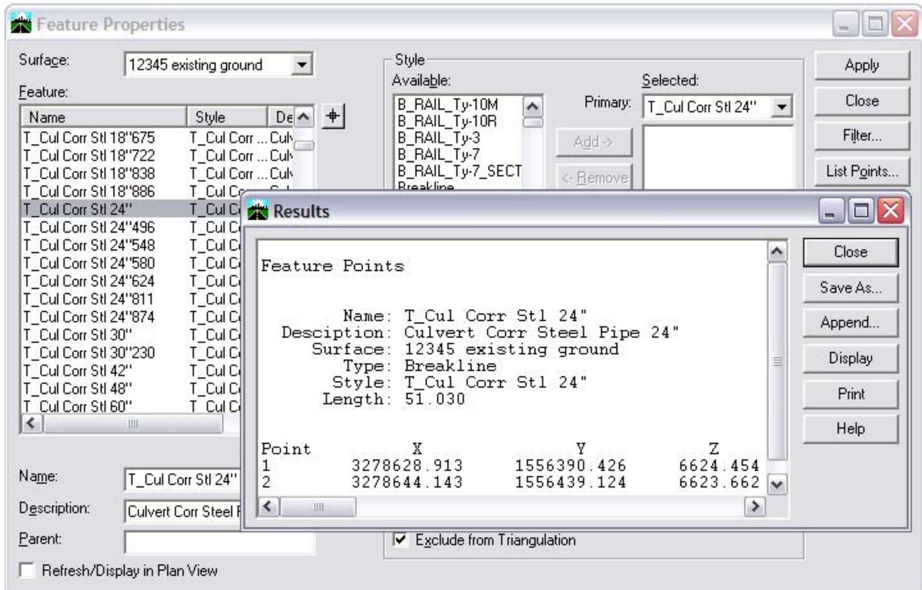
Surfaces

Select **Surface > Surface Properties** and choose the surface you desire. Then select **Report**.



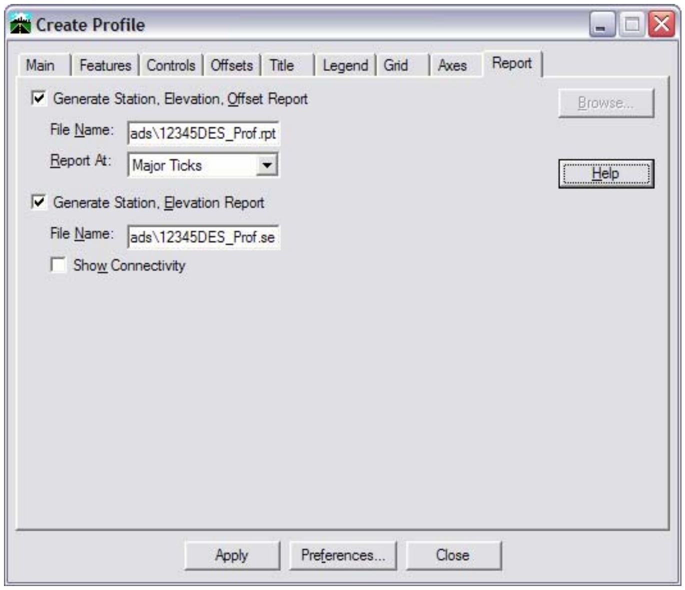


You can report on individual features by selecting **Surface > Feature > Feature Properties**, identifying the feature in question (by highlighting or using the target button to choose it graphically) and selecting **List Points**.



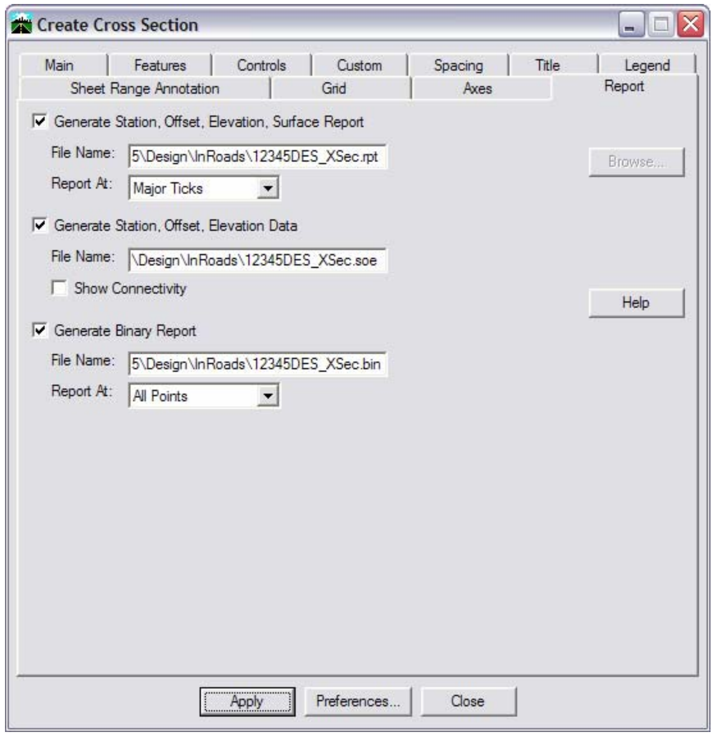
Profiles

On the **Create Profile** dialog, there is a **Report** tab that allows you to specify two different types of text reports as shown below. If toggled on, when you create the profile, these report files are automatically generated.



Cross Sections

On the **Create Cross Sections** dialog, there is a **Report** tab that allows you to specify three different reports, two of which are ASCII (text) and one of which is a binary file.



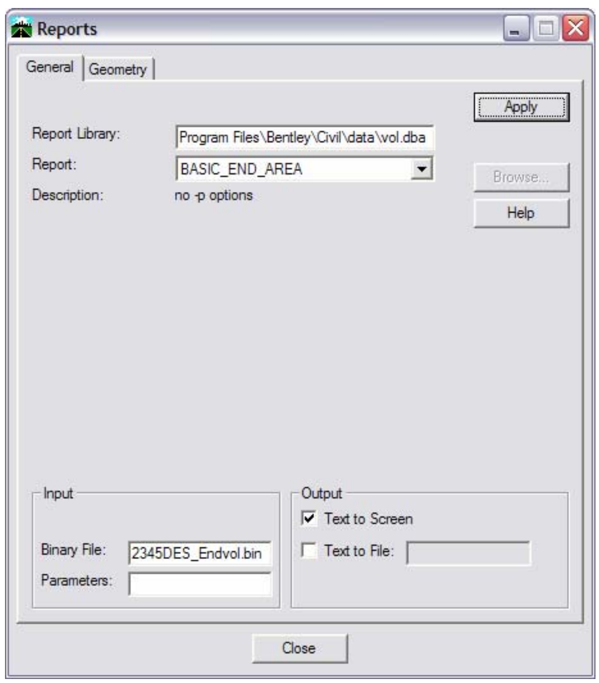
DBAccess Reports

DBAccess reports comprise a method of formatting binary files into ASCII (text) files. These binary files consist of the geometry project (**.alg**), and files created from **Roadway Modeler**, **Cross Sections**, and **End-Area Volumes** (**.bin**). DBAccess libraries delivered with InRoads contain a series of pre-determined formats for these reports.

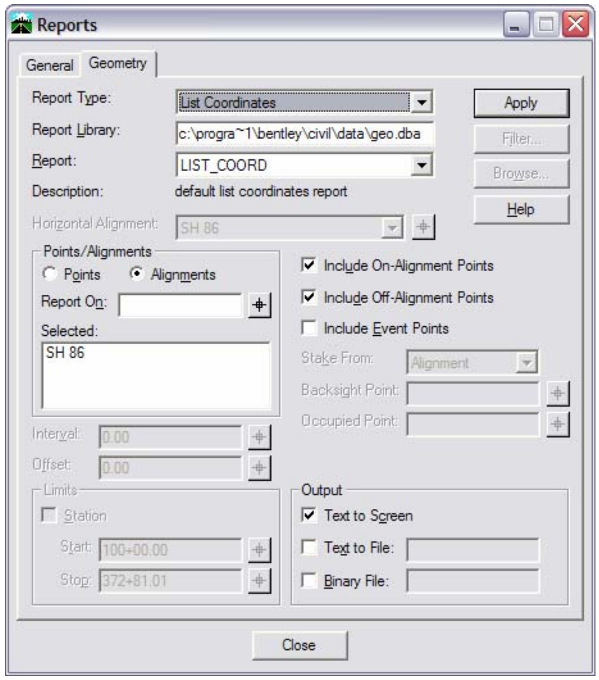
DBAccess reports are being replaced by the XML reports described in the next section, however there are some reports that are not yet available in the XML command, such as **End Area Volume** reports.

Select **Tools > Reports** and then you can choose between the **Geometry** tab for reports from the active geometry project and the **General** tab for reports from binary files created with one of the aforementioned commands.

For **General** Reports, you must first specify the DBAccess library containing the format you desire. These libraries are categorized by the type of report (**rwy.dba** for Roadway Modeler reports, **vol.dba** for Volume reports, etc.). Within each, specify the Report template. The Binary File must be entered (by using **Browse** or keying it in) and the method of output specified.



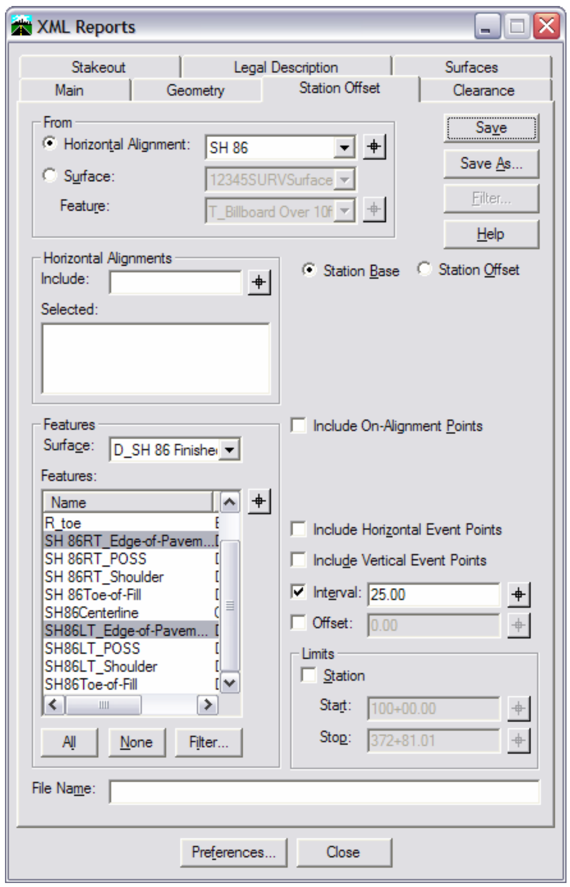
For **Geometry** Reports, the DBAccess library is chosen by default, and you are just required to choose the **Report Type** and **Report** (format), then enter the criteria for the data on which you want to report. Different options become available depending upon which report you choose. Again, the method of output must be specified.



XML Reports

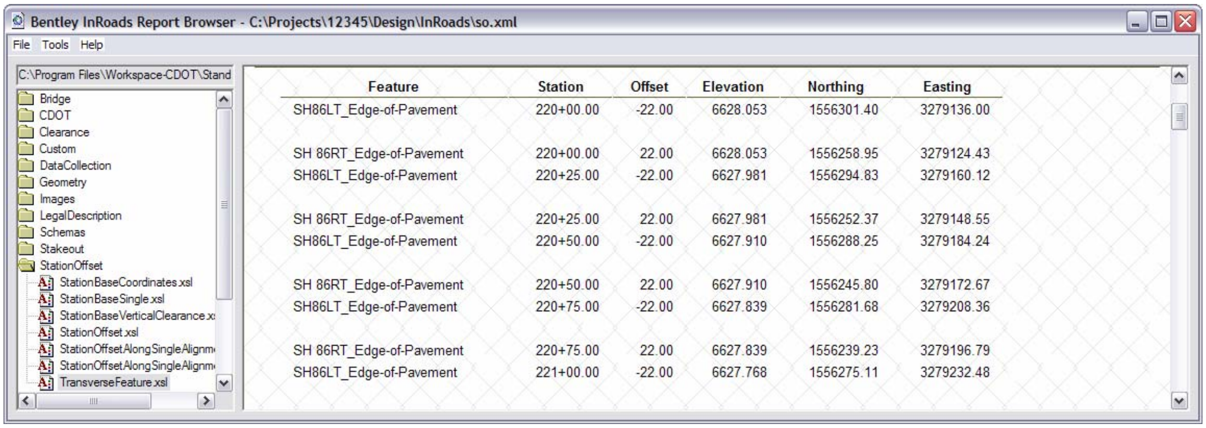
XML reports are on their way to replacing the DBAccess reports. Their concept is similar, but they pull the information directly from your data files rather than from binary files you must create. They also allow the mixing of data types – for example, you can report on stations and offset from an alignment to a surface feature.

Another advantage of the XML reports is their use of a style sheet (**.xsl**) file to format the report. The programming of the format is very familiar to HTML, so if you're familiar with HTML programming, you can create your own style sheets or modify the predefined ones.



Select **Tools > XML Reports**. (If the XML Reports command is not available on your pulldown menu in InRoads, first toggle **XML Reports** on in **Tools > Application Add-ins**.) Choose the tab associated with the type of report you wish to create, and specify the criteria on which to report.

Select **Save As** and specify a name for the **.xml** file that will be created. The **Tools > View XML Reports** command is automatically executed, and a default format chosen for your report. Other formats may be chosen from the list along the left of the screen.



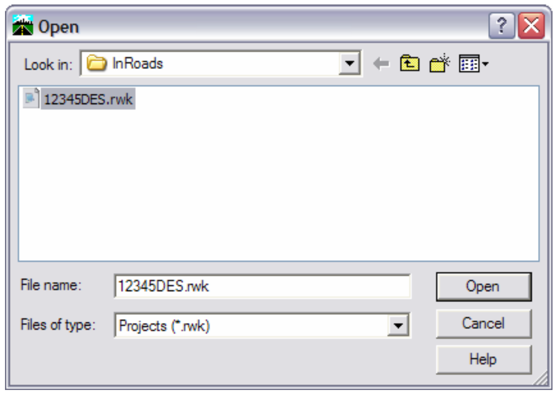
Lab 13 – Creating Reports

Start InRoads

1. Start InRoads and open **12345DES_Model.dgn** from the **\Design\Drawings\Reference_Files** folder.

Open your InRoads data files

1. Select **File > Open**.



2. Ensure the **Files of Type** option is set to **Projects (*.rwk)**.

3. Double-click on **12345DES.rwk**.

   Double-clicking is the equivalent of highlighting the file and choosing **Open**.

4. **Cancel** the dialog.

Make lock settings.

1. Toggle **Write** lock ***off***.

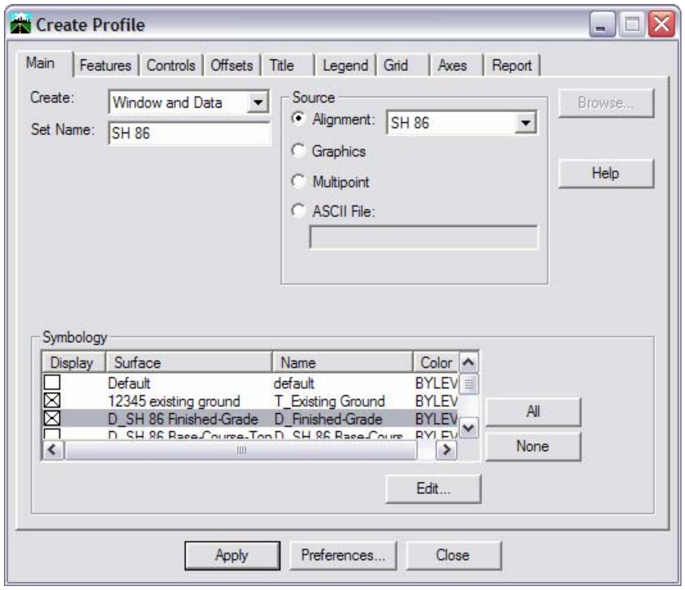
2. Toggle **Report** lock ***off***.

3. Toggle **Station** lock ***on***.

Creating a new profile and report

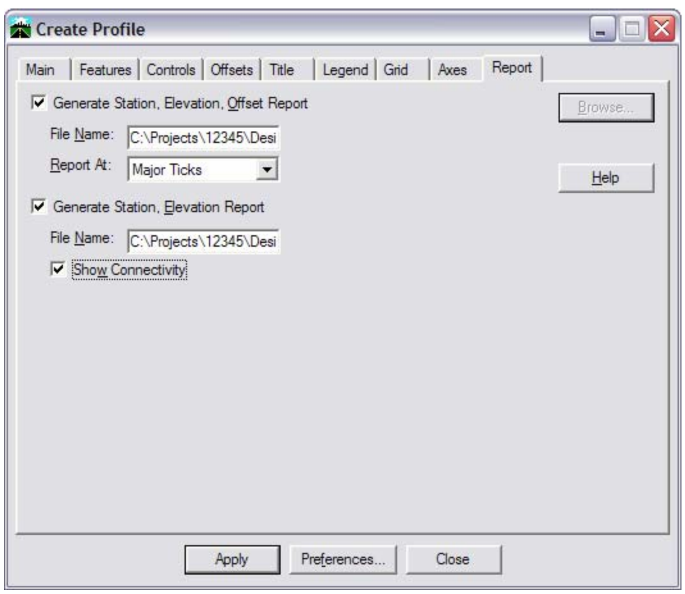
Create a new profile that contains the existing and proposed surfaces.

1. Select **Evaluation > Profile > Create Profile**.



   - On the **Main** tab, set the source to **Alignment** and choose **SH 86**.
   - Select the surfaces **12345 existing ground** and **D_SH 86 Finished-Grade**.

2. Select the **Report** tab.



- Toggle on **Generate Station, Elevation, Offset Report** .
- Browse to the **Design\InRoads** folder and key in the File Name: **12345DES_Prof.rpt**.
- Set Report At: **Major Ticks**.
- Toggle on **Generate Station, Elevation Report**.
- Browse to the **Design\InRoads** and key in the File Name: **12345DES_Prof.se**.
- Toggle on **Show Connectivity**.

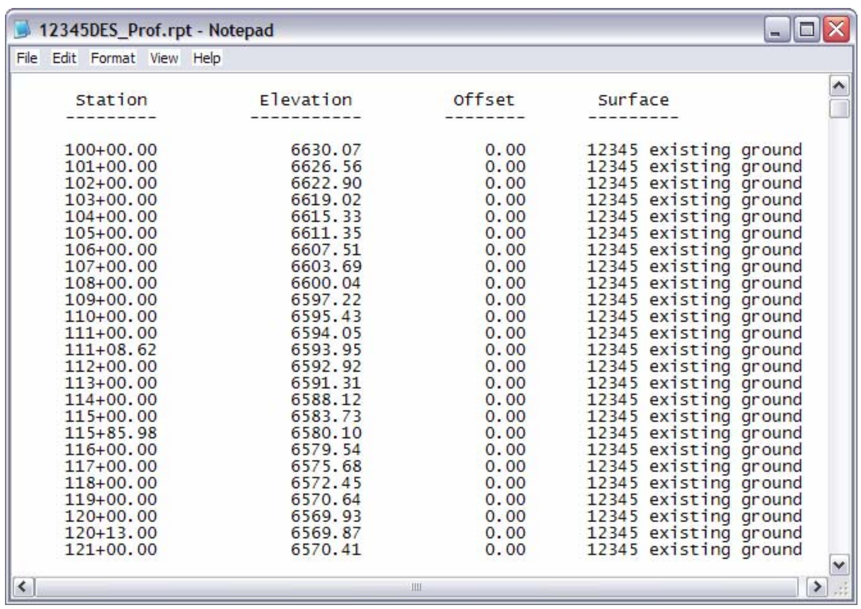
3. Select **Apply**.

4. Place a **<D>** in the design file to define the lower left corner of the profile plot.

5. Select **Close** to dismiss the profile command.

   Since we don't really need another profile display, you turned **Write** lock off before using this command. Therefore, you can **Update** the view and the profile display disappears, but the report file stays on your hard drive.

6. Open the **12345DES_Prof.rpt** file with **Notepad**. (It should be in your **Design\InRoads** folder.)



12345DES_Prof.rpt - Notepad

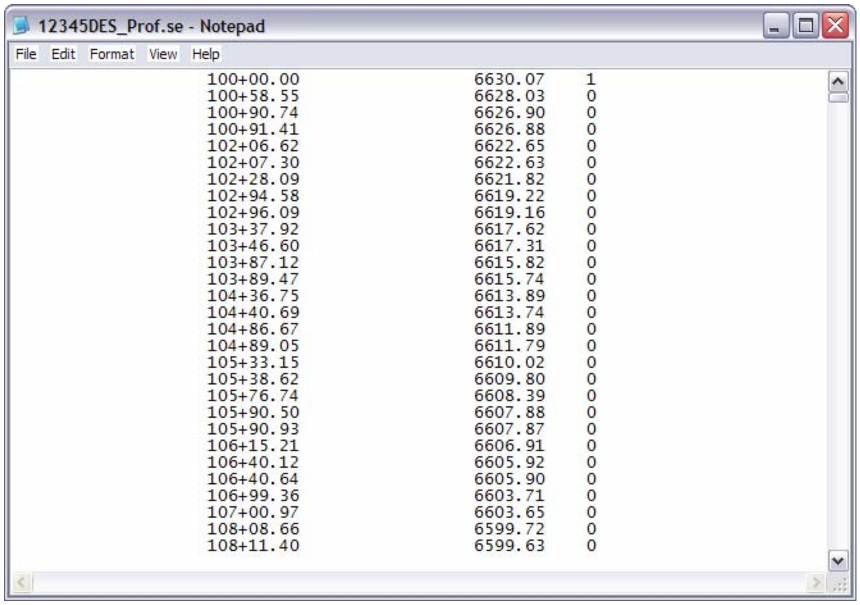
File Edit Format View Help

Station	Elevation	Offset	Surface
100+00.00	6630.07	0.00	12345 existing ground
101+00.00	6626.56	0.00	12345 existing ground
102+00.00	6622.90	0.00	12345 existing ground
103+00.00	6619.02	0.00	12345 existing ground
104+00.00	6615.33	0.00	12345 existing ground
105+00.00	6611.35	0.00	12345 existing ground
106+00.00	6607.51	0.00	12345 existing ground
107+00.00	6603.69	0.00	12345 existing ground
108+00.00	6600.04	0.00	12345 existing ground
109+00.00	6597.22	0.00	12345 existing ground
110+00.00	6595.43	0.00	12345 existing ground
111+00.00	6594.05	0.00	12345 existing ground
111+08.62	6593.95	0.00	12345 existing ground
112+00.00	6592.92	0.00	12345 existing ground
113+00.00	6591.31	0.00	12345 existing ground
114+00.00	6588.12	0.00	12345 existing ground
115+00.00	6583.73	0.00	12345 existing ground
115+85.98	6580.10	0.00	12345 existing ground
116+00.00	6579.54	0.00	12345 existing ground
117+00.00	6575.68	0.00	12345 existing ground
118+00.00	6572.45	0.00	12345 existing ground
119+00.00	6570.64	0.00	12345 existing ground
120+00.00	6569.93	0.00	12345 existing ground
120+13.00	6569.87	0.00	12345 existing ground
121+00.00	6570.41	0.00	12345 existing ground

   The elevations are only shown to the nearest tenth of a foot. The elevation precision is controlled by the precision for elevations in **Tools > Options**.

7. **Close** the report.

8. Open the **profile.se** file with **Notepad**.


12345DES_Prof.se - Notepad

File Edit Format View Help

100+00.00	6630.07	1
100+58.55	6628.03	0
100+90.74	6626.90	0
100+91.41	6626.88	0
102+06.62	6622.65	0
102+07.30	6622.63	0
102+28.09	6621.82	0
102+94.58	6619.22	0
102+96.09	6619.16	0
103+37.92	6617.62	0
103+46.60	6617.31	0
103+87.12	6615.82	0
103+89.47	6615.74	0
104+36.75	6613.89	0
104+40.69	6613.74	0
104+86.67	6611.89	0
104+89.05	6611.79	0
105+33.15	6610.02	0
105+38.62	6609.80	0
105+76.74	6608.39	0
105+90.50	6607.88	0
105+90.93	6607.87	0
106+15.21	6606.91	0
106+40.12	6605.92	0
106+40.64	6605.90	0
106+99.36	6603.71	0
107+00.97	6603.65	0
108+08.66	6599.72	0
108+11.40	6599.63	0

The **profile.se** file is displayed in a window that can be scrolled through. The elevations are also shown to the nearest tenth of a foot.

This file can be used to plot a profile by reading in the ASCII data.

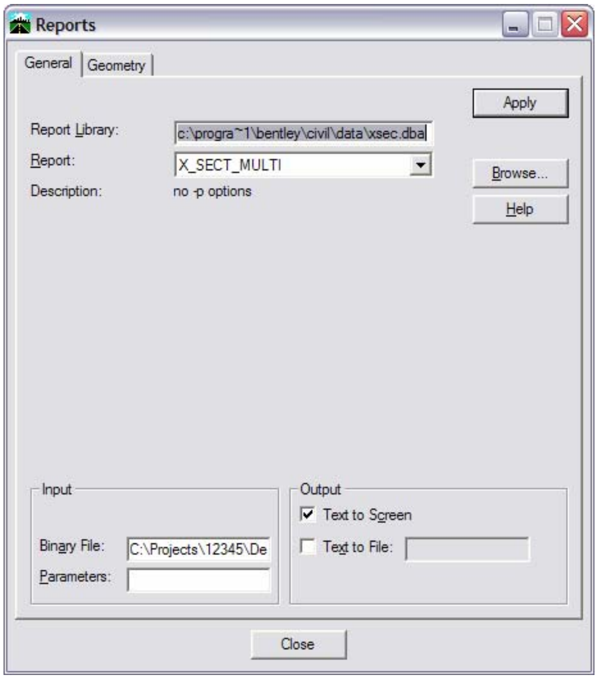
9. **Close** the report.

Create an ASCII cross section report

Take the binary report file created, cross.bin, and apply a format template to it to create an ASCII cross section report file.

1. Select **Tools > Reports**.

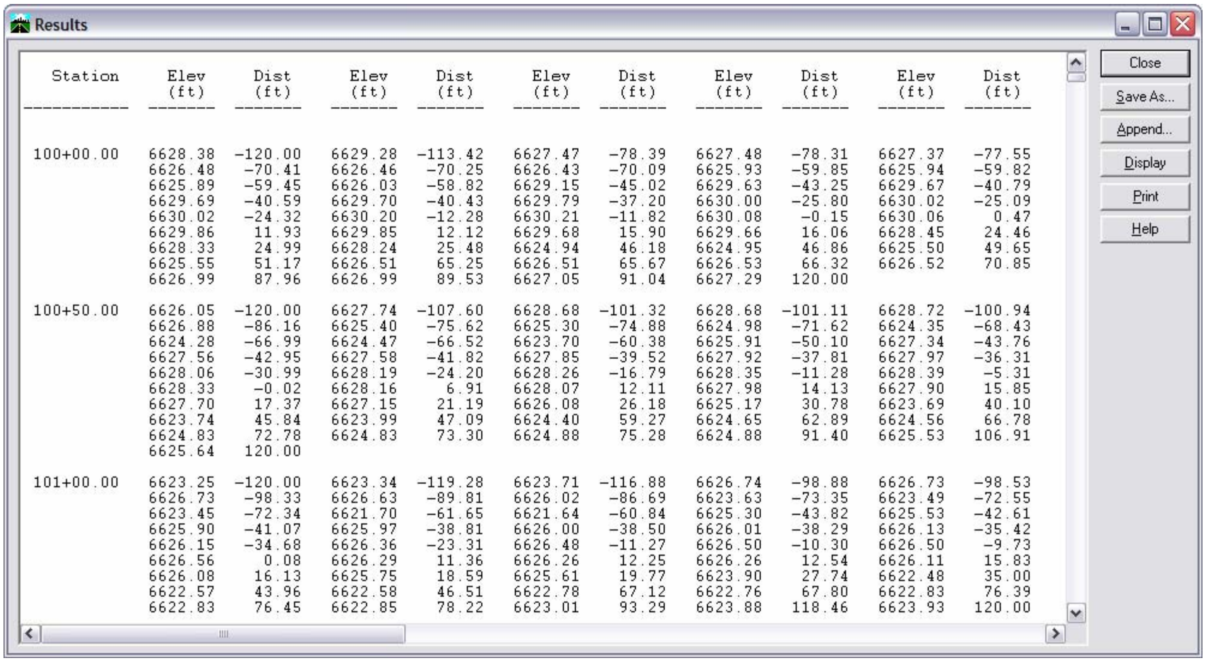
2. Select the **General** tab.



- Click in the Report Library field and select **Browse**.
- Select **xsec.dba** from the **\Program Files\Bentley\Civil\data folder**.
- Select **Open**.
- From the Report drop-down list, Select **X_SECT_MULTI**.
- Click in the Binary Input field and select **Browse**.
- Select **12345DES_XSec.bin** from the **C:\Projects\12345\Design\InRoads** folder and **Open**.
- Toggle on **Text to Screen**

3. Select **Apply**

   The ASCII report is displayed to the screen in a window that can be scrolled through, and an ASCII file can be saved to the disk.



Station	Elev (ft)	Dist (ft)	Elev (ft)	Dist (ft)	Elev (ft)	Dist (ft)	Elev (ft)	Dist (ft)	Elev (ft)	Dist (ft)
100+00.00	6628.38	-120.00	6629.28	-113.42	6627.47	-78.39	6627.48	-78.31	6627.37	-77.55
	6626.48	-70.41	6626.46	-70.25	6626.43	-70.09	6625.93	-59.85	6625.94	-59.82
	6625.89	-59.45	6626.03	-58.82	6629.15	-45.02	6629.63	-43.25	6629.67	-40.79
	6629.69	-40.59	6629.70	-40.43	6629.79	-37.20	6630.00	-25.80	6630.02	-25.09
	6630.02	-24.32	6630.20	-12.28	6630.21	-11.82	6630.08	-0.15	6630.06	0.47
	6629.86	11.93	6629.85	12.12	6629.68	15.90	6629.66	16.06	6628.45	24.46
	6628.33	24.99	6628.24	25.48	6624.94	46.18	6624.95	46.86	6625.50	49.65
	6625.55	51.17	6626.51	65.25	6626.51	65.67	6626.53	66.32	6626.52	70.85
	6626.99	87.96	6626.99	89.53	6627.05	91.04	6627.29	120.00		
100+50.00	6626.05	-120.00	6627.74	-107.60	6628.68	-101.32	6628.68	-101.11	6628.72	-100.94
	6626.88	-86.16	6625.40	-75.62	6625.30	-74.88	6624.98	-71.62	6624.35	-68.43
	6624.28	-66.99	6624.47	-66.52	6623.70	-60.38	6625.91	-50.10	6627.34	-43.76
	6627.56	-42.95	6627.58	-41.82	6627.85	-39.52	6627.92	-37.81	6627.97	-36.31
	6628.06	-30.99	6628.19	-24.20	6628.26	-16.79	6628.35	-11.28	6628.39	-5.31
	6628.33	-0.02	6628.16	6.91	6628.07	12.11	6627.98	14.13	6627.90	15.85
	6627.70	17.37	6627.15	21.19	6626.08	26.18	6625.17	30.78	6623.69	40.10
	6623.74	45.84	6623.99	47.09	6624.40	59.27	6624.65	62.89	6624.56	66.78
	6624.83	72.78	6624.83	73.30	6624.88	75.28	6624.88	91.40	6625.53	106.91
	6625.64	120.00								
101+00.00	6623.25	-120.00	6623.34	-119.28	6623.71	-116.88	6626.74	-98.88	6626.73	-98.53
	6626.73	-98.33	6626.63	-89.81	6626.02	-86.69	6623.63	-73.35	6623.49	-72.55
	6623.45	-72.34	6621.70	-61.65	6621.64	-60.84	6625.30	-43.82	6625.53	-42.61
	6625.90	-41.07	6625.97	-38.81	6626.00	-38.50	6626.01	-38.29	6626.13	-35.42
	6626.15	-34.68	6626.36	-23.31	6626.48	-11.27	6626.50	-10.30	6626.50	-9.73
	6626.56	0.08	6626.29	11.36	6626.26	12.25	6626.26	12.54	6626.11	15.83
	6626.08	16.13	6625.75	18.59	6625.61	19.77	6623.90	27.74	6622.48	35.00
	6622.57	43.96	6622.58	46.51	6622.78	67.12	6622.76	67.80	6622.83	76.39
	6622.83	76.45	6622.85	78.22	6623.01	93.29	6623.88	118.46	6623.93	120.00

4. Review the report and close the window when complete.

5. **Close** the dialog box.

Create an end-area volume report

Two report files were created when the end-area volumes were calculated – **12345DES_EndVol.txt** and **12345DES_EndVol.bin**. Review the ASCII **12345DES_EndVol.txt** file.

1. In **Notepad**, open **C:\Projects\12345\Design\InRoads\12345DES_EndVol.txt**.
2. Review the information contained in the report.
3. **Close Notepad**.

Create another ASCII report for end-area volumes, this time using the **12345DES_EndVol.bin** file that was created when the volumes were computed.

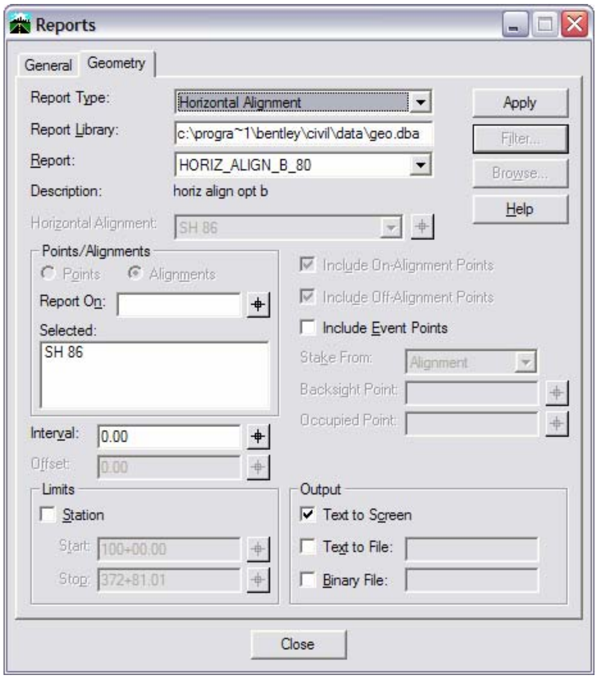
4. Select **Tools > Reports**.
5. Select the **General** tab.
   - Click in the Report Library field and select **Browse**.
   - Select **vol.dba** from the **Program Files\Bentley\Civil\data folder**.
   - Select **Open**.
   - From the Report drop-down list, select **BASIC_END_AREA_80**.
   - Click in the Binary Input field and select **Browse**.
   - Select **12345DES_EndVol.bin** from the **C:\Projects\12345\ Design\InRoads** directory and **Open**.
   - Toggle on **Text to Screen**.
   - Toggle off **Text to File**.
6. Select **Apply**

   The ASCII report is displayed to the screen in a window that can be scrolled through.
7. Review the report and close the window when done.
8. Select **Close** to dismiss the dialog box.

Creating an alignment report

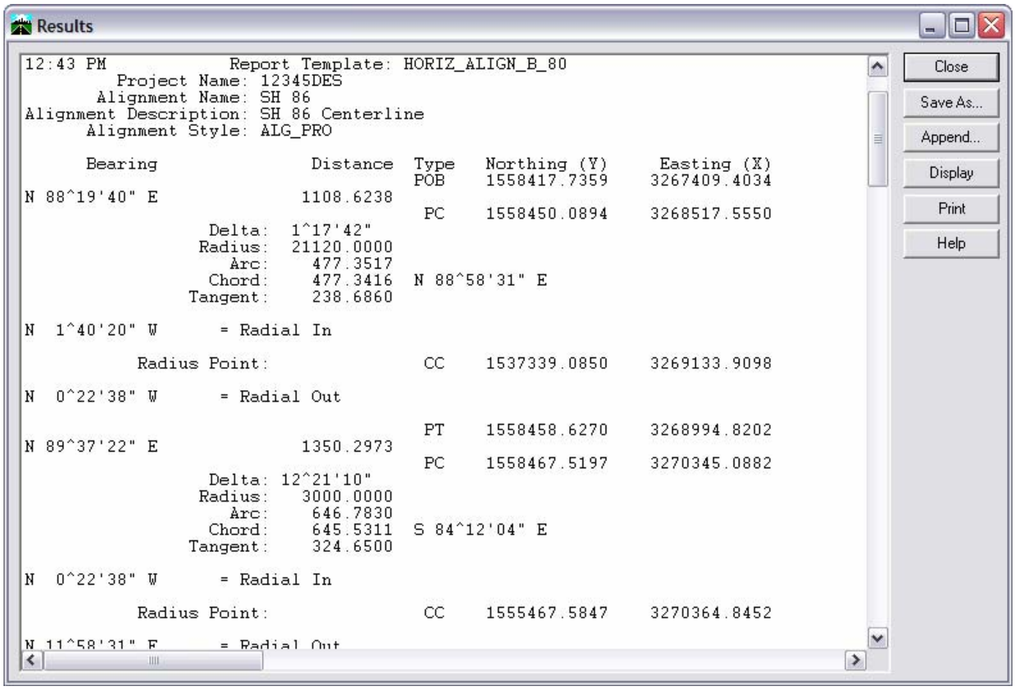
Using the data stored in the binary geometry project file, **12345DES.alg**, create an alignment report.

1. On the **Reports** dialog, select the **Geometry** tab.



- Set the Report Type: **Horizontal Alignment**.
- Click in the Report Library field and choose **Browse**.
- Select **geo.dba** from the **Program Files\Bentley\Civil\data** folder.
- Select **Open**.
- From the Report drop-down list, select **HORIZ_ALIGN_B_80**.
- Under Output, toggle on **Text to Screen**.
- Toggle off **Text to File**.
- Pick the **Target Button** next to the **Report On** field and click on your horizontal alignment.
- Set the **Interval** to ***25***.

2. Select **Apply**.



The ASCII report is displayed to the screen.

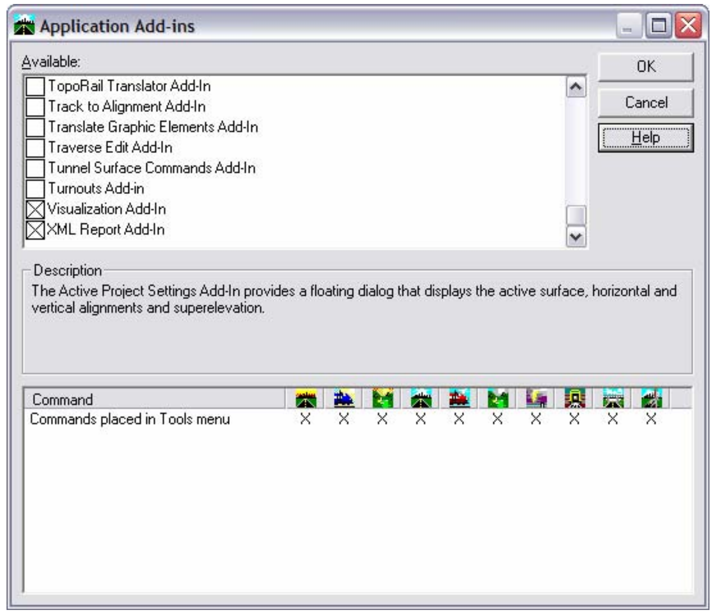
3. Review the report and close the window when done.

4. Select **Close** to dismiss the **Reports** box.

Creating an XML report

1. Choose **Tools > Application Add-ins**.

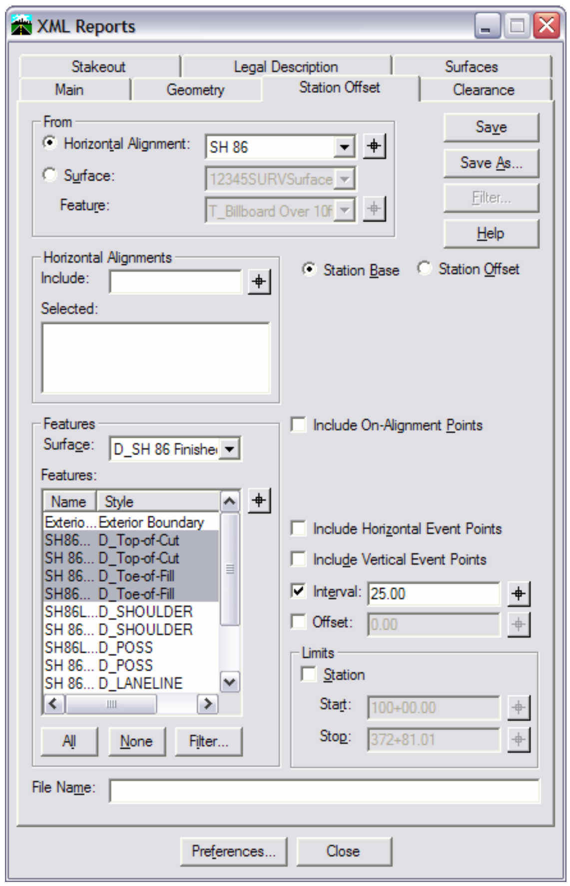
   - Toggle on XML Reports if it isn't already on.



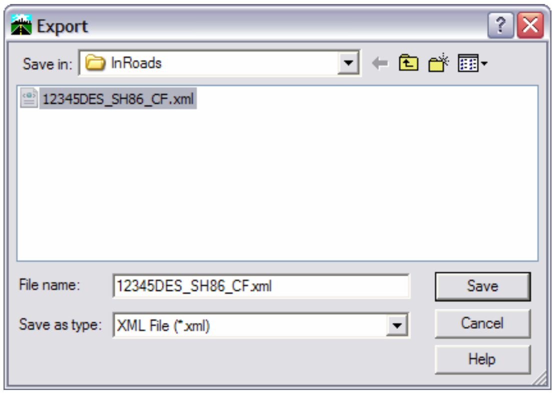
   - Choose **OK**.

2. Choose **Tools > XML Reports**.

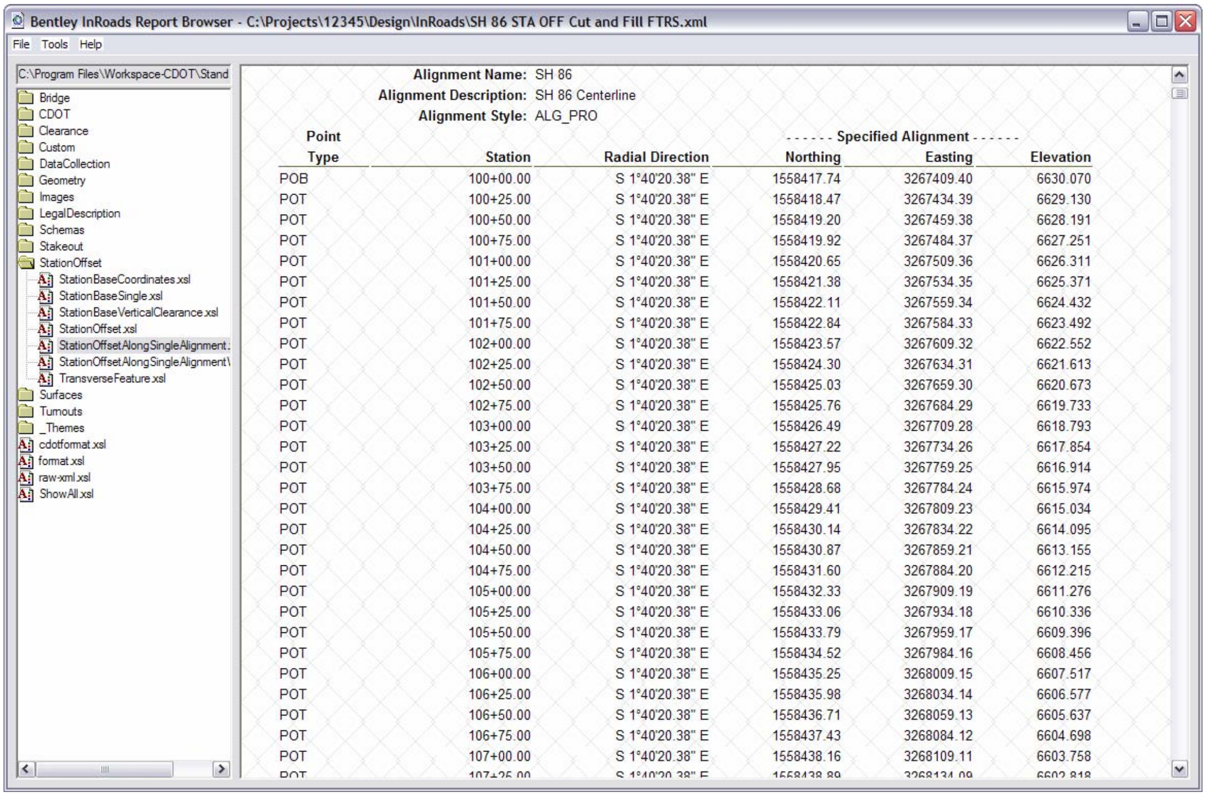
   - Select the **Station Offset** tab.
   - Set the **From Horizontal Alignment** to ***SH 86***.
   - Toggle on **Station Base**.
   - Under the **Features** category:
   - Set the **Surface** to **D_ SH 86 Finished-Grade**.
   - Highlight the cut and fill features. Hint: You can sort by Style to make it easier to find them.
   - Toggle on **Interval** and key in ***25***



3. Choose **Save** and key in the name ***12345DES_SH86_CF.xml***



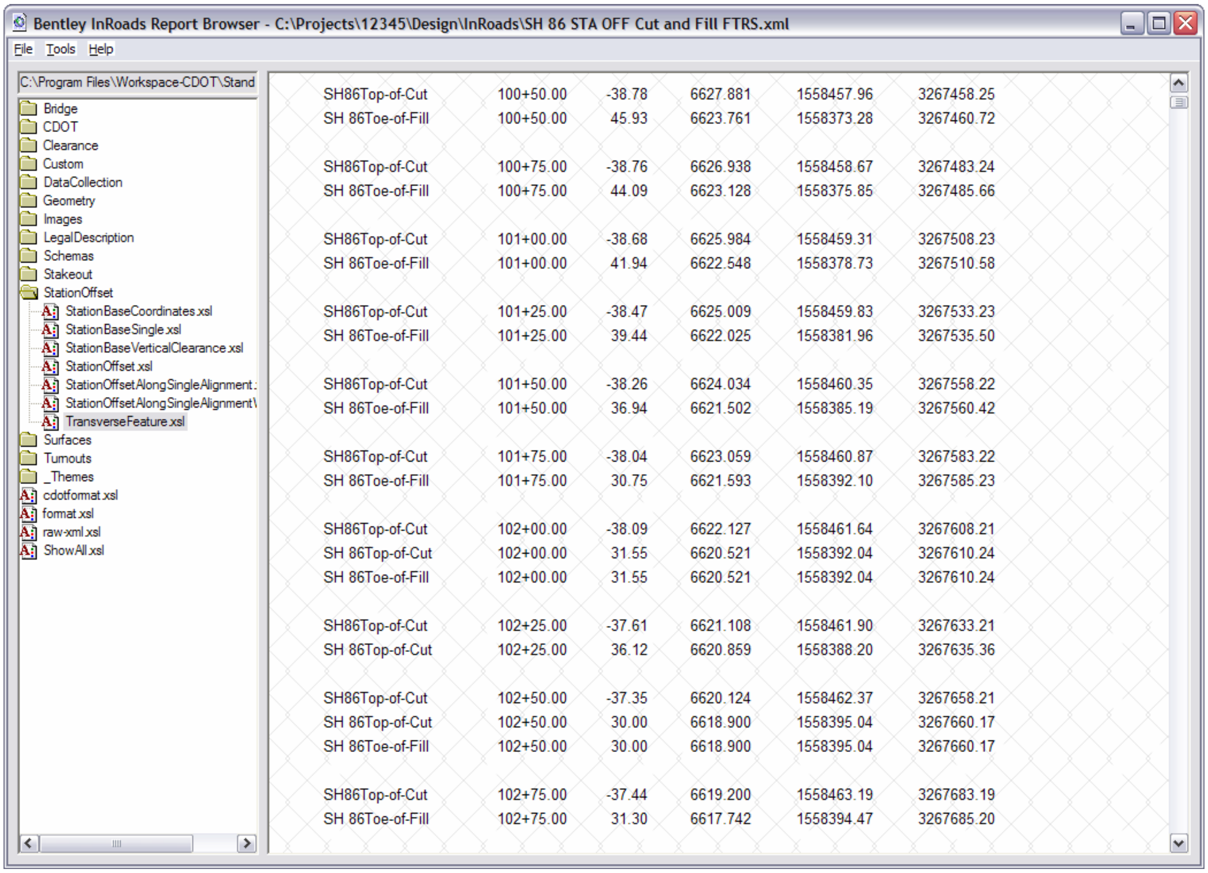
The report browser will start automatically. If it doesn't for some reason or you want to look at this same report later, choose **Tools > View XML Reports**.



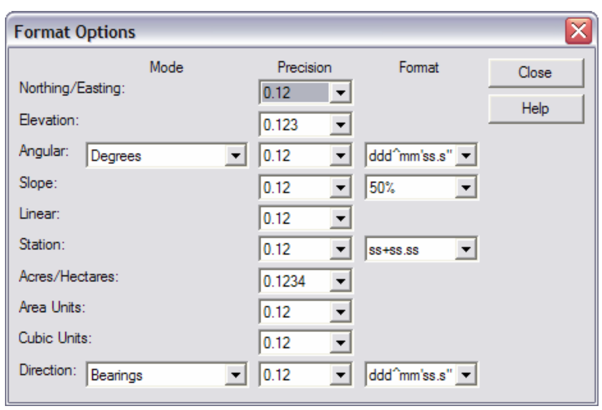
Alignment Name: SH 86
Alignment Description: SH 86 Centerline
Alignment Style: ALG_PRO

Point			------ Specified Alignment ------		
Type	Station	Radial Direction	Northing	Easting	Elevation
POB	100+00.00	S 1°40'20.38" E	1558417.74	3267409.40	6630.070
POT	100+25.00	S 1°40'20.38" E	1558418.47	3267434.39	6629.130
POT	100+50.00	S 1°40'20.38" E	1558419.20	3267459.38	6628.191
POT	100+75.00	S 1°40'20.38" E	1558419.92	3267484.37	6627.251
POT	101+00.00	S 1°40'20.38" E	1558420.65	3267509.36	6626.311
POT	101+25.00	S 1°40'20.38" E	1558421.38	3267534.35	6625.371
POT	101+50.00	S 1°40'20.38" E	1558422.11	3267559.34	6624.432
POT	101+75.00	S 1°40'20.38" E	1558422.84	3267584.33	6623.492
POT	102+00.00	S 1°40'20.38" E	1558423.57	3267609.32	6622.552
POT	102+25.00	S 1°40'20.38" E	1558424.30	3267634.31	6621.613
POT	102+50.00	S 1°40'20.38" E	1558425.03	3267659.30	6620.673
POT	102+75.00	S 1°40'20.38" E	1558425.76	3267684.29	6619.733
POT	103+00.00	S 1°40'20.38" E	1558426.49	3267709.28	6618.793
POT	103+25.00	S 1°40'20.38" E	1558427.22	3267734.26	6617.854
POT	103+50.00	S 1°40'20.38" E	1558427.95	3267759.25	6616.914
POT	103+75.00	S 1°40'20.38" E	1558428.68	3267784.24	6615.974
POT	104+00.00	S 1°40'20.38" E	1558429.41	3267809.23	6615.034
POT	104+25.00	S 1°40'20.38" E	1558430.14	3267834.22	6614.095
POT	104+50.00	S 1°40'20.38" E	1558430.87	3267859.21	6613.155
POT	104+75.00	S 1°40'20.38" E	1558431.60	3267884.20	6612.215
POT	105+00.00	S 1°40'20.38" E	1558432.33	3267909.19	6611.276
POT	105+25.00	S 1°40'20.38" E	1558433.06	3267934.18	6610.336
POT	105+50.00	S 1°40'20.38" E	1558433.79	3267959.17	6609.396
POT	105+75.00	S 1°40'20.38" E	1558434.52	3267984.16	6608.456
POT	106+00.00	S 1°40'20.38" E	1558435.25	3268009.15	6607.517
POT	106+25.00	S 1°40'20.38" E	1558435.98	3268034.14	6606.577
POT	106+50.00	S 1°40'20.38" E	1558436.71	3268059.13	6605.637
POT	106+75.00	S 1°40'20.38" E	1558437.43	3268084.12	6604.698
POT	107+00.00	S 1°40'20.38" E	1558438.16	3268109.11	6603.758

4. On the Report Browser, select the style sheet **TransverseFeature.xsl.**



5. Choose **Tools > Format Options** from the browser.



You can change any of the formats or precisions shown and it will automatically change the report.

6. Choose **Close**.

If you would like, save the file by choosing **File > Save As**. It can be saved as an HTML file, or you can copy and paste the data into another text editor.

7. **Exit** the browser and **Close** the **Report** dialog.
8. **Exit** MicroStation and InRoads. If prompted '***Do you wish to save changes to geometry project* 12345DES*?***' Select **No**.

Optional Activities

1. Print one of your reports if a printer is available.
2. Experiment with any other report options you would like.

14. Intersection Modeling

Overview

It is not unusual, when you are working with InRoads, to run across situations that don't fit neatly into the roadway modeling mold – situations where a template and alignments or even templates, tables and alignments don't give you the flexibility you need. For example, intersections and interchanges – something you run into all the time in highway design.

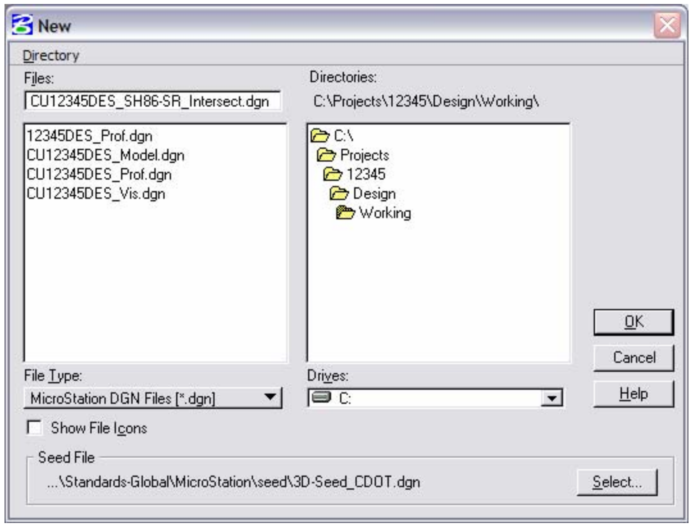
One of the best ways to accomplish these tasks is to model the features. You can think of it as developing the breaklines that would be collected if the site were surveyed after being built. This is accomplished using a variety of techniques, including some commands that you have already used in class and some new commands introduced here.

We'll start by running **Roadway Modeler** for each of the roadways, then use several different **Design Surface** and **Edit Surface** tools to combine the two surface created by **Modeler** and the develop the returns. These same techniques are employed in many situations, such as interchanges and pedestrian refuges.

Lab 14 – Intersection Modeling

Start InRoads

1. Start InRoads using your desktop icon.
2. From the MicroStation Manager, select File > New.
   - Set the folder to **\Design\Working** and key in the name **CU12345DES_SH86-SR_Intersect.dgn** file.



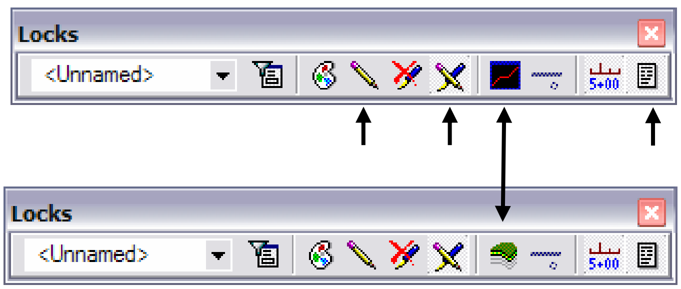
3. Select **OK** to create and **OK** again to open the file.

Open your InRoads data files

1. Select **File > Open**.
2. Toggle the **Files of Type** option to **Projects (*.rwk)**.
3. Double-click on **12345DES.rwk**.
4. **Cancel** the **Open** dialog.

Set your InRoads locks

1. On the locks toolbar, ensure that **Write** lock is on in **Pencil** mode and toggle **Locate Graphics** to **Locate Features** and **Report** lock is on.

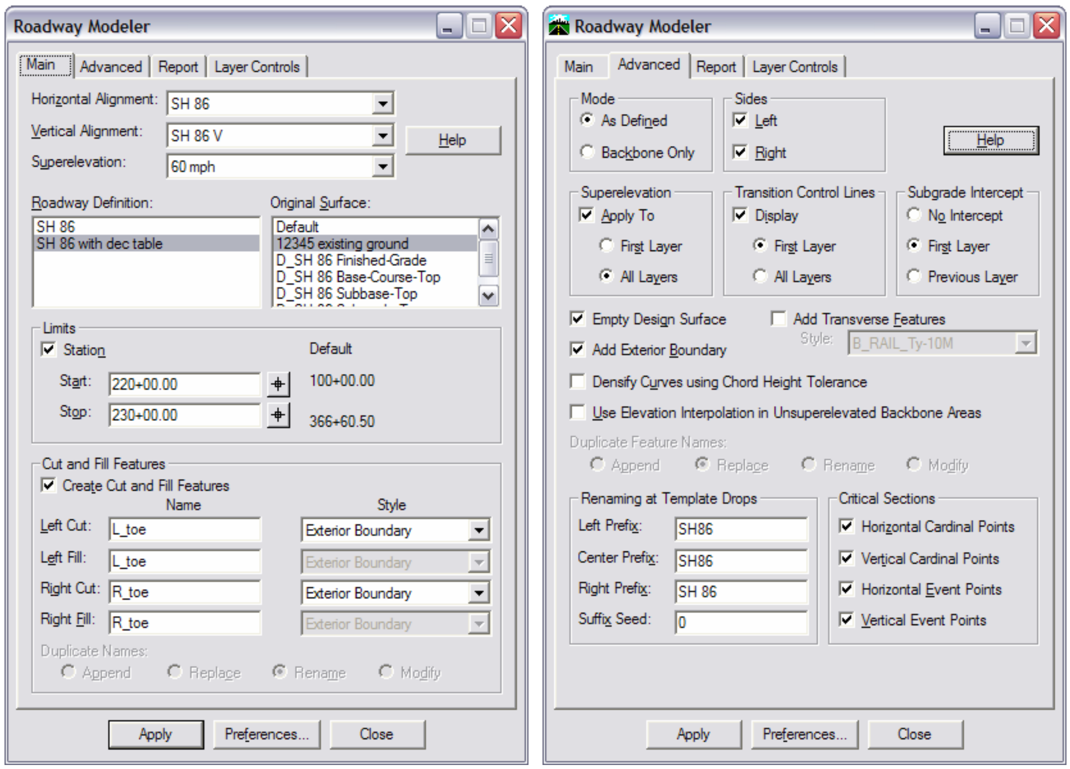


Model the Roadways

The first portion of modeling an intersection involves modeling the roadways. In the next series of steps, you will model both roadways, but rename the surfaces so you will have each roadway as a separate model.

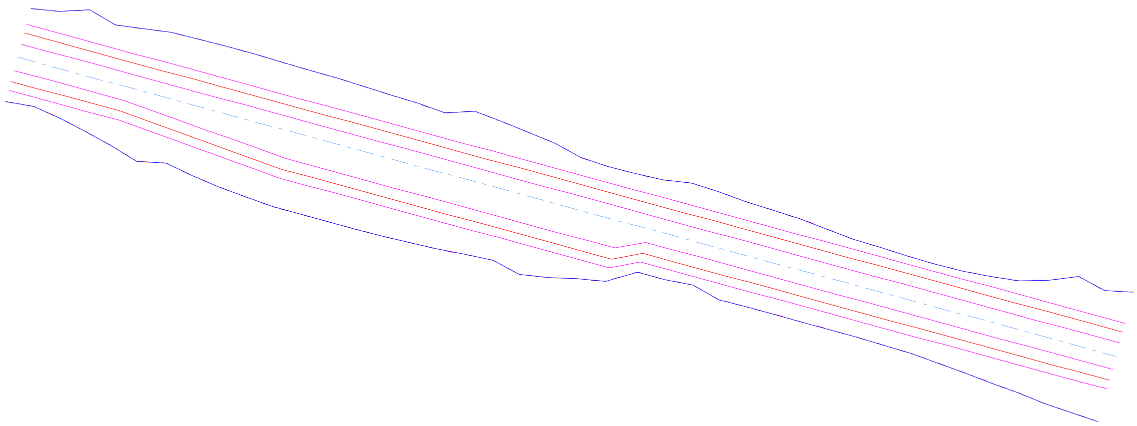
Model SH 86

1. Select **Modeler > Roadway Modeler**.



- On the **Main** tab, select the **SH 86 with dec table**.
- Choose **SH 86** as the Horizontal Alignment.
- Select the **12345 existing ground** as the original surface
- Set the Begin Station to: ***220+00***
- Set the End Station to: ***230+00***
- While you would normally model the entire roadway, you will limit the model here, making a smaller intersection surface to speed the process.
- Toggle on **Create Cut and Fill Features** and set them as shown. This creates a continuous feature for the left and right toes, which will later be used in making an exterior boundary.
- Set the **Advanced** tab as shown.

2. **Apply**.



Save the Surfaces

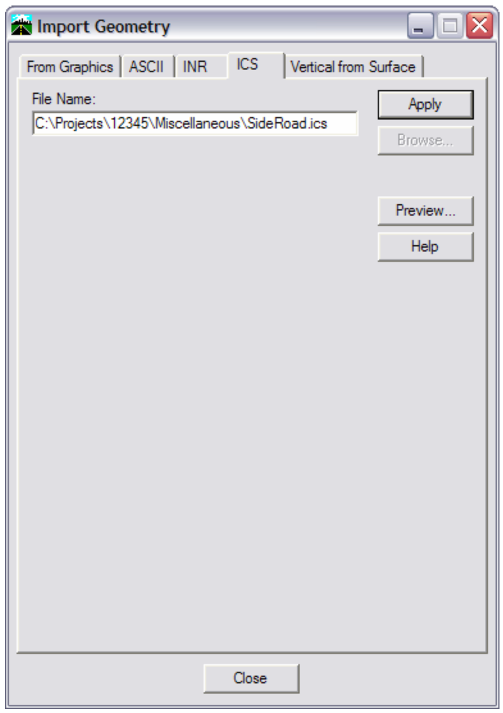
3. Select **File > Save > Project**.

Model the side road

Import the horizontal alignment

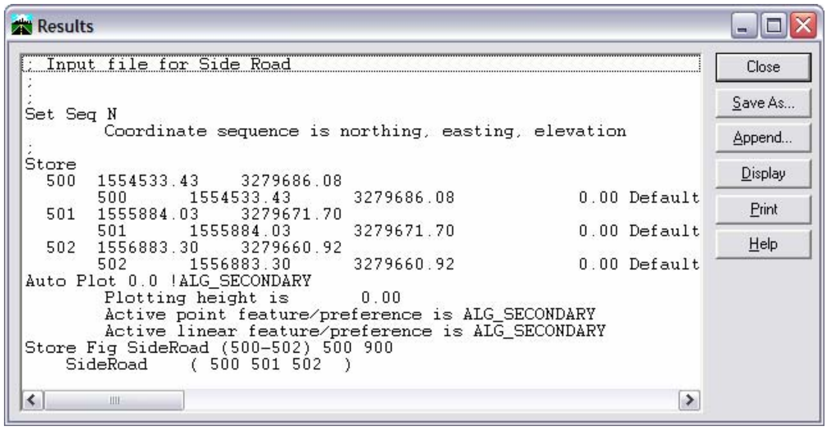
The side road alignment has already been defined in an input file, which you will load in the next series of steps.

1. Select **File > Import > Geometry**.
2. Choose the **ICS** tab.
3. Browse and choose the **SideRoad.ics** file from the **C:\Projects\12345\Miscellaneous** folder.

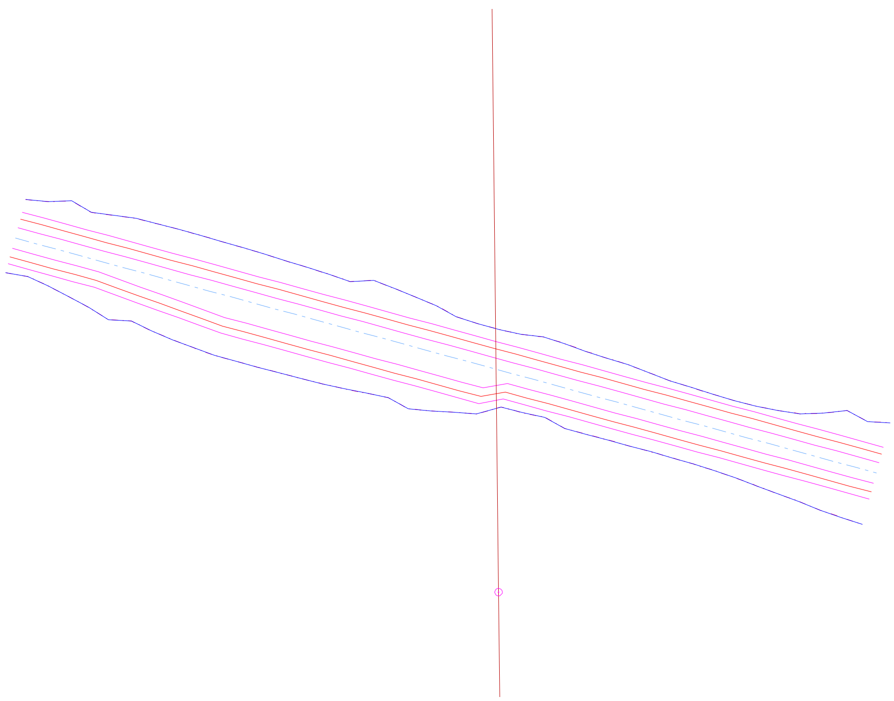


- Choose **Preview** if you would like to see the contents of the ics file.

- Choose **Apply** to import the alignment.

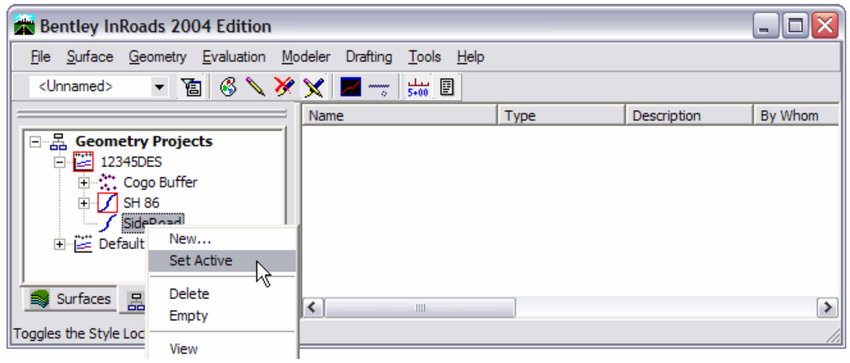


4. The **Results** box appears and lists the points and alignment just created.
5. **Close** the **Results** box.
6. **Fit** your view.



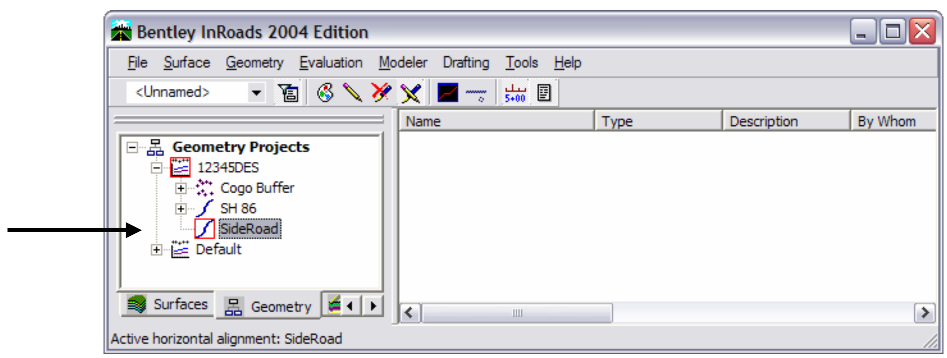
Since **Auto Plot** is used in the text file, the graphic displays for the alignment as it's created.

7. Make the new alignment active.



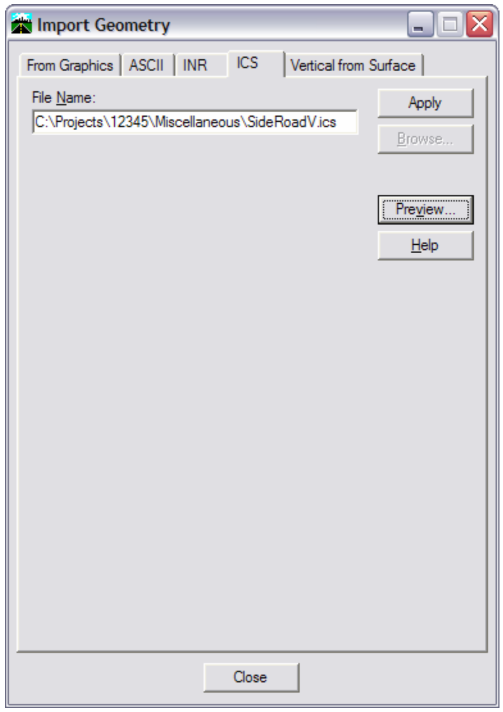
- Right-click on the **SideRoad** alignment in the **Geometry** portion of the **Explorer** menu. (Select the **Geometry** tab at the bottom if it is not the active tab.)
- Choose **Set Active**.

8. Verify that the side road alignment is active by checking that the red box is to the left of the name SideRoad.



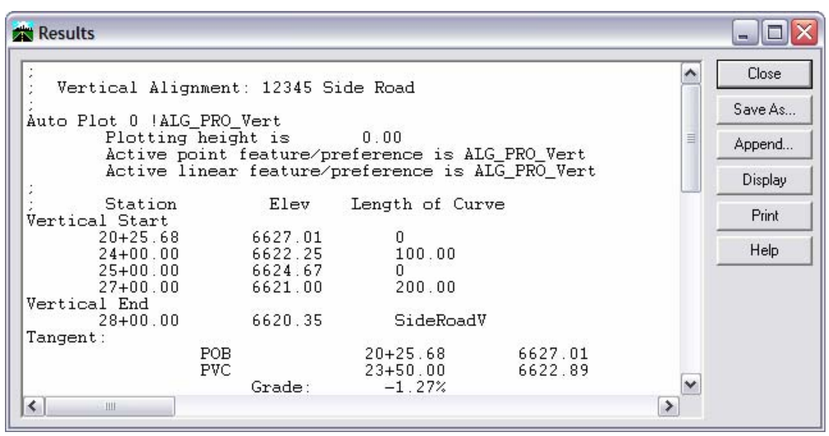
9. Back on the **Import** dialog, (If you closed it before, choose **File > Import > Geometry** and select the **ICS** tab.)

   - Browse again and choose **sideroadV.ics** from the **C:\Projects\12345\Miscellaneous** folder.



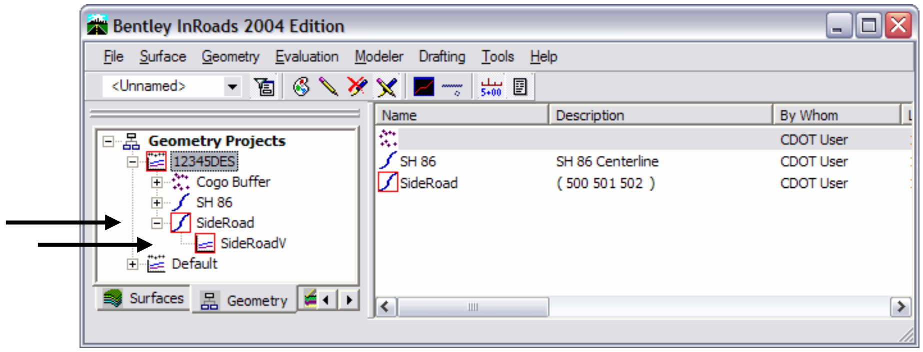
10. Choose **Apply** to import the vertical alignment.

    - The **Results** box will appear again with the vertical alignment information.



- **Close** the **Results** box and the **Import Geometry** dialog.

11. Verify that the vertical alignment was imported by looking at the Explorer portion of the InRoads menu. By using the + sign next to the geometry project and the horizontal alignment, you can 'drill' down to see the horizontal and vertical alignments.

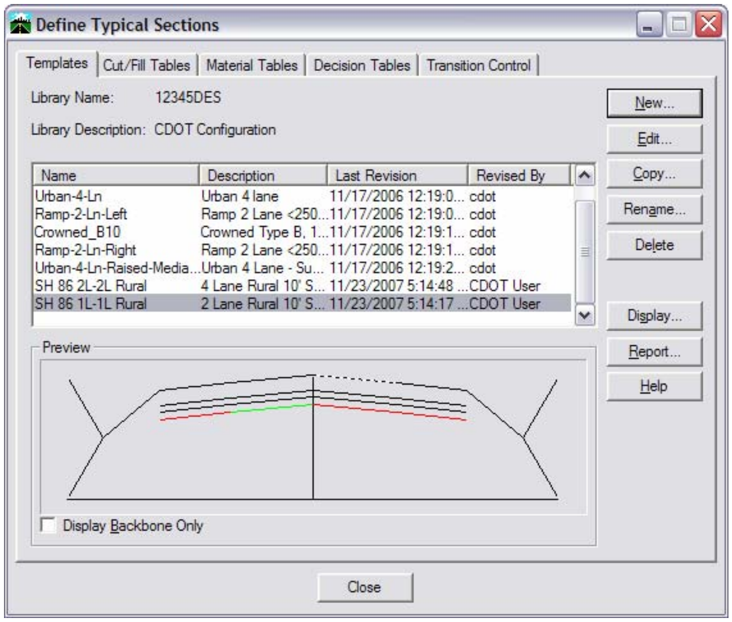


12. Choose **File > Save > Geometry Project** to save the geometry project with the new alignments.

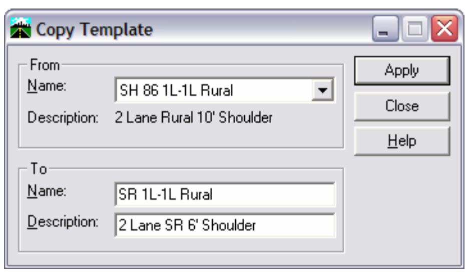
Copy and modify a typical section to use for the approach road

Instead of creating a new typical section, for the approach road you will use a copy of the 2-lane typical you created previously.

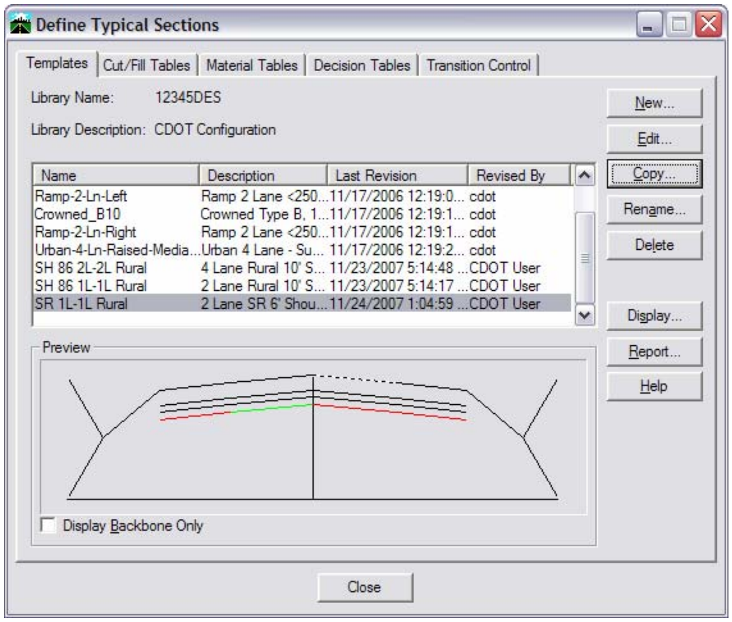
1. Select **Modeler > Define Typical Section**.



2. Highlight ***SH 86 1L-1L Rural*** and select **Copy**.

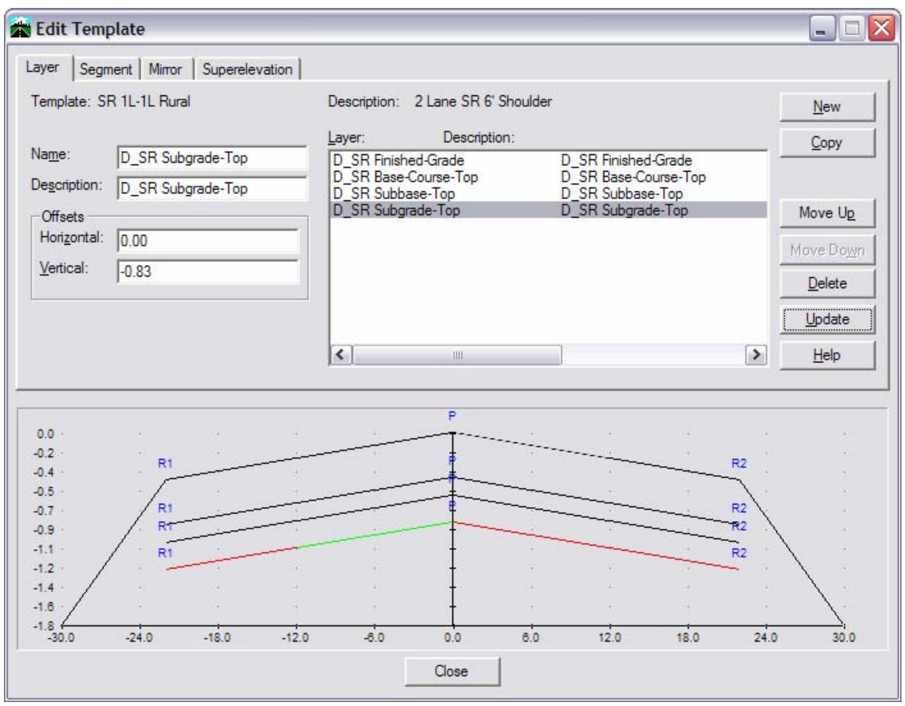


3. Change the name as shown and choose **Apply**.

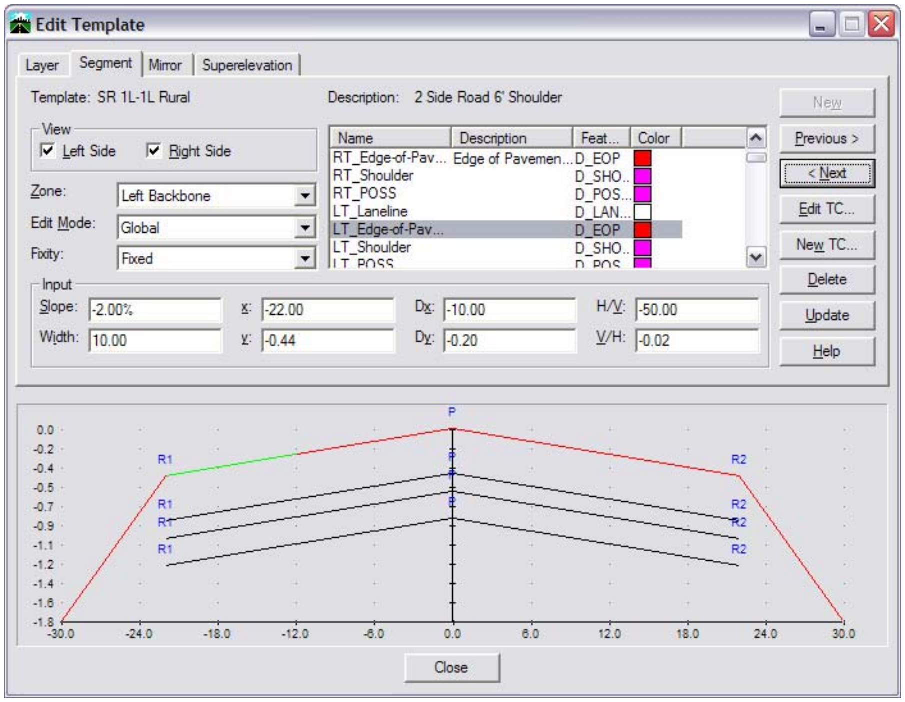


With the ***SR 1L – 1L Rural*** typical highlighted, select **Edit**.

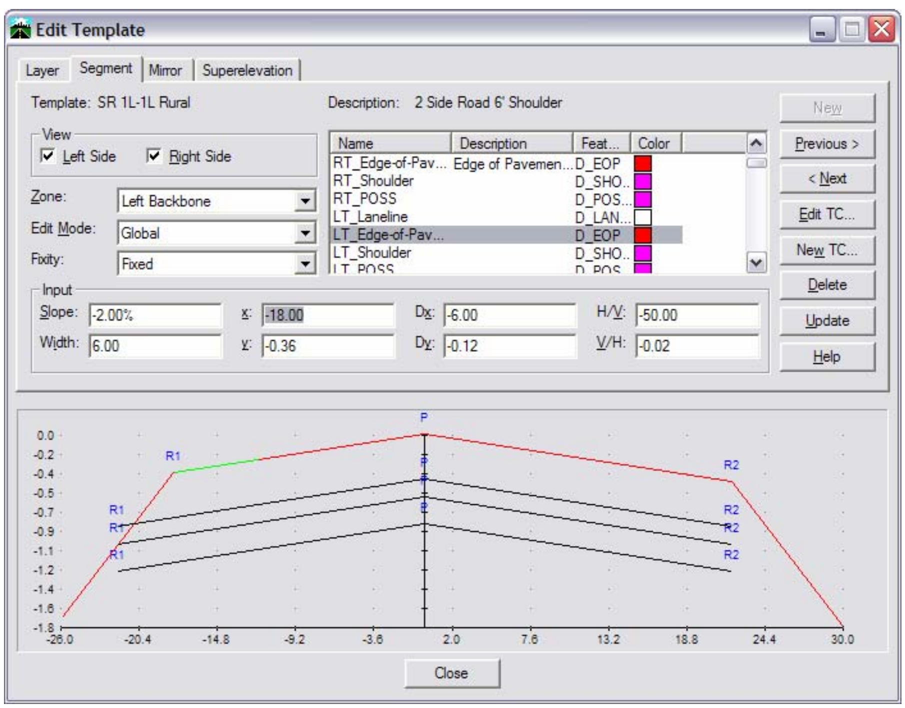
4. Change *each* of the layer names from **D_*SH 86*** to **D_*SR*** by highlighting the layer, keying in the new name and selecting **Update**.



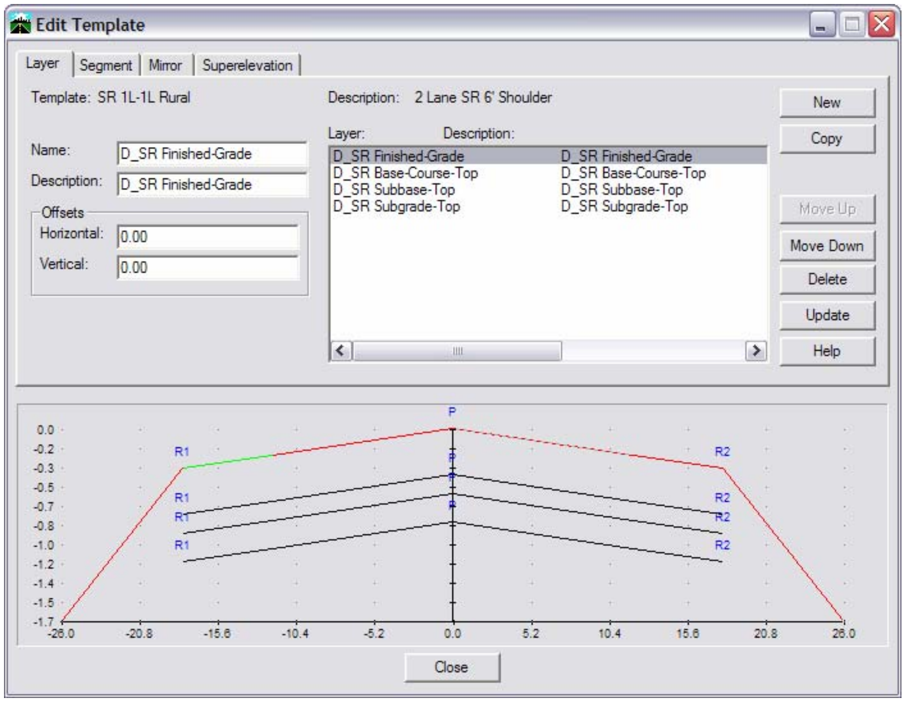
5. Highlight the Finished Grade and select the **Segment** tab



6. Set the **Zone** to **Left Backbone**.
7. Set the **Edit Mode** to **Global**.
8. Use **Previous>** or **<Next** to make the shoulder segment active (green).
9. Change the **Width** to ***6*** and tab.



10. Repeat for the Right side and for each layer.



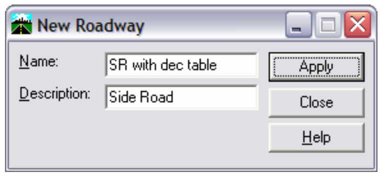
11. **Save** the typical section library.

Create a roadway definition

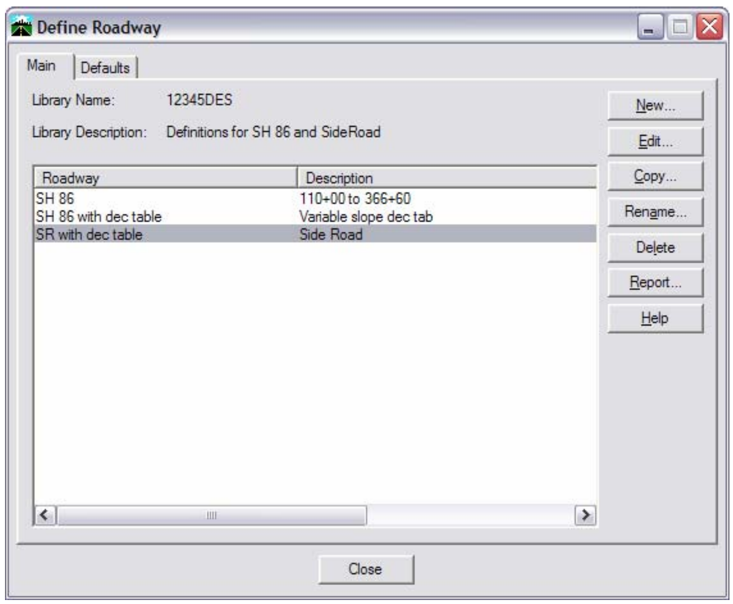
Before modeling, you must have a roadway definition for the Side Road. For this example, you will use the new two-lane template and the same variable slope decision table.

12. Choose **Modeler > Define Roadway**.

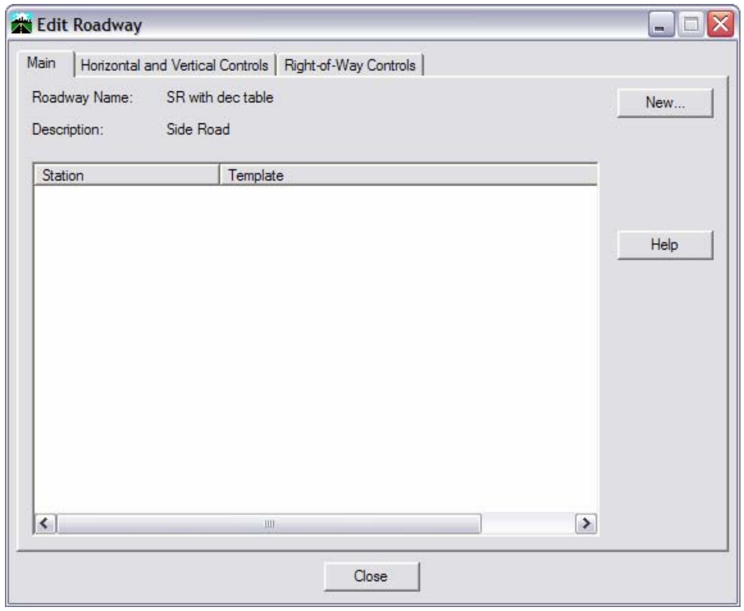
13. Choose **New**.



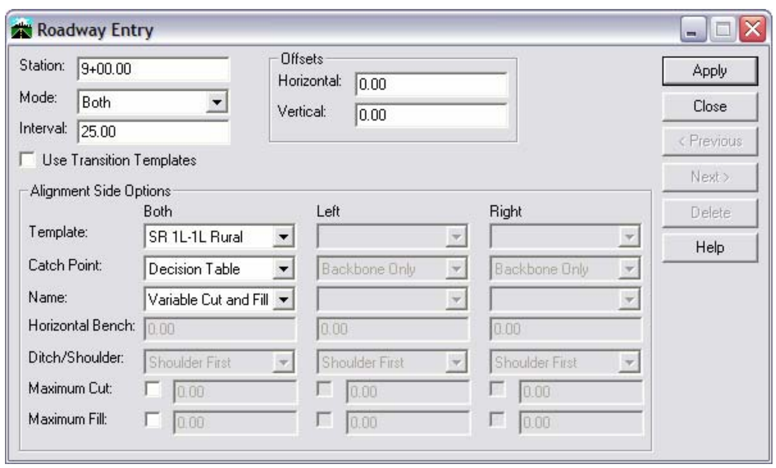
- Enter the **Name** and **Description** as shown.
- Choose **Apply**.



14. Highlight the new roadway definition and choose **Edit**.



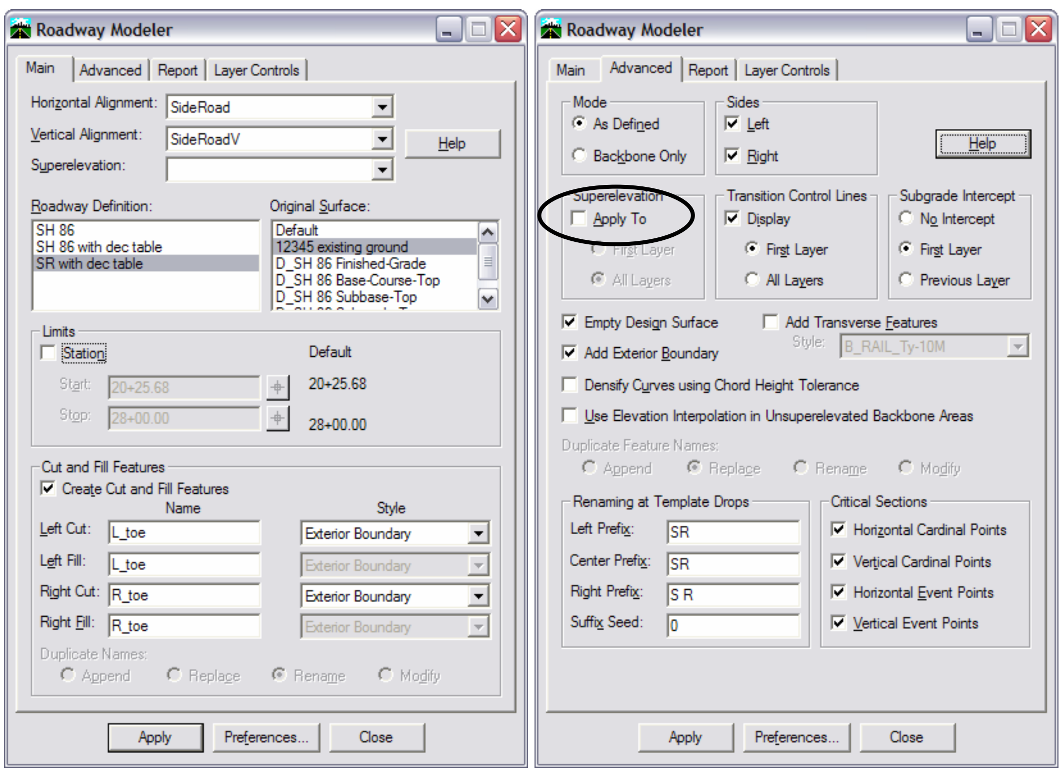
15. Choose **New** and enter the information shown.



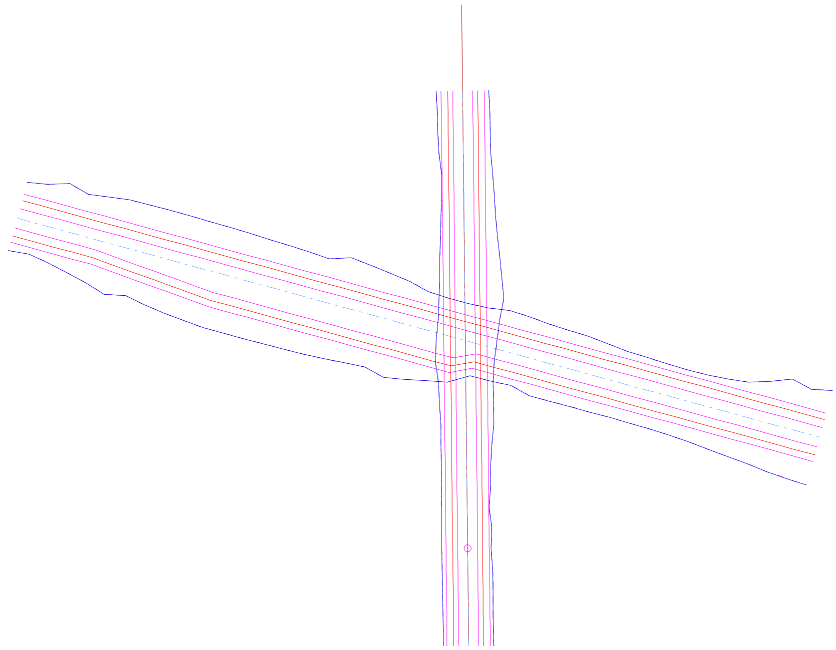
- Select **Apply** to create the Entry.
- **Close** the **Roadway Entry** dialog.
- **Close** the **Edit Roadway** dialog.
- **Close** the **Define Roadway** dialog.

16. Select **Modeler > Roadway Modeler**.

   - On the **Main** tab,
   - Choose **SideRoad** as the Horizontal Alignment and **SideRoadV** as the **Vertical**.
   - Highlight the **Roadway Definition SR with dec tab.**
   - Select the **12345 existing ground** as the original surface.
   - Toggle off the **Station Limits**.
   - Toggle on **Create Cut and Fill Features** and set them as shown. This creates a continuous feature for the left and right toes, which will later be used in making an exterior boundary.
   - On the **Advanced** tab, toggle off **Superelevation**.
   - Change the **Left**, **Center** and **Right Prefix** as shown to designate side road features in the new surfaces. Be sure to make the right and left prefixes unique by putting a space after the "S" in the right prefix.

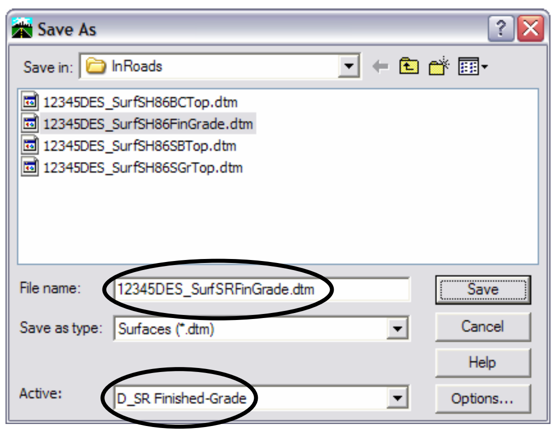


17. **Apply**.



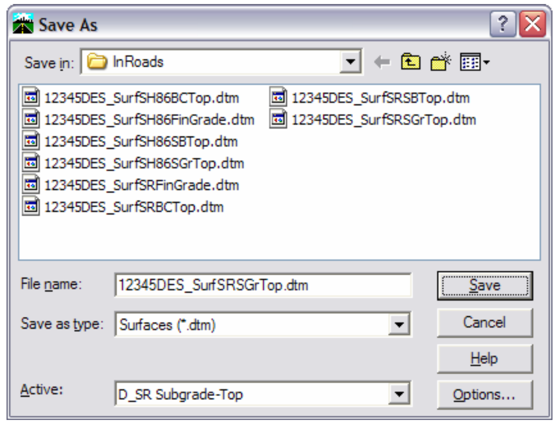
Save the Surface

18. Select **File > Save As**.



- Set the **Active Surface** to **D_SR Finished-Grade**.
- Set the **File name** to **12345DES_SurfSRFinGrade.dtm**
- Choose **Save**.

- Continue and save the **D_SR Base Course Top**, **Subbase,** and **Subgrade** surfaces using the naming convention shown**.**

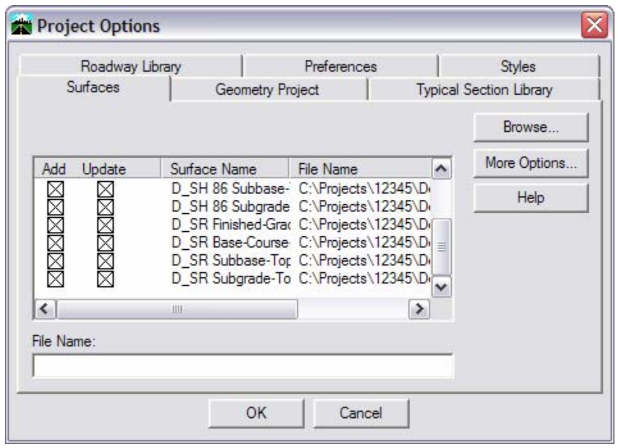


- Cancel the **Save As** dialog.

Add the new surfaces to your project file

19. Choose **File > Save As**.

    - Set the **Save as type** to **Projects *.rwk**.
    - Click on **12345DES.rwk**.
    - Choose **Options**.
    - On the **Surfaces** tab, click on **Add** and **Update** for the new Side Road surfaces.



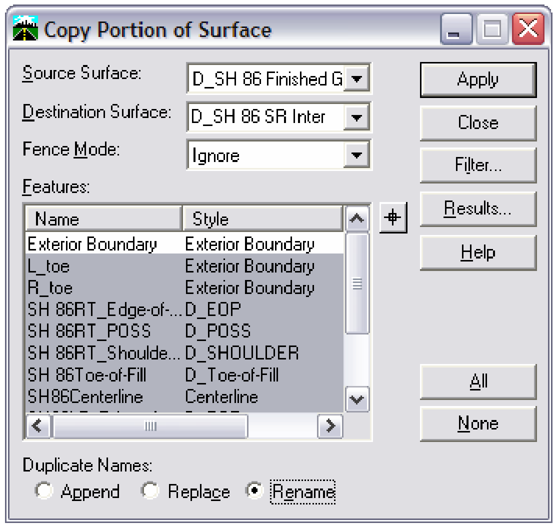
20. Choose **OK**

21. Choose **Save** on the **Save As** dialog and overwrite the current .rwk.

Combine the two models

After completing the two individual models, next you'll combine the features from each to create a third surface. Each of the current models has an exterior, which is the only feature that you do not want from either model.

1. Select **Surface > Edit Surface > Copy Portion of Surface**.



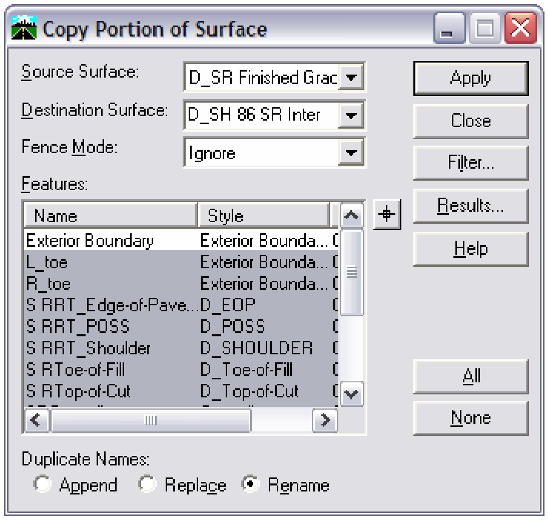
- Set the **Source Surface** to **D_SH 86 Finished-Grade**
- Key in ***D_SH 86 SR Inter*** for the **Destination Surface**.

The new surface does not have to be created ahead of time – it is created when you select **Apply** below.

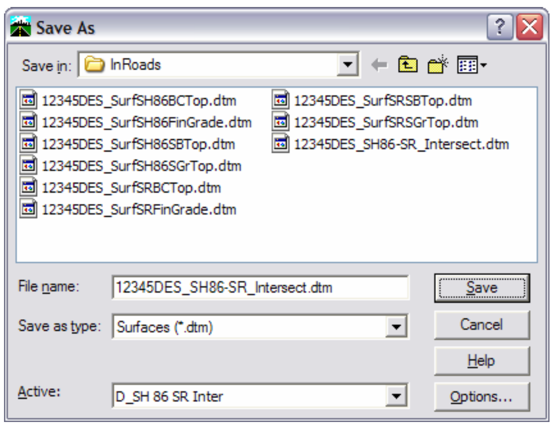
- Hold down your **<CTRL>** key and pick the feature Name **Exterior Boundary** to un-highlight it in the **Feature** list.
- Set the **Duplicate Names** to **Rename**.

2. Choose **Apply**. Do ***not*** choose **Apply** more than once, or it will copy the features again.

3. Set the **Source Surface** to **D_Side Road Finished-Grade** and repeat the previous process, being certain not to include the **Exterior** from this surface, either.



4. Select **File > Save As**.

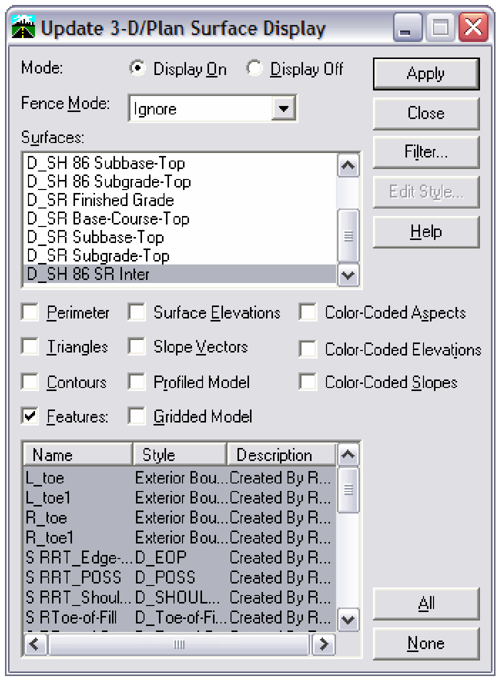


- Set the **Active Surface** to ***D_SH 86 SR Inter***.
- Key in the **File name** ***12345DES_SH86-SR_Intersect.dtm***
- Choose **Save**.
- Cancel the **Save As** dialog.

Display the features

Since the features currently shown in your file are not from the new surface intersection, you should display the new ones.

1. Make the intersection surface active.
2. Using MicroStation, delete all of the features (TC lines) that currently exist in your design file. (You can delete everything in the file using a fence or selection set.
3. Select **Surface > Update 3D/Plan Surface Display**.



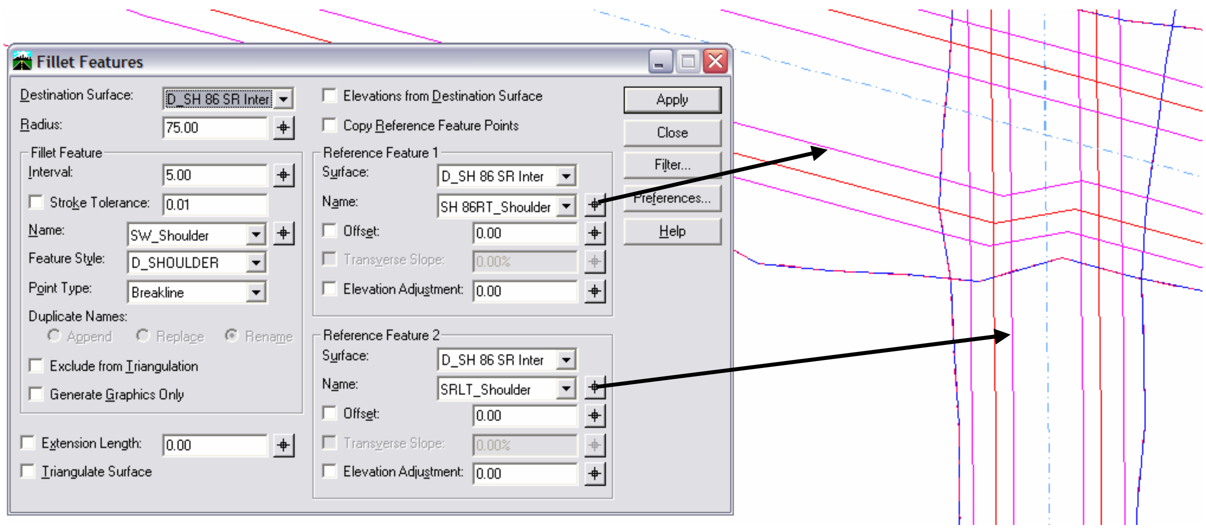
- Set the **Mode** to **Display On**.
- Highlight the intersection surface.
- Toggle on **Features**.
- Select **All**
- Choose **Apply**

Model the returns

1. Ensure that **Write** lock is on in **Pencil** Mode.
2. Ensure that **Locate Feature/Locate Graphics** is set to **Locate Features**.

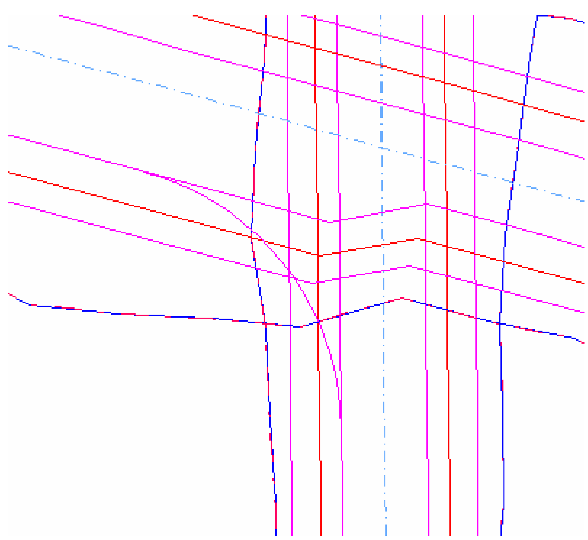
3. Select **Surface > Design Surface > Fillet Features**.

   - Set the dialog as shown. Use the target button to graphically choose the shoulder features.



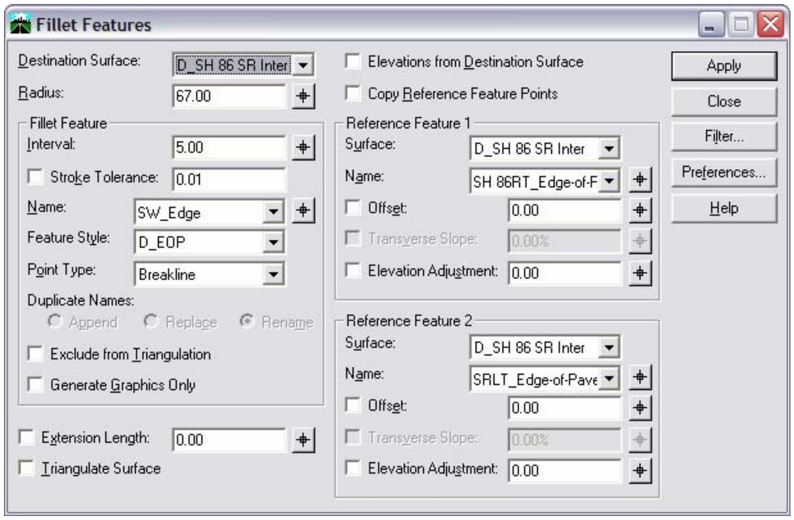
Apply and move your cursor to see the options for filleting the two features.

- When the fillet is in the quadrant you want, **<D>** to accept it.

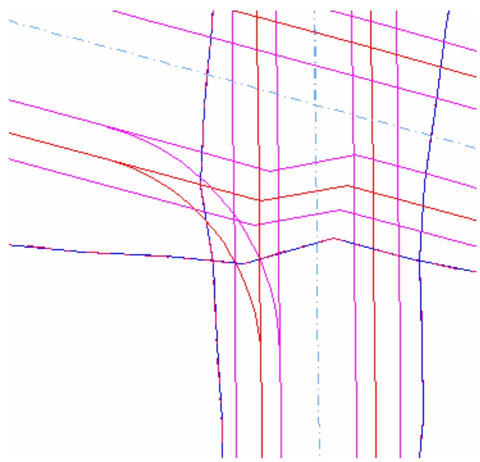


4. Change the **Radius**, reference features, feature name and feature style as shown.

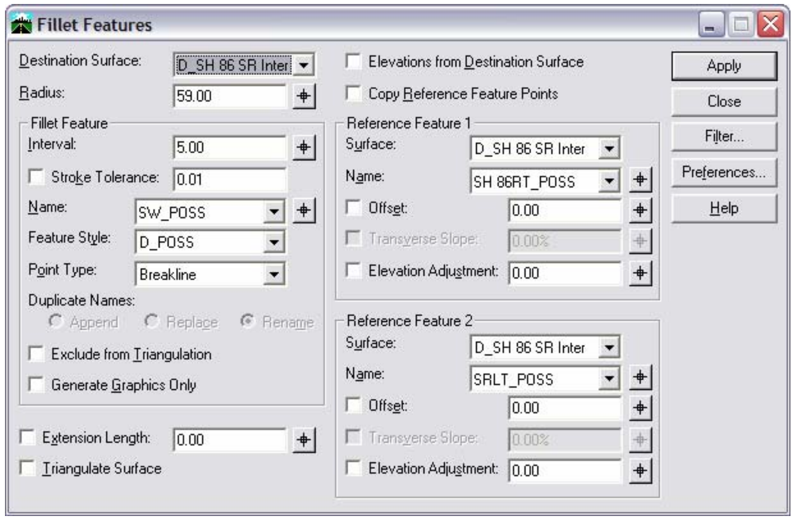
    - Remember to use the target button to graphically choose the EOP features on the SH 86 and Side Road.



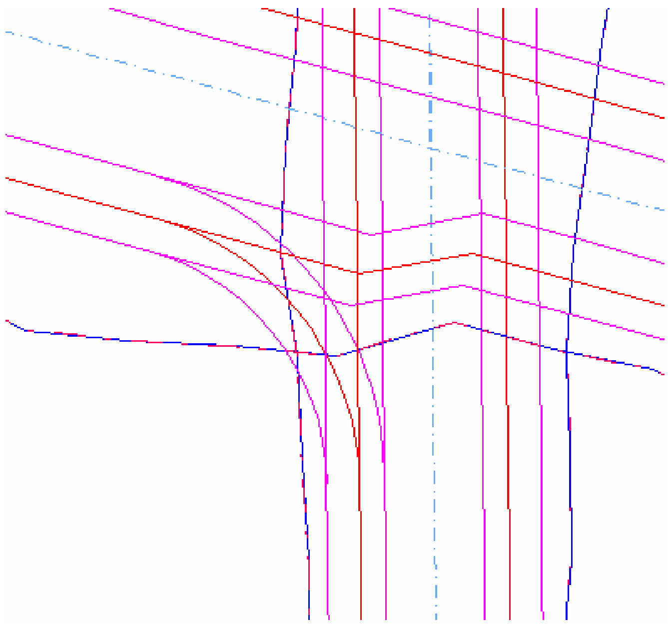
5. **Apply** and **Accept** with a **<D>** to fillet the edges.



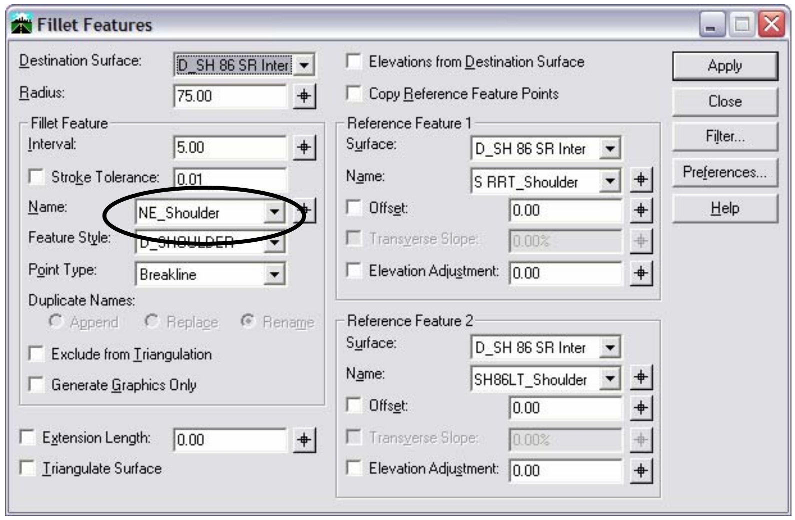
6. Change the **Radius**, reference features, feature name and feature style as shown.

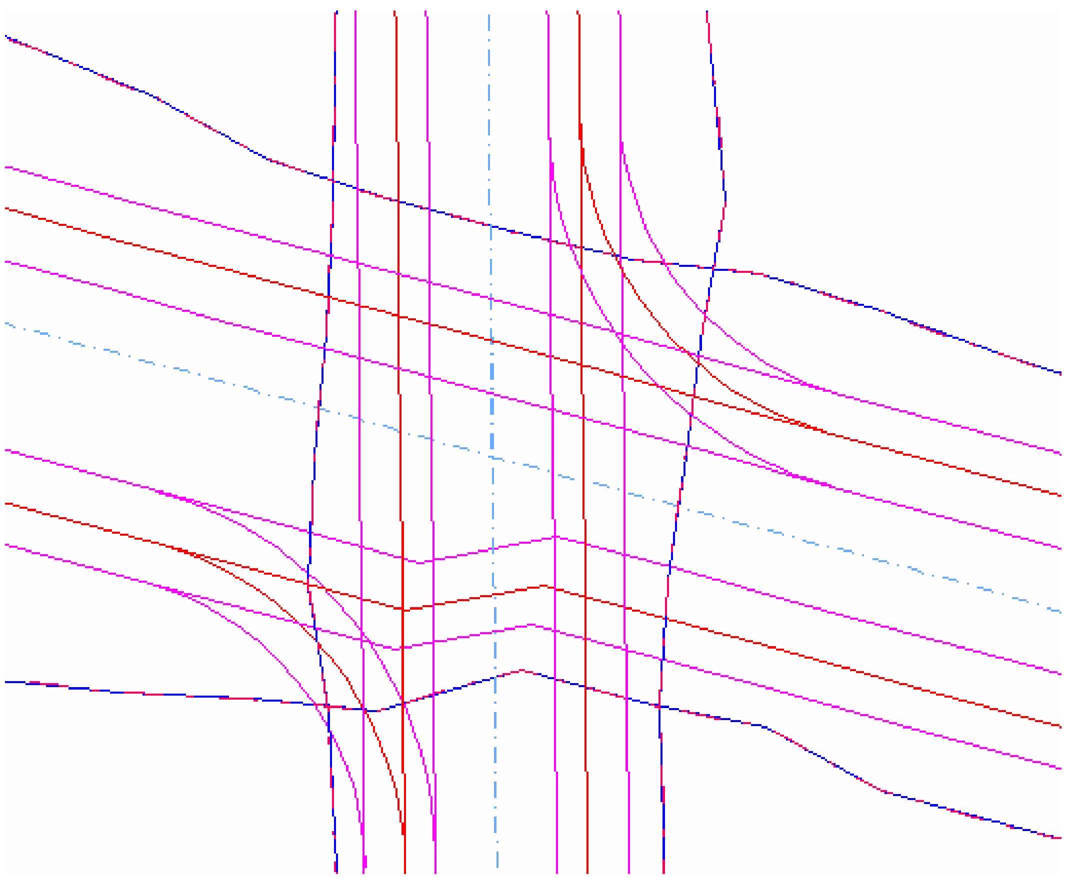


7. **Apply** and **Accept** with a **<D>** to fillet the POSS.



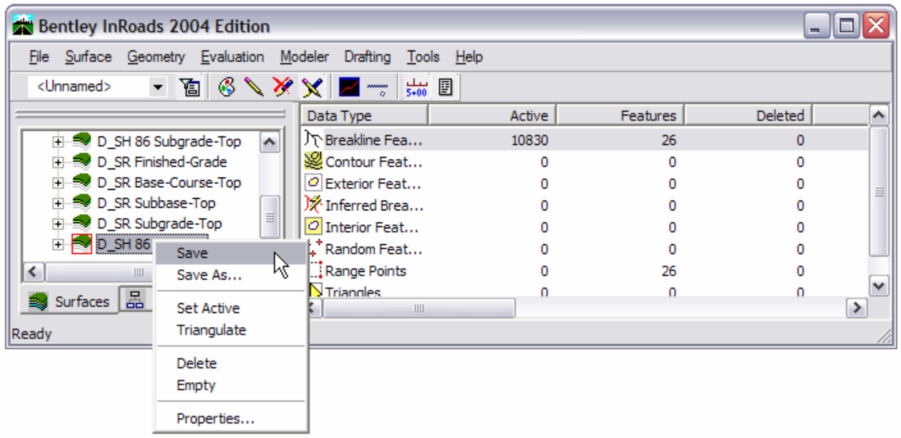
8. Repeat the process in the NE quadrant for the ***NE_Shoulder***, ***NE_Edge-of-Pavement*** and ***NE_POSS***. Don't forget to use **SE** as the prefix for the feature name.

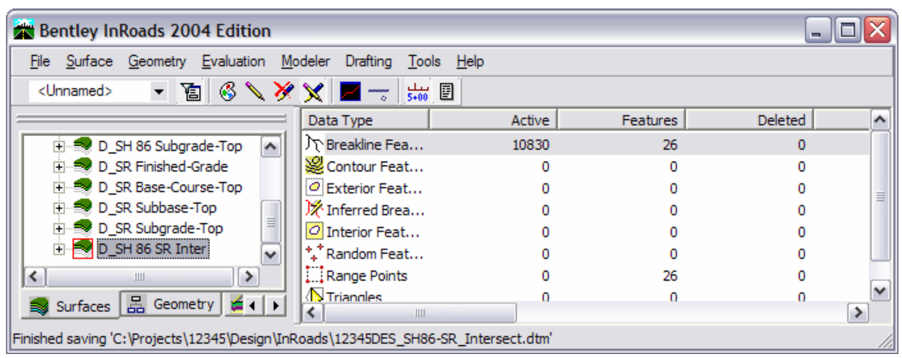




Save the Intersection Surface

1. Save the intersection surface by right-clicking it in the Explorer menu and selecting **Save**. You will need to choose the **Surfaces** tab first.



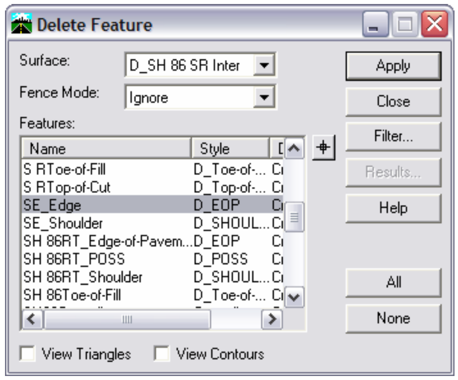


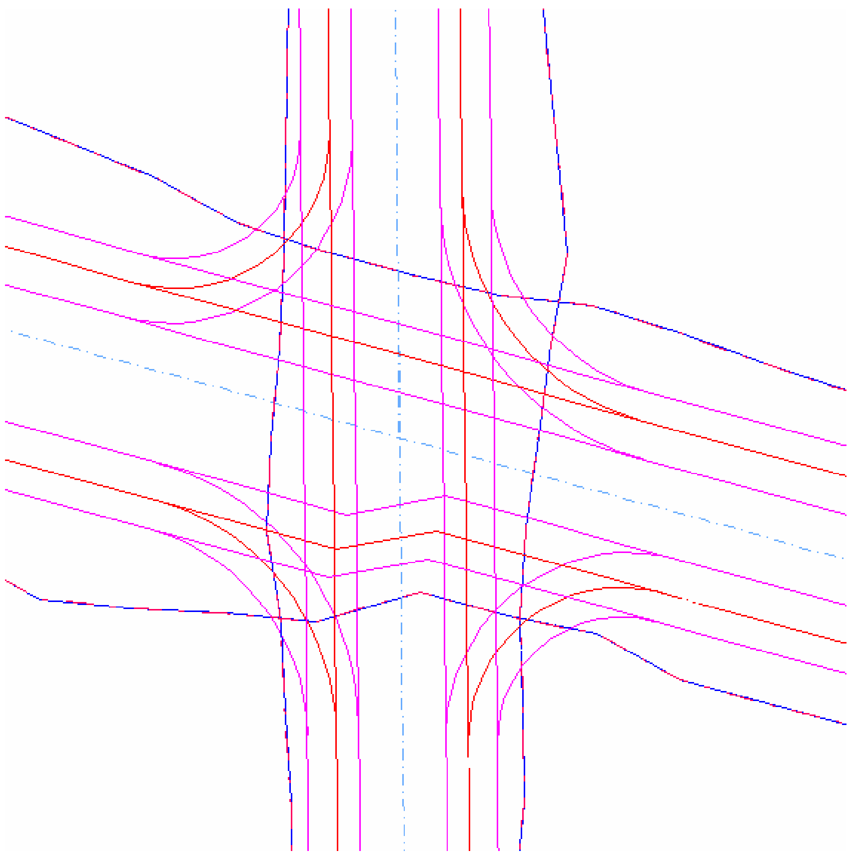
After choosing **Save**, the message will appear as shown above, letting you know the surface has been saved to the hard drive.

You can save your surface using this method at any time.

2. Repeat the process in the other two quadrants, using Radii of **50** for the Shoulder, **42** for the Edge and **34** for the POSS.

3. During the process, if you create a feature incorrectly, you can delete the feature using **Surface > Edit Surface > Delete Feature**. Warning: MicroStation Delete does NOT remove the feature from the surface!



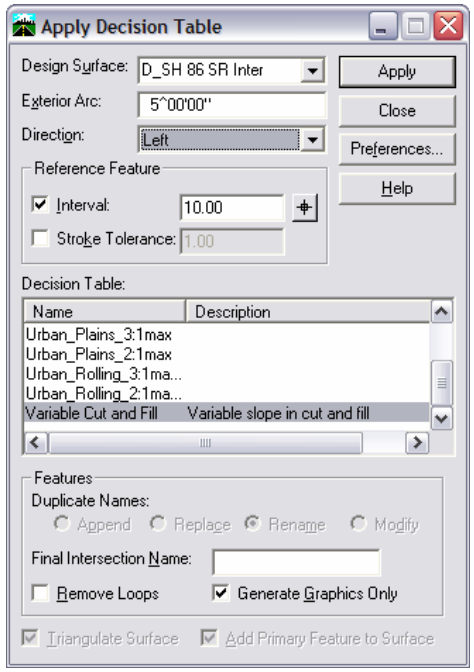


4. **Save** the Surface again.

Create sideslopes for the returns

In the next series of steps, you will use your decision table to create the sideslopes around the returns. In scenarios where a more complex template was used for the roadways, such as curb and gutter sections, you can create a decision table that includes all of the features from the first fillet out instead of only the sideslopes.

1. Select **Surface > Design Surface > Apply Decision Table**.

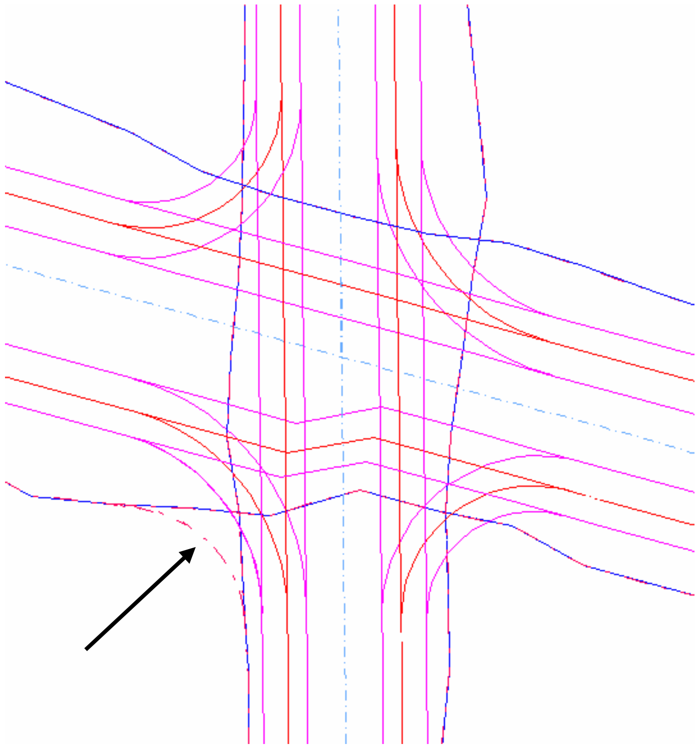


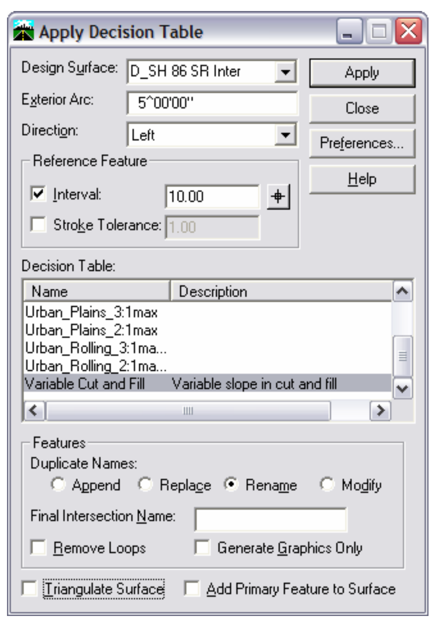
- Choose **D_SH 86 SR Inter** as the **Design Surface**.
- Set the **Direction** to **Left**.
- Toggle on **Interval** and key in ***10***.
- Toggle off **Stroke Tolerance**.
- Select the **Decision Table Variable Cut and Fill**.
- Delete anything that is currently in the **Final Intersection Feature Name** field.
- Toggle on **Remove Loops**.
- Toggle on **Generate Graphics Only**.

2. Apply and identify the new POSS feature as the **Primary** and the **Reference Features**.

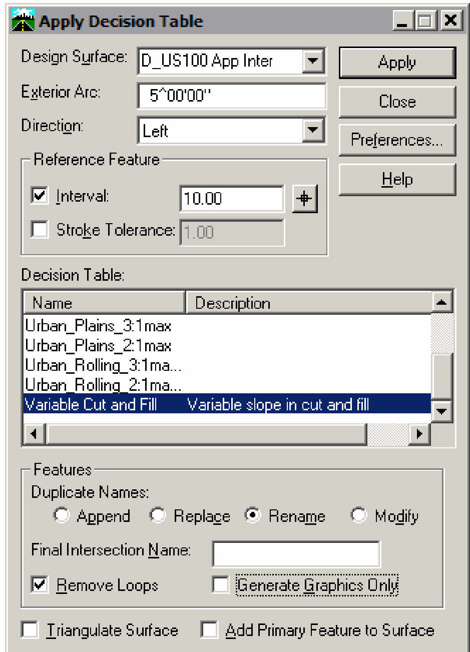
   - <**R**> to run the decision table along the entire feature.

3. Visually check the graphics to make certain they are on the correct side of the return (i.e. on the outside). If so, toggle off **Generate Graphics Only, Triangulate Surface and Add Primary Feature to Surface,** then run the command again to generate the features.

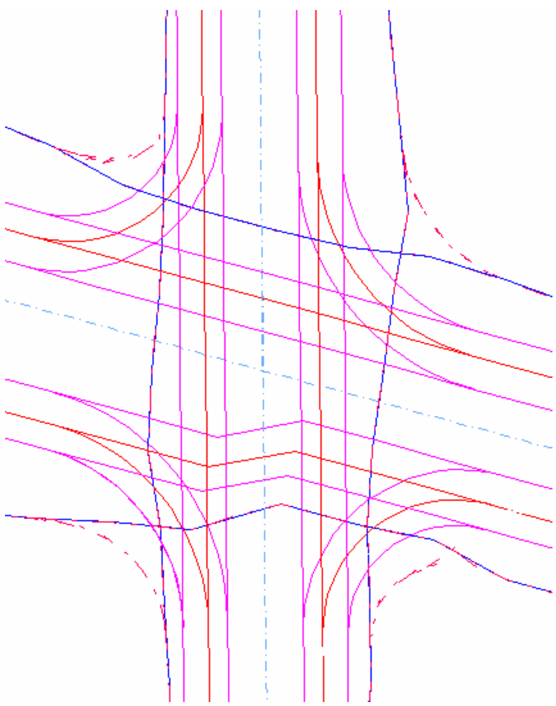




4. If the graphics appeared on the wrong side, delete the toe of slope graphic with MicroStation, change the **Direction** to **Left** and try again.



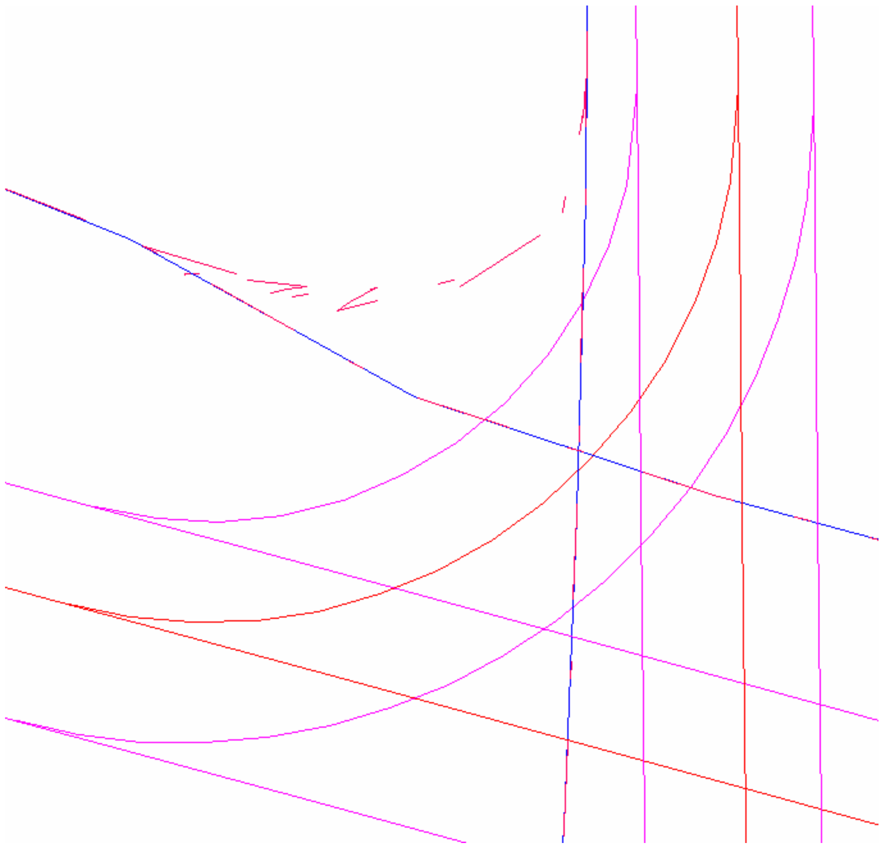
5. Repeat this process for the other returns.



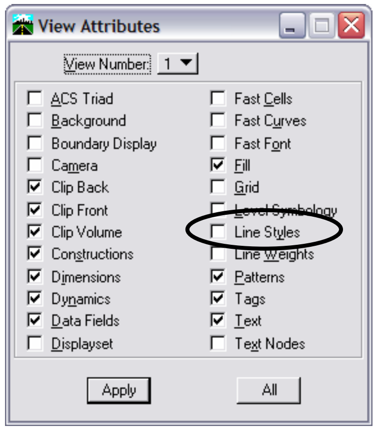
6. **Save** the intersection surface.

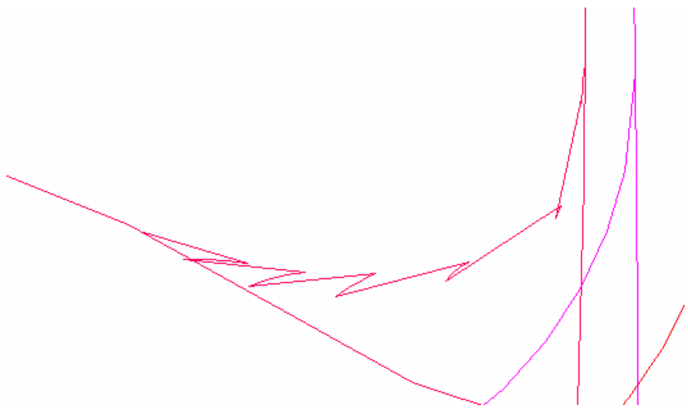
Clean up the decision table features

When a decision table is run on returns such as these, it is not uncommon for the resulting features to have 'jags' in them. Using the **Generate Longitudinal Feature** command, you will smooth out these jagged features by modifying them with a set interval, which will ignore the vertices causing the problems.

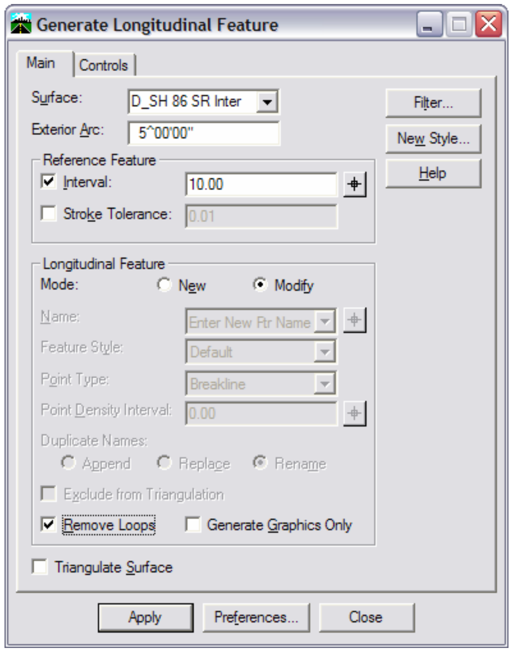


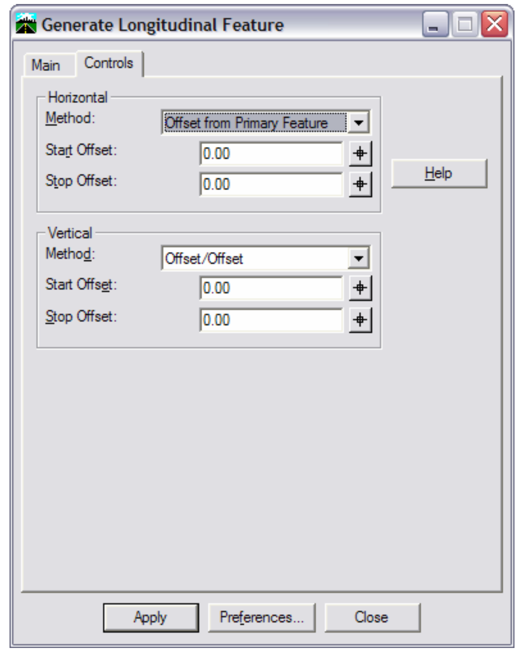
1. This will be easier to see if you turn **Line Styles** off under **Settings > View Attributes** on the MicroStation menu, then select **All**.





2. Select **Surface > Design Surface > Generate Longitudinal Feature**.

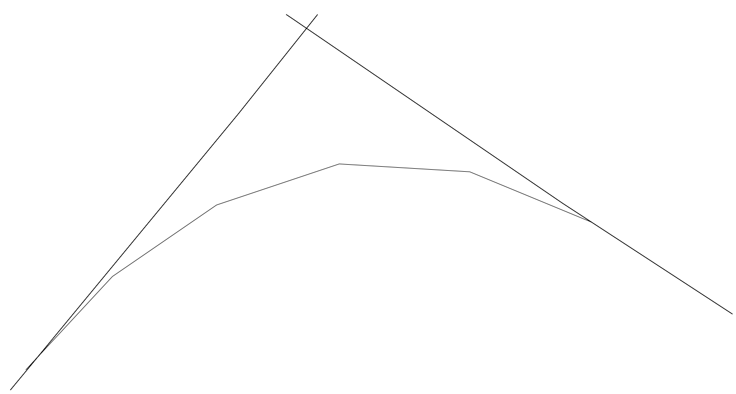




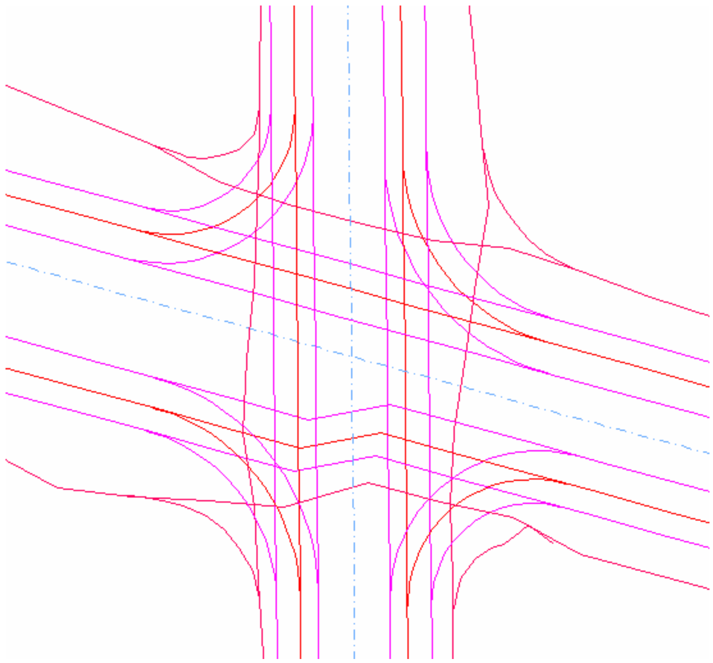
- Set the dialog as shown.

3. **Apply** and follow the prompts to identify the sideslope feature as the primary feature, again as the reference feature and then **<R>** to modify the entire element. Review the changes to the feature.

4. If the feature is acceptable, repeat for the other decision table features. If not, **Apply** the command again to further smooth the feature.



5. **Save** the intersection surface.

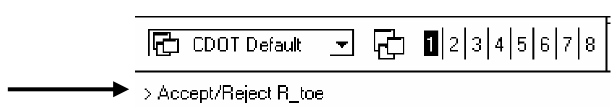


Break the SH 86 toe features

The toe features created by **Roadway Modeler** consist of one continuous feature for both cut and fill on each side of the roadways. In order to join these features into one exterior boundary later, you will break the toe features so they can later be joined all the way around the combined surface.

1. Select **Surface > Edit Surface > Break Feature**.
2. **<D>** on the **SH 86 R_toe** feature to identify it.

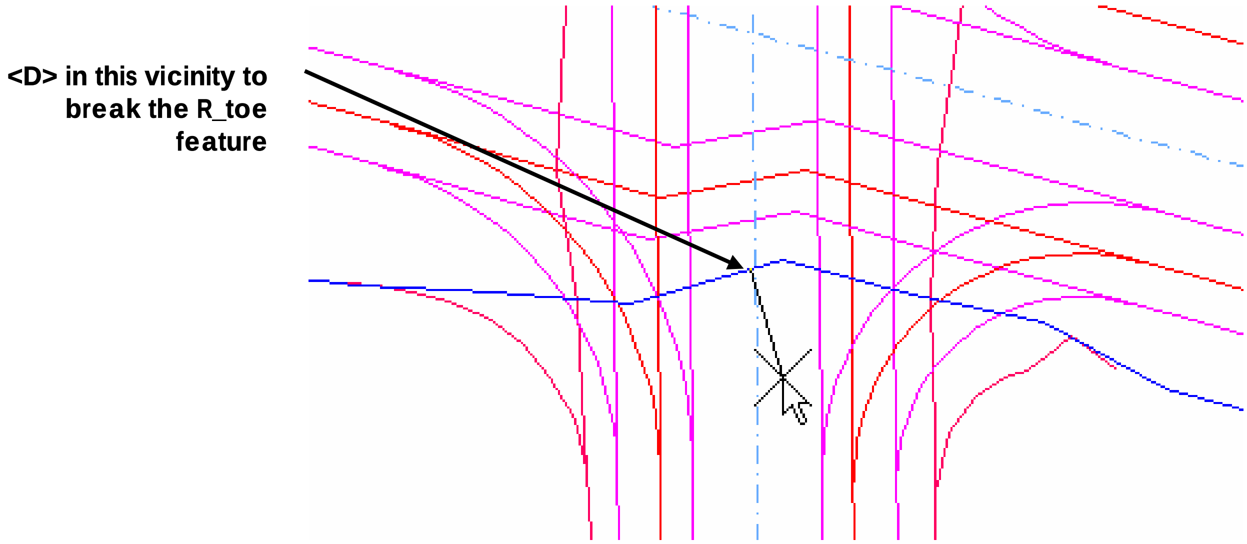
   <u>Note:</u> There are two features at the toe – one for the **RT_Top-of-Cut** and one for the **R_toe.** ***It is important that you choose the*** **R_toe feature** ***as the correct feature to break.*** When you identify the feature, read your prompts to determine which feature you've selected.

   If you select the Top-of-Cut feature first, then **<R>** to select the R_toe feature.

3. **<D>** to Accept the **R_toe** feature. You can now track the feature with your cursor.

4. **<D>** in the middle of the intersection to break the feature.

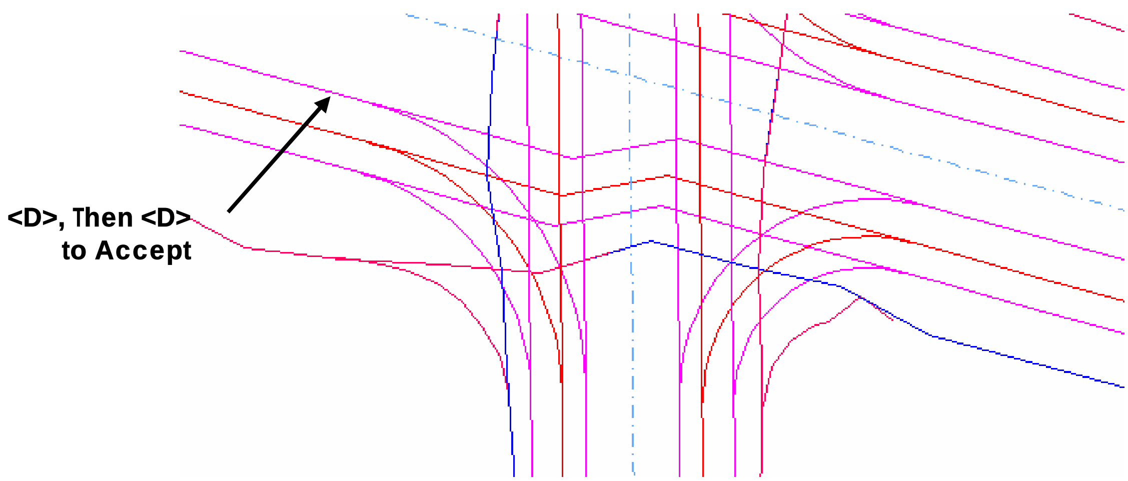


5. Repeat for the other side of SH 86.
6. Repeat for each side of the Side Road.

Partial Delete the features

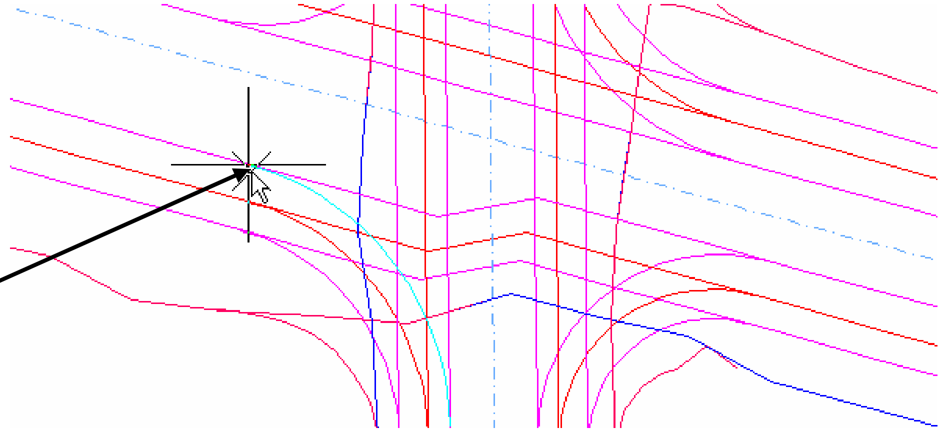
In these steps, you will delete the portion of the features that run through the intersection.

1. Select **Surface > Edit Surface > Partial Delete**.
   - **<D>** on the right shoulder from SH 86. When it highlights, **Accept** with another **<D>** as shown:

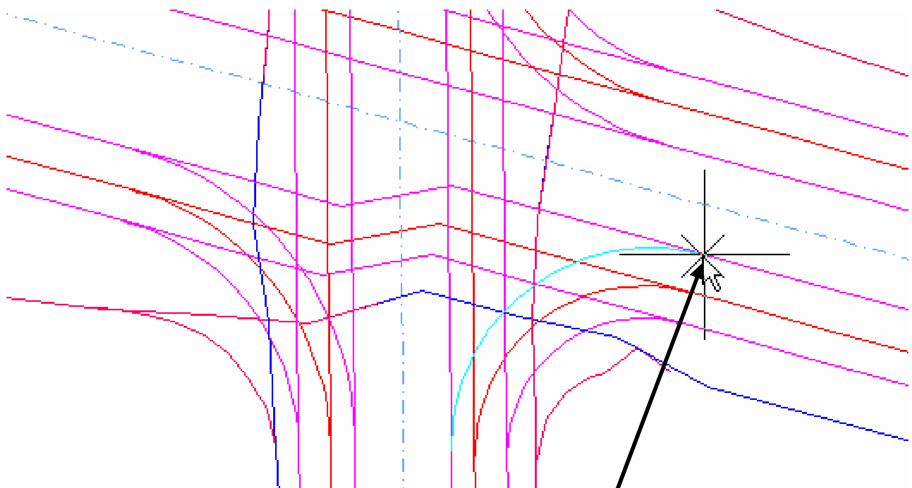


- To identify the Starting Point, **<T>** on the end of the fillet, then **<D>** to Accept as shown: (Be sure to get the very end of the fillet – the fillet will highlight when you **<T>** on it. If you don't get it on the first **<T>**, you can continue to **<T>** and until you do.)

<T>, Then <D> to Accept

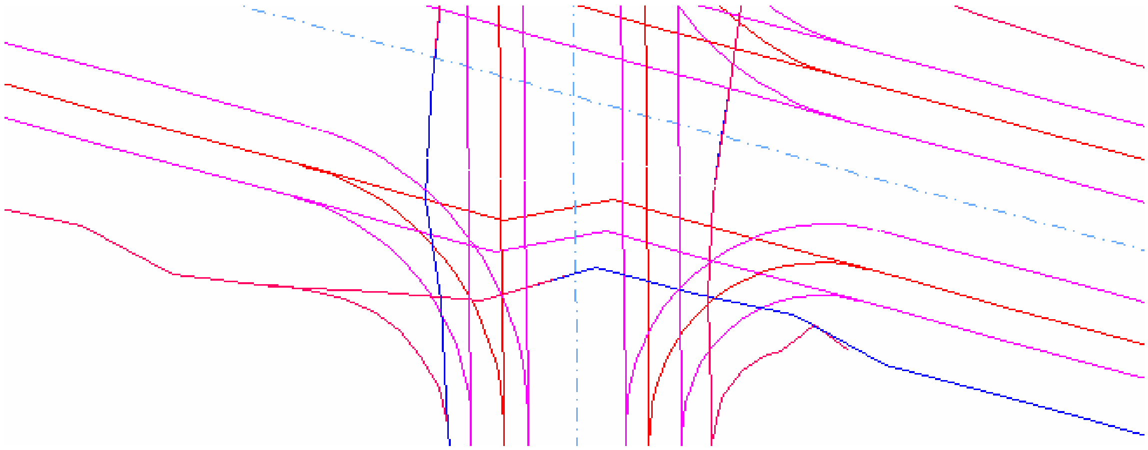


- To identify the Ending Point, **<T>** on the end of the opposite fillet, then **<D>** to Accept as shown:

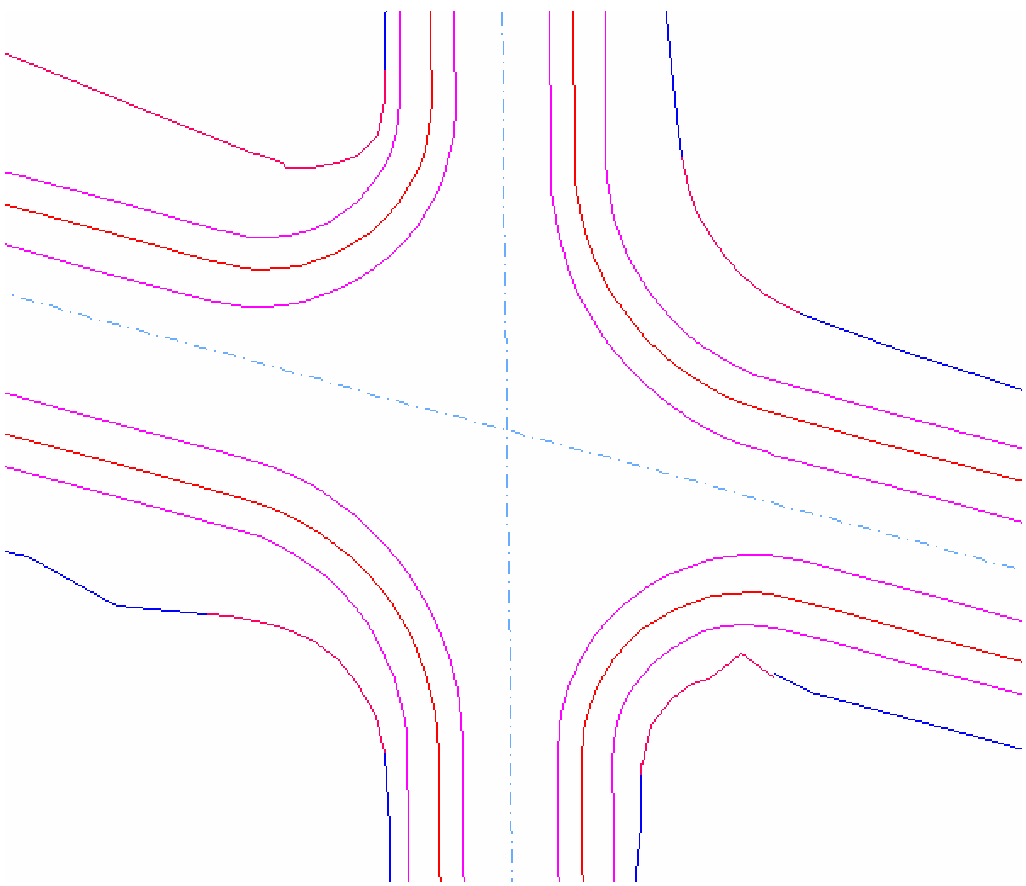


<T>, Then <D> to Accept

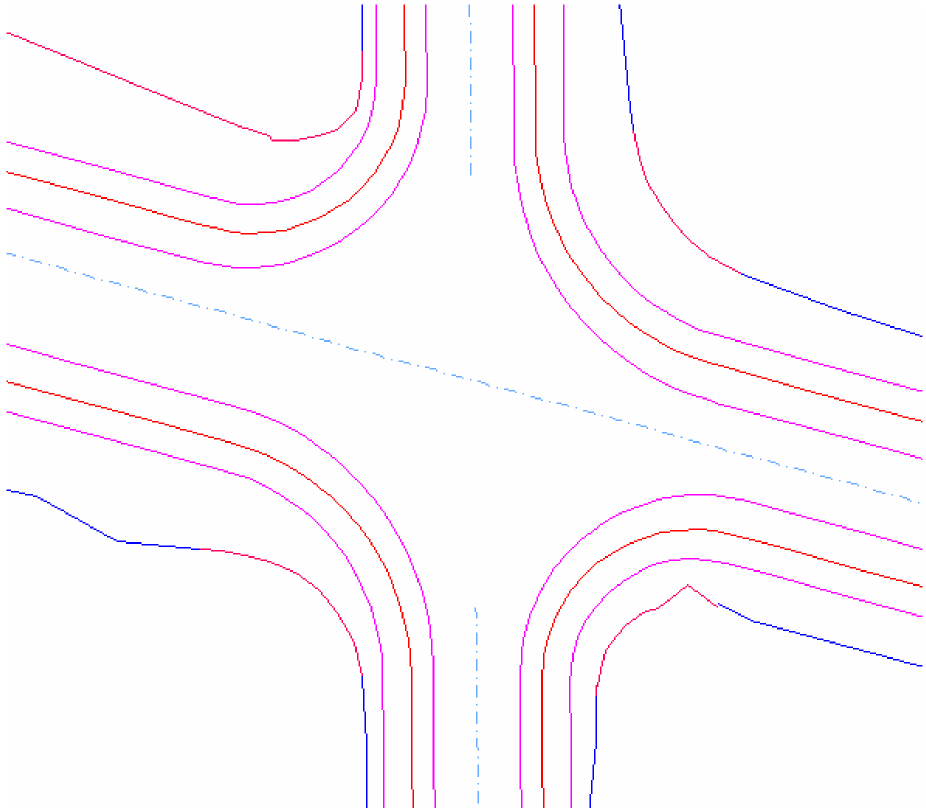
Note the feature is deleted through the middle of the intersection.



2. Repeat for each of the other features in the intersection. Remember that there are two features at each toe – one for the Top-of-Cut or Toe-of-Fill and one for the toe.



3. **Partial Delete** the Centerline of the Side road.



4. **Save** the intersection surface.

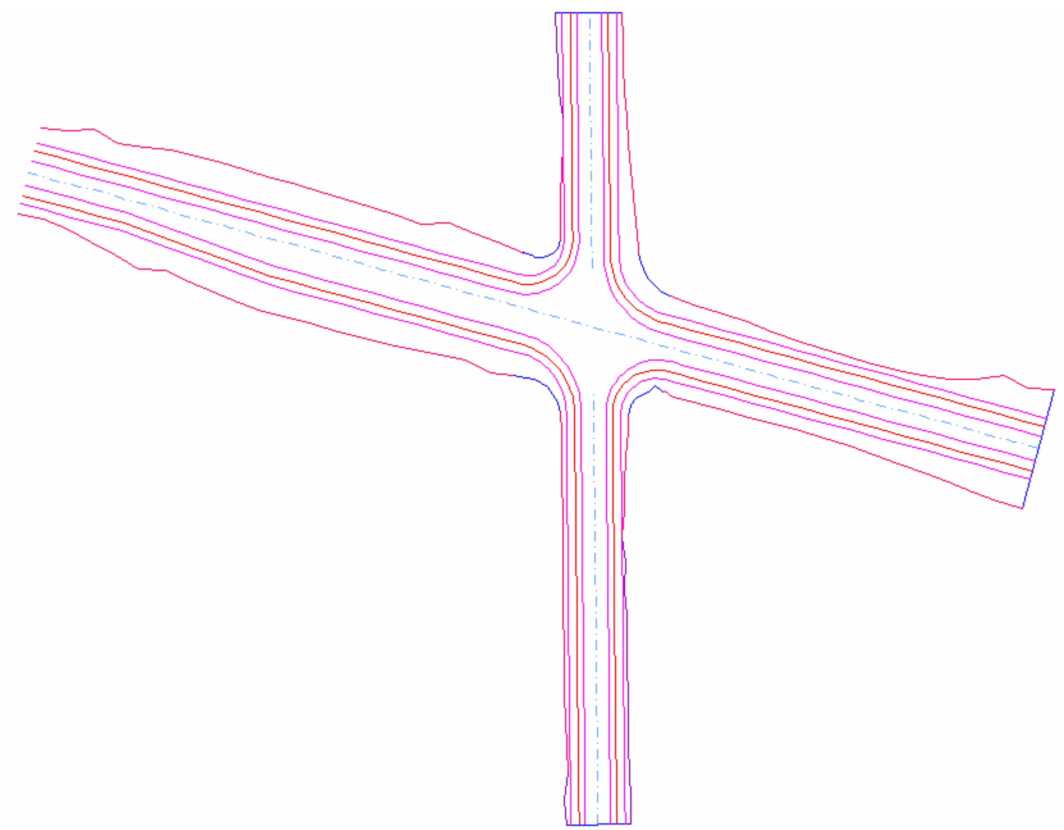
Create an exterior boundary

1. Select **Surface > Edit Surface > Join Features**.

   - Identify and accept the features around the perimeter of the intersection surface in turn. Be certain to identify the new toes of slope created inside the returns when you come to them as you proceed around the perimeter.
     You MUST identify and accept each feature individually. (i.e. you CANNOT accept a feature at the same time you identify the next one.)

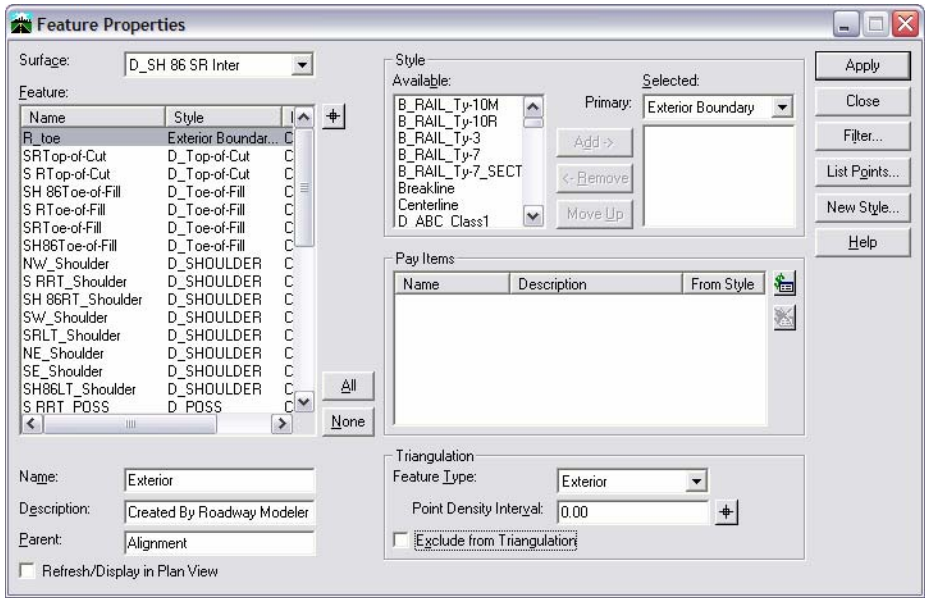
   When you are identifying the features, be certain to choose the L_toe and R_toe features along the roadways and the cut features for the returns. If the wrong one is chosen, **<R>** and it will select the other one.

   You do not have to close the feature; it will be closed automatically when you change it to an **Exterior** point type in the next step.



Change the feature to an exterior

1. Select **Surface > Feature > Feature Properties**.



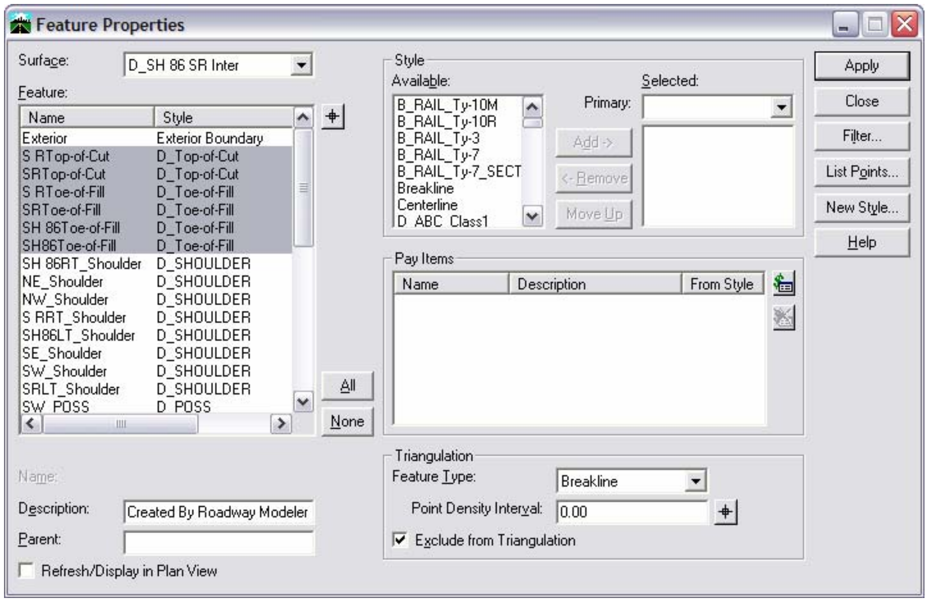
- Highlight the feature that you just created by joining feature around the perimeter. (The name will depend upon which feature you started with when combining them.)

Note: The new feature takes on the name of the feature you started your join command with, so it may not be the same as the dialog shown. Use the target button to graphically identify the feature if you're not sure of the name.

- Change the **Name** to **Exterior**.
- Toggle off **Exclude from Triangulation**.

2. Choose **Apply**.

3. Click on the **Style** heading to sort by **Style**



4. Scroll down and find the D_Toe-of-Fill and D_Top-of-Cut features.

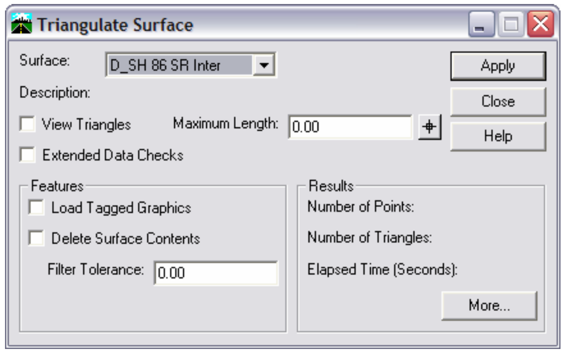
5. Highlight all of them, and toggle on **Exclude from Triangulation**.

6. Choose **Apply**.

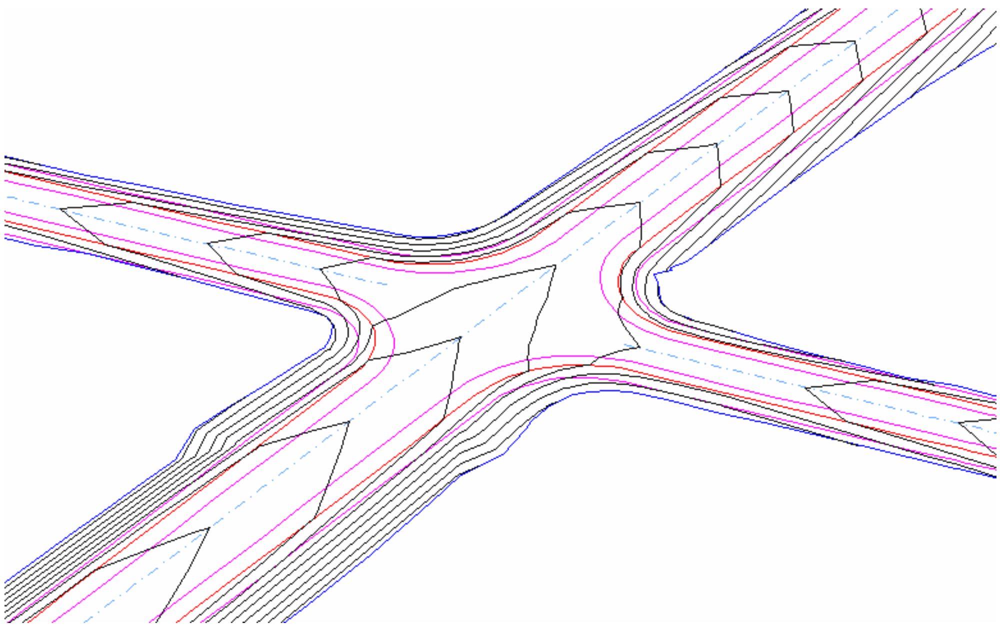
   Since you changed the non-triangulating Toe lines to triangulate, you no longer need these in the triangulation.

7. **Save** the intersection surface.

8. Triangulate the surface using **Surface > Triangulate Surface**.



9. Using what you have learned throughout the class, review the surface using displays, rotating the view, etc.



10. **Save** the intersection surface.

11. **Exit** MicroStation and InRoads.

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