

Working With
InRoads SelectCAD

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Introducing InRoads SelectCAD

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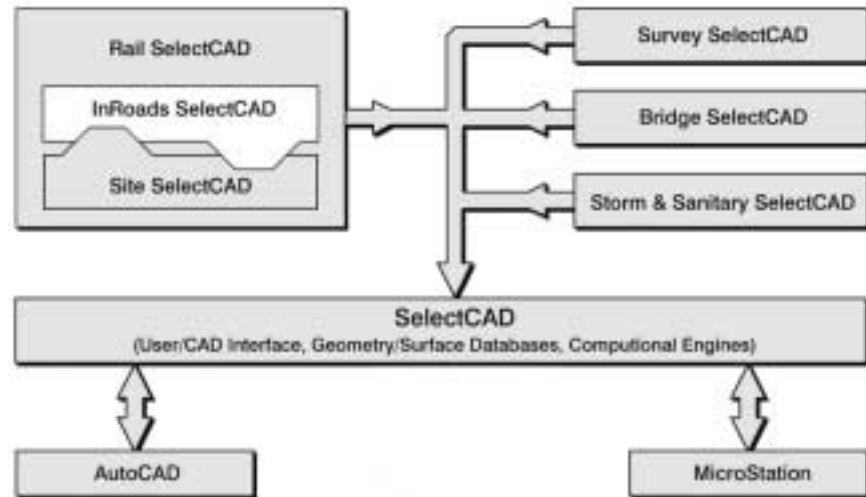
Welcome to InRoads SelectCAD®! The latest in transportation engineering software by Bentley Systems, InRoads SelectCAD is a one-stop solution for transportation engineers and civilworks professionals. InRoads SelectCAD provides a comprehensive set of tools for transportation system design, civil and site engineering for roadways, highways, waterways, and airports. Developed using the familiar Microsoft® Windows standards, InRoads SelectCAD runs on the Microsoft Windows NT®, Windows® 98/ME and Windows® 2000 operating systems.

InRoads SelectCAD lets you work in a graphic environment to create a 3-D digital surface, create horizontal and vertical alignments, cut profiles, define template criteria and roadway conditions, generate cross-sections and 3-D model, calculate volumes, generate reports, evaluate the design, and create plan and profile sheets. These extensive features, along with additional application add-in tools, make designing a complex highway system or simply laying out a small subdivision an interactive and easy process.

With InRoads SelectCAD, you can continue using the computer-aided design (CAD) platform with which you are familiar. When starting the product, you can select AutoCAD® 2000i or Release 14, or MicroStation® SE/J, as your CAD engine. This SelectCAD environment is a hallmark feature of civil engineering solutions by Bentley Systems.

InRoads and the SelectCAD Product Suite

InRoads SelectCAD is a member of the SelectCAD product suite.



In fact, the SelectCAD product suite includes six civil engineering products:

- ❑ InRoads SelectCAD provides complete solutions from field to design to construction for the transportation professional.
- ❑ Site SelectCAD provides site design and digital terrain modeling, lot layout, and geometry for civil-works, environmental, and site-development projects. Site SelectCAD is a subset of InRoads SelectCAD
- ❑ Rail SelectCAD provides advanced production tools for track layout and railway design.
- ❑ Survey SelectCAD helps surveyors transfer electronic field book data into the graphics environment.
- ❑ Bridge SelectCAD helps bridge design professionals define geometry and model complex, continuous-span bridges or simple span bridges.
- ❑ Storm and Sanitary SelectCAD is the first software to offer an integrated package for storm water and sanitary sewer design, combining the power of CAD with proven analytical tools and enhanced interactive graphics.

InRoads SelectCAD Version 8.2: What's New?

1

InRoads SelectCAD, Version 8.2 offers several new commands and enhanced features:

- **SelectCAD Workspace Explorer.** This enhanced organization and display feature allows new ways to interact with project data. Tabs allow you to display a view of specific SelectCAD objects within the overall project. Views correspond to sub-trees within the Explorer. For example, click the **Surfaces** tab to display only surface data within the project. You can “tear away” the view and the Workspace bar containing the sub-tree can be docked at any location on the screen for easy access. InRoads provides the following predefined views: **Surfaces, Geometry, Typical Sections, Roadways, and Preferences.** See *Chapter 3, Using InRoads SelectCAD* for more details.
- **Evaluation.** Cross sections are specified as a set, by name (defaults to the active horizontal alignment name). The **Rename Set** command allows you to modify set names. You can now create cross sections with an unlimited number of surfaces, and symbology is always taken from the surface. Slope length is now available for the **Annotate Cross Section** command. **Label Points** (for offset and elevation), **Label Segments** (for slope, slope length, horizontal width and vertical depth) are new commands and **Cross Section Editor** has been modified.

Profiles function similar to cross sections with named sets, unlimited surfaces, and with features included when the profile is created. They utilize **Symbology Manager** and **Feature Style Manager** to govern symbology and feature styles. There are enhancements to **Surface Properties** and **Offsets** (16 per surface and stored in the DTM). The new **Update Profile** command allows you to update/refresh/turn on or off a profile elements during the design process. The new **Annotate Feature in Profile** command allows for annotating points and line segments. Profiles also include new **Label Points** and **Label Segments** commands.

Plan and Profile Generator now includes **Match Lines.**

- **Modeler.** Reserved transition control names can now be renamed. Transition control items can be multi-deleted. Transition control tab items can be sorted. The internal names of the roadway library (.rwl) and the typical section library (.tml) can now be renamed. Features can be used as targets in a

decision table. Superelevation pivot points can now be offset vertically from a design layer. Modeler now automatically sets the surface properties for plan, profile, and cross section symbology to the surface name.

- ❑ **Geometry.** Updates to geometry include changes in the Explorer with integrity checks and the inclusion of parabolic to vertical circle feature. Enhancements to commands include **Edit Horizontal Event Points**, **Edit Horizontal Element** (to maintain connectivity), and **Copy Horizontal Element** (paralleling option). Similar changes also appear in the **Edit Vertical** commands.

The new **View Curve Set** command allows for annotating horizontal curve sets. The new **View Station Base/Clearance** command allows for annotating station and offsets. The new **Vertical Change in Plan** command allows for annotating vertical geometry in plan view.

- ❑ **Advanced Geometry.** The new **Horizontal Regression** and **Vertical Regression** commands allow for advanced mathematical computations. Regression points can be added from multiple sources. Advanced analysis (single or multi-element regression) can be performed utilizing data ordering, curvature, and slew diagrams

Experienced users will continue to find advanced programming features such as the **Run Macro** command that allows software customization for specialized environments.

About Your Documentation

To assist the beginning and advanced user, InRoads SelectCAD provides two complementary forms of documentation. The software kit includes:

- ❑ *Working With InRoads SelectCAD.* Delivered as Adobe® Acrobat® Portable Document Format (PDF) files, this introductory document contains information on getting started, common design workflows, and a tutorial and sample data set that provides step-by-step instructions for learning how to create a new road.
- ❑ *SelectCAD Help Topics.* This comprehensive online reference material consists of help topics that detail each command and dialog box parameter within the product.

Product Training: Learn It Your Way

1

In addition to the documentation provided with your software, Bentley Systems Civil Engineering provides various levels and forms of product training.

Bentley Systems Facility Training

Standard courses are offered at various times throughout the year. You can also schedule a custom class to be held at any Bentley Systems facility that offers a training center. For training facility information or a complete listing of training courses, visit the Bentley Systems website at [Standard civil courses include:](#)

- Road Design Basics
- InRoads Basics
- InRoads Survey
- InRoads SelectCAD
- Site SelectCAD
- Storm & Sanitary SelectCAD
- Survey SelectCAD
- Bridge SelectCAD

On-Site Training

On-site training can consist of the standard course offerings on SelectCAD civil engineering products or customized training. You are allowed up to 12 students in an on-site training course.

Customized Training Courses

Customized training courses are available for customers whose training requirements exceed our standard offerings. You determine the content of the course based on your requirements. You can use your data and specific workflow - utilizing our industry experts to help meet production and design deliverables. Customized training is offered at an Bentley Systems facility, at your site, or by Long Distance Learning (LDL).

Long Distance Learning

LDL is a combination of state-of-the-art technology with specialized workflow training. Developed by product experts, LDL utilizes the World Wide Web to communicate in a “give and take” classroom environment. These training sessions are inexpensive - no travel is required because it

can be done from your desktop or local conference room. Use your specific data and workflow with an unlimited number of students in attendance at your location. The sessions are available in 2-hour increments.

For more information on civil product training, 1-877-705-7471 ext. 5422. Also, see *Appendix A, How To Reach Bentley Systems* for more information.

Typeface Conventions Used in InRoads SelectCAD Documentation

1

ALL CAPS	<p>Keyboard keys</p> <p>If keys are separated by a comma, press them in sequence. For example: ALT,F5. If they are joined by a plus sign, press them at the same time.</p> <p>For example: CTRL+z.</p>
Bold Unserifed Type	<p>An item in the graphical interface, such as the title of a dialog box or a tool. Paths through menus use right angle brackets between items you click.</p> <p>For example: Click File > Open to load a file.</p>
Courier Type	<p>Information you type.</p> <p>For example: Type <code>breaklines.dat</code> in the dialog box field.</p>
<i>Italic type</i>	<p>A document or section title, the first occurrence of a new or special term, directory and file names, or information about what the software is doing.</p> <p>For example: The <i>civil.ini</i> file contains preference settings.</p>

What You Need to Know Before Working with InRoads SelectCAD

While InRoads SelectCAD is a comprehensive design package, it is also an intuitive product in which a new user could become productive in a short time with some assistance. The documentation and tutorial in InRoads SelectCAD assume that you have:

- ❑ A basic understanding of the computer operating system
- ❑ The ability to move around in the Windows environment
- ❑ Working understanding of your CAD system
- ❑ General knowledge of engineering concepts and terms

2

Getting Started

InRoads SelectCAD can be installed on Intel-based hardware using the Windows 2000, Windows 98/ME, or Windows NT 4.0 (Service Packs 4 and 5), operating system. The following instructions assume that you have already installed one of these operating systems on your machine. You must also have installed CAD software on your machine. InRoads SelectCAD will run on AutoCAD 2000/Map 2000/Release 14, and MicroStation SE/J. See the *CAD Package Requirements* section that matches your operating system for a list of software tools.

2

In Windows 2000, Windows NT 4.0, and Windows 98/ME

This section details what you need to efficiently run InRoads SelectCAD.

CAD Package Requirements

- CAD software (one of the following): AutoCAD, version 2000i, Map 2000 or Release 14, Patch E; MicroStation, Version SE or J.
- Pentium 200 Mhz minimum, 400 Mhz or more recommended
- 64MB RAM minimum, 128MB or more recommended
- 150MB disk space minimum, 200MB or more recommended
- VGA or better
- Access to a CD-ROM drive
- Mouse or compatible digitizer for input
- Compatible plotter or printer for output (optional)

Downloading from the CD

Prior to installing InRoads SelectCAD, make sure you have exited all other civil engineering software. In Windows 2000, the setup program automatically starts when the CD is loaded. If Autoplay is not enabled on your system, follow the steps below.

1. Insert the CD in your CD-ROM drive.
2. From the Start menu, click **Run**.

3. In the **Run** dialog box, type `d:\install.html`, where `d:` is the letter assigned to your CD-ROM drive.
4. Click **OK** and follow the instructions on the screen.

Downloading Across the Network

If you are downloading InRoads SelectCAD across a local area network, mount the shared network CD drive and double-click on *install.html* from the SelectCAD Explorer or File Manager. Or, navigate to the product directory and run *Setup.exe*.

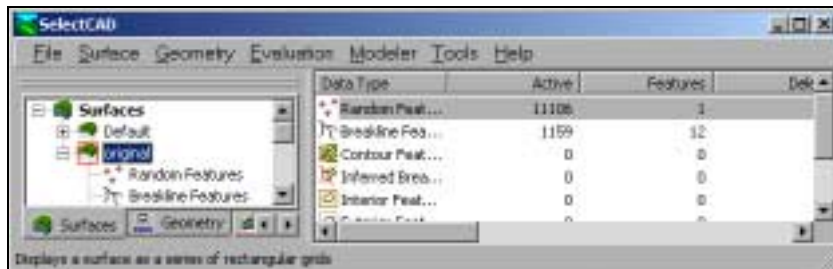
Starting InRoads SelectCAD

Once you have successfully downloaded the software, you are ready to start the product.

1. From the **Start** menu, click **Start > Programs > Bentley Civil Engineering > InRoads SelectCAD**.
2. MicroStation users must first select a design file. Navigate to a design file or demonstration directory and select a file or create a new one.

AutoCAD automatically opens with a default drawing file at startup.

The InRoads SelectCAD menu is displayed in the SelectCAD Explorer.



You have successfully installed InRoads SelectCAD, selected your CAD platform, and opened a drawing/design file.

Exiting InRoads SelectCAD

To exit InRoads SelectCAD and leave the CAD software running, select **File > Exit** from the InRoads SelectCAD menu.

To exit InRoads SelectCAD and the CAD software, select **File > Exit** from the CAD main menu. If you exit the CAD software *prior* to exiting

InRoads SelectCAD, the product will also exit. You are prompted to save any open files.

3

Using InRoads SelectCAD

An Overview

From project definition to plan and profile sheet creation, InRoads SelectCAD provides the tools you need to create highways, roads, and other construction and transportation engineering projects. In addition, several add-in applications are available to assist you in completing specific civil engineering production tasks. The advanced programming tools offer ways to customize your work environment to accomplish unique tasks or meet customer deliverables.

Starting with geometric, alignment, and surface point data, you can do the following:

1. Graphically represent the base map ground surface, topographic features, and property boundaries. Display and analyze surface contours, slope vectors and other terrain data.
2. Review existing or legacy plans to identify new controls. Through an iterative process, generate preliminary plan sheets, create new horizontal and vertical alignments, specify roadway template criteria, cut/fill conditions and roadway definitions. You can also compute volumes, check the design and generate reports.
3. Generate a 3-D model of the design. Generate cross-sections, compute triangle volumes, calculate end-area volumes, make modifications, and redesign as needed to meet specifications.
4. Prepare and plot plan and profile drawings. Generate final reports for production requirements or customer deliverables.

The results of your project can be stored for future use and integrated with other Bentley Systems civil engineering and GIS industry solutions.

Basic Concepts in InRoads SelectCAD

There are a few concepts to review prior to using InRoads SelectCAD, version 8.2. Some of these concepts are tools that provide more flexibility in the way you work, such as customized toolbars. Others are simply ways of thinking about features, preferences and symbology: how they interact with each other and how they function within the DTM. The next several topics discuss basic concepts in InRoads SelectCAD.

Digital Terrain Model

A computerized model of a 3-D ground surface is a visual representation of triangle and point data. This data, in x,y,z numerical coordinates, defines the *Digital Terrain Model (DTM)*, also commonly referred to as a *surface*.



In InRoads SelectCAD version 8.2, the DTM remains an integral and important part of your project. Feature data resides in the DTM and profiles, cross-sections, volumes and other design analysis and computations are performed on the data in the DTM. This functionality allows you to place features, execute commands, view surface properties, make design modifications all in the design surface. The DTM requires fewer interactions with graphical menus and dialog boxes while expanding the function and definition of the traditional design feature.

Types of DTM Display

In the InRoads SelectCAD project, surface representation and features can be displayed in three different *views* or modes: 3-D Planimetric, Profile, and Cross Section.

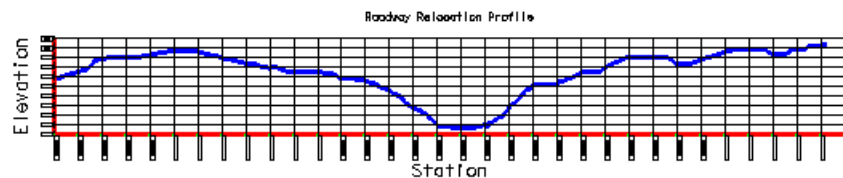
- 3-D planimetric view, commonly referred to as *plan*, is a top-level aerial view of the entire surface.



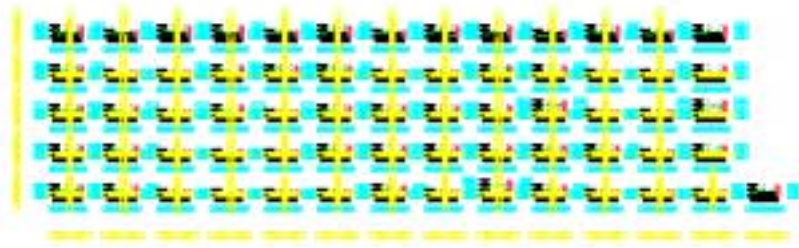
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This view allows you to see any of the point types (random, breakline, contour, and so on) in the digital terrain model.

- Profile is an extracted side view of the vertical elevation of a surface along an entire active horizontal alignment (or just a portion of it). A legend, correlating surface line symbology, surface name and the scale used on the profile, can also be displayed.



- Cross Section is a portion of the roadway model at a specified location. Displayed in individual graphic windows, each section shows surface configurations perpendicular or at a skew angle to a linear feature, such as the horizontal alignment (often the centerline of the roadway). Cross sections differ from profiles in that they show detailed sections of the surfaces, from one station to the next transverse to an alignment; profiles show surface elevations longitudinally along an entire alignment.



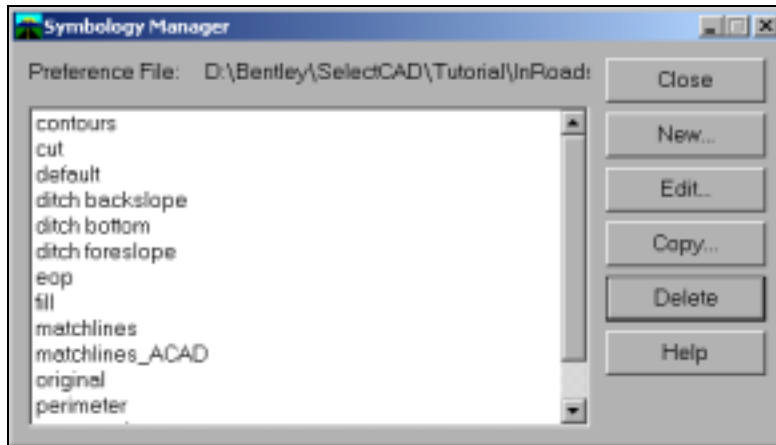
Together, these display modes allow you to view, evaluate, and design your project from various important perspectives. Objects in the DTM can be represented in one view or all of these views.

Symbology

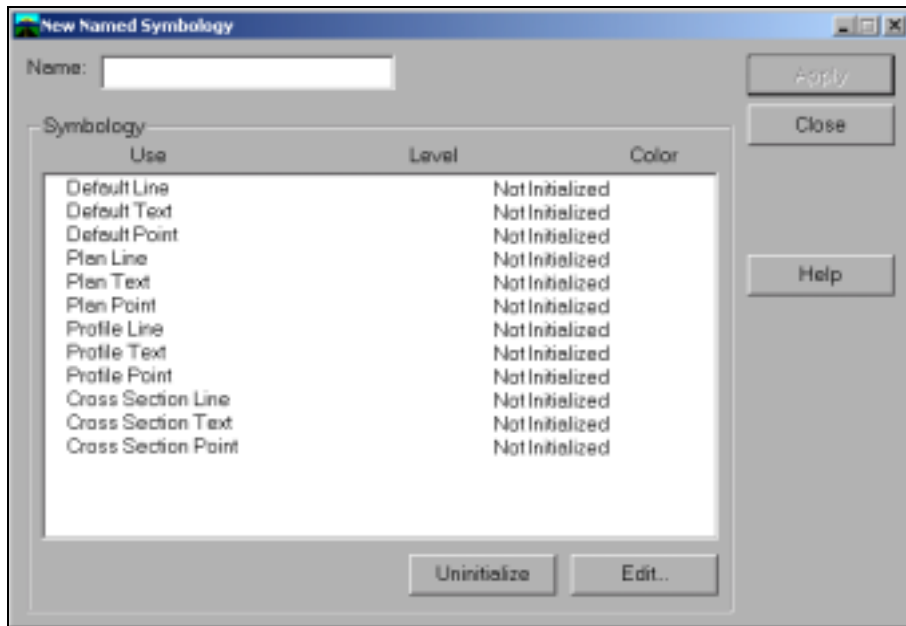
Symbology (line style, weight, color and so on) can be defined for any surface object or feature. Uniquely specifying symbology for objects or features allows for quick identification within the model as well as uniformity across the project. In InRoads SelectCAD, symbology can be set in two ways: *named symbology* using the **Symbology Manager** and basic command-level symbology.

Named Symbology with Symbology Manager

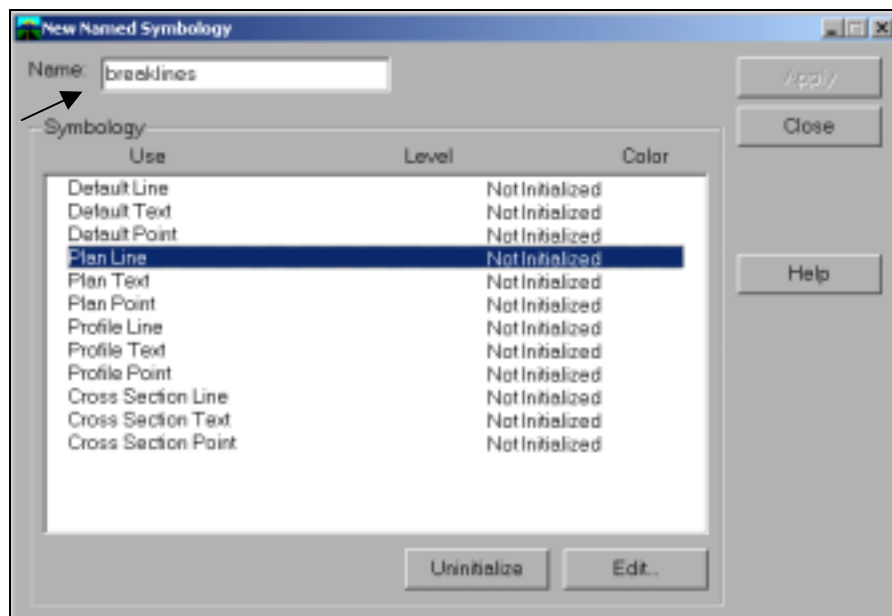
The **Tools > Symbology Manager** allows you to define and name symbology settings for surface objects and features. These settings, along with many other preference settings, are stored in the *civil.ini* preference file. This customizable file contains basic default settings, including predefined symbology, and is delivered when you install InRoads SelectCAD. These predefined symbology settings are displayed when you access **Symbology Manager**.



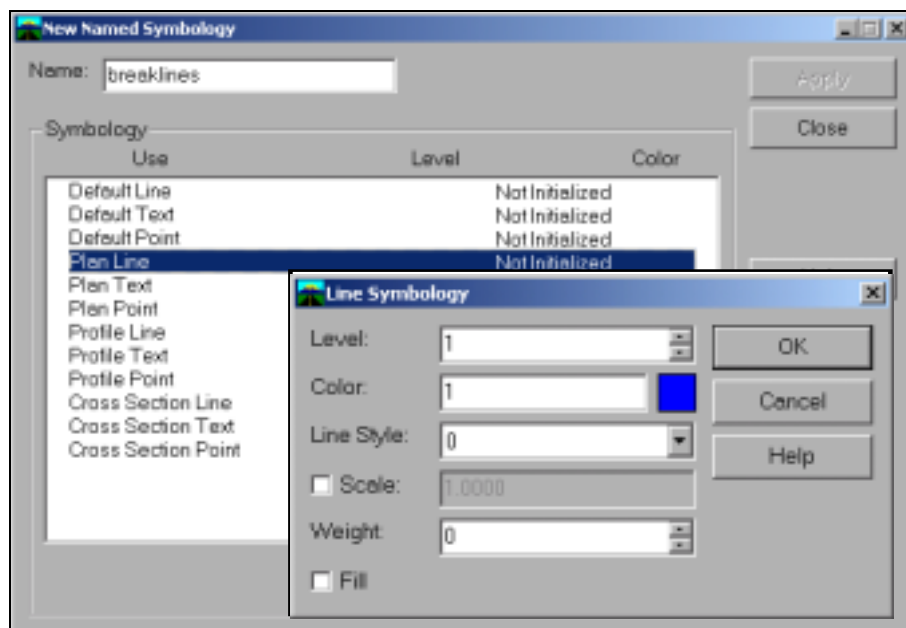
By clicking **New**, you can define additional symbology.



New symbology is first given a *name*. Providing a name allows you to associate the symbology with a feature or object and later reference the symbology by this name.

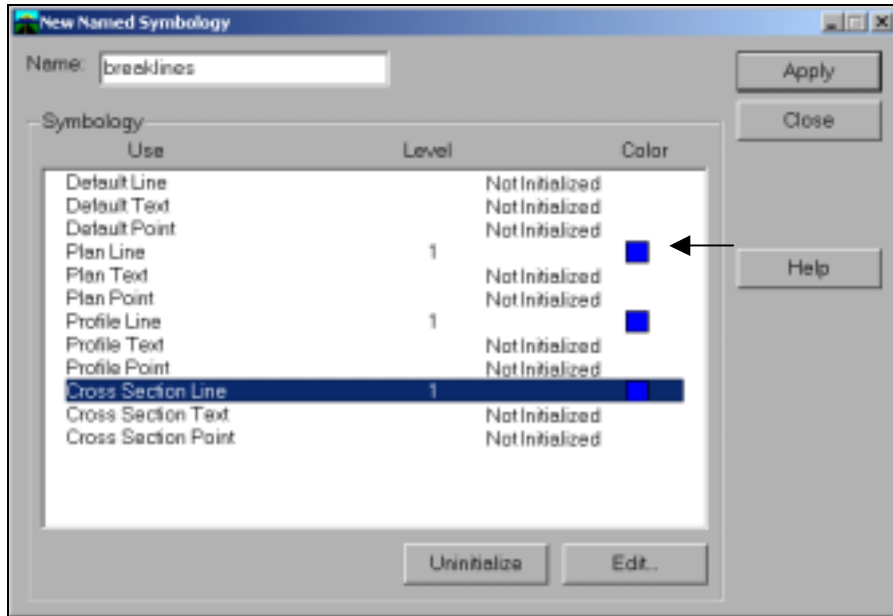


By double-clicking on an item or selecting the item and clicking the **Edit** button, you can set symbology for lines, text, and points in one or all three of the views.



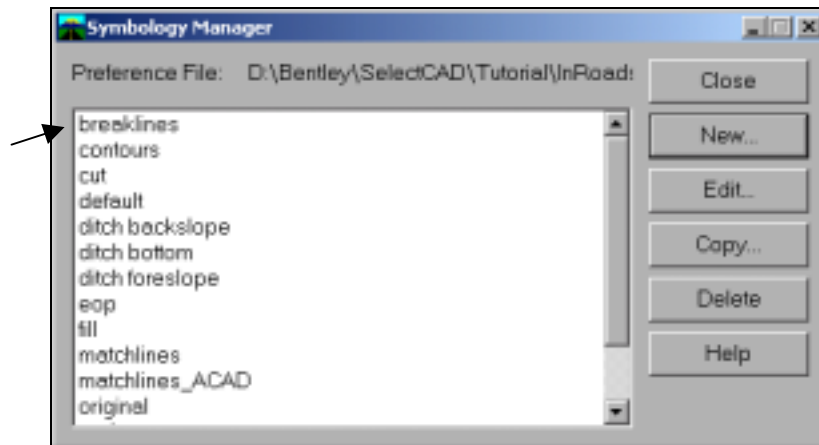
Once you have defined symbology for more than one representation (line, point or text) or for more than one view (plan, profile or cross section),

you actually have a *set* of symbology. In **Symbology Manager**, you create named symbology sets.



3

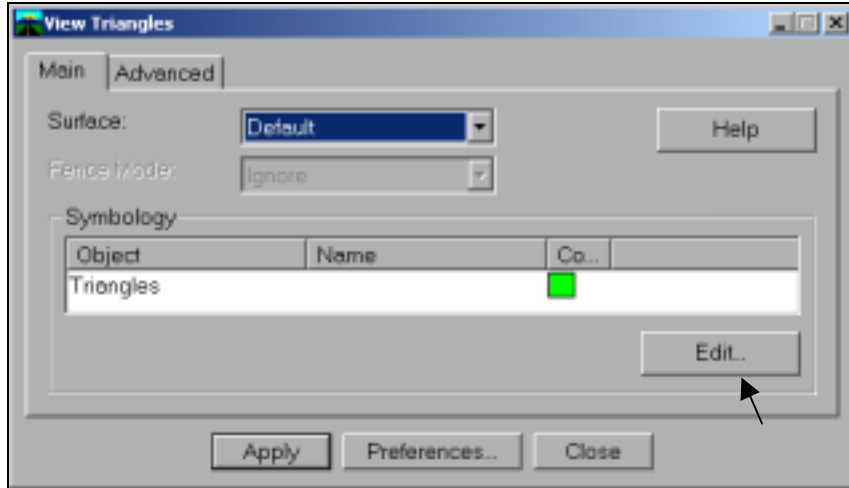
Defined symbology is considered *initialized* after you click **OK**. *Default* symbology applies when specific symbology for Plan, Profile or Cross Section is not defined. If default symbology is not defined, the system settings delivered with InRoads SelectCAD will apply.



Named symbology can only be created and modified using the **Symbology Manager** command.

Command-level Symbology

While InRoads SelectCAD provides the opportunity to name symbology, you are not required to do so. You may continue to select local symbology at anytime during the project using the **Edit** button that appears on most dialog boxes. For example, **Surface > View Surface**.



Once you have selected symbology for a specific command, the settings can be saved to a preferences file for future use.

Features in the DTM

In InRoads SelectCAD, features are key to the design process. A *feature*, is a unique instance of an item or 3-D entity that is represented in the DTM by lines, points, or text. A *line* is actually a linear segment. *Points* can be represented as symbols or cells. Annotation is considered *text*. The following are examples of common road design features:

- A single random point
- A single interior boundary
- A flowline
- A single curb line
- A single utility (pipe, pole, manhole)
- A collection of utilities (poles, manholes)

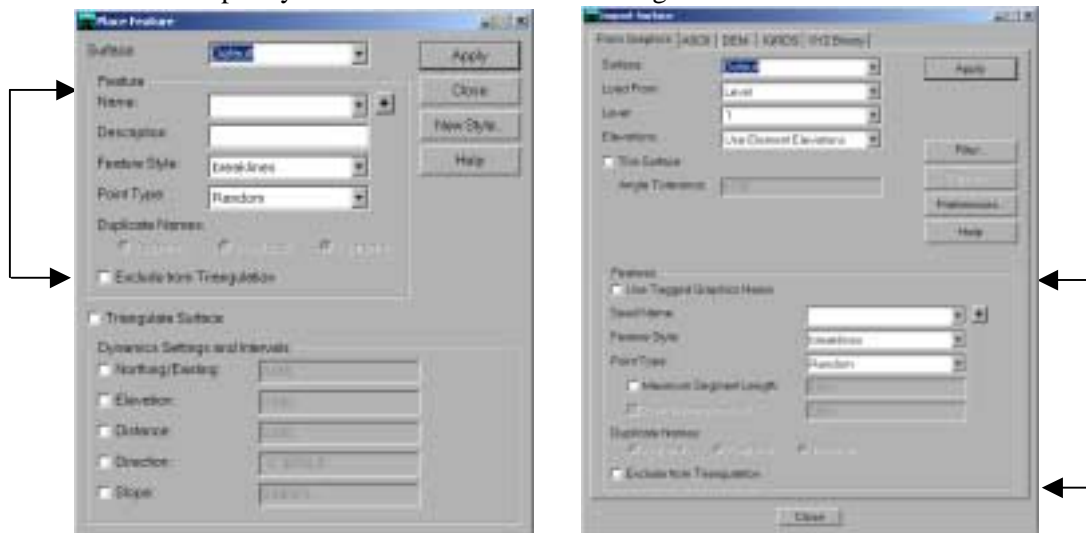
A feature then is any single component that is part of the DTM. Further, for features such as random points, you can store more than one random point feature type in a DTM. This flexibility allows you to control the

display of the random points in the surface separately from other features, such as manholes.

In InRoads SelectCAD version 8.2, features can be created or imported into the DTM with a level of “intelligence”; that is, they know *what* they are and *how* they are to display.

Intelligent Features

Whether you begin your design by using **Surface > Design Surface > Place Feature** or **File > Import > Surface**, you can indicate what a feature is before it becomes a part of the active surface. You can provide a feature name and description, select a feature style, indicate the point type, and specify whether or not it is to be triangulated.



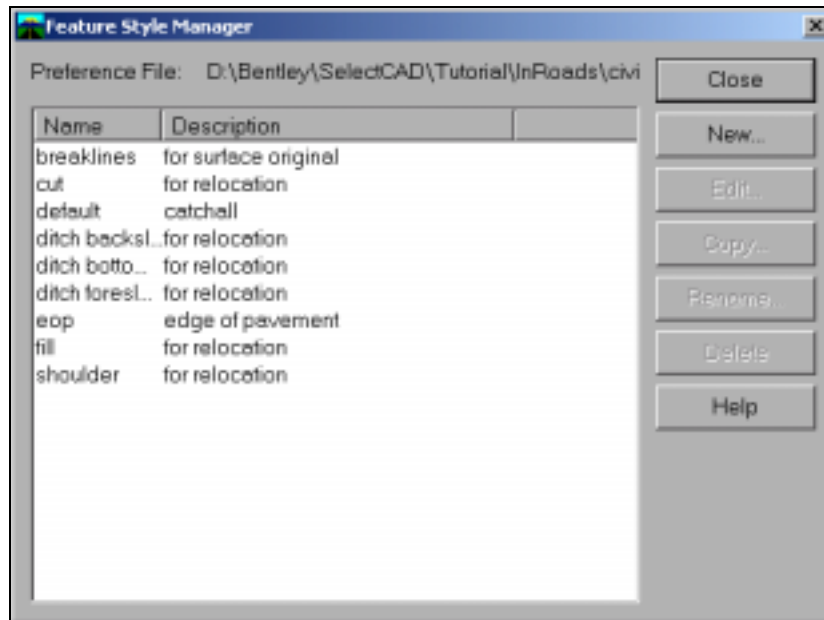
All of this information is associated with the feature and available for quick reference once it becomes a part of the surface.

The key to working with features in the surface is determining how the features will display. *How* a feature is represented and *where* it displays can be specified by a *style*. Feature styles are created and organized by the **Feature Style Manager**.

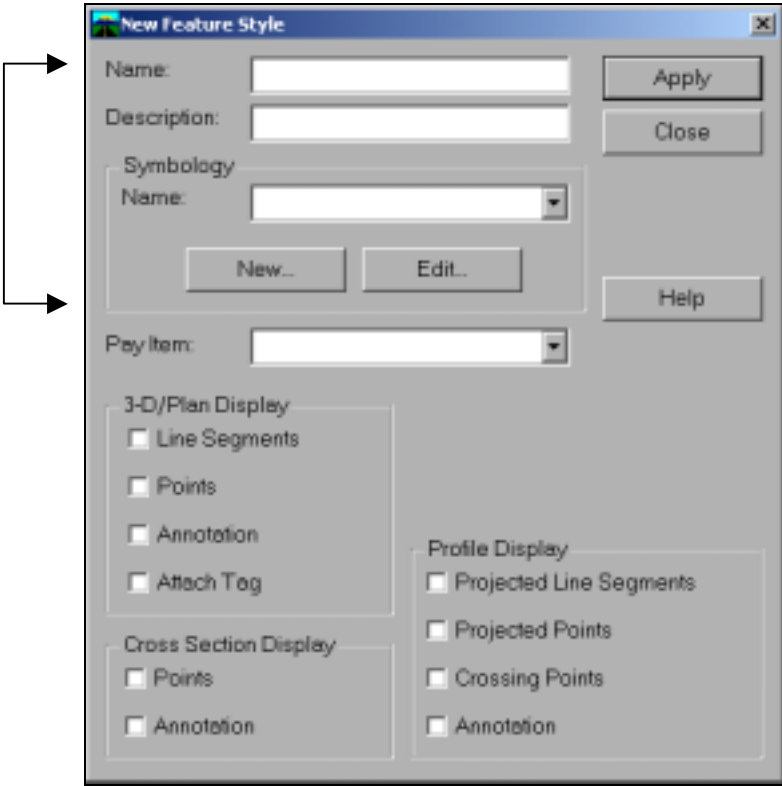
Feature Styles with Feature Style Manager

A style uniquely defines how a feature is represented and determines the symbology for its display. Once defined, the style is *one-to-many*; meaning any one style can be used to display many features. For example, a feature style for *centerline* could be used for both the roadway centerline as well as for any other secondary road centerline.

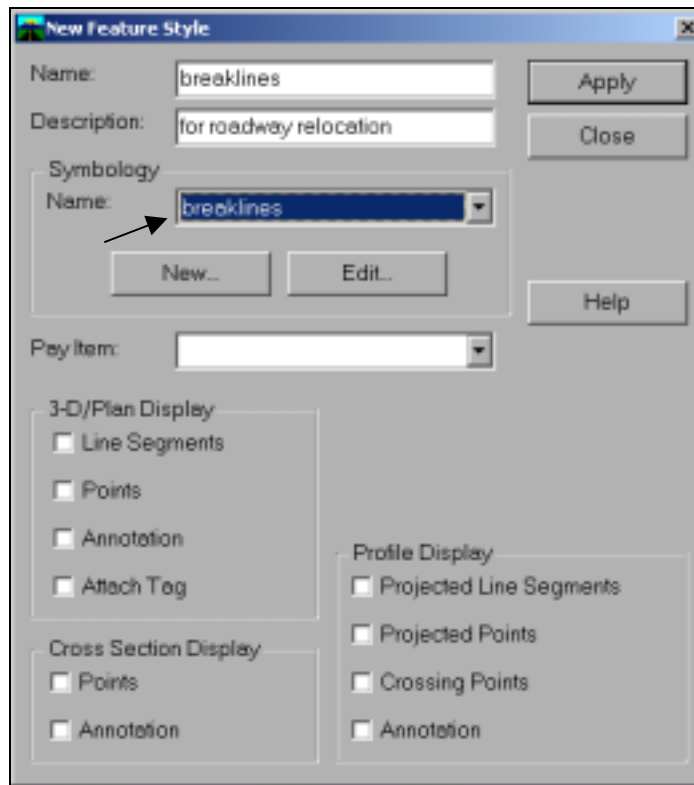
When you select **Tools > Feature Style Manager**, any predefined styles currently in the *civil.ini* preference file are displayed.



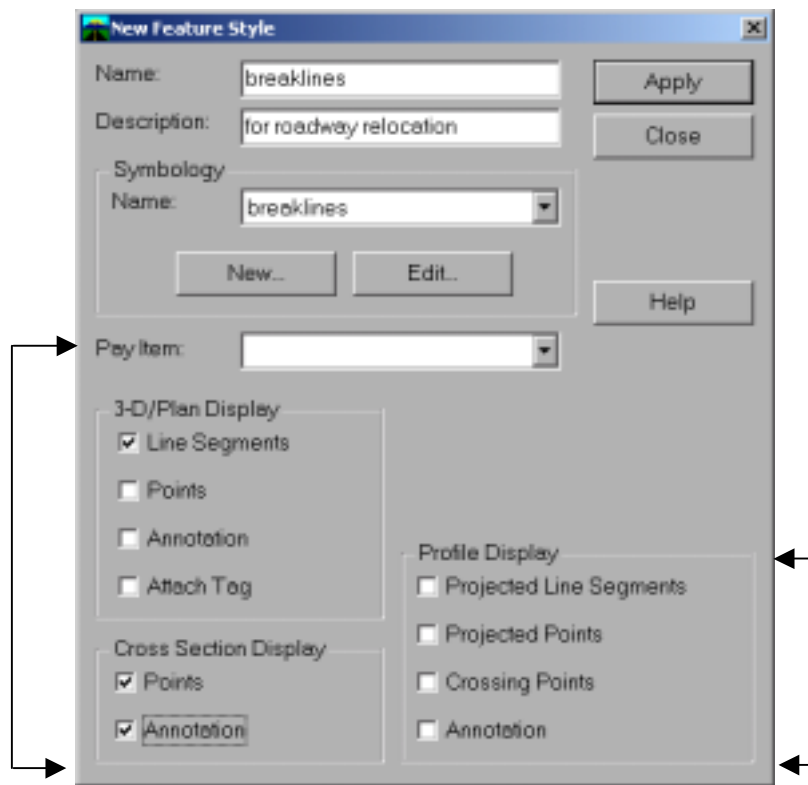
Click **New** to create additional styles.



A feature style includes a unique name, description (optional) and named symbology. Here, you can choose a named symbology that was predefined for this feature style; modify an existing named symbology and rename it; or create a new one.

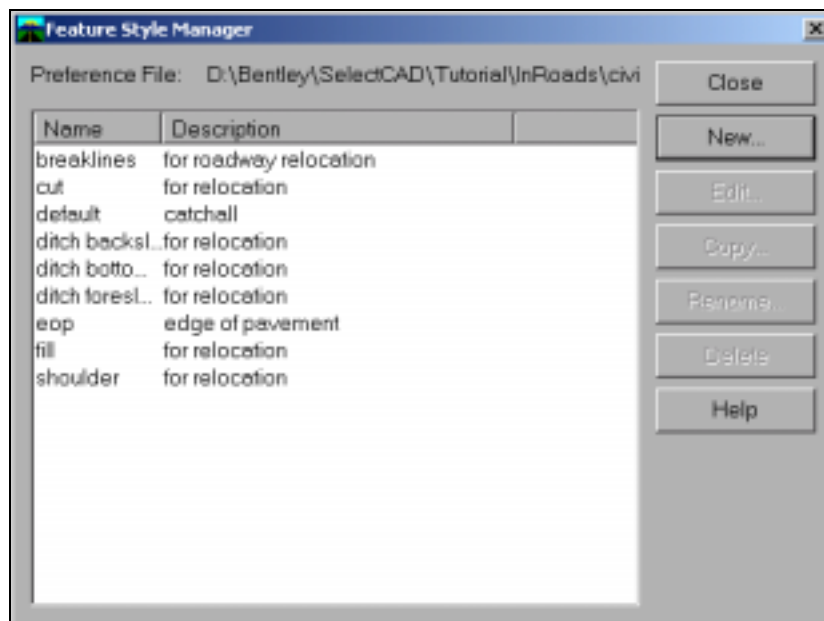


Optionally, you can type more details about the feature style in the Pay Item field and specify how the feature is to be represented in the graphic view (as a line segment, point, annotation or attached tag). For example, to see the features using this style displayed in cross section, turn on **Points** in the **Cross Section Display** section.

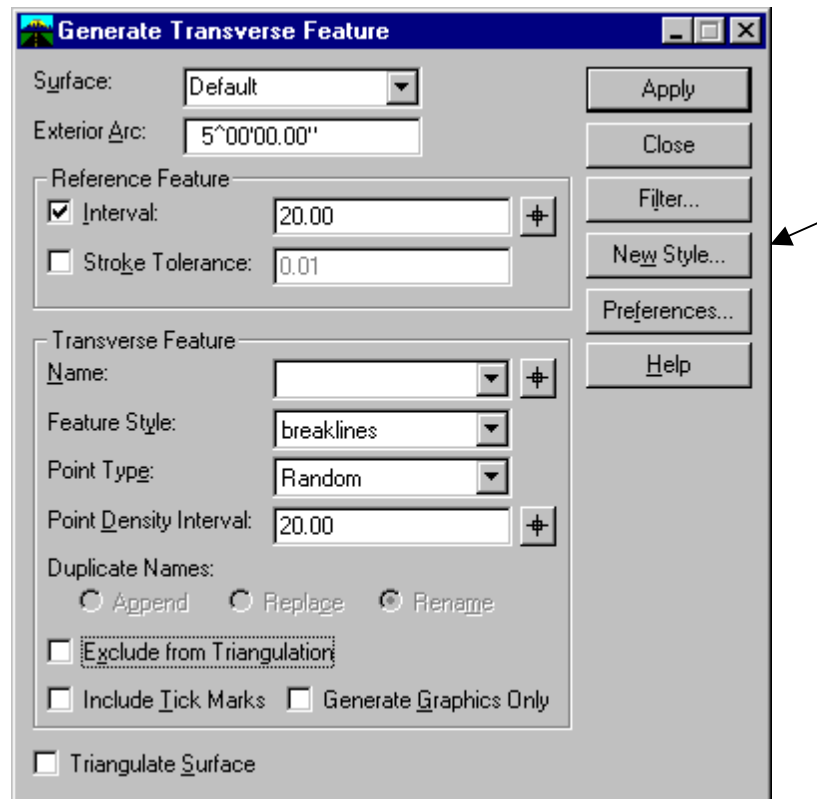


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Newly created feature styles are listed in the **Feature Style Manager** and stored in the *civil.ini* file.

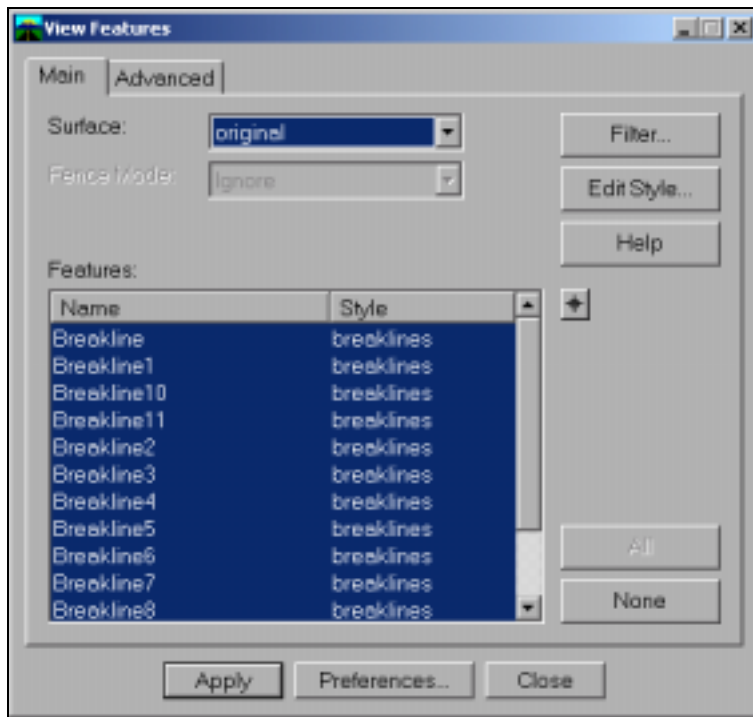


Feature styles can be created or modified from any of the **Style** buttons that appear on most **Surface > Design Surface** commands.



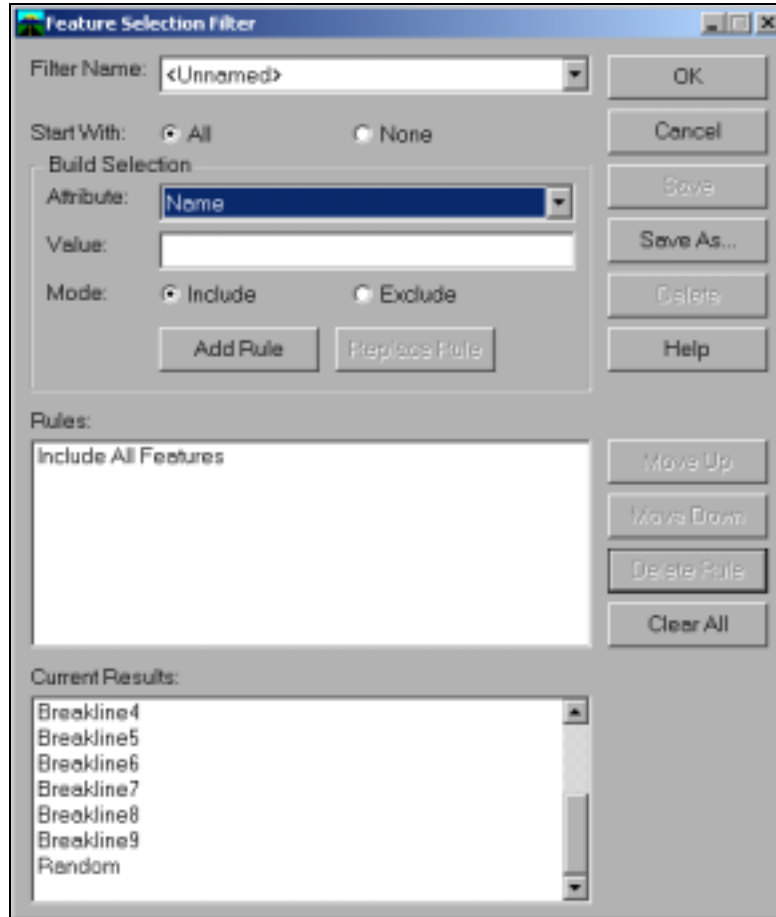
View Surface Features

Features that are a part of the active surface can be displayed for review. To see the features, use the **Surface > View Surface > Features** command.

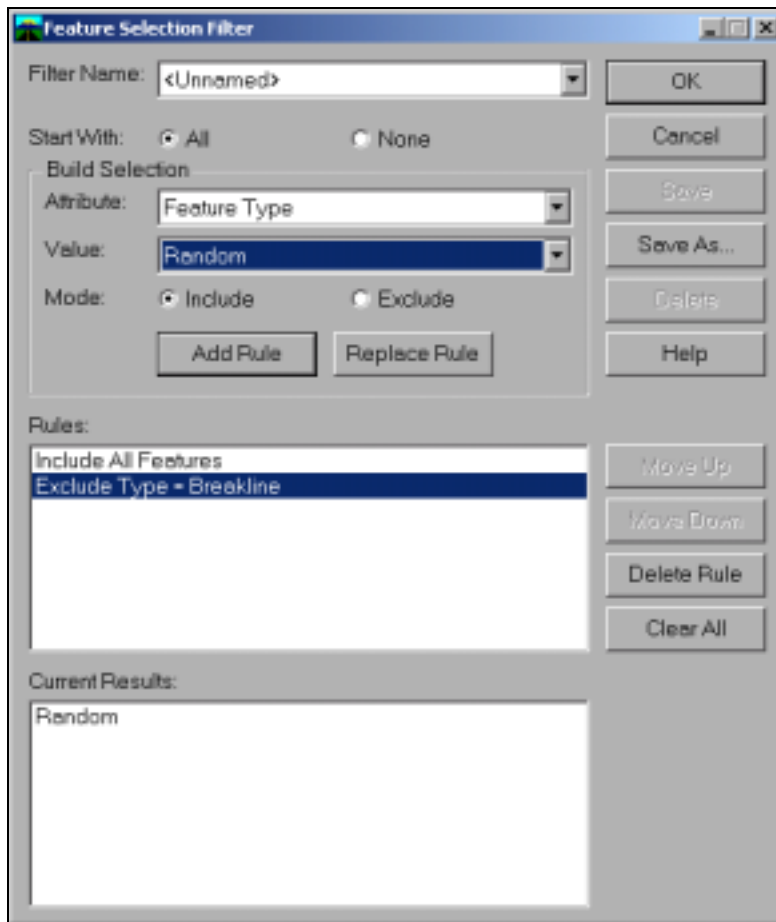


After choosing a surface, you can select individual features from the list, select all of the features or click **Filter** to build a feature selection set to view.

Viewing Surface Features using the Feature Selection Filter

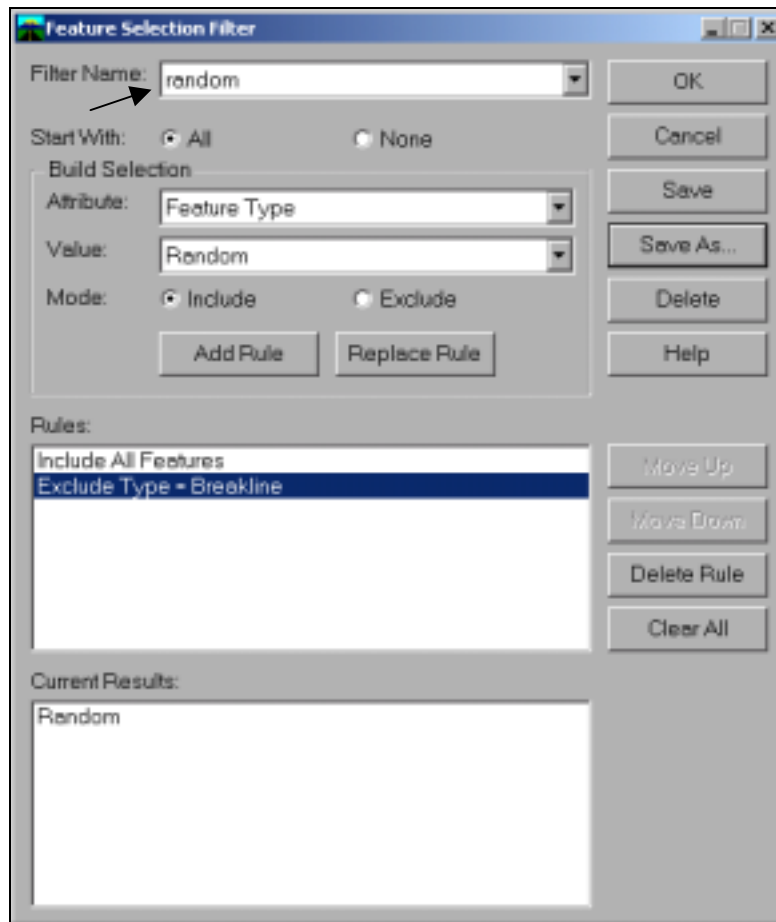


The **Filter** option on the **View Feature** dialog box is a shortcut to the **Surface > Feature > Feature Selection Filter** command. This command allows you to quickly specify a feature selection set.

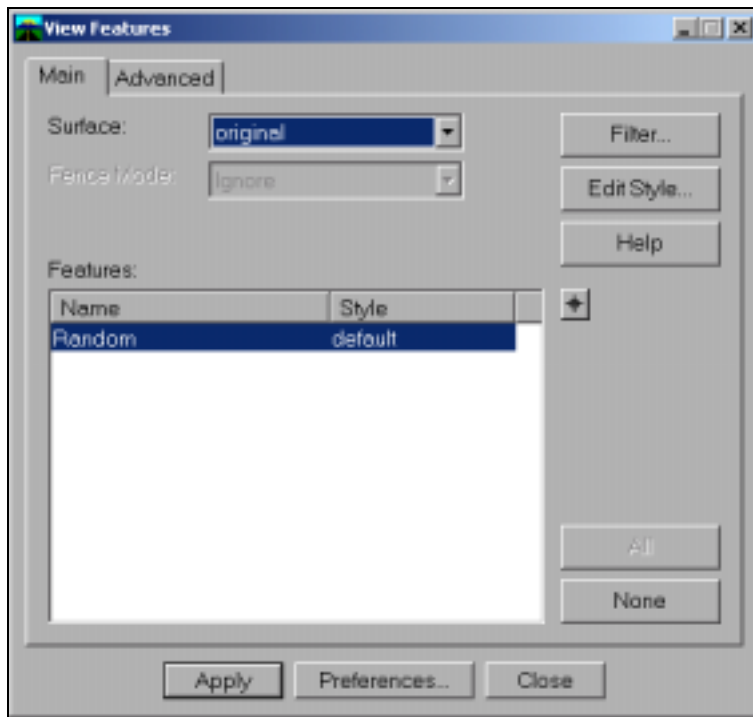


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By clicking **Save As**, the filtered selection-set can be saved and associated with a *name* for future reference.



Note: Before **OK** is applied, make sure the **Feature Filter Lock** is on. If the filter lock is *not* on, filters are not applied. Turn on this lock by clicking **Tools > Locks > Feature Filter Lock**.

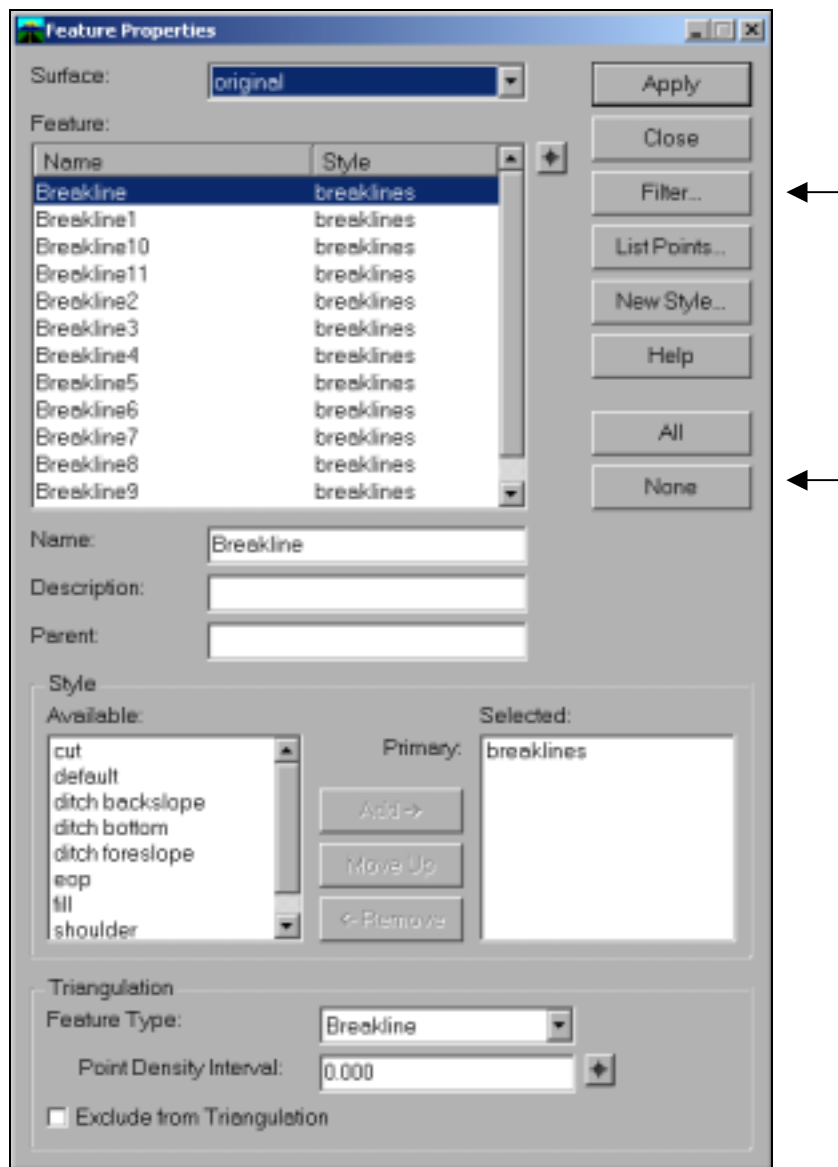


When you click **OK**, selected features are listed in the **View Features** dialog box. When you click **Apply**, these features are displayed.

Once features are in the surface, you can display and modify feature properties.

Feature Properties

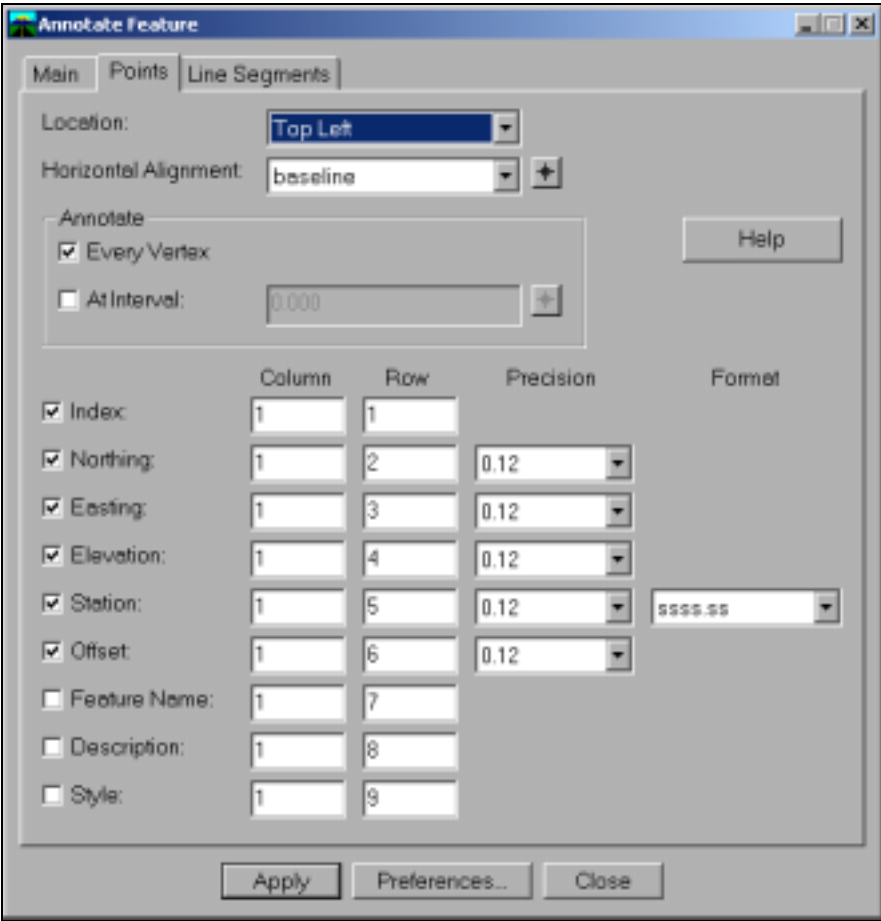
The **Surface > Feature > Feature Properties** command allows you to edit feature properties. Use this command to change the feature name, modify the description or style, and set the criteria for triangulation. You can take action against all features in the surface, against a filtered feature-selection set, or against selected features.



Once features are defined or modified and displayed, you can annotate them within the design file.

Annotating Features

The **Surface > View Surface > Annotate Feature** command allows you to annotate features within the DTM.

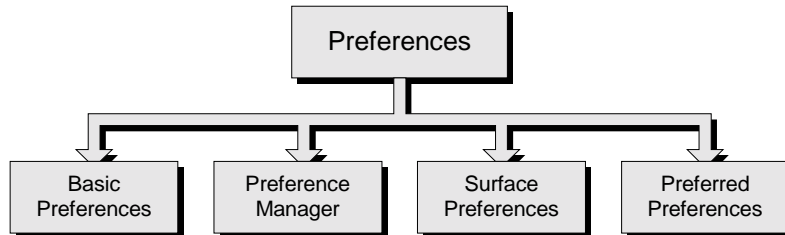


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Click **Apply** to display the annotation.

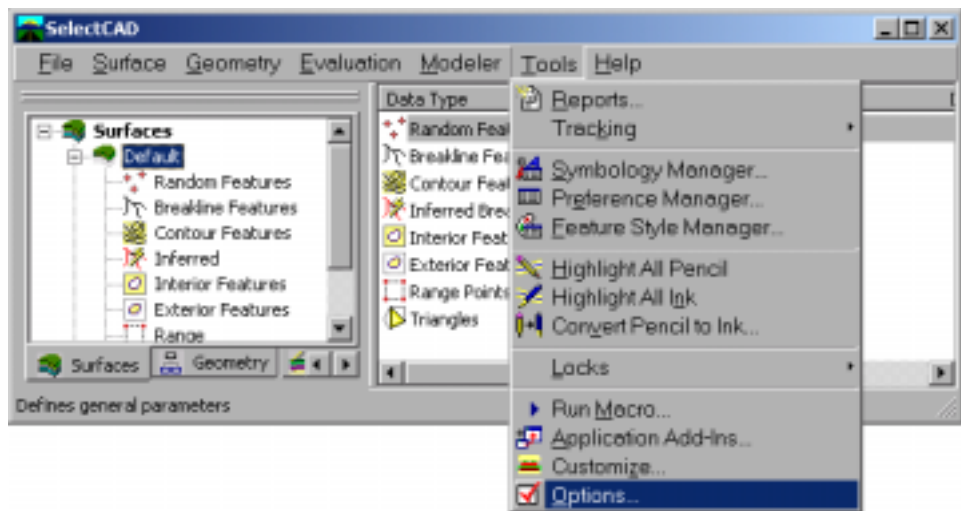
Preferences

Preferences allow you to define everything from general operating parameters (like units of measure, decimal places to display, stationing format, and symbology) to specific instructions as to which settings apply to a particular design surface. In InRoads SelectCAD, preferences are now a flexible system that could be considered as a single group of information that is simply defined in four different ways:

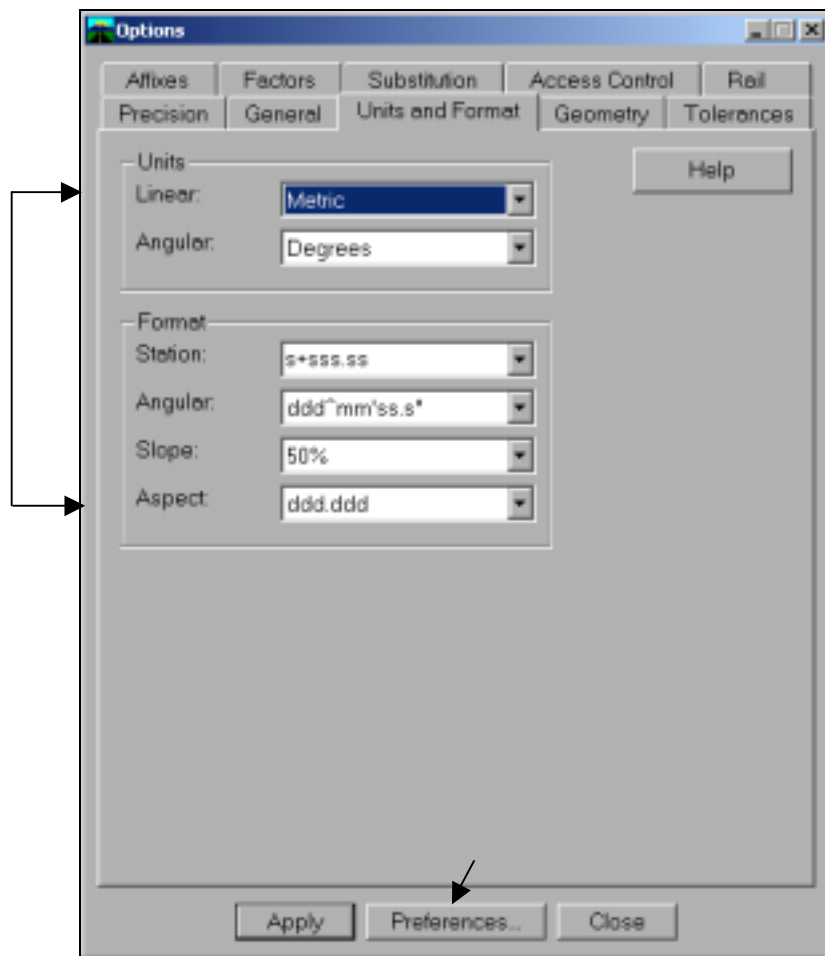


Basic Preferences

Basic preferences are settings that are defined at the command level. These values are set on the individual command dialog box located on most InRoads SelectCAD menus.

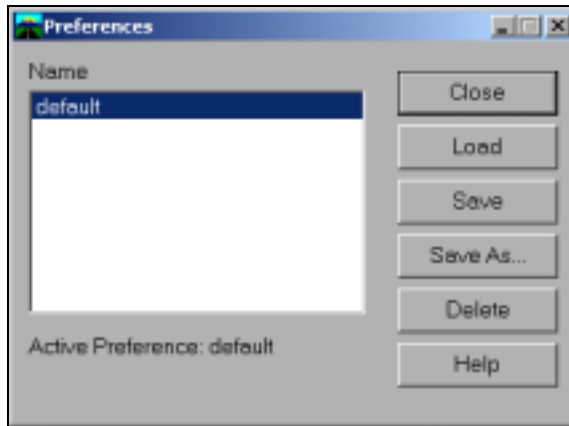


Basic preferences govern general operating parameters such as units of measure, stationing format, decimal places, local symbology, and so on.



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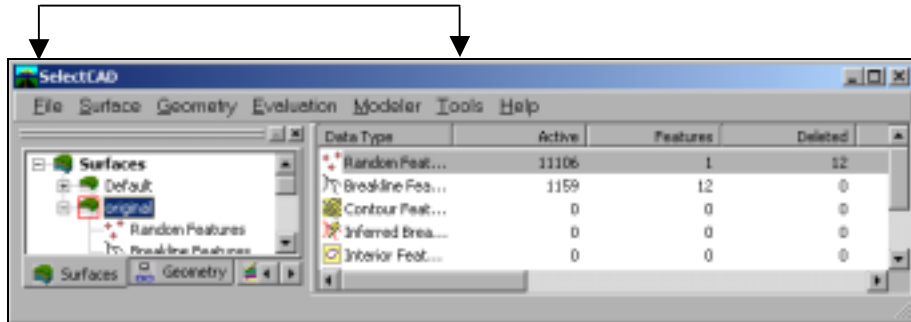
Settings that have been selected across the various tab options can all be saved to a preference set. Preferences are stored in the *civil.ini* file. When you want these configured settings for a particular design session, you can load the saved file from the **Preferences** dialog box. At start up, all available preference files currently in the *civil.ini* are listed here:



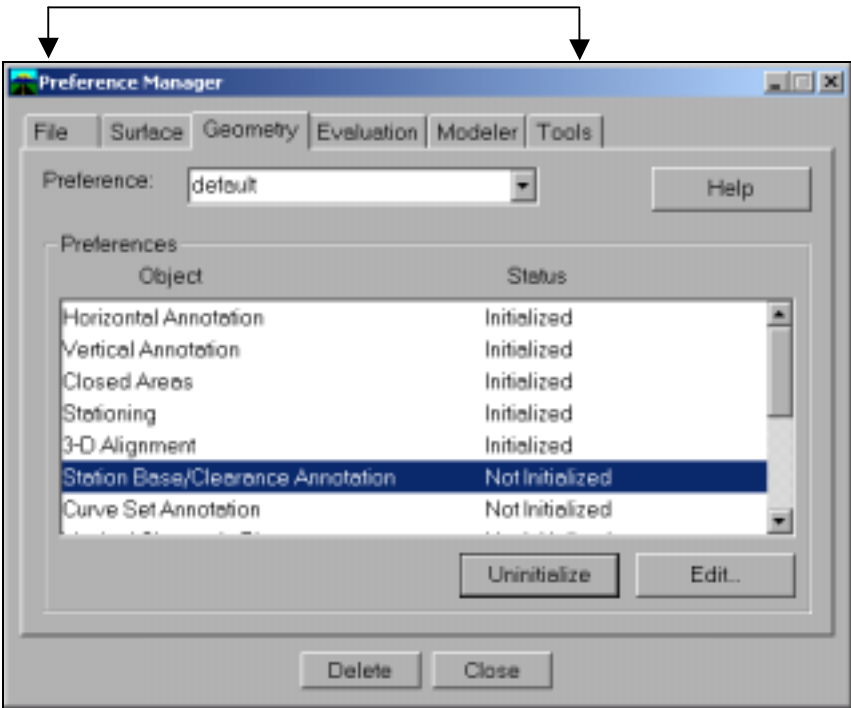
You can create or modify basic preferences at any time from the **Preferences** dialog box.

Preference Manager

You could set basic preferences for every command under each InRoads SelectCAD menu, as previously mentioned:

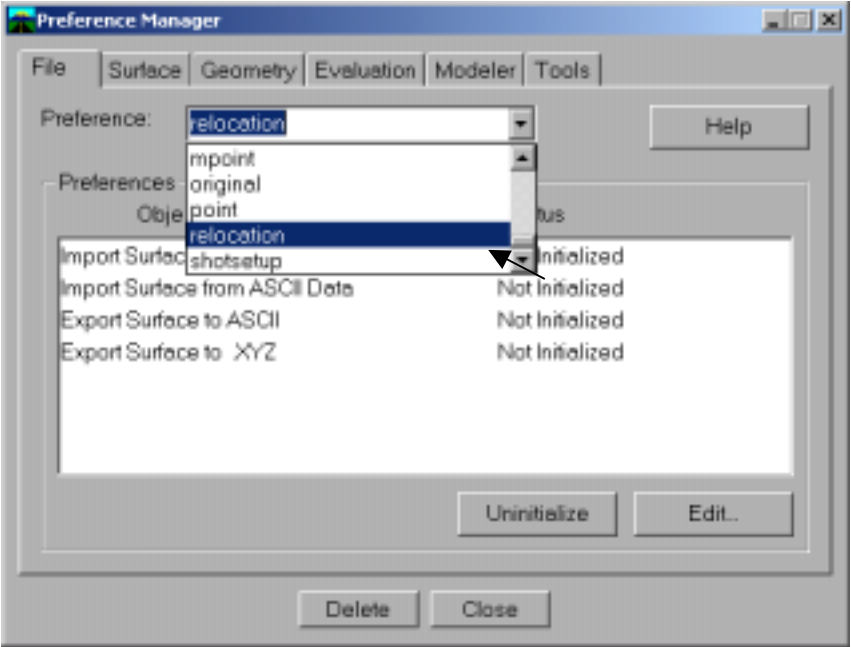


Or, you could globally set all of these values (in addition to other detailed settings required by some commands) in one place at one time, using the **Tools > Preference Manager** command. Previously known as the **Preference Editor**, **Preference Manager** now acts as the global editor that allows you to specify preferences across InRoads SelectCAD.

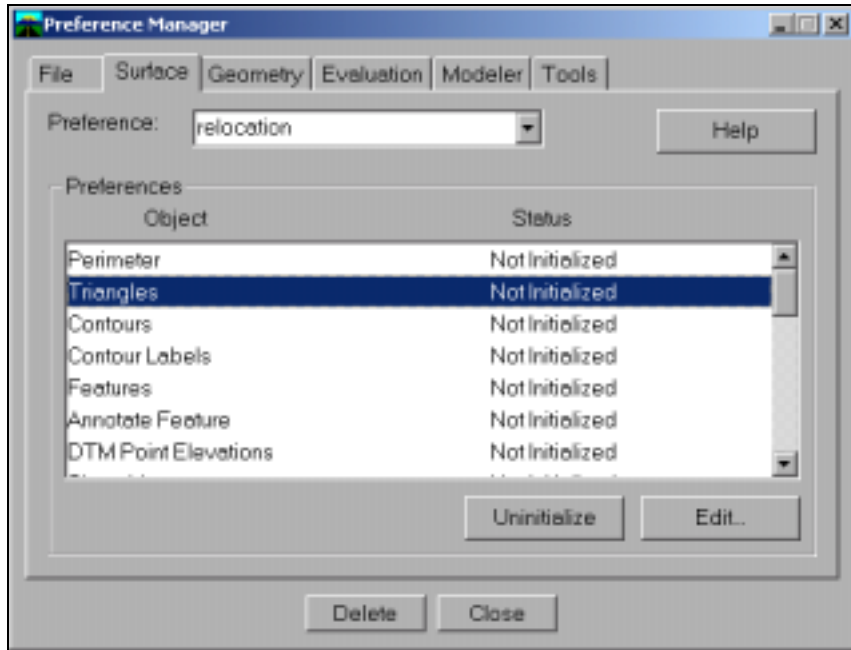


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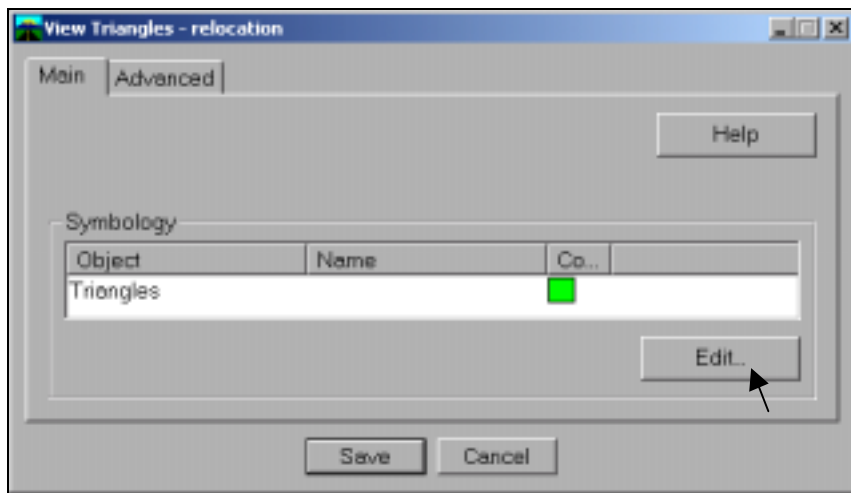
In **Preference Manager**, begin by entering a **Preference** name. Here, you could type a unique name for a new preference set, or you could select an existing preference set from the list (any setting change will modify the set).



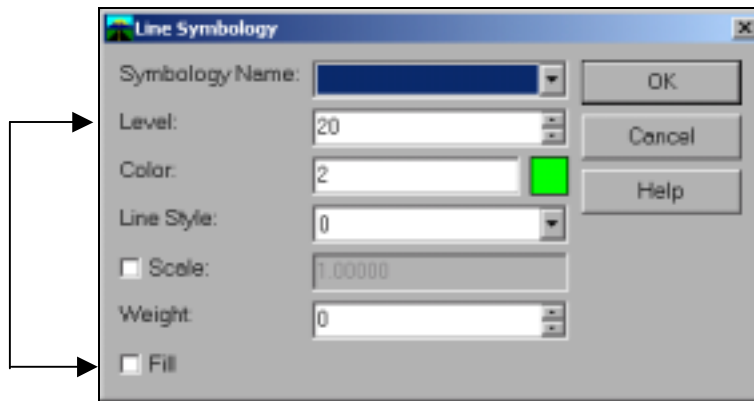
Notice that in the **Status** field, it is indicated whether or not a preference object has already been defined for this preference set (either at the command dialog box or in **Symbology Manager**). If *initialized* is displayed, preferences for the object have already been defined; however, you can modify the settings here and associate them with the new preference set. This is helpful if you want to standardize preferences across a design session or meet a specialized customer deliverable.



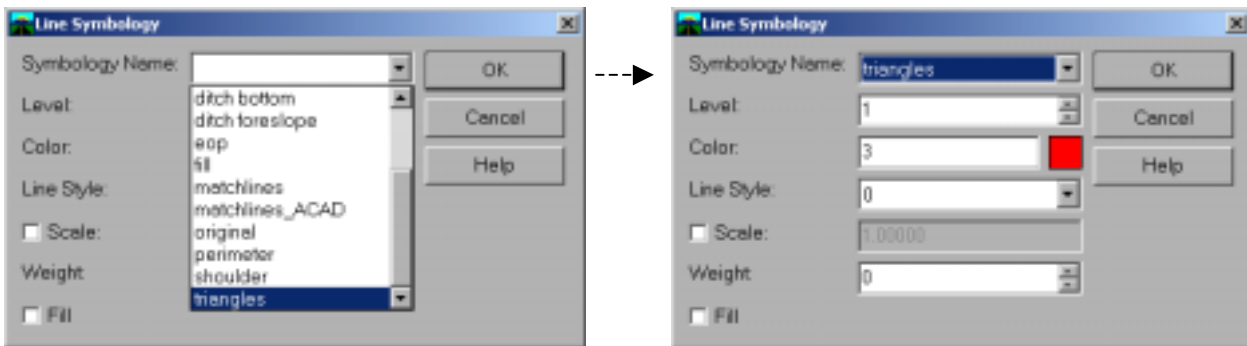
To set preferences, double-click on an object (or select it and click **Edit**).



Individually set each value for an object:

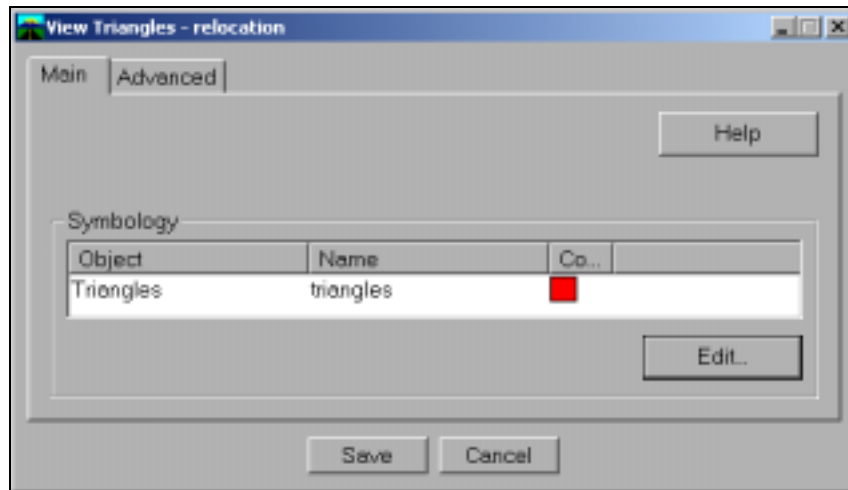


Or, you can select a named symbology. If you choose a named symbology, the values previously defined in **Symbology Manager** populate the dialog box:

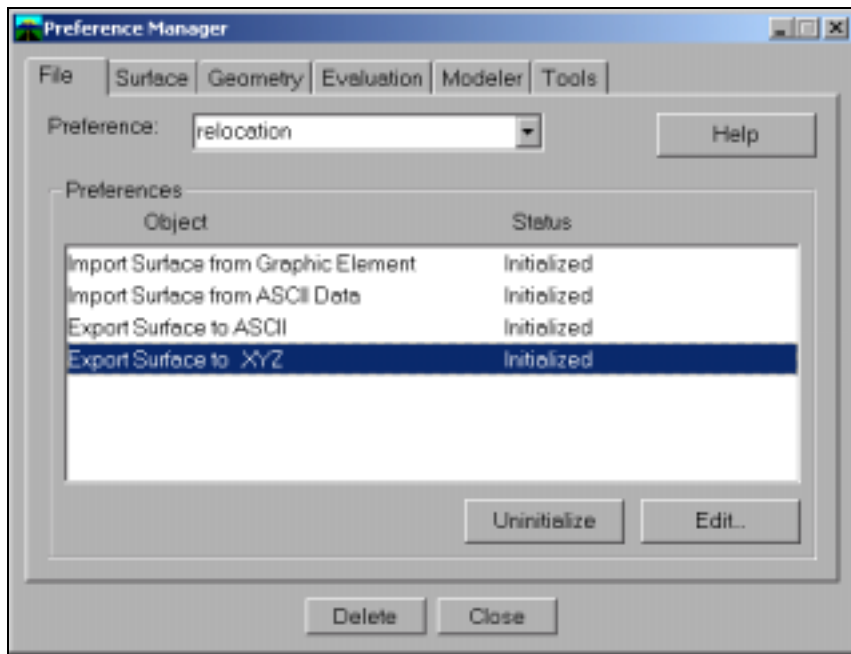


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You must individually save each object preference.



When you have selected and saved all of the preferences, click **Close** to dismiss **Preference Manager**:



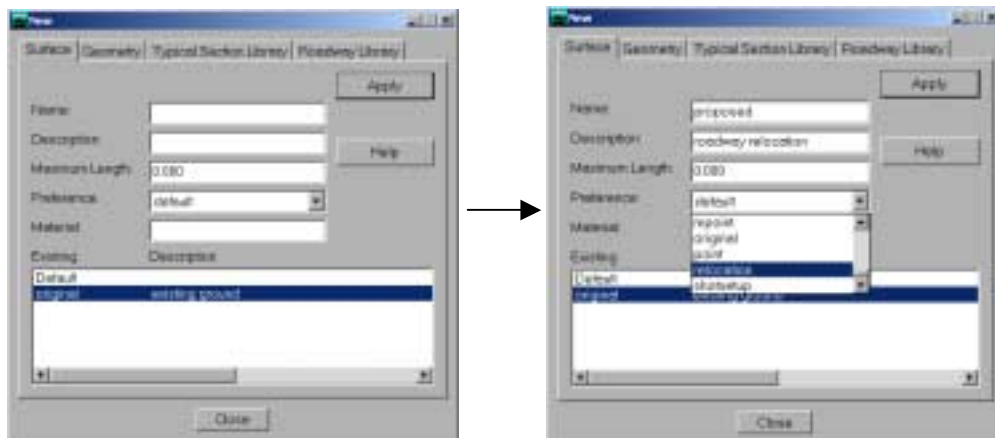
Named preferences are saved and stored in the *civil.ini* file.

Surface Preference

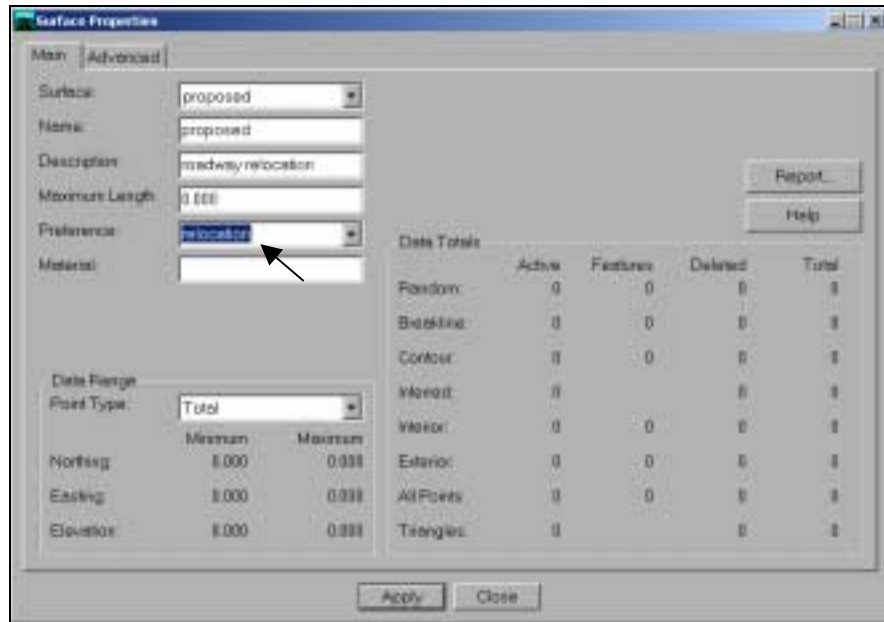
A surface preference is a named preference that you want to associate with a surface. When a preference is associated with a surface, all of the settings and display characteristics that were previously defined will be active for the surface.

Note: The **Tools > Locks > Style** command must be on. If **Style Lock** is *not* on, the basic preferences from the command dialog box will apply.

A surface preference can be specified when creating a surface with the **File > New > Surface** command.



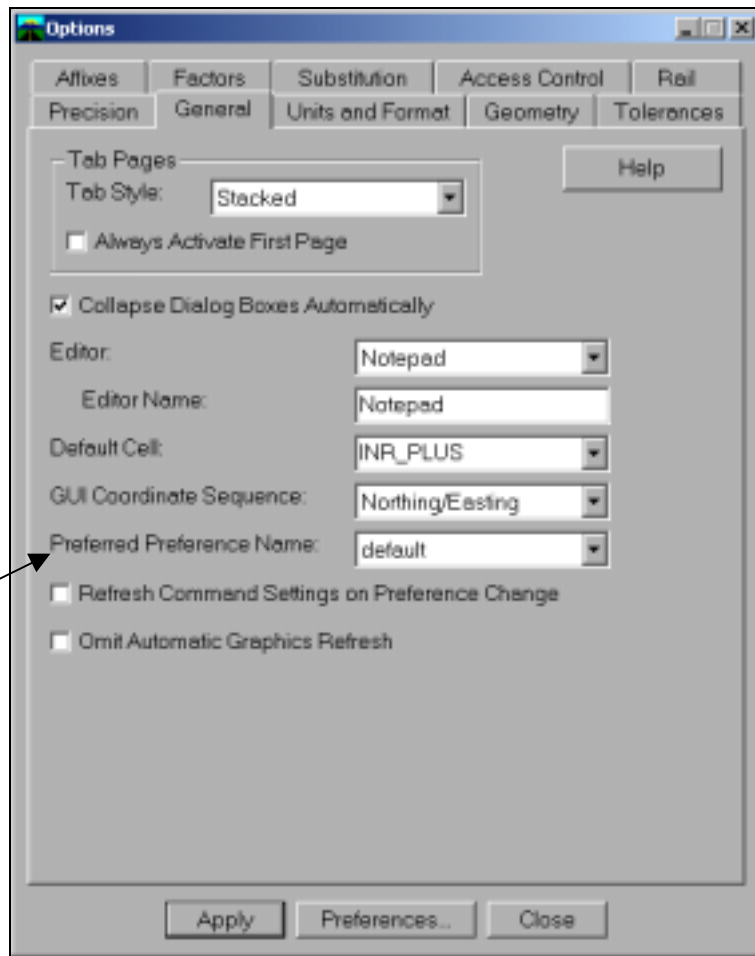
In addition, you can change surface preferences at any time during a design session using the **Surface > Surface Properties** command.



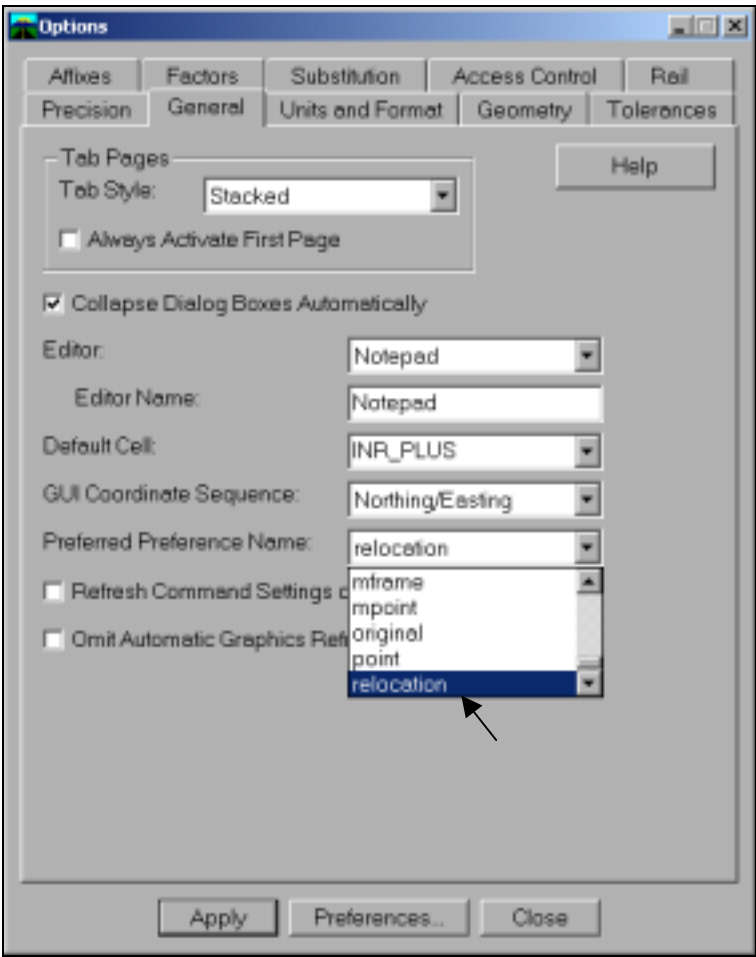
If, during a design session, you choose a different surface preference, use the **Surface > Update 3-D/Plan Surface Display** command to refresh the graphic display with the new preferences.

Preferred Preference

The *preferred* preference is the default global preference set. At start up, the preferred preference is the system **Default** (these are selected settings delivered with InRoads SelectCAD). If you have created a named preference set and desire to have it as the default, access the **Tools > Options > General** tab. For **Category**, select **Settings**.



When specifying a preferred preference, if the **Refresh Command Settings on Preference Change** toggle is on, all of the InRoads SelectCAD commands that are affected by the preference change are updated to reflect the new preference settings. If a command dialog box does not have a named preference corresponding to the preferred preference, the system defaults continue to apply for that dialog box.

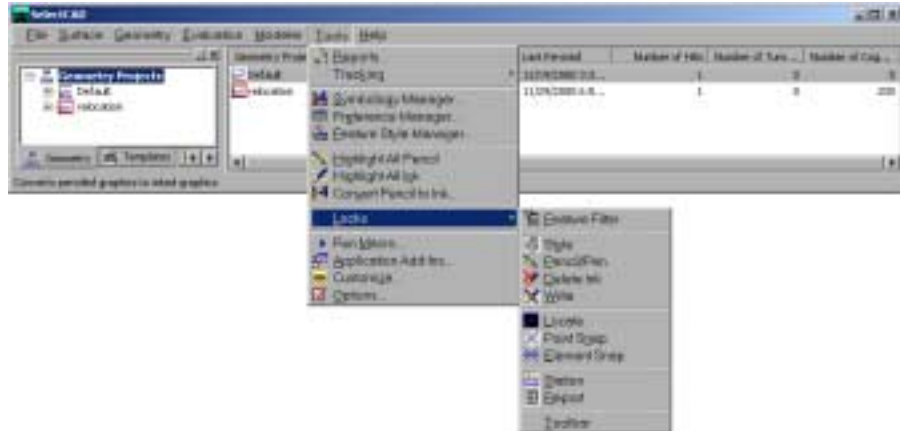


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Click **Apply** to activate the preferred preference.

Locks

In InRoads SelectCAD, there are several *lock* features that work together with **Symbology Manager**, **Preference Manager**, and **Feature Style Manager** to streamline your required interaction with the software.

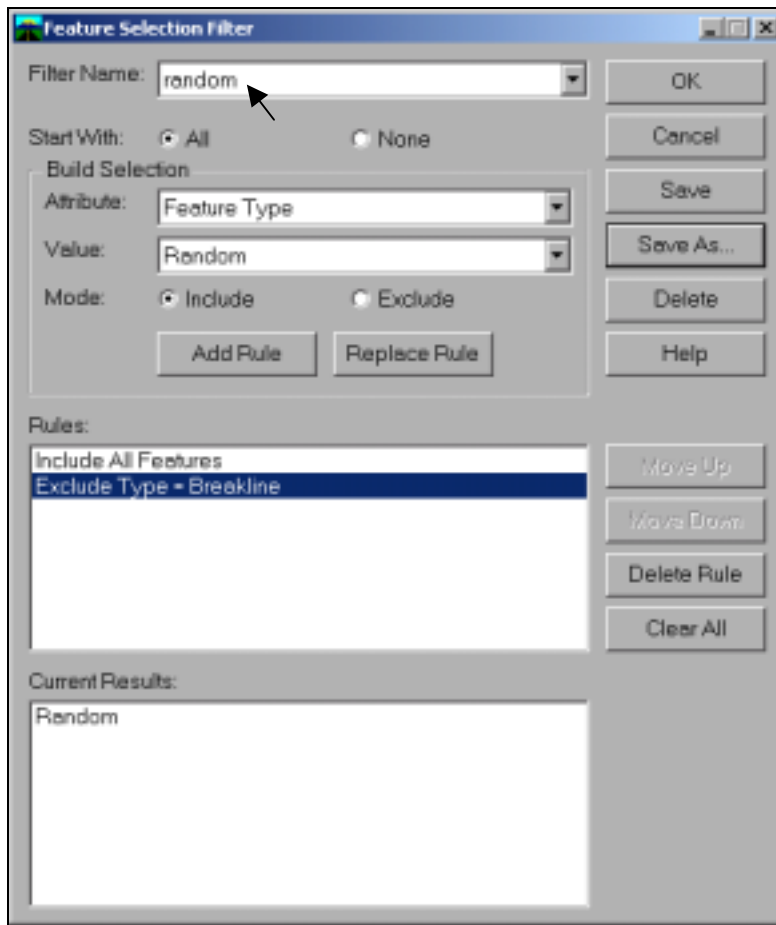


For quick access to the lock commands, select **Tools > Locks > Toolbar**:



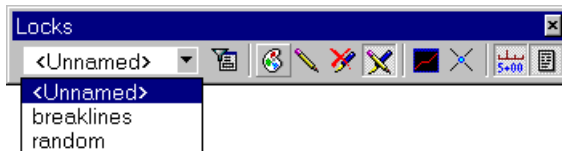
Feature Filter Lock

The **Feature Filter** lock works in conjunction with the **Surface > Feature > Feature Selection Filter** command to automatically make available a filtered feature-selection set. When a selection set is created using the **Feature Selection Filter** command, it is given a name for future use.



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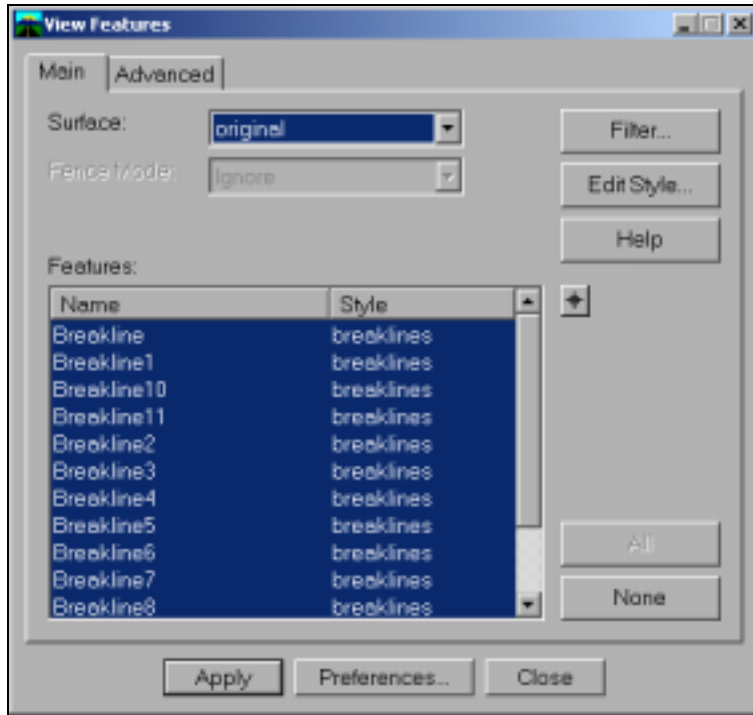
Not only is the feature-selection set saved to the *civil.ini* file, the name assigned to the set is listed in the **Feature Filter List** located on the **Locks** toolbar.



When the **Feature Filter** toggle is turned on, these selection sets are now exclusively available for display without any further interaction with the **Feature Selection Filter** command dialog box.



Subsequently, when the **Surface > View Surface > Features** command is selected, only those feature types specified in the selection set are available for display.

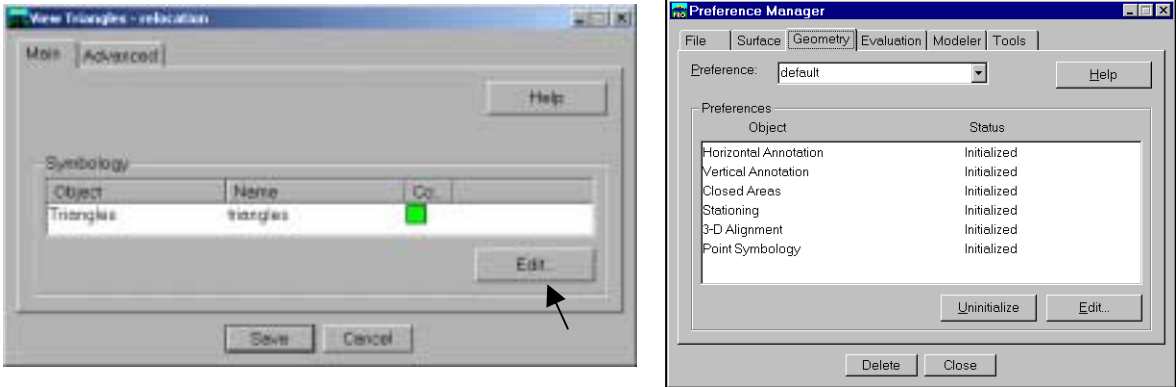


Click **Apply** to display the features in the surface. Or, you could use the **Locate** button to identify features (of the filtered type) by datapoint in the surface.

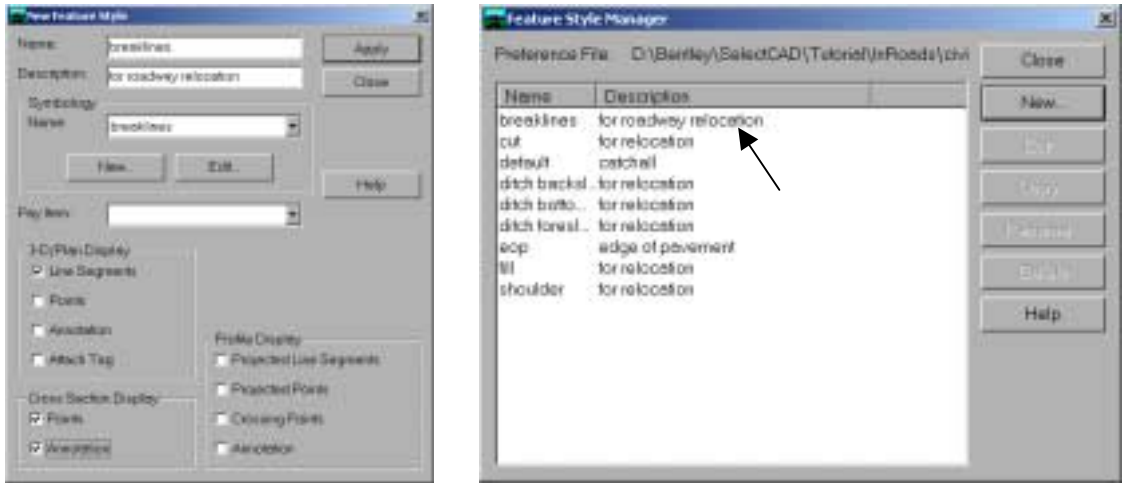
Note: When the **Feature Filter** lock is off, defined feature selection sets are not available or applied.

Style Lock

The **Style** lock works together with **Preferences**, **Preference Manager** and **Feature Style Manager** to automatically display global preference settings and defined features styles. As previously detailed, preference settings are defined at the local command dialog box or globally in the **Preference Manager**.



Feature styles are created and named using the **Tools > Feature Style Manager > New** command, and are listed in **Feature Manager**.



Once preferences and feature styles have been defined, you can turn on the **Style** lock toggle to have these settings automatically display during the design session, without any further interaction with command dialog boxes.



When the **Style** lock is on and a command is selected, data preferences are active and displayed; no dialog box is presented. When **Style** lock is off, each time a command is selected a dialog box is presented allowing you to define display preference and style.

This command allows you to reduce required interaction with InRoads SelectCAD commands.

Write Lock

The **Write** lock generates graphics in one of two modes: display and write or display only.



During a design session, when the **Write** lock toggle is on, graphics created by each command are displayed in the CAD views and are written to the active design/drawing file. In this mode, you can use any of the CAD windowing functions to access a different view of the data, or the editing commands to modify the data.

During a design session, when **Write** lock is toggled off, all graphics are generated in the display-only mode. This means the generated graphics are only displayed in one or more CAD views, but are not written to the active design/drawing file. In this mode, using any of the CAD windowing commands will remove the graphics from the view because the elements have not been written to the design file. In addition, because the elements do not actually exist in the active design/drawing file, you can not edit or modify display-only graphics.

Designing with **Write** lock off is useful when you need to view large amounts of terrain model data and then quickly remove that data from the screen. Since the display-only mode does not write graphics to the active design/drawing file, you can decrease design file size and increase the speed in which all graphics display in the CAD views using this mode.

In InRoads SelectCAD, version 8.2, **Write** lock works in conjunction with the **Pencil/Pen** mode. When **Write** lock is toggled on, it activates the additional **Pencil/Pen** mode.

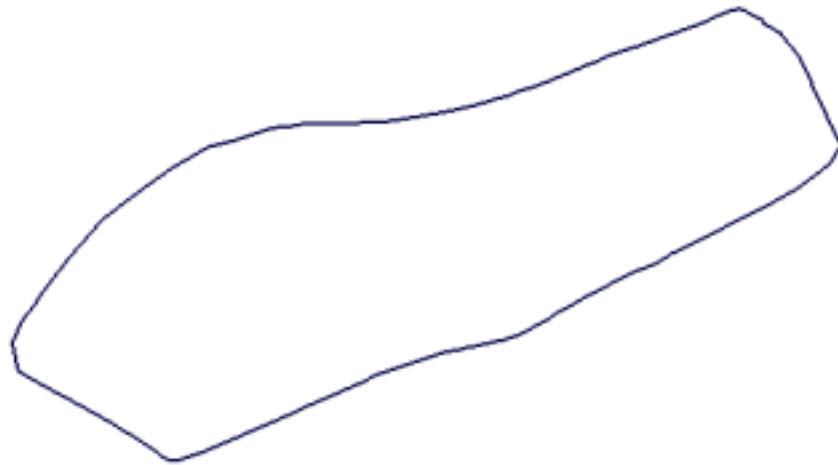


Pencil/Pen Mode

When graphics are generated and written to the design/drawing file, the **Pencil/Pen** mode is available. These modes are an enhancement to the **Write** lock feature in that they allow you to write to the design/drawing

file in either temporary or permanent form. This idea is similar to drawing on a sheet of paper with pen or pencil. When writing in pencil, you can quickly erase a drawing to remove it. In contrast, writing in ink (pen) is a more permanent form that must be deleted to be removed. Similarly, in InRoads SelectCAD graphics written in pencil are not retained between iterations of display, and graphics written in ink are retained each time the object is displayed.

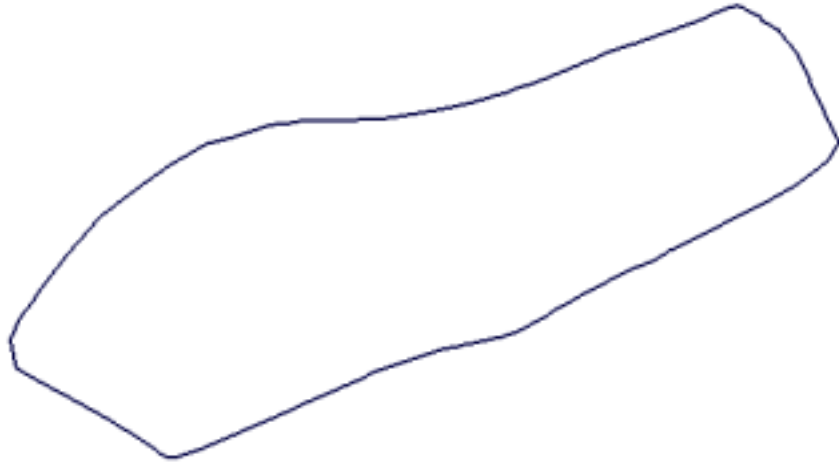
For example, if you turn on **Pencil** mode and select the InRoads SelectCAD **Surface > View Surface > Perimeter** command, the graphic is displayed and written to the CAD design/drawing file.



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Then, using a CAD manipulation command, such as **Move** you relocate the graphic. Next, select **Surface > View Surface > Perimeter** to display it again. The previous graphic is “erased” and only the most recent graphic appears.

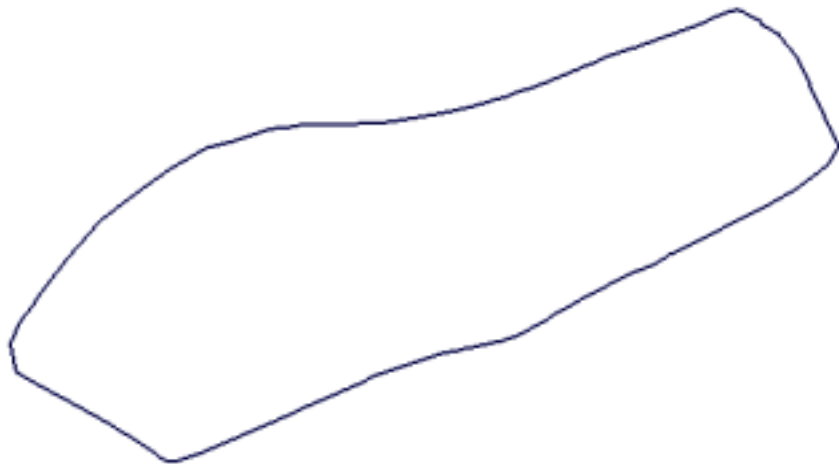
Note: The **Pencil/Pen** mode that is active when the graphic is initially displayed determines whether or not it is erased when it is redisplayed.



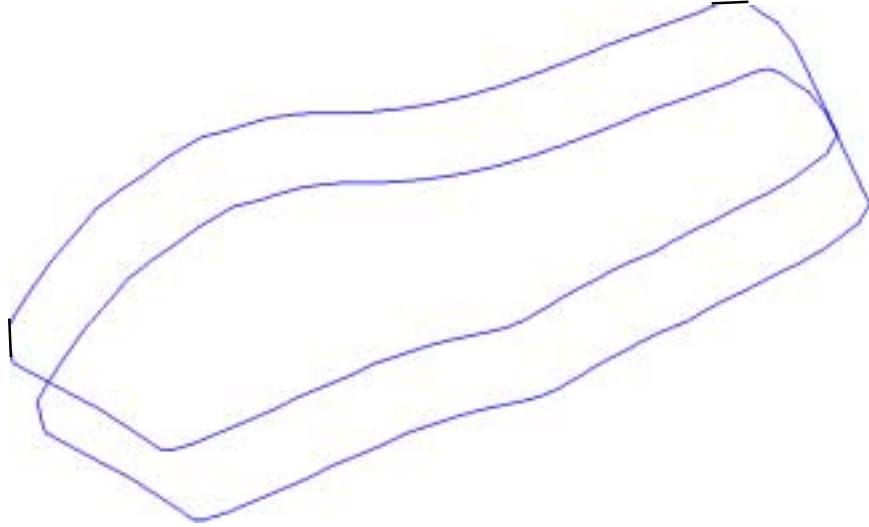
Graphics written in **Pencil** mode are retained only until the next time the same graphic is selected for display.

Note: During a design session in **Pencil** mode, there may be an occasion where you do not want pencil graphics to automatically be erased. To override this action, select the **Tools > Options > General** tab. For **Category**, select **Settings** and turn on the **Omit Automatic Graphics Refresh** toggle. All graphics, written in pencil or ink, will be retained until you manually delete them.

In contrast, if in **Pen** mode you select **Surface > View Perimeter**, the graphic is displayed and written to the design/drawing file.



Then, using the CAD **Move** command, you relocate the graphic. Next, select **Surface > View Surface > Perimeter** again. Both graphics appear. The first is retained because it was written in ink, the second appears because it is the most recent.



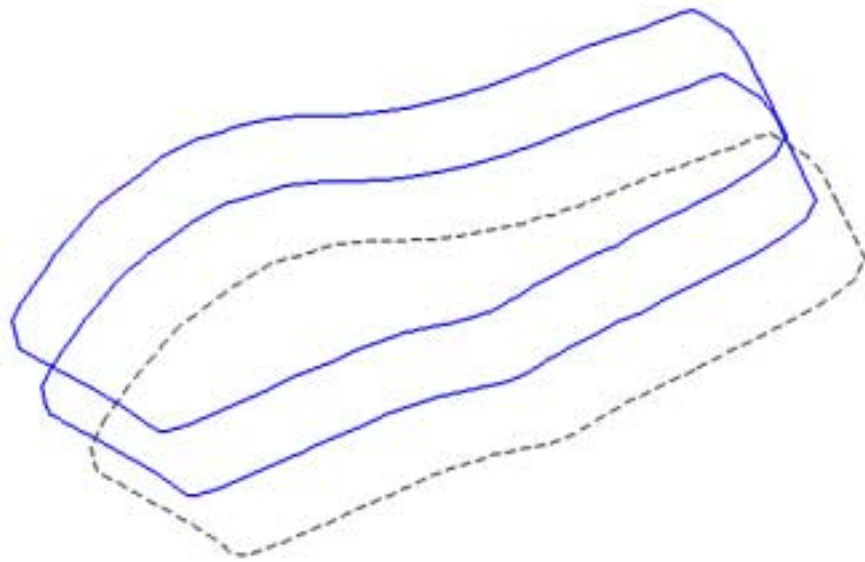
All graphics written in **Pen** mode are retained until they are deleted. Graphics can be manually removed using the CAD **Delete** command or by activating the InRoads SelectCAD **Delete Ink** lock.



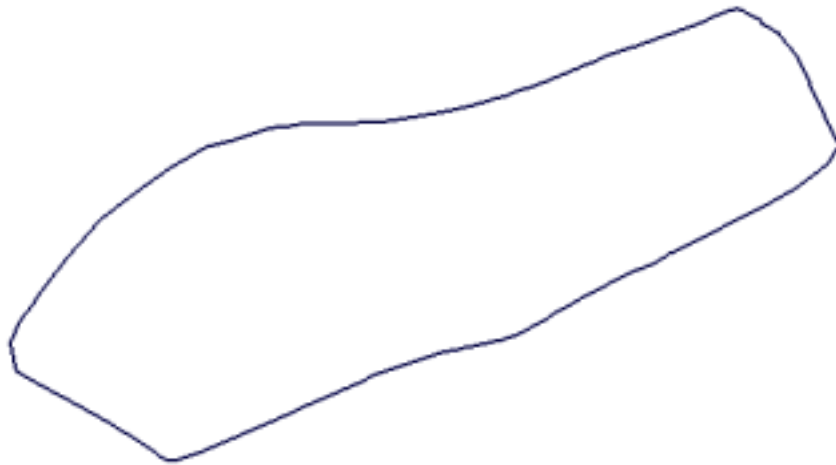
Delete Ink Lock

The **Delete Ink** lock is available when **Write** lock is on. Turn on this toggle to quickly remove all graphics that were previously written in ink.

For example, if you have three iterations of a graphic that was written in ink, all three graphics appear in the design/drawing file.



Then, if you turn on the **Delete Ink** lock and select the command again, only the current graphic is displayed.



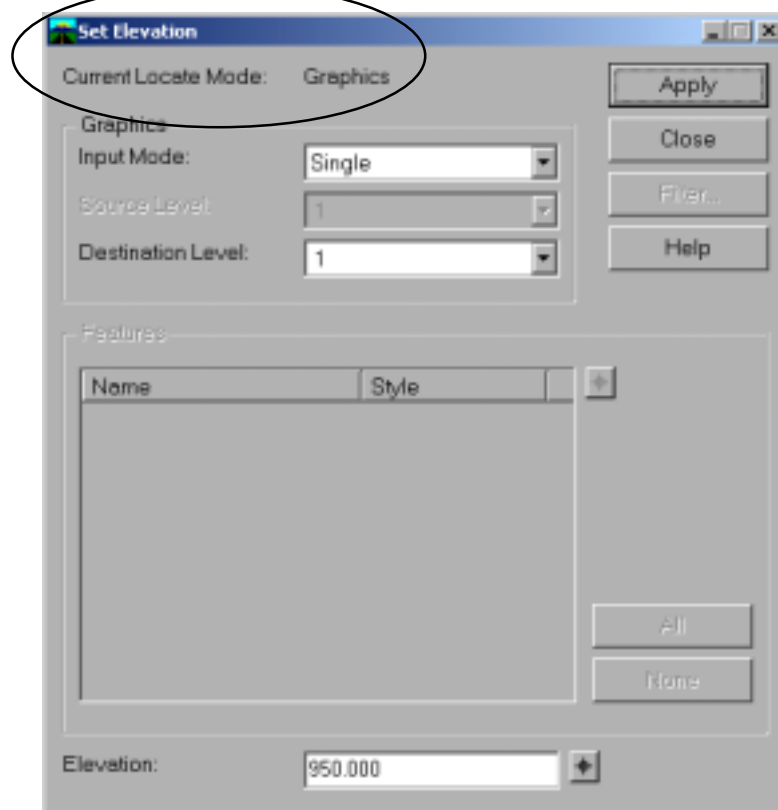
All of the previously displayed graphics are deleted. To override the **Delete Ink** lock, select the **Tools > Options > General** tab. For **Category**, select **Settings** and turn on the **Omit Automatic Graphics Refresh** toggle. All graphics, written in pencil or ink, will be retained until you manually delete them.

Locate Graphics/Features

During an InRoads SelectCAD design session, you create, edit and manipulate objects in two different environments: the CAD design/drawing file and the DTM model surface. Objects located in the CAD design/drawing file are referred to as *graphics*. Objects located in the DTM model (design surface) are referred to as *features*. The **Locate Graphics/Locate Features** mode lets you quickly specify the environment from which to select objects.



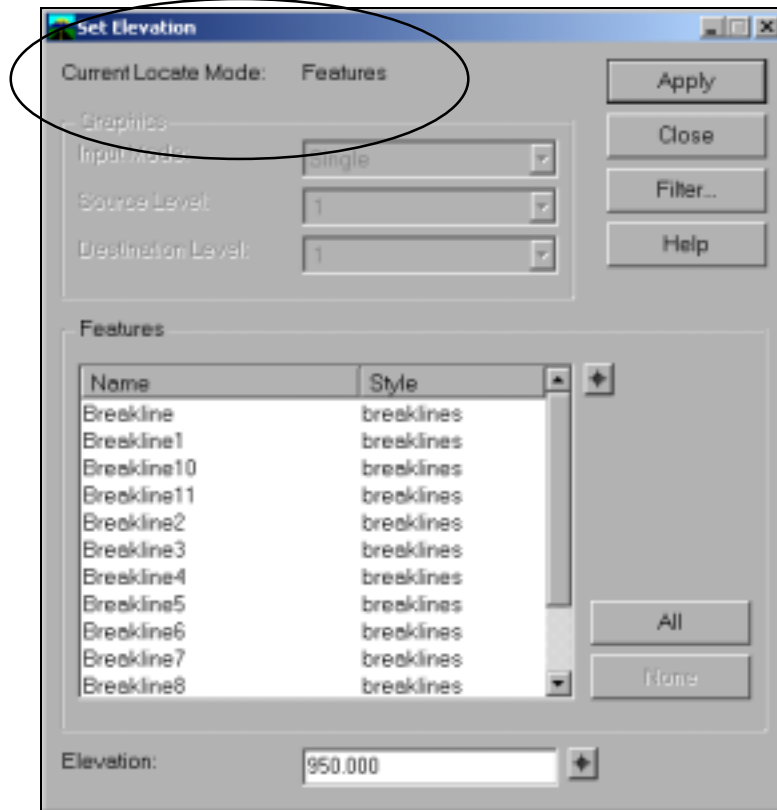
For example, if you toggle to **Locate Graphics** and select the **Surface > Design Surface > Set Elevation** command for a **Single** graphic element, you are prompted to identify an element within the CAD design/drawing file.



While remaining in the same command dialog box, you can toggle the mode to **Locate Features**.



The dialog box options dynamically change. You can now identify *features* in the surface.



Identify and locate individual features or select all available features in the surface.

Note: While an alignment (*.alg) is another way to manipulate objects during a design session, the *geometry* data in the alignment is not accessible from the **Locate Graphics/Locate Features** command.

Point/Element/No Snap Lock

This lock is a three-way toggle that allows you to specify the snap mode when working with feature and geometry data.

- **Point Snap.** This lock allows you to snap onto any point contained in the geometry project. This mode is helpful when placing geometry

elements. For example, if you want to input point data into a dialog box, toggle this lock on and place a data point in the design file. InRoads SelectCAD will find the closest point and display the point data in the dialog box.

- **Element Snap.** This lock allows you to snap or lock onto any geometry element (any object that would require multiple data points to define) in the geometry project. This mode is helpful when using the direction, distance, length, radius, and/or angle of an existing geometry element to design a new element. When this lock is on, InRoads SelectCAD snaps to the element nearest the data point you place in the design file
- **No Snap.** This mode disables both point and element snap.

Station Lock

This on/off lock is applicable only when the first station specified on the horizontal alignment is an odd-numbered station (for example, 2+39) and you are generating cross sections, executing the roadway modeler, or generating station type reports. When this lock is turned on, InRoads SelectCAD applies a given command action to the first station, and then forces all subsequent actions to even-numbered stations. For example, if the first station 2+39 and the station interval is defined as 50, InRoads SelectCAD performs the command action at stations 2+39, 2+50, 3+00, and so on. When the **Station** lock is turned off and the first station is odd-numbered, InRoads SelectCAD applies the command action to odd-numbered stations only (for example, 2+39, 2+89, 3+39) and so on.

Report Lock

This on/off lock is used by several commands to control whether or not the output displays in a dialog box as the command calculations are performed. If this lock is off, the command processes and stores results without displaying them in an output dialog box.

General InRoads SelectCAD Review

While InRoads SelectCAD includes expanded functionality in several areas, many of the software's standard features remain.

Comprehensive Data Structure

The data structure for InRoads SelectCAD remains much more comprehensive than those of the CAD platforms on which it runs. It accommodates the intelligence needed to perform sophisticated 3-D design operations such as earthwork analysis, profile generation, and superelevation. Its ability to maintain double-precision numbers is not dependent upon the CAD platform. As you place or locate design elements or coordinate geometry points, InRoads SelectCAD tools accommodate double-precision input. Even graphical selection tools automatically snap to points and elements in your geometry project with double-precision accuracy.

Horizontal and Vertical Alignments

Alignments continue to represent longitudinal features, such as centerlines, lanes, access ramps, and ditch grade lines. The horizontal and vertical geometry of an alignment is designed separately, with the vertical being a child of the horizontal. There are no restrictions on how many vertical alignments you can attach to a horizontal alignment. Alignments are designed using the geometry component of InRoads SelectCAD, which has an array of features for locating points and designing the curvilinear geometry through them.

InRoads SelectCAD automates the creation of horizontal and vertical geometry. In the initial design phase, you can use a backdrop of graphics such as a DTM, aerial photo, MicroStation graphics, and so forth. You can define curve and tangents, in any order, with or without automatic spiral placement, and if you need to add spirals, you can do so as you define the circular curves. See *Chapter 5, Learning InRoads SelectCAD* for detailed instructions.

When the rough geometry is complete, you can begin to refine the alignment. You can dynamically manipulate elements or use precision key-ins. The software provides immediate visual feedback and automatically adjusts the geometry throughout the alignment, maintaining coincidence and colinearity between all the elements where appropriate.

Typical Sections

Typical sections remain one of the most powerful features of InRoads SelectCAD' corridor design capabilities. Contrasted with alignments, which represent longitudinal geometry, typical sections represent transverse geometry. Typical sections consist of templates, which are the backbone of your road design, and various tables that can be used to create the side slopes. Templates can be fixed or controlled by horizontal and/or vertical geometry by using simple offsets.

When typical sections are paired with horizontal and vertical alignments and superelevation, they define the surface of a corridor. Typical sections are flexible design components--as easily applied to ditches and sidewalks as to multilane highways with superelevated curves and variable side slopes.

Side Slopes

Side slopes, representing embankments and cuttings between a corridor surface and the original ground, can be designed with any of four methods provided by InRoads SelectCAD:

- Decision table
- Cut/Fill table
- Material table
- Template

The decision table method encompasses almost all the functionality of the other three methods. Whether your design is simple (one slope up/one slope down) or requires toe-of-slope ditches or noise berms, the decision table method provides a high degree of flexibility, with tight control over the placement of side slopes. You can set up decision tables not only to define multiple intersections with design surfaces, but also to adjust those surfaces (for topsoil stripping, for example) and to recognize and attach to independent horizontal and vertical alignments.

InRoads SelectCAD includes three other methods that provide subsets of the functionality in decision tables. The template method extends the template beyond the backbone (hinge points) based on the cut and fill slopes you define. Side-slope intercepts for sublayers are defined exclusively with the template method. The cut/fill table method allows a straightforward selection from a series of slopes depending on which one hits original ground. If you want to vary the side slope in cut, strictly according to the material you are cutting through, you can use a material table to determine the appropriate slope. Both cut/fill and material

methods have capabilities to automatically design ditches or shoulders as required. Both can also add benches, either at fixed intervals from the road or at constant elevations.

Evaluation

InRoads SelectCAD continues to provide tools to make preliminary evaluation of your model quick and simple. These tools allow you to do the following:

- Display triangles and slope vectors and view them from any angle.
- Produce contours, cross sections, and profiles to compare original surfaces with design surfaces.
- Compute volumes using the triangle, grid, or end-area method.
- Produce Mass-Haul diagrams.

Superelevation

Superelevation relates to the banking applied to offset the lateral acceleration that vehicles experience when going around curves. More specifically, it is the transverse slope between the inner and outer edges of a banked curve. InRoads SelectCAD continues to accommodate all commonly used methods of calculating superelevation rates, including the five AASHTO methods and numerous international methods. Plus, InRoads SelectCAD gives you control over how superelevation is achieved longitudinally along an alignment, with parametric control over transition lengths and methods of transition.

The Roadway Model

Roadway Modeler pulls together all of your design data to create the corridor model. The modeler uses a roadway definition to place appropriate templates and side slopes at intervals and at critical design points along the alignment. In addition, it applies superelevation and adjusts the templates to the longitudinal features as necessary, as well as checks right-of-way limits. The end result of this is a DTM for each of the layers in the proposed corridor surface. These layers are comprised of 3-D linear features and xyz random points, providing a full 3-D model of the proposed roadway. The model features can then be displayed in the CAD design/drawing file.

For simple projects, InRoads SelectCAD provides Express Modeler, which produces a model quickly, with only minimal information. You only need to provide an existing surface, a horizontal alignment, and a

single template. If you wish, you can also provide a vertical alignment, but InRoads SelectCAD will use elevations derived from a horizontal alignment if no vertical alignment is provided.

Drawing Production

Plan and profile drawings can now be easily generated from InRoads SelectCAD graphics. You can create construction documents, such as plan/profile, cross sections, and detail sheets.

Reports

Reporting in InRoads SelectCAD is flexible and comprehensive. You can produce reports on any data that you have created or manipulated in the course of a project. Such reports might include listings of coordinate geometry points, alignment clearances, and earthwork data. InRoads SelectCAD also allows you to track your design activities. You can save your activities as report files or append them to other report files; they are invaluable for project documentation. All reports are generated in ASCII format for easy manipulation in a text editor or word processing program.

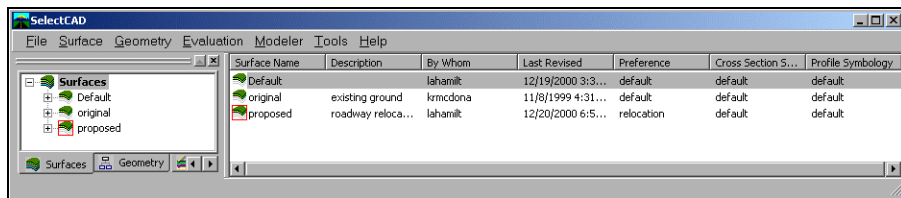
Visualization

Designs produced with InRoads SelectCAD can be used with visualization software to create photo-realistic images, which help your project team or client better visualize the design. Bentley Systems also complements InRoads SelectCAD with a range of applications for editing and manipulating images to create photomontages or video presentations. These capabilities help you prepare presentations for non-technical audiences.

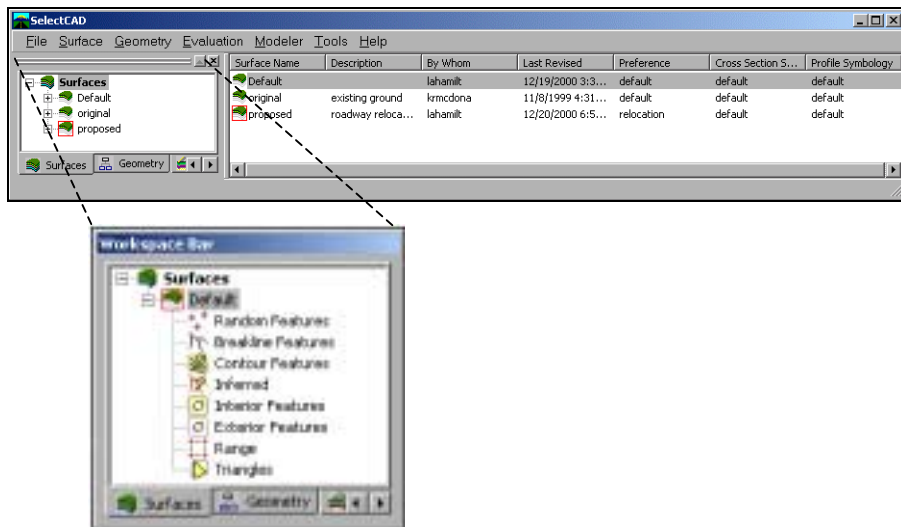
Getting Around in InRoads SelectCAD

Using the Interface

InRoads SelectCAD utilizes the Windows *Explorer* environment for file management. It works like the Explorer in the Microsoft Windows environment. By either clicking the plus sign (+) in the square next to an item or double-clicking on the name, a subgroup of items displays just like a directory tree. The SelectCAD Explorer provides a quick view of files that have been loaded and are available in a working session.

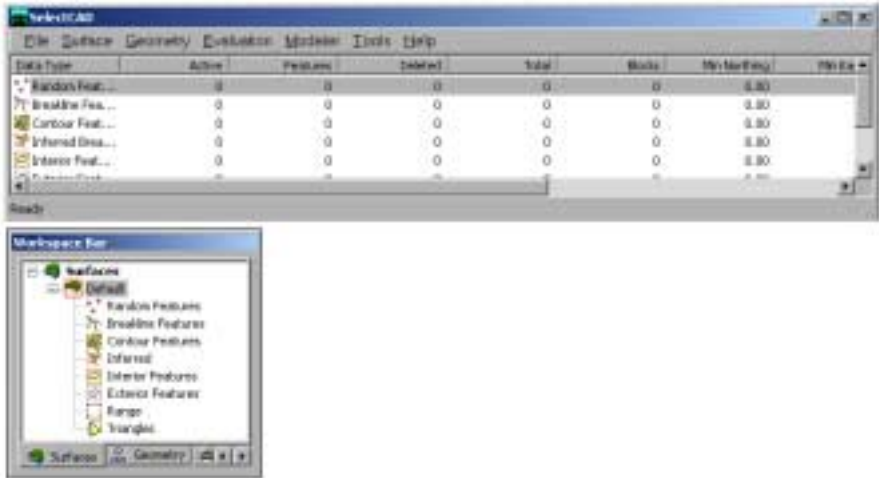


From the InRoads SelectCAD Explorer, you can “tear away” the left-pane Explorer tree, now referred to as the Workspace Bar:

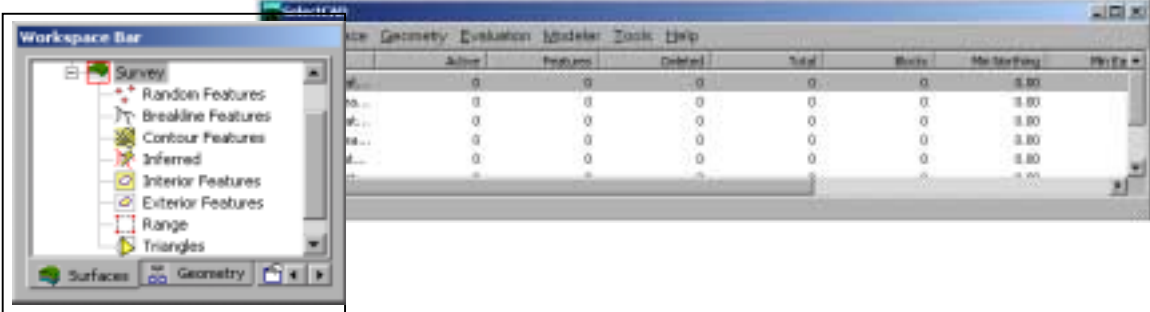


There are several unique advantages of the Workspace Bar. First, major objects are represented by tabs at the bottom of the view. Each tab corresponds to a particular view of the overall SelectCAD hierarchy. Second, by clicking a tab, such as the Surfaces, you’ll see all (and only) the surface objects in the project.

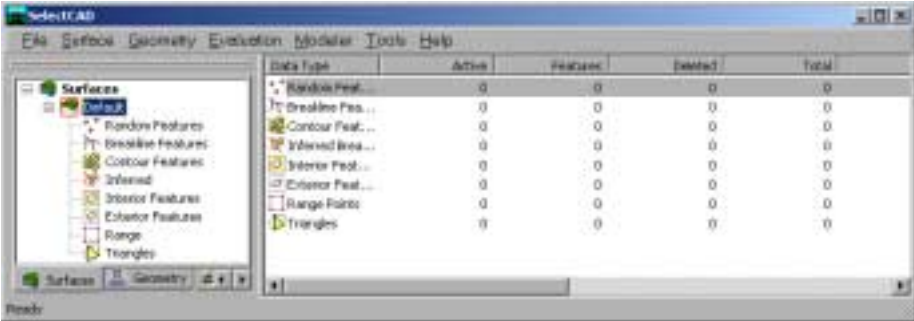
Workspace Bar’s can be docked anywhere on the screen for easy access:



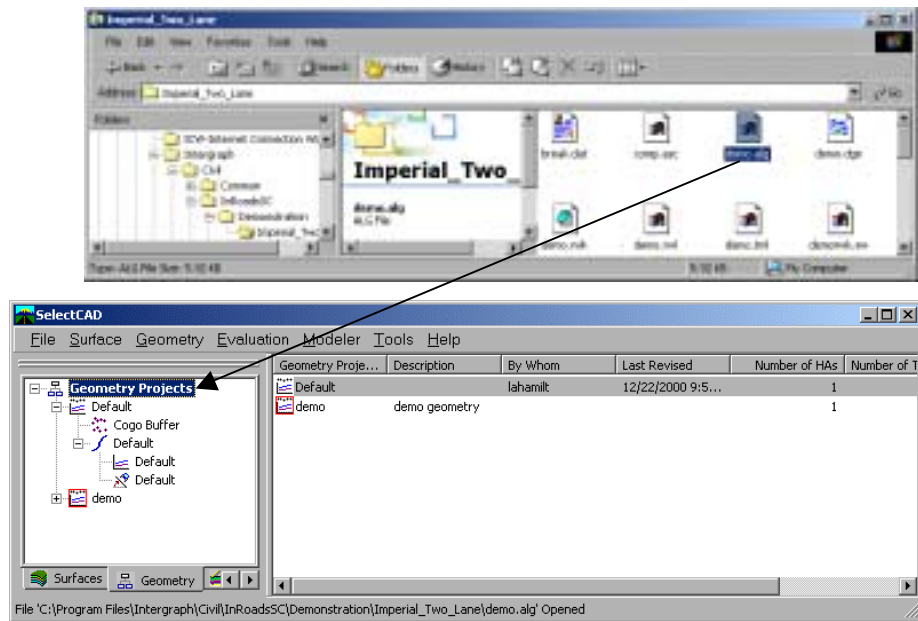
To return the Workspace Bar back to the Explorer, click and drag the box to the desired location:



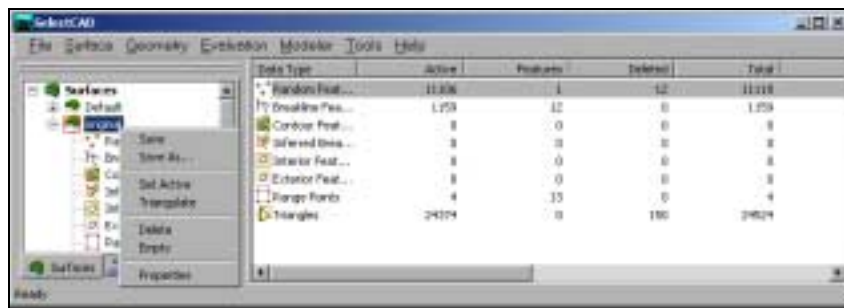
3



Once you are in SelectCAD, you can drag and drop your InRoads SelectCAD data directly from the Windows Explorer. The status of the data is displayed in the bottom portion of SelectCAD window.



In the SelectCAD Explorer, you can access additional options that are available for an entity. For example, if you select (highlight) a surface and right-mouse click, a pop-up menu appears with additional options for surfaces.



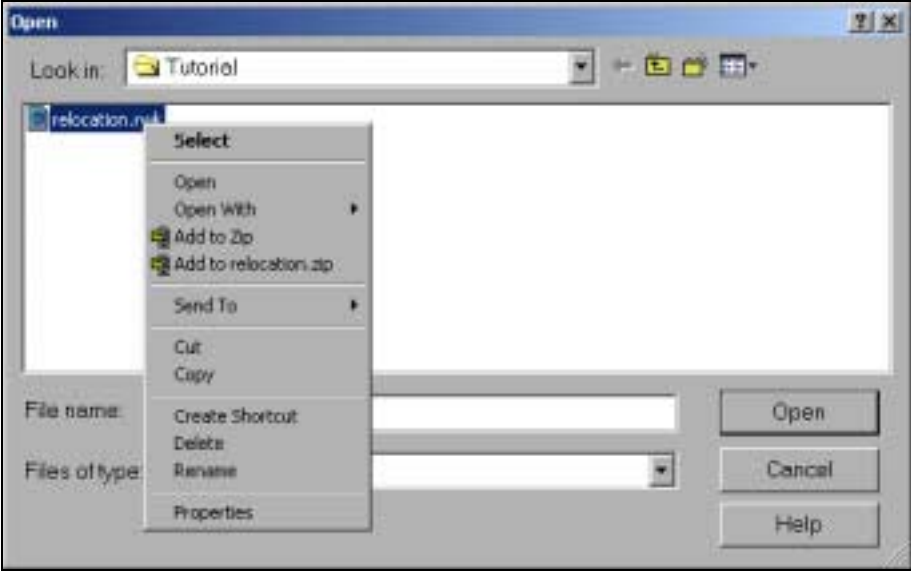
The additional options that are available depend on the entity that you select. In the SelectCAD Explorer, you can also access to the following shortcuts:

- Press the **Insert** key to activate the **New** dialog box.
- Press the **Delete** key to delete the current item.
- Drag-and-drop features between surfaces.
- Click an item to rename it.
- Hold down the **Shift** key to display all the points in a feature, not just the first hundred.

- Review file revision data.

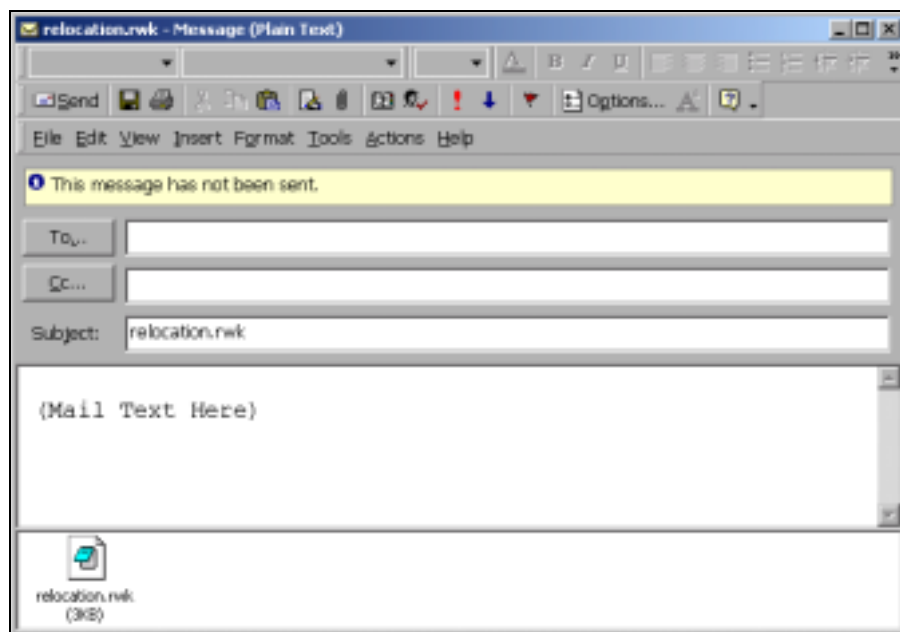
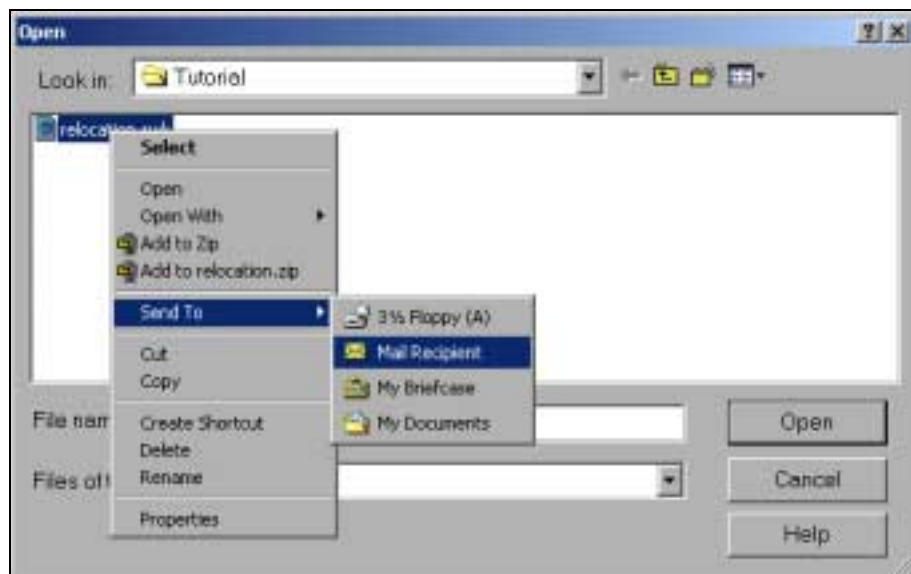


- Cut and paste between fields.
- Click **File > Open** then, right-mouse click to edit ASCII files, using the default text editor. For example, to open and InRoads SelectCAD project file:



3

Review the right-mouse click menu for additional file and mailing options.



The SelectCAD Explorer can be moved to a convenient location on the screen and make several common tasks faster and easier.

Accepting/Rejecting Solutions

If MicroStation is your CAD platform and you are using the default mouse configuration, you accept an InRoads SelectCAD solution by clicking the

left mouse button. You reject an InRoads SelectCAD solution by clicking the right mouse button.

If AutoCAD or is your CAD platform, you accept an InRoads SelectCAD solution by clicking the right mouse button, by typing `accept` or `a`, or by pressing **Enter**. You reject an InRoads SelectCAD solution by typing `reject` or `r`.

On both CAD platforms, you exit an InRoads SelectCAD command by pressing **Esc**.

Using Access Control

Access control allows you to share files among multiple users while controlling read-write access to the data. Using access control, you can essentially “lock” your data so that another user cannot overwrite it while you are working on it. The other user can open the data (read-only access) but cannot make changes to it while you have it opened with read-write access. Likewise, if another user has some data opened with read-write access, your only option is to open the data with read-only access.

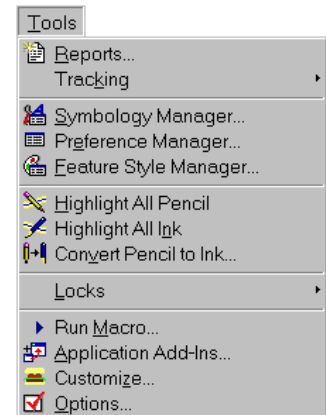
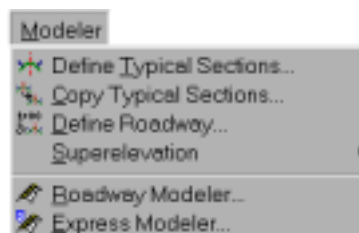
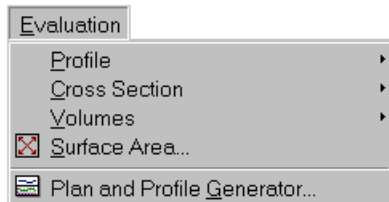
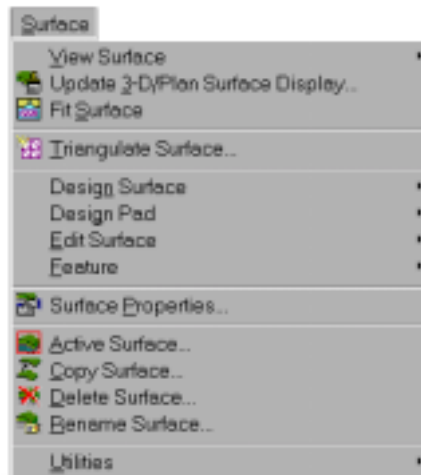
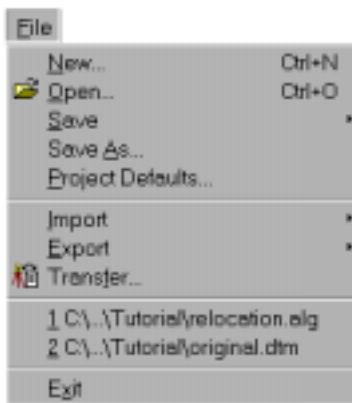
Access control works with individual horizontal alignments, the cogo buffer, and preference files. However, with preference files, you lock the entire file—not individual preferences. When you have read-write access to a horizontal alignment, you also have read-write access to all data associated with the horizontal alignment: vertical alignments, superelevations, vertical event buffers, and horizontal event buffers.

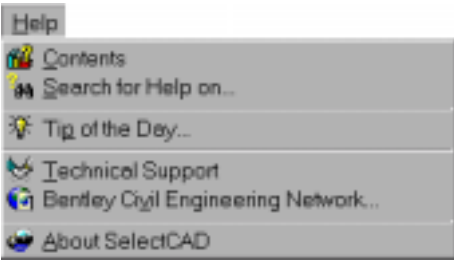
To set the access status, right-mouse click the horizontal alignment, cogo buffer, or preference file in SelectCAD Explorer. When the menu appears, select either **Read-Write** or **Read-Only**. The status is reflected in SelectCAD Explorer.

For more information about access control, see the *SelectCAD Help*.

Menus

The SelectCAD Explorer contains menus that are the primary source of interaction with InRoads SelectCAD.

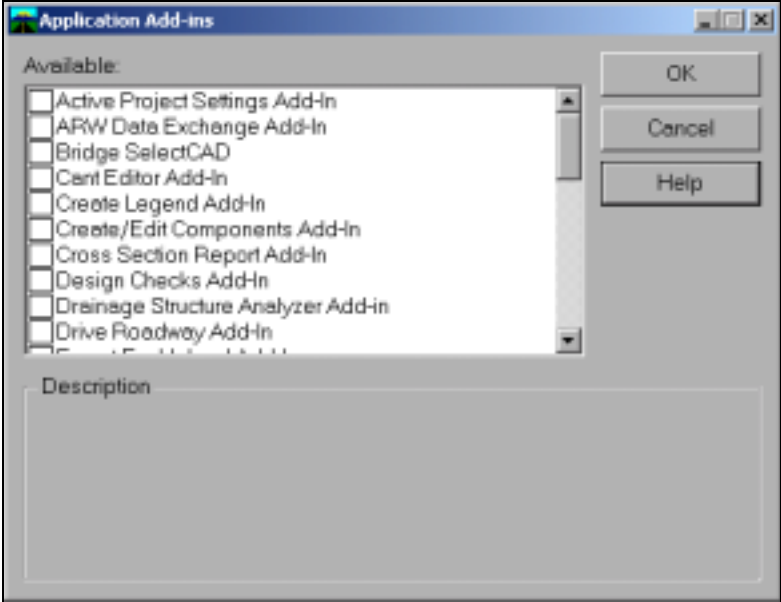




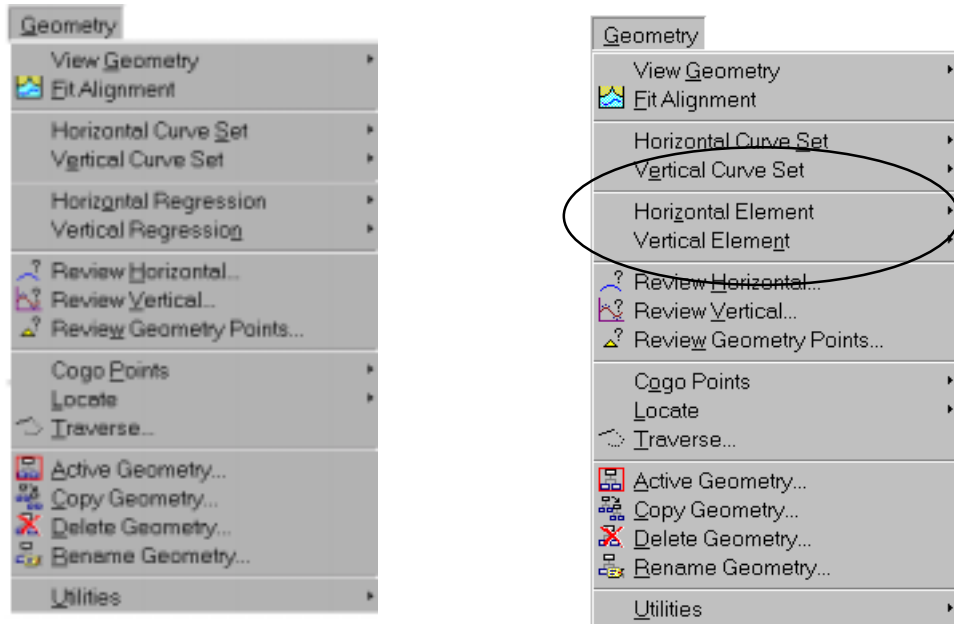
The menu titles are intuitive to a function of the design process. They help you navigate to groups of commands used for a specific task. A small right arrow by a command indicates an additional menu with commands.

Menus and Application Add-Ins

InRoads SelectCAD is delivered with several additional software modules that allow you to complete specialized or advanced tasks, including data translation. To access these features, select **Tools > Application Add Ins**.



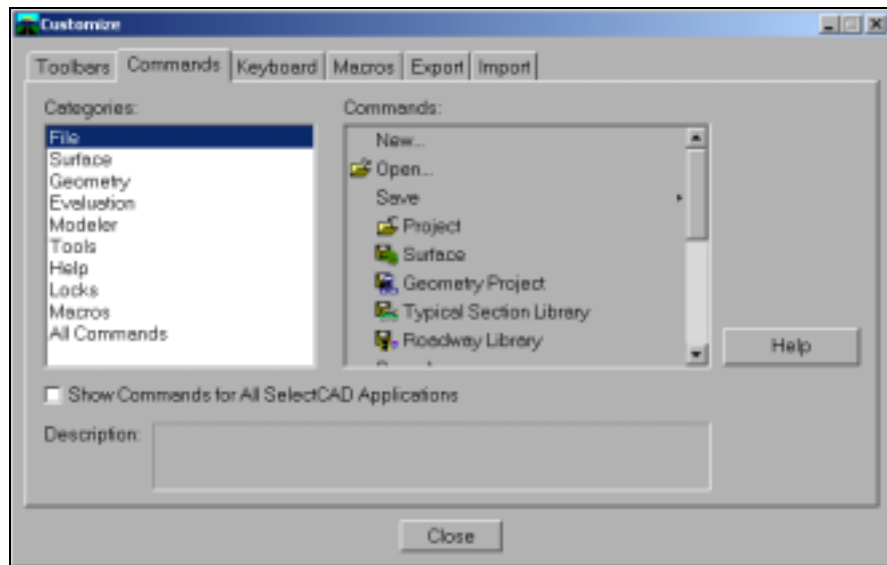
By default, these additional commands do not appear on InRoads SelectCAD menus because they are “turned off”. However, when you select add-in applications, menus are dynamically updated and the commands are listed on the appropriate menu. For example, by default the **Geometry** menu does not include the **Horizontal and Vertical Element Add-In**. If you select it to turn it on and click **Apply**, the command is dynamically added to the menu:



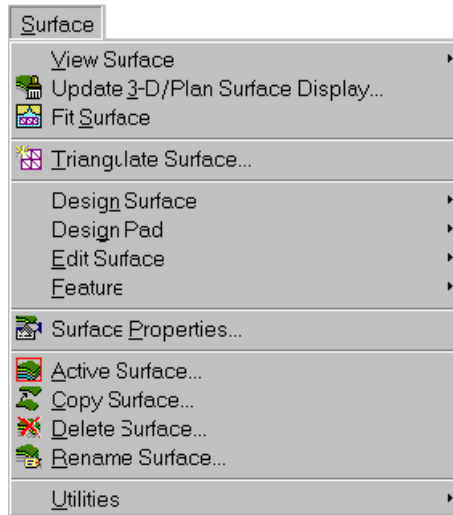
Add-in applications can be turned on and off at anytime during a design session.

Customize Menus

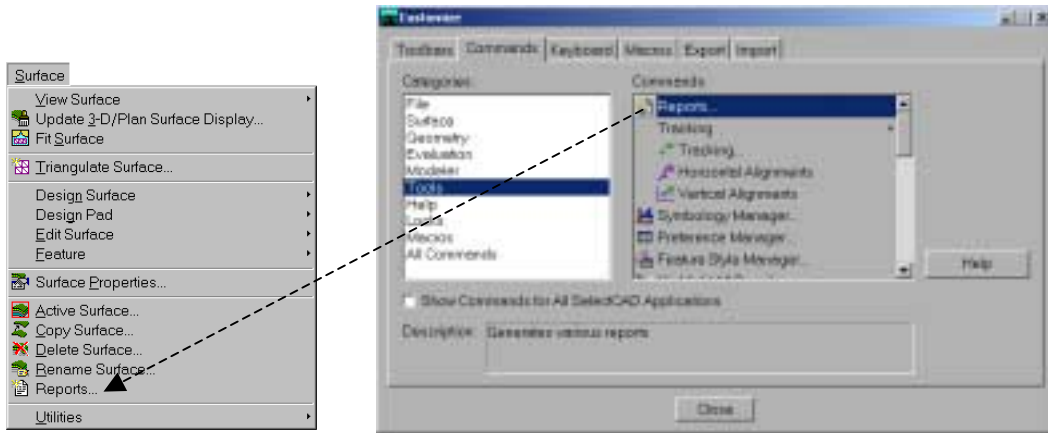
You can also create customized InRoads SelectCAD menus using the **Tools > Customize > Command** tab.



This command allows you to group specific commands together on a menu. First, select the menu on which to place the commands.



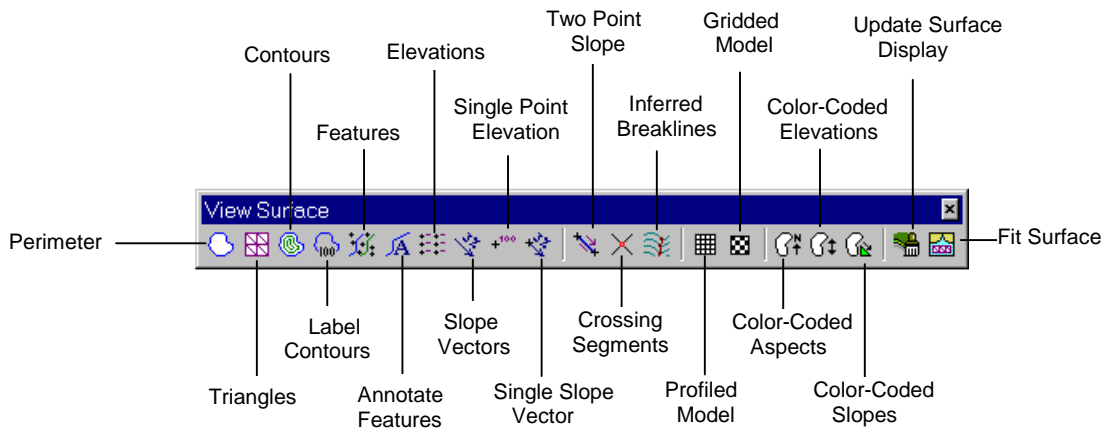
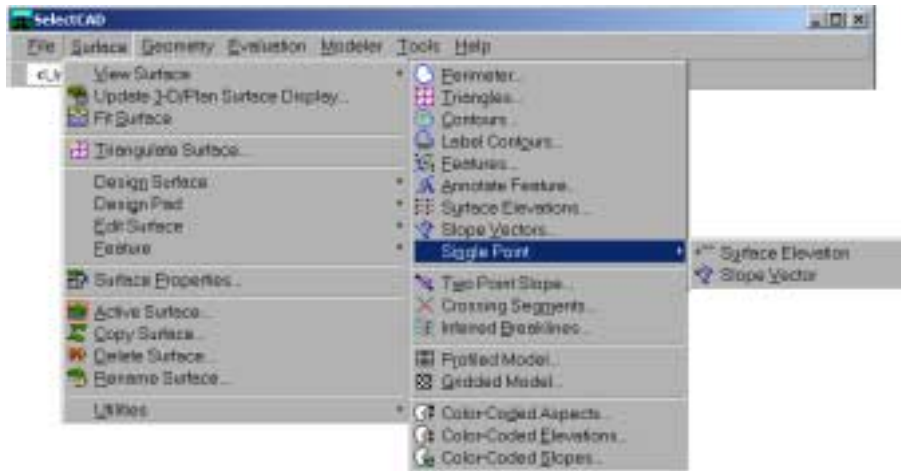
Then, drop and drag the selected command onto the menu.



The command is added to the menu.

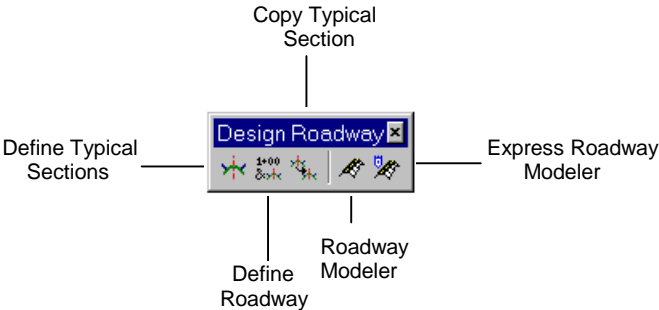
Customize Toolbars

With the **Tools > Customize > Toolbars** command, you can select predefined toolbars to display that provide quick access to frequently used commands. There are toolbars for specific groups of menu commands, such as **View Surface**.

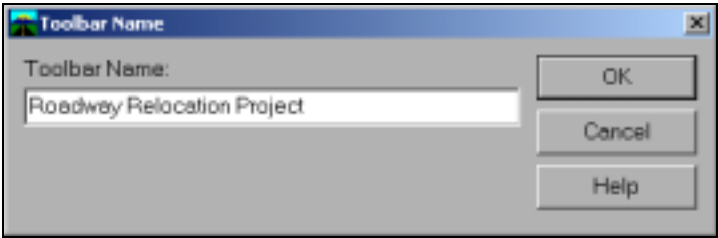


Note: Notice that the **Fit Surface** command is on the toolbar but not on this particular pull-menu. The command is added here for convenience: once you display various representations of the surface, you can quickly fit the surface in the view.

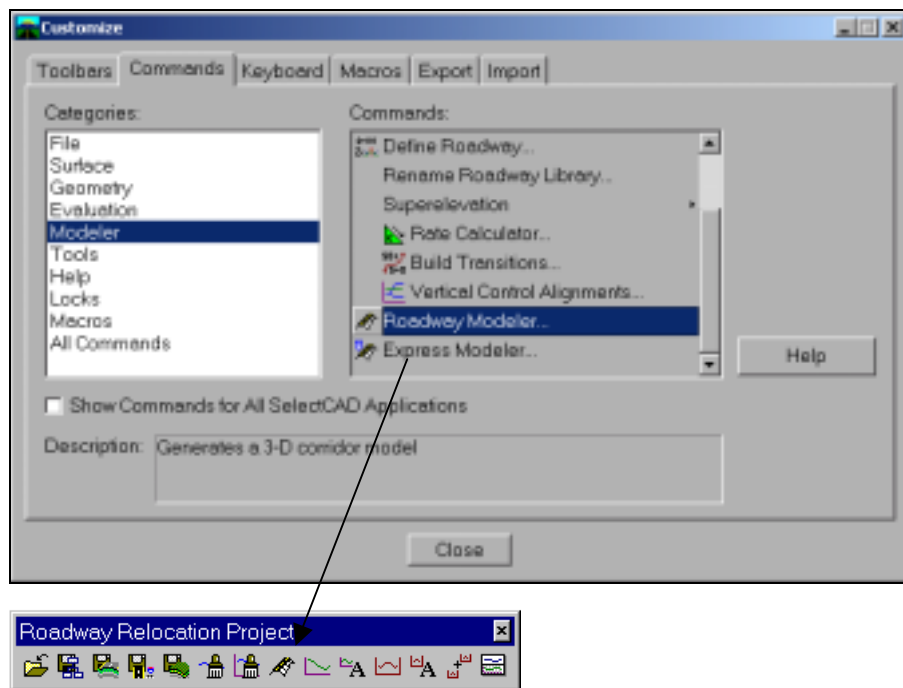
There are also predefined toolbars for common design workflows. The commands on the workflow toolbars may not appear together on any one menu or all of the available commands may not appear, but several are grouped together on the toolbar for a specific function. For example, **Design Roadway**.



If a predefined toolbar does not meet your design needs, you can create customized toolbars for unique workflows. Select **Tools > Customize > Toolbars > New**.

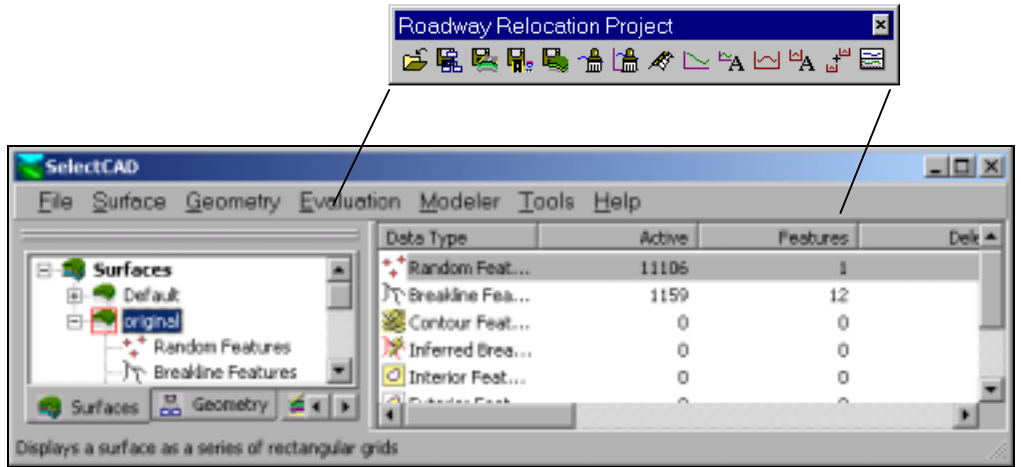


Click the **Commands** tab. Select commands from the list to drag and drop onto the toolbar.



With customized toolbars, you can step through the design process from surface creation to plan and profile sheet generation using a single toolbar.

Once toolbars are displayed, they can be moved to a convenient location on the screen or they can be “docked” onto the SelectCAD Explorer. To dock a toolbar, click and hold on the toolbar, drag it to the SelectCAD Explorer and release it.



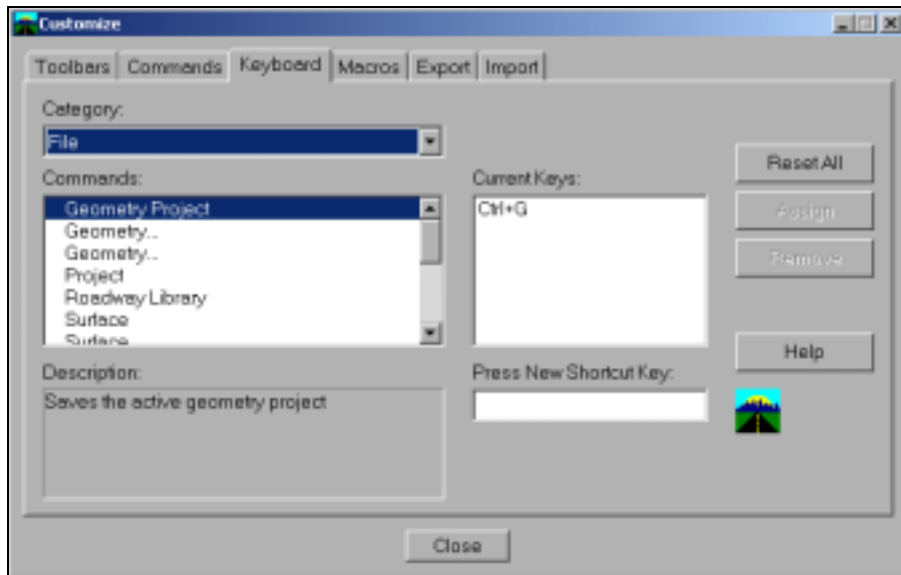
Docked toolbars remain in the SelectCAD Explorer until you delete them.

To remove a docked toolbar, click on it and drag it away from the SelectCAD Explorer and click the **X** button. Or, to remove *all* customized toolbars and menus, click **Tools > Customize > Toolbars > Reset All**.

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Shortcut Keys to InRoads SelectCAD Commands

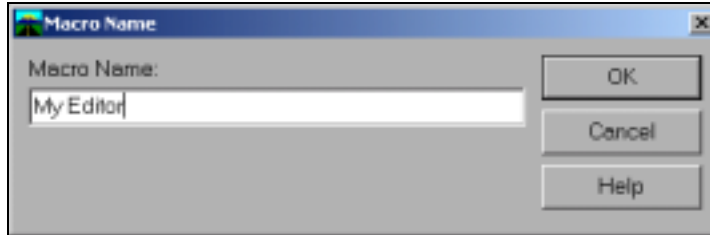
Use the **Tools > Customize > Keyboard** tab to create new keystrokes to activate InRoads SelectCAD commands.



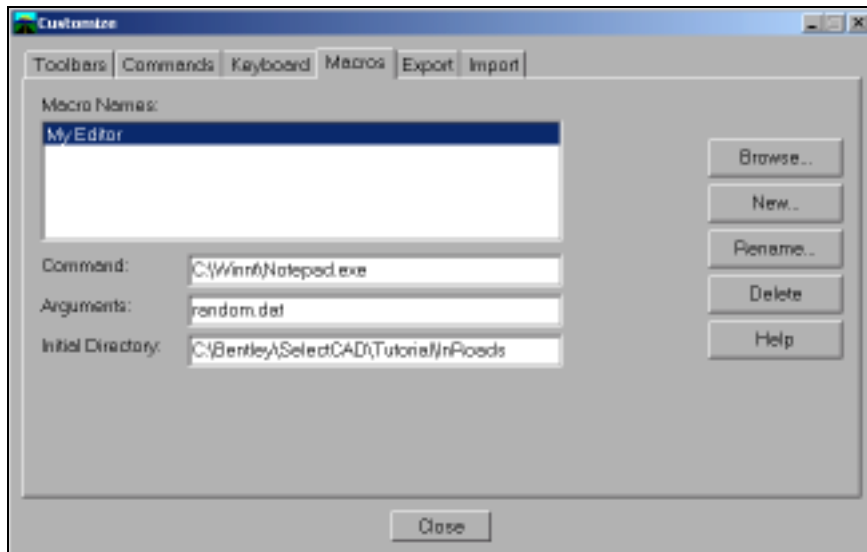
You can create new shortcut keys or modify existing ones.

Customize Macros

The **Text > Customize > Macros** command provides access to external software programs that can be run within InRoads SelectCAD. For example, you can click **New** to create a macro to run Notepad®, a Microsoft text editor, in a specific directory.

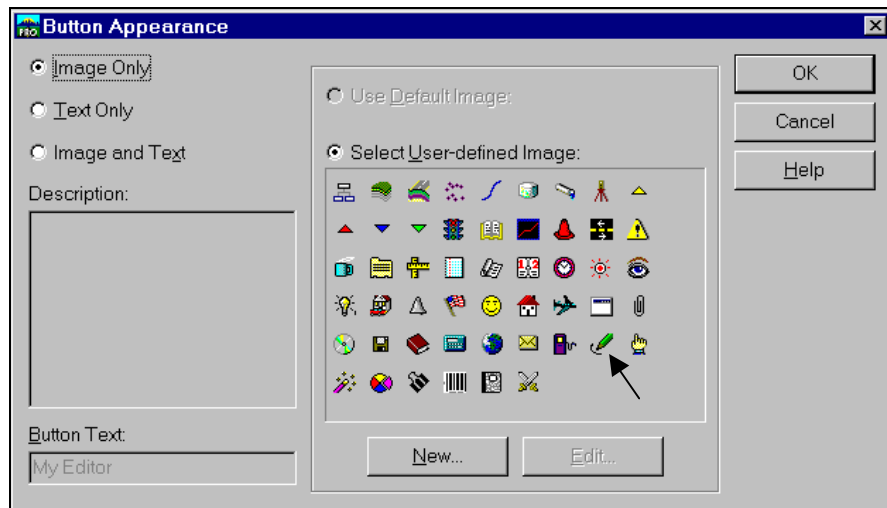


Click **Browse** to locate the Notepad executable. This automatically populates the command field. Then, specify the Argument (file on which to run the editor) and the initial directory (where the file is located).

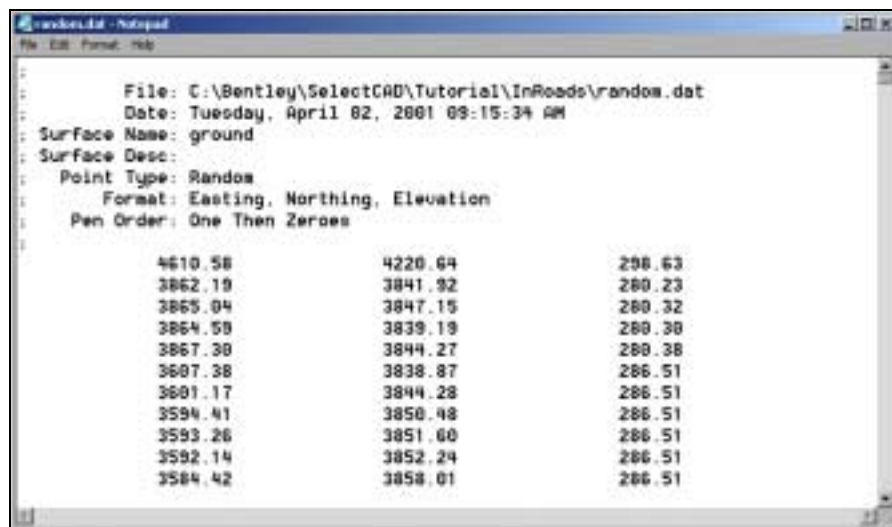


Click **Close**. Now, the new macro appears in the **Commands** list. You can then drag and drop the new macro onto a toolbar or menu.

The **Button Appearance** dialog box appears. Select an icon to represent the macro.



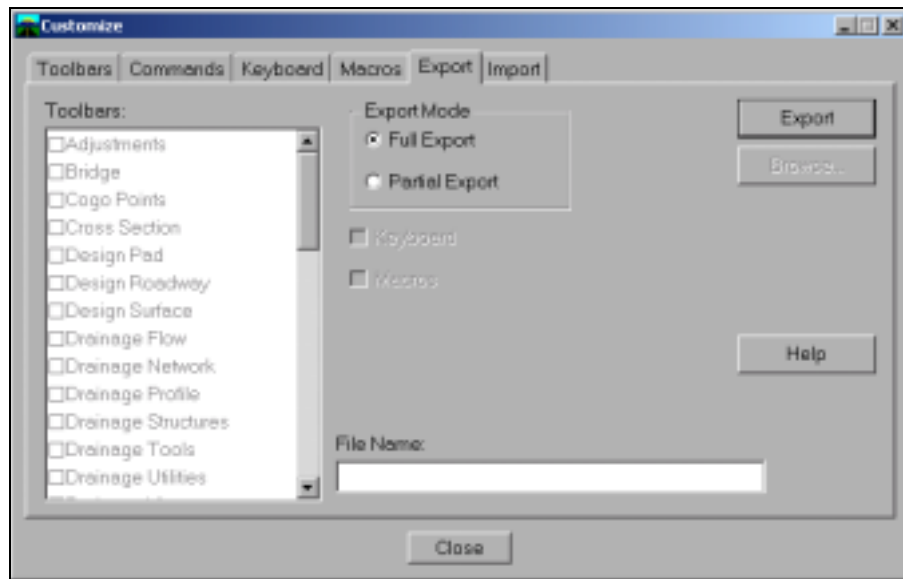
The icon appears on the toolbar. Now, double-click the icon to start the command.



You can also use the **Tools > Customize > Macros** command to run advanced software programs created using the *InRoads SelectCAD Application Programming Interface (APIs)*. APIs give you direct access to the InRoads SelectCAD alignment and surface data. See SelectCAD Help for more information on customizing InRoads SelectCAD with APIs.

Exporting Custom Settings

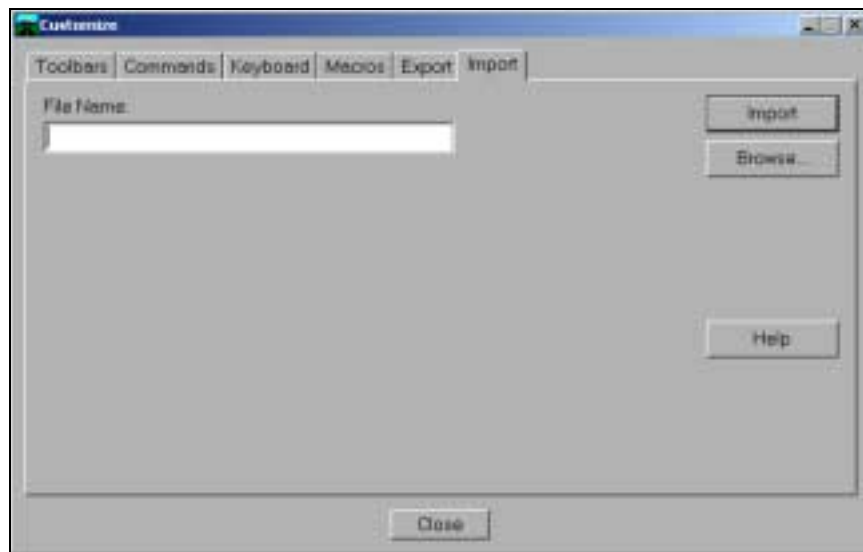
Once custom menus, toolbars and command-shortcut keys have been created, you can save all of the settings to a file for use in future design sessions. To access this command, select **Tools > Customize > Export**.



- **Full Export** – Use this option to save all custom settings.
- **Partial Export** – Turn on this option to individually choose which toolbars to save. You may also specify shortkeys, macros or both.

Importing Custom Settings

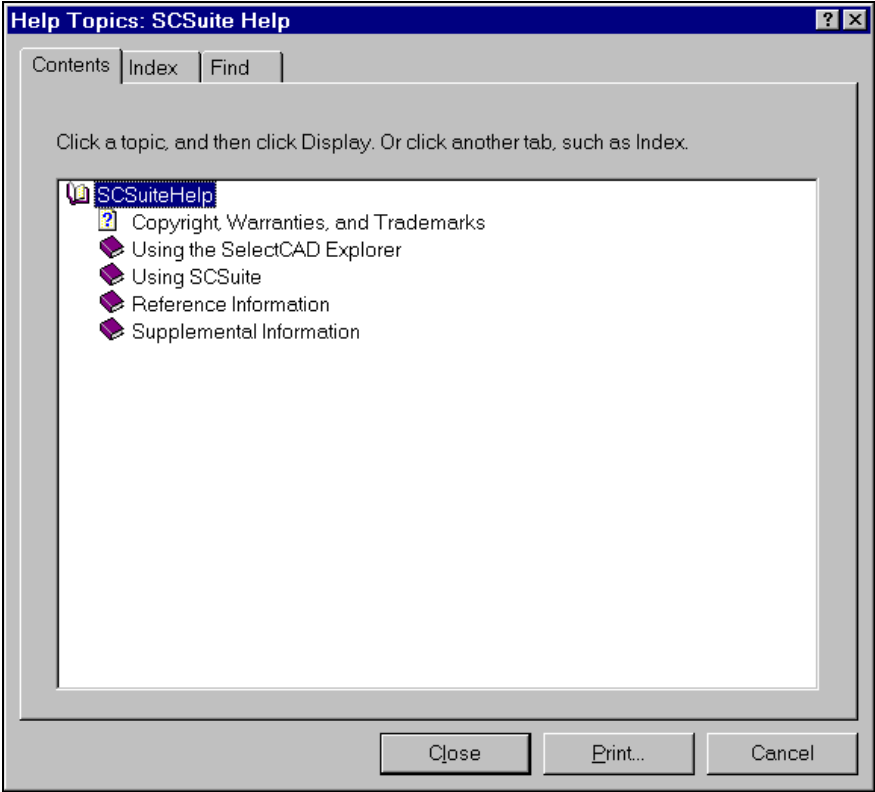
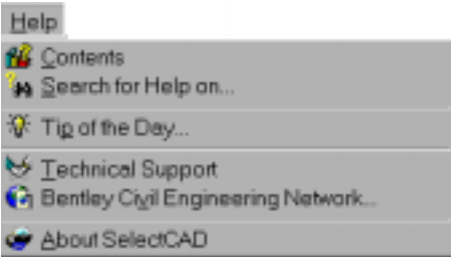
Previously defined settings can be imported for a current design session. To access these settings, select **Tools > Customize > Import**.



Click **Browse** to locate the settings file.

Using the Online Help System

To display Help when InRoads SelectCAD is active, click **Help > Contents** from the main menu.



3

SelectCAD Help Topics

InRoads SelectCAD is delivered with comprehensive online reference information for each command. This information is available through the InRoads SelectCAD Help system. The Help topics include a brief

overview of the command, a detailed description of the dialog box options, and a step-by-step workflow that shows how to use the command.

InRoads SelectCAD allows you to design while integrated with other SelectCAD applications. In this environment, you can access the online Help topics for these applications in addition to InRoads SelectCAD Help.

Note: If Help was not installed on your hard drive during setup, you must have the InRoads SelectCAD CD in the CD-ROM drive or be connected to the network node containing the Help files.

- ❑ Click the **Contents** tab to display the Contents page for InRoads SelectCAD Help. This page is similar to a table of contents in that it lists everything that is available in the Help files. Double-click a file to display it. After reviewing a topic, you can close it or print it.
- ❑ Click the **Index** tab to enter a command name, phrase, or word for which to search. This page is similar to a book index with items listed in alphabetical order. As you type a word, the list dynamically updates as the sorting feature narrows the search. Double-click the topic when it appears in the list, or click the **Display** button.
- ❑ Click the **Find** tab to access a full-text retrieval search. Full-text retrieval allows you to search for specific words instead of alphabetized categories. First, the software builds a database of words from all available Help files. Once the database is compiled, you can search it for any key word. A workflow wizard steps you through this brief process. Double-click a located word or click the **Display** button to display the search results.

To display SelectCAD Help outside of the product, from the **Start** menu, click **Programs > Bentley Civil Engineering > Civil SelectCAD Suite Help>**.

SelectCAD Help is context sensitive, which means that you can press F1 to display Help for the active command or dialog box. You can also click the **Help** button on each dialog box.

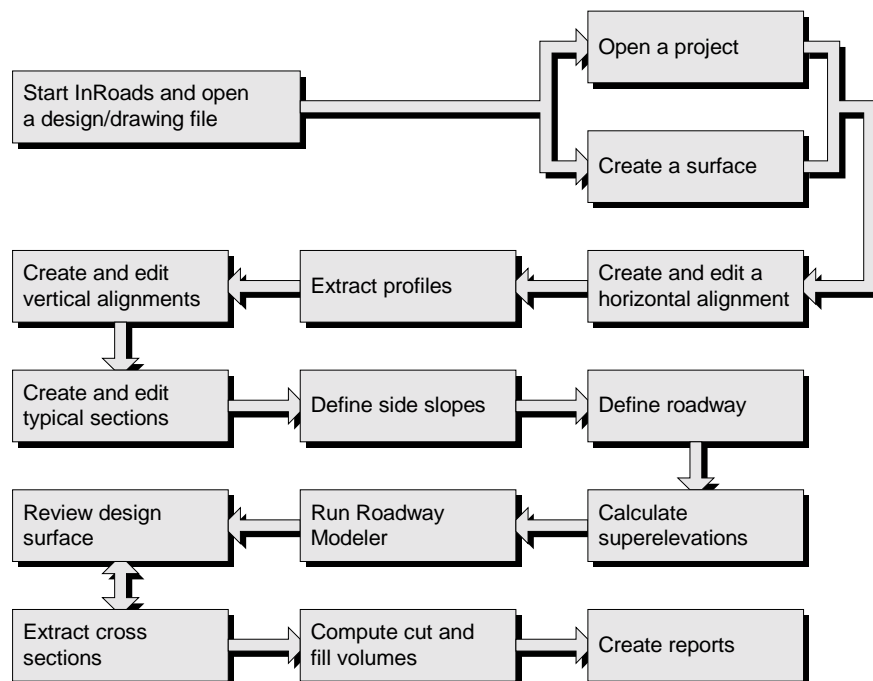
4

Looking at InRoads SelectCAD Workflows

The following workflows represent typical paths you might take when designing a civilworks project using InRoads SelectCAD. Your particular workflow may vary depending on the needs of your project.

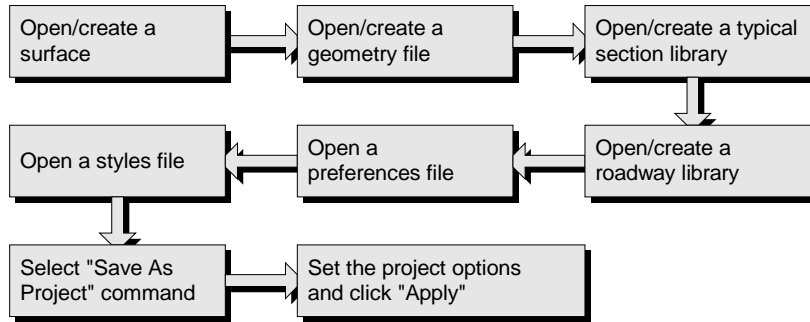
Master Workflow

This workflow diagram presents a few of the paths that you could take through the application to finish your project.



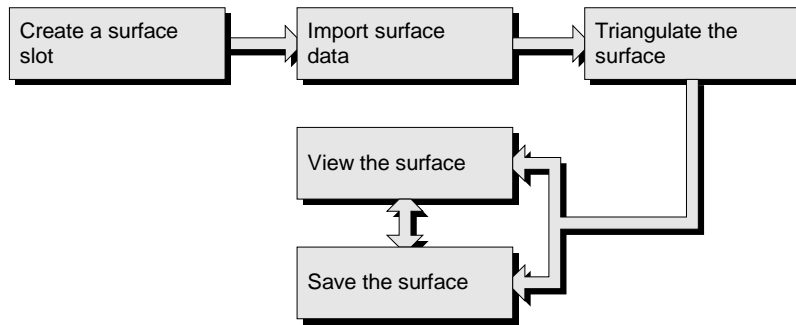
Creating an Overall Project

The following diagram illustrates a general workflow for creating overall InRoads SelectCAD projects.



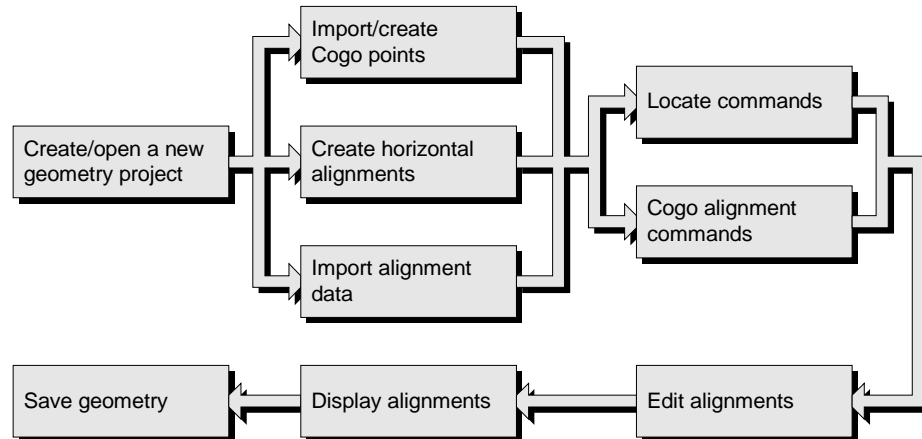
Creating a Surface

The following diagram illustrates a general workflow for creating surfaces.



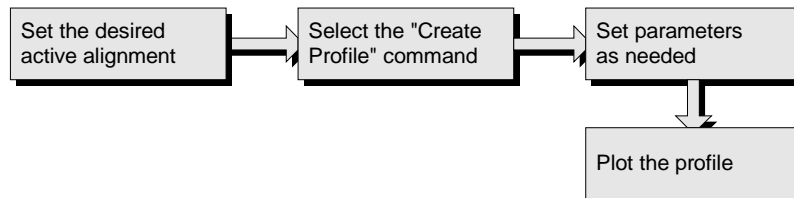
Creating or Editing Geometry Projects and Associated Horizontal Alignments

The following diagram illustrates a general workflow for creating and editing geometry projects and their associated horizontal alignments.



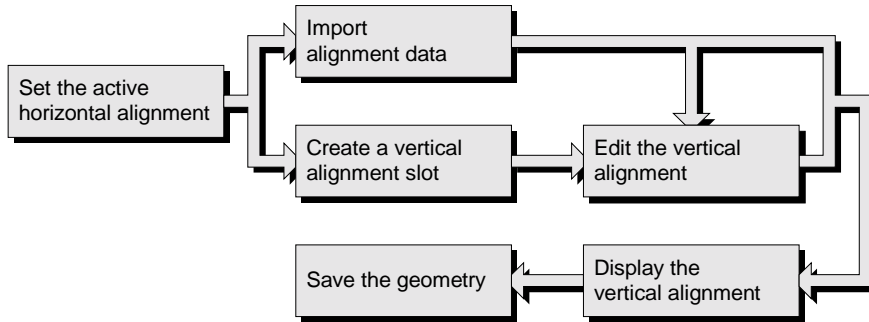
Extracting Profiles

The following diagram illustrates a general workflow for extracting profile information from your horizontal alignment. This is an optional task if you are using the vertical alignment editor.



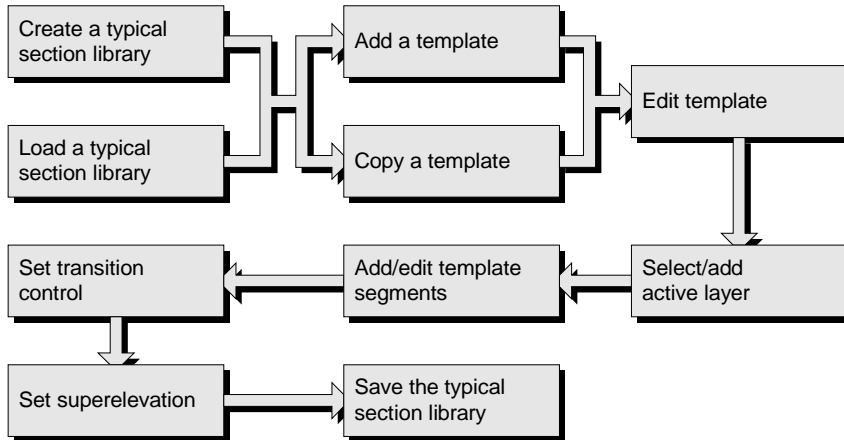
Creating or Editing Vertical Alignments

The following diagram illustrates a general workflow for creating and editing vertical alignments.



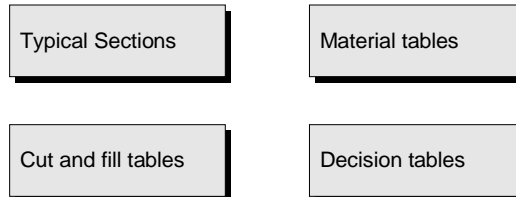
Creating or Editing Typical Sections

The following diagram illustrates a general workflow for creating or editing roadway templates. This is an optional task. You could also use the surface design, cross section editing, or import geometry to surface commands with similar results.



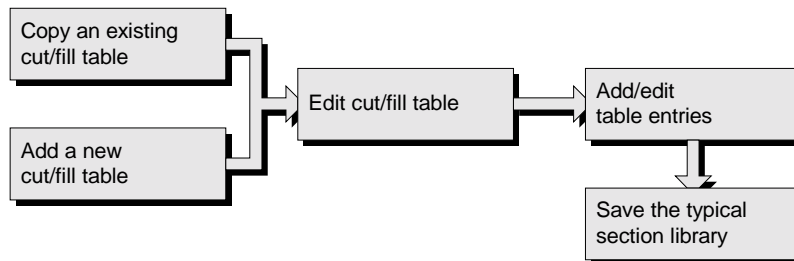
Defining Side Slopes

InRoads SelectCAD defines side slopes several ways.



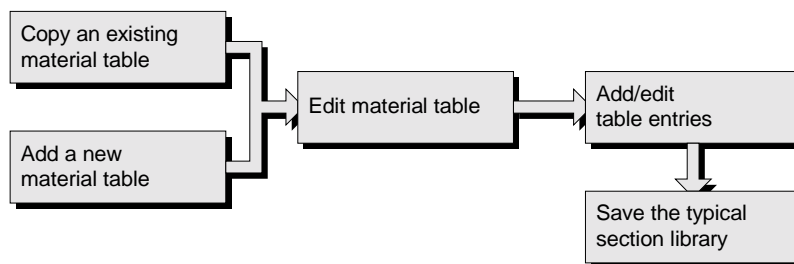
Defining Side Slopes with Cut/Fill Tables

The following diagram illustrates a general workflow for defining side slopes by using cut/fill tables.



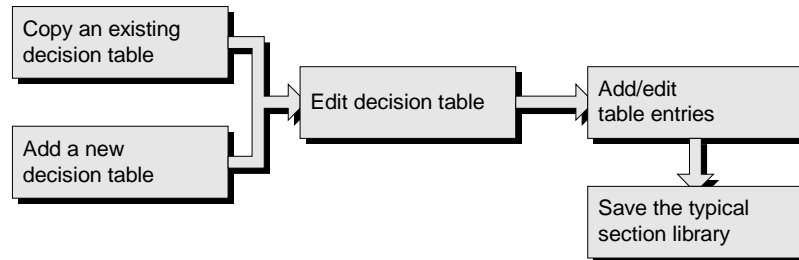
Defining Side Slopes with Material Tables

The following diagram illustrates a general workflow for defining side slopes by using material tables.



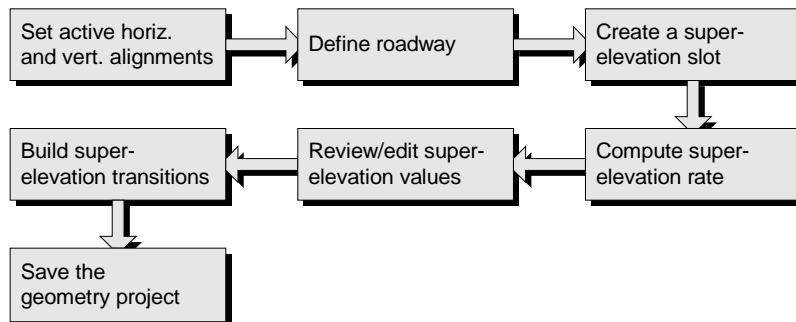
Defining Side Slopes with Decision Tables

The following diagram illustrates a general workflow for defining side slopes by using decision tables.



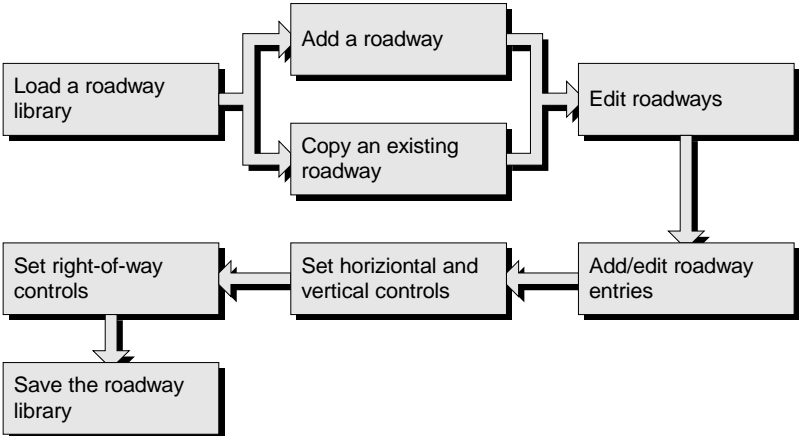
Creating and Calculating Superelevations

The following diagram illustrates a general workflow for defining superelevations. This is an optional task.



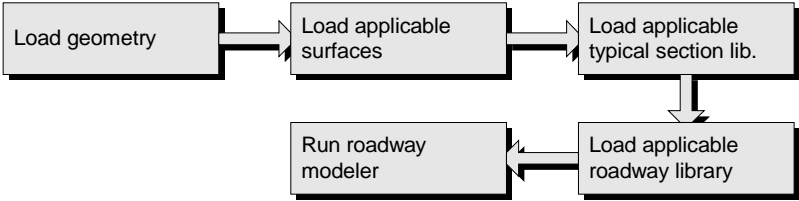
Defining the Roadway

The following diagram illustrates a general workflow for defining roadways.



Running the Roadway Modeler

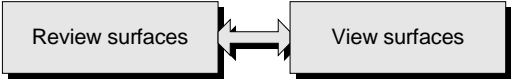
The following diagram illustrates a general workflow for modeling the roadway.



4

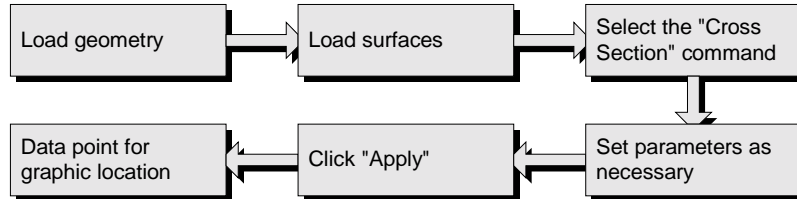
Reviewing the Design Surface

The following diagram illustrates a general workflow for reviewing the design surface.



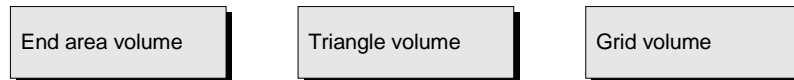
Extracting Cross Sections

The following diagram illustrates a general workflow for extracting cross sections from the roadway.



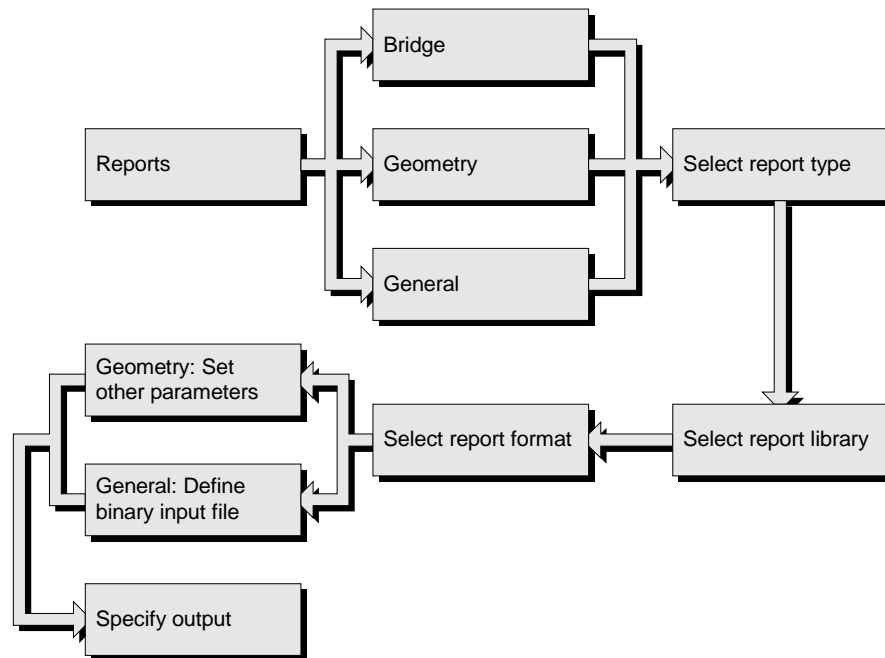
Computing Volumes

InRoads SelectCAD calculates volumes in three ways.



Creating Reports

The following diagram illustrates a general workflow for creating reports.



5

Learning InRoads SelectCAD

This chapter contains lessons that provide a brief look at creating a roadway using InRoads SelectCAD. The workflow represents a typical approach to roadway design and gives you a practical application of some of the more commonly used commands in the product.

It is recommended that you start at the beginning of the tutorial and work through to the final lesson. However, you can complete the lessons individually, in any order.

While the lesson demonstrates how to accomplish an entire road design, it is not meant to be a comprehensive discussion of every possible command and parameter within the product. For more details on a specific command or concept in the lesson, see the *SelectCAD Help Topics* (click **Help > Contents** or press **F1**).

Prerequisites

Before you start, you should already know how to run your CAD software. If you are a new user, it is recommended that you read the introductory chapters of this document to gain a general understanding of the software. If you are an experienced InRoads SelectCAD user, you may want to review the introductory chapters, as there are many changes in this version of the software.

InRoads SelectCAD must be successfully installed and running on your machine. The tutorial files are downloaded during Setup with a **Typical** installation. The files are stored in the *C:\Bentley\SelectCAD\Tutorial\InRoads* directory.

Note: It is assumed that you installed InRoads SelectCAD to the C drive and default directory path. If you installed the product on a different drive or directory path, the location of the files is different than those in the lessons.

Saving Your Work

Throughout the lesson, you will load files from and save files to the `\Tutorial\InRoads` directory. However, you can create another directory and save your files there. If, in the lesson, the instructions tell you to load a file that you created or modified, you can load the file from your directory.

Before Starting Each Lesson

Before starting each lesson, you must first extract the lesson files. To extract the files, do the following:

1. From the **Start** menu, click **Programs > Windows NT Explorer** if you are running Windows NT, or **Programs > Windows Explorer** if you are running Windows 98 or Windows 2000.
2. Set the directory to `C:\Bentley>SelectCAD\Tutorial\InRoads` (or to the appropriate directory if you copied the files).
3. The self-extracting tutorial files are named `roadlesson1.exe`, `roadlesson2.exe`, and so on. Double-click the file that corresponds to the lesson that you are on. For example, double-click `roadlesson3.exe` to extract the files for Lesson 3.

Note: If you have already extracted the files for a previous lesson, you may be prompted to overwrite some files. To overwrite these files, type Y at the prompts.

If you start the lesson and see that you have done something wrong, you can exit the lesson, extract the files again, and start over using the new files that are provided. This lets you recover quickly from any problems that may occur as you manipulate your files.

Basic Roadway Design

In this tutorial, you create a new roadway. You will complete the following tasks:

- Start the software.
- Set units of measure.
- Create a surface.
- Create a horizontal alignment.
- Create a profile along an alignment.
- Create a vertical alignment.
- Create plan sheets.
- Create a typical section.
- Create a decision table.
- Create a roadway library.
- Create a roadway model.
- Evaluate the design.
- Create reports.
- Create final plan and profile sheets.

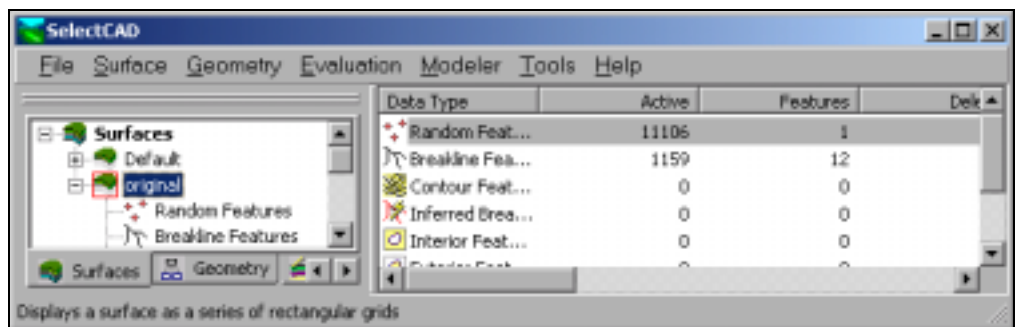
Note: Depending on your CAD software, the graphical examples in the lesson may be different from what you experience. Where necessary, specific CAD instructions are provided.

Lesson 1: Starting InRoads SelectCAD

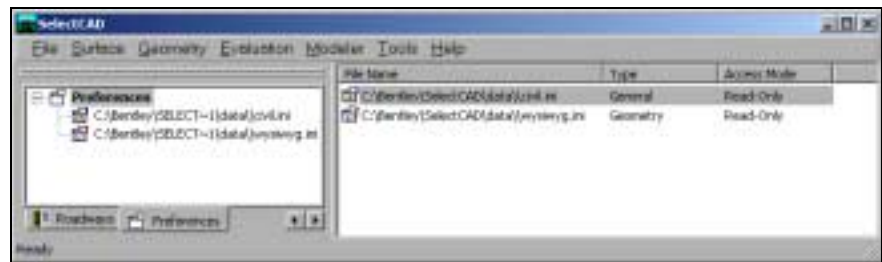
Begin the design session by starting InRoads SelectCAD.

1. Extract *roadlesson1.exe*. For more information on extracting lesson files, see the *Before Starting Each Lesson* section at the beginning of this chapter.
2. Start InRoads SelectCAD. Click **Start > Programs > Intergraph Civil Engineering > InRoads SelectCAD**. On MicroStation, open *road.dgn*. On AutoCAD open *road.dwg*. These files are located in the Tutorial\InRoads directory.

Note: For MicroStation users only, the *road_ref.dgn* file that appears in this directory is a reference file for *road.dgn*. Open *road.dgn*



3. Click the **Preferences** tab at the bottom of the Explorer.
4. Click the plus sign (+) next to **Preferences**. Notice that there are two files listed. The *civil.ini* and *wysiwyg.ini* files were loaded when InRoads SelectCAD started.
5. To the right you should see three columns: **File Name**, **Type**, and **Access Mode**. The *civil.ini* file is labeled **General** and the *wysiwyg.ini* file is labeled **Geometry**.
6. Click the plus sign (+) next to **Preferences** in the SelectCAD Explorer. Notice that there are two files listed. The *civil.ini* and *wysiwyg.ini* files were loaded when InRoads SelectCAD started.



The **General** preference file sets units of measure (imperial or metric) and the settings and layers on which everything in the design, except the geometry, displays. The **Geometry** preference file determines how the horizontal alignment, coordinate geometry points, and closed figures would display.

Next, you will modify the general preferences file.

Setting Units of Measure

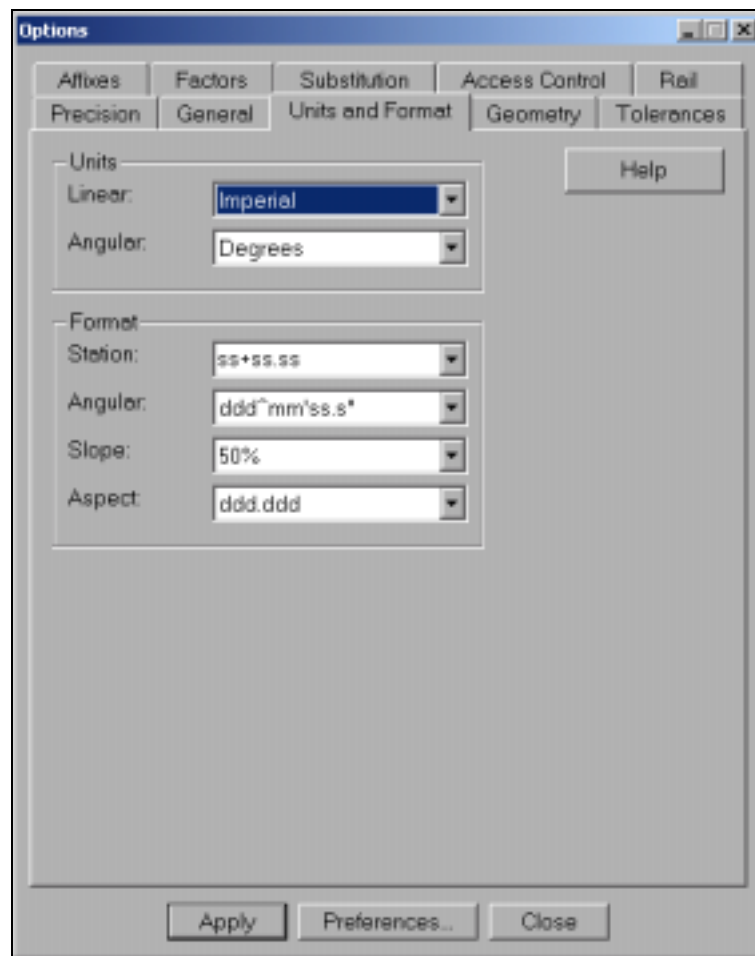
InRoads SelectCAD uses the units of measure selected during installation, either imperial or metric. This setting is saved in the *civil.ini* file. The location of the *civil.ini* is shown in the SelectCAD Explorer when you click **Preferences**. InRoads SelectCAD starts each session using this *civil.ini* file.

For this lesson, you will use metric units in a file prepared for this tutorial: *civilm_tut.ini*. To define settings, do the following:

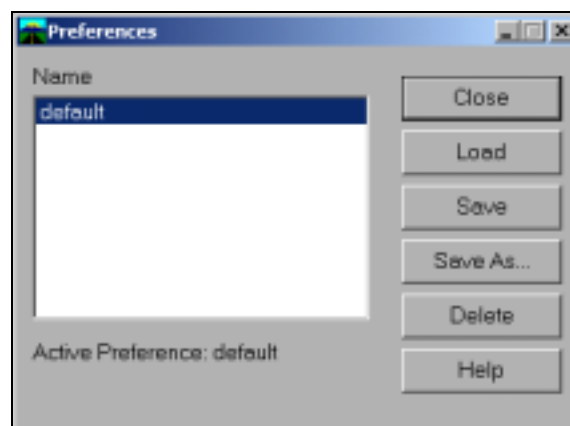
1. Click **File > Open**.
2. Change **Files of type** to **Preferences (*.ini)**.
3. Navigate to the *C:\Bentley>SelectCAD\Tutorial\InRoads* directory.
4. Select *civilm_tut.ini* and click **Open**.
5. Change **Files of type** to **Styles (*.ini)**.
6. Select *wysiwig.ini* and click **Open**.
7. Click **Cancel** to dismiss the dialog box.

You have opened the preference files for metric settings. Next, set the units of measure within InRoads SelectCAD.

8. Click **Tools > Options**.
9. Click the **Units and Format** tab. Under **Units**, for **Linear**, select **Metric**. For **Angular**, select **Degrees**. Click **Apply**.



10. Click the **Preferences** button.
11. Click **Save**.



This updates the settings in the file. When you exit the product, the *.ini* file is saved so that next time you start InRoads SelectCAD the settings are the same.

12. Click **Close** to dismiss the **Preferences** dialog box.

You've just modified the *civilm_tut.ini* file.

13. Click **Close** to dismiss the **Options** dialog box.
14. Click **File > Exit** and then exit your CAD software, or continue to the next lesson.

Lesson 2: Digital Terrain Modeling

InRoads SelectCAD uses DTMs as the basis for much of its engineering calculations. DTMs consist of a series of measured points connected together as triangles to form a 3-D faceted surface. In this lesson, you load points from a field survey, create a DTM, and display the surface perimeter, contours, and triangles.

One reason for modeling the existing terrain is to design the grade of your road using the existing terrain as a reference. When you are done designing the proposed road, you compare the roadway surface against the original surface to compute earthworks (volumes) for your design.

Before Getting Started

If you did not exit InRoads SelectCAD and the CAD software in the previous lesson, skip to *Creating a Surface*. If you are just beginning the tutorial here, complete the following steps:

1. Extract *roadlesson2.exe*. For more information, see *Before Starting Each Lesson* at the beginning of this chapter.
2. Start InRoads SelectCAD, and open the *road.dwg* or *road.dgn* file. These files are located in the *\Tutorial* directory where you installed InRoads SelectCAD. For more details on starting the software, see *Chapter 2, Starting InRoads SelectCAD*.
3. Click **File > Open**.
4. Set the directory to *C:\Bentley>SelectCAD\Tutorial\InRoads*.
5. For **Files of type**, select **Preferences (*.ini)**.
6. Select *civilm_tut.ini*, and click **Open**.
7. Change **Files of type** to **Styles (*.ini)**
8. Select *wysiwyg.ini*, and click **Open**.

These preference files contain default settings for this tutorial.

9. Click **Cancel** to dismiss the **Open** dialog box.

Creating a Surface

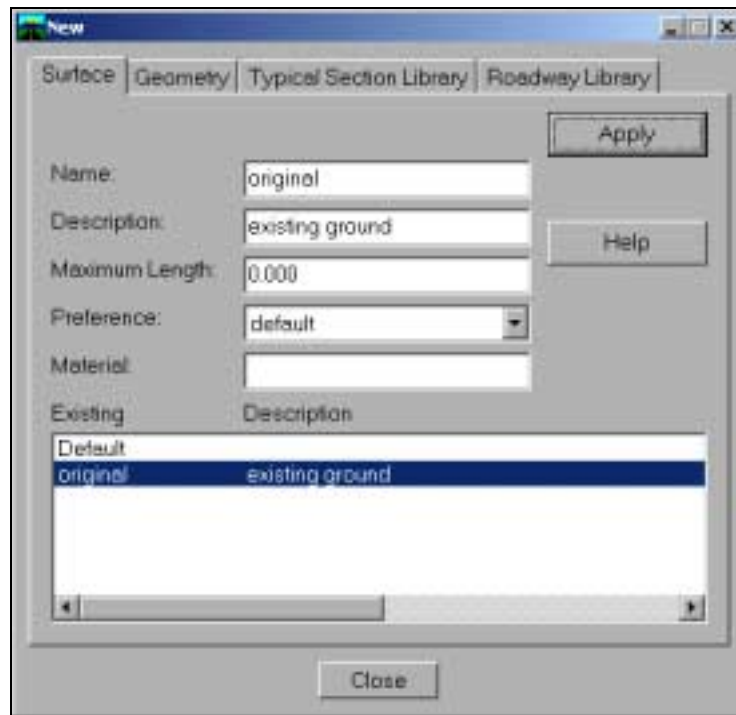
The first step in your project is to create a model representing the existing ground in the project area. For this step, assume that a survey has already been made of the area. The data, in the form of xyz coordinates, has been put into two point files. Before you can load any surface information from these files, you must create a new surface to hold the data.

Note: A surface can be created in several ways, such as when importing a surface. In this lesson, you create a surface using the **File > New** command.

1. Click **File > New**.
2. Click the **Surface** tab.
3. For **Name**, type `original`. Press the **TAB** key.

Note: It is important that you press the **TAB** key rather than the **ENTER** key after you type an entry in a field. The **ENTER** key can activate the command; the **TAB** key accepts a key-in without processing the dialog box.

4. For the **Description**, type `existing ground`.
5. For the **Preference**, select **default**.
6. Press the **TAB** key, and click **Apply**.



InRoads SelectCAD creates a new surface named *original*. When the process is complete, *original* is listed in the **Existing** list box and it should be highlighted. The highlight shows that it is the active surface.

7. Click **Close** to dismiss the **New** dialog box.

Loading an ASCII Surface

Next, you load xyz points (collected by surveyors or photogrammetry) from two ASCII files into the surface you just created. These points define a surface that represents the existing (or original) terrain.

1. Click **File > Import > Surface**.
2. Click the **ASCII** tab.
3. For the **Surface**, select **original**.

Note: If you have previously placed a region or fence and the **Region/Fence Mode** is active, select **Ignore**. If you do not select **Ignore**, only the area defined will be loaded.

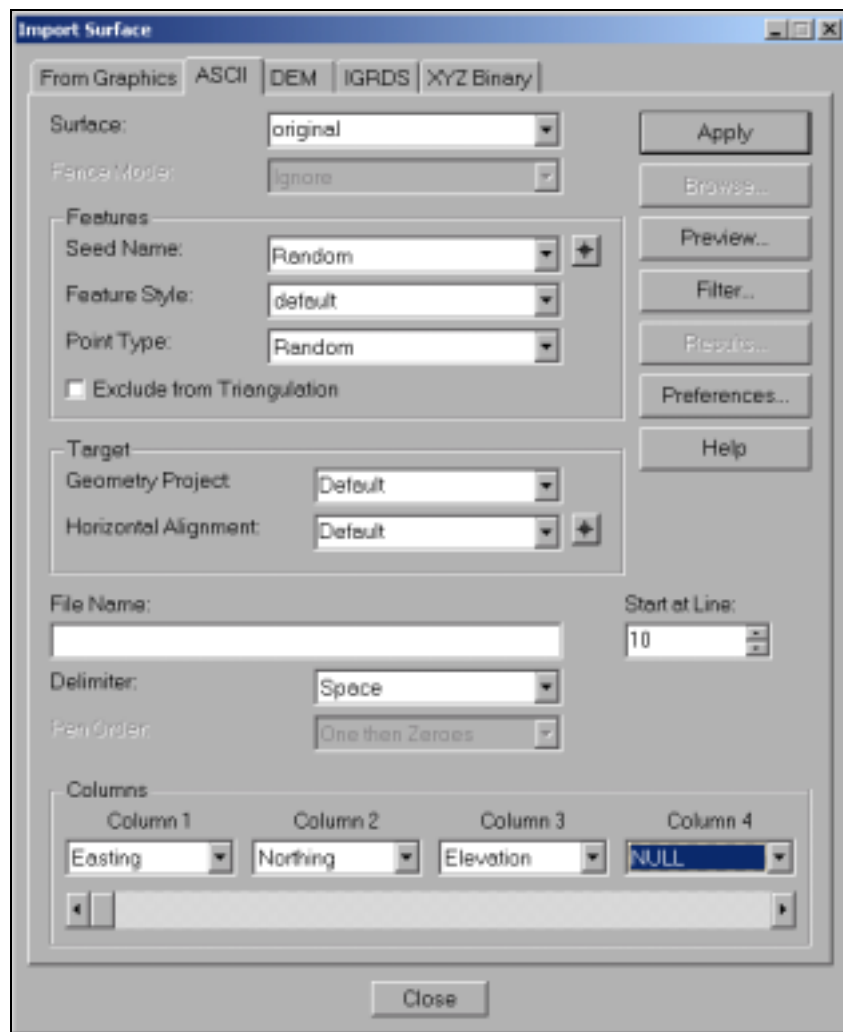
4. For **Seed Name**, type **Random**.
5. For **Feature Style**, select **default**.
6. For the **Point Type**, select **Random**.
7. Make sure the **Exclude from Triangulation** toggle is turned off.
8. For the **Delimiter**, select **Space**.

Each bit of data in the file will be separated by at least one space.

9. For the **Start At Line**, type 10.

This setting tells InRoads SelectCAD to skip over the first 9 lines in the file.

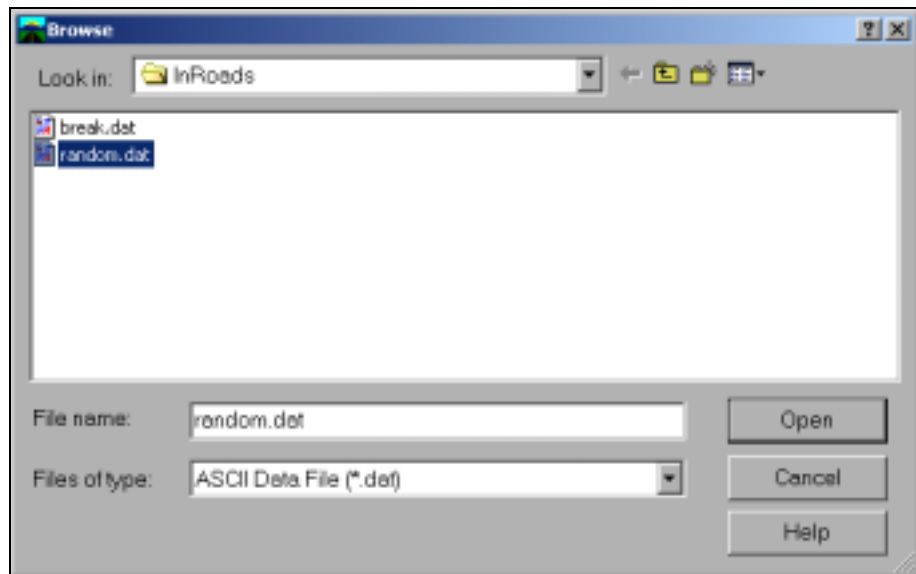
10. In the **Columns** section, do the following. For **Column 1**, select **Easting**. For **Column 2**, select **Northing**. For **Column 3**, select **Elevation**. For **Column 4**, select **NULL**.
11. Keep the defaults for all other settings.



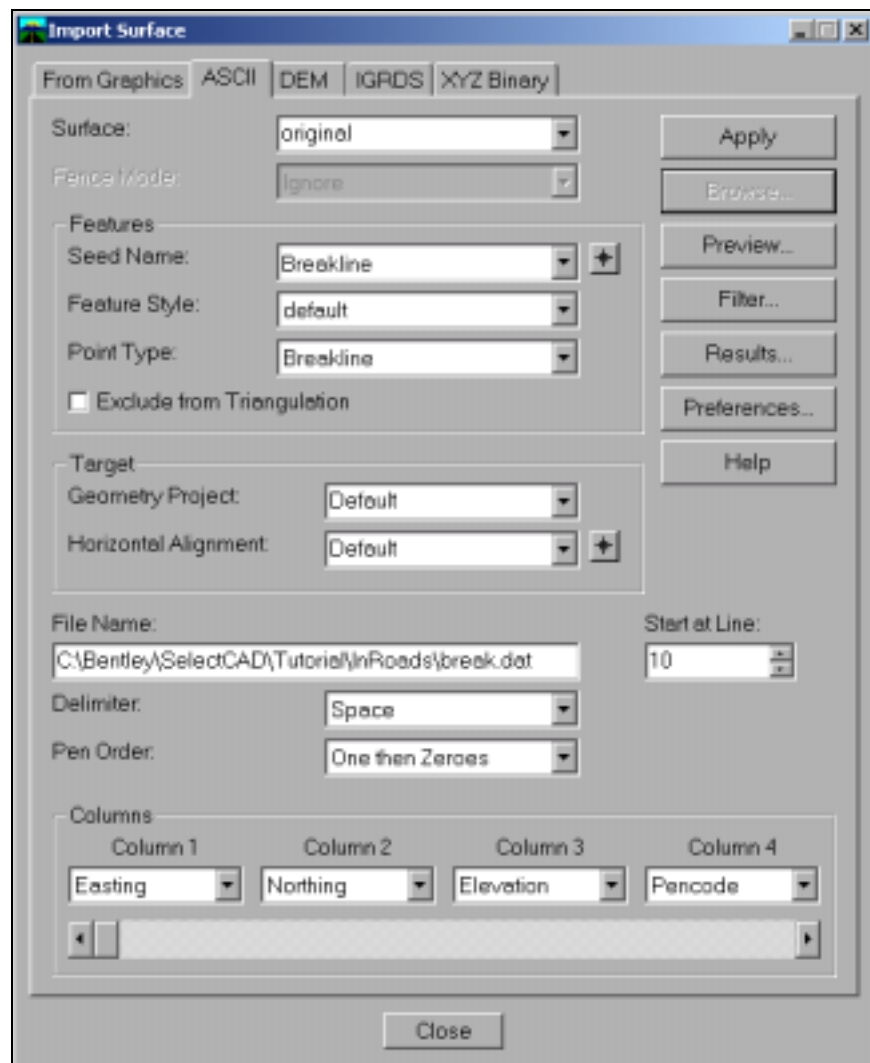
Easting-Northing-Elevation describes the format of the coordinates in the point file as xyz and anything after that in the line should be ignored.

5

12. Click in the **File Name** field, and click **Browse**.
13. Set the directory to *C:\Bentley>SelectCAD\Tutorial\InRoads*. Select **random.dat** and click **Open**.



8. Click **Apply**.
InRoads SelectCAD loads the points contained in *random.dat* to the surface *original* as random points.
9. For the **Seed Name**, type Breakline.
10. For the **Feature Style**, select **default**.
11. For the **Point Type**, select **Breakline**.
12. Make sure the **Exclude from Triangulation** toggle is turned off.
13. For the **Pen Order**, select **One then Zeroes**.
The pen order defines where the breakline begins and ends.
14. For **Column 4**, select **Pencode**.
15. Click in the **File Name** field, and click **Browse**.
16. Select **break.dat**, and click **Open**.

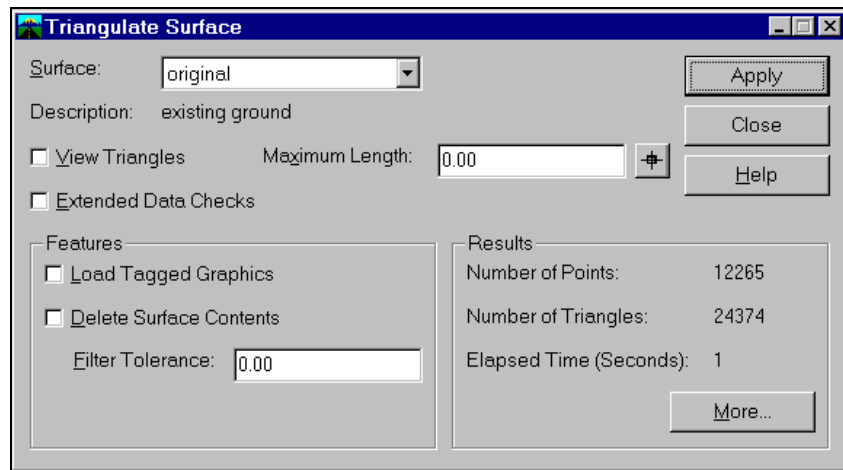


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17. Click **Apply**.

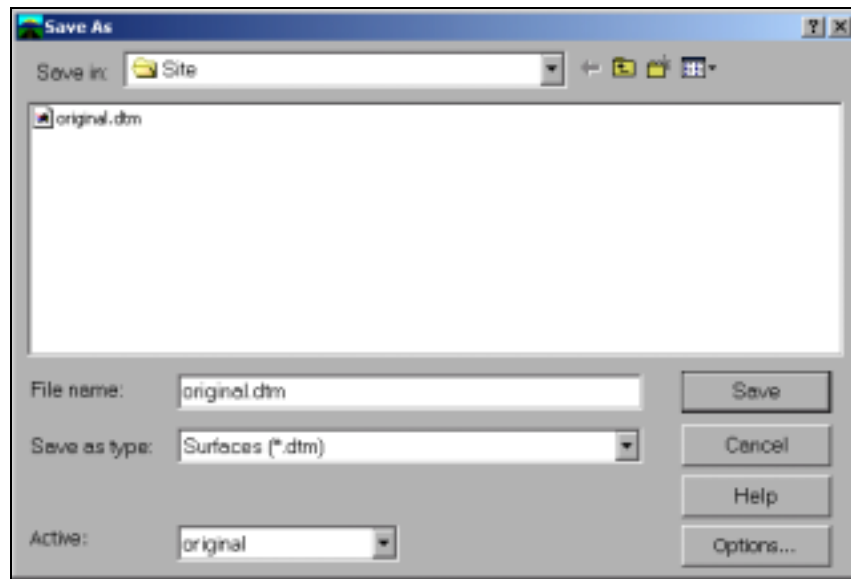
InRoads SelectCAD loads the points contained in *break.dat* into the surface *original* as breakline points.

18. Click **Close**.
19. Click **Surface > Triangulate Surface**.
20. For the **Surface**, select **original**. Make sure that none of the toggles are on, and then click **Apply**.



InRoads SelectCAD connects the points in surface *original* to form a faceted surface of triangles. When the process is finished, the **Triangulate Surface** dialog box reports how many points and triangles exist in the DTM.

21. Click **Close** to dismiss the dialog box.
22. Save the surface you just created. Click **File > Save As**.
23. Set the directory to *C:\Bentley>SelectCAD\Tutorial\InRoads*.
24. For **Save as type**, select **Surfaces (*.dtm)**.
25. For **Active**, select **original**.
26. For the **File Name**, type *original.dtm*.
27. Click **Save** to save the DTM.



28. Click **Cancel** to dismiss the dialog box.

You have created a surface and loaded ground survey points into the surface. Next, you define some criteria for the surface and display it.

Terrain Model Display

Now that you have loaded the data from the field survey into InRoads SelectCAD, you can display the DTM that represents the original ground. InRoads SelectCAD contains more than a dozen commands to view terrain models (surfaces) in a variety of ways, including points, triangles, contours, isopachs, and color-coded representations of elevation, slope, and aspect, and so on.

In this section, you will create symbology for objects in the DTM, create a preference set for the surface *original*, use three of the viewing commands (perimeter, contours and triangles), learn about **Pencil/Pen** and **Write** lock commands.

5

Creating Named Symbology

InRoads SelectCAD allows you to uniquely define criteria, such as symbology for objects that appear in the DTM. The symbology is selected and given a specific name for future use. Before displaying the surface, you will select symbology for the surface perimeter, triangles, and contours.

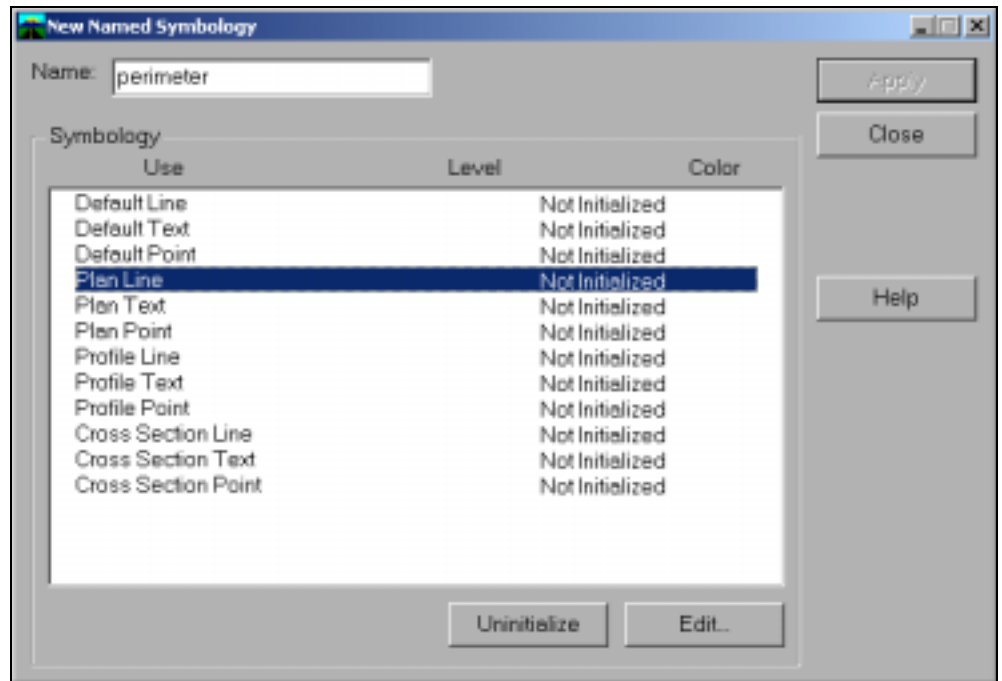
1. Click **Tools > Symbology Manager**.

Symbology settings defined in the Symbology Manager are stored in the *civil.ini* file. For this tutorial, the preference file is *civilm_tut.ini*.

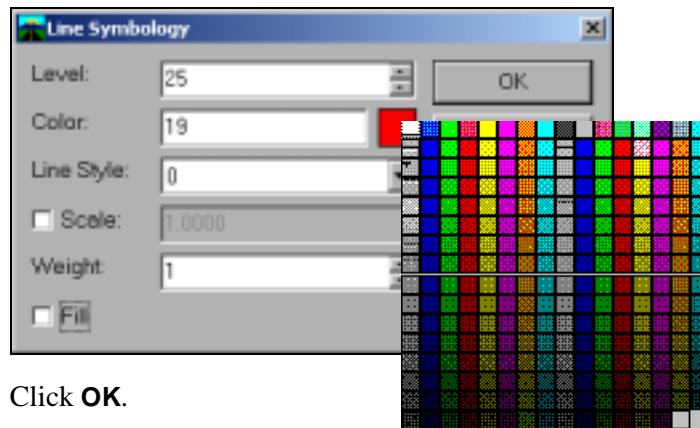
2. Click **New**.
3. For **Name**, type *perimeter*.

The settings you select are only for the surface perimeter.

4. Click **Plan Line**.



5. Click **Edit** (or double-click on **Plan Line**).
The settings here will apply to lines displayed in Plan view only.
6. For **Layer/Level**, select **25**.
7. For **Color**, click on the color palette and select red or, type 19 (type 10 on AutoCAD in the field).
8. On MicroStation, for **Line Style**, select **0**. On AutoCAD, for **Line Type**, select **Continuous**.
9. On MicroStation, for **Weight**, select 1.



10. Click **OK**.
11. Click **Apply**.

You have successfully created symbology with the *name* **perimeter**.

12. For **Name**, type contours.
13. Double-click **Plan Line**.
14. For **Layer/Level**, select **1**.
15. For **Color**, click the color palette and select blue or, type 17 (type 170 on AutoCAD) in the field.
16. Accept all other default settings and click **OK**.
17. Click **Apply**.

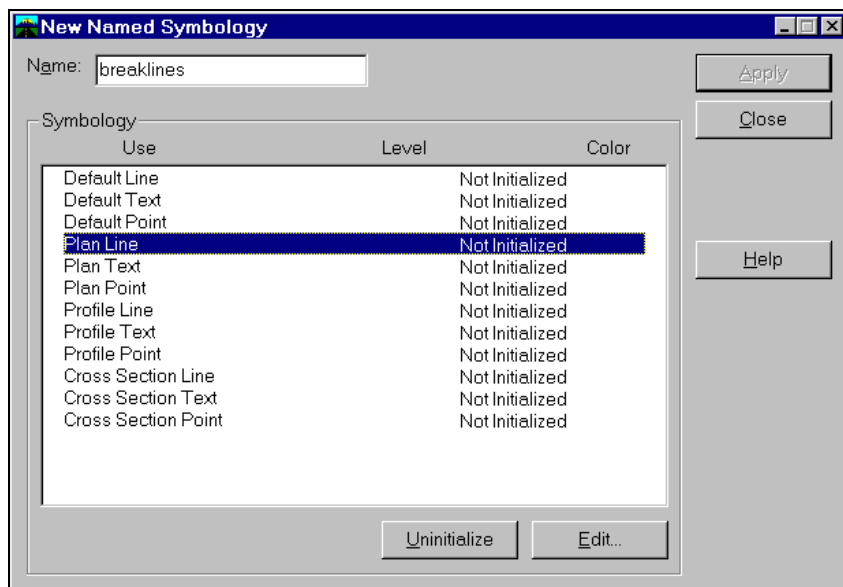
You have created symbology named *contours*.

18. For **Name**, type triangles.
19. Double-click **Plan Line**.
20. For **Layer/Level**, select **20**.
21. For **Color**, click the color palette and select green or, type 2 (type 80 on AutoCAD) in the field.
22. Accept all other the defaults and click **OK**.
23. Click **Apply**.

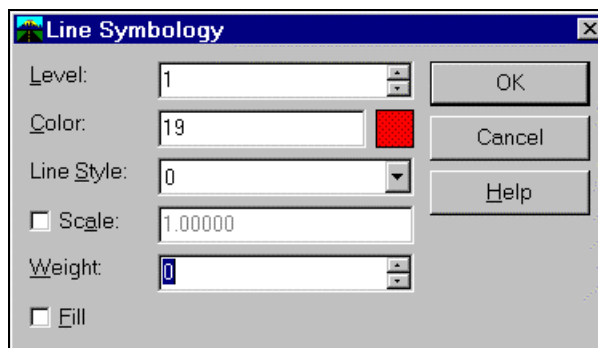
You have created symbology named *triangles*. Perimeter, contours, and triangles now appear in the Symbology Manager list.

Notice: Line symbology for these objects were defined because as a representation of the surface they appear only as linear elements, only in Plan view. In contrast, line and *text* symbology are defined for a surface *feature*, such as breaklines. Surface features appear in Plan, Profile, and Cross Section views.

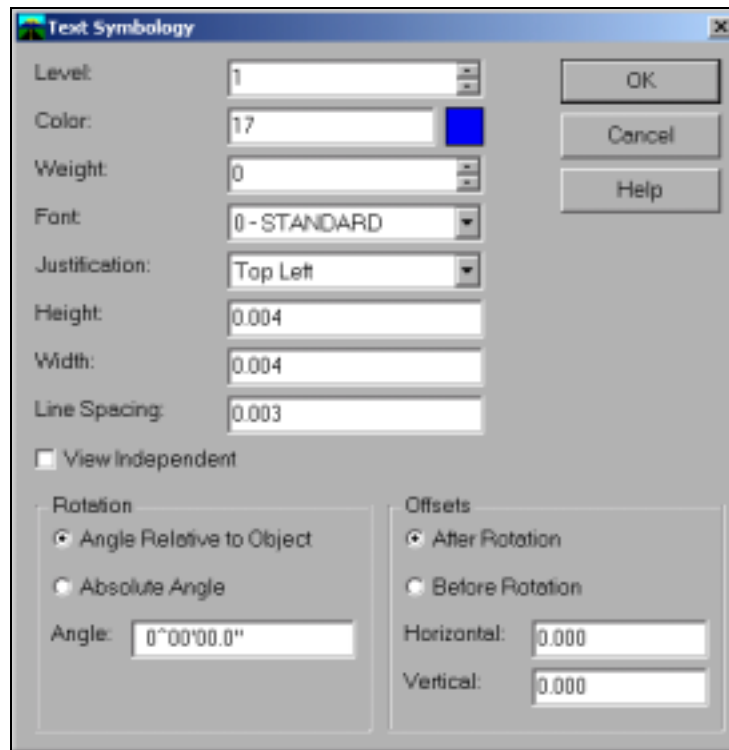
24. For **Name**, type breaklines.
25. Double-click **Plan Line**.



26. For **Layer/Level**, select 1.
27. For **Color**, click the color palette and select red or, type 19 (type 10 on AutoCAD) in the field.



28. Accept all other default settings and click **OK**.
29. Double-click **Plan Text**.
30. For **Layer/Level**, select **1**.
31. For **Weight**, select **1**.
32. For **Color**, click the color palette and select blue or, type 17 (type 170 on AutoCAD) in the field.



33. Accept all other default settings and click **OK**.
34. Double-click **Profile Line**.
35. Repeat Steps 26 to 28.
36. Double-click **Profile Text**.
37. Repeat Steps 30 to 32.
38. Double-click **Cross Section Line**.
39. Repeat Steps 26 to 28.
40. Double-click **Cross Section Text**.

41. Repeat Steps 30 to 32.

42. Click **Apply**.

You have created symbology named *breaklines*. Breaklines now appear in the Symbology Manager list.

43. Click **Close** to dismiss the Symbology Manager dialog box.

Next, you will create a preference set for the surface *original*.

Creating a Surface Preference

In this task, you will select symbology for the surface in the form of a preference set. A preference set is a *group of settings* that specify how objects that represent an individual surface are displayed. Surface preferences may include specialized symbology or other criteria that distinguishes one surface from another.

1. Click **Tools > Preference Manager**.

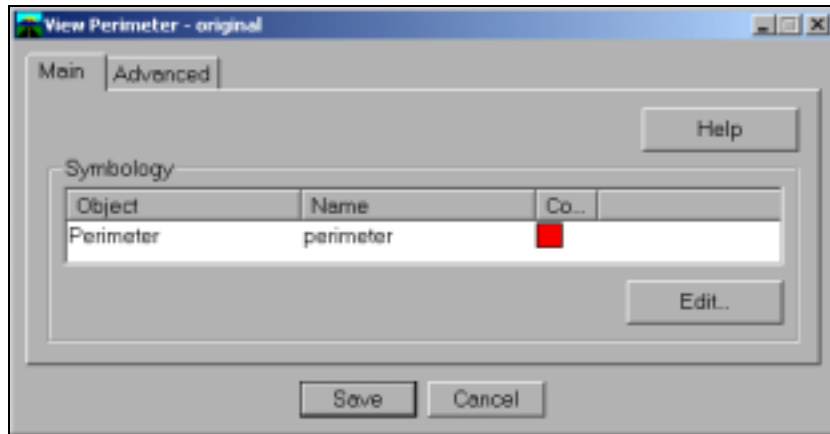
2. Click the **Surface** tab.

3. For **Preference**, type *original* and press Tab.

The preference set is named *original* to help remember the association with the surface named *original*.

4. In the **Preferences** section, double-click **Perimeter**.

The settings you previously defined for perimeter populates the dialog box.



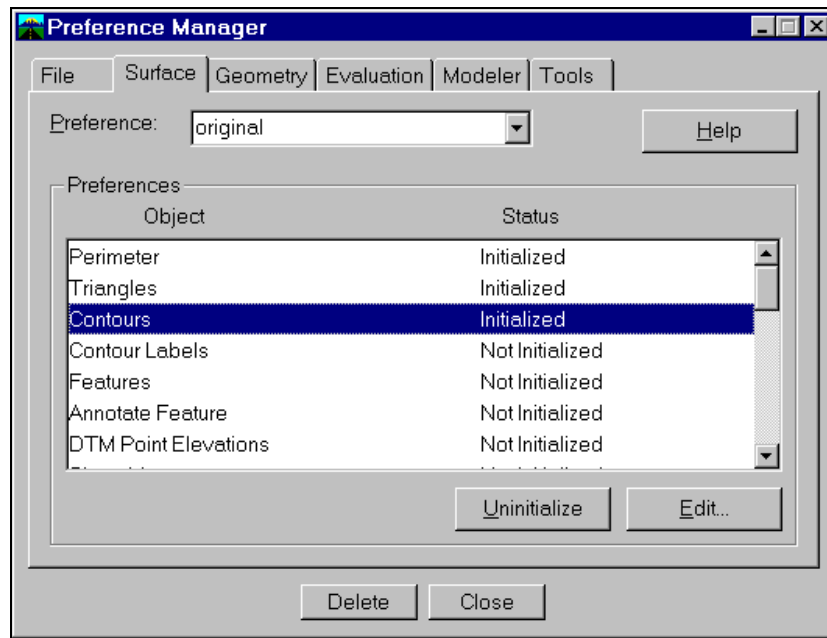
The perimeter for surface *original* will display on layer/level 25 in Color 19.

5. Click **Save**.

6. In the **Preferences** section, double-click **Triangles**.
7. Double-click **triangles** (or click **Edit**).
8. Click **Save**.
9. In the **Preferences** section, double-click **Contours**.
10. Click **Edit**.
11. For **Symbology Name**, select **contours**.

Remember, you are modifying symbology here to create a preference set for the surface *original*.

12. Click **OK**.
13. Click **Save**.



The status for each surface object has changed from Not Initialized to Initialized. *Initialized* indicates that the entire preference set for the object is now active. The default system settings apply to objects not yet initialized.

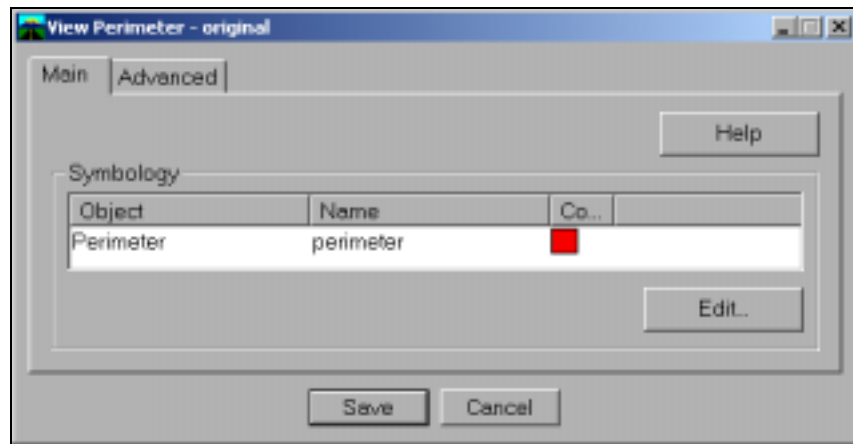
10. Click **Close**.

You have successfully defined symbology and created a surface preference. Next, you will display the surface.

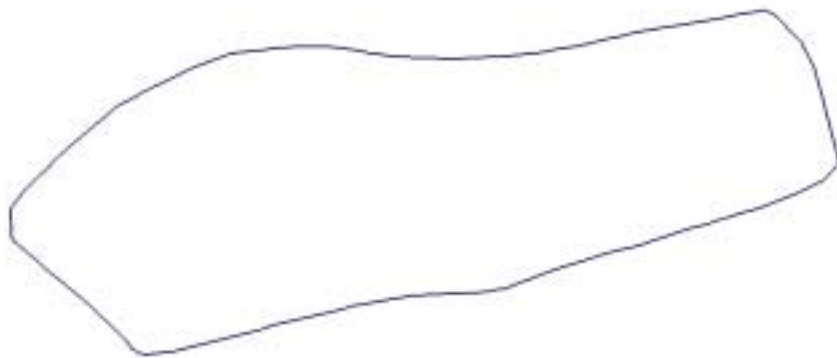
Displaying a Surface Perimeter

In this task, you display the perimeter of the surface *original* to view the extent of the DTM data contained in the surface.

1. Click **Tools > Locks**, and turn on **Write** lock.
2. Click **Tools > Locks**, and turn off **Style** lock.
3. Click **Tools > Locks**, and turn on **Pencil** mode.
4. From the CAD menu, turn on all levels/layers. On MicroStation, click **Setting > Level > Display** and ensure all levels are on. On AutoCAD, click **Format > Layer** and ensure all layers are on. Close all CAD dialog boxes.
5. Click **Surface > View Surface > Perimeter**.



6. Click **Apply**, and then click **Close**.



InRoads SelectCAD displays the perimeter of the surface *original* in the drawing file.

7. If the perimeter is not visible on the screen, ensure that all display levels/layers are turned on.

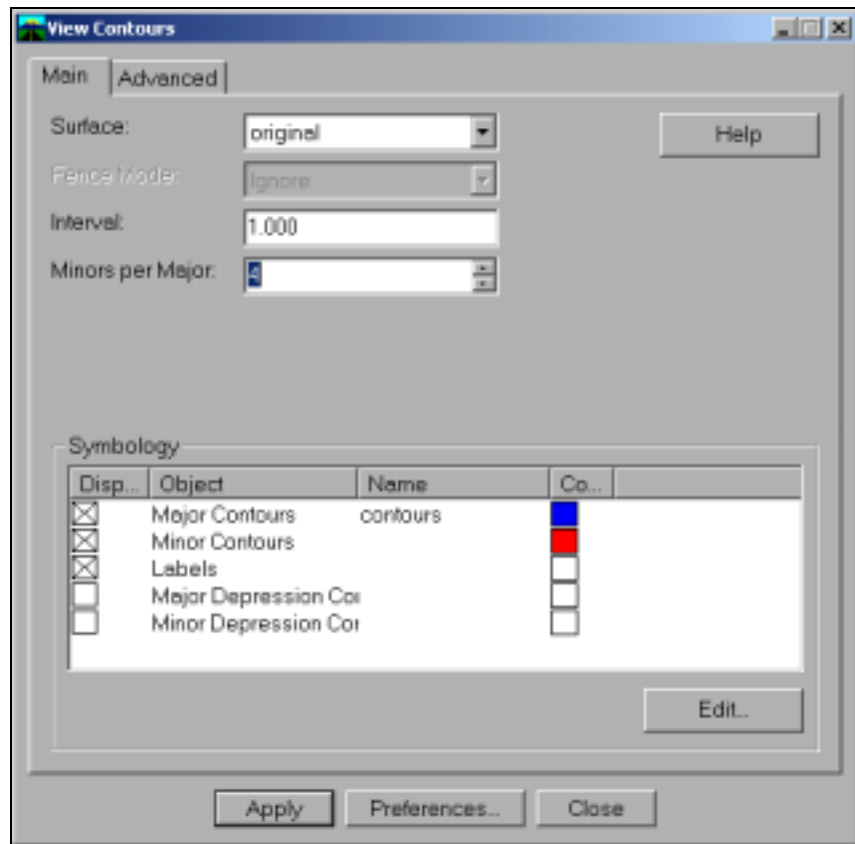
Displaying Surface Contours

In this section, you display the contours of the surface *original*.

1. Click **Tools > Locks**, and turn off **Write** lock.
2. Click **Surface > View Surface > Contours**.
3. Click the **Main** tab.
4. For the **Surface**, select **original**. For the **Interval**, type 1. For the **Minors Per Major**, type 4.
5. Under **Symbology**, turn off **Labels**.

Note: If you have previously placed a region or fence and the **Region/Fence Mode** is active, select **Ignore**.

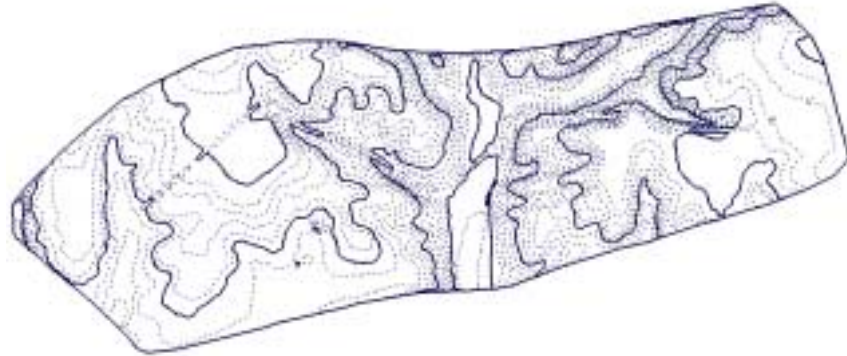
Contours will be displayed every meter, with 4 minor contours between major contours.



In the next few steps, you save the settings you just made in the **View Contours** dialog box to the preference set for surface *original*. At any point while using InRoads SelectCAD, you can save the current settings of any command to a preference set. Different preference sets can be saved for later use.

You can save and load preference sets for InRoads SelectCAD commands or surfaces using the **Preferences** button located at the bottom or right side of most dialog boxes. Remember, when you add to a preference set the *.ini* file is modified. In this lesson, you modify the *civilm_tut.ini* file.

6. Click **Preferences**.
7. Make sure that **original** is highlighted. Click **Save**, and then click **Close**.
8. Click **Apply** on the **View Contours** dialog box.



InRoads SelectCAD computes the contour segments for each elevation, connects them into polylines/linestrings, and displays the contours in the drawing file.

9. When the command is finished processing, click **Close** to dismiss the **View Contours** dialog box.

Using the Write Lock

The **Write** lock command lets you display InRoads SelectCAD graphics in either temporary or permanent mode. When the **Write** lock is selected (on), graphics are written into the graphics file. These graphics can then be manipulated by using commands such as **Delete**, **Move**, **Copy**, and **Change Color**.

When the **Write** lock is not selected (off), graphics are displayed in temporary mode and will disappear as soon as the view is updated. This feature is convenient, for example, when you want to view the triangles or contours of a DTM, and then remove them from the screen.

10. Update (View/Redraw on AutoCAD) the view. Notice that the perimeter is redrawn on the screen. However, the contours are not redrawn because they were created with the **Write** lock turned off.
11. Click **Tools > Locks > Toolbar** to turn on the toolbar.



The **Locks** toolbar lets you control the status of several InRoads SelectCAD locks. Keep this toolbar docked on the SelectCAD Explorer or floating on the side of your screen as a convenient way to review and set your locks.

12. Turn on the **Write** lock by clicking the icon.

This is equivalent to using the **Tools > Locks > Write** command from the InRoads SelectCAD menu.



13. Click **Surface > View Surface > Contours**.

14. Click **Apply** to redisplay the contours.

15. Update the view.

The contours remain displayed because they were written to the graphics file.

16. Click **Close** to dismiss the **View Contours** dialog box.

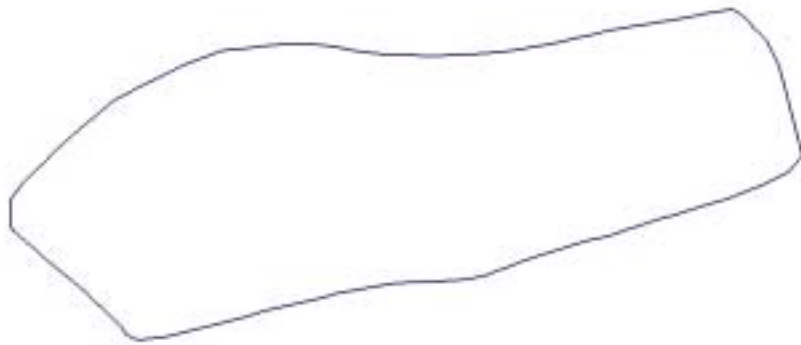
17. Using your CAD software, delete the contours.

Using Write Lock with Pencil/Pen

When **Write** lock is on, the **Pencil/Pen** command lets you temporarily (pencil) or permanently (ink) write to the graphics file. This concept is similar to drawing on paper. Using a pencil, you have the ability to quickly erase a drawing to remove it. In contrast, graphics drawn in ink are of a permanent form and must be deleted to be removed. The **Delete Ink Lock** command is used to removed graphics drawn in ink. These features are helpful when you want to display several iterations of a graphic until the desired graphic is displayed. Then, after comparing the objects, you can remove those not desired.

Ensure that **Write** lock is on, and the contours have been deleted.

1. Update the view. The perimeter is drawn on the screen.



2. Make sure that you are in **Pencil** mode.

This command is Either/Or meaning you are either in pencil mode or ink mode (unlike Write lock, which is either on or off).



3. Using your CAD software, move the perimeter.
4. Click **Surface >View Surface >Perimeter**.
5. Click **Edit**.
6. For **Color**, click the color palette and select a different color.
7. Click **OK**.
8. Click **Apply**, then click **Close**.

The first perimeter was erased and the second (current) perimeter was displayed. The perimeter is written to the design file because **Write lock** is on.

Note: If the graphic is not erased, click **Tools > Options**. Ensure the **Omit Automatic Graphics Refresh** option is turned off. When this option is on, graphic display is not refreshed: all graphics remain displayed.

9. Toggle to **Pen** mode.

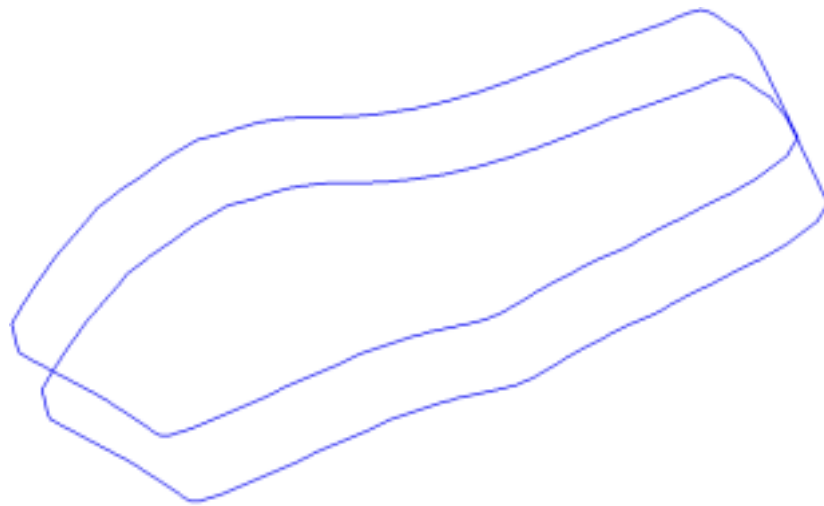


10. Click **Surface > View Surface > Perimeter**.
11. Click **Edit**.
12. For **Color**, click on the color palette and select a different color.
13. Click **OK**.
14. Click **Apply**.

The previous graphic, written in pencil, is erased. The current perimeter is drawn in the graphics file in ink.

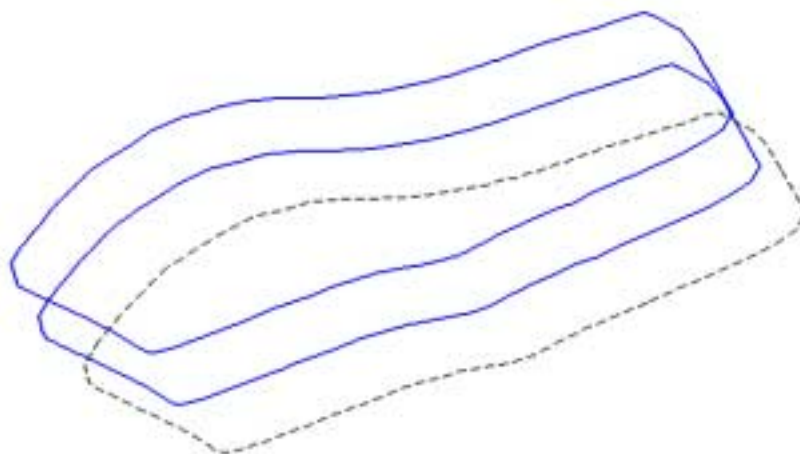
15. Using your CAD software, move the perimeter.
16. In the **View Perimeter** dialog box, click **Apply** again.

The second perimeter is displayed. The first graphic remains because it was written to the graphics file in ink.



17. Using your CAD software, move the second perimeter.
18. Toggle to **Pencil Mode**.
19. In the **View Perimeter** dialog box, click **Edit**.
20. On MicroStation, for **Line Style**, select **2**. On AutoCAD, for **Line Type**, select a **dashed** type.
21. On MicroStation, for **Weight**, select **1**.
22. Click **OK**.
23. Click **Apply**.

The third perimeter is drawn in pencil. It has a different line style.



24. Click **Close** to dismiss the **View Perimeter** dialog box.

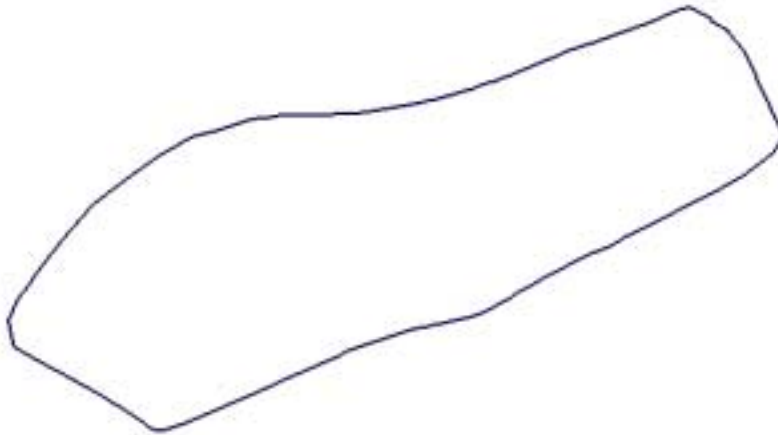
Pen mode allows you to display several versions of a graphic; **Pencil** mode only allows you to display one.

25. Turn on **Delete Ink Lock**.



26. Click **Surface >View Surface >Perimeter**.
27. Click **Edit**.
28. For **Color**, click the color palette and select a different color.
29. On MicroStation, for **Line Style**, select **0**. On AutoCAD, for **Line Type**, select **Continuous**.
30. On MicroStation, for **Weight**, select **1**.
31. Click **OK**.
32. Click **Apply**.

The two perimeters written in ink are deleted because **Delete Ink Lock** is on. The perimeter written in pencil is removed because **Pencil** mode only retains the most recent graphic. The current (last) graphic is displayed.



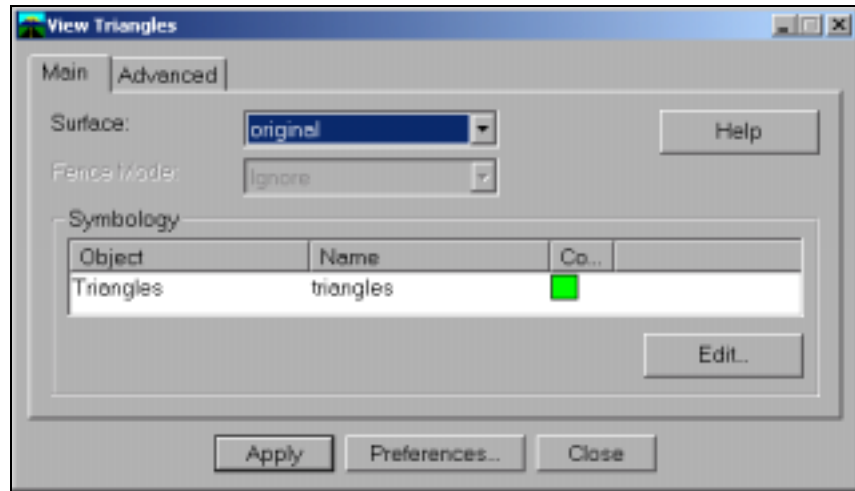
33. Click **Close** to dismiss the **View Perimeter** dialog box.
34. Turn off **Delete Ink lock**.

Displaying Surface Triangles

In the next task, you display the triangles that make up the faceted surface.

1. Turn off **Write** lock.
2. Click **Surface > View Surface > Triangles**.
3. For the **Surface**, select **original**.

Note: If you have previously placed a region or fence and the **Region/Fence Mode** is active, select **Ignore**.



4. Click **Apply**.
InRoads SelectCAD displays the triangles in the drawing file.



5

5. When processing is finished, click **Close** to dismiss the **View Triangles** dialog box.

Looking at the displayed DTM, you should notice a feature running left-to-right across the entire surface. This is an existing road. In this

project, that road is part of the original ground. You will design a new road to run through this region. Later you can examine cross sections comparing the newly designed road against the existing ground.

6. For AutoCAD users only: if your triangles did not display in color, do the following:
 - From the AutoCAD menu, click **Tools > Preferences**.
 - Click the **Display** tab.
 - Click **Colors**.
 - Turn off the **Monochrome Vectors** toggle.
 - Click **OK** on both the **AutoCAD Window Colors** and **Preferences** dialog boxes.
7. Update the view to remove the triangles.

Creating a Feature Style

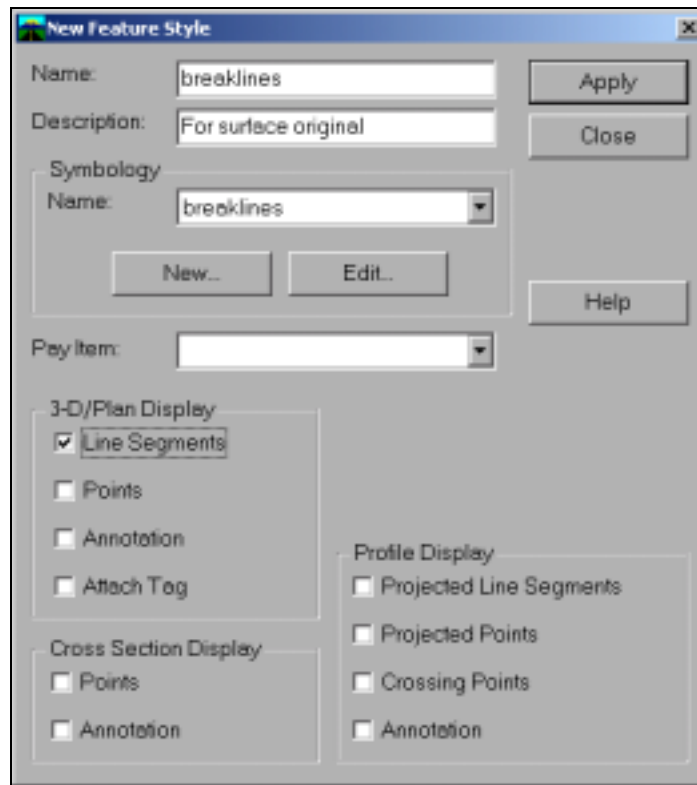
Now that you have displayed the objects that represent the surface, you can determine how and where features would appear *in* the surface. How and where a feature displays is determined by the feature *style*. In this task, you will define a feature style for surface breaklines. Breaklines commonly represent linear features, such as curblines and ditches in a roadway project.

1. Click **Tools > Feature Style Manager**.
2. Click **New**.
3. For **Name**, type breaklines.
4. For **Description**, type For surface original.
5. Under **Symbology**, for **Name**, select **breaklines** from the list.

The new feature style that you are creating is borrowing the symbology that you previously set for breaklines. These settings determine *how* the feature displays.

6. Under **3-D/Plan Display**, click to turn on **Line Segments**.

These setting instruct InRoads SelectCAD to display breaklines in plan view. These setting determine *where* the feature displays.

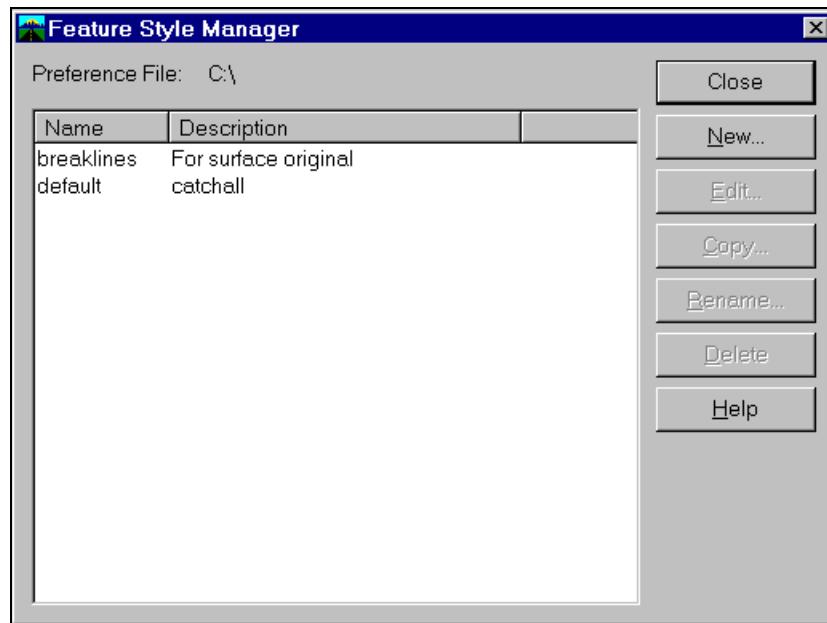


7. Click **Apply**.

You have successfully created a feature style.

8. Click **Close** to dismiss the dialog box.

The new feature styles are listed in the **Feature Style Manager** dialog box.



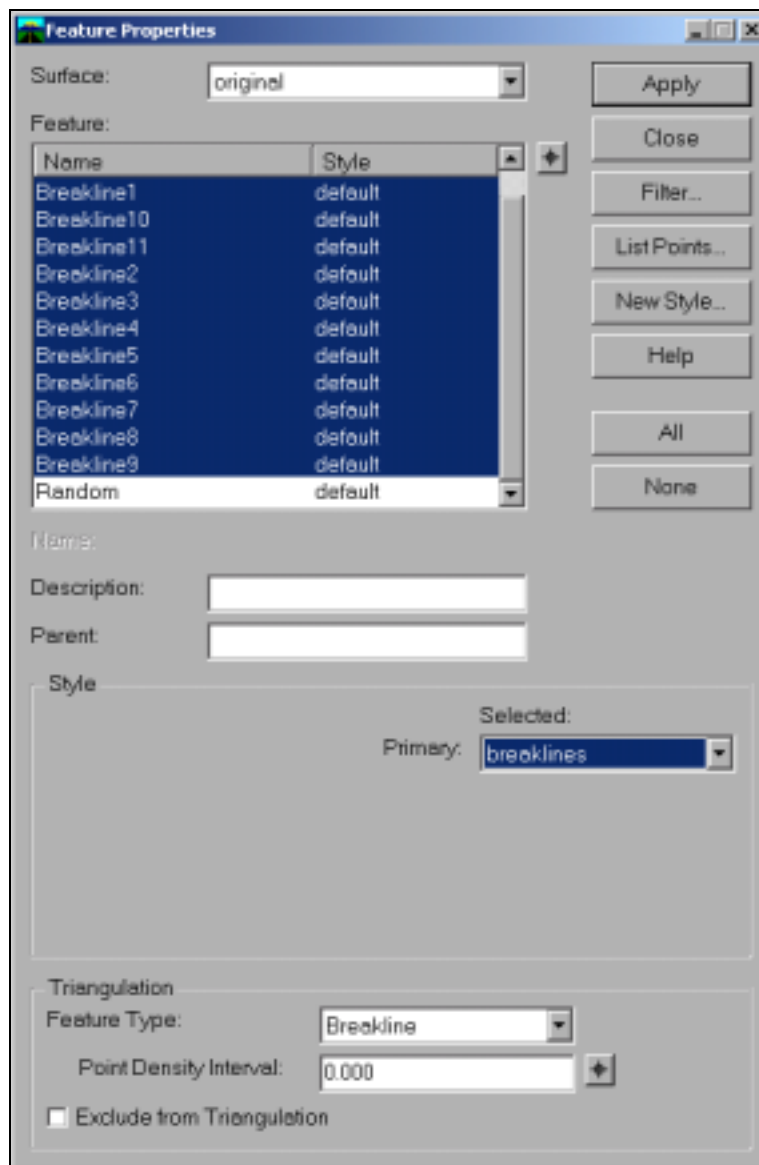
9. Click **Close** to dismiss the dialog box.

Next, you will apply the feature style to all of the breaklines in the surface *original*.

10. Click **Surface > Feature > Feature Properties**.
11. For **Surface**, select **original**.
12. Highlight all breaklines in the **Feature** list.

Caution: Do not use the **All** button. You do not want to include the Random feature and the bottom of the list.

13. Under **Style**, for **Primary** select **breaklines**.



14. Click **Apply**.

The new feature style *breaklines* is applied to each breakline in the surface.

15. Click **Close** to dismiss the dialog box.

Creating a Feature Selection Filter

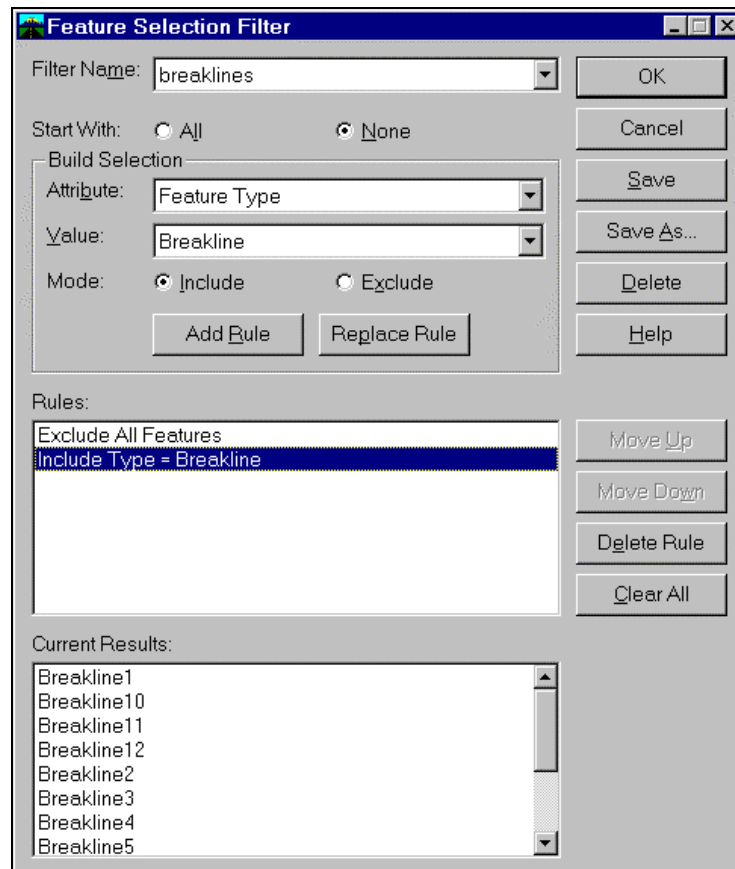
Most roadway projects utilize many types of features. Once you have created and applied styles to feature-types in the surface, you can build a

selection set from which to choose features. In this task, you create a selection filter to only display breakline features.

1. Click **Surface > Feature > Feature Selection Filter**.
2. For **Start With**, select **None**.
3. Under **Build Selection**, for **Attribute** select **Feature Type**.
4. For **Value**, select **Breakline**.
5. For **Mode**, select **Include**.
6. Click the **Add Rule** button.

The breaklines appear in the **Current Results** list.

7. Click **Save As**.
8. For **Name**, type breaklines.
9. Click **OK** to dismiss the dialog box.



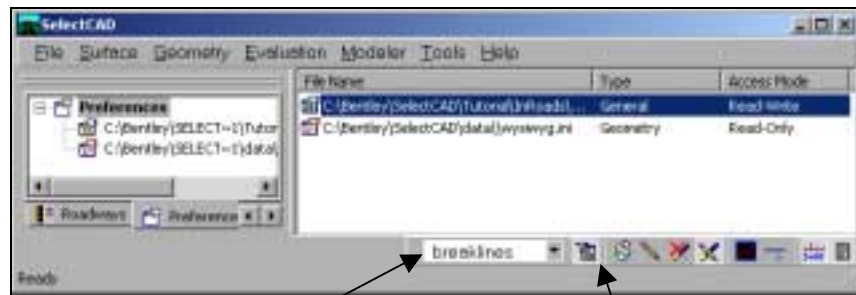
10. Click **OK**.

You have successfully created a feature selection filter.

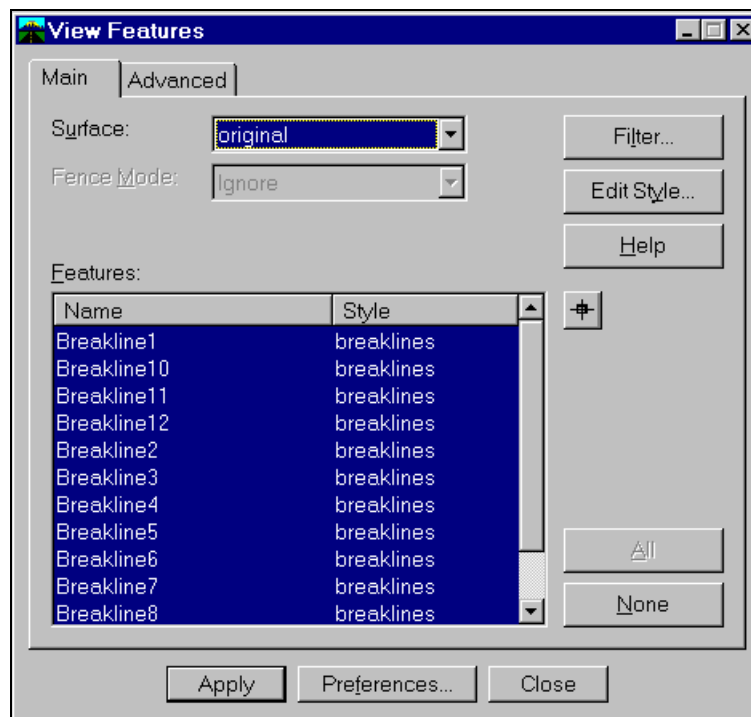
Displaying Surface Features

Once you have created a selection filter, you can quickly display surface features. In the final task for Lesson 2, you display all breaklines in the surface *original*.

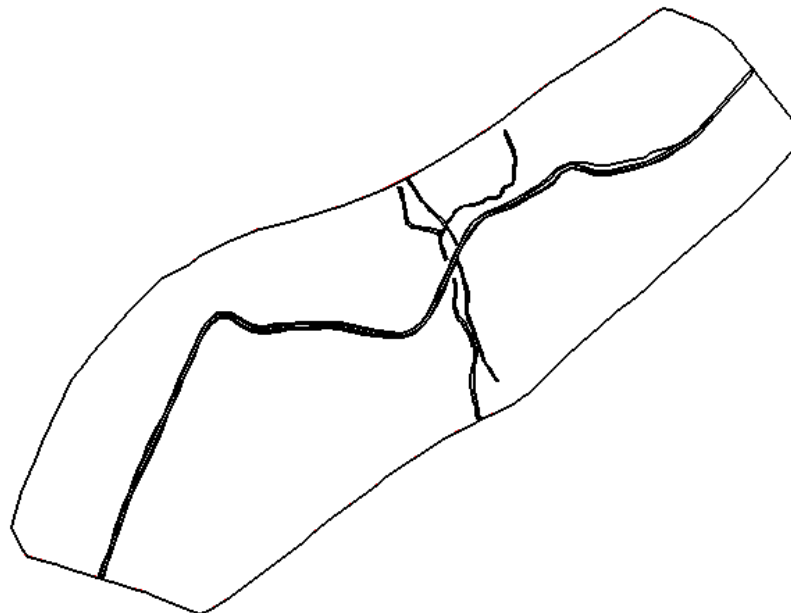
1. Turn **Write** lock on.
2. In the **Feature Filter** list in the SelectCAD Explorer, select **breaklines**.
3. Turn on the **Feature Filter Lock** located next to the **Feature Filter** list field.



4. Click **Surface > View Surface > Features**.
5. For **Surface**, select **original**.
6. Scroll down the list. Only breaklines are listed and selected.



7. Click **Apply**.



8. Click **Close** to dismiss the dialog box.

9. Use the your CAD tools to delete the breaklines and perimeter.
10. Update the view.
11. From the CAD menu, save *road.dgn* or *road.dwg*.
12. From InRoads SelectCAD, click **File > Save > Surface**.
13. Click **File > Exit** and then exit your CAD software, or continue to the next lesson.

Lesson 3: Horizontal Alignment Design

Now that you have modeled the existing surface by creating a DTM, the next phase of your road design is to define the planimetric position of the proposed road. To do this, you lay out a horizontal alignment. InRoads SelectCAD supports the definition of even the most complex alignments consisting of reverse curves, compound curves, and transition and compound spiral curves.

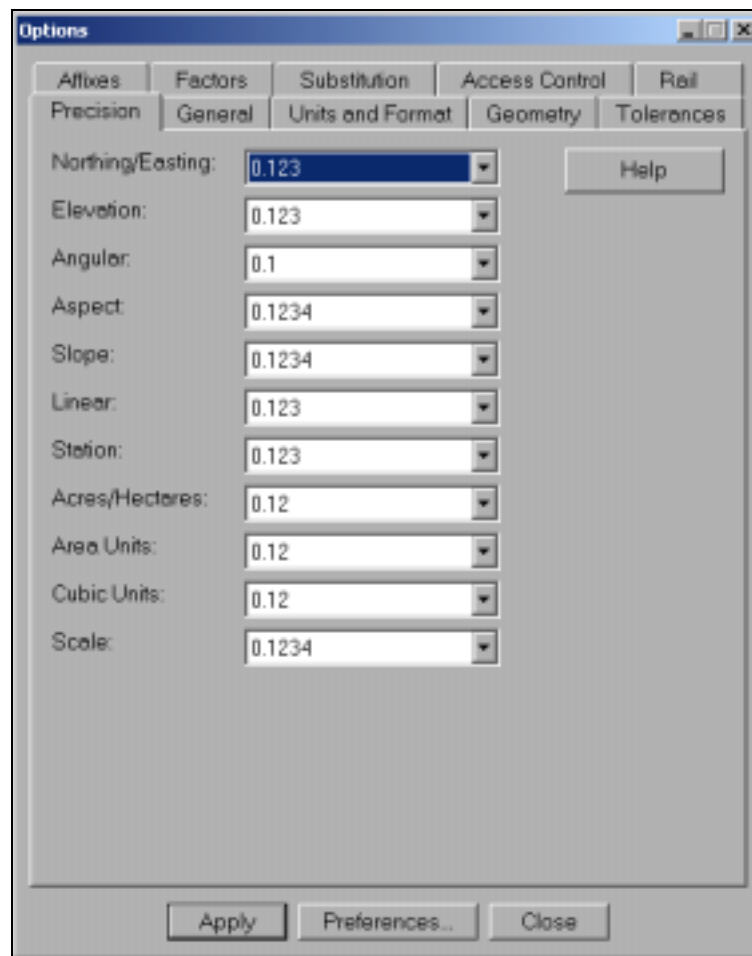
If you did not exit InRoads SelectCAD and the CAD software in the last lesson, skip to *Setting Work Session Options*. If you are just beginning the tutorial here, complete the following steps:

1. Extract *roadlesson3.exe*. For more information, see *Before Starting Each Lesson* at the beginning of this chapter.
2. Start InRoads SelectCAD, and open the *road.dwg* or *road.dgn* file. These files are located in the `\Tutorial\InRoads` directory where you installed InRoads SelectCAD.
3. Click **File > Open**.
4. For the **Files of type**, select **Surfaces (*.dtm)**.
5. Set the directory to `C:\Bentley\SelectCAD\Tutorial\InRoads`.
6. Select *original.dtm* and click **Open**.
7. For the **Files of type**, select **Preferences (*.ini)**.
8. Select *civilm_tut.ini*, and click **Open**.
9. For the **Files of type**, select **Styles (*.ini)**.
10. Select *wysiwyg.ini*, and click **Open**.
11. Click **Cancel** to dismiss the dialog box.

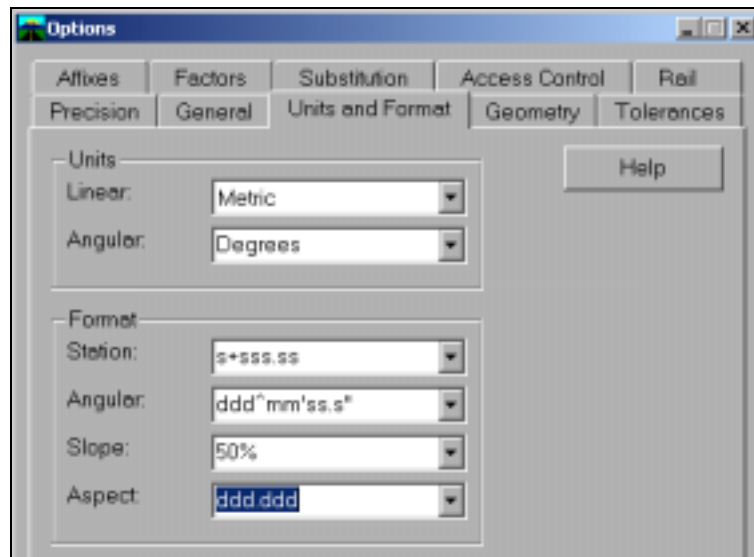
Setting Work Session Options

Before creating a geometry project, you must set the working units and decimal precision for coordinates, stationing, distances, angles and gradients.

1. Click **Tools > Options**.
2. Click the **Precision** tab. For **Northing/Easting**, select **0.123**. For **Elevation**, select **0.123**. For **Angular**, select **0.1**. For **Slope**, select **0.1234**. For **Linear**, select **0.123**. For **Station**, select **0.123**. Retain all other default precision settings. Click **Apply**.



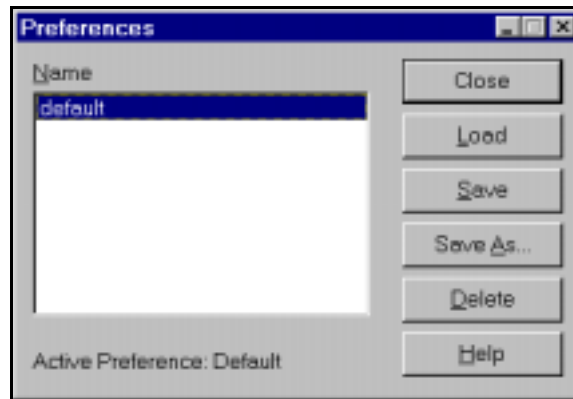
15. Click the **Units and Format** tab. Under **Units**, for **Linear**, confirm **Metric**. For **Angular**, confirm **Degrees**. Under **Format**, for **Station**, select **s+sss.ss**. For **Angular**, select **ddd^mm'ss.s"**. For **Slope**, select **50%**. For **Aspect**, select **ddd.ddd**. Click **Apply**.



16. Click the **General** tab. For **GUI Coordinate Sequence**, select **Northing/Easting**. Click **Apply**.
17. Click the **Geometry** tab. Under **Curve Definition**, For **Horizontal**, select **Arc**; for **Vertical**, select **Parabolic**. Turn on both toggles under **Always Confirm**. For **Angular Mode**, select **Bearings**. Click **Apply**.



18. Click **Preferences**.
19. Select **default**.
20. Click **Save**.



This updates the settings in the file. When you exit the product, the *.ini* file is saved so that next time you start InRoads SelectCAD the settings are the same.

21. Click **Close** to dismiss the **Preferences** dialog box.

You've modified the *civilm_tut.ini* file.

22. Click **Close** to dismiss the **Options** dialog box.

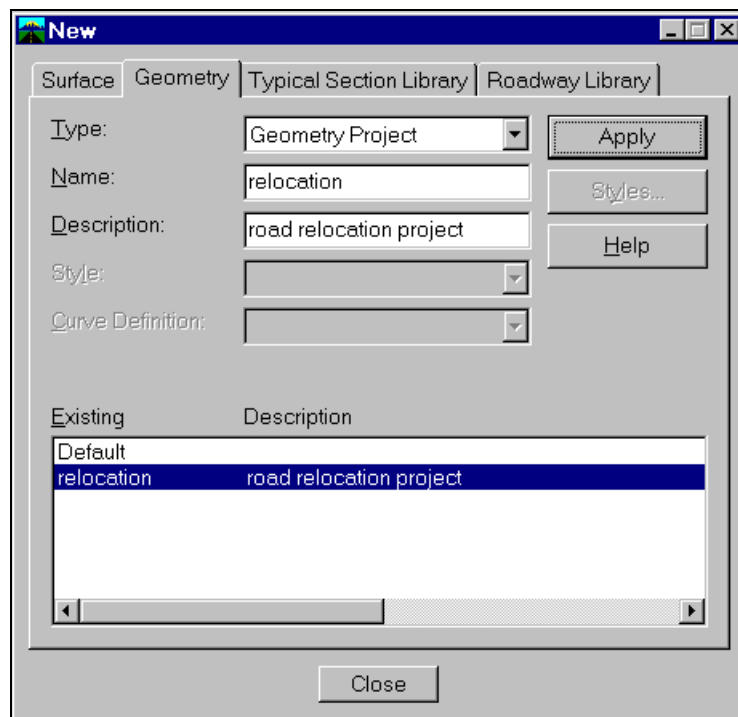
The Geometry Project

InRoads SelectCAD stores coordinate geometry information in a geometry project (*.alg file). As you progress through the tutorial, you define a horizontal and a vertical alignment. This information is stored in the geometry project. You can save as many alignments and sets of points as you like in a geometry project.

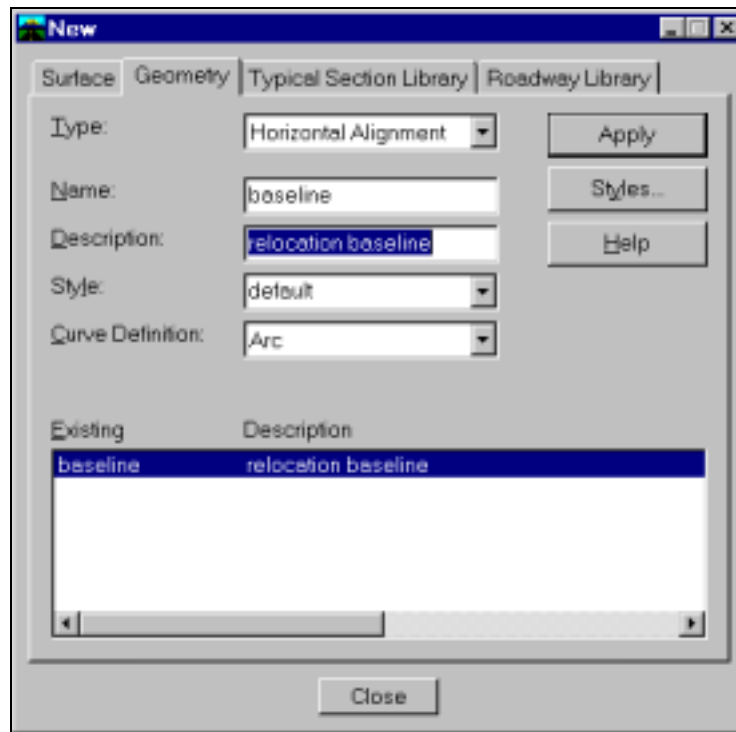
This lesson describes several processes related to the geometry project: importing an existing alignment, defining horizontal alignments, and defining stationing and station equations. You create a geometry project; then, within that project you will create horizontal and vertical alignments. These alignments are the basis for defining the centerline for the proposed road.

Creating a Geometry Project

1. Click **File > New**.
2. Click the **Geometry** tab.
3. For the **Type**, select **Geometry Project**.
4. For the **Name**, type relocation. Press the **TAB** key.
5. For the **Description**, type road relocation project. Press the **TAB** key, and then click **Apply**.

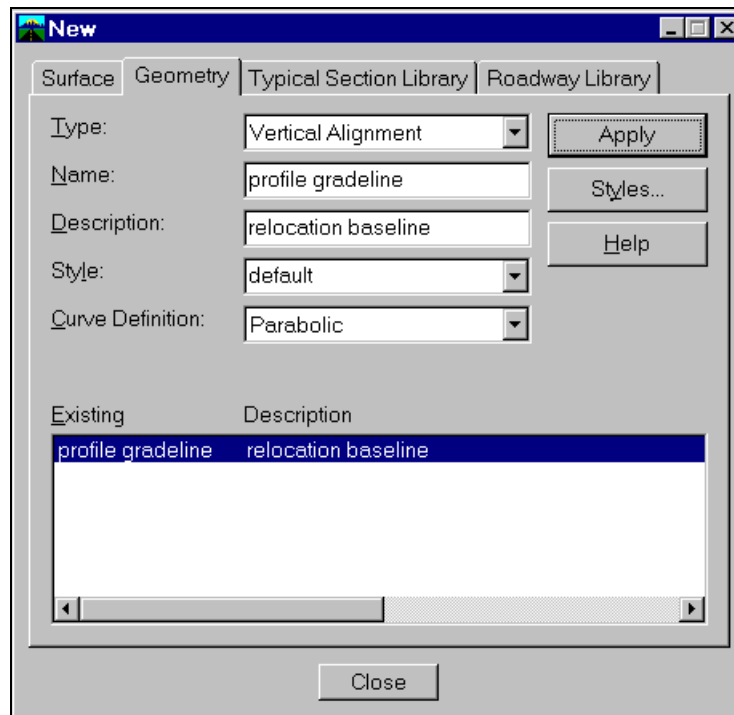


6. For **Type**, select **Horizontal Alignment**.
7. For the **Name**, type baseline. Press the **TAB** key.
8. For the **Description**, type relocation baseline. Press the **TAB** key.
9. For **Style**, select **default**. Press the **TAB** key.
10. For **Curve Definition**, select **Arc**. Press the **TAB** key, then click **Apply**.



You have successfully defined the horizontal alignment name for the geometry.

11. For **Type**, select **Vertical Alignment**.
12. For the **Name**, type profile gradeline. Press the **TAB** key.
13. For the **Description**, type relocation baseline. Press the **TAB** key.
14. For **Style**, select **default**. Press the **TAB** key.
15. For **Curve Definition**, select **Parabolic**. Press the **TAB** key, then click **Apply**.



You have successfully defined a vertical alignment name. In the next task, you will create a horizontal alignment.

16. Click **Close** to dismiss the **New** dialog box.

InRoads SelectCAD provides several methods for creating horizontal alignments. One approach lets you add points of intersection (PIs) and curve sets. Another method allows you to design alignments using horizontal elements. Finally, for more complex road designs, you can use multiple element regression to create alignments. The first two methods are detailed in the following sections. You can choose to complete either one or both of the alignment workflows. For a detailed discussion of creating alignments using regression analysis, see the tutorial lessons for the Rail SelectCAD product.

To create a horizontal alignment using PIs, continue to the next section, otherwise, skip to *Creating an Alignment by Horizontal Element Design*.

Creating an Alignment by Horizontal Curve Set

Now that you have created a geometry project, you can create the alignment for the new road. To begin, you will identify the initial tangents of the horizontal alignment by placing PIs. By connecting PI to PI, the centerline of the new road is created. You will finish up this task by creating curve sets to smooth out the alignment.

1. Click **Surface > View Surface > Perimeter**.
2. Click **Apply**, and then click **Close**.
3. Fit the perimeter in the view.
4. Click **Geometry > Horizontal Curve Set > Add PI**.
5. At the prompt: **Identify alignment end**, click in the CAD command window and type NE=3255 . 5 , 3124 . 8. Press the **TAB** key.

Note: If your command window does not appear, click **Utilites > Key-ins** on MicroStation. For AutoCAD users, click in the command key-in field.

Move the mouse to see the beginning of the active horizontal alignment.

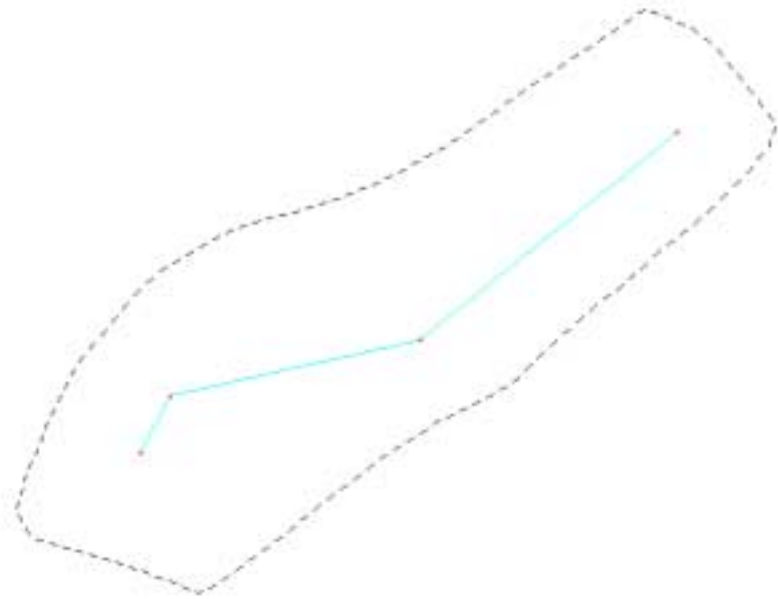
6. At the prompt: **Identify Point/Reject**, type NE=3400 , 3200 in the CAD command window. Press the **TAB** key.

Note: You can define a PI by keying in coordinates or by selecting the point graphically. When selecting the point graphically, the coordinates are displayed in the lower-left corner of the SelectCAD Explorer. For this lesson, you will key in each PI. When using the CAD key in window, you can press **Enter** or press the **TAB** key.

7. At the prompt: **Identify Point/Reject**, type NE=3540 , 3825 in the CAD command window. Press the **TAB** key.
8. At the prompt: **Identify Point/Reject**, type NE=4064 . 2 , 4470 . 2 in the CAD command window. Press the **TAB** key.
9. At the prompt: **Identify Point/Reject**, reject.

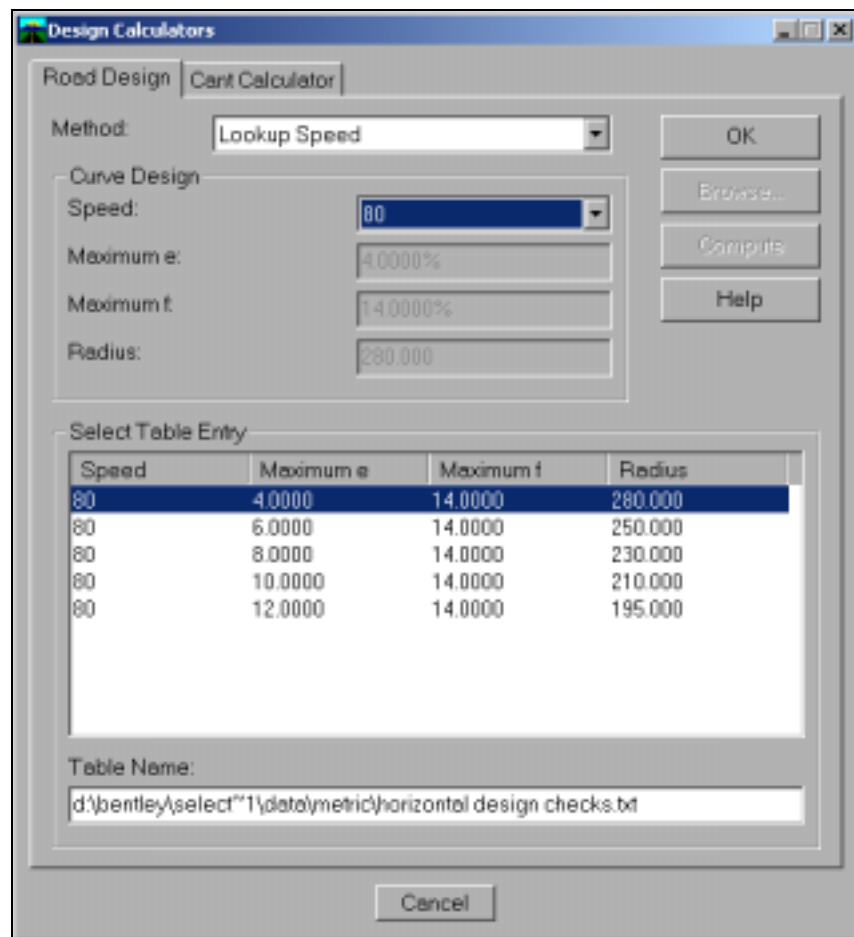
Note: Remember, on MicroStation left mouse click is **accept**; right mouse click is **reject**. On AutoCAD, right mouse click is **accept** and key in "R" is **reject**.

10. At the prompt: **Identify alignment end**, reject.

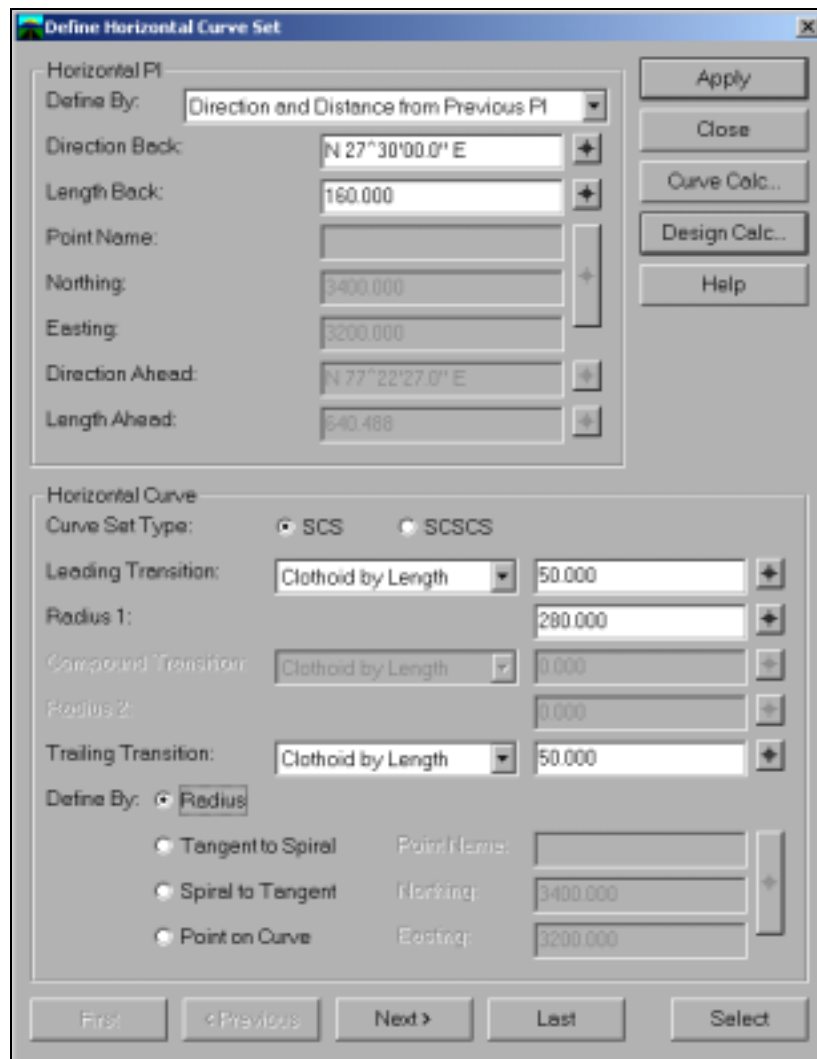


You have successfully added PIs to create tangents for the new alignment. Next, you define the curves.

11. Click **Geometry > Horizontal Curve Set > Define Curve**.
12. Under **Horizontal PI**, for **Define By**, select **Direction and Distance From Previous PI**.
13. For **Direction Back**, type N 27 30 E. Press the **TAB** key.
14. For **Length Back**, type 160. Press the **TAB** key.
15. Click the **Design Calc.** button.
16. Click the **Road Design** tab.
17. Under **Curve Design**, for **Speed**, select **80**.
18. Under **Select Table Entry**, click on the first row (Maximum e of 4.00 and Radius of 280).

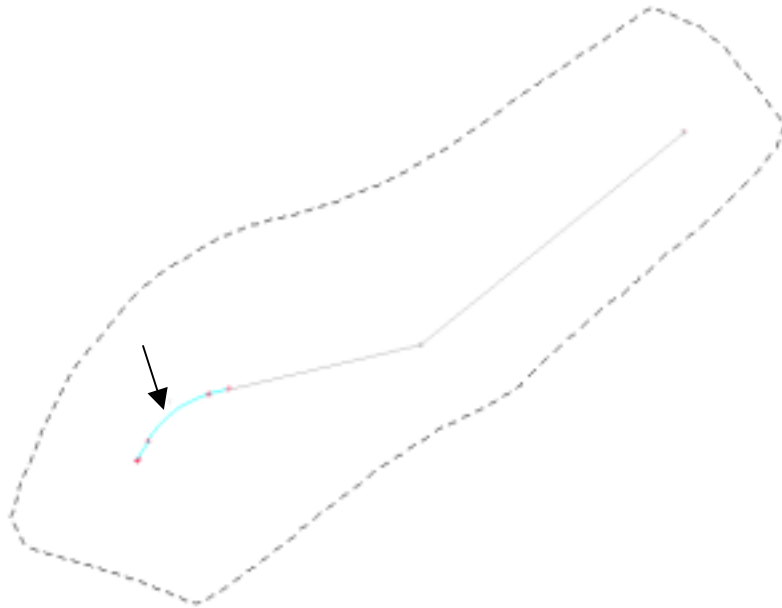


19. Click **OK**.
The **Radius** of 280 is displayed in the dialog box.
20. Under **Horizontal Curve**, for **Leading Transition** type 50. Press the **TAB** key. For **Trailing Transition**, type 50. Press the **TAB** key.



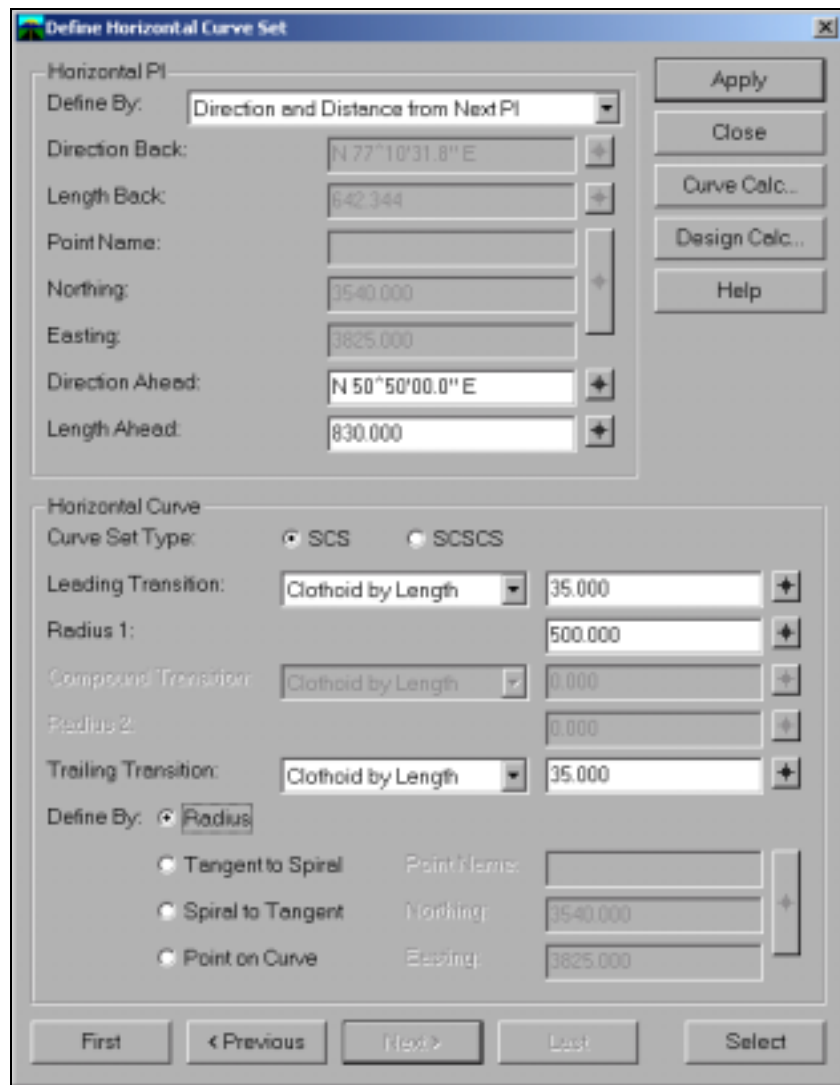
21. Click **Apply**.

5

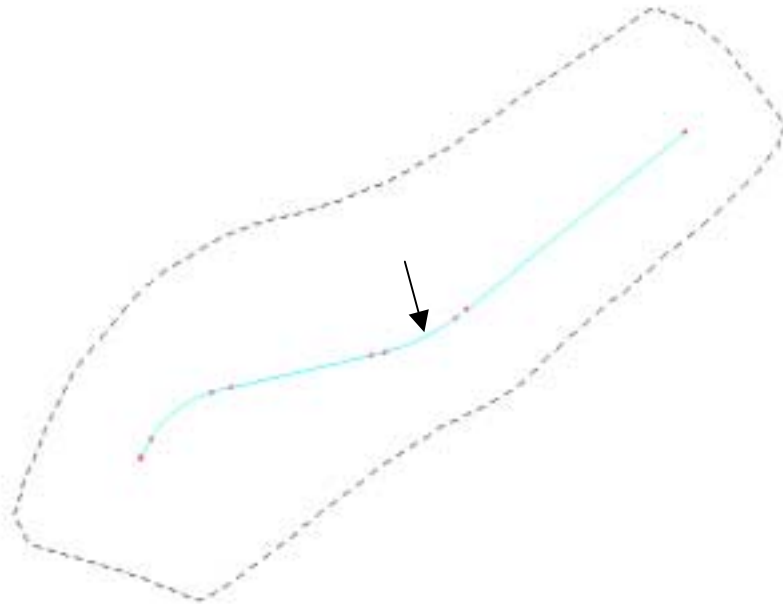


InRoads SelectCAD computes a curve set at the second PI (between the first and second tangent lines) and displays the message: *Successful completion* in the SelectCAD Explorer status field.

22. Click **Next** to move to the third PI.
23. Under **Horizontal PI**, for **Define By**, select **Direction and Distance From Next PI**.
24. For **Direction Ahead**, type N 50 50 E. Press the **TAB** key.
25. For **Length Ahead**, type 830. Press the **TAB** key
26. In the **Horizontal Curve** section, for **Leading Transition** type 35. Press the **TAB** key. For **Radius**, type 500. Press the **TAB** key. For **Trailing Transition**, type 35. Press the **TAB** key.



27. Click **Apply**.



You have successfully created a horizontal alignment.

28. Click **Close** to dismiss the **Define Horizontal Curve Set** dialog box.
Now is a good time to save your project.
29. Click **File > Save As** to save the geometry project.
30. Set the directory to *C:\Bentley>SelectCAD\Tutorial\InRoads*.
31. For the **Save as type**, select **Geometry Projects (*.alg)**.
32. For the **Active**, select **relocation**.
33. For the **File Name** type *relocation.alg*, and click **Save**.

The geometry project called *relocation*, which contains the horizontal alignment data and the empty vertical alignment, is saved.

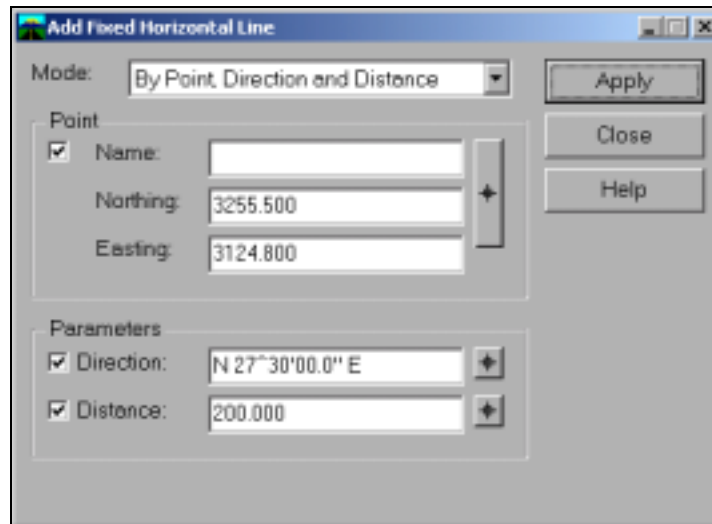
Note: As you progress through the workflow, you can periodically use the **File > Save > Geometry Project** command to save your project. Later, you can reload the geometry project using **File > Open** and set the **File as type to Geometry Projects (*.alg)**.

34. Click **Cancel** to dismiss the dialog box. Now, skip to *Defining the Beginning Station*.

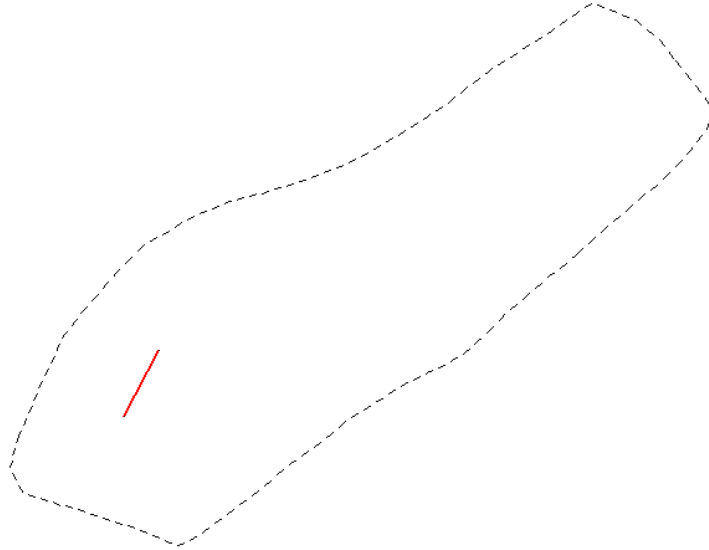
Creating an Alignment by Horizontal Element Design

Now that you have created a geometry project, you can create the alignment for the new road.

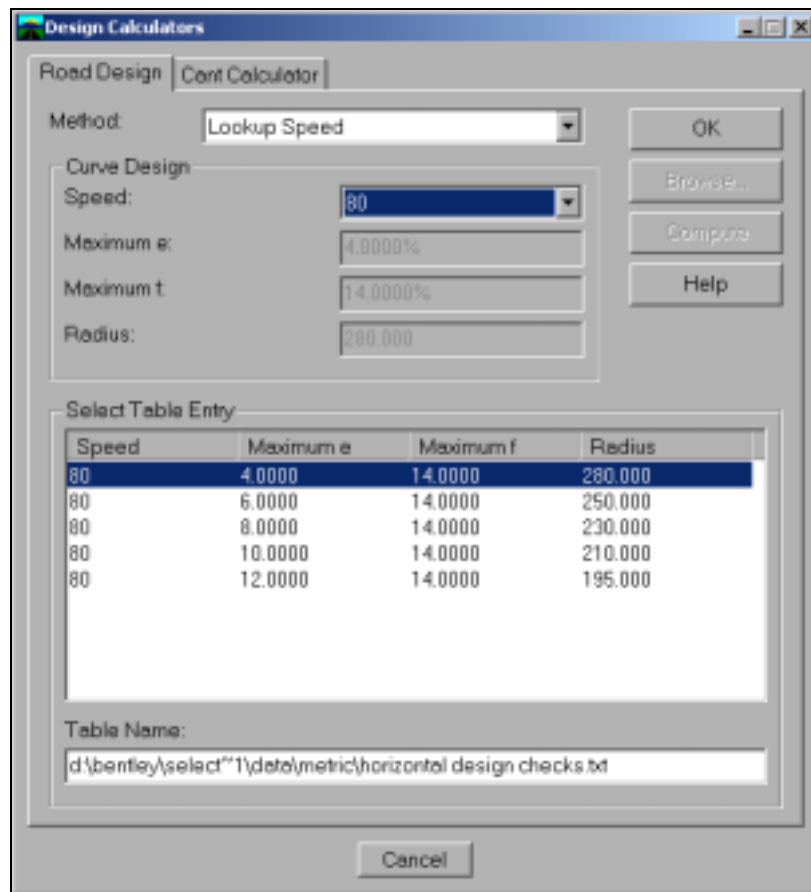
1. Click **Geometry > Horizontal Element > Add Fixed Line**.
2. For **Mode**, select **By Point, Direction and Distance**.
3. In the **Point** section, click the **Name** check box to turn it on.
4. In **Northing** field, type 3255 . 5. Press the **TAB** key.
5. In **Easting** field, type 3124 . 8. Press the **TAB** key.
6. In the **Parameters** section, click the **Direction** check box to turn it on.
7. In the **Direction** field, type N 27 30 E. Press the **TAB** key.
8. In the **Parameters** section, click the **Distance** check box to turn it on.
9. In the **Distance** field, type 200. Press the **TAB** key.



10. Click **Apply**.
11. At the prompt: **Accept/Reject**, accept the solution.



12. Click **Close** to dismiss the dialog box.
13. Click **Geometry > Horizontal Element > Add Floating Curve**.
14. For **Mode**, select **By Point and Radius**.
15. Ensure that the **Name** check box is turn off.
16. Click **Design Calc.** button.
17. Click the **Road Design** tab.
18. Under **Curve Design**, for **Speed**, select **80**.
19. In the **Select Table Entry** section, click on the first row (Maximum e of 4.00 and Radius of 280).



20. Click **OK**.

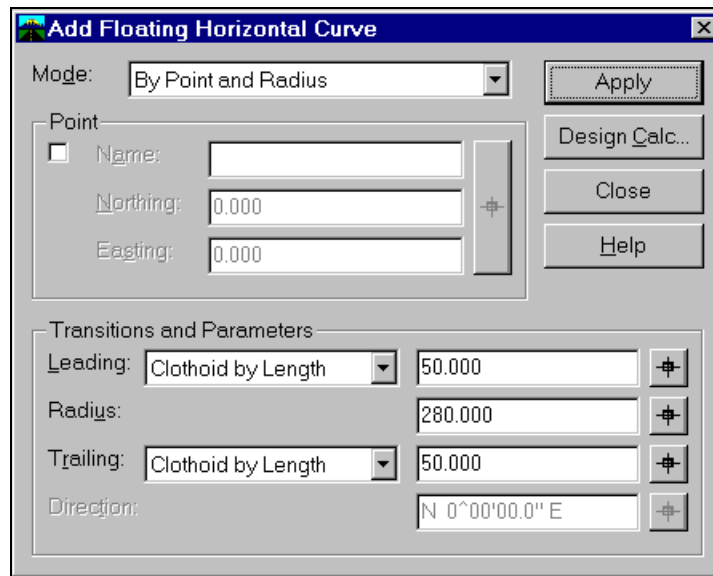
The **Radius** of 280 is displayed in the dialog box.

21. For **Leading Transition**, select **Clothoid by Length**.

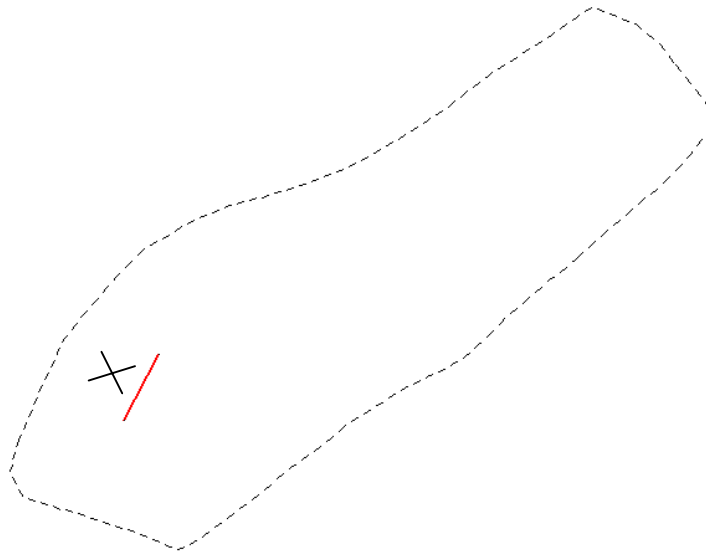
22. In the **Leading Transition** field, type 50. Press the **TAB** key.

23. For **Trailing Transition**, select **Clothoid by Length**.

24. In the **Trailing Transition** field, type 50. Press the **TAB** key.



25. Click **Apply**.
26. At the prompt: **Identify Element**, place a datapoint adjacent to the linear element as shown:

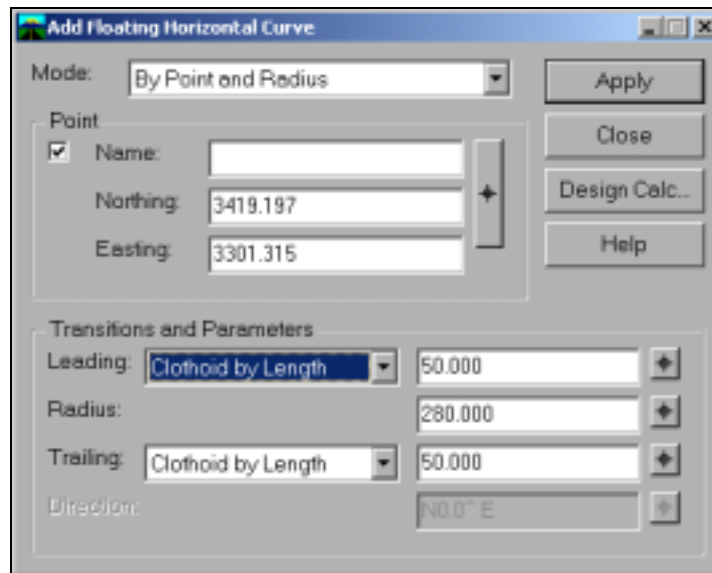


You can dynamically place the floating curve.

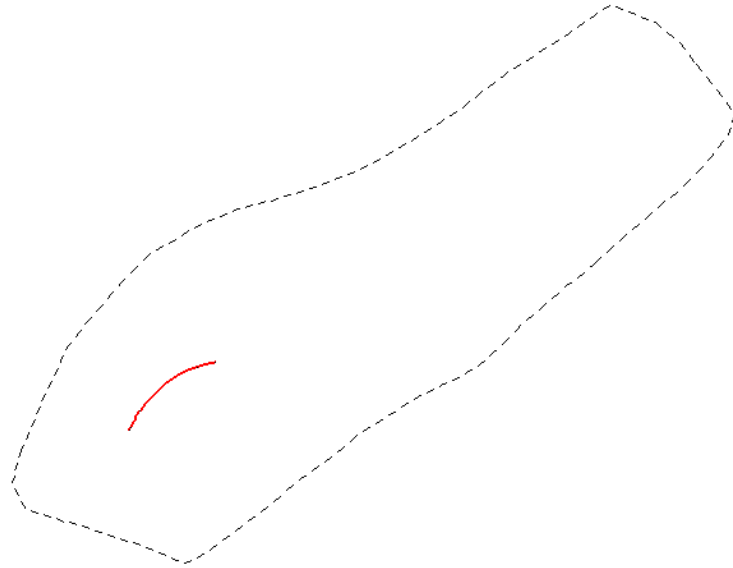
27. At the prompt: **Identify a Point**, place a datapoint in the middle of the surface where the road might go.

Note: You can actually click anywhere in the surface because you are going to reject the solution. This step simply allows you to see that you can place a curve dynamically in graphics. In the next few steps you will place the curve with actual coordinates.

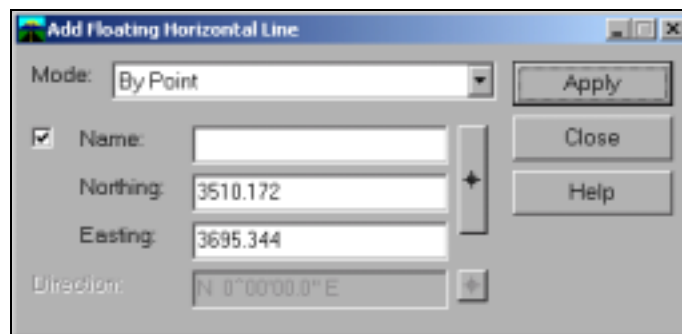
28. At the prompt: **Accept/Reject**, reject.
29. At the prompt: **Identify element**, reject.
30. In the **Point** section, click the **Name** check box to turn it on.
31. In the **Northing** field, type 3419.1965. Press the **TAB** key.
32. In the **Easting** field, type 3301.3151. Press the **TAB** key.



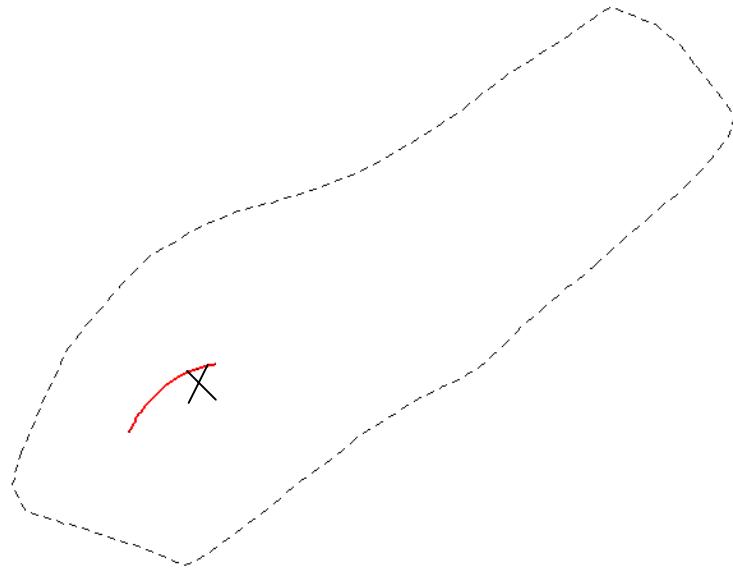
33. Click **Apply**.
34. At the prompt: **Identify element**, place a data point adjacent to the line.
35. At the prompt: **Accept/Reject**, accept the curve.



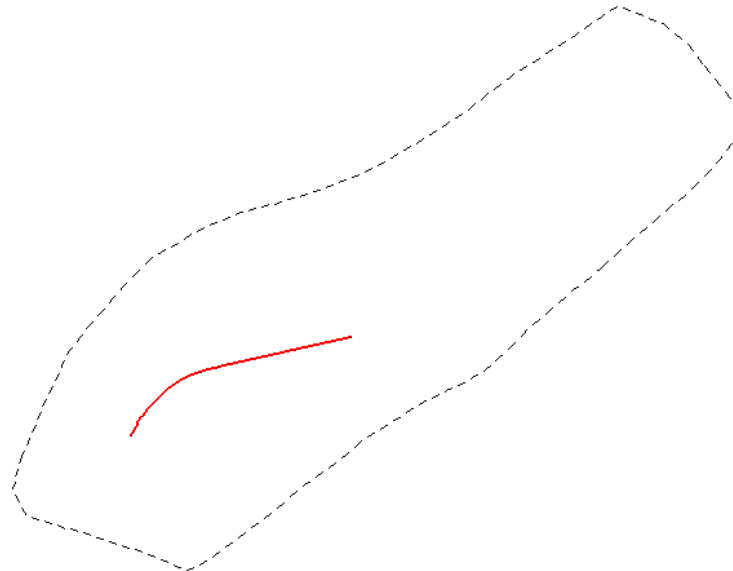
36. At the prompt: **Identify element**, reject.
37. Click **Close** to dismiss the dialog box.
38. Click **Geometry > Horizontal Element > Add Floating Line**.
39. For **Mode**, select **By Point**.
40. In the **Point** section, click the **Name** check box to turn it on.
41. In the **Northing** field, type 3510.1723. Press the **TAB** key.
42. In the **Easting** field, type 3695.3444. Press the **TAB** key.



43. Click **Apply**.
44. At the prompt: **Identify element**, place a data point near the end (but within) the circular arc as shown:



45. At the prompt: **Accept/Reject**, accept the line.

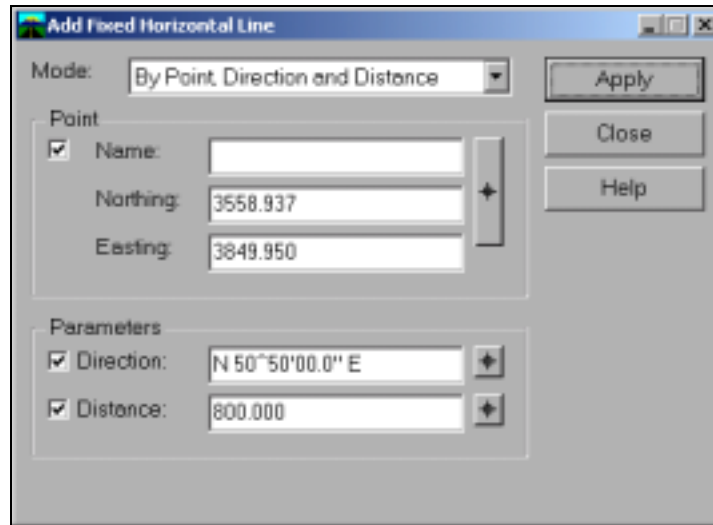


46. At the prompt: **Identify element**, reject.

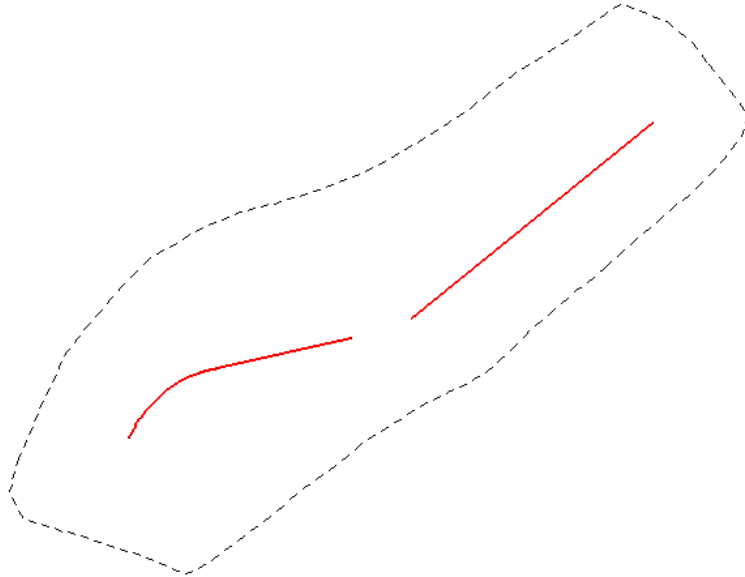
47. Click **Close** to dismiss the dialog box.

48. Again, click **Geometry > Horizontal Element > Add Fixed Line**.

49. For **Mode**, select **By Point, Direction and Distance**.
50. In the **Point** section, click the **Name** check box to turn it on.
51. In **Northing** field, type 3558.9373. Press the **TAB** key.
52. In **Easting** field, type 3849.9504. Press the **TAB** key.
53. In the **Parameters** section, click the **Direction** check box to turn it on.
54. In the **Direction** field, type N 50 50 00.0 E. Press the **TAB** key.
55. In the **Parameters** section, click the **Distance** check box to turn it on.
56. In the **Distance** field, type 800. Press the **TAB** key.



57. Click **Apply**.
58. At the prompt: **Accept/Reject**, accept the line.



You have successfully created a horizontal alignment. Don't be alarmed by the gap in the alignment, you will fix it later in the lesson.

59. Click **Close** to dismiss the dialog.

Now is a good time to save your project.

60. Click **File > Save As** to save the geometry project.
 61. Set the directory to *C:\Bentley>SelectCAD\Tutorial\InRoads*.
 62. For the **Save as type**, select **Geometry Projects (*.alg)**.
 63. For the **Active**, select **relocation**.
 64. For the **File Name** type *relocation.alg*, and click **Save**.

The geometry project called *relocation* is saved.

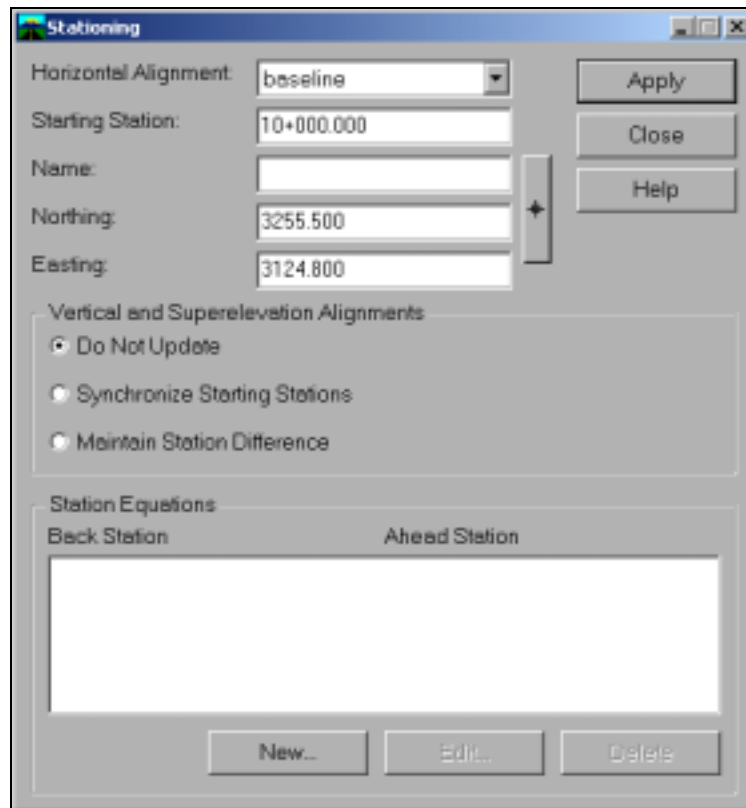
Note: As you progress through the workflow, you can periodically use the **File > Save > Geometry Project** command to save your project. Later, you can reload the geometry project using **File > Open** and set the **File as type to Geometry Projects (*.alg)**.

65. Click **Cancel** to dismiss the dialog box.

Defining the Beginning Station

Now that you have created an alignment, you can define the beginning station.

1. Click **Geometry > Horizontal Curve Set > Stationing**.
2. For **Starting Station**, type 10+000.000, and click **Apply**.



3. Click **Close** to dismiss the dialog box.

Next, you can review the alignment.

Reviewing the Horizontal Alignment

Before fully displaying the alignment, now is a good time to review the alignment for any discontinuities. You can review the entire alignment or check the tangents, spirals, and stationing element by element.

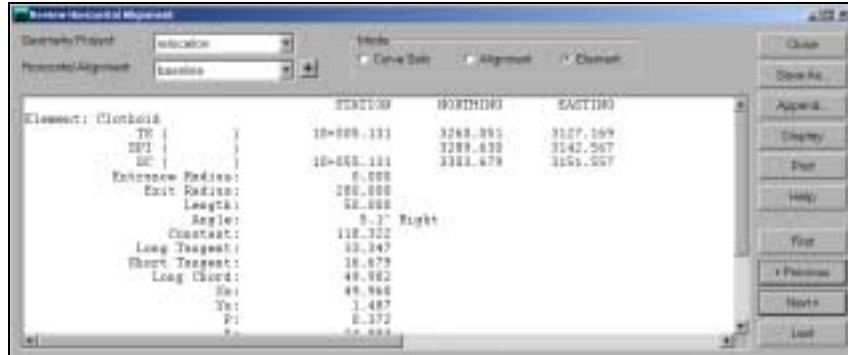
1. Click **Geometry > Review Horizontal**.
2. In the **Mode** section, click **Element**.

This option displays individual elements within the alignment.

3. Click the **Next** button to move along the alignment.

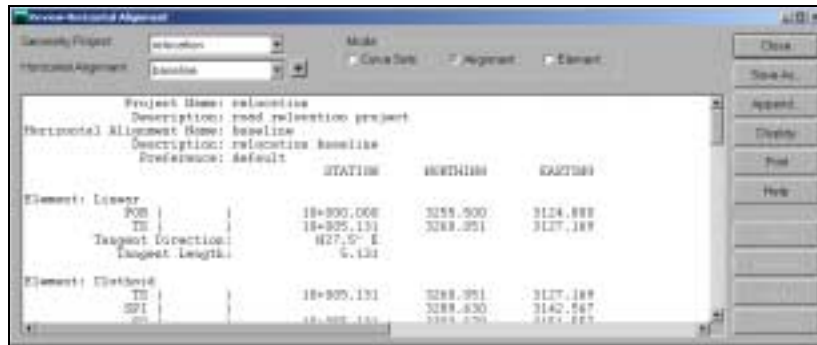
Notice that as you move along the alignment, the element is highlighted in the graphics file.

4. Take a few minutes to review the alignment. You can use the **Last**, **Previous** and **First** buttons to navigate elements in the file.
5. If you created the alignment by curve sets, the review appears as shown below:

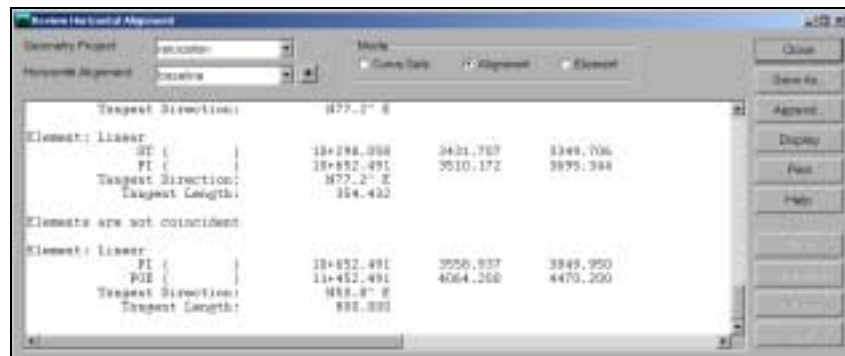


Creating an alignment by Horizontal Curve Set keeps elements collinear and connected. There are no warnings for this alignment.

6. If you created the alignment by horizontal design elements, the review appears as shown below:



Scroll down to the end of the file.



Notice the warning: *Elements are not coincident*. This means there are discontinuities within the alignment. Unlike creating an alignment with curve sets, creating an alignment by Horizontal Design Element does not force the alignment to be collinear and connected.

7. Click **Print**.

Note: If you do not have access to a printer, see *Appendix B, Horizontal Alignment Review* for a copy of these results.

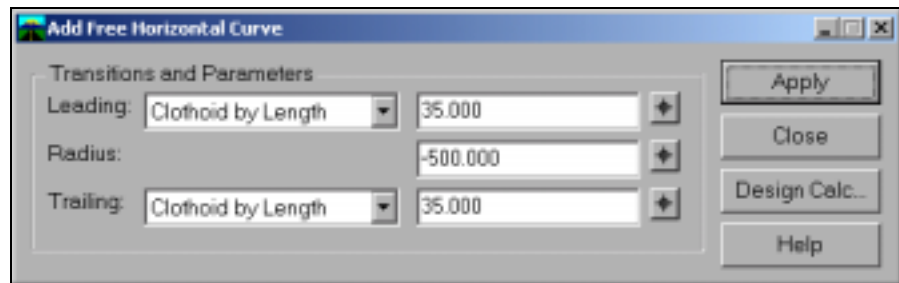
8. Click **Close** to dismiss the dialog box.

If you just created the alignment by **Horizontal Design Element**, continue to the next task; otherwise, skip to *Displaying an Alignment*.

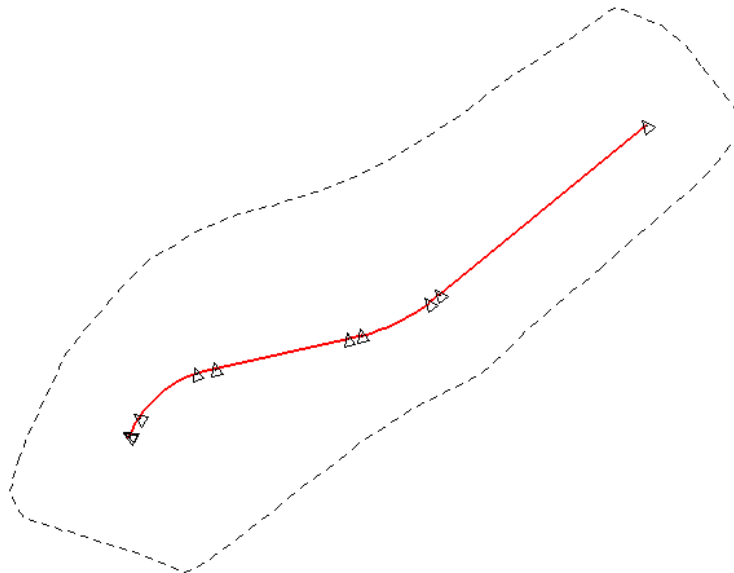
Resolving Discontinuities in a Horizontal Alignment

Once you have reviewed an alignment and discovered discontinuities, you can connect elements to make them collinear.

1. Click **Geometry > Horizontal Element > Add Free Curve**.
2. For **Leading Transition**, select **Clothoid by Length**.
3. In the **Leading Transition** field, type 35. Press the **TAB** key.
4. For **Radius**, type -500. Press the **TAB** key.
5. For **Trailing Transition**, select **Clothoid by Length**.
6. In the **Trailing Transition** field, type 35. Press the **TAB** key.



7. Click **Apply**.
8. At the prompt: **Identify first element**, place a data point adjacent to the line to the left of the gap.
9. At the prompt: **Identify second element**, place a data point adjacent to the line to the right of the gap.
10. At the prompt: **Accept/Reject**, accept the curve.
11. At the prompt: **Identify first element**, right mouse click to return to the dialog box.



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The elements are connected.

12. Click **Close** to dismiss the dialog box.

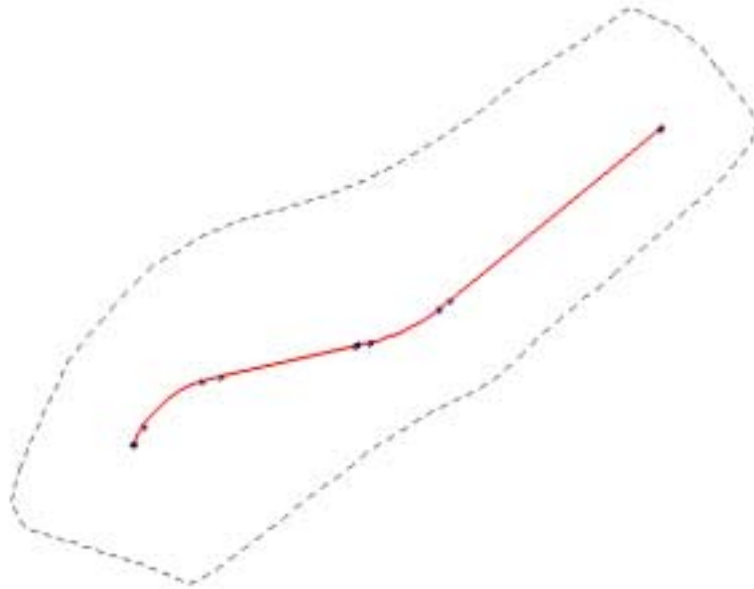
Displaying the Alignment Stationing

With the beginning station defined, you are now able to display the stations along the alignment, and even define station equations, or points of station inequalities, along the alignment. In this task, you display the stationing along the centerline.

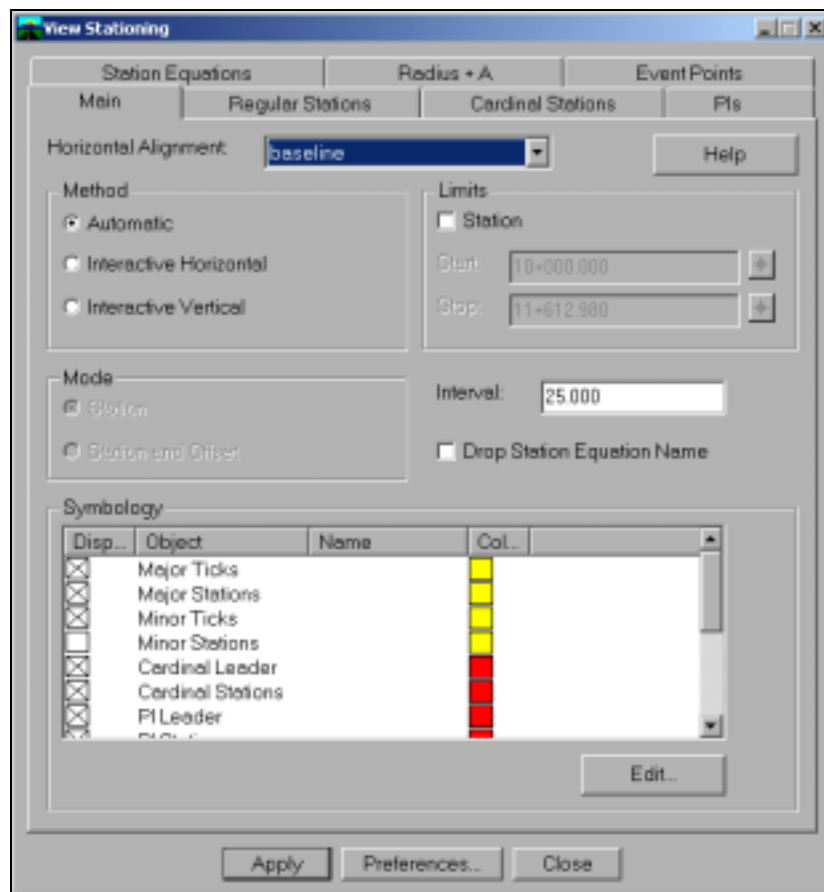
1. Click **Tools > Locks** and turn on **Pencil** mode.

Note: For AutoCAD, you must have **Quick Text (Tools > Drawing Aids)** turned off and the **Write** lock turned on to see the stationing text.

2. Click **Geometry > View Geometry > Active Horizontal** to see the elements and cardinal points of the alignment.



3. Click **Geometry > View Geometry > Stationing**.

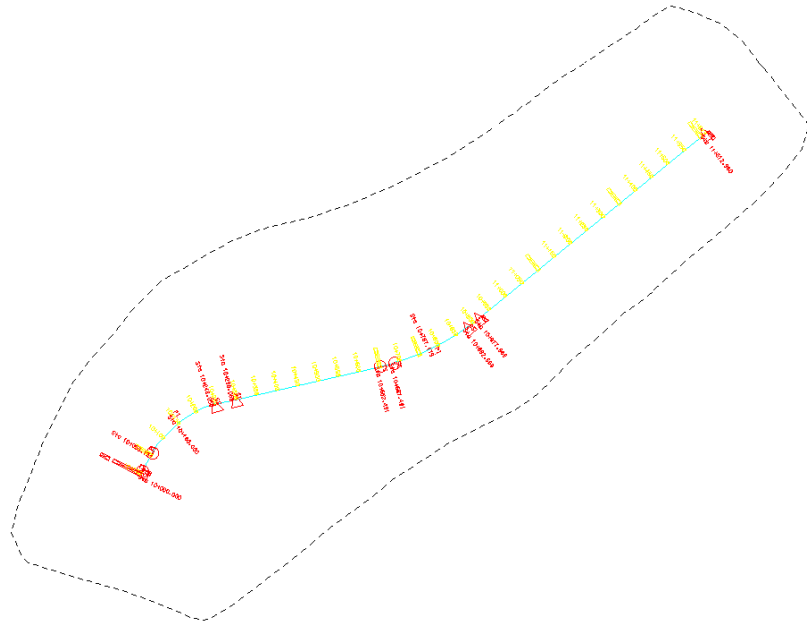


4. Click the **Regular Stations** tab.
5. For **Orientation** in the **MAJOR** section, click **Perpendicular**.
6. In the **Direction** section, click **Up Station**.
7. For **Placement**, select **Left**.
8. For **Justification**, select **Right Center**.
9. For **Precision**, select **0**.
10. For **Format**, select **s+sss.sss**.
11. For **Offset**, type 0.007. Press the **TAB** key.
12. For **Ticks Left Offset**, type -0.005. Press the **TAB** key.
13. For **Ticks Right Offset**, type 0.005. Press the **TAB** key.
14. For **Ticks/Minors/Majors**, type 4. Press the **TAB** key.

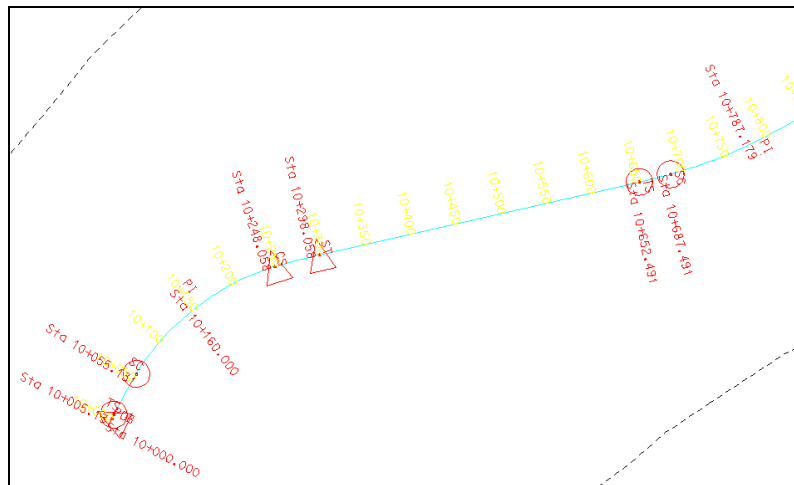
Note: The minor settings remain the default. In this lesson, you only display major tick marks.

15. Click the **Cardinal Stations** tab.
16. For **Orientation**, click **Perpendicular**.
17. For **Direction**, click **Up Station**.
18. For **Placement**, select **In**.
19. For **Justification**, select **Right Center**.
20. For **Precision**, select **0.123**.
21. For **Format**, select **s+sss.sss**.
22. For **Text**, select **Multiple Lines**.
23. For **Leader 1**, type -0.120 . Press the **TAB** key.
24. For **Offset**, type 0 . Press the **TAB** key.
25. Click the **PIs** tab.
26. For **Orientation**, click **Perpendicular**.
27. For **Direction**, click **Up Station**.
28. For **Placement**, select **Out**.
29. For **Justification**, select **Right Center**.
30. For **Precision**, select **0.123**.
31. For **Format**, select **s+sss.sss**.
32. For **Text**, select **Multiple Lines**.
33. For **Leader 1**, type -0.050 . Press the **TAB** key.
34. For **Offset**, type 0 . Press the **TAB** key.
35. Click the **Main** tab.
36. For **Method**, click **Automatic**.
37. For **Interval**, type 50 . Press the **TAB** key.
38. Ensure that symbology for the following objects are turned on: **Major Ticks, Major Stations, Cardinal Leader, Cardinal Station, PI Leader, PI Station**. Turn off all other objects.
39. Click the **Preferences** button.

40. Select *default* and click **Save** to store the preferences in the *civilm_tut.ini* file.
41. Click **Close** to dismiss the **Preferences** dialog box.
42. Click **Apply**.



43. Use the **Zoom** command to see the stationing.



44. You can experiment with the different stationing displays by using the tabs or the **Symbology Edit** option located on the **Main** tab of the dialog box.

45. When you are finished, toggle to **Pen** mode. Click **Apply** one more time on the **View Stationing** dialog box, and then click **Close** to dismiss the dialog box.
46. Using your CAD software, save the *road.dwg* or *road.dgn* file.
47. From InRoads SelectCAD, click **File > Save > Geometry Project**.
48. Click **File > Exit** and then exit your CAD software, or continue to the next lesson.

Lesson 4: Profiles

With the location of the horizontal alignment in place, the next step in designing a roadway is the definition of the design grade line or vertical alignment. Before you define the vertical alignment, you extract a profile of the original surface along the horizontal alignment. Then you use the surface profile as a reference for designing the vertical alignment.

When profiles are created, they are done so as a part of a set (even if there is only one profile within the set). Profiles are maintained as a part of a set so that they are easily identified when you want to update a profile or edit features within a specific profile. When a profile is created, it appears in the drawing file in a rectangular box, called the profile window. As you add segments to the vertical alignment, they appear in the profile window. This lesson covers profile generation. The next lesson covers vertical alignment layout within the profile and profile annotation.

If you just finished the lesson on horizontal alignments, skip to *Generating a Profile Along an Alignment*. If you are just beginning the tutorial here, complete the following steps:

1. Extract *roadlesson4.exe*. For more information, see *Before Starting Each Lesson* at the beginning of this chapter.
2. Start InRoads SelectCAD, and open the *road.dwg* or *road.dgn* file. These files are located in the *\Tutorial\InRoads* directory where you installed InRoads SelectCAD. For more information on starting the software, see *Chapter 2, Starting InRoads SelectCAD*.
3. Click **File > Open**.
4. Set the directory to *C:\Bentley>SelectCAD\Tutorial\InRoads*.
5. For the **Files of type**, select **Preferences (*.ini)**.
6. Select *civilm_tut.ini*, and click **Open**.
7. For the **Files of type**, select **Geometry Projects (*.alg)**.
8. Select *relocation.alg*, and click **Open**.
9. For the **Files of type**, select **Surfaces (*.dtm)**.
10. Select *original.dtm*, and click **Open**.
11. Click **Cancel** to dismiss the dialog box.

Generating a Profile Along an Alignment

To extract a profile, which represents the elevation of the existing surface *original* along the horizontal alignment centerline, complete the following steps.

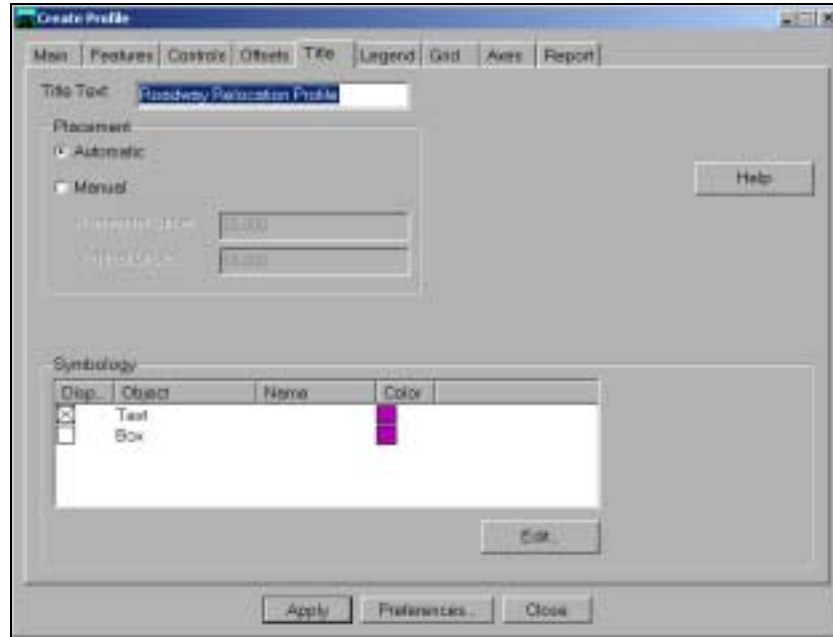
1. Click **Evaluation > Profile > Create Profile**.
2. Click the **Main** tab.
3. For **Create**, select **Window and Data**.
4. For **Set Name**, a default name is provided: **baseline**. This profile set will contain only one profile and will be associated with the alignment *baseline*.
5. Under **Source**, for **Alignment**, select **baseline**.
6. Under **Symbology**, under **Display**, turn on the **Surface, original**.

This tells InRoads SelectCAD that the elevation data in surface *original* should be used for the profile.



7. Click the **Features** tab. Turn off all options.
8. Click the **Controls** tab.
9. Under **Limits**, ensure that both toggles are turned off.
10. Under **Exaggeration**, for Vertical, type 10.00. For Horizontal, type 1.0.

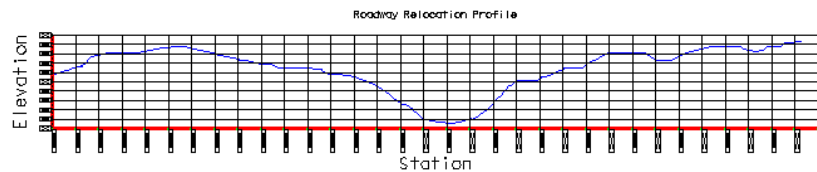
11. Click the **Title** tab.
12. For **Title Text**, type, Roadway Relocation Profile.
13. Under **Placement**, turn on **Automatic**.



14. Click **Tools > Locks**, and make sure that the **Write** lock is on.
15. Click **Apply**, and place a data point somewhere to the right of the surface *original*.

This location identifies the origin of the axes used in the profile generation (justified about the lower-left corner), and InRoads SelectCAD extracts and displays the profile at the specified point.

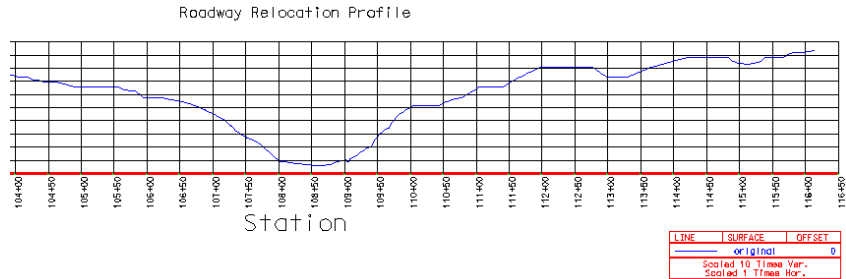
The graphics in the profile show the elevation of the existing ground along the path of the horizontal alignment.



5

Note: If the details of the profile, such as the title and text, do not appear, modify the symbology colors and redisplay the profile.

16. Use the CAD software **Zoom** commands to view the profile and legend.



17. You can turn off the **Write** lock and experiment with the parameters that control the operation of the **Create Profile** command by selecting the tabs on the **Create Profile** dialog box. When you are satisfied with the results, turn **Write** lock on and re-run the command. To save a setting, click **Preferences** on the dialog box. Select *default*, click **Save** then, **Close**.
18. When you are finished, click **Close** to dismiss the **Create Profile** dialog box.
19. Using your CAD software, save the *road.dwg* or *road.dgn* file.
20. Click **File > Exit** and then exit your CAD software, or continue to the next lesson.

Lesson 5: Vertical Alignments

Now that you have extracted a profile of the existing terrain, you can define the longitudinal grade of the road using the existing ground as a reference. In this lesson, you create and define a vertical alignment. You define the vertical alignment within the bounds of a profile generated along a horizontal alignment. It is important to understand that a vertical alignment defines the elevations for a given horizontal alignment. In this way, a vertical alignment is related to a particular horizontal alignment.

If you just finished the lesson on profiles, skip to *Creating a New Vertical Alignment*. If you are just beginning the tutorial here, complete the following steps:

1. Extract *roadlesson5.exe*. For more information, see *Before Starting Each Lesson* at the beginning of this chapter.
2. Start InRoads SelectCAD, and open the *road.dwg* or *road.dgn* file. These files are located in the `\Tutorial\InRoads` directory where you installed InRoads SelectCAD. For more details on starting the software, see *Chapter 2, Starting InRoads SelectCAD*.
3. Click **File > Open**.
4. Set the directory to `C:\Bentley>SelectCAD\Tutorial\InRoads`.
5. For the **Files of type**, select **Preferences (*.ini)**.
6. Select *civilm_tut.ini*, and click **Open**.
7. For the **Files of type**, select **Geometry Projects (*.alg)**.
8. Select *relocation.alg*, and click **Open**.
9. For the **Files of type**, select **Surfaces (*.dtm)**.
10. Select *original.dtm*, and click **Open**.
11. Click **Cancel** to dismiss the dialog box.

Creating a New Vertical Alignment

InRoads SelectCAD provides three methods for creating a vertical alignment. One approach lets you add points of intersection (PIs) and curve sets. Another method defines the geometry by vertical element design. Finally, you can create a vertical alignment using regression analysis. The first two methods are detailed in this lesson. You can complete the instructions for one method or, you can practice creating alignments using both methods. For detailed instructions on creating a

vertical alignment using regression analysis, see the tutorial lessons for the Rail SelectCAD product.

To create a vertical alignment using curve sets, continue to the next section, otherwise, skip to *Creating an Alignment by Vertical Element Design*.

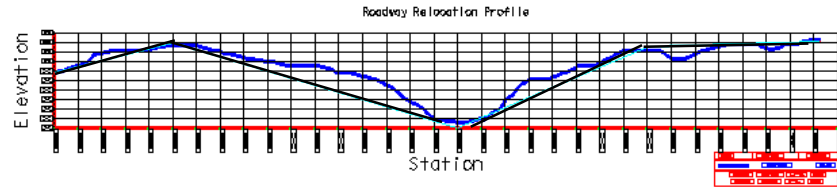
Creating an Alignment by Vertical Curve Set

In this task, you create a new vertical alignment to define plan grade along the horizontal alignment centerline.

1. Click **Geometry > Vertical Curve Set > Add PI**.

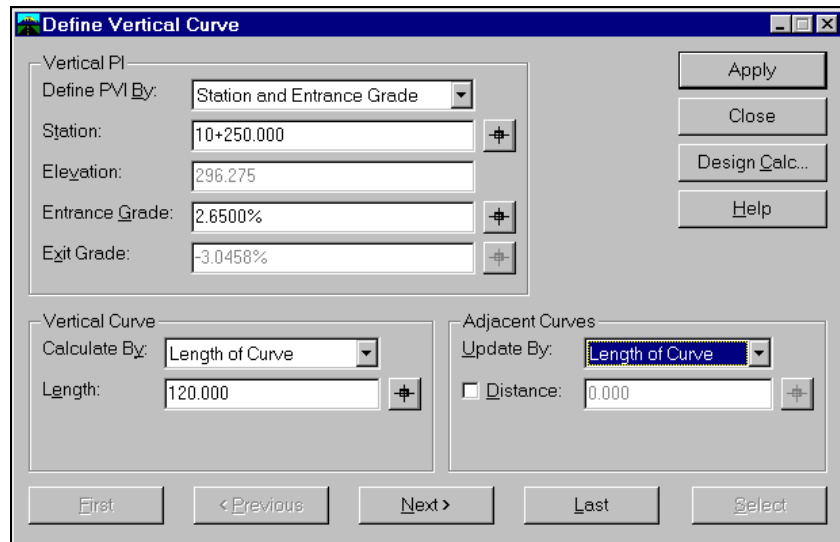
Note: You can define a PI by keying in coordinates in the dialog box, keying in coordinates in the CAD command window, by selecting the point graphically. When selecting the point graphically, the coordinates are dynamically displayed in the lower-left corner of the SelectCAD Explorer. For this lesson, you will key in each PI in the CAD command window. You may need to move the collapsed dialog box to see the prompts in the lower-left corner of the Explorer.

2. Select **Apply** on the **Add Vertical PI** dialog box.
3. At the prompt: **Identify alignment end**, click in the CAD command window and type `se=10000 , 289 . 65`. Press the **Enter** key.
The beginning of the active vertical alignment is displayed in the profile.
4. At the prompt: **Identify Point/Reject**, type `se=10250 , 296` in the CAD command window. Press the **Enter** key.
5. At the prompt: **Identify Point/Reject**, type `se=10850 , 278` in the CAD command window. Press the **Enter** key.
6. At the prompt: **Identify Point/Reject**, type `se=11250 , 295` in the CAD command window. Press the **Enter** key.
7. At the prompt: **Identify Point/Reject**, type `se=11612 . 7999 , 296 . 30` in the CAD command window. Press the **Enter** key.
8. At the prompt: **Identify Point/Reject**, reject.
9. Reject again to redisplay the dialog box.
10. Close the Add Vertical PI dialog.



You have successfully added PIs to create tangents for the new vertical alignment. Next, you define the curves.

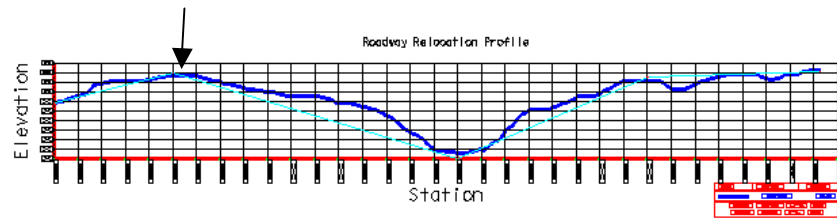
11. Click **Geometry > Vertical Curve Set > Define Curve**.
12. Under **Vertical PI**, for **Define PVI By**, select **Station and Entrance Grade**.
13. For **Station**, type 10+250. Press the **TAB** key.
14. For **Entrance Grade**, type 2.65%. Press the **TAB** key.
15. Under **Vertical Curve**, for **Calculate By**, select **Length of Curve**.
16. For **Length**, type 120. Press the **TAB** key.



5

The curve set will have a length of 120 meters.

17. Click **Apply**.
- The first curve is placed:



The message: *Successful completion* is displayed in the SelectCAD Explorer.

18. Click **Next** to move up the alignment to compute the next curve set.
19. For **Define PVI By**, select **Station and Elevation**.
20. For **Station**, type 10+850. Press the **TAB** key.
21. For **Elevation**, type 278. Press the **TAB** key.
Next, you will use the design calculator to define the curve length.
22. Click the **Design Calc.** button.
23. For **Method**, select **Lookup Speed**.
24. Under **Curve Design**, for **Range**, turn on the **Upper** toggle.
25. For **Speed**, select **80**.

Vertical Design Calculator

Method: Lookup Speed

Curve Design

Range: Upper Lower

Speed: 80

K Value: 32.000

Length: 233.467

Curve Type: Sag

Headlight Sight Distance

Type: Stopping Passing

Distance: 140.000

Friction: 30.0000%

Eye Height: 1.070

Object Height: 0.150

Table Name:

d:\bentley\select**1\data\metric\vertical design checks.txt

OK

Cancel

Browse...

Compute

Help

26. Click **OK**.

Note: The calculated length of curve is 233.467. Since it is best to use an even number for curve length, type 234 in the **Length of Curve** field. Press the **TAB** key.

Define Vertical Curve

Vertical PVI

Define PVI By: Station and Elevation

Station: 10+850.000

Elevation: 278.000

Entrance Grade: -3.0458%

Exit Grade: 4.2500%

Vertical Curve

Calculate By: Length of Curve

Length: 234.000

Adjacent Curves

Update By: Length of Curve

Distance: 0.000

Apply

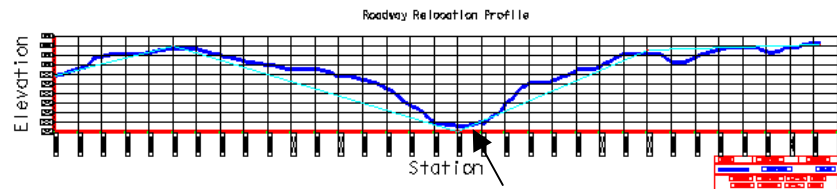
Close

Design Calc...

Help

First < Previous Next > Last Select

27. Click **Apply**.



28. Click **Next** to move up the alignment to complete the curve set.

29. For **Define PVI By**, select **Station and Exit Grade**.

30. For **Station**, type 11+250. Press the **TAB** key.

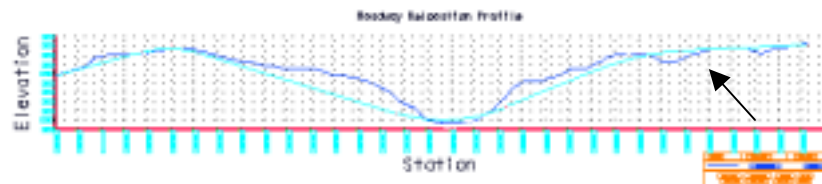
31. For **Exit Grade**, type 0.5%. Press the **TAB** key.

32. For **Calculate By**, select **Length of Curve**.

33. For **Length**, type 180. Press the **TAB** key.

34. Click **Apply**.

The final curve set is computed with a length of 180 meters.



The message: *Successful completion* is displayed in the SelectCAD Explorer.

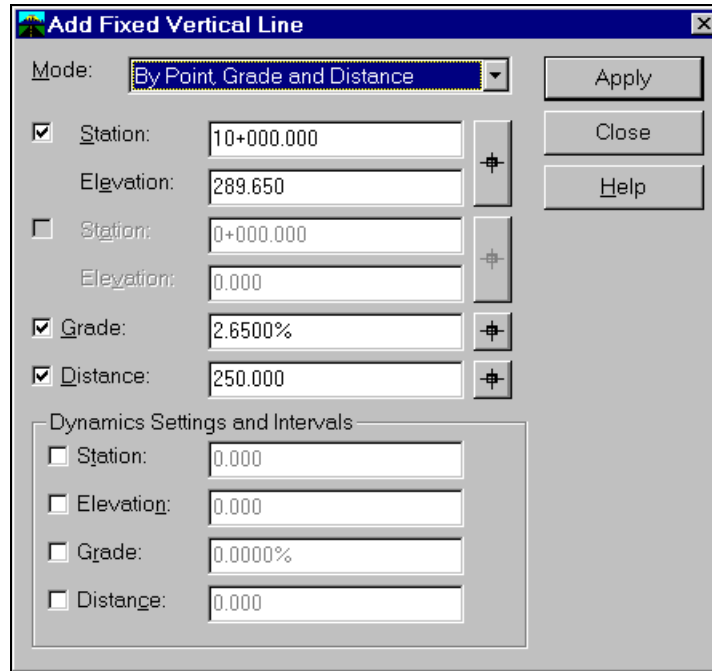
35. Click **Close** to dismiss the dialog box.

Creating an Alignment by Vertical Element Design

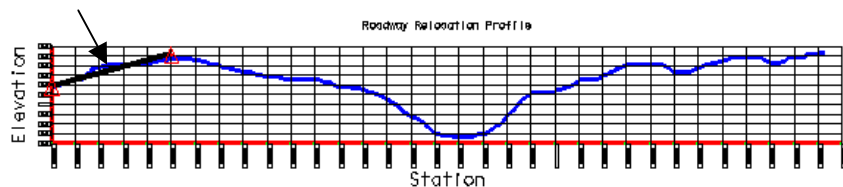
Once the horizontal alignment in a geometry project is in place, you can define elevations along the centerline of the new road.

1. Click **Geometry > Vertical Element > Add Fixed Line**.
2. For **Mode**, select **By Point, Grade and Distance**.
3. Click the **Station** check box to turn it on.
4. For **Station**, type 10+000. Press the **TAB** key.
5. For **Elevation**, type 289.65. Press the **TAB** key.
6. Click the **Grade** check box to turn it on.

7. For **Grade**, type 2.65%. Press the **TAB** key.
8. For **Distance**, type 250. Press the **TAB** key.

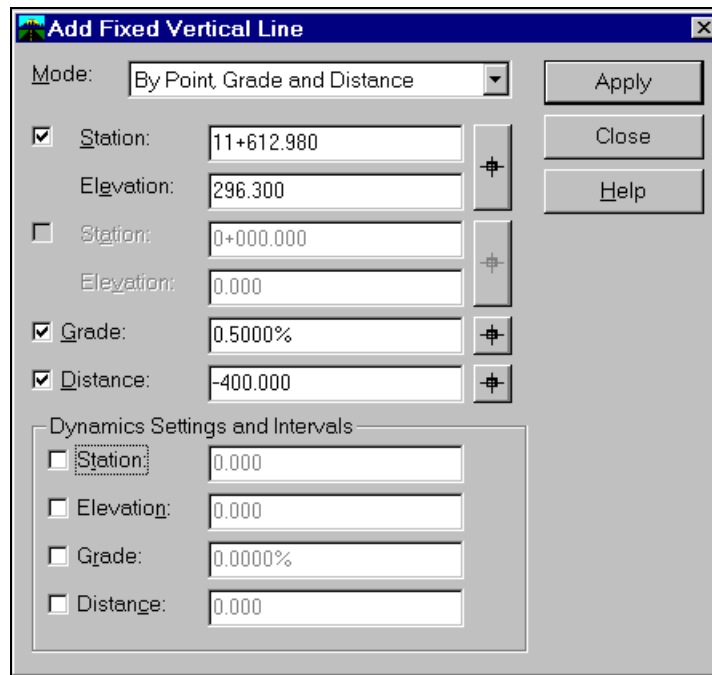


9. Click **Apply**.
10. At the prompt: **Accept/Reject**, accept the solution.

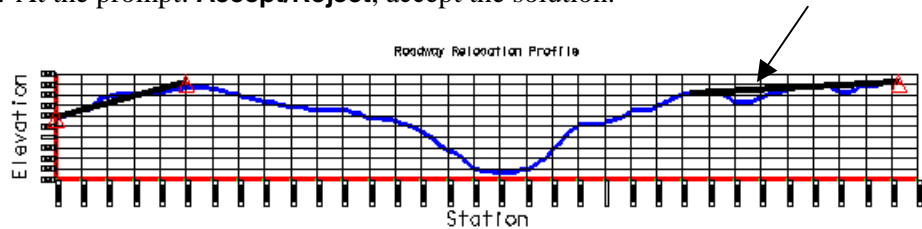


Next, you add the last tangent to the vertical alignment.

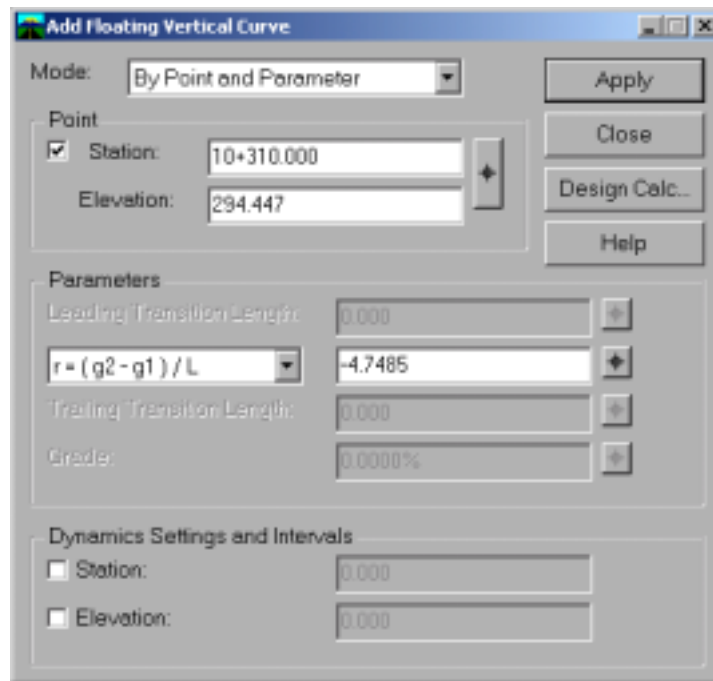
11. For **Station**, type 11+612.7999. Press the **TAB** key.
12. For **Elevation**, type 296.30. Press the **TAB** key.
13. For **Grade**, type 0.5%. Press the **TAB** key.
14. For **Distance**, type -400. Press the **TAB** key.



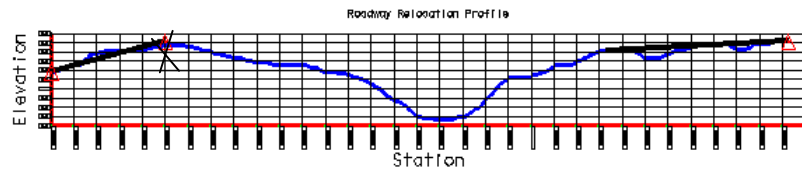
15. Click **Apply**.
16. At the prompt: **Accept/Reject**, accept the solution.



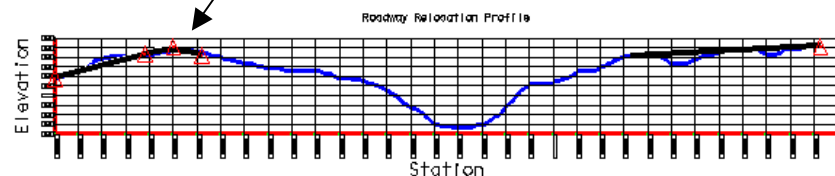
17. Click **Close** to dismiss the dialog box.
18. Click **Geometry > Vertical Element > Add Floating Curve**.
19. For **Mode**, select **By Point and Parameter**.
20. Click the **Station** check box to turn it on.
21. For **Station**, type 10+310. Press the **TAB** key.
22. For **Elevation**, type 294.4475. Press the **TAB** key.
23. In the **Parameter** section, select $r = (g_2 - g_1) / L$ and in the field, type -4.7485.



24. Click **Apply**.
25. At the prompt: **Identify Element**, place a data point near the end, but within the extents of the first tangent as shown:

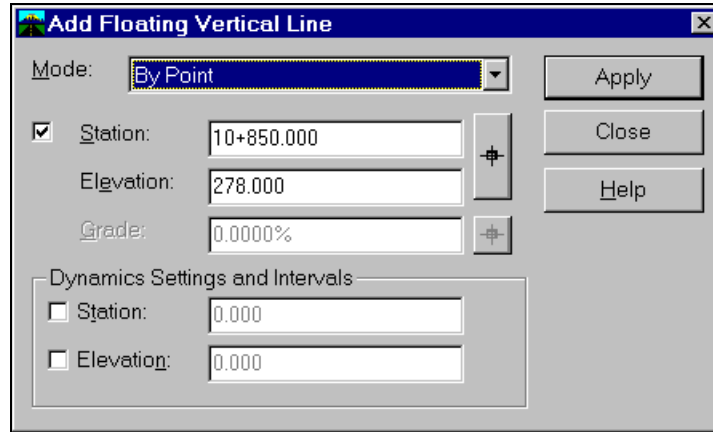


26. At the prompt: **Accept/Reject**, accept the solution.
27. At the prompt: **Identify element**, reject/stop.

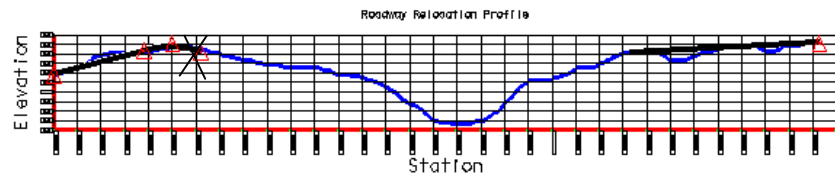


28. Click **Close** to dismiss the dialog box.
29. Click **Geometry > Vertical Element > Add Floating Line**.
30. For **Mode**, select **By Point**.

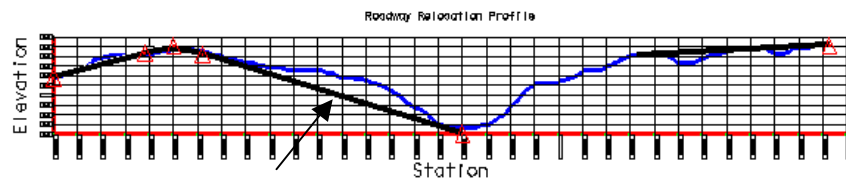
31. Click the **Station** check box to turn it on.
32. For **Station**, type 108+50. Press the **TAB** key.
33. For **Elevation**, type 278. Press the **TAB** key.



34. Click **Apply**.
35. At the prompt: **Identify element**, place a data point near the end (but within) the circular arc as shown:



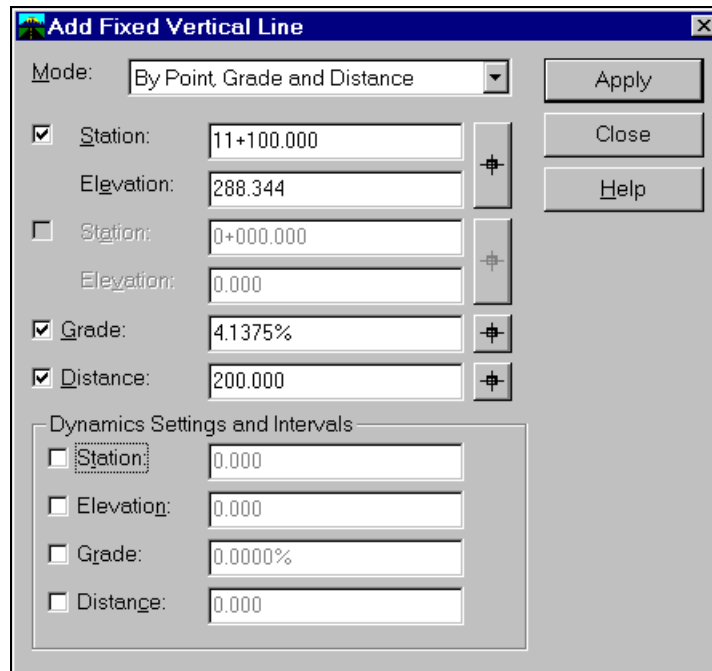
36. At the prompt: **Accept/Reject**, accept the line.
37. At the prompt: **Identify element**, reject/stop.



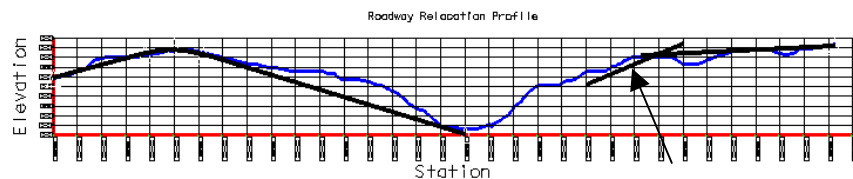
5

38. Click **Close** to dismiss the dialog box.
39. **Geometry > Vertical Element > Add Fixed Line**.
40. For **Mode**, select **By Point, Grade and Distance**.
41. Click the **Station** check box to turn it on.

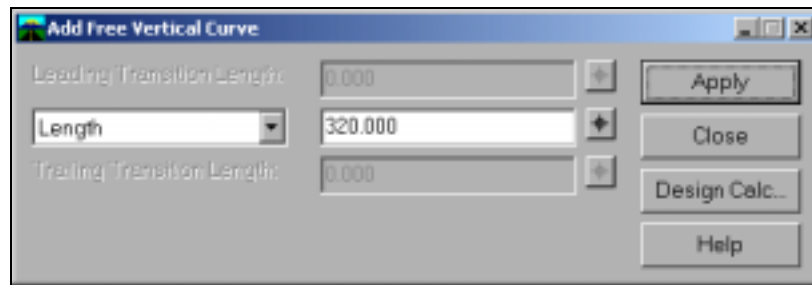
42. For **Station**, type 11+100. Press the **TAB** key.
43. For **Elevation**, type 288.3438. Press the **TAB** key.
44. Click the **Grade** check box to turn it on.
45. For **Grade**, type 4.1375%. Press the **TAB** key.
46. Click the **Distance** check box to turn it on.
47. For **Distance**, type 200. Press the **TAB** key.



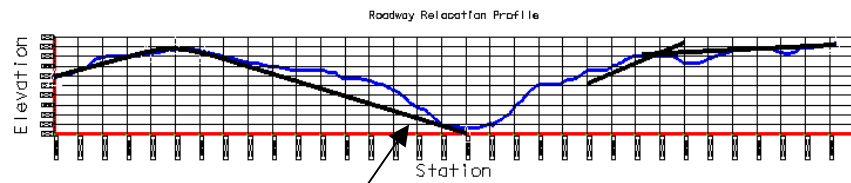
48. Click **Apply**.



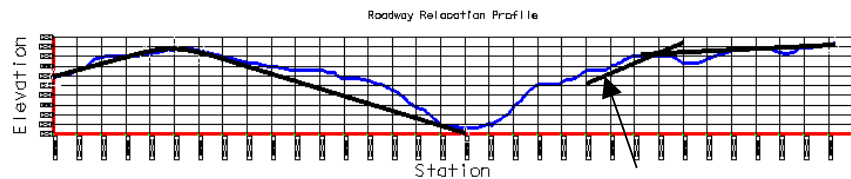
49. At the prompt: **Accept/Reject**, accept the line.
50. Click **Close** to dismiss the dialog box.
51. Click **Geometry > Vertical Element > Add Free Curve**.
52. For **Length**, type 320. Press the **TAB** key.



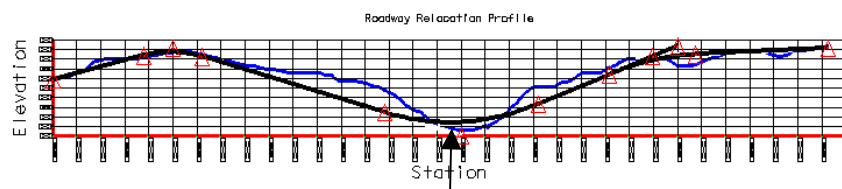
53. Click Apply.
54. At the prompt: **Identify first element**, place a data point near the second tangent:



55. At the prompt: **Identify second element**, place a data point near the third tangent:

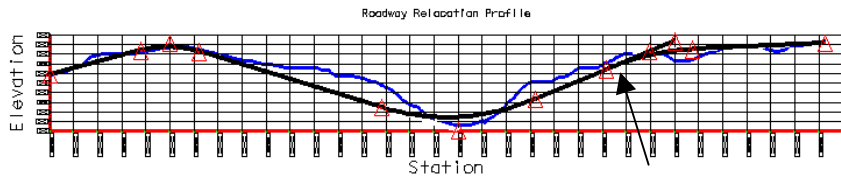


56. At the prompt: **Accept/Reject**, accept the line.
57. At the prompt: **Identify first element**, reject/stop and return to the dialog box.

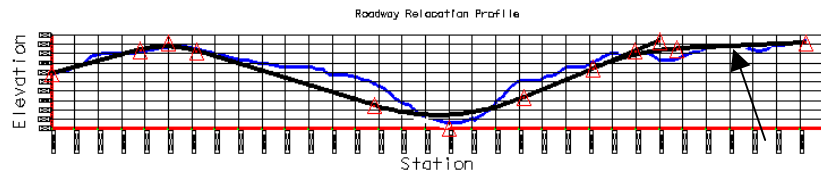


5

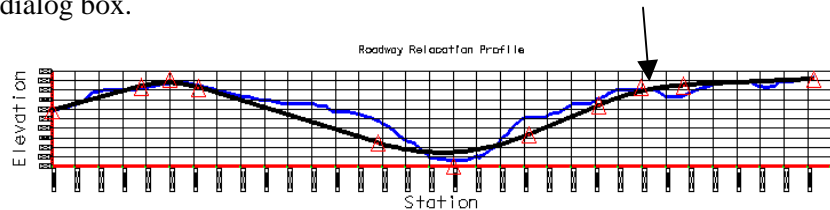
58. For **Length**, type 180. Press the **TAB** key.
59. Click **Apply**.
Next, place the final curve.
60. At the prompt: **Identify first element**, place a data point near the third tangent:



61. At the prompt: **Identify second element**, place a data point near the last tangent:



62. At the prompt: **Accept/Reject**, accept the curve.
63. At the prompt: **Identify first element**, reject/stop and return to the dialog box.



You have successfully created a vertical alignment.

66. Click **Close** to dismiss the dialog.
Save your project.
67. Click **File > Save As** to save the geometry project.
68. Set the directory to *C:\Bentley\SelectCAD\Tutorial\InRoads*.
69. For the **Save as type**, select **Geometry Projects (*.alg)**.
70. For the **Active**, select **relocation**.
71. For the **File Name** type *relocation.alg*, and click **Save**.

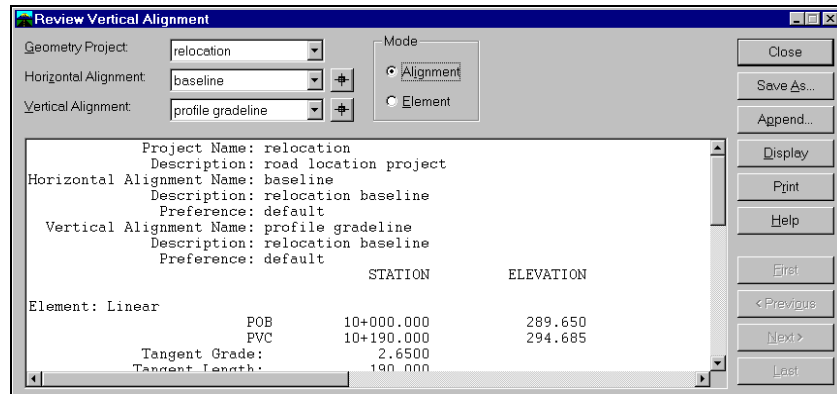
Note: As you progress through the workflow, you can periodically use the **File > Save > Geometry Project** command to save your project. Later, you can reload the geometry project using **File > Open** and set the **File as type to Geometry Projects (*.alg)**.

72. Click **Cancel** to dismiss the dialog box.

Reviewing a Vertical Alignment

Before fully displaying the alignment, now is a good time to review it. You can review the entire alignment or check the tangents element by element.

1. Click **Geometry > Review Vertical**.



2. In the **Mode** section, click **Element**.

This option displays individual elements within the alignment.

3. Click the **Next** button to move along the alignment.

Notice that as you move along the alignment, the element is highlighted in the graphics file.

4. Take a few minutes to review the alignment. You can use the **Last**, **Previous** and **First** buttons to navigate elements in the file.

9. In the **Mode** section, click **Alignment**.

10. Click **Print**.

Note: If you do not have access to a printer, see *Appendix C, Vertical Alignment Review* for a copy of these results.

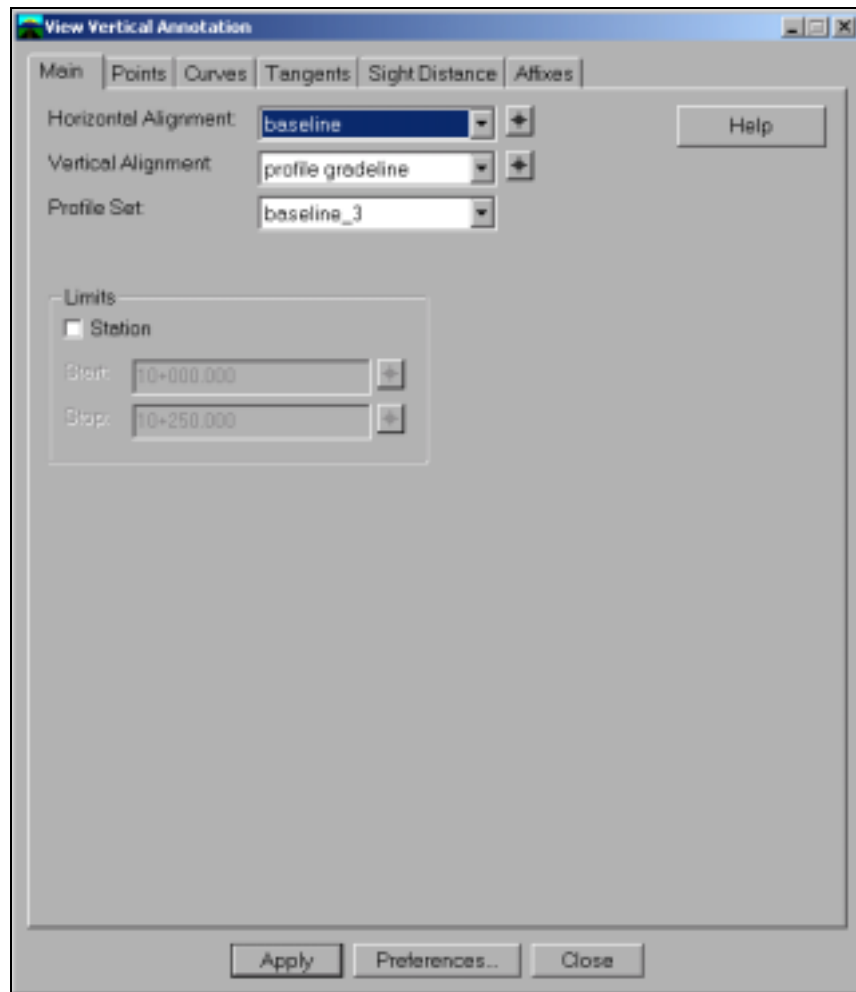
11. Click **Close** to dismiss the dialog box.

Profile Annotation

Many profile sheets are annotated with, at a very minimum, the stationing and elevation of the existing ground and design grade. InRoads SelectCAD provides the ability to annotate many other alignment attributes, including superelevation rates and degree-of-curvature. By providing the ability to display these latter two parameters along the profile, InRoads SelectCAD gives you the means to properly blend horizontal and vertical alignment curves to meet well-established guidelines.

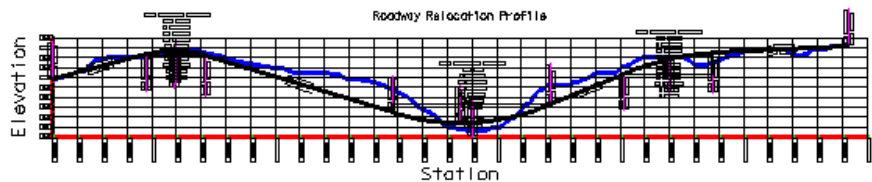
Displaying Vertical Alignment Annotation

1. Click **Tools > Locks**, and ensure that the **Write** lock is on.
2. Click **Tools > Options > Factors** to set **Text Factor** to 5.00. Click **Apply**; then **Close**.
3. Click **Geometry > View Geometry > Vertical Annotation**.



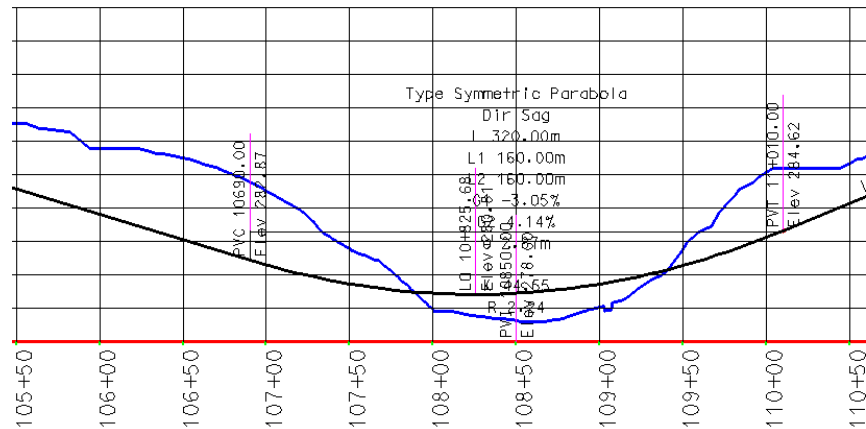
4. Click **Apply**.
5. At the prompt: **Select profile window to be annotated**, place a data point in the profile window.

5



6. Use your CAD **Zoom** commands to view the annotation.

Roadway Relocation Profile



7. Click **Close** to dismiss the dialog box.
8. Using your CAD software, save the *road.dwg* or *road.dgn* file.
9. Click **File > Exit** to exit InRoads SelectCAD, then exit your CAD software.

Lesson 6: Plan and Profile Generator

You have successfully created a horizontal and vertical alignment for the proposed roadway, so now would be a good time to create initial plan and profile sheets for the project. Creating the sheets at this point in the process allows you see where the sheets will fall along the alignment.

In InRoads SelectCAD, the **Plan and Profile Generator** command is designed to assist you in assembling sheets along an alignment. The sheets may be plan sheets only, plan and profile sheets, or profile sheets only. Data for the *plan views* comes from plan view graphics already displayed in your CAD design/drawing file. Data for the *profile views* is created in your active CAD design/drawing file using this command. The Host file contains the title block and border information. The plan and profile views created are composed in a Host file as reference files or in viewports to your model file if you are using AutoCAD. If you are using AutoCAD, the sheets will always be composed in your current file. The plan view can be referenced from other files.

Once you have the parameters for all the tabs set, you can save the dialog settings to a preference file that can be loaded in a future design session so you do not have to re-enter all the parameters.

It is assumed that you know the basics of how to open and manipulate alignments and surfaces (See Lessons 1 through 3 for details). It is also assumed that you know the basics of how to set up the parameters for plotting a profile from within InRoads SelectCAD (See *Lesson 4: Profiles* for details).

Before You Start This Lesson

For this lesson, the following preferences have been set for you and delivered with InRoads SelectCAD: 1) **Plan and Profile Generator** dialog box preferences, 2) profile preference border cells or blocks. Use the data delivered in the Tutorial directory for Lesson 6.

Note: If you did not exit InRoads SelectCAD and the CAD software in the previous lesson, stop here and exit.

In a real-world workflow, you should set and store in a preference file the parameters and symbology standards for the **Create Profile** command. The **Plan and Profile Generator** command requires that you specify which profile preference is used to control how the profiles are displayed in the design/drawing file.

To begin Lesson 6, complete the following steps:

1. Extract *roadlesson6.exe*. For more information, see *Before Starting Each Lesson* at the beginning of this chapter.
2. Start InRoads SelectCAD. On MicroStation from the \Tutorial\InRoads directory, open *plprseed.dgn*. Attach *infra.cel* to the design file. Then, open *road.dgn* and attach *infra.cel* to the design file.

Note: The cell *infra.cel* is located in the \Tutorial\InRoads directory. This cell must be attached to both design files.

On AutoCAD, open *road.dwg* located in the \Tutorial\InRoads directory where you installed InRoads SelectCAD. For more details on starting the software, see *Chapter 2, Starting InRoads SelectCAD*.

3. Click **File > Open**.
4. For the **Files of type**, select **Preferences (*.ini)**.
5. Select *civilpp_tut.ini*, and click **Open**.
6. For the **Files of type**, select **Styles (*.ini)**.
7. Select *wisiwyg.ini*, and click **Open**.
8. For the **Files of type**, select **Geometry Projects (*.alg)**.
9. Select *relocation.alg*, and click **Open**.
10. For the **Files of type**, select **Surfaces (*.dtm)**.
11. Select *original.dtm*, and click **Open**.
12. Click **Cancel** to dismiss the **Open** dialog box.

Defining and Creating the Views

1. Click **Evaluation > Plan and Profile Generator**.
2. AutoCAD User's only, click **Preferences**. Select **ACAD**; then, click **Load**. Click **Close** to dismiss the preferences dialog box.
3. On the **Main** tab of the **Plan and Profile Generator** dialog box, confirm the following settings:
 - **Horizontal Alignment:** **baseline**
 - **Method**
Plan and Profile: on

Use Station Limits: on

- **Sheets**

Generate Sheets: on

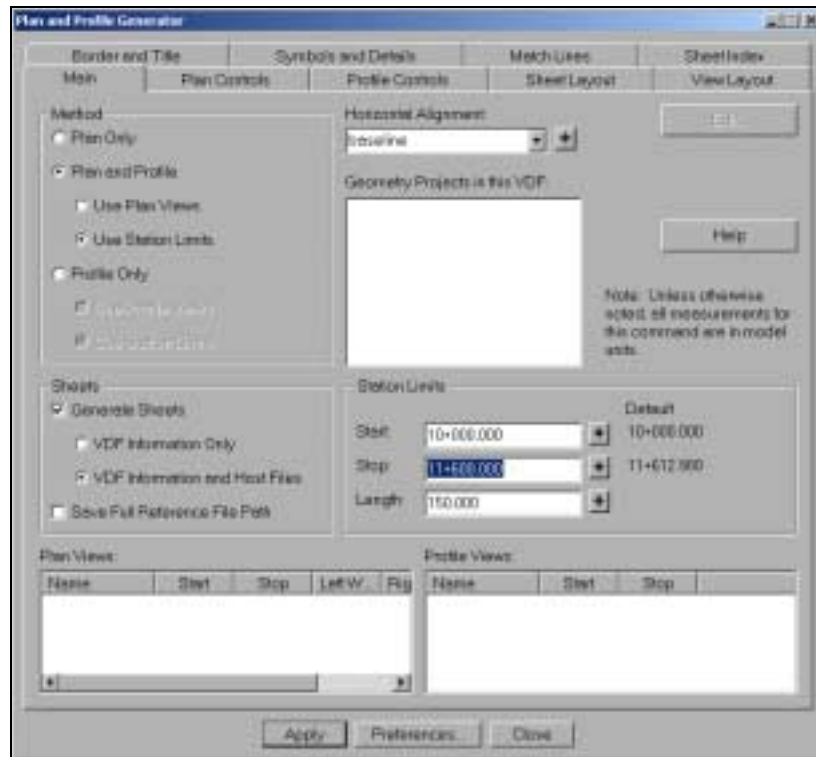
VDF Information and Host Files: on

- **Station Limits**

Start Station Limits: 10 + 000.00

Stop Station Limits: 11 + 600.00

Length: 150.00



5

4. Click the **Plan Controls** tab, and confirm
5. the following settings:

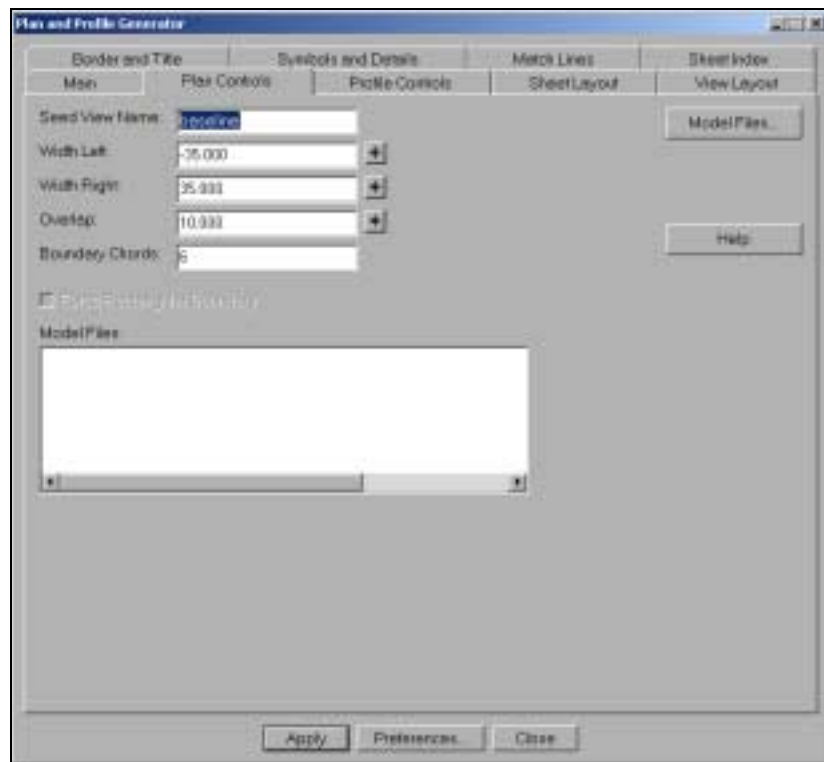
Note: The *plan controls* determine how much of the plan will be shown to the left and right of the alignment. Left widths should be negative and right widths should be positive. If you want to show data on only one side of the alignment make both widths positive or both of them negative.

- **Seed View Name:** **baseline**
- **Width Left:** **-35** (in model units, meters)
- **Width Right:** **35** (in model units, meters)
- **Overlap:** **10** (in model units, meters).

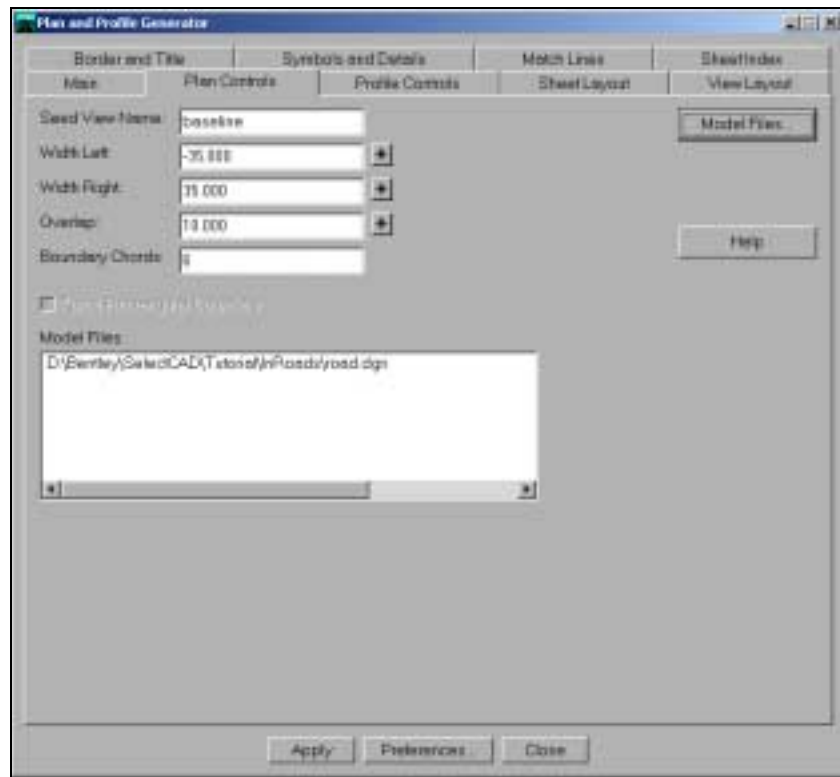
This distance is measured before and after the start and stop station, respectively, to extend the clipping boundary beyond the start and stop station of each view.

- **Boundary Chords:** **6**.

This field lets you specify the number of chords on each side of the alignment view. Increasing the number of chords produces a smoother edge on the clipping boundary along curves. AutoCAD views will be rectangular view ports; the **Boundary Chords** field is not available for these CAD systems.



6. Click the **Model Files** button.
7. Set the directory to *C:\Bentley>SelectCAD\Tutorial\InRoads*
8. Select **road.dwg** or **road.dgn**. Click **Open**.



9. Click the **Profile Controls** tab, and confirm the following settings:

Note: The profile height is in elevation axis units.

Important Note: The profile views always use the current design file as the model file.

- **Seed View Name:** baseline
- **Set Name:** baseline
- **Profile Preference:** default
- **Vertical Alignment:** None

The surfaces that are highlighted and the vertical alignment that is chosen will be used to determine window clearances. The surfaces that are checked (X) will be drawn in the profile.

- **Surface:** original (highlighted and checked)
- **Profile Elevation Shifts**

Shift Where Needed: on

- **Profile Height:** 12
- **Profiles per Column:** 1
- **Margins**

Top: 3 (in model units, meters)

Bottom: 12 (in model units, meters)

Left: 16 (in model units, meters)

Right: 3 (in model units, meters)

Note: These margins are placed around the profile or window and extend the clipping boundary for the profile view. If you set these margin values to zero, the created view will not show any graphics (for example, axis annotation) outside the profile window (axes).

- **Horizontal Spacing**

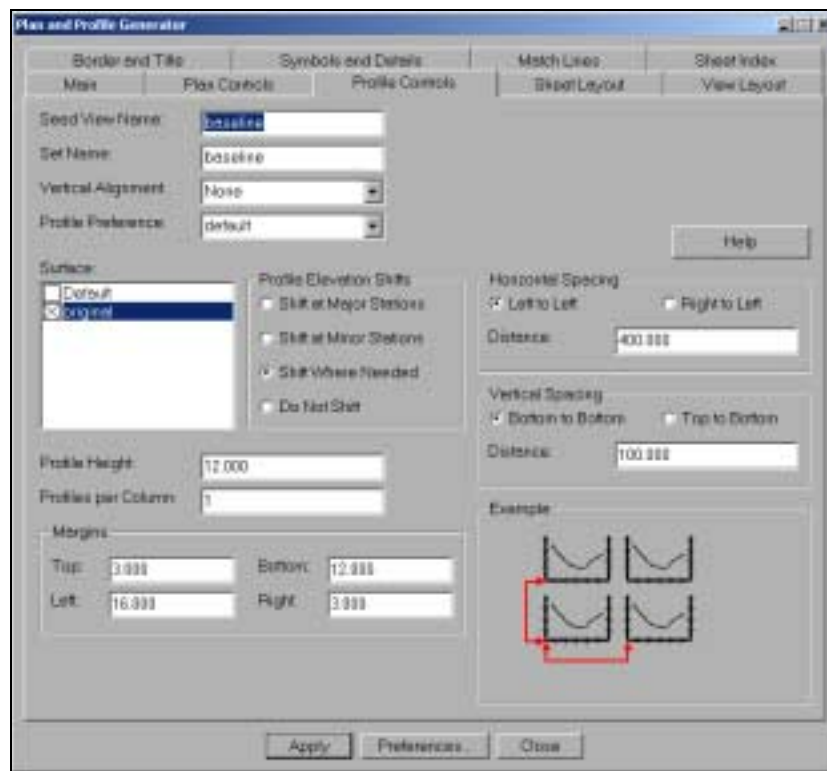
Left to Left: on

Distance: 400

- **Vertical Spacing**

Bottom to Bottom: on

Distance: 100



10. Click the **Sheet Layout** tab. On MicroStation, confirm the following settings.

Note: AutoCAD user's skip to Step 11.

- **Sheet Number:** 1
- **Name:** Plan and Profile 1
- **Host File:** sheets.dgn
- **Seed Host File:** plprseed.dgn

Note: If necessary, click **Browse** to locate these files in the `\Tutorial\InRoads` directory where you installed InRoads SelectCAD.

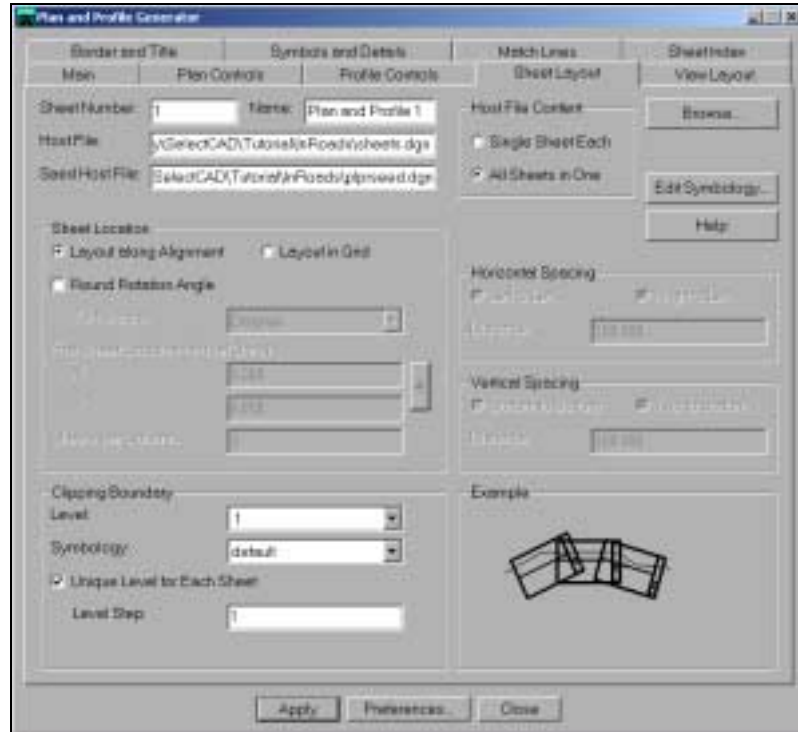
- **Sheet Location**

Layout along Alignment: on

This means the borders will be scaled up to fit along the horizontal alignment; the coordinates and bearing are preserved.

Round Rotation Angle: off

- **Host File Content**
All Sheets in One: on
- **Clipping Boundary**
- **Unique Level for Each Sheet:** on



11. AutoCAD user's, click the **Sheet Layout** tab. Confirm the following settings.

- **Sheet Number:** 1
- **Name:** Plan and Profile 1
- **Sheet Location**
First Sheet Location
X = 0
Y = 0
Sheet per Column = 3
- **Horizontal Spacing**
Right to Left: On

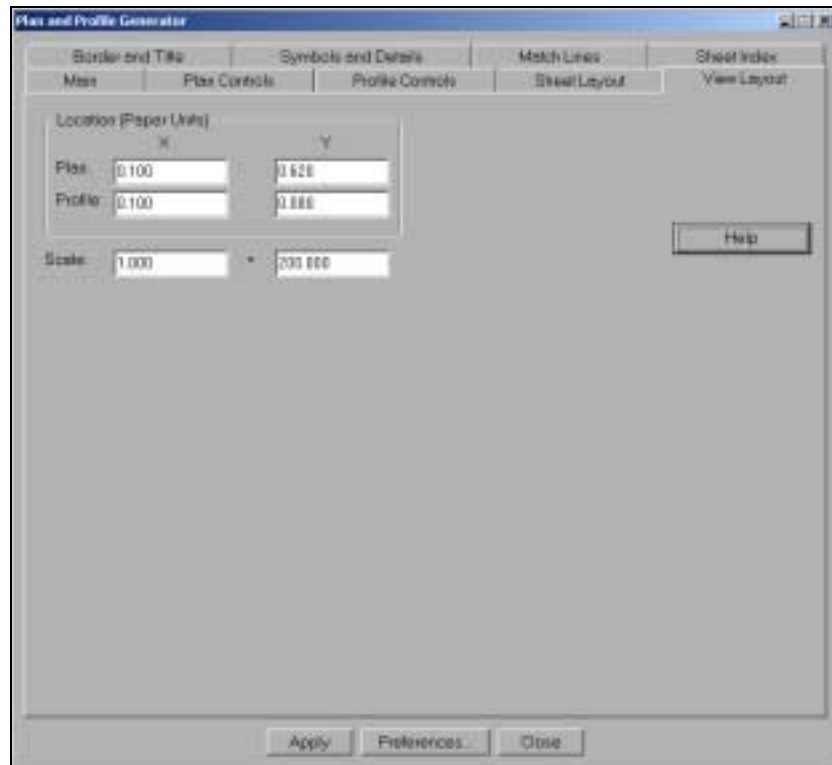
Distance: 1

Top to Bottom: On

Distance: 1

12. Click the **View Layout** tab, and confirm the following settings:
 - **Location (Paper Units)**
 - Plan X: 0.100** (0.100 meters from the Left edge of the sheet)
 - Plan Y: 0.620** (0.620 meters from the Bottom edge of the sheet)
 - Profile X: 0.100** (0.100 meters from the Left edge of the sheet)
 - Profile Y: 0.080** (0.080 meters from the Bottom edge of the sheet)
 - **Scale: 1 : 200** (1 meter on paper equals 200 meters in the model)

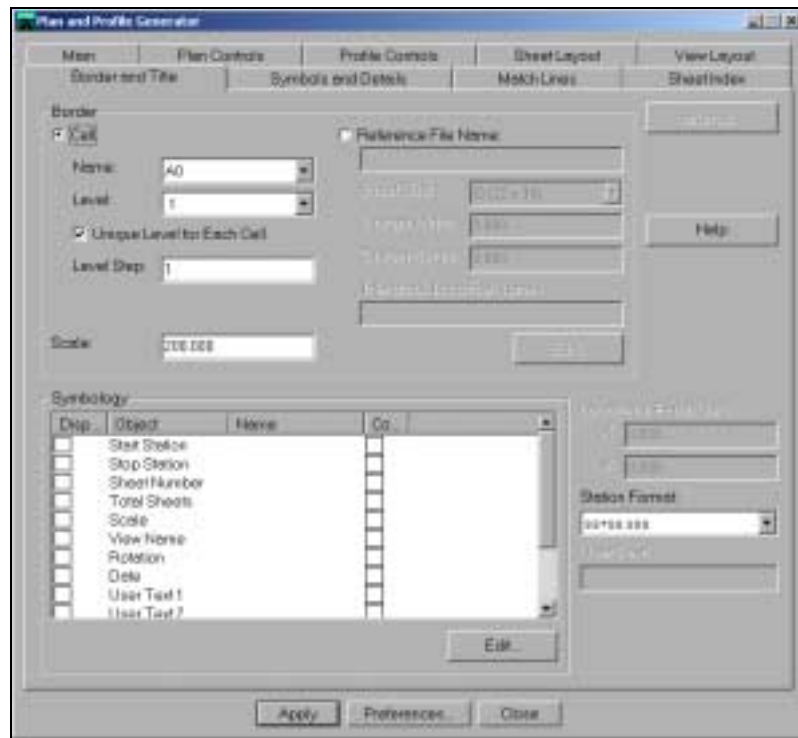
Both the plan and profile view will have the same scale. It is normally the same as the sheet scale.



13. Click the **Border and Title** tab, and confirm the following settings:

Note: **Scale** is not available in the AutoCAD because the border is placed in paper space at 1:1.

- **Border**
 - Cell/Block:** on
 - Name:** A0
 - Level/Layer:** 1
 - Unique Level for Each Cell:** on
 - Level/Layer Step:** 1
 - Scale:** 200 (1 meter paper units is equivalent to 200 meter model units)



14. Click the **Symbols and Details** tab, and confirm the following settings:

- **North Arrow**

Attach: on

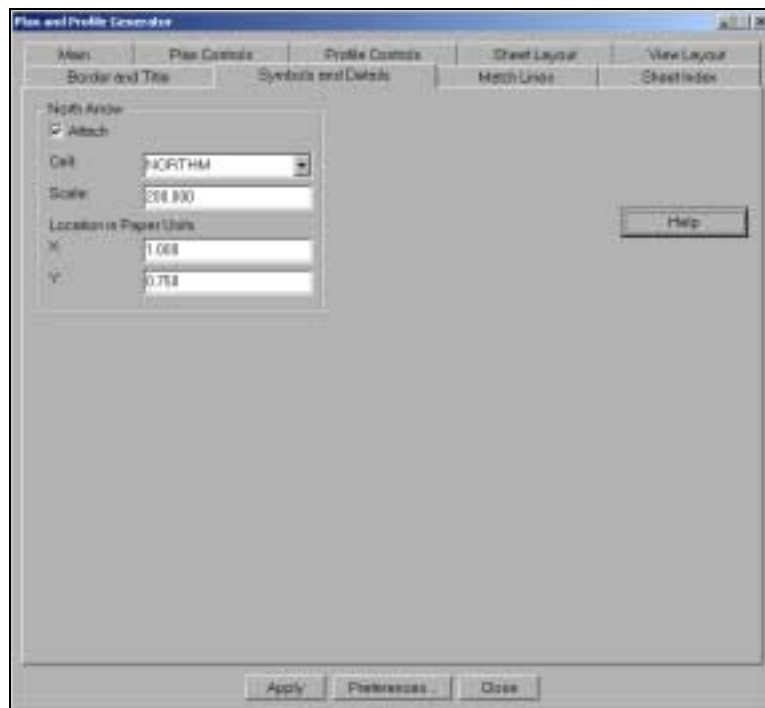
Cell/Block: NORTHM

Scale: 200 (On MicroStation) **Scale:** 1 (On AutoCAD)

- **Location in Paper Units**

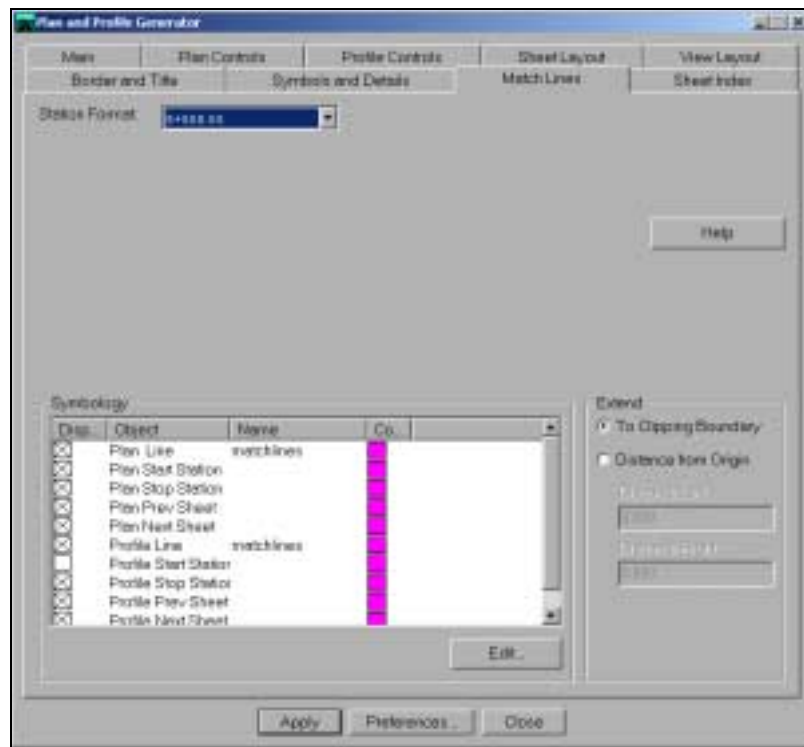
X: 1.000 (places the symbol origin 1 meter from the left edge of the sheet)

Y: 0.750 (places the symbol origin 0.750 meters from the bottom edge of the sheet).



15. Click the **Match Lines** tab.

16. For **Station format**, select **s+sss.ss**

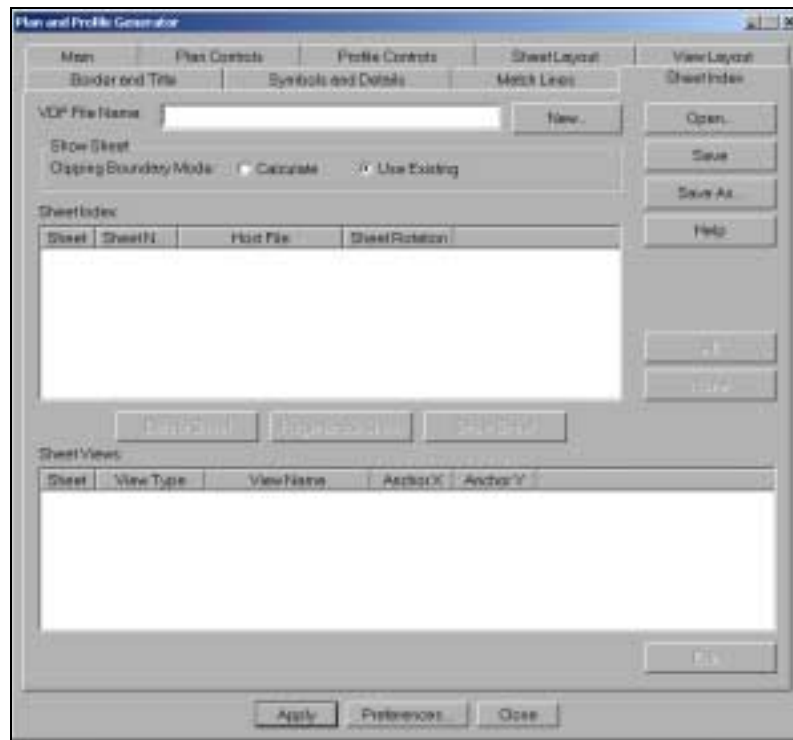


Symbology settings for the sheets were previously prepared for this lesson.

- Under **Object**, click **Plan Line**. Notice to the right under **Extend**, the **To Clipping Boundary** is option is **on**. This indicates that the match line will extend up to the clipping boundary.
- Under **Object**, click **Plan Start Station**. Notice that you can add a prefix or suffix to the start station. A suffix has been provided for the lesson.
- Under **Object**, click **Plan Stop Station**. You can add a stop station prefix or suffix to the stop station.
- Under **Object**, click **Plan Prev Sheet**. You can add a prefix or suffix to the previous sheet.
- Under **Object**, click **Plan Next Sheet**. You can add a prefix or suffix to the next sheet.

All of these options are also available for each of the **Profile** symbology object settings. Take a moment to click through the **Profile** symbology settings.

17. Click the **Sheet Index** tab.



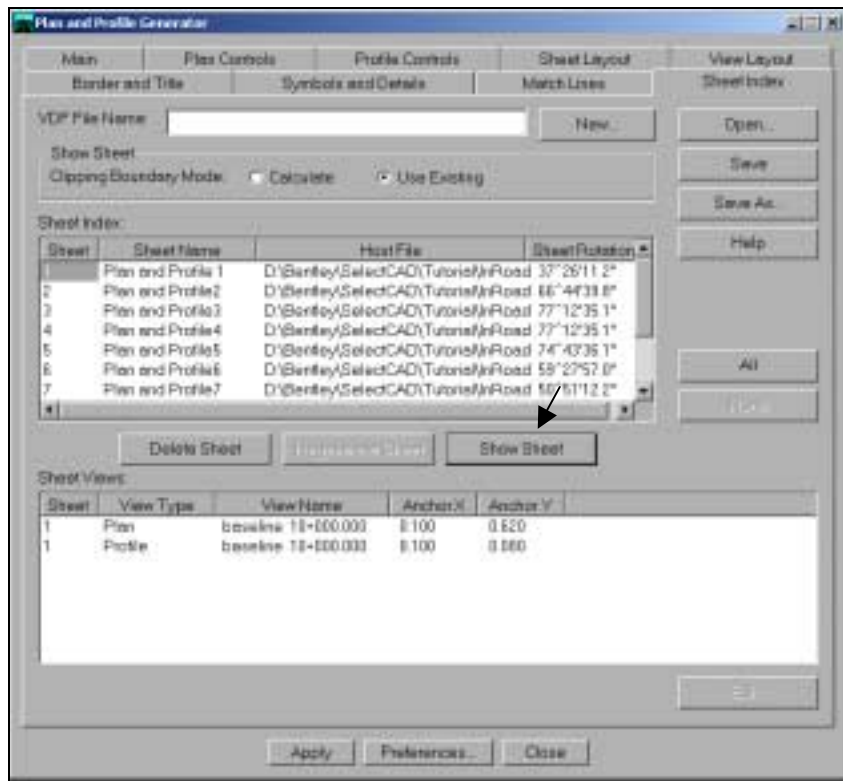
Note: For AutoCAD User's, **Object Snaps** (OSNAP) must be toggled off before executing the plan and profile generator.

18. Click **Apply**.
19. At the prompt: **Identify location**, identify a location in the design/drawing for the profiles.

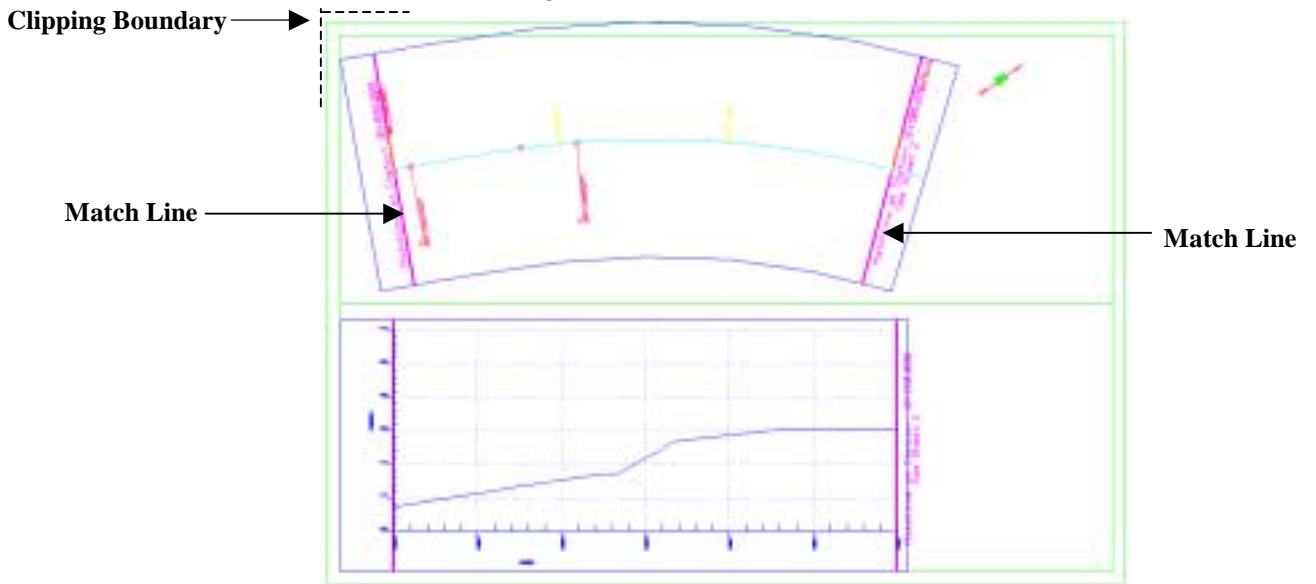
Horizontal alignment view definitions are created. These views are used to define the start and stop stations for the profile view definitions. Individual profiles are cut and placed in the current CAD file using the profile view definitions.

The first sheet is displayed. On MicroStation, you are now in *sheets.dgn*.

17. Click **Show Sheet** to display the highlighted sheet in the **Sheet Index** list.



18. The highlighted sheet is displayed in the view. You are currently in the *sheets.dgn* design file.



19. Uncollapse the **Plan and Profile Generator** dialog box. Take a few minute to view the plan and profile sheets. Do not dismiss the dialog box.

Saving the VDF

You can save the view definitions to an ASCII file and then load this file during subsequent design sessions.

20. Click **Save As** on the **Sheet Index** tab.
21. Change to the tutorial directory.
22. On MicroStation, for **File Name**, type `relocation`, and click **Save** then **Cancel**. On AutoCAD, for **File Name**, type `relocationACAD`, and click **Save** then **Cancel**.
23. Click **Close** to dismiss the **Plan and Profile Generator** dialog box.
24. From the CAD menu, save the `road.dgn` or `road.dwg`.
25. Click **File > Exit** and exit your CAD software, or continue to the next lesson.

Lesson 7: Typical Sections

A typical section consists of points and lines representing a cross section of the road. InRoads SelectCAD uses typical sections to define the geometry of the roadway as a cross section. The surface of the road is defined by placing typical sections at intervals along the alignment using the elevations defined in the vertical alignment.

A typical section is comprised of four types of definitions: Templates, Cut/Fill Tables, Material Tables, and Decision Tables. You learn more about these later in the lesson.

The main portion of the typical section usually defines the travel lanes and the shoulder. This section is called a backbone. The left and right backbone zones of your roadway never intercept an existing surface. It is in these two zones that superelevation of the roadway occurs. Everything outside the backbone is called the exterior portion of the typical section. Generally, the slopes and widths of the backbone do not vary from what is defined, but the widths of the exterior portions will vary depending on the amount of cut or fill needed to intersect existing ground.

InRoads SelectCAD defines the surface of a road using typical cross sections. A typical section defines the cross section of a road at a single station on the alignment. However, typical sections define an entire roadway surface when they are applied successively along an alignment.

In this lesson, you create a typical section library and create and define a template for a four-lane road. You then save the typical section library to disk. Typical section libraries allow you to save typical sections (such as templates) so that they can be accessed by different users or on different roadway design projects.

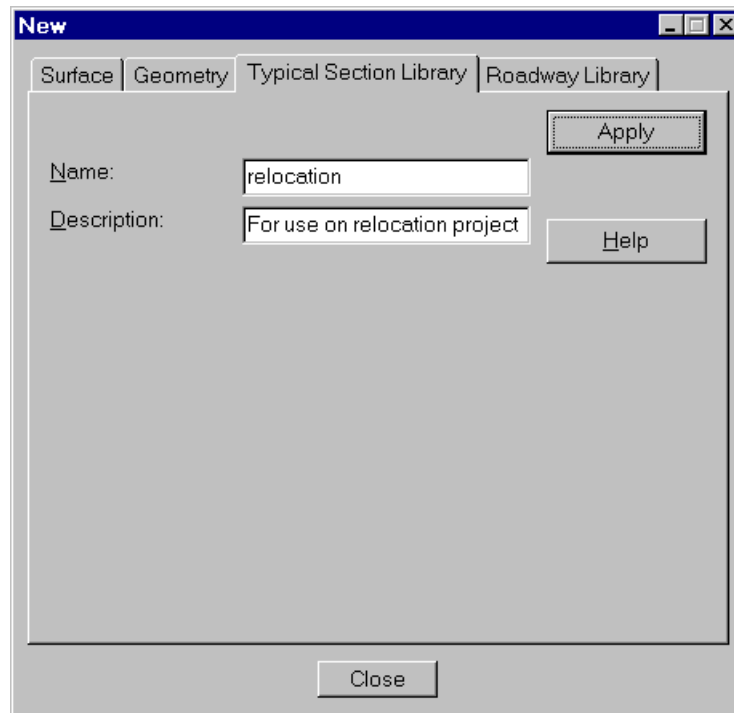
If you just finished the lesson on creating plan and profile sheets, skip to *Creating a Typical Section Library*. If you are just beginning the tutorial here, complete the following steps:

1. Extract *roadlesson7.exe*. For more information, see *Before Starting Each Lesson* at the beginning of this chapter.
2. Start InRoads SelectCAD, and open the *road.dwg* or *road.dgn* file. These files are located in the `\Tutorial\InRoads` directory where you installed InRoads SelectCAD. For more information on starting the software, see *Chapter 2, Starting InRoads SelectCAD*.
3. Click **File > Open**.
4. Set the directory to `C:\Bentley\SelectCAD\Tutorial\InRoads`.

5. For the **Files of type**, select **Preferences (*.ini)**.
6. Select *civilpp_tut.ini*, and click **Open**.
7. For the **Files of type**, select **Styles (*.ini)**.
8. Select *wysiwyg.ini*, and click **Open**.
9. Click **Cancel** to dismiss the dialog box.

Creating a Typical Section Library

1. Click **File > New**.
2. Click the **Typical Section Library** tab.
3. For the **Name**, type *relocation*. Press the **TAB** key.
4. For the **Description**, type *For use on relocation projects*. Press the **TAB** key.



Note: The files used in this tutorial are named the same. It is good practice to name all your files the same for a project. It helps with backups and archiving the project information.

5. Click **Apply**.

InRoads SelectCAD creates a new typical section library in memory. You must save the library to a file for later use.

6. Click **Close** to dismiss the dialog box.
7. Click **File > Save As**.
8. Set the directory to *C:\Bentley>SelectCAD\Tutorial\InRoads*.
9. For the **Save as type**, select **Typical Section Libraries (*.tml)**.
10. For the **File Name**, type *relocation.tml*.
11. Click **Save**.

InRoads SelectCAD creates the file *relocation.tml* and saves the typical section library in it.

12. Click **Cancel** to dismiss the dialog box.

Throughout the remainder of this section, as you are defining typical sections, you should periodically use the **File > Save > Typical Section Library** command to save the defined typical sections to the typical section library file.

Defining Transition Controls

Before you define a typical section, you create transition controls (TCs). TC entries are codes you assign to each point in a template to control how these points are to be connected longitudinally, and to which features they are assigned. The entries determine the name and style of the features that are placed in the DTM when you run the roadway modeler.

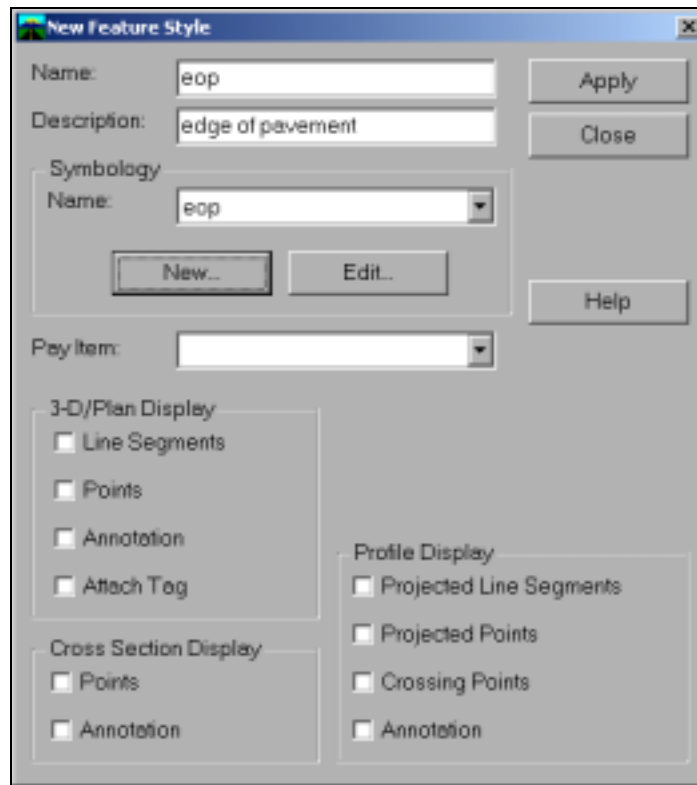
During the modeling process, transition controls allow you to override the default settings when, during a transition between two templates, there are different numbers of segments (such as going from a two-lane highway to a four-lane highway). In this situation, by default the roadway modeling process attaches centerline points, left hinge points, and right hinge points together. Then, the modeler works outward from the centerline, attaching successive template segment points together. To override this modeling action, you can assign common transition-control names to points on both templates. This forces the points to be connected with one another at successive applications of the template.

Creating Transition Control Entries

In InRoads SelectCAD, transition control entries (codes) are used to create features in a surface by running by Roadway Modeler. Each feature has a feature style. In this task, you first define feature styles. Later you will associate the feature styles with the following roadway transition control

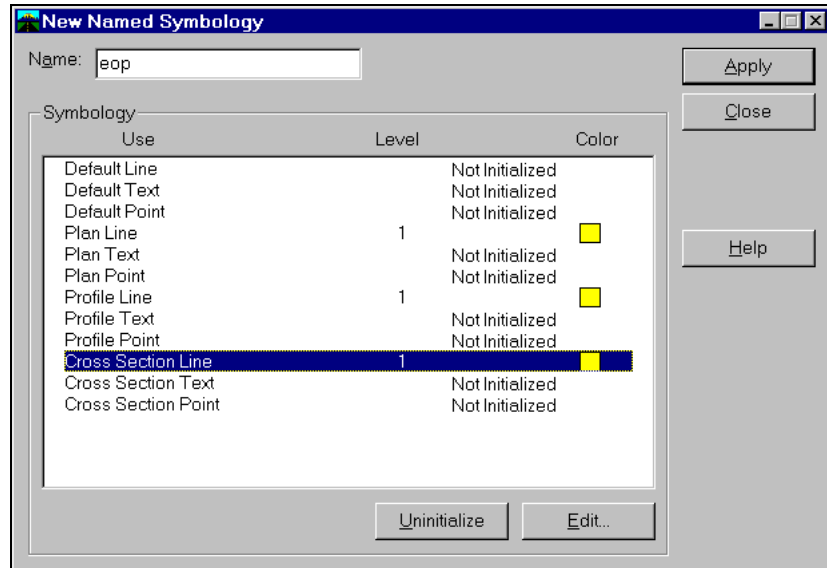
codes: *edge of pavement, shoulder, cut, fill, ditch foreslope, backslope and bottom*. . If you are beginning the tutorial here, it may be helpful to review *Creating a Feature Style* in Lesson 1.

1. Click **Tools > Feature Style Manager**.
2. Click the **New** button.
3. For **Name**, type eop.
4. Click **Description**, type edge of pavement.

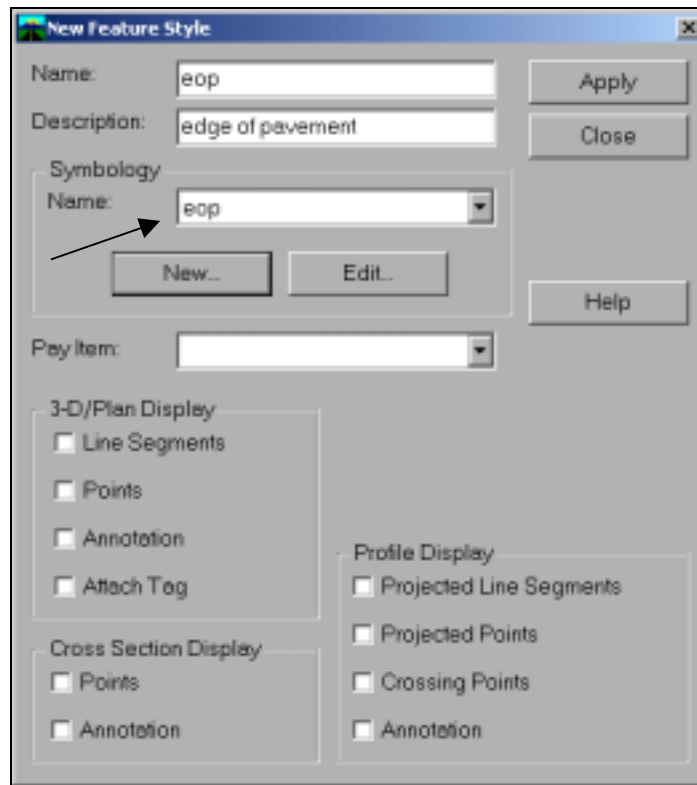


5. Under **Symbology**, click the **New** button.
6. For **Name**, type eop.
7. Double-click on **Plan Line**.
8. For **Color**, click on the color palette and select yellow.
9. For **Line Style**, select 0.
10. Keep all other default settings.
11. Click **OK** to dismiss the **Symbology** dialog box.
12. Double-click on **Profile Line**.

13. Repeat Steps 8 to 11.
14. Double-click **Cross Section Line**.
15. Repeat Steps 8 to 11.

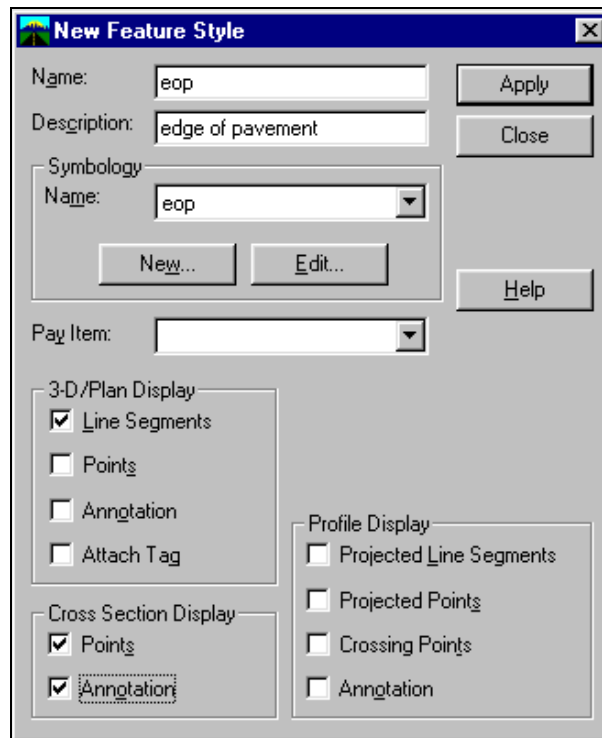


16. Click **Apply** then **Close** to dismiss the **New Named Symbology** dialog box.
17. The named symbology for the edge of pavement feature is created.



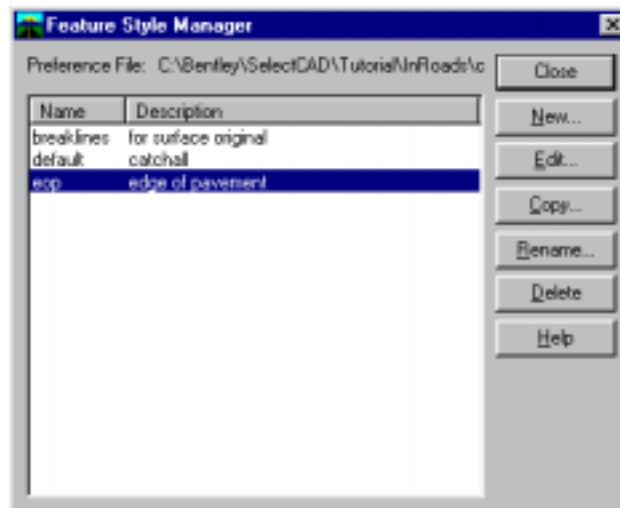
Now, define how and where the feature will display.

18. Under **3-D Plan/Display**, click on **Line Segments** to turn it on.
19. Under **Cross Section Display**, turn on **Points** and **Annotation**.
20. Under **Profile Display**, leave all options turned off.



21. Click **Apply**. Do not dismiss the dialog box.

The feature and description are displayed in the **Feature Style Manager** list.

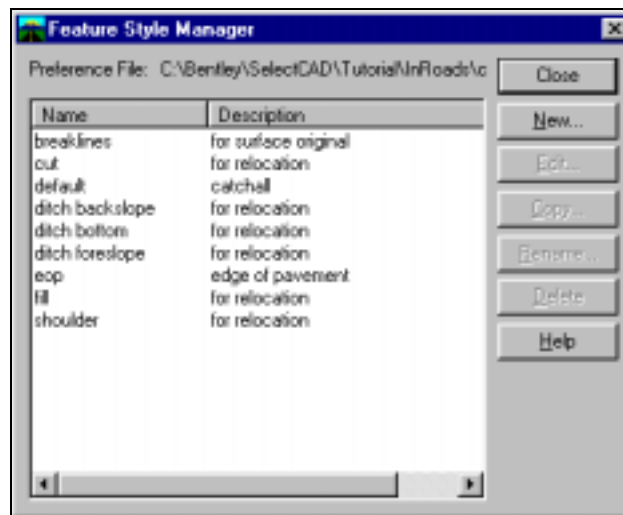


You have successfully created a feature style for *edge of pavement*.

Repeat Steps 3-16 for the following features. For the Description, type for relocation.

<u>Feature</u>	<u>Color</u>
shoulder	gray
cut	green
fill	red
ditch foreslope	gray
ditch backslope	gray
ditch bottom	Gray

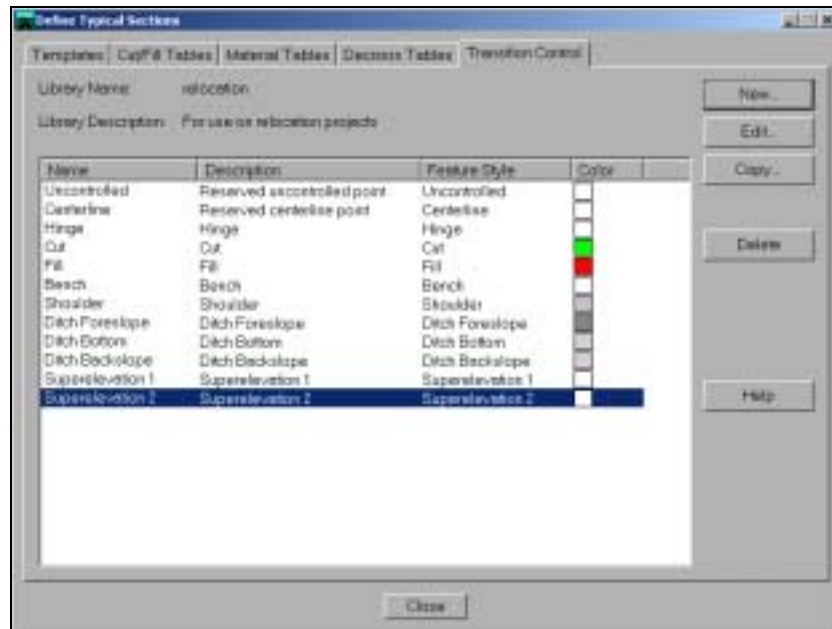
When you are finished, the **Feature Style Manager** list should appear as shown:



22. Click **Close** to dismiss the **New Feature Style** dialog box.
23. Click **Close** to dismiss **Feature Style Manager**.

The feature style settings are saved to the *.ini* file. Next, you will associate the feature styles with transition control entries. These entries are used later in the lesson to create the roadway template.

24. Click **Modeler > Define Typical Sections**.
25. Click the **Transition Control** tab.

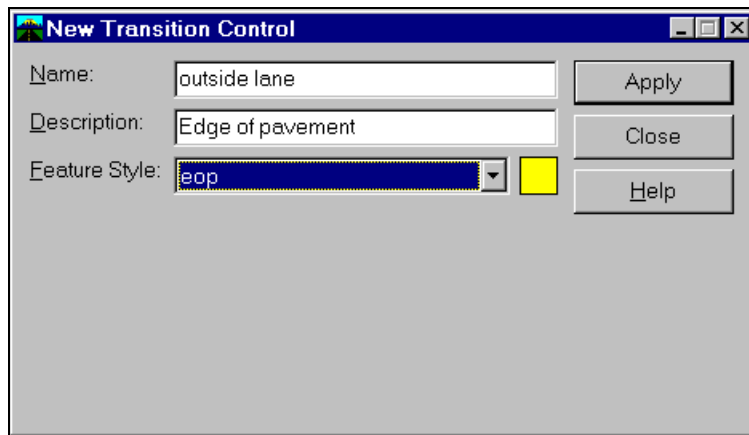


The feature style settings stored in the *.ini* file are automatically displayed.

26. Click the **New** button.
27. For **Name**, type `outside lane`. Press the **TAB** key.

Note: Remember to press the **TAB** key to move through the dialog box.

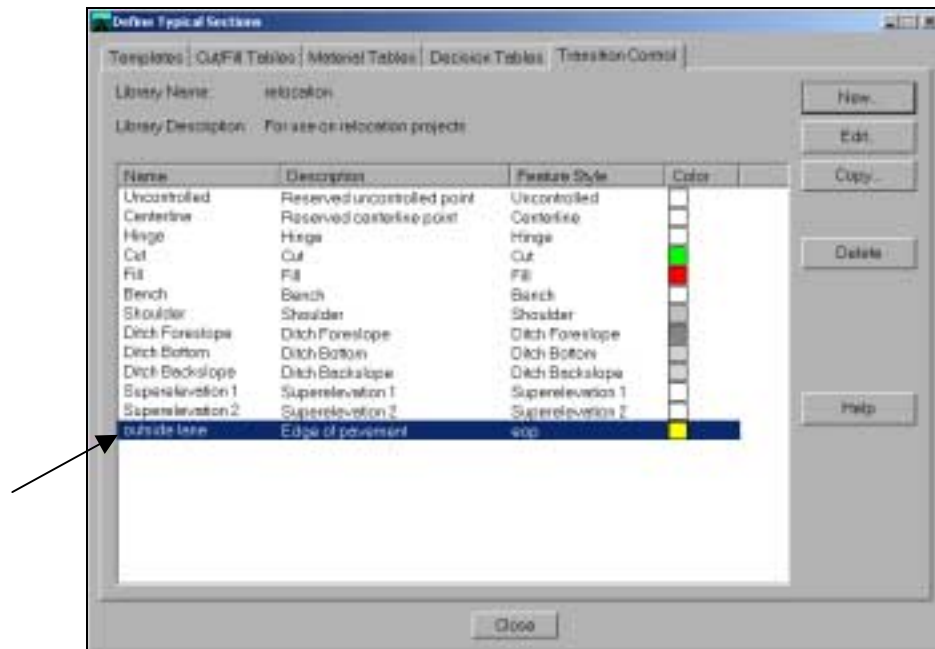
28. For **Description**, type `Edge of pavement`.
29. For **Feature Style**, select **eop** from the droplist.



The symbology previously defined for the feature *edge of pavement* is displayed.

30. Click **Apply**. Do not dismiss the dialog box.

The entry is displayed in the transition control list.

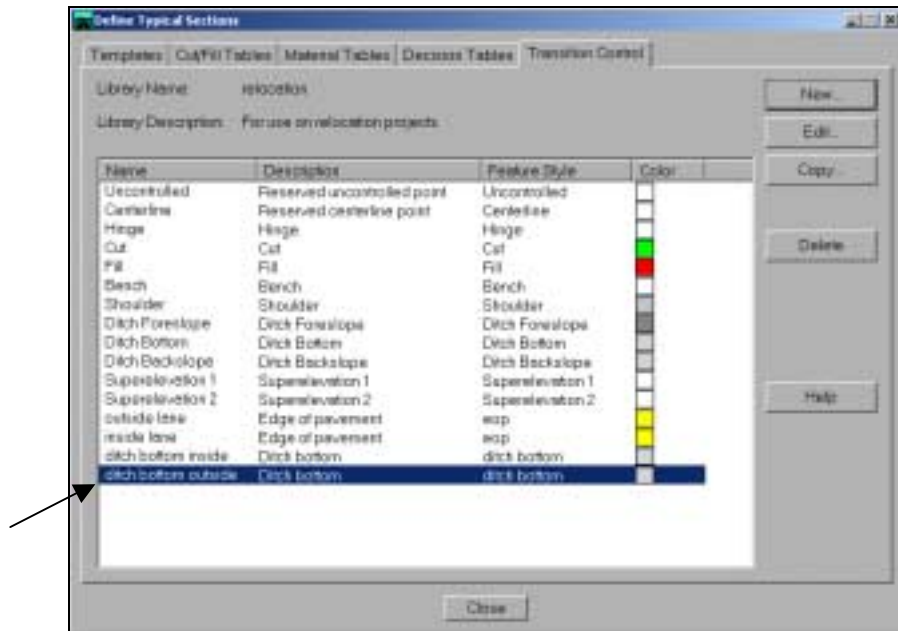


Create the remaining entries.

31. For **Name**, type inside lane.
32. For **Description**, type Edge of pavement.
33. For **Feature Style**, select **eop** from the droplist.

34. Click **Apply**.
35. For **Name**, type ditch bottom inside.
36. For **Description**, type Ditch bottom.
37. For **Feature Style**, select **ditch bottom** from the droplist.
38. Click **Apply**.
39. For **Name**, type ditch bottom outside.
40. For **Description**, type Ditch bottom.
41. For **Feature Style**, select **ditch bottom** from the droplist.
42. Click **Apply**.

The transition control list should appear as shown:



You have successfully created transition control entries.

43. Click **Close** to dismiss the dialog box.

Now is a good time to save the typical section library.

44. Click **File > Save > Typical Section Libraries**.

Defining Typical Sections

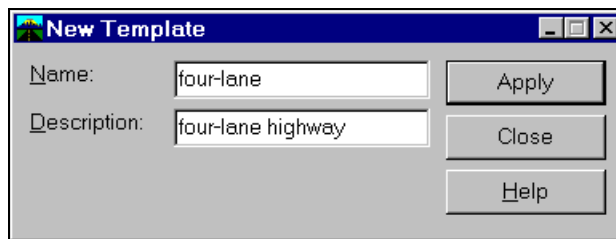
Now that you have created a typical section library with transition control entries, you can create a typical section. The typical section you define in

the following exercise will contain only one layer, representing the surface of the road. You name this layer *proposed*. Later, when you place this typical section along the alignment, that layer will define a DTM of the same name, *proposed*.

Creating a Typical Section Template

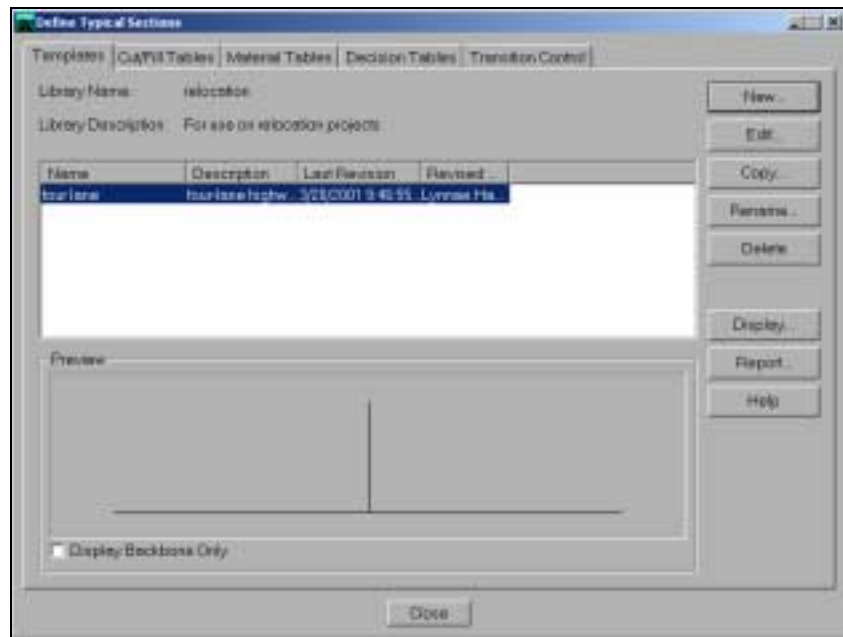
Before you can define a typical section, you must create and name it.

1. Click **Modeler > Define Typical Sections**.
2. Click the **Templates** tab.
3. Click **New** to create a template.
4. For **Name**, type four lane. Press the **TAB** key.
5. For **Description**, type four-lane highway. Press the **TAB** key.



6. Click **Apply** then **Close**.

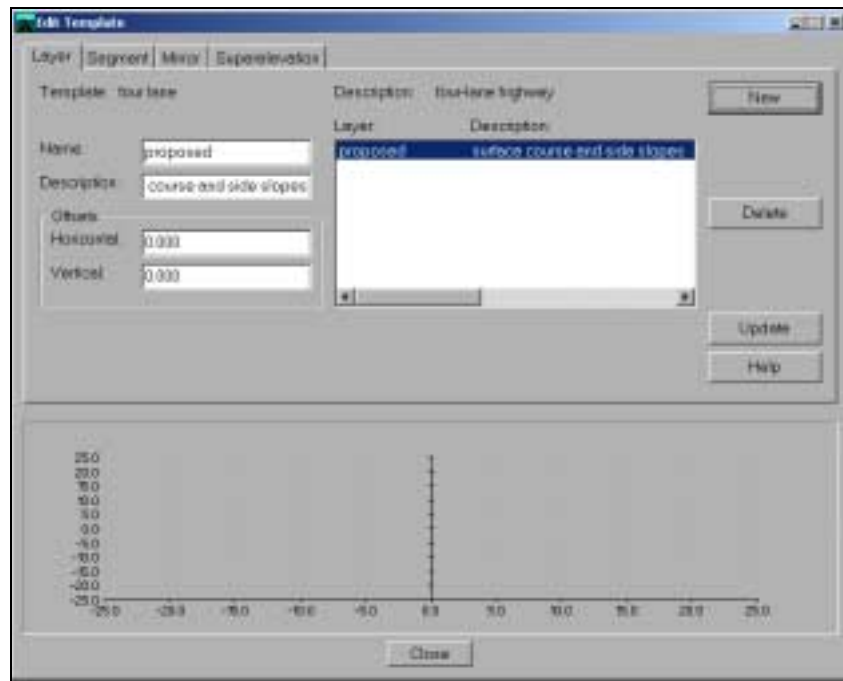
InRoads SelectCAD adds the template *four-lane* to the typical section library named *relocation*. The new template is displayed in the list.



7. Double-click on the template (or select it and click the **Edit** button.).
8. Click the **Layer** tab.
9. For **Name**, type proposed. Press the **TAB** key.

This template layer will be used as the surface name later in the tutorial when the roadway modeler places templates at intervals along the horizontal alignment.

10. For **Description**, type surface course and side slopes. Press the **TAB** key.
11. Keep all of the other default settings, including **Horizontal and Vertical Offsets** at **0.00**.
12. Click **New**.



13. Click **Close** to dismiss the dialog box.

You have successfully created a template layer.

Adding Segments to a Template Layer

Now that a template layer has been created and stored in the typical section, you can add segments.

1. Click the **Segment** tab.

Here, you define the slope, width and other parameters for the layer segment. These settings determine how features are added to the proposed surface. Begin with the right side of the roadway.

2. For **Zone**, select **Right backbone**.

3. For **Edit Mode**, select **Add After**.

This instructs the software to append segments to one another as they are added.

4. For **Fixity**, select **Fixed**.

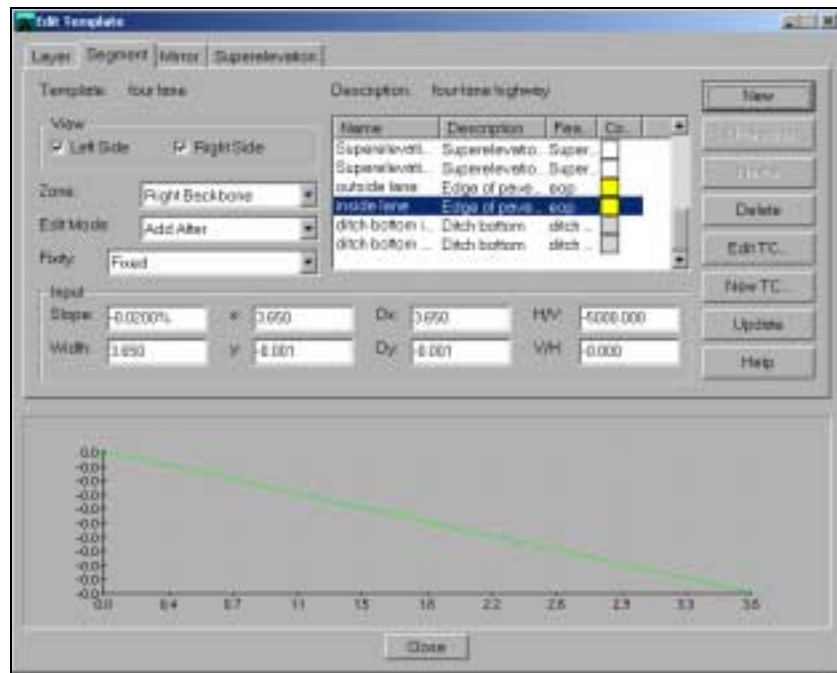
5. In the TC list, scroll down and select (highlight) **inside lane**.

6. In the **Input** section, for **Slope** type -0.020 . Press the **TAB** key.

7. For **Width**, type 3.650 . Press the **TAB** key.

8. Click **New**.

InRoads SelectCAD adds a segment that is 3.65 meters wide and has a slope of -0.02% . This segment, which starts at the centerline, is added to the layer *proposed*.



9. Scroll down the TC list and select **outside lane**.

10. Click **New**.

The segment is automatically added.

11. From the list, select **Shoulder**. For slope, type -0.040 . Press the **TAB** key. For **Width**, type 1.500 . Press the **TAB** key.

12. Click **New**.

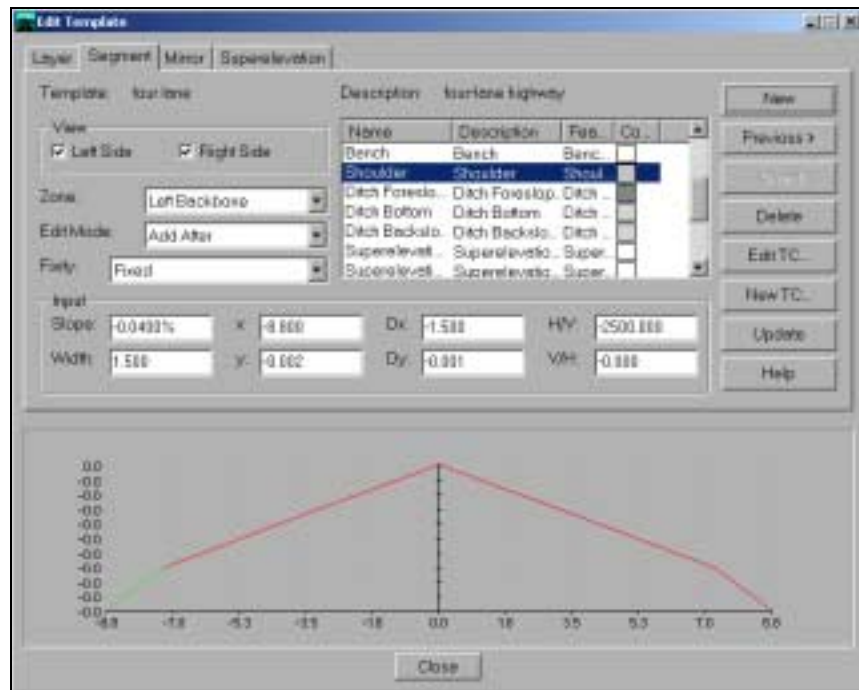
This 1.5 meter segment is the shoulder of the road. You have completed all segments for the right lane. Next, create three segments for the left lane.

13. For **Zone**, select **Left Backbone**.

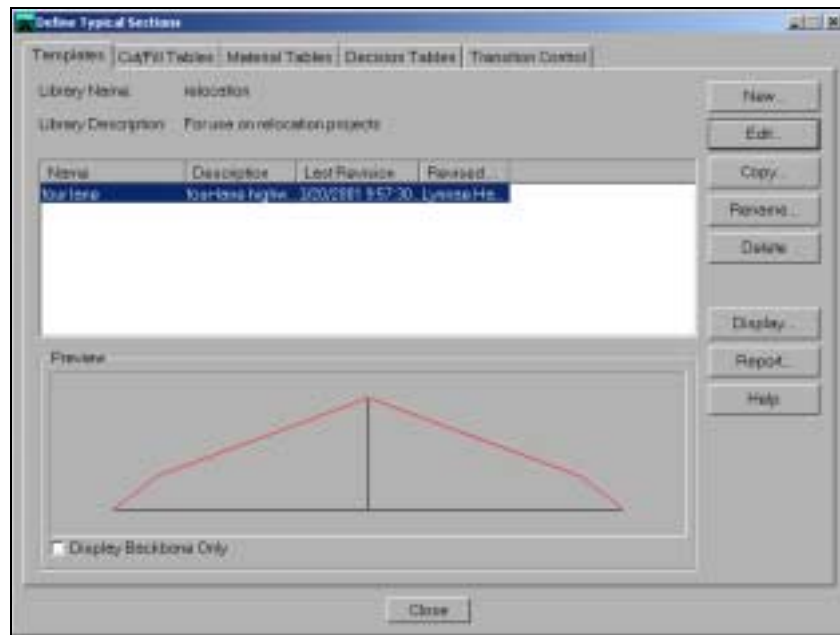
14. From the list, select **inside lane**. For **Slope**, type -0.020 . Press the **TAB** key. For **Width**, type 3.650 . Press the **TAB** key.

15. Click **New**.

16. From the list, select **outside lane**. For **Slope**, type -0.020 . Press the **TAB** key. For **Width**, type 3.650 . Press the **TAB** key.
17. Click **New**.
18. From the list, select **Shoulder**. For **Slope**, type -0.040 . Press the **TAB** key. For **Width**, type 1.500 . Press the **TAB** key.
19. Click **New**.



20. Click **Close** to dismiss the **Edit Template** dialog box.



The left and right backbone zones are displayed.

21. Click **Close** to dismiss the dialog box.
22. Save the typical section library named relocation using the **File > Save Typical Section Library** command.

You just defined a template, saved it to a typical section library, and saved the typical section library to a file on the hard disk. You will use the template later to model the roadway using the **Roadway Modeler** command.

23. Click **File > Exit** and then exit your CAD software, or continue to the next lesson.

Lesson 8: Decision Tables

Once the roadway template has been created, you are ready to define the side slopes. In InRoads SelectCAD, the most powerful tool for defining your roadway side slopes is a *decision table*. Decision Tables allow you to check multiple design scenarios at each location at which a typical section is placed along your roadway.

A decision table is a list of line segments that are projected transverse to your alignment, starting from the edge of the typical section, and seeking an intersection with a target—usually the existing ground. The segments are combined in sequences which are considered to be successful if they hit the target. Successful sequences are retained and stored in your design model.

Multiple targets can be incorporated in a single table, allowing you to design retaining walls, ditches, and so on. See the InRoads SelectCAD Online Reference topics for a more in-depth overview of how decision table work.

In this lesson, you create a decision table to define the side slopes for the new roadway.

If you just finished the lesson on typical sections, skip to *Creating a Decision Table*. If you are just beginning the tutorial here, complete the following steps:

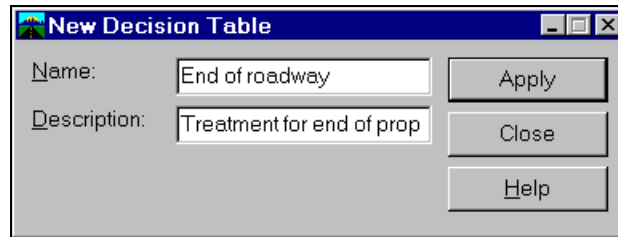
1. Extract *roadlesson8.exe*. For more information, see *Before Starting Each Lesson* at the beginning of this chapter.
2. Start InRoads SelectCAD, and open the *road.dwg* or *road.dgn* file. These files are located in the `\Tutorial\InRoads` directory where you installed InRoads SelectCAD. For more details on starting the software, see *Chapter 2, Starting InRoads SelectCAD*
3. Click **File > Open**.
4. Set the directory to `C:\Bentley>SelectCAD\Tutorial\InRoads`.
5. For the **Files of type**, select **Preferences (*.ini)**.
6. Select *civilpp_tut.ini*, and click **Open**.
7. For the **Files of type**, select **Styles (*.ini)**.
8. Select *wysiwyg.ini*, and click **Open**.
9. For the **Files of type**, select **Surfaces (*.dtm)**.
10. Select *original.dtm*, and click **Open**.

11. For the **Files of type**, select **Typical Sections Libraries (*.tml)**.
12. Select *relocation.tml*, and click **Open**.
13. Click **Cancel** to dismiss the dialog box.

Creating a Decision Table

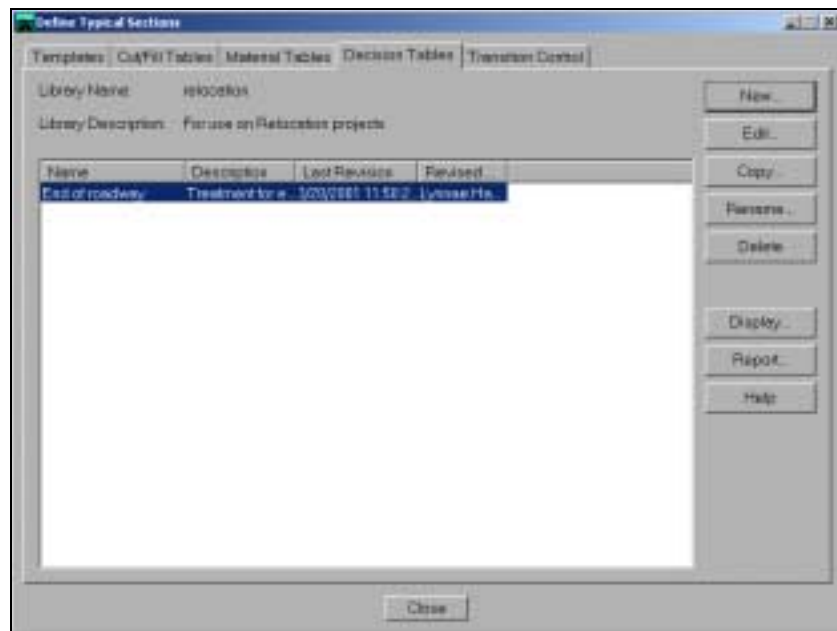
Before you can define the content of a decision table, you must create it and name it.

1. Click **Modeler > Define Typical Sections**.
2. Click the **Decision Tables** tab.
3. Click **New**.
4. For the Name, type End of roadway. Press the **TAB** key.
5. For the Description, type Treatment for end of proposed roadway. Press the **TAB** key.



6. Click **Apply**.
7. Close **Close** to dismiss the **New Decision Table** dialog box.

You have successfully created a decision table in memory. Next, define the decision table segments.



Creating Decision Table Segments

8. Double-click on *End of roadway* in the list (or select it and click the **Edit** button.)

The **Edit Decision Table** dialog box is displayed. This dialog box allows you to set the slope and width of the segments. First, you will define a ditch to ensure minimum drainage.

9. Click **Add After**.
10. Click on the **New Target** and **New Group** toggles to turn them on.

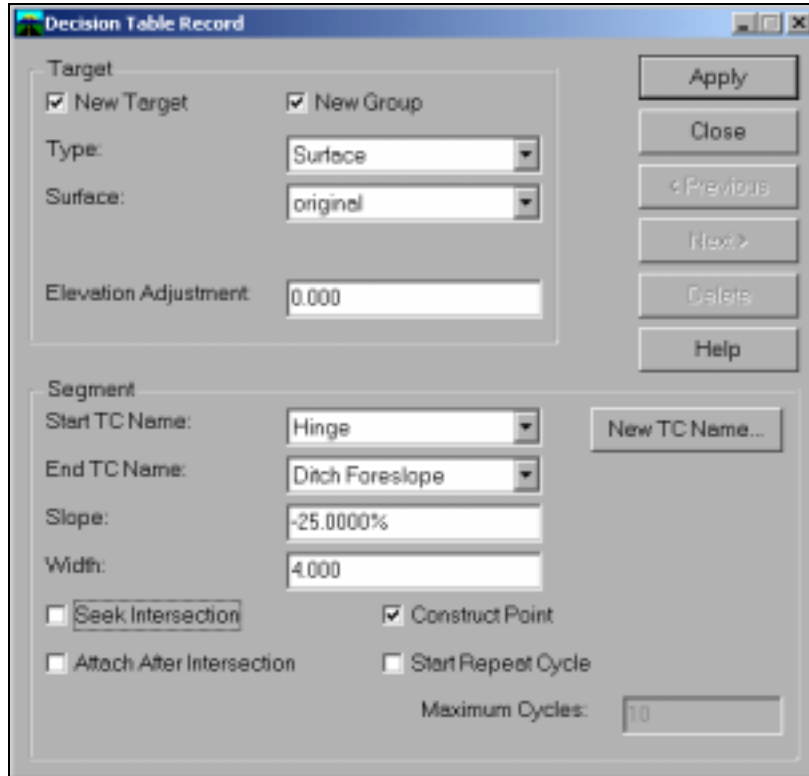
These toggles instruct the software to create a new target block and new target group after successfully hitting a target and placing the segment.

11. For **Target Type**, select **Surface**.
12. For **Surface**, select **original**.
13. Under **Segment**, for **Start TC Name**, select **Hinge**.
14. For **End TC Name**, select **Ditch Foreslope**.
15. For **Slope**, type $-1 : 4$. Press the **TAB** key.
16. For **Width**, type $4 . 0$. Press the **TAB** key.
17. Click on the **Seek Intersection** toggle to turn it off.

This toggle instructs the software to not seek an intersection with the surface.

18. Click on the **Construct Point** toggle to turn it on.

This toggle instructs the software to place the point (of intersection) in the model if the target block is successful.



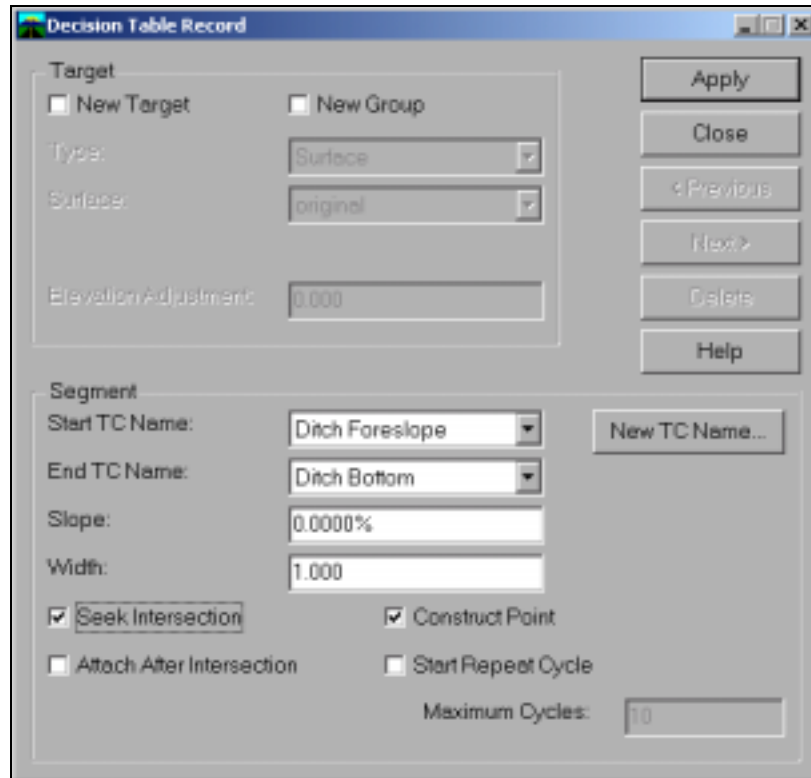
19. Click **Apply**. Do not close the dialog box; you will create additional segments.

The new record is stored and the segment is saved to the decision table.

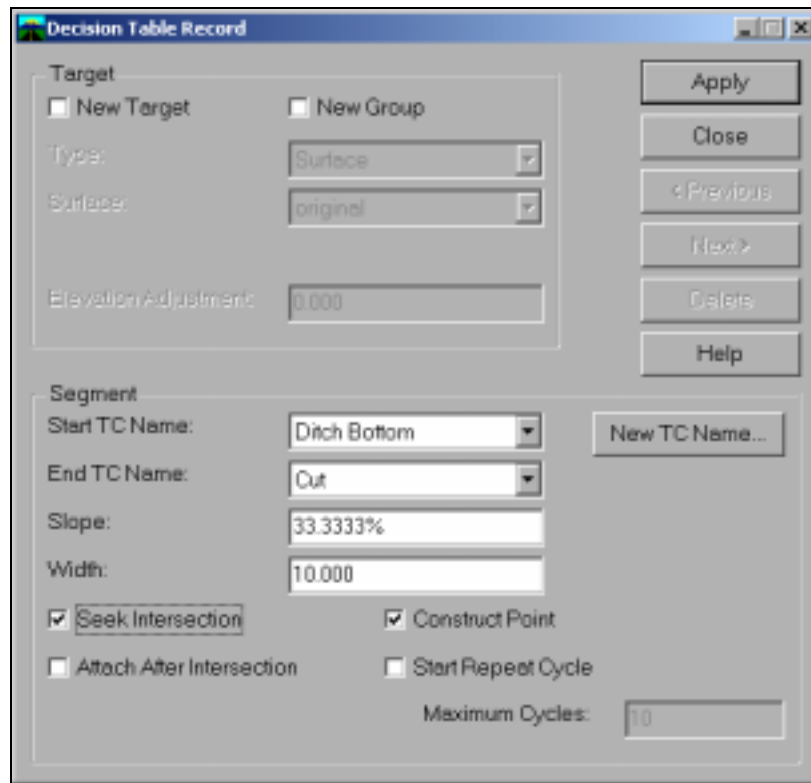
If the segment cannot hit the specified target, the table proceeds to the next group for Fill condition.

20. Turn off **New Target** and **New Group**.
21. Under **Segment**, for **Start TC Name**, select **Ditch Foreslope**.
22. For **End TC Name**, select **Ditch Bottom**.
23. For **Slope**, type 0. Press the **TAB** key.
24. For **Width**, type 1.0. Press the **TAB** key

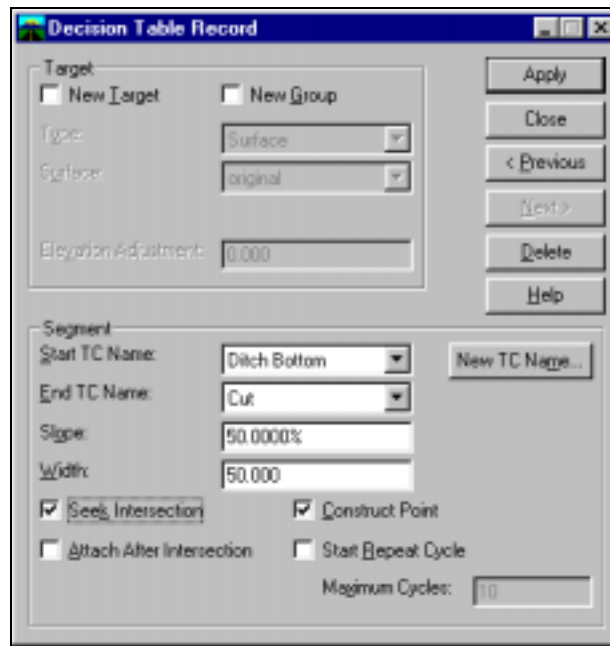
25. Click on the **Seek Intersection** toggle to turn it on.
26. Ensure that **Construct Point** is on.



27. Click **Apply**.
If the target is successfully hit, the table stops. This segment allows drainage from under the roadway.
28. Ensure that **New Target** and **New Group** are turned off.
29. Under **Segment**, for **Start TC Name**, select **Ditch Bottom**.
30. For **End TC Name**, select **Cut**.
31. For **Slope**, type 1 : 3. Press the **TAB** key.
32. For **Width**, type 10 . 00. Press the **TAB** key.
33. Turn on **Seek Intersection** and **Construct Point**.



34. Click **Apply**.
If the target is hit, the table stops; otherwise, it proceeds to the next record checking for a steeper slope.
35. Ensure that **New Target** and **New Group** are turned off.
36. Under **Segment**, for **Start TC Name**, select **Ditch bottom**.
37. For **End TC Name**, select **Cut**.
38. For **Slope**, type 1 : 2. Press the **TAB** key.
39. For **Width**, type 50 . 0. Press the **TAB** key.
40. Ensure that **Seek Intersection** and **Construct Point** are on.



41. Click **Apply**.

If the target is successful, the table stops; otherwise, it is assumed that the roadway is in Fill condition. Next, define the segments for Fill .

42. Turn **New Target** and **New Group** on.

Surface and **original** are already selected as target and surface, respectively.

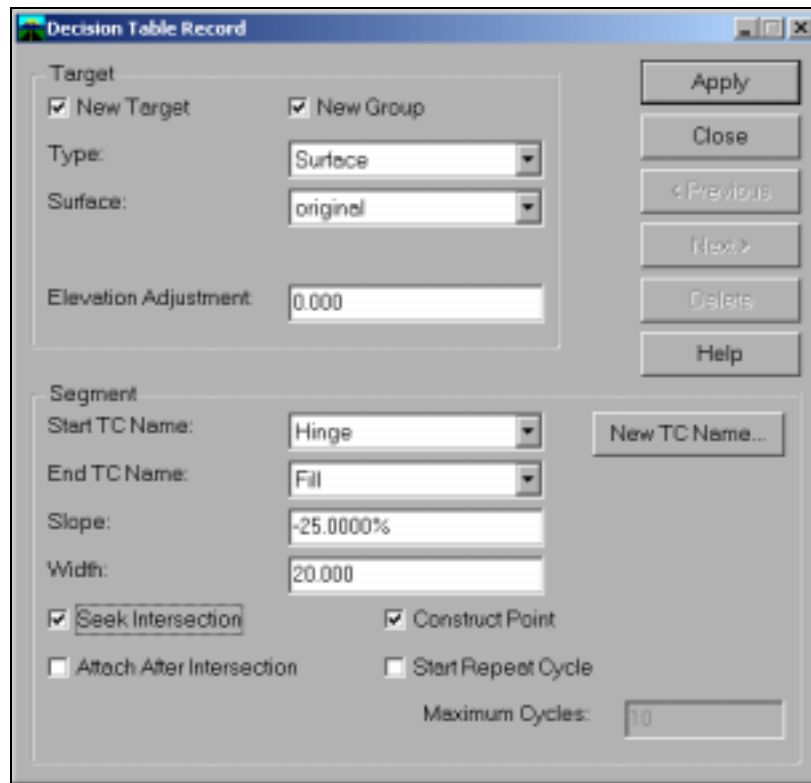
43. Under **Segment**, for **Start TC Name**, select **Hinge**.

44. For **End TC Name**, select **Fill**.

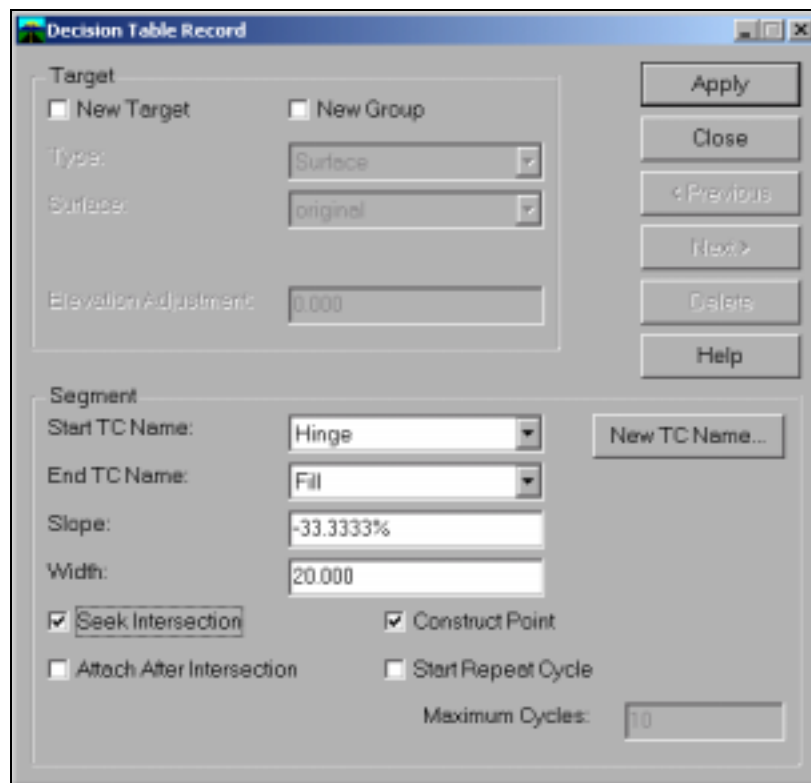
45. For **Slope**, type -1 : 4. Press the **TAB** key.

46. For **Width**, type 20 . 0. Press the **TAB** key.

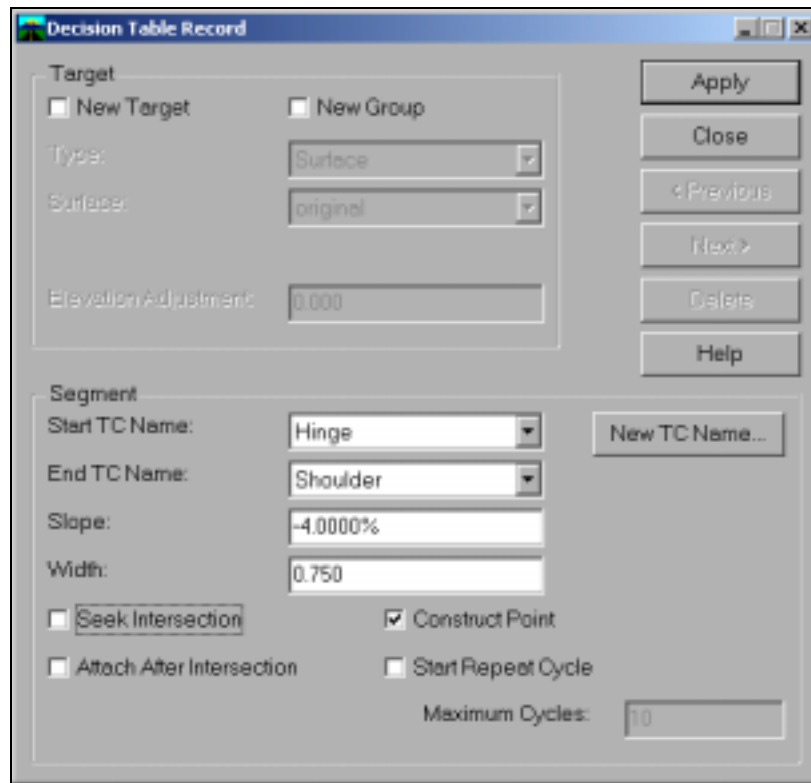
47. Ensure that **Seek Intersection** and **Construct Point** are on.



48. Click **Apply**.
If the target is not successful, the table proceeds to the next record checking for a steeper slope.
49. Ensure that **New Target** and **New Group** are turned off.
50. Under **Segment**, for **Start TC Name**, select **Hinge**.
51. For **End TC Name**, select **Fill**.
52. For **Slope**, type -1 : 3. Press the **TAB** key.
53. For **Width**, type 20 . 0. Press the **TAB** key.
54. Ensure that **Seek Intersection** and **Construct Point** are on.

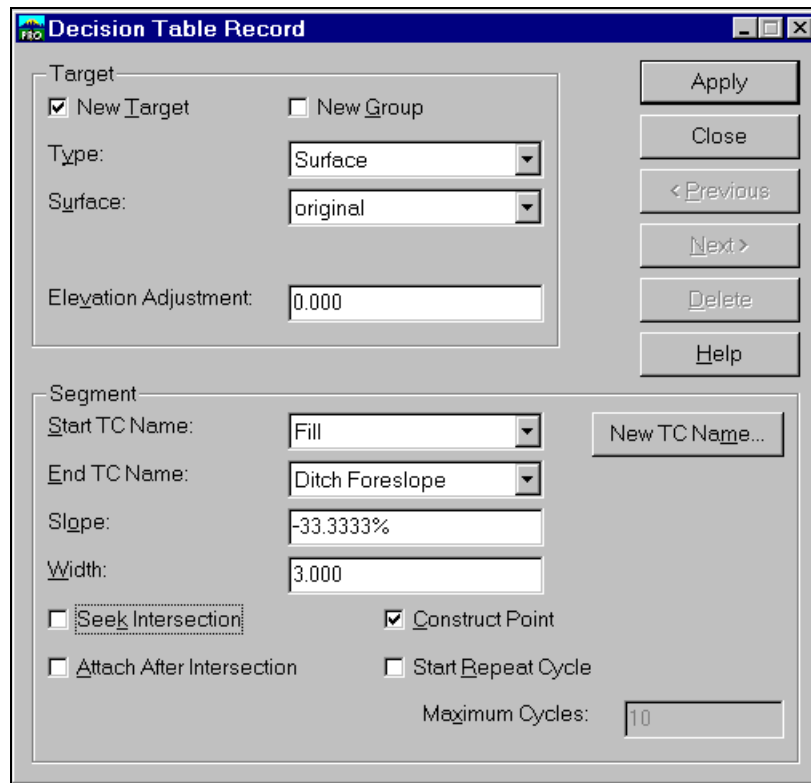


55. Click **Apply**.
If this segment fails, the roadway is in a 50% Fill. In this case, a guardrail is required, so the next segment will first extend the Shoulder.
56. Ensure that **New Target** and **New Group** are turned off.
57. Under **Segment**, for **Start TC Name**, select **Hinge**.
58. For **End TC Name**, select **Shoulder**.
59. For **Slope**, type -4.0% . Press the **TAB** key.
60. For **Width**, type $.75$. Press the **TAB** key.
61. Turn **Seek Intersection** off.
62. Ensure **Construct Point** is on.

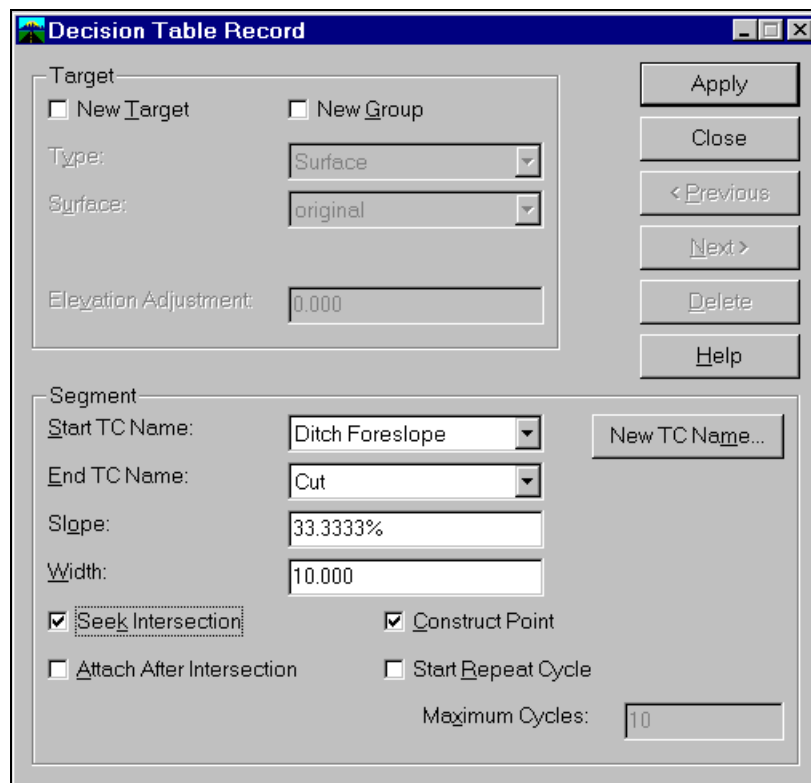


63. Click **Apply**.
64. Ensure that **New Target** and **New Group** are turned off.
65. Under **Segment**, for **Start TC Name**, select **Shoulder**.
66. For **End TC Name**, select **Fill**.
67. For **Slope**, type -1 : 2. Press the **TAB** key.
68. For **Width**, type 10 . 00. Press the **TAB** key.
69. Turn **Seek Intersection** and **Construct Point** on.

70. Click **Apply**.
71. Turn on **New Target**
72. Turn off **New Group**.
73. For **Start TC Name**, select **Fill**.
74. For **End TC Name**, select **Ditch Foreslope**.
75. For **Slope**, type $-1 : 3$. Press the **TAB** key.
76. For **Width**, type $3 . 0$. Press the **TAB** key.
77. Turn **Seek Intersection** off.
78. Ensure **Construct Point** is on.



79. Click **Apply**.
80. Ensure that both **New Target** and **New Group** are turned off.
81. For **Start TC Name**, select **Ditch Foreslope**.
82. For **End TC Name**, select **Cut**.
83. For **Slope**, type 1 : 3. Press the **TAB** key.
84. For **Width**, type 10 . 00. Press the **TAB** key.
85. Ensure that both **Seek Intersection** and **Construct Point** are on.

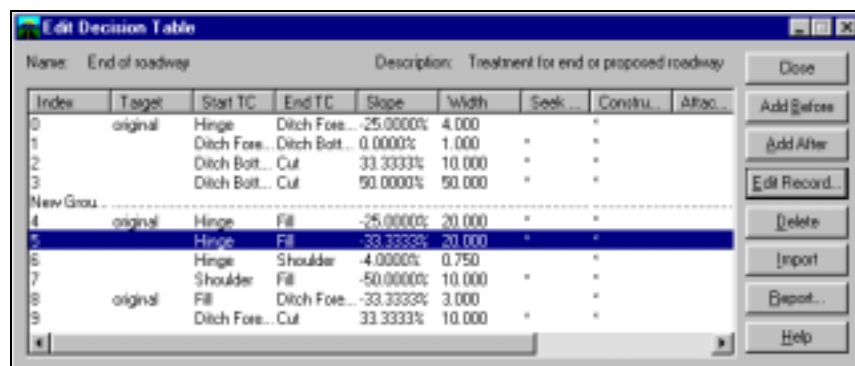


86. Click **Apply**.

The ditch defined here will carry water away from the base of a high Fill. The decision table can add this record to the end of a successful target and again intersect the same surface or other target type.

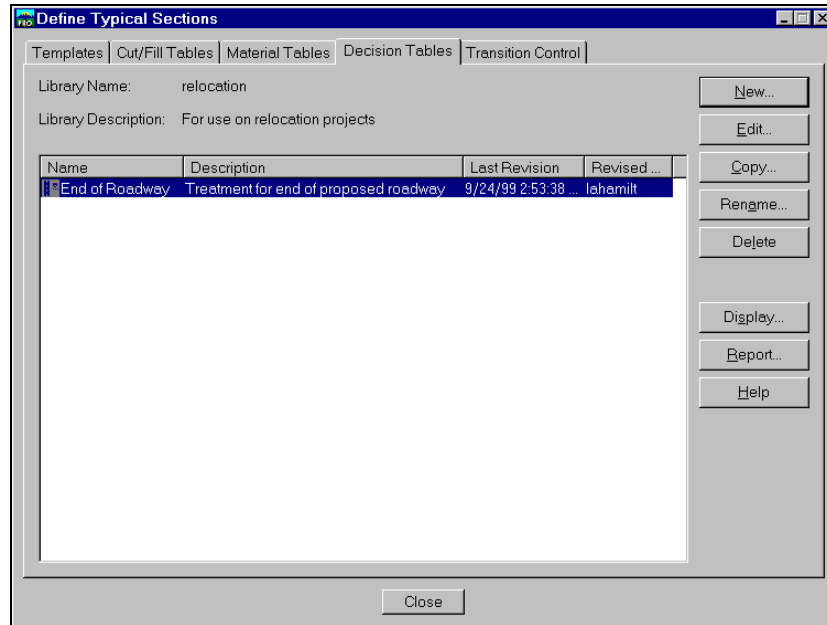
You have successfully created a decision table.

87. Click **Close** to dismiss the **Decision Table Record** dialog box.

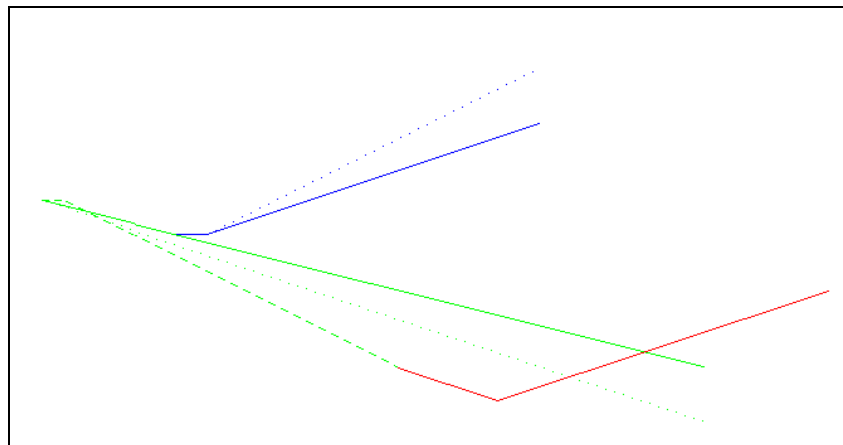


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88. Click **Close** to dismiss the **Edit Decision Table** dialog box.



89. Click the **Display** button to view a graphic representation of the decision table records.
90. At the prompt: **Identify Point/Reject**, datapoint in a clear area of the graphics window.
91. Use your CAD **Zoom** command to view the graphics. These graphics show the side slope treatment you just defined for the proposed roadway.



92. Click **Close** to dismiss the **Define Typical Sections** dialog box.

93. Use the CAD **Delete** command to remove the decision table graphics.
94. Click **File > Save > Typical Section Library**.
95. Click **File > Exit** and then exit your CAD software, or continue to the next lesson.

Lesson 9: Roadway Libraries

So far, you have defined an original surface, horizontal and vertical alignments, a typical section, and a decision table. The final step before you can generate a roadway model is to create a roadway definition, which describes which typical sections to use along the alignment, how often to place them, and which method to use to control side slopes.

In this lesson, you create a roadway definition, which controls the roadway modeling process. The roadway definition will specify the template *four lane* every 10 meters along the centerline alignment *baseline*, from station 10+000 to station 10+300, using the vertical alignment *profile gradeline*. The definition will also identify the decision table, *End of roadway*, which you created earlier, as the means of determining side slopes.

After you complete this roadway definition, you save it in a roadway library. The benefit of having a roadway library is that you can create and store various roadway definitions for combinations of existing alignments, templates, and slide-slope controls.

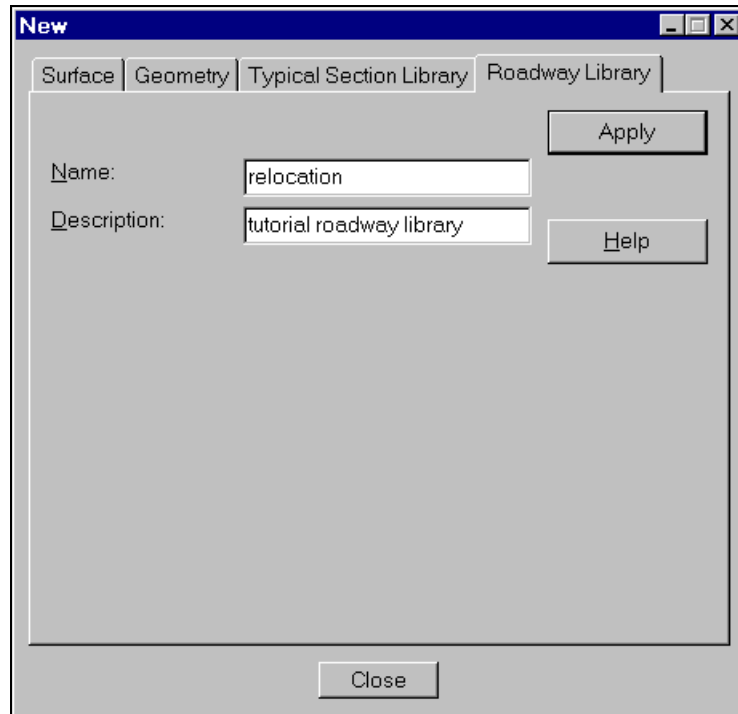
If you just finished the lesson on decision tables, skip to *Creating a New Roadway Library*. If you are just beginning the tutorial here, complete the following steps:

1. Extract *roadlesson9.exe*. For more information, see *Before Starting Each Lesson* at the beginning of this chapter.
2. Start InRoads SelectCAD, and open the *road.dwg* or *road.dgn* file. These files are located in the *\Tutorial\InRoads* directory where you installed InRoads SelectCAD. For more details on starting the software, see *Chapter 2, Starting InRoads SelectCAD*.
3. Click **File > Open**.
4. Set the directory to *C:\Bentley>SelectCAD\Tutorial\InRoads*.
5. For the **Files of type**, select **Preferences (*.ini)**.
6. Select *civilpp_tut.ini*, and click **Open**.
7. For the **Files of type**, select **Styles (*.ini)**.
8. Select *wysiwyg.ini*, and click **Open**.
9. For the **Files of type**, select **Typical Section Libraries (*.tml)**.
10. Select *relocation.tml*, and click **Open**.
11. Click **Cancel** to dismiss the dialog box.

Creating a New Roadway Library

In this lesson, you create a new roadway library and save the library to a roadway library file.

1. Click **File > New**.
2. Click the **Roadway Library** tab.
3. For the **Name**, type `relocation`. Press the **TAB** key.
4. For the **Description**, type `tutorial roadway library`. Press the **TAB** key, and click **Apply**.



5. Click **Close** to dismiss the dialog box.

InRoads SelectCAD generates a new roadway library named *relocation*. The roadway library currently exists only in temporary memory. You must now save the file to your hard disk.

6. Click **File > Save As** command.
7. For the **Save File as type**, select **Roadway Libraries (*.rwf)**.
8. For the **File Name**, type `relocation.rwf`. Click **Save**.

InRoads SelectCAD creates a file named *relocation* and saves the new roadway library to that file.

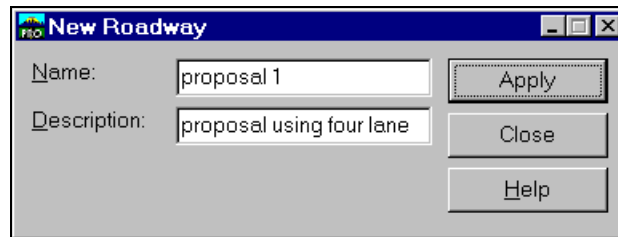
9. Click **Cancel** to dismiss the dialog box.

Creating a Roadway Definition

Once the roadway library has been created, you can create a roadway definition. A roadway definition specifies which typical section to place, how often to place it, and how to determine the side slopes.

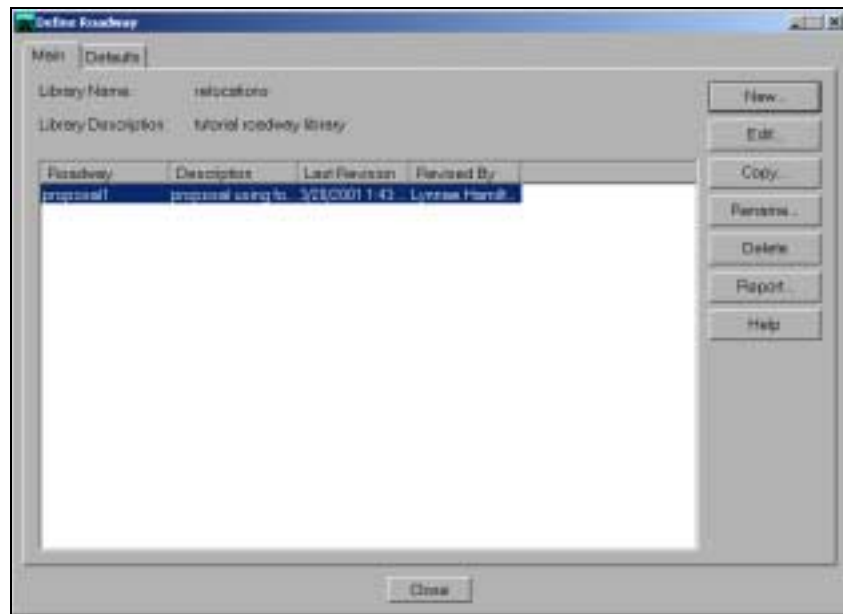
The basic content of a roadway definition is a list of stations and templates. The stations and templates define which template to use along which parts of the alignment. Each template is used from its corresponding station until the station of the next entry in the list.

1. Click **Modeler > Define Roadway**.
2. Click **New** to add a new roadway definition.
3. For the **Name** of the roadway definition, type `proposal 1`. Press the **TAB** key.
4. For the **Description**, type `proposal using four lane`. Press the **TAB** key, and click **Apply**.



5. Click **Close** to dismiss the **New Roadway** dialog box.

InRoads SelectCAD creates a new roadway definition named *proposal 1*.



6. Double-click on the roadway definition **proposal 1** (or select it and click the **Edit** button).

The **Edit Roadway** dialog box will list all station and template entries for the roadway named *proposal 1*. Because this roadway definition has just been created, it does not yet contain any station and template entries.

7. Click **New** on the **Edit Roadway** dialog box.

The **Roadway Entry** dialog box contains all parameters that affect how a template is placed along the alignment.

8. For the **Station**, type 0+000.000.

This defines where to start placing the templates along the alignment.

9. For the **Mode**, select **Both**.

By doing this, you force InRoads SelectCAD to use the same template on the left and right sides of the horizontal alignment centerline.

10. For the **Interval**, type 10.000.

This tells InRoads SelectCAD to place a template every 10 meters along the alignment.

11. Click on the **Use Transition Template** toggle to turn it on.

In this lesson, there is only one entry in the roadway definition so this toggle won't have an affect in this particular workflow. However, if

additional roadway entries are added to the list, you would want to linearly transition from one template to the next without an abrupt change in the roadway where the modeler changes templates.

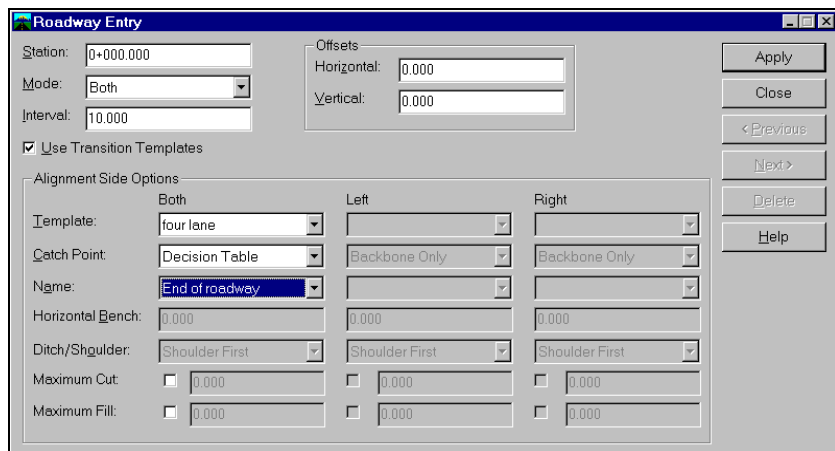
12. Under **Alignment Side Options**, for **Templates**, select **four lane**.

The template name *four lane* appears in the **Template** field. InRoads SelectCAD will use the template named *four lane* as the basis for modeling the roadway corridor.

13. For the **Catch Point**, select **Decision Table**.

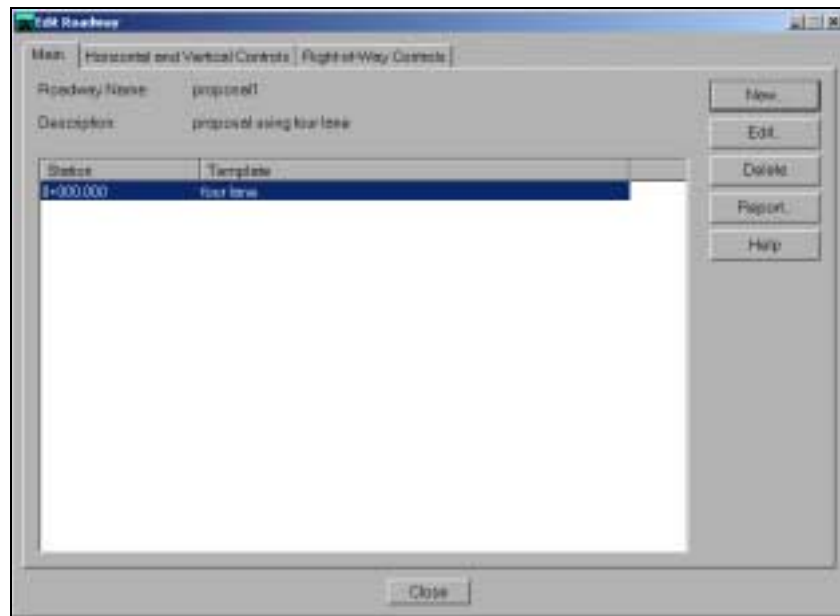
14. For **Name**, select **End of roadway**. You created this table in the previous lesson.

InRoads SelectCAD will retrieve the appropriate slope information from this decision table as it computes side slopes for the roadway model.



15. Other parameters are available on this dialog box, but for this example just click **Apply**, and then click **Close**

A single station and template entry appears in the **Edit Roadway** dialog box. The template *four lane* is used beginning at station 0+000 for the entire alignment. At this point, you could add additional station and template entries, and InRoads SelectCAD would automatically transition between the templates. However, you use only one template in this lesson.



16. Click **Close** to dismiss the **Edit Roadway** dialog box.
17. Click **Close** to dismiss the **Define Roadway** dialog box.
18. Click **File > Save > Roadway Library** to save the roadway library.

InRoads SelectCAD saves all the information contained in the roadway library, including the roadway definition, to the file *relocation.rwl*.

You have just created a basic roadway definition. The roadway definition tells InRoads SelectCAD to apply the template four lane every 10 meters, beginning at station 0+000, and use the decision table *End of roadway* to define side slopes. Later, you run the **Roadway Modeler** command to generate your model. When you do that, the roadway definition will control the **Roadway Modeler** command.

5

Note: The roadway definition you are using is a simple example, naming only one template along the entire alignment. However, if you were to incorporate multiple templates, InRoads SelectCAD could calculate linear transitions between templates automatically. Also, in many projects you have to design the roadway within right-of-way limits.

19. Click **File > Exit** and then exit your CAD software, or continue to the next lesson.

Lesson 10: Roadway Modeler

In this lesson, you generate a roadway using the information you have defined throughout this tutorial. Up to this point, you have defined all the information required to create a roadway model. You created the DTM data, then defined the horizontal and vertical alignments for your proposed roadway, constructed the typical sections, and created the roadway definition. InRoads SelectCAD requires this information to generate a roadway model.

These separate sets of data are brought together to form the roadway model using the **Roadway Modeler** command. Using this command, you instruct InRoads SelectCAD which horizontal and vertical alignments to use, which surface to base its computations on, and which roadway definition to follow.

As the command processes, InRoads SelectCAD generates a new DTM for each layer defined in the templates specified in the first roadway entry. You can treat these new DTMs as any other surface; that is, you can generate contours, display triangles, compute volumes, save the information to an InRoads SelectCAD DTM file, and so forth.

If you just finished the lesson on roadway libraries, skip to *Loading Other Files*. If you are just beginning the tutorial here, complete the following steps:

1. Extract *roadlesson10.exe*. For more information, see *Before Starting Each Lesson* at the beginning of this chapter.
2. Start InRoads SelectCAD, and open the *road.dwg* or *road.dgn* file. These files are located in the *\Tutorial\InRoads* directory where you installed InRoads SelectCAD. For more details on starting the software, complete the following steps:
3. Click **File > Open**.
4. Set the directory to *C:\Bentley>SelectCAD\Tutorial\InRoads*.
5. For the **Files of type**, select **Preferences (*.ini)**.
6. Select *civilpp_tut.ini*, and click **Open**.
7. For the **Files of type**, select **Styles (*.ini)**.
8. Select *wysiwyg.ini*, and click **Open**.
9. For the **Files of type**, select **Surfaces (*.dtm)**.
10. Select *original.dtm*, and click **Open**.
11. For the **Files of type**, select **Geometry (*.alg)**.

12. Select *relocation.alg*, and click **Open**.
13. For the **Files of type**, select **Typical Section Libraries (*.tml)**.
14. Select *relocation.tml*, and click **Open**.
15. For the **Files of type**, select **Roadway Libraries (*.rwl)**.
16. Select *relocation.rwl*, and click **Open**.
17. Click **Cancel** to dismiss the dialog box.

Loading Other Files

If you have been working the tutorial from the start and have not exited InRoads SelectCAD, go to the section *Generating a Roadway Model*. Otherwise, continue and load only the files you need.

1. Click **File > Open**.
2. For the **Files of type**, select **Surfaces (*.dtm)**.
3. Set the directory to *C:\Bentley>SelectCAD\Tutorial\InRoads*.
4. Select *original.dtm* from the list of files, and click **Open**.
5. For the **Files of type**, select **Geometry Projects (*.alg)**.
6. Select *relocation.alg* from the list of files, and click **Open**.
7. Click **Cancel** to dismiss the dialog box.

Generating a Roadway Model

In this lesson, you use the **Roadway Modeler** command to generate the model. This command employs the template *four-lane* and the decision table *End of roadway*. The template is applied along the horizontal alignment *baseline* using elevations from the vertical alignment *profile gradeline*.

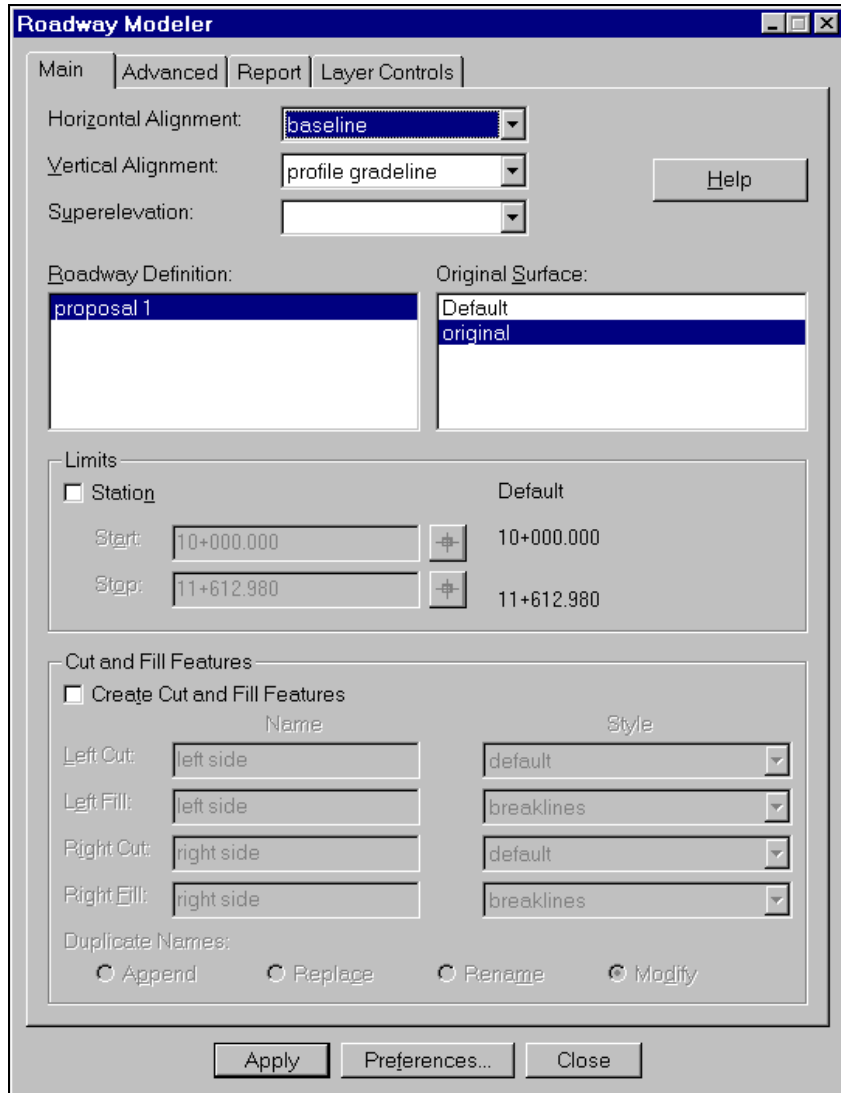
1. Ensure that **Write** lock is turned on.
2. Click **Modeler > Roadway Modeler**.

The **Roadway Modeler** dialog box displays the active horizontal and vertical alignments and all available roadways and surfaces.

3. For **Horizontal Alignment**, select **baseline**. For the **Vertical Alignment**, select **profile gradeline**. For **Roadway Definition**, select **proposal 1**. For the **Original Surface**, select **original**.

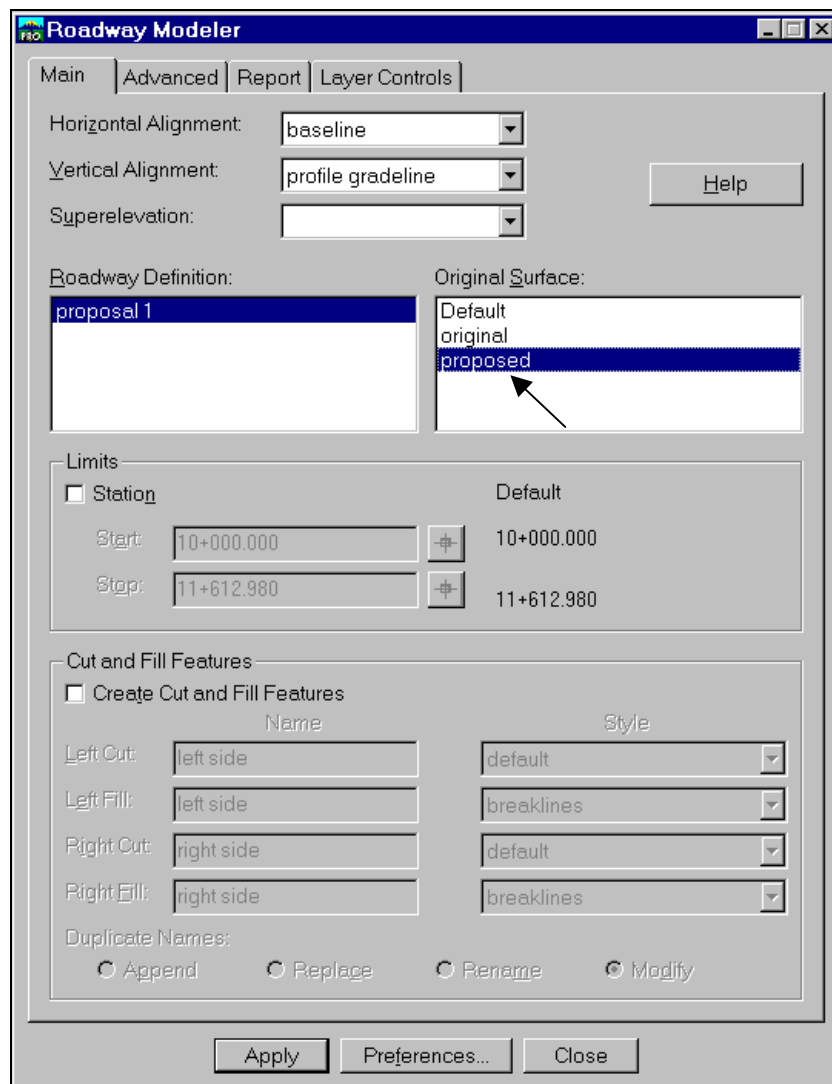
InRoads SelectCAD uses the specified horizontal and vertical alignments to compute a new DTM based on the template defined in

the roadway definition *proposal 1*. The side slope conditions are computed using decision table *End of roadway*.



4. Click **Apply**.

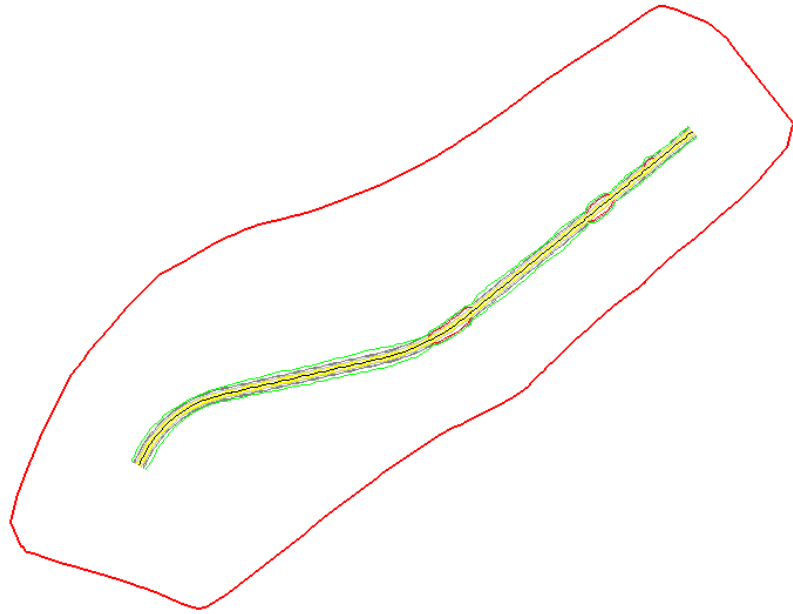
InRoads SelectCAD carries out the computations to model the new roadway surface. As it processes, a status bar showing the percent complete appears at the bottom of the SelectCAD Explorer. When processing is complete, notice that a new DTM named **proposed** appears in the **Original Surface** list. This new surface is a DTM that represents the newly designed roadway.



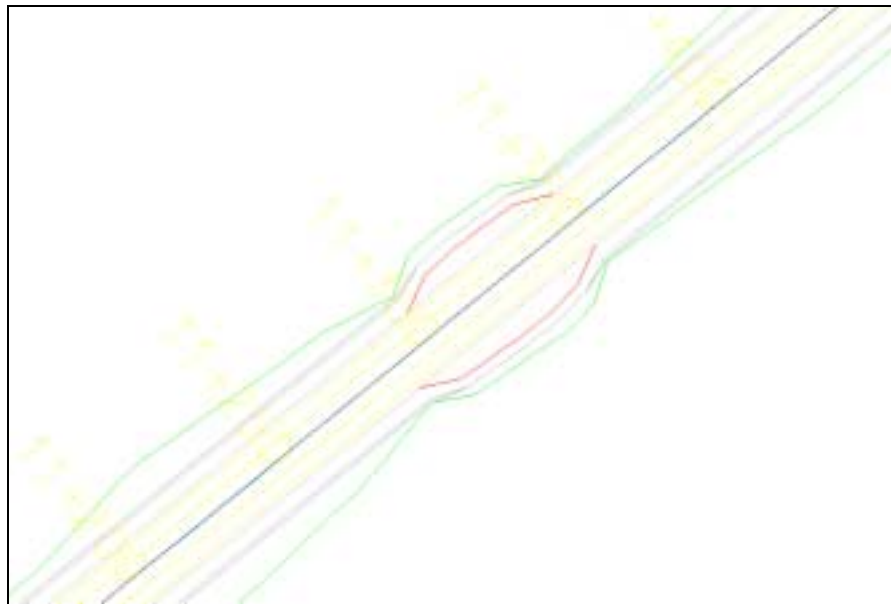
- When the command is finished processing, click **Close** to dismiss the dialog box.

Now that you have a surface that represents your model (*proposed*), you can examine the results.

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6. You may want to use the **Zoom** tools to get a closer look at the features in the roadway model.



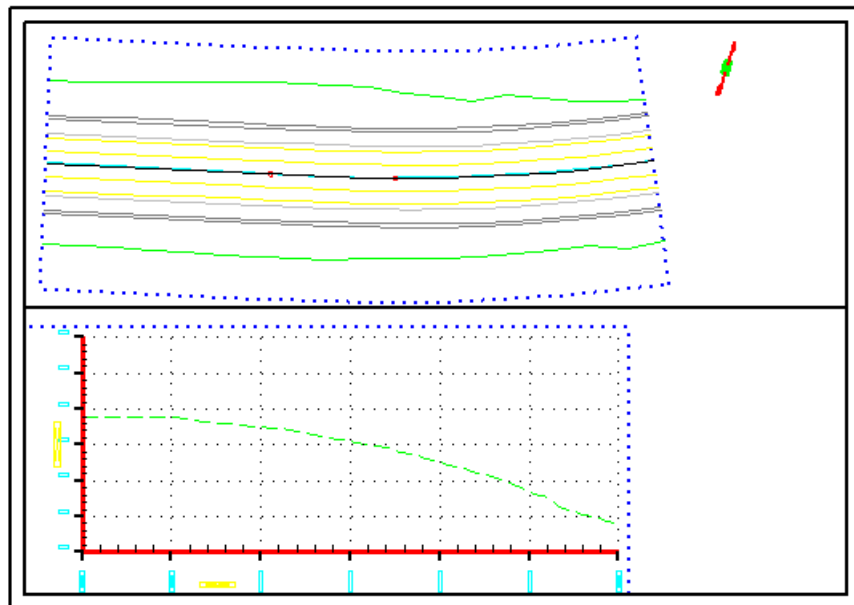
7. Click **Evaluation > Plan and Profile Generator**.
8. Click the **Sheet Index** tab.

9. Click **Open** and select *relocation.vdf* (*relocationACAD.vdf* on AutoCAD). Click **Open** then click **Cancel** to dismiss the dialog box.

Note: This file was created in *Lesson 6: Plan and Profile Generator*.

10. Select and highlight one of the sheets.
11. Click **Show Sheet**.

Review the sheets. You are currently in the design file *sheets.dgn*.

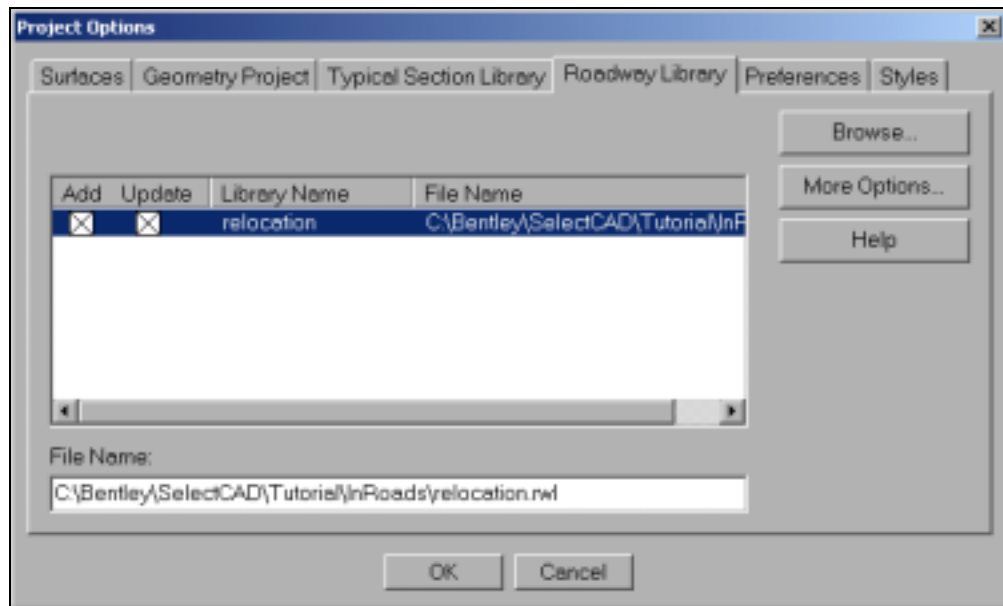


12. Uncollapse and **Close** the **Plan and Profile Generator** dialog box.
13. From the MicroStation menu, reopen *road.dgn*. On AutoCAD, return to model space.
14. From the CAD menu, save the *road.dgn* or *road.dwg* design file.
15. Click **File > Save As** to save the proposed surface.
16. Set the directory to *C:\Bentley>SelectCAD\Tutorial\InRoads*.
17. For the **Save File as type**, select **Surfaces (*.dtm)**.
18. For the **Active**, select **proposed**.
19. For the **File Name**, type *proposed.dtm*. Click **Save**.

Creating a Projects File

Throughout the tutorial you have been loading and saving files one at a time. There is an easier way using a *projects* file. A projects file is an ASCII file that has pointers to each file that is loaded or saved by InRoads SelectCAD.

1. If you are still in the **Save As** dialog box, go to the next step. If not, click **File > Save As**.
2. For the **Save as type**, select **Projects (*.rwk)**.
3. Click **Options**.
4. Click the **Roadway Library** tab.
5. Select *relocation*.
6. Turn on the **Add** and **Update** toggles for *relocation*.



7. Click the **Preferences** tab.
8. Select the *civilpp_tut.ini* preference.
9. Turn on the **Add** and **Update** toggles.
10. Click the **Surfaces** tab.
11. Select *original*.
12. Turn on the **Add** and **Update** toggles.
13. Select *proposed*.
14. Turn on the **Add** and **Update** toggles.

15. Click the **Geometry Project** tab.
16. Select *relocation*.
17. Turn on the **Add** and **Update** toggles.
18. Click the **Typical Section Library** tab.
19. Select *relocation*.
20. Turn on the **Add** and **Update** toggles.
21. Click the **Styles** tab.
22. Click to turn off the default *wysisyg.ini* file.
23. Click **OK**.

You just selected which files you would like to save and load when you save the project file. The next time you enter InRoads SelectCAD and open the project file, all the selected files will automatically load.

24. For the **File Name**, type *relocation.rwk*. Click **Save**.
25. Click **Cancel**.
26. Click **File > Exit** and then exit your CAD software, or continue to the next lesson.

Lesson 11: Design Evaluation

You have completed some of the more complex design tasks associated with InRoads SelectCAD, and are ready to compute the volume of earth required to build the road. InRoads SelectCAD provides three independent algorithms for computing cut, fill, and net volumes, with each method supporting compaction and expansion factors.

Volume Computation Methods

The triangle volume method is the most precise volume calculation method available in InRoads SelectCAD, but generally takes longer to process. During processing, it projects proposed surface triangles onto the original surface to form three-sided columns of volume. This method results in the exact mathematical volume between two DTMs: not an estimation of volume.

The grid volume method overlays a rectangular grid network on top of the design and original DTMs, and computes the cut or fill volume within each grid cell. You control the dimensions of each grid cell (grid density) and thus the accuracy of the volume computations.

The third volume method uses the traditional end-area volume method. To compute volumes using this method, you first extract and display two or more cross sections in the drawing file, and then use the **End-Area Volume** command to compute cut, fill, and net volumes from the cross sections. This is the method you will use in this lesson.

If you just finished the lesson on roadway modeler, skip to *Extracting Cross Sections*.

1. Extract *roadlesson11.exe*. For more information, see *Before Starting Each Lesson* at the beginning of this chapter.
2. Start InRoads SelectCAD, and open the *road.dwg* or *road.dgn* file. These files are located in the *\Tutorial\InRoads* directory where you installed InRoads SelectCAD. For more details on starting the software, see *Chapter 2, Starting InRoads SelectCAD*.
3. Click **File > Open**.
4. Set the directory to *C:\Bentley>SelectCAD\Tutorial\InRoads*.
5. For the **Files of type**, select **Projects (*.rwk)**.
6. Select *relocation.rwk*, and click **Open**.

The geometry project, two surfaces, the typical section and roadway libraries, and the preference file are opened.

7. Click **Cancel** to dismiss the dialog box.

Extracting Cross Sections

InRoads SelectCAD provides several methods to extract and display cross sections in the drawing file. With each method, you have complete control over all the parameters affecting the left and right offsets of the cross section and the format and symbology of the cross section display. Additionally, each method allows generation of several detailed ASCII reports.

Before computing the volumes using the end-area method, you must extract and display cross sections along the alignment centerline.

1. Turn on **Write** lock.

Cross sections must be written to the design/drawing file to compute end-area volumes later.

2. Click **Evaluation > Cross Section > Create Cross Section**.

3. For **Create**, select **Window and Data**.

4. For the **Interval**, type 50.

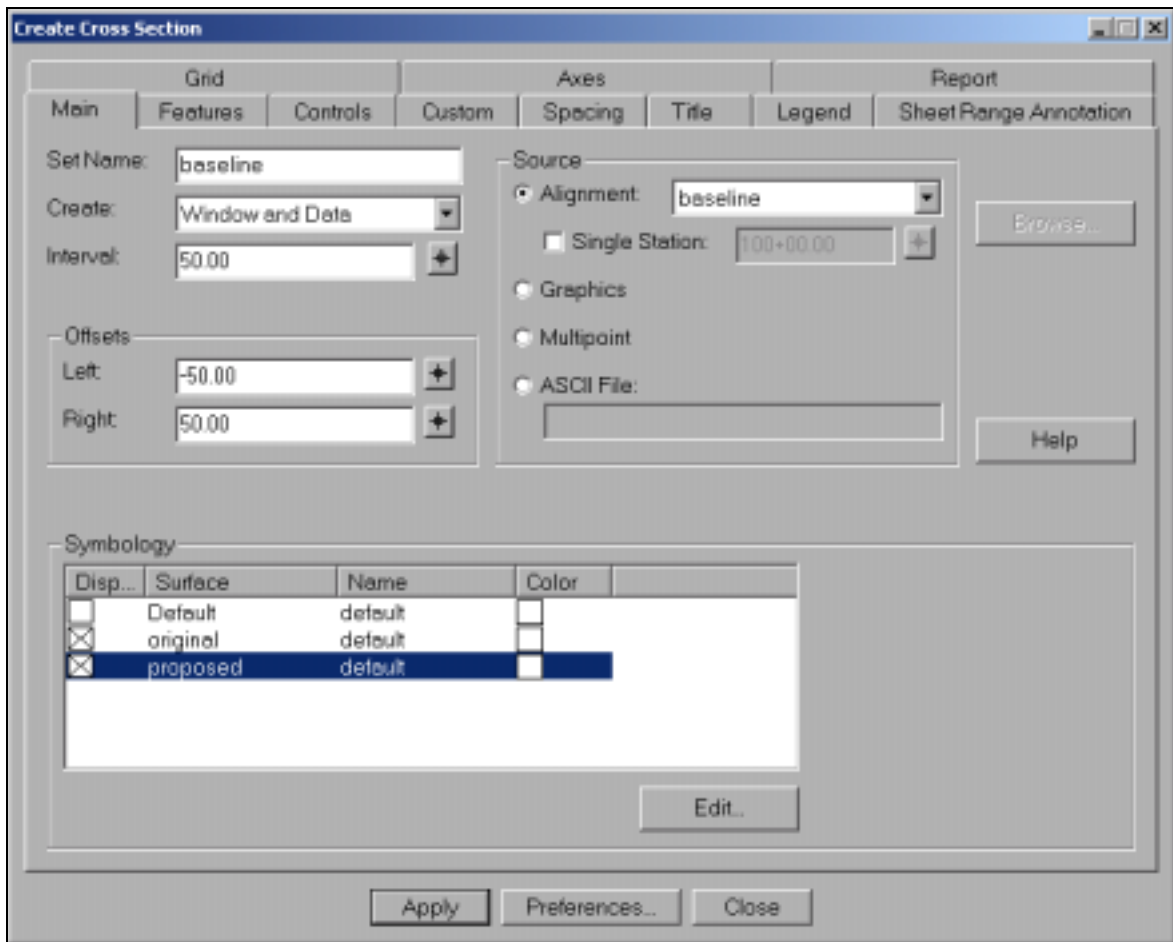
The distance along the alignment between extracted cross sections will be 50 meters.

5. For the **Left Offset**, type -50. For the **Right Offset**, type 50. Press the **TAB** key.

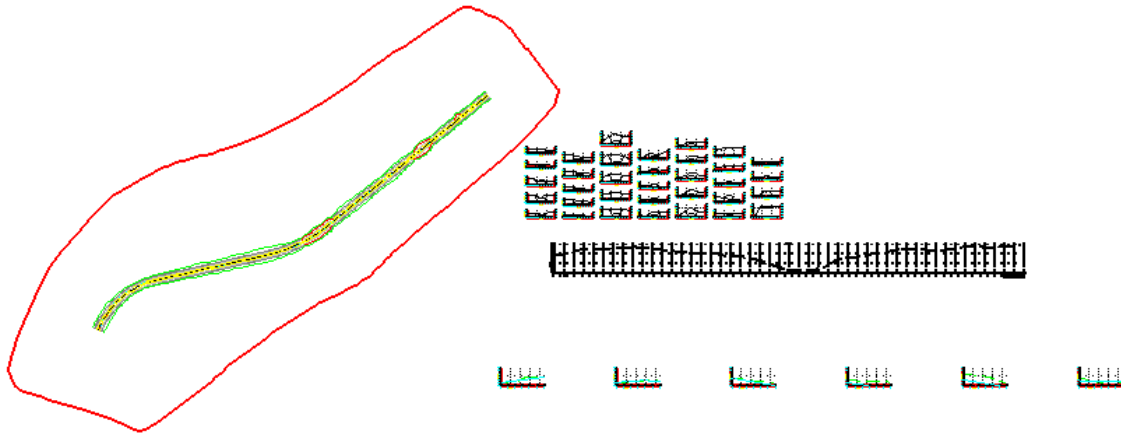
6. The cross sections will span 50 meters to the left of the horizontal alignment and 50 meters to the right of the alignment. InRoads SelectCAD lets you set different left and right offset values that define the span of cross sections.

7. In the **Symbology** area, click the **original** box and the **proposed** box. Both surfaces should be selected in the **Surface** list.

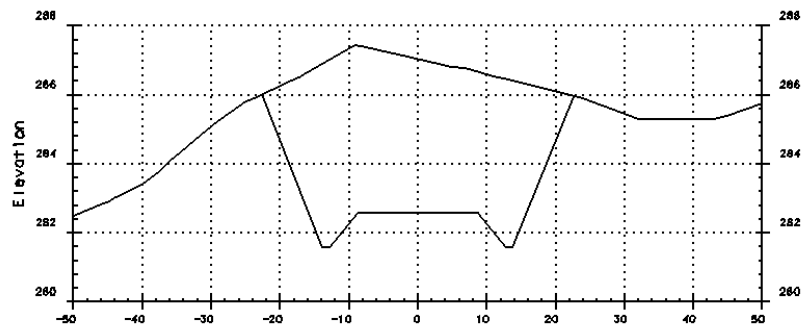
8. Under **Source**, select **Alignment**. Verify that the active alignment is *baseline*.



9. Click the **Features** tab. Turn off all features.
10. Click **Apply**, and place a data point to the right of the perimeter of surface *original* and above the profile extracted earlier in this tutorial. The cross section matrix is displayed above and to the right of the data point.



InRoads SelectCAD extracts and displays the cross sections in the drawing file.



10. When processing is finished, click **Close** to dismiss the **Cross Section** dialog box.

You extracted a cross section every 50 meters along the horizontal alignment centerline. The cross section shows the site and proposed surfaces. Later, you use the cross sections in the drawing file as the source for volume calculations.

11. Click **Evaluation > Cross Section > Cross Section Viewer**.
12. Click **Run** to view all of the cross section. Hit **Escape** to stop.
13. Click **Close** to dismiss the **Cross Section Viewer** dialog box.

Computing End-Area Volumes

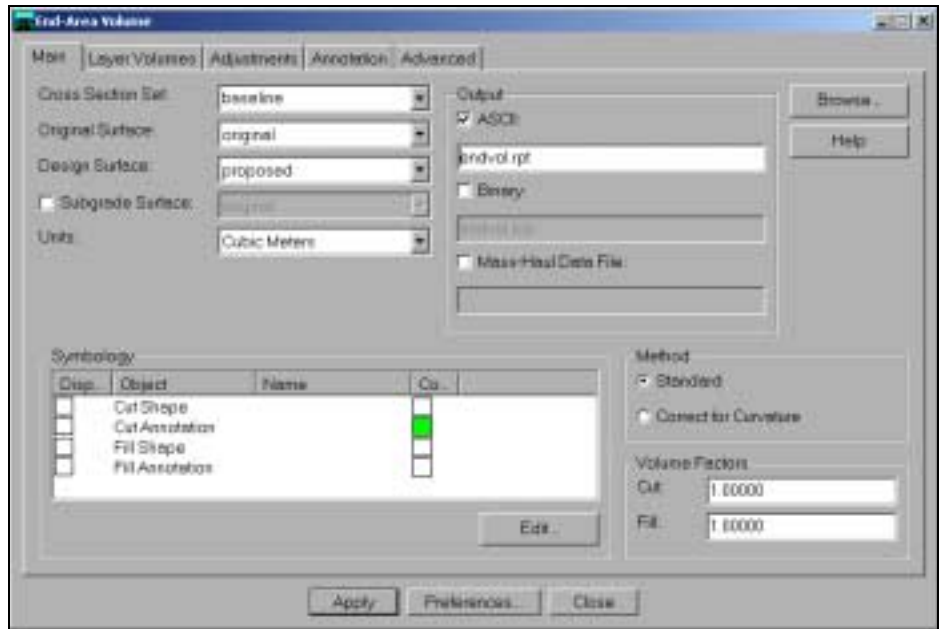
As noted in the opening paragraphs of this lesson, InRoads SelectCAD supports the computation of volumes using three different methods. In this portion of the lesson, you compute volumes using the traditional end-

area volume algorithm, and generate a detailed ASCII report listing station-by-station quantities.

1. Click **Evaluation > Volumes > End-Area Volume**.

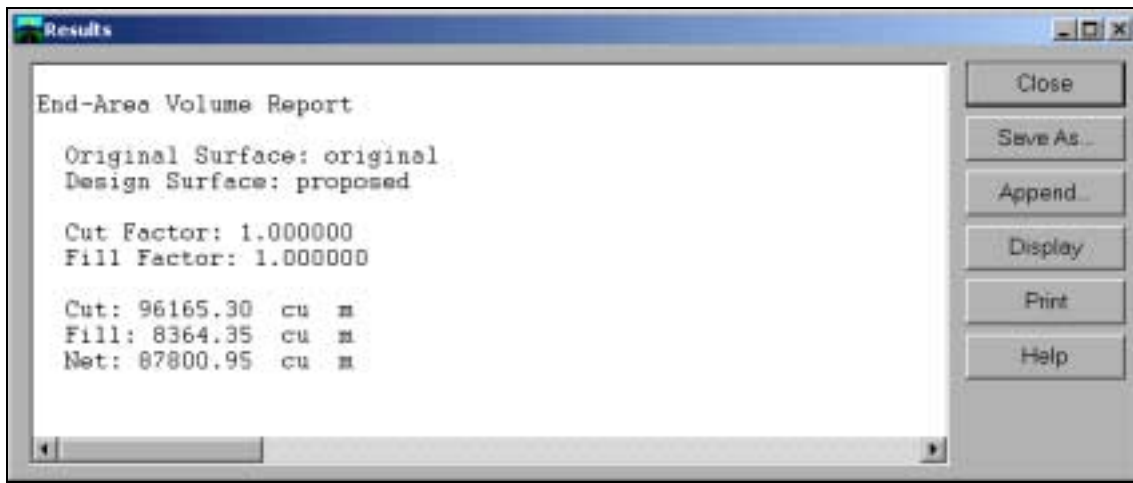
In the **Cross Section Set** field, the name *baseline* is displayed. This name identifies the group of cross sections just generated for alignment *baseline*.

2. For the **Original Surface**, select **original**.
3. For the **Design Surface**, select **proposed**.
4. For Output, turn on the **ASCII** toggle.
5. For the name of the ASCII file, type `endvol.rpt`.
6. Make sure all the other toggles are off.



7. Click **Apply**.

When you compute end-area volumes, InRoads SelectCAD generates a report in the file *endvol.rpt*. The file is written to *C:\Bentley>SelectCAD\data*.



InRoads SelectCAD computes cut, fill, and net volumes using the end-area method. The results are displayed in the **Results** dialog box, and a report is saved in the file *endvol.rpt*.

8. Click **Close** to dismiss the **Results** dialog box.
9. Click **Close** to dismiss the **End-Area Volume** dialog box.
10. From the CAD menu, save *road.dgn* or *road.dwg*.
11. Click **File > Exit** and then exit your CAD software, or continue to the next lesson.

You computed end-area volumes between the proposed and original surfaces. Also, you wrote an ASCII volume report to the file *endvol.rpt* in your *\Tutorial\InRoads* directory.

Lesson 12: Final Plan Sheets

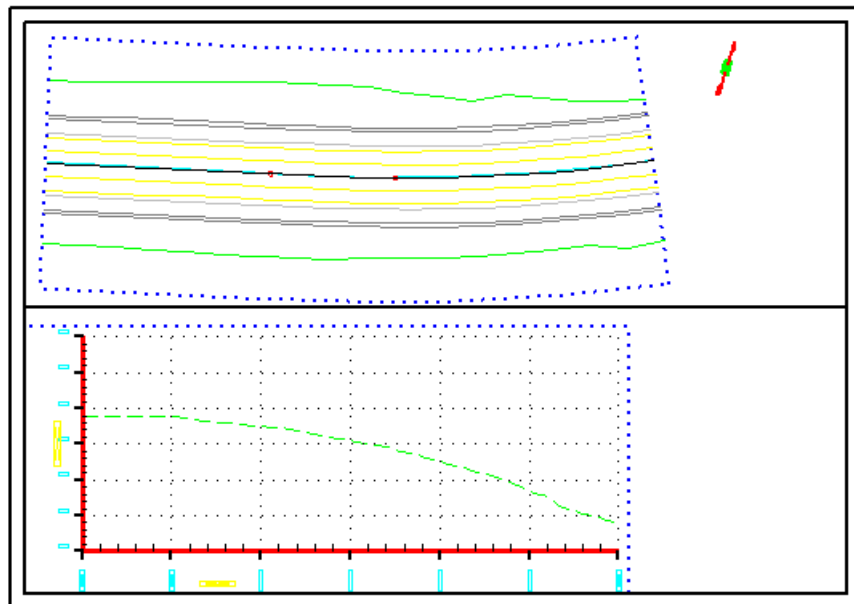
In this final lesson of the tutorial, you view the final plan and profile sheets for the relocation project. In Lesson 6, just after defining the new alignment, you created initial plan sheets. Now that you have generated typical sections, defined and modeled the roadway, and evaluated the design, you can view the final plan and profile sheets for the proposed roadway.

If you just finished the lesson on design evaluation, skip to *Final Plan and Profile Sheets*; otherwise, complete the following steps:

1. Extract *roadlesson12.exe*. For more information, see *Before Starting Each Lesson* at the beginning of this chapter.
2. Start InRoads SelectCAD, and open the *road.dwg* or *road.dgn* file. These files are located in the `\Tutorial\InRoads` directory where you installed InRoads SelectCAD. For more details on starting the software, complete the following steps:
3. Click **File > Open**.
4. Set the directory to `C:\Bentley>SelectCAD\Tutorial\InRoads`.
5. For the **Files of type**, select **Preferences (*.ini)**.
6. Select *civilpp_tut.ini*, and click **Open**.
7. For the **Files of type**, select **Styles (*.ini)**.
8. Select *wysiwyg.ini*, and click **Open**.
9. For the **Files of type**, select **Surfaces (*.dtm)**.
10. Select *original.dtm*, and click **Open**.
11. Select *proposed.dtm*, and click **Open**.
12. For the **Files of type**, select **Geometry (*.alg)**.
13. Select *relocationl.alg*, and click **Open**.
14. For the **Files of type**, select **Typical Section Libraries (*.tml)**.
15. Select *relocation.tml*, and click **Open**.
16. For the **Files of type**, select **Roadway Libraries (*.rwl)**.
17. Select *relocation.rwl*, and click **Open**.
18. Click **Cancel** to dismiss the dialog box.

Creating Final Plan and Profile Sheets

1. Click **Evaluation > Plan and Profile Generator**.
2. Click the **Sheet Index** tab.
3. Click the **Open** to locate *relocation.vdf* (*relocationACAD.vdf* on AutoCAD). Click **Cancel** to dismiss the dialog box.
4. Select and highlight a sheet.
5. Click the **Show Sheet** button.
6. Review the remaining sheets. You are currently in the design file *sheets.dgn*.



7. Uncollapse and **Close** the **Plan and Profile Generator** dialog box.
8. From the MicroStation menu, reopen *road.dgn*. From AutoCAD, return to model space.
9. From the CAD menu, save the *road.dgn* or *road.dwg*.
10. Click **File > Exit** from the CAD menu to exit InRoads SelectCAD.

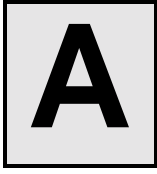
Summary

Congratulations! Using the data provided in the tutorial files, you have done the following:

- Created a digital terrain model.
- Created a horizontal and a vertical alignment.
- Generated a profile along an alignment.
- Create initial plan and profile sheets.
- Created a typical section template for roadway modeling.
- Create a decision table for roadway definition.
- Create a roadway library.
- Generated a roadway model.
- Extracted cross sections and computed end-area volumes.
- Generated reports on the data.
- Created final plan and profiles sheets along an alignment.

You can re-extract the tutorial files at any time and experiment with the different methods and options.

For detailed information on each command and instructions for using each command, see the *SelectCAD Help*.



How to Reach Bentley Systems

Electronic Self-Help Support

Bentley Systems provides several electronic self-help support tools to answer your support questions 24 hours a day, seven days a week.

Bentley Systems World Wide Web Information Server

Using any Web browser, you can access Bentley Systems on the World Wide Web at <http://www.bentley.com>, and follow the links from **Support**.

The Bentley Systems Web site also contains:

- ❑ Bentley Systems product information and direction, including brochures and interactive demonstration software.
- ❑ Lists and descriptions of training classes and technical documents.
- ❑ Bentley Systems user-group updates—activities, meeting dates, and schedules—and international home pages.
- ❑ Contact points for the Bentley Systems worldwide dealer network.

Bentley Systems Civil Engineering Knowledge Bases

The Bentley Systems Civil Engineering Knowledge Base web system (available to maintenance customers) provides a searchable collection of technical information to help you quickly find solutions to technical problems, product and training information, and tips for using any of the civil engineering products.

If you have a valid maintenance agreement, you can login to the knowledge base. If you do not have a valid maintenance contract or want more information about the knowledge base, contact Bentley Systems at 1-800-BENTLEY.



Logging Customer-Support Worksheets

Bentley Systems customer-support representatives are available to answer your questions about technical issues related to **InRoads SelectCAD**. To log a worksheet with a customer-support representative, call 1-800-BENTLEY from anywhere within the United States. Outside the United States, call your Bentley Systems representative.

If you have a Bentley Systems maintenance contract, you can also propose software enhancements. For information about software maintenance contracts, call 1-800-BENTLEY, or follow the customer-services-and-support links to Software Support Programs on the World Wide Web at <http://www.bentley.com>.

Information You Need When Requesting Support

In addition to a brief description of the problem, you may be asked to provide the following information:

About You

- Your name and the name of your company.
- Your site ID, LAN ID, or service number. The site ID and LAN ID numbers are on the packing slip shipped with **InRoads SelectCAD**. If you cannot find the packing slip, call the Bentley Systems sales office or dealer from whom you purchased **InRoads SelectCAD**.
- The number of a voice phone near the system with the problem.

About Your Bentley Systems Software

- Product name or acronym: **InRoads SelectCAD**.
- Software version number. This is in the *Readme* file and in the **About** box available from the **Help** menu.

About Your Computer System

- Brand and model
- Processor (Pentium or Pentium II, for example)
- RAM Memory
- CPU speed
- Operating system (Windows NT 4.0, for example)

- Networking software and version (PC/TCP or PC-NFS, for example)

If We Need Your Data to Reproduce a Problem

Often civil works problems can only be reproduced using your data, and Bentley Systems support analysts may need a copy of certain files. These files can be transferred over the Internet; or you can send files on tape, diskette, or CD-ROM to Bentley Systems.

Telephone Numbers

Note: Outside the United States, call your Bentley Systems representative.

Bentley Systems Corporate Education Services

For information about training:

From anywhere within the United States—1-800-BENTLEY

Bentley Systems Customer Response Center

To log a worksheet: 1-800-BENTLEY

Bentley Systems Customer Services

For the number of your Bentley Systems representative or Business Partner, or for information about Bentley Systems services: 1-800-BENTLEY

North American Service Plans

The following service plans are available:

Complimentary Service

30-day phone support

Bentley Systems provides free telephone support for 30 days from the date of product purchase. This lets you explore the support alternatives that best suit your needs and to experience the quality of support you can expect from Bentley Systems. Customer response hours are 7:00 a.m. to 7:00 p.m. Central Time. The toll free number is 800-BENTLEY.

A

Premium Service

Full support for all Bentley Systems-developed product software

Bentley Systems provides total support for all Bentley Systems-developed product software. Our Premium Service plan features

- ❑ Software upgrades
- ❑ Software updates and fixes
- ❑ Help Desk technical support
- ❑ Incident logging via electronic mail
- ❑ Bentley Systems Online (World Wide Web)
- ❑ Knowledge bases (via internet)
- ❑ Product Reissue (transferring licenses to new platforms)
- ❑ Customer site visits
- ❑ Internet Collaborative Support

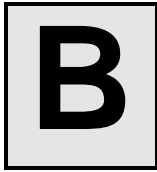
The Premium Service plan is the **best value** for software maintenance.

Advantage Service

Our Advantage Service Plan features

- ❑ Help Desk technical support
- ❑ Incident logging via electronic mail
- ❑ Bentley Systems Online (World Wide Web)
- ❑ Software fixes
- ❑ Knowledge bases (via internet)
- ❑ Internet Collaborative Support

For more information or the number of a sales representative or Solution Center near you, contact Bentley Systems.



Horizontal Alignment Review

Project Name: relocation
 Description: road relocation project
 Horizontal Alignment Name: baseline
 Description: relocation baseline
 Style: default

	STATION	NORTHING	EASTING
Element: Linear			
POB ()	10+000.000	3255.500	3124.800
TS ()	10+005.131	3260.051	3127.169
Tangent Direction:	N 27°30'00.0" E		
Tangent Length:	5.131		

Element: Clothoid			
TS ()	10+005.131	3260.051	3127.169
SPI ()		3289.630	3142.567
SC ()	10+055.131	3303.679	3151.557
Entrance Radius:	0.000		
Exit Radius:	280.000		
Length:	50.000		
Angle:	5°06'56.5" Right		
Constant:	118.322		
Long Tangent:	33.347		
Short Tangent:	16.679		
Long Chord:	49.982		
Xs:	49.960		
Ys:	1.487		
P:	0.372		
K:	24.993		
Tangent Direction:	N 27°30'00.0" E		
Radial Direction:	S 62°30'00.0" E		
Chord Direction:	N 29°12'18.4" E		
Radial Direction:	S 57°23'03.5" E		
Tangent Direction:	N 32°36'56.5" E		

Element: Circular			
SC ()	10+055.131	3303.679	3151.557
PI ()	10+155.601	3388.306	3205.711
CC ()		3152.759	3387.403
CS ()	10+248.058	3419.197	3301.315
Radius:	280.000		
Delta:	39°28'42.1" Right		
Degree of Curvature(Arc):	20°27'46.0"		
Length:	192.928		
Tangent:	100.471		
Chord:	189.134		
Middle Ordinate:	16.453		
External:	17.480		



Working with InRoads SelectCAD

Tangent Direction: N 32^36'56.5" E
 Radial Direction: S 57^23'03.5" E
 Chord Direction: N 52^21'17.6" E
 Radial Direction: S 17^54'21.4" E
 Tangent Direction: N 72^05'38.6" E

Element: Clothoid

CS ()	10+248.058	3419.197	3301.315
SPI ()		3424.325	3317.187
ST ()	10+298.058	3431.707	3349.706
Entrance Radius:	280.000		
Exit Radius:	0.000		
Length:	50.000		
Angle:	5^06'56.5" Right		
Constant:	118.322		
Long Tangent:	33.347		
Short Tangent:	16.679		
Long Chord:	49.982		
Xs:	49.960		
Ys:	1.487		
P:	0.372		
K:	24.993		
Tangent Direction:	N 72^05'38.6" E		
Radial Direction:	S 17^54'21.4" E		
Chord Direction:	N 75^30'16.7" E		
Radial Direction:	S 12^47'24.9" E		
Tangent Direction:	N 77^12'35.1" E		

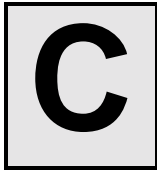
Element: Linear

ST ()	10+298.058	3431.707	3349.706
PI ()	10+652.491	3510.172	3695.344
Tangent Direction:	N 77^12'35.1" E		
Tangent Length:	354.432		

Elements are not coincident

Element: Linear

PI ()	10+652.491	3558.937	3849.950
POE ()	11+452.491	4064.200	4470.200
Tangent Direction:	N 50^50'00.0" E		
Tangent Length:	800.000		



Vertical Alignment Review



 Project Name: relocation
 Description: road relocation project
 Horizontal Alignment Name: baseline
 Description: relocation baseline
 Style: default
 Vertical Alignment Name: profile gradeline
 Description: relocation baseline
 Style: default

		STATION	ELEVATION
Element: Linear			
	POB	10+000.000	289.650
	PVC	10+190.025	294.686
	Tangent Grade:	2.6500	
	Tangent Length:	190.025	
Element: Parabola			
	PVC	10+190.025	294.686
	PVI	10+250.000	296.275
	PVT	10+309.975	294.448
	VHIGH	10+245.832	295.425
	Length:	119.950	
	Entrance Grade:	2.6500	
	Exit Grade:	-3.0458	
	$r = (g2 - g1) / L$:	-4.7485	
	$K = 1 / (g2 - g1)$:	21.0593	
	Middle Ordinate:	-0.854	
Element: Linear			
	PVT	10+309.975	294.448
	PVC	10+689.999	282.873
	Tangent Grade:	-3.0458	
	Tangent Length:	380.024	
Element: Parabola			
	PVC	10+689.999	282.873
	PVI	10+849.999	278.000
	PVT	11+009.999	284.620
	VLOW	10+825.684	280.807
	Length:	320.000	
	Entrance Grade:	-3.0458	
	Exit Grade:	4.1375	

Working with InRoads SelectCAD

$r = (g2 - g1) / L:$ 2.2448
 $K = 1 / (g2 - g1):$ 44.5476
Middle Ordinate: 2.873

Element: Linear

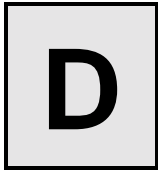
PVT 11+009.999 284.620
PVC 11+158.239 290.753
Tangent Grade: 4.1375
Tangent Length: 148.240

Element: Parabola

PVC 11+158.239 290.753
PVI 11+248.239 294.477
PVT 11+338.239 294.927
Length: 180.000
Entrance Grade: 4.1375
Exit Grade: 0.5000
 $r = (g2 - g1) / L:$ -2.0208
 $K = 1 / (g2 - g1):$ 49.4845
Middle Ordinate: -0.818

Element: Linear

PVT 11+338.239 294.927
POE 11+612.800 296.300
Tangent Grade: 0.5000
Tangent Length: 274.561



Glossary

abutment

The support substructure at each end of a bridge; also referred to as end bent.

access control

Access control allows you to share files among multiple users while controlling read-write access to the data.

active depth/elevation

The plane in a MicroStation 3D design file or AutoCAD drawing file in which you can place elements and perform manipulations.

active geometry

The current geometry project (alignments, superelevation, and coordinate geometry) in memory that can be manipulated and evaluated. You can have only one geometry project, one horizontal alignment, one vertical alignment, and one superelevation list active at any time. The name of the active geometry project is indicated with a red box in the explorer window.

active horizontal

The current horizontal alignment in memory that can be manipulated and evaluated. Only one horizontal alignment can be active at a time. The name of the active horizontal alignment is indicated with a red box in the explorer window.

active surface

The surface in memory that some commands act upon by default. For example, the Tools > Tracking command does not specify a surface on which to operate – it uses the active surface. Only one surface can be active at a time. The name of the active surface is indicated with a red box in the explorer window.

active vertical

The current vertical alignment in memory that can be manipulated and evaluated. Only one vertical alignment can be active at a time. The name of the active vertical alignment is indicated with a red box in the explorer window.

added quantities

An adjustment that is made to the End-Area volume calculation that defines how much external fill to add to your design and how much cut material to remove from it.

affixes

All prefixes and suffixes used for annotation display to conform to company standards.

ahead tangent

D

The tangent exiting a curve.

ALG

A file containing coordinate geometry information, superelevation, and alignment information for a specific geometry project.

alignment

A chain of tangents, curves, and transition spirals that describes a centerline.

AASHTO

An association comprised of principal executive and engineering officers of the various state highway and transportation agencies and the U. S. Dept. of Transportation. Its main purpose is to develop and improve methods of administration, design, construction, operation, and maintenance of highways. AASHTO consults with Congress about highway legislation; develops technical, administrative, and operational standards and policies for highways; and cooperates with other agencies in the consideration and solution of highway problems.

angle

An angular measurement taken from the intersection of two lines, given in either degrees, minutes, and seconds or radians or grads. Degrees and minutes are given as integers, but seconds can contain a decimal part. Angles can be measured either clockwise or counterclockwise.

angular mode

Mode used to specify the orientation of angle measurement.

application add-ins

Any product or command that is not defined in the product's base menu but can be added to the menu. Some Add-Ins are delivered with the product and can be added to the menu simply by activating them with the Tools > Application Add-Ins command. Other Add-Ins (from maintenance releases or custom applications) can be added to the product even after the product is installed.

arc definition

Highway definition: one of the methods of defining a curve. The radius R is used to define the curve and is defined by the equation $R=5729.58/D$ where the degree of curvature D is the central angle subtended by a 100-foot arc.

ASC (ASCII)

File format used to import and export ASCII data. ASCII files are text files and can be opened with a standard text editor.

attribute

A property or characteristic of a structure, element, or display.

audit trail file

An ASCII file automatically created every time the coordinate geometry commands are used with the software. The file records all inputs relating to the coordinate geometry commands of the software. This file is available only with Cogo Classic.

back tangent

The tangent entering a curve.

backbone

The portion of the corridor that lies between the template hinge points.

backslope

The ditch segment that is farthest from the centerline. The backslope extends upward from the ditch bottom.

batch mode

Entry of coordinate geometry commands to the software using an input file.

beam

A structural member type typically placed with the member axis in a nominal horizontal orientation.

bearing depth

Vertical distance measured from the bottom of the beam or girder to the top of the bearing seat.

bearing pad

Usually, a built-up rectangular pad of varying thickness composed of rubber and steel shims, which are placed under the beams.

bearing point

Location on bearing seat where elevation is determined for beam placement; usually the center point of the bearing pad.

bearing seat

Level area on substructure to accommodate bearing end of beam or girder.

bench

A terrace or ledge created along the corridor to break the continuity of a steep slope.

bench datum

A reference elevation for calculating the elevations for horizontal benches.

block

In AutoCAD, one or more objects that are combined to create a single object.

boundary survey

A type of survey that determines the length and direction of landlines and establishes the position of these lines on the ground.

boundary chord

A part of an element defining the clipping boundaries of plan views along a curved horizontal control line. As the number of boundary chords increases, the path defined by the chords more closely approximates a smooth curve.

breakline

A surface feature consisting of a collection of spatial coordinates that have an implied linear relationship. No triangle side (in the triangulated surface) can cross over a breakline.

bridge

A three-dimensional highway or rail support structure containing a superstructure and substructure, whose members are defined by various horizontal and vertical alignments.

bypass flow

The flow that cannot be captured by an inlet.

camber

Fabricated vertical deflected shape of a structural member.

cant

The term used to denote the raising of the outer rail on curved track to allow higher speeds than if the two rails were level. Cant compensates for the centrifugal force arising from a train traversing a curve. If a track was canted to the level required for the maximum speed of the fastest train, the level of tilt would be too high for a slower train. A compromise degree of cant is therefore used, known as *cant deficiency*.

capacity

Amount of flow or volume can be handled by a structure.

cardinal point

One of the points used to define the geometry of an alignment. Cardinal points include PC, PT, PI, and CC points.

catch point

The point at which a fill slope intercepts the original surface.

cell

In MicroStation, a permanent association of elements that can be stored and placed as a group, and then manipulated as individual elements.

cell library

In MicroStation, a file in which cells are stored. Cells from the active cell library can be placed in a drawing file.

center of curvature (CC)

The center point, or radius location, of a circularly curved element in an alignment.

centroid

The center of mass of an area.

chainage

The distance along a horizontal alignment measured from some reference point on the alignment. Also referred to as station.

channel

V-Shaped, Trapezoidal, or Rectangular open structure that directs water drainage.

chord definition

One of the methods of defining a curve. The radius R is used to define the curve, and is defined by the equation $R=50/\text{SIN}(0.5*D)$ where the degree of curvature D is the central angle subtended by a 100-foot chord.

chord height tolerance

Specifies the largest distance between a chord and the arc it subtends (middle ordinate). This parameter is used to control the number of points along a curve that are added during graphic display of spirals, parabolas, and vertical circles.

clearance

The vertical distance from the bottom of the superstructure to the surfaces and/or passing roadway surface below.

clipping boundary

An element that defines the size and shape of a reference file (model file) view.

closed alignment

An alignment in which the first and last PIs have the same x, y, z coordinates. Only horizontal alignments may be closed.

closed shape

A graphic element in which the first and last points have the same x, y, z coordinates.

closure line

The line between the actual end point of a traverse and the desired end point.

clothoid

A transition spiral that has circular curves at both ends.

cogo point

Coordinate geometry point.

color table

Each tile in the color palette represents a color in the active color table. An element's color attribute is stored with the element in the design file as a number in the range 0-254. The color table determines the correspondence between the 255 color attribute values and display colors.

color-coded aspect

This command varies triangle color with the direction in which the triangle faces. For example, you could display all triangles facing between N 45° E and S 45° E, or those roughly facing east, with one color, and all other triangles with another color.

color-coded elevation

This command assigns colors to a set of displayed triangles based on their elevation, and is used to evaluate the changes in elevation in a model. A triangle that covers more than one elevation range is divided into closed figures, and each division contains the color for that range.

color-coded slope

This command varies triangle colors based upon the grade of each triangle.

compaction factor

Defines how much the volume of the fill material will decrease after it is placed into the site.

component

A single tangent or curved section of an alignment. Each component in an alignment is defined by a unique set of geometry parameters.

component editor

A tool that lets you assemble arcs, spirals and tangents into a combination of fixed, floating and free elements that form an alignment.

composite

Design which takes into account members made of more than one material.

compound curve

A curve with two or more different degrees of curvature, both in the same direction.

connectivity

Details whether the data in the corresponding row is the first or last point in the extracted profile or cross section, or whether it is an intermediate point. This mode allows you to store centerline and offset data in the same file. Initial data points have a value of 1, final data points 2, and intermediate data point 0.

construction survey

A type of survey performed to enable you to stake out, locate, and monitor public and private engineering works.

continuous span

A unit comprised of two or more spans, which distributes the effective loads more efficiently carrying the moment across the supports.

control survey

The establishment of the horizontal and vertical positions of arbitrary points to be used as a baseline for further collection or location.

contour

A linear symbol representing points of equal elevation relative to a given datum.

coordinate

The location of a point along the X, Y, or Z axis.

corridor

A strip of land connecting and providing a path between two entities.

cover

Distance from the outside top of the pipe to the final grade of the ground surface.

critical depth

Depth of flow in an open channel for which specific energy is at minimum value.

critical flow

The state of flow for a given discharge at which the specific energy is minimum.

critical slope

A slope that causes normal depth to coincide with critical depth.

critical velocity

The velocity of water at critical depth.

cross section

A graph showing surface elevation extracted perpendicular to defined path (such as a centerline). Cross sections can display surface features such as utilities, drainage, and curbs.

crossing segment

Overlapping breakline segments.

cul-de-sac

A circular widening in a road allowing room for automobiles to turn around, often occurring at the end of a dead end street.

culvert

A conduit to convey a stream or runoff through an embankment.

curvature

The rate of change of the unit tangent vector to a curve with respect to arc length of the curve.

cut slope

Original or designed terrain which slopes upward.

DAT

A file format for ASCII data.

D

data types

The different categories of information that can be keyed into the data field of a software coordinate geometry command.

database

A collection of comprehensive informational files having a predetermined structure and organization that can then be communicated, interpreted, or processed by a specific program.

daylight point

The point at which a cut slope intercepts the original surface.

DBA

A file containing DBAccess library information used for generating reports.

decision table

A table consisting of a list of records, each defining a line segment by slope and width, used to model terrain.

default

The predetermined value of a parameter that is automatically supplied by the system or program whenever a value is not specified by the user.

deflection angle

Angular measurement between the extension of a line and another line.

degree of curvature (DOC)

Central angle of a circle which subtends a 100-foot arc and is equal to $18000/(\pi \cdot r)$ degrees where r is the radius of the circle.

Delauney Condition

The criterion that determined which regular points form triangles in a triangulate surface. The condition states that, after all triangles in a surface have been formed, the interior of a circle prescribed by the three vertices of any triangle should contain no other regular point. *The software overrides this condition in the vicinity of breaklines, obscure areas, and edge features so that no triangle side crosses these features.*

delimiter

A character that marks the beginning or end of a unit of data.

DEM

A file that is useful for site location and preliminary engineering. The U.S. Geological Survey collects the data in a grid pattern, with a grid cell size of 30 by 30 meters. This data is available in 7.5 minute topographic sheets from the U.S. Geological Survey for a small fee.

design checks

Tests that can be performed to verify your alignment, superelevation, or turnout design.

design file

A MicroStation file containing graphic and text data.

design speed

Desired vehicle speed that is used to determine roadway design.

design surface

A digital terrain model of a proposed surface. (Compare with original surface.)

diameter

A straight line beginning at a given point of intersection with an arc or circle, passing through the origin, and terminating at the corresponding point of intersection 180 degrees from beginning point.

diamond crossing

Point where two tracks cross without connection. Named after the shape of the track formation which occurs.

diaphragm

Transverse structural member which connects beams and girders for horizontal stability.

direction round

A group of surveying observations taken at a point in time and space.

discharge units

The rate at which flow is discharged.

ditch

A narrow excavation dug along a roadway, typically used for drainage or runoff control.

double slip

Track formation where two tracks cross and are connected across the obtuse angles through interconnecting pointwork. Double slips are expensive to build and maintain and are used only where space is very limited.

drape

The process of vertically projecting elements onto a surface so that the element elevations are defined by the digital terrain model.

drawing file

An AutoCAD file containing graphic and text data.

DTM

Numerical representation of a surface, based on a set of X, Y, Z coordinates (triplets).

easting

A term used in plane surveying that corresponds to the x-position on a cartesian plane.

D

edge

Special case of a breakline. It is structurally the same as an obscure area except that the part of the terrain model that lies outside the edge is treated as "hidden." Only one edge can be defined per model. No triangle sides cross over edge lines.

element

Basic building block of a geometric figure; also completed geometric figures such as lines, shapes, circles, and so forth.

elevation

The height, or Z value, of a point.

elevation bound

A major contour and its associated minor contours that lie between it and the next major contour.

energy grade line

Line graphed along a one-dimensional hydraulic system representing total energy or total head at every point along the system.

event point

A specific, named location along a horizontal or vertical alignment. Event points enable you to indicate significant stations. Some commands that perform a task at regular intervals or at even stations can perform that task also at event points. For example, you can extract cross sections every 50 feet AND at stations corresponding to event points.

expansion factor

Defines how much the volume of the cut material will increase after it is removed from the ground.

expansion joint

Open joint placed between spans to accommodate expansion and contraction of structure.

extrude

Creating a three dimensional representation of girders and beams in a bridge superstructure.

exterior boundary

A closed polygon that defines a region/fence outside of which there exists no valid terrain model data.

fascia

The left- and right-most edge of a bridge slab.

feature

A single instance of a 3D geometric representation in the Digital Terrain Model (DTM). A feature can be one of five types, corresponding to the type of DTM points contained: random, breakline, exterior boundary, interior boundary, or contour. Although features are a new and powerful concept, they are essentially just groups of DTM points -- each group is given a name and assigned a feature style (feature styles control everything about how features gets displayed). The ability to

identify different features by name, to select and edit them using filters and to independently control their display characteristics are benefits of organizing the DTM into features.

feature style

A feature style is assigned to individual features to determine whether points, line segments, or annotation for that feature can be displayed in plan view, in cross sections, or in profiles.

fence

A tool in MicroStation used to select an element or group of elements within the design file.

figure

A sequence of coordinate geometry point numbers that represents an alignment.

file

A collection of logical records stored as a unit.

fill slope

An original or designed surface that slopes downward.

fillet

A stroked arc placed at an intersection of two features.

filter

Defines a selection set of features.

flow

The continuous movement of a fluid.

flow rate

The quantity of fluid flowing per unit of time.

footing

Part of a bridge substructure that transfer loads from the columns or piles to the subsoil.

forced balance

An adjustment that is made to the End-Area volume calculation that defines when cut and fill volumes are forced to balance out (to a zero net) by a given station.

foreslope

The segment of the ditch between the hinge and the ditch bottom.

forward tangent

The tangent exiting a curve.

friction factor

The maximum coefficient of friction that can be assumed between the tires and the road at the design speed.

GEO

A file type containing a data record for input to HEC-RAS.

geodetic surveying

That type of surveying that takes into account the true shape of the earth (a sphere). See also plane surveying.

geometry project

A collection of horizontal and vertical alignments, superelevation, and coordinate geometry information, saved as an ALG file.

geometry style

A set symbology assigned to geometry points, lines, arcs, and spirals. Geometry styles are defined through the Geometry Style Manager.

girder

The primary longitudinal structural member of the bridge superstructure that transfers the loads from the bridge deck to the abutments and piers. Also could be referred to as beams or stringers.

GIS

A file type generated by HEC-RAS.

grade contour

A path that traverses a triangulated Digital Terrain Model (DTM), ascending as steeply as possible without exceeding a specified maximum slope.

gridded model

A grid of evenly spaced points laid out over the terrain model, taking the elevations from the triangles on which these points fall.

gutter

A pavement gutter is defined as the section of pavement next to the curb, which conveys water during a storm runoff event.

haunch

Space between top of beam and bottom of slab created by the difference in vertical profile of the two members. Also could refer to an additional depth of a beam or girder at a support.

hinge

(1) One of two points on a template that define the backbone of a template. (2) In bridge design, a splice location where structural beams or girders are mechanically joined in the field.

horizontal distance

The distance between two points computed using only the northing and easting coordinates of the points.

host file

The file that is created by execution of the Plan and Profile Generator command. It is created by copying the Seed Host File, and contains all information pertaining to the location and rotation of plan and profile views, as well as the border or reference file, and the north arrow.

hydraulic grade line

A line drawn along a one-dimensional hydraulic system depicting potential energy expressed as position plus pressure head at all points along the system.

hydraulics

The branch of science or engineering which treats water or other fluid in motion.

hydrograph

Graphical or tabular representation of flow rate with respect to time.

hydrographic surveying

Surveying bodies of water for the purposes of navigation, water supply, or below water construction.

hydrology

The science dealing with the properties, distribution, and flow of water on or in the earth.

ICS

An Intergraph Corporation software product, Interactive Coordinate Geometry Subsystem and its associated file type. An ICS file contains cogo-related commands that can populate a geometry project when imported into the Civil products.

IDF

An Intensity-Duration-Frequency table file used by the Storm & Sanitary product.

INI

A preference file that contains the control settings of all the dialog boxes within the product.

inlet

Surface connection to a tile drain; structure at the diversion end of a conduit; upstream end of any structure through which water may flow.

INR

A binary point file used to import and export geometry data including horizontal and vertical alignments, event points and cogo points.

IGRDS

A cross section based file used for road design. The American Association of State Highway Transportation Officials (AASHTO) sponsors this type of file format, which is abbreviated as

IGRDS. IGRDS produces three files that define a digital terrain model: a random point file, a breakline file, and an exterior boundary file.

interactive mode

Input and output performed at the keyboard of a terminal; the process of sending one command at a time to the computer.

interior boundary

A closed polygon that defines a region/fence inside of which there exists no valid terrain model data. Also referred to as obscure areas or *void* areas.

interval

A measured distance between two entities.

inverse

A distance and direction based on two given cogo points.

invert elevation

The lowest point on the internal diameter of the pipe.

isopach

A surface containing data derived from two other surfaces. The isopach data is obtained by subtracting the elevations in one surface from those in the other surface.

justification

The position of an element (such as text) relative to its origin.

key point

One of the cardinal points along a horizontal or vertical alignment. These include PC, PT, PI, PVI, PVC, PVT, SC, CS, TS, and ST.

land survey

The type of survey which determines the length and direction of landlines and establishes the position of these lines on the ground.

layers

A logical grouping of data that are like transparent acetate overlays on a drawing that can be viewed individually or in combination. Used in AutoCAD.

leader

A graphic element used to lead the person's eyes from an element to a word or number.

least squares transformation

A two-dimensional conformal transformation that retains the true shape of the body of points.

legend

An explanatory caption or box that contains important information to a graph or drawing.

levels

The MicroStation design place consists of a multilevel design structure. Elements can be organized in any fashion of 63 levels, although no element can span two levels. Only one level can be active at a time, but any combination can be displayed or removed from the screen. The active level is always displayed.

linestring

An open graphic element composed of up to 100 line segments connected at the vertices.

longitudinal slope

The slope along the length of the linear path (e.g., a gutter parallel to the road centerline).

lot

An area of land having fixed boundaries.

LST

A WSPRO output file type.

macro

A software program that automates an often used, usually short sequence of operations.

major contour

The primary elevational line indicating a specific elevation in a surface model. Usually major contours are drawn with a heavier line weight or using a different color. Elevation text labels are usually drawn in association with major contours.

manhole

A hole through which an underground structure, such as a sewer, can be entered.

mass haul diagram

A diagram that shows a cumulative total of cut and fill volumes along a horizontal alignment. The diagram is a tool for measuring how much material is being added to and removed from the design site along a given path or roadway.

material table

A table that defines different cut-slope values for different surface materials. Every DTM can be assigned a surface material.

metric system

A decimal system of weights and measures based on the meter and on the kilogram.

MHD

A mass haul data file usually created with the End Area volume command, and necessary for generating mass haul diagrams.

minor contour

A secondary elevational line indicating a specific elevation in a surface model. Minor contours are often drawn without special color or weight indexing and without elevation text labels.

mismatched elevations

A condition that occurs when breaklines cross at different elevations. You can view mismatched elevations using the View Surface > Crossing Segments command.

model file

A file that contains plan view information to be referenced by the plan and profile sheets. The concept is the same as a MicroStation reference file.

moisture density control (MDC)

A type of excavation necessary if the material in the existing ground is unsuitable as a foundation for the road due to the fact that it may not drain well, it may be slippery, or it may be difficult to compact. This is existing material that must be removed, not for cut reasons, but so that it can be replaced with dirt of acceptable quality.

movie mode

A mode in which you can view in succession each cross section in an entire set displayed for a specified time.

multicenter curve

One-center, two-center, or three-center compound curves. A return created with either 1, 2, or 3 curves.

nadir

The lowest point, that is, the point opposite the zenith.

network

A graphic representation of a drainage system.

network profile

A scaled graphic representation of specified drainage structures, the hydraulic grade line (HGL), and a cross section of the pipes at junction structures.

nontangency

Exists when a circular component is not tangent to adjacent elements.

normal depth

Depth of uniform flow for given conditions.

northing

A term used in plane surveying that corresponds to the y-position on a Cartesian plane.

obscured area

Special case of a breakline. The first and last points are either equal or connected by a line segment. Any part of the terrain model that lies inside the closed polygon defining an obscured area is treated as "hidden." No triangle sides cross over the polygon defining an obscured area.

offset

The distance perpendicular to an alignment or established course, denoted as minus left and positive right.

open alignment

An alignment in which the first and last PIs in the alignment do not have the same x, y, z coordinates. Both horizontal alignments and vertical alignments may be open.

order

The sequence in which a particular annotation will appear when displayed with a cross section or profile.

original surface

A surface representing the terrain as it exists prior to construction. (Compare with design surface.)

OUT

A HEC-2 output file type.

outfall

The discharge end of drains and sewers.

Outlet

Point of water disposal from a stream, river, lake, tidewater, or artificial drain.

overhang

Normal distance from the centerline of the outside fascia girder beam to the edge of the slab, or slab fascia.

pad

A "footprint" that can represent a parking lot, building, or retention pond or some similar planar surface.

PC

Point of curvature on an alignment; the point where the curve begins.

peak flow

The maximum flow rate of water through a specified size pipe.

pen order

The sequence of pen up/pen down control information in the ASCII file. If the pen order is set to One then Zeroes, a 1 in the last column in the ASCII file represents the beginning of a line, and 0 represents points on the line. The opposite is true of the setting Zero then Ones.

perimeter

The outermost edge of a terrain model.

photogrammetric surveying

Uses the principles of aerial and terrestrial photogrammetry, in which measurements made on photographs are used to determine the positions of photographed objects.

PI

Point of intersection between two line segments on a traverse. PIs can be either horizontal PIs or vertical PIs.

pier

Part of the bridge substructure which supports the superstructure at intermediate points between the abutments. Sometimes called interior bents.

pier cap

The actual top of the pier or interior bent, on which the longitudinal members of the bridge superstructure rest.

pipe

A hollow cylinder used to convey stormwater toward a receiving stream.

planar area

The area covered when the surface is projected onto a horizontal plane.

plane surveying

That type of surveying that ignores the physical shape of the earth (spherical), or where the mean surface of the earth is considered a plane (flat).

planimetric

Relating to the horizontal position of a feature or element, without regard to elevation. Also refers to graphics that are typically seen in a top view as opposed to a profile or cross section view.

plate girder

Steel plates consisting of a top flange, web and bottom flange welded together to form an I-Shape.

point density

The density of triangle vertices along the feature when the surface is triangulated.

point file (XYZ)

A file storing randomly spaced data points (x, y, z triplets). The file is normally assigned an extension XYZ and is also known as a XYZ file.

point fixity

Defines whether a point is fixed or normal.

positional tolerance

Specifies the smallest distance that geometry commands use to check alignment continuity.

preference

Settings for a particular dialog box. Preference settings can be saved and recalled later.

profile

A graph showing elevation extracted from one or more surfaces along a defined path, such as along an alignment.

project

A collection of surfaces, geometry projects, template libraries, roadway libraries, and preferences files, all identified in a single file with an RWK extension. The project file allows you save a group of files (those specified in the RWK) all at once.

Note the distinction between a project and a geometry project – a project can contain one or more geometry projects.

property survey

The type of survey which determines the length and direction of landlines and establishes the position of these lines on the ground.

PT

Point of tangency on an alignment; the point where the curve ends.

query

A method of retrieving information from a database by specifying various search criteria.

radius

The length of a line joining the center and a point of a circle or sphere.

random

One type of point used to define a digital terrain model. Random points are discrete points that have no relation to other points. They are sometimes referred to as *regular points*, *spot heights*, or *mass points*.

region

A tool used in AutoCAD to select an element or group of elements within the drawing file.

regression analysis

A method in which a best fit line or arc is developed through a series of points.

regular point

A set of X, Y, Z coordinates (triplets) representing a point on the terrain model surface. There is no implied relationship between regular points. Also called random points.

reverse curve

Connected curves that change hand.

rollover

The difference in slope between the road and the shoulder during superelevation.

roughness coefficient

A factor in some flow equations that represents the effect of channel or conduit roughness on energy losses in the flowing water.

route surveying

The control, topographic, and construction surveys needed for the location and construction of lines of transportation or communication such as highways, canals, transmission lines, and pipelines.

RPT

An ASCII report file.

RTC

A Rainfall/Time of Concentration table file.

running speed

Typically from 83% to 100% of the design speed.

runoff

The amount of precipitation that is carried off from the area on which it fell to some specific location (for example, the amount of precipitation that reaches a stream, culvert, or catch basin).

runoff coefficient

A dimensionless proportionality factor used to account for infiltration and evapotranspiration.

RWK

A project file containing the paths to the surfaces (DTM), typical section libraries (TML), coordinate geometry projects (ALG files), roadway libraries (RWL), and preference files related to a particular project. Note the distinction between a project and a geometry project – a project is a higher-level concept than a geometry project. A project can contain one or more geometry projects.

RWL

A roadway library file, containing roadway modeling definitions. This file stores station and typical section information used by the Roadway Modeler command to create surface models along a horizontal alignment.

scale factor

A factor used to resize an element.

screed

Tool or machine used to strike the top of the concrete in a profile, usually between two points.

SDB

A Storm & Sanitary drainage database file. An SDB file stores information about project pipes, manholes, culverts, inlets, and other drainage items.

SE

An ASCII profile file containing station and elevation information.

segment

A portion of a typical section, such as a template or a decision table, defined by slope and width.

setback

A determined distance from the front, left, right, and/or back side of a lot that defines where property can be developed within the lot.

side slope

The embankment of a design surface. In a pad, for example, the side slope extends from the footprint to the toe of slope (or top of slope). In a roadway model, the side slope typically extends from the hinge.

simple span

Bridge design which considers each span as an independent unit with no load transfer between spans and no moment transfer between beam and support.

sit

The intersection of the tangents of the spiral.

skew

Angle of difference between the bearing of the reference line and the bearing of a construction line placed normal to the alignment; usually less than 90 degrees.

slab fascia

Defines the outside edge of the slab.

sleeper

A transverse member of trackwork, made of wood, concrete or sometimes steel, used to secure rails at the correct gauge. In the US, sleepers are known as *ties*, short for *crossties*. Cast steel chairs fixed to the sleepers hold the rails in place by means of clips or keys.

slope distance

The distance between two points computed using the northing, easting and elevation coordinates of the points.

slope stake

The point where a designed surface slope intersects an original surface.

SOE

The ASCII file used by the cross-section annotation command to specify points by station, offset, and elevation.

span

Describes the length of one segment of a bridge structure usually measured from centerline to centerline of abutments or piers.

SPI

The point of intersection of the shifted circular curve.

spiral in

A transition spiral with decreasing radius; that is, going from a line to a circle.

spiral out

A transition spiral with increasing radius; that is, going from a circle to a line.

splice

Point in which two like or unlike beams or girders are joined mechanically.

spread

The maximum width (spread) of water in the gutter just before it reaches an inlet.

spot heights

Similar to regular points. A distinction is made in input and display options to establish the special nature of this feature. Usually spot heights represent local minimums or maximums in the terrain.

station

The length of an alignment along a path from the starting point to another point on the alignment, measured in the horizontal plane. Also referred to as chainage.

station equation

The point along an alignment at which the stationing is redefined. Also referred to as an *inequality point*. Station equations may be either *gap*, where the outgoing stationing is larger than the incoming stationing, or *overlap*, where the outgoing stationing is less than the incoming stationing.

steady flow

Flow characteristics do not change with respect to time.

stiffener

Steel plates that are welded onto beams or girders to help strengthen the web against buckling.

stripping

An adjustment that is made to the End-Area volume calculation that defines the volume of topsoil that is removed or stripped along an alignment.

style

See Geometry Style or Feature Style.

subcritical flow

Depth greater than normal depth and slower velocity than critical velocity.

substructure

Typically the portion of the supporting structure from the top of the support to the top of the foundation.

supercritical flow

Depth less than normal depth and faster velocity than critical velocity.

superelevation

Banking applied to curves in the horizontal alignment to help offset centrifugal force.

surface

Environment; a section of virtual memory that contains all information related to one digital terrain model surface.

superstructure

Considered to be the portion of the bridge structure which extends from the top of the slab to the bottom of the beams.

symbology

A set of properties (such as color and line style and line weight) that define what an element looks like when it is displayed.

tabling

The placement of horizontal course data for curves and tangents into a table versus on the drawing and elements themselves. Defines the prefix and seed numbers for line, circle, and spiral tabled annotation.

tag

A nongraphical element that can be attached to and give meaning to graphics.

tailwater

Water leaving a storm sewer or culvert.

tangent

A linear component, or straight section, of an alignment.

target surface

A surface into which point or triangle data from another surface will be added.

TBR

A toolbar file that allows the import and export of customizable toolbars from one user to another.

D

template

A cross section of the design surface showing special features such as (in the case of a road design) the median and drainage ditches. Templates can be saved in the typical section library.

template library

A file that stores definitions for templates, cut and fill tables, material tables, and decision tables, and transition control features.

text scale factor

Defines the scale factor to be multiplied by the defined text size at placement in the graphics file. For example, if you used a text scale factor of 1.5 and your original text height was 10, all text would have a default height of 15.

thin

A process by which unnecessary (redundant) random points are removed from a surface, based on tolerances set in the command before activation.

throat

Constricted flow area in a hydraulic structure.

time of concentration

Time required for water to flow from the most remote point of a watershed to the outlet.

TIN

Triangulated Irregular Network. A surface created from a set of 3D triangular planes. The triangular planes are created based on the Delauney Condition.

TML

A typical section library file.

toe of slope

The computed point where the side-slope of a designed surface meets the existing surface.

tolerance

A value that specifies the leeway for variation from a standard.

toolbar

A customizable palette of command buttons offering quick access to various commands. Toolbars can be organized to represent specific workflows. There are standard toolbars and user-definable toolbars.

topographic map

A map that indicates the configuration of the terrain and location of natural and man-made objects.

topographic survey

A survey made to obtain data from which a topographic map can be made.

tracking

Dynamically displays the northing and easting coordinates of the cursor location, as well as the surface elevation, slope, and aspect.

transposed figure

A coordinate geometry figure in reverse order.

traverse

A collection of straight or tangent elements used to define an alignment.

tributary

A stream that feeds or flows into or joins a larger stream or a lake.

trickle

The path of a drop of water down a selected DTM surface or up the surface to the water source.

trim

Removing a portion of a non-random feature, based on the intersection of that feature and a specified element, known as a cutting element, which defines where to clip the feature.

true area

The total area of all triangular facets in the surface.

TTN

Topological Triangle Network. A file that contains all the input terrain data and the resultant triangle network generated by the software. The data includes information about each triangle and its neighboring triangles, the vertical scale, Z base, multiplier, and other information. A TTN file also stores information about the design plane of the DGN file; therefore, its usability is restricted to design files with similar units.

turnout

A file that stores templates, cut/fill tables, material tables, decision tables, and transition control definitions.

typical section library

Trackwork where a single track splits to become two tracks and equipped with moving rails to change the route. Also referred to as *points* in the UK and a *switch* in the US.

utility

Linestrings or complexed elements draped over a surface to represent utilities such as gas, cable, or telephone lines.

VDF

View Definition File. Stores information about the views contained by the plan and profile sheets and how those views are displayed in the sheets. This file is created by the Plan and Profile Generator command.

vertical correction

The amount of deflection required to match the profile of the beam to that of the slab used to minimize haunch.

vertical scale

A scaling factor that exaggerates the vertical scale of graphics when they are drawn.

volume

A calculation of the volume between two surfaces. Volumes between surfaces are reported in terms of cut and fill. See the Evaluation > Volumes commands.

volume exceptions

An adjustment that is made to the End-Area volume calculation for areas where volumes are not calculated, such as a bridge. No fill material is required under a bridge, so it is not necessary to compute fill volume there.

WSP

A data record file for inputting to WSPRO.

XSC

An ASCII custom cross sections file.

XYZ

A file storing randomly spaced data points (x, y, z triplets). The file is normally assigned an extension of XYZ and is also known as a XYZ file.

Z Base

The location, in working units, of the elevation base of a 3D design. It is also called the Z origin.

zenith

The highest point, that is, the point opposite the nadir.

zoom factor

Used to change the magnification of the view. Enter a value greater than 1.0 to zoom out from the cross sections. Enter a value less than 1.0 to zoom in toward the cross sections.

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