Chapter 1: Introducing Roadway Modeling

Chapter Overview
The chapter addresses the following topics:
- How Roadway Modeling Works in InRoads
- Opening and Exploring Typical Section Libraries
- Modeling a Road using Express Modeler
- Be able to effectively Manage the newly-created surface(s)

Section 1 - Roadway Modeling Overview

Typical vs. "Deviations from Typical"

Proposed Roads, in the "real world," tend to be specified by a relatively small number of "typical [cross] sections" along a horizontal and vertical alignment. These "typical sections" are not "universal" sections as there inevitably exists engineering details that deviate from the "typical" section. Solutions to these "deviations from typical" are generally not explicitly spelled out by the specification documents, but are left to "best engineering practices."

These "deviations from typical" may be
- easily "definable" like lane additions, drops, and transitions,
- independently controlled like ditch bottoms, or
- irregular or "not easily definable" like curve returns and match points.

Modeling Roads in InRoads is similar in that Roadways are defined by Typical Sections "dropped" along a horizontal and vertical alignment. "Deviations from Typical" are handled in a number of ways. The easily definable and independent controls are handled well from within the InRoads Roadway Modeling functionality. The irregular details are often better handled by the InRoads Surface Editing functionality.

InRoads Roadway Modeling is a bulk process that parallels the corridor specification process. The primary advantage (other than raw power) of using the Roadway Modeling tools to model corridors rather than "manual" tools is repeatability. Anything that is defined in the "Roadway Definition" can be repeated at the push of a button. In the event of a change to the roadway engineering, manual edits typically must performed again essentially from scratch.

There are number of questions about how to model the "deviations from typical." Do the deliverables require details of this deviation? Will the "details" ever show up on Production Sheets? If so, should they be incorporated into the Roadway Definition or should they be modeled "manually?" It often takes less time to "manually" (using the Surface Editing tools) define some deviations such as start and end of the alignment and/or intervening intersections rather than defining the "deviations" within the Roadway Definitions. One-button Repeatability, however, is lost.

Roadway Modeling in InRoads

Let's take a look at how InRoads models roadways (or "corridors"). InRoads, again, uses the "real world engineering workflow" as the model for its implementation.

InRoads uses a Typical Section Library and a Roadway Library to define "Roadways." In its simplest form a "Roadway Definition" is a list of Typical Sections and the Station they first occur.

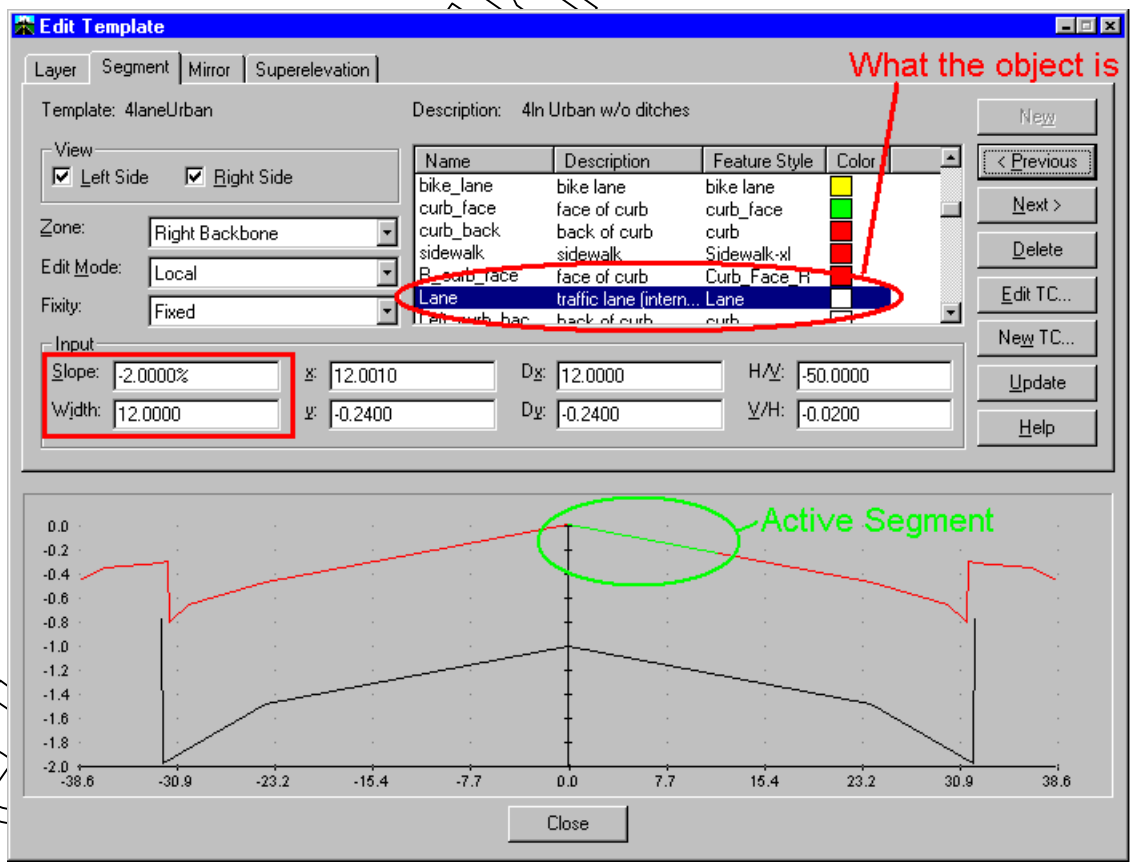
A simple road may be defined by a single "typical section" along the entire length of an alignment. If a road has a transition from two lanes to three lanes, its Roadway Definition will include the starting two-lane template, the Station of the start of the transition to three lanes and the Station of where the transition to three lanes is complete. Roadway Definitions also can contain considerably more detail, such as how the side slopes are computed and how typical sections are constrained by independent controls.

InRoads Typical Sections

An InRoads Typical Section represents engineering objects offset horizontally and vertically from the attachment point of the Section, which is often the Profile Grade Line of an alignment (a 3D point determined by the horizontal and vertical alignment).

InRoads Typical Sections or "templates" consist of one or more named layers representing pavement or earthwork layers such as finished grade, subgrade or sub-base. One of these layers usually is designed to tie in to a target surface.

Each typical section layer contains a number of Segments which have a Slope, Width, and an "object" Name, as shown below:



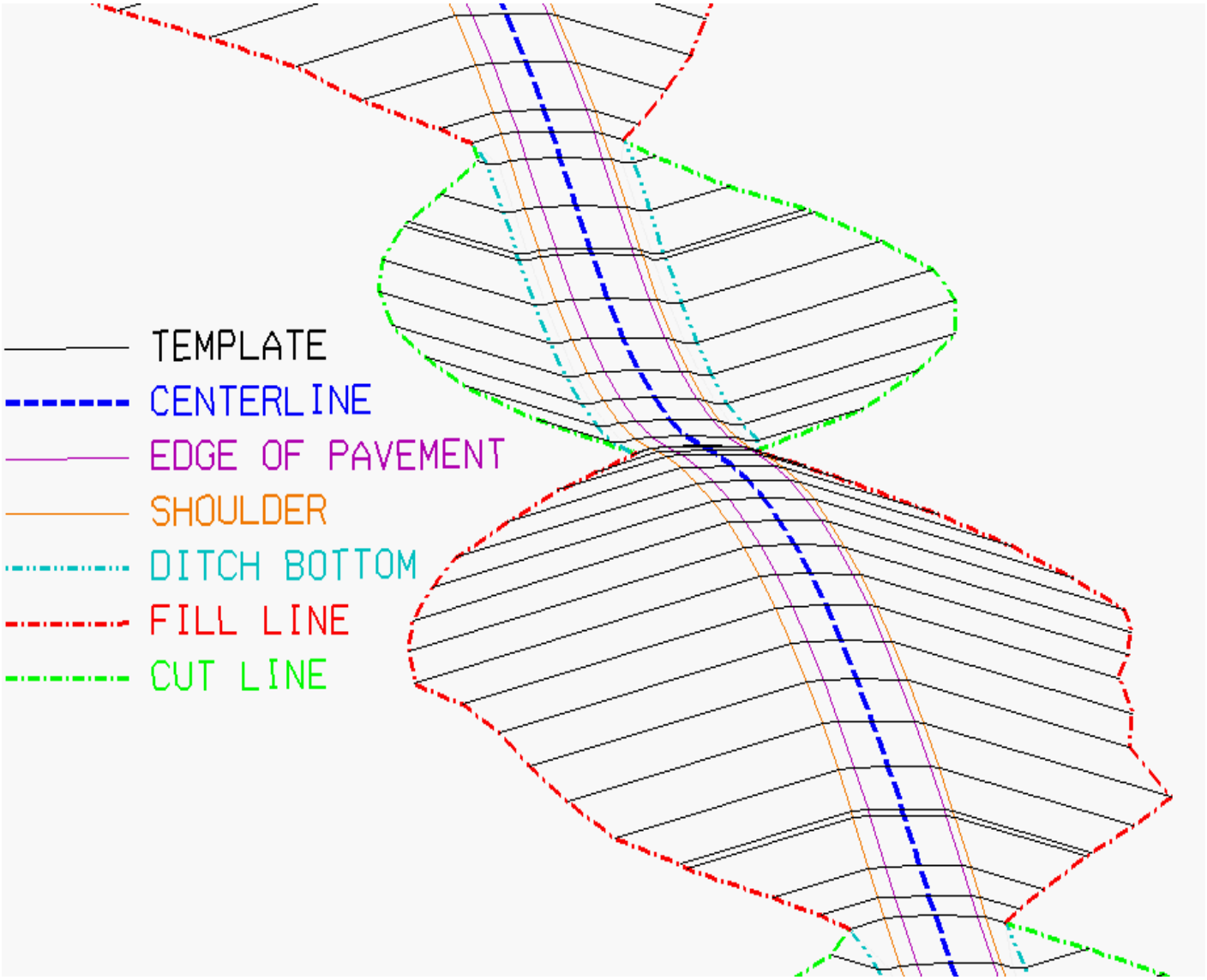
"Dropping Templates"

"Dropping Templates" is a term that is used to describe how InRoads models corridors. The cross-sectional information (object and location) defined in the typical section is placed at user-specified intervals relative to a horizontal and vertical alignment.

Surface Features are named, intelligent 3D objects stored within an InRoads DTM and are the perfect mechanism to store the intelligent 3D information defined by dropping templates.

The two commands used to "drop templates" or Model Roadways, Express Modeler and Roadway Modeler, create a surface for each layer in the Typical Section and create Features defined by each segment in the typical section.

The screenshot below shows a front view of "dropping templates" for a typical section containing a single layer. The black lines represent templates dropped along a horizontal and vertical alignment at a user-specified interval. Features are created between similar segments of adjacent template drops.

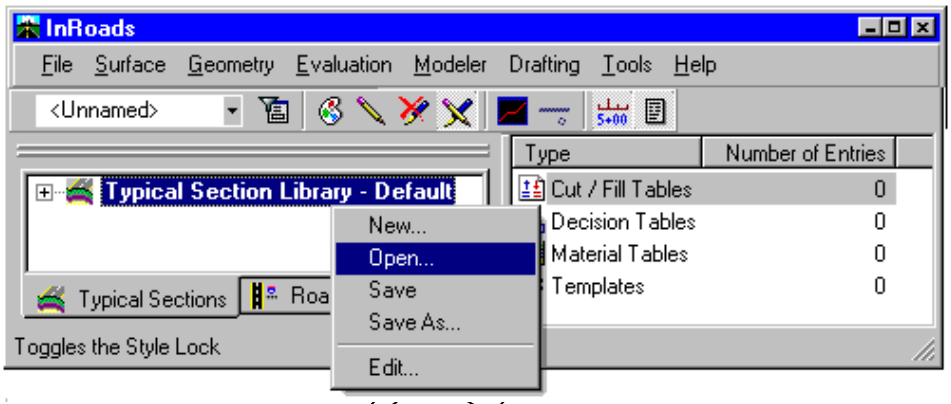


The result of this Roadway Model is a surface named "finished_grade" containing 3D Centerline, Edges of Pavement, Shoulders, Ditch Bottom, and Cut and Fill line Features. This surface is like any other InRoads surface: contours can be displayed; Profiles and Cross-Sections can be cut; etc.

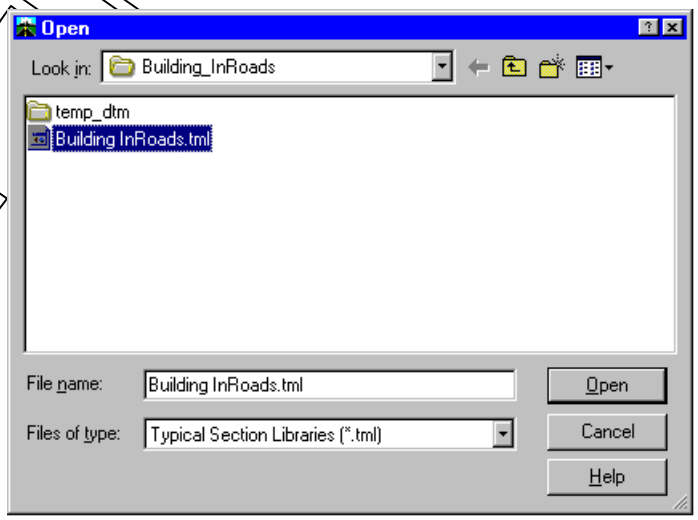
Section 2 - Exploring Typical Sections in a Library

Loading the "Building InRoads" Typical Section Library

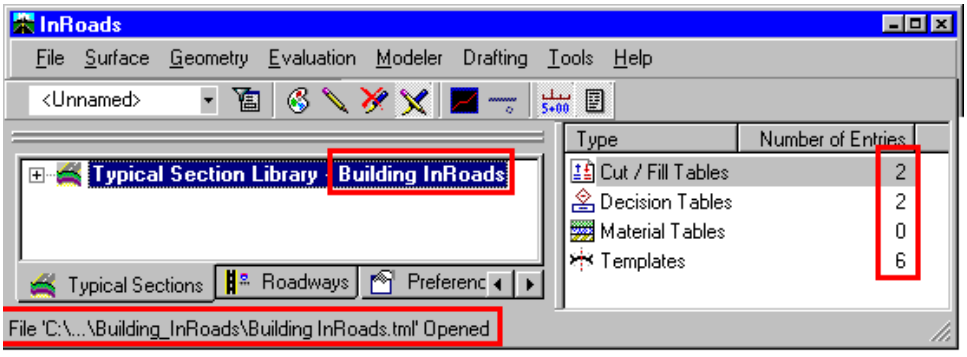
1. Select the Typical Section Library tab in the InRoads Explorer.
2. Right Click on the Typical Section Library object.
3. Select Open.



4. Select "Building InRoads.tml" in the project directory.
5. Hit Open.
6. Close the form.



Feedback:
Upon successfully opening the Building InRoads Typical Section Library, "Building InRoads" is displayed in the Workspace pane and in the feedback pane the Number of Entries reflects the contents of the library.

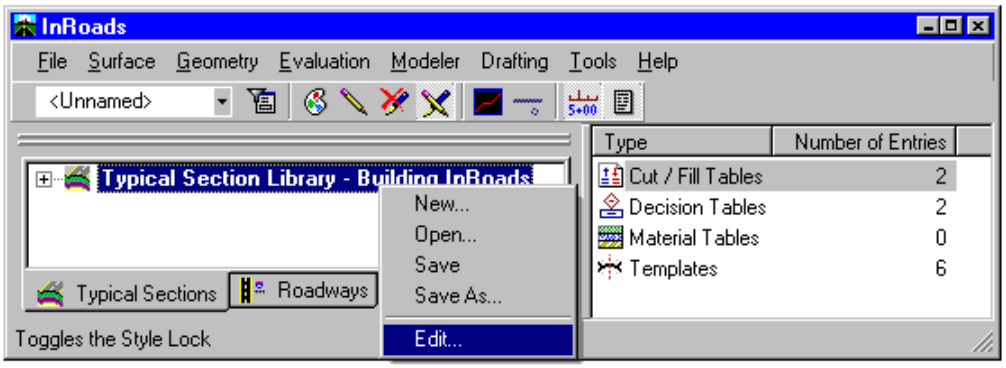


Explore the Typical Section Library

7. Select InRoads>Modeler>Define Typical Section

or

8. Right-Click on the Typical Section Library object in the InRoads Explorer
9. Select Edit...

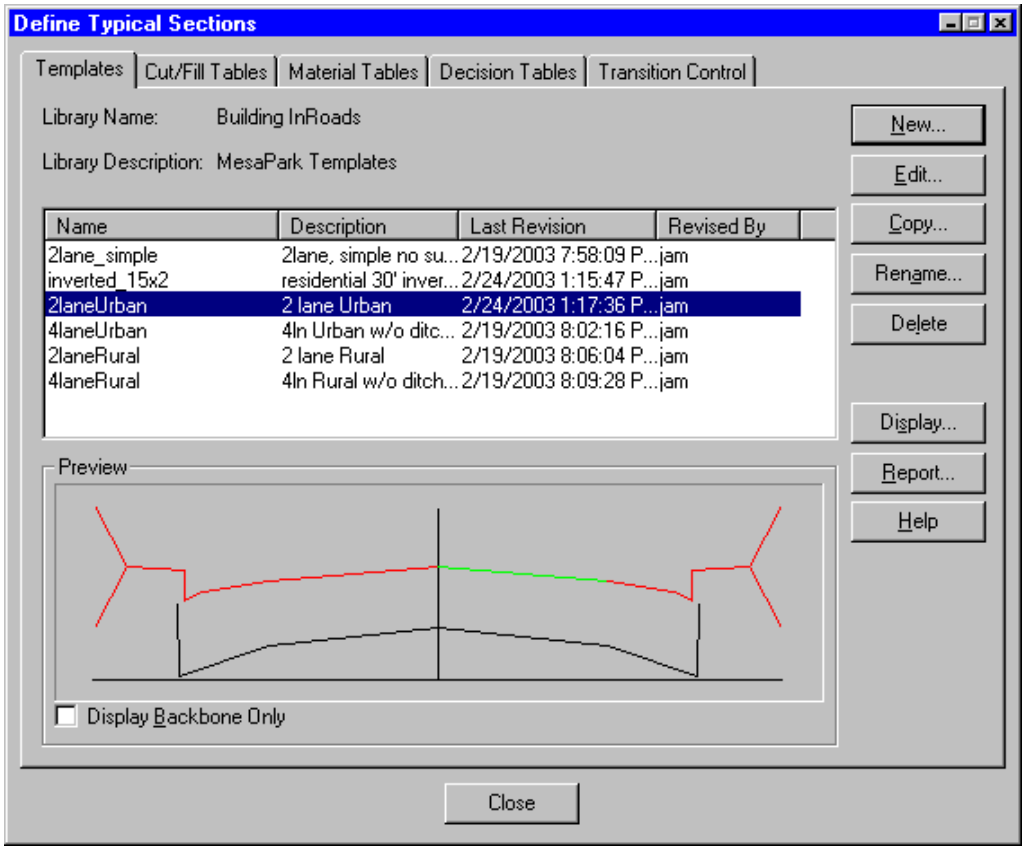


This launches the Define Typical Sections form, which is the primary interface for editing Typical Sections (Templates), Side Slope treatments and Typical Section segment names.

The Template tab lists all the Typical Sections in the library.

10. Double-click on a template

(or select a template, then hit the "Edit" button).

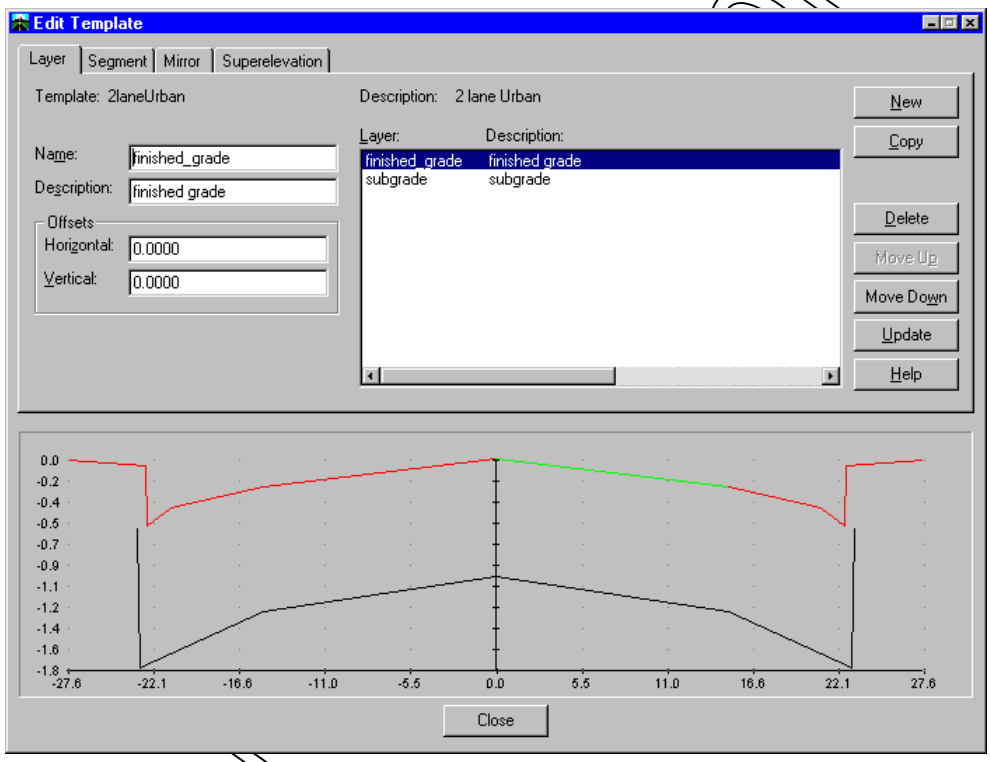


Reviewing Template Information

The Layer tab is used to select which template layer to edit. Note that the "active" template layer graphics are red, with the active segment shown in green.

Select "finished grade."

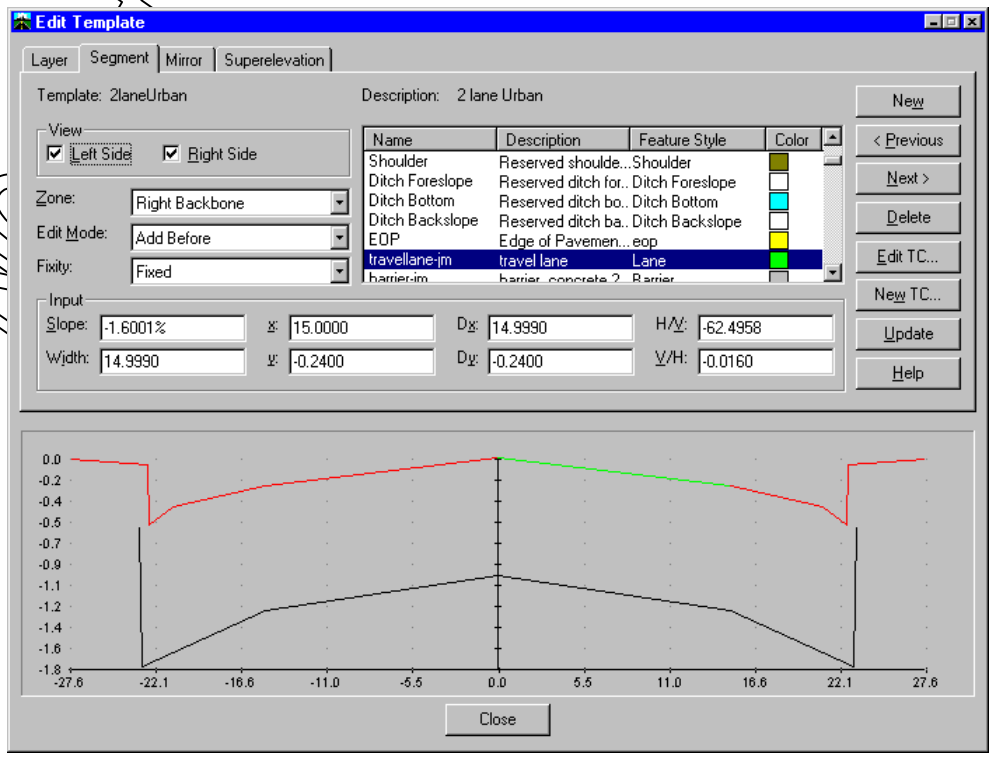
Select the "Segment" tab.



Information is shown for the active segment, highlighted in green.

The Next and Previous buttons can be used to move to adjacent segments.

The Zone listbox is used to select which part of the templates is "active" for editing (Left and Right Backbone, Cut and Fill).



Items of particular importance are the Slope, Width and Name of each segment. The Name and associated Feature Style determines the Name and Style of the surface feature created during Roadway Modeling.

Using the Edit Template functionality, take a look at the various Templates contained in the template library.

Section 3 - Modeling a Roadway using Express Modeler.

Express Modeler is a simple, limited subset of the full "Roadway Modeler" functionality. It is available in InRoads Site, whereas Roadway Modeler is not.

Pre-requisites:

Before creating a new roadway surface the following data are required:

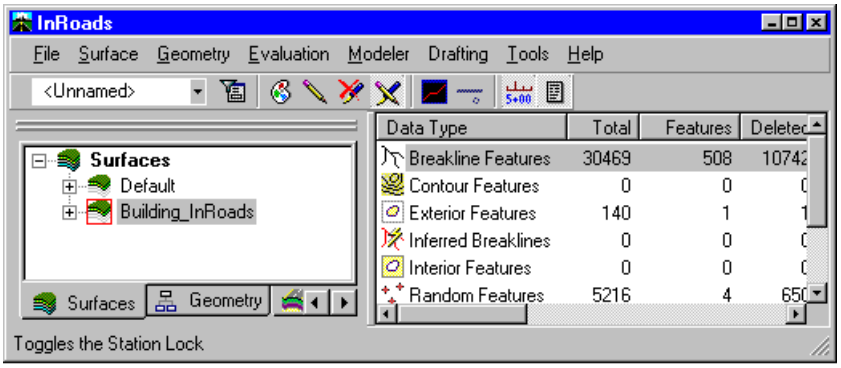
A horizontal alignment with a vertical alignment.
A typical section.
A target surface (if intercepting a surface with cut/fill slopes).

11. Make sure the geometry project, the existing surface, and the typical section is loaded.

Running Express Modeler

Anticipate:
Express Modeler will create at least one surface (one surface per Typical Section layer) along an alignment. We can expect feedback in the Explorer reflecting creation of new surfaces. We can also expect graphics to be created along the alignment.

12. For feedback, select the Surfaces tab in the InRoads Explorer.
13. Fit the CAD window around the alignment which will be modeled.
14. Erase all CAD graphics.



15. Select InRoads>Modeler>Express Modeler

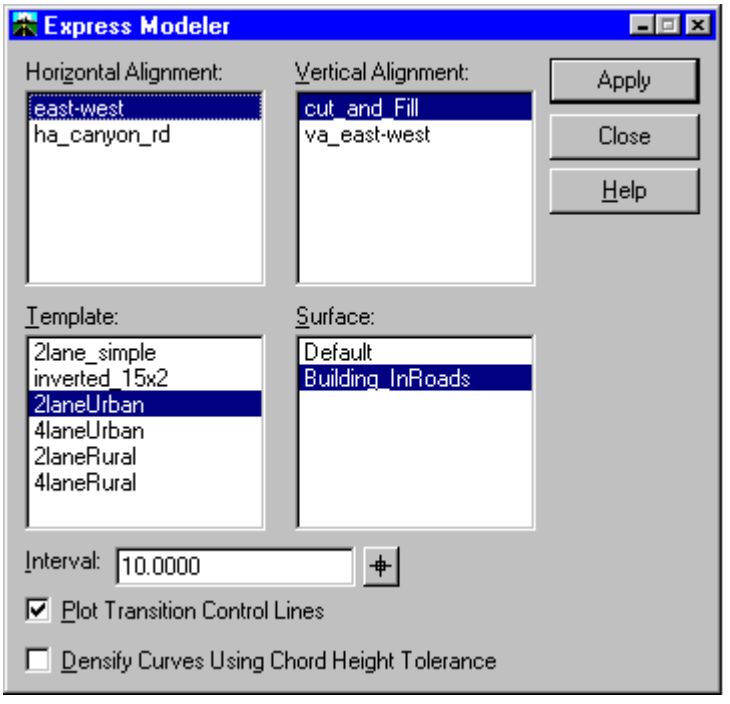
To model a proposed roadway InRoads needs the following information

Horizontal Alignment
Vertical Alignment
The Template to drop, and
The [Target or Intercept] Surface.

The Interval is the distance between "template drops."

"Plot Transition Control Lines" displays the newly-created Features upon completion of the Modeling.

"Densify Curves Using Chord Height Tolerance" will drop additional templates along curves so that the Chord Height Tolerance (the "maximum

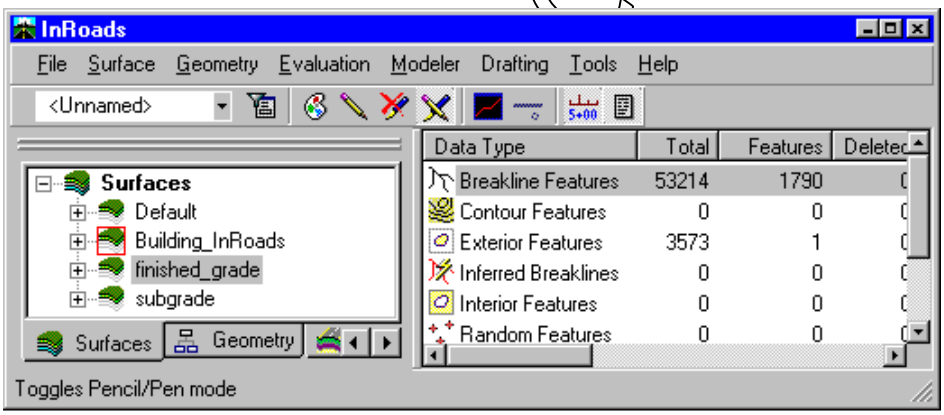


the Chord Height Tolerance (the "maximum error" set under InRoads>Tools>>Tolerances).

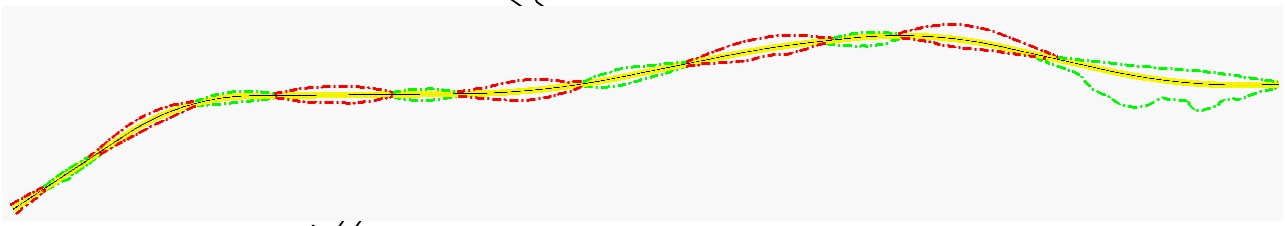
If any of the Listboxes in the Express Modeler is blank, the corresponding file (Geometry, Typical Section Library, or Surface) is not loaded.

16. Select the Horizontal and Vertical Alignments, Template and intercept Surface as shown above.
17. Hit Apply.

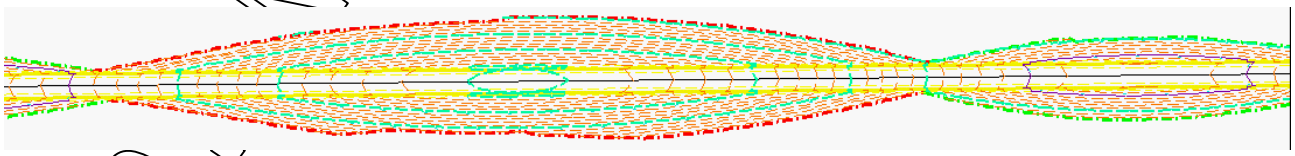
Authenticate:
The InRoads Explorer should reflect the new surface(s).



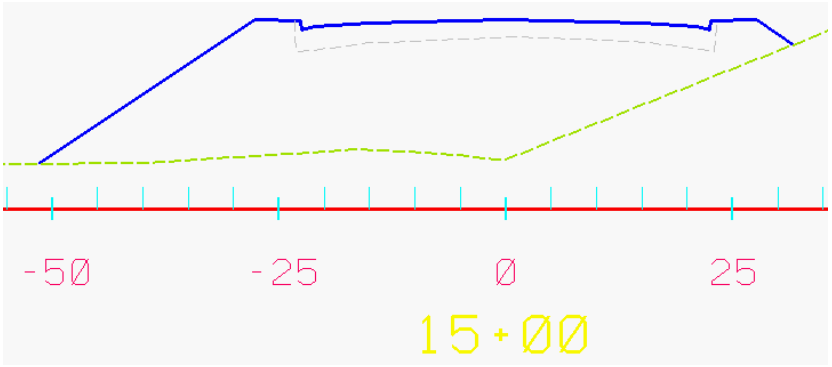
CAD Graphics of the Surface Features should be created.



Additional Authentication Steps:
Display Contours of the Proposed Surface



Create Cross Sections of the Proposed Roadway.



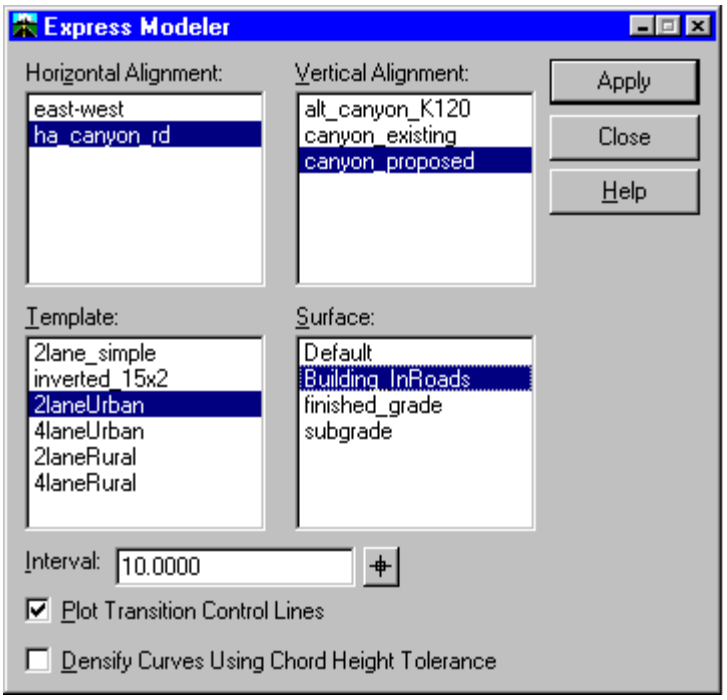
Section 4 - Managing the Newly Created Surfaces

Safeguarding Surfaces

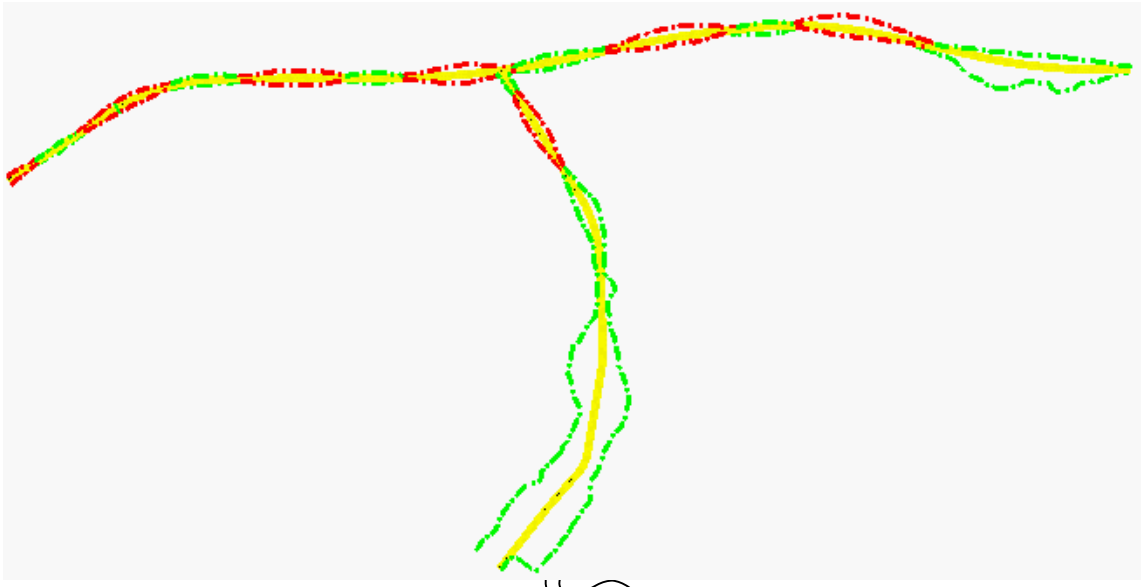
Express Modeler and Roadway Modeler create Features in surfaces with names equal to the Typical Section layer names. If no surface with that name exists, it creates the surface. If a surface already exists with the same name as the Typical Section layer name, the surface information is overwritten.

If we were to use Express Modeler again, this time using "ha_canyon_rd" as the active alignment, Express Modeler would create a proposed road along Canyon Road. If we did not safeguard the proposed roadway surface along "east-west," InRoads would overwrite the surfaces and we would lose the "east-west" information.

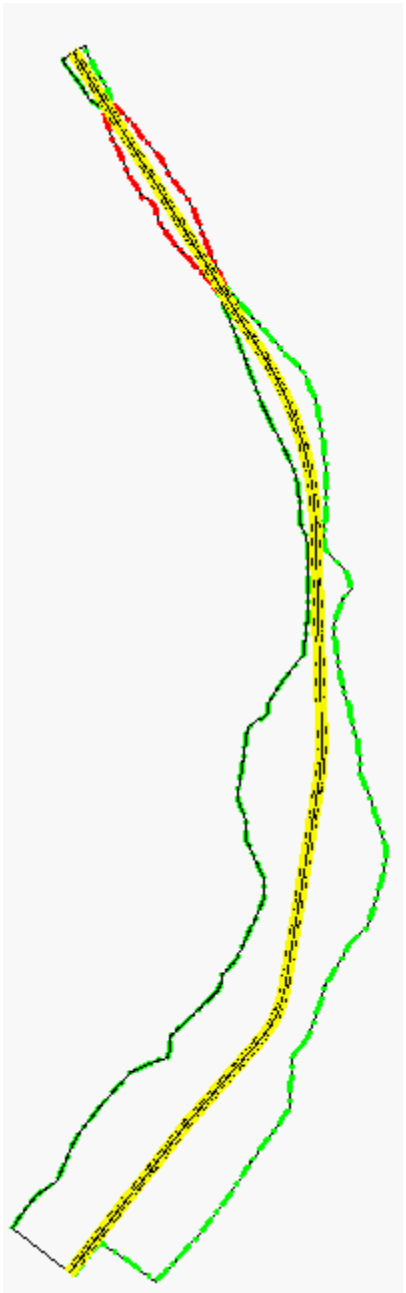
For example, if, immediately after running Express Modeler along "east-west" we were to designate "ha_canyon_rd" and hit Apply, we would get the result below:



This looks reasonable, but look closer.



Deleting the graphics and redisplaying the "finished_grade" features, however shows the real story: the information along east-west no longer exists!



Good technique suggests that the first task upon verifying that the Express Modeler or Roadway Modeler command completed successfully is to Manage the new Surfaces.

So how do we manage proposed surfaces?

Surface Management Techniques

Overriding Philosophy on Managing Surfaces: Take advantage of the InRoads and Operating System's ability to explicitly document the information you need to keep large projects manageable. Engineering is an iterative process. You want to be able to differentiate between portions of a project as well as between iterations of the same portion.

Some important steps to Managing surfaces include:

1. Give the Surface an Appropriate and Explicit label (internal name).
2. Save the Surface with an Appropriate and Explicit filename.
3. Set appropriate properties.
4. Use the Description field, it comes in handy when trying to differentiate old files.
5. Bulk edit Surface Features' Description and Parent fields (optional, but very useful for managing complex surfaces).

InRoads creates a surface for each layer in the typical section, using the name of the typical section layer. This label can be somewhat generic, specifying what layer it is ("finished grade", "subgrade", etc.). This is useful information, but is seldom sufficient. What road is this the subgrade for? It is very useful when managing multiple files to have the name of the alignment in the Surface Name.

The Name of the Surface is a label internal to InRoads. It is not necessarily linked to the filename on the hard drive. When saving the surface to the hard drive or server, take advantage of the Operating Systems "long name" capability. The filename should be explicit enough to differentiate it from past and future iterations and other alignments.

The internal label and the filename should be closely correlated to minimize confusion.

Managing the new Proposed Surfaces

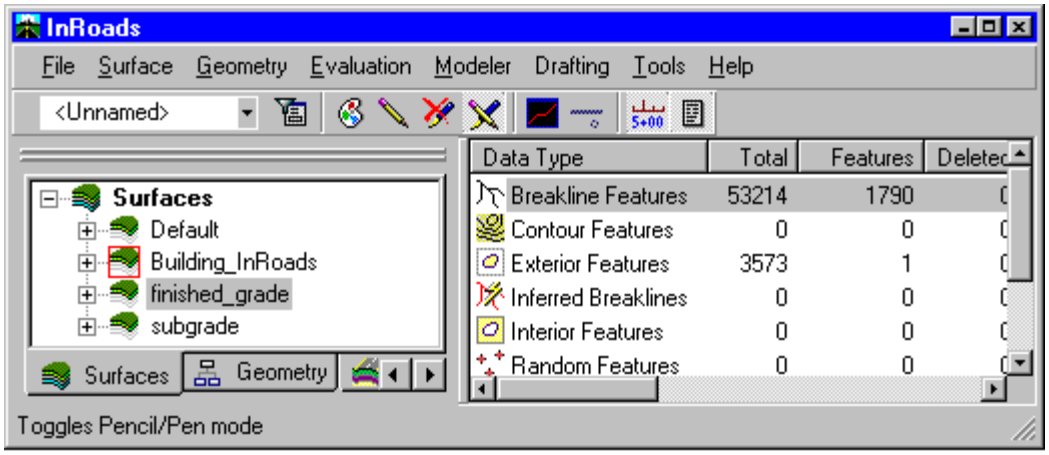
Let's manage the proposed surfaces along "east-west" starting with "finished_grade."

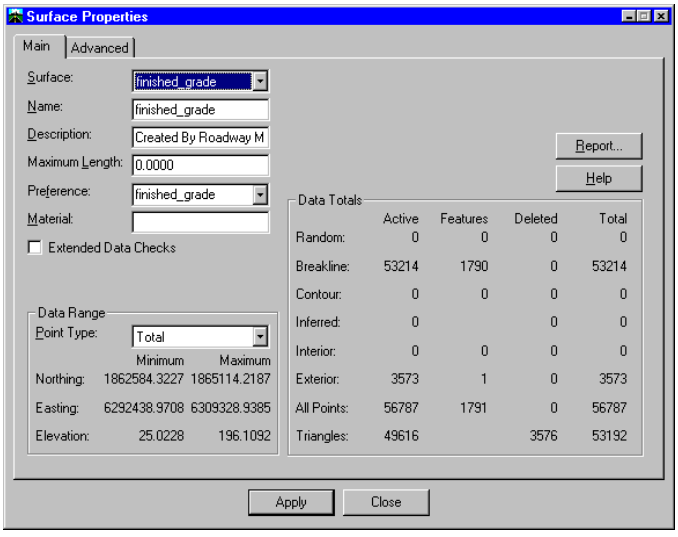
Authenticate:
Make sure that you are saving what you think you are saving. Erase all graphics then redisplay the features of the surface "finished_grade."

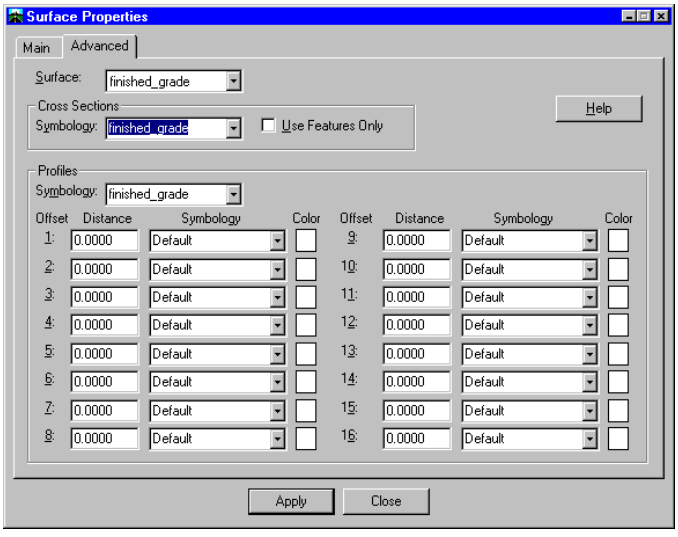
Let's look at the Surfaces in the InRoads Explorer.

18. Right-click on "finished_grade."
19. Select "Set Active"
20. Right-click on "finished_grade."
21. Select "Properties"

The Surface Properties form is invoked.







InRoads automatically populates the Surface Name, the Preference and Cross Section and Profile Symbologies with the name of the typical section layer. It also populates the Description field with "Created by Roadway Modeler."

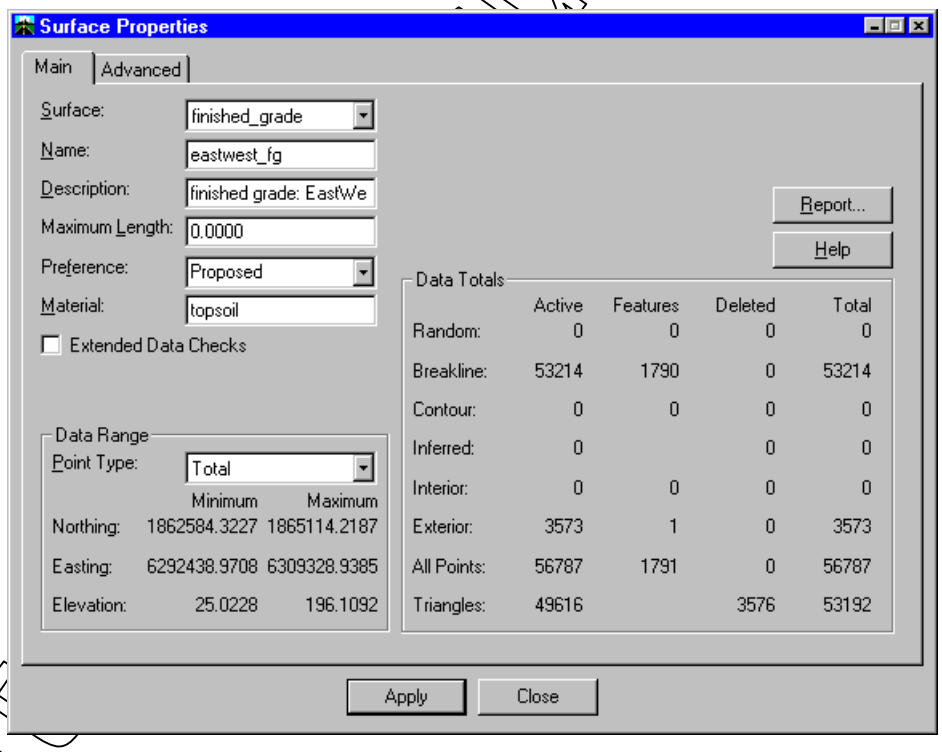
The Preference, Cross Section Symbology and Profile Symbology fields are designed to control the style of plan, cross-section and profile graphics display. For example, existing surfaces probably are displayed with different symbology than proposed surfaces. Setting these properties can ensure appropriate display.

Since the finished grade surface is the finished grade for "east-west" road, we should name it as such.

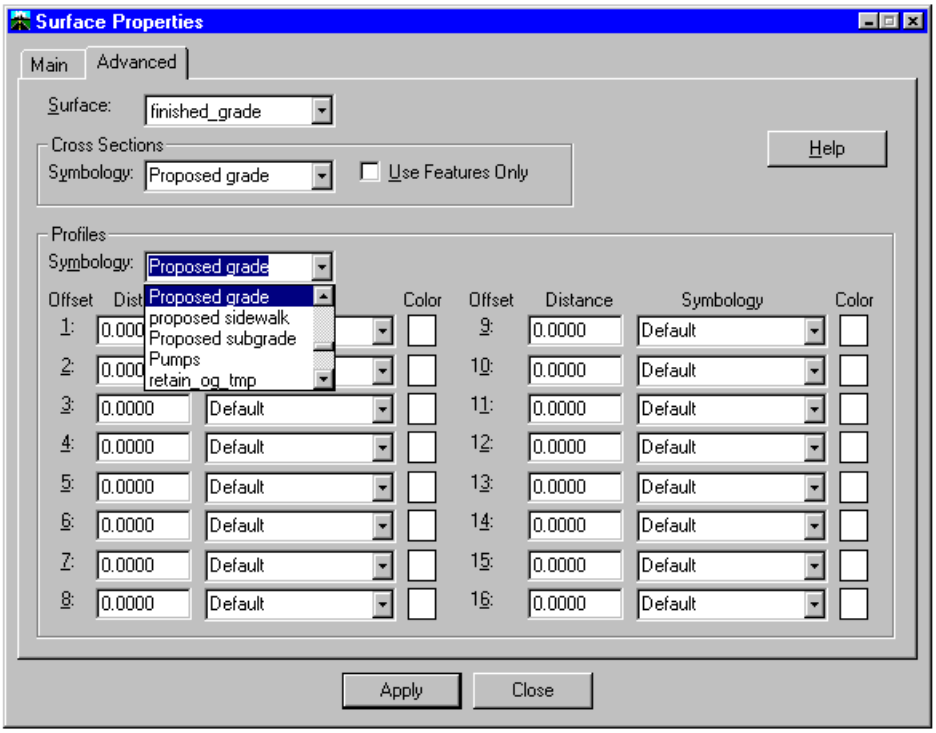
22. In the Name field, key in "eastwest_fg".
23. Key in a useful description; the horizontal alignment and vertical alignment should be included.
24. Select the Preference listbox, scroll down to and select "Proposed."

The Material is useful primarily when different side slopes will be used for different materials (such as bedrock).

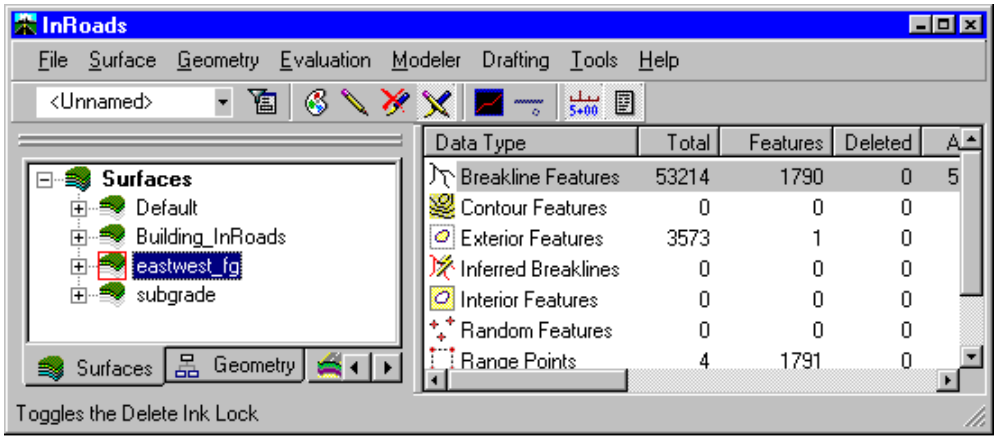
25. Key in a representative Material type.



26. Click the Advanced tab.
27. Select Proposed Grade for both the Cross Section and Profile Symbologies.
28. Hit Apply.



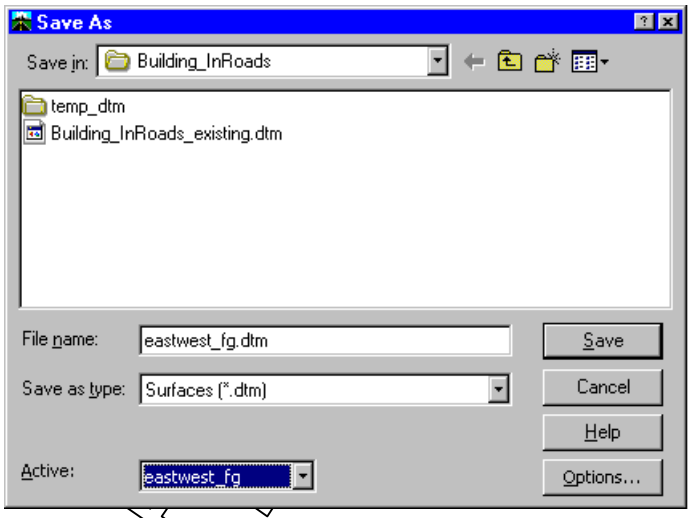
Authenticate:
The new name is reflected in the InRoads Explorer.



Save the Surface!

29. Right-click on “eastwest_fg”.
30. Select Save.

The Save As… form is invoked.

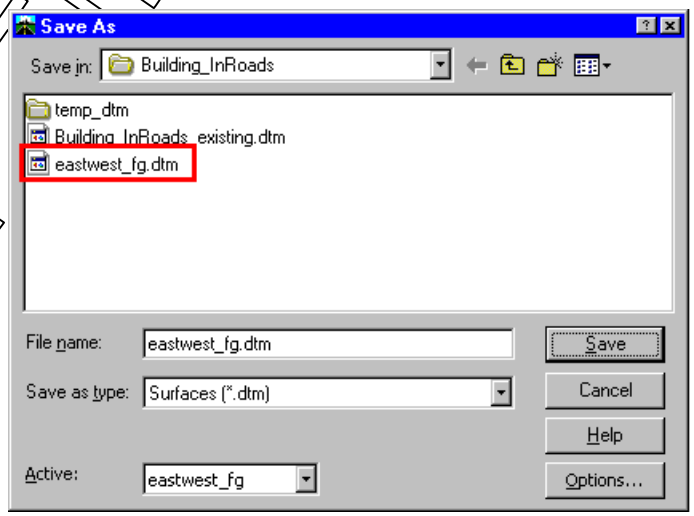


31. Key in a useful, explicit name for the DTM.

It can be identical to the Surface label or can vary (make sure that a close correlation remains).

Shortcut: By default, the Surface Right-clicked will be the Surface listed in the Active listbox. Often the Filename defaults to “*.dtm”. Re-selecting the Active dtm will populate the “File name” field with the surface name.

Authenticate:
Once the surface is saved the file is reflected in the Save As… form. The InRoads Explorer message field also confirms the save.



Adding Information to the Features

This step is useful primarily when incorporating the features of this DTM into a larger, more complicated DTM. An example may be an interchange composed of multiple main lines and many ramps and connectors.

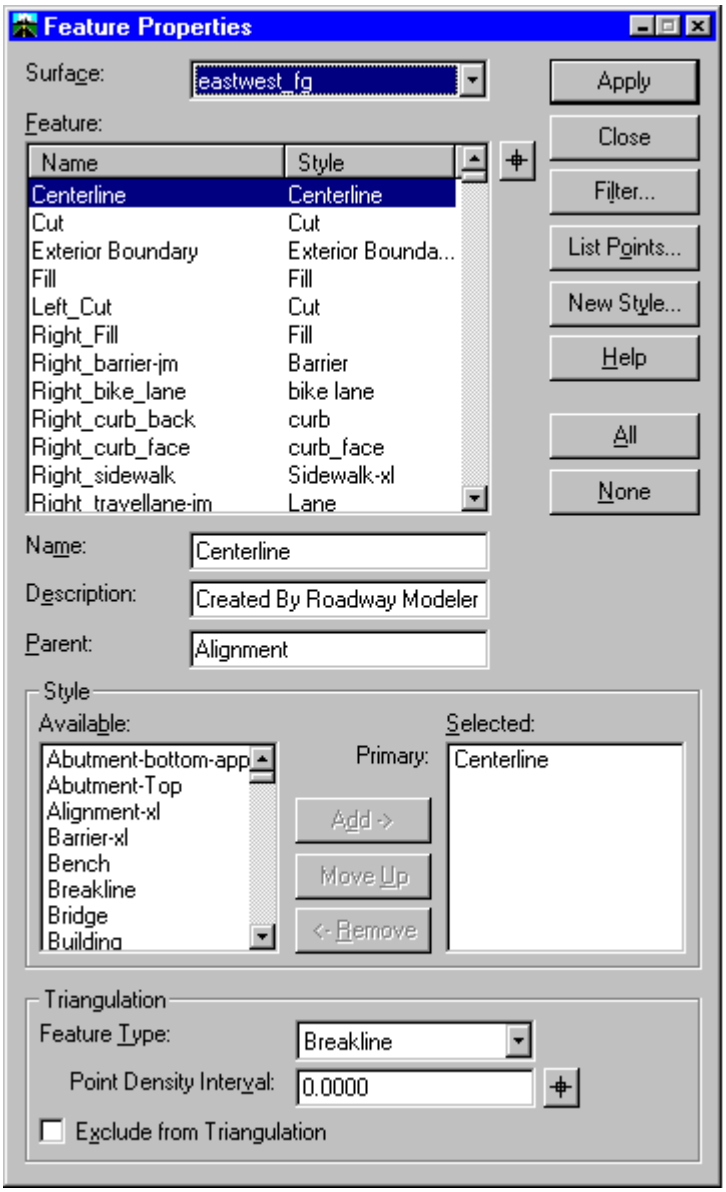
32. Select InRoads>Features>Feature Properties

InRoads invokes the Feature Properties form and lists (alphabetically) all the features in the active surface.

In this case, Centerline is the first Feature, its properties are shown. The Description is listed as "Created by Roadway Modeler" and its Parent is listed as "Alignment," which, frankly, is of marginal use.

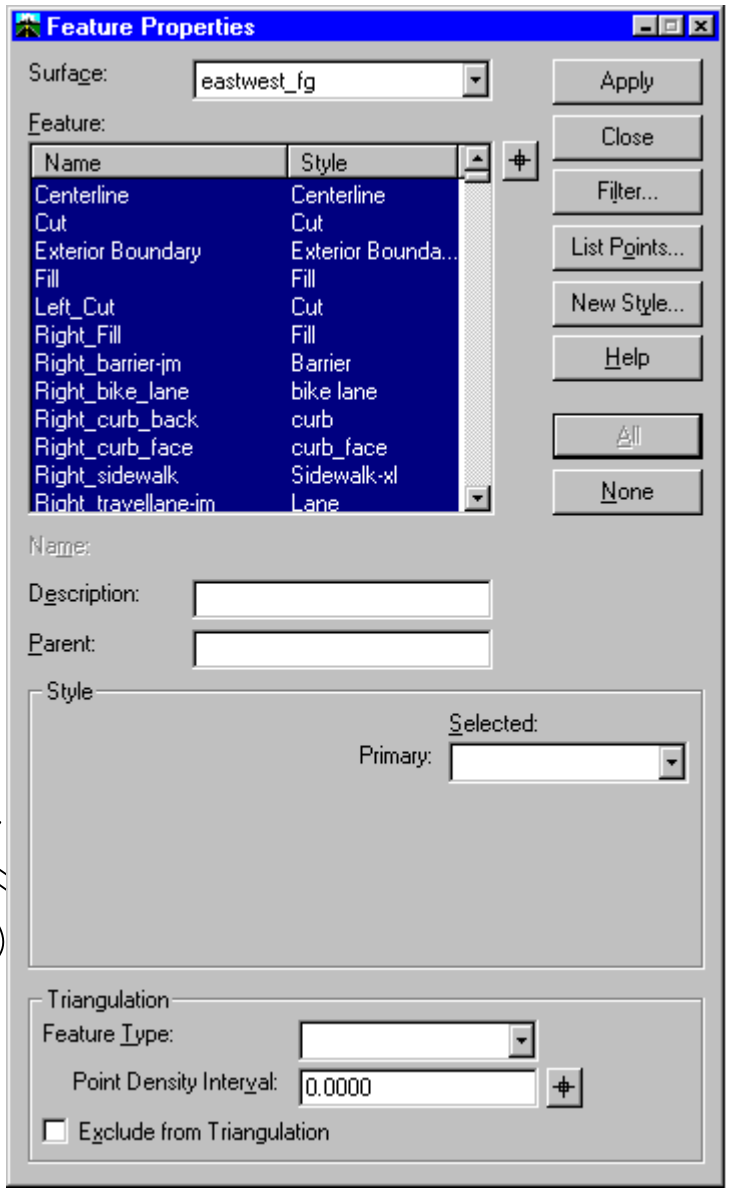
We will provide a more explicit Description and Parent for all the Features in this Surface.

Select the "All" button to select All the Features.



When multiple Features are selected, certain controls on the form are disabled. Changes to remaining controls will change the properties of all the selected features.

33. Key in "`east-west fg, va: cut_and_fill`" in the Description textbox.
34. Key in "`east-west proposed`" in the Parent textbox.
35. Hit Apply.



These feature properties can be used in filters to segregate features along this alignment from features along other alignments.

Authenticate:
Select any single Feature to see its Description and Parent.

Save the Surface.

Managing the Subgrade surface:
Using the tools learned in this section, give "subgrade" a more useful name and save the surface.

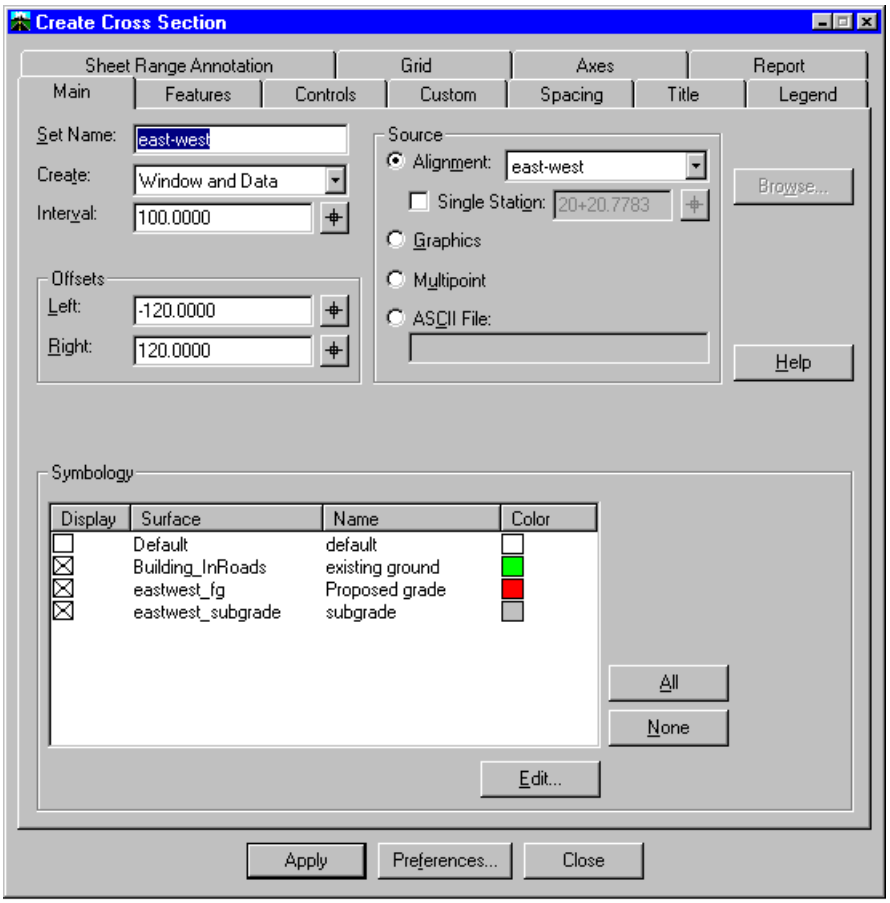
By default InRoads used "subgrade" for Preference, Cross Section Symbology and Profile Symbology, which is a Named Symbology with predefined symbology settings.

Example: Cross-Section Symbology

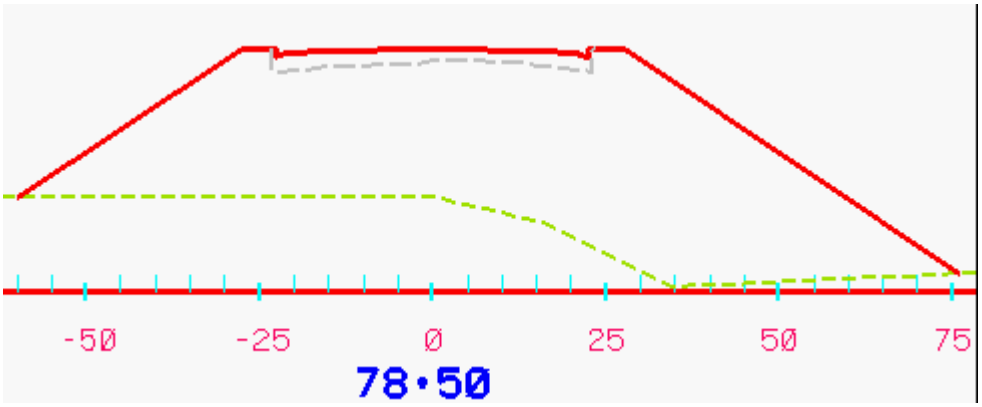
36. Select InRoads>Cross Section>Create Cross Sections.

Notice the Symbology for the three surfaces.

Note: double-clicking on the Surface in the Symbology takes you to the wrong place (it takes you to the Edit Named Symbology form). The proper way to change how the Surface displays in Profile or Cross Section is to change the appropriate Surface Property.

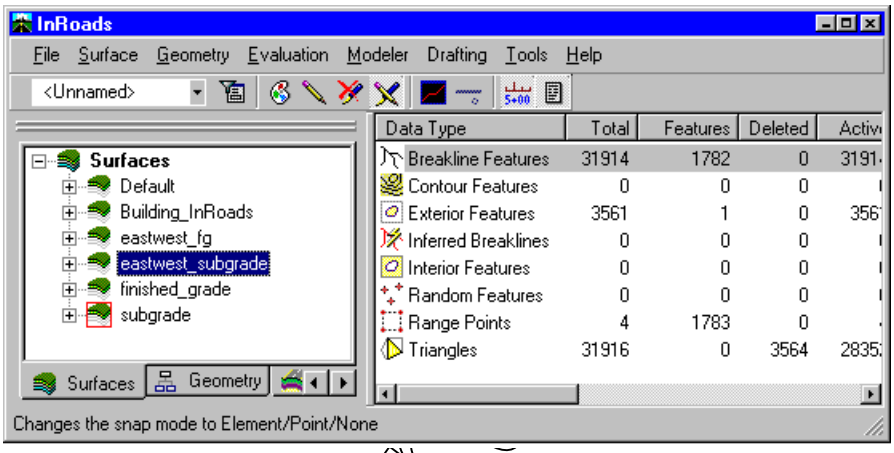


Example of Cross Section with "Standard" Surface Symbology.



The new Surfaces for "east-west" are now well-managed and safe. Running Express Modeler on "ha_canyon_rd" will not overwrite the "east-west" data as the screenshot below shows:

The new Express Modeler run creates surfaces named "finished grade" and "subgrade;" the well-managed east-west surfaces are safe.



Chapter Review

Now that you have completed this chapter, you should:

- Understand how Roadway Modeling Works in InRoads
- Be able to Open and Explore Typical Section Libraries
- Be able to Model a Road using Express Modeler
- Be able to Effectively Manage the newly-created surface(s)