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.

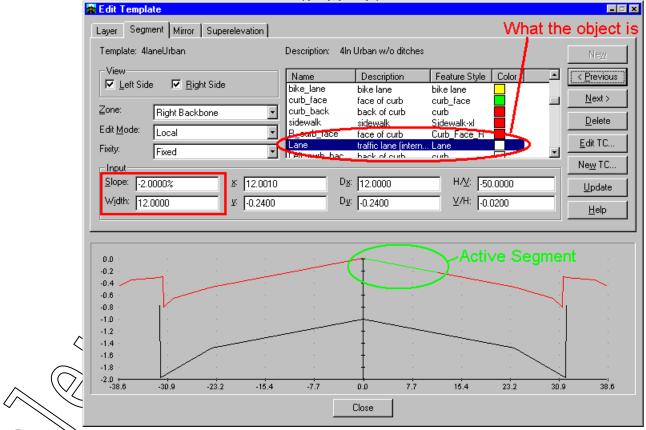
A simple road may be defined by a single "typical section" along the entire length of an alignment. If a road has a transition from two lanes to three lanes, its Roadway Definition will include the starting two-lane template, the Station of the start of the transition to three lanes and the Station of 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:



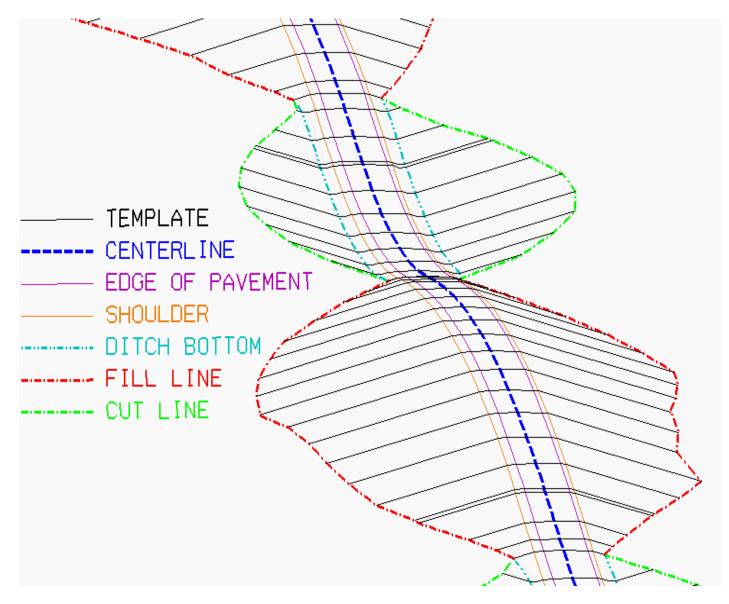
"Dropping Templates"

"Dropping Femplates" 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.

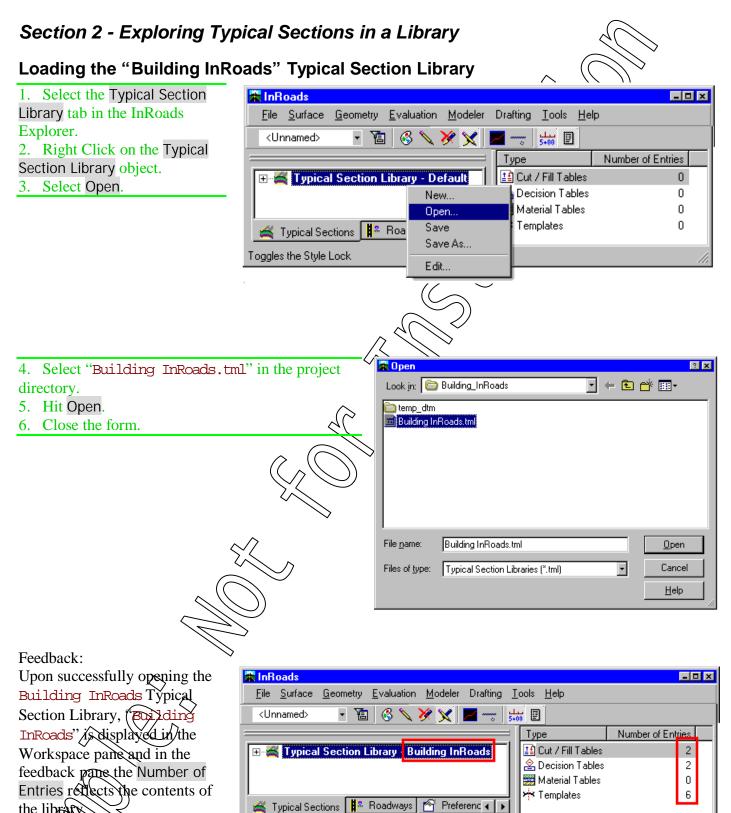
Surface Features are named, intelligent 3D objects stored within an InRoads DTM and are the perfect mechanism to store the intelligent 3D information defined by dropping templates.

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.



File 'C:\...\Building_InRoads\Building InRoads.tml' Opened

the library

Explore the Typical Section Library

7. Select	🛣 InRoads			
InRoads>Modeler>Define	<u>File</u> Surface <u>G</u> eometry Evaluation	<u>M</u> odeler Drafting	<u>T</u> ools <u>H</u> elp	
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or			Туре	Number of Entries
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object in the InRoads		Open	📰 Material Tables	0
Explorer	Martin Louis HS Baadways	Save	😽 Templates	6
9. Select Edit	🚄 Typical Sections 🖡 Roadways	Save As		
J. Beitet Eun	Toggles the Style Lock	E dit		1.

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).

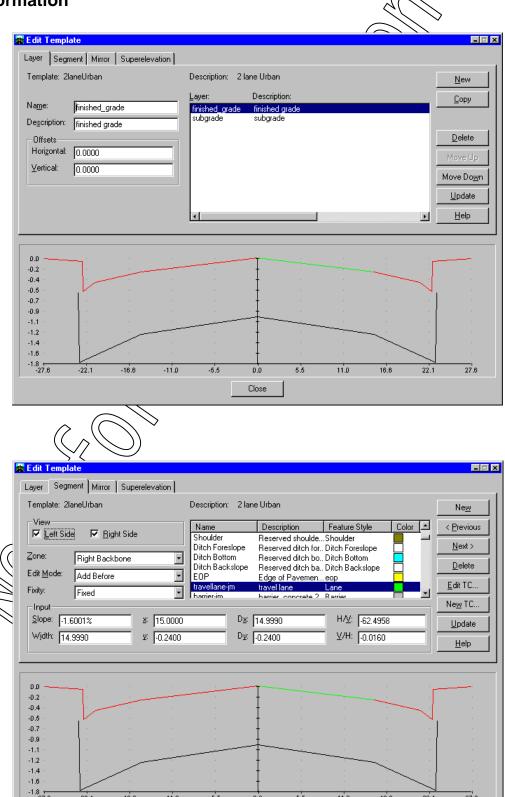
-		Decision Tables Trans	sition Control	
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Library Description: Mes	aPark Templates			<u>E</u> dit
Name	Description	Last Revision	Revised By	<u>С</u> ору
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2laneUrban 4laneUrban 2laneRural 4laneRural	2 Iane Rural	2/24/2003 1:17:36 F c 2/19/2003 8:02:16 F 2/19/2003 8:06:04 F ch 2/19/2003 8:09:28 F	Pjam Pjam	Deļete
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Reviewing Template Information

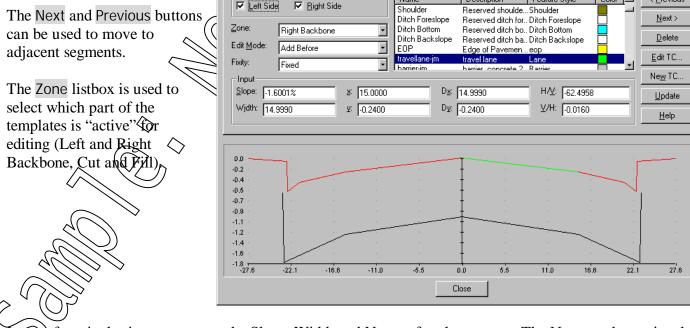
The Layer tab is used to select which template layer to edit. Note that the "active" template layer graphics are red, with the active segment shown in green.

Select "finished grade."

Select the "Segment" tab.



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



tems 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.

🛣 InRoads - 0 × File Surface Geometry Evaluation Modeler Drafting Tools Help 12. For feedback, select the Surfaces tab 12 🚳 🔪 🎘 🗙 📕 🚽 <Unnamed> يبل • in the InRoads Explorer. Total Data Type Features Deletec 📤 13. Fit the CAD window around the \mathcal{N} Breakline Features 30469 508 10742 🖃 🌒 Surfaces alignment which will be modeled. 🗄 🖘 Default 鯼 Contour Features 0 0 14. Erase all CAD graphics. 🗄 🍣 Building_InRoads 140 Exterior Features 1 🕅 Inferred Breaklines 0 0 Interior Features 0 0 Random Features 5216 😂 Surfaces 🔠 Geometry 🚄 🖣 Toggles the Station Lock

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.

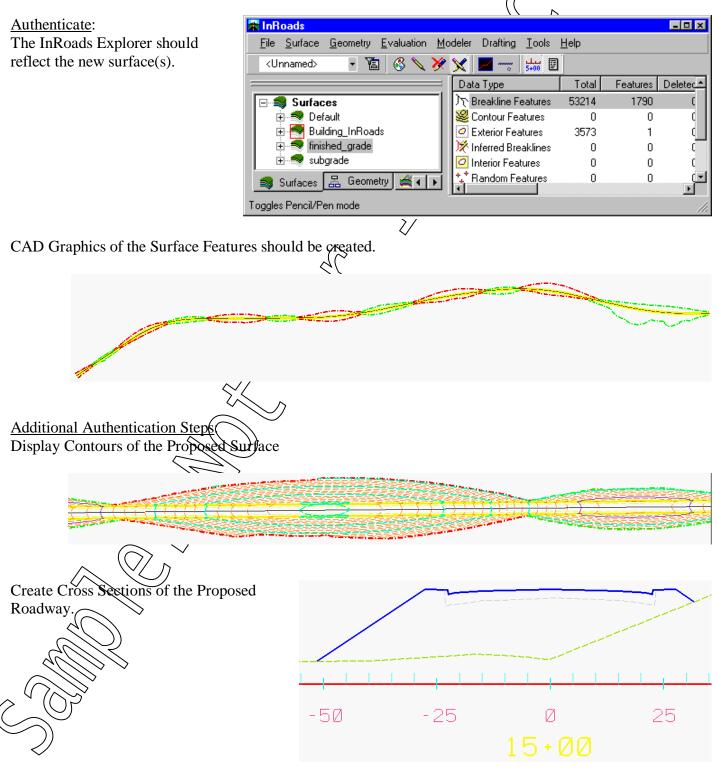
"Densify Curves Using Chord Height Tolerance" will drop additional templates along curves so that the Chord Height Tolerance (the "maximum

🛣 Express Modeler		- I ×
Horizontal Alignment: east-west ha_canyon_rd	Vertical Alignment: cut_and_Fill va_east-west	Apply Close <u>H</u> elp
<u>T</u> emplate: 2lane_simple inverted_15x2 2laneUrban 4laneUrban 2laneRural 4laneRural	<u>S</u> urface: Default Building_InRoads	
Interval: 10.0000	Lines Chord Height Tolerance	

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 is shown above. 17. Hit Apply.



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:

🛣 Express Modeler 👘		
Horizontal Alignment:	Vertical Alignment:	Apply
east-west ha_canyon_rd	alt_canyon_K120 canyon_existing	Close
na_canyon_ra	canyon_proposed	
		<u>H</u> elp
<u>T</u> emplate:	<u>S</u> urface:	
2lane_simple	Default	
inverted_15x2 2laneUrban	Building InRoads finished_grade	
4laneUrban 2laneBural	subgrade	
4laneRural		
Interval: 10.0000	+	
Plot Transition Control	Lines	
Densify Curves Using	Chord Height Tolerance	

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

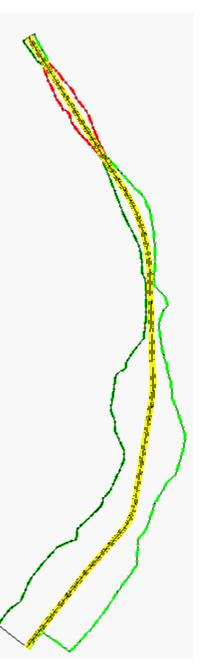
Surface Management Techniques

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.

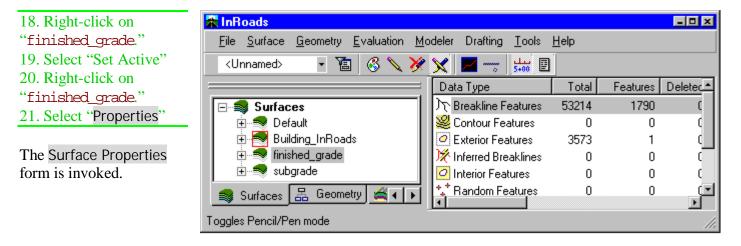
Managing the new Proposed Surfaces

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.



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	ICUNS		Breakline:	53214	1790	0	53214
			Contour:	0	0	0	0
Data Range Point Type: T			Inferred:	0		0	0
	otal Iinimum	Maximum	Interior:	0	0	0	0
		65114.2187	Exterior:	3573	1	0	3573
Easting: 629243	8.9708 63	09328.9385	All Points:	56787	1791	0	56787
Elevation: 2	5.0228	196.1092	Triangles:	49616		3576	53192

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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.

		102			
🛣 Surface Properties					
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	Contour:	0	0	0	0
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	Interior:	0	0	0	0
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Easting: 6292438.9708 6309328.9385	All Points:	56787	1791	0	56787
- Elevation: 25.0228 196.1092	Triangles:	49616		3576	53192
	Surface: finished_grade Name: eastwest_fg Description: finished grade: EastWe Maximum Length: 0.0000 Preference: Proposed Material: topsoil Extended Data Checks Data Range Point Type: Total Minimum Maximum Northing: 1862584.3227 Easting: 6292438.9708 6309328.9385 Elevation: 25.0228 196.1092	Main Advanced Surface: finished_grade Name: eastwest_fg Description: finished grade: EastWe Maximum Length: 0.0000 Preference: Proposed Material: topsoil Extended Data Checks Breakline: Contour: Inferred: Inferred: Inferred: Point Type: Total Minimum Maximum Northing: 1862584.3227 Elevation: 25.0228 196.1092	Main Advanced Surface: finished_grade Name: eastwest_fg Description: finished grade: EastWe Maximum Length: 0.0000 Preference: Proposed Material: topsoil Extended Data Checks Data Totals Active Random: 0 Breakline: 53214 Contour: 0 Inferred: 0 Inferred: 0 Interior: 0 Interior: 0 Interior: 0 Interior: 3573 All Points: 56787 Triangles: 49616	Main Advanced Surface: finished_grade Name: eastwest_fg Description: finished grade: EastWe Maximum Length: 0.0000 Preference: Proposed Material: topsoil Extended Data Checks Data Totals Data Range O Point Type: Total Minimum Maximum Northing: 1862584.3227 Iseasting: 6292438.9708 Gasting: 25.0228 196.1092 Triangles:	Main Advanced Surface: finished_grade Name: eastwest_fg Description: finished grade: EastWe Maximum Length: 0.0000 Preference: Proposed Material: topsoil Extended Data Checks Active Data Range Minimum Point Type: Total Minimum Maximum Northing: 1862584.3227 Easting: 6292438.9708 Elevation: 25.0228 196.1092 Tiangles:

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

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Cross Sections					<u>H</u> elp
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Authenticate:

The new name is reflected in the InRoads Explorer.

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Save the Surface!

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29. Right-click on "eastwest_fg".
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                                                                     Save in: 🛅 Building_InRoads
30. Select Save.
                                                                     🛅 temp_dtm
                                                                     🖬 Building_InRoads_existing.dtm
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).
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Shortcut: By default, the Surface Right-clicked will
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be the Surface listed in the Active listbox. Often the
                                                                    Active:
Filename defaults to "*.dtm". Re-selecting the
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Active dtm will populate the "File name" field with
the surface name.
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 Save As... form. The InRoads Explorer message
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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 x_{0} 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.

🛣 Feature Properties 👘			= 0 ×
Surfa <u>c</u> e: eastwest	fg	·	Apply
Eeature:			Close
Name Centerline	Style Centerline	<u>-</u> +	Filter
Cut Exterior Boundary	Cut Exterior Bounda		List P <u>o</u> ints
Fill Left_Cut	Fill Cut		New Style
a second second	Fill Barrier		<u>H</u> elp
Right_bike_lane	bike lane curb		
Right_curb_face	curb_face Sidewalk-xl		
Right travellane-im	Lane		None
Na <u>m</u> e: Centerline	•		
Description: Created B)y Roadway Mode	ler	
Parent: Alignment	t		
Style			
Availa <u>b</u> le:		<u>elected:</u>	
Abutment-bottom-app Abutment-Top	Primary:	Centerline	
Alignment-xl Barrier-xl	A <u>d</u> d ->		
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Feature <u>T</u> ype:	Breakline	•	
Point Density Inter⊻al:	0.0000		+
Exclude from Triangula	ation		

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.

	Name	Style	∸ ♥	
33. Key in "east-west fg, va: cut_and_fill"	Centerline	Centerline		Filter
in the Description textbox.	Cut Exterior Boundary	Cut Exterior Bounda		List P <u>o</u> ints
34. Key in "east-west proposed" in the Parent textbox.	Fill Left_Cut Right_Fill	Fill Cut Fill		New Style
35. Hit Apply.	Right_barrier-jm	Barrier		<u>H</u> elp
These feature properties can be used in filters to segregate features along this alignment from features along other alignments.	Right_bike_lane Right_curb_back Right_curb_face Right_sidewalk Right_travellane-im	bike lane curb curb_face Sidewalk-xl Lane	T	<u>∆</u> II <u>N</u> one
	Name:			
Authenticate: Select any single Feature to see its Description and Parent.	Description:			
Save the Surface.	- Style	Primary:	<u>S</u> elected:	•
	 Triangulation Feature <u>I</u>ype: Point Density Interg. 	ak la 2000	•	
	Exclude from Trians	1		+

🛣 Feature Properties

eastwest_fg

Surface:

Feature:

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.

- 🗆 X

Apply

Close

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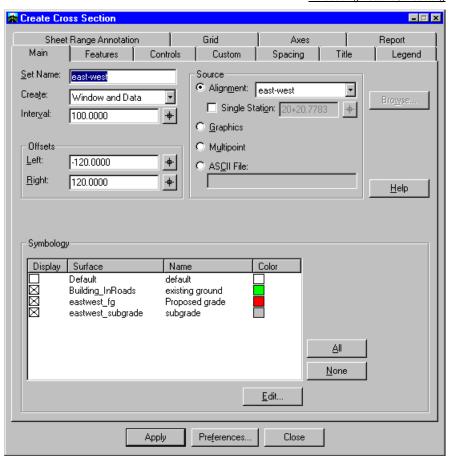
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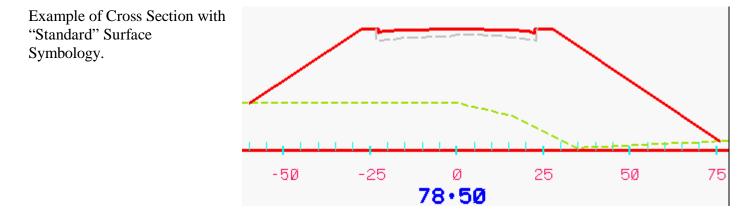
Example: Cross-Section Symbology

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

Notice the Symbology for the three surfaces.

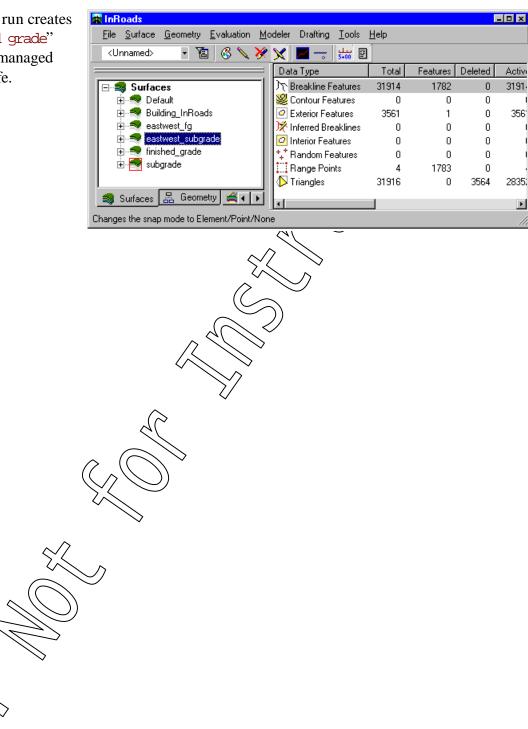
Note: double-clicking on the Surface in the Symbology takes you to the wrong place (it takes you to the Edit Named Symbology form). The proper way to change how the Surface displays in Profile or Cross Section is to change the appropriate Surface Property.





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)