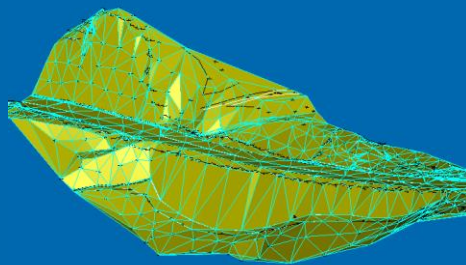# Surfaces - Objectives

- Cover the Basic DTM Point Types
- Creating a new InRoads Surface
- Surface processing in InRoads
- Loading 3D data into a Surface
- A bit about Surface Properties
- Overview of the View Surface commands
- A bit about earthwork volumes
- InRoads Locks, … a beginning
  - A glimpse of the DTM Design & Editing tools (If time allows)

Digital Terrain Models

- Digital Terrain Models are 3-D surfaces
- Representing:
  - Existing conditions
  - Design conditions
- Surfaces are key to many InRoads operations
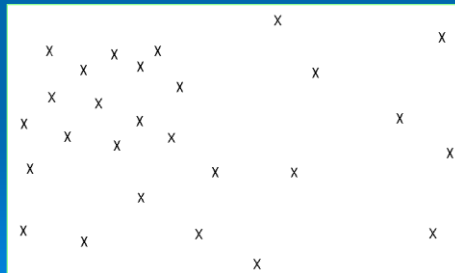
Surface Point Types

- The software uses several different types of points:
  - **Random points.**
  - **Breakline points.**
  - **Interior boundary points.**
  - **Exterior boundary points.**
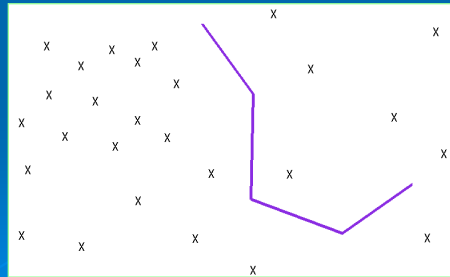 - **Contour points.**

Random Points

- Random, or regular points, are singular points with X, Y and Z coordinates
- They have no direct relationship with other points.

Breaklines

- Breaklines are used in a surface model where a linear relationship exist along a path
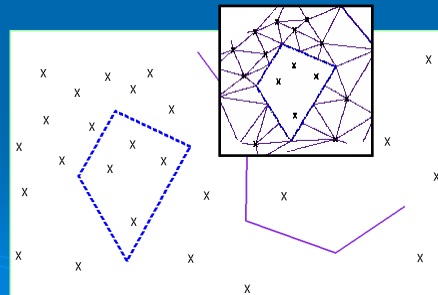- <u>Two</u> or more points are required to define a breakline.

Interior Boundary

- Interior boundaries define void areas
  - No computations occur *inside* these void areas.
  - Must be a closed figure
  - A single surface can have many Interior Boundaries
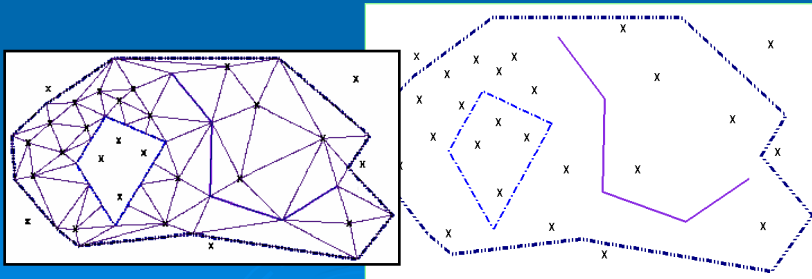- Can be collected around perimeters of ponds, buildings, lakes or inaccessible

Exterior Boundary

- Exterior boundary points are used to limit the outer extent of the model.
    - No computations occur *outside* the exterior limit.
    - Only 1 exterior boundary can be defined per model.
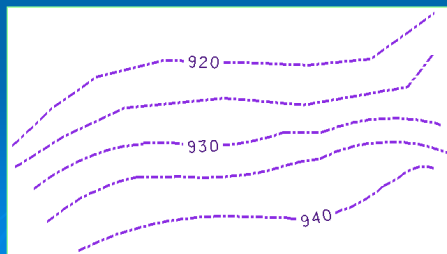
Contours

- A contour is a graphic element in which all points are at a single elevation.
- Contour points are generated from aerial photographs or from existing quadrant maps from the United States Geographical Survey.

Creating a Surface

- First add the 'pieces' that define the elevational controls
- Next, processing associates and forms the relationships between all the data contained in the surface model
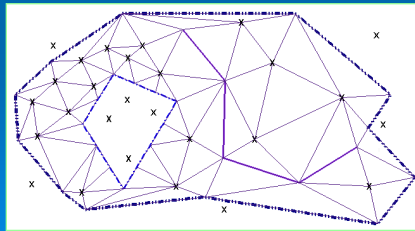
Data Conflicts

- The InRoads DTM allows only <u>one</u> Z (elev.) value for each X-Y coordinate.

X=123.4567
Y=987.8765
Z=138.8752

X=123.4567
Y=987.8765
Z=138.8752

SAME X AND Y COORDINATES

DIFFERENT COORDINATE

X=123.4567
Y=987.8765
Z=125.6925

X=123.4567
Y=987.8766
Z=125.6925

Resolving Data Conflicts

- InRoads will still 'auto-resolve' the crossing breaklines when it triangulates
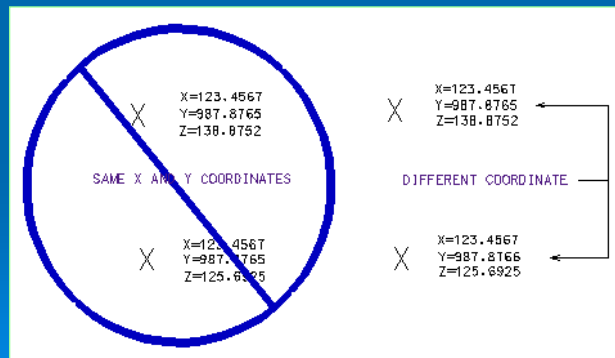- Another tool has been added to help here

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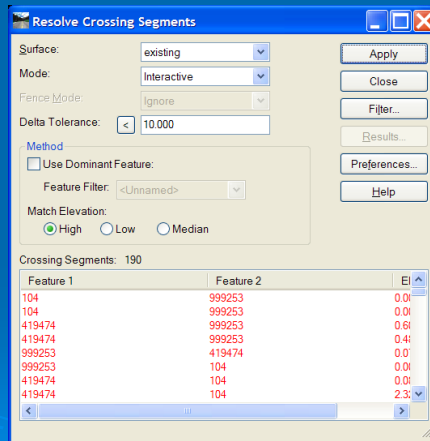
Creating a Surface 'slot'

- The *File* > *New* is used to create a placeholder
  - Set the Tab to *Surface*
  - Key in the information
  - *Apply* it
  - The 'slot' is empty
- **Type** setting:
  - Existing
  - Design
  - Substratum
  - Ignore
  - Subgrade
- This setting relates to the End Area Volumes
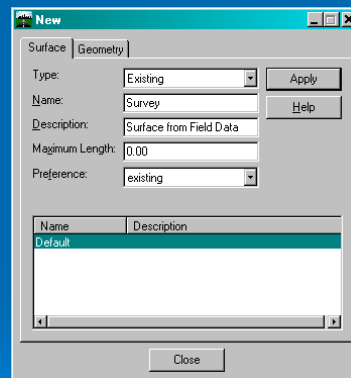
Loading Surface Data
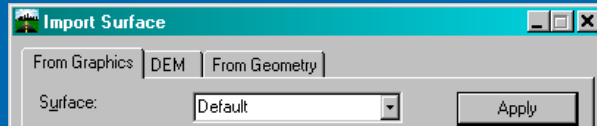
- *InRoads > File > Import > Surface...*
- File > Text Import Wizard
  - ASCII surface information
  - …
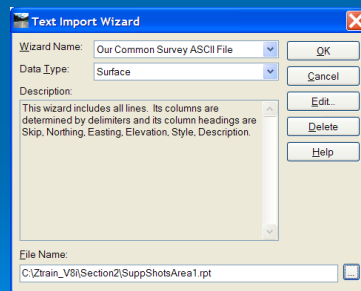
Triangulate Surface

- Defines the data relationships within the surface model
- Select *Surface > Triangulate...*
- The *Extended Data Checks* option will correct and report on various problems that may be in your surface
- Lock Triangulation
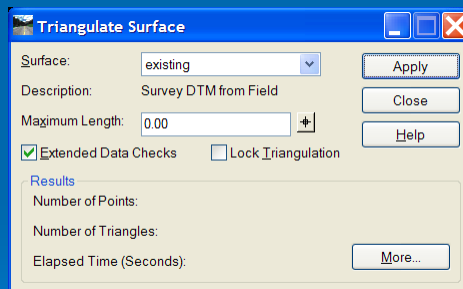
Surface Properties - Main Tab

- Name
- Description
- Max Length
- Preference
- Type
- Data Range
- Data Totals
- Lock Triangles

Feature Properties

- *Feature Properties* show the complete Feature 'picture' for the surface
  - Name
  - Description
  - Style
  - Point Type
  - Point Density
  - Exclude from Triangulation
  - Refresh…
  - Primary
  - Secondary

DTM – Contents
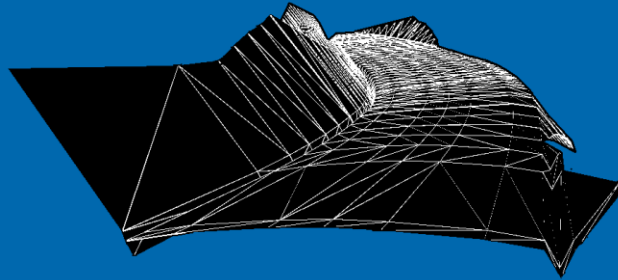
- Digital Terrain Models are composed of:
  - The 'pieces' or Features and
  - The Triangle network of relationships
- Some surface commands are Feature-based and others are Triangle-based.

View Surface Commands

View Components

View Bathymetric Elevations

View Surface Features

View Point Elevations

View Slope Vectors

Label Contours

Annotate Feature

View Single Point Elevation

Contours

Triangles

Perimeter

View Single Slope Vector

Fit Surface

View Two Point Slope

Gridded Model

View Surface Options

Update 3-D Plan Surface Display

View Inferred Breaklines

Profiled Model

Color-Coded Aspect, Elevation & Slope
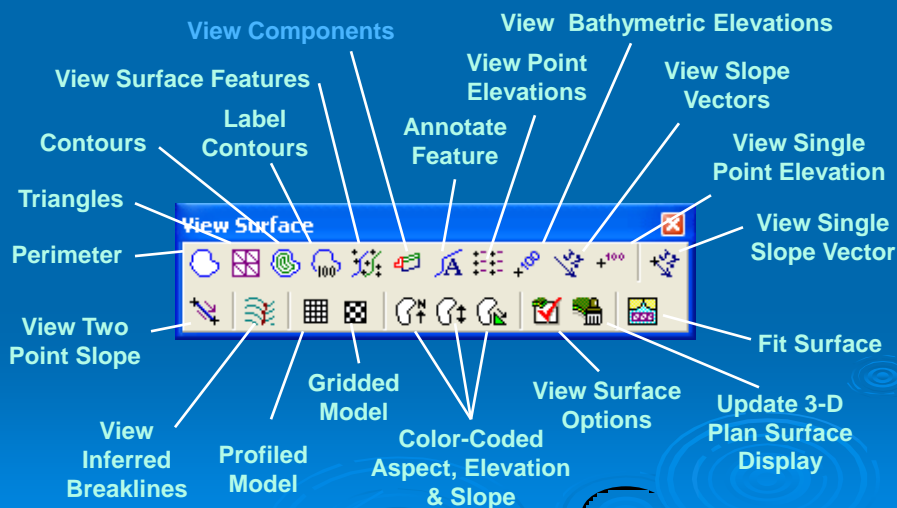
Volume Methods

- **Triangle Volumes** - the precise volume between any 2 InRoads DTMs

  - Triangle Volume...
  - Triangle Volume by Station
  - Grid Volume...
  - End-Area Volume...

- **Grid Volumes** - used to calculate an estimated volume between 2 DTMs, or to match calcs made against a gridded mass grading plan

- **End-Area Volumes** - generates volumes based on the historically used cross section method

- **Triangle Volume by Station** – Triangle Precision with End-Area Volume stationing control (V8.3 only)

Triangle Volumes

- 2 triangulated surfaces are required before calculating triangle volumes (and grid volumes)
- Triangles are projected between the original surface and the design surface
 - The software then forms three-sided prismoids from these projections
- The volume of cut and fill is calculated from the prismoids.

Triangle Volumes

- 3 Modes:
  - Entire Surface
  - Fence / Region
  - Selected Shapes
- Identify the Original Surface & Design Surface
- Cut / Fill; Shrink / Swell; Expansion / Contraction Factors can be used if desired
- Functionality to run multiple volumes at a time has returned to the Triangle Volumes
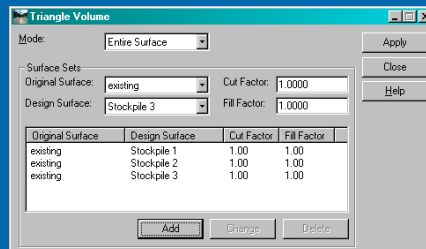
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Grid Volumes

- Two triangulated DTMs are compared against a grid overlay
- Cut / Fill is computed within each grid cell
- The size of the grid cell is defined by the user
- The smaller the grid size, the more accurate the results, but with slower processing.
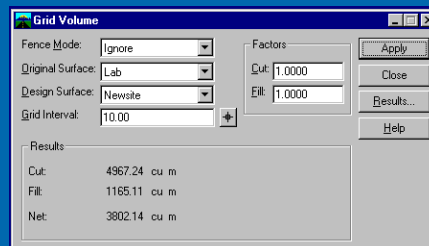
© 2010 Zen Engineering / Mark S. Ditko

InRoads Locks

- *InRoads > Tools > Locks*
- These Controls regulate the output, input or processing of certain InRoads commands

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Pen / Pencil Lock

- ***Pen / Pencil*** relates to what occurs on later re-display of that InRoads item
- The CAD package itself does not care about this setting, only InRoads.

Pencil Setting

Pencil

- Information displayed is physically written to the design file, but it is considered a 'Draft' version.
    - An alignment is written to the design file in 'Pencil'; the alignment is revised in InRoads and then re-displayed; the previous graphics are updated resulting in 1 alignment in the CAD file.
    - Contours are displayed in 'Pencil'; revising the DTM in InRoads and re-displaying contours will update the current ones resulting in 1 set of contours written to the CAD file.
- Use *Pencil* to <u>update</u> earlier graphical versions after modifications are made and displayed.

Pen Setting

Pen

- Information displayed is physically written to the design file, and considered 'Final'
    - An alignment is written to the design file in 'Pen'; the alignment is revised in InRoads and then re-displayed; this results in 2 alignments written to the CAD file.
    - Contours are displayed in 'Pen'; revising the DTM in InRoads and re-displaying contours results in 2 sets of contours in the CAD file.
- Use *Pen* mode to <u>retain</u> earlier graphical versions after modifications are made and displayed.

InRoads Locks

Locks

<Unnamed>

- InRoads is in permanent 'Write' mode
  - Get used to it, it's gone
- Feature Highlight Lock will highlight the selected surface feature in the CAD view
- Tool Tip indicates the position of the lock

Feature Filter Lock Off

Feature Filter Lock On

Style Lock Off

Style Lock On

Report Lock Off

Report Lock On

Surfaces – Summary

- The 5 DTM Point Types are Random, Breakline, Interior & Exterior Boundaries and Contours
- ASCII & Graphical 3D DTM input is common
- Triangulation is required to produce a surface
- Surfaces have a .DTM file extension
- On redisplay, Pen is retained / Pencil is updated

Surfaces – Hands on

Lecture Pause …
    … Start Lab, Chapter 2-3

Surface Design Commands

Longitudinal Feature

Transverse Feature

Fillet Features

Apply Template

Set Linear Elevation

Place Feature

Design Surface

Set Slope Along

Drape Surface

Sloped Surface

Project Line to Surface

Isopach

Edit Surface Commands

Delete Feature Points

Divide Feature

Reverse Feature Direction

Delete Feature

Edit Feature Point

Partial Delete

Copy Single Feature

Break Feature

Join Feature

Delete Triangle

Extend Features

Intersect Two Features

Merge Surfaces

Transform Surface

Trim Features

Copy Portion of Surface (Copy Multiple Features)

Feature Editing in Plan

- Some Edit tools have dialog boxes
  (… means that a dialog box will follow)
- Some Edit tools don't have dialog boxes
- Watch the InRoads Prompts! (If there isn't a dialog box following prompts is required)

Surfaces – Summary 2

- The 5 DTM Point Types are Random, Breakline, Interior & Exterior Boundaries and Contours
- ASCII & Graphical 3D DTM input is common
- Triangulation is required to produce a surface
- Lock Triangulation will not allow the triangles to change
- Surfaces have a .DTM file extension
- There are a handful of specialized surface design tools along with a collection of surface editing tools that work directly with the DTM
- The volume commands require 2 surfaces
- Triangle Volumes are able to run multiple volumes at once
- On redisplay, Pen is retained / Pencil is updated