VDOT Survey Training – GEOPAK 2004 Edition

Training Manual

TRN008650-1/0001

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VDOT Survey Training

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Introduction

GEOPAK is a comprehensive software package for all of your survey processing needs: from raw field data to a finished drawing all within the MicroStation environment. GEOPAK performs traverse entry / edit / reduction, coordinate geometry and mapping without having to leave MicroStation.

VDOT's implementation of GEOPAK will focus mainly on coordinate geometry and digital terrain modeling for post processing of field data.

Using GEOPAK will help ensure consistency and accuracy of survey data from initial field collection all the way to construction staking.

1.1 File Names

GEOPAK uses and/or creates files during the design process. The files are detailed in the table below.

job###.gpk	This binary file is created when the user starts a coordinate geometry (COGO) session for the first time or through Project Manager and may be appended to during the design process. All coordinate geometry elements are stored in this file. Multiple users can access this file at the same time, and only one file should be created for each project. The "###" is the only variable in this name. It represents a job number (up to 3 alphanumeric characters) unique to a project and is defined by the user upon creation.
fname###.ioc **Example: align999.ijd**	ASCII input file for loading data during a COGO session. "###" represents the job number and "oc" is the operator code (users initials).
fname###.ooc **Example: align999.ojd**	ASCII output file created by GEOPAK during a COGO session. Variables are the same as defined above.
fname.dat	A binary file that contains string and point information to be used for digital terrain model construction.
fname.tin	A binary file containing triangular surfaces also known as the digital terrain model (DTM).
project.prj	Binary file resulting from the creation of a new project.

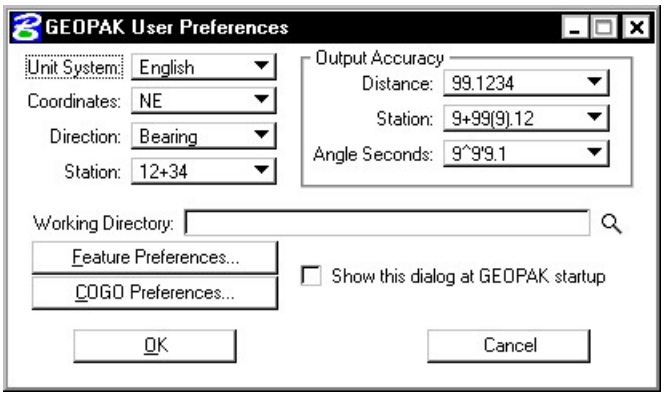
1.2 Accessing GEOPAK

GEOPAK is started upon entering a MicroStation File. To verify that GEOPAK is active, scan the MicroStation menu bar where the Applications menu appears. Simply pull down **Applications > GEOPAK SURVEY**. When each GEOPAK tool is selected, the corresponding dialog will appear. In addition, several dialogs may be opened simultaneously.

To close a dialog, simply click the X in the upper right corner of the dialog. In addition, the Coordinate Geometry dialog and Design and Computation Manager may be closed by selecting the **File > Exit** option. Other various dialogs have a **Cancel** button, which exits the dialog. Exiting the MicroStation file automatically closes all GEOPAK dialogs.

1.3 User Preferences

When a user begins Geopak for the first time or after Geopak has been reloaded, there are certain **User Preferences** the user needs to set. The **User Preferences** dialog can be accessed from **Applications > Geopak SURVEY > User Preferences**. The following dialog appears.

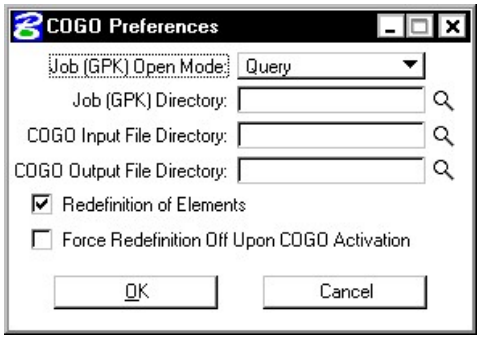


Most of the settings in this dialog are defined when the project is set up.

The **Working Directory** identifies where the data files for a particular project can be found. This is to say that GEOPAK will look here by default, for any files needed to read or write to by any application. If a user does not want to specify a directory, the field may be left blank, and Geopak uses the directory wherein the open MicroStation file is located.

By pressing the **COGO Preferences** button, the following dialog is invoked.

Everything about this dialog refers to COGO and the COGO database (.gpk).



Job Open Mode

This determines the file creation constraints imposed on creating new coordinate geometry database file. Coordinate geometry data is stored into a file named job** .gpk where ** is the user-specified job number for a given project. Each time the Coordinate Geometry window is invoked for a job number that does not correspond with a job**.gpk file in the current or specified working directory, GEOPAK creates a new job**.gpk file contingent on the constraints imposed by the Job Open Mode parameter.

Create - Automatically creates a new coordinate geometry database.

No Create - This mode does not permit creation of a new coordinate geometry database and provides a warning.

Query - With this mode, the user is queried when a job number is requested that does not correspond with a job**.gpk file in the current directory. Once queried, the designer may proceed with the database creation or cancel it.

Directories

Job Directory

The job directory will force the creation of the coordinate geometry database (.gpk) somewhere other than the project working directory. This may be desirable simply for file maintenance, to keep the gpk separate from all the other project data files.

COGO Input File Dir.
COGO Output File Dir.

Normally, input and output files are stored in the project directory, in which case, these fields would be blank. However, there are times when they are located in other directories, which can be keyed into these fields. In lieu of typing, pressing any of the Select buttons invokes the Select Directory Manager, wherein the desired directory may be specified.

Redefinition of Elements

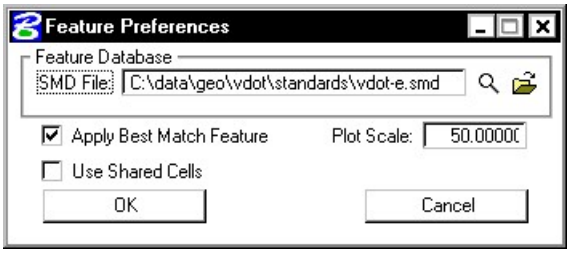
When the toggle button is active, existing elements in the Coordinate Geometry component can be redefined. For example, point number 8523 that was previously defined to coordinate values can be set to new coordinate values when this toggle is active. Otherwise, the Coordinate Geometry component would not store the new coordinate values with point number 8523 and a warning message "Element already exists" is displayed on the screen. This serves as a protection to the integrity of the coordinate geometry database. The same functionality can be achieved by the Redefine toggle in the Coordinate Geometry window.

Force Redefinition Off Upon COGO Activation

When this toggle is activated, and coordinate geometry is invoked, the Redefine button is not active, so that no redefinition of elements is permitted. However, at any time during the session, the Redefine toggle may be activated.

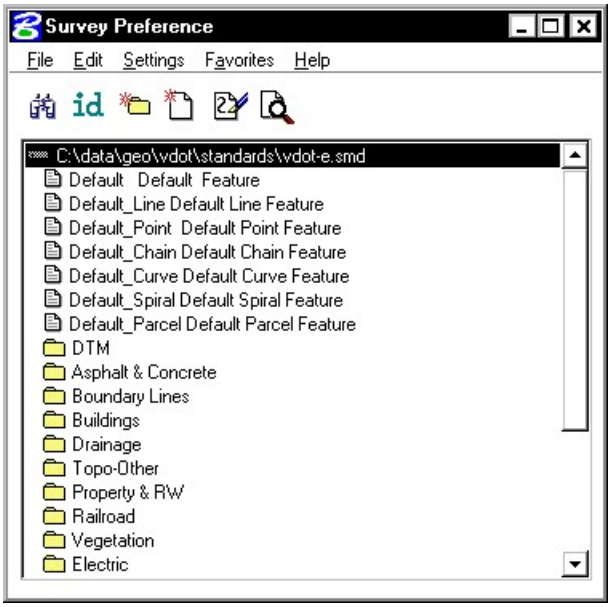
1.4 Feature Preferences

From the main user preference dialog access can be gained to the GEOPAK survey manager database or .smd file. The SMD file is where feature preferences are set so that the field-collected features are mapped according to desired symbology. By pressing the **Feature Preferences** the following dialog is invoked.



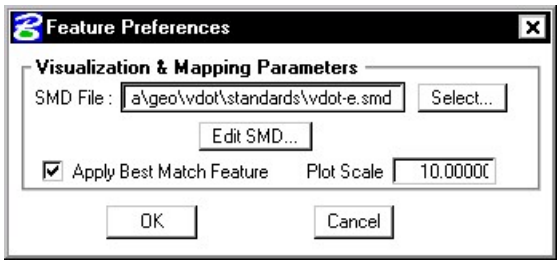
The SMD File keyin allows for the selection of the desired database.

From this dialog, if the **Edit SMD** button is selected, access is granted to the database via the dialog below.



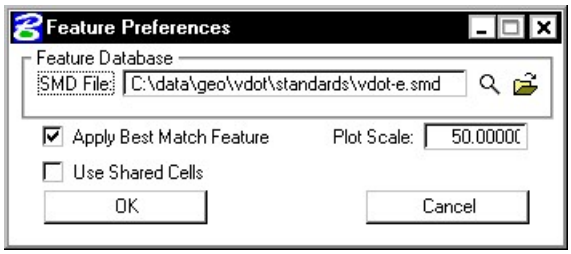
From this dialog interface, a complete database can be configured to the desired symbology for individual features. This database contributes to consistency agency wide when field data is mapped into a MicroStation file.

The other two options from the **Feature Preferences** dialog, **Apply Best Match Feature** and **Plot Scale**, allow the user to not only to vary scales of the features when mapped but also to control how the software matches field codes to those found in the database itself.



When the **Apply Best Match Feature** toggle is activated, the program, when processing the data, will search the database for a candidate feature code that most closely matches the code as entered in the field. This can be used to your benefit when collecting multiple, like features.

The last option on the Feature Preference dialog is the **Use Shared Cells** option. When selected the program will enforce the use of shared cells when placing multiple instances of a feature, such as trees.



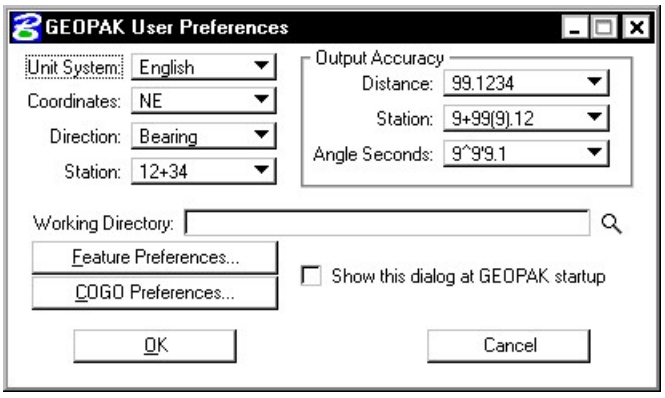
User Preferences

Introduction

Step 1. Open the MicroStation file **c:\data\geo\vdot\s1373\s1373.dgn**

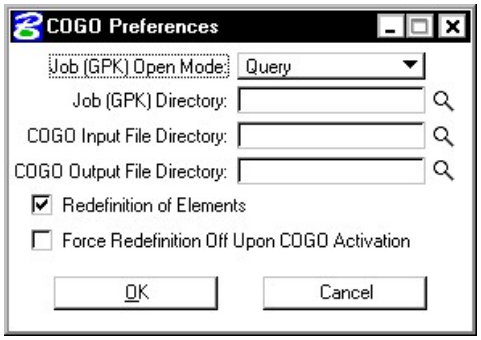
Step 2. Access the GEOPAK User Preferences dialog from the Applications pulldown. **Applications > GEOPAK Survey > User Preferences.**

Step 3. The **User Preferences** dialog will appear as shown.

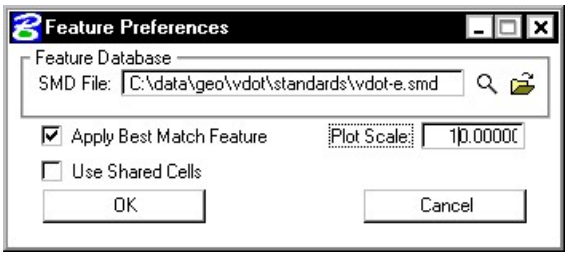


Step 4. Access the COGO Preferences dialog by pressing the **COGO Preferences** button.

Step 5. Set the preferences in the dialog as shown on the dialog below and press **OK**.



Step 6. From the main User Preference dialog, press the **Feature Preference** button.



Step 7. The SMD file for this project will be c:\data\geo\vdot\standards\vdot-e.smd. Press the **Select** button to navigate to: c:\data\geo\vdot\standards\vdot-e.smd

NOTE: Most agencies assign one person as the caretaker of the SMD file and this file is password protected. The password protected SMD file is made available to all users. This helps ensure consistency in data that is processed.

Coordinate Geometry

2.1 Introduction

Objectives Learn to set up and access the coordinate geometry database. Become proficient in using GEOPAK Coordinate Geometry.

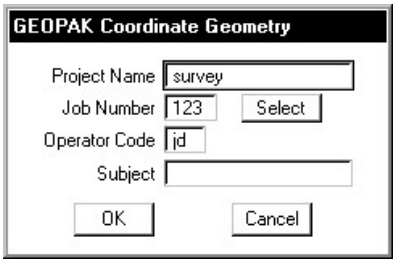
Tool

Menu Bar Application **GEOPAK Survey > Geometry > Coordinate Geometry**

The Coordinate Geometry dialog is an interactive graphical user interface for storing coordinate geometry elements: points, lines, curves, spirals, chains, parcels and profiles as well as calculate roadway superelevation.

2.2 Accessing COGO

If Coordinate Geometry is started from the Survey Tools icon instead of the Survey Operations dialog, (without Project Manager running) then the Start-Up Dialog appears.



The fields in the Start-Up dialog are detailed below.

Project Name Name displayed on reports. This is an optional entry, with a maximum of 60 alphanumeric characters. If Project Manager is active, this field is populated automatically.

Job Number Identifies coordinate geometry database and is a required field. The job number is a maximum of three alphanumeric characters. If Project Manager is active, this field is populated automatically.

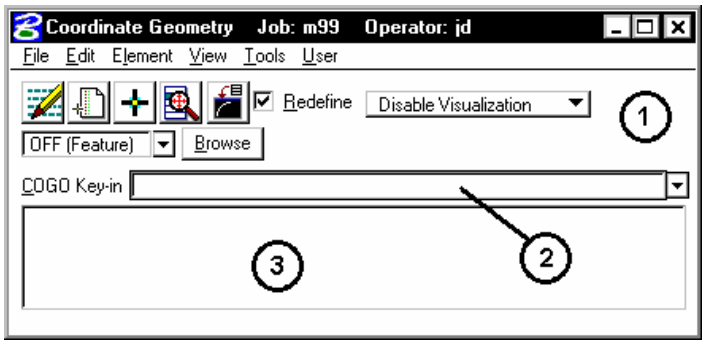
Operator Code Unique 2-character code which enables multiple users access to database. The user's initials are suggested. Note this field is not required for single user access, but highly recommended. If Project Manager is active, this field is populated automatically.

Subject Description for audit trail file with a maximum of 48 alphanumeric characters. Note this field is optional.

Note: The Job Number is the only required field, although the Operator Code is useful for saving the audit trail and required for multiple user access.

After the dialog is populated, and the **OK** button is pressed, the main coordinate geometry dialog is invoked.

2.3 Coordinate Geometry Dialog

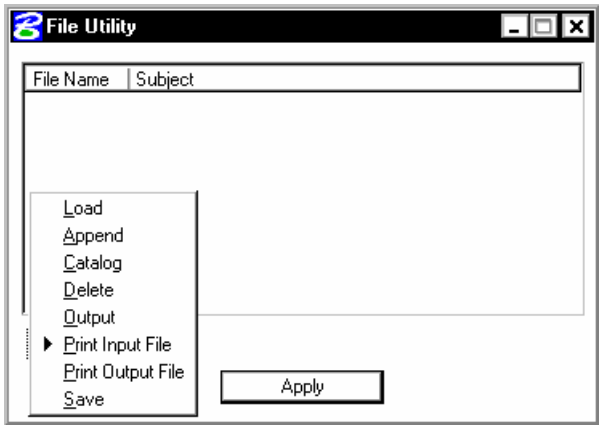


The coordinate geometry dialog box is made up of three separate display areas:

- **Tool Bar** (1) consisting of pull down menus and icons. The icons are customizable.
- **Command Key-in** (2) enables manually typing of commands. The drop down button allows for a history of commands to be seen.
- **Output Display Window** (3) shows the results generated by the commands.

Note the dialog is resizable for ease of use.

2.3.1 File Utility Commands



The File Utility Commands are located from the File pulldown. They are detailed in the table below.

Load	When selected, a menu appears listing all saved input files. Highlight a file, then click the OK button. The input lines from the highlighted file are now displayed in the display window for viewing, editing, or processing.
Append	This command is for *input files* only. A new input file is created by copying the contents of an existing input file to the end of the current input file. The

Save command must be used in order to store this new file.

Catalog When selected, a menu appears listing all saved input files (under the current operator code) in the project directory. This is for reference only, no action is taken.

Delete When selected, a menu appears listing all saved input files. *Highlight* a file, then click the **OK** button to remove this file from your project directory. Although the file is deleted, the elements stored as a result of processing the commands are not deleted.

Output Writes an ASCII file of the current display for reviewing and / or printing. (Fname999.ooc, where 999 is the current job number and oc is the operator code).

Print Input File Sends your input file to the printer.

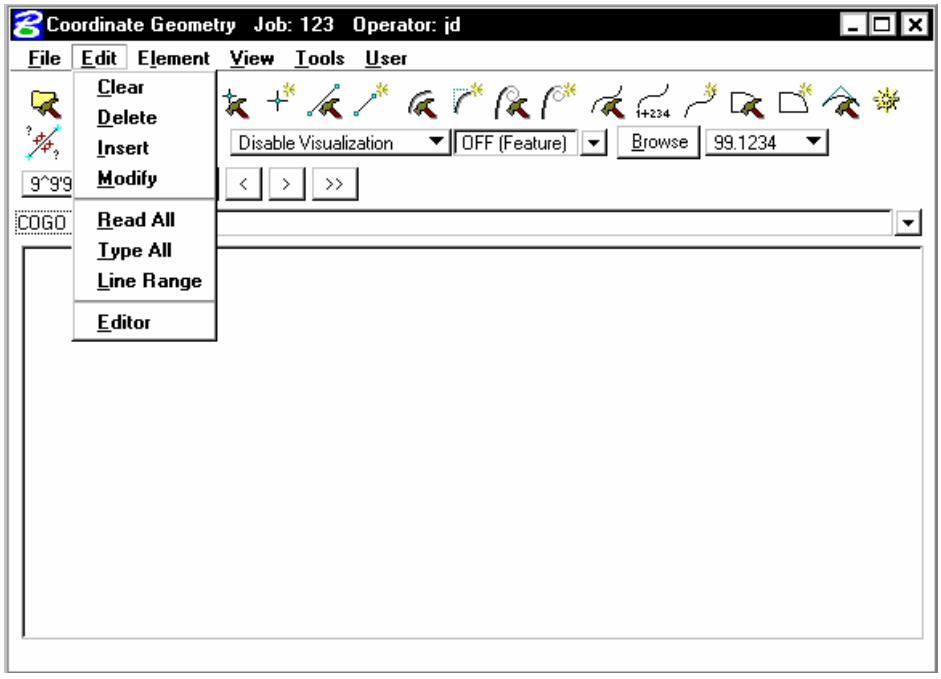
Print Output File Sends your output file to a printer.

Save Saves the current audit trail to a file. (Fname999.ioc, where 999 is the current job number and oc is the operator code.).

Additional File Commands

Export	Exports GEOPAK points, chains and profiles into formats for use in various data collectors.
Import	Imports horizontal and vertical alignments and points from various formats into the GEOPAK .gpk file.
Exit	Closes the COGO dialog box and ends the coordinate geometry session. A prompt to save the session appears. **Yes** saves the audit trail, **No** exits without saving, **Cancel** returns to the COGO session. Whether you pick **Yes** or **No** everything you did is still saved in the **.gpk** file.

2.3.2 Edit Commands



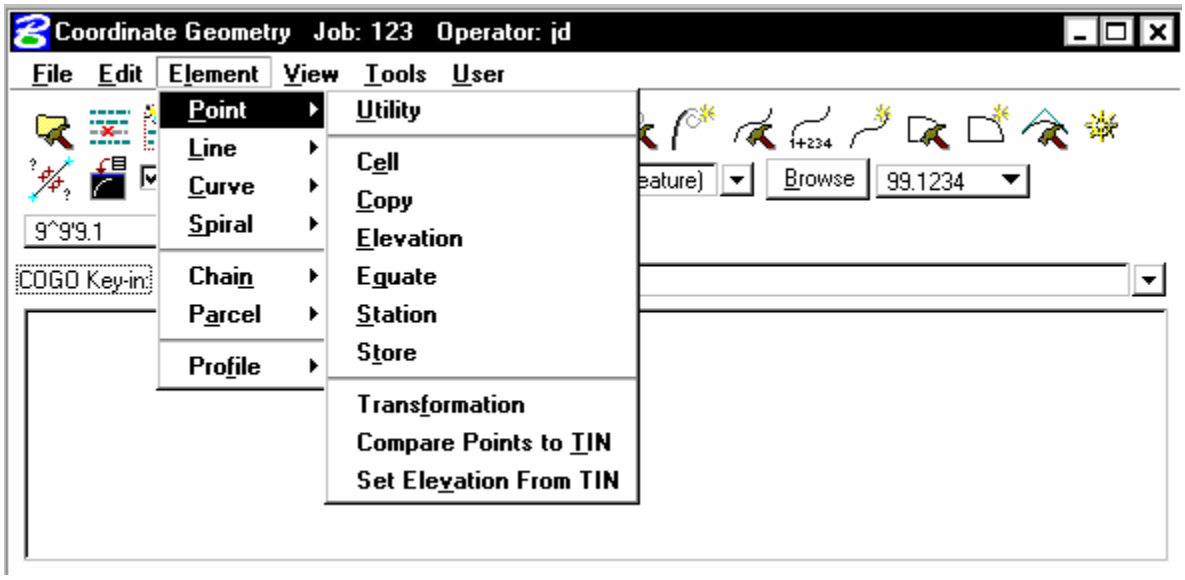
The Edit commands (as displayed in the exploded view above) are detailed in the table below.

Clear	Empties the memory of the current audit trail without saving and initializes the line numbers to begin a new sequence of commands. Note this does not clear the display window.
Delete	Deletes input commands in the input buffer by line number (or range of line numbers) and re-sequences the line numbers for the remaining commands.
Insert	Adds a command line to the current input buffer *before* a specified line number; subsequent command lines shift down and line numbering is automatically re-sequenced.
Modify	Changes a fragment in a command line. The modified command line is not processed until a Read command is performed.
Read All	Processes the specified lines in the audit trail. This may be done for the entire file (All) or by specifying a range of line numbers (Line Range).
Type All	Displays the content of the audit trail, (All) or a portion of the audit trail by specifying a range of line numbers (Line Range).
Line Range	Allows specifying a line range for reading or typing
Editor	Opens the GEOPAK COGO Command Editor, which enables the user to edit the current input file.

2.3.3 Element Commands

The mainstay of GEOPAK Coordinate Geometry is the various element commands. Tools are supported for storing, stationing, adding additional data, deleting, etc. GEOPAK supports a wide variety of elements: points, curves, spirals, chains or alignments, parcels, and profiles. Each element is detailed below.

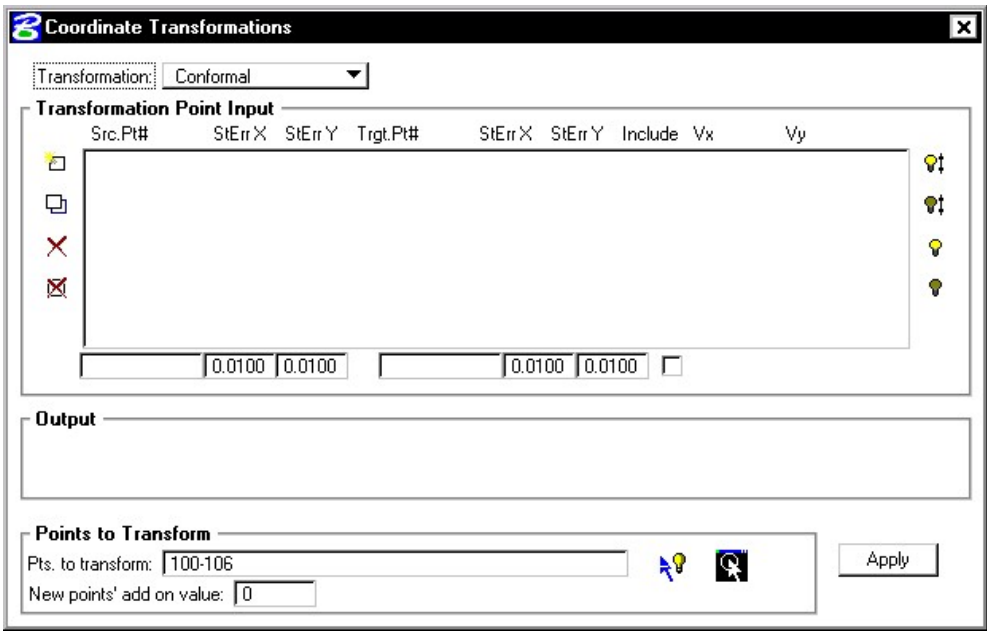
2.3.3.1 Element > Point



One of the most utilized sets of COGO tools are the point commands, as detailed in the table below. Cogo now has the ability to automatically determine the next available element name and place in any dialog storing an element. This includes all elements and dialogs listed on the above pulldown.

Utility	Provides option to Delete, Print and Display a point.
Cell	Assigns a cell name to a previously stored point.
Copy	Copies points or a point range to a new point number or range within the same GEOPAK database
Elevation	Assigns an elevation to a previously stored point
Equate	Stores a new point with the same values as a previously stored point
Station	Adds a station to a previously stored point.
Store	Stores a point by key-in coordinates or by selecting a location graphically. A station, elevation, point code, cell, feature, or description can be optionally stored with the point.

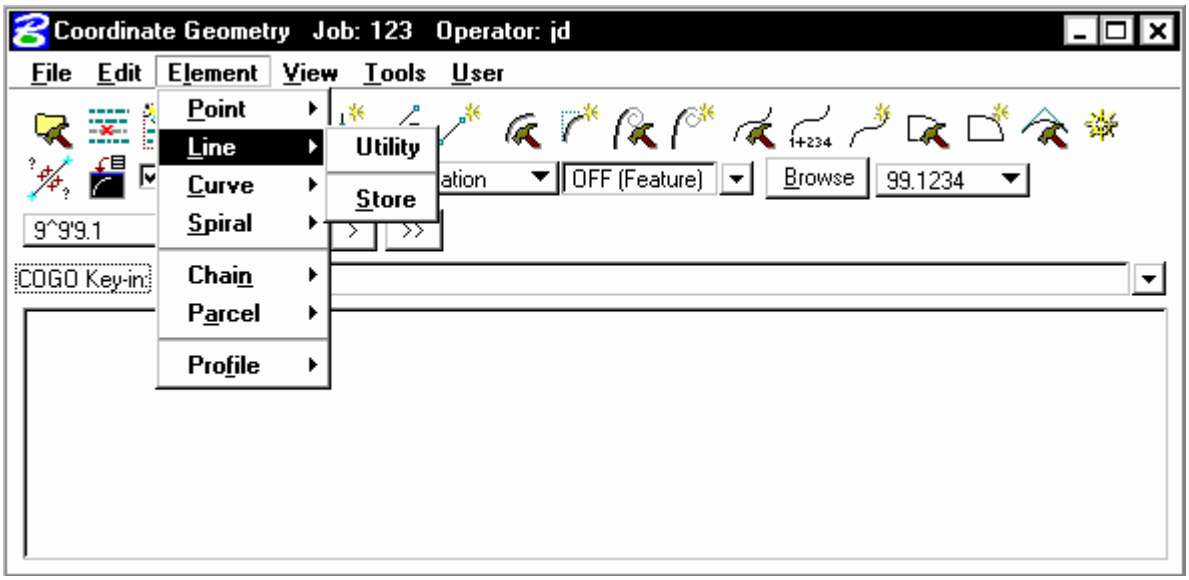
Transformation Used to transform a set of points to a new coordinate system.



Compare Points to TIN Utilizing a set of COGO points (with elevations) compares the COGO elevation to the TIN elevation and completes statistical analysis for "goodness of fit."

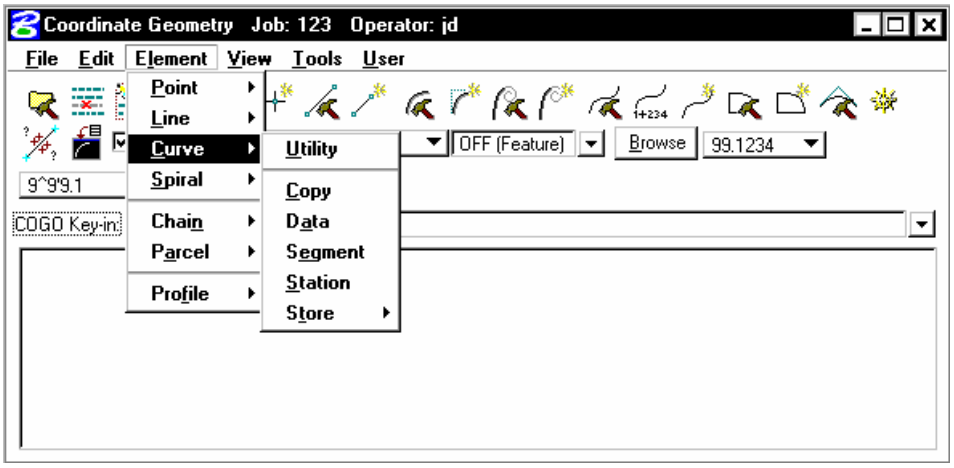
Set Elevation from TIN Utilizing this command, GEOPAK adds or updates an elevation to a previously defined point, based on a TIN model.

2.3.3.2 Element > Line



Utility	Provides options to Transpose, Delete, Print and Visualize.
Store	Allows input for storing a line.

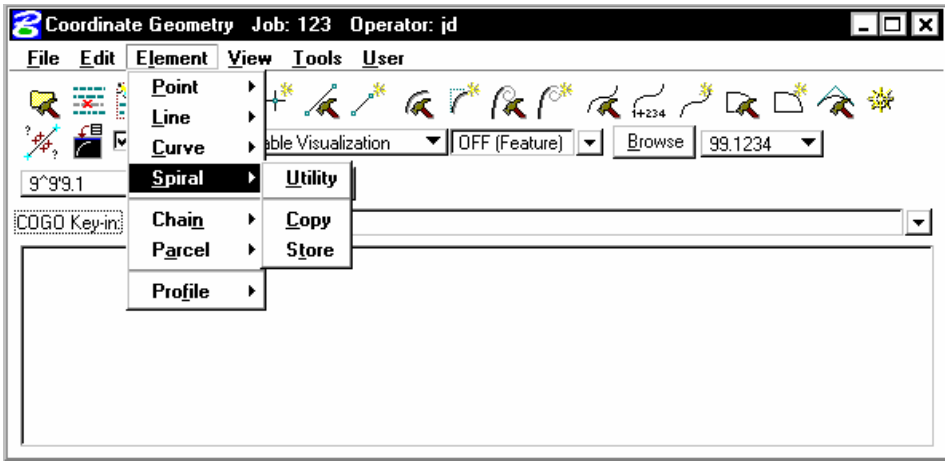
2.3.3.3 Element > Curve



The Curve commands (as displayed in the exploded view above) are detailed in the table below.

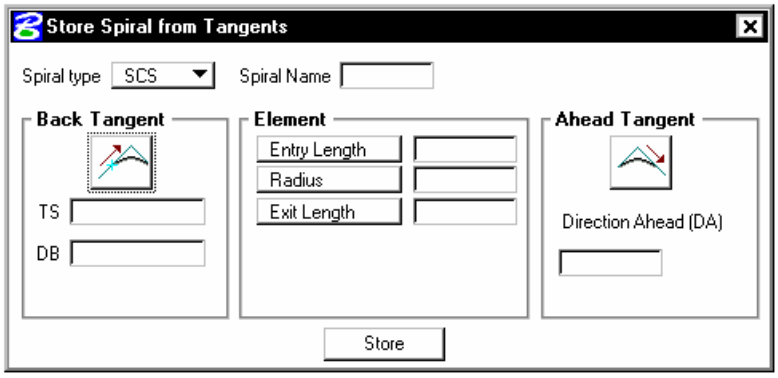
Utility	Provides options to Transpose, Delete, Print and Visualize.
Copy	Copies a specified curve to another curve name.
Data	Calculates the geometric parameters of a curve, displaying values for Delta, Degree, Tangent, Length and Radius.
Segment	Defines new curves by dividing a stored curve into segments.
Station	By identifying a curve and the position on the curve (PC, PI, or PT), a station value may be assigned.
Store	Provides various options for defining and storing lines and curves such as Store Curve from Tangents as shown below.

2.3.3.4 Element > Spiral

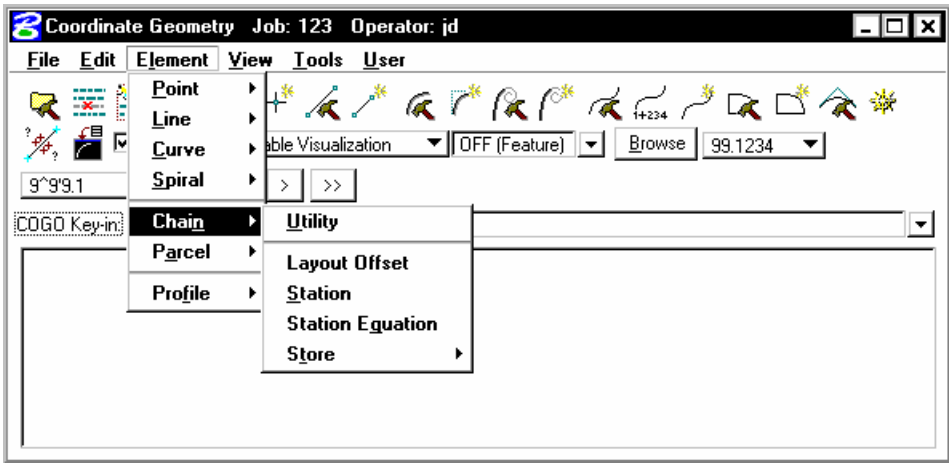


The Spiral commands (as displayed in the exploded view above) are detailed in the table below.

Utility	Provides options for Delete, Print and Visualize.
Copy	Copies a specified spiral to another spiral name.
Store	Provides various options for defining and storing spirals.



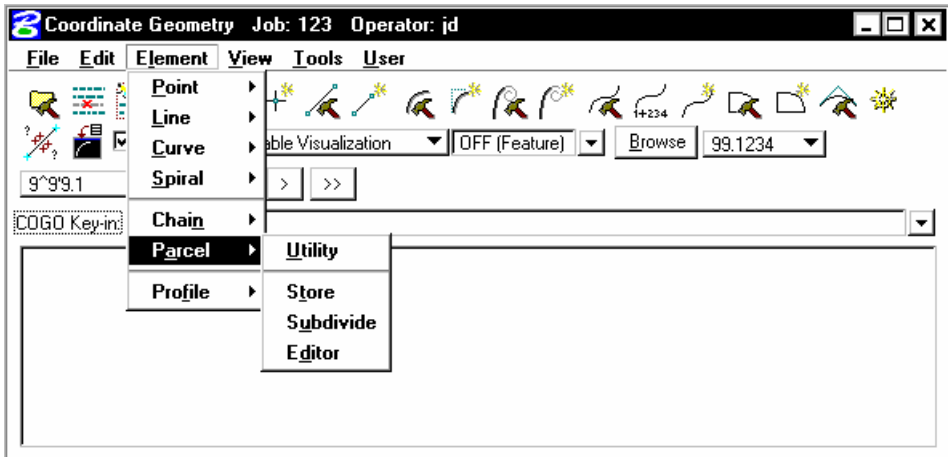
2.3.3.5 Element > Chain



The Chain (GEOPAK alignment) commands (as displayed in the exploded view above) are detailed in the table below.

Utility	Provides options to Compute chain Area, Delete, Describe, Print and Visualize.
Layout Offset	Provides a method for computing station and offset between chains and points or other chains.
Stationing	Provides a method for stationing or re-stationing a chain.
Station Equation	Provides a method for applying a station equation to a chain.
Store	Provides three options for storing a chain in the database, **From Elements, From Offset Chain and a Transition Chain.** (Chain name can be between 1-9 alphanumeric characters)

2.3.3.6 Element > Parcel



The Parcel commands (as displayed in the exploded view above) are detailed in the table below.

Utility	Provides options to Delete, Describe, Print and Visualize.
Store	Stores a parcel by adding points, curves and spirals.
Subdivide	Divides a parcel into individual lots.
Editor	Edits a parcel.

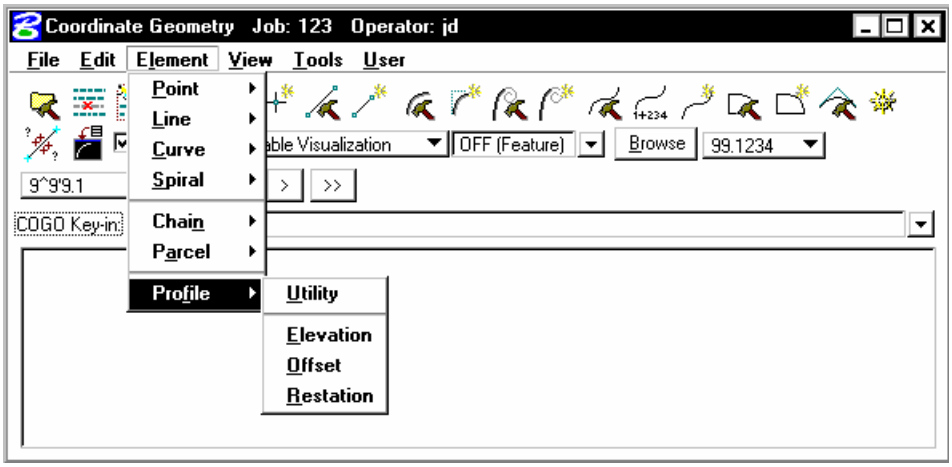
2.3.3.7 Parcel Commands (Manual Entry)

Several parcel commands are supported by manual entry or via the Map Check dialog. Each of these commands accept the input of specific names associated with each element. I.e. taken names, easement names, etc.

Store Taken	Store the portion of a parcel taken by entering point and curve names in either a clockwise or counterclockwise direction.
Store Easement	Store an easement by entering point and curve names in either a clockwise or counterclockwise direction.
Own Parcel	Stores the name of the owner associated with a previously stored parcel.
Make Legal	Creates a metes and bounds description and writes it to a user named text file. See also *Legal Description Editor* for the ability to create detailed and customizable legal descriptions.

For more detailed parcel information, refer to the *GEOPAK Manual* or online help.

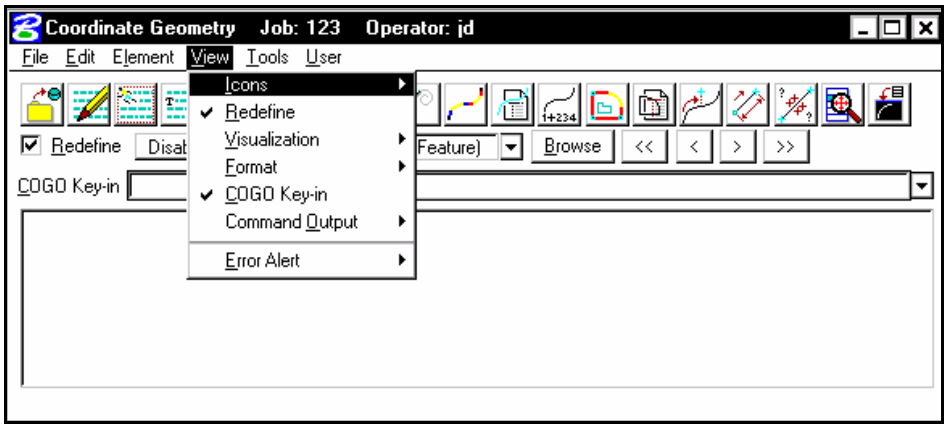
2.3.3.7 Element > Profile



The Profile commands (as displayed in the exploded view above) are detailed in the table below. Note additional commands are supported as keyin only commands. For details, refer to the GEOPAK Online Help.

Utility	Provides options for Deleting and Printing.
Elevation	Provides three options for reporting elevations along a selected profile, **Station**, **Even Station, Incremental Stations.**
Offset	Facilitates the copying of a profile in the vertical direction
Restation	Options for modifying station of an existing profile.

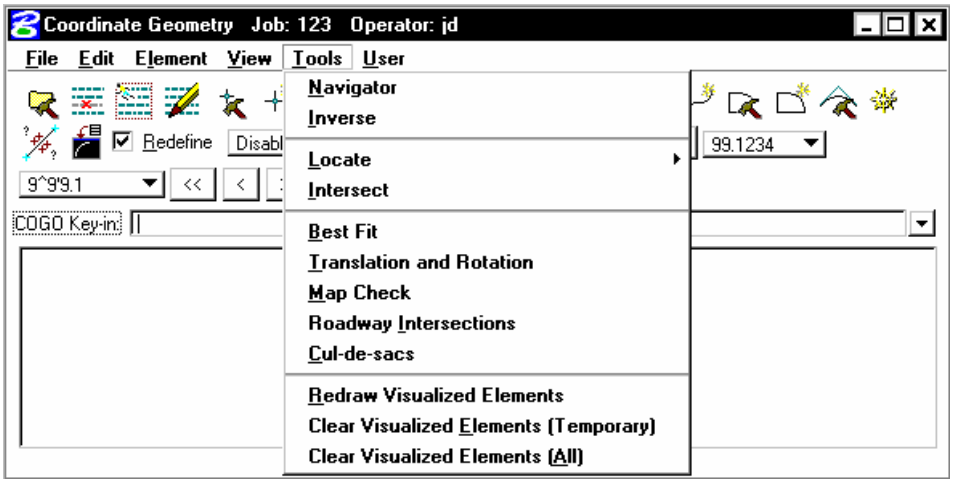
2.3.4 View Commands



The View commands (as displayed in the exploded view above) are detailed in the table below.

Icons	Enables the user to customize which icons appear in the tool bar.
Redefine	Displays the **Redefine** box on the tool bar.
Visualization	Displays the visualization items on the tool bar.
Format	Displays the format items (i.e. number of decimals, station format, etc.) on the tool bar.
COGO Key-in	Displays the COGO Key-in box for entering commands in the dialog.
Command Output	Displays the Command Output Window in the dialog box, and controls options for the Command Output Window.
Error Alert	Enables the user to activate a *beep* and/or restore a minimized COGO dialog when an error occurs.

2.3.5 Tools Commands

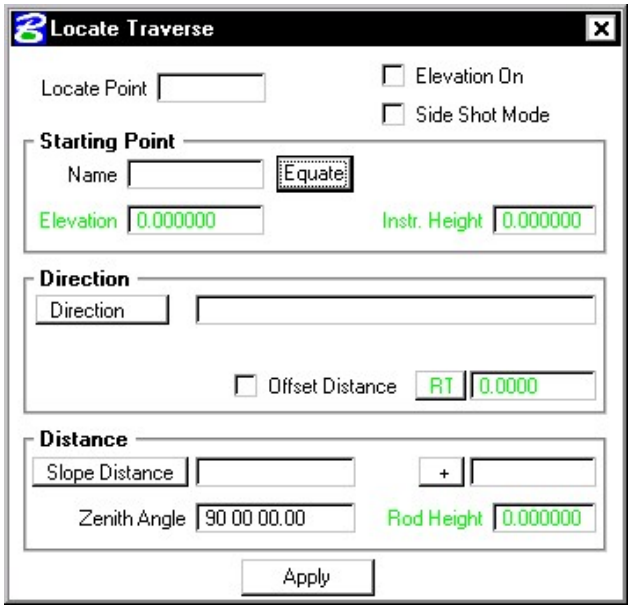


The Tools commands are detailed in the table below.

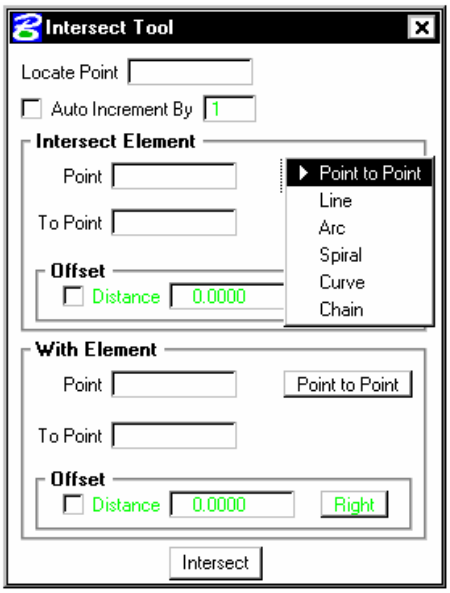
Navigator — Invokes the COGO Navigator.

Inverse — Calculates the distance and direction between points.

Locate — Stores a point not by specifying coordinates, but based on another point using several methods. To locate by distance and bearing, use the **Tools > Locate > Traverse** as depicted in the dialog below.



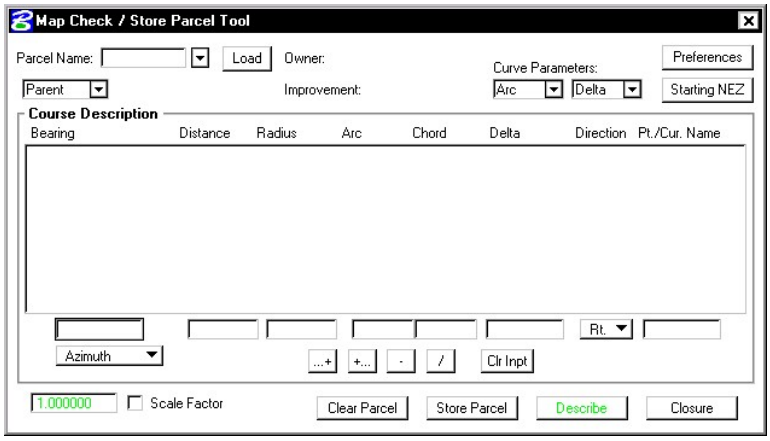
Intersect — Stores a point at the intersection of the defined elements



Best Fit Calculates a best-fit chain through a set of points.

Translation and Rotation Moves, rotates, and scales a data set.

Map Check Stores and/or Edits a parcel.



Roadway Intersection Calculates data for the intersection of two COGO elements, usually chains.

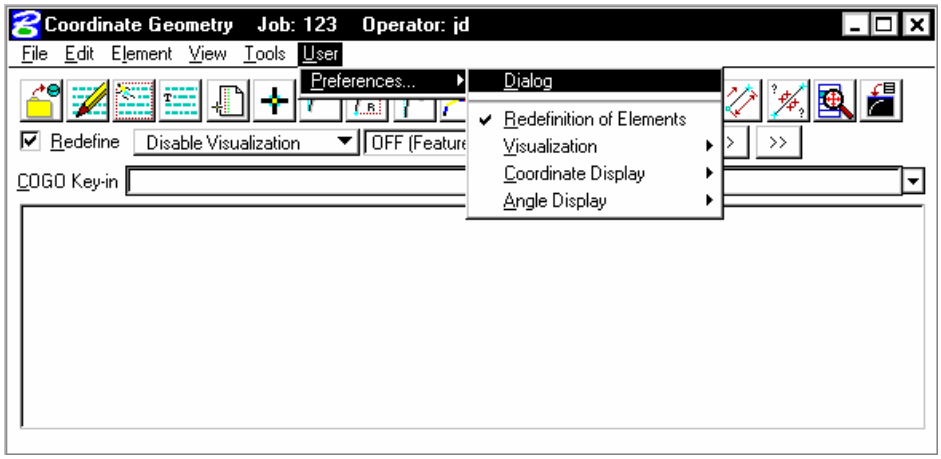
Cul-de-sacs Calculates data for a cul-de-sac.

Redraw Visualized Elements Re-syncs the displayed COGO elements in the MicroStation file with the coordinate geometry data.

Clear Visualized Elements (Temporary) Removes all temporary visualized elements from the view.

Clear Visualized Elements (All) Clears all temporary and permanent visualized elements from the MicroStation file.

2.3.6 User Preferences



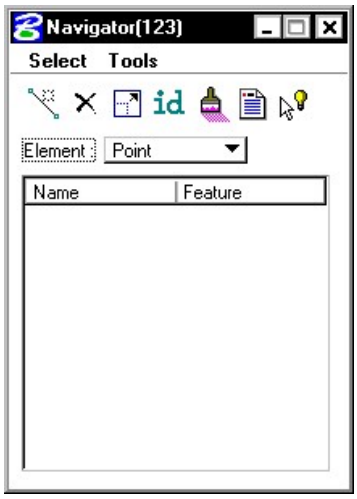
The User Preferences (as displayed in the exploded view above) are detailed in the table below.

Dialog	Allows access to COGO Preferences dialog box.
Redefinition of Elements	Toggles the Redefine option on/off. If Redefine is on, COGO data can be redefined/overwritten.
Visualization	Enables the elements to be displayed in the MicroStation file permanently or temporarily.
Coordinate Display	Toggles between displaying NE or XY coordinates.
Angle Display	Toggles between displaying Bearing or Azimuth.

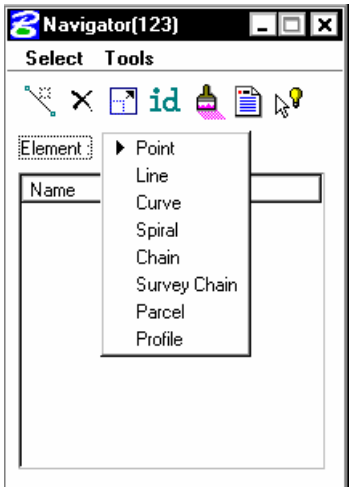
2.4 COGO Navigator

Feature / Function	View, edit and display COGO elements.
Tools	
COGO Menu Bar	Tools > Navigator

The COGO Navigator is a tool to easily view and edit COGO data. Store, edit, print elements, plus visualization and selection set commands are easily accessible via the Navigator, which can be accessed by the pull down menu **COGO > Tools > Navigator** or by the Navigator icon. The following dialog appears.

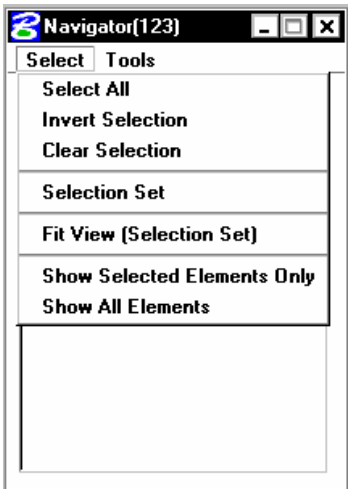


From the **Navigator**, points, curves, spirals, chains, survey chains, parcels, and profiles can be added, deleted, modified, identified, visualized, printed, or selected.



2.4.1 Navigator > Select Tools

A variety of selection tools can be invoked via the Select pulldown, as depicted in the exploded view below.

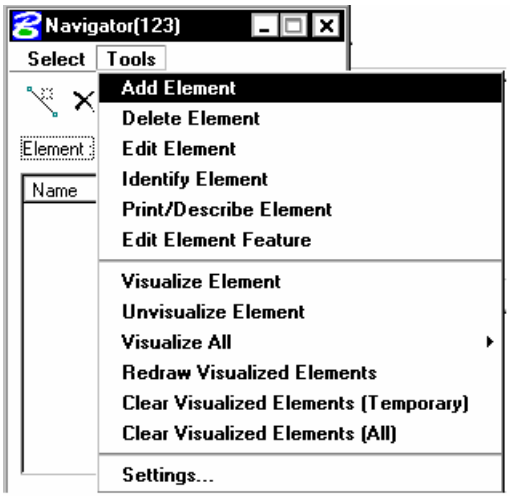


The tools are detailed in the table below.

Select All	Selects all data items of a certain type. (I.e. all points)
Invert Selection	Selects all items not previously selected, and unselects all items previously selected.
Clear Selection	Unselects all items.
Selection Set	Allows the user to create a selection set that meets particular criteria. Same as using the **Selection Set** icon
Fit View (Selection Set)	Fits the selected items to the active MicroStation window.
Show Selected Elements Only	Only the items in the selection set are displayed in the MicroStation window.
Show All Elements	All items in the database are displayed in the MicroStation window.

2.4.2 Navigator > Tools

A variety of tools can be invoked via the Tools pulldown, as depicted in the exploded view below. Many can also be invoked via the shortcut icons displayed at the top of the Navigator.



Add Element

Enables the selected type of element to be stored. When selected, the appropriate Store Element dialog is invoked.

Delete Element

Deletes the highlighted of element.

Edit Element

Invokes the appropriate Store Element dialog, populated with the associated data of the selected element for editing.

Identify Element

When pressed and a COGO element is graphically selected, the element is highlighted in the display field. If the selected element is not the displayed element type (i.e., curve or point), the element type is also changed.

Print/Describe Element

Displays the selected element's data.

Edit Element Feature
Changes the feature code of the element.

Visualize Element

Displays the selected elements according to their feature code or default symbology.

Unvisualize Element
Un-displays the selected elements.

Visualize All
Displays all of the elements of a certain type, or all elements.

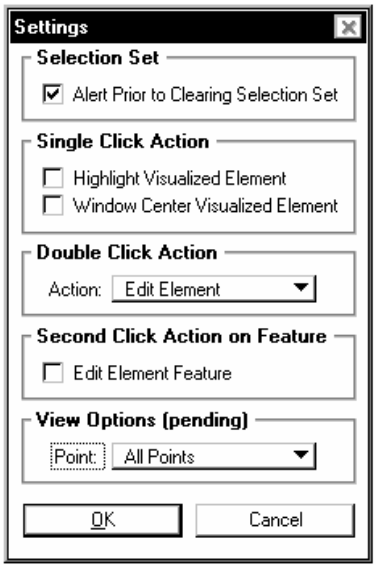
Redraw Visualized Elements
Re-syncs the coordinate geometry data with the data displayed in the MicroStation file.

Clear Visualized Elements (Temporary)
Clears only temporary visualized elements from the view.

Clear Visualized
Clears all visualized elements from the MicroStation file.

Elements (All)

Settings Enables the user to define certain actions and behaviors of the Navigator.



2.5 COGO Best Fit

Feature / Function	View and edit COGO points to determine best fitted alignment.
Tools	
COGO Menu Bar	Tools > Best Fit

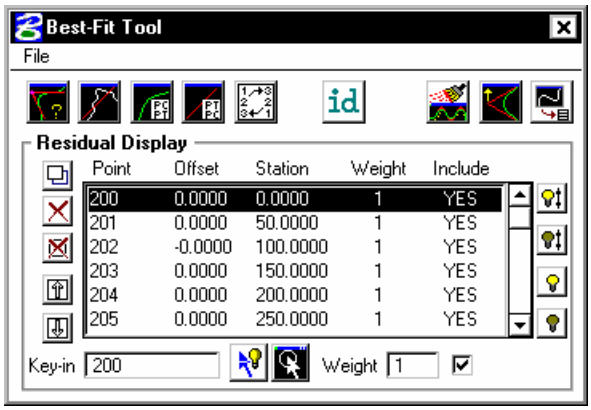
Based on a series of points the GEOPAK Best Fit Tool can determine the best fitting line, curve, or alignment using a combination of least squares methods and other residual based computations.

The GEOPAK Best Fit Tool supports the following features:

- Mass selection and sorting of points in any order or by key-in
- Single solutions for lines and curves can be computed as well as an entire alignment of tangent curves
- The user can automatically locate where the tangent and curve break points (Line to Arc) are or insert/delete them manually
- The user can interactively force the geometry to the location desired by including/excluding points, changing weights, and/or designating how many and which points are between the break points
- Instant visualization of where and what the residuals are and in which direction from the calculated geometry, by using color codes
- Best fit residuals are always perpendicular to the computed geometry
- Fast point and click navigation to the desired points of interest
- The user is able to invert the list of points so that the desired direction of the line, curve or alignment is correct.

- The points are always read from the database on every calculation
- Compound curves are automatically computed when curves overlap (no two consecutive curves can overlap)
- To display points with offsets add the point to the list but do not include it in the calculation (turn it off by using the light bulb)
- Full capability to modify the tangents and curves to the desired locations after the best fit has been done
- Generates the required commands for automatic input into the GEOPAK coordinate geometry database file, with audit trail.

The best fit tool should be used like a calculator to get the near best fit possible element for the given points, which can be accessed by the pull down menu **COGO > Tools > Best Fit** or by the Best Fit icon. The following dialog depicted below is displayed.



2.5.1 Best Fit > File

This file is used to save the order of the points and the placement of the PCs and PTs and if the point is included in the computations of the best fit or not. This file then can be imported (opened) back into the list at a later time in order to finish any modifications to the best fit list. IMPORTANT!--Any modifications such as moving tangents or changing the radius of the best fit curves will not be saved in this file, it is strictly just to get the order of the points back in to the list. This file can be modified to change the order or to place PCs or PTs if the user already knows where they need to be placed. Be careful, all PCs have to have a coinciding PT following it further down in the list. Changing the radius in this file will not change the radius in the dialog box. Once the (.bft) file is opened, the best fit least squares routine will do the calculations. Doing this sort of bypasses having to import the points all over again and then trying to figure out where the geometry (PCs and PTs) need to be.

Open

The Open option invokes a File Manager, wherein the Points (.bft) File may be selected. One sample format of this file is depicted below.

```
Point     Offset     Station     Weight     Include
-----     ------     -------     ------     -------
200      0.0000      0.0000        1          YES
201      0.0000      50.0000       1          YES
```

```
PC      Rad=      2000.0000     Tan=    771.0674
202     0.0000     100.0000     1         YES
203     0.0000     150.0000     1         YES
204     0.0000     200.0000     1         YES
205     0.0000     250.0000     1         YES
206     0.0000     300.0000     1         YES
207     0.0000     350.0000     1         YES
PT      ------     --------     ----      ----
209     0.0000     450.0000     1         YES
210     0.0000     500.0000     1         YES
```

Save The save option saves current data to active file.

Save As The Save As option saves current data to new file.

2.5.2 How The Best Fit Process Works:

Best Fit calculates the best fit line until geometry (PCs and PTs) are added to the list.

If the there is only one PC and one PT and they are located at the ends of the list the result will be a best fit curve, only if the number of points between the PC and PT exceed the “Pass Thru Point” number.

The process of computing the tangent curve alignments works by calculating the best fit lines and intersecting them to get the PIs. It then computes the curves by least squares or by the average radii of the “Pass Thru” points to obtain a radius. Once a radius is computed, the corresponding PI gets assigned the radius value and then the alignment is generated. (Piece Wise Method)

2.5.3 Fit > Tools

Add Geometry (Best Guess)

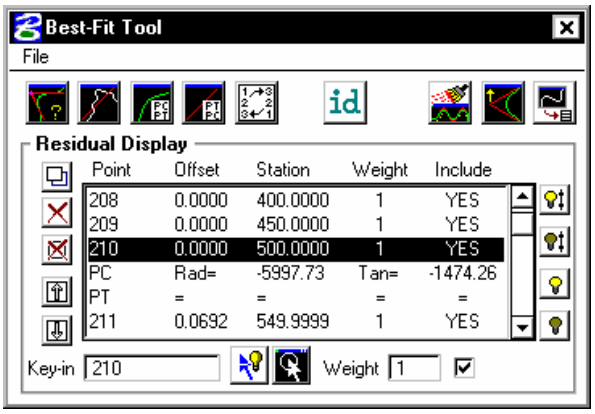
Commences the Best Fit processing. Use this icon if you want to let Best Fit automatically determine where the PCs and PTs are to be placed. It uses the “Max Radius” value to determine this “best guess” placement of geometry. It will not place any PIs (point of intersections) for alignments. You will have to do this manually with the Insert Curve Tool.

Delete All Geometry

Deletes all geometry (PCs and PTs) created with the Best Fit Processing.

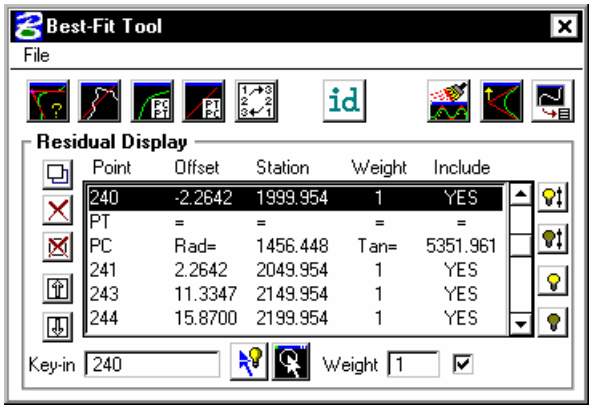
Insert Curve

Highlight the point in the Residual Display just above where the curve is to be added, then press the **Insert Curve** button. The list box changes as depicted below where the new curve was added. When a PC and PT are adjacent to each other as shown, this tells best fit to intersect the two lines into a point of intersection (PI) or really it is a curve but it has no radius. Only until there is a point between the PC pt1 PT will there be a curve radius calculated. If there is only one point between, the curve will pass thru the single point exactly. If there are two points between, the radius of the curve is determined by the average of the two separate radii. If there are four points between and the “Pass Thru Points” threshold is set to three the radius will be calculated based on a least squares routine instead of an averaging of radii.



Insert Tangent

Highlight the point in the Residual Display just above where the PT and PC lines are to be added, then press the **Insert Tangent** button. The lines are added as depicted in the dialog below.



A tangent can only be inserted within a curve (previous PC). When a PT and PC are adjacent, best fit will test to see if the curves should be a compound or leave as a small tangent in the middle of two curves. This tangent is considered to be unknown (less than two points on it), therefore both curves on each end have to be known (more than the "Pass Thru Points" number on it). If an unknown tangent is adjacent to and unknown curve, the solution is impossible and the user will be told that there are **Too Many Unknowns.** The quickest way to fix this is to make sure that all the tangents (PT .. PC) have at least two points between them or decrease the number "Pass Thru Points".

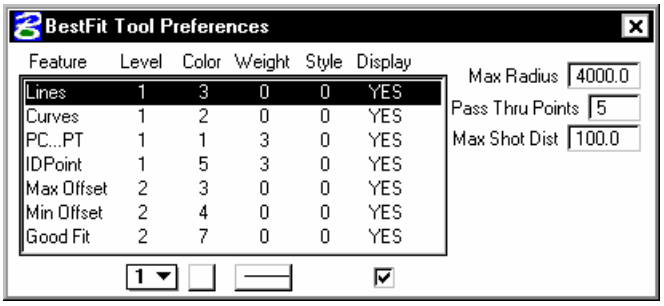
Invert List

Pressing this icon inverts the Best Fit list. For example, if the original list had 101, 102, PC, 103, PT, 104, and 105, and the icon was pressed, the inverted list would be 105, 104, PC, 103, PT, 102 and 101. Pressing the icon reverts the list back to its original listing.

Identify Point

Press this icon, then select a point by data pointing close to it in MicroStation and the corresponding point will be highlighted in the Residual Display list.

Preferences



Max Radius

The Maximum radius should be set to a number that is just above what the user thinks is the largest radius throughout the series of points. This does not mean that best fit will not calculate a radius above this number. This number is used only by the “Add Geometry Best Guess” icon when the user lets the computer figure out where the geometry (PCs and PTs) need to be placed.

Pass Thru Points

The number of Pass Thru Points can be set to any integer. It is the threshold of where a curve gets calculated by least squares or by just averaging the radii of each curve projected (pass thru) through each point: For example: if a curve has only 6 points to define it (above 17.2 .bft) and the pass thru threshold is set to 4, the curve gets a radius value calculated based on a least squares routine. In this same example if the pass thru threshold was set to 8 the curve would get a radius value that is calculated from the average of all 6 radii by the tangent curve that passed through each 6 points separately, holding the known tangents (200-201 and 209-210).

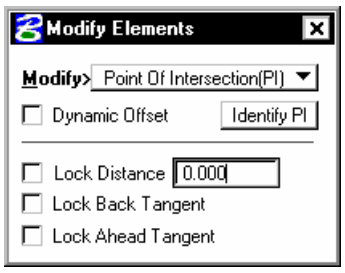
If the number of points on a curve (between the PC and PT) exceed the number of "Pass Thru Points" the result is a least squares calculation of the radius ... if under this threshold, the result is and average of the radii derived from having two tangents and passing a separate curve through each point.

Max Shot Dist

The Maximum Shot Distance should be set to a number that is just above the maximum distance between any two given points in the list. This value is very important for best fit to be able to automatically sort the points in order. If best fit finds that this distance has been exceeded, it will give an error message saying so.

Modify Elements (Done with Best Fit)

At this point, if the user modifies any of the elements, the user cannot go back to the best fit without losing all of the modifications (changes in radius, tangents, etc) This means no moving points around or shifting the PCs and PTs or including/excluding any points in the list box. (anything that would cause the best fit to do a recalculation).

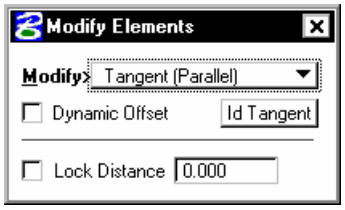


The Dynamic Offset toggle allows the user to see the visualized offsets

as the elements are being relocated. If this toggle is turned off the offsets will be displayed when the element modification has ceased.

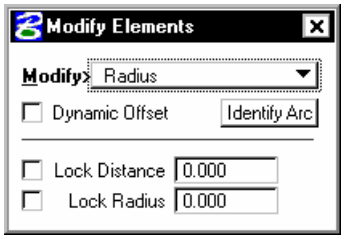
In this dialog, **Points of Intersection** can be modified. Press the **Identify PI** button, then select a PI or end of a line on the screen. The cursor is now attached to the selected element. Activate the desired locks and modify as desired.

Another modification option is **Modify Tangent**, as depicted below.



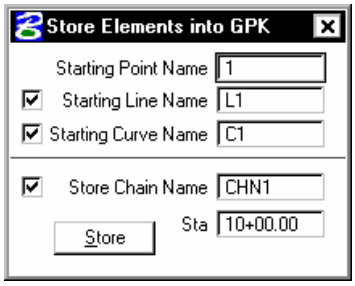
Press the **Identify Tangent** button, then select a tangent within the Best Fit elements on the screen. The cursor is now attached to the selected element. Activate the desired locks and modify as desired.

Another modification option is **Modify Radius**, as depicted below.



Press the **Identify Arc** button, then select an arc within the Best Fit elements on the screen. This is done by clicking near the PI of that curve. The cursor is now attached to the curve. Activate the desired locks and modify as desired.

Store Elements into GPK



When every element is considered to be the “best fit”, this icon will let the user store the line, curve, or alignment into the database file.

The **Starting Point**, **Line** and **Curve Name** are specified by the next available element in the database, along with the **Chain**

2.5.3 Best Fit > Manipulating Points in the Residual Box

The Residual Display group box contains the list box for points and associated data, edit buttons to add, edit, manipulate, and delete data in the list box, and Include / Exclude buttons to determine which data is included in the current Best Fit processing.

Get Pts from Navigator

For elements from the navigator, access the COGO navigator and highlight the desired point names. Then press the icon. GEOPAK automatically populates the dialog.

Pts from MicroStation Selection

For the selection set option, place the desired points in a MicroStation selection set, then press the icon. GEOPAK scans the selection set and populates the dialog automatically.

Pts from Key-in

Key-in the range of points in any order, one at a time or all at once. Best fit will then sort and order them based on the preferences set. Once geometry (PCs PTs) has been added the keyed in points will be placed into the list box after the current high lighted point, no automatic sorting will be performed.

Once the points are in the list box, they can be edited by use of the edit buttons located at the left side of the dialog and detailed below.

Modify

To modify, highlight the line to be modified and GEOPAK populates the edit fields. Change the desired field(s), then press the **Modify** button. This button is usually used to edit the weight of a given point.

Delete

To delete a point, simply highlight the line, then press the **Delete** button. If the user deletes a PC the next PT will also be deleted. If the user deletes a PT the next PC will also be deleted.

Delete All

To delete all the points in the list box, press the **Delete All** button. No highlighting is required.

Move Up

To move an entry up in the list box, simply highlight the line, then press the Move Up icon. Each pressing of the button moves the line up one place, and moves other entries down. No entry is deleted, their order is simply changed. The top entry cannot be moved up. A PC cannot be swapped with a PT.

Move Down

To move an entry down in the list box, simply highlight the line, then press the Move Down icon. Each pressing of the button moves the line down one place, and moves other entries up. No entry is deleted, their order is simply changed. The bottom entry cannot be moved down. A PC cannot be swapped with a PT.

PCs and PTs:

The two terms (PC and PT) are just representations of where the break between which points get calculated for a line and which are used for the curve. They are not where the PC and PT are going to be placed, but the user should attempt to move these PCs and PTs to where the actual curves begin and end to get a better fit of the data.

The user can change which points are utilized in the Best Fit, without deleting them from the list box. To accomplish this, the light bulbs located at the right side of the dialog are utilized, as detailed below.

The bright light bulb (top) activates all **Include** toggles, regardless of their current status. The darkened bulb (second one down) deactivates all **Include** toggles, regardless of their current status, which excludes them from the Best Fit. The bottom two light bulbs activates and de-activates the **Include** toggle. Note clicking on any line places the associated data directly below the list box AND changes the **Include** toggle from its current status. Note the column to the right of the **Weight** indicates whether the toggle is on (Included) or off (Excluded). If the user double clicks on the point in the list box, the **Include** status is toggled YES/NO accordingly.

The user can also change which points are utilized in the Best Fit, by giving them different weights. This is only used when the least squares methods are being used. If you have nine points in the list and they all but one have a weight of 1 and the other has a weight of a 1000, the solution will be a line that gets really close to that one point because it got put into the calculations 999 more times than the other points.

2.6 Additional Information

Additional COGO commands and information can be found in the *GEOPAK Manual*, or *on-line Help* under Applications – GEOPAK Survey – Help – Coordinate Geometry.

Coordinate Geometry

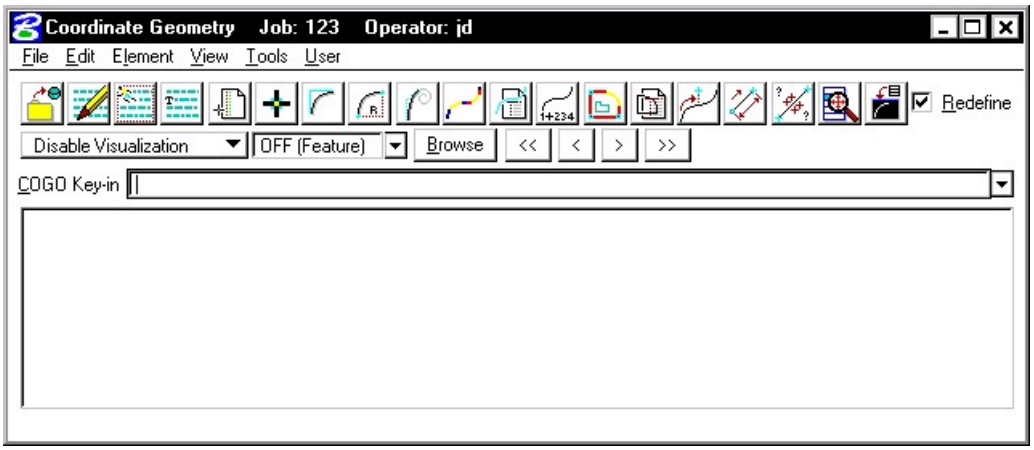
2.1 Basic Alignments

Step 1. Open the MicroStation file **c:\data\geo\vdot\s1373\s1373.dgn**.

Important: Before beginning, attach saved view ALIGN.

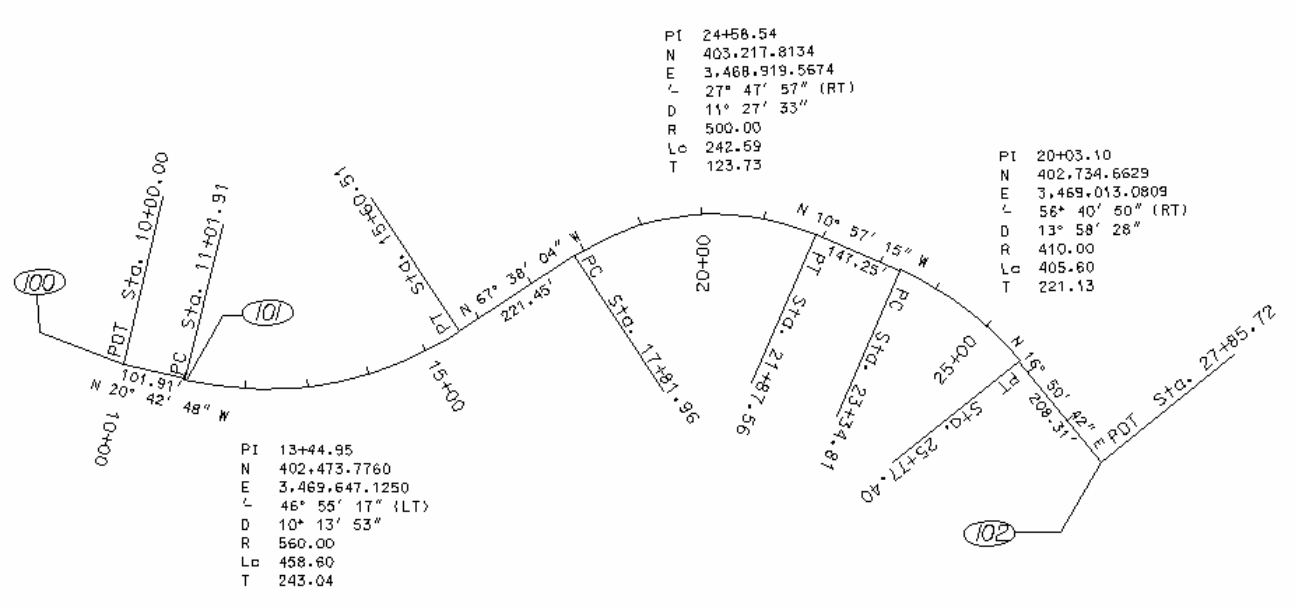
Step 2. Select the **Coordinate Geometry** icon.

Step 3. The Coordinate Geometry (**COGO**) dialog appears.



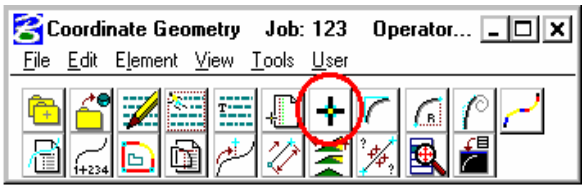
This dialog is completely resizable, so you can position it where you're most comfortable.

In the next few steps, we'll use Coordinate Geometry to store the following alignment:

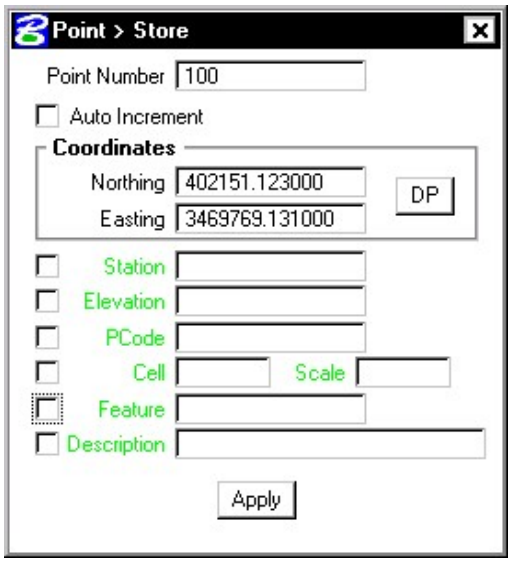


Step 4. Turn on the PERMANENT Visualization on the main COGO dialog.

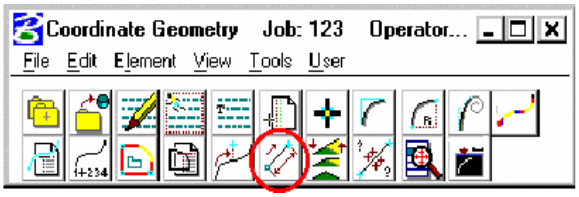
Step 5. Select the Store Point icon as depicted below.



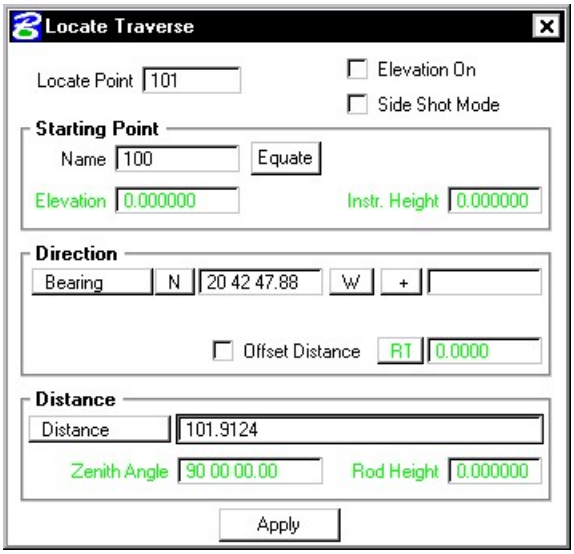
Store Point 100 with the coordinates shown.



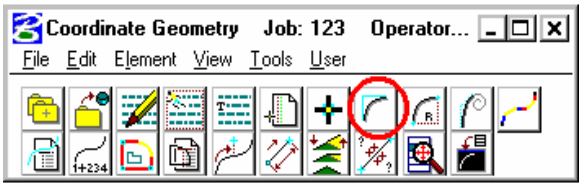
Step 6. Select the Locate Traverse icon as depicted below.



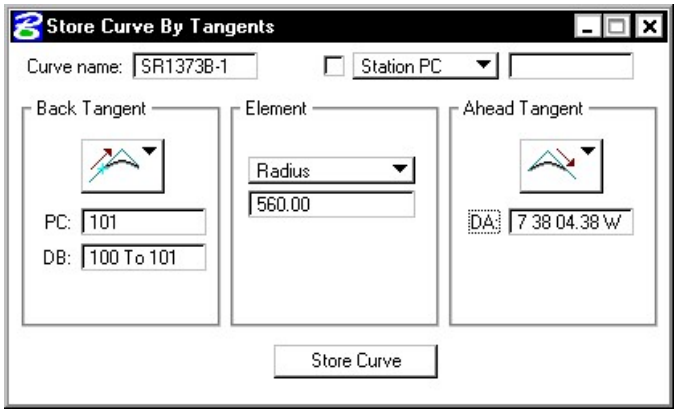
Locate point 101 as shown.



Step 7. Select the Store Curve from Tangents icon as depicted below.



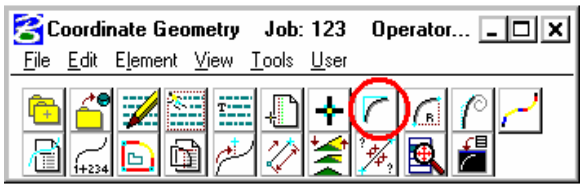
Store the curve SR1373B-1 as shown.



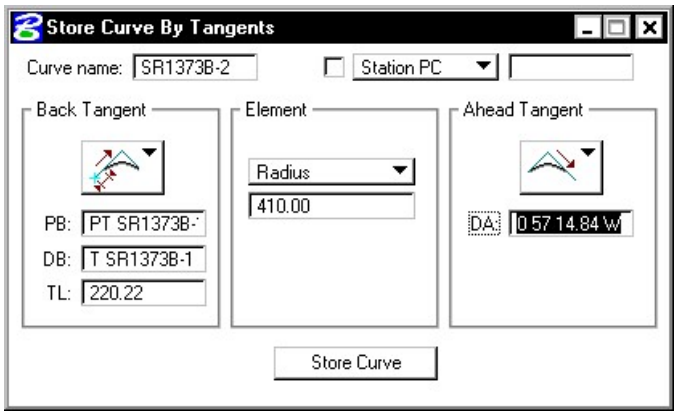
Fill in the **PC** field and **DB** field by selecting the Visualized points.

Note: The Direction Ahead (DA) is N 67 38 04.38 W.

Step 8. Select the Store Curve from Tangents icon as depicted below.



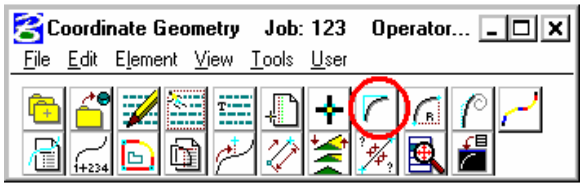
Store the curve SR1373B-2 as shown.



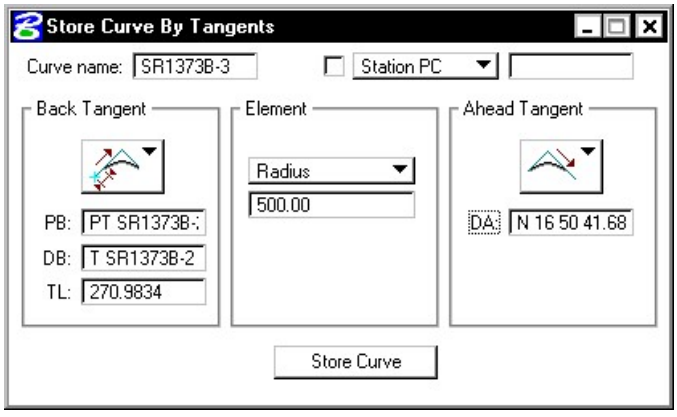
Notice that we can identify points by the PI, PC and PT of curves, even though a stored point doesn't exist at those locations.

Note: The Direction Ahead (DA) is N 10 57 14.84 W.
The DB is “PI SR1373B-1 TO PT SR1373B-1”.

Step 9. Select the Store Curve from Tangents icon as depicted below.

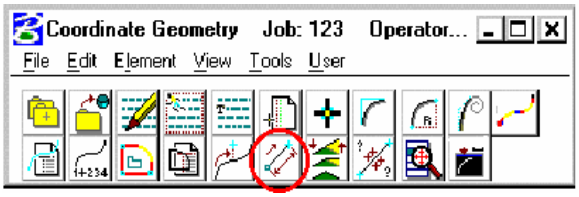


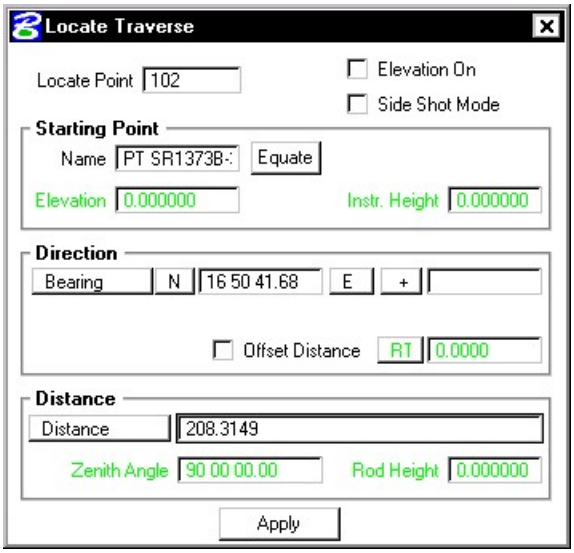
Store the curve SR1373B-3 as shown.



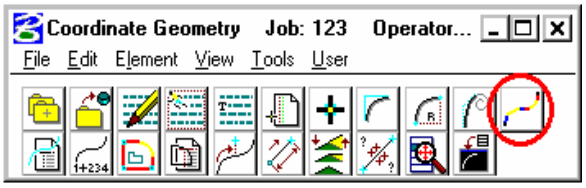
Note: The Direction Ahead (DA) is N 16 50 41.68 E.
The DB is “PI SR1373B-2 TO PT SR1373B-2”.

Step 10. Select the Locate Traverse icon as depicted below.

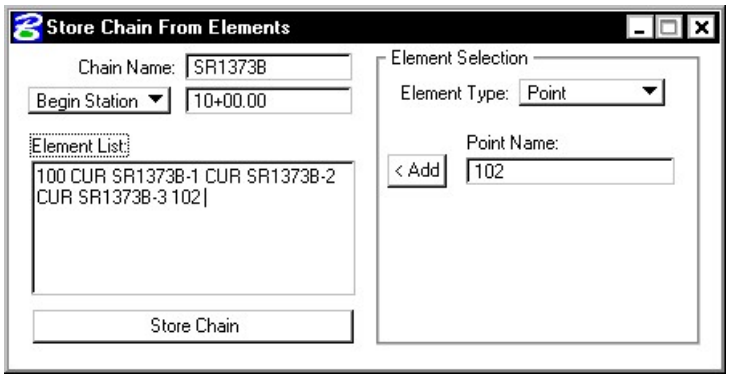




Step 11. Select the Store Chain From Elements icon as depicted below.

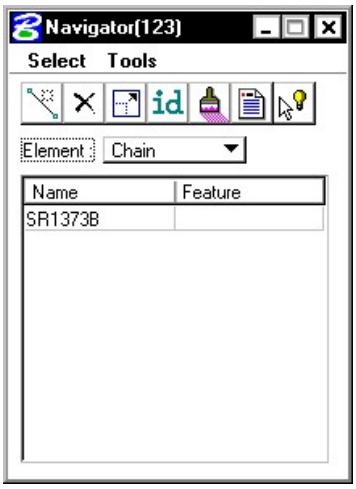


Store the centerline chain “SR1373B”.

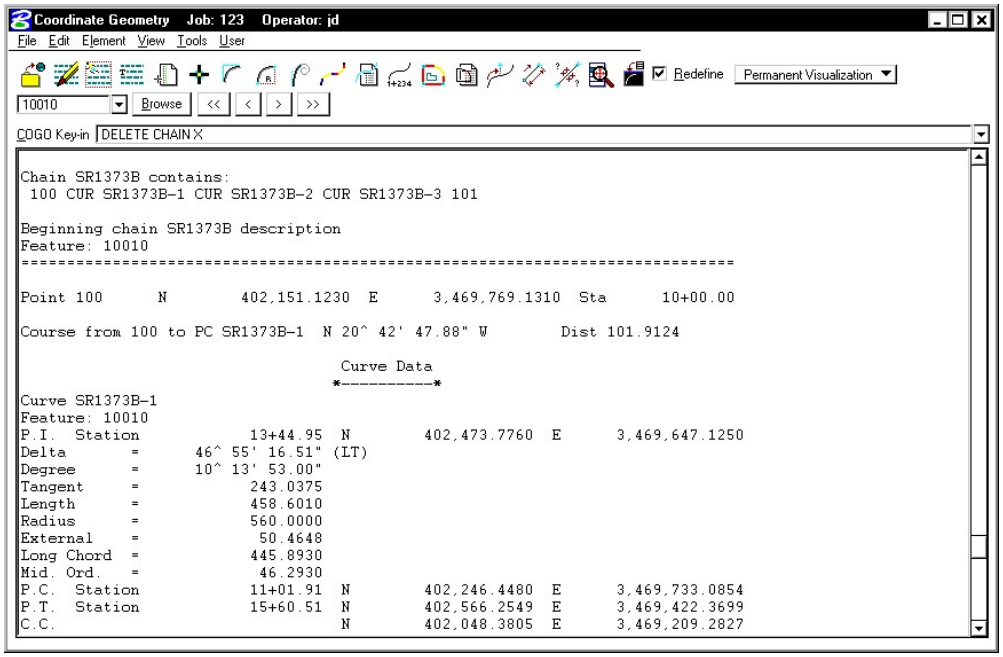


You can fill in the Elements field by typing OR by graphically selecting the visualized elements in the design file.

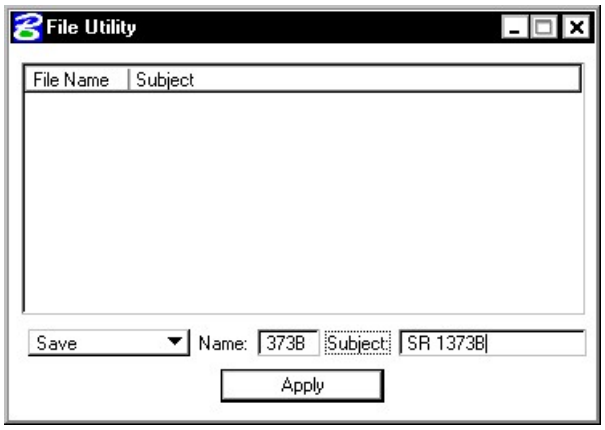
Step 12. Describe Cha “SR1373B.”



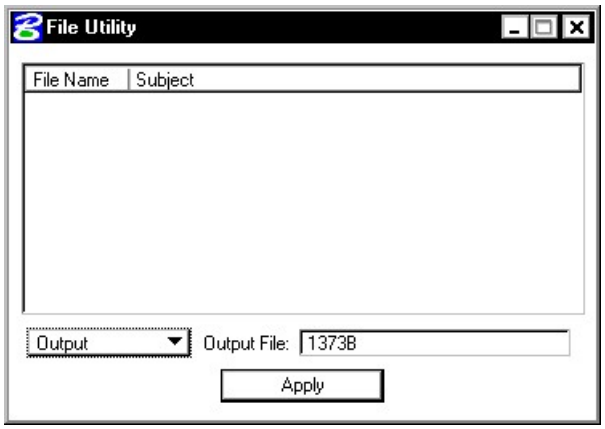
A fragment of the description is displayed below.



Step 13. Save an audit trail of your commands. You can access this dialog from the **File > Utility** pulldown and set the option toggle to **Save.**

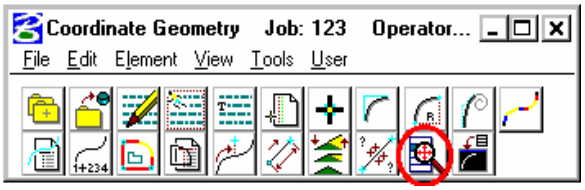


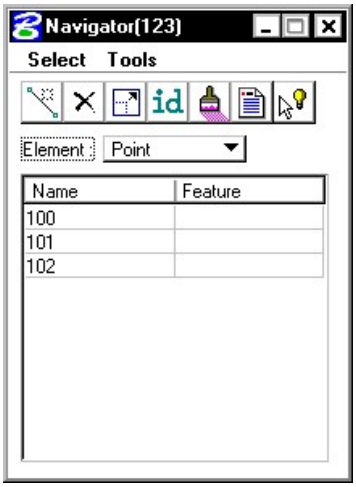
Step 14. Save an output file. You can access this dialog from the **File > Utility** pulldown and set the option toggle to **Output**.



Step 15. Review the input file and output file using the GEOPAK editor.

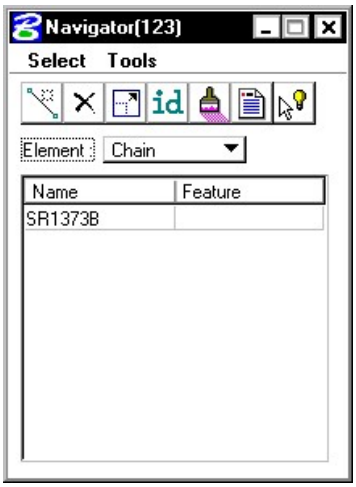
Step 16. Select the **Navigator** icon to access the Navigator dialog.





Step 17. Select points 100, 101, and 102 and **Visualize** by selecting the **Eyeglasses** icon.

Step 18. Change the element pulldown to Chains and **Visualize** chain SR1373B.



Step 19. **Exit** Coordinate Geometry.

2.2 Additional Alignments – Graphical COGO

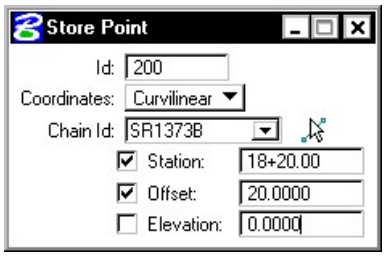
Important: Before proceeding, attach saved view BORROW.

Step 1. Open COGO and turn on the PERMANENT Visualization on the main COGO dialog.

Step 2. Select the Graphical COGO icon from the Road Tool Palette.

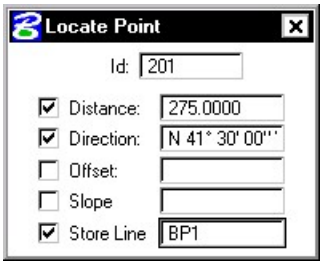
Step 3. From the Graphical COGO tool bar select the first icon for storing a point.

Store Point 200 using the dialog options as shown below.



Step 4. Select the Locate point icon from the Store Elements tool bar as depicted below.

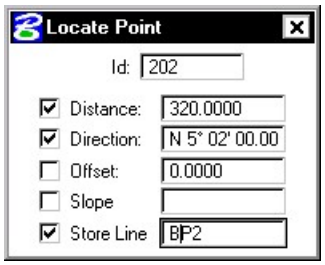
Locate Point 201 using the settings shown below.



The bearing from 200 to 201 should be N 41 30 00 W

This will store point 201 using the bearing and distance above. Be sure to activate the **Store Line** toggle so as to store **BP1** in the gpk file.

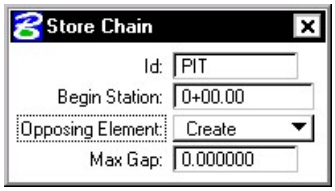
Step 5. Locate Point 202 using the settings shown below.



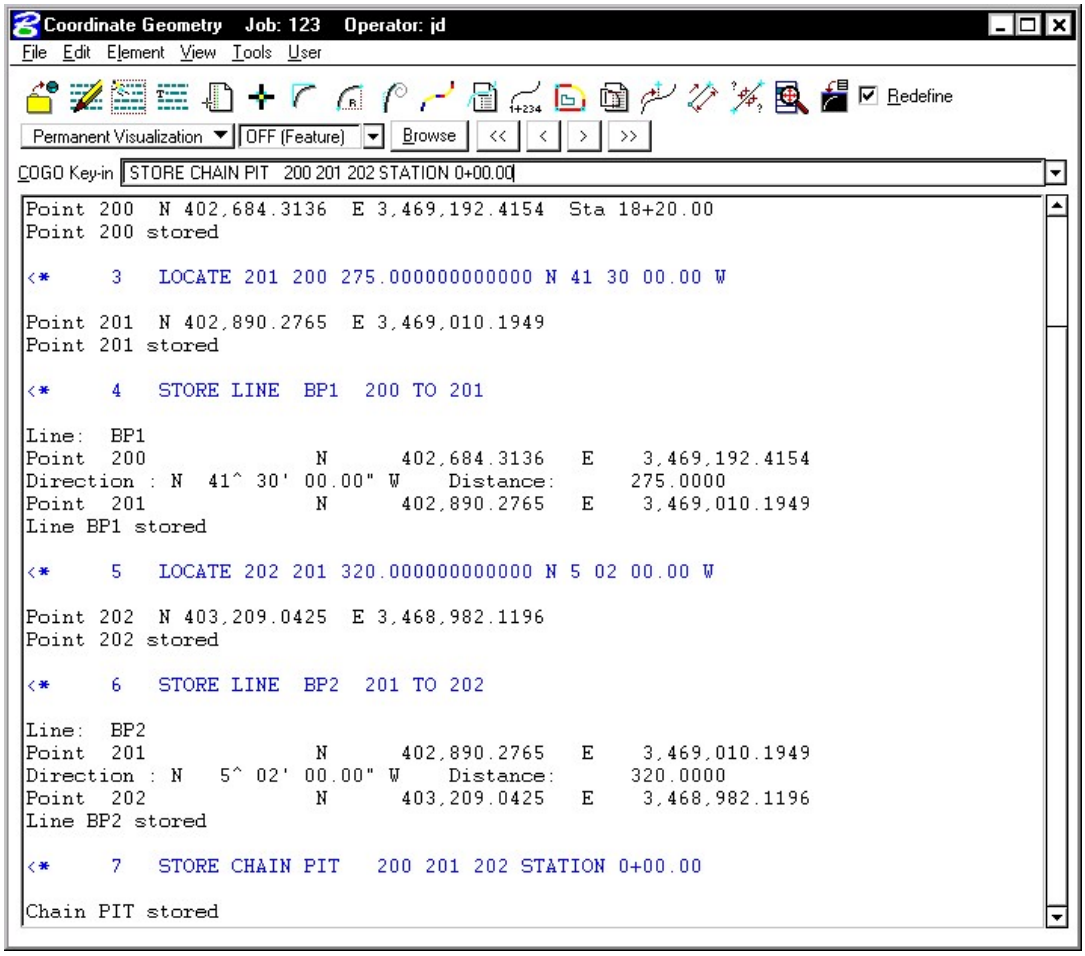
The bearing from 201 to 202 should be N 05 02 00 W

Step 6. Select the **Store Chain** icon from the Groups tool bar as shown below.

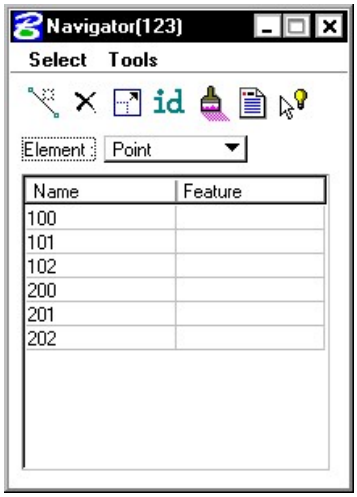
Step 7. Store the chain **PIT** as shown below by selecting the element **BP1** and **BP2** and using the dialog settings shown.



Below is an example of the correct syntax to store the baseline.



Step 8. Select the **Navigator** icon to access the Navigator dialog.



Select points 200-202 **and Visualize** by selecting the **Eyeglasses** icon.

Change the element pulldown to Chains and **Visualize** chain PIT.

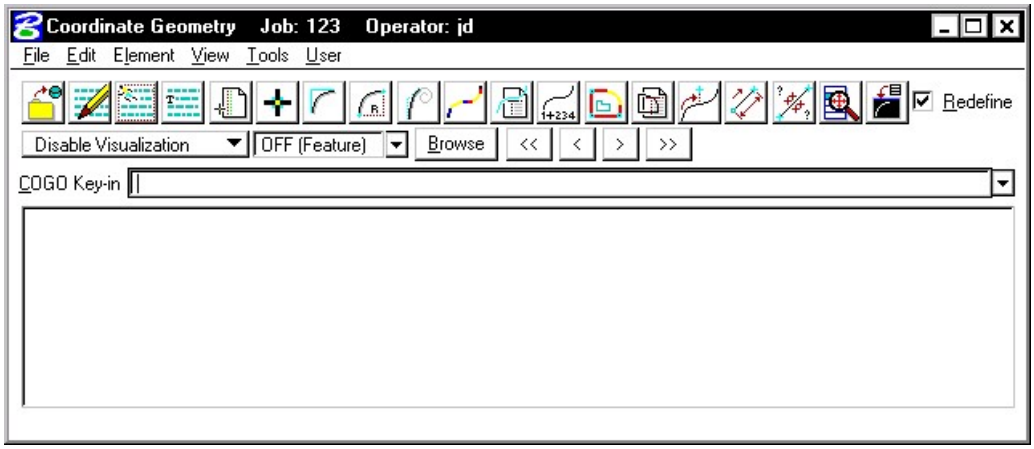
2.3 Additional Alignments – Spirals

Step 1. Open the MicroStation file **c:\data\geo\vdot\s1373\s1373.dgn**.

Important: Before beginning, attach saved view SPIRAL.

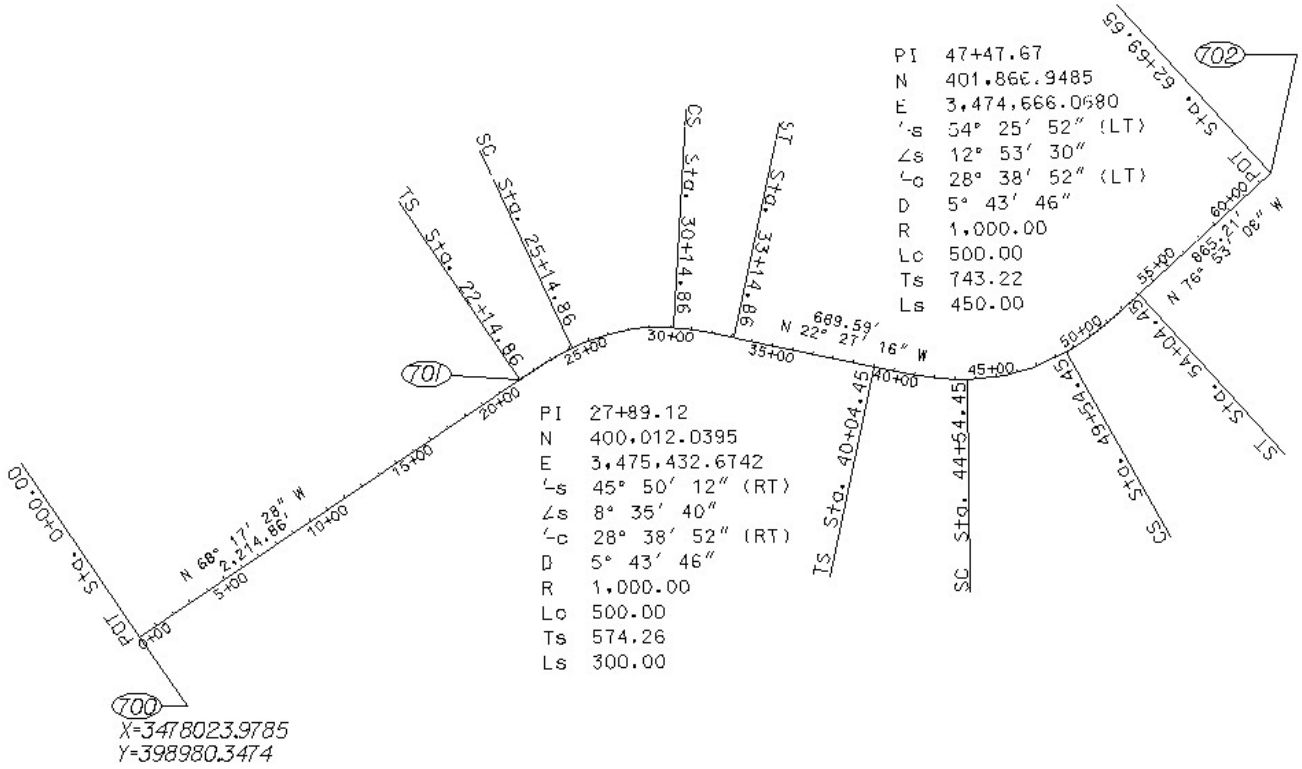
Step 2. Select the **Coordinate Geometry** icon.

Step 3. The Coordinate Geometry (**COGO**) dialog appears.



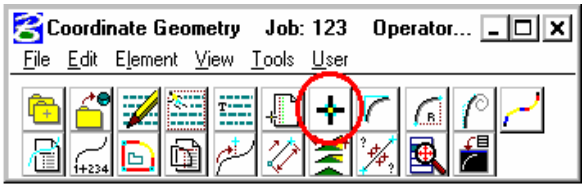
This dialog is completely resizable, so you can position it where you're most comfortable.

In the next few steps, we'll use Coordinate Geometry to store the following alignment:

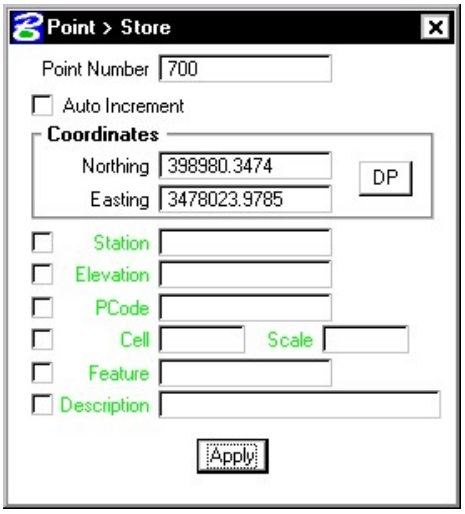


Step 4. Turn on the PERMANENT Visualization on the main COGO dialog.

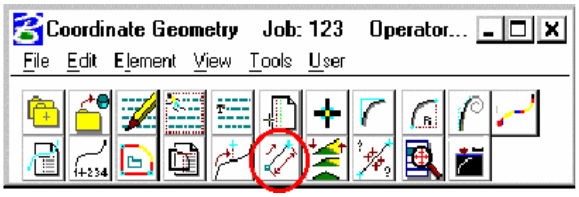
Step 5. Select the Store Point icon as depicted below.

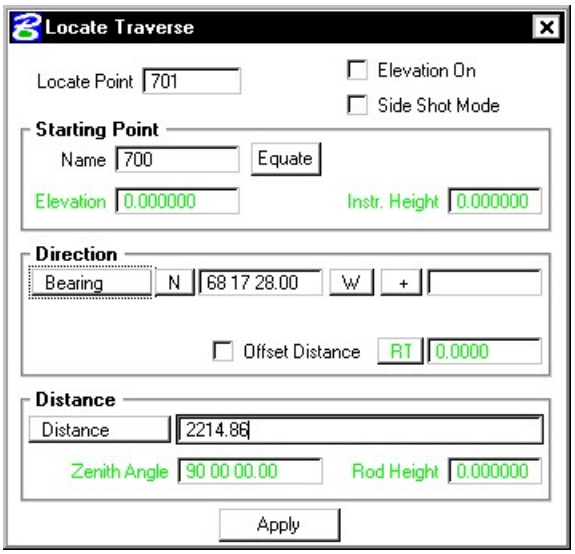


Store Point 700 with the coordinates shown.

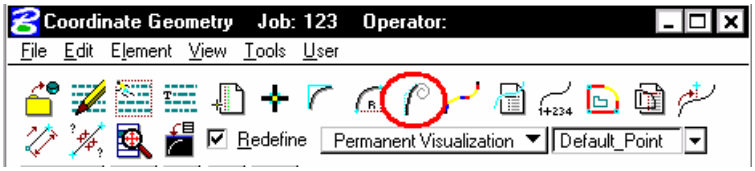


Step 6. Select the Locate Traverse icon as depicted below.

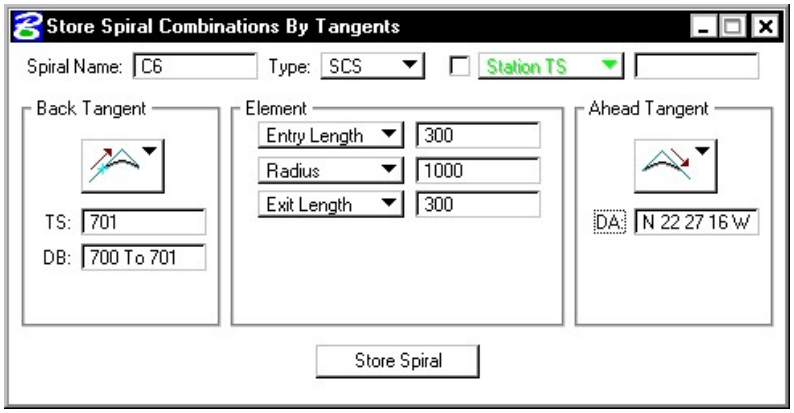




Step 7. Select the Store Spiral icon as depicted below.

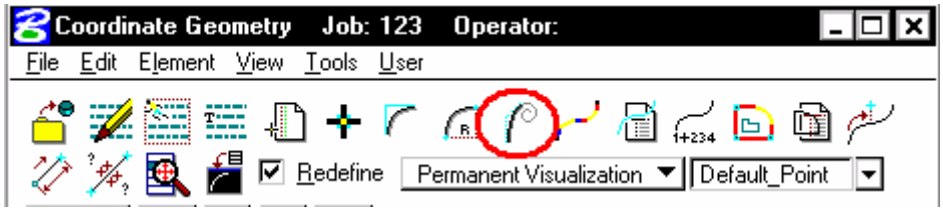


Store the spiral C6 as shown.

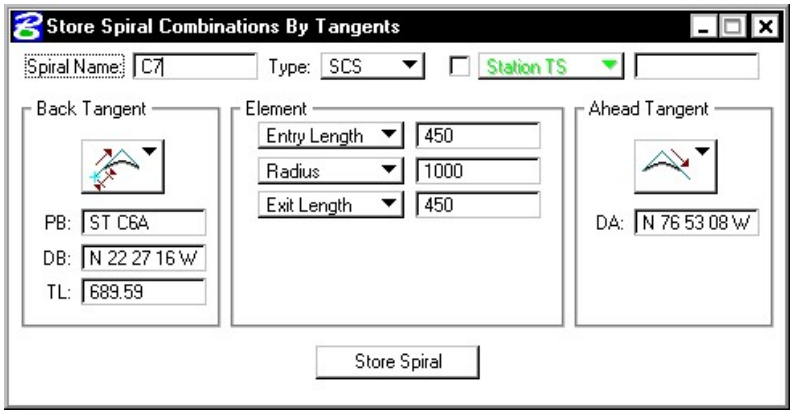


Note: The Direction Ahead (DA) is N 22 27 16 W.

Step 8. Select the Store Spiral icon as depicted below.



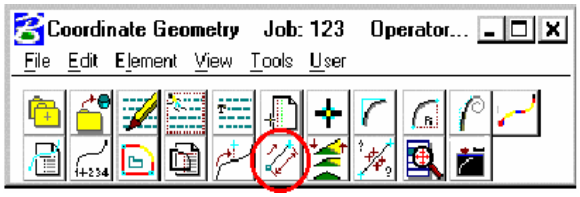
Store the spiral C7 as shown.

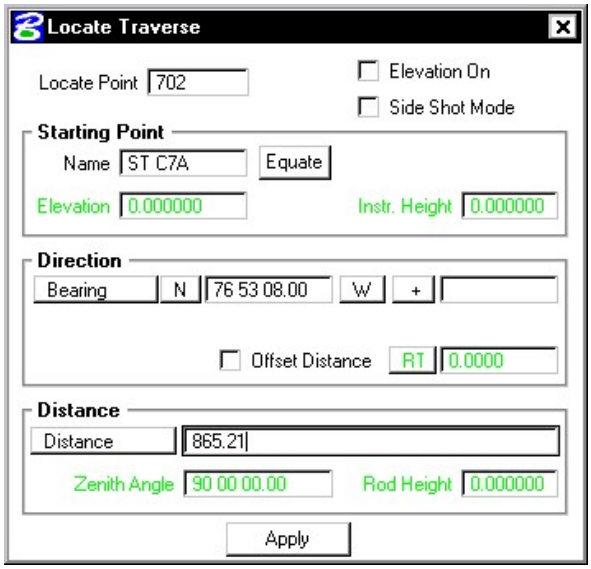


Notice that we can identify points by the TS or ST of spirals, even though a stored point doesn't exist at that location.

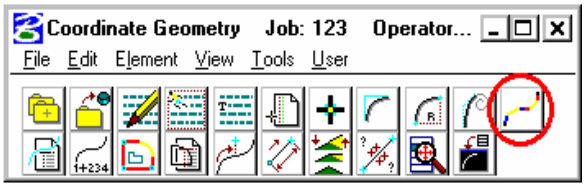
Note: The Direction Ahead (DA) is N 76 53 08 W.

Step 9. Select the Locate Traverse icon as depicted below.

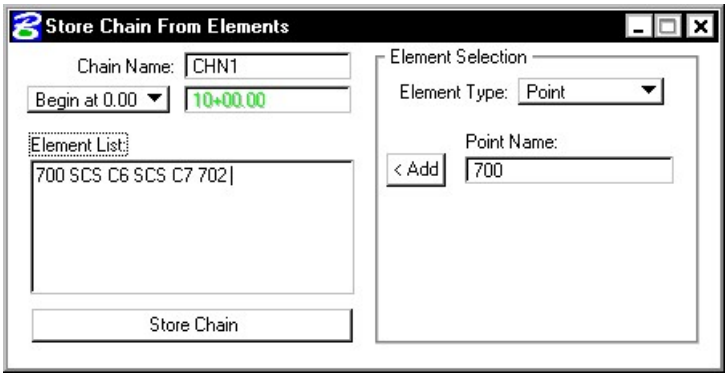




Step 11. Select the Store Chain From Elements icon as depicted below.

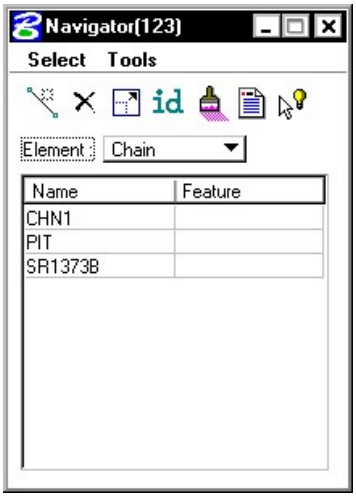


Store the chain “CHN1”.



You can fill in the Elements field by typing OR by graphically selecting the visualized elements in the design file.

Step 12. Describe Cha “CHN1.”

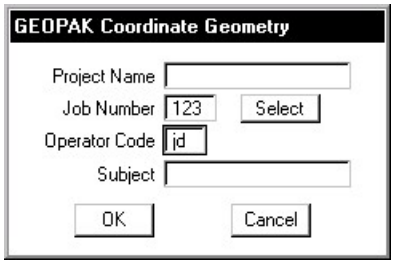


2.4 Additional Alignments – Import PLT

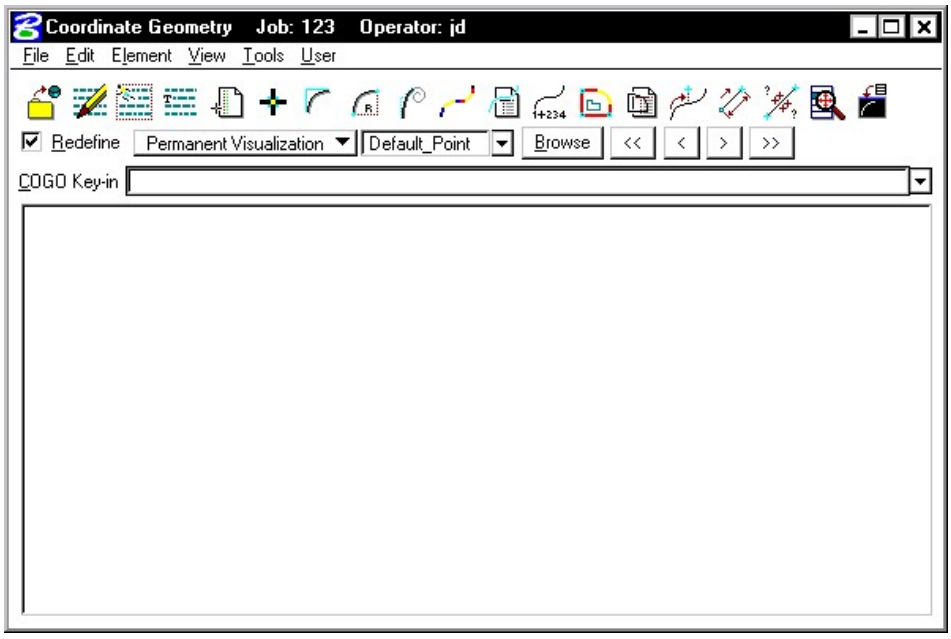
The next exercise will review the process of importing VDOT’s traditional **PLT** files directly into COGO.

Step 1. Open the MicroStation file **c:\data\geo\vdot\s1373\s1373.dgn**.

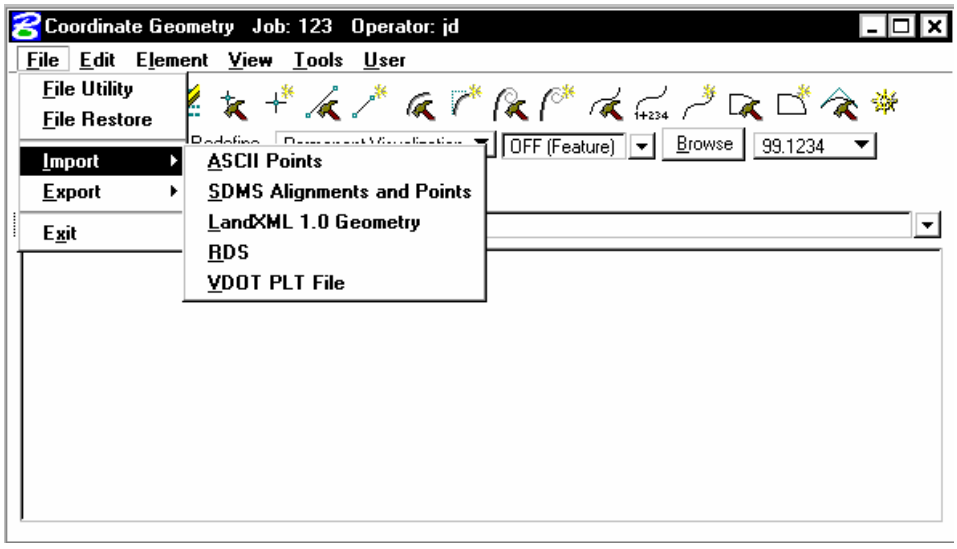
Step 2. Select the **Coordinate Geometry** icon and open the desired gpk.



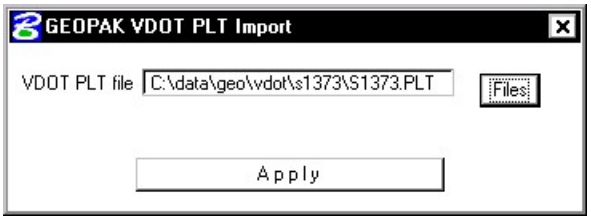
Step 3. The Coordinate Geometry (**COGO**) dialog appears.



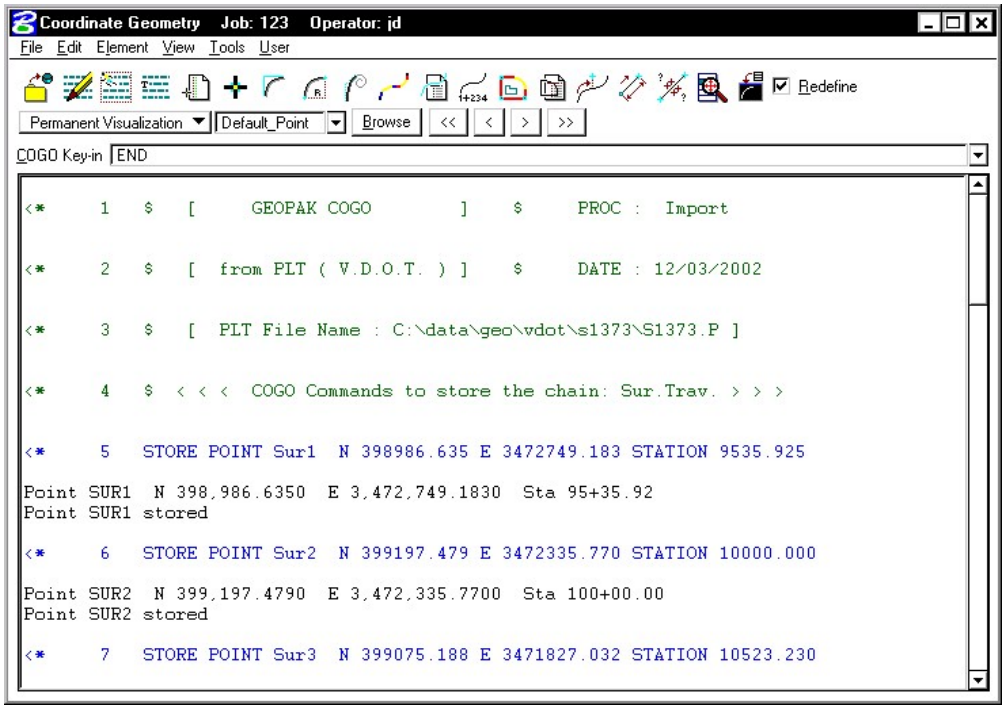
Step 4. Select from the **File** pulldown, the option to import the PLT file. **File>Import>VDOT PLT**



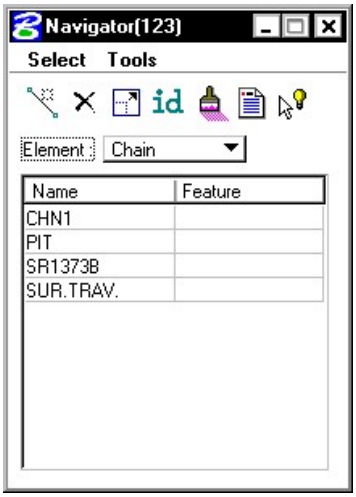
Step 5. When the following dialog appears, use the **File** button to select the desired PLT file and then press the **Apply** button.



Step 6. This will process the PLT file into COGO, automatically storing the points, curves, spirals, and chains.



Step 7. Once the COGO elements have been stored you can access the **COGO Navigator** to visualize them MicroStation.



2.5 Right of Way Commands in COGO

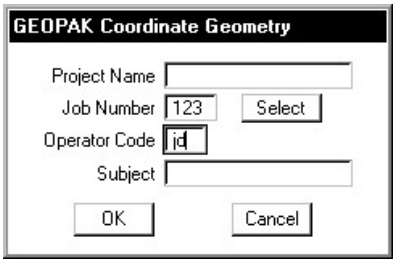
This section discusses entering an existing parcel from a deed, offsetting a centerline chain and taking additional property from the parcel. During the course of creating the taking area, several coordinate geometry commands will be introduced.

All exercises in this session use Coordinate Geometry **JOB123.GPK** and use the **S1373.DGN** file.

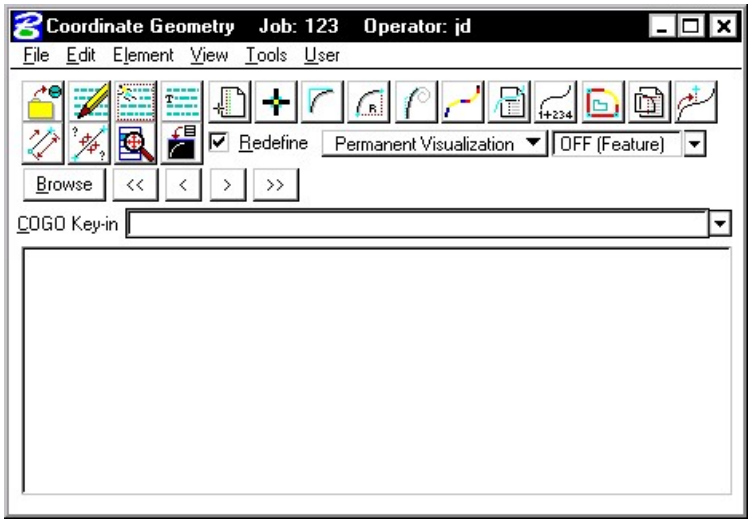
Step 1. Open the **S1373.DGN** file and invoke the Project Manager.

Step 2. Attach saved view **PLAT.**

Step 3. Invoke Coordinate Geometry by accessing the **GEOPAK Survey > Geometry > Coordinate Geometry**. Populate the dialog as shown below to access COGO.

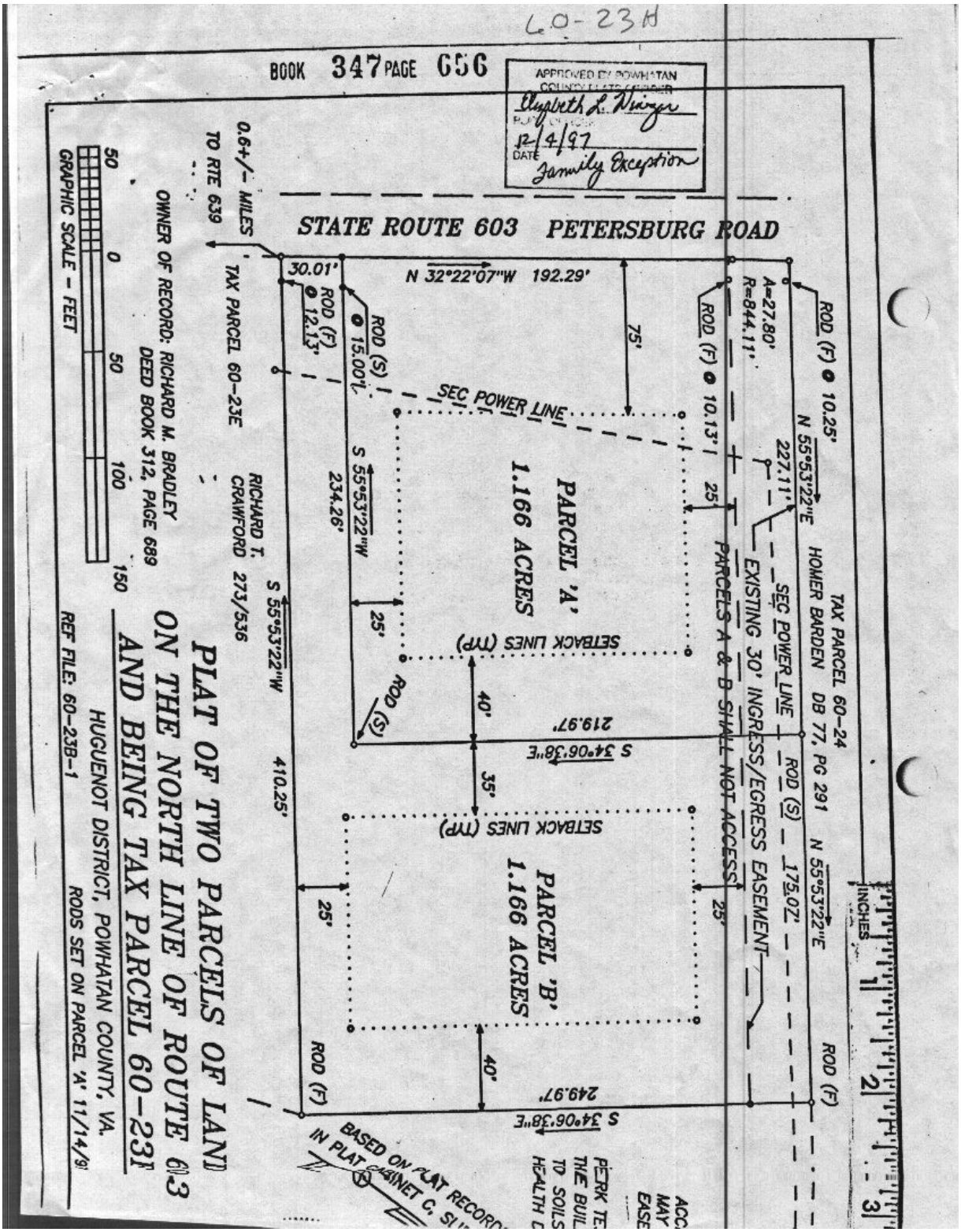


Step 4. The COGO session should have the **Redefine** toggle active, Visualization set to **Permanent Visualization** and the current Feature set to **Off**. Depending on how your COGO view options are set, a portion of your screen may resemble the graphic below:

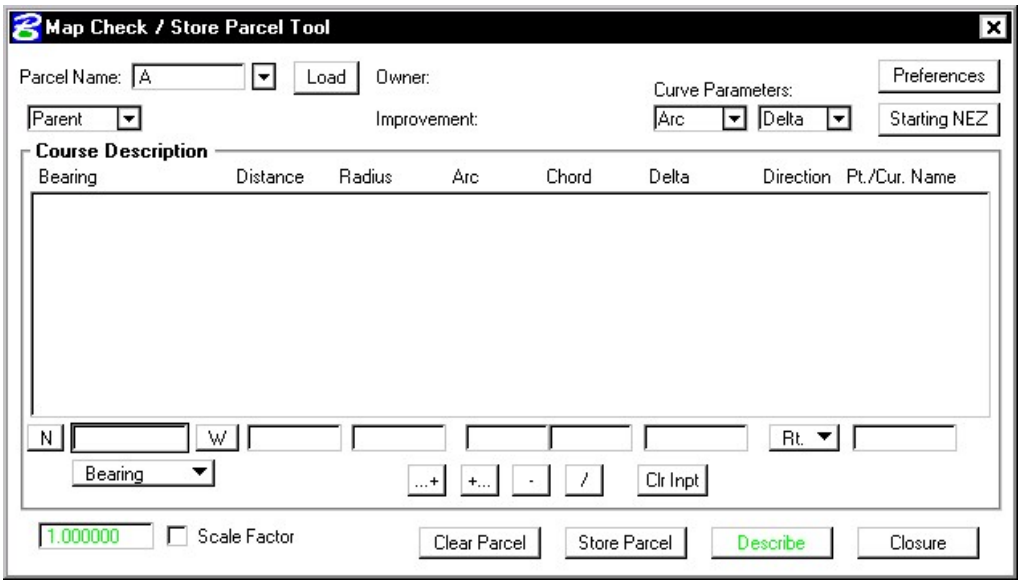


2.5.1 Parcel Editor/Map Check

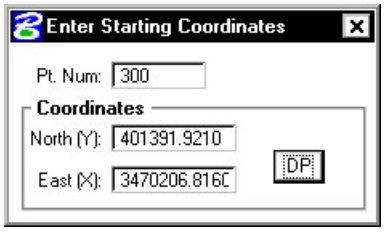
Below is a plat of the parcel we will store in COGO.



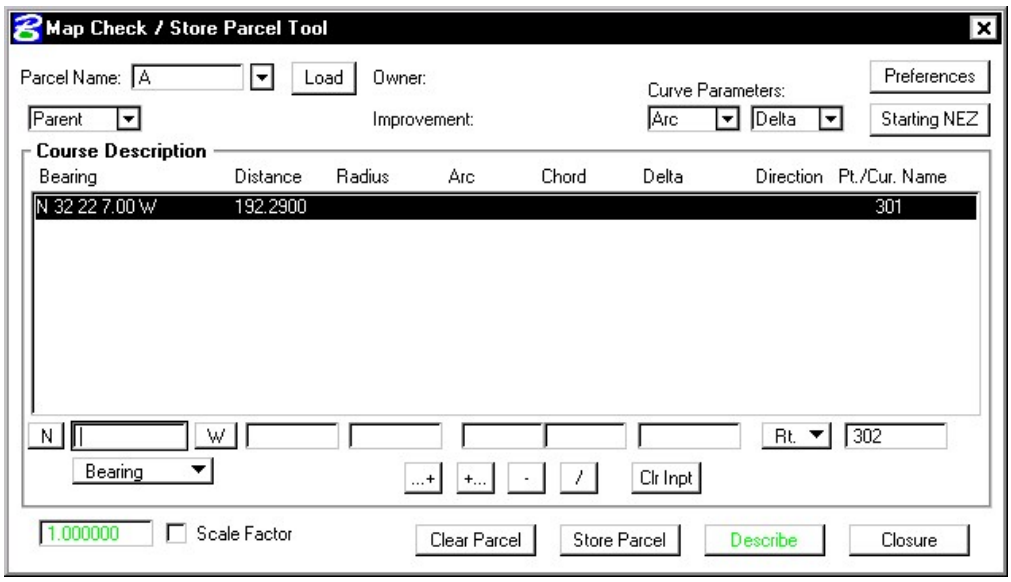
Step 1. Access the Map Check/Store Parcel tool by selecting **Tools > Map Check**. The following dialog is displayed.



Step 2. Enter the Parcel Name **A** by typing over the entry already present. Press the **Starting NEZ** button and set the starting point as follows:

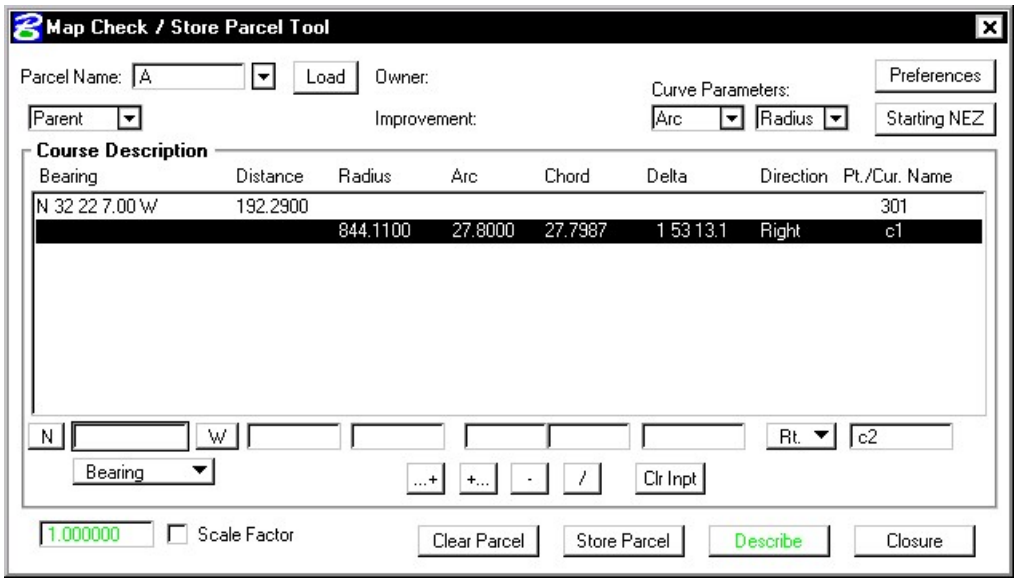


Step 3. Close the Enter Starting Point dialog. Set the Curve Parameters to **Arc** and **Radius**. To enter data, fill in the edit fields just below the list box, then press one of the edit buttons located directly below edit fields. Several buttons are supported: **Add Below**, **Add After**, **Delete**, and **Modify**. Enter the first **Bearing**, **Distance** and **PT / Desc Name** in the edit fields just below the list box, as depicted in the graphic below.



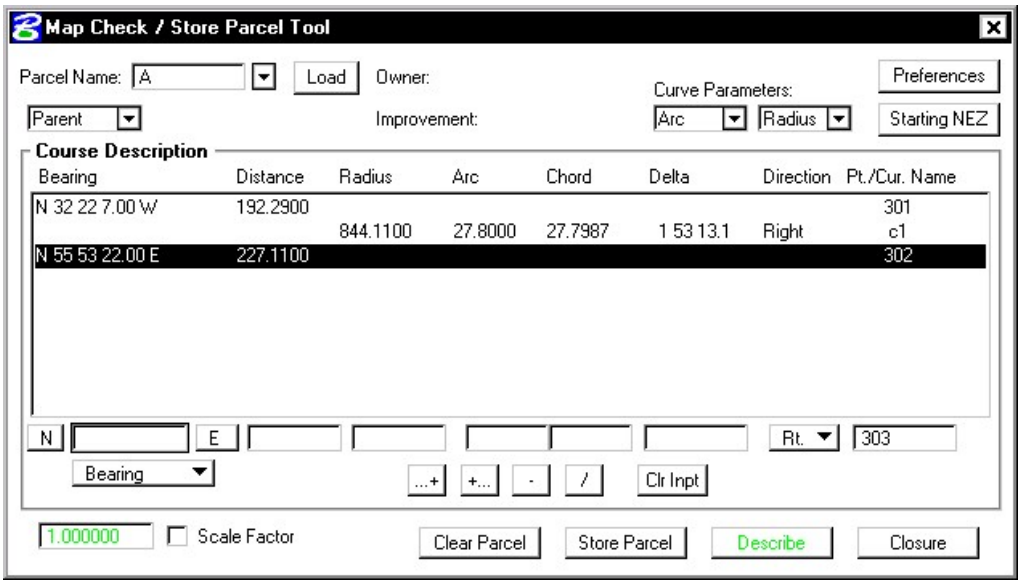
When complete, press the **Add** button directly below the edit fields. The information is now displayed in the list box and the edit fields are cleared for subsequent input.

Step 4. To add the first curve, leave the **Bearing** and **Distance** fields blank. Populate the **Radius**, **Arc**, **Direction**, and **Curve Name** as depicted in the graphics below.

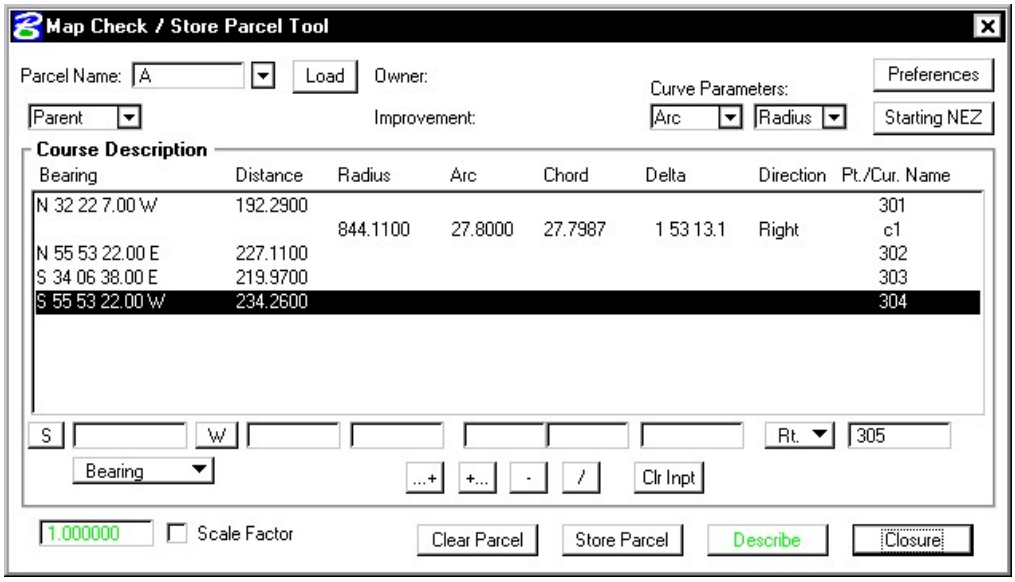


Step 5. When the edit fields are populated, press the **Add After** (…+) button to add the information to the list box.

Step 6. Add in the next **Bearing** (be sure to change the W to E), and **Distance**. Note the Pt Number automatically incremented. Once the edit fields are populated, press the **Add After** (…+) button.



Step 7. Continue adding information, utilizing the edit buttons. If a line is entered incorrectly, highlight the line in the list box, change the incorrect data, then press the Modify (/) button. The Clr Input button clears all data in the list box. When complete, your dialog should match the dialog graphic below.



Step 8. Press the **Closure** button to check the closure. The closure report appears in the COGO display output window. One sample is depicted below.

```
<*     1   $               Parcel Closure Report: A

<*     2   $ - - - - - - - - - - - - - - - - - - - - - - - - - - - - -

<*     3   $ Start Coordinates,  North: 401391.9210   East: 3470206.8160  Name:-
 300

<*     4   $  Line:   N 32^ 22' 7.00" W   Dist.: 192.2900  PtNum: 301

<*     5   $  Curve: c1  Rad.: 844.1100  Delta:   1^ 53' 13.15" rt.  Arc: 27.80-
00

<*     6   $     Degree:   6^ 47' 15.77"  Tan.: 13.9013  Mid Ord.: 0.1145  Ext.-
 0.1144

<*     7   $     Chord Bearing: N 31^ 25' 30.43" W   Chord Dist.: 27.7987

<*     8   $  Line:   N 55^ 53' 22.00" E   Dist.: 227.1100  PtNum: 302

<*     9   $  Line:   S 34^ 06' 38.00" E   Dist.: 219.9700  PtNum: 303

<*    10   $  Line:   S 55^ 53' 22.00" W   Dist.: 234.2600  PtNum: 304

<*    11   $ End Coordinates,  North: 401391.9192   East: 3470206.8144

<*    12   $ Error North: -0.0018   Error East: -0.0016

<*    13   $ Error Direction: N 40^ 22' 39.82" E   Total Distance Error: 0.0024

<*    14   $ Error of Closure: 1/372826.4646

<*    15   $ Perimeter: 901.4300

<*    16   $ Area: sq. Feet: 50789.6561  Acres: 1.1660
```

Step 9. Once satisfied with the closure, press the **Store Parcel** button to store the parcel into COGO. Commands are generated to store the parcel points and curves.

2.6 Translate & Rotate

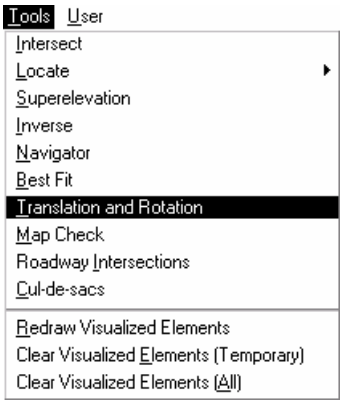
This section discusses using translate & Rotate application to adjust the parcel location.

All exercises in this session use Coordinate Geometry **JOB123.GPK** and use the **S1373.DGN** file.

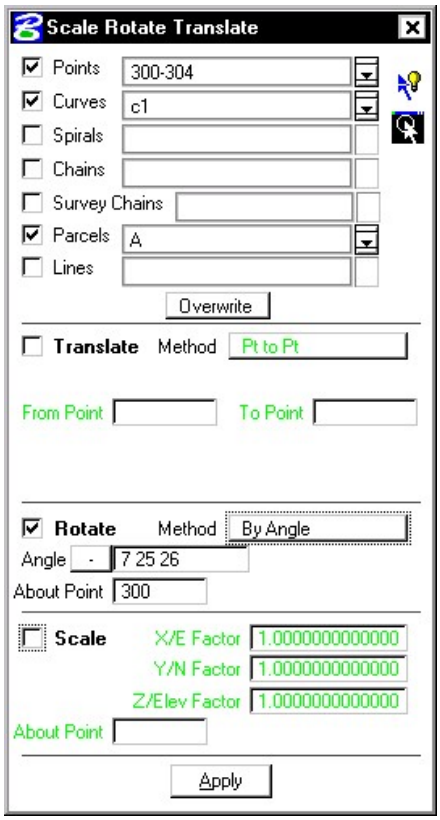
Step 1. Open the **S1373.DGN** file and invoke the Project Manager.

Step 2. Attach saved view **PLAT**.

Step 3. From the **Tools** pulldown within COGO, select the Translate & Rotate option.

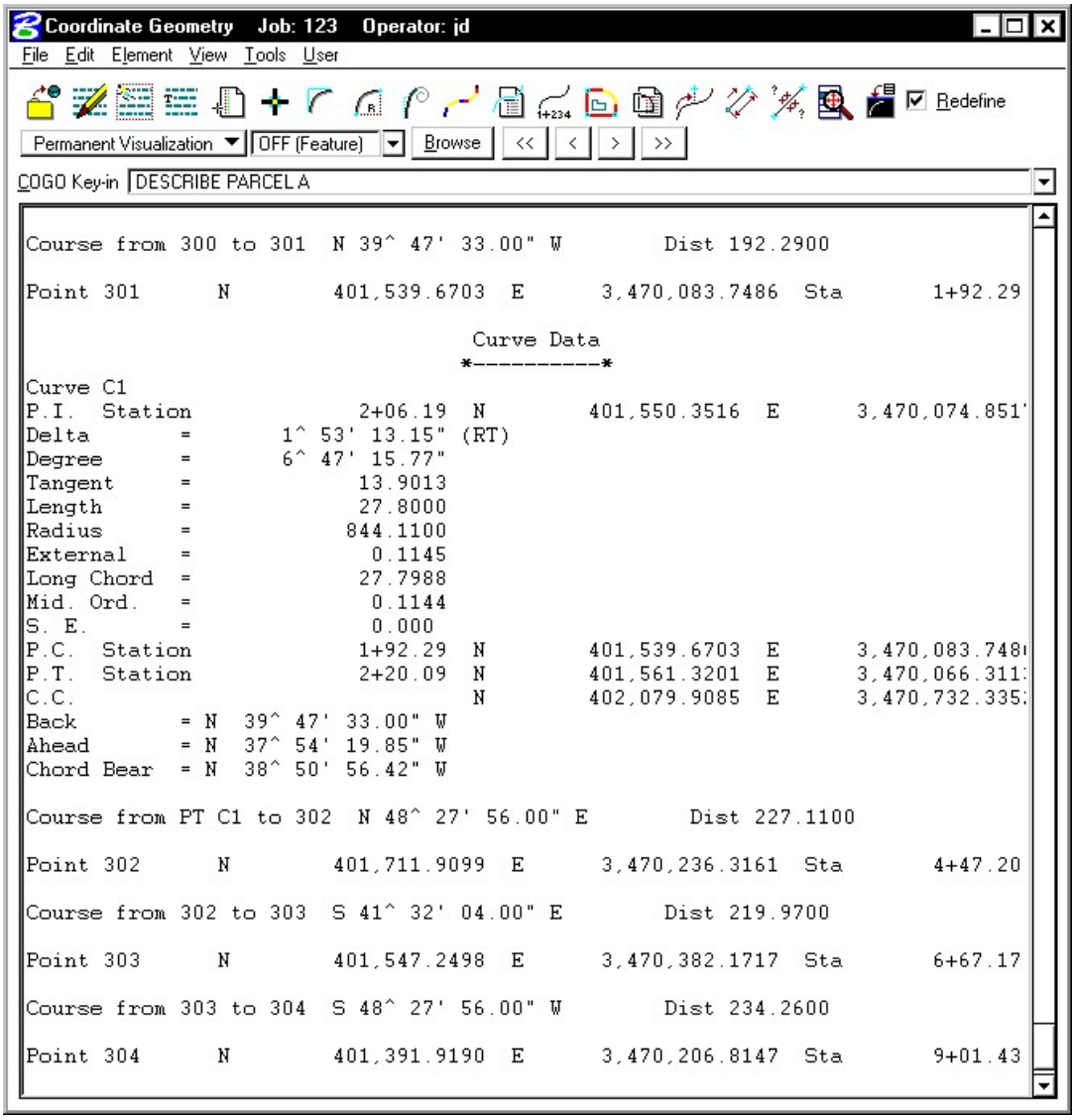


Step 4. Once the dialog appears we will want to adjust everything related to the parcel as shown below.



Step 5. Once all of the information has been entered into the dialog press the **Apply** button to execute the command.

Step 6. Now access coordinate geometry and **Describe** parcel A



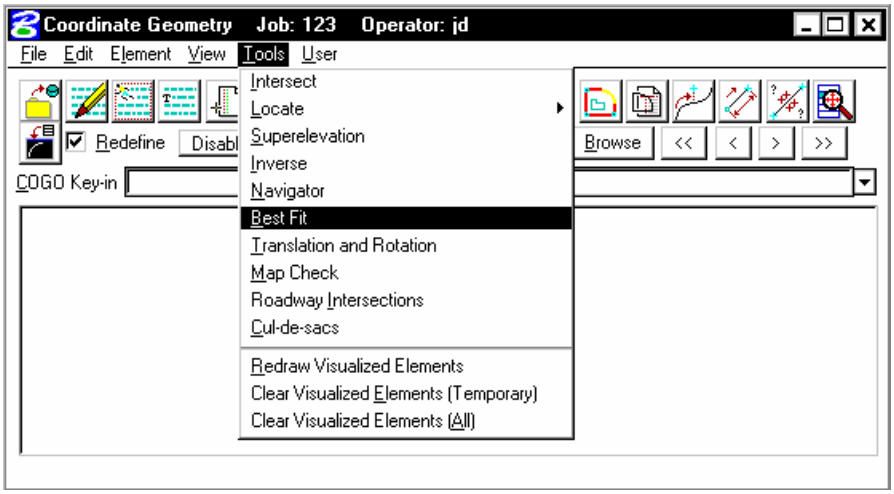
2.7 Best Fit

Step 1. Attach the saved view **FIT.**

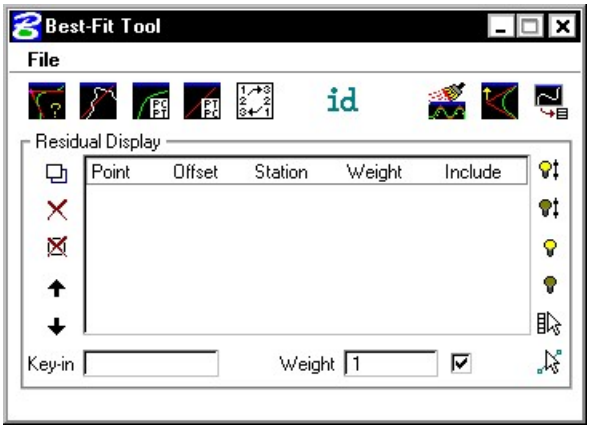
Step 2. Using the MicroStation Select tool, create a selection set of the displayed points.

You will want too turn OFF level 3 before creating the selection set.

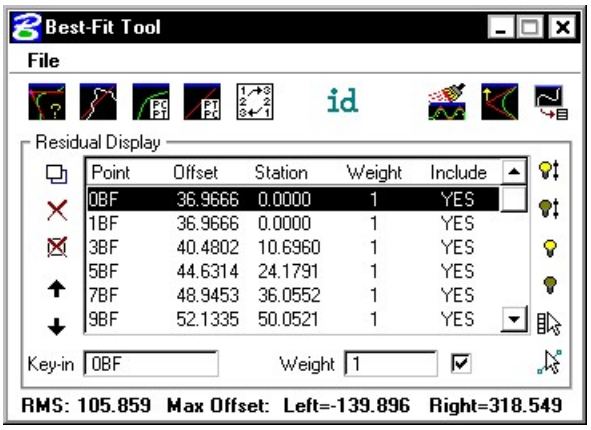
Step 3. Now from the **Tools** pulldown in COGO, select the **Best Fit** tool.



Step 4. Choose the icon on the bottom of the Best Fit dialog to populate the display window with the points in the selection set.

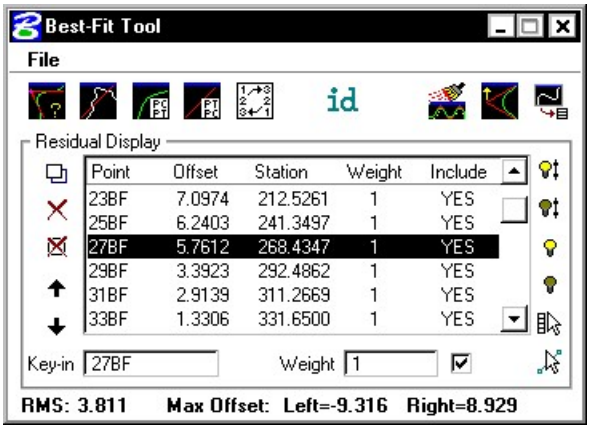


This will populate the dialog as shown below.

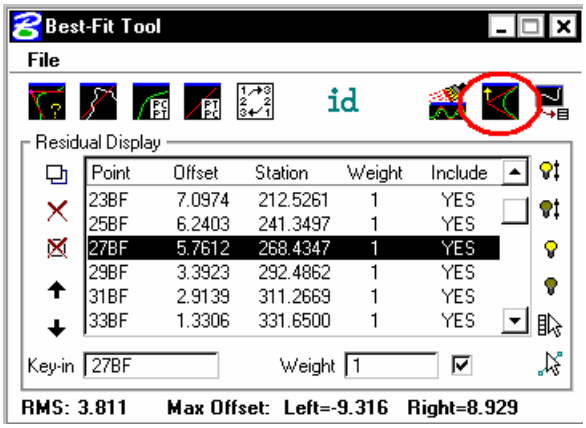


Step 5. Now select the first icon **Add Geometry** on the top left of the dialog to let COGO apply a best guess of where the curves and tangents are located in the point data. This should now be represented graphically.

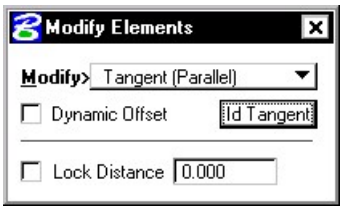
Step 6. Proceed through the list of points until you reach the point shown in the dialog below.



Step 7. Now select the Modify Elements icon to modify the tangent sections.

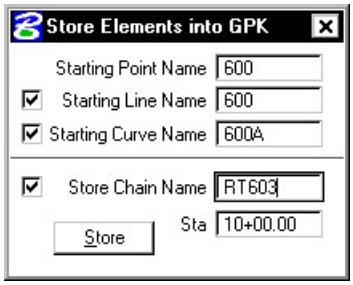


Step 8. Now change the settings as shown below so as to make modifications to the tangent section.



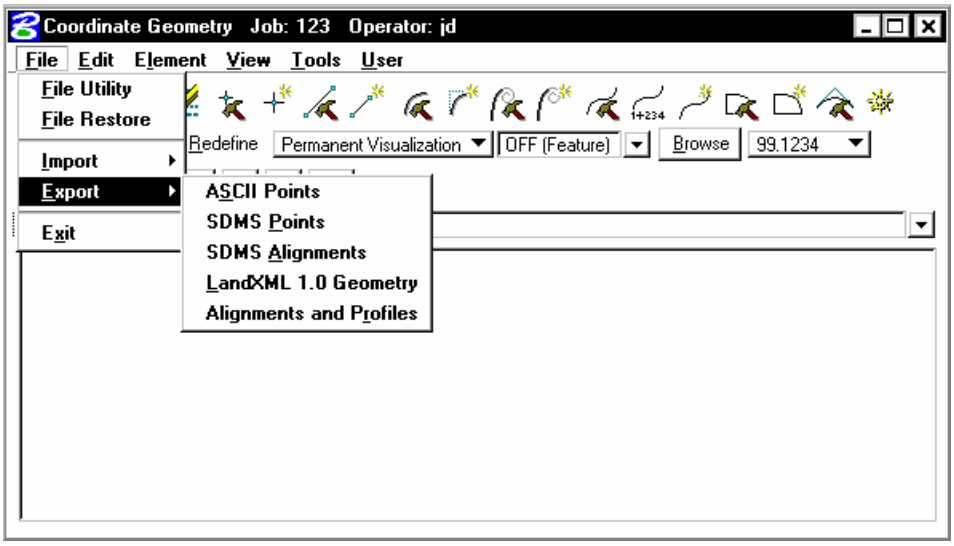
Step 9. Select the **Id Tangent** button and dynamically slide the tangent on the screen to a more acceptable location to fit the points.

Step 10. After the tangent has been placed, select the icon on the far upper right of the dialog and populate as shown below. This will allow us to store the alignment into the gpk.

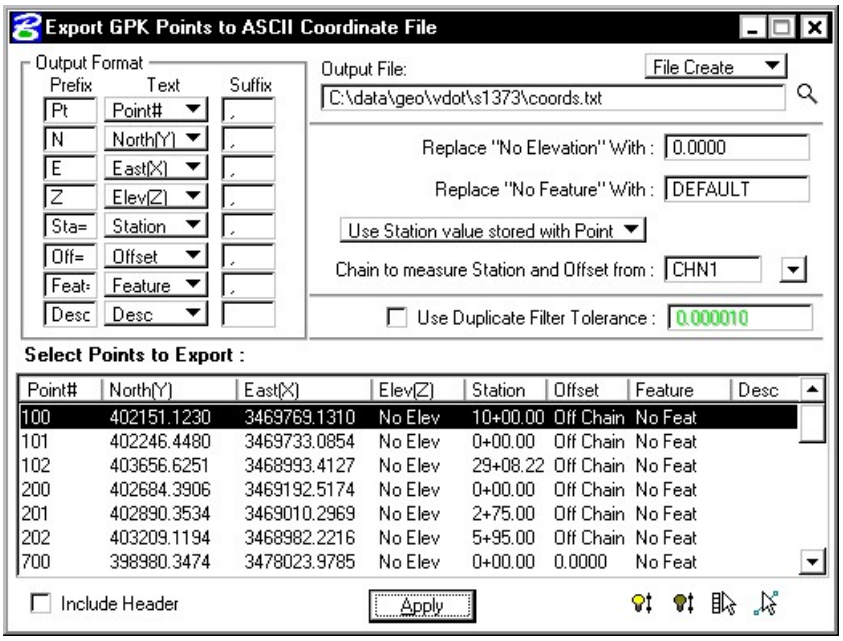


2.8…Export to ASCII

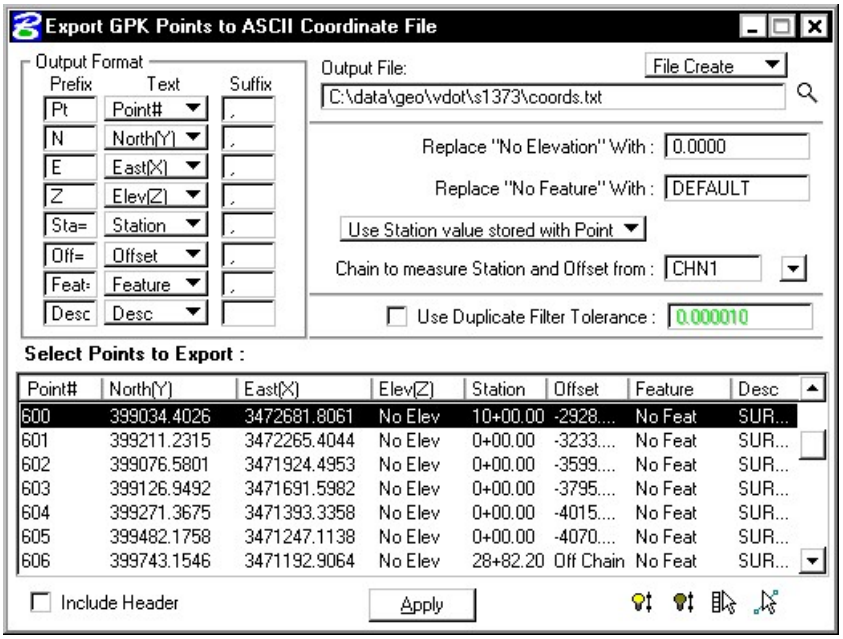
Step 1. From the COGO **File** pulldown, select the **Export** option for writing out ASCII as shown below.



This will invoke the following dialog.

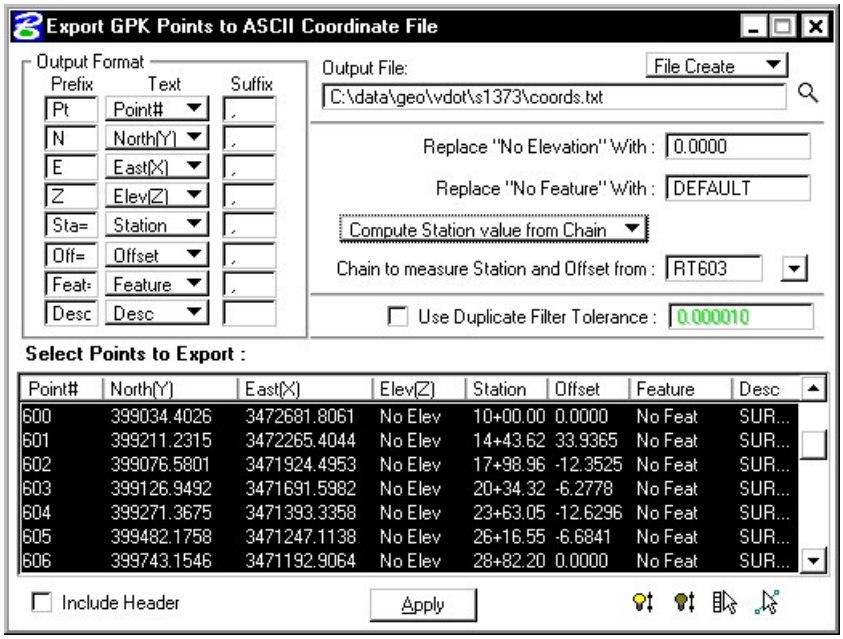


Step 2. From this dialog there are several option for controlling the filtering of points, by using the control toggles above each column. We will want to generate a list of the PI points created from the alignment we previously stored. Scroll down to the bottom of the list until reaching the 600 point range.

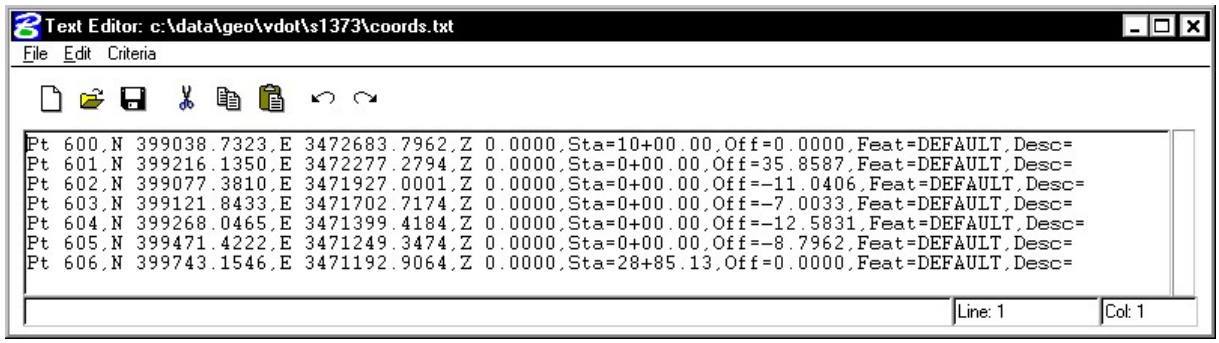


Step 3. Highlight the desired points to export, thus creating a selection set.

Step 4. Once the dialog settings are made, select the **Apply** button to create the ASCII file.



Step 5. Now you should have an ASCII file like the one shown below.



Digital Terrain Model

3.1 Introduction

Objectives	Learn how to create, display and analyze DTMs.
Tools	
Menu Bar Application	GEOPAK Road > DTM Tools

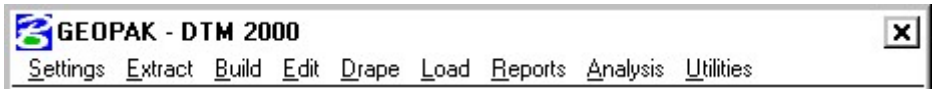
A **Digital Terrain Model (DTM)** represents the topography of a project in the form of a triangulated network. The DTM can be drawn in a 2D or 3D file, and then rotated to see the existing surface of the project area.

Digital Terrain Models can be generated from various sources including MicroStation Elements, survey data, photogrammetry data, **GEOPAK** cross-sections, and geometry data.

Triangulation is a mathematical process applied to ground points and vertices along longitudinal features to create planar surfaces. The result of triangulation is the creation of triangles connecting these points. These triangles are included in the GEOPAK TIN file from which existing ground profiles and existing ground cross sections can be generated.

3.2 Accessing

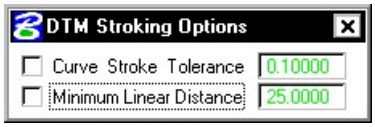
Pressing the **Existing Ground** button from the Road Project: SR95.prj dialog within Project Manager invokes the tool frame shown to the right. All of the DTM tools can be accessed from the tool frame or from the DTM menu that can be accessed from the top/left icon on the tool frame.



3.3 Settings

Tool	
Menu Bar	**Settings > Stroking**

When the Stroking Options tool is opened, the dialog depicted below is displayed.



Two user-defined stroking values can be defined before graphics can be extracted to create a DTM. Stroking is the process of automatically adding shots to the DTM Input file by interpolating new shots from the linear and curved sections of the data. If the source topography data is mapped in a **3D-design** file, stroking may be applied. Stroking is not available if the topography data resides in a 2D-design file.

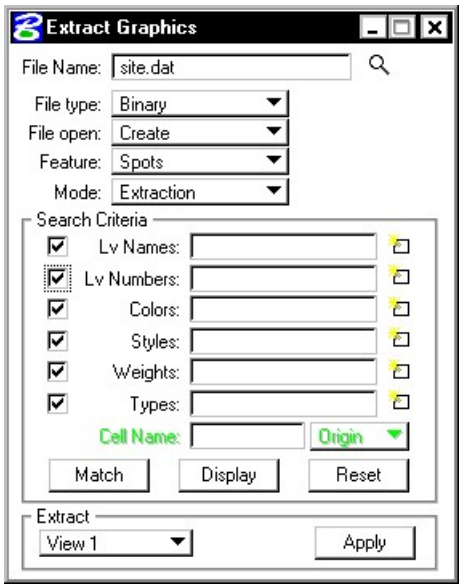
Curve Stroke Tolerance — The maximum distance between the arc and the chord used to approximate the arc in the DTM. Stroking is only applied to breaks and contours.

Minimum Linear Distance — If a linear segment is greater than the Minimum Linear Distance, points are interpolated and added to the segment such that the distance between the points in not greater than the Minimum Linear Distance.

3.4 Extract Graphics

Tool	
DTM Menu Bar	**Extract > Graphics**

The Extract Graphics tool reformats MicroStation elements into DTM input data. When accessed, the dialog shown below is displayed.



The fields/options are detailed in the table below.

File Name — The name of the file to be created for storing the input data.

The **.dat** extension is automatically assigned so the user is not required to key this in; however, an alternate extension may be defined.

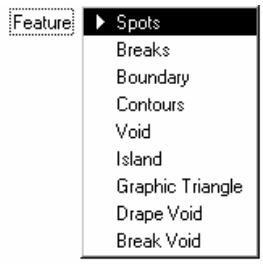
If file already exists, it may be found using the **Files** button.

File Type — Format of the new file. Either format produces the same results. The difference between the two is **ASCII** files can be viewed and edited with any text editor while **Binary** files process faster, but cannot be viewed.

For ASCII file designation, the user must define the number of decimal places for the data.

File Open — Indicates whether a file is being created **(Create)** or the user is appending data **(Append)** to an existing .dat file.

Feature Type This notifies GEOPAK of the feature type that the extract graphics will put in the DTM.



Spots – Random survey points. Can also be vertices of a Line or a Line String.

Breaks – Designate linear features such as edges of pavement, ditch bottoms, ridges, etc. No triangle leg will cross a Break.

Boundary – The external boundary of the digital terrain model – only per .dat file.

Contours – For use in extracting digitized or otherwise imported contours.

Void – Closed shapes representing an area with missing data or obscure areas. (I.e. ponds, headwalls, concrete pads, etc.) The void coordinates determine void lines, which are inserted as drape lines on the triangulated surface and do not alter the slope or elevations of the TIN.

Island – Area within a void that contain data and should be included in the model.

Graphic Triangle – For use in extracting triangles from a TIN model that has been otherwise created or imported.

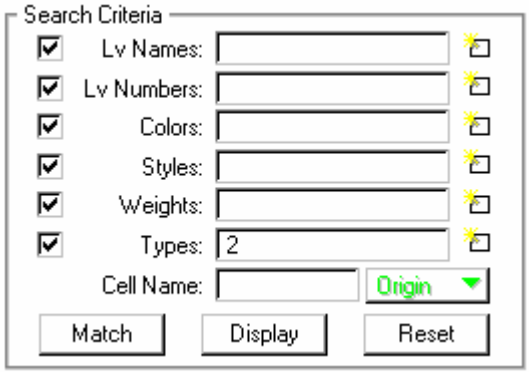
Drape Void – Same as Void, except the Void's vertex elevations are ignored and the triangulated model elevations at these vertex points are utilized.

Break Void – Same as Void, except the void elevations are included in the triangulated model at it's x y coordinates; therefore, the slope and elevations are modified on the TIN surface.

Mode

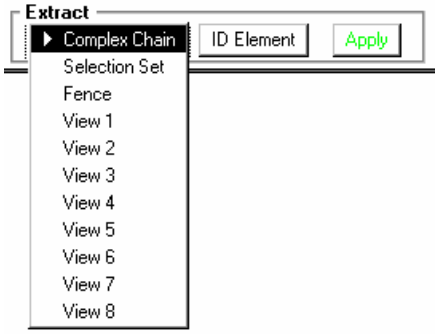
The **Extraction** mode calculates XYZ data directly from the coordinate values of 3D MicroStation elements. The **Interpolation** mode produces XYZ data by interpolating between spot elevations along linear MicroStation elements. This mode works in both 2D and 3D files wherein the elements are not represented with a defined Z value.

Select Criteria



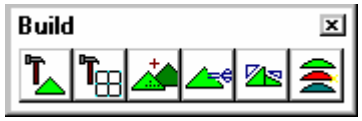
The **Select Criteria** group box provides options to specify the features to be extracted. When a "check" is placed in the box next to **Levels**, the **Select** box is activated. Then press the **Select** button to invoke the Level Mask dialog wherein only those levels you want GEOPAK to search for when extracting data can be selected. If the Levels box is *not* turned on, GEOPAK searches **all** levels. The same procedure is utilized for other criteria selections. The three buttons located at the bottom of the **Select Criteria** group box **Match, Display** and **Reset** enable the user to interactively define, highlight elements that match the search criteria or clear the search criteria respectively.

Extract



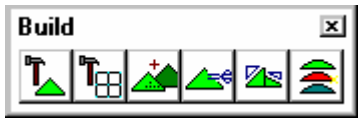
The **Extract** group box has several options for data extraction. **Complex Chain** reads those elements along adjoining MicroStation elements. **Selection Set** uses the MicroStation selection set tools to identify elements to extract. **Fence** extracts all elements within a fence boundary. **View1, View2, View3, etc.** extracts all selected elements displayed in the selected view.

3.5 Build Tools

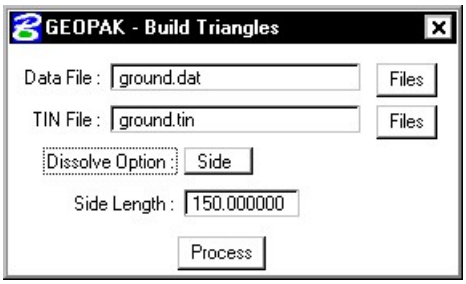
Tools	
Menu Bar	**Build > Triangle** **Build > Lattice** **Build > Merge TINs** **Build > Clip TIN** **Build > Pad** **Build > Delta Surface**

Included under the **Build** pull down and icons are options for creating, manipulating and merging DTM models. This class addresses, in detail, *only* those options utilized in routine DTM operations.

3.5.1 Build Triangles

Tool	
DTM Menu Bar	**Build > Triangle**

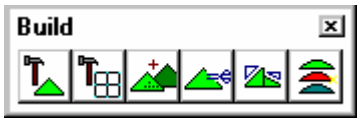
The Build Triangle tool processes the information stored in a DTM input file (**.dat**) to create a triangulated model (**TIN**). The file extension **TIN** (which is automatically assigned) represents a *triangulated irregular network*. When invoked, the dialog depicted below is displayed.



The fields/options in the dialog are detailed in the table below.

Data File	The DTM input file where the extracted topological features are stored. The file can also be selected via the **Files** button. If the full path is not given, GEOPAK utilizes the working directory to locate the file.
TIN File	The filename in which the DTM data will be stored in a binary format. The file can also be selected via the **Files** button if the file exists. If the full path is not given, GEOPAK utilizes the working directory to locate the file.
Dissolve Option	This option will allow the elimination of external triangles based on the selected option. Note that internal triangles are not affected. The three options are: **None** - no external triangles are deleted. **Sliver** - long, thin triangles based on a hard-coded formula within the software are deleted. **Side** - external triangles where a side is longer than the user specified length are deleted.
Process	Commences the TIN creation process.

3.5.2 Additional Build Options

Tool	
Menu Bar	**Build > *Additional Tools***

Several additional Build tools are supported, which are detailed in the table below.

Lattice	Creates a gridded mesh (**.lat**) of the triangulated data (TIN) to create a three dimensional visual display of the topography.
Merge TINs	Two triangulated models to be merged together as long as the boundaries of one model overlaps the other at a minimum of one point. This process creates a third model (**TIN**) from the combination of the two existing models.
Clip TIN	Creates a new model (**TIN**) from a portion of an existing model. The area is defined as internal or external to a user defined polygon.
Build Pad	Defines a pad (such as a building) and integrates the pad into the existing terrain with a variety of slope options.
Build Delta Tin	Creates a new model based on the difference between two other models or a model and elevation surface.

3.6 Reports

Tools	
Menu Bar	**Reports > Duplicate Points** **Reports > Crossing Features** **Reports > Tin Statistics** **Reports > Lattice Statistics**

Options under the **Reports** pull down and tool frame include a way to check for duplicate points or crossing breaklines, and the ability to generate statistics associated with a **TIN** or **Lattice** file. Each report is described in the table below.

Duplicate Points	Reports points with the same x and y coordinates
Crossing Features	Reports intersecting (same xy location, varying z) breaklines or contours.
Triangle Statistics **Lattice Statistics**	Displays a summary indicating the total count of each element type and minimum and maximum X, Y, Z ranges for the specified TIN or LAT file.

3.7 Utilities

Tools	
Menu Bar	**Utilities > Convert TIN** **Utilities > ASCII to Binary** **Utilities > Binary to ASCII** **Utilities > Check Triangulation** **Utilities > Metric to English** **Utilities > Export Lattice to Trimble** **Utilities > Import XML** **Utilities > Export XML**

Tools under the **Utilities** pull down and tool frame include a way to check the validity of a triangulated file, converting triangulated files from previous versions of GEOPAK, converting the DTM data file between ASCII and binary format; as well as exporting the LATTICE information to the Trimble DTX format. They are detailed in the table below.

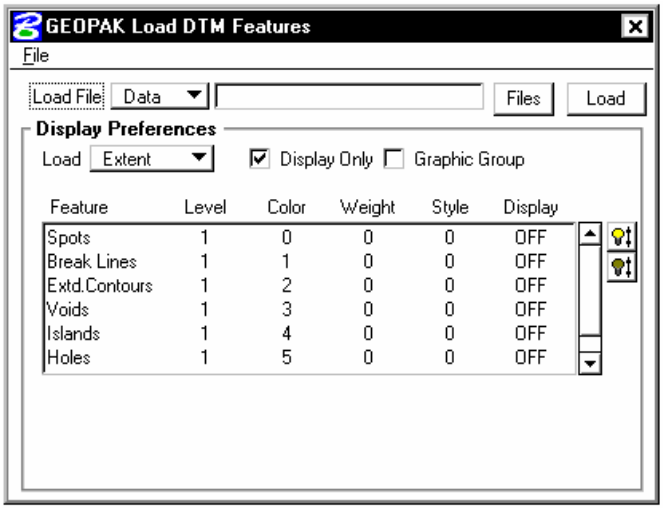
Convert TIN	Converts a pre-GEOPAK 98 triangulated file to the current format.
ASCII to Binary **Binary to ASCII**	Reformats the DTM data file (**.dat)**.
Check Triangulation	Verifies the integrity of the triangulated file. A message appears indicating "Triangulation Valid" if the file structure is intact.

English to Metric **Metric to English** **Metric to Imperial** **Custom**	GEOPAK TIN files are neither English nor metric. English and metric preference settings within GEOPAK are for volume purposes and do not affect the TIN. This utility converts an entire TIN file with optional translation and rotation tools.
Export Lattice to Trimble	This tool utilizes a lattice file to generate a Trimble DTX file suitable for use in Trimble field equipment.
Import XML	Allows the importation of XML data into a .dat file for triangulation.
Export XML	Allows the exportation of .tin data to an XML format.

3.8 Load DTM Features

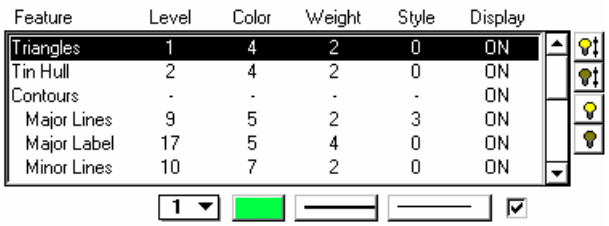
Tool	
Menu Bar	**Load > DTM Feature**

Load is the process by which we can visualize the DTM data, TIN model, lattice model, and contours. By selecting the Load DTM Feature icon, the following dialog appears.



The user can choose to load the DTM data (**.dat**), the TIN file (**TIN**), or the Lattice file (**.lat**). Each of these files can be loaded for the model extents, within a fence, or selected view.

Activating the **Display Only** toggle enables the user to view the elements without writing them to the MicroStation file (temporary display). Conversely, deactivating the toggle writes the DTM features to the MicroStation design file at the defined symbology. These elements can be placed as a graphic group when **Display Only** is deactivated.


Feature Level Color Weight Style Display
Triangles 1 4 2 0 ON
Tin Hull 2 4 2 0 ON
Contours - - - - ON
Major Lines 9 5 2 3 ON
Major Label 17 5 4 0 ON
Minor Lines 10 7 2 0 ON
1

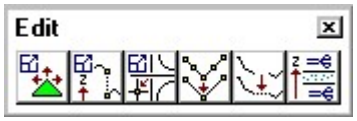

Activates the display of all Features.


Turns off the Display of all Features.


Turns on only the selected Feature. This can also be accomplished by activating the toggle (below the list box) or double-clicking on an item that is turned off within the list box.


Will turn off only the selected item. This can also be accomplished by activating the toggle (below the list box) or double-clicking on an item that is turned on within the list box.

3.9 Edit Tools

Tools	
Menu Bar	**Edit > Triangles** **Edit > Duplicate Points** **Edit > Crossing Features** **Edit > Filter Vertices** **Edit > Join Linear Features** **Edit > Z Range Clip**

GEOPAK supports an extensive range of powerful editing tools, both pre- and post TIN generating. The tools are detailed in the table below.

Triangles — The triangulated model can be dynamically edited in terms of adding, deleting or moving spot elevations. Break lines can be added, draped or deleted.

Duplicate Points — Interactive editing of points in a DTM data file with the same X and Y coordinates within the data (DAT) file.

Crossing Features — Interactive editing of crossing break lines and extracted contours within the data (DAT) file.

Filter Vertices — Removes vertices from break lines or extracted contours within the data (DAT) file when located within the specified Tolerance of another vertex.

Join Linear Features — The Join Linear Feature is useful when the source break line or contour line consists of several elements containing numerous vertices. In these cases, the end of one break line is the beginning of the next break line, so the software utilizes this as two separate break lines. During the Joining process, GEOPAK changes these from the beginning and end of individual elements to the beginning and subsequent shots of one element.

Z Range Clip — Deletes individual vertices from the data file (**.DAT**) based on a user defined elevation range.

3.10 Analysis Tools

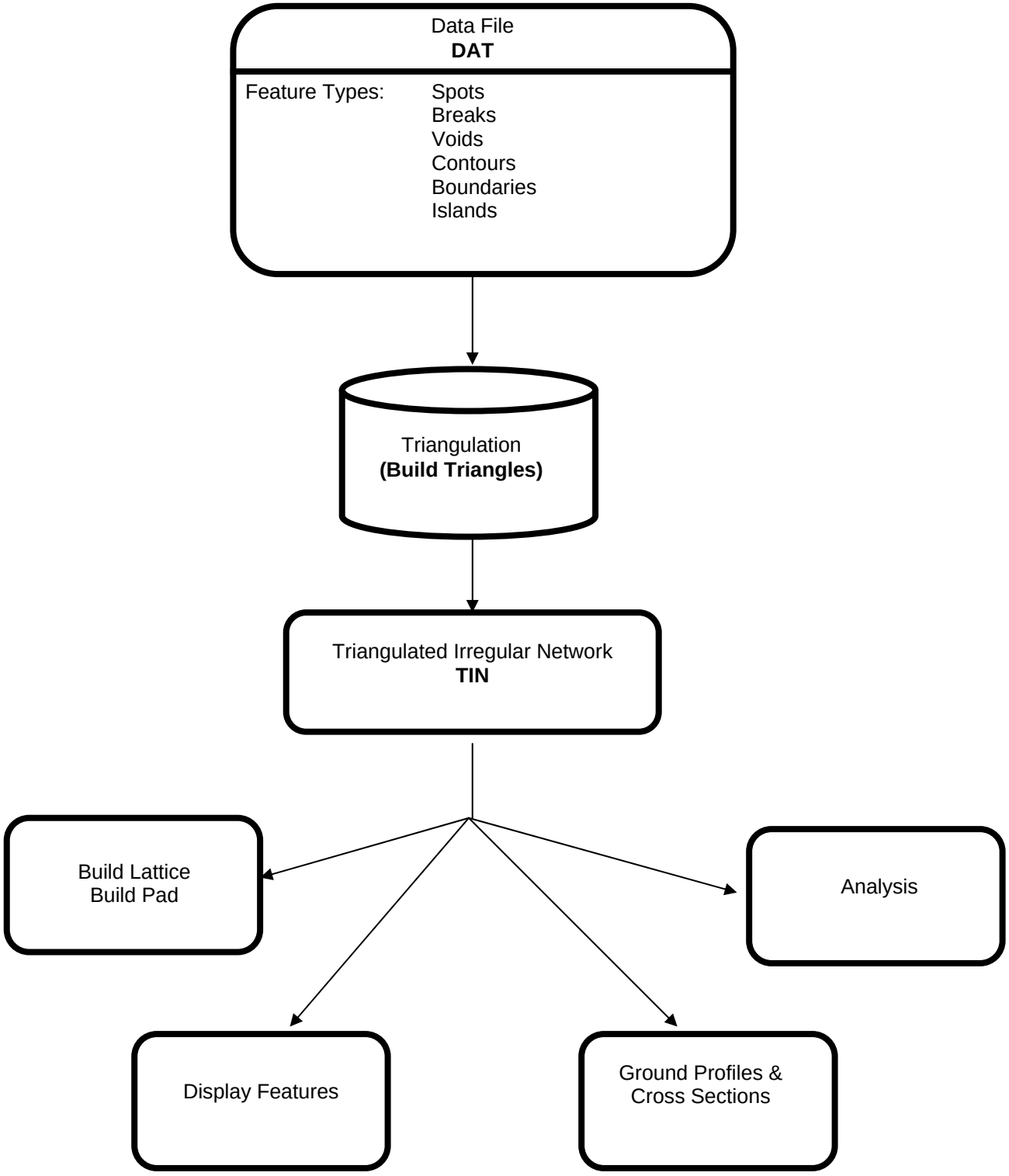
Tools	
Menu Bar	**Analysis > Height** **Analysis > Profile** **Analysis > Volumes** **Analysis > Elevation Differences** **Analysis > Slope Area** **Analysis > Themes** **Analysis > Drainage Tools** **Analysis > Visibility** **Analysis > Trace Slope Path** **Analysis > DTM Camera** **Analysis > Trench Volumes**

The **Analysis** tools allow the user to visually analyze the digital terrain model utilizing numerous tools as a profile analysis, thematic analysis, drainage flow patterns, and visual portions on the model from any given location.

Height	To determine the height and other associated data dynamically based on user-defined data points within the model.
Profile	View a profile based on a user defined MicroStation element.
Volumes	To compute the volume between two TIN models, the volume between a TIN model and a plane, or the cut and fill totals between two TIN models while applying a shrinkage/swell factors.
Elevation Differences	Will display the elevation difference, or the amount of cut and fill between two TIN models, or a TIN model and a plane of constant elevation.
Slope Area	The Slope Area tool displays the horizontal area and actual slope area (area following the terrain of the Model).
Themes	Displays the digital terrain model based on different user definable themes such as elevation ranges, slope percentage, slope degree, or aspect.
Drainage	Displays and analyzes drainage patterns within a TIN model. Tools include delineating watersheds, drawing flow arrows, determining upstream and downstream traces, finding high and low points, and ridge and sump lines.
Visibility	Based on a user-defined point of origin, GEOPAK visually displays which triangles can and cannot be seen, or what is visible between two points.
Trace Slope Path	Traces a path along a tin.
DTM Camera	Views a 3D terrain model in a MicroStation 3D model
Trench Volumes	Computes trench and bedding volumes from Drainage Project

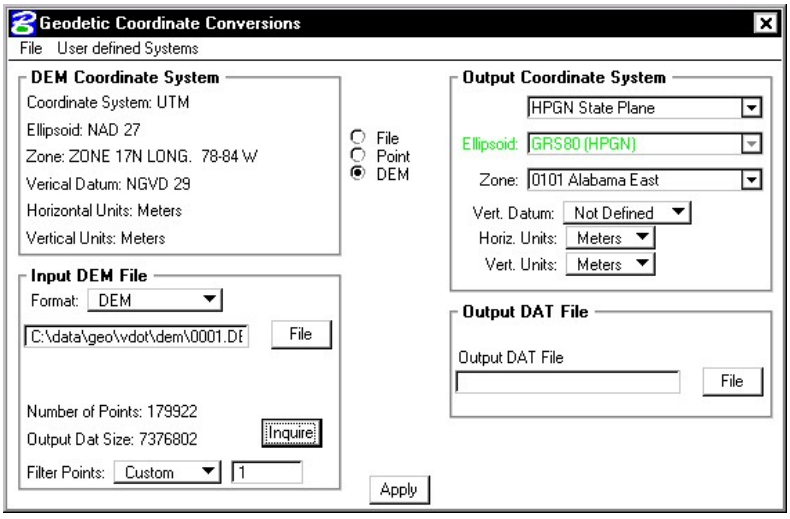
Review of the steps required in creating a surface model and its subsequent output.

Digital Terrain Model (TIN)

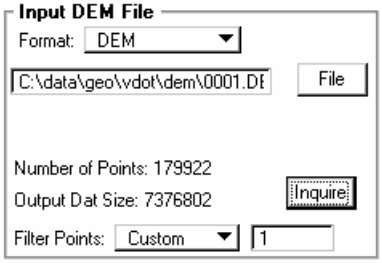


3.11 Digital Elevation Models - Importing DEM Files

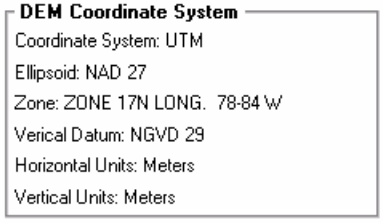
A **Digital Elevation Model** (DEM), consists of a sampled array of elevations for ground positions that are normally at regularly spaced intervals. The basic elevation model is produced by or for the Defense Mapping Agency (DMA), but is distributed by the USGS, EROS Data Center, in the DEM data record format. A wealth of information on DEM formatted data can be obtained from www.usgs.gov. When the DEM option is selected in the center section of the dialog, the dialog changes to reflect the selection.



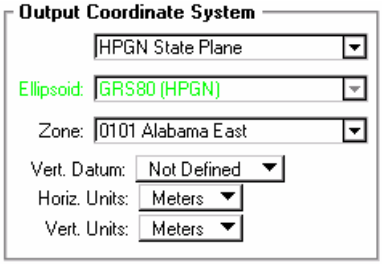
Within the **Input DEM File** group box, the data format is selected. The group box changes based on the selection. Once the selection is made, the File Name may be typed in, or selected via the Files button. This portion of the dialog also provides control for filtering the number of points to import. This is necessary due to the raw DEM file having a tremendous amount of point data. The filter facilitates a more manageable file size based on a user definition.



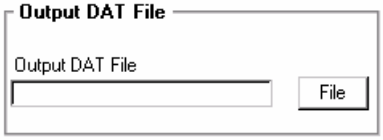
Once the file is read, the **DEM** Coordinate system group box is populated automatically. Therefore, the **DEM Coordinate System** group box is display only and the values cannot be edited.



The **Output Coordinate System** box includes System type, Ellipsoid, and Zone. As each system is selected, the ellipsoid and zone unghost as needed.



The **Output DAT File** group box has a single key-in field for the file name of the DAT file to be created. This file can be used within the Build Triangles dialog in the DTM tools. Manually enter the file name or select via the File button.



Digital Terrain Modeling

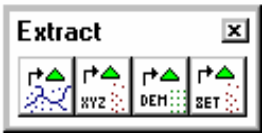
3.1 Accessing DTM Tools

Step 1. Open the MicroStation file **c:\data\geo\vdot\s1373\s1373.dtm**.

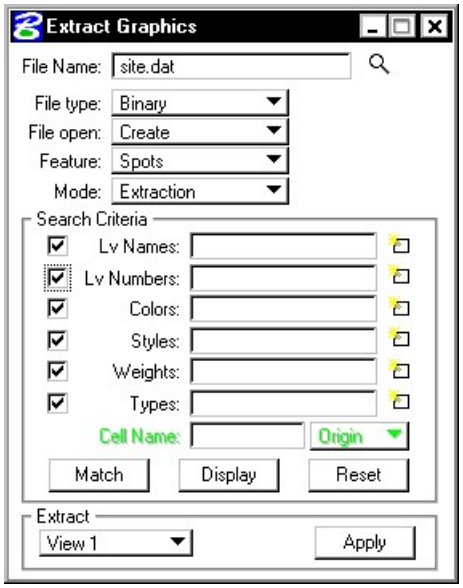
Access **Applications>GEOPAK Road>DTM Tools.**

Step 2. This invokes the DTM Tool Frame.

3.2 Extract Graphic Elements

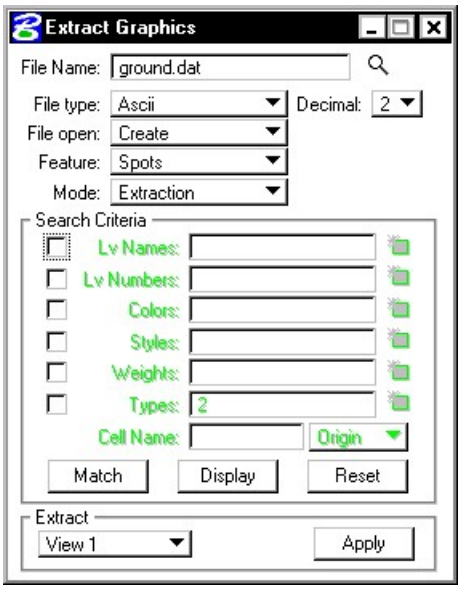


Step 1. Select the **Extract Graphics** icon from the tool frame to invoke the following dialog.

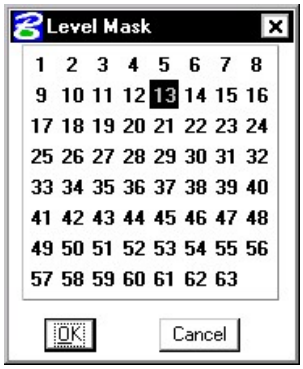


Step 2. To extract the ground spot shots, complete the dialog as indicated below:

File Name	ground.dat
File Type	ASCII
File Open	Create
Feature	Spots
Mode	Extraction



Step 3. Set the appropriate level for the graphical elements that you wish to extract as Spots. Activate the **Level Numbers** toggle, and press the **Select** button beside Levels to invoke the Level Mask dialog. Select level **13** and press **OK**.

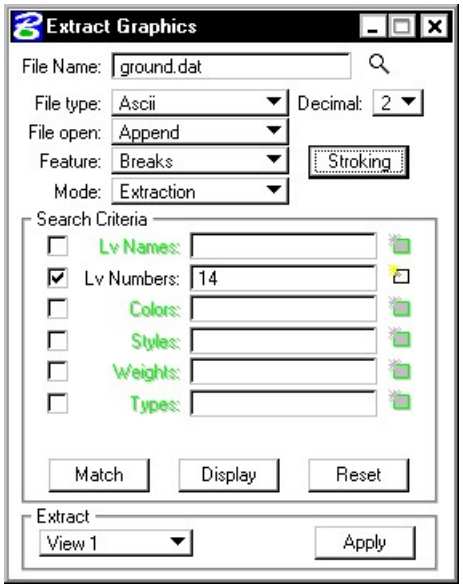


Step 4. Ensure that the entire design file has been fit into View 1.

Step 5. Press **Apply** to initiate the Extraction of the Spots.

Step 6. Proceed to extract the Breaks as defined below:

File Name	ground.dat
File Type	ASCII
File Open	Append
Feature	Breaks
Mode	Extraction



Notice that when the Feature type is switched to **Breaks**, the **Stroking** button is accessible from the Extract Graphics dialog. Access the Stroking Options dialog by pressing this button and populate the dialog as shown below.

Close the DTM Stroking Options dialog.

Also, we are adding the Break elements to the .dat file; therefore, we are **Appending** rather than **Creating**.

Set the Level for the Breaks to **Level 14**. Be sure to turn off Level 13.

Step 7. Again, ensure that all graphic elements are fit into View 1 and Press **Apply**.

Step 8. Lastly, we will extract the graphical element representing the Obscure area as a Drape Void. This will be to ensure that the elevations at the Void coordinates are included in the surface model and the slopes will be resolved to the Void when triangulation occurs.

File Name	ground.dat
File Type	ASCII

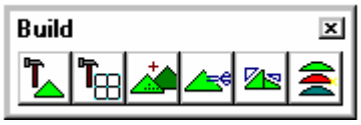
File Open	Append
Feature	Drape Void
Mode	Extraction

Step 9. Set the Level for the Drape Void to **Level 15**. Be sure to turn off level 14.

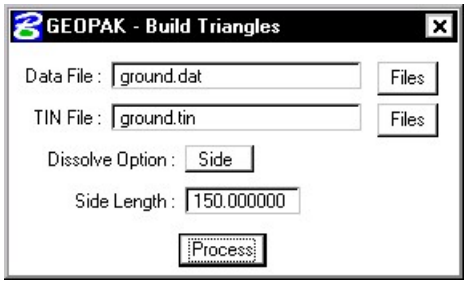
Step 10. Ensure that the obscure area is contained within View 1 and press **Apply**.

Step 11. Close the Extract Graphics dialog and Save Settings.

3.3 Build TIN



Step 1. Select the **Build TIN** icon from the tool frame to invoke the following dialog.



Step 2. To Build the **TIN** file, complete the dialog as indicated below:

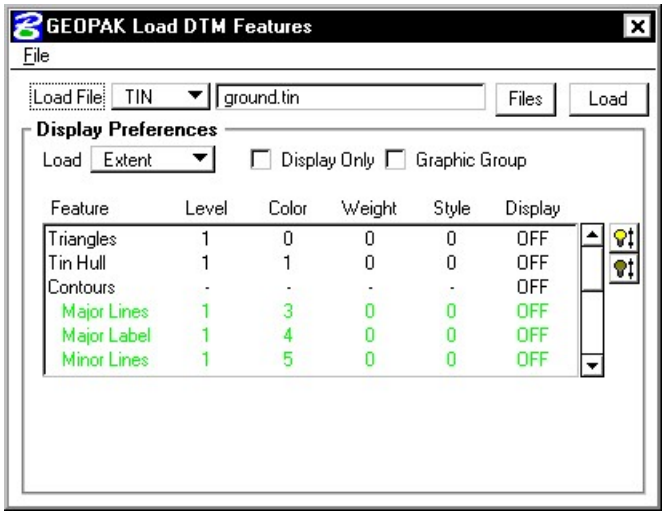
Data File	ground.dat
TIN File	ground.tin
Dissolve Option	Side
Side Length	150

Step 3. Press the **Process** button to initiate the creation of the TIN file.

Step 4. Close the Build Triangles dialog and Save Settings.

3.4 Display DTM Features

Step 1. Select the **Load Features** icon from the tool frame to invoke the following dialog.



Step 2. Change the **Load File** option to **TIN**.

Step 3. Select the TIN file **'ground.tin'** by pressing the **Files** button.

Step 4. Select the **Triangles** Feature by highlighting in the list box. Notice that initially the display is set to OFF. You can control the display of an item three ways:

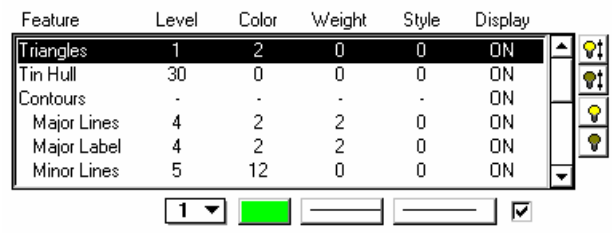
Use the "lightbulb" icons to the right of the dialog

Double-click on an item

Use the "display" toggle in the lower right corner of the dialog

Set the Triangles display to ON.

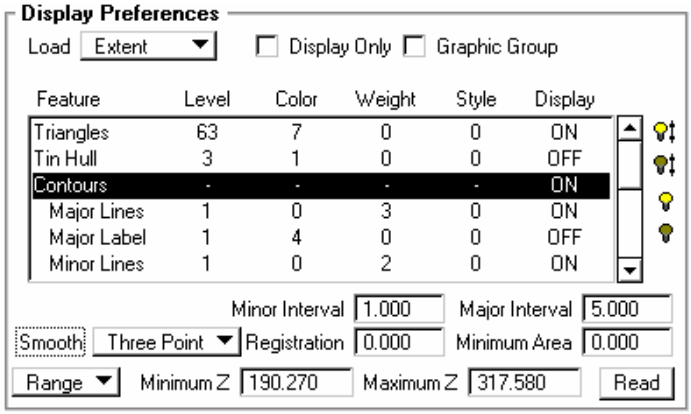
Step 5. Set the display symbology for the Triangles as indicated below:



Step 6. Select the **Tin Hull** (the boundary of the surface model) feature. Activate the Display of the feature and set the symbology as follows; Level = 30, Color = 0, Weight = 0, Style = 0.

Step 7. Select the **Contours** feature. Activate the **Display** Feature. Verify that **On** is set in the Display field.

Step 8. Complete the bottom of the dialog as indicated below. To complete the Minimum and Maximum Z, Press the Read button, which will review the active TIN file and determine these values.



Step 9. Activate the Display of the Contour **Lines** and **Labels** and set the symbology as indicated below:

	Level	**Color**	**Weight**	**Style**	**Font**	**Th / TW**	**Distance**
Major Lines	10	4	3	0			
Major Labels	10	4	3	0	23	TH=6 TW=6	100
Minor Lines	9	7	1	0			

Step 10. Set the Load option to **Extent**, activate the **Graphic Group** toggle and activate the **Display Only** toggle.

Step 11. Press the **Load** button to initiate the process.

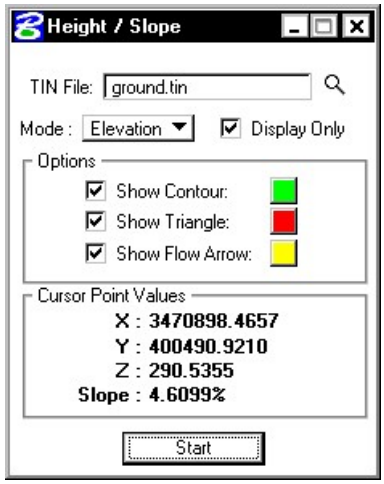
Step 12. Close the Load DTM Features dialog and Save Settings.

3.5 Analysis Tools

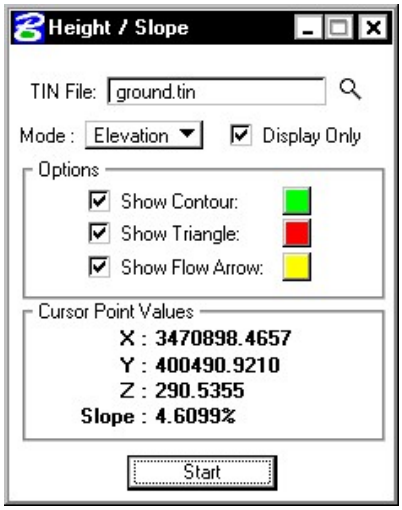
We will review several analysis tools in the following exercises. These include the height, themes, and profiles tools.

3.5.1 Height Tool

Step 1. Select the **Height** icon from the tool frame to invoke the following dialog.



Step 2. Activate the **Show Contour** and **Show Flow Arrow** toggles. The color may be altered to your choice of colors from the active color table on the Height dialog. The weight of the contour line and arrow are controlled by the active MicroStation settings.



Step 3. Press the **Dynamic** button and scan the surface model with the cursor to display the values for xyz and the slope on the model at the cursor point.

Step 4. The **DP** option can be utilized to review this information at a specific location and the **Draw** option will label the elevation at the selected data point.

Step 5. Close the Height dialog.

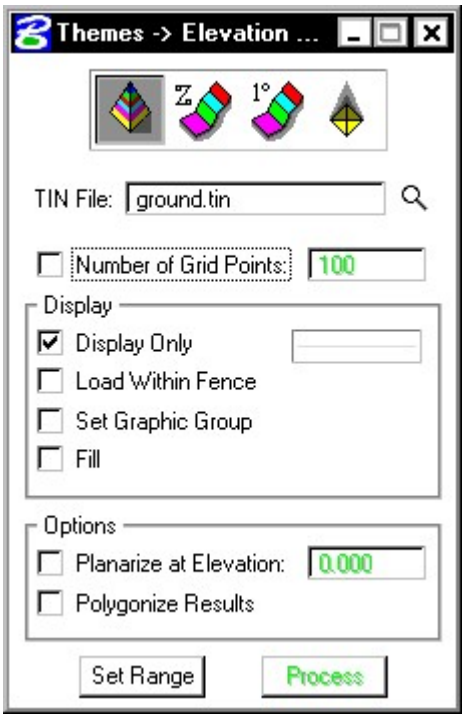
3.5.2 Themes Tool

Step 1. Select the **Themes** icon from the Analysis tool box to invoke the dialog depicted below.

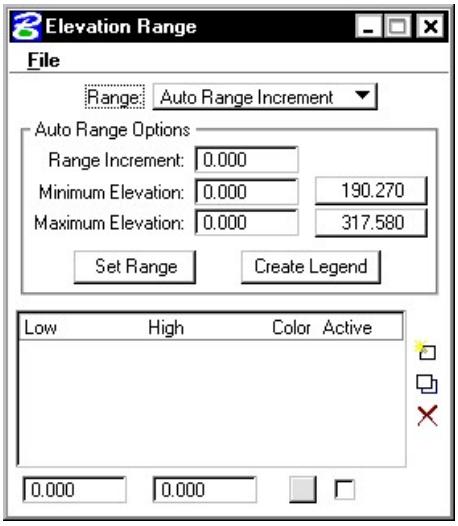
Step 2. Ensure that all graphic elements are Fit in View 1.

Step 3. We will determine the Elevation Range first for the **TIN File** 'ground.tin'. (This is the first icon on the dialog).

Step 4. Activate the **Display Only** toggle and the **Fill** toggle.



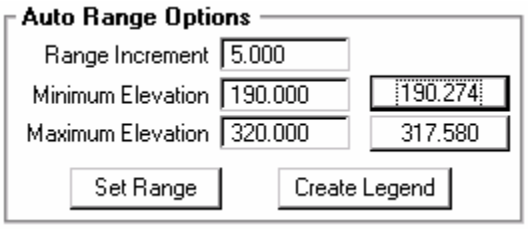
Step 5. Next, press the **Set Range** button to access the following dialog.



As shown on the right of the **Minimum** and **Maximum** Elevation Fields, the values for the active TIN elevations are listed. By pressing these buttons individually, the elevation fields will automatically be populated.

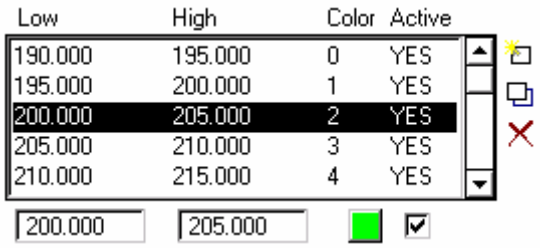
Step 6. Set the Range option to **Auto Range Increment**.

Step 7. Set the Auto Range Options as shown below:



Step 8. Press the **Set Range** button to populate the list box on the bottom portion of the dialog.

Selection of any list of elevations will populate the fields at the bottom.



Utilizing the buttons on the right side of the list box will permit additional ranges to be included in the list, modifications to be made to elevation ranges (or the color display of this range), or deleting a particular elevation range.

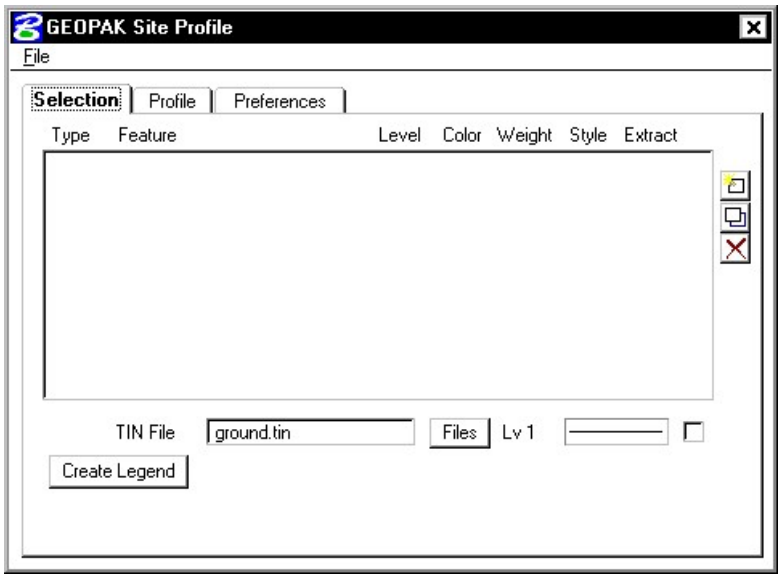
Step 9. Close the Elevation Range dialog (select the X in the upper right hand corner of the dialog).

Step 10. Press the **Process** button to initiate the display of the Elevation Ranges for the surface model.

Step 11. Close the Themes dialog and Save Settings.

3.5.3 Profile Tool

Step 1. Select the Profile icon from the Analysis tool palette to invoke the following dialog.

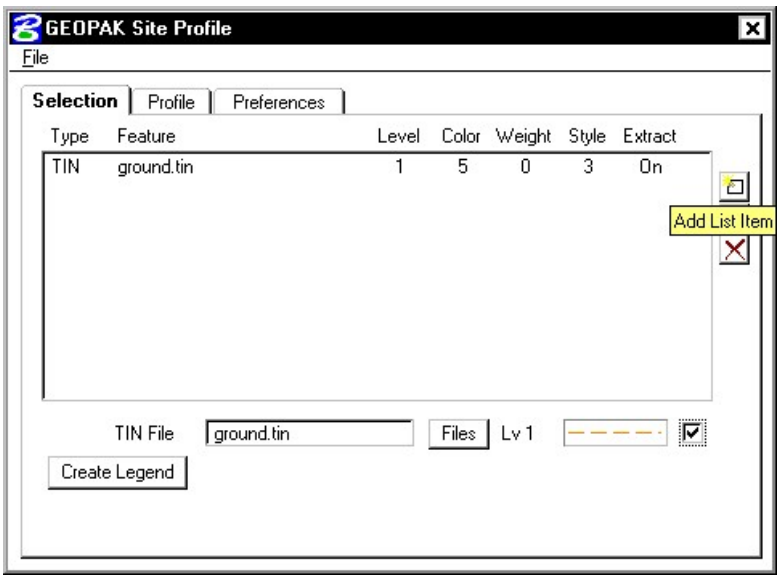


Step 2. Use the **Selection** tab to identify your surface model (TIN File) which you will generate a profile from, and the symbology for your profile.

Step 3. Select the Tin File 'ground.tin' by using the **Files** button.

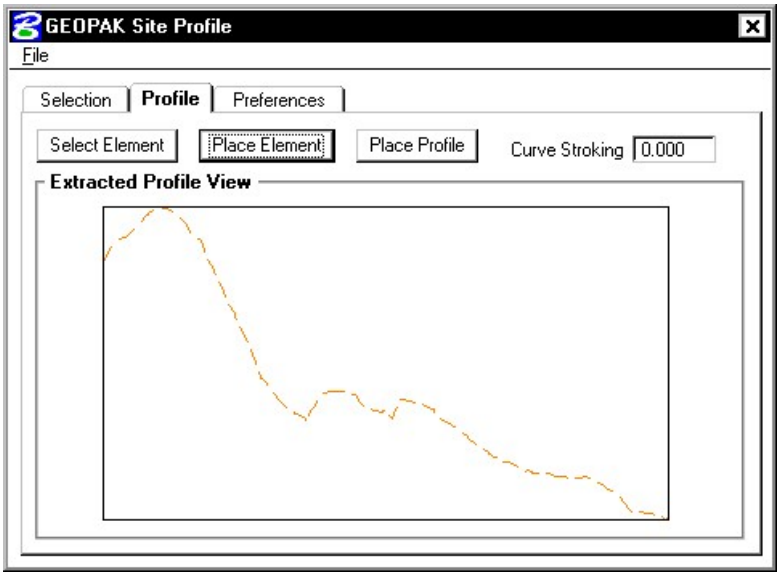
Step 4. Double-click on the symbology box (field to the right of the **Files** push button) to set the symbology representing the ground surface profile. You may choose any symbology you wish. Once the symbology has been set, press OK.

Step 5. Press the **Add** icon (top icon next to the list box) to add the feature to the collection box.



Step 6. Select the **Profile** Tab.

Step 7. Press the **Place Element** button to cut your actual profile at any desired area by just placing two data points (i.e. a line) or a series of data points (i.e. a line-string) across your surface model at any location.

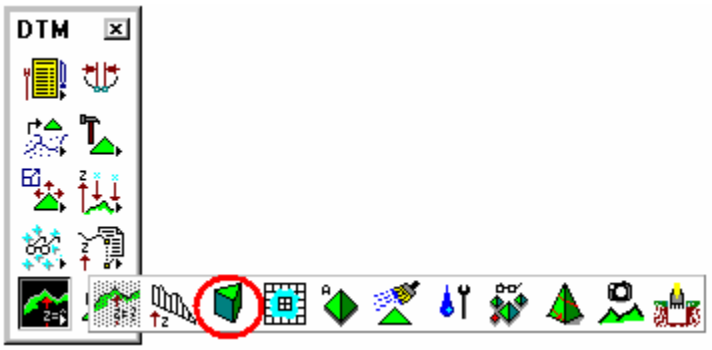


Step 8. You can use the **Preferences** tab to set up a grid for your profile if desired.

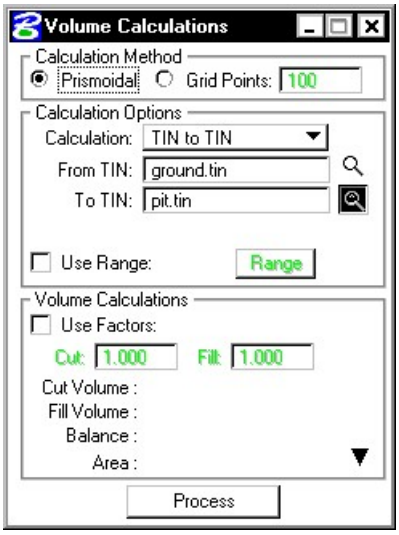
Step 9. Close the Profile dialog and remove the DTM Tools tool frame.

3.6 Prismoidal Volumes

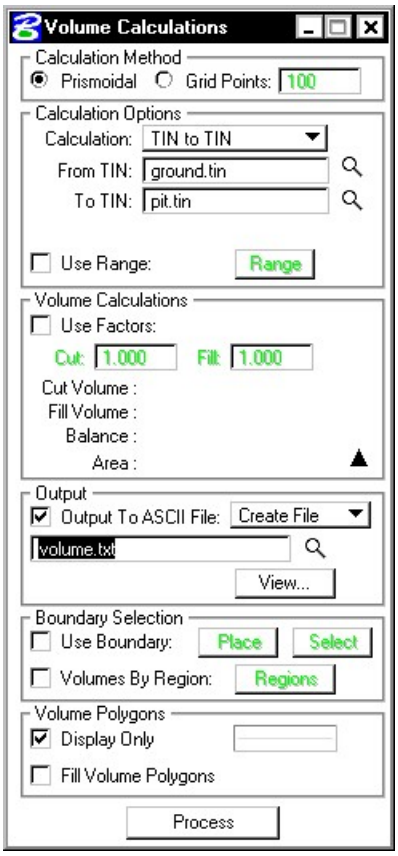
Step 1. From the DTM tool palette select the **Analysis>Volumes** tool.



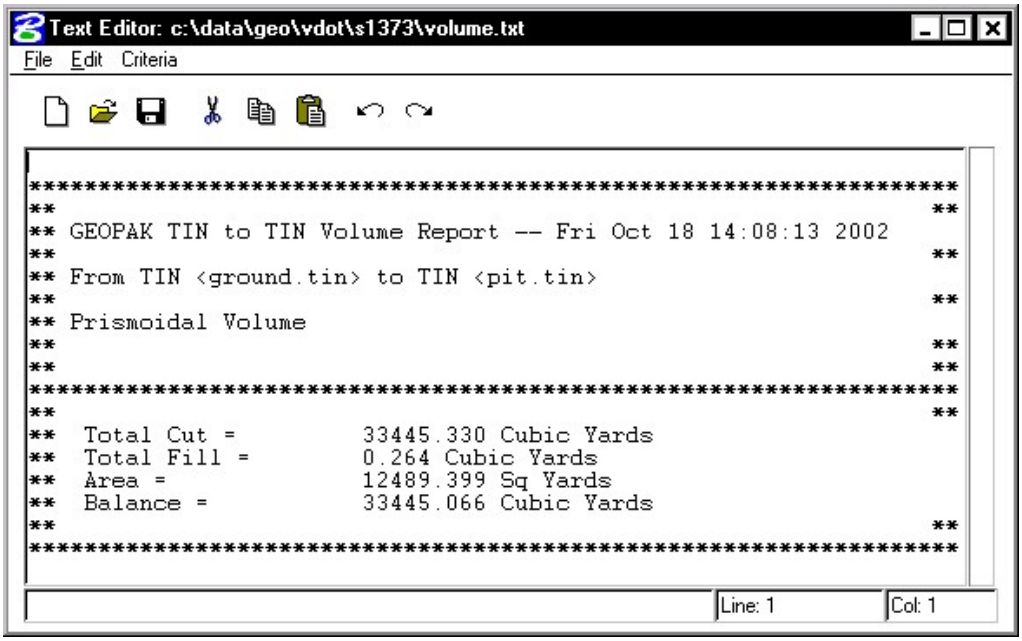
Step 2. Make the settings as shown below and select the **Process** button.



Step 3. Now select the “slam down” button to expand the dialog and fill in as shown below.



Step 4. Select the **Process** button again and then review the file volume.txt to see the final calculations.

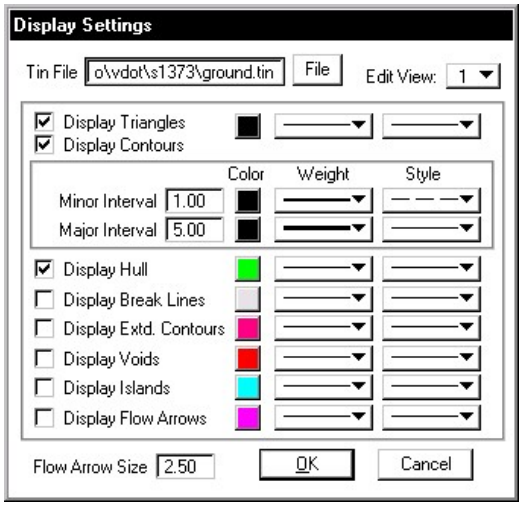


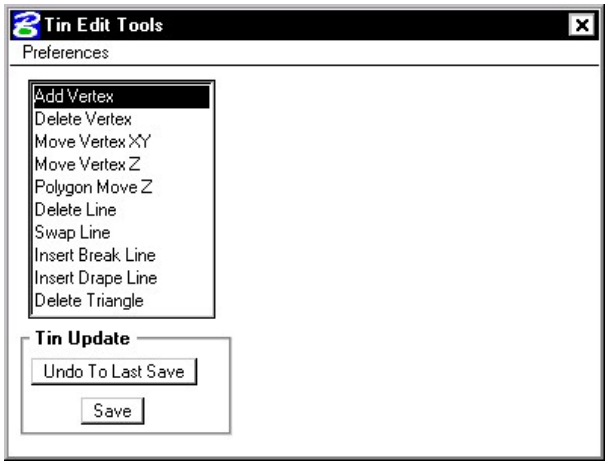
3.7 TIN Editing

Step 1. Attach the saved MS saved view **Edit.**

Step 2. From the DTM tool palette select the **Edit Tin** icon.

Step 3. This will invoke the 2 dialogs shown below. Make the appropriate settings in the **Display Settings** dialog and select **OK**.

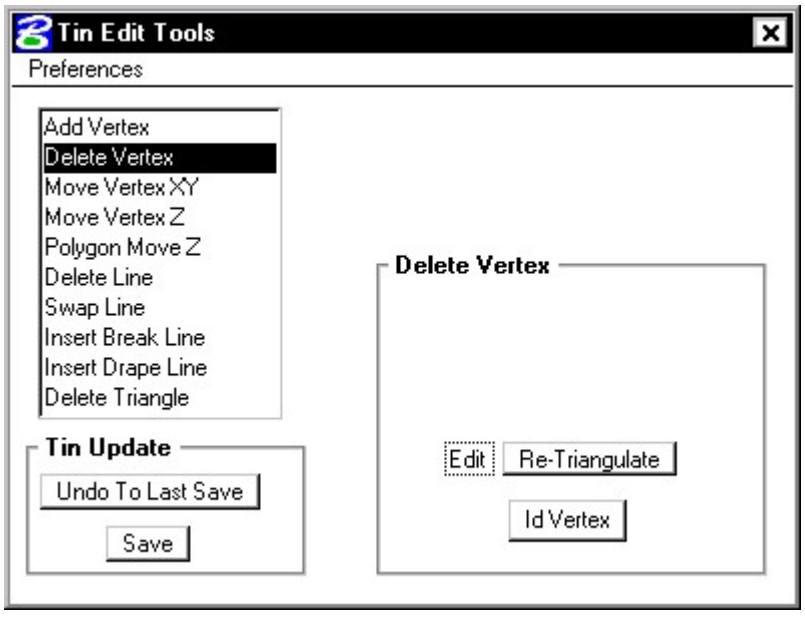




Step 4. The graphic below identifies a bad shot in the tin file that we will edit in order to clean up the tin file.

In order to edit the tin file we need to delete this point and allow the tin to re-triangulate the area that is affected. To do this, select the **Delete Vertex** option from the **Tin Edit Tools** dialog.

Step 5. In the delete vertex dialog make sure the **Edit** toggle is set to **Re-Triangulate**.



Step 6. Select the **Id Vertex** button from the dialog and the Id the vertex on the triangles that you wish to delete.

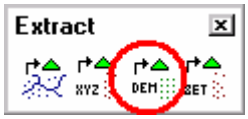
Step 7. Once the Id is made, one more data point to accept the selection will initiate the command.

Digital Elevation Models

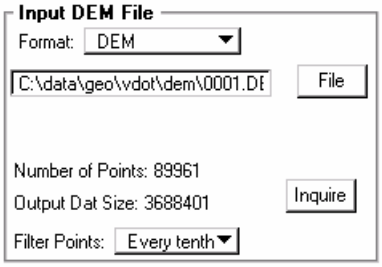
3.8 Importing DEM Files

Step 1. Open the file C:\data\geo\vdot\dem\dem3d.dgn

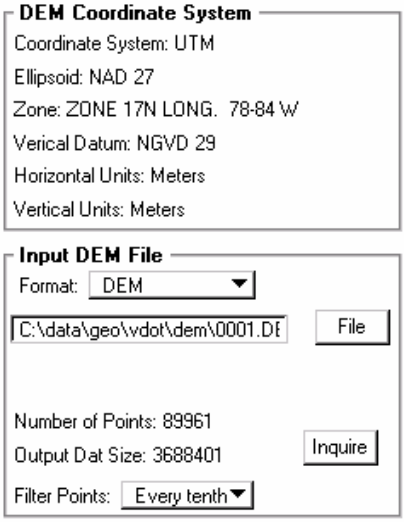
Step 2. Select the icon for importing DEM files.



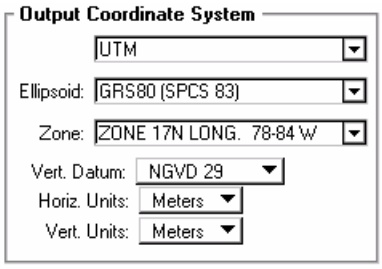
Step 3. Using the **File** button in the **Input DEM File** portion of the dialog, choose the file **C:\data\geo\vdot\dem\0001.DEM**



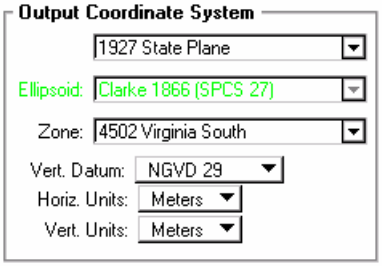
Step 4. Once the file has been loaded select the **Inquire** button to populate the **DEM Coordinate System** portion of the dialog. This process reads the vital information from the DEM file and displays it for review.



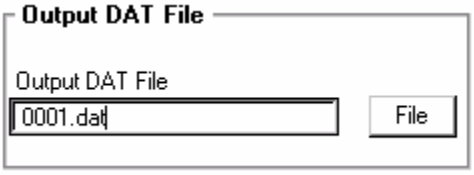
Step 5. Referencing the information in the **DEM Coordinate System** portion of the dialog, make the appropriate settings in the **Output Coordinate System** portion of the dialog.



If it is desirable to convert to State Plane Coordinates then settings make be changed to look something like the dialog below.



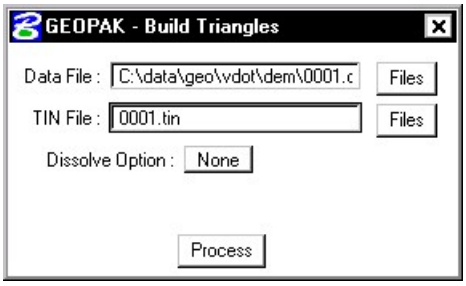
Step 6. The last setting is to assign an output file to write the converted points to. This is done by entering a file name into the field in the **Output DAT File** portion of the dialog.



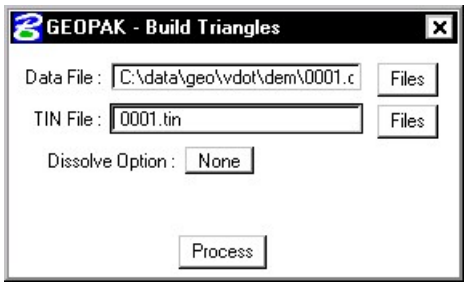
Step 7. Once this is done, select the **Apply** button to convert the DEM file.

Step 8. After the conversion is complete, select the **Build TIN** icon from the **Build** tool bar.

Step 9. Using the **Files** button select the **DAT** file that was created in the previous steps.



Step 10. Now provide the **TIN** file name and select the **Process** button.



Once the TIN has been created any of the query or display tools may be used to review, analyze, or edit the tin file.

Existing Ground Cross Sections

4.1 Introduction

Objectives	To generate existing ground cross sections based on a horizontal alignment and the surface model beneath the alignment, and to review the sections utilizing the Cross Section Navigator tool.
Tools 	
Menu Bar Application	GEOPAK Road > Cross Sections > Draw Pattern by Station Range GEOPAK Road > Cross Sections > Ground Cross Sections from DTM GEOPAK Road > Cross Sections > Navigator

The prerequisites to generate existing cross-sections utilizing digital terrain modeling are:

- ·GEOPAK coordinate geometry database wherein the horizontal alignment is stored.
- ·GEOPAK binary TIN file, Site Model or Site Object. If you have not already created your binary TIN file, see the DTM online documentation for a detailed discussion of the Digital Terrain Modeling features. The Site Model or Object are created utilizing GEOPAK Site Modeler software and are stored within the GEOPAK Site project (gsf) file.
- Pattern lines if pattern by design is to be utilized.

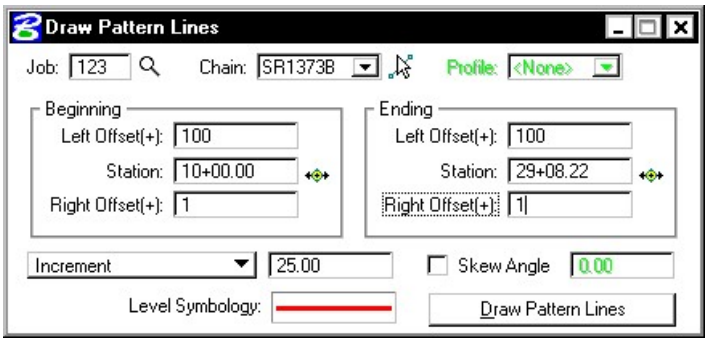
The generation of existing ground cross sections must be invoked from within the 2D MicroStation design file wherein the sections are to be drawn. GEOPAK does not create this MicroStation design file. The user creates the blank design file utilizing the desired seed file, and then GEOPAK draws into it.

4.2 Pattern Lines

Project Manager	Draw Pattern
Tools 	
Menu Bar Application	GEOPAK Road > Cross Sections > Draw Patterns By Station Range

Pattern lines are graphical lines and/or line strings in a MicroStation design file that define locations at which the cross sections will be cut.

From the **Project Manager** you will select **Draw Pattern**, and create or select an existing run. When completed, the following Draw Pattern Lines dialog appears.



Once all of the fields have been completed, and the application is initiated, graphic lines (on the specified level, color and style) are drawn along the chain. This is a visual representation of the location of the cross sections to be generated.

Six methods are supported for drawing the pattern lines:

- Increment – starts at the beginning station, and draws a pattern line at the given increment.
- Even – draws pattern lines at stations divisible by the given value.
- Once – draws a pattern line at a given station.
- Control Points Horizontal – draws a pattern line at each of the critical point (i.e. POT, PC, PT, etc.) within a chain.
- Control Points Vertical – Draws a pattern line at each VPC and VPT in addition to the sag and crest station of vertical curves based on the profile defined in the dialog.
- Superelevation Transitions - The current design file is scanned for Superelevation shapes created with the specified chain. A pattern line is drawn at the beginning and end of each Superelevation shape, ignoring the beginning and ending station fields in the dialog. Note the Superelevation shapes cannot be in a reference file.

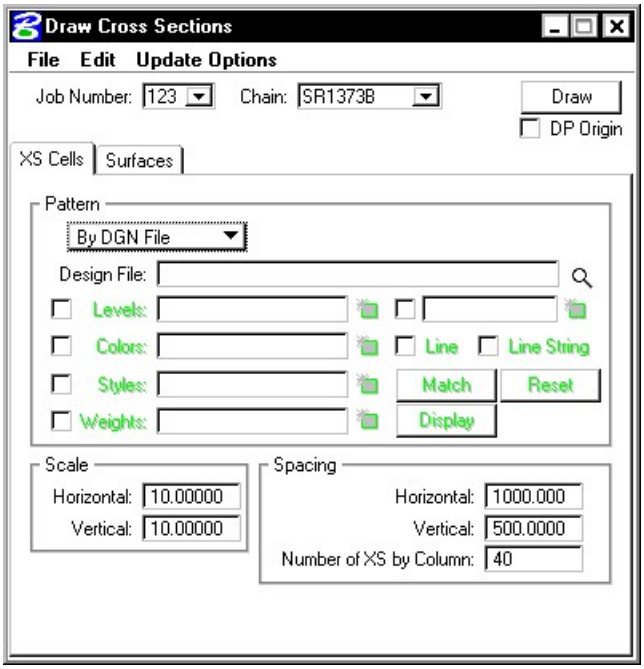
The pattern lines are drawn into the current MicroStation design file. The user can use the MicroStation **Place Smartline** or **Place Line** command to draw additional pattern lines at any user defined location. In addition, MicroStation commands can be utilized to modify pattern lines drawn via the dialog to lengthen, shorten, delete, copy, move, etc.

NOTE: This should be completed before the existing ground cross sections are generated.

4.3 Generating Cross Sections

Tools 	
Menu Bar Application	GEOPAK Road > Cross Sections > Draw Cross Sections from Surfaces

Once the pattern lines have been drawn, the cross sections can be generated. Note the Job Number must be defined in order to populate the Chain list. Once the Chain is defined, the dialog unghosts as depicted below.



The rest of the dialog consists of a menu bar with three listings:

File — Standard file utilities to load, or save settings, plus a dialog exit option.

Edit — Options to Cut, Copy and Paste rows in the surfaces list box. Also, save and restore settings in the RSC file or clear list of all surfaces.

Update Options: — User-defined options on how the software handles the redrawing of cross sections.

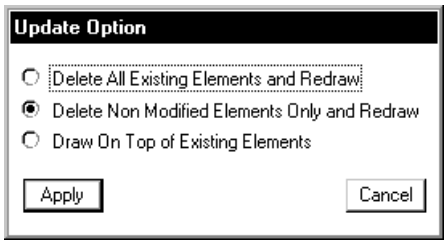
Delete Existing Elements and Redraw — When this option is activated, any existing ground lines previously drawn with this tool are deleted and new ground lines are drawn.

Delete Non-modified Elements and Redraw — When this option is activated, any existing ground lines previously drawn with this tool are deleted and new ground lines are drawn.

Draw on Top of Existing — When this option is activated, any previously drawn ground lines are ignored and a new set is drawn, resulting in two sets of ground lines.

Query — When activated, the user is prompted each time the Draw button is

pressed.



Two tabs on the dialog support the input data required to draw cross sections:

XS Cells Defines the location of cross sections utilizing either pattern by station or pattern by design. In addition, the scale and spacing are defined on within this tab.

Surfaces Define the surfaces utilized for drawing cross sections. Note multiple surfaces may be drawn in a single processing. Source data includes GEOPAK TIN files, Site Models, or Site Objects.

On the **XS Cells tab**, the **Pattern** group box has three choices:

Pattern by Station Utilizes Begin and End Station values in addition to an Increment/Even option and Left and Right Offset fields to determine cross section location. This works well when no sections are needed that are at odd stations, skewed or kinked relative to the Chain.

Pattern by DGN This method utilizes graphical representation and draws one cross section for each line or line string of the specified parameters. Those parameters include Design File which is the name of the file that contains the lines and line strings in addition to their associated symbology.

In Existing Only No user input is required, as this option draws ground lines only for cross section cells which were previously drawn. Therefore, no other pattern requirements are needed.

4.4 Cross Section Navigator

Project Manager	Not accessible from within Project Manager
Tools 	
Menu Bar Application	GEOPAK Road > Cross Sections > Navigator

The Cross Section Navigator tool is used to view and traverse between cross sections. It can also be used to draw cross section information.

When the Navigator is invoked, the following dialog appears.

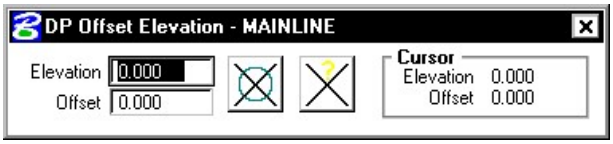
The user can scan through the cross sections by either choosing the station from the drop down list, or by using the First Section, Previous Section, Next Section, or Last Section icons (arrowheads). The Reset Navigator icon window centers the current station to the view.

The **Open View Control Dialog** enables the user to open several windows to view different portions of the cross section at the same time. The user can view the whole cross section in view 1, the left side in view 2, and the right side in view 3, etc.

Cross section elements can be added or modified using MicroStation tools or GEOPAK cross section drawing tools, as detailed in the table below.

DP Offset Elevation

Data points at a given offset/elevation, or find the offset/elevation of the cursor location.



DP Delta Distance Slope

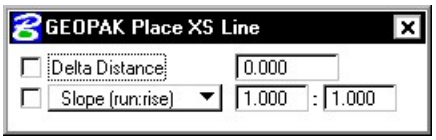
Draws a line at a given horizontal distance and slope.

XS Active Angle Tool

Sets the active angle to the given value. If a MicroStation tool is used with the active angle option, this value is used.

Draw XS Line

Draws a cross section line. The length and/or slope can be specified.



4.5 Summary - Basic Steps to Creating Existing Ground Cross Sections from a DTM

Step 1. Requires a horizontal alignment stored in *.GPK file.

Step 2. Requires an existing triangle file (TIN) from a DTM.

Step 3. Draw pattern lines.

Step 4. Process cross sections through GEOPAK.

Step 5. Review and modify (if necessary).

Existing Ground Cross Sections

4.1 Draw Patterns

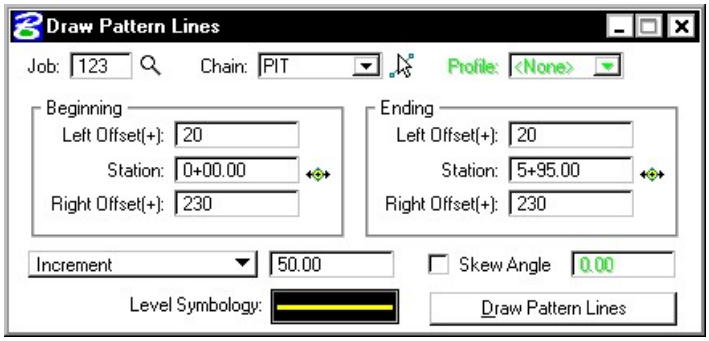
The first step is drawing MicroStation lines or line strings to define the location of the existing ground cross sections.

Step 1. Open the MicroStation file **c:\data\geo\vdot\s1373\s1373.dgn**

Attach the saved view called borrow.

Step 2. Select the **Draw Pattern** button from the **Applications>GEOPAK Road>Cross Sections>Draw Patterns By Station**.

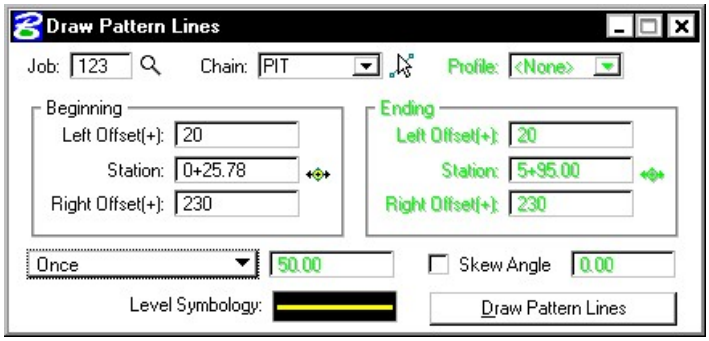
Step 3. Populate the dialog as depicted below.



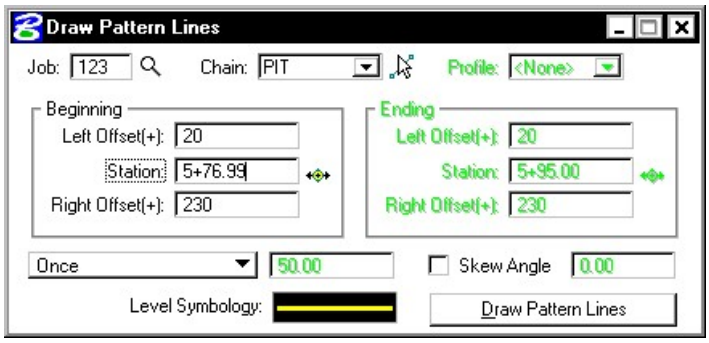
Step 4. Press **Draw Pattern Lines** to initiate the plotting of the patterns into the design file.

Step 5. Change the interval toggle to **Once**. Since the pit begins and ends between nominal cross sections we will add one for the beginning and end.

Step 6. To place a pattern at that station, key in the station value and press **Apply**.



Step 7. Repeat the process for the ending station of the pit.



Step 8. Review the pattern lines.

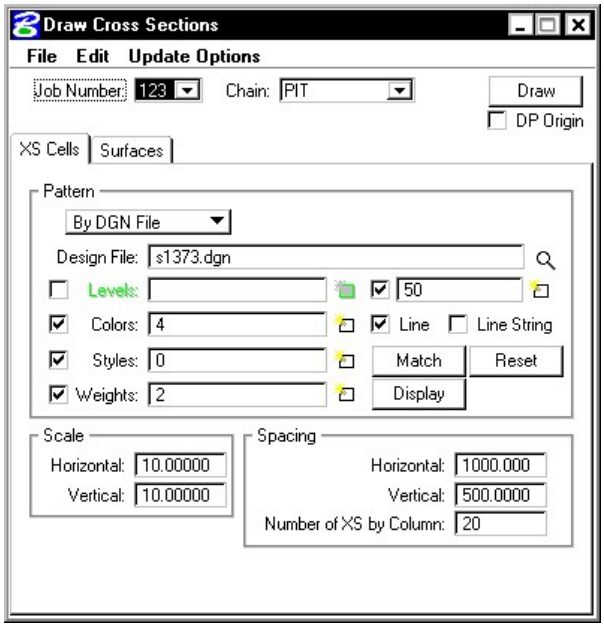
Step 9. **Exit** the Draw Pattern dialog and Save Settings.

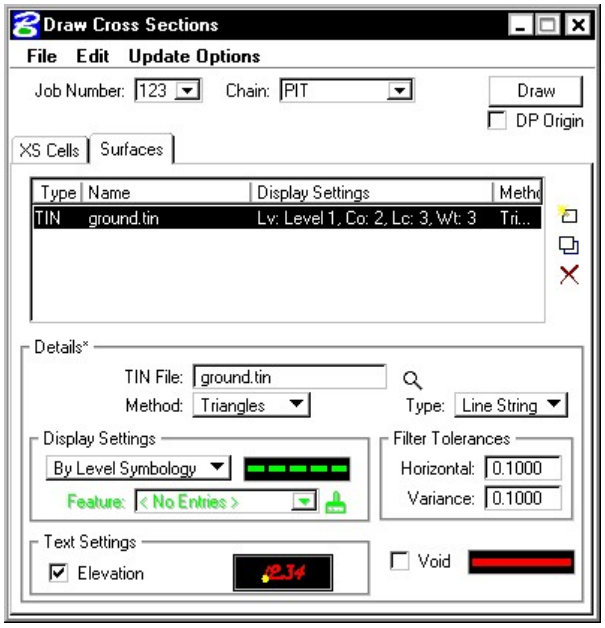
4.2 Generate Existing Ground Cross Sections

Step 1. Open the MicroStation file **c:\data\geo\vdot\s1373\xs.dgn**

Step 2. Select **Applications>GEOPAK Road>Cross Sections>Draw Cross Sections from Surfaces**.

Step 3. Generate the existing ground cross-sections by populating the dialog as shown on the following dialogs and pressing the **Draw** button to initiate the routine.

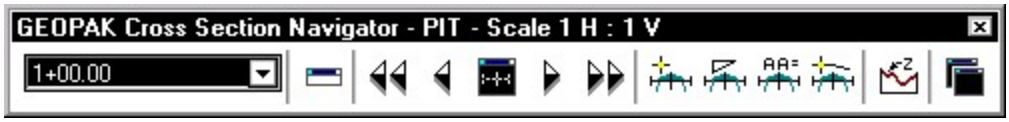




Step 4. Exit the dialog and Save Settings.

4.3 Review Cross Sections

Step 1. Select the **Cross Section Navigator** tool from the **Road Tools** tool frame.



Step 2. Use the **Cross Section Navigator** to browse and check your existing cross sections.

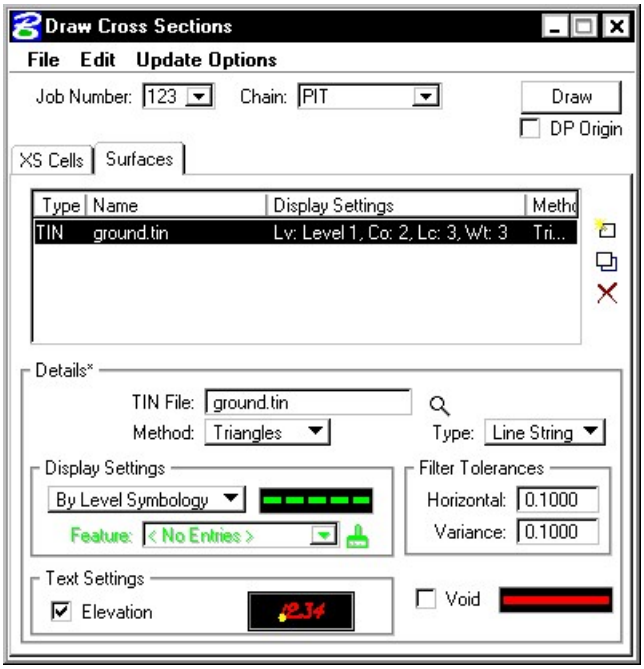
Step 3. **Exit** the XS Navigator dialog when done.

Step 4. Upon reviewing the sections, it is desirable to "lock" the elements to prevent accidental deletion or modification in later steps. Click **Edit > Select All** from the MicroStation menu bar. Then click **Edit > Lock** to lock the elements.

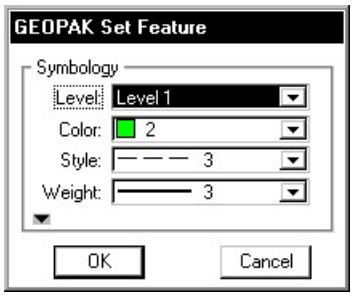
4.4 Generating Additional Cross Sections (Borrow Pit)

Additional cross sections may be desired if surveying a borrow pit or waste mound. The next steps will show how to add sections to the existing ones created in the previous step.

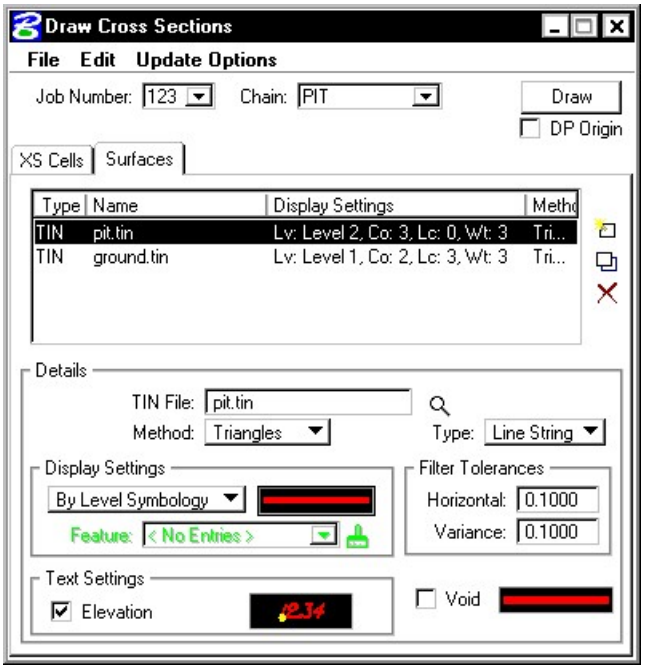
Step 1. Access the **Draw Cross Sections from Surfaces** dialog.



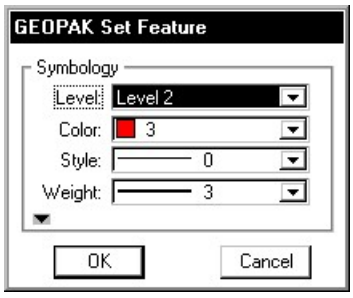
The symbology should appear as shown in the dialog below.



Step 2. This time we can either add the new sections to the list box and process both existing and new. Or delete the previous run and simply process the new. For this exercise we will add the pit and process both.



The symbology should appear as in the dialog below.



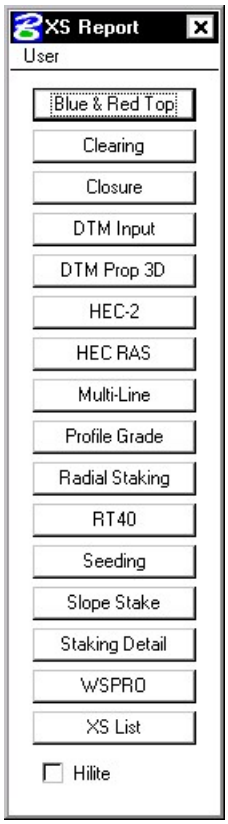
Step 3. Press the **Draw** button and close the dialog.

4.5 Closure Report

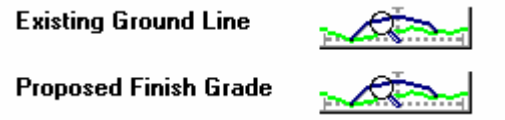
Invariably additional cross sections will not tie precisely to the existing ground cross sections. The **Closure Report** will automate the process of connecting non-tied slopes.

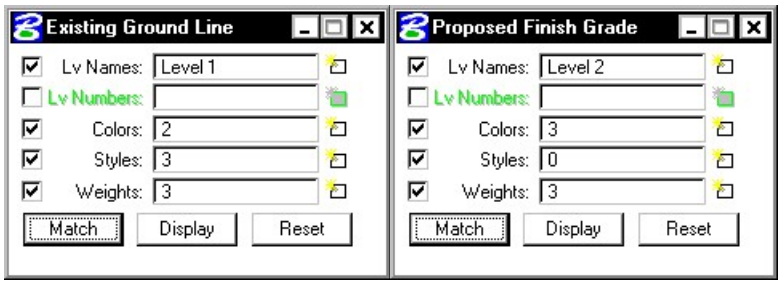
Step 1. Access the **Cross Section Reports** dialog.

Step 2. From the reports dialog select the **Closure Report.**

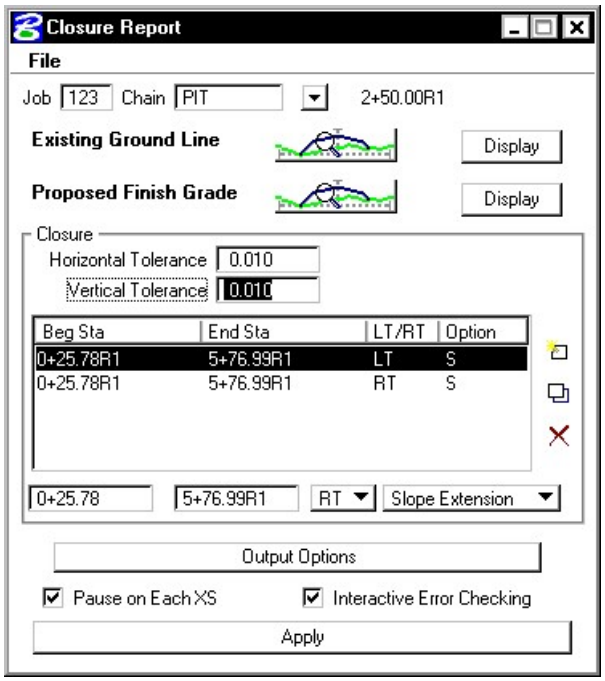


Step 3. Using the icons shown below identify the existing and as-built surfaces by setting the symbology for each, as shown in the dialog below.

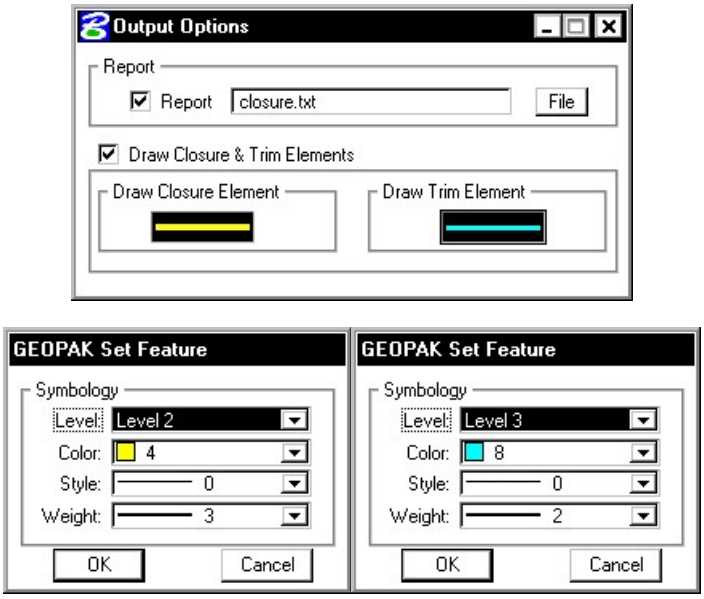




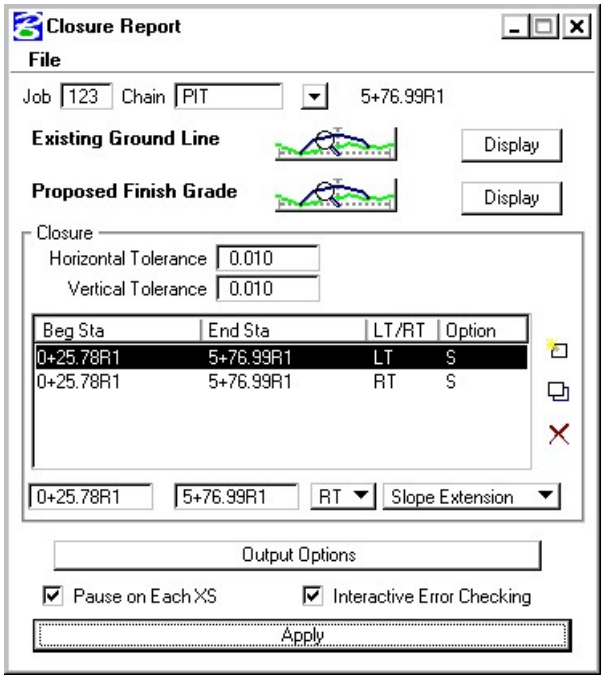
Step 4. Now select the desired method of correction in the **Closure** portion of the dialog. We will select slope extension for both the left and right sides of our sections.



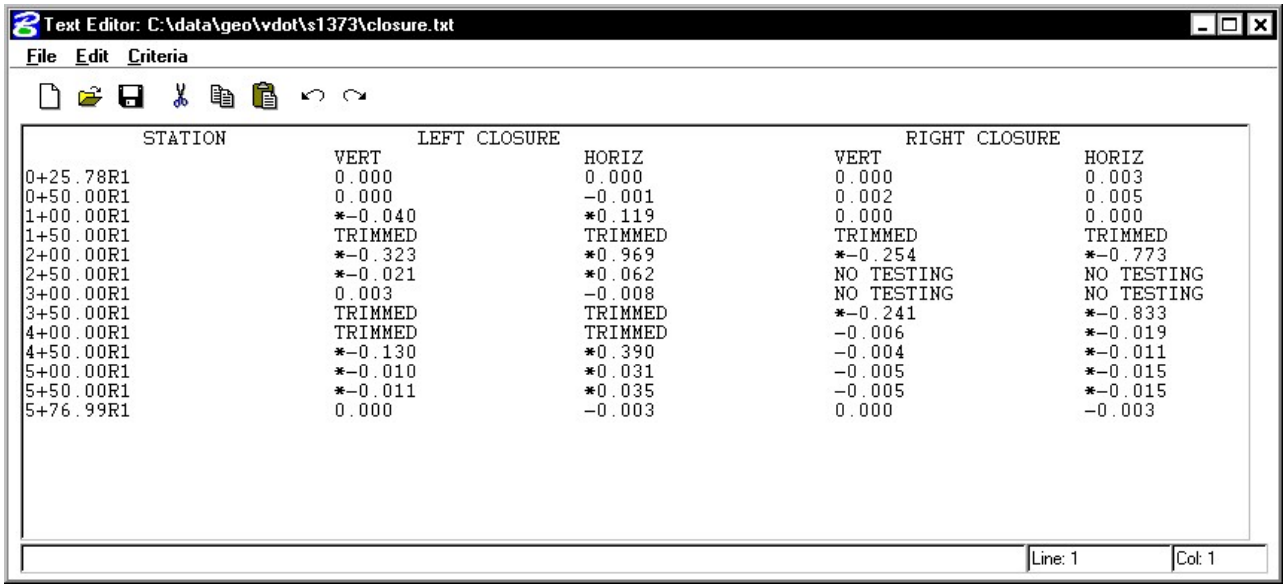
Step 5. Once done, select the **Output Options** button so we can set the desired output. Complete the dialog as shown below and close.



Step 6. From the main dialog press the **Apply** button.



Step 7. Using the text editor, open the closure.txt file and review the closure operations.



STATION	LEFT CLOSURE		RIGHT CLOSURE	
	VERT	HORIZ	VERT	HORIZ
0+25.78R1	0.000	0.000	0.000	0.003
0+50.00R1	0.000	-0.001	0.002	0.005
1+00.00R1	*-0.040	*0.119	0.000	0.000
1+50.00R1	TRIMMED	TRIMMED	TRIMMED	TRIMMED
2+00.00R1	*-0.323	*0.969	*-0.254	*-0.773
2+50.00R1	*-0.021	*0.062	NO TESTING	NO TESTING
3+00.00R1	0.003	-0.008	NO TESTING	NO TESTING
3+50.00R1	TRIMMED	TRIMMED	*-0.241	*-0.833
4+00.00R1	TRIMMED	TRIMMED	-0.006	*-0.019
4+50.00R1	*-0.130	*0.390	-0.004	*-0.011
5+00.00R1	*-0.010	*0.031	-0.005	*-0.015
5+50.00R1	*-0.011	*0.035	-0.005	*-0.015
5+76.99R1	0.000	-0.003	0.000	-0.003

Design and Computation Manager

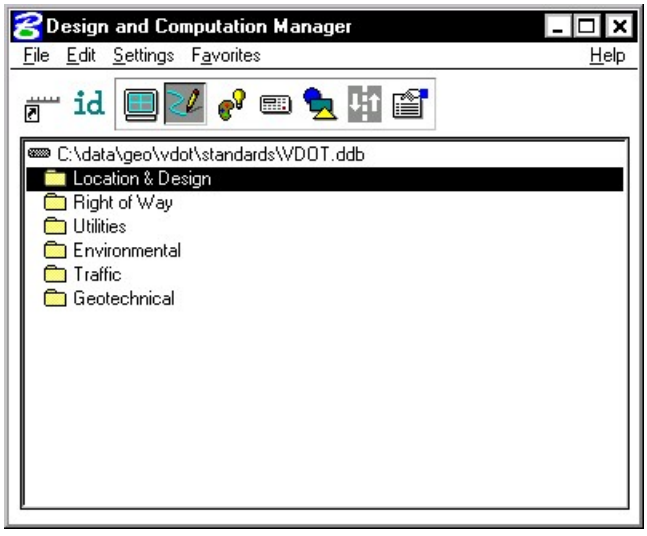
5.1 Introduction

Objectives	Understand the use of the **D&C Manager** to plot horizontal alignments into MicroStation. Understand the format of the hierarchical database and how to use it.
Road Tool Frame 	Plan View Design
Menu Bar Application	
	GEOPAK Road > Design and Computation Manager

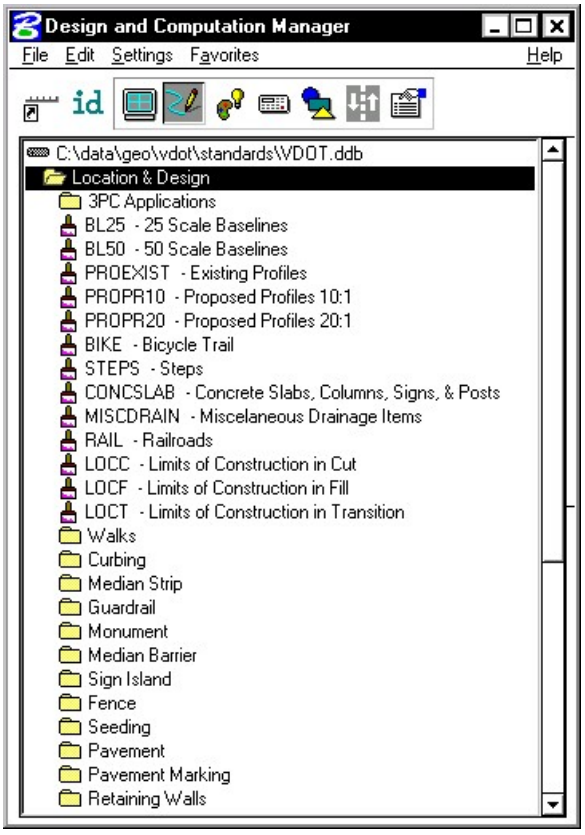
The **Design and Computation Manager** (D&C Manager) is a tool that allows the user to standardize graphics elements for drafting and pay item quantities.

A hierarchical database is used with the **Design and Computation Manager**. This database stores information concerning functional classification and display preferences for each feature and item used in a MicroStation file. This file is commonly referred to as the **ddb** file (*.ddb).

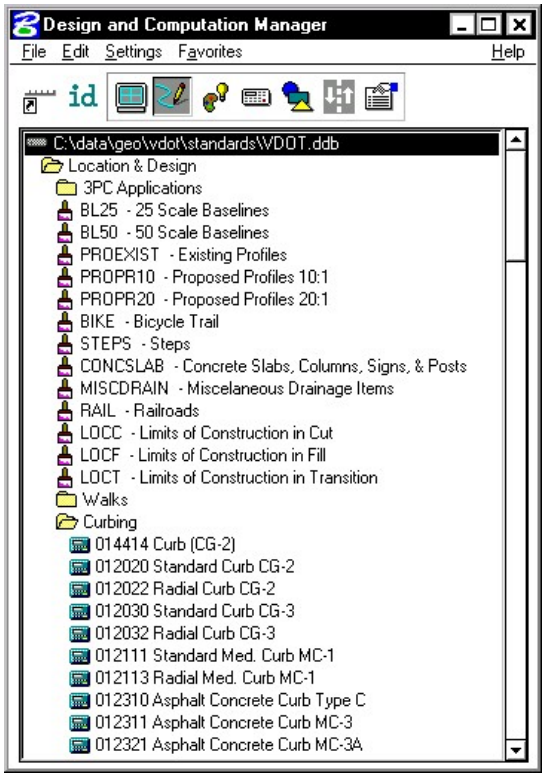
Categories are used to group and classify the features and items used in creating construction drawings. Two common examples of these categories are **Pay Items** and **Drafting Standards** as shown in the following diagram.



These categories each contain sub-categories. The sub-categories break down each classification into more specific items. For example, **Location & Design** may be broken into several additional categories such as **Walks, Curbing**, etc.



Within a category (represented by the folder icon), the items that are included are designated according to the process that they will be used for (as a drafting item indicated by a paintbrush shown in the following diagram):



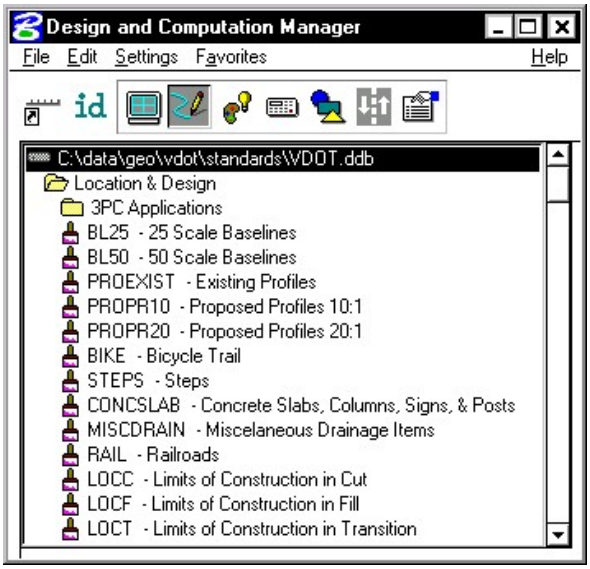
Each entry represents a specific item. The various icons representing the function they will be utilized for can identify items.

- Calculator (quantities calculations)
- Paintbrush (draw design elements)
- Report icon (default, pavement design, pavement markings, etc.)

The database may also be password protected if desired. This can be used as a security measure to protect the integrity of the database file and ensure its consistent application on a statewide or company wide basis.

5.2 Accessing the Design and Computation Manager

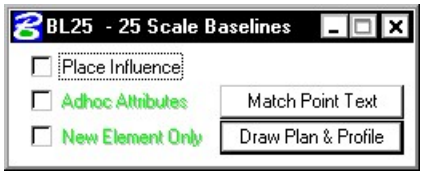
When the Design and Computation Manager is accessed, two dialogs are displayed.



The main D&C Manager dialog is composed of two distinct areas:

- Across the top are icons for the various modes. The D&C Manager may be configured to operate in seven different modes: **Display, Design, Set, Compute, Shape, Pavement Marking** and **Preferences.** As various modes are selected, more icons are displayed within this area.
- The **Path box** displays the name of the attached database file and your current position within the database structure. It lists the categories, sub-categories and items available for selection. This hierarchical data structure functions much like a directory. Double-clicking enables the user to move up or down within the database.

A second dialog appears differently depending on the mode of operation. This dialog enables the user to set other options not available on the main dialog.



5.2.1 File Commands

For the GEOPAK designer, the only file command options needed are **Open** and **Exit**. The other commands such as **Save**, **Merge** and **Compress** are used by personnel who maintain the database.

As mentioned previously, the **Password** option may be used to password protect the database so a user would not be able to make changes to it.

5.2.2 Edit Commands

As a designer, the most-used Edit commands will be Find, Identify and Review Item.

Find – This tool will search the database (from your current location) for an item or category. If the database is password protected, all other items will be disabled.

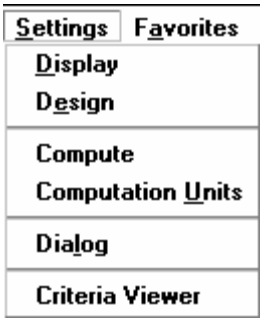
Identify – This tool will allow you to select an element in the design file to identify which item it matches in the database.

Review Item – This tool will allow you to review the settings/symbology for a particular item in the database.

5.2.3 Settings

Display Settings - temporarily changes the display of elements on the screen to one common color, then the user may specify additional elements to be viewed in their original colors. This tool enhances visualization when working on a complex project.

Design Settings - sets the *maximum gap* tolerance and *deduction tolerance* used in computations and the drawing scale for placing cells.



5.2.4 Favorites

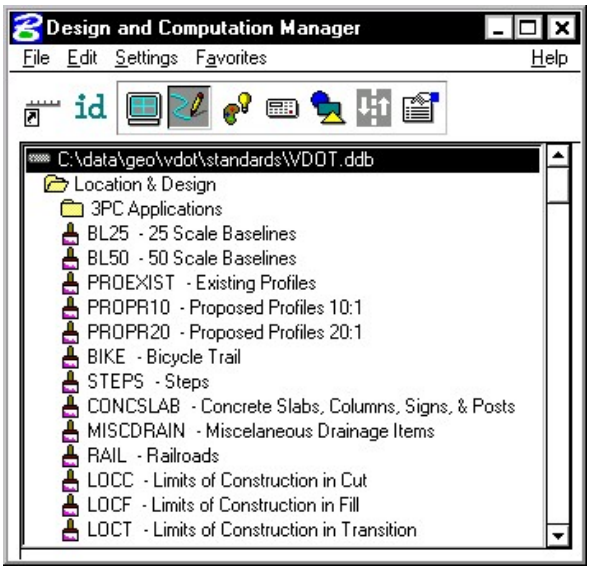
Add to Favorites - saves current D&C Manager path for easy recall in the future.

Organize Favorites – allows the organization of previously saved paths.

5.3 Operational Mode - Design

The Design mode enables the user to draw each roadway element or COGO element (and associated attributes) in the design file based on drafting item parameters.

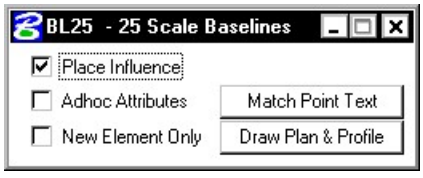
First, the desired item is highlighted in the main dialog list box, i.e., alignment, edge of pavement, etc.



The **Place Influence** option sets the level, symbology and attribute tags of elements drawn or copied using MicroStation commands. When the **Place Influence** toggle is activated, elements are drawn using the level, symbology and attributes as defined in the GEOPAK database. When **Place Influence** is off, elements are drawn using the active level, symbology and attributes of MicroStation.

The **Draw Cogo Element** button is for drawing COGO elements to a design file. A single click to this button prompts the user for a job number, then opens a dialog that enables the user to choose a COGO item to draw.

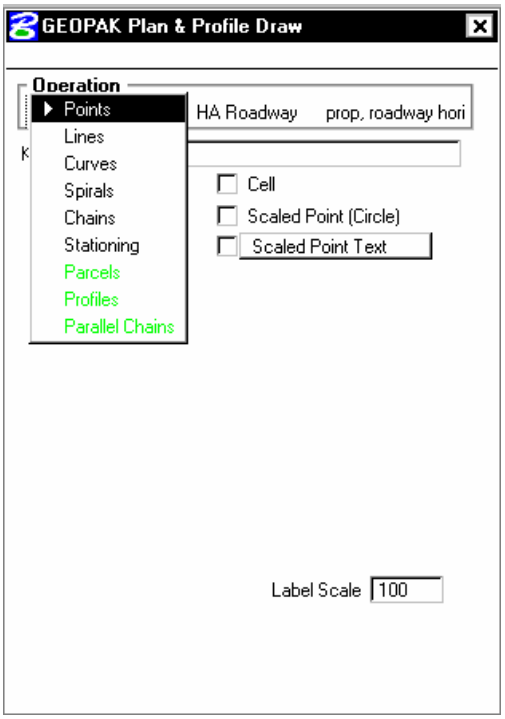
If an alignment, profile or parcel item is chosen, the **Draw Cogo Element** button changes to **Draw Plan and Profile**.



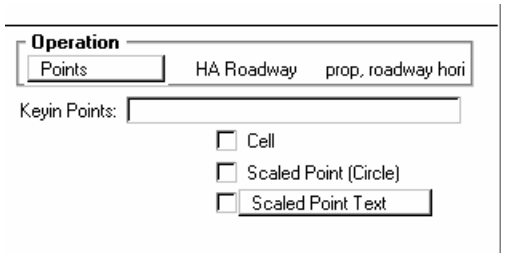
From the secondary dialog that is opened, press the **Draw Plan & Profile** button to initiate the drawing of COGO elements into the design file. Pressing this button prompts the user for a job number (the coordinate geometry database file wherein the COGO elements are stored), and then opens a dialog that enables the user to choose a COGO item to draw. **Do Not** activate the **Place Influence** toggle when using **Draw Plan & Profile**.

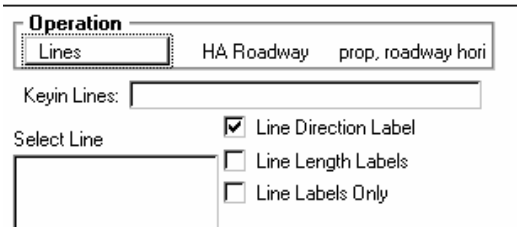
If utilizing the Design & Computation Manager within Project Manager, you are not be prompted for a job number since this is associated with the active project.

Eight operations may be accessed from the Plan and Profile Draw dialog: Points, Lines, Curves, Spirals, Chains, Stationing, Parcels, and Profiles. Each of these operations dynamically changes the dialog to reflect the selection with the various draw and label features used when placing a COGO element in a graphics file.

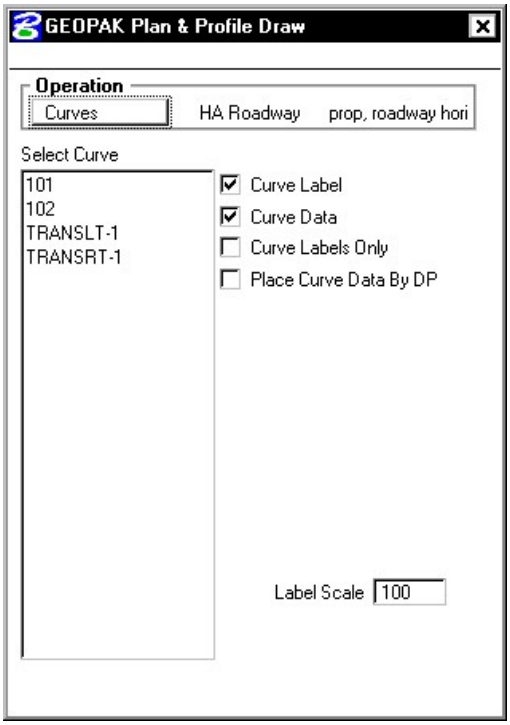


The points and lines dialog boxes have a key-in field that allows the user to specify the names of the COGO elements to be drawn. To use the line operation, the user must use point numbers to specify the ends of the line. The points/lines are drawn immediately after you enter their respective names and press the enter key. To draw more than one point or line, place a dash in-between the point numbers. To draw a line without using consecutive point numbers, use a forward slash (i.e. 10/11).





The dialog settings for curves, spirals, chains, stationing, parcels, and profiles have a list box that display the names of all curves, spirals and chains stored in the active coordinate geometry database file. Highlighting one of the available elements initiates further commands to draw the element into the design file. Each type of item has a list of parameters that can be optionally plotted.



GEOPAK can draw elements to non-active levels. After elements are drawn, it may be necessary to turn on appropriate levels and fit the elements into the view.

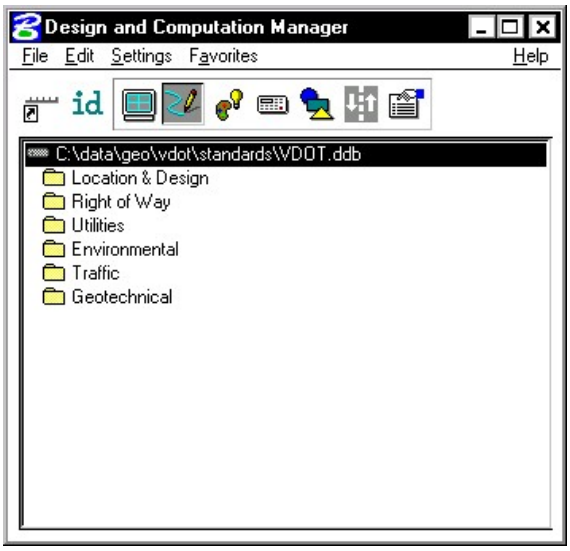
D&C Manager – Plans Production

5.1 Accessing Design and Computation Manager

Step 1. Open the MicroStation file **c:\data\geo\vdot\s1373\s1373.dgn**

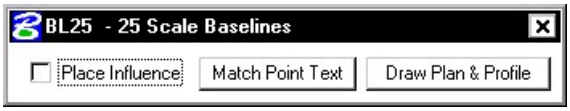
Step 2. Access **D&C Manager** from the **Road Tools Palette**.

Step 3. This should bring up the following dialog.



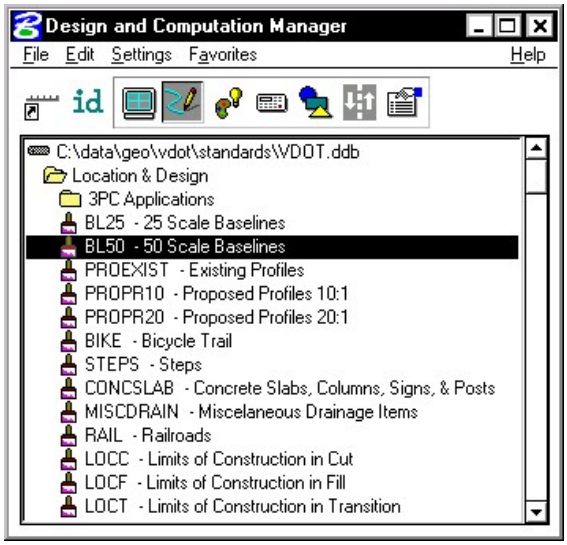
5.2 Drawing Alignments

Step 1. A secondary dialog will appear to be used in conjunction with the Design and Computation Manager dialog.

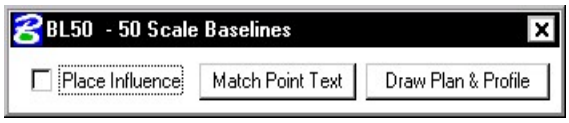


Step 2. Select the following item:

Location & Design > BL50 – 50 Scale Baselines.

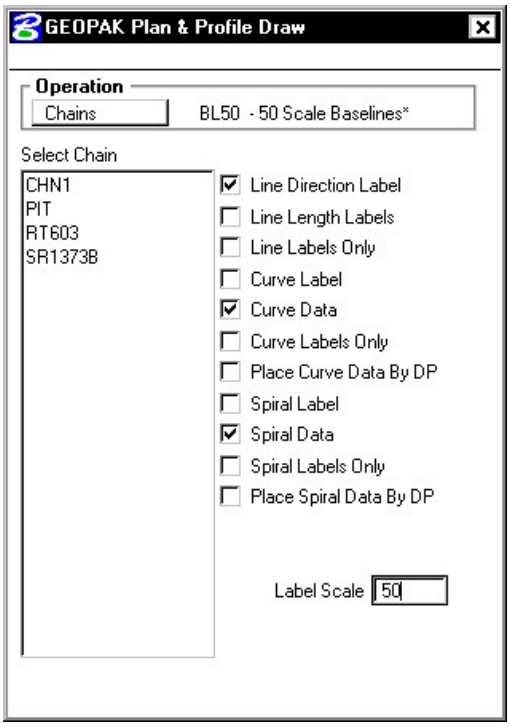


Step 3. Next, select the **Draw Plan and Profile** button from the secondary dialog:



Step 4. Select the **Chains** operation. Chain 'CHN1' should be displayed in the list box as shown. Notice that the options that are to be drawn with the chain are already activated. Set the Label Scale to **50**.

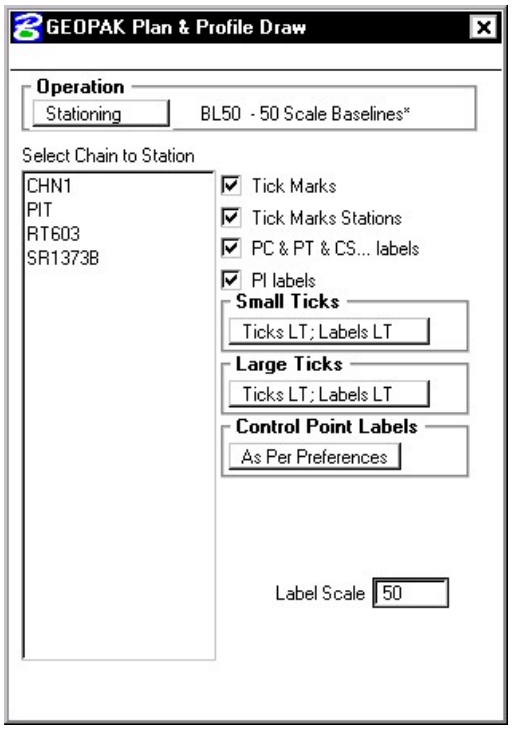
Step 5. To draw the chain, select **CHN1** in the list box. Only click once!!



Step 6. Change the Operation to **Stationing** and annotate the alignment **CHN1** by selecting the chain name in the list box.

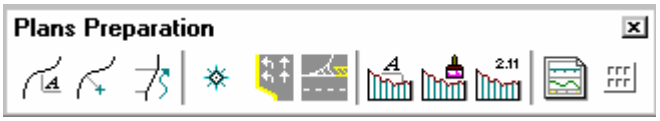
Close the GEOPAK Plan and Profile dialog.

Step 7. Review the results of Steps five and six.



Existing Ground Profiles

6.1 Introduction

Objectives	Learn to calculate existing ground profiles extracted from a surface model.
Tools 	
Menu Bar Application	GEOPAK Road > Geometry > Ground Profile

The Draw Profile tool enables the user to draw several profiles from a variety of sources simultaneously.

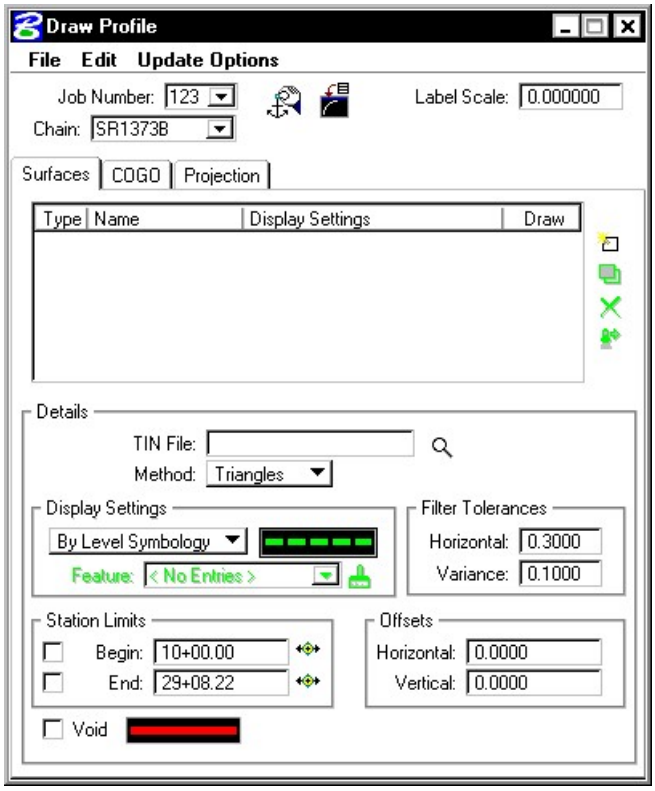
- GEOPAK coordinate geometry database wherein the vertical alignment is stored.
- GEOPAK binary TIN file, Site Model or Site Object. The Site Model or Object are created utilizing GEOPAK Site Modeler software and are stored within the GEOPAK Site project (gsf) file.

In addition, if the source data is TIN files or site components, the resultant profile may optionally be stored within the coordinate geometry database.

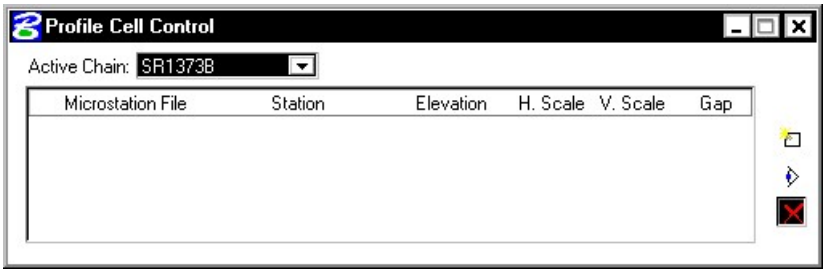
Invoking the Draw Profile Tool

The Draw Profile Tool is not supported by Project Manager. It can be accessed by selecting Applications > GEOPAK ROAD > Plans Preparation > Draw Profile or from the GEOPAK ROAD Tools tool frame.

The generation of profiles must be invoked from within the 2D MicroStation design file wherein the profile is to be drawn.



The initial entries that are required are the Job Number and Chain name. Once selected, click Dialog Profile Cell Control (to the right of the Job Number field).



Select the Active Chain that the new or existing profile is to be stationed along. If no profile cell exists, click Place Profile Cell along the right side of the window to place a new cell. If multiple profile cells exist, highlight the desired cell and click Activate Profile Cell.

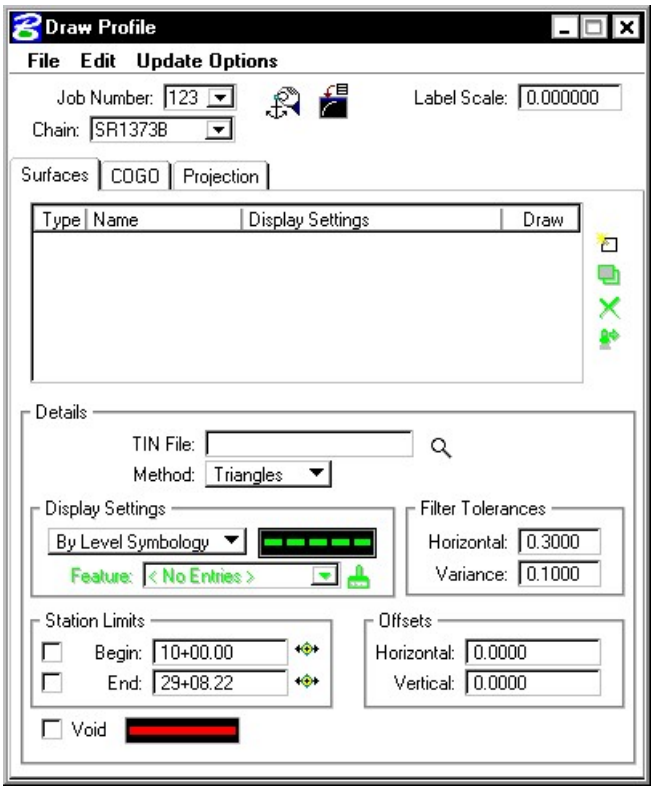
Update Options

Four update options exist that allow the user the control needed to tell the software what to do if a profile has been previously drawn in the file and needs updated. The options are toggled off / on by each selection of the option by clicking the **Update Options** pulldown. The check to the left of the option indicates the option is active. Only one option may be active at any given time, therefore, if an option is selected, the previous active option is de-activated. The four options are detailed in the table below.

Delete Existing Elements and Redraw	When this option is activated, any profiles previously drawn with this tool are deleted and new ground lines are drawn.
Delete Non-Modified Elements and Redraw	When this option is activated, any profiles previously drawn with this tool and not modified with any MicroStation commands are deleted and new ground lines are drawn.
Draw on Top of Existing	When this option is activated, any previously drawn profiles are ignored and a new set is drawn, resulting in multiple copies of each profile.
Query	When activated, the user is prompted each time the Draw button is pressed.

Surfaces Tab

The Surfaces tab defines the surfaces utilized as source data when drawing profiles. Multiple surfaces from a variety of sources can be drawn in a single processing. When the tab is selected and a profile cell is placed, the dialog dynamically changes as depicted below.



Each surface to be drawn must be added to the list box. This is accomplished via the action / edit buttons on the right side of the dialog box. Each surface draws a cross section line string or lines. When a line is added to the list box, the profile is drawn. Note: clicking on the draw toggle in the list box deletes or redraws the profile.

To add to the list box, simply select the source data and method, Display Settings, Tolerances and Offsets, and then add the profile to the list. Once a profile is drawn, it may be updated at any time by using **Update Profile**. Refer to the **Update Options** section to review those options. Any profile may optionally be stored to the GPK file if desired.

Display Settings

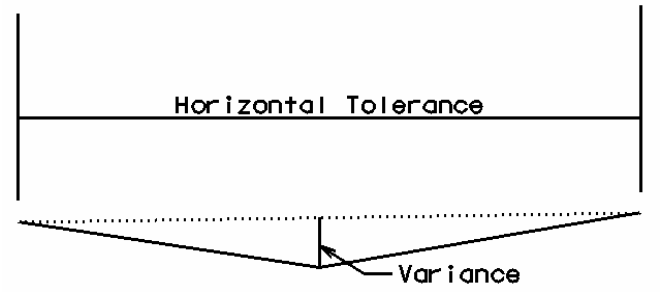
The Display Settings group box specifies the element symbology of the cross section elements being generated. The symbology may be specified using Level Symbology or a feature selected from a D&C Manager database.

To use **By Level Symbology**, set the option to By Level Symbology, then double click on the graphic. This opens the Set Feature dialog box, wherein the symbology can be specified. Click OK when completed.

To use **By Feature**, set the option to By Feature. Next, press the Paintbrush icon, which invokes the current Design and Computation Manager. Select the desired item, and then press the OK button, which closes the Design and Computation Manager, and populates the Draw Profile Display Settings group box.

Filter Tolerances

Both Horizontal and Variance filter tolerances are considered together for each pair of profile segments. The middle point is deleted if both segment lengths are less than the Horizontal filter tolerance while the projected distance between the mid-point and the chord between the two end points is less than the Variance tolerance.

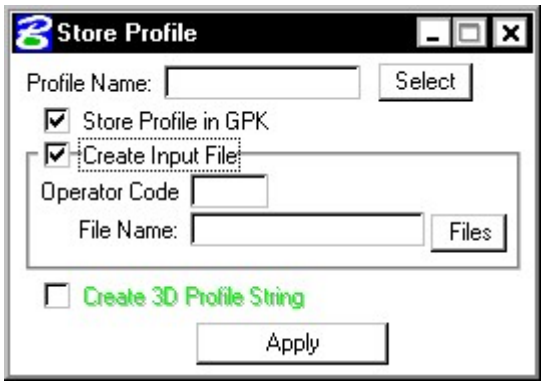


Offsets

Vertical or Horizontal Offsets may be specified in terms of master units (i.e., feet or meters). The Horizontal Offset is the distance offset from the Chain. Once the horizontal location for the profile is determined, the data source is utilized to determine the profile. Any Vertical Offset is applied after the profile is generated from the source data.

Store Profile to COGO

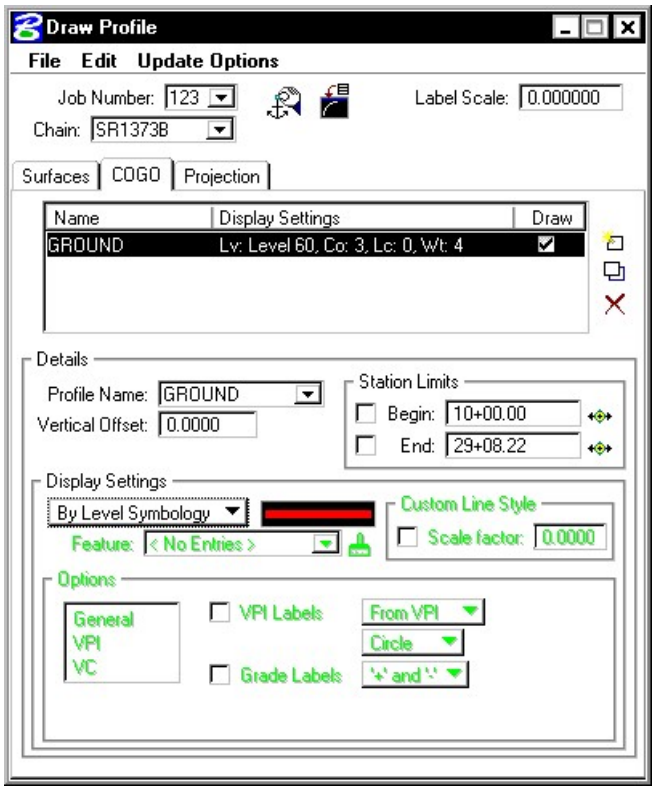
When the profile is drawn, it may also be stored in COGO by pressing this button, which opens the dialog box depicted below left.



The profile may be stored, or just the input file may be created. If an input file is created, the Operator Code and File Name are required. If the dialog box is invoked while in a 3D file, the user may toggle on the option to create a 3D profile string. The 3D profile string consists of the circles denoting every location where the design centerline intersects topographic elements. If the circles are not deleted at this time, they can be deleted at any time with a single application of the MicroStation "Delete Element" command.

Cogo Tab

The Cogo Tab is utilized for drawing any profile that has been previously stored into the GPK file.

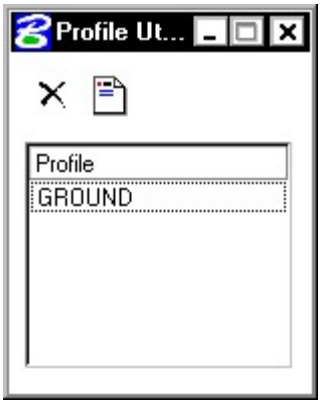


To draw a profile, first select the Profile Name to be drawn. The Vertical Offset defaults to a value of 0, but can be set to any value. This instructs the software to draw the profile at a distance above or below the elevations in the GPK file. Station Limits may also be specified to have the software draw only a portion of the profile. If the Display Settings are set to By Feature and a feature is selected, the Options area of the dialog box is un-ghosted. This is where various labeling options for the profile can be specified. If a value is given for the Strip Grade Increment, elevations will be placed at that increment along the bottom of the profile.

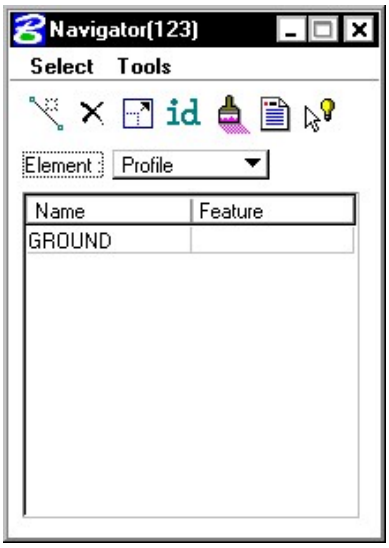
Profile Report

To review a textual report listing stations and elevations of a ground profile, open the GEOPAK Coordinate Geometry dialog box. A couple of different methods can be used to create this listing for any profile.

By selecting **Element > Profile > Utility** then highlighting a specific profile name and clicking **Print**. The results of this command will be displayed in the Command Output window of the Coordinate Geometry dialog box. To obtain a hardcopy of this information, create an output file using the **File > File Utility > Output** command and supply a filename of 1-5 characters. Then use the **File > File Utility > Print Output File** command to print this to the default system printer.

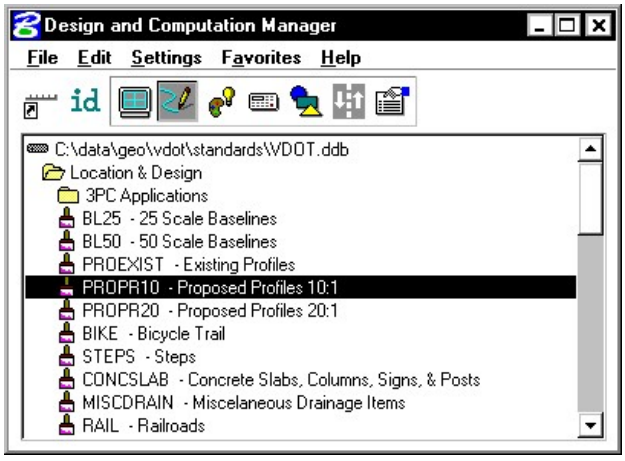


The second method utilizes the COGO Navigator tool to create the **Print Profile** command. The advantage to this method is that multiple profiles can be identified at once and printed to the Command Output window. Start the COGO Navigator by clicking **Tools > Navigator** or selecting the icon from the COGO dialog box. Change the **Element** to **Profile** then highlight the desired profile(s). Once selected, click the **Print/Describe Element** icon on the Navigator to process the profile(s).

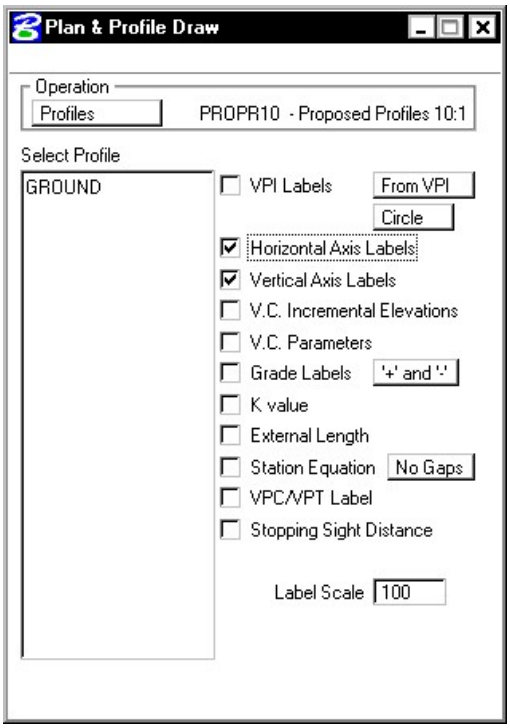


Drawing Profiles with D&C Manager

As with other COGO elements, Design and Computation Manager will be utilized to draw any type of profile into a MicroStation file: existing roadway, proposed roadway, utility, special ditch, etc. To get started, open D&C Manager then navigate to the desired item for plotting of the profile. Upon selecting an item, click on the **Draw Plan & Profile** button on the supplemental D&C dialog box.



The next dialog box that appears is the **GEOPAK Draw Plan & Profile** window, as depicted below.



If it is not already selected, change the **Operation** to **Profiles**. Displayed in the window is a list of profiles currently stored in the GPK file. Along the right side of the window are labeling options for the profile that is to be plotted. Configure these as desired before selecting a profile to plot.

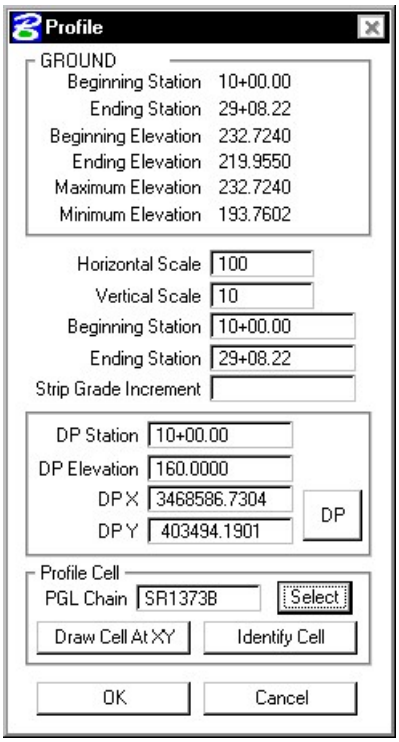
- **VPI Labels** – Labels the station and elevation of the VPI – typically turned off for plotting of existing profiles.
- **Horizontal Axis** – Places stations along the bottom of the profile.
- **Vertical Axis** – Places elevations along the left side of the profile.
- **VC Parameters** – Labels the length of the vertical curve if applicable.
- **VPC/VPT Labels** – Annotates the station and elevation of a vertical curves control points.
- **Stopping Sight Distance** – Places text for crest vertical curves representing the curves stopping sight distance as defined by AASHTO.

After selecting a profile to plot, the dialog box below opens. Since a profile does not have XY coordinates, the user must specify a location in the MicroStation file to place the profile and a scale at which to plot the profile. When using a ratio other than 1:1, the horizontal dimensions of the profile remain true and the vertical is exaggerated.

The location can be selected by clicking on the **DP** button then specifying a location in the file by issuing a data point in the view. The coordinates can also be keyed in to the dialog box. A **Profile Cell** can be drawn into the file to represent the location of the data point and associated information. This cell can be used in any other GEOPAK tool that needs to know the location of the profile. A PGL Chain must be selected before drawing the profile cell. This chain will be the chain that the profile is stationed along.

If a value is specified for the **Strip Grade Increment**, elevations will be calculated at the desired interval along the profile and placed just above the **Horizontal Axis Labels** (stations).

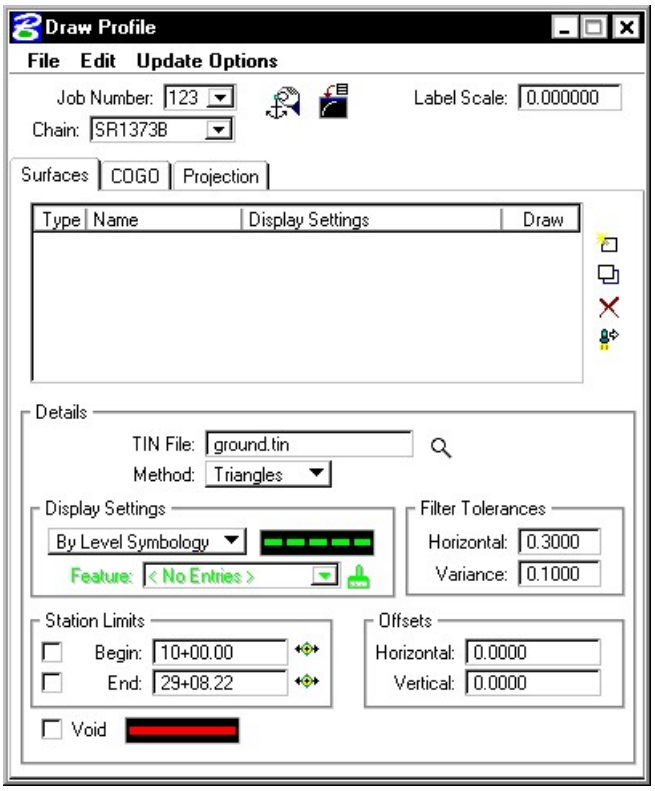
Click **OK** to draw the profile.



Existing Ground Profile

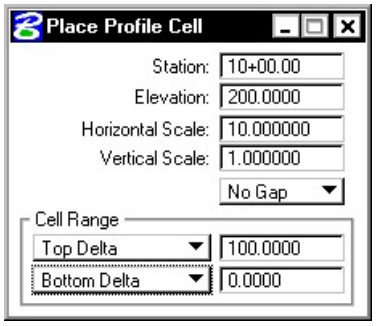
6.1 Extract Existing Ground Profile

1. Open the MicroStation file ***c:\data\geo\vdot\S1373\profile.dgn***.
2. Access *Applications > GEOPAK Road > Plan Preparation > Draw Profiles*



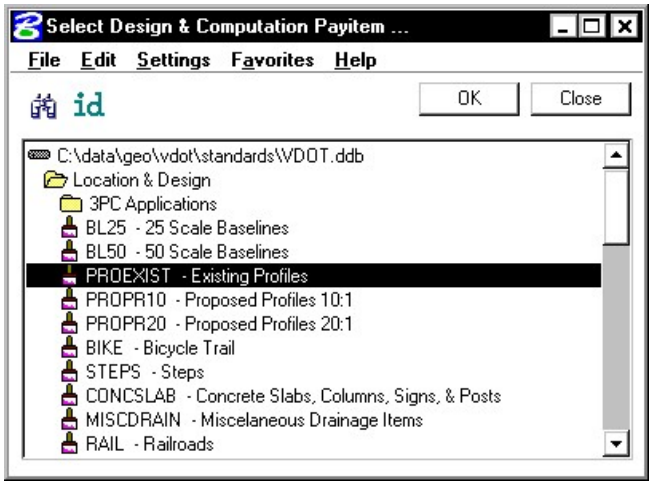
3. Select Job Number **123** and select chain **SR1373B**.

4. Click **Dialog Profile Cell Control** icon (to the right of Job Number).
5. Set the **Active Chain** to **SR1373B**.
6. Click **Place Profile Cell** on the right side of the dialog.



7. Populate the dialog as shown above and then DP anywhere in order to place the profile cell into the design file.
8. Fit the view contents.
9. Close the **Profile Cell Control** dialog.
10. From the Surfaces tab, select the **Browse TIN File** button in the **Details** area, then select the **GROUND.TIN** file for the **TIN File** to cut the profile.
11. Set the **Method** to **Triangles**.

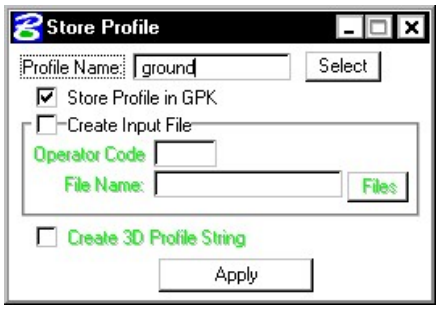
    This instructs the software to compute elevations at each location that the chain intersects a triangle leg from the TIN.
12. Set the option button to **By Feature** in the **Display Settings** area of the dialog.
13. Click the **Browser Feature (Paintbrush)** icon then navigate to the item shown below.



14. Click **OK**
15. Click **Add Surface Settings** to add the profile to the list box as well as draw the profile into the MicroStation file.

Store Profiles into COGO Database

1. Click **Store Surface** in COGO.

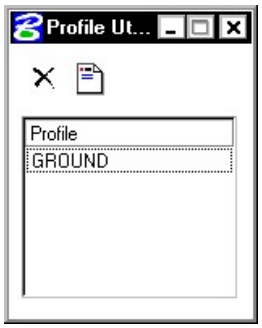


2. Populate the dialog as shown above.
3. Click **Apply**.
4. Close the **Store Profile** dialog.
5. Click **Remove Surface**.

This erases the profile from the DGN file. We will re-draw the profile shortly.

Review Profiles in COGO

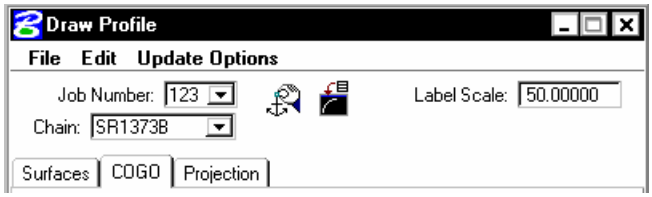
1. Select the Coordinate Geometry tool.
2. Click **OK** to accept your project name, etc.
3. Select **Element > Profile > Utility.**



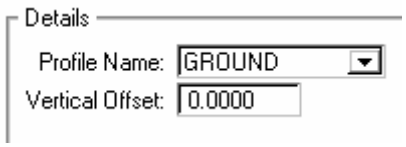
4. Select the profile **'GROUND'**
5. Click **Print**.
6. Review the profile information in the COGO output display window.
7. Close the Coordinate Geometry dialog. When prompted to save the COGO session, select **No**.

Drawing and Labeling the Existing Centerline Profile

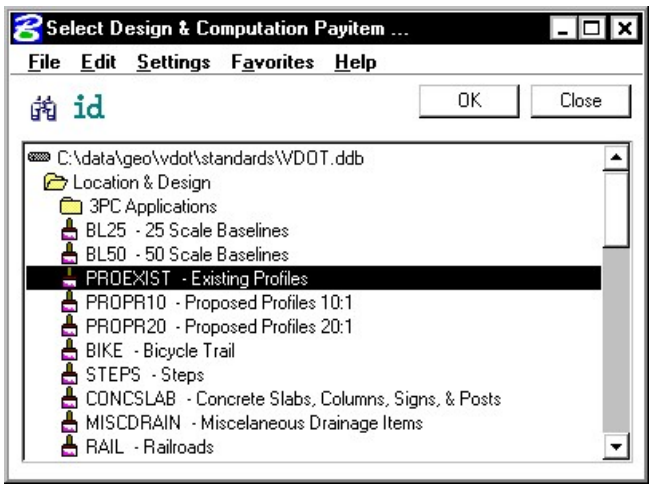
1. Click the **COGO** tab then set the **Label Scale** to **50** in the upper right hand corner.



2. Select the **Profile Name** MLGROUND in the **Details** section.

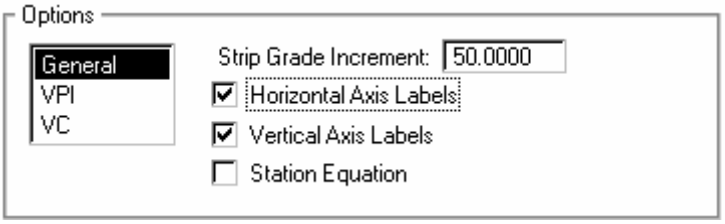


3. Set the option to **By Feature** in the **Display Settings** section.
4. Click the **Browser Feature (Paintbrush)** icon then navigate to the item shown below.



5. Click **OK**.
6. Select **General** in the **Options** area and set the **Strip Grade Increment** to **50**.

   This will label the elevations every 50’ along the bottom of the profile area.



7. Click **Add COGO Profile Settings** to draw the profile.

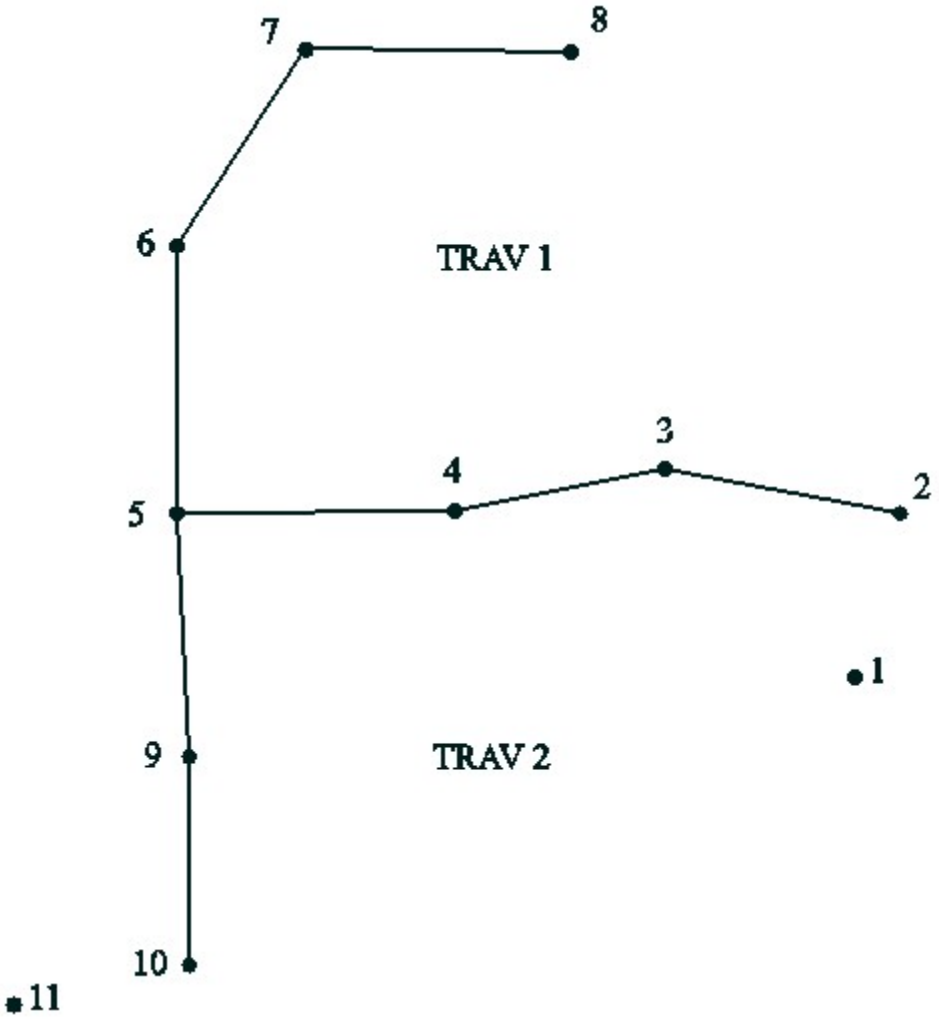
   This will draw the existing ground profile with the proper symbology in addition to labeling the stations and elevations along the bottom of the profile and the elevations along the left side of the profile.
8. Close the **Draw Profile** dialog.

Adjusting Traverses

Introduction

GEOPAK Coordinate Geometry has the ability to balance and adjust traverses using the Compass Rule method. Traverses can be run as either Open (no closing coordinate) or Closed (having a closing coordinate or direction). The traverse information is entered, course by course as lines in an input file. Once the required information is entered, the final command END TRAV will execute the adjustment routine. Once completed traverse points will be stored in the .GPK file.

In the example shown below we will actually run 2 separate traverses. The first one, TRAV 1, will be entered into cogo and adjusted. The second one TRAV 2, will be run from the adjusted points in TRAV 1. We will hold the previously adjusted data "Fixed" and adjust the second traverse to it.



Below is an example of the input file format and command syntax for the traverse adjustment entry:

1 trav trav1 - *(Executes the Trav Command and name of traverse, in this case TRAV1)*

2 compass – (*Method of Adjustment)*

3 closure 30000 10 - (*Closure must meet 1:30,000 angles are +/- 10")*

4 back ref 2 to 1 - (*Your Backsight Reference)*

5 lin 2 to 3 503.88 p 91 43 52 - (*Traverse legs, angle Right is "P" angle left is "M")*

6 lin 3 to 4 621.05 p 156 28 43

7 lin 4 to 5 583.40 p 187 21 49

8 lin 5 to 6 560.07 p 266 21 36

9 lin 6 to 7 572.06 p 195 56 58

10 lin 7 to 8 770.03 p 257 28 42 - (*Closing Leg)*

11 end trav - (E*nd traverse info execute the TRAV command)*

In the above example, points 1,2, and 8 must be stored prior to running the traverse adjustment. If no azimuth is defined for begin/end azimuth, an assumed backsight reference of North 00 East will be used. If you wish to close on a point that does not have a predefined value, you can run as an open traverse. Line 1 would be modified to read: (***Trav Trav1 Open***.)

Once you type the **END TRAV** statement, GEOPAK will run the Compass routine.

The Output is shown below:

COMPASS ADJUSTMENT

Closure information:

Total error 0.067

Error in X -0.036 in Y -0.057

Closure accuracy: 53,632.395

Total Perim 3,610.490 Fix Perim 0.000 Perim 3,610.490

Closing link S 31° 58' 33" W

CLOSED TRAVERSE

Point		Field Coords	Correction	Adjusted Coords			
2	X	20,600.479	0.000	20,600.479	Y	10,309.304	0.000
10,309.304							
3	X	20,116.340	-0.005	20,116.335	Y	10,448.962	-0.008
10,448.954							
4	X	19,500.505	-0.011	19,500.494	Y	10,368.648	-0.018
10,368.631							
5	X	18,917.105	-0.017	18,917.088	Y	10,367.969	-0.027
10,367.942							
6	X	18,880.897	-0.022	18,880.875	Y	10,926.868	-0.036
10,926.832							
7	X	19,002.205	-0.028	19,002.177	Y	11,485.918	-0.045
11,485.873							
8	X	19,772.226	-0.036	19,772.191	Y	11,489.666	-0.057
11,489.609							

COURSE FROM	TO	ADJUSTED DISTANCE	ADJUSTED BEARING	ADJUSTED ANGLE
2	3	503.883	N 73° 54' 36" W	91° 43' 48"
3	4	621.057	S 82° 34' 08" W	156° 28' 44"
4	5	583.406	S 89° 55' 57" W	187° 21' 49"
5	6	560.062	N 3° 42' 26" W	266° 21' 37"
6	7	572.050	N 12° 14' 33" E	195° 56' 59"

7 8 770.022 N 89° 43' 19" E 257° 28' 47"

Chain TRAV1 stored

We will run the second Traverse based on the adjustment of the first Traverse. In this case we will set up on point 5 and the Backsight Reference(back ref) will be the adjusted course point 5 to 4.

Below are the commands and the output:

* 1 trav trav2

* 2 compass

* 3 closure 30000 10

* 4 back ref 5 to 4

* 5 lin 5 to 9 529.90 p 86 18 34

* 6 lin 9 to 10 601.85 p 186 29 08

* 7 ahead ref 10 to 11 ang 268 20 50 – (*Here we are turning into a line, 10 to 11 that was previously stored.)*

* 8 end trav

COMPASS ADJUSTMENT

Preliminary angle adjustment:

Total error: 0° 00' 02" Error per angle: 0° 00' 01"

Closure information:

Total error 0.060 Error in X -0.015 in Y 0.058

Closure accuracy: 18,860.831

Total Perim 1,131.750 Fix Perim 0.000 Perim 1,131.750

Closing link N 14° 27' 59" W

Warning : Accuracy not achieved. Traverse points will not be stored.

Since our traverse did not meet our stated limit of precision 1:30,000, GEOPAK will not store the points in the .GPK file. It is up to the user to review the output data and decide on how to proceed. In this case we will accept the closure in X and Y, and modify the input file to lower the level of expected precision. As shown below:

* 3 trav trav2

* 4 compass

* 5 closure 10000 10 – *(Here we have modified the accepted level of precision to 1:10,000)*

* 6 back ref 5 to 4 – (*Backsight Reference*)

* 7 lin 5 to 9 529.90 p 86 18 34

* 8 lin 9 to 10 601.85 p 186 29 08

* 9 ahead ref 10 to 11 ang 268 20 50 – (*Tying into our existing azimuth*)

* 10 end trav

COMPASS ADJUSTMENT

Preliminary angle adjustment:

Total error: 0° 00' 02"

Error per angle: 0° 00' 01"

Closure information:

Total error 0.060

Error in X -0.015 in Y 0.058

Closure accuracy: 18,860.831

Total Perim 1,131.750 Fix Perim 0.000 Perim 1,131.750

Closing link N 14° 27' 59" W

CLOSED TRAVERSE

Point		Field Coords	Correction	Adjusted Coords
5	X	18,917.088	0.000	18,917.088
	Y	10,367.942	0.000	10,367.942

9	X	18,951.822	-0.007	18,951.815
	Y	9,839.182	0.027	9,839.209
10	X	18,923.186	-0.015	18,923.171
	Y	9,238.014	0.058	9,238.072

COURSE		ADJUSTED	ADJUSTED	ADJUSTED
FROM	TO	DISTANCE	BEARING	ANGLE
5	9	529.872	S 3° 45' 28" E	86° 18' 35"
9	10	601.820	S 2° 43' 41" W	186° 29' 09"

Since we have achieved the desired level of precision after changing it in the input file, GEOPAK automatically stores the new traverse points into the .GPK file for later use.

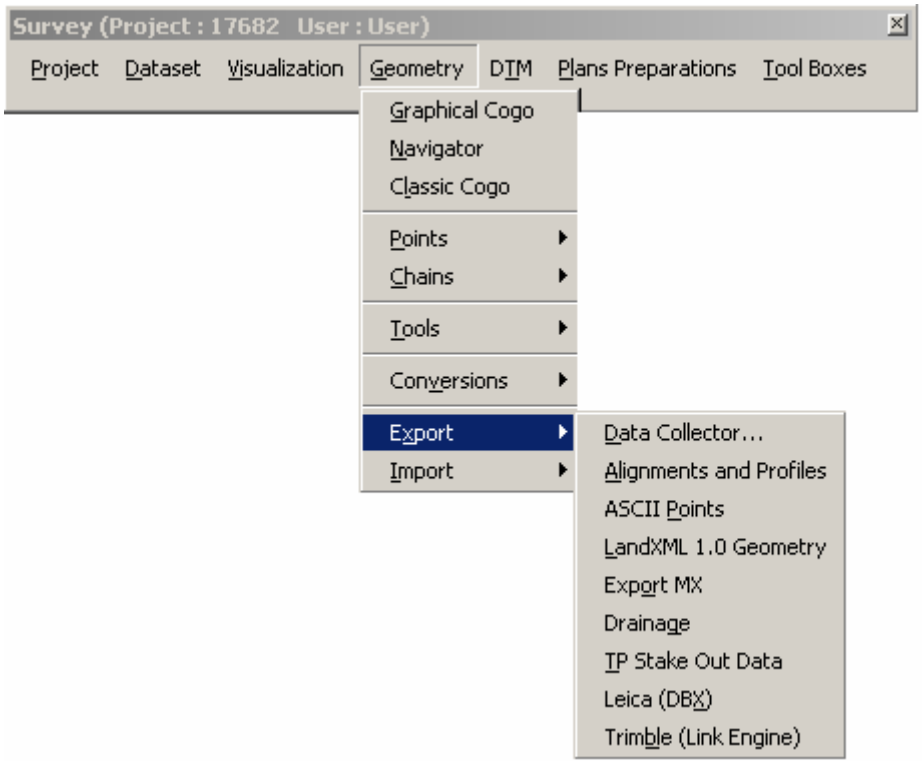
Export Staking Data

Introduction

GEOPAK provides the ability to export point, chain and profile data directly to supported data collector file formats for easy download.

TDS Chains and Profiles

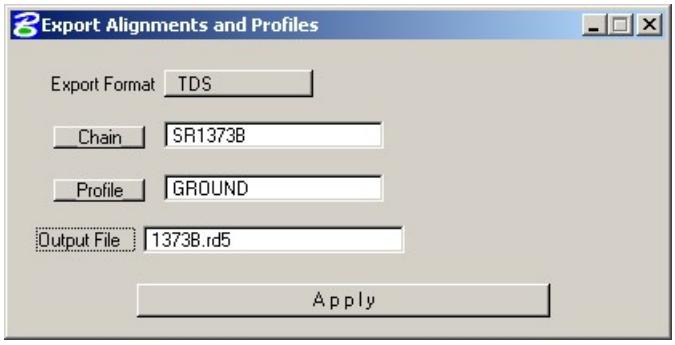
The export utility is accessed from the main survey menu bar **Geometry > Export**.



Several options are available depending on what is to be exported. In order to export chains and profiles to a TDS format the option for **Alignments and Profiles** is selected.

This dialog allows the user to select the chain and profile by clicking on the respective buttons and making the proper selection.

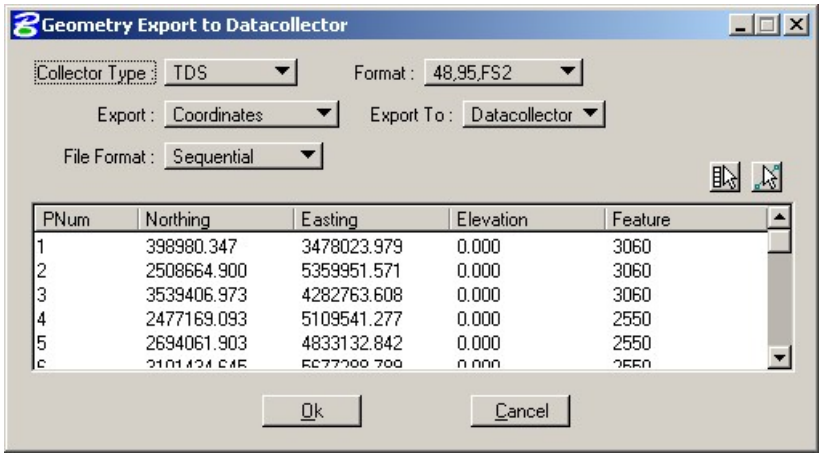
Once the desired chain and profile have been selected a file name is entered to save the geometry to. After all settings are completed the **Apply** button is clicked and the file is created



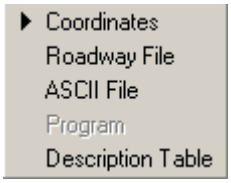
This file can then be downloaded to the data collector via the **Export > Data Collector** option.

Downloading

Once the alignment files have been created the points and alignments are ready for downloading to the data collector. This is accomplished by selecting from the same menu **Geometry > Export** and then selecting the **Data Collector** option.

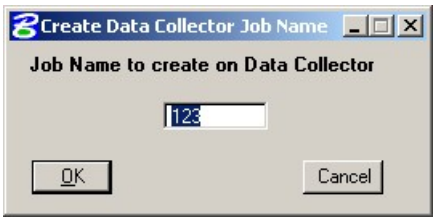


Several export types are supported for TDS data.



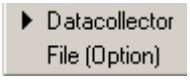
Coordinates	Coordinate list from the gpk.
Roadway File	Chain and Profile from the gpk.
ASCII File	Coordinate list from any source
Description Table	

In the case of exporting a **Coordinate** file, all the desired coordinates are highlighted in the list window and when the **OK** button is selected a second dialog will appear asking for a job number to create on the data collector.



This job number will be created and all the highlighted points dumped to the data collector.

Another option to downloading directly to the data collector is to change the **Export To** toggle to **File (Option)**. This will create a **cr5** file and write the selected points to it, placing it on the hard drive instead of placing them directly on the data collector. This option is only available when exporting coordinates.



Special Reports

Horizontal Alignment Reports

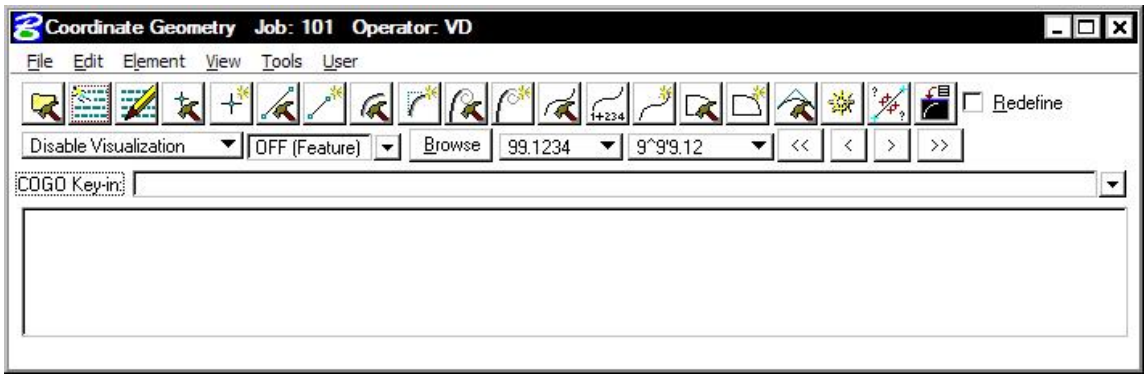
In this section we will generate a **Horizontal Alignment** report using Coordinate Geometry.

Step 1. Execute **C:\data\geo\VDOT\road1\LAB21.EXE**.

Step 2. Open the MicroStation file **c:\data\geo\VDOT\road1\d17682des.dgn.**

Step 3. Access **Project Manager**. It should automatically access the Road workflow dialog box since we "remembered" the options in Exercise 2.

Step 4. Select the **Coordinate Geometry** icon from the **Road Project: 17682.prj** workflow dialog box. The coordinate geometry dialog box shown below should appear.



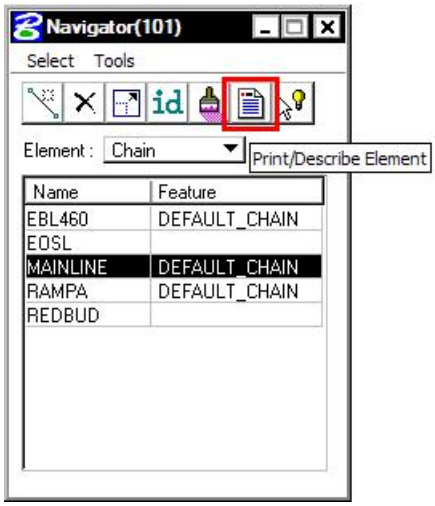
This dialog box is completely re-sizable, so you can position it where you're most comfortable.

21.1.1 Describe Chain

From the COGO dialog window, let's preview the geometry of the chain **MAINLINE**.

Step 1. Select the **COGO Navigator** icon

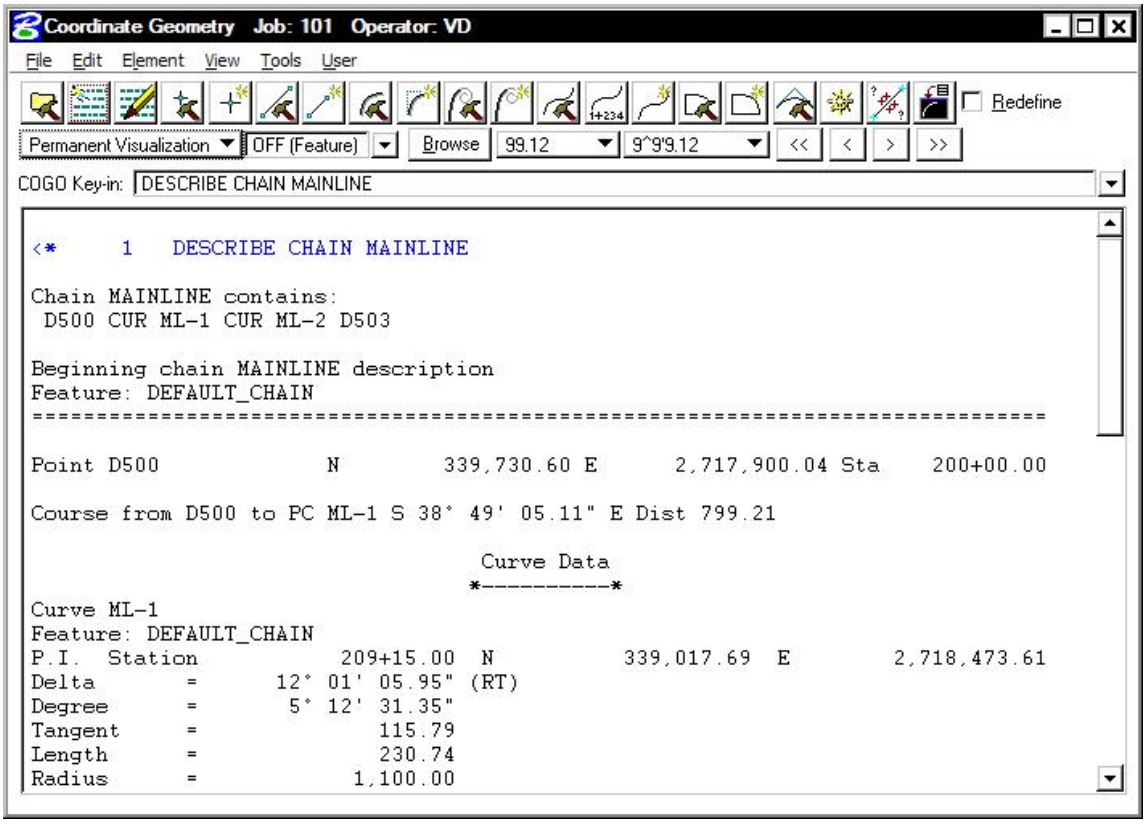
or use the **Tools > Navigator** option on the COGO menu bar to access the **COGO Navigator** dialog box.



Step 2. Set the element option to **Chain** and highlight the chain **MAINLINE.**

Step 3. Press the "**Print/Describe Element**" icon.

Step 4. The chain geometry output will be displayed in the main COGO window.

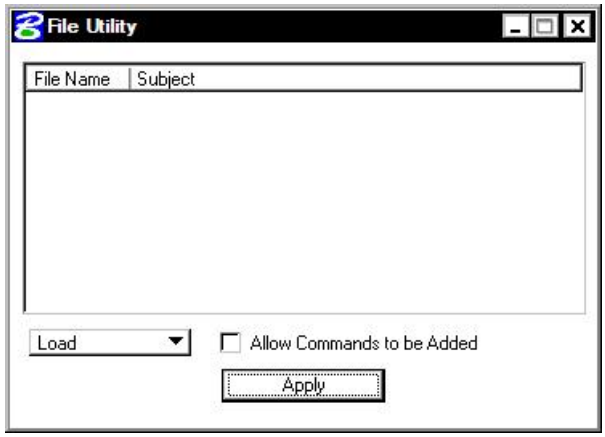


21.1.2 Create Output File

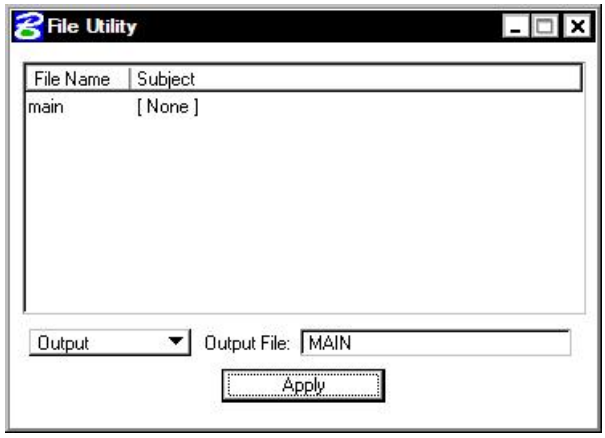
In the following steps we will save an output file with the computations of chain **MAINLINE**.

Step 1. Access the **File Utility** dialog by pressing the **File Utility** icon

or by selecting **File > File Utility**. The dialog below should appear.



Step 2. To save an output file with the actual results of the computations, set the option button to **Output** on the **File Utility** dialog. Enter "**MAIN"** as the **Output File** name then click **Apply**.



A file named **"main101.ovd"** will be created in the working directory.

Step 3. Dismiss the **File Utility** dialog box by clicking the **X** in the upper right hand corner.

Step 4. From the Edit pulldown, select **Edit > Clear** to 'clear' out all the commands that we just previously executed.

This will not remove the stored data from COGO.

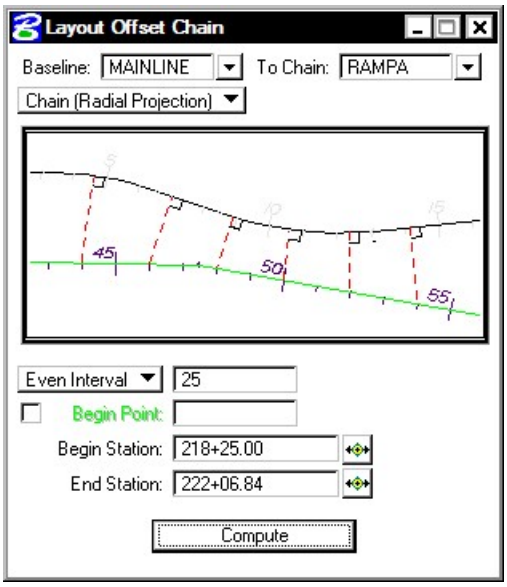
21.1.3 Create Alignment Relation Report (Layout Offsets)

From the COGO dialog window, let's create an Alignment Relation report between chains **MAINLINE** and **RAMPA**.

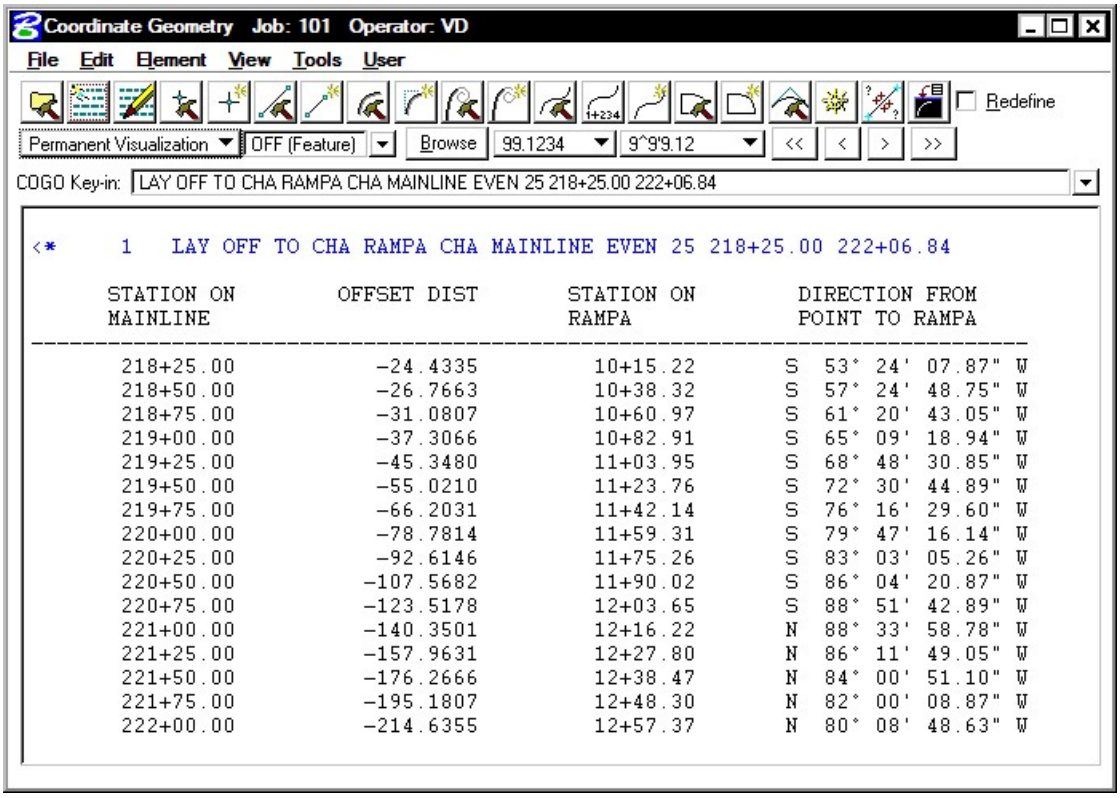
Step 1. Use the **Element > Chain > Layout Offset** option on the COGO menu bar to access the **Layout Offset Chain** dialog box.

Step 2. Populate the dialog box as shown.

Step 3. Click "**Compute**".



Step 4. The offsets between chains **MAINLINE** and **RAMPA** will be displayed in the main COGO window.



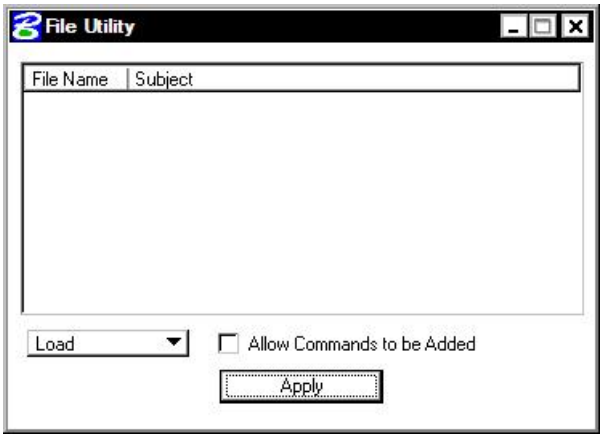

```
<*     1   LAY OFF TO CHA RAMPA CHA MAINLINE EVEN 25 218+25.00 222+06.84

     STATION ON        OFFSET DIST       STATION ON        DIRECTION FROM
     MAINLINE                            RAMPA             POINT TO RAMPA
-------------------------------------------------------------------------------
       218+25.00          -24.4335         10+15.22       S  53° 24' 07.87" W
       218+50.00          -26.7663         10+38.32       S  57° 24' 48.75" W
       218+75.00          -31.0807         10+60.97       S  61° 20' 43.05" W
       219+00.00          -37.3066         10+82.91       S  65° 09' 18.94" W
       219+25.00          -45.3480         11+03.95       S  68° 48' 30.85" W
       219+50.00          -55.0210         11+23.76       S  72° 30' 44.89" W
       219+75.00          -66.2031         11+42.14       S  76° 16' 29.60" W
       220+00.00          -78.7814         11+59.31       S  79° 47' 16.14" W
       220+25.00          -92.6146         11+75.26       S  83° 03' 05.26" W
       220+50.00         -107.5682         11+90.02       S  86° 04' 20.87" W
       220+75.00         -123.5178         12+03.65       S  88° 51' 42.89" W
       221+00.00         -140.3501         12+16.22       N  88° 33' 58.78" W
       221+25.00         -157.9631         12+27.80       N  86° 11' 49.05" W
       221+50.00         -176.2666         12+38.47       N  84° 00' 51.10" W
       221+75.00         -195.1807         12+48.30       N  82° 00' 08.87" W
       222+00.00         -214.6355         12+57.37       N  80° 08' 48.63" W
```

21.1.4 Create Output File

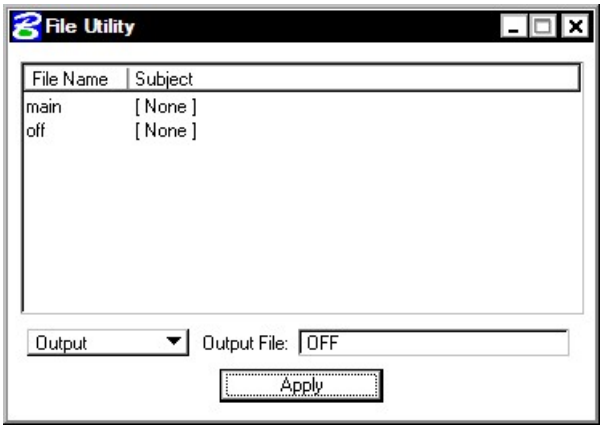
In the following steps we will save an output file with the offset list between chains **MAINLINE** and **RAMPA**.

Step 1. Access the **File Utility** dialog by pressing the **File Utility** icon

or by selecting **File > File Utility**. The dialog below should appear.



Step 2. To save an output file with the actual results of the offset list, set the option button to **Output** on the **File Utility** dialog. Enter "**OFF"** as the **Output File** name then click **Apply**.



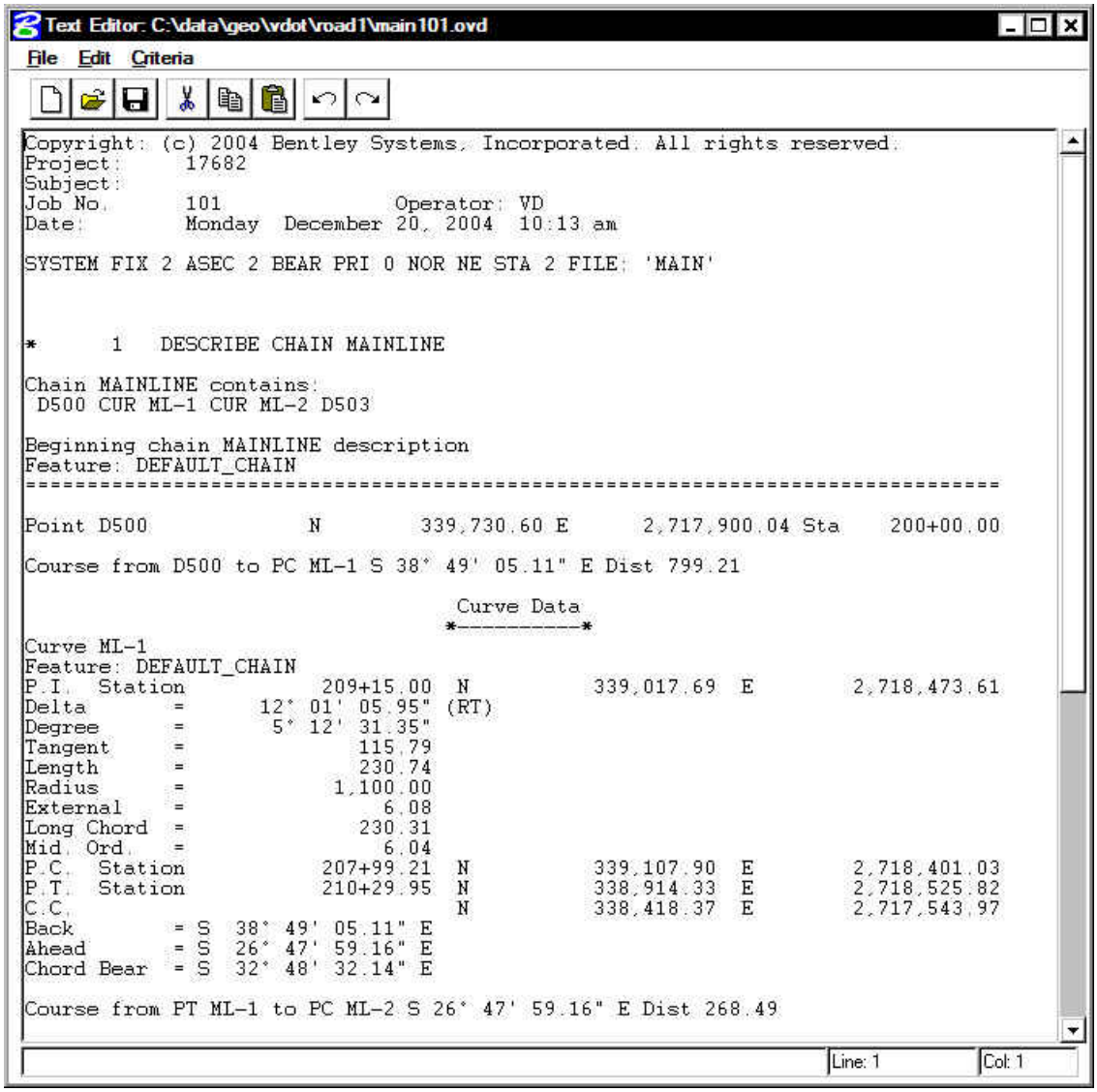
A file named **"off101.ovd"** will be created in the working directory.

Step 3. Dismiss the **File Utility** dialog box by clicking the **X** in the upper right hand corner.

Step 4. Exit **COGO** by clicking the **X** in the upper right hand corner.

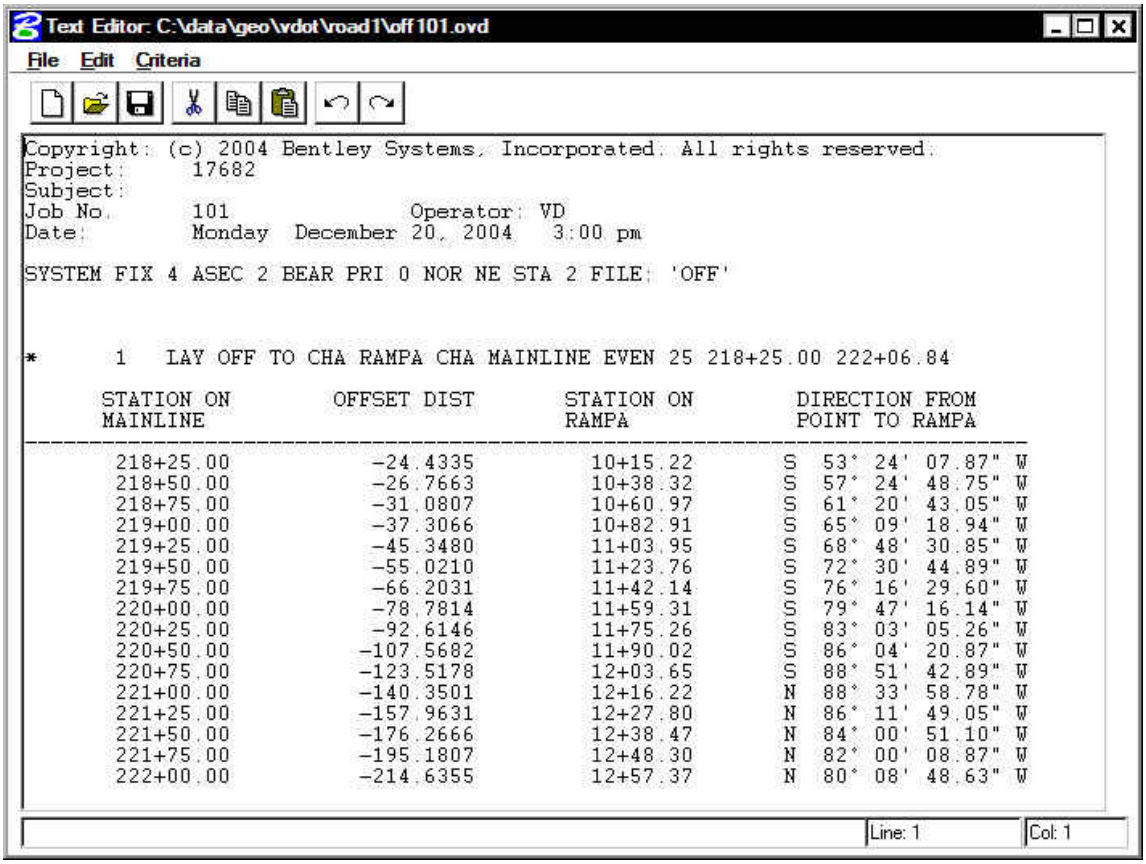
NOTE: When you are prompted to Save the Session, click "**No**" since you have already saved your input.

Step 5. Review the output file by opening **"main101.ovd"** with the GEOPAK Text Editor. The file should appear as below.



A report of the stored chain which describes its geometry including coordinates, stations, distances, bearing, curves, and spiral data. Any break in the stationing detected during the description of the chain will be considered a station equation and numeric regions will be assigned by GEOPAK starting at one. If the chain contains station equations, they are listed in the description.

Step 6. Review the output file by opening **"off101.ovd"** with the GEOPAK Text Editor. The file should appear as below.



The **Layout Offset Chain** using the **Radial Projection** option calculates stations on Chain RAMPA and the radial distance from a specified interval on the Chain MAINLINE. The offset distances and direction are perpendicular or radial to the Chain MAINLINE.

Step 7. Exit **MicroStation.**

21.2 Vertical Alignment Reports

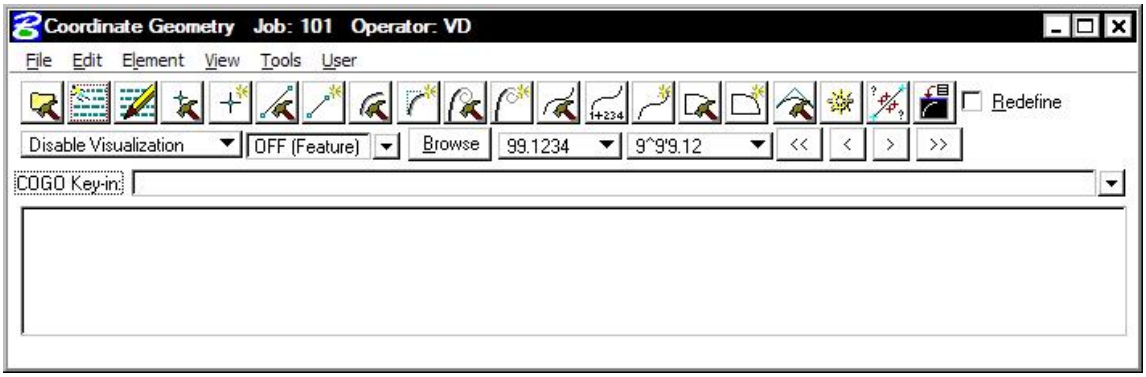
In this section we will generate a **Vertical Alignment** report using Coordinate Geometry.

Step 1. Open the MicroStation file **c:\data\geo\VDOT\road1\d17682prof.dgn.**

It is not required that this report be run while in the profile file. It can be run from any MicroStation design file.

Step 2. Access **Project Manager**. It should automatically access the Road workflow dialog box since we "remembered" the options in Exercise 2.

Step 3. Select the **Coordinate Geometry** icon from the **Road Project: 17682.prj** workflow dialog box. The coordinate geometry dialog box shown below should appear.



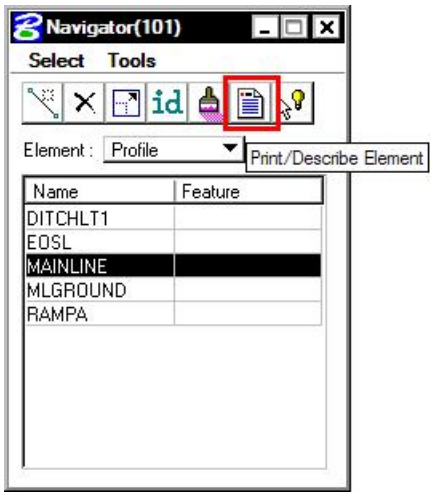
This dialog box is completely re-sizable, so you can position it where you're most comfortable.

21.2.1 Describe Profile

From the COGO dialog window, let's preview the geometry of the profile **MAINLINE**.

Step 1. Select the **COGO Navigator** icon

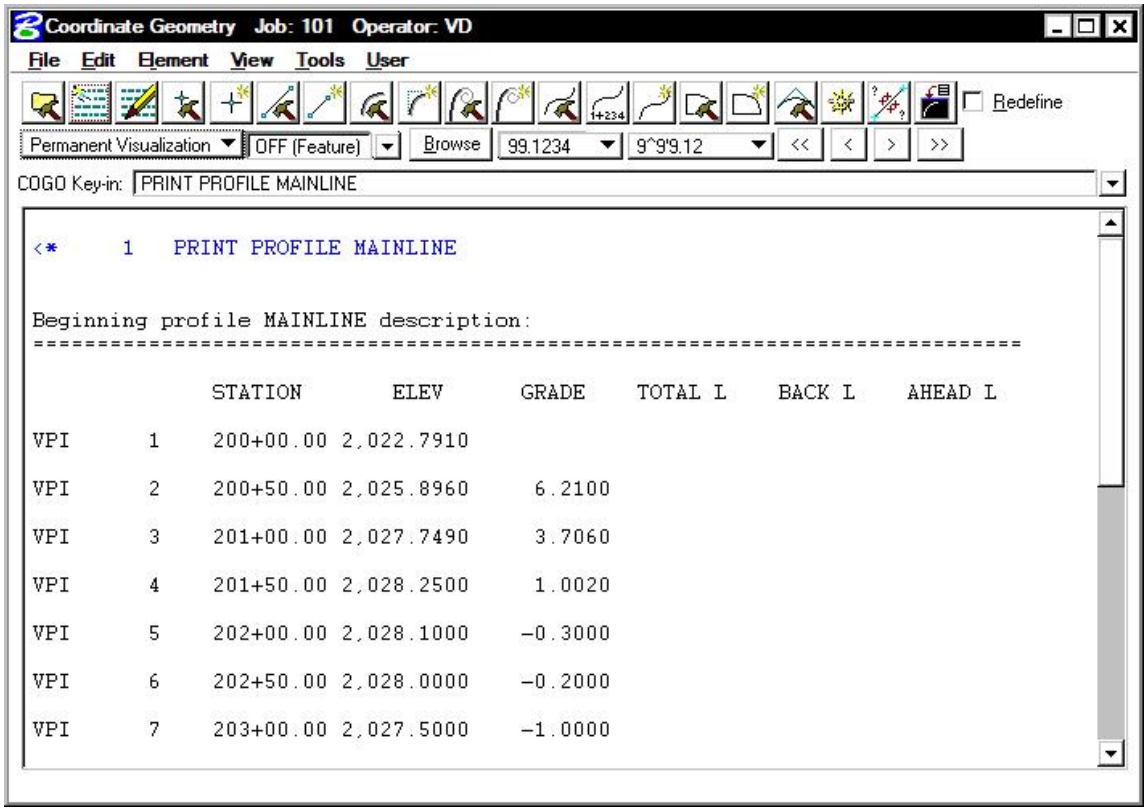
or use the **Tools > Navigator** option on the COGO menu bar to access the **COGO Navigator** dialog box.



Step 2. Set the element option to **Profile** and highlight the chain **MAINLINE.**

Step 3. Press the "**Print/Describe Element**" icon.

Step 4. The profile geometry output will be displayed in the main COGO window.

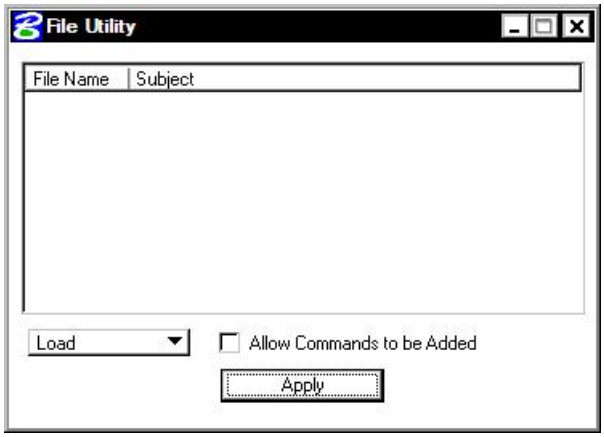


21.2.2 Create Output File

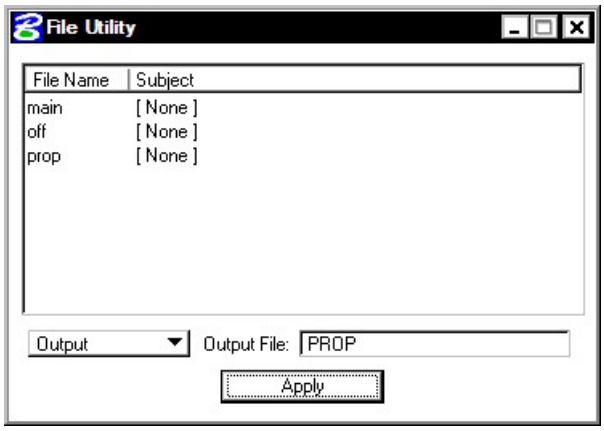
In the following steps we will save an output file with the computations of profile **MAINLINE**.

Step 1. Access the **File Utility** dialog by pressing the **File Utility** icon

or by selecting **File > File Utility**. The dialog below should appear.



Step 2. To save an output file with the actual results of the computations, set the option button to **Output** on the **File Utility** dialog. Enter "**PROP"** as the **Output File** name then click **Apply**.



A file named **"prop101.ovd"** will be created in the working directory.

Step 3. Dismiss the **File Utility** dialog box by clicking the **X** in the upper right hand corner.

Step 4. From the Edit pulldown, select **Edit > Clear** to 'clear' out all the commands that we just previously executed.

This will not remove the stored data from COGO.

21.2.3 Create Profile Grade List

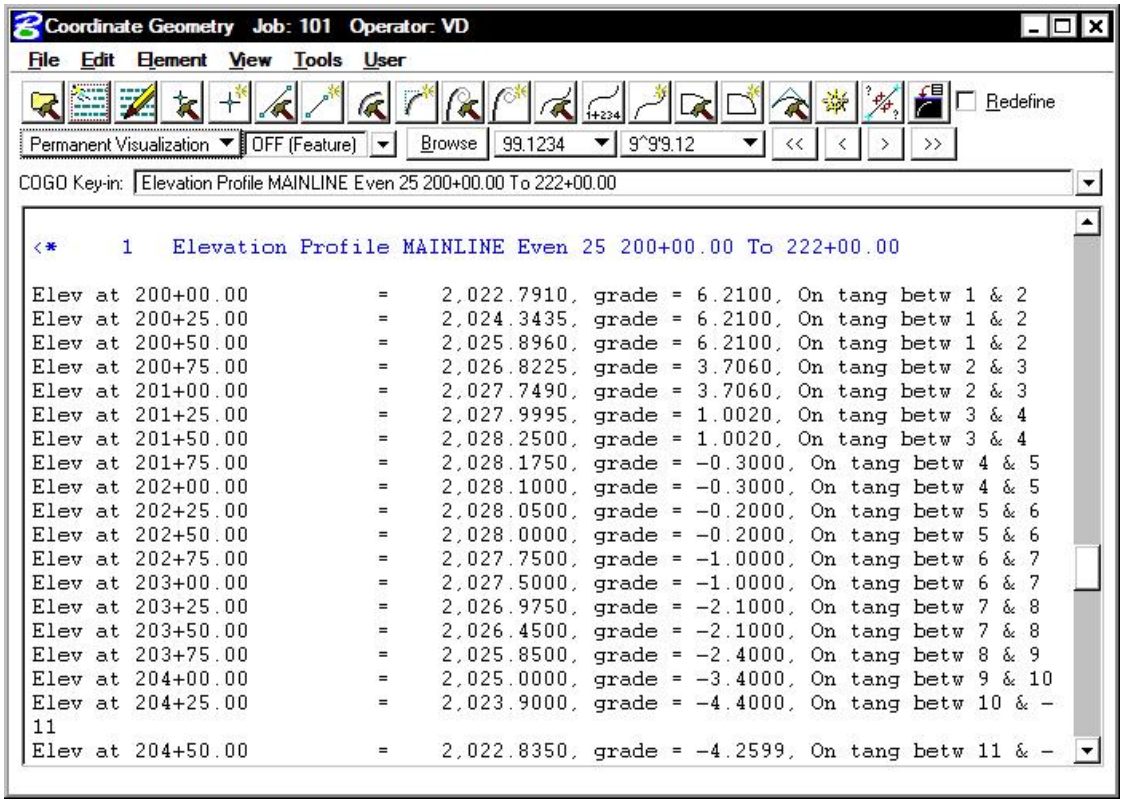
From the COGO dialog window, let's create a profile grade list of the profile **MAINLINE**.

Step 1. Use the **Element > Profile > Elevation** option on the COGO menu bar to access the **Profile Elevation** dialog box.

Step 2. Populate the dialog box as shown.

Step 3. Click "**Compute Elevation**".

Step 4. The profile grade list will be displayed in the main COGO window.

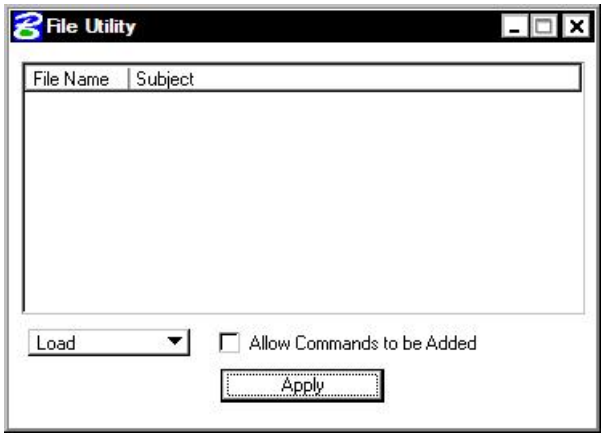


21.2.4 Create Output File

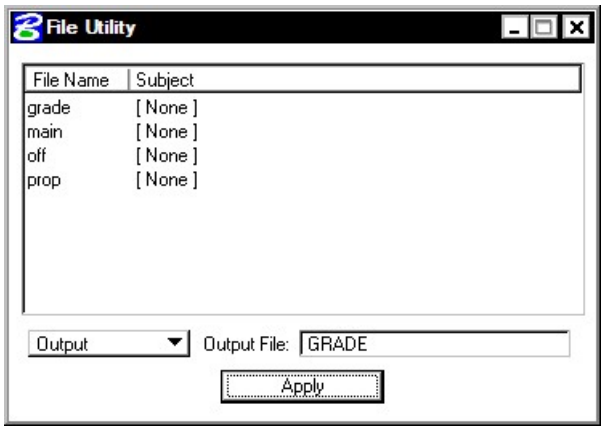
In the following steps we will save an output file with the profile grade list of profile **MAINLINE**.

Step 1. Access the **File Utility** dialog by pressing the **File Utility** icon

or by selecting **File > File Utility**. The dialog below should appear.



Step 2. To save an output file with the actual results of the profile grade list, set the option button to **Output** on the **File Utility** dialog. Enter "**GRADE"** as the **Output File** name then click **Apply**.



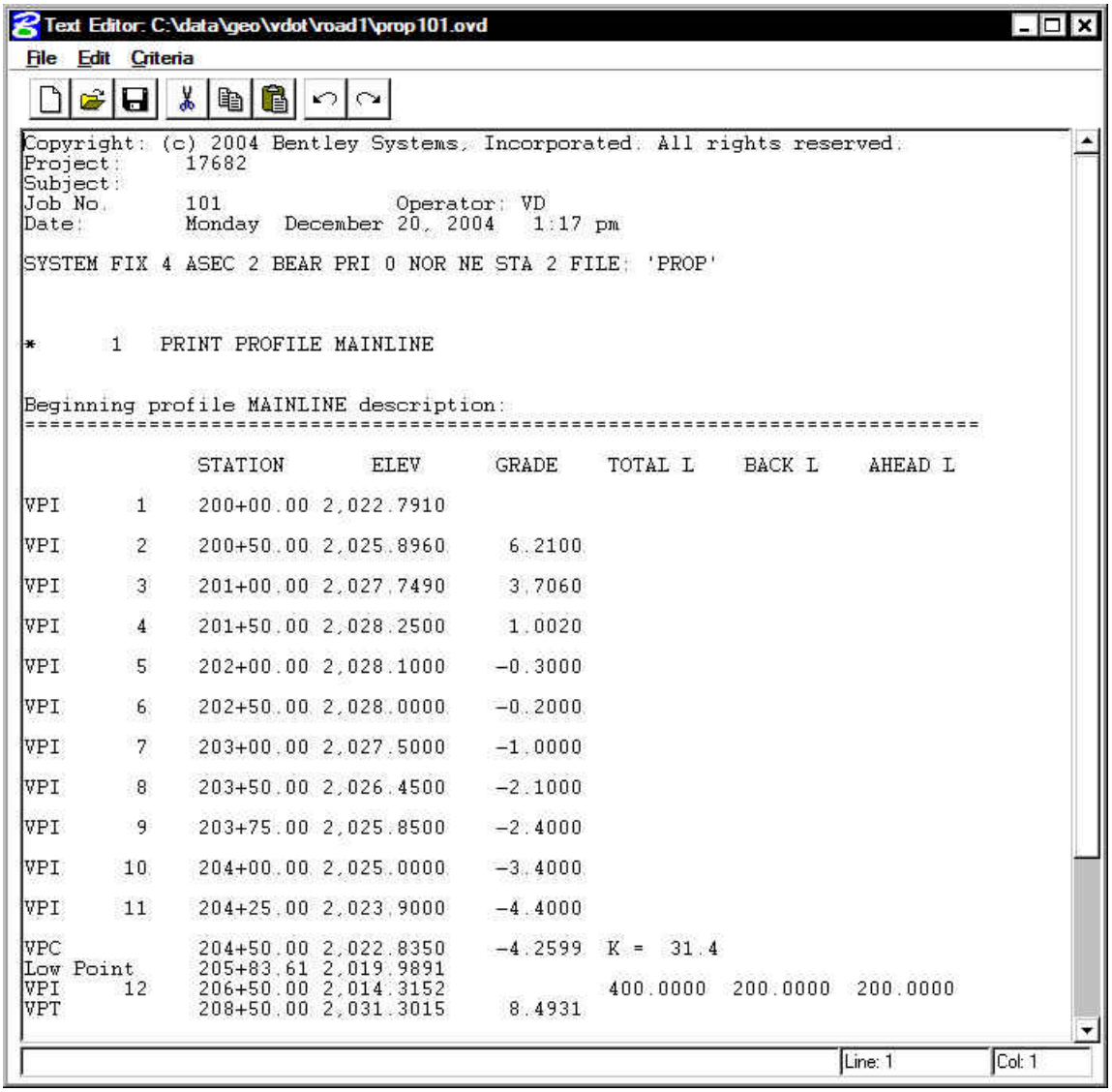
A file named **"grade101.ovd"** will be created in the working directory.

Step 3. Dismiss the **File Utility** dialog box by clicking the **X** in the upper right hand corner.

Step 4. Exit **COGO** by clicking the **X** in the upper right hand corner.

NOTE: When you are prompted to Save the Session, click "**No**" since you have already saved your input.

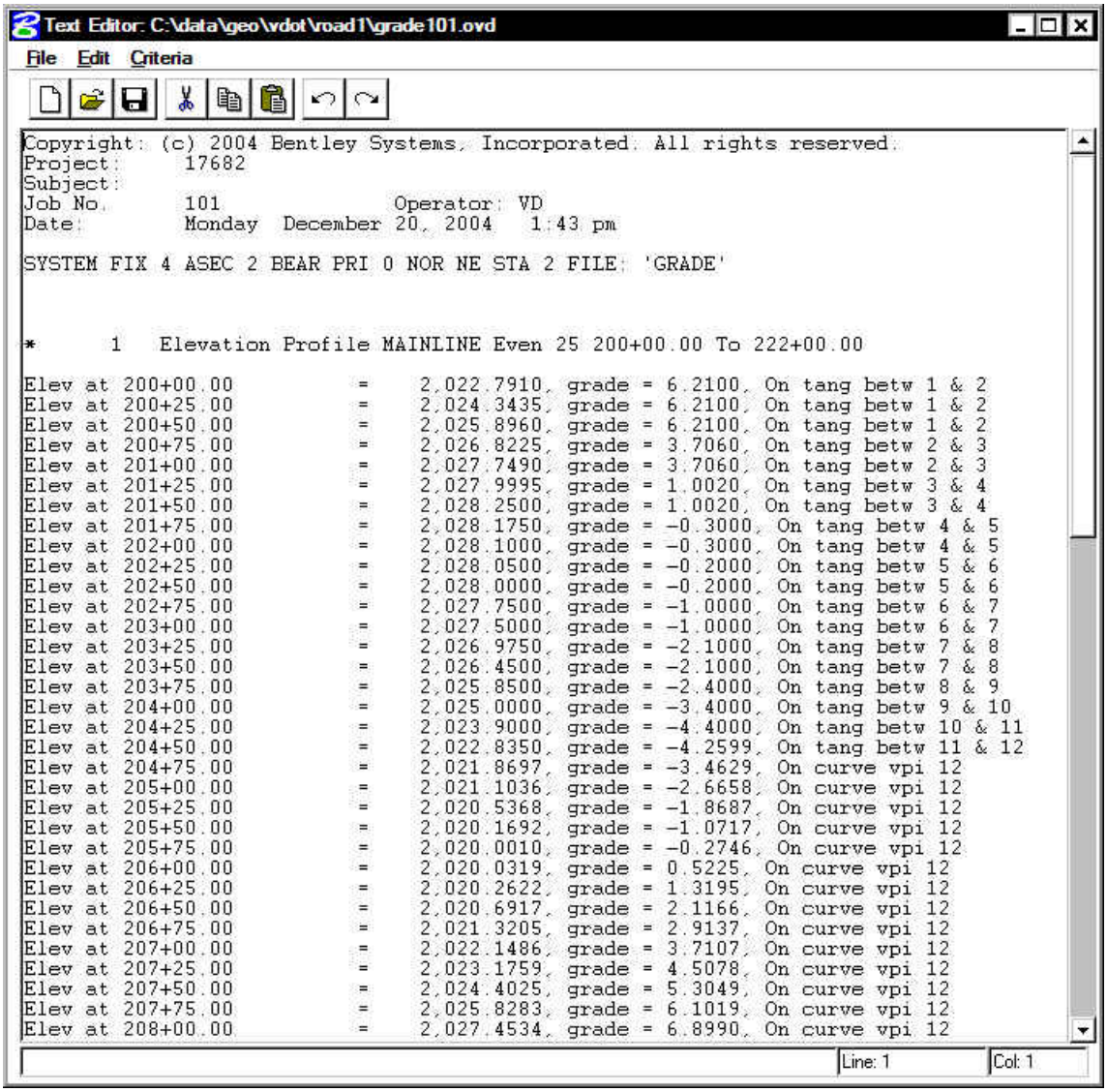
Step 5. Review the output geometry file by opening **"prop101.ovd"** with the GEOPAK Text Editor. The file should appear as below.




```
Copyright: (c) 2004 Bentley Systems, Incorporated. All rights reserved.
Project:     17682
Subject:
Job No.      101              Operator: VD
Date:        Monday  December 20, 2004   1:17 pm

SYSTEM FIX 4 ASEC 2 BEAR PRI 0 NOR NE STA 2 FILE: 'PROP'


*      1   PRINT PROFILE MAINLINE

Beginning profile MAINLINE description:
================================================================================

               STATION       ELEV      GRADE    TOTAL L    BACK L    AHEAD L

VPI       1    200+00.00 2,022.7910

VPI       2    200+50.00 2,025.8960     6.2100

VPI       3    201+00.00 2,027.7490     3.7060

VPI       4    201+50.00 2,028.2500     1.0020

VPI       5    202+00.00 2,028.1000    -0.3000

VPI       6    202+50.00 2,028.0000    -0.2000

VPI       7    203+00.00 2,027.5000    -1.0000

VPI       8    203+50.00 2,026.4500    -2.1000

VPI       9    203+75.00 2,025.8500    -2.4000

VPI      10    204+00.00 2,025.0000    -3.4000

VPI      11    204+25.00 2,023.9000    -4.4000

VPC            204+50.00 2,022.8350    -4.2599  K =  31.4
Low Point      205+83.61 2,019.9891
VPI      12    206+50.00 2,014.3152             400.0000  200.0000  200.0000
VPT            208+50.00 2,031.3015     8.4931
```

Geometric data for the profile name, including stations, elevations (including the high point), grade and lengths (back, ahead and total) for VPC's, VPI's and VPT's.

Step 6. Review the output geometry file by opening **"grade101.ovd"** with the GEOPAK Text Editor. The file should appear as below.




```
Copyright: (c) 2004 Bentley Systems, Incorporated. All rights reserved.
Project:     17682
Subject:
Job No.      101              Operator: VD
Date:        Monday  December 20, 2004   1:43 pm

SYSTEM FIX 4 ASEC 2 BEAR PRI 0 NOR NE STA 2 FILE: 'GRADE'



*      1   Elevation Profile MAINLINE Even 25 200+00.00 To 222+00.00

Elev at 200+00.00          =    2,022.7910, grade = 6.2100, On tang betw 1 & 2
Elev at 200+25.00          =    2,024.3435, grade = 6.2100, On tang betw 1 & 2
Elev at 200+50.00          =    2,025.8960, grade = 6.2100, On tang betw 1 & 2
Elev at 200+75.00          =    2,026.8225, grade = 3.7060, On tang betw 2 & 3
Elev at 201+00.00          =    2,027.7490, grade = 3.7060, On tang betw 2 & 3
Elev at 201+25.00          =    2,027.9995, grade = 1.0020, On tang betw 3 & 4
Elev at 201+50.00          =    2,028.2500, grade = 1.0020, On tang betw 3 & 4
Elev at 201+75.00          =    2,028.1750, grade = -0.3000, On tang betw 4 & 5
Elev at 202+00.00          =    2,028.1000, grade = -0.3000, On tang betw 4 & 5
Elev at 202+25.00          =    2,028.0500, grade = -0.2000, On tang betw 5 & 6
Elev at 202+50.00          =    2,028.0000, grade = -0.2000, On tang betw 5 & 6
Elev at 202+75.00          =    2,027.7500, grade = -1.0000, On tang betw 6 & 7
Elev at 203+00.00          =    2,027.5000, grade = -1.0000, On tang betw 6 & 7
Elev at 203+25.00          =    2,026.9750, grade = -2.1000, On tang betw 7 & 8
Elev at 203+50.00          =    2,026.4500, grade = -2.1000, On tang betw 7 & 8
Elev at 203+75.00          =    2,025.8500, grade = -2.4000, On tang betw 8 & 9
Elev at 204+00.00          =    2,025.0000, grade = -3.4000, On tang betw 9 & 10
Elev at 204+25.00          =    2,023.9000, grade = -4.4000, On tang betw 10 & 11
Elev at 204+50.00          =    2,022.8350, grade = -4.2599, On tang betw 11 & 12
Elev at 204+75.00          =    2,021.8697, grade = -3.4629, On curve vpi 12
Elev at 205+00.00          =    2,021.1036, grade = -2.6658, On curve vpi 12
Elev at 205+25.00          =    2,020.5368, grade = -1.8687, On curve vpi 12
Elev at 205+50.00          =    2,020.1692, grade = -1.0717, On curve vpi 12
Elev at 205+75.00          =    2,020.0010, grade = -0.2746, On curve vpi 12
Elev at 206+00.00          =    2,020.0319, grade = 0.5225, On curve vpi 12
Elev at 206+25.00          =    2,020.2622, grade = 1.3195, On curve vpi 12
Elev at 206+50.00          =    2,020.6917, grade = 2.1166, On curve vpi 12
Elev at 206+75.00          =    2,021.3205, grade = 2.9137, On curve vpi 12
Elev at 207+00.00          =    2,022.1486, grade = 3.7107, On curve vpi 12
Elev at 207+25.00          =    2,023.1759, grade = 4.5078, On curve vpi 12
Elev at 207+50.00          =    2,024.4025, grade = 5.3049, On curve vpi 12
Elev at 207+75.00          =    2,025.8283, grade = 6.1019, On curve vpi 12
Elev at 208+00.00          =    2,027.4534, grade = 6.8990, On curve vpi 12
```


The Profile Elevation tool computes elevations along a profile based on user-defined parameters. Next, the profile grade is calculated and if the station is on a tangent or curve.

The application reads the Begin stationing, then determines the next even station (divisible by the Even Station value). For example, the beginning station is 200+00.00 and Even 25 is set. The Even 25 dictates to the software to display the first station as 200+00.00, followed by 200+25.00, 200+50.00, etc.

Step 7. Exit **MicroStation.**

21.3 Cross Section Reports

These reports must be run from the proposed cross section file.

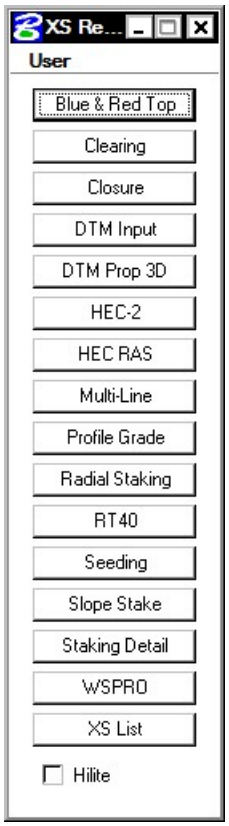
21.3.1 Design Cross Section List

In this section we will generate a **Design Cross List** using **XS List** from the Cross Section Reports.

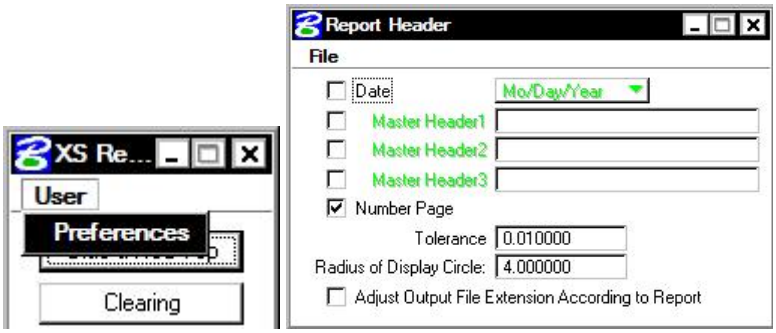
Step 1. Open the MicroStation file **c:\data\geo\VDOT\road1\d17682xsmainline.dgn.**

Step 2. Access **Project Manager**. It should automatically access the Road workflow dialog box since we "remembered" the options in Exercise 2.

Step 3. Select the **Reports & XS Quantities** icon from the **Road Project: 17682.prj** workflow dialog box. The **XS Reports** dialog box shown below should appear.



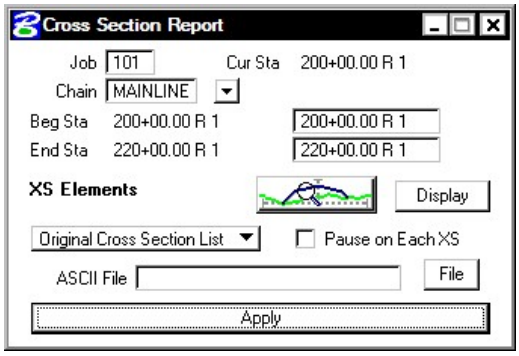
Step 4. From the **XS Reports** dialog box, select the **User > Preferences** dialog box.



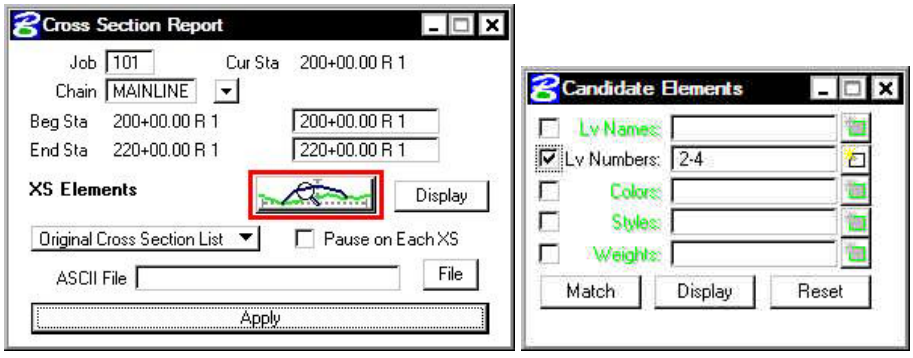
Set the tolerance to **.01**.

Step 5. Dismiss the **Report Header** dialog box by clicking the **X** in the upper right hand corner.

Step 6. From the **XS Reports** dialog box, select the **XS List** report. The **Cross Section Report** dialog box below should appear. **Job Number**, **Chain Name**, and **Station Range** should be populated from Project Manager.



Step 7. Click the symbology settings button then populate the **Candidate Elements** dialog box as shown.



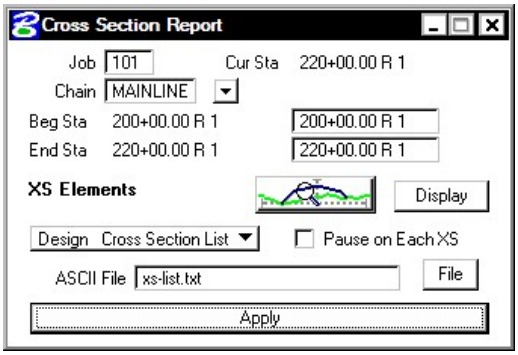
Note: The levels for XS Elements should only refer to 2-4. These are the levels that make up the top of Finish Grade.

Step 8. Dismiss the **Candidate Elements** dialog box by clicking the **X** in the upper right hand corner.

Step 9. Set the option button to **"Design Cross Section List"**.

Step 10. Enter **"xs-list.txt"** for the ASCII File name.

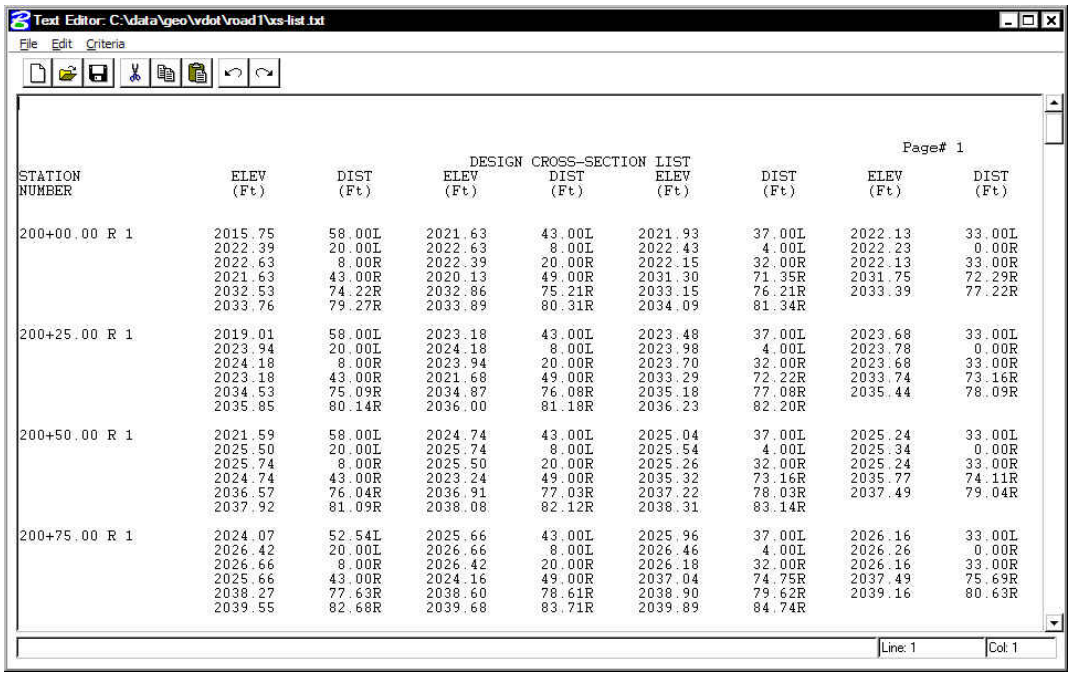
The **Cross Section Report** dialog box should appear as below.



Step 11. Click **Apply**. A file named **"xs-list.txt"** will be created in the working directory.

Step 12. Dismiss the **Cross Section Report** dialog box by clicking the **X** in the upper right hand corner.

Step 13. Review the Cross Section list file by opening **"xs-list.txt"** with the GEOPAK Text Editor. The file should appear as below.



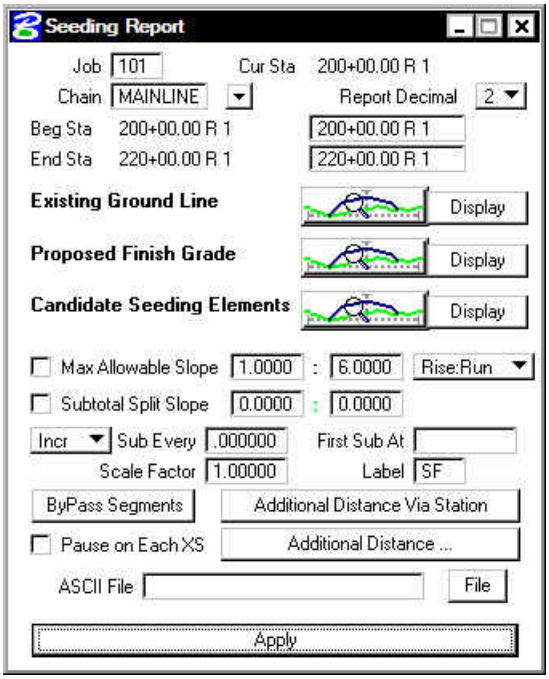
For each station, the XS List report provides the elevation and offset for each cross section element identified via user defined search criteria. Offsets to the Left of the centerline contain an "**L**" and offsets to the right of the centerline contain an "**R**".

Do **NOT** dismiss the **XS Reports** dialog box.

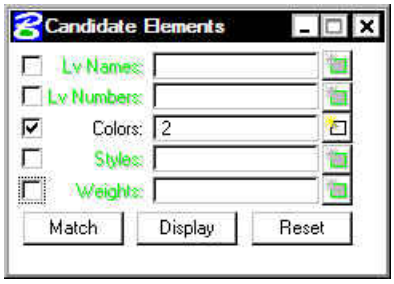
21.3.2 Seeding Report

In this section we will generate a **Seeding Report** from the Cross Section Reports.

Step 1. From the **XS Reports** dialog box, select the **Seeding** report. The **Seeding Report** dialog box below should appear. Most of the dialog box should be populated from Project Manager.



Step 2. Click the **Candidate Seeding Elements** symbology settings button then populate the **Candidate Elements** dialog box as shown.



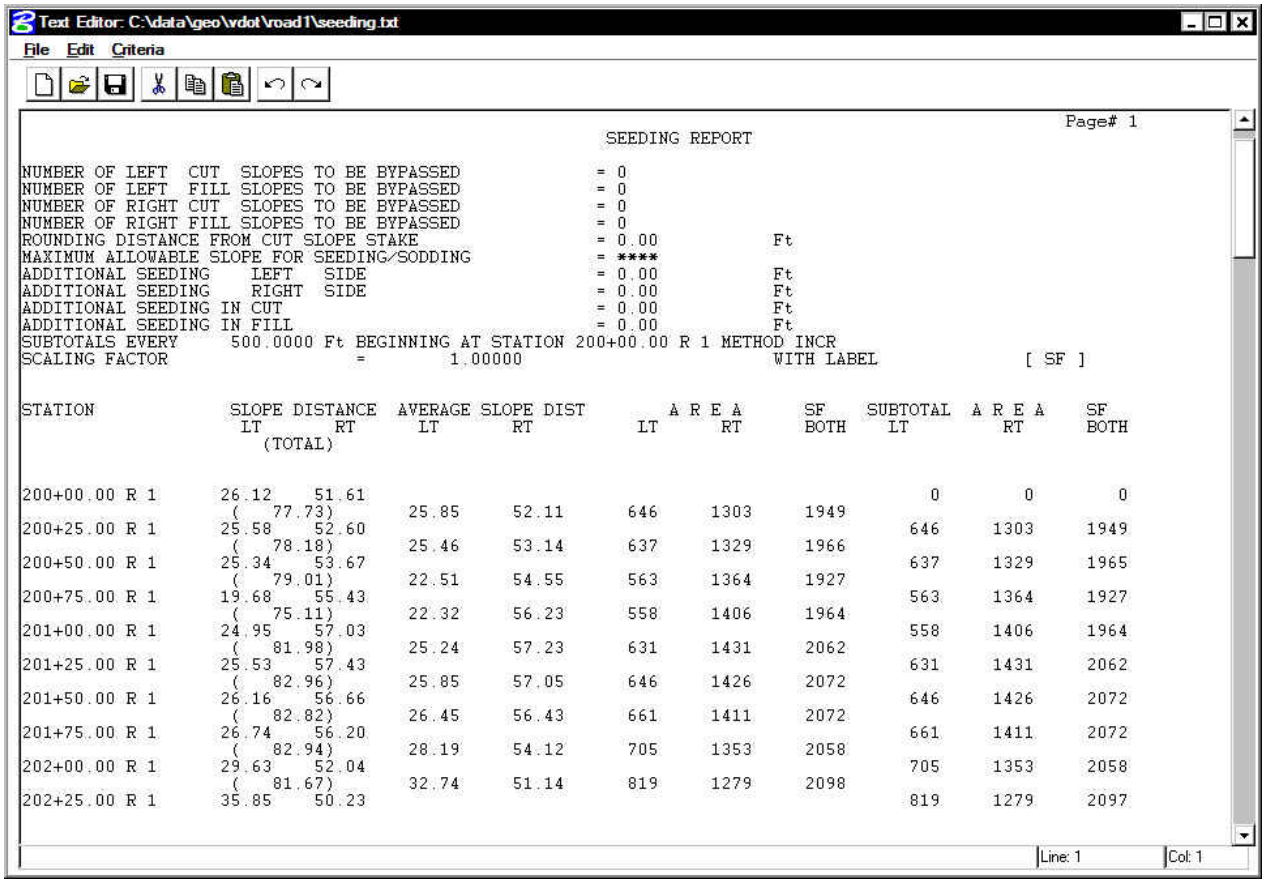
Step 3. Dismiss the **Candidate Elements** dialog box by clicking the **X** in the upper right hand corner.

Step 4. Enter **"seeding.txt"** for the ASCII File name.

Step 5. Click **Apply**. A file named **"seeding.txt"** will be created in the working directory.

Step 6. Dismiss the **Seeding Report** dialog box by clicking the **X** in the upper right hand corner.

Step 7. Review the Seeding Report file by opening **"seeding.txt"** with the GEOPAK Text Editor. The file should appear as below.



Text Editor: C:\data\geo\vdot\road1\seeding.txt

File Edit Criteria

Page# 1

SEEDING REPORT

```
NUMBER OF LEFT  CUT  SLOPES TO BE BYPASSED            = 0
NUMBER OF LEFT  FILL SLOPES TO BE BYPASSED            = 0
NUMBER OF RIGHT CUT  SLOPES TO BE BYPASSED            = 0
NUMBER OF RIGHT FILL SLOPES TO BE BYPASSED            = 0
ROUNDING DISTANCE FROM CUT SLOPE STAKE                = 0.00          Ft
MAXIMUM ALLOWABLE SLOPE FOR SEEDING/SODDING           = ****
ADDITIONAL SEEDING    LEFT   SIDE                     = 0.00          Ft
ADDITIONAL SEEDING    RIGHT  SIDE                     = 0.00          Ft
ADDITIONAL SEEDING IN CUT                             = 0.00          Ft
ADDITIONAL SEEDING IN FILL                            = 0.00          Ft
SUBTOTALS EVERY     500.0000 Ft BEGINNING AT STATION 200+00.00 R 1 METHOD INCR
SCALING FACTOR                =       1.00000                 WITH LABEL          [ SF ]
```

STATION	SLOPE DISTANCE LT	SLOPE DISTANCE RT	SLOPE DISTANCE (TOTAL)	AVERAGE SLOPE DIST LT	AVERAGE SLOPE DIST RT	AREA LT	AREA RT	SF BOTH	SUBTOTAL LT	SUBTOTAL RT	SF BOTH
200+00.00 R 1	26.12	51.61	(77.73)						0	0	0
200+25.00 R 1	25.58	52.60	(78.18)	25.85	52.11	646	1303	1949	646	1303	1949
200+50.00 R 1	25.34	53.67	(79.01)	25.46	53.14	637	1329	1966	637	1329	1965
200+75.00 R 1	19.68	55.43	(75.11)	22.51	54.55	563	1364	1927	563	1364	1927
201+00.00 R 1	24.95	57.03	(81.98)	22.32	56.23	558	1406	1964	558	1406	1964
201+25.00 R 1	25.53	57.43	(82.96)	25.24	57.23	631	1431	2062	631	1431	2062
201+50.00 R 1	26.16	56.66	(82.82)	25.85	57.05	646	1426	2072	646	1426	2072
201+75.00 R 1	26.74	56.20	(82.94)	26.45	56.43	661	1411	2072	661	1411	2072
202+00.00 R 1	29.63	52.04	(81.67)	28.19	54.12	705	1353	2058	705	1353	2058
202+25.00 R 1	35.85	50.23		32.74	51.14	819	1279	2098	819	1279	2097

Line: 1 Col: 1

The top of the file contains the values from the ByPass Segments and Additional Distances, followed by a listing of each station, its left and right slope distances (measured along the slope, not horizontal distance). Utilizing two stations, GEOPAK calculates the average slope distance then computes the areas.

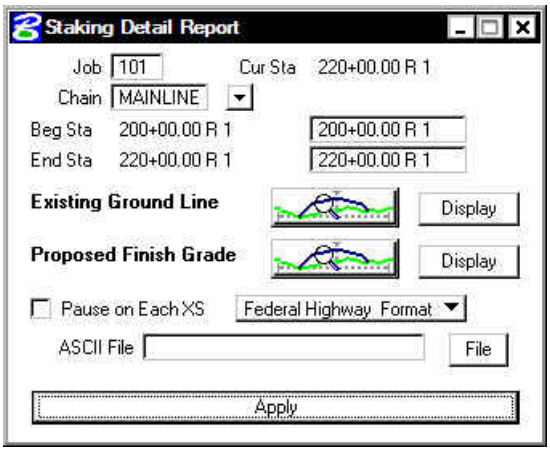
For each station, the **Seeding Report** provides seeding slope distances left and right. Then GEOPAK computes the average slope distance on each side, and uses the results to compute seeding areas. Areas, in Square Feet, are listed next for the Left side, Right side, and both. Next a subtotal is listed, in Square Feet, for the Left side, Right side, and both.

At the bottom of the seeding report, totals are provided for the Left side, Right side, and both (in both Square Feet and Acres).

21.3.3 Staking Detail Report

In this section we will generate a **Staking Detail Report** from the Cross Section Reports.

Step 1. From the **XS Reports** dialog box, select the **Staking Detail** report. The **Staking Detail Report** dialog box below should appear. The dialog box should be populated from Project Manager.



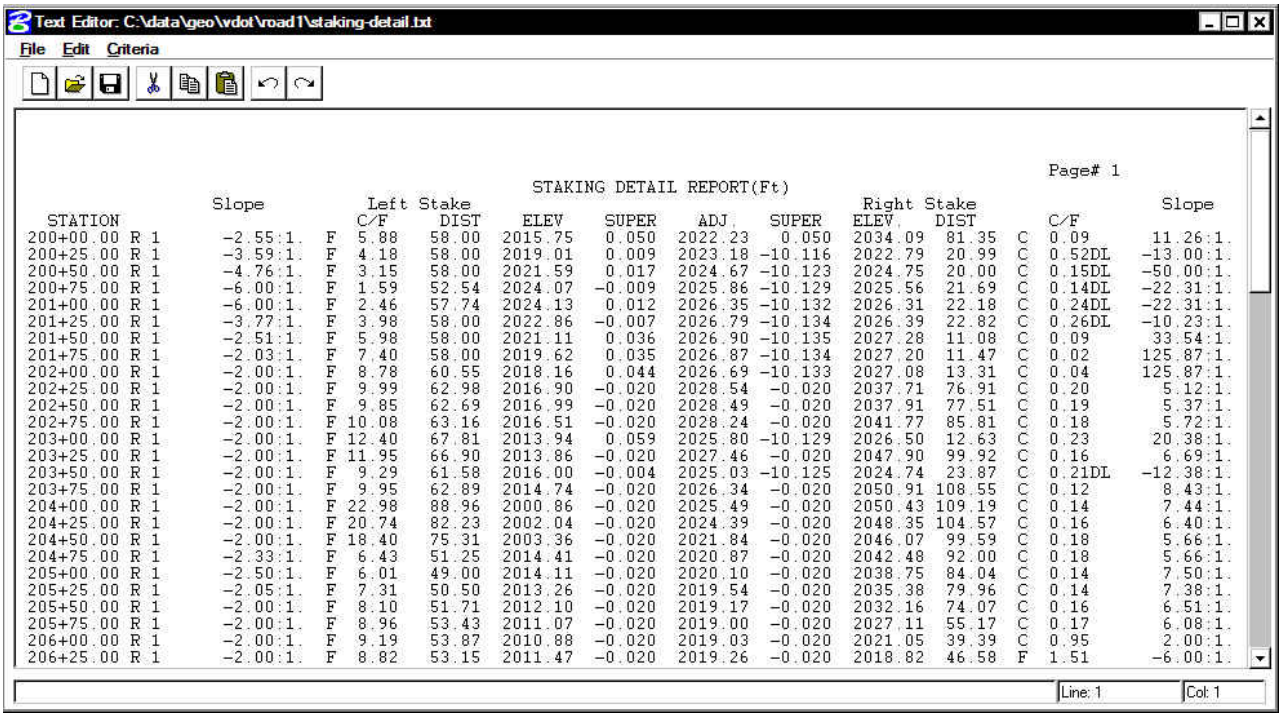
Step 2. Enter **"staking-detail.txt"** for the ASCII File name.

Step 3. Click **Apply**. A file named **"staking-detail.txt"** will be created in the working directory.

Step 4. Dismiss the **Staking Detail Report** dialog box by clicking the **X** in the upper right hand corner.

Step 5. Dismiss the **XS Reports** dialog box by clicking the **X** in the upper right hand corner.

Step 6. Review the Staking Detail Report file by opening **"staking-detail.txt"** with the GEOPAK Text Editor. The file should appear as below.



Text Editor: C:\data\geo\vdot\road1\staking-detail.txt

File Edit Criteria

Page# 1

STAKING DETAIL REPORT(Ft)

STATION	Slope	Left Stake C/F	Left Stake DIST	Left Stake ELEV	Left Stake SUPER	Left Stake ADJ.	Right Stake SUPER	Right Stake ELEV.	Right Stake DIST	Right Stake C/F	Slope
200+00.00 R 1	-2.55:1.	F 5.88	58.00	2015.75	0.050	2022.23	0.050	2034.09	81.35 C	0.09	11.26:1.
200+25.00 R 1	-3.59:1.	F 4.18	58.00	2019.01	0.009	2023.18	-10.116	2022.79	20.99 C	0.52DL	-13.00:1.
200+50.00 R 1	-4.76:1.	F 3.15	58.00	2021.59	0.017	2024.67	-10.123	2024.75	20.00 C	0.15DL	-50.00:1.
200+75.00 R 1	-6.00:1.	F 1.59	52.54	2024.07	-0.009	2025.86	-10.129	2025.56	21.69 C	0.14DL	-22.31:1.
201+00.00 R 1	-6.00:1.	F 2.46	57.74	2024.13	0.012	2026.35	-10.132	2026.31	22.18 C	0.24DL	-22.31:1.
201+25.00 R 1	-3.77:1.	F 3.98	58.00	2022.86	-0.007	2026.79	-10.134	2026.39	22.82 C	0.26DL	-10.23:1.
201+50.00 R 1	-2.51:1.	F 5.98	58.00	2021.11	0.036	2026.90	-10.135	2027.28	11.08 C	0.09	33.54:1.
201+75.00 R 1	-2.03:1.	F 7.40	58.00	2019.62	0.035	2026.87	-10.134	2027.20	11.47 C	0.02	125.87:1.
202+00.00 R 1	-2.00:1.	F 8.78	60.55	2018.16	0.044	2026.69	-10.133	2027.08	13.31 C	0.04	125.87:1.
202+25.00 R 1	-2.00:1.	F 9.99	62.98	2016.90	-0.020	2028.54	-0.020	2037.71	76.91 C	0.20	5.12:1.
202+50.00 R 1	-2.00:1.	F 9.85	62.69	2016.99	-0.020	2028.49	-0.020	2037.91	77.51 C	0.19	5.37:1.
202+75.00 R 1	-2.00:1.	F 10.08	63.16	2016.51	-0.020	2028.24	-0.020	2041.77	85.81 C	0.18	5.72:1.
203+00.00 R 1	-2.00:1.	F 12.40	67.81	2013.94	0.059	2025.80	-10.129	2026.50	12.63 C	0.23	20.38:1.
203+25.00 R 1	-2.00:1.	F 11.95	66.90	2013.86	-0.020	2027.46	-0.020	2047.90	99.92 C	0.16	6.69:1.
203+50.00 R 1	-2.00:1.	F 9.29	61.58	2016.00	-0.004	2025.03	-10.125	2024.74	23.87 C	0.21DL	-12.38:1.
203+75.00 R 1	-2.00:1.	F 9.95	62.89	2014.74	-0.020	2026.34	-0.020	2050.91	108.55 C	0.12	8.43:1.
204+00.00 R 1	-2.00:1.	F 22.98	88.96	2000.86	-0.020	2025.49	-0.020	2050.43	109.19 C	0.14	7.44:1.
204+25.00 R 1	-2.00:1.	F 20.74	82.23	2002.04	-0.020	2024.39	-0.020	2048.35	104.57 C	0.16	6.40:1.
204+50.00 R 1	-2.00:1.	F 18.40	75.31	2003.36	-0.020	2021.84	-0.020	2046.07	99.59 C	0.18	5.66:1.
204+75.00 R 1	-2.33:1.	F 6.43	51.25	2014.41	-0.020	2020.87	-0.020	2042.48	92.00 C	0.18	5.66:1.
205+00.00 R 1	-2.50:1.	F 6.01	49.00	2014.11	-0.020	2020.10	-0.020	2038.75	84.04 C	0.14	7.50:1.
205+25.00 R 1	-2.05:1.	F 7.31	50.50	2013.26	-0.020	2019.54	-0.020	2035.38	79.96 C	0.14	7.38:1.
205+50.00 R 1	-2.00:1.	F 8.10	51.71	2012.10	-0.020	2019.17	-0.020	2032.16	74.07 C	0.16	6.51:1.
205+75.00 R 1	-2.00:1.	F 8.96	53.43	2011.07	-0.020	2019.00	-0.020	2027.11	55.17 C	0.17	6.08:1.
206+00.00 R 1	-2.00:1.	F 9.19	53.87	2010.88	-0.020	2019.03	-0.020	2021.05	39.39 C	0.95	2.00:1.
206+25.00 R 1	-2.00:1.	F 8.82	53.15	2011.47	-0.020	2019.26	-0.020	2018.82	46.58 F	1.51	-6.00:1.

Line: 1 Col: 1

For each station, GEOPAK determines the tie down point between the proposed finish grade and the existing ground.

Referencing this tie down point, the **Staking Report** lists the left and right offset and its corresponding elevation, and the slope of the proposed finish grade.

Next, a "**C**" or "**F**" is provided if the tie down point is in Cut or Fill along with a vertical distance to the next break point in the original section.

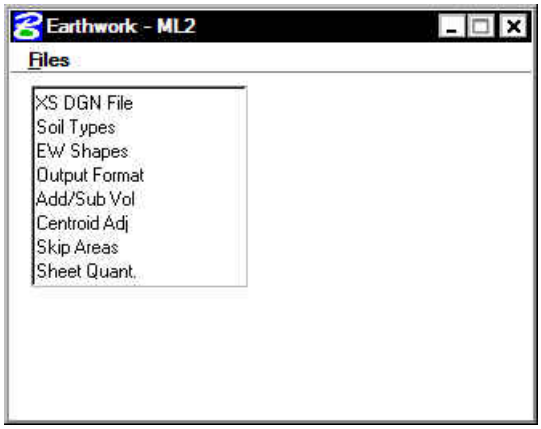
The centerline elevation (adjusted for pivoting on the inside edge) is given in addition to the superelevation rate of the pavement.

21.3.4 Detailed Earthwork Computations

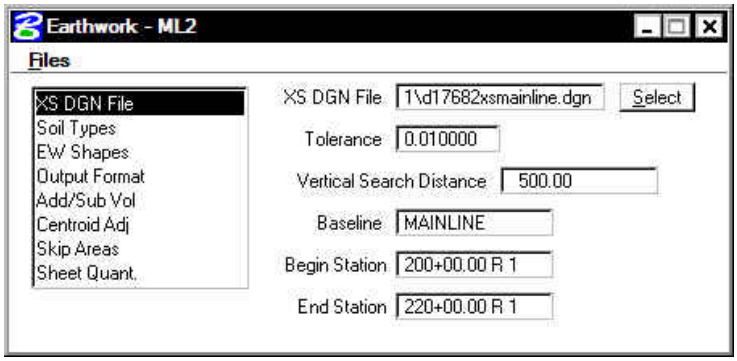
In this section we will generate a **Detailed Earthwork Report**. An area of top soil removal will be included in this report. Cross sections that require the top soil removal have been hand drafted using a unique symbology. This will need to be done on any projects where top soil removal is required.

Step 1. **Project Manager** should still be invoked.

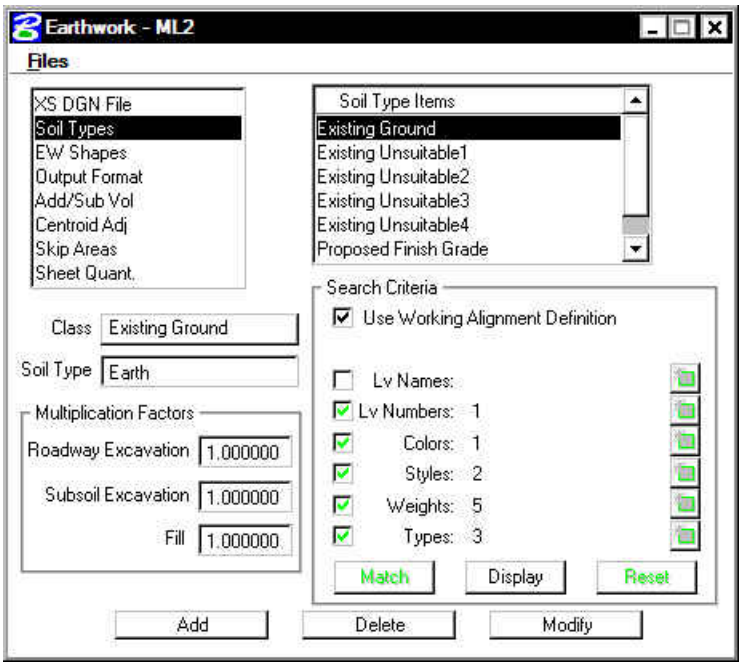
Step 2. Click **Earthwork** from the Project Manager dialog box and create a new run named **ML2**. Open the new run.



Step 3. Populate the **XS DGN File** section of the dialog box as shown below:



Step 4. In the **Soil Types** section of the dialog box, create the following classifications and soil types utilizing the parameters detailed in the table below.



Class	Soil Type	Search Criteria
Existing Ground	Earth	Working Alignment Definition
Proposed Finish Grade	Earth	Working Alignment Definition
Existing Unsuitable1	RootMat_Cut	LV=29, WT=8, LC=0, CO=3, TYPE=Line
Existing Unsuitable2	RootMat_Fill	LV=29, WT=8, LC=0, CO=7, TYPE=Line
Existing Unsuitable3	Top_Soil	LV=29, WT=8, LC=0, CO=0, TYPE=Line
Existing Unsuitable4	Exist_Pavt	LV=59, WT=3, LC=2, CO=88, TYPE=Line
Excavation Limit	None	LV=25, WT=0, LC=0, CO=55, TYPE=Line

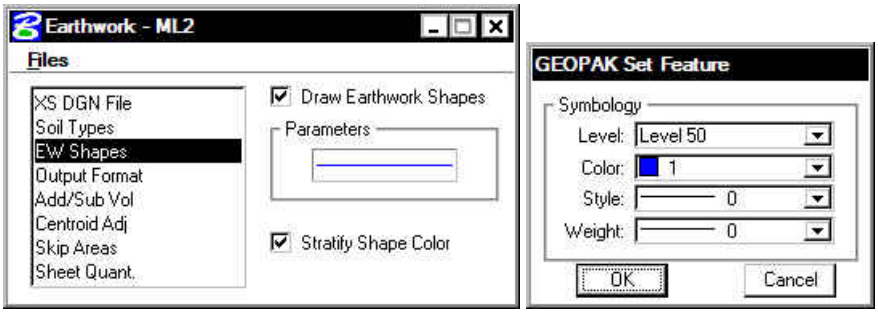
You can manually define the symbologies using the settings in the Search Criteria portion of the dialog box. When using these settings, there are also three additional buttons to help you.

Match Prompts you to identify an element. Once you do, it will fill in the symbology settings with the symbology of the identified element.

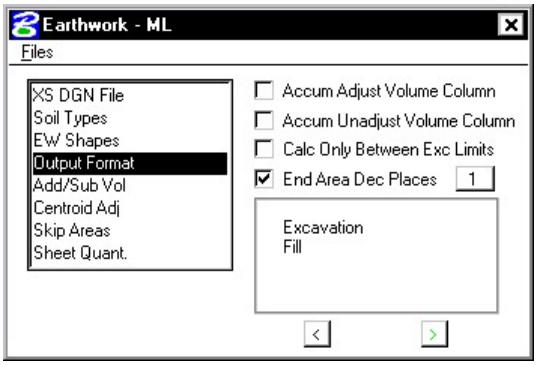
Display/Undisplay Highlights all elements in the design file matching the set symbology.

Reset Clears all symbology settings.

Step 5. In the **EW Shapes** section of the dialog box, toggle on **Draw Earthwork Shapes** and **Stratify Shape Color**. Populate the **Set Feature** dialog box with the parameters as shown below.



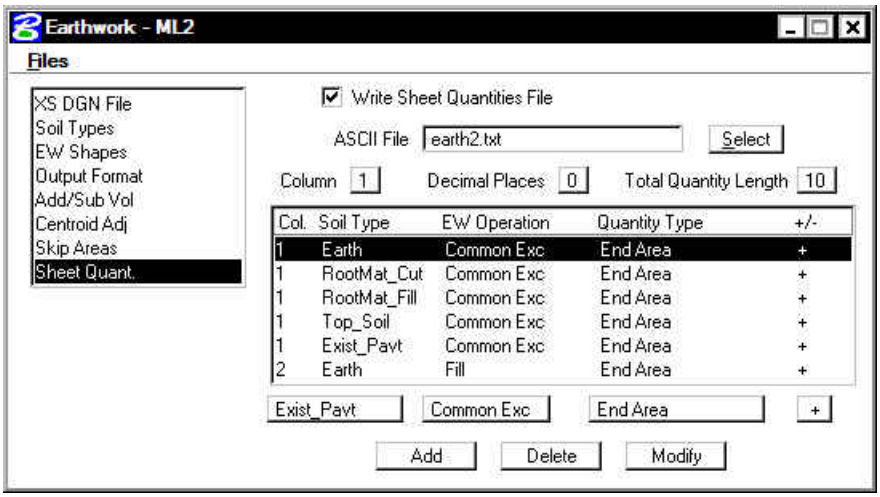
Step 6. Populate the **Output Format** section as shown below.



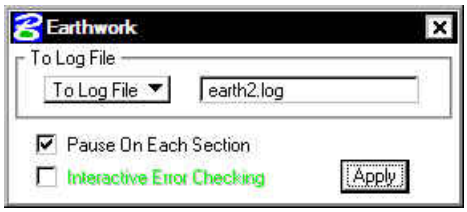
NOTE: Use the arrows (< or >) to change the format to **Excavation** and **Fill**.

Step 7. In the **Sheet Quantities** section, toggle on the **Write Sheet Quantities File**. Name the file **"earth2.txt"**. Add the following columns to the file with **Decimal Places = 0** and **Total Quantity Length = 10**:

Col.	Soil Type	EW Operation	Quantity Type	+/-
1	Earth	Common Exc	End Area	+
1	RootMat_Cut	Common Exc	End Area	+
1	RootMat_Fill	Common Exc.	End Area	+
1	Top_soil	Common Exc.	End Area	+
1	Exist_Pavt	Common Exc.	End Area	+
2	Earth	Fill	End Area	+



Step 8. Using the **Files > Run** pulldown, run the earthwork for the proposed cross sections. Place your output into a log file as shown in the dialog box below and **Pause on Each Section**.



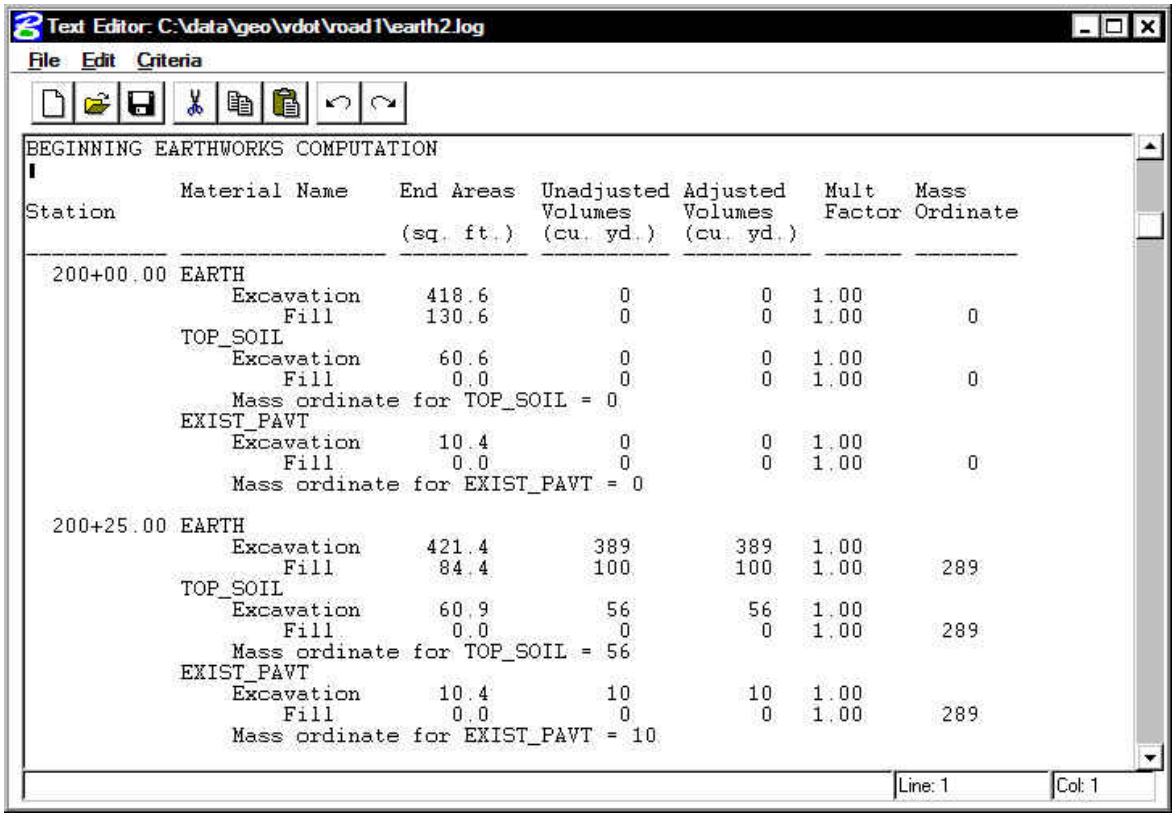
Step 9. Click **Apply**.

Step 10. Review the earthwork quantities. Toggle off **"Pause On Each Section"** then click **"Continue"**.

Step 11. After the process has completed, click **"Exit"**. Files named **"earth2.log"** and **"earth2.txt"** will be created in the working directory.

Step 12. Dismiss the **Earthwork** dialog box by clicking the **X** in the upper right hand corner. When prompted to **Save Earthwork Settings**, click **"Yes"**.

Step 13. Review the Detailed Earthwork Report file by opening **"earth2.log"** with the GEOPAK Text Editor. The file should appear as below.




```
BEGINNING EARTHWORKS COMPUTATION

                Material Name    End Areas  Unadjusted Adjusted   Mult   Mass
Station                                     Volumes    Volumes    Factor Ordinate
                                 (sq. ft.)  (cu. yd.)  (cu. yd.)
--------- ---------------------- ---------- ---------- ---------- ------ --------
  200+00.00 EARTH
                    Excavation      418.6          0          0   1.00
                        Fill        130.6          0          0   1.00        0
              TOP_SOIL
                    Excavation       60.6          0          0   1.00
                        Fill          0.0          0          0   1.00        0
                    Mass ordinate for TOP_SOIL = 0
              EXIST_PAVT
                    Excavation       10.4          0          0   1.00
                        Fill          0.0          0          0   1.00        0
                    Mass ordinate for EXIST_PAVT = 0

  200+25.00 EARTH
                    Excavation      421.4        389        389   1.00
                        Fill         84.4        100        100   1.00      289
              TOP_SOIL
                    Excavation       60.9         56         56   1.00
                        Fill          0.0          0          0   1.00      289
                    Mass ordinate for TOP_SOIL = 56
              EXIST_PAVT
                    Excavation       10.4         10         10   1.00
                        Fill          0.0          0          0   1.00      289
                    Mass ordinate for EXIST_PAVT = 10
```

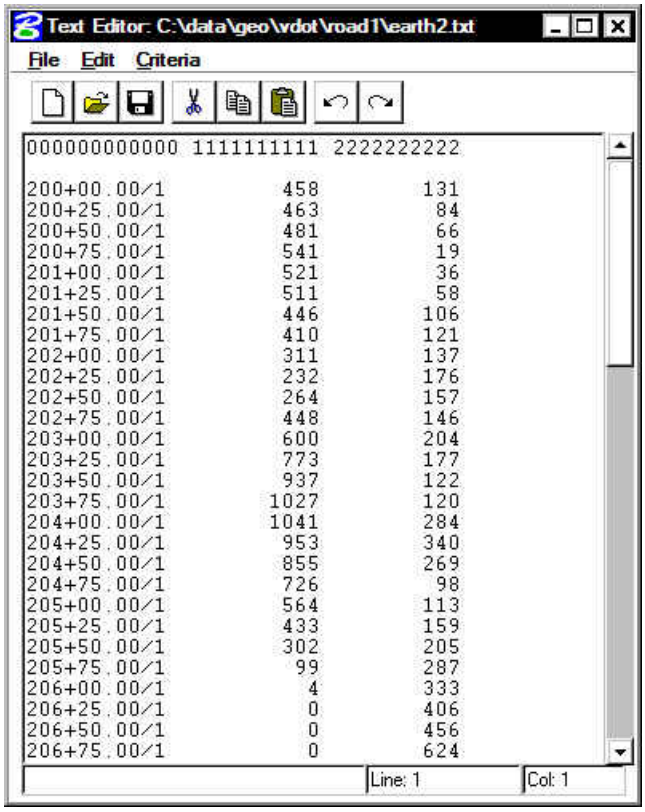
The earthwork report consists of four major parts:

- Individual cross section quantities
- Grand Total Summary
- Balance Point Summary (Included only if there are balance points)
- Centroid Adjustment Summary (Included only if the centroid adjustment option is active.)

Each station is listed in numerical order (including regions), regardless of the order in the cross section design file. Then for each material type, each type of excavation and fill is listed, followed by the end areas in master units (either square feet or meters). Then unadjusted and adjusted volumes follow. The last two columns are the multiplication factor used to generate the adjusted volumes from the unadjusted volumes, and the mass ordinate, which is the cumulative total of the adjusted volumes.

Step 14. Dismiss the **GEOPAK Editor** dialog box by clicking the **X** in the upper right hand corner.

Step 15. Review the Sheet Quantity Earthwork Report file by opening **"earth2.txt"** with the GEOPAK Text Editor. The file should appear as below.



The earthwork component of GEOPAK produces the ASCII text file as a byproduct of the standard earthwork volume calculation run. The first line of the ASCII file is a series of 0's, 1's, 2's, etc. denoting the columns.

GEOPAK automatically provides the column denoted by 0's. This column is where the station is written by GEOPAK.

Column 1, 2, etc. contains the earthwork quantities as per the settings in Step 7. The earthwork quantities will be placed on sheets using settings in the Cross Section Sheet tool.

Step 16. Dismiss the **GEOPAK Editor** dialog box by clicking the **X** in the upper right hand corner.

Step 17. Exit **MicroStation.**

21.4 Cross Section Reports Using Visual Basic Applications

The dialog box to access Visual Basic Applications can be invoked from either the MicroStation pulldown menus by selecting **Utilities > Macro > Macros** or entering **vba run** in the Keyin Browser.

These reports must be run from the proposed cross section file.

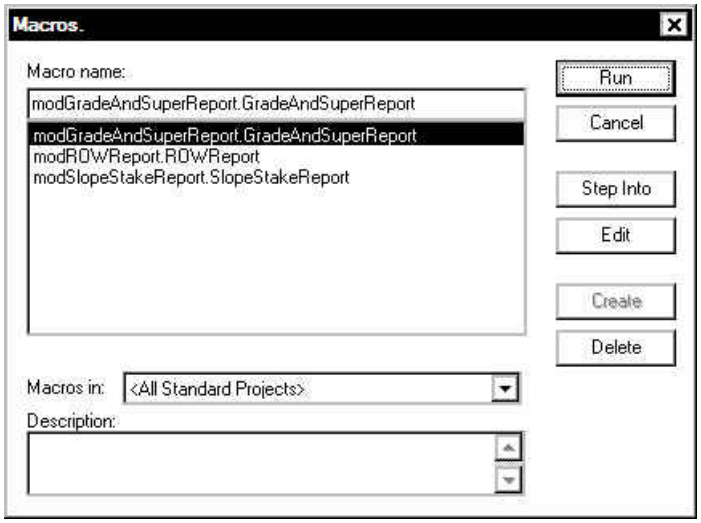
21.4.1 Grade and Superelevation Report

In this section we will generate a **Grade and Superelevation Report** utilizing a custom Visual Basic Application.

Step 1. Open the MicroStation file **c:\data\geo\VDOT\road1\d17682xsmainline.dgn.**

Step 2. Access **Project Manager**. It should automatically access the Road workflow dialog box since we "remembered" the options in Exercise 2.

Step 3. From the MicroStation pulldown menu select **Utilities > Macro > Macros**. The dialog box below should appear.



Step 4. Select **modGradeAndSuperReport** then click **Run**.

Step 5. Populate the **Grade and Super Report** dialog box with the information below:

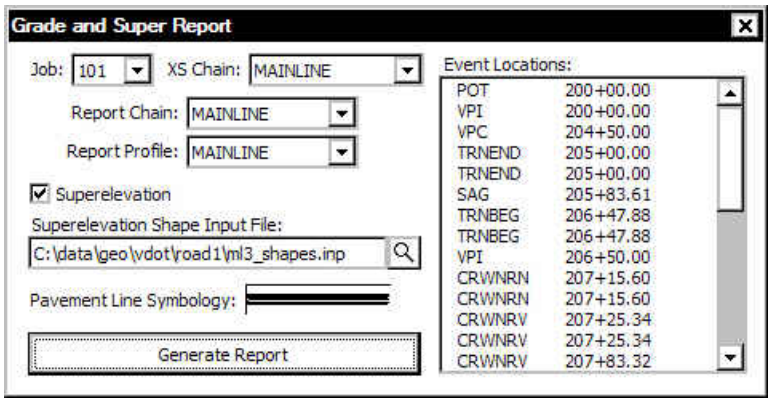
Job: 101

XS Chain: MAINLINE

Report Chain: MAINLINE

Report Profile: MAINLINE

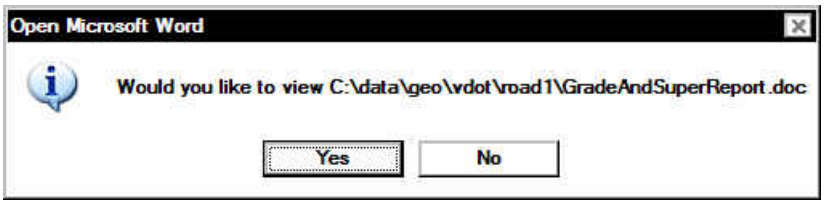
Step 6. Toggle on **Superelevation** then select **C:\data\geo\vdot\road1\ml3_shapes.inp.** The **Grade and Super Report** dialog box should appear as below.



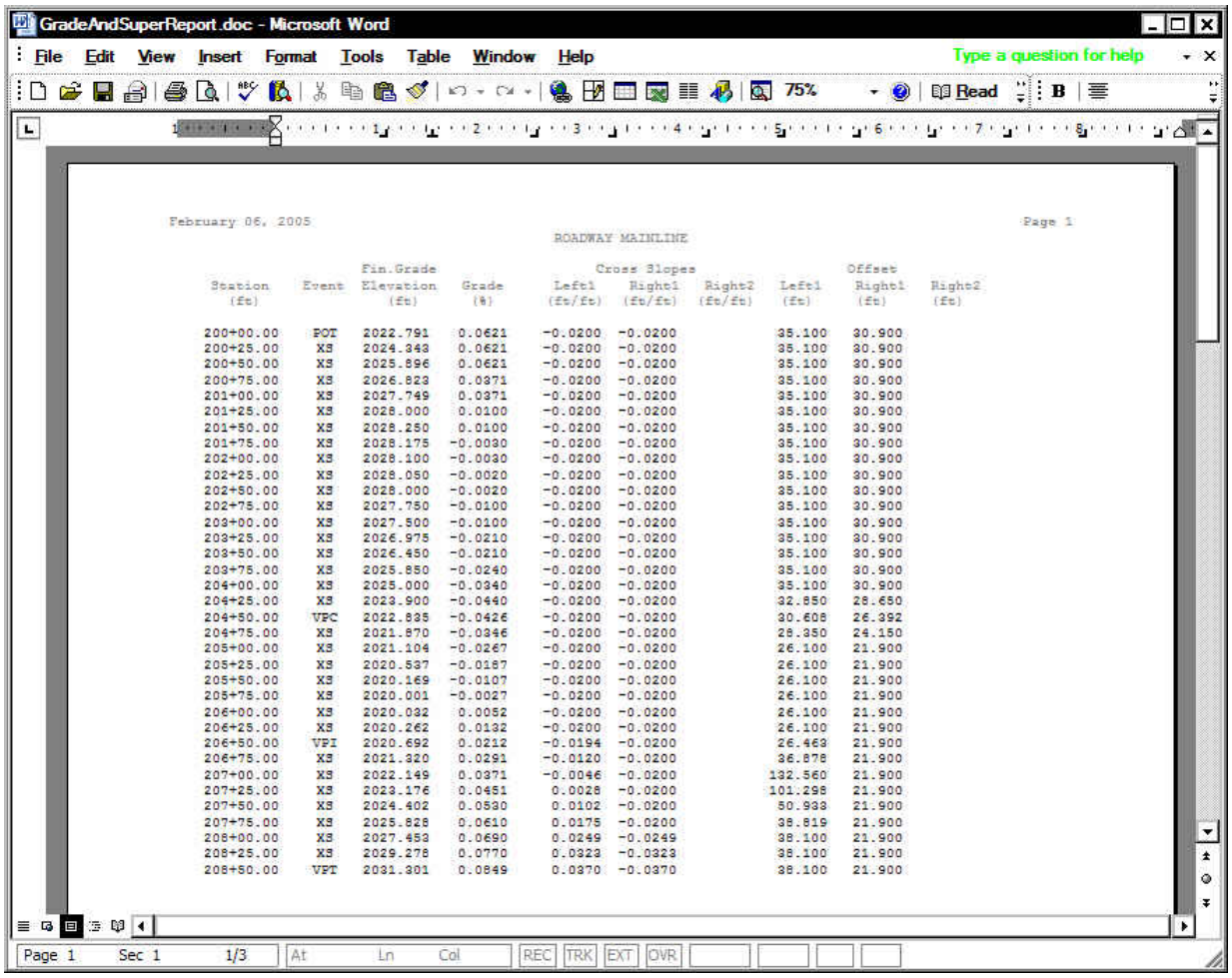
Step 7. Click **Generate Report**.

Step 8. In the **Save Report As** dialog box enter **GradeAndSuperReport.doc** then click **Save**.

Step 9. When the dialog box below appears, click **Yes**.



Step 10. Review the **Grade and Super Report** below then exit **Microsoft Word**.



GradeAndSuperReport.doc - Microsoft Word

File Edit View Insert Format Tools Table Window Help Type a question for help

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ROADWAY MAINLINE

Station (ft)	Event	Fin.Grade Elevation (ft)	Grade (%)	Cross Slopes Left1 (ft/ft)	Right1 (ft/ft)	Right2 (ft/ft)	Offset Left1 (ft)	Right1 (ft)	Right2 (ft)
200+00.00	POT	2022.791	0.0621	-0.0200	-0.0200		35.100	30.900	
200+25.00	XS	2024.343	0.0621	-0.0200	-0.0200		35.100	30.900	
200+50.00	XS	2025.896	0.0621	-0.0200	-0.0200		35.100	30.900	
200+75.00	XS	2026.823	0.0371	-0.0200	-0.0200		35.100	30.900	
201+00.00	XS	2027.749	0.0371	-0.0200	-0.0200		35.100	30.900	
201+25.00	XS	2028.000	0.0100	-0.0200	-0.0200		35.100	30.900	
201+50.00	XS	2028.250	0.0100	-0.0200	-0.0200		35.100	30.900	
201+75.00	XS	2028.175	-0.0030	-0.0200	-0.0200		35.100	30.900	
202+00.00	XS	2028.100	-0.0030	-0.0200	-0.0200		35.100	30.900	
202+25.00	XS	2028.050	-0.0020	-0.0200	-0.0200		35.100	30.900	
202+50.00	XS	2028.000	-0.0020	-0.0200	-0.0200		35.100	30.900	
202+75.00	XS	2027.750	-0.0100	-0.0200	-0.0200		35.100	30.900	
203+00.00	XS	2027.500	-0.0100	-0.0200	-0.0200		35.100	30.900	
203+25.00	XS	2026.975	-0.0210	-0.0200	-0.0200		35.100	30.900	
203+50.00	XS	2026.450	-0.0210	-0.0200	-0.0200		35.100	30.900	
203+75.00	XS	2025.850	-0.0240	-0.0200	-0.0200		35.100	30.900	
204+00.00	XS	2025.000	-0.0340	-0.0200	-0.0200		35.100	30.900	
204+25.00	XS	2023.900	-0.0440	-0.0200	-0.0200		32.850	28.650	
204+50.00	VPC	2022.835	-0.0426	-0.0200	-0.0200		30.608	26.392	
204+75.00	XS	2021.870	-0.0346	-0.0200	-0.0200		28.350	24.150	
205+00.00	XS	2021.104	-0.0267	-0.0200	-0.0200		26.100	21.900	
205+25.00	XS	2020.537	-0.0187	-0.0200	-0.0200		26.100	21.900	
205+50.00	XS	2020.169	-0.0107	-0.0200	-0.0200		26.100	21.900	
205+75.00	XS	2020.001	-0.0027	-0.0200	-0.0200		26.100	21.900	
206+00.00	XS	2020.032	0.0052	-0.0200	-0.0200		26.100	21.900	
206+25.00	XS	2020.262	0.0132	-0.0200	-0.0200		26.100	21.900	
206+50.00	VPI	2020.692	0.0212	-0.0194	-0.0200		26.469	21.900	
206+75.00	XS	2021.320	0.0291	-0.0120	-0.0200		26.878	21.900	
207+00.00	XS	2022.149	0.0371	-0.0046	-0.0200		132.560	21.900	
207+25.00	XS	2023.176	0.0451	0.0028	-0.0200		101.298	21.900	
207+50.00	XS	2024.402	0.0530	0.0102	-0.0200		50.933	21.900	
207+75.00	XS	2025.828	0.0610	0.0175	-0.0200		38.819	21.900	
208+00.00	XS	2027.453	0.0690	0.0249	-0.0249		38.100	21.900	
208+25.00	XS	2029.278	0.0770	0.0323	-0.0323		38.100	21.900	
208+50.00	VPT	2031.301	0.0849	0.0370	-0.0370		38.100	21.900	

Page 1 Sec 1 1/3 At Ln Col REC TRK EXT OVR

Station – Cross Section Station.

Event – Cross Section or Critical point.

Fin. **Grade Elevation** – Profile Grade Elevation.

Grade - % of grade at each station.

Cross Slopes – Slope of Pavement at each station.

Offset – Offsets to each edge of pavement at teach station.

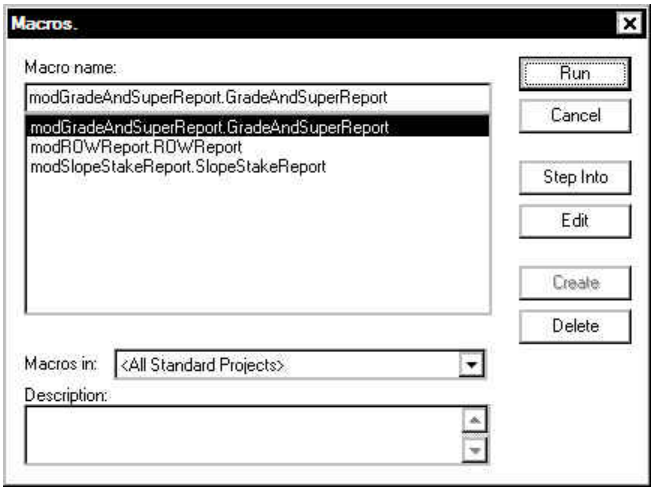
Step 11. Dismiss the **Grade and Super Report** dialog box by clicking the **X** in the upper right hand corner.

21.4.2 ROW Report

In this section we will generate a **Right Of Way Report** utilizing a custom Visual Basic Application.

Step 1. Open the MicroStation file **c:\data\geo\VDOT\road1\d17682des.dgn.**

Step 2. From the MicroStation pulldown menu select **Utilities > Macro > Macros**. The dialog box below should appear.



Step 3. Select **modROWReport** then click **Run**.

Step 4. Populate the **Right of Way Report** dialog box with the information below:

Job: 101

Chain: MAINLINE

Beginning Station: 200+00.00

Ending Station: 222+06.84

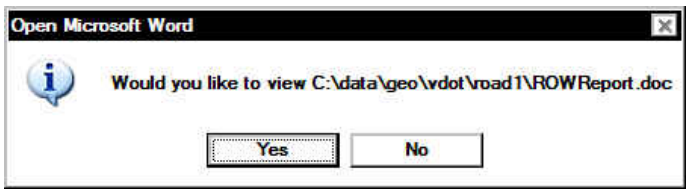
Station Increment: 25

Beginning Point Number: D6000

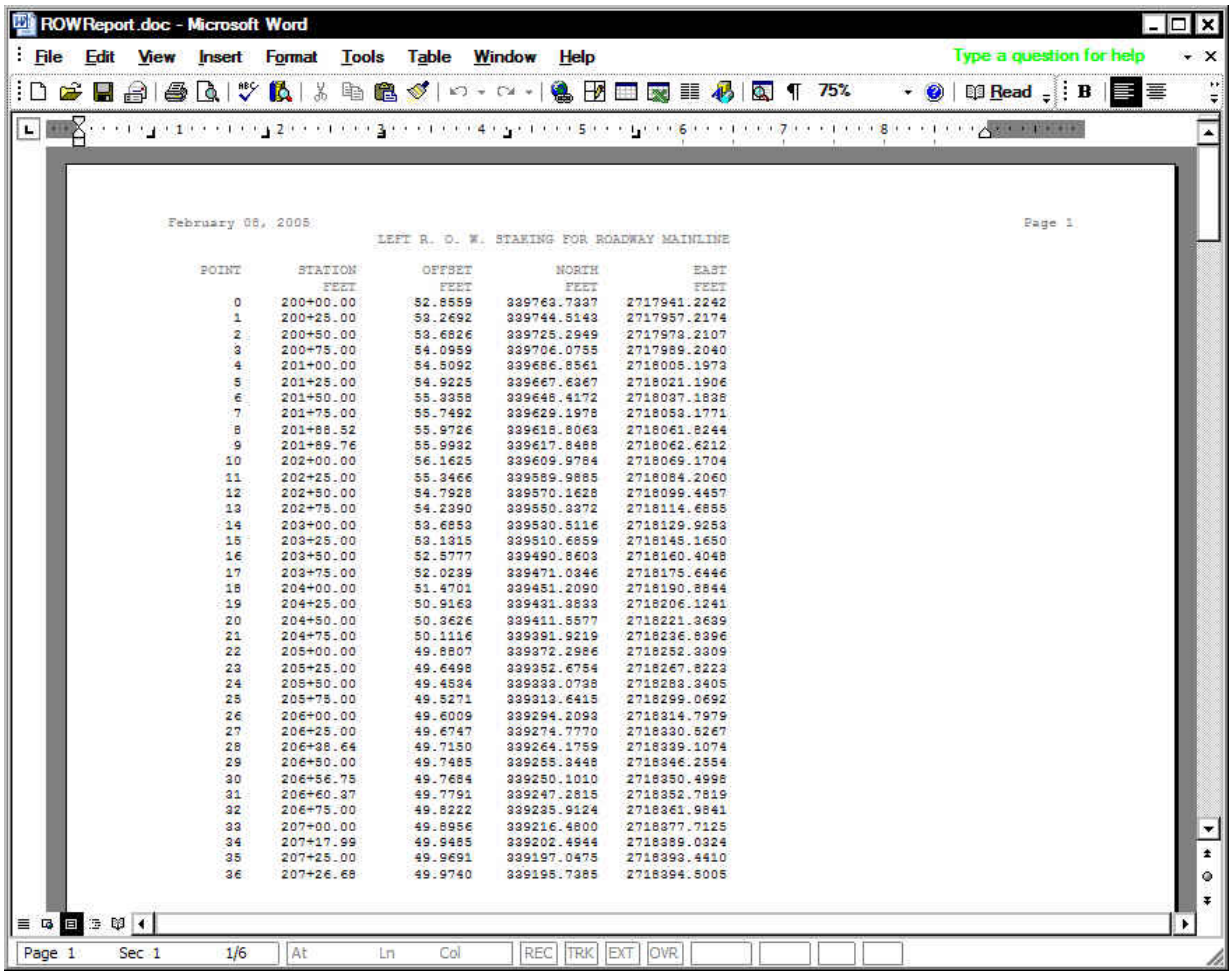
Step 5. Click **Generate Report**.

Step 6. In the **Save Report As** dialog box enter **ROWReport.doc** then click **Save**.

Step 7. When the dialog box below appears, click **Yes**.



Step 8. Review the **Right of Way Report** below then exit **Microsoft Word**.



ROWReport.doc - Microsoft Word

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LEFT R. O. W. STAKING FOR ROADWAY MAINLINE

POINT	STATION FEET	OFFSET FEET	NORTH FEET	EAST FEET
0	200+00.00	52.8559	339763.7837	2717941.2242
1	200+25.00	53.2692	339744.5143	2717957.2174
2	200+50.00	53.6826	339725.2949	2717973.2107
3	200+75.00	54.0959	339706.0755	2717989.2040
4	201+00.00	54.5092	339686.8561	2718005.1973
5	201+25.00	54.9225	339667.6367	2718021.1906
6	201+50.00	55.3358	339648.4172	2718037.1838
7	201+75.00	55.7492	339629.1978	2718053.1771
8	201+88.52	55.9726	339618.8063	2718061.8244
9	201+89.76	55.9932	339617.8488	2718062.6212
10	202+00.00	56.1625	339609.9784	2718069.1704
11	202+25.00	55.3466	339589.9885	2718084.2060
12	202+50.00	54.7928	339570.1628	2718099.4457
13	202+75.00	54.2390	339550.3372	2718114.6855
14	203+00.00	53.6853	339530.5116	2718129.9253
15	203+25.00	53.1315	339510.6859	2718145.1650
16	203+50.00	52.5777	339490.8603	2718160.4048
17	203+75.00	52.0239	339471.0346	2718175.6446
18	204+00.00	51.4701	339451.2090	2718190.8844
19	204+25.00	50.9163	339431.3833	2718206.1241
20	204+50.00	50.3626	339411.5577	2718221.3639
21	204+75.00	50.1116	339391.9219	2718236.8396
22	205+00.00	49.8807	339372.2986	2718252.3309
23	205+25.00	49.6498	339352.6754	2718267.8223
24	205+50.00	49.4534	339333.0738	2718283.3405
25	205+75.00	49.5271	339313.6415	2718299.0692
26	206+00.00	49.6009	339294.2093	2718314.7979
27	206+25.00	49.6747	339274.7770	2718330.5267
28	206+38.64	49.7150	339264.1759	2718339.1074
29	206+50.00	49.7485	339255.3448	2718346.2554
30	206+56.75	49.7684	339250.1010	2718350.4998
31	206+60.37	49.7791	339247.2815	2718352.7819
32	206+75.00	49.8222	339235.9124	2718361.9841
33	207+00.00	49.8956	339216.4800	2718377.7125
34	207+17.99	49.9485	339202.4944	2718389.0324
35	207+25.00	49.9691	339197.0475	2718393.4410
36	207+26.68	49.9740	339195.7385	2718394.5005

Point – COGO points stored in Coordinate Geometry

Station – Cross Section station at Incrementation or Critical Points.

Offset – Offset from Centerline to Right Of Way line.

North – Northing Coordinates of the stored point.

East – Easting Coordinates of the stored point.

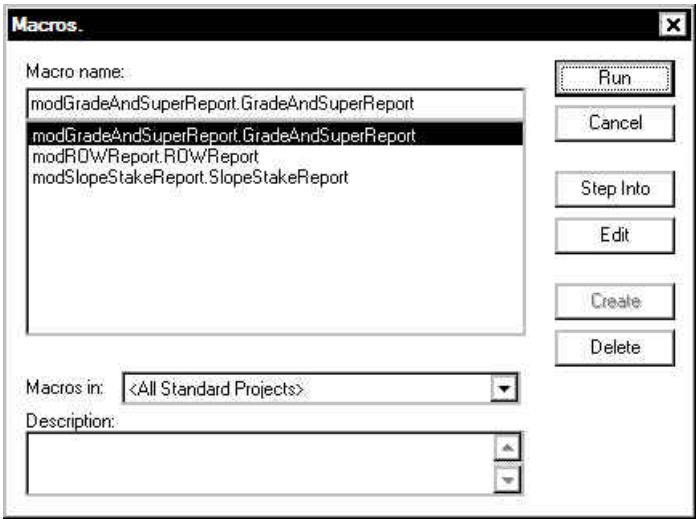
Step 9. Dismiss the **ROW Report** dialog box by clicking the **X** in the upper right hand corner.

21.4.3 Slope Stake Report

In this section we will generate a **Slope Stake Report** utilizing a custom Visual Basic Application.

Step 1. Open the MicroStation file **c:\data\geo\VDOT\road1\d17682xsmainline.dgn.**

Step 2. From the MicroStation pulldown menu select **Utilities > Macro > Macros**. The dialog box below should appear.



Step 3. Select **modSlopeStakeReport** then click **Run**.

Step 4. Populate the **Slope Stake Report** dialog box with the information below:

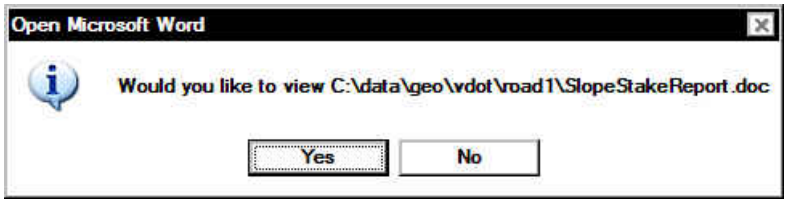
Job: 101

Chain: MAINLINE

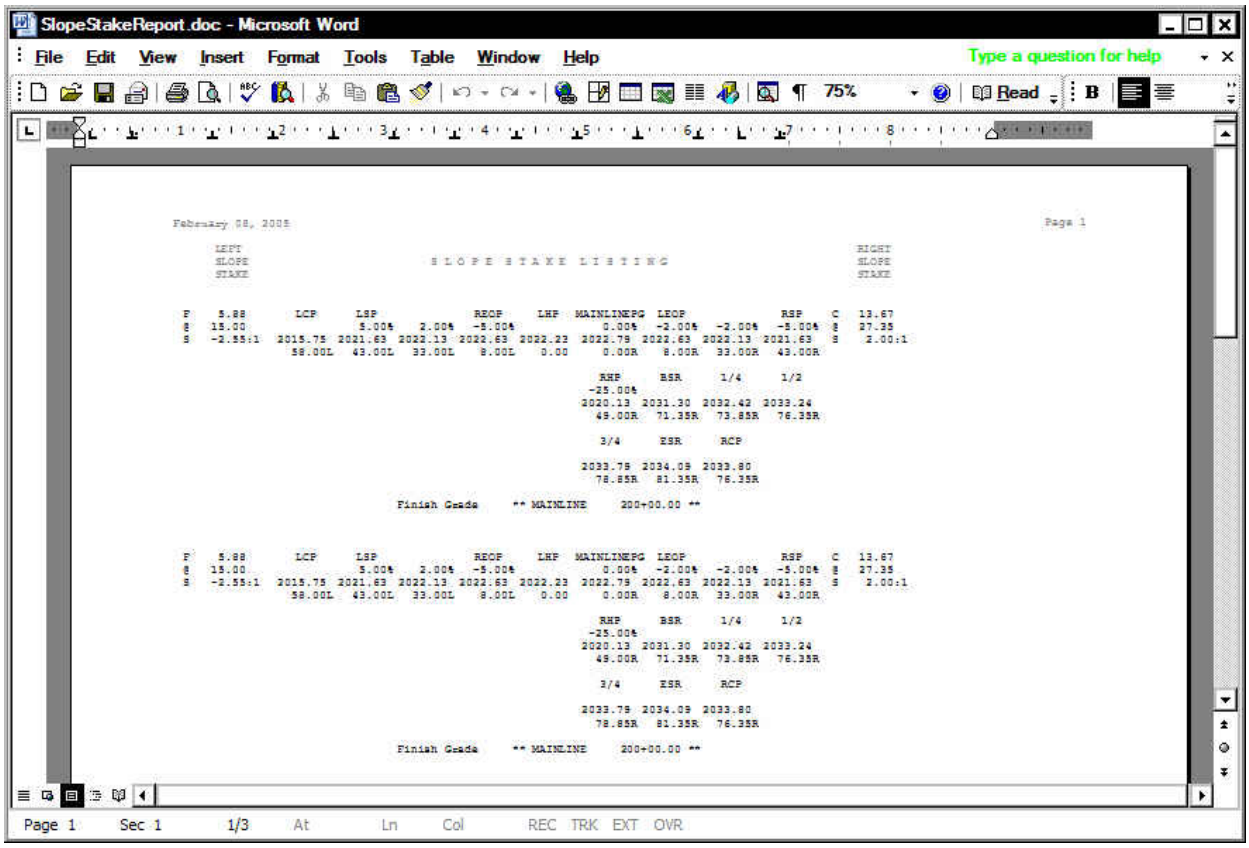
Step 5. Click **Generate Report**.

Step 6. In the **Save Report As** dialog box enter **SlopeStakeReport.doc** then click **Save**.

Step 7. When the dialog box below appears, click **Yes**.



Step 8. Review the **Slope Stake Report** below then exit **Microsoft Word**.



LCP – Left side catch point.

LSP – Left side shoulder point.

REOP – Right edge of pavement for the left roadway.

LHP – Left hinge point.

MAINLINEPG – Profile Grade Line.

LEOP – Left edge of pavement for the right roadway.

RSP – Right side shoulder point.

RHP – Right hinge point.

BSR – Begin slope rounding.

1/4 – Quarter of slope rounding.

1/2 – Half of slope rounding.

3/4 – Three quarters of slope rounding.

RCP – Right side catch point.

Step 9. Dismiss the **Slope Stake Report** dialog box by clicking the **X** in the upper right hand corner.

Step 10. Exit **MicroStation.**