Coordinate Geometry

2.1 Introduction

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

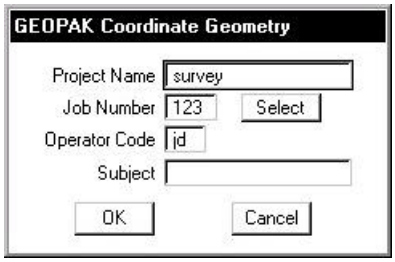
Tool

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.

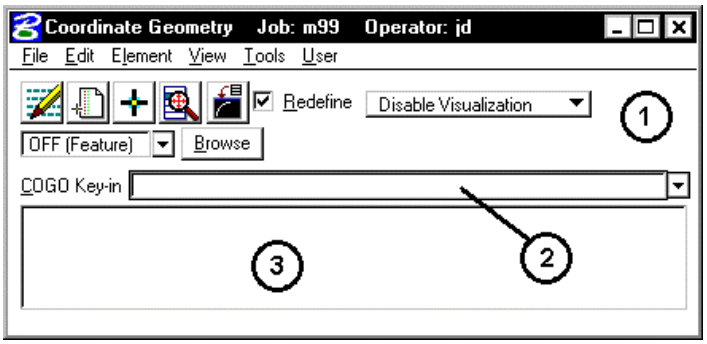
Operator Code Unique 2-character code which enables multiple users access to database. The user's initials are suggested. Note this field is not required for single user access, but highly recommended. If Project Manager is active, this field is populated automatically.

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

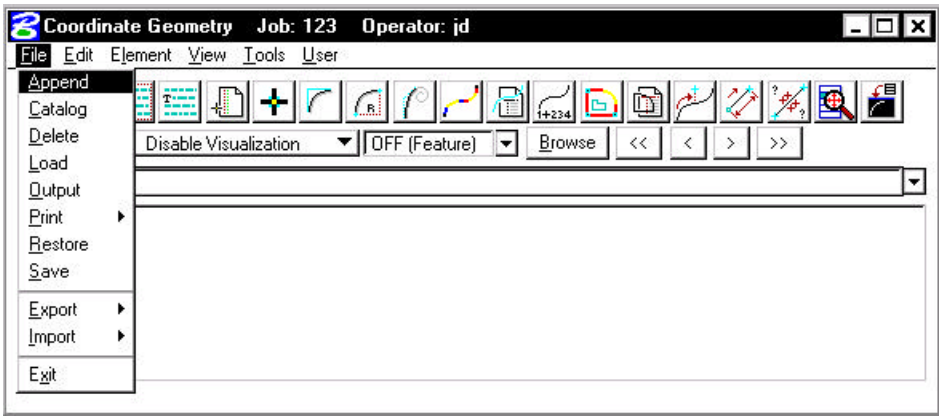


The coordinate geometry dialog box is made up of three separate display areas:

- **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 Commands



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

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.

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.

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 Sends your output/input file to the printer.

Restore Loads an ASCII file of GEOPAK commands into the display window. Note no processing occurs. The file must be named j999ooc.inp, where 999 is the current job number and oc is the operator code.

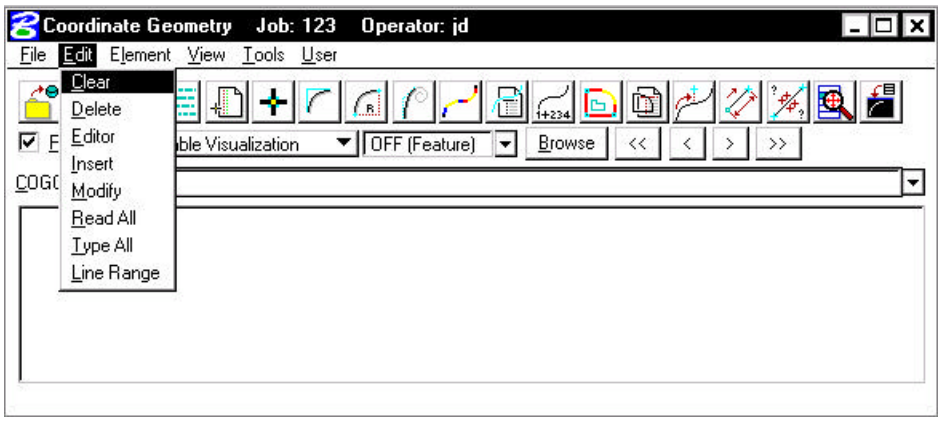
Save Saves the current audit trail to a file. (Fname999.ioc, where 999 is the current job number and oc is the operator code.).

Export Exports GEOPAK points, chains and profiles into formats for use in various data collectors.

Import Imports horizontal and vertical alignments and points from RDS and SDMS format 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.

Editor Opens the GEOPAK COGO Command Editor, which enables the user to edit the current input file.

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.

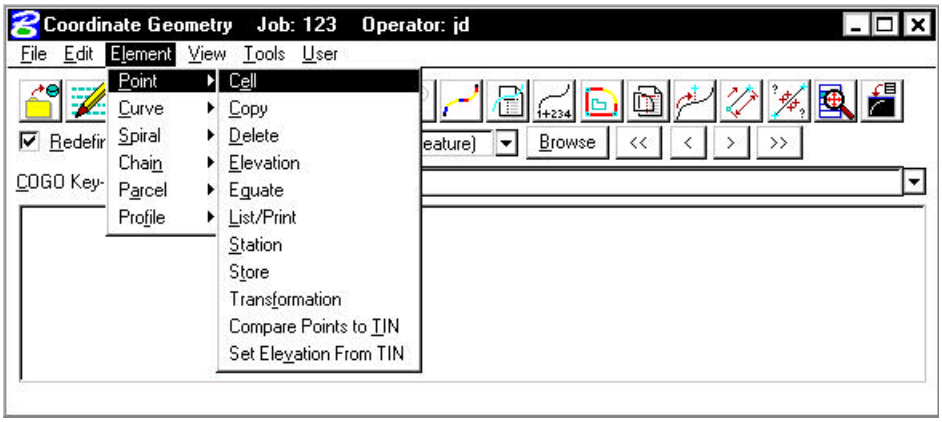
Read Processes the specified lines in the audit trail. This may be done for the entire file (All) or by specifying a range of line numbers (Line Range).

Type Displays the content of the audit trail, (All) or a portion of the audit trail by specifying a range of line numbers (Line Range).

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.

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

Delete Deletes a point number (or range of numbers) from the database.

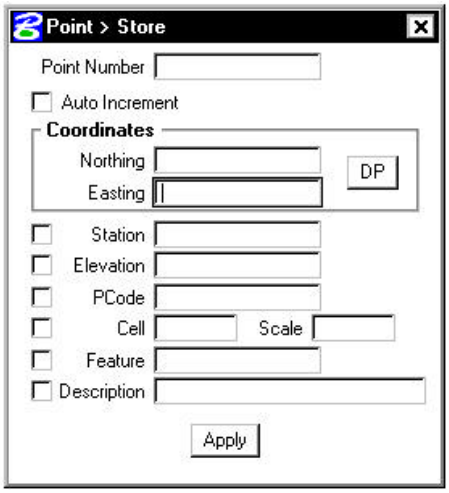
Elevation Assigns an elevation to a previously stored point

Equate Stores a new point with the same values as a previously stored point

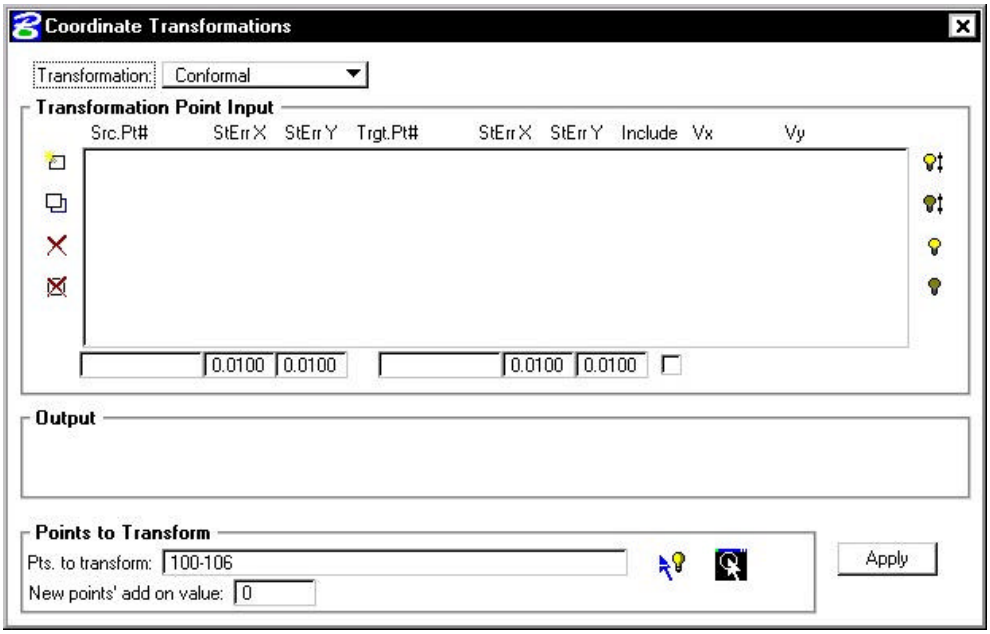
List/Print input a range of point numbers. **List** displays the point numbers (but no associated data) currently stored in the .gpk file within the specified range. **Print** displays point number, x, y, z coordinates, station value and other stored information in the display output window for the requested points.

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.

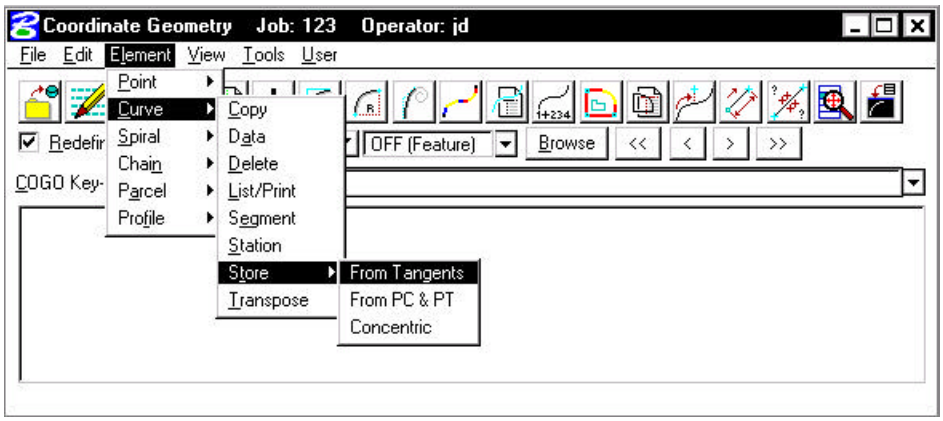


Transformation Used to transform a set of points to a new coordinate system.



Transformation	Performs coordinate transformations based on user-defined control pairings
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.

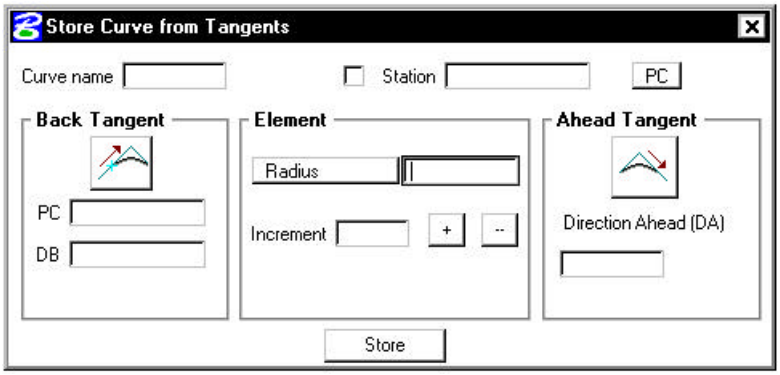
2.3.3.2 Element > Curve



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

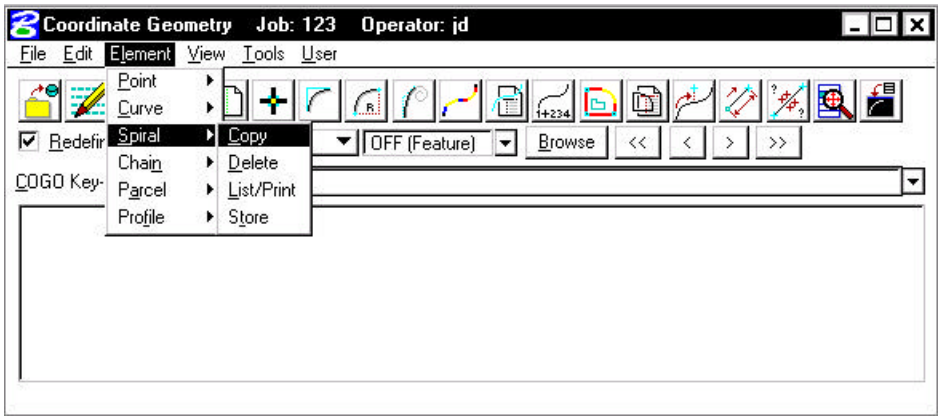
Copy	Copies a specified curve to another curve name.
Data	Calculates the geometric parameters of a curve, displaying values for Delta, Degree, Tangent, Length and Radius.
Delete	Deletes selected curve from the database.
List/Print	Displays all curve data for the selected curve. List displays only the curve names currently stored in the .gpk file. Print displays the curve data of the selected curve.
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.



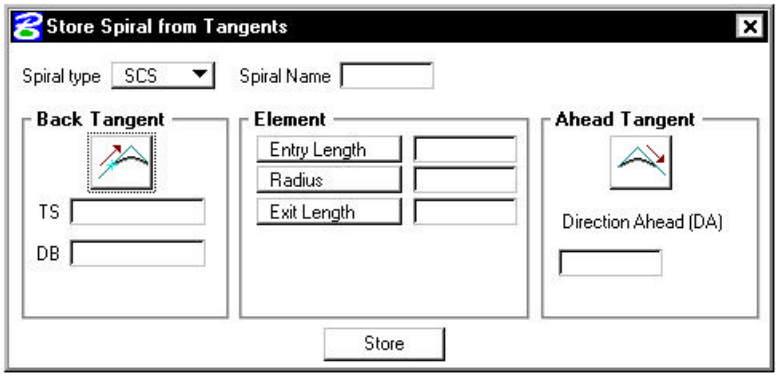
Transpose Reverses the curve direction each time the **Apply** button is pressed..

2.3.3.3 Element > Spiral

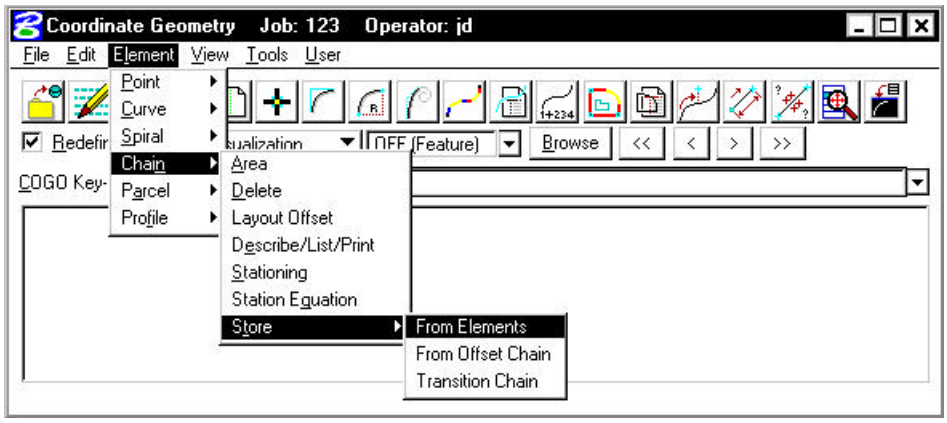


The Spiral commands (as displayed in the exploded view above) are detailed in the table below.

Copy	Copies a specified spiral to another spiral name.
Delete	Deletes the selected spiral from the database.
List/Print	Displays all spiral data for the selected curve. List displays only the spiral names currently stored in the .gpk file. Print displays the spiral data of the selected spiral.
Store	Provides various options for defining and storing spirals.



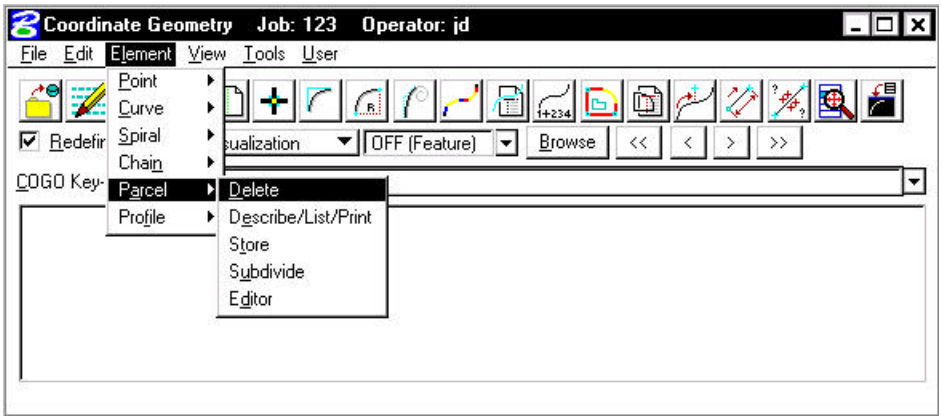
2.3.3.4 Element > Chain



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

Area	Calculates the area of a closed chain
Delete	Deletes selected chains from **.gpk** database
Describe/List/Print	Displays chain information. **Print** displays the name of each chain element. **Describe** displays the alignment data of each element in the selected chain.
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)

2.3.3.5 Element > Parcel



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

Delete	Deletes selected parcels from the database
Describe/List/Print	Displays parcel information. Describe displays the elements of composition, the area of tract stored, taken and remaining and a point, bearing, distance description of the specified tract. Print displays the elements of composition, the area of tract stored, taken and remaining.
Store	Stores a parcel by adding points, curves and spirals.
Subdivide	Divides a parcel into individual lots.
Editor	Edits a parcel.

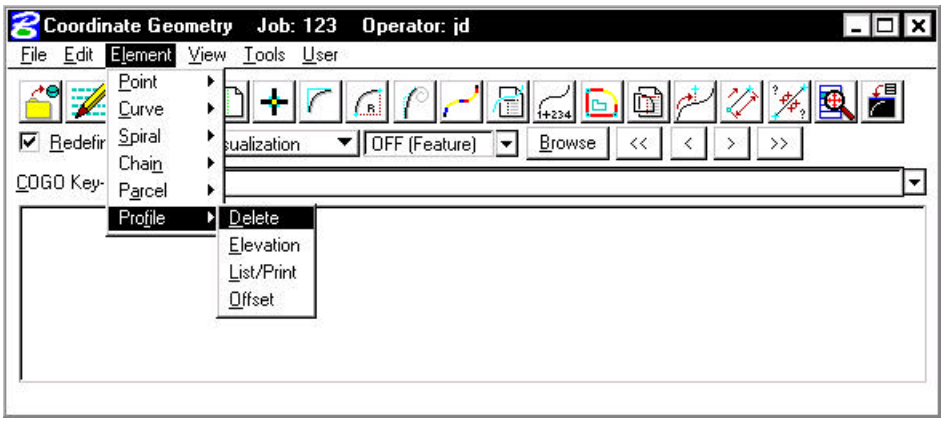
2.3.3.6 Parcel Commands (Manual Entry)

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.

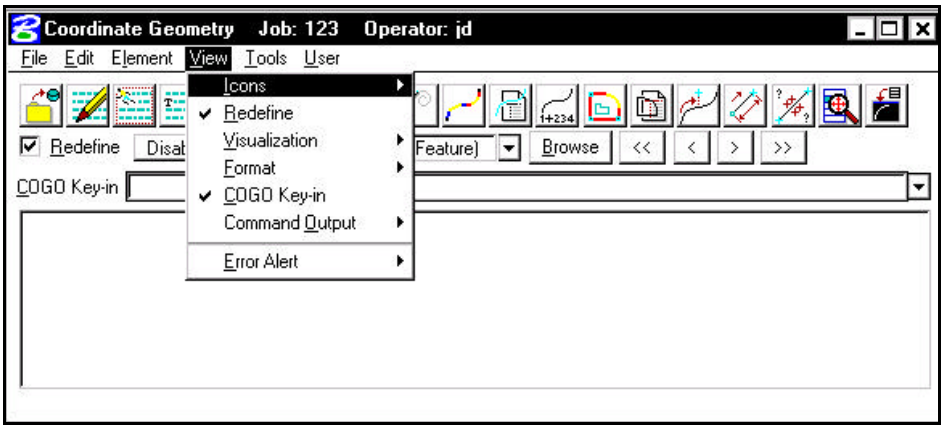
2.3.3.7 Element > Profile



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.

Delete	Deletes selected profiles from the database.
Elevation	Provides three options for reporting elevations along a selected profile, **Station**, **Even Station, Incremental Stations.**
List/Print	Displays profile information. **Print** displays the data of the selected profile from the database
Offset	Facilitates the copying of a profile in the vertical direction

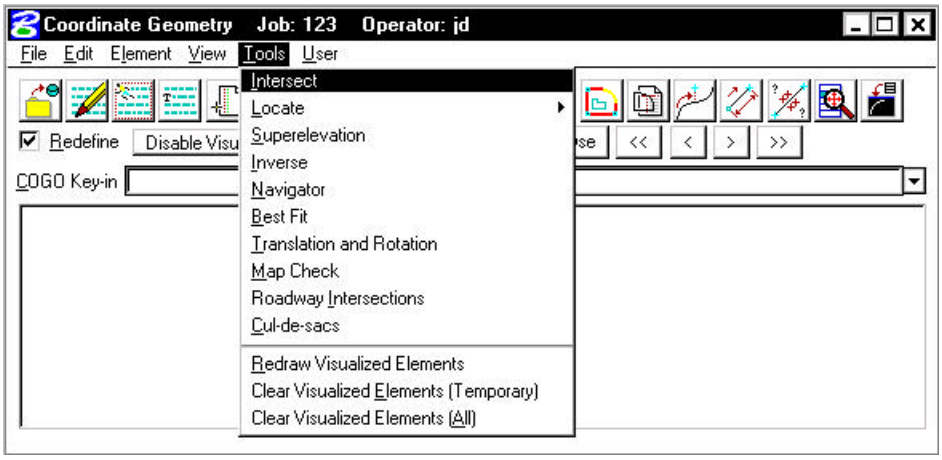
2.3.4 View Commands



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.

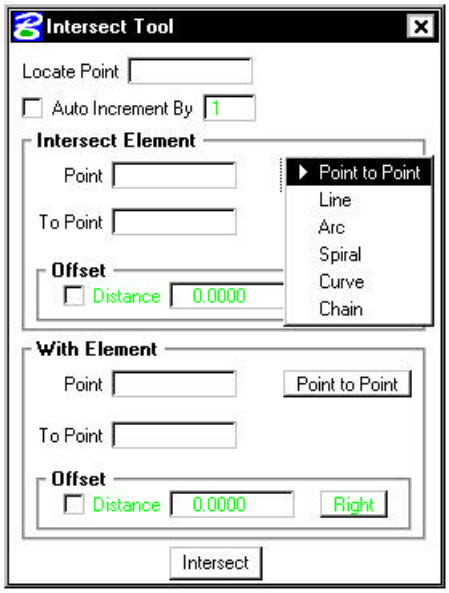
2.3.5 Tools Commands



The Tools commands are detailed in the table below.

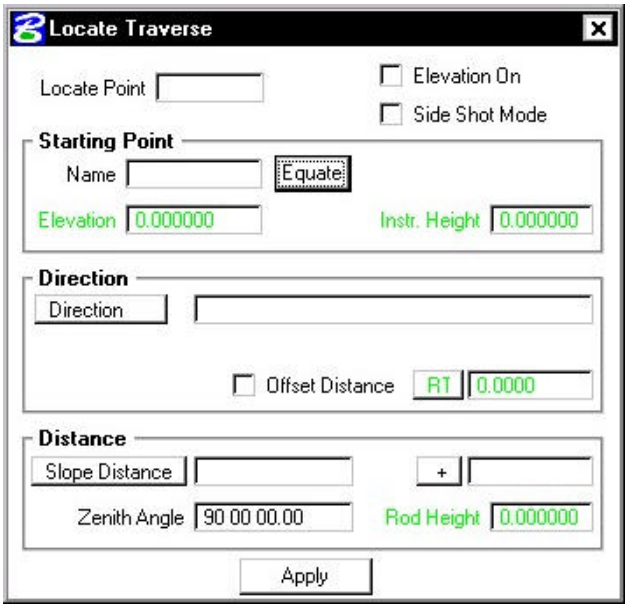
Intersect

Stores a point at the intersection of the defined elements



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.



Superelevation Calculates the superelevation transitions for a given chain and design speed.

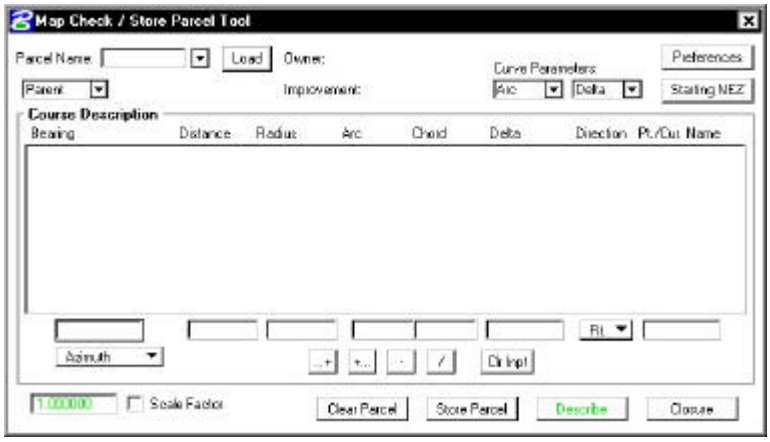
Inverse Calculates the distance and direction between points.

Navigator Invokes the COGO Navigator.

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.

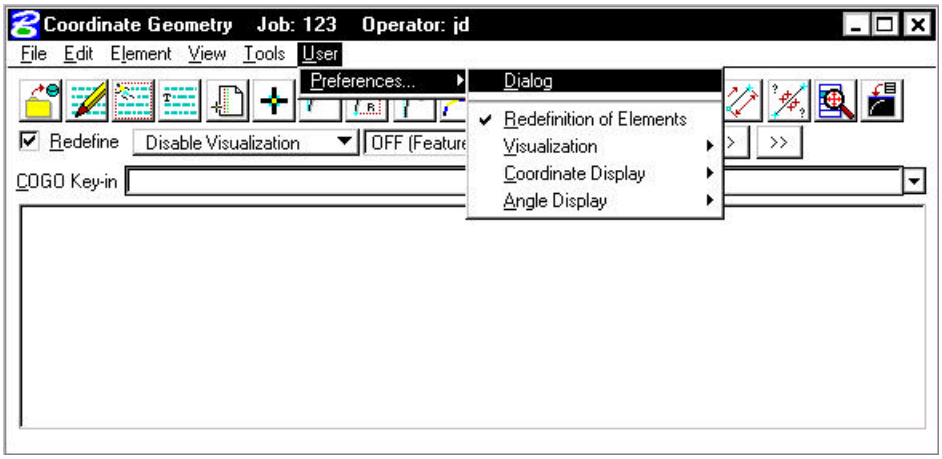
Redraw Visualized Elements Re-syncs the displayed COGO elements in the MicroStation file with the coordinate geometry data.

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

(Temporary)

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

2.3.6 User Preferences



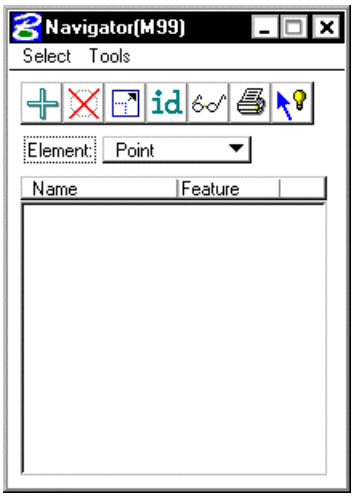
The User Preferences (as displayed in the exploded view above) are detailed in the table below.

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.

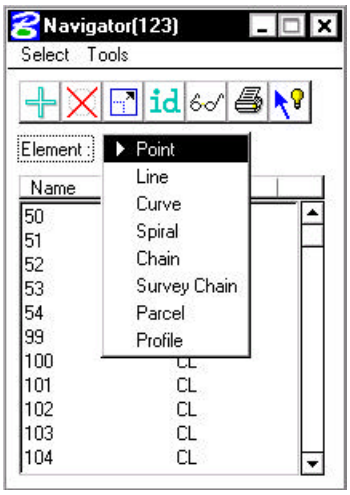
2.4 COGO Navigator

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.

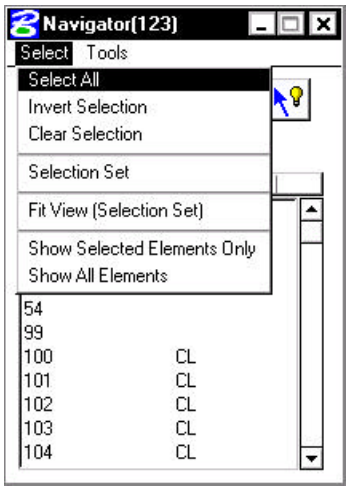


From the **Navigator**, points, curves, spirals, chains, survey chains, parcels, and profiles can be added, deleted, modified, identified, visualized, printed, or selected.



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.

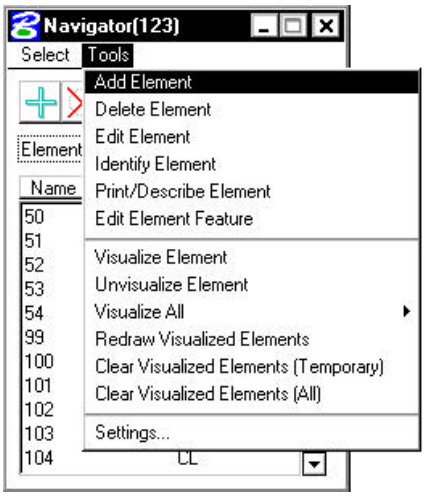


The tools are detailed in the table below.

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)

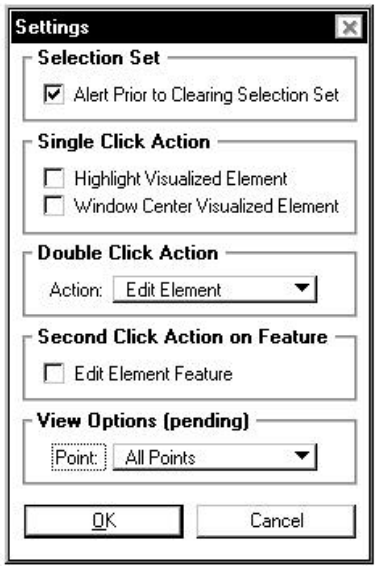
Clears only temporary visualized elements from the view.

Clear Visualized

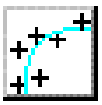
Clears all visualized elements from the MicroStation file.

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

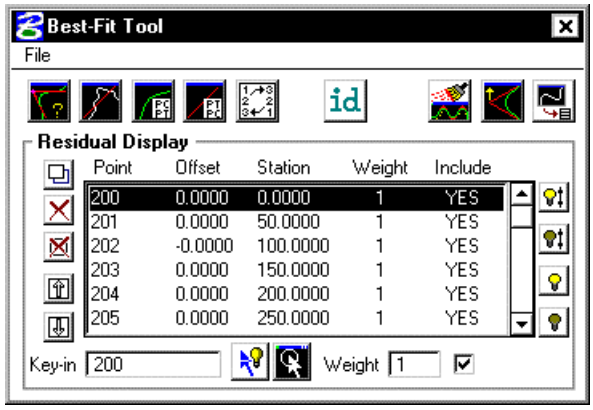
Based on a series of points the GEOPAK Best Fit Tool can determine the best fitting line, curve, or alignment using a combination of least squares methods and other residual based computations.

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)

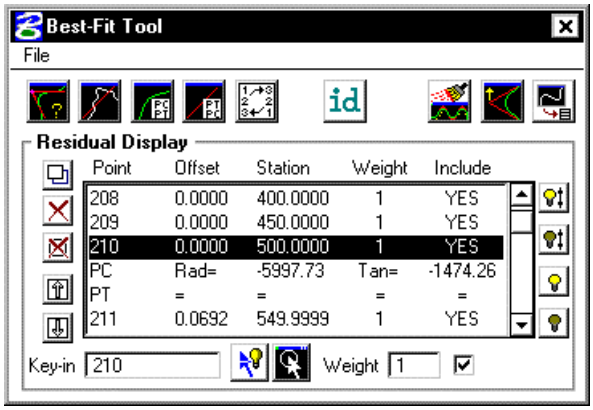
Commences the Best Fit processing. Use this icon if you want to let Best Fit automatically determine where the PCs and PTs are to be placed. It uses the “Max Radius” value to determine this “best guess” placement of geometry. It will not place any PIs (point of intersections) for alignments. You will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

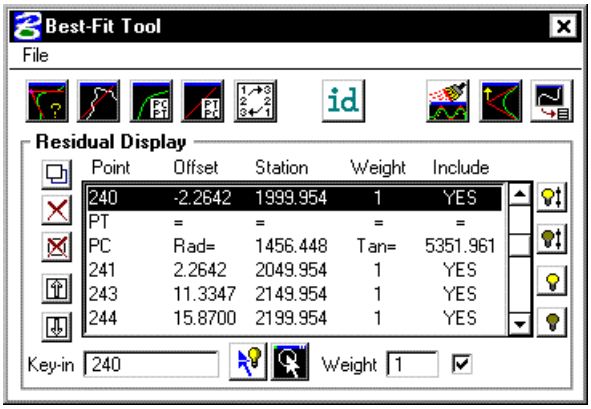
Insert Curve

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".

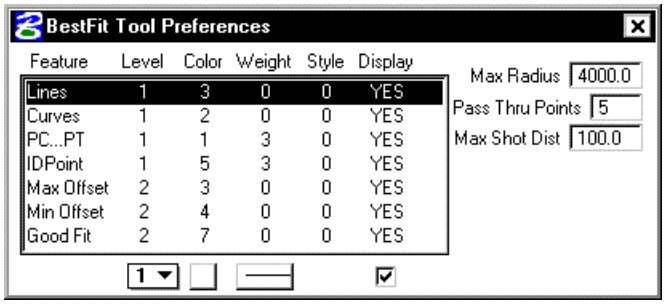
Invert List

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).

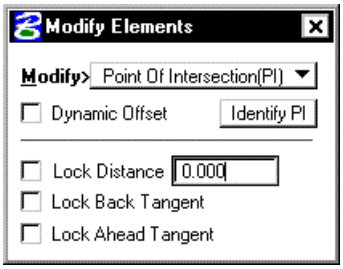
If the number of points on a curve (between the PC and PT) exceed the number of "Pass Thru Points" the result is a least squares calculation of the radius ... if under this threshold, the result is and average of the radii derived from having two tangents and passing a separate curve through each point.

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).

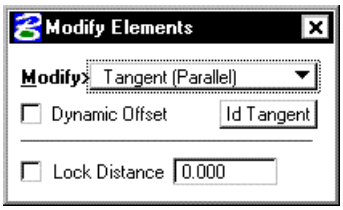


The Dynamic Offset toggle allows the user to see the visualized offsets

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

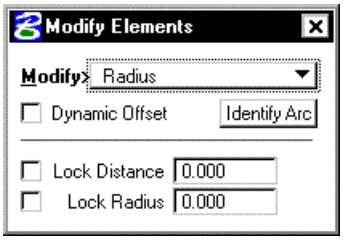
In this dialog, **Points of Intersection** can be modified. Press the **Identify PI** button, then select a PI or end of a line on the screen. The cursor is now attached to the selected element. Activate the desired locks and modify as desired.

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



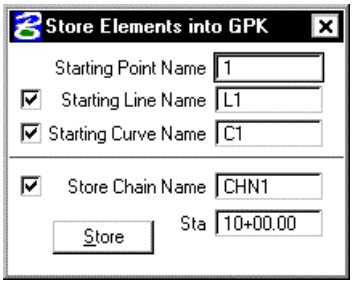
Press the **Identify Tangent** button, then select a tangent within the Best Fit elements on the screen. The cursor is now attached to the selected element. Activate the desired locks and modify as desired.

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.