

Chapter 5

Coordinate Geometry

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5.1 Objectives

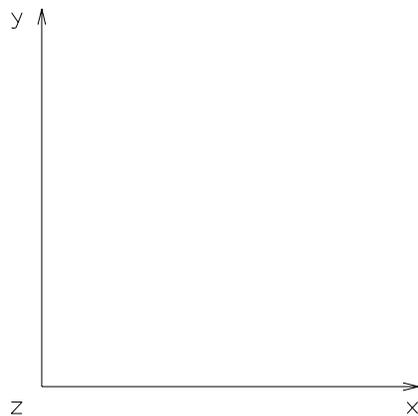
- Learn to set up and access the coordinate geometry database.
- Become proficient in using Geopak Coordinate Geometry.

5.2 Definitions

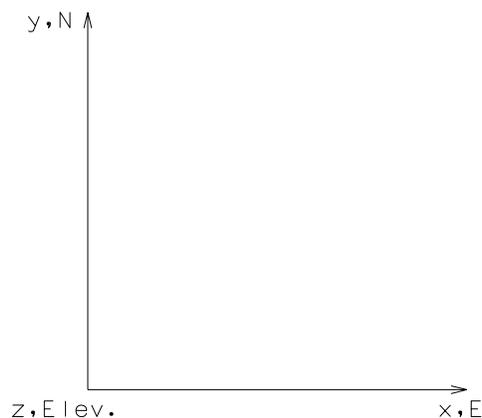
Coordinate Geometry (COGO) is a method of using XYZ coordinates to store geometric elements such as points, lines, curves, spirals, chains, parcels, and profiles. The **Coordinate Geometry** dialog box is an interactive graphical user interface for storing coordinate geometry elements.

5.2.1 Coordinate System

The coordinate system is defined with **XYZ** coordinates. The **X** and **Y** coordinates define a horizontal plane, while the **Z** coordinate defines the vertical dimension. All points in a cogo element are defined by at least an **X** coordinate and a **Y** coordinate. If an elevation is to be stored, the **Z** coordinate will also be defined.



The **XYZ** coordinates can also be referred to in **Northing (N)**, **Easting (E)**, and **Elevation (Z)** coordinates. The **Northing** coordinate refers to the **Y** value, the **Easting** coordinate refers to the **X** value, and the **Elevation** refers to the **Z** value.



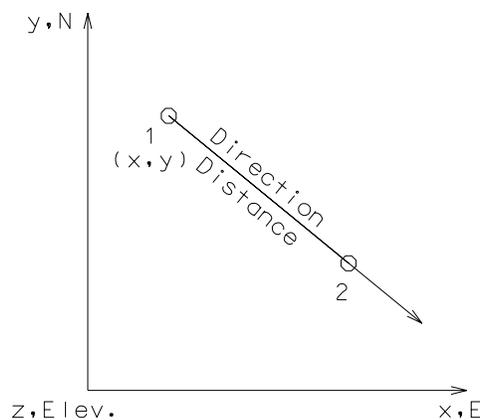
The user must be aware of the coordinate system the data is in, and the coordinate system that GEOPAK is using. When referring to the **XYZ** coordinate system, the coordinates are listed as **(X, Y, Z)**. When referring to the **Northing, Easting, Elevation** coordinate system, the coordinates are listed as **(N, E, Elev.)**. When translating this to the **XYZ** coordinate system, the coordinates would be **(Y, X, Z)**.

5.2.2 Points

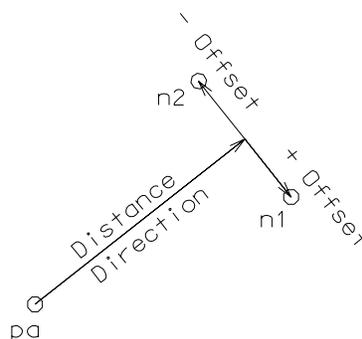
Points are defined by a single set of coordinates. Each **point** will have an X and a Y coordinate. The point may also have a Z coordinate if an elevation is defined.

Point names are alpha-numeric. If alphabetic characters are used, they must come before any numeric characters. The **point** name must contain at least 1 numeric character at the end of the name. Names can be up to 9 characters in length, although limiting the name to 8 characters is recommended.

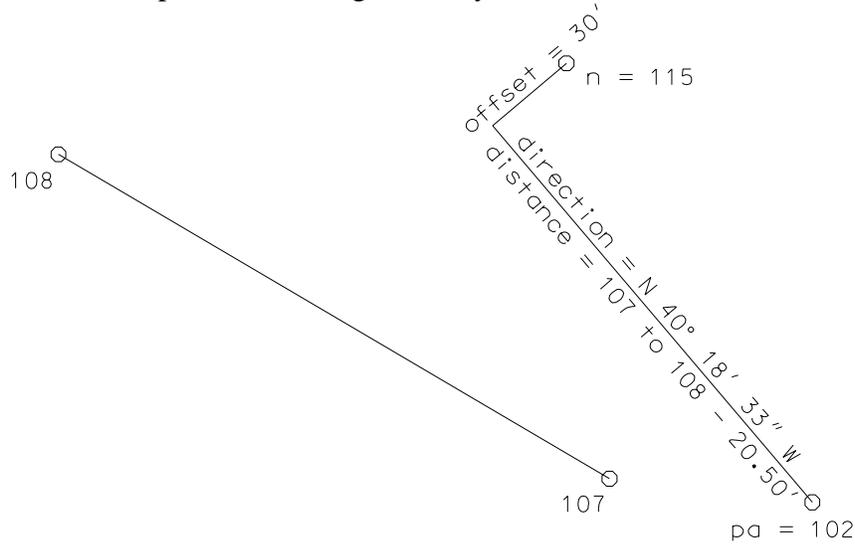
Points can be stored from a set of coordinates, or located from other elements. To define a point from another point, a distance and direction need to be defined.



Modifiers can be added to the direction and distance. An offset can be applied. This will locate the point at the specified distance and direction from the starting point, then perpendicular to the specified direction for the specified offset distance. A positive offset will go to the right of the specified direction, and a negative offset will go to the left of the specified direction.



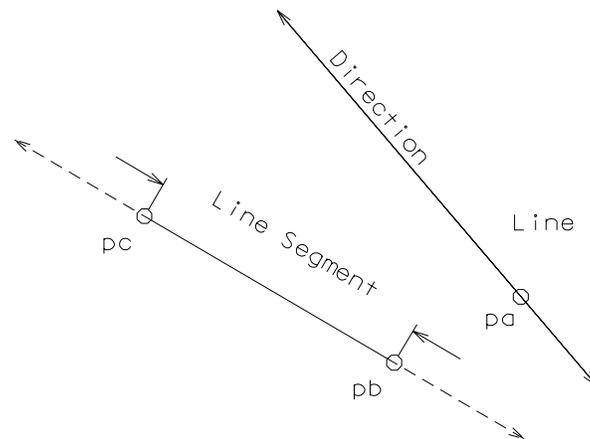
Distances and directions can also be found mathematically. Values can be added, subtracted, multiplied, divided, or computed with a trigonometry function



loc 115 trav 102 dis 107 to 108 m 20.50 n 40 18 33 w off 30

5.2.3 Lines and Line Segments

Lines are defined by a location point and a direction, and are infinite in length. **Line Segments** are a portion of a line that is defined by a beginning and an ending point. **Line Segment** names can be alpha-numeric up to nine characters, but cannot be numeric-alpha.



5.2.4 Curves

Curves are a segment of a circular arc. **Curves** can be defined by either the **arc method** (central angle that produces a 100' arc) or **chord definition** (central angle that produces a 100' chord). MoDOT uses the arc definition for all new alignments, however the chord definition has been used in the past, and may still be shown on old plans.

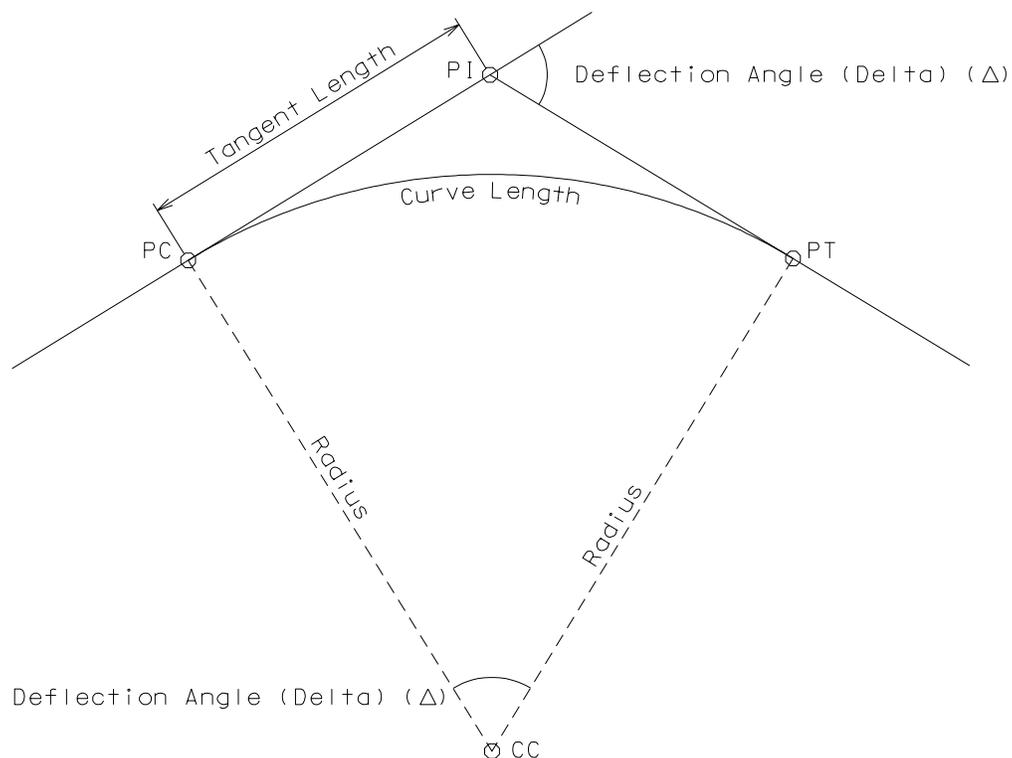
A **curve** has several points associated with it. These points help to define the **curve**, and are stored automatically when the **curve** is stored.

PC – Point of Curvature; Beginning of the curve.

PT – Point of Tangency; End of the curve.

PI – Point of Intersection; Point where the two tangents meet.

CC – Circle Center; Point at the center of the circle from which the curve is segmented.



Curve names can be any alpha-numeric characters up to nine characters in length.

5.2.5 Spirals

Spirals are a transitional curve. Typically a **spiral** will transition from a tangent (infinite radius) to a specified radius defined by a curve. **Spirals** can also transition between 2 specified radii as defined by 2 curves.

Several points are also stored with a **spiral**. They are as follows:

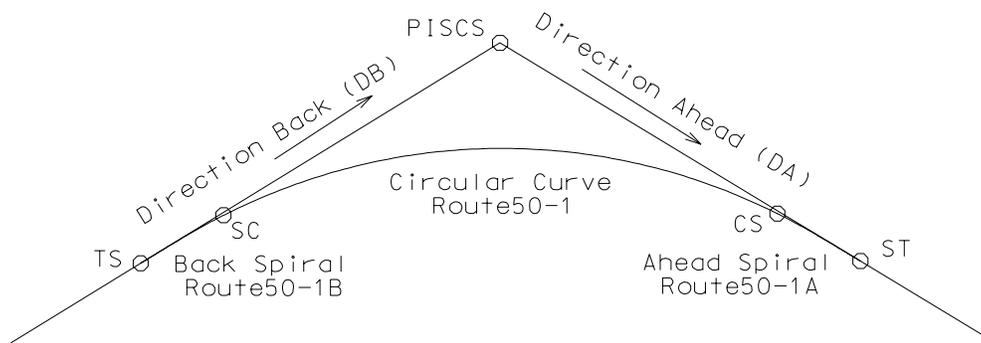
TS – Tangent to Spiral Point

SC – Spiral to Curve Point

CS – Curve to Spiral Point

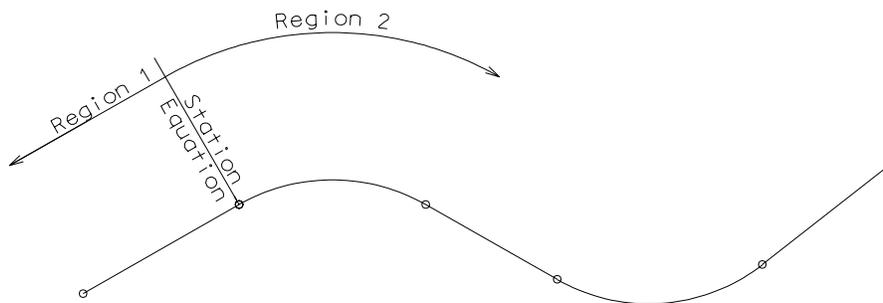
ST – Spiral to Tangent Point

PISCS – Overall Point of Intersection for the spiral-curve-spiral combination.



5.2.6 Chains

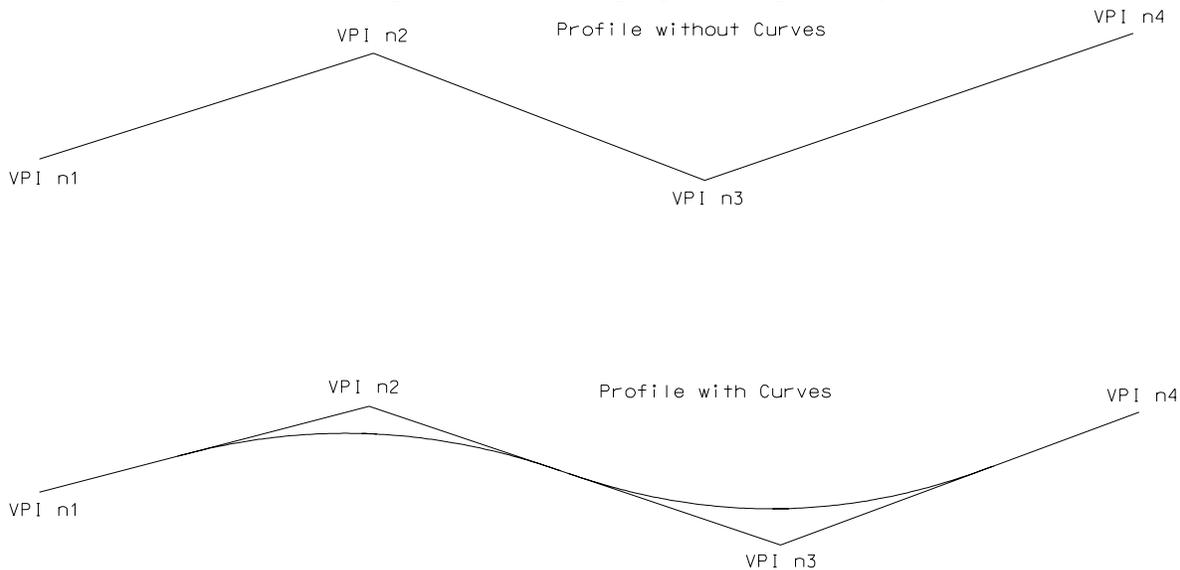
Chains are a combination of other elements. They can consist of points, curves, spirals, or other chains. **Chains** can represent horizontal alignments, or the horizontal location of some element. **Chains** have **stationing** associated with them. Locations along the chain can be determined by the **stationing**. If the **stationing** is adjusted along the **chain** a **station equation** is used. The **stations** from the beginning of the **chain** to the first **station equation** are referred to as Region 1. The **stations** from the first **station equation** to the second **station equation** or the end of the **chain** are referred to as Region 2.



Chain names can be any alpha-numeric characters up to a length of nine characters.

5.2.7 Profiles

Profiles are vertical alignments defined by stations and elevations. They are generally associated with some horizontal chain. **Profiles** can be stored with or without vertical curves. **Profiles** without curves generally represent the existing ground profile, or a ditch profile. **Profiles** with vertical curves are generally used as proposed alignment profiles.



5.3 Accessing



From **Project Manager** choose **Coordinate Geometry**, or choose the **Coordinate Geometry** icon.

When Coordinate Geometry is started, the **Start-Up Dialog Box** appears.

Project Name – shows name displayed on reports (optional entry, 60 alphanumeric characters max). If **Project Manager** is used, this field will be filled in automatically.

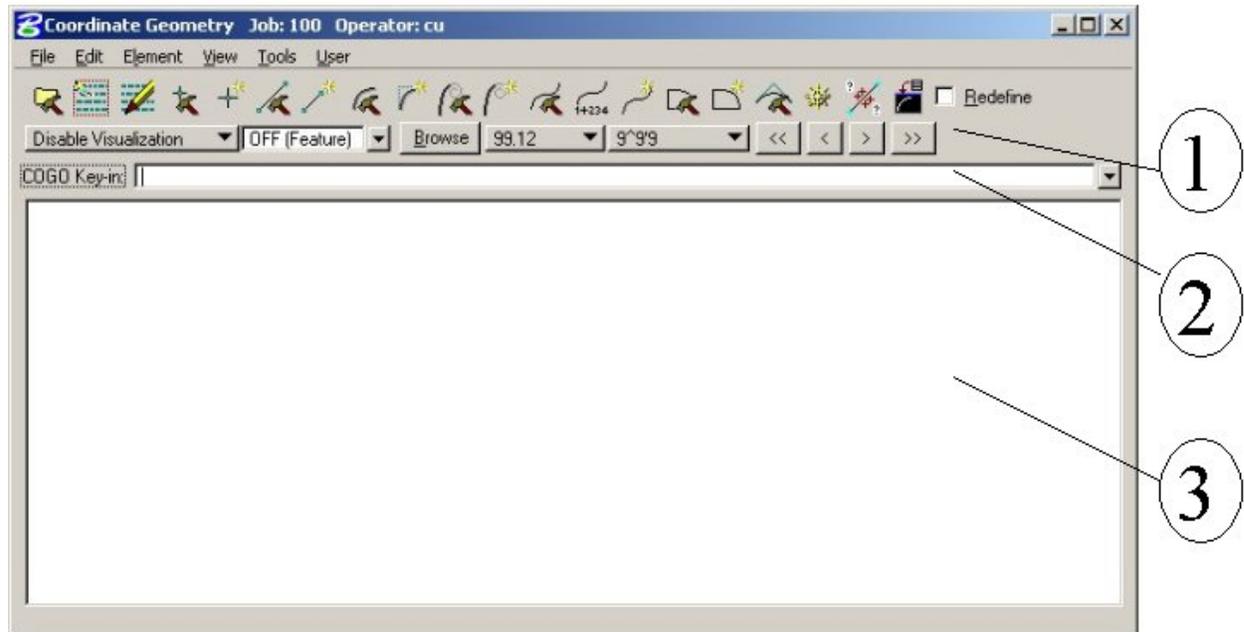
Job Number - identifies coordinate geometry database (3 alphanumeric characters, max) (required). If **Project Manager** is used, this field will be filled in automatically.

Operator Code – identifies a unique 2-character operator code. Allows multiple users access to database. (Required, user's initials suggested). If **Project Manager** is used, this field will be filled in automatically.

Subject - description of work (48 alphanumeric characters, max) (optional)

Once these parameters have been defined, the coordinate geometry dialog box will appear.

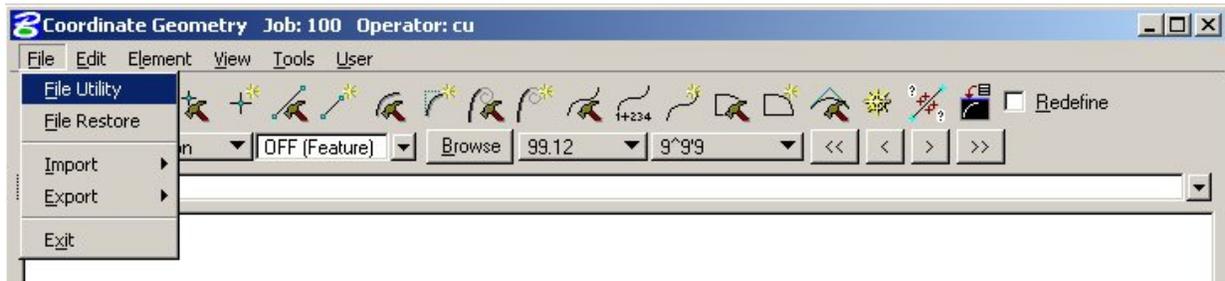
5.4 Coordinate Geometry Dialog Box



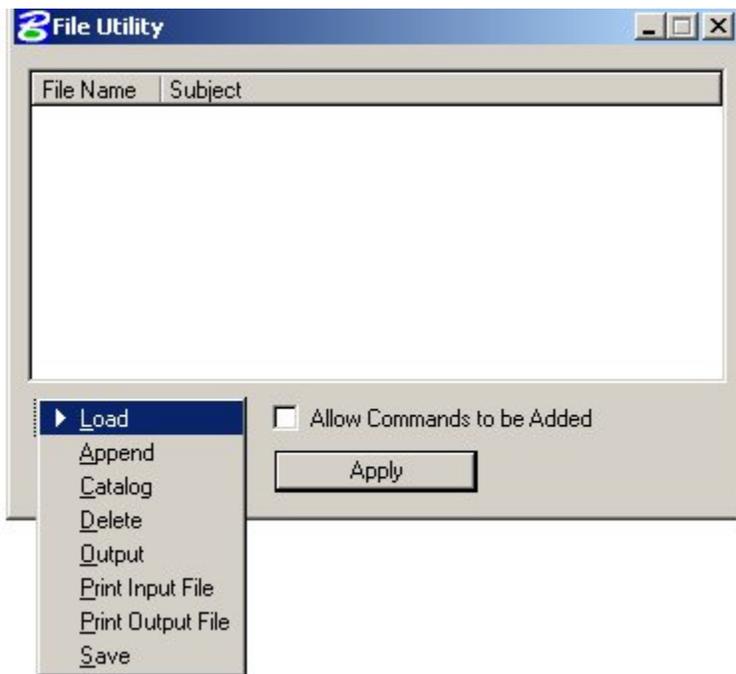
The coordinate geometry dialog box is made up of three separate display areas:

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

5.4.1 File Commands



File Utility – this tool is for manipulating *input files*. When this tool is selected, the dialog with a list of available input files below appears. File utilities include **Load, Append, Catalog, Delete, Output, Print, and Save**.



Load - *Highlight* a file then click the **Apply** button. The input lines from the highlighted file are now displayed in the output buffer and are ready for modify, delete, edit or read.

Append - A new input file is created by copying the contents of an existing input file to the end of the current input file; you must use the **Save** command to store this new file.

Catalog - when selected, a menu appears listing all saved input files in the project directory. This is for reference only no action is taken.

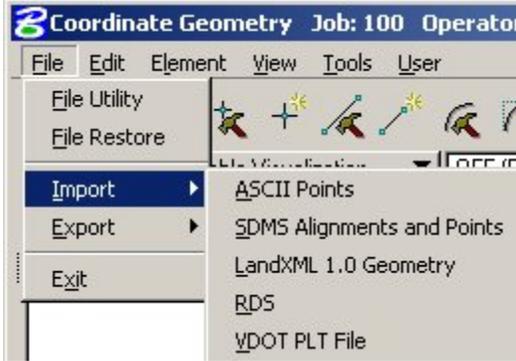
Delete - when selected, a menu appears listing all saved input files. *Highlight* a file then click the **OK** button to remove this file from your project directory.

Output - writes a Geopak output file from your current output buffer session to a newly created file for reviewing and printing. (**Fname999.ooc**)

Print Input File - sends your input file to the printer.

Print Output File - sends your out file to the printer.

Save - will save the current input buffer to a file. (**Fname999.ioc**)

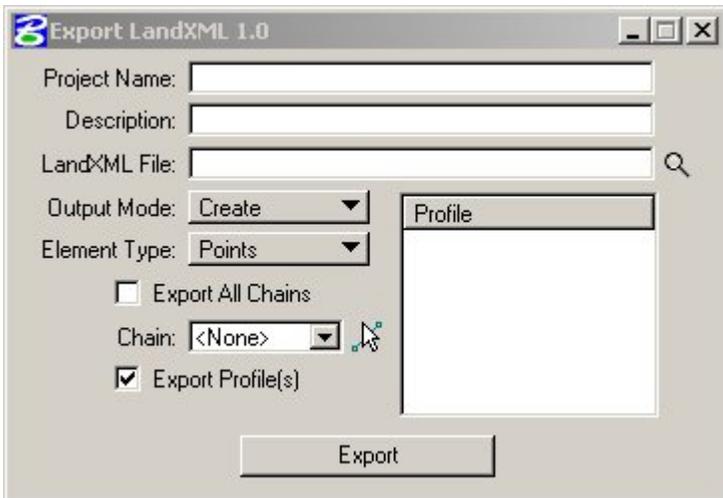
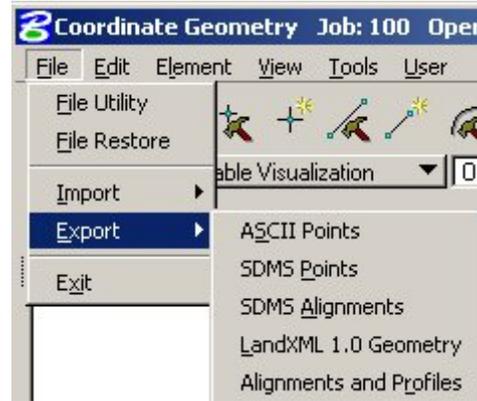


File Restore – converts an ASCII file of Geopak commands to a Geopak COGO input file.

Import - will import horizontal and vertical alignments and points from RDS, SDMS, LandXML 1.0 Geometry, and Virginia Department of Transportation file format into the Geopak .gpk file.

Export - will export Geopak, points, chains and profiles into into SDMS format and LandXML 1.0 Geometry.

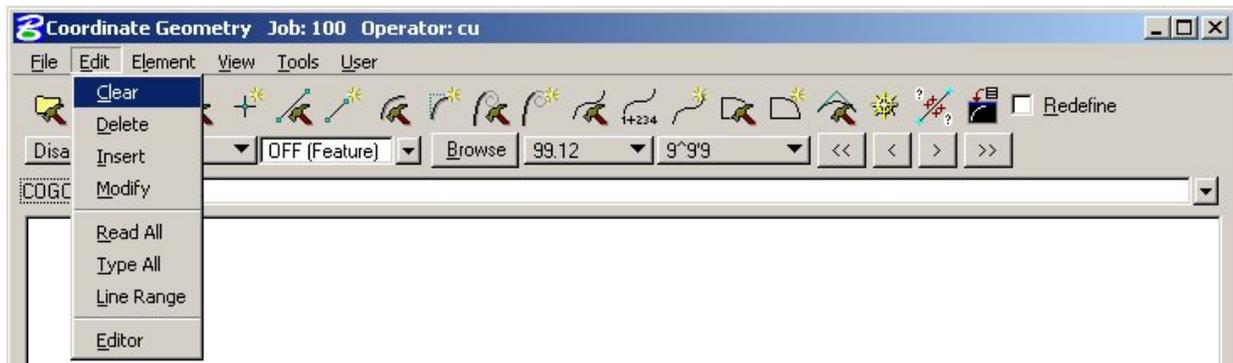
Since most surveying software now reads LandXML format, it is recommended to extract geometry into this format for providing it to contractors.



The Export option in GEOPAK for profile is only activated (visible on the dialog) when you are also exporting chains. You cannot export just a profile by itself as LandXML does not permit this.

Exit - closes the COGO dialog box and ends the coordinate geometry session. A prompt to save the session appears. **Yes** saves the input buffer, **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.

5.4.2 Edit Commands



Clear - empties the memory of the current input and output buffers without saving and initializes the line numbers to begin a new sequence of commands.

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 - allows the user to add a command line to the current input buffer *before* a specified line number; the other command lines will shift down and line numbering will automatically be re-sequenced

Modify - allows the user to change a word in a command line. The modified command line will not be computed until the operator uses the **Read** command.

Read All - the lines in the output buffer are processed. This may be done for the entire file (**All**) or by specifying a range of line numbers (**Line Range**).

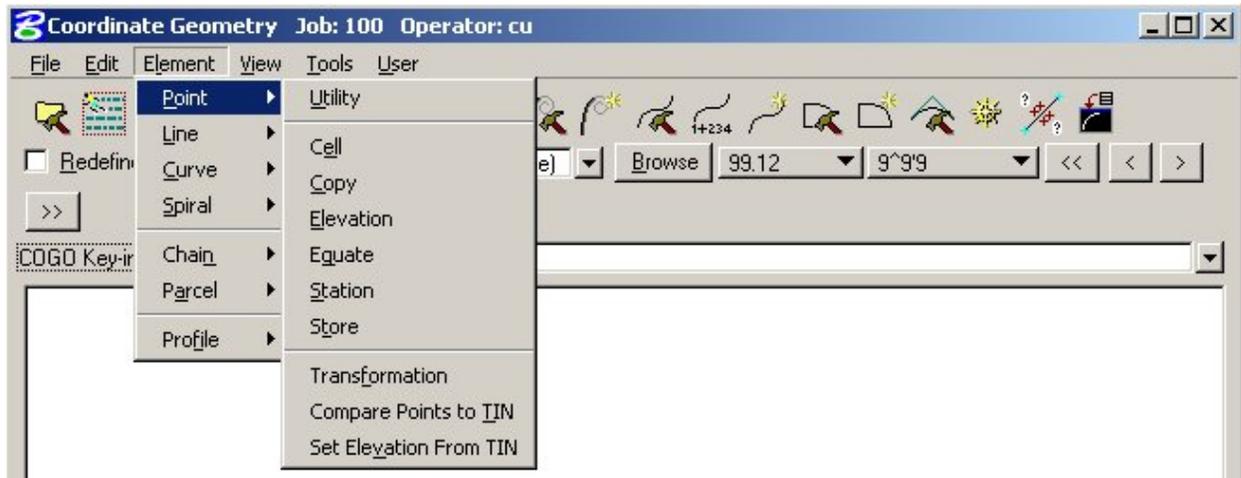
Type All - displays the content of the current input file, (**All**) or a portion of the file by specifying a range of line numbers (**Line Range**).

Line Range - displays a portion of the file by specifying a range of line numbers.

Editor - opens the **GEOPAK COGO Command Editor**, which allows the user to edit an input file before executing.

5.4.3 Element Commands

5.4.3.1 ELEMENT>>POINT



Utility - The Point Utility tool displays a list of all stored points, and has options for deleting, printing, or visualizing points.



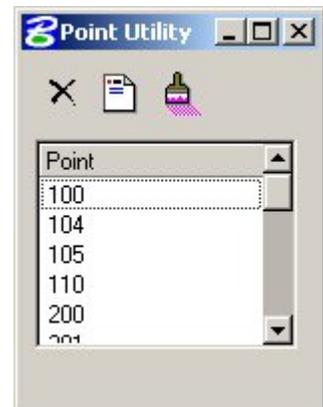
Delete – deletes one point or multiple points currently stored in the .gpk file. User must highlight the points to be deleted in the utility tool display list, then click on the delete icon.



Print - prints point data currently stored in the .gpk file including coordinates and other associated data.



Visualize– visualizes currently stored points in the .gpk file according to the visualization settings in the coordinate geometry dialog. If visualization is turned off, points will not be visualized.



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 defined point

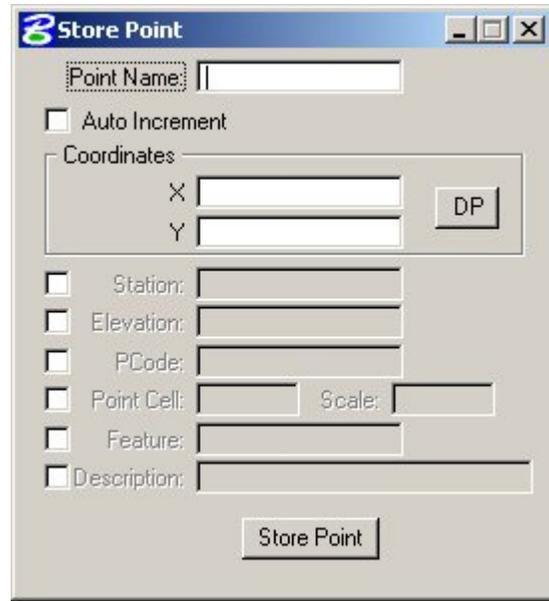
Station - allows you to specify a station for an existing point.

Store - stores a point located by key-in or by digitizing a point on the screen. A station, elevation, point code, cell, feature, or description can be added to the point.

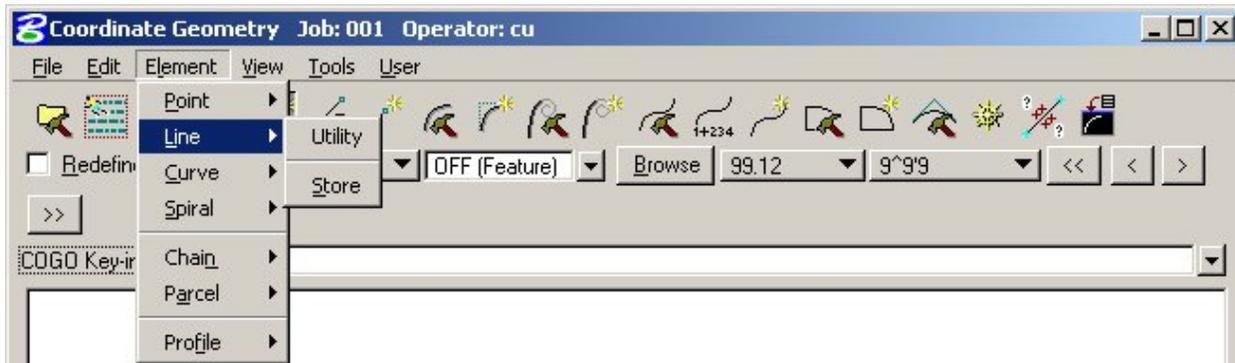
Transformation - transform one set of points into a new coordinate system.

Compare Points to TIN – computes the elevations of a given set of points based on a given DTM, and outputs the elevations to a text file.

Set Elevation From Tin – computes the elevations of a given set of points based on a given DTM, and stores the elevations to the points.



5.4.3.2 ELEMENT>>LINE



Utility - displays all stored lines, and has options for transposing, deleting, printing, or visualizing lines.



Transpose – Changes the direction of the selected lines.



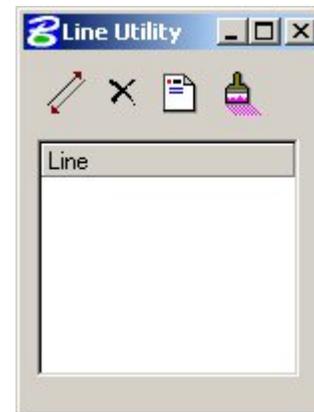
Delete – Removes the selected lines from the GPK.



Print – Writes information about the selected lines to the COGO output window.



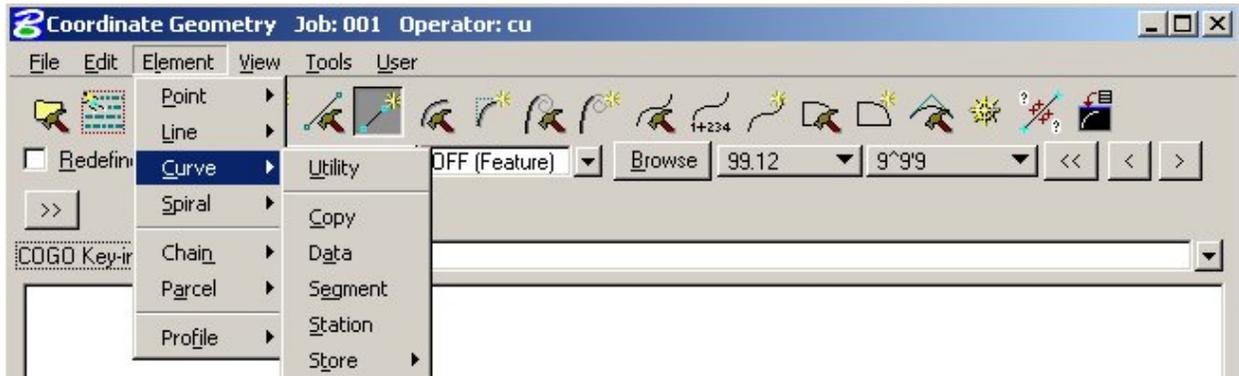
Visualize - Plots lines based on current COGO visualization settings.



Store - stores a line based on one point and a direction or two points. The line name can be alpha-numeric (but not numeric-alpha) to a maximum of nine characters.



5.4.3.3 ELEMENT>>CURVE



Utility - displays all stored lines in .gpk file, and has options for transposing, deleting, printing, or visualizing lines.

Copy - copy a specified curve to another curve name

Data - calculates the geometric parameters of a curve, displaying values for Delta, Degree, Tangent, Length and Radius

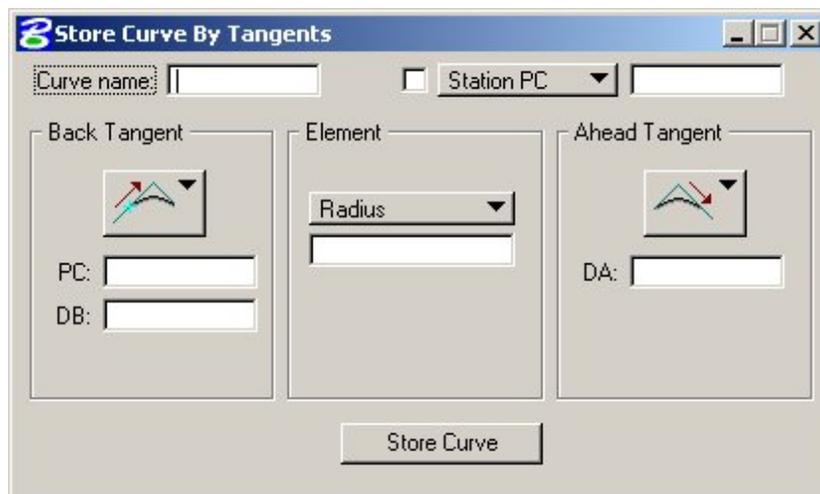
Segment – defines new curves by dividing a stored curve into segments.

Station - allows the user to identify a curve and the position on the curve (PC, PI, or PT) that a station value may be assigned.

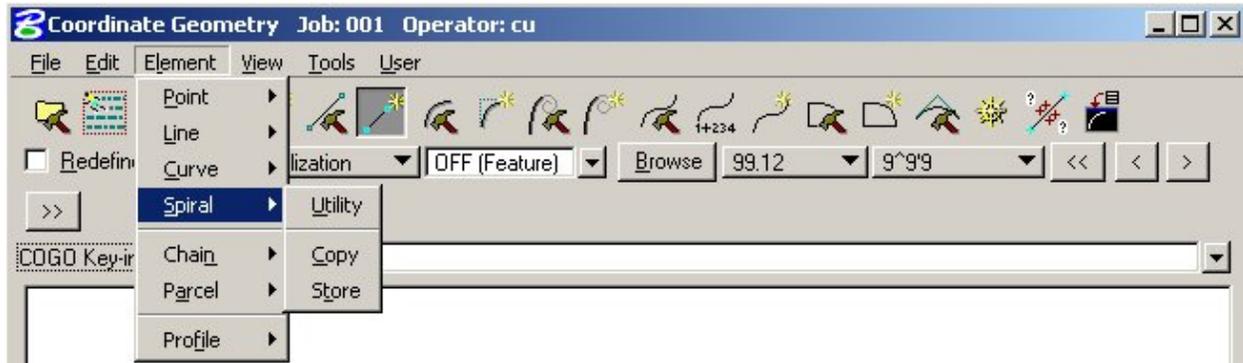
Store – provides the following three options for defining and storing curves: **By Tangents**, **By End Points (from PC and PT previously stored)** and **Concentric** as shown to the right.



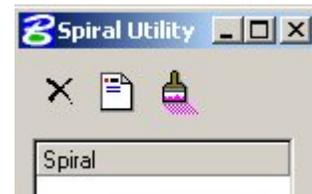
Storing a curve **By Tangents** is the most commonly used tool to store curves. Its dialog is shown below.



5.4.3.4 ELEMENT>>SPIRAL

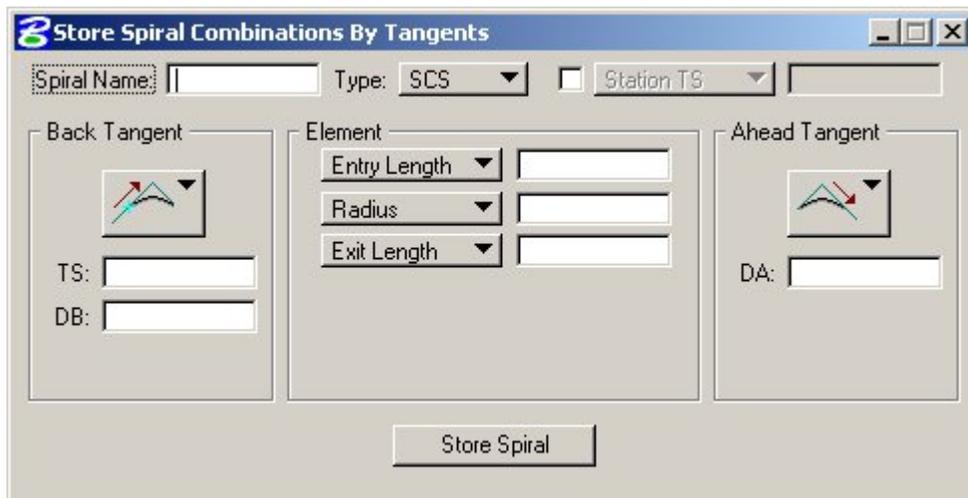


Utility - displays all stored spirals in the GPK file, and has options for deleting, printing, and visualizing spirals.

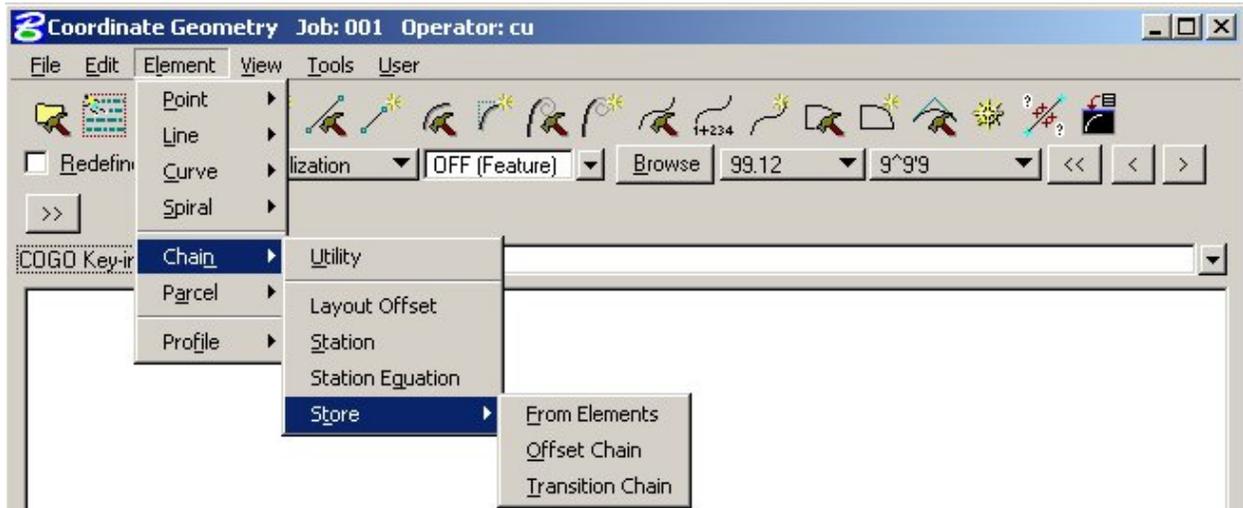


Copy - copy a specified spiral to another spiral name

Store – provides various options for defining and storing spiral combinations. The dialog for an Spiral-Curve-Spiral (SCS) combination is shown below.



5.4.3.5 ELEMENT>>CHAIN



Utility - displays all stored chains in the .gpk file, and has options for computing area, deleting, printing, describing, or visualizing chains.



Area – calculates the area of a closed chain previously stored in the GPK file.



Delete – deletes chains stored in the .gpk file.



Print – displays the name of each chain element.



Describe – displays the alignment data of each element in the selected chain.



Visualize - plots chains based on current COGO visualization settings.

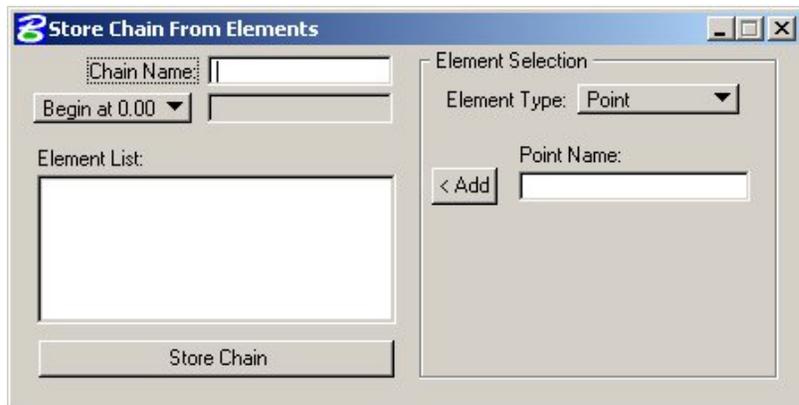


Layout Offset – computes the station and offset of a point or a chain based on a given chain.

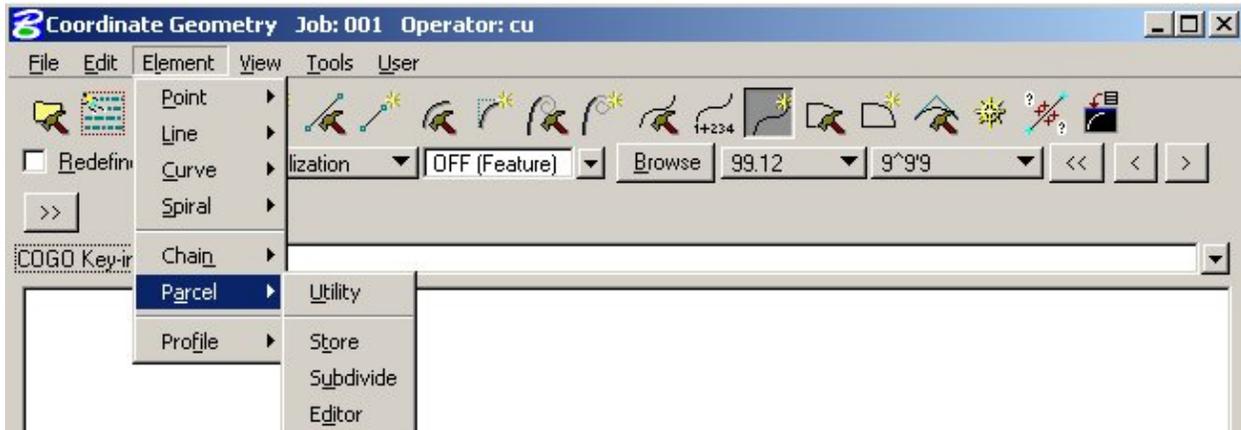
Station - provides a method for stationing or re-stationing a chain.

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 **Transition Chain**.



5.4.3.6 ELEMENT>>PARCEL



Utility - displays all stored parcels in .gpk file, and has options for describing, deleting, printing, or visualizing parcels.

Store - allows a user to store a parcel by adding points, curves and spirals.

Subdivide – divides a parcel into individual lots.

Editor – edits a parcel

Manual Entry - Parcel Commands

Store Taking - allows you to store the portion of a parcel taken by entering point and curve names in either a clockwise or counterclockwise direction.

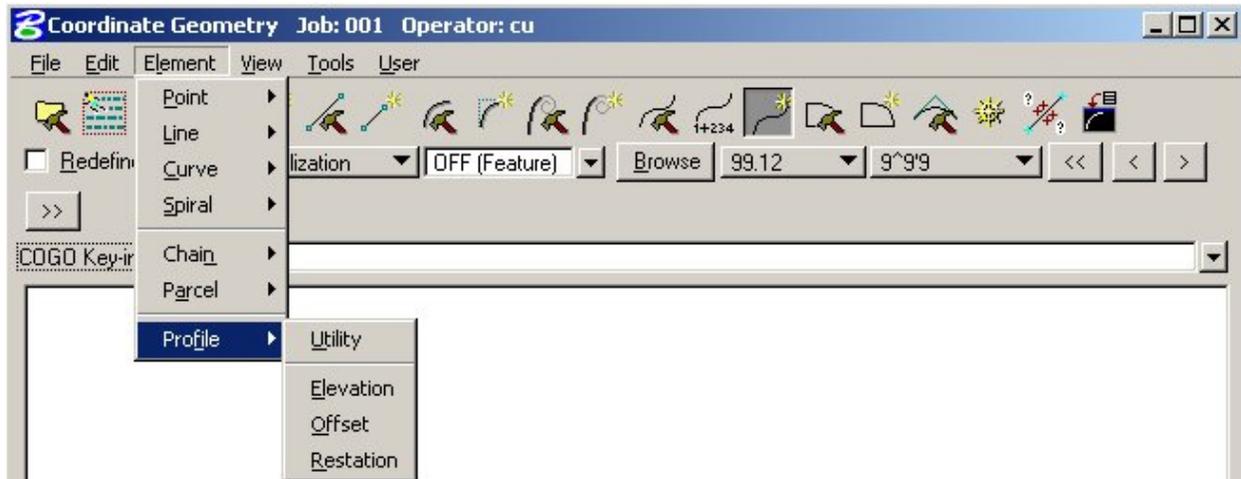
Store Easement - allows you to store an easement by entering point and curve names in either a clockwise or counterclockwise direction.

Own Parcel - stores the name of the owner associated with a previously stored parcel.

Make Legal - creates a legal description and writes it to a user named text file.

For more detailed parcel information, see GEOPAK Help.

5.4.3.7 ELEMENTS>>PROFILES



Utility - displays all stored profiles in .gpk file, and has options for deleting or printing profiles.

Elevation - provides three options for reporting elevations along a selected profile, **Station**, **Even Station**, **Incremental Stations**

Offset – stores a new profile at a given vertical offset.

Restation - creates a **Target Profile** based on a **Source Profile** and **Chain**, but uses the **Begin Station** specified in the dialog.



5.4.4 View Commands



Icons – allows the user to customize which icons appear in the tool bar.

Redefine – shows the **Redefine** box on the tool bar.

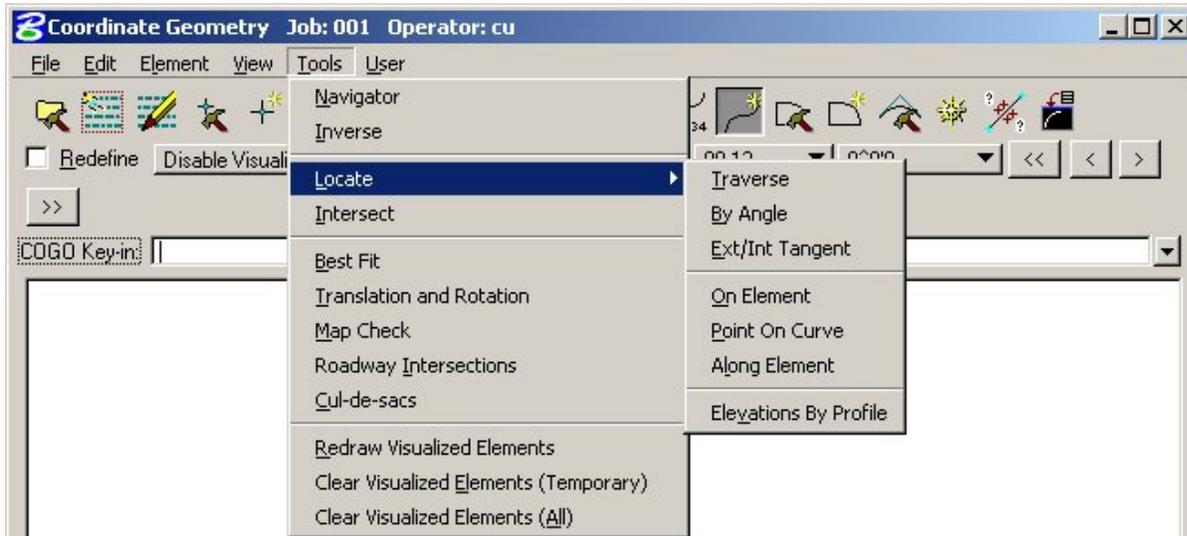
Visualization – shows the visualization items on the tool bar. **Format** – shows the format items (i.e. number of decimals, station format, etc.) on the tool bar.

COGO Key-in – shows the COGO Key-in box for entering commands in the dialog.

Command Output - show the Command Output Window in the dialog box, and controls options for the Command Output Window.

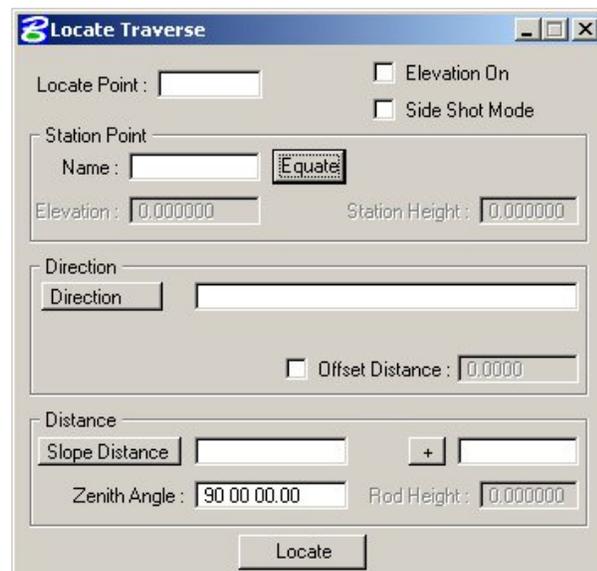
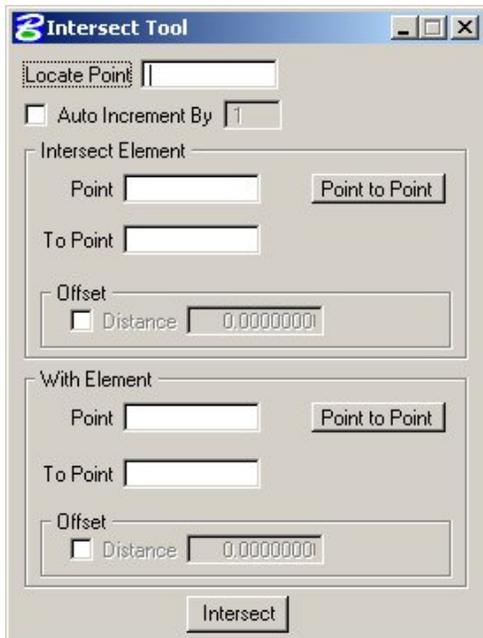
Error Alert – allows the user to turn on a *beep* and/or bring up the COGO dialog when an error occurs.

5.4.5 Tools Commands



Intersect – stores a point at the intersection of the defined elements

Locate – locates a point from another point by several methods such as distance and direction, or station and offset. (To locate by distance and bearing, use the Tools >> Locate >> Traverse)



Superelevation – calculates the superelevation for a given chain. (This will be covered in more detail in Chapter 11)

Inverse – calculates the distance and direction between points.

Navigator – starts the COGO Navigator. (This will be covered in more detail in Section 5.5)

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

Translation and Rotation – moves, rotates, and scales a data set.

Map Check – edits a parcel.

Roadway Intersection – calculates the data for the intersection of two roadways.

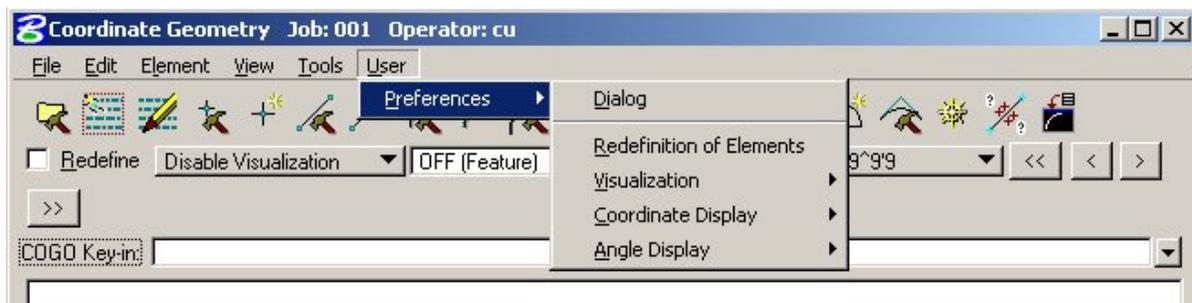
Cul-de-sacs – calculates the data for a cul-de-sac.

Redraw Visualized Elements – re-syncs the coordinate geometry data with the data displayed in the Microstation file.

Clear Visualized Elements (Temporary) – clears the temporary visualized elements from the view.

Clear Visualized Elements (All) – clears the visualized elements from the Microstation file.

5.4.6 User Preferences



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. (It is recommended to work with **Redefine** off so the user does not overwrite another user’s data.)

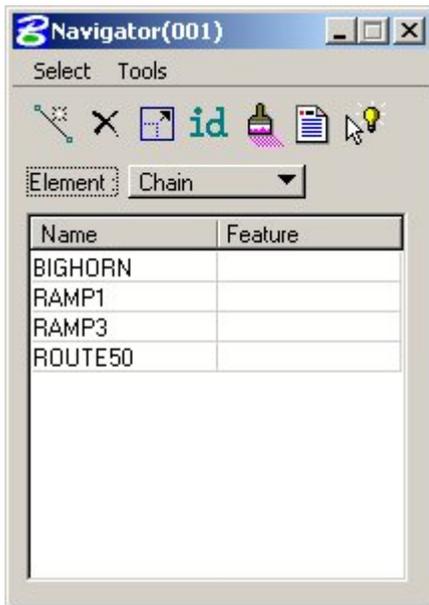
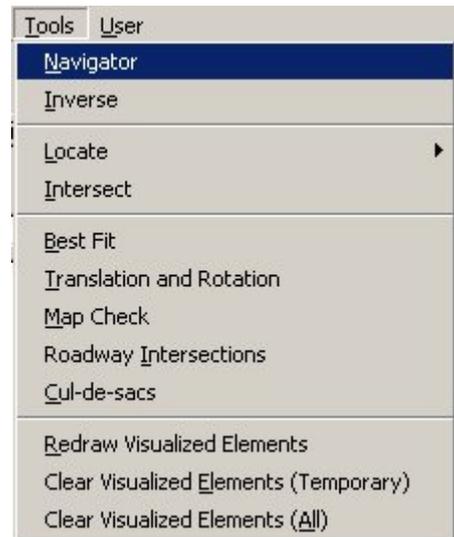
Visualization – allows the elements to be displayed in the Microstation file permanently or temporarily.

Coordinate Display – toggles between displaying NE or XY coordinates.

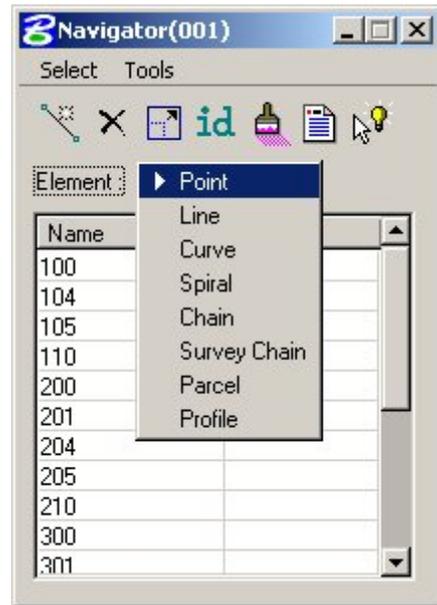
Angle Display – toggles between displaying Bearing or Azimuth.

5.5 COGO Navigator

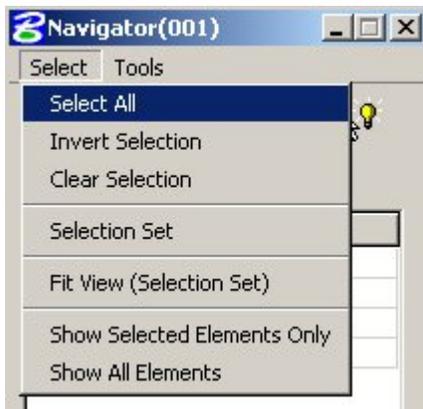
COGO Navigator is a tool to easily view and edit COGO data. **Navigator** can be accessed by the pull down menu **COGO >> Tools >> Navigator** or by the **Navigator** icon. The following dialog box will appear.



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



5.5.1 Select



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.



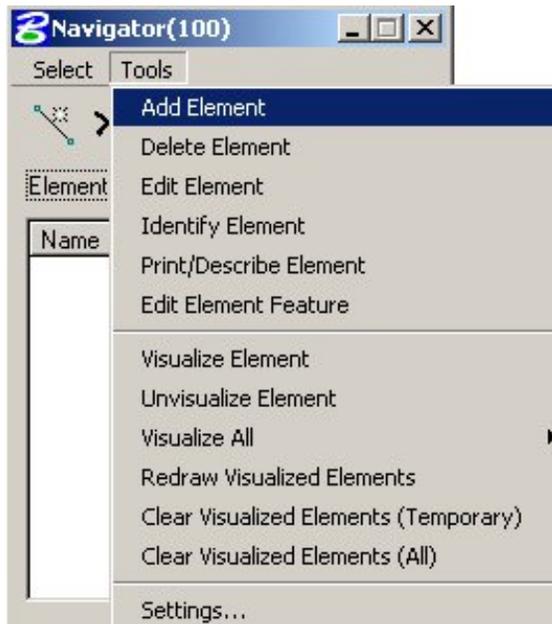
Selection Set - allows the user to create a selection set that meets particular criteria. This is the same as using the **Selection Set** icon.

Fit View (Selection Set) – fits the items selected to the active Microstation window.

Show Selected Elements Only – only the items in the selection set will be displayed in the MicroStation window.

Show All Elements – all items in the database will be displayed in the MicroStation window.

5.5.2 Tools



Add Element – allows the selected type of element to be stored.



Delete Element – deletes the selected type of element.



Edit Element – allows the selected element to be edited.



Identify Element – allows the user to select an element by selecting it graphically.



Print/Describe Element – displays the selected element's coordinate or alignment data.

Edit Element Feature – Changes the feature code of the element.



Visualize Element – displays the selected elements according to their feature codes.

Unvisualize Element – un-displays the selected elements.

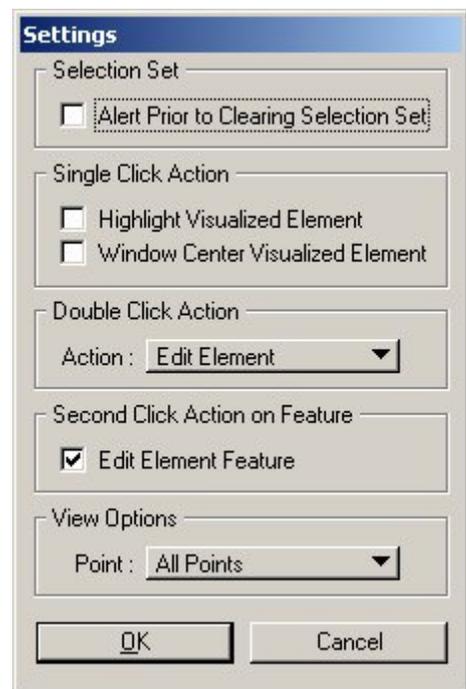
Visualize All – displays all of the elements of a certain type, or all elements.

Redraw Visualized Elements - re-syncs the coordinate geometry data with the data displayed in the Microstation file.

Clear Visualized Elements (Temporary) – clears the temporary visualized elements from the view.

Clear Visualized Elements (All) – clears the visualized elements from the Microstation file.

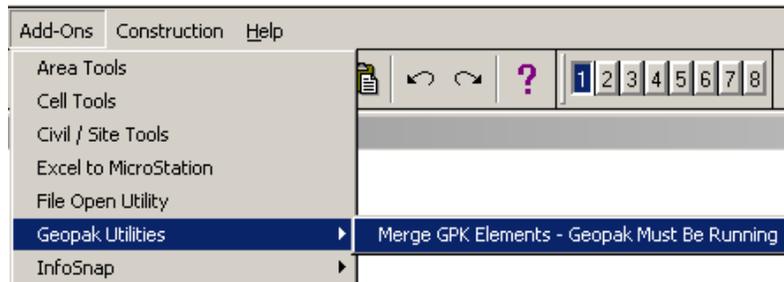
Settings – allows the user to define certain actions and behaviors of the Navigator.



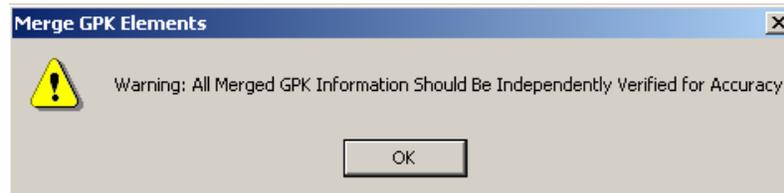
5.6 Merging GPK Elements

A Visual Basic Application (VBA) is available to allow users to merge elements from one GPK to another. This VBA is located under the MicroStation Add-Ons pull down menu.

Add-Ons>>Geopak Utilities>>Merge GPK Elements – Geopak must be running.

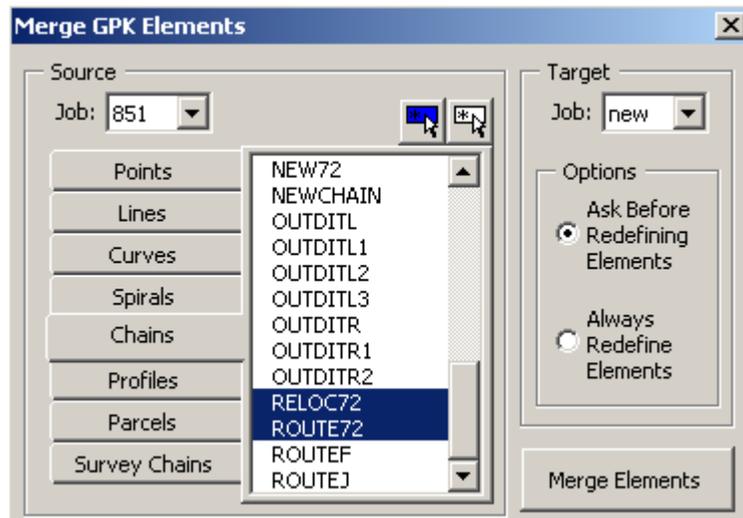


When opening the tool, the user will get the following dialog box. Select OK to dismiss.



The tool requires a source and a target GPK. Both databases must exist before running the tool. The source GPK is defined as the database from which the elements are extracted, and the target one is where the elements will be transferred.

The user can select multiple type geometry at one time. To select an element, first select the type of geometry and then high light from the available list. The tool offers two options for handling existing geometry in the target GPK with the same name. One is to always “**Ask Before Redefining Elements**”, and the second one is to “**Always Redefine Elements**”. If any redefinition of elements must be done, the Redefine toggle must be checked on in the Coordinate Geometry dialog box.



Once the tool is set up, select **Merge Elements**. Once the tool is done merging elements, the user will get the message to the right. To view the log file select **Yes**.



5.7 Importing CEAL Data

A CEAL interface file can be imported using the following command:

LOAD CEAL FILE *filename*

where *filename* is the name of the CEAL interface file. This command will create a Geopak input file that can be saved or read. Points, curves, spirals, chains, and alignment profiles can be transferred to Geopak from CEAL. Once the above command has been executed, to store the data into the .gpk file the input file must be read by going to **Edit>>Read All**.

5.8 Bridge Deck Elevation Commands

COGO solves the deck elevation requirements for the design of highway bridges. The elevations computed by GEOPAK are top of slab elevations within the limits of the bridge. The program computes deck elevations on a per span basis along the edge of the deck, gutterlines, centerline bearings, beams parallel to any line defined by two points, curves or lines concentric to the baseline, or non-parallel lines defined by unequal spacing along the piers. The software is also capable of computing deck elevations between parallel or non-parallel piers. Note these commands are not located on pull down menus and must be keyed in.

Most of the commands in this chapter are provided with graphic illustrations and are indexed in the following order:

BRIDGE name	name of the bridge for output
PROFILE name	a profile already stored in GPK.
TIE value	defines the location of the profile grade line
SE commands	width and slopes across the bridge
ALI name	a chain already stored in GPK.
PIER command	defines the direction of the piers (optional)
SPAN command	defines the layout of the span
CB command	refers to Centerline Bearing Elevations (optional)
FC command	refers to the edge of the deck elevations (optional)
GU command	refers to the gutterline elevations (optional)
BEAM commands	set the framing plan for the current span
End Span command	initiates the calculation
Edit Text command	displays the results of the calculation

The following convention will be used in presenting the bridge deck commands: Words in all upper case letters indicate command names. Lower case words indicate alphanumeric values provided by the user. Since many keywords can be abbreviated, the minimum required is underlined. As always, it is recommended that COGO element names be limited to nine characters. For a full presentation of the COGO conventions go to **Applications >> GEOPAK Road >> Help >> Coordinate Geometry** and select the topic **General Reference / General Conventions**.

5.8.1 Bridge Name

BRIDGE name

The **Bridge name** command stores the name of the bridge. The name of the bridge and the name of the span together form the name of the Deck Elevations Table for the current span.

5.8.2 Profile Name

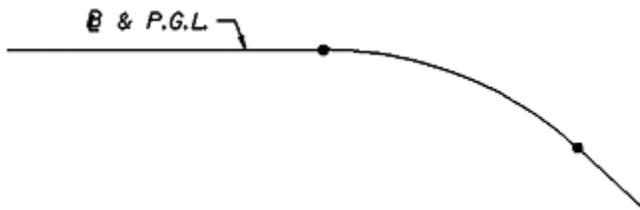
PROFILE name

The **Profile name** command refers to a previously defined profile utilized to define the deck elevations of the bridge. If the profile name is not stored, a message will be printed. Station equations along this profile, if any, must match the station equations along the chain (ALI name).

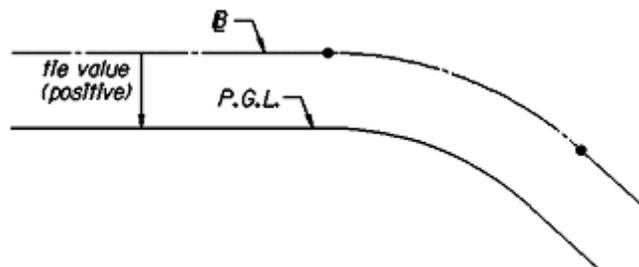
5.8.3 Tie Value

TIE value

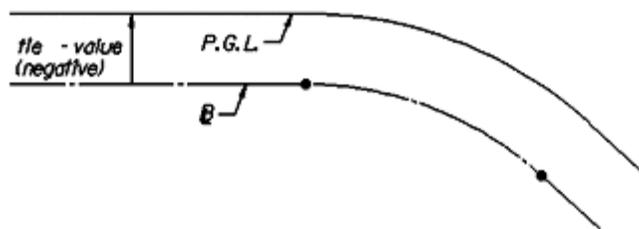
The **Tie Value** command defines the horizontal location of the Profile Grade Line (PGL) by a radial distance (or value) measured from the baseline or centerline of construction of the bridge. When the PGL is located to the left of the baseline the tie value is negative.



When the profile grade line is coincident with the baseline, the Tie value is zero as depicted above.



When the profile grade line is to the right of the baseline, the Tie value is positive as depicted above.

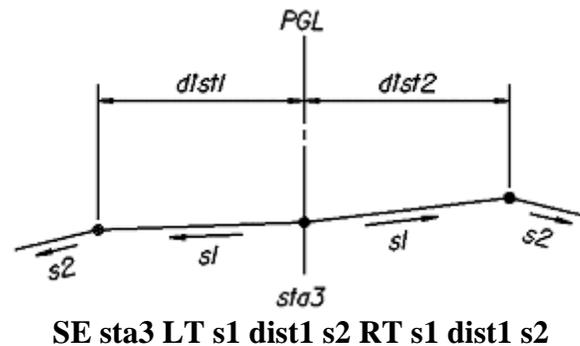
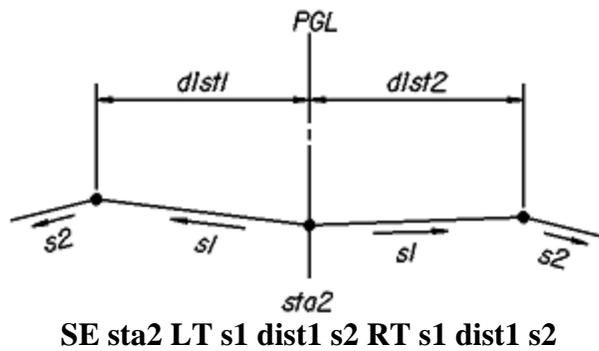
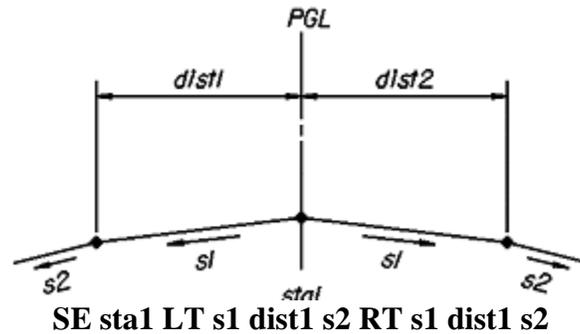


When the profile grade line is to the left of the baseline, the Tie value is negative as depicted above.

5.8.4 SE Command

SE station (R region) LT slope1 dist1 slope2 RT slope1 dist1 slope2

The **SE command** set the slopes in percentage across the bridge from the PGL, left and right. The slope1 in percentage applies across the distance dist1, and slope2 applies to any point beyond the distance dist1 (left and right). Slopes are negative when going down away from the PGL. Three examples are given below.



5.8.5 ALI Name

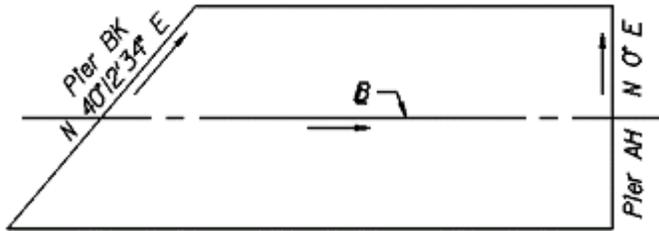
ALI name

The **ALI name** command refers to a chain already stored in the GPK. It defines the stationing of the bridge. Station equations along this alignment or chain, if any, should match the station equations along the profile.

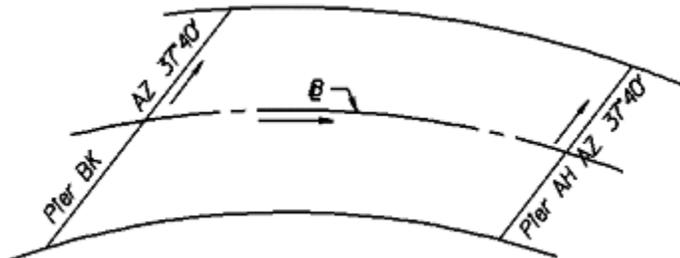
5.8.6 Pier Command

PIER BK direction AH direction

The **Pier** command sets the direction from right to left of the pier centerline. When the Pier command is not used, the piers are assumed perpendicular or radial to the baseline.



Pier BK N 40 12 34 E AH N 0 E

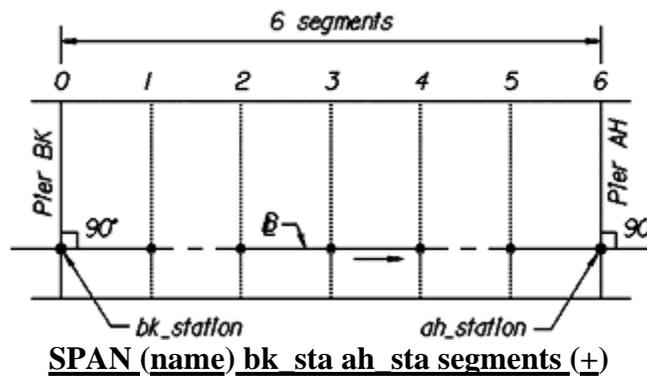


Pier BK AZ 37 40 AH AZ 37 40

5.8.7 Span Command

The **Span** commands define the beginning station (bk_sta) and the end station (ah_sta) of the current span along with the location of the required elevations.

Format A:

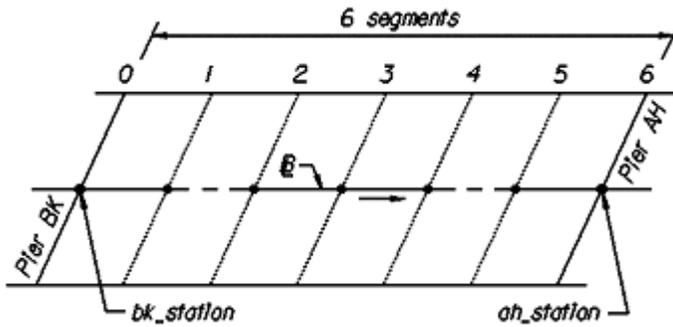


Defines the current span defined from pier on bk_sta to pier on ah_sta, where:

- name** = the name of the span,
- bk_sta** = the station value for the centerline of the back pier,
- ah_sta** = the station value for the centerline of the ahead pier, and
- segments** = the number of equal length segments along the span.

Elevations are calculated perpendicular or radial to the baseline at each segment. The optional (+) calculates elevations on the pier ahead.

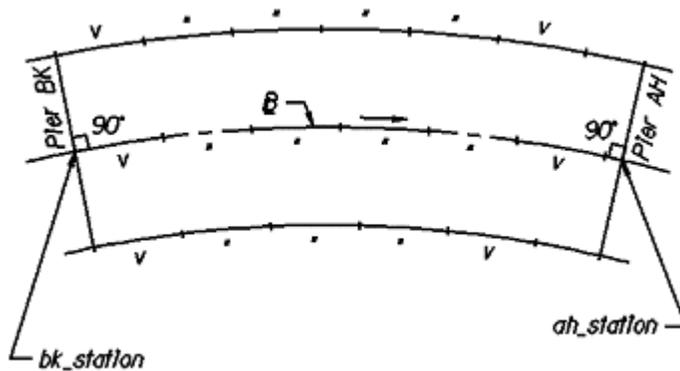
Format B:



SPAN (name) bk sta ah sta segments (+) P

Current span defined from pier on bk_sta to pier on ah_sta, with the terms used as defined above. Elevations are calculated at each segment and parallel (**P**) to the pier on bk_sta. The optional (+) calculates elevations on pier ahead.

5.8.7.1 FORMAT C



SPAN (name) bk sta ah sta IN v (+)

Current span defined from pier on bk_sta to pier on ah_sta, where:
 v = interval length and the rest of the terms are used as define above.

Elevations are calculated at equal intervals (IN v) measured from the pier on bk_sta. The optional (+) calculates elevations on pier ahead.

5.8.8 CB Command

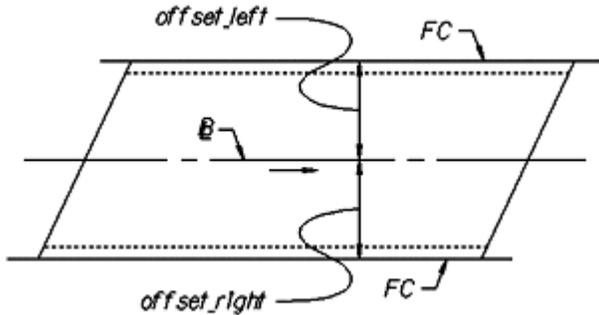
CB value

The **CB** commands calculate deck elevations at the Centerline Bearing of the current span. When **value** is positive, the elevations are computed along a line parallel to and right of the pier on the back station; when **value** is negative the elevations are computed along a line parallel to and left of the pier on the ahead station. Centerline bearing elevations are specified with asterisks (*) in the table of elevations for the current span.

5.8.9 FC Command

The **FC commands** calculate deck elevations along the Face of Copping or edge of the deck. This edge is defined by a line concentric to the baseline at the offset distance **offset_left** or **offset_right**, or along a line designated by two points.

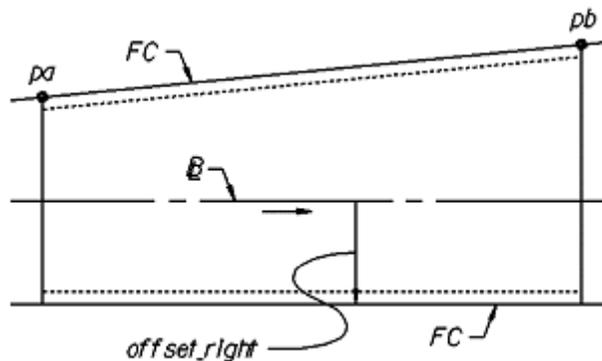
Format A:



FC offset_left offset_right

Deck elevations along a line concentric to the baseline at offset distances, left and right.

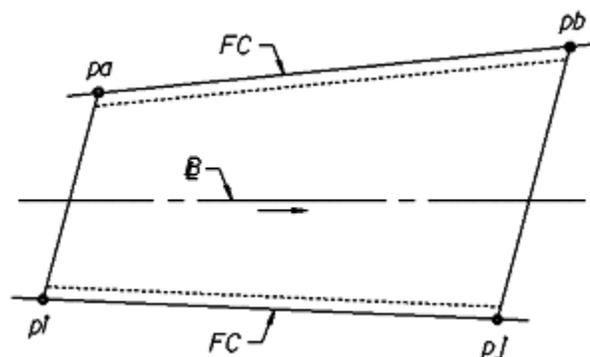
Format B:



FC pa, pb offset_right

Deck elevations along a line to the left of the baseline, from **pa** to **pb**, and along a line to the right and concentric to the baseline at offset distance.

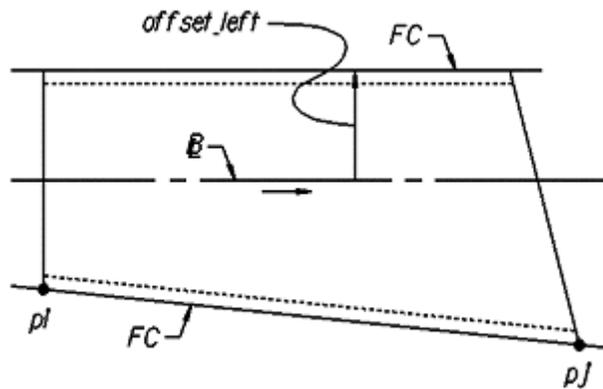
Format C:



FC pa, pb pi, pj

Deck elevations along a line to the left of the baseline, from **pa** to **pb**, and to the right of the baseline from **pi** to **pj**.

Format D:



FC offset left pi, pj

Deck elevations along a line to the left and concentric to the baseline at offset distance **offset_left**, and along a line to the right of the baseline from point **pi** to point **pj**.

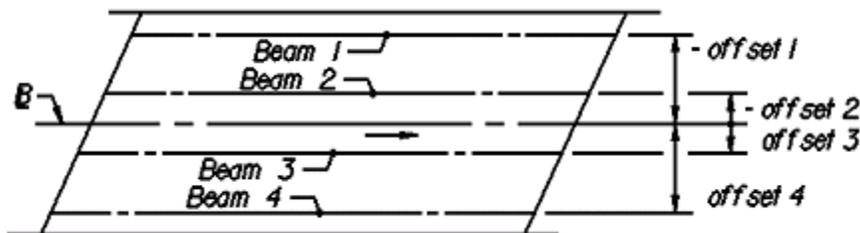
5.8.10 GU Command

The **GU commands** calculate deck elevations along the gutterline of the current span. The gutter is defined by a line concentric to the baseline at the offset distance **offset_left** or **offset_right**, or along a line designated by two points **pa, pb** (to the left of the baseline) or **pi, pj** (to the right of the baseline). It uses the same four formats as the FC Command

5.8.11 Beam Command

The **Beam** commands calculate deck elevations along beams defined by offset distances concentric to the baseline (Format A); parallel to a line pa, pb (Format B); by points (Format C) or along unparallel lines defined by unequal spacing along the piers (Format D).

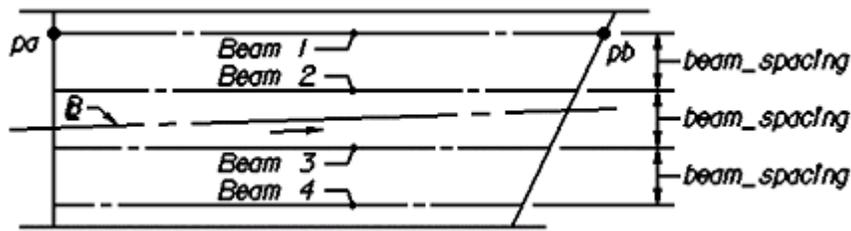
Format A:



BEAM OFF offset1 offset2 offset3 . . . offsetn

Negative offsets are to the left of the baseline and positive offsets are to the right.

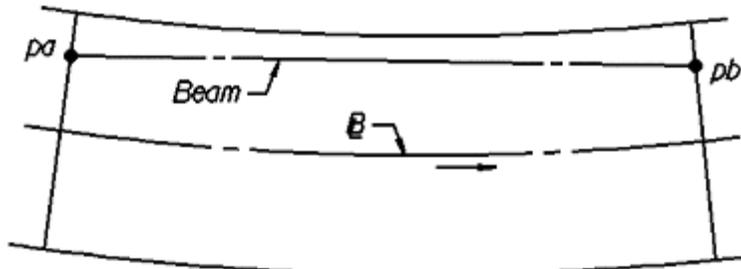
Format B:



BEAM PAR pa, pb beam spacing number of beams

The beams are laid out parallel to the line from **pa** to **pb**, which defines the location of the left most beam as shown above. The value **Beam_spacing** designates the spacing between the beams with the value **number_of_beams** indicates the number of beams.

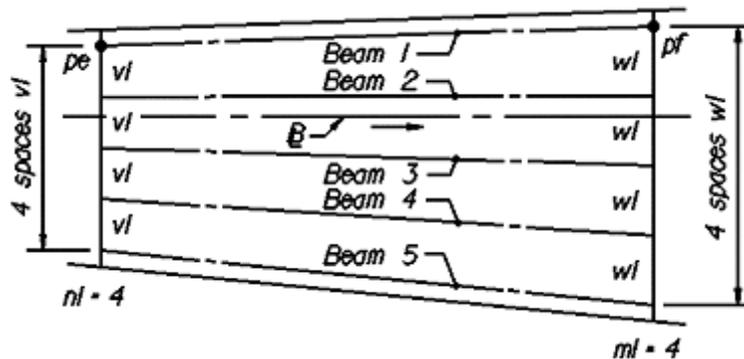
Format C:



BEAM BY POI pa, pb

Locates a single beam running from **pa** to **pb**.

Format D:



BEAM pe, pf FROM n1 SPS v1 n2 SPS v2... TO m1 SPS w1 m2 SPS w2...

The line from the previously defined point **pe** to the previously defined point **pf** locates the left most beam with the other beams located along the back (**FROM**) pier at **n1** spaces of length **v1**, **n2** spaces of length **v2**...and located along the ahead (**TO**) pier at **m1** spaces of length **w1**, **m2** spaces of length **w2**....

5.8.12 End Span Command

END SPAN

The **End Span** command initiates the calculation of elevations for the current span and stores, on disk, a table of elevations with a name composed of the name of the bridge, a hyphen, and the name of the span (bridge-span). An ASCII file is also stored for digital terrain modeling purposes. This ASCII file has a name composed of the name of the span, a dot, and the extension xyz. If no name has been stored for the current span, COGO, assigns numbers to the span starting with number 1. The XYZ file can be used to store COGO points at each of the locations where a deck elevation was calculated. This procedure is presented in **Section 5.9 Store ASCII XZ DAT file to COGO**.

5.8.13 Edit Text Command

EDIT TEXT bridge-span.TXT

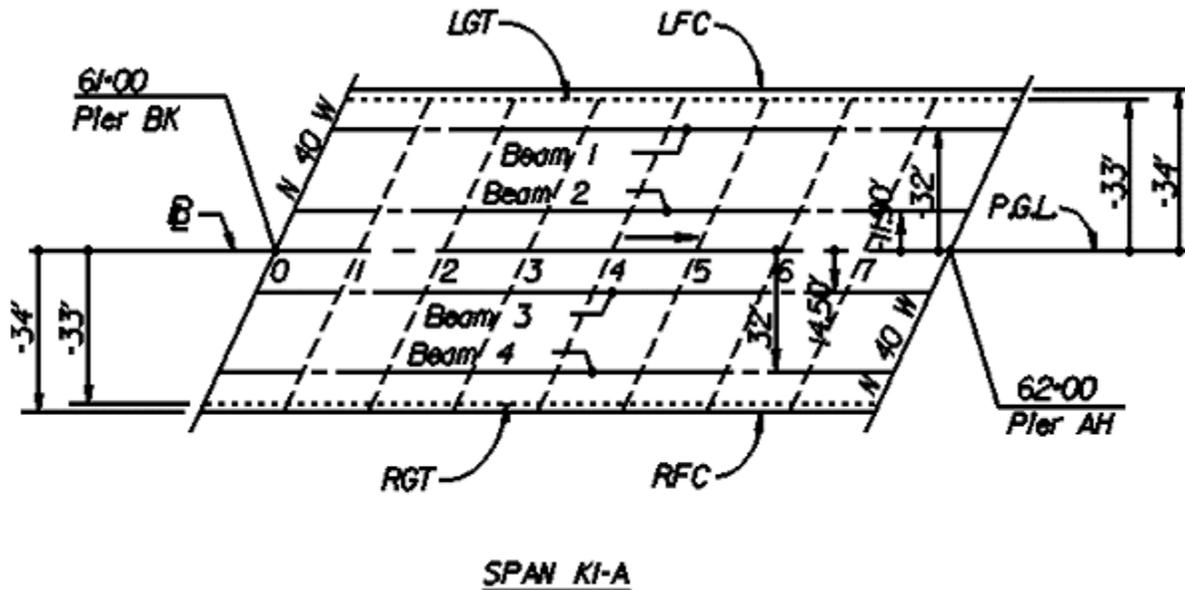
The Edit Text command displays the table of deck elevations stored on disc as bridge-name, hyphen, span-name. When the table exceeds 8 columns, COGO breaks the table into groups of 8 columns. The file can also be viewed with any text-editing program.

5.8.14 Point Elevation Command

POI/EL list

The Point elevation commands calculate deck elevations for any points on the deck, which has been stored in the coordinate geometry database file, where **list** is the list of points. This command is active only when the Alignment, Profile, Tie, and Cross-slopes (SE commands) have been previously designated.

5.8.15 Example



The input commands for the above figure are:

```
*1 BRIDGE K1
*2 PROFILE ABC
*3 TIE 0
*4 SE 60+00 LT -2 24 -3 RT -2 24 -3
*5 SE 63+00 LT -2 36 -3 RT -2 36 -3
*6 SE 65+00 LT 4 24 4 RT -4 24 -4
*7 ALIG IN
*8 GU -33 33
*9 FC -34 34
*10 PIER BK N 40 W AH N 40 W
*11 SPAN A 61+00 62+00 8 P
*12 BEAM OFF -32 -11.90 14.50 32
*13 END SPAN
*14 END
```

The resulting output is:

```
Bridge deck elevation
Span K1-A 61+00.00 to 62+00.00
LFC 11.4187 11.1029 11.3712 11.3712 11.3554 11.3396 11.3237 11.3079
LGT 11.4490 11.4331 11.4015 11.4015 11.3856 11.3698 11.3540 11.3381
BM 1 11.4792 11.4634 11.4475 11.4317 11.4159 11.4000 11.3842 11.3684
BM 2 11.9250 11.9042 11.8834 11.8625 11.8417 11.8209 11.8000 11.7792
BM 3 11.8811 11.8603 11.8394 11.8186 11.7978 11.7769 11.7561 11.7353
BM 4 11.4941 11.4783 11.4625 11.4466 11.4308 11.4150 11.3991 11.3833
RGT 11.4644 11.4485 11.4327 11.4169 11.4010 11.3852 11.3694 11.3535
RFC 11.4346 11.4188 11.4029 11.3871 11.3713 11.3554 11.3396 11.3238
PGL 12.1667 12.1458 12.1250 12.1042 12.0833 12.0625 12.0417 12.0208
```

5.9 Store ASCII XZ DAT file to COGO 3PC

The XYZ data file created when calculating the deck elevations as described in Section 5.8.12 End Span Command above can be used to store COGO points at the locations where an elevation was calculated. A 3PC application has been written to accomplish this task. It can be launched from the 3PC section of the Design and Computation Manager.



5.9.1 Launching the Tool

To launch the application, go to the **D&C Manager path 3PC Tools\Store ASCII XYZ DAT File to COGO**, which is highlighted in the following figure.

5.9.2 GPK Job Number Prompt

Double-clicking on the Store ASCII XYZ DAT File to COGO entry brings up the following Prompt. **Enter the GPK Job Number** (for example enter “300” for job300.gpk) and click **OK**.



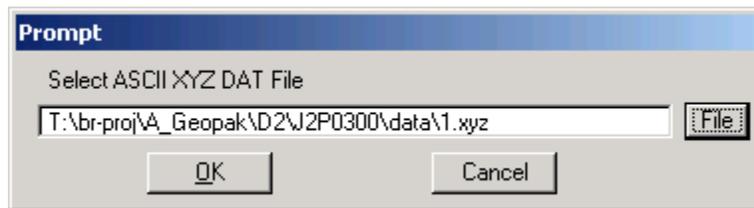
5.9.3 Select Redefine Option for COGO

The next step is to determine if you want **Redefine to be On or Off** when the points are stored. Off is used for the example. If you set it to on, make sure you choose a safe beginning point namer. Click **OK** to accept your choice.

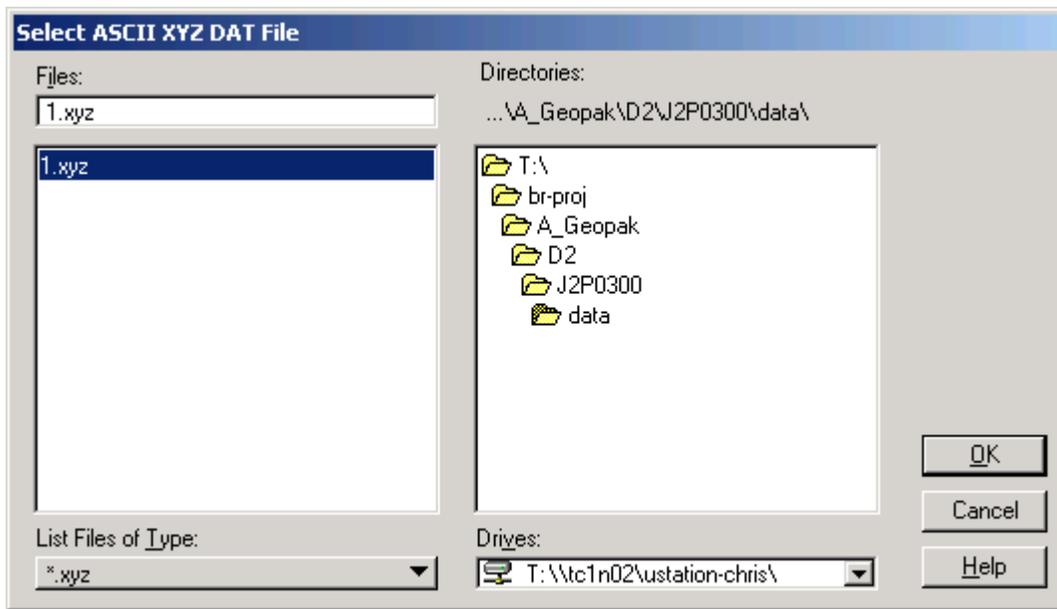


5.9.4 Select ASCII XYZ DAT File

The name of the file containing the XYZ data is requested next, as shown below.



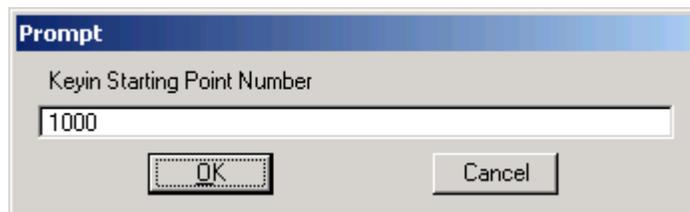
It can be typed in or the **File** button can be used to navigate to the file and select it using the following dialog.



Click **OK** to proceed to the next prompt.

5.9.5 Keyin Starting Point Number

This prompt asks for the name to be assigned to the first point number to be stored. Since the names for the successive points are incremented by 1 be sure to use a starting name that will allow for a sufficient range of unused point names. 1000 is used below. Click **OK** to proceed.



5.9.6 Keyin Optional Point Descriptions

A description can be assigned to the points using this prompt. Enter the description you wish to use and click **OK** or leave in blank if you do not wish to use a description. This completes the process and the points are added to the GPK. At any point in the process you may click the **Cancel** button to end it at this point. Any values entered to that point are remember the next time you launch the application.



5.10 Additional Information

Additional COGO commands and information can be found in the GEOPAK Help.