PC Survey Reference Manual

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Overview

This portion of the documentation is a detailed explanation of all the functions. The surveyor who is unfamiliar with the program should first work through the tutorial.

A summary of all the menu functions will be presented first. Following the menu summaries is a ***General Concepts*** section that contains discussions of various concepts and functions that have frequent use.

The program uses multiple windows in an attempt to group the functions according to the nature of the work. Consequently there is a window titled ***Survey*** specifically for working with field data. The ***COGO*** window is used for most of the drawing and calculation functions associated with the point data. The ***Layout*** window is used for assembling and arranging selected portions of the drawing data along with auxiliary pieces such as title blocks, north arrows and certifications. The operation of each of these window types follows the ***General Concepts*** section.

Most of the information is organized according to function name. Some functions are closely related and are therefore explained together. Use the **Menu Summary** to quickly find a detailed explanation on any of the menu functions.

Online Help

The program has an extensive online help system. There are several ways to access the help system.

1) Press the <**F1**> key when inside a function dialog. This will bring up *context-sensitive* help - jumping to the section in the online help that talks about the current function.
2) Press the <**F1**> key while a menu item is highlighted. Again, this will bring *context-sensitive* help regarding the currently highlighted menu function.
3) Select ***Contents*** from the ***Help*** menu in the Main window. (The Main window is the window with the name of the program as its title.) This will bring up a help screen with a list of subjects.

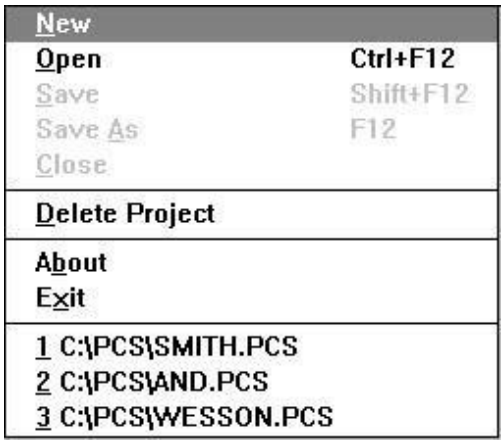
Words that appear in the online help in double underlined green are *jumps* - left-clicking on these words will move to a more detailed explanation in another portion of the online help.

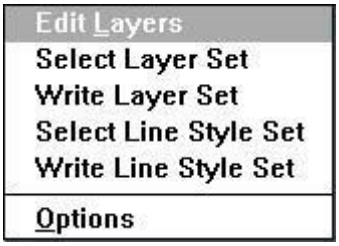
Suggestion*: Select the Using Help command from the Help menu in the Main window if you are not familiar with the Windows help system.*

Menu Summary

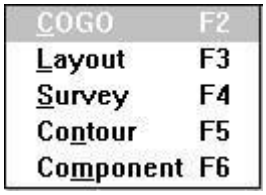
Main Menus

Project Menu		
Command	**Page**	**Description**
New	50	Starts a new project
Open	50	Opens an existing project
Save	50	Saves current project
Save As	50	Saves current project with new name
Close	50	Closes the current project
Delete Project	51	Deletes a project from computer
Authorize	52	Software protection function
About	52	Program version information
Exit	53	Exits the program
1,2,3...	53	Opens previous projects





Environment Menu		
Command	**Page**	**Description**
Edit Layers	54	Changes your haircut style
Select Line Style Set	55	Load predefined line styles
Write Line Style Set	55	Save currently defined linestyles
Options	55	Program options



'iew Menu		
Command	**Page**	**Description**
COGO	93	Coordinate Geometry
Layout	204	Drafting and page design
Survey	62	Field data entry and adjustment
DTM	193	Contours, profiles, volumes
Component	224	Accesses component libraries

Help Menu		
Command	**Page**	**Description**
Contents	10	Help Contents
Using Help	10	How to use Help

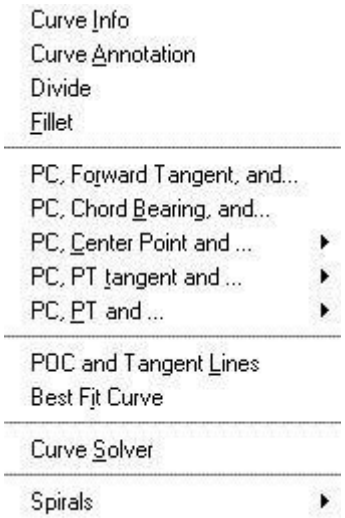
Cogo Menus

Project Menu		
Command	**Page**	**Description**
New	50	Starts a new project
Open	50	Opens an existing project
Save	50	Saves current project
Save As	50	Saves current project with new name
ASCII Formats	103	ASCII format editor
Import Points from...		
File	65	Insert point data from ASCII file
Data Collector	65	Insert point data from a data collector
DXF	35	Import DXF file
Export Points to...		
File	35	Save point data to ASCII file
Data Collector	35	Save point data to a Data Collector
DXF	35	
Print	109	Print the screen
Exit	53	Exits program

COGO Menu

Command	Page	Description
Sideshot	125	Point creation from observation data
Traverse	125	Same as above, except occupy point is updated
Inverse	177	Distance, direction info between two points
Coordinate Transformation		
Standard	183	Rotation, scaling, linear transformation, copying
State Plane to Ground		Convert between state plane and local grid coordinate systems
Best Fit	186	Least squares best fit transformation
Offset	133	Curve and/or line offsets
Occupy/Backsight	189	Sets the current occupy point and backsight
Connect Points	133	“Connect the dots” function
Best Fit Line	135	Fit a line to a set of points
Options		Various environmental controls for COGO

Points Menu		
Command	**Page**	**Description**
Next Number	190	Numbering protection and control
Create Points		
Array	119	Create an array (grid) of points
Box Corner	120	
By Coordinates	120	Create point by northing, easting, elevation information
Random	120	Creates points at the cursor location
By Station /Offset	120	Create by station and offset value
Digitize	120	Input from digitizer tablet
Point in direction	123	Creates points in a given direction at a specified distance
Edit Individually	125	Edits point information and display attributes of selected points
Modify Group	125	Edits common point characteristics of selected points
Copy\Renumber	123	Moves and optionally copies selected points to a different point range
Edit Data	123	Spreadsheet editor for point data
Stake Tools		
Radial	125	Radial stake out of selected points
Curve	128	Stake out selected curves
Station/Offset Report	129	Report station/offset values of selected points relative to a specified alignment

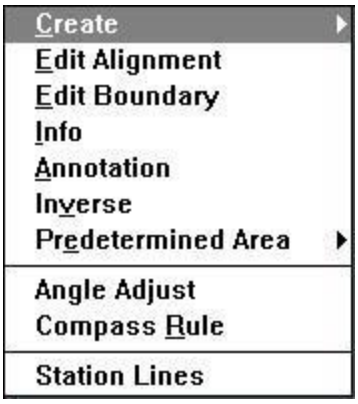


Curves Menu		
Command	**Page**	**Description**
Curve Info	142	Provides information on all selected curves
Curve Annotation	143	Controls annotation of selected curves.
Divide	143	Splits selected curves at selected points
Fillet	143	Generates a "fillet" curve for all adjacent pairs of lines or for a selected pair or a line and/or curve.
PC, Forward Tangent and...	146	Creates a curve given the PC, Forward Tangent direction and a third curve parameter
PC, Chord Bearing, and...	147	Creates a curve given the PC, chord bearing and a third parameter
PC, Center Point & (Curve Parameter)	149	Creates a curve given the PC, Center Point and a curve parameter
PC, Center Point & (PT Tangent)	149	Creates a curve given the PC, Center Point and a point on the PT tangent line
PC, PT Tangent & (PI)	152	Creates a curve given the PC, a point on the PT tangent line, and the PI
PC, PT Tangent & (Center point)	150	Creates a curve given the PC, PT and a center point of the curve.
PC, PT & Curve Parameter	150	Creates a curve given the PC, PT, and a parameter of the curve
PC, PT & point on PC/PT tangent	150	Creates a curve given the PC, PT and a point on either the PC or PT tangent line
PC, PT & Point on Curve	151	Creates a curve given the PC, PT and a point on the curve (3 Point Curve)
POC and Tangent Lines	153	Creates a curve given a point on the curve (POC) and tangent lines to the PC and PT
Best Fit Curve	153	Fit Curve to selected points
Curve Solver	153	Curve parameter calculator

Edit Menu

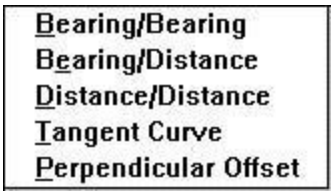
Command	Page	Description
Modify Line Text	115	Options to modify text location, regenerate text values and position
Split Lines	136	Breaks lines at selected points on the line
Line Extend	136	Extend selected lines to specified object.
Line Style	117	Sets the line style for selected lines
Edit Text	142	Edit existing text
Align Texts	140	Rotate selected texts to given angle
Set Font		
Default	53	Changes the font of selected text back to default
Other	53	Changes the font of selected text to one of your choice
Set Color	117	Change the color of selected objects
Set Layer		
Default	118	Changes the layer of selected objects back to default
Other	118	Changes the layer of selected objects to one of your choice
Clear Select	110	Resets (clears) the selection list
Hide Objects	96	Make selected objects invisible
Unhide Objects	96	Makes selected hidden objects visible
Extract to Overlay	114	Change the overlay of selected objects
Edit Overlay	114	Add, delete, modify overlays
Delete Objects (DEL)	118	Deletes selected objects
Undo	118	Undoes actions of previous commands

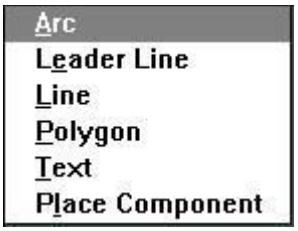
Alignment Menu		
Command	**Page**	**Description**
Create	183	Creates alignments from selected lines/curves.
Edit	155	Edits selected alignments
Info	163	Displays info on selected boundaries
Annotation	163	Controls annotation of selected boundaries
Inverse	115	Generates inverse reports
Offset	76	Creates one or more offsets
Angle Adjust	156	Angle balance an alignment
Compass Rule	165	Compass Rule adjust an alignment
Station Lines	156	Create/Edit Station Lines
Profiles	158	Create/Edit Profiles



Boundary Menu		
Command	**Page**	**Description**
Create	119	Creates boundaries from selected lines/curves.
Edit	163	Edits selected boundaries
Info	163	Displays info on selected boundaries
Annotation	163	Controls annotation of selected boundaries
Inverse	115	Generates inverse reports
Predetermined Area		Functions to "chop off" an area of specified size
By Pivot Line	165	By a line that pivots around a point
By Sliding Line	166	By a line with fixed direction
Offset	76	Creates one or more offsets
Fill Boundary		Sets the fill type of a boundary or layout object

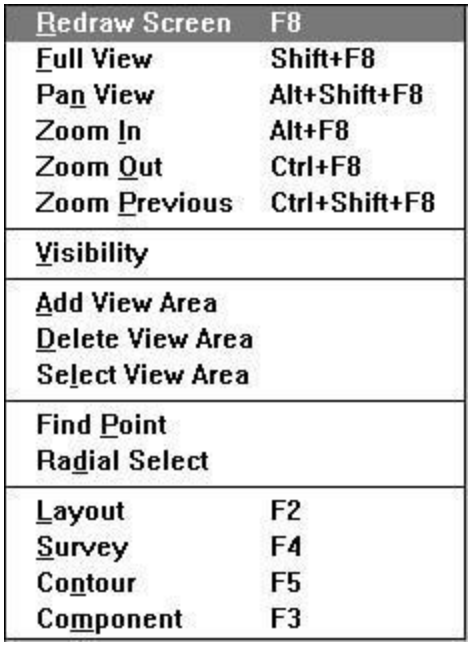
ntersections Menu		
Command	**Page**	**Description**
Bearing/Bearing	173	Creates a point at intersection of two user-defined lines
Bearing/Distance	173	Creates a point at the specified intersection of a user-defined line and circle
Distance/Distance	174	Creates a point at the specified intersection of two user-defined circles
Tangent Curve	174	Circle/Tangent line intersection
Perpendicular Offset	174	Create points and/or finds distances for locations perpendicular to a line or curve





Draw Menu

Command	Page	Description
Arc	40	Draw an arc
Leader Line	135	Add a leader line
Line	42	Draw a line
Polygon (Polyline)	39	Draw a polygon/polyline
Text	44	Add text
Component	217	Insert a component



View Menu

Command	Page	Description
Redraw Screen	38	Refresh the screen
Full View	38	Zoom to full extents
Pan View	38	Look for golden objects
Zoom In	38	Enlarge the view
Zoom Out	38	Reduce the view
Zoom Previous	38	Go to previous view
Visibility	96	Data visibility control
Add View Area	113	Create a view area
Delete View Area	113	Exterminate a view area
Select View Area	113	Go to a saved view area
Find Point	91	Find a point by number
Radial Select	110	Use circular selection region
Layout	204	Drafting and page design
Survey	62	Field data entry and adjustment
DTM	193	Contours, profiles, volumes
Component	224	Accesses component libraries

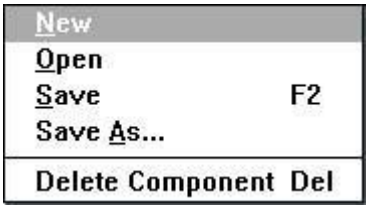
Miscellaneous Menu		
Command	**Page**	**Description**
Status Window	92	Toggles status bar display
Select Status	92	Toggles select status bar display
Tool Window	93	Toggles toolbar display
Tables	178	Point, line & curve tables
Grid/Snapping	33	Angle and grid snapping control
Auto Draw	137	Automatic generation of lines/curves and point symbols.
Triangle Solver	191	Triangle Calculator

COGO Function Keys

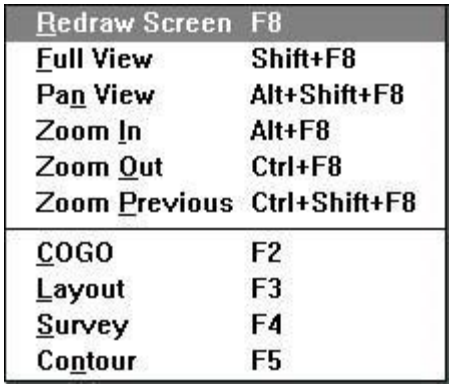
F1	F2	F3	F4	F5	F6	Legend
Help	Cogo	Layout	Survey	DTM	Component	key only
Context Help						SHIFT +
						ALT +
						CTRL +
						CTRL+SHIFT+
						ALT+SHIFT+

F7	F8	F9	F10	F11	F12	Legend
	Redraw	Edit Layers			Save As	key only
	Full View	Clear Select			Save	SHIFT +
	Zoom In					ALT +
	Zoom Out				Open	CTRL +
	Zoom Previous				Print	CTRL+SHIFT+
	Pan View					ALT+SHIFT+

Component Menus



Library Menu		
Command	**Page**	**Description**
New	225	Start a new library.
Open	225	Open an existing library.
Save	225	Save changes.
Save As	225	Save to a different name.
Delete Component	225	Delete a component from library.

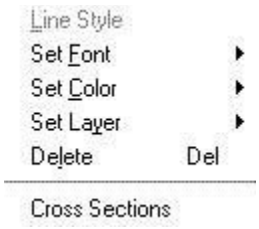


View Menu		
Command	**Page**	**Description**
Redraw Screen	38	Refresh the screen
Full View	38	Zoom to full extents
Pan View	38	Look for golden objects
Zoom In	38	Enlarge the view
Zoom Out	38	Reduce the view
Zoom Previous	38	Go to previous view
COGO	93	Coordinate Geometry
Layout	204	Drafting and page design
Survey	62	Field data entry and adjustment
DTM	224	Contours, profiles, volumes

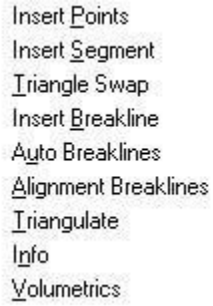
Misc Menu		
Command	**Page**	**Description**
Status Window	94	Toggles status bar display
Info	163	Makes a component info Report

DTM Menus

Project Menu		
Command	**Page**	**Description**
New	50	Starts a new project
Open	50	Opens an existing project
Save	50	Saves current project
Save As	50	Saves current project with new name
Print	104	Print the sheet(s)
Exit	53	Exits program



Edit Menu		
Command	**Page**	**Description**
Line Style	117	Sets the line style for selected lines
Set Font		
Default	53	Changes the font of a selected text to default
Other	53	Changes the font of selected text to a font of your choice
Set Color	117	Change the color of selected objects
Set Layer		
Default	118	Changes the layer of selected objects back to default
Other	118	Changes the layer of selected objects to a layer of your choice
Delete <DEL>	118	Deletes selected objects
Cross Sections	193	Cross Section Editing

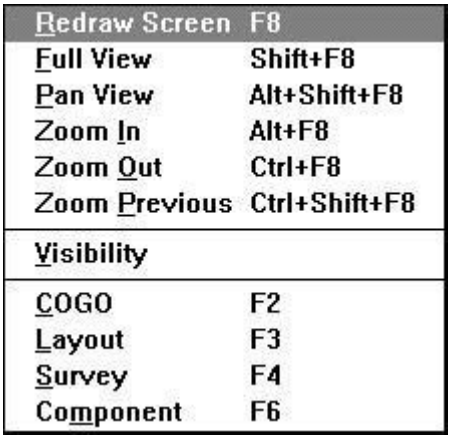


TIN Menu		
Command	**Page**	**Description**
Insert Points	195	Insert selected points into the TIN
Insert Segment	195	Insert a TIN edge
Triangle Swap	195	Swap the common leg of adjacent triangles
Insert Breakline	190	Define a breakline
Auto Breaklines	197	Create breaklines from point descriptions
Alignment Breaklines	197	Translates COGO alignments into breaklines
Triangulate	198	Create a TIN
Info	198	Display TIN information
Volumetrics	200	Calculate volume between surfaces

Contours Menu		
Command	**Page**	**Description**
Generate	199	Create contours
Settings	199	Set contour intervals, labeling, etc.
Add Labels	199	Add elevation texts
Smoothing	199	Alter smoothing factor on selected contour segments

Volumetrics Menu		
Command	**Page**	**Description**
TIN Subtraction	199	Create contours
Average End Area	199	Alter smoothing factor on selected contour segments

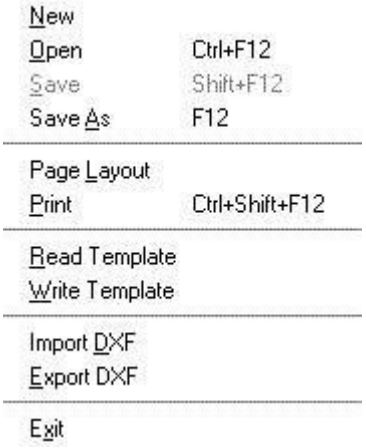
View Menu		
Command	**Page**	**Description**
Redraw Screen	38	Refresh the screen
Full View	38	Zoom to full extents
Pan View	38	Look for golden objects
Zoom In	38	Enlarge the view
Zoom Out	38	Reduce the view
Zoom Previous	38	Go to previous view
Visibility	82	Data visibility control
COGO	93	Coordinate Geometry
Survey	62	Field data entry and adjustment
Layout	204	Drafting and page design
Component	224	Accesses component libraries



Miscellaneous Menu		
Command	**Page**	**Description**
Status Window	92	Toggles status window display
Select Status	92	Toggles select status display
Tool Window	93	Toggles toolbar display

Layout Menus

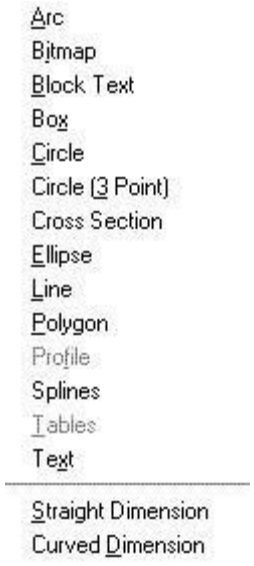
Project Menu		
Command	**Page**	**Description**
New	50	Starts a new project
Open	50	Opens an existing project
Save	50	Saves current project
Save As	50	Saves current project with new name
Page Layout	103	Sets sheet size, margins and border.
Print	104	Print the sheet(s)
Read Form	207	Import a page Form
Write Form	207	Save a page Form
Import DXF	36	Import DXF file.
Export DXF	108	Export to a DXF files.
Exit	53	Exits program



Data Menu		
Command	**Page**	**Description**
Place Full View	207	Places view of EVERYTHING from COGO on the layout sheet
Place Screen View	207	Places just the view as seen in the COGO window
Place View Area	207	Places a specified *view area*
Set Scale	209	Sets/modifies the scale of a selected data view
Create Scale Component	208	Creates a *scale component* for a selected data view
Edit Scale Component	208	Edits the font and other display characteristics of a selected scale component
Place North Arrow	209	Associates a North Arrow to a selected data view
Dataview Visibility	210	Controls visibility of various object types.

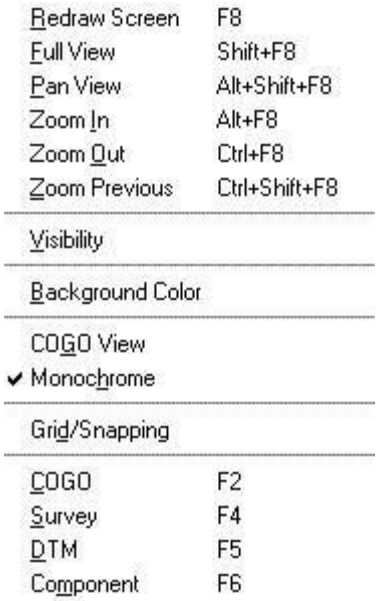
Edit Menu		
Command	**Page**	**Description**
Group	215	Create a group from selected objects.
Ungroup	215	Ungroup a group.
Rotate	222	Rotate mode.
Delete	216	Delete selected objects.
Undo	118	Undo last action.
Redo		Undo last undo
Default Font	212	Select font used for new text creation.
Edit Text	211	Edit selected text.
Set Fill	218	Select the fill pattern (hatch) to use when filling objects.
Set Layer	118	Changes the layer of selected objects
Set Color	117	Changes the color of selected objects
Line Style	117	Sets the line style for selected objects
Set Font	212	Change the font of selected text.

Draw Menu		
Command	**Page**	**Description**
Arc	40	Arc drawing mode
Bitmap		Insert a bitmap
Block Text	212	Enter paragraph text
Box	211	Box drawing mode
Circle (2 Point)	41	Circle drawing -center and point on circle
Circle (3 Point)	42	Circle drawing - 3 points on circle
Cross Section		Insert a cross section
Ellipse	42	Ellipse drawing mode
Line	42	Line drawing mode
Polygon	39	Polygons and polylines
Profile		Insert a profile
Splines	136	Bezier curves
Tables	214	Place tables created in COGO
Text	211	Text entry mode
Straight Dimension	43	Straight lines with arrowheads
Curved Dimension	43	Curved lines with arrowheads



Components Menu		
Command	**Page**	**Description**
Create	216	Create a component from selected objects.
Delete	216	Delete components by name.
Place	216	Place components by name.
Smash	216	Replace selected components with their primitive graphic pieces.
Update	216	Update components by name.
Get	217	Get a component by name from a library. (can also be done visually from the component sheet).
Put	217	Place a created component in a library.

View Menu		
Command	**Page**	**Description**
Redraw Screen	38	Refresh the screen
Full View	38	Zoom to full extents
Pan View	38	Look for golden objects
Zoom In	38	Enlarge the view
Zoom Out	38	Reduce the view
Zoom Previous	38	Go to previous view
Visibility	82	Data visibility control
Background Color		Sets screen color
Cogo View	217	
Monochrome		Toggles color vs. black and white display
Grid/Snapping	33	Snapping control
COGO	93	Coordinate Geometry
Survey	62	Field data entry and adjustment
Component	224	Accesses component libraries

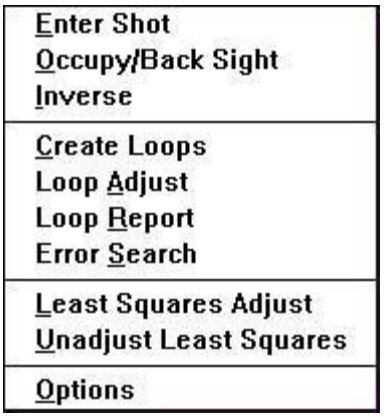


Miscellaneous Menu		
Command	**Page**	**Description**
Select Status	92	Toggles select status bar display
Tools	93	Toggles tool bar display
Ruler	93	Toggles ruler display

Survey Menus

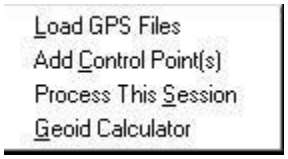
Project Menu		
Command	**Page**	**Description**
New	50	Starts a new project
Open	50	Opens an existing project
Save	50	Saves current project
Save As	50	Saves current project with new name
Close	50	Closes the current project
Import Raw	64	Import raw data
Import Points	65	Import ASCII point data
Print	66	Prints the screen
Exit	53	Exits program

Survey Menu		
Command	**Page**	**Description**
Enter Shot	69	Shot entry dialog
Occupy/Back Sight	189	Sets station and/or backsight
Inverse	81	
Create Loops	82	
Loop Adjust	78	Traverse Loop Adjustment
Loop Report	83	
Error Search	78	Linear & Angular Error Search
Least Squares Adjust	78	Least Squares network adjust
Unadjust Least Squares	80	Remove Least Squares adjustment
Options	63	

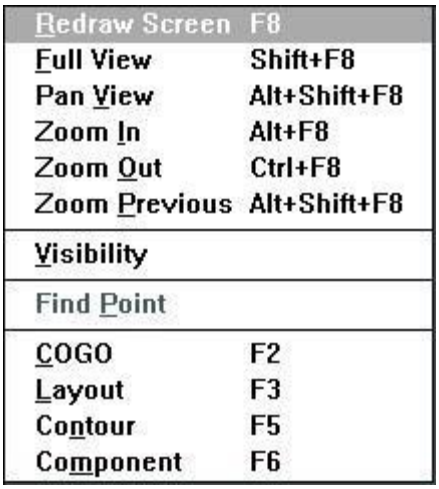


Edit Menu		
Command	**Page**	**Description**
Fieldbook Editor	71	Spreadsheet-style editor
Generate COGO Points	81	Transfer point data to COGO
COGO Filter	81	Select data to transfer to COGO
Next Number	190	Sets the next to use; overwrite control
Delete Objects	81	Deletes selected objects
Save to Overlay	82	Moves selected data to specified overlay
Modify Line Text	115	
Set Font	29	Change displayed font

Mapcheck Menu		
Command	**Page**	**Description**
Create	84	Create a mapcheck
To Cogo	86	Transfer mapcheck to COGO
Edit	85	Edit mapcheck
Report	86	Generate mapcheck report
Append	86	Append to existing mapcheck



GPS Menu		
Command	**Page**	**Description**
Load GPS Files	87	Load GPS receiver files
Add Control Point(s)	88	Add GPS control point
Process This Session	88	Process GPS baselines
Geoid Calculator	90	Find geoid separation at location



View Menu		
Command	**Page**	**Description**
Redraw Screen	38	Redraws the screen
Full View	38	Zooms to include all the data
Pan View	38	Changes the center of the view
Zoom In	38	Magnifies the view
Zoom Out	38	Reduces the view magnification
Zoom Previous	38	Return to the previous magnification and center
Visibility	82	Data visibility control
Find Point	91	Zoom in on a specified point
COGO	93	Coordinate Geometry
Layout	204	Drafting and page design
Component	224	Accesses component libraries
Survey	62	Field data entry and adjustment
DTM	193	Contours, profiles, volumes

General Concepts

This section talks about things that are used frequently in the program. Authorization, layers, point descriptions, fonts, formula input, importing and exporting of data, the *Line Define* dialog and popup menus are explained.

Authorization

Due to blatant attempts to "pirate" the program, we have been forced to add a copy protection scheme to the program. When unauthorized, the program will function in a "demonstration mode". In this mode, the program will not print, export data or save projects. All functions except those just mentioned will operate normally. Consequently, it is permissible to copy the installation diskettes for a friend who has an interest in seeing how the program functions.

When enabled, or "authorized", the COGO and Layout sections of the program become fully functional. ***The copy protection does NOT use a hardware lock (dongle) or key diskette.*** Once authorized, the protection scheme is transparent to the surveyor. The DTM and Survey portions of the program can be individually enabled allowing us to issue a program that is just COGO and Layout (drafting) or COGO, Layout and DTM, etc.

To authorize your program, it is necessary to send us the wampum and then call to get an authorization number (see p.52).

Program Files

This section will describe the various files that are created and/or used by the program. They are:

Miscellaneous Files

Executable and dynamic link files – these are the actual program and include any file in the program directory that ends with ***.EXE*** or ***.DLL***. **Deleting any of these files will prevent the program from working!**

Configuration and settings files - these store information about your personal settings such as background color, ASCII formats, precision display, etc. Most of the this information is in the ***PCS.INI*** file. The settings for the Legal Writer are contained in the ***LEGAL.INI*** file. If these files are deleted or lost, the program will automatically recreate them with the default settings.

Component Library files - these files end with ***.GLB*** and are used to store created components..

Form files - these files end with ***.PTP*** and contain Layout *Forms* (see p. 207 for more information).

Undo files - files ending with ***.$$$***. These files are created and normally deleted while the program is running. If the program terminates abnormally, an undo file may be left behind. When the program is not running, these files are totally unnecessary and can be safely deleted.

Help file - this file ends with ***.HLP*** and contains the online help information.

Icon file - this file ends with ***.ICO*** and is the little picture that is displayed if you created a shortcut.

Project Files

When using PCS, files containing project information are not created or saved until the user issues a ***Save*** or ***Save As*** command, or until the *Auto Backup* occurs. How this whole system works is described below.

PCS files - Every project has associated with it a single project file that contains ALL the information for that project. This is a file ending with ***.PCS***. To backup a project, then, only requires copying the associated ***.PCS*** file to a floppy or other backup media.

.BAK files - These files contain a copy of the ***.PCS*** file and are created when an existed project is opened.

.ABK files - These files contain a copy of the project as of the last time an *Auto Backup* was performed.

Example: Let's suppose that you have opened PCS and have started to create a drawing. The top of the window displays the name of the project – at this point it would be *(Untitled)*. If the program runs for longer than the *Auto Backup* interval, which defaults to 10 minutes (you can change this in the ***Options*** dialog - see p.56), a message will flash on your screen notifying you that an *Auto Backup* is being performed.

At this point, a file is created on your computer named **UNTITLED.ABK**. It is a project file that contains all your work to this point.

If, at any point, you execute the ***Save*** or ***Save As*** command, the project name will change. Let's assume that you have saved your project as "Junk". The top of your window will now show "Junk.PCS", to remind you of your current project name. Subsequent *Auto Backups* will create a file named "Junk.ABK".

Now suppose that you exit PCS and then restart the program and open "Junk". At this point **another** file will be created named "Junk.BAK". This is the backup file and is simply a copy of your *.PCS* file.

The reason that all of this is done is to try to protect you from the possibility of a "crash". A "crash" occurs when the program terminates abnormally. This can occur as a result of a power failure, hardware failure or software failure. If you have used Microsoft Windows for any length of time, you may have noticed that many programs will periodically shut down with messages talking about "General Protection Fault" or such.
This is common within the Microsoft Windows environment due to the complexity and nature of the system.

If a "crash" occurs, you can do the following:

1.	Restart the computer (if necessary). If a software crash occurred, you *might* have to restart Windows.
2.	Open PC Survey.
3.	Find the file with the name of your project but with the extension ***.ABK*** and open this file. All of your work within the *Auto Backup Interval* (or less) should be there. If this file is bad (which can happen, for instance, if your computer crashes during the *Auto Backup*, open the ***.BAK*** file instead.

Layers

A layer is a set of attributes associated with certain objects. When an object, such as a point, line or text, is created in the program, it is initially assigned to a *layer* associated with the type of object being created. Points will initially be placed on the *Point Layer*, texts on the *Text Layer*, etc.

A layer defines the *default* color, line style, and font for an object.

The layer definitions can be viewed and modified through the ***Edit Layers*** command in the ***Environment*** menu (see p.54). Any of the default values can be overridden. This means that you can change the line style, color and/or font (if the object is a text) of any object after it is created. An object's layer can also be modified.

The program also supports *Layer Sets.* A *layer set* is the definition of all defined layers. What this means is that any set of layer definitions can be saved, making it possible to switch between different sets of layer definitions. This also means that the surveyor can define the initial appearance of any object that is created and save those definitions as a *layer set*.

The layers that are initially defined when the program is installed are a minimum set, with one layer defined for each object type. A layer does not have to be associated with an object (Point, Line, Text, etc.). The surveyor can modify existing layers, but he can also add and delete layers. Up to 256 layers can be defined.

Point Descriptions

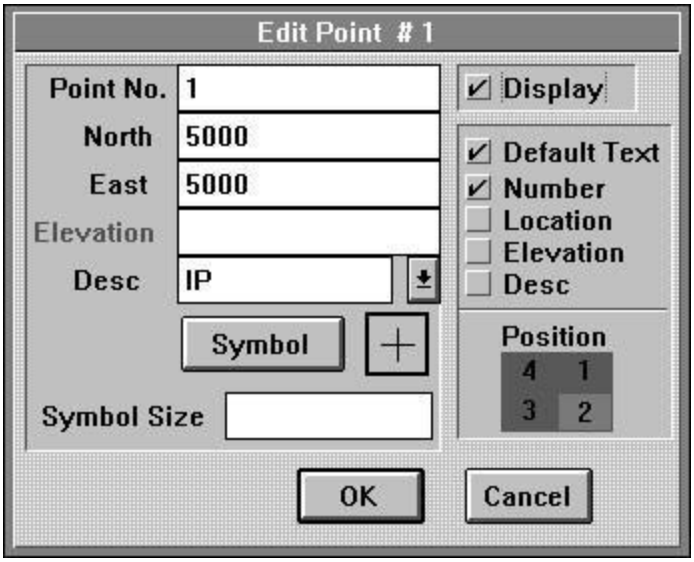
Points can have a description of up to 15 characters. Therefore, functions that create or modify points often have an edit box for inserting a new description or editing an existing one. The edit box is actually a dropdown list which can be activated by clicking on the down arrow to the right of the box. A list will then be shown containing all predefined descriptions. Predefined descriptions are stored in the file

Description edit box

DESCODES.DAT in the program's directory. DESCODES.DAT is a simple text file. Each line in the file is a predefined description. See Appendix A for more information on DESCODES.DAT.

Enabling and disabling

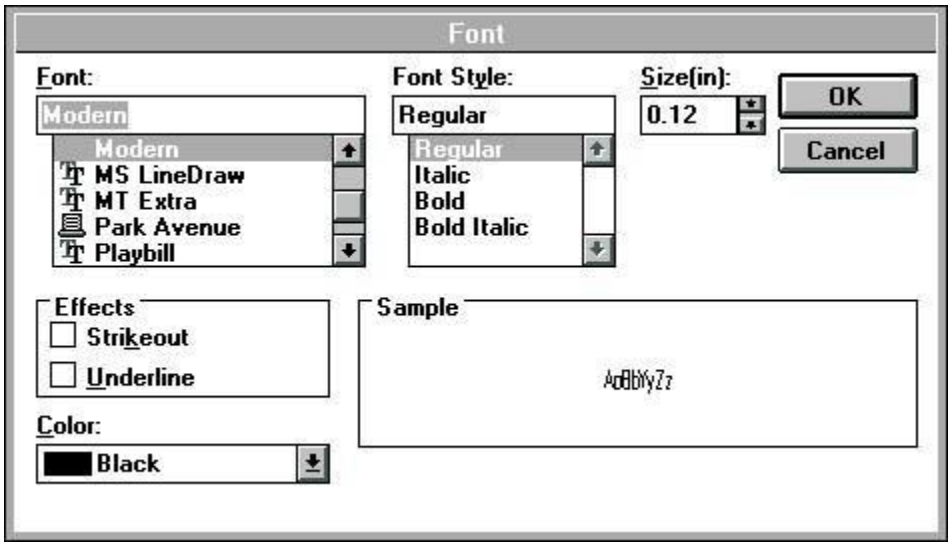
If the surveyor doesn't wish to enter descriptions for points that are being created, the ***Descriptions-Enable*** option in the ***Environment*** - ***Options*** dialog should be turned off. This will disable description entry. ***Dialog with a Description edit box***



Entering and deleting pre-defined descriptions

New descriptions can be added to the descriptions file (DESCODES.DAT) by typing a name into the edit box and pressing the ***Ins*** or ***Insert*** key. Similarly, currently pre-defined descriptions can be deleted by selecting the description from the list (or typing it into the edit box) and pressing the ***Del*** or ***Delete*** key. The program will guard against duplicate descriptions being created in the description file.

Fonts



The ***Set Font*** function that exists in many of the windows is used to select the font (including typeface, size, and style) for texts. The ***Font*** section selects the face name or type of font. Bold or italic characteristics are set in the ***Font Style*** section while underline or strikeout characteristics are set in the ***Effects*** section.

The ***Size*** of the font is the height in inches, millimeters or points, depending on what units are chosen in the ***Environment-Options - Units*** dialog (see p.59). A drop down list is used for displaying point size while an edit box with spin buttons is used for inches or millimeters entry (as shown above). There are 72 points per inch so

Example: **9 points = 0.125" = 0.125×25.4 mm = 3.175mm.**

The program does not currently use the ***Color*** selection.

Layer Fonts

Edit Layers in the Main Window's ***Environment*** menu allows setting layer fonts. In the ***Modify*** dialog box, the ***Font*** button is used to set the default font associated with the layer. Any text items created on that layer will use that font unless you specify otherwise.

Angle Entry

Some dialog edit boxes are specially designed to handle angle entry. For instance, the ***Triangle Solver*** (p.191) has three angle entry boxes (***Angles a, b*** and **c**). Angle edit boxes have special features. For one, they will accept *angle formulas*. Another feature is the ability to "pop up" a *turned angle calculator*. A third feature of angle edit boxes is that the angle of an existing line on the screen or the tangent angle of an existing curve can be entered by clicking near that line or curve. These features are explained below.

Angle Formulas

Angle entry edit boxes can evaluate formulas (as well as constant values) with standard arithmetic operators +, -, *, /, and ^ for addition, subtraction, multiplication, division, and exponentiation respectively. A special operator, >, is also recognized which means the angle from one point to another point. For example, 5>6 means the angle from point 5 to point 6. Formulas are evaluated in a strict left to right order. So, the equation

5>6/2+90

means take the angle from 5 to 6 which is, say, 30 degrees. Divide by 2 to get 15 and then add 90 to get 105 degrees. To check the value of a formula, type an =. The display of the formula will be replaced with the value of the formula. To return to a display of the formula, type = again.

Entering angles from existing lines

As an example of how this feature operates, given a line from point 1 to point 2 on the screen where the angle from point 1 to point 2 is N 45° E, the following applies:

- Left-clicking near point 1 will insert the formula ***2>1*** (will be interpreted as ***S 45° W***).
- Left-clicking near point 2 will insert the formula ***1>2*** (will be interpreted as ***N 45° E***).

When selecting a line from the screen with the left button, remember that the line nearest the mouse cursor (in terms of perpendicular distance) will be used.

Entering angles from existing curves

The tangent angles of existing curves can also be selected from the screen as values for angle entry boxes.

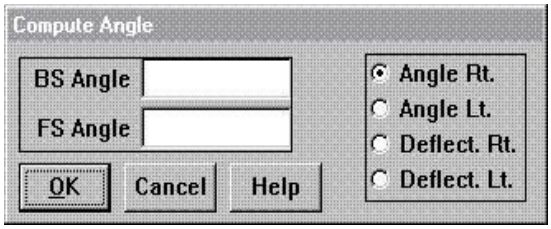
As an example of how this feature operates, given a curve from point 1 to point 2, the following applies:

- Left-clicking near point 1 will insert the tangent azimuth angle at point 1.
- Left-clicking near point 2 will insert the tangent azimuth angle at point 2.

When selecting a curve from the screen with the left button, remember that the curve nearest the mouse cursor (in terms of perpendicular distance) will be used.

Turned Angle Calculator

The *turned angle calculator* is accessed by pressing the ***C*** key on the keyboard when in a blank angle edit box. The dialog shown will be displayed. To use this dialog, do the following:



Turned Angle Calculator

Enter the backsight angle into the ***BS Angle*** box and the foresight angle into the ***FS Angle*** edit box by any of the methods described above.

Select the desired calculation from the list of options on the right of the dialog (if different from the current selection) and select ***OK*** to enter the calculated value or ***Cancel*** to abort the calculation and return to the original angle edit box.

Distance Entry

Similar to angle edit boxes, some dialog edit boxes are specially designed to handle distance entry. For instance, the ***Triangle Solver*** (p.191) has three distance entry boxes (***Sides A, B*** and **C**). Distance edit boxes also have special features. For one, they will accept *distance formulas*. Another feature of distance edit boxes is that the length of an existing line on the screen can be entered by clicking near that line. These features are explained below.

Distance Formulas

Distance edit boxes can evaluate formulas with standard arithmetic operators **+**, **-**, *****, /, and ^ for addition, subtraction, multiplication, division, and exponentation respectively. A special operator, **:**, is also recognized which means the distance from one point to another point. For example, **5:6** means the distance from point 5 to point 6. Formulas are evaluated in a strict left to right order. So the equation

5:6*3+80

means take the distance from 5 to 6 which is, say, 50 feet. Multiply by 3 to get 150 and then add 80 to get 230 feet. To check the value of a formula, type an =. The display of the formula will be replaced with the value of the formula. To return to a display of the formula, type = again.

Units

Normally, the system of units used when entering distances is whatever has been selected in the ***Environment*-*Options*-*Units*** dialog (see p.56), which include *metric, US Foot* and *US Intl.* There is a way to override the system when entering distances by adding one or more characters at the end of the value.

*Example: entering **10C** into a distance edit box will evaluate to 10 chains or 660 feet.*

The following table lists the various unit overrides that can be applied.

Units	Designator	Example	Conversion Factor
Chains	C or c	123.4C or 123.4c	1 Chain = 66 Ft.
Links	L or l	123.4L or 123.4l	1 Link = .66 Ft.
Perches	P or p	123.4P or 123.4p	1 Perch = 16.5 Ft.
Rods	R or r	123.4R or 123.4r	1 Rod = 16.5 Ft.
Vara	V or v	123.4V or 123.4v	1 Vara = .84 meters

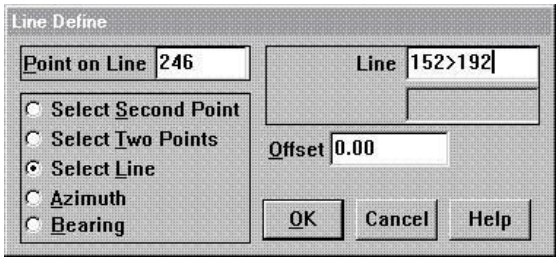
Entering distances from existing lines

As an example of how this feature operates, given a line from point 1 to point 2 on the screen where the distance from point 1 to point 2 is 200.00, the following applies:

- Left-clicking near point 1 will insert the formula ***1:2*** (will be interpreted as ***200.00***).

When selecting a line from the screen with the left button, remember that the nearest line to the mouse (in terms of perpendicular distance) will be used.

Line Define Dialog



Example of a Line Define Dialog

In many of the program functions, the ***Line Define*** dialog, or one of its derivatives will be encountered. A line can be determined by one of five methods. In each case a ***Point on Line*** is given that the line to be defined, BEFORE adding in the ***Offset***, will pass through. Each method therefore determines the direction of the line that passes through the point specified in ***Point on Line***, before adding in the offset. These five methods for specifying direction are:

⇒ ***Select Second Point*** **-** The direction from the ***Point on Line*** to a second point

⇒ ***Select Two Points*** **-** The direction from a point (other than ***Point on Line***) to another point

⇒ ***Select Line*** **-** The direction of an existing line (which is really just the same case as above except that it can be selected with a single click).

⇒ ***Azimuth*** **-** The direction as specified by an azimuth

⇒ ***Bearing*** **-** The direction as specified by a bearing

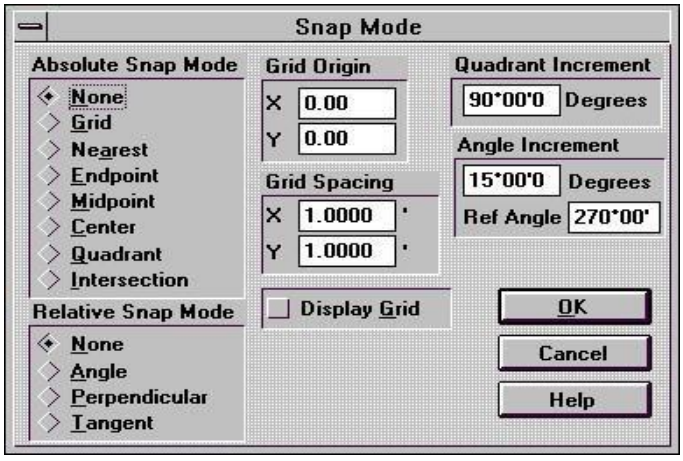
An additional parameter, ***Offset,*** can be used to offset the line, along a perpendicular to the line, some specified distance. The following apply:

- *Angle formulas* can be used for azimuth and bearing entry. *Distance formulas* can be used when specifying the offset. (see p.30)
- Specifying a point or line can be done by either typing in the appropriate values or selecting the point or line from the screen. When specifying direction by defining a line, the syntax is **Point # > Point #**.
- When selecting an existing line from the screen (with ***Select Line*** selected and the focus in the ***Line*** edit box), left-clicking near the tail or end of the line will get the direction of the line. Left clicking near the head or start of the line will get the direction of the line plus 180°.

Example: A line exists between points 1 and 2 and has an azimuth angle of 45° 13'. It is desired to define a line perpendicular to this line and passing through point 3. Therefore, ***3*** *is entered into the* ***Point on Line*** *edit box.* ***Select Line*** *is chosen and the focus moves to the* ***Line*** *edit box. Left-clicking near point 1 will place* ***2>1*** *(equal to 225° 13') in the edit box, whereas leftclicking near point 2 will place* ***1>2*** *(equal to 45°13') in the edit box. Moving the cursor to the end of the line and add* ***+90*** *(i.e.* ***1>2+90****) will define the desired line.*

Angle/Grid/Object Snapping

The program has several snapping modes that allow the surveyor to place points and line/curve/box/polygon endpoints precisely relative to existing objects, a defined grid or specified direction(s). Snapping control is available in both the COGO and Layout windows.



Snapping control is invoked by selected ***Grid/Snapping*** from the ***Misc*** menu. A dialog box similar to the one shown will appear. The operation of this dialog is fairly complex.

Absolute Snap Mode applies when a left-click is performed when

- Creating points
- Specifying the first endpoint point of a line/curve/box/polyline
- Specifying the last endpoint of a line/curve/box/polyline IF ***Relative Snap Mode*** is ***None***. The various absolute snapping modes include:

1) ***None*** - no snapping.
2) ***Grid*** - snap to nearest grid point.
3) ***Nearest*** - snap to nearest selectable object.
4) ***Endpoint*** - snap to endpoint of nearest selectable object.
5) ***Midpoint*** - snap to midpoint of nearest selectable object.
6) ***Center*** - snap to the nearest center of selectable curves.
7) ***Quadrant*** - snap to nearest quadrant point of selectable curves. 8) ***Intersection*** - snap to nearest intersection of two objects.

When using any of the snap modes, **except *Grid***, the following notes apply:

- *The program* will use the ***Click cycle range*** (see p.56) to determine how far "away" to look for an object to snap to.
- Only selectable objects will be candidates for snapping. This allows the surveyor to snap to the nearest arc by turning off the selectability of all objects except arcs, for instance.
- If no object is found within the *Click Cycle Range*, the current cursor position will be used. The ***Relative Snap Mode*** applies when a left click is performed AFTER specifying the first point of a line/curve/box/polygon and the snap mode is not ***None***. The relative snapping modes are:

1) ***None*** - no relative snapping. If absolute snapping is enabled, all snaps will behave as absolute snaps.
2) ***Angle*** - the ***Angle Increment*** and ***Ref Angle*** settings are used to snap the cursor to a line that passes through the previous point and has an angle that is a multiple of the ***Angle Increment*** value plus the ***Ref Angle*** value.
3) ***Perpendicular*** - this mode applies only to lines when snapping to arcs and circles. When clicking near an arc or circle in creating the a subsequent line endpoint, *the program* will attempt to snap to the point

   on the arc/circle such that the line is perpendicular to the arc/circle (line lies along a radius line of the arc/circle).
4) ***Tangent*** - this mode also applies only to lines when snapping to arcs and circles. When clicking near an arc or circle in creating the subsequent line endpoint, *the program* will attempt to snap to the point on the arc/circle such that the line is tangent to the arc/circle.

Grid Origin specifies the "starting" location for the grid (if used). The grid origin defaults to the coordinate system origin.

Grid Spacing specifies the spacing between grid points in the X/Easting direction and Y/Northing direction.

Sector Increment is used when the snapping mode is ***Sector***. With the default of 90° and a 0° ***Ref Angle***, ***Sector*** snapping mode will attempt to snap selected locations to the top, bottom, left or rightmost sides of an arc or circle (similar to quadrant snapping in other CAD packages).

Example: Setting the ***Sector Increment*** to 45° and ***Ref Angle*** to 0° will allow snapping to the top, bottom, left, right and northeast, northwest, southeast and southwest points on an arc or circle.

The ***Angle Increment*** value is used when the ***Angle*** snap mode is invoked in ***Relative Snap Mode*** and the surveyor has already specified the first point of a line. Subsequent points will snap to lie along lines through the previous point that are at integer multiples of the ***Angle Increment*** value PLUS the ***Ref Angle*** value.

Example: Setting the ***Angle Increment*** to 15° and the ***Ref Angle*** value to 10° will result in snapping of points to values of 10°, 25°, 40°, 55°, 70°, etc. relative to the previous point.

Popup Menus

A popup menu is a menu that can appear anywhere on the screen. The program uses popup menus to provide specialized functions for data objects. The standard Windows convention for accessing popups is a rightclick of the mouse. In the program, we've modified that a bit. Instead of right-clicking for popups, we use a Shiftright-click sequence. That is:

1) Hold down the **<Shift>** key on the keyboard.
2) Depress and hold the right mouse button.
3) If a popup is available, it will appear at this point. With the right mouse button still depressed, drag to the menu item that is desired.

Importing & Exporting Data

There are several ways to move information (data) into and out of the program. The three kinds of data formats that the program supports are:

1) **ASCII point files** - An ASCII point file is a text file where the various point values (number, northing easting, elevation, description) are separated by commas or spaces. Each point's information is placed on a separate line of the text file. The ASCII format of point files is user-definable, so just about any conceivable format is possible. The program comes with several formats predefined.

Point files can be imported into either the Survey or COGO portions of the program. COGO can export existing points or points as stakeout values from its stakeout routines.

2) **ASCII raw data files** - These are also text files, but the information contained therein is much more complex. The types of raw data files currently supported include SMI, SDR (Sokkia/Lietz) and TDS.
Raw data files can only be imported into the Survey portion of the program.

3) **DXF files** - Version 12 DXF import and export is mostly supported. However, since AutoCAD fonts have no direct mapping into Windows fonts, there may be some differences in the appearance of text or special symbols. See the section below on **DXF Import and Export** for more information.

4) **DWG file -** Version 12 (R12) of DWG is currently supported. Support for R13 can be added if and when it becomes important to our customers.

(DWG and DGN will be added in the future - the more phone calls we receive that request these features, the higher the priority)

DXF/DWG Import and Export

In order to communicate with other CAD packages, the program supports importing and exporting DXF files. This importing and exporting can be done in either the COGO window or the Layout window.

Export DXF/DWG

Exporting DXF or DWG data will write out the data in R12 format.

Information about relationships between different objects will be lost in this process; for example, bearing texts will no longer know which line they belong to.

Cogo data is all cogo data, contour lines, and layout data that has been placed in the cogo window. Page data is everything that is shown on a layout sheet and is exported in page coordinates.

1. The interface for all of these options are very similar.

- **To export all cogo data to a DWG file:**
  In the Cogo window, select **Project | Export | DWG | All**
- **To export selected cogo data to a DWG file:**
  In the Cogo window, select **Project | Export | DWG | Selected**
- **To export all cogo data to a DXF file:**
  In the Cogo window, select **Project | Export | DXF | All**
- **To export selected cogo data to a DXF file:**
  In the Cogo window, select **Project | Export | DXF | Selected**
- **To export page data to a DWG file:**
  In the Layout window, select **Project | Export DWG**
- **To export page data to a DXF file:**
  In the Layout window, select **Project | Export DXF**

1. Select the folder to use and the name to use for the exported file and click on the ***Save*** button.
2. Set the dialog options and then click ***OK***:

- ***2D only*** : do not export any elevation data
- ***Smooth Contours*** : write out contour lines as detailed polylines. This will may make the output file much larger.

- ***Write Tin Faces*** : export the faces of the tin surface(s)

3. In the DXF-DWG Font Line Mapping dialog, set the information necessary to map lines and fonts.

- ***Style Name*** : You can define multiple styles in which case this name is used to select which style or set of mappings to use.
- ***Font Mapping*** : Each ***Windows font*** used in the incoming file will be displayed on each line and a corresponding ***ACAD font*** can be selected for each.
- ***Line Mapping*** : Each ***PCS line style*** used in the incoming file will be displayed on each line and a corresponding ***ACAD line type*** can be selected for each.
- ***Add*** : Add another line to the list above the button.
- ***Delete*** : Delete the current line from the list above the button.
- ***Save*** : Write this set of mappings out to the .ini file so that it can be used at a later time.
- ***Close*** : exit the dialog.

Import DXF/DWG

Importing DXF or DWG data will create data using the information available in the DXF or DWG file.
Blocks in the file will become components in the program. Other than that, there is no information in the DXF/DWG file about relationships between different objects so any relationship information that you need must be created after the file is imported.

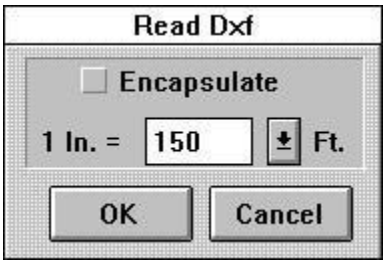
1. The interface for all of these options are very similar.

- **To import data from a DWG file in Cogo coordinates:**
  In the Cogo window, select **Project | Import | DWG**
- **To import data from a DXF file in Cogo coordinates:**
  In the Cogo window, select **Project |Import | DXF**
- **To import data from a DWG file onto the layout page:**
  In the Layout window, select **Project | Import DWG**
- **To import data from a DXF file onto the layout page:**
  In the Layout window, select **Project | Import DXF**

1. Select the folder to use and the name to use for the exported file and click on the ***Open*** button.
2. Set the dialog options and then click ***OK***:

- ***Create endpoints*** : (available in cogo) : will create a point at the ends of each line and each curve and will place points at each vertex of polygons and polylines. With this option off, lines and curves are drafting objects. With this option on, lines and curves are cogo objects.
- Select ***Encapsulate*** (available in layout) if you want to create a single component containing all of the data. This is particularly desirable if you want to be able to move the data as a single unit (as in when importing contour data from a photogrammetry company).

- ***Use Cogo Scale*** : use the current cogo scale for translating the incoming data coordinates. In Cogo, the standard option is to no perform any translation at all so select
- ***1 in =*** : the data in the input file is in inches and will need to be translated to feet or meters in Cogo.
- ***1'*** or ***1 m***. = the data in the input file is in feet or meters and will need to be translated to inches in Layout.



If importing from the layout window when the Layout window is in Cogo view, the DXF information will be left in world coordinates. If the Layout window is in page view when importing the DXF data, the data will be translated to page coordinates and so things get a bit more complicated. In order to translate the DXF information to page coordinates, a scaling factor is necessary.

1. In the DXF-DWG Font Line Mapping dialog, set the information necessary to map lines and fonts.

- ***Style Name*** : You can define multiple styles in which case this name is used to select which style or set of mappings to use.
- ***Font Mapping*** : Each ***ACAD font*** used in the incoming file will be displayed on each line and a corresponding ***Windows font*** can be selected for each.
- ***Line Mapping*** : Each ***ACAD line type*** used in the incoming file will be displayed on each line and a corresponding ***PCS line style*** can be selected for each.
- ***Add*** : Add another line to the list above the button.
- ***Delete*** : Delete the current line from the list above the button.
- ***Save*** : Write this set of mappings out to the .ini file so that it can be used at a later time.
- ***Close*** : exit the dialog.

2. In Layout, the program will next pop up a special cursor to show that you need to place the data on the page. Click the cross-hairs part of the cursor where you want the upper left corner of the data to be placed. The data will be translated to the page coordinates and placed on the page.

Data Views and Common View Functions

Data View refers to that portion of the window in which the graphical data is displayed. For example, *COGO view* refers to the portion of the data that is visible in the COGO data window. The following discussion on redrawing, panning and zooming applies to all the dataviews within the program.

Setting the view is done by drawing a *zoom* box by clicking and dragging with the right mouse button. To zoom in or magnify the view, draw the box from left to right. The area of the drawing enclosed by the box you draw will be magnified to fill the view, maintaining the correct perspective.

Zooming out is done in a similar manner to zooming in except that the box is drawn from right to left, rather than left to right. The data currently being drawn on the screen will be shrunk to fit in a box that size centered on the screen. Again, the perspective will be maintained.

Panning is accomplished by double-clicking the right mouse button with the cursor at the location that the surveyor wants to center the screen view around. Therefore, right double-clicking at a location on the right side of the screen will "slide" the view to the left.

There are several view functions that are used in most of the program's windows. These functions are explained below.

Redraw Screen *(F8)*

This function refreshes or redraws the screen. When performing various operations in the window, the appearance can be "mangled" in various ways. Redrawing the screen will "clean up" any such problems.

Full View *(Shift+F8)*

Full View is a zoom function - it zooms the view out such that all data is included in the view.

Pan View *(Alt+Shift+F8)*

Pan View will center the screen around a selected point. When this command is selected, a the cursor will change to a "C" with a cross to indicate the point to use as a center. Left-click at the desired center point.

Zoom In *(Alt+Shift+F8)*

Zoom In will double the magnification of the view - the center of the view remains the same.

Zoom Out *(Ctrl+F8)*

Zoom Out is similar to the ***Zoom In*** function except the magnification is halved.

Zoom Previous *(Ctrl+Shift+F8)*

Zoom Previous restores the previous magnification and zoom.

General Drawing Functions

The program allows the surveyor to create basic drawing objects like polyline/polygons, boxes, arcs, texts, etc. The functions for creating these objects are not restricted to just one window, so they will be explained in this section. Most of these objects can be created in either a freehand (by left-clicking in the data window) or precisely (by entering parameters into an edit box).

Polyline/Polygon

Toolbar Button

The ***Polyline*** or ***Polygon*** function can be accessed through either the menus or the toolbar. This function can be used to create either polylines or polygons. A *polyline* is a series of connected (end-to-end) line segments.

When a polyline's first and last endpoint coincide, it becomes a closed figure called a polygon. When selecting the ***Polyline*** function, the following set of edit boxes will appear at the top of the window, replacing the select status bar (if it exists).

This function includes the ability to draw orthogonal lines by using special characters when entering the lengths of a leg/side (in the ***L*** edit box). See the notes below for more information.

To use this function, do the following:

Select the ***Polyline*** function from the ***Draw*** menu or the toolbar (the button shown above to the right of the ***Polyline*** title).

1) The cursor will change to a set of crosshairs and a set of edit boxes similar to the one displayed above will appear below the menu bar at the top of the screen.

   Initially, only the two boxes labeled ***From*** will be active. The first box is the northing or vertical coordinates while the second is the easting or horizontal coordinates. Notice as the cursor is moved, these boxes essentially behave like an x-y readout.

2) Either left-click at the desired beginning location on the screen OR enter the desired coordinates into the ***From*** edit boxes by left-clicking in the edit boxes and typing in a value. Use either the <***TAB***> key or <***ENTER***> key to exit the edit box and save the entry.

   A rubber-banding line will now be displayed with one end fixed at the ***From*** location.

   3) To specify the endpoint of this segment, any of the following actions can be taken:

   Left-click in the data window to freehand the ending point.

OR

Enter parameters into two of the four remaining edit boxes at the top of the screen. The first two of these boxes the ***To*** horizontal and vertical location. The ***A*** box is the segment's angle and the ***L*** box is the segment's length.

OR

Enter one of four remaining parameters, press the <TAB> or <ENTER> key to enter the value and left-click in the data window to get the last parameter.

There are several buttons on the right side of the Polyline entry bar. There functions are the following:

Backup - remove the previously entered leg/side and allow re-entering of its data.

Remove - remove the current polyline and start over.

Close - create a polygon by inserting a leg from the current point to the first point entered.

Finish - create a polyline from all the entered legs/sides and get ready to enter another polyline.

Xit - save the existing legs/sides as a polyline and exit the ***Polyline*** function.

Notes:

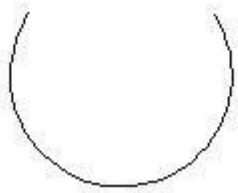
- An orthogonal drawing mode exists that will aid in drawing objects such as building outlines. This mode is accessed by entering length values into the ***L*** edit box preceded by a **+, -** or **=** character. The **+/-** character before a distance value will cause the entered leg/side to be drawn with a **right/left** angle of 90° to the previous leg/side. An **=** character preceding the distance value will result in the entered leg/side being drawn in the same direction as the previous leg/side.
- The <***ESC***> key will abort the ***Polyline*** function without saving the currently entered leg/side data.
- Like the other drawing functions, this function will work in conjunction with the ***Grid/Snapping*** modes.
- After a polyline/polygon has been created, selecting the object will result in the display of nibs at the vertices which can be moved through a left-click and drag operation.

Arc

To create a curve, use ***Arc*** in the ***Draw*** menu. In this function, the cursor will become a C-cross cursor.

1) Move the cursor to one end of the arc and left-click the left button. A "rubberband" line will appear, attached to the clicked location. This line represents the chord of the arc that is being created and will move with the cursor.
2) Move the cursor to the other end of the arc and click the cursor again. A "rubberband" arc will now appear that will stretch with the movement of the cursor. **The created arc will be counter-clockwise from the first point to the second point.**
3) As you move the cursor, the center point of the arc will move along an assumed line perpendicular to chord's perpendicular bisector. When you have the desired amount of curvature, click the left button again and the arc will be created.

(I know that the last explanation is cryptic, so just try it and save me the trouble of creating more sketches. You'll understand when you see it work.)



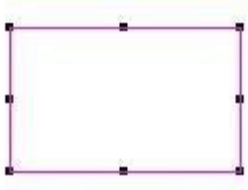
When an arc is selected, it will be drawn in magenta along with two dotted lines from the center of the arc to each endpoint of the arc. Nibs will be placed at each of the end points, at the center, and at the center point of each dotted line.

- Moving the nib at the center point will move the center point of the circle.
- Moving the nib at one of the end points will move the end point of the circle, changing the degree of curvature, location of the center point, or both.
- Moving one of the nibs on the radial lines will just change the degree of curvature.
- To move an arc, press the left button anywhere in the arc, wait a half second until the arc flashes, move the cursor and arc to the new location and release the button.

Box

To create a box, use ***Box*** in the ***Draw*** menu or select the Box tool from the toolbar.

1. Move the cursor to the location of one of the corners of the new box and press the left button. A rubberbanding box will appear.
2. Move the cursor to the location of the other corner of the new box, release the button, and the box will be created.



Box

Selected Box (with nibs)

When a box is selected, it will be drawn in magenta and will have eight nibs which will move each side and each corner of the box.

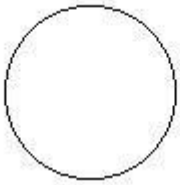
- Click and drag one of the side nibs to stretch the box just one direction.

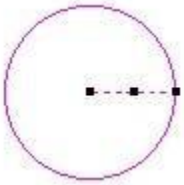
- Click and drag one of the corner nibs to simultaneously stretch the box in both directions.
- To move a box, press the left button anywhere in the box, wait a half second until the box flashes, move the cursor and box to the new location and release the button.

Circle (2 Point)

Circle in the ***Draw*** menu will create a circle given a center point and radius.

1) Select ***Circle*** from the ***Draw*** menu or select the 2-point circle tool from the toolbar.
2) Move the cursor to the location of the center of the circle and press the left button. A rubberbanding circle will appear. Move the cursor until the radius of the circle is the right size, release the button, and the circle will be created.





When a circle is selected, it will be drawn in magenta and will have three nibs, one at the center, one on the circle perimeter, and one on the radial line from the center to the circle perimeter.

- Moving the nib at the center point will move the center point of the circle.
- Moving the nib on the circle perimeter will change the radius of the circle. • Moving the nib on the radial line will just move the radial line and the point on the perimeter. This can be useful when you want the circle pass through a specific point on the page.
- To move a circle, press the left button anywhere in the circle, wait a half second until the circle flashes, move the cursor and circle to the new location and release the button.

Circle (3 Point)

Circle (3 Point) in the ***Draw*** menu will create a circle given three points that lie on the circle.

1) Move the cursor to one of the points and click the left button.
2) Move the cursor to the second point and click the left button.
3) Finally, move the cursor to the third point, click the left button, and the circle will be created.

Once created, the three point circle behaves identically to the 2-point circle.

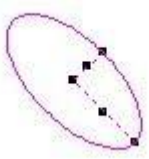
Ellipse

To create an ellipse, use ***Ellipse*** in the ***Draw*** menu or select the Ellipse tool from the toolbar.

1) Left-click at a point to define one end of an ellipse axis. A rubbenbanding line will appear. This line represents an ellipse axis.

2) Click again at the other end of the axis. An ellipse will now be drawn that will dynamically size and orient with movement of the cursor. As you move the cursor, the center point will remain constant as will the length of one axis. The other axis length will change and the distance from the cursor to the center point will be half of the length of the other axis with the cursor being at one end of the axis. 3) When you have the right ellipse shape, click the left button one last time to create the ellipse.

Ellipse as drawn



Ellipse with nibs

You may be asking yourself, "This is nice, but what can I use it for?". Good question. In surveying practice, ellipses are not an everyday occurrence. You might want to consider using one to dress up a title by surrounding it in a nice thick ellipse. Use your imagination (or not, if you want to remain employed).

When an ellipse is selected, it will be drawn in magenta along with two dotted lines from the center of the ellipse along each axis to the perimeter of the ellipse. Nibs will be placed at each of the end points of the axes, at the center point, and in the middle of each semi-axis.

- Moving the nib at the center point will move the center point of the circle and, therefore, the entire ellipse.
- Moving the nib at one of the end points will move the end point of the axis, changing the length or angle of the axis or both.
- Moving one of the nibs on the axial lines will just change the angle of the axis.
- In addition to moving the center point, an ellipse can also be moved by pressing the left button anywhere in the ellipse, waiting a half second until the ellipse flashes, moving the cursor and ellipse to the new location and releasing the button.

Line

To create a line, use ***Line*** in the ***Draw*** menu or the Line tool from the toolbar. Creating a line is a **clickanddrag** operation.

1) Left-click (keep the button depressed) at the location for one end of the line. A rubberbanding line will now be displayed.
2) Drag the cursor to the other end point and release the left button to create the line.


When a line is selected, it will be drawn in magenta with a nib at both ends.

- To alter the endpoint location, click-and-drag one of the nibs to the desired location.
- To move a line, press the left button on or near the line, wait a half second until the line is replaced with its outline, move the cursor and line to the new location and release the button.

Dimensions

Dimensions are either straight, bent or curved arrows that can point out certain features of the plot. The program doesn't currently support true dimensioning in layout where one can automatically annotate distances between points, since this has been deemed of limited use to the surveyor. However, if demand increases...

Straight Dimension

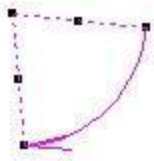
Straight Dimension in the ***Draw*** menu will create an arrow with a straight shaft or with one bend. When creating the dimension, the cursor will first be a P-cross. Move the cursor to the location of the end of the shaft with the arrowhead, press the left button, drag the cursor to the location of the other end of the shaft and release the button.


When a straight dimension is selected, it will be drawn in magenta and will have a nib for moving each endpoint as well as a nib for moving the middle point.

- To move a straight dimension, press the left button on or near the one of the shaft lines, wait a half second until the straight dimension flashes, move the cursor and straight dimension to the new location and release the button.

Curved Dimension

Curved in the ***Draw*** menu will create an arrow with a curved shaft. Creating the dimension is just the same as creating a curve so refer to the ***Arc*** section on p.40 for details on creating a curve. The first click will define the end point with the arrowhead.



Altering and moving a curved dimension are also identical to altering and moving an arc.

Adding Text

The ***Text*** function is used for adding text in either COGO or Layout. To use this function:

1) Invoke the function by selecting ***Text*** in the ***Draw*** menu or through the toolbar.
2) Left-click at the location in the dataview where you wish to place the text. A vertical insertion mark will appear in the color of the text layer. Text is initially created horizontally - it can be rotated later.
3) Type in the text. The <**Enter**> key can be used to create multiline text.

When finished with the current text,

- Press <**Esc**> or select a different command from the menu or toolbar to finished entering the text

OR

- Left-click at another location to insert another text.

Once unattached text has been entered, it can be rotated and moved as any other text.

Notes:

- A degree symbol can be entered while typing in text by holding down the **<*Ctrl*>** key and then pressing the **<*D*>** key.

The Command Line

The status bar in the various windows does double duty as a command line echo. This means that, when you type in commands from the keyboard, the command will appear in the status bar, replacing the information that is normally there. The advantage of using the command line is that many functions are much faster to execute since it is generally faster to type in parameters as a series of values separated by a space or comma than to call up a dialog box and enter the data in the various edit boxes, checkboxes, et. al.

The program commands are, for the most part, alternative ways to execute the functions in the menus. Implementation of command line codes is an ongoing process. An attempt has been made to document existing commands within the functions that they pertain to as well as in a summary at the beginning of the window sections of the manual. Upgrades to the program may likely have additional commands not contained in your copy of the documentation. Call technical support if

you have any question or requests for command line implementations that will be of use to you in your work.

Most of the commands are specified as two letter codes followed by a series of parameters separated by spaces or commas.

Examples: Typing **CS 5000 5000 <Enter>** will create a point at N:5000 E:5000.

Typing **TR 45, 5, 104** will traverse by turning an angle right of 45 degrees with a horizontal distance of 104.

The program remembers the most recently used command. The command code does not have to be reentered when executing the previous command again. Pressing the **<Spacebar>** or entering a value from the keypad (the number pad on the right of the keyboard) will reenter the previous command code on the status line.

Example: Typing **CS 5000 5000 <Enter>** creates a point at 5000,5000. Typing <**Spacebar**> **4500,5000** immediately afterward will cause the command line to read **CS 4500,5000**. The **CS** will appear as soon as the **<Spacebar>** is pressed.

Notice that spaces and commas are used interchangeably when separating parameters on the command line.

When using the command line in conjunction with the keypad (the group of number keys on the right of the keyboard), there is a problem - the keypad has neither a space or comma key. The command line has been especially optimized for use with the keypad. Remember, the **<Num Lock>** must be on to use the keypad for entering numbers. The following applies when using the keypad:

- To enter a comma, press the + key. To enter a +, press the + key twice.
- The previous command will be echoed on the line as soon a keypad key is pressed, just as if pressing the <**Spacebar**>.

Printers/Plotters

The term “printer” in a Windows environment refers to both printers and “plotters”. The term “printer” therefore will be used to refer to both kinds of devices.

If you don’t have a plotter....

Unfortunately not everyone owns their own plotter. This section is written with those people in mind. Three other ways of printing out a job Include:

Installing on a computer that has access to a printer:

Sometimes the owner of a printer will allow you to install the program on the computer with access to the printer. In that case just call Soft-Art, Inc. at (615) 230-5745 or (800) 652-7279 for a long-term temporary authorization. You can then simply copy the project file onto the printer’s computer, open and print it.

Printing to a file:

If you are working with a printing company to plot a drawing sometimes they will allow you to give them a
PRN file. You can make one by installing the driver for the company's printer onto your system and setting its output to "FILE". When you then print, a dialog will appear asking for the name of the file to print to.

Sending a DXF/DWG file:

DXF/DWG files are so generic that anyone with CAD software can read one in and make a print of it. So just **Export** a DXF or DWG file from the Layout window, and send it to whomever you need to print the job. There is one downside to using DXF/DWG files in that that they do not support all of this program's linestyles, or Window's fonts. The result is that the general appearance of the text will usually be different than what you see on the screen, since font substitutions must be made.

If you have a printer, but it does not work.....

Modern inkjet printers such as the Designjets by Hewlett-Packard aren't too difficult to troubleshoot. However, there are still quite a few of the old pen printers out there, and these can be a real pain in the derriere to get working, largely due to the fact that most of them communicate through the serial port instead of the parallel (or printer) port.

Following is a list of some of the most common problems we have run into, but I am sure you will come up with a few of your own.

The printer only prints a part of the drawing...

If the printer only prints part of the border then the first thing to check is the page margins. If the margins are closer than .5 inches, try using slightly larger margins. If that helps then your printer is not capable of handling margins that close to the edge of the page. If you use an inch and a half or more, and it does not help the problem then the problem probably lies somewhere else.

Another thing you need to ask is how much memory is in the printer. If it is less than 4 megabytes of RAM and you are printing a 24"x36" drawing with a contour map of the Rockies there could be a definite memory problem. Some printers have the option of processing the drawing in the computer or the printer. If yours is one of them, select the option to process in the computer. This setting will generally be in the printer's setup routines in the Windows Control Panel or Printer dialogs. Printing will be slower, but as long as you have plenty of room on your hard drive the printer will not run out of memory.

In some printers the I/O Time-out setting in the printer settings may be too short. Increase the setting and try again.

Sometimes this indicates a discrepancy between the actual plotting area on the loaded media and the plotting area understood by your software or, using words people without a Ph.D. in English

can understand, “The Page Layout and the Print Setup do not match.” For example, you are printing a 24x36 drawing, your page layout is set for 24x36, by default most printers are set to 8.5x11, so change the printer’s page setup to correspond to Layout’s page setup. If the size you want is not available you will need to refer to your printer manual for custom, or more available sizes.

The Printer gives no response when told to print...

If you press “OK” on the Print dialog and the printer just sits and looks at you, one of a few things could be happening.

The printer is not installed **correctly** and you will need to refer to your printing manual to make sure the correct driver is installed and the correct options are being used. Such as using the HP® C3190A™ driver when you should have installed the C3191A™ driver, or using LPT2 when the correct port was LPT1, etc.

Another thing that could be causing a problem is if the driver is corrupted or outdated. With the constant introduction of new operating systems, updated drivers are often required in order to maintain compatibility Most of the time major printer manufacturers have “web sites” that have downloadable drivers for their printers, and sometimes that’s all it takes to make a printer work.

The file may be too big for the printer’s memory. Look on the screen for any error message: some drivers allow you to choose a different printing mode change the option and try again. If no other printing mode is available, or if your file still does not print, you may need to consider obtaining additional memory.

If the plot is completely blank...

Check ink cartridges, and memory. See if it prints a test page. This could be caused by a lot of other things and you will probably want to refer to your troubleshooting guide in your printer instruction manual.

If the drawing is distorted or unreadable...

If you are using a serial interface between the printer and your computer, make sure the printer’s serial interface settings match the settings and requirements of your hardware. The Windows port settings, accessed through the Control Panel, have to correspond to the serial port settings on the printer in this situation.

If the printer seems too slow...

Possible solutions are:

- Check the settings in the “Print Setup/Options” dialog box, where some of the settings impact speed. If in doubt refer to the on-screen help provided in the dialog.
- Increase the computer or printer memory.
- Get a faster computer.
- Try switching to Windows NT.

If the entire plot is on one corner of the page...

- Check the Page Layout settings in the Layout ***Project*** menu. Make sure that your paper settings in the Printer Setup correspond..

- Try changing the printer's Graphics Language setting, using the printer settings in Windows

The printer does not handle "True Type Fonts" correctly...

- If the printer is placing text all over the place and has no control of size. The problem is once again in the driver. With some printers there is an option to use a vector language (such as HPGL™) or raster language, Raster (essentially means bitmap) is a much better way to print anyway so pick it and see if it makes a difference. • If you are using a pen plotter you generally cannot print "True Type Fonts" anyway so you will have to make sure that all your text is set to Modern, Roman, or Script (the standard Windows plotter fonts).

The printer does not print curves with a large radius...

As much as we hate to admit it this is a bug that is more noticeable in earlier versions of the program, but we do have a "work-around" and a fix for the problem. The "work-around" is to go into the ***Environment*** | ***Options***, press the ***Advanced*** button, and check ***Print curves as chords***. There are also options for ***chords per curve*** and ***degrees per chord*** leave those as default, unless the curve looks broken. The fix is to call us at Soft-Art, Inc., and have us send an update, or you can download updates at our website. The address is "**http://www.pcsurvey.com**."

A note about Windows95™.

Windows95™ is not our favorite operating system and we have had more troubles with it than anything else as far as printing is concerned. Just because a driver works in Windows 3.1™ does not mean it works in Windows95™ This is especially the case with most pen printers. Windows 95™ has some drivers built into it, but if they do not work, or if that driver is not listed you will have to contact the manufacturer get a driver specifically designed for Windows 95™. We have had better success with Windows NT.

Before you call us...

We here at Soft-Art, Inc. do not mind receiving feedback from our customers. If there is a problem with our software we want to hear about it. Unfortunately talking long distance costs a lot, and we have not had as much time recently to personally walk through a lot of printing problems. Which is why this section has been written. So all we ask is that you read through this, and any trouble shooting guides that came with your printer, and try two things to determine whether the problem is our software, another software, or a hardware issue.

1. Try to print a test page; most printers have some way of doing that.

2. Try to print from a Windows based software such as Microsoft Word™ or Word Perfect™.

If one of these ideas does not work, refer to the Windows trouble shooting guide for printers, or call Tech Support for the appropriate Company. If these work and the program still does not print and this section does not help, give us a call at one of our Tech Support numbers.*(The only number below that applies to us is the one to Soft-Art, Inc.)*

Tech support numbers:
Soft-Art, Inc. (615) 230-5745
Hewlett Packard (208) 323-2551

Data Collectors

The program has the ability to import and export delimited ASCII coordinate files. The ASCII formats can be user-defined. Certain raw data formats are also supported. These include SDR 2.x, SDR 3.x, TDS RW5 and SMI raw formats.

Almost all other data collectors can export a delimited ASCII coordinate file which can be read by or directly imported to the program.

SDR 2.x
SDR 3.x

The program can import the OBS and POS view data directly from the SDR data collectors.

TDS

Direct communication with the TDS data collectors is supported for import and export of the CR5 (coordinate) data. Direct import of the RW5 (raw) data is also supported.

SMI

Direct import of the SMI coordinate data is supported through the SPACE and COMM output options. The program can read the SMI raw data, but it must first be transferred to the computer using the SMI transfer program.

The Main Window

Overview

This window is the "master" window - all other windows in the program will always remain in front of the main window. The main area of the window is used for logging function invocations, data information queries and other reporting activities. The menus associated with this window include "system wide" functions such as layer definition and the program system options.

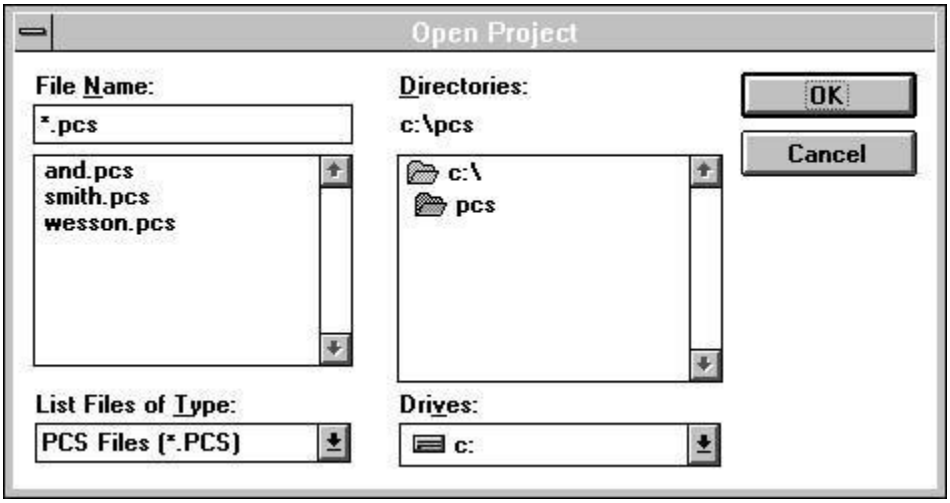
Project Menu

New

If a project is already open, ***New*** will close the project. An unnamed project will then be created. A "new" project is not saved until the ***Save*** or ***Save As*** command is issued (see below).

Open

Open will open a project that has already been created. If a project is already open, ***Open*** will first close that project after prompting for saving any changes that have been made. In the dialog box used for selecting the project to open, the
Drives and ***Directories*** sections specify where the file is to be found.



File Name is the name of the file. Either type in the name in the top box or select the file from the list box. ***List Files of Type*** allows limiting the files displayed to those with the specified extension. The same result is generated by just typing <***>. PCS**, for example, in the ***File Name*** box. The *file extension* (the characters after the period in the file name) can be something other than **.PCS**.

Saving a Project

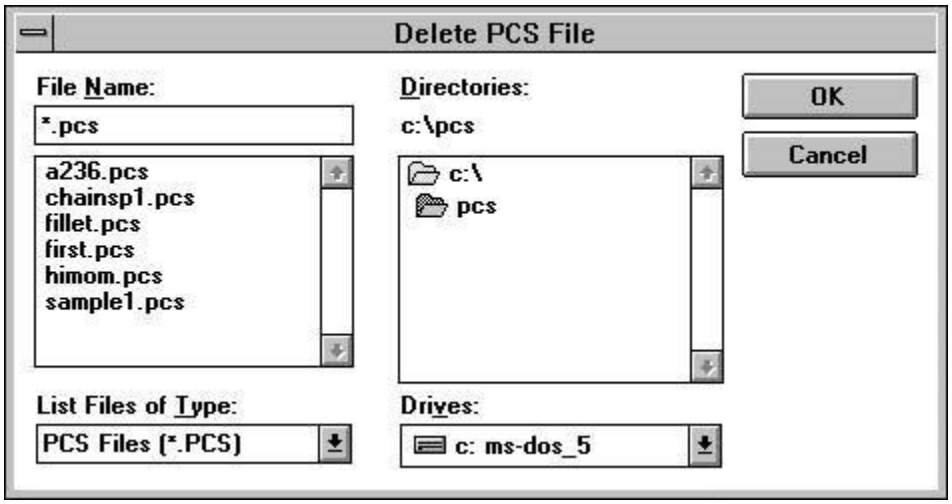
Save As

Save As is used to save a project that either has not been named yet or that needs to be renamed or saved as a different type. Refer to ***Open*** in this section of the manual for an explanation of the ***Save As*** dialog box since the two dialog boxes are virtually identical. Unlike the ***Open*** dialog, the file name is generally not selected from the list but, instead, typed in to the *File Name* box unless it is desired to overwrite an existing file.

Save

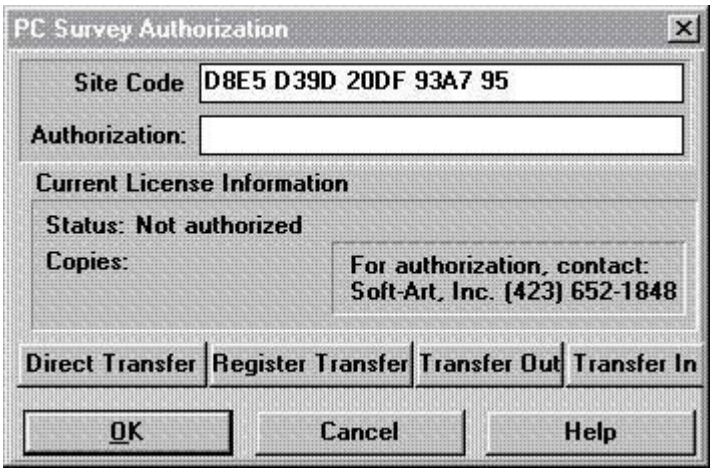
If the current project has a name, ***Save*** will save the project with that name. If the current project has not yet been named, ***Save*** will behave just like ***Save As***, using the same dialog box in the same manner.

Delete Project



Delete Project can be used to remove old projects. The dialog box works just the same as the ***Open*** dialog box. The project file that is selected will be deleted from your hard disk or floppy disk. Project files can also be deleted by using the DOS ***DEL*** command from the DOS prompt or by using the delete function in the Windows file manager. For more detail on the operation of this dialog box, refer to the ***Open*** function in this section of the manual.

Authorize



As shipped, the program will not allow the surveyor to export data, print or save files. To enable these functions, the program must be ”authorized”. This is a form of copy protection. The process of authorization can enable various portions of the program selectively. If, for example, the surveyor wants COGO, drafting, and Contouring but has no interest in the Survey functions, all but the Survey module can be enabled during authorization. Portions of the program that are not enabled will result in their window options in the ***View*** menu being grayed out (disabled).

1) To authorize the program, start the program and IMMEDIATELY select the ***Authorize*** command from the ***Project*** menu in the main window. A dialog, similar to the one shown, will appear.

2) At the top of the dialog is a ***Site Code***. This is a code that is unique to your computer. Call Soft-Art, Inc. at the number shown. They will ask for the ***Site Code***.

3) If you have paid for the software, an ***Authorization*** code will then be given, which you will enter into the dialog. Once the ***Authorization*** code has been entered, the program will be enabled for whatever functions have been paid for.

If it is desired to move the program to a different location on the computer’s hard drive, do the following: ***1)*** Copy the program files to the new location. ***Do NOT delete the original files yet!***

2) Select ***Authorize*** from the ***Project*** menu on the ORIGINAL program.

3) Select ***Direct Transfer***. Enter the FULL path to the new location (i.e. D:\PCS\PCS.EXE).

4) Select ***OK***.

Authorization for the program can also be transferred between two different computers. Use the procedure given above if transferring between two computers on a network. To transfer the authorization by floppy, copy the program to the computer that is to receive the authorization (the TARGET computer) use the following procedure:

1) Run the program on the TARGET computer.

2) Select ***Authorize***.

3) Select ***Direct Transfer*** and enter the drive name for the floppy drive that is to be used (normally A: or B:).

4) Take the floppy out of the TARGET computer and place it in the computer that currently has the authorization (the SOURCE computer).

5) Run the program on the SOURCE computer. Select ***Authorize***.

6) Select ***Transfer Out*** and specify the drive where the floppy is located. The authorization will be removed from the SOURCE computer and placed on the floppy.

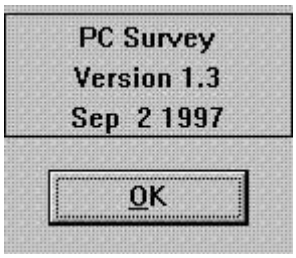
7) Put the floppy in the TARGET computer.

8) Select ***Transfer In*** and specify the floppy's drive once again.

The authorization will now have been removed from the SOURCE computer and placed on the TARGET computer.

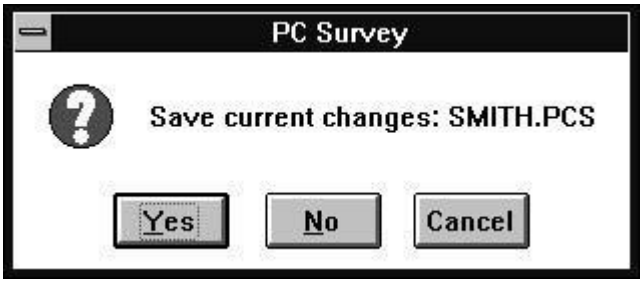
About

The ***About*** dialog gives the program version and its date of creation. When calling for technical support or software updates, have this information available.



Exit

Selecting this command terminates the program. If there is a current project that has unsaved changes, the program will prompt for whether the project should be saved as shown in the dialog to the right. Selecting ***Yes*** will save the current changes whereas ***No*** won't. ***Cancel*** will return to the program.



1, 2, 3, 4

The bottom section of the ***Project*** menu contains a list of the most recent projects edited by the program. To open one of these files, just go to the ***Project*** menu and single click on the file to open or type the number to the left of the project file name.

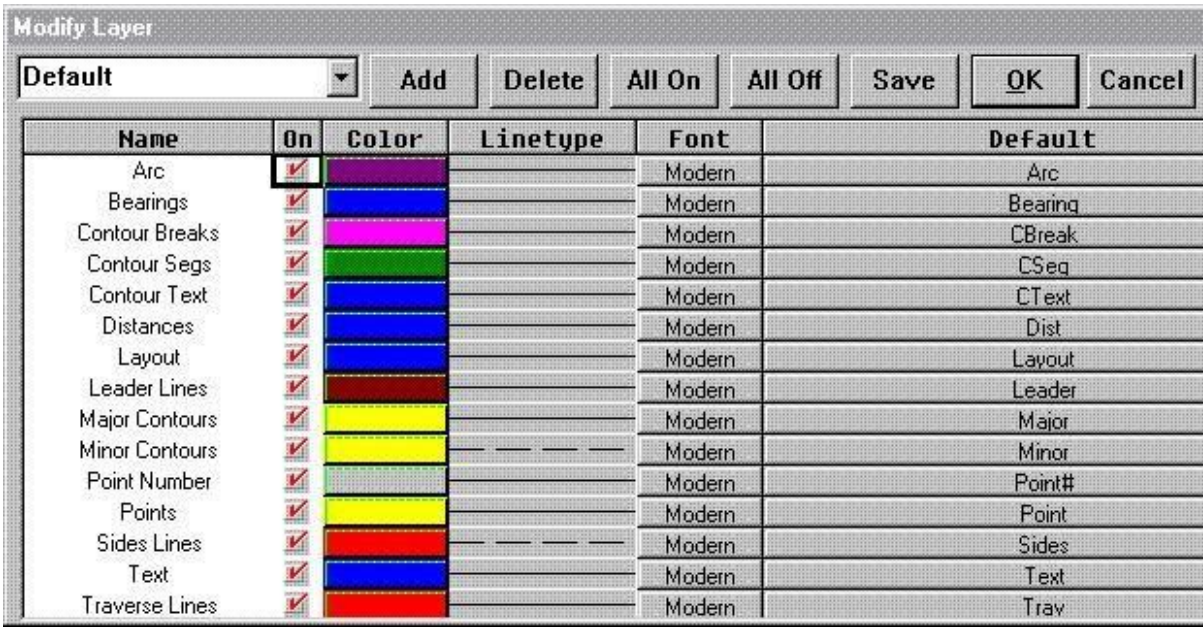
Environment Menu

Layers

In the program, a ***layer*** associates an object with a set of characteristics that include visibility, color, line style, and font. When an object is first created, it is placed or associated with the layer that has the object's type assigned to that layer.

For instance, there is a predefined layer called *Bearings* to which all newly created bearing texts are assigned.
The bearing text layer might have a color of blue, a solid single width line style, and the modern(plotter) font
(that's the name of the font - modern(plotter)) of size 0.10 inches assigned to it. All bearing text would then be initially created as blue text with the modern(plotter) font at a 0.10 inch height. The line style, in this case, is irrelevant since text does not use line styles.

Edit Layers



Layer attributes are accessed through the ***Edit Layers*** command in the ***Environment*** menu of the ***Main Window***. This dialog can also be accessed by pressing ***F9*** from anywhere else in the program. The top level dialog (the dialog box initially displayed) is a table listing the various layers with their ***Name***, along with their visibility, ***Color***, ***Linetype***, ***Font*** and ***Default*** object type (if any)..

Layer Sets

Multiple *layer sets* can be defined. For instance, one might define a *layer set* for working with a pen plotter and a different *layer set* when printing to an inkjet because the fonts that are used are generally different between these two kinds of printers/plotters. Each *layer set* has a name, displayed in the upper left of the dialog. New *layer sets* can be created by simply typing in a name and pressing the ***Save*** button.

Name

The ***Name*** of a layer is up to the user. By double-clicking in this column, the name can be edited. Be sure to use a unique name for each layer.

Visibility (On)

The column labeled ***On*** displays a cross for all layers that are currently visible. A layer can be toggled on or off by clicking on the layer's row and then clicking on the ***On*** column. If the layer is "on", it is visible. Layer visibility allows the user to turn off the display of given data types. The ***All On*** and ***All Off*** buttons will toggle the visibility of every layer on or off, respectively. Normally a different layer is associated with each basic data type (points, point numbers, bearings, lines, etc.) Turning off the point number layer, for instance, will hide all the point numbers on that layer -- which would be ALL point numbers unless the user has deliberately moved them to another layer. Again, data on invisible layers is not available to COGO functions.

Colors

The color of a layer can be changed in the ***Edit Layers*** dialog box by clicking on the ***Color*** button. The standard windows color dialog will appear. Simply select the desired color and then select ***OK***.

Linetype

Linetype refers to the style used to draw a line. There are several predefined line styles included with the program. Among these are solid lines with various widths, lines with various combinations of dashes and dots, as well as some special line styles. The surveyor can create his own line styles as well. A picture of the current linetype is displayed for each layer. Clicking on this picture will display the *linetype* dialog. Simply pick the desired linetype, optionally modify its width and select ***OK*** to return to the main dialog.

Font

Clicking on the Font button will bring up a dialog box which allows setting font parameters for the layer. Any text items created on that layer will use that font unless you specify otherwise. For more information on fonts, refer to ***Fonts*** in the ***Data Appearance*** section of this manual.

Default

Every object (line, point, contour, etc.) in the program has a data type. *Arcs*, for instance, are a type of data. Data types normally have an associated layer referred to as the data type's *layer*. When an object is created, it is placed on its layer. This is configurable by the surveyor and is

specified by the layer's ***defaults***. For instance, the first layer in the picture above is named ***Arc***. It also has ***Arc*** specified in its ***defaults*** column. This means that whenever an arc is created, it is placed on the layer named ***Arc***. Another example, a few lines down, is the layer name ***Dot Layer***. It is the default layer for ***Pnt***. So all new points that are created will have the point symbol placed on the ***Dot Layer*** layer. These layer assignments cannot be changed here but must be changed by clicking on the ***Modify*** button.

Save

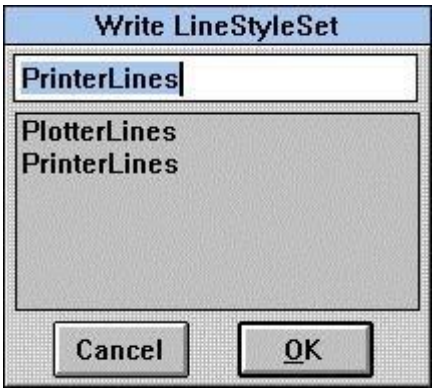
Pressing the ***Save*** button will save the current settings (the *layer set)* along with its name (displayed in the upper left corner). If a new name has been entered, pressing ***Save*** will create a new *layer set* and the new name will be added to the list in the upper left.

Write Line Style Set

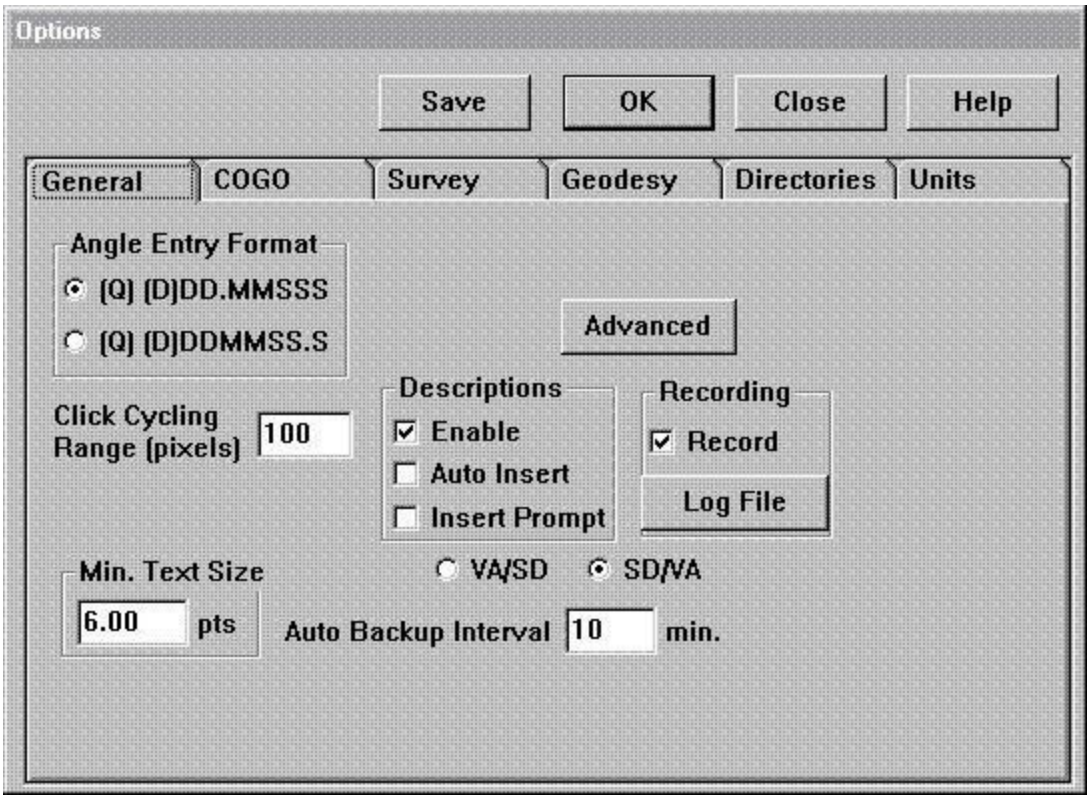
Write Line Style Set saves the set of currently defined line styles so that they can be accessed again for another project. The function will first prompt for a name for this line style set and will store the information in the pcs.ini file.

Select Line Style Set

Select Line Style Set will read in a previously defined set of line styles for use in the current project. This function will provide a list of the currently defined line style sets from which you can select the line style set that you want.



Options



The ***Options*** dialog is used to access the numerous settings used throughout the program. This is what is called a "tabbed dialog" (or "property sheet") due to the file folder style interface. Various kinds of settings are displayed here and further explained below.

Save

Selecting ***Save*** will save all the settings as the default program configuration.

General Options

Angle Entry Format

Angles can be entered in one of two formats as shown in the dialog above. In the first format, a period separates the degrees from the minutes. So 29 degrees, 3 minutes, 26.2 seconds is entered as 29.03262. In the second format, the period separates seconds from hundredths of seconds. So 29 degrees, 3 minutes, 26.2 seconds is entered as 290326.2. When entering a direction as a bearing, the quadrant number (1 -4) can be entered followed by a space and then the angle.

Click Cycle Range

The click cycle range is associated with selecting data using a single click. When the user clicks the left mouse button without moving (dragging) the cursor, the program will find the nearest

object to the cursor and select it. If the user clicks the left button again without moving the mouse in between, the program unselects the previous object and tries to find the next nearest object -- this is click cycling. This process continues with each succeeding click selection until the next nearest object is outside the click cycle range. The program then starts all over with the nearest object to the cursor.

Descriptions

Enable Descriptions are "enabled" when this box is checked. When descriptions are not enabled, the edit boxes used for description entry in the various dialogs are disabled. Additionally, no description information will be shown in the status bar.

Auto Insert

When Auto Insert is checked, entered descriptions are automatically inserted into the description file if it is not yet in the file

Insert Prompt

Insert Prompt applies only when Auto Insert is on. When Insert Prompt is on and a description is entered that is not already in the description file, a message will appear asking whether the new description should be put into the description file. The surveyor can then choose to put the description in the file or leave it out of the file. A description does **not** have to be entered into the description file to be used as a point description.

Recording

The program has the capability of keeping an audit trail of functions performed. Some states require keeping such a record. By checking the Record option, the audit trail will be sent to the Main window.

Log File

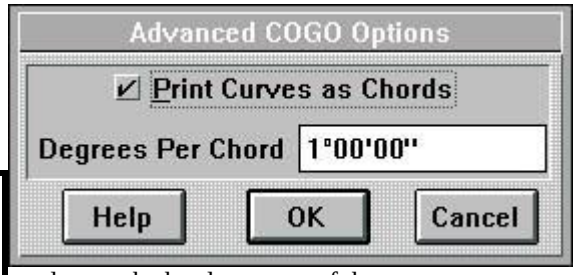
To keep a record of the audit trail on disk, select Log File and enter the name of the file in which to store the information.

Minimum Text Size

When bearing or distance text is created, the program checks the length of the line that the text will be placed on. The line length, together with the COGO scale, determines the maximum size of the text that will fit on the line. If this size is less than the specified *Minimum Text Size* value, no text will be created. If the user desires to place bearing/distance text on very short lines, it is best to use the *Add Leader Line* function.

Advanced

The advanced options control how curves are both displayed and printed. Some plotters don't support the drawing of an arc. In these cases, the option ***Print Curves as Chords*** should be enabled. The ***Degrees Per Chord*** setting determines the delta used on each chord segment of the curve.



> ***Warning: A small value for Degrees Per Chord can result in slow screen redraws!***

Selecting ***Save*** writes the current settings to the PCS.INI file so that the next time the program is started, the current settings will be used.

Cogo Options

See p.100

Survey Options

See p. 63

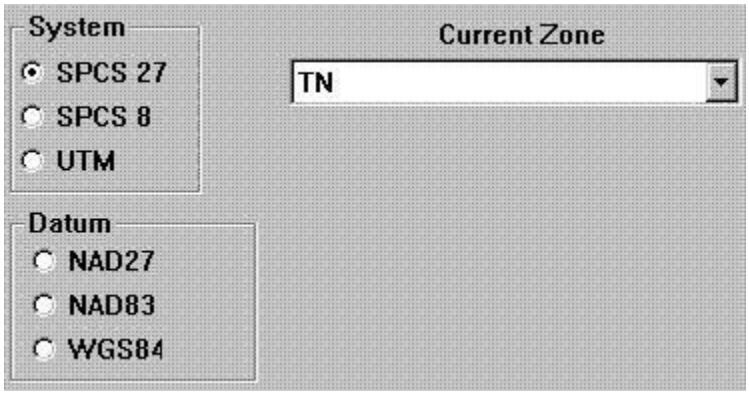
Geodesy Options

The Geodesy options are used for selecting state plane/UTM zones and datums for use in geodetic transformations. These settings are used when interpreting latitude/longitude coordinate conversions in the ***Project:Import Points from…:File*** (see p.104) function of the COGO window.

There are three currently supported systems. The following guidelines apply:

- State Plane Coordinate System of 1927 (SPCS 27)

  The only allowable ***Datum*** is NAD83. The ***Current Zone*** data will include all applicable state plane zones. • State Plane Coordinate System of 1983 (SPCS 83)



The only allowable ***Datum*** is NAD27. The ***Current Zone*** data will include all applicable state plane zones.

- Universal Transverse Mercator (UTM)

  Any of the listed datums are supported. The ***Current Zone*** data will include all applicable UTM zones consisting of 6 degree longitudinal increments.

Directories Options

When opening or saving files of various types, the program uses the directory paths specified in this dialog as initial directories in the Open or Save dialogs.

The ***Project*** directory is used for opening or saving the program files.

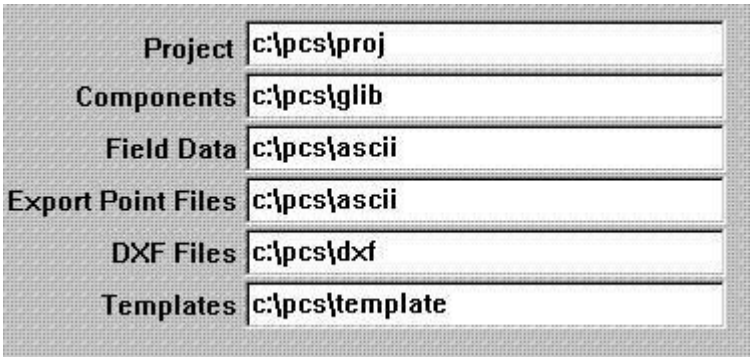
The ***Components*** directory is where the program initially looks when attempting to place components.

The ***Field Data*** directory is used when importing raw or ASCII point files.

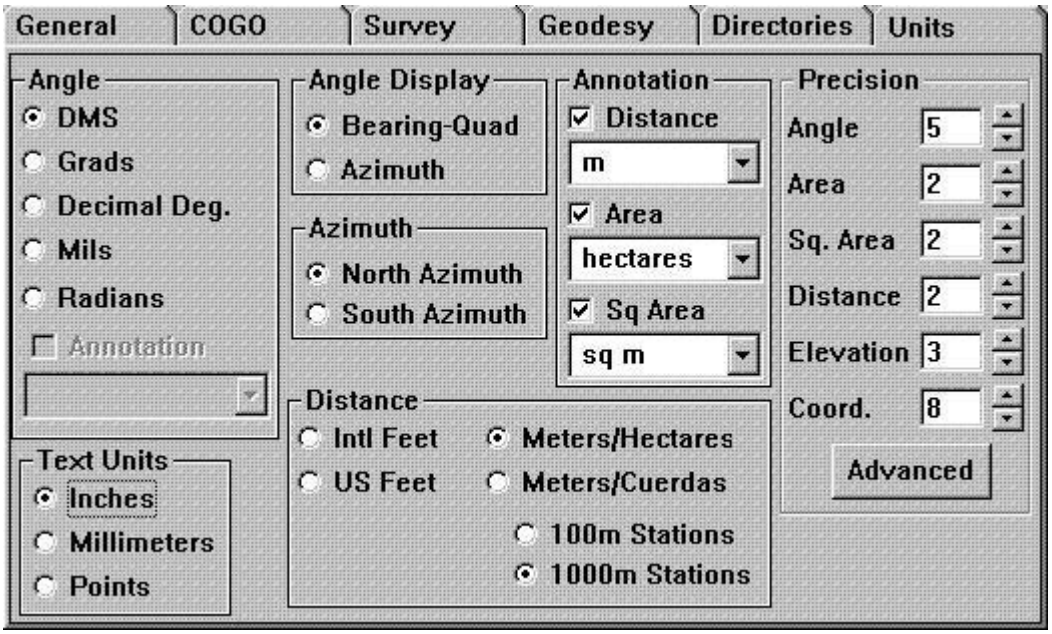
The ***Export Point Files*** directory is used for ASCII point file export, including stakeout point files.

The ***DXF Files*** directory is used for importing and exporting DXF files.

The ***Forms*** directory is where the Layout *Forms* are normally stored.



Units Options



The units dialog controls the input measurement units and the annotation used.

Angle

As can be seen, angles can be entered in ***DMS*** (degrees, minutes and seconds) or decimals degrees, grads, mils or radians. If the angle unit selected is something other than ***DMS***, the annotation used can be altered by enabling the ***Annotation*** checkbox and selecting or entering the annotation desired. Disabling the ***Annotation*** checkbox will result in NO annotation being used. The default *Angle* setting is *DMS*.

Angle Display

Angles can be annotated as either ***Bearing-Quad***s or ***Azimuth***s. Select the format you prefer. The default is *Bearing-Quad*.

Azimuth

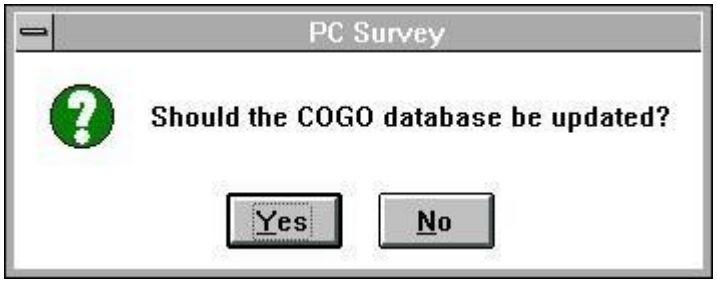
Select ***North Azimuth*** or ***South Azimuth*** according to your area's convention. The default is ***North Azimuth***.

Text Units

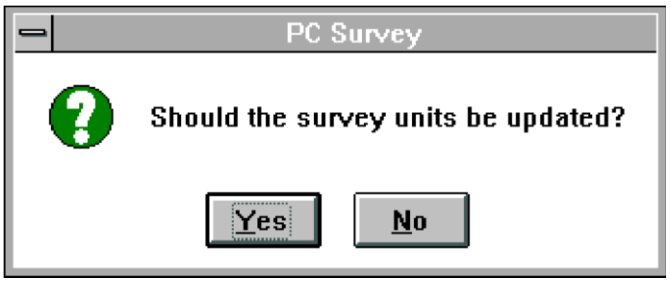
When specifying text font sizes, three options are available - ***Inches***, ***Millimeters***, and ***Points***. There are 72 points in an inch and 25.4 millimeters in an inch. The default is *Inches.*

Distance

Distance units include the US and International foot as well as meters (metric).
If the Distance unit is changed, the program will ask if you want to update the database.



If you say yes, the data that was stored will be translated to the new units. So, if you entered the data in feet and you want to change it to metric, selecting Yes will transform the job to use metric units. If you entered some metric data in the program but didn't realize that the program was set up for US Feet, then you would not want to update the database.



Survey units can also be updated, if desired.

Stationing

If using Metric units, stationing of alignments (see p.156) can be either in the 1000 meter or 100 meter format. That is, 1381 meters would be 1+381 in 1000 meter stationing or 13+81 in 100 meter stationing.

Annotation

The suffix used for distance, area and square area are all user-definable like angle annotation (except DMS). Disabling the checkboxes will result in NO annotation being used. In other words, only the numerical value will be displayed. To change the default suffix values, just type in a different text string. Annotation is not used for **Data**, **Status**, or **Readout** values but only for **Display** values. Changes made to the units values or annotation will not affect strings that have already been created until the strings are reset.

Precision

Display precision refers to the number of digits after the decimal point displayed for most types of data. Another way to think of it is as a rounding function. Angular data is somewhat different as will be explained below. The six types of data which can have separately controlled levels of precision of output are Angle, Area, Square Area, Distance, Elevation, and Coordinate, each representing a different unit of measurement.

A summary of each measurement type follows.

Angle

When angle data is in a format other than DMS (degrees-minutes-seconds), the display precision value is as described above. When the angular units are DMS, however, values mean as shown in the table below:

DMS Roundi ng		
Value	**Rounding to Nearest -**	**3°45'59.123" Becomes -**
0	degree	123°
1	tens of minutes	123°50'

Area
Area is measured in either acres (English) or hectares (metric). Square area is only associated with boundaries and traverses. This setting will affect the number of decimal digits displayed in such things as boundary annotation (when displaying square area) and traverse loop reports.

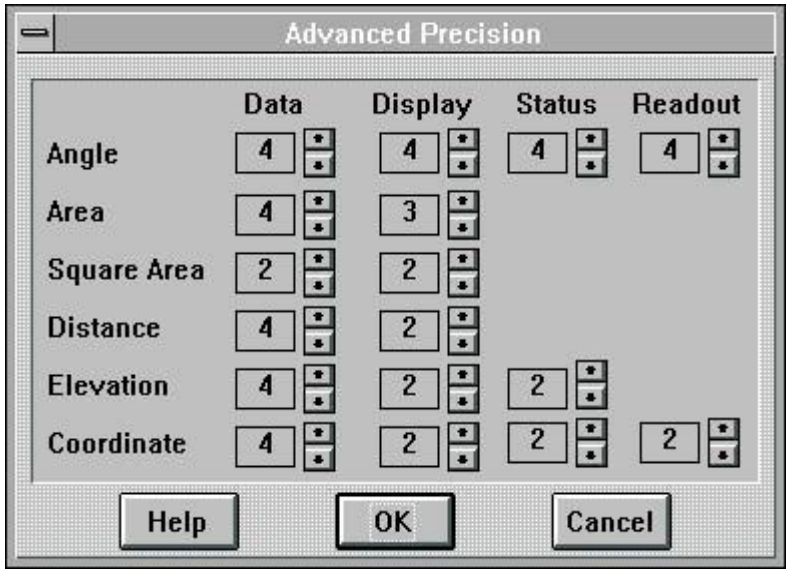
2	minute	123°46’
3	tens of seconds	123°46’00”
4	second	123°45’59”
5	tenths of seconds	123°45’59.1”
etc.		

Square Area
Square Area is either in square feet or square meters.

Distance
Distance is also in feet or meters and is seen in the distance strings on lines in the display window as well as in various information displays.

Elevation
Elevation, if enabled, will be shown in the occupied point's status in the status bar. It can also be displayed in the point data in the display window or in various information boxes.

Coordinate
Coordinates are either in feet or meters.



Advanced
Clicking on the ***Advanced*** button will bring up another dialog that allows more detailed control. It contains some combination of the following types of display:

1) **Data** - refers to information displayed in various dialog or "pop-up" boxes. A good example of this is the ***Inverse*** function.

2) **Display** - refers to data display in the main or drawing window. For example, bearing and distance strings associated with Cogo lines will use Display to determine their precision.

3) **Status** - refers to data display in the status bar.

4) **Readout** - refers to the Coordinate Display precision.

View Menu

The View Menu in the main window is used for opening (or bringing to the front) the other program windows. Clicking on one of these selections will open the corresponding window if it is not already open. If it is open, it will placed in front of the other windows. The five different windows, other than the main window, are:

- COGO
- Layout
- Survey
- DTM
- Component

The Survey Window

Overview

The Survey window of the program is designed to handle entry of field data, perform desired corrections, and adjust traverse data. Field data is permanently stored (unless deleted) with the project. Corrections allowed include atmospheric, curvature and refraction, EDM carrier wave adjustments, and correction of constant errors including prism offset and constant and EDM offset. Traverse adjustment techniques include balancing of angles, compass rule and Crandall rule adjustments.

The program automatically recognizes and creates closed traverse loops unless significant error exists in the entry of the loop (in which case the loops can be manually created by graphical selection). Various field techniques are also automatically recognized and handled appropriately. These include windings, reciprocal shots, multiply-determined sideshots, resections, and turning points. Options that are allowed with a shot include bringing the elevation from the foresight to the station, holding either the distance or angle constant during adjustments, and specifying the use of a stadia rod. Any shot can have a unique equipment, temperature and pressure, and corrections assignment.

Data entry can be performed through a single shot dialog or a spreadsheet dialog. Shot data is displayed graphically as it is created, allowing the user to not only see the relationship between entered shots, but also select shots graphically for editing or review. Editing of shots results in an automatic update of all dependent shots.

Survey vs. COGO and the rest of the program

Survey maintains a separate window and a separate set of data. As mentioned, the data that is entered is stored with the project until deleted. Survey allows multiple points with the same point number to be displayed simultaneously so that the surveyor can see differences in measurements. COGO only allows one point per point number.

COGO points are created from Survey points by the ***Generate Cogo Points*** command in the ***Edit*** menu. In the case of multiple measurements on a point, the point location data can be averaged to generate the COGO point or multiple COGO points can be created (although with different point numbers). If the point is already in COGO and is connected with lines, the lines also will move to maintain their connection. Curves that are attached to any of these points are a different matter. The surveyor will need to examine the results and probably regenerate the curves.

Terminology

The following is a list of the special abbreviations and words or phrases that are used throughout this section of the manual:

SD - slope distance

VA - vertical angle

HD - horizontal distance

HA - horizontal angle

EL - elevation

HI - height of instrument above ground level

Prism - height of prism above ground when used in editor dialogs.

Loop, Traverse Loop or ***Traverse*** - a sequence of station points with each successive station backsighting the previous station and foresighting the next station in the loop.

Shot - a measurement.

Occupy point, Station point or ***Station*** - a location from which measurements are taken by the surveyor using a theodolite and/or EDM or total station.

Elevation measurement/shot- a measurement that only records elevation value or SD and VA. The HA is not measured.

Direction measurement/shot - a measurement that only records HA. Used for establishing only the direction of a point from some location without concern for its distance.

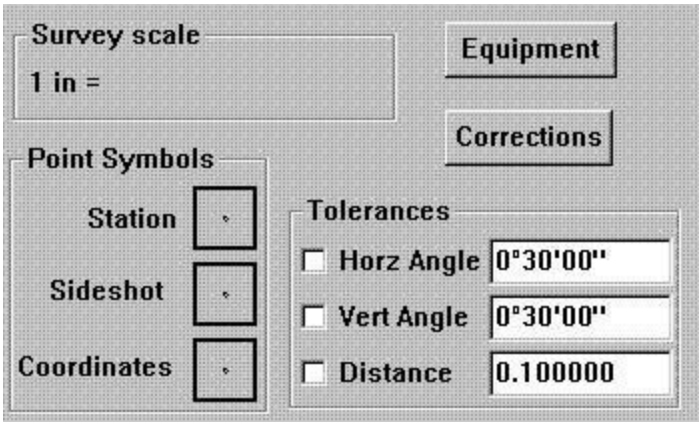
Distance measurement/shot - can consist of either SD and VA or just HD.

Survey Options

The Survey ***Options*** dialog gives the surveyor control over point symbols used, plotting scale, equipment and corrections defaults and tolerance checking.

Point Symbols

There are three types of point symbols that can be assigned. The ***station symbol*** will be placed at all points which are used as station points. Similarly, sideshot points will be marked with the ***sideshot symbol*** and fixed coordinates points will be marked with the ***coordinates symbol.***



Measurement Tolerances

Enabling any of the tolerance values by checking the appropriate checkbox will cause the program to check repeated measurements to verify that they remain within the tolerances specified. Using these options can quickly spot errors from bad field data values or entering the data in the wrong fields.

The Equipment and Corrections buttons allow defining the defaults settings which will be used when entering new data. For further information on these functions, refer to the *Corrections* and *Equipment Settings* sections of this manual.

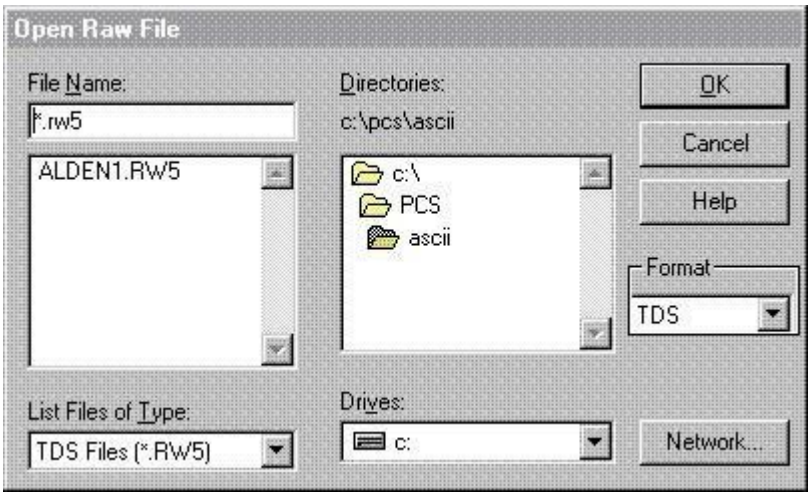
Project Menu

Import Raw From…

The term "raw data" refers to field measurement data, such as vertical angles, turned angles, slope distances and stored coordinates. Raw data can be represented in a variety of ways, but the most common formats are the SDR, TDS and SMI formats. The program can import data in any of these formats. Direct import from the SDR and TDS data collectors is supported. SMI data collectors must first be downloaded through the SMI transfer program.

File

Import Raw From.. File in the ***Project*** menu is used to read in a file that contains raw data and create the measurements and displayed points and lines. Raw data is field data that contains shot information such as azimuths, turned angles, distances, and vertical angles.

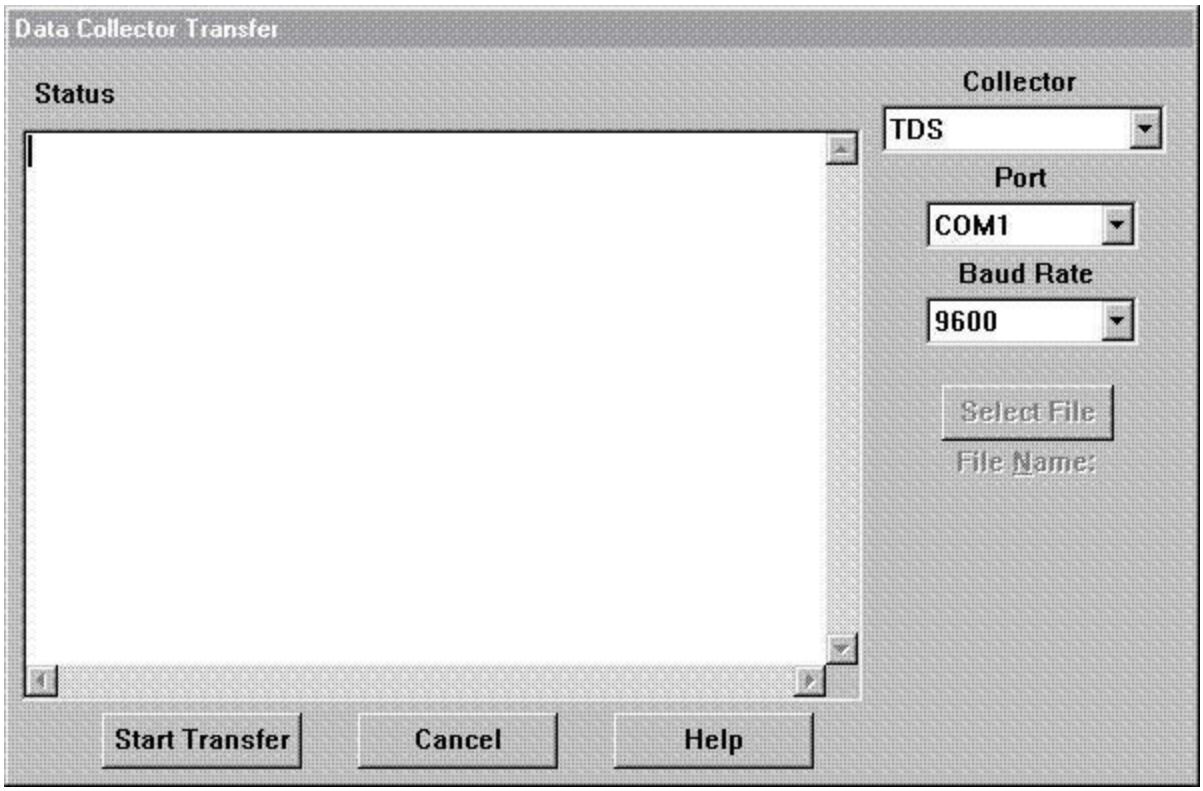


Raw data can be in the SDR POS View, TDS RW5 or SMI Raw formats. To use this function:

1) Select ***Project*** : ***Import Raw From…*** : ***File***. A dialog similar to the one shown above will be displayed.
2) Select the desired ***Format*** from the list on the right
3) Using the drive, directory and file name lists, locate and select the file to be imported.
4) Select ***OK*** to complete the operation. A drawing should appear on the screen representing the field data.

   The ***Edit*** : ***Fieldbook Editor*** function can be used to view the field data after the import is complete.

Data Collector



If you are using the SDR:

- On the SDR

1) In Comms Setup, make sure that Speed matches the Baud rate set in the program and that Parity is Not Set, Word length is 8, and Format is ASCII.
2) Select Comms Output.

- On the Computer

3) Set Collector to SDR2x or SDR3x, depending on which type of format your data collector uses.
4) Set Port to the correct COM port.
5) Make sure the baud rate matches that set in Comms Setup on the data collector.
6) Select ***Select File***. Set the directory and file name for where to put the file that is coming from the data collector and then click the Save button.
7) Press the ***Start Transfer*** button.

- *Back on the SDR*

8) The Data Collector will ask "Send all jobs?". Type a N for No.
9) The Data Collector will then list all jobs it has. Select the job to send, followed by <Enter>.

After the transfer is completed,

Hit the Cancel button in the dialog box.

If you are using the TDS:

• *On the TDS*

1) In File Transfer (menu function S), the following settings should selected:

File type: **RAW**
IR/Wire: **Wire**
Baud rate: **9600** Parity: **None**

2) Select **Send**.
3) Use the up and down arrows to select the file to be sent.

• *On the Computer*

4) Set Collector to TDS.
5) Set Port to the correct COM port.
6) The baud rate should be 9600 (to match the TDS settings).
7) Select ***Select File***. Set the directory and file name for where to put the file that is coming from the data collector and then click the Save button.
8) Press the ***Start Transfer*** button.

• *Back on the TDS*

9) Press the **Select** button (the A button if using the HP48).
10) After the transfer is completed, press the Cancel button in the dialog box.

Import Points From…

File

Import Points From… File will read in a delimited ASCII file and create Survey points. This function is identical to the COGO ***Import Points*** function and is covered in detail in the ***Import Points*** section of the COGO reference manual (see p.104).

Data Collector

Use the same procedure as described in the ***Import*** : ***Points From…*** : ***Data Collector*** section of COGO (see p. 104)

Print

Selecting ***Print*** from the **Survey** ***Project*** menu will print the current view of the data in the **Survey** window. This generates a quick plot. For greater control over the plot, use the **Layout** window to graphically place items on the page and then select ***Print*** from the **Layout** ***Project*** menu.

Editors - Data Entry

There are two ways to enter field data - either through the ***Enter Shot Dialog*** or the ***Fieldbook Editor***. Both editors have the same command set that can be used to accelerate data entry by enabling/disabling edit boxes or setting entry mode parameters.

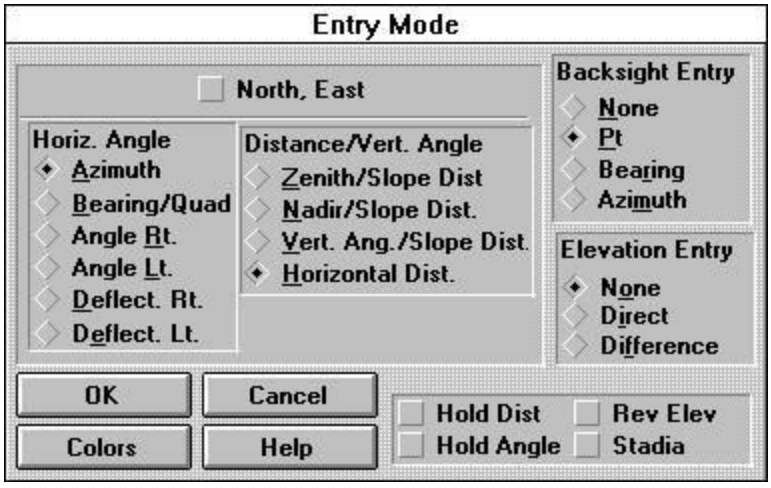
Mode Command Set

The following mode commands are available from within both of the survey editors, the ***Enter Shot Dialog*** and the ***Fieldbook Editor***. These commands turn various data modes on or off. Modes that are "toggles" (on or off) have the following convention: the last character is an '**O**' if the command turns the mode on and the last character is an '**X**' if the command turns the mode off. Commands can be entered in any of the edit boxes (except the description edit box) by typing the command followed by <SPACE> or <ENTER>**.**

AD	Angle Distance - Horizontal Angle, Distance & Vertical Angle (if elevations are enabled)
AL	Angle Left
AR	Angle Right
AZ	Azimuth
BQ	Bearing-Quad
DEF	Save current settings as defaults
DL	Deflection Left
DR	Deflection Right
DO	Descriptions On
DX	Descriptions Off
EO	Elevations On
EX	Elevations Off
HA	Horizontal Angle
HAO	Hold Angle mode on
HAX	Hold Angle mode off
HD	Horizontal Distance
HSO	Hold Side mode on
HSX	Hold Side mode off
NA	Nadir Angles
NE	Northing, Easting

NEZ	Northing, Easting, Elevation
RA	Repeat Angle - copies the horizontal angle from the previous winding to the current field. Especially useful for doubled angles.
REO	Reverse Elevation mode on - Elevation at the FS is used to determine elevation at the station point
REX	Reverse Elevation mode off
SO	Stadia mode on - slope distances are adjusted as stadia shots
SS	Sideshot
SX	Stadia mode off
TR	Traverse
VA	Vertical Angles
VD	Vertical Distance - slope distance and vertical angle.
ZA	Zenith Angles

Entry Modes



This dialog is accessible from within both editors. Most of the options contained in this dialog are accessible through the command set as described above. The selected options comprise the "entry mode" and control which edit boxes become enabled as well as the format of the entry data in both editors. The units used in data entry are determined by the settings in the ***Environment*** - ***Options*** dialog.

North, East

When this option is checked, all other options with the exception of **Elevation Entry** - **None** and **Direct** become disabled (since all other options are meaningless in this mode).

Horizontal Angle

Angles can be input as absolute directions (azimuth or bearing) or as turned angles from the BS or deflection angles from the FS.

Distance/Vertical Angle

There are three types of vertical angles - **Zenith** (referenced from straight up), **Nadir** (referenced from straight down) and **Vertical Angle** (referenced from the horizontal). Together with **Slope Distance**, they comprise three of the four entry modes in this section. If any of these three are enabled, the **Elevation Entry** mode options are disabled.

The final entry mode is directly entering the **Horizontal Distance** in which case **Elevation Entry** mode options are enabled.

Backsight Entry

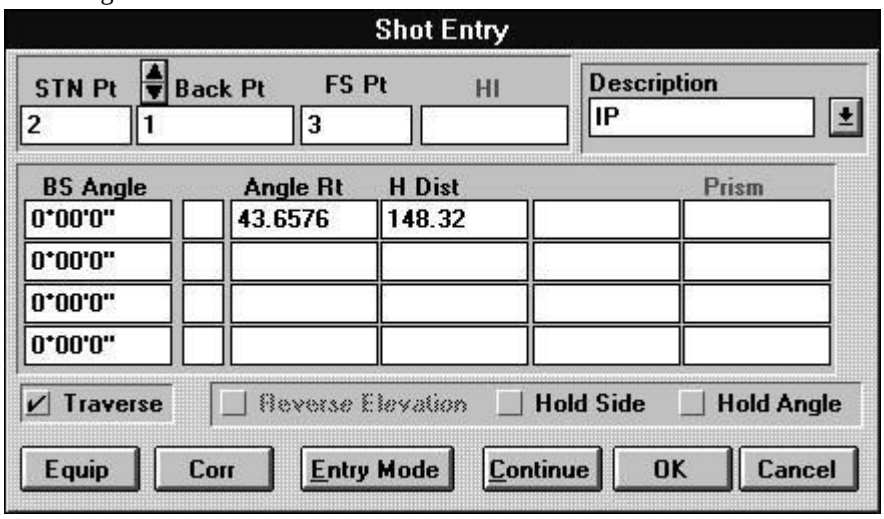
The backsight can be specified as a **Bearing**, an **Azimuth**, or a **Point**. When using an absolute angle entry mode (Azimuth or Bearing), the back sight can still be used but this only makes sense if you are doing azimuth surveying.

Elevation Entry

Selecting **Horizontal Distance** enables the **Elevation Entry** modes, allowing the surveyor to select whether he wants to input elevations as **Direct** (absolute elevation relative to sea level), **Difference** (relative to the station elevation) or **None** (no elevation value at FS point).

Enter Shot

The Shot Editor has been designed for the entry of a set of measurements from a given station and backsight to a given foresight. This is a convenient editor to use for entering shots with windings or for leaving as much of the data window visible as possible during entry. The Shot Editor can be started by either selecting ***Enter Shot*** in the ***Survey*** Menu or clicking on the  button in the tool bar.



STN Pt

Enter the station point number here. If entering a Northing and Easting value, this is the point number that will be used for the created point.

Backsight

This edit box can be toggled to one of three backsight types by clicking on the spin button to the left of the text. The three type of backsights are: 1) **BS Pt**, 2) **BS bearing** and 3) **BS Azimuth**. These can also be set through the **Entry Mode** dialog. If the horizontal angle mode is **Azimuth** or **Bearing**, the backsight mode can also be disabled by setting the mode to **None**. Using an Azimuth with a backsight is only used for azimuth surveying.

FS Pt

Enter the foresight point number here. This edit box will be disabled in the **Northing/Easting** entry mode. Otherwise this will usually be the number of the point that will be created. If, however, you want to do a two point resection, you can enter a known point for the foresight point and an unknown point for the station point; The program will then calculate the position of and generate the station point.

HI and Prism

HI is the height of the instrument above ground.

Prism is the rod or prism height above ground.

These boxes will be enabled only when measuring with one of the three types of vertical angles - Zenith, Vertical or Nadir. Elevations will also need to be enabled. If elevations are not enabled and a vertical angle is being used, the vertical angle/slope distance information will be used to figure the horizontal distance but no elevation information will be calculated.

Description

The description edit box will be enabled only if descriptions are "on", as set in the ***Environment Options*** in the main window or command line input. This is the description for the point to be created.

BS Angle

This is the reading on the instrument when sighting the backsight. The first entry will normally be zero but will obviously change in the second and later lines if performing certain kinds of windings as explained earlier.

Horizontal Angle, Vertical Angle, Distance

These are the first three columns in the dialog . Horizontal angles include azimuths, bearings, angles right or left, and deflections right or left.

Vertical angles include Zenith, Vertical (0° is horizontal) and Nadir angles. The vertical angle will be disabled and will not be labeled if the entry mode is set to **horizontal angle**. There may be a column for absolute elevation or elevation difference if one of these modes is enabled.

The distance may be a slope distance or horizontal distance depending on the entry mode.

Traverse

This check box doesn't affect the measurement but controls the point numbers that are automatically inserted in the dialog if the **Continue** button is selected. If checked, ***on the next shot entry***, the current FS number is inserted into the STN Pt box and the STN Pt number is inserted into the BS box. The next available number is used for the FS number.

Reverse Elevation

Reverse Elevation means that the FS point elevation, together with the SD and VA information (or HD and EL data), is used to calculate the elevation at the instrument location (STN Pt). This checkbox is disabled if vertical information is not available.

Hold Side

When performing any of the traverse adjustments, measurements that have this option enabled will have their distance held constant. ***The distance will not be adjusted*.**

Hold Angle

When performing any of the traverse adjustments, measurements that have this option enabled will have their horizontal angles held constant. ***The horizontal angle will not be adjusted*.**

Equip

Pressing this button brings up the equipment dialog. The equipment parameters can be changed for each shot. This allows the surveyor to change, for instance, prisms when the prisms have different offsets or constants.

Corr

Pressing this button brings up the corrections dialog. Individual shots can have different corrections settings. The program will issue a warning if the sea level correction setting varies during a job since such a condition is generally not desirable. Use this dialog to alter the temperature and pressure settings if correcting for atmospheric conditions with the program.

Entry Mode

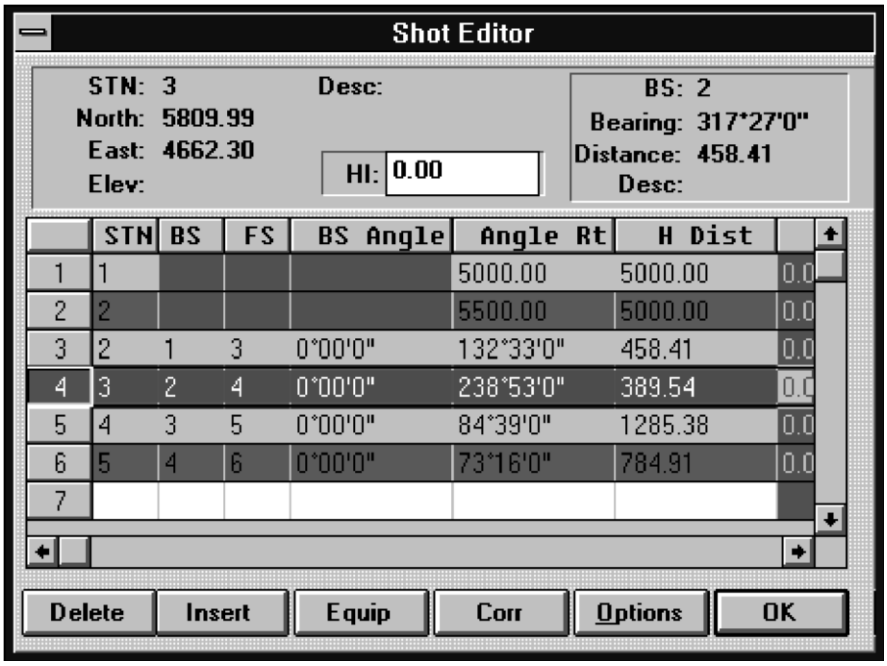
This will bring up the entry mode dialog box explained earlier.

Continue, OK, Cancel

When the ***OK*** or ***Continue*** button is clicked, the shot defined by the current parameters will be created. If the ***Continue*** button is clicked, the point fields will be updated to reflect a traverse or side shot, depending on the state of the ***Traverse*** field, and the other fields will be cleared to prepare for the input of the next shot. If the ***OK*** or ***Cancel*** button is clicked, the dialog box will be closed.

Fieldbook Editor

The ***Fieldbook Editor*** allows the user to see a large number of sequential measurements at one time. Data is in a pure tabular format. It is therefore easy to check the entered data against field notes as well as to more rapidly enter field notes in quantity**.** ***Note: the data shown in this dialog will always be the original field data, even after adjustments have been performed.*** This way, if you find a mistake after adjusting a loop, you can just edit the value in here and then readjust the loop.



Clicking on a field in the spreadsheet will "select" the row that the field is in. The header information for the columns of the spreadsheet will show the types of the data fields for that measurement. The upper left and center sections contain information about the station point for the current measurement, while the right upper section contains information on the backsight for that measurement.

When a field is selected, the corresponding measurement in the display will be highlighted. If the measurement is a coordinate store, the point will be highlighted. Otherwise, the line representing the shot will be selected. It also works the opposite way. If you click near a line in the display, the line will be highlighted and the spreadsheet cursor will move to the row that represents that shot.

Each winding for a shot will be placed on consecutive lines and they will have the same background color. Also, other multiple shots which create a single point, such as a reciprocal shot, will also be placed together and shown in the same color. This helps to see at a glance which spreadsheet lines are combined to create a single Survey point.

Changing the spreadsheet size or column widths

To alter the size of the dialog, move the cursor to an outside edge until it becomes a pair of arrows - the Windows sizing cursor. Click and drag the edge to change the size of the dialog. The spreadsheet will resize with the dialog. To alter the width of the individual columns within the dialog, move the cursor to the top (header) row over one of the vertical lines separating the columns. The cursor will become two vertical lines and a couple of arrows at this point. Click and drag the column divider to the desired width.

Delete/Insert

The **Delete** button will delete the current measurement while the **Insert** button will create a new row immediately before the current row to allow the entering of a new measurement.

Equip and Corr

Selecting the equipment or corrections button will bring up the dialogs described in the ***Equipment*** and ***Corrections*** sections of this manual. The settings in these dialogs will be applied to all subsequent measurements if these buttons are selected while the last row is selected. Selecting a row with measurement data already in it and selecting either button will show the settings for that particular measurement and allow editing of the equipment/corrections settings for that measurement.

Options

This will bring up the entry mode dialog box explained earlier.

Measurement types and techniques

Sideshot vs. Traverse

When a measurement is made on a foresight that is not subsequently used as a station point, the foresight is considered a *sideshot*. Conversely, foresights that are subsequently used as station points are called *traverse* points. Traverse points should be measured with high precision techniques since they will be the foundation of later measurements, especially when part of a control loop.

Windings/Repeating Angles

Survey can handle several of the methods used in taking multiple readings on a foresight. Multiple measurements are an error-reducing technique that is effective in removing collimation and other errors.

1) In one approach, the forward and reverse pair approach, the surveyor zeroes on the backsight, turns to the foresight and records the data. The scope is then reversed (flopped) and turned again to the backsight where the backsight angle is recorded (it will be approximately 180°). Another measurement is recorded after turning to foresight again. Any number of measurements can be taken in this manner within the spreadsheet dialog. The surveyor can choose to zero or not to zero the backsight on each measurement.

2) Another approach sometimes used starts by taking a normal first measurement. Then, with the upper motion locked, the lower motion is loosened and the scope is

centered on the backsight point. The lower motion is then locked and the upper motion is loosened. A measurement is taken on the foresight at this point. Like the first method, this procedure can be repeated many times.

Reciprocal

Reciprocal measurements are useful for reducing distance errors. The procedure is best explained by example: The surveyor stations on point A and takes a foresight measurement on point B. He then stations on B, foresights A and records the distance. The distance from A to B is averaged with the distance from B to A to determine the distance used in generating point B.

Resection

When the surveyor stations on an unknown location (a point not previously measured as a foresight) and then takes measurements on previously determined or known points, he is performing a *resection*. For example, if you have a point 1 and 2 but not 3 and then you station point 3, backsight point 2 and foresight point 1, a resection shot will be created to calculate the location of point 3.

Reverse Elevation

This term applies to the technique of using the elevation of the foresighted point to determine the elevation at the station. This is a toggle in the shot and spreadsheet dialogs. Taking a full or elevation measurement from a station with an elevation value on a foresight with an elevation value will cause the program to prompt for whether the station elevation should be updated.

Multiply-determined Sideshot

Multiply-determined sideshots occur when the surveyor foresights and measures a given point from more than one station point. The results are averaged to determine the generated COGO coordinates.

Turning Points

On-Line

An on-line turning point occurs in this manner: the surveyor stations on point A and foresights point B, recording the turned angle. The rod/prism is placed on the line between A and B at some intermediate distance. This is the *turning point, TP*. The surveyor then measures and records the SD and VA from A to TP. He then stations on point B and again measures the SD and VA from B to TP. The data is reduced to determine the location and elevation of point B.

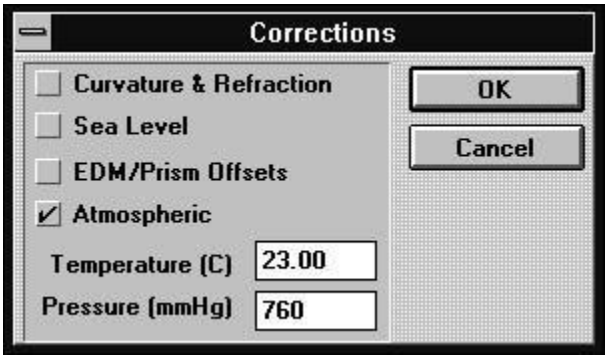
Off-Line

Off-line turning points are used to determine the elevation at a existing point B when the elevation at another existing point A is known, and it is not possible or desirable to obtain the elevation directly by taking a measurement on B from A.

Instead, the surveyor foresights a point, TP, that is visible from both A and B. Such a point, for instance, could be a nail in a tree. An elevation measurement is made from A to TP followed by an elevation
measurement from B to TP. The elevation at B can then be calculated, based on the elevation at A and the turning point measurements.

Corrections

Atmospheric



The EDM uses an electromagnetic signal to measure distance. Atmospheric temperature and pressure affect the propagation of the EDM and can introduce a small amount of error in the EDM distance reading. This error is quite small - about 1/10.000 of the measured distance or less. For larger distance measurements, however, this error can become significant. Modern total stations contain an atmospheric correction system. If the EDM used doesn't have an correction

system or the system is not used, the
correction can be optionally performed by the program. **Do not use this correction for a taped measurement!** The program currently doesn't support temperature corrections to taped measurements. This
correction is automatically disabled for stadia measurements.

$$K_a = RI - \frac{C_{cw} \times P}{273.2 + T}$$

$$SD = SD \times \left(1 + \left[K_a \times 10^{-6}\right]\right)$$

The following formula is used in making atmospheric corrections where:

SD = slope distance

K_a= correction factor in ppm (parts per million)

RI = group refractive index for EDM's carrier wave

C_{cw} = EDM carrier wave constant

P = pressure (in *mmHg*)

T = temperature (in °Celsius)

Curvature & Refraction

Curvature and refraction errors become more appreciable as longer distances are measured. Curvature errors occur due to the curved surface of the earth, resulting in larger horizontal and vertical distance values than are actually present. Atmospheric refraction offsets the curvature affect to some degree, causing the EDM carrier wave to bend slightly towards the earth as it travels. Modern EDMs correct for these effects internally. If internal correction is either not available or disabled on the EDM for a given measurement, the program can be used to correct for these effects. **Curvature & refraction corrections are only applied to slope distance measurements.** They will not be applied to measurements that are entered as horizontal distances and/or elevations.

Sea Level

Enabling Sea Level corrections will result in the adjustment of horizontal distances to sea level values. This is simply a mapping onto a sphere whose radius corresponds to sea level elevation. The following equation is applied:

$$HD_{new} = HD_{old} \cdot \frac{(R_{sl} - EL)}{R_{sl}}$$

HD = horizontal distance

R_{sl} = Mean spheroid radius at sea level = 6372.2 km

EL = station elevation

EDM/Prism constants and offsets

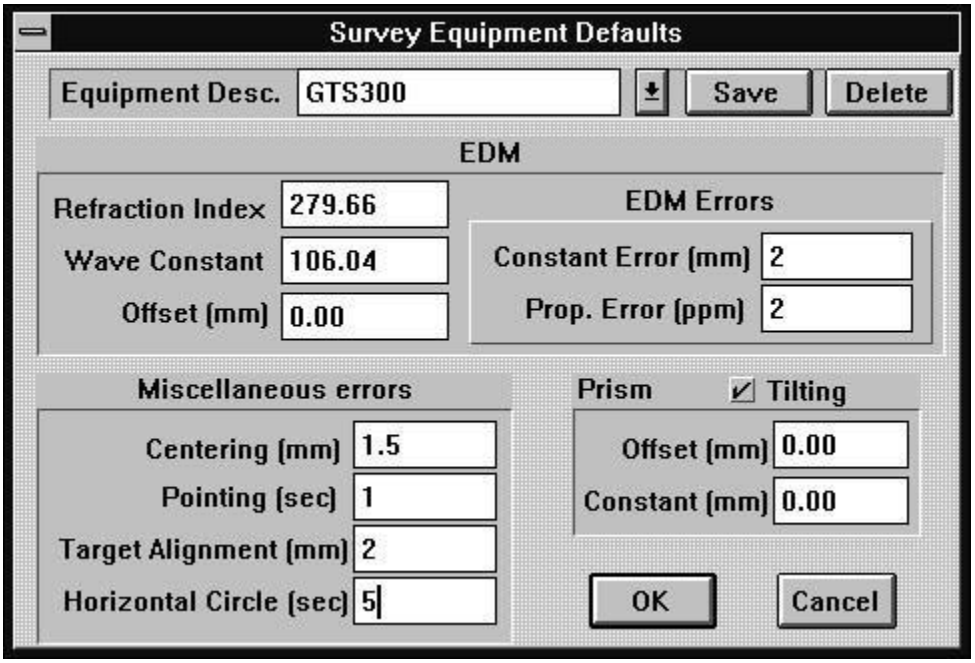
A prism's center can have both a vertical *prism offset* as well as an offset along the direction of sight. The offset in the direction of sight is specified as the *prism constant* - the offset in millimeters towards (a negative value) or away from (a positive value) the telescope. The EDM may also have an offset in the vertical direction. Instead of an EDM constant, there is generally an error specifying the range of error in the sighting direction and an error that is proportional to the distance being measured. For example, one might see an entry in the instruments manual like this:

Measurement Accuracy: ±(2 mm + 2 ppm) m.s.e.

The first value, 2 mm, is the *EDM constant error*. The second value, 2 ppm (2 parts per million), is the *EDM proportional error*. *m.s.e.* is an abbreviation for *mean standard error*. To fully understand what this means, refer to a text on probability on statistics. Explained crudely, a distance measurement of 100 meters with this particular EDM means that the real distance can be somewhere between

100m ± .(2 mm + 100m × .000002) or 100m ±2.2mm

Equipment Settings



The equipment settings are used for curvature & refraction,
atmospheric, and
EDM/Prism
Offsets corrections if such corrections are enabled. The equipment settings also contain error values used in least squares adjustment routines.

Equipment Name

Clicking on the down arrow to the
right of the edit box will display a list of the currently defined equipment types. This list is maintained in the PCS.INI file. The surveyor can select an item from this list or type in a new name to create a new equipment definition.

EDM values

The EDM has several parameters that must be defined in order to process atmospheric and offset corrections as well as perform a least squares adjustment that will take the EDM deviation into account.

Refraction Index and Wave Constant

This is a “lumped” value that can be obtained from the EDM’s specifications. Look for a section on atmospheric corrections in the EDM’s manual.

Offset

The EDM offset is its vertical offset from the telescope's line-of-sight axis. Modern instruments normally have a zero offset for the EDM.

Constant Error and Propagation Error

These values should be contained in the EDM's specifications. They are generally specified in a format similar to: ±(2 mm + 2 ppm) m.s.e. In this example, the constant error is 2 mm (2 millimeters) and the propagation error is 2 ppm (2 parts per million)

Prism values

The prism values are used if the ***EDM/Prism offset corrections*** option is selected. The prism ***constant*** is the prism's offset in the direction of the line-of-sight. The prism ***offset*** is the prism's vertical offset from the measured center. If your prism is a tilting prism, check the ***Tilting*** option. This is the default. Non-tilting prisms can introduce an error that increases with increasing vertical deflection from the horizontal axis. The program will correct for this if ***Tilting*** is NOT selected.

Miscellaneous Errors

Centering

Centering errors occur when attempting to precisely place an instrument above a station marker.

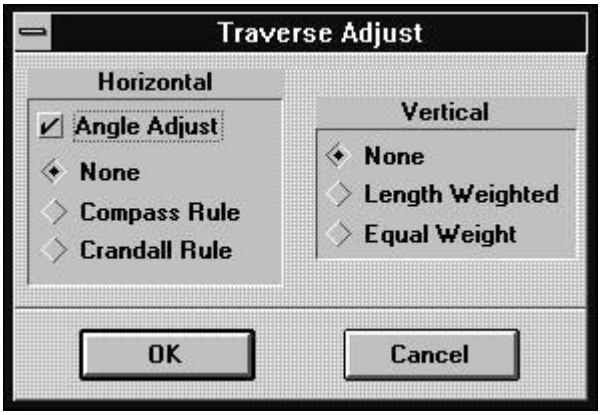
Pointing

Pointing errors result from the finite thickness of the telescopes crosshairs.

Target Alignment Horizontal Circle

The ***Horizontal Circle*** error is a measurement of the instrument's accuracy in measurement of angles. A 10 second instrument, for example, has a 10 second horizontal circle error.

Adjustments



The program has a variety of adjustment procedures. They include ***Angle Adjust***, ***Compass Rule***, and ***Crandall Rule*** adjustment.

Measurements that have the "Hold Side" and /or "Hold Angle" option set will not have their distance and/or direction altered during these procedures.

Angle Adjust (or Angle Balance)

Angle adjustment refers to the distribution of total angular error in a traverse among the individual angles. Angle adjustment can be performed whenever a traverse exists whose first and last legs have known directions or, in the case of closed traverse.

Compass Rule

Compass rule adjustment is a standard technique where the total error is distributed among the legs of the traverse in proportion to the individual leg length. For example, if the length of the leg is 10 feet and the perimeter is 100 feet , then the percentage of the total error which is applied is 10%. If the leg were 15 feet with the same perimeter, then the percentage of total error would be 15%.. This rule works well in most single loop cases. The balancing of the angles is generally done before the compass rule is applied, but the angle balance can be turned off if desired.

Crandall Rule

The Crandall rule is a type of least squares adjustment. Angle adjustment MUST be performed before the rule is applied for correct results. Therefore, the performing of an angle adjustment is not an option in this case. Also, the traverse must be capable of being angle adjusted.

Least Squares Adjustment

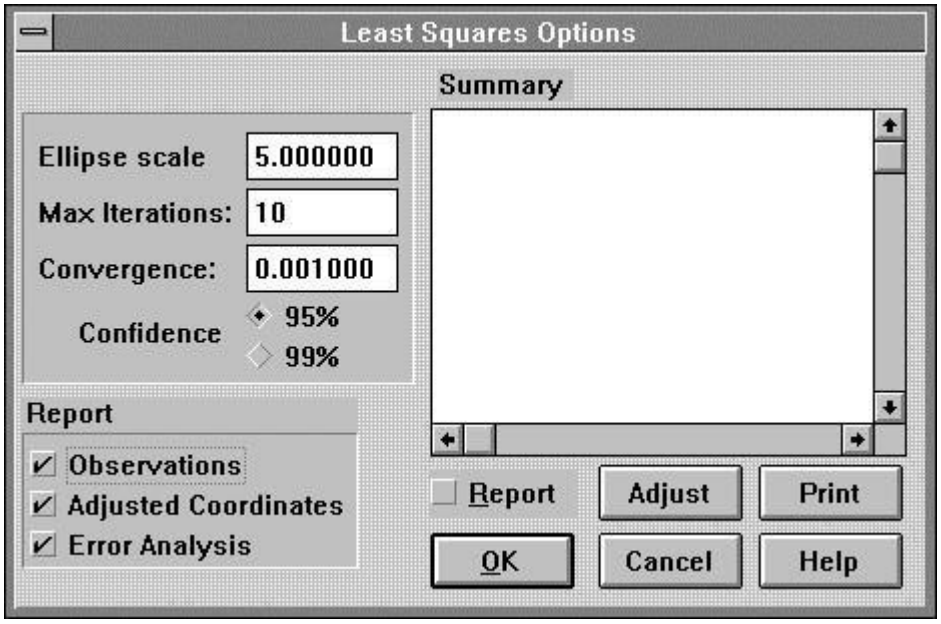
The program supports two-dimensional least squares adjustment by observation equations. This means that the northing and easting coordinates of points generated by angle and/or distance measurements are adjusted such that the adjusted location minimizes the sum of the squares of the errors that result from using that location. Since least squares adjustment is a high precision technique, *the program* assumes that measurements will be performed with a total station (or EDM and theodolite) and doesn't support least squares adjustment of measurements obtained with a transit and chain.

Least squares adjustment is generally used in cases where the surveyor has obtained a *network* of shots as opposed to shooting a simple traverse loop. Using least squares to adjust simple loops generally doesn't provide any better results than using the compass or Crandall rule. Least squares is appropriate when one or more points have been foresighted from more than one station when those points lie within a loop or mesh (as opposed to a simple resection).

The advantage of using *the program* for least squares adjustment is that the same fieldbook is used for this technique as well as other adjustment methods. There is still a graphical display of the shot data as opposed to systems that use a text file for entry. There is also immediate visual feedback of the results through the display of *error ellipses* (more on these later).

Successful use of least squares adjustment with this method requires accurate values for several sources of random errors. These values are entered through the ***Equipment*** dialog. Read the section on **Equipment Settings** on p.76 for more information.

The EDM errors (constant and proportional) and horizontal circle error are of primary importance and are usually provided with the instrument.



To perform a least squares adjustment,

1) Select ***Least Squares Adjust*** from the ***Survey*** menu. The dialog shown above will appear.
2) Adjust the parameters as desired.
3) Select ***Adjust*** to perform the adjustment and save the data to a file. The program will use the standard file dialog to prompt for a file name.

Least Squares Adjustment Parameters

Ellipse Scale - Error ellipses will be generated to graphically show the uncertainty or probable error associated with the adjusted location of each point in the network. Normally, these ellipses are very small when displayed at a 1:1 scale, so the surveyor is given the option of magnifying the size of the ellipses by changing their scale factor.

Max Iterations - Least squares adjustment is an iterative technique - computations are performed to calculate new point locations and the new locations are used to perform another set of computations and so on. When the difference between successive computations is less than some specified value, the adjustment is complete (the results have *converged*). It is possible for conditions to be such that a large number of iterations might be necessary to achieve convergence. Since least squares adjustment can take a large amount of time for each iteration, the procedure may take too long under such conditions. Setting the maximum number of iterations to some small value will force the program to terminate calculation after the specified number of iterations.

Convergence - When the difference between successive computations is less than the value specified here, the results are considered to have converged and so the computation is finished.

Confidence - The probability that the true position lies within the area of the error ellipse. (If the error ellipse has been scaled, the area.)

The ***Report*** options specify what data to include in the generated report.

- ***Observations*** includes all the angle and distance measurements that were used in the adjustment calculations.
- ***Adjusted Coordinates*** includes the new locations for all the points in the adjustment.
- ***Error Analysis*** provides a detailed summary of the errors associated with the points.

Miscellaneous Controls

Summary - Shows some basic information after the adjustment.

Print - Print out the data from the file to the printer.

Report - Create a separate dialog to display the full report.

Unadjust Least Squares

This function simply removes any least squares adjustments that have been performed.

Error Search

The *Linear Error Search* function will take the linear error between the first and last points and will apply the error to each shot in the loop and will check the resulting loop for the resulting linear error, displaying the result in the log window. The shot which, when adjusted by the error, produces the smallest resulting error will also be displayed.

The *Angular Error Search* function will take the angular error between the first and last turned angles and will apply the error to each angle in the loop.. The resulting loop will be checked for the resulting angular

error and the result will be displayed in the logging screen. The angle which, when adjusted by the error, produces the smallest resulting error will also be displayed.

Edit Functions

Generate COGO Points and COGO Filter

To create COGO points from the Survey points, select ***Generate COGO points*** from the ***Edit*** menu of **Survey**. To configure the Survey to COGO mapping without actually generating the COGO points yet, select ***COGO Filter*** from the ***Edit*** menu of **Survey**. The same dialog box is used in either case.

This dialog box behaves similarly to the ***Fieldbook Editor***. As the current row changes, the headings at the top of the columns may change as well to reflect the kind of data that is in each column of the current row. The checkboxes in the first two columns are the only fields which can be edited. The other fields are provided for reference only. Any points which have the same point number or are 'very' close together will be listed together to show that they can optionally become the same COGO point. The ***Use*** column tells whether the point will be transferred to COGO or not. If it is not checked, no COGO point will be created. The ***Mult*** column is used when multiple points are grouped together. Any point that is not checked in this column and is checked in the ***Use*** column will be directly transferred to COGO. When both columns are checked, the position will be averaged in with any others which are also checked in both columns to become a single Cogo point.

Just as in any other dialog which contains a spreadsheet, the size of the columns can be changed by moving the mouse to the line in the header row which separates that column from the next column. The cursor will change to a || with arrows on each side. Click and drag with the mouse will then resize the column.

Inverse, Next Number, Modify Line Text, Set Font

These functions are identical to their counterparts in COGO and are explained in the COGO section of the manual.

Inverse - see p.177

Next Number - see p.190

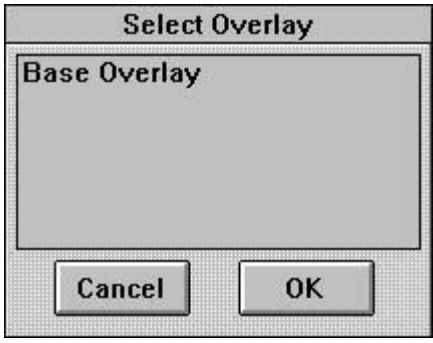
Modify Line Text - see p.115 ***Set Font*** - see p.200

Delete Objects

Delete Objects will delete all selected objects. If the object is a part of a mapcheck, the entire mapcheck will be deleted. If the object is a shot, any shots which are dependent on it will be also be deleted. In other words, if you delete the shot which created point #3, then any shots which stationed at point #3 will also be deleted. So use this function with care.

Save to Overlay

To move Survey objects to a specific overlay, select ***Save to Overlay*** from the Survey ***Edit*** menu. A dialog box will appear allowing you to select which overlay to save the data on. For more information about Overlays, refer to the discussion of overlays on p.114.



Create Loops

Most of the time, loops will be created automatically as the data is entered. If the program has failed to create a loop, select the lines which represent the shots that constitute the loop. Then select ***Create Loops*** from the Survey ***Edit*** menu. A loop will be created if it is possible using all of the selected shots and only the selected shots.

Survey Functions

Occupy/Back Sight

This dialog is identical to the dialog used in the Cogo window but sets the station and backsight points in the Survey data. For more information, refer to ***Occupy/Back Sight*** in the **Cogo** section.

In the ***Shot Editor*** and the ***Fieldbook Editor***, the occupy and backsight points for a given shot are explicitly stated.

Loop Report

To display information about a loop, select the loop and then select ***Loop Report*** from the **Survey** menu. The following information will be displayed:

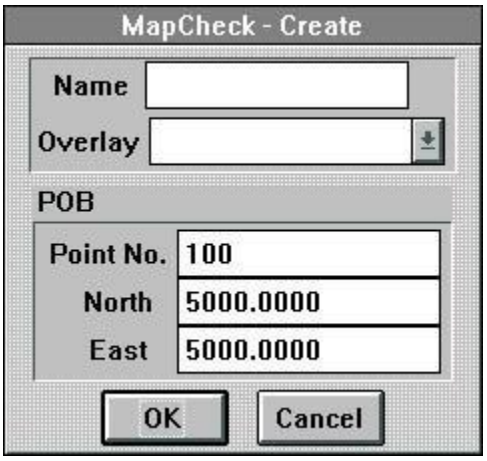
```
Analysis of Closed Loop "Loop0"
Number of Sides : 6
    ERROR
==================
Angular   : 0°17'39"
Northing  : 35.70'
Easting   : -33.86'
Elevation : N/A
Absolute  : 49.21'
Direction : 133°29'18"
==================
Perimeter : 1836.52'
Precision : 37.32
```

Mapcheck Functions

Mapcheck routines are for the entering and error checking of existing plat data. The user can optionally create COGO objects (points, lines, arcs, etc.) now or later for further use. Lines are entered as distances and directions (azimuths or bearings). Curves can be entered with a variety of parameters. The mapcheck report contains a summary of the boundary data, and the closure, area, and perimeter values.

Create

The ***MapCheck*** - ***Create*** dialog allows the input of a name, optional COGO data creation, overlay assignment and starting point data. The ***Name*** and ***Overlay*** fields are optional; defaults are assigned for the ***POB*** fields.

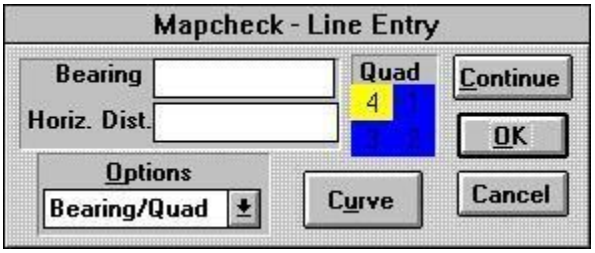


Mapcheck Creation Dialog

If more than one mapcheck will be created within a given project, assign unique names to each one so as to distinguish between them.

- The ***Overlay*** list allows the generated COGO data to be placed on a separate overlay. This feature is useful when the surveyor wishes to be able to easily turn the mapcheck data on or off.
- The ***POB*** data is simply the point number, northing and easting for the starting point in the mapcheck.

When you click OK, another dialog will be opened for entering information for the first time from the plat.

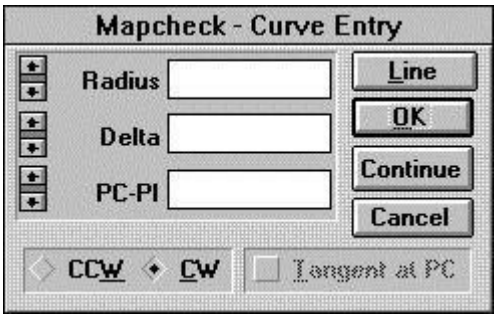


Line Entry

The information is entered as an angle and a distance. The angel can be entered as either a bearing or an azimuth. To change the angle mode, click on the down arrow for the ***Options*** list and select the desired angle mode.

- To enter a mapcheck curve, click on the ***Curve*** button which will open the mapcheck Curve dialog.

Curve Entry

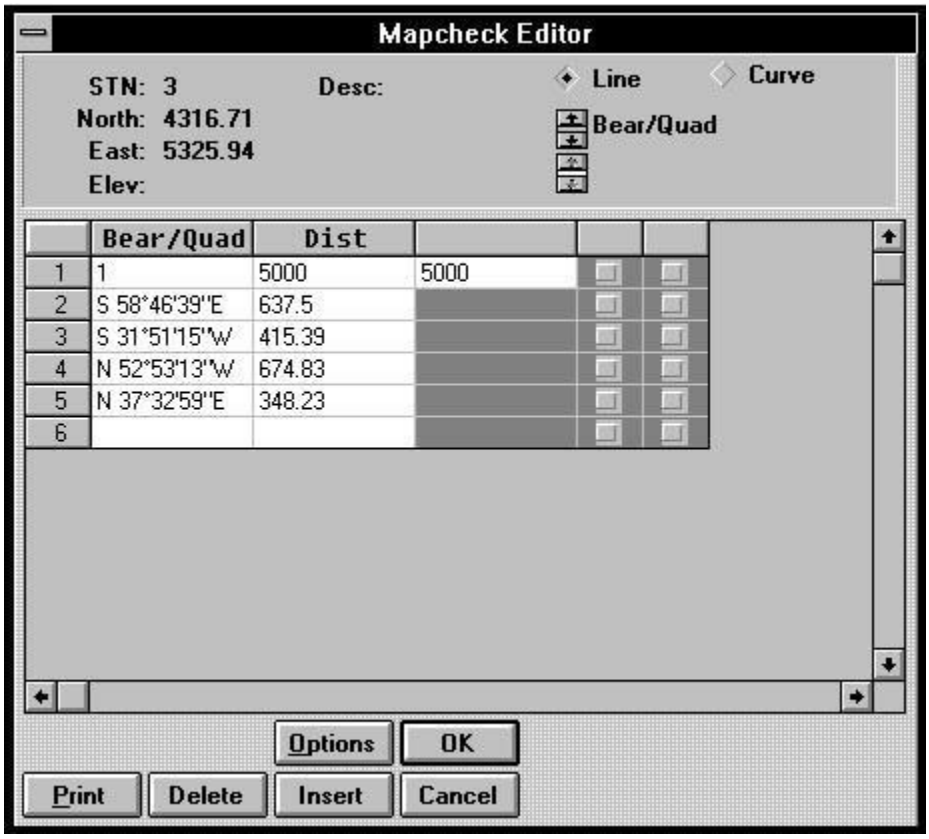


- The first two parameters are selected from ***Radius***, ***Tangent***, ***Length***, ***Chord***, ***Delta***, ***PI-PT*** (angle from the Point of Intersection to the Point of Tangency) and ***RP-PT*** (angle from the Radius Point to the Point of Tangency). ***PI-PT*** requires that the other parameter be the Tangent distance. ***RP-PT*** requires that the other value be the Radius distance. Otherwise, any combination of two of these parameters will work.
- The third edit box is used for specifying the ***PC-PI*** angle. If the curve is tangent to the incoming line or curve, just enable ***Tangent at PC***. This will disable the ***PC-PI*** edit box and will set the curve tangent to the incoming line or curve (assuming of course that this curve is not the first segment of the mapcheck in which case there is no incoming line or curve and so ***Tangent at PC*** is disabled). ***CW*** or ***CCW*** are selected to specify clockwise or counter-clockwise, respectively. To return to line mode, select ***Line***.

Edit (Mapcheck)

Editing a mapcheck is very similar to editing fieldbook data, but a lot simpler. The first line will always be the point number, northing, and easting for the starting point. The rest of the lines will be either lines or curves and the headers for the column will reflect the data which is in the current row. The Point information in the upper left of the dialog box shows the information for the point which was created by that line of the mapcheck.

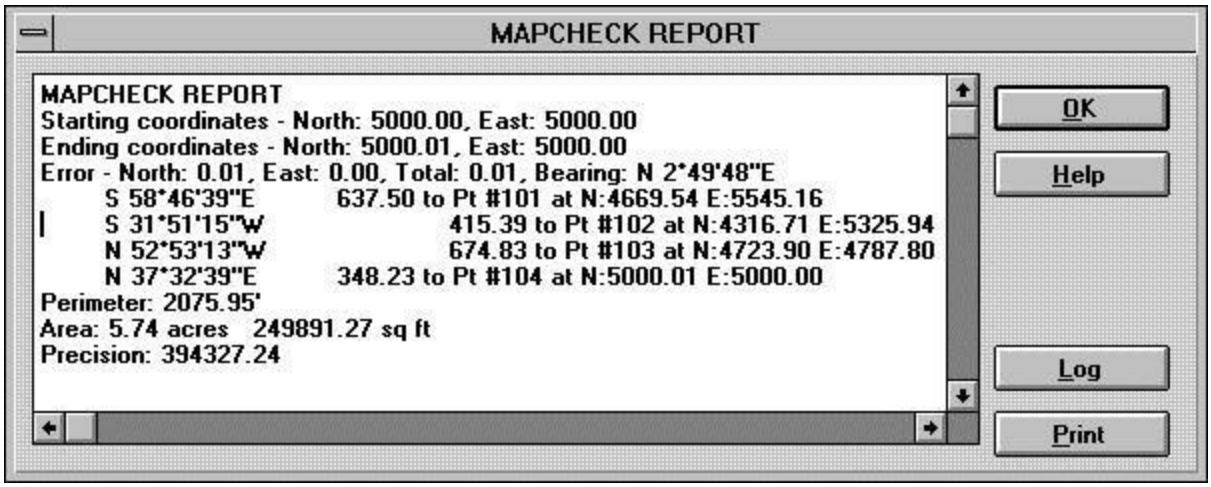
- To change from ***Line*** to ***Curve*** mode, click on the appropriate radio button in the upper right corner of the
  dialog.
- For Lines, the first column is the angle and the second column is the distance. To change the angle mode for the current line, click on the top spin button which, in this example, says ***Bear/Quad***.



- For Curves, the first two columns are selected from ***Radius***, ***Tangent***, ***Length***, ***Chord***, ***Delta***, ***PI-PT*** (angle from the Point of Intersection to the Point of Tangency) and ***RP-PT*** (angle from the Radius Point to the Point of Tangency). ***PI-PT*** requires that the other parameter be the Tangent distance. ***RP-PT*** requires that the other value be the Radius distance. Otherwise, any combination of two of these parameters will work. The third column is the ***PC-PI*** angle. If the curve is tangent to the incoming line or curve, just enable the checkbox in the last column which is ***Tangent at PC***. This will disable the ***PCPI*** column and will set the curve tangent to the incoming line or curve (assuming of course that this curve is not the first segment of the mapcheck in which case there is no incoming line or curve and so ***Tangent at PC*** is disabled). The fourth column specifies whether the curve travels clockwise or counterclockwise.

Report

To create a report of the mapcheck, select ***Report*** from the ***Mapcheck*** menu. The report will include the starting and ending coordinates, error of closure, and information for each leg or curve of the mapcheck. A dialog containing the report will appear, similar to the one shown below.



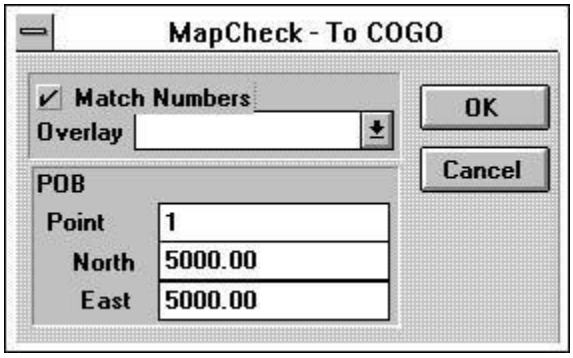
Example of a Mapcheck Report

Once the report is displayed, the surveyor has the option of printing and/or logging the report by selecting either the ***Print*** or ***Log*** buttons. If multiple mapchecks are selected, their reports can be viewed one at a time in the dialog. The surveyor can then view and optionally print each of the mapchecks in turn. The following additional buttons become available to allow this:

Log - send the selected mapcheck reports to the session log ***Print*** - send the selected mapcheck reports to the printer.

As usual, select ***OK*** to leave this function or ***Help*** to invoke the online help.

To COGO



If you didn't generate Cogo points when the mapcheck was created, you can generate them later by selecting ***To Cogo*** from the ***Mapcheck*** menu. This is a simplified version of the dialog box used for creating the mapcheck. ***Match Numbers***, ***Overlay***, and ***POB*** all mean the same as they did when creating the mapcheck. ***Match Numbers*** will create Cogo numbers that are the same as the numbers used in Survey. ***Overlay*** will place the numbers on the specified overlay.
POB will set the Cogo point number and location for the start of the mapcheck. When ***OK*** is selected, a copy of the points, lines, and curves will be created in Cogo and a boundary will also be created consisting of the entire mapcheck.

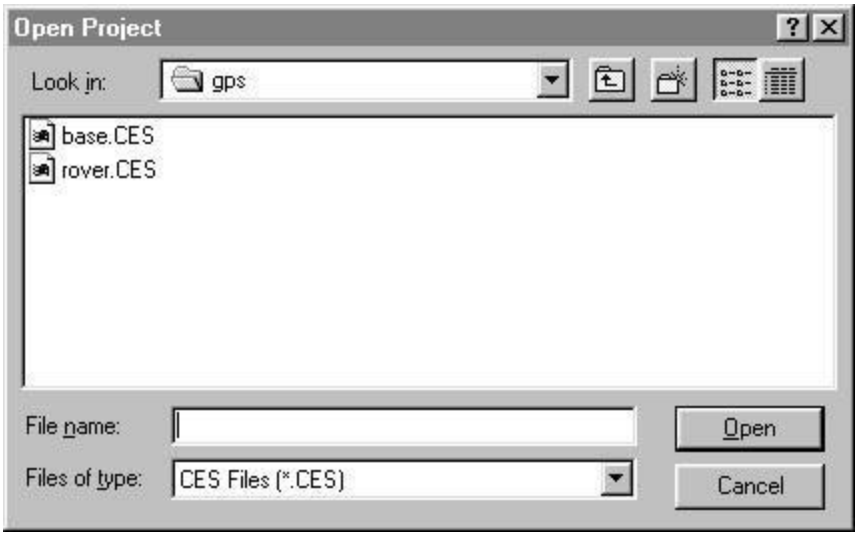
GPS Functions

The GPS functions are for processing GPS receiver data. To process a baseline, the order of steps to follow is:

1) Transfer the receiver files to the computer.
2) Load the receiver files for the desired points using the ***Load GPS Files***.
3) Select a control point with the mouse.
4) Select ***Add Control Point***.
5) Select ***Process This Session.***

Load GPS Files

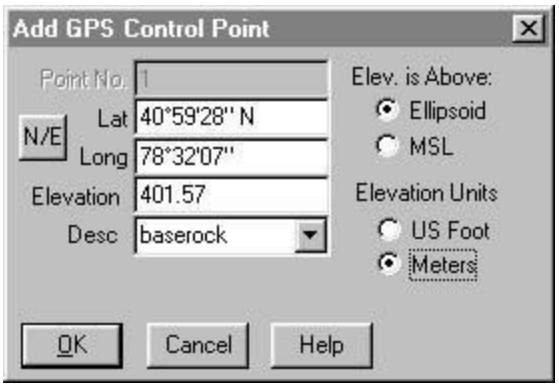
The first step in GPS processing is to load the receiver data files. GPS data collected with the GMS data collector will have the suffix **.CES**. There will be at least one file for each receiver that can contain one or more points. The receiver files should already have been transferred to the computer before this point. To use this function:



1) Select ***Load GPS Files*** from the ***GPS*** menu. The standard Windows file dialog will appear. The current folder (or "Look In" folder) will default to the ***GPS*** directory specified in the ***Options | Directories*** settings.
2) Select each of the receiver files, by left-clicking on the file name followed by pressing the ***OK*** button.
3) After all files have been loaded, select ***Cancel*** to finish.

At this point, the points with their associated baselines should appear on the screen for static sits. For kinematic mode, a series of gray dots will appear showing the path traveled while in kinematic mode.

Add Control Point



Once the GPS files have been loaded, one point must be selected and designated as the control point. This point will not be adjusted during processing and is typically a GPS station point that is a geodetic monument with known state plane and/or lat/long coordinates. To use this function:

1) Select the desired control point by left-clicking and dragging a selection box around the point. Baselines associated with this point will be selected as well, but that will not affect this function since ***Add Control Point*** is only concerned with selected points.

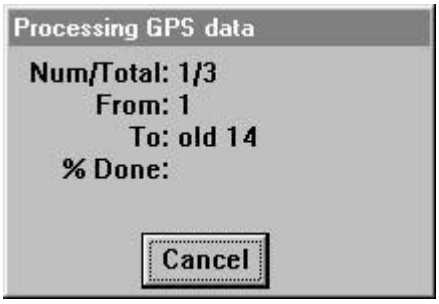
2) Select ***Add Control Point*** from the ***GPS*** menu. A dialog will appear, displaying the coordinates for the selected point along with the options of ***Ellipsoid*** or ***MSL*** and ***Feet*** or ***Meters***. The default values will be shown as ***Ellipsoid*** and ***Meters*** and are the approximate geodetic coordinates as derived from the GPS receiver data.

3) If the selected point is a geodetic monument, modify the data to reflect the correct information.

4) Select ***OK*** to close the function.

The selected point's symbol will change to a triangle to reflect the fact that it is now a control point. The displayed position may also shift somewhat.

Process This Session



After the GPS files have been loaded and a control point has been designated, the baseline processing may be done. To use this function:

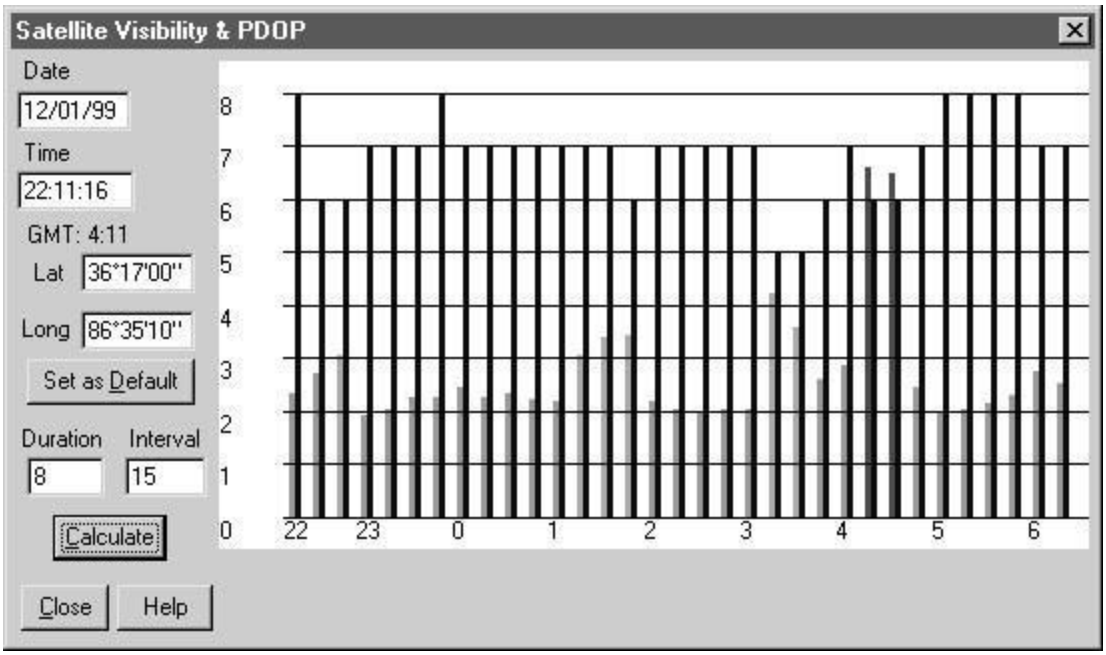
1) Select ***Process This Session*** from the ***GPS*** menu. A status window will appear, displaying information on how many baselines have been processed, how many total baselines are to be processed and how much of the processing has been completed, as a percentage, on the current baseline.

When the processing is done, the colors of the baselines will be updated to reflect their status. The colors are:

Green- Good baseline.

Red- Bad baseline. The data is not considered reliable.

Satellite Planner



The ***Satellite Planner*** is a critical piece for successful use of GPS equipment. The planner displays the number of satellites visible and the PDOP value for specified times at a given location. This function, along with the ***Satellite Viewer*** (explained next), requires an almanac file to be present in the ***Almanac*** directory in order to work. (See ***GPS Almanacs*** on page 239 for more information.)

The PDOP value (Position Dilution of Precision) is, by far, the most critical information. PDOP values are color-coded green, yellow and red depending on their value in order to quickly see how good or bad the satellite configuration will be. The numbers on the left side of the bar graph indicate the number of visible satellites above 15 degrees vertical angle for the blue bars or the PDOP value for the green, yellow or red bars. The bottom axis is graduated in military hours.

Red values represent PDOP values above 5.0 and indicate times that should be avoided. In the picture above, this includes the time from about 4:15am toa 4:45am.

Yellow values represent PDOP values between 3.0 and 5.0 and indicate times that are not ideal and should be avoided when performing kinematic GPS sessions.

Green values represent PDOP values below 3.0 and indicate times suitable for either static of kinematic GPS sessions.

To use this function:

1. Set the ***Time*** and ***Date***. These will default to the computer's current time and date settings. Use the format shown in the picture above.
2. Specify the location as a latitude and longitude. When entering these values, use the format

(D)DD.MMSS where D = Degrees, M = Minutes, and S = Seconds. The latitude shown in the picture was entered as 36.1700, for example. If the value entered is the normal location for GPS use, press the ***Set as Default*** button to store this as the default value.

3. Specify the ***Duration*** in hours (default is 8 hours).
4. Specify the sample ***Interval*** (default is 15 minutes). As an example, an interval of 15 minutes will show 4 bars per hour as in the picture above.
5. Press ***Calculate***.

Satellite Viewer

The ***Satellite Viewer*** is used to view the satellite configuration for a specific date, time and location. This can be useful when trying to acquire GPS points that are partially obstructed such as locations next to a line of trees or next to a building. In cases of partial obstruction, GPS measurements need to be made at times that have at least 4 (and preferably 5 or more) satellites above the elevation mask that are unobstructed from view with respect to the receiver.

Geoid Calculator

The ***Geoid Calculator*** computes the separation between the geoid and the ellipsoid at a designated location. The calculation uses the Geoid 96 data as provided by the US government and is expressed as a distance.
The distance is the height/elevation of the geoid with respect to the ellipsoid. Negative values, for instance, (which will be the case for all locations within the conterminous United States) indicate that the geoid is below the ellipsoid. To use this function:

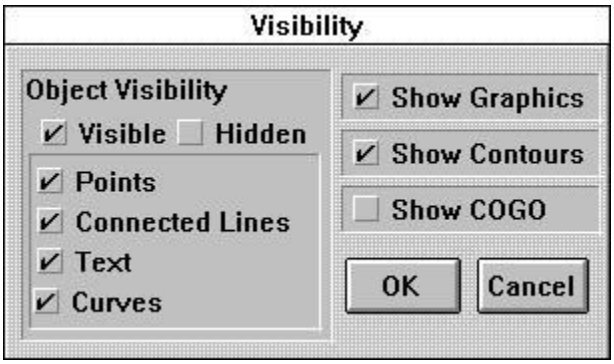
1) Select ***Geoid Calculator*** from the ***GPS*** menu.
2) Enter the desired ***Latitude*** and ***Longitude*** values.
3) Select ***Calculate***. The geoid separation value will be displayed.

View Functions

See the section on Common View Functions on p.38 for information about ***Redraw Screen***, ***Full View***, ***Pan View***, ***Zoom In***, ***Zoom Out*** and ***Zoom Back***.

Visibility

This controls the visibility of various elements in the Survey window.



Show Graphics, ***Show Contours***, and ***Show COGO*** control whether data created in Layout, DTM, and ***COGO*** windows respectively are to be displayed in this window. When one of these is checked, the data created in the corresponding window will be displayed in a light gray color.

Points, ***Connected Lines***, ***Texts***, and ***Curves*** control whether the corresponding Survey items are displayed in this window. To turn off the display of all Survey texts, for example, click on the ***Text*** checkbox to remove the check.

Displayed objects may be visible or hidden. If ***Visible*** is selected, only visible objects will be displayed. If ***Hidden*** is selected, only hidden objects will be displayed. If both are selected, all objects will be displayed.

Find Point

This function is the same as ***Find Point*** in ***COGO*** so refer to the ***COGO*** section for information on this function.

COGO, Layout, DTM, Component

These functions will create the window of the specific type. For information on these functions, refer to the COGO section.

Misc Functions

Status Window, Select Status, Tool Window

These functions are the same as their COGO counterparts so for information about these functions, refer to the Cogo section.

Close

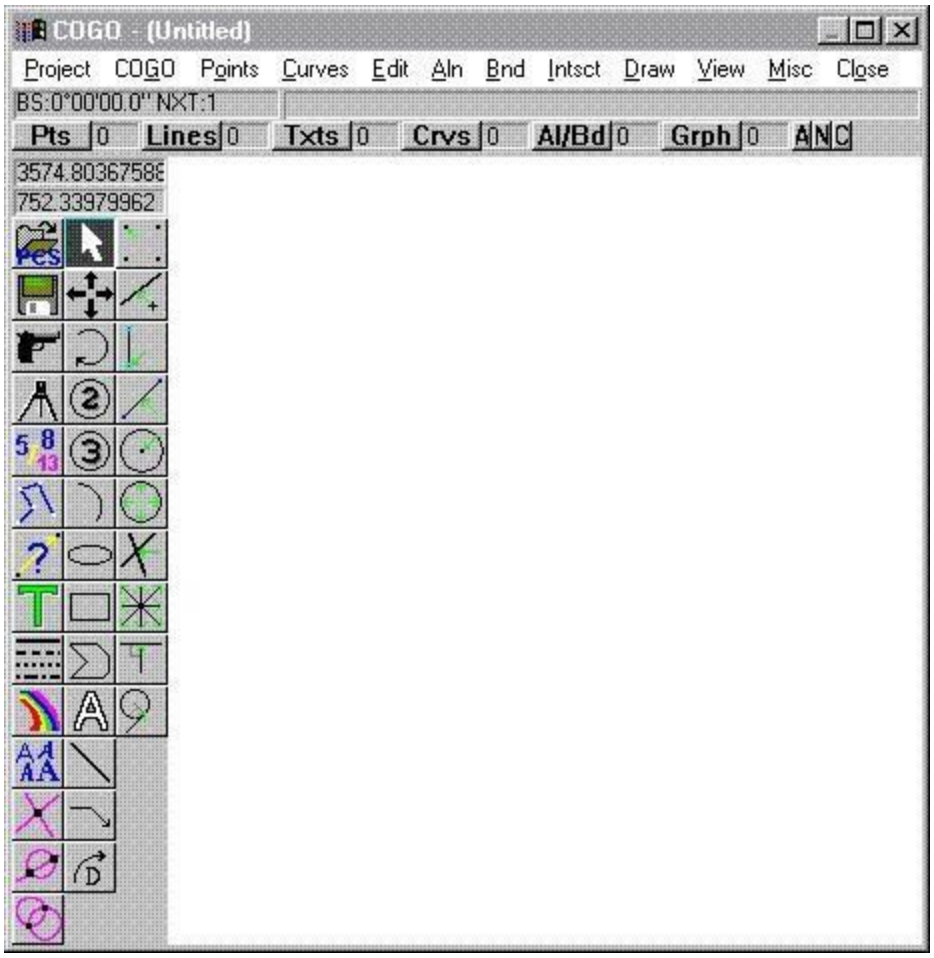
Close the Survey window.

The COGO Window

Window Items

The Cursor

The cursor is the pointer controlled by your mouse. Normally, the cursor will look like an arrow. The program also uses special cursors in some of its functions. The cursor is normally used to actuate the menus at the top of the window, select menu items, push buttons and operate dialog boxes, select data, and zoom or pan within the project.



Data Window

This is where your data is displayed. The data window, in conjunction with various mouse actions, is also used to manipulate project information. Selection, placement, zooming and

panning are all done within the data window.

Title Bar

The Title Bar is at the top of the window. The name of the program is displayed followed by the name of the current project (if any) is displayed in the bar.

Menu Bar

The Menu Bar lies directly below the title bar. Clicking on the menu bar with the left button of the mouse or using the keyboard accelerators associated with the items in the bar (ALT P for Project, for instance) will display a list of various functions associated with the COGO window.

Tool Bar

The COGO Toolbar is a column of buttons that appears on the left side of the COGO window when enabled.
It is simply a quick way to access commonly used functions that are also available through the menu bar.
From top to bottom, the functions in the first column are: ***Open(Project), Save(Project)***, ***Traverse/Side Shot***,
Occupy, ***Next Number***, ***Point Traverse***, ***Inverse***, ***Text On/Off***, ***Line Style***, ***Color***, ***Font***,

Bearing/Bearing(Intersection), ***Bearing/Distance***(***Intersection)*** and ***Distance/Distance(Intersection)***.

The ***Text On/Off*** button displays a green "T" when text drawing is enabled. When disabled, a crossed out red "T" is displayed.

The second column of the tool bar are drawing functions. From top to bottom, they are:
Select, Rotate, Two-
point Circle, Three-point Circle, Arc, Ellipse, Rectangle, Polygon/Polyline, Text, Line, Straight Dimension, Curved Dimension.

The third column contains buttons that toggle various snapping modes on and off. The first seven are absolute snap modes and are, from top to bottom: ***Grid, Nearest, Endpoint, Midpoint, Center, Quadrant, Intersection.*** The last three are relative snap modes and are ***Angle, Perpendicular, Tangent***. These buttons act like radio buttons – only one of the absolute snap modes and only one of the relative snap modes can be on at a time. To turn off the snap mode that is already on (depressed), press that button again. (see p.221 for more information on snapping).

The Tool Bar can be toggled on or off through the ***Misc*** menu.

Status Bar

The status bar is the gray bar immediately underneath the menu bar. The left box of the status bar displays the current back sight and the *next number* that will be used when a new point is created. The back sight can be displayed as either a point number or as an azimuth. See the section of COGO options for more information on this feature.

The right box displays information about the occupied point including point number, northing, easting, elevation (if enabled) and description. Elevation display is enabled or disabled through the ***EnvironmentOptions*** dialog box that can be accessed from the ***Environment*** menu.

When commands are entered through the keyboard (the command line - see p.45) they replace the occupied point information.

The Status Bar can be toggled on or off through the ***Misc*** menu.

Select Status Bar

The Select Status Bar is a series of buttons and boxes containing numbers directly beneath the Status Bar. The buttons are used to actuate the selection filters, which are discussed in detail in the "Data Selection" section of this manual. The numbers indicate how many items of each type of data are selected (see the *Data Types* section immediately following). Additionally, there are three buttons labeled **A, N** and **C** on the far right of the select status bar. The **A** button stands *ALL*. Pushing this button will enable all selection types. The **N** button stands for *NONE*. Pushing this button will disable all selection types. The **C** button stands for *CLEAR*. Pushing this button unselects anything that is selected.

The Select Status Bar can be toggled on or off through the ***Misc*** menu.

Coordinate Display

The Coordinate Display is on the top of the toolbar Normally, the top box of the display shows the northing and the bottom shows the easting of the cursor. In the radial select mode, this display will show the absolute distance from the occupied point.

Data Types

Points

Points are just a number and location with an optional elevation and description. Descriptions are currently limited to 15 characters. Control over displayed points is very flexible. Each displayed point has an associated symbol and location for text data. Each text value (number, location, elevation, and description) can be individually turned on or off. The placement of each point's data is also controllable.

Lines

There are two basic types of COGO lines -- *connected* and *leader* lines. Connected lines always start and end at a point. Leader lines are usually used to place text associated with a connected line or a curve when the text will not otherwise fit (usually because the connected line or curve is very short). A line's color, line style and width are all individually definable. Line width can only be defined for solid lines (as opposed to, say, dashed).

Texts

Texts in COGO can be associated with point data, bearings, distances and curve data or placed as unassociated (*floating* or *free-standing*) text. Free-standing text may also be placed in the project through the Layout part of the program.

Although some text is automatically created, all text can be manually moved and resized. Text will have an associated default font and size. However, when fitting text to a line, the program will automatically shrink the text size, if necessary, in order to make it fit on the line. It will not automatically increase the text size beyond the default settings. The default sizes are controlled through the layer values (see the section on Layers and Overlays).

Curves

Curves in the program are currently limited to simple (constant radius) curves. Again, line type and color are definable, as well as width for solid line style curves. Curves always have a starting and ending point. Curve radius and length can be automatically placed along the curve. Curve tables can be automatically generated to display other curve parameters.

Alignments & Boundaries

Alignments and boundaries are sequences of objects that can include points, lines, curves and other alignments/boundaries.

A boundary represents an area and is generally used for things like property boundaries. Boundaries have an associated perimeter, area, acreage and precision of closure. The precision of closure is the ratio of the perimeter to the distance between the starting and ending point of the boundary. This information can be accessed through the Alignment/Boundary Info function. ***Compass Rule*** and ***Angle Adjust*** functions are performed on alignments.

An example of an alignment would be a road centerline. It has a perimeter (or length) but no area, acreage or precision of closure.

Graphics

Graphics are CAD objects (opposed to “point-based” objects) such as simple arcs, lines, texts, etc. However, the *Select Status* will include the number of selected CAD lines (as

opposed to connecting lines) and CAD curves (as opposed to CAD curves with the ***Lines*** and ***Crvs*** selected count, rather than the ***Grph*** number.

Data Visibility

There are several ways to control whether or not data appears on the screen. Most of the time, data that does not appear on the screen will not appear in a print or plot -- exceptions to this rule will be noted.
Additionally, data that is not visible is also not selectable and therefore cannot be used by any of the COGO functions.

Hiding Objects

Data can be sub classified as ***visible*** or ***hidden***. Individual selected objects can be *hidden* by using the ***Hide Objects*** command in the ***Edit*** menu. In a similar manner hidden objects can be *unhidden* by using the ***Unhide Objects*** command. However, to unhide an object, it must first be selected. To select it, you must be able to SEE it. Ooh- Catch-22! Hidden objects can be made visible (and, ergo, selectable) by using the ***Visibility*** command as explained below.

Text On/Off

This function enables or disables the drawing of **ALL** text on the screen. It is accessed through the Text On/Off button in the toolbar. Turning the drawing of screen text off is useful when the user is not currently interested in textual information (like bearings and distances) and has a lot of data on the screen. Screen redraws can be much faster when text drawing is disabled. When disabled, the Text On/Off button will have a red "T" with an X through it. When enabled, the X disappears and the "T" is a bright green.

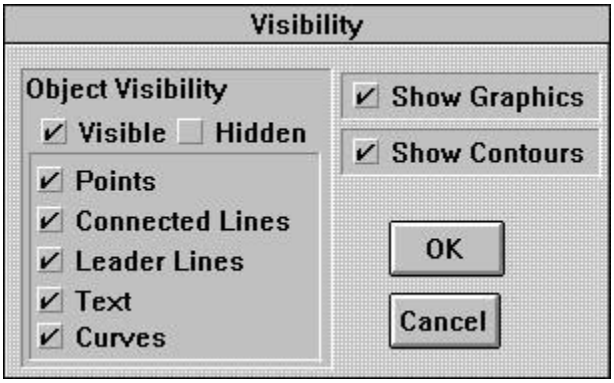
Layer Visibility

Layer visibility allows the user to turn off the display of given data types. Normally a different layer is associated with each basic data type (points, point numbers, bearings, lines, etc.) Turning off the point number layer, for instance, will hide all the point numbers on that layer -- which would be ALL point numbers unless the user has deliberately moved them to another layer. Again, data on invisible layers is not available to COGO functions.

Layer visibility is accessed through the ***Edit Layers*** command in the ***Environment*** menu of the ***Main Window***. The top level dialog (the dialog box initially displayed) is a table listing the various layers, along with their color, line width and line style. The second column is labeled "On". If the layer is "on", it is visible. Clicking with the mouse on this column will toggle the state between checked (ON) and unchecked (OFF). This state can also be modified from within the next dialog box that is accessed by clicking on the *Modify* button at the bottom of the ***Edit Layers*** dialog.

Data Type Visibility

Yet another way to disable the display of a specific data type is through the ***Visibility*** command in the ***View*** menu. This command explicitly addresses five COGO data types -- *Points*, *Connected Lines*, *Leader Lines*, *Texts*, and *Curves*.



There is another check box called ***Show Graphics***. Graphics are created and placed in the Layout portion of the program. If ***Show Graphics*** is checked, these items are visible from within COGO. They will normally be drawn in gray and they are not selectable. ***Visible*** and ***Hidden*** describe whether objects that are normally visible or hidden will be displayed.

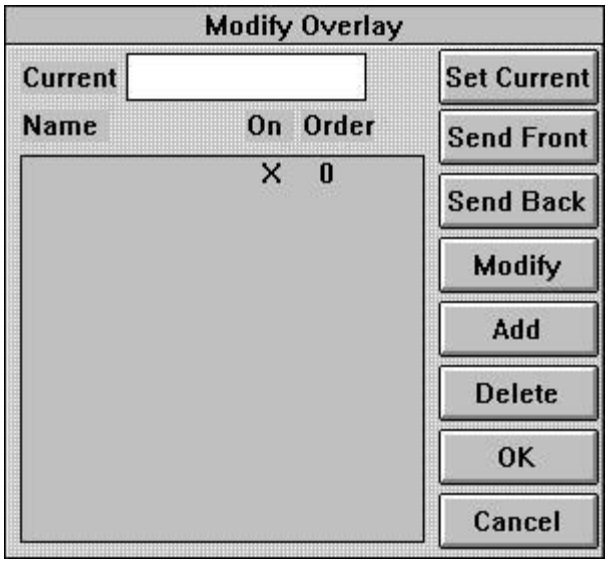
The ***Show Contours*** is similar to ***Show Graphics***. If you don't have the contouring version of the program, this checkbox will not do anything. However, if you *have* generated contours, this is a quick way to prevent contouring data (including the TIN) from being drawn while you're working in COGO. Since contouring data can be time-consuming to draw, this option can be valuable.

At the beginning of this section, the idea of hiding and unhiding objects was discussed. To *unhide* an object, it must first be selected so that the ***Unhide Objects*** command can be used. Normally *hidden* objects are not selectable -- this is why there is a checkbox in the ***Visibility*** dialog box to allow the drawing of hidden objects. Likewise, it is possible to turn off the display of *visible* objects. Both of these actions should be temporary and used in conjunction with changing objects from *visible* to *hidden* or vice versa.

Overlay Visibility

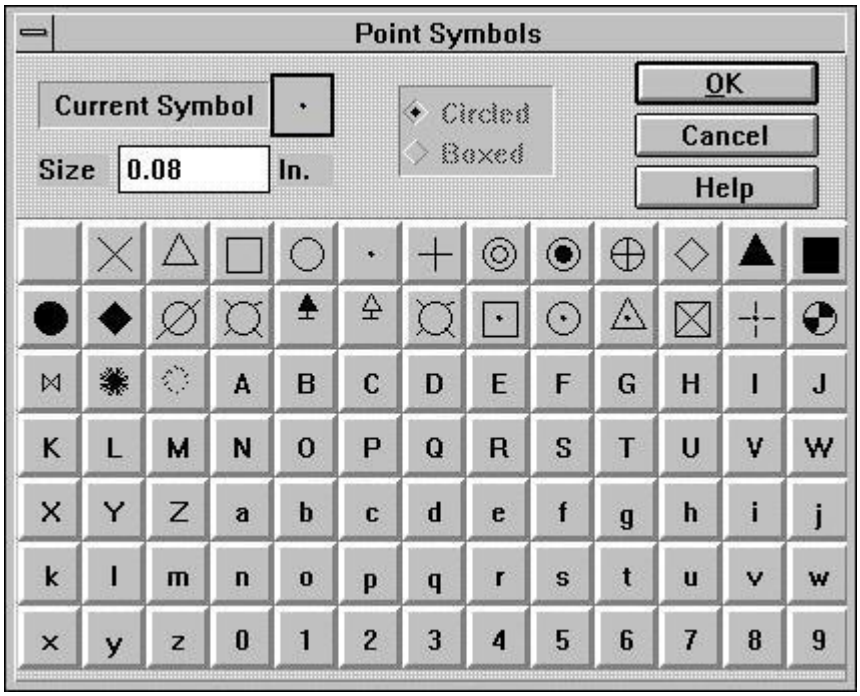
Overlays can also be used to set the visibility of certain objects. Layers can control line types and widths, colors, and fonts in addition to visibility, Overlays control visibility and the order of drawing. Turning off the visibility of an overlay will hide all objects on that overlay.

Overlay visibility is accessed through the ***Edit*** ***Overlay*** command in the ***Edit*** menu. The top level dialog (the dialog box initially displayed) is a table listing the various overlays. The second column is labeled "On". If the layer is "on", it is visible. Clicking with the mouse on this column will toggle the state between checked (ON) and unchecked (OFF). This state can also be modified from within the next dialog box accessed by clicking on the ***Modify*** button at the right of the Edit Overlay dialog.



Point Symbols

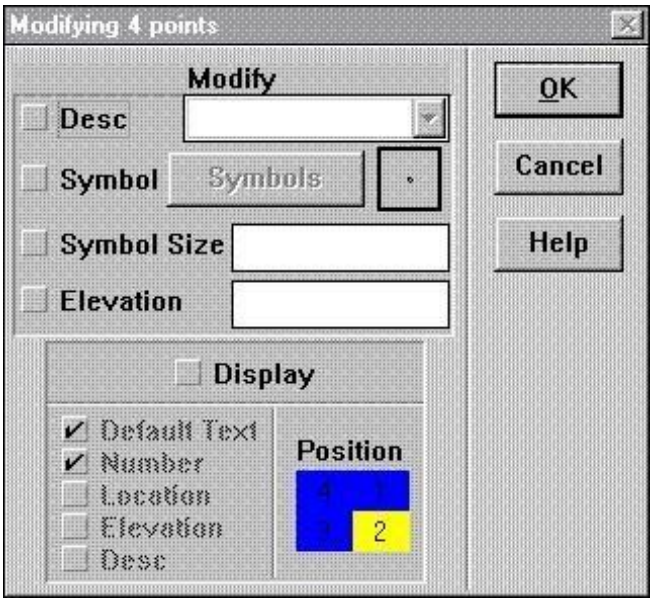
Point Symbols are the markers used to represent the actual point. The default symbol is a cross but other available symbols include a circle, diamond, cross in circle, and even letters in boxes or circles.



Options in the ***COGO*** menu sets the point symbol to use for points yet to be created. Click on the
Symbol button in the ***Points*** section which is in the middle of the dialog box to bring up the dialog box for editing point symbols.

Clicking on the button with a picture of the desired symbol type will set that type as the ***Current Symbol*** type. The size of the symbol can be specified in inches. The size of the symbol as displayed in the COGO window is a
function of both this size and the *COGO scale* (which is also set in the ***Options*** dialog box). If a letter or number is selected, then ***Circled*** or ***Boxed*** can also be selected which will
determine if the character is enclosed by a box or a circle.

Modify Group and ***Edit Individually*** in the ***Points*** menu (see p.125) can change the symbol of a point that already exists. Select the point(s) to modify before calling this function. If only one point was selected, click on the *Symbol* button. If multiple points are selected, enable ***Symbol*** and then click on the ***Symbols*** button. This uses the same dialog box as ***Options*** in the ***COGO*** menu but the changes will only affect the selected point(s).



Modify Group dialog box

Command Line Functions

This is a growing list that will be added to with time. If there is a function(s) not in the list that you desire a command line interface for, please contact us. We will happily add a command line for functions as requested and at no charge.

Some commands can be issued through the keyboard. Typed in commands appear in the status bar (if the status bar is displayed), replacing the occupied point status until the **<Enter>** key is depressed. A command consists of a function name (usually an abbreviation) followed by an *argument list*. An *argument list* is computerspeak for a series of parameters. The type of arguments used is dependent upon the function being executed.

Function entries prefixed with an ***** denote functions that can be accessed in the menus.

Arguments can be of the following types:

Ang - an angle entered as an azimuth.

Dist - a distance entered as a floating point number.

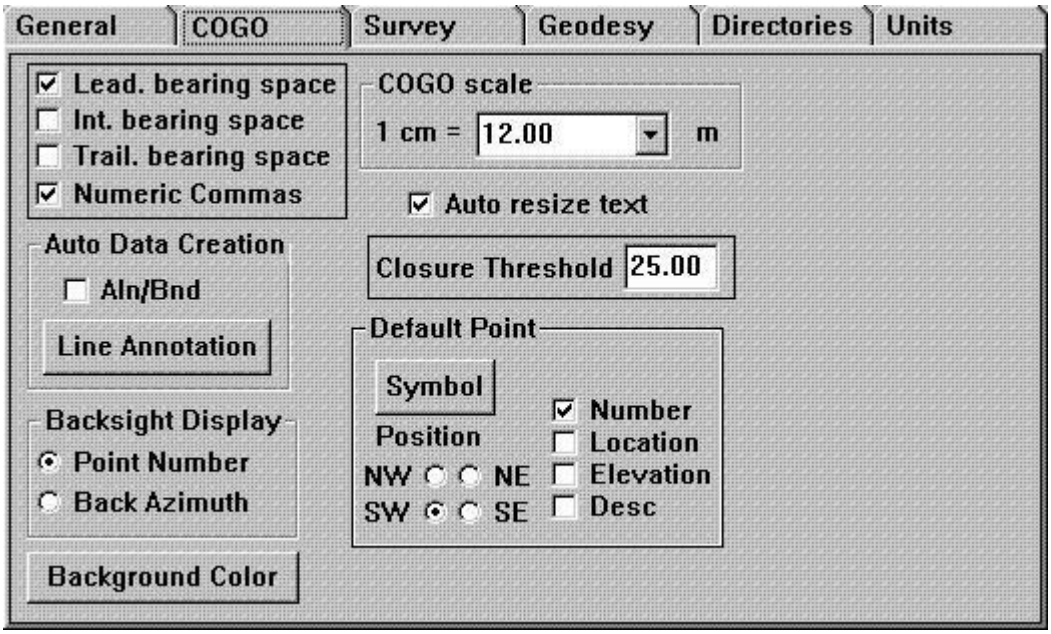
Float - floating point number (number with decimals such as 4.52) *Pnt* - a point number.

Pnt Range - a range of points entered as a point number followed by a hyphen and then another point number. Example: **2-17** is a point range specifying points 2 through 17.

Pnt List - a list of points entered as a combination of *Pnt*s and *Pnt Range*s separated by either spaces or commas. Example: **1,3,5,9-13,52**.

Command	Function	Arguments
BB	*__B__earing-__B__earing Intersection	*Pnt, Ang, Pnt, Ang*
BS	__B__ack__S__ight a point (also in the ***Occupy*** dialog)	*Pnt*
BD	*__B__earing-__D__istance Intersection	*Pnt, Ang, Pnt, Dist*
CS	*Create Points - by Coordinates (__C__oordinate __S__tore)	*North, East, Pnt*, Elevation**
DD	*__D__istance __D__istance Intersection	*Pnt, Dist, Pnt, Dist*
FP	*__F__ind __P__oint	*Pnt*
HI	__H__eight of __I__nstrument (also in the ***Occupy*** dialog)	*Float*
HR	__H__eight of __R__od (also in the ***Occupy*** dialog)	*Float*
NN	***N__N__ext __N__umber	*Pnt*
OC	***OC__C__upy a point	*Pnt*
PE	*Edit Individually (__P__oint __E__dit)	*Pnt*
PT	***P__P__oint __T__raverse	*Pnt List*
SP	__S__elect __P__oint(s)	*Pnt List*
UP	__U__nselect __P__oint(s)	*Pnt List*
TR	*__TR__averse and *Sideshot	**Variable** - *see* **page 132**
ZA	*Full View (__Z__oom __A__ll)	**None**
ZI	*__Z__oom __I__n	**None**/*North,East*
ZO	*__Z__oom __O__ut	**None**
ZP	*__Z__oom __P__revious	**None**

COGO Options



COGO options are controlled through the ***Options*** function found at the bottom of the ***COGO*** menu. These options have far-ranging effect on the display and creation of data. It is therefore important to understand them thoroughly.

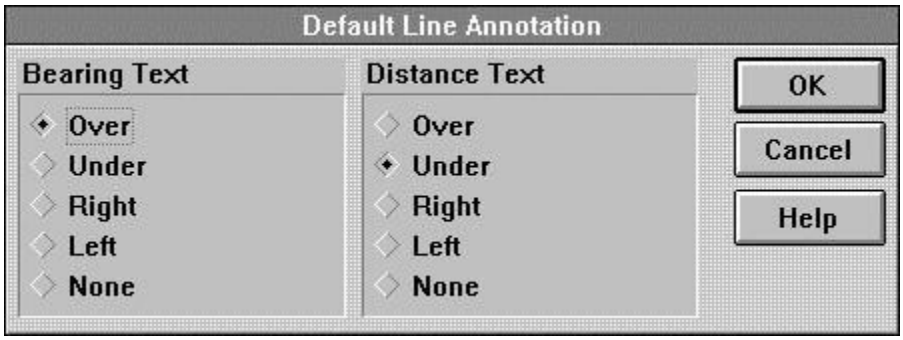
Auto Data Creation

Aln/Bnd

When a traverse is performed, the user may optionally create alignments/boundaries. Automatic alignment/boundary creation can be performed when doing either a Traverse, Point Traverse, or a curve function.

Line Annotation

Pressing this button will display the dialog box shown. This function controls how (and if) bearing and distance text is to be placed on newly created lines. When a line is



created, no text is placed on the line unless one or both of these options are NOT ***None***. Line text can be placed in either an over/under or right/left orientation. The following definitions of these terms are used:

- ***Right/Left*** - All lines have a starting and ending location. The right/left side is interpreted as if the surveyor were positioned at the starting location looking towards the ending location. This orientation is independent of drawing rotation.
- ***Over/Under*** - This orientation is dependent upon a reference direction. Initially the reference direction is due north. Text is placed ***Over*** (above) the line or ***Under*** (below) the line relative to the reference direction. In the case of vertical lines, ***Over/Under*** is considered to be to the left/right of the line.

  Text will read either left to right except in the case of vertical lines, when it will be placed in a bottom to top direction.

  Text can be added later through the ***Modify Line Text*** (see p.115) function, so if a user wants to draw a lot of lines without annotation, these options should both be set to ***None***. The reference direction for placement of ***Over/Under*** text is also controlled through the ***Modify Line Text*** function. Alternatively, the surveyor may wish to annotate created lines with just a distance text or just a bearing text. In this case, selecting ***None*** for just ***Bearing Text*** or ***Distance Text*** is appropriate.

Back Sight Display

The back sight can be displayed in the status bar as either an angle referenced to north (azimuth) or as a back sight point number. If ***Point Number*** is specified, the back sight point number will be displayed in the status bar ***unless*** no number is available. The back sight azimuth will then be displayed. Specifying ***Back Azimuth*** as the display mode will result in the back sight azimuth always being displayed in the status bar. The back sight point number, if available, will still appear in some cases. The ***Stake Tools***, for instance, will always list the back sight point number if one exists.

COGO Scale

The default scale is used when initially placing the data in layout (after the data is placed in layout, the scale can be "over-ridden"). Also, the scale combines with both point symbol sizes and point font sizes to determine the size of a point symbol and a point font relative to the rest of the drawing.

Example: if the COGO scale is 1 inch = 100 feet and the point symbol size is 0.125 inches, then points which use that point symbol will appear to be 12.5 feet wide on the drawing. With the same scale and a font size of 18 points, the point number will appear to be 25 feet high. (There are 72 points per inch so 18 points = 1/4 inch and 100 feet/inch * 1/4 inch = 25 feet).

Save

Settings made in the Options dialog can be saved by clicking on the ***Save*** button. Saved options will remain in effect for this project and for new projects subsequently created. Therefore, do not save the options if you wish the changes to apply only to this project.

Default Point

The default point symbol determines which point symbol to use for all newly created points and for assigning a symbol to imported point data. Point symbols can always be modified after creation. The other options in this section control what annotation to use and where to place it upon initial point creation. All of these display characteristics can be altered after the point has been created.

Symbol

For more detail, refer to **Point Symbols** on p.98.

Number, Location, Elevation, Desc, Position

These options control the ***Position*** in which the chosen parameters (***Number, Location, Elevation,***
Description) are displayed. This initial annotation is placed in one of four quadrants relative to the point

symbol, but can be moved to any desired position and/or rotation through the point editing function ***Modify Group*** (see p.125)

Background Color

The screen background color defaults to black, but can be toggled to white. A white background is primarily useful when using a computer with an LCD display such as a laptop or notebook. For CRT displays, most users will find a white background visually irritating when working. As an aside, Layout uses a white background, but forces all objects to black so as to best approximate the appearance of the data when printed or plotted.

Closure Threshold

Closure Threshold determines when a created alignment/boundary is labeled as an alignment or a boundary. The value of the closure threshold is the minimum value of the precision of closure for an alignment/boundary to be considered a *boundary* when created. The default is 25 so, with this value, an alignment/boundary that has a perimeter of say, 40 ft (or meters) and a distance between the first and last points that is greater than 10 ft (meters) will be labeled as an *alignment*.

Miscellaneous

Lead. Bearing space

If checked, a space will appear between the leading N or S and the angle in a bearing text.

Int. Bearing space

If checked, a space will be inserted after the degree symbol and the minutes symbol.

Trail. Bearing space

If checked, a space will appear before the trailing W or E in a bearing text.

Numeric commas

If checked, commas will be used to delimit numeric texts *(i.e. 1,000 vs. 1000)*.

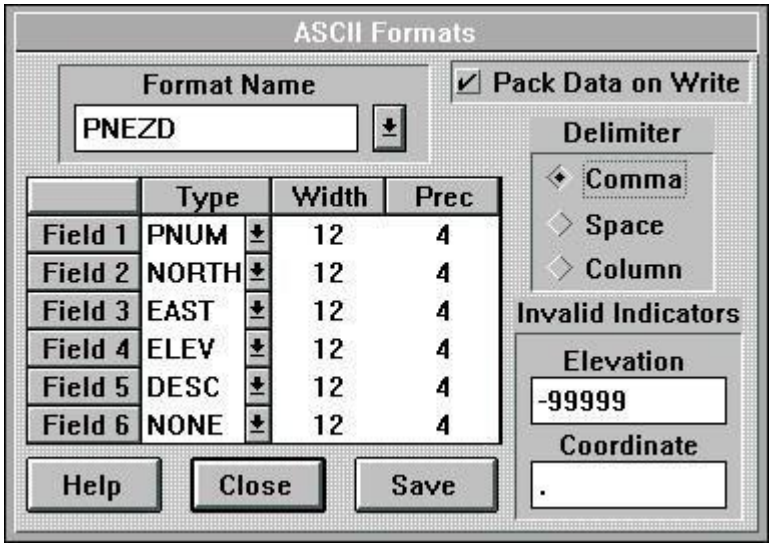
Auto Resize Text

When enabled, line and curve text will be reduced in size, if necessary, to fit the line or curve that the text is being placed on. If the font size necessary to allow the text to fit decreases below the ***Min. Text Size*** setting in the ***Environment Options*** dialog (see p.55), the text will not be created. The surveyor may wish to use a leader line when such conditions occur (see ***Leader Line*** on p.135).

Project Functions

New, ***Open***, Saving a Project, and ***Close*** have already been discussed in the Main Window section of this manual. See p.50 for more information.

ASCII Formats



The ***ASCII Formats*** dialog is shown on the right. This command allows the user to customize the import and export formats for point data by creating new format definitions of modifying existing ones.

The ***Format Name*** must be a unique name (one of a kind among the format definitions). In the example shown, the name *PNEZD* is being used (meaning Point, North, East, Elevation (Z) and Description). Picking a name from the drop-down list will display all the parameters for that format. To create a new name, type a new name into the text box, set all the parameters as desired and select ***Save***.

Up to six fields can be defined (even though we can't imagine a reason for more than five at this time). Each field has a type, a width and a precision (Prec). The types of fields currently allowed are ***PNUM*** (Point number), ***NORTH*** (Northing), ***EAST*** (Easting), ***ELEV*** (Elevation), ***DESC*** (Description), and ***NONE*** (not the flying kind).

Width refers to how many total characters are in the field, including the decimal point.. ***Prec*** refers to how many decimal places are to be used. When importing data, ***Width*** and

Prec have no relevance EXCEPT when the file is ***Column*** delimited. When exporting a file, the specified precision will be used in creating the point data (except for fields of type ***PNUM*** and ***DESC***, obviously).

Delimiter refers to the separator used between fields. A ***Comma*** delimited file will have a comma after each field, whereas a space is used for ***Space*** delimited files. ***Column*** delimited files are a little different - fields are *position-dependent*. That is, they are aligned in columns with each column being of the character width specified by the ***Width*** value for the field

If ***Pack Data on Write*** is NOT enabled, some of the above needs to be amended. Not enabling ***Pack Data on Write*** has no effect when importing files or when exporting column delimited files. However, when exporting ***Comma*** or ***Space*** delimited files, data is aligned in columns, much like in a column delimited file. In fact, ***Space*** delimited files will appear the same as ***Column*** delimited files. ***Column*** delimited files will still have a comma immediately after each field, but spaces will also be inserted to pad the fields so as to column align them.

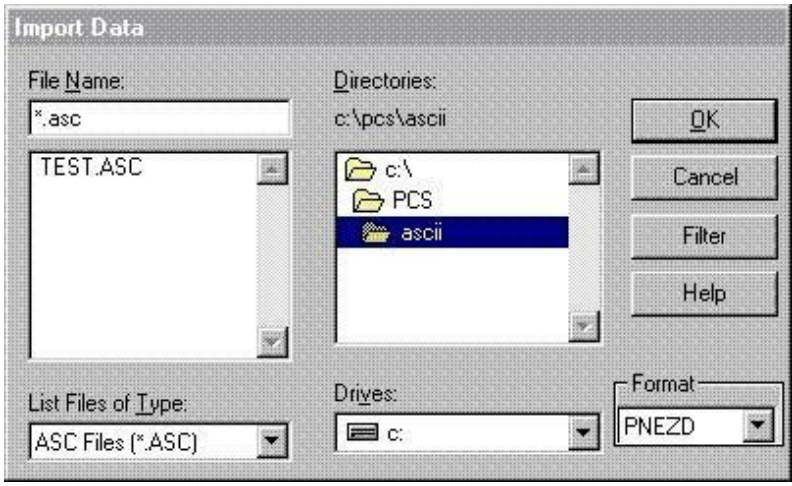
The ***Elevation*** and ***Coordinate Invalid Indicators*** are values which the program will interpret as NO VALUE. Fields that are left blank have a similar effect.

Save will save any changes made to an existing format or create a new format if a new name has been entered. ***Close*** will exit the dialog box.

Import

Points From…

File

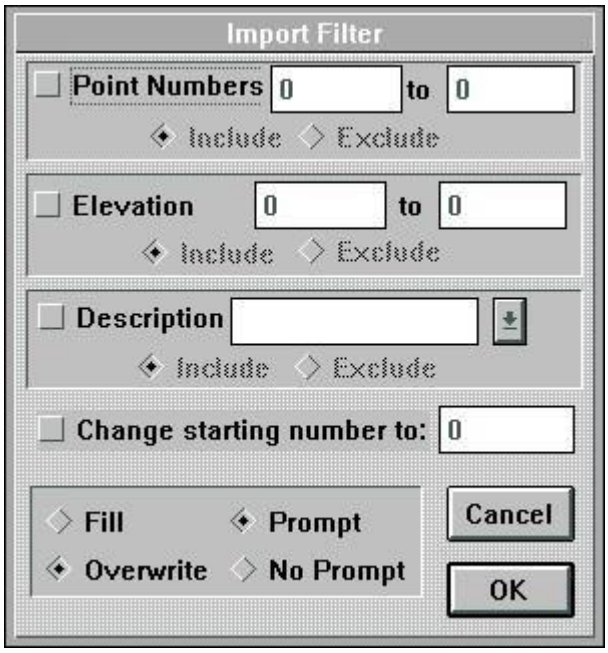


Example of Import Points Dialog

This function reads in a point file and inserts the points into the current project. The dialog box works similarly to the ***Open*** dialog box except for the addition of the ***Format*** and ***Filter*** controls. For more detail on the operation of this dialog box, refer to the ***Open*** function on p.50. Currently the program will only allow importing delimited ASCII files. The allowable formats are ASCII files - text files that contain point information such as northing, easting, elevation, and description. The format for the ASCII file is defined by the ***ASCII Formats*** command (see p.103). For example, in the dialog shown, the ASCII format *PNEZD* has been selected. This is the name of a format that might contain point number, northing, easting, elevation (Z coordinate) and description.

The ***Filter*** button will bring up a dialog box like the one shown on the right. This dialog is very similar to the *Point Select* filter (see p.111). The surveyor can control which points are imported based on any combination of the criteria shown (point number, elevation and description). The imported point numbers can also be shifted to a different starting number by enabling the ***Change starting number to:*** option and specifying some number.

If a point in the file being imported has the same number as a point in the current project, the conflict is resolved using the options set in the ***Next Number*** command. Refer to the ***Next Number*** command on p.190 for a detailed description of these options.



Import Points Filter Dialog

Data Collector

The program can import coordinate files directly from the SDR 2.x, TDS and SMI data collectors.

The methods used for transferring are described below.

If you are using the TDS:

• *On the TDS*

1) In File Transfer (menu function S), the following settings should selected:

   File type: **CRD**
   IR/Wire: **Wire**
   Baud rate: **9600**
   Parity: **None**

2) Select **Send**.

3) Use the up and down arrows to select the file to be sent.

• *On the Computer*

4) Set Collector to TDS.

5) Set Port to the correct COM port.

6) The baud rate should be 9600 (to match the TDS settings).

7) Set the ***Format*** to *PNEZD*

8) Press the Start Transfer button.

• *Back on the TDS*

9) Press the **Select** button (the A button if using the HP48).

10) After the transfer is completed, press the Cancel button in the dialog box.

If you are using the SMI:

• *On the SMI*

1) Select ***TOPC***
2) Select **COMM**

• *On the Computer*

3) Set Collector to SMI
4) Set Port to the correct COM port.
5) The baud rate should be 9600
6) Set the ***Format*** to *PNEZD*
7) Press the ***Start Transfer*** button.

• *Back on the SMI*

8) Select the job to send
9) After the transfer is completed, press the Cancel button in the dialog box.

Base Map (GMS Survey only)

A base map is a bitmap that is geo-referenced; in other words, it has a predetermined location in the real world. An example would be a bitmap that is a part of a quad. **To read in a base map:**

1. In the Cogo Window, in the **Project** menu, select **Import... | Base Map**.
2. Set ***Files of type*** to the type of bitmap that will be read in. PC Survey can read in Tiff, BMP, DIB, RLE, FLF, CUT, PCX, DCX, PCT, GIF, JPEG, TGA, RAS, and IM8.
3. Select the bitmap file to read in and then click ***Open***.
   If there is a .TFW file with the same prefix as the bitmap file, the bitmap will be placed using the georeferencing information in the file.
   If there is no .TFW file:
1. The hourglass will stay up and the status bar will display the message ***Click first point***. Click on the bitmap at a location which you know the northing and easting for. A coordinate dialog will be displayed.
2. Enter the ***northing*** and ***easting*** and any other information that you want and click ***OK***.
3. The status bar will now display ***Click second point***. Click on the bitmap at a location of a second point.
4. Again, enter the ***northing*** and ***easting*** and any other information and click ***OK***.
5. This time, the status bar will display ***Click third point***. Click on the bitmap at a location of a third (and final) point.
6. One last time enter the ***northing*** and ***easting*** and any other information and click ***OK***.

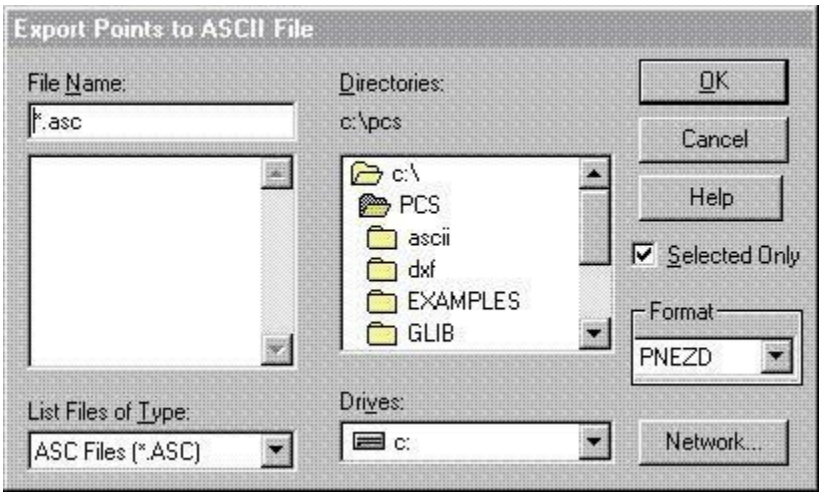
The bitmap should now be displayed at the appropriate location with the appropriate orientation.

Export

Points To…

File

Use this function to create an ASCII delimited coordinate file. This function will only be accessible when at least point exists in the project. Selecting this function will display a dialog similar to the following:



To use this function:

1) If exporting less than all the project's points, select the desired set of points to be exported.
2) Select ***Project*** : ***Export*** : ***Points To…*** : ***File***.
3) Enter a ***File Name*** and select the desired destination directory. The default file extension is **ASC**, though this may changed by entering the file name with a different extension. The default directory will be whatever is specified in the ***Options - Directory*** settings. (see p.56) 4) If exporting a selected set of points, enable ***Selected Only***.
5) Select the desired ***Format***. This is one of the user-defined formats. See the ***ASCII Formats*** command on p.103 for more information.
6) Select ***OK*** to create the points file.

Notes:

- The most common format is what the program installs as PNEZD (Point number, Northing, Easting,
  Elevation, Description), a comma-delimited format. Consult your target software's documentation if this format doesn't work. Just about any ASCII-delimited format can be defined.
- Avoid exporting directly to a floppy drive. This is sage advice for any export. Floppy drives have a nasty tendency to run out of room with unpredictable results.

Data Collector

If you are using the TDS:

- *On the Computer*

1) Select Data Collectors/DC Transfer In the Misc menu of the Cogo window.
2) Set Collector to TDS.
3) Set Port to the correct COM port.
4) The baud rate should be 9600 (to match the TDS settings).

• *On the TDS*

5) In File Transfer (menu function S), the following settings should selected:

File type: **CRD**
IR/Wire: **Wire**
Baud rate: **9600** Parity: **None** 6) Select **Recv** (the B key on the HP48).

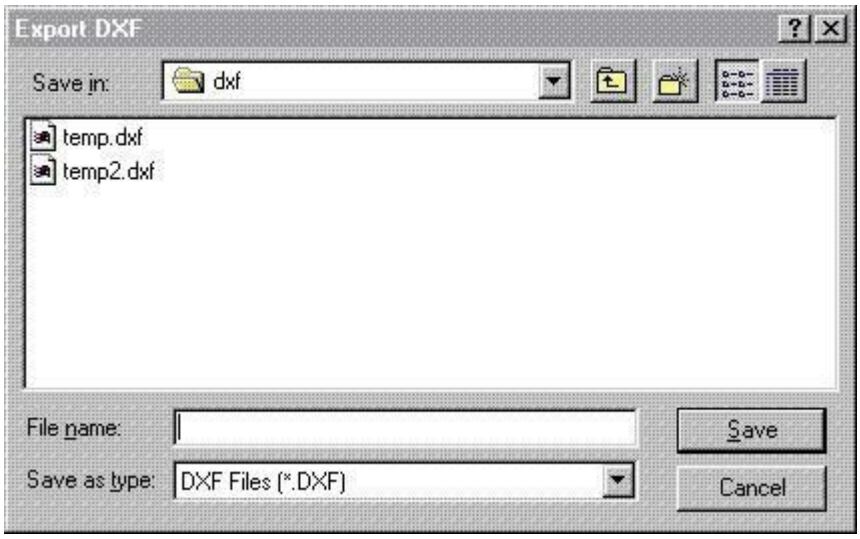
• *Back on the Computer*

7) Press the Start Transfer button.

After the transfer is completed, press the Cancel button in the dialog box.

Export DXF (All or Selected)

This function saves either everything (***All***) or just the ***Selected*** objects (except boundaries and alignments) in a DXF-format file. All relational information is lost (bearing and distance text, for instance, becomes unattached DXF texts instead of texts that are associated with a parent line), so the main purpose of this function is to allow the surveyor to send a "picture" to another CAD program for further drawing after Survey, COGO and Contouring operations have been completed.



To use this function:

1) If wishing to send just selected objects, select everything that you want to send to your DXF file.
2) Select ***Export DXF***. A dialog similar to the one shown will be displayed. This is just the standard Windows file dialog.
3) Specify a file name and location and select ***OK***.

Notes:

- The ***Options*** - ***Directories*** settings control what directory is initially used. See p.58 for more information.

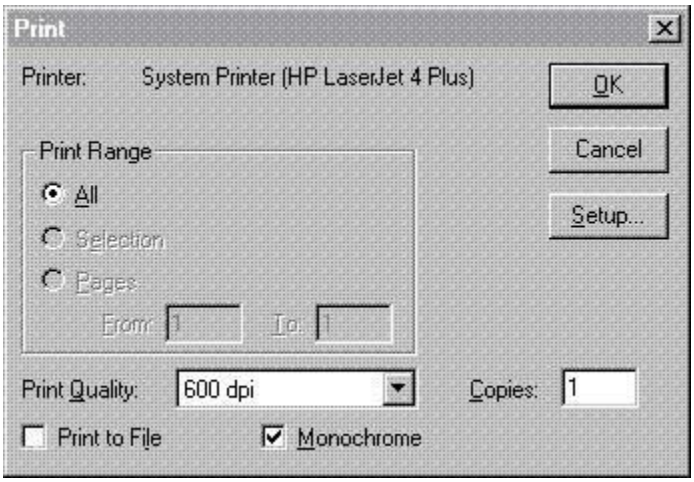
Base Map

A base map is a bitmap that is geo-referenced; in other words, it has a predetermined location in the real world. An example would be a bitmap that is a part of a quad.

To export a base map:

1. In the Cogo Window, in the **Project** menu, select **Export... | Base Map**.
2. The only type of file that this function will export is a monochrome BMP file. Type the name for the bitmap file and then click ***Save***. A file with that name will be written out as well as a file with the same prefix but ending with .TFW. The .TFW file will have the geo-referencing information.
3. Printing/Plotting

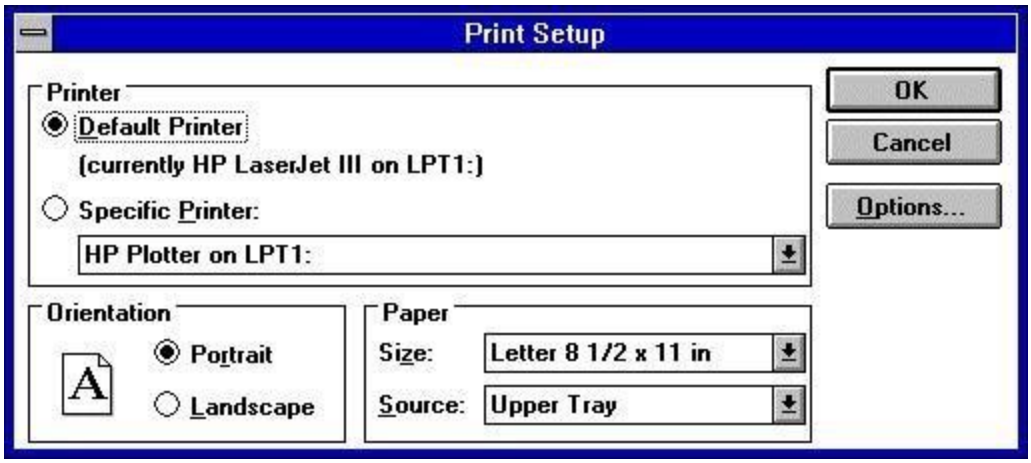
   Printing or plotting from the COGO window involves the same steps that are used in other Windows programs. Using the ***Print*** function in COGO is only good for generating screen prints. If a more finished appearance is desired, use the ***Layout Window*** functions (see the section on the Layout Window beginning on p.193). The first step is to install your printer/plotter by connecting it to either a serial or parallel port on your computer.



   Make sure that you have installed the printer you want to use and that the Windows control panel has set the printer as the current default printer before executing ***Print***. When ***Print*** is selected from the ***Project*** menu, a dialog similar to the one shown on the right is displayed:

   At the top of the dialog is shown the current target printer on your system. Ignore the ***Print Range*** settings - The program doesn't use them for COGO printing and we're too lazy to get rid of them right now (maybe later, after about a zillion other "enhancements" are made). Refer to your Windows user manual if the other settings don't make any sense to you. (and ignore the ***Collate Copies*** checkbox - this belongs in la-la land as well).

   If you wish to use a different printer that has been configured and is connected to your system or to change the current printer's settings, select ***Setup.***



You get this really ugly dialog to play with. You can enable ***Specific Printer*** and select a printer from the list. Some printers provide more control through the ***Options*** button. Again, this is better left to the realm of the Windows user manual since dinner is on the table and my fingers are cramping.

Data Selection

Many of the functions operate on what will be called the **select list**. The select list is just a collection of points, lines, curves, texts and/or alignments/boundaries. As talked about in the User's Guide, selecting is done by drawing a select box (clicking and dragging with the left mouse button from left to right). Any objects within the box or intersecting the box will be selected *UNLESS* they are 1) not visible or 2) excluded through the **select filters**. Objects that are selected will be highlighted; that is, they will be drawn in magenta and lines and curves will be thicker.

For instance, the user can exclude points with numbers in a certain range from selection. In a more complex scenario, the user can select points based on their number, elevation and description. Similarly, the other data types also have filters that operate based on the data type's attributes.

Selection of a given data type can be completely disabled by *graying* the number next to that type's filter button. There are five numbers in the select status bar, one for each of the five basic data types -- Points, Lines, Texts, Curves, and Alignments/Boundaries. The number indicates the number of objects of the associated data type that are currently selected. Normally these numbers are black, indicating that the data type associated with that number is selectable (though possibly filtered). By clicking with the left button in the number box, the number will toggle between black and gray. When the number is gray, selection of the associated data type is disabled. So, to select (or unselect) just lines, disable all other types of data by graying the numbers for Points, Texts, Curves and Al/Bd.

Unselecting is done in a similar manner to selecting -- only instead of drawing the selection box from left to right, the box is drawn right to left.

Radial Select

There is an additional mode for selecting called ***Radial Select***. This is done by selecting the Radial Select command from the ***View*** menu. In this mode, when a click-and-drag is performed with the left button, a circle will be displayed around the occupied point

instead of a box. This circle is currently not visible until the mouse is moved. The objects inside the circle will be selected or unselected depending on whether the cursor is moved to the right or the left. This function is generally used with the ***Stake Tools*** functions and is useful for getting all points within a desired radius. In the ***Radial Select*** mode, when a click-and-drag is performed, the coordinate readout shows the word **Radial** in the left box and the radial distance in the right box.

Clear select

Unselects all selected data.

Select Status bar

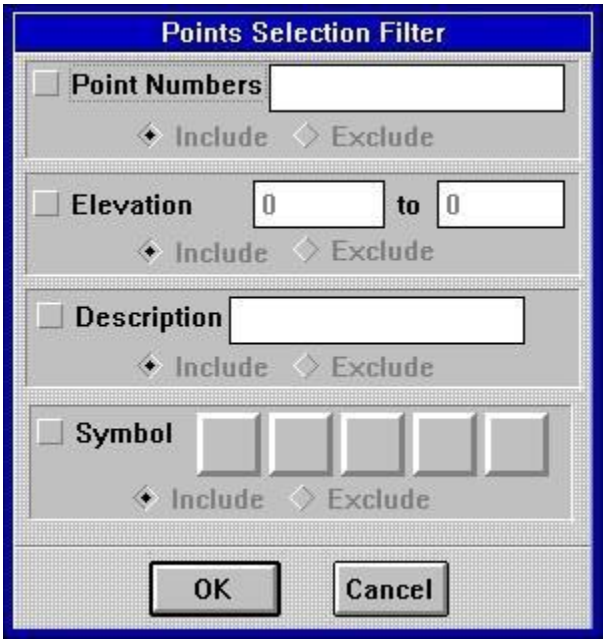
This section describes the various parameters in the COGO selection filters. These filters are accessed by clicking on the appropriate button in the select status bar located at the bottom of the screen (when enabled). The select status bar can be turned on or off by toggling the command ***Select Status Bar*** in the ***Misc*** menu.

The left side of the select status bar is the coordinate readout. To the right of this readout are five buttons, each with a number displayed to the right of it. Finally, at the far right are three buttons: **A**, **N**, and **C**. The **A** button stands for ***ALL.*** Clicking on this button will enable the selection of all types of data. The **N** button stands for ***NONE***. Selecting this button disables the selection of all data. Finally, the **C** button stands for ***CLEAR***. Clicking this button unselects *everything* that is selected -- it is provided as a quick way to reset the select list. ***Clear Select*** in the ***Edit*** menu performs the same function.

These three buttons allow one to quickly set the selectability of a given type of data. For instance, if it is desired to allow only the selection of *point* data, one could turn off the other four types by clicking once in each of the four boxes to the right of the buttons for lines, texts, curves and alignments/boundaries.
However a faster method is to click once on the **N** button to turn all five data types off and then clicking once on the *points* selection number to enable *points* filtering.

Points Filter

The ***Points Filter*** allows filtering the selection using the attributes ***Point Numbers***, ***Elevation***, ***Description*** and/or ***Symbol***. The filter can be used to include or exclude points with that attribute.



Each of these attributes has a checkbox in front of it. The checkbox must be enabled before the attribute will be used as a filter. In this manner any combination of attributes is allowed. If, for example, filtering is desired using only ***Point Numbers***, then check the ***Point Numbers*** checkbox while leaving all the others unchecked.

The ***Include*** and ***Exclude*** radio buttons (one and only one can be selected) specify whether to select only points that include the enabled (checked) and specified attributes.

Point Numbers can be entered as a series of values that include range values. Commas or spaces can

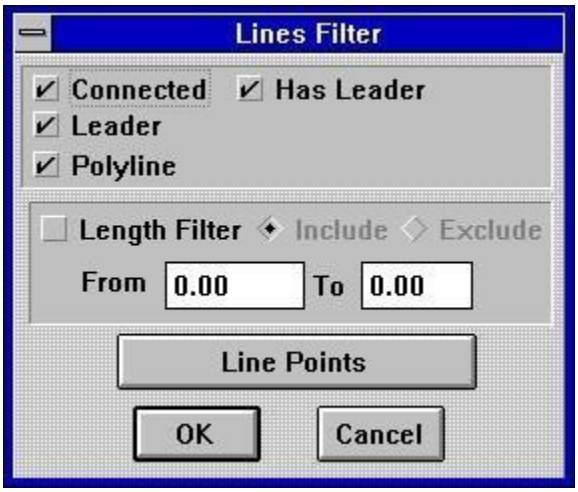
be used to separate values. For example, entering
1,3,5-7 will specify points 1, 3, 5, 6 and 7. "**5-7"** is a range value. If ***Include*** is selected, only these five points will be selectable. If ***Exclude*** is selected, all points EXCEPT these five will be selectable.

The ***Description*** can be a *regular expression* (see p.192) so that the surveyor can use a string pattern such "Iron Pin ?" to find all points with descriptions that start with "Iron Pin" followed by a space and some other character (Iron Pin 1, Iron Pin B, etc.).

Example: Suppose that when you draw your selection box you only want to select points between 15 and 40 whose description is anything other than "Iron Pin". To do this, click on ***Point Numbers*** to enable filtering based on point numbers. Set the point number range to 15 to 40 by typing in **15-40** and click on ***Include*** so that only those points will be selectable. Leave ***Elevation*** alone so that it will not affect the filtering. Click on ***Description*** to enable filtering based on description, type **Iron Pin** in the description box, and click on ***Exclude*** so that points with these descriptions cannot be selected.

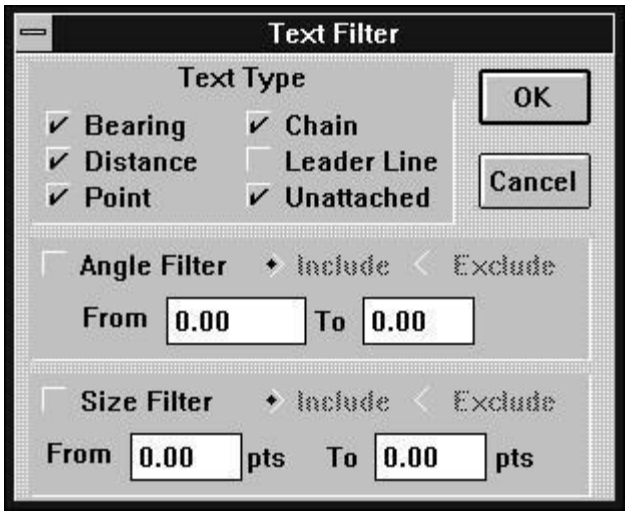
Lines Filter

The ***Lines Filter*** allows filtering the selection of lines by using the type of line and/or a range of line lengths. ***Connected***, ***Leader***, and *Polyline* refer to the type. ***Has Leader*** refers to connected lines which have leader lines. The ***Length Filter*** allows including or excluding lines with a length within the specified range.



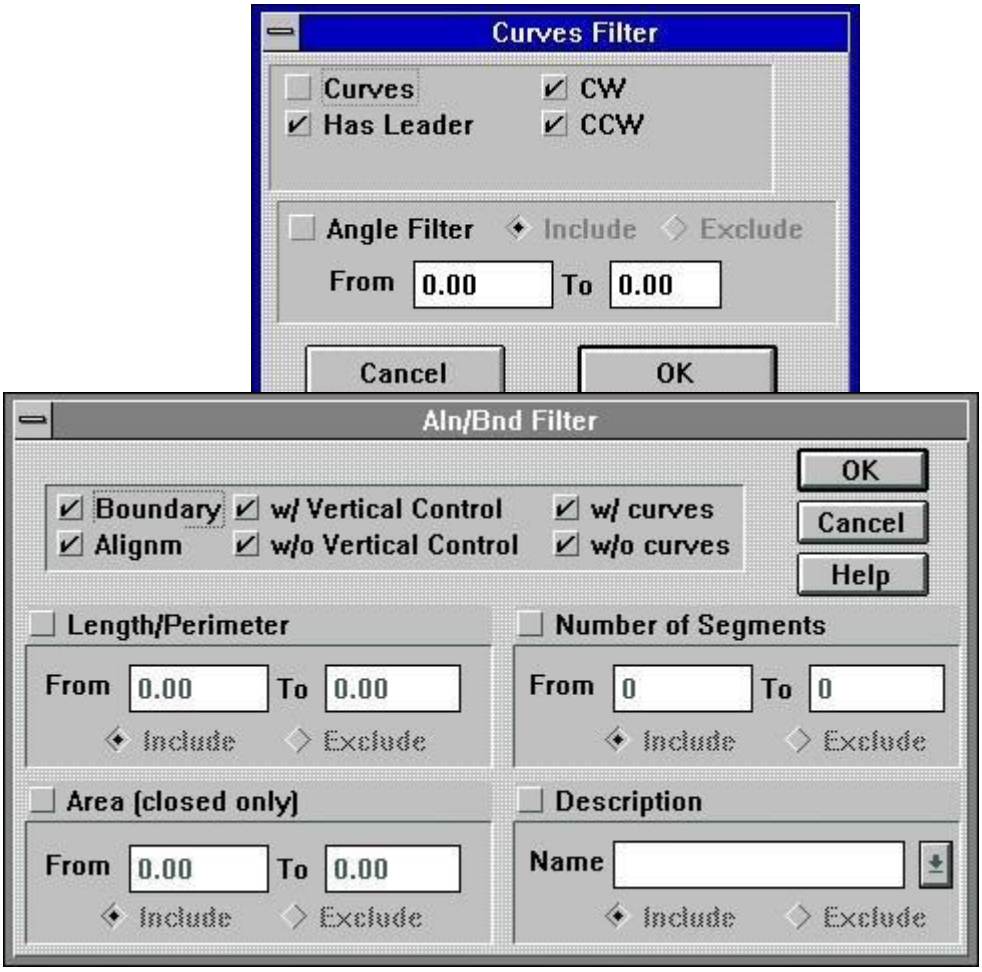
Text Filter

The ***Text Filter*** allows filtering text selection by the type of parent, the drawn angle of the text, and the text font size. For instance, text selection can be limited to only distance texts that have a point size between 8 and 12 points.



Curves Filter

Curves Filter allows filtering the selection of curves by using the type of curve and/or a range of arc lengths. ***Has Leader*** refers to connected curves which have leader lines. ***CW*** is
clockwise while ***CCW*** is *counterclockwise.* The ***Angle Filter*** allows including or excluding curves with an arc length within the specified range.



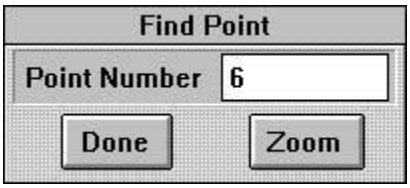
Al/Bd Filter (Alignments & Boundaries)

The ***Al/Bd Filter*** allows filtering the selection of alignments/boundari es by many features. *Boundary* and
Alignment control whether to include boundaries and/or alignments. *w/*

Vertical Control and *w/o Vertical Control* decide whether to include alignments with and without vertical controls. *w/ curves* and *w/o curves* control
whether to include alignments/boundaries with and without curves. *Length/Perimeter* controls whether to include or exclude alignments/boundaries whose length is in the specified range. *Number of Segments* controls whether to include or exclude alignments/boundaries whose number of segments falls in the specified range. *Area* controls whether to include or exclude boundaries with an area within the specified range. *Description* controls whether to include or exclude alignments/boundaries with the specified name.

View Functions

See the section on Common View Functions on p.38 for information about ***Redraw Screen***, ***Full View***, ***Pan View***, ***Zoom In***, ***Zoom Out*** and ***Zoom Back***.



Find Point

Find Point will prompt for a point number. When you click ***Zoom***, the view will change so that it is centered on the point you specified. Successive clicks on ***Zoom*** will cause the display to "zoom in" (hence the button's name, *Zoom*. Bet you didn't get that one, huh?) on the specified point. Select ***Done*** when you've had enough and the function will terminate. (Wish I could do that with certain politicians).

Find Point Dialog

Command: FP *Pnt*

The **FP** accepts a single point number as an argument. The command can be repeated to zoom in closer to the desired point by either typing entering the command without an argument or pressing the spacebar followed by the **<Enter>** key.

Example:

1) Type **FP 13 <Enter>** to center the display point 13 (assuming point 13 exists).
2) Type **FP<Enter>** OR **<Spacebar><Enter>** to zoom in on point 13.
3) Repeat the above step to zoom closer.

View Areas

View areas are helpful when there are specific areas of the data to which you will refer often. They are also used in layout for placing a view of a specific portion of the data. Refer to the ***View Area*** function in the ***Data*** section of the ***Layout*** portion of this manual for more information.

Add

Add View Area will first ask for the name to assign to the view area that you are about to create. Then the cursor will become a P-cross to show that the program is waiting for a button press. Draw a box around the view just as you normally do for zooming in. After pressing the left button, the cursor will change to an R-cross. After releasing the left button, the cursor will return to normal and the view will zoom in to the view specified. The view will also be saved as a view area that can be referred to later.

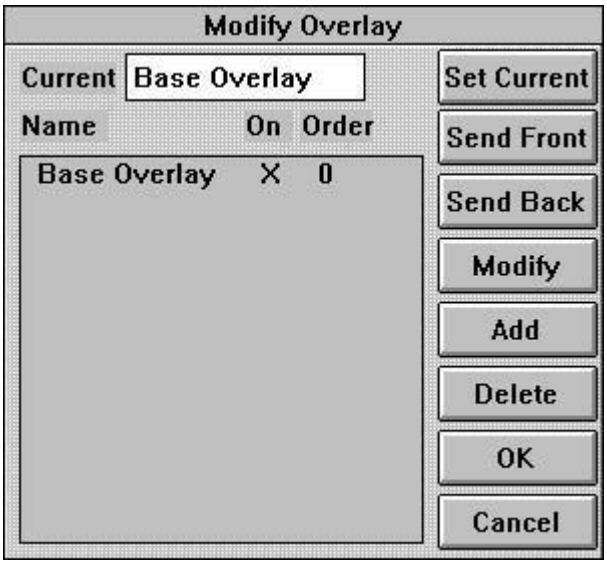
Select

Select View Area will display the list of defined view areas. Upon selecting an item from the list, the view will be set to the selected view area.

Delete

Delete View Area will also display the list of defined view areas. This time, after selecting a view area from the list, it will be deleted from the list of view areas in this project.

Overlays



Whereas layers can control line types and widths, colors, and fonts in addition to visibility, **Overlays** control visibility and the order of drawing. Turning off the visibility of an overlay will hide all objects on that overlay. (Precedence or order of drawing has not yet been implemented.)

Overlay attributes are accessed through the ***Edit Overlay*** command in the ***Edit*** menu. The top level dialog (the dialog box initially displayed) is a table listing the various overlays, along with their visibility and order of precedence.

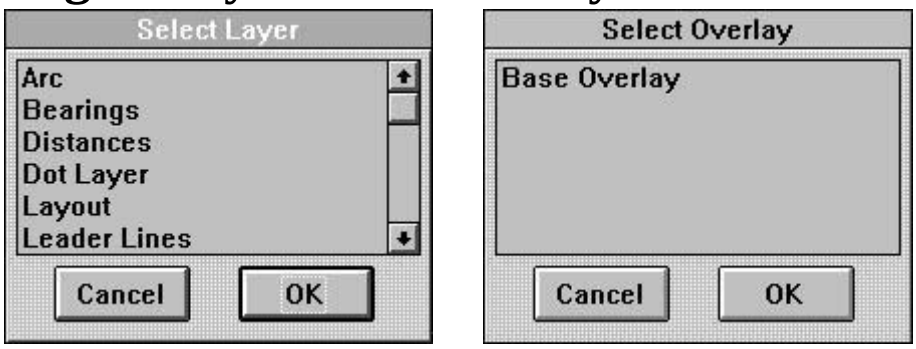
Visibility

The second column of the ***Edit Overlay*** function dialog box is labeled "On". If the layer is "on", it is visible. Clicking with the mouse on this column will toggle the state between checked (ON) and unchecked (OFF). This state can also be modified from within the next dialog box accessed by clicking on the *Modify* button at the right of the Edit Overlay dialog.

Order (Precedence)

The precedence number refers to the order in which the overlays are drawn.
The larger the number, the earlier the items on that overlay will be drawn. Think of an overlay as a transparent sheet on which are drawn various objects. *Overlays* are like transparent sheets stacked on top of each other. The larger the number, the lower the sheet is in the stack and the more likely it is to be obscured by data on sheets with lower numbers. An overlay number of zero means that no other overlays can obscure it. This is used when you want an object to appear to be behind another object.

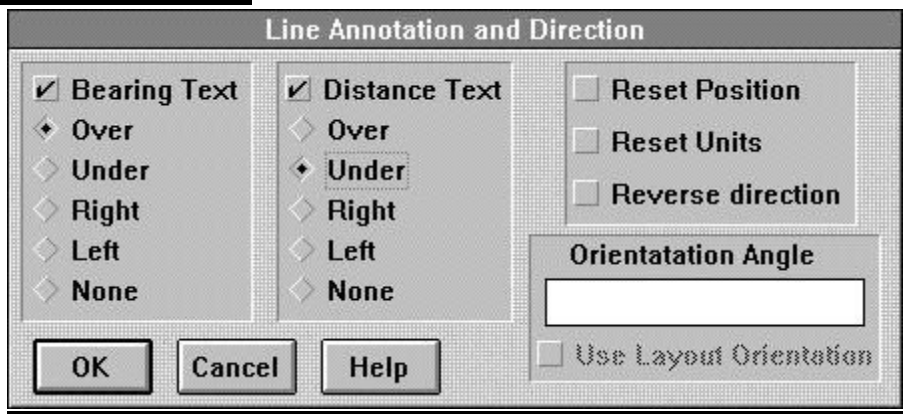
Extracting to Layers and Overlays



Extract Objects to Layer and ***Extract to Overlay*** are used to move data items from one *layer* or *overlay* to another. Both operate on the select list. ***Extract Objects to Layer*** will ask for the destination layer and will move all selected objects to the specified layer. Similarly, ***Extract to Overlay*** will ask for the destination overlay and will move all selected objects to the specified overlay.

Edit Functions

Modify Line Text



Modify Line Text in the ***Edit*** menu alters the appearance and placement of bearing and distance text. All selected lines are affected.. The direction of the selected lines can also be reversed from within this dialog.

If you have one or more lines selected, you can set all bearings for the lines ***Over, Under, Right*** or ***Left***, remove them (***None***), or leave them unchanged. The same applies to the distances. To change the current text placement, enable the appropriate check box and select one of the five options. Leaving the ***Bearing/Distance Text*** checkboxes disabled (unchecked) leaves the bearing/distance text unchanged.

When using the ***Over*** or ***Under*** options, the ***Orientation Angle*** is used to determine the placement of the text. The ***Orientation Angle*** defaults to 0° so the ***Over*** is towards the top of the screen and ***Under*** is towards the bottom. However, when placing the data on sheet in Layout, it is often desirable to rotate the view in order to better fit the sheet. In such cases, it will also often be desirable to adjust the up/down orientation of the

bearing/distance text. When data has been placed in the Layout window, the ***Use Layout Orientation*** checkbox will become enabled IF

1) There is one data view placed, or
2) There are more than one data views placed but all with the same rotation angle

Checking the ***Use Layout Orientation*** box will set the ***Orientation Angle*** to the rotation of the data view. If the ***Bearing Text*** and/or ***Distance Text*** options are enabled, as well as the ***Over*** and/or ***Under*** options, the text will be placed with respect to the rotation of the data view's rotation in Layout.

Checking ***Reset Position*** will reset the bearing and/or distance texts back to their original positions.

Checking ***Reset Units*** has an effect only if the system units have been changed. For instance, if the system units have been changed from US Foot to Metric (see the ***Units*** dialog on p.59), distance text that has already been created will remain in US Foot units.

Checking the ***Reverse Direction*** box will cause all selected lines to change direction by 180°. The bearing text will updated accordingly.

Notes:

- If you are sitting on the starting point of a line and facing the next point, ***Right*** means the text is on the right side of the line and ***Left*** means the text is on the left side of the line.
- The default bearing/text placement is controlled by the ***Line Annotation*** (p.100) dialog in the COGO ***Options*** function.

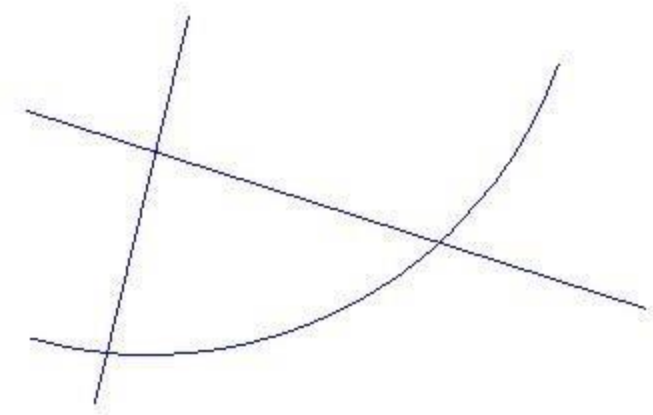
Trim

The ***Trim*** function is used to clip off pieces of graphics (lines, curves, polygons, etc.) at the intersections with other graphics. To use this function,

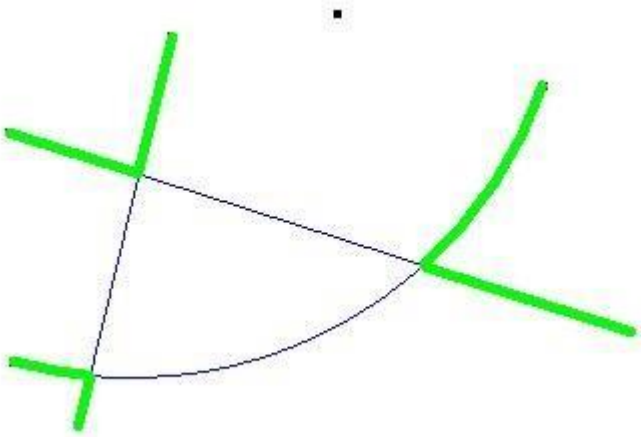
1) Select both the objects to trim AND the objects to the trim at.
2) Select **Edit | Trim** in the COGO window. A dialog will be displayed similar to the one shown.
3) Move the cursor near the pieces of the selected objects that you wish to delete and left-click. The piece will be highlighted. This action is a *toggle*. Left-clicking near a piece that has already been highlight will unhighlight that piece.
4) When all the pieces that are to be trimmed have been highlighted, select ***OK*** from the ***Trim*** dialog.

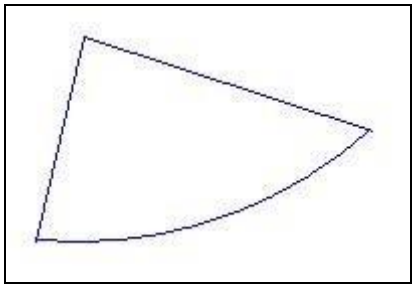
Example:

The simple drawing shown consists of an arc and two lines. Assume that one wishes to trim off all the end pieces. First, select everything (both lines and the arc). Then, left-click near each end piece.



At this point, all the end pieces should be highlighted, similar to the picture shown . Finally click on the ***OK*** button to complete the function.

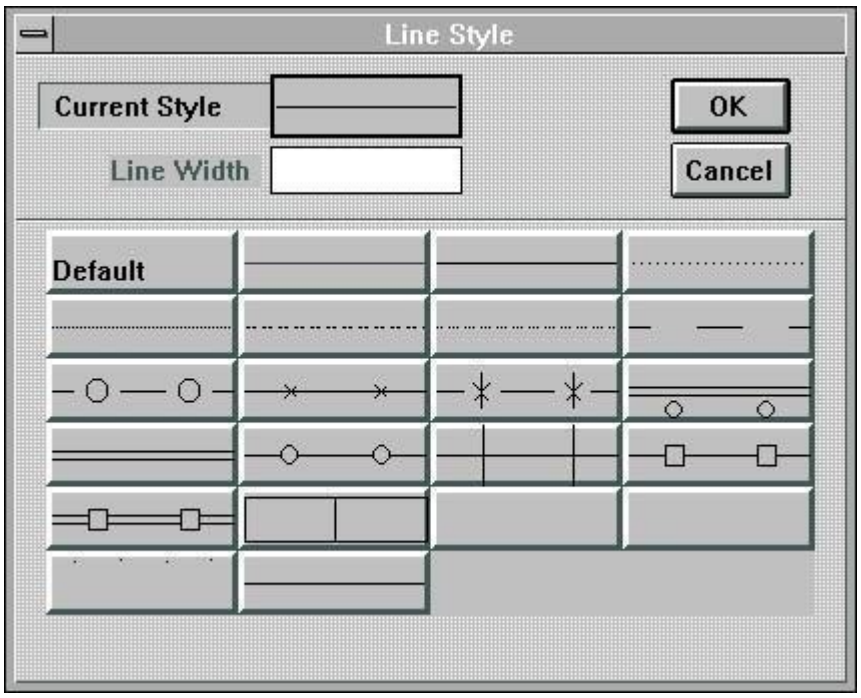




The final result would be this.

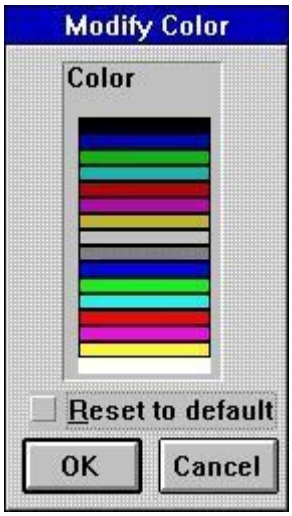
Line Style

The ***Line Style*** command can be used to quickly modify the line style of selected lines and/or curves. Lines and curves are given the line style of their layer when they are first created. However, any given line or curve's line style can be modified with this function. At least one line or curve must be selected in order for ***Line Style*** to be accessible. Selecting ***Line Style*** will bring up a dialog box containing several buttons as shown.



Simply click on the button that contains the desired line style, followed by ***OK*** to change the line style of all selected lines and curves or ***Cancel*** to abort the function.

Set Color



The ***Set Color*** function in the ***Edit*** menu allows the surveyor to set the displayed color for all applicable selected objects. This includes points, lines, texts and curves. Since objects use the layer color settings when created, using this function will override the *default* color attributes. See the section on *Layers* on p.27 for more information.

To use this function:

1) Select all the objects that are to have their color altered.
2) Select ***Set Color*** from the ***Edit*** menu. The dialog shown will be displayed.
3) Select the desired color from the dialog *or* select ***Reset to default*** to change the objects' color back to the objects' default layer color. 4) Select ***OK*** to complete the function or ***Cancel*** to abort.

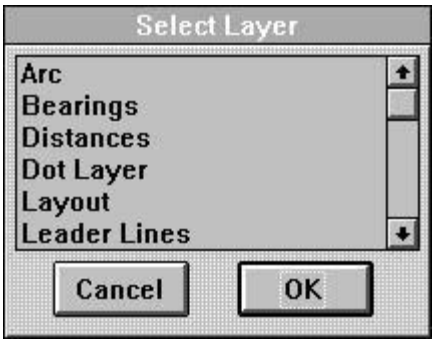
•

Set Layer

The ***Set Layer*** functions in the ***Edit*** menu allow the surveyor to set the layer for all applicable selected objects. This includes points, lines, texts and curves. ***Set Layer*** has a submenu with two entries - ***Default*** and ***Other***.

Set Layer - Default will set the layer of all selected objects to their default. When using the layer definitions as provided with the program, for instance, selecting ***Default*** will change selected bearing texts to the *Bearing* layer, selected distance texts to the *Distance* layer, selected arcs to the *Arc* layer, etc.

Selecting ***Set Layer - Other*** will display a dialog box similar to the one shown to the right. Select the desired layer from the list that the objects are to be moved to. Select ***OK*** to finish the operation or ***Cancel*** to abort the function.



Select Layer - Other Dialog

See the section on *Layers* on p.27 for more information.

Delete Objects

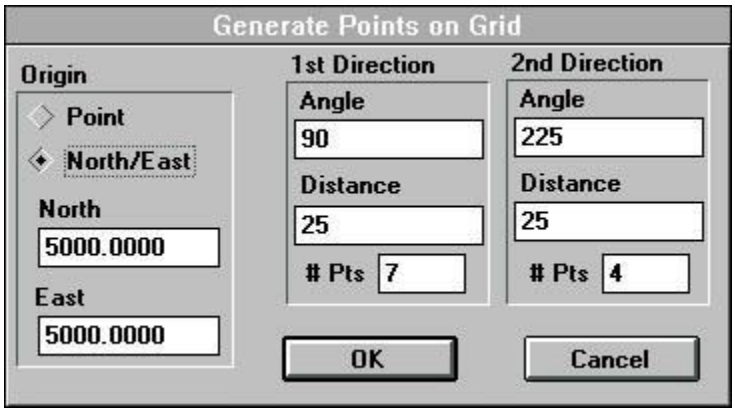
Delete Objects in the ***Edit*** menu will delete all selected objects from the project.

Undo

Undo in the ***Edit*** menu will undo the last command executed. Currently, there is not a one-to-one correlation between the command invoked and the undo command. Suppose, for example, that you delete three points.

Undo will only add them back in one point at a time.

Point Functions



Create Points - Array

This function is generates a two dimensional array of points. The array doesn't have to be square. To use this function:

1) Select ***Create Points*** - ***Array*** from the ***Points*** menu.
2) Specify an origin (corner of the array) either by

- Selecting ***Point***, followed by entering the point number or selecting the desired point from the screen with the mouse.

or

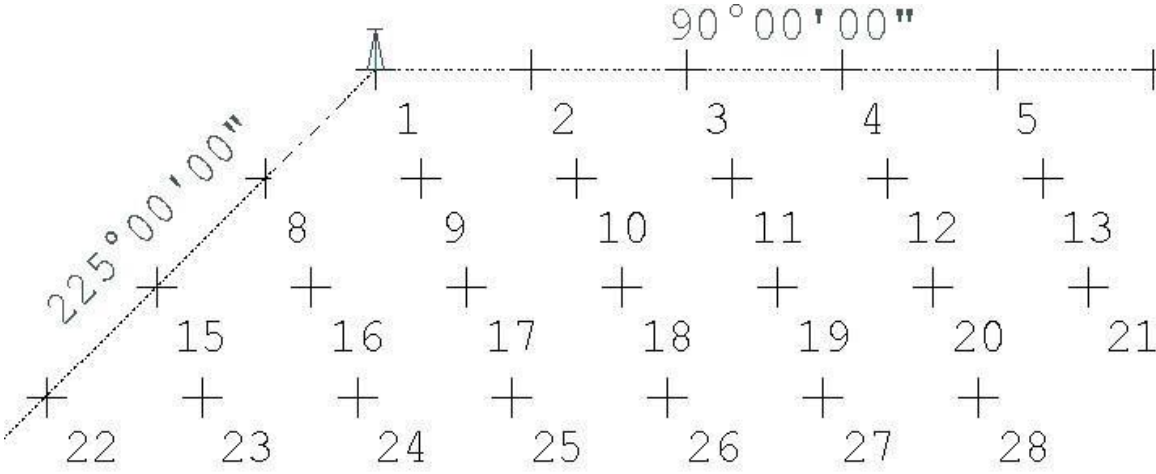
- Selecting ***North/East*** and entering the ***North*** and ***East*** coordinate values.

3) Enter the ***Angle*** of the ***1st Direction***. This angle specifies the direction of one of the sides of the array where one end of the side is the array's origin.
4) Enter the ***Distance*** between each point in the ***1st Direction***.

5) Enter the ***# Pts*** (number of points) to insert in the ***1st Direction***.

6) Repeat these steps for the ***2nd Direction***.

7) Select ***OK*** to generate the array or ***Cancel*** to abort the function.



Create Points - Array Example

In the example shown, a ***1st Direction*** of 90° with 7 points and a ***2nd Direction*** of 225° with 4 points is used. The ***Distance*** values were the same (25 feet, in this case).

- Notice that the point numbers along in the ***1st Direction*** and then skip down to the next "row" in the direction of the ***2nd Direction***.
- When using the ***Point*** origin option, the point number defaults to the current occupied point.

Create Points - Box Corner

Given three points representing the three corners of a box (actually a parallelepiped), this function will create a point at the remaining corner. To use this function:

1) Select three points in the map. EXACTLY three must be selected - no more or less.

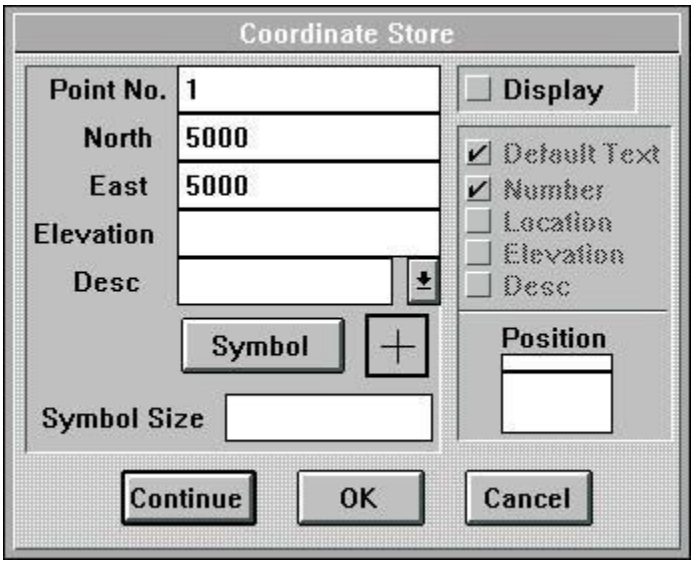
2) Select ***Create Points - Box Corner*** from the ***Points*** menu.

The fourth point will be created.

Notes*:*

- A parallelepiped is a four-sided figure with opposite sides parallel (and therefore of equal length) to each other. A rectangle (box) is simply a parallelepiped with 90 degree corners.
- The *Next Number* settings will be used for the fourth point's point number. The elevation will be set not be set.

Create Points - By Coordinates



Create Points - ***By Coordinates*** in the ***Points*** menu allows creating points by specifying the northing and easting values. The ***Elevation*** and ***Description*** are optional fields. ***Elevation*** will not be enabled (editable) unless elevations are enabled in the ***Environment*** ***Options*** dialog**.** The default point symbol, shown to the right of the ***Symbol*** button, will be used unless a different symbol is chosen. Symbols can be chosen by selecting one from the symbols dialog that is displayed when clicking on the ***Symbol*** button. If you want to create more than one point at a time, click ***Continue*** after each point. Click ***OK*** to create this point but no others. Click ***Cancel*** to stop creating points, including the current one.

Command: CS *Northing Easting {Pnt} {Elevation}*

Create Points - Random

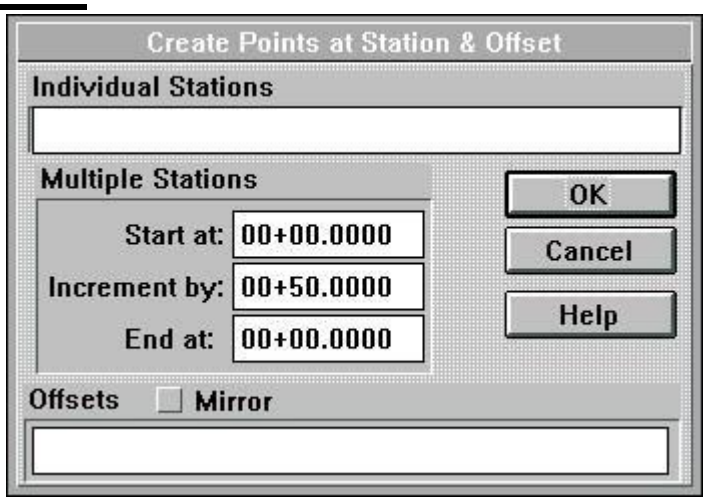
Create Points - ***Random*** in the ***Points*** menu can be used for rapidly creating a set of points to play with or for use with a digitizing pad to enter points from an existing plot. The dialog box allows you to just create points or to create both points and lines. To use this function:

1) Select ***Create Points*** - ***Random*** from the ***Points*** menu. The dialog box shown to the right will appear.
2) Select ***Points Only*** if it is desired to just created random points without connecting each succeeding point with a line from the previous point. Leaving this option unchecked will result in connecting lines being drawn (and annotated with bearing/distance text if automatic annotation is enabled in the ***COGO*** - ***Options*** dialog - see p.100).
3) Enter a value for ***Elev***ation if it is desired to create points with an elevation value. Leaving this value blank will cause all created points to be essentially two-dimensional (no assigned elevation). The ***Elev*** value affects only points created after the ***Elev*** value has been altered.
4) Left-click in data view window to create a point at (or near, if the snapping options are enabled - see p.33) the cursor location.
5) Select ***Done*** to exit the function.

The following notes apply:

- Each new point will become the occupied point.
- The options (***Points Only*** and ***Elev***) can be altered at any time.
- This function can be used in conjunction with the ***Grid/Snapping*** functions to create points at intersections, midpoints, endpoints, etc. by clicking near the desired object(s).

Create Points - Station/Offset



This function creates points at specified station and offset values relative to all selected alignments/boundaries. Points can be created at regular station intervals or offset locations. Individual station/offset values can be specified at the same time. To use this function:

1) Select a alignment(s)/boundary(s)
2) Select ***Create Points*** - ***Station/Offset*** from the ***Points*** menu. A dialog similar to the one shown will be displayed.
3) To create the points, an offset(s) must be specified. Enter the offset value(s) in the ***Offsets*** edit box.
   Multiple values can be separated by spaces or commas. Positive values specify offsets to the right, while negative values specify offsets to the left of the alignment/boundary.
4) Select ***Mirror*** to create points at the negative of all specified ***Offsets*** values. For instance, entering an offset value of **10** and enabling ***Mirror*** will result in the creation of points at offsets of **10** AND **-10**.

   To create points at regular station intervals,

5) Enter the station value to begin creating points at in the ***Start at:*** edit box.
6) Enter the station increment value in the ***Increment by:*** edit box. If point creation at regular station intervals is NOT desired, enter **0** (if not already **0**).
7) Enter the station ending value in the ***End at:*** edit box. An empty or **0** value will cause points to be created up to the end of the alignment/boundary.

   Individual Stations values are station values that are not included in the ***Multiple Stations*** specification. ***Individual Stations*** would be used when specifying a single station/offset pair, for instance.
8) Enter ***Individual Stations*** values (if any) in the ***Individual Stations*** edit box. If entering multiple values, separate them with either a comma or space.
9) Select ***OK*** to create the points or ***Cancel*** to abort the function.

Notes:

• Station values can entered as either floating point values (i.e. **25.5**) or in station format (i.e. **00+25.5**).

Create Points - Digitize

Use this function to input points from an existing drawing using a digitizing tablet. This approach is viable when only a relatively rough approximation to the original data is necessary. Digitizing from a drawing with a 1"=100ft scale, for instance, can easily produce location errors of 5 feet, assuming a point error of 1/20" in aligning the tablet's point device (puck, stylus or whatever).

To use this function,

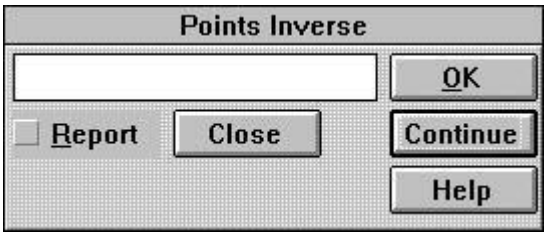
1) Place the plat on the digitizer. The area to be digitized must lie within the area of the tablet that is used for the Windows cursor control. Attach the plat with tape or use some other method that will prevent the paper from shifting during the digitizing process. Placing brick over the center of the paper is probably not a good idea since you'll probably obscure the area you're trying work with. Avoid using Super Glue as well.
2) Select ***Create - Digitize*** from the COGO ***Points*** menu. A *"**Click first point**"* message will appear in the status bar, prompting for the first reference point.
3) You now must provide three reference points from the plat along with their coordinates in order to calibrate the ***Digitize*** function. No two of the three points can lie along either the horizontal or vertical axis of the digitizer.
4) Left-click on the first reference point. A dialog will appear, prompting for the point's coordinates. This is the same dialog as used in the ***Create - By Coordinates*** function (see p.120). Enter at least the Northing and Easting values. The elevation value and other settings can optionally be modified at this time Select ***OK*** to continue.
5) Continue this process for the second and third reference points. The status bar will prompt for each point with a ***"Click second point"*** and ***"Click third point"*** message.
6) After entering the third point, the select status bar will be replaced with a series of edit boxes that allow for the insertion of point number, elevation and description data. The data that is entered in these boxes will be applied to every subsequent point that is digitized. Enter the values that you wish to use for the points you are about to digitize.
7) Left-click with the tablet's pointing device at the desired points on the map. If the point is within the viewing range of the screen, it will be displayed. If not, it will still be created, but you won't see it appear on the screen until you finish and zoom out.
8) Continue digitizing until done. The point number, elevation and description information can be altered at any time.
9) Press the **<*Esc*>** key or left-click on the ***X*** button in the status bar area to exit this function. The select status bar will reappear at this time.

Notes:

- When digitizing contour data, digitize the points of each contour sequentially and avoid the necessity of constantly changing the elevation value.

- The ***Digitize*** function will automatically handle the rotation angle of the plat on the sheet, so it is not necessary to perfectly align the plat with respect to rotation angle. Just slap the thing on the digitizer any old way that is convenient.

Points Inverse

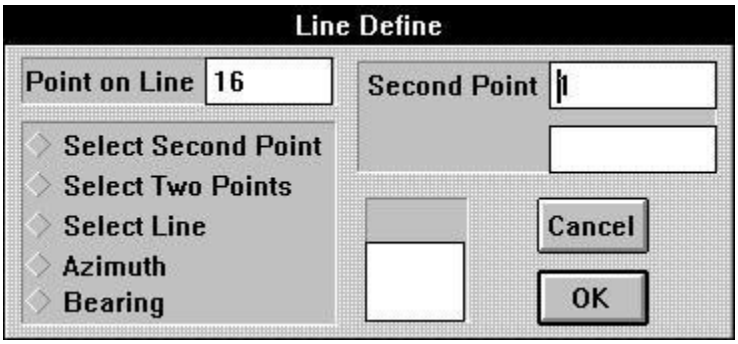


This function inverses between points and generates a report.

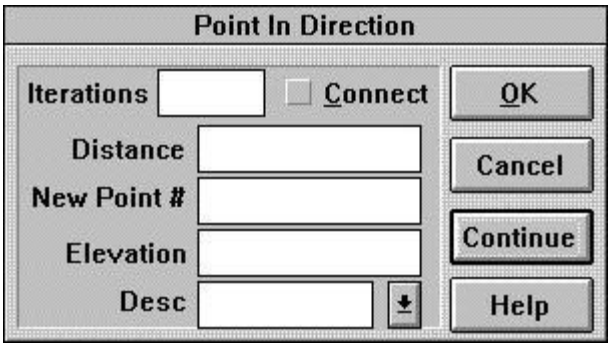
1) Select ***Points Inverse*** from the ***Points*** menu. A dialog similar to the one shown will be displayed.
2) Type in the sequence of point numbers to inverse between.

Point In Direction

Point In Direction in the ***COGO*** menu will create a new point that is a given distance along a given angle away from another point. To use this function,



1) Select ***Point In Direction*** from the ***COGO*** menu. The first dialog that will appear is the ***Line Define*** dialog, used to establish the direction for this function. See the section on ***Line Define*** on p.31.

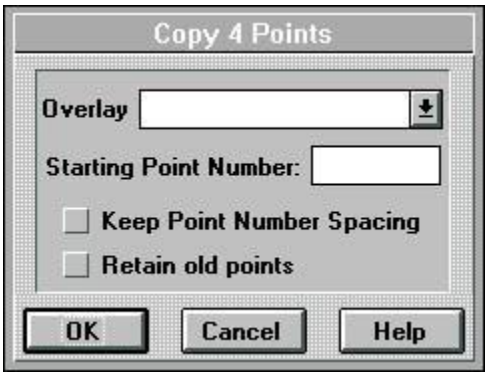


2) After defining the angle, click on ***OK*** and the dialog box will be replaced with another one in which you specify the ***Distance*** of the new point from the source point as well as the ***New Point #, Elevation,*** **and** ***Notes*** for the new point. ***Iterations*** will default to **1**. Increasing this value will add one point for each iteration at the ***Distance*** value from the previous point. Enabling ***Connect*** will result in lines being created between each successive point.
3) To create the new point(s) and quit, click on the ***OK*** button. To quit without creating this point(s), click on the ***Cancel*** button. To create the new point(s) and then continue to create another point, click on the ***Continue*** button. After selecting ***Continue***, the values can be changed while maintaining the same defined direction. Additional points will be placed relative to the last created point.

   Each new point will continue in the same direction and the direction will be from the previous point. The distance for each successive point will default to the same value as for the previous entry, but it can be

   changed.

Copy/Renumber



Copy Selected Points Dialog

This function can be used both to create a copy of all points that are selected as well as to move a set of selected points to another point range (a renumbering function). When trying to create the new point numbers, the ***Next Number*** (see p. 190) settings are used.

The ***Overlay*** field, if empty will default to the Base Overlay. Optionally, the surveyor can select a different overlay, if other overlays have been created, from the drop-down list.

The ***Starting Point Number*** defines the first point number to use as the destination of the copy. If for instance the ***Starting Point Number*** is specified as **25** and the lower number of the selected points is **4**, then point **4** will be copied to point number **25**.

Enabling ***Keep Point Number Spacing*** will maintain any numbering "gaps" that may exist in the selected point numbers. Example: points 2, 5, 6 and 8 are selected. If the ***Starting Point Number*** is **25**, the new point numbers (assuming they haven't been already used) will be 25, 28, 29 and 31 if ***Keep Point Number Spacing*** is on. If it is off, the new point numbers will be 25, 26, 27 and 28 (again assuming that those numbers are previously unused).

The ***Retain Old Points*** has the following behavior

- If enabled, this function is truly a copy function - a duplicate of the selected points is made, albeit with different point numbers.
- If not enabled, this function acts like a renumbering function, moving the points to a different set of point numbers.

Selecting ***OK*** executes the function while selecting ***Cancel*** will abort the function (as usual).

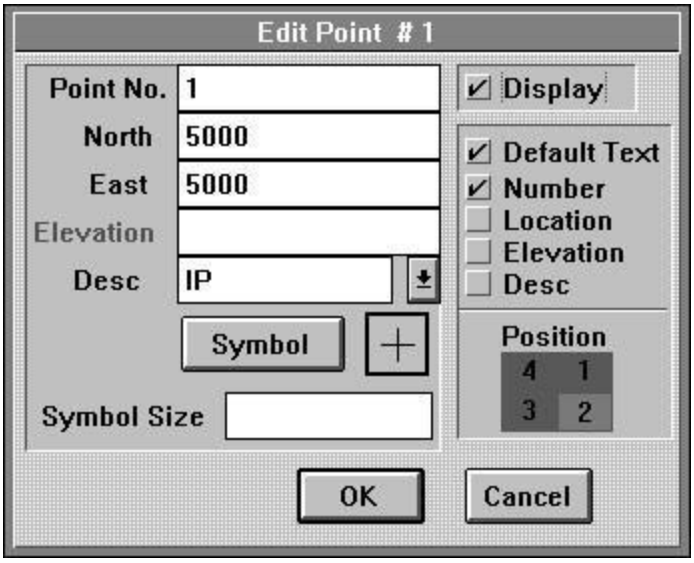
Editing Points

Edit Individually

Edit Individually in the ***Points*** menu allows the user to change the parameters of all selected points the selected points.

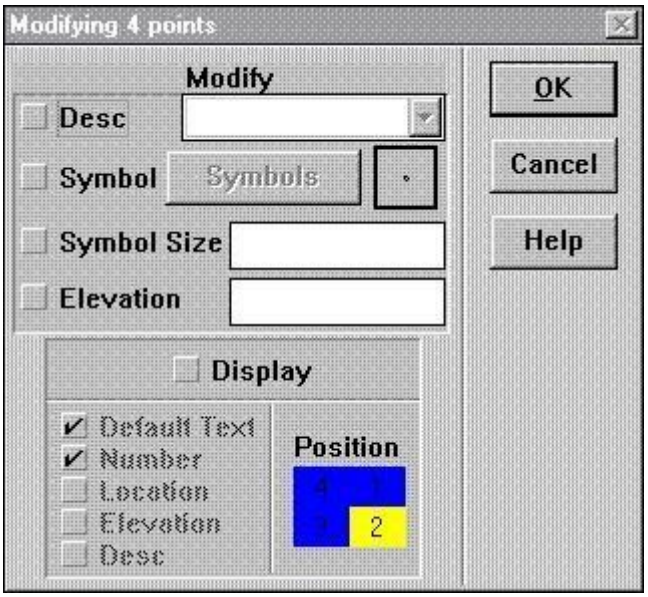
If just one point is selected, a single dialog box will appear.

If more than one point is selected, the dialog box will appear for each point in order of their point number until all the points have been presented for editing or the surveyor ***Cancel***s the function. The same dialog box as for a single selected point except for all points except the last in the list, the ***OK*** button is replaced by a ***Next*** button. Additionally, the title of the box will provide information on the current point being modified and how many points are left (by displaying a message of the form "3 of 32" in the title bar). Selecting ***Cancel*** will keep all changes made except to the current point. The dialog box will allow the
user to set the ***North, East, Elevation*** (if enabled), ***Notes*** and ***Symbol.*** The ***Display*** checkboxes control which text information about the point will be displayed in the COGO window. Any combination of ***Number, Location, Elevation,*** and ***Notes*** can be selected. All of these texts are displayed on the point number layer. The ***Position*** refers to the placement of the point text (such as number) relative to the point symbol. When ***Default Text*** on, the point text will appear in whichever quadrant is selected in the ***Position*** control (relative to the point). Turning off ***Default Text*** allows the surveyor to move and rotate the point text to any desired position in the drawing. ***Default Text*** is normally on in order to conserve memory.



Modify Group

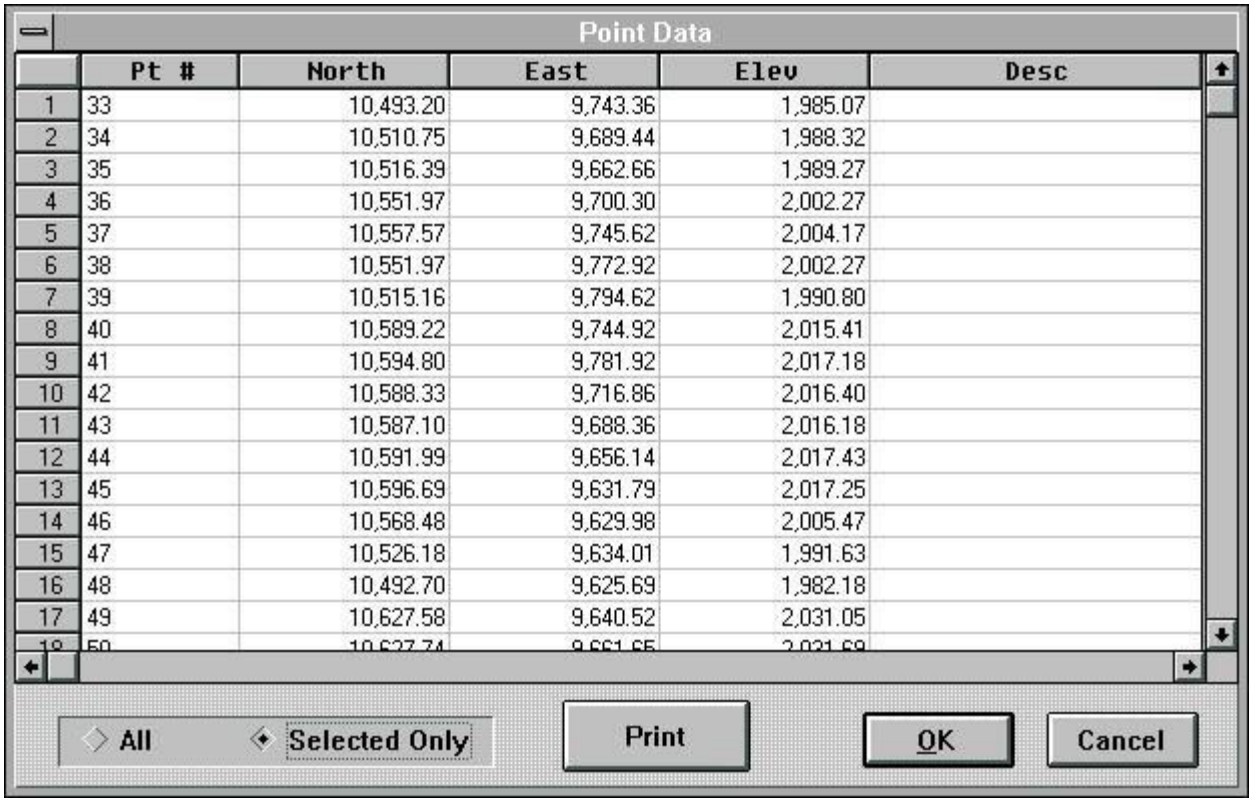
The ***Modify Group*** option is useful for applying the same parameters or values to a group of points. In this dialog, the positions and elevations cannot be changed. However, the notes can be changed by enabling ***Desc*** and entering the notes in the edit box. These notes will be attached to **all** selected points. A symbol can be used for all the points also by checking the ***Symbol*** checkbox and selecting the desired symbol. Setting the ***Display*** and ***Position*** are the same as for a single point but also apply to all selected points. See the ***Edit Individually*** section above for more information.



For more information on changing the symbol, refer to the ***Point Symbols*** section on p.98.

Edit Data

This function is useful for editing the point data - northing, easting, elevation and description. ***Edit Data*** uses a spreadsheet-style editor with each point's data occupying a separate row of the spreadsheet.



	Pt #	North	East	Elev	Desc
1	33	10,493.20	9,743.36	1,985.07	
2	34	10,510.75	9,689.44	1,988.32	
3	35	10,516.39	9,662.66	1,989.27	
4	36	10,551.97	9,700.30	2,002.27	
5	37	10,557.57	9,745.62	2,004.17	
6	38	10,551.97	9,772.92	2,002.27	
7	39	10,515.16	9,794.62	1,990.80	
8	40	10,589.22	9,744.92	2,015.41	
9	41	10,594.80	9,781.92	2,017.18	
10	42	10,588.33	9,716.86	2,016.40	
11	43	10,587.10	9,688.36	2,016.18	
12	44	10,591.99	9,656.14	2,017.43	
13	45	10,596.69	9,631.79	2,017.25	
14	46	10,568.48	9,629.98	2,005.47	
15	47	10,526.18	9,634.01	1,991.63	
16	48	10,492.70	9,625.69	1,982.18	
17	49	10,627.58	9,640.52	2,031.05	
18	50	10,627.74	9,661.65	2,031.69	

To use this function:

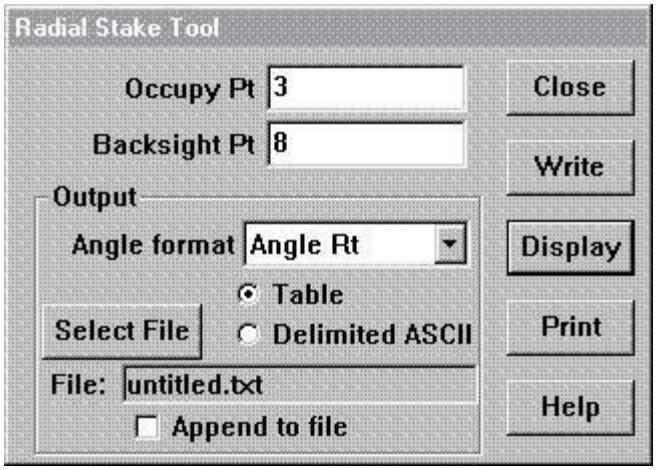
1) ***Edit Data*** can edit either ALL the COGO points or just the selected points. Therefore, if the surveyor wishes to edit just SOME of the COGO points, it can be easier to first select the points that are to be edited.
2) Select ***Edit Data*** from the ***Points*** menu. A dialog box similar to the one shown above will appear.
3) Select either ***All*** or ***Selected Only*** for either viewing ALL the point data or just the selected points' data.
4) Double-click on the value or description to be edited. The value can then be changed by simply typing in a new value or description.
5) Continue editing until satisfied.
6) Select ***Print*** to send the spreadsheet to the printer, if desired.
7) Select ***OK*** to accept the changes or ***Cancel*** to abort the function.

Notes:

- The ***Elevation*** column will appear only if the ***Use Elevations*** option is enabled in the ***Environment*** - ***Options*** dialog.
- Point numbers cannot be edited in this function.

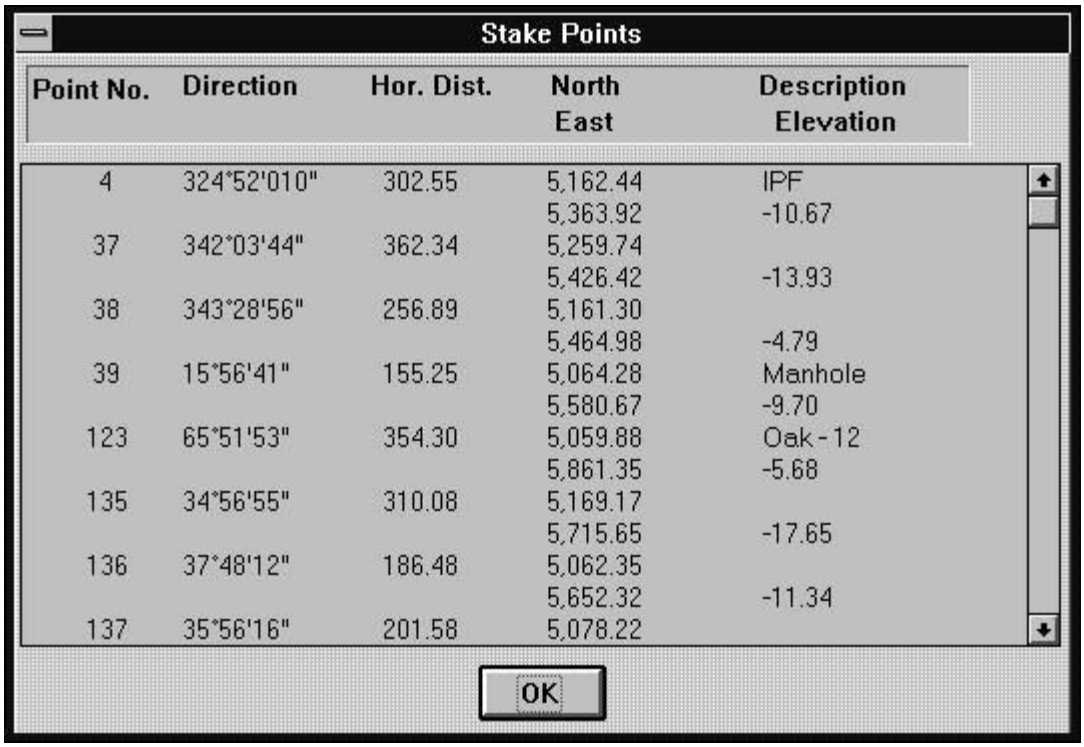
Stake Tool - Radial

Stake Tool-Radial in the ***Points*** menu creates a list of angles, distances, and elevation changes for a set of points based on a given occupy point and backsight. To create the list, select the points that will go in the list **before** calling ***Stake Tool-Radial***. The ***Occupy Point*** will default to the current occupy point. This value can be changed either by typing in a new value or clicking near the desired point while the occupy point box has the focus. The ***Back Sight*** value will default to the current back sight point



The horizontal ***Angle format*** can be in one of five formats: ***Direction, Angle Rt, Angle Lt,***

Deflect Rt and Deflect Lt. Pick the desired format from the dropdown list box before selecting ***Display*** *or* ***OK***.

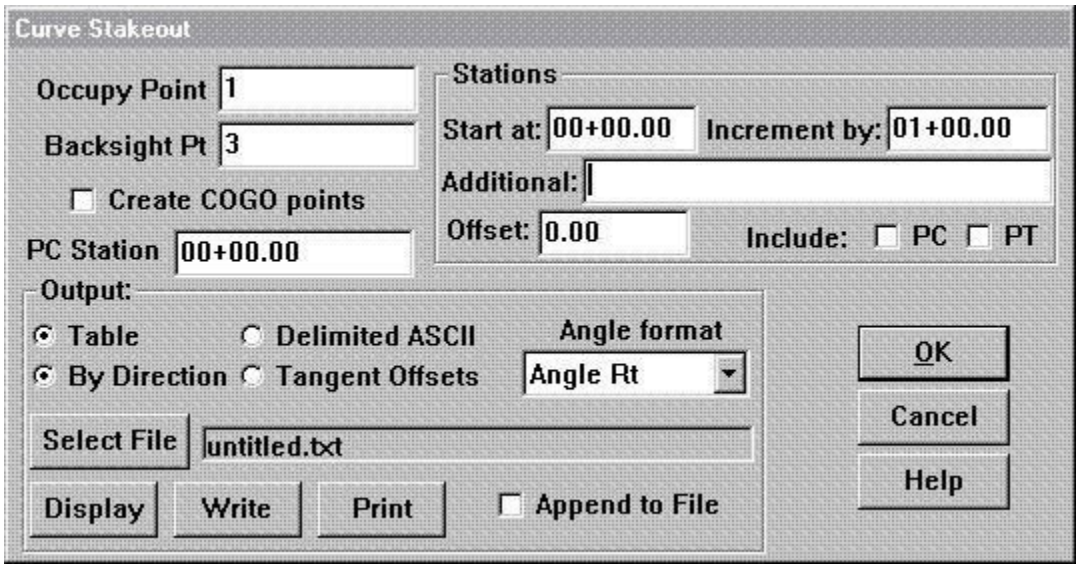


Stake Tool Display Sample

After setting these initial values, if you click on the ***Display*** button, another dialog box will be displayed showing each selected point, the angle of the specified type, the distance from the point to the *Occupy Point*, the point coordinates, description (if any) and the elevation difference between the *Occupy Point* and the new point. Click ***OK*** to remove this dialog box.

If you want to write this information out to a file, use the ***Select File*** button to specify an output file. Select either ***Table*** or ***Delimited ASCII*** for the format of the file to be written. The ***Table*** format was designed for printouts and the ***Delimited ASCII*** format facilitates data transfer to other programs. When you click on the ***OK*** button, if a ***File Name*** is specified, a text file containing the stake information will be placed in the same directory as the current project if a complete path (file name *and* directory location) is not specified. The file can be viewed and printed from any editor including the NotePad application in the Windows accessories.

Stake Tool - Curves

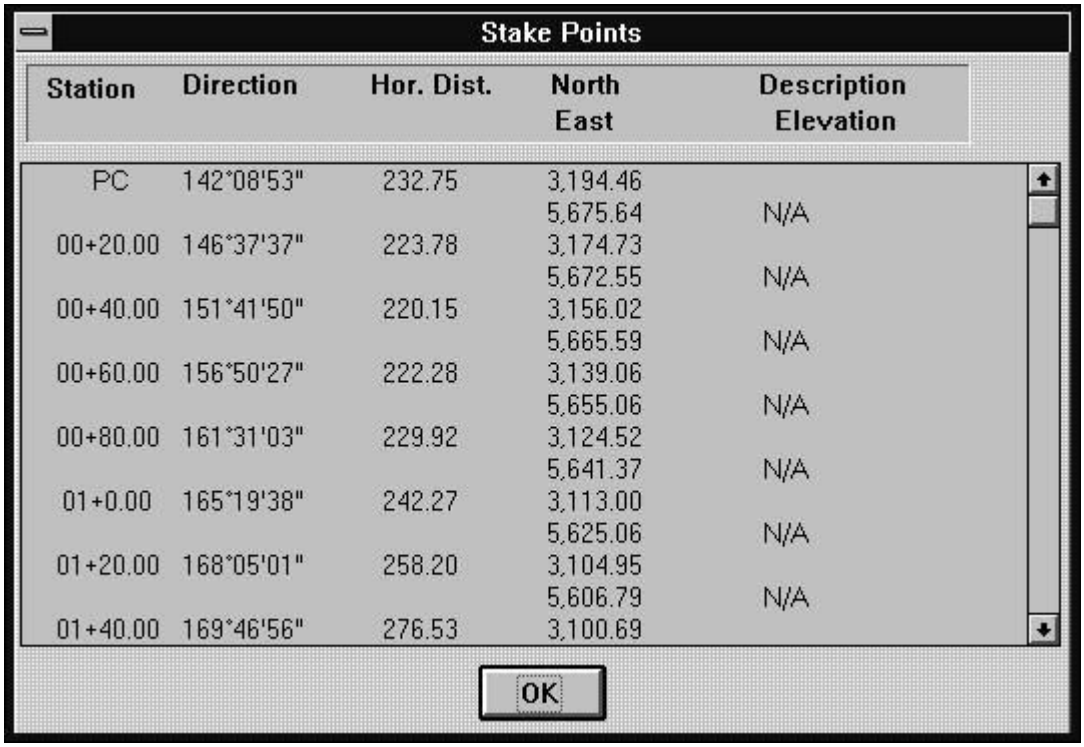


The Stake Tool for Curves allows the surveyor to stake a curve(s) at specific intervals along the curve's length. The output specification is similar to that of the Stake Tool for points with one exception. There is an option to allow staking curves ***By Direction*** (just like points) or by ***Tangent Offsets*** (tangent distance and offset distance).

The ***Stations*** section of the dialog allows the surveyor specify a starting offset from the PC. For example, if a
Start at value of 00+10 is used, the first stake point will be placed at an arc length of 10 feet/meters from the
PC. The ***Increment by*** value specifies the interval for placing stake points. For example, if a value of 01+0.00 is used, stake points will be placed every 100 feet/meters along the curve after the *Start at* value.

If additional stake points are required at some irregular interval, these can be specified in the ***Additional*** edit box, separating each station by a comma. For example: **00+17.6, 01+23.6,** etc.

The Stake Tool for Curves will create COGO points at the specified locations if the ***Create COGO points*** option is checked. The values can be displayed on the screen by clicking on the ***Display*** button. Selecting ***OK*** will create the file specified in the ***Select File*** dialog, while ***Cancel*** returns to the program without creating the file.

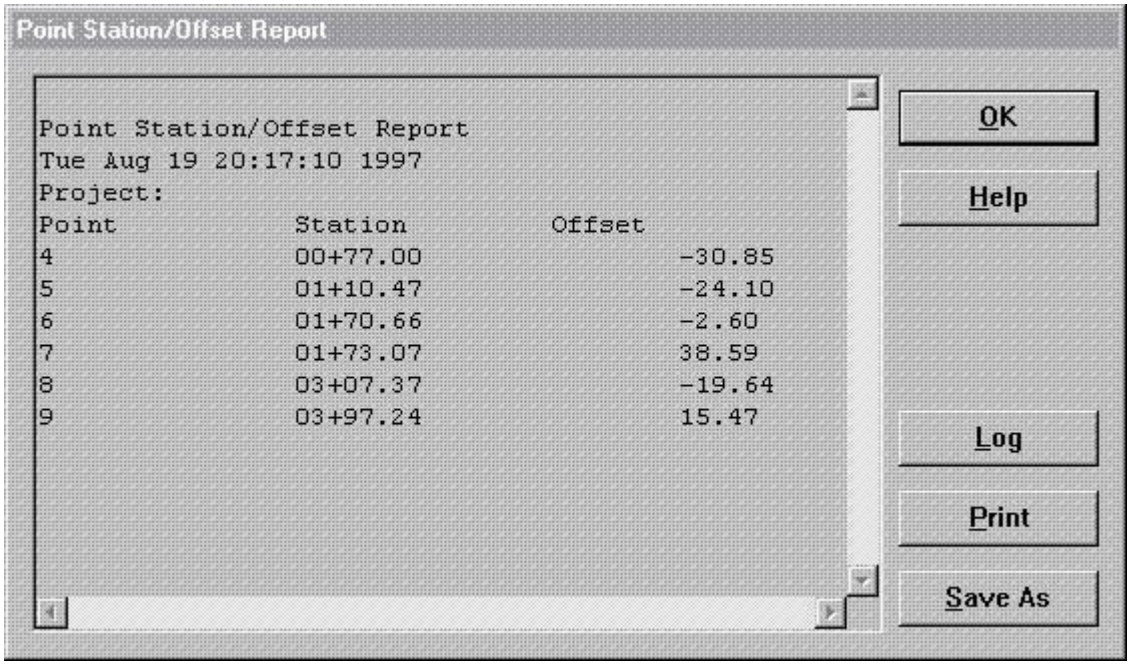


Station/Offset Report

Use this function to calculate the station and offset values of a set of selected points relative to a selected alignment.

To use this function:

1) Select the alignment that will be used to calculate the station/offset values from.
2) Select the points whose station/offset values are to be calculated.
3) Select ***Points*** - ***Station/Offset Report***. A report dialog similar to the one below will be displayed.
4) Select ***OK*** to close the report. Select ***Print*** to print the report or ***Save As*** to save it to a file for later use. *Select* ***Log*** to save the report in the log file.



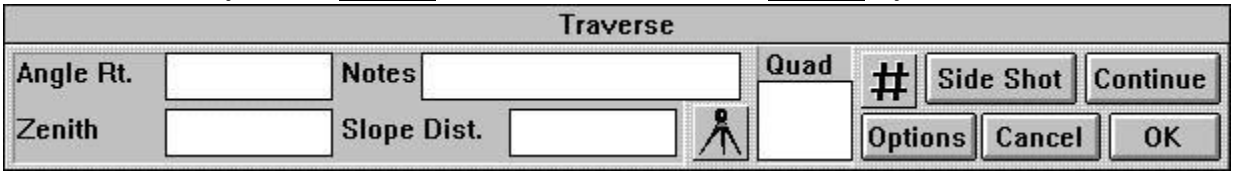
Related Subjects:

Creating alignments - see p.155

Line Functions

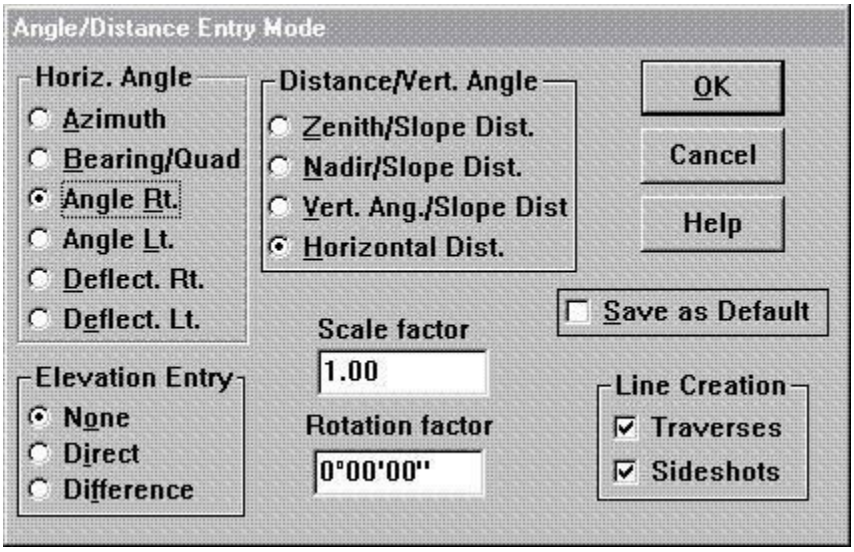
Traverse/Side Shot

Traverse and ***Side Shot*** in the ***COGO*** menu create both points and lines at a given angle and distance from the current occupied point. If automatic boundary creation is enabled, then the new lines will be inserted in boundaries by ***Traverse*** but not by ***Side Shot***. Changing from ***Traverse*** to ***Side Shot*** mode is as simply as clicking on the button labeled ***Side Shot*** if you are in ***Traverse*** mode or on the button labeled ***Traverse*** if you



are in ***Side Shot*** mode. The type of data expected by the dialog box for positioning the new point depend on the mode selected which is explained in the following section on ***Options***. *Notes* for the new point can also be entered. To create the new point and quit, click on the ***OK*** button. To create the new point and then create another point, click on the ***Continue*** button. To quit without creating this point, click on the ***Cancel*** button.

Options



Clicking on the ***Options*** button brings up a dialog box that allows selecting the modes to use for entering the angle and distance. To use the current modes for other projects, enable the ***Save as Default*** feature.

The angle modes are ***Azimuth, Angle Right, Angle Left, Deflection Right, Deflection Left***, and ***Bearing/Quad***. ***Azimuth*** mode will traverse an angle that is the number of degrees clockwise from north. ***Angle Right*** and ***Angle Left*** mode will traverse an angle that is the specified number of degrees clockwise or counter clockwise, respectively, from the backsight. ***Deflection Right*** and ***Deflection Left*** will traverse an angle that is the specified number of degrees clockwise or counter clockwise, respectively, from the foresight. The foresight is just the 180 degree reverse of the backsight, so a backsight of 270 degrees will mean a foresight of 90 degrees. ***Bearing/Quad*** mode will traverse an angle that is the specified number of degrees from north or south in the specified quadrant.

The distance modes are ***Zenith/Slope Distance, Nadir/Slope Distance, Vertical Angle/Slope Distance,*** **and** ***Horizontal Distance***. For ***Zenith/Slope Distance***, a distance and a zenith angle need to be entered. The zenith angle is the number of degrees from vertically up. The distance is the distance from the starting point along the zenith angle to the new point. For ***Nadir/Slope Distance***, a distance and a nadir angle are entered where the nadir angle is the number of degrees from vertically down. For ***Vertical Angle/Slope Distance***, a distance and a vertical angle are entered where the vertical angle is the number of degrees from horizontal. For ***Horizontal Distance***, the horizontal component of the distance is entered. When ***Horizontal Distance*** mode is selected the ***Elevation Entry*** modes become enabled. The surveyor can select whether he wants to enter elevations as ***Direct*** (absolute values), ***Difference*** (change in elevation from station's value), or ***None*** (no elevation value at the foresight point). If elevations are not enabled, no elevation entry is allowed.

Horizontal distances are multiplied by the ***Scale Factor*** value, so a value greater than 1.0 will increase the input distance value while a ***Scale factor*** less than *1.0* will decrease distance values. This can be useful when transforming ground measurement values to state plane values. Similarly, any ***Rotation factor*** other than *0* will alter the horizontal angle value by adding to it the specified value.

The ***Line Creation*** settings control whether lines will automatically be created from the occupied point to the foresight point. Traverse line and sideshot line creation can be individually controlled. For instance,
enabling ***Traverses*** and disabling ***Sideshots*** will cause lines to be added for each traverse leg will only created points at the foresight for sideshot entries.

The Traverse/Sideshot Command Line

The command line for the Traverse and Sideshot commands is very involved and therefore merits a special section to describe it. Unlike the Traverse/Sideshot dialogs, the command line permits the input of curve data as well as normal shot data. The command line is a much faster method inputting data than the dialogs, so it is highly recommended that the surveyor study this section closely.

The command syntax for entering traverse and sideshots from the keyboard is: **TR** *Ang {Mode} Dist {VA} {Pnt} {Desc}*

The following applies when entering traverses and sideshots:

- *Ang* is a horizontal angle. It can be an azimuth, bearing or turned angle with its interpretation depending on the current *Mode*.
- *Mode* is an optional digit from 1 to 8 and controls how the command information is interpreted. The various mode values are as follows:

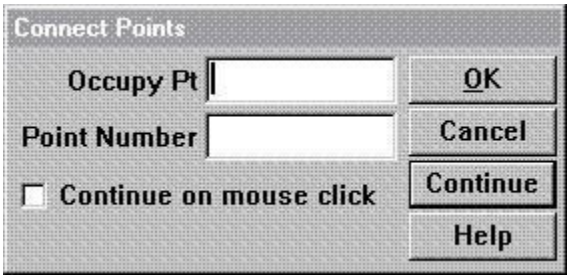
Mode	Ang	Dist
0	North Azimuth	Normal
1	Bearing in quadrant 1	Normal
2	South Azimuth or Bearing in quadrant 2	Normal
3	Bearing in quadrant 3	Normal
4	Bearing in quadrant 4	Normal
5	Angle right	Normal
6	Deflection right	Normal
7	Delta of curve	Radius of curve
8	Arc Length of curve	Radius of curve

- The *Dist* parameter is either a horizontal or slope distance depending on whether the *VA* (Vertical Angle) parameter is present. **Entering a negative value for the distance will create a sideshot.**
- *VA* is the optional Vertical Angle. If no *VA* parameter is entered, the *Dist* parameter is interpreted as a horizontal distance. With a *VA* value specified, *Dist* is interpreted as a slope distance.
- *Pnt* specifies an point number. This is also an optional parameter and will override the ***Next Number*** setting when present.

- *Desc* is the optional point description. If the description includes embedded spaces, enclose the description in double quotes. *Example:* **TR 33.2532, 532.23, "I am a note"<Enter>** When entering curves - modes 7 and 8 - the following applies:
- *Ang* is either the delta (mode 7) or the arc length (mode 8) of the curve. Entering a negative value will generate a counter-clockwise turning curve. A positive value generates a clockwise turning curve.
- Curves will be tangent to the previous line or curve that was entered. To generate a non-tangent curve, use the ***Curve*** functions in the main menu.
- *Dist* is the curve radius.

Connect Points

Connect Points in the ***COGO*** menu creates lines between points that already exist. If the automatic creation of boundaries is enabled, these lines will be added to boundaries. To create a line between two points, enter the first point in the ***Occupy Pt*** box and the second point(s) in the ***Point Number*** box. The ***Occupy Pt*** value will default to the currently occupied point but can be set to any point.



There are three ways to enter a point number into the ***Occupy Pt*** edit box:

1) Type the number into the edit box.
2) Middle-click (click the middle mouse button) near the point that is desired. The point number of the nearest point will be entered into the edit box automatically and the focus will be moved to the ***Point Number*** edit box. Other dialogs that use an *Occupy Point* should behave the same way.
3) Make the edit box active (either by clicking the left mouse button in that box or by tabbing to it) and then select the desired point from the COGO data window. When this method is used, the "old" point number is replaced with the "new" point number automatically and the ***Point Number*** edit box is activated.

Either the first or third method can be used for entering a point number into the ***Point Number*** edit box. Clicking near another point while the focus is still in the box will erase the old point number and replace it with the new point number.

If you want to create several contiguous lines, there are two methods possible.

1) The first is to enable the ***Continue on mouse click*** feature and set the focus to the ***Point Number*** field. Then, when you click near a point in the data window, a line will be created between the old ***Occupy Pt*** and the point nearest the click; then the ***Occupy Pt*** value will be set to the new point and the ***Point Number*** will be cleared. That option removes the requirement of clicking on the ***Continue*** button to add a line to the next point.
2) A second method that can be used to connect several points in one step is to enter a series of points in the ***Point Number*** box. If the points are non-sequential, merely list the point numbers with a comma or space separating them. For a series of sequential points, enter

the lowest point number followed by a hyphen and then the highest point number. This can also be used for alphanumeric points if the part of the name that changes is the numbers at the end of the string, such as TREE5-TREE18.

Example: If you wish to connect from the occupy point to points 3, 5, 7, 8, 9, 10 and 12 (in that order), you could enter the following in the ***Point Number*** box: **3 5 7 8-10 12** or **3,5,7,8-10,12** or, even, **3,5 7 810,12**.

A semicolon can be used between point numbers to stop line drawing at the point number before the semicolon and restart at the point number following the semicolon.

Example Specifying the point numbers **1-3;4-6** will create lines 1-2 and 2-3 followed by lines 4-5 and 5-
6.

The command line syntax for this function is:

PT *Pnt List*

- To create the new line and quit, click on the ***OK*** button.
- To create the new line and then create another line, click on the ***Continue*** button.
- To quit without creating this line, click on the ***Cancel*** button. • To REALLY quit, rip the mouse out of the computer and hurl it at extreme velocity towards your monitor screen. Don't worry - monitors implode (as opposed to explode), so you're less likely to get caught in any flying debris.

Offset

There are two ***Offset*** functions in the COGO window. One is in the ***COGO*** menu and the other is in the ***Aln/Bnd*** menu. Both will generate offsets, but they behave somewhat differently.

Offset in the ***COGO*** menu can generate offsets of lines and curves. ***Offset*** in the ***Aln/Bnd*** menu will generate offsets to alignments or boundaries. Offset points (relative to the curve/line endpoints or the alignment/boundary inflection points) will always be created.

Line and curve offsets are created in the following manner:

1) Select ***Offset*** from the ***COGO*** menu. The dialog shown to the right will appear.
2) Enter the ***Distance*** and ***Offset*** for the desired offset (formulas and screen selections are allowed). The ***Distance*** value is the perpendicular distance in the case of a line or the distance along a radial line in the case of a curve. The ***Offset*** distance is a distance to offset the new line to the right of perpendicular/radial offset direction. ***Offset*** defaults to *0*. ***Offset*** does not apply to curves.
3) A ***Direction*** value can be entered instead of an ***Offset*** value to specify the direction of the offset relative to the perpendicular offset direction (i.e. *0* is the direction of the perpendicular to the line). ***Direction***s are evaluated as clockwise values.

4) ***How many?*** defaults to 1. Larger values will create successive offsets - each new offset will be generated using the above parameters from the previous offset. The result is a "stair-step" appearance.

5) Once the values have been entered, ***with the focus (the vertical flashing cursor) in the*** *How Many?*
edit box, click on the side of the line/curve that you wish to create the offset at.

The following occurs for the indicated type of selected object.

- **Line** - if the line has endpoints, new points will be placed along a perpendicular(s) to the line passing through the endpoint(s) at the ***Distance*** from the endpoint(s).
- **Curve** - if the curve has an endpoint(s), new points will be created along the endpoint's radial line (line passing through the endpoint and the curve center or radius point) at the ***Distance*** from the endpoint. **If the offset distance is larger than the radius of the curve and the offset is on the inside of the curve, no offset will be created.**

Add Leader Line

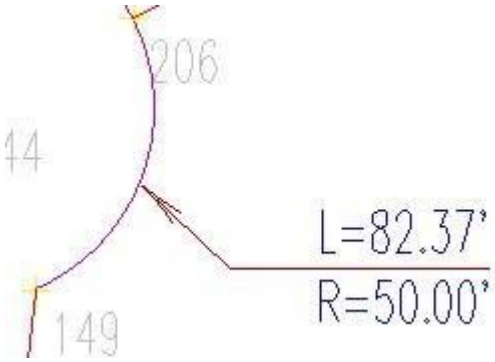
Add Leader Line in the ***Draw*** menu creates leader lines off of connected lines and curves. To use this function,

1) Select ***Add Leader Line*** from the ***Draw*** menu. The cursor will be changed to a bent arrow.
2) Move the cursor near the point on the line or curve that you want the leader line attached to and press and hold the left button.
3) Drag the mouse until the line is as long as you want it and in the direction that you want and then release the button. The leader line will be drawn and the text on the line or curve will be moved to the leader line.

The program will stay in this mode until you click the right button or type <**ESC**>, so you can continue to add leader lines until exiting this mode.

Adding a leader line will remove the text that is currently on the line or curve and place it on the tail of the leader line. Currently there is no way to put, for instance, only the distance or only the bearing text on the leader line - both will be placed on the leader line. Deleting a leader line will result in moving the text back to the object to which the leader line was originally attached (if the text will fit).

Leader line from a curve



Once a leader line has been added, it can be bent and its head can be relocated. To modify a leader line, 1) Select the leader line. A selected leader line has three nibs on it.

2) Move the mouse until it is over one of the nibs. The cursor will change into a crosshairs at this point.

3) Grabbing and dragging the center nib will result in bending the leader line. The head can likewise be dragged, but the head will remain attached to its line or curve. Grabbing and dragging the endpoint will stretch the tail of the leader line. The leader line text will be placed at the end of the tail.

Leader lines that are not attached to a line or curve (independent leader lines) can be added in the ***Layout Window*** with the ***Straight Dimension*** and ***Curved Dimension*** functions. See p.43 for more information on these functions.

Best Fit Line

Best Fit Line will fit a line to a set of selected points. To use this function,

1) Select all the points that are to be used in fitting the line. Be sure that no other points are selected. (You may wish to clear all selections first by clicking on the ***C*** button in the select status bar before selecting the points to use.)

2) Select ***Best Fit Line*** from the ***COGO*** menu.

A line and its endpoints will be created. The endpoints will be created such that the selected points that lie at either end of the line are along a perpendicular that passes through the endpoints.

Split Lines

The ***Split Line*** function in the ***Edit*** menu is used to "break up" a line at selected points that lie along the line. The line will be replaced with a set of lines that will start and end at the original line's starting point and ending point but will also start and end at the selected intermediate points along the original line.

For example, selecting a line along with a point that lies at its midpoint will result in the replacement of the original line with two lines. The first new line will start at the original starting point and end at the midpoint while the second line will start at the midpoint and end at the original endpoint.

To use this function:

1) Select the line(s) and point(s) on the line(s) where the line is to be broken.

2) Select ***Split Line*** from the ***Edit*** menu. The line(s) will be broken as explained above.

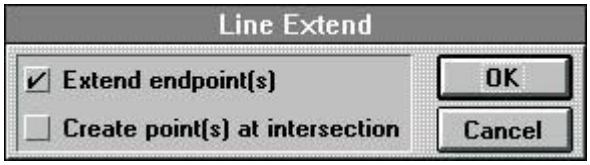
It's that simple. Remember that this function can be used to operate on several lines at once since all selected lines are possibly affected (if there exist selected points along the selected lines).

Line Extend

The ***Line Extend*** function is used to "stretch" an existing line (or lines) till it contacts another line or an arc. This function requires selection of objects in two steps and is used in the following way:

1) Select the line(s) that are to be extended. Note that multiple lines can be selected.

2) Select ***Line Extend*** from the ***Edit*** menu. A dialog similar to the one shown will appear.

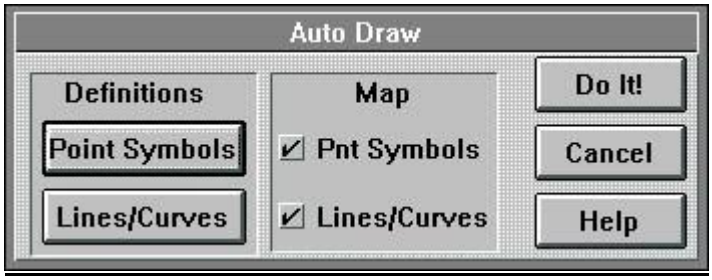


3) Select the line or arc that you wish to extend the previously selected line(s) to.

4) Select ***Extend endpoint(s)*** if the you wish to move the endpoints of the lines that are to be extended. Select ***Create point(s) at intersection*** if you wish to add point(s) at the intersection of the extended line(s) and the line or arc extended to.

   Select ***OK*** to complete the operation or ***Cancel*** to abort.

Auto Draw



Auto Draw in the ***Misc*** menu creates lines and curves and inserts point symbols based on the information in the description field. The surveyor must first create a set of definitions that specify what actions to perform when a specified pattern is found within the description field of a point. The definitions are entered through a spreadsheet interface and are stored in the PCS.INI file. When executing this function, the program will look at each point's description field to see if it matches user-specified patterns in the Auto Draw definitions. These patterns are called *regular expressions.* ***It is suggested that you read the section on*** *regular expressions* ***on p.192 before proceeding with this section.***

The ***Map*** portion of the dialog specifies which actions to perform - whether or not to perform the ***Point Symbols*** and/or the ***Lines/Curves*** mapping definitions.

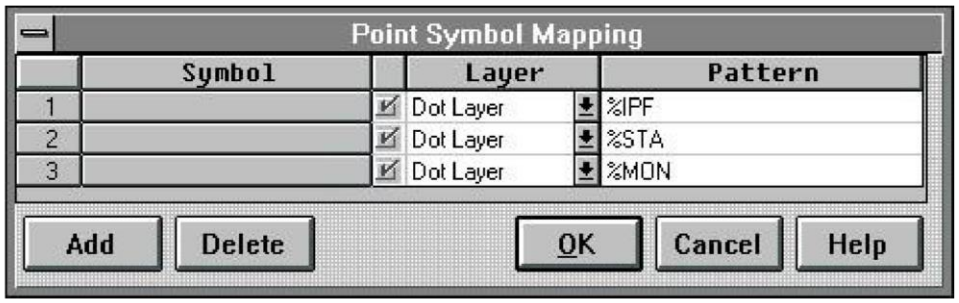
Pressing the ***Do It!*** button will execute the ***Auto Draw*** function. The function will first step through the enabled (see below) ***Point Symbols*** definitions followed by the ***Lines/Curves*** functions.

Pressing the ***Cancel*** button will terminate the dialog. Any changes made to the ***Definitions*** are kept, however, since they are saved at the time their dialogs are exited. Press ***Help*** for online information concerning this function.

The ***Definitions*** portion of the dialog is used to edit the ***Auto Draw*** definitions.

Point Symbol/Annotation Mapping

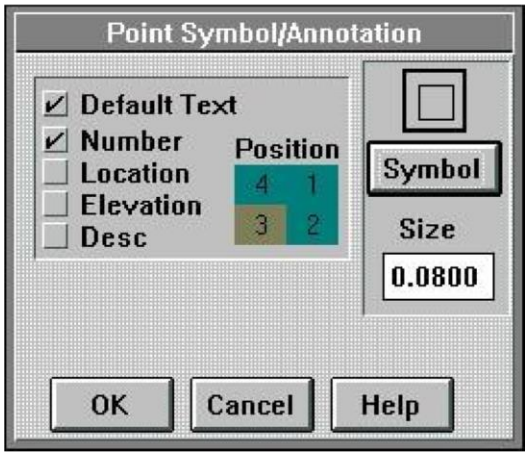
Selecting the ***Point Symbols*** button will display a spreadsheet similar to the one shown. Each row of the spreadsheet contains one mapping definition. The columns ***Point Symbol***, ***Size***, ***Layer***, ***Pattern*** contain the elements of the definition.



The ***Symbol/Anno*** column contains a button that, when depressed, will display a dialog similar to the one shown to the right. In this dialog the point symbol, symbol size, and annotation can be specified.

Selecting the ***Symbol*** button will display the *Point Symbol* dialog (see also p.98). The surveyor can select the desired point symbol from this dialog. The currently selected symbol is displayed immediately above the ***Symbol*** button.

Below the ***Symbol*** button is the ***Size*** edit box. Entering a value for ***Size*** is optional. If no size is entered, the point symbol will be placed with its default size (as defined in the *Point Symbol* dialog). In the example dialog, the "Square" point symbol is specifically given a size of 0.08, overriding the default size of this point symbol.



The annotation of the point is controlled with the checkboxes and ***Position*** control on the left side of the dialog.

Default Text, if checked, will cause any annotation to be placed in the quadrant (relative to the point) specified by the ***Position*** control. If ***Default Text*** is unchecked, the point annotation will be created as a freestanding text which can be moved and rotated (default point texts have a fixed location and orientation).

Number, Location, Elevation and ***Desc*** refer to the point's number, northing/easting coordinates, elevation and description. Checking any of these boxes will result in the corresponding parameter being displayed at the specified ***Position***.

The remaining three spreadsheet columns are used as follows:

The enabling column is unlabeled - it is the one with the check boxes. When checked, the definition in the checked row will be applied. Conversely, unchecking the checkbox will exclude that row's point definition when the ***Auto Draw*** function is executed (by pressing the ***Do It!*** button).

The ***Layer*** parameter will default to the layer used for point symbols (the *Dot Layer* is used initially after installing the program). A different layer can be selected by clicking on the down arrow button to the right of the edit box and then selecting a name from the displayed list of layers. The default layer for points is the "Dot Layer".

The ***Pattern*** must be specified before the definition will be accepted. This is a *regular expression* that is used to search the point number descriptions for a match. In the first row of the dialog shown, for instance, the point symbol and annotation specified by that row's ***Symbol/Anno*** dialog will be used for all points with descriptions beginning with the characters **IPF** (the **%** means "beginning with"). Similarly, in the second row, the point symbol specified in that row's ***Symbol/Anno*** dialog will be used for all points with descriptions beginning with **STA.**

Pressing the ***Add*** button will insert a new row after the current row (where the cursor is).

Pressing the ***Delete*** button will delete the current row.

Select the ***OK*** button to save the current definitions or ***Cancel*** button to discard any changes that have been made.

Line/Curve Mapping

Selecting the ***Lines/Curves*** button will display another spreadsheet. Again, each row contains the information for one definition. Each definition is capable of generating a connected set of lines and curves with control over the displayed line style, color and annotation.

One of the differences between this spreadsheet and the ***Point Symbols*** spreadsheet is that line/curve auto draw definitions have a ***Name*** field. The name can be up to 63 characters in length. A recommendation is to use a name that indicates what it is that is being drawn. *EPL* or *Left Pavement* might be used to designate the left edge of pavement, for instance.

Start, if entered, specifies the description pattern that will signify the first point of a connection sequence.
End, if entered, specifies the description pattern that will signify the last point of a connection sequence. Points with the description pattern specified in ***Cont.*** will be included in the sequence if they are between the start point and the end point. The points in the database will be searched in numeric order. Once one sequence is ended, the program will continue to search through the existing points for the next description field that matches either the ***Start*** or ***Cont.*** pattern.

Example Let's assume a project has the following points and descriptions: 1=PT, 2=PTA, 3=PT, 4=PT, 5=PTB, 6=PTA, 7=PTB, 8=PT, 9=PTA, 10=PT. If the ***Start*** is "PTA", the ***Cont.*** is "PT", and ***End*** is "PTB", ***Auto Draw*** will create a line sequence of 2-3-4-5, another line of 6-7, and a final line of 9-10. Points 1 and 8 will not be used in any line since the function looks for a PTA to start the line. The last line, 9-10, did not have a PTB but the end of the list of points automatically ends any unfinished lines. If ***Start*** is left blank but leave the other fields the same, ***Mapping*** will create the lines 1-3-4-5 and 8-10.

The PTA's will not be a part of any line. 7 will also not be a part of any alignments/boundaries since you cannot have a single point alignment/boundary. Leaving ***Start*** and ***End*** blank will create the line sequence 1-3-4-8-10. Leaving ***End*** blank but not ***Start*** will create the line sequence 2-3-4-8-10 since the PTA on point 2 will start it and there is nothing to stop it.

In the first definition, *Example 3*, a special pattern is used in the ***Cont.*** pattern.

A # character specifies that an integer number is expected. This value specifies an ordering of the points that overrides the point number order.

Example: Given the sequence of points and descriptions: 1 = A2, 2=A1, 3=A3, 4=A6, 5 = A4, performing an auto draw with the *Example 3* definition will result in the connection sequence **2,1,3,5,4** (instead of 1,2,3,4,5). Unused sequence values (such as A4 in this case) are ignored by stepping until the next number in sequence is found.

PI Crv is used when automatically generating curves with a known PI and known points on the PC and PT tangent lines. Given these three points, one more parameter is needed to fully specify the curve.

This last parameter must be provided in the PI point's description field immediately following the ***PI Crv*** pattern. The parameter must begin with a single alphabetic character followed by a number. The alphabetic character must be one of the following:

E - External	***L*** - Arc Length
C - Chord Length	***R*** - Radius
D - Degree of Curve (hwy definition)	***T*** - Tangent Length

Example: If the ***PI Crv*** pattern is **%PI**, the description **PIT75.0** specifies a curve with a tangent length of 75.0 feet or meters (depending on what units are being used).

The ***Layer*** column allows a layer other than the default (normally *Traverse Lines*) to be specified. Changing this value is optional.

The ***Style*** column can be used to override the default line style for the layer. Again, this is optional. Pressing this button will display the *Line Style* dialog (see p.). Simply select the picture of the desired line style and press the ***OK*** button to return to the ***Line/Curve*** dialog.

The ***Color*** button allows for the overriding of the default color. The button will display the text *Default* if no color is chosen. Otherwise, the button will be displayed in the selected color.

The ***Anno.*** button is used to select the desired annotation by displayed the *Modify Line Text* dialog (see p.).

An optional ***Comment*** can be entered as a personal reminder of - well, whatever needs to be reminded about. This field affects nothing, but is just a possible convenience.

The ***Add*** button will insert a new row after the current row (which is wherever the cursor currently resides).

The ***Delete*** button will delete the current row. If you delete something by mistake, use the ***Cancel*** button to exit without saving the changes.

Press the ***OK*** button to save the definitions.

Text Functions

Moving & Rotating Text with the Mouse

Any text in COGO, with the exception of curve text can be easily moved and rotated with the mouse.

Moving text:

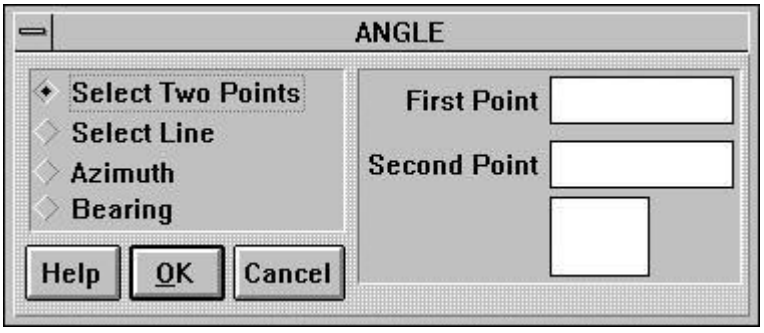
1) Select the text that is to be moved.
2) Depress the left mouse button while the cursor is over the text. **Keep the button depressed and don't move the mouse** for about a half second. The text should be replaced with an outline box. ***It is important that the mouse not move until the outline box appears***.
3) With the left button still depressed, drag the text outline to the desire location.
4) Release the button.

That's all there is to it. Rotation of text is very similar. Rotation of text works in conjunction with the ***Text Rotation*** function if angle snapping is enabled (see p.33) to allow only certain angles of rotation.

Rotating text:

1) Select the text that is to be moved.
2) While holding down the <**Ctrl**> key with one hand, depress the left mouse button with the other hand while the cursor is over the text. **Keep the button depressed and don't move the mouse** for about a half second. The text should be replaced with an outline box. ***It is important that the mouse not move until the outline box appears***.
3) With the left button still depressed, move the cursor to rotate the text outline.
4) Release the button.

Align & *Align Texts*



The text ***Align*** function is accessed through the Shift-right-click popup menu. (see Popup Menus on page 34). ***Align*** allows the surveyor to assign a specific angle to the

selected text. The ***Align Texts*** function in the ***Edit*** menu performs the same function except that it works on ALL selected texts at once.

The dialog that appears is very similar to the *Line Define* dialog, allowing the specification of a text angle by several different methods. See the section on the use of this dialog (p. 32) for more information.

Text on Curve

When you create a curve in cogo, the arc length, delta, and radius are automatically annotated along the curve (as long as the text fits). But what if you have some other text that you want to be drawn following a curve? Or what if you want curved text as part of a component in layout? This is done using the following procedure:

1. Create the text.
2. Create the curve.
3. Select the curve. Make sure that it is the only curve selected.
4. Position the cursor over the text and <shift-right-click> to get the popup menu for texts.
5. Select **Curve** from the popup menu.

   The text will now follow the curve. Specifically, the text will be drawn following the path of a circle using the same center point as the selected curve but with a radius extending out to the text. This radius may therefore be smaller or larger than the radius of the selected curve.

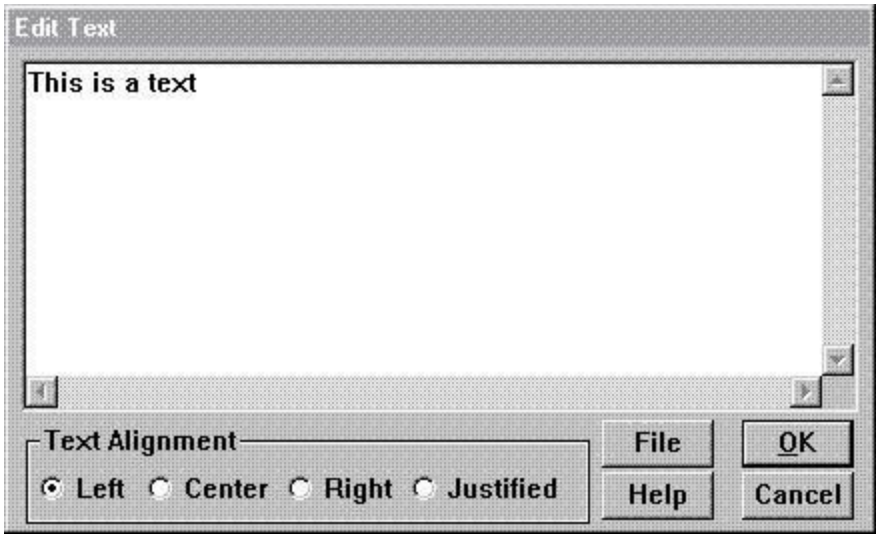
   To remove the curving of the text:

1. Position the cursor over the text and <shift-right-click> to get the popup menu again.
2. Select **Curve** from the popup menu. This will toggle the curving of the text off again.

   In Cogo, PC Survey knows that the curve controls the curving of the text so, as the text and curve are moved, the curving of the text will increase or decrease as the text moves closer or farther from the center of the curve.

   In Layout, unlike Cogo, PC Survey just remembers the distance from the text position to the center of the curve. So, as the text is moved, the curvature of the text will remain the same.

Edit Text



Edit Text will operate on ALL texts in COGO. This includes both attached and automatic texts (such as bearings, distances, and boundary annotations).

To use this function from the menu,

- Select the text you wish to edit and select ***Edit Text*** from the ***Edit*** menu.

  OR

- Use the ***Edit*** function from the object pop-up menu.

- Select ***Left***, ***Center***, or ***Right*** to control the justification of the text.

Notes:

Degree symbols can be entered by holding down the **<*Alt*>** key while typing ***248*** on the keypad and then releasing the **<*Alt*>** key.

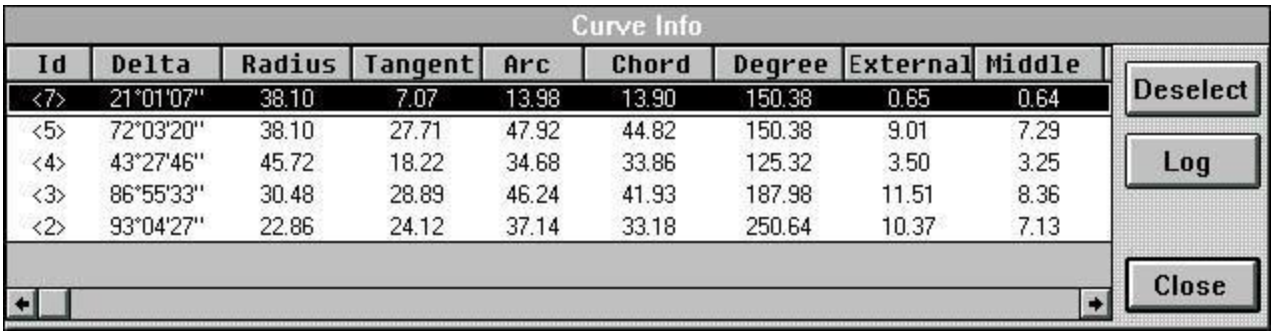
Text can be copied to the Windows clipboard by highlighting the desired text with the mouse and/or keyboard keys followed by holding down the **<*Ctrl*>** key and pressing the **<*Ins*>** key. This is called a *Copy* command.

Once text has been copied to the clipboard, it can be retrieved by placing the cursor in the edit box where the clipboard text is to be inserted, holding down the **<*Shift*>** key and pressing the **<*Ins*>** key. This is called a *Paste* command.

Warning! Changing the value of automatic texts can be dangerous if the numerical values are altered since the drawing could then contain erroneous data.

Curves

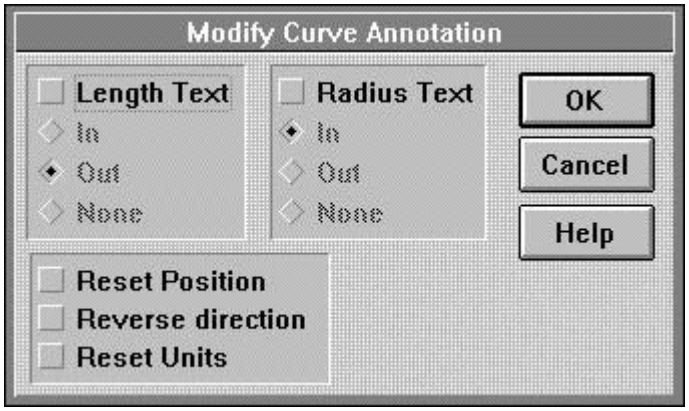
Curve Info



Curve Info in the ***Curves*** menu will display the parameters of all of the selected curves. When you start this function, all of the selected curves will be temporarily un highlighted. If you click on one of the curve lines in the list box, that curve will be highlighted in the data window. When you click on another line, that curve will be highlighted and the previous one will be un highlighted. If you click on the ***Deselect*** button, the currently highlighted curve will be unselected and will be removed from the list. When you are done, click ***OK*** or ***Cancel.***

Curve Annotation

Curve Annotation in the ***Curves*** menu alters the appearance and placement of arc length (***Length***, for short) and degree/radius text (***Radius***, for short). All selected curves are affected.. The direction of the curves can also be reversed from within this dialog.



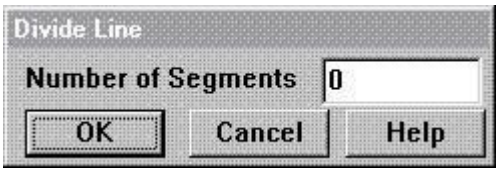
If you have one or more curves selected, you can set all length texts for the curves ***In*** or ***Out***, remove them (***None***), or leave them unchanged. You can also set all degree/radius texts ***In*** or ***Out***, remove them (***None***), or leave them unchanged To change the current text placement, enable the appropriate check box and select one of the three options. Leaving the checkboxes disabled (unchecked) leaves the text unchanged.

In refers to the inside of the curve while ***Out*** refers to the outside of the curve (of course).

Checking ***Reset Units*** has an effect only if the system units have been changed. For instance, if the system units have been changed from US Foot to Metric (see the ***Units*** dialog on p.59), distance text that has already been created will remain in US Foot units.

Divide

Divide will split a selected curve(s) into a specified number of equal length arcs, creating a new point at each junction.



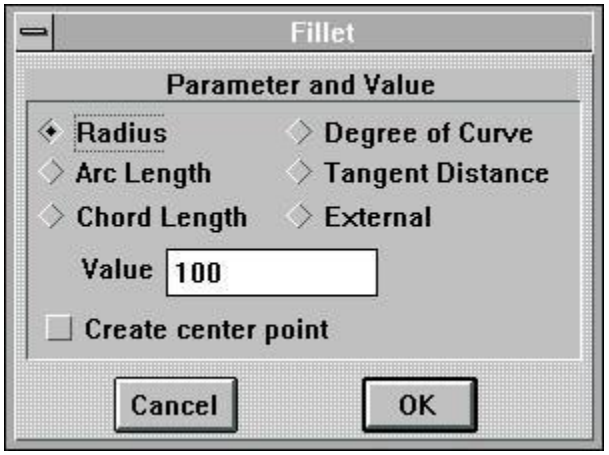
1) Select the curve(s) that you wish to divide.
2) Select ***Divide***. A dialog box similar to the one shown will appear.
3) Enter the ***Number of Segments*** to split the curve into and select ***OK***.

Fillet

This function can be used in one of two ways. One method involves selected a set of lines that have pairs sharing a common endpoint. An example of this would be an alignment consisting of tangents with no transition arcs. In this case, the ***Fillet*** function will generate tangent arcs with the specified parameter between each pair of lines sharing a common endpoint. Endpoints for the arcs will be generated and the tangents will be trimmed to terminate at those endpoints.

A second use is to generate a fillet arc between any pair consisting of two lines and/or curves. This applies to a line and a curve, two lines or two curves. In this case, the program will display all possible fillet arc solutions and allow the user to pick which arc to use. Options are included for trimming/extending objects to the fillet arc.

To use the first method:



1) Select all of the lines to use for generating transition arcs. Remember that arcs will be only be generated where a common endpoint exists between a pair of selected lines.
2) Select the ***Curve*** | ***Fillet*** function. A dialog box similar to the one shown on the right will be displayed.
3) Enter a curve parameter by selecting the desired parameter and entering its value. This parameter can be ***Radius, Arc Length, Chord Length,*** ***Degree of Curve, Tangent Distance,*** or ***External***.
4) Select ***OK*** to complete the function.

Example*:* Suppose the curves are to have a radius of 25 feet (or meters, if the units are metric). Select ***Radius*** and set the ***Value*** to 25. Then click on the ***OK*** button to continue. Each intersection will be replaced by a curve with the specified parameters.

To use the second method:

1) Select two lines, two curves or a line a curve. Check the select status numbers to make sure that a total of two lines/curves are selected.

2) Select ***Curve*** | ***Fillet***. A dialog box similar to the one shown above will appear.

3) Enter the desired values in the dialog according the to instructions in step 3 above and select ***OK***. A set of temporary arcs will appear on the screen, representing the possible solutions along with a dialog similar to the one shown on the right.

4) Left-click near the desired fillet – its color will change, indicating that this is the desired solution.

5) Select ***Trim/Extend Line*** to automatically trim or extend the selected line(s) to meet the fillet arc. Similarly for ***Trim/Extend Arc*** for the selected arc(s).

6) Select ***OK*** to generate the fillet.

General Curve Creation

The following curve functions require different parameters but behave similarly. The normal starting point (PC, point of curvature) defaults to the occupied point. However, this point can be changed once the curve function is invoked. If auto-boundary creation is on, changing the PC to a point different than the occupied point will start a new boundary that begins at the PC.

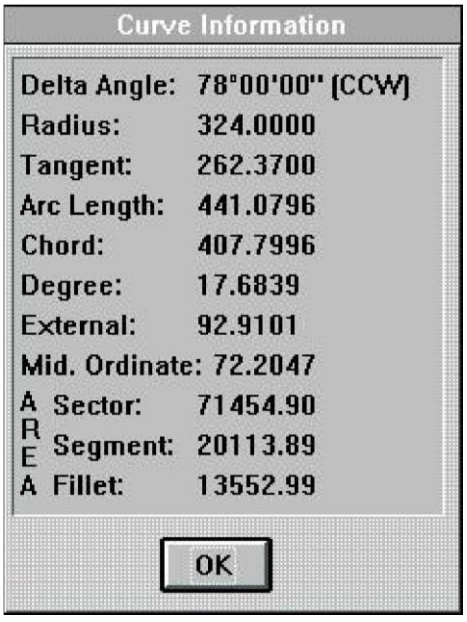
For those functions that require a forward tangent, the starting information defaults to the reverse of the backsight and is the angle of the line tangent to the curve at the starting point, pointing in the direction that the curve will traverse.

After entering the requested parameters, click ***OK*** to continue or ***Cancel*** to quit.

If a curve can be created, selecting ***Info*** will display the curve in magenta in the data window and a *Curve Information* dialog box will show the parameters of the curve. You can therefore check to see what the curve will look like before actually creating it.

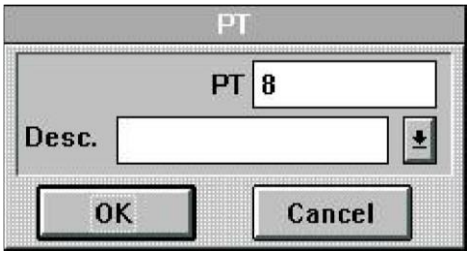
Both the curve center point and PI can be optionally created in those curve functions that don't use an existing center/PI point. In those cases where center/PI point creation is optional, enable the corresponding checkbox(s) to create the point(s). The point number and description can then be modified by selecting the ***Center Pt*** or ***PI*** buttons.

To modify the description or point number for the ***PT*** in those functions that create a PT point, the procedure is the same - select the ***PT*** button, fill in the ***Desc.*** box and modify the point number (top edit box) if desired.



Info Dialog Box

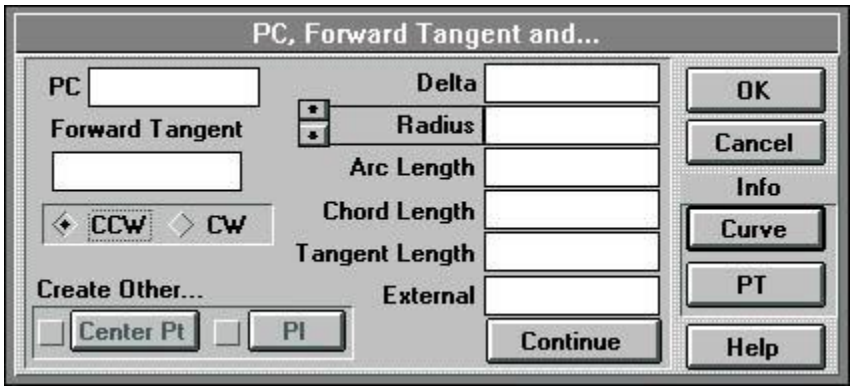
If a curve can be created, it will be displayed in the data window and a dialog box will show the parameters of the curve. If a data point can be created, you can enter any notes for the point to be created in the ***Desc.*** box. To quit without creating the new arc or point, select ***Cancel***. otherwise select ***OK***. Selecting ***Continue*** will create a new arc and point and then continue around the circle in the same direction for the same distance.



Example of curve point number and description modification dialog

Creating Curves from a PC, Forward Tangent and Two Parameters

The ***PC, Forward Tangent and ...*** function is used for creating a curve that has a known ***PC*** and a known direction for the tangent at the ***PC*** (the ***Forward Tangent***). Any combination of two of the remaining curve parameters (***Delta, Radius/Degree, Arc Length, Chord Length, Tangent Length,*** and ***External***) and specifying whether the curve turns counter-clockwise (***CCW***) or clockwise (***CW***) completely defines the curve.



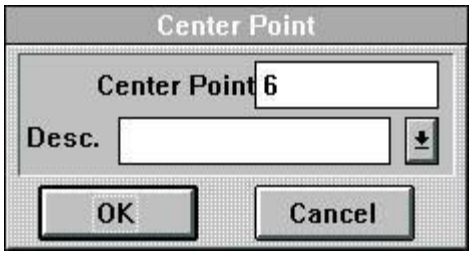
To use this function, supply the following data:

1) ***PC*** - defaults to the current occupied point. A different point number can be selected from the screen or typed in, if desired.
2) ***Forward Tangent*** - the angle of the tangent to the ***PC***. Can be entered as an *angle formula* (see p.30).
3) ***CCW*** or ***CW*** - should the curve turn counter-clockwise(***CCW***) or clockwise (***CW***)?
4) ***Delta, Radius/Degree(HWY)/Degree(RR), Arc Length, Chord Length, Tangent Length, External*** - TWO and ONLY two of these entries must have valid values before generating the curve. This is similar in operation to the ***Curve Solver*** function (see p.153).
5) ***Create Other...*** - if the surveyor wants to create a ***Center P***oin***t*** or ***PI*** point when creating the curve, enable the corresponding checkboxes to the left of the ***Center Pt*** and/or ***PI*** buttons.

6) ***Center Pt, PI, PT*** - pressing these buttons will display a dialog that allows the user to edit the point number and description. The point number will have a valid default value.

7) ***Curve***- after the data has been entered, the ***Curve*** button can be selected to display information about the curve and display what the curve will look like before actually creating the curve.

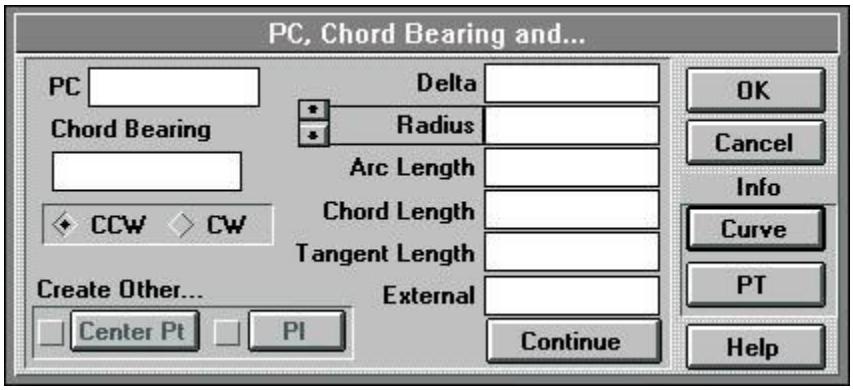
8) Select ***OK*** to create the curve, ***Cancel*** to abort the function.



Example of the Number & Description Dialog

Creating Curves from a PC, Chord Bearing and... Curve Parameter

The ***PC, Chord Bearing and ...*** function is used for creating a curve that has a known ***PC, Chord Bearing*** and some curve parameter (***Delta, Radius/Degree, Arc Length, Chord Length, Tangent Length,*** or ***External***). This information, together with specifying whether the curve turns counter-clockwise (***CCW***) or clockwise (***CW***), completely defines the curve.



To use this function, supply the following data:

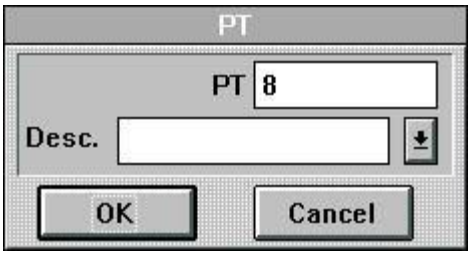
1) ***PC*** - defaults to the current occupied point. A different point number can be selected from the screen or typed in, if desired.

2) ***Chord Bearing*** - the angle of chord. It can be entered as an *angle formula* (see p.30).

3) ***CCW*** or ***CW*** - should the curve turn counter-clockwise(***CCW***) or clockwise (***CW***)?

4) ***Delta, Radius/Degree(HWY)/Degree(RR), Arc Length, Chord Length, Tangent Length, External*** - ONE and ONLY one of these entries must have valid values before generating the curve. This is similar in operation to the ***Curve Solver*** function (see p.153) except that this dialog uses a single entry instead of two..

5) ***Create Other...*** - if the surveyor wants to create a ***Center P***oin***t*** or ***PI*** point when creating the curve, enable the corresponding checkboxes to the left of the ***Center Pt*** and/or ***PI*** buttons.



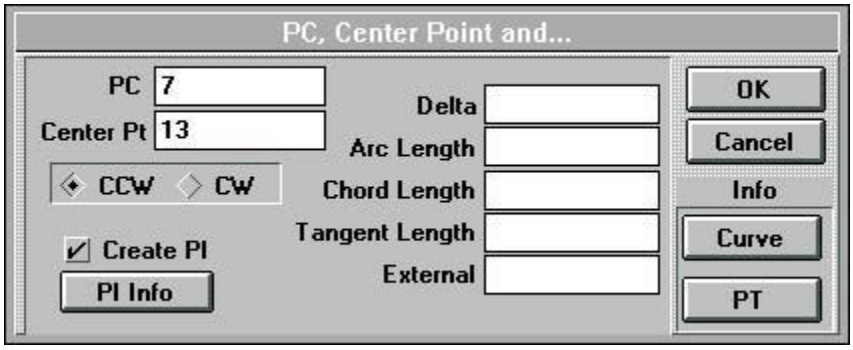
6) ***Center Pt, PI, PT*** - pressing these buttons will display a dialog that allows the user to edit the point number and description. The point number will have a valid default value.

7) ***Curve***- after the data has been entered, the ***Curve*** button can be selected to display information about the curve and display what the curve will look like before actually creating the curve.

8) Select ***OK*** to create the curve, ***Cancel*** to abort the function.

Creating Curves from a PC, Center Point and...Curve Parameter

The ***PC, Center Point and Curve Parameter*** function is used for creating a curve that has a known ***PC, Center Pt*** and some curve parameter (***Delta, Arc Length, Chord Length, Tangent Length,*** or ***External***). This information, together with specifying whether the curve turns counter-clockwise (***CCW***) or clockwise (***CW***), completely defines the curve.



To use this function, supply the following data:

1) ***PC*** - defaults to the current occupied point. A different point number can be selected from the screen or typed in, if desired.

2) ***Center Pt*** - point number of the center point of the curve.

3) ***CCW*** or ***CW*** - should the curve turn counter-clockwise(***CCW***) or clockwise (***CW***)?

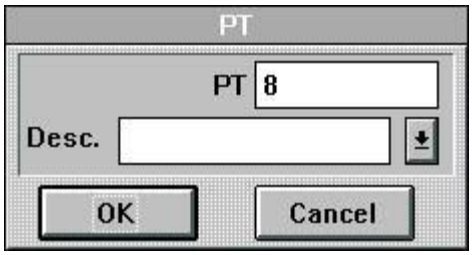
4) ***Delta, Arc Length, Chord Length, Tangent Length, External*** - ONE and ONLY one of these entries must have valid values before generating the curve. This is similar in operation to the ***Curve Solver*** function (see p.153) except that this dialog uses a single entry instead of two.

5) ***Create PI...*** - if the surveyor wants to create a ***PI*** point when creating the curve, enable the this checkbox.

6) ***PI, PT*** - pressing these buttons will display a dialog that allows the user to edit the point number and description. The point number will have a valid default value.

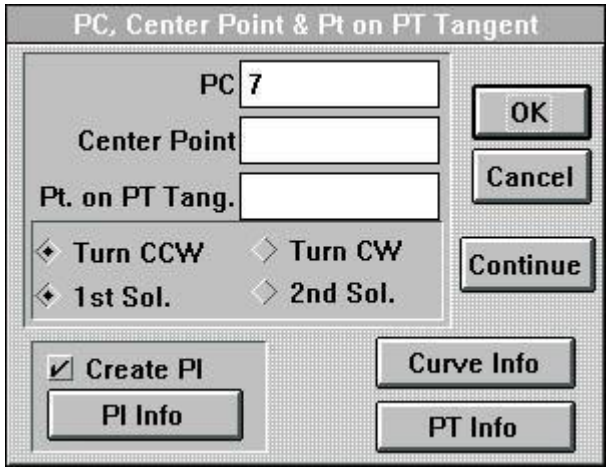
7) ***Curve***- after the data has been entered, the ***Curve*** button can be selected to display information about the curve and display what the curve will look like before actually creating the curve.

8) Select ***OK*** to create the curve, ***Cancel*** to abort the function.



PT Tangent

The ***PC, Center Point and PT Tangent*** function is used for creating a curve that has a known ***PC, Center Point*** and a known point on the PT tangent.. This kind of curve problem generally has two solutions. Specifying whether the curve turns counter-clockwise (***CCW***) or clockwise (***CW***) and picking the desired solution completely defines the curve.



To use this function, supply the following data:

1) ***PC*** - defaults to the current occupied point. A different point number can be selected from the screen or typed in, if desired.

2) ***Center Pt*** - point number of the center point of the curve.

3) ***Pt. on PT Tangent*** - the point number of a point that lies on a line passing through the PT.

4) ***Turn CCW*** or ***Turn CW*** - should the curve turn counter-clockwise(***CCW***) or clockwise (***CW***)?

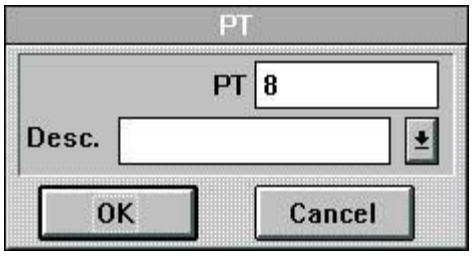
5) ***1st Sol.*** or ***2nd Sol.*** - after choosing either of these, select ***Curve Info*** to display the curve to see if this is the solution that is desired.

6) ***Create PI...*** - if the surveyor wants to create a ***PI*** point when creating the curve, enable the this checkbox.

7) ***PI Info, PT Info*** - pressing these buttons will display a dialog that allows the user to edit the point number and description. The point number will have a valid default value.

8) ***Curve Info***- after the data has been entered, the ***Curve Info*** button can be selected to display information about the curve and display what the curve will look like before actually creating the curve.

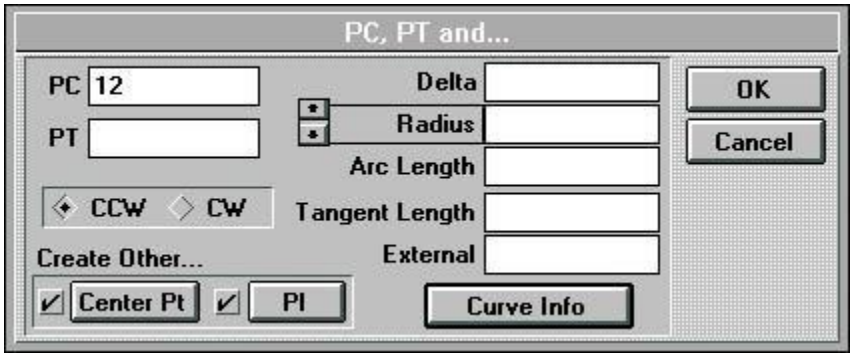
9) Select ***OK*** to create the curve, ***Cancel*** to abort the function.



Creating Curves from a PC, PT and ...

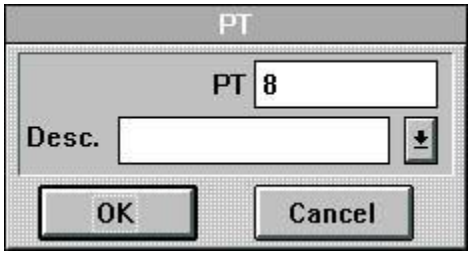
Curve Parameter

The ***PC, PT and Curve Parameter*** function is used for creating a curve that has a known ***PC, PT*** and one of the primary curve parameters (***Delta, Radius/Degree, Arc Length, Tangent Length, External***). This information, together with specifying whether the curve turns counter-clockwise (***CCW***) or clockwise (***CW***), completely defines the curve.



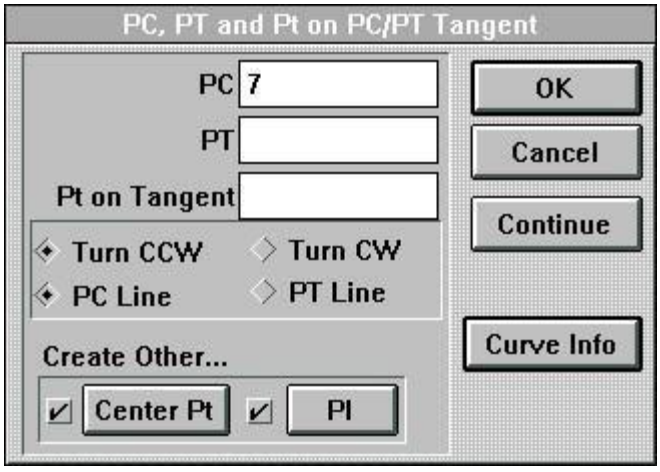
To use this function, supply the following data:

1) ***PC*** - defaults to the current occupied point. A different point number can be selected from the screen or typed in, if desired.
2) ***PT*** - point number of the PT of the curve.
3) ***Delta, Radius/Degree, Arc Length, Tangent Length, External*** - ONE and ONLY one of these entries must have valid values before generating the curve. This is similar in operation to the ***Curve Solver*** function (see p.153) except that this dialog uses a single entry instead of two.
4) ***CCW*** or ***CW*** - should the curve turn counter-clockwise(***CCW***) or clockwise (***CW***)?
5) ***Create Other....*** - if the surveyor wants to create a ***PI*** or ***Center*** point when creating the curve, enable the checkbox to the left of the ***PI*** button or the ***Center Pt*** button.
6) ***Center Pt, PI***- pressing these buttons will display a dialog that allows the user to edit the point number and description. The point number will have a valid default value.



7) ***Curve Info***- after the data has been entered, the ***Curve Info*** button can be selected to display information about the curve and display what the curve will look like before actually creating the curve.
8) Select ***OK*** to create the curve, ***Cancel*** to abort the function.

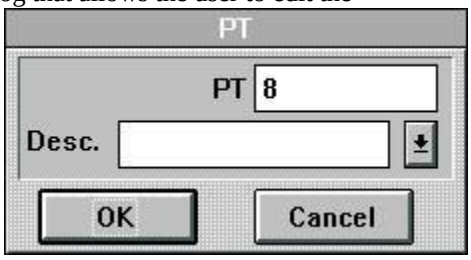
Point on PC or PT tangent line



The ***PC, PT and Point on PC/PT Tangent*** function is used for creating a curve that has a known ***PC, PT*** and a point on the either the PC or PT Tangent line. This information, together with specifying whether the curve turns counter-clockwise (***CCW***) or clockwise (***CW***), completely defines the curve.

To use this function, supply the following data:

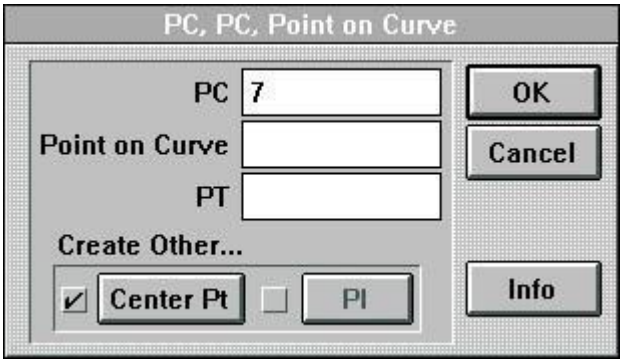
1) ***PC*** - defaults to the current occupied point. A different point number can be selected from the screen or typed in, if desired.
2) ***PT*** - point number of the PT of the curve.
3) ***Pt on Tangent*** - point number of a point on the specified tangent line.
4) ***CCW*** or ***CW*** - should the curve turn counter-clockwise(***CCW***) or clockwise (***CW***)?
5) ***PC Line*** or ***PT Line*** - Selecting ***PC Line*** means that the ***Pt on Tangent*** is a point on the tangent line to the ***PC***. Selecting ***PT Line*** means that the ***Pt on Tangent*** is a point on the tangent line to the ***PT***.
6) ***Create Other....*** - if the surveyor wants to create a ***PI*** or ***Center*** point when creating the curve, enable the checkbox to the left of the ***PI*** button or the ***Center Pt*** button.
7) ***Center Pt, PI***- pressing these buttons will display a dialog that allows the user to edit the point number and description. The point number will have a valid default value.



8) ***Curve Info***- after the data has been entered, the ***Curve Info*** button can be selected to display information about the curve and display what the curve will look like before actually creating the curve.
9) Select ***OK*** to create the curve, ***Cancel*** to abort the function.

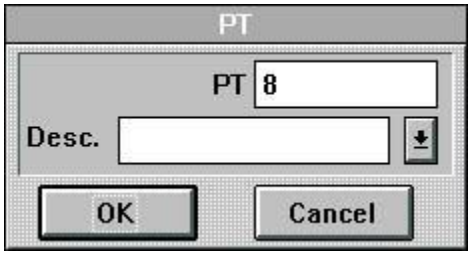
PT and POC (PT and Point on Curve)

The ***PC, PT and Point on Curve*** function is used for creating a curve that has a known ***PC, PT*** and some other point that lies on the curve. This information completely defines the curve.



To use this function, supply the following data:

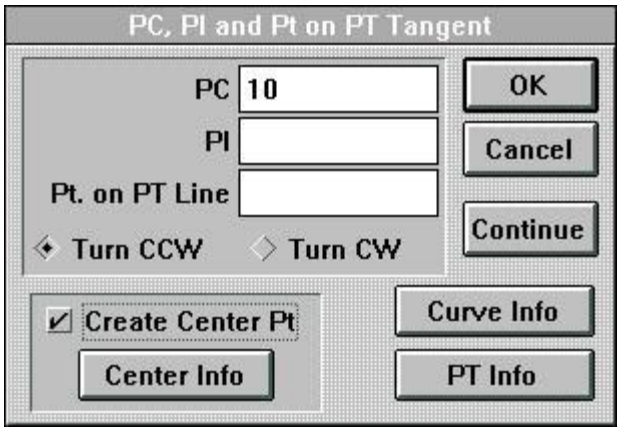
1) ***PC*** - defaults to the current occupied point. A different point number can be selected from the screen or typed in, if desired.
2) ***Point on Curve*** - the point number of any point that lies on the curve.
3) ***PT*** - point number of the PT of the curve.
4) ***Create Other....*** - if the surveyor wants to create a ***PI*** or ***Center*** point when creating the curve, enable the checkbox to the left of the ***PI*** button or the ***Center Pt*** button.
5) ***Center Pt, PI***- pressing these buttons will display a dialog that allows the user to edit the point number and description. The point number will have a valid default value. ***Info***- after the data has been entered, the ***Info*** button can be selected to display information about the curve and display what the curve will look like before actually creating the curve.
6) Select ***OK*** to create the curve, ***Cancel*** to abort the function.



Example of the Number & Description Dialog

Creating Curves from a PC, PI and ...

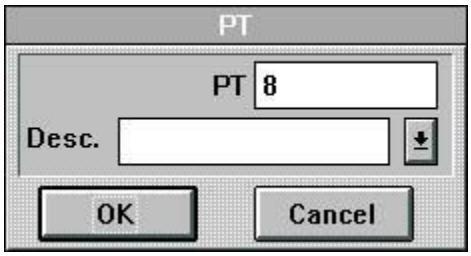
PC, PI and Point on PT Tangent



The ***PC, PI and Point on PT Tangent*** function is used for creating a curve that has a known ***PC, PI*** and a point on the line tangent to the PT. This information, together with specifying whether the curve turns counter-clockwise (***CCW***) or clockwise (***CW***), completely defines the curve.

To use this function, supply the following data:

1) ***PC*** - defaults to the current occupied point. A different point number can be selected from the screen or typed in, if desired.
2) ***PI*** - point number of the PT of the curve.
3) ***CCW*** or ***CW*** - should the curve turn counter- clockwise(***CCW***) or clockwise (***CW***)?
4) ***Create Center Pt....*** - if the surveyor wants to create a ***Center*** point when creating the curve, enable this checkbox
5) ***Center Pt, PT Info***- pressing these buttons will display a dialog that allows the user to edit the point number and description. The point number will have a valid default value.



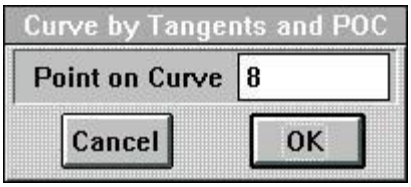
6) ***Curve Info***- after the data has been entered, the ***Curve Info*** button can be selected to display information about the curve and display what the curve will look like before actually creating the curve.
7) Select ***OK*** to create the curve, ***Cancel*** to abort the function.

Curve by Point on Curve and Tangent Lines

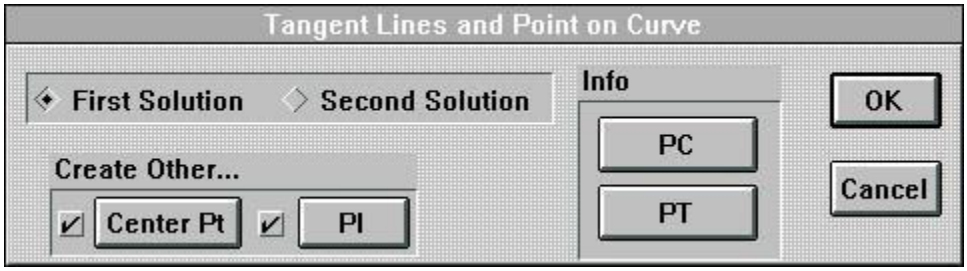
The ***POC and Tangent Lines*** command in the ***Curve*** menu allows for the creation of a curve that passes through some specified point (the POC or ***Point on Curve***) and is tangent at the PC and PT (points yet to be created) to two specified tangent lines. To use this function:

1) Select the ***POC and Tangent Lines*** command from the ***Curves*** menu.
2) The *Line Define* dialog will appear (see p.32). Define the first tangent line and select ***OK***. A magenta line will appear on the screen to represent the first line that was defined.
3) The second *Line Define* dialog will appear. Define the second tangent line with this dialog and select ***OK***. A second magenta line will appear on the screen to represent the second tangent line. The PI of the curve lies at the intersection of the two lines.

4) Next, a dialog for defining the ***Point on Curve*** will appear as shown on the right. Select the ***Point on Curve*** from the screen or type in its point number and select ***OK***.



5) After the two lines and the POC are defined the ***POC and Tangent Lines*** dialog will appear. The two magenta lines will be replaced by a magenta curve representing the ***First Solution*** to the problem.



Dialog for defining the POC

The data in this dialog is as follows:

6) ***First Solution*** and ***Second Solution*** - There are two solutions to this problem. The solution corresponding to which of these two options is selected will be displayed on the screen in magenta. The ***First Solution*** is initially displayed. To see the second solution, select the ***Second Solution*** radio button. The ***First Solution***'s curve will be removed and the ***Second Solution***'s curve will be drawn in its place.

7) ***Create Other....*** - if the surveyor wants to create a ***PI*** or ***Center*** point when creating the curve, enable the checkbox to the left of the ***PI*** button or the ***Center Pt*** button.

8) ***Center Pt, PI, PC, PT***- pressing these buttons will display a dialog that allows the user to edit the point number and description of the corresponding point. The point number will have a valid default value.

9) Select ***OK*** to create the curve or ***Cancel*** to abort the function.

Best Fit Curve

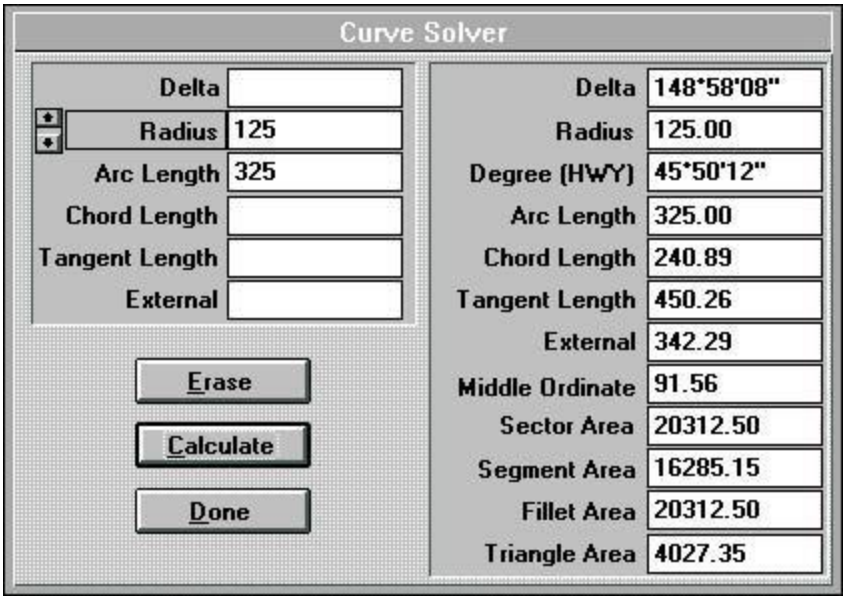
Best Fit Curve in the ***Curve*** menu is useful for fitting a curve to a set of points that have been obtained along some curve in the field. This function will create a curve along with its PC, PT and center point that is the "best fit" to the points that are specified. To use this function:

1) Select the points that are to be used for calculating the curve.

2) Select ***Best Fit Curve*** from the ***Curve*** menu.

The PC and PT are both place along a line connecting the center point and a selected point that lies at either end of the curve.

The Curve Solver



The ***Curve Solver*** is useful for finding any curve parameter when given any two of the following parameters - ***Delta, Radius or Degree*** of curve***, Arc Length, Chord Length, Tangent Length, and External***. To use this function,

1) Enter the two known parameters in the corresponding edit boxes on the left side. The second entry
(shown as ***Radius***) can be toggled by using the spin buttons (the up and down arrows to the left) to either ***Radius, Degree(HWY)*** (highway definition) or ***Degree(RR)*** (railroad definition)

2) Select ***Calculate*** to generate the results which will be displayed in the columns on the right.

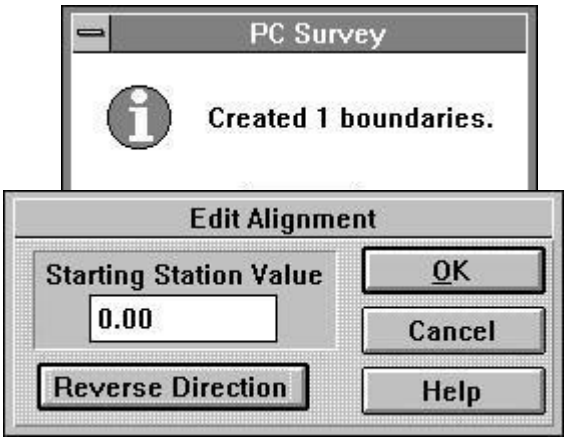
- Select ***Erase*** to clear the edit boxes.
- Select ***Done*** to exit the function.

The value displayed can be copied into the clipboard and inserted into another edit box in a different function, if desired.

Alignments

Create

Create Alignment in the ***Aln/Bnd*** menu will see if there is any way to take all of the currently selected lines and curves and form a single continuous sequence. If it can, it will create the alignment.



Edit

Edit Alignment is used to alter the beginning station value and/or the direction of all selected alignments. To use this function,

1) Select the alignment(s) that you wish to modify.
2) Select ***Edit Alignment*** from the ***Aln/Bnd*** menu. The dialog shown to the right will appear.
3) Enter the desired ***Starting Station Value***, if any. This value is used when creating station lines (described later in this section) and profiles.
4) Press ***Reverse Direction*** (if desired) to change the start point from one of the alignment to the other end. The beginning segment of an alignment will be highlighted as half-white and half-yellow.
5) Select ***OK*** to exit the function or ***Cancel*** to abort.

Offset

Optionally, ***Offset*** creates an offset line, curve, alignment or boundary (depending on the object selected). Multiple offset distances can be entered (as shown by the example to the right).

To generate an offset(s):

Example of Offset dialog

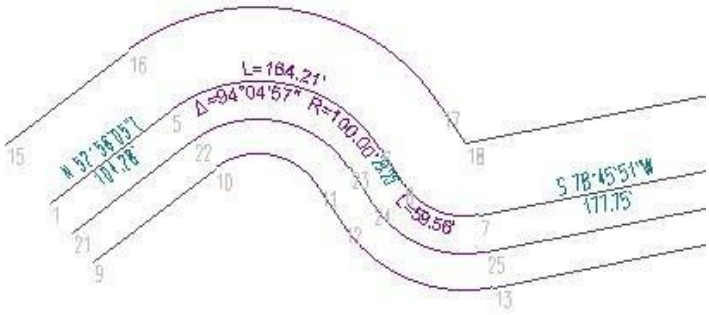
1) Select all objects that offsets are to be created for. **If one or more alignments/boundaries are selected, the *Offset* function will ignore selected lines and curves.** This is to prevent accidental offset creation from selected lines or curves that are also in a selected alignment/boundary.
2) Enter the desired offset values in the ***Offset distances*** text box as positive or negative numbers separated by either commas or spaces.
3) If only offset point generation is desired (no lines or curves), disable ***Auto Linedraw.***

4) If using ***Auto Linedraw*** and annotation is desired on the lines/curves that will be created, disable ***No Annotation***.

   The following occurs for the indicated type of selected object.

- **Alignment/Boundary** - Alignments and boundaries consist of lines and curves, so an offset to an alignment or boundary will also consist of lines and curves. Curves will offset according to the curve rule given above. Lines will also offset according the line rule above **except** in the case of adjacent lines (line that have a common endpoint). In this case, offset points are created along a perpendicular bisector of the angle between the two lines. Positive/negative offset distance values will offset to the right/left of the alignment/boundary. When selected, the first half of the first segment of an alignment/boundary is drawn in white to indicate its direction.

Example: In the ***Offset*** dialog shown, three offsets are specified at offset distances of ***50***, ***-50***, and ***25.5***. Three offsets will therefore be generated (if possible) for every selected object. Two offsets will be to the right at 25.5 and 50.0, and one offset will be generated to the left at 50.0. These values were applied to an alignment with two curves of radii 100 and 25 in the example shown. Notice the "clipping" that occurs on the top offset (the -50 value) due to offsetting a curve with a radius smaller than the offset distance.



Offset example

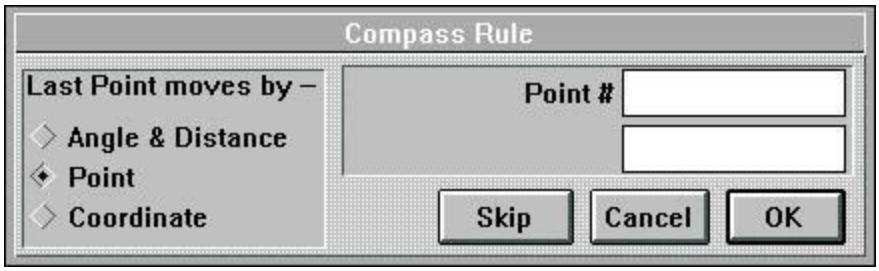
Angle Adjust

Angle Adjust in the ***COGO*** menu ensures that the final segment of a alignment is heading at a specific angle. This angle can be set using either ***Final Angle*** or ***Angle of Error***. ***Final Angle*** specifies the desired angle of the last segment of the alignment and defaults to the current angle of the last segment. ***Angle of Error*** specifies the angle to rotate the last segment by and defaults to the difference between the angles of the first and last segments of the alignment. ***Angle Adjust*** calculates the amount to rotate the last segment by and distributes the change between all of the angles of the alignment.

If more than one alignment is selected, the function will adjust one alignment at a time, prompting for the adjustment values between each alignment.

Compass Rule

Compass Rule in the ***COGO*** menu provides a means of closing an alignment. Select the alignment before calling the function. There are three ways to specify the means of closing the alignment.



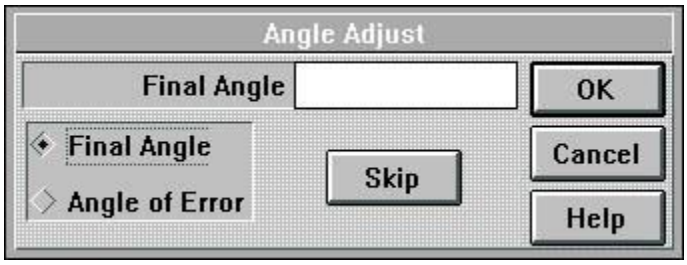
Compass Rule Dialog

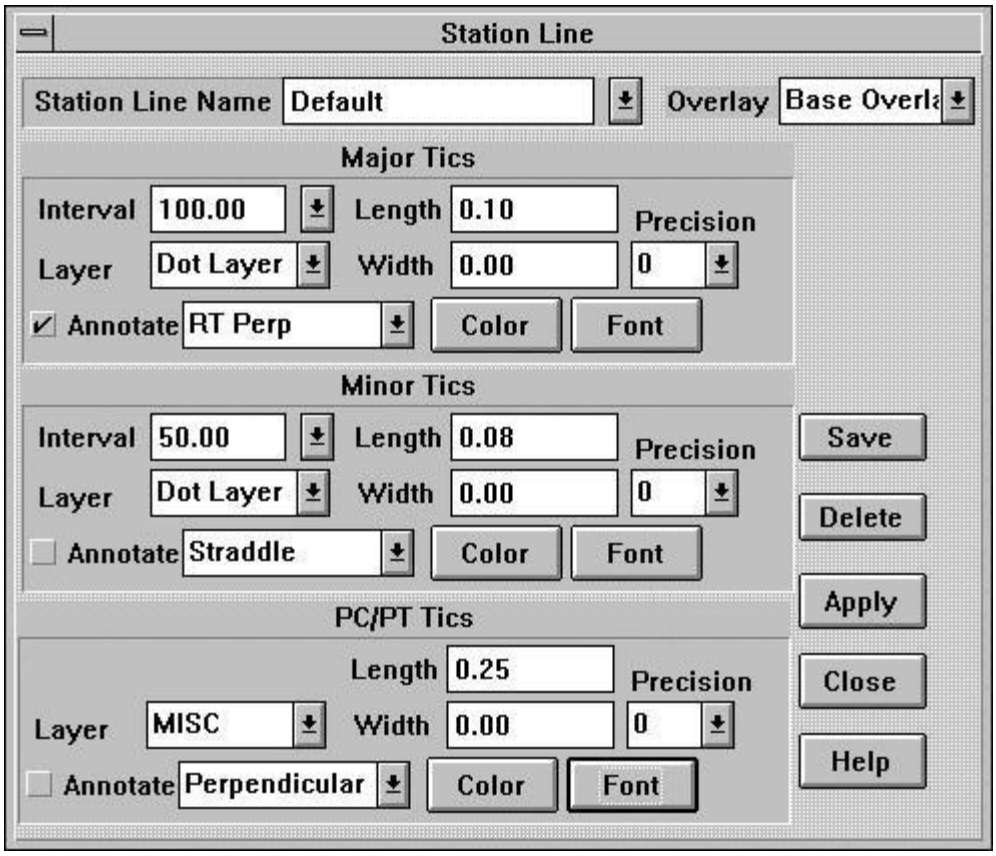
By Angle & Distance will move the last point on the alignment by the ***Angle*** and ***Distance*** specified to reach the new position. ***To Point*** will move the last point of the alignment to the position of the given point. ***To Coordinate*** will move the last point to the specified north and east values. In all cases, the default values will move the last point of the alignment to the first point. The distance error and angle error will be distributed among all of the points of the alignment.

If more than one alignment is selected, the function will adjust one alignment at a time, prompting for the adjustment values between each alignment. ***Skip*** will not make any adjustments to the current alignment, causing the function to examine the next alignment, if any.

Station Lines

Station Lines in the ***Aln/Bnd*** menu is used to define and generate station lines. Station lines are a series of tic marks and, optionally, station texts that are applied to an *alignment* to show the station values at various points along the alignment with respect to some user-specified starting station value at the beginning of the alignment.





The surveyor has control over both major and minor tic specifications (short lines that cross and are perpendicular to the alignment), as well as tic length, width, color, overlay and layer. Tics can be optionally annotated with the station value at the tic with control over the position and number of decimal places in the station value.

This dialog can be used to both create new station line definitions and to apply a definition to a selected
alignment(s). The term “definition” refers to the set of parameters and their values as shown in the dialog above.

- To create a new station line definition:

1) Enter the ***Station Line Name*** - this name should be unique (not used by any existing station line definitions).
2) For the ***Major Tics***,
3) Enter the ***Interval***. This is the separation distance, in the system units, between successive tics.
4) Enter the ***Length***. This is the drawn length of the tic mark. The tic mark will be a line perpendicular to, and bisected by, the alignment.
5) Enter the ***Width***. This is the drawn line width of the tic mark.
6) Select the ***Overlay*** if something other than the default, the *Base Overlay*, is desired.
7) Select the ***Layer*** if something other than the default, the *Traverse Line* layer, is desired.
8) Select the ***Color*** if something other than the selected layer’s color is desired.
9) Select the ***Font*** if something other than the selected layer’s font is desired.
10) Check the ***Annotation*** checkbox if station values are to be printed at the tics.

11) If ***Annotation*** is enabled, select the annotation position from the list box below the checkbox. The options here are

Straddle - station values will split across the alignment.

Rt. Perp. - station text will be printed on the right side, and parallel with, the tic marks.

Lt Perp - station text will be printed on the left side, and parallel with, the tics marks.

Rt Parallel - station text will be printed parallel to the alignment on the right side.

Lt Parallel - station text will be printed parallel to, and on the left side of, the alignment.

12) Select the ***Precision*** (the number of digits to the right of the decimal point) from the list box if a value other than the default of ***0*** is desired.
13) Do the same for the ***Minor Tics***. The ***Major Tics Interval*** should be an integer multiple of the ***Minor Tics Interval***.
14) Select ***Save*** to save the definition.

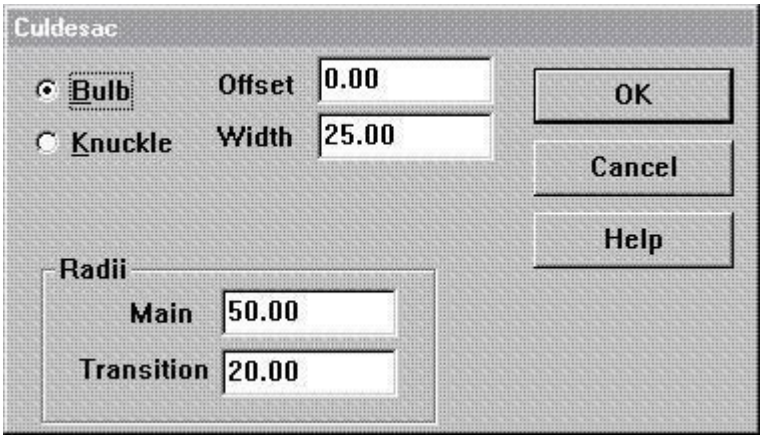
- To create a station line:

1) Select the alignment(s) that is to be stationed.
2) Select ***Station Line*** from the ***Aln/Bnd*** menu.
3) Select the station line definition from the ***Station Line Name*** list OR enter the desired values into the dialog as explained above.
4) Select ***Apply***.

- To delete an existing station line definition:

1) Select ***Station Line*** from the ***Aln/Bnd*** menu.
2) Select the name of the station line definition that is to be deleted from the ***Station Line Name*** list. 3) Select ***Delete.***

Culdesac



Given an alignment, the ***Culdesac*** function can generate either a bulb or knuckle culdesac with user-specified main radius, transition radii and entry width. This function is also used to modify an existing culdesac. Generated culdesacs will consist of three arcs.

The parameters of a culdesac consist of the following:

Bulb - a round culdesac at the end of a street.

Knuckle - a culdesac at the bend of a road.

Offset - the perpendicular distance from the centerline to the radius point of the main culdesac arc. As with other offsets, a positive offset is to the right and a negative offset is to the left.

Width - the entrance width to the culdesac.

Radii - Main - the main arc's radius.

Radii - Transition - the radii of the transition arcs from the road to the main culdesac arc.

To create a new culdesac:

1) Select an alignment that represents the road centerline for the culdesac.
2) Select ***Aln*** : ***Culdesac***. A dialog similar to the one shown will appear.
3) Fill in the desired values.
4) Left-click near the end of the alignment where you wish to place the culdesac.
5) Select ***OK*** to close the function **To modify an existing culdesac:**

1) Select ***Aln*** : ***Culdesac***. A dialog similar to the one shown will appear.
2) Left-click near the culdesac that is to be modified. An ***Apply*** button will appear in the lower right corner of the dialog and the dialog parameters will change to the selected culdesacs parameters.
3) Fill in the desired values and select ***Apply***.

Profiles and Vertical Controls

Creating Profiles and Vertical Controls

1) Select an alignment from the drawing. If you are creating a vertical control, make sure that all points on the alignment have elevations.
2) Select ***Profile/Vert Control*** from the ***Aln*** menu. The *Vertical Profiles* dialog will appear.
3) If desired, enter a ***Name*** for the profile/vertical control. The ***Name*** is an optional field since the profile or vertical control will automatically carry, as a primary name, the name of the selected alignment.
4) Click on the ***Create*** button.
5) Define the characteristics following the steps in the following *Modify Profile Parameters* section. Selecting "Cogo Points Surface" will create a vertical control. Selecting one or more tins will create profiles.
6) Click on the ***OK*** button. A window will be displayed showing the profile/vertical control. This window is similar to other windows in this program and, for example, allows zooming and selecting just like all of the other windows.

Editing Profiles and Vertical Controls

1) Select ***Profile/Vert Control*** from the ***Aln*** menu.
2) Click on the down arrow to the right of the *Name* edit box. A list of all profiles will be displayed.
3) Click on the profile/vertical control that you want to edit.

4) Click on the ***Edit*** button.
5) Define the characteristics of the profile following the steps in the following *Modify Profile Parameters* section.
6) Click on the ***OK*** button. The Profile Window will be displayed.

Displaying Profiles and Vertical Controls

1) Select ***Profile/Vert Control*** from the ***Aln*** menu.
2) Click on the down arrow to the right of the *Name* edit box. A list of all profiles will be displayed.
3) Click on the profile that you want to show. 4) Click on the ***Show*** button.

- Existing profiles will also be added to the view menu so a faster way to display an existing profile is to simply select it by name from the bottom of the ***View*** menu.

Deleting Profiles and Vertical Controls

1) Select ***Profile/Vert Control*** from the ***Aln*** menu.
2) Click on the down arrow to the right of the *Name* edit box. A list of all profiles will be displayed.
3) Click on the profile that you want to delete.
4) Click on the ***Delete*** button.
5) A dialog will be displayed asking *Are you sure you want to delete this profile?* to make sure that you will not delete it accidentally. Click on the ***OK*** button (or ***Cancel*** if you don't want to delete it). 6) Click on the ***OK*** button.

Profiles/Vertical Control selection

If this is a new profile/vert. Control and there are no other profiles defined for this alignment, 1)

Define the name if you want to or leave it blank.

2) Click Create.

If you are creating a profile and another profile already exists for this alignment, 1)

You must type something in the name field to distinguish this profile from the other one.

2) Click Create.

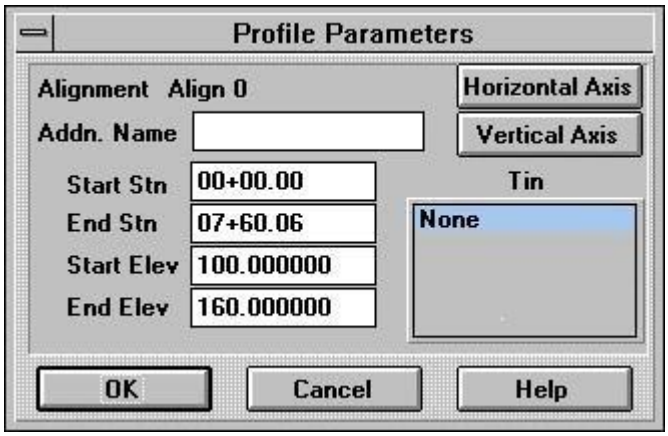
If you want to edit a profile/vert control that already exists, you don't have to first select the alignment.

1) Click on the down button in the name list
2) Select the profile that you want to edit 3) Click Edit.

For another way to edit a profile/vert control that already exists:

1) Go to the view menu in the Cogo window. At the bottom of the menu will be a list of all profiles/vert controls that have been created. Select the vertical control from this menu.

Modify Profile Parameters



Setting up profile/vert control information:

- **Addn. Name**

  This is the name, if any, that was entered in the preceding dialog which can be used to distinguish two different profile definitions for the same alignment. This can be changed here.

- **Start Stn and End Stn**

  Initially set to the starting and ending station values for the alignment. These can be edited if you just want to profile part of the alignment.

- **Start Elev and End Elev**

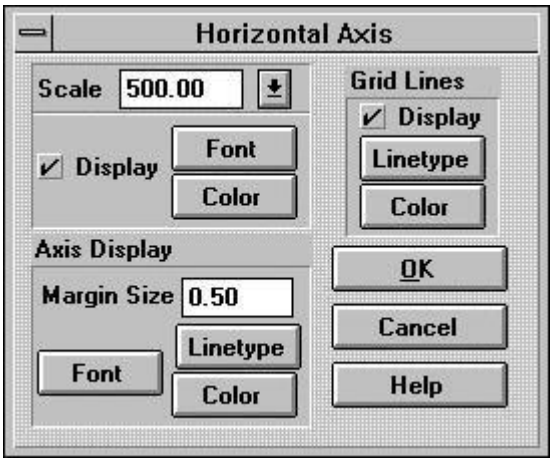
  Initially set to lowest and highest elevations of the points along the alignment. Change these values if you want to change the range of elevations displayed along the vertical axes of the cross sections.

- **Existing, Proposed,** and **Other Surfaces**

  If you want to display elevation values for one or two surfaces at each grid line, you can select the surface for the existing or proposed surface. The elevation of the alignment on the surface selected for Existing will be displayed (by default) to the left of the grid line and the elevation on the surface selected for Proposed will be displayed to the right of the grid line. Both of these surfaces will have their profile shown. If you want to show the profile of any other surfaces, select them in the Other Surfaces dialog box.

  Set the axis information by selecting the Horizontal axis button and/or Vertical axis button. (When finished, select OK to return to the profile/vert control information dialog box.)

Modify Profile Axis Parameters



The ***Horizontal Axis*** and ***Vertical Axis*** buttons are used to define the display characteristics of the axes. They both use the same dialog.

- ***Scale***

  The scale used for each axis can be separately controlled.

- ***Display***

  The Display checkbox is used to turn on and off the display of the scale (1"=500') information. To change the font or text size, click on the ***Font*** button next to the ***Display*** checkbox. To change to color, click on the ***Color*** button next to the ***Display*** checkbox.

- ***Axis Display*** controls the display parameters for the tick marks and tick labels. The ***Margin Size*** is the amount of space to

  reserve in inches between the axis line and the edge of the window to display the ticks and tick labels. The major ticks will be half of this size. The ***Font*** button controls the font used for the tick labels, ***Linetype*** controls the linetype used for the axis and the ticks and color is used for the axis, ticks and tick labels.

- ***Major and Minor Grid***

  control whether or not to display the corresponding grid lines. Click on the Info button to control the interval
  or spacing between the grid lines as well as the linetype and color to use for the grid lines.

- ***Major and Minor Tics***

  control whether or not to display the corresponding tic marks. Click on the Info button to control the interval
  or spacing between the tic marks, the length in inches of the tic marks, as well as the linetype and color to use.

- ***Existing Lt/Finish Rt*** and ***Finish Lt/Existing Rt***

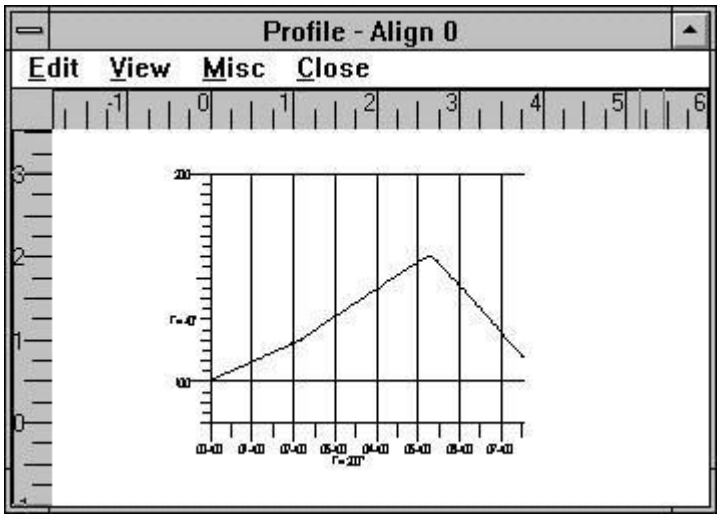
  Controls which side of the 0+00 grid line to place the elevations of the existing and proposed surfaces.

- ***Annotate Elevations***

  Turn on or off the display of the existing and proposed elevations on the 0+00 grid line.

The Profile/Vertical Control window

In the Profile Window, the View menu and the Close function are just the same as you find everywhere else in the program.



- To turn off the rulers, select ***Ruler*** from the ***Misc*** menu.
- To edit the grid and label parameters, select ***Edit*** from the ***Edit*** menu and then follow the steps in the preceding *Modify Profile Parameters* section.
- To change the color or linetype of a surface line in the profile:

1) Select the line in the profile by drawing a selection box intersecting any part of the line. It will be highlighted.
2) Select ***Set Color*** or ***Linestyle*** from the ***Edit*** menu.

Notes:

If the profile still does not look quite like what it should, it can be edited further in Layout.

Vertical Controls

Whenever you create a profile that includes "Cogo Points Surface" for one of the surfaces, that is a vertical control although initially it doesn't look any different from the other surface profiles. However, there is a difference in that the individual segments of the line are selectable. Also, points are created at the ends of the segments and these points are displayed and are selectable. These points are referred to as PVI points since, when a vertical curve is created, the point is the PI of the curve. **To create a new point,**

1) Select "Insert PVI" from the Edit menu.
2) Enter the station along the alignment to add the point and enter the elevation of the point. If a point already exists at this station, the elevation will be changed. **To create a vertical curve,** 1) Select a PVI point.

   2) Select "Modify PVI/Curve" from the Edit Menu. 3) Set appropriate parameters.

   4) Click OK.

Edit Vertical Control

Another way to edit a vertical control is to select "Edit Vertical Control" from the Edit menu. This will bring up a dialog box that will allow editing the station and/or elevation of a PVI, the grade of the line leaving the PVI, or the parameters of the curve leaving the PVI, if there is one. **Vertical Curve Solver**

This allows you to enter three parameters for a curve and have it display the other values of a curve.

Create Cogo Points

Cogo points can be created from the profile and vertical control information.

To create cogo points at each intersection of a profile or vertical control with the grid lines, select one or more profiles and/or vertical control and then select ***Create Cogo Points*** from the ***Edit*** menu.

To create cogo points at each point of the vertical control (including PVI points), make sure that no profiles or vertical controls are selected when calling ***Create Cogo Points*** from the ***Edit*** menu.

A brief message will be displayed showing the point numbers of the cogo points created.

Printing Profiles and Vertical Controls

1) Go to the Layout window.
2) Select Profile from the Draw menu.
3) A pink box will be displayed showing the dimensions necessary to display the profile. Move the pink box to the appropriate position on the sheet and then click the left mouse button.
4) The profile/vertical control will be displayed on the sheet. If you want to further refine the display of the information, you can select the profile/vertical control information as

placed on the sheet and then select Smash from the Components menu. This will break down all of the information into individual lines and texts.

5) Select Print from the Project menu of the Layout window.

Boundary Functions

Create

Create Boundary in the ***Bnd*** menu will create every possible boundary using the selected lines and curves. The boundaries need to actually start and end at the same point rather than meet the precision of closure defined in the ***Options*** dialog box in the ***COGO*** menu (see p.100).

Edit

Edit Boundary in the ***Bnd*** menu provides a graphical interface for editing a boundary. The dialog box allows you to decide whether or not to delete lines that are no longer in the boundary (and are not in any other boundaries). With this dialog box up and ***Alter Lines*** selected, if you press the left button when the cursor is near a point on the selected boundary, the lines in the boundary connected to that point will be highlighted. As you move the cursor, the lines will rubber band to the cursor position. If you release the button near another point in the project that is not on the boundary, the new point will replace the old point in the boundary. If you release the button near another point that is on the boundary, the old point will be removed from the boundary along with any other points between the old point and the new point.

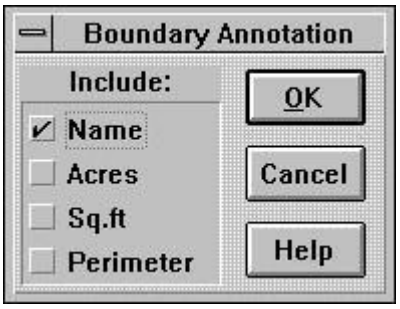
If you press the left button when the cursor is near a line of the boundary but not near a point on the boundary, the line will be highlighted. As you move the cursor, two lines will rubber band from the cursor position to the two end points of the line. If you release the button near another point in the project that is not on the boundary, the new point will be inserted between the two end points of the previous line.

Selecting ***Change Origin*** allows the surveyor to change the origin of the boundary by simply left-clicking near the point that is desired as the new origin.

Selecting ***Reverse Direction*** will reverse the direction of the boundary (clockwise to counter-clockwise or vice versa).

When you are done editing this boundary, click on the ***OK*** button in the dialog box.

Annotation



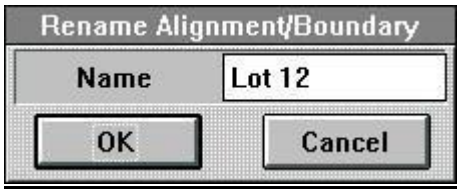
The ***Annotation*** function controls the automatic annotation parameters of all selected boundaries. This function creates a text block containing a list of the desired boundary parameters. To use this function,

1) Select the boundary(s) to modify.
2) Select ***Annotation*** from the ***Bnd*** menu. A dialog similar to the one shown will appear.
3) Check those parameters that you wish to display with the selected boundary(s).
4) Select ***OK*** to complete the function or ***Cancel*** to abort the function.

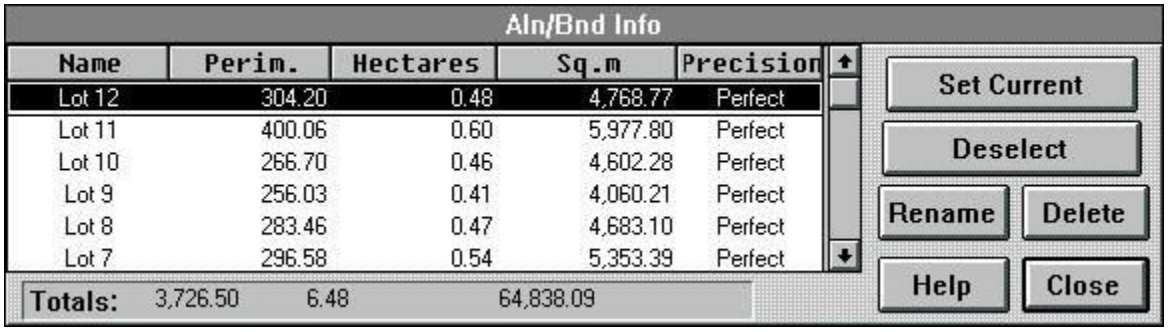
The ***Name*** can be modified with the ***Info*** function (see above). The text block can be modified with the ***Edit Text*** function (see p.142). However, executing the ***Annotation*** function after editing the text will remove any changes that are made with the ***Edit Text*** function.

Info

Info in the ***Bnd*** menu will display the parameters of all of the selected boundaries. When you start this function, all of the selected boundaries will be temporarily un highlighted. If you click on one of the boundary lines in the list box, that boundary will be highlighted in the data window. When you click on another line, that boundary will be highlighted and the previous one will be un highlighted. If you click on the ***Deselect*** button, the currently highlighted boundary will be unselected and will be removed from the list. If you click on the ***Delete*** button, the currently highlighted boundary will be deleted and will be removed from the list. To rename a boundary, click on the ***Rename*** button, enter the name in the edit box, and click *OK*.



If you want subsequent traverses and point traverses to be appended to the end of a boundary, hilight that boundary in the list box and then click on the ***Set Current*** button. When you are done with ***Info***, click ***OK*** or ***Cancel***.



Inverse (Aln or Bnd)

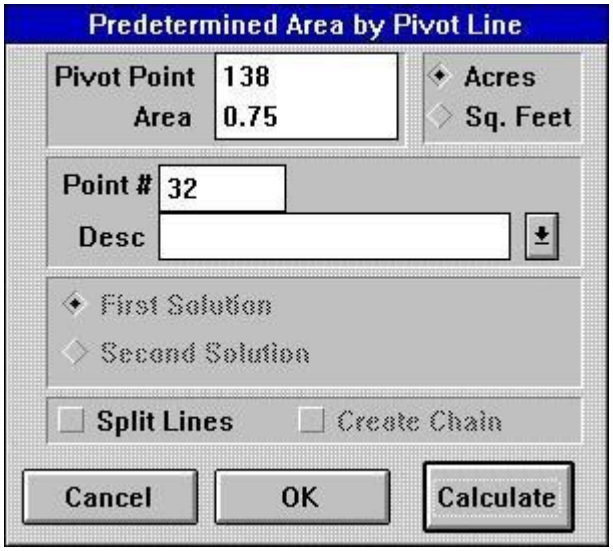
```
Chain Inverse of Lot 13
Starting at Point #5 North:649.54 East:95.80 Elev:n/a
      S54°49'57"W        631.02 to Pt #4 at N:286.09 E:-420.04
      S20°41'30"E      1,008.02 to Pt #3 at N:-656.90 E:-63.87
      N63°26'28"E        737.48 to Pt #7 at N:-327.16 E:595.79(PC of curve)
            Curve Parameters
          ==========================
          Radius Pt at N:-180.43  E:522.44
          PT Pt #6at N:-85.96  E:656.55
          Delta        =98°36'08"
          Radius        =164.04
          Arc Length    =282.31
          Tangent Length =190.72
          Chord Length   =248.74

      N35°09'41"W        875.63 to Pt #1 at N:629.89 E:152.29
Ending at Point #1 North:629.89 East:152.29 Elev:n/a

Perimeter: 3,534.44'          Area: 19.00 acres 827,607.47 sq ft      Precision: 59.09
```

Example of the output produced by Inverse.

The ***Inverse*** function in the ***Bnd*** menu generates a separate report on every selected boundary that contains the starting and ending point information, bearing and direction of each leg, parameters of any included curves, the perimeter, area, and the precision. The report is sent to the main window and the log file (if the log has been opened).

Predetermined Area

By Pivot Line



Predetermined Area by Pivot Line in the ***Bnd*** menu uses a selected alignment/boundary and pivots a line about one of the points on the alignment/boundary to obtain a specified area. ***Pivot Point*** in the dialog box is the point about which the line will pivot and must be on the alignment/boundary. ***Area*** is the area to create and is initialized to the area of the selected boundary or, if an alignment, it is the area that would exist if a line was added between the first and last points. ***Acres*** (or ***Hectares***) and ***Sq. Feet*** (or ***Sq. Meters***) give the units for the area. ***Point #*** is the number to assign to the new point. ***Desc*** is the description to attach to the new point.

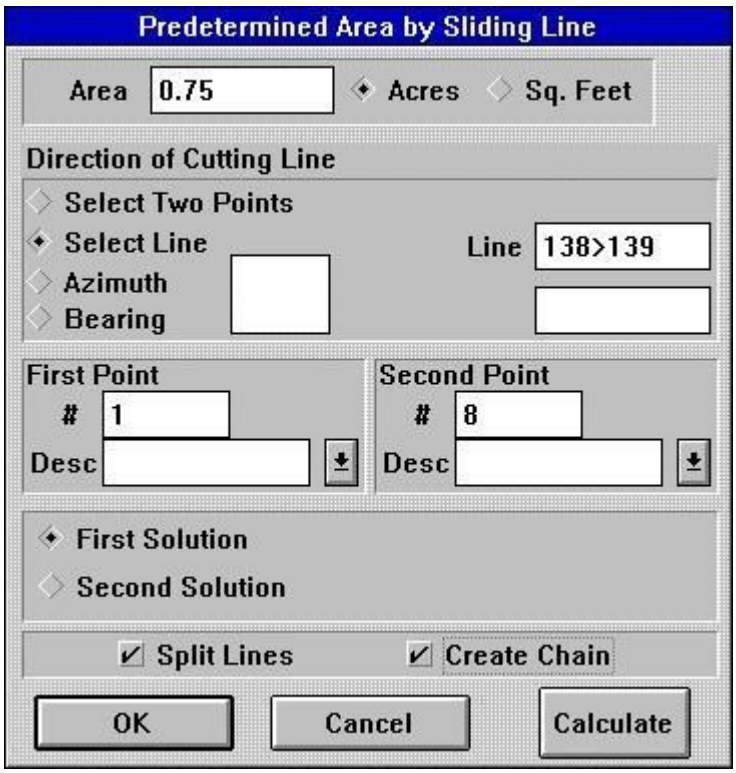
When you click on the ***Calculate*** button, the program will calculate all of the possible solutions; there are up to two solutions. For each possible solution, a line will be drawn from the pivot point to the point that, if in the alignment/boundary, would create a

alignment/boundary of the requested area. The bearing from the pivot point to the solution point will be shown in the dialog box next to one of the solution radio buttons. If there are no solutions, the solution section of the dialog box will be grayed out. If there is one correct solution, it will be displayed as the first solution and the second solution will be grayed out. If there are two correct solutions, they will both be displayed. You can select between them by clicking on the correct solution in the dialog box or by clicking near the appropriate point in the data window. Click on the ***OK*** button to create the point or click on ***Cancel*** to quit without creating the point.

When working with a boundary, the ***Area*** must be smaller than the area of the boundary. If working with an alignment, the ending segments are assumed to be of infinite length to find possible solutions.

By Sliding Line

Predetermined Area by Sliding Line in the ***Bnd*** menu uses a selected alignment/boundary and will move a line of a given angle through the alignment/boundary from both directions to find up to two solutions that would give the specified area. Alignments behave exactly as if they are a boundary by inserting an imaginary
line connecting the first and last points. ***Area*** is the area to create and is initialized to the area of the alignment/boundary. The area cannot be larger than the area of the alignment/boundary. ***Acres*** (or ***Hectares***) and ***Sq. Feet*** (or ***Sq. Meters***) give the units for the area.



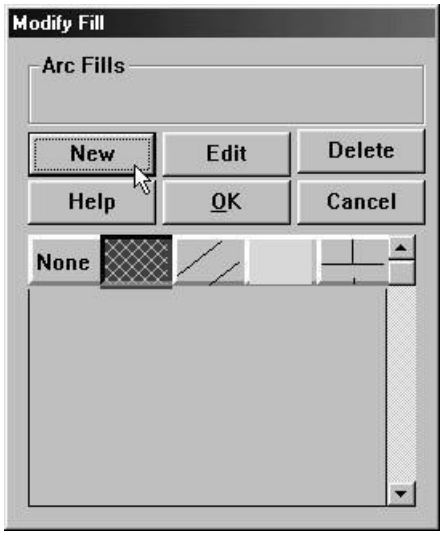
The angle of the line can be specified as an ***Azimuth***, a ***Bearing***/quad, or it can be specified to be parallel to a line. This line can be a drawn line in the data (***Select Line***), or a line defined by two points (***Select Two Points***). This section is very similar to the ***Line Define*** procedure on p.31.

First Point # and ***Second Point #*** are the numbers to assign to the two new points and *Desc* is the description to attach to each point.

When you click on the ***Calculate*** button, the program will calculate all of the possible solutions; there are up to two solutions. For each possible solution, a line will be drawn representing the position of the line that would yield the requested area. If there are no solutions, the solution section of the dialog box
will be grayed out. If there is one
correct solution, it will be displayed as

the first solution and the second solution will be grayed out. If there are two correct solutions, they will both be displayed. You can select between them by clicking on the correct solution in the dialog box or by clicking near the appropriate line in the data window. Click on the ***OK*** button to create two points or click on ***Cancel*** to quit without creating the points.

Fill Boundary



You can create a hatched or solid fill with the ***Fill Boundary*** function. To select one of the preexisting fills, click on a pattern in the hatch window and click ***OK***. To create your own, click on the ***New*** button. Select either "solid" or "line". If solid, you will see a color pallet. Choose a color, and click ***OK***. If line, you will see a dialog box asking for angle and spacing of lines. Click the ***Linetype*** button, and you will be able to choose any of the predefined or custom line styles in PC Survey. Select the ***Second Line*** option to create a hatch. Click ***OK***.

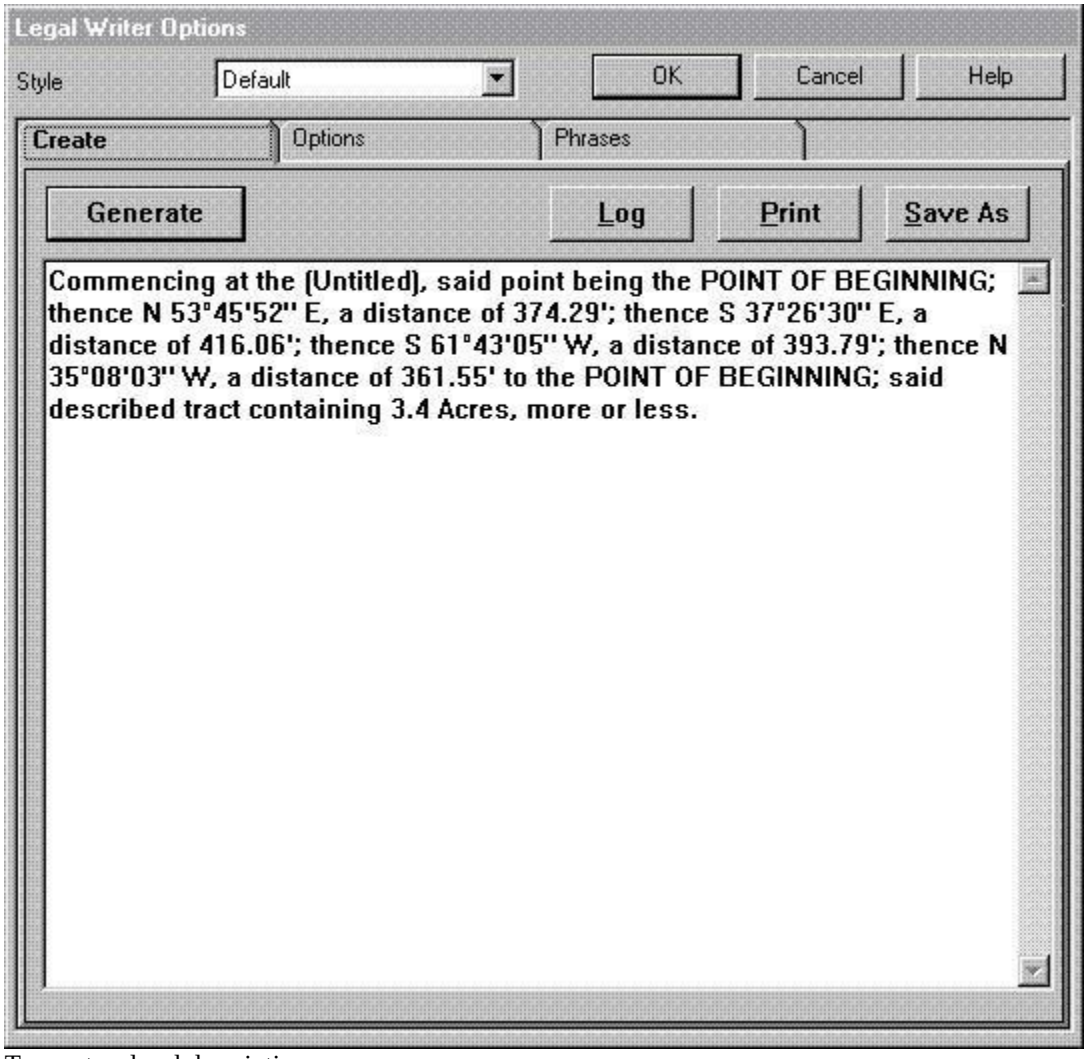
Legal Writer

PC Survey can generate a user-configurable legal description given a selected boundary or alignment along with optionally selected lines and/or curves representing a commencing course to the boundary/alignment. Therefore, before using this function, a boundary or alignment must have been created that represents the property or route that you wish to describe. When working with a boundary, one may wish to start the description from a point not on the boundary, following some course to the POB of the boundary. This is a *commencing course*. When using a commencing course, all the lines and/or curves comprising the course must also be created before using Legal Writer.

The Legal Writer works by examining each leg in turn of the selected course and applying an appropriate userdefinable "phrase" to the leg. Each phrase can contain "parameters" which are place-holders for values such as distances, bearings and names. The program places the leg's values into the appropriate parameters and appends the phrase to the legal description. A default set of phrases is built into the program, but the user can modify these at any time in the ***Phrases***.

In addition to being able to program the phrases, the user also has control over the formatting of the parameters by modifying the settings in the ***Options*** portion of the function. The system units, precision, and use of parenthetical values are some of the things that can be modified.

Changes to the phrases and options can be stored as a customized user definition. Multiple style definitions can be stored if desired.



To create a legal description:

1) Open the COGO Window.

2) Select the alignment or boundary that for which you wish to generate the description. If working with a boundary and there exists a commencing course to the boundary, also select the lines and/or curves comprising the commencing course.

3) Select **Aln/Bnd | Legal Writer**. A dialog will appear similar to the one shown above. The ***Create*** tab will be on top.

4) Select ***Generate***. The legal description will be generated and will appear in the large edit box in the ***Generate*** tab.

   Once a legal description has been generated, it can be edited, printed, saved to a file or copied to the clipboard. Generally, the surveyor will want to bring the legal description into a word processor in order to add additional information such as adjacent lot data, or county record details. The legal description created by PC Survey is not formatted (bold, italic, right justified, etc.). Importing the file into a word processor such as Microsoft Write (one of the Windows "Accessories" programs) allows the surveyor to both format and add additional information to the legal description.

Phrases

The ***Phrases*** tab allows one to review and edit the phrases that will be applied. There is a different phrase for each possible kind of leg. In addition, after describing the legs, either the *Closed Trav* or *Open Trav* phrase will be applied. In the definitions given below, the following terms will be used:

Commencing course - a series of lines and/or connected lines leading to a boundary. If a commencing course is selected, the point where the commencing course connects to the boundary will be treated as the POB *Commencing point* - the point at the beginning of a commencing course.

POB - or Point Of Beginning. If a boundary is being described and no commencing course has been selected, the POB will be the beginning of the boundary. The beginning half of the beginning course of a boundary is highlighted in half-white.

The following are the possible phrase types that appear in the drop-down list of the ***Phrases*** dialog.

Start w/Line - Line coming off of the commencing point.
POB to Line - Line that is the first leg in a boundary
Line - A line that does not meet one of the other line conditions
Same Line - A line that comes immediately after another line in the alignment or boundary that proceeds in the same direction (has the same bearing).
Line to POB - A line that is the last in the course of a boundary, therefore terminates at the POB ***Start w/Crv*** - curve coming off of the commencing point.
POB to Crv - curve that is the first leg in a boundary

The following apply to curves that are the first leg in boundaries that have a commencing course.

***POB to Tan* Crv** - curve is tangent to the last leg (line or curve) in the commencing course.
POB to Non-tan Crv - curve is non-tangent to the last leg (line or curve) in the commencing course. ***POB to Comp. Crv*** - curve is a compound curve - tangent to the last leg of the commencing course, same rotation, but different radius.
POB to Rev. Crv - curve is a reverse curve - tangent to the last leg of the commencing course, but with different rotation.
POB to Same Crv - curve has the same radius and rotation direction as the last curve in the commencing course.

The following applies to all other curves.

Tan Crv - curve that is tangent to the previous leg (line or curve).

Non-tan Crv - curve that is non-tangent to the previous leg (line or curve).
Comp. Crv - curve that is tangent to the previous leg (curve), has same rotation direction but different radius.
Rev. Crv - curve that is tangent to the previous leg (curve), but has different rotation direction.
Same Crv - curve that is tangent to the previous leg (curve), has same rotation direction and radius.

Cusp - not implemented. If interested in recognizing cusps, call to request implementation. ***Crv to POB*** - curve is last leg of commencing course.

The following phrases are applied at the end of the description.

Open Trav - used if describing an alignment.
Closed Trav - used if describing a boundary.

Parameters are various keywords, preceded and followed by a "%" character, that are placed within the phrases as placeholders for object values.

An example of how this works is the default phrase for the "Tan Crv" phrase:

to the point of curvature of a tangent curve, concave to the %CONDIR%, having a radius of %RAD% and a central angle of %DELTA%; thence %ADIR% along said curve, a distance of %ALEN%

When this phrase is actually applied to a tangent curve in a boundary, the following text may result **to the point of curvature of a tangent curve, concave to the southeast, having a radius of 100.00' and a central angle of 91°50'30; thence northerly along said curve, a distance of 160.29'; thence N 88°02'45" E, a distance of 110.57'**

The parameters in this phrase are CONDIR (concave direction), RAD (radius length), DELTA (delta), ADIR (approximate direction) and ALEN (arc length).

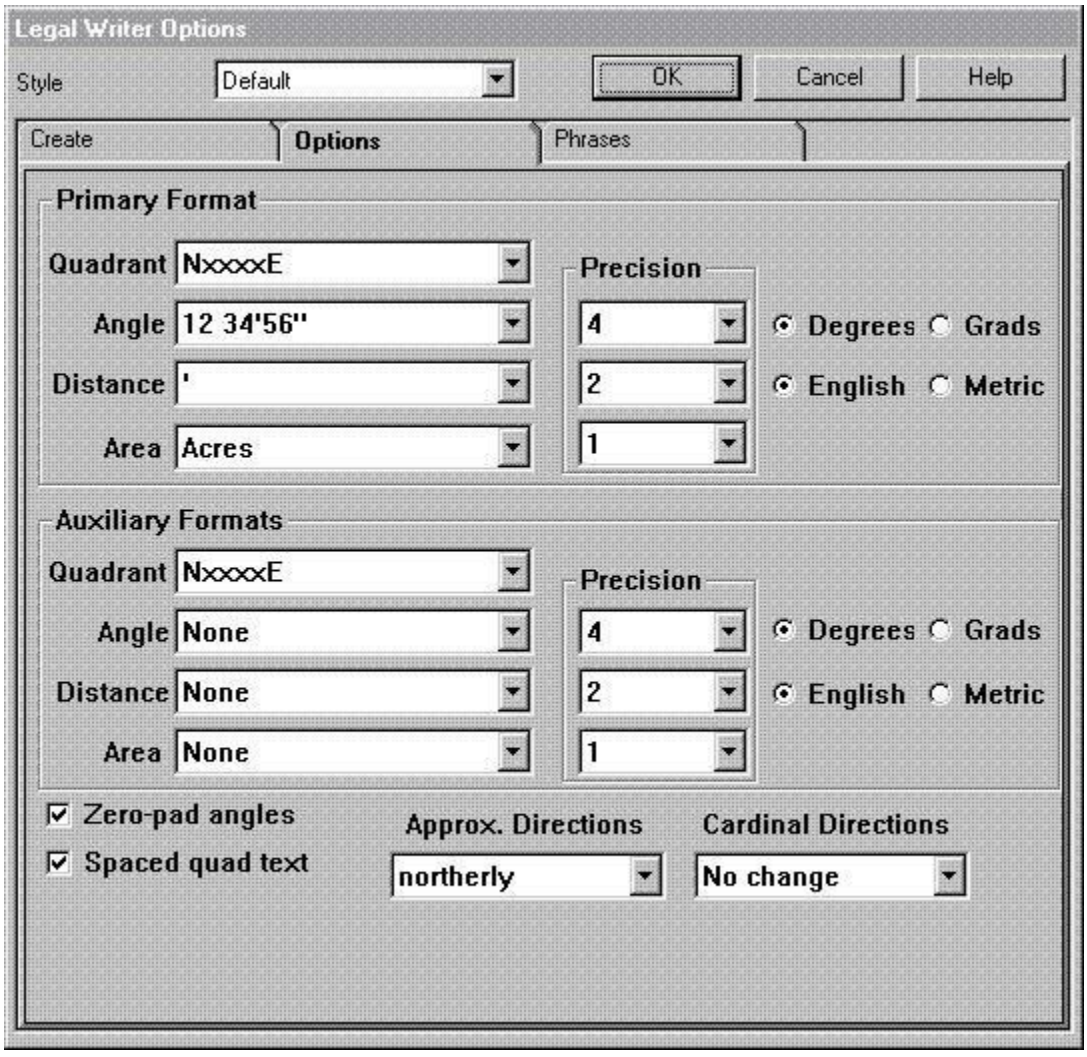
The following is a list of the parameters that can be used within the phrases:

ANG	ANGle/bearing of line
DIST	DISTance(lengt) of line
ALEN	Arc LENgth
DELTA	arc DELTA
CHBEAR	CHord BEARing
CHLEN	CHord LENgth
CLR	Curve to the Left/Right
CONDIR	CONcavity DIRection
RPDIR	Radius Point DIRection
ADIR	Approximate DIRection
RAD	RADius length
AREA	AREA of boundary (Acres, Hectare, Cuerdas)
SQAREA	SQuare AREA of boundary (square feet, square meters)
PERIM	PERIMeter length

BNAME	Boundary NAME
PNAME	Point NAME (description) of "from" point
PNAME2	Point NAME2 (description) of "to" point

Options

There are numerous options available for controlling the format of the displayed values. Selecting the ***Options*** tab will display a dialog similar to the one shown below.



There are two main sections to this dialog - *Primary Format* and *Secondary Format*. Primary format refers to the principal value that is placed in the body of the text. Secondary format refers to an optional parenthetical value that is inserted after the principal value.

There are three types of values - Angles, Distances and Areas. For each of these there is control over how many digits of ***Precision*** are displayed. In the case of angles, a precision of 4 will display minutes and seconds, whereas a precision of 5 will displays minutes, seconds and tenths of seconds, etc.

Quadrant

The following options are available for the ***Quadrant*** settings. For each setting, an example value of S 45°32'18" W (precision of 4) will be used to display the possible formats. **as azimuth** **225°32'18"** **N.E.xxxx** **N.E. 45°32'18"**

NExxxx **NE 45°32'18"** **NxxxxE** **N 45°32'18" E**

NorthEastxxxx **NorthEast 45°32'18"**
North-Eastxxxx **North-East 45°32'18"** **NorthxxxxEast** **North 45°32'18" East** The values shown are with the assumption that ***Spaced Quad Text*** is turned on, resulting in a padding space between the quadrant text and the angle values.

Angle

The angle formats allowed are shown below - simply pick the desired format from the drop-down list. The formats displayed are dependent on the system of units chosen (metric or English). The displayed values are for an example angle of 12° 34' 56" in the case of English units and 12.345 grads in the case of metric units. As mentioned above, a ***Precision*** value of 4 will display to the nearest second in the case of English units or to 4 decimal places in the case of metric units (i.e. 12.3456).

When English units are selected -
None (only for secondary formats)
12 34 56
12-34-56
12°34'56"
12° 34' 56"
12.3456 Degrees
12.3456 degrees
12 Deg 34 Min 56
Sec" 12 deg 34 min 56 sec 12 Degrees 34 Minutes...

When Metric units are selected -
None (only for secondary formats)
12.345 Grades
12.345 grades
12.345 Grad
12.345 grad
12.345 G

12.345 Distance

The supported distance formats are shown below. Again, pick the style desired from the list. There are, again, two possible sets of formats - English or Metric. There is also a ***Precision*** control for these units. If English units are chosen -
None (only for secondary formats) **Feet feet Ft ft.**
F
'

If Metric units are chosen - **None** (only for secondary formats)

Meters meters

M

m Area

Area formats are straight-forward. Select from the list shown below. ***Precision*** control is allowed as usual.

None (only for secondary formats)
Square Feet
Acres
Square Meters
Hectares
Cuerdas

Approx. Directions

The approximate directions are used in describing the approximate direction of curves. There are four formats available.

north	north, northeast, east, southeast, etc.
North	North, Northeast, East, Southeast, etc.
northerly	northerly, northeasterly, easterly, southeasterly, etc.
Northerly	Northerly, Northeasterly, Easterly, Southeasterly, etc.

Cardinal Directions

This setting controls how angles are displayed when they are exactly in one of the four cardinal directions (North, East, South or West).

No change angles are displayed normally (i.e. N 90° 00' 00" E)
North/South.. North, South, East, West
due North/due South.. due North, due South, due East, due West

Zero-Pad Angles

When enabled (the default), **1° 2' 3"** is displayed as **1° 02' 03"**, etc.

Spaced Quad Text

As mentioned above, checking this option (the default) inserts a space between the quadrant text and the angle values in bearings.

Intersections

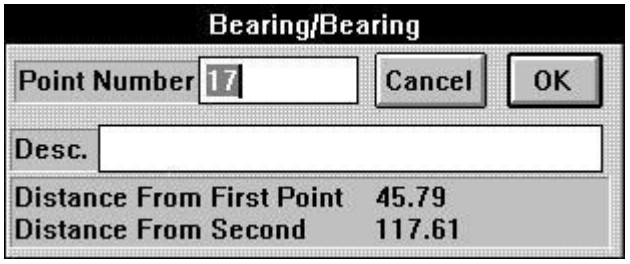
Bearing/Bearing

Bearing/Bearing in the ***Intsct*** menu creates a new point at the intersection of two lines with known angles going through specified points. **The *Line Define* dialog is used to define these two lines. If you are not already familiar with this dialog, please review its operation on p.32**. To use this intersection function, 1) Select ***Bearing/Bearing*** from the ***Intsct*** menu. The first of two ***Line Define*** dialogs will be displayed.

2) Define the first line by filling in the appropriate information for your problem in the ***Line Define*** dialog. Select ***OK.***. A magenta line will be displayed on the screen representing the line you have just defined and the second ***Line Define*** dialog will appear.

3) Define the second line by filling in the appropriate information for your problem in the ***Line Define*** dialog. Select ***OK***. A second magenta line will appear. The solution lies at the intersection of the two lines. A third dialog, as shown below, will appear.

4) A default ***Point Number*** will be shown. Enter a new ***Point Number*** or leave the default. Enter a ***Desc***ription for the new point, if desired.. The dialog will also display the ***Distance From First Point*** to the point of intersection and the ***Distance From Second Point*** to the point of intersection. These are the points that were specified as the ***Point on Line*** in the previous dialog boxes.



5) Select ***OK*** to generate the new point. The magenta lines will disappear at this time.

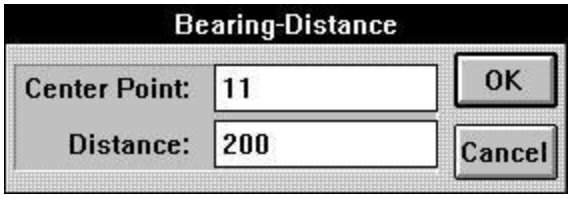
The following may be kept in mind,

- Selecting ***Cancel*** in any of the dialog boxes will abort this function.
- If the intersection point is initially off the edge of the screen, the display will automatically *zoom* to include the intersection point.
- Like other functions, the dialogs are moveable while in this function. The dialog may obscure the intersection point. If such is the case, just move the dialog if you wish to see the area. You can also zoom with the right mouse button at any time.

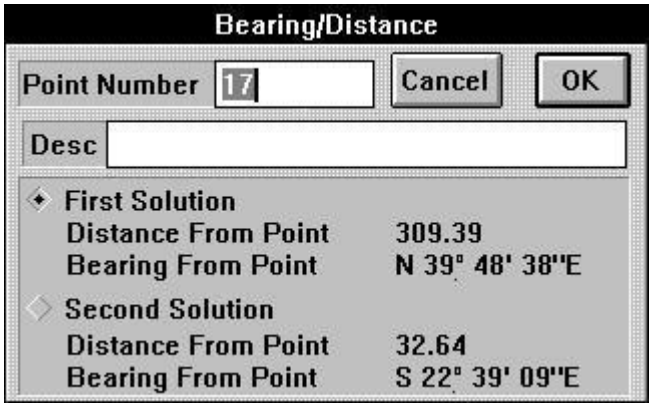
Bearing/Distance

Bearing/Distance in the ***Intsct*** menu creates a new point at an intersection of a line and a circle. To define the line, a dialog box will be used. In this dialog box, enter the point number for a point on the line as the ***Point on Line***. Like ***Point in Direction***, the angle can be specified as an ***Azimuth,*** a ***Bearing***/quad, or parallel to a drawn line in the data (***Line***), a line defined by the source point and another point (***Select Second Point***), or a

line defined by any two points in the project (***Select Two Points*).** For more detail on these options, refer to the ***Point in Direction*** function. When you click ***OK***, a magenta line will be drawn representing the line you described.



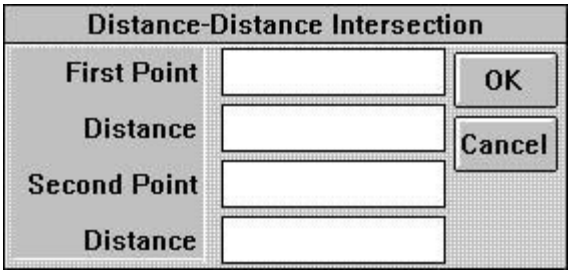
The circle represents the set of all points that are a given distance from a point. In the next dialog box, enter that point as the ***Center Point*** for the circle and then enter the ***Distance*** from the point that is the radius of the circle. When you click ***OK***, a magenta circle will be drawn, showing the set of all points that are the given distance from the point. The point(s) at which the line and circle intersect represent the possible solutions.



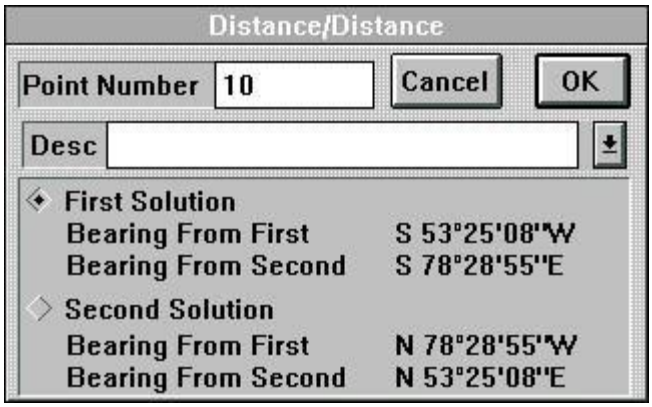
The final dialog box allows entering the ***Point Number*** and ***Desc***ription for the new point. It will also display the two possible solutions. The ***Distance From Point*** represents the distance from the ***Point on Line*** to the intersection point. The ***Bearing From Point*** represents the bearing from the center of the circle to the intersection point. Selecting a solution can be done by clicking on ***First Solution*** or ***Second Solution*** in the dialog box or by clicking near the desired intersection in the data window.

Clicking ***Cancel*** at any time will abort this function.

Distance/Distance



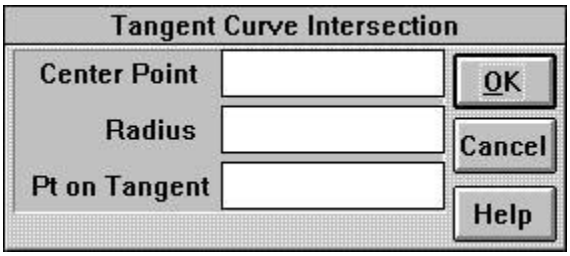
Distance/Distance in the ***Intsct*** menu creates a new point at an intersection of two circles. The circles represent the set of all points that are a given distance from a point. In the first dialog box, enter one of the center points as the ***First Point*** and then enter the ***Distance*** from that point that is the radius of the circle. Next, enter the other center point as the ***Second Point*** and enter the ***Distance*** from that point for the radius of the second circle. When you click ***OK,*** two magenta circles will be drawn, showing the set of all points that are the given distances from the two points. The point(s) at which the circles intersect represent the possible solutions.



The final dialog box allows entering the ***Point Number*** and ***Desc***ription for the new point. It will also display the two possible solutions. The ***Bearing From First*** represents the bearing from the center of the first circle to the intersection point. The ***Bearing From Second*** represents the bearing from the center of the second circle to the intersection point. Selecting a solution can be done by clicking on ***First Solution*** or ***Second Solution*** in the dialog box or by clicking near the desired intersection in the data window.

Clicking ***Cancel*** at any time will abort this function.

Tangent Curve



Tangent Curve in the ***Intsct*** menu creates a new point that at the intersection of a circle and a line tangent to the circle that passes through a specified point. There will be two solutions. To use this function:

1) Select ***Tangent Curve*** from the ***Intsct*** menu. At least two points must already exist in order to use this function. The dialog shown to the right will appear.

2) The ***Center Point*** is the center point of the circle. Either click near this point on the screen with the left mouse button or enter the point number into the edit box from the keyboard.

3) Enter the ***Radius*** of the circle or select a line that has the desired radius as its length from the screen with the left mouse button. The ***Radius*** value must be less than the distance between the ***Center Point*** and ***Pt on Tangent***.

4) The ***Pt on Tangent*** is a point outside of the circle that lies on the tangent line. Enter a point number into the edit or select a point on the drawing with the left mouse button when the cursor is in this edit box.

5) There should now be values in all three edit boxes. Select ***OK***. If all the values are acceptable (the point numbers be those of existing points), a circle and two lines, tangent to the circle and passing through the ***Pt on Tangent,*** will be drawn on the screen. A dialog box will appear, similar to the one shown in the picture below.

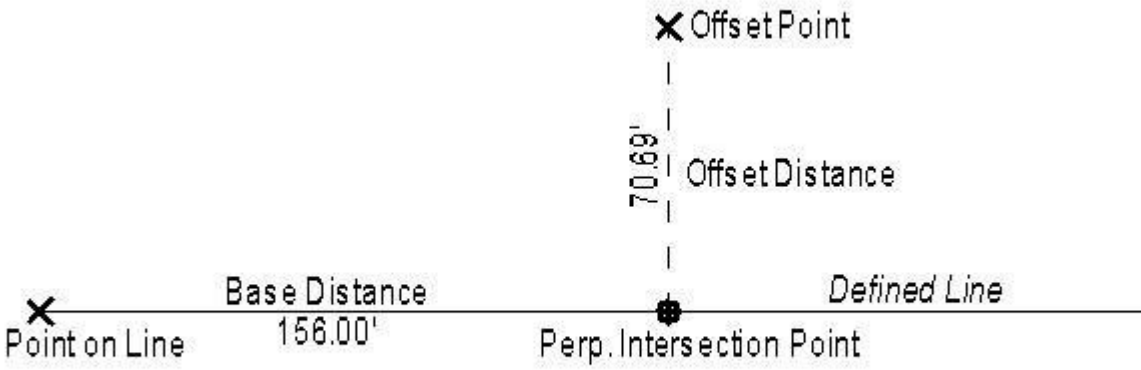
6) The ***Point Number*** is for the point that will be created at the intersection. Optionally, you can enter a description for this point and/or change the point number. There are two solutions. Select the solution

   that is desired either by left-clicking near the desired intersection point (where the circle meets the lines) or selecting the solution from the dialog. If you select the intersection point from the drawing with the left mouse button, the corresponding solution in the dialog will be checked. Select ***OK*** to create the intersection point.

Clicking ***Cancel*** at any time will abort this function.

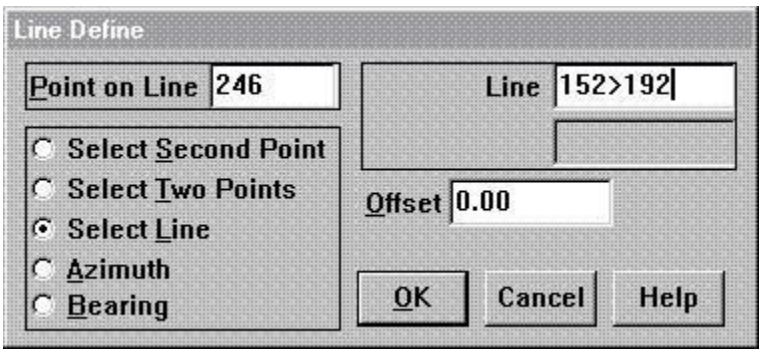
Perpendicular Offset

This function will calculate the perpendicular distance from any selected point to a defined line or to an

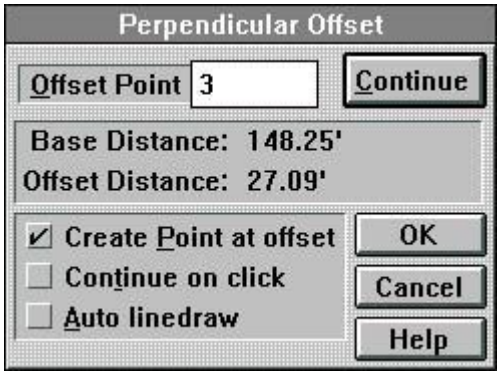


existing selected object. Optionally, points can be created on the defined line or selected object at the point where a perpendicular line passing through the select offset point intersects the defined line or selected object (the ..***Point at offset***). Also, optionally, a line connecting the ***Point at offset*** and the selected offset point can be created.

To use this function with a defined line:



1) If anything is currently selected, clear the selections by using the ***C*** button in the select status bar or the ***Clear Select*** function in the ***Edit*** menu.
2) Select ***Perpendicular Offset***. The standard *Define Line* dialog will appear (see p.32).
3) Fill in the desired parameters and select ***OK***. A purple line will appear on the screen representing the reference line you have defined. Another dialog will appear, similar to the one shown below.



4) Enter the ***Offset Point*** that is the point whose distance you want to check. You can either type in a point number or click near the point in the data window. The ***Offset Distance*** is the distance from the ***Offset Point*** to the near point on the line. If you were sitting on the ***Point on Line***, facing down the line in the direction of the ***Offset Point***, the ***Offset Distance*** will be positive if the point is on your right and negative if the point is on your left. The ***Base Distance*** is the distance from the ***Point on Line*** to the point on the line that is closest to the ***Offset Point***.

5) If you want the program to generate a new point on the line where it comes closest to the ***Offset Point***, click on ***Create Point at offset***. If you click ***Continue***, a new point may be created (depending on whether ***Create Point at offset*** is enabled or not) and the ***Offset Point*** will be cleared so that another point can be checked. ***Continue on click*** will activate the ***Continue*** button whenever you click near a point in the data window but only if ***Create Point at offset*** is enabled.

6) If it is desired to additionally created line connecting the offset point and the ***point at offset***, enable the ***Auto linedraw*** option.

To use this function with a selected object:

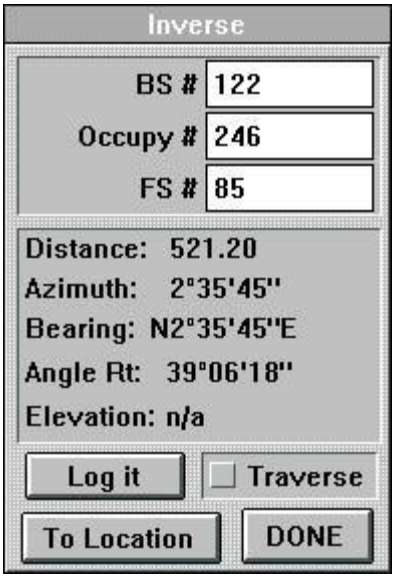
1) Select the object to calculate the perpendicular offset to. There must be only one selected object. If more than one object is selected, the function will revert to using the *Line Define* dialog. You may wish to clear the selection list first using the ***Clear Select*** function and then select the desired object.

2) Select ***Perpendicular Offset***. This time the *Perpendicular Offset* dialog will appear immediately, instead of the *Line Define* dialog being first displayed.

3) Follow steps 4 through 6 from above to complete the function.

Data Information

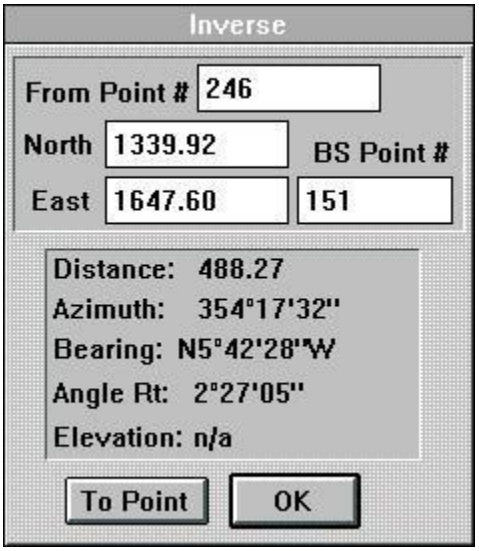
Inverse



Inverse in the ***COGO*** menu allows checking the bearing and distance between any two points in the project. When the function is first called, the ***From Point*** is assumed to be the occupy point but can be changed to any other point by typing in the point number, or by middle clicking near the desired point in the data window, or by setting the focus to the ***From Point*** edit box and left clicking near the desired point. Setting a point number in the ***To Point*** edit box is a similar operation except that it will not accept a middle click. Whenever there are valid point numbers in both the ***From Point*** and
To Point boxes, the lower area of the dialog box will display the ***Distance*** between the points as well as the ***Azimuth*** and ***Bearing*** from the first point to the second point. If elevations are enabled, ***Elevation*** will show the elevation difference between the two points if the points both have valid elevations.

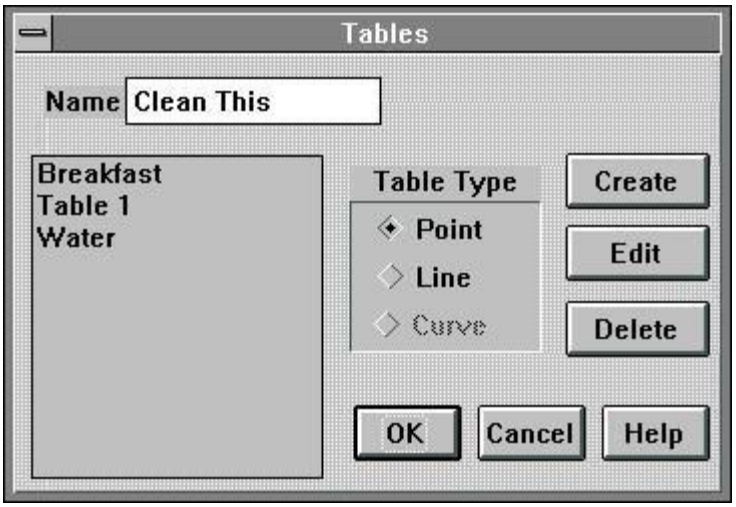
To Location

Clicking on the ***To Location*** button will change the dialog to allow inversing between a point and a coordinate location as shown. Like the ***Inverse*** ***(To Point)*** function, the distance between the points, as well as the azimuth and bearing from the occupied point to the coordinate, will be displayed. The ***North*** and ***East*** values can be typed in or picked off the data window by left clicking the mouse at the desired location. Clicking on the ***To Point*** button changes back to the first dialog.



Tables

The ***Tables*** command in the ***Misc Menu*** creates point, line or curve tables. Although the tables are created in COGO, they are actually placed on the sheet in the Layout window (yes, this is a little "non-intuitive" - maybe we'll find a way to make it easier in a later release).



Multiple tables are allowed. The table entries, ordering, fonts and borders are all user-configurable. Once created, tables can be edited and deleted.

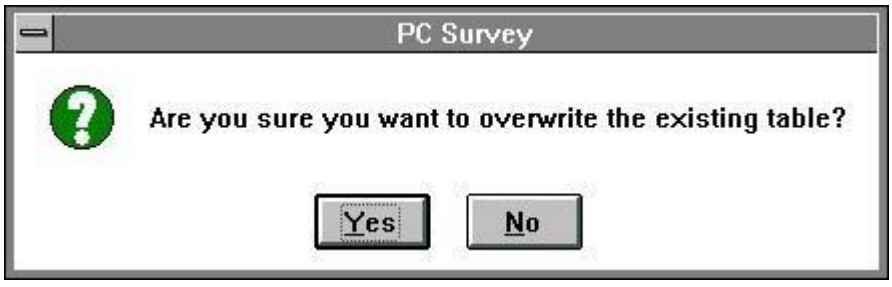
The list box on the left of the dialog displays all the currently defined tables of the type selected by the ***Table Type*** buttons.

The Table Dialog

To create a table:

1) Select the objects that you wish to place in the table (the points, lines or curves).
2) Give the table a unique ***Name***. This is an internal name - it does not appear in the actual table (unless you title the table with that name), but is for your use when identifying which table to use in the various table functions.
3) Select the ***Table Type***.
4) Select ***Create.***

At this point, one of three dialogs will appear, depending on which ***Table Type*** was chosen, unless a ***Name*** was specified that already existed in the list. These dialogs are explained in sections immediately following this one. If a ***Name*** is selected that is already in use, the program will prompt with the message shown below to make sure that an overwrite of the table previously defined with that name is desired. Selecting ***Yes*** at this point will replace the previously defined table with the new definition and will also cause any tables with this name and type in the Layout window to be deleted and replaced with this new definition.



Select ***OK*** in the ***Tables*** dialog to finish the operation (or ***Cancel*** to abort the operation).

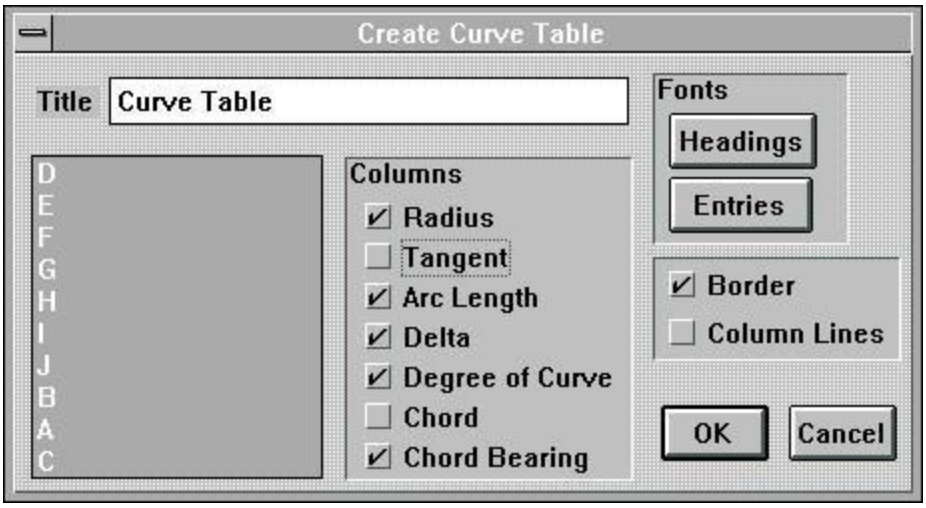
Remember: Tables are created, deleted, defined and modified in COGO with the ***Misc-Tables*** command. Tables are placed and displayed in the Layout window with the ***Draw-Table*** command.

The following entries are common to all the table creation dialogs (like the one below):

- Enter the table's title in the ***Title*** box.
- The ***Columns*** section controls which parameters will be displayed in the table. Check the items that will appear in the table. Those which are not checked will not appear in the table.
- Selecting ***Border*** will put a box around the table.
- Selecting ***Column Lines*** will print lines between the columns in the table.
- Selecting ***Headings*** will display the *Fonts* dialog (see p.29) to allow specification of the font to use for the title and column headings.
- Selecting ***Entries*** will display the *Fonts* dialog (see p.29) to allow specification of the font to use for the actual data lines in the table (bearings, chord length, etc.).

The following sections are explanations of the properties that are unique to the three types of tables.

Curve



Curve tables use a *designator* to identify the curve that is referenced in the table. The *designator* is a boxed character that will appear by the curve. The left-hand list box shows the designators for all selected curves.

All designators that are highlighted will be shown in the layout table. Designators that are not highlighted will not be included in the table. Since there is currently no easy way to know which designator applies to which curve before the table is created, be sure to select only those curves that you wish to place in the table.

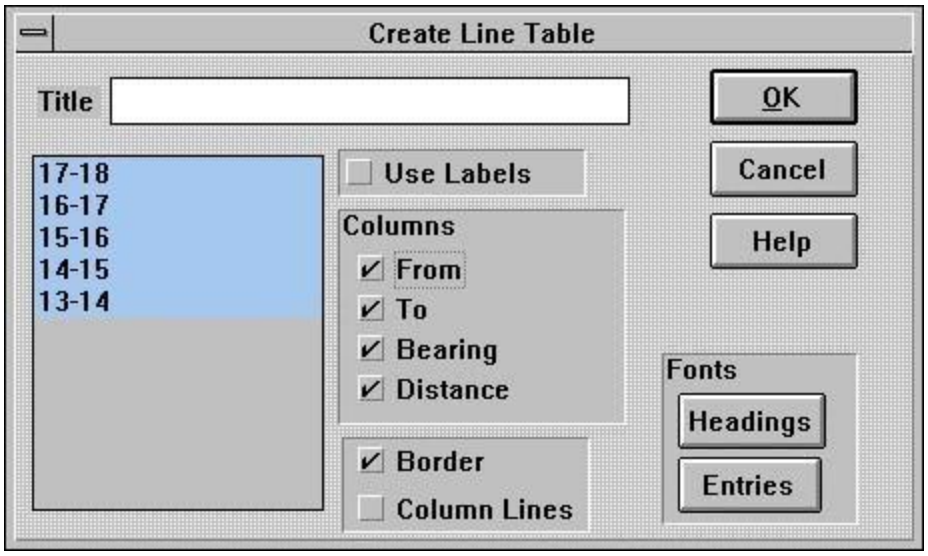
When the table is created, the designators will appear by their curves in the COGO window. **You will generally want to move the designators using the standard left-click-hold-and-drag operation after they have been created**. This is because there is

no way for the program to intelligently place the designators, so they default to a position on top of the curve.

The curve parameters which can be displayed in the table are ***Radius, Tangent, Arc Length, Central Angle, Degree of Curve, Chord,*** **and** ***Chord Bearing***.

By default, curve designators begin with the letter '**C**', followed by a number (**C1, C2, ... C21, ...,** etc.). It is possible to change the designator by editing its contents with the ***Edit Text*** command. Changing the designator text will automatically change its value in the table as well.

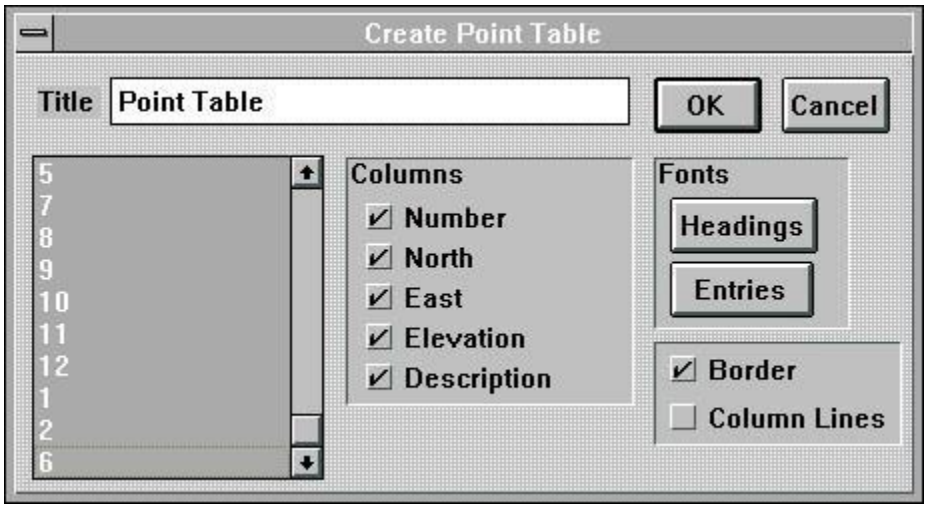
Line



The left-hand list box shows the endpoint numbers for all selected lines with a dash between the starting and ending point numbers. All lines that are highlighted will be shown in the layout table. Lines that are not highlighted will not be included in the table. Lines can be highlighted or un highlighted by clicking on the entries with the mouse. The line parameters that can be displayed are ***From*** point, ***To*** point, ***Bearing***, and ***Distance*****.**

Selecting ***Use Labels*** will assign a label to each of the lines in the table. The label values default to *L1, L2, L3,* etc. Similarly to the curve tables, the labels will appear as moveable graphics near the center of their line in the COGO window. The labels can be edited with the ***Edit Text*** function after first selecting the label graphic in the COGO window. Changes that are made to the text of the label will be reflected in the table as well.

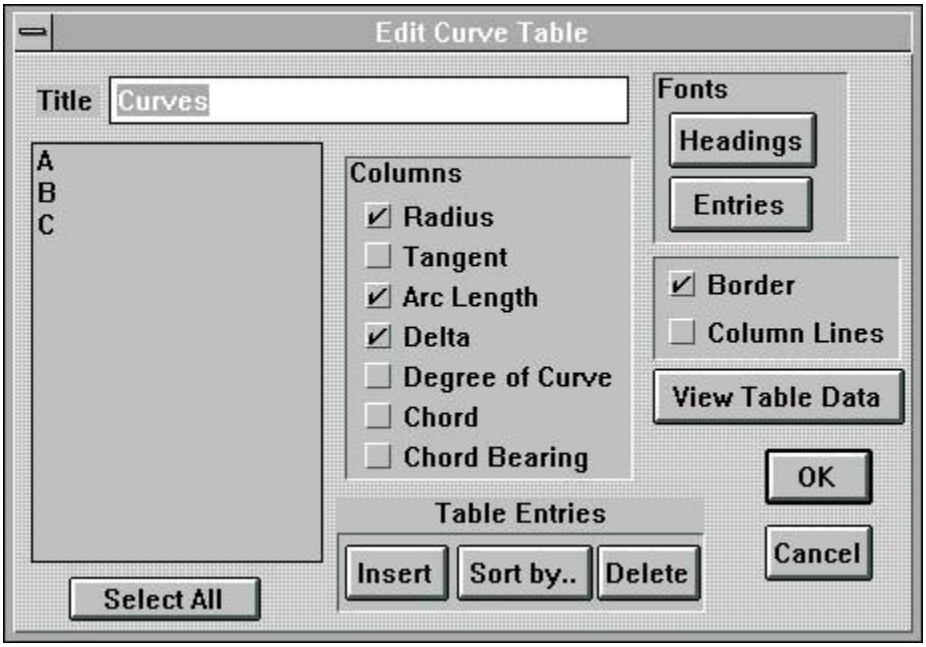
Point



The left-hand list box shows all selected point numbers. All points that are highlighted will be shown in the layout table. Points that are not highlighted will not be included in the table. The point parameters that can be displayed are ***Number, North, East, Elevation,*** **and** ***Description***.

Editing Tables

Once a table has been created, it can be edited. Editing a table allows the surveyor to add or delete table entries, modify the display characteristics (fonts, borders, and column lines), change the included parameters, sort the entries, and examine the table contents.



Example of the Edit Curve Table Dialog

To edit a table:

1) Select the ***Table Type*** in the ***Tables*** dialog box (see p.178). A list of all tables of that type will appear in the listbox on the left.

2) Select the name of the table that is to be edited from the list.

3) Select ***Edit***. One of the *Edit Table* dialogs will appear.

Once the *Edit Table* dialog appears, the columns, fonts, etc. can be altered in the same way as when the table was initially created. There are some additional features, however.

The ***Table Entries*** section allows the surveyor to ***Insert***, ***Sort*** and ***Delete*** entries in the table.

To ***Insert*** additional or ***Delete*** table entries:

1) Select all objects that are to be added to/deleted from the table before invoking the ***Tables-Edit*** function.

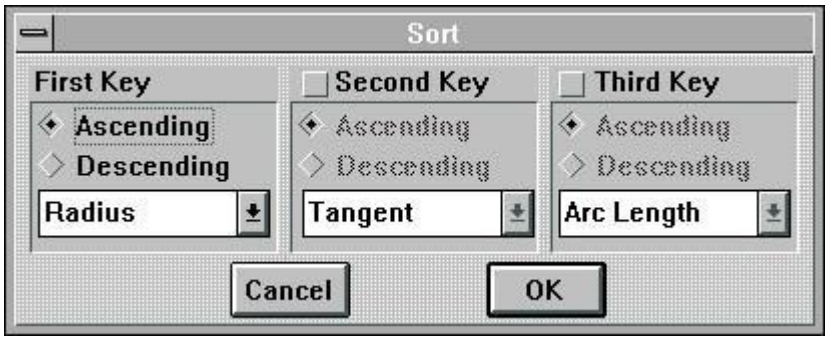
2) Select the items in the ***Edit Table*** listbox on the left side. ***Select All*** will select everything.

3) Select ***OK***.

To ***Sort*** the table entries:

1) Select all entries that are to be sorted from the listbox on the left.

2) Select ***Sort by...***. The ***Sort*** Dialog will appear.



The Table Sort Dialog

The dialog allows the surveyor to sort the table by up to three "keys". A key is a field to order the table by. For instance, in the dialog shown, the ***First Key*** is *Radius* in ***Ascending*** order**.**

This means that selected curves will be placed in the table in the order of their *Radius* value. Therefore a curve with a radius of 10 will precede a curve with a radius of 15. The order would be reduced if ***Descending*** was specified.

The ***First Key*** is required, but the second and third keys are optional -that is why they have checkboxes next to them. Second and third keys are used only if the value of the first key for more than one entry is the same. For instance, if three curves all have a radius of 50 and the ***First Key*** is *Radius*, they would appear together in the table. Then, specifying a second key of *Arc Length* would then allow those curves to be further ordered accord to their *Arc Length*, and so forth.

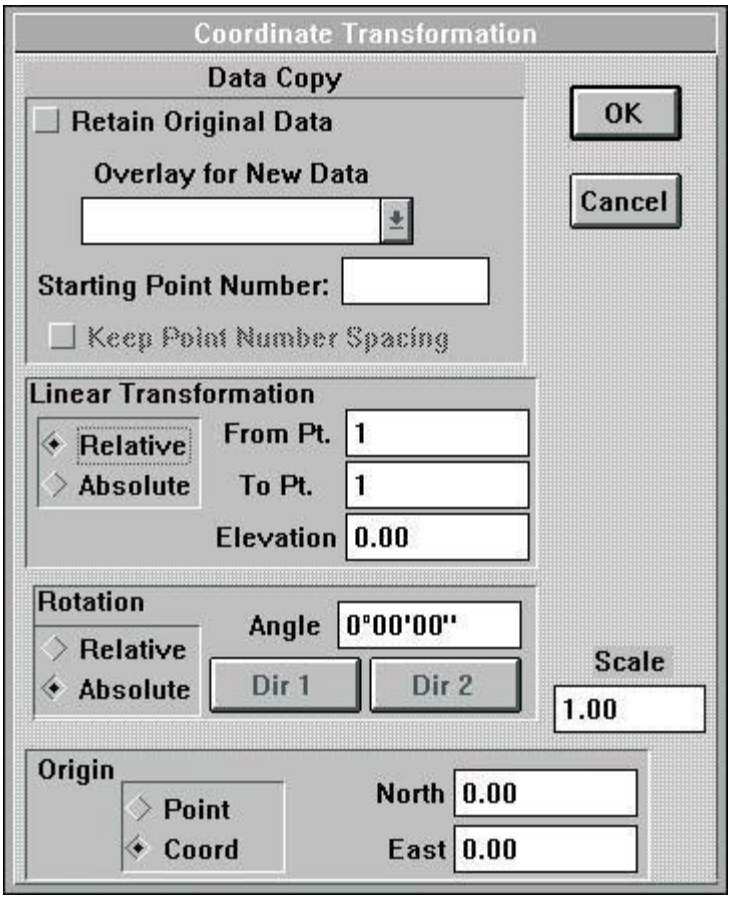
Select ***OK*** when the settings are complete.

Data Modification

Coordinate Transformations

There are two ***Coordinate Transformation*** routines provided within the COGO routines. The ***Standard*** method allows the surveyor to transform a set of points given specific linear and/or angular transformation values. The ***Best Fit*** method is a two-dimensional least square approach that will find a transformation for a selected set of points given two or more *control pairs* (i.e. point A moves to point B, point C moves to point D, etc.) that minimizes the total error (distance) between the control pairs. This second method is useful for problems such assembling multiple sets of property data.

Standard



Coord. Transformation - ***Standard*** in the ***COGO*** menu will scale, rotate, and translate a group of objects. The original data can be retained, in which case a different overlay can be used to place the new data. If keeping the original data, a new point range must also be specified.

Rotation and scaling are performed around an origin point that can either be specified as a ***Coord***inate that will have a ***North*** and ***East*** value or as a ***Point*** that just takes a point number. The ***Scale*** is a multiplication factor. Example: a scaling factor of 2 will double the distance between the point and the origin. Set the ***Rotation Angle*** to the number of degrees to rotate the point counter-clockwise about the origin.

Linear Transformation refers to the translation to perform on the point after rotation and scaling. An ***Absolute*** mode will move each point by the specified ***North*** and ***East*** values. *Relative* mode will move the points by the amount necessary to move the ***From Pt.*** to the ***To Pt. Elevation*** is the change to apply to the elevations of the points, if elevation is enabled.

To use this function: 1) Select the objects to transform. Objects include points, text, lines, and arcs.

2) Select ***Coord. Transformation*** from the ***COGO*** menu.

3) Fill in the dialog and select ***OK***.

The following conditions apply:

Data Copy:

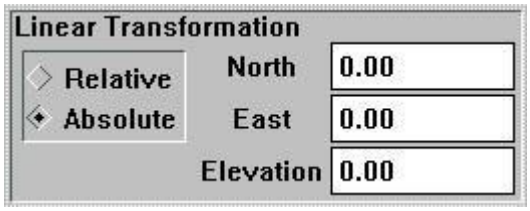
- If ***Retain Original Data*** is not enabled, entries in this section are disabled
- When ***Retain Original Data*** is enabled, the following apply:

◊ The ***Overlay for New Data*** will default to the Base overlay. To place the translated data on a new overlay, a second overlay must first exist. (See the section on *Overlays* on p.114 to learn how to create new overlays.) It is recommended that a unique overlay be used so as to be able separate the new data from the old.

◊ The ***Starting Point Number*** specifies what number to start at for placing the new data.

◊ If ***Keep Point Number Spacing*** is enabled, newly created points will maintain the same point number spacing as the original data. For instance, if the original data points were points 3,5,7,8, and 9, the ***Starting Point Number*** is 40 and ***Keep Point Number Spacing*** is enabled, the new points would be numbered 40, 42, 44, 45, and 46.

Linear Transformation:



- Linear transformation defaults to "no linear transformation".
- Specifying an ***Elevation*** value other than zero will cause all selected points' elevations to be incremented by the given value. An elevation of 5.0 will cause a point with an elevation of 20.0 to have a new elevation of 25.0.
- When ***Relative*** mode is chosen, a linear transformation is performed from the first specified point to the second specified point. That is, all objects are moved the distance from the ***From Pt.*** to ***To Pt.*** and along the same angle as that from the ***From Pt.*** to the ***To Pt***.
- When ***Absolute*** mode is chosen, the transformation values become ***North*** and ***East*** as shown to the right.
  Transformation of all selected objects is then the specified distance in the North and East directions.

Rotation:

- The default rotation value is "no rotation".
- Selecting the ***Absolute*** rotation mode permits specifying the rotation as an absolute angle (which can also be a formula). Positive angles are clockwise, negative angles are counter-clockwise.
- Selecting the ***Relative*** rotation mode allows the angle to specifying as the angle from ***Dir 1*** (direction 1) to ***Dir 2*** (direction 2) As shown on the right, the ***Angle*** text box will become disabled**.** The ***Dir 1*** and ***Dir 2*** buttons are invoke the familiar *Line Define* dialog for defining the directions

Origin:

- The ***Origin*** defaults to North:0.0, East:0.0.
- The ***Origin*** values are not used unless a rotation other than 0 or a ***Scale*** factor other than 1 is specified. With a non-zero rotation, all selected data is rotated with the ***Origin*** value as the pivot location.
- In the ***Coord*** entry mode (the default), the origin is specified as a Northing and Easting.
- In the ***Point*** entry mode, a point number is either typed into the box labeled ***Point*** or selected from the screen (see picture on the right).

Scale:

- The scale defaults to 1 - no change. • Scale factors greater than one will increase distances while values less than one will decrease distances. Scaling is relative to the ***Origin.***

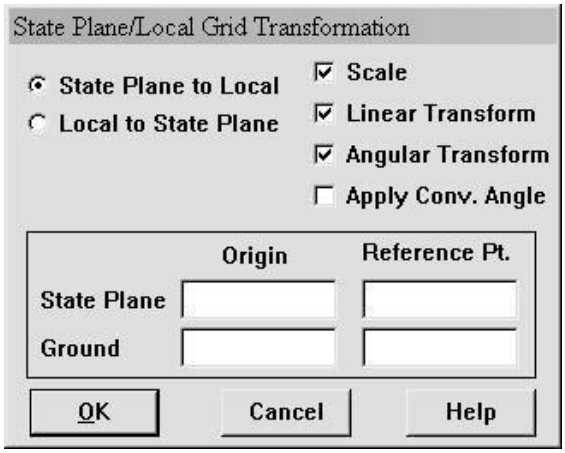
State Plane to Ground

This function is used to convert point locations between a state plane and local grid coordinate system. The transformation can work in either direction and involves linear, angular and scaling transformations. Scale factors are obtained by calculating the centroid of the area bounded by the selected points and calculating the combined scale factor at that location using standard state plane formulas. Linear transformations are possible only if a state plane and ground(local grid) origin are specified. For angular transformations, an additional pair of points must be designated. Scaling can be done independently when given only state plane coordinates.

As a reminder, state plane coordinates are, by definition, on the ellipsoid and are, with few exceptions, closer together than the same coordinates as measured on the ground since the ellipsoid is typically about 100 ft. below sea level.

To use this function:

1. Select the points that are to be transformed.
2. Select ***COGO-Coord. Transformation-State Plane to Ground.*** The following dialog will be displayed.



There are several ways to use this function.

- **You have state plane coordinates and want to scale them to obtain relative positions as would be measured on the ground.**

3. Select ***State Plane to Local***

4. Check ***Scale*** and select an ***Origin*** by either typing the number of or clicking near a selected point (cursor must be flashing in the ***Origin*** edit box when clicking near a point).

- **The same problem as above but, in addition, you want to rotate the system to true north.** Remember that state plane north and true north are different and that the difference is essentially what is called the "convergence angle". The program can calculate the convergence angle and automatically apply it if desired. Apply the same steps as above but check ***Apply Conv. Angle***.

- **You have state plane coordinates and one corresponding ground coordinate and want to put those two points on the same coordinates.** (Select the state plane points if you wish to translate them to the ground coordinates or else the local grid points if you want to translate them to state plane coordinates.)

3. Select ***State Plane to Local*** if transforming state plane points else select ***Local to State Plane*** if transforming local grid points to state plane.
4. Check ***Linear Transform*** and ***Scale***. Uncheck ***Angular Transform***.
5. Enter or select the origins for the state plane points and the local grid points. The selected set of points will be translated so that these two origin will be at the same location.

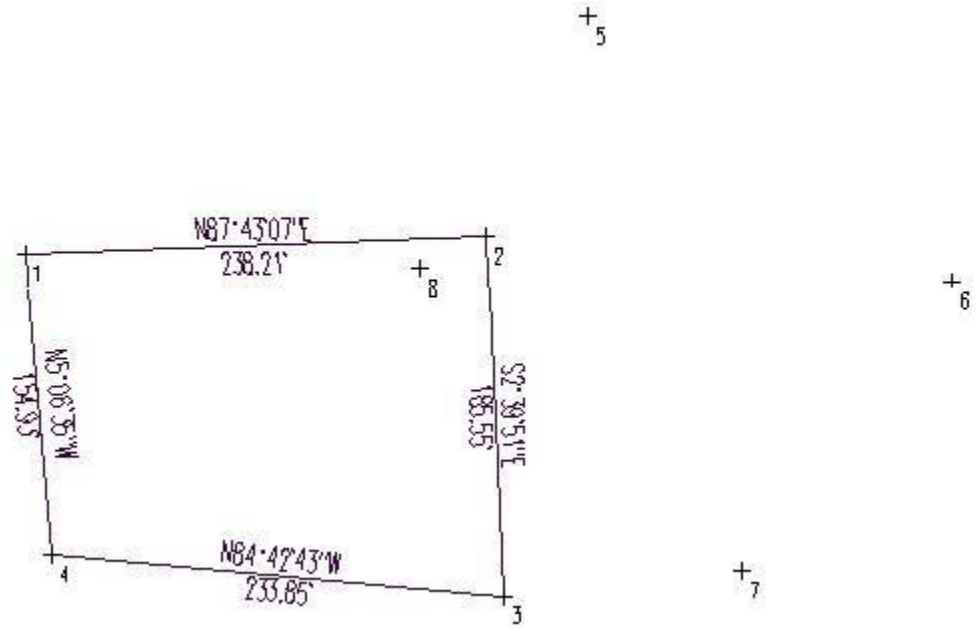
- **You have state plane coordinates and two corresponding ground coordinates and want to match locations of the first pair of coordinates and rotate so that the second pair of of coordinates are in the same direction from the first pair of coordinates.**
  Apply the same steps as above and add the following steps:

6. Check ***Angular Transform***.
7. Enter or select the ***Reference Pt.*** values for the state plane and local grid points.

Final Step

8. Press ***OK***.

Best Fit



In the set of points shown above, assume that points 1 through 4 represent data obtained from a map. Assume that points 5 through 8 represent data obtained in the field which we want to match to the map data. Assume, moreover, that we know that point 8 corresponds to point 4, point 6 corresponds to point 2 and point 7 corresponds to point 3. We want to find a transformation of point 5 through 8 that will minimize the total distance error between the three pairs we just listed.

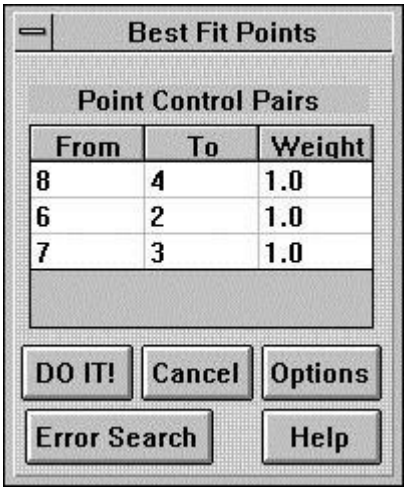
Coordinate Transformation **-** ***Best Fit*** is a function that can do this. Given a set of selected points and a set of control pairs such as that we just described above, this routine will calculate a best fit of the control point pairs through a least squares method and apply the transformation to all the selected points. Additionally, the point pairs can be individually *weighted* (assigned higher or lower priority) in the calculation.

In this example, to use this function,

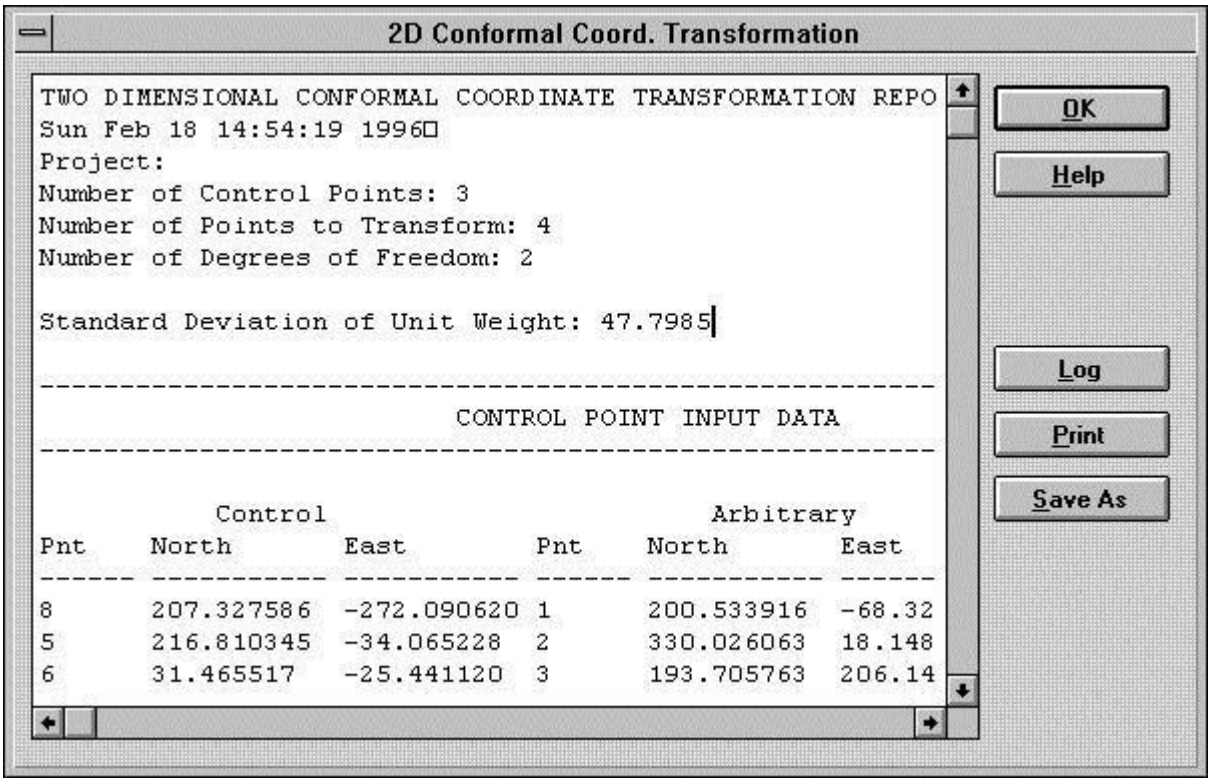
1) Select points 5 through 8 either with the mouse or through the command line (by typing ***SP 5-8*** **<** ***Enter***>).

2) Select ***Coordinate Transformation*** **-** ***Best Fit*** from the ***COGO*** menu in the COGO window. A dialog similar to the one shown on the right will appear (it'll probably be taller, but we're trying to conserve paper). Each line of the dialog's spreadsheet represents one control pair. The ***From*** column must contain an existing point from the selected points. The ***To*** point is an existing point that must be unselected. The ***Weight*** will default to 1.0.

3) Enter the control pair data. Data can be entered by either typing in the desired values or, in the case of the ***From*** and ***To*** columns, selecting a point from the screen with the left mouse button. The entries in the picture correspond to the example shown above.



4) Select ***DO IT!***. A report dialog will appear, similar to the one shown below, giving a report of the results of the transformation. The data can be examined within the report dialog, logged to the session log file, printed with the ***Print*** button, or saved to some specific file with the ***Save As*** button.



5) Select ***OK*** to complete the function. The selected points will be transformed and redisplayed on the screen. The picture to the right shows the result of the transformation on the example data.

Notes:

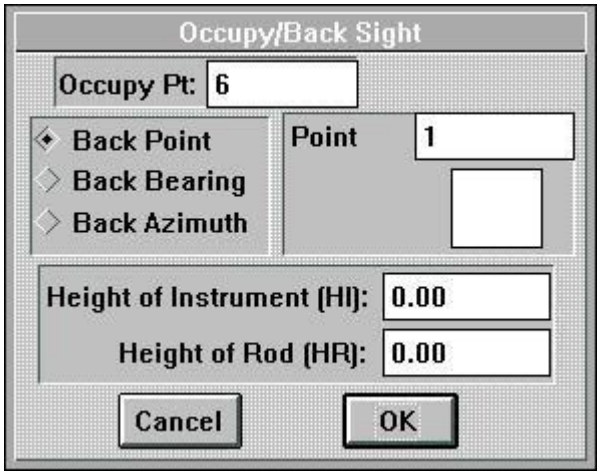
- The ***Edit*** - ***Undo*** function can be used to undo the transformation.

- This is a two-dimensional transformation - point elevation data is unaffected.

Other Functions

Occupy/Backsight

Occupy/Backsight in the ***COGO*** menu sets the current stationing or occupy point, backsight point or angle (bearing or azimuth), the height of instrument and rod. When the ***Occupy/Backsight*** command is selected, the dialog box shown on the right displays.



Occupy Point

This setting specifies the point that is currently occupied/or stationed. The point can be selected from the data window or entered from the keyboard.

Command: OC *Pnt*

Backsight Settings

Occupy/Backsight Dialog

The backsight may be specified by either the point number, the measured bearing and quadrant, or the measured azimuth. Each option is described in the following section:

Back Point	This setting sets the backsight by point number. When this option is used, a "Point" edit box displays on the right side of the Occupy/Backsight dialog box. The point may be selected from the COGO data window, or the corresponding point number can be entered in.
Back Bearing	This setting sets the backsight by specifying the measured bearing and quadrant. When this option is used, a "Bearing" edit box will display on the right side of the Occupy/Backsight dialog box.
Back Azimuth	This setting sets the backsight by specifying the measured azimuth. When this option is used, an "Azimuth" edit box displays on the right side of the Occupy/Backsight dialog box.

Command: BS *Pnt*

Height of Instrument (HI)

This edit box establishes the instrument height to be used. This is the elevation of the optical axis of the instrument above datum (not the height above ground).

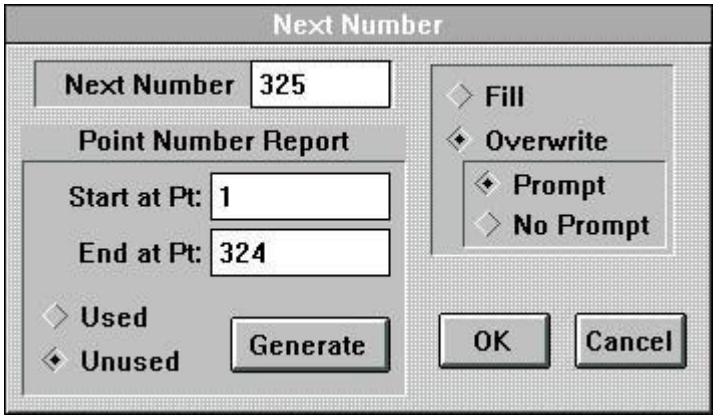
Command: HR *Val*

Height of Rod (HR)

This edit box establishes the rod (prism) height to be used.

Command: HR *Val*

Next Number



Next Number in the ***POINTS*** menu controls the number that will be assigned to the next point created.

- Enter the number in ***Next Number*** that the program should attempt to use for creating the next point.
- ***Fill*** will not allow using any point number that has already been used. If the program attempts to create a point with a point number already in use, the new point will be assigned the next unused number.
- ***Overwrite*** allows using numbers already in use and therefore can overwrite exiting points. For that reason (this option can be dangerous), ***Overwrite*** has a ***Prompt*** and a ***No Prompt*** option.

⇒ In ***Prompt*** mode, whenever the program attempts to create a point with a number already in use, it will ask whether or not to overwrite the old point with the new point.

⇒ If ***No Prompt*** is selected, the program will automatically overwrite the old point with the new point.

The ***Point Number Report*** options can be used to generate a report of the used or unused point numbers within a project and within a given range of values. The report is sent to the Main Window.

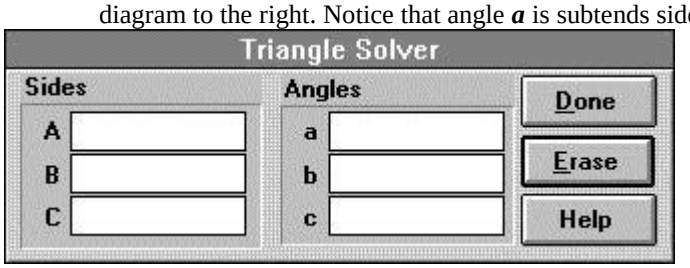
- Enter the beginning and ending point number values in the ***Start at Pt*** and ***End at Pt*** edit boxes.
- Select ***Used*** or ***Unused*** according as to whether you want to know which point numbers have been used or which point numbers have not yet been used.

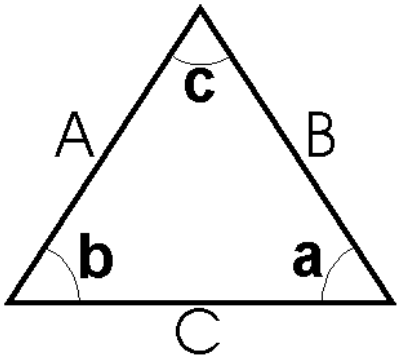
- Select ***Generate***.

  Example: if ***Start at Pt*** is 25 and ***End at Pt*** is 64, only point numbers with values between 25 and 64

Triangle Solver

The ***Triangle Solver*** in the ***View Menu*** is a calculator that, given three triangle side/angle parameters or values, calculates the values for the remaining three side/angles. The abbreviations used in the dialog are demonstrated in the diagram to the right. Notice that angle ***a*** is subtends side ***A***, angle ***b*** subtends side ***B*** and angle ***c*** subtends side ***C***.





To solve for a

triangle, any of the following sets of parameters (or values) can be used:

- Three sides.
- Two sides and an included angle (i.e. side A, side B and angle C).
- Two angles and any side. To use this dialog:

1) Enter the desired values into the corresponding edit boxes. Use the mouse or the <TAB> key to move between edit boxes.
2) After the third value is entered, press the <TAB> key or left-click with the mouse on an edit box other than the one just used. The remaining values will be displayed in their corresponding edit boxes.
3) Select ***Done*** to exit the function or ***Erase*** to clear the values and start another calculation.

   The following notes apply:

- After two values are entered into the dialog, certain entry boxes will be disabled in order to force the conditions just mentioned. For instance, after entering a value for angle ***a*** and angle ***c***, the edit box for angle ***b*** will be disabled since specifying the three corner angles does not provide a unique solution.
- Distance formulas and distance selection from the screen can be used for entering the ***Sides*** data.
- Angle formulas and direction selection from the screen can be used for entering ***Angles*** data.
- As with all edit boxes, values can be cut, copied and pasted via the Windows clipboard.

Regular Expressions

Regular expressions are used for specifying a single pattern which can match any number of strings. Regular expressions provide a means of specifying many strings using a single pattern. The following characters are used:

*****	O or more occurrences of preceding pattern.
%	Beginning of line
$	End of line
?	Any character
[	Beginning of character set
]	End of character set
^	Negation of character set if immediately follows **[**
-	Used for range of characters when between **[** and **]**
#	integer value - used in ***Auto Draw***
\	Interpret a special character literally.
\t	Tab character
\n	Newline character

Some examples are:

%AB matches any string that starts with AB such as **AB**, **ABC**, **ABCDEFGHI**.
AB$ matches any string that ends with AB such as **AB**, **GXAB**, **DEFGHAB**.
%AB$ matches only those strings that are simply **AB**.
AB*C matches only those strings that have an A and a C with 0 or more Bs in between such as **AC**, **ABBC**,
XBYABBBBCDEF.
A?C matches those strings with an A and a C and any character in between such as **ABC**, **WATCH**. **PT[012]** matches any string with **PT0**, **PT1**, or **PT2** in it.
PT[0-9] matches any string with **PT0**, **PT1**, **PT2**, **PT3**, **PT4**, **PT5**, **PT6**, **PT7**, **PT8**, or **PT9** in it.

PT[^0-9] matches any string with a PT in it that is not immediately followed by a digit. **APTX**, and **PT** will match but **IPT5** will not.
PT[A-Za-z] will match any string with a PT that is immediately followed by an alphabetic character.
PT[A-Za-z0-9] will match any string with a PT that is immediately followed by an alphanumeric character. **PT[A\Z]** will match only those strings with **PTA**, **PTZ** or **PT-** in them.

The DTM Window

The DTM (**D**igital **T**errain **M**odel) Window is used for generating the TIN (**T**riangulated **I**rregular **N**etwork), contour lines, TIN-based profiles and calculating volumes. Control over contour parameters include the major and minor contour intervals, minimum and maximum elevation values over which to generate the contours and the degree of "smoothness" for individual contour segments. The TIN can be manually adjusted. Break lines can be used to identify local minimums and maximums. The line types and colors of

contours can be altered. Elevation labels can be manually inserted or automatically generated at a user-specified interval.

The first step in using the DTM is to define at least one surface. Surfaces are initially created through the ***TIN***-***Insert Points*** function after selecting a set of points that comprise the surface. Each defined surface must have a unique name consisting of one or more characters (*Surface 1, Ground Zero, Fido's Craters,* etc.). Once a surface is defined, it can be ***TINTriangulate***d to create its TIN. Contours can be generated once the TIN has been created through the ***Contours***-***Generate*** function.

Project

New, Open, Save, Save As, Close, Exit

These all behave the same as they do in all of the other windows.

Print

This will print the current view as shown in the DTM window. The screen view will be scaled to fit the printer page, maintaining the aspect ratio. (That just means that the relative sizing in both the x and y directions will be the same so that one will not stretch more than another. To keep the aspect ratio the same, it may be necessary to include more data in either the x or y dimension than is shown on the screen.).

Edit

Linestyle

Set Font

Set Color

Set Layer

Delete

Delete is a generic function that will delete all selected objects, be they points, segments, or breaklines. Just select the objects that you want to delete and **only the objects you want to delete** and then select ***Delete*** from the ***TIN*** menu.

Cross Sections

To create a cross section:

1. Create alignment
2. Create tin(s) and/or make sure that all alignment points have elevations.
3. Select alignment

4. Select **Cross Sections** in **Edit** menu in DTM window.
5. Set up cross section information

To set up cross section information:

- ***Start Elev and End Elev***
  Initially set to lowest and highest elevations of the points along the alignment. Change these values if you want to change the range of elevations displayed along the vertical axes of the cross sections. • ***Offsets***
  Be SURE to enter the distance to the left and right that the cross sections will extend off of the alignment.
- ***Multiple Stations***
  Enter the starting station, ending station, and how often between these stations to create cross sections.
- ***Individual Stations***
  Add any other station values at which to create cross sections.
- ***Existing, Proposed, and Other Surfaces***
  If you want to display elevation values for one or two surfaces at an offset of 0 for each cross section (in other words, at the point that is on the alignment), you can select the surface for the existing or proposed surface. The elevation of the alignment on the surface selected for ***Existing*** will be displayed (by default) to the left of the grid line at 0+00 and the elevation on the surface selected for ***Proposed*** will be displayed to the right of the grid line. Both of these surfaces will have their profile shown in the cross section. If you want to show the profile of any other surfaces, select them in the ***Other Surfaces*** dialog box.
- ***Horizontal Axis/Vertical Axis***
  Set the axis information by selecting the ***Horizontal axis*** button and/or ***Vertical axis*** button.

To set the axis information:

- ***Scale***
  set the scale in feet/inch
- ***Display***
  controls whether to display the scale information and, if so, what font and color to use.
- ***Axis Display***
  control the size in inches of the margin as well as the font to use for the tic annotations and the linetype and color to use
  for the tics.
- ***Major and Minor Grid***
  control whether or not to display the corresponding grid lines. Click on the ***Info*** button to control the interval or spacing
  between the grid lines as well as the linetype and color to use for the grid lines.
- ***Major and Minor Tics***
  control whether or not to display the corresponding tic marks. Click on the ***Info*** button to control the interval or spacing
  between the tic marks, the length in inches of the tic marks, as well as the linetype and color to use.
- ***Existing Lt/Finish Rt and Finish Lt/Existing Rt***
  Controls which side of the 0+00 grid line to place the elevations of the existing and proposed surfaces.

- ***Annotation Elevations***
  Turn off the display of the existing and proposed elevations on the 0+00 grid line.
- ***Edit Window***
  To look at one of the cross sections, click the ***Edit Window*** button. This will bring up a list of the cross sections that have been or will be created along this alignment. Select the appropriate cross section and click ***OK***. A window will be displayed showing the selected cross section. This window is similar to other windows in the program and, for example, allows zooming and selecting just like all of the other windows.
  If one of the parameters already selected needs to be changed, go to the **Edit** menu in the Cross Section window and select **Edit** from the menu. This returns you to the same dialog you were just in so you can change any of the above parameters. Objects in this window can be selected and their colors and/or linestyles changed. They can also be deleted.

To print out the cross section:

1. Go to the Layout window.
2. Select **Cross Section** from the **Draw** menu. A pink box will be displayed showing the dimensions necessary to display all cross sections.
3. Move the pink box to the appropriate position on the sheet and then click the left mouse button. The cross sections will be displayed on the sheet. They will be placed as a unit and are moved as a unit. If you want to further refine the display of the information, you can select the complete cross section information as placed on the sheet and then select **Smash** from the **Components** menu. This will break down all of the information into the constituent lines and texts.
4. Select **Print** from the **Project** menu of the Layout window.

TIN

These functions control the points which can be in the TIN, the segments which are in the TIN, and the breaklines.

Insert Points

Insert Points is used to select which points can be placed in the TIN. The DTM window will only allow selecting points which have a valid elevation. Points with an invalid elevation will not be selectable. Points that are not currently "in the net" will be drawn in gray. To use this function,

1) Select the points that you want in the TIN. The points which are selected will be highlighted, the same as if they had been selected in the COGO window..

2) Then select ***Insert Points***. The points will be redrawn in their original COGO color. Only these inserted points will be used when creating the TIN.

3) Use the ***Triangulate*** function to create the TIN from the inserted points.

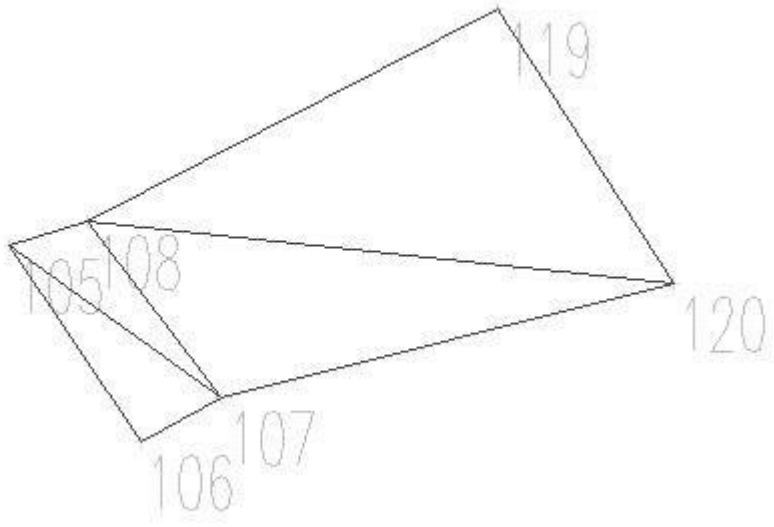
The DTM window has a point filter that is similar to that of the COGO window (see p.111). This filter can be used, among other things, to restrict the range of point elevations that can be selected.

Insert Segment

Insert Segment is used to manually create a triangulation segment. This might be used when the automatic TIN generator does not create the TIN exactly as desired. To add segments, select ***Insert Segment*** from the ***TIN*** menu. You will first be prompted for the TIN in which to insert the segments. Then you can type in the point numbers or click near the points in the DTM window. If you just want to create the one segment, select ***DONE*** after entering the point numbers. To create more, select ***Continue***. To quit without creating this segment, select ***Cancel***. More than one segment can be created at once, using commas to separate point numbers and semicolons to end one segment before starting another. In the example dialog, segments will be created from 4-5, 10-11, 11-12, and 12-14.

Triangle Swap

Triangle Swap will remove selected segments between two triangles and will replace them with a segments that connect the opposite corners of the triangles. For example, given the following triangulation,

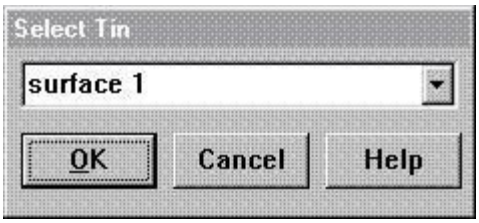


if you select the segment connecting 108 to 120 and the segment connecting 105 to 107, the segment connecting 108 to 120 will be replaced with a segment connecting 107 to 119 and the segment connecting 105 to 107 will be replaced with a segment connecting 106 to 108.

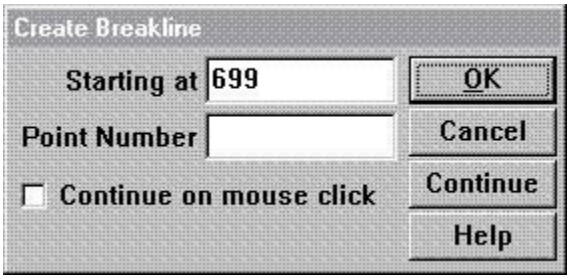
Insert Breakline

Insert Breakline is used to create a breaklines - segments of the triangulation that will be "locked in" during triangulation. Breaklines are usually used for peaks and valleys within the surface to force correct contour generation. To use this function:

1) Select ***Insert Breakline*** from the ***TIN*** menu. You will first be prompted for the TIN in which to insert the breaklines as shown in the dialog to the right. Select ***OK*** when done.



2) A dialog similar to the one on the right will then be displayed. This dialog behaves in a similar manner to the ***Connect Points*** dialog (see p.133). Insert a point number into the ***Starting at*** edit box either by typing in a number or, with the focus in the edit box, clicking near the desired point on the screen.



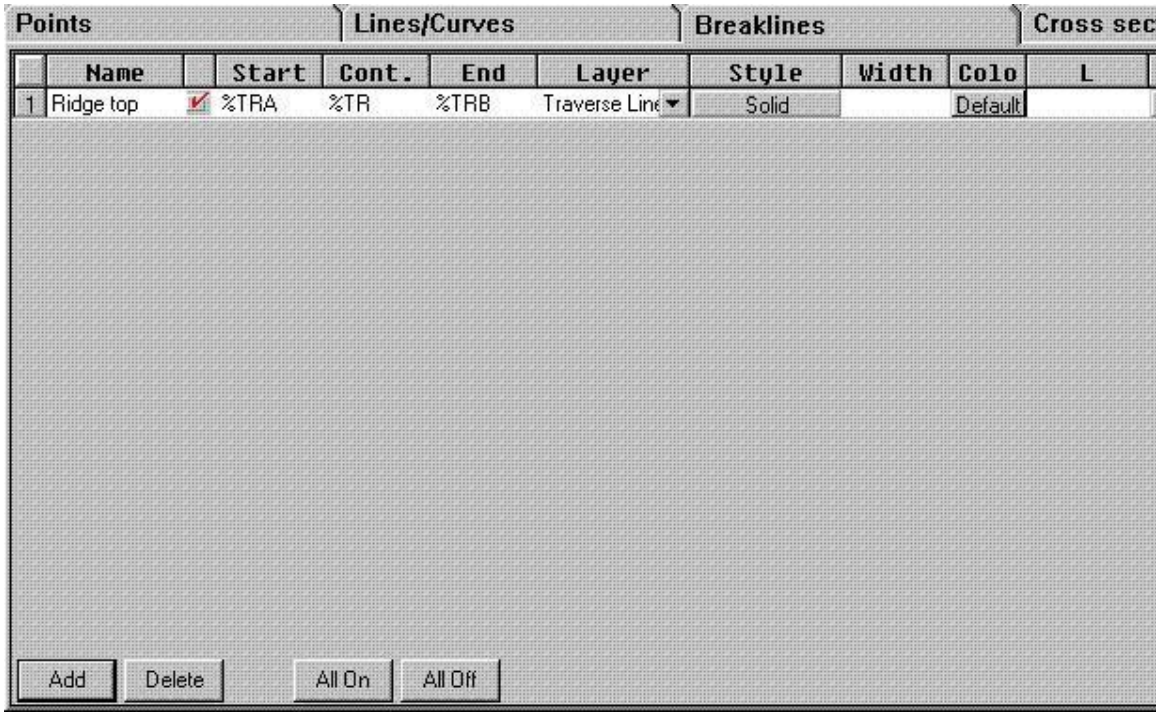
3) Next, enter one or more numbers into the ***Point Number*** edit box ***OR*** turn on the ***Continue on mouse click*** option and click near each point on the screen to enter successive breakline segments.

4) Select ***OK*** when you are finished. Select ***Continue*** if you are typing in the ***Point Number***s and wish to add some more. Select ***Cancel*** to abort the function.

Notes:

- More than one segment can be created at once, using commas to separate point numbers and semicolons to end one segment before staring another, In the example dialog above, the segments 2-5, 5-6, 6-7, 7-8, and 4-9 will be created.

Auto Breaklines



Using a system similar to the ***Auto Draw*** function (see p.137), breaklines can be automatically created by using the point descriptions.

To use this function,

1) Select ***Auto Breaklines*** from the ***TIN*** menu. A dialog similar to the one shown above will appear. Each line of the dialog contains a auto-breakline *definition* that controls how the breaklines will be generated.
2) The checkbox in the second column of each controls whether that line will used in the mapping. Check/uncheck all the rows that are to be used/not used.
3) Select ***OK*** to create the defined breaklines. Select ***Cancel*** to abort the function.

To ***Add*** a new definition,

1) Select ***Add***. An empty line will be added to the list below the current line (the line that has the focus or cursor flashing in one of the line's boxes).
2) Enter a unique ***Name*** for the definition in the ***Name*** column.
3) Enter the ***Start, Cont***inue and ***End*** patterns. Remember that these can be regular expressions.
4) The layer, line style, width and color will be that of the default layer for breaklines unless changed in the mapping definition. For example, changing the width from 0.00 (which tells the program to use the default value) to 0.01 will alter the width of the lines used for the breakline generated by that definition, but will leave all other settings the same as the default values.

To ***Delete*** an existing definition,

1) Left-click anywhere in the row that is to be deleted.
2) Select ***Delete***. The row that currently has the focus will be deleted.

Alignment Breaklines

Alignment Breaklines is used to translate cogo alignments into breaklines - segments of the triangulation that will be "locked in" during triangulation. To use this function:

1) If the alignment(s) does not yet exist, create it in COGO.
2) Select one or more alignments.
3) Select ***Alignment Breaklines*** from the ***TIN*** menu. Breaklines will be created for each line in the selected alignments.

Triangulate

This function triangulates all current contour points within a selected surface.

1) First, make sure that all desired points have been selected and inserted into the list of contour points with the ***Insert Points*** command.
2) Select ***Triangulate*** from the ***TIN*** menu. If more than one TIN has been defined the ***Select TIN*** dialog will appear. If so, select the desired TIN from the ***Select TIN*** list and select ***OK***.

3) The TIN will now be generated. Dialog boxes will appear showing the state of the triangulation. Clicking on ***Cancel*** in one of these dialogs will abort the generation of the triangulation.

Notes:
If breaklines are to be used, insert these first, either by using the manual ***Insert Breakline*** function or the ***Auto Breaklines*** function.

Info

The ***Info*** function is used to obtain general information about all existing TINs. Information provided includes the perimeter and surface area.

Contours

Generate

This function creates the contour lines for a specified surface. The ***Contours***-***Settings*** function control the major and minor contour intervals, automatic labeling and the elevation range over which to contour.

Settings

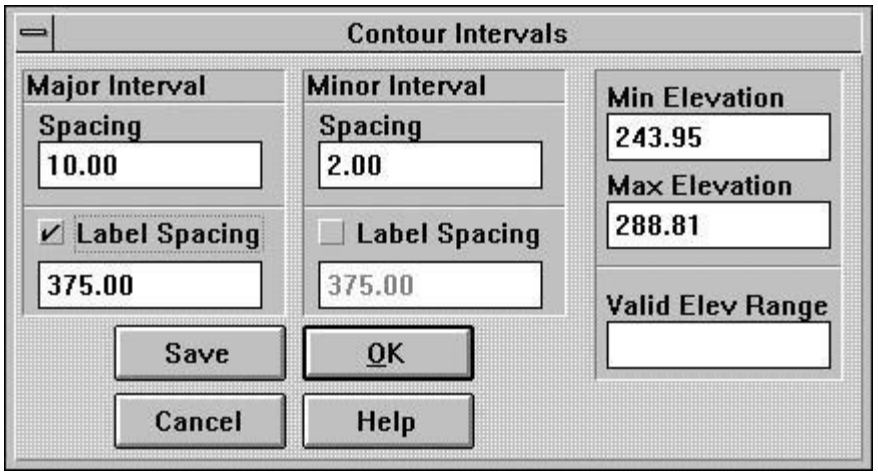
The ***Contour Settings*** dialog is used to control which elevation contours are generated as well as automatic label generation.

Major Interval and ***Minor Interval*** are used to define the major and minor contour lines. Major and minor contours are placed on different layers, so it is possible to use different line styles for each type of contour. Generally, minor contours are specified so as to occur at some even interval between the major contours. For example, one might place major contours at 10 ft. intervals (100, 110, 120, etc.) with minor contours at 2 ft intervals (102, 104, 106, 108, 112, etc.).

The surveyor can also specify what ***Min***imum ***Elev***ation and ***Max***imum ***Elev***ation to use for generating the contours. Contours with elevations below the ***Min Elevation*** or above the ***Max Elevation*** values will not be generated.

Valid Elevation ***Range*** is used to specify what point elevation values are useable in generating the TIN. If it is blank, all selected points with elevations are inserted in the net.

Valid range strings must start with a number followed by a hyphen. A maximum range value is optional.
Examples: 200-450(all values between 200 and 400, inclusive) or *1-(all values greater than or equal to 1)*



So, in the example from the following dialog box, minor contour lines will be placed for every two foot change in elevation and they will not be labeled. Major contour lines will be placed for every ten foot change in elevation and they will be labeled with the elevation value of the line and the labels will be placed every 375 feet along the contour line. The contour lines will not include elevations lower than 243.95 or higher than 270.32 so, in this case, major contour lines will be created for 250, 260, and 270. Minor contour lines will be created for 244, 246, 248, 252, 254, 256, 258, 262, 264, 266, and 268. Grid points will be placed every 10 feet.

Add Labels

Contour elevation labels can be generated automatically through the ***Contour Intervals*** dialog (see above) or they can be manually placed with the ***Add Labels*** function. To use this function, 1) Select ***Add Labels*** from the ***Contours*** menu.

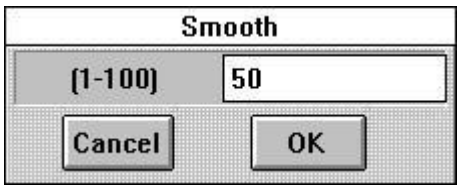
2) Move the mouse cursor to the point on the desired contour where an elevation label is to be inserted.

3) Left-click the mouse. The contour line will be broken and a elevation text will be inserted at that point.

Notes:

- The precision (number of decimal places) in the label is controlled by the ***Precision*** settings in the ***Environment*** - ***Options*** dialog (see p.60).
- Once created, elevation labels can be moved and rotated like other texts. Contour lines will be broken or repaired automatically.

Smoothing



This function allows you to control how much the contour lines curve. Before explaining the different options for applying the smoothing factor, a couple of definitions are helpful:

⇒ Contour Segment: The part of a contour line that crosses from one TIN line to another. Each contour segment is separately selectable, primarily to allow this function to apply different smoothing factors to different parts of a contour line. Longer contour segments

will curve more than short contour segments and may need to have smaller smoothing values.

⇒ Smoothing: The amount of curvature of a contour line from one TIN line to another. This number can be between 1 and 250 where 1 is no smoothing and 250 is maximum smoothing. The default value is 50.

The options for applying the smoothing value to the selected contour segments are:

- *Apply to entire contours*: The smoothing value will be applied to the entire contour lines for all contour segments that have been selected.
- *Apply to ends of segs*: The smoothing value will apply to both ends of all selected contour segments.
- *Apply to intersections*: The smoothing value will only be applied to the common endpoint of adjacent selected contour segments.

Set Font

• This function operates on selected contour labels. See the ***Fonts*** section on p.29 for more information

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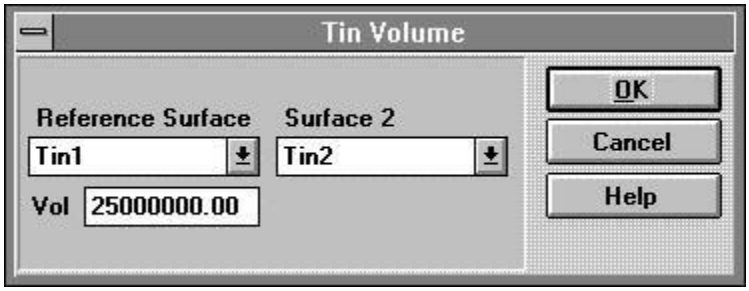
Volumetrics

Prismoidal

The ***Prismoidal*** volumetrics function is used for volume calculations. It will display the following dialog:



To calculate the total volume between two surfaces:

1. Create the two TINS which represent the existing and proposed (or design) surface.
2. Select ***Existing Surface*** and pick the surface to use.
3. Select the surface to use for the ***Design Surface***.
4. Click ***Calculate.*** The cut and fill values will be displayed.

To calculate the volume between a surface and a reference elevation:

1. Create the TIN which represents the proposed (or design) surface.

2. Select ***Datum Elevation*** and enter the elevation.
3. Select the surface to use for the ***Design Surface***.
4. Click ***Calculate.*** The cut and fill values will be displayed.

To calculate the volume between two surfaces within a specified area:

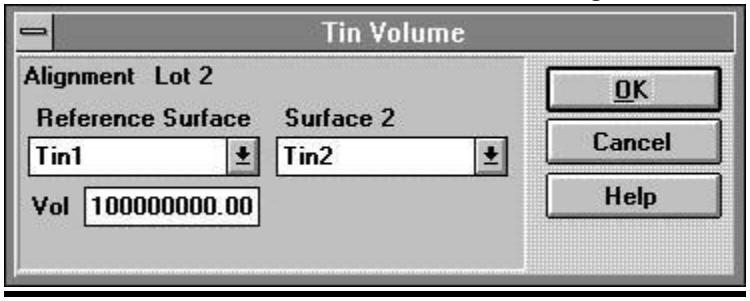
1. Create the two TINS which represent the existing and proposed (or design) surface.
2. Select one or more boundaries before selecting **Volumetrics | Prismoidal**. If exactly one boundary has been selected before starting this function, the name of the alignment will be displayed at the top of the dialog box.
3. Select the ***Existing Surface*** and pick the surface to use.
4. Select the surface to use for the ***Design Surface***.
5. Click ***Calculate.*** The sum of the cut and fill values within the boundaries will be displayed.

To calculate the volume between a surface and a reference elevation:

1. Create the TIN which represents the proposed (or design) surface.
2. Select one or more boundaries before selecting **Volumetrics | Prismoidal**. If exactly one boundary has been selected before starting this function, the name of the alignment will be displayed at the top of the dialog box.
3. Select ***Datum Elevation*** and enter the elevation.
4. Select the surface to use for the ***Design Surface***.
5. Click ***Calculate.*** The sum of the cut and fill values within the boundaries will be displayed.

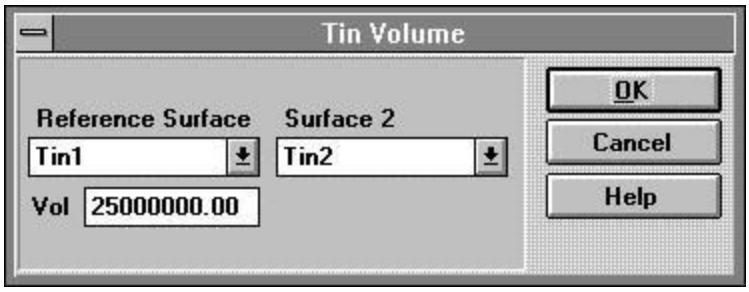
To get a printed report of the results:

1. Click ***Report***.
2. Click ***Print***.
3. Click ***OK*** to return to the Prismoidal Volumetrics dialog box.



Average End Area

The ***Average End Area*** volumetrics function is to calculate the volume along an alignment that has cross sections. It will display the following dialog:



To calculate the total volume between two surfaces:
Create the two TINS which represent the existing and proposed (or design) surface.

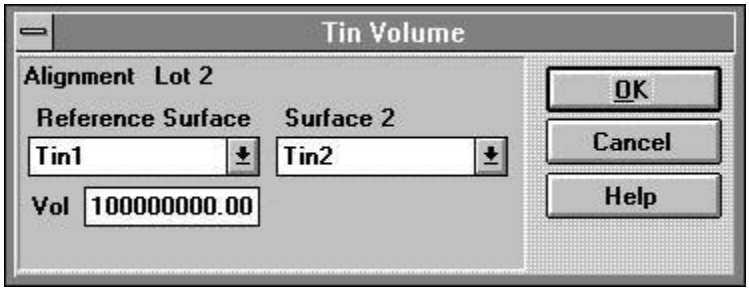
1. Create the two TINS which represent the existing and proposed (or design) surface.
2. Select the alignment.
3. Select ***Existing Surface*** and pick the surface to use.
4. Select the surface to use for the ***Design Surface***.
5. Click ***Calculate.*** The volume will be displayed.

To calculate the volume between a surface and a reference elevation:

1. Create the TIN which represents the proposed (or design) surface.
2. Select the alignment.
3. Select ***Datum Elevation*** and enter the elevation.
4. Select the surface to use for the ***Design Surface***.
5. Click ***Calculate.*** The volume will be displayed.

To get a printed report of the results:

1. Click ***Report***. The report will show the area at each station as well as the volume between each consecutive pair of stations and the running total of the volumes.
2. Click ***Print***.
3. Click ***OK*** to return to the Prismoidal Volumetrics dialog box.

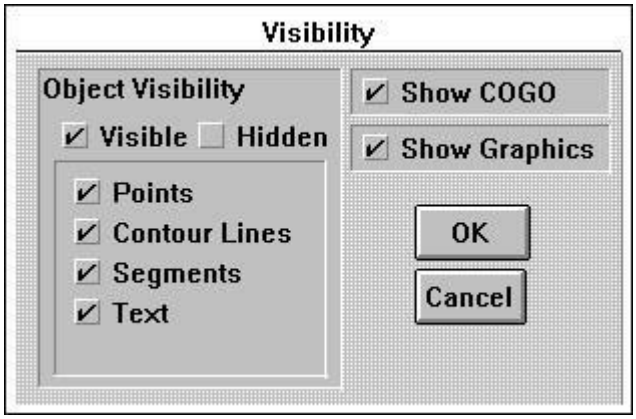


View Menu

See the section on Common View Functions on p.38 for information about ***Redraw Screen***, ***Full View***, ***Pan View***, ***Zoom In***, ***Zoom Out*** and ***Zoom Back***.

Visibility

This function behaves just like ***Visibility*** in the other windows. You can alter the visibility of COGO and Layout objects, of Points, Contour Lines, Segments and Texts as well as showing hidden objects.



Options

Select Status

Toggle the visibility of the select status bar which shows the mouse position and the select status for points, contour lines, texts, and segments.

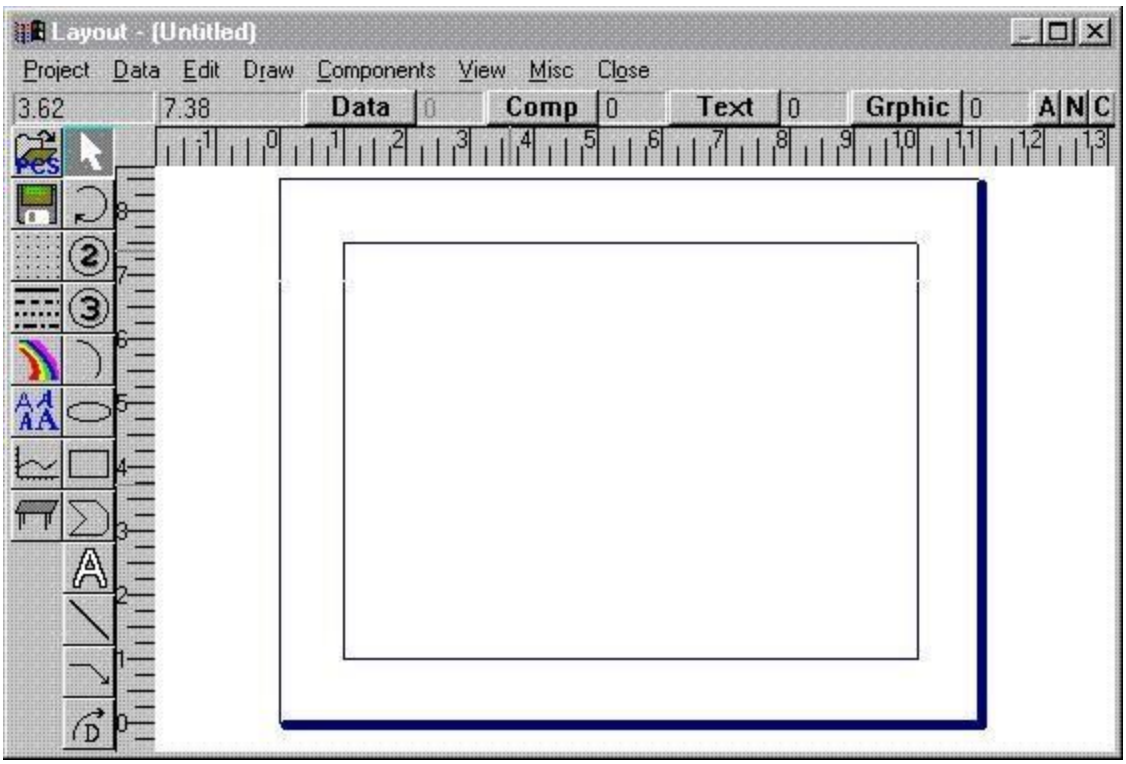
Tools

Toggle the visibility of the tool bar to the left of the viewing area.

Close

Close the contour window.

The Layout Window



While COGO is used for editing map data, Layout is used for placing the map on the page and adding graphic items such as title blocks, certifications, north arrows and scenes from the L.A. riots (the latter is accomplished very simply - just cut out the picture of your choice from a copy of Newsweek or Time, apply a sparing amount of Elmer's glue, and - voila!).

Layout has several powerful features that allow the creation of finished plats in just minutes. To make the most of Layout, it is important to understand what *components* are and how they work. By using components, everything from a simple symbol to a complete page *Form* can be created and stored in a library for future use. For instance, a component might consist of a border, title block and various certifications that can be placed as a single entity on the page. Alternatively, title blocks, certifications, et. al. can be stored as individual pieces. Multiple libraries are supported as well.

Another powerful feature of Layout is the ability to import and export DXF files. Drawings imported as DXF files will retain their hierarchy and layers. Blocks that exist in a DXF file will be imported as components that can be readily transferred to a library.

The items in the layout window are similar to the COGO window items (see p.93). To open the layout window, select ***Layout*** from the ***View*** menu or press ***F3***.

Tool Bar

The Layout Toolbar is a column of buttons that appears on the left side of the Layout window when enabled. It is simply a quick way to access commonly used functions that are also available through the menu bar.

From top to bottom, the left side functions are – ***Open*** (Project), ***Save***, ***Grid/Snapping***, ***Linestyle***, ***Color***,
Font, ***Profile***, ***Table***. From top to bottom, the right side functions are – ***Select*** (normal mode), ***Rotate***, ***Circle***, ***Circle (3 Point)***, ***Arc***, ***Ellipse***, ***Box***, ***Polygon***, ***Text***, ***Block Text***, ***Line***, ***Rotate***, ***Straight Dimension***, and ***Curved Dimension***.

Use the ***Misc*** menu to toggle the Tool Bar on or off.

Coordinate Display

The Coordinate Display is in the lower left corner of the window and is part of the Select Status Bar. The left box of the display shows the x coordinate of the cursor and the right side shows the y coordinate of the cursor.

Select Status Bar

The Select Status Bar is a series of buttons and boxes containing numbers. This is just the same old thing that you've seen before in COGO and Survey - just the names have been changed to protect the innocent (at least that's what I'm going to plead in court).

So, let's recap. The buttons actuate the selection filters (although none have been implemented yet). The numbers indicate the number of each type of data that are selected. *Data* refers to plot views on the page. *Comp* (components) refers to the tables, scale components, north arrows and groups of primitive graphics. *Text* refers to.. TEXT (wow). *Grphic* refers to the primitive graphic items -- lines, boxes, arcs, circles, ellipses, polygons, straight dimensions, and curved dimensions.

Additionally, there is a "C" (for **CLEAR**) button on the far right which is a quick way to unselect all selected data.

Use the ***Misc*** menu to toggle the Select Status Bar on or off.

Data Types

Data (Dataviews)

This is the view of the COGO data that is placed on the layout page. A *view* can be all of the COGO data, a collection of selected items, a zoomed in view (screen view) or a *view area* (defined by the ***Set View*** COGO function in the ***View*** menu).

Graphics

Graphics are the primitive elements that are used to make more complex items. These primitive elements include *lines, texts, boxes, arcs, circles, ellipses, polygons, straight dimensions*, and *curved dimensions*. You must be over 18 to use the extra features of the adult version.

Texts

Texts can be just a few characters or very long strings (paragraphs) that are fitted into a rectangular area. Long texts wrap (i.e. begin a new line) at the end of each line. Texts can be fitted to a rectangular area. They can be resized, stretched, rotated, and of any kind of font that your printer/plotter will support (note: put another commercial for inkjets or thermals in here).

Yes, fans, you can squeeze them, twirl them, create them and destroy them with utmost prejudice. Amaze your friends and family. *Free with proof of purchase.*

Components

Graphics that were created separately can be grouped into an item called a component. This component can then be moved about, placed, and resized as if it were a primitive graphic element. There are also special components that include *Tables, Scale Components,* and *North Arrows* that the program creates or manipulates automatically. Layout also supports *groups* - temporary collections of graphics and components that are manipulated as a single unit.

Tables

Tables (curve, line, and point) were defined in the COGO section. Layout just allows placing them on the page. To look at it another way, a table's spiritual essence has its morphological origins within the swirling chaos of the COGO universe. Over time (hopefully not on a galactic scale), the table achieves visible incarnation in the physical realm of Layout through the god-like intercession of you, the user. Isn't that simple?

Scale Components

A scale component is associated with a plot view and shows the scale of the view. Changes in the view's scale result in the updating of its scale component (if it has one).

Example of a Scale Component

North Arrows

Each north arrow is associated with a plot view and shows the direction of north in the plot. The arrow itself is defined by a component.

Groups

Several graphic items can be grouped together, without making them into a component, and then manipulated as if they are a single item.

Data Selection

Just as in the COGO window, many of the layout functions operate on a *select list.* Layout's *select list* is separate from the select list for COGO and consists of the selected layout items. For more information on selecting and unselecting items and on select lists, refer to the ***Data Selection*** section of the ***COGO*** chapter.

Some items, such as lines, will be highlighted by being drawn in magenta and other items, such as dataviews, will be highlighted with a magenta box around the entire item.

All selected items will have little black boxes on the magenta lines. These black boxes are called *nibs* and are used for altering the item. Opening little black boxes can be very dangerous, so we have taken the precaution of disallowing that feature. When the cursor is over a nib, it will change to a cross. When you have this cross cursor, if you press the left button and drag, some aspect of the item will change. To move the item, press the left button when the cursor is on the object at some point other than a nib, hold the button down for half a second until the object(s) is replaced with a box outline, drag and then release the cursor.

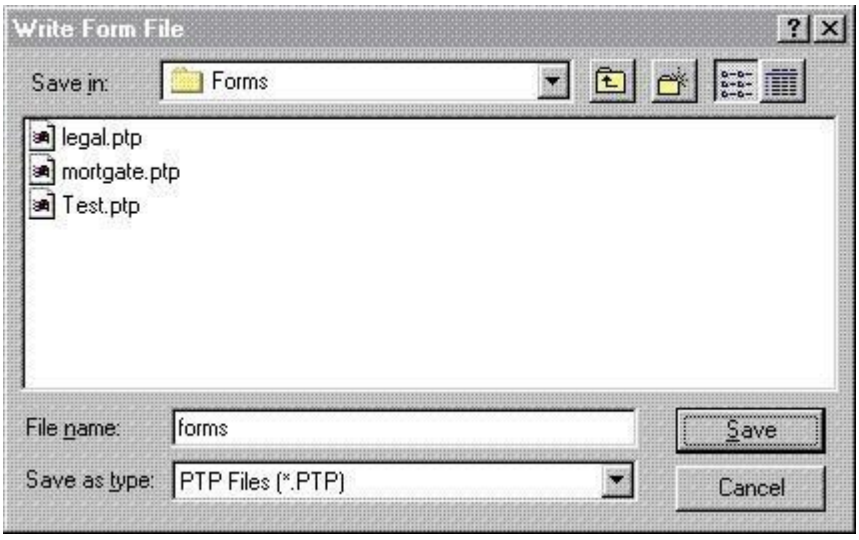
Forms

Forms can be used to store commonly used sheet arrangements. A ***Form*** can store page size, orientation, and border settings. Components and graphics can also be stored with the exception of scale components and north arrows.

Read/Write Form

To create a ***Form***,

1) Set all the parameters to the desired values (page size, orientation, borders, margins, rows and columns).



2) Place all the components and graphics that are to appear on the *Form* (title blocks, cut lines, certifications, etc.)

3) Select ***Write Form*** from the Layout ***Project*** menu. A standard file dialog will appear, similar to the one shown above, to prompt for the *Form* name. *Form* file names have the default extension of **.PTP** (i.e. myform.ptp is a possible *Form* name). The *Form* file directory is designated in the *OptionsDirectories* settings (see p.58).

4) Select ***OK*** to save the *Form*.

Retrieving a ***Form*** is similar to opening a project.

1) Select ***Read Form*** from the ***Project*** menu. A dialog similar to the one shown above will appear.

2) Select the *Form* that is desired and select ***OK***.

Data functions

Dataview Placement

There are three ways to place the COGO data on the layout page: ***Full View***, ***Screen View***, and ***View Area***, each in the ***Data*** menu. The term, *dataview*, will be applied to an instance of a data placement in layout.

- ***Full View*** will place a view that will include ALL of the COGO data.
- ***Screen View*** will place a view that includes what is currently displayed in the COGO window. If the COGO data window is showing a full view of the data, then ***Full View*** and ***Screen View*** will have the same effect.
- ***View Area*** will place a selected view area on the layout page. The perspective will depend on the COGO scale set in the ***COGO*** - ***Options*** dialog box (see p. 100).

To place one of these dataviews, select the appropriate option from the ***Data*** menu. If you are placing a view area, the function will first ask which view area to place. The cursor will become a box with an x. Place the cursor so that the upper left corner of the cursor is where the upper left corner of the plot will be and click the left button.

A selected dataview has a magenta outline and four nibs that move each side of the outline. Changing the size of the outline changes the area of the COGO data that is visible on the layout page - it *clips* the view. It will not change the scale.

To move a dataview, press the left button anywhere in the dataview, wait a half second until the dataview is erased leaving only the outline, move the cursor and outline to the new location and release the button.

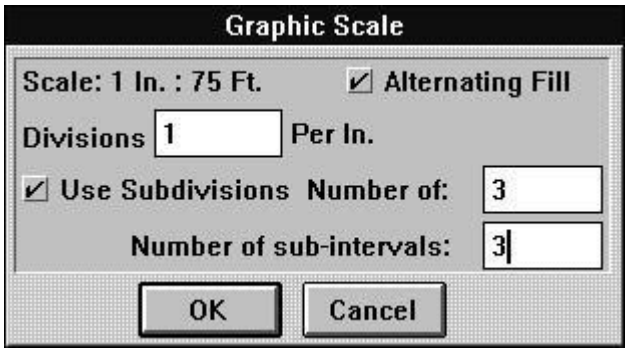
Use the ***Rotate*** function in the ***Edit*** menu or from the toolbar to rotate a dataview (see p.).

Each dataview placed can have a unique scale setting and, therefore, a unique scale component (see p.208) and north arrow (see p.209).

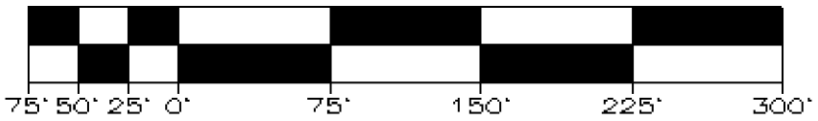
Dataview Accessories

Scale Components

Scale Components show what the scale of a plot is. To create a scale component,



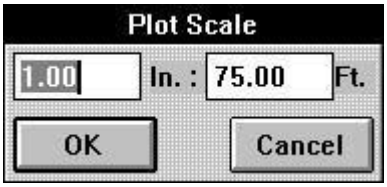
1) Select the view that the scale component will represent.
2) Select ***Create Scale Component*** from the ***Data*** menu. A dialog similar to the one shown will appear. The dialog box will show the scale of the plot but will not allow it to be changed.
3) Enter the number of ***Divisions*** per inch. Select ***Use Subdivisions*** if you wish to subdivide the first inch into smaller units. If so, ***Number of*** is the number of subintervals for the first division and ***Number of sub-intervals*** is the number of labels for the first division. ***Alternating Fill*** controls whether to fill alternating boxes in the scale component.
4) Select ***OK*** and the cursor change to look like miniature scale.
5) Place the upper left corner of the cursor where the upper left corner of the scale component is to be and click the left button. A 5" wide scale component will be created using the default font for the text.



Notes:

- If a scale component needs to be changed, select the scale component and then select ***Edit Scale Component*** in the ***Data*** menu. This will bring up the same dialog as that used by ***Create Scale Component*** and will fill the fields with the current values. Make the appropriate changes and click ***OK***. • Scale components can be resized after they have been created. A selected scale has a magenta outline and eight nibs for moving each side and each corner of the outline. Changing the height of the outline will change the height of the boxes in the component. Changing the width of the outline will increase or decrease the total number of divisions visible. There will always be at least one division and, if the component uses subdivisions, there will always be at least two divisions.
- Use ***Set Font*** to change the font of the numbers at the bottom of the scale component.
- To move a scale, press the left button anywhere in the scale, wait a half second until the scale is erased leaving only the outline, move the cursor and outline to the new location and release the button.

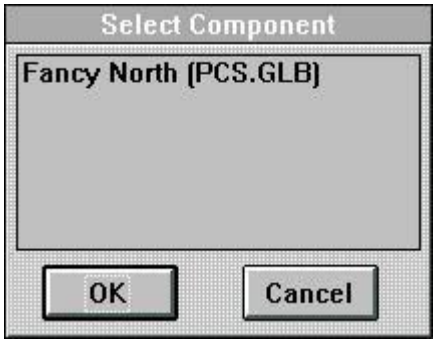
Set Scale



To change the scale of a plot, select the plot and then select ***Set Scale*** in the ***Data*** menu. The current scale value will be displayed. Change the old scale value to the desired value and select ***OK***. The plot will be redrawn to reflect the new scale. Any scale component associated with the plot will also be redrawn to reflect the new scale. If the new scale value doesn't match the scale value in COGO, a dialog will appear asking if the COGO scale should be changed to match the new layout scale.

Note: Changing the scale in layout has a different effect than changing the scale in COGO. Changing the layout scale results in the resizing of the entire view. Text that was drawn as 0.10 inches high in COGO will no longer be drawn 0.10 inches high in Layout UNLESS the COGO scale is reset to match the Layout scale. Changing the scale in Layout to a different value than that of COGO is similar to performing a zoom - EVERYTHING selected is either shrunk or enlarged.

Place North Arrow



To associate a north arrow with a plot, you first need to have a component of the north arrow. For more information on components, refer to the ***Components*** section of the ***Layout*** chapter.

Select the plot to associate the north arrow with and select ***Place North Arrow*** in the ***Data*** menu. Select the component that you want from the list and click ***OK***. Now, as you move the cursor, a magenta box will also move, representing the outline of the component that you want to place. To place the component, click the left button.

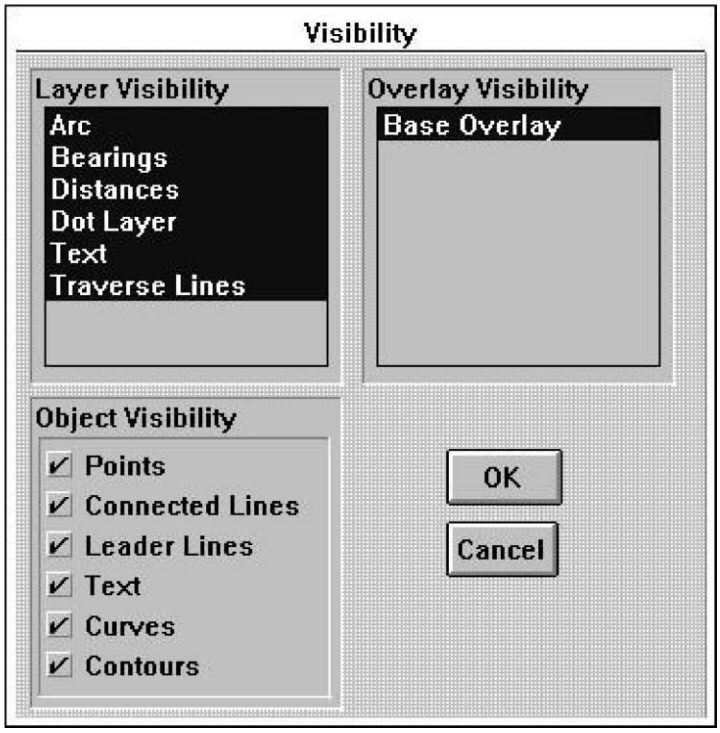
When a north arrow is placed, it looks just like any other component as far as selection and movement is concerned. However, when a dataview is rotated, associated north arrows, if any, will rotate with the dataview so they will always point the direction of north for the plot.

A north arrow is a special kind of component and, with the exception of rotation, is handled just like other components. To move or resize a north arrow, refer to the ***Component*** section.

Dataview Visibility

Dataview Visibility controls the type of data that will be displayed in a dataview on the layout page. Select the dataview that you want to edit (making sure of course that ***Data*** types are selectable) before selecting ***Dataview Visibility***. All layers and overlays that are actually used in the view will be listed and selected. Clicking on a layer or overlay name will toggle whether or not objects on the layer or overlay will be displayed. Clicking on ***Points***, ***Connected Lines***, ***Leader Lines***, ***Text***, ***Curves***, or ***Contours*** will toggle the display of those types of data for the selected dataview.

A common use of this function is turn off the point numbers. To do this simply turn off the *Point Number* layer in the ***Layer Visibility*** section.



Draw functions

Texts

Text

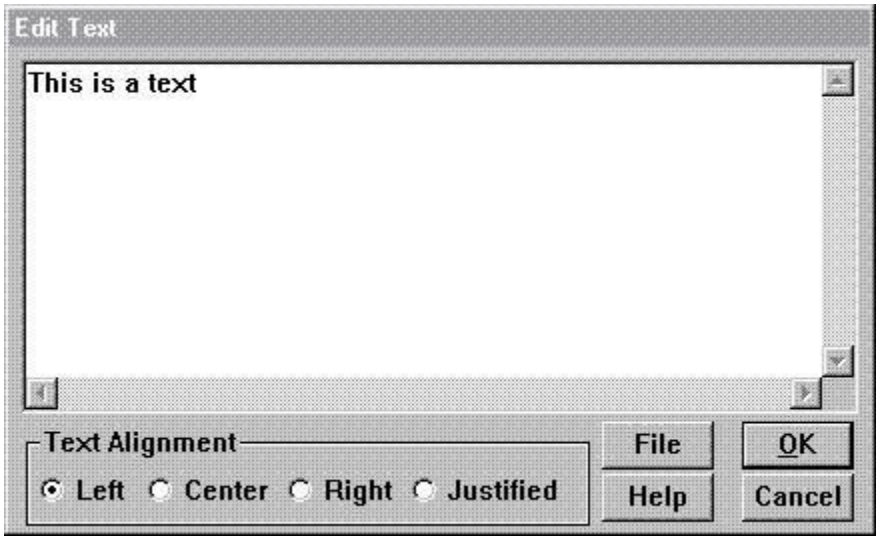
Layout text is very versatile - especially when utilizing TrueType fonts on a raster printer. To create text,

1) Enter Text mode by either **a)** selecting ***Text*** from the ***Draw*** window, or **b)** clicking on the Text icon in the toolbar.
2) Place the text cursor where you want to enter the text and left click.
3) Type in the text that is desired. If multiline text is desired, use the ENTER key to separate lines.

Existing text can be altered in many ways. To modify existing text, select the text that is to modified.

- The text font can be changed by selecting a different font from the ***Set Font*** command in the ***Edit*** menu. This will affect ALL selected texts.
- The bounding box for the text can be altered. When changing the bounding box, text will automatically *wrap* to fit inside the box. Changing the bounding box is accomplished by left-clicking and dragging any of the nibs.
- Text can be stretched by holding down the SHIFT key and left-clicking and dragging any of the nibs to the desired size.
- Text can be resized by either **a)** choosing a different font size or **b)** holding down the CONTROL key and (you guessed it..) left-clicking and dragging to the desired size. Of course, text can be moved and rotated like any other Layout object.
- To **move** a text, press and hold the left button anywhere in the text, wait a half second until the text is erased and replaced with an outline, move the cursor and outline to the new location and release the button.
- To **rotate** the text select the ***Rotate*** tool from the toolbar or from the ***Edit*** menu (see p.222). Left-click somewhere in the text and hold till the text outline replaces the text. Now, drag the mouse to rotate the text. The ***Angle Snapping*** function in the ***View*** menu can be used to help rotate the text to a specific angle.

Edit Text



To change a text, select the text to change and then select ***Edit Text*** in the ***Edit*** menu. A dialog will appear, displaying the selected text similar to example shown.

The text can be edited by typing characters in with the keyboard, using the backspace key, etc.

Text Justification can be ***Left***, ***Center*** or ***Right***.

Text can be imported from a file by selecting ***File***.

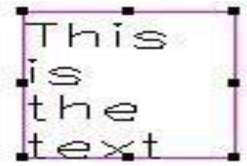
Text files must be in a generic text format in order to be imported. Word processor formats, such as *Word*, *WordPerfect*, etc. cannot be imported. If using a word processor to create text, be sure to save the text in a generic text format (sometimes called MSDOS format).

Block Text

Block Text in the ***Draw*** menu places text within a bounding box, wrapping at the right side of the box if necessary.

1) To define the text, just type it into the large edit box in the dialog box. To force a new line in the text, type an <ENTER>.

2) To set the bounding box, press the left button in the layout data window at one of the corners of the desired bounding box. ***Bounding Box*** will show the cursor position. As the cursor moves, ***Bounding Box*** will be updated with the coordinates of the box. When the cursor is at the other corner of the bounding box, release the button.



A selected block text has a magenta outline and eight nibs that move each side and each corner of the outline.

- Changing the size of the outline will change the size of the bounding box.
- Text will “wrap” to the next line to fit the bounding box or when there is a carriage return (created by pressing the <ENTER> key).
- To move a block text, press the left button anywhere in the block text, wait a half second until the block text is erased leaving only the outline, move the cursor and outline to the new location and release the button.

- If you have an ASCII file with the text in it, select ***File***. The standard *File Open* dialog will appear, allowing you to select a file for importing text. The file will be read in and appended to the end of the text in the large edit box.

Edit Block Text

To change a block text, select the block text to change and then call ***Edit Block Text*** in the ***Edit*** menu. The current text will be shown in the large edit box and it can be changed in the same manner as it was created.

Default Font

Default Font in the ***Edit*** menu sets the font to be used when creating new texts, block texts, scale components, or tables. For more information on fonts, refer to ***Fonts*** in the ***Data Appearance*** section of the COGO reference manual.

Set Font

Set Font in the ***Edit*** menu changes the font for all selected texts, block texts, scale components, and tables. For more information on fonts, refer to ***Fonts*** in the ***Data Appearance*** section of the COGO reference manual.

Bitmap

To place bitmaps,

1. Select ***Bitmap*** in the ***Draw*** menu.
2. Select the bitmap from the standard file open dialog that is created. When this is done, the cursor will change to a C with a +.
3. Place the cursor so that the upper left corner of the bitmap will be about where the + is and click. The bitmap will then be placed. Depending on the size of the bitmap, it may be necessary to zoom in to see the bitmap.

   Since bitmaps can vary in size anywhere from a few bytes to megabytes in size, PC Survey gives you the option of storing the bitmap as a part of the job or just storing a link to a source bitmap. To change from one to the other, do a Shift-right-click while the cursor is over the bitmap to get to the popup menu. (See Popup Menus on page 34). One of the options is ***Linked***. If there is a checkmark, the job just stores a link to the original bitmap. If not, the entire bitmap is stored inside the .PCS file.

⇒ Clicking on the ***Linked*** menu entry when it is checked will remove the link and will cause the bitmap to be stored with the job the next time it is written out.

⇒ If you click on the ***Linked*** menu entry when it is not checked, a dialog box will appear for selecting the file name to use for the link.

♦ If the file you specify does not exist, the current bitmap in the job will be written out to that file.

♦ If the file already exists, the program will tell you the file already exists and ask if you want to replace the file.

- If you answer yes, the version of the bitmap in the job will be written out to the file.
- If you answer no, the file version will be read into the job.
- If you cancel, the link will not be created.

Cross-Section Profile

- To place a profile view on the sheet:

1) Select ***Profile*** from the ***Draw*** menu.
2) A box will be displayed representing the size of the profile. Move this box to the desired position on the page and click with the left button to place it.

- To change a part of the profile that is still not quite right:

1) Place the profile on the page if that has not yet been done.
2) Select the placed profile just as you would select anything other graphics object.
3) Select ***Smash*** from the ***Component*** menu. This will replace the profile as a single entity with the individual lines and texts which comprise the profile. At this point, all of the data can be edited separately.

Tables

Point Table

Number	North	East
32	1,060.39 m	1,479.75 m
33	1,123.95 m	1,487.30 m
115	1,028.42 m	1,564.37 m
120	1,028.61 m	1,475.98 m
121	1,081.58 m	1,482.27 m
224	1,044.40 m	1,467.42 m
113	1,134.36 m	1,576.95 m
122	1,134.54 m	1,488.56 m

Example of a Point Table

To place one of the tables defined in the COGO window, use ***Tables*** in the ***Draw*** menu.

1) Select ***Curve***, ***Line***, or ***Point*** for the type of table to place. A magenta box will follow the cursor, showing the size of the table to be placed.

2) When the box is in the right position, click the left button and the table will be placed there.

When a table is selected, it will be outlined in magenta but will **not** have any nibs.

• Use ***Set Font*** to change the table font. • To move a table, press the left button anywhere in the table, wait a half second until the table is erased leaving only the outline, move the cursor and outline to the new location and release the button.

Curvy Things

Id	Radius	Arc Length	Delta Ang.	Chord
A	22.86 M	37.14 M	93°04'27"	33.18
B	38.10 M	47.92 M	72°03'20"	44.82

Example of a Curve Table with creative font selection

Straight Dimension

Curved Dimension

Edit functions

Groups

Groups are used for operating on many graphics items simultaneously. Like components, groups are sets of graphics primitives that behave as if they were all one object. Unlike components, groups cannot be saved in a library.

A selected group has a magenta outline but no nibs. To move a group, press the left button anywhere in the outline, wait a half second until the inside of the outline is erased leaving only the outline, move the cursor and outline to the new location and release the button.

Group

Group in the ***Edit*** menu puts all of the currently selected layout items in a single group to be used by the group functions. This function only handles one group at a time. The items that go into the group will be unselected.

Ungroup

Ungroup in the ***Edit*** menu will remove all items from the selected group.

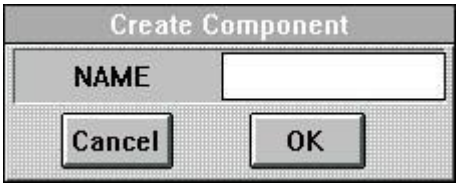
Components

Sometimes you will create a picture using several things, such as lines and texts for a title block, and then handle the picture as a single unit. Sometimes making a group will be sufficient but when you want to save the work for use in another project, a better method is to use *components*. Like groups, components are a collection of more primitive items that are manipulated as a group. Unlike groups, however, components can have multiple copies placed on a page and even be used in more than one job.

When a component is selected, it will be drawn in magenta and will have eight nibs which will move each side and each corner. Moving a nib will change the dimensions of the current component but not the dimensions of the original. If you place another component, it will still have the same size that it was originally created with. To move a placed component, press the left button anywhere in it, wait a half second until it is erased and replaced with an outline, move the cursor and outline to the new location and release the button.

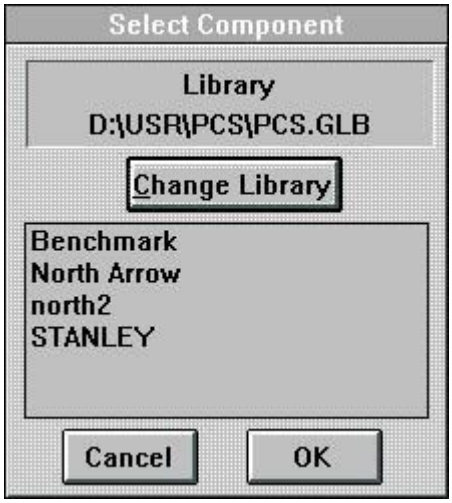
Create

To create a component, use ***Create*** in the ***Component*** menu. Before calling the function, select just those graphics that are to be a part of the component. ***Create*** will ask for a name for the component that can be used later to refer to it. The selected graphics that are a part of the component will be unselected after the component is created.



Delete

To delete a component, use ***Delete*** in the ***Components*** menu. It will provide a list of all components associated with this job. Select the component to delete from the list and click ***OK***. The component will be removed from the list of components associated with the job and all instances of that component on the layout page will be deleted.



Place

To place a component on the page, use ***Place*** in the ***Components*** menu. It will provide a list of all components associated with this job. A file name in parentheses following the name of a component refers to the component library from which the component was read. Select the component to place and click

OK. An outline of the component will be drawn in magenta.

Move the cursor and outline to the location to place the component and click the left button.

Smash

To replace a component with the elements of which it was made, use ***Smash*** in the ***Components*** menu. It will provide a list of all components associated with this job. Select the component to smash and click ***OK***. The component will be removed from the list of components associated with the job and all instances of that component on the layout will be replaced with their constituent elements.

Update

If the components in a library have changed and you want all instances of those components in this job to reflect the changes, use ***Updates*** in the ***Components*** menu. The dialog box will define the library from which to read the components. Refer to ***Open*** in the ***File Functions*** section of the COGO reference manual for a detailed explanation of the fields in this dialog box. After selecting the library and clicking ***OK***, all components that are in this job and are also in the library will be updated.

Get

To add a component from a library to the list of components associated with this job, use ***Get*** in the ***Components*** menu. The first dialog box will define the library from which to read the component. Refer to ***Open*** in the ***File Functions*** section of the COGO reference manual for a detailed explanation of the fields in this dialog box. After selecting the library and clicking ***OK***, a list of all components in that library will be displayed. Select the component to add to this job and click ***OK***. If a component of that name is already in the job, it will be replaced by the new component.

Put

To take a component from this job and add it to a library, use ***Put*** in the ***Components*** menu. The first dialog box will define the library in which to write the component. Refer to ***Saving a Project*** on p.50 for a detailed explanation of the fields in this dialog box. After entering the library name and clicking ***OK***, a list of all components associated with this job will be displayed. Select the component to add to the library and click ***OK***. If a component of that name is already in the library, it will be replaced by the new component.

View Functions

See the section on Common View Functions on p.38 for information about ***Redraw Screen***, ***Full View***, ***Pan View***, ***Zoom In***, ***Zoom Out*** and ***Zoom Back***.

COGO View

Executing the ***COGO View*** command is like stepping into a view that has been placed on the sheet. We say that you are now "in the *COGO View"* as opposed to the "Layout View". The ***COGO View*** command is a *toggle*. Selecting the ***COGO View*** command a second time will return from the COGO View to the Layout page.

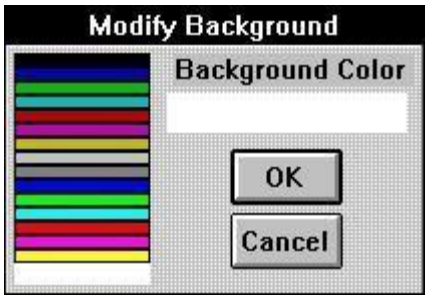
This is primarily useful when it is desired to add layout objects (components, graphics, etc.) that will maintain their position and orientation relative to the COGO data. For instance, if a circle is placed while in the COGO View, movement, rotation and/or scaling of the dataview will result in the circle being moved, rotated and/or scaled as well.

Any layout objects placed while in this mode are in COGO coordinates and will be visible in the COGO data window but cannot be edited from that window. To return to a view of the page, select ***COGO View*** in the ***View*** menu again. Any objects placed will be visible in the in the layout sheet views but can only be edited by returning to the COGO View.

- Text placed from Layout in the COGO View is essentially the same as text that is created while in COGO with the COGO text tool.
- Placing a north arrow in the COGO view will insure proper directional orientation of the arrow since it will rotate when the view is rotated. Unlike the Layout ***Place North Arrow*** function, however, the COGO View's north arrow will rotate about the view's center rather than about the center of the North Arrow component.

Display Functions

Set Background Color



This function in the ***View*** menu brings up a dialog box that allows choosing the color that to be used for the background. This is mainly useful if the white background is too much of a strain on the eyes. Just select the color that you want by clicking on it in the color list and then click ***OK***.

Set Fill

- This function is used to set the fill type of a boundary or a layout object. To use this function:

1) Select all of the objects to be filled with the same fill type. If in Cogo, select all boundaries to be filled. If in Layout, select all of the graphics to be filled (arcs, boxes, circles, ellipses, polygons).
2) Select ***Set Fill*** from the ***Edit*** menu, or ***fill boundary*** in the ***Aln/Bnd*** menu if in *Cogo*. A dialog box similar to the one shown above will appear.

- To use a fill type that does not yet exist:

1) Click on the ***New*** button.
2) Define the characteristics of the fill following the steps in the following *Modify Fill* section.
3) Make sure that the highlighted button is the desired fill type.
4) Click on the ***OK*** button to leave this dialog.

- To use a fill type that already exists:

1) Click on the button with the picture of the desired fill.
2) Click on the ***OK*** button to leave this dialog.

- To use the current fill type but change it:

1) Make sure that the highlighted button is the desired fill type.
2) Click on the ***Edit*** button.

3) Define the characteristics of the fill following the steps in the following *Modify Fill* section.

4) Click on the ***OK*** button to leave this dialog.

- To use a fill type that already exists but change some of the characteristics:

1) Click on the button with the picture of the desired fill.

2) Click on the ***Edit*** button.

3) Define the characteristics of the fill following the steps in the following *Modify Fill* section.

4) Click on the ***OK*** button to leave this dialog.

- To delete a defined fill type:

1) Click on the button with the picture of the fill to be deleted.

2) Click on the ***Delete*** button.

3) Make sure that the highlighted button is the desired fill for the selected objects.

4) Click on the ***OK*** button to leave this dialog.

- To unfill the selected objects:

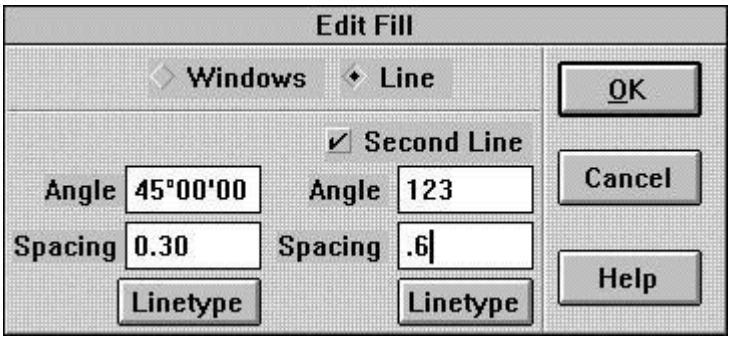
1) Click on the ***None*** button

2) Click on the ***OK*** button to leave this dialog.

Notes:

- The Arc Fills information will only be displayed if at least one arc is selected.
- To fill to the center of the circle represented by the arc, select ***To Center (Pie Slice)***. The result will look like a pie slice.
- To fill just to the chord of the arc, select ***To Chord***.

Edit Fill



- To create a solid fill

1) Click on the ***Windows*** checkbox.

2) Click on the solid black bar at the top of the Hatch selection box.

3) To set the color, click on the Color button to bring up the dialog which allows selecting a color.

4) Click ***OK***.

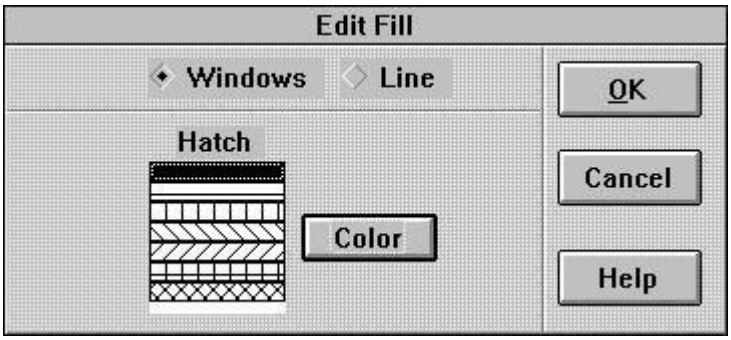
- To create a hatch fill using the Windows hatch types:

1) Click on the ***Windows*** checkbox.

2) Click on the type of hatch desired from the options displayed in the Hatch selection box.

3) To set the color, click on the Color button to bring up the dialog which allows selecting a color.

4) Click ***OK***.



- To create a WYSIWYG (What You See Is What You Get) fill with a repeated line pattern:

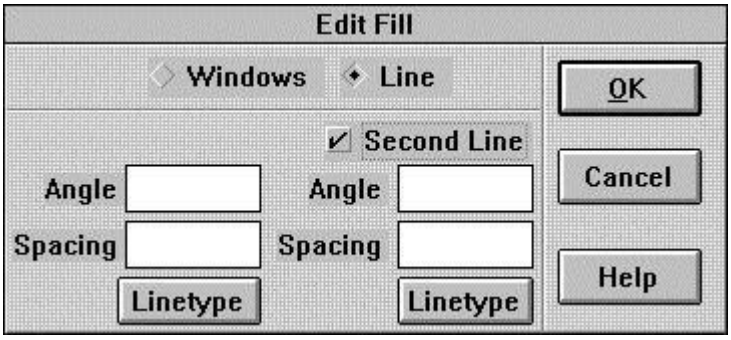
1) Click on the ***Line*** checkbox.

2) Enter the angle as an azimuth for the lines.

3) Enter the spacing between lines in inches.

4) To set the linetype to use for the lines, click on the Linetype button and select the desired linetype.

5) Click ***OK***.



- To create a WYSIWYG fill with hatched lines:

1) Click on the ***Line*** checkbox.

2) Enter the angle as an azimuth for the first line.

3) Enter the spacing between first lines in inches.

4) To set the linetype to use for the first line, click on the ***Linetype*** button and select the desired linetype.

5) Click on the ***Second Line*** checkbox.

6) Enter the angle for the second set of lines.

7) Enter the spacing between the second set of lines in inches.

8) Set the linetype for the second set of lines by clicking on the ***Linetype*** button.

9) Click ***OK***.

Notes:

- For WYSIWYG line fills, the scale will determine how many lines per feet will be used to fill a boundary. Like text, if the scale changes, the spacing of the plotted lines will not change although the apparent spacing relative to COGO coordinates will change.

Miscellaneous

Select Status

Toggles select status bar display.

Tools Ruler

Toggles tool bar display.

Toggles Ruler display.

Close

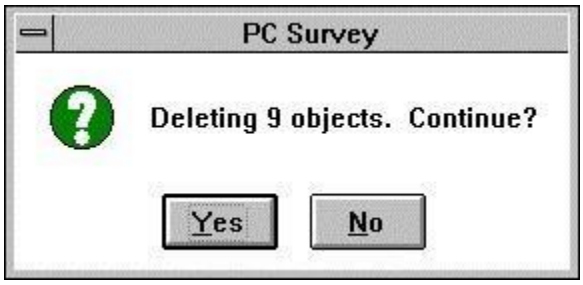
Close in the main layout menu will close the layout window.

Delete

Delete in the ***Edit*** menu will delete all selected layout objects. This function is also mapped to the <DEL> key on the keyboard. Therefore, to delete something(s) (view, graphic, component, etc.),

1) Select the items and select ***Delete*** or press the <DEL> key.

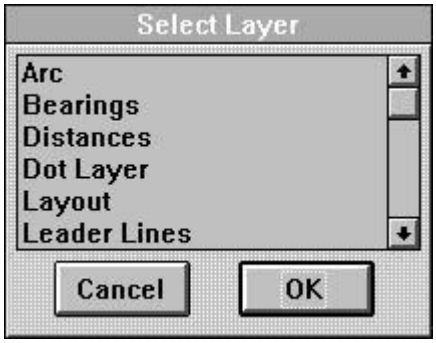
2) A dialog similar to the one shown will appear, showing the number of objects that have been selected. Select ***Yes*** to delete the selected objects or ***No*** to cancel the function.



Oftentimes, deleting objects will leave the screen display a little muddled. This is a normal result of erasing things on the screen. Selecting ***Redraw Screen*** from the ***View*** menu will clear things up.

Extract Objects to Layer

Extract Objects to Layer in the ***Edit*** menu moves selected layout items to another layer. It asks for the destination layer and moves all selected objects to the specified layer. To use this function, 1) Select the objects that you wish to move to a different layer.



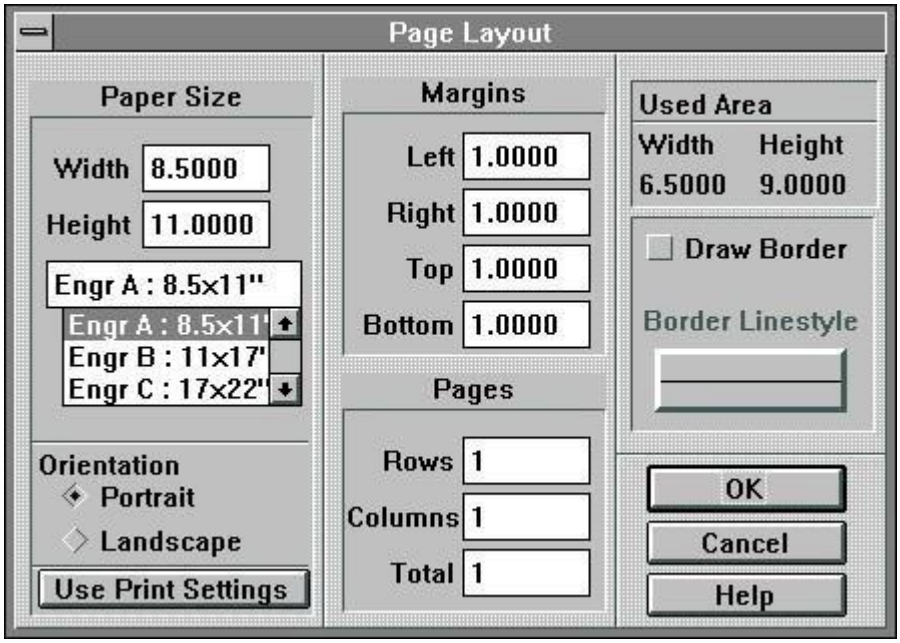
2) Select ***Extract Objects to Layer***. A dialog similar to the one shown will be displayed.
3) Select the destination layer for the selected objects from the list by left-clicking on the name of the destination layer. The selection will then be highlighted.
4) Select ***OK*** to complete the operation or ***Cancel*** to cancel the operation.

Layers are defined through the ***Edit Layers*** function in the ***Environment*** menu of the main window (see p.54).

Grid/Snapping

See p.33 for a description of these functions.

Page Layout



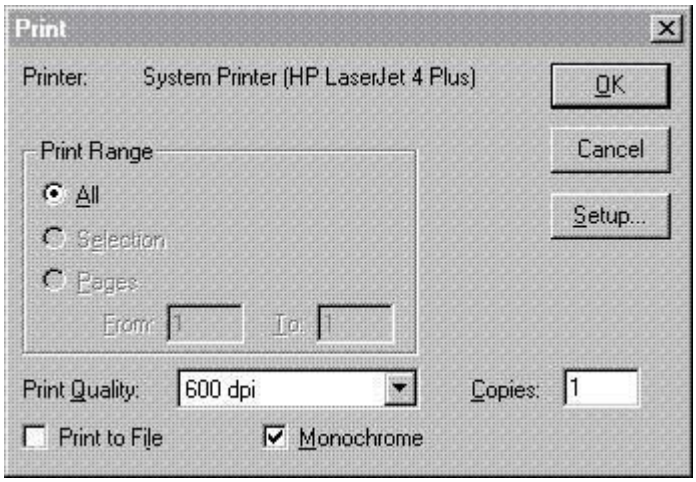
To control the display of the data on a printout, use ***Page Layout*** in the ***Project*** menu. The dialog box allows selecting a standard *Paper Size* or specifically setting the page ***Width*** and ***Height***. The ***Margins*** can also be set to be a specific distance in from the sides of the page. The ***Orientation*** can be ***Portrait*** (tall) or ***Landscape*** (wide). ***Use Print Settings*** will use the settings that the current printer is already using.

The entries in the ***Pages*** section can be used for more than one output page, such as if the drawing spans several pages or if you want to have a full view of the plot on one page and a zoomed in view of part of the plot on another page.

Used Area shows the number of inches or centimeters available for printing in based on the paper size and margins.

Print

Print in the ***Project*** menu will print either
All the layout pages or the specified ***Pages*** (if there are more than one) to the default printer. To change the default printer, you will need to go to the Windows control panel and select the printer icon.



Rotate

This function rotate layout objects. ***Rotate*** is a mode - this means you can continue to rotate objects until the ***Rotate*** mode is exited by either pressing the **<Esc>** key or by clicking on another toolbar button at the top right of the toolbar. The cursor associated with ***Rotate*** looks like an arc with a cross in the center. To use this function:

1) Depress the left button over a selected item and wait a half second until the object flashes or is replaced with an outline.
2) Move the cursor - the object will rotate about its origin or center.

   The angles through which the object can rotate are controlled by the ***Set Angle Snapping*** function (see p.33). When the object has the desired angle, release the button. The program will stay in rotate mode until you press **<Esc>** or execute another command.

• While in the ***Rotate*** mode, objects can still be selected/unselected using the left mouse button in the normal fashion.

The Component Window

The Component Window is used for visually accessing the component libraries. Components in a given library will be drawn on top of a sheet outline (the *component sheet*) similar to what is seen in the Layout Window. A status bar, located below the window's menu displays the name and dimensions of the currently selected component (or *current component*). The current component will be surrounded by a magenta outline box.

Components can be organized (moved around) on the component sheet. Components can also be deleted and renamed.

There are many different ways to organize component information. Some suggestions are:

1) Store related components in the same library. For instance, one library might have nothing but certifications. Another library may contain sheet *Forms* (a component with a border, title block and any other commonly used components that fits a given sheet size
2) Store components that are used on a given sheet size together.

3) Store components according to job type usage (i.e. property survey vs. subdivision development components).

Moving Components

To move a component-

1) Place the cursor somewhere in the component, press the left button, wait a half second for the component to be replaced with an outline and a cross at the origin. ***Keep the mouse button depressed***. At this point the chosen component can be moved to another location on the component sheet or dragged and dropped onto the layout sheet (***IF*** the layout window is open).

2) Move the component to the new location and release the button. The component can be moved somewhere else on the component sheet or onto the layout page. If it is moved to the layout page, a copy will remain on the component sheet.

   Dropping a component from the component sheet onto the layout page is the equivalent of using ***Get*** and the ***Place*** commands in the ***Components*** menu except that you don't need to know that the name of the component beforehand.

   When the component is dragged onto the layout sheet, the outline box will generally change dimensions due to the difference between the displayed component sheet scale vs. the layout sheet scale.

Library Functions

New

If a library is already open, ***New*** will first close out the library. The current library will then be empty and unnamed. For more detail on closing a library, refer to the ***Close*** function in this section of this manual.

Open

Open will open a library that has already been created. If a library is already open, ***Open*** will first close out that library. Refer to p.50 for a detailed explanation of the fields in this dialog box. For more detail on closing a library, refer to the ***Close*** function in this section of this manual.

Save

If the current library has a name, ***Save*** will save the library with that name. If the current library has no name, ***Save*** behaves just like ***Save As***, using the same dialog box in the same manner.

Save As

Save As saves a library that either has no name yet or that needs to be renamed. Refer to p.50 for a detailed explanation of the fields in this dialog box.

Delete Component

Delete Component removes the current component.

View

See the section on Common View Functions on p.38 for information about ***Redraw Screen***, ***Full View***, ***Pan View***, ***Zoom In***, ***Zoom Out*** and ***Zoom Back***.

Close

Close will close the current library and the window. If the library has been changed since the last time that it was written out, ***Close*** will first ask whether or not to save the changes.

Appendix A - descodes.dat

The DESCODES.DAT file is a simple text file located in the program's directory. An example of what this file might look like is shown below:

CB
CL
EPL
EPR
IP
SB
TREE

The file can be viewed or edited with any text editor. The Notepad program supplied with Windows is an example of a simple text editor.

It is recommended that descriptions be entered from within the program since entering descriptions in the program should be as fast and is safer than using a text editor. If descriptions are entered directly into the DESCODES.DAT file with a text editor, use the following guidelines:

- Enter each description on a separate line.
- Don't leave any blank lines, except the one at the beginning of the file.
- Don't insert any non-printing characters such as tabs and spaces.
- Avoid entering the same description more than once.
- Descriptions are *case-sensitive* in the program - ABC is considered to be different from ABc.

The program will automatically alphabetically sort the file when it uses it, so don't worry about the alphabetical order of the descriptions.

Appendix B - Line Styles

Line styles are defined in the ***pcs.ini*** file. Multiple sets of line styles can be defined. The *LineStyleSet* keyword in the ***[PCS]*** section specifies the name of the set of line styles currently being used. So, if the ***[PCS]*** section includes the line

LineStyleSet=SurveyStyles then SurveyStyles is the set of line styles being used.

When reading a job in, the line style definitions in the default line style set in the pcs.ini will be added to the job. Any line style already in the job that has the same name as a line style in the pcs.ini will be replaced with the definition in the pcs.ini file.

Each section labeled ***[LineStyleSet,<name>]*** defines the line styles that are part of the *<name>* set. Each line of this section consists of a keyword which is the name of the line style, an '=', the length of the pattern (in inches), whether or not the pattern is scalable, and finally the graphic elements which comprise the line. If the length is 0, then only one iteration of the pattern is used for each line. Otherwise, the pattern will keep repeating from the beginning until the ending of the line. If the style is scalable, then the elements of the line will be shrunk or expanded to provide an integral number of repetitions of the pattern for the length of the line.

The different line elements with their parameters are listed below. The <common> parameters are an x offset, a y offset, and whether this element is scalable (which only applies if the whole line style is also scalable.) The x and y offset are the starting point for the element relative to the start of the line segment.
All sizes are specified in inches, except for line widths where 1 is a regular line, 2 is a heavier line, etc.

- *Win(line_type, line_width, <common>)* This uses one of the default windows line styles.
  line_width line width. **line_type** line style.

0 solid line
1 dashed line
2 dotted line
3 dash-dot line
4 dash-dot-dot line

- *Line(width, <common>)*
  This is just a solid line. It is no different from a *Win* line of type 0. **width** line width

- *Dash(width, length, <common>)* Draw a line segment.
  width line width
  length length of the line segment

- *Slash(width, length, angle, <common>)* Draw a dash at an angle.
  width line width **length** line segment length **angle** angle relative to the line at which to draw the slash.

- *Square(size, angle, width, <common>)* Draw a square.
  size width of the square
  angle angle relative to the line o draw the square **width** line width

- *Rect(angle, length, height, width, <common>)* Draw a rectangle **angle** angle relative to the line at which to draw the rectangle
  length length of the rectangle **height** height of the rectangle **width** line width.

- *Circle(size, width, <common>)* Draw a circle **size** radius of the circle.

- *Dot(size, <common>)*

Draw a filled in circle

size radius of the circle

- *Arc(radius, start, end, width, <common>)* Draw an circular arc.
  radius radius of the circle
  start starting angle **end**
  ending angle **width** line width

- *Ellipse(angle, major, minor, width, <common>)* Draw an ellipse
  angle relative to the line at which to draw the ellipse **major** major axis length **minor** minor axis length **width** line width

- *Char(c, size, angle, <common>)* Display a text character as part of the line.
  c character
  size height of the character **angle** angle relative to the line to draw the character.

Some default line styles that are installed with the program are:
[LineStyleSet,SurveyStyles]

- *WinSolid1=0,1,Win(0,1,0,0,1)* Draw a regular width, solid line.
- *Solid2=0,1,Line(2,0,0,1)* Draw a heavy solid line.
- *DashDot=0.2,1,Dash(1,0.05,0,0,1),Dot(0.025,0.1,0, 1),Dash(1,0.05,0.15,0,1)*
  Draw a dash starting at the beginning of the pattern and extending 0.05 inches, followed by a dot with a radius of 0.025 inches centered on the line 0.1" from the start of the line, and ending with another dash beginning
  0.15" from the start of the line and extending for another 0.05". All elements are scalable and have a line width of 1. The pattern is 0.2" long so the first dash for the next pattern will start right where the dash for the first pattern ended.
- *Fence=0.5,1,Dash(1,0.15,0,0,1),Char(*,0.4,0° 00' 00",0.17,-0.15,1),Dash(1,0.15,0.35,0,1)*
  Draw a fence line which will consist of a line segment starting at the beginning of the line and extending 0.15"
  in the direction of the line. Follow this with a '*' character drawn at the same angle as the line and with a height of
  0.4" with the left edge of the character placed 0.17" from the start of the line and with the baseline of the character 0.15" below the line. End this pattern with another line segment starting 0.35" from the start of the line and continuing for 0.15" which ends the segment at 0.5" which is the length of the pattern.
- *Fence Post=0.5,1,Line(1,0,0.025,1),Line(1,0,-0.025,1),Circle(0.05,1,0.25,-0.1,1)*
  Draw a fence post line which consists of two solid parallel lines, one 0.025" above the center and the other 0.025" below the center. Place circles of size 0.05", centering the first one 0.025" from the start and 0.1" below the center and placing subsequent circles every 0.5".
- *Power Line=0.5,1,Dash(1,0.2,0,0,1),Circle(0.05,1,0.25,0,1),Dash(1,0.2,0.3,0,1)*

Draw a power line which will consist of a dash starting at the beginning of the line and 0.2” long. Follow this with a circle of radius 0.05”, centered 0.25” from the start, and end with another dash, also 0.2” long, starting 0.3” from the start of the line.

- *Railroad Track=0.2,1,Line(1,0,0,1),Slash(1,0.2,90° 00' 00",0.1,0,1)*
  Draw a railroad track consisting of a solid line punctuated by slashes at 90° to the line that are 0.2” tall, starting
  0.1” from the start of the line and every 0.2” thereafter.
- *Stone Fence=0.5,1,Dash(1,0.2,0,0,1),Square(0.1,0° 00' 00",1,0.2,0,1),Dash(1,0.2,0.3,0,1)*
  Draw a stone fence which consists of a dash of length 0.2” starting at the start of the pattern. Follow this with a square starting 0.2” from the start of the pattern, parallel to the line, with sides of length 0.1”. Finish with another dash 0.2” long starting 0.3” from the beginning.

- *Block Wall=0.2,1,Rect(0° 00' 00",0.2,0.1,1,0,0,1)*
  Draw a block wall consisting of rectangles parallel to the line. The rectangle dimensions are 0.2”x0.1”, starting at the beginning of the line and placed every 0.2”.

Appendix C - GPS

Overview

GPS (Global Positioning System) is a measurement technology that allows a highly accurate determination of location through the use of radio signals received from orbital satellites. GPS surveying has the advantage of being able to establish positions without the need for a series of distance and angle measurements from a known point. GPS has the disadvantage of being adversely affected by physical obstructions such as trees and buildings. This section will attempt to explain the general concepts behind the use of GPS, as well as when and how to use it.

General Concepts

Basic Theory

The US and Russian governments have both set up a number of satellites (or *constellation*) for the explicit purpose of aiding in navigation. The US constellation is called NAVSTAR and the Russian constellation is called GLONASS. The satellites constantly transmit information that includes their orbital data (*ephemeris*) along with signals that are used by GPS receivers to calculate their distance from each satellite.

From the exact position of each satellite and the distance from it, a calculation of the receiver’s position can be determined by trilateration - such is the basic concept. If one had a precise knowledge of the time of transmission and reception of the satellite data, the observation of only three satellites would be necessary for the calculation. However,

this information is not available due to various reasons, so an additional satellite is necessary, bringing the minimum number of observable satellites to four.

Additionally, the presence of various errors (including the deliberate introduction of error by the government for military reasons) requires that at least two receivers be used to simultaneously observe the same set of satellites.

The satellite data includes information that gives the receiver an immediate rough distance measurement. A more precise distance is necessary for surveying purposes. To obtain this distance, however, a number of observations (called *epochs*) must be made on each satellite over a period of time.

IMPORTANT! Satellite reception is primarily LINE OF SIGHT. Like the laser beam in an EDM, there generally must be an unobstructed line of sight between the receiver's antenna and the satellite for successful reception.

GPS vs. DGPS

For survey-grade accuracy (1 cm or less), two receivers must be used in order to correct for certain errors. An alternative approach, if something less than this order of accuracy is needed, is to use a single receiver in conjunction with a second set of data from a source that, in effect, substitutes for the second receiver. This approach is called *Differential GPS* or *DGPS*, for short. The three common sources for the second data source are the publicly available government transmitters operated by the US Coast Guard, government data downloaded from the Internet after returning to the office, and commercially available sources that transmit the information via satellite. When using the government transmitters or the commercial satellite sources, the receiver position is calculated in real-time so that there is no need for further adjustment in the office.

The advantage of DGPS is that only one receiver is necessary. The disadvantage is that positions are not accurate enough for most surveying requirements. Using the government transmitters will typically yield an accuracy of no better than about a meter. Satellite DGPS receiver accuracy can be on the order of a few decimeters. Such accuracies might be suitable for applications that require only a crude position, however. These include some GIS/LIS projects, percolation test locations, etc.

Another use for DGPS is navigation. The GMS 2x00, with the optional DGPS receiver, allows the user to input a desired coordinate and then uses a compass display (along with distance to target, cross-track, ground speed, etc.) to guide the user to that location. When trying to locate geodetic monuments, for instance, getting within a meter of the monument is good enough to find the marker.

General Technique

Survey-grade GPS requires the use of at least two receivers. One receiver serves as the reference receiver which we will call the *base station*. We will call the other receiver(s) *rover(s).*

Selecting a site

Perhaps the most critical problem in using GPS is in choosing a site for the base station that is as clearly unobstructed above a 15 degree vertical angle as possible. (Fifteen degrees is the typical *mask angle* used in GPS surveying. Below this angle the satellite transmission has to go through too much atmosphere, with its attendant interference and signal delay, to be very useful.) Any obstructions above this angle (telephone wires, tree limbs, dirigibles, mutant flying elephants, etc.) can potentially interfere with a satellite's transmission and therefore prevent the software from determining the receiver's position. If the base station location is completely clear ("good"), the rover location isn't as critical. A given position might be partially obstructed but, since the satellites are in constant motion, satellite positions will usually, given enough time, be reached that give the rover enough data to allow processing. A satellite map, such as the one included with the GMS system, can be very helpful in cases where there is an obstruction. By examination of the map, one can quickly determine where the satellites are currently located. Regardless, it is best to try to pick rover sites that are as clear from obstruction as possible.

Setting up the equipment

Every GPS receiver has an antenna and it is to the *phase center* of the antenna that a GPS measurement is made. The phase center is roughly (within a few millimeters) located at the physical center of the antenna and will be centered over the antenna pole. Therefore, when making measurements, it is important to know exactly where your antenna is relative to the ground. The GMS system uses a fixed height antenna pole in order to try to avoid possible confusion in this regard. Additionally, the pole must obviously be kept perpendicular to the ground in order to get the correct horizontal position, so a level is typically included with the pole.

The GMS receivers can mount to the antenna pole using the included bracket or be placed on the ground and connected to the receiver with the longer of the two cables that are provided. A common approach is to place the base station receiver in its bag on the ground along with an additional battery attached to the auxiliary power connector. The rover receivers, on the other hand, are commonly mounted to the pole for easier access to the data collector.

Acquiring data

The base station is generally set up and started first. The rovers are then placed at the desired acquisition points. The amount of time spent collecting data is called the *sit time*. Minimum effective sit times are primarily dependent upon the *baseline* distance (the distance between the base station and the rover), the quality of the site with respect to satellite visibility, the number of satellites in view above the mask angle and the satellite "geometry" (the relative location of the satellites to each other). Shorter baselines, more satellites, better visibility and geometry allow for shorter sit times. Sit times for a single frequency system are typically about 10 minutes plus one minute per kilometer of baseline distance when observing at least 5 satellites.

Limitations

Canopy

The primary limitation in using GPS equipment is *canopy*. Canopy refers to overhead obstructions and, in particular, trees. Kinematic acquisition is not feasible in the woods or in other locations that have frequent overhead obstructions. Static acquisition might work, but will probably require long sit times. In areas of frequent overhead foliage, high buildings or other such obstructions, it is probably best to set a GPS point in a peripheral location that is relatively unobstructed and then use a total station to acquire points in obstructed areas, tying into the GPS points.

Multipath

Multipath refers to signals that reach the antenna after bouncing off of other objects such as buildings and vehicles. This is especially a problem in urban environments. The problem with multipath is that everything will appear to be working just fine. Real-time displays will show coordinates, the number of satellites being tracked will look wonderful, etc. However, processing will fail to find an acceptable coordinate. While some multipath is acceptable (modern receivers will discard some of it), too much will result in a waste of a day - so avoid getting close to metallic objects that are above the height of the antenna.

Time

GPS acquisition can be slow, depending upon conditions and requirements. Static processing with good data will get you under 1 cm, but will take anywhere from several minutes to an hour or more. Kinematic acquisition may take only a few seconds, but is guaranteed to give only about 2-4 cm of accuracy and will often fail completely in areas with canopy.

Accuracy

As commonly used, GPS, in an absolute sense, is not very accurate. A typical static accuracy of 1 cm doesn't compare favorably with what a total station can do for short distances. GPS can yield millimeter accuracies, but requires expensive equipment and extensive time to do so.

The advantage of GPS is in its ***relative*** accuracy over long distances. A single frequency system can reliably determine a location within 1 cm at distances of several miles. Additionally GPS doesn't require line-of-sight between the base station and rover, so getting locations in areas of rough terrain become much quicker (assuming that you're not in a rain forest).

Single Frequency vs. Dual Frequency

Navigation satellites broadcast two signals at two different frequencies, referred to as the L1 and L2 frequencies. L1 was designed for civilian use whereas L2 was designed as a

military frequency and is consequently encrypted. Final calculation of position is done with the L1 frequency only. One advantage of using L2 is in being able to get closer to the final solution more quickly. The second major advantage is in being able to eliminate the errors that arise due to the passage of the signal through the earth's ionosphere. This is only a problem for long baselines (in excess of 10 miles).

The disadvantage of dual frequency systems is that they are expensive. One must ask the question of whether to spend an additional thirty or more thousand dollars in order to get slightly shorter sit times (perhaps 6 - 10 minutes vs. 10 - 20 minutes). For most applications, dual frequency, at the time of this writing, can't be financially justified. This will change as the cost of dual frequency receiver boards comes down.

Static vs. Kinematic

Static GPS refers to processing each baseline independently, requiring sit times of several minutes. Static GPS is the most accurate. Kinematic GPS allows the receiver to move either continuously or to sit for just a few seconds at each point. Positions are calculated by knowing the previous position and that the previous position was a very short distance from the current position. The software can then search for a solution in a much more limited area and requires less data to find it. Kinematic is not as accurate as static but is a good approach when acquiring points for digital terrain modeling where centimeter accuracy is not required, but accuracy within a few centimeters is acceptable.

Real-time vs. Post-processing

Real-time GPS generates positions immediately and is used in conjunction with kinematic processing (thus, RTK or Real Time Kinematic). This requires processing software to be located in the receiver system. In a survey-grade system that requires two receivers, a radio link between the receivers is also necessary in order to do the calculations since the software must have the data from both receivers. This introduces another problem - the reliability of the radio link. In the eastern half of the US, where ground obstructions are many, varied and weird, RTK hasn't worked very well. RTK has performed much better in areas such as Arizona and Kansas.

Post-processing refers to acquiring the data and then processing it at a later time.

Since real-time GPS is significantly more expensive than post-processing, one must ask what advantages there are to having the geodetic coordinates of a point at the time of acquisition. Though this might be really nice for stake-out, GPS doesn't have the accuracy necessary for building construction stake-out. Also, a robotic total station is probably just as fast and cheaper than an RTK GPS system, as well as being generally more reliable.

Relative Positions vs. Referencing to State Plane

GPS processing accurately computes the position of one receiver relative to another when both receivers have observed the same satellites over the same period of time. GPS processing doesn't accurately determine the true or geodetic position of a receiver by itself. When processing, at least one point is designated the *control point*. All other positions are derived from the control point. If the control point's position is not precisely known, so also the other GPS point positions will not be precisely known except with respect to each other. This is perfectly acceptable when the project doesn't require state plane coordinates.

State plane coordinates are derived from geodetic coordinates. If an accurate state plane coordinate is desired, one of the GPS receiver positions must be on a known state plane location. This point becomes the control point and all other points are referenced to it.

Practical GPS

Applications

- **Remote Site Location**
  Location of oil wells, cellular telephone towers, percolation test points are all examples where GPS might be applicable.

- **Traverse Control**

Typical surveying practice requires establishing a control loop. In large projects or areas with difficult terrain, this can be a very time-consuming task. By removing the need to shoot a closed loop or even remove the need to shoot any traverse at all, the surveyor can potentially save vast amounts of time. (An alternative is simply to shoot the customer. This eliminates the problem completely.)

GPS allows the surveyor to establish known control points at two ends of a project and shoot an open traverse between them that is position adjustable if a single GPS point is available at both ends and optionally angle adjustable if two GPS points are established at both ends.

In difficult terrain conditions, a one or more GPS points can be established in areas that are hard to traverse to and a separate set of points can be measured with the total station and tied into the GPS locations.

- **Aerial Control**
  Flight control for aerial mapping is another prime example where GPS excels since mapping control points are generally widely spaced.

- **Fence Line Demarcation / Mapping**
  If one has a DGPS receiver, positions are accurate in real-time to about 1 meter (3 feet). Such accuracy is adequate for marking fence lines and, oftentimes, general mapping of features such as road centerlines, power poles, fire hydrants, etc. The advantage of DGPS is that it works quite well in canopied areas since a continuous lock is not necessary – any satellite lock will suffice since positions are real-time.

Selecting Receiver Locations

Though discussed earlier, it is worthwhile to review this issue.

- If possible, select a base station site that is completely clear of obstructions above a vertical angle of fifteen degrees. A general rule for determining what a fifteen degree vertical angle is, is to stretch one arm straight out horizontally and make a fist. Make a fist with your other hand and place it on top of the first fist. Do this one more time. Each fist represents approximately five degrees. Sighting along the top of the third fist therefore is about a fifteen degree angle. (After figuring this out, please don't contact the author and let him know where you would like him to put *his* fist.)
- Try to select rover locations that are also free of obstruction. If unable to do so, use the satellite map view of the data collector to determine whether there are at least four or five satellites completely clear of the obstructions. If not, you may wish to select a different site or acquire a different point and return later. If the obstructions are intermittent, such as the branches of a tree, you can acquire the point with a lengthier sit time.

General Techniques

There are several ways in which to use the receivers.

Radial

In a radial approach, the base station remains fixed for the duration of the project. If using this approach, try to find a central location for the base station. If acquiring points in a difficult location (partially obscured, traffic congestion, a Democratic convention, etc.) it may be desirable to choose a location closer to those points in order to decrease the sit time and/or probability of successful processing.

Multiple Rovers

If using more than two receivers, a couple of possibilities exist.

Simultaneous measurement

In this case, the rovers are turned on at approximately the same time, requiring that at least one person be available to man each rover. This results in an additional baseline(s) being obtained between the rovers.

Alternating placement

This can be done with just one person. After the first rover is started, the second rover is placed and turned on. The surveyor then travels back to the first rover, and moves it to a third location and so on.

Both of these cases result in less total time spent in the field. The advantage of the simultaneous approach is that additional baselines are created between the rovers themselves. These additional baselines serve both as an error check and, in a least squares adjustment, allow a more accurate location to be established. The advantage of using alternating placement is that it can done by a single individual. (If desired, the rovers can be left on long enough to create additional baselines, but that would negate any savings in time.)

Leapfrogging

When working with a single-frequency system, baselines should be kept below about 6 miles. Baselines up to 10 miles are possible, but the probability of such distances resulting in a failed processing session begin to increase significantly. In this case, the leapfrog method might be employed. Leapfrogging alternates the base station between the receivers. The rover on the first baseline becomes the base station for the second baseline and so on…. Long distances can be handled in this manner. This method can be also be used for creating a network of baselines which can then utilize least squares for adjustment and refinement of the positions.

GPS and Coordinate Systems

GPS processing gives a precise location of one receiver relative to another in terms of a change in X, Y, and Z in an
EarthCentered Earth-Fixed (ECEF, for short) coordinate system. This is not the coordinate system used on the ground nor is it any other commonly used coordinate system. It is the coordinate system from hell. Consequently, the GPS processing software typically reduces the information (the author is tempted to insert a period here) to geodetic (latitude/longitude) or state plane grid coordinates.

State Plane is not Ground!

The problem with state plane coordinates is that they are not easily mapped to ground coordinates. State plane coordinates are mapped to the ellipsoid, a mathematical idealization whose surface exists at about sea level. If you inverse in the state plane coordinate system, the distances are not the same as those that would be obtained between the same points on the ground. Similarly, state plane grid azimuth is also not the azimuth that would be determined on the ground. Usually, ground distances are longer than state plane distances. Consequently, one cannot simply mix measurements on the ground with GPS measurements except at altitudes near sea level and over short distances.

Adjusting with GPS Data

To work with GPS data, one must choose a coordinate system and stick with it. If a state plane system is to be used, all ground measurements must be scaled and translated to fit the state plane grid. Similarly, if a local grid system is to be used, the GPS coordinates must be scaled and then translated.

Combined Factor

To translate coordinates between grid systems, the scale factor relating the two must first be obtained. There are, in reality, two scale factors involved. The first is the grid scale factor - it relates the distance between points on the state plane grid to the distance between the same points on the ellipsoid. The second is the elevation factor - it relates the distance between two points at essentially sea level to the distance between the same two points at the measured elevation. Multiplying these two together produces the *combined factor* or *CF*. Multiplying the ground distance between two points by the CF yields the state plane distance. Conversely, dividing the state plane distance between two points by the CF yields the ground distance.

Moving to a Common Grid System

When working with both GPS and ground measurements, the following steps are followed to merge the two. Both cases assume that at least two points have been used both as GPS points and ground points and that all measurements have been reduced and the points transferred to COGO.

There should be two pairs of points in the project that need represent the same two points in field. As an example, suppose that point 1 is the same point as point 101, point 1 being a point measured on the ground and 101 being a GPS point. Similarly for point 2 and 102.

Local Grid to State Plane

1) If not in COGO, open the COGO window.
2) Select all the points in the project that are to be moved to state plane coordinates.
3) Select **COGO | Coord. Transformation | Standard**.
4) Using this example, enter **1** into the ***From Pt.*** box and **101** into the ***To Pt.*** box.
5) Press ***OK***. Point **1** should now be at the same location as point **101**.
6) Pick two points at opposite corners of the project area.
7) If there are other objects close to the points turn off the selectability of everything except for points. 8) Place the cursor near each point, hold down the <Shift> key and press the right mouse button.
9) Select ***Info*** from the popup menu.
10) Jot down the CSF value.
11) Add the two values (one from each point) and divide by two to obtain their average.
12) Select **COGO | Coord. Transformation | Standard** 13) Put the averaged CSF value into the ***Scale*** box and select ***OK***.
14) Select **COGO | Coord. Transformation | Standard** again. 15) Select ***Relative*** in the ***Angular Rotation*** section.
16) Press ***Dir 1***. Select ***Select Two Points*** in the Angle dialog box that appears. Enter **1** (or **101**) for ***First Point*** and **2** for ***Second Point***. Press ***OK***.
17) Press ***Dir 2***. Enter **1** (or **101**) for ***First Point*** and **102** for ***Second Point***. Press ***OK***.
18) Press ***OK*** to complete the operation. This last step rotates the ground points to align with the GPS points.

State Plane to Local Grid

1) If not in COGO, open the COGO window.
2) Select all the points in the project that are to be moved to local grid.
3) Select **COGO | Coord. Transformation | Standard**.
4) Using this example, enter **101** into the ***From Pt.*** box and **1** into the ***To Pt.*** box.
5) Press ***OK***. Point **101** should now be at the same location as point **1**.
6) Pick two points at opposite corners of the project area.
7) If there are other objects close to the points turn off the selectability of everything except for points. 8) Place the cursor near each point, hold down the <Shift> key and press the right mouse button.
9) Select ***Info*** from the popup menu.
10) Jot down the CSF value.
11) Add the two values (one from each point) and divide by two to obtain their average. Calculate the inverse of this value
(divide it into 1.0). We'll call this the average inversed CSF
12) Select **COGO | Coord. Transformation | Standard**
13) Put this average inversed CSF value into the ***Scale*** box and select ***OK***.
14) Select **COGO | Coord. Transformation | Standard** again. 15) Select ***Relative*** in the ***Angular Rotation*** section.
16) Press ***Dir 1***. Select ***Select Two Points*** in the Angle dialog box that appears. Enter **1** (or **101**) for ***First Point*** and **102** for ***Second Point***. Press ***OK***.

17) Press ***Dir 2***. Enter **1** (or **101**) for ***First Point*** and **2** for ***Second Point***. Press ***OK***.
18) Press ***OK*** to complete the operation. This last step rotates the ground points to align with the GPS points.

GPS monuments

When working with GPS, it is usually important to tie the system to state plane coordinates. To do this, one needs only to station one of the measured points on a state plane monument. This leads to the questions of "How do I find the GPS monuments in the area where I am working?". Unfortunately, this is becoming more difficult because the people you thought were working for you (your local government officials) oftentimes do not want to provide this information because of liability issues. There is a source, however. Since the US Government has exempted itself from the laws that you and I have to follow by making itself immune to lawsuits, it sees no difficulty in posting the information on the Internet. So, get on the web and go to:

http://www.ngs.noaa.gov/FORMS/ds_area.html

Sample Monument Document

Below is a sample of a monument document from the NGS. The important features are the following:

Horizontal Location: Specified typically as NAD83, this is generally specified as a precise latitude and longitude. In addition, there may be ECEF Cartesian coordinates (XYZ) coordinates given.

Height: This is where one might get confused. There are three different heights generally provided - **NAVD88** - this is the orthometric (or MSL) height, often given in both meters and feet.

ELLIP HEIGHT - the height above the ellipsoid, usually only in meters

GEOID HEIGHT - this is NOT the height of the point in any form - it is the height of the geoid with respect to the ellipsoid at this location. The orthometric height can be determined as H = h - N where H is the orthometric height, h is the height above the ellipsoid and N is the geoid height.

LAPLACE CORR - (Laplace Correction) This is the difference between the geodetic azimuth and astronomic azimuth at this location.

1 National Geodetic Survey, Retrieval Date = MAY 7, 1999

GC0770
****
GC0770 DESIGNATION - INDIAN AZ
GC0770 PID - GC0770
GC0770 STATE/COUNTY- TN/SUMNER
GC0770 USGS QUAD - HENDERSONVILLE (1983) GC0770
GC0770 *CURRENT SURVEY CONTROL
GC0770

GC2195* NAD 83(1995)- 36 18 49.57099(N) 086 35 32.44101(W) ADJUSTED

GC0770* NAVD 88 - 150.669 (meters) 494.32 (feet) ADJUSTED
GC0770

GC0770 GEOID HEIGHT- -29.46 (meters) GEOID96
GC0770 DYNAMIC HT - 150.542 (meters) 493.90 (feet) COMP
GC0770 MODELED GRAV- 979,786.9 (mgal) NAVD 88 GC0770
GC0770 VERT ORDER - SECOND CLASS 0
GC0770
GC0770.The horizontal coordinates were scaled from a topographic map and have GC0770.an estimated accuracy of +/- 6 seconds.
GC0770
GC0770.The orthometric height was determined by differential leveling GC0770.and adjusted by the National Geodetic Survey in June 1991.
GC0770
GC0770.The geoid height was determined by GEOID96.
GC0770
GC0770.The dynamic height is computed by dividing the NAVD 88
GC0770.geopotential number by the normal gravity value computed on the GC0770.Geodetic Reference System of 1980 (GRS 80) ellipsoid at 45 GC0770.degrees latitude (G = 980.6199 gals.).
GC0770
GC0770.The modeled gravity was interpolated from observed gravity values. GC0770
GC0770; North East Units Estimated Accuracy
GC0770;SPC TN - 219,330. 545,790. MT (+/- 180 meters Scaled) GC0770
GC0770 SUPERSEDED SURVEY CONTROL
GC0770
GC0770 NGVD 29 - 150.76 (m) 494.6 (f) RESET 3
GC0770
GC0770.Superseded values are not recommended for survey control.
GC0770.NGS no longer adjusts projects to the NAD 27 or NGVD 29 datums.
GC0770.See file dsdata.txt to determine how the superseded data were derived. GC0770
GC0770 MARKER: DD = SURVEY DISK
GC0770 SETTING: 30 = SET IN A LIGHT STRUCTURE
GC0770 STAMPING: INDIAN AZI 1961
GC0770 STABILITY: D = MARK OF QUESTIONABLE OR UNKNOWN STABILITY GC0770
GC0770 HISTORY - Date Condition Recov. By
GC0770 HISTORY - 1961 MONUMENTED TNHD
GC0770
GC0770 STATION DESCRIPTION
GC0770
GC0770 DESCRIBED BY TN HIGHWAY DEPT 1961 GC0770 0.9 MI E FROM HENDERSONVILLE.
GC0770 FROM THE POST OFFICE IN HENDERSONVILLE, GO EAST ON U.S. HIGHWAY GC0770 31 FOR 0.9 MILE TO A CONCRETE CULVERT UNDER THE HIGHWAY. THE
GC0770 AZIMUTH MARK IS 49 FEET NORTH OF THE CENTERLINE OF U.S. HIGHWAY GC0770 31E, 16 FEET SOUTH OF A FENCE LINE, AND 13 FEET SOUTHEAST OF GC0770 A TELEPHONE POLE. THE DISK IS CEMENTED IN A DRILLED HOLE IN GC0770 THE NORTHEAST END OF THE CULVERT.

GPS Almanacs

The Satellite Planner and Satellite View functions both require a GPS satellite almanac in order to calculate the satellite data. The almanac can be downloaded from the following website and should be updated about every one or two months. **ftp://ftp.navcen.uscg.mil/GPS/almanacs/sem/**

The general website is **http://www.navcen.uscg.mil** - you can also go there and navigate to the GPS section followed by going to the Almanac area and then the SEM section.

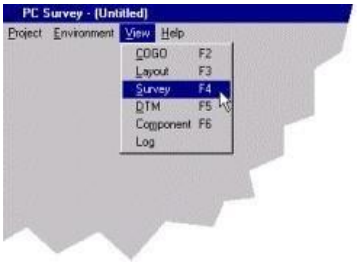
There are two formats for a GPS almanac - ***SEM*** and ***YUMA***. PC Survey can use either format, but the SEM format takes less space. A GPS almanac will start with either **SEM** or **YUMA** followed by a *week number* followed by the extension **TXT**. Week numbers range from 0 to 1023 with weeks beginning on Sunday at midnight GMT (Greenwich Mean Time). Week 0 began the week of August 22, 1999. As an example, **SEM18.TXT** is the SEM format almanac for the 18th GPS week - from December 26, 1999 through Jan 1, 2000.

When downloading the file, place it in the PC Survey almanac directory (the default is C:\PCS\ALMANAC), specified in the Directories section of the Options function. If there are multiple almanacs in the almanacs directory, PC Survey will use the most recent one, so all others can be safely deleted.

GPS Post Processing Tutorial

NOTE: Make sure your GPS hardware lock is securely attached to your parallel (printer) port before starting PC Survey.

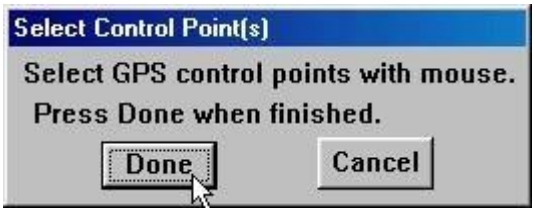
1. Start PC Survey. Go to "View Survey", or press the Function 4 key (F4) on your keyboard.



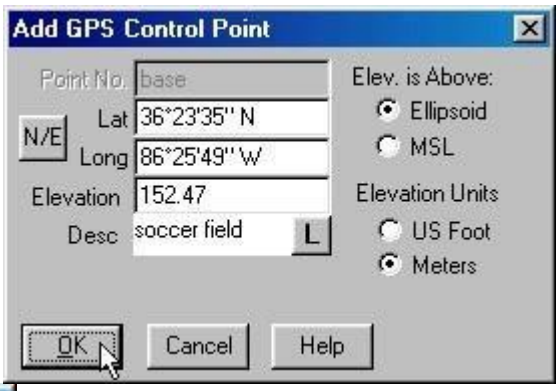
2. Go to GPS Load GPS Files. You will see what appears to be a standard "open file" dialog box. Select your first CE Survey file (usually your base point) and click "Open".

3. Notice that the "open file" dialog flashes briefly, then reappears. You may now select your next CE Survey file (usually a rover points file) and again click "Open". Repeat this process for any remaining files. When you are finished, click "Cancel".

4. Your points should now be visible in the working field. A dialog appears, instructing you to select your control points. Click on your control point(s) (usually your base) in the working field. Return to the dialog box and click "Done".



5. Next, the "Add GPS Control Point" dialog appears. If you have a known GPS monument that you have set up on, then enter its values here. This will tie your selected control point into a known control point. If you do not have any values to enter, then leave those fields untouched. Click "OK".



6. Did you receive this error message?

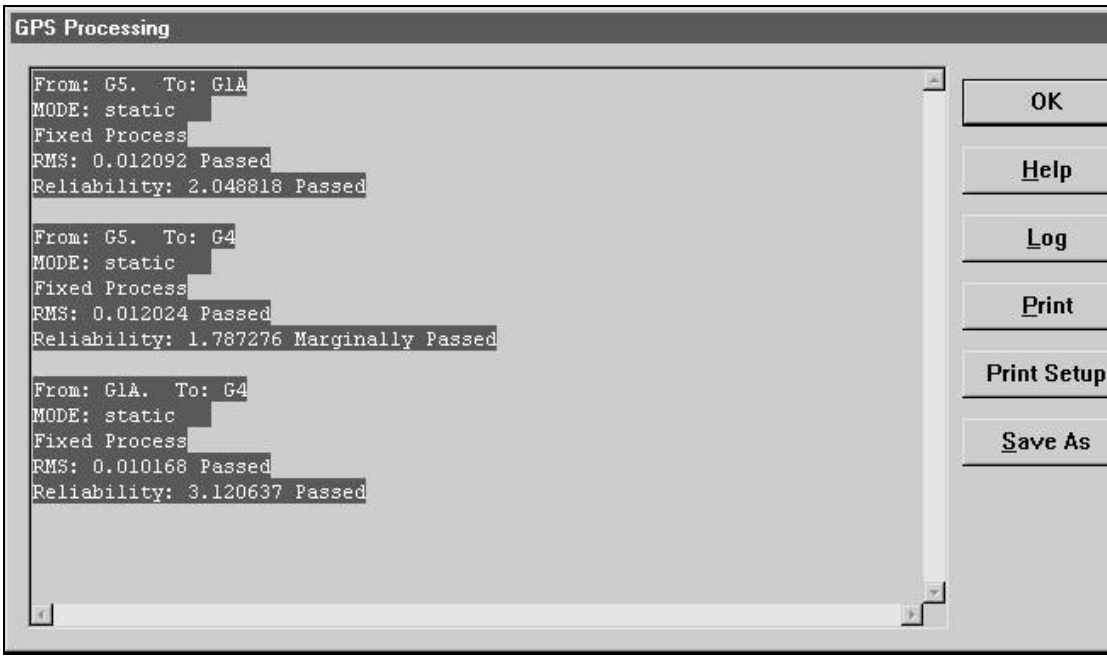
   Let's hope not. If so, you'll have to reprocess those points.

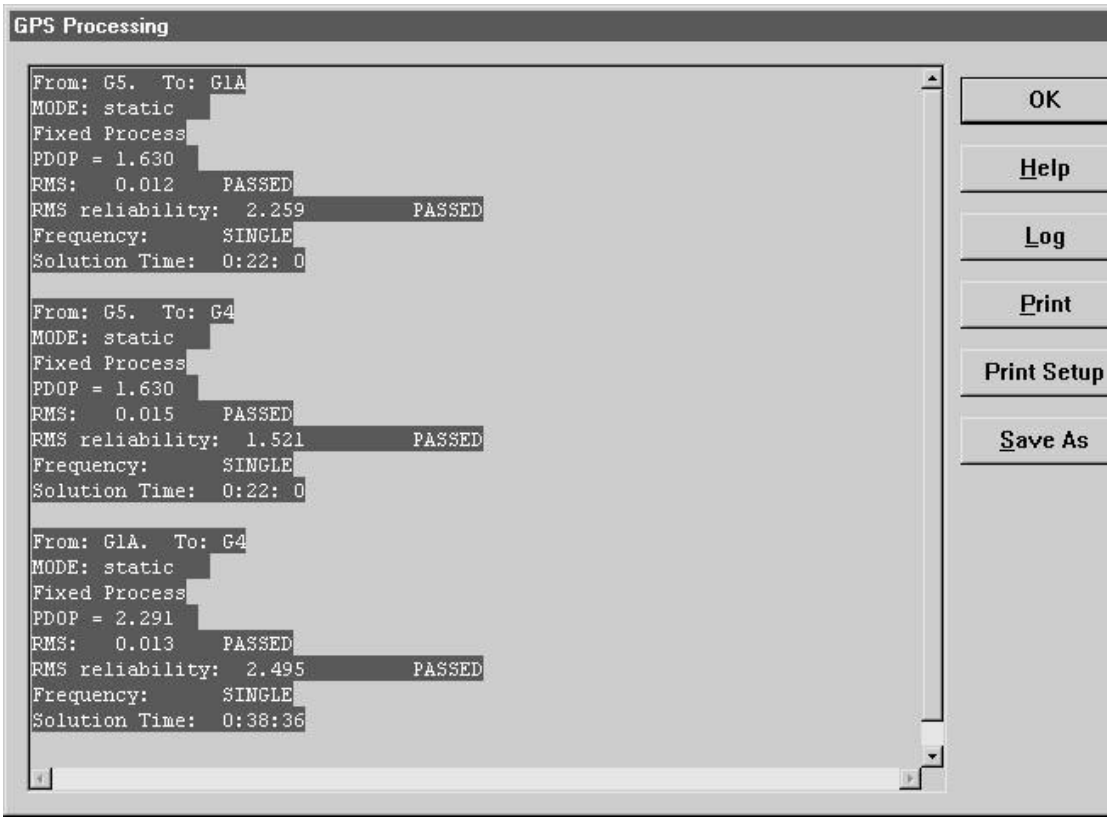
7. GPS post processing will now begin. If all is well with your points, they will change in color; first to blue, and then to green. If they change to red, those points failed. If they change to pink, then it is time to see a doctor, as you may be pregnant (just kidding).

8. The following table summarizes the possible colors.

	Line Color	Result
	Gray	Unprocessed
	Red	Failed
	Green	Passed

9. After processing, a report will appear that will show information about each baseline. Following are some examples of processing reports.



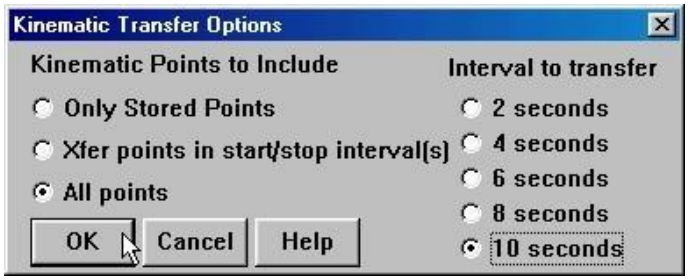


You may see either kind of report depending on which version of the software you are using. The most important information is the RMS and Reliability (called RMS Reliability in the old report style) values. The higher the

RMS value, the less noise there was in the data. The higher the Reliability value, the higher the probability that the result is the correct one. The more important of the two is the Reliability. Ideally, this value should be greater than 2.0. The software will consider the baselines as "passed" when the value exceeds about 1.4. However, the higher the value, the safer you are from an error. Generally, the longer you collect data in a static mode, the higher this value will go. At least 20 minutes is usually necessary to obtain a 2.0 Reliability value with a single frequency receiver in good conditions (no trees, etc.). If the RMS value fails, the data was very noisy – usually indicating the presence of multipath or an obstructed view of the satellites. If a baseline fails, one or both of the RMS and Reliability values will be below the minimum. Regardless, this doesn't mean that the baseline is wrong – indeed, you will find that most of the time when this happens, the solution is correct. What it means is that the probability that the solution is incorrect has become significant. In this situation, you can either recollect the data or, if you have performed error checks in the field, use the error check to verify the answer. CE Survey attempts to adjust for a lot of the problems that you can encounter while processing by extending the recommended sit time. However, the software has no way of knowing about multipath or trees unless the satellites actually become blocked. Signals that are delayed or deflected by things such as leaves on a tree will often appear as "good" data but will result in erroneous results. Tree leaves are particularly bad for kinematic surveying.

10. KINEMATIC ONLY! If running static mode, go to step11.

Next, the "Kinematic Transfer Options" dialog appears. Kinematic, as you know, collects one point every two seconds. The "Kinematic Transfer Options" dialog allows you to reduce file size by transferring only certain categories of points to COGO. After you select the points to transfer, click "OK".

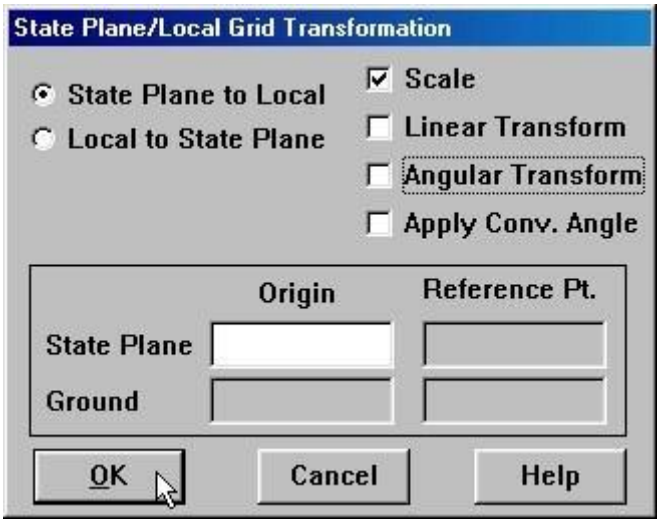


11. Your points should now automatically transfer, and the COGO window will appear. If not, go to "Edit Generate Cogo Points". Then, go to "View COGO".

    At this time, all the points are in a state plane reference system, meaning that the assumed surface is either precisely (if you used a state plane monument for control) or approximately the WGS84 ellipsoid. Inverse distances between points will typically be less than the measured distances on the ground (e.g. with an EDM). To transform between the ellipsoid and the ground, a conversion function has been supplied. A simplified use of this function follows and a more detailed explanation of it is in the reference manual on p.185

12. Select your points (refer to the PC Survey Tutorial if you are unsure how), then go to "COGO Coord. Transformation State Plane to Ground".

13. The "State Plane/Local Grid Transformation" dialog will appear. Select the "State Plane to Local" radio button. Uncheck all transformation options EXCEPT "Scale". Finally, enter your origin (base) in the "State Plane/Origin" prompt (the only option not greyed out at the bottom of the dialog). Click "OK".



Congratulations! You have usable, centimeter accurate COGO points. Now you can create alignments and boundaries, generate contours, and all the other functions you've become accustomed to performing in PC Survey.

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