

# **Survey/Map Module**

**Version 5**

*Softree Technical Systems Inc.*

## ***Document Version 5.0 - 6/18/2007***

The software described in this document is furnished under a license agreement or non-disclosure agreement. The software may be used or copied only in accordance with the terms of that agreement. No part of this manual may be reproduced or transmitted in any form or by any means, electronic or mechanical, including photocopying and recording, for any purpose other than the purchaser's personal use without the written permission of Softree Technical Systems Inc.

No warranty is expressed or implied as to the documented function or performance of the software described. The user of the software is expected to make the final evaluation of the results in the context of his own application.

Copyright Softree Technical Systems Inc. 2007. All rights reserved.

### Trade Marks

AutoCAD is a registered trademark of Autodesk.

Criterion and LaserSoft are registered trademarks of Laser Technology, Inc.

Hewlett-Packard, HP and LaserJet are trademarks of Hewlett-Packard Company

Microsoft Windows NT, Windows 2000, Windows XP, Windows Vista, Microsoft Word, Microsoft Excel are trademarks of Microsoft Corporation

RoadEng® and Terrain Tools® are registered trademarks of Softree Technical Systems Inc.



---

---

## Table of Contents

TABLE OF CONTENTS.....	3
GETTING STARTED .....	4
Checkpoints.....	4
Conventions.....	4
On-line Help.....	5
Tutorial Units .....	5
ENTERING AND CLOSING A BOUNDARY TRAVERSE.....	6
Setting up the Traverse Entry Screen .....	6
Entering Survey Notes .....	9
Creating a Map Document .....	12
Closing the Boundary Traverse.....	16
ROAD P-LINE TRAVERSE WITH CROSS SECTIONS EXAMPLE .....	18
Customizing the Traverse Screen for a P-Line Survey .....	18
Entering a Traverse with Side Shots .....	20
SURVEY ADJUSTMENTS.....	25
Making a Map with Multiple Traverses .....	25
Absolute Coordinates .....	27
Inserting a File.....	39
Correcting a Traverse using Station Equations .....	43
Adjusting for Magnetic Anomalies .....	45
SURVEY FORMATS AND CUSTOMIZATION.....	50
Transit Survey (An Example of a Block Boundary) .....	50
Level Survey .....	55
User Defined Columns and Picklists.....	59
INDEX .....	62

## Getting Started

This manual is formatted as a hands-on tutorial, which can be used by novice or experienced users.

The tutorial files referred to in the examples are found in the installation default directory **C:\Program Files\Softree\Roadeng\Tutorial\Survey**. If the location of this directory is moved remember to apply the corresponding change to the tutorial example.

If these files get inadvertently changed, re-load them from the CD before the next user of the tutorial tries to access them.

---

**NOTE:** To replace the tutorial files, reinstall the software from the CD and say NO to over-writing all files except the tutorials files.

---

### Checkpoints

Checkpoints identified by a checkmark indicate the beginning of an example. All files required to start from a checkpoint are included on the installation CD or Internet download file.

### Conventions

The following conventions are used throughout the manual:

- Menu functions are delimited by a line “|”. *File|Open* means to click on *File* in the menu bar and then select *Open* from the drop down menu.
- Checkboxes, dialog boxes, column headings, and button names are italicized.
- When directed to highlight, select, or activate a field or object, it becomes the active field or object. For instance, "highlight the Traverse window" means to click on the Traverse title bar to activate it.

- The symbols “<>” with words in between indicate keyboard function. For example < shift + enter> means to hold down the *Shift* key and then press the *Enter* key.
- File names, path names and text to be typed in are in **bold**.

## *On-line Help*

Help information is available by choosing the *Help* menu or pressing F1. On-line Help includes detailed technical information about menus, dialog boxes, and operation of the program.

It may be useful to refer to the On-line Help while working through the examples in this manual.

## *Tutorial Units*

Most examples in this tutorial are in metric units. To correctly follow the examples ensure Metric Units are enabled (menu **Module | Setup**) before starting. If other units are used they will be specified at the start of the example. The procedures and concepts described apply to all unit systems.

## Entering and Closing a Boundary Traverse

This exercise demonstrates how to customize the notes entry options, enter survey notes for a boundary traverse, close the traverse and create a map.

### *Setting up the Traverse Entry Screen*

1. Open the Survey/Map Module. File | New. Select Traverse Document. Press OK. An *Untitled Traverse 1* document will appear. Or simply press the *New* button in the toolbar.

Layout files are useful for personalizing the Survey/Map module screen. Window options such as scales, columns, tab/enter sequence etc. can be setup and saved in a layout file for future use. The default layout screen for a new traverse is **normal.SLT**. Additional customization such user defined columns and pick lists is described in the **Survey Formats and Customization** section.

2. Choose Module | Setup. Ensure the *Units* are in metric. If correct press cancel.

The following steps demonstrate how layouts can be used to quickly change the screen format.

3. Choose menu File | Retrieve Screen Layout and select file **C:\Program Files \Softree \RoadEng\ block.SLT**. Notice how the columns change after this screen layout is read in. Change back to the default screen layout, by selecting **normal.SLT** from the *Screen Layout* box in the toolbar.

---

**NOTE:** Commonly used screen layout files are saved in the RoadEng directory allowing them to be accessed from the *Screen Layout* box.

---

4. To customize the traverse entry screen and create a personalized layout file, choose Edit | Traverse Entry Options or double click on any gray area of the traverse notes to pop up the *Traverse Entry Options* dialog box shown in Figure 2.0.

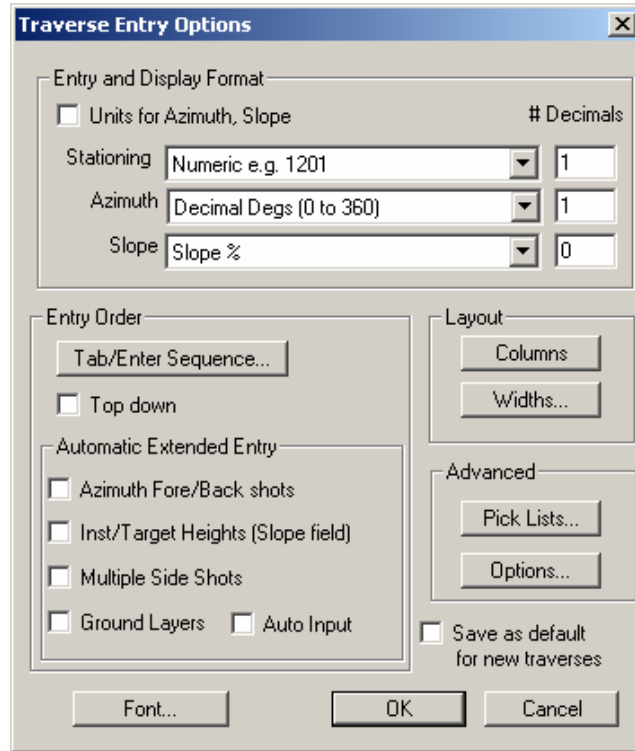


Figure 2.0 *Traverse Entry Options* Dialog Box

5. To add or remove columns, press the *Columns* button, and the *Columns Select* dialog box as shown in Figure 2.1 will appear.

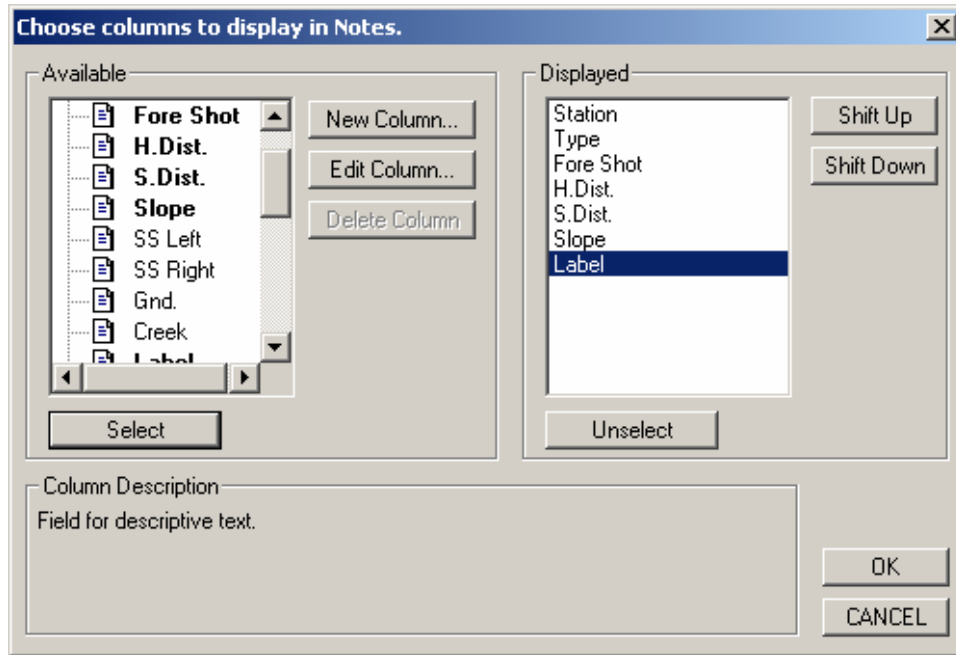


Figure 2.1: Columns Select Dialog Box

6. Change the items in the *Selected* list to match the *Selected* list in Figure 2.1. To remove an item from the *Selected* list, highlight it under *Selected* and press the *Remove* button. Similarly to add an item to the *Selected* list, highlight it under *Available* and press the *Add* button. Highlight an item in the *Selected* list and press the *Shift Up* or *Shift Down* button to change its position. When done, press OK.
7. Click on the *Tab/Enter Sequence* button and a similar dialog box to Figure 2.1 will appear. Using the same procedure as in step 6, list in order *Label*, *Type*, *Fore Shot*, *Slope* and *S. Dist.* in the *Selected* list. Press OK twice to close both dialog boxes.

**NOTE:** To enter horizontal distance, use Edit | Traverse Entry Options, and select the *H. Dist* in the *Tab/Enter Sequence* option. At the same time remove *S. Dist.*

8. File | Save Traverse Screen Layout. Save the layout as **unit** in the **Tutorial\Survey\Notes** directory.

A Softree Prompt appears stating “To make the layout available in your tool bar it must end in **.DLT** (Location), **.ILT** (Terrain), **.SLT** or **.MLT** (Survey/Map). “ Press OK.

The new customizations are now saved (along with the rest of the Traverse Entry Options), so that they can be retrieved at another time without having to re-customize. The screen layout will be saved with the given name and the extension **\*.SLT**. If you save a screen layout to the **\RoadEng** directory, it will appear in the Screen Layouts Box in the tool bar for quick access.

### *Entering Survey Notes*

1. Start entering the Block 1 traverse notes shown in Figure 2.2. Place your cursor in the label field at the bottom of the screen and type **main 699.1** then press <Enter> to move to the *Type* field.

---

**NOTE:** The notes shown in Figure 2.2 are bottom-up note entry. Notes can also be entered from top-down by simply turning on the *Top Down* switch shown in Figure 2.0

---

Sta.	Az.	H.D.	% Slope	S.D	June-2-97
0+898.0	= End Traverse				
	345.0	43.1	+16	43.6	
0+855.0	297.0	44.8	+16	45.4	
0+810.2	291.0	88.5	+11	89.0	
0+721.7	291.5	12.4	-4	12.4	
0+709.3	254.5	27.8	-21	28.4	
0+681.5	234.5	62.3	-34	65.8	= main 502.1
0+619.2	197.0	21.1	-51	23.7	
0+598.1	197.0	30.0	-21	30.7	
0+568.1	197.0	46.0	-50	51.4	
0+522.1	199.0	93.0	-50	48.1	= end of spur
0+479.1	196.5	65.2	-20	66.5	
0+413.9	98.5	97.7	+19	99.4	
0+316.2	94.5	145.0	+25	149.5	
0+236.2	155	65.0	+20	66.3	
0+171.2	25.0	100.0	0	100.0	
0+126.1	155	54.9	+5	55.0	
0+071.2	12.0	29.2	+24	30.0	
0+042.0	354.5	42.0	+22	43.0	
0.000	= Start Traverse				= main 699.1

Figure 2.2: Block 1 Traverse Notes

The <Enter> or <Tab> key will move between the fields selected in the Tab/Enter Sequence; <Shift +Enter> or <Shift +Tab> will reverse the direction.

2. Press <Enter> again to accept the default **FS** indicating that this is a normal Foreshot.
3. Type **354.5** under the *Fore Azim* column <Enter>.
4. Type **22** under the *Slp%* column <Enter>.
5. Type **43** under the *S.D.* column <Enter>, and <Enter> again to bypass the *Labels* column.

Note that:

- The Station is calculated and displayed.
  - The cursor skips over the *HD* column to the *Slp%* column.
  - Horizontal distance is automatically calculated from the slope distance and the percent slope.
6. Press <Enter> to indicate that the 2nd line of the traverse is an **FS** type shot and continue from the notes in Figure 2.3.
  7. At Station 71.2 (the 3<sup>rd</sup> line of the traverse) type in **I** and press <Enter>. This indicates that this shot will be an IFS (Intermediate Foreshot).

---

**NOTE:** IFS shots (Intermediate Foreshots) differ from Foreshots (FS Type) in a number of ways. Foreshots have an azimuth while IFS shots do not. An IFS shot has the same azimuth as the next FS type shot. Secondly, IFS shots always start at the last station or hub. A number of IFS shots in a row will all start at the last non-IFS station and all distances will reference back to that station.

*When and why are IFS shots used instead of Foreshots or FS shots?*

IFS shots are used when approaching a location where topography is important but creating a hub is not (such as a gully or stream crossing). IFS shots are used rather than FS shots because the total chainage does not increase and hence neither does the error that can build up with excessive FS type entry.

---

Radial Shots (RS type shots) like IFS shots always start at the last station hub or turning point but unlike IFS shots have their own azimuth and hence do not define the centerline of the survey. They are used as reference (tie) stations or for topography.

8. Press <Enter> .The program will correct the IFS azimuth later when it is defined. In this case it will be the bearing of the subsequent shot (25.0 degrees).


This traverse has already been saved in the tutorial directory as **\Tutorial\Survey\Notes\ block1.TR1**.

9. File | Close. Say NO when prompted to save changes.

## Creating a Map Document

A Map Document is a collection of traverse names. Traverses can be added or removed from the map without affecting the traverse documents.

In this section a map of the boundary traverse entered in the previous section will be created.

1. File|Open. Select **\Tutorial\Survey\Notes\block1.TR1**.
2. To create a map from an open traverse, select View | Quick Map menu, or the *Create Map* button  from the tool bar. A Map will open that has the name Untitled Map 1. Alternatively open File | New Map Document. Select **\Tutorial\Survey\Notes\block1.TR1**
3. File|Save the Untitled Map 1 as **Tutorial\Survey\Notes\block1.MAP** (**block1 map** already exists, press Save when prompted to overwrite the existing file).
4. Arrange the map and traverse screens side by side, with Window | Tile Vertically. To view the Station column in **block1.TR1** slide the bottom scroll bar to the far left

**NOTE:** Clicking on the title bar of a document will activate it. Menu functions and toolbar buttons will change depending on which type of document is active.

5. Click on **block1.MAP** title bar.
6. Select View | Options to open the *Map View Options* dialog box as shown in Figure 2.3.

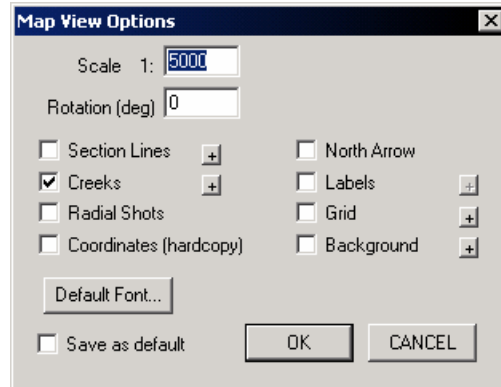



Figure 2.3: *Map View Options* DialogBox.

7. Turn on *Labels*. Press the adjacent  button. The dialog box shown below will appear.

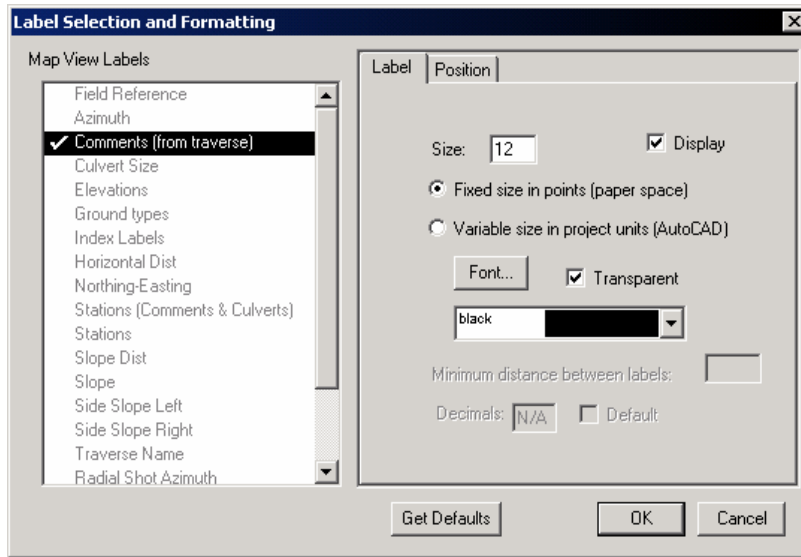


Figure 2.4: Label Selection and Formatting Dialog Box

8. If necessary, activate the *Comments (from Traverse)* label by selecting or highlighting *Comments (from Traverse)*, and press *Display*. A check mark will appear beside the word *Display*, and in front of the label name. A double click on the label name will also activate and de-activate the label. Press OK twice to return to main screen.
9. Hover the arrow cursor over the boundary line of the block in the *block1.MAP* window, a text box will appear with the name of the traverse and the station that you are closest to.
10. Left click on the top right corner of the boundary. Two things have happened, the cross-hair moved to that station in the map and the also to the corresponding station in the traverse notes. This also works in reverse. Select a station in the traverse notes and the cross-hair will move to the corresponding station in the map.

**NOTE:** Double-clicking on a traverse in a map document will open the corresponding traverse notes

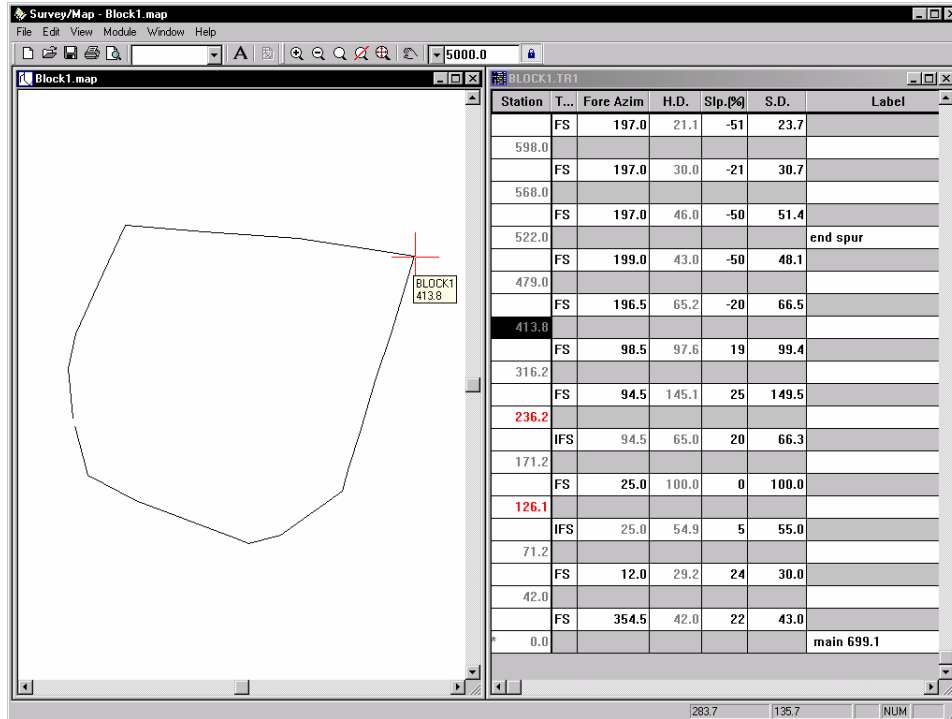


Figure 2.5: Final Traverse and Map Documents

## Closing the Boundary Traverse

This example illustrates how to close a boundary by determining its area and the closing error.

1. If the previous exercise was not completed then File | Open  
  \Tutorial\Survey\Notes\block1.TR1 and  
  \Tutorial\Survey\Notes\block1.MAP. Use Window | Tile Vertically to  
  arrange the map and traverse documents side by side

Note there is a small gap between the first and last station. See Figure 2.5

2. Click on the Traverse Document title bar (titled **block1.TR1**) to activate it.
3. Select Coordinates | Close Traverse. A confirmation prompt will appear asking whether you want to close the traverse. Press OK.
4. Another dialog box will appear called *Coordinate Adjustment Log*. It states that there is a northing and easting deviation (2D) at station 898.0 of 6.60 meters, a closed area of 5.56 Ha and a closure error of 0.74%. Press OK.

---

**NOTE:** Scroll the traverse notes so that the last shot is visible. Station 898.0 now has an asterisk beside it (indicating an absolute coordinate). This means that station 898.0 has fixed X, Y, and Z coordinates, in this case the same as station 0.0. The coordinates of the first station in a traverse are always absolute. The coordinates between absolute stations are determined using the Compass Rule.

---

A diagram showing a table with four rows and three columns. The first row has a blacked-out cell, 'FS', and a greyed-out cell. The second row has '898.0', 'FS', and a greyed-out cell. The third row has a greyed-out cell, 'FS', and '345.0'. The fourth row has '855.0', 'FS', and a greyed-out cell. A box labeled 'Asterisk' has an arrow pointing to a small asterisk in the left margin of the second row.

	FS	
898.0	FS	
	FS	345.0
855.0	FS	

*Figure 2.6: Asterisk Showing Absolute Coordinates*


5. File|Close both map and traverse. Do not save changes.

## Road P-Line Traverse with Cross Sections Example

Entering traverse notes without using the mouse is a faster method for the experienced user. All functions for entering traverse notes can be accomplished with keystrokes. The following example demonstrates some techniques using keystrokes to minimize data entry time.

### *Customizing the Traverse Screen for a P-Line Survey*

Unlike the previous boundary example, the P-line traverse in this example includes perpendicular side slopes, creek crossings, and ground types. To accommodate this additional information you will need to configure your entry screen and save it as a new layout.

1. File|New, select Traverse Document. Press OK. Maximize the window by clicking the maximize button  on the top right of the traverse document window.
2. File | Retrieve Screen Layout. Select screen layout **\Tutorial\Survey\Notes\pline.SLT**.
3. Select Edit|Traverse Entry Options. Press the *Columns* button. In the *Selected* list, display in order: *Station, Type, Foreshot, Backshot, Slope, S.Dist, SS Left, SS Right, Gnd, Creek, and Label*. Refer to *Customizing the Traverse Screen* for instructions (step 6 on page 8). Press OK.
4. Press the *Tab/Enter Sequence* button. Ensure the *Selected* list displays, in order: *SS Left, SS Right, Gnd, Creek, Label, Type, Foreshot, Backshot, Slope* and *S.Dist*. Press OK.
5. Enable the *Multiple Side Shots* in the *Automatic Extended Entry* area. Press OK to exit the *Traverse Entry Options* dialog box.

6. Save your customized traverse screen layout by File|Save Traverse Screen Layout. Save in \Tutorial\Survey\Notes directory. Type in **unit2.SLT** for the layout name. (You can later retrieve this layout using menu File|Retrieve Screen Layout).

---

**NOTE:** If a layout is saved in the RoadEng directory it will be available through the Screen Layouts box.

---

7. Save the empty Traverse Document by selecting File| Save in \Tutorial\Survey\Notes\ directory. Type in **spur2** for the file name.

## Entering a Traverse with Side Shots

Sta.	Spur Traverse (P. line)						June-3-97	Compass #15 P. Smith A. Jones
	F.Az	B.Az	H.D	%slope	S-D	%L		
0+342.3 = End Traverse						75/20	-75	HP block 1 sta 522
0+326.8	93.0	274.0	24.4	+15	24.7	+20/25, +60	-75	HP
0+295.9	100.0	279.0	28.9	+6	29.0	+20/30, +65	-20/2, -75	HP
0+295.9	94.0	275.0	62.7	+10	63.0			
0+233.2						+20/30, +65	-20/6, -75	HP
0+177.8	103.0	282.0	55.4	+15	56.0	+20/30, +70	-20/20, -5	SR
0+145.0	105.0	285.0	56.7	+14	57.3	+20/25, +65	-20/30, -70	SR banks 2m high
0+121.1	IFS	IFS	24.0	+5	24.0	+9	-12	HP culvert size 809m elev 117.1
0+102.1	76.0	255.0	19.0	+15	19.2	0/5, +15	-5	HP/1.0SR
0+102.1	24.5	205.0	19.2	+23	19.6			
0+087.9						-10	+15	HP/1.0SR
0+087.9	0.0	181.0	5.7	+10	5.7			
0+082.2						-20/10, -30	+25	HP/1.0SR
0+082.2	357.0	175.0	12.0	+15	12.1			
0+070.2						-17/5, -25	+20/20, +30	HP
0+070.2	345.0	166.0	22.6	+18	23.0			
0+047.6						-15/10, -50	+15	SR
0+047.6	330.0	150.0	47.6	+7	47.7			
0+000						-20/40, -100	+25	SR main sta 657.5

Figure 3.0: Spur Traverse Notes

- Left click in the SSL field at the bottom of the screen to open the *Extended Side Shot Edit* dialog box (Figure 3.1). The *Extended Side Shot Edit* dialog box allows perpendicular side shots (cross section shots) to be entered.

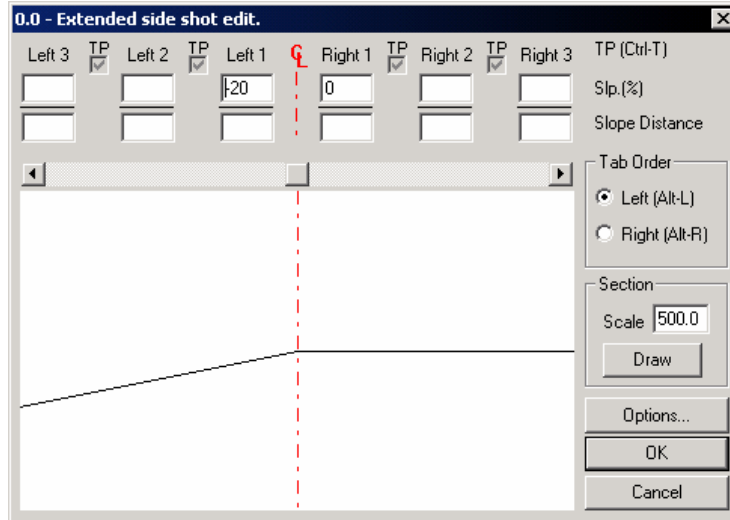


Figure 3.1: Extended Side Shot Edit Dialog Box

**NOTE:** Pressing the <Tab> key moves the cursor from field to field within dialog boxes. Pressing <Shift + Tab> reverses the direction. In the *Extended Side Shot Edit* dialog box, <Page Up> mimics <Tab> and <Page Down> mimics <Shift + Tab>; this allows one-handed entry from the keyboard.

9. Referring to the Traverse notes in Figure 3.0, type the first left slope **-20**, press <Page Down>. Type in the slope distance **40**, press <Page Down>. Type final left slope **-100**. Press <Enter> or click OK. The dialogue box will re-fresh; the cursor will positioned to enter the shots right of the centerline (<Alt + R> will also jump to the right hand side). Type **25** in this box. Press <Enter> to exit the *Extended Side Shot Editor*.

**NOTE:** The extended side shots defined in the dialog box will be displayed in the *SSL* and *SSR* fields as one line of text (-20/40.0 T,-100/..). It is possible to directly type extended side shots in the *SSL* and *SSR* fields once the syntax is known. The “T” stands for turning point and represents a check in the corresponding *TP* box in the dialog box. A slash, “/”, can be typed instead of a comma between shots if desired.

10. The cursor should be positioned in the *GND* column. Type **SR** (Solid Rock), under the *GND* column. Press <Enter> <Enter> to skip the *creek* column.

**NOTE:** Ground types are used to determine engineering properties, such as cut/fill angles for road design. It is important to record them in the field correctly. If using the traverse for road design, check to see that the cut/fill angles and ground types are pertinent to the geographic location. Changing the ground types can be done using Edit|Ground Types Editor menu item.

11. The cursor should now be in the *Label* column, type **main stn 657.5**, press <Enter>.
12. Press <Enter> again, to accept the default shot type **FS** (Foreshot).
13. Type **330.0** in *Fore Azimuth* column, press <Enter>. Type **150** in *Back Azimuth* column, press <Enter>.
14. Type **7** in the *slp%* column, press <Enter>.
15. Type **47.7** in the *S.D.* column, press <Enter>.
16. The *Extended Side Shot Edit* dialog box will appear again. Type **-15** <Page Down> type **10** <Page Down> type **-50** <Enter>; and for the right type **15** <Enter>.
17. Press <Enter> again to indicate that **SR** will also apply to the second survey station, and <Enter> <Enter> to skip Creeks and Labels entry fields.

Use Edit|Traverse Entry Options|Tab/Enter Sequence to remove any columns infrequently used (such as *Creeks* and *Labels*) from the entry sequence; these fields can always be selected with the mouse or use <Control + Arrow keys> to input data.

18. Continue entering notes in Figure 3.0 until station 82.2 *GND* field.

19. The ground type at station 82.2 indicates a 1.0m layer of HP on top of SR.
20. At station 82.2, with the cursor in the *GND* column, double click or press <Control + O> to open the Extended Depths dialog box (Figure 3.2).

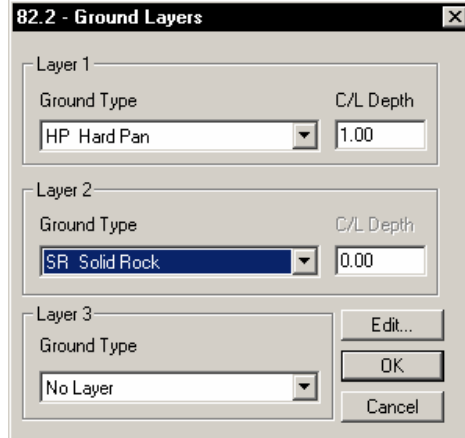


Figure 3.2: Extended Depths Dialog Box

21. Select *HP Hard Pan* depth 1.0 for *Layer1*; select *SR Solid Rock* for *Layer2* (layer 2 depth is ignored unless there is a third layer). Press OK.

For the next two stations the program will automatically default to the previous ground type. Ground types only have to be entered in when the ground type has changed. Don't forget to change the ground type to HP at station 121.1.

**NOTE:** Extended depths and ground types can be entered by double clicking in the *GND* column, or by <Control + O> when the cursor is in the *GND* column. The materials and layer depths can be typed directly in the *GND* field (i.e. **HP/1/SR**).

**NOTE:** Layers are displayed in the cross section of the *Extended Side Shot Edit* dialog box.

22. Continue entering notes in Figure 3.0 until station 349.3.

**NOTE:** For IFS (Intermediate Foreshots) shots, type **I** under the *Type* column and skip the *Azimuth* column(s). The azimuth of the IFS will automatically be determined from the azimuth of the next non-IFS shot.

**NOTE:** For culvert dimensions, type the pipe diameter in mm in the *CRK* column. <Control + O> or a double click in the *CRK* field will provide more options for entering creek/culvert information.

23. File|Close. Do not save changes.


## Survey Adjustments

Surveys may be adjusted for a number of reasons.

- Traverses may tie to other traverses as well as features on the ground or GPS coordinates.
  - Alternate routes for a part of a road traverse may be considered. Instead of re-traversing the entire road, a segment may be inserted at the location of the alternate route
  - Files may be joined and closed to determine the area enclosed by a number of traverses.
  - Traverses may be corrected in areas with magnetic anomalies.

### *Making a Map with Multiple Traverses*

The next example demonstrates how to display several traverses on the same map and adjust the positions of the traverses with respect to each other.

1. Choose File|Open. Select **C:\Program Files\Softree\Roadeng\Tutorial\Survey\Adjust\block1.MAP**.
2. Maximize the window by clicking the maximize button  on the top right of the traverse document window. Edit|Add/Remove Traverses, the *Map traverses* dialog box, shown in Figure 4.0, will appear.

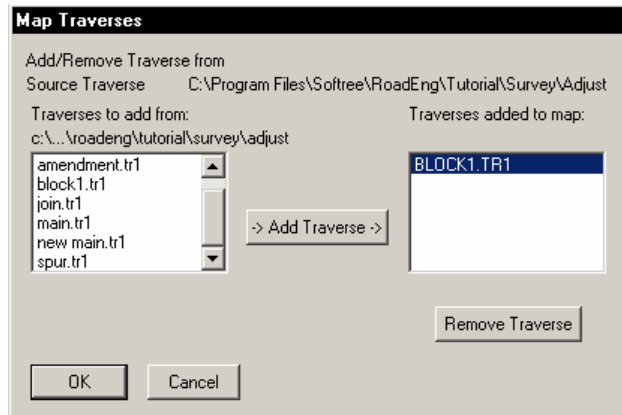
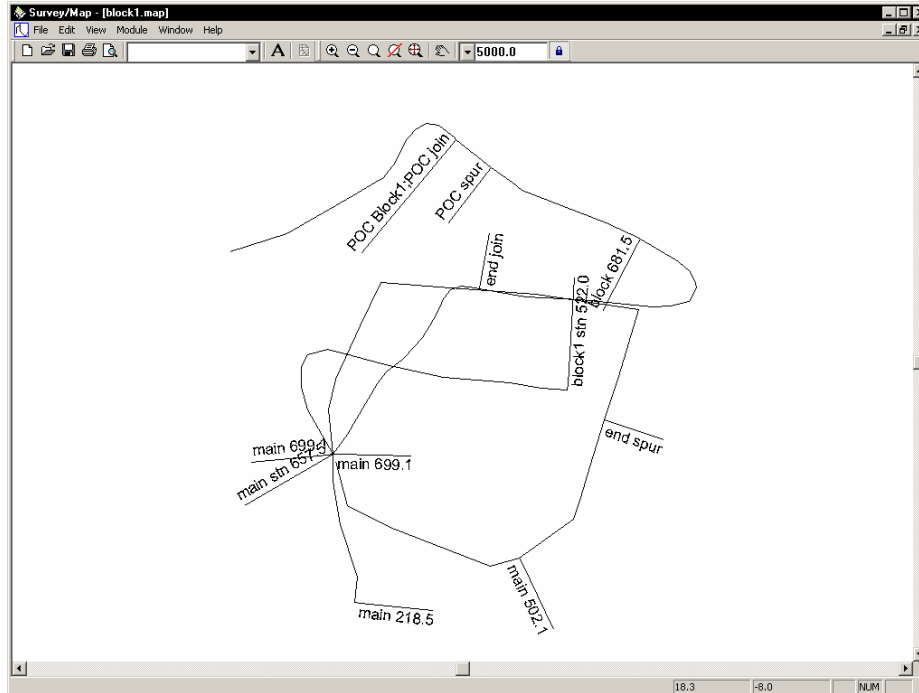


Figure 4.0: Add/Remove Traverses Dialog Box

3. Select **spur.TR1** and press the *Add Traverse* button. **spur.TR1** appears in the *Traverse added to* list box. Do the same with **join.TR1** and **main.TR1** Press OK.
4. File | Retrieve Screen Layout, select \Tutorial\Survey\Adjust\block1.MLT.

The map should now appear as shown in Figure 4.1.

**NOTE:** The same map can be also be created by selecting menu File|New, choosing Map Document, and then selecting the four traverses (**block1.TR1, spur.TR1, join.TR1 and main.TR1**) with the mouse, while holding the <Control> key.



*Figure 4.1: Map View After Adding Additional Traverses*

5. Double-click on any of the traverses in block1.MAP and the corresponding traverse notes will open.
6. File|Close all documents. Do not save changes.

## ***Absolute Coordinates***

All traverses start from an absolute coordinate. By default, all other coordinates are calculated from this starting point. Arbitrarily, the value (0, 0, 100) is assigned for the X, Y, and Z coordinate of the first station. If these coordinates are changed the entire traverse is shifted (provided no other absolute coordinates have been set). Other coordinates within the traverse can be set absolute by using the Coordinates|Set/Get XYZ Coordinates menu (Traverse Document),

Coordinates | Close Traverse menu (Traverse Document), or the Edit | Coord Adjustment menu (Map Document). The traverse is stretched or shrunk, using the Compass Rule, to fit between two or more absolute coordinates, as shown in Figure 4.2.

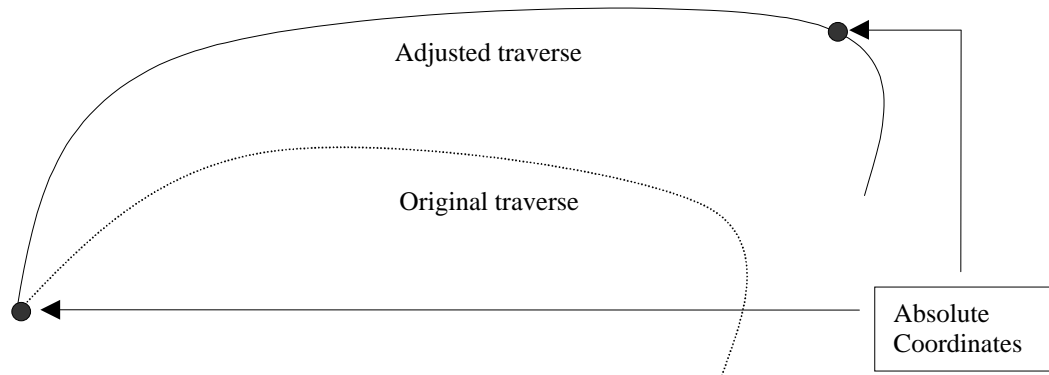


Figure 4.2: Adjusted Traverse and Original Traverse

### Shifting, Joining, and Adjusting Traverses

Method 1 demonstrates how to make a coordinate adjustment in the Traverse Document Screen. Method 2 shows how to modify traverses from the Map Document screen. In both cases the coordinate changes are saved with the Traverse Document. Raw field data (bearings, distances etc.) remain unchanged.

#### Method 1 -Setting Absolute Coordinates in the Traverse Document

1. File | Open \Tutorial\Survey\Adjust\method1.MAP. There are two traverses **main.TR1** and **block1.TR1**
2. Double-click on each traverse in the Map Window to open the corresponding traverse document. Select Window | Tile Vertically after opening each traverse document to arrange screen layout.

3. Click on the **block1.TR1** title bar. From menu File|Retrieve Screen Layout, select **Tutorial \Survey \Adjust\ travjoin.SLT**. Press Open. Select **main.TR1** title bar and retrieve screen layout **\travjoin.SLT**

This screen layout displays stations, corresponding labels and XYZ coordinates. Block1 will be adjusted with respect to Main because it is more accurate.

4. Highlight **main.TR1**. Scroll to find **POC block1** in the *Label* column (station 699.1). Note the X, Y, and Z coordinates (this is the “Point of Commencement” of block1.
5. Highlight **block1.TR1**, and select Station 0.0.
6. From menu Coordinates|Set/Get XYZ Coordinates, change Station 0.0 coordinates of **block1.TR1** to the same coordinates at **main.TR1** station 699.1 Type **114.9** for X, **294.2** for Y, **193.0** for Z. Press OK.
7. Close **block1** by selecting Coordinates|Close Traverse menu. Press OK to confirm closing of the traverse. Alternatively you could have selected Coordinates|Set/Get XYZ Coordinates, turned on *XY Absolute* and *Z Absolute* and changed the coordinates to equal those of station 0.0.
8. A Coordinate Adjust Log dialog box appears, indicating the deviation to Absolute station 898.00, area of the closed traverse of 5.56Ha and a closure error of 0.74%. Press OK.
9. Find “block 681.5” (station 502.1) in the *Label* column of **main.TR1**. Make note of the coordinates (286.8, 201.4 and 174.9). This corresponds to station 681.5 in **block1.TR1**.
10. Highlight **block1.TR1**. Scroll to find “main 502.1” in the *label* column.
11. Coordinate|Set/Get XYZ Coordinates, turn on *XY Absolute* and *Z Absolute* and change the coordinates to equal those of Station 502.1 in **main.TR1**. Type **286.8** for X, **201.4** for Y, **174.9** for Z. Press OK

12. A *Coordinate Adjust Log* dialog box appears as shown in Figure 4.3. It lists the (XY) and (Z) adjustments, area of the closed traverse and a closing error. Press OK.

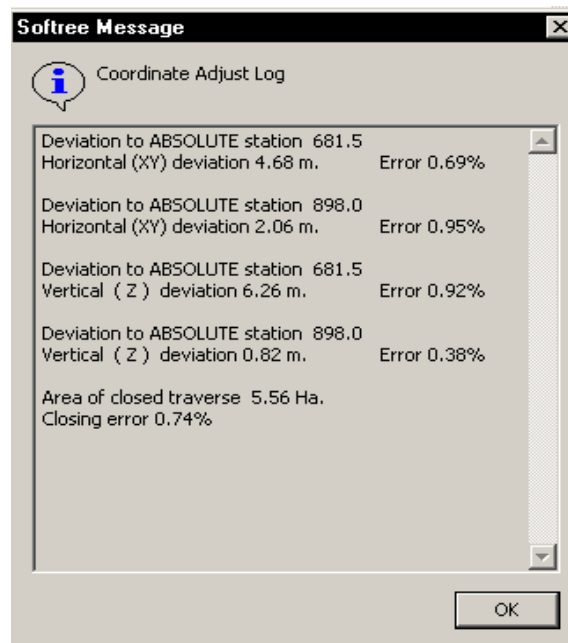


Figure 4:3 *Coordinate Adjust Log Dialog Box*

**block1.TR1** is now closed and adjusted it to match the two stations intersecting **main.TR1**.

Figures 4.4 and 4.5 show **method1.MAP** before and after the final adjustments.

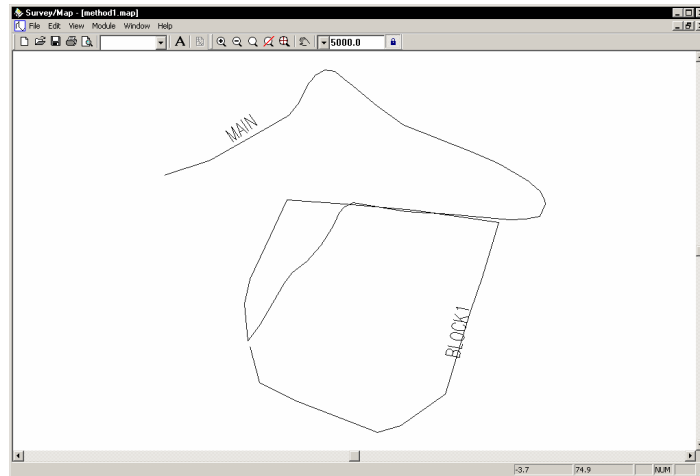


Figure 4.4: Method1.MAP Before Adjustments

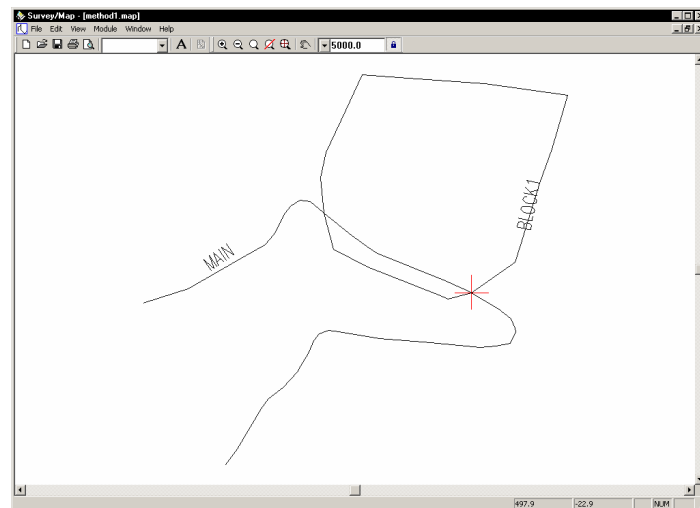


Figure 4.5: Method1.MAP After Final Adjustment



13. File|Close both the Traverse and Map Documents. Do not save the changes.

## Method 2 - Adjusting in the Map Screen

The map display (Method 2) provides a simpler method of implementing, undoing shifts and other adjustment functions. It demonstrates how to do adjustments without modifying the Traverse Document coordinates.

Method 2 has the following advantages over Method 1

- Opening of multiple Traverse Documents not required.
- Direct feedback on whether the adjustment worked or not, as the user is viewing the map rather than coordinates within Traverse Documents.
- The last adjustment can be undone using the *Delete* key in the Traverse Adjustments dialog.

1. File|Open. Select **Adjust\method2.MAP** and press the *Zoom Extents*  button. The map shown in Figure 4.6 will appear. Maximize the window by clicking the *maximize* button  on the top right of the Traverse Document window.

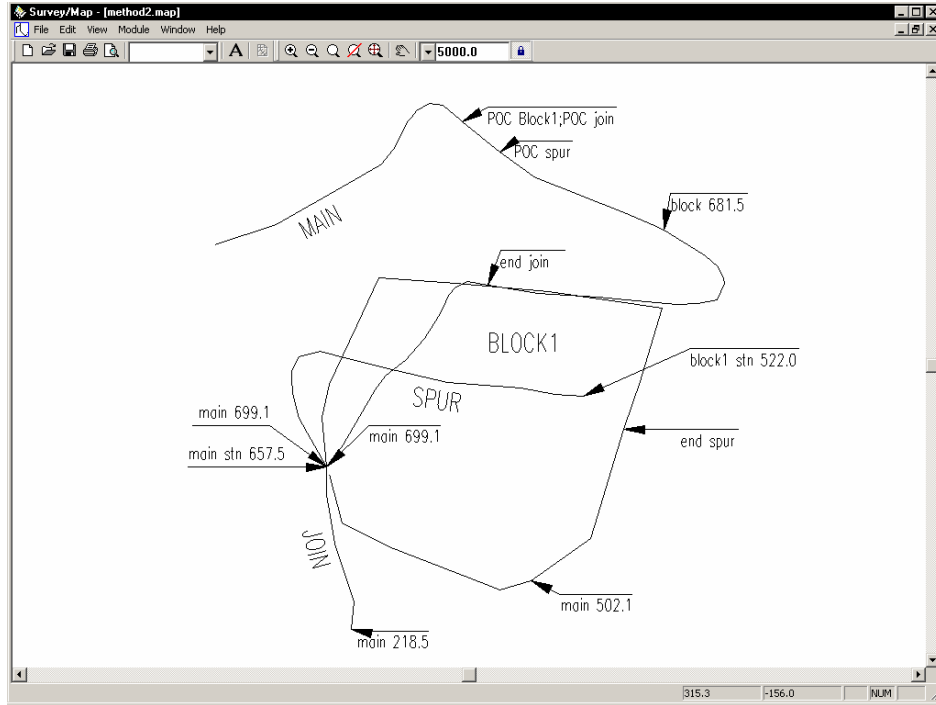


Figure 4.6: Map Document of method2.MAP

This example includes four traverses main, block1, spur and join.

2. Select Edit | Coord Adjustment to open the Traverse Adjustments dialog box shown in Figure 4.7.

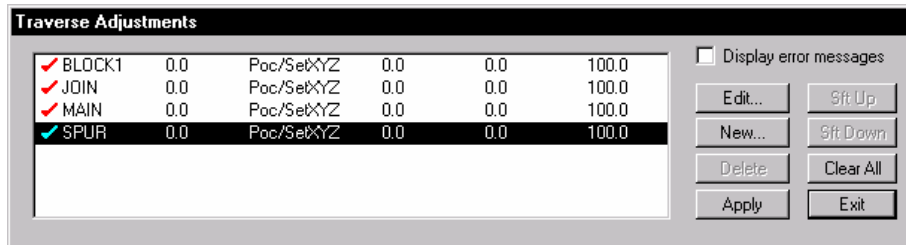


Figure 4.7: Traverse Adjustment Dialog Box

3. Press the *New* button, and change the information in the dialog box to match Figure 4.8. Note that both *Shift* and *Set absolute XY* is checked. Press OK and then press Apply.

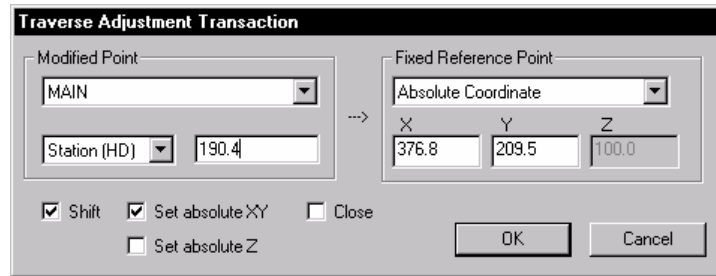


Figure 4.8: Traverse Adjustment Transaction Dialog Box

Note that main traverse has been shifted to the set of coordinates on the *Fixed Reference Point* side. You may need to left click on the Traverse Adjustment title bar and drag the dialog box down and sideways to see the map changes.

**NOTE:** The absolute coordinates used in this example are local coordinates. UTM coordinates can be used in place of the above local coordinates.

4. Press the *New* button. Change the *Modified Point* to **Main** and *Modified Point Station* to **9999**. (9999 is used for end station). Change the *Fixed Reference Point* to **Absolute Coordinate** and the *Fixed Reference Point X* to **172.6** and *Fixed Reference Point Y* to **246**. Ensure that *Set AbsoluteXY* is the only selected option. Press OK.
5. A Softree Prompt “Station not found, Nearest Station is: 958.1”. Press OK to acknowledge. The *Modified Point Station* will automatically change to 958.1. Press OK and *Apply*. A checkmark will appear in front of that adjustment in the adjustment list. The traverse was stretched to fit between the two sets of local coordinates.
6. Press *New* and change the *Modified Point Traverse* to Block1 and *Reference Station* to **0.0**. Change the *Fixed Reference Point Traverse* to **Main** and the *Reference Station* to **699.1** Make sure *Shift* and *Set AbsoluteXY* are selected. Press OK and then *Apply*.

The start of **main.TR1** identified by labels “POC Block1, POC join” now coincides with the start of **block1.TR1**.

*Table 1 Traverse Adjustment Steps*

	<b>Action</b>	<b>Modified traverse</b>	<b>Modified Station</b>	<b>Fixed Traverse</b>	<b>Fixed Station</b>	<b>Result</b>
<b>1</b>	Shift and Set Absolute XY	Main	190.4	376.8 X and 209.5 Y	0.0	Puts main in correct position with respect to Absolute set of coordinates
<b>2</b>	Set Absolute XY	Main	End	172.6 X and 246 Y	End	Accommodate second absolute set of coordinates (main is stretched). Note that “9999” is used for end station. Main is now tied to the 2 Absolute points.
<b>3</b>	Shift and Set Absolute	Block 1	0.0	Main	699.1	Shifts Block1 to Main.
<b>4</b>	Close					Close Block1.
<b>5</b>	Set Absolute XY	Block 1	681.5	Main	502.1	Shift Block to position on Main
<b>6</b>	Shift and Set Absolute	Spur	0.0	Main	657.5	Shift Spur to position on Main.
<b>7</b>	Set Absolute XY	Spur	End	Block 1	522.0	Attach Spur to Block1.

7. Press *New* and make sure that *Close* is checked. Press OK then *Apply*. The block1 traverse will close. (Step 4 of Table 1)
8. Zoom in. Note that the “block 681.5” and “main 502.1” do not coincide. Block1 needs to tie to main at this point.
9. Press *New* and turn off the *Close* option. Change the *Modified Point Traverse* to **block1** and *Reference Station* to **681.5**. Change the *Fixed Reference Point Traverse* to **main** and the *Reference Station* to **502.1**. Make sure that *Shift* is **not** checked and *Set Absolute XY* is checked. Press OK and then *Apply*. “block 681.5” and “main 502.1” now coincide.

10. Follow the above procedure to complete steps 6 and 7 of Table 1. Figure 4.9 and 4.10 should provide some guidance.

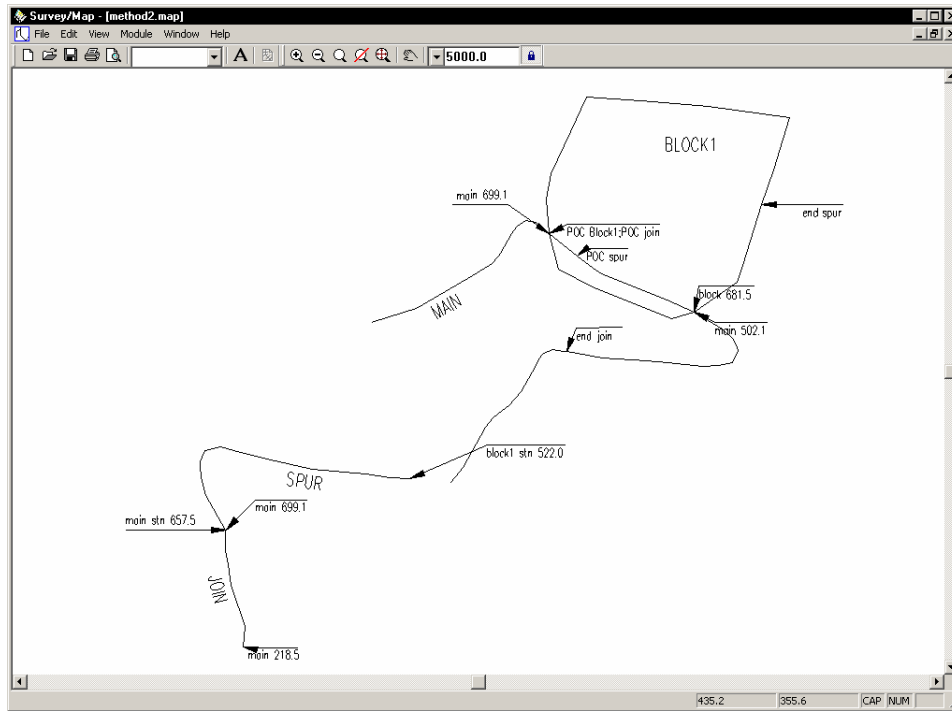


Figure 4.9: Method2.MAP Before Adjusting spur.TR1

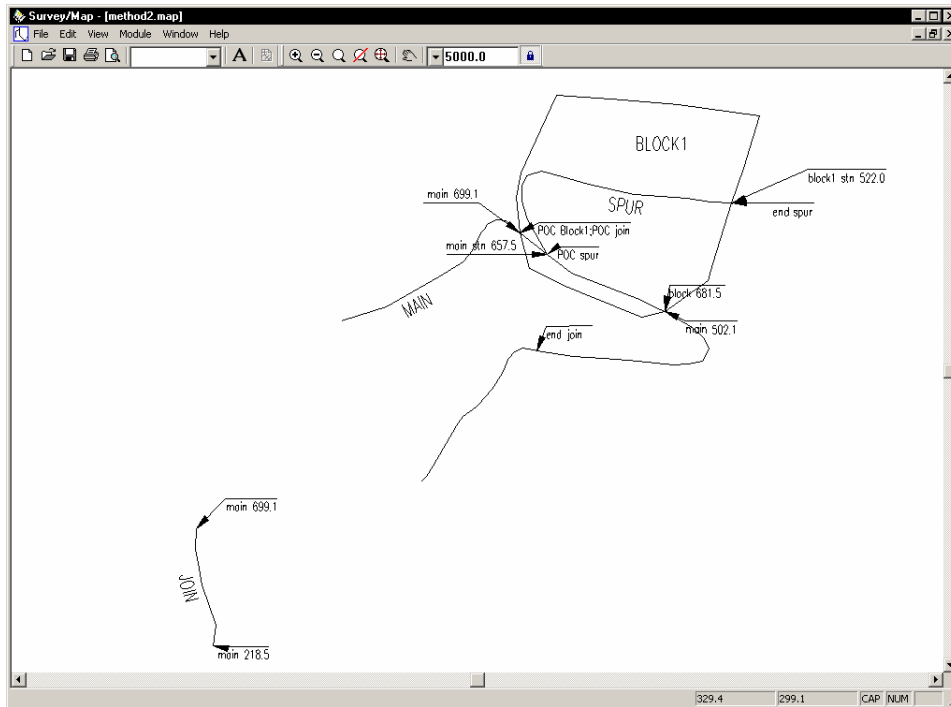


Figure 4.10: Method2.MAP After Adjusting spur.TR1

At this point all traverses except **join** have been adjusted. This operation is similar to that for **spur**. Keep in mind the final position of **join** in Figure 4.10.

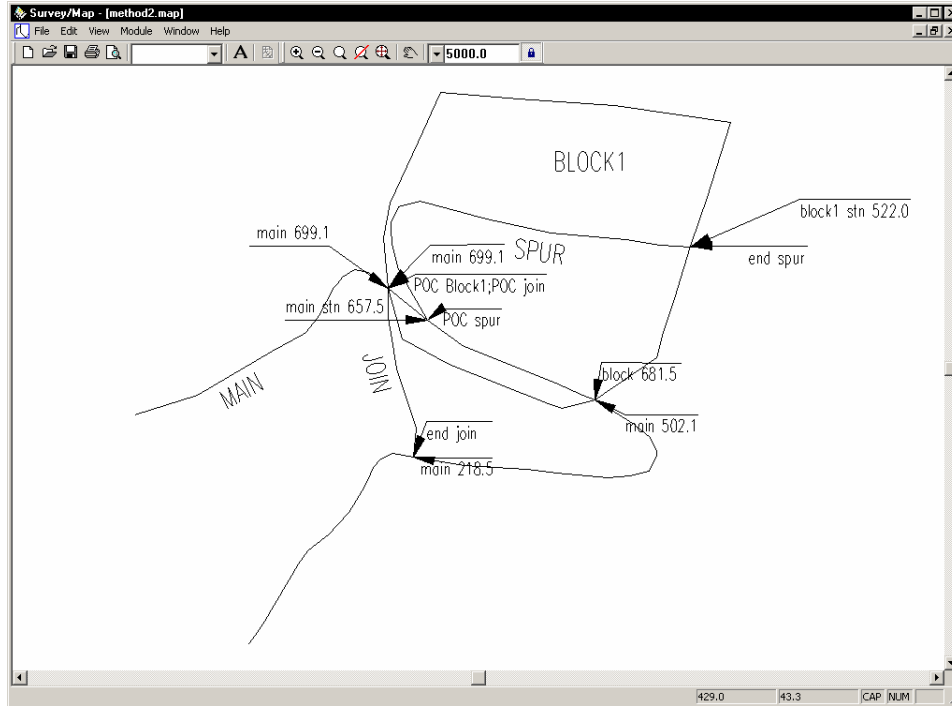


Figure 4.11: method2.MAP After Adjusting join.TR1

**NOTE:** Only coordinates and absolute points are modified by adjustments. Raw traverse data (Azimuth, Distance, Slope, etc...) are unaffected. All adjustments can be removed by pressing the *Delete* or *Clear All* buttons in the Traverse Adjustment dialog box (see Figure 4.7).

Adjustments can be independent or dependent on previous adjustments. It all depends on the order of operations. The last operation in the list supercedes previous operations for that traverse. For example, move the end of **main** to a different location.

11. Press *New* and change the *Modified Point Traverse* to **main** and the *Modified Reference Point* to **958.1**. Change the *Fixed Reference Point Traverse to Absolute Coordinate* and the *Fixed Reference Point Station* to **376.8** for X and **209.5** for Y. Make sure that *Shift* is checked and press OK and then *Apply*.

You will notice that **main** has moved without affecting other traverses and that last operation on traverse **main** supersedes the previous operations.

To move other traverses with **main** simply change the hierarchy of the last operation.

12. Using the *Shift up* button, move last operation so that it is just above the operation:  

<b>block1</b>	<b>0.0</b>	<b>Shift/Set XY</b>	<b>main</b>	<b>699.1</b>
---------------	------------	---------------------	-------------	--------------

 Press *Apply*.

13. Now press the *Delete* button and press *Apply*. The final adjustment will now look like Figure 4.10, because the previous main adjustments in the list now take affect.

**NOTE:** All adjustments in this example were with reference to the XY direction (2D) only. 3D adjustments can also be done by turning on *Absolute Z* in the Traverse Adjustment Transaction dialog box.

14. File|Close. Do not save changes.

## Inserting a File

This example demonstrates how to extract a section of a traverse from one document and insert it into another.

In Figure 4.12 the entire traverse **amendment** is inserted into a section of **main** from stations 430.9 to 720.1

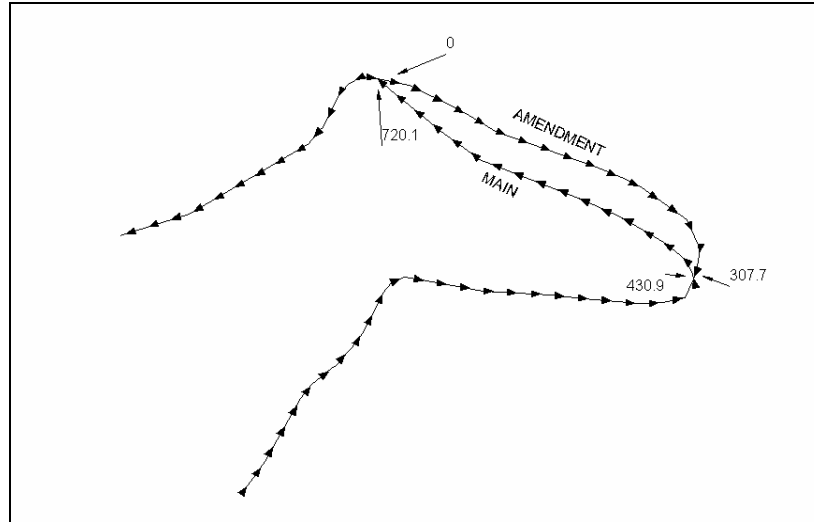


Figure 4.12: Original Traverse and Amendment.

1. File|New. Select New Traverse Document. Press OK.
2. Place the cursor at station 0.0 of the new Traverse Document. From menu Station|Insert File, select and open **Tutorial\Survey\Adjust\main.TR1..** The *Insert File* dialog box shown in Figure 4.13 will appear.

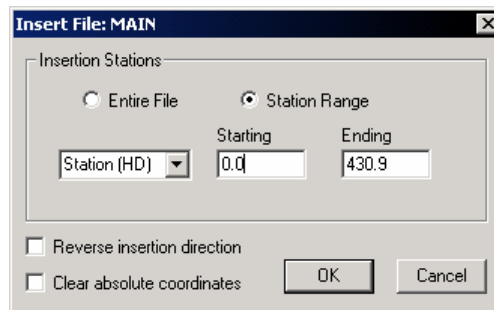


Figure 4.13: File Insert Dialog Box.

3. Configure the dialog box so that it appears as shown in Figure 4.13. Ensure *Clear Absolute Coordinates* is not checked. Press OK.
4. A Softree Prompt appears “Insert file at Station 0.0?” Press OK to confirm

All Stations from 0 to 430.9 appear in the new traverse. A “+” sign appears in the *Station* column signifying the stations which were added.

The next step is to insert the entire traverse called **amendment**. Notice in Figure 4.12 that **amendment** is running in the opposite direction to main and must be inserted in reverse direction.

5. Place the cursor in the *Station* column, after Station 430.9 of the untitled traverse.
6. Station | Insert File, select \Tutorial\Survey\Adjust\amendment.TR1. Press Open.
7. In the *File Insert* dialog box, *Entire File* and *Reverse Insertion Survey Direction* should be selected. Press OK.
8. A Softree Prompt appears “Insert file at Station 430.9?” Press OK to confirm
9. Stations 0 to 307.7 appear above station 430.9 as Stations 436.2 to 738.5.
10. Place the cursor in the *Station* column, after Station 738.5 of the untitled traverse.
11. From menu Station | Insert File, select \Tutorial\Survey\Adjust\main.TR1. Press Open.
12. Configure the dialog box so that it appears as shown in Figure 4.14. Be sure that *Clear Absolute Coordinates* is not checked. Press OK.

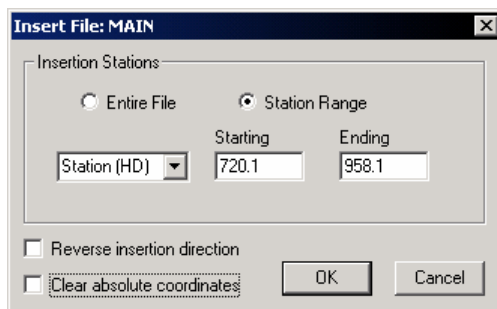


Figure 4.14: File Insert Dialog Box

A Softree Prompt appears “Insert file at Station 738.5?” Press OK to confirm

13. File | Save. Type **new main2.TR1** Press Save

14. Press the *Create Map*  button.

15. To verify the changes made select Edit | Add/Remove Traverses.  
Highlight **main.TR1** on the left. Press the *Add Traverse* button.  
**main.TR1** now appears on the right. Press OK. The map now resembles  
the original traverse and amendment as shown in Figure 4.12.

16. File | Close. Do not save changes.

## Correcting a Traverse using Station Equations

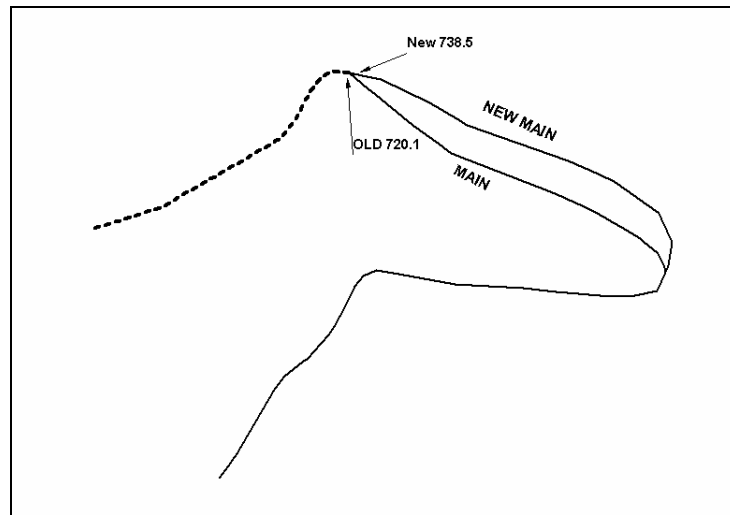


Figure 4.15: Old Route (Main) and New Route (New Main)

Note the discrepancy between the stations of **main** (old route) and **new main** (new route) in Figure 4.15. If the stationing is left as is, the stations after 720.1 in the field would be different than the stations in the traverse module. To correct this a *Field Reference* column is added to the new main traverse notes.

1. File|Open. Select and open \Tutorial\Survey\Adjust\main.TR1. and Adjust\new main.TR1.
2. Place the Traverses side by side using Window | Tile Vertically.
3. Highlight **main.TR1** and scroll up to station 720.1. Highlight **new main.TR1** scroll up to station 738.5.

4. To add a *Field Reference* column to **new main.TR1**. Select Edit | Traverse Entry Options. Press the *Columns* button and add *Field Ref.* from the *Available* side to the *Selected* side. Press the *Shift Up* button until *Field Ref* is just below *Station* on the *Selected* Side. Press OK twice.
5. Select Edit | Survey Information, press the *Stn. Equations* button.
6. Press the *Add* button in the resulting dialog box.
7. Type **738.5** in the *Backwards* frame, and **720.1** in the *Forwards* frame. Press OK to close all dialog boxes.

Station	Field Ref.	T...	Fore Azim	H.D.	S.D.	Slp (%)	SSL...	SSR...	G...
769.2	750.8	FS	218	4.5	4.6	19	-42/17	46/12	HP
762.5	744.1	FS	219	6.8	6.8	12	-43/10	43/6.2	SR
750.4	732.0	FS	240	12.1	12.6	28	-27/15	27/1.5	SR
738.5	738.5=720.1	FS	280	11.8	12.0	-18	-24/24	36/15.3	SR
727.0	727.0	FS	281	11.5	12.5	-42	-27/6.3	13/17.8	HP
717.2	717.2	FS	281	9.8	10.0	-19	-12/0.2	12/21.8	HP
717.1	717.1	FS	277	0.1	0.1	-20	-20/3.3	12/21.4	HP
715.2	715.2	FS	277	1.9	1.9	-7	-19/1.0	20/3.0	HP
714.5	714.5	FS	277	0.7	0.7	-8	-20/13	19/1.2	HP
713.8	713.8	FS	277	0.7	0.7	-7	-21/13	21/1.5	HP
688.5	688.5	FS	296	25.3	25.3	1	-21/18	21/25.8	HP

Station	T...	Fore Azim	H.D.	S.D.	Slp. (%)	SSL Stp. (%) / S.D.
732.0	FS	240.0	12.1	12.6	28	-27/15.8 T, -20/0.2 T, -3
720.1	FS	280.0	11.8	12.0	-18	-24/24.4 T, -47/17.7 T, -
701.3	FS	309.0	18.8	19.4	-25	-43/25.5 T, -79/12.0 T, -
699.1	FS	311.0	2.2	2.2	6	-21/3.1 T, -43/23.4 T, -
657.5	FS	309.0	41.6	41.7	5	-21/19.6 T, -45/32.7 T, -
633.4	FS	306.0	24.1	24.1	4	-46/55.0 T, -46/...
621.5	FS	306.0	11.9	12.3	24	-49/55.6 T, -49/...
537.5	FS	291.0	84.0	84.5	11	-50/21.9 T, -31/26.6 T, -
513.3	FS	295.0	24.2	24.4	14	-31/34.3 T, -31/18.0 T, -
502.1	FS	295.0	11.1	11.2	-2	-31/29.0 T, -31/23.3 T, -
463.8	FS	301.0	38.3	38.3	1	-30/2.6 T, -31/41.4 T, -

Figure 4.16: new main.TR1 With Field Reference to main.TR1

The *Field Ref* column opposite station 738.5 of **new main.TR1** reads 738.5 = 720.1. Notice that in the *Field Ref* column of *New Main.TR1* above station 738.5 corresponds to the stations in *Main.TR1* above station 720.1.

8. File|Close. Do not save changes.

## Adjusting for Magnetic Anomalies

Certain geographic locations have problems with magnetic fields that may disturb compass readings. If the foreshots to next station and the backshots from next station differ significantly, magnetic anomalies may be the problem. This example will demonstrate how to correct this problem.

1. File|Open. Select and open \Tutorial\Survey\Adjust\absazim.MAP and \Adjust\absazim.TR1.
2. Select Window|Tile Vertically.

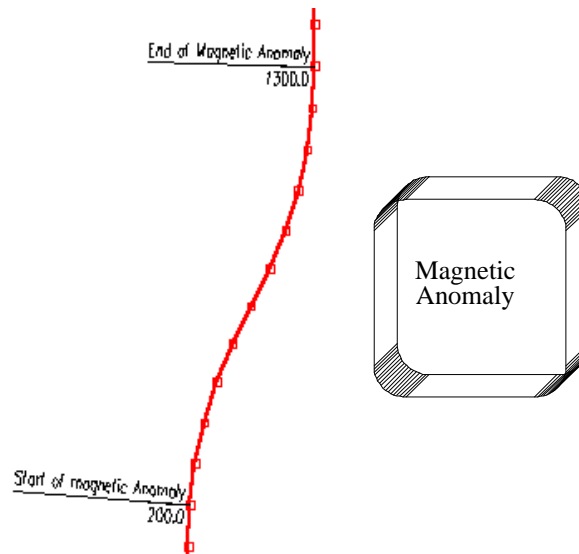


Figure 4.17: Compass Errors from Magnetic Anomalies

The traverse should have been a straight line at a bearing of 0, but due to a magnetic anomaly, the traverse is skewed. The traverse is correct up to station 200. After station 200, the foreshot and corresponding backshot start to differ. Once the traverse proceeds beyond the anomaly (Station 1300), it reverts back to the initial bearing. There is a simple way of fixing this problem.

3. Select the Traverse Document title bar.
4. From Edit|Traverse Entry Options menu, choose the *Options* button and select the *Automatic Magnetic Anomaly Adjustment* check box. Press OK twice.

This automatically enables the *Foreshot/Backshot Tolerance (degrees)* option and the default setting of 1.00. This means that when the foreshot and corresponding backshot differ by more than 1.00 degree, there will be an adjustment to correct for the magnetic anomaly.

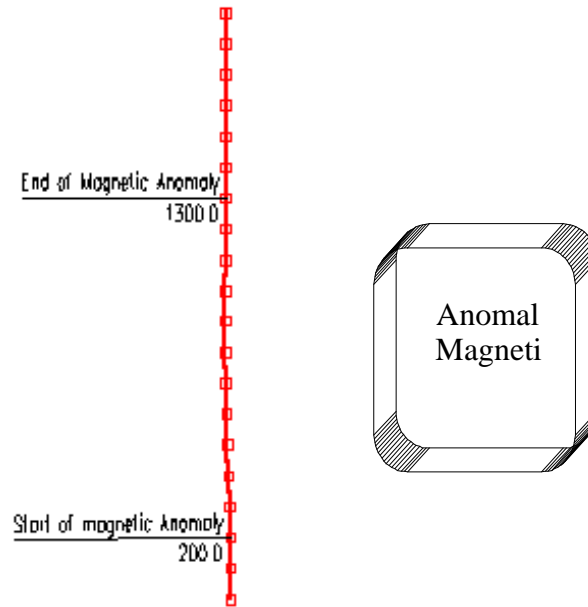
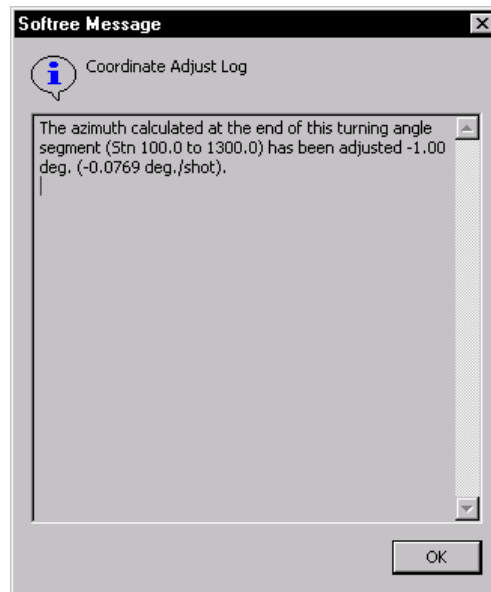


Figure 4.18: Corrected Traverse

**NOTE:** Magnetic Anomalies are corrected by using foreshot and backshot to calculate relative changes in angle (turning angles). These turning angles are used to calculate each azimuth from the previous one (similar to a theodolite survey). This works because the deflection error from the anomaly is the same for both the foreshot and the backshot taken from the same point.

5. Highlight the traverse document. Open Coordinates | Adjust XYZ. The Coordinate Adjust Log as shown in Figure 4.19 appears. Press OK.



*Figure 4.19: Turning Angle Adjustment Message*

This dialog box identifies the azimuth error adjustments, when a calculated azimuth at the end of a relative segment is reconciled with an absolute azimuth. In this case the azimuth was adjusted 1.0 degree.

The symbol “ ~ ” appears in the *Station* column, indicating the stations which were calculated using turning angles.

**Warning:** You might at some point find that the difference between foreshot and corresponding backshot = zero “0.0”, when you pass through an anomaly, as shown in the Foreshot/Backshot dialog box below. In this case the magnetic anomaly may not be corrected automatically, and a manual adjustment of the offending station may be required.

To manually adjust a magnetic anomaly, enable the *Calculate Azimuth* using Turning Angle and last Azimuth option, shown in the Foreshot/Backshot dialog box below.

A double click on the Foreshot field will display this dialog box, you can also set up the Traverse Entry Options to automatically display the dialog box .

Stn 378.2 - FORESHOT/BACKSHOT

Foreshot to Next Station	Backshot from Next Station		OK
114.0	294.0	Unadjusted	Cancel
	114	Adjusted by	
		180 deg	

Average = 114.0  
Difference = 0.0

Calculate Azimuth using Turning Angle and last Azimuth

6. Select menu File | Close both documents. Do not save changes.

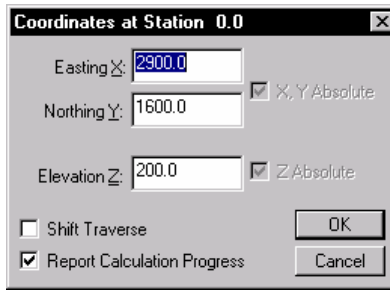
## Survey Formats and Customization

This section demonstrates several features such as instrument and target height, initial backshot angle, and vertical angle formats to allow entry of theodolite and leveling surveys.

### *Transit Survey (An Example of a Block Boundary)*

Transit surveys are conducted by taking an initial backshot, and a series of foreshots that are calculated using turning angles. The horizontal angle is measured by turning right from the backshot to the foreshot

1. File|New, select Traverse Document. Press OK.
2. File|Retrieve Screen Layout, select **Tutorial\Survey\Other\transit.SLT**.
3. Double click in any gray area to access the Traverse Entry Options dialog box. The screen layout **transit.SLT** has been configured for entry of *Azimuth* in *Deg:Min:Sec (0-360)*, and *slope%* in *Zenith deg:min:sec (0-180)* angle. Press the *Options* button, ensure that the horizontal angles will be calculated using *turning angles*. Press OK to return to main screen.
4. Select menu Coordinates|Set/Get XYZ Coordinates.

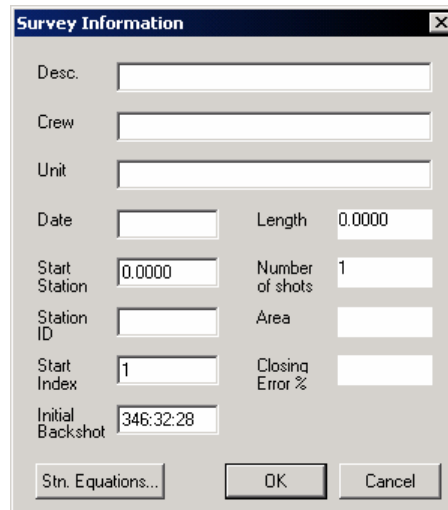


The dialog box titled "Coordinates at Station 0.0" contains the following fields and options:

- Easting X: 2900.0
- Northing Y: 1600.0
- Elevation Z: 200.0
- X, Y Absolute
- Z Absolute
- Shift Traverse
- Report Calculation Progress
- OK button
- Cancel button

Figure 5.0: Set/Get XYZ Coordinates Dialog Box at Station 0.0

- Using the coordinates in Figure 5.0, type **2900.0** for Easting (X), **1600.0** for Northing(Y) and **200.0** for Elevation (Z) Report Calculation Progress should be enabled. Press OK.
- Right click and select Survey Information, the dialog box shown below will appear.



The "Survey Information" dialog box contains the following fields and options:

- Desc.:
- Crew:
- Unit:
- Date:
- Length: 0.0000
- Start Station: 0.0000
- Number of shots: 1
- Station ID:
- Area:
- Start Index: 1
- Closing Error %:
- Initial Backshot: 346:32:28
- Str. Equations...
- OK button
- Cancel button

Figure 5.1: Survey Information Dialog Box

- Type in the *Initial Backshot* **346:32:28** shown in Figure 5.1. Press OK.

8. Place the cursor in the *Label* column and *Index 1* row. Type in **BM** as the first label. Press <Enter>.
9. Using the Theodolite Survey notes in Figure 5.2, in the Fore Right (HORZ  $\sphericalangle$ ) for Pt # 2 type **106.4409**. Press <Enter> A SOFTREE Error appears, stating “Invalid value (minutes and seconds must be from 0 to 60)”. Press OK
10. Type **106.44.09** Press <Enter>.

**NOTE:** Type all Horizontal angles (Fore Right) and Vertical angles (Zenith) as *deg.min.sec* or *deg.min:sec*, for example 106.44.09 or 106:44:09 **not** 106.4409.

With the exception of labels, the notes can be entered using the number pad only. Use decimal point-delimited fields for ease of entry. The values will be displayed with the colon.

11. In S.D. (Foresight slope distance) type **137.33**. Press <Enter>.
12. For Zenith (Foresight vertical angle) type **89.1220**. (See Note above) Press <Enter>.
13. Type in the HI (Instrument Height) of **5.2**. Press <Enter>.
14. Type in the Rod Ht (Target Height) of **5.2**. Press <Enter>.

Notice that the instrument and target heights have been copied into the next record. Any changes can be typed in, otherwise <Enter> will accept the previous value.

15. Continue entering the remaining notes from Figure 5.2. Starting at PT # 3.

PT	HORZ <	S.D.	VERT <	ROD HT
SET UP ON PT#1	NORTHING : 1600			
	EASTING : 2900			
	ELEVATION : 200			
	BS. PT#9 = 346.3228			
	HI = 5.2			
PT#2	106.4409	137.33	89.1220	5.2
SET UP ON PT#2	HI = 5.2			
PT#3	180.0000	1034.91	89.1220	6.3
SET UP ON PT#3	HI = 5.2			
PT#4	104.4347	60.08	90.3030	5.2
SET UP ON PT#4	HI = 5.2			
PT#5	180.0000	615.06	91.3000	5.2
SET UP ON PT#5	HI = 5.2			
PT#6	109.4501	349.813	90.5040	6.12
SET UP ON PT#6	HI = 5.2			
PT#7	94.0409	451.039	89.4515	5.2
SET UP ON PT#7	HI = 5.2			
PT#8	225.1929	560.387	89.3010	6.5
SET UP ON PT#8	HI = 5.2			
PT#9	180.0000	340.04	89.2012	6.0
SET UP ON PT#9	HI = 5.2			
PT#1	79.2325	419.80	89.4008	9.4

Figure 5.2 Theodolite Survey Notes.

16. File | Save. Save as **Tutorial\Survey\Other\transit2.TR1**
17. Select Coordinates | Close Traverse. Press OK to confirm closing of traverse. A Coordinate Adjust Log appears reporting a closure error and area of closed traverse. Press OK.

18. Right Click to access the Survey Information dialog box. Closure error is 0.002%, Area 72.89 Ha, and the length of the traverse is 3968.0391 meters. Press OK.

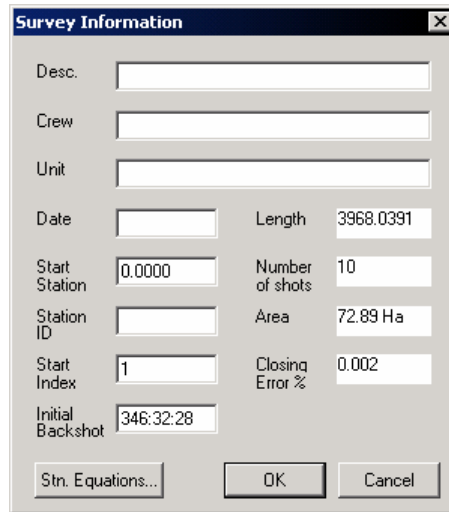



Figure 5.3: Survey Information Dialog Box.

19. Press , to create a map of the closed boundary.
20. File | Retrieve Screen Layout, select **\Tutorial\Survey\Other\transit.MLT**. The screen should now appear as shown in Figure 5.4. Arrange Windows by Window | Tile Vertically.

Notice that there is a “~” in the *Station* column. This indicates that Turning Angles were used to calculate the azimuths

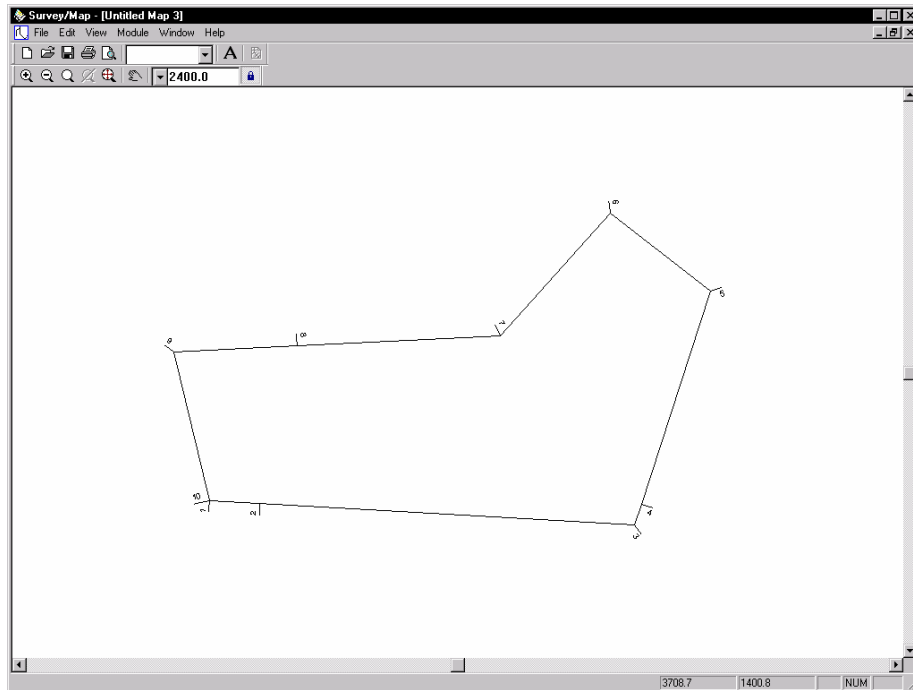


Figure 5.4: Final Closed Block Boundary.

21. File|Close both the Traverse and Map Documents. Do not save changes.

## Level Survey

This example will demonstrate how to enter a level survey with radial shots. Accurate elevations radiating from a central point are determined. They are conducted by using a series of *Backshots* and *Foreshots* at Station Hubs with a number of non-perpendicular side shots originating from these hubs.

1. File|New, select Traverse Document. Press OK.

2. File | Retrieve Screen Layout, select \Tutorial\Survey\Other\level.SLT. Press Open.
3. Double click on any gray area in the traverse document to open the Traverse Entry Options edit box. Notice that the screen layout, Level.SLT has been configured for entry of *Azimuth* in *Quadrants* (e.g. N32W), and slope in *Level (elevation)* Press OK.
4. Open Coordinates | Set/Get XYZ Coordinates dialog box.

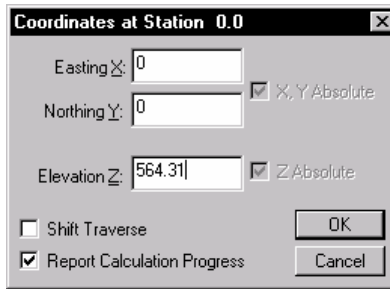


Figure 5.5 Set: /Get XYZ Coordinates Dialog Box


5. Type in the *Elevation* **564.31** Press OK. Press <Enter> to move to the *Type* column.
6. Under the *Type* column type **RS** (r is sufficient). Press <Enter>.
7. Type **E** under the *Fore Bearing* column. Press <Enter>. This indicates that the first sideshot is heading due east.
8. Type **10** under the *S.D.* column. Press <Enter>.
9. Type **565.17** under the *Next Z* column. Press <Enter>.

	Bearing	S.D.	BS	HI	RS	FS	ELEV	dZ
Bm28			1.56	565.87			564.31	
605	E	10.0			0.70		565.17	+ .86
606	N45W	20.0			2.90		562.97	-1.34
607	S50W	10.0			3.50		562.37	-1.94
608	S20E	15.0			6.70		559.17	-5.14
609	N25E	15.0			11.90		553.97	-10.34
TP.2	N10E	20.0	0.41	554.65		11.63	554.24	-10.07
610	N45E	10.0			3.20		551.45	-2.79
611	N10W	10.0			8.60		546.05	-8.19
612	S30W	10.0			9.00		545.65	-8.59
613	S40E	20.0			12.20		542.45	-11.79
614	S20E	10.0			9.30		545.35	-8.89
615	N60W	10.0			8.40		546.25	-7.99
616	S85E	10.0			7.10		547.55	-6.69
617	N15E	20.0			8.40		546.25	-7.99
618	N25W	20.0			7.00		547.65	-6.59
619	N65E	10.0			4.10		550.55	-3.69
TP.3	N	25.0	8.02	559.98		2.73	551.92	-2.32
			9.99					
					564.31	14.36		
					559.98	9.99		
			check		4.37 =	4.37	✓	OK.

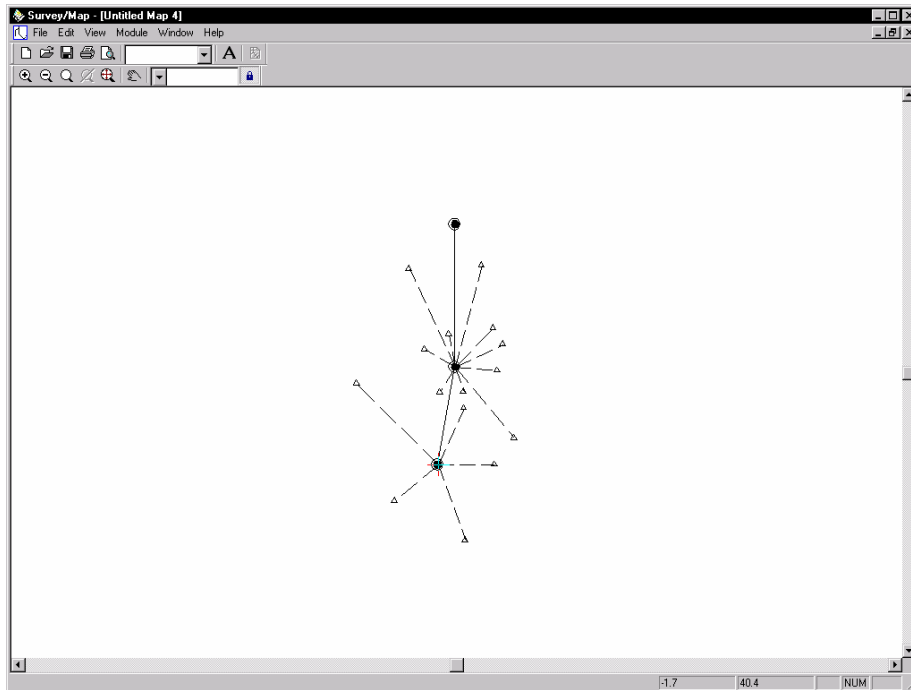
Figure 5.6: Level Survey Notes

10. Type in the traverse notes in Figure 5.6, starting at point 606. Only the *Bearing*, *S.D.* and *Elev* columns are required from Figure 5.6.

**NOTE:** TP.2 and TP.3 are Foreshots (**FS** in the *Type* column). All other shots are Radial Shots (**RS** in the *Type* column)

11. Save the Traverse Document as \Tutorial\Survey\Other\level2.TR1
12. Select View | Quick Map or press  to open a new Map Document.
13. From File | Retrieve Screen Layout, select \Tutorial\Survey\Other\normal.MLT. Press OK.

14. Right Click in the map document. Select Options, change the *scale* to **500** and select the *Radial Shots* option. Press OK. The Map Document should look like Figure 5.7.



*Figure 5.7: Map of Level Survey*

15. File|Close. Do not save changes

## User Defined Columns and Picklists

In this section we will describe additional features for creating *User Defined Columns* and *Picklists*.

User defined columns can be used to save information along the traverse. To demonstrate user defined attributes we will create a new columns for *Tree Species*.

1. File|New, select Traverse Document. Press OK.
2. Choose menu Edit | Traverse Entry Options. Press the *Columns* button then select *New Column*. The *Create New Column* dialog box will appear as shown below.

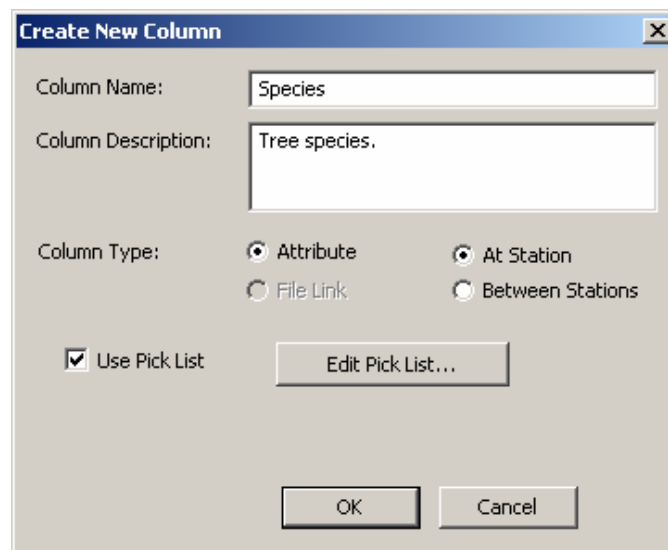
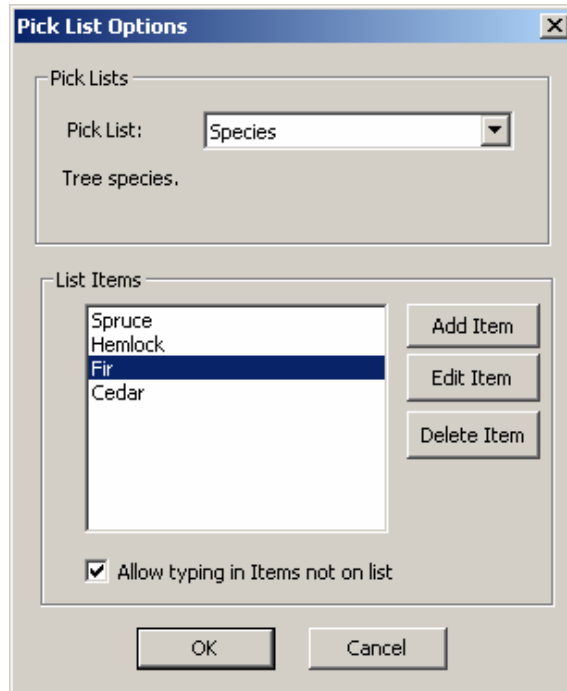


Figure 5.8: New Column Dialog Box

3. Type in “Species” for Column Name and type in the description as shown in Figure 5.8 above.

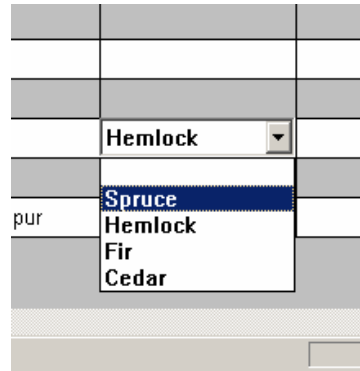
Picklists allow you to predefine common field entries. With picklists users can quickly pick a column entry from a list.

4. Check “Use Pick List” and press “Edit Pick List”. Press the “Add Item” and add “Spruce”. Press the “Add Item” button again and create a “Hemlock” entry. Continue this process and create entries for Fir and Cedar. Then press OK.



*Figure 5.9: Pick List Options Dialog Box*

After returning to the main traverse screen, notice how the new species column allows picklist entries.



*Figure 5.10: Picklist entry*

16. File|Close. Do not save changes

# Index

**2**

2D  
adjustment, 39

**3**

3D  
adjustment, 39

**A**

Absolute  
coordinate, 16, 27, 28, 38  
Absoute Z, 39  
Add  
button (in Traverse Entry Options\columns), 8  
remove traverses /edit, 25  
traverse button, 26  
Add/Remove  
traverses, 42  
Adjust  
for magnetic anomalies, 45  
XYZ, 47  
Adjusting  
in the map screen, 32  
traverses, 28  
Adjustment  
automatic magnetic anomaly, 46  
coordinate, 28  
Area  
of closed traverse, 30  
Automatic  
magnetic anomaly adjustment, 46  
Available

column (in Traverse Entry Options\columns), 8  
Azimuth  
column, 11, 24  
error adjustments, 48  
in degrees,minutes,seconds (in Traverse Entry Options), 50  
in quadrants (in Traverse Entry Options), 56

**C**

Calculate  
azimuth using turning angle, 49  
Checkpoints, 4  
Clear  
absolute coordinates, 41  
Close  
and enter a simple boundary traverse, 6  
boundary traverse, 16  
traverse, 16, 28, 35  
Closing  
error, 30, 54  
Column  
azimuth, 11, 24  
GND, 22  
label, 29  
SD, 11, 22  
slp%, 11  
station, 48  
Columns  
adding and removing, 7  
button (in Traverse Entry Options), 7, 44  
field reference, 45  
Colums  
field reference, 43  
Compass  
rule, 16, 28  
Control

selecting multiple traverses in one map document, 26

Coord  
adjustment, 28

Coordinate  
absolute, 25, 27, 28  
close traverse, 16, 28

Coordinate Adjust Log  
dialog, 29, 47

Coordinate Adjustment Log, 16

Coordinates  
adjust XYZ, 47  
close traverse, 53  
menu item, 29  
Set/Get XYZ coordinates, 27, 29, 50, 56

Create Map  
button, 42

CRK  
column, 24

Cross Hairs, 14

Culvert  
dimensions, 24

Cursor Tracking, 14

Custom  
survey formats, 50

## D

Default  
directory installation, 4  
setting for foreshot/backshot tolerance (degrees) (in Traverse Entry Options), 46  
shot type, 22  
to the previous ground type, 23

Deviation  
2D, 16

Display  
label options, 14  
layers in a cross section (extended side shot edit), 23

Double click, 23

## E

Enter  
creek/culvert information, 24  
survey notes, 9  
tab/enter sequence, 8  
traverse from top down, 9

Error  
azimuth adjustments, 48

Extended  
depths and ground types, 23  
side shot dialog box, 22  
side shot edit, 20, 21

## F

Field Ref  
column, 44

Field Reference, 43

Fore Shots, 11

Foreshot  
/backshot tolerance (degrees) (in Traverse Entry Options), 46  
intermediate, 24  
to next station (in Foreshot\backshot dialogue box), 22

Foreshot/Backshot  
dialog, 49

FS Shots, 11, 22

## G

GND  
column, 22, 23

Ground  
types, 22  
types and extended depths, 23

## H

Height  
of instrument, 52

Help  
On-Line, 5

**I**

IFS Shots, 11, 24  
Index  
Column, 54  
Initial  
backshot (in survey information), 51  
Insert  
a file, 41  
a files, 41  
Insert File  
dialog, 40  
Inserting  
a file, 39  
Installation  
default directory, 4  
Intermediate Foreshots, 11

**J**

Join  
traverses, 28

**L**

Label Selection and Formatting  
dialog, 13  
Layout Files, 6  
Level (elevation) (in Traverse Entry  
Options), 56  
Level Survey, 55

**M**

Magnetic  
anomalies, 45, 47  
anomaly adjustment, 46  
Map

creating a document, 12  
document, 26, 28, 31  
quick, 12  
view options, 13  
with multiple traverses, 25  
Map Traverses  
dialog, 25  
Menu  
functions, 13  
metric units, 5  
Multiple  
traverses in a map, 25  
Multiple side shots  
option (in Traverse  
entry options), 18

**N**

New  
map document, 26  
traverse document, 6

**O**

On-line  
Help, 5  
Opening  
a traverse from a map document, 15, 27  
Options  
button (in Traverse Entry Options), 46,  
50  
menu, 58  
view, 13

**P**

*Picklists*, 59

**Q**

Quick

map, 12, 45, 54, 57

## R

Radial shots  
 option (in options), 58  
 Radial Shots, 12  
 Remove  
 button (in Traverse Entry Options), 8  
 Retrieve  
 screen layout, 6, 19, 29, 56  
 Reverse  
 insertion direction of files (in insert file),  
 41  
 RS Shots, 12

## S

Save  
 traverse screen layout, 9  
 Screen, 9  
 layout, 6, 9  
 Screen Layout, 6, 19  
 SD  
 column, 11, 22  
 Selected  
 column (in Traverse Entry  
 Options\columns), 8  
 Selecting with the mouse  
 on map, 14  
 Set, 29  
 /Get XYZ coordinates, 27, 29  
 Set Absolute XY, 34, 35  
 Set/Get XYZ Coordinates  
 Coordinates, 50  
 Setup  
 change units, 6  
 Shift  
 coordinate adjustment, 35  
 coordinates, 34  
 Shift down  
 button (in Traverse Entry  
 Options\columns), 8

Shift key, 21  
 Shift up  
 button (in Traverse Entry  
 Options\columns), 8  
 Shifting traverses, 28  
 Shots  
 IFS, 24  
 Slope  
 column, 11, 22  
 distance, 11  
 percent, 11  
 Slp%  
 column, 11  
 Station  
 column, 41, 48  
 equations, 43  
 fixed, 35  
 insert files, 41  
 modified, 35  
 Stn Equations  
 button, 44  
 Survey  
 adjustments, 25  
 level, 55  
 Survey Information  
 dialog, 54  
 dialog, 44, 51  
 Surveys  
 theodolite, 52, 53  
 transit, 50

## T

Tab key  
 movement in dialog boxes, 21  
 movement in dialog boxes, 11  
 Tab/enter sequence, 8  
 button (in Traverse Entry Options), 8, 18,  
 22  
 Target  
 height, 52  
 Theodolite Survey, 52  
 Tile  
 vertically, 12

Top Down  
  entry, 9  
Transit  
  surveys, 50  
Traverse, 14  
  add button, 26  
  add/remove, 25  
  added to list box, 26  
  close, 16, 28, 35  
  comments from, 14  
  customizing the screen, 6, 18  
  document, 6, 16, 18, 28  
  entering a road p-line with cross sections,  
    18  
  entering and closing a boundary, 6  
  entry from top down, 9  
  entry options, 7, 18, 46  
  fixed, 35  
  modified, 35  
  save screen layout, 9, 19  
*Traverse Adjustment Steps*, 35  
Traverse Adjustment Transaction  
  dialog, 34  
Traverse Adjustments  
  dialog, 34  
Traverse Entry Options, 18  
Traverse Entry Options  
  dialog, 44  
Traverse Entry Options  
  dialog, 50  
Traverse Entry Options  
  dialog, 55  
Traverse Entry Options  
  dialog, 56

Turning  
  angles, 47, 48, 50, 54  
Type  
  column, 24  
  ground, 22, 23

**U**

*User Defined Column*, 59  
UTM  
  coordinates, 34

**V**

View  
  options, 13, 58  
  quick map, 12

**W**

Windows  
  tile vertically, 28  
Working in proper units, 6

**Z**

Zenith  
  angle, 50  
Zoom  
  to extents button, 32