TerraSurvey User's Guide

122	1	21224.668	48929.083	15.968
122	2	21233.691	48927.146	15.984
122	3	21242.170	48924.964	15.992
122	4	21250.316	48923.396	16.163
205	5	21258.950	48922.355	16.163
205	6	21266.753	48921.886	16.218
205	7	21271.335	48921.933	16.007
205	8	21273.847	48922.317	16.031
205	9	21275.825	48924.181	15.890

```
5=1 4=122 37=21224.668 38=48929.083 39=15.968
5=2 4=122 37=21233.691 38=48927.146 39=15.984
5=3 4=122 37=21242.170 38=48924.964 39=15.992
5=4 4=122 37=21250.316 38=48923.396 39=16.163
5=5 4=205 37=21258.950 38=48922.355 39=16.163
5=6 4=205 37=21266.753 38=48921.886 39=16.218
5=7 4=205 37=21271.335 38=48921.933 39=16.007
5=8 4=205 37=21273.847 38=48922.317 39=16.031
5=9 4=205 37=21275.825 38=48924.181 39=15.890
```

MicroStation
Powered

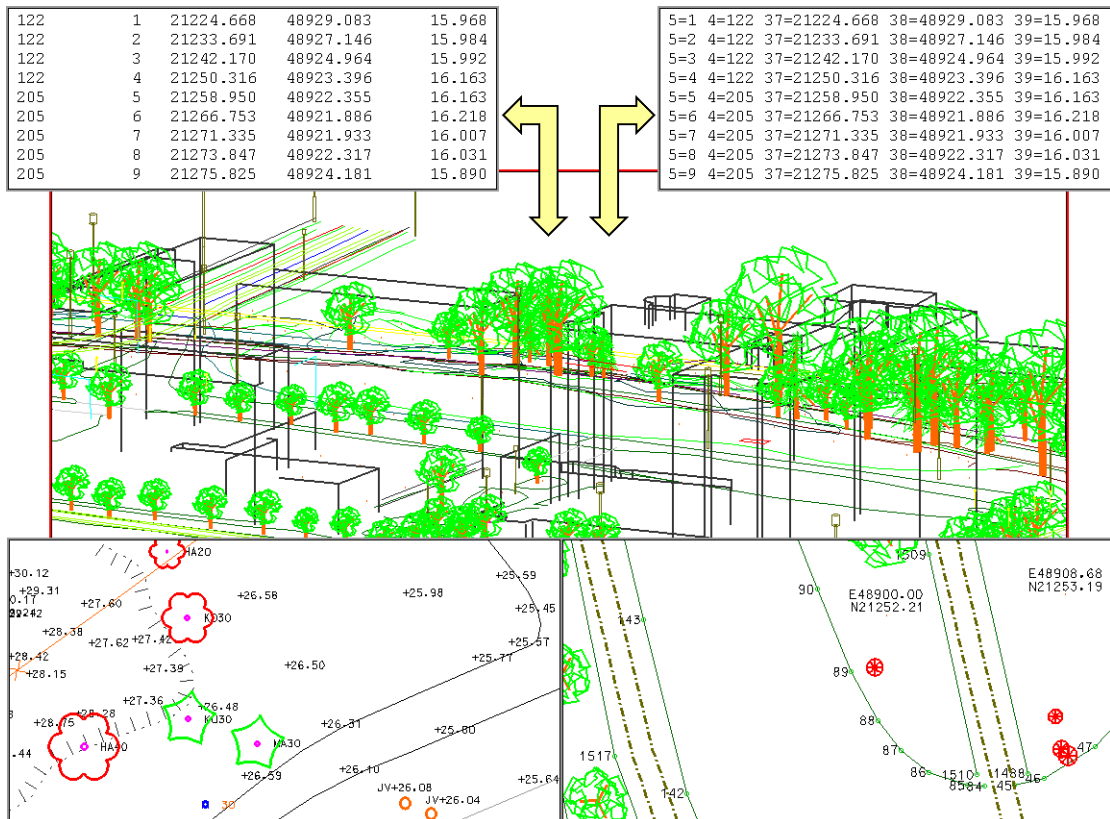*Terrasolid Ltd*

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Table of Contents

Part I: Getting Started

Part II: Tutorial

Part III: Tool Reference

Part IV: Settings Reference

About the documentation

This document serves as a user's guide for two versions of TerraSurvey. The entry-level version, TerraSurvey Field, is functionally a subset of the full version which is called TerraSurvey for MicroStation. All of the tools in TerraSurvey Field are available in the full version as well and work identically in the two versions. The full MicroStation version provides some additional tools which are not available in the entry-level version. In this documentation, those features are marked as 'Not Field'.

This User's Guide is divided into four parts:

- Getting Started - contains general information about TerraSurvey and instructions on how to install and run the application.
- Tutorial - contains lessons introducing the basic concepts and the most common tools in the application.
- Tool Reference - contains detailed descriptions of all the tools in TerraSurvey.
- Settings Reference - contains detailed descriptions of settings concerning survey file formats and feature codes.

Accessing documentation on-line

The documentation is accessible as an Acrobat Reader document which serves the role of on-line help. Accessing the electronic format of the documentation has the following unique advantages:

- You can conduct automated searches for keywords in topic names or body text.
- You can click hypertext to "jump" to related topics.

Document conventions

The following conventions and symbols appear in this guide:

- Keyboard keys are enclosed in angle brackets - for example, <Return>.
- Alternate procedures are separated by "OR". Alternate steps in a procedure are separated by "or".
- "Key in" means to type a character string and then press <Return> (or <Tab> in dialog boxes).
- The following icons are used to specify special information:

Icon:	Appears next to:
✍	Notes
✔	Hints and shortcuts
➢	Procedures

- When no distinction between MicroStation 95, MicroStation SE, MicroStation J, MicroStation GeoOutlook and MicroStation PowerDraft is necessary, this document refers to the CAD environment simply as "MicroStation".
- Features which are available only in TerraSurvey for MicroStation and can not be used with TerraSurvey Field are labeled as *Not Field*.
- When no distinction between TerraSurvey for MicroStation and TerraSurvey Field is necessary, this document refers to the application as "TerraSurvey" or as "the application".

MicroStation documentation

This document has been written assuming that the reader knows how to use basic MicroStation features. You should refer to MicroStation printed documentation or on-line help whenever you need information on using the CAD environment.

Part I: Getting Started

1   Introduction

TerraSurvey is a survey drawing application built on top of MicroStation. It reads in survey data from a text file and creates a survey drawing as a design file.

TerraSurvey is able to read in survey data from various formats: Geodimeter, Wild, Sokkisha, SdrMap or Tekla. The ability to create user defined file formats lets you read in practically any text files containing point data organised into readable fields. The survey data can be based on coordinates or on surveyed angles. When you read in a file, the application recognizes the data format automatically so there is no need for conversion between file formats.

You control the survey drawing generation with a feature list. This list determines how each of the surveyed features will be drawn in the map. Each feature code can be assigned one or more drawing rules, which produce lines, line strings, curves, text elements, cells, patterned lines and so on.

TerraSurvey is especially well suited to loading in and validating data from various sources. It does not make any difference whether the input file was created by a survey data collector, a spreadsheet application or a database reporting tool. You just load in the data, assign drawing rules, check for errors, make necessary corrections - all this interactively while viewing the resulting survey drawing.

TerraSurvey comes with a number useful utilities when working with survey drawings. For example, *Set Scale* tool will rescale an existing drawing for a new plotting scale. It resizes all appropriate text elements and cells in the drawing. *Draw Point Table* tool lets you attach a columnar table of selected points to the drawing. This table will display the feature codes, point indexes and coordinates of selected points.

Terra application family

TerraSurvey is just one in a full family of civil engineering applications. All of Terra applications are tightly integrated with MicroStation presenting an easy-to-use graphical interface to the user.

TerraBore is a solution for reading in, editing, storing and displaying bore hole data. You can triangulate soil layers with the help of TerraModeler.

TerraModeler creates terrain surface models by triangulation. You can create models of ground, soil layers or design surfaces. Models can be created based on survey data, graphical elements or XYZ text files. The application is able to handle up to 12 different surfaces in the same design file.

TerraPark is an easy-to-use package for park design and landscaping. It has all the necessary tools for designing roads, regions, plants and utilities inside the park.

TerraPhoto rectifies digital photographs taken during laser scanning survey flights and produces orthorectified images.

TerraPipe is used for designing underground pipes. It gives you powerful tools for designing networks of drainage, sewer, potable water or irrigation pipes.

TerraScan processes laser scanning data. It reads in laser points from text files and lets you view the points three dimensionally, classify the points and create vectors based on the points.

TerraStreet is an application for street design. It includes all the terrain modeling capabilities of TerraModeler. Street design process starts with the creation of horizontal and vertical geometries for street alignments.

All of these applications are available for MicroStation 95, SE or J under Windows 95 / 98 / NT for Intel or Windows NT for Alpha environments. Some of the applications are available for MicroStation PowerDraft.

2   Installation

Hardware and software requirements

TerraSurvey is built on top of MicroStation. You must have a computer system capable of running this CAD environment.

The requirements below apply to Intel based Windows configurations.

To run TerraSurvey, you should have the following:

- Pentium or higher processor
- Windows 95 or Windows 98 or Windows NT
- mouse
- 1024*768 resolution display or better
- 64 MB RAM
- MicroStation 95, MicroStation SE, MicroStation J, MicroStation GeoOutlook or MicroStation PowerDraft installed

Installation of TerraSurvey requires about 3 MB of free hard disk space.

Installation media

TerraSurvey may be delivered on a single floppy or on a CD.

The floppy is big enough only to contain the actual software and the example data sets — it does not include the on-line Acrobat manual.

Terra Installation CD includes the software, example data and the on-line documentation. When you install from the CD, the software and the documentation will be copied to you hard disk.

Installation CD includes versions for multiple environments. You should locate the directory which corresponds to your operating system and version of MicroStation.

TerraSurvey for MicroStation directories on CD

Directory on CD	For operating system	For MicroStation
\alphant\eng\msse\	Windows NT for Alpha	SE or J
\windows\eng\ms95	Windows 95, 98 or NT for Intel	95 or GeoOutlook
\windows\eng\msse	Windows 95, 98 or NT for Intel	SE or J

TerraSurvey Field directories on CD

| Directory on CD	For operating system	For MicroStation
\windows\eng\field	Windows 95, 98 or NT for Intel	95, SE, J, GeoOutlook or PowerDraft

Installation from floppy

➢ **To install TerraSurvey from floppy:**

1. Insert TerraSurvey floppy in your local drive (usually drive A:).

2. Select **Run** command **Start** menu.

3. Type

   a:\setup   (if floppy is in A: drive)

4. Click OK.

   The installation program will need to know where MicroStation has been installed. It will automatically search all local hard disks to find the MicroStation directory.

   The installation dialog box opens:
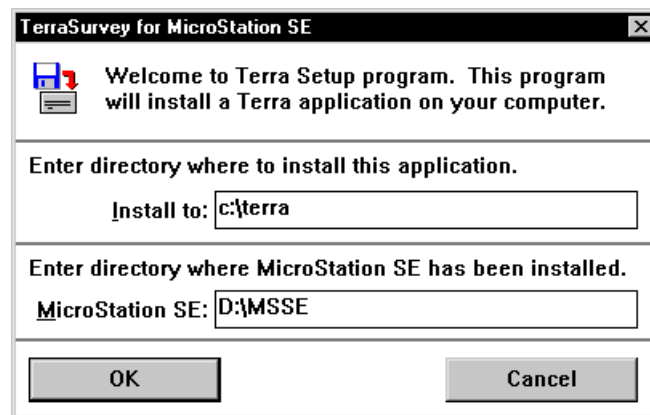
5. The installation program prompts you to enter the directory where to install TerraSurvey. The default path is C:\TERRA. You can set this to another location if you prefer. The specified directory will be automatically created, if it does not exist.

6. At this stage you should check the directory where MicroStation was found. Replace the path if the correct location was not found.

7. Press <Return> to continue.

   When the installation is finished, a message is displayed and you are prompted to press any key to continue.

See chapters **Installation Directories** on page 113 and **Configuration Variables** on page 114 for more information.

Installation from CD

➢ **To install TerraSurvey from CD:**

1. Insert TerraSurvey CD into your CD-ROM drive.

2. Locate the correct directory which corresponds to your computer configuration.

3. Start SETUP.EXE from that directory.

   The installation program will first want to know what applications you want to install. The setup dialog box opens:
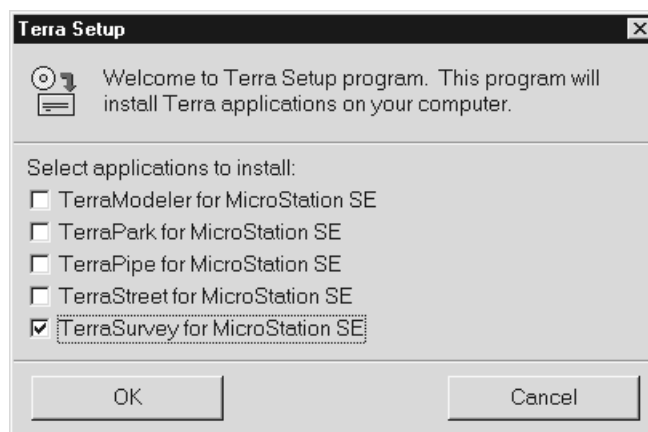
4. Check **TerraSurvey for MicroStation** item in the dialog. You may select other applications as well for which you have a valid license.

5. Click OK.

   The installation program will need to know where MicroStation has been installed. It will automatically search all local hard disks to find the MicroStation directory.

   The installation dialog box opens:

6. The installation program prompts you to enter the directory where to install the applications. The default path is C:\TERRA. You can set this to another location if you prefer. The specified directory will be automatically created, if it does not exist.

7. At this stage you should check the directory where MicroStation was found. Replace the path if the correct location was not found.

8. Press <Return> to continue.

   When the installation is finished, a message is displayed and you are prompted to press any key to continue.
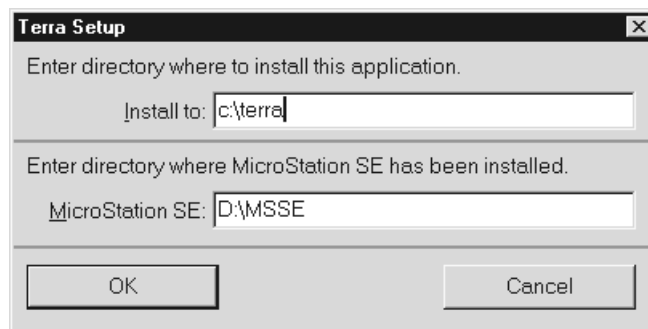
See chapters **Installation Directories** on page 113 and **Configuration Variables** on page 114 for more information.
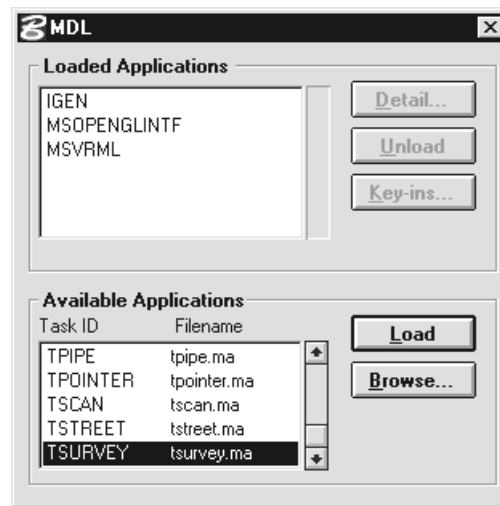
3 Starting TerraSurvey

TerraSurvey is an MDL application that runs within MicroStation.

➢ **To start TerraSurvey:**

1. From the **Utilities** menu, choose **MDL Applications**.

   The **MDL** dialog box opens:

2. In the **Available Applications** list box, select TSURVEY.
3. Click the **Load** button.

   OR

1. Key in MDL LOAD TSURVEY.

User settings determine what menus and tool boxes the application will open during startup. In addition to its **Main** tool box, TerraSurvey may create an **Applications** menu in the command window.
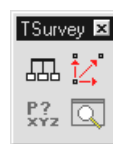
✍ **Available Applications** list box shows all the MDL applications that MicroStation is able to locate. MicroStation searches for MDL applications in the directories listed in MS_MDLAPPS configuration variable. If MicroStation can not find TSURVEY.MA, you should check the value assigned to this configuration variable. Make sure the directory path of TSURVEY.MA file is included in this variable. To view configuration variables, choose **Configuration** command from the **Workspace** menu. See **Installation Directories** on page 113 and **Configuration Variables** on page 114 for more information.

Unloading TerraSurvey

TerraSurvey will unload automatically when you exit MicroStation. Sometimes you may want to unload TerraSurvey while continuing to work with MicroStation. This will free up memory reserved by TerraSurvey.

➢ **To unload TerraSurvey:**

1. Close TerraSurvey's **Main** tool box. The application will be unloaded.

    OR

1. From the **Utilities** menu, choose **MDL Applications**.

    The **MDL** window box opens:
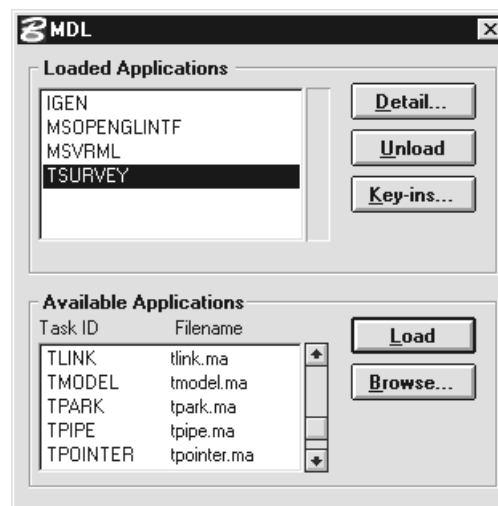

2. In the **Loaded Applications** list box, select TSURVEY.
3. Click the **Unload** button.

    OR

1. Key in MDL UNLOAD TSURVEY.

Part II: Tutorial

4   Tutorial

This tutorial will help you learn some of the basic tools in TerraSurvey. It will introduce some concepts and terminology used by the application. With the help of an example data set, you will be guided through a number of exercises using some of the most important features in TerraSurvey.

This tutorial assumes that you are already familiar with MicroStation and know how to manipulate view windows, how to use drawing tools and how to open design files.

The example data set has been supplied as a courtesy of Pekka Björklund from the Geotechnical Department in the City of Helsinki.

TerraSurvey interface

The user interface of TerraSurvey is very similar to that of MicroStation. When you load TerraSurvey, it will open its **Main** tool box. All of TerraSurvey's tools are located in this tool box, which is actually a parent of four child tool boxes. These child tool boxes contain icons representing individual tools. To activate a tool, click the tool icon.
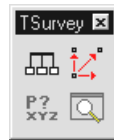
You can control the operation of a tool with tool settings. These are control fields affecting the operation of that specific tool. Most of the tools will display their settings in a **Tool settings** window which is shared by MicroStation and MDL applications. The **Tool settings** window will display the controls for the active tool. Some of the tools will open a separate window or a dialog box where you can enter the appropriate settings.

Creating an empty design file

You should start working on this tutorial with an empty design file loaded. It is recommended that you will create the empty design file from a seed file that was installed with TerraSurvey.

➢ **Creating a suitable empty design file:**

1. From MicroStation's **File** menu, choose **New**.

   The **Create Design File** dialog box opens:
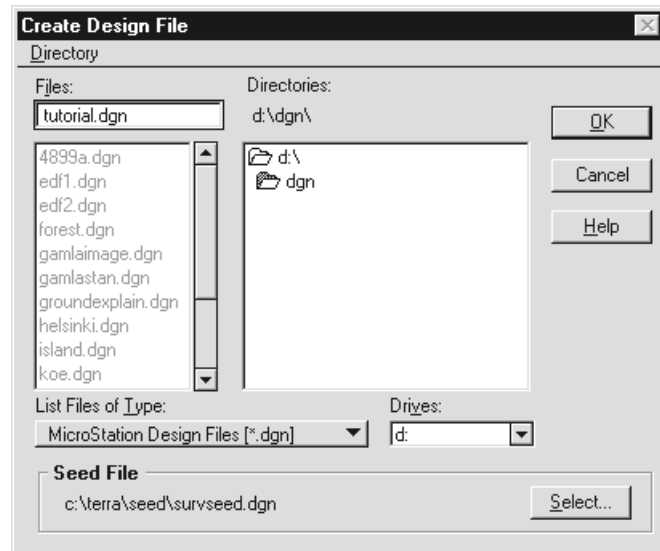
2. Assign a name for the file to be created by typing TUTORIAL.DGN in the **Files** text control.

3. Click **Select** to select the seed file to be used.

   The **Select Seed File** dialog box opens.

4. Locate SURVSEED.DGN seed file by browsing your computer's directory structure. If you installed TerraSurvey in the default directory C:\TERRA, you can find this file in path C:\TERRA\SEED\SURVSEED.DGN. When you have located this file, select in the **Files** list box.

   Alternatively, you can type in the full path of the example file in the **Files** text control.

5. Click OK to accept the seed file.

6. Click OK to accept the creation of a new design file.

Starting TerraSurvey

To start TerraSurvey, go through the steps described in chapter **Starting TerraSurvey** on page 13.

Opening a feature list

Feature list defines the various objects that may be drawn in a survey drawing. Feature list is basically a table of features including drawing rules assigned to each feature. In this way, the active feature list defines the graphical presentation of surveyed objects.

Each survey point is assigned a feature code which defines what was surveyed - a tree, a road center line, an elevation point or may be a manhole cover. When processing survey points, TerraSurvey tries to find a matching feature code for each of the survey points and will apply all of the associated drawing rules.

You can have several feature list for different purposes but only one feature list can be active at a time.

➢ **To open the tutorial feature list:**

1. Select the *Define Features* tool.

   The **Feature list** window opens.

2. From **File** menu, choose **Open**.

   This opens a dialog box which allows you to select a feature list to open.

3. Locate TUTORIAL.FEA file by browsing your computer's directory structure. If you installed TerraSurvey in the default directory C:\TERRA, you can find this file in path C:\TERRA\TSURVEY\TUTORIAL.DGN. When you have located this file, select in the **Files** list box and click OK.

   TerraSurvey reads in the selected file and it becomes the active feature list.
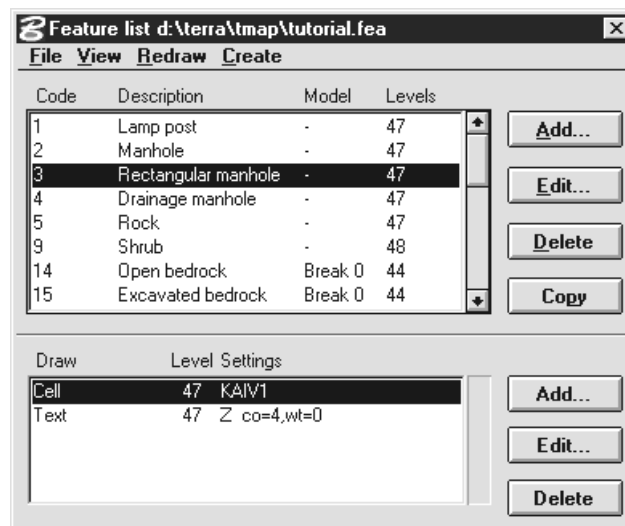
The upper list box contains all the features in the active feature list. The lower list box displays all drawing rules assigned to the currently selected feature. When you select another row in the feature list box, the contents of the lower list will change.

At this stage you may want to scroll through the upper list to get an overview of the various features. When you are done, you can close the **Feature list** window.

Loading a survey file for verification

Having activated the appropriate feature list, you are now ready to start processing survey data. You will first load a survey file which was created using a Geodimeter total station.

When loading in a survey file for the first time, you should always use the *Load Survey Verify* tool. It reads in the file and creates the survey drawing first in temporary mode. It allows you to verify the data, fix errors and modify drawing rules before writing the survey drawing permanently to the design file.

➢ **To load the example survey file for verification:**

1. Select the *Load Survey Verify* tool.

   This opens a dialog box which allows you to select a single file to process.

2. Locate TUTORIAL.DAT file by browsing your computer's directory structure. If you installed TerraSurvey in the default directory C:\TERRA, you can find this file in path C:\TERRA\DATA\TUTORIAL.DAT. When you have located this file, select in the **Files** list box and click OK.

   The **Survey file information** dialog opens.

3. You can leave this information empty and just click OK.

4. The **Load Survey Verify** dialog opens. The coordinate axes show the coordinate values of the first point found in the survey file.
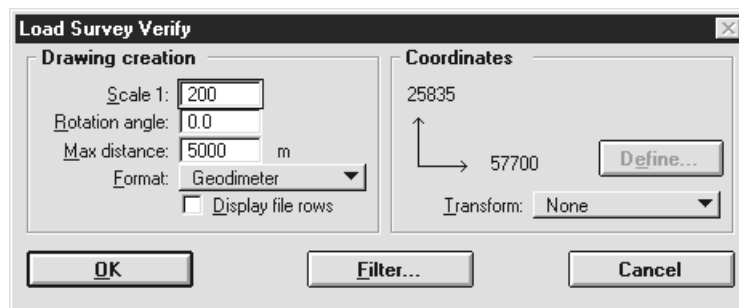
5. Enter 200 in the **Scale** field.

6. Click OK.

   TerraSurvey reads the selected file, creates a survey drawing in temporary mode and opens the **Loaded survey points** window.

Viewing survey data

You should now see both a temporary survey drawing and a window displaying all of the points found.

The upper list in the **Loaded survey points** window contains all of the survey points and the lower list displays problems encountered when creating the survey drawing. While this window is open, the survey drawing is visible as temporary elements which you can redraw whenever you have made modifications to the survey data.

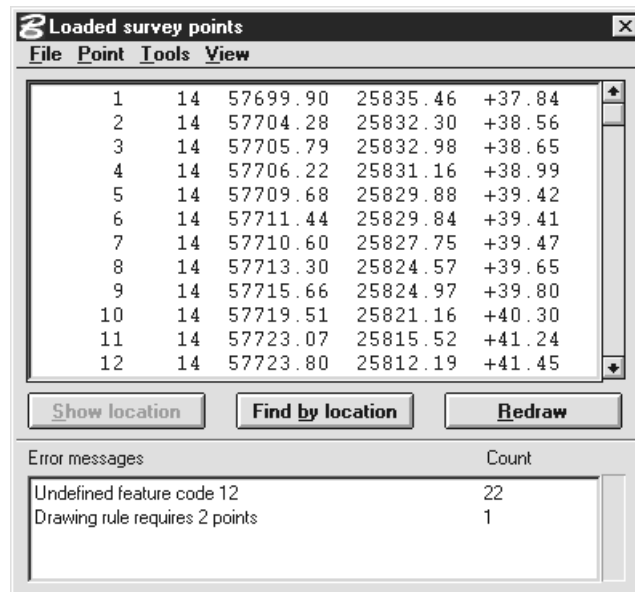In order to properly view the survey drawing, you should now zoom in a smaller area of the surveyed. You can freely use MicroStation's view manipulation tools to move around in the drawing.

Show location and **Find by location** buttons help in seeing the relationship between survey points and the resulting graphical elements. **Show location** button should be used when you are looking at a point in the list box and want to find its the graphical location.

➢ **To locate selected survey points:**

1. Select one or several survey points in upper list box by clicking on them.
2. Click on **Show location**.
3. Move the mouse inside a view. TerraSurvey shows the location(s) of the selected points by drawing a large cross or by drawing small rectangles.
4. You may enter a data click to center the view at the location of the first selected point.

Find by location button should be used when you are looking at a graphical element in the survey drawing and would like to find the corresponding survey point in the list box.

➢ **To select a point from the drawing:**

1. Find a location of interest in the survey drawing.
2. Click on **Find by location**.
3. Move the mouse inside a view. As you move the mouse, TerraSurvey will find the closest survey point and draw a circle around it.
4. Enter a data click.

   This highlights the closest survey point in the list box.

Experiment freely with these tools to get an overview of the survey data and the resulting survey drawing.

Viewing problem points

Survey data coming directly from the field requires careful inspection as it often contains small problems and errors. When TerraSurvey tries to create a survey drawing, it may encounter a number of problems which it will display in the lower list box of the **Loaded survey points** window.

Our example data generates two problem messages:

Undefined feature code 12	22
Drawing rule requires 2 points	1

The first one indicates that the survey team has used a feature code 12 which has not been defined in the active feature list. This problem was generated by 22 points.

The second problem was generated by only one point. A drawing rule associated with the survey code requires that the object be surveyed by two points but only one point was found.

If you click on a problem message in the lower list box, the application will select corresponding points in the upper list. In this way, you can immediately see the survey data which caused the problem. Furthermore, if you want to view the graphical location of the points, click on **Show location** and identify a view!

The survey drawing itself only displays points which can be drawn using the feature list based drawing rules. However, many survey problems may cause the feature list based drawing generation to fail for certain points. For example, the points with an undefined feature code 12 cannot be solved from the feature list. Fortunately, the application provides a method to display the locations of error points.

➢ **To switch on display of problem points:**

1. From **View** menu, choose **Display settings**.

    This opens the **Loaded point display** settings dialog:
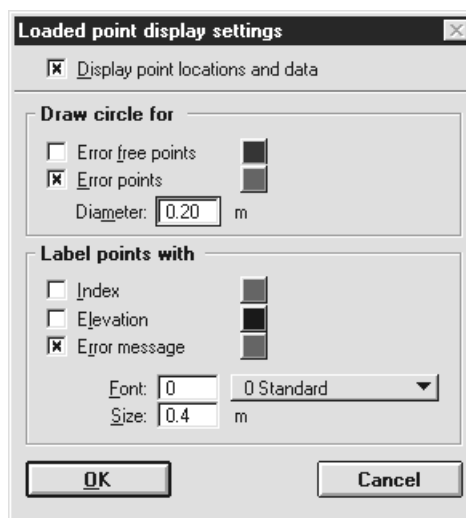
2. Enter settings as shown above and click OK.

    This will draw a red circle and an error message at the location of each error point.

Fixing reported problems

When verifying the incoming data, you may often need to fix problems caused by insufficient input data, survey errors or problems related to the feature list. The most common methods for fixing problems include:

- Fill in missing information. For example, you can assign feature codes to uncoded survey points.
- Delete erroneous points.
- Modify survey point information such as coordinate values or dimension.
- Create a new feature in the active feature list if you encounter a new feature code.

Our example data produces to error messages which we need to look into.

➢ **To fix the single point problem:**

1. Click on the second error message (Drawing rule requires 2 points).

   This highlights the point causing the problem in the upper list box.

2. Click on **Show location** to view the graphical location of the point.

3. Identify a view window.

   This centers the view window at the problem location.
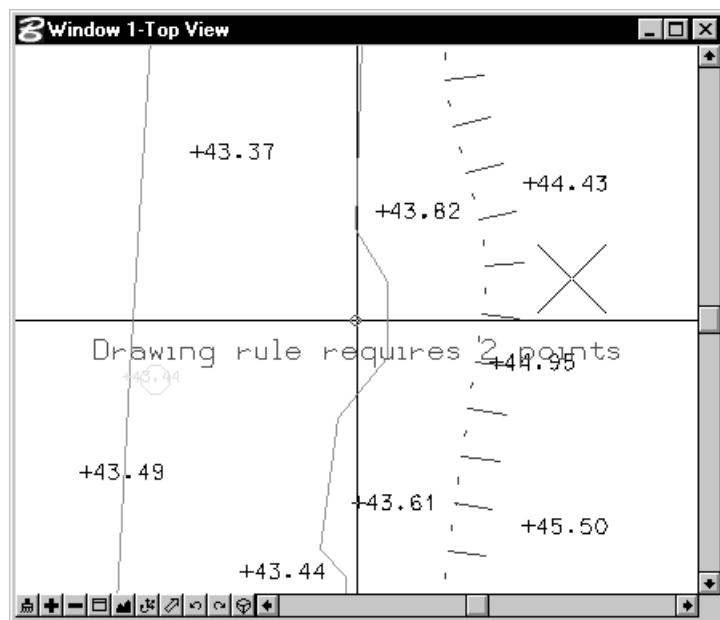
This point was surveyed accidentally using feature code 4 which is meant for surveying drainage manholes by two points. The correct feature code should be 2 which is used to survey any manholes using just one point.

4. From **Point** menu, choose **Edit selected**.

   This opens the **Survey point** dialog where you can modify any of the data fields associated with a survey point.

Survey point

Survey point information

Index: 565

Code: 4   Select...

Dimension: 600   mm

Information:

String: 0

Surface: 0

Coordinates

Easting: 57751.030

Northing: 25828.580

Elevation: 43.323

OK   Cancel

5.   Modify the **Code** text field to contain feature code 2.

6.   Click OK.

The modified information is stored in the list of survey points.

7.   (Optional) You may want to redraw the survey drawing to see the result. If you click on **Redraw**, the survey drawing will now display a circular symbol and an elevation label at the location of the problem point.

➢   **To fix the other problem:**

1.   Click on the first error message (Undefined feature code 12).

This highlights the points causing the problem in the upper list box.

2.   Click on **Show location** to view the graphical location of the points.

3.   Identify a view window.

This centers the view window at the location of the first problem point.

The correct feature code for these points is 21 which stands for a pathway. The surveyor accidentally typed in 12.

4.   From **Point** menu, choose **Edit selected**.

This opens the **Edit several points** dialog which is used when you are modifying several selected points at the same time.

Edit several points

[X] Code   21   Select...

[ ] Dimension   0   mm

[ ] Information

[ ] String   0

[ ] Surface   0

[ ] Elevation   41.436

[ ] Dz   0.000

OK   Cancel

5.   Set **Code** toggle on and modify the feature code to be 21.

6.   Click OK.

7.   Click **Redraw** to regenerate the survey drawing.

The survey drawing should appear as shown below:
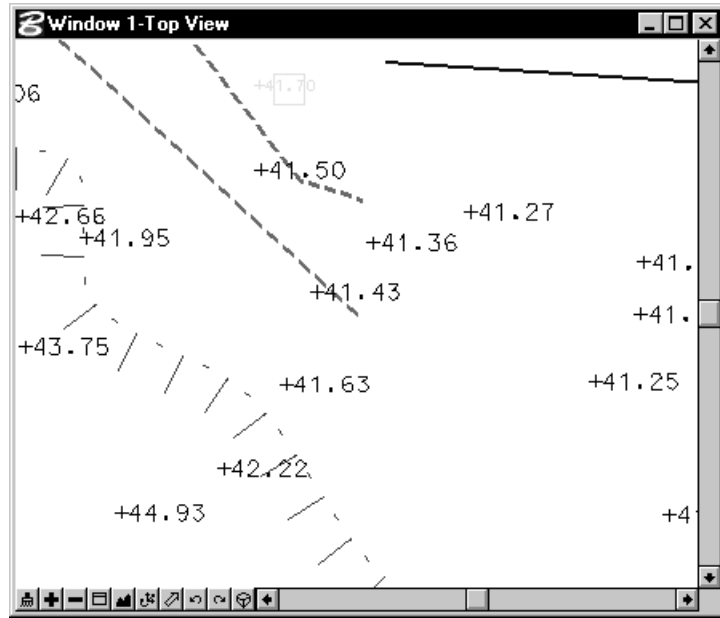
The list of error messages should now be empty as you have fixed both of the problems.

Fixing unreported problems

The incoming survey data may contain problems which will not produce an error message. Typical examples of such problems include mistyped feature codes, incorrect dimensions or unterminated strings.

You may already have noticed a very large tree in the lower left (Southwest) corner of the surveyed area. This is probably caused by an incorrect dimension. The incoming survey file provides trunk dimensions for all surveyed trees. Drawing rules has been set to display a tree cell scaled by the surveyed dimension.

➢ **To fix the tree dimension:**

1.   Zoom in to view the lower left corner of the surveyed area.

2.   Make sure you can see the large tree symbol.
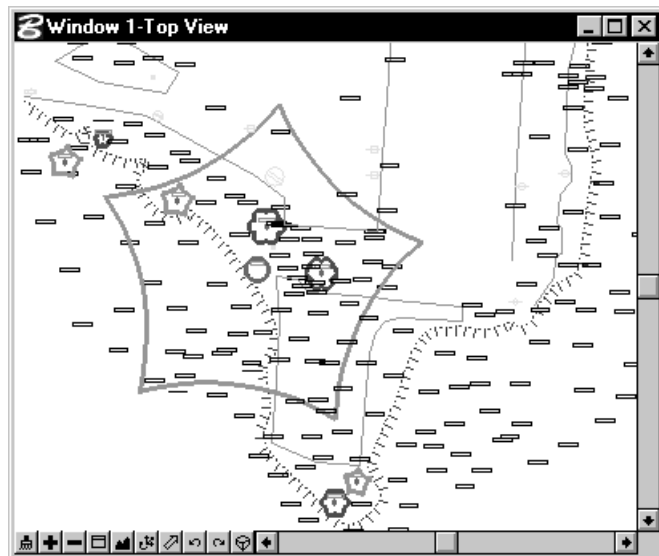
3.   Click on **Find by location**.

4.   Enter a data click close to trunk center point.

This should select point with index 114, survey code 82 and elevation +40.65 in the list box.

5.   From **Point** menu, choose **Edit selected**. Alternatively, you can double click on the selected row in the list box.

This opens the **Survey point** dialog:

6.   Modify **Dimension** field to be 300.

7.   Click OK.

8.   Click **Redraw**.

This regenerates the survey drawing. The tree cell should now appear in a more sensible size.

Another obvious problem is visible a little north from the tree. There seems to be an orange road edge line intersecting another road line. This should naturally never happen. A crazy line going across the survey drawing is often a result of a missing break point. When finished surveying one edge of a road, the surveyor has moved to another road edge without taking any other points in between. This causes TerraSurvey to assume that all the consecutive points with the same feature code belong to the same string.

The picture below show the extra line segment marked by a cross.
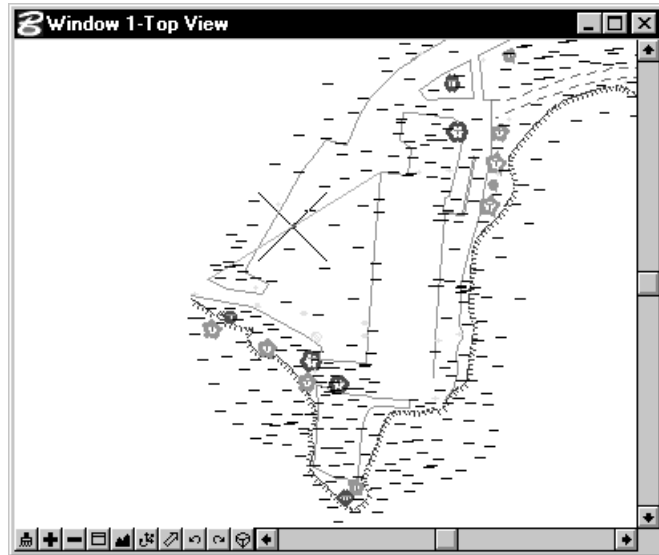
➢ **To insert a break point:**

1. Zoom in to view the left edge of the surveyed area.
2. Make sure you can see the extra line segment as shown in the picture above.
3. From **Tools** menu, choose **Break string**.

   As you move the mouse inside a view, TerraSurvey highlights the closest string segment.

4. Enter a data click close to the middle point on the extra line segment.

   This changes the color of the line segment and marks it with a red cross. A break point has been inserted between segment start and end point.

5. Click on **Redraw** to regenerate the survey drawing.

   The extra line segment has been removed from the survey drawing.

Connecting building corners

When surveying buildings using a total station, you can only see some of the corners from each station location. Therefore, it is impossible to survey all of the building corners as consecutive points. This results in buildings being displayed as a collection of unconnected line segments in the survey drawing.

If you would like the buildings to appear as closed shapes, the are two ways to accomplish this:

- Use a string number out in the field. Assign the same string number to all the points in the same building and let the application join disjoint strings by string number.
- Survey without a string number. Build closed shapes by connecting building corners to each other using **Connect string** command in the **Loaded survey points** window.

We will use the latter approach to construct a closed shape of the building in the upper part of the surveyed area. The picture below shows the building line segments in a very thick line weight.
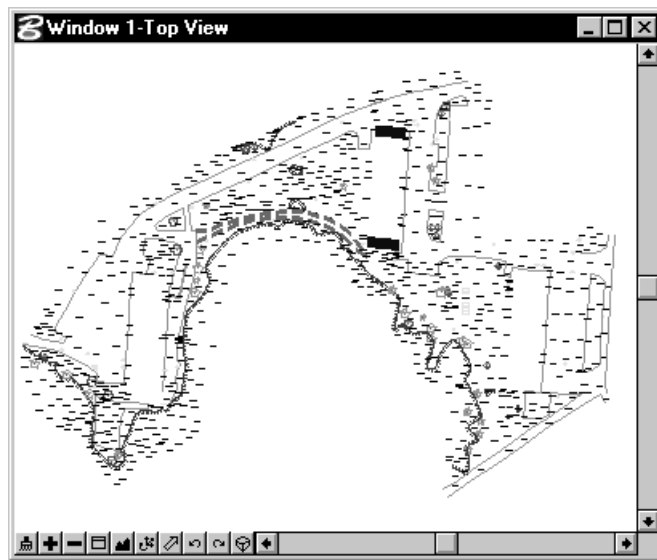
➢ **To connect building corners:**

1. Zoom in to view the upper part (north) of the surveyed area.
2. Make sure you can see the building line segments as shown in the pictures above and below.
3. From **Tools** menu, choose **Connect string**.
4. As you move the mouse inside a view, the application will find the closest string end point and display a circle around it.
5. Enter a data click close to the upper right (Northeast) corner of the building.
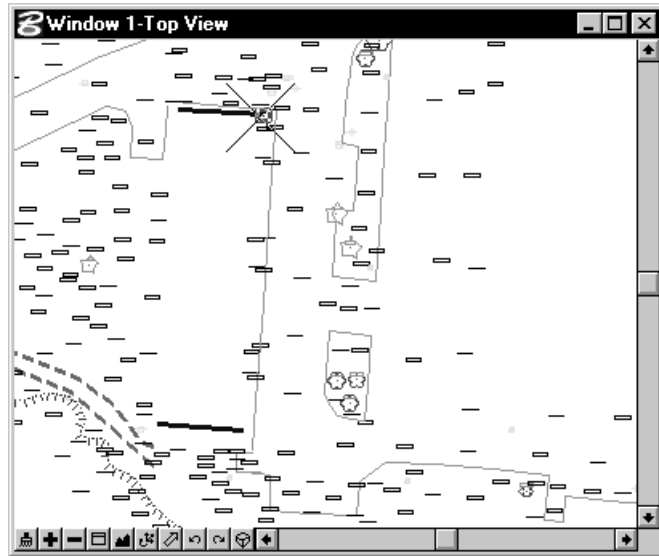
This highlights the upper building line segment. As you move the mouse inside a view, a line is displayed extending from the identified corner point.

6.   Enter a data click close to the lower right (Southeast) corner of the building.
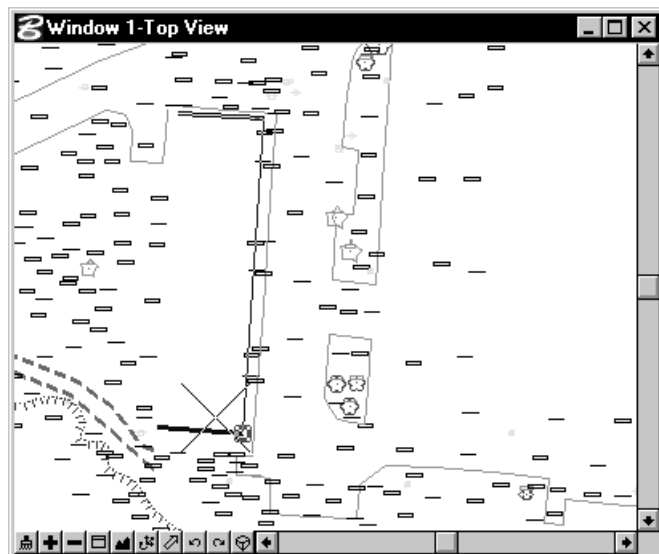
7.   Enter a reset to complete this string.

The building corner points have been moved to the end of the point list. They are now four consecutive points.

8.   Enter a second reset to abort the **Connect string** tool.

9.   Click **Redraw**.

The survey drawing is regenerated and the building should now appear as a closed shape. The was no need to connect the points on left side of the building as the shape drawing rule can construct the closing line segment.

Writing the verified survey drawing

The verification of the survey data is now complete and you are ready to write the survey drawing to the design file.

➢ **To write the survey drawing to the design file:**

1. Close the **Loaded survey points** window by double clicking in the upper left corner.

   The application asks you if you want to write the survey drawing to the design file.

2. Click **Yes**.

   The **Loaded survey points** window is closed and the survey drawing now appears as normal MicroStation design file elements.

This completes the processing of the first example file.

Loading borehole locations

TerraSurvey has builtin logic to support input and output of several total station related file formats. In addition to builtin formats, you can also define your own file formats. This ability makes TerraSurvey especially well suited for processing data coming from various sources.

The next step in this tutorial demonstrates these capabilities by loading in a text file created by a spreadsheet application. The file contains the coordinates of planned borehole locations.

➢ **To load borehole locations:**

1. Select the *Load Survey Verify* tool.

   This opens a dialog box which allows you to select a single file to process.

2. Locate BOREHOLE.DAT file by browsing your computer's directory structure. If you installed TerraSurvey in the default directory C:\TERRA, you can find this file in path C:\TERRA\DATA\BOREHOLE.DAT. When you have located this file, select in the **Files** list box and click OK.

   TerraSurvey tries to recognize the file format. If this fails, it will automatically open the **File format** window where you can define the format.

   This file is a text file with six rows in it. Each row represents a borehole location with point number, northing and easting fields separated by white space.

3. Select **Index** as the data in the first field.
4. Select **Northing** as the data in the second field.
5. Select **Easting** as the data in the third field.
6. Make sure other settings appear as in the picture above.
7. Click OK.

   The **Survey file information** dialog opens.

8. You can leave this information empty and just click OK.

   The **Load Survey Verify** dialog opens.

9. Click OK.

   TerraSurvey reads the selected file and opens the **Loaded survey points** window.

Assigning codes to borehole points

The loaded file did not contain any feature code information so TerraSurvey can not really create at this stage. The error list box in the Loaded survey points window displays one problem:

Undefined feature code 6

Note also that all of the points are set to zero elevation as the incoming file did not include elevation data.

In order to create a survey drawing, the points need to have feature code.

➢ **To assign a feature code:**

1. Click on the error message in the lower list box.

   This selects all of the points in the upper list box.

2. From **Point** menu, choose **Edit selected**.

   This opens the **Edit several points** dialog which is used when you are modifying several selected points at the same time.
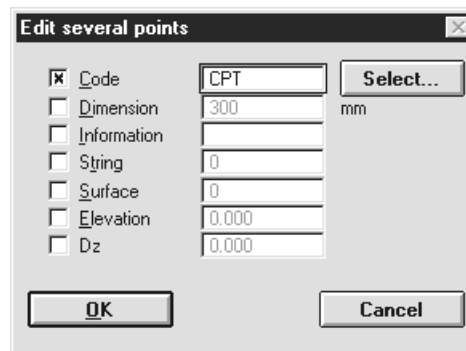
3. Set **Code** toggle on and modify the feature code to be CPT. Feature codes in TerraSurvey can include any combination of letters and numbers upto fifteen characters in length.

4. Click OK.

5. Click **Redraw** to regenerate the survey drawing.

   The planned borehole locations are now marked with a red triangle shaped symbol.

Modifying borehole drawing rules

Zoom in to the lower left corner of the surveyed area where the boreholes are located. You can use **Show location** button to help you locate the boreholes.

The borehole locations are marked by a red triangle shaped cell. In addition to the symbol, you may want to see the point numbers as well. To accomplish this, we will simply modify the drawing rules assigned to the CPT feature.

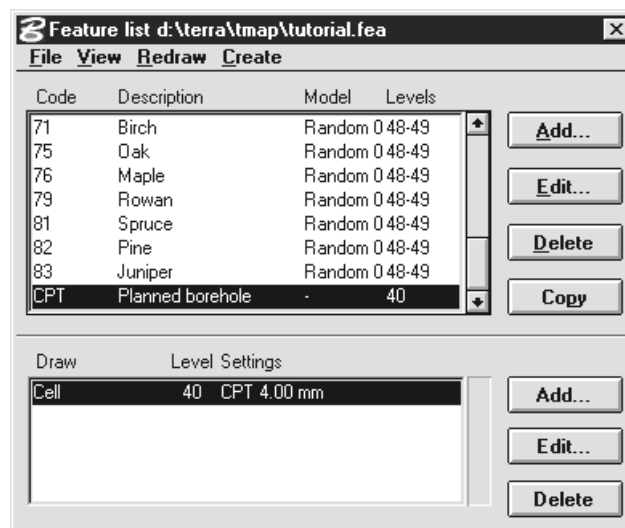➢ **To modify CPT drawing rules:**

1. Select the *Define Features* tool.

   This opens the **Feature list** window.

2. Locate CPT feature in the upper list box by scrolling down the list. It should be the very last feature in the list.

3. Click on CPT feature in the feature list box.

The lower list box now displays the drawing rules assigned to CPT feature. At the moment, it only has one drawing rule which places a cell at the point location. The cell is scaled so that it would be 4 mm in size when plotted on paper.

4. Click on **Add** button next to the lower list box.

   The **Drawing rule** dialog box opens.

5. Select **Text** drawing rule type in the **Draw** field.

6. Select **Index** in the **Write** field.

7. Type # character in the **Prefix** field.

8. Choose **Paper distance** in the **Offset** field.

9. Type 3.000 as the horizontal offset in the **Dx** field.

10. Choose red color in the **Color** field.
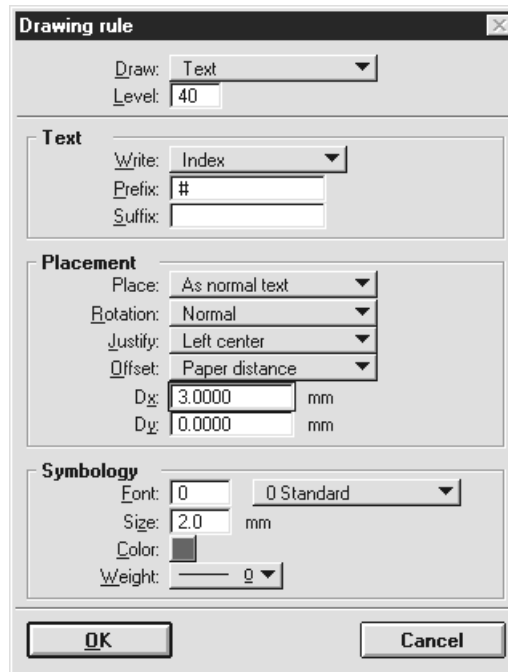
11. Make sure the settings appear as shown in the picture above.

12. Click OK to close the **Drawing rule** dialog.

     The text drawing rule is added to the list of drawing rules assigned to the CPT feature.

13. Close the **Feature list** window.

14. Click **Redraw** in the **Loaded survey points** window to regenerate the survey drawing.

     The planned borehole locations are now labeled with the point index.
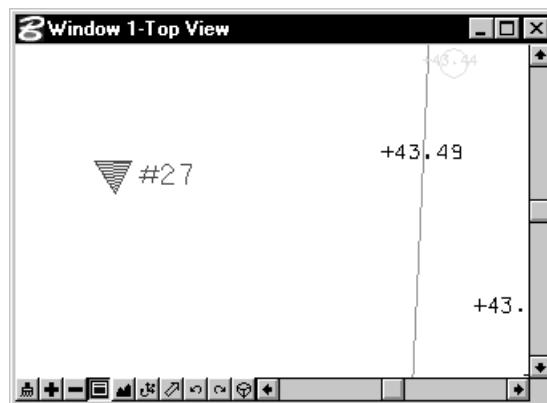
You can close the **Loaded survey points** windows and write the survey drawing permanently to the design file.

Outputting points to a text file

In addition to reading in points from a text file TerraSurvey can output data to any coordinate based format it knows about. The borehole locations in our example design file can be listed to a total station file so that the total station can be used to measure out and to mark the planned locations.

➢ **To output borehole locations:**

1. Select the *List Survey* tool.

   This opens the **List Survey** dialog:
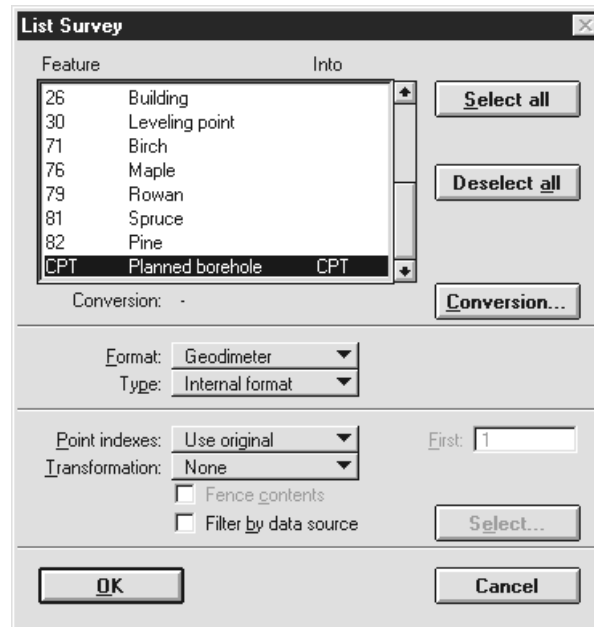
2. Scroll down the list of features and click on the CPT feature at the end of the list.

   This deselects all other rows and selects the CPT feature.

3. Choose **Geodimeter** option in the **Format** field.

4. Choose **Use original** option in the **Point indexes** field.

5. Make sure settings appear as shown in the picture above.

6. Click OK.

   A standard dialog box for choosing an output file name opens.

7. Enter a name such as OUT.DAT for the output file.

   A file with the given name is created with the borehole locations in it. The file is in a format that can loaded into a Geodimeter total station.

You can use Notepad or another editor to view the contents of the output file.

Part III: Tool Reference

5   General Tools

General tool box

The tools in the **General** tool box are used to define user settings, to manage survey files, to define features, to control data sources and to access on-line help.

To:	Use:	
Change user settings		*Settings*
Define survey feature codes and drawing rules		*Define Features*
Define and display reference points		*Manage Reference Points*
Manage survey files		*Manage Survey Files*
View data sources of the survey drawing		*View Data Sources*
View information about TerraSurvey		*About TerraSurvey*
View on-line help		*Help On TerraSurvey*

Settings

Settings tool lets you change a number of settings controling the way TerraSurvey works. Selecting this tool opens the **TerraSurvey settings** window.
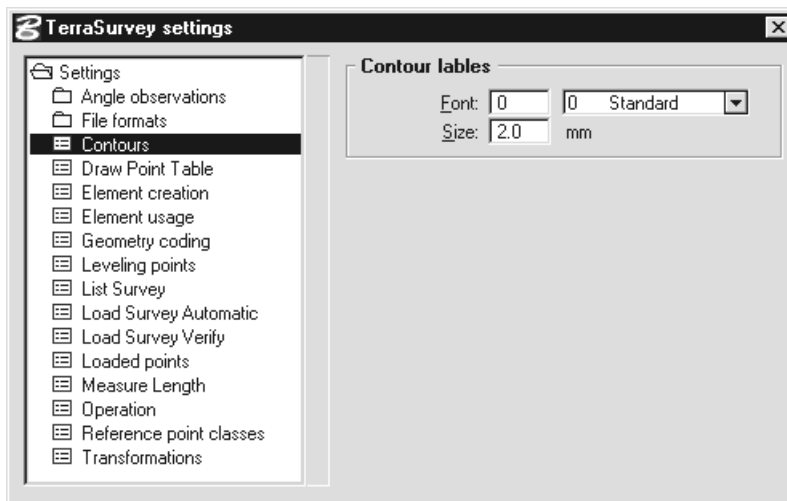
Settings are grouped into logical categories. Selecting a category in the list causes the appropriate controls to be displayed to the right of the category list.

Angle observations / Angle systems category

Angle systems category in **Angle observations** folder contains a list of angle systems which may be used in angle based survey files. A definition of an angle system consist of the orientation and the number of angle units in both vertical and horizontal directions.
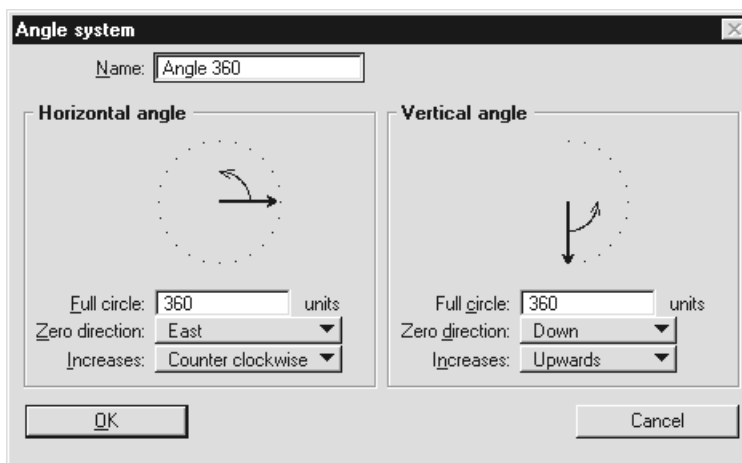
Setting:	Effect:
Horizontal - Full circle	Number of units in a full horizontal circle.
Horizontal - Zero direction	Default zero direction (north, east, south or west).
Horizontal - Increases	Direction in which angles increase.
Vertical - Full circle	Number of units in a full vertical circle.
Vertical - Zero direction	Default zero direction (up, horizontal, down).
Vertical - Increases	Direction in which angles increase.

Angle observations / Observation corrections category

Observation corrections category in **Angle observations** folder contains a list of user defined correction settings for processing angle based observations. The correction settings determine what corrections will be applied to observed distances and angles.
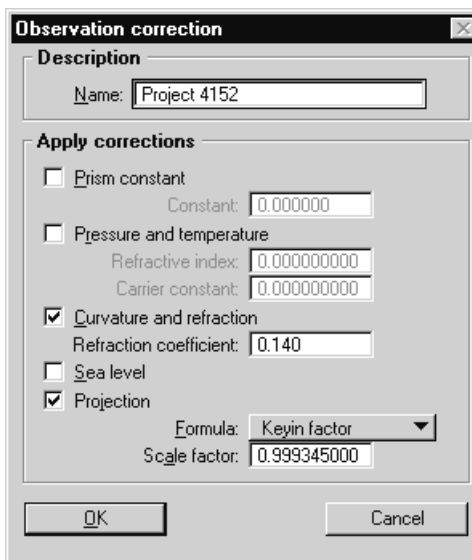
Angle observations / Processing observations category

Processing observations category in **Angle observations** folder determine how reference points and reference stations will be used when reading in a raw observation file. These settings essentially determine how automatically the application can recognize observations as reference observations and retrieve target coordinates.

Setting:	Effect:
Set - From a matching reference point	If on, the application will try to find coordinates for a station from the active reference point list. It will compare the station number with reference point numbers to find a match.
Interpret as reference point	If on, observations with a given code will be interpreted as observations to a reference point.
Interpret as reference station	If on, observations with a given code will be interpreted as observations to a reference station.
Search - From a matching station	Some raw file formats contain information which indicates that an observation is a foresight or a backsight observation. If on, the application will try to match foresight/backsight observations with other loaded station locations.
Search - From a matching reference point	If on, the application will try to match foresight/backsight observations with reference point numbers.

Angle observations / Scale factor formulas category

Scale factor formulas category in **Angle observations** folder contains a list of mathematical formulas for computing scale factors. These scale factors can be used to scale observed distances when processing angle based observations.

The mathematical formula may contain:

- P – atmospheric pressure during observations (mmHg).
- T – temperature during observations (Celsius).
- E – project easting.
- N – project mean northing coordinate.
- Z – project mean elevation.
- Mathematical functions such as sin(a), cos(a), tan(a), exp(a), log(a), log10(a), pow(a,b), sqrt(a), ceil(a), fabs(a) and floor(a) where a and b are floating point values.

You can input the actual pressure, temperature and project coordinate values when reading in observations with the *Process Angle Observations* tool.

File formats / Builtin angle category

Builtin angle category in **File formats** folder contains a list of angle based file formats supported by builtin application logic. All of these formats are raw total station formats.

TerraSurvey supports Geodimeter angle, Nikon angle, Sokkia angle, Wild angle GSI-8, Wild angle GSI-16 and Wild binary formats. You can only modify some settings relating to the survey information in these files.

See chapter **Builtin Angle File Formats** on page 100 for more information about these formats.

File formats / Builtin xyz category

Builtin xyz category in **File formats** folder contains a list of file formats supported by builtin application logic. Some of the file formats are total station related, some are general survey data transfer formats.

TerraSurvey supports Geodimeter, Moss genio, SDRmap, Sokkia, Wild xyz GSI-8, Wild xyz GSI-16, MTM, Binary database, KF85 and David file formats. You can not delete the builtin file formats. You can only modify some settings relating to the survey information in these files.

See chapter **Builtin Xyz File Formats** on page 102 for more information about these formats.

File formats / User angle category

User angle category in **File formats** folder contains a list of angle file formats which have been defined by the user.

You can extend this list by adding definitions for new file types. A file format definition can be created for practically any file format which is organized so that one row in the file contains the fields of one angle based observation.

See chapter **User Defined File Formats** on page 98 for more information.

File formats / User xyz category

User xyz category in **File formats** folder contains a list of xyz file formats which have been defined by the user.

You can extend this list by adding definitions for new file types. A file format definition can be created for practically any file format which is organized so that one row in the file contains the fields of one survey point.

See chapter **User Defined File Formats** on page 98 for more information.

Contours category

Contours category defines the font and size of contour labels.

Setting:	Effect:
Font	Font for contour elevation labels.
Size	Size of labels as millimeters on paper.

Draw Point Table category

Draw Point Table category defines title texts and symbology for point tables.

Setting:	Effect:
Column titles	Title labels for columns in the point table.
Row count	Maximum row count in one point table. If the number of valid points exceeds this count, the application will split the points in more than one table.
NE order	Defines if northing or easting coordinate should appear first.

Element creation category

Element creation category defines element attributes and settings used when writing survey drawing elements to the design file.

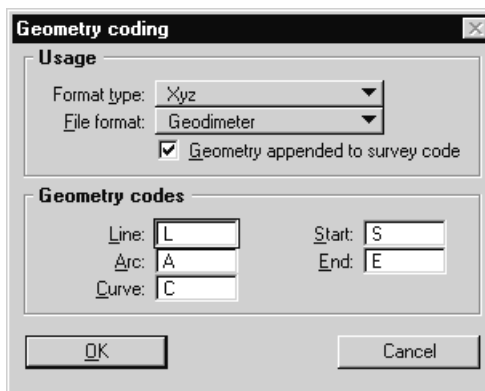| Setting:	Effect:
Add attribute for TerraInspector	If on, TerraSurvey will add an extra attribute in survey elements. From this attribute TerraInspector will find a description for that feature.
Create as view independent	If on, text elements will be created as view independent. This type of text elements will always face the viewer regardless of view rotation.
Nonsnappable (if origin moved)	If on, text elements will be created as nonsnappable in case the text element's origin point is not the same as the survey point.

Element usage category

Element usage category defines how design file elements are converted into points.

Setting:	Effect:
Radius	Circles smaller than **Radius** are interpreted as a single point (circle center). Larger circles are stroked into several points along the circumference.

Geometry coding category

Geometry coding category lets you define how geometry is coded in each file format that you read in. One geometry coding definition determines how line, arc and curve geometry types are coded in a specific file format.

Setting:	Effect:
Format type	Whether the definition applies to a xyz or an angle based file format.
File format	File format to which this definition applies.
Geometry appended to survey code	If on, geometry codes are appended to feature codes. When reading in the survey file, the application will try to split survey codes into feature code and geometry code parts.
Line	Line geometry code.
Arc	Arc geometry code.
Curve	Curve geometry code.
Start	Code for starting a new string.
End	Code for ending a string.

Leveling Points category

Leveling points category defines the format of elevation labels the application will create.

Setting:	Effect:
Accuracy	Number of decimals to display in elevation values.
Display plus	If on, positive elevation values will display a plus sign.
Display minus	If on, negative elevation values will display a plus sign.

List Survey category

List Survey category defines what kind of element feature attributes *List Survey* tool will search for when scanning the design file for elements to output.

Setting:	Effect:
Created by old TerraSurvey	If on, search for elements created by an older version of TerraSurvey which used a different attribute structure.
Created by PRO600	If on, search for elements created by Leica's PRO600 application and use feature codes stored in the elements.
Created by Geogrpahics	If on, search for elements created by Geographics and use the feature codes stored in the elements.
Created by MGE	If on, search for elements created by MGE and use the feature codes stored in the elements.

Load Survey Automatic category

Load Survey Automatic category defines how *Load Survey Automatic* tool reports problems and errors when reading in files and generating a survey drawing.

Setting:	Effect:
Write error log to file	If on, error messages will be written to a text file.
File name	How to derive a file name for the error log: • Variable TSURVEY_LOGFILE - environment variable defines the full path and name of the log file • Derive from design file - add extension err to the design file name (d:\dgn\pasila\pasila.err) • Derive from data file - add extension err to the data file name (c:\terra\data\surv4039.err)
Drawing errors	How to report errors related to feature coding and drawing rules: • Log only once - do not report the same error twice • Log each occurrence - generate an error message with a row number for each occurrence
Data error	How to report errors originating from survey data. See above.
No drawing rule for feature xxx	If on, the tool will not generate an error message from a feature code which has no graphical presentation.

Load Survey Verify category

Load Survey Verify category defines whether the application should suggest saving modified points to a text file when closing the **Loaded survey points** window.

Setting:	Effect:
Prompt for output when closing	If on and loaded points have been modified but not saved, the application suggest saving the points to a text file.

Loaded points category

Loaded points category defines the symbology for highlighting points and for marking changes when working with loaded points.

Settings group:	Effect:
Point selection group	Color and line weight for a circle marking a selected point. These settings will be used when you use either **Show location** or **Identify** features.
Modified point group	Size, color and line weight for a circle marking a point which has been modified using **Assign points** feature.
Modified segment group	Color, style and weight for lines indicating modified segments. These will be drawn between consecutive points in a string constructed by **Connect string** feature.
Broken segment group	Size, color and weight for a cross indicating a broken string segment. This setting is used by **Break string** feature.

Measure Length category

Measure Length category defines the format in which *Measure Length* will create labels.

Setting:	Effect:
Font	Font for measurement labels.
Size	Text size. Given in millimeters on paper.
Length prefix	Text that will be placed as a prefix for a line length label.
Angle prefix	Text that will be placed as a prefix for a direction angle label.
Radius prefix	Text that will be placed as a prefix for an arc radius label.

Operation category

Operation category defines what menus will be opened during application startup and how the application can be unloaded.

Setting:	Effect:
Create Applications Menu	If on, TerraSurvey will create an **Applications** menu in MicroStation's command window at startup. This menu will contain items for opening TerraSurvey toolboxes.
Open Main tool box	If on, the application will open its **Main** tool box at startup.
Main tool box is closed	If on, the application will be unloaded when **Main** tool box is closed.

Reference point classes category

Reference point classes category contains a list of class definitions for known points. Each class can have its default symbology.

Transformations category

Transformations category contains a list of coordinate transformations which are used to convert survey file coordinates into design file coordinates. Transformations can be used with *Load Survey Verify*, *Load Survey Automatic*, *List Survey* and *List Elements* tools.

TerraSurvey supports three types of coordinate transformations:

* Linear - you can assign a coefficient and a constant offset for each coordinate axis. Computes a design file coordinate by multiplying the survey file coordinate with the given coefficient and by adding a given constant value.
* Equation - you can enter mathematical equations for calculating the coordinates.
* Known points - you can specify the coordinates of two known points in the survey coordinate system and their respective coordinates in the design file.

Linear transformation

Setting:	Effect:
Multiply by - X	Coefficient for multiplying easting.
Multiply by - Y	Coefficient for multiplying northing.
Multiply by - Z	Coefficient for multiplying elevation.
Add constant - X	Value to add to easting.
Add constant - Y	Value to add to northing.
Add constant - Z	Value to add to elevation.

Equation transformation

Setting:	Effect:
X	Equation for calculating X coordinate. The mathematical equation may contain: • Sx - survey file X coordinate. • Sy - survey file Y coordinate. • Sz - survey file Z coordinate. • Mathematical functions such as sin(a), cos(a), tan(a), exp(a), log(a), log10(a), pow(a,b), sqrt(a), ceil(a), fabs(a) and floor(a) where a and b are floating point values.
Y	Equation for calculating Y coordinate.
Z	Equation for calculating Z coordinate.

Known points transformation

Setting:	Effect:
Survey X, Y, Z	First known point in the survey coordinate system.
X, Y, Z	Second known point in the survey coordinate system.
Design X, Y, Z	First known point in the design file coordinate system.
X, Y, Z	Second known point in the design file coordinate system.

Define Features

Define Features tool opens a window for managing feature codes and their drawing rules.

Feature coding is a method for identifying surveyed objects. Each survey point is assigned a feature code which defines what was surveyed - a tree, a road center line, an elevation point or may be a manhole cover.

The graphical appearance of a feature is defined by drawing rules. Normally each feature code is assigned one or more drawing rules. There is no limitation on how many drawing rules you can assign to a feature.

When processing survey information, TerraSurvey tries to find a matching feature code for each of the survey points. If a match is found, the application goes through all drawing rules assigned for that feature. The actual graphical presentation is created by combining the survey point information with the settings in drawing rules.

You should create at least one feature list of your own. This feature list should include all feature codes used by the survey team in your organization. In the long run, you will probably want to create several feature lists for different purposes. You may need to create a separate feature list for processing surveys done by an outside surveying company because they will probably use a different set of feature codes. You may also want to have different feature lists for creating different types of survey drawing for specific tasks. Feature lists are stored as text files. Only one feature list can be active at a time.

➢ **To view the active feature list:**

1. Select the *Define Features* tool.

   The **Feature list** window opens:
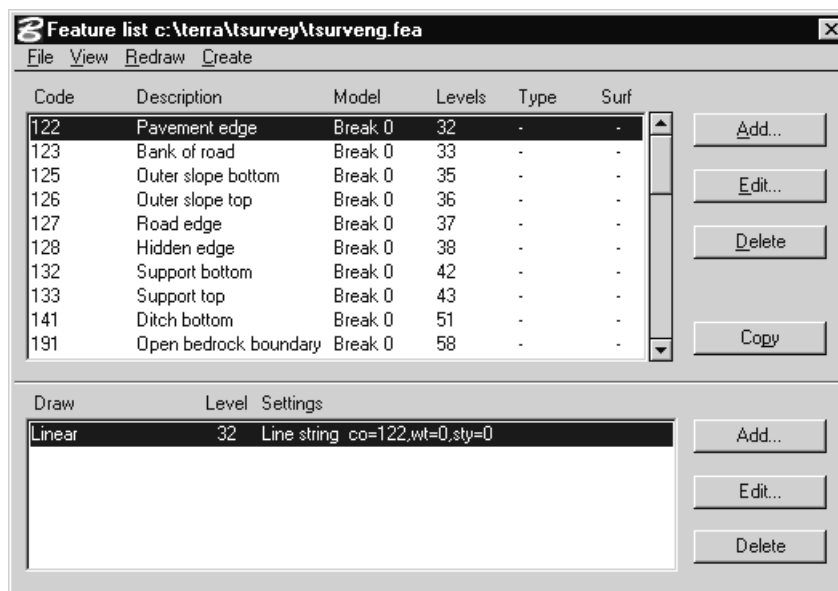
The upper list box contains a list of all features in the active feature list. The lower list box displays all drawing rules assigned to the currently selected feature. When you select another row in the feature list box, the contents of the lower list will change.

➢ **To add a new feature:**

1. Click the **Add** button.

   The **Feature code** dialog box opens:
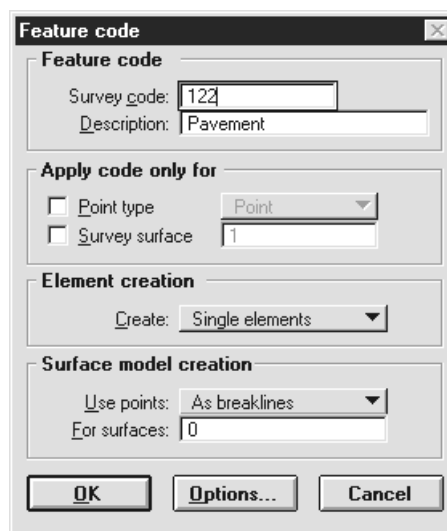
2. Enter settings values and click OK.

   The feature is added to the active feature list. You will now probably want to assign drawing rules to the new feature.

Setting:	Effect:
Survey code	Unique feature code. An alphanumeric text string upto 15 characters in length.
Description	An optional description.
Point type	If on, the feature code applies only to single points or to points in a chain. This setting should be used only if your survey files contain chain information and you want to use the same feature code for two types of features: single and chain.
Survey surface	If on, the feature code applies only to survey points belonging to selected surface. This setting should be used only if your survey files contain surface information and you want to use the same feature code for features on different surfaces.
Create	How to combine elements from multiple drawing rules: • Single elements - individual elements are not linked. • Graphical group - link elements to each other as a graphical group.
Use points	How to use points when creating surface models.
For surfaces	Surface types for which to accept the points. For example: • 0 - use for surface type 0. • 0,2-4 - use for surface types 0, 2, 3 and 4.

➢ **General procedure for adding drawing rules to a feature:**

1. Select the desired feature in upper list box.

2. Click the **Add** button on the side of the lower list box.

   The **Drawing rule** dialog box opens.

3. Choose the drawing rule type and fill in settings values.

4. Click OK.

   The new drawing rule is added to the lower list box which displays all rules assigned for the selected feature.

See chapter **Drawing Rule Settings** on page 88 for more information about drawing rules.

Feature list files

Feature lists are stored as text files which have a default extension ".fea". The **File** menu in the **Feature list** window has commands for opening existing feature list files and for saving the active feature list into a file.

When you start TerraSurvey, it automatically loads the feature list which was used during the last working session.

✓ You can use a text editor to edit feature list files. This may prove useful if need to copy features and drawing rules from one feature list to another.

Printing a list of features

When you modify your feature list, you will naturally have to keep your surveying team informed about the changes. The easiest way is to print out the current feature list and hand it to the surveyors.

➢ **To print a list of features.**

1. From the **Create** menu, choose **Listing**.

   Create feature listing dialog box opens.

2. Enter a name for the output file

3. Click OK.

   The feature codes and descriptions are written to a file with the given name. You should use a text editor or the operating system to output the text file to a printer.

Generating level names from features

Each element in a design file is on one of 63 drawing levels which provide a basic method for organizing your work. By switching levels on or off, you can control which levels are visible in a view window and what elements you will manipulate.

In order to make your work easier, you should carefully plan how to organize your level usage and assign consistent levels for the drawing rules in your feature list.

Instead of refering to levels by number only, you can assign more a descriptive name for each level. A level name should indicate what type of graphical information is stored on that level. For a survey drawing, the level names can be created automatically from the **Feature list** window.

➢ **To generate level names from features:**

1. From the **Create** menu, choose **Level names**.

   The **Level names from features** dialog box opens:

2. Enter settings values and click OK.

   Level names are created from the feature descriptions in the current feature list.

| Setting:	Effect:
Group	Level group in which to create the level names.
Delete existing names	If on, delete existing level names first.
	If off, add new names to existing level names.

Manage Reference Points

Manage Reference Points tool opens a window for managing reference points. These are known points which can be used when setting up a station location in the field.

➢ **To view the active reference points:**

1. Select the *Manage Reference Points* tool.

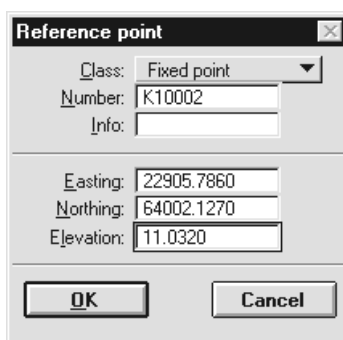   The **Reference points** window opens:
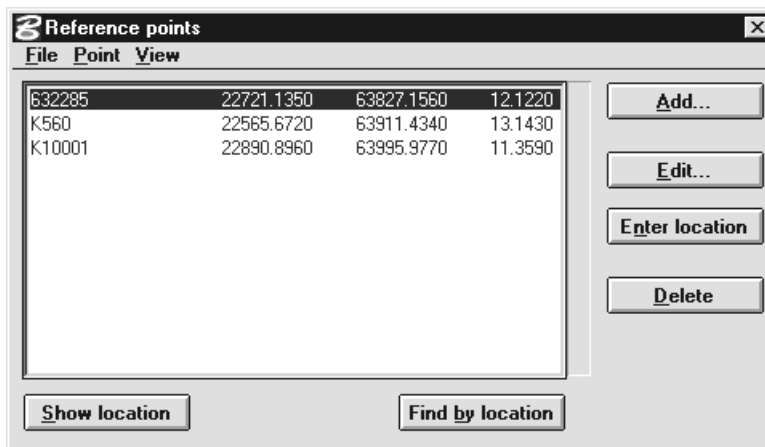
    The list box contains a list of all the known points in the active reference point file.

➢ **To add a new reference point:**

1. Click the **Add** button.

    The **Reference point** dialog box opens:

2. Enter a unique identifier for the point in the **Number** field.
3. Enter coordinates for the point.
4. Click OK.

    The point is added to the active reference point list.

Reference point files

Reference points are stored in binary files which have a default extension ".rpo". If you want to, you can divide your known points to several files based on geographical location or usage. There is no practical limit on how many reference points one file can contain.

The file menu in the **Reference points** window has commands for opening existing reference point list files and for saving the active list into a file.

When you start TerraSurvey, it automatically loads the reference points which were used during the last working session.

Importing reference points from text files

You can read in reference points from any xyz file format that TerraSurvey can understand. In addition to builtin formats, this also includes user defined file formats.

➢ **To import reference points:**

1. Select **Import** command from **File** menu.

   This opens a dialog which allows you to select one file to read in.

2. Select the desired file and click OK.

3. (Optional) If TerraSurvey does not recognize the file format, it opens a dialog for defining the file format.

   The application reads the file and adds extracted points into the active list of reference points.
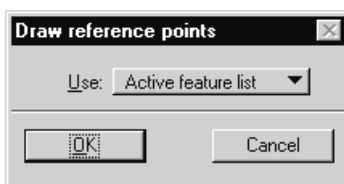
Drawing reference points

Reference points can be drawn into the design file. The drawing method can be:

• Active feature list – You have defined drawing rules in the feature list. Each reference point class should have a feature definition where the survey code of the feature matches the **ID** or the **Abbreviation** of the reference point class. This method allows you to define exactly what kind of elements will be created.

• Builtin drawing rules – Application draws each reference point class using its unique symbology. All reference points will be drawn with a zero length line, a circle and a number label.

➢ **To draw reference points into the design file:**

1. Select **Draw points** command from **File** menu.

   This opens the **Draw reference points** dialog:

2. Choose drawing method and click OK.

   This draws all active reference points into the design file.

Manage Survey Files

Not Field

Manage Survey Files tool opens a window displaying a list of all the survey files which have once been loaded by TerraSurvey. The list displays file names together with descriptions and site names you have entered for each survey file.

You can use this window to locate a survey file you have once processed, to modify survey file information or to create a survey drawing from a particular survey file.

View Data Sources

Not Field

View Data Sources tool lets you view survey elements by the data sources from which they have originated from. For TerraSurvey, a data source is analogous to a survey file drawn into the design file.

A survey drawing is often a combination of data from various sources which may differ by their accuracy, reliability or creation date. For example, you may combine an aerial photograph survey together with a recent and an older total station survey.

View Data Sources tool lets you assign override symbology for a data source and thus make it easy to see which elements originate from a specific data source. For example, you could assign a red override color to the older total station survey to see where it overlaps the recent, more reliable surveys.

➢ **To assign override symbology for a data source:**

1. Select the *View Data Sources* tool.

   The **View Data Sources** window opens display a list of data sources drawn into the active design file. The other fields in the dialog box display the current settings for the data source which is selected in the list box.
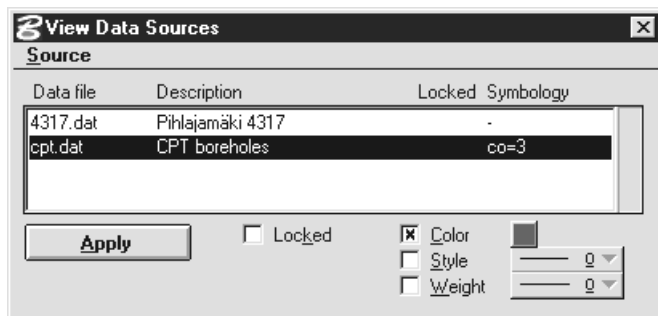
2. Select a data source in the list.
3. Set **Color**, **Weight** or **Style** override locks on and adjust the desired symbology controls.
4. Click **Apply**.

   All open view windows are updated. The selected data source is now drawn using the assigned override symbology settings.

Setting:	Effect:
Locked	If on, modification of data source elements is disabled.
Color	If on, display data source elements using a specific color.
Style	If on, display data source elements using a specific style.
Weight	If on, display data source elements using a specific weight.

Locking a data source

Normally you can make modifications to any of the elements in the active design file. However, it is possible to mark elements as locked which means that modification tools will not affect those elements. *View Data Sources* tool makes it possible to lock all elements originating from selected data sources.

➢ **To modify elements from selected data sources:**

1. Select the *View Data Sources* tool.

    The **View Data Sources** window opens.

2. Select a data source which you want to leave unchanged.

3. Lock the data source by setting **Locked** on.

    Repeat steps 2 and 3 for each data source you want to keep unchanged.

4. Click **Apply**.

    TerraSurvey scans the design file and locks all elements originating from the locked data sources. You can now use tools such as *Delete Fence Contents* or *Hide Overlapping Texts* to manipulate elements from the unlocked sources only.

Deleting a data source

View Data Sources tool lets you delete a data source and destroy all elements originating from that data source.

➢ **To delete a by data source:**

1. Select the *View Data Sources* tool.

    The **View Data Sources** window opens.

2. Select a data source.

3. From the **Source** menu, choose **Delete**.

About TerraSurvey

About TerraSurvey tool opens a window which shows information on TerraSurvey and on user license.

Help On TerraSurvey

Help On TerraSurvey tool launches Acrobat Reader for accessing on-line help.

The on-line help is identical in structure to the printed documentation. The on-line version has hypertext links built in, so you can jump between topics by clicking on the underlined topic names.

☞ Floppy based installation does not include on-line documentation. You can access on-line help only if you have installed from CD. Accessing on-line help also requires that you have Acrobat Reader installed on your computer.

6 Survey Tools

Survey tool box

The tools in the **Survey** tool box are used to load survey files, to draw a point table from survey points and to create text file listings from the design file.

To:	Use:	
Process angle observations into coordinates		*Process Angle Observations*
Load single survey file in verify mode		*Load Survey Verify*
Load survey files in automatic mode		*Load Survey Automatic*
Draw survey point as a table		*Draw Point Table*
List survey elements into a survey file		*List Survey*
List graphical elements into a survey file		*List Elements*
Export survey elements to Geographics or MGE		*Export to GIS*
Generate contours from survey points		*Generate Contours*

Process Angle Observations

Process Angle Observations tool computes coordinates from angle based observation data. You can load in one or several raw angle based survey files in order to solve station locations and compute coordinates for surveyed points.

➢ **General procedure for processing angle observations:**

1. Select the *Process Angle Observations* tool.

   The **Process Angle Observations** window opes.

2. (Optional) Select **Settings** command from **File** pulldown menu and verify that the active angle system and observation corrections are correct.

3. Select **Load** command from **File** pulldown menu to load a raw angle based survey file.

   This opens a dialog box which allows you to select a single file to process.

4. Select the desired file and click OK.

   Application reads the file and displays stations in the upper list and observations in the lower list.
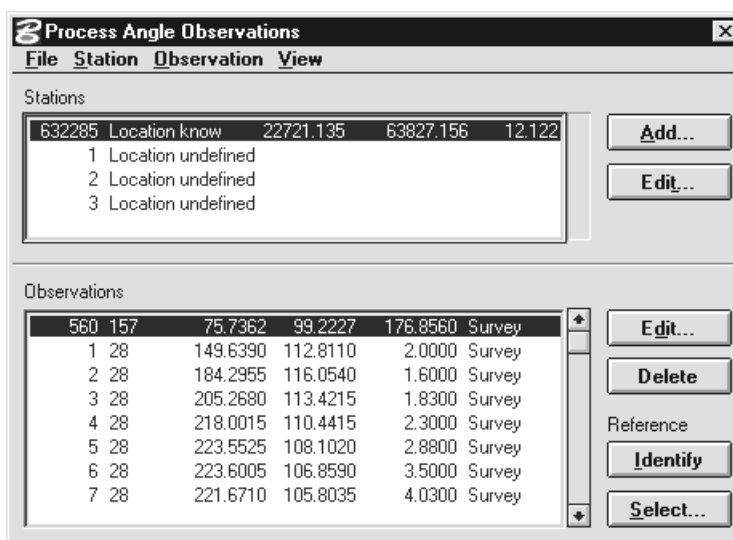
A typical survey file contains a number of stations and a number of observations from each station location. In order to compute coordinates for the stations, the application needs to know which observations were made to known reference points or to other station locations. Depending on user settings and the incoming file format, TerraSurvey may be able to automatically interpret some of the reference observations.

5. Fill in information about stations and reference observations until the application can compute station locations.

6. (Optional) Select **Output coordinates** command from **File** pulldown menu to output computed coordinates for survey points into a file.

7. (Optional) Select **Process coordinates** command from **File** pulldown menu to create a survey drawing from survey points.

Stations

The upper list in the **Process Angle Observations** window displays a list of stations. Each station has a station number which serves as a unique alphanumeric identifier for that location. If two station setups share the same number, the application assumes they have the exact same xyz location.

During processing the locational status of a station can be any of:

- Location undefined - the location is unknown.
- Location known - user has assigned coordinates for the station or it has been automatically matched as being at a known point (from reference point list).
- Location computed - application has computed the location from reference observation(s).
- Oriented - location and orientation has been solved. In addition to knowing the coordinates, the application also knows the true direction of observed angles.
- Adjusted - location and orientation has been solved. Furthermore, the station position has been adjusted using a traverse adjustment routine.

When the status is **Oriented** or **Adjusted**, TerraSurvey can compute coordinates for the survey observations.

Observations

The lower list in the **Process Angle Observations** window displays a list of observations made from the station selected in the upper list. Observations fall into five classes:

- Survey point - a point which will be drawn in the survey drawing.
- Reference point - an observation to a known reference point. This observation will be used when to solve station location.
- Reference station - an observation to another station location. This observation will be used to solve either one of the station locations.
- Control point - an observation to a reference point. This type observation is effectively ignored.
- Control station - an observation to another station. This type of observation is effectively ignored.

Load Survey Verify

Load Survey Verify tool loads a single survey file for verification and survey drawing creation. It reads in the file and displays the loaded points in a window together with a list of errors encountered. You can verify the data, fix errors or modify drawing rules all while viewing the survey drawing in a temporary mode. When you are completely satisfied with the resulting survey drawing, you can draw it permanently by closing the verification window.

➢ **To load a survey file for verification:**

1. Select the *Load Survey Verify* tool.

   This opens a dialog box which allows you to select a single file to process.

2. Select the desired file and click OK.

3. (Optional) If TerraSurvey does not recognize the file format, it opens a dialog for defining the file format.

   The **Survey file information** dialog opens.

4. Fill in the survey file information and click OK.

   The **Load Survey Verify** dialog opens. The coordinate axes show the coordinate values of the first point found in the survey file.
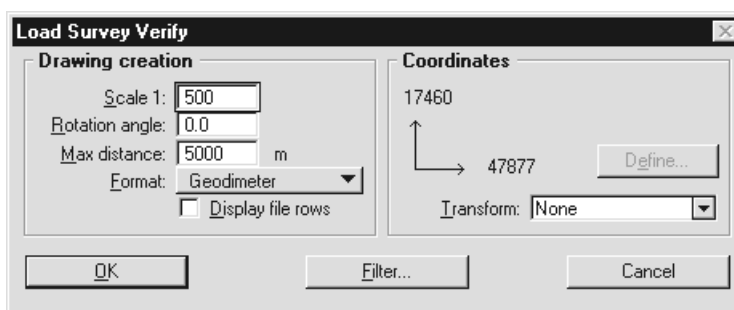
5. Enter settings values for drawing creation and click OK.

   TerraSurvey processes the file for a while loading survey points into memory. When done, it creates a survey drawing in temporary mode and opens the **Loaded Survey Points** window which lets you verify the loaded survey data.

Setting:	Effect:
Scale	Intended plotting scale affects the size of text elements and cells.
Rotation angle	Rotation angle of the survey drawing. Affects the orientation of text elements.
Max distance	If a survey point is more than **Max distance** away from all the previous points, it will be rejected as an error.
Format	How to interpret the file. You can choose from all formats that match file to load.
Display file rows	If on, display rows in the status bar while reading in the file. The process will be faster when this setting is off.
Transform	Coordinate transformation for converting survey coordinates into design file coordinates.

Viewing loaded points

Whenever you load a survey file using the *Load Survey Verify* tool, it first displays the loaded points in the **Loaded survey points** window.

While this window is open, the survey drawing is visible as temporary elements which you can redraw whenever you have made modifications to the survey data. When you close the window, the applications asks you if youy want to draw the survey drawing permanently into the design file.
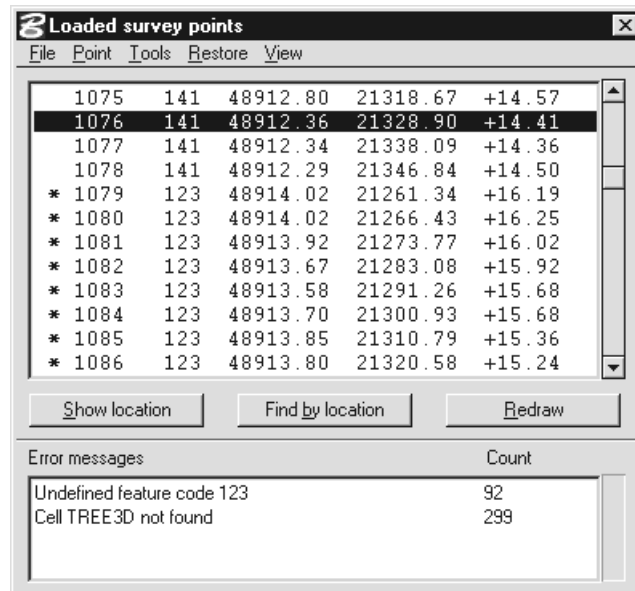
The upper list box displays all the survey points extracted from the survey file. The lower list box shows all errors encountered when drawing the survey points.

The **Loaded survey points** window offers several tools for reviewing survey points and related error messages:

To:	Action:
Choose what fields are visible in the list	Choose **Fields** form the **View** menu
View the location of selected survey points	Click **Show location** and move the mouse in a view
Select a survey point by entering a location	Click **Identify** and enter location data point
Redraw survey drawing after modifications	Click **Redraw**
Check what points caused an error	Select the error row. This will select all points which caused the selected error.

Fixing errors in survey data

The **Loaded survey points** window offers several methods for verifying and fixing survey data before generating a permanent survey drawing. You can fix problems by doing any of the following:

- Fill in missing information. For example, you can assign feature codes to uncoded survey points.
- Delete erroneous points.
- Modify survey point information such as coordinate values or dimension.
- Create a new feature in the active feature list if you encounter a new feature code.
- Change the graphical presentation of a feature by modifying the drawing rules in the feature list.
- Attach another cell library if correct cells are not found.
- Find and fix intersecting breaklines using the *Find Intersecting Breaklines* tool.

Whenever you make modifications which affect the survey drawing, you should click **Redraw** to recreate the survey drawing and the error list in the lower list box.

➢ **To modify a single survey point:**

1. Select the point you want to modify in the upper list box.
2. From the **Point** menu, choose **Edit**.

   The **Survey point** dialog opens:
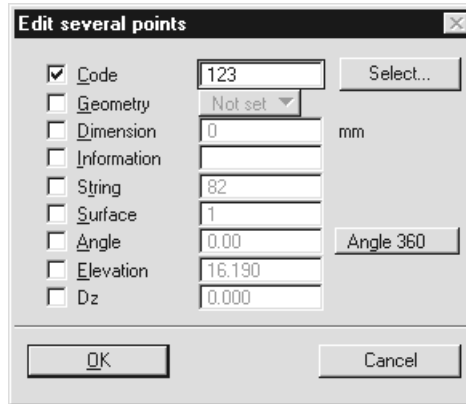

3. Modify the desired field values and click OK.

   The new values are stored.

➢ **To modify several survey points as one operation:**

1. Select all those points in the upper list box which you want to modify.
2. From the **Point** menu, choose **Edit**.

   The **Edit several points** dialog opens. The toggle buttons let you select what information fields will be modified.

3. Set on the toggle for the fields you want to modify.
4. Key in the new values for the fields and click OK.

   This modifies the given fields in all selected survey points.

Displaying survey points

TerraSurvey generates a survey drawing which displays the survey points using feature list based drawing rules. While the **Loaded survey points** window is open, you can display additional information about the survey points without the need to define drawing rules for each feature.

➢ **To display survey point information:**

1. From the **View** menu, choose **Display settings**.

   The **Loaded point display** settings dialog opens:
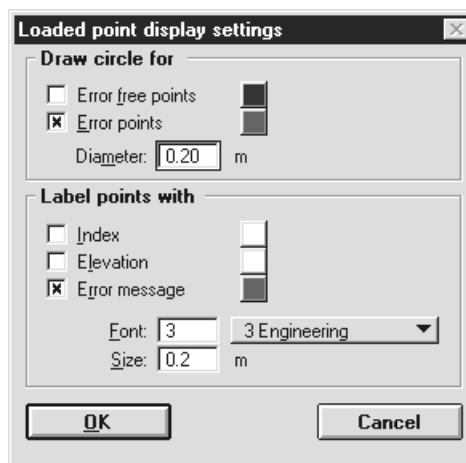
2. Select desired display options and click OK.

   Selected information is displayed for the loaded survey points.

Setting:	Effect:
Error free points	If on, a circle will be drawn at each error free point.
Error points	If on, all the points causing an error will be indicated a circle.
Diameter	Diameter of display circle.
Index	If on, each point will display its index above the point.
Elevation	If on, each point will display its elevation next to the point.
Error message	If on, each point will display the error message generated from it below the point location.

Storing verified survey points

After fixing errors in the survey data, you may want to save the verified list of survey points into a separate file.

➢ **To store verified survey points:**

1. From the **File** menu, choose **List points**.

   The **List Loaded Points** dialog opens:
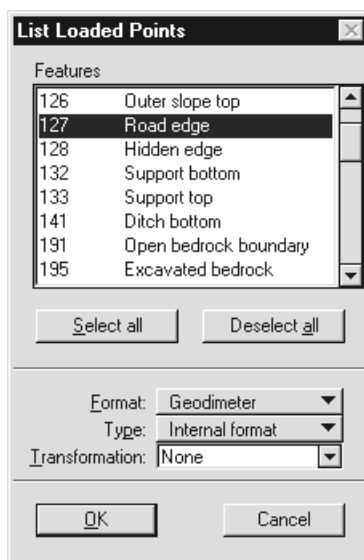
2. (Optional) Select the features you want to output. All features are selected by default.
3. Choose an output format and a subtype in the **Format** and **Type** fields.
4. (Optional) Choose a coordinate transformation if you want the output file to use a coordinate system different from the active design file.
5. Click OK.

   This opens a dialog box which allows you to enter a name for the file to create.

6. Key in a name for the output file and click OK.

   The verified points are written to the output file.

Load Survey Automatic

Load Survey Automatic tool processes one or several survey files in batch mode. It loads the survey files and creates a survey drawing automatically.

This tool will recognize the file format of the selected files automatically and apply appropriate logic when interpreting the information. The files have to match one of the builtin of user defined file formats.

➢ **To load survey file(s) automatically:**

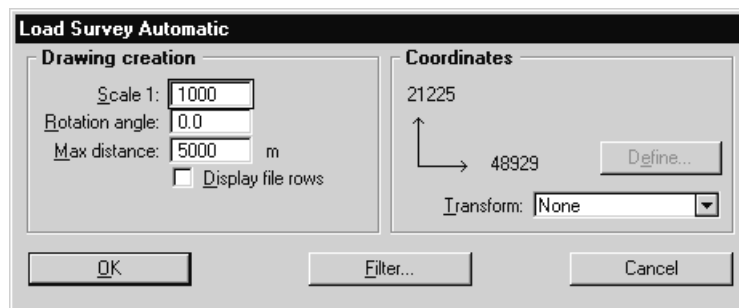1. Select the *Load Survey Automatic* tool.

   This opens a dialog box which allows you to select one or several files to process.

2. Add the desired file(s) to the list of files to process and click **Done**.

3. (Optional) If the first selected file has never been processed by TerraSurvey, it will open the **Survey file information** dialog. Fill in the survey file information and click OK.

   The **Load Survey Automatic** dialog opens. The coordinate axes show the coordinate values of the first point found in the survey file.

4. Enter settings values for drawing creation and click OK.

   TerraSurvey will process each selected survey and create a survey drawing. If any errors are encountered, an error log window will open displaying all error and warning messages.

Setting:	Effect:
Scale	Intended plotting scale affects the size of text elements and cells.
Rotation angle	Rotation angle of the survey drawing. Affects the orientation of text elements.
Max distance	If a survey point is more than **Max distance** away from all the previous points, it will be rejected as an error.
Display file rows	If on, display rows in the status bar while reading in the file. The process will be faster when this setting is off.
Transform	Coordinate transformation for converting survey coordinates into design file coordinates.

Error log

Load Survey Automatic tool creates an error log if it encounters any problems in the survey data. This log will always display in an on screen window. Optionally may be written into a text file as well. You can control the error log creation with user settings. See **Load Survey Automatic category** on page 42 for more information.

Which Load Survey tool to use

Load Survey Verify and *Load Survey Automatic* tools accomplish essentially the same task. Both tools read in survey files and create a drawing based on the loaded survey points. However, there are a lot of differences in the way these two tools work.

Load Survey Verify tool lets you:

- Select only one file at a time.
- Define the file format, if the format is not recognized.
- Select the correct file format, if there are several formats that match the file.
- Verify and fix errors.
- Fill in missing information in the survey data.
- Modify survey file information even if the file has been loaded before.

It is a good idea to use the *Load Survey Verify* tool whenever you load a survey file for the first time. *Load Survey Automatic* tool can be used later on when you have already verified the survey data. This automatic tool:

- Lets you select several files to process.
- Interprets the file(s) using the first matching format.
- Creates an error log but offers no tools for fixing errors.

Draw Point Table

Draw Point Table tool draws a tabular listing of survey points in the design file. It extracts survey point information from the survey elements and creates a table of points with selected feature codes. The point table will be drawn as a cell or as a group of cells.

This tool works with both permanent survey drawing elements and temporary elements created by *Load Survey Verify*.

➢ **To draw a point table:**

1. Select the *Draw Point Table* tool.

   TerraSurvey scans the design file to create a list of feature codes used in the survey drawing and opens the **Point table** dialog box:
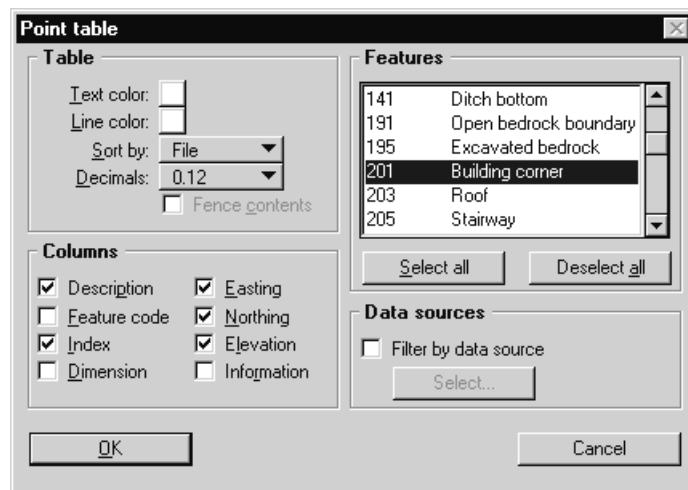
2. Select the feature codes you want to include in the table.
3. Fill in settings values and click OK.
4. Enter a data point to position the cell or the group of cells.

Setting:	Effect:
Sort by	Sort order of points: • File - keep the same order as in which the survey points were drawn. • Index - sort by survey index. • Code - sort by feature code.
Decimals	Number of decimals for coordinates and elevation values.

List Survey

List Survey tool produces a text file listing from the survey drawing. The output file format can be any of the builtin or the user-defined survey file formats which contain coordinates of the survey points. You can choose to output all the survey points or filter the points by the feature code.

This tool creates the listing from the vertices of survey elements which are elements created by the *Load Survey Verify*, *Load Survey Automatic* or *Draw As Feature* tools.

In a sense, the *List Survey* does the opposite for the process carried out by the *Load Survey Verify* and the *Load Survey Automatic* tools. You can combine these tools into a workflow such as:

1. Load survey data using the *Load Survey Verify* tool.

2. Validate the data and make initial corrections in the **Loaded points** window before writing the survey drawing permanently to the design file.

3. Use MicroStation's tools to make further corrections in the survey drawing. For example, you may want to delete unnecessary elements, move vertices or join elements into complex chains.

4. Output the corrected survey data into a text file using the *List Survey* tool. You may choose the output file format to be different from the original input format.

➢ **To list survey points into a text file:**

1. Select the *List Survey* tool.

   TerraSurvey scans the design file to create a list of feature codes used in the survey drawing and opens the **List Survey** dialog box:
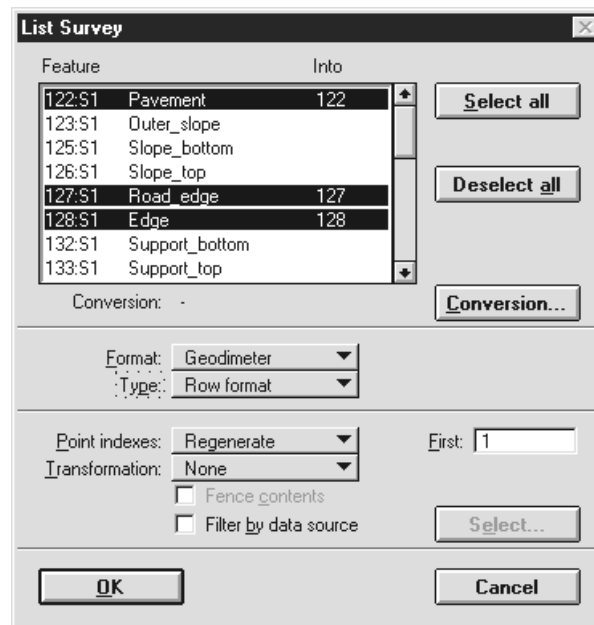
2. If you want to include all features in the list, click **Select all** to select all features in the list. If you want to output only some of the features, select those features in the list. The easiest way to select individual features is to click on the row of each feature while holding down the <Ctrl> key.

3. Click OK to close the dialog.

   A standard dialog box for choosing an output file name opens.

4. Enter a name for the output file.

A file with the given name is created and the selected features are written to that file.

Setting:	Effect:
Format	Output file format. You can select from any of the coordinate based builtin or user defined file formats.
Point indexes	How to output point indexes. You can choose to use the original survey point indexes or to generate new incrementing point indexes.
First	Index for the first output point when regenerating point indexes.
Transformation	Coordinate transformation to apply to survey points.
Fence contents	If on, output only points within fence contents.
Filter by data source	If on, you can use **Select** to select which data sources to include in the output.

List Elements

Not Field

List Elements tool produces a text file listing from graphical design file elements. The output file format can be any of the builtin or the user-defined survey file formats which contain coordinates of the survey points.

This tool creates the listing from the vertices of graphical elements filtered by level and element type. The elements may have been created by another application or by manual drawing.

➢ **General procedure for listing elements into a text file:**

1. Select the *List Elements* tool.

    The **List elements** window opens.

2. Select **File format** for the output file.

3. Create a rule list for elements to include in the listing. Alternatively, you can load a previously saved set of rules from a disk file.

4. Click **Output** and choose a name for the output text file.
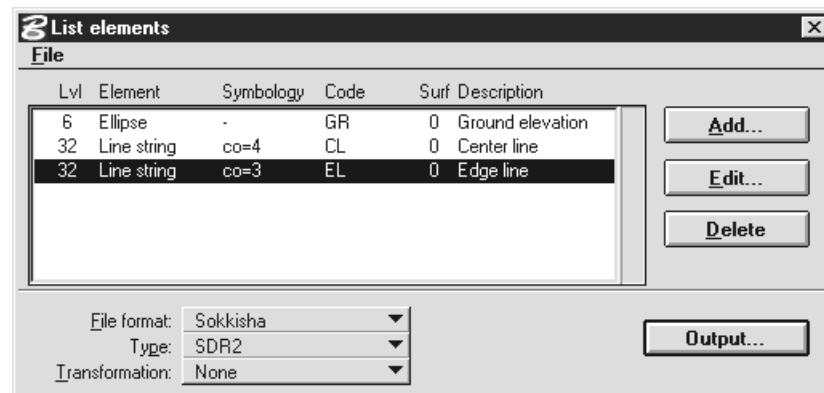
Each listing rule defines one element type residing on a specific level and assigns a output feature code for that element.
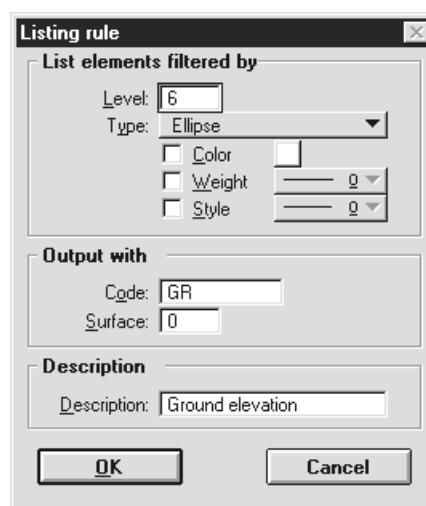
Setting:	Effect:
Level	Level this rule applies to.
Type	Type of element this rule applies to.
Color	If on, filter elements by color.
Weight	If on, filter elements by line weight.
Style	If on, filter elements by line style.
Code	Feature code to output points with.
Surface	Survey surface to output the points with. This setting is relevant only with survey file formats which have a surface field.
Description	An explanatory text string describing the feature.

✓ You can use the *Selection* tool as an aid in creating new rules. Select an example element before clicking the **Add** button.

Export to GIS

Not Field

Export to GIS tool passes survey elements to Geographics or MGE. It does this by attaching a Geographics or MGE feature attribute to survey elements so that those systems will be aware of the feature that the graphical elements represent.

Generate Contours

Generate Contours tool draws contours based on survey points. It searches for input points from two sources:

- Points in the **Loaded survey points** window (loaded using using *Load Survey Verify*). The active feature list determines what points can be used for the surfacce.
- Survey elements drawn permanently into the design file. Settings which were active at creation time will determine which elements can be used for the surface.

Contours will be drawn in the design file as permanent elements.

➢ **To generate contours:**

1. Select the *Generate Contours* tool.

    The **Generate Contours** dialog box opens:
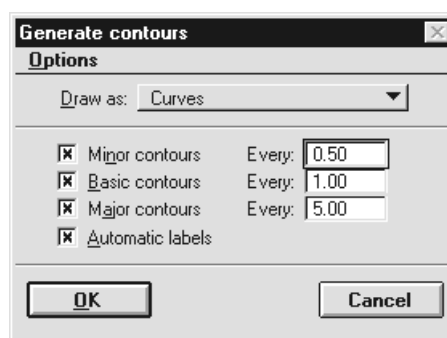
2. Fill in settings values in the dialog and click OK.

    The applications gathers input points, creates a triangulated surface model internally and displays contours in the design file.

TerraSurvey supports three different types of contours. Minor contours, basic contours and major contours can be distinguished from each other by line color, weight or style. You can select which of the contour types will be displayed and at what intervals.

Options pulldown menu has commands for defining options for contours and labels.

7　Manipulate Tools

Manipulate tool box

The tools in the **Manipulate** tool box are used to manipulate survey drawing elements. You can view survey information of elements, rescale the survey drawing, hide overlapping texts, reformat leveling texts, soften elements, find intersecting breaklines or draw elements as survey features.
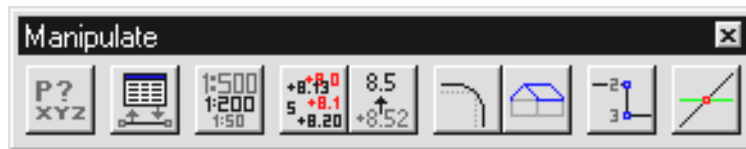
To:	Use:	
View survey information of an element		*Show Survey Info*
Set plotting scale and rescale drawing		*Set Scale*
Hide overlapping texts		*Hide Overlapping Texts*
Format leveling texts		*Format Leveling Texts*
Soften element by adding vertices		*Soften Element*
Build roof shape between line segments		*Build Roof Shape*
Find intersecting breaklines		*Find Intersecting Breaklines*
Draw element using survey drawing rule		*Draw As Feature*

Show Survey Info

Show Survey Info tool lets you view the survey information of an element. It opens a window showing all the survey data which was stored into a survey drawing element.

➢ **To view the survey information of an element:**

1. Select the *Show Survey Info* tool.
2. Identify the element to view.

    The **Survey information** window opens:

Show Survey Info	
Survey point information	
File:	soilwatr.dat
Index:	3470
Code:	232
Description:	Traffic light
Dimension:	0
Information:	
Surface:	9
Coordinates	
Easting:	48867.988
Northing:	21348.504
Elevation:	21.105
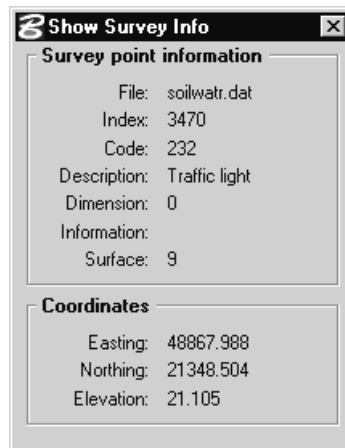
    You can continue to step 2.

Set Scale

Set Scale tool sets the intended plotting scale of the survey drawing and rescales elements. Plotting scale affects all survey text elements and those cells for which the size has been defined as millimeters on paper.

➢ **To set the intended plotting scale and rescale elements:**

1. Select the *Set Scale* tool.

    The **Set scale** window opens:

    Set scale
    Intended plotting scale
    Old scale 1: 500
    New scale 1: 1000
    Rescale drawing
    ☑ Redraw survey elements
    OK   Cancel
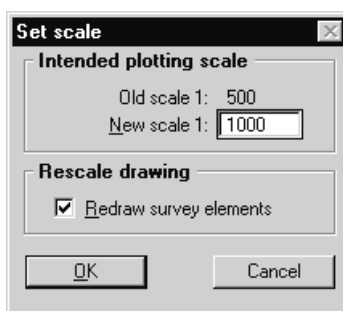
2. Enter value for the new scale.

    The new scale will affect all subsequent elements which TerraSurvey will create. If **Redraw survey elements** is on, this tool will redraw all the survey points which have been assigned scale dependent drawing rules.

Hide Overlapping Texts

Hide Overlapping Texts tool finds overlapping text elements and hides the extra elements by moving them to a specific level. When you rescale a survey drawing for a higher scale, text elements will get bigger and may overlap each other. This tool will hide some of the extra elements to a specific level which can be switched off before plotting.

➢ **To hide overlapping text elements:**

1. Select the *Hide Overlapping Texts* tool.

   The **Hide overlapping texts** window opens:

   ```
   Hide overlapping texts                              ×
   ┌ Operation ──────────────────────────────────┐
   │        Compare:  Text rectangles      ▼      │
   │   Move to level: │60        │                │
   │    Text margin: │0.0       │  mm            │
   │   ☑ Fence contents                          │
   │   ☐ Compare with reference files            │
   └─────────────────────────────────────────────┘
   ┌ Hide ───────────────────────────────────────┐
   │   ☑ Survey elevation texts                  │
   │   ☑ Survey dimension texts                  │
   │   ☑ Other survey texts                      │
   │   ☐ Other text elements                     │
   └─────────────────────────────────────────────┘
   ┌ If they overlap with ───────────────────────┐
   │   ☑ Survey elevation texts                  │
   │   ☑ Survey dimension texts                  │
   │   ☑ Other survey texts                      │
   │   ☐ Other text elements                     │
   └─────────────────────────────────────────────┘
       │   OK   │              │  Cancel  │
   ```
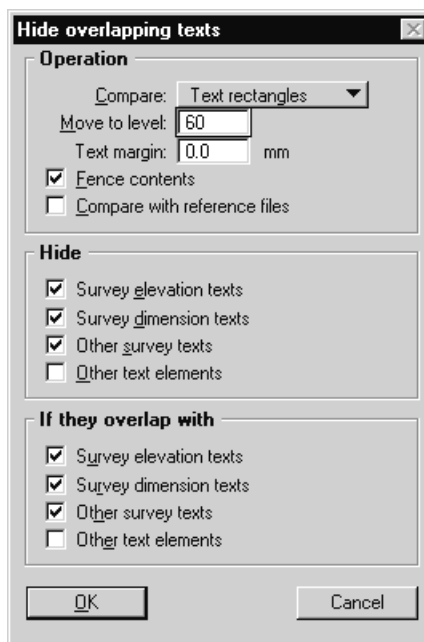
2. Enter settings values and click OK.

   Overlapping text elements are moved to the given level.

Setting:	Effect:
Move to level	Level on which to move text elements.
Text margin	Margin of free space required around text elements.
Fence contents	If on, process only fence contents.
Compare with reference files	If on, scan reference files.

Format Leveling Texts

Format Leveling Texts tool reformats the elevation text elements in a survey drawing. It lets you decide the number of decimals in the text elements and decide if the preceding sign should be drawn.

➢ **To reformat elevation text elements:**

1. Select the *Format Leveling Texts* tool.

    The **Format leveling texts** dialog box opens:
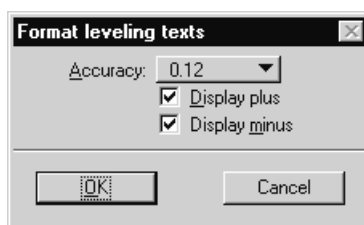
2. Choose settings values in the dialog.
3. Click OK.

    The existing leveling texts elements are redrawn and the new settings will be used when loading and drawing any new survey files.

Setting:	Effect:
Accuracy	Number of decimals to display in elevation values.
Display plus	If on, positive elevation values will display a plus sign.
Display minus	If on, negative elevation values will display a plus sign.

Soften Element

Not Field

Soften Element tool softens elements by adding new vertices around sharp corners. This feature can be used to make the survey elements appear smoother and more natural when creating visualization images. This tool lets you control how far the new points may be placed from the original line segments connecting surveyed points.

The new vertices will be used when you create a surface model from the survey elements. If the actual feature in the field is smooth, a softened element will produce a better looking surface model and more natural rendered images.

You can use this tool with most types of linear elements. Valid element types include line strings, curves, arcs, ellipses, shapes, complex chains and complex strings.

➢ **To soften linear element(s):**

1. Select the *Soften Element* tool.
2. Identify the element to soften.
3. Accept the element.

   The element will be softened. You can continue to step 2.

   OR

1. Select element(s) to soften.
2. Select the *Soften Element* tool.
3. Accept element(s).

   The element will be softened.
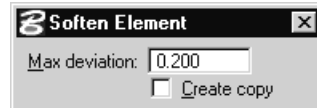
Setting:	Effect:
Max deviation	Maximum distance between the new vertices and their projection to the original line segment.
Create copy	If on, the original element will not be affected. Instead, a copy of the element will be created.

Build Roof Shape

Not Field

Build Roof Shape tool draws a rectangular shape between two parallel line segments. This tool can be used to create roof surfaces when the ridge and the edges have been collected as lines or line strings.

> ➢ **To build a roof shape:**

1. Select the *Build Roof Shape* tool.
2. Identify the first line segment defining the roof shape.
3. Identify the second line segment.

    This draws a rectangular shape between the two line segments. You can continue to step 2.
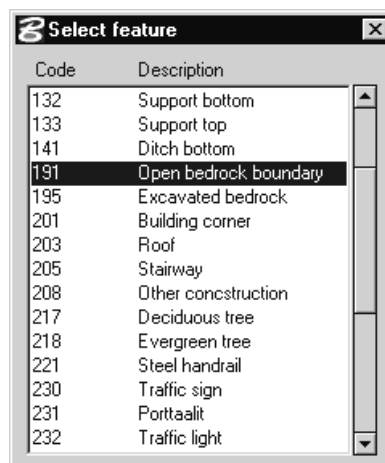
Draw As Feature

Not Field

Draw As Feature tool redraws a graphical element using the drawing rules of a selected survey feature. This tool extracts vertices from an existing element and creates survey drawing elements using those vertices.

The original elements may have been created by another application or another organization. You can use this tool to convert those elements into the correct survey drawing symbology.

➢ **To redraw element(s) as survey features:**

1.   Select the *Draw As Feature* tool.

   The **Select feature** window opens:

| Code	Description
132	Support bottom
133	Support top
141	Ditch bottom
191	Open bedrock boundary
195	Excavated bedrock
201	Building corner
203	Roof
205	Stairway
208	Other concstruction
217	Deciduous tree
218	Evergreen tree
221	Steel handrail
230	Traffic sign
231	Porttaalit
232	Traffic light

2.   Select the desired feature code in the list.
3.   Identify the element to redraw.
4.   Accept the element.

   The element is redrawn using feature based drawing rules. You can continue to step 2 or 3.

   OR

1.   Select element(s) to redraw.
2.   Select the *Draw As Feature* tool.

   The **Select feature** window opens.

3.   Select the desired feature code from the list.
4.   Accept element(s).

   The element is redrawn using feature based drawing rules.

Draw As Feature

Index: 55
Dimension: 0   mm
Information:
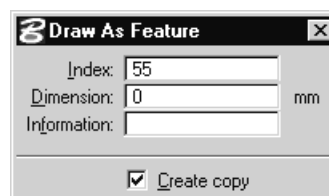
☑ Create copy

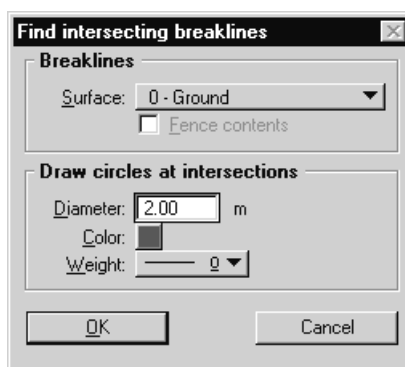| Setting:	Effect:
Index	Survey index for the first vertex.
Dimension	Dimension for all vertices.
Information	Information text for all vertices.
Create copy	If off, delete the original element. If on, keep the original element.

Find Intersecting Breaklines

Find Intersecting Breaklines tool finds locations where survey drawing elements would result in intersecting breaklines in a surface model. It lets you view the intersection locations and fix the problems by moving a survey point to a new location if necessary.

This tool works with both permanent survey drawing elements and temporary elements created by *Load Survey Verify*.

➢ **To find intersecting breaklines:**

1. Select the *Find Intersecting Breaklines* tool.

   The **Find intersecting breaklines** dialog opens:

2. Enter settings values in dialog and click OK.

    TerraSurvey creates a list of breakline segments and processes the list to find intersections. If any are found, the **Breakline intersections** window opens.

Setting:	Effect:
Surface	Surface type to process. Compare only breakline elements which would be used to create a surface of this type.
Fence contents	If on, process only fence contents.
Diameter	Diameter for circles which will be drawn to indicate intersecion locations.

The **Breakline intersections** window displays a list of all intersections found. It lets you view the intersection locations and to correct the problem by moving one of the survey points.
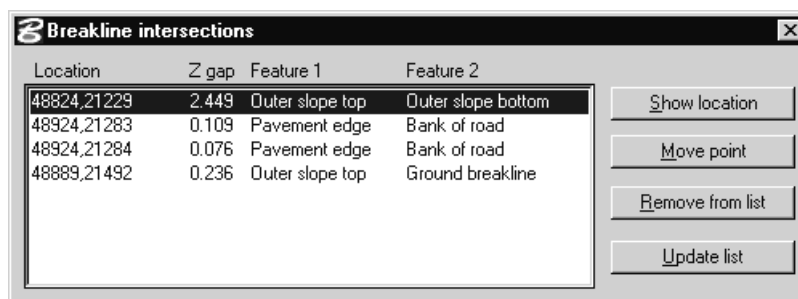
➢ **To view the location of an intersection:**

1. Select the desired row in the list of intersection.
2. Click the **Show location** button.
3. Move the mouse inside a view. This tool shows to location by drawing a large cross.
4. You may enter a data click to center the view by the intersection location.

➢ **To correct an intersection problem:**

1. Select the desired row in the list of intersection.
2. Click the **Move point** button.
3. Select the segment point to move. This can be any one of the end points in the two line segments causing the intersection.
4. Select the correction method in the **Move to** field.
5. Enter or accept the new location.

Setting:	Effect:
Move to	Correction method: • New xy location - enter a new xy location with a data click. • Intersection - move to the xyz intersection. • End point - move to an xyz end point of the other line segment. • Along segment - move along the three dimensional line segment.

8   Utility Tools

Utilities tool box

The tools in the **Utilities** tool box are general purpose tools which are useful in every day work with MicroStation. These tools let you set a dynamic magnification view, measure element length, control visible levels or set the active angle.
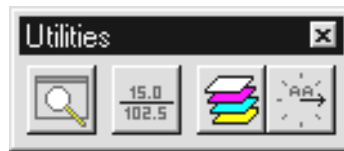
To:	Use:	
Set dynamic magnification view		*Magnify*
Measure and label length of an element		*Measure Length*
Control visible levels		*Levels*
Set active angle		*Set Active Angle*

Magnify

Magnify tool works like a magnification class. It is useful in viewing small details scattered around a large design file. It lets you choose a dynamic magnification view which will display a magnified image from the location of your mouse movement.

➢ **To magnify small details:**

1. Make sure you have at least two view windows open.
2. Select the *Magnify* tool.
3. Set **View** as the view which will be dynamically updated.
4. Set **Scale** to the desired magnification ratio.
5. Move the mouse inside other view. As you move the mouse, the magnification view will be dynamically updated to show a magnified view from the mouse location.
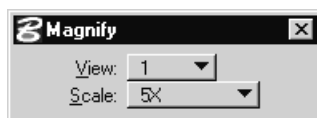
Setting:	Effect:
View	Magnified view.
Scale	Magnification ratio from the source view to the magnified view. If set to **No change**, the existing scale of the magnification view will not be changed.

Measure Length

Measure Length tool measures a line or an arc. When used to measure a line, this tool displays the length and the direction angle of the line. When used to measure an arc, this tool will display the length and the radius of the arc.

➢ **To measure an element:**

1. Select the *Measure Length* tool.
2. Identify the element.

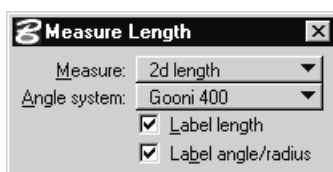   If the element is a line, the length and the direction angle will be displayed. If the element is an arc, the length and the radius will be displayed.

3. Enter a data click to accept the labeling or a reset to reject the labeling.

   You can continue to step 2.

Levels

Levels tool makes it fast and easy to control visible levels by level names. This tool opens a window with two list boxes showing all level names. The **On** list displays all level names which are switched on in a selected view. The **Off** list displays all level names which are switched off in a selected view.

To toggle the state of a level, just click on its row in a list. This will toggle the state of the level in the selected view and move the level name into the other list.

➢ **To control visible levels:**

1. Select the *Levels* tool.

    The **Levels** dialog box opens.

2. To set a level on, click on its row in the **Off** list.
3. To set a level off, click on its row in the **On** list.
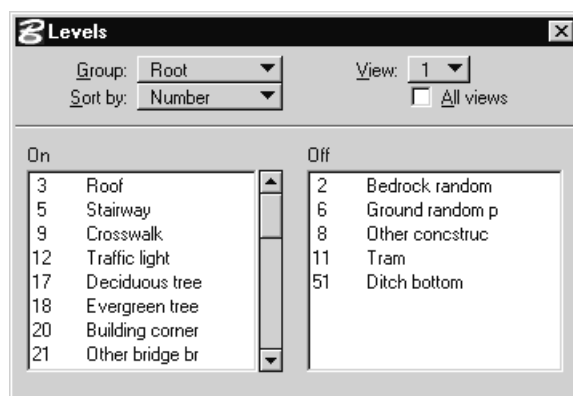
Setting:	Effect:
Group	Selects the level name group to display.
Sort by	Sets the sort order of list names.
View	View to operate on.
All views	If on, all views will be affected.

Set Active Angle

Set Active Angle tool lets you set the active angle using any of the angle systems defined in user settings.

This tool affects the same active angle setting which you can set using MicroStation's builtin features. The additional benefit from this tool is being able to use the angle systems used in surveying.

➢ **To set the active angle:**

1. Select the *Set Active Angle* tool.
2. Enter the desired angle in the key-in field.
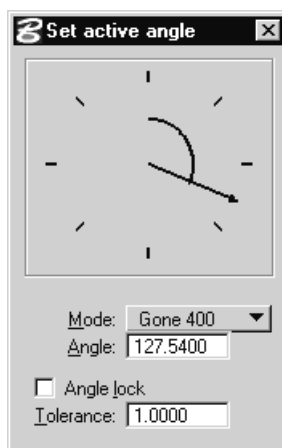
Setting:	Effect:
Angle	Sets the active angle.
Mode	Angle system to use.
Angle lock	If on, the active angle is rounded to the nearest multiple of the specified **Tolerance**.
Tolerance	If **Angle lock** is on, the active angle is constrained to multiples of this value.

Part IV: Settings Reference

9   Drawing Rule Settings

The graphical presentation of a feature is built by assigning one or several drawing rules to it. When drawing a feature into the design file, TerraSurvey processes each of the drawing rules assigned to the feature and creates elements using information from both the survey points and the drawing rule settings.

Point count requirements

For some drawing rules, a single survey point is sufficient. Cell, text and circle drawing rules are all based on a single survey point.

Some drawing rules require more than one survey point. Because all linear drawing rules require at least two points, an error message will be generated if attempting to draw a linear feature using a single point. Linear drawing rules can handle up to 2000 points in a chain which will be drawn without gaps between the elements. For example, the line drawing rule would create three line elements from a chain of four points.

Some drawing rules always process two points at a time - no matter how many points a chain contains. For example, a multipoint cell drawing rule would create two cells from a chain of four points.

The table below lists the number of points various drawing rules require. **Max chain** column indicates the maximum number of points the drawing rule can process as chain. Chains exceeding the maximum will be broken down.

Rule:	Requires:	Max chain:
Cell	1	1
Text	1	1
Circle	1	1
Linear - line	2	2000
Linear - line string	3 (2 creates a line)	2000
Linear - shape	3	2000
Linear - curve	3 (2 creates a line)	2000
Linear - arc	3	2000
Multipoint cell	2	2
Surface element - cell	1	1
Surface element - row of cells	2	2000
Surface element - pile	1	2
Surface element - wall	2	2000
Structure - window	2	2
Structure - pillar	2	2
Structure - beam	2	2000
Structure - culvert	2	2

Placement offset

Many drawing rules allow the use of an offset distance. This means that the graphical element is placed at a given distance from the survey point location. The offset can be given as a true distance in meters or as a paper distance in millimeters.

Setting:	Effect:
Offset	Offset type: • True distance - given in meters. • Paper distance - given in millimeters on paper.
Dx	A negative value indicates an offset to the left. A positive value indicates an offset to the right.
Dy	A negative value indicates an offset downwards. A positive value indicates an offset upwards.

Cell drawing rules

Cell drawing rules place a cell element defined in a cell library. Cells are identified by a name which is a text string up to six characters in length. TerraSurvey uses the name to search for the definition of the cell from:

1. The design file as a shared cell definition.
2. The active cell library.
3. Cell libraries specified in the cell library list (MS_CELLLIST).

A cell can be scaled to a true size, to a paper size or by a survey diameter. When scaling a cell, TerraSurvey automatically first inspects the size of the cell in the library.

Setting:	Effect:
Cell	Cell name
Size as	How to scale the cell: • Library size - use the library cell as such. No scaling. • True size - scale to a natural size given in meters. • Paper size - scale to a fixed size when plotted on paper. The size is given in millimeters. The true size of the cell depends on the intended plotting scale. • Scale by diameter - scale to the surveyed diameter. Requires that a dimension is included in the survey file.

Text drawing rules

Text drawing rules create a text element which contains information about a survey point. This can be point index, x coordinate, y coordinate, elevation, dimension, information, elevation distance to a surface or a free text string.

Setting:	Effect:
Write	Selects the survey point field to write. Available options include **Index**, **X**, **Y**, **Z**, **Dimension**, **Info**, **Free text** and **Dz to surface**.
Prefix	An optional text to add before the actual survey information.
Suffix	An optional text to add after the actual survey information.
Place	Type of element to generate: • As normal text - generate a simple text element. • With note line - include a line extending from the surveyed point to the location defined by the offset.
Rotation	Text rotation: • Normal - placed horizontally. • Along string - run as parallel to the string at the point location. • Perpendicular to string - perpendicular to the string. • Surveyed angle - measured angle associated with survey point determines direction. • Fixed angle - direction angle is fixed in the drawing rule.
Justify	How text is aligned with respect to the placement point. In addition to standard justification methods, an elevation text can be placed by **Decimal point**. This produces an elevation text with the decimal point indicating the survey point location.

A free text string allows you to type a format string such as 'Location #x,#y' where the application will replace the following fields:

Field:	Replace by survey point:
#x	X coordinate (easting)
#y	Y coordinate (northing)
#z	Elevation
#d	Dimension
#i	Information text

Circle drawing rules

Circle drawing rules create a circle element. The diameter can be specified as true size or as a paper size dimension.

Setting:	Effect:
Diameter	Circle diameter: • True size - given in meters. • Paper size - given in millimeters on paper. The true size depends on the intended plotting scale.

Linear drawing rules

Linear drawing rules create linear elements - lines, line strings, shapes, curves or arcs.

Setting:	Effect:
Build complex chains	If on, build a complex chain from simple elements.
Draw at zero elevation	If on, create elements at zero elevation. This setting can be used to make that linear patterning appears uniform regardless of changes in elevation.
Construction element	If on, create construction class elements.
Style	Type of line style: • Standard - one of eight standard line types. • Custom - custom line style from a line style library. • Patterned - linear pattern from a cell library.

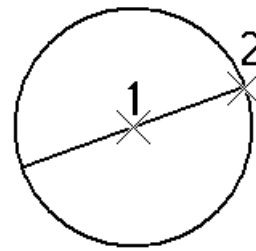# Multipoint cell drawing rules

Multipoint cell drawing rules create cell elements to represent features surveyed as two points. The second point is used to determine the size and possibly the rotation of the cell.

Rotated 2D cell

This rule places a cell with the origin at the first survey point location. The second point is used to scale and to rotate the cell. The library cell should be drawn with the second point directly to the right from the origin.
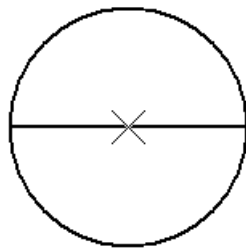
Library cell, X = origin   Placed, top view

3D cell

This rule places a cell with the origin at the lower of the two points. The elevation difference of the two points is used to scale the cell. This rule will typically be used with three dimensional tree cells.

Front view

Rotated 3D cell

This rule places a cell with the origin at the lower of the two points. The other point determines the horizontal size, the vertical size and the rotation of the cell. This rule can be used for three dimensional objects such as lamp posts. The library cell should be drawn with the second point directly to the right from the origin.
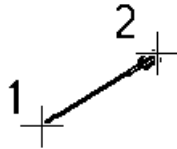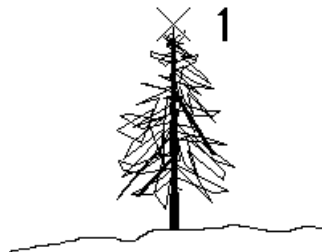
Top view   Front view

## Surface element drawing rules

Cell

This rule places a three dimensional cell surveyed with just one point. The surveyed point represent the top of the cell. The cell origin is located at the elevation of a surface model at the survey point xy location. This rule is typically used to survey trees with just one point.

Front view

Row of cells

This rule creates a row of three dimensional cells between two survey points which represent the top line of the cells. The origins of the cells are placed according to the elevation of a surface model. This rule will typically be used to draw a row of trees or shrubs.

Top view

Front view
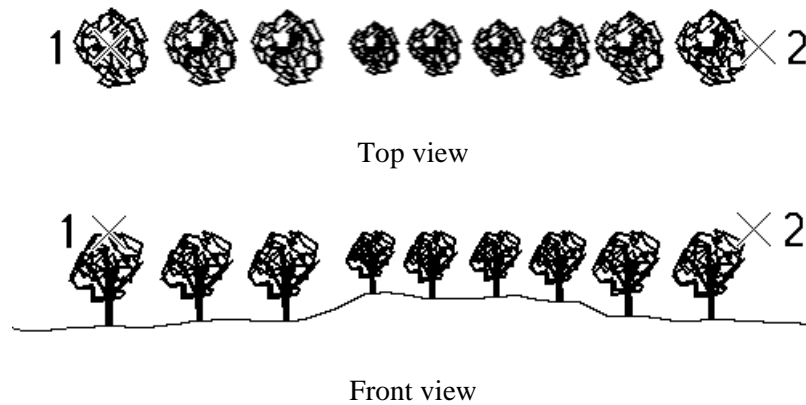
Setting:	Effect:
Spacing	Spacing between cells as a percentage of cell size.

Pile

This rule creates a vertical pile onto the elevation of a surface model. The top of the pile can be defined by a single point or by two points.

If a single point is used, that point defines the top center of the pile. Width setting from the drawing rule defines the pile size.

If two points are used, they define two opposite corners from the top of the pile.

Top view   Isometric view

Setting:	Effect:
Width	Pile size in millimeters when the pile location is defined by a single point. If there are two points, the distance between the points is used as a diagonal size.

Wall

This rule creates a shape element between two survey points which represent the top line of a wall. The bottom of the wall extends to run along a surface model. This rule will typically be used to draw a fence or the walls of a building.
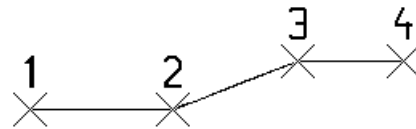
Top view
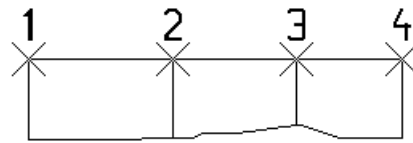
Front view

Structure drawing rules

Window, pillar and beam drawing rules are used when surveying buildings. These drawing rules create symbols for the surveyed structures of a building. Although the symbols themselves are two dimensional, they will be drawn at the correct elevation of the survey points.

Window

This rule creates a two dimensional window symbol based on two survey points. The first point is the left corner and the second point is the right corner of the window opening. A survey dimension defines the depth of the window.
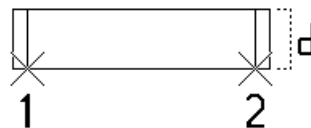
Top view

Setting:	Effect:
Default size	Default depth if neither of the points has a survey dimension.

Door

This rule creates a two dimensional door symbol based on two survey points. The first point is the left corner and the second point is the right corner of the door opening. A survey dimension defines the depth of the door.
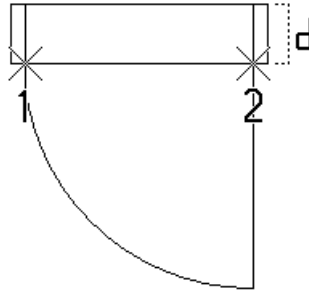
Top view

Setting:	Effect:
Default size	Default depth if neither of the points has a survey dimension.
Handle	Defines if the door handle is on the left or on the right side. It is a good idea to define two separate survey codes for these two cases.

Pillar

This rule creates a two dimensional pillar symbol based on two survey points. The first point is the left corner and the second point is the right corner of the pillar. A survey dimension defines the second edge length of the rectangular pillar. If no survey dimension is given, a rectangular pillar is created.
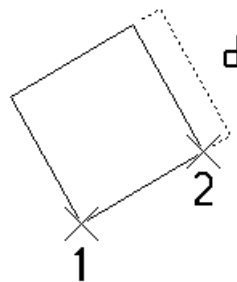
Top view

Beam

This rule creates a two dimensional beam symbol based on two or more survey points. The survey points represent the center line of the beam. Survey dimensions define the width of the beam at the corresponding survey point.
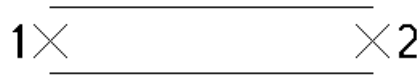
Top view

Setting:	Effect:
Default size	Default width if no survey dimension given.

Culvert

This rule creates a three dimensional cone element based on two survey points which can represent the top, the center or the bottom of the culvert. A survey dimension defines the diameter of the cone element.
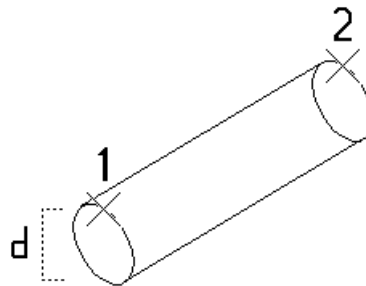
Isometric view

Setting:	Effect:
Default size	Default diameter if neither point has a survey dimension.
Survey at	Surveyed position: top, center or bottom of culvert.

10   User Defined File Formats

With the ability to define your own file formats, you can read in and write to a wide variety of text based file formats. The only basic requirement is that the file must be organized so that one row contains the fields of one survey point.

A file can be interpreted using either delimer based logic or fixed length fields. In a delimeter based file, fields are separated from each other by a reserved character. This delimeter is normally comma, space or tabulator character.

A file with fixed length fields is defined by the column position of various fields. The same data always occupies the same columns on a row.

➢   **To define a new file format:**

1. Select the *Settings* tool.

    The **Settings** window opens.

2. Click on **File formats** folder to open it.

3. Select **User xyz** category.

4. Click on **Add** button.

    The **File format** dialog opens.

5. Choose the definition type in **Field type** (either **Delimeted** or **Fixed length**).

6. (Optional) Select **Load example** command from **File** pulldown menu to load an example file.

7. Enter settings.

8. (Optional) Verify that file format definition is correct by clicking **Test recognition** button.

9. Click OK.

Delimeted format definition

Delimited format files consist of fields which are separated by a specific delimiter character.

Setting:	Effect:
For output only	If on, TerraSurvey will not try to use this file format when reading in files.
Format name	Name for the file format.
Comment character	Rows starting with this character will be ignored.
Delimeter	Delimeter character: space, tabulator, comma or semicolon.
Break code	Feature code used to break strings.
Dimension unit	Dimension unit.
Strings have continuous point indexes	If on, a non-continuous point index will be interpreted to start a new string. For consecutive points to be in the same string, the point index must remain the same or increase by one.
Join disjoint strings by number	If on, points will be sorted by string number so you don't have to survey each string as consecutive points. TerraSurvey will reorder points so that points with the same string number will form a string.
String number appended to code	If on, string number is stored in the same field as a feature code, for example CL10. This setting requires that the feature code is built from letters A-Z. The first digit starts the string number.

Fixed length format definition

A file with fixed length fields always contains the same data in the same column positions on a row. To define such a file format, you enter a number of field definitions with a gived length.

11   Builtin Angle File Formats

TerraSurvey recognizes a number of builtin angle based file formats automatically. All of these formats are specific to certain total stations and data collectors.

You can control certain aspects of these raw survey file formats.

➢   **To modify settings for a builtin angle file format:**

1.   Select the *Settings* tool.

The **Settings** dialog box opens.

2.   Click on **File formats** folder to open it.

3.   Click on **Builtin angle** row in the category list.
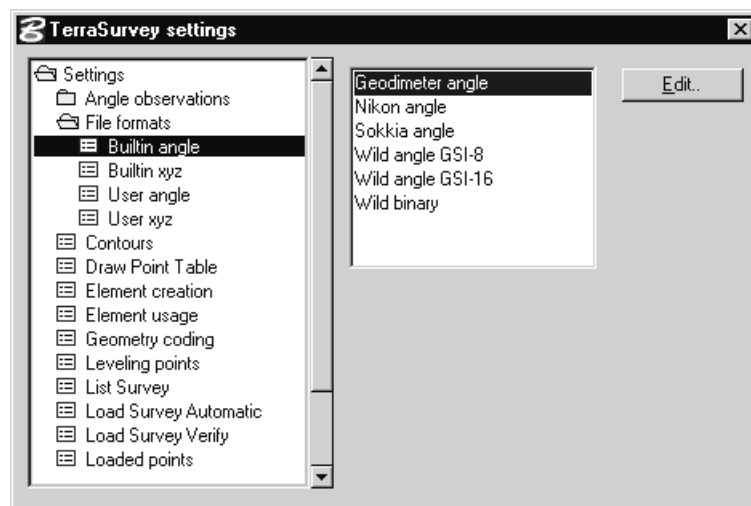
A list of supported builtin file formats appears:

4.   Select the desired file format in the list.

5.   Click **Edit** to open a settings dialog for the selected format.

Wild angle GSI-8 format

Wild total station file formats are organized so that each row contains the information for one survey point. The data is built from blocks of sixteen characters (8+8). The first two characters in a block are used to identify the data content of that block. Several pieces of data may appear in the same block.

TerraSurvey's user settings allow you to specify the field identifier (first two characters) of the block where a data item is located in. You can also specify the starting column and the ending column of the actual data within the block. The columns usually range from three to fifteen as the first two characters contain the field identifier and the last one is unused.

Setting:	Effect:
Index - Field	Field identifier for block containing point index.
Index - Characters	Point index columns.
Feature code - Field	Field identifier for block containing feature code.
Feature code - Characters	Feature code columns.
Dimension - Field	Field identifier for block containing dimension.
Dimension - Characters	Dimension columns.
Dimension - Unit	Dimension unit. Default is centimeters.
Horizontal angle - Field	Field identifier for block containing easting.
Horizontal angle - Characters	Horizontal angle columns.
Vertical angle - Field	Field identifier for block containing northing.
Vertical angle - Characters	Vertical angle columns.
Distance - Field	Field identifier for block containing observed distance.
Distance - Characters	Distance columns.
Distance - Distance	Type of distance - 3D or 2D distance.
Break	Feature code used to break strings.

12   Builtin Xyz File Formats

TerraSurvey recognizes a number of builtin file formats automatically. Some of these formats are specific to certain total stations and data collectors. The rest of the formats exist as general data transfer formats.

You can control certain aspects of these file formats.

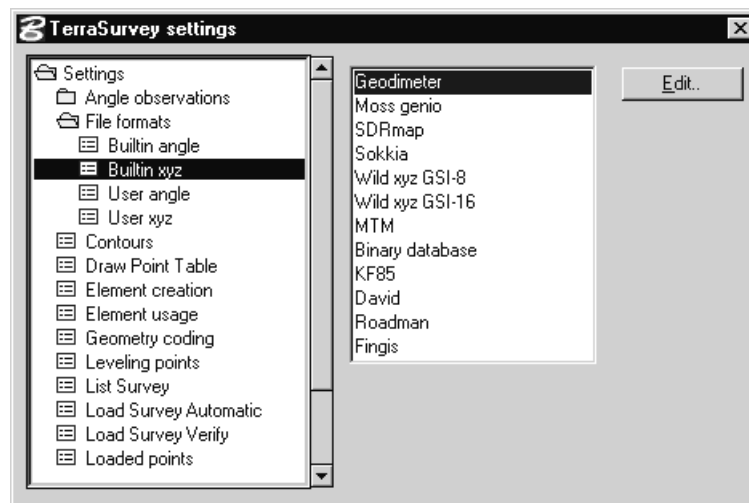➢ **To modify settings for a builtin xyz file format:**

1. Select the *Settings* tool.

   The **Settings** dialog box opens.

2. Click on **File formats** folder to open it.

3. Click on **Builtin xyz** row in the category list.

   A list of supported builtin file formats appears:

4. Select the desired file format in the list.

5. Click **Edit** to open a settings dialog for the selected format.

Geodimeter

TerraSurvey can read in coordinate based survey files which have been produced by Geodimeter/ Geoditech total stations. The files can be in **Internal format** or **Row format**. These two variations differ only in the way line breaks appear in the file. Internal format is the native format which the Geodimeter total stations use. In this format each data item followed by a line break.

Setting:	Effect:
Feature	Label for feature code field. Default is 4.
Index	Label for running point index field. Default is 5.
Easting	Label for easting field. Default is 38.
Northing	Label for northing field. Default is 37.
Elevation	Label for elevation field. Default is 39.
Dimension	Label for optional dimension field. Default is 63.
Info	Label for optional information field. Default is 0. Information field may specify a free text string associated with a point.
A-distance	Label for optional offset distance. Default is 72.
B-distance	Label for optional offset distance. Default is 73.
Position	Label for equipment position identifier field. Default is 2.
Connection	Label for identifying the connection for an equipment position. Default is 62.
Ignore	A list of labels which should be ignored. The application produces a warning message if it encounters a label which has not been specified as a field label or as a label to ignore.
Use string to sort points	If on, input files may contain a string number for each point. The string number will be used to join disjoint strings.
Label	Label for string field. Default is 89.
Break	Feature code for break points. Default is 100.
First prism	Feature code for first prism point. Default is 99. The second prism point has the feature code of the surveyed feature.
Dimension	Dimension unit. Default is centimeters.

Geodimeter example file fragment (Row format)

```
50=4317
2=2 37=25625.072 38=53290.189 62=137=25643.057 38=53425.147 21=91.5658
5=1 4=20 63=0 37=25619.34 38=53317.29 39=23.99
5=2 4=20 63=0 37=25615.84 38=53308.16 39=24.499
5=3 4=20 63=0 37=25612.3 38=53298.95 39=25.065
5=4 4=20 63=0 37=25609.01 38=53290.42 39=25.61
5=5 4=20 63=0 37=25607.05 38=53285.51 39=25.892
```

Geodimeter example file fragment (Internal format)

```
5=1
4=20
63=0
37=25619.34
38=53317.29
39=23.99
5=2
4=20
63=0
37=25615.84
```

Moss genio

TerraSurvey supports input and output of survey points in Moss genio format. There are no user settings for this file format.

Moss genio example file fragment

```
GENIO,MODELNAME
080,UK  ,7=3
400925.05500193586.04700     87.45400
400930.16600193569.10200     87.43000
400935.35000193551.39100     87.49400
400941.07800193531.49200     87.54200
400948.08600193508.36700     87.60200
400954.16500193487.61700     87.67800
     0.00000     0.00000      0.00000
```

SDRmap

SDRmap is a general data exchange format for survey point information. In this format every data item appears on a row of its own. The only user setting for this format defines the feature code being used as a break code.
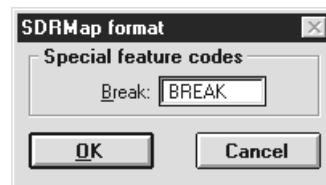
SDRmap example file fragment

```
1000
247.5418
104.8073
10.1177
""
"DRAIN"
1027
224.8157
92.5795
10.1399
""
"CL"
```

Sokkia

TerraSurvey's support for Sokkia files includes SDR2, SDR20 and SDR33 versions.

Sokkia setting:	Effect:
Sort by	If set to Feature and string, points belonging to the same string do not have to follow each other. TerraSurvey will reorder points so that points with the same feature code and the same string number will form a string.
Start command	Command for identifying the start of a new string.
Allow two features for one point	If on, you can enter two feature codes for one point. TerraSurvey will treat this as if two points had been surveyed.
Break	Feature code used as a break code.
Station	Command for identifying the station location.
Dimension	Dimension unit. Default is centimeters.

Sokkia example file fragment

```
08TP101380424.419845250.158430.6983925TOLPPA
08TP101480422.816745250.003330.6344447VA 15
08TP101580423.139445250.253430.5894506PAITA ST
08TP101680420.641545250.087530.5608064KO 20
08TP101780417.583745251.199730.7761387LAR
08TP101880416.549545252.676231.2366355LYRO
08TP101980411.451745252.736831.4676974LYRO
```

Wild xyz GSI-8 format

Wild total station file formats are organized so that each row contains the information for one survey point. The data is built from blocks of sixteen characters (8+8). The first two characters in a block are used to identify the data content of that block. Several pieces of data may appear in the same block.

TerraSurvey's user settings allow you to specify the field identifier (first two characters) of the block where a data item is located in. You can also specify the starting column and the ending column of the actual data within the block. The columns usually range from three to fifteen as the first two characters contain the field identifier and the last one is unused.

Wild xyz setting:	Effect:
Index - Field	Field identifier for block containing point index.
Index - Characters	Point index columns.
Feature code - Field	Field identifier for block containing feature code.
Feature code - Characters	Feature code columns.
Dimension - Field	Field identifier for block containing dimension.
Dimension - Characters	Dimension columns.
Dimension - Unit	Dimension unit. Default is centimeters.
Easting - Field	Field identifier for block containing easting.
Easting - Characters	Easting columns.
Northing - Field	Field identifier for block containing northing.
Northing - Characters	Northing columns.
Elevation - Field	Field identifier for block containing elevation.
Elevation - Characters	Elevation columns.
Break	Feature code used to break strings.

Wild xyz GSI-8 example file fragment

```
110109+00000105 71....+00000122 81..00+48872996 82..00+21348553 83..00+00020778.
110110+00000106 71....+00000122 81..00+48872156 82..00+21354788 83..00+00021020.
110111+00000107 71....+00000122 81..00+48871729 82..00+21360663 83..00+00021152.
110112+00000108 71....+00000122 81..00+48871145 82..00+21366655 83..00+00021449.
110113+00000109 71....+00000122 81..00+48870358 82..00+21372594 83..00+00021621.
110114+00000110 71....+00000122 81..00+48868452 82..00+21380376 83..00+00021988.
110115+00000111 71....+00000122 81..00+48866462 82..00+21388423 83..00+00022214.
```

Wild xyz GSI-16 format

Wild xyz GSI-16 format is similar to **Wild xyz GSI-8** format. The only difference is block length which is 24 characters in this format (8+16).

13 String Handling in Survey

This chapter describes how TerraSurvey handles construction of strings from the incoming survey points. A string often represents a linear feature such as a center line of a road, the edge of pavement or a river bank. These are often displayed as linear elements in the survey drawing.

When surveying such features, one needs to control which points belong to the same linear feature and where another linear feature starts.

The application is capable of using several different methods to break strings or to construct strings. Some of these methods require that the incoming survey file contains string numbers.

Some of the builtin file formats include specific logic for starting and terminating strings. This chapter only describes methods which can be used with a number of file formats.

Default logic

A string consists of a number of consecutive points that have the same feature code. The actual drawing rules assigned to that feature determine whether those points will generate linear elements or single point elements in the survey drawing.

A string is terminated whenever a point has a different feature code than the previous point. If feature code remains the same, the point belongs to the same string as the previous point. This means that a problem arises when the surveyor moves from one linear feature to another similar linear feature using the same feature code. For example, measuring points along the left river bank and then moving over to measure points along the right river bank. If nothing special is done, the application will incorrectly connect the last point of the left river bank with the first point of right river bank.

The simplest way of solving this problem is to survey something else in between - a leveling point for instance.

Break codes

A break code is a special survey code that will not generate anything visible in the survey drawing. It is reserved just for terminating or breaking strings. The coordinates of a break point are ignored.

The surveyor can record one point as a break point before moving from one linear feature to another similar one.

You can define what survey code will be interpreted as a break code with each file format.
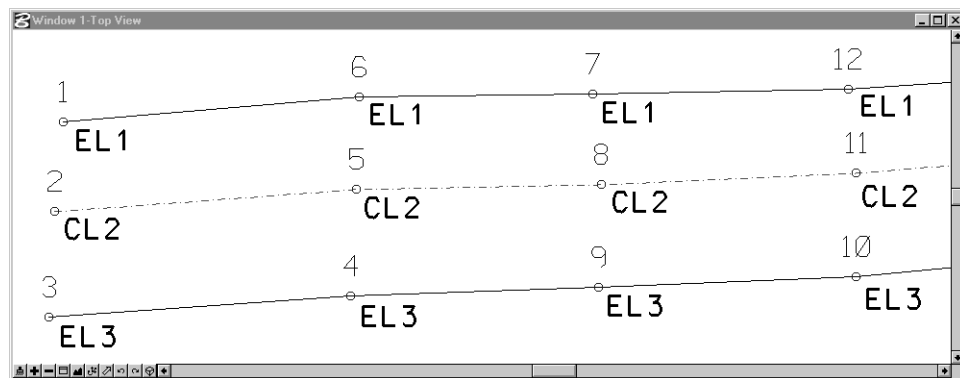
Point indexes

User defined file formats include a setting called **Strings have continuous point indexes**. If this toggle is on, point indexes can act as terminators. Consecutive points will belong to the same string only when the point index remains the same or increases by one.

String numbers

Some file formats can contain string numbers. If so, those will be used in determining where one string ends and another one starts. Consecutive points will belong to the same string only if their string numbers are equal.

Furthermore, it is possible to use string numbers to construct strings from non-sequential points. For user defined file formats, this will be determined by the **Join disjoint strings by number** setting. If sorting is used, the surveyor can freely choose the order in which he measures points as long as he assigns a string number for each point in a linear feature.

This is most often used to enable cross sectional order when surveying longitudinal objects. For example, a road could be surveyed as three linear features: left edge (EL), center line (CL) and right edge (EL).

The surveyor can choose the order of points freely. The picture above shows the original point order as point index labels.

Sectional master codes

Keying in string numbers for each point can be a tedious task for the surveyor. As an alternative, TerraSurvey also supports sectional master codes. These are survey codes which are actually linked to a user defined list of feature codes. A feature code can be defined as a sectional master code using the **Options** button in the **Feature code** dialog.

For the case in the picture above, you could define a feature code (RS) as a sectional master code and link it to a list of feature codes EL, CL and EL. Furthermore, you could set the **Repeat in reverse order** toggle on so that the sequence will automatically be repeated in reverse order.

 The surveyor can then use a single survey code (RS) for all of the points. First point in a sequence will become an EL1 point, second a CL2 point, third an EL3 point, fourth an EL3 point, fifth a CL2 point, sixth an EL1 point, seventh an EL1 point and so on.

The advantage of this method is saving time out in the field. The surveyor does not have to change the survey code and does not have to type in string numbers.

The obvious disadvantage is that the surveyor must carefully follow a certain order in measuring points.

14   Observation Corrections

This chapter presents the formulas used in observation corrections. As many of these corrections can be handled by a modern total station, the user will select which ones are used when processing angle based observations.

The correction formulas appear in the same order in which they are applied.

Prism constant correction

This correction applies to the 3D distance:

$$s = s + C$$

where

    s   is the measured / corrected 3D distance
    C   is the prism constant

Pressure and temperature correction

This correction applies to the 3D distance:

$$s = s + 0.000001 * s * (J - ((N * P) / (273.2 + T)))$$

where

    s   is the measured / corrected 3D distance
    J   is the refractive index
    N   is the carrier constant
    P   is atmospheric pressure in mmHg
    T   is the dry air temperature in Celsius

Curvature and refraction correction

This correction applies to both the 3D distance and the vertical angle:

$$a = a + ((1 - K) * s / (2 * 6367000))$$

$$d = d - K * K * s * s * s / (24 * 6367000 * 6367000)$$

where

    a   is the measured / corrected vertical angle (in radians)
    s   is the measured / corrected 3D distance
    K   is the coefficient of terrestrial refraction

Sea level correction

This correction applies to 2D distance. If **Sea level** correction is not active, 2D distance is computed as:

$$d = cos(a) * s$$

If **Sea level** correction is active, 2D distance is computed as:

$$Dz = sin(a) * s$$
$$Dh = H + Dz$$
$$Sm = s - (Dz * Dz / (2 * s))$$
$$So = Sm * 6367000 / (6367000 + (0.5 * (H + Dh)))$$
$$d = So * (1 + (So * So / (24 * 6367000 * 6367000)))$$

where

s	is the observed / corrected 3D distance
a	is the observed / corrected vertical angle (radians)
d	is the computed 2D distance
H	is the source height (station elevation + instrument height)

Projection correction

This correction applies to 2D distance:

$$d = d * S$$

where

d	is the computed / corrected 2D distance
S	is the projection scale factor

15   Installation Directories

TerraSurvey shares the same directory structure with all Terra Applications. It is recommended that you install all Terra Applications in the same directory.

The list below shows a typical directory structure when TerraSurvey has been installed in path C:\TERRA.

c:\terra		directory where TerraSurvey was installed
📁	cell	for cell libraries
	📄 karttali.cdx	cell library index file
	📄 karttali.cel	cell library
📁	config	for configuration files
	📄 tsurvey.cfg	defines environment variables
📁	data	for survey data files
	📄 borehole.dat	example data file for tutorial
	📄 tutorial.dat	survey file for tutorial
	📄 soilwatr.dat	example survey data
📁	docs	for documents and on-line help
	📄 tsurvey.pdf	on-line help
📁	license	for user license files
	📄 tsurvey.lic	user license
📁	ma	for application files (draftma in Field)
	📄 tsurvey.ma	application
	📄 tsurvey.dll	library
📁	seed	for seed files
	📄 survseed.dgn	example seed file
📁	tsurvey	for feature lists and settings
	📄 tsurvey.fea	default feature list
	📄 tutorial.fea	feature list for tutorial

16   Configuration Variables

MicroStation is able to locate TerraSurvey with the help of configuration variables. When you install TerraSurvey, the installation program will create a configuration file TERRA.CFG which defines the required environment variables. This file is placed in MicroStation's CONFIG\APPL subdirectory.

For example, C:\USTATION\CONFIG\APPL\TERRA.CFG may contain:

```
#----------------------------------------------------
#
#  TERRA.CFG - Configuration for Terra Applications
#
#----------------------------------------------------

TERRADIR=c:/terra/
TERRACFG=$(TERRADIR)config/
TERRADOCS=$(TERRADIR)docs/

MS_MDLAPPS < $(TERRADIR)ma/
MS_MDLAPPS < $(TERRADIR)draftma/

%if exists ($(TERRACFG)*.cfg)
%   include $(TERRACFG)*.cfg
%endif
```

This configuration file will include all the configuration files in C:\TERRA\CONFIG directory. TerraSurvey's configuration file TSURVEY.CFG contains:

```
#----------------------------------------------------
#
#  TSURVEY.CFG - TerraSurvey Configuration File
#
#----------------------------------------------------

TSURVEY_DATA=$(TERRADIR)data/
TSURVEY_LICENSE=$(TERRADIR)license/
TSURVEY_LOGFILE=$(TERRADIR)data/survey.err
TSURVEY_REFPOINTS=$(TERRADIR)data/

#   Directory for user preferences (user has write access)

TSURVEY_PREF=$(TERRADIR)tsurvey/

#   Directory for settings (may point to read-only directory)

TSURVEY_SET=$(TERRADIR)tsurvey/

#   Files for settings (may be shared by organization)

TSURVEY_REFCLASS  = $(TSURVEY_SET)refclass.inf
TSURVEY_CORSETS   = $(TSURVEY_SET)corsets.inf
TSURVEY_GEOMCOD   = $(TSURVEY_SET)geomcod.inf
TSURVEY_SCALEFRM  = $(TSURVEY_SET)scalefrm.inf
TSURVEY_TRANSFORM = $(TSURVEY_SET)trans.inf
TSURVEY_XYZFMT    = $(TSURVEY_SET)xyzfmt.inf
```

```
TSURVEY_ANGLEFMT  = $(TSURVEY_SET)anglefmt.inf
TSURVEY_ANGLESYS  = $(TSURVEY_SET)anglesys.inf


#   Cell library required for tutorial

MS_CELL < $(TERRADIR)cell/
MS_CELLLIST > karttali.cel
```

In a default configuration, MicroStation will automatically include these settings as configuration variables. You can use MicroStation's **Configuration** command from **Workspace** menu to check the values for these variables. In case these variables have not been defined correctly, you should define them manually.

- MS_MDLAPPS should include the directory where TSURVEY.MA is located.
- TSURVEY_DATA should point to the default directory for survey data files are located.
- TSURVEY_LICENSE should point to the directory where user license TSURVEY.LIC is located.
- TSURVEY_LOGFILE defines the name of the error log file which the *Load Survey Automatic* tool generates.
- TSURVEY_REFPOINTS should point to the default directory for reference point files.
- TSURVEY_PREF defines the directory where user settings TSURVEY.INF and TSURVEY.UPF will be stored. The user must have write access to this directory.
- TSURVEY_SET defines a directory which contains sharable settings files. This directory may be a server directory to which the user has read access only.

The following configuration variables define the paths and names of sharable settings files. These may be located in a private directory or in a shared directory.

- TSURVEY_REFCLASS defines the file for reference point classes.
- TSURVEY_CORSETS defines the file for observation correction settings.
- TSURVEY_GEOMCOD defines the file for geometry coding definitions.
- TSURVEY_SCALEFRM defines the file for scale factor formulas.
- TSURVEY_TRANSFORM defines the file for coordinate transformations.
- TSURVEY_XYZFMT defines the file for user xyz file formats.
- TSURVEY_ANGLEFMT defines the file for user angle file formats.
- TSURVEY_ANGLESYS defines the file for angle systems.