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## ***SCC Training***

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# 1 SCC Training Manual

The following document outlines the main principles, concepts and tools within SCC Survey, Volumes and Section Modules during an SCC Training day.

## *On-line help*

In addition to the printed documentation, additional help is available in the form of on-line context sensitive help from within SCC. The on-line help is likely to contain more up to date information than the printed manuals, and additionally will contain extra multi-media content such as video examples covering the use of different program options. For the very latest documentation and program updates, visit the SCC web site at [www.atlascomputers.ie](http://www.atlascomputers.ie)

## *Documentation Conventions*

NOTES are something of special interest. They should be remembered. If not, at least they will be easy to find in the future when surrounded by a double border.

All menu and command options will be in inverted commas, with the main menu title appearing in CAPITAL LETTERS.

All actions required by you, will be indented and appear in italics.

There will be a heading at the top right of the instructions describing the aim of the exercise.

Follow these exact instructions to achieve the proper results.

An example might be:

### ***Action Identifier Table Heading***

***From 'MODEL Tab > Join str'***

***Pick the two strings from the graphic model***

# 2 Installation and set-up

SCC installation is available on DVD or from links to the Atlas ftp site. Full installations or upgrade files are available for installation. If you have a previous version of SCC installed the user can choose to update current version using an update file

If you have a previous version of SCC installed the user can choose to update current version using an update file.

### ***To Install/Update SCC from link***

***If you have SCC already installed on your computer, backup your existing SCC directory and any sub-directories off it.***

***Plug the SCC hardware lock (dongle) into USB port***

***Download file from link***

***Once downloaded, right click on file and select 'Run As Administrator'***

***Follow prompts installing in the default location***

***The hardware lock driver will also install.***

***Select Finish***

***Run SCC, either by double clicking on the SCC icon or by selecting SCC from the Windows program menu.***

Before performing any operations in SCC, it is important to ensure directories and external links are setup correctly. It is sufficient to set up these links once.

## Directories & Files:File Structures

### Setting up SCC Directories and Files:

SCC can have direct links to a text editor, CAD and/or MX. Having a link to a CAD system or MX will mean that when exporting a model, the CAD system or MX will open automatically and the drawing will be generated in that program.

The Executable files, Projects and Temporary files directory will be filled in automatically during installation. If the default settings differ from yours ensure you change them to correspond to your specific directory structure.

The Windows WordPad is used as the default Text Editor. No path directory has to be entered in this option, simply type the word NOTEPAD. Any time any reports are edited they will be presented in the Text Editor. Having a link to a CAD system or MX will mean that when exporting an SCC model or section, to either CAD or MX, they will be automatically opened and the drawing generated in that system.

**Go to 'DATA tab > Settings > General Options > Directories and Files' panel**

**Check and see that the executable files directory is correct.**

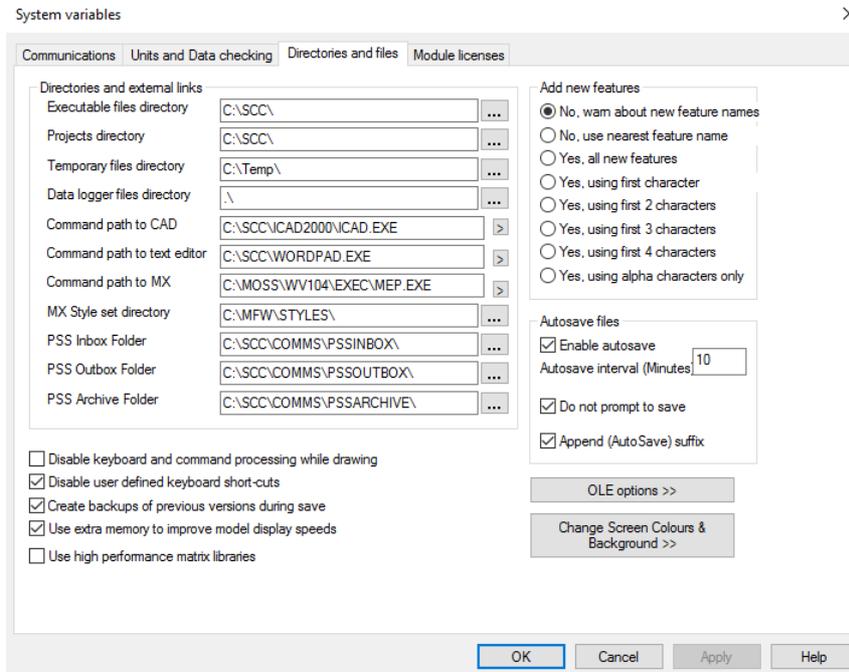
**If you have installed SCC in a directory other than the default, type in the correct path to this directory.**

**Check and see that the projects directory is correct. This should normally be the same directory as the executable file directory.**

**Make sure that the temporary directory stated exists. If not create this directory.**

**Select the path to your CAD executable file.**

**Identify the text editor you wish to use for SCC generated reports.**



SCC uses the Windows Wordpad as its default Text Editor. This link will be automatically set during installation. SCC generates reports for some functions it carries out, such as traverse reduction, adjustment and volume calculation. If you choose to edit/view these reports while

SCC is running the selected editor will display the report.

It is also possible to change the background colour of SCC from this panel as well as the screen colours themselves as colours that are visible on a white background may be less visible on a black background.

## Module Licences

Maintenance codes will be specific to your dongle number/node lock number and the expiry date. 10 days before your maintenance is due to expire, a reminder message will be displayed on opening the program. This message will be displayed until the maintenance has been renewed.

**Go to 'DATA tab > Settings > General Options'**

**Select the 'Module Licenses' panel**

**Ensure you have entered the correct maintenance code and maintenance expiry date.**

The screenshot shows the 'System variables' dialog box with the 'Module licenses' tab selected. The 'Software Maintenance (Level 1201)' section is expanded, showing the following settings:

- Maintenance enabled (with a 'Purchase Maintenance' button)
- Code 1: 00MY0EP00E9A
- Code 2: 536-158-636
- Maintenance Expiry Date (dd/mm/yyyy): 31/12/2017
- Disable maintenance expiry messages

Other sections in the dialog include:

- License type and expiry:** Radio buttons for Demo, Perpetual (selected), Timed, and Academic. Buttons for 'Change license type' and 'Extend license period'.
- SCC Survey module:**  Module Enabled (with 'Purchase this module' button), Code 1: 00FA01MS0E46, Code 2: [empty].
- SCC Volumes module:**  Module Enabled (with 'Purchase this module' button), Code 1: 00H703090E5G, Code 2: [empty].
- SCC Alignment module:**  Module Enabled (with 'Purchase this module' button), Code 1: 00L10A7D0E80, Code 2: [empty].
- SnakeGrid Integration:**  Module Enabled (with 'Purchase this module' button), Code 1: 00J106E10E60, Code 2: [empty], Snake Grid Expiry Date (dd/mm/yyyy): [empty].

At the top right, it shows 'Serial No: 2065450778' and 'Node locked license'. At the bottom, there are 'OK', 'Cancel', 'Apply', and 'Help' buttons. An 'Edit user details >>' button is also present.

### To install Maintenance Codes and Expiry Date:

**Go to 'DATA tab > Settings > General Options'**

**Within the 'System Variables' dialog box go to 'Module Licenses'**

**Enter Maintenance Code 2 and Maintenance Expiry Date**

**Select 'Purchase Maintenance'**

**A black correct symbol should appear in the box beside 'Maintenance Enabled'**

## Units & Data Checking

During the download procedure, SCC also range checks every field against a user definable range of values. Any exceptions are reported to the log file, and optionally to screen during the download process. The log file also includes any other potential errors relating to the input data, reduction, adjustment and subsequent analysis.

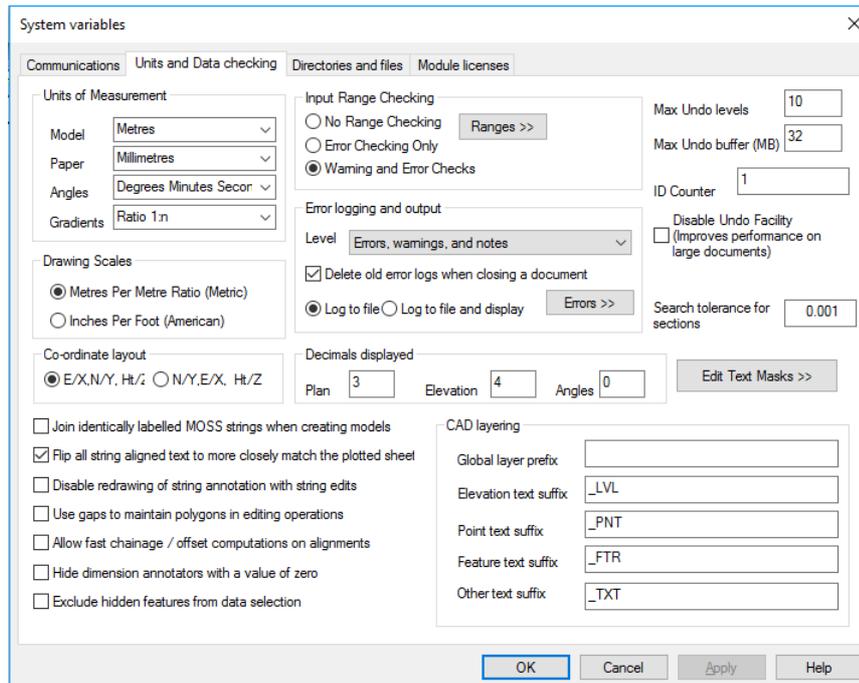
The level of detail included in the log file is also user definable, ranging from minimal to full diagnostic. When run in diagnostic mode, SCC will also log all intermediate computational

results to the log file for QA purposes, such as matrix dumps in least squares analysis or transformation, triangulation computations during modelling, etc... This can prove an invaluable tool both for support, and when attempting to track down a complex data related error or query.

**Go to 'DATA tab > Settings > General Options> Units & Data Checking' panel**

**Select the type of 'Input Range Checking', 'Error Reporting Method' and 'Error Reporting Detail' options you prefer.**

**You may also set the 'Undo' facility in this panel but remember that the more undo levels you select, the more memory taken.**



### 3 32 bit & 64 bit SCC Versions

SCC now includes separate native 32 bit and 64 bit versions of SCC. The 64 bit version of SCC requires Windows 7 (64 bit) with 2GB or more of RAM.

## 4 Basic Concepts

This section deals with the basic concepts and terms used within SCC. It aims to explain how SCC generates maps and surfaces from observed survey data, and what mechanisms are used to transfer the information generated into other CAD and design packages such as AutoCAD, MicroStation and MX.

### 4.1 Data storage and user interface

#### **Data Storage**

SCC uses the Microsoft document/view architecture to store and edit all its information. A document is a file on your computer used to store one or more pieces of related information in a self contained format, that is recognisable by the Windows operating system. Examples of documents include Word documents, Excel spreadsheets, etc.. Each of these document types have corresponding disk files and are registered with the operating system for use with other programs, such as explorer.

When using SCC, all the documents relating to a given survey project, including SCC

documents and other data such as CAD drawings, will be stored in a project folder. This folder is created when the 'New Project' option is selected, taking its name from the project name. The location of this folder is set-up in the 'General Options > Directories and Files' dialog, by default it will be 'C:\SCC'. When we create a new project, a new SCC project document is opened in the project folder, based on a selected project template. All data downloaded or imported, and models and sections generated in this project are stored in this new folder. While you can enter names for all documents, file extensions are controlled by SCC. As with other document based Windows software, when closing a file within SCC you will be prompted to save this file if it has been modified. If you are carrying out a lot of editing on any document, and you are not using a version control system to manage your revisions, we recommend that you regularly save your changes, given each saved version a revision based file name. For example, if you create a model called MyModel, the first time you save it you might call it MyModel01.Model. Intermediate edits might be saved as MyModel02.Model, MyModel03.Model, etc., and the final model saved as MyModel-Final.Model. In this way, if you make any errors during the editing process, you can always revert to a previous version. Alternatively, you can use an automated back software, such as Active Backup ([www.ajcsoft.com](http://www.ajcsoft.com)), to do this for you.

### ***SCC versions and updating***

Please note the following with regards to SCC versions and version compatibility. The SCC version is made up of three digits; the release number, the major version, and the minor version. For example, SCC 11.4.8 is SCC release 11, version 4, sub version 8. The release number typically changes on an annual basis, when all users with a current maintenance contract are issued with new full installation CDs and supporting documentation. The major version changes when a modification is made that necessitates a file format change, that may in turn lead to backward incompatibility with previous versions. For example, SCC 11.0.0 may not be able to fully read all files created with 11.1.0. A minor version change indicates a software modification that has no bearing on file format compatibility, for example SCC 11.4.2 can read files created in 11.4.8 as all data created in SCC 11.4.x has the same file format. Therefore, for a group of SCC users wishing to ensure that they will be fully data compatible, they should all be on the same release of SCC and the same major version. Note that like most commercial software, such as AutoCAD, MS Office, etc., all versions of SCC can always read all files created from any previous version. Compatibility issues only arise when attempting to read files created by a later version than the version in use.

### ***XML Support***

SCC also supports loading and saving of all of its document files in the industry standard XML format, in addition to its native formats. XML (extensible mark-up language) is an ASCII format widely used in Internet and database applications for the exchange and archiving of data. It has the following advantages; Data saved by SCC in XML format is both backward and forward compatible with any XML enabled version of SCC. XML is an open data format, thus SCC XML data may be translated into other formats by third party software where required. Note that XML has the disadvantages that it is much slower to save and load, and is much larger in size than native SCC binary formats. SCC XML options are available from the File / XML menus throughout the program.

### ***User Interface***

The view is the principal graphical interface to a document. Some documents have a single view, for example in Word, the view is the area on screen where you type in your text. Other programs will have multiple views, for example in Excel, you might have a single spreadsheet that contains many pages, though each page belongs to the same .XLS document. SCC documents typically have multiple views, for example in a survey data set, detail observations and reduced coordinates are presented in separate spreadsheet views. All of the views in SCC are either spread sheet views, or interactive graphical views, and have a unique name and graphical icon, displayed in a tab at the bottom of the view. The simplest way to switch between views is to left click on this tab with the mouse.

## Documents

SCC creates and works with the following document types: Projects, Survey Datasets, Traverses, Models, Sections, Transformations, Alignments and Program modules. A brief description of each document is given below, along with the views available and icons used.

### 4.1.1 Project

A project document is used to share station coordinates between other SCC documents in the project folder, and to determine drawing and modelling conventions used. It contains four sheet views



Station coordinates, used to establish and maintain the grid system used in this project.



Feature Library, used to control naming conventions, drawing standards and modelling defaults.



Ground Type Library, used to break down different parts of the surface model into various ground types for viewing and analysis purposes.



Advanced Survey Coding, used to control how coding in the field is interpreted into features and reduction options.

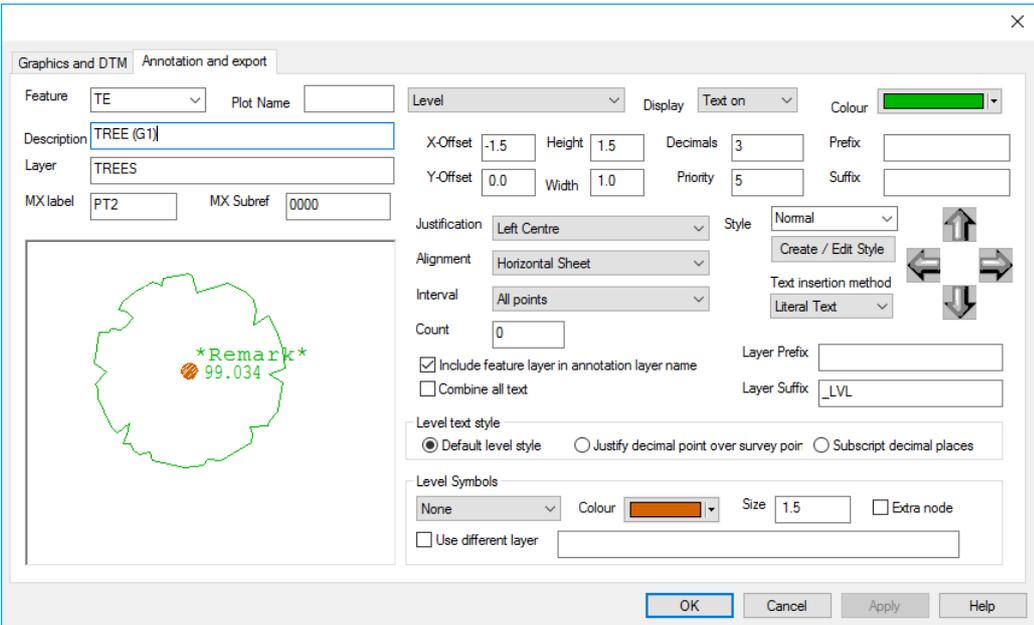
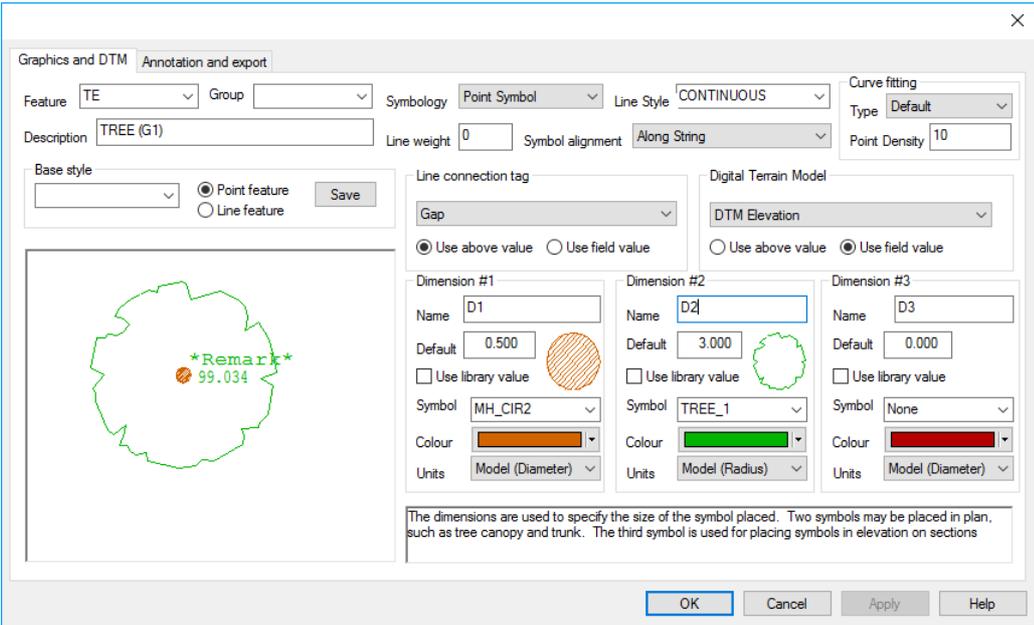
In addition to this the project file stores copies of all ancillary drawing support items such as symbols, line-styles, sheet layouts, text styles, and bitmaps that are used in model and section drawing.

	Name	Feature	X,Y Type	Z Type	Source	-E/X-	-N/Y-	-H/Z-	-E/X-	-N/Y-	-H/Z-	Lat
1	Q047A1	CONTROLREC	Fixed	Fixed	Traverse	10000.000	10000.000	100.0000	0.000	0.000	0.0000	00
2	Q047A2	CONTROLREC	Free	Free	Traverse	10102.541	10102.541	98.5794	0.000	0.000	0.0000	00
3	Q047A3	CONTROLREC	Free	Free	Traverse	10130.161	10076.758	98.2596	0.000	0.000	0.0000	00
4	Q047A4	CONTROLREC	Free	Free	Traverse	10202.199	9939.483	97.8962	0.000	0.000	0.0000	00
5	SC442	CONTROLREC	Free	Free	Traverse	13615.296	24685.533	58.2150	0.000	0.000	0.0000	00
6	SC443	CONTROLREC	Free	Free	Traverse	13749.489	24724.305	64.0280	0.000	0.000	0.0000	00
7	TS1	CONTROLREC	Free	Free	Traverse	9946.229	9976.470	104.7007	0.000	0.000	0.0000	00
8	TS2	CONTROLREC	Free	Free	Traverse	10216.803	9831.689	99.1645	0.000	0.000	0.0000	00
9	TS3	CONTROLREC	Free	Free	Traverse	10138.804	9847.980	100.0466	0.000	0.000	0.0000	00

#### Project - Station Coordinate Sheet

	Feature	Field Code	Description	Plot name	Ground type	Layer	Lbl	Subr	Tag	Master	DTM	Master
13	CU	CU	CULVERT (SINGLE LINE)			STRUCTURES	CU	CU	S	Survey	B	Library
14	CUS	CUS	CULVERT (SINGLE LINE)			STRUCTURES	CU	CU	S	Survey	B	Library
15	DHC	DHC	DITCH (CENTRE)			DITCHES	D	D	S	Survey	B	Library
16	DHS	DHS	DITCH (SINGLE LINE)			DITCHES	D	D	S	Survey	B	Library
17	EP	EP	ELEC POST	EP		UTILITIES	PBT	0000	G	Library	D	Library
18	ER	ER	EDGE OF ROAD			ROADS	ER	ER	S	Survey	B	Library
19	EY	EY	ELEC PYLON (STRING)	E.PYLON		UTILITIES	EY	EY	S	Survey	B	Library
20	FE	FE	FENCE			FENCES	F	F	S	Survey	B	Library
21	FG	FG	FOLIAGE RIGHT			TREES	VD	VD	S	Survey	E	Library
22	FGL	FGL	FOLIAGE LEFT			TREES	VD	VD	S	Survey	E	Library
23	FH3	FH3	FIRE HYDRANT (G3)	HYD		UTILITIES	FH	FH	Rec3	Library	D	Survey
24	FPS	FPS	FOOTPATH (SINGLE LINE)			FOOTPATHS	FP	FP	S	Survey	B	Library
25	GE	GE	GATE (G2)			FENCES	GA	GA	S	Survey	D	Survey
26	GH	GH	GLASSHOUSE			BUILDINGS	GH	GH	S	Survey	B	Library
							GP	0000	G			Library

#### Project - Feature Library Sheet



Project - Feature Wizard

4.1.2 Traverse

The **traverse** document is used to store observations relating to traverse and network adjustments. Within the Traverse document you can reduce and edit setups, apply relevant corrections and perform adjustments. The traverse document includes three sheet views



The traverse observation view, including observed angles and distances, reduced values, and computed residuals



The traverse coordinates view, including provisional and adjusted station

coordinates, and computed error ellipse axes



Station coordinates, a back-up of the station coordinates used in this traverse, such that the traverse document is fully self contained.

	Setup	Round	At Stn.	To Stn.	Code	Use Obs	Inst Ht.	Rod Ht.	HA	zVA	-SI Dist.	Prism	Apply	Remark
1	1	1	PGM10	PGM20	ORO	Yes	1.5000	1.5210	355 27 45	091 14 18	180 028	0.0000	No	
2	1	1	PGM10	APEX101	SS	Yes	1.5000	1.5880	217 24 55	089 01 57	44 876	0.0000	No	
3	1	1	PGM10	APEX100	SS	Yes	1.5000	1.5140	173 04 13	088 48 34	47 050	0.0000	No	
4	2	1	APEX100	PGM20	BS	Yes	1.5180	1.0600	354 58 01	091 20 54	227 058	0.0000	No	
5	2	1	APEX100	APEX101	SS	Yes	1.5180	1.5880	288 33 33	090 22 01	34 746	0.0000	No	
6	3	1	APEX101	APEX100	BS	Yes	1.4960	1.5130	108 33 33	089 29 07	34 744	0.0000	No	

### TraverseSheet

**Corrections**

Refraction, 'k', and curvature

No corrections      Standard value for 'k'      0.14

Earth curvature only

Earth curvature, standard 'k'      Radius of the Earth      6380000.000

Earth curvature, calculated 'k'

Local Scale Factor

None applied      Local map scale factor      1

User defined scale factor      Scale factor along C.M.      1

Transverse Mercator, User defined      Easting of central meridian      0.000

TM, Ireland (Airy modified)      Minimum survey easting      0.000

TM, England (Airy)      Maximum survey easting      0.000

ITM, Ireland (GRS80)

Centring errors

Do not compute centring errors     Compute but do not apply     Compute and apply

Horizontal (Instrument)      0.000      Horizontal (Target)      0.000      Vertical (Instrument)      0.000

Horizontal Angle correction      000 00 00      Vertical Angle correction      000 00 00

Apply temperature and pressure     Apply mean sea level correction

Load defaults    Save defaults    Reset defaults    OK    Cancel

### Corrections

The image displays two screenshots of the 'Traverse Setup' dialog box, showing the 'Opening Setup' and 'Closing Setup' tabs.

**Opening Setup Tab:**

- Opening Station:** Name: Q047A2, E/X: 10102.541, N/Y: 10102.541, Level/Z: 98.579
- Reference Object Station:** Name: Q047A3, E/X: 10130.161, N/Y: 10076.758, Level/Z: 98.260
- Station type:** XY: Free, Z: Free
- Orientation method:**  Entered as a Bearing,  Calculated from Coordinates
- RO Stn Type:** XY: Free, Z: Free
- Opening Orientation:** 090 00 00

**Closing Setup Tab:**

- Closing Station:** Name: Q047A3, E/X: 10130.161, N/Y: 10076.758, Level/Z: 98.260
- Reference Object Station:** Name: Q047A4, E/X: 10202.199, N/Y: 9939.483, Level/Z: 97.896
- Station type:** XY: Free, Z: Free
- Orientation method:**  Entered as a Bearing,  Calculated from Coordinates,  Computed backsight bearing
- RO Stn Type:** XY: Free, Z: Free
- Closing Orientation:** 000 00 00

*Traverse - Setup Dialogs*

### 4.1.3 Dataset

The survey document is used to store raw detail observations and reduced detail coordinates in a normalised format. Survey datasets can be created by downloading data from a survey instrument, or importing reduced data from another file. Depending on the data source, they may or may not contain any observation data. The survey document is made of the following five sheet views;



The detail observation spreadsheet contains all of the observations in any given survey. Note that these observations can be total station angles and distances, GPS latitude, longitude, height, or X, Y, Z. These different observation types may be also freely mixed in a given job. From the observation view, we can also specify various reduction parameters and defaults including corrections, mapping projections and GPS datum and transformation. Any changes made in the Detail Observation view will require the detail co-ordinates to be rebuilt in order to reflect the new changes. If the co-ordinates were not formed from a detail survey then this sheet will be blank.

No.	Str	Feature	Stn.	Tag	DTM	-Rod Ht.	-HA	-zVA	-SI Dist.	Prism	Apply	D(1)	D(2)	D(3)	POfs L/R	POfs F/B
31	1	FE	1	S	D	1.2000	007 08 40	092 55 16	232.799	0.0000	No	0.000	0.000	0.000	0.000	0.000
32	1	FE	1	S	D	1.2000	007 17 58	092 38 15	245.090	0.0000	No	0.000	0.000	0.000	0.000	0.000
33	1	FE	1	G	D	1.2000	007 22 09	092 38 36	259.077	0.0000	No	0.000	0.000	0.000	0.000	0.000
34	1	FE	1	S	D	1.2000	007 20 38	092 26 21	263.267	0.0000	No	0.000	0.000	0.000	0.000	0.000
35	1	FE	1	S	D	1.2000	007 14 21	092 29 45	273.915	0.0000	No	0.000	0.000	0.000	0.000	0.000
36	1	FE	1	S	D	1.2000	007 07 13	092 00 51	282.635	0.0000	No	0.000	0.000	0.000	0.000	0.000
37	1	FE	1	S	D	1.2000	006 59 53	092 20 43	291.771	0.0000	No	0.000	0.000	0.000	0.000	0.000
38	1	FE	1	S	D	1.2000	006 51 09	092 09 00	298.669	0.0000	No	0.000	0.000	0.000	0.000	0.000
39	1	FE	1	S	D	1.2000	006 32 56	092 09 03	318.281	0.0000	No	0.000	0.000	0.000	0.000	0.000
40	0	GP	1	S	A	1.2000	007 20 40	092 37 05	262.889	0.0000	No	0.000	0.000	0.000	0.000	0.000
41	0	GP	1	S	A	1.2000	007 20 40	092 39 36	259.423	0.0000	No	0.000	0.000	0.000	0.000	0.000
42	0	GP	1	S	A	1.2000	005 59 48	093 52 37	170.913	0.0000	No	0.000	0.000	0.000	0.000	0.000
43	0	GP	1	S	A	1.2000	005 46 25	093 56 45	167.038	0.0000	No	0.000	0.000	0.000	0.000	0.000
44	2	FE	1	S	D	1.2000	006 57 19	093 09 02		0.0000	No	0.000	0.000	0.000	0.000	0.000



**At Stn** Instrument Set-ups, containing observed back-sights, used to orient the horizontal circle whenever the total station is moved. The instrument set-up sheet also contains distance and coordinate misclosures, along with other QA fields. Each instrument set-up is numbered, and each detail observation contains a corresponding set-up number. Modifying the station set-up details will require the associated survey to be re-coordinated and the model to be rebuilt. If the co-ordinates were not formed from a detail survey then this sheet will be blank.

Number	At Stn.	XYZ	To Stn.	XYZ	-Inst Ht.	-Rod Ht.	-HA	-zVA	-SI Dist.	Prism	Apply	Obs. Zero	Mean Zero	Zero Err	-X	
1	1	7	Yes	8	Yes	1.5330	1.4850	000 00 00	091 02 47	353.783	0.000	No	353 05 53	353 05 53	000 00 00	-0.0
2	2	220	Yes	7	Yes	1.4880	1.4850	000 00 01	097 14 01	78.201	0.000	No	276 04 35	276 04 35	000 00 00	0.0
3	3	221	Yes	7	Yes	1.5210	1.4850	000 00 01	096 45 51	100.852	0.000	No	264 38 50	264 38 50	000 00 00	-0.0
4	4	221	Yes	7	Yes	1.5600	2.1900	359 59 59	096 23 48	100.770	0.000	No	264 38 52	264 38 52	000 00 00	-0.0
5	5	220	Yes	7	Yes	1.5950	1.4850	000 00 00	097 18 43	78.194	0.000	No	276 04 36	276 04 36	000 00 00	0.0
6	6	224	Yes	220	Yes	1.5950	1.4850	000 00 00	090 41 14	128.159	0.000	No	280 43 43	280 43 43	000 00 00	-0.0
7	7	223	Yes	220	Yes	1.6160	1.4850	000 00 00	084 05 59	137.036	0.000	No	343 30 16	343 30 16	000 00 00	-0.0
8	8	225	Yes	223	Yes	1.5480	1.4850	000 00 00	090 46 58	198.206	0.000	No	315 35 19	315 35 19	000 00 00	0.0
9	9	225	Yes	223	Yes	1.6000	1.4850	000 00 00	090 47 40	198.195	0.000	No	315 35 19	315 35 19	000 00 00	0.0

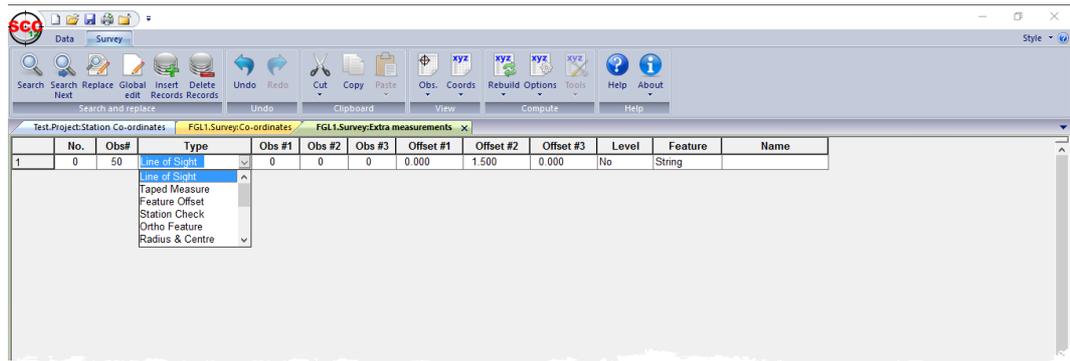


**Notes** Text Notes, used to store text data and placement details.

Obs#	Remark	Feature	E/X	N/Y	Height	Width	Angle
1	47 R2.2	HE	193628 157	375603 108	1.500	1.500	037 17 12
2	56 R2.2	HE	193691 618	375583 532	1.500	1.500	293 15 17
3	62 R2.2	HE	193715 114	375535 743	1.500	1.500	292 37 13
4	268 L2.2	HE	193644 102	375272 478	1.500	1.500	031 59 51
5	376 L2.2	HE	193780 365	375355 835	1.500	1.500	035 16 40
6	378 L2.2	HE	193789 367	375362 835	1.500	1.500	115 45 40
7	410 L2.2	HE	193772 166	375400 868	1.500	1.500	115 53 35
8	498 R02.2	HE	193773 135	375401 311	1.500	1.500	018 09 02
9	779 L02.2	HE	193750 835	375122 533	1.500	1.500	035 26 14
10	833 OAK	TE	193801 533	375156 213	1.500	1.500	000 00 00
11	834 D.3	TE	193794 420	375151 601	1.500	1.500	000 00 00
12	835 D.3	TE	193786 517	375146 201	1.500	1.500	000 00 00
13	836 D.35	TE	193779 142	375140 856	1.500	1.500	000 00 00
14	837 D.3	TE	193777 938	375140 689	1.500	1.500	000 00 00
15	838 D.3	TE	193763 348	375131 786	1.500	1.500	000 00 00
16	839 D.4	TE	193757 349	375126 172	1.500	1.500	000 00 00
17	1025 L02.00	HE	193909 311	375083 945	1.500	1.500	062 25 21



**D1** Extra Measurements, used to store measurements other than direct observations, such as tape measurements and copied strings. If the co-ordinates were not formed from a detail survey then this sheet will be blank.



Detail Coordinate Sheet, used to store reduced topographic coordinates, sorted alphabetically by feature name and string number. Note that the detail coordinates sheet may contain interpolated data, such as curve fit points, in addition to reduced observations or imported coordinates.

No.	Str	Pos	Feature	Type	Tag	DTM	E/X	N/Y	Ht/Z	D(1)	D(2)	D(3)	Chainage	Offset	Obs#	Gr	
61	20	1	17	FE	Detl	S	D	193609.899	375520.674	15.9000	0.0000	0.0000	0.0000	0.000	0.000	20	C
62	21	1	18	FE	Detl	S	D	193611.878	375531.273	15.9971	0.0000	0.0000	0.0000	0.000	0.000	21	C
63	22	1	19	FE	Detl	G	D	193613.394	375539.421	15.9810	0.0000	0.0000	0.0000	0.000	0.000	22	C
64	23	1	20	FE	Detl	S	D	193614.246	375544.374	16.3330	0.0000	0.0000	0.0000	0.000	0.000	23	C
65	24	1	21	FE	Detl	S	D	193615.082	375547.560	16.0388	0.0000	0.0000	0.0000	0.000	0.000	24	C
66	25	1	22	FE	Detl	S	D	193612.549	375551.089	15.8570	0.0000	0.0000	0.0000	0.000	0.000	25	C
67	26	1	23	FE	Detl	S	D	193612.537	375552.838	16.5068	0.0000	0.0000	0.0000	0.000	0.000	26	C
68	27	1	24	FE	Detl	S	D	193614.011	375570.389	15.7550	0.0000	0.0000	0.0000	0.000	0.000	27	C
69	28	1	25	FE	Detl	S	D	193615.317	375579.387	16.4721	0.0000	0.0000	0.0000	0.000	0.000	28	C
70	29	1	26	FE	Detl	S	D	193616.397	375588.186	15.6436	0.0000	0.0000	0.0000	0.000	0.000	29	C
71	30	1	27	FE	Detl	S	D	193617.126	375595.165	15.4004	0.0000	0.0000	0.0000	0.000	0.000	30	C
72	31	1	28	FE	Detl	S	D	193618.005	375605.763	15.7326	0.0000	0.0000	0.0000	0.000	0.000	31	C



Station coordinates, a back-up of the station coordinates used in this survey, such that the survey document is fully self contained. In addition to the above sheet views, the survey document also includes a copy of the downloaded survey data as a text file in its native format, such that the other spreadsheets can be reconstructed in their originally downloaded state at any time.

#### 4.1.4 Model

Models are used to display and manipulate survey data graphically as plan drawings, in a similar manner to CAD. Models can contain a mixture of 2d and 3d information, and will typically include a triangulated surface model or TIN. The surface model is used to interpolate elevations that have not been directly observed, for analysis purposes such as contouring and volume calculation. Models can be formed either directly from coordinates sources, such as CAD or MX GENIO, or from reduced survey datasets. SCC includes an extensive range of graphic editing tools that enable simultaneous editing of the planimetry and 3d surface. In addition to graphic editing, the model may also be edited as a spread-sheet using a split screen editor. SCC models contain the following views;



Plan view, used for all graphical display and editing



Station coordinates, copied from the surveys used when creating the model. You may also cut and paste in additional unreferenced stations from the project as required.



Feature Library, copied from the project, used to control naming conventions, drawing standards and modelling defaults.

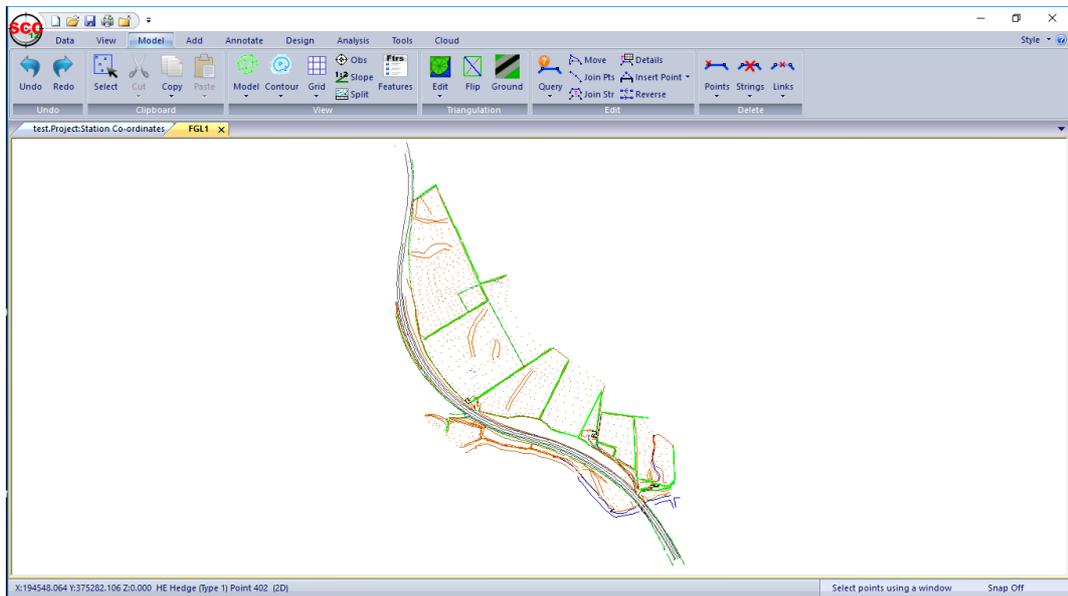


Ground Type Library, copied from the project, used to break down different parts of the surface model into various ground types for viewing and analysis purposes.

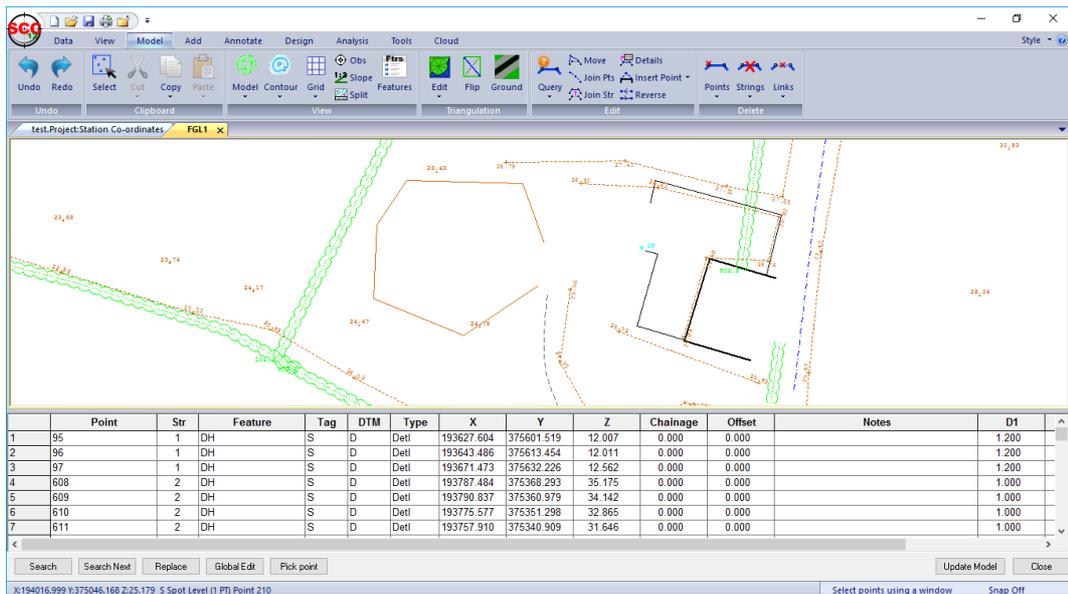


ZVI station coordinate, used for ZVI station positions in visual intrusion analysis

As with the project, the model also stores copies of all referenced symbols, line styles, text styles, bitmaps, and sheet layouts, such that it forms a fully self contained document. Additional SCC documents, including traverses, alignments, sections and even other models may also be attached to a model for graphical display purposes.



**Model**



*Model - Split View option which allows the user to browse the dataset table whilst the cursor interactively moves to the chosen x, y, z*

## 4.1.5 Section

A **section** document is used to graphically represent profiles, long sections and cross sections. Sections can either be cut from a model or generated directly from coordinate or chainage / offset data, can include any number of surfaces per section, and can be drawn to user defined standards. A section document contains the following views;

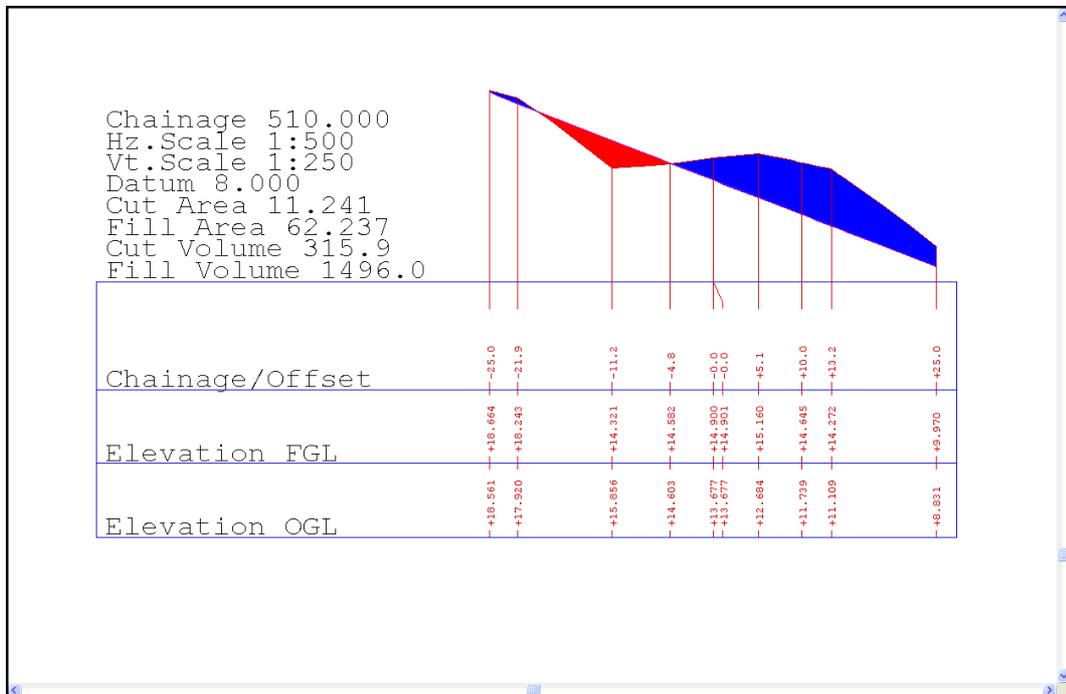


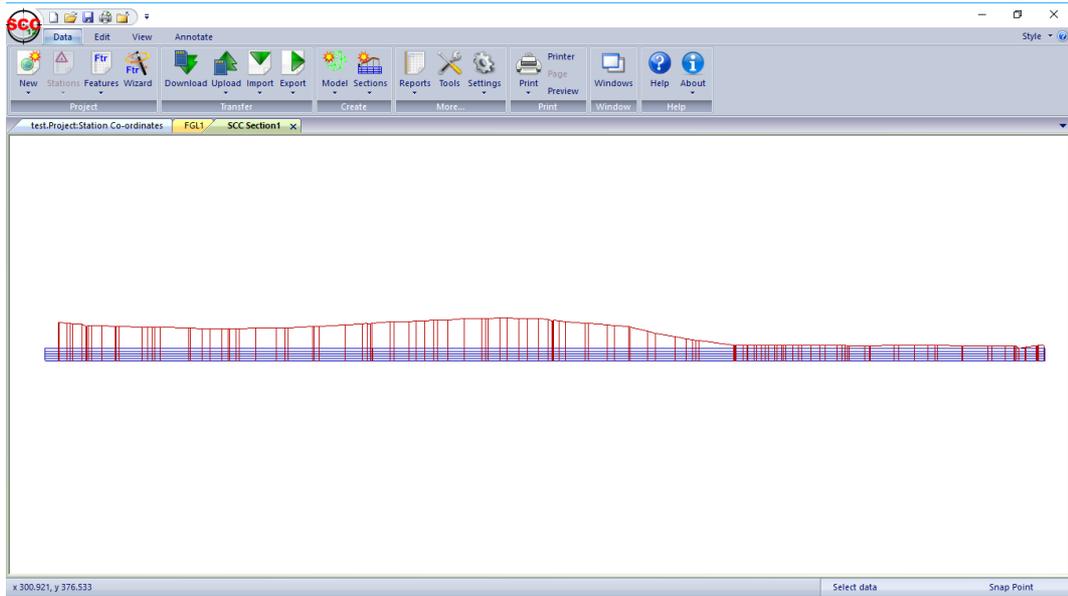
Section view, used for all graphical display and editing



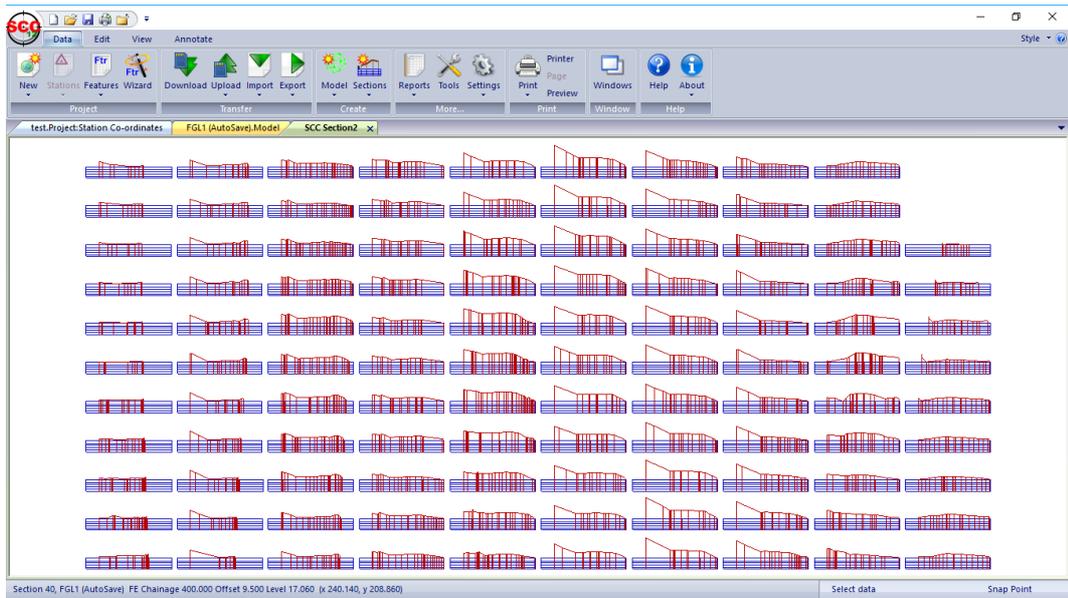
Feature Library, copied from the project, used to control naming conventions, drawing standards and modelling defaults

As with the project, the model also stores copies of all referenced symbols, line styles, text styles, bitmaps, and sheet layouts, such that it forms a fully self contained document. Section style files can also saved and loaded from section views to simplify the process of applying standard drawing styles and sheet layouts to different types of section drawings. Sections can also be attached to ground models, to show their plan position, and annotated with chainage and offset.

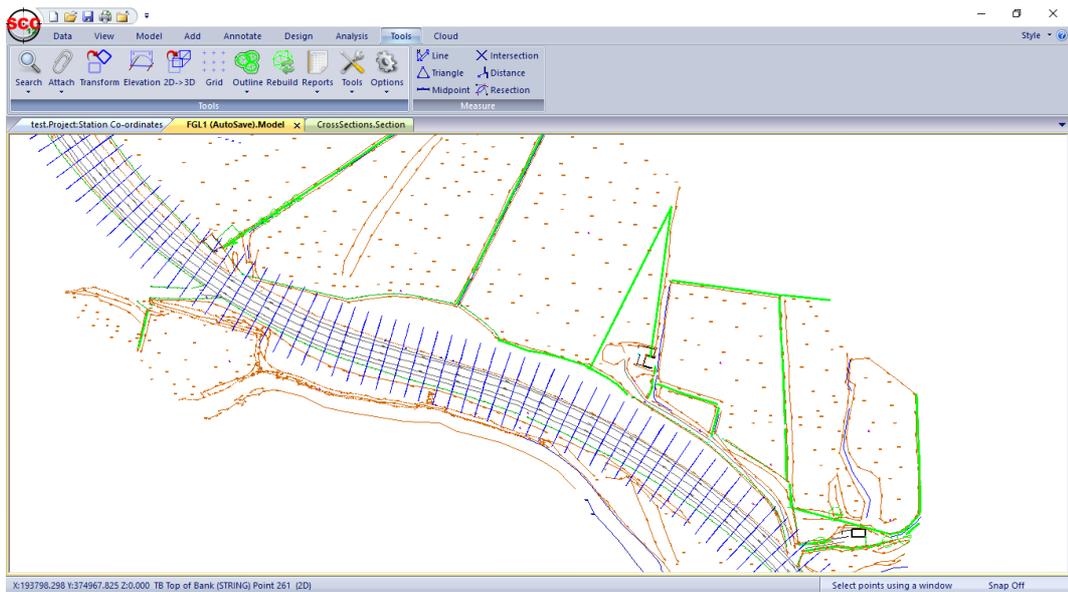




*Section – Long Section from An Existing String*



*Section – Cross Section from An Existing String*



Section – Cross Section File Attached to Model

#### 4.1.6 Transformation



The **transformation** document has a single spreadsheet view consisting of pairs of control co-ordinates used to move datasets between coordinate systems. SCC includes 2D affine plus level shift, 2D / 3D conformal, 2D / 3D scale free and 2D / 3D best fit (2 or more points) transformations. Furthermore, SCC supports national grid transformations between ITM, Irish Grid, OSGB36 and ETRS89. These transformations utilise Grid Inquest software provided by Quest Geo Solutions. Transformations may be applied to project stations, reduced coordinates and models.

No.	Description	Ea/Xa	Na/Ya	Ht/Za	Eb/Xb	Hb/Yb	Ht/Zb	rE/X	rN/Y	rH/Z
1	Q123P001	10000.000	10000.000	100.0000	20000.000	40000.000	200.0000	0.000	0.000	0.0000
2	Q123P002	10000.000	10073.508	95.4547	20036.754	40063.861	195.4547	0.000	0.000	0.0000
3	Q123P003	10024.393	10045.539	91.0283	20043.894	40027.242	191.0283	0.000	0.000	0.0000
4	Q123T001	9981.415	10101.951	95.9646	20034.881	40097.585	195.9646	0.000	0.000	0.0000

Transformation - Local Grid to National Grid

#### 4.1.7 Alignment

The **alignment** document stores all information relating to horizontal, vertical, and section template design data. SCC enables you to create linear and polygonal designs, using both interactive graphics and spreadsheets. Designs can include surfaces and multiple section templates for different chainage ranges. Linear designs can be created either from horizontal and vertical intersection points, or directly from entities. Designs may also be imported from MX GENIO geometry and master alignment strings, and from other design packages. The SCC alignment document contains the following views;



Horizontal intersection points



Vertical intersection points



Horizontal entities



Vertical entities



Section template points



Super-elevation nodes



Interactive section template design



Interactive vertical design

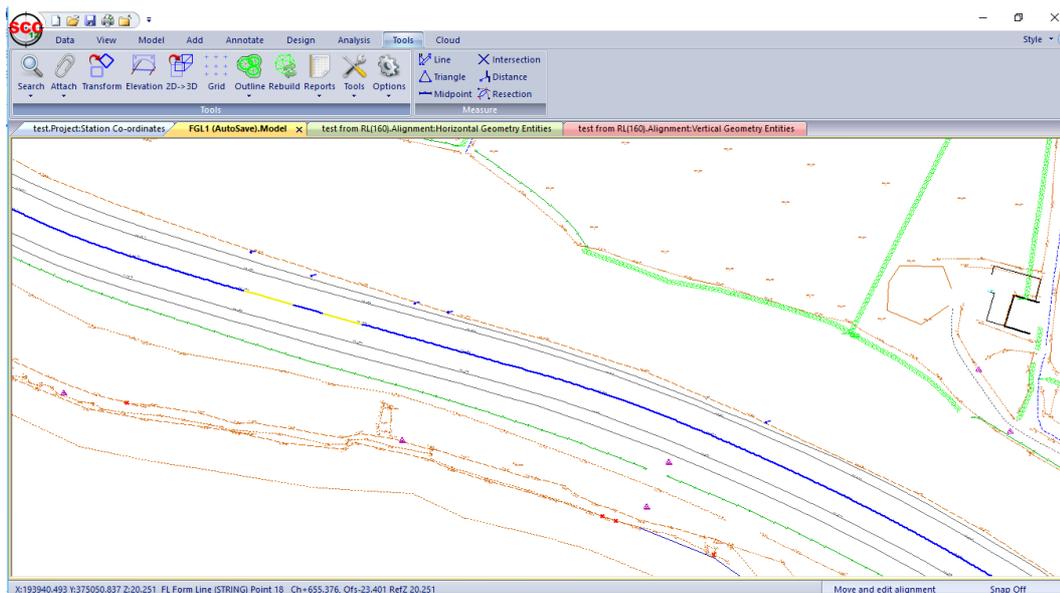
Interactive horizontal design is carried out in plan in the model view. As with the project, the model also stores copies of all referenced symbols, line styles, text styles, bitmaps, and sheet layouts, such that it forms a fully self contained document. Alignment documents can also include attached models representing non-alignment related strings in the design, and a model for level reference.

No.	Type	E-X	N-Y	Chainage	Vector	Length	Radius 1	Radius 2
1	Straight	193584.013	375495.477	0.000	260.31.06	2.869	0.000	0.000
2	Straight	193593.541	375492.647	2.869	260.25.18	4.004	0.000	0.000
3	Circular Arc	193592.874	375488.699	6.874	260.24.37	4.738	-1054.889	-1054.889
4	Circular Arc	193592.096	375484.025	11.611	260.34.44	5.070	-641.634	-641.634
5	Circular Arc	193591.285	375479.020	16.682	261.06.19	5.002	-957.014	-957.014
6	Straight	193590.525	375474.076	21.684	261.33.13	4.975	0.000	0.000
7	Circular Arc	193589.794	375469.155	26.659	261.30.34	5.215	-899.037	-899.037
8	Circular Arc	193589.039	375463.995	31.874	261.44.40	5.394	-573.994	-573.994
9	Circular Arc	193588.290	375458.653	37.268	262.10.56	5.513	-420.475	-420.475
10	Circular Arc	193587.576	375453.187	42.781	263.09.51	5.571	-1070.653	-1070.653
11	Straight	193586.927	375447.653	48.352	263.36.34	5.498	0.000	0.000
12	Circular Arc	193586.315	375442.189	53.850	263.21.24	5.465	-399.594	-399.594
13	Circular Arc	193585.720	375436.757	59.315	263.54.23	5.632	-252.980	-252.980
14	Circular Arc	193585.184	375431.151	64.947	265.05.03	6.001	-221.160	-221.160

*Alignment - Horizontal Geometry Entities*

No.	Type	Chainage(t)	Length	Base Level	Gradient	Grade Diff.
1	Straight	0.000	2.869	16.5432	+1:51.2	0.0
2	Straight	2.869	4.004	16.5992	+1:51.0	0.0
3	Straight	6.874	4.738	16.6777	+1:51.2	0.0
4	Straight	11.611	5.070	16.7701	+1:51.7	0.0
5	Straight	16.682	5.002	16.8682	+1:52.5	0.0
6	Straight	21.684	4.975	16.9634	+1:53.6	0.0
7	Straight	26.659	5.215	17.0563	+1:54.2	0.0
8	Straight	31.874	5.394	17.1525	+1:54.6	0.0
9	Straight	37.268	5.513	17.2512	+1:54.8	0.0
10	Straight	42.781	5.571	17.3519	+1:54.6	0.0
11	Straight	48.352	5.498	17.4539	+1:54.2	0.0
12	Straight	53.850	5.465	17.5553	+1:54.0	0.0
13	Straight	59.315	5.632	17.6565	+1:54.2	0.0
14	Straight	64.947	6.001	17.7605	+1:54.8	0.0
15	Straight	70.948	6.575	17.8700	+1:55.8	0.0

*Alignment - Vertical Geometry Entities*



*Alignment Attached to Model*

#### 4.1.8 Using SCC with Microsoft Office and other Windows Applications

Any SCC documents may be transferred to other Windows programs by cutting or copying data to the clipboard and pasting it into the target location. SCC supports standard 'Cut', 'Copy', 'Paste', 'Paste Special' and 'OLE' commands. You may also cut and paste data from other packages into SCC. SCC spreadsheets support text and Microsoft Excel clipboard formats. SCC models additionally support cut, copy and paste of graphical data between any other OLE compliant software.

##### **Cutting or Copying Data within SCC**

Spreadsheet data may be cut or copied between spreadsheets.

**Highlight the cells to be cut or copied. Go to 'EDIT tab > Cut/Copy'.**

**Highlight the cell where you wish to place the data. Go to 'EDIT tab > Paste'.**

Data within models may be selected for cutting or pasting using the Data Selection dialog.

Copying a model to a new dataset or to a new model is different than exporting models, in that, only the survey points selected are copied. Model data may also be copied to the clipboard in its native format or as a bitmap. When data is copied to the clipboard it may be pasted or inserted into any other Windows program. When copied in its native format it may be inserted into another document as an OLE object.

##### **OLE**

An object created in another application that supports OLE may be inserted into SCC. To insert objects such as Microsoft Excel worksheet objects, use the 'Insert New Object' command or the 'Paste Special' command, both found under the Edit menu.

Similarly objects created in SCC may be input into any other Windows application. Objects are created in SCC by using the 'Copy to Clipboard' option.

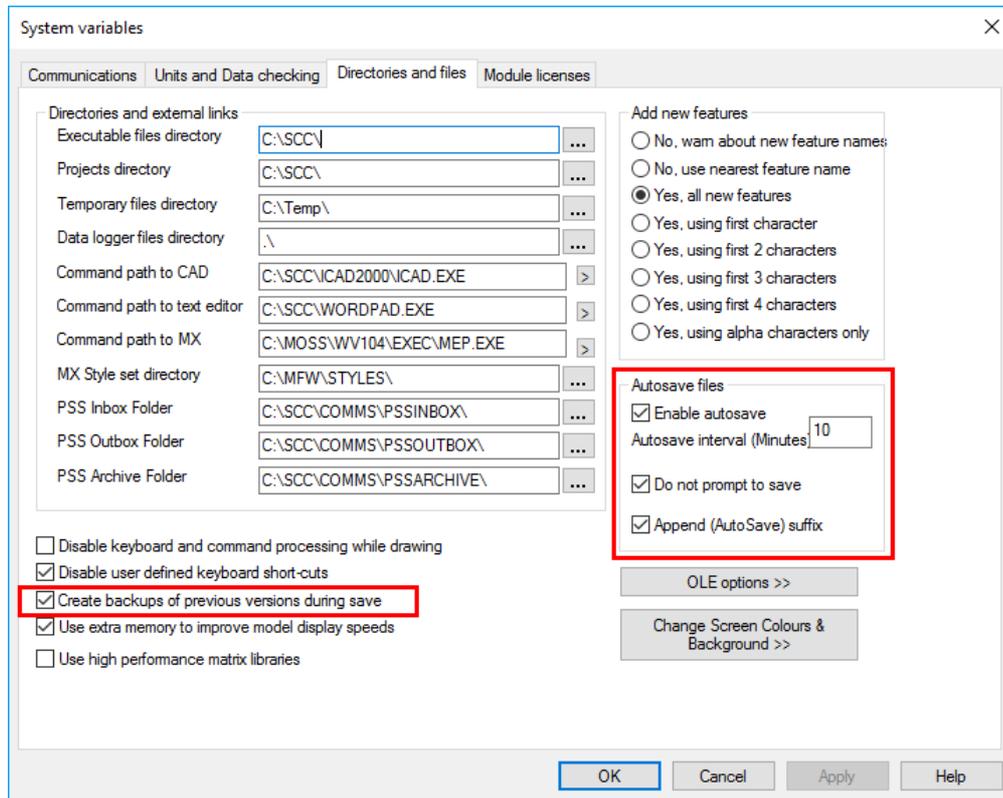
##### **Send**

Send attaches the current file to a new blank e-mail message. Select the recipient and type your message.

### 4.1.9 Backup Strategies

We recommend that in addition to saving your documents using a revision number based file naming convention, that you include your main SCC folder in you backup plan. Good practice is to keep any important data in at least two physical locations at any given time.

In addition, several options are available within 'DATA tab > Settings > General Options > Directories and Files' to allow the user to select auto save options but also to create backup files automatically.



## 4.2 Feature Names Conventions & The Feature Library

A feature name is the name given to one or more similar surveyed objects used to group strings and points of the same type. Examples of feature names include TREE, ROADEDGE, DITCH, WALL, MANHOLE and shortened or mnemonic versions such as TE, RE, DH, WL, MH. In SCC, a feature name can be up to eight characters long although it is common to use shorter abbreviations. In SCC, feature names are used to determine how survey data is drawn and modelled. This is controlled by the feature library, which is essentially a spreadsheet containing a large number of fields against each feature determining how it will be interpreted for modelling, mapping, and export purposes. These fields include colour, line-style, annotation defaults, symbology, MX label, and CAD layer.

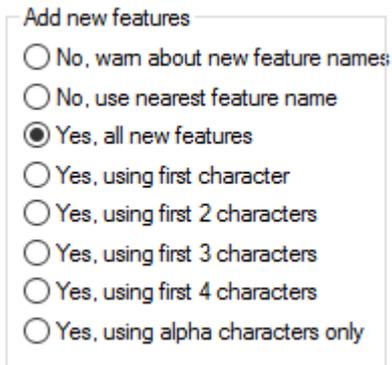
Many large organisations will have their own naming conventions, whether it be based on string labelling conventions for MX users, layer naming conventions for AutoCAD users, or both.

The feature library controls the application of a feature, layer, and string naming conventions when generating SCC models and sections, AutoCAD and Microstation drawings or MX models. The key field in the feature library is the feature name.

Most survey data collectors will include a feature name or point code field that can either be directly used as a feature name, or mapped onto a feature name using the advanced field coding sheet. When transferring data from a MX SURVEY or GENIO file, the feature may be the first few characters of the string label that define the object. For example, the SW from the

MX string label SW01 might indicate the string is a sidewalk. The numeric 01 part of the label indicates string number or occurrence of this feature in the current model. When transferring from AutoCAD or Microstation to SCC, the layer name, entity type, colour and line-style can all be used to determine the SCC feature.

In SCC, the method of matching survey features with feature names in the feature library is determined in SCC by a parameter within General Options. ('**DATA tab > Settings > General Options > Directories and Files**').



Add new features

- No, warn about new feature names
- No, use nearest feature name
- Yes, all new features
- Yes, using first character
- Yes, using first 2 characters
- Yes, using first 3 characters
- Yes, using first 4 characters
- Yes, using alpha characters only

The variable name is 'Add new features' and its value will be one of the following;

- No, warn about new feature name
- No, use nearest feature name
- Yes, all new features
- Yes, using first character
- Yes, using first 2 characters
- Yes, using first 3 characters
- Yes, using first 4 characters
- Yes, using alpha characters only

### ***Feature Wizard***

The feature library contains a very large number of fields, approximately four hundred per feature, that allow for a very fine degree of control on how any given feature is drawn and annotated. While this allows for a very high degree of field to finish automation, it can be quite daunting to edit and maintain.

The solution to this dilemma is the 'Feature Wizard', which can be accessed using 'Data tab > Feature Wizard' from the feature library spreadsheet. This displays the dialog shown below;

The symbology option allows the user to specify the geometry used, and the number of survey points required to place a symbol on this feature. For example, a tree is a point symbol, with a new tree placed for each survey point coded with the tree feature. A gate, on the other hand, requires two points, which are used to size and orient the gate symbol.

The base style lets the user select the general feature type from a list of possible styles. Thus speeding up the process of creating a lot of similar features.

The preview panel gives the user the idea of how points coded with this feature will be depicted in the model, complete with text annotation.

The help box describes the number of points and/or dimensions used for the different symbologies.

Line Connection Tag and Digital Terrain Model tags can be defined and forced by Library by selecting 'Use above value' or set to exact values from the raw survey file using 'Use field value'.

The user can place up to three symbols per point based on the symbology selected. Symbol dimensions can be taken from the survey or from the library, and the units can be specified either in paper or model terms.

The text annotation and export box allows the user to precisely control the placement of text against each of the supported fields.

The Create/Edit Style button allows the user to set up the font type, for example, italics, bold and underlining.

Text can be exported to individual CAD layer either containing the feature layer name or only the specified layer prefix/suffix. Text can also be combine onto one specific layer using the Combine All Text Option.

The Arrow buttons allows the user to interactively move the piece of text specified in the Text Annotation box.

The Text Insertion Method controls how the text is placed in the model. Text Macro are the most flexible, as the value of the text is updated when the model changes.

The placement of the decimal place can be specified as either justified over the survey point or subscript as is the norm for bathymetric charts.

The Extra Node option creates an extra display point for every survey point. This point is placed on the same layer as the surveyed feature and can be used to show the survey point in a layered manner on complex features such as macro-lines when exporting to CAD.

The feature wizard is an automation tool that helps you generate and maintain feature libraries with the minimum of effort. It offers the following facilities;

- All of the fields for a given feature are displayed in a single dialog, with a preview panel that shows a sample string or point for that feature, including annotation and symbology. This preview panel is updated when any field is changed.
- Feature styles may be saved and re-used. For example, if you set up a manhole with a circular symbol, and the plot name and cover level to the left of the symbol, you might save this as a man hole feature style. If you then wish to set-up a similarly drawn feature, such as a gas valve, you simply re-select the man-hole feature style, and the gas valve will inherit the man holes symbology and annotation settings.
- The feature wizard also allows you to create and edit text styles, which consist of font selection and display attributes, such as italicisation, and underlining.

## 4.3 Strings

In order to form a surface model and map from a survey, it is necessary to create a number of distinct geometric entities from the observed points. These include points, lines, curves, and combinations of lines and curves. In SCC, these entities are referred to as strings. An example of a string might be the edge of a road. This string would include sections of straight lines, curves and possibly gaps or discontinuities. A string can be two or three-dimensional and can have varying significance to the surface depending on how it is defined. An example of a two dimensional string might be an overhead telecommunications line which is displayed in plan for cartographic purposes. An example of a non DTM three dimensional line might be an overhead transmission line where the conductor cable could be represented as a three dimensional line in CAD and not influence the formation of the surface model. An example of a three dimensional string might be the edge of an embankment which is fully represented as a 3 dimensional line which significantly influences the surface model formation since it delineates a characteristic fold in the physical terrain.

### *String Number*

The string number field, available in detail coordinates view of the survey data set, indicates the instance of a given feature within a survey. All points in a survey with the same feature name and string number will be sequentially joined to form a single string. It is therefore used to distinguish multiple occurrences of the same feature. For example, if there are two distinct buildings in the survey both having the feature name BUILDING, all the points on the first BUILDING would have a string number of 1, and all the points on the second have a string number of 2. This makes it possible to survey part of Building 1 and move on to BUILDING 2. It would then be possible to subsequently come back to continue the first building by picking up the next sequential point on BUILDING 1. A string number of 0 is used to denote a point feature (unconnected point) such as a spot level, bus stop, traffic signal etc.

### *Tags*

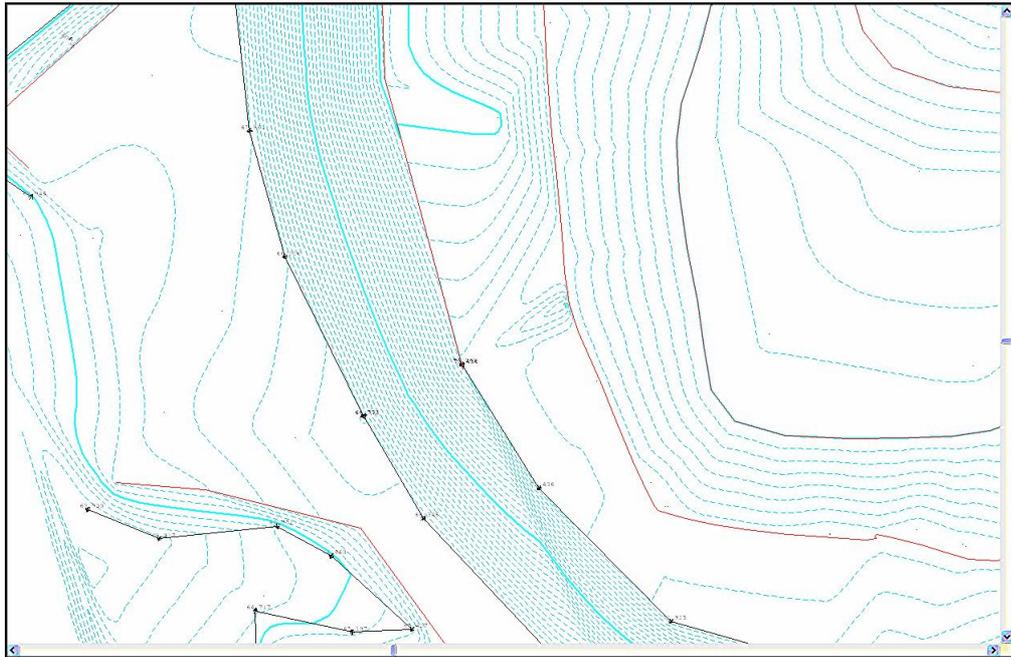
The tag code determines the connective geometry and specifies how the current point on the string will be connected to the next point on the string. This can be used to specify straight lines, curves, arcs, and squared up pieces of geometry in a string.

### *DTM Code*

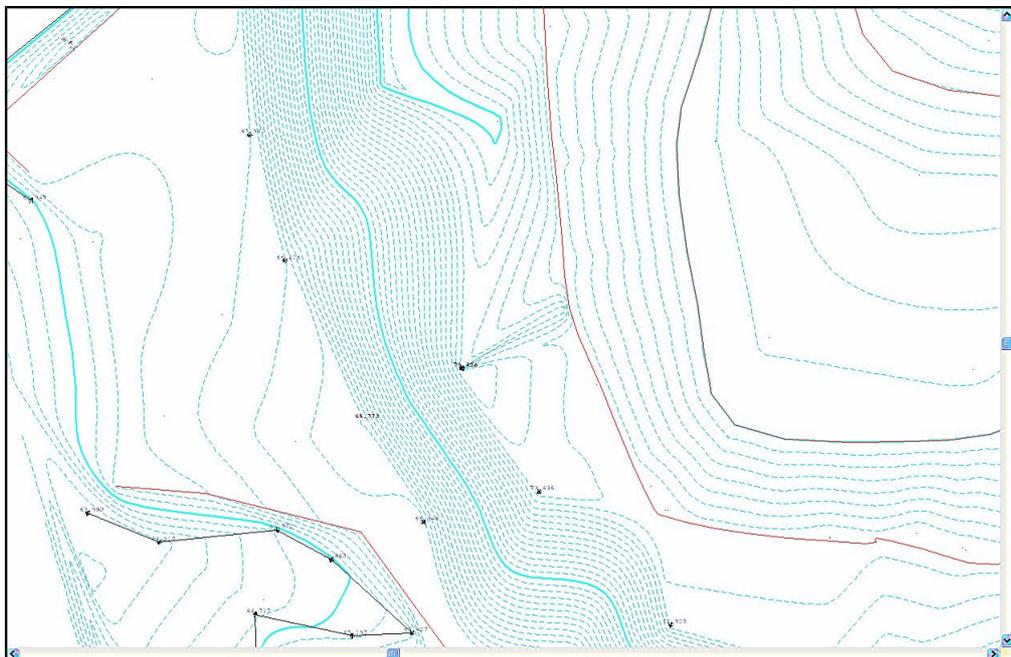
The DTM (Digital Terrain Model) status code determines the significance of the point of the surface model / digital terrain model being generated.

## 4.4 Models

Models within SCC are formed from a variety of co-ordinate files, such as reduced survey, DXF and GENIO. A model in SCC consists of the plan drawing and the feature library. If a SCC dataset is used to create a model then the feature library from that project will be copied as the feature library for the model file. If the model is generated directly from a co-ordinate file, new features encountered will be added to the default feature library (depending on the setting defined within General Options). A model comprises of cartographic map detail formed from the strings and a surface or TIN model used to form contours. TIN stands for Triangular Irregular Network. Put simply, this means that points adjacent to one another are connected to form triangular facets. These facets can be considered as oblique planes for the express purpose of interpolating contours, profiles, cross sections, volumes, and other surface analysis tasks. Strings are paramount in the creation of TIN as they are used to form breaklines, that is, linear areas of the surface, such as banks, ditches, and walls, where there is a sharp or marked discontinuity of the terrain surface. See diagram below:



The picture below shows the effect of not creating a breakline from a string where one was required. Compare this picture to the previous one of the same model. The dataset in terms of spatial co-ordinates remains the same but the formation of the triangulation has been deformed because the correct DTM code has not been selected. The selection of sufficient point density and the delineation of the physical surface characteristics for the purposes of intended use are prime requirements during the surveying process.



Models, which were created from SCC datasets, have links back to their original co-ordinate and survey observations files. As such they may also be used to graphically query all aspects of the detail survey database. Thus recovery from measurement errors, mistakes in DTM definition, feature object dimensions etc. may be achieved interactively. Data may be combined from a variety of sources for model creation.

## 4.5 Field Practice Applicable to SCC

### *Field Practice for Topographic Surveying*

SCC models are formed from point or line string information. Point strings are discrete points such as trees and spot heights whereas line strings are connected features such as roads, walls and hedges. In order for strings to appear in the model, the surveyor must record string information when surveying. This involves recording one or more fields that tell the software the type of feature being surveyed, e.g. Wall, Tree, Road, and optionally additional geometric information to specify the string number or instance of that feature, for example, WALL 02 might be the second wall surveyed.

The coding of string information in the field is dependent on the data collector being used. Data collectors, such as PocketDTM and AutoGRAD/MSMM, include distinct feature name and string number fields. This has the advantage that points on a string do not have to appear in sequential and unbroken order within the survey. For example, we could observe points on a road in sectional format from a number of different set-up stations yet they would appear as strings in the model. This can greatly reduce the overall amount of fieldwork. Modern total stations allow a high degree of customization, allowing us to collect as many or as few fields as required.

We can also collect geometric codes that allow us to specify the geometry connecting string sections, such as straights, curves, arcs, and rectangles, dimensional information, and various offsets.

On data logging systems without explicit fields for feature code, string number, tag code, etc... we can use the advanced field coding sheet to achieve most of the same results given a single point code field. This sheet determines whether a field code represents a feature code or a control code, and what to do with numeric values within a point code. For example, we might say that KB represents a KERB feature, connected by straights, whereas KBC might be a KERB feature connected by curves. Thus KB and KBC would lie on the same string. Similarly, we can say that for KB and KBC, any numerics in the point code represent the string number, such that KB02 and KBC02 represent straight line and curved segments of KERB string 2. We can also use control codes, for example ST might be used to start a new string with the current feature. Individual observations may also have more than one code when surveyed in this manner, for example HE01 GA might represent the junction point between HEDGE string 1 and a GATE. This type of coding allows us to replicate topographic field surveying techniques used in many popular legacy systems such as SDRMap, Panterra, LandScape and NRG.

### *Field Practice for Traversing*

SCC supports both traverse and network adjustment. As with topographic surveying, the method of collecting a traverse will vary between data loggers and instruments used. When surveying combined topographic detail and traverse data in a single job, observations with a specified feature code can be extracted into the traverse sheet for adjustment purposes.

A traverse connects chains of straight lines with measured lengths and angles. A traverse is one means of providing 2 or 3 dimensional control in which position is determined by a combination of angle and distance measurements between successive lines joining control stations. SCC allows closed and open traversing with several methods of traverse adjustment computed. The calculations will generate co-ordinates based on the error adjustment selected and it is the surveyor's responsibility to assess the accuracy of the calculated co-ordinates.

It is always good survey practice to record more information than necessary. When observing traverse information, sight to all possible stations. If extra measurements are observed to form a network the Least Squares traverse adjustment should be carried out. This adjustment can also be computed in PocketDTM prior to using SCC.

When observing an open traverse no adjustment may be selected and provisional co-ordinates used.

Where possible ensure the RO is part of the traverse and not an external observation.

The accuracy of the traverse is governed largely by the observation and measurement techniques applied and by the type of equipment used.

### ***Field Practice for Setting Out***

SCC allows uploading of data from co-ordinate files to a number of dataloggers. Sections, strings or contours may be uploaded to the logger.

Generally design data will be imported into SCC from MX, DOER or CAD. This data would be uploaded to the datalogger to set out positions of proposed buildings or structures.

Road alignments are usually set out in section. It is important that the stringing is correct before uploading sections for setting out. When you have created the sections you wish to set out, export the section file to a survey dataset (co-ordinate file) and upload the dataset.

The zero contour line on an isopachyte model may be set out on the ground to determine the extent of boundary between the cut and fill on the ground. The position of the cut or fill contours from the isopachyte model may be uploaded to set out the position of the excavations.

## **5 Getting Started**

### **5.1 Creating A New Project**

A new project should be created before data may be downloaded into SCC or models formed. The project file stores the co-ordinates of stations used in the surveys which are stored in the current directory.

It is important that there is only one project file open at a time.

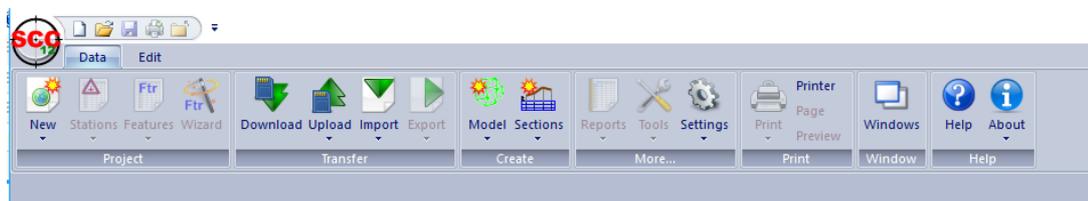
#### ***Creating a New Project***

Two options are available when SCC is opened, either open an existing project or start a new project.

When using SCC for the first time, it is necessary to start a new project.

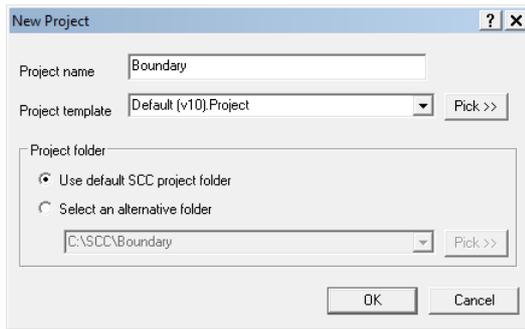
#### ***Starting the Software***

**Double click the SCC Icon**



**From the 'DATA tab > New'**

If a project from the New drop down menu at this point, **no directory** will be set up for the project directory. This option will simply create a project file in the 'C:\SCC\' directory, and associated files will be placed there as well. This will make it difficult to track project work files. Selecting the 'New' button gives the user the option to select a Project Template (Feature Library).



### Creating A Project Directory

From the Main Screen, select 'DATA tab > New'

Enter in a Project/Job name

Select a Project Template from the list 'Default v11 Complex.Project'

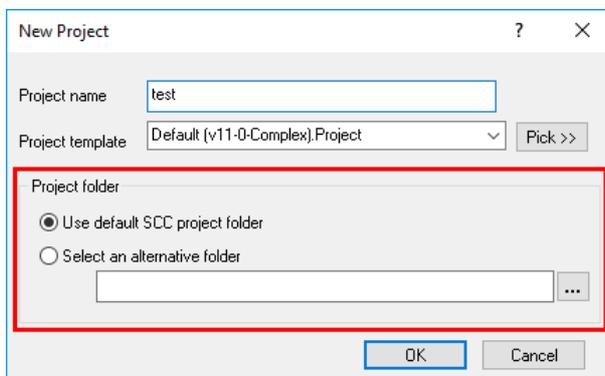
Select 'OK'

The **project template** contains all the feature coding, layering, string labelling, modelling, symbology and annotation standards that will be applied to the project.

The project itself consists of a spreadsheet containing the control stations used in the project, along with a feature library spreadsheet.

Feature	Field Code	Description	Plot name	Ground type	Layer	Lbl	Subr	Tag	Master	DTM	Master
13	CU	CULVERT (SINGLE LINE)			STRUCTURES	CU	CU	S	Survey	B	Library
14	CUS	CULVERT (SINGLE LINE)			STRUCTURES	CU	CU	S	Survey	B	Library
15	DHC	DITCH (CENTRE)			DITCHES	D	D	S	Survey	B	Library
16	DHS	DITCH (SINGLE LINE)			DITCHES	D	D	S	Survey	B	Library
17	EP	ELEC POST	EP		UTILITIES	PBT	0000	G	Library	D	Library
18	ER	EDGE OF ROAD			ROADS	ER	ER	S	Survey	B	Library
19	EY	ELEC PYLON (STRING)	E.PYLON		UTILITIES	EY	EY	S	Survey	B	Library
20	FE	FENCE			FENCES	F	F	S	Survey	B	Library
21	FG	FOLIAGE RIGHT			TREES	VD	VD	S	Survey	E	Library
22	FGL	FOLIAGE LEFT			TREES	VD	VD	S	Survey	E	Library
23	FH3	FIRE HYDRANT (G3)	HYD		UTILITIES	FH	FH	Rec3	Library	D	Survey
24	FPS	FOOTPATH (SINGLE LINE)			FOOTPATHS	FP	FP	S	Survey	B	Library
25	GE	GATE (G2)			FENCES	GA	GA	S	Survey	D	Survey
26	GH	GLASSHOUSE			BUILDINGS	GH	GH	S	Survey	B	Library

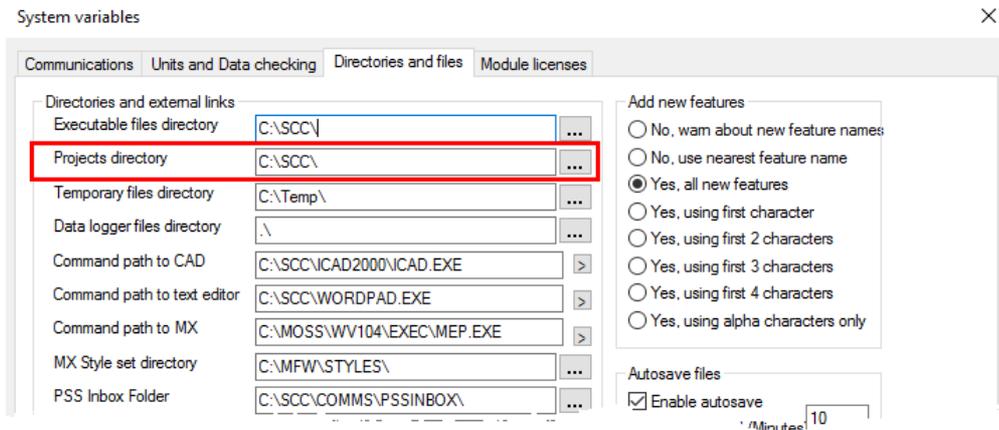
### Project Folder



### Use default SCC project folder

This option creates a directory under the SCC root level directory/Project Directory ('General Options > Directories and Files'), and creates a project file in that directory. The name of the new directory is taken from the project name.

For example, within the General Options the user has the Project Directory set to 'C:\SCCProjects\' as shown below:



Therefore, a new project folder will be created called Test ('C:\SCCProjects\Test\') and associated files will be downloaded/saved and exported to this directory.

### **Select an alternative folder**

This option allows the user to specify a specific project directory different to the directory specified within the General Options in which the project file is placed.

## **5.2 The Feature Library**

The feature library controls how survey spreadsheets are translated into graphical SCC models, CAD drawings, and MX models. It includes a large number of fields for each survey feature that control how it is drawn, annotated, modelled, and output. Each project in SCC should have its own feature library.

To set-up a new feature it is often easiest to use the feature wizard as follows;

**Type the feature name and description into the boxes at the top right of the dialog.**

**Pick a base style that most closely matches the feature you are creating. Scrolling through the base styles is a good way of looking at how different features can be drawn.**

**Change the CAD layer, MX label, and any other fields as required.**

**To change any annotators, select the annotator in question from drop down menu, e.g. Level, and then modify the other annotation fields.**

**If you wish to create a number of other features with a similar look, type in a new base style and press 'Save'.**

**When you have finished, press OK**

**Select 'SCC button > Save' or 'SCC button > Save As' to save the project.**

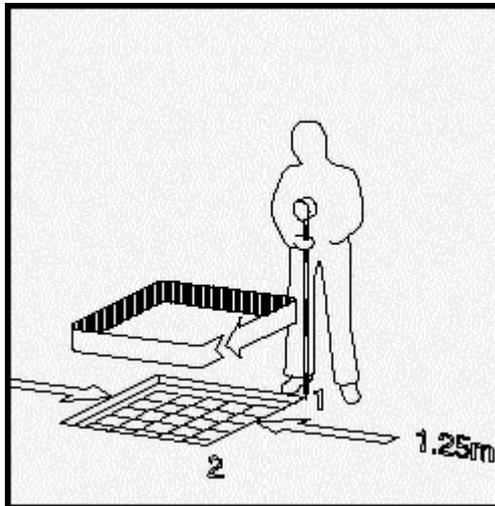
If you wish to change a field value for a large number of features, it will be quicker to do this directly in the feature library spreadsheet using the search and replace function.

### **5.2.1 Using the Feature Library**

This section describes how to record specific features in the field and then set up SCC so as it will automatically draw these specific features when they are downloaded.

### 5.2.1.1 Creating Rectangles (Using the Feature Library)

The rectangle option speeds up the process of surveying rectangular features such as inspection covers, road gullies or simple buildings. The surveyor need only record two successive points while moving in a clockwise direction around the feature. The breadth of the feature must then be entered in the dimension field of the data logger.

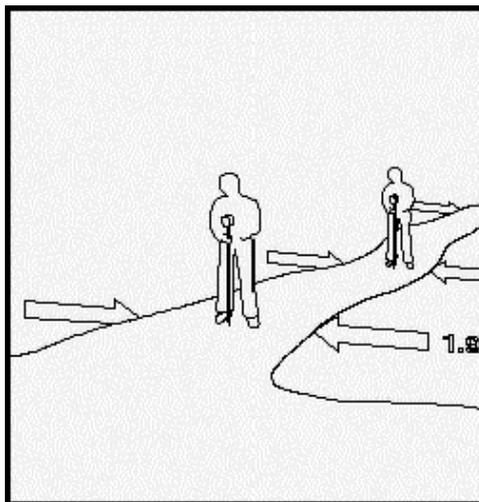


To generate rectangles in SCC the switch Create squares and rectangles in the Co-ordinate Reduction options must be turned on, and the symbology field for that particular feature name must be set to Rectangle in the Feature Library.

Note that if any feature is inadvertently surveyed in an anti-clockwise direction then the rectangle will be generated on the wrong side of the surveyed line. This can be corrected by reversing the string direction using the global editor.

### 5.2.1.2 Creating Strip Levels (Using the Feature Library)

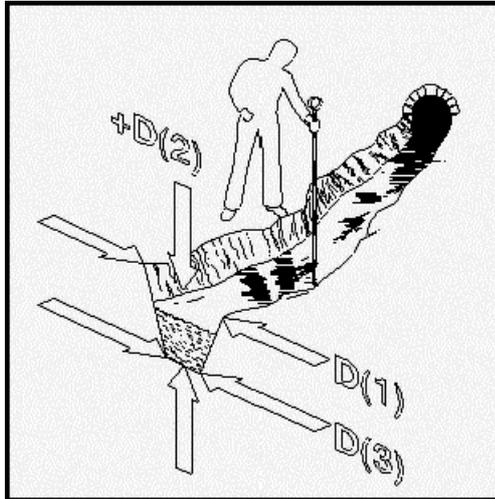
Surveying the centre-line of a linear feature such as a track, ditch or wall generates a strip-level. As the surveyor progresses along the centre-line the width of the feature must be entered into the dimensional field in the survey data recorder.



When the survey data is processed in SCC the feature will be displayed as a strip of the appropriate width. The centre-line will not be displayed. In order to have specific features treated as strip-levels, turn on the switch to Create 'Strip levels' within the co-ordinate reduction options and in the Feature Library the symbology field for that particular feature name must be set to Strip level. Note that all instances of that feature will now be treated

as a strip-level.

SCC provides the option to model three-dimensional strip-levels. Thus, features such as streams, ditches or walls may be surveyed as a series of points along the centre-line with an associated width for the top and the base; the height or depth of the feature at each surveyed point should also be recorded. In the case of a stream the rod will typically be placed on the stream bed, the strip-level dimensions should be entered into the data logger's dimensional fields as indicated in the diagram.

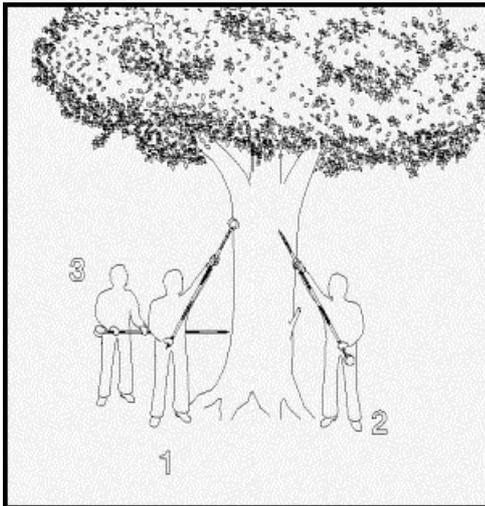


Note that the depth of the stream course will be positive if the rod is placed on the bed. To have all streams treated as strip-levels set the options within SCC as described above.

In the case of a wall, the dimensions should be entered into the survey data recorder dimension fields as illustrated in figure below. Note that because the top of the wall has been observed the height should be entered into the second dimensional field as a negative value. In order to have walls treated as strip-levels in the SCC model, follow the procedure described above. The second width (that is the third dimensional field) must always be less than the first width as over-hangs cannot be triangulated. If the first and second dimensions are recorded, but the third field is omitted SCC will supply a default width for the third field (the value for the first dimension will be copied into the third dimension).

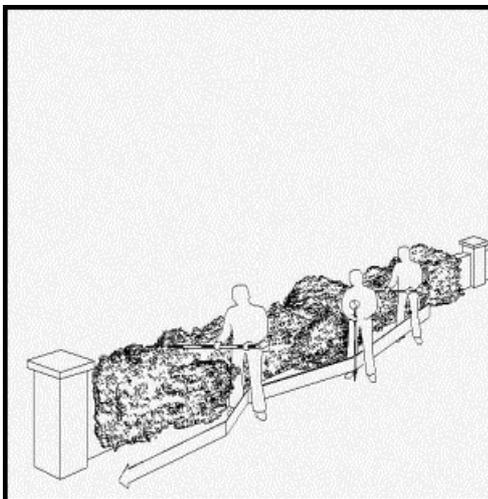
### 5.2.1.3 Creating Trees (Using the Feature Library)

SCC places two symbols for trees; one representing the canopy and the other the trunk. The process of surveying a tree is illustrated in the diagram. Generally, the reflector is first placed to the side of the trunk such that the observer can measure the distance from the instrument to the centre of the trunk. The centre-line of the trunk - relative to the instrument - is then indicated so that the instrument operator may hold the observed distance fixed whilst observing the correct horizontal angle; these are then downloaded to the data recorder as a pair. Finally, the assistant will measure the mean canopy and trunk diameters; these will be entered in the D (1) and D (2) fields of the data logger respectively. In order to have trees appear as scaled symbols in the model the following options must be set within the SCC feature library; you must enter the symbol name Tree in the Symbol field for the feature TREE and symbology field must be set to Scaled Point.



#### 5.2.1.4 Inaccessible Linear Features

The diagram illustrates the process of surveying an inaccessible linear feature; in this instance a wall, which is obscured by a hedge. The feature is recorded as an offset; an offset right in this example, as the wall lies to the right of the line of progress. A series of points are observed in convenient positions and the offset distance to the wall is entered into the dimensional field of the data recorder. SCC treats offsets to the right as positive and those to the left as negative. To have offsets processed you must set the Parallel feature offsets switch in the co-ordinate reduction options dialog to Apply in the X-Y Plane. This option may be found in the File menu of the Detail Observations and Detail Co-ordinate spreadsheets. The other settings within this option are used when processing building facade surveys



### 5.3 Import & Downloading Files Into SCC

Having created the project, it is necessary either to import data into a dataset or to download traverse and detail information. SCC must be told what survey instrument/logger format to use, what type of data is being downloaded and what type of media it is being downloaded from.

For training purposes, the download process from some of the common survey instruments and logging formats are discussed.

### 5.3.1 Importing Data Into SCC

SCC can import files from various other systems. All imported files are co-ordinate files and are displayed in the co-ordinate spreadsheet. Because only co-ordinate information was input it is not possible to access detail observations, instrument set-ups or extra measurements information.

Select 'DATA tab > Import drop down' and select file type from given list.

### 5.3.2 Downloading & Processing Traverse Data

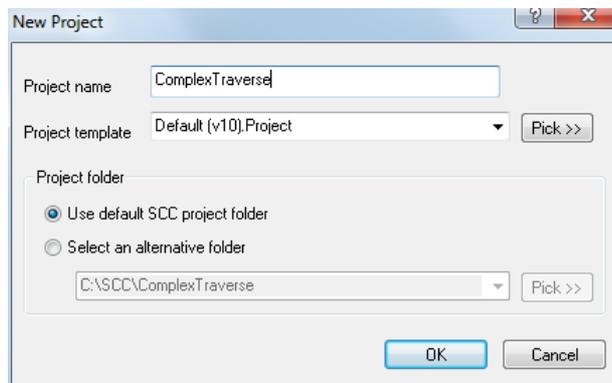
From the 'DATA tab > Download Survey Data' dialog, it is possible to select the type of datalogger used (Detail Topography, Traverse, As Set Out or Levelling) and the input device being used. It important to specify which type of data is being input.

#### 5.3.2.1 Processing A Complex Traverse

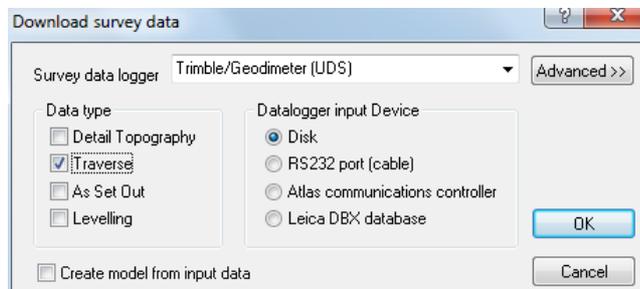
The following worked example shows how to process a complex control project in SCC that includes interlinked traverses, cross braces and additional side-shots. This includes processing the complete observation set as an unconstrained network via least squares, extracting separate traverses for Bowditch adjustment, and fixing the primary stations for constrained least squares adjustment. The steps to achieve this are given below;

#### *Project Creation & Download*

'DATA tab > New' to create a new project based around the default template.



Into this project use 'DATA tab > Download ' to download the Trimble / Geodimeter UDS file, \SCC\Tutorials\ComplexTrav.DAT, using the parameters shown.



Trimble/Geodimeter data input

Input data type

Angle and distance observation

GPS local X,Y,Z Coordinates

GPS WGS84 X,Y,Z Coordinates

OK

Cancel

Advanced >>

User defined fields (Detail)

D1 90 String No 999 Offset 92

D2 91 Tag code 999 Remark 0

D3 999 DTM Code 999

Disable automatic string number (FCG)

Disable extended feature coding

Landscape coding extensions Edit >>

Re-process radial and right-angle offsets (72,73)

Default dimensions between observations

User defined fields (Traverse)

Sighted Station 5 Traverse Code 9

Traverse Feature 990

Use enhanced coding extensions View >>

Code separator

Comma  Decimal point  Space

Last Field in Detail record 9 Slope Distance

Last Field in Setup record 9 Slope Distance

Last Field in Station record 39 Z / Elevation

Last Field in Traverse record 9 Slope Distance

This results in the traverse spread-sheet given below;

Setup	Round	At Stn.	To Stn.	Code	Use Obs	Inst Ht.	Rod Ht.	HA.	-VA.	-SI Dist.	Prism	Apply	Remark
1	1	SH02	SH13	ORO	Yes	1.6510	1.6420	085 39 04	086 55 49	108 231	0.0000	No	Line: 1 Obs:9
2	1	SH02	SH01	SS	Yes	1.6510	1.5610	105 09 35	089 02 51	52 819	0.0000	No	Line: 2 Obs:19
3	1	SH02	SH03	SS	Yes	1.6510	1.6330	014 50 08	089 21 12	103 271	0.0000	No	Line: 3 Obs:29
4	2	SH05	SH04	BS	Yes	1.6630	1.6670	352 33 49	089 34 55	99 590	0.0000	No	Line: 4 Obs:42
5	2	SH05	SH06	SS	Yes	1.6630	1.7920	172 00 01	089 29 34	113 354	0.0000	No	Line: 5 Obs:52
6	2	SH05	SH20	SS	Yes	1.6630	1.6820	114 25 12	090 51 28	38 521	0.0000	No	Line: 6 Obs:62
7	3	SH20	SH05	BS	Yes	1.6820	1.6630	078 41 50	089 08 36	38 520	0.0000	No	Line: 7 Obs:75
8	3	SH20	SH21	SS	Yes	1.6820	1.5950	282 26 33	092 49 54	31 918	0.0000	No	Line: 8 Obs:85
9	4	SH21	SH20	BS	Yes	1.6260	1.6900	287 45 12	087 13 13	31 920	0.0000	No	Line: 9 Obs:98
10	4	SH21	SH22	SS	Yes	1.6260	1.5920	302 58 46	104 36 21	11 647	0.0000	No	Line: 10 Obs:108
11	4	SH21	SH23	SS	Yes	1.6260	1.6000	343 20 44	103 26 21	12 361	0.0000	No	Line: 11 Obs:118
12	4	SH21	SH24	SS	Yes	1.6260	1.6000	114 23 00	103 06 34	12 260	0.0000	No	Line: 12 Obs:128
13	4	SH21	SH25	SS	Yes	1.6260	1.6000	126 31 05	097 53 30	20 291	0.0000	No	Line: 13 Obs:138
14	4	SH21	SH26	SS	Yes	1.6260	1.6000	170 22 37	107 22 54	9 226	0.0000	No	Line: 14 Obs:148
15	5	SH22	SH21	BS	Yes	1.5920	1.6260	000 00 07	075 27 08	11 645	0.0000	No	Line: 15 Obs:165
						1.5310					0.0000	No	Line: 16 Obs:178

## Adjustment of Traverse

Adjust the control in its entirety, using a least squares adjustment with minimal constraints.

Select 'TRAVERSE tab > Set-up', and enter an opening setup as shown in the dialog below.

Note that only the closing station and RO should be left 'Free'.

Select 'TRAVERSE tab > Adjust' and adjust this data by least squares.

When prompted, save the adjusted values to the project station sheet.

Traverse Setup

Opening Setup Closing Setup

Opening Station

Name: SH02

E/X: 10000.000

N/Y: 10000.000

Level/Z: 100.000

Reference Object Station

Name: SH13

E/X: 10000.000

N/Y: 10108.076

Level/Z: 105.806

Station type

XY: Fixed

Z: Fixed

Orientation method

Entered as a Bearing

Calculated from Coordinates

RO Stn Type

XY: Free

Z: Free

Opening Orientation: 090 00 00

OK Cancel Apply Help

Traverse Adjustment

Adjustment method

Bowditch / Compass Rule

Least Squares / Variation of Coordinates

Exclude fixed bearing observations for opening and closing set-ups

Force station constraints

Compute provisional values only

No plan adjustment

Least squares height adjustment

No height adjustment

Default/manual weighting

Height accuracy (mm): 3

Distance weighting (mm per KM): 1.442

Output report filename: ComplexTrav\REP

Horizontal accuracy (secs): 3

Distance accuracy (mm): 5

Scale accuracy (ppm): 2

Convergence tolerance: 0.001

Maximum iterations: 10

OK Cancel

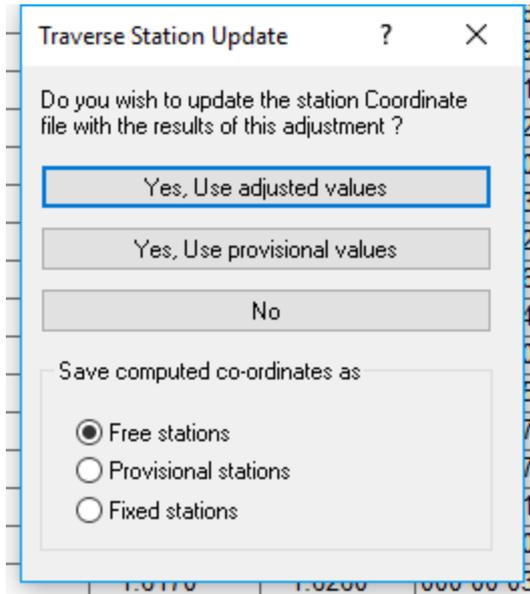
### Review report

SCCW64r

Traverse adjustment report written to file ComplexTrav.REP

Do you wish to edit this report ?

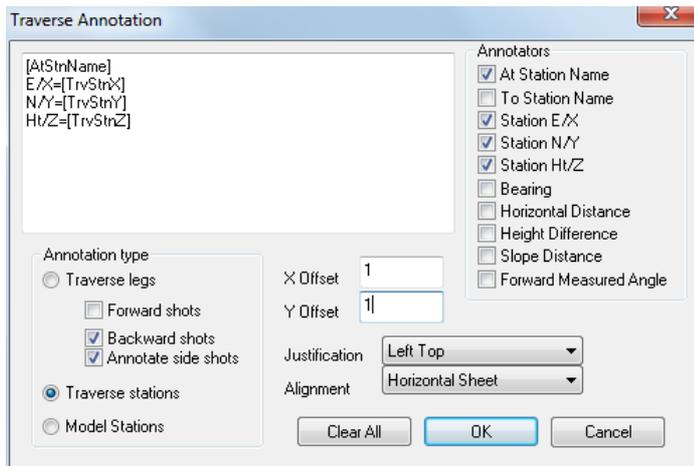
Yes No



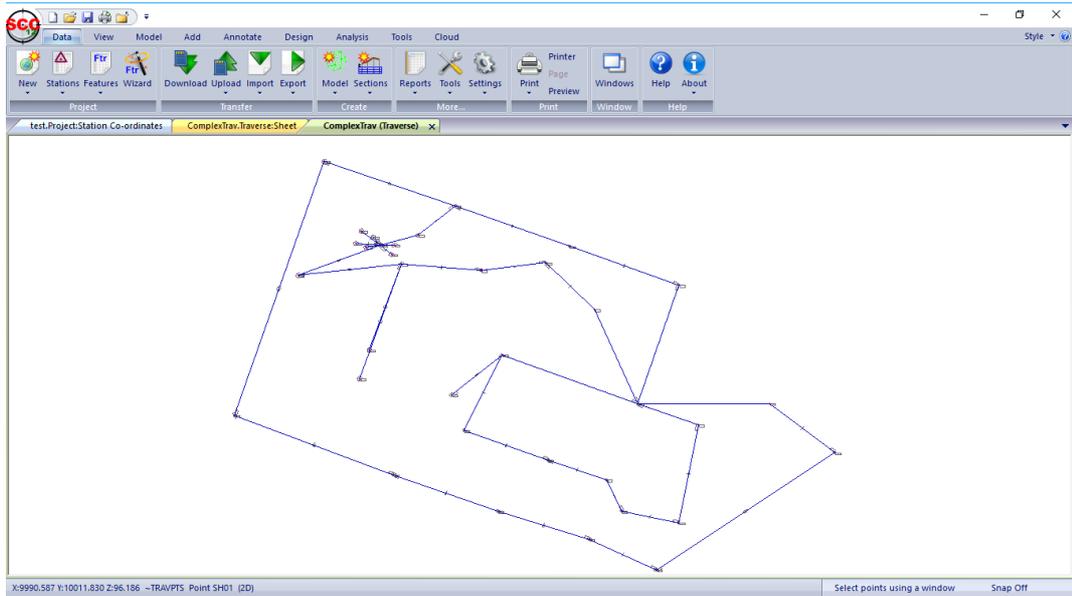
### ***Initial Plot & Annotation of Network***

Select 'TRAVERSE tab > Model'

Annotate the station names using the Traverse Annotation dialog as shown below:



This will result in the following traverse diagram, that we will use to select potential Bowditch adjustable loops.



Save this model as 'ComplexTrav.Model'

### Extract Primary Loop Traverse

Go back to the traverse view and select 'TRAVERSE tab > Set-up',

In our set-up screen now enter the opening and closing stations and references objects for the loop we wish to extract, in this case opening 'SH03-SH02', closing 'SH02-SH03'.

Traverse Setup

Opening Setup Closing Setup

Opening Station		Reference Object Station	
Name	SH03	Name	SH02
E/X	10033.934	E/X	10000.000
N/Y	10097.533	N/Y	10000.000
Level/Z	101.235	Level/Z	100.000

Station type Orientation method RO Stn Type

XY	Free	<input checked="" type="radio"/> Entered as a Bearing <input type="radio"/> Calculated from Coordinates	XY	Fixed
Z	Free		Z	Fixed

Opening Orientation 090 00 00

OK Cancel Apply Help

Select 'TOOLS drop down menu > Extract new route' to search for any potential routes through the control network using these opening and closing conditions.

In this case, SCC can find nine possible routes that would meet these conditions, which are outline in the route selection dialog.

The route details panel in this dialog shows the set-up sequence for each potential route. This is in the form S#<Setup number> <From Station> - <At Station> - <To Station>, for each set-up. It is useful to refer to our previously generated traverse diagram, to confirm the desired route.

In this case, we will pick the second possible route.

We can now adjust this traverse, using 'TRAVERSE tab > Adjust', via a Bowditch method to give the following results.

Traverse Adjustment

Adjustment method

- Bowditch / Compass Rule
- Least Squares / Variation of Coordinates
  - Exclude fixed bearing observations for opening and closing set-ups
- Compute provisional values only
- No plan adjustment

Least squares height adjustment

- No height adjustment
- Default/manual weighting

Height accuracy (mm)

Distance weighting (mm per KM)

Output report filename

Horizontal accuracy (secs)

Distance accuracy (mm)

Scale accuracy (ppm)

Convergence tolerance

Maximum iterations

OK Cancel

Given that these results are acceptable, we will save this traverse as ‘Outer-loop.Traverse’.

When prompted, save the adjusted values to the project stations sheet. We can now change the values of all or some of these stations from ‘Free’ to ‘Fixed’ or ‘Fixed XY’ in the project stations sheet, and repeat the least squares adjustment on ‘ComplexTrav.Traverse’. This will re-adjust all the remaining stations using the fixed values from this primary loop.

SCCW64r

Traverse length 1305.467  
Angular misclosure 000 00 16.0

Before angular adjustment (Compass Rule)

Length misclosure 0.024  
Linear accuracy is 1 in 55305

Misclosure in E/X is 0.006  
Misclosure in N/Y is 0.023  
Misclosure in Z is 0.0010

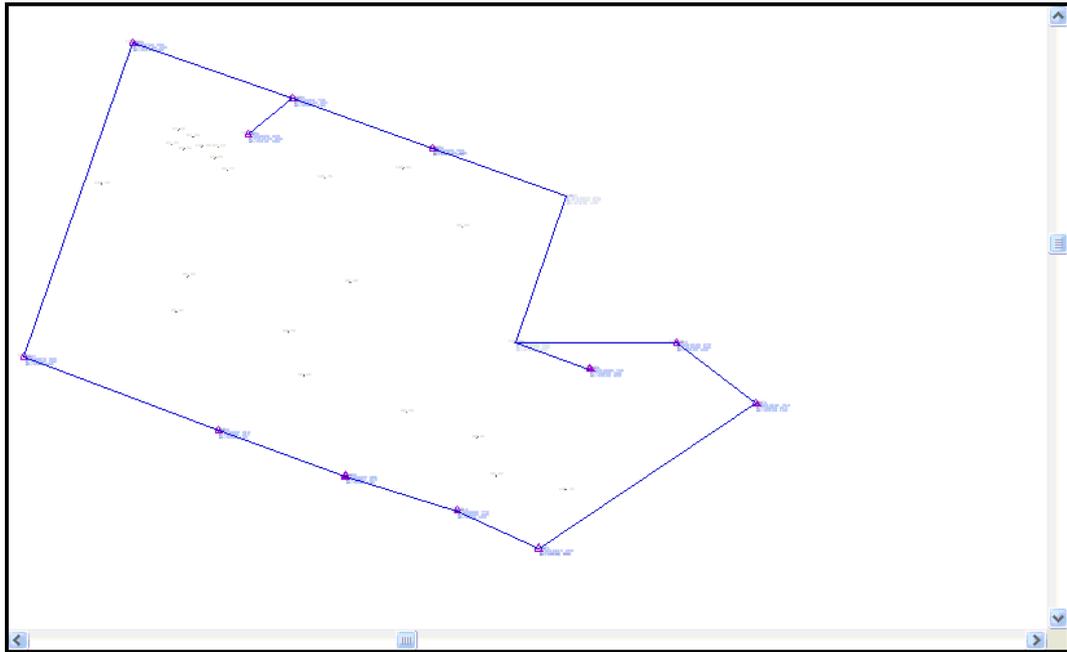
After angular adjustment (Bowditch)

Length misclosure 0.031  
Linear accuracy is 1 in 42541

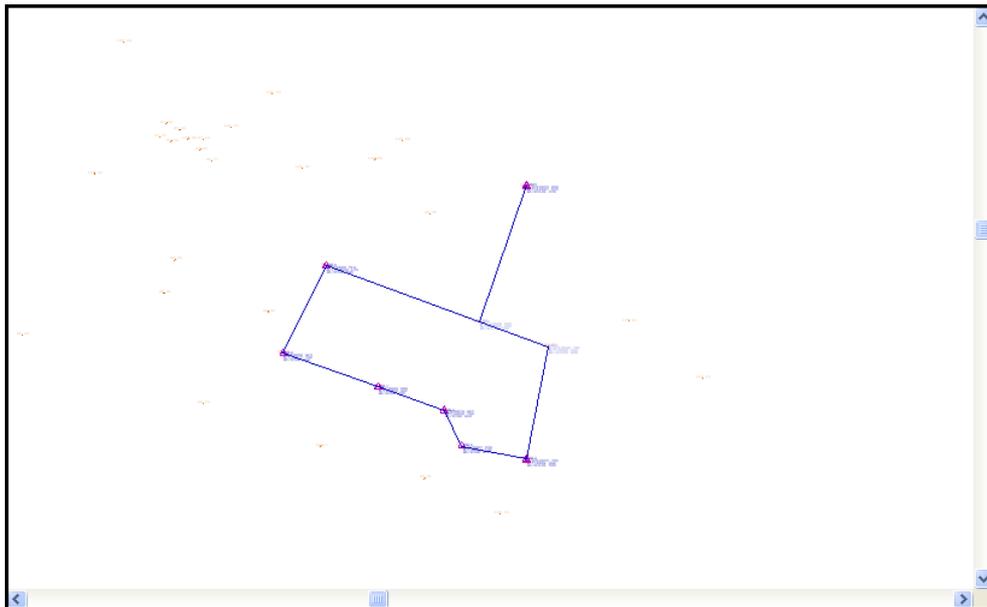
Misclosure in E/X is 0.009  
Misclosure in N/Y is 0.029  
Misclosure in Z is 0.0010

OK

To generate a graphic of our primary loop, go back to our model (Stns.Model), select ‘FILE > Attach/Detach > Edit/Detach > Detach All’, followed by ‘FILE > Attach/Detach > Attach traverse’ and select ‘Outer-Loop.Traverse’. Save the result using ‘FILE > Save As’ giving the name ‘Outer-Loop.Model’



Repeat the above exercise on the inner loop, with opening set-up 'SH01-SH02', closing set-up 'SH02-SH01', to yield the results



We can extract as many loops or linked segments for this type of analysis as required. Note that the route extraction module may use side-shots as fore-sights, and reverse set-up sequences in order to establish potential routes. This allows us to swap opening and closing setups to reverse a traverse.

If we wish to exclude any observations from this, or any other analysis, change the 'Use Obs' flag on those observations from 'Yes' to 'No'.

### 5.3.2.2 Processing A Resection Network

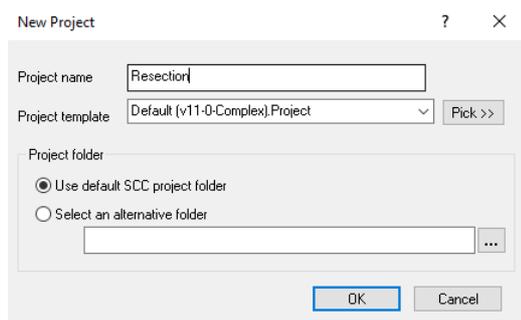
The following tutorial covers the processing of the Leica GSI control network provided in the file 'Resection-Network.GSI' (available in \SCC\Tutorials). The job consists of a large number of total station measurements from primary unknown stations to other secondary unknown stations. The network can be computed as there are enough common target points between each set-up to allow computation of provisional values of all primary stations by resection (or

free-station), and secondary stations by direct trigonometry. Due to the interdependency of the stations, the computation of provisional coordinates is iterative, whereby new station coordinates are generated with each iteration thus providing base information for successive iterations. Having computed all of the provisional station coordinates, the network can then be adjusted using a least squares variation of coordinates method, which provides the best and most consistent final station values for the observed data.

The steps taken to process this job are as follows:

### ***Project Creation & Download***

**'DATA tab > New' to create a new project based around the default template.**



**Into this project use 'DATA tab > Download ' to download the 'Leica GSI 8/16', \SCC\Tutorials\Resection-Network.gsi, using the parameters shown.**



Leica data input ? X

Detail fields

Feature	41	LOS.Ofs L/R	999	D1	42
Tag code	999	LOS.Ofs F/B	999	D2	43
DTM Code	999	Par.Ofs L/R	999	D3	44
String No	999	Par.Ofs F/B	999		
Remark	999	Ht/Z Ofs	999		

Extra measurement fields

Type	71	Feature	72		
D1	73	D2	74	D3	75

Point duplication

Disable duplicate points

Enable for multiple code lines with 'Duplicate' tag code

Enable for all multiple code lines

Carry first feature entered  Carry last feature entered

Traverse observation feature code

Use instrument height field (88) to indicate new setup

Store station co-ordinates

Landscape coding extensions

Use enhanced coding extensions

Codes precede observation

Use topo X,Y,Z in preference of Ha,Va,Sd

Default units are millimeters

### Traverse Reduction Processing of Traverse Data

Given the size of the job, 1076 observations to 321 stations, it is advisable to reduce the data prior to adjustment.

Select 'TRAVERSE tab > Tools drop down menu > Reduce' to reduce the data.

Traverse reduction options X

Reduce face left / face right  Output results to Crystal reports

Reduce multiple rounds

Search for reversed rounds

Report only, do not store results

Store differences as obs residuals

Store reduction standard deviations as standard errors

Turn off out of tolerance obs

Highlighting tolerances

dHoriz.Angle	000 00 05
dVert.Angle	000 00 10
dSlope.Dist	0.010

Use LU reduction method and output

The reduction creates mean forward measured angles and distances for multiple similar observations, in this case reducing the number of input observations from 1076 to 538. The reason for doing this is primarily processing time. Many of the matrix manipulation routines in the least squares adjustment are making a number of computations based on the square of number of observations times the number of unknown stations, i.e.  $(1076 \times 1076 \times 320 = 370,488,320$  for unreduced data, or  $538 \times 538 \times 320 = 92,622,080$  for reduced data). Using the reduced data also provides better initial provisional coordinates, such that fewer iterations of the transformation are required to get a final result. The net effect is that on a 1.5Ghz machine, adjusting the data without first reducing it will take about 110 minutes, whereas adjusting the reduced data takes about 7 minutes. If individual observation residuals, as opposed to residuals on averaged measurements, are required, you should not reduce the data prior to the adjustment.

## Processing of Traverse Data

Enter the opening and closing set-ups.

Select 'TRAVERSE tab > Set-up' and enter the setups as shown below.

The screenshot shows the 'Traverse Setup' dialog box with the 'Opening Setup' tab selected. It contains two main sections: 'Opening Station' and 'Reference Object Station'. The 'Opening Station' fields are: Name (STN00999), E/X (10000.000), N/Y (10000.000), and Level/Z (100.000). The 'Reference Object Station' fields are: Name (R003), E/X (10000.000), N/Y (10005.758), and Level/Z (99.309). Below these are 'Station type' (XY: Fixed, Z: Fixed), 'Orientation method' (radio buttons for 'Entered as a Bearing' and 'Calculated from Coordinates'), and 'RO Stn Type' (XY: Free, Z: Free). An 'Opening Orientation' field contains '000 00 00'. At the bottom are 'OK', 'Cancel', 'Apply', and 'Help' buttons.

The screenshot shows the 'Traverse Setup' dialog box with the 'Closing Setup' tab selected. It contains two main sections: 'Closing Station' and 'Reference Object Station'. The 'Closing Station' fields are: Name (0), E/X (0.000), N/Y (0.000), and Level/Z (0.000). The 'Reference Object Station' fields are: Name (0), E/X (0.000), N/Y (0.000), and Level/Z (0.000). Below these are 'Station type' (XY: Free, Z: Free), 'Orientation method' (radio buttons for 'Entered as a Bearing', 'Calculated from Coordinates', and 'Computed backsight bearing'), and 'RO Stn Type' (XY: Free, Z: Free). A 'Closing Orientation' field contains '090 00 00'. At the bottom are 'OK', 'Cancel', 'Apply', and 'Help' buttons.

As we have no known station values, we are using the minimum allowable constraints which are one known station to provide position, and one known bearing, to provide orientation.

## Adjustment of Traverse

From Select 'TRAVERSE tab > Adjust' and enter the parameters shown.

**Traverse Adjustment** ? X

Adjustment method

Bowditch / Compass Rule

Least Squares / Variation of Coordinates

Exclude fixed bearing observations for opening and closing set-ups

Force station constraints

Compute provisional values only

No plan adjustment

Least squares height adjustment

No height adjustment

Default/manual weighting

Height accuracy (mm)

Distance weighting (mm per KM)

Output report filename

Horizontal accuracy (secs)

Distance accuracy (mm)

Scale accuracy (ppm)

Convergence tolerance

Maximum iterations

This will create the report shown at the end of this document. When prompted, update the project station values with the adjusted results, and save the traverse and project

### Annotation of Traverse

Create a model of the data, showing the stations, network, and error ellipses.

**From 'TRAVERSE tab > Model' as dataset. Set up the following:**

**Traverse Annotation** X

[AtStrName]  
E/X=[TrvStrX]  
N/Y=[TrvStrY]  
Ht/Z=[TrvStrZ]

Annotation type

Traverse legs

Forward shots

Backward shots

Annotate side shots

Traverse stations

Model Stations

X Offset

Y Offset

Justification

Alignment

Annotators

At Station Name

To Station Name

Station E/X

Station N/Y

Station Ht/Z

Bearing

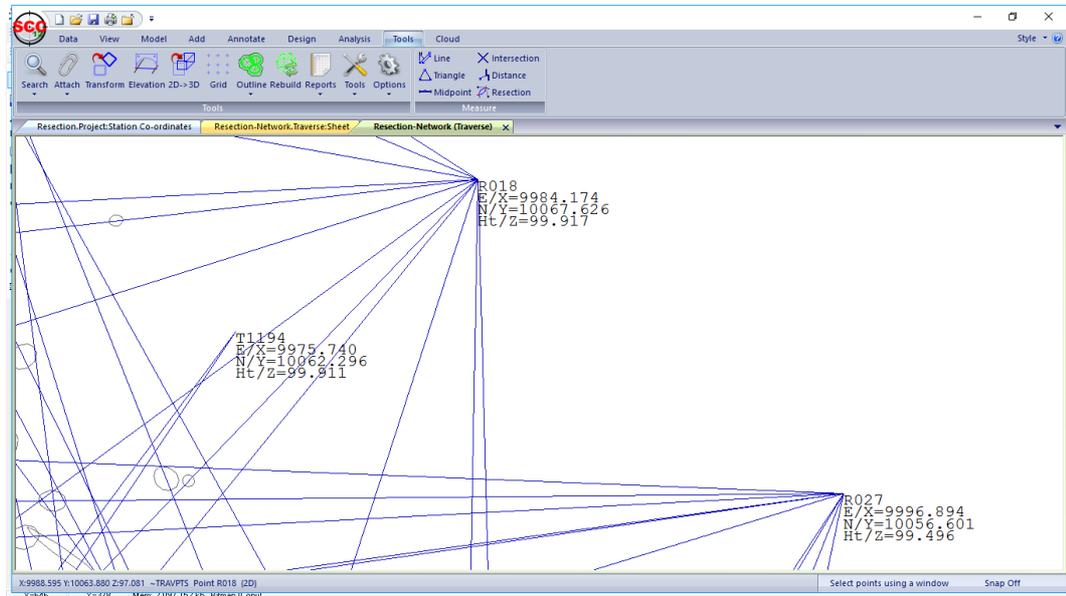
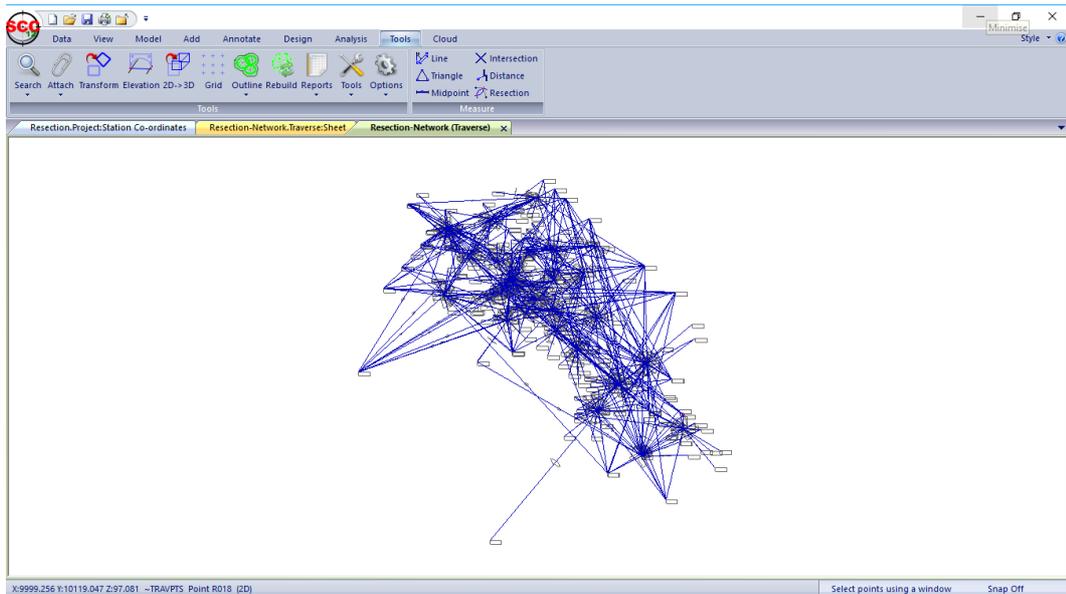
Horizontal Distance

Height Difference

Slope Distance

Forward Measured Angle

This will generate the picture shown below.



### 5.3.3 Downloading & Processing Detail Topography Data

Once station coordinates have been computed, detail topography can be downloaded.

It is important to remember that only the survey file is automatically saved on download. All other files must be saved by the user.

Sample download proceeds for specific data formats are examined as follows:

#### 5.3.3.1 Downloading Leica Data

SCC includes a number of different Leica interfaces to support correspondingly different data collection strategies. The simplest of these is the TPS series interface which maps user definable fields on the instrument directly onto SCC observation fields.

#### **Leica GSI 8/16**

##### **Downloading Leica Data**

Select 'DATA tab > Download Survey Data'

Set Survey Data Logger to 'Leica GSI 8/16'

Highlight 'Traverse' or 'Detail Topography' as the Data Type

Set Input Device to 'Disk', 'RS232 port (cable)' or 'Atlas communications controller' as required

Select 'OK'

Download survey data

Survey data logger: Leica GSI 8/16 [Advanced >>]

Data type:

- Detail Topography
- Traverse
- As Set Out
- Levelling

Datalogger input Device:

- Disk
- RS232 port (cable)
- Atlas communications controller
- Leica DBX database

Create model from input data

[OK] [Cancel]

Select the file you require and 'OK'

Leica data input

Detail fields:

Feature	41	LOS.Ofs L/R	99	D1	42
Tag code	99	LOS.Ofs F/B	45	D2	43
DTM Code	99	Par.Ofs L/R	99	D3	46
String No	99	Par.Ofs F/B	99		
Remark	44	Ht/Z Ofs	99		

Extra measurement fields:

Type	99	Feature	99		
D1	99	D2	99	D3	99

Point duplication:

- Disable duplicate points
- Enable for multiple code lines with 'Duplicate' tag code
- Enable for all multiple code lines
- Carry first feature entered
- Carry last feature entered

Traverse observation feature code: 990

- Use instrument height field (88) to indicate new setup
- Store station co-ordinates
- Landscape coding extensions [Edit >>]
- Use enhanced coding extensions [View >>]
- Codes precede observation
- Use topo X,Y,Z in preference of Ha,Va,Sd
- Default units are millimeters

[OK] [Cancel]

In this case, for example, field 41 on the instrument will be used to store the SCC feature name. Any SCC fields that are not being recorded in the field should be set to 99.

Note that these settings will become the defaults for all future downloads from the Leica and do not have to be entered with each download.

An alternative method is to use the LisCADD or WildSoft style coding (Leica 1100/1200 (GSI config)) which will be more familiar to LisCadd users. In this case field 41 on the instrument is always used to determine what is stored in other instrument fields. For example, in the dialog shown below, if field 41 contains the word 'FEATCODE' the feature code is expected in field 42, whereas if it contains 'Remark' a survey remark is expected

in field 42.

Leica data input (1100/1200/Wildsoft/LisCADD)

Format file:  Save

Input data fields

	41 (Record Type)	Obs Type	42	43	44	Not
1	CodeNum	Detail	Str No	Not Used	Not Used	Not
2	FEATCODE	Detail	Feature	Not Used	Not Used	Not
3	INSTHGHT	Stn Obs	Not Used	Not Used	Not Used	Not
4	INSTRSTN	Stn Obs	At Stn	Not Used	Not Used	Not
5	REFSTN	Ref Obs	To Stn	Not Used	Not Used	Not
6	Remark	Detail	Remark	Not Used	Not Used	Not
7	StnSetUp	Stn Obs	Not Used	Not Used	Not Used	Not
8	TARGET	Detail	Not Used	Not Used	Not Used	Not

Add Delete  Use any other 41 block as feature names

Point duplication

Disable duplicate points  
 Enable for multiple code lines with 'Duplicate' tag code  
 Enable for all multiple code lines

Codes precede observation  
 Offsets follow observation

Include all observations in traverse sheet  
 Only include observations with this feature code

Only include CHK,FLY,BS,FS,SS, FSTN observations in traverse  
 Include observations to any previously occupied or sighted stations  
 Traverse codes precede observation  
 Split multiple level runs into seperate files

Store station co-ordinates  
 Ignore all topo X,Y,Z data (81,82,83)  
 Use topo X,Y,Z in preference of Ha,Va,Sd  
 Use instrument height field (88) to indicate new setup  
 Use point number field (11) for sighted station  
 Use enhanced coding extensions Edit >>

Process dimensions as enhanced codes  
 Default units are millimeters  
 Allow space seperated GSI fields  
 Treat 1m slope distances as zero distance

Hidden point feature code

OK Cancel

Note that in both cases, a traverse feature code may be provided to determine that subsequent observations are to be included in the traverse spreadsheet. This is provided to facilitate combined detail topography and traverse surveys.

### ***SCC Settings for Leica coding using Leica TPS1200 Instruments***

**Open SCC and set up Project**

**Select 'Data tab > Download Survey'**

**Select 'Leica 1100/1200 (GSI Config)' as Survey Data Logger**

**Select the required 'Data Type'**

**Select 'Data logger input Device'**

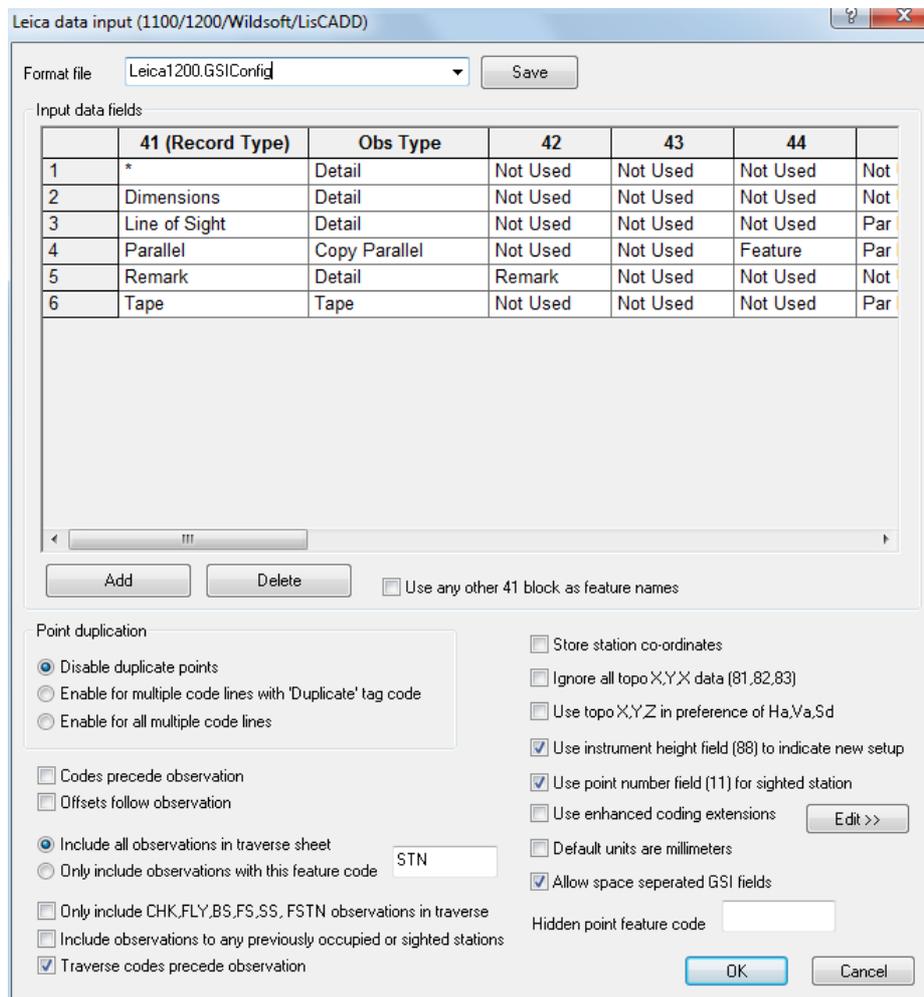
**Select 'OK'**



### Pick raw file

### Select 'Leica1200.GSIConfig' Format File

### Set up additional settings as shown below:



### Select 'OK'

### Traverse Observation Feature Code

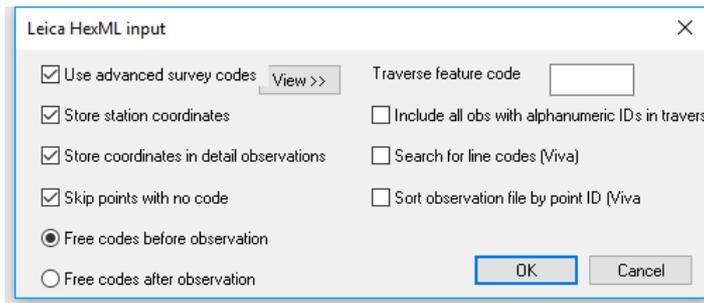
Traverse Observation Feature Code field should be filled with the user's individual code i.e. PSSA or STN etc.

If this is not filled in, no stations file will be produced.

## Leica HexML Data

The SCC HexML interface to Leica Captivate includes supports for embedded photography within observation files and models. Model points that include embedded photos will be highlighted using an extra marker controlled by the ~OBSPIC feature. Observation photographs can be previewed and edited under the observation tag using the Query & edit functions. When exporting to AutoCAD DWG and DXF, embedded photographs are available as hyper-links attached to the survey point.

The SCC HexML interface supports advanced coding through both point codes and free codes, which can be used in conjunction with Captivate curve and arc codes.



### 5.3.3.2 Downloading Trimble Data

#### Trimble ACU Output

SCC support downloading files from the Trimble ACU, running Tsce software, using the SDR33 output format. These attributes can be used to describe dimensions, offsets, parallel features, and all other items available through the SCC extended coding library. We will demonstrate the use of this facility through the sample file 060228D.DAT. Note that in this file, Tsce attributes are stored in 13AT records, see extract below for an example;

```

2NM      9020      308417.642000000231995.58500000051.33300000000001.50000000000000
07NM      9020              9021      27.900185437685727.9001854376857
03NM1.700000000000000
09F1      9020              9021      12.874430000000088.109739263113027.9001854376857STN
09F1      9020              1001      18.593340000000088.669171829746923.1694290000000BG
13ATOffset              0.300000000000000
09F1      9020              1002      17.165240000000088.759832243491514.1117367500000BG

```

To process this file in SCC, do the following:

**Create a new project, based on a 'Trimble\_TSCE\_ALPHA.Project'**

**Select 'DATA tab > Features drop down menu > Advanced Survey Coding'**

Record for each attribute type present in the Tsce format being used has been entered. For example, for the OFFSET attribute, we add a new record with the name and code of OFFSET, type of 'Control Code with Parameter (CCP)', and SDR Control type of 'Par Ofs L/R'. This means that when SCC encounters an attribute called OFFSET, it will take the attribute value and store it in the parallel offset field in SCC. For this job, the rest of the records will be as follows;

Code	Feature	Description	Type	Tag	Master	DTM	Master	Str	SDR Control	PntInFtr	
112	LCW	LCW	Public Lighting Cover (2pt+w)	PC	Rec2	Library	D	Survey	0	None	ignore
113	LINETAG	LINETAG	Line Connection Tag	CCP	S	Survey	D	Survey	0	Tag Code	ignore
114	LND	LND	Lighting	PC	S	Survey	D	Survey	0	None	ignore
115	LOSFB	LOSFB	Line of Sight Forward or Back	CCP	S	Survey	D	Survey	0	LOS Offs F/B	ignore
116	LOSLR	LOSLR	Line of Sight Left or Right	CCP	S	Survey	D	Survey	0	LOS Offs L/R	ignore
117	LPCU	LPCU	Lamp Post Large (1pt)	PC	S	Survey	D	Survey	0	None	ignore
118	LPO	LPO	Lamp Post (1pt)	PC	S	Survey	D	Survey	0	None	ignore
119	LU	LU	LUAS Track	PC	S	Survey	D	Survey	0	None	ignore
120	LUS	LUS	LUAS Shelter	PC	S	Survey	D	Survey	0	None	ignore
121	MHCO	MHCO	Manhole Circle (1pt)	PC	S	Survey	D	Survey	0	None	ignore
122	MHCT	MHCT	Manhole Circle (3pt)	PC	S	Survey	D	Survey	0	None	ignore
123	MHRO	MHRO	Manhole Rectangle (1pt)	PC	S	Survey	D	Survey	0	None	ignore
124	MHRT	MHRT	Manhole Rectangle (3pt)	PC	Rec3	Library	D	Survey	0	None	ignore
125	MHRW	MHRW	Manhole Rectangle (2pt+w)	PC	Rec2	Library	D	Survey	0	None	ignore
126	MON	MON	Monument	PC	S	Survey	D	Survey	0	None	ignore
127	MONO	MONO	Monument (1pt)	PC	S	Survey	D	Survey	0	None	ignore
128	MPO	MPO	Marker Post (1pt)	PC	S	Survey	D	Survey	0	None	ignore
129	NTLO	NTLO	NTL Cover (1pt)	PC	S	Survey	D	Survey	0	None	ignore
130	NTL	NTL	NTL Cover (3pt)	PC	Rec3	Library	D	Survey	0	None	ignore
131	NTLW	NTLW	NTL Cover (2pt+w)	PC	Rec2	Library	D	Survey	0	None	ignore
132	OE	OE	Line Eircom Overhead	PC	S	Survey	A	Library	0	None	ignore
133	OESB	OESB	Line ESB Overhead	PC	S	Survey	A	Library	0	None	ignore
134	OLU	OLU	Line LUAS Overhead	PC	S	Survey	A	Library	0	None	ignore
135	PARFB	PARFB	Parallel Offset Forward or Back	CCP	S	Survey	D	Survey	0	Par Offs F/B	ignore
136	PARLR	PARLR	Parallel Offset Left or Right	CCP	S	Survey	D	Survey	0	Par Offs L/R	ignore
137	PBXO	PBXO	Phone Box (1pt)	PC	S	Survey	D	Survey	0	None	ignore
138	PBXT	PBXT	Phone Box (3pt)	PC	Rec3	Library	D	Survey	0	None	ignore

Note that regular features that contain embedded string numbers should also appear in this sheet with a type of 'PC' and a PntInFtr setting of 'String'. This sheet can also be used to control default tag and DTM codes for these features.

Once you have completed editing this translation table, you should save the project as a new template in the SCC folder, such that you do not have to repeat this exercise.

**Select 'DATA tab > Download'**

**Set Survey Data logger to 'Trimble TSC/TSCe (DC)'**

**Highlight 'Detail Topography' as the Data Type**

**Set Input Device to 'Disk'**

Download survey data

Survey data logger: Trimble TSC/TSCe (DC) [Advanced >>]

Data type:

- Detail Topography
- Traverse
- As Set Out
- Levelling

Datalogger input Device:

- Disk
- RS232 port (cable)
- Atlas communications controller
- Leica DBX database

Create model from input data

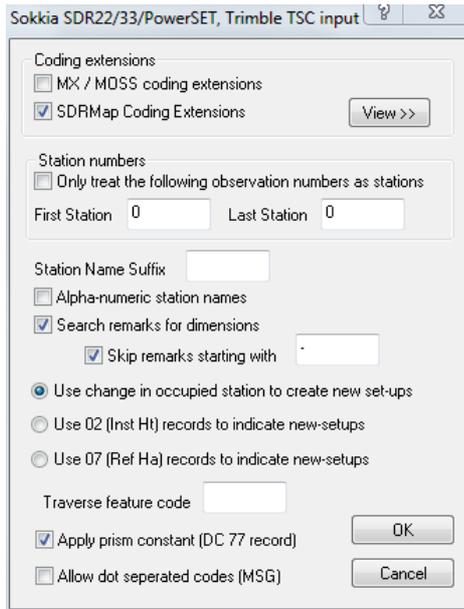
OK Cancel

**Select 'OK'**

**Select '060228D.Dat' from '\SCC\Tutorials' directory**

**Select 'Open'**

**Select 'OK'**



**Set 'SDRMap Coding Extensions' and 'Search remarks for dimensions'  
Select 'OK'**

This will generate the following detail survey file;

No.	Str	Feature	Stn.	Tag	DTM	Rod Ht.	HA	-VA.	-SI Dist.	D(1)	D(2)	D(3)	POfs L/R	POfs F/B	LOfs L/R	LOfs F/B	H/Z Ofs	MO	
1	1001	0 S	1	S	D	1.7000	023 10 10	088 40 09	18.593	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	No
2	1001	0 BG	1	S	D	1.7000	023 10 10	088 40 09	18.593	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	No
3	1002	0 BG	1	S	D	1.7000	014 06 42	088 45 35	17.165	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	No
4	1003	0 BG	1	S	D	1.7000	039 03 47	088 33 41	13.976	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	No
5	1003	0 KB	1	S	D	1.7000	039 03 47	088 33 41	13.976	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	No
6	1004	0 KB	1	S	D	1.7000	027 48 25	088 36 98	12.754	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	No
7	1005	0 KB	1	S	D	1.7000	019 58 59	088 59 36	13.237	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	No
8	1006	0 KB	1	S	D	1.7000	013 17 01	089 16 25	14.353	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	No
9	1007	0 KB	1	S	D	1.7000	006 40 29	089 12 37	15.805	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	No
10	1008	0 KB	1	S	D	1.7000	003 19 55	089 05 14	19.754	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	No
11	1009	0 KB	1	S	D	1.7000	003 35 34	089 01 49	21.964	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	No
12	1010	0 KB	1	S	D	1.7000	338 52 14	089 15 34	23.772	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	No
13	1011	0 KB	1	S	D	1.7000	332 16 54	089 14 05	18.450	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	No
14	1012	0 KB	1	S	D	1.7000	324 43 25	089 17 02	17.393	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	No
15	1013	0 KB	1	S	D	1.7000	301 00 35	089 11 14	14.853	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	No
16	1014	0 KB	1	S	D	1.7000	288 58 01	088 39 58	14.418	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	No
17	1015	0 KB	1	S	D	1.7000	293 49 02	088 49 39	13.905	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	No
18	1016	0 MHC	1	S	D	1.7000	293 49 02	088 49 39	13.905	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	No

\*.DC files from TSCE containing observations in DC formats as defined in DC10.70 or DC7.5 are also supported. Observations must be in HA,Va,Sd or X,Y,Z formats. SCC does not currently read GPS vectors, or GPS lat,long, height records from this format.

### Combined Total Station & GPS Files Trimble Data

SCC supports the download of combined Total Station and GPS information contained within one complete file.

#### Total Station Detail

```
08PD      1853      240109.491174308230536.45323307880.5785407722807CONC2
08PD      1854      240106.941616718230533.14415286880.4446191824330CONC2
08PD      1855      240106.934895243230533.12155861780.4350418868451K2
08PD      1856      240103.591644851230535.66377808680.3671757765827K2
08PD      1857      240102.973759388230536.67287284980.3818527249702K2
08PD      1858      240102.946912372230537.66137346080.3672869395576K2
08PD      1859      240108.024260067230544.61543070080.4062528838890K2
```

#### GPS Data

```
09F1      S4      1871      19.485780000000086.2995339500897308.269300500000SL
```

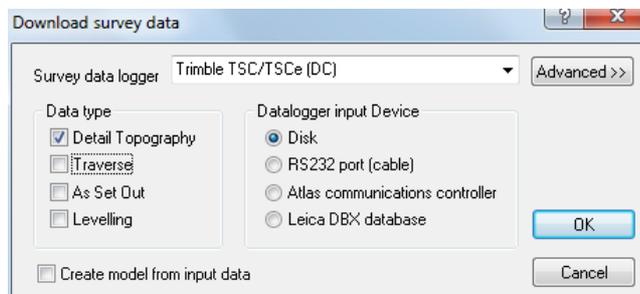
09F1	S4	1872	20.122220000000086.2101823251036306.161937000000HE3
13NMOFFSET	HE3 2.0M LEFT		
09F1	S4	1873	26.350400000000086.0417014778084314.111125500000HE3
09F1	S4	1874	36.881090000000086.4799984710826316.234896000000HE3
09F1	S4	1875	45.070550000000086.8506673231004318.345708000000HE3
09F1	S4	1876	56.991010000000087.4670758972154318.269134018868HE3
09F1	S4	1877	58.376750000000087.5556657440944316.922418000000EP
09F1	S4	1878	60.863180000000087.5235304357424318.604251600000B10
09F1	S4	1879	60.548220000000087.5381532946088326.509790400000B10

Select 'DATA' tab > Download'

Set Survey Data logger to 'Sokkia SDR33/22 & Trimble TSC'

Highlight 'Detail Topography' as the Data Type

Set Input Device to 'Disk'

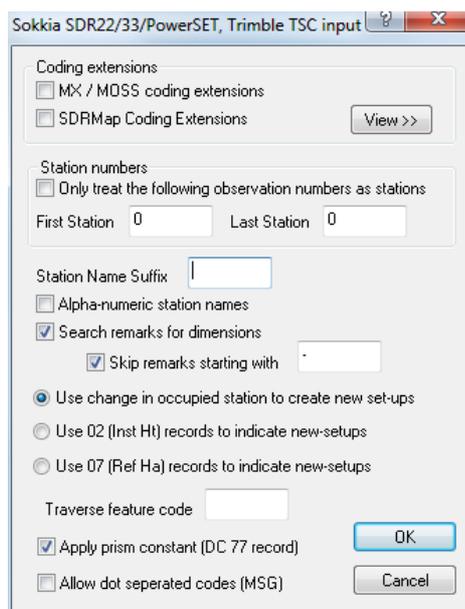


Select 'OK'

Select 'RAWsdr33dc.dc' from '\SCC\Tutorials' directory

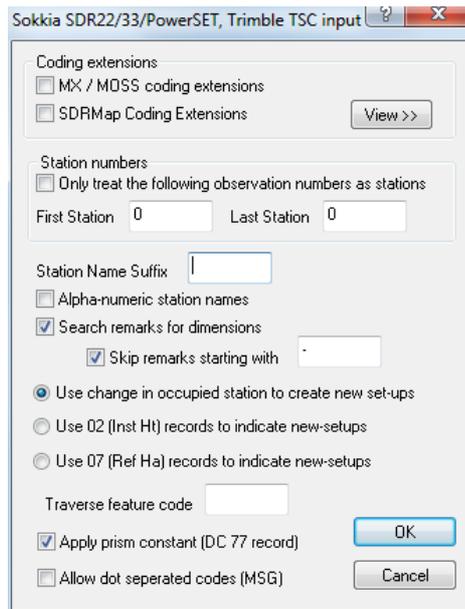
Select 'Open'

Select 'OK'



Set 'Search remarks for dimensions'





**Set 'Search remarks for dimensions'**

**Select 'OK'**

### ***Trimble/Geodimeter UDS***

SCC supports Trimble/Geodimeter format and can be processed as follows:

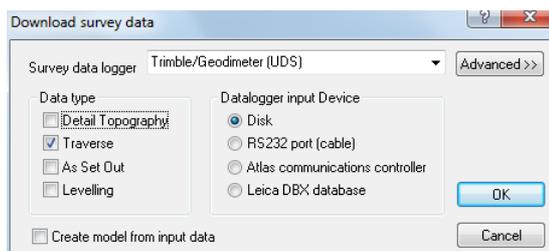
**Select 'DATA tab > Download'**

**Set Survey Data Logger to 'Trimble/Geodimeter UDS'**

**Highlight 'Traverse' or 'Detail Topography' as the Data Type**

**Set Input Device to 'Dsk', 'RS323 port (cable)' or 'Atlas communications controller' as required**

**Select 'OK'**



**Select the file you require and 'OK'**

Additional settings may be checked at this stage that relate to the field coding standards used that are particular to a given instrument. Note that these settings will become the defaults for all future downloads from the Geodimeter and do not have to be entered with each download.

**Trimble/Geodimeter data input**

Input data type

Angle and distance observation

GPS local X,Y,Z Coordinates

GPS WGS84 X,Y,Z Coordinates

OK

Cancel

Advanced >>

User defined fields (Detail)

D1	94	String No	99	Offset	93
D2	95	Tag code	98	Remark	92
D3	96	DTM Code	97		

User defined fields (Traverse)

Sighted Station: 5

Traverse Code: 999

Traverse Feature:

Last Field in Detail record: 97 Tag Code

Last Field in Setup record: 9 Slope Distance

Last Field in Station record: 39 Z / Elevation

Last Field in Traverse record: 9 Slope Distance

Disable automatic string number (FCG)

Disable extended feature coding

Landscape coding extensions Edit >>

Re-process radial and right-angle offsets (72,73)

Default dimensions between observations

Use enhanced coding extensions View >>

Use decimal point as code separator

Codes 90 through to 99 in the Geodimeter are user definable and may be used log extra dimensions in SCC. For existing 'Landscape' users, the first time we download into SCC, we will also have to set up the coding options as shown above. The LandScape coding options determine how the numeric field codes entered in the instrument will be translated into SCC tag codes, DTM codes, and ancillary measurements based on existing 'Landscape' techniques.

**Landscape coding translation options**

Coding extensions

Linear features

Straight (2d)	1	<input checked="" type="checkbox"/> Point Features	Circular (1 point + dim)	0
Straight (3d)	1		Point (1 point)	1
Curved (2d)	2		Rectangular (2 points)	2
Curved (3d)	2		Triangular (2 points)	3
Parallel	3		Rectangular (3 point)	4

Keep full numeric point codes

Comma seperated alpha-coding

Use alpha-coded standard SCC tags

End String: 999

Close String: 998

New String: 997

Control Obs: 990

Ref Station: 991

OK

Cancel

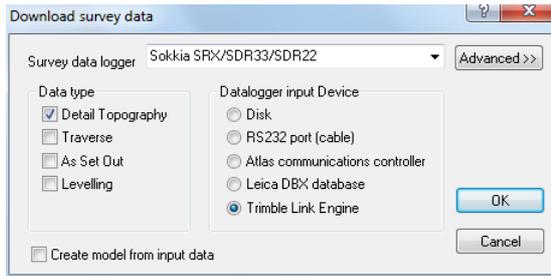
SCC lets us freely mix data from a range of different instrument manufacturers and instrument types within a given project. The LandScape processing options are currently enabled for the Geodimeter and Leica instruments.

## Trimble Exchange

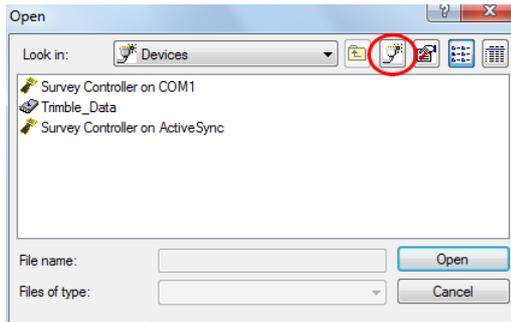
The user can download using Trimble JXL, Trimble DC, SDR33, Geodimeter UDS or GPS X,Y,Z formats using the Trimble Link Engine.

To download from using Trimble Link Engine in SCC, use the following steps;

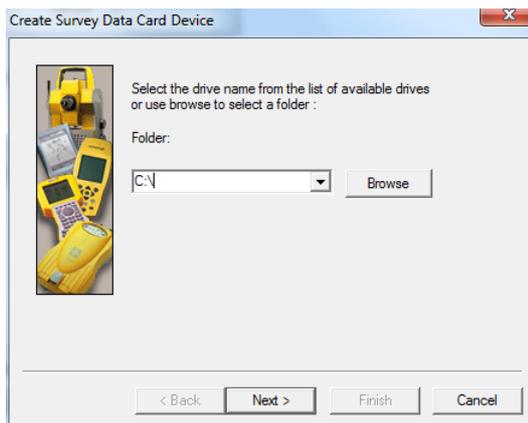
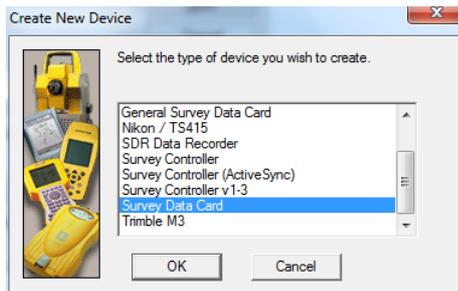
**Go to 'DATA tab > Download survey'**



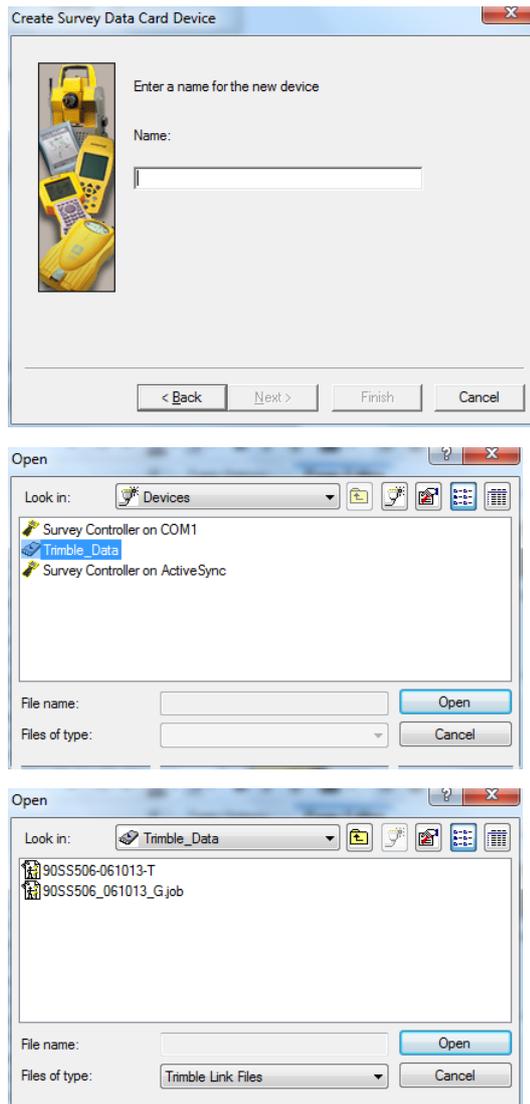
**If this is the first time using TLE, and downloading from file, press the 'Create New Device' icon**



**Create a Survey Data Card device for the folder containing your raw Trimble data.**

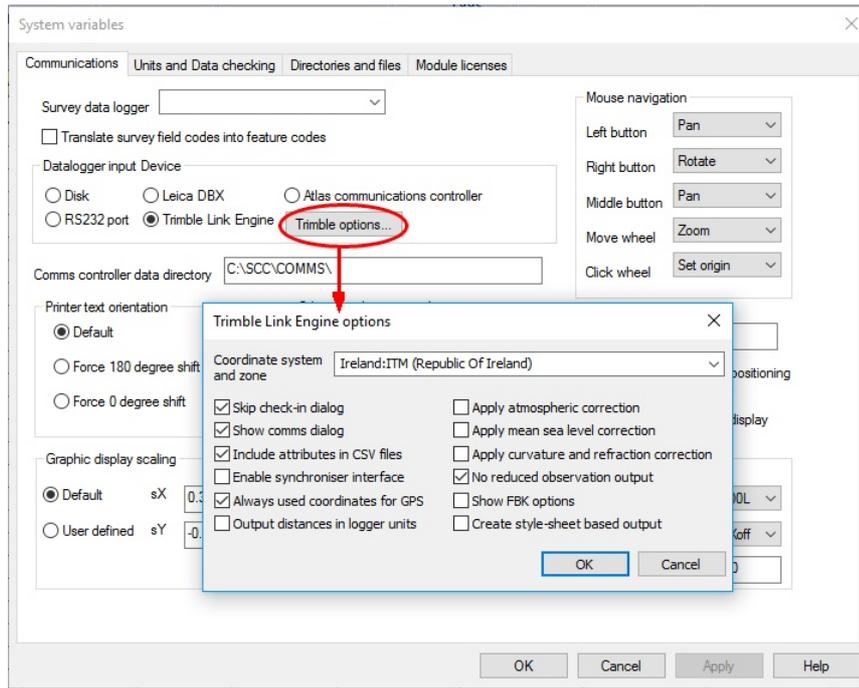


**Select the device, select the job and press Open to begin downloading.**



**General SCC download steps can be implemented from this stage.**

**The TLE interface can be configured under 'Data tab > Settings > General options > Communications > Trimble options'**



Zone may need to be changed to reduce RTK to coordinates, but most of the other defaults should be ok.

### 5.3.3.3 Downloading X,Y,Z coordinates from GPS

The following examines downloading coordinate files into SCC using 'GPS XYZ' Download option. Note that in this case the coordinates are initially placed in the observation sheet, such that they can be processed by the survey reduction. This allows for curve fitting, squaring up strings, and completion of any other survey geometry.

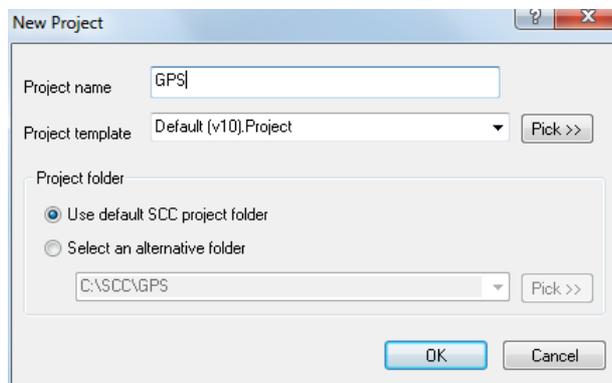
## Setting up Project

### Set up Project

Open SCC

'From the 'DATA tab > New'

Enter the Project Name and attach the 'Default(v6-9 Complex).Project' template.



## Download & Model Creation

### Downloading the sample detail file

Go to 'DATA tab > Download Survey'

Select 'GPS X, Y, Z' as the survey data logger

Select 'Detail Topography' as the data type and set the datalogger input device to 'disk'

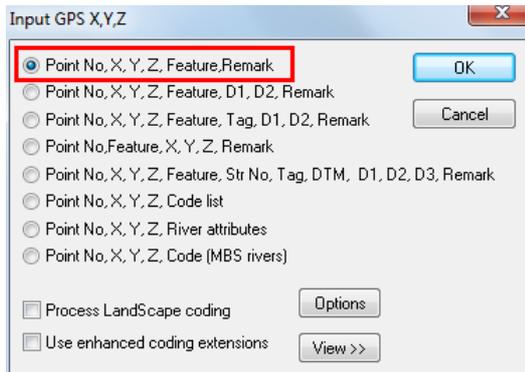
Select 'OK'



Select 'GPSTEST.txt'

Extract of 'GPSTEST.txt'

```
121,936.4463,1078.9469,42.5348,WL,BRICK
122,935.3751,1076.8353,42.6115,WL,BRICK
123,932.9097,1072.0190,42.5418,WL,BRICK
124,932.2931,1070.8306,42.6371,WL,BRICK
125,931.0534,1068.3674,42.5873,WL,BRICK
126,927.4137,1062.1438,42.5386,TE,OAK
127,925.6250,1059.3698,42.5524,TE,ASH
```



Select 'Point No., X, Y, Z, Feature, Remark'

Select 'OK'

This method has the advantage of the 'Detail Observation' Sheet being available for editing.

No.	Str	Feature	Stn.	Tag	DTM	Rod Ht.	HA	zVA	SI Dist	Prism	Apply	D(1)	D(2)	D(3)	POfs L/R	POfs F/B
1	121	1 WL	1	S	A	1.5000	000 00 00	090 00 00	0.000	0.0000	No	0.000	0.000	0.000	0.000	0.000
2	122	1 WL	1	S	A	1.5000	000 00 00	090 00 00	0.000	0.0000	No	0.000	0.000	0.000	0.000	0.000
3	123	1 WL	1	S	A	1.5000	000 00 00	090 00 00	0.000	0.0000	No	0.000	0.000	0.000	0.000	0.000
4	124	1 WL	1	S	A	1.5000	000 00 00	090 00 00	0.000	0.0000	No	0.000	0.000	0.000	0.000	0.000
5	125	1 WL	1	S	A	1.5000	000 00 00	090 00 00	0.000	0.0000	No	0.000	0.000	0.000	0.000	0.000
6	126	1 TE	1	S	A	1.5000	000 00 00	090 00 00	0.000	0.0000	No	0.000	0.000	0.000	0.000	0.000
7	127	1 TE	1	S	A	1.5000	000 00 00	090 00 00	0.000	0.0000	No	0.000	0.000	0.000	0.000	0.000

	No.	Str	Pos	Feature	Type	Tag	DTM	E/X	N/Y	Ht/Z	D(1)	D(2)	D(3)	Chainage	Offset	Obs#	Grc
1	126	1	1	TE	Detl	S	A	927.414	1062.144	42.5386	0.0000	0.0000	0.0000	0.000	0.000	6	C
2	127	1	2	TE	Detl	S	A	925.625	1059.370	42.5524	0.0000	0.0000	0.0000	0.000	0.000	7	C
3	121	1	1	WL	Detl	S	A	936.446	1078.947	42.5348	0.0000	0.0000	0.0000	0.000	0.000	1	C
4	122	1	2	WL	Detl	S	A	935.375	1076.835	42.6115	0.0000	0.0000	0.0000	0.000	0.000	2	C
5	123	1	3	WL	Detl	S	A	932.910	1072.019	42.5418	0.0000	0.0000	0.0000	0.000	0.000	3	C
6	124	1	4	WL	Detl	S	A	932.293	1070.831	42.6371	0.0000	0.0000	0.0000	0.000	0.000	4	C
7	125	1	5	WL	Detl	S	A	931.053	1068.367	42.5873	0.0000	0.0000	0.0000	0.000	0.000	5	C

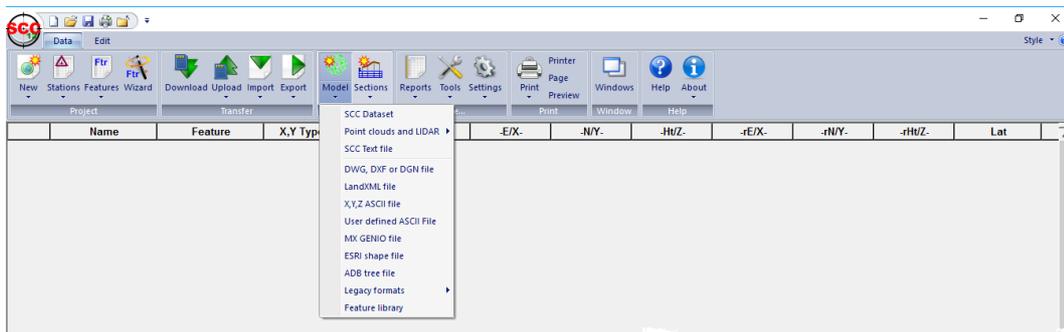
	Obs#	Remark	Feature	E/X	N/Y	Height	Width	Angle
1	1	BRICK	WL	936.446	1078.947	1.500	1.500	000 00 00
2	2	BRICK	WL	935.375	1076.835	1.500	1.500	000 00 00
3	3	BRICK	WL	932.910	1072.019	1.500	1.500	000 00 00
4	4	BRICK	WL	932.293	1070.831	1.500	1.500	000 00 00
5	5	BRICK	WL	931.053	1068.367	1.500	1.500	000 00 00
6	6	OAK	TE	927.914	1062.144	1.500	1.500	000 00 00
7	7	ASH	TE	926.125	1059.370	1.500	1.500	000 00 00

## 5.4 Creating A Model

A SCC model can now be generated using the survey dataset files.

### 5.4.1 Topographic Model Creation & Editing

A model in SCC is a visual representation of one or more surveys that includes all the annotated planimetry and a TIN surface model which in turn generates contours, slope lines, relief mapping, etc.. Note that all of the colours used within SCC, both foreground and background, are fully user definable to suit the users preference, and the media in use.



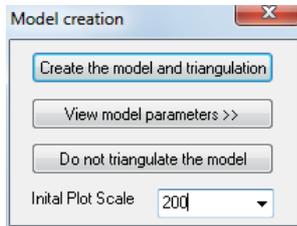
Before becoming a visual graphic representation, each model starts out as text in one form or another. The most common form of data files are SCC Datasets, DXF files, MX Genio and X,Y,Z ASCII files. These sources can be mixed and matched. SCC will keep track of where the data comes from. Your responsibility rests in choosing the right data to combine into your model.

#### Creating the Model

To create the model, go to 'DATA tab > Model > select all 4 downloaded datasets from

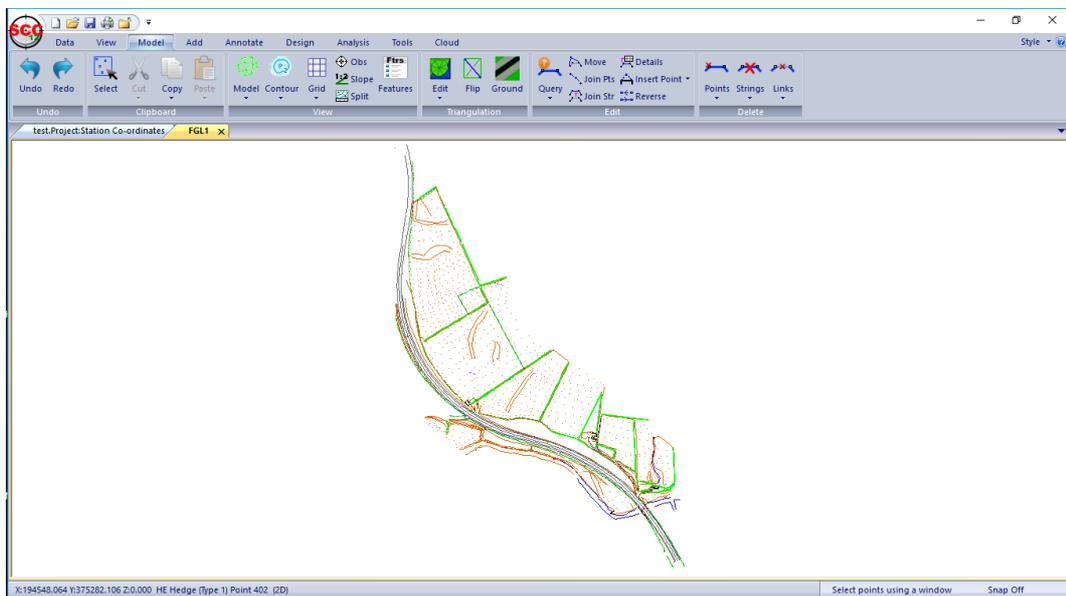
C:\SCC\ by holding down the CTRL key and picking 'FGL1.Survey', 'FGL2.Survey', 'FGL3.Survey' and 'FGL4.Survey' files

Select 'Create the model and triangulation' and set Initial Plot Scale of 200



Select 'OK' to Attributes summary dialog

Your model should like the image below



## 5.4.2 Creating A Model from An External File

SCC can also create models from existing SCC data or directly from external files. The external co-ordinate files are files, which are imported into SCC.

### 5.4.2.1 Modelling A DXF File

The following examines the direct modelling of a DXF file

Select 'DATA tab > Model drop down menu > DWF, DXF or DGN file'

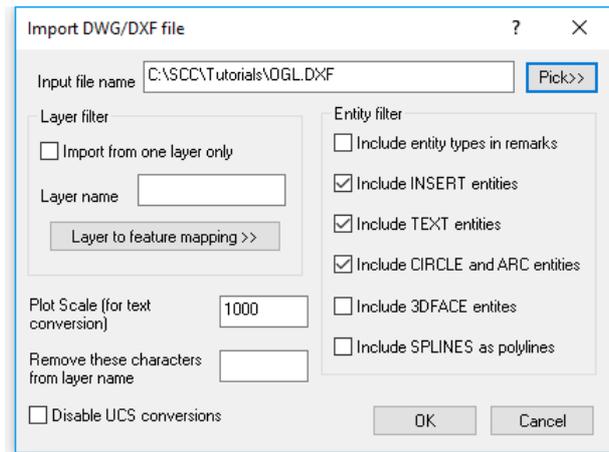
A dialog will be presented requiring the external file to be selected.

When querying the model using the Query and Edit Points (Model tab) option from the Model tab only feature information will be available. If the file was imported, saved as a SCC dataset and then a model created feature and co-ordinate information would be available.

The option to Edit String Details under the Edit menu allows access to global editing without having to import the file.

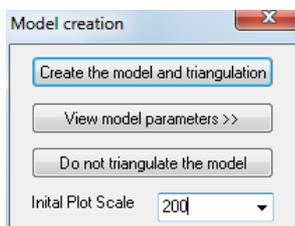
Select 'DATA tab > Model > DWG/DXF File'

Using the Pick button on the Import DXF file dialog, go to the \SCC\TUTORIAL\ directory and select the file OGL.



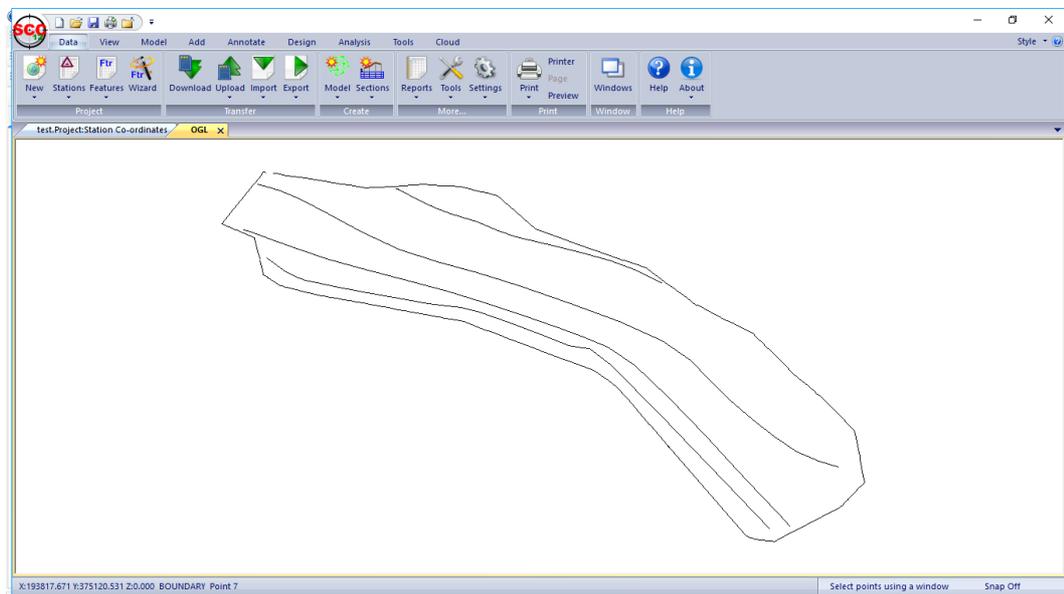
Select 'OK'

Select 'Create model and triangulation and set the Initial Plot Scale '200'



Select 'OK' for the SCCW window which summarises model attributes

The model OGL will be drawn:



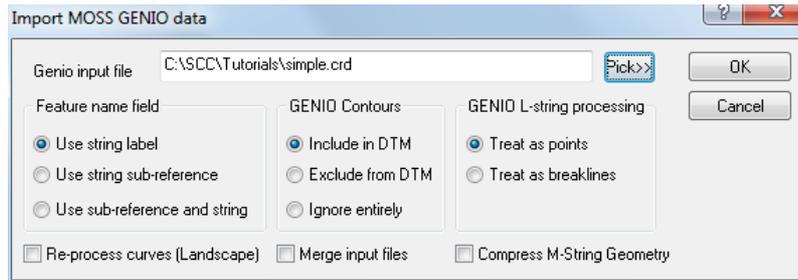
### 5.4.2.2 Modelling A GENIO File

The following examines the direct modelling of a GENIO file

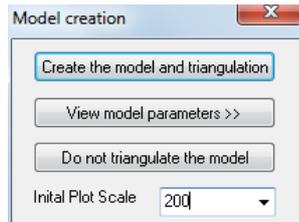
Go to 'DATA tab > Model drop down> MX GENIO file'.

Select the file 'GROUND.CRD' from the TUTORIALS directory

Set the Feature Name field to 'Use string label', the GENIO Contours to 'Ignore' entirely and GENIO L-string processing to 'Treat as points'.

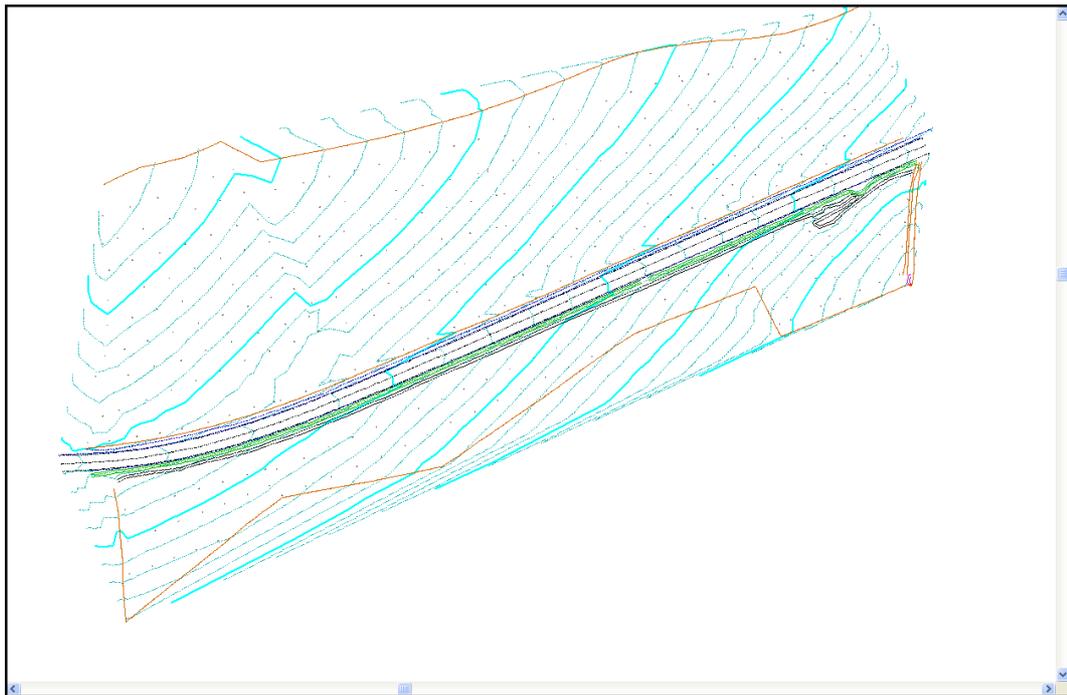


Select 'OK'



Set the Initial Plot Scale as '200'

Select 'Create the model and triangulation'



Go to 'SCC button > Save'

Save the model as 'Ground.Model'

## 5.5 Editing A Model

The following outlines the tools to edit a model.

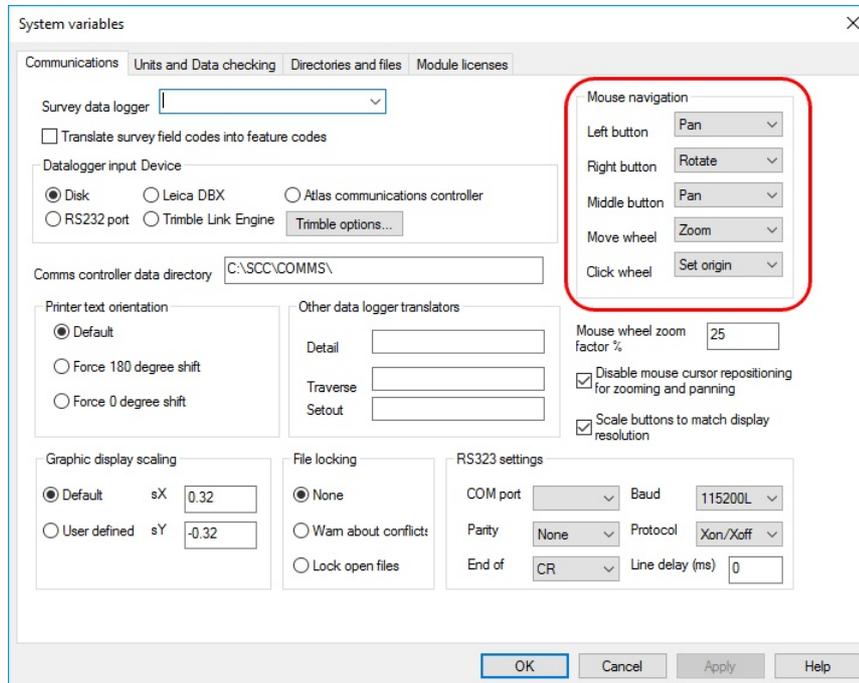
### 5.5.1 Model Navigation & Shortcuts

The mouse can be used to navigate the model. Such options are controlled within the General Options

## General Options

Go to 'DATA tab > Settings drop down > General Options > Communications'

Review 'Mouse Navigation' options



**For example, to rotate data using the mouse, simply**

**Press Mouse Wheel at rotate origin point**

**Press Right Mouse Button down and move cursor to pivot model**

Note the cursor is moved around in the cloud, either in plan or another view, the x,y,z position of the cursor in the cloud is shown, and the user can snap to cloud positions.

## Keyboard Shortcuts

In addition to mouse controls, keyboard shortcuts can be used, such as 'P' and 'E' when moving between plan and elevation view.

This coincides with other general SCC keyboard zoom controls such as Home (Zoom Extent), Page Up/ Page Down (Zoom In/Zoom Out), Space Bar (Pan).

Other keyboard options are + and – to widen or narrow the area of interest, and L and X to move between long section and cross section related view when selection a sectional area relative to an alignment.

When a horizontal section / area of interest is in use the arrow keys may be used to raise or low the elevation of the section.

Other general controls are noted as:

<b>Esc</b>	Quits any of the interactive editing options
<b>Home</b>	Zoom Extents
<b>End</b>	Zoom Previous
<b>Page Up</b>	Zoom Out

<b>Page Down</b>	Zoom In
<b>Space Bar</b>	Zoom Centre (Pan)
<b>TAB</b>	Pan to the next crossing breakline, next duplicate point, or next potential model error. This option will only pan to crossing breaklines and / or duplicate points if they are currently being displayed. This is controlled using 'View / Triangulation options'. Other potential model errors that are detected with this option include links between 2d and 3d points, duplicate 3d points with different elevations, and polygons with less than three points. This key press is very useful when correcting survey errors interactively.
<b>F2</b>	Pressing this key pans to the next selected point. This option should be used in conjunction with the data selection dialog, and is very useful for finding specific points in the model. For example, to find a specific point in the model, use the advanced section of the data select dialog to highlight the point (or point range), and press F2 to pan to that point.
<b>s</b>	Pressing 's' toggles between the available snap lock modes, including nearest point, nearest DTM point, nearest 2D point, gird position, midpoint, perpendicular (to string), perpendicular (current string) and design grid (chainage/offset).
<b>n</b>	Pressing 'n' turns snap lock off.
<b>g</b>	Pressing 'g' enables snap to grid mode.
<b>m</b>	Pressing 'm' enables multiple point selection mode. This is useful when selecting a point, or piece of text that overlaps other items. If multiple point selection is enabled, and a position on screen is selected where there are multiple overlapping points, a dialog will be presented that allows you to select the desired point from a list of points within a specified range from the cursor.
<b>\</b>	Use of '\ ' and '*' keyboard shortcuts can be used to the create text function, as per other text editing functions. Note that when creating new free form text, the drop down feature list in the tool bar may be used to set the texts feature and hence colour and CAD layer.
<b>H or V</b>	Pressing 'H' or 'V' will snap vertically or horizontally. The base point used will be the last point on the string if you're already creating a string, or the cursor position if not, so you can extend from an existing point using snap point and then press 'H' or 'V' for subsequent points.
<b>O</b>	Pressing 'O' snaps perpendicular from the last two points, or horizontal if no points have been entered. The default behaviour after picking a point with snap horizontal or vertical is switch to snap perpendicular from the last two points. This can be turned on or off in the snap points dialog.
<b>Q</b>	Pressing 'Q' closes the string and updates the model using the Link Square tag. This creates a new point by intersecting a line at right angles from the last two points selected with another line at right angles to the first two points. Thus if you have entered three points, pressing 'Q' will square off by creating a fourth point to form a quadrilateral.
<b>L</b>	Pressing 'L' closes the string and updates the model using the

normal Link tag. Thus if you have entered three points, pressing 'L' will give you a triangle.

You can also use the mouse wheel to zoom in and out of the current position, and to pan around the model by moving the mouse with the wheel pressed down.

## Snap Controls

The snap control option available from the 'VIEW' menu has the following options:

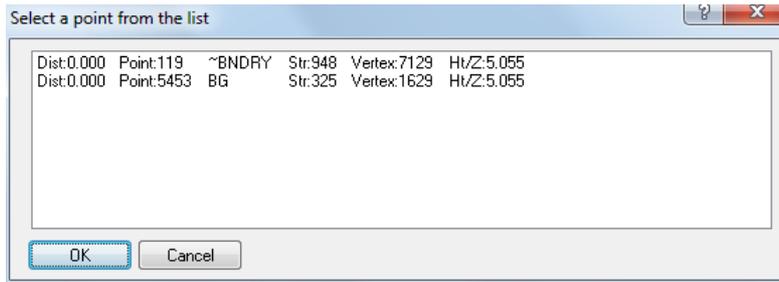
This dialog allows you to force the cursor to always lock onto a specific point or grid co-ordinate while editing the model. It is particularly useful when positioning points exactly on top of survey points, for example, when generating a boundary string.

Pressing 's' on the keyboard toggles through the snap options. The current snap option is displayed on the bottom right of the status bar.

Select points using a window      Snap Point,Multi      NUM

The snap control dialog is also used in the selection of overlapping points. If you highlight the 'Enable search for multiple points' option, a list of all points within the prescribed radius is displayed whenever you have to select a point in the editing options. This is particularly useful when querying points that overlap or join strings at the junction point of other strings.

The snap selection may be changed in the middle of a command. For example, if adding points the user snaps to grid and in the middle the user wishes to snap to a feature, the snap control can be changed to 'Nearest point' and allow the user to continue with the previous command, 'adding strings with cursor'.



Pressing 'm' on the keyboard enables a shortcut key to 'Enable search for multiple points'.

There are three methods of editing a model within SCC.

**Point editing** allows you to query a point in the model and modify any information relating to that point.

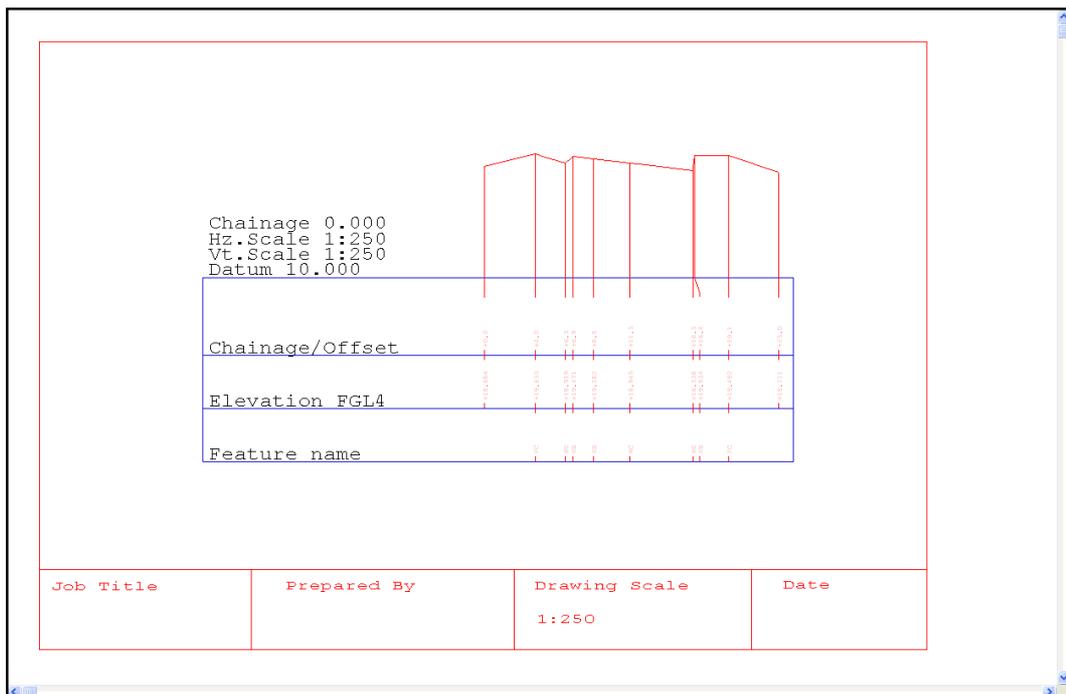
**String editing** allows you to identify string lines in the model. Field errors relating to connectivity can be edited here.

**Triangle editing** allows you to identify which triangles you will use in modelling applications.

## 5.5.2 Probable Modelling Errors

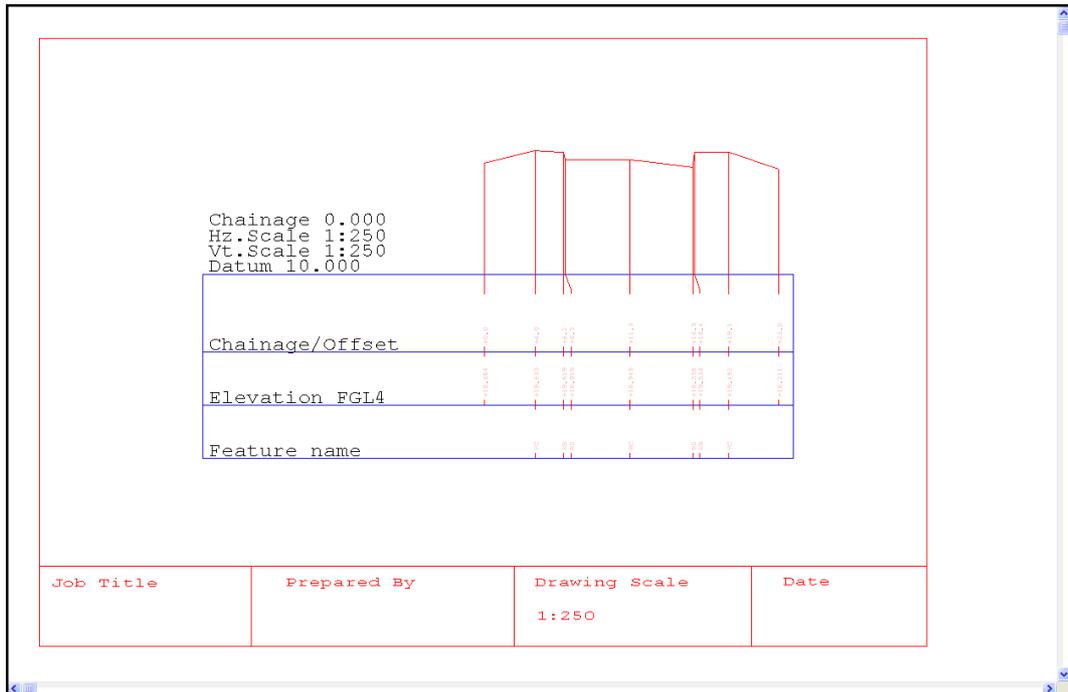
SCC graphically highlights probable modelling errors such as crossing strings and duplicate points. Crossing strings are indicated by red crosses and by pressing the TAB key, the screen will be re-centred over each one, allowing them to be easily located and therefore easily resolved.

While crossing strings do not necessarily pose a problem in themselves, they are often indicative of a survey or modelling error that could have more serious implications. For example, where a kerb top and kerb channels are surveyed as two separate 3d strings. These strings are very close to one another in plan, and may actually cross in a number of places. While this makes very little difference to the plan, it has a serious effect on the 3d model as shown in the section below.



Using the 'move points' option to shift the offending point by a few millimetres in plan quickly

resolves this problem, as shown in the second section drawing.



### 5.5.3 Correcting Survey Errors

In a model the most easily recognisable survey errors are crossing breaklines. Crossing breaklines are identified by the Breakline Intersection Point (~BRK\_INT) feature. This is a standard SCC feature. The symbol for this feature is a red X. Look around this model there are a few red Xs. When editing the model the operator should aim to remove all crossing breakline from a model. Depending on the strings and how they overlap different editing tools may be used to rectify the errors.

#### 5.5.3.1 Determining The Height Value of Crossing Breakline

##### *New Project*

Go to 'DATA tab > New'

Enter Project Name 'Crossing Breaklines' and attach Project Template 'Default (v10).Project'

New Project

Project name: CrossingBreaklines

Project template: Default (v10).Project [Pick >>]

Project folder:

Use default SCC project folder

Select an alternative folder

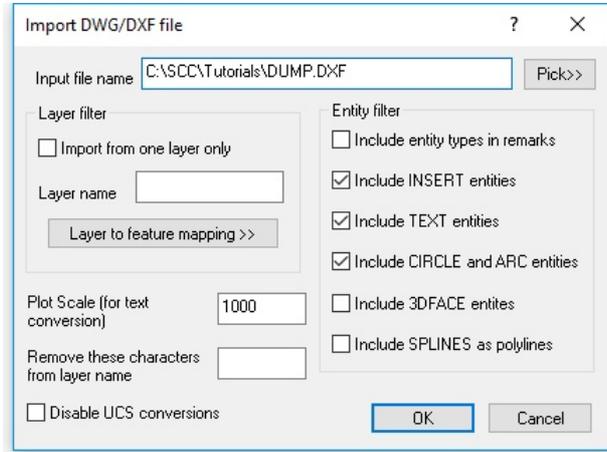
C:\SCC\CrossingBreaklines [Pick >>]

OK Cancel

## Model DXF

Within the 'DATA tab > Model drop down menu > DWG, DXF or DGN file'

Using 'Pick>>' button select 'DUMP.dxf' from the SCC\Tutorials directory

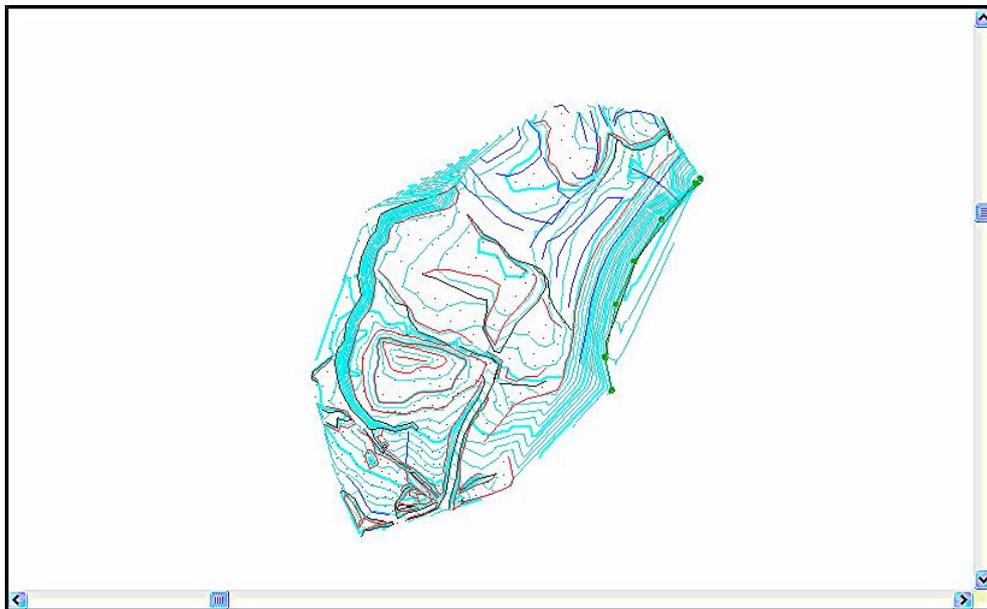


Select 'OK'

Select Initial Plot Scale of 250

Select 'Create the model and triangulation'

Select 'Ok' to Model Attributes dialog



Zoom in and then select 'VIEW tab > Position button' and enter 1878.360, 3275.959'



Note the drainage line running perpendicular to the top and bottom of bank. Where the drainage lines meet the bank a crossing breakline symbol is generated. What we are going to do is insert a point onto both strings at each point where they cross. The height of the new points will be taken from the height of the point interpolated.

**Set the snap lock to snap point by pressing the 's' key. On the right of the status bar the current snap setting is displayed.**

## 5.5.4 Point Editing

The 'Query and Edits points' option from the 'Model tab' allows the user to select a point of interest for which a number of different detail tabs are displayed.



We have already mentioned the feature library tab and how it is used to set up or make changes to the characteristics of the point. Any changes made to the library using this tab, will present you with the option to update the project file.

The other four tabs are extracts from the survey file or SCC dataset used to create the model. The Detail Co-ordinate and Detail Observation tabs are nearly identical. The main difference relates to which dataset is being changed.

- If the **Detail Observation** tab is changed, the survey co-ordinates will be rebuilt to reflect the change.
- If the **Detail Co-ordinate** tab is changed, the detail observations are **not** affected.

A copy of the original survey file is kept so the coordinate files may be rebuilt from raw observations at any time you require them.

When querying a model that was created from multiple datasets, the dataset from which the queried point originated is displayed at the top of the dialog. In this example the queried point is taken from the 'FGL3' dataset.

Another item of particular interest is the **Instrument Setup** tab. This tab displays what station you were set up on for the point in question and also what station was backsighted to.

Query Model:FGL1 Obs# 193

Feature	Library Entry	Detail Coordinate	Detail Observation	Instrument Setup	Station Coordinates
No	1	Inst Ht	1.533	Field notes	1
		Rod Ht	1.485		
Occupied Station	7	<input checked="" type="checkbox"/> X,Y,Z		Backsight Station	8
					<input checked="" type="checkbox"/> X,Y,Z
Backsight Observation		Orientation			
Horizontal Angle	000 00 00	Observed Zero	353 05 53		
Vertical Angle	091 02 47	Mean Zero	353 05 53		
Slope Distance	353.783	Zero Error	000 00 00		
Misclosure		Atmospherics		Computed Values	
dX	-0.001	Observed k'	-0.5047873	Join Dist.	353.790
dY	0.008	Mean k'	-0.5047887	Join Brg	353 05 53
dZ	0.005	Temperature	20	Hor. Dist	353.724
dSldist	-0.008	Pressure	1012.8849	Ht Diff	-6.403
		Scale	1		

OK Cancel Apply Help

In the **Station Coordinates** menu, you can determine the position of each station that was set up upon. Sometimes the wrong station name is entered in the field, resulting in a disorientation of part of the survey. This can be easily tracked and corrected.

Editing models with the 'Query and Edit Points' option will undo any local string editing carried out on your model for the queried dataset. For this reason, it is advisable to do any query based editing prior to carrying out interactive string editing.

As changes are made to the model using the 'Query and Edit Points' option the survey file will be automatically updated.

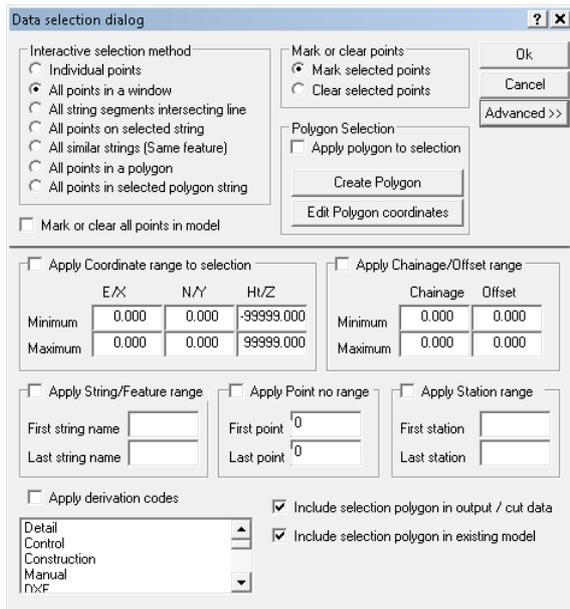
## 5.5.5 String Editing

### Add Tab

SCC has an extensive set of string editing tools, similar to CAD tools, to interactively edit the model. This editing always occurs simultaneously in plan and 3d. String editing tools include trim, extend, move, copy, rotate, copy parallel, join, split, partial delete, reverse string, change geometry, change feature, and change DTM status can all be located under the Add tab.



All tools work both interactively and with pre-selected data, such that they can be used to carry out a given operation on a large amount of points as a single operation. To access the 'Data Selection Dialog', you must press the right mouse button once when in the model.



### ***Display String Direction & Point Numbers on a String***

**Press Escape to clear any active editing operation**

**Press the right mouse button to access the 'Data Selection Dialog'**

**Select 'All points on selected string'**

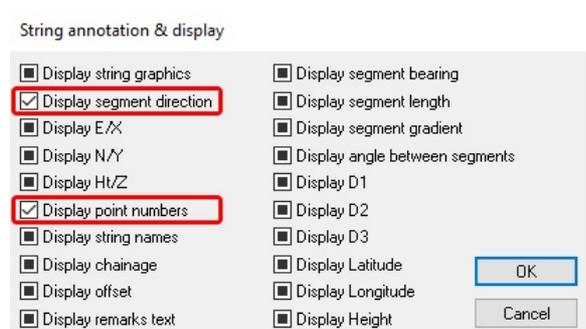
**Select 'Mark selected points'**

**Press 'OK'**

**Pick the string you wish to annotate**

**Go to the 'ANNOTATION tab > Annotate points'**

**Turn on 'Display point numbers' and 'Display segment direction'**



'All points on selected string' will remain the default data selection method now until you change it, such that to similarly annotate subsequent strings you only have to go through the last three stages.

### ***Model tab***

Additional Tools can be accessed from the Model tab such as Copy, Join Points / String, Move Points, Break Links, etc.



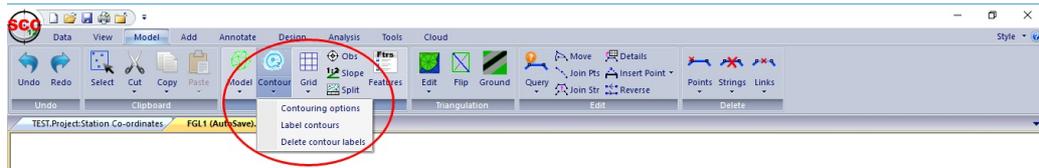
## 5.5.6 Survey Error Detection & Correction

There are various facilities available in SCC to rectify survey errors depending on how they were formed. Apart from red crosses, which highlight probable errors in your model, contours also play a part in highlighting possible height errors in the model. Selecting a small contour interval will draw your attention to any discrepancies in the survey.

### **Changing The Contour Interval**

Activate the window FGL.model

From Model tab, go to 'Contour > Contour Options'

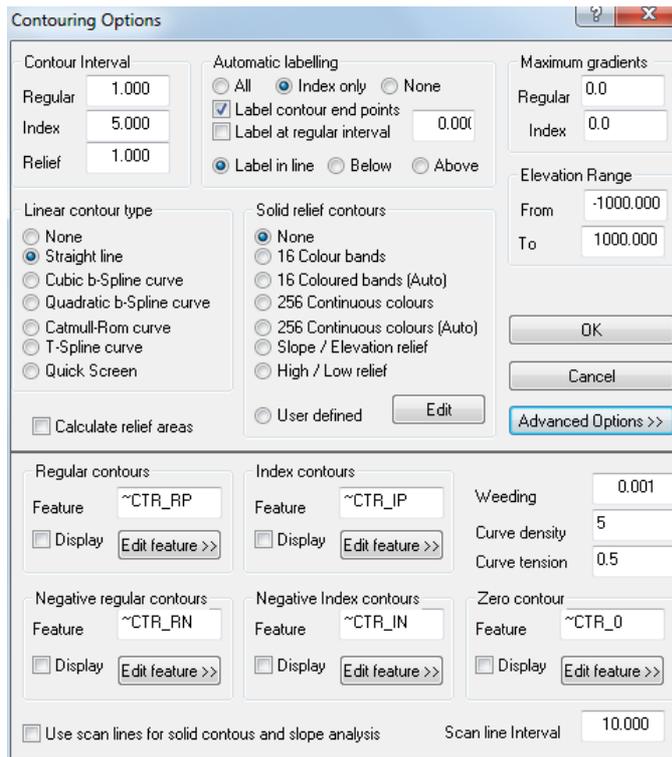


Change the Regular Contour Interval to 0.5 and the Index to 2.0.

Set the Linear contour type to 'Quick Screen' and the Solid Relief Contours to 'None'.

Select 'OK'

You should immediately be able to see if there are any height discrepancies in the model.



## 5.5.7 Using SCC Editing Facilities to Rectify Survey Errors

The following examines specific editing tools to correct survey errors in the model.

### 5.5.7.1 Delete Points & Strings

At the bottom of the model along the road there are three crossing breakline symbols. If you look closely at this area you will see that there are four short lines running in the direction of the road. It seems that the surveyor began surveying the road with these short

lines, but they were never finished. The road was surveyed using different strings. It may have been surveyed on a different day and/or by a different surveyor.

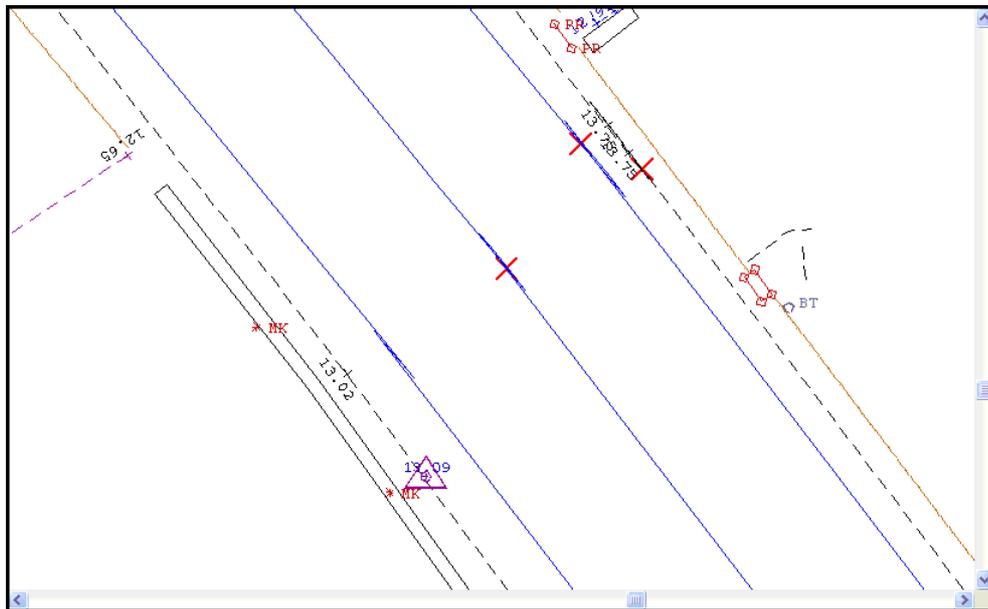
We want to delete the short intersecting lines. Select these lines by drawing a polygon around them. All points along these short lines will be selected as shown in the picture below. When the option to delete points is selected a dialog will be presented as to whether or not you want to delete the selected points. Choose Yes.

### Selecting Points By Creating A Polygon

To view the Breakline Intersection Points more easily turn off the contours.

Zoom into an area where extra unnecessary points have been generated.

The co-ordinate of the top corner is 194140E, 374888N and the bottom right co-ordinate is 194166E, 374868N.



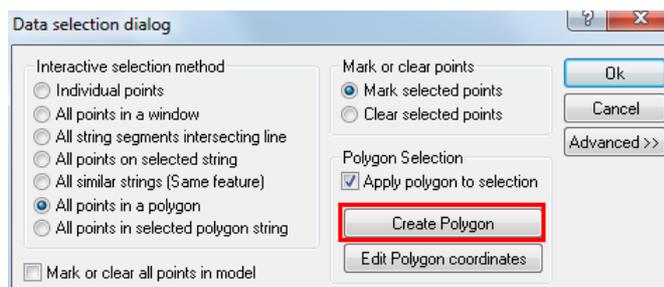
You will see that there are four short lines running in the direction of the road. It seems that the surveyor began surveying the road with these short lines, but they were never used to finish it. The road was surveyed using different strings. It may have been surveyed on a different day and/or by a different surveyor.

Left click mouse to bring up 'Data Selection Dialog'.

Select 'Create A Polygon'

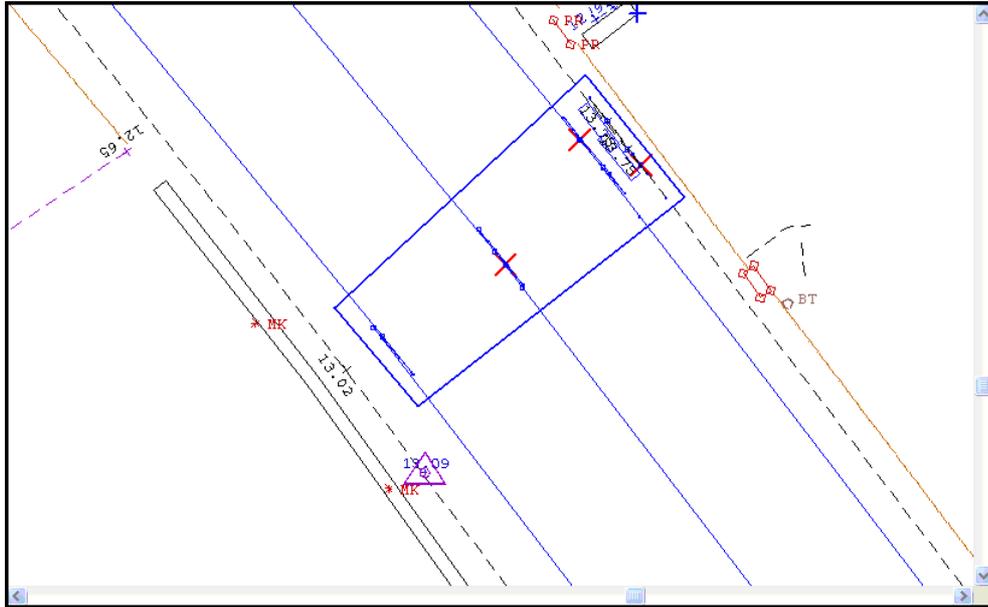
This automatically selects 'All points in selected polygon string' and 'Mark selected points'

The option can also be used to 'Clear selected points' from an area where points have already been selected.



Draw a polygon around the four short lines by right clicking mouse to form 3 sides of the polygon and left clicking mouse button to close the polygon. All points along these short

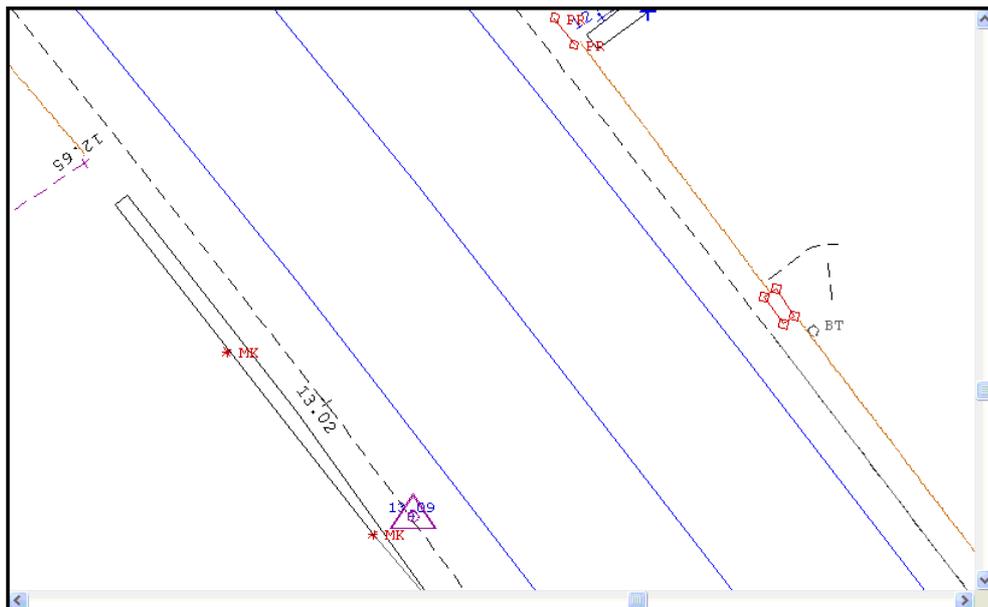
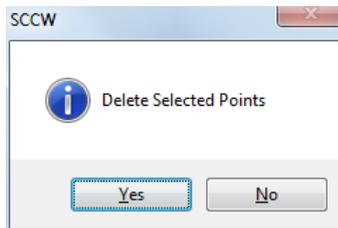
lines will be selected.



### Delete Points and Strings

Go to 'MODEL tab > Points button > Delete Points'

Select 'Yes' to 'Delete Selected Points'

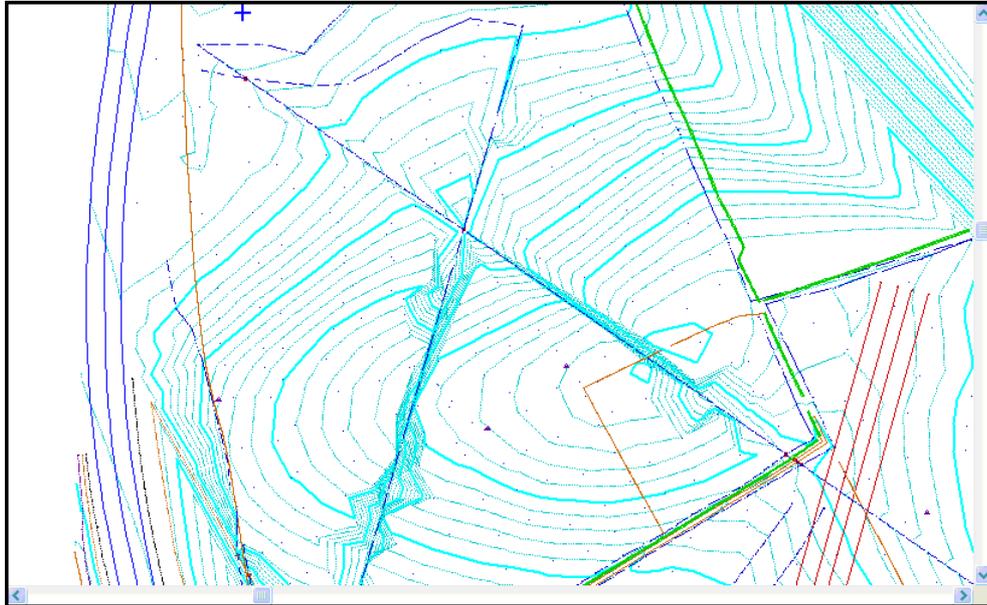


If you delete information that you do not intend to delete, or perform any other editing operation that has undesired results, select the 'Undo' option from the edit menu or press Ctrl-Z

### 5.5.7.2 Breaking String Links

While the previous option allowed us to delete entire strings or points, we will often want to simply break a string into two separate parts by removing an undesired connecting link. Breaking string links may be achieved by selecting the above button or the 'Break Strings' option in the 'MODEL tab > Links button'.

Zoom into the top left area to see the unwanted crossing strings.

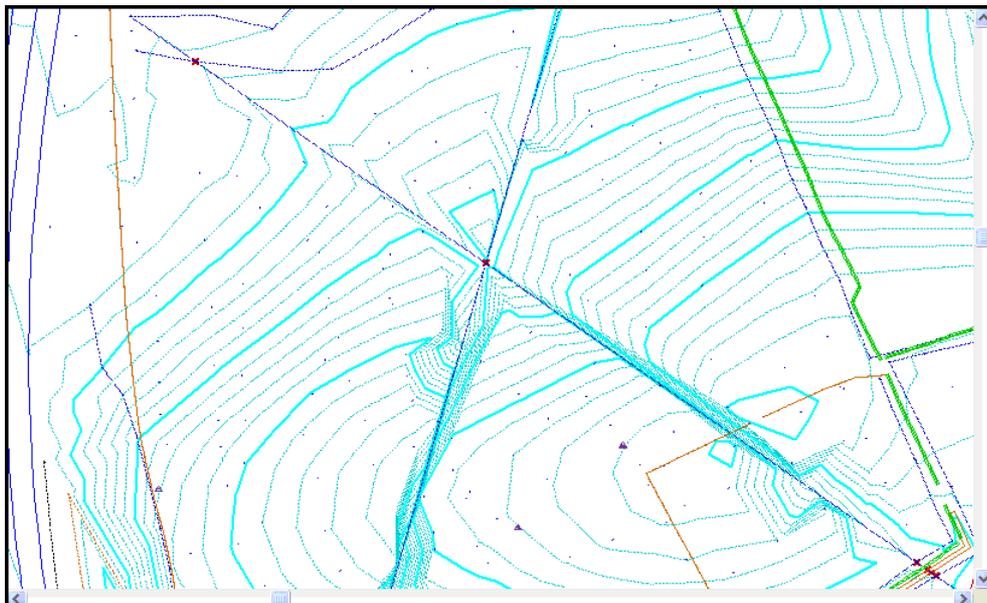


As you move the cursor on screen you will see a thick blue line that you can align to potentially unwanted string links. When this line lands on the correct link, press the left mouse button and the link will be removed. Alternatively you can use the 'Individual Points' options from the data selection dialog to mark the end points of the unwanted link and then select the 'Break Links' option.

#### ***Breaking A String***

**Zoom into the top of the model. There are two lines crossing.**

**If a segment of one of the lines were deleted, there would be no crossing breaklines.**

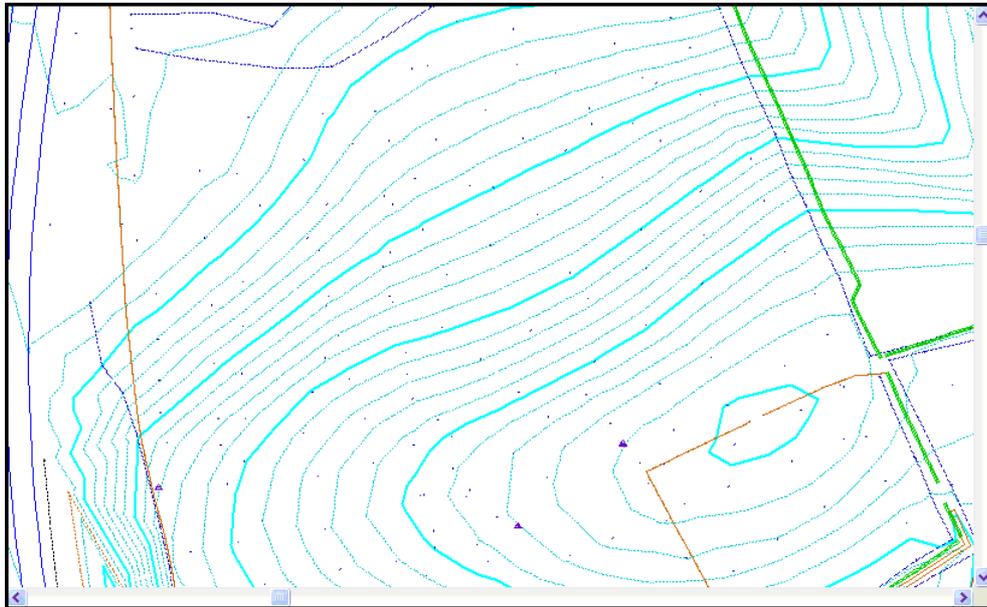


Go to 'MODEL tab > Links button'.

Align the cursor along the string segment you wish to break and click the left mouse button.

Place cursor over line segment.

This option inserts a gap into the string. The line tag of the point at the start of the segment is changed to GAP.



Note:

To move to the next set of crossing breaklines hit the Tab key. SCC will retain the current view size and move to the nearest set of crossing breaklines. This facility saves zooming in and out of the model looking for crossing breaklines.

### 5.5.7.3 Partial Delete

This option may be accessed from the 'MODEL tab > Links button > Delete Partial'. 'Partial Delete' allows any segment of a string to be deleted. It differs from the 'Break Links' option in that, the segment being deleted does not have to be between two surveyed points, it may be anywhere along the string.

#### ***Deleting Any Part Of A String***

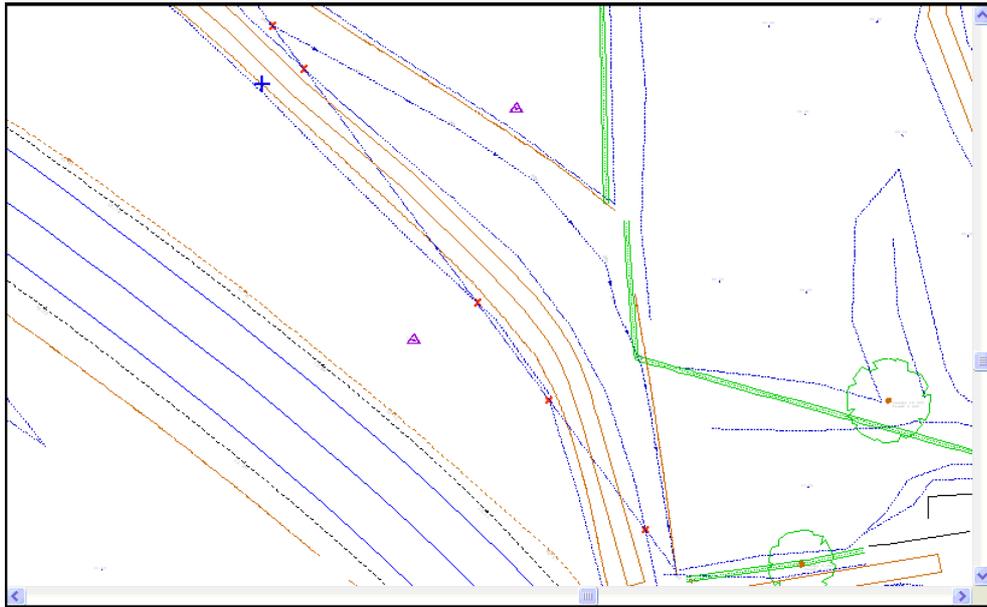
Go to 'MODEL tab > Links button > Delete Partial'

Select the string you wish to delete – a blue bar appears perpendicular to the chosen string

Select a point on this string where you wish to delete from by left clicking mouse, and then the point you wish to delete to by left clicking mouse again.

### 5.5.7.4 Annotating Strings

In the last few examples, the string errors in the model were very easy to identify, but in many cases the error can be quite subtle and it helps to annotate the strings in order to figure out what is going on. Panning down and to the right on the model we see another area, where there are many crossing breaklines.



It appears to be an unwanted string link but we will do some more investigation to be sure. Using the 'Data Selection Dialog' select the string of interest. Go to 'EDIT' and 'Edit text annotation' and display the point numbers and segment direction.

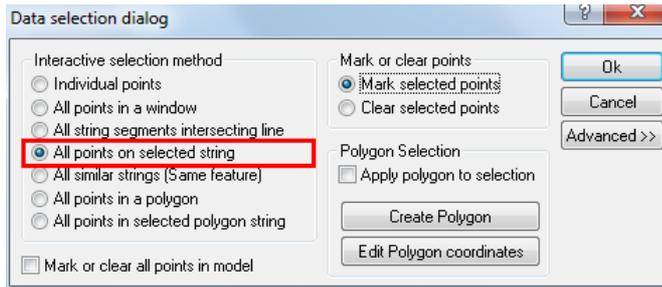
**Zoom into an area at the bottom of the model where the end of one string seems to be joined to the beginning of another.**

**The co-ordinate of the top corner is 194054E, 374987N and the bottom right co-ordinate is 194178E, 374919N.**



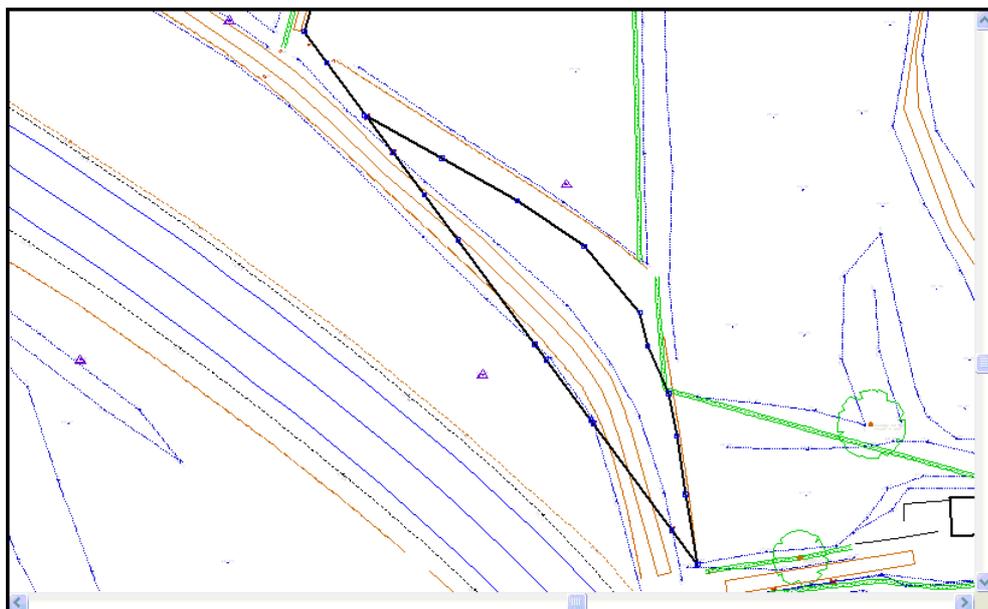
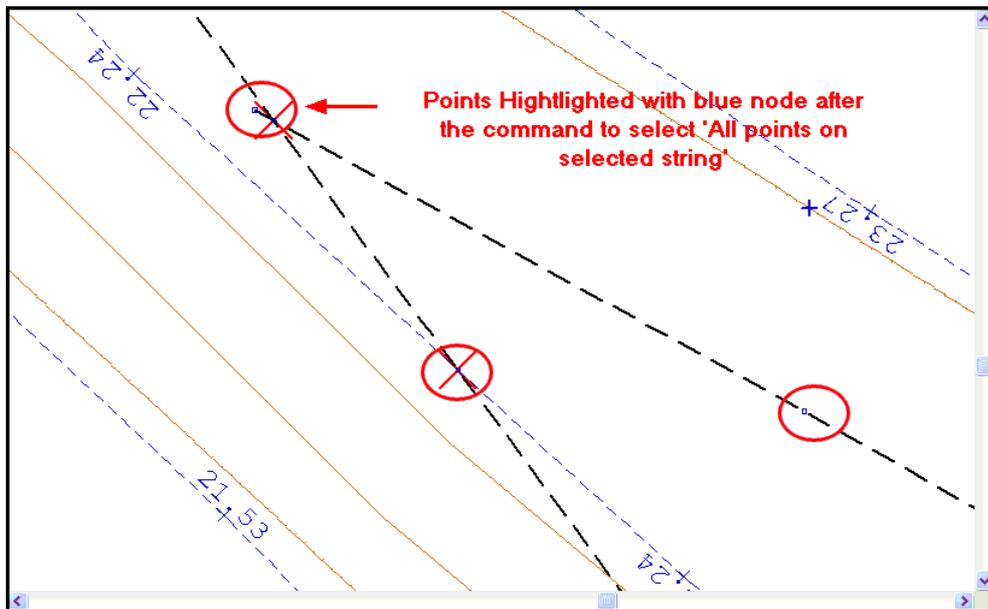
Note: The string of interest has been highlighted in the diagram.

**Left click mouse to bring up 'Data Selection Dialog'.**



Select 'All points on selected string' and 'OK'

Left click on string, all points on the string are highlighted in blue nodes



**Display Point Numbers & Segment Direction**

Go to the 'ANNOTATION tab > Annotate points'

Turn on 'Display point numbers' and 'Display segment direction'

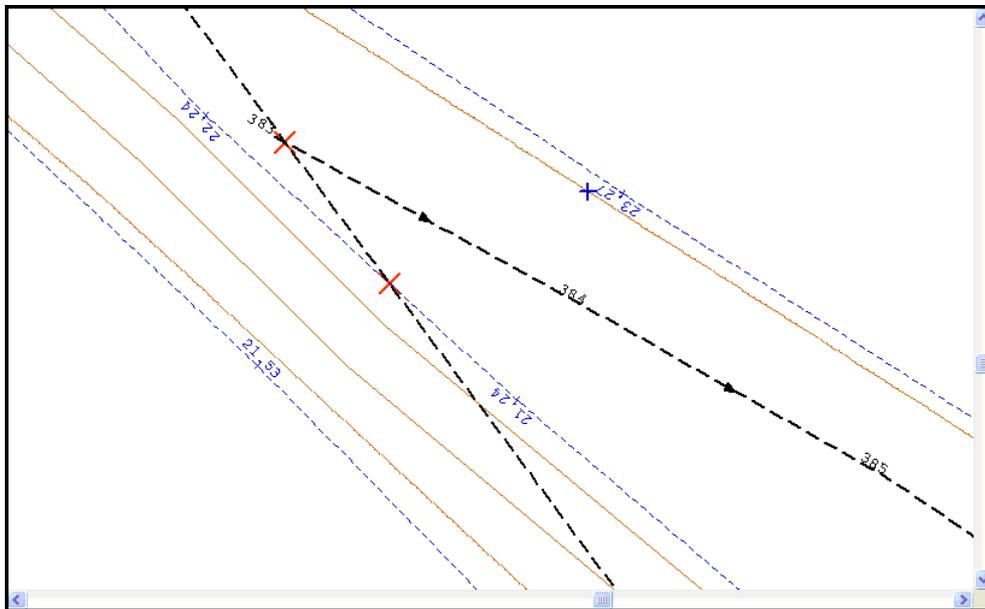
String annotation & display

<input type="checkbox"/> Display string graphics	<input type="checkbox"/> Display segment bearing
<input checked="" type="checkbox"/> Display segment direction	<input type="checkbox"/> Display segment length
<input type="checkbox"/> Display E/X	<input type="checkbox"/> Display segment gradient
<input type="checkbox"/> Display N/Y	<input type="checkbox"/> Display angle between segments
<input type="checkbox"/> Display Ht/Z	<input type="checkbox"/> Display D1
<input checked="" type="checkbox"/> Display point numbers	<input type="checkbox"/> Display D2
<input type="checkbox"/> Display string names	<input type="checkbox"/> Display D3
<input type="checkbox"/> Display chainage	<input type="checkbox"/> Display Latitude
<input type="checkbox"/> Display offset	<input type="checkbox"/> Display Longitude
<input type="checkbox"/> Display remarks text	<input type="checkbox"/> Display Height

OK  
Cancel

Note that highlighting boxes in this dialog will turn the associated text on, clearing boxes will turn text off, and leaving boxes grayed out will not effect associated text at all.

Select 'OK'



You will notice one long segment going from point number 392 to 397 over which all the crossing breaklines lie. If this segment is deleted or removed then there will be no crossing breaklines.

Go to 'MODEL tab > Details'

Left click on string, which will bring up a coordinate spreadsheet containing the coordinates of each point.

Change Point 392 tag code from 'Straight' to 'Gap'

Select 'Update string in model'



The annotated string appears as shown in the figure to the left. From this we can see that the string runs from point 383 to point 398 with a gap most probable required between after point 382. We could use the break strings option to establish this gap but in this case we are going to use the string editor instead. Please note that the 'Break Strings' option is not suitable for non-DTM strings, and it may sometimes be preferable to re-label one half of the string rather than simply breaking the link. In these cases we use the string editor.

### 5.5.7.5 Using The String Editor

Selecting the '**MODEL tab > Details**' option in the model view accesses the string editor. To select a string simply press the left mouse button over any point on the string we wish to edit. A spreadsheet containing the co-ordinate details of the select string, is displayed.

No.	Str	Pos	Feature	Type	Tag	DTM	E/X	N/Y	Ht/Z	D(1)	D(2)	D(3)	Chainage	Offset	Obs#	Grc	
1	465	93	25	FL	Detl	S	D	194141.501	374943.691	21.8510	0.0000	0.0000	0.0000	0.000	0.000	465	C
2	466	93	26	FL	Detl	S	D	194149.808	374942.887	21.8097	0.0000	0.0000	0.0000	0.000	0.000	466	C
3	467	93	27	FL	Detl	S	D	194158.395	374941.718	20.8306	0.0000	0.0000	0.0000	0.000	0.000	467	C
4	468	93	28	FL	Detl	S	D	194165.621	374939.686	19.7344	0.0000	0.0000	0.0000	0.000	0.000	468	C
5	469	93	29	FL	Detl	S	D	194162.203	374949.101	21.5136	0.0000	0.0000	0.0000	0.000	0.000	469	C
6	470	93	30	FL	Detl	S	D	194162.579	374960.917	23.0492	0.0000	0.0000	0.0000	0.000	0.000	470	C
7	471	93	31	FL	Detl	S	D	194167.744	374966.890	23.6453	0.0000	0.0000	0.0000	0.000	0.000	471	C
8	472	93	32	FL	Detl	S	D	194170.578	374964.183	21.5115	0.0000	0.0000	0.0000	0.000	0.000	472	C
9	473	93	33	FL	Detl	S	D	194173.084	374943.963	19.7628	0.0000	0.0000	0.0000	0.000	0.000	473	C
10	474	93	34	FL	Detl	S	D	194174.545	374940.816	19.4593	0.0000	0.0000	0.0000	0.000	0.000	474	C
11	475	93	35	FL	Detl	S	D	194178.749	374937.765	19.3270	0.0000	0.0000	0.0000	0.000	0.000	475	C
12	476	93	36	FL	Detl	S	D	194184.498	374937.511	18.5603	0.0000	0.0000	0.0000	0.000	0.000	476	C
13	477	93	37	FL	Detl	S	D	194186.449	374948.121	20.4265	0.0000	0.0000	0.0000	0.000	0.000	477	C
14	478	93	38	FL	Detl	S	D	194182.497	374954.987	21.5476	0.0000	0.0000	0.0000	0.000	0.000	478	C
15	479	93	39	FL	Detl	S	D	194179.212	374961.740	22.4173	0.0000	0.0000	0.0000	0.000	0.000	479	C
16	480	93	40	FL	Detl	S	D	194174.027	374971.184	23.7481	0.0000	0.0000	0.0000	0.000	0.000	480	C
17	481	93	41	FL	Detl	S	D	194169.553	374982.145	25.1592	0.0000	0.0000	0.0000	0.000	0.000	481	C
18	482	93	42	FL	Detl	S	D	194171.502	374993.121	26.7070	0.0000	0.0000	0.0000	0.000	0.000	482	C
19	483	93	43	FL	Detl	S	D	194172.689	375003.390	28.3025	0.0000	0.0000	0.0000	0.000	0.000	483	C
20	484	93	44	FL	Detl	S	D	194175.177	375016.828	30.5133	0.0000	0.0000	0.0000	0.000	0.000	484	C
21	485	93	45	FL	Detl	S	D	194175.947	375025.467	31.4958	0.0000	0.0000	0.0000	0.000	0.000	485	C
22	486	93	46	FL	Detl	S	D	194173.878	375030.513	32.1263	0.0000	0.0000	0.0000	0.000	0.000	486	C
23	487	93	47	FL	Detl	S	D	194174.567	375039.353	33.1293	0.0000	0.0000	0.0000	0.000	0.000	487	C

The string editor is the most versatile of the editing tools and can be used to add and remove points, change the direction of parts of a string, re-label a string etc. If you can't find another way of performing a string editing operation, you will usually be able to do it in the string editor.

### 5.5.7.6 Moving Points On A String

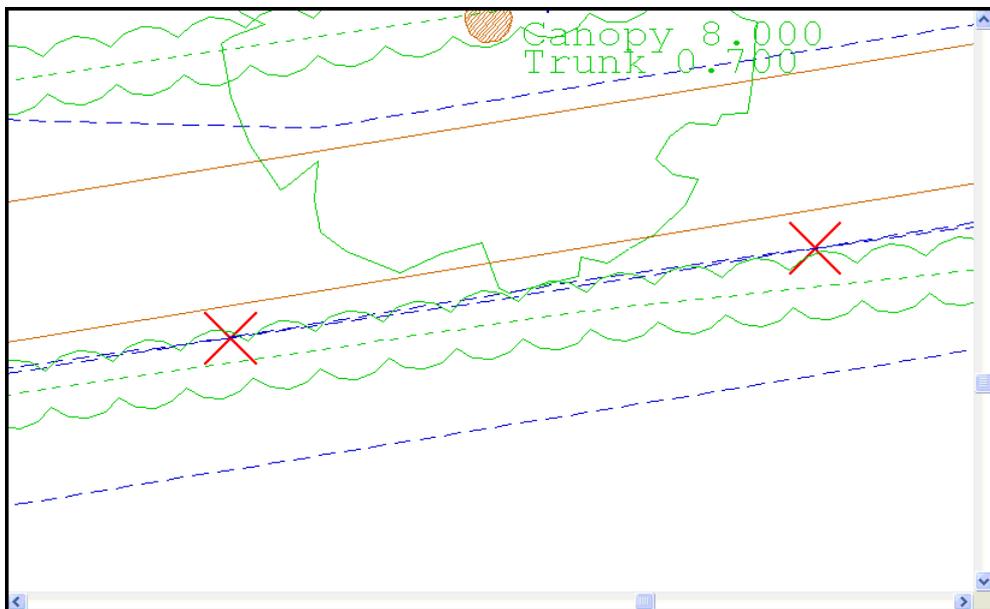
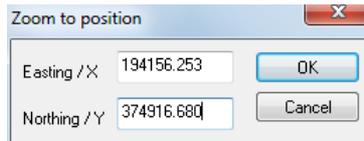
We are now going to look at a crossing breakline problem caused by two strings overlapping. Using the 'Move Points' option best solves this type of problem. First go to the area of interest.

#### **Zooming to specific coordinates**

Press 'Page Down' to zoom in quite close

Select 'VIEW tab > Position button'

On the dialog, enter coordinates of 194156.253, 374916.680



Select the 'Move' option from the MODEL tab to move the point on the dashed string (Point 598) to the far side of the string it crosses, hence removing the overlap and the crossing break lines.

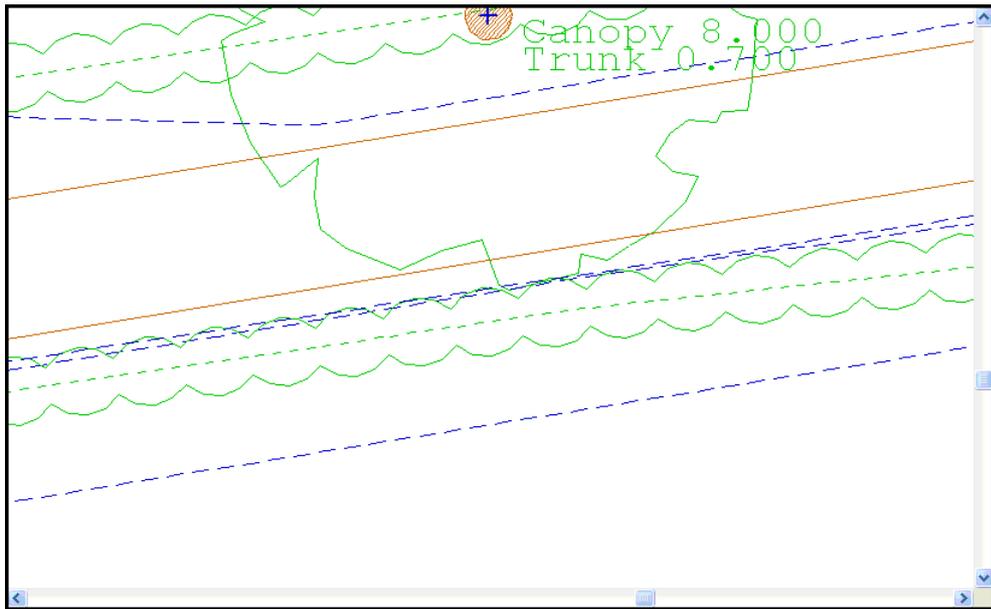
#### **Moving Point**

Select 'MODEL tab > Move' 

Left click on the dashed string (Point 598) and drag to the far side of the string it crosses, hence removing the overlap and the crossing breaklines.

The 'Move' option should be used in conjunction with the snap controls where the ends of two strings that meet, overlap slightly. It is better used free hand when fixing problems such as the one above, and re-aligning tops and bottoms of kerbs for example.

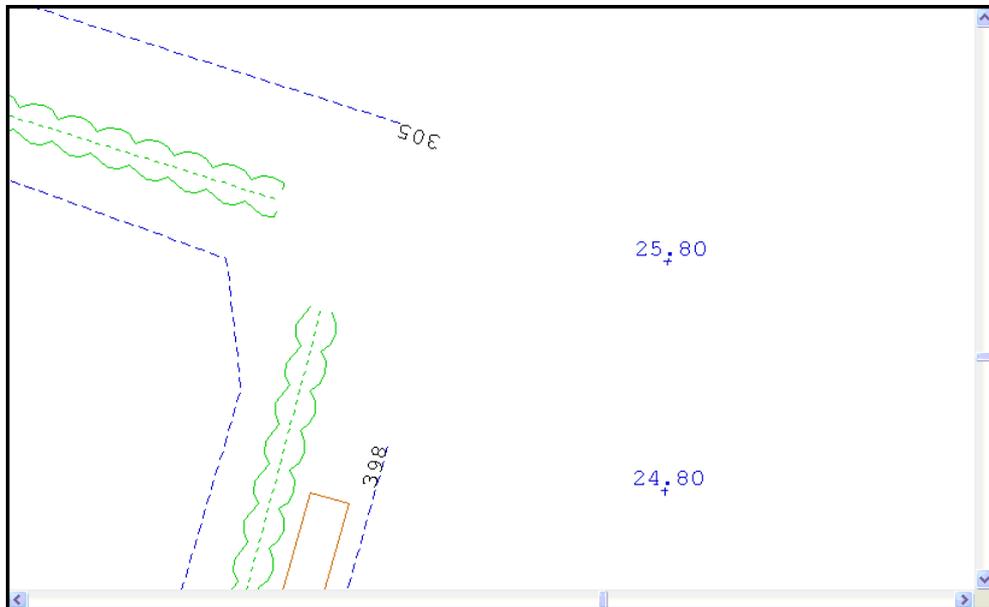
Below is the result of using the 'move' option.



### 5.5.7.7 Extending Strings To Intersect

Apart from breaking string links there is often a requirement to join strings together. This typically occurs on larger jobs where several crews may be surveying the same string, either at different times or from different directions. This will often leave a string in many separate sections that needs to be connected.

If we zoom back up to the area where we were using the string editor we can see a few strings that may need to be joined up.



The 'Join Str' option  may be used to join two strings together with a single line which is available from the MODEL tab. Alternatively the 'Extend to Intersect' option may be used to extend the two strings until they meet which is available from the ADD tab.

The 'Join Str' option will convert the two separate strings into a single string if they both are of the same type. If they are not the same type an extra segment will be added to the end of the first string to make it meet the second string, in this case they will remain separate strings.

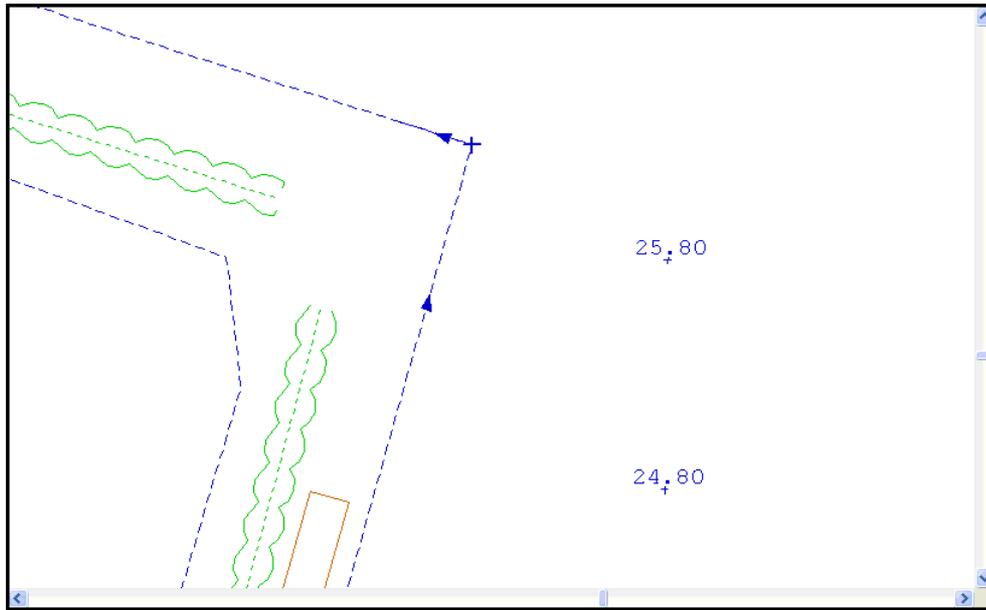
Select the 'Extend to Intersect' option and press the left button first on point 398 and then on point 305 to join up the outer fence string.

### ***Extend Lines To Intersect***

Go to 'ADD tab > Extend drop down > Extend To Intersect'

Select point 398 and then select point 305

Both lines will be extended until they intersect



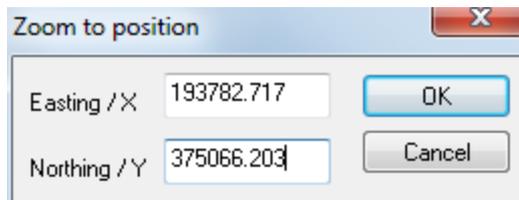
### **5.5.7.8 Trim Lines**

Strings may sometimes extend further than they should. If this happens use the 'Trim' command to trim the strings back to a cutting edge.

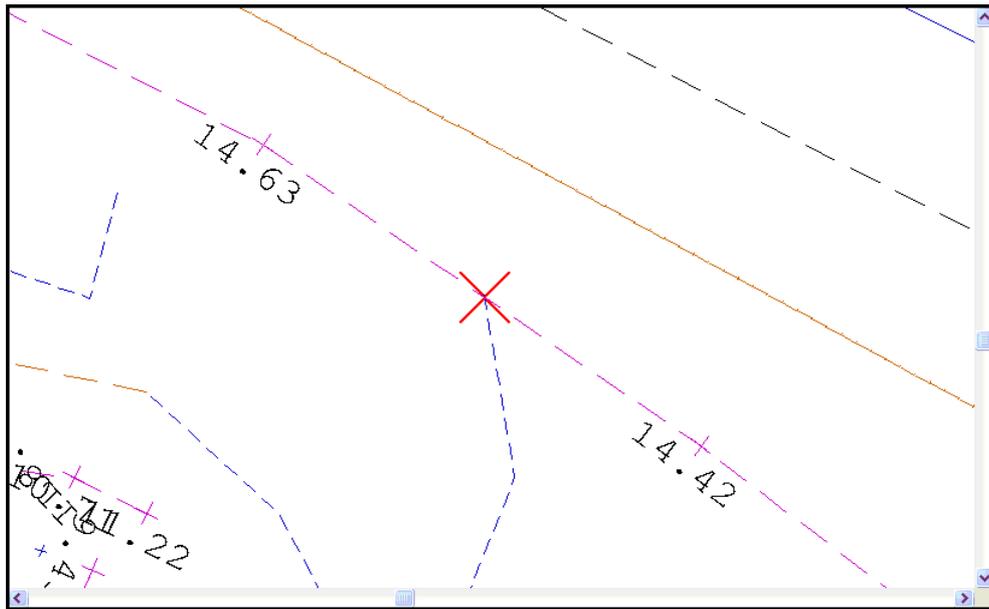
#### ***Trim A Line***

Select 'VIEW > Position'

Type in the X and Y co-ordinates 193782.717 and 375066.203 respectively



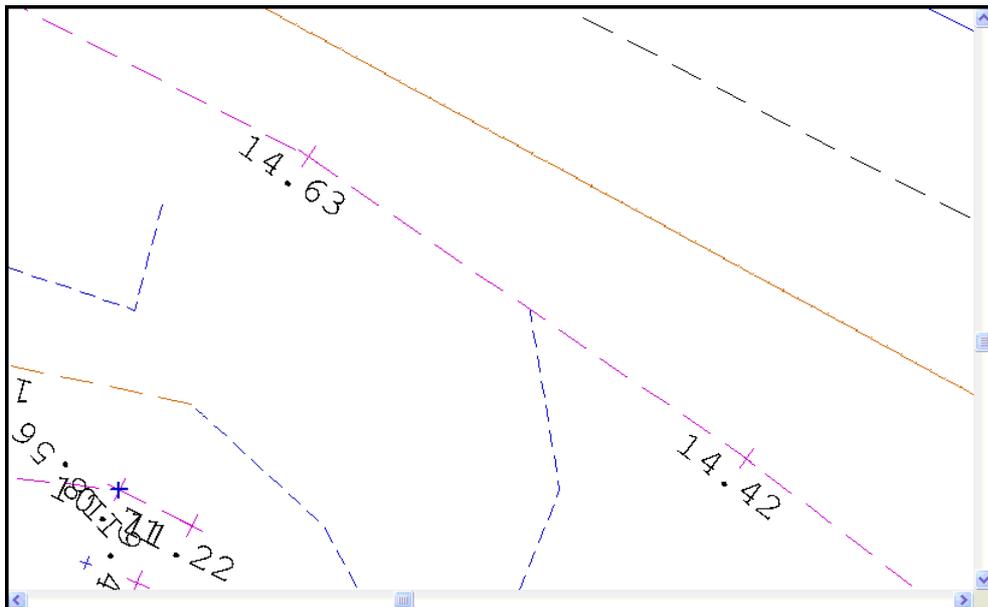
Select 'Ok'



Go to 'ADD tab > Trim button' or

Pick 'TB' as the cutting string for trim – once selected, the cutting edge will turn to red

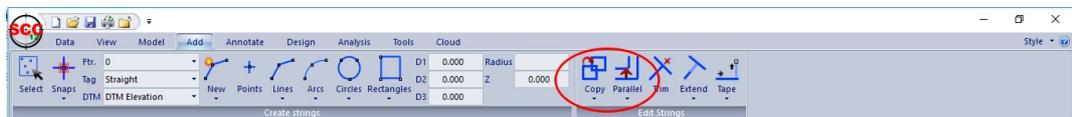
Select 'FL', as string to trim



Press 'ESC' quit this command

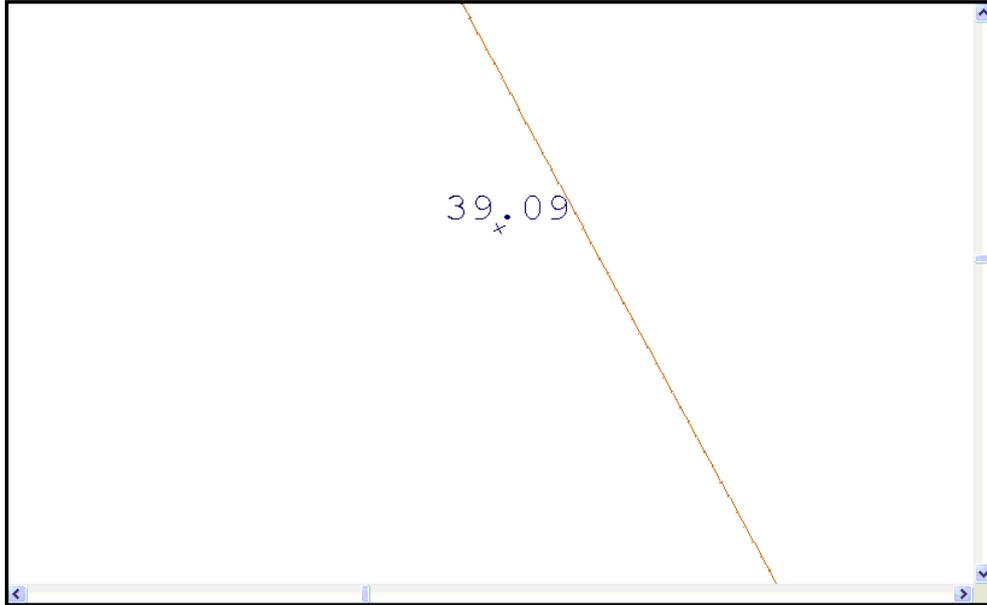
### 5.5.7.9 Copying/Moving Strings

Copy / Move strings and parallel strings is available from the ADD tab.



Consider due to an error in the original survey, it may be necessary to offset a string a certain distance, or copy a string parallel. For example, if a hedge has been offset 2.0m to

the left instead of 2.0m to the right, then, by using the above command, you can offset the hedge string 4.0m to the correct position.

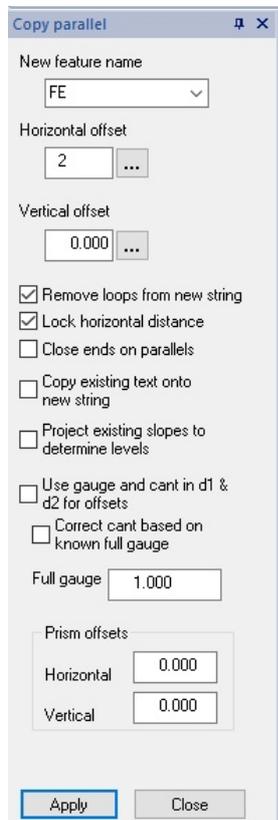


### **Copy A String Parallel**

**Select 'ADD tab > Parallel button'**

**Enter the horizontal distance of 2m in the relevant box and turn on the 'Lock Horizontal Distance' and 'Remove loops from new string' options.**

**Using Drop Down Feature Menu select 'FE' as the new feature name**



**Left click on existing string and move/drag cursor in correct offset direction**

Left click to place new string

Select 'Close'



A vertical offset may also be entered though the new string will assume the levels of the original string if the box is left at 0.000. If a horizontal distance is not specified and the 'lock horizontal distance' box left blank, then the string selected can be moved automatically with the cursor and the distance is shown in the 'horizontal distance' display.

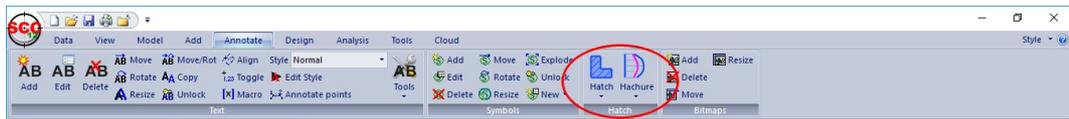
### 5.5.7.10 Adding Slope Lines To A Model

As well as adding text to the model, you may wish to add a feature such as a slope string, which indicates the slope of a selected area and the direction in which it is falling. Slope strings can be added using two methods:

- Slope lines between strings or
- Slope lines using reference string

The first method allows you to pick two strings and generates the slope lines between the two from the lowest to the highest.

The second method is more likely to be used when the two strings are more curved or jagged and in this case, the first method will not work. To add the slope strings between strings of this nature, you need to add a reference string first. When the reference string has been added, the slope string can be drawn, by selecting, in order, the first string, the second string and finally the new reference string.



### Add Slope Strings Using A Reference String



Add the reference string by selecting the **New** icon from the toolbar. Right click mouse to update the string in the model.

Select 'ADD tab > Hatchure > Hatch with reference string'

A blue cross will appear at the end of the cursor.

Select the First String and then second string by left clicking mouse on each respectively

Select the reference string

Enter in your own values

OR

Accept the defaults

Select 'OK'

### 5.5.7.11 Adding Hatching To A Model

SCC also gives you the option to add hatching to a model. The two options available are:

- 'Hatch Polygon' assumes a closed link between the first and last points on the string regardless of whether it is displayed in the model.



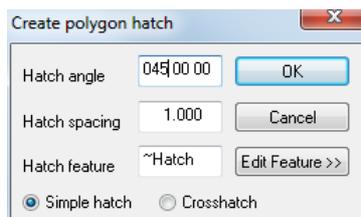
- 'Hatch Strings' will hatch between any two strings selected by the user. The strings must be selected prior to using this option. This can be done using the 'Data Selection Dialog'.



### ***Hatch A Polygon***

**‘ADD tab > Hatch > Hatch a polygon’**

**Left click mouse on polygon you wish to hatch**



**Enter in the values for angle and spacing and select whether you want simple or cross hatching displayed.**

**Select ‘OK’**

### **5.5.8 Editing Pre-selected Data**

Using the data selection dialog allows various methods of point and string selection. If points have been pre-selected and then an editing option chosen, you will be asked if you wish to perform this task on the selected points.

The following editing options may be used with pre-selected:

- Move points
- Delete points and strings
- Break Strings
- Unlock Text
- 3Pts Arc
- Fillet Arc
- Arc 2Pts + Radius
- Arc 2Pts + Tangent
- 2Pts Circle

- 3Pts Circle
- Circle, Radius + Arc
- 2Pt Rectangle
- 3Pts Rectangle

### ***Creating A 3Pts Arc From Pre-selected Data***

**Open the FGL model**

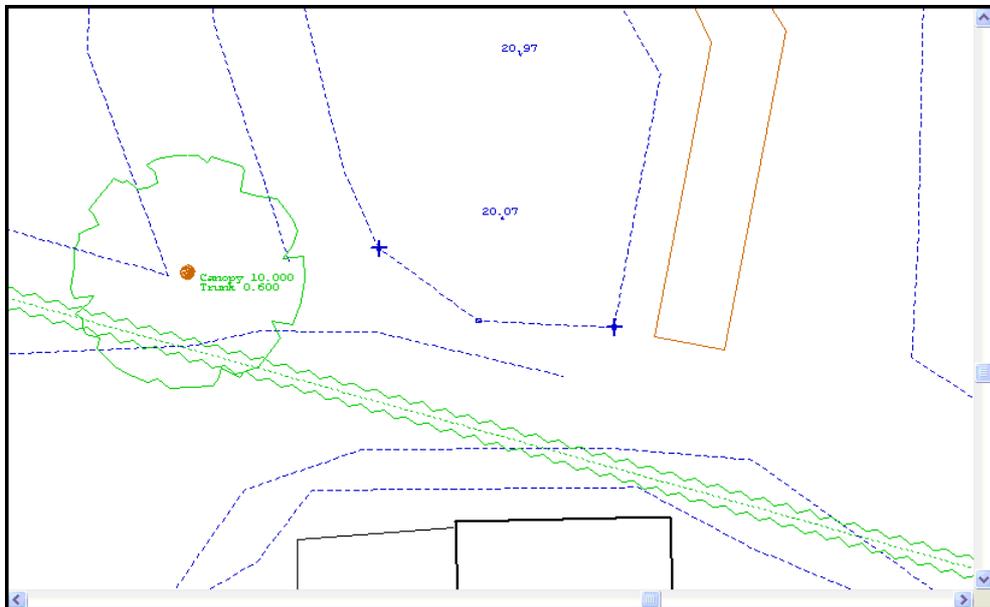
**Zoom into the south east of the model as shown in the diagram below**

**Click the right mouse button to access the 'Data Selection Dialog'**

**Set the selection method to 'Individual Points'**

**Select OK**

**Select the points shown below**



**Go to the ADD tab**

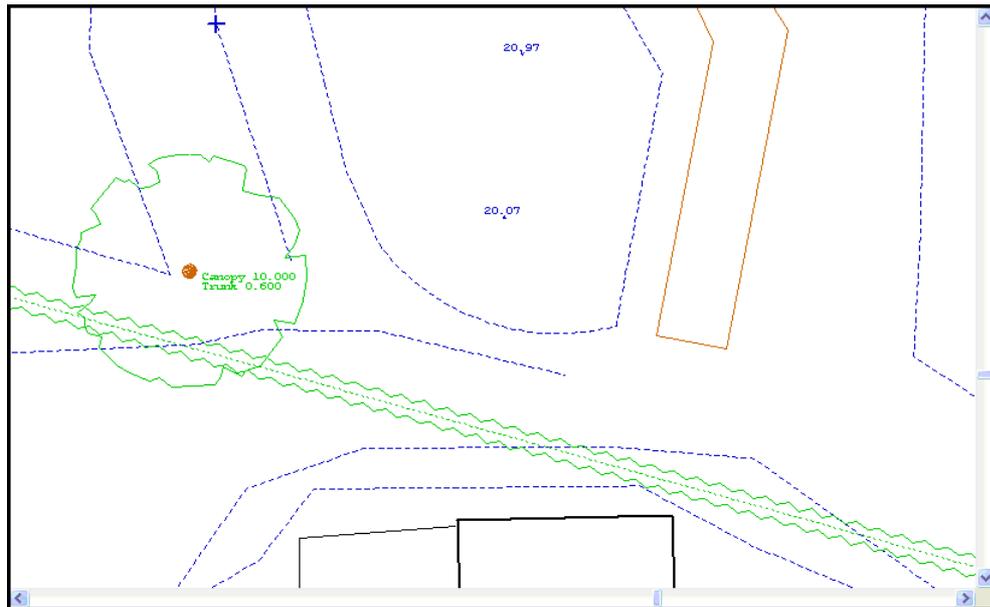


**Set the Change Radius to 0.1**

**Select 'Arcs' drop down button > 3 point arc**

**Select 'Yes' to 'Convert selected points'**

**The result should look as below.**



### 5.5.8.1 Surveying Circular and Curved Objects

The following examines tag codes (Curve, Arc Fit & Circle Fit) assigned to man made circular structure.

It must be considered that circular objects on site have been designed with a specific defined radius. As the radius is unknown the surveyor must implement geometry tag codes between survey points to best represent the structure on the ground.

It is important to note that curve fitting in plan is merely a plan fit in 3D and therefore not recommended for man made structures on an incline/decline i.e. sloping ground.

In conclusion, circle fit is shown to give the best representation of man made object.

#### **Curve / Curve Fitting Within SCC:**

Extra curve points are generated in between surveyed curve points. The type of curves used is 'Splines under tension'. Curve generation parameters may be further defined by tension and point density parameters. Points used to define curves should be surveyed at even intervals apart. The number of points required for accurate delineation of a curve depends on the accuracy requirements. As a guide on tight curves on road belmouths, points for engineering accuracy requirements may be as close as 1 -2 meters - very tight curves on traffic islands may be at 0.1 to 0.2 meters centres depending on the tightness of the curve - main highway curves may be as far apart as 10 to 20 meter centres depending again on requirements.

#### **Curve Type**

The following curve-fitting algorithm can be assigned;

##### **Default**

The curve fitting settings will be the default one found in the coordinate reduction options dialog.

##### **Catmull-Rom (Tight)**

A Catmull-Rom curve will be fit through the survey points. This curve type stays very close to the survey line and has user definable tension and tangent weights.

### ***Tspline (Circular)***

A trigonometric spline curve will be fit through the survey points. This curve is suitable for more circular features that are not true circles. A T-Spline curve through an equilateral triangle will result in a circle. When collecting points on this type of curve, it helps if they are reasonably evenly spaced. Failure to do so may result in a curve that billows away from the surveyed line.

### ***Circle fit***

This option creates a best fit circle through all the points on the surveyed polygon. It is useful when dealing with circular tanks, small roundabouts, and other man-made circular features.

### ***Curve point density***

This is the ratio of curve fit points to surveyed points. For example, a value of 10 would result in ten extra 3d curve fit points being generated for every survey point.

### ***Curve tension***

This applies to Catmull-Rom curves only, and defines the closeness of the surveyed line to the curve. The default value of 0.5 rarely needs to be changed. A value of 0 results in a straight line. A value of greater than 0.5 allows the curve to billow further from the line, (i.e. it loosens the curve).

### ***Curve tangent weight***

This applies to Catmull-Rom curves only, and defines the effect of the incoming and outgoing tangents on the curve. The default value of 1.0 rarely needs to be modified.

## **Coordinate Reduction Option**

The Coordinate Reduction option allows the user to edit configurable parameters relevant to the generation of the detail co-ordinate information. These parameters are used when creating detail co-ordinates from the detail observation spread sheet.

**Go to 'DATA tab > Settings drop down > Coordinate Reduction Options'**

Coordinate reduction parameters

**Curve fitting**

Disable curve fitting      Curve point density:

Treat Arcs as Curves      Curve spline tension:

Process Arcs and Curves      Curve tangent weight:

**Default curve type**

T-Spline (More circular)

Catmull-Rom (Tighter to survey line)

Replace curves with arcs and circles

Tolerance:        Plane fit elevations

Max fit:        Use mean elevation

Interpolate elevations from obs

**Origin shift**

E/X:       N/Y:       Ht/Z:

**Exaggeration / Scale**

E/X:       N/Y:       Ht/Z:

Use of numbers in features

Ignore

Use as strings

Remove from features

Parallel Feature Offsets

Do not apply offsets

Apply in X<->Y Plane

Apply in X<->Z Plane

Apply in Y<->Z Plane

Line of sight offsets

Apply to slope distance

Apply to horizontal distance

Missing Stations

Coordinate from [0,0,0]

Warn about missing stations, do not create coordinates

Close ends on parallels

Use MSMM offset conventions

Create squares and rectangles

Resolve MOSS partial coding

Create 'Strip levels'

Query file updates

Include construction points

Include curves in TIN

Force string numbers in advanced coding

Default tag and dtm codes in advanced coding

Allow observations between points on two and three point rectangles, arcs and circles

Enable duplicate tag code

Concatenate multiple remarks

Change string with new feature

Strip leading zeros from point IDs

Force point IDs to upper case

Reduce to active viewpoint

Load defaults    Reset defaults    Save defaults

OK    Cancel

## Feature Library

Also specific settings may be assigned to individual features within the Feature Library – Feature Wizard as shown below.

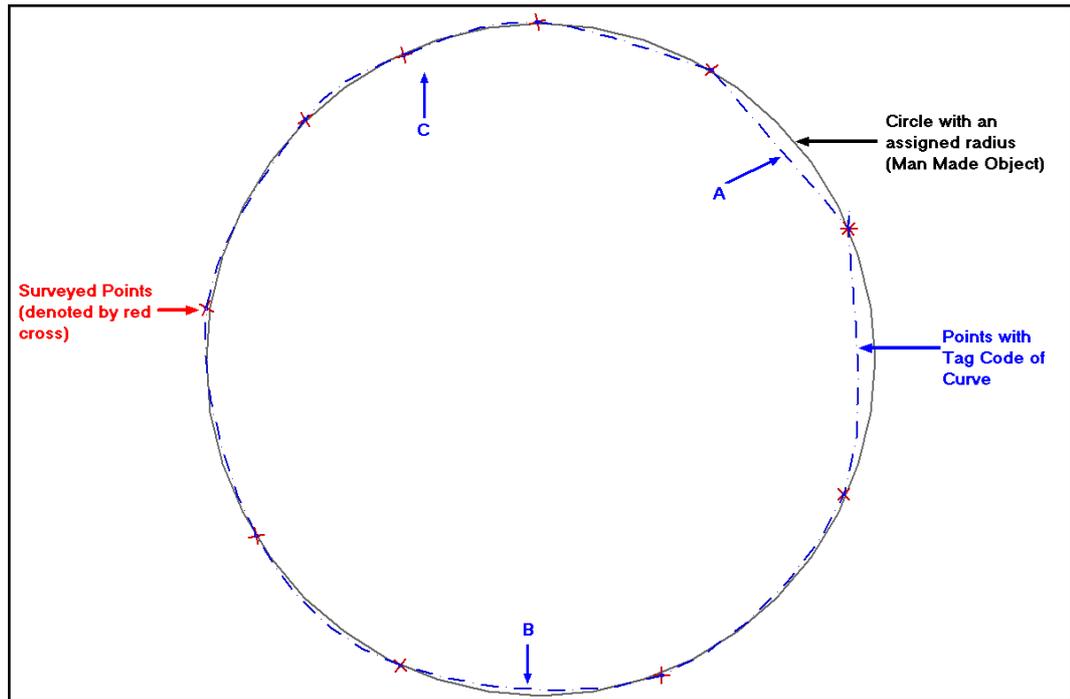
**Go to 'DATA tab > Feature Wizard button'**

### Case Study:

Consider the Man Made Object with a defined radius denoted in each scenario in red. Ten survey points have been pick up in the field.

#### Scenario 1: **Curve 'C' Tag Code**

In the field, the surveyor has pick up 10 points and assigned the relevant 'C' tag code to each. Extra curve points are generated in between surveyed curve points.

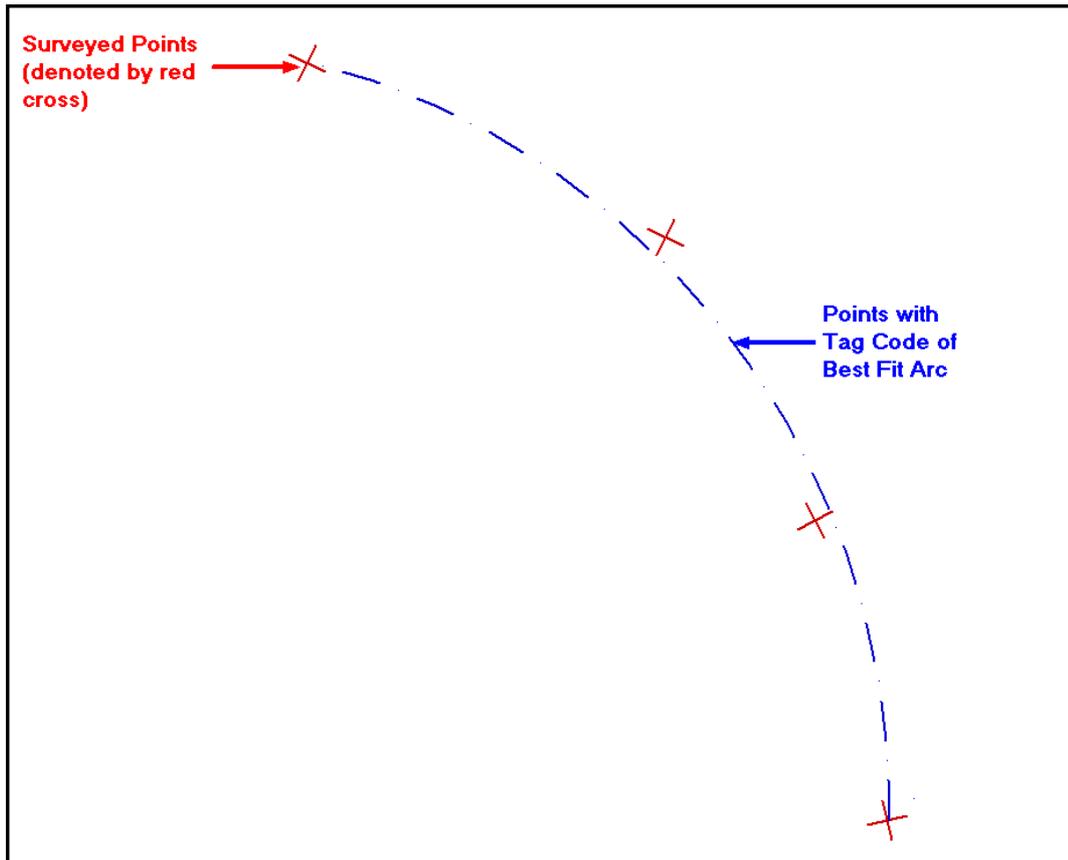


Note the influence of the point spacing in area A and B. In area C, points have been surveyed closer together and as a result the curve is a better representation of what is on the ground.

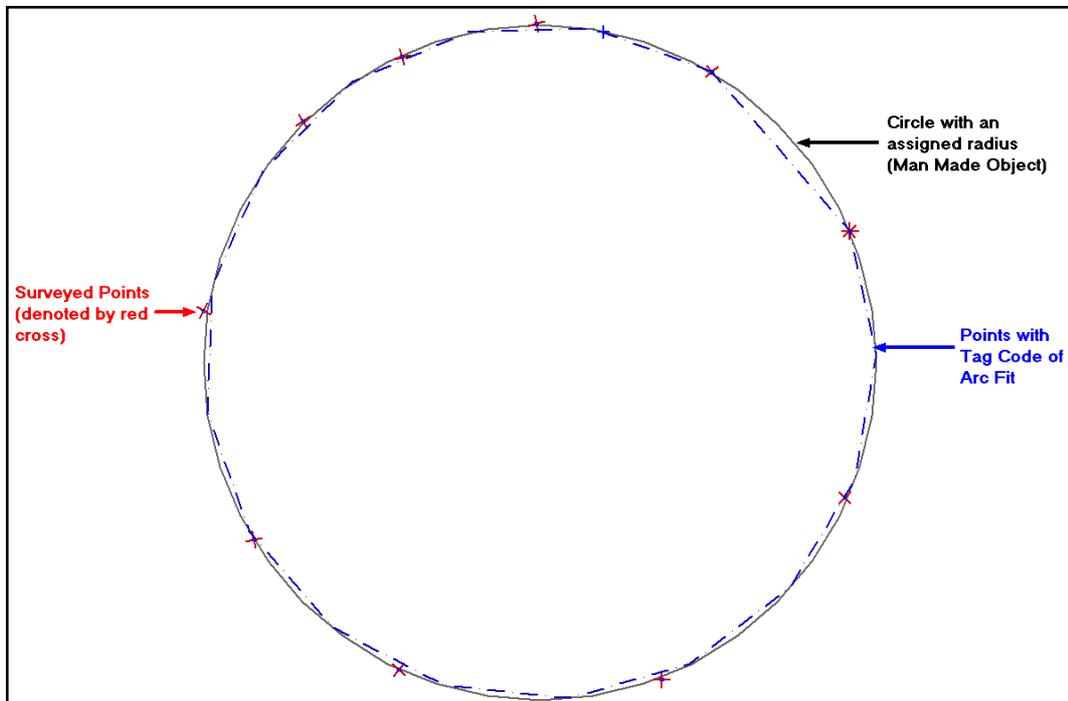
### **Scenario 2: Arc Fit Tag Code**

An Arc Fit Tag Code assigns a best-fit circular arc to the surveyed points.

When more than 3 points are used to generate the arc, the additional points are used only to influence the arc. That is, the arc will not intersect or pass through all points, as shown below:



The position and spacing of survey points is important.

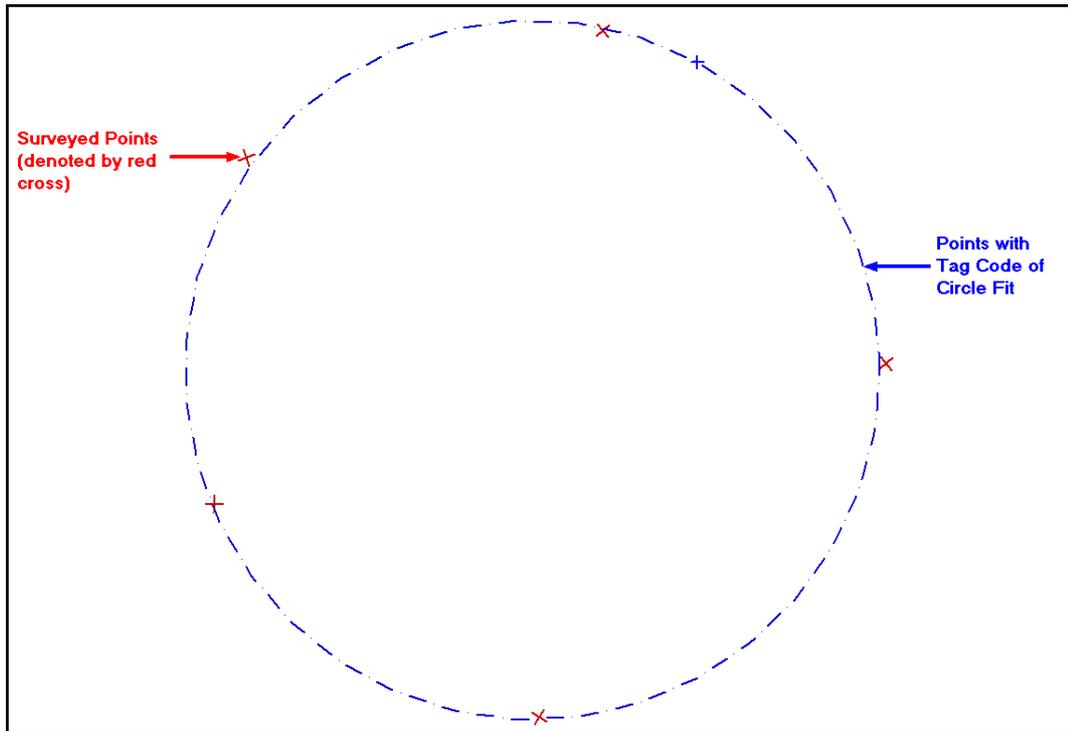


### Scenario 3: Circle Fit Tag Code

This option creates a best-fit circle. It is useful when dealing with circular tanks, small roundabouts, and other man-made circular features.

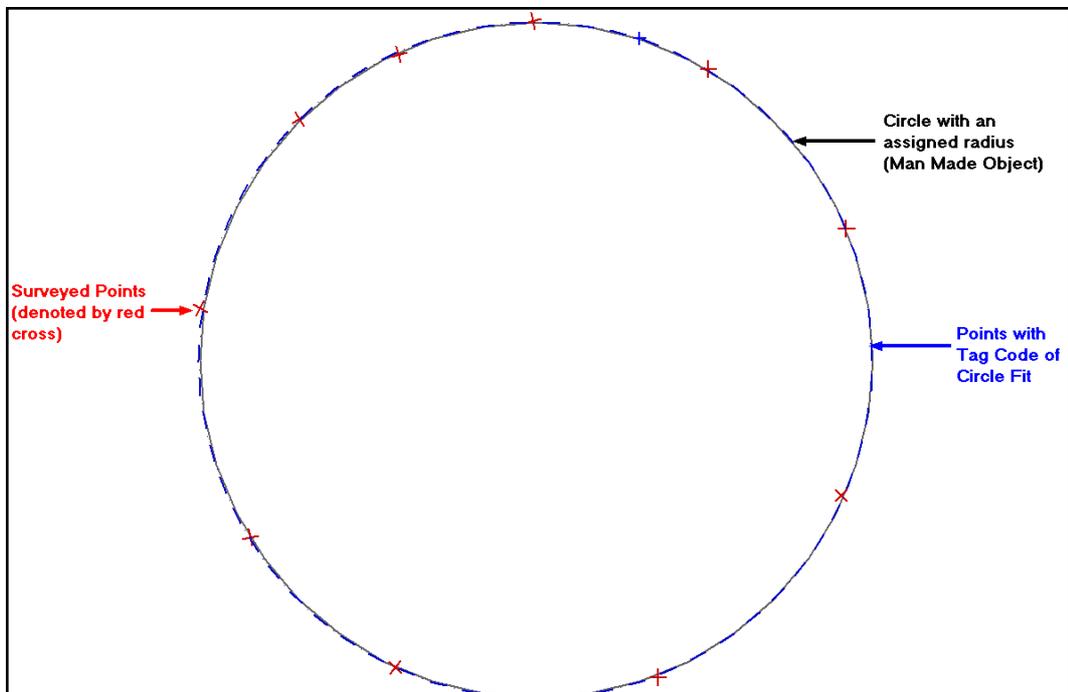
Like Arc fit, not all survey points are intersected but rather influence the position of the

circle.



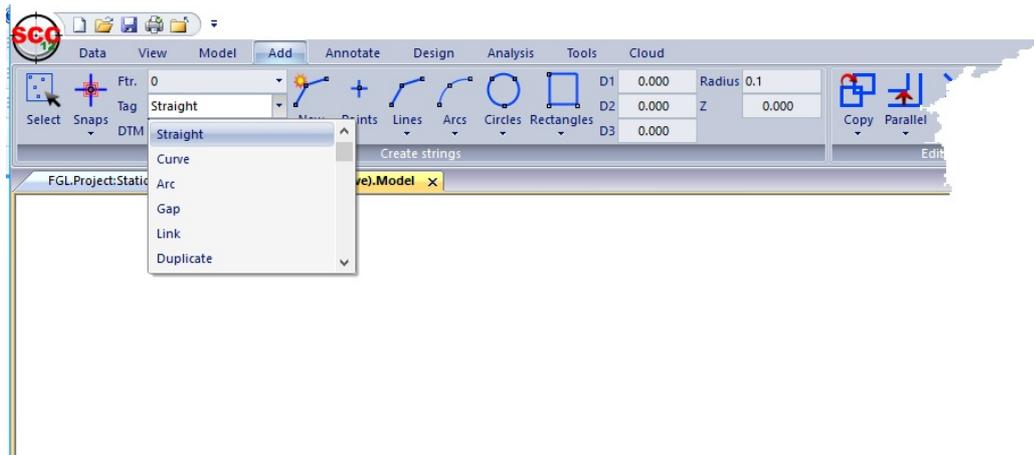
When generating a circle fit use the snap point command to pick up each survey point.

As shown below, the circle fit is the best representation of the man made object.



Note:

Additional Tag Codes have been added to the tag code drop down menu within 'ADD tab'



## 5.6 Triangle Editing

SCC supports two methods of triangulation: 'Delaunay' or '3D Nearest Neighbour'. Either of these may be selected depending on the requirements of the dataset under consideration. Generally the final model produced by either method for a given dataset will be almost identical.

**Delaunay triangulation** forms the set of most equilateral triangles for a set of points. As such it is deciding the final triangulation based on a purely 2 dimensional criterion and then adding elevations to form a surface. As a rule it normally gives the most even spread of triangles, and hence interpolation results, particularly in areas where data is sparse.

**3D nearest neighbour** joins every point to all its nearest neighbours while not allowing any edges to cross. While not providing as even a spread of triangles as Delaunay, the triangulation is being weighted on a 3D criterion. This may often be more suitable for surfaces where strings have not been surveyed and points are being selected randomly from the surface, e.g. for bathymetric work. This is because triangle edges will form more along contours than across them, hence finding the equivalent of natural strings.

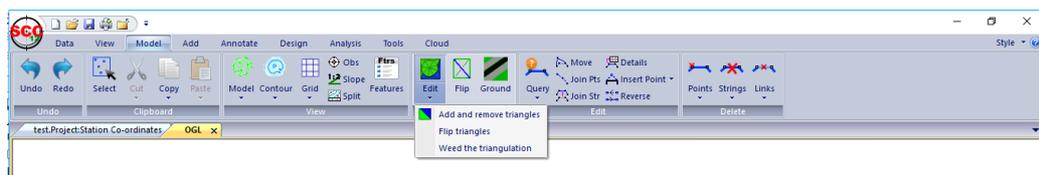
The triangulation is derived from the strings and points in the model. Therefore, all efforts should be made to edit the strings before editing the triangulation. Editing the triangulation allows further control over the final model surface and its boundaries.

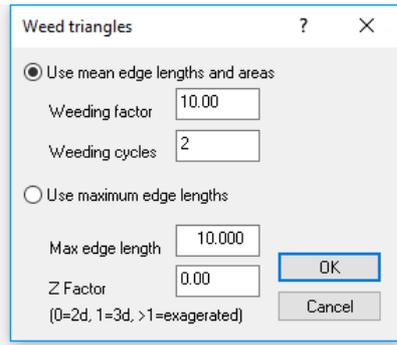
### Triangle Weeding

The simplest way of triangle editing is to 'Weed the Triangulation'.

#### Weeding Model Triangles

From select 'MODEL tab > Edit drop down > Weed the Triangulation'





Select OK to accept the defaults 'Use mean edge lengths and areas'

The weeding factor determines how many standard deviations from the normal will be required to eliminate the triangle. A higher number will eliminate fewer triangles.

Weeding cycles determine how many times the system will run through this process.

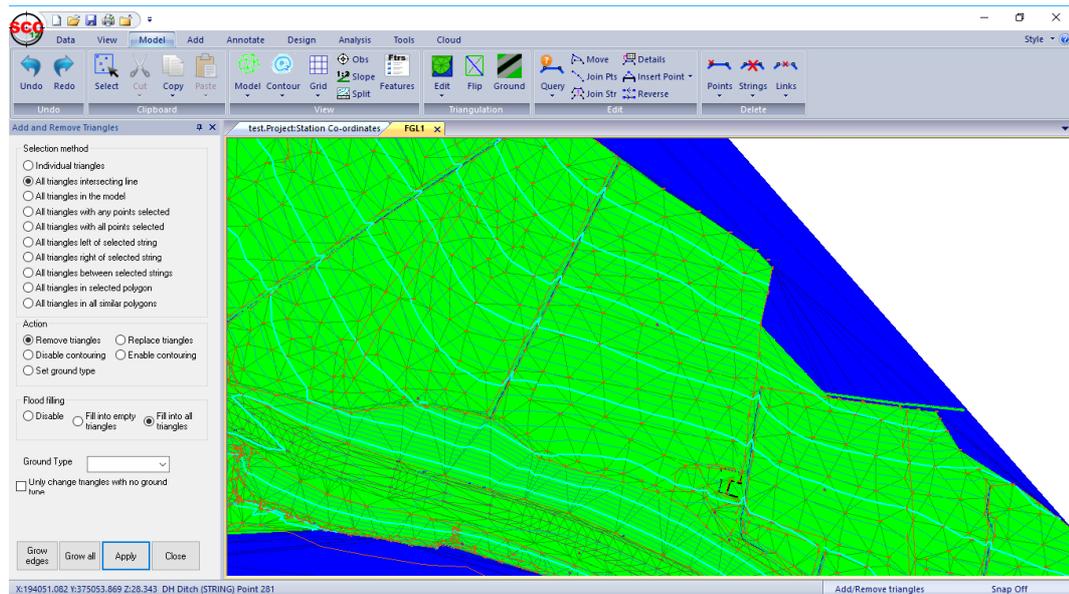
### Adding And Removing Triangles

The weeding defaults work reasonably well on most models but it is possible that some triangles may be eliminated from the interior of the model that you wish to keep. The 'Add/Remove' option will allow you to replace any of those triangles.

Additionally, there may be triangles the weeding did not remove, that are invalid. These may be close to equilateral triangles crossing a concave area, or triangles interior to a building or other flat surface. The above option also allow you to remove any of these unwanted triangles.

By selecting 'MODEL tab > Edit button', you will activate the triangle editor. You know when this editor is active because the colour of the triangles in your model will be filled in either green or blue. Triangles may be interactively selected or by using previously selected points. The invalid or removed triangles are shown in blue and the valid triangles are shown in green.

When you select this option a dialog will be displayed. This dialog allows you to control how the triangles are selected and the action you wish to apply to them.



By selecting points in advance, for example all points on a road center line, it is very easy to set triangles by feature or string. In this case, selecting 'All triangles with any points

selected' will usually refer to any triangle in contact with a road centre line. This will be much quicker than selecting triangles manually.

### **Triangle Editing**

From 'MODEL tab > Edit button'

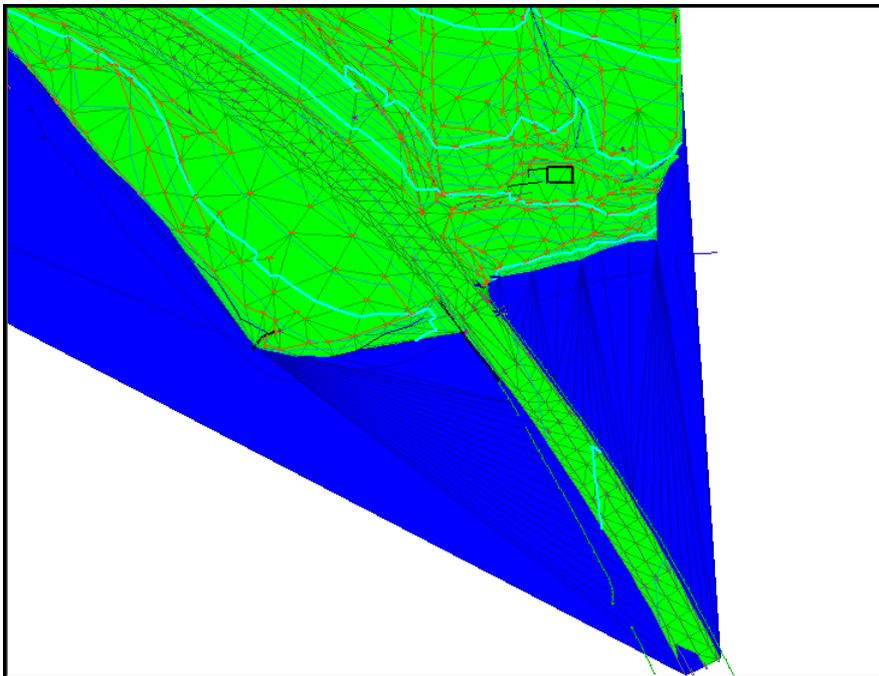
Highlight 'All triangles intersecting line'

Highlight 'Remove triangles'

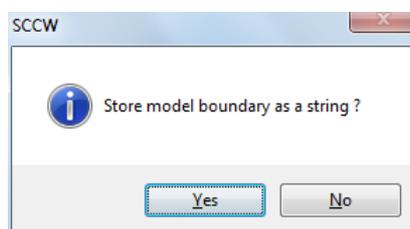
Click OK

Select the triangles shown in blue in the image below by left click mouse to start the intersecting line, move the cursor across triangle you wish to remove and then left click mouse to end intersecting line.

Select Close (or press ESC) when finished



SCCW then gives you the option of storing the boundary you have created using the 'Add/Remove Triangles' option, as a boundary string. If you say 'Yes' to this, a boundary string called '~BNDRY' is created and stored in your model. This is very useful especially when volume calculations may be needed.



Click 'Yes' to 'Store model boundary as a string'



The 'Add/Remove Triangles' option also allows you to disable contours in a given area, but keeping the triangles active. For example, on a road, you may not want to display contours across the hard surface but will wish to generate profiles and cross sections of the road at a later stage. Removing the triangles from this area will mean that no sections can be generated at all so therefore you would use the 'Disable contours' option instead.

### ***Flip Triangle Edges***

This option allows you to switch the connecting edge between two adjacent triangles. If you have proper breakline strings defined, this will not be necessary, whereas models made up mostly of points, will require this option more.

When the flip triangle edges option is active, the triangulation will be drawn. As you move the cursor around the model, the triangle edges to be flipped will be highlighted. The left mouse button will switch the connecting points.

This option will normally only be used on models made primarily of points. Using correct stringing will usually give a better result.

### ***Triangle Edge Flipping***

Select ' MODEL tab > Flip button'

The link to be changed will be highlighted

Select a link (Choose a large triangle)

Left click mouse

Click on  to exit the option or Esc

## **5.6.1 Generation Of Boundaries**

Boundaries are important for volume calculations. If the surface used in volume calculation is not clearly defined the result of the volume calculation will be ambiguous. If a boundary has not been surveyed in the field for whatever reason, one must be generated in SCC.

We have already discussed how to use the 'Add/Remove Triangles' option to create a boundary in the model.

Here we will describe how to use the 'Add String With Cursor' option to generate a new string in your model. If your model already contains strings that may form part of the surface boundary, they may be used to generate the new boundary. The most common way to generate boundary strings is to select the outmost surveyed points in the model. It is important therefore that the snap control is set to nearest point.

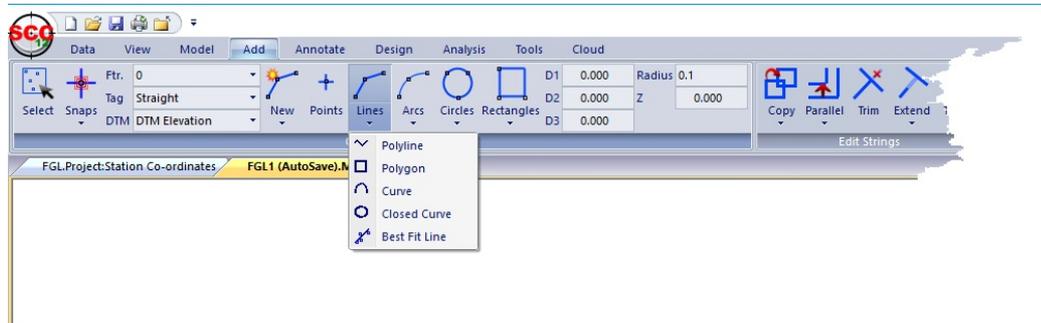
### Adding A New String To The Model

It is possible to add strings to a model using the ADD tab tools.



**Using the field boxes above, set the feature code to 'boundary' and the tag code to 'straight'. The DTM code is set to 'clip polygon' because we wish to use this string as a boundary where all contours and triangles outside of the polygon are clipped out of the DTM.**

**Pick Polygon from 'ADD tab > Lines drop down'**



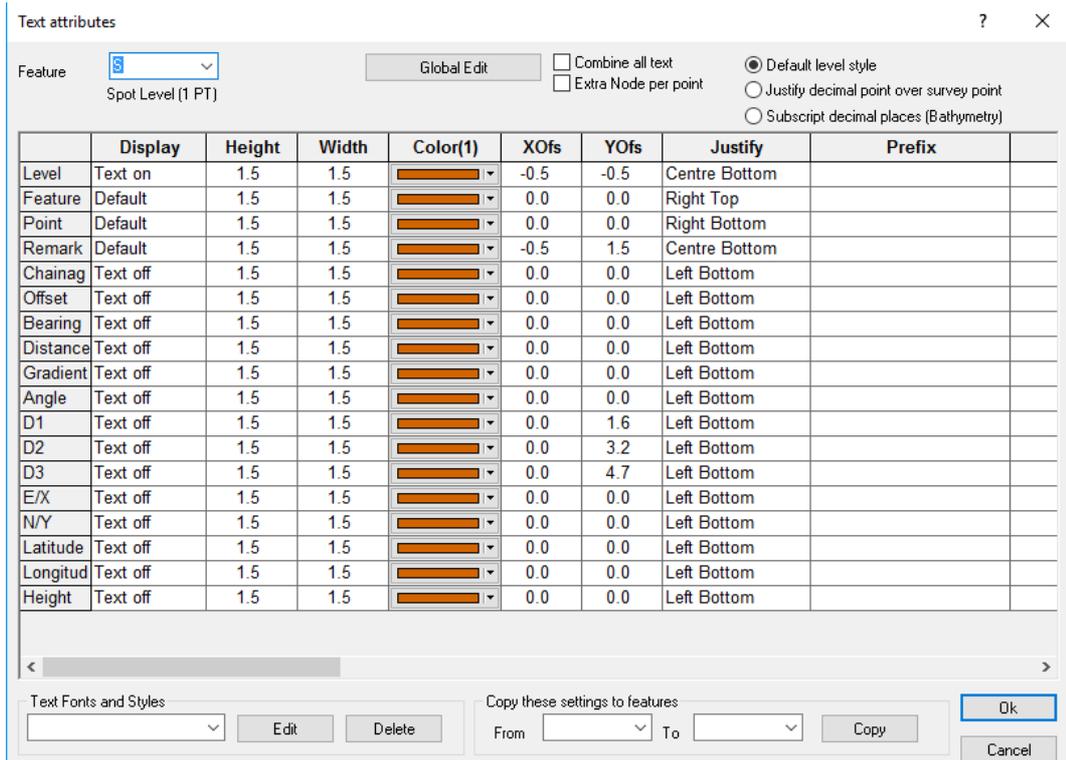
**Click the left mouse button once for each point you wish to add, and right click mouse to 'Update String In Model' button.**

A very useful technique on this menu is the option to 'Save Co-ordinates As Dataset'. This allows the new boundary co-ordinates that you have created to be saved as a separate dataset that can then be used as a boundary for multiple sub-surfaces.

## 5.7 Annotation In The Model

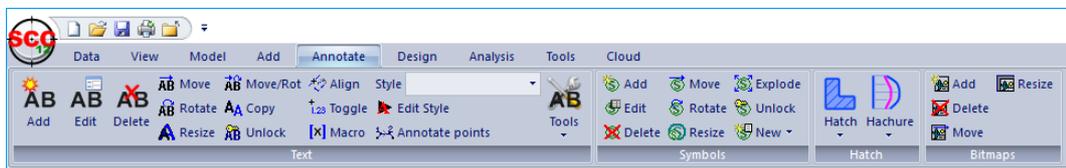
In terms of text placement, SCC has eighteen automatically annotatable fields per point. For each of these fields it is possible to specify text size, width, position relative to the point, justification relative to the point, alignment relative to string, grid and sheet, suffix and prefix, output layer, font and style. Additionally you can specify whether to annotate all or selected points for this feature and field, and what the relative priority of this field is when automatically deleting overwriting text. This can all be set up in the feature library prior to download, thereby reducing the amount of work that needs to be done to produce the final plot.

Once in the model, these settings can be viewed through the 'Query & Edit Points' option.



However, it is recommended that any further editing of text should be done using one of the following options:

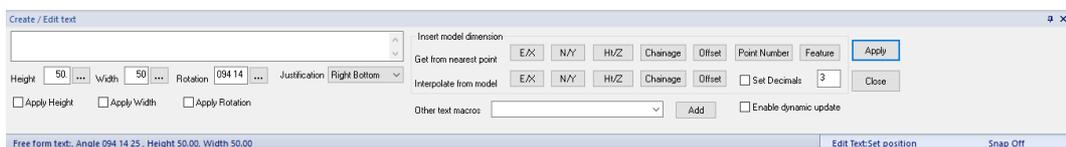
### Text Node Editing



### Create Text



This option allows you to add free form text and text macros to your model. Selecting it presents the 'Create / Edit Text' dialog shown below.



Type in the text you wish to add to the model. Then click on the model where you wish to insert the text. You may set the height, width, rotation and justification of the text in the dialog or interactively when the text is inserted into the model. Font information for the text will be determined by the current text style.

There is also the option of adding X,Y and Z co-ordinates (in text form) to the model using the nearest and interpolation macros available. To do this, select X,Y or Z from either 'Get from nearest point' or 'Interpolate from model' and hit the 'APPLY' button. As you move the cursor about the model, the text will be automatically updated, giving you either the interpolated co-ordinates of the point at the end of the cursor or the co-ordinates of the nearest point, depending on the option selected. Ticking the 'Enable dynamic update'

option means that if at a later stage you have to move the text, it will be updated automatically to display the co-ordinates of the new position.



### **Edit Existing Text**

This option allows you to edit existing text in the model. The option works in a similar manner to the create edit text option, but in this case you must initially select the text with the mouse, rather than entering it in the dialog.



### **Delete Text**

This option allows you to delete existing text. Select this option and then select the text you wish to delete. To select the text, click on it with the mouse. Use the 'Data Selection Dialog' prior to selecting this option to delete a large amount of text at the same time.



### **Move Text**

This option allows you to move existing text. Select the text by clicking on it and then moving it with the mouse to its position. Use the 'Data Selection dialog' prior to selecting this option to delete a large amount of text at the same time. Pressing the '\*\*'key in move or rotate text changes the mode between moving and rotating the selected text item.



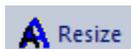
### **Rotate Text**

This option allows you to rotate existing text graphically about the insertion point of the text. The insertion point of text is to the bottom left of the text. Use the 'Data Selection dialog' prior to selecting this option to rotate a large amount of text at the same time. This will give you an option to either set a fixed angle for all the selected text or add a relative rotation to that text.



### **Move and rotate text**

This option combines the move and rotate function into one button. After selecting this option you can move text and then left click to change to rotate function.



### **Resize Text**

This option allows you to resize exiting text interactively on the screen. Use the 'Data Selection Dialog' prior to selecting this option to resize a large amount of text at the same time.



### **Copy Text**

This option allows the user to copy text and paste the text multiply.



### **Text Style**

The text style controls the font and effects for model text. To set the style of text nodes in the model, first use the 'Data Selection Dialog' to select the text nodes you wish to modify, then select the desired text style from the list given in this control.



### **Edit Text Style**

This option allows you to create or edit a text style, using the standard Windows Font dialog. To create a text style, enter the name of the style and press this button. To edit an existing text style, select the name of the style and press this button. Apart from being displayed and plotted in SCC, text styles may be exported to CAD.

**Unlock Text**

This allows you to convert associative dimension text into literal text, in order to make it editable. Once dimensional text has been unlocked it is converted into remarks text for the purposes of the model annotation dialog. Use the 'Data Selection Dialog' prior to selecting this option to unlock a large amount of text at the same time. This option is only applicable for annotation items that have a feature library 'Insert Method' set to 'Associative Dimension'. This will typically only be the case when working with very large models.

**Show / Hide Macro Text**

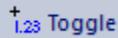
This option shows or hides text macro details, in order to let you see how various text items have been created, and what they represent. Text macros are typically used for annotating point dimensions, such as elevation and point number. All feature library text macros will appear as '[VTX]' with any appropriate prefixed and / or suffixes. A complete list of text macros currently in use in SCC is given below

Macro Name	Description
[VTX]	Any point annotation generated by the feature library
[Name]	The file title of the current model
[Path]	The full file name and folder location of the current model
[Scale]	The plot scale
[Client]	The client name, entered in the 'Scales, titles and grids' dialog.
[Date]	The date, entered in the 'Scales, titles and grids' dialog.
[Surveyor]	The surveyor name, entered in the 'Scales, titles and grids' dialog.
[ProjectTitle]	The project title, entered in the 'Scales, titles and grids' dialog.
[Project]	The SCC project name.
[Operator]	The operator name, entered in the 'Scales, titles and grids' dialog.
[Time]	The current system date and time.
[Version]	The SCC version number
[Page]	The number of sheets in the model
[Pages]	The sheet number currently being plotted or displayed.
[ContourScale]	A graphic representing the colour contour scale for relief contours
[ModelX]	The X ordinate of the text node
[ModelY]	The Y ordinate of the text node
[ModelZ]	The Z ordinate of the text node, interpolated from the triangulation
[ModelChainage]	The chainage of the text node, interpolated from the active alignment
[ModelOffset]	The offset of the text node, interpolated from the active alignment

[NearestX]	The X ordinate of the nearest model point to the macro text node
[NearestY]	The Y ordinate of the nearest model point to the macro text node
[NearestZ]	The Z ordinate of the nearest model point to the macro text node
[NearestChainage]	The chainage, generated from the active alignment, of the nearest model point to the macro text node
[NearestOffset]	The offset , generated from the active alignment, of the nearest model point to the macro text node
[NearestD1]	The first dimension of the nearest model point to the macro text node
[NearestD2]	The second dimension of the nearest model point to the macro text node
[NearestD3]	The third dimension of the nearest model point to the macro text node
[NearestPoint]	The point number of the nearest model point to the macro text node
[NearestFeature]	The feature name of the nearest model point to the macro text node
[Stn <n> Name]	The name of the <n>th station in the model, normally used for creating station schedules in sheet layouts.
[Stn <n>X]	The X ordinate of the <n>th station in the model
[Stn <n>Y]	The Y ordinate of the <n>th station in the model
[Stn <n>Z]	The Z ordinate of the <n>th station in the model
[Stn <n>]	The name X,Y and Z of the <n>th station in the model
[Ftr <n> Name]	The name of the <n>th feature in the model, normally used for creating legends in sheet layouts.
[Ftr <n> Layer]	The layer name of the <n>th feature in the model
[Ftr <n> Title]	The description of the <n>th feature in the model
[Ftr <n>]	The name, layer name and description of the <n>th feature in the model
[DrawFtr <n>]	A graphic sample of the <n>th feature in the model
[Fcode <n> Name]	The name of the feature, with feature named <n>in the model, normally used for creating fixed coded legends in sheet layouts.
[Fcode <n> Layer]	The layer name of the feature named <n>in the model
[Fcode <n> Title]	The description of the feature named <n> in the model
[Fcode <n>]	The name, layer name and description of the feature named <n> in the model
[DrawFcode <n>]	A graphic sample of the feature named <n> in the model
[Signature]	A graphic of the surveyor's signature, created by the

PocketDTM ADC module. Used for signed models.

### ***Toggle Text On/Off***



This option turns on or off all the text associated with a given point and is provided as an alternative to manually deleting text, or using the delete overlapping text option.

### ***Align Text To A String***



This option aligns text to a given reference string, either interactively or by pre-selecting a number of text nodes.

### ***Delete Overlapping Text***



This option allows SCC to delete any overlapping text based on the number entered in the 'Priority' field of the text attributes in the feature library. Each piece of associated text is given a number and the higher the number, the higher the priority. Therefore, if there are two pieces of text overlapping where the point number has a priority of 3 and the elevation has a priority of 6, then, the point number will be deleted. This option can be used in conjunction with the 'Data Selection Dialog' to highlight either certain areas, features or strings.

#### ***Delete Overlapping Text Using The Data Selection Dialog***

**First, press the 'Escape' button. This will cancel any active editing process.**

**Press the right mouse button and the 'Data Selection Dialog' should appear.**

**Select 'All point in a window'**

**Select 'OK'**

**In the model, draw a window around the area in question.**

**All points within this area should be highlighted blue.**

**Go to 'MODEL tab > Delete Overlapping Text button'**

**SCC will then inform you of how many pieces of text were deleted during the process.**

Any remaining text can then be interactively moved, rotated, resized, deleted or edited. Text that has been deleted can also easily be restored using the 'Annotate Strings' tool, which again works best in combination with the data selection tool.

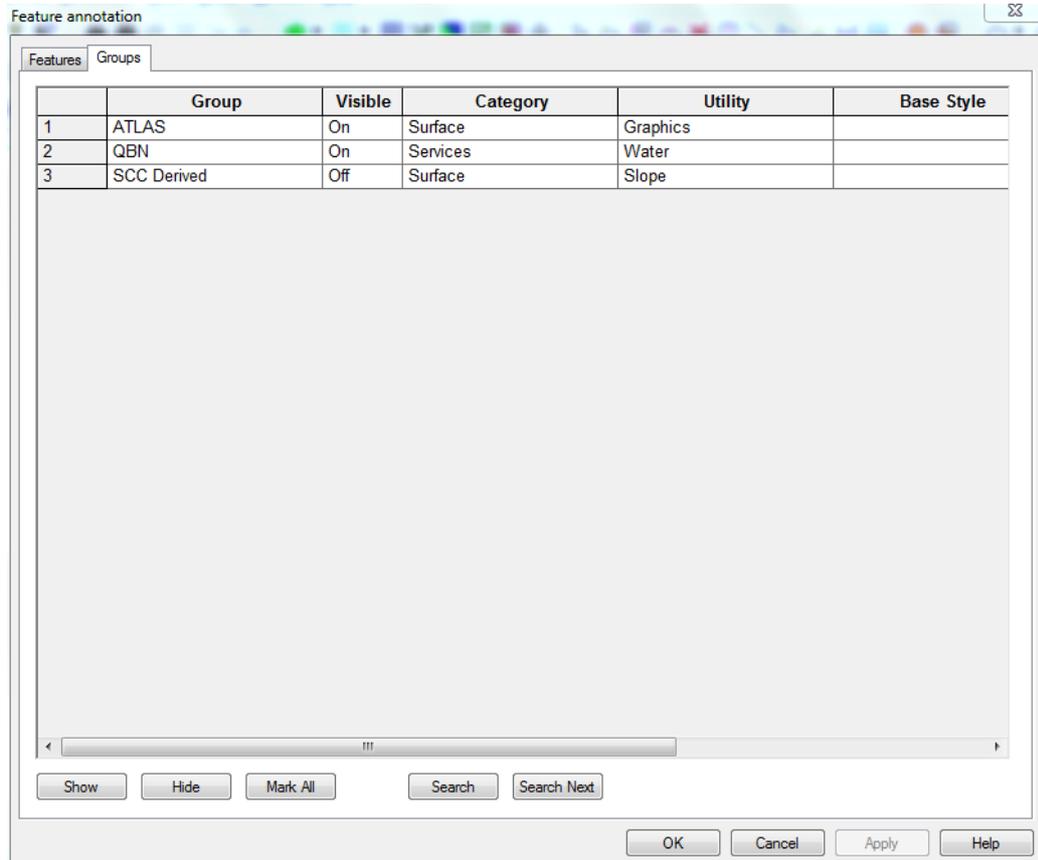
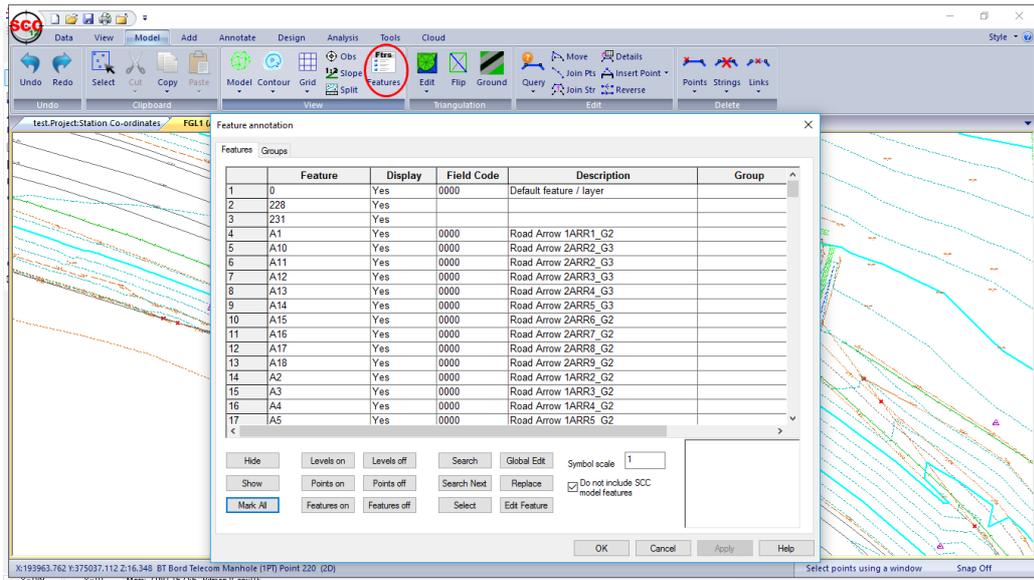
### ***Feature Annotation***



The feature annotation option is similar to the string annotation option except that it allows the user to add annotation to the model by feature rather than selected points or strings. Remember that a feature refers to all strings of the same type, such as all hedges, all walls etc. Group information set up within the feature library is also displayed within the Feature Annotation dialog. This allowing the user to modify, select and display data based on their defined group.

#### ***Viewing Feature Annotation***

**Select 'MODEL tab > Feature Annotation button'**



Note that Feature Annotation option modifies the models feature library, and re-annotates all strings for any features that are altered. This is liable to undo other text editing and should be used with caution.

## 6 Import & Export From Model

SCC includes a wide range of methods for communicating with other software packages and survey devices. These comprise of general purpose data exchange methods and functions that are specifically for communication with a given package. The general purpose methods

include cut & paste, full OLE (object linking and embedding) client, server and automation support and user defined ASCII import and export. The cut and paste routines support cut and paste in text format, Microsoft Excel and Access format, bitmap format, OLE object format, and internal SCC coordinate exchange format. This means that cut and paste can be freely used both internally within SCC and to transfer information between most other Windows software.

The specific functions include highly configurable bi-directional CAD and MX/MX interfaces.

## 6.1 Importing Additional Model Data

There may be instances where you have recorded a survey, downloaded it into SCC, created and edited the model and then you are required to take more survey information. To add this extra survey information to your existing model, you will need to download the new survey into SCC, using the original project file, save this file as a dataset (survey file) and add it to the existing model. The 'Add Strings from File' option, under the 'TOOLS' menu allows you to do this.

Data can be added to the model from files other than SCC datasets. SCC is capable of accepting additional information from DXF files, ASCII files and MX (Moss) Genio files.

Create a model using the existing survey files, FGL1, FGL2 and FGL3 and then add the Survey file FGL4 to the model.

### ***Adding More Survey Information to an Existing Model***

**Go to 'DATA tab > Model'**

**Highlight the files, 'FGL1.Survey', 'FGL2.Survey' & 'FGL3.Survey'.**

**Select 'Create the model and Triangulation' as before**

**Select OK**

**Save the model as 'FGL123.model'**

**Go to 'TOOLS tab > Tools drop down > Add Strings from File > SCC datasets'**

**Highlight the file 'FGL4.survey'**

**Select Open**

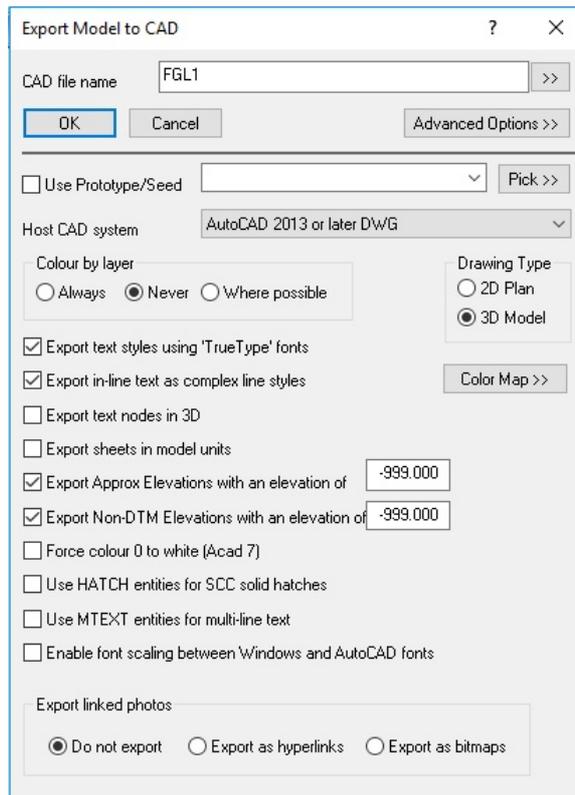
**Select 'Normal Topographic Data'**

**Select OK**

Selecting 'Normal Topographic Data' means that SCC uses the elevation/height detail from the SCC dataset you are adding. If you select '2D boundary strings', SCC will drape the X and Y co-ordinates on to the model and add the elevation/height information from the existing ground surface. This is more commonly selected when adding boundary strings.

## 6.2 Export Data from SCC to CAD

The CAD interface supports a wide variety of CAD packages, and where the CAD system is available on the same computer as SCC, SCC will automatically run the model into CAD. The CAD export also includes user definable colour matching for Microstation, and nearest colour palette mapping where relief mapping is in use. Note the Microstation DGN output supports alpha-numeric layer names.



The key thing to remember in exporting model data to CAD is 'what you see on screen is what will be transferred'. That includes grids, text contours and triangles, etc. The feature library is used to control MX labelling and CAD layering such that it is entirely independent of the field coding in use.

SCC will create AutoCAD line styles and text styles to match the SCC drawing with the minimum number of entities. Note that when exporting in 3d, all polylines will appear as continuous lines. This is a restriction in AutoCAD rather than SCC.

### ***Export Model To Cad Drawing***

**Go to 'DATA tab > Export drop down > CAD'**

**Enter in a file name**

**Select 'Advanced Options'**

**Select the host Cad system you are using**

**Select whether you want 2D or 3D information and other required settings**

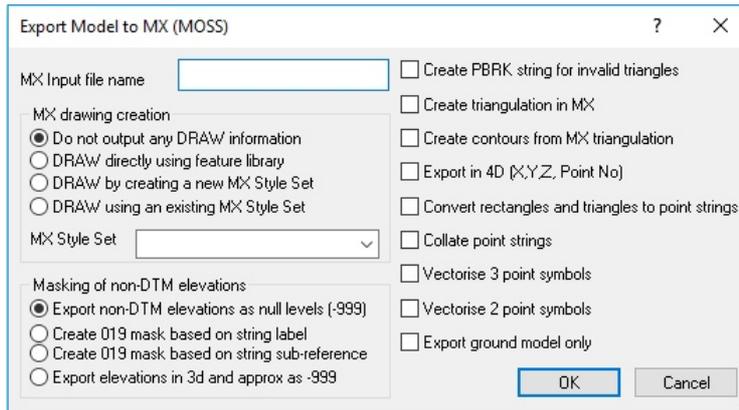
**Select 'OK'**

Direct links (within General Options) may be created from SCC to Windows based CAD systems.

## **6.3 Export Data from SCC to MX**

### ***The MX Interface***

The MX interface includes support for transfer of model, section, alignment and drawing data, using GENIO and other MX formats. Output of model data can be in 3d or 4d, where the fourth dimension is the survey point number, and includes support for non-DTM 3d data such as invert levels and overhead features. The 'Export to Moss' option can be located under the 'DATA tab > Export drop down > MX GENIO'.



### **Export Model To Moss Model**

**Go to 'DATA tab > Export drop down > MX GENIO'**

**Enter in a file name**

**Select the options 'Do not output any DRAW information', 'Export non-DTM elevations as null levels (-999) and 'Collate point strings'**

**Select 'OK'**

**The input file will be saved in your current working directory**

### **MX String Labelling**

The feature library controls the conversion of SCC survey data sets into MX models. Part of this process is the automatic allocation of MX string labels. This may be either totally automatic, or where required, full MX string labels may be coded in field.

In the feature library, the 'LBL' field is used to determine the label of any MX string generated for a given feature. For example, if coniferous tree is coded as TCONIF, the 'LBL' field might have a value of 'TC', hence point strings for this feature would be labelled PTC0 to PTCZ, and line strings coded TC00 to TCZZ.

In MX SURVEY based data collectors, the surveyor may code strings with a full four character MX string label. If the initial characters of the string label agree with the 'LBL' field of the matching feature in the feature library, the surveyed string label will be carried through. For example, say the centre line of the road being surveyed is given a feature name of CL05. SCC is set up to use the nearest matching feature in the feature library, which in this case might be CL. The feature CL also has CL set in its 'LBL' field, thus the feature name CL05 will be created as string CL05 in the MX model. If a MX SURVEY file contains a feature of less than four characters in length this is treated the same as any other feature, in MX this is referred to as a partial string label.

The characters M (Master alignment string) or G (Geometry string) should be avoided as the first character in the 'LBL' field as they denote strings of special significance in MX.

## **7 Typical QA Procedures for Survey Models**

Before delivering the model you should check the following:

There are no crossing breaklines. Crossing breaklines are identified in SCC as a red cross, and indicate that the elevation at that point in the model is either incorrect or ambiguous. They typically highlight string linkage errors, inaccurate surveying, or string naming and hence DTM coding errors.

- Strings representing single continuous features on the ground should consist of a single continuous string in the model. This can be checked using the 'All points on string' option with the 'Data Selection' dialog and picking any point on the string. If the string is continuous

all points on it will have a selection highlight. For example, if the survey contains a road centerline, that centerline should be a single string, such that you can use it to generate long sections and cross sections for the length of the road. The same is true of boundary strings and other closed strings, where the software is dependent on the polygonal nature of the string for certain calculations.

- Strings should not contain two or more consecutive gaps. While SCC allows this, if exporting your model to MX, this will cause the GENIO file generated to fail in MX. This can be checked using the 'Report String Details' under the 'TOOLS' menu and checking the right hand side of the report for consecutive gaps. These gaps can be removed either using the string editor or the 'Delete points' option.
- Strings should not contain more than one closing link. Such errors will automatically be fixed by SCC and noted in the log file.
- Strings with less than 3 points should not contain a closing link. Such errors will automatically be fixed by SCC and noted in the log file.
- Point strings should not contain gaps or closing links. Such errors will automatically be fixed by SCC and noted in the log file.
- Strings, particularly road strings, should not contain duplicate points or double back on themselves. An example of what this looks like and how to rectify it is shown in the section on point deletion.
- Gaps should not be used to break up separate strings. It is a common survey mistake to end each string with a gap such that the same string label can be re-used. SCC provides an END tag for this purpose. Using a gap means that many options such as copying and offsetting the string will not work correctly, as the option will be applied to too many points. It also means that if such a string is closed with a link, the link will probably join back the wrong point. Gaps, and MX DISC codes, should only be used to represent a gap in a given string that corresponds to an actual gap on the ground, for example a gap in a fence for a gate, or a gap in a major road for a junction with a minor road.
- String editing can be the most time consuming part of model editing. It can generally be minimized by good field practice.

### ***Checking The Accuracy Of The DTM***

Checking the accuracy of the DTM is usually very simple and involves checking there are no spurious elevations in the model and no features that have been included in the DTM that are not part of the ground surface. Checking for spurious elevations is achieved by looking for obvious anomalies in the contours. The relief contours tend to highlight such problems. Generally, if a single point or a single point on a string causes a significant change in the contours, shown as a series of circular contours around that point, the point is suspect and should be investigated further.

It is good survey practice to survey in strings rather than discrete points. While discrete points can be used to adequately describe smooth and reasonably flat surfaces, they are unsuitable for describing irregular surfaces containing significant grade changes such as embankments, spoil heaps, pits & hollows, etc. Strings are used as breaklines and as such, constrain the triangulation around irregular areas, the net effect of not using strings where they are required is that embankments, pit edges, etc. may appear to spill. Note that the only difference in survey procedure is to enter a unique non-zero string number for any string being surveyed. Not providing strings where they are required can often lead to serious volumetric errors.

Another method, applicable to road and similar surveys, is to take a series of cross sections down the center of the road and check for anomalies on the sections.

Where high accuracy is required and must be proven, the usual method is to abstract either a grid or sections from the model, get an independent crew to stake them out on the ground and compare elevations using a level. This is a time consuming job and would normally only be required where elevation accuracy is of primary importance.

## QA Tools in SCC

In order to speed up the process of QA checking in a model, SCC provides an extensive range of tools to rapidly identify and correct all of the potential modelling problems outlined. Please read the topics listed below for details on these tools.

## 8 Volumetric Analysis & QA

### Overview of Different Methods of Volumetric Analysis

In SCC there are 3 methods by which volumes may be calculated.

1. Cross Sectional End Areas method
2. Prismoidal / Isopachyte method
3. Grid method

All three methods of volume calculation should be performed when calculating volumes, as each method is mathematically independent of the other and hence each provides a check on the other. Differences of more than one or two percent indicate possible errors.

When calculating volumes it is important that there is a common boundary between the two surfaces, defining a common plan area over which volumes will be measured. Accurate volumes can usually not be calculated between two surfaces where a common boundary is not defined, due to the ambiguous nature of the area over which the measurement is taken. Poor boundary definitions are probably the most common cause of gross error in volume calculations.

### 8.1 Creating Profiles & Sections

Before volumes are calculated we will take a brief look at creating profiles and sections which are available within the ANALYSIS tab.



#### Profiles

Profiles can be taken through any number of models, using existing strings or selecting points with the cursor. In either case, a SCC section file will be created containing the profile information.

##### With A Cursor

To create a profile with the cursor, using the left mouse button, simply select points on the model where you want the profile to run. When you are finished with the profile and are ready to view the section, click your right mouse button. Your profile will be displayed and can be saved as a '.Section' file. If you wish, you can continue adding points to the profile by using the left mouse button again.

##### Using Existing Strings

Select 'Long Section From Existing String', and then in the model, select any point on the string you wish to generate a long section from. Again, your profile will be displayed automatically and can be saved appropriately.

##### From Coordinate Data

This option allows you to use the X, Y co-ordinates of another file to define the plan path

of the profile. The elevations will be derived from your current model. The data can come in many formats, datasets, DXF and ASCII being the most common.

## Cross Sections

### From Existing String

For this option you will be asked to provide the left and right offset distances. You can choose to have sections taken at regular intervals, at the survey points, or both.

### From Coordinate Data

This option is used where you have previously created a long section using one of the profile options under the 'SECTION' menu. After choosing this option you will select the file to generate the cross sections from and then proceed as using an existing string above.

To get some experience with sections, open the example project and the FGL model. Create a profile along the center of the length of this model and save the section file as 'FGL long.Section'.

### Opening An Existing Model

Open the Project Example.project

Go to 'FILE > Open'

Change the Files of Type to SCC Models (\*.Model)

Select the model 'FGL.Model'

After opening the Example project and the FGL model:

### Creating A Profile

Go to 'ANALYSIS > L.Sect'

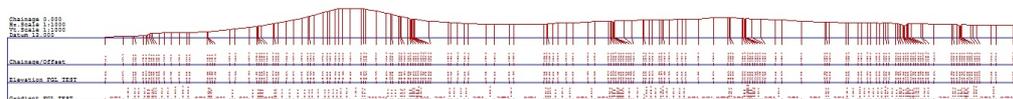
Select three or four points with the left mouse button following the center of the FGL model

When finished, click the right mouse button

View the profile

Select 'SCC button > Save As' and call the file 'FGL long.Section'

Close



Now let's create the cross sections

### Creating Cross Sections

Go to 'ANALYSIS > X.Sect'

Set the Chainage Interval to 10

Set Offsets to 100 (should go beyond required area)

Leave the option to 'Add Sections at Regular Interval' on

**Create Cross Sections** ? X

Chainage Interval

Left Offset

Right Offset

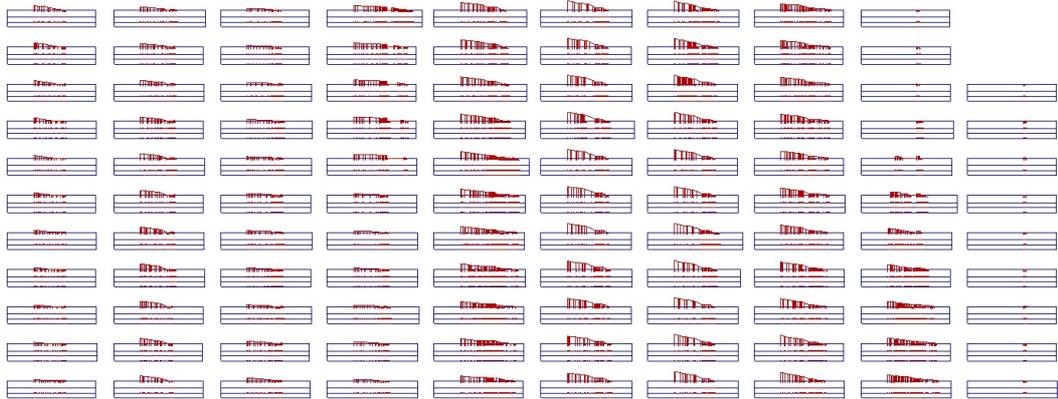
Add sections at regular interval

Add sections at surveyed points

Select OK

Left click on road center line string

View the cross sections



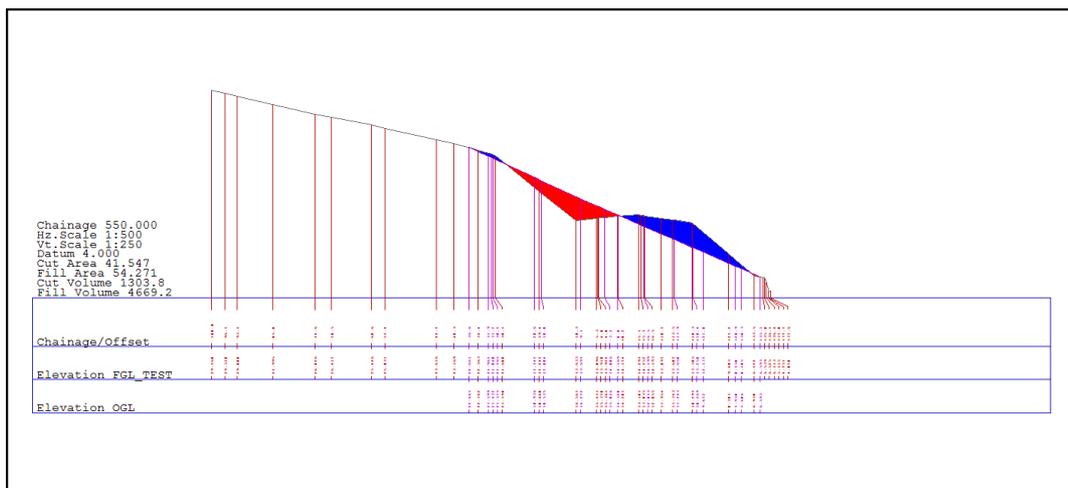
Select 'FILE > Save As' and save as FGL Cross.Section

Have the file FGL cross.section file open:

Adding a Second Surface to the Sections

Within Section file, select 'EDIT tab > Append button'

Select OGL.Model from tutorials directory



Data from the OGL surface is now added to the FGL sections. This only occurs where the two models overlap.

When displaying sections in SCC it is important to select a datum that is lower or equal to the lowest point of any of the models being analysed.

## 8.2 Calculation Of Volumes Using Different Methods

Using the models FGL and OGL we will calculate volumes using prismatic, grid and cross sectional methods. Both these models have been previously created. However no boundary has been defined on either model. We will define a boundary on the smaller model, OGL. This model already contains a boundary string, probably surveyed in the field, however the DTM extends beyond this string (look at the contours). We need to change the DTM status of this string to 'Clip Polygon', which means that no information outside this line will be included in the DTM.

Changing the DTM status of an existing string can be done in two ways, by using the string editor (that is, 'MODEL tab > Details') or using the DTM list boxes on the 'ADD tab'. The method below describes the latter.

### ***Creating A Boundary From An Existing String***

**Open the model OGL**

**Click on the right mouse button to bring up the 'Data Selection Dialog'**

**Select 'All points on selected string'**

**Press OK**

**In the model, select a point on the outermost string (the boundary string)**

**Once it has been highlighted, go to the DTM list boxes on the 'ADD tab' and change the code in the DTM status box to 'Clip Polygon'.**

**You will be asked 'Do you wish to convert all points to Clip polygon', press OK**

**Save the model**

## 8.3 Average End Area Method

To calculate volumes using this method, you must first create sections that contain all the surfaces being considered. The reference string can be an existing string or a profile you created using the 'L.Sect' option. In either case, the following procedure is the same.

1. Create section set
2. Append surface of additional models
3. Calculate volumes between surfaces of interest

Having the model FGL active:

### ***Opening Existing Edited Models from Tutorials***

**Select 'SCC button > Open'**

**Select 'FGL.Model'**

**Repeating the same steps, select 'SCC button > Open' and select 'OGL.Model'**

Both models have been triangulated correctly and the relevant boundaries formed prior to calculating volumes.

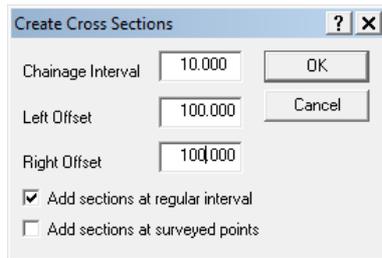
### ***Generation of Cross Sections***

**Within 'FGL.Model', go to 'ANALYSIS > X.Sect'**

**Set the Chainage Interval to 10**

**Set Offsets to 100 (should go beyond required area)**

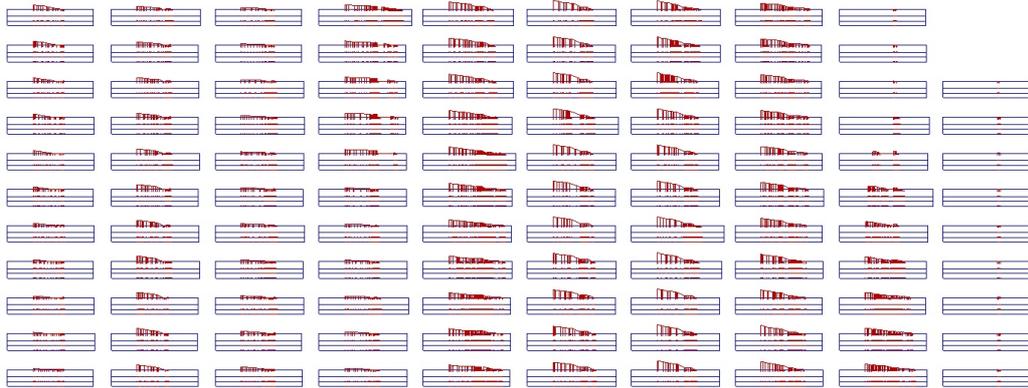
**Leave the option to 'add sections at regular interval' on**



Select OK

Left click on the road center line

View the cross sections



Select 'Save' and save as FGL cross.section

### **Append Surface**

Within Section file, select 'EDIT tab > Append button'

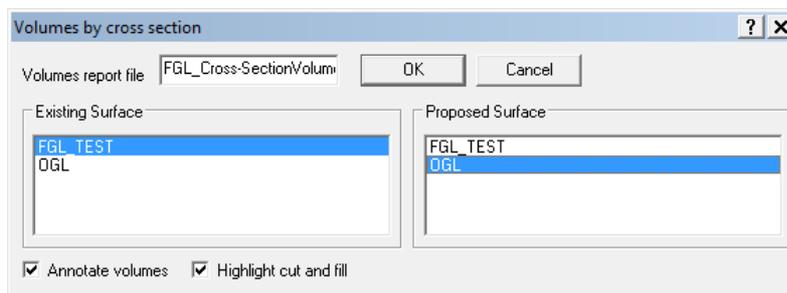
Select OGL.Model from tutorials directory

### **End Area Volumes**

Within Section file, select 'EDIT tab > Append drop down > Volumes'

Select Existing Surface and Proposed Surface

Select to 'Annotate Volumes' and to 'Highlight cut and fill'



Examine report and results



Section annotation

Descender annotation order

No	Type	Surface	Digits	Dp	Title text	Colour	X.Ofs
1	Chainage/Offset	0	10	1			0.0
2	Elevation	0	8	3			0.0
3	Elevation	1	8	3			0.0
4	Elevation	2	8	3			0.0

Add Delete Sort

Descender placement

- Every grade change / Triangle Intersection
- String Intersections
- Changes of direction in plan
- At Regular Intervals / Offsets 10.000
- Allow surface annotation without descenders
- Interpolate levels for all surfaces

Overlapping descender text

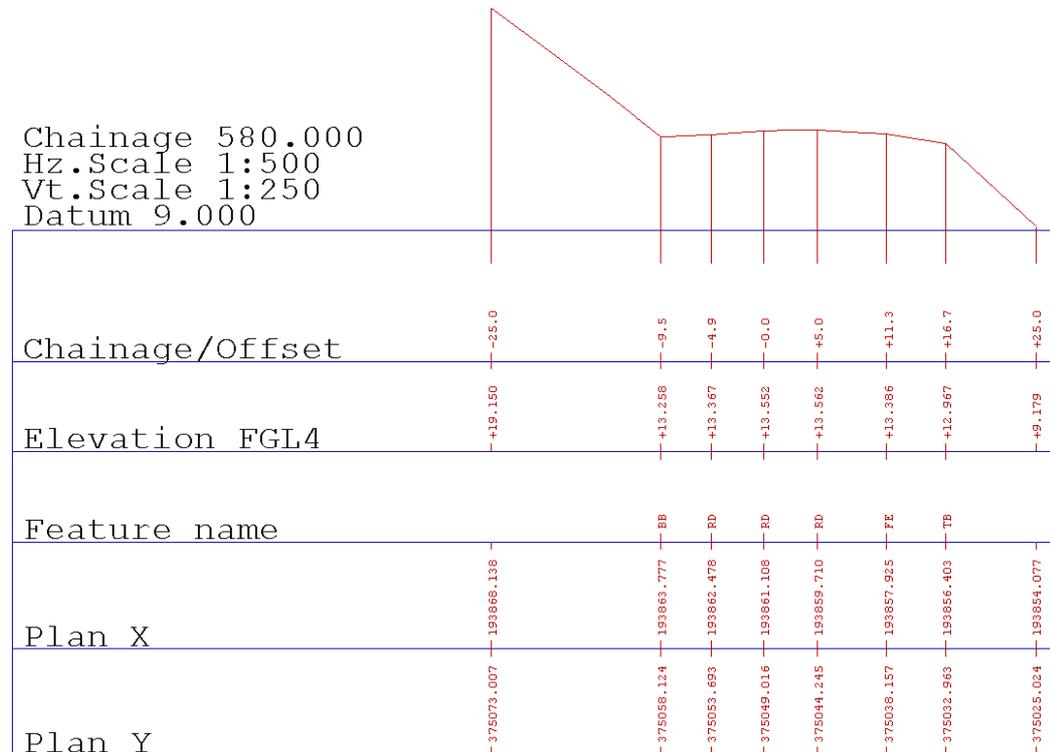
- Ignore
- Remove within 0.00:
- Widen annotation box

Descender style

- Text to right of descender
- Text centered under descender
- Text to left of descender

- Annotate Plan Position / XY
- Annotate Feature Names
- Annotate Gradient:
- Centre Gradients
- Show '+' on Chainage / Offset
- Show '+' on Elevation
- Use plot names for features
- Only show surface at strings

OK Cancel



**Exporting User Defined File**

Within the Section File, select 'DATA tab > Export drop down > User Defined ASCII File'

Export sections to ASCII file

File details

Output File

Format

Save OK Cancel

Add field macros

Field

Width  Decimals

Add

File header

Section header

Section Details

Section Footer

File footer

**Select 'Section Details' and place cursor in the box below**

**Select required 'Field' from drop down menu with the 'Add Field to Macros'**

**For example, 'Chainage' and select 'ADD'**

**Manually enter a comma ',' between each macro field added to construct a csv file**

Export sections to ASCII file

File details

Output File: CH0-1100.txt

Format: Section\_Test

Save OK Cancel

Add field macros

Field: Feature

Width: 0 Decimals: 0

Add

File header

Section header

Section Details

[Chainage],[Offset],[X],[Y],[Z],[Feature]

Section Footer

File footer

Enter a Format Name within Field Details 'Section\_Test' and select 'Save'

This saves the format to allow the user to output other files using same Section Details. The Format should be available from the drop down 'Format' Menu in future.

Enter 'Output File'. 'Ch0-1100.txt'

Select 'OK'

Select 'No' to 'Output surface intersection points only'

SCCW

Output surface intersection points only

Yes No

Extract of File Shown below:

```

0.000,    -100.000,    193692.647,    375479.004,    19.584,0
0.000,     -99.014,    193691.675,    375479.167,    19.552,0
0.000,     -98.382,    193691.051,    375479.271,    19.522,0
0.000,     -94.799,    193687.517,    375479.861,    19.380,0
0.000,     -93.068,    193685.810,    375480.146,    19.296,FL
0.000,     -81.994,    193674.888,    375481.970,    18.813,0
0.000,     -73.145,    193666.159,    375483.428,    18.057,0
0.000,     -67.501,    193660.592,    375484.358,    17.606,0
0.000,     -61.539,    193654.711,    375485.340,    16.907,FL
0.000,     -52.869,    193646.160,    375486.768,    16.667,0
0.000,     -46.577,    193639.954,    375487.805,    16.385,0
0.000,     -33.948,    193627.497,    375489.885,    16.033,0
0.000,     -27.429,    193621.067,    375490.959,    15.902,0
0.000,     -17.478,    193611.253,    375492.598,    15.818,0
0.000,     -14.144,    193607.964,    375493.147,    15.970,0
0.000,     -12.891,    193606.728,    375493.354,    16.100,0
0.000,      -9.593,    193603.475,    375493.897,    16.260,0
0.000,      -4.925,    193598.872,    375494.666,    16.394,RL

```

0.000,	-1.074,	193595.073,	375495.300,	16.517,0
0.000,	0.000,	193594.013,	375495.477,	16.543,RL
0.000,	1.135,	193592.894,	375495.664,	16.521,0
0.000,	4.983,	193589.099,	375496.298,	16.471,RL
10.000,	-100.000,	193691.000,	375469.177,	20.680,0
10.000,	-92.998,	193684.094,	375470.328,	20.342,0
10.000,	-89.331,	193680.476,	375470.931,	20.131,0
10.000,	-88.681,	193679.835,	375471.037,	20.087,0
10.000,	-84.014,	193675.231,	375471.805,	19.833,0
10.000,	-79.447,	193670.727,	375472.555,	19.502,FL
10.000,	-72.407,	193663.782,	375473.713,	18.940,0

**Note:**

The user defined output from the Section Screen, is unaffected by the Annotations Settings.

For instance, if the user turns all descenders off as shown below and outputs using 'SectionTest.SCCOutput' the \*.txt file will remain the same.

### 8.4 Prismoidal Method

The first and most accurate method of computing volumes is the Prismoidal projection method.

This method involves the creation of an isopachyte or thickness model from the two surfaces under consideration. This is achieved by calculating differences in elevation from all surveyed points, and along all surveyed strings, in both models, and triangulating the result. Once the isopachyte model has been formed, prismoidal volumes are calculated by adding the volume of each triangular prism generated by projecting the isopachyte triangle to a datum of zero. Note that individual triangular prisms may contain both cut and fill with this type of measurement.

The volume calculation report generated from the volume computation shows us the plan and surface areas under consideration as well as the total cut and fill volumes. It also gives us average material depth and calculates the effect of survey elevation accuracy on the volume.

Volume options are available within 'ANALYSIS tab'.

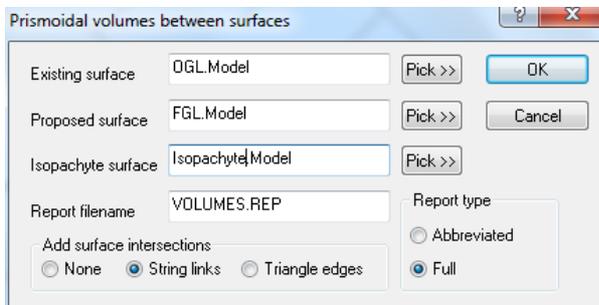


To calculate prismoidal volumes you must have a model window active.

#### Calculating Prismoidal Volumes

Select 'ANALYSIS > Prism Surf.'

Fill in the dialog box with the existing surface and the proposed surface

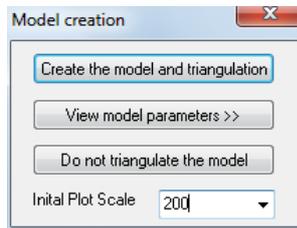


Since SCC provides the default name of VOLUMES.REP to all volume reports, you may want to use a specific file name to avoid having the data overwritten

Select 'OK'

## Isopachyte Surface Model

Select 'Create the model and triangulation' and set the Initial Plot Scale as 200



Select 'OK' to the Model Attributes Dialog

### Examine Report

Once we have created an isopachyte model, we can colour it according to depth of material and calculate material volumes by depth. Note that this is using an end areas method based on horizontal sections whose accuracy is dependent on the vertical interval.

## 8.5 Grid Method

This option is similar to the prismatic method, except that the volumes are derived from a regular grid of rectangular prisms. Each prism is generated by calculating height differences for the four grid points that make up its vertical edges. The total volume is computed as the sum of the volumes of the individual prisms. You can use the default grid sizes, or fill in different values on the dialog box.

The main disadvantage of using this technique to compute your volumes is that it does not provide graphical representation of the results. It does have the advantage though that it does not require any additional memory resource to compute the volumes, other than required by the input models. This is useful when using larger models and computer resource limitations are an issue.

Volume options are available within 'ANALYSIS tab'.



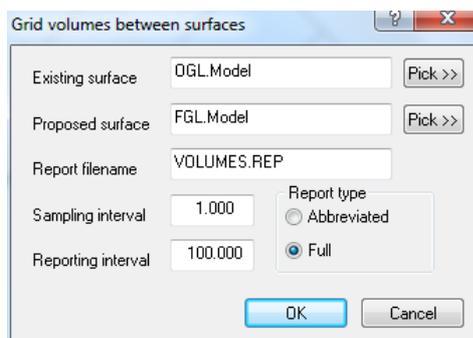
### Volumes Calculations

Select 'ANALYSIS > Grid Surf.'

Fill in the dialog box with the existing surface and the proposed surface

Using the 'Pick>>' button select the existing and proposed surfaces

Enter report filename



Both prismatic and grid volumes also report the plan areas for which there is no overlap and

compute the probable and worst case effects this is likely to have on the result. Also reported is the effect that elevation accuracy will have on the measurements. This can prove useful in dictating appropriate survey methods, and overall confidence in the measure.

## 8.6 Calculating Spoil Heap Volumes

Often when calculating spoil heap volumes the original ground surface is not available. Therefore, the original surface has to be estimated from the surveyed surface. The base of spoil heap or the top of a quarry site would be taken as the original ground surface.

We are going to use the model DUMP.

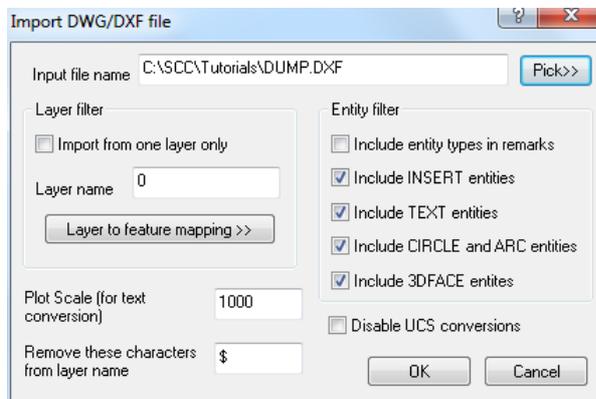
### **Create the model 'DUMP' from DXF file**

**Go to 'DATA tab > Model > DWG, DXF or DGN file'**

**Select Pick button**

**Select the file DUMP.DXF from the directory \SCC\Tutorials\**

**Select Open**



**Select OK**

**Select 'Create Model and Triangulation'**

**Select OK**

**Save model as DUMP.Model**

There is a spoil heap in the bottom half of this model. Using the Data Selection Dialog (right click mouse), highlight all points on the base string of the spoil heap and from the DTM list box, convert the string to 'Clip Polygon'.

### **Creating The Boundary String**

**Zoom into the area of the spoil heap**

**Click the right mouse button to access the Data Selection Dialog**

**Set the selection method to 'All points on selected string'**

**Select OK**

**Select the string indicating the base of the spoil heap (See image below)**

**Go to 'ADD tab', from the DTM list boxes, select 'Clip Polygon' from the DTM status box.**

**Select 'Yes' to convert the string**

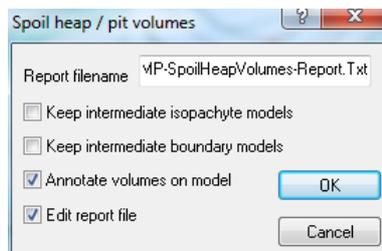
**Save the model**



From the 'ANALYSIS tab', selecting the 'Heaps/Pits' option will calculate the volumes of any spoilheap or pit so long as there is a clip polygon string around it. This option also allows multiple clip polygons in the model. SCC copies the boundary string to a second model and then computes volumes between the two using the prismatic method. It does this in one step and gives you the option of keeping the intermediate boundary model, the isopachyte model and report file and whether you wish to annotate the volumes on the model.

### **Computing Spoil Heap Volumes**

Select 'ANALYSIS > Heaps/Pits'

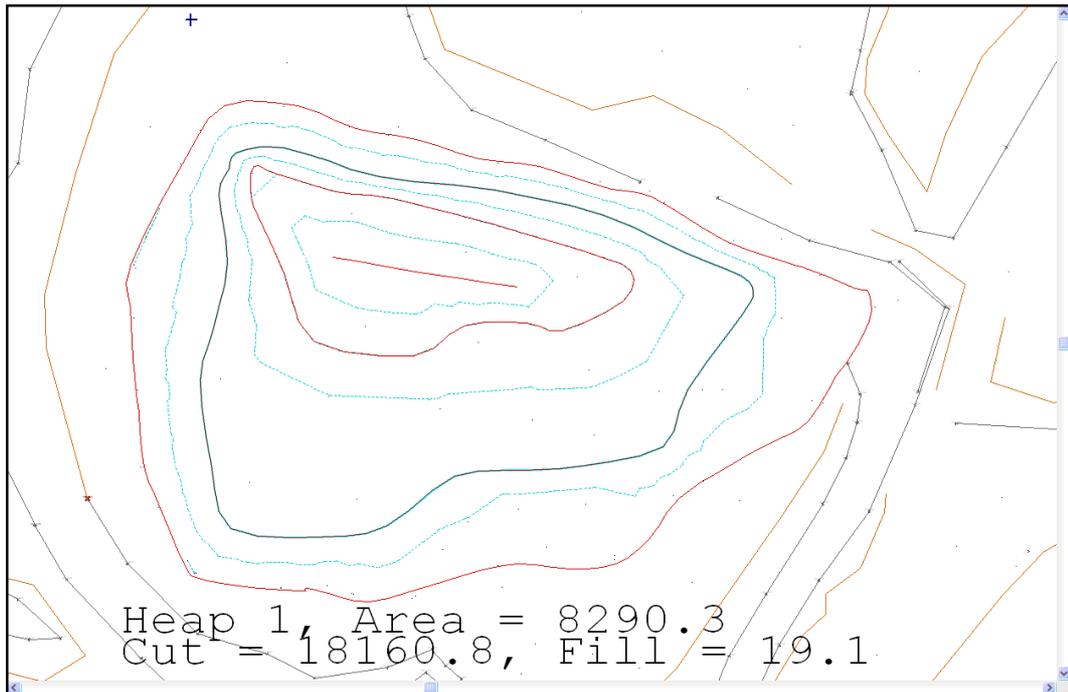


**Enter in a new or accept the default report name**

Select the options you require, if the options to 'Keep intermediate isopachyte models' and 'Keep intermediate boundary models' are not turned on, these two models will be stored in your current working directory regardless.

Select 'OK'

**Review Report**

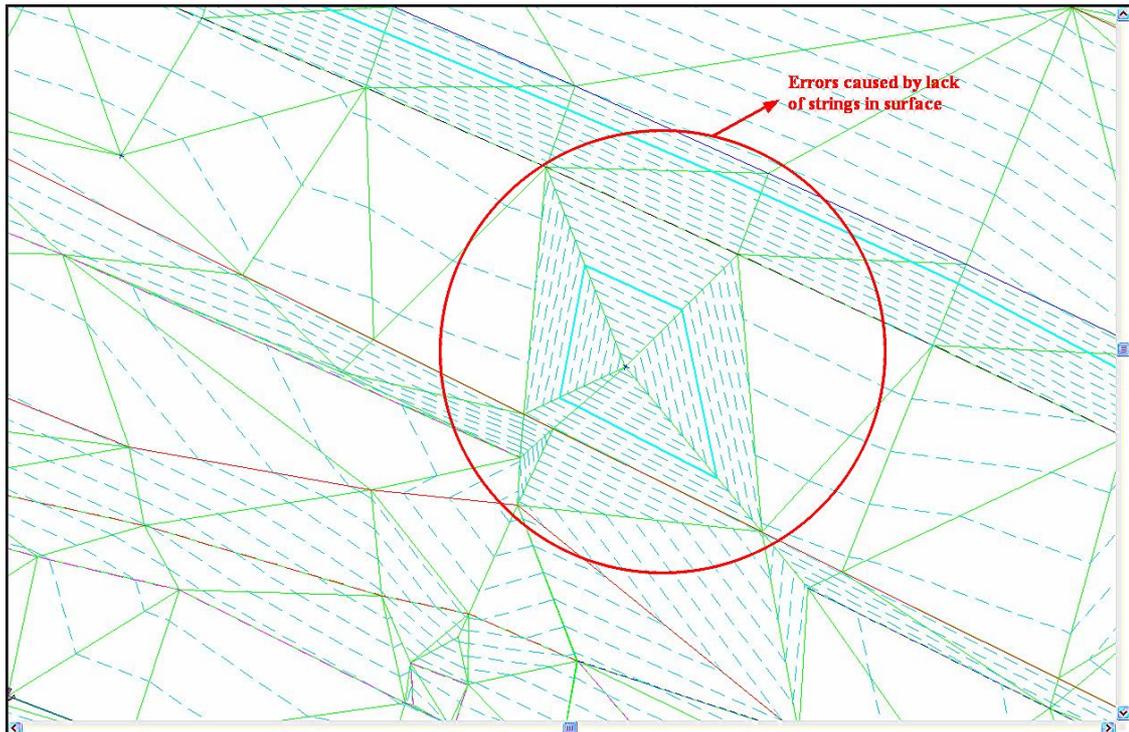


## 8.7 Identification of Potential Errors In Volumes

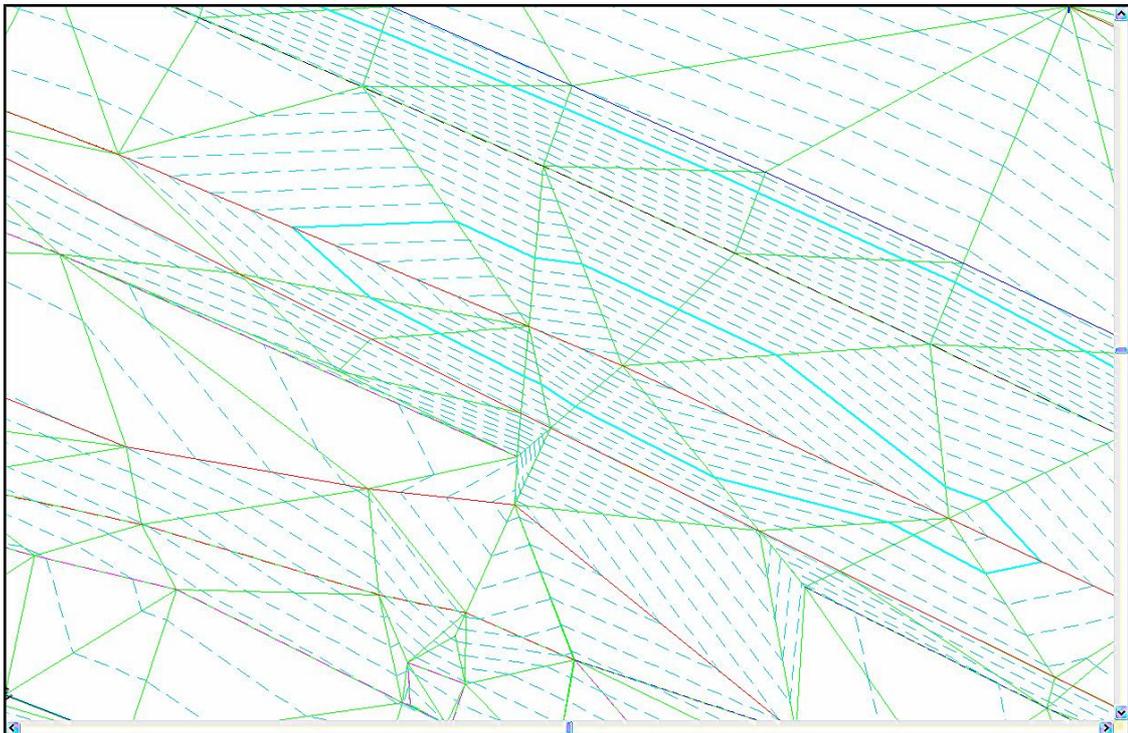
Before volume calculations are carried out both models should be checked for the following points.

### ***Define Topography Using Strings Not Entirely Discrete Points***

Ensure that the models are defined using strings and not entirely of discrete points (spot elevations). While discrete points can be used to adequately describe smooth and reasonably flat surfaces, they are unsuitable for describing irregular surfaces containing significant grade changes such as embankments, spoil heaps, pits & hollows, etc. Strings are used as breaklines and as such constrain the triangulation around irregular areas, the net effect of not using strings where they are required is that embankments, pit edges, etc. may appear to spill as illustrated in the diagram below;



The error shown above is corrected by connecting the discrete points defining the embankment / grade change with a string to produce the results shown in the following picture.



Note that the only difference in survey procedure is to enter a unique non-zero string number for any string being surveyed. Not providing strings where they are required can often lead to serious volumetric errors.

When calculating prismatic volume between models that contain only point information, there is an option to 'Add Surface Intersections' to 'Triangle Edges'. Make sure that this is set before computing the volumes.

## **Boundary**

The survey model should always extend beyond the design area to facilitate side slope design, and the side slopes should be recomputed whenever the survey model is modified. For accurate volumetric analysis, a common boundary string, normally generated from the side slope intercept points, should be included in both models.

## **Accurate Volumes**

Accurate volumes cannot be calculated between two surfaces where a common boundary is not defined. Poor boundary definitions are probably the most common cause of gross error in volume calculations. The boundary string should always have a DTM status of clip polygon and will normally take the form of an existing string line, one generated by interface design, or one added manually to the model in SCC. If a boundary is not provided, most modeling packages, including SCC, will automatically determine a boundary, using a convex hull or similar algorithm. Such boundaries rarely reflect conditions on site, as can be seen in many cases, by contours appearing outside the surveyed areas. In any case, such a boundary is ambiguous, as it is dependent on the algorithm selected by the software package rather than the judgement/agreement of the engineers and surveyors on site. Weeding and the adding/removing of triangles may also be used to define plan areas although use of a boundary string is far superior.

## **Visual Verification**

Both models, that is, the survey and design or OGL and FGL, should always be visually verified prior to computing volumes, as if there are any discrepancies in either model the result is liable to be a gross error in the results. To verify a model, increase the contour interval, say to 0.2m and visually check the contours. It is also wise to generate a number of profiles and cross sections, with vertical exaggeration of say 5:1, through the model to further check for anomalies.

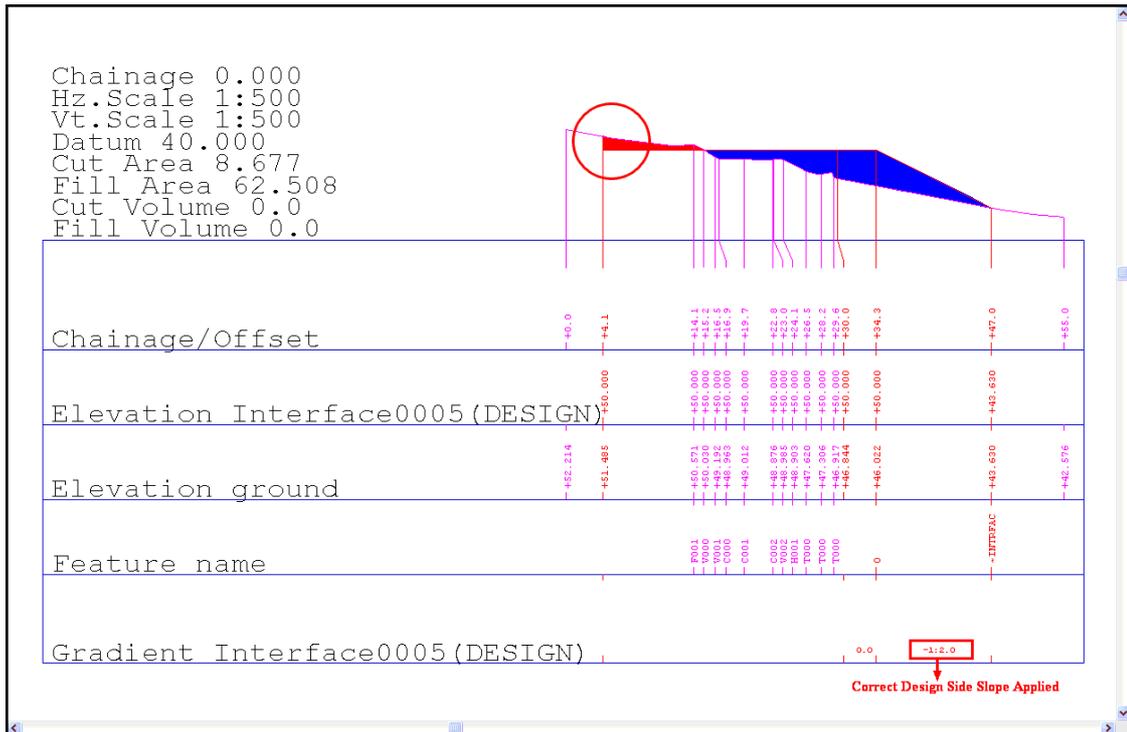
## **Volume Verification**

Having verified all models you may then proceed with volume calculations. When calculating volumes, it is advisable to use all three methods, i.e. prismatic, grid and cross sectional, and compare the results. Each method is mathematically independent of the other, and hence each provides a check on the other. Differences of any greater than approx. 0.5% indicate ambiguities in either the surface or boundary conditions. Of the three methods, cross-sections are most prone to error, particularly when dealing with survey models in rough terrain. The reason for this is that cross sectional volumes assume that data along the cross section is typical of data between cross sections, which is often not the case. If you have errors in your data, cross sectional volumes are liable to magnify their effect.

Cross sectional volumes may also contain errors due to curvature. The end-areas method of calculation also assumes that cross sections being used are parallel to one another. This may not be the case where cross sections are being taken along a curved centre line, such as a road centre line. In this case, small errors can occur where there is fill on one side of the centre line and cut on the other side, or vice-versa. This is another reason to measure your volume using more than one method, prismatic and grid volumes do not suffer from this error.

## **Using Cross Sections To Verify Design**

In many measurements, including road and building footprint design, it is the case that the design and survey surfaces meet at the boundary string. This will normally be carried out through a process of interface design, either in SCC, or using another specific design package such as MX or DOER. If this is the case, it is necessary to check that the two models do actually meet at the boundary. The simplest way of doing this is to take a regular set of cross sections through both models and check that there are no vertical side slopes visible, as shown in the following figure.



This can be caused by a number of different factors. The most common reasons are that the survey model does not cover a large enough area to accommodate the interface design, or that one or both models have been altered after the interface has been designed and the design has not been updated. In either case, the result is liable to be a gross error in the volumes.

### Contours

When verifying the contours in a design model where interface strings are being employed with fixed side slopes, the contours along those side slopes should be parallel to one another. In the case of a flat building footprint, they should also be parallel to the edge of the design model. If this is not the case, there is probably an error in the interface design that will lead to errors in sections and volumes.