SCC Help Files

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13

Table of Contents

1 Introduction

1.1 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

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

1.2 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.

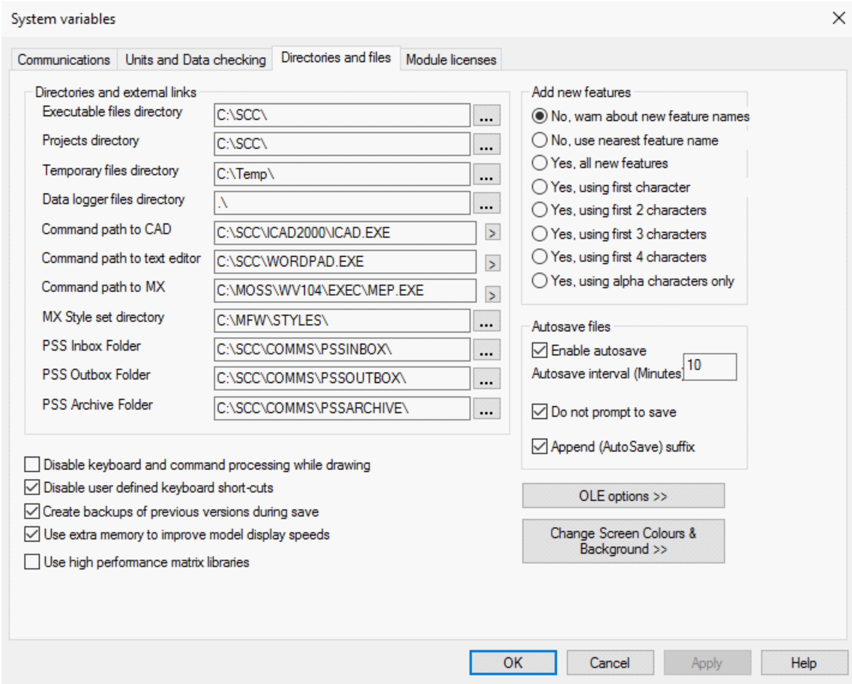
If you have installed SCC in a directory other than the default, type in the correct path to this directory.

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.

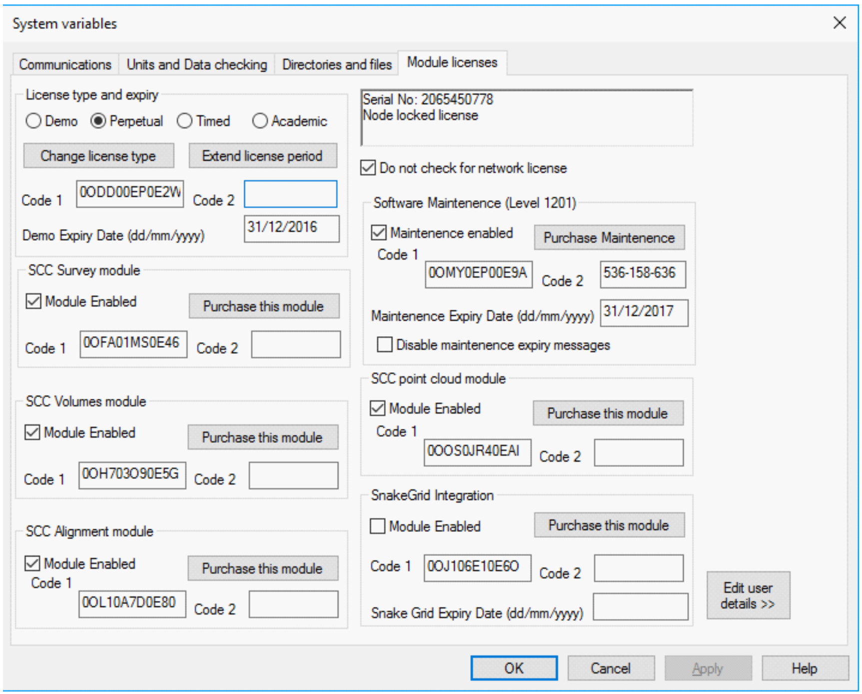
Module Licences

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 the entered the correct maintenance code and maintenance expiry date.



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

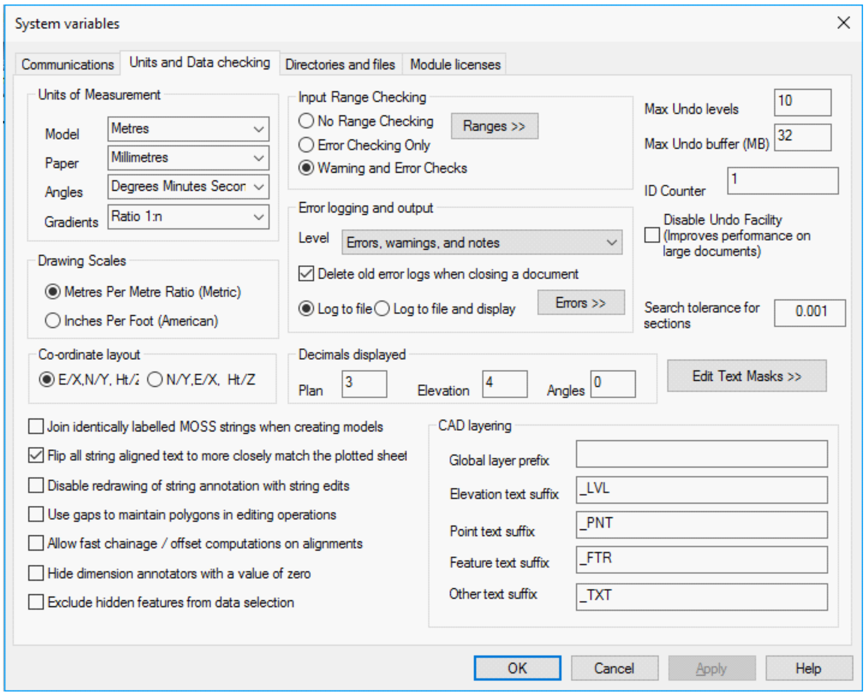
During the download procedure, SCC also range checks every field against a user definable range of values. Any exceptions are reported to the log file, and optionally to screen during the download process. The log file also includes any other potential errors relating to the input data, reduction, adjustment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



1.3 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.

2 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.

2.1 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), 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

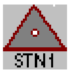
The view is the principal graphical interface to a document. Some documents have a single view, for example in Word, the view is the area on screen where you type in your text. Other programs will have multiple views, for example in Excel, you might have a single spreadsheet that contains many pages, 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

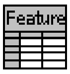
SCC creates and works with the following document types: Projects, Survey Datasets, Traverses, Models, Sections, Transformations, Alignments and Program modules. A brief description of each document is given below, along with the views available and icons used.

2.1.1 Project

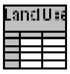
A project document is used to share station coordinates between other SCC documents in the project folder, and to determine drawing and modelling conventions used. It contains four sheet views



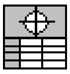
Station coordinates, used to establish and maintain the grid system used in this project.



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

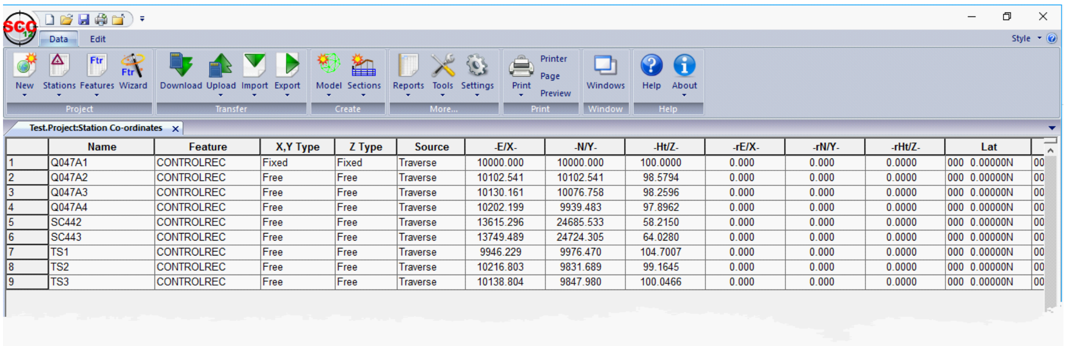


Ground Type Library, used to break down different parts of the surface model into various ground types for viewing and analysis purposes.



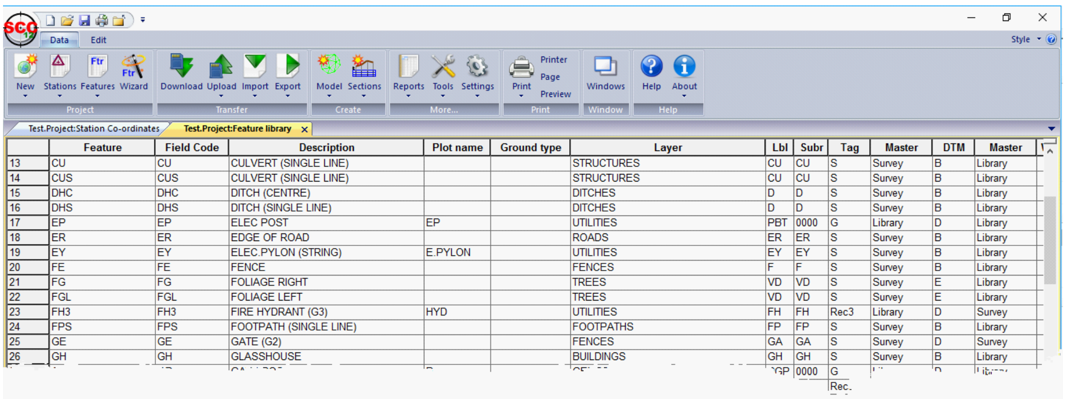
Advanced Survey Coding, used to control how coding in the field is interpreted into features and reduction options.

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.



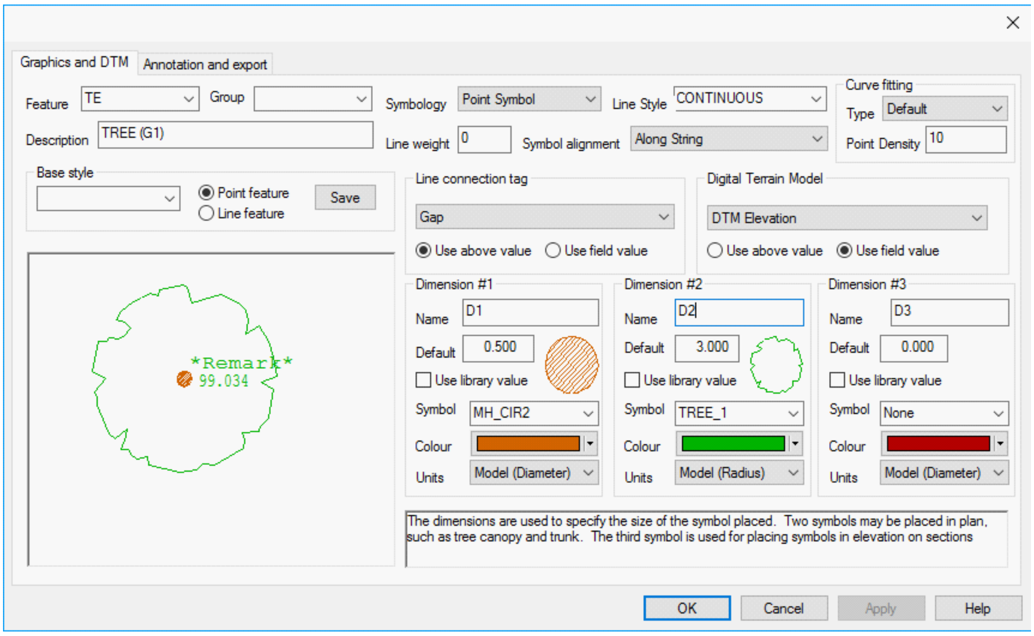
	Name	Feature	X,Y Type	Z Type	Source	-E/X-	-N/Y-	-Ht/Z-	-rE/X-	-rN/Y-	-rHt/Z-	Lat	
1	Q047A1	CONTROLREC	Fixed	Fixed	Traverse	10000.000	10000.000	100.0000	0.000	0.000	0.0000	000 0.00000N	00
2	Q047A2	CONTROLREC	Free	Free	Traverse	10102.541	10102.541	98.5794	0.000	0.000	0.0000	000 0.00000N	00
3	Q047A3	CONTROLREC	Free	Free	Traverse	10130.161	10076.758	98.2596	0.000	0.000	0.0000	000 0.00000N	00
4	Q047A4	CONTROLREC	Free	Free	Traverse	10202.199	9939.483	97.8962	0.000	0.000	0.0000	000 0.00000N	00
5	SC442	CONTROLREC	Free	Free	Traverse	13615.296	24685.533	58.2150	0.000	0.000	0.0000	000 0.00000N	00
6	SC443	CONTROLREC	Free	Free	Traverse	13749.489	24724.305	64.0280	0.000	0.000	0.0000	000 0.00000N	00
7	TS1	CONTROLREC	Free	Free	Traverse	9946.229	9976.470	104.7007	0.000	0.000	0.0000	000 0.00000N	00
8	TS2	CONTROLREC	Free	Free	Traverse	10216.803	9831.689	99.1645	0.000	0.000	0.0000	000 0.00000N	00
9	TS3	CONTROLREC	Free	Free	Traverse	10138.804	9847.980	100.0466	0.000	0.000	0.0000	000 0.00000N	00

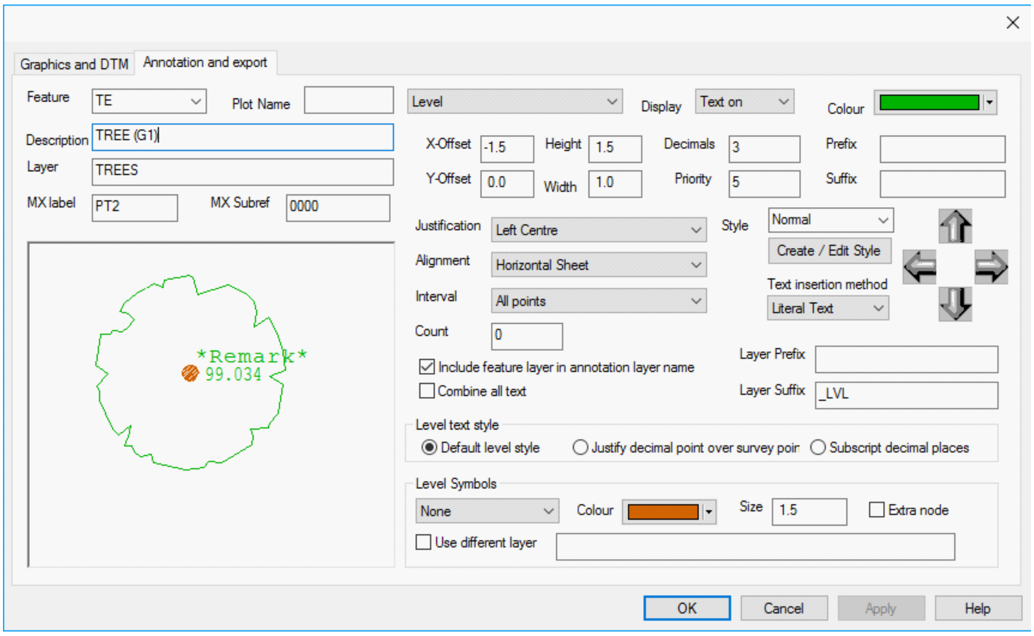
Project - Station Coordinate Sheet



	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

Project - Feature Library Sheet

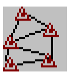




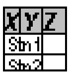
Project - Feature Wizard

2.1.2 Traverse

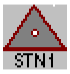
The **traverse** document is used to store observations relating to traverse and network adjustments. Within the Traverse document you can reduce and edit setups, apply relevant corrections and perform adjustments. The traverse document includes three sheet views



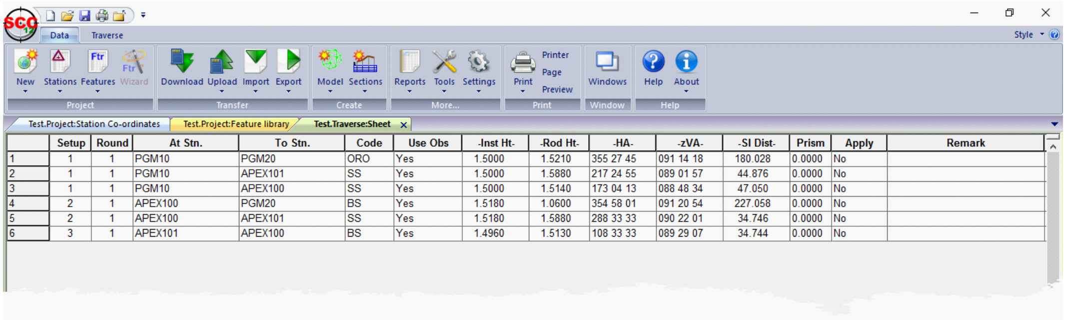
The traverse observation view, including observed angles and distances, reduced values, and computed residuals



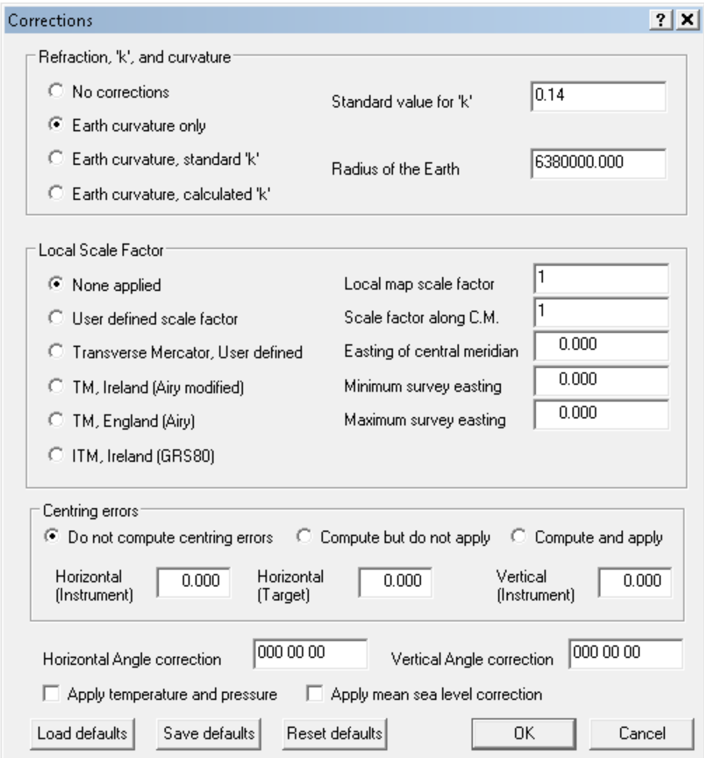
The traverse coordinates view, including provisional and adjusted station coordinates, and computed error ellipse axes



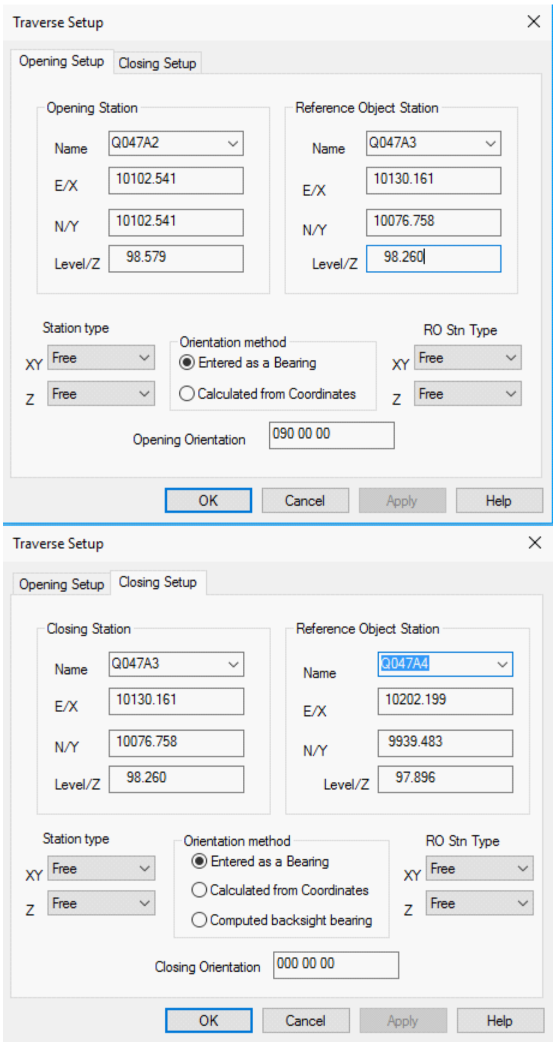
Station coordinates, a back-up of the station coordinates used in this traverse, such that the traverse document is fully self contained.



Traverse Sheet



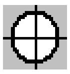
Corrections



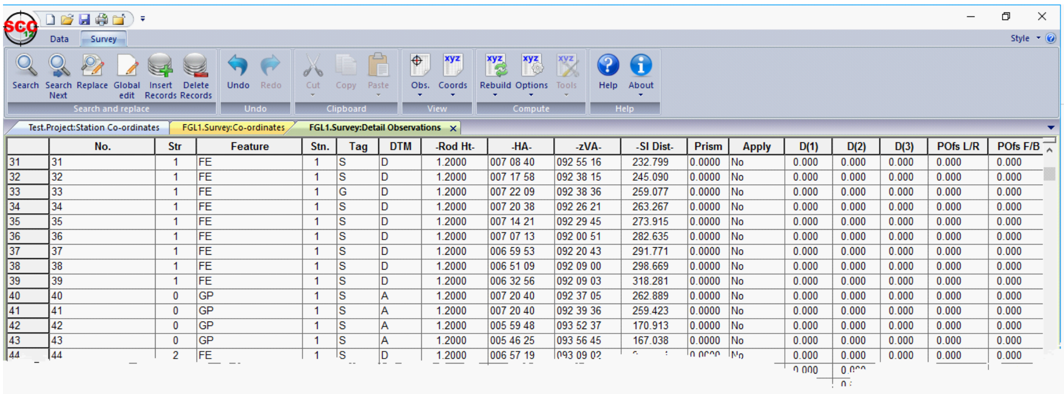
Traverse - Setup Dialogs

2.1.3 Dataset

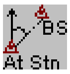
The survey document is used to store raw detail observations and reduced detail coordinates in a normalised format. Survey datasets can be created by downloading data from a survey instrument, or importing reduced data from another file. Depending on the data source, they may or may not contain any observation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



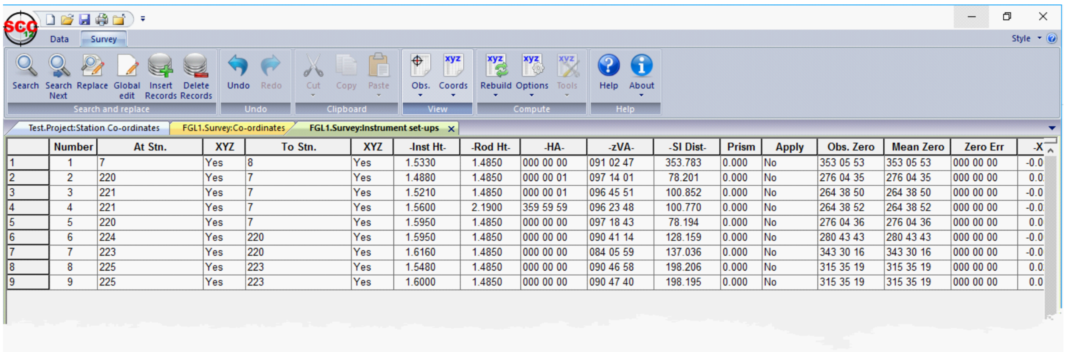
The detail observation spreadsheet contains all of the observations in any given survey. Note that these observations can be total station angles and distances, GPS latitude, longitude, height, or X, Y, Z. These different observation types may be also freely mixed in a given job. From the observation 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.



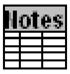
	No.	Str	Feature	Stn.	Tag	DTM	-Rod Ht-	-HA-	-zVA-	-SI Dist-	Prism	Apply	D(1)	D(2)	D(3)	POfs L/R	POfs F/B
31	31	1	FE	1	S	D	1.2000	007 08 40	092 55 16	232.799	0.0000	No	0.000	0.000	0.000	0.000	0.000
32	32	1	FE	1	S	D	1.2000	007 17 58	092 38 15	245.090	0.0000	No	0.000	0.000	0.000	0.000	0.000
33	33	1	FE	1	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	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	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	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	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	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	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	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	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	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	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	44	2	FE	1	S	D	1.2000	006 57 19	093 09 02	[illegible]	[illegible]	No	0.000	0.000	0.000	0.000	0.000



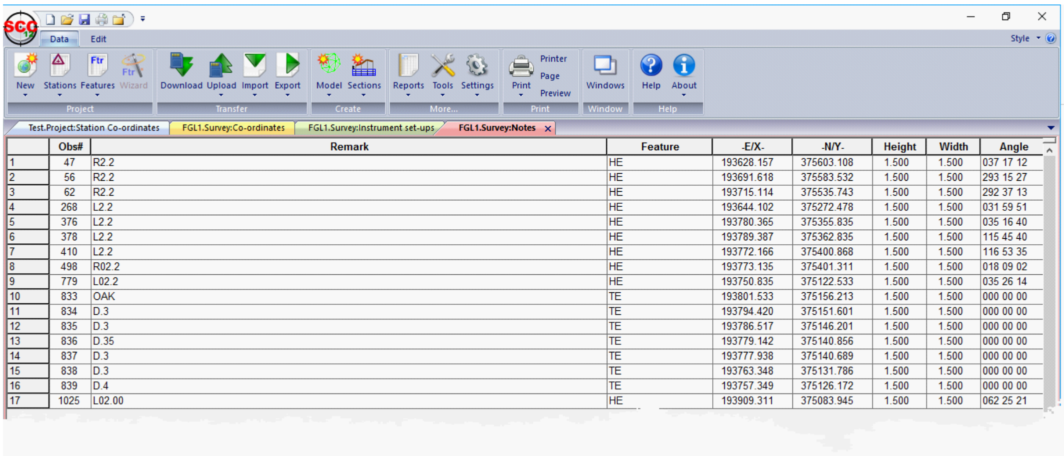
Instrument Set-ups, containing observed back-sights, used to orient the horizontal circle whenever the total station is moved. The instrument set-up sheet also contains distance and coordinate misclosures, along with other QA fields. Each instrument set-up is numbered, and each detail observation contains 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

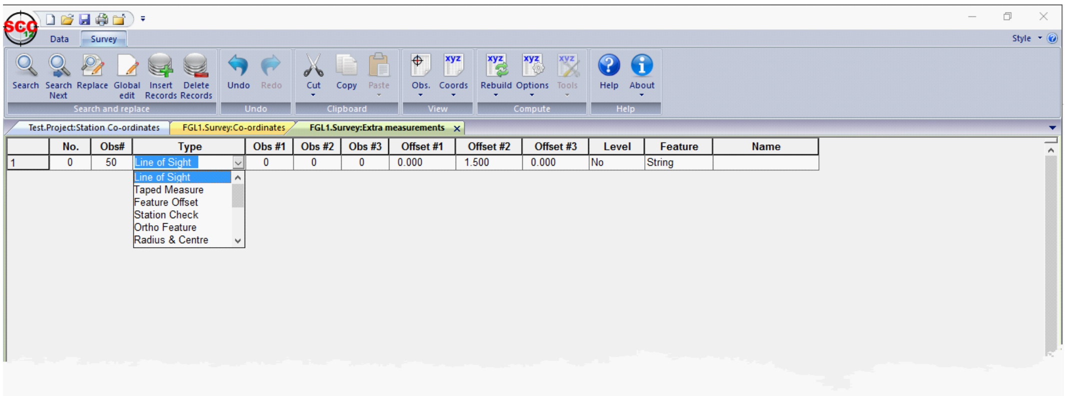


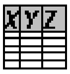
Text Notes, used to store text data and placement details.



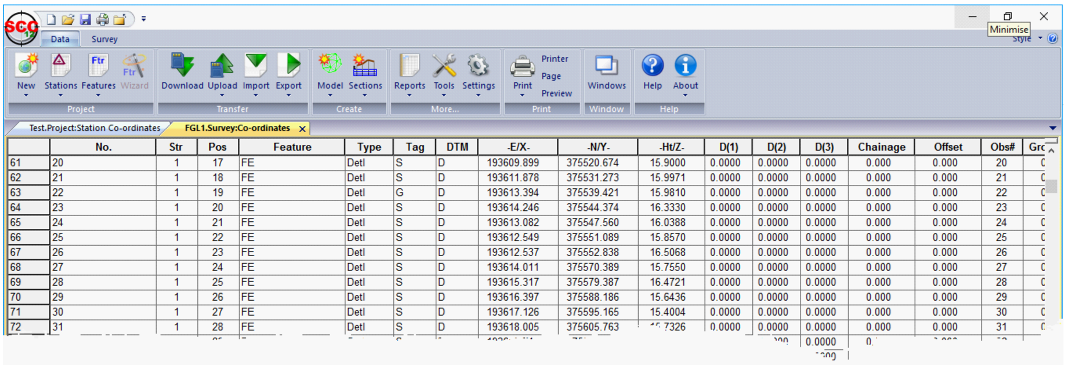
	Obs#	Remark	Feature	-E/X-	-N/Y-	Height	Width	Angle
1	47	R2.2	HE	193628.157	375603.108	1.500	1.500	037 17 12
2	56	R2.2	HE	193691.618	375583.532	1.500	1.500	293 15 27
3	62	R2.2	HE	193715.114	375535.743	1.500	1.500	292 37 13
4	268	L2.2	HE	193644.102	375272.478	1.500	1.500	031 59 51
5	376	L2.2	HE	193780.365	375355.835	1.500	1.500	035 16 40
6	378	L2.2	HE	193789.387	375362.835	1.500	1.500	115 45 40
7	410	L2.2	HE	193772.166	375400.868	1.500	1.500	116 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

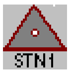
Extra Measurements, used to store measurements other than direct observations, such as tape measurements and copied strings. If the co-ordinates were not formed from a detail survey then this sheet will be blank.





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.



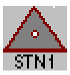


Station coordinates, a back-up of the station coordinates used in this survey, such that the survey document is fully self contained. In addition to the above sheet views, the survey document also includes a copy of the downloaded survey data as a text file in its native format, such that the other spreadsheets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

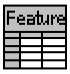
2.1.4 Model

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;

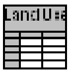
Plan view, used for all graphical display and editing



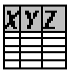
Station coordinates, copied from the surveys used when creating the model. You may also cut and paste in additional unreferenced stations from the project as required.



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

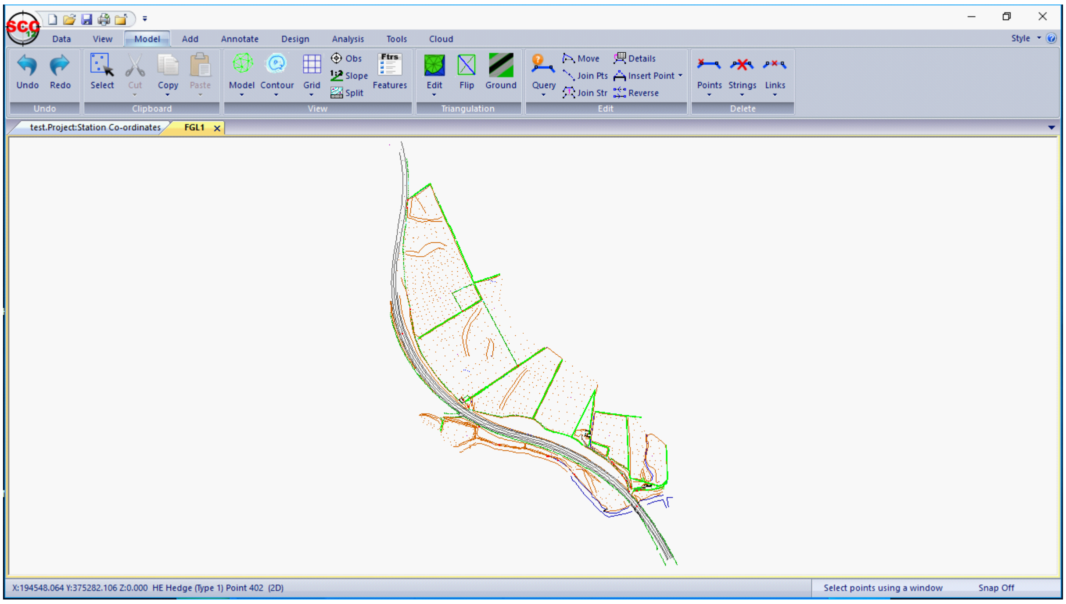


Ground Type Library, copied from the project, used to break down different parts of the surface model into various ground types for viewing and analysis purposes.

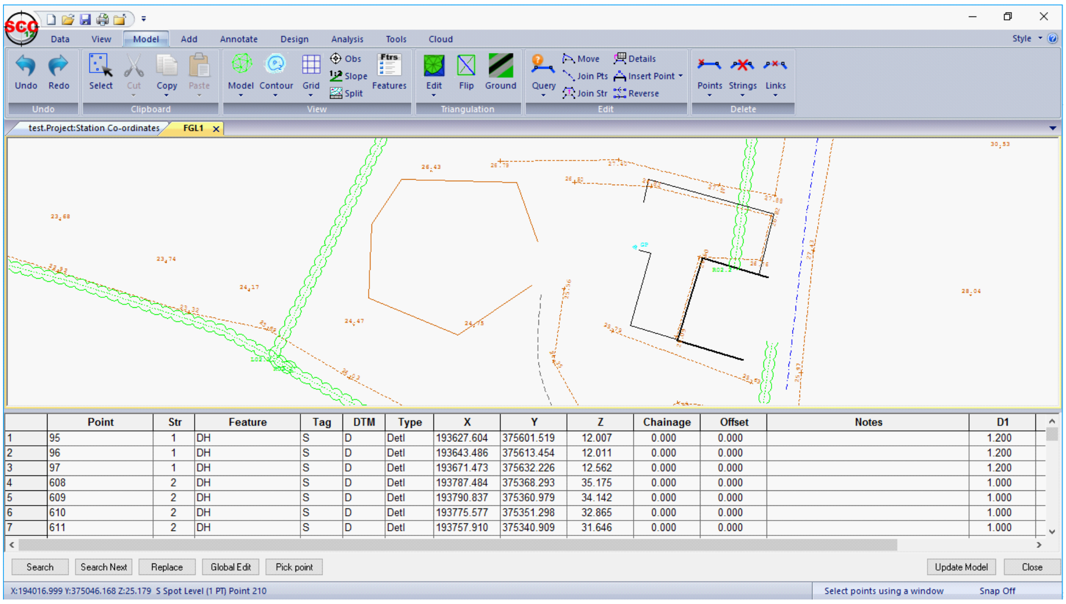


ZVI station coordinate, used for ZVI station positions in visual intrusion analysis

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

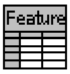


Model - Split View option which allows the user to browse *the dataset table whilst the cursor* *interactively moves to the chosen x, y, z*

2.1.5 Section

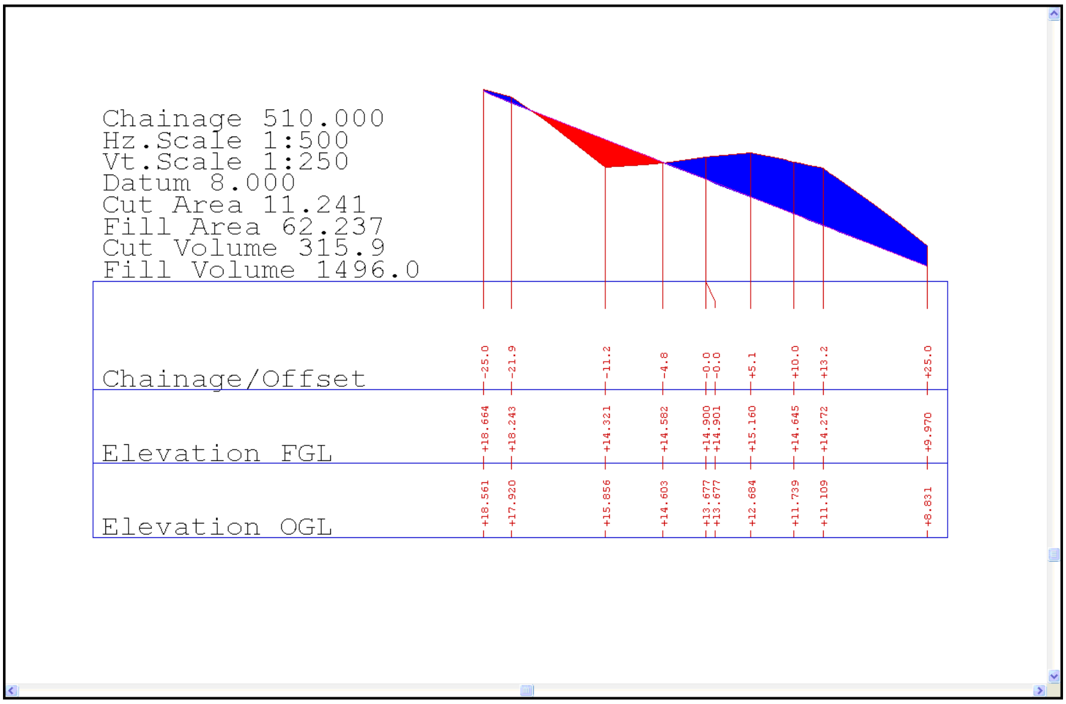
A **section** document is used to graphically represent profiles, long sections and cross sections. Sections can either be cut from a model or generated directly from coordinate or chainage / offset data, can include any number of surfaces per section, and can be drawn to user defined standards. A section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

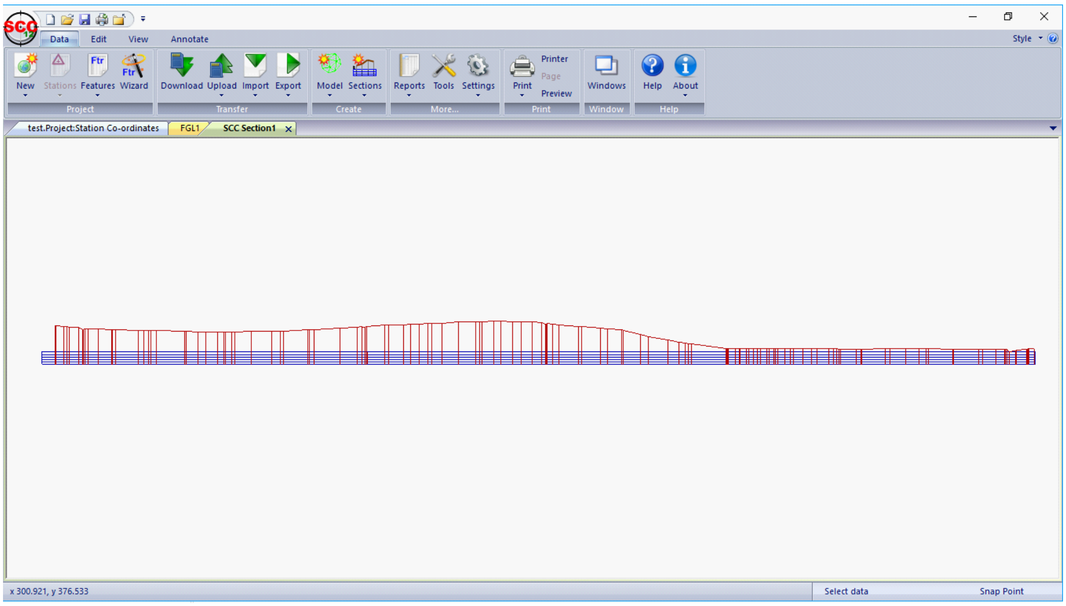
Section view, used for all graphical display and editing



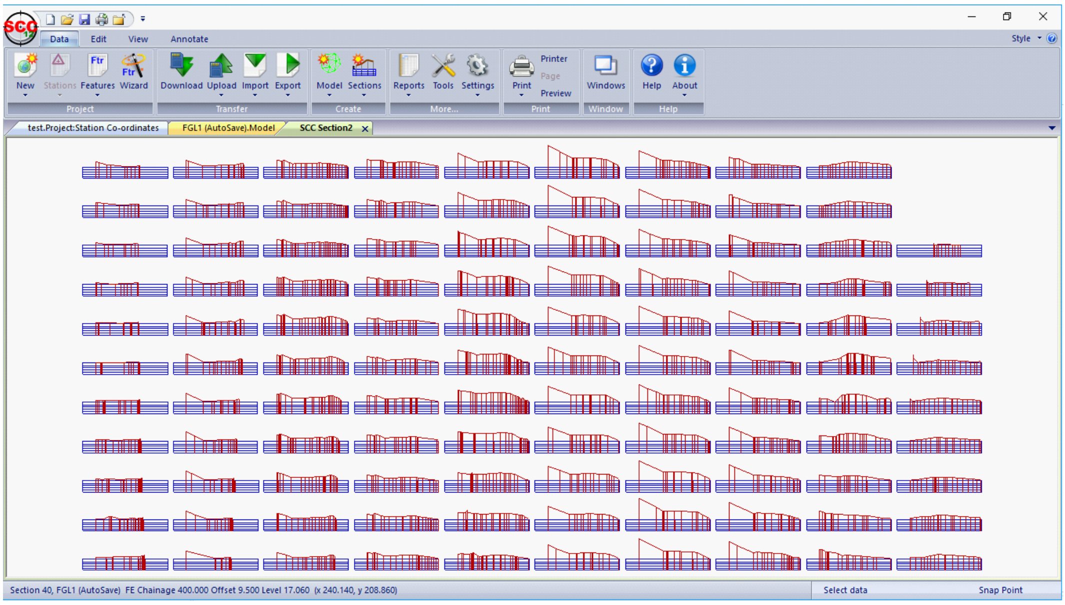
Feature Library, copied from the project, used to control naming conventions, drawing standards and modelling defaults

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.

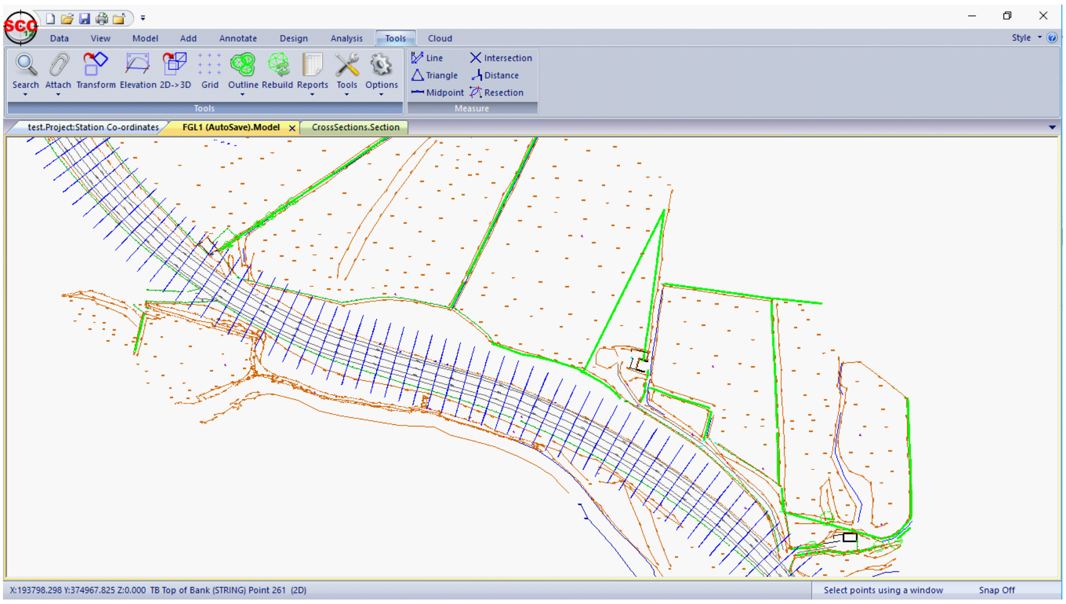




Section – Long Section from An Existing String

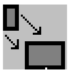


Section – Cross Section from An Existing String

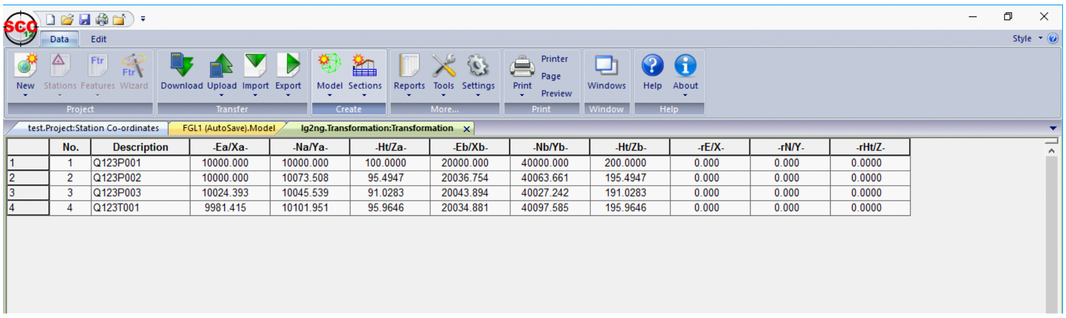


Section – Cross Section File Attached to Model

2.1.6 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 transfromations 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.



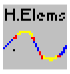
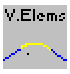
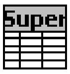
	No.	Description	-Ea/Xa-	-Na/Ya-	-Ht/Za-	-Eb/Xb-	-Nb/Yb-	-Ht/Zb-	-rE/X-	-rN/Y-	-rHt/Z-
1	1	Q123P001	10000.000	10000.000	100.0000	20000.000	40000.000	200.0000	0.000	0.000	0.0000
2	2	Q123P002	10000.000	10073.508	95.4947	20036.754	40063.661	195.4947	0.000	0.000	0.0000
3	3	Q123P003	10024.393	10045.539	91.0283	20043.894	40027.242	191.0283	0.000	0.000	0.0000
4	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

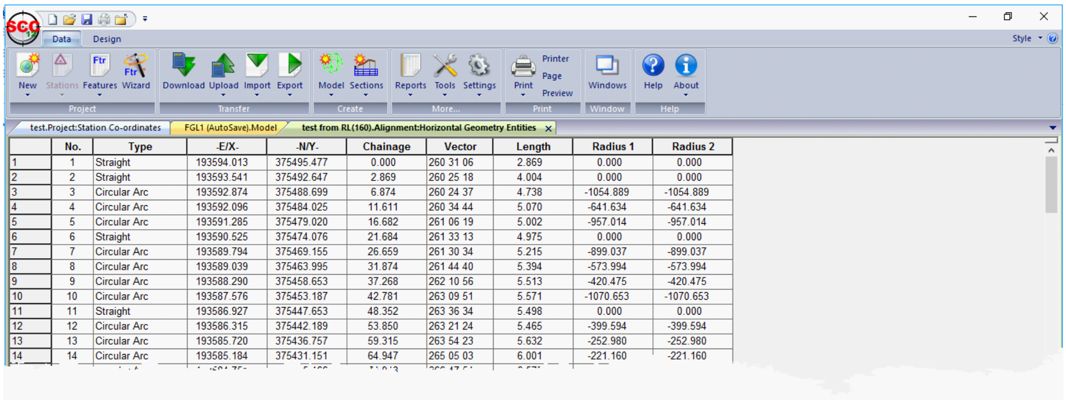
2.1.7 Alignment

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

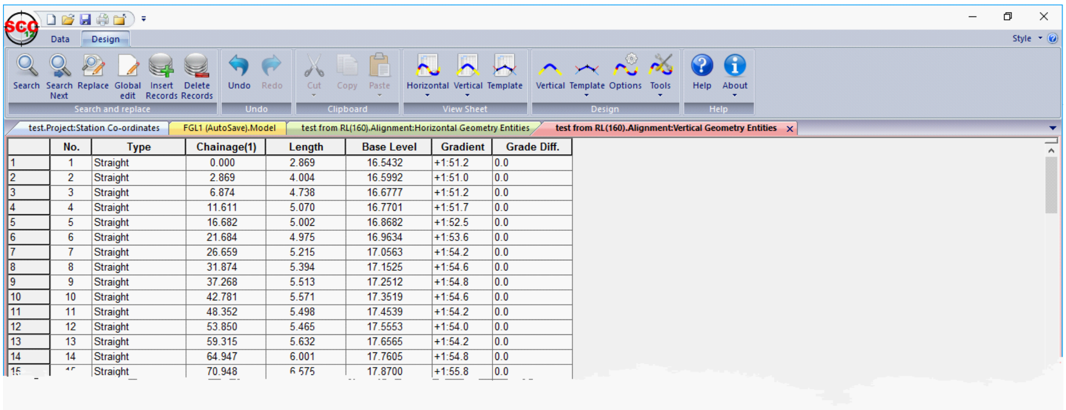
	Vertical intersection points
	Horizontal entities
	Vertical entities
	Section template points
	Super-elevation nodes
	Interactive section template design
	Interactive vertical design

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.



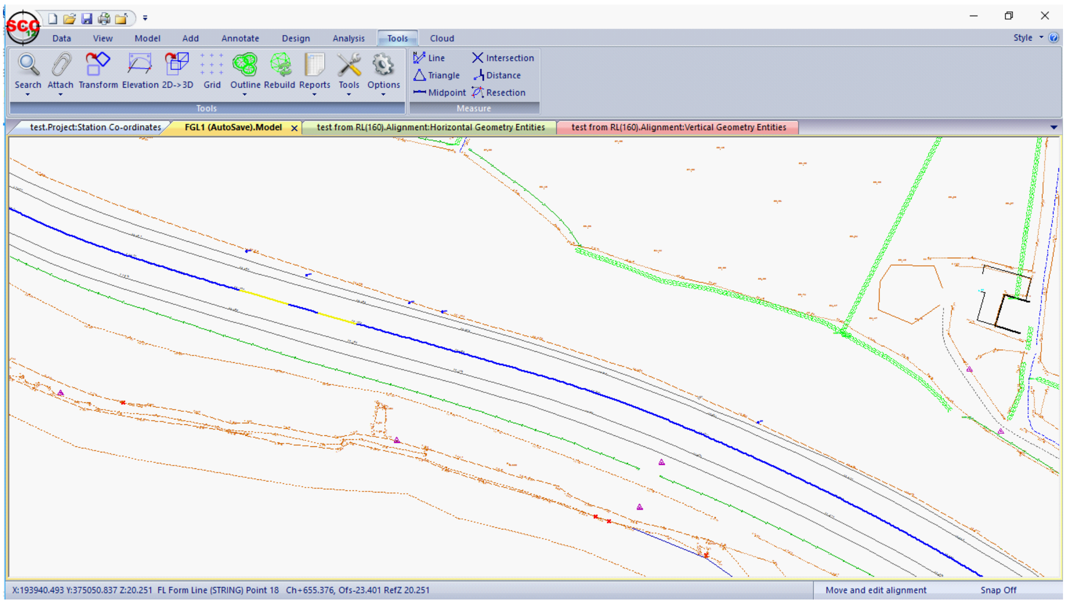
	No.	Type	-E/X-	-N/Y-	Chainage	Vector	Length	Radius 1	Radius 2
1	1	Straight	193594.013	375495.477	0.000	260 31 06	2.869	0.000	0.000
2	2	Straight	193593.541	375492.647	2.869	260 25 18	4.004	0.000	0.000
3	3	Circular Arc	193592.874	375488.699	6.874	260 24 37	4.738	-1054.889	-1054.889
4	4	Circular Arc	193592.096	375484.025	11.611	260 34 44	5.070	-641.634	-641.634
5	5	Circular Arc	193591.285	375479.020	16.682	261 06 19	5.002	-957.014	-957.014
6	6	Straight	193590.525	375474.076	21.684	261 33 13	4.975	0.000	0.000
7	7	Circular Arc	193589.794	375469.155	26.659	261 30 34	5.215	-899.037	-899.037
8	8	Circular Arc	193589.039	375463.995	31.874	261 44 40	5.394	-573.994	-573.994
9	9	Circular Arc	193588.290	375458.653	37.268	262 10 56	5.513	-420.475	-420.475
10	10	Circular Arc	193587.576	375453.187	42.781	263 09 51	5.571	-1070.653	-1070.653
11	11	Straight	193586.927	375447.653	48.352	263 36 34	5.498	0.000	0.000
12	12	Circular Arc	193586.315	375442.189	53.850	263 21 24	5.465	-399.594	-399.594
13	13	Circular Arc	193585.720	375436.757	59.315	263 54 23	5.632	-252.980	-252.980
14	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(1)	Length	Base Level	Gradient	Grade Diff.
1	1	Straight	0.000	2.869	16.5432	+1:51.2	0.0
2	2	Straight	2.869	4.004	16.5992	+1:51.0	0.0
3	3	Straight	6.874	4.738	16.6777	+1:51.2	0.0
4	4	Straight	11.611	5.070	16.7701	+1:51.7	0.0
5	5	Straight	16.682	5.002	16.8682	+1:52.5	0.0
6	6	Straight	21.684	4.975	16.9634	+1:53.6	0.0
7	7	Straight	26.659	5.215	17.0563	+1:54.2	0.0
8	8	Straight	31.874	5.394	17.1525	+1:54.6	0.0
9	9	Straight	37.268	5.513	17.2512	+1:54.8	0.0
10	10	Straight	42.781	5.571	17.3519	+1:54.6	0.0
11	11	Straight	48.352	5.498	17.4539	+1:54.2	0.0
12	12	Straight	53.850	5.465	17.5553	+1:54.0	0.0
13	13	Straight	59.315	5.632	17.6565	+1:54.2	0.0
14	14	Straight	64.947	6.001	17.7605	+1:54.8	0.0
15	[illegible]	Straight	70.948	6.575	17.8700	+1:55.8	0.0

Alignment - Vertical Geometry Entities



Alignment Attached to Model

2.1.8 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 in 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.

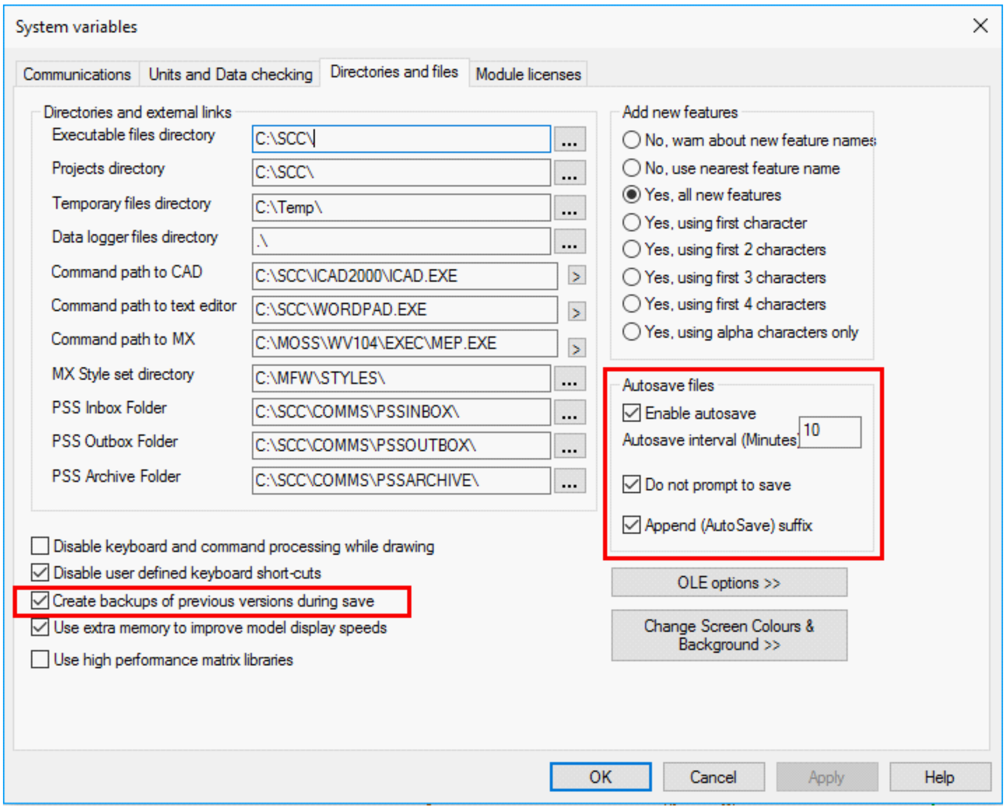
Send

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

2.1.9 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 > D irectories and Files'** to allow the user to select auto save options but also to create backup files automatically.



2.2 Feature Names Conventions & The Feature Library

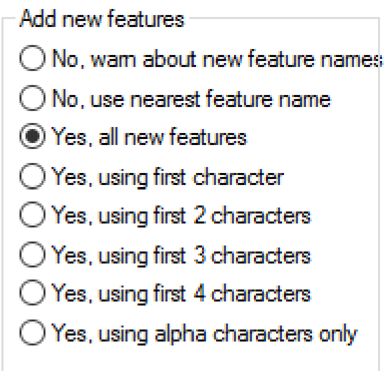
A feature name is the name given to one or more similar surveyed objects used to group strings and points of the same type. Examples of feature names include TREE, ROADEDGE, DITCH, WALL, MANHOLE and shortened or mnemonic versions such as TE, RE, DH, WL, MH. In SCC, a feature name can be up to eight characters 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 there 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'**).



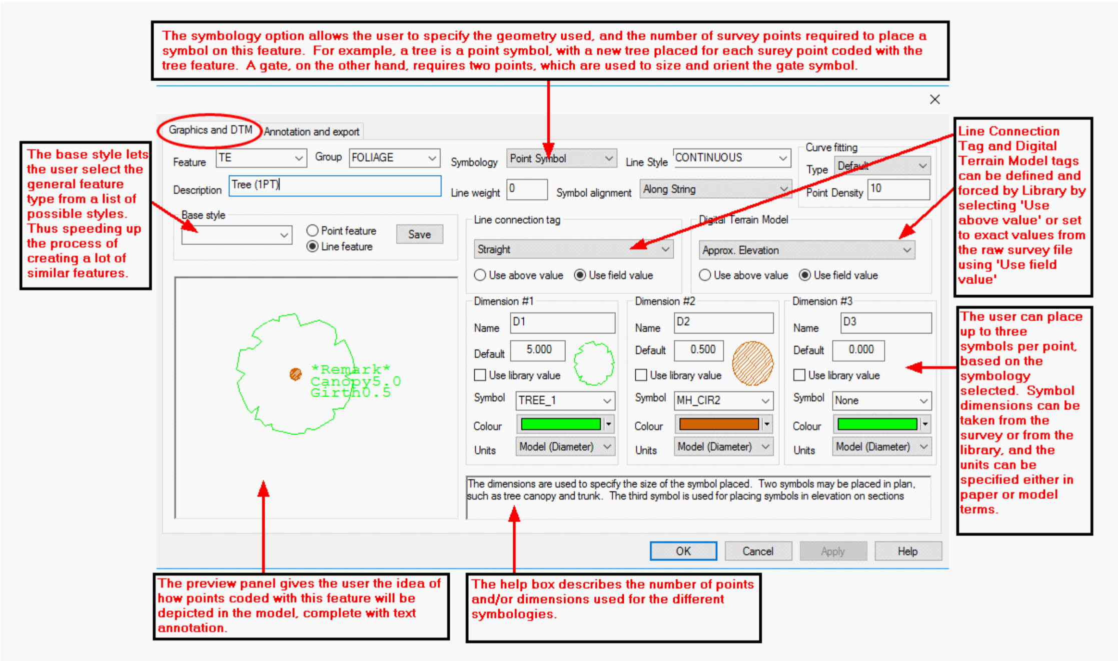
The variable name is 'Add new features' and its value will be one of the following;

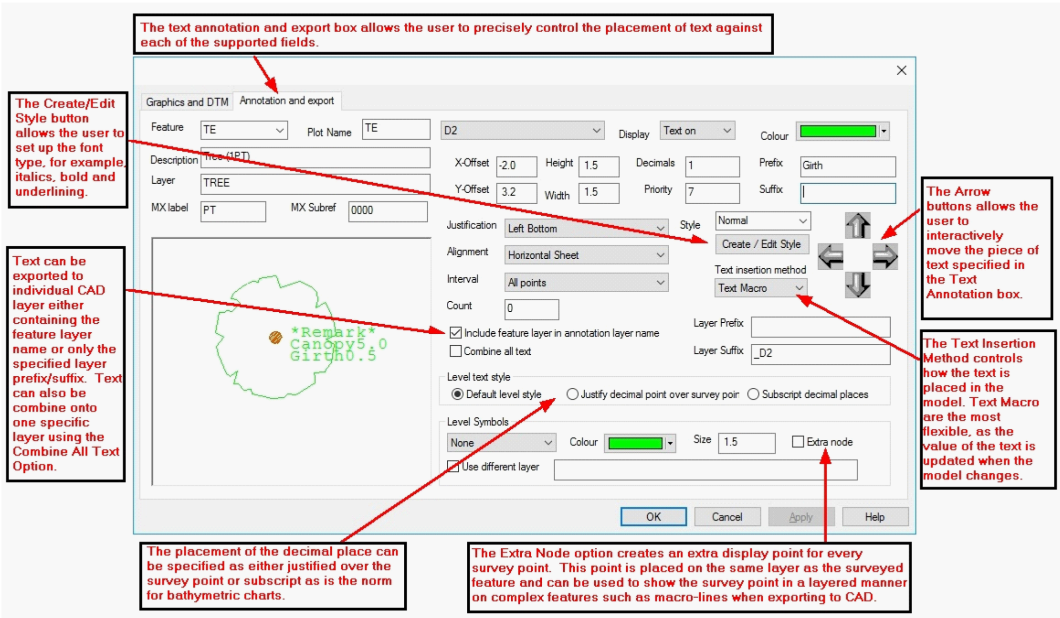
- No, warn about new feature name
- No, use nearest feature name
- Yes, all new features
- Yes, using first character
- Yes, using first 2 characters
- Yes, using first 3 characters
- Yes, using first 4 characters
- Yes, using alpha characters only

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 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.

2.3 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

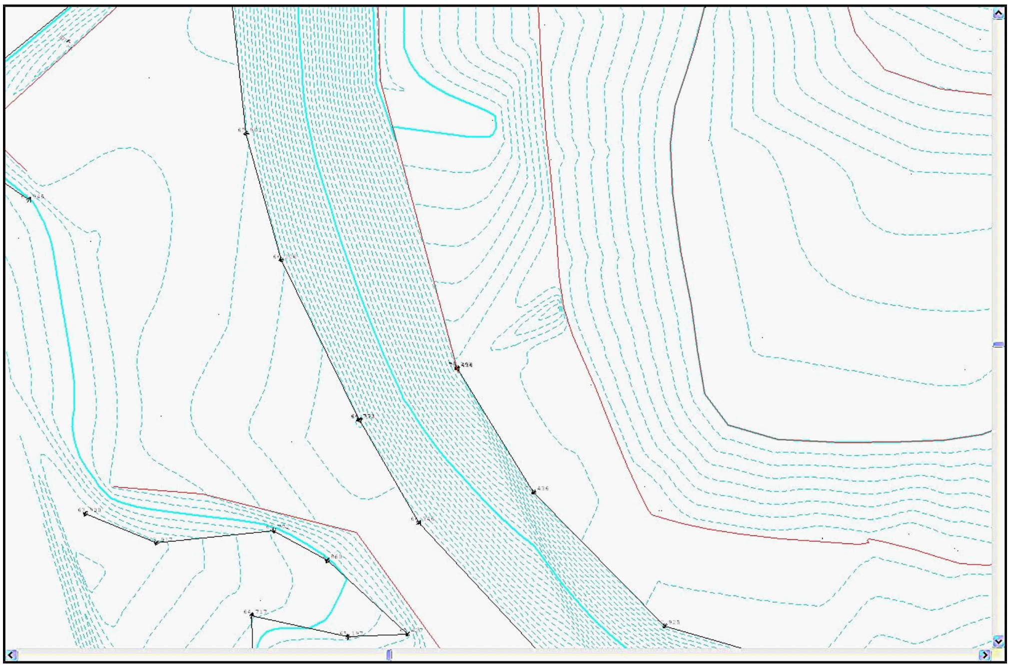
The tag code determines the connective geometry and specifies how the current point on the string will be connected to the next point on the string. This can be used to specify straight lines, curves, arcs, and squared up pieces of geometry in a string.

DTM Code

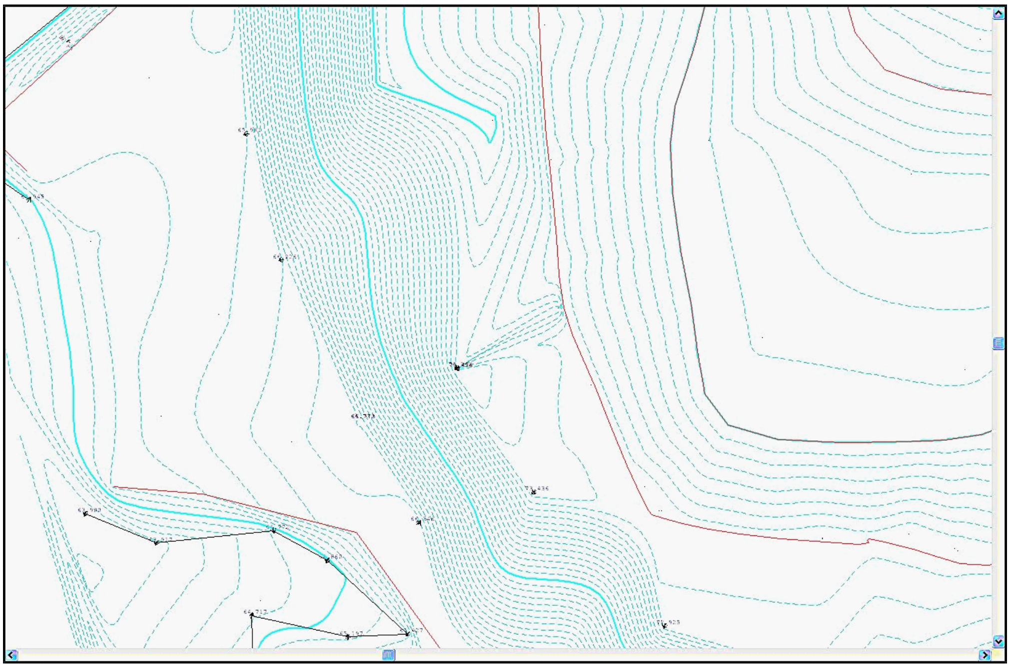
The DTM (Digital Terrain Model) status code determines the significance of the point of the surface model / digital terrain model being generated.

2.4 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.

2.5 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.

3 Getting Started

3.1 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.

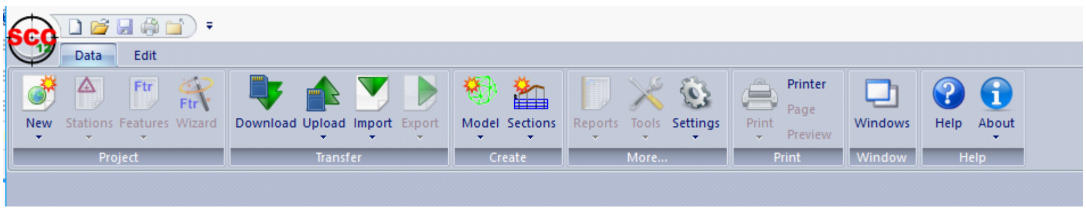
Creating a New Project

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.

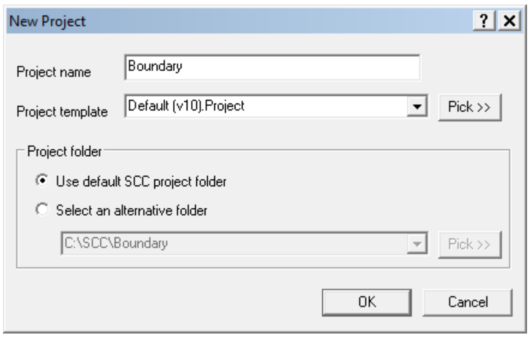
Starting the Software

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''

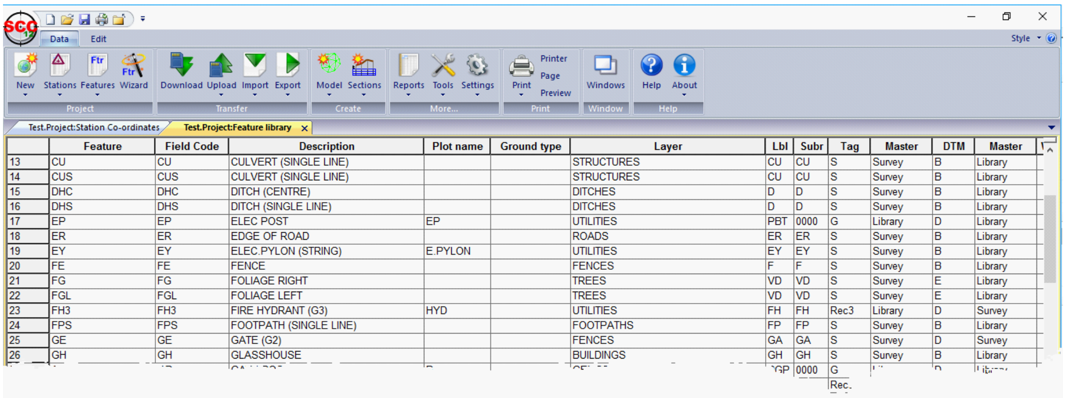
Enter in a Project/Job name

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

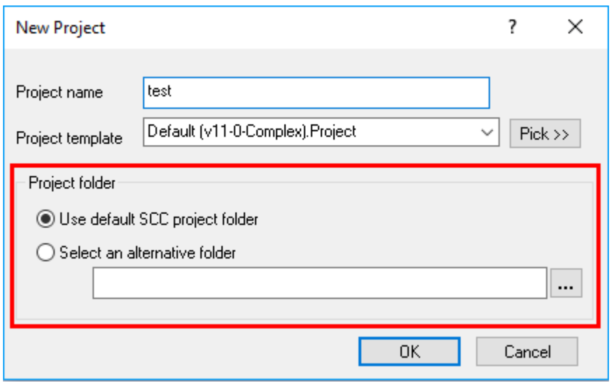
Select 'OK'

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.



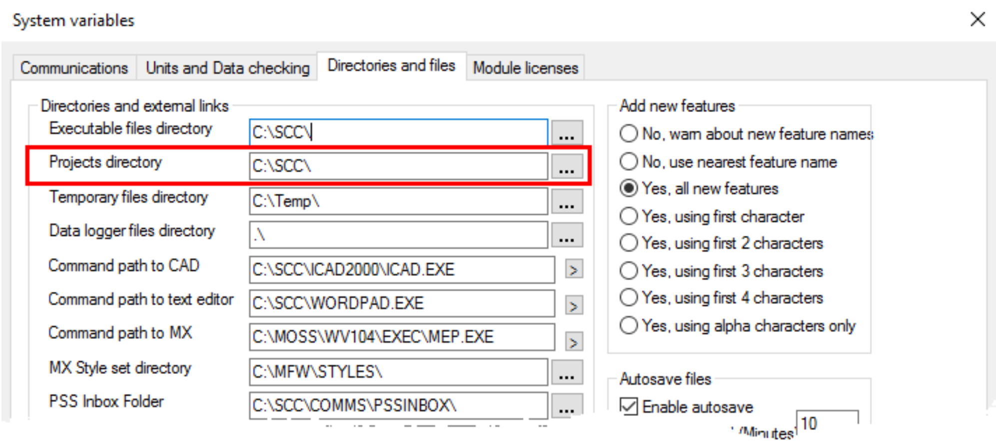
Project Folder



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.

3.2 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.

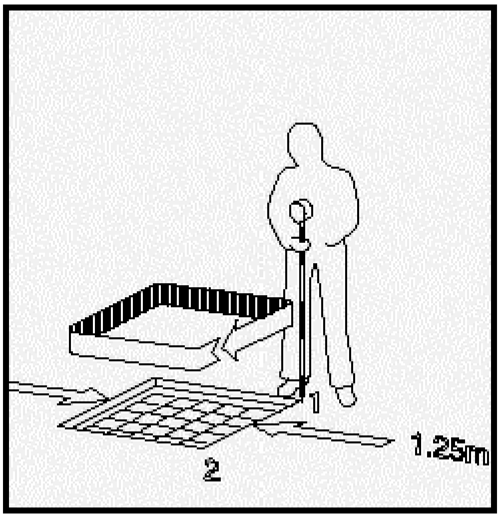
If you wish to change a field value for a large number of features, it will be quicker to do this directly in the feature library spreadsheet using the search and replace function.

3.2.1 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.

3.2.1.1 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.

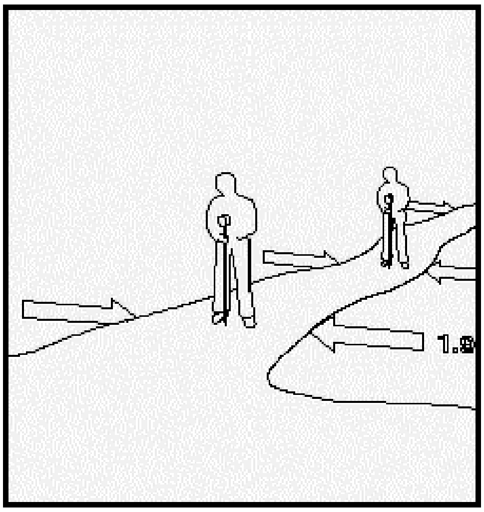


To generate rectangles in SCC the switch Create squares and rectangles in the Co-ordinate Reduction options must be turned on, and the symbology field for that particular feature name must be set to Rectangle in the Feature Library.

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.

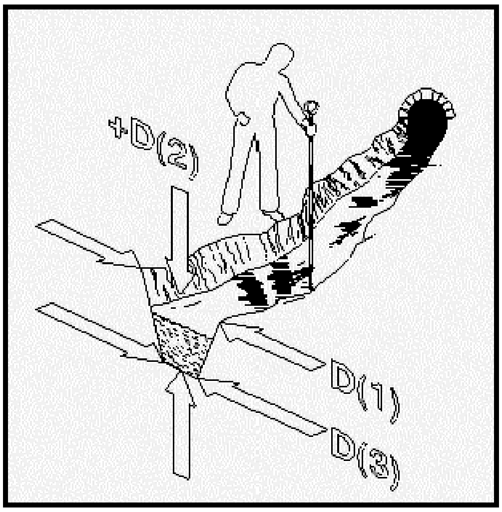
3.2.1.2 Creating Strip Levels (Using the Feature Library)

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.

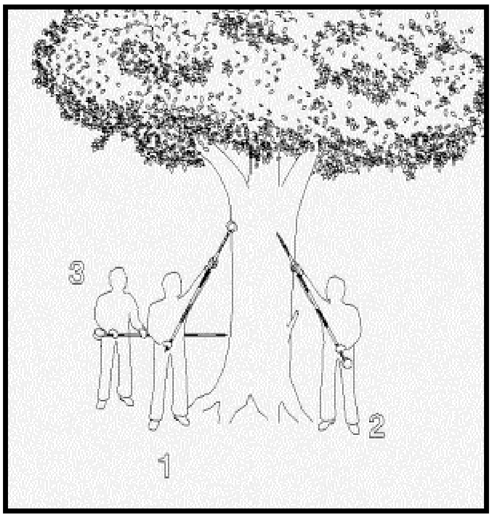


Note that the depth of the stream course will be positive if the rod is placed on the bed. To have all streams treated as strip-levels set the options within SCC as described above.

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).

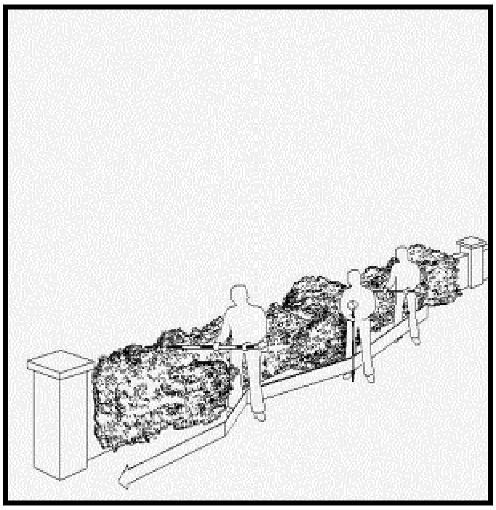
3.2.1.3 Creating Trees (Using the Feature Library)

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.



3.2.1.4 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



3.3 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.

3.3.1 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.

3.3.2 Downloading & Processing Traverse Data

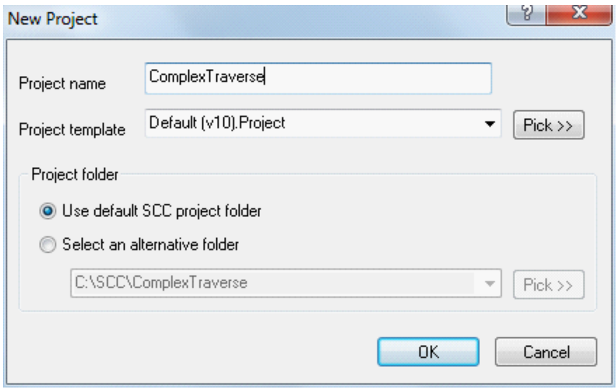
From the 'DATA tab > Download Survey Data' dialog, it is possible to select the type of datalogger used (Detail Topography, Traverse, As Set Out or Levelling) and the input device being used. It important to specify which type of data is being input.

3.3.2.1 Processing A Complex Traverse

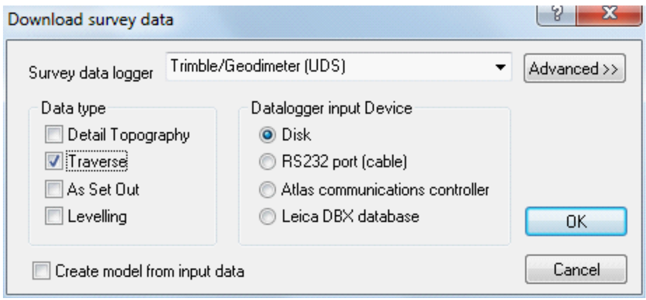
The following worked example shows how to process a complex control project in SCC that includes interlinked traverses, cross braces and additional side-shots. This includes processing the complete observation set as an unconstrained network via least squares, extracting separate traverses for Bowditch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

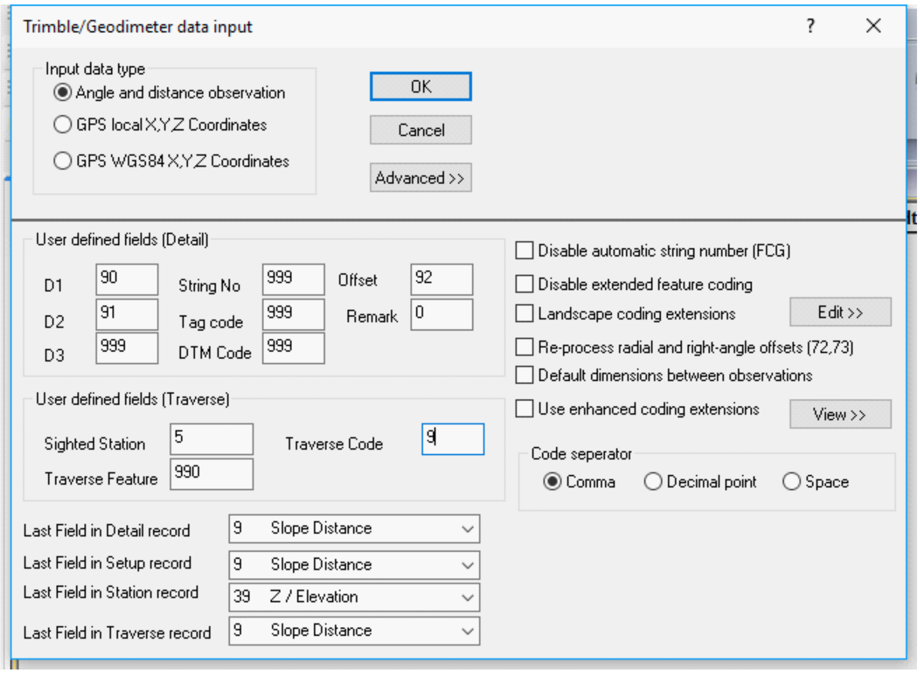
Project Creation & Download

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

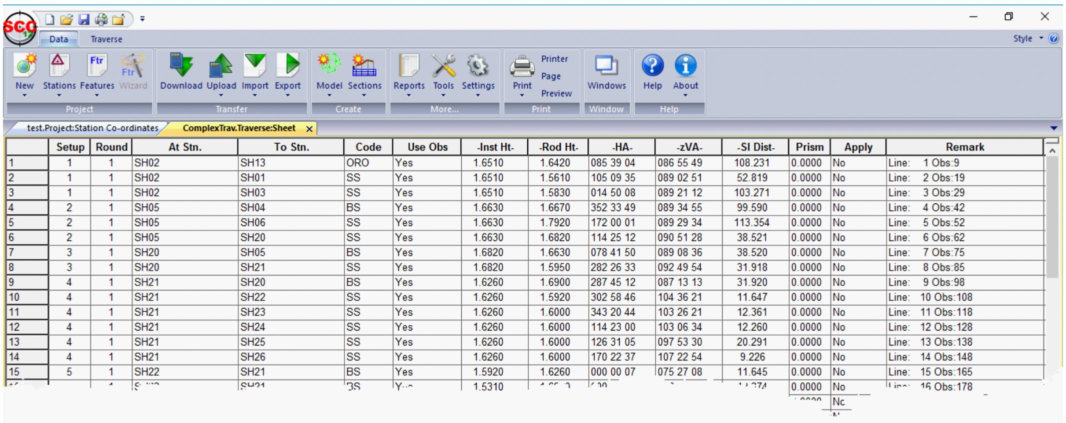


Into this project use 'DATA tab > Download ' to download the Trimble / Geodimeter UDS file, \SCC\Tutorials\ComplexTrav.DAT, using the parameters shown.





This results in the traverse spread-sheet given below;



	Setup	Round	At Stn.	To Stn.	Code	Use Obs	-Inst Ht-	-Rod Ht-	-HA-	-zVA-	-Sl Dist-	Prism	Apply	Remark
1	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	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	1	SH02	SH03	SS	Yes	1.6510	1.5830	014 50 08	089 21 12	103.271	0.0000	No	Line: 3 Obs:29
4	2	1	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	1	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	1	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	1	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	1	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	1	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	1	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	1	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	1	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	1	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	1	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	1	SH22	SH21	BS	Yes	1.5920	1.6260	000 00 07	075 27 08	11.645	0.0000	No	Line: 15 Obs:165
[illegible]	[illegible]	[illegible]	[illegible]	SH21	[illegible]	[illegible]	1.5310	[illegible]	[illegible]	[illegible]	[illegible]	0.0000	No	Line: 16 Obs:178

Adjustment of Traverse

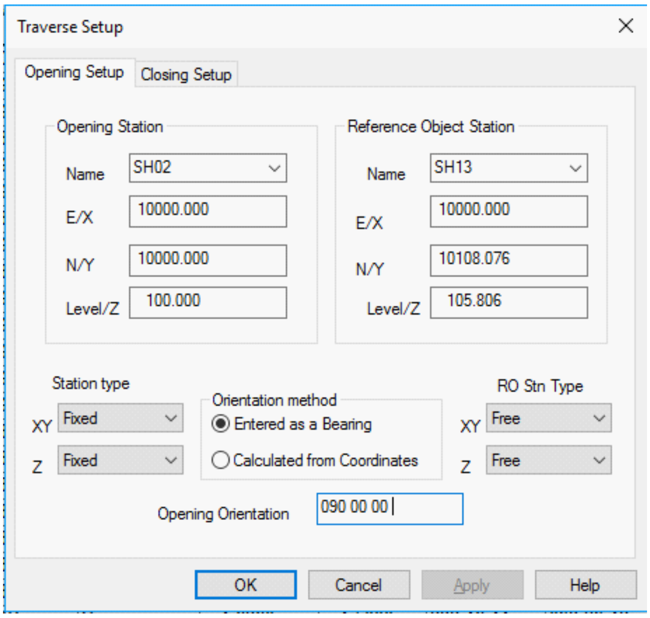
Adjust the control in its entirety, using a least squares adjustment with minimal constraints.

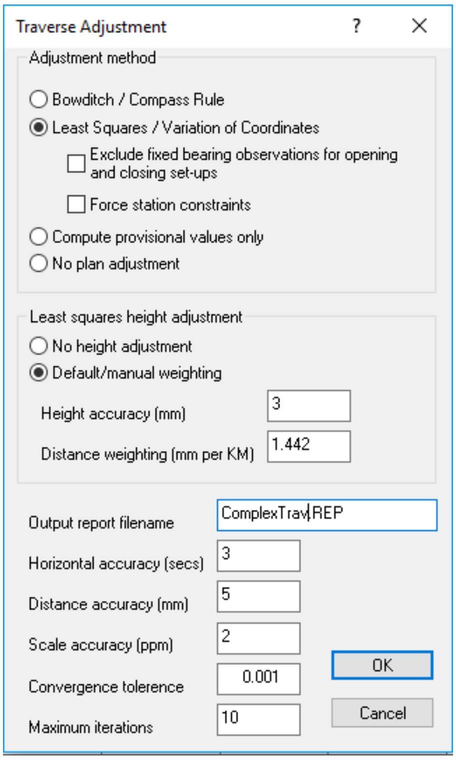
Select 'TRAVERSE tab > Set-up', and enter an opening setup as shown in the dialog below.

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

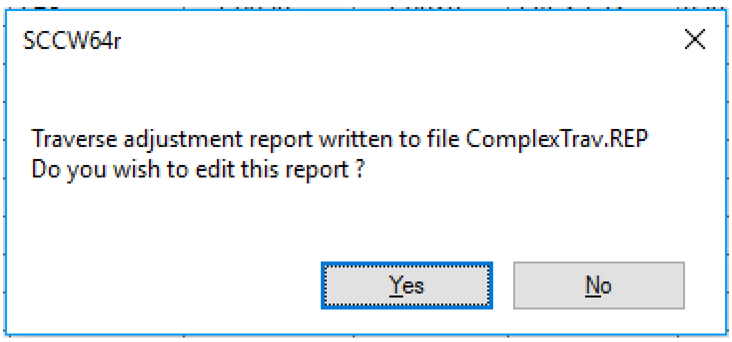
Select 'TRAVERSE tab > Adjust' and adjust this data by least squares.

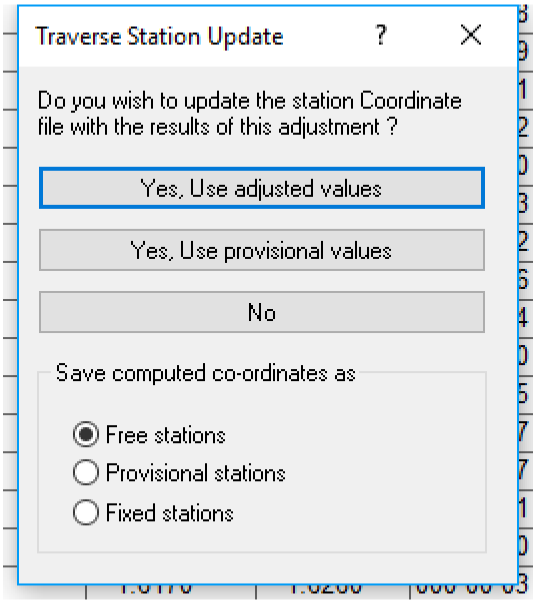
When prompted, save the adjusted values to the project station sheet.





Review report

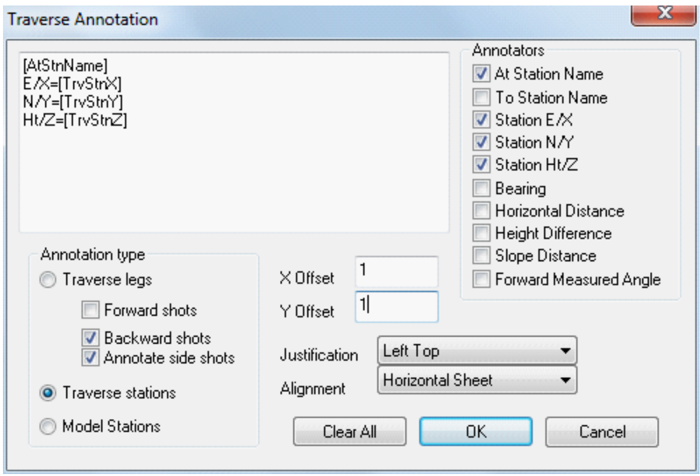




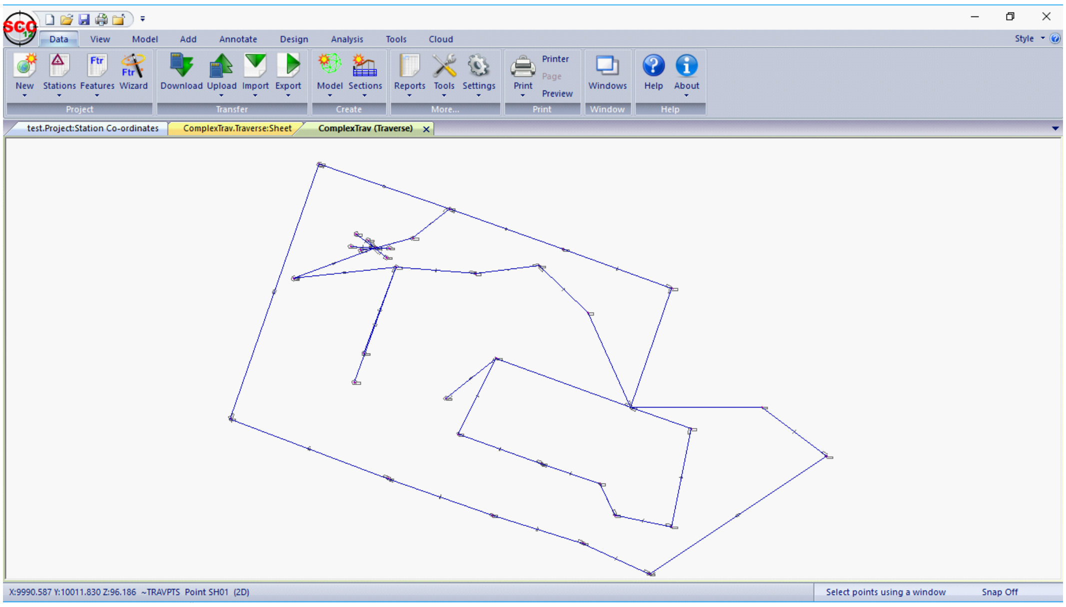
Initial Plot & Annotation of Network

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.

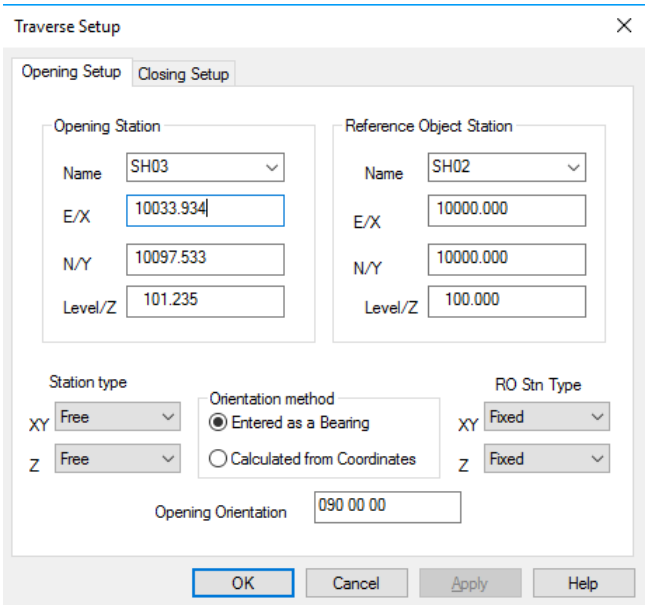


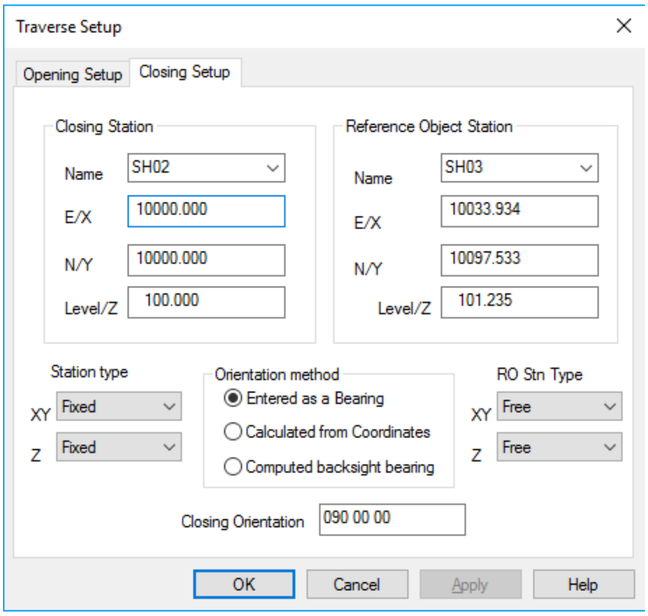
Save this model as ‘ComplexTrav.Model’

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’.

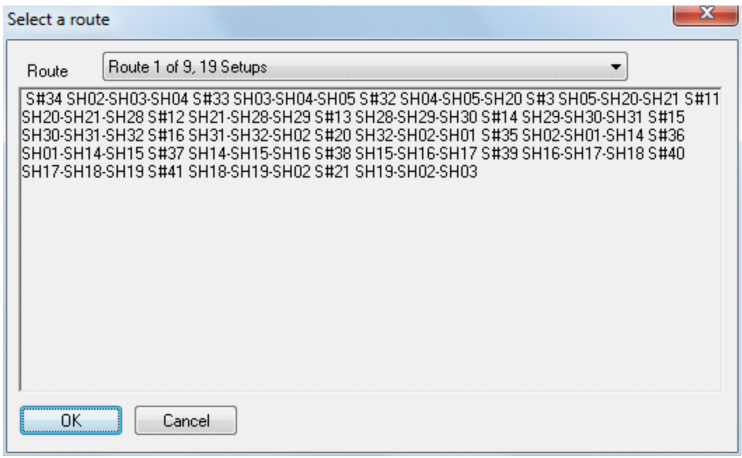




Select 'TOOLS drop down menu > Extract new route' to search for any potential routes through the control network using these opening and closing conditions.

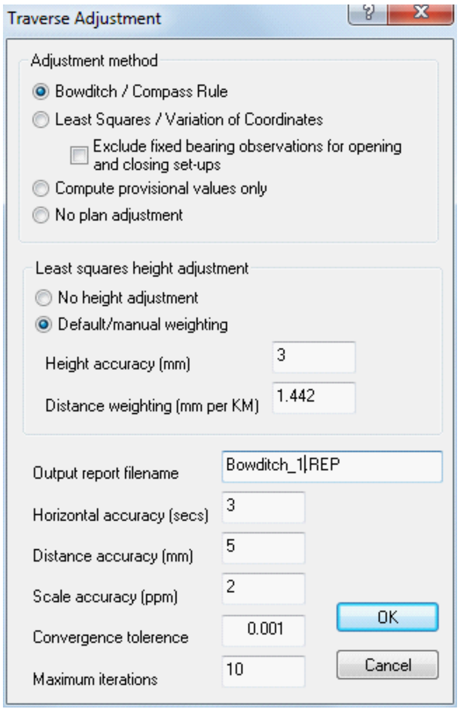
In this case, SCC can find nine possible routes that would meet these conditions, which are outline in the route selection dialog.

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.



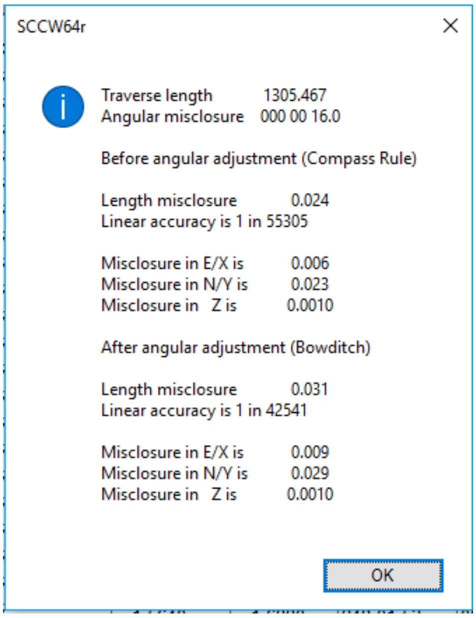
In this case, we will pick the second possible route.

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

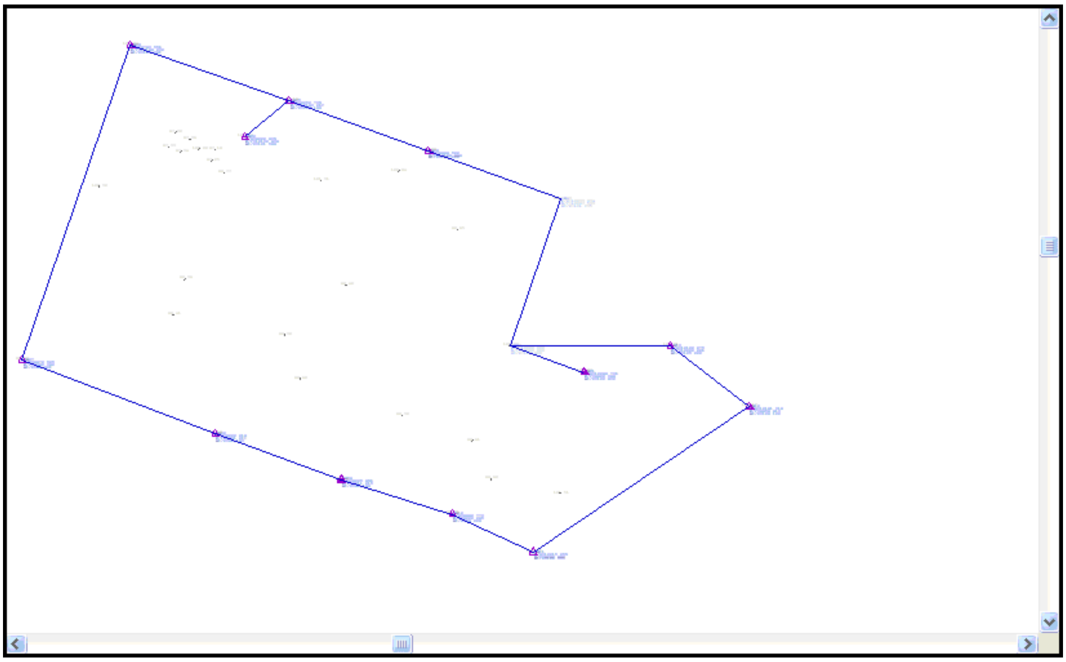


Given that these results are acceptable, we will save this traverse as 'Outer-loop.Traverse'.

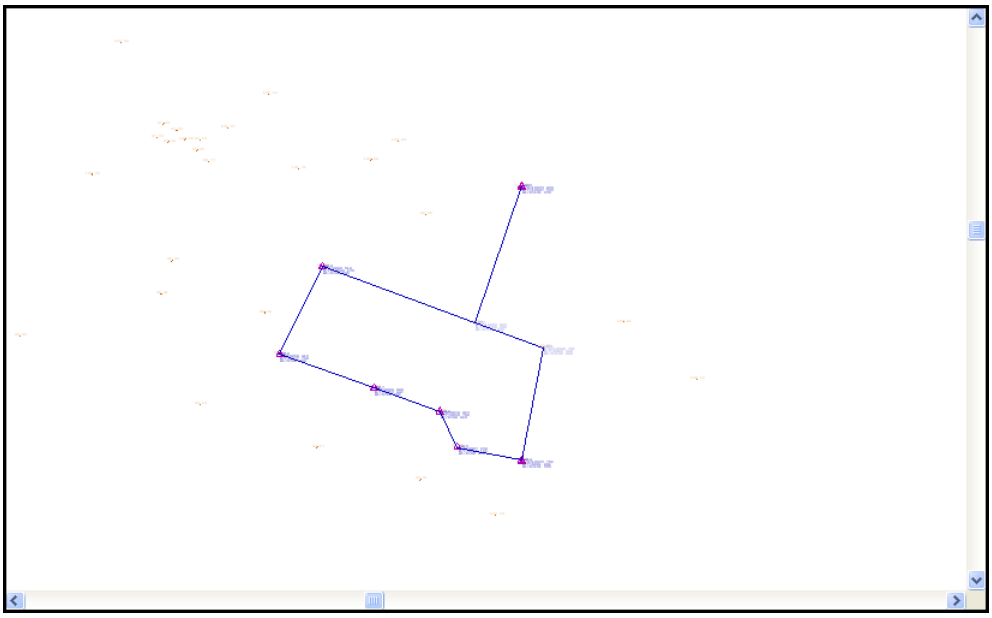
When prompted, save the adjusted values to the project stations sheet. We can now change the values of all or some of these stations from 'Free' to 'Fixed' or 'FixedXY' in the project stations sheet, and repeat the least squares adjustment on 'ComplexTrav.Traverse'. This will re-adjust all the remaining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



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'.

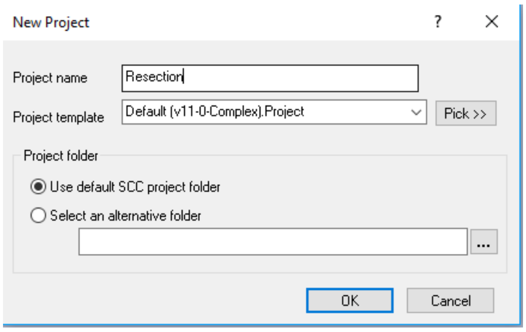
3.3.2.2 Processing A Resection Network

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.

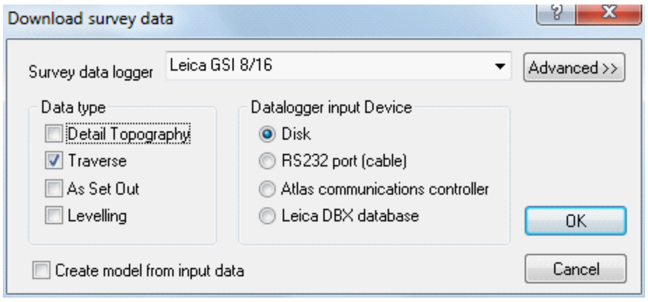
The steps taken to process this job are as follows:

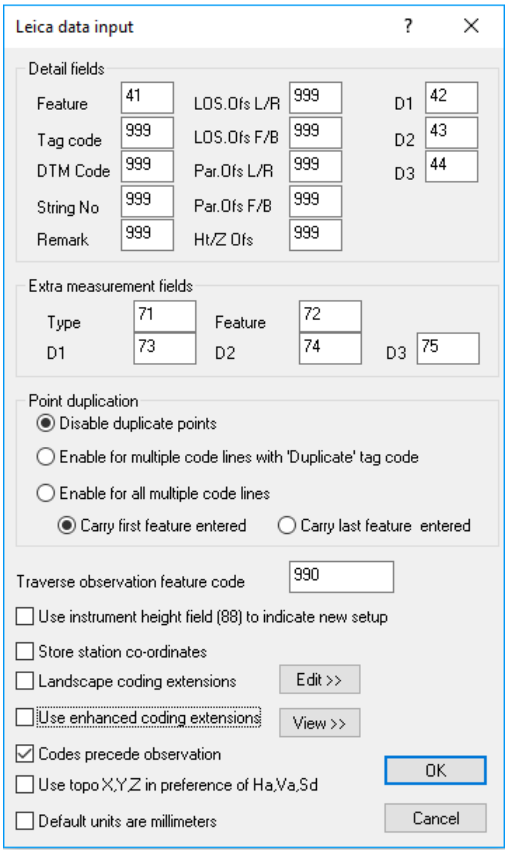
Project Creation & Download

'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.

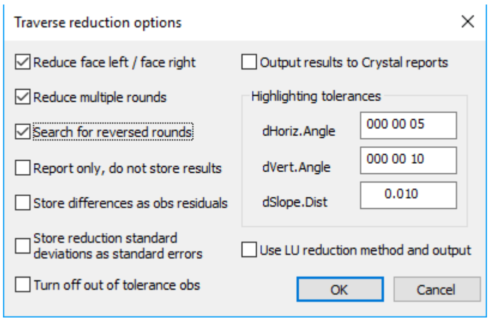




Traverse Reduction Processing of Traverse Data

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.

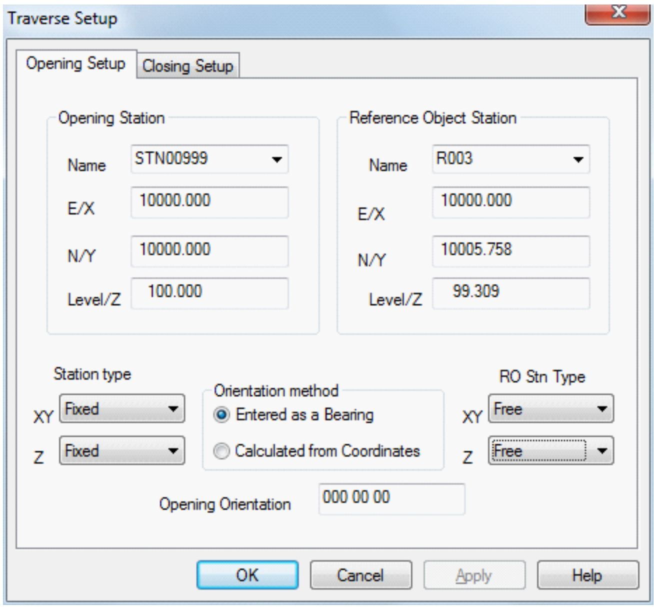


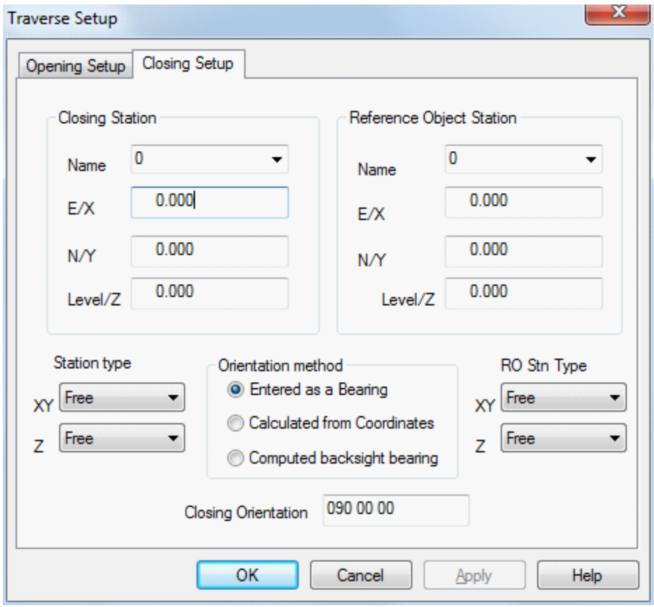
The reduction creates mean forward measured angles and distances for multiple similar observations, in this case reducing the number of input observations from 1076 to 538. The reason for doing this is primarily processing time. Many of the matrix manipulation routines in the least squares adjustment are making a number of computations based on the square of number of observations times the number of unknown stations, i.e. (1076x1076x320 = 370,488,320 for unreduced data, or 538x538x320 = 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.

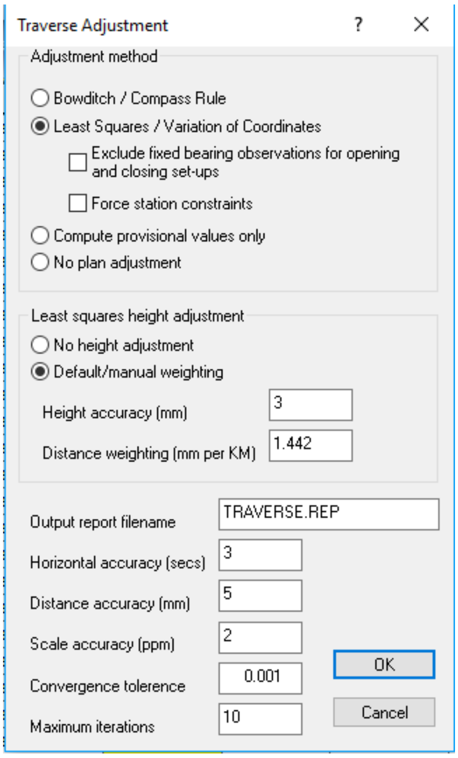




As we have no known station values, we are using the minimum allowable constraints which are one known station to provide position, and one known bearing, to provide orientation.

Adjustment of Traverse

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

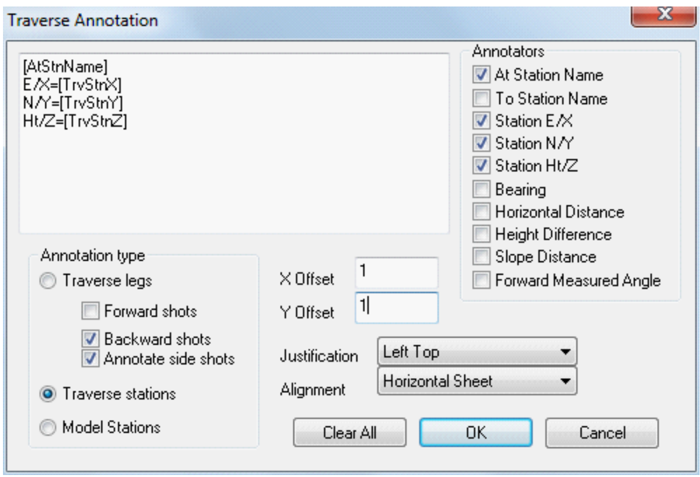


This will create the report shown at the end of this document. When prompted, update the project station values with the adjusted results, and save the traverse and project

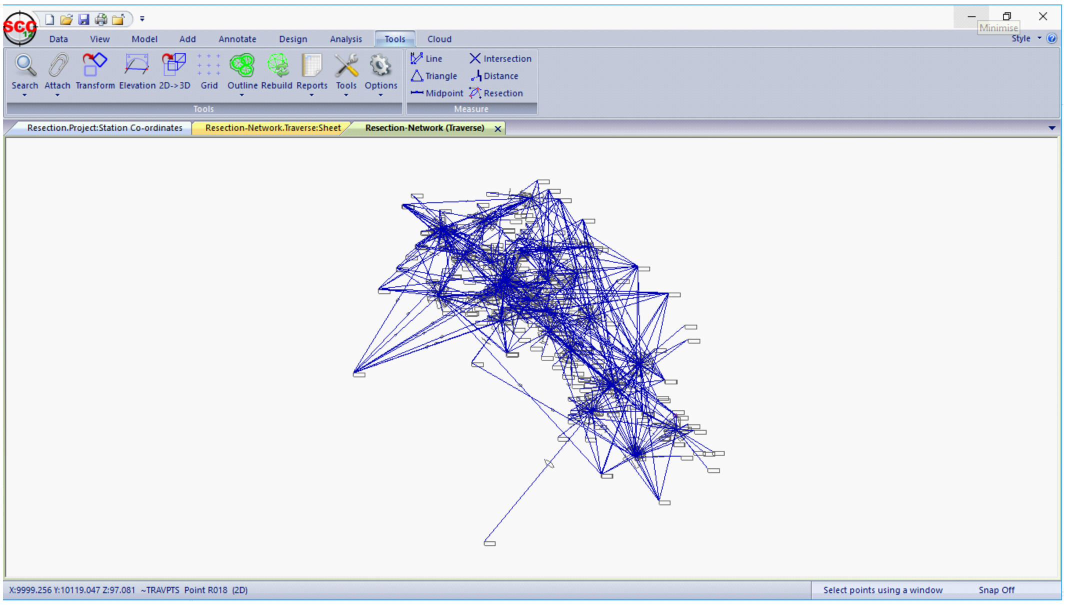
Annotation of Traverse

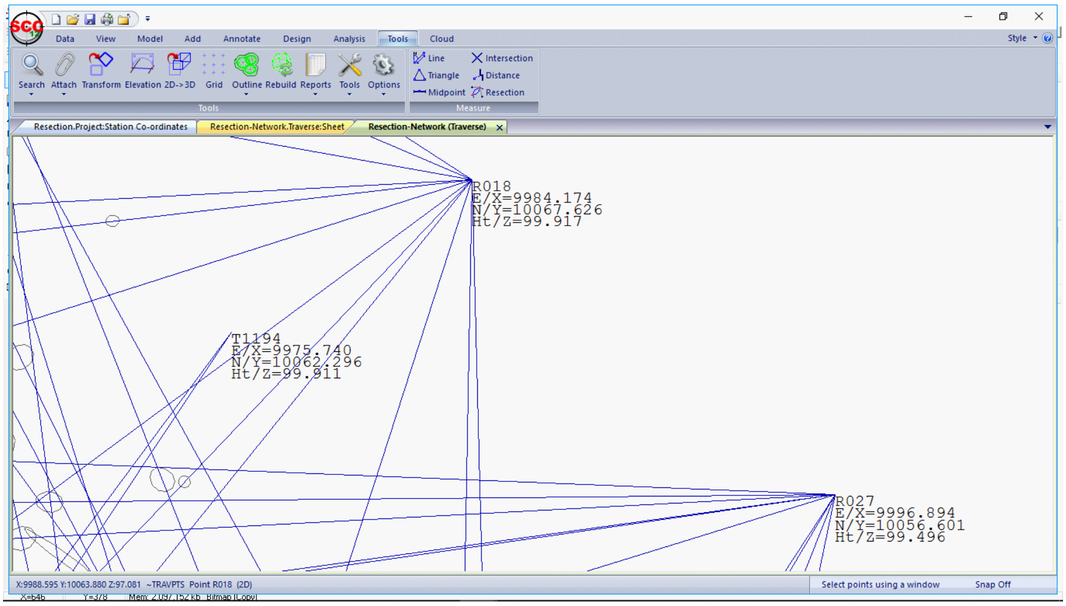
Create a model of the data, showing the stations, network, and error ellipses.

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



This will generate the picture shown below.





3.3.3 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:

3.3.3.1 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

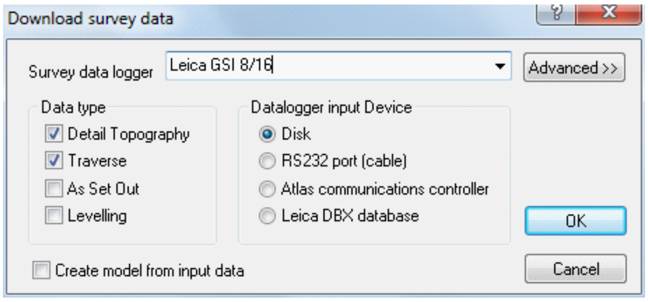
Select 'DATA tab > Download Survey Data'

Set Survey Data Logger to 'Leica GS1 8/16'

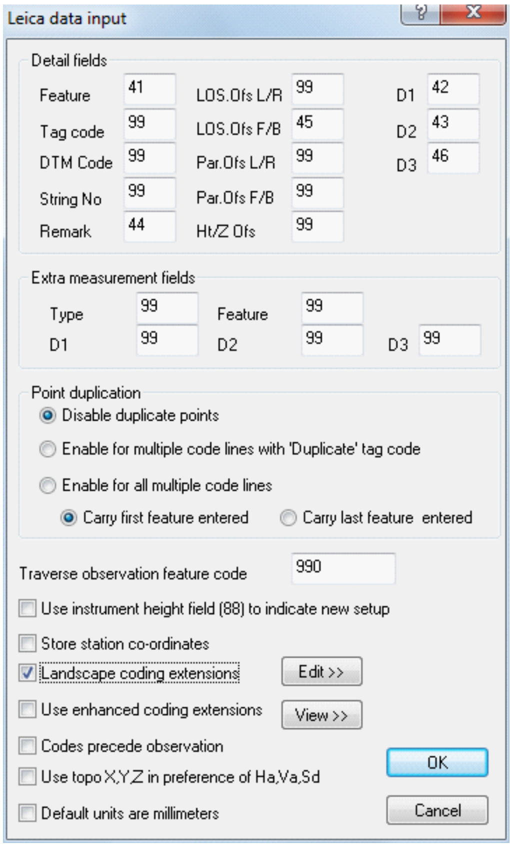
Highlight 'Traverse' or 'Detail Topography' as the Data Type

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

Select 'OK'



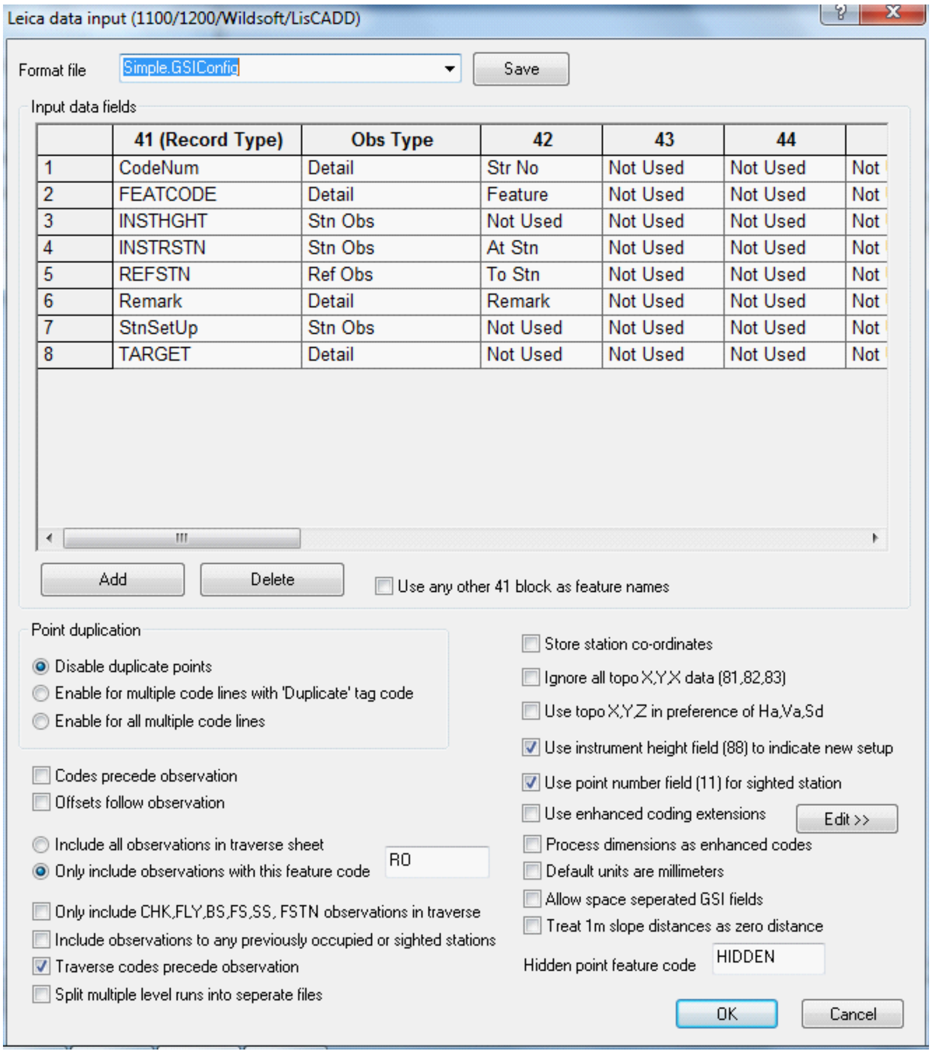
Select the file you require and 'OK'



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.



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

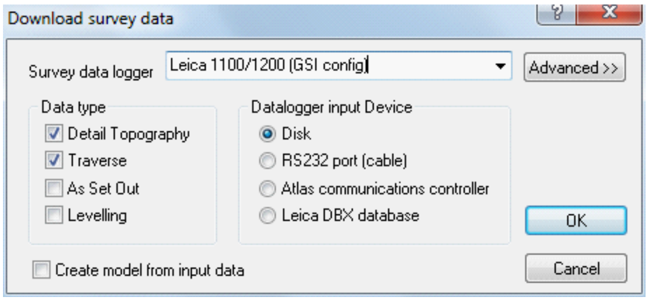
Select ‘Data tab > Download Survey’

Select ‘Leica 1100/1200 (GSI Config)’ as Survey Data Logger

Select the required ‘Data Type’

Select ‘Data logger input Device’

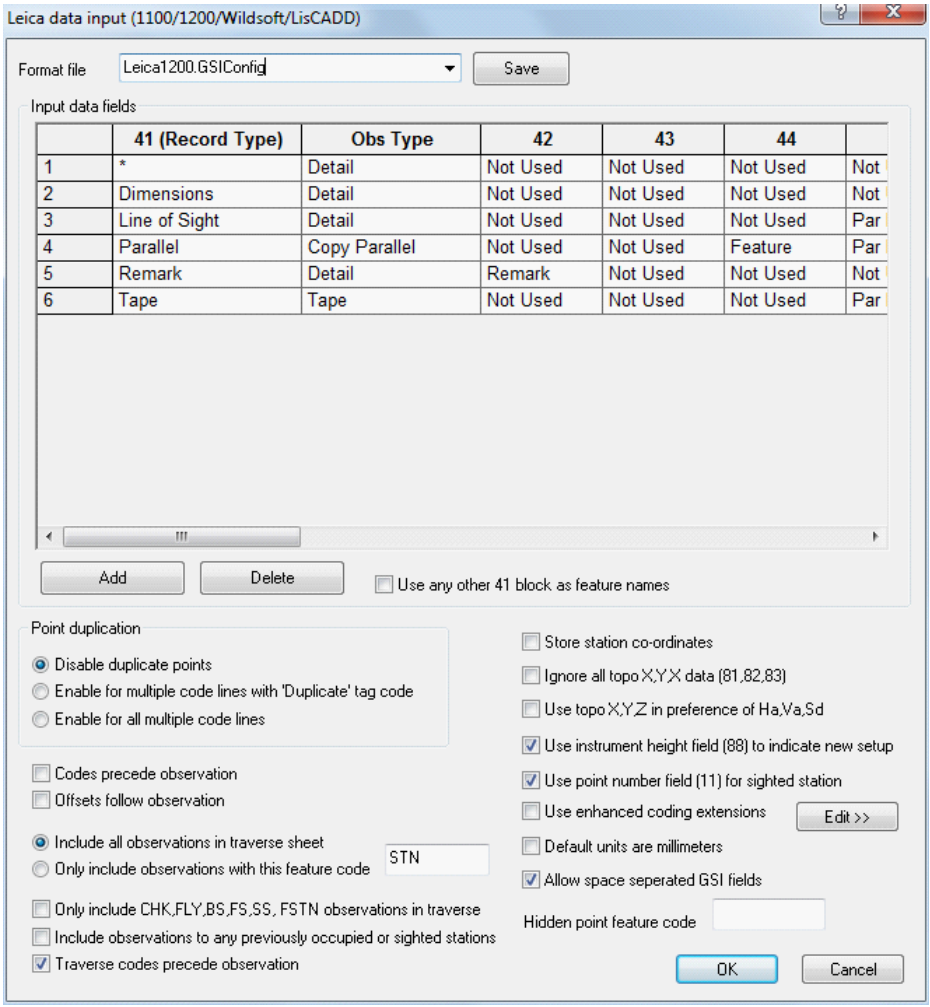
Select ‘OK’



Pick raw file

Select 'Leica1200.GSIConfig' Format File

Set up additional settings as shown below:



Select 'OK'

Traverse Observation Feature Code

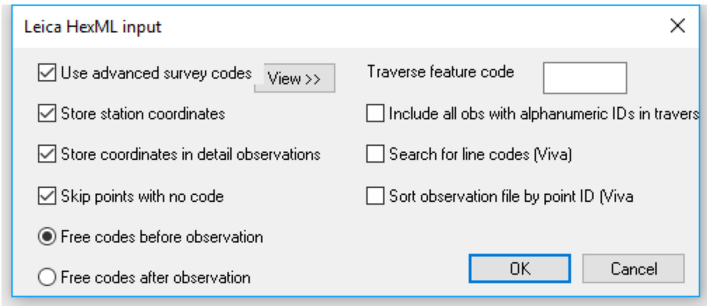
Traverse Observation Feature Code field should be filled with the user's individual code i.e. PSSA or STN etc.

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.



3.3.3.2 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;

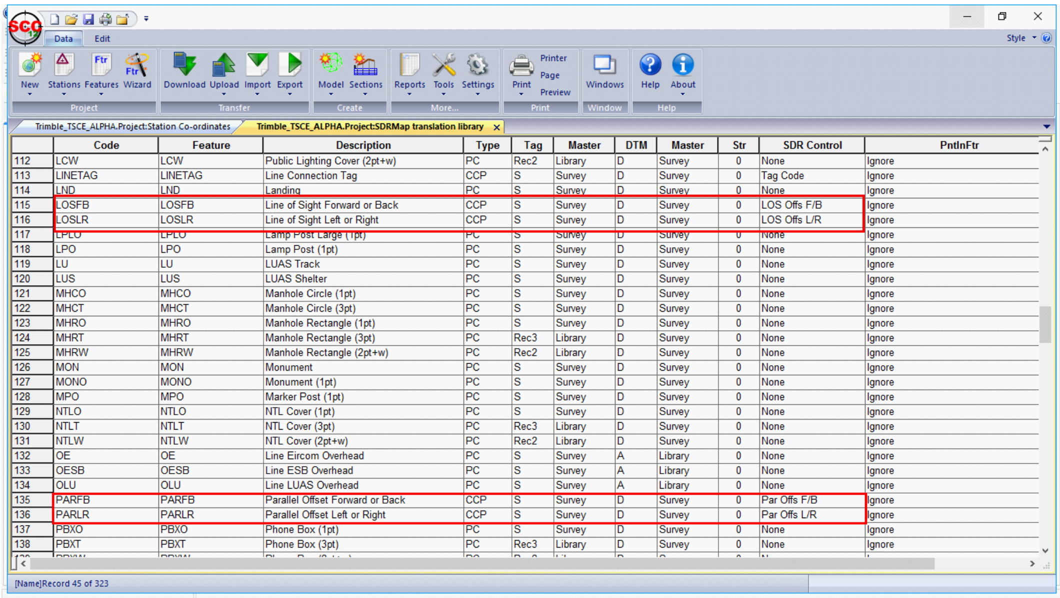
```
2NM         9020
308417.642000000231995.58500000051.33300000000001.50000000000000
07NM         9020              9021     27.900185437685727.9001854376857
03NM1.70000000000000
09F1         9020              9021
12.874430000000088.109739263113027.9001854376857STN
09F1         9020              1001
18.593340000000088.669171829746923.1694290000000BG
13ATOffset                0.30000000000000
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;



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.

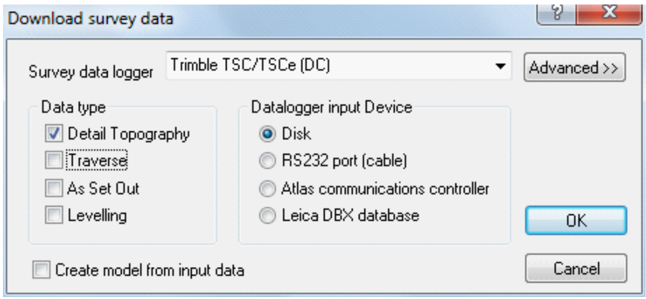
Once you have completed editing this translation table, you should save the project as a new template in the SCC folder, such that you do not have to repeat this exercise.

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'

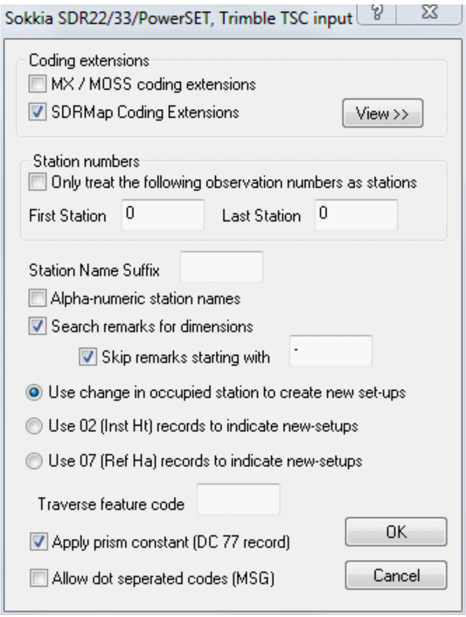


Select 'OK'

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

Select 'Open'

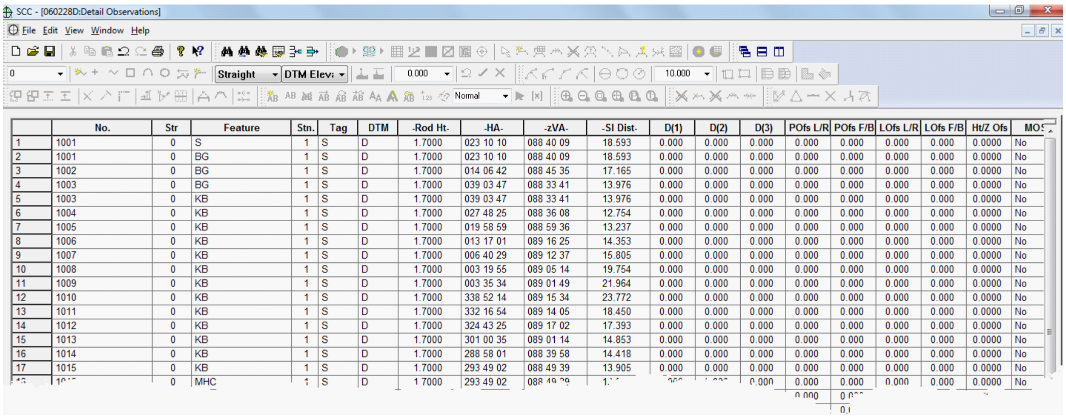
Select 'OK'



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-	-zVA-	-Sl Dist-	D(1)	D(2)	D(3)	POfs L/R	POfs F/B	LOfs L/R	LOfs F/B	Ht/Z Ofs	MOS
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	0.0000	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	0.0000	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	0.0000	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	0.0000	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	0.0000	No
6	1004	0	KB	1	S	D	1.7000	027 48 25	088 36 08	12.754	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0000	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	0.0000	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	0.0000	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	0.0000	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	0.0000	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	0.0000	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	0.0000	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	0.0000	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	0.0000	No
15	1013	0	KB	1	S	D	1.7000	301 00 35	089 01 14	14.853	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0000	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	0.0000	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	0.0000	No
[illegible]	[illegible]	0	MHC	1	S	D	1.7000	293 49 02	[illegible]	[illegible]	[illegible]	[illegible]	0.000	0.000	0.000	0.000	0.000	0.0000	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

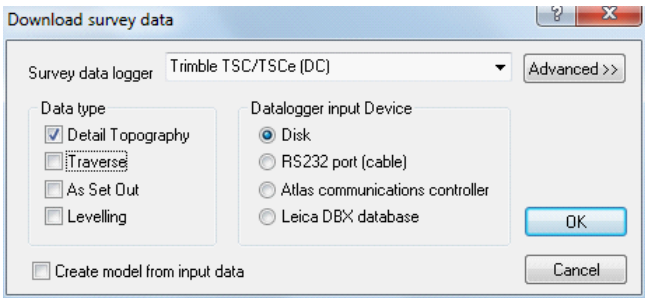
```
09F1         S4               1871
19.485780000000086.2995339500897308.269300500000SL
09F1         S4               1872
20.122220000000086.2101823251036306.161937000000HE3
13NMOFFSET HE3 2.0M LEFT
09F1         S4               1873
26.350400000000086.0417014778084314.111125500000HE3
09F1         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'

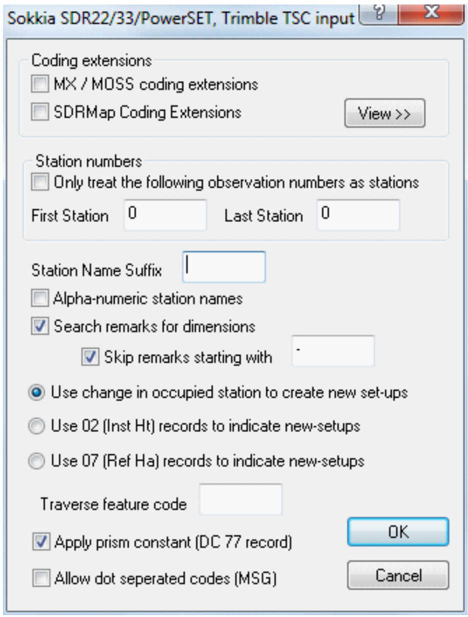


Select 'OK'

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

Select 'Open'

Select 'OK'



Set 'Search remarks for dimensions'

Select 'OK'

Note that the option to strip string numbers from field codes has bee selected with the 'Coordinate Reduction Options'.

Trimble DC Format

SCC also supports the direct download of DC format as follows:

```
D2NM1021.70000000000                  0.14200000000000
       69FD           S22       137412.769000000253513.23000000046.1450000000000CON
          11
       E0NM          S22       1.620000000000001.000000000000001
       E1NM         S22              S21                        190.187083794199

           77NM1.500000000000002.000000000000000.00000000000000
       D9F1         S22              S21
91.250749347157591.8136377610403190.187083794199CON
50.003182501540000.001388888888890.00138888888889
       A6F1                    -0.00090101528280.00846784874555
       D9F1         S22              1
90.790027562819091.9271004383258190.244880000000S
10.010181580100000.001388888888890.00138888888889
       D9F1         S22              2
90.795487574480291.9263806245318190.249560000000S
10.010181591020000.001388888888890.00138888888889
           77NM2.000000000000002.000000000000000.00000000000000
           10.010192322360000.001388888888890.00138888888889
       D9F1         S22              8001
86.761130395951992.3277570859462213.880050000000HEC1
10.010173522320000.001388888888890.00138888888889
       D9F1         S22              8002
77.753634782899292.0915956056461219.797010000000HEC1
10.010155507320000.001388888888890.00138888888889
           77NM1.500000000000002.000000000000000.00000000000000
       D9F1         S22              8003
73.815260826027192.3056179106150224.597520000000HEC1
10.010147630580000.001388888888890.00138888888889
       D9F1         S22              8004
68.620739011095391.8354586405055234.321300000000HEC1
10.010137241520000.001388888888890.00138888888889
```

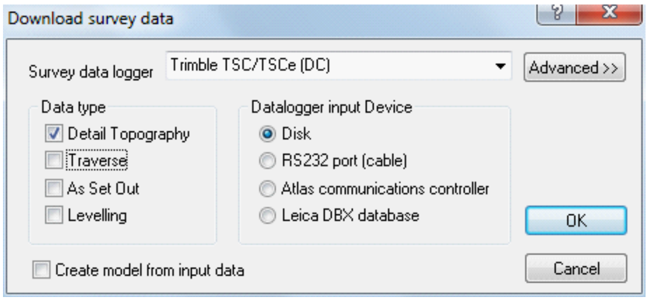
```
        D9F1          S22              8005
64.289547497628291.1620741098151249.494310000000HEC1
    10.010128579120000.001388888888890.00138888888889
```

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'

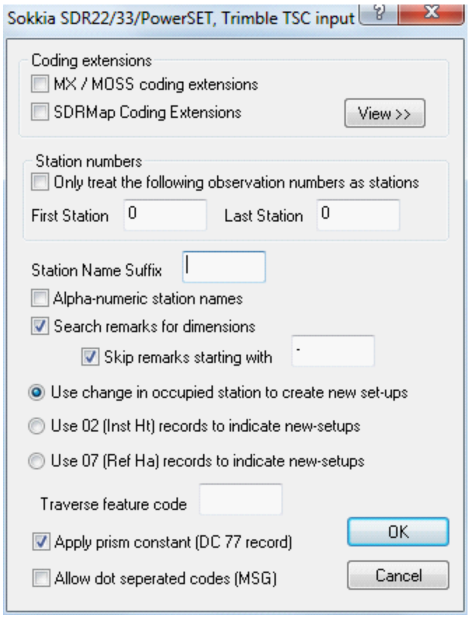


Select 'OK'

Select File

Select 'Open'

Select 'OK'



Set 'Search remarks for dimensions'

Select 'OK'

Trimble/Geodimeter UDS

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

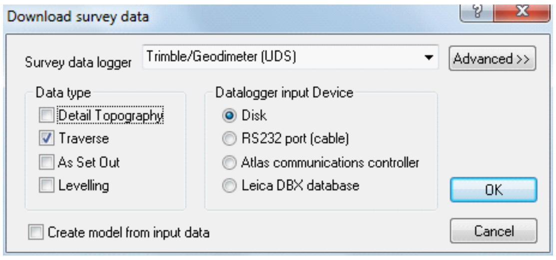
Select 'DATA tab > Download'

Set Survey Data Logger to 'Trimble/Geodimeter UDS'

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

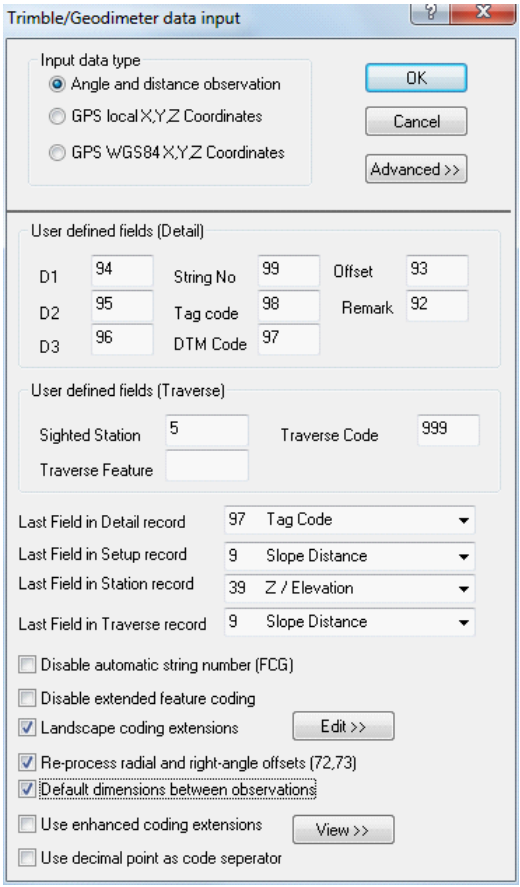
Set Input Device to 'Dsk', 'RS323 port (cable) 'or 'Atlas communications controller' as required

Select ‘OK’

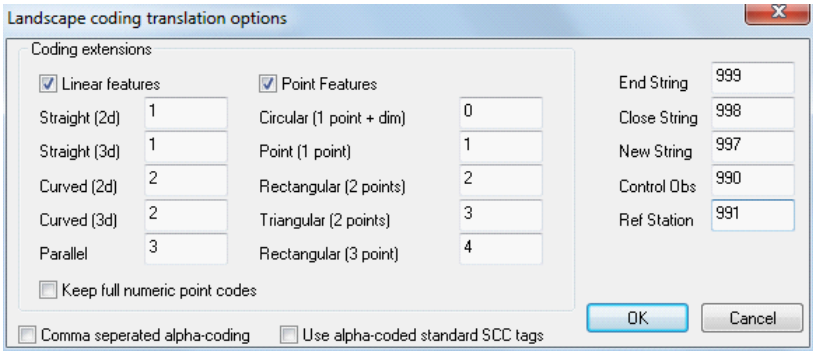


Select the file you require and ‘OK’

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.



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.



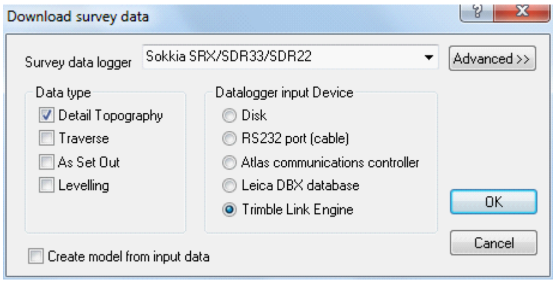
SCC lets us freely mix data from a range of different instrument manufacturers and instrument types within a given project. The LandScape processing options are currently enabled for the Geodimeter and Leica instruments.

Trimble Exchange

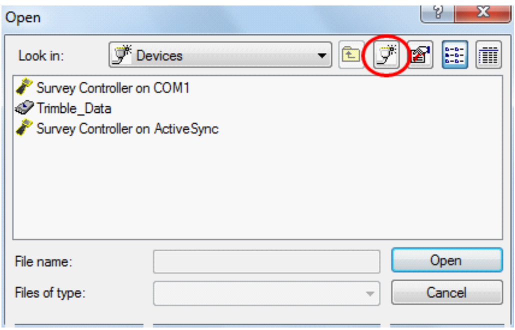
The user can download using Trimble JXL, Trimble DC, SDR33, Geodimeter UDS or GPS X,Y,Z formats using the Trimble Link Engine.

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

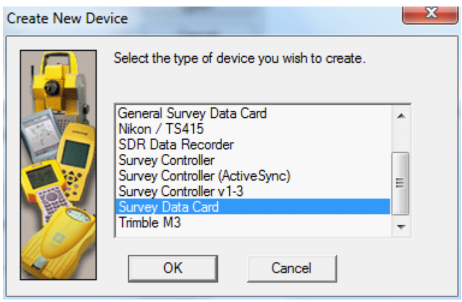
Go to 'DATA tab > Download survey'

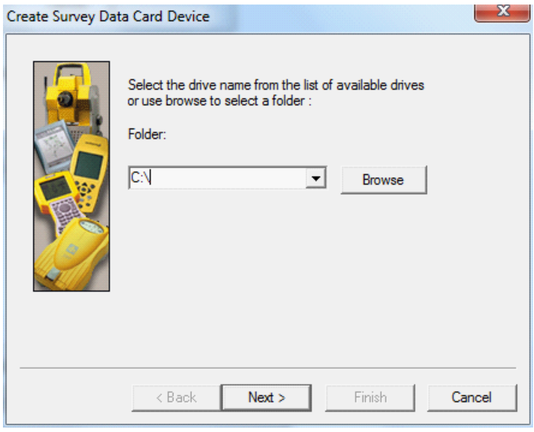


If this is the first time using TLE, and downloading from file, press the 'Create New Device' icon

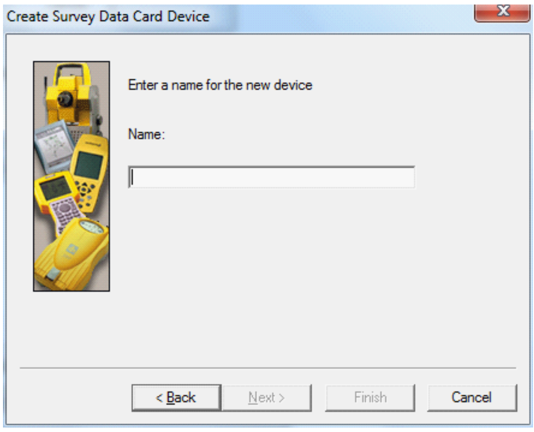


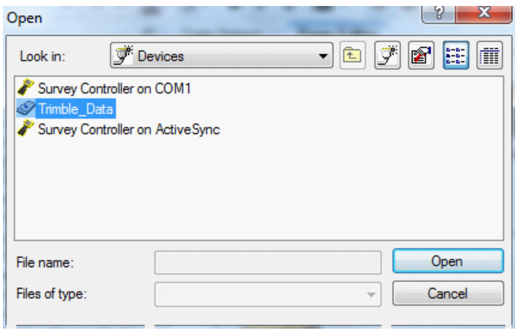
Create a Survey Data Card device for the folder containing your raw Trimble data.

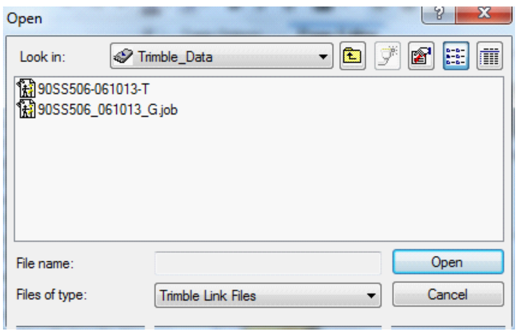




Select the device, select the job and press Open to begin downloading.

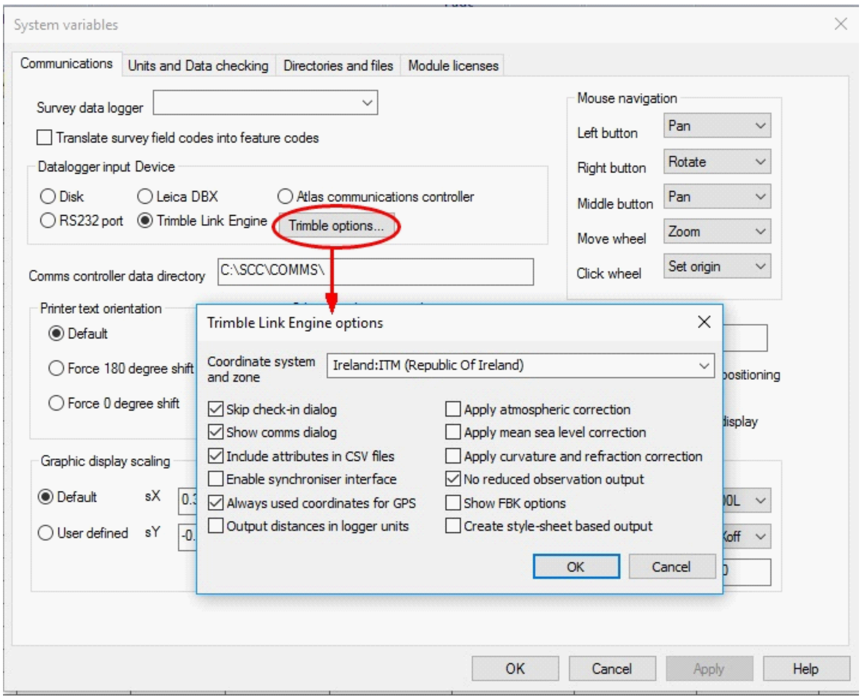






General SCC download steps can be implemented from this stage.

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.

3.3.3.3 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.

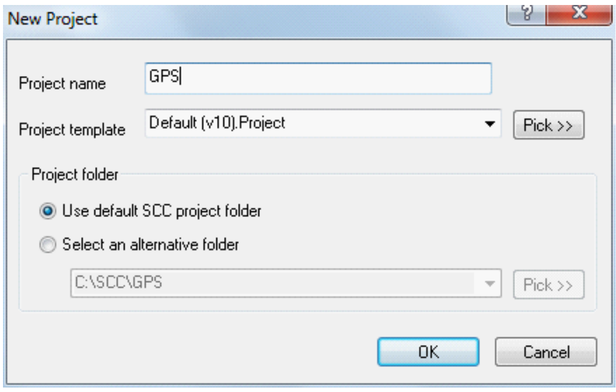
Setting up Project

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

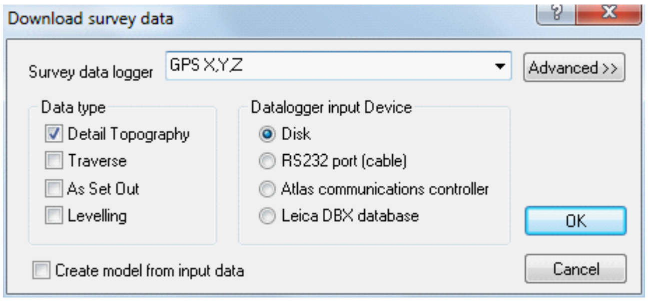
Downloading the sample detail file

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'

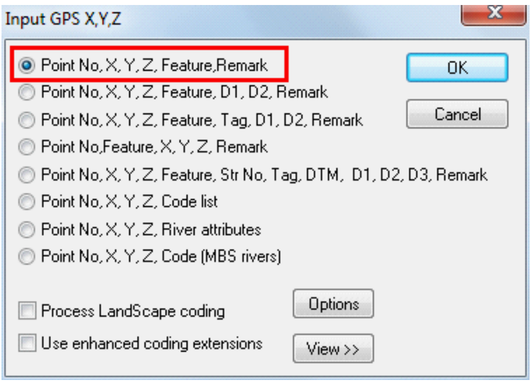
Select 'OK'



Select 'GPSTEST.txt'

Extract of 'GPSTEST.txt'

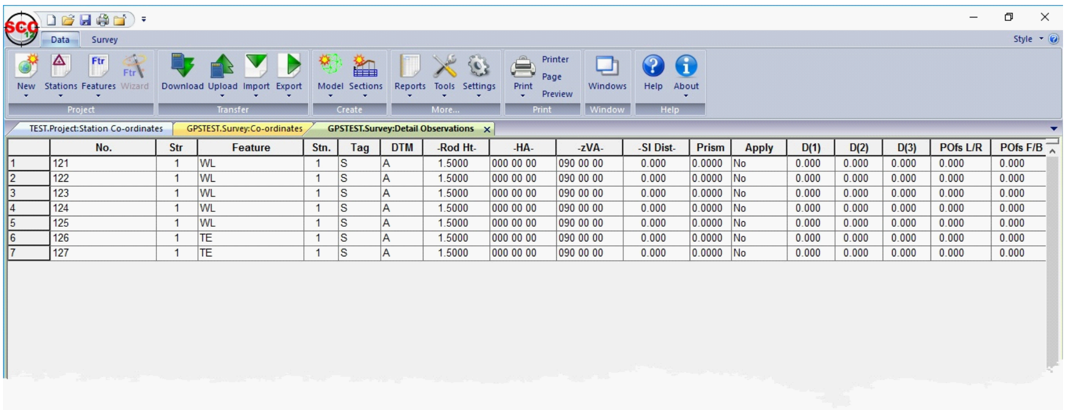
```
121,936.4463,1078.9469,42.5348,WL,BRICK
122,935.3751,1076.8353,42.6115,WL,BRICK
123,932.9097,1072.0190,42.5418,WL,BRICK
124,932.2931,1070.8306,42.6371,WL,BRICK
125,931.0534,1068.3674,42.5873,WL,BRICK
126,927.4137,1062.1438,42.5386,TE,OAK
127,925.6250,1059.3698,42.5524,TE,ASH
```

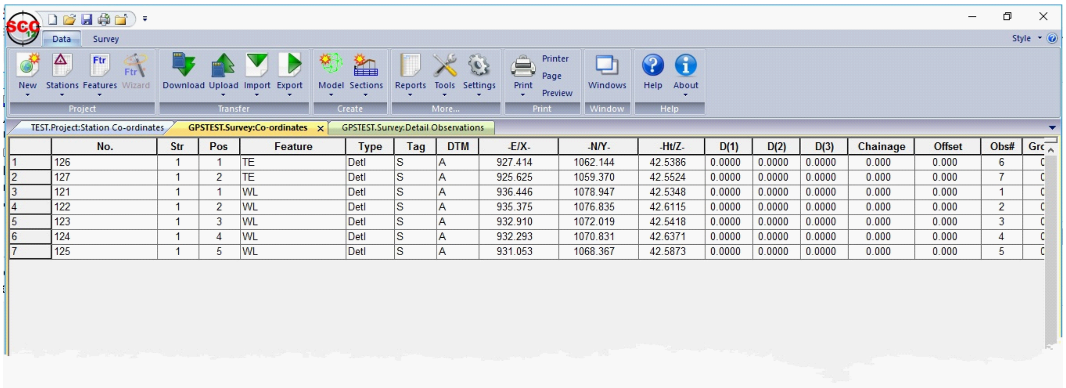


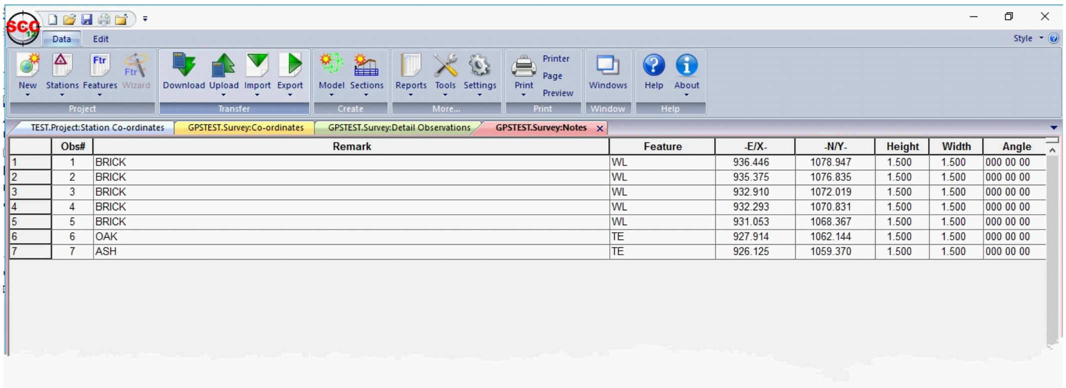
Select 'Point No., X, Y, Z, Feature, Remark

Select 'OK'

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





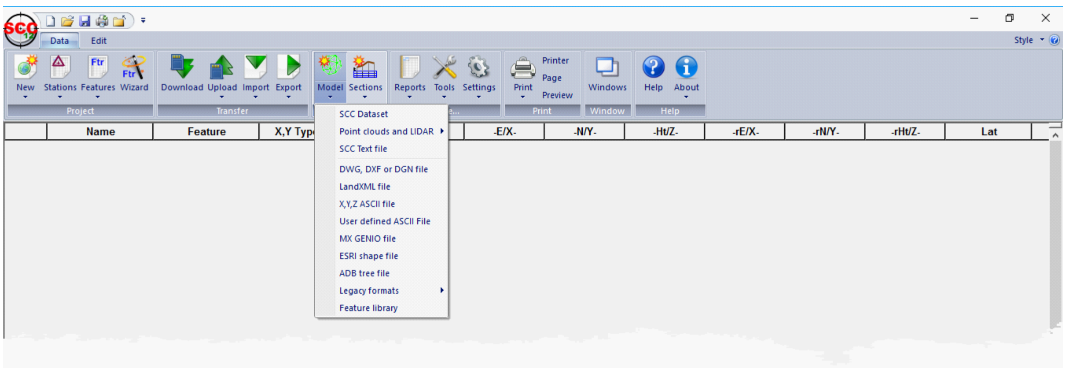


3.4 Creating A Model

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

3.4.1 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.



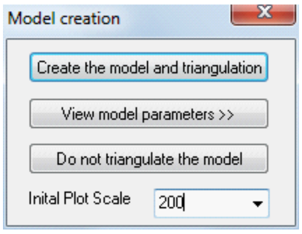
Before becoming a visual graphic representation, each model starts out as text in one form or another. The most common form of data files are SCC Datasets, DXF files, MX Genio and X,Y,Z ASCII files. These sources can be mixed and matched. SCC will keep track of where the data comes from. Your responsibility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

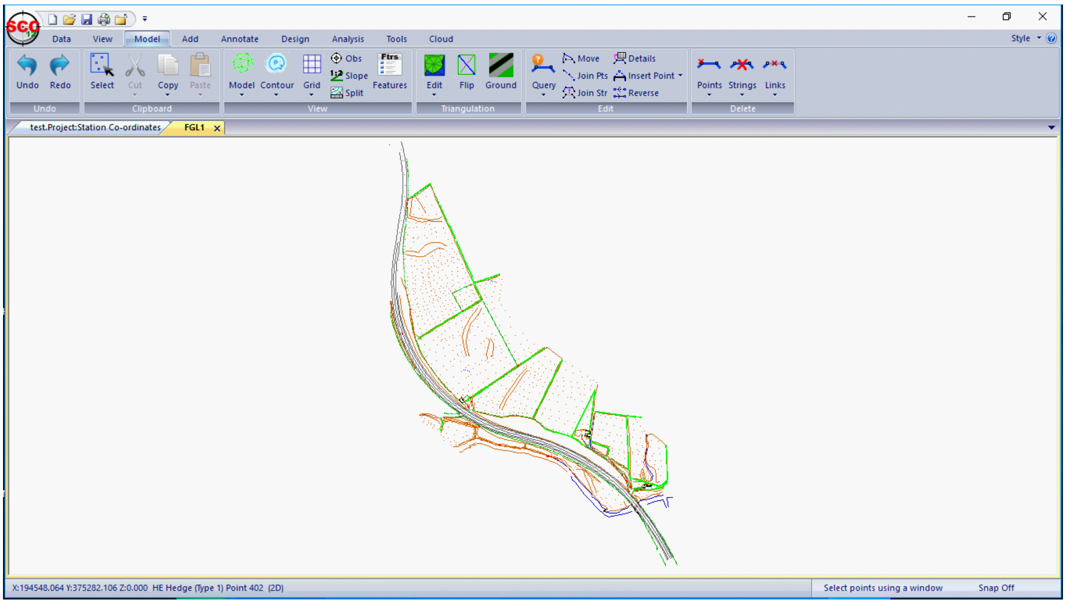
by holding down the CTRL key and picking 'FGL1.Survey', 'FGL2.Survey', 'FGL3.Survey' and 'FGL4.Survey' files

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



Select 'OK' to Attributes summary dialog

Your model should like the image below



3.4.2 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.

3.4.2.1 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'

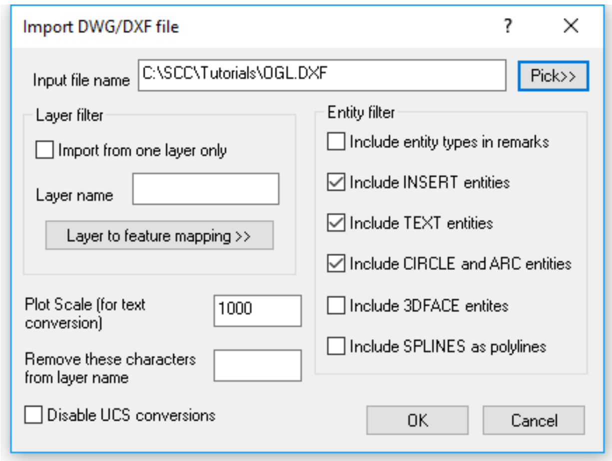
A dialog will be presented requiring the external file to be selected.

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.

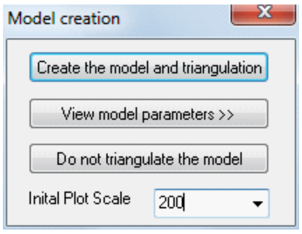
Select 'DATA tab > Model > DWG/DXF File'

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



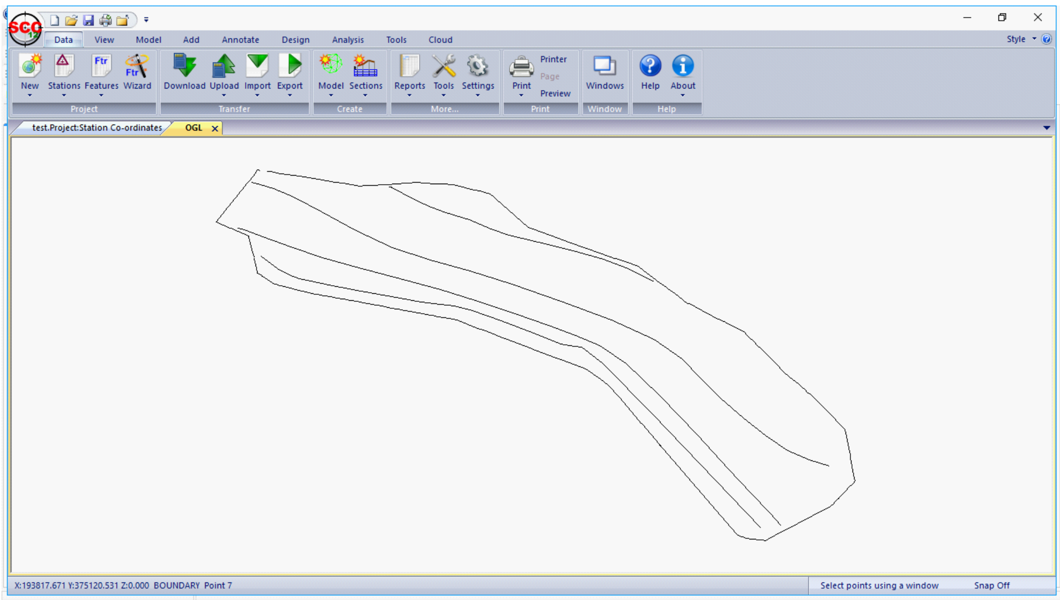
Select 'OK'

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:



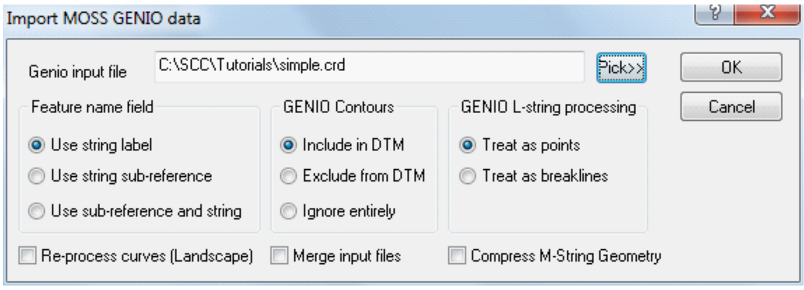
3.4.2.2 Modelling A GENIO File

The following examines the direct modelling of a GENIO file

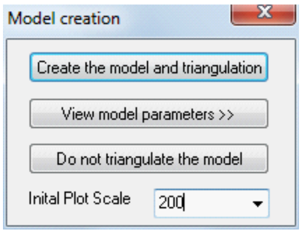
Go to 'DATA tab > Model drop down> MX GENIO file'.

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'.

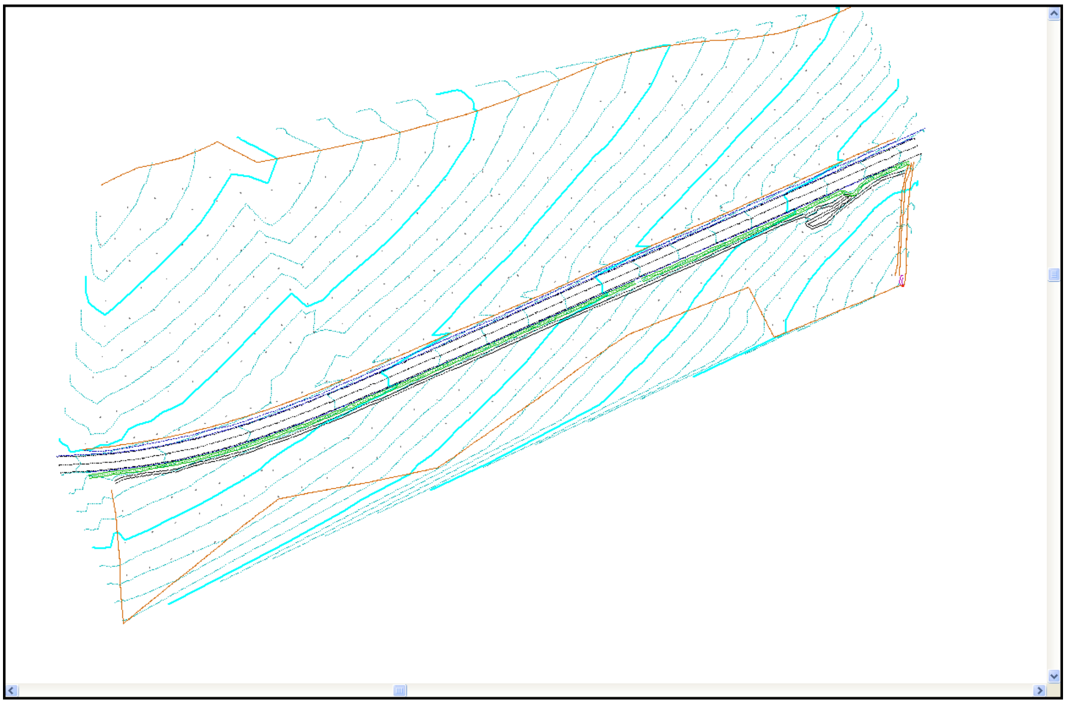


Select 'OK'



Set the Initial Plot Scale as '200'

Select 'Create the model and triangulation'



Go to 'SCC button > Save'

Save the model as 'Ground.Model'

3.5 Editing A Model

The following outlines the tools to edit a model.

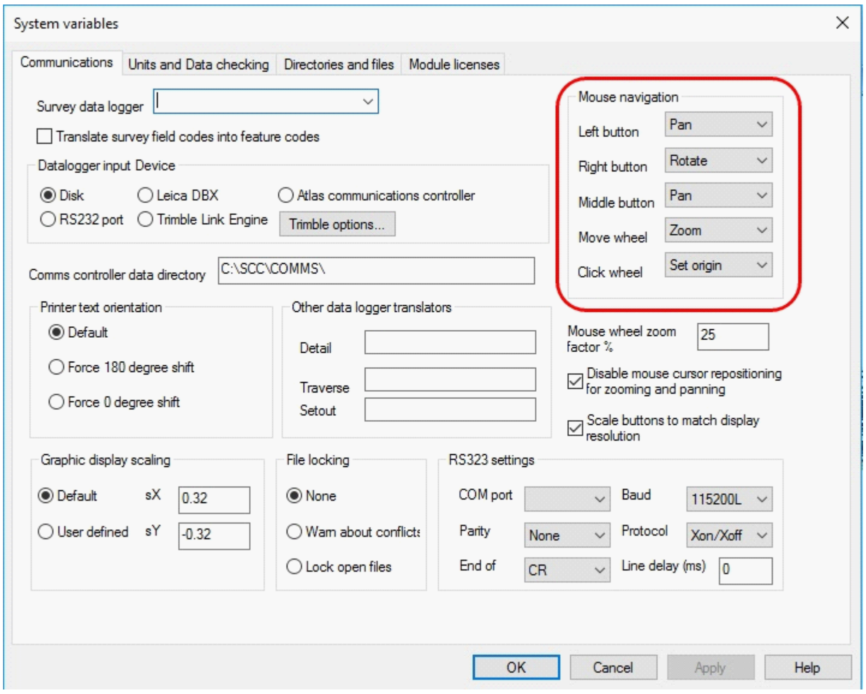
3.5.1 Model Navigation & Shortcuts

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:

Esc	Quits any of the interactive editing options
Home	Zoom Extents
End	Zoom Previous

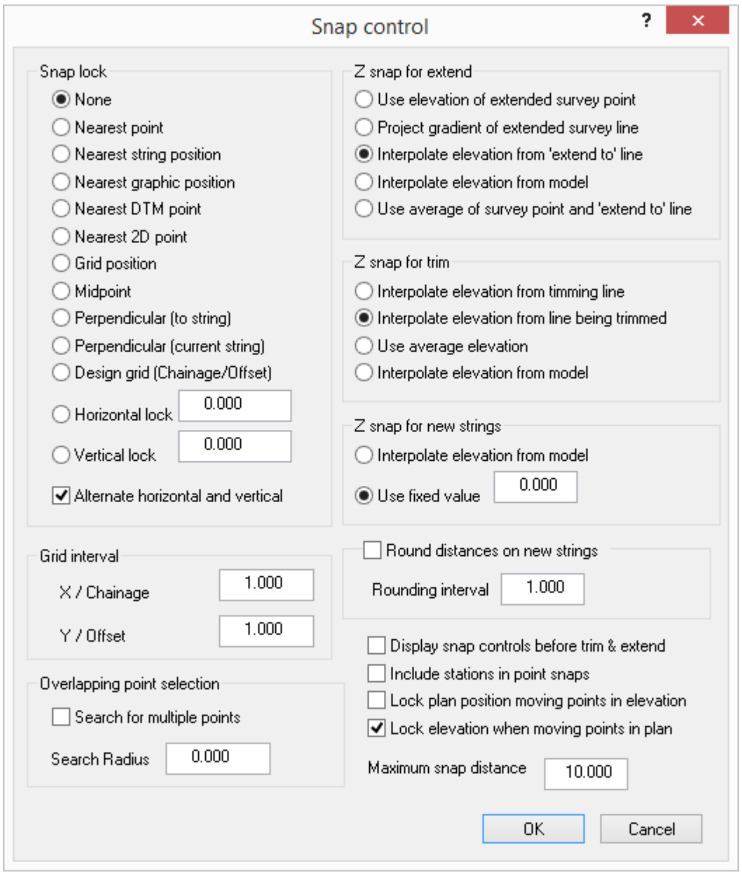
Page Up	Zoom Out
Page Down	Zoom In
Space Bar	Zoom Centre (Pan)
TAB	Pan to the next crossing breakline, next duplicate point, or next potential model error. This option will only pan to crossing breaklines and / or duplicate points if they are currently being displayed. This is controlled using `View / 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.
F2	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.
s	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).
n	Pressing ‘n’ turns snap lock off.
g	Pressing ‘g’ enables snap to grid mode.
m	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.
****	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.
H or V	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.
O	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.
Q	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 from a quadrilateral.
L	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:

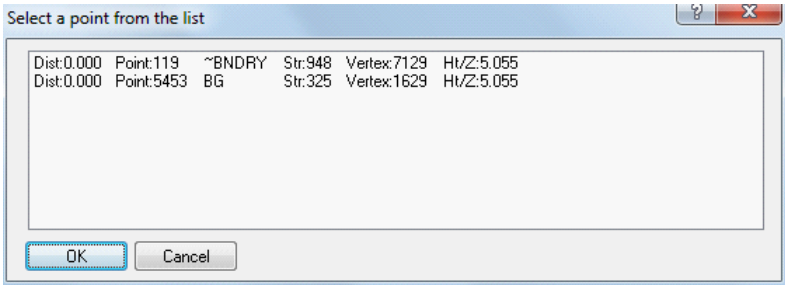


This dialog allows you to force the cursor to always lock onto a specific point or grid co-ordinate while editing the model. It is particularly useful when positioning points exactly on top of survey points, for example, when generating a boundary string.

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

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.

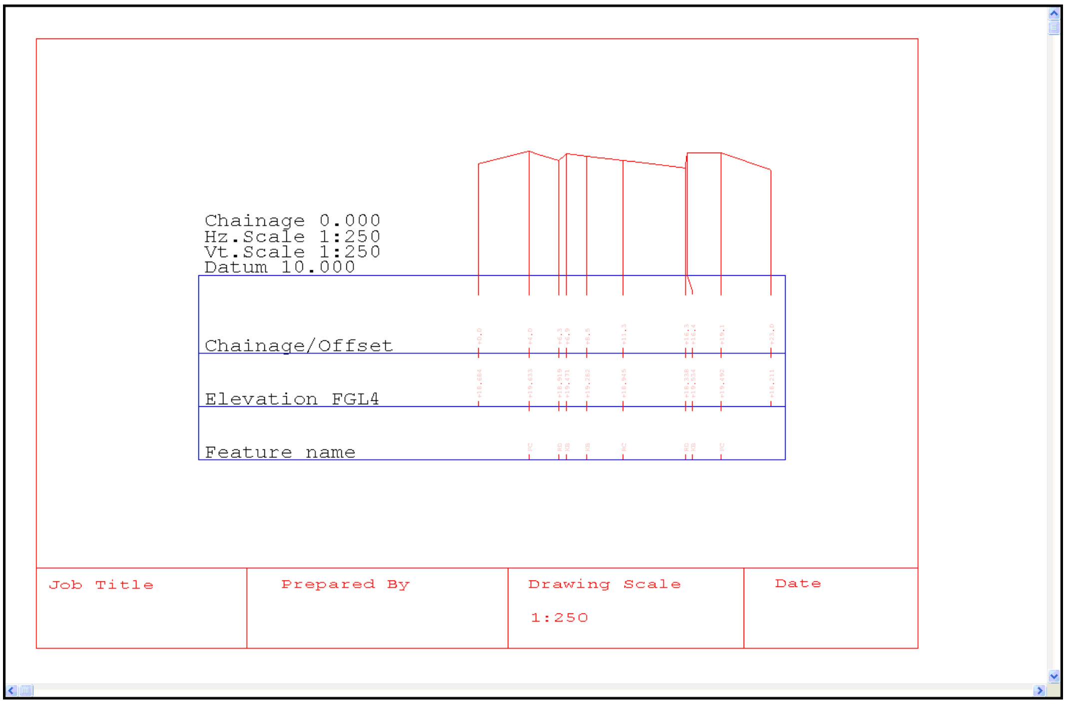
String editing allows you to identify string lines in the model. Field errors relating to connectivity can be edited here.

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

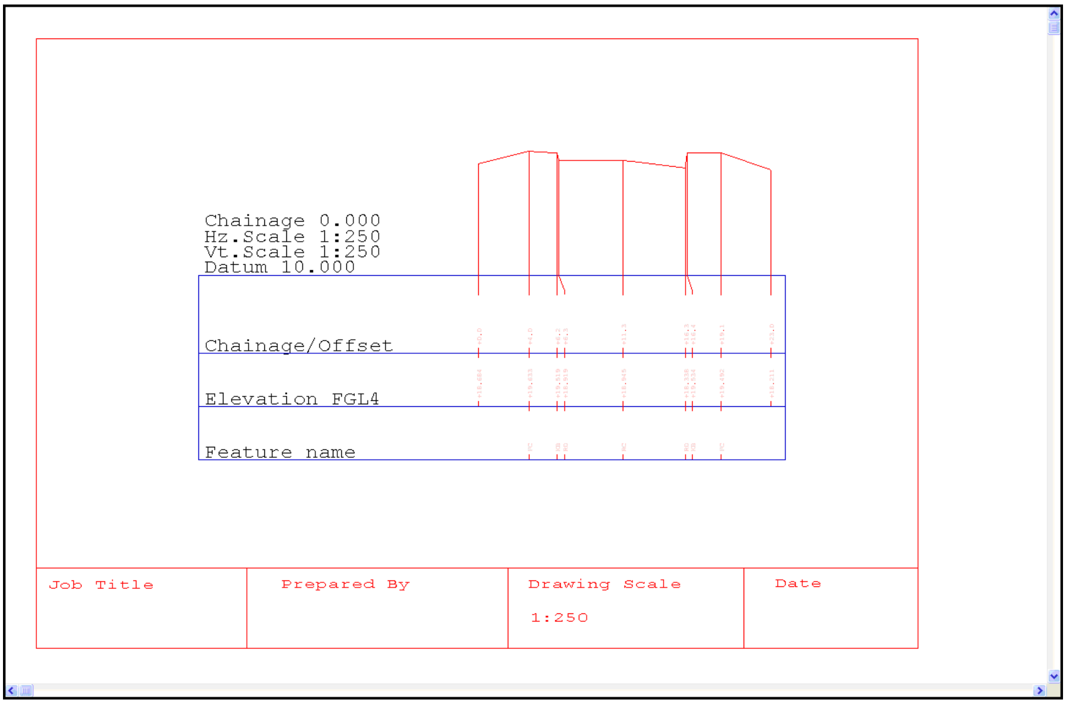
3.5.2 Probable Modelling Errors

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.



3.5.3 Correcting Survey Errors

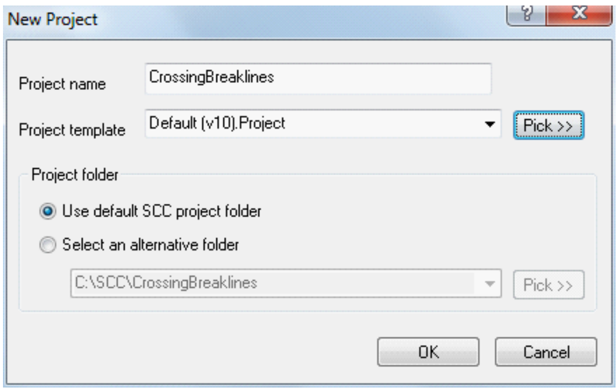
In a model the most easily recognisable survey errors are crossing breaklines. Crossing breaklines are identified by the Breakline Intersection Point (~BRK_INT) feature. This is a standard SCC feature. The symbol for this feature is a red X. Look around this model there a few red Xs. When editing the 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.

3.5.3.1 Determining The Height Value of Crossing Breakline

New Project

Go to 'DATA tab > New'

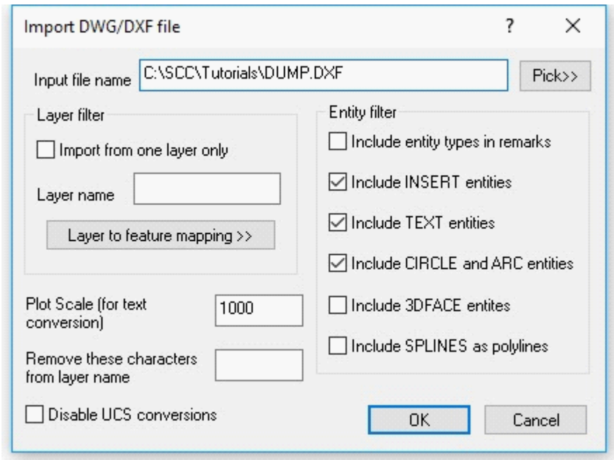
Enter Project Name 'Crossing Breaklines' and attach Project Template 'Default (v10).Project'



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

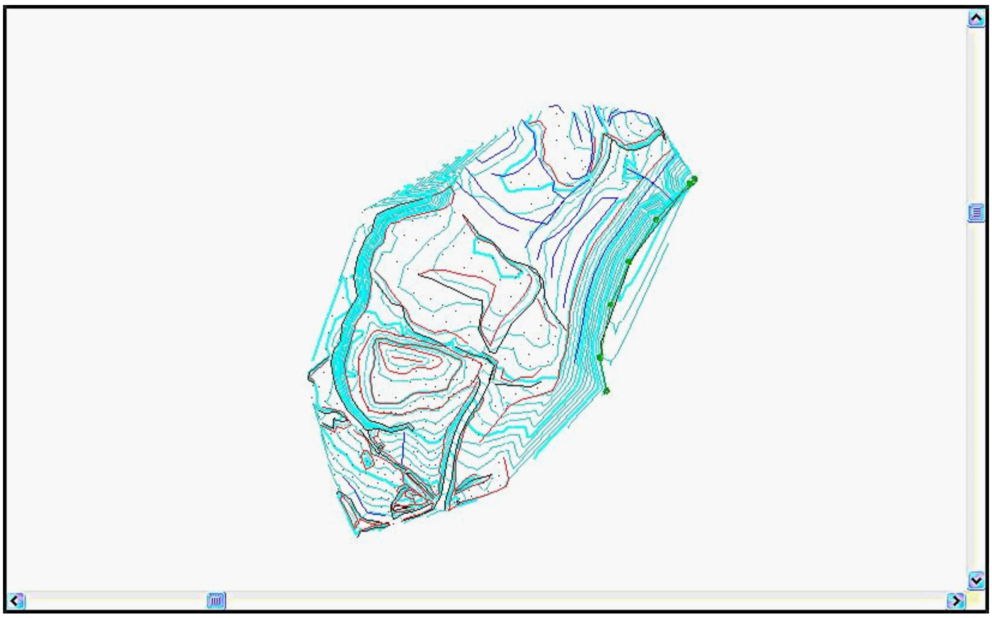


Select 'OK'

Select Initial Plot Scale of 250

Select 'Create the model and triangulation'

Select 'Ok' to Model Attributes dialog



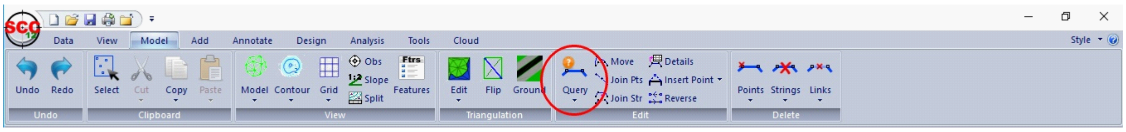
Zoom in and then select 'VIEW tab > Position button' and enter 1878.360, 3275.959'

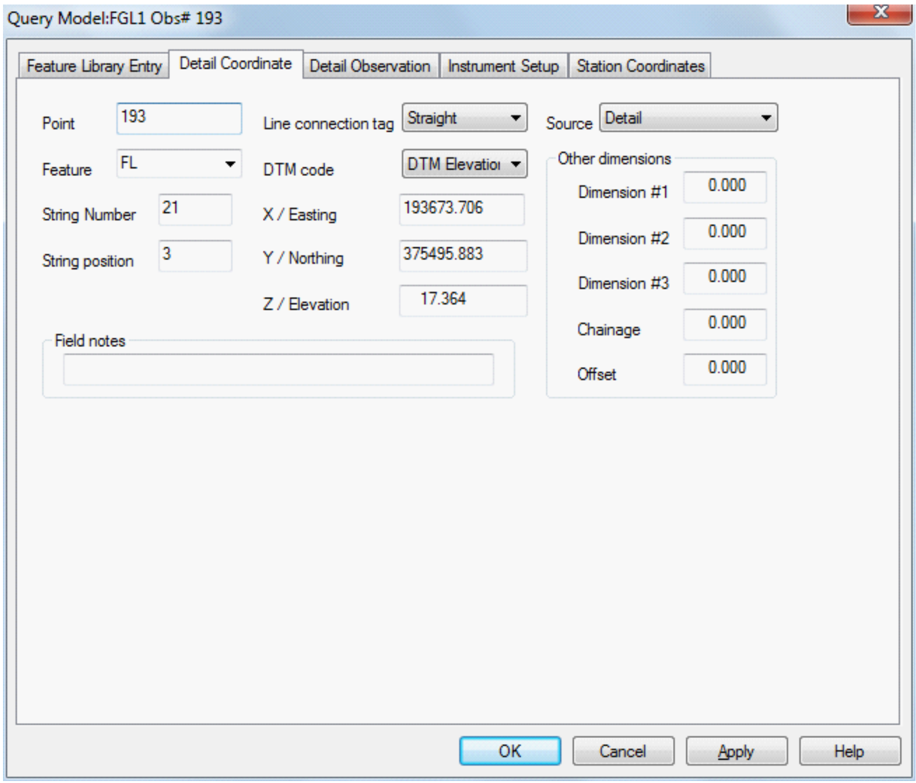
Note the drainage line running perpendicular to the top and bottom of bank. Where the drainage lines meets the bank a crossing breakline symbol is generated. What we are going to do is insert a point onto both strings at each point where they cross. The height of the new points will be taken from the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

3.5.4 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.

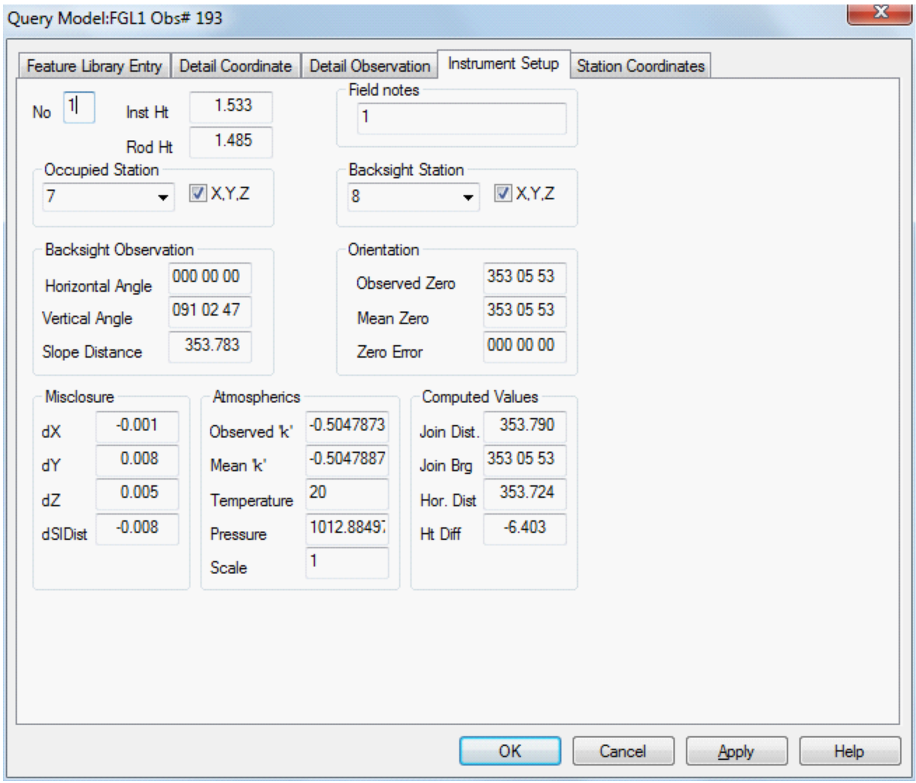
The other four tabs are extracts from the survey file or SCC dataset used to create the model. The Detail Co-ordinate and Detail Observation tabs are nearly identical. The main difference relates to which dataset is being changed.

- 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.



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.

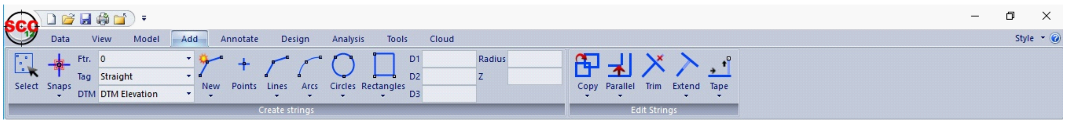
Editing models with the 'Query and Edit Points' option will undo any local string editing carried out on your model for the queried dataset. For this reason, it is advisable to do any query based editing prior to carrying out interactive string editing.

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

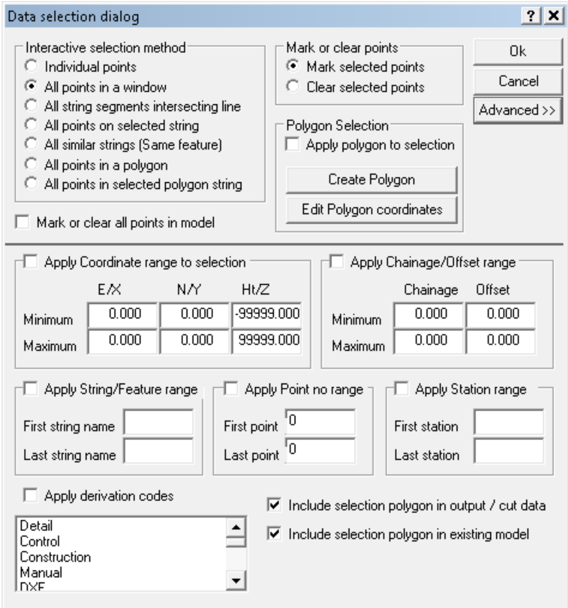
3.5.5 String Editing

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'

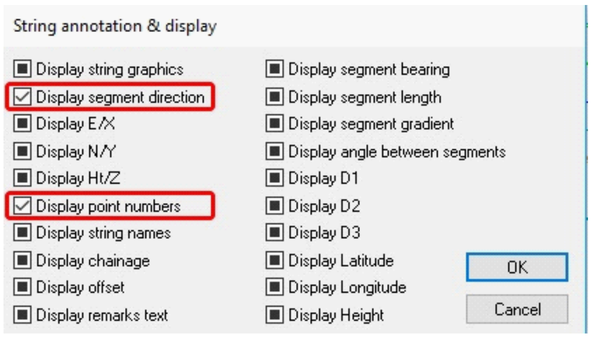
Select 'Mark selected points'

Press 'OK'

Pick the string you wish to annotate

Go to the 'ANNOTATION tab > Annotate points'

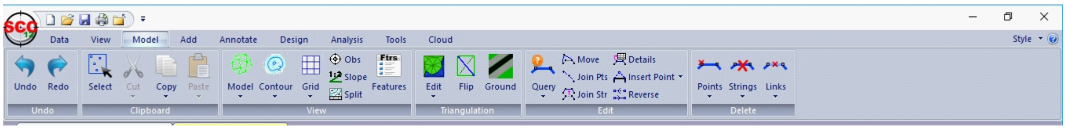
Turn on 'Display point numbers' and 'Display segment direction'



'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.



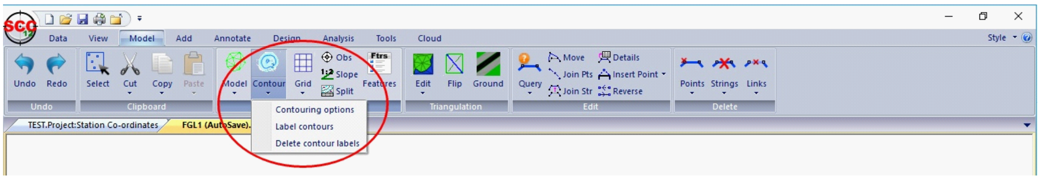
3.5.6 Survey Error Detection & Correction

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'

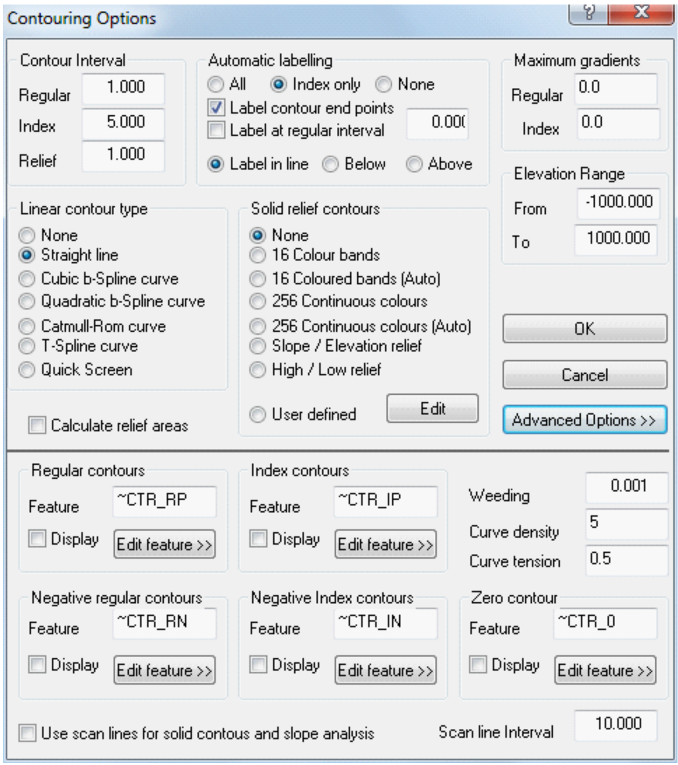


Change the Regular Contour Interval to 0.5 and the Index to 2.0.

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.



3.5.7 Using SCC Editing Facilities to Rectify Survey Errors

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

3.5.7.1 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.

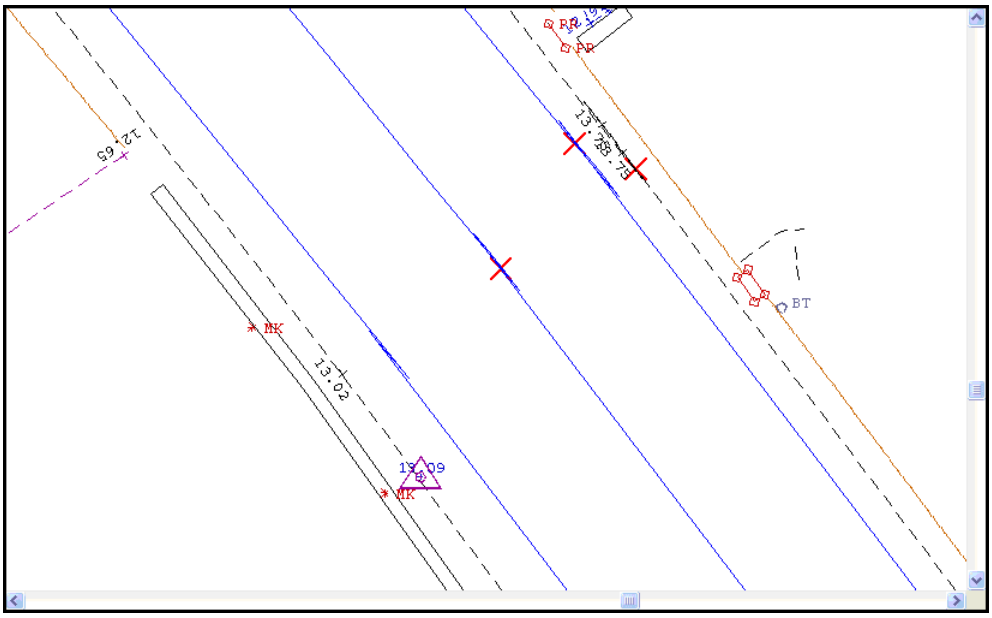
We want to delete the short intersecting lines. Select these lines by drawing a polygon around them. All points along these short lines will be selected as shown in the picture below. When the option to delete points is selected a dialog will be presented as to whether or not you want to delete the selected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



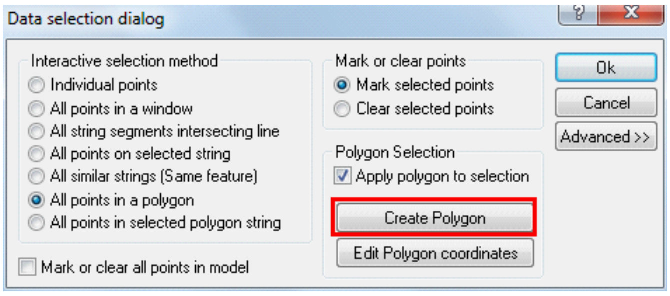
You will see that there are four short lines running in the direction of the road. It seems that the surveyor began surveying the road with these short lines, but they were never used to finish it. The road was surveyed using different strings. It may have been surveyed on a different day and/or by a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

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

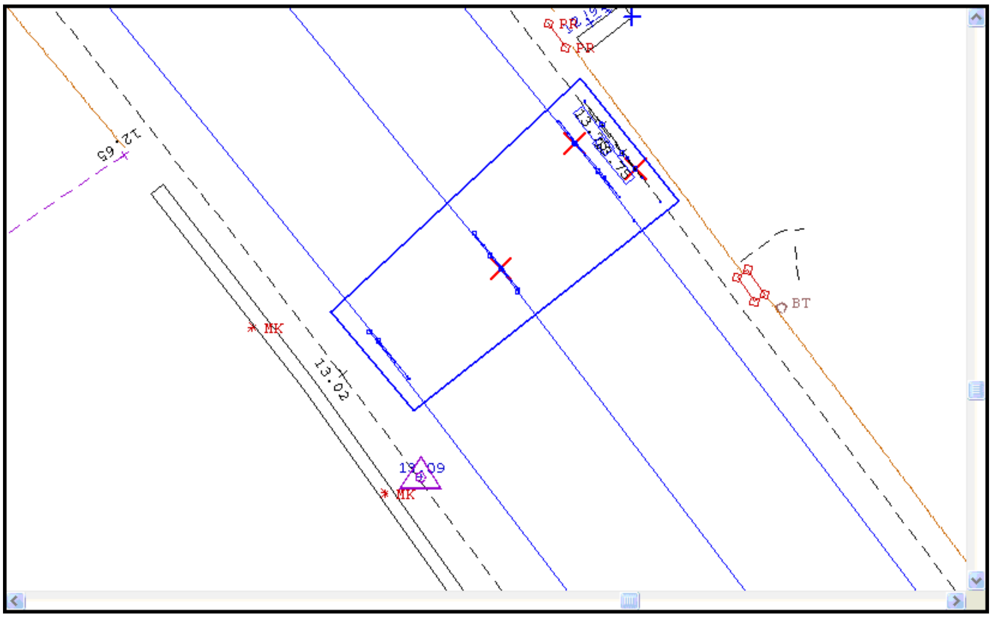
Select 'Create A Polygon'

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.



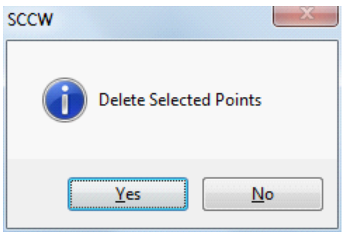
Draw a polygon around the four short lines by right clicking mouse to form 3 sides of the polygon and left clicking mouse button to close the polygon. All points along these short lines will be selected.

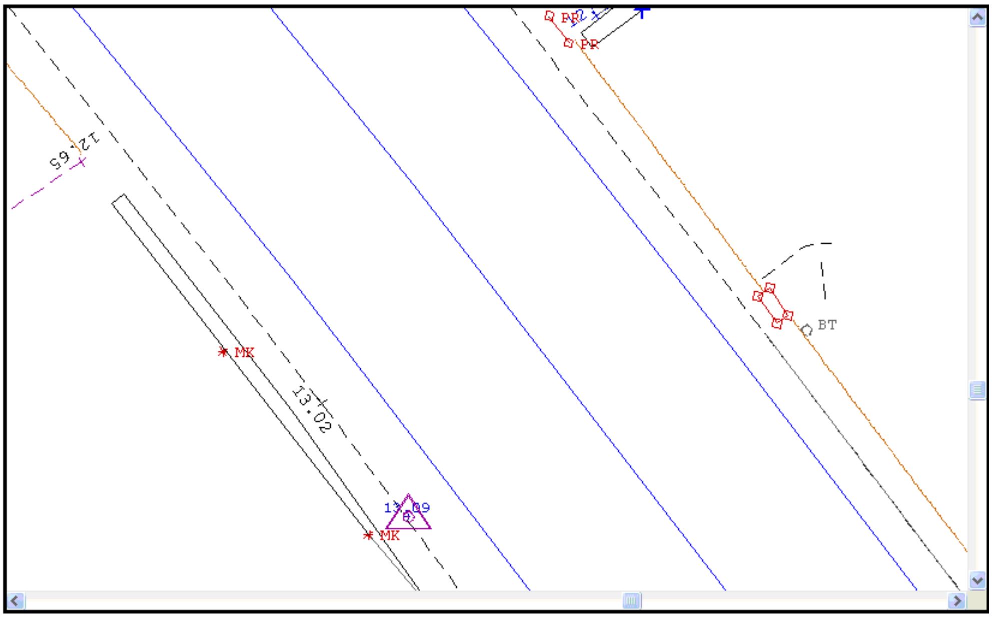


Delete Points and Strings

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

Select 'Yes' to 'Delete Selected Points'



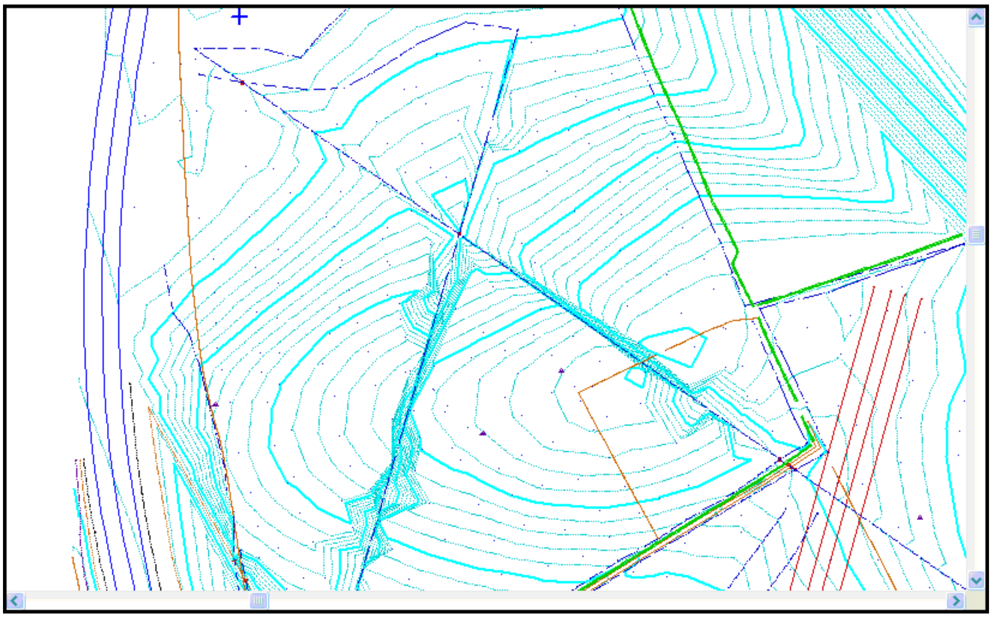


If you delete information that you do not intend to delete, or perform any other editing operation that has undesired results, select the 'Undo' option from the edit menu or press Ctrl-Z

3.5.7.2 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.

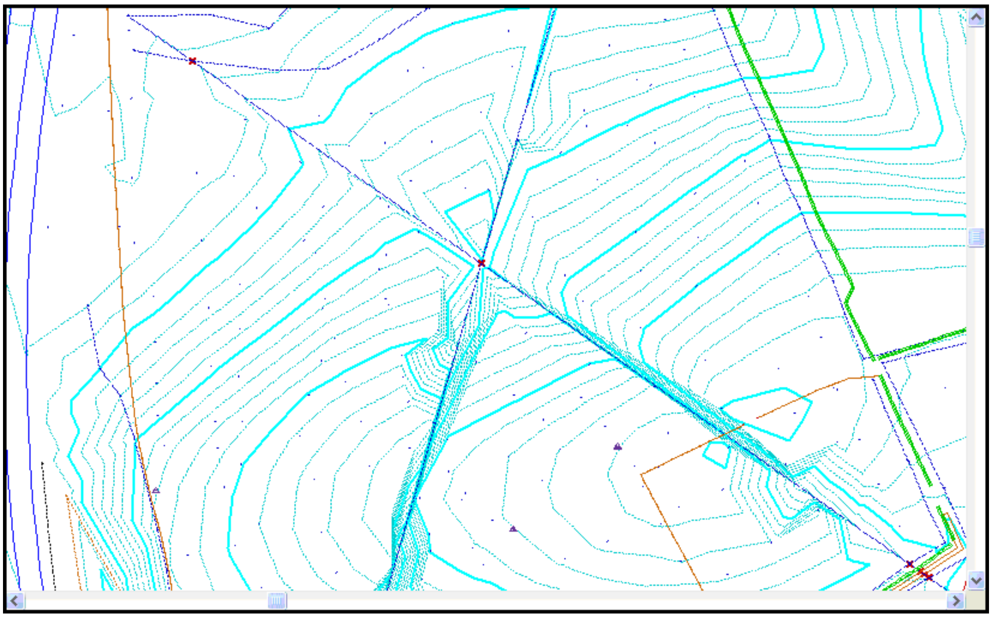


As you move the cursor on screen you will see a thick blue line that you can align to potentially unwanted string links. When this line lands on the correct link, press the left mouse button and the link will be removed. Alternatively you can use the 'Individual Points' options from the data selection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

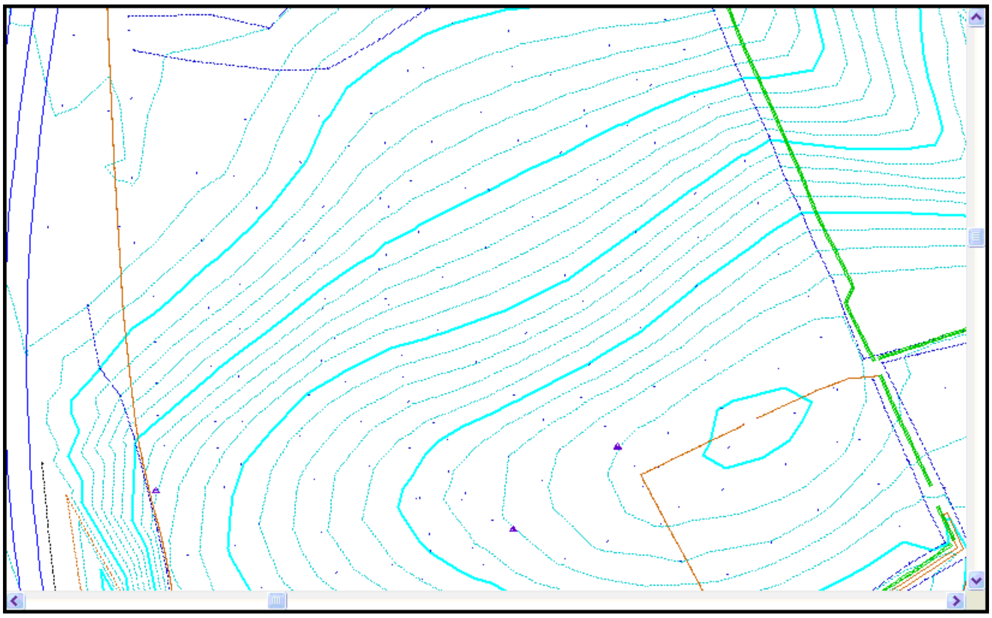


Go to 'MODEL tab > Links button'.

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.

3.5.7.3 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

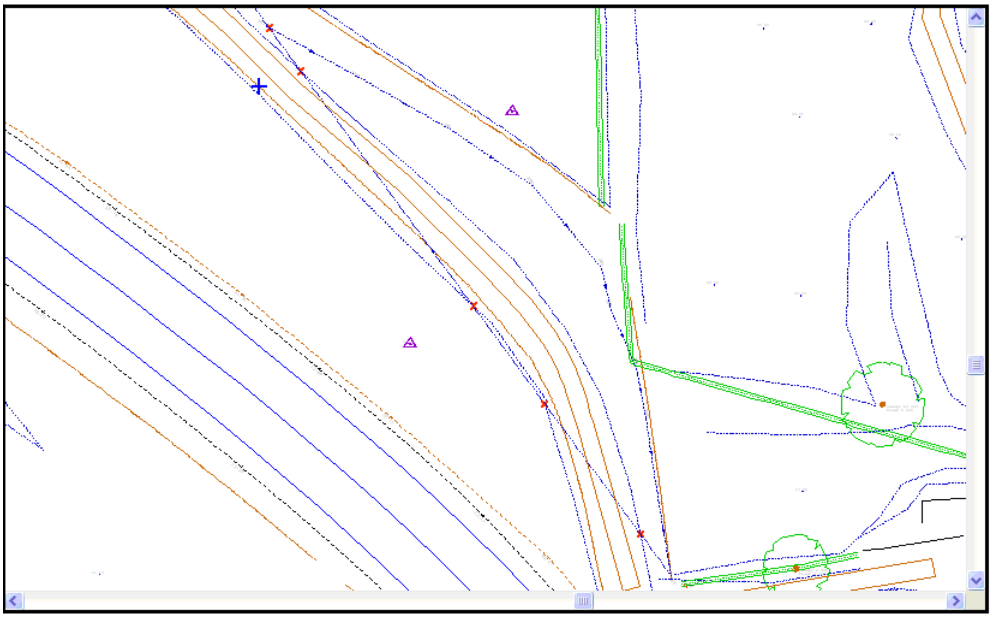
Go to ‘MODEL tab > Links button > Delete Partial'

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.

3.5.7.4 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.

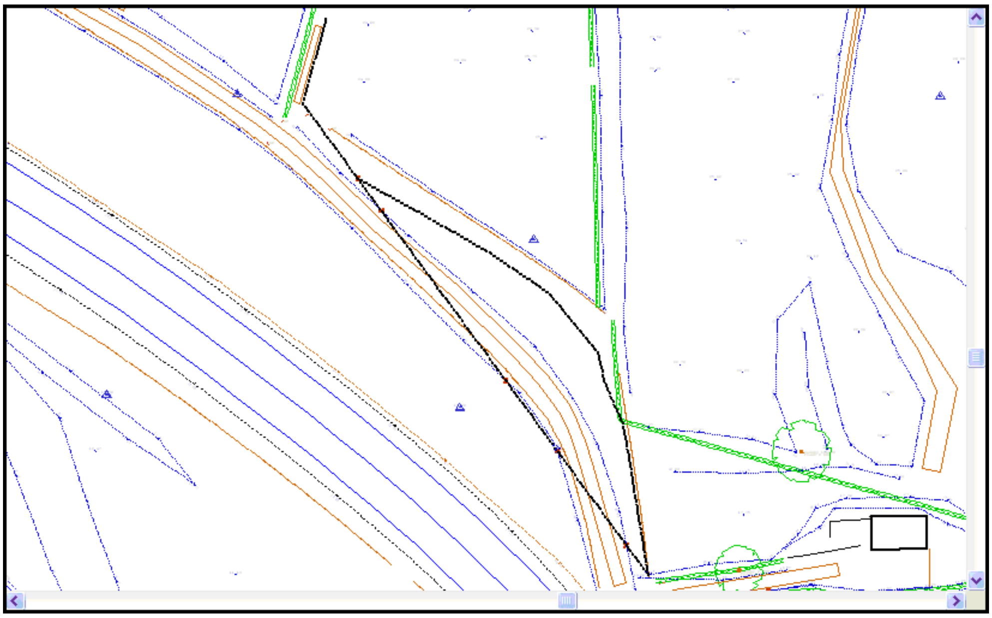


It appears to be an unwanted string link but we will do some more investigation to be sure.

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.

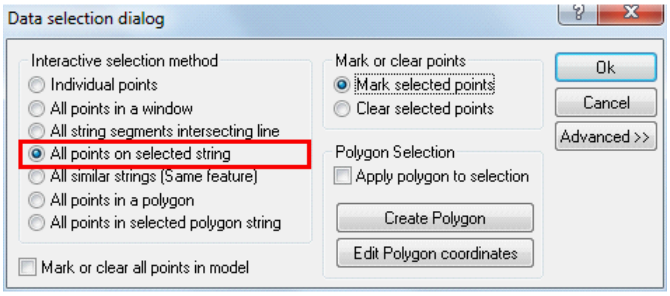
Zoom into an area at the bottom of the model where the end of one string seems to be joined to the beginning of another.

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



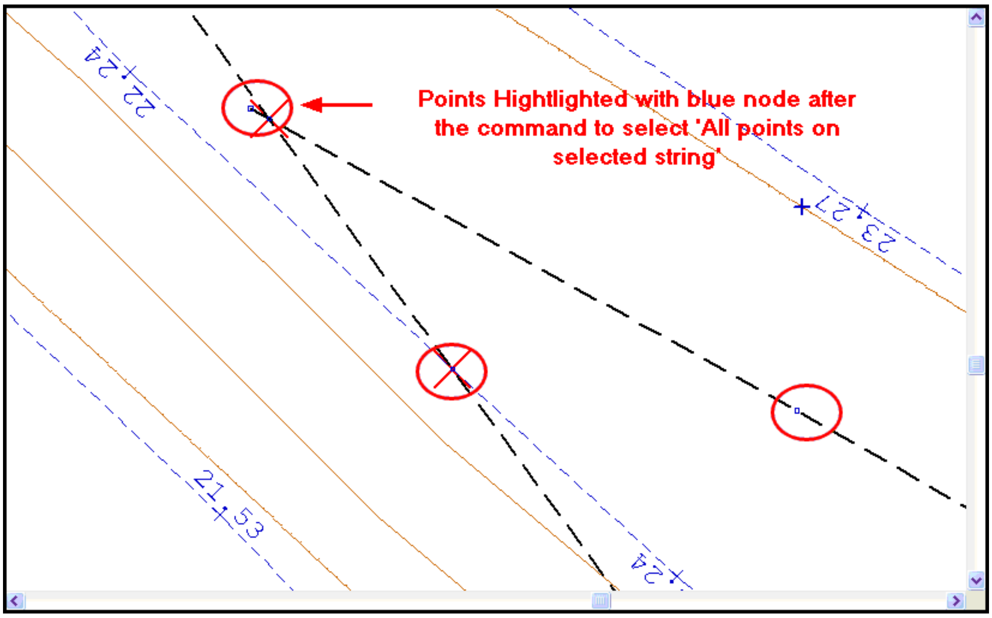
Note: The string of interest has been highlighted in the diagram.

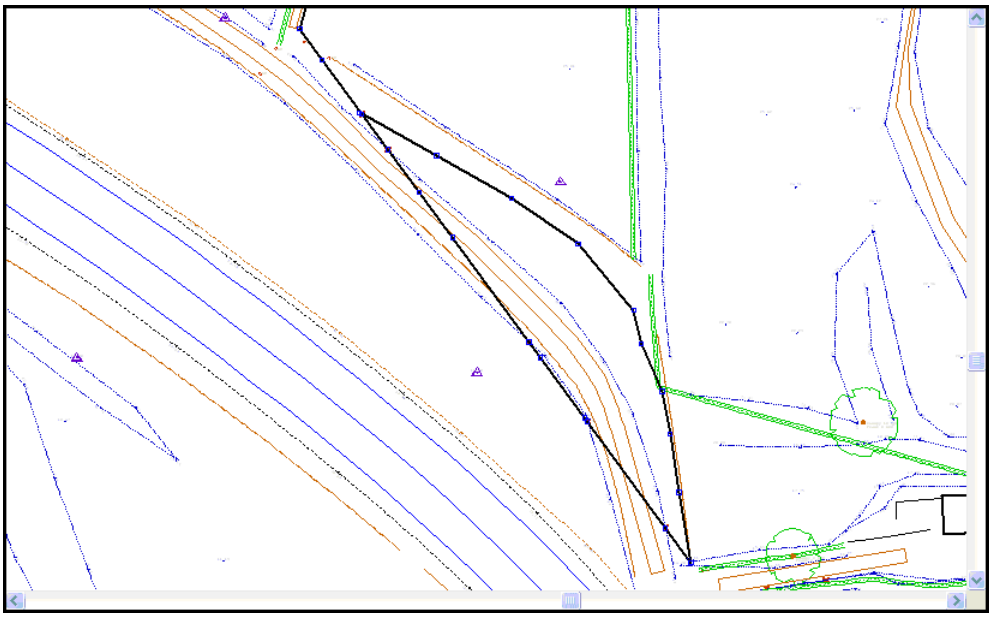
Left click mouse to bring up 'Data Selection Dialog'.



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

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

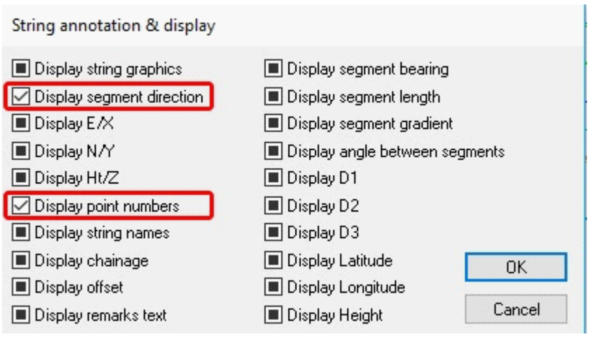




Display Point Numbers & Segment Direction

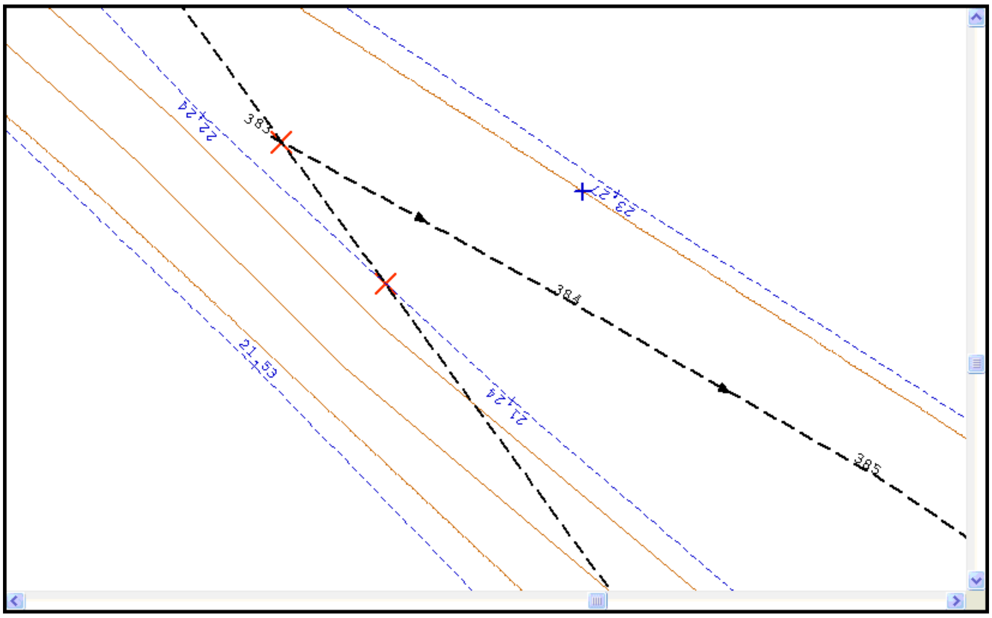
Go to the 'ANNOTATION tab > Annotate points'

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



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'



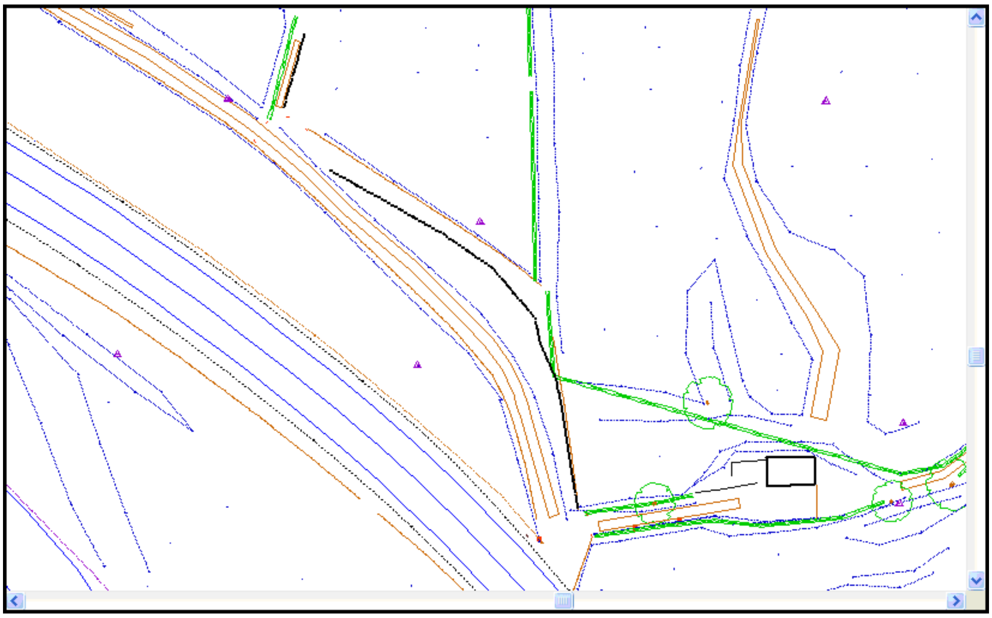
You will notice one long segment going from point number 392 to 397 over which all the crossing breaklines lie. If this segment is deleted or removed then there will be no crossing breaklines.

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'

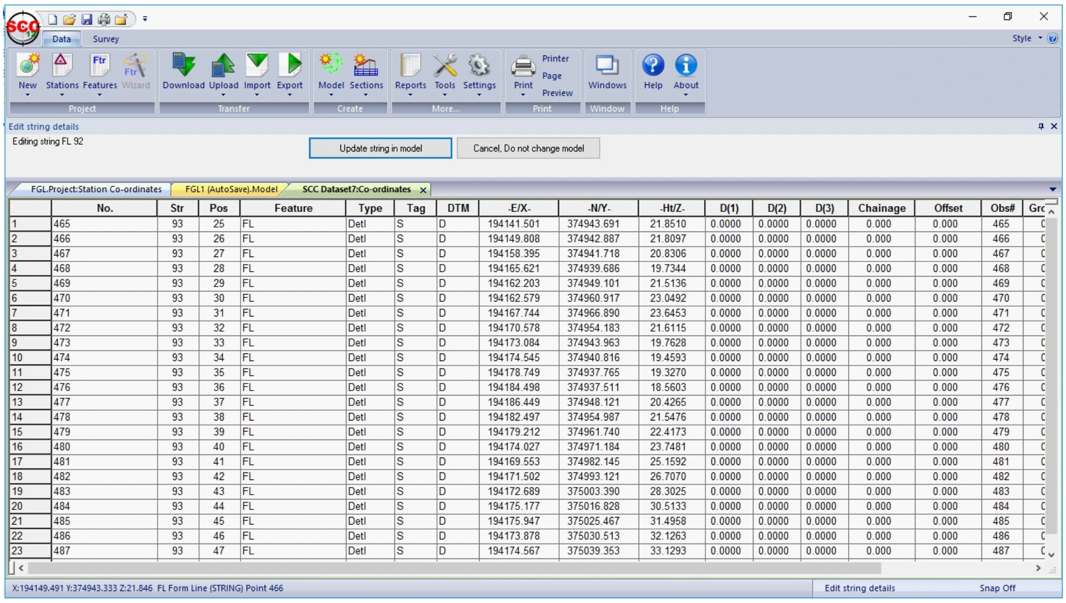
Select 'Update string in model'



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.

3.5.7.5 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.



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.

3.5.7.6 Moving Points On A String

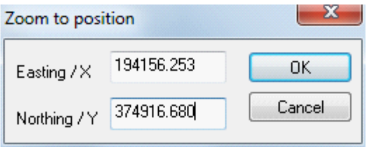
We are now going to look at a crossing breakline problem caused by two strings overlapping. Using the 'Move Points' option best solves this type of problem. First go to the area of interest.

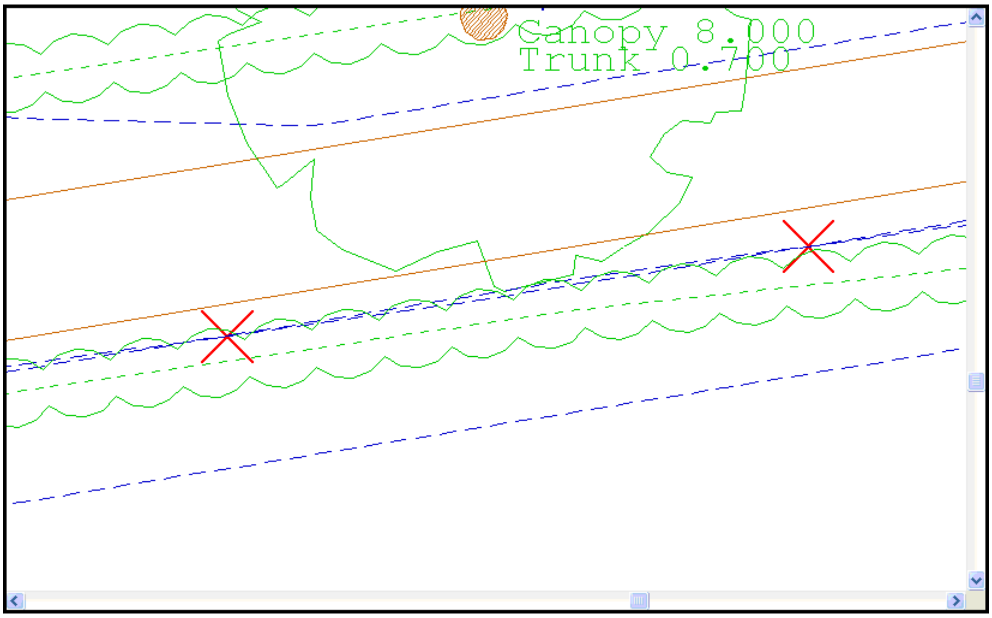
Zooming to specific coordinates

Press 'Page Down' to zoom in quite close

Select 'VIEW tab > Position button'

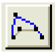
On the dialog, enter coordinates of 194156.253, 374916.680





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.

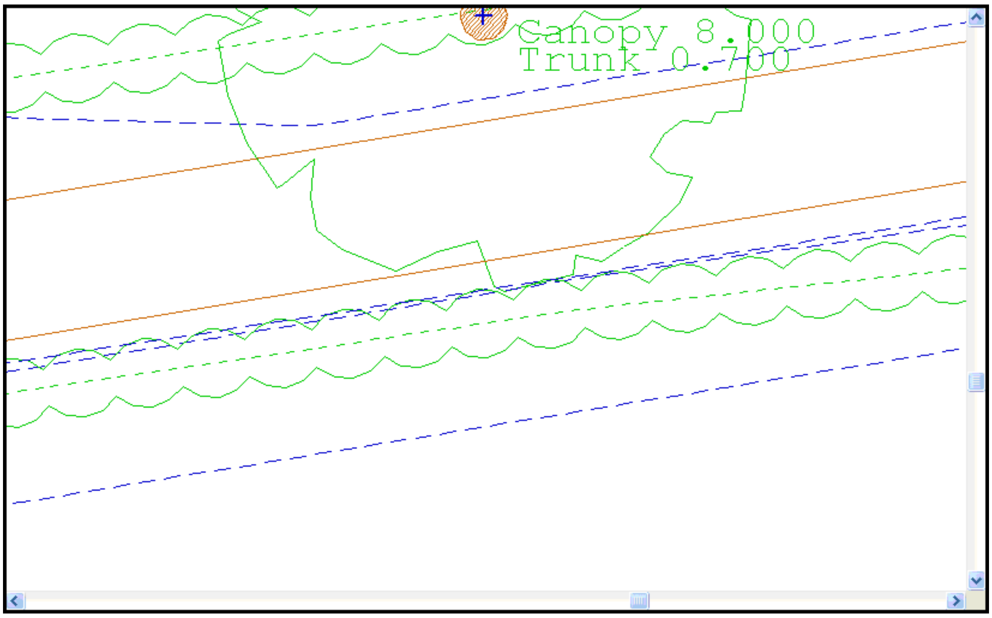
Moving Point

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.

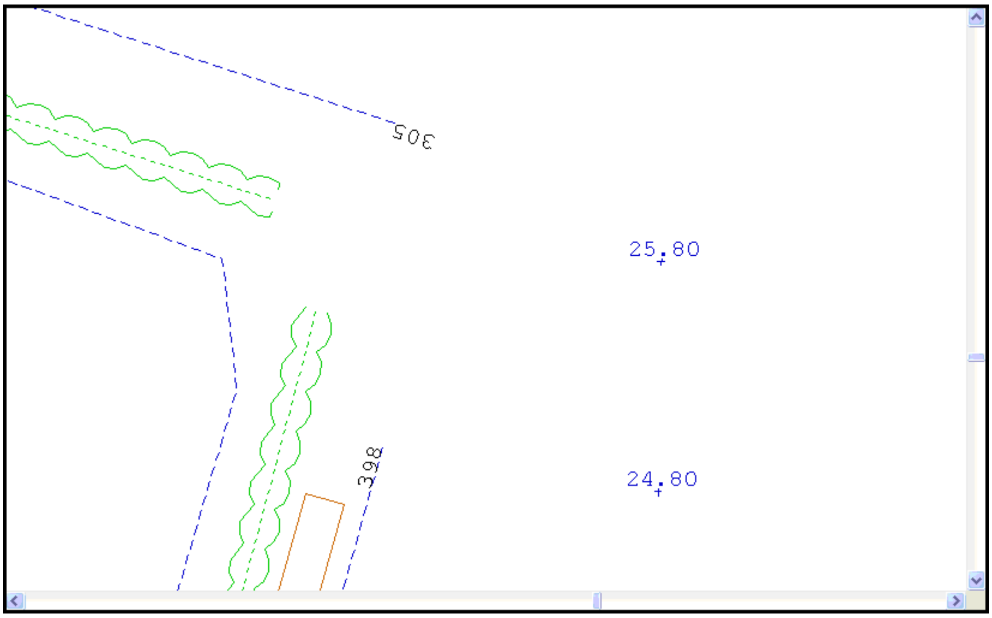
Below is the result of using the ‘move’ option.

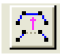


3.5.7.7 Extending Strings To Intersect

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 Stri' 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.

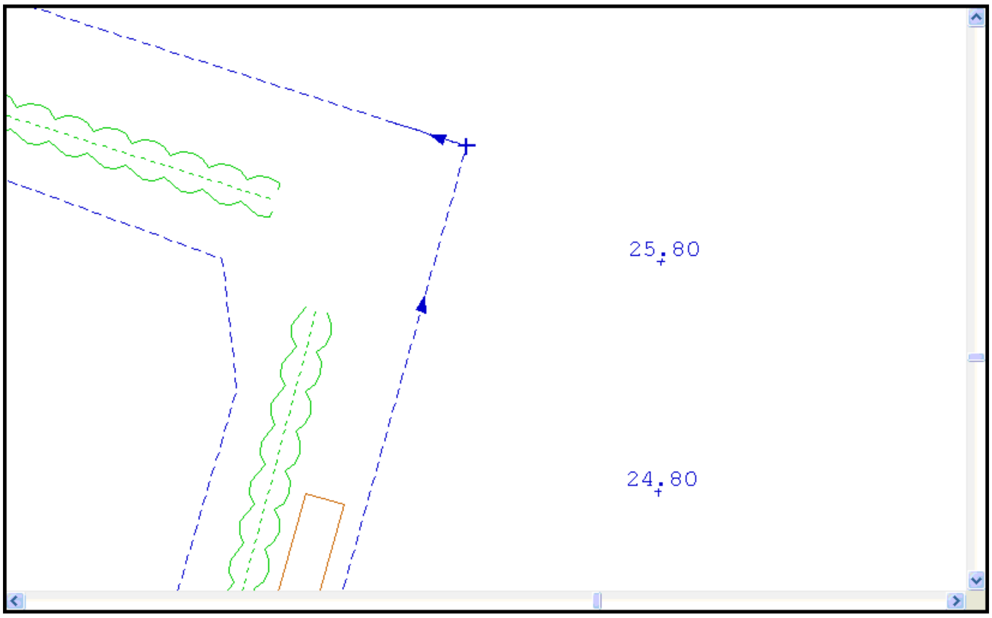
Select the 'Extend to Intersect' option and press the left button first on point 398 and then on point 305 to join up the outer fence string.

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



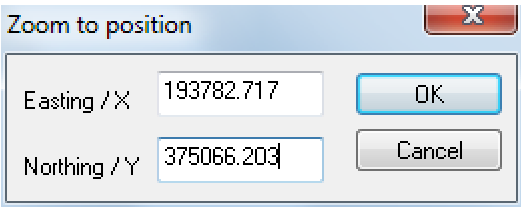
3.5.7.8 Trim Lines

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

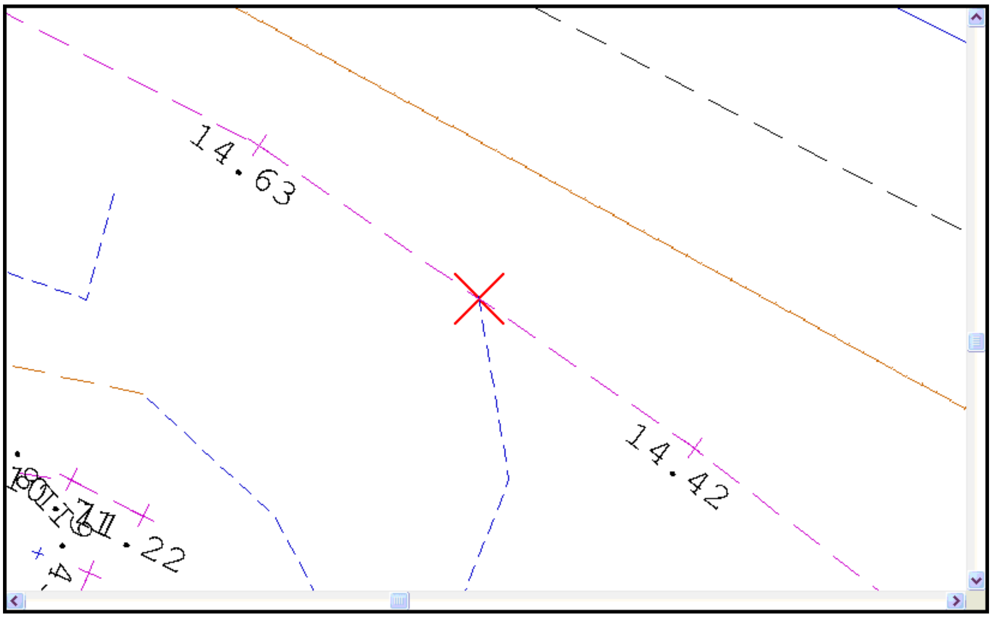
Trim A Line

Select ‘VIEW>Position’

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



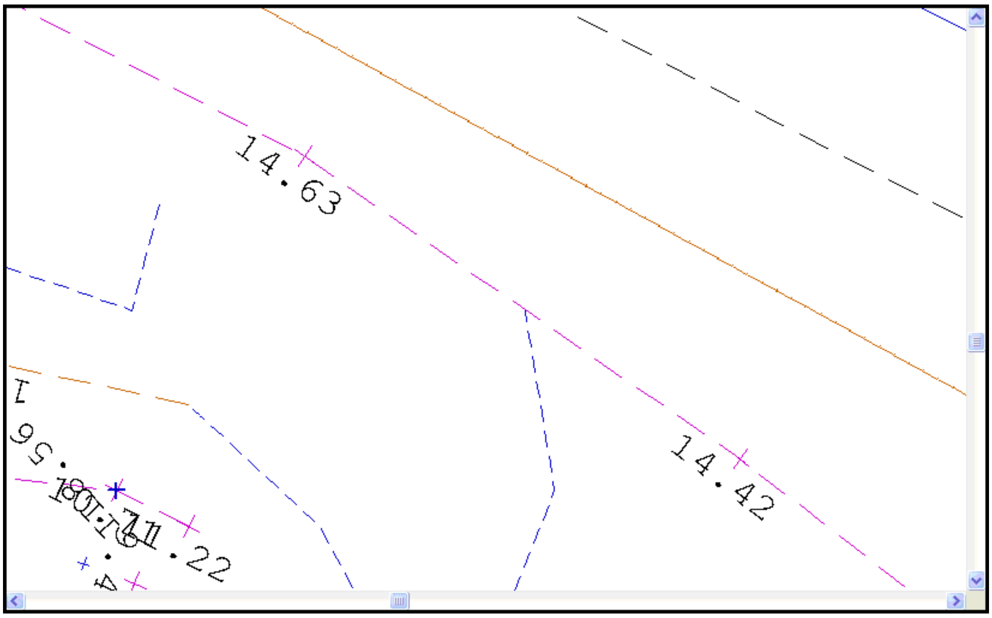
Select 'Ok'



Go to ‘ADD tab > Trim button’ or 

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

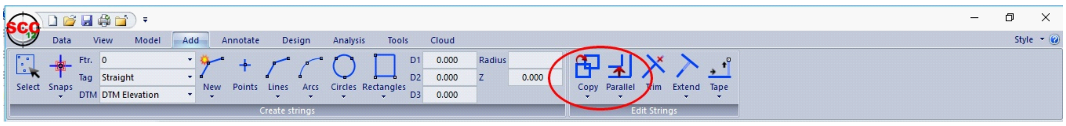
Select 'FL', as string to trim



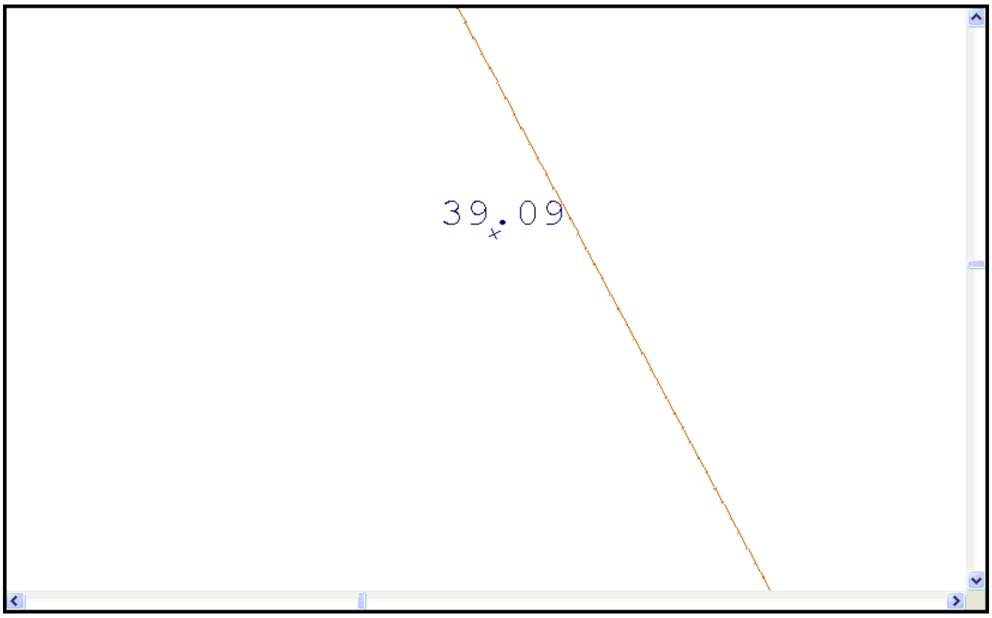
Press 'ESC' quit this command

3.5.7.9 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.

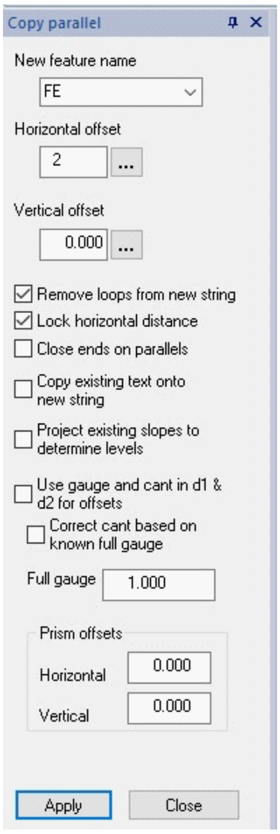


Copy A String Parallel

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.

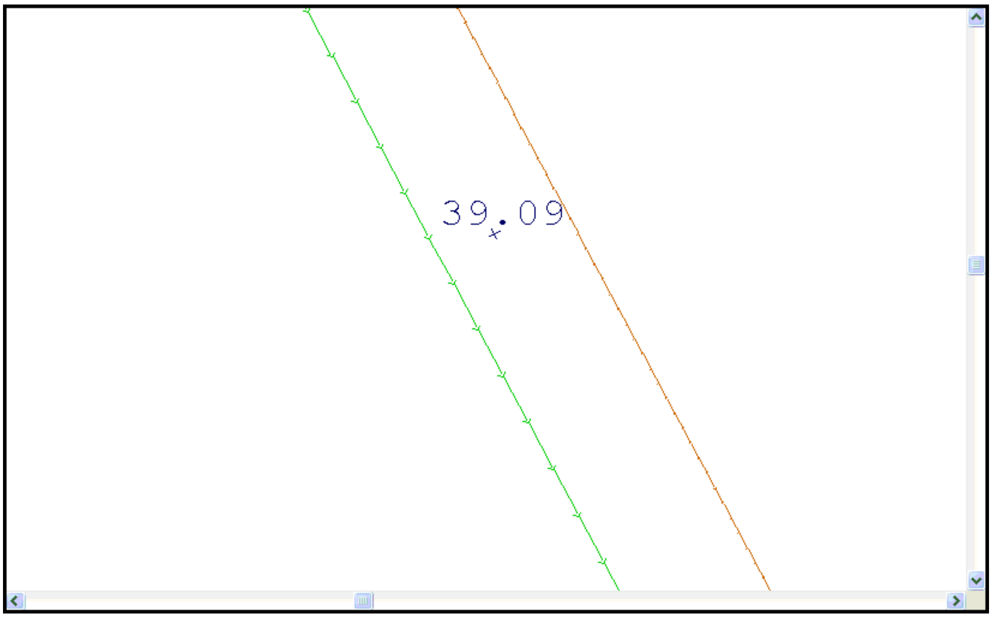
Using Drop Down Feature Menu select 'FE' as the new feature name



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.

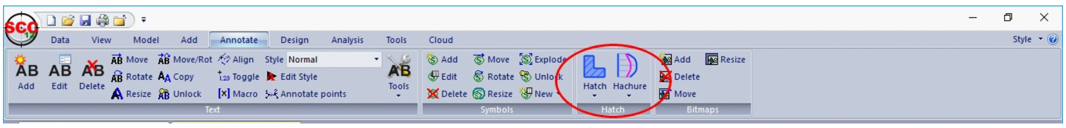
3.5.7.10 Adding Slope Lines To A Model

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  **icon from the toolbar. Right click mouse to update the string in the model.**

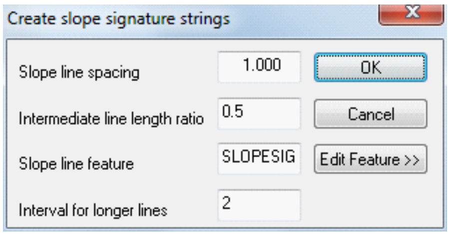
Select 'ADD tab > Hachure > Hatch with reference string'

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

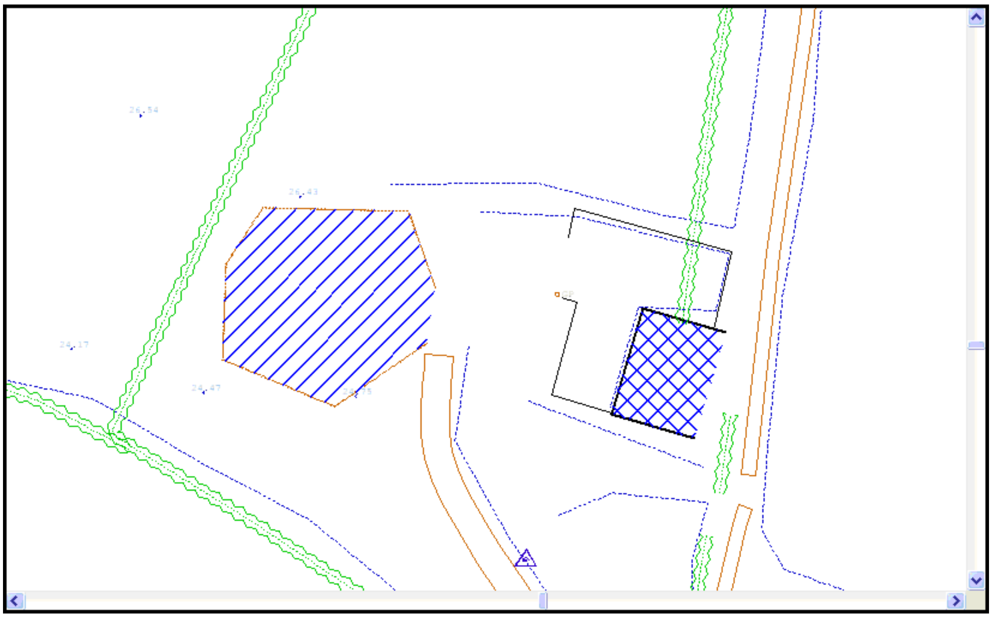
Accept the defaults

Select 'OK'

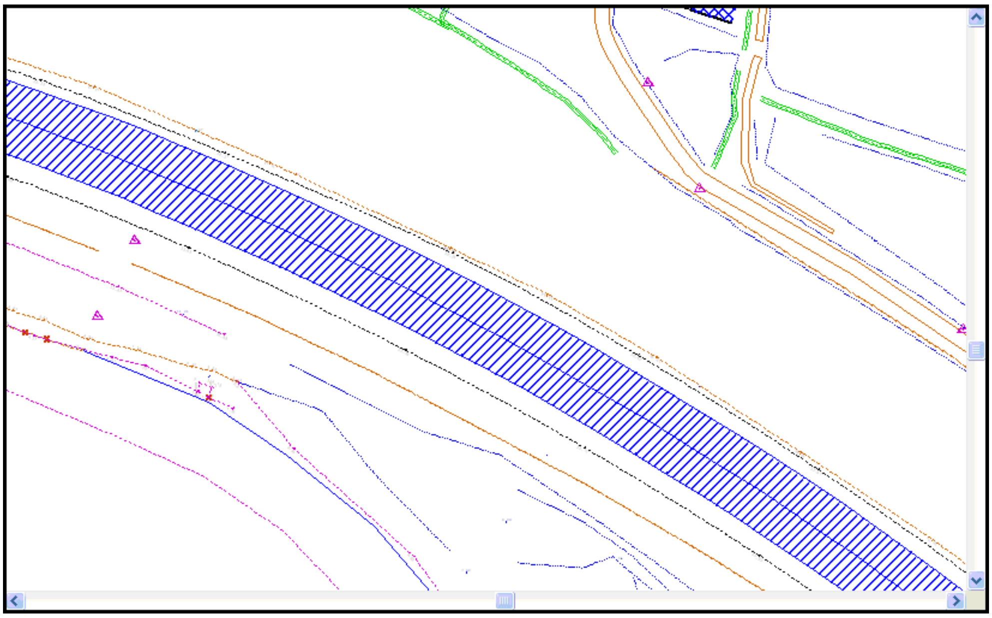
3.5.7.11 Adding Hatching To A Model

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.



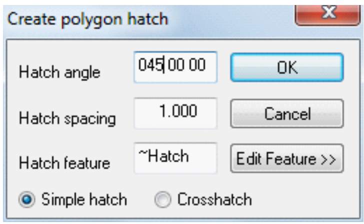
- 'Hatch Strings' will hatch between any two strings selected by the user. The strings must be selected prior to using this option. This can be done using the 'Data Selection Dialog'.



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'

3.5.8 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

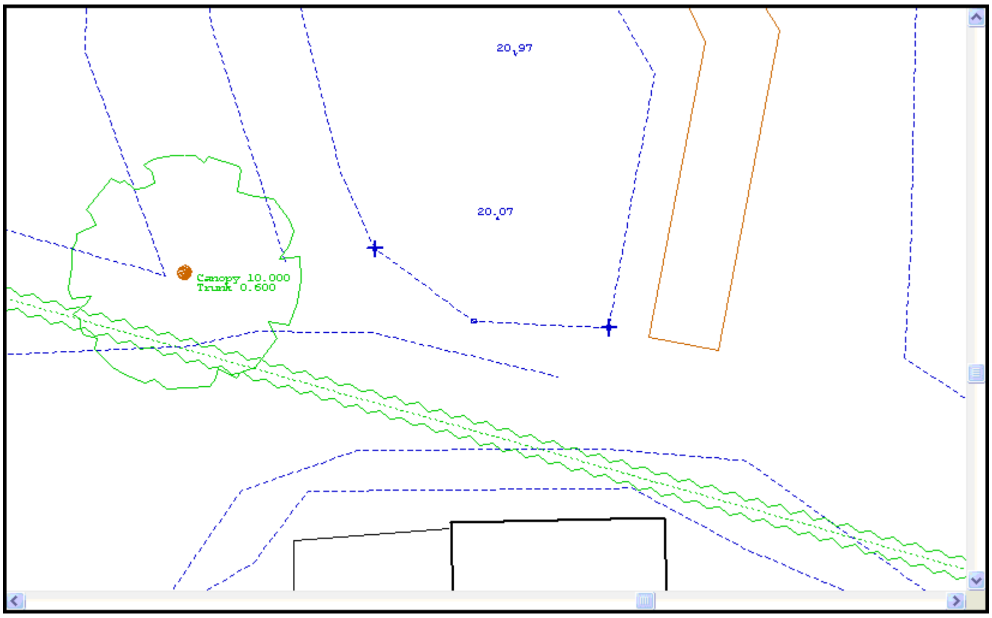
Zoom into the south east of the model as shown in the diagram below

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

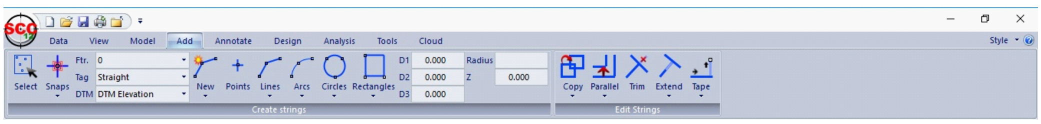
Set the selection method to 'Individual Points'

Select OK

Select the points shown below



Go to the ADD tab

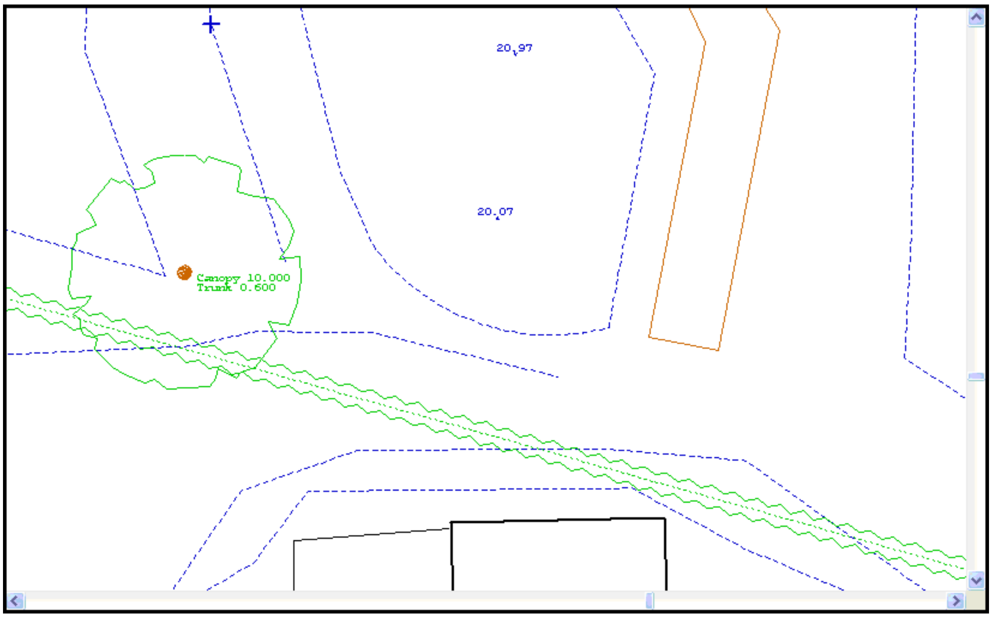


Set the Change Radius to 0.1

Select 'Arcs drop down button > 3 point arc

Select 'Yes' to 'Convert selected points'

The result should look as below.



3.5.8.1 Surveying Circular and Curved Objects

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

It must be considers that circular object 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 polgon. It is usefull 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 rarley 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).

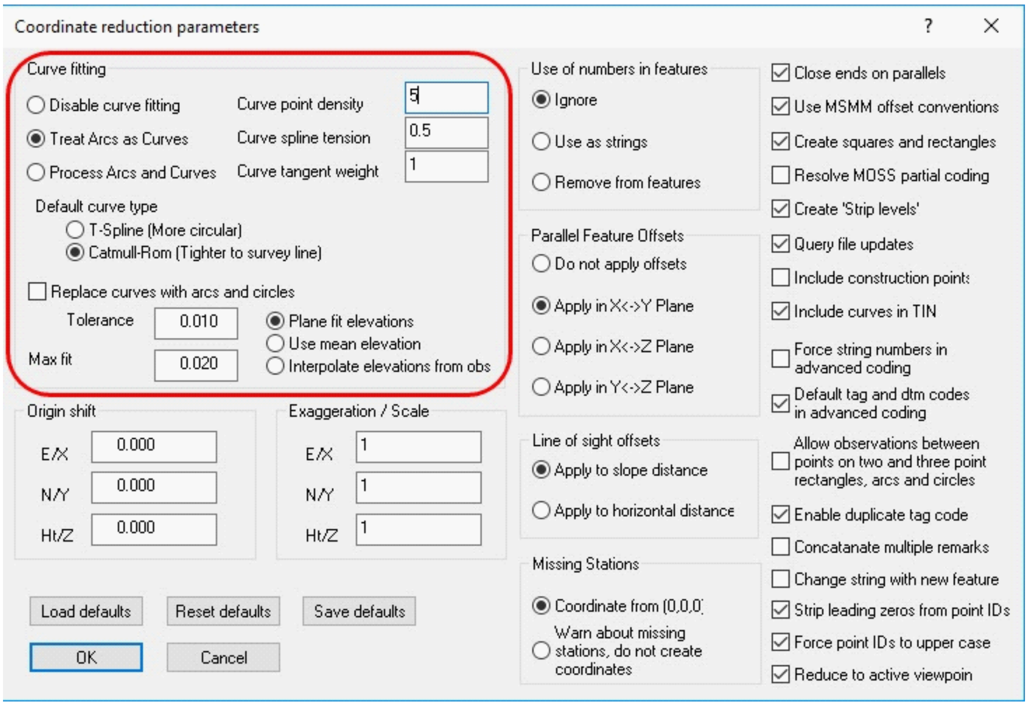
Curve tangent weight

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.

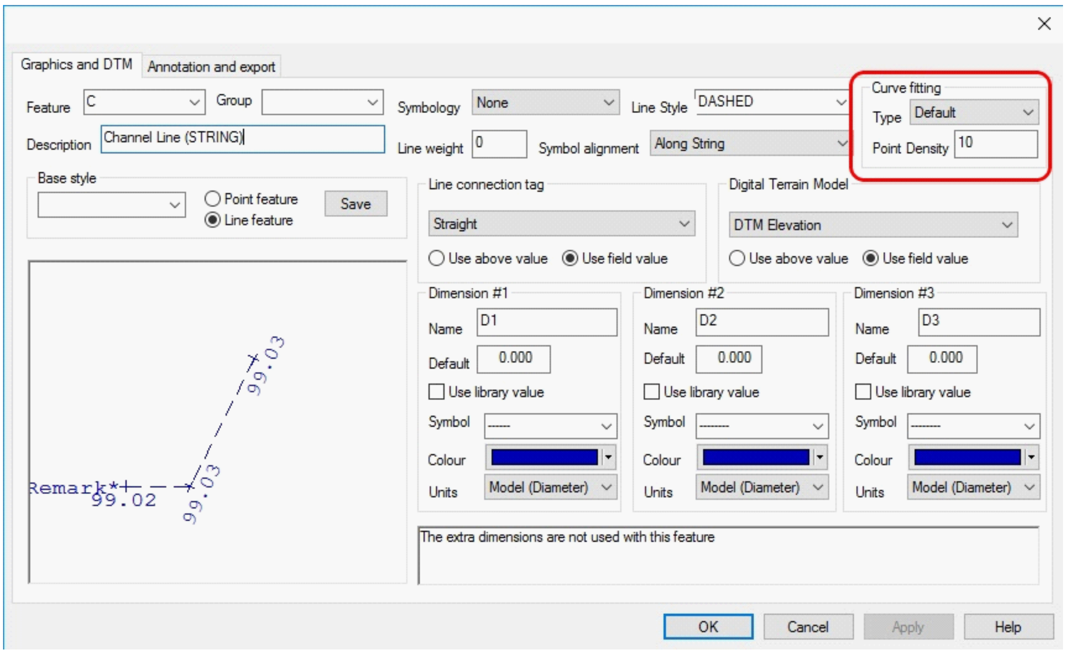
Go to 'DATA tab > Settings drop down > Coordinate Reduction Options'



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'

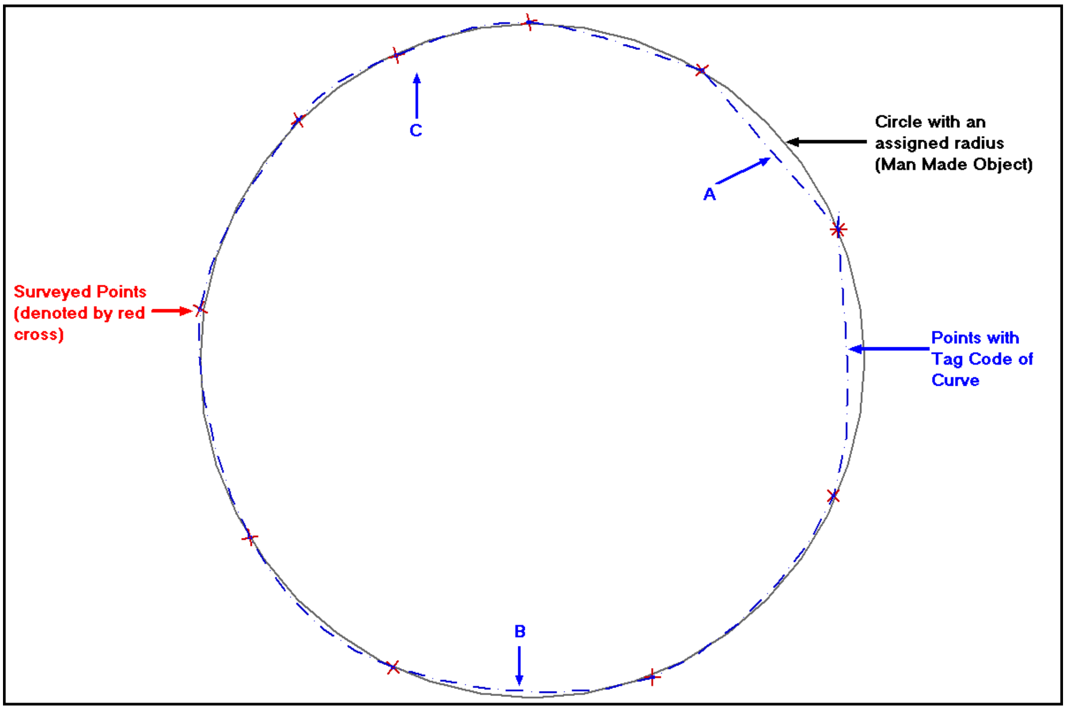


Case Study:

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.

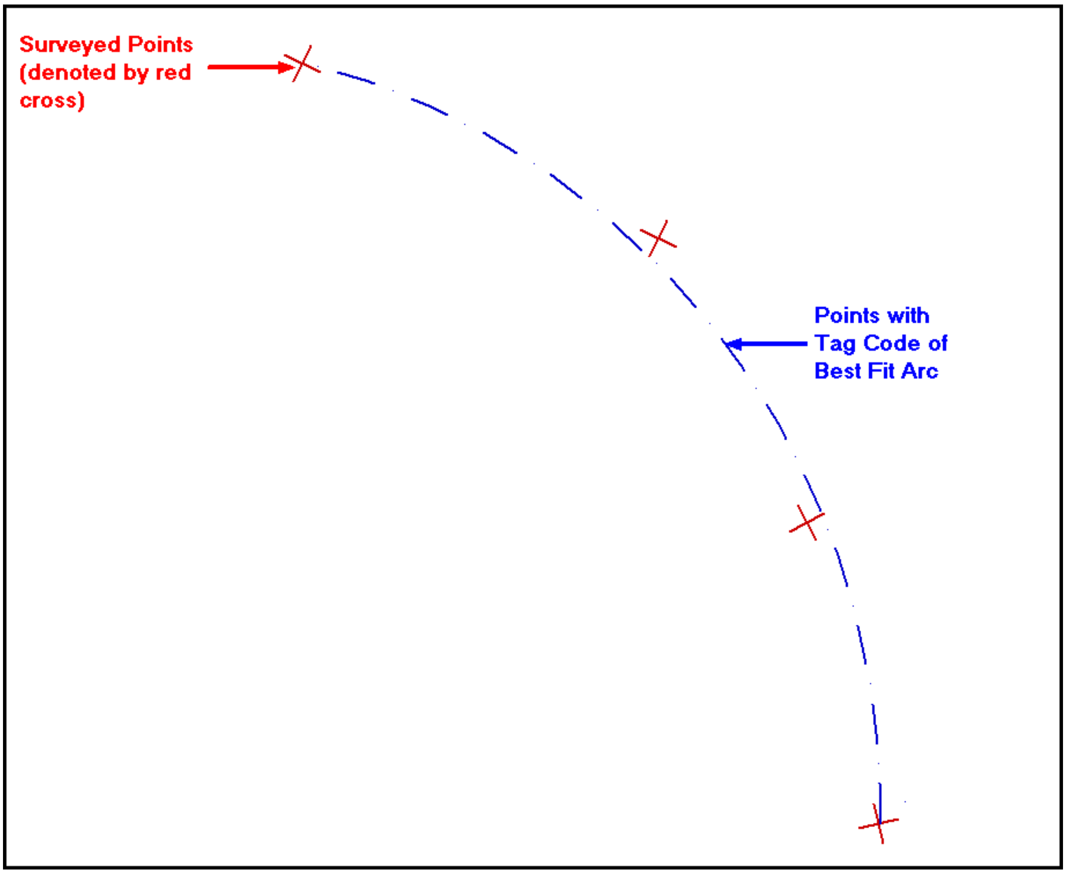


Note the influence of the point spacing in area A and B. In area C, points have been surveyed closer together and as a result the curve is a better representation of what is on the ground.

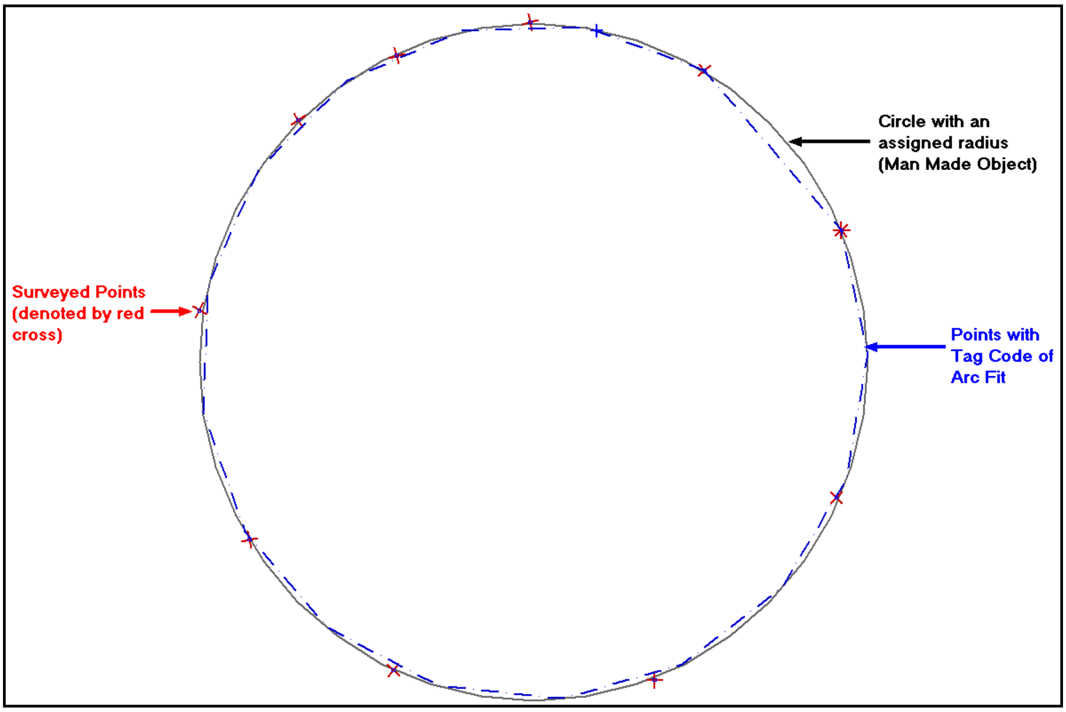
Scenario 2: Arc Fit Tag Code

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:



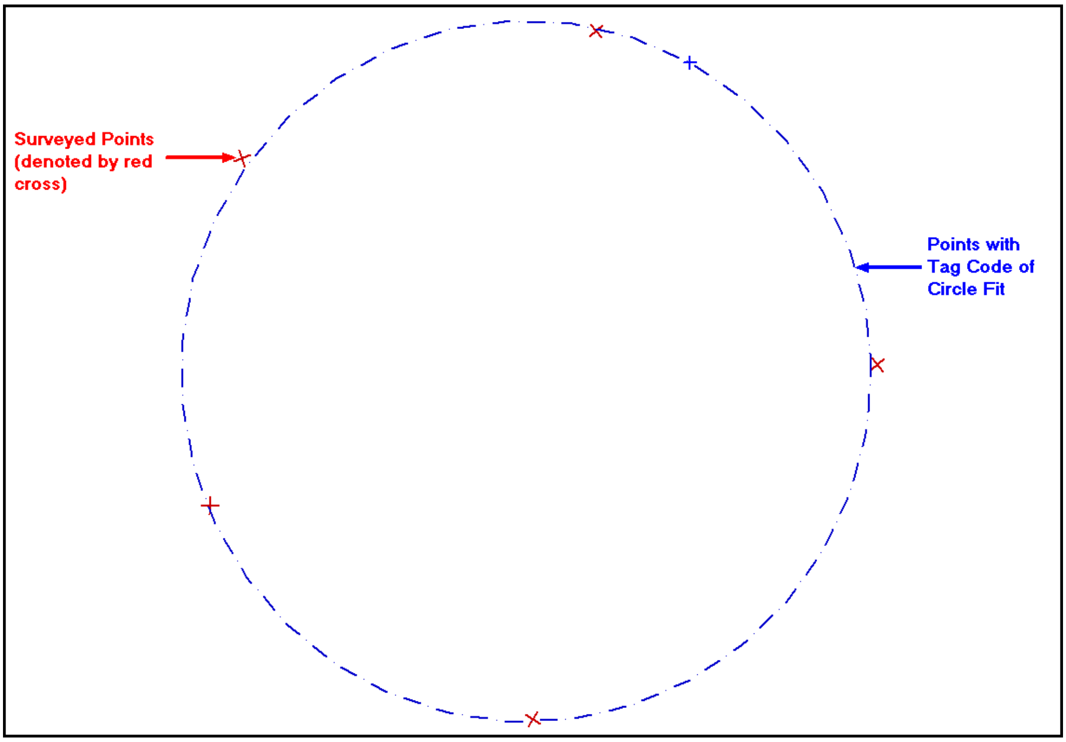
The position and spacing of survey points is important.



Scenario 3: Circle Fit Tag Code

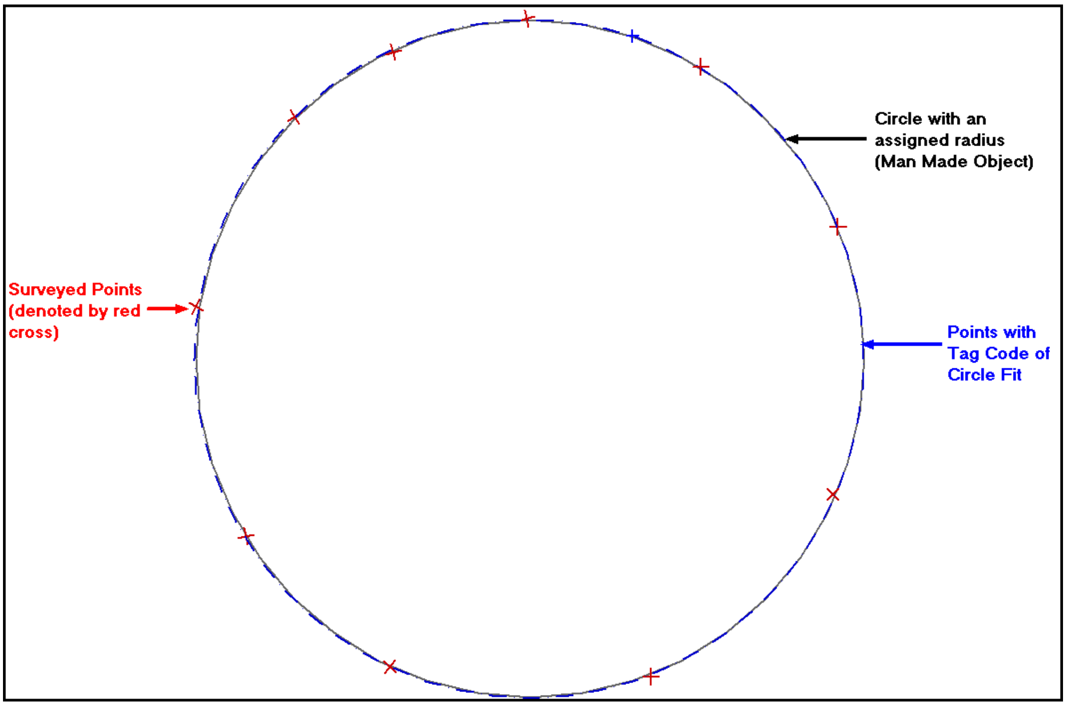
This option creates a best-fit circle. It is useful when dealing with circular tanks, small roundabouts, and other man-made circular features.

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



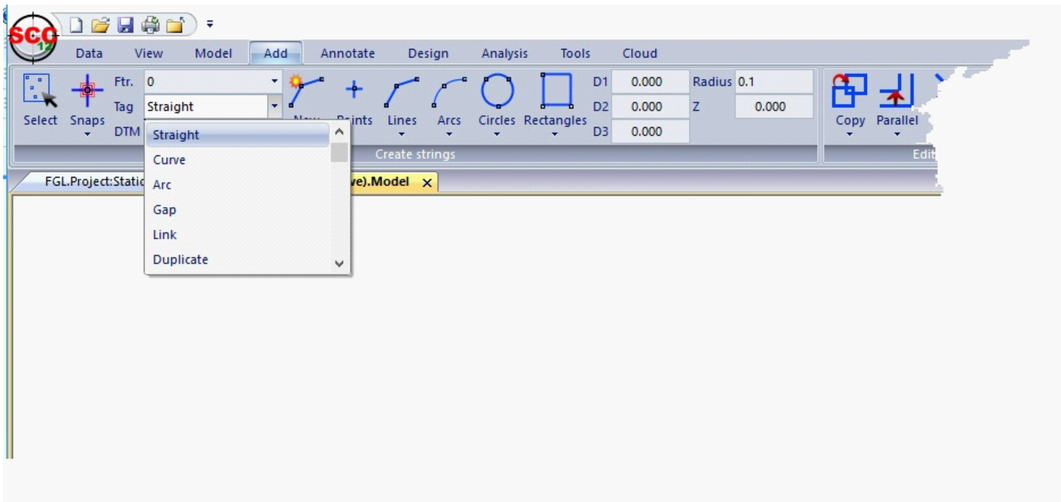
When generating a circle fit use the snap point command to pick up each survey point.

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''



3.6 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.

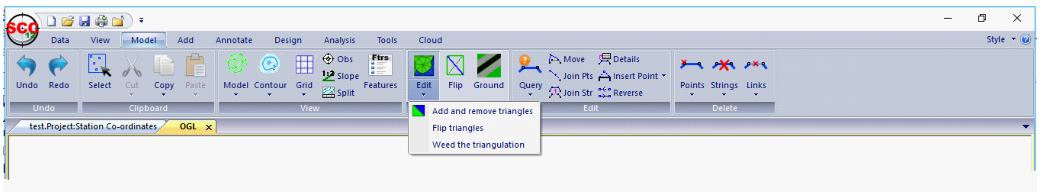
The triangulation is derived from the strings and points in the model. Therefore, all efforts should be made to edit the strings before editing the triangulation. Editing the triangulation allows further control over the final model surface and its boundaries.

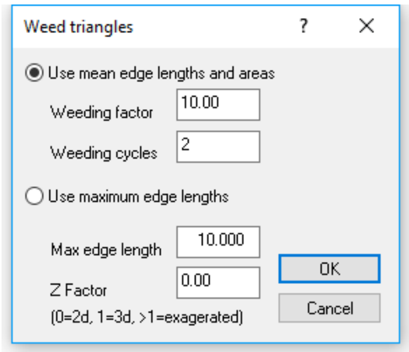
Triangle Weeding

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.

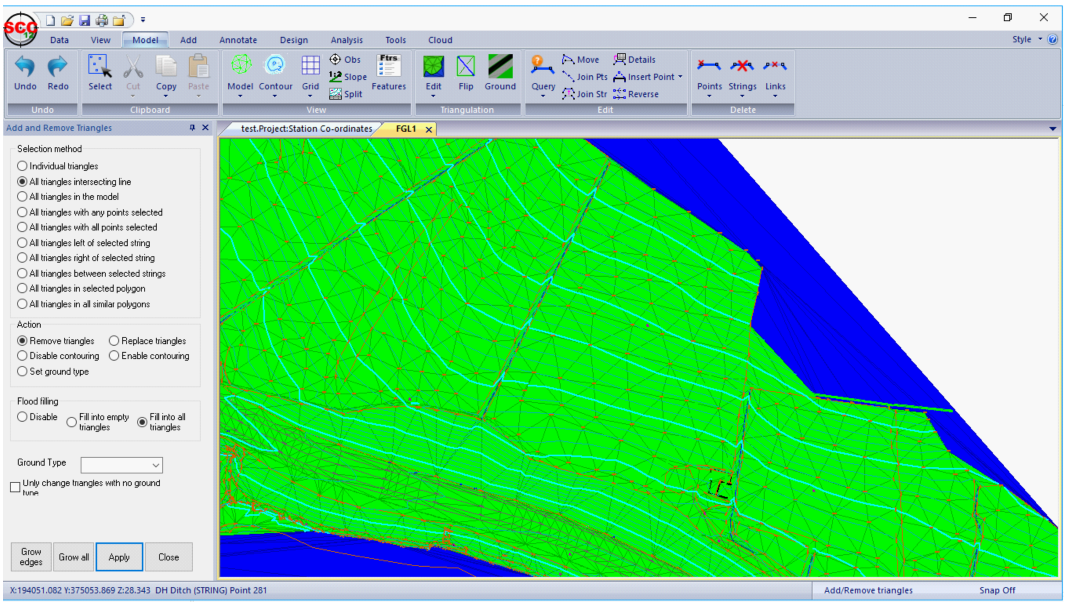
Adding And Removing Triangles

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 ‘A dd/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’

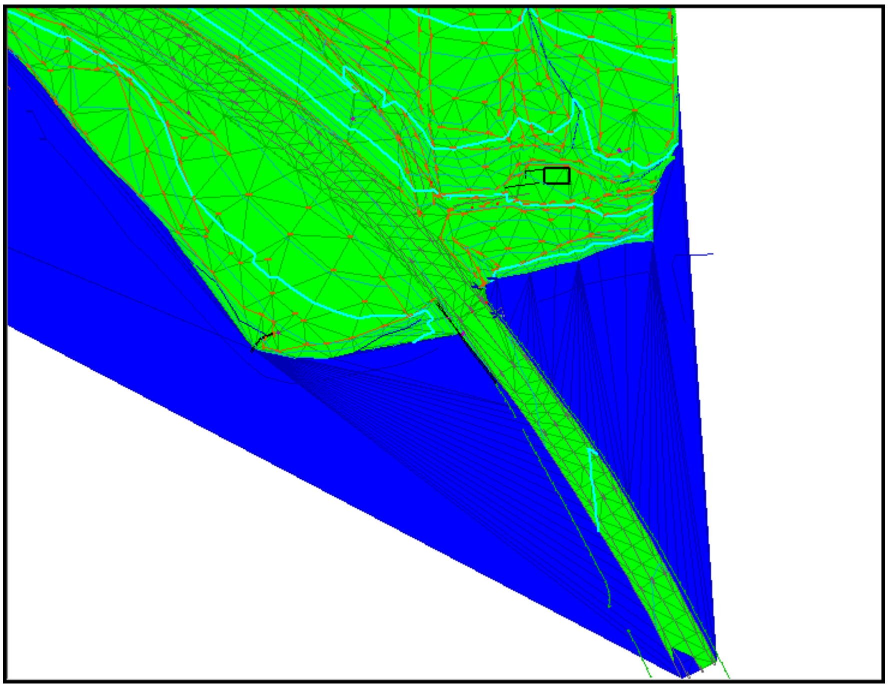
Highlight ‘All triangles intersecting line’

Highlight ‘Remove triangles’

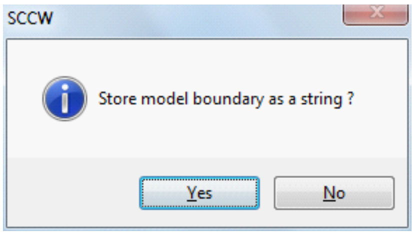
Click OK

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



SCC 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**

3.6.1 Generation Of Boundaries

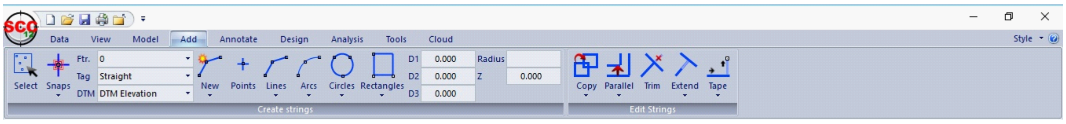
Boundaries are important for volume calculations. If the surface used in volume calculation is not clearly defined the result of the volume calculation will be ambiguous. If a boundary has not been surveyed in the field for whatever reason, one must be generated in SCC.

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.

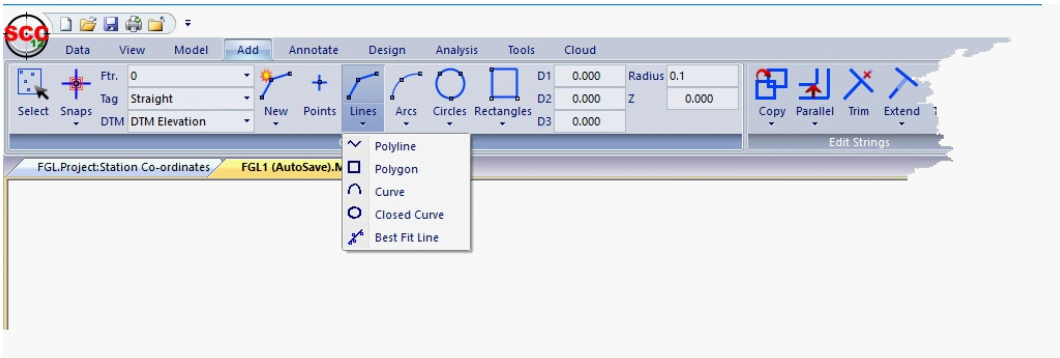
Adding A New String To The Model

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'



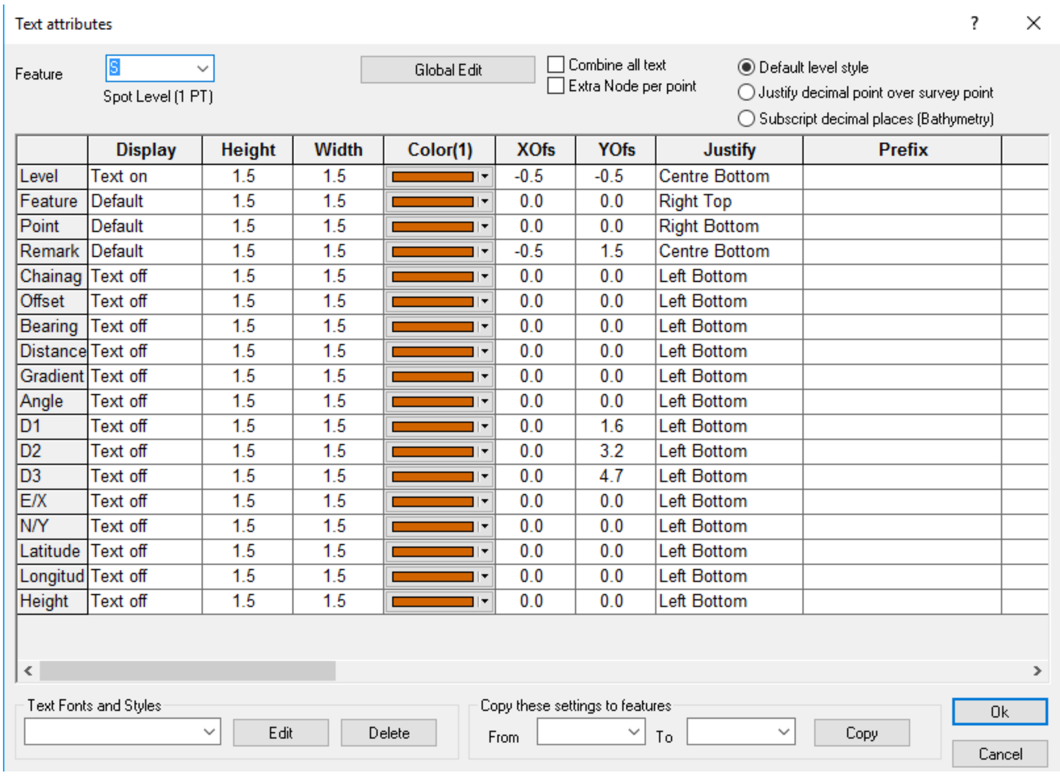
Click the left mouse button once for each point you wish to add, and right click mouse to ‘Update String In Model’ button.

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.

3.7 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.


Text attributes

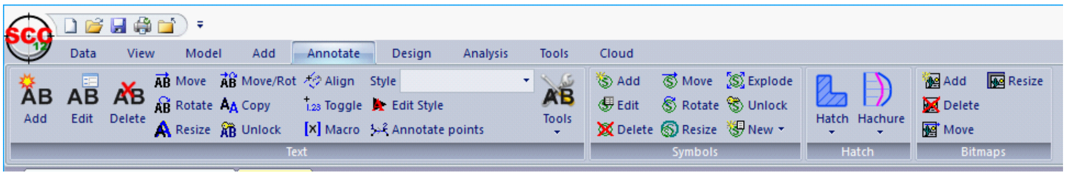
Feature: S — Spot Level (1 PT) | Global Edit | Combine all text | Extra Node per point | Default level style | Justify decimal point over survey point | Subscript decimal places (Bathymetry)

	Display	Height	Width	Color(1)	XOfs	YOfs	Justify	Prefix
Level	Text on	1.5	1.5		-0.5	-0.5	Centre Bottom	
Feature	Default	1.5	1.5		0.0	0.0	Right Top	
Point	Default	1.5	1.5		0.0	0.0	Right Bottom	
Remark	Default	1.5	1.5		-0.5	1.5	Centre Bottom	
Chainag	Text off	1.5	1.5		0.0	0.0	Left Bottom	
Offset	Text off	1.5	1.5		0.0	0.0	Left Bottom	
Bearing	Text off	1.5	1.5		0.0	0.0	Left Bottom	
Distance	Text off	1.5	1.5		0.0	0.0	Left Bottom	
Gradient	Text off	1.5	1.5		0.0	0.0	Left Bottom	
Angle	Text off	1.5	1.5		0.0	0.0	Left Bottom	
D1	Text off	1.5	1.5		0.0	1.6	Left Bottom	
D2	Text off	1.5	1.5		0.0	3.2	Left Bottom	
D3	Text off	1.5	1.5		0.0	4.7	Left Bottom	
E/X	Text off	1.5	1.5		0.0	0.0	Left Bottom	
N/Y	Text off	1.5	1.5		0.0	0.0	Left Bottom	
Latitude	Text off	1.5	1.5		0.0	0.0	Left Bottom	
Longitud	Text off	1.5	1.5		0.0	0.0	Left Bottom	
Height	Text off	1.5	1.5		0.0	0.0	Left Bottom	

Text Fonts and Styles: Edit | Delete — Copy these settings to features: From | To | Copy — Ok | Cancel

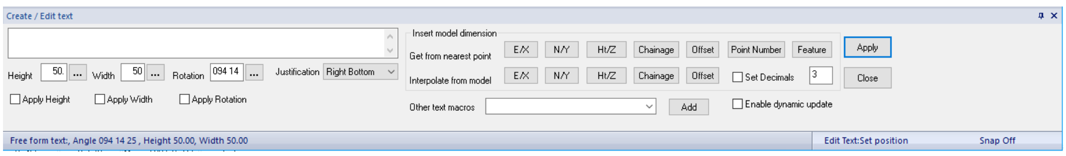
However, it is recommended that any further editing of text should be done using one of the following options:

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 of 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.

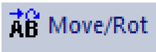
Edit Existing Text

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.

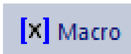
Edit Text Style

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 an 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 <nth> 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.

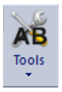
Toggle Text On/Off

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.

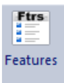
All points within this area should be highlighted blue.

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.

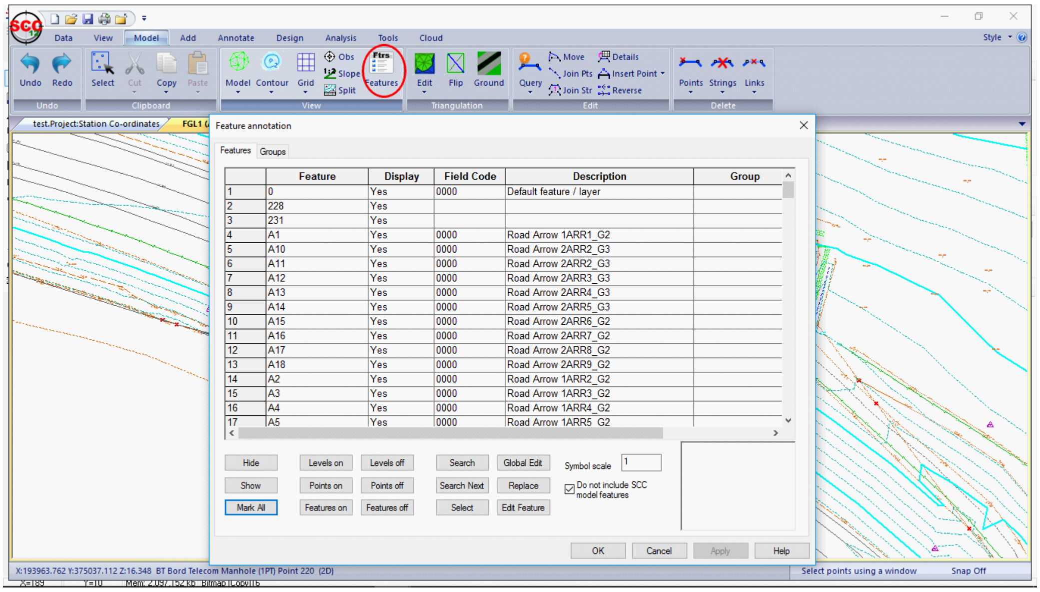
Feature Annotation

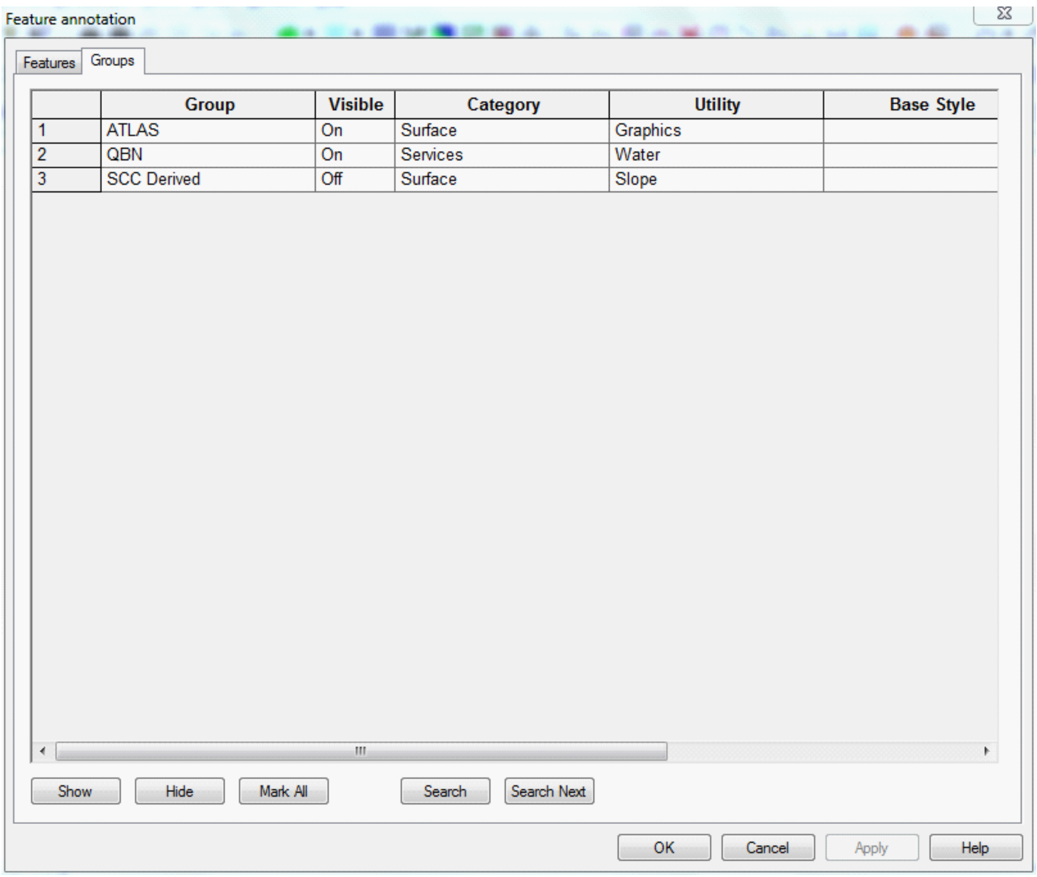


The feature annotation option is similar to the string annotation option except that it allows the user to add annotation to the model by feature rather than selected points or strings. Remember that a feature refers to all strings of the same type, such as all hedges, all walls etc. Group information 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.

4 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.

4.1 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

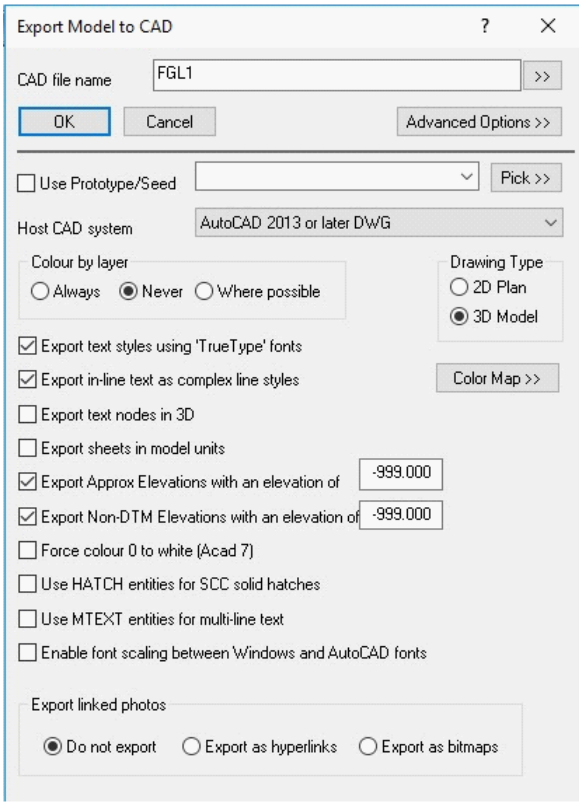
Select ‘Normal Topographic Data’

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.

4.2 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

Goto '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

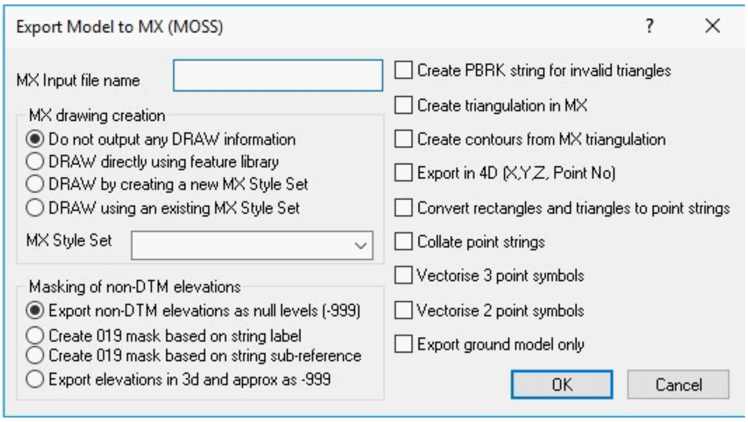
Select 'OK'

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

4.3 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.

5 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.

6 Volumetric Analysis & QA

Overview of Different Methods of Volumetric Analysis

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

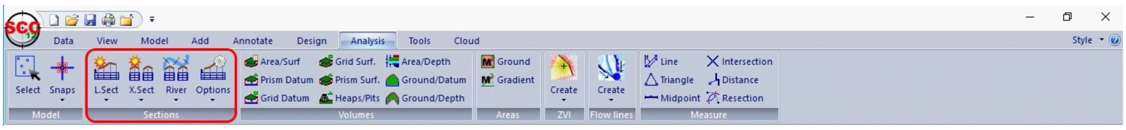
1. Cross Sectional End Areas method
2. Prismoidal / Isopachyte method
3. Grid method

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.

6.1 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'

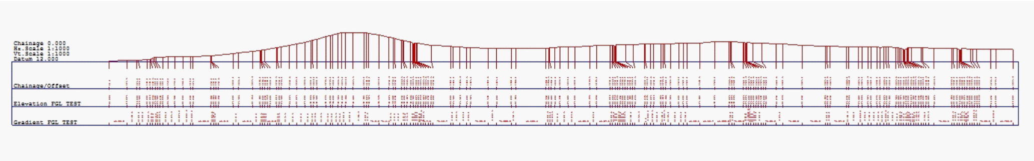
Select three or four points with the left mouse button following the center of the FGL model

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

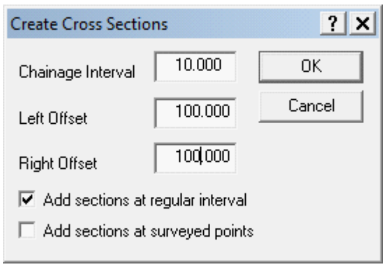
Creating Cross Sections

Go to 'ANALYSIS > X.Sect'

Set the Chainage Interval to 10

Set Offsets to 100 (should go beyond required area)

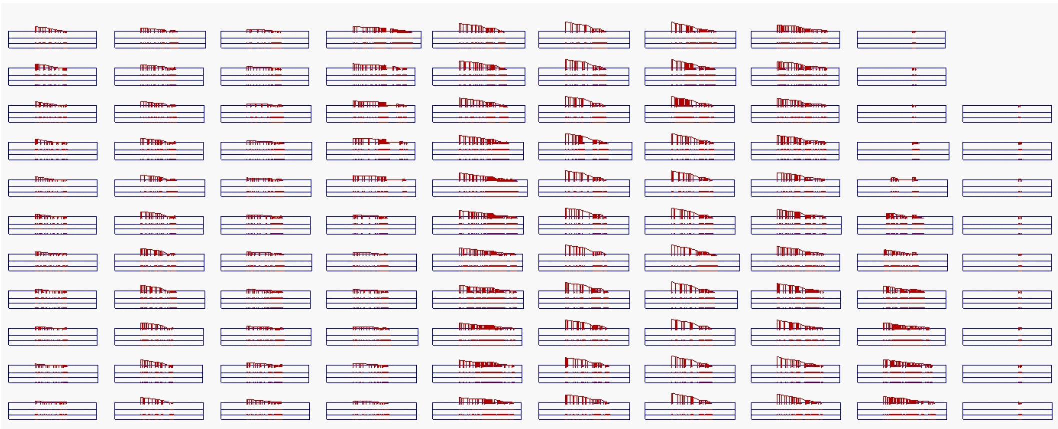
Leave the option to 'Add Sections at Regular Interval' on



Select OK

Left click on road center line string

View the cross sections



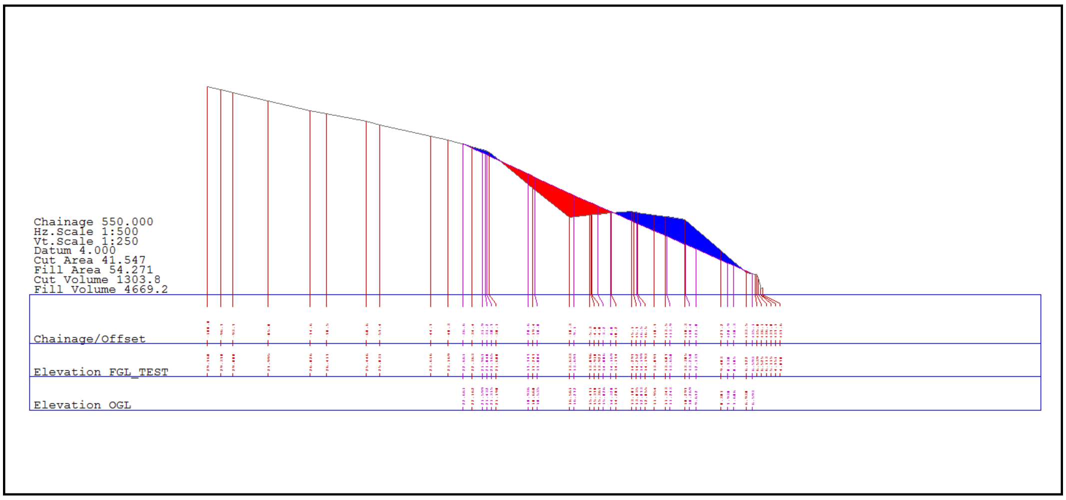
Select 'FILE > Save As' and save as FGL Cross.Section

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.

6.2 Calculation Of Volumes Using Different Methods

Using the models FGL and OGL we will calculate volumes using prismoidal, 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

6.3 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.

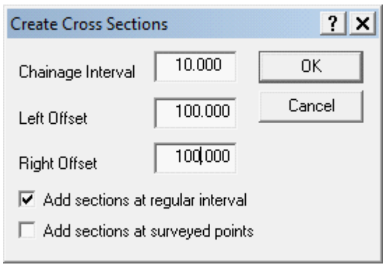
Generation of Cross Sections

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

Set the Chainage Interval to 10

Set Offsets to 100 (should go beyond required area)

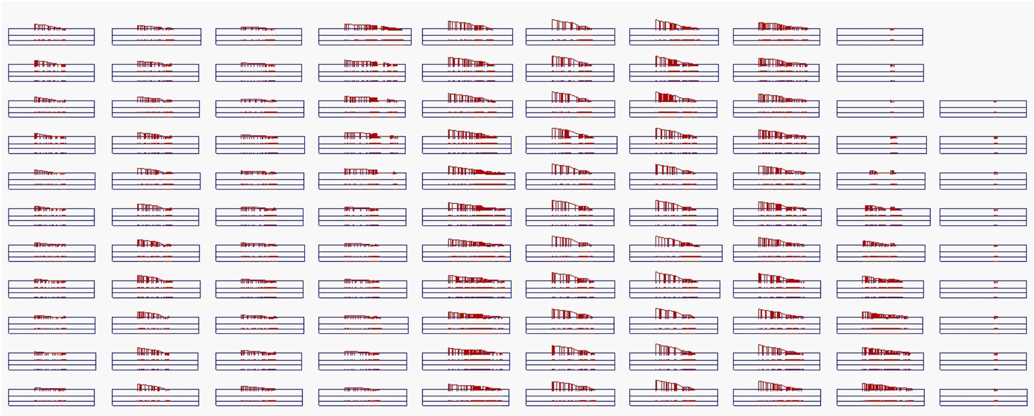
Leave the option to 'add sections at regular interval' on



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'

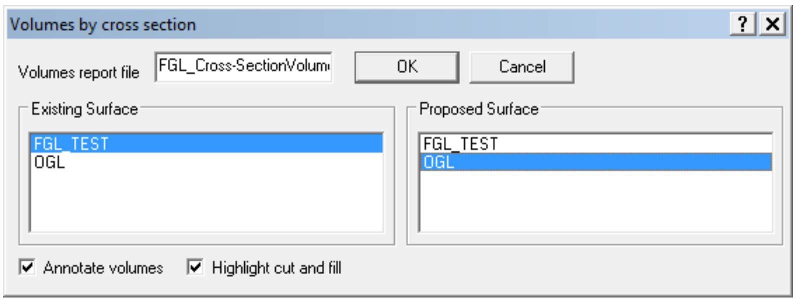
Select OGL.Model from tutorials directory

End Area Volumes

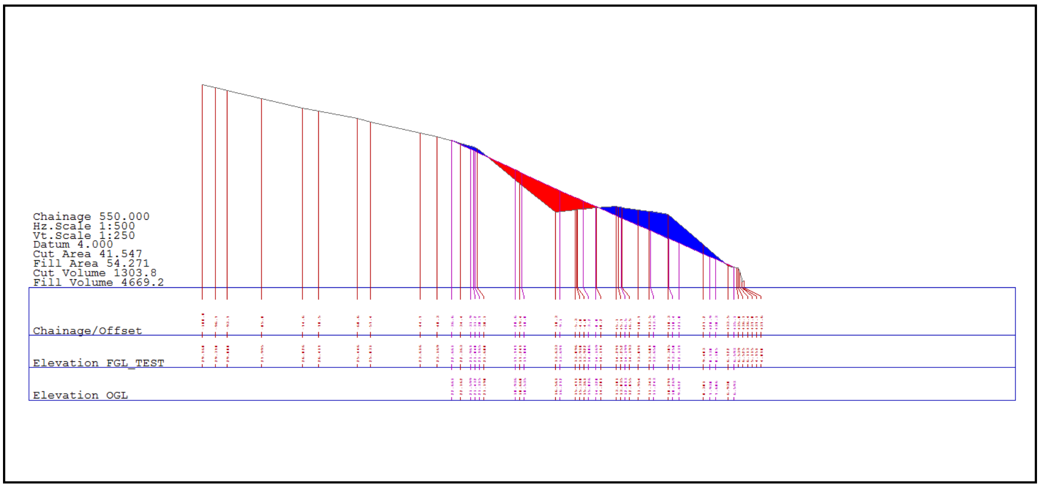
Within Section file, select 'EDIT tab > Append drop down > Volumes'

Select Existing Surface and Proposed Surface

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



Examine report and results



6.3.1 Exporting User Defined ASCII file From Sections

The following examines the exporting of a user-defined file from a Section file.

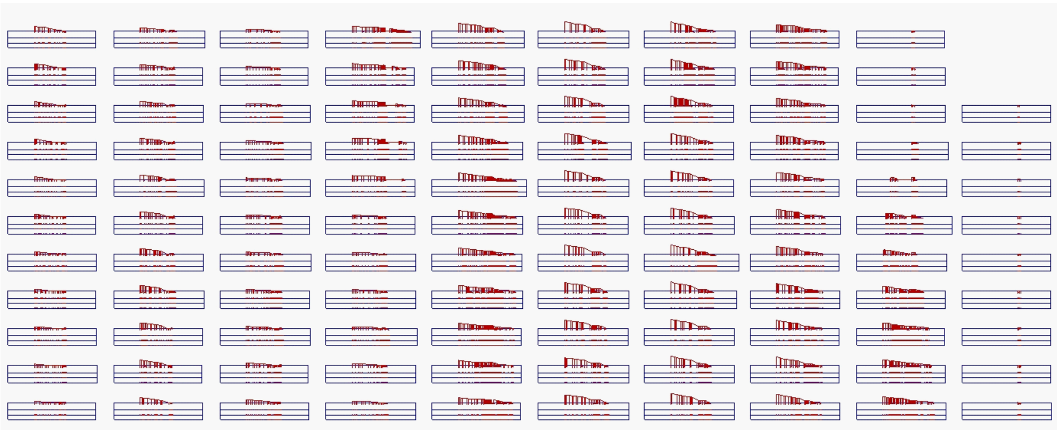
Case considers the export of a *.txt file containing Chainage, Offset, X, Y, Z, Feature of all ground points within the Section File.

Section File

Open Project File

Open Section File

In this instance, Cross Section have been generated along a string at Chainage Intervals of 10.00m .

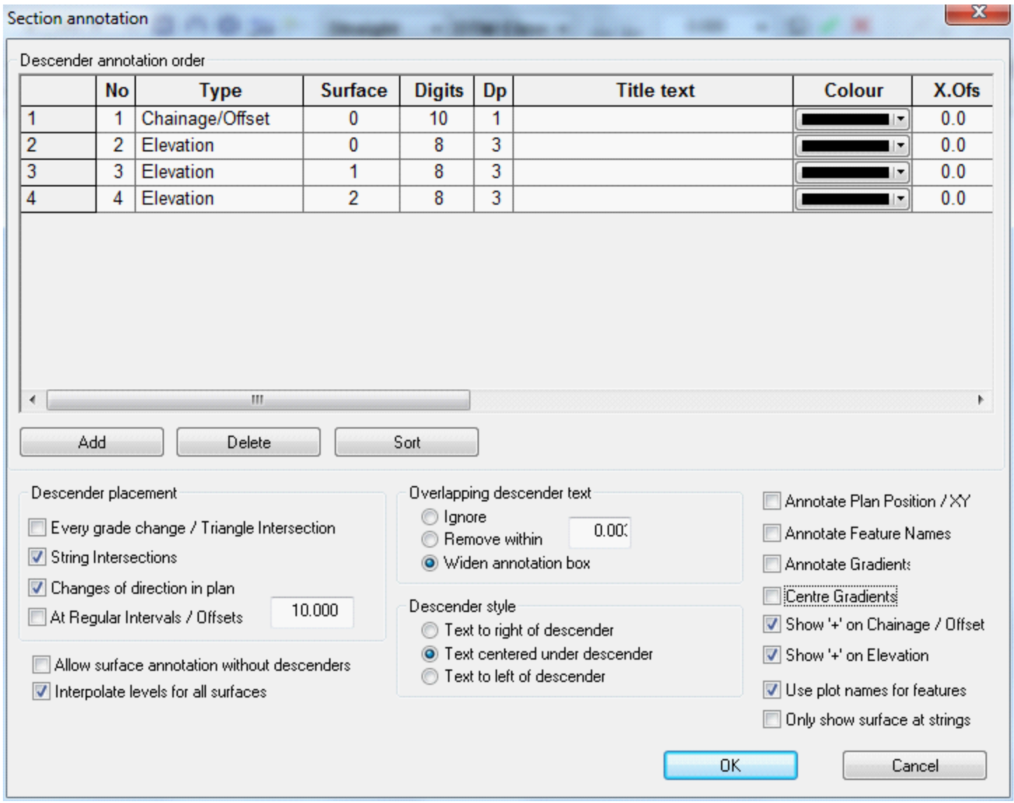


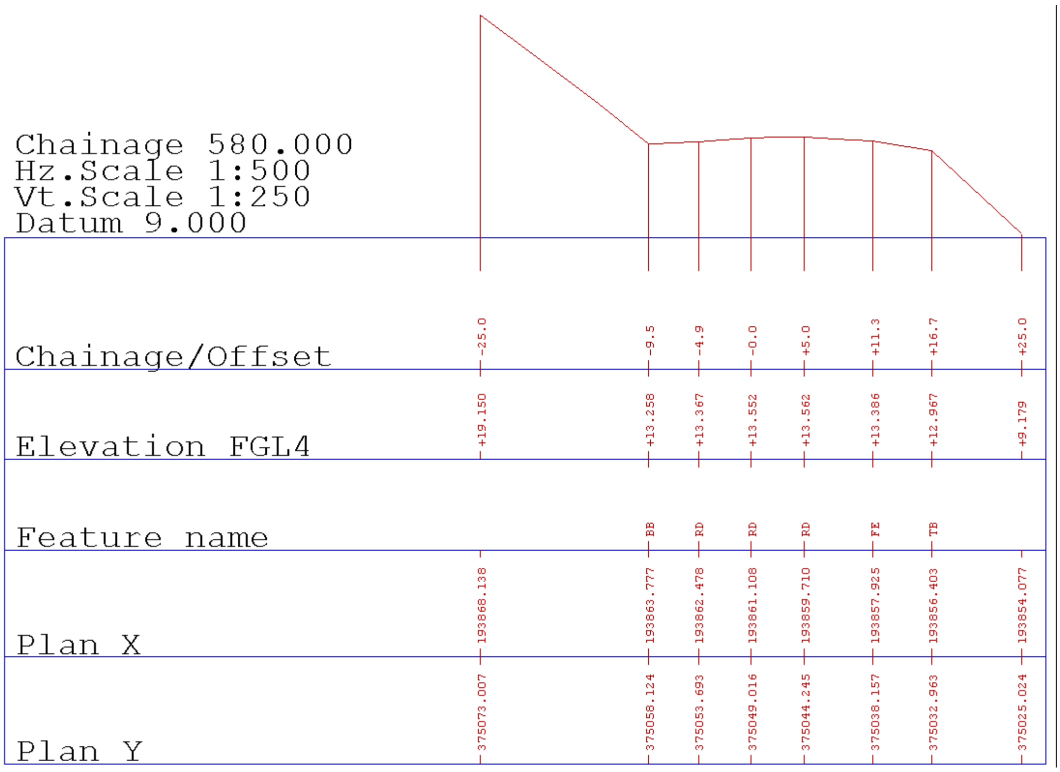
Output Ground Points

The User is required to output a *.txt file of Chainage, Offset, X, Y, Z, Feature of all ground points:

Annotation Settings:
Within Section, go to 'VIEW > Descender'

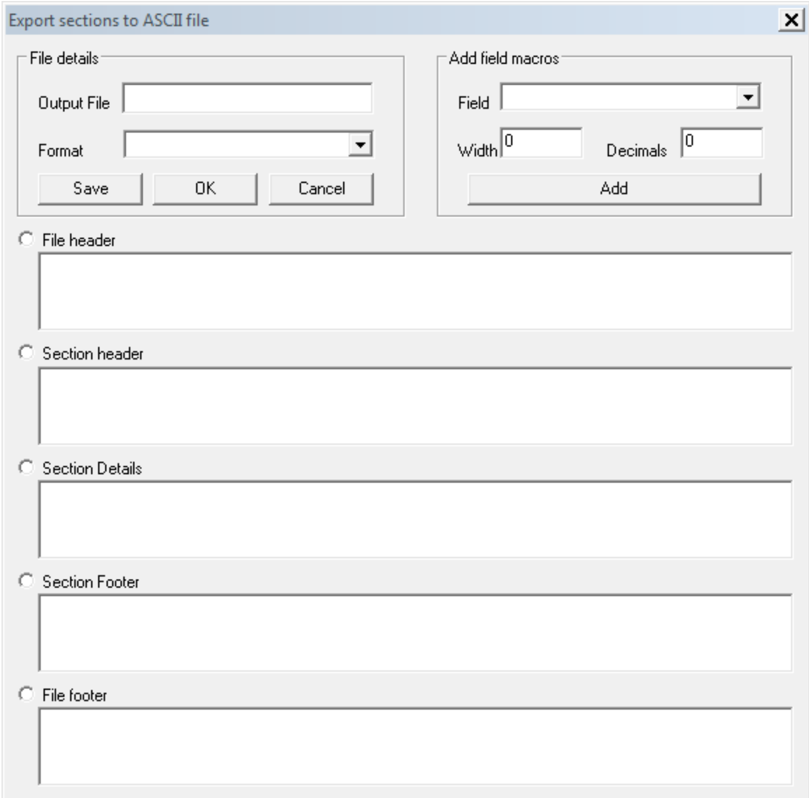
Assign the following





Exporting User Defined File

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

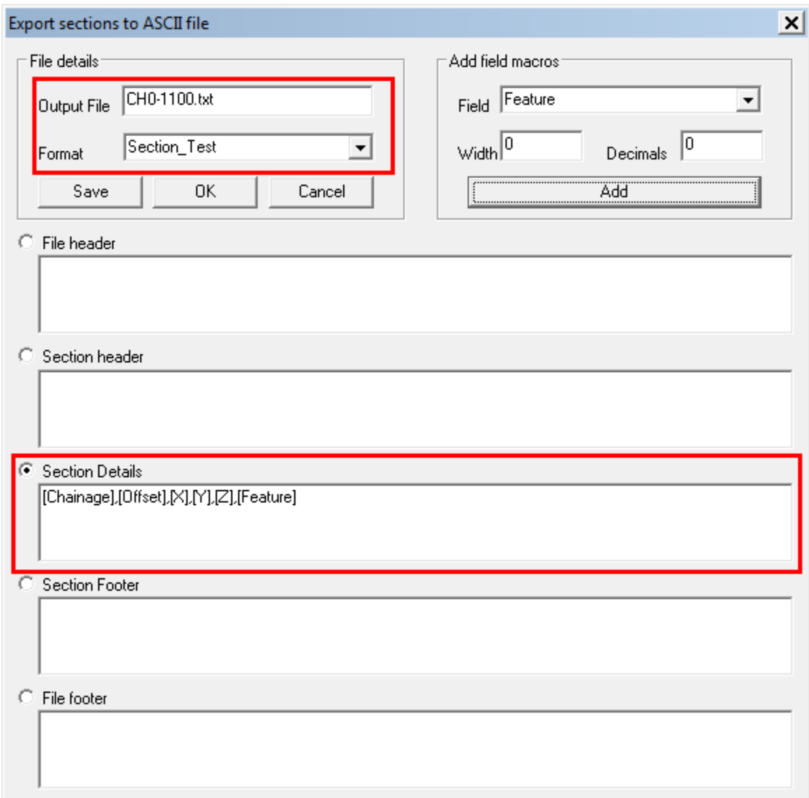


Select 'Section Details' and place cursor in the box below

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



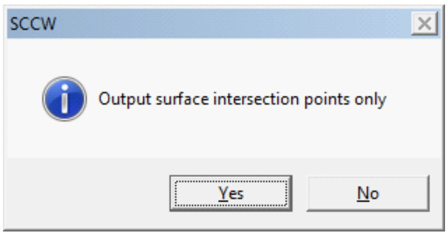
Enter a Format Name within Field Details 'Section_Test' and select 'Save'

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'



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.

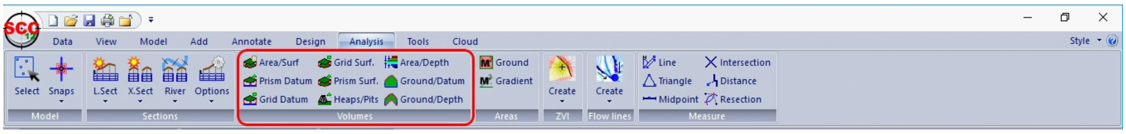
6.4 Prismoidal Method

The first and most accurate method of computing volumes is the Prismodial 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'.

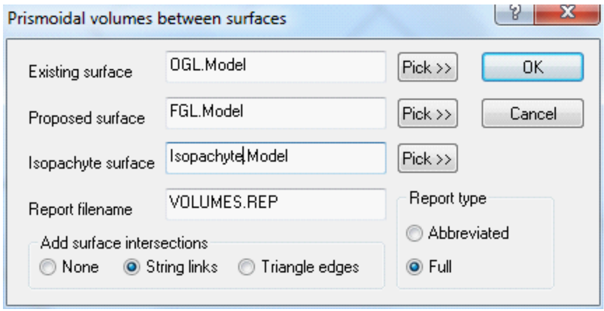


To calculate prismoidal volumes you must have a model window active.

Calculating Prismoidal Volumes

Select 'ANALYSIS > Prism Surf.'

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

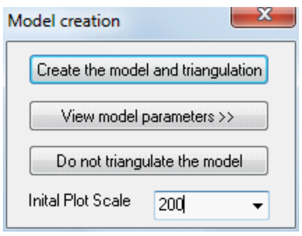


> Since SCC provides the default name of VOLUMES.REP to all volume reports, you may want to use a specific file name to avoid having the data overwritten

Select 'OK'

Isopachyte Surface Model

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



Select 'OK' to the Model Attributes Dialog

Examine Report

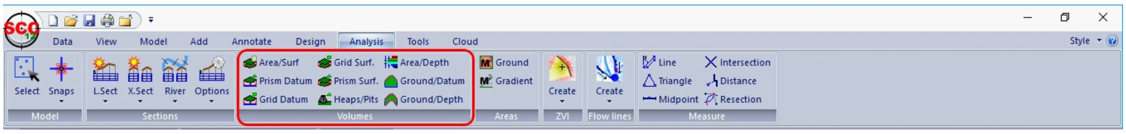
Once we have created an isopachyte model, we can colour it according to depth of material and calculate material volumes by depth. Note that this is using an end areas method based on horizontal sections whose accuracy is dependent on the vertical interval.

6.5 Grid Method

This option is similar to the prismoidal 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'.



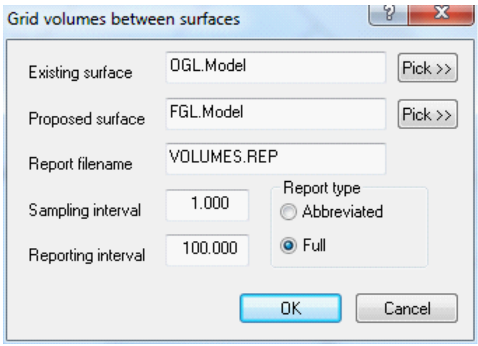
Volumes Calculations

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 prismoidal 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.

6.6 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.

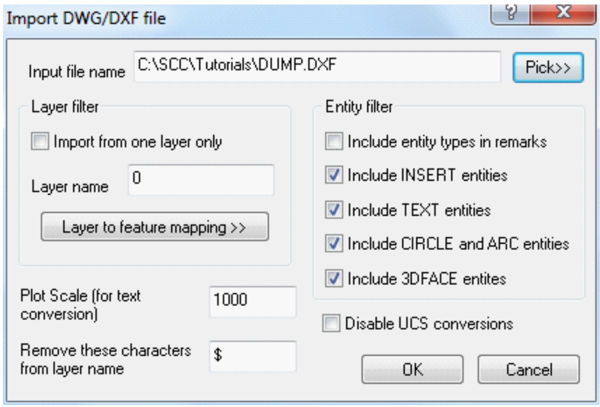
Create the model 'DUMP' from DXF file

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'

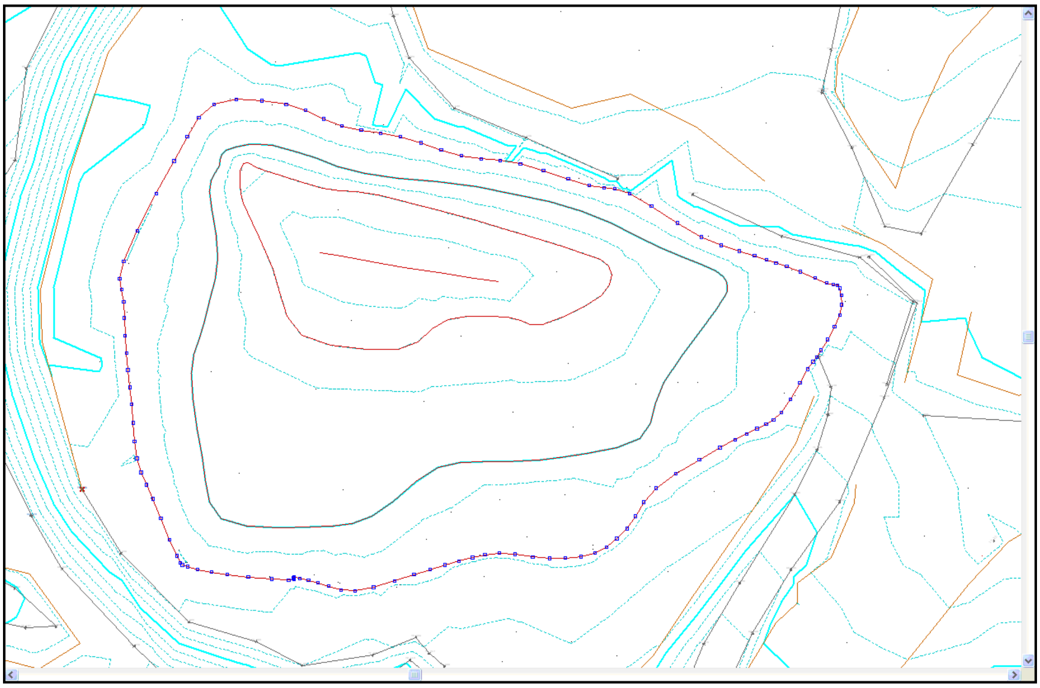
Select OK

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

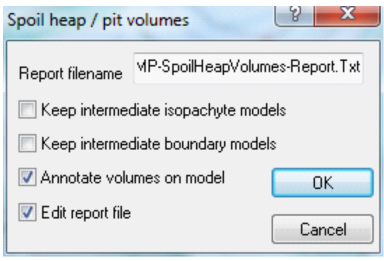
Save the model



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 prismodial 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’

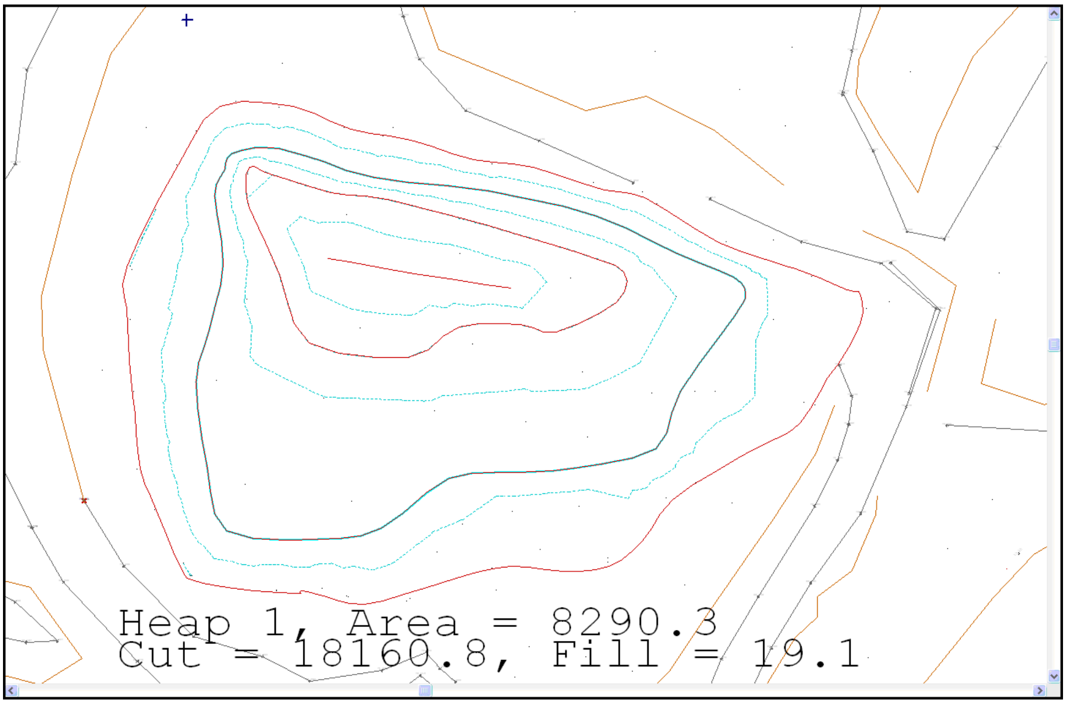


Enter in a new or accept the default report name

Select the options you require, if the options to ‘Keep intermediate isopachtye 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

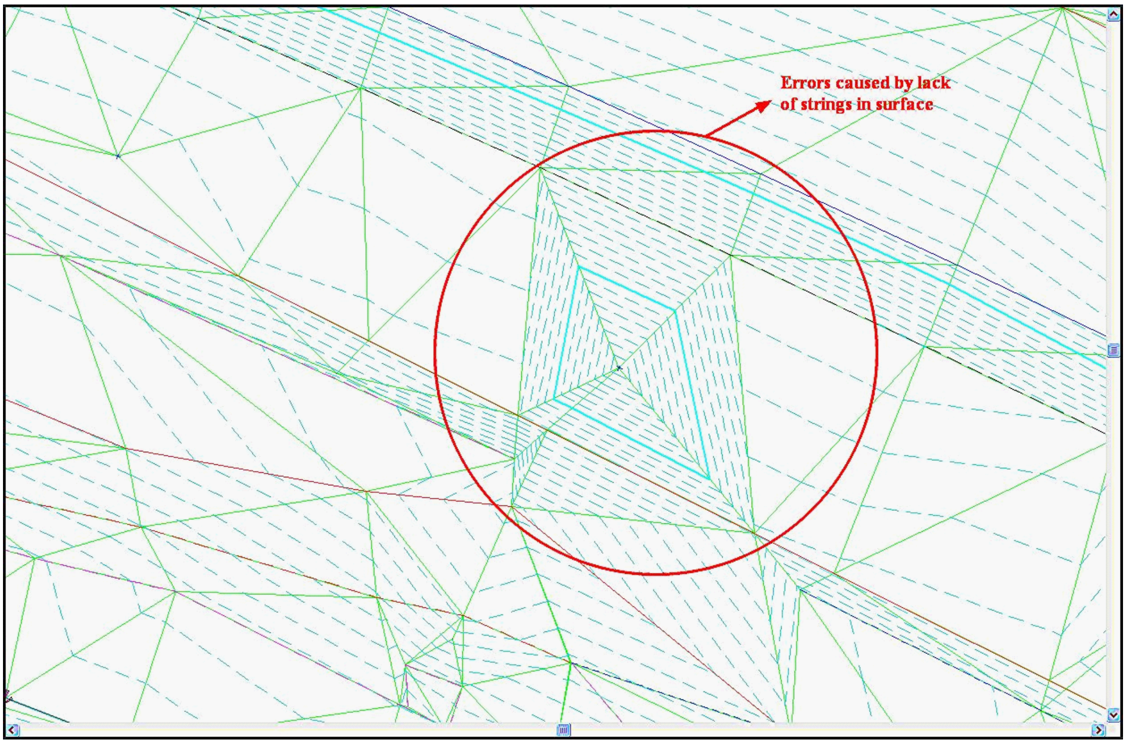


6.7 Identification of Potential Errors In Volumes

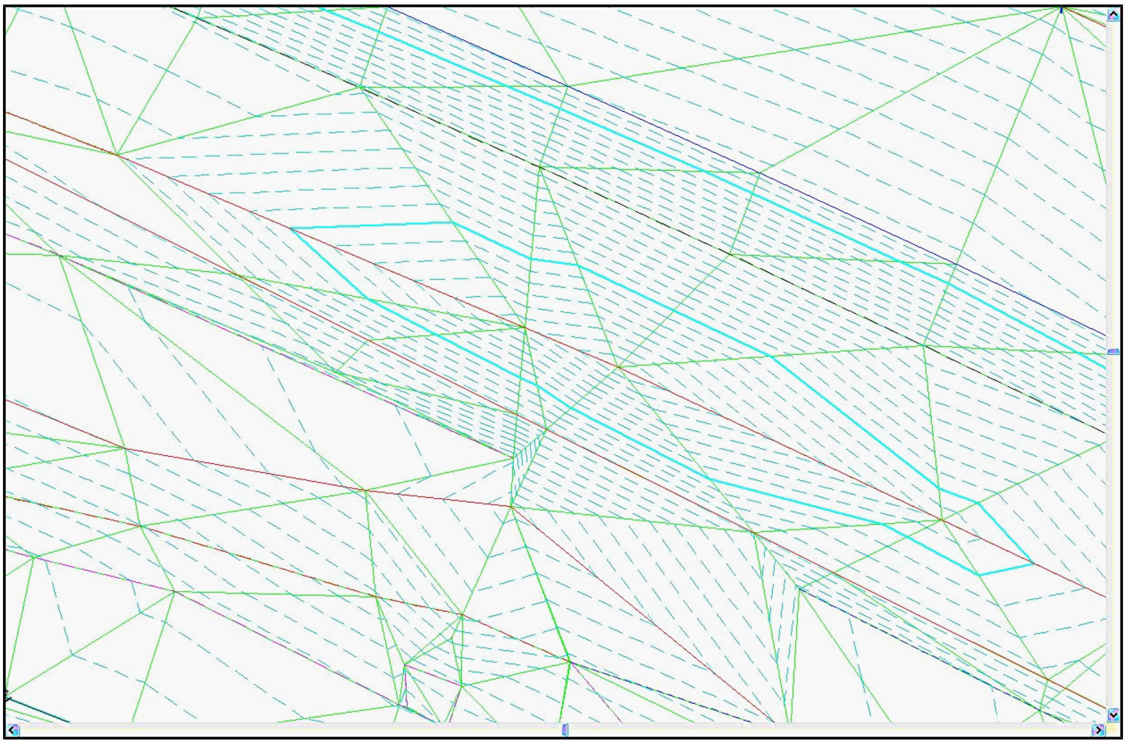
Before volume calculations are carried out both models should be checked for the following points.

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 prismoidal 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 traingles 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.

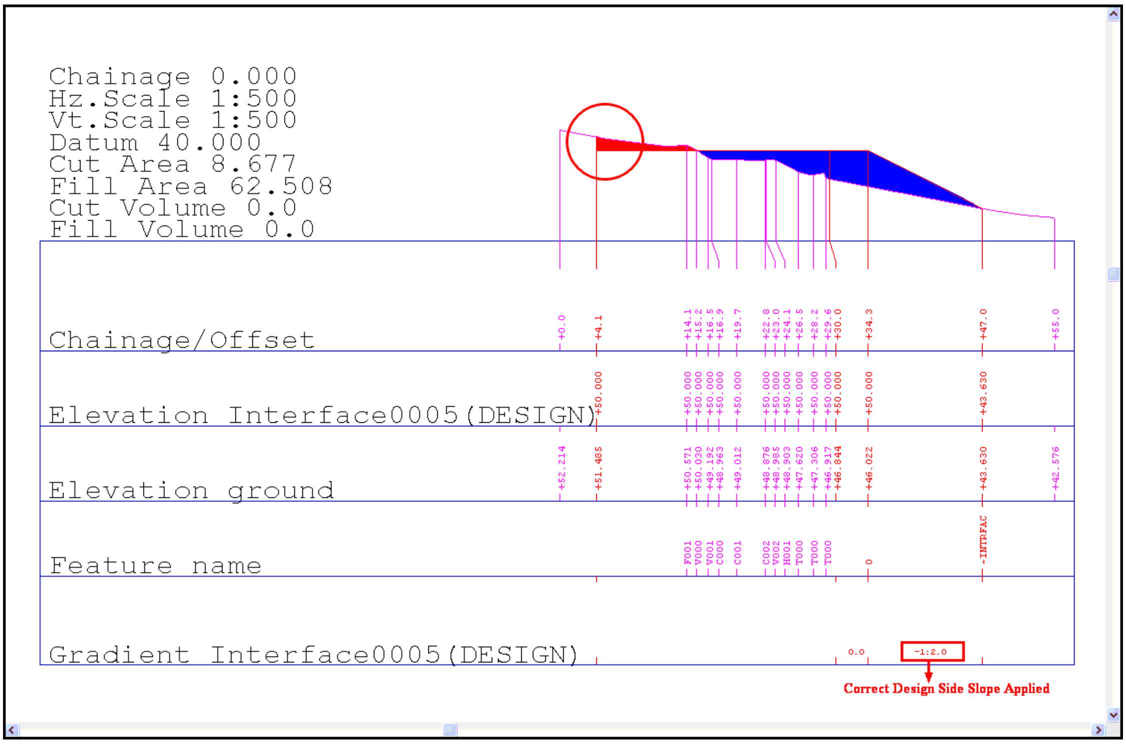
Volume Verification

Having verified all models you may then proceed with volume calculations. When calculating volumes, it is advisable to use all three methods, i.e. prismoidal, 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, prismoidal 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.

7 Interface Design Using The Alignment Module

SCC's Alignment module allows simple and straightforward interface design.

Create a model from a MX GENIO file. Design a simple building interface which can then be moved about the model until the amount of cut and fill indicated is roughly equaled.

Creating A Model From A GENIO file

Close all open windows except the Project Window

Go to 'FILE > Model > MX GENIO file'

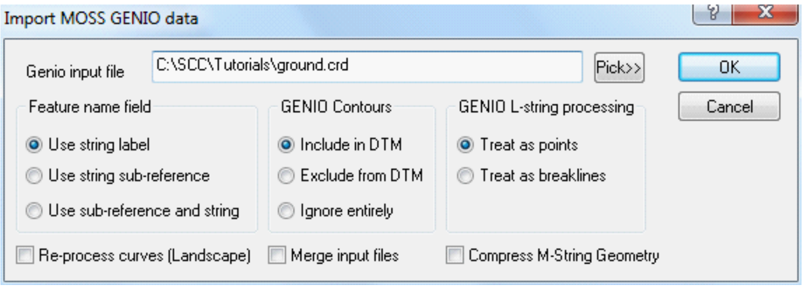
Select Pick

Go to the directory \SCC\Tutorials

Select the file 'GROUND.CRD'

Select Open

Set the GENIO L-string processing to Treat as points



Save the model as GROUND.model

Designing A Building Interface

Fill in the list boxes as required.

Enter 50.0 into the Level Control box

Go to 'EDIT > Add Strings with cursor'

Click on the right mouse button

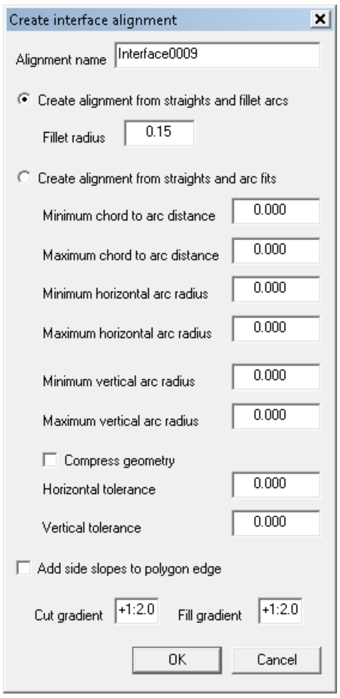
Select 'New > Polygon'

Draw a simple building

When you are finished, click the right mouse button

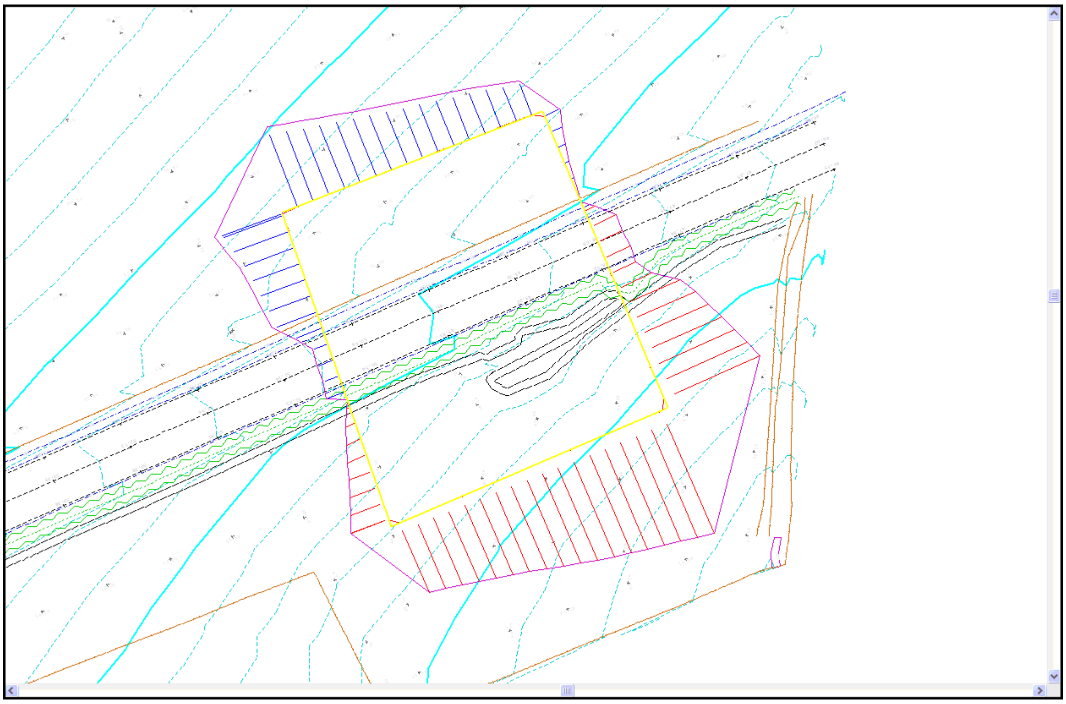
Select 'Save string as interface'

Set the Fillet Radius to 0.15



Select OK

The option Move/Edit Alignment is automatically activated and the design can be moved about the model until the correct amounts of cut and fill are indicated.

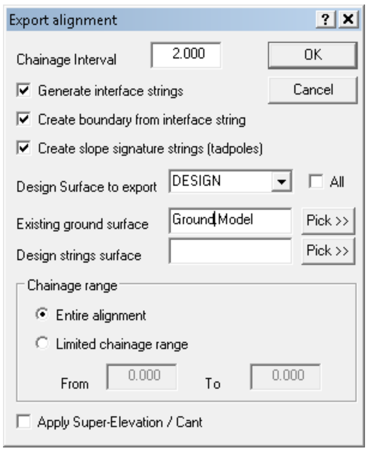


The design can then be exported to a model and used for calculating volumes as before.

Export Design To A Model

Go to the 'DESIGN > Export Design as a Model'

The dialog below will be displayed



Enter the relevant details

Select Ok to create the model

The model can be saved and volumes calculated between the design and the survey.

7.1 Simple Football Pitch Design

The following outlines designs steps with SCC to design a football football pitch (130m * 80m) with 1:2 side slopes and in turn to balance cut and fill. Specific parameters may be changes where appropriate to achieve the desired design

Open Existing Data

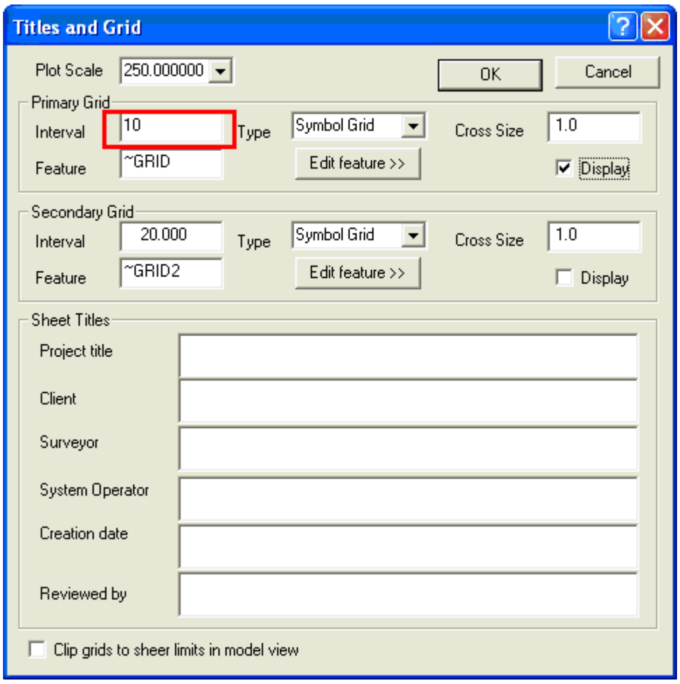
Select 'FILE>Open'

Open Project and Model

Construct Pitch

Turn On Grid as show below so that we can snap to grid points when drawing in pitch

Select 'VIEW > Titles & Grids'



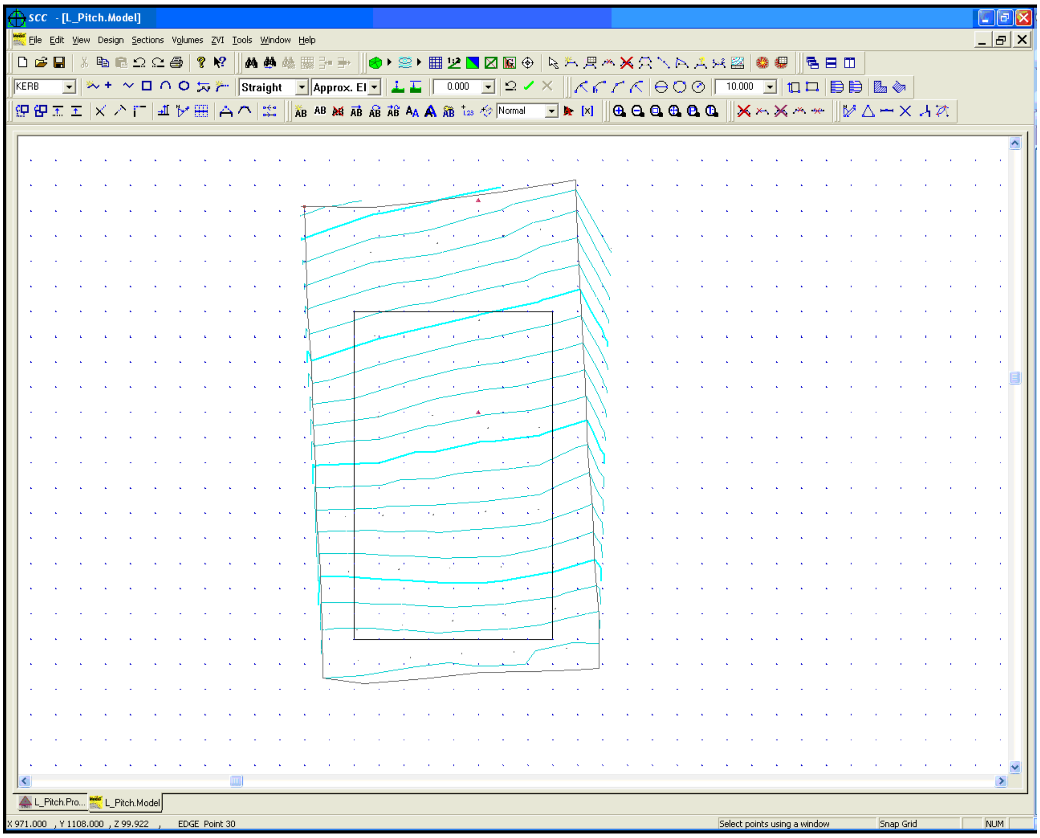
Pick feature from the drop down menu 'KERB' or 'PITCH' for example

Set the DTM status as 'Approx Elevation'

Turn snap grid on and Left click mouse at corner points of pitch

Right Click mouse, select 'Update string in model' to end string

With the grid points turned on the user can easily set out 130m*80m



Create Alignment String

We can use the alignment module to apply side slope to the pitch boundary string

Pick feature from the drop down menu 'KERB' or 'PITCH' for example

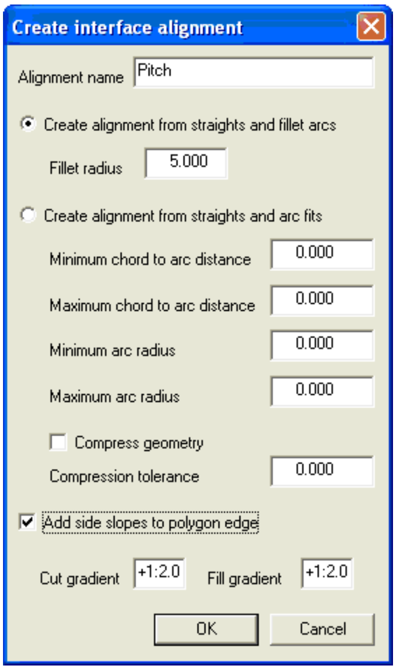
Set the DTM status as 'DTM'

Set the elevation to 90 (In this instance, 90 is the average height)

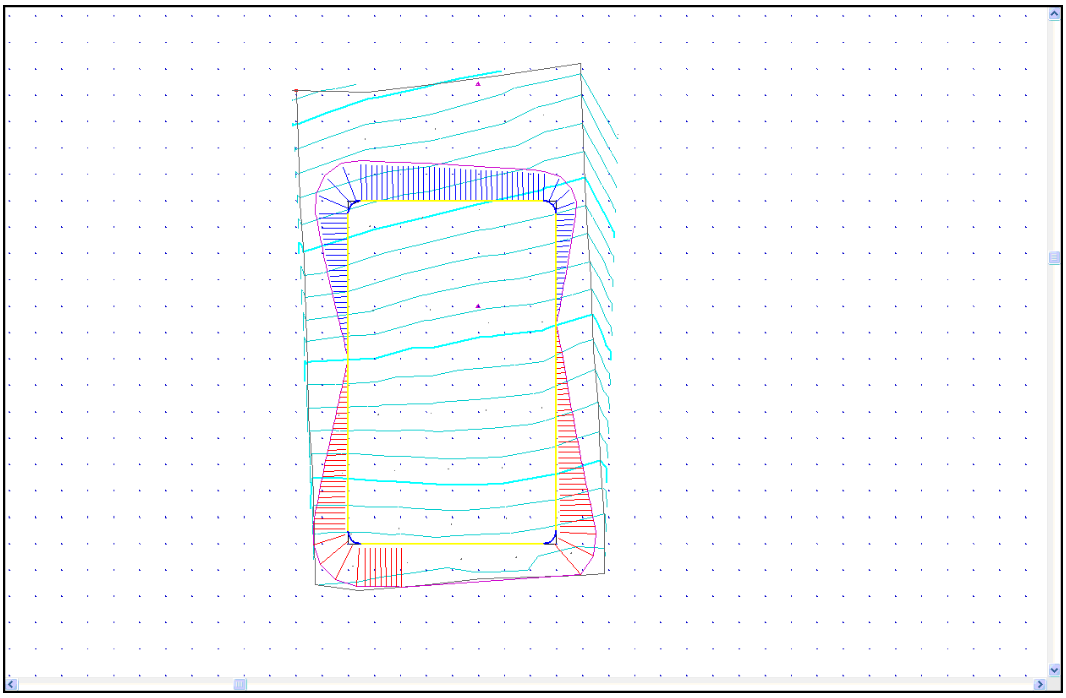
Turn snap grid on and Left click mouse at corner points of pitch

Right Click mouse, select 'Save As Interface String'

Set up the following:

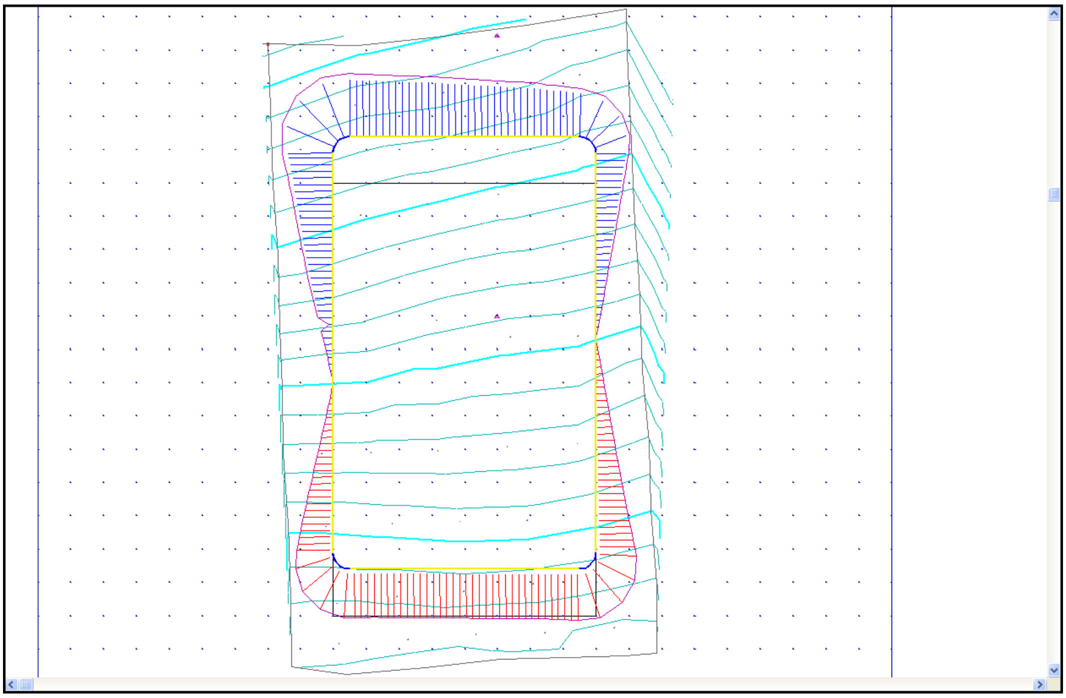


Revert to model



As can be seen in the model above, the pitch with 1:2 side slope does not currently fit (bottom side slopes not shown). We can manually move the alignment as follows:

Left click mouse on model, move cursor and a blue line will appear which will allow you to move the alignment in the line direction.



To check design parameters, select 'DESIGN > Section Template'

Turn on side slope of 1:2 for left side (String was drawn in a clockwise direction so we want the slope outside so therefore left must be selected)

Balance Cut & Fill

In order to allow the optimise cut and fill function to work the surface/model needs to be larger.

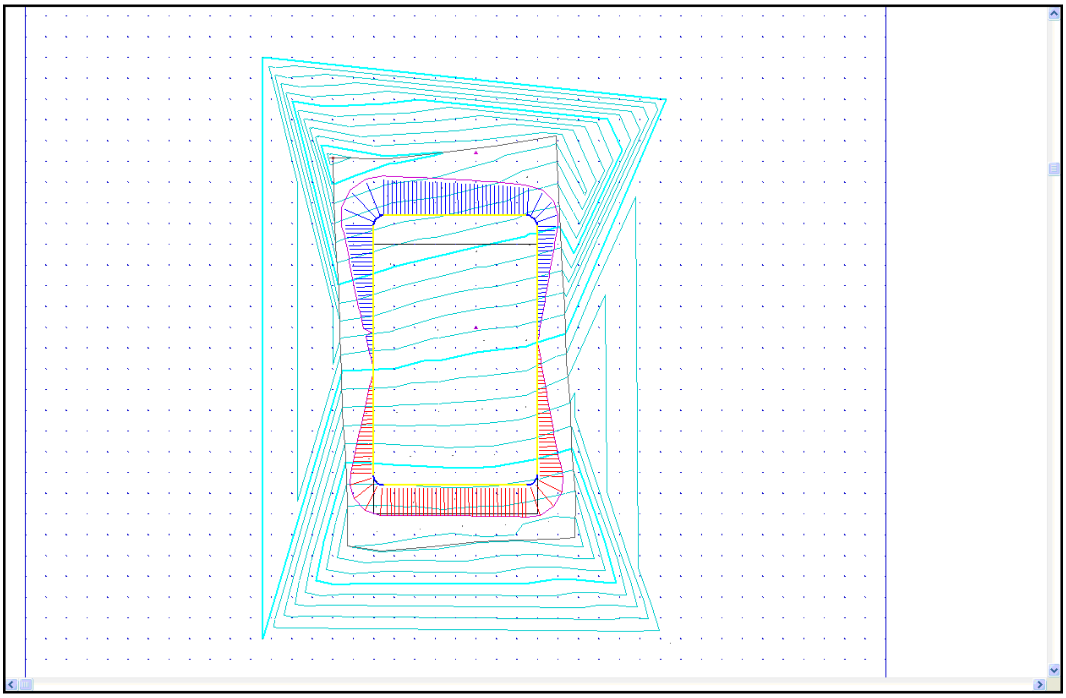
Draw in an arbitrary string around the field boundary at height of 90 for instance.

Pick feature from the drop down menu '0' for example

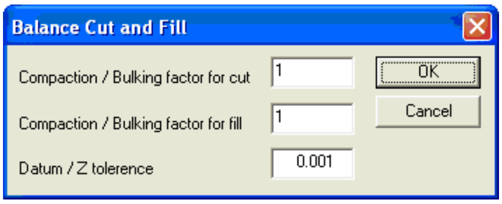
Set the DTM status as 'DTM' and height of '90' in the elevation box (circled in image below)

Left click mouse to place point

Right click mouse to select 'Update String in model'



Select 'DESIGN > Balance Cut and Fill'



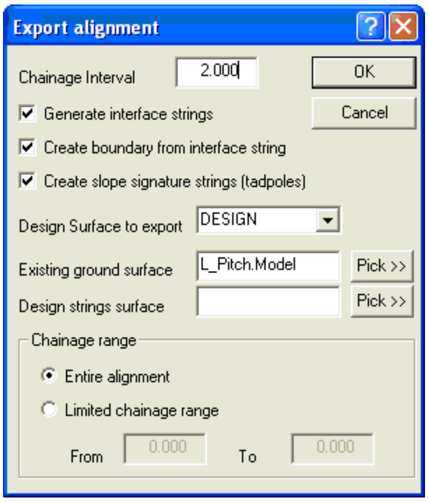
Select 'Ok' to except default 'Balance Cut and Fill' settings

Remove arbitrary string (delete points command)

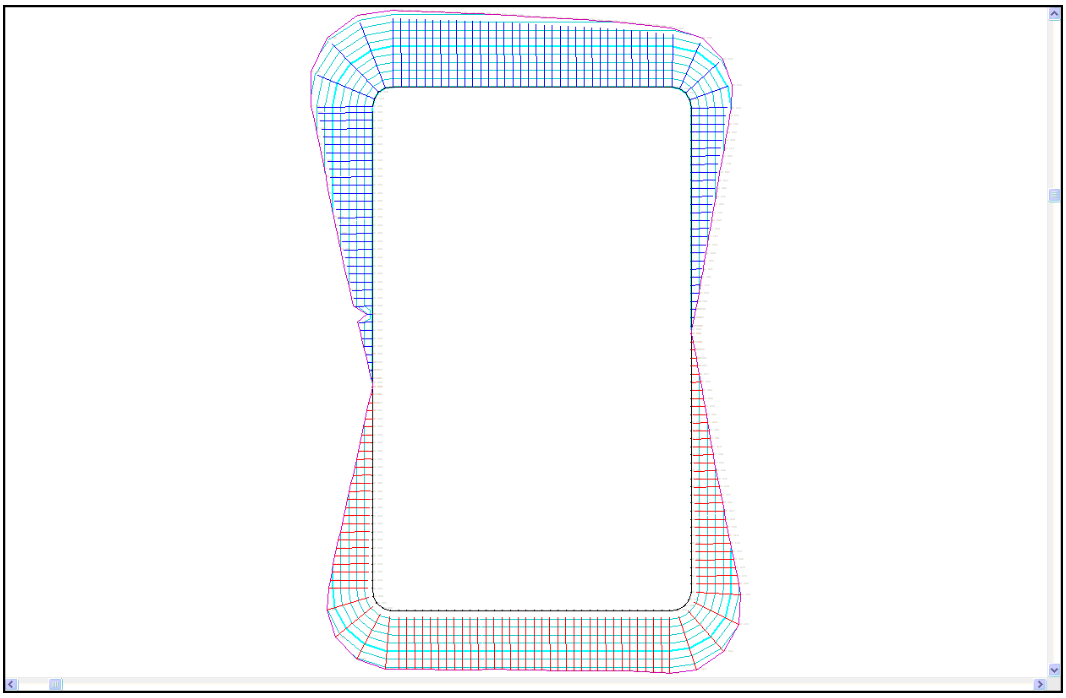
Export Design

Select 'DESIGN > Interface & Export parameters

Set up the following and ensure that original model is set as the ground surface



Select 'OK'



Sections

To verify a design generate cross sections:

Within Design Model, select 'SECTIONS > Long Section with Cursor'

Left click on first point of section and left click on last point

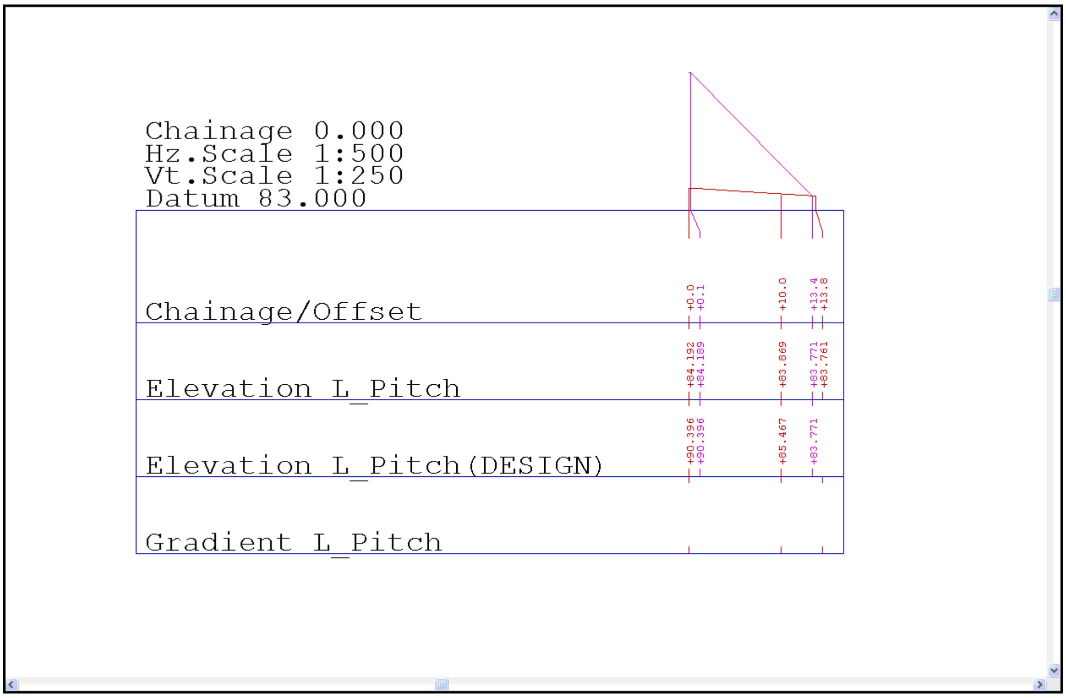
Right click to finish section

A good check is to also append the original surface:

Within the section, select 'VOLUMES > Append Surface'

Pick original surface

See sample section below:



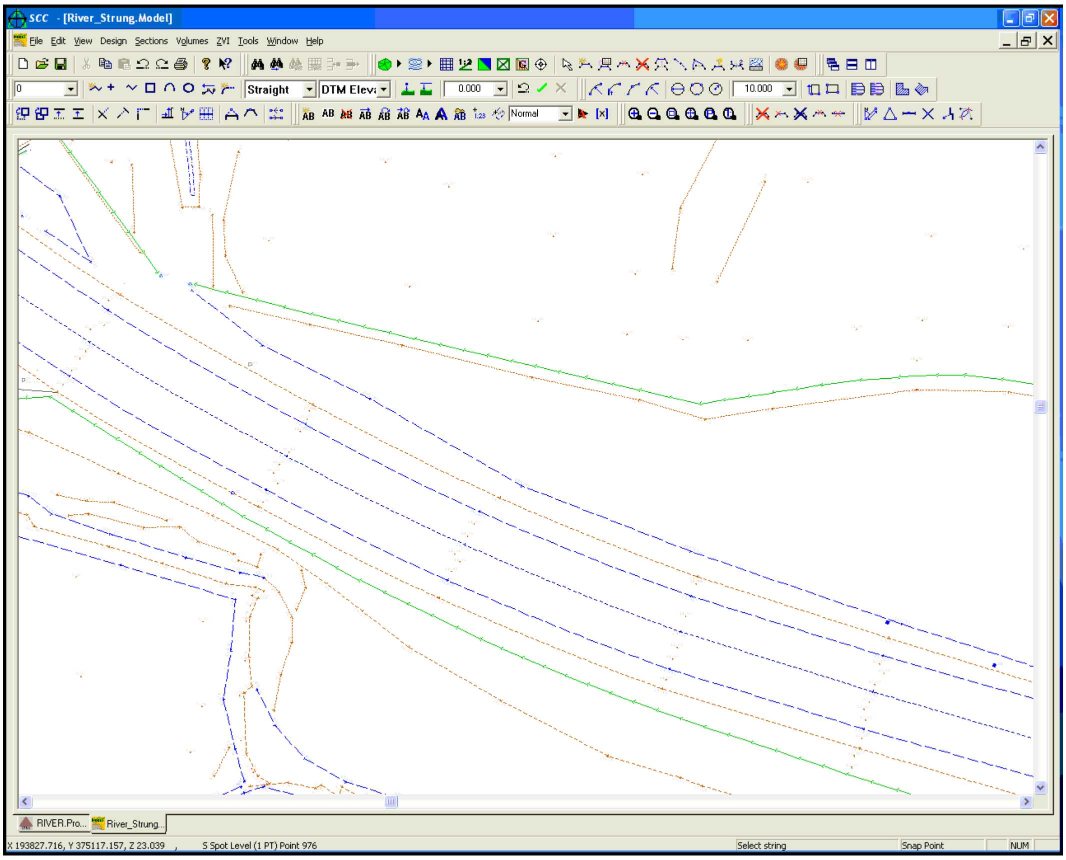
7.2 River Section: Sections From A Bandwidth

The following tutorial outlines the steps to generate River Sections from a centreline using a bandwidth.

'Section From A Bandwidth' method is typically used when creating river sections, where the surveyed section line is greater than the actual river width. The section is created using the surveyed elevations snapped, at right angles, onto the user-defined centreline**.**

Open Existing Data

Open 'RIVER.Project' and 'RIVER_Strung.Model' from '\SCC\Tutorials'

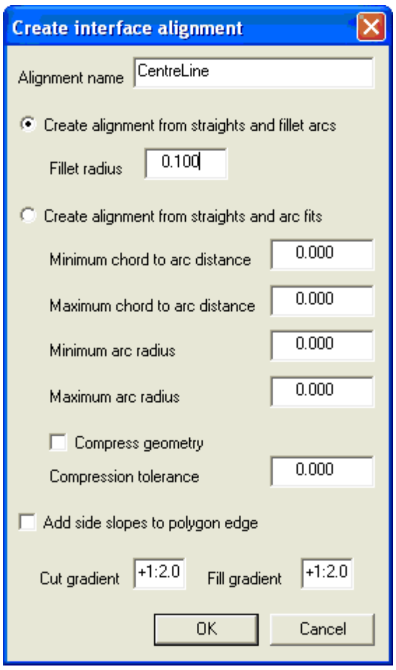


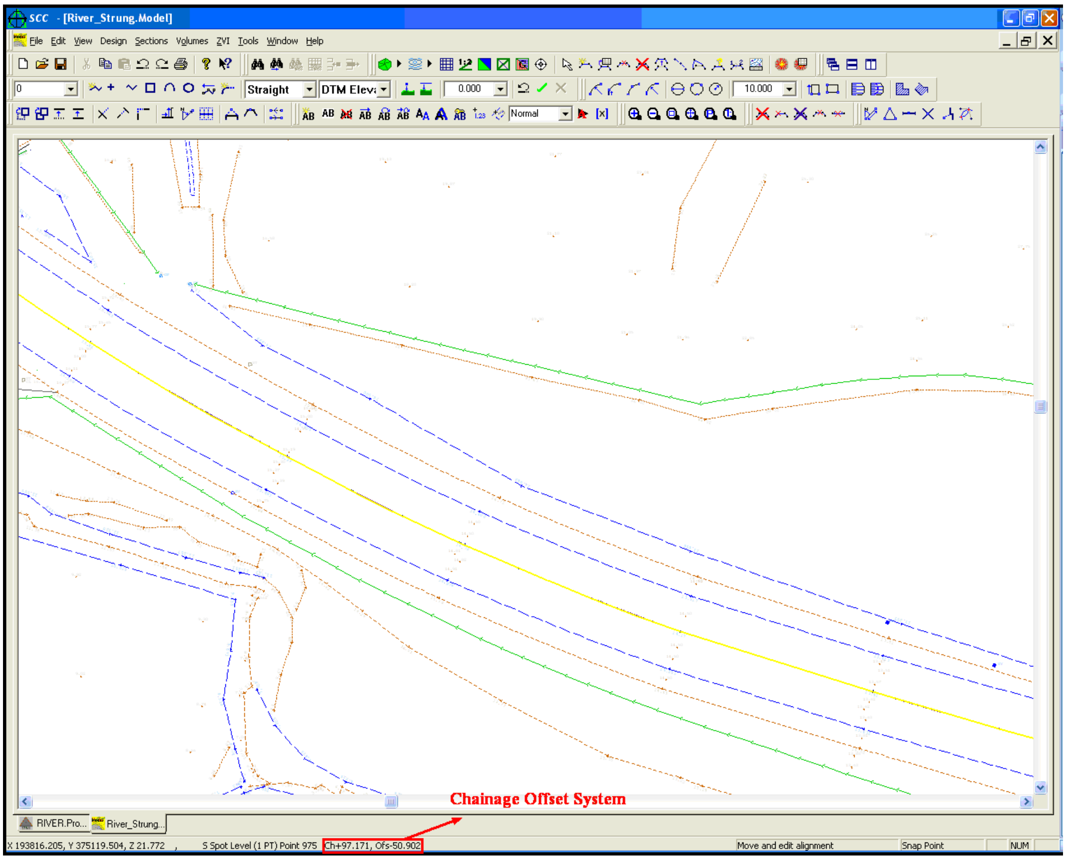
Creating Centreline Alignment

Select 'DESIGN > Create Alignment from String'

Left click on centreline of river

Enter Alignment Name



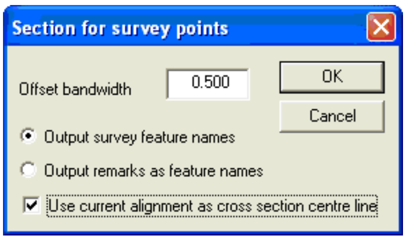


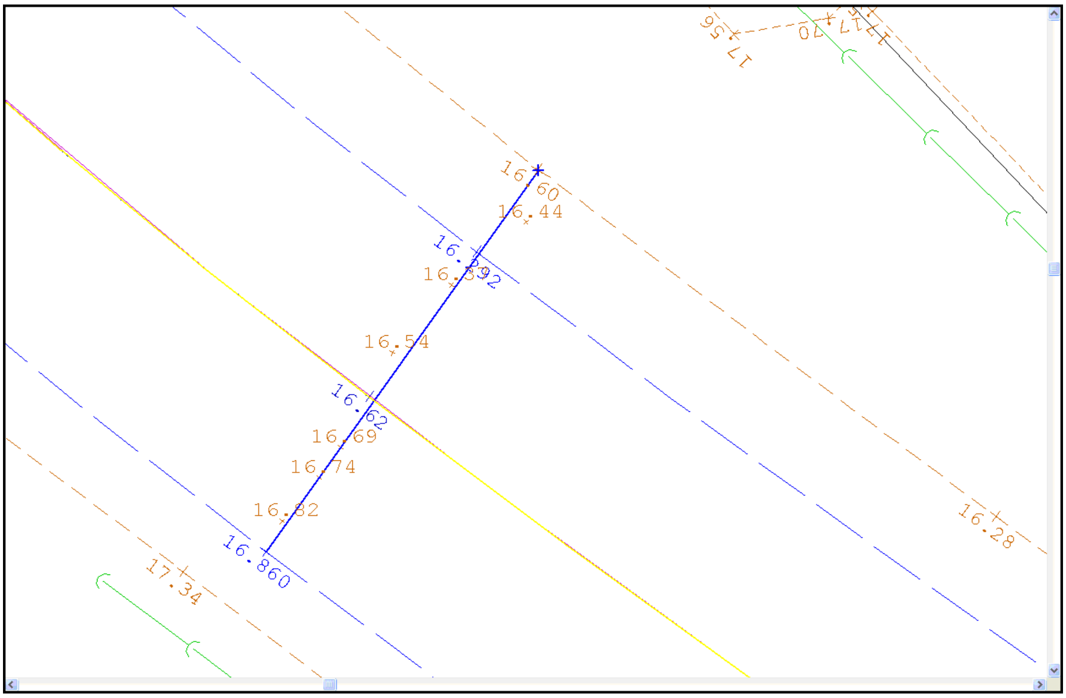
Generation of Sections

Select 'SECTIONS > Sections from a Bandwidth'

Set the desired bandwidth '0.500' for example

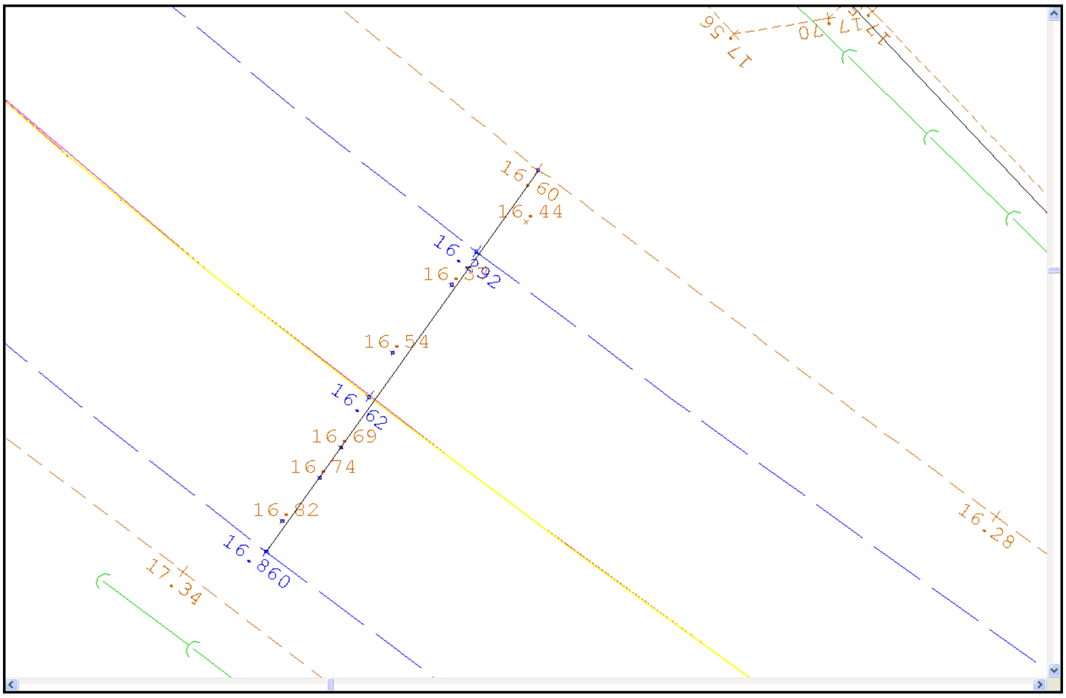
Set 'Output survey feature names' and 'Use current alignment as cross section centre line' as outlined below:

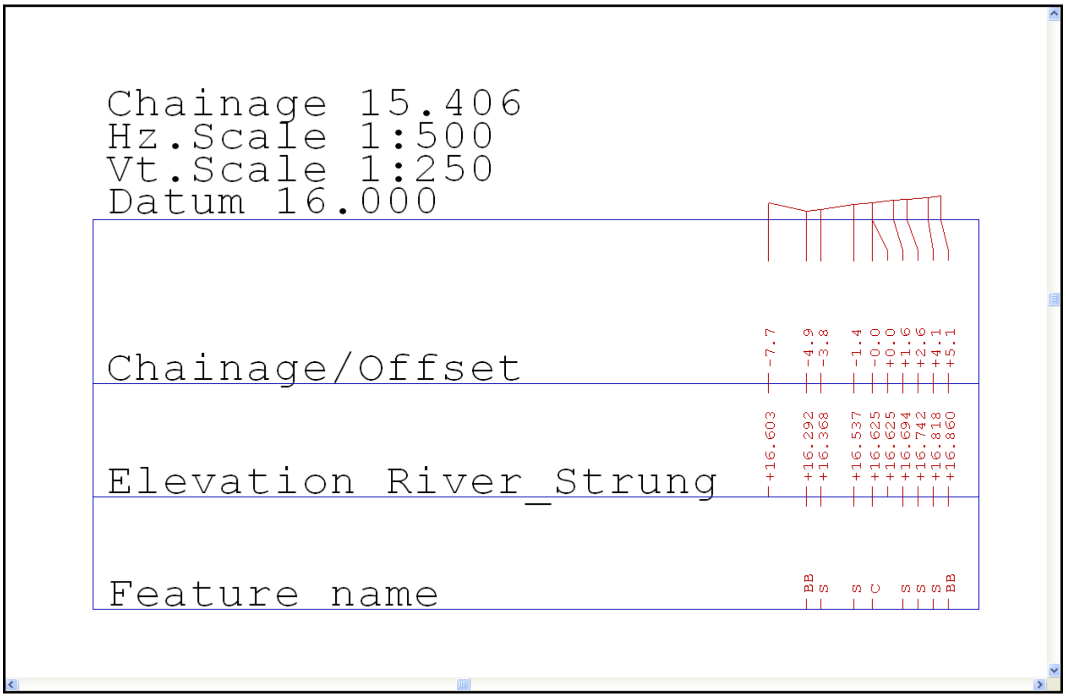




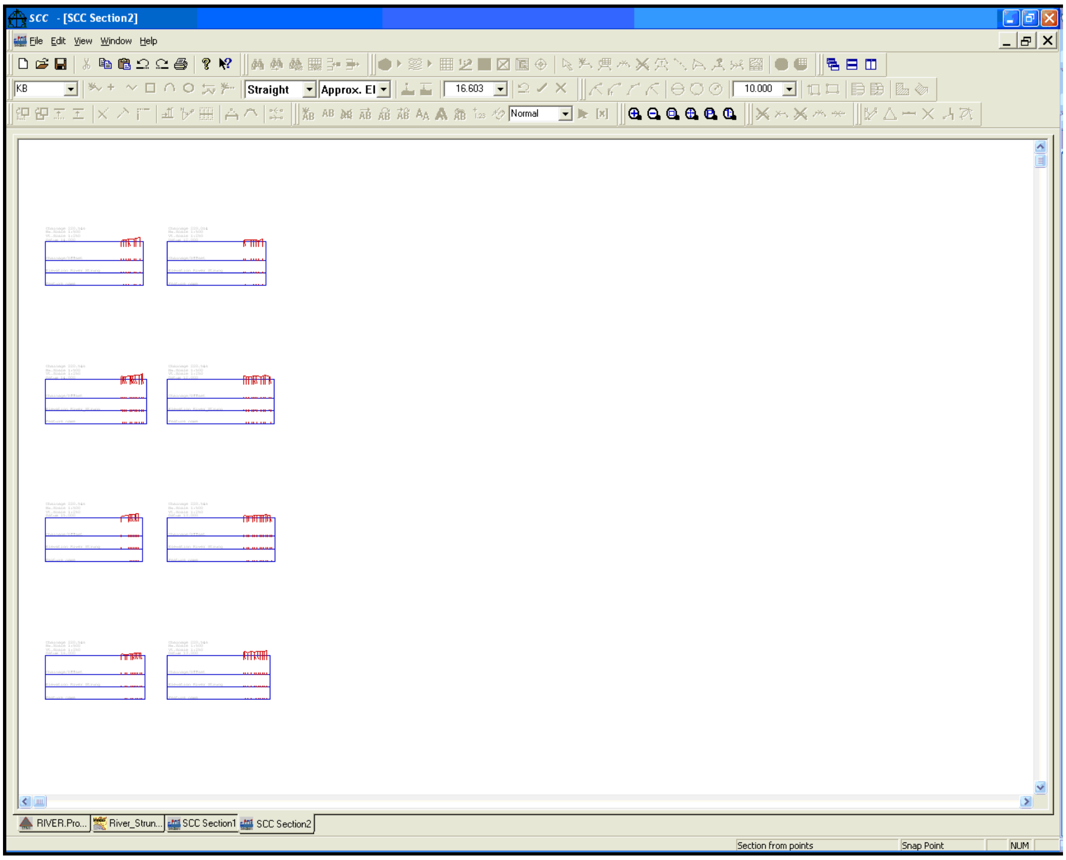
And secondly, all point within the set bandwidth are highlighted (in blue) for inclusion

Right click mouse to produce Section





By reverting to the model view without dropping the ‘Sections from a bandwidth’ command, that is, without selecting ‘Esc’, the user can move to the next cross section position and create a section.



Select ‘FILE > Save As > River.Sections’

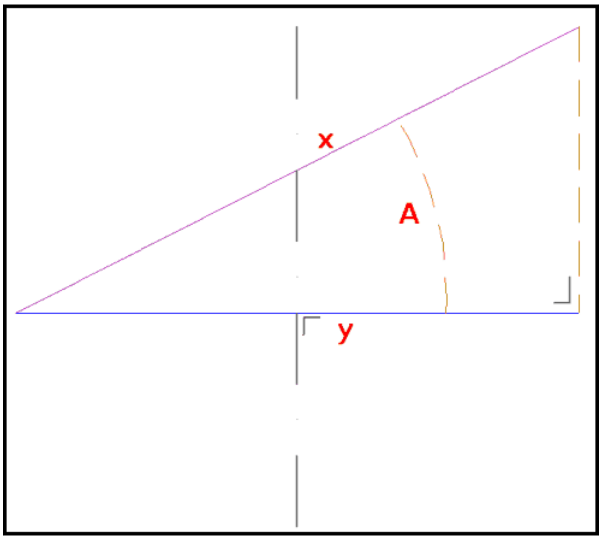
Skew Angle

Skew Angle is the angle of deviation from the normal to the centre line, that is, a skew angle of 0° implies that the cross section is at normal, right angle to the centre line.

A large skew angle means that the area of the cross section will be significantly larger than the cross section area at the river at that point.

Dividing the offsets of the cross section (the width of the cross section) by the Cosine of the skew angle may be used to normalise the cross section.

y = xCosA

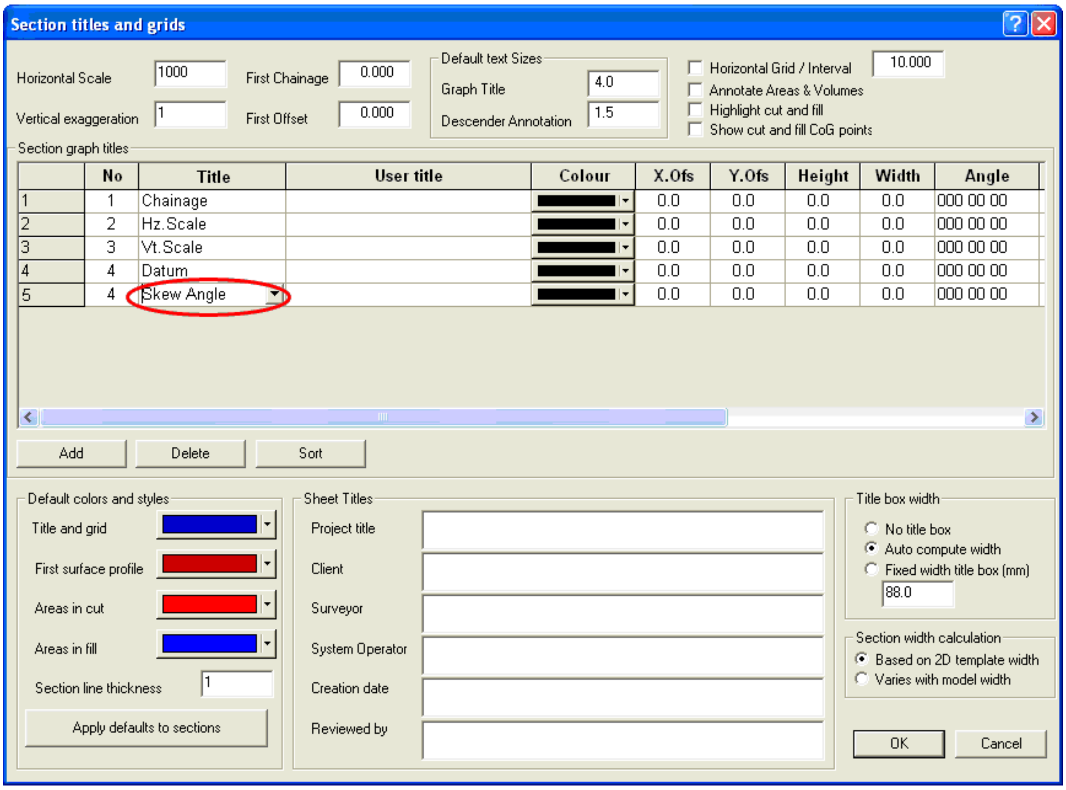


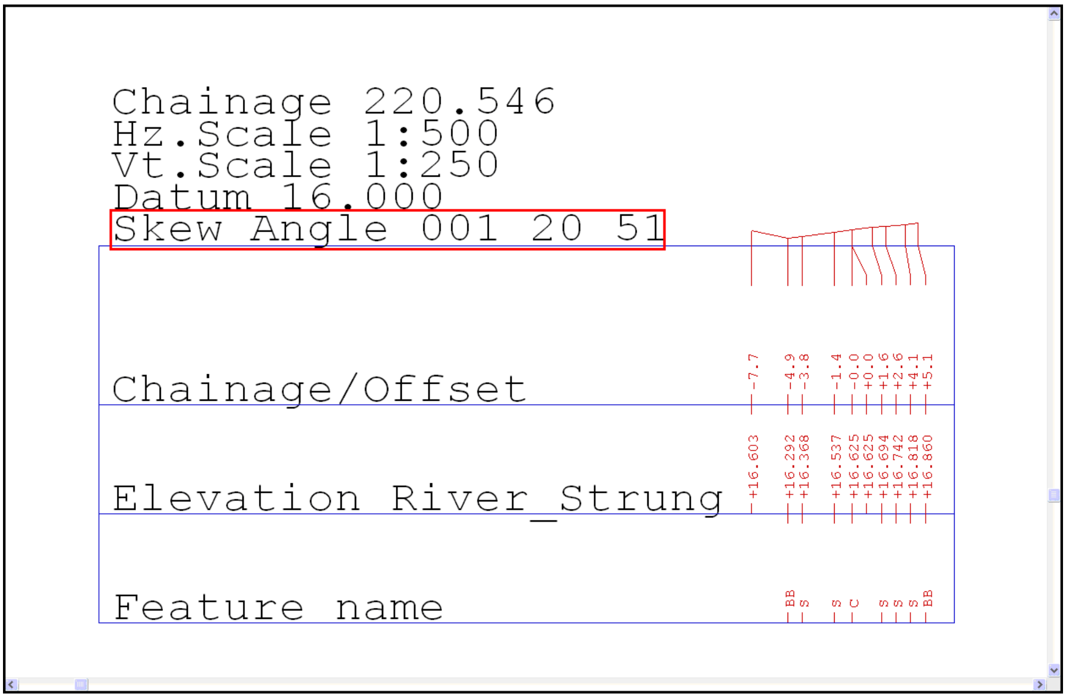
Annotation of Skew Angle

Select 'View > Scales, Titles & Grids'

Select 'Add' within the 'Section Graph Titles' Area

Within the Title Column, select 'Skew Angle' from drop down menu

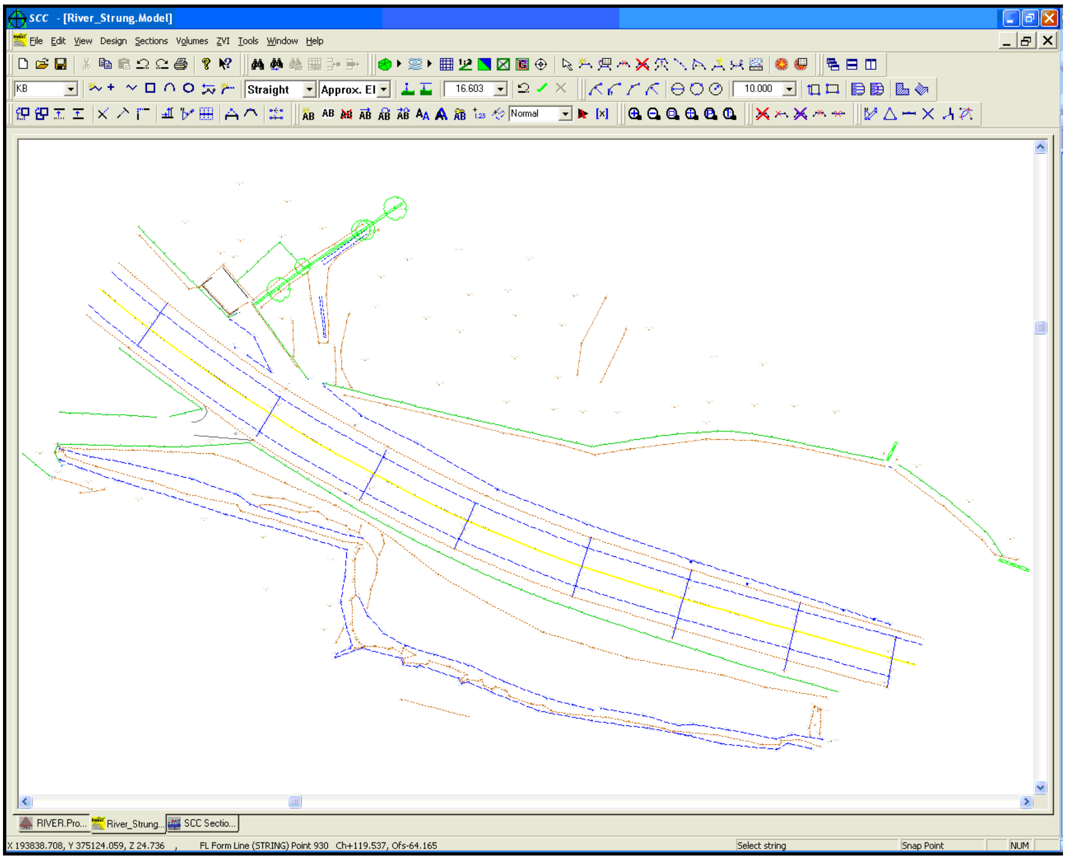




Attaching Sections

Select 'FILE > Attach/Detach > Attach Section File'

Select 'River.Sections'

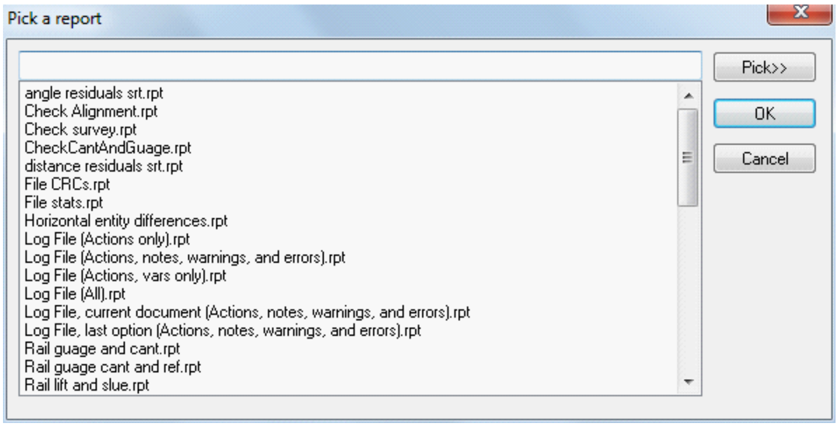


8 Reports Within SCC

SCC produces high quality reports from all SCC documents using the industry acclaimed Crystal reports engine. These reports can include data, charts, bitmaps and other rich content, and can be output to printers, PDF, Excel, HTML and Word files.

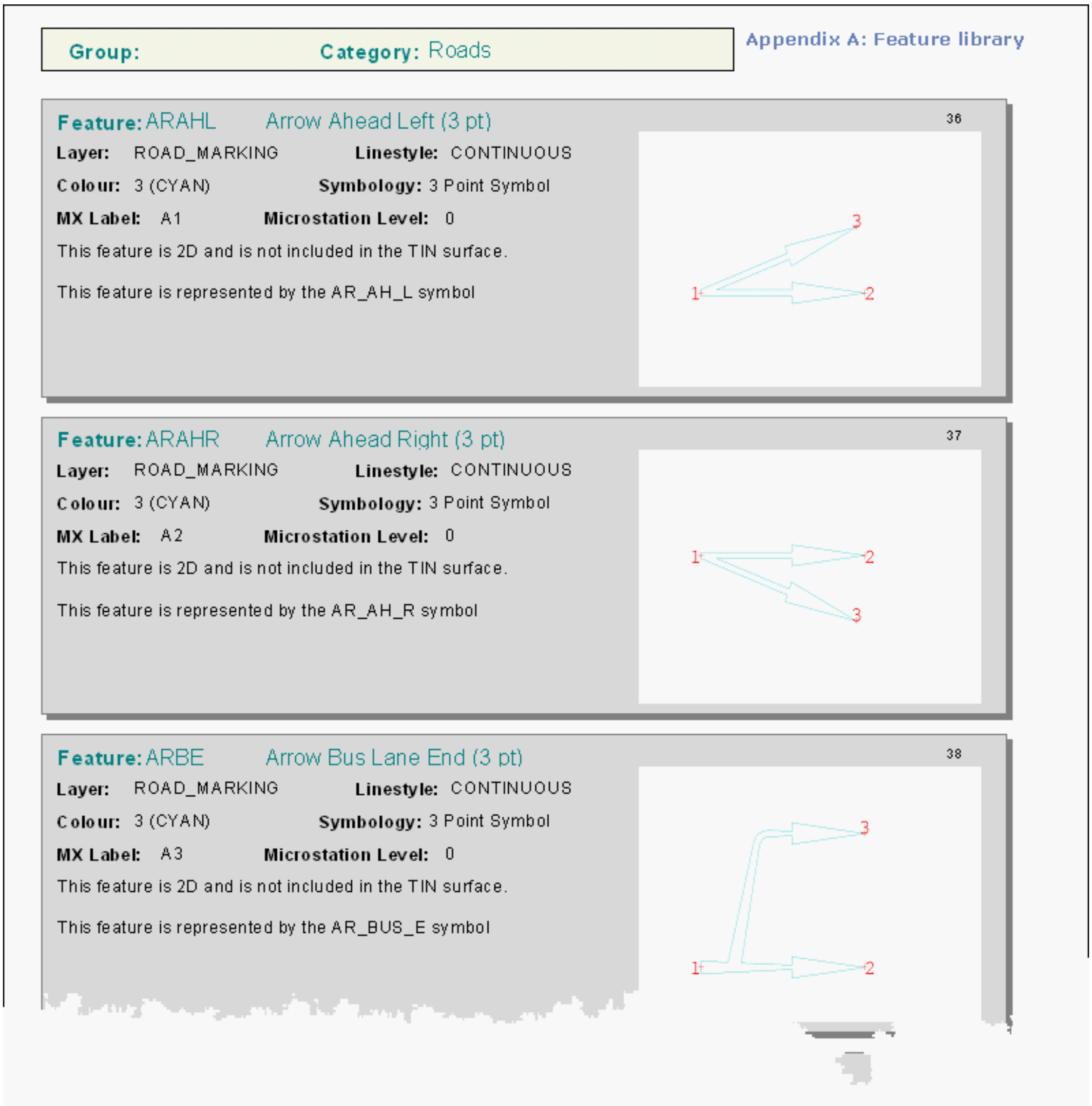
Sample reports are available within the SCC directory. These templates can be used to regenerate project specific report data directly from SCC. The Crystal reports also have the advantages that they allow the report layout to be readily changed without affecting the content, they allow automatic highlighting of out of spec values such that they can be easily picked up by anyone reading the report, and they can be readily exported to a range of formats including Word, PDF, Excel and HTML.

Note that while creation of new report formats requires a Crystal reports license, creation, viewing, printing and export of reports is included within the SCC license. To view a report, click **'FILE>Reports'** and select sample report.



Extract from sample files provides can be viewed below:

Sample Feature Library Report:



Group: **Category:** Roads

Appendix A: Feature library

Feature: ARAHL Arrow Ahead Left (3 pt) 36

Layer: ROAD_MARKING **Linestyle:** CONTINUOUS

Colour: 3 (CYAN) **Symbology:** 3 Point Symbol

MX Label: A1 **Microstation Level:** 0

This feature is 2D and is not included in the TIN surface.

This feature is represented by the AR_AH_L symbol

Feature: ARAHR Arrow Ahead Right (3 pt) 37

Layer: ROAD_MARKING **Linestyle:** CONTINUOUS

Colour: 3 (CYAN) **Symbology:** 3 Point Symbol

MX Label: A2 **Microstation Level:** 0

This feature is 2D and is not included in the TIN surface.

This feature is represented by the AR_AH_R symbol

Feature: ARBE Arrow Bus Lane End (3 pt) 38

Layer: ROAD_MARKING **Linestyle:** CONTINUOUS

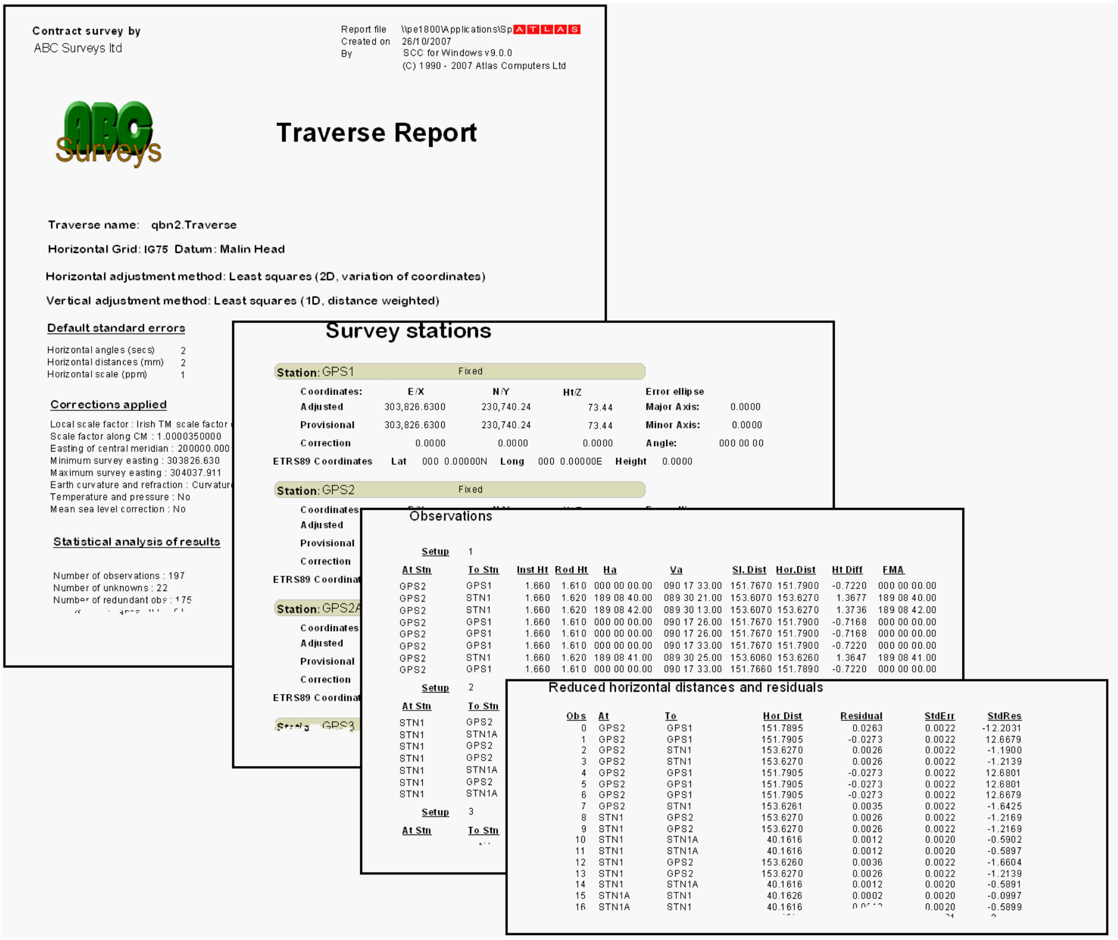
Colour: 3 (CYAN) **Symbology:** 3 Point Symbol

MX Label: A3 **Microstation Level:** 0

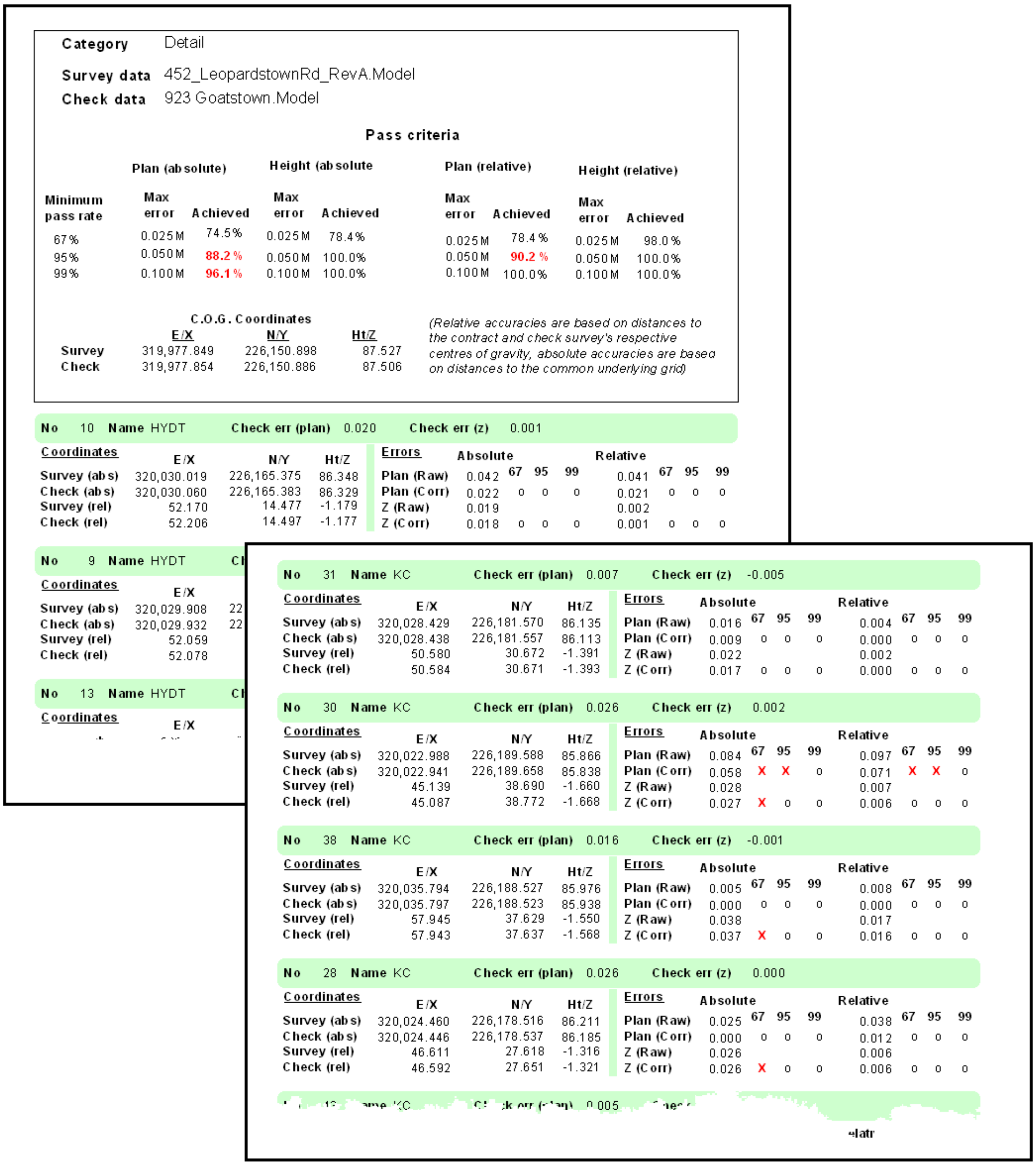
This feature is 2D and is not included in the TIN surface.

This feature is represented by the AR_BUS_E symbol

Sample Traverse Report:



Sample Check Survey Report:



Category	Detail
Survey data	452_LeopardstownRd_RevA.Model
Check data	923 Goatstown.Model

Pass criteria

Minimum pass rate	Plan (absolute) Max error	Achieved	Height (absolute) Max error	Achieved	Plan (relative) Max error	Achieved	Height (relative) Max error	Achieved
67%	0.025M	74.5%	0.025M	78.4%	0.025M	78.4%	0.025M	98.0%
95%	0.050M	88.2%	0.050M	100.0%	0.050M	90.2%	0.050M	100.0%
99%	0.100M	96.1%	0.100M	100.0%	0.100M	100.0%	0.100M	100.0%

C.O.G. Coordinates

	E/X	N/Y	Ht/Z
Survey	319,977.849	226,150.898	87.527
Check	319,977.854	226,150.886	87.506

(Relative accuracies are based on distances to the contract and check survey's respective centres of gravity, absolute accuracies are based on distances to the common underlying grid)

No 10 **Name** HYDT **Check err (plan)** 0.020 **Check err (z)** 0.001

Coordinates	E/X	N/Y	Ht/Z	Errors	Absolute	67	95	99	Relative	67	95	99
Survey (abs)	320,030.019	226,165.375	86.348	Plan (Raw)	0.042				0.041			
Check (abs)	320,030.060	226,165.383	86.329	Plan (Corr)	0.022	o	o	o	0.021	o	o	o
Survey (rel)	52.170	14.477	-1.179	Z (Raw)	0.019				0.002			
Check (rel)	52.206	14.497	-1.177	Z (Corr)	0.018	o	o	o	0.001	o	o	o

No 9 **Name** HYDT

Coordinates	E/X
Survey (abs)	320,029.908
Check (abs)	320,029.932
Survey (rel)	52.059
Check (rel)	52.078

No 13 **Name** HYDT

No 31 **Name** KC **Check err (plan)** 0.007 **Check err (z)** -0.005

Coordinates	E/X	N/Y	Ht/Z	Errors	Absolute	67	95	99	Relative	67	95	99
Survey (abs)	320,028.429	226,181.570	86.135	Plan (Raw)	0.016				0.004			
Check (abs)	320,028.438	226,181.557	86.113	Plan (Corr)	0.009	o	o	o	0.000	o	o	o
Survey (rel)	50.580	30.672	-1.391	Z (Raw)	0.022				0.002			
Check (rel)	50.584	30.671	-1.393	Z (Corr)	0.017	o	o	o	0.000	o	o	o

No 30 **Name** KC **Check err (plan)** 0.026 **Check err (z)** 0.002

Coordinates	E/X	N/Y	Ht/Z	Errors	Absolute	67	95	99	Relative	67	95	99
Survey (abs)	320,022.988	226,189.588	85.866	Plan (Raw)	0.084				0.097			
Check (abs)	320,022.941	226,189.658	85.838	Plan (Corr)	0.058	X	X	o	0.071	X	X	o
Survey (rel)	45.139	38.690	-1.660	Z (Raw)	0.028				0.007			
Check (rel)	45.087	38.772	-1.668	Z (Corr)	0.027	X	o	o	0.006	o	o	o

No 38 **Name** KC **Check err (plan)** 0.016 **Check err (z)** -0.001

Coordinates	E/X	N/Y	Ht/Z	Errors	Absolute	67	95	99	Relative	67	95	99
Survey (abs)	320,035.794	226,188.527	85.976	Plan (Raw)	0.005				0.008			
Check (abs)	320,035.797	226,188.523	85.938	Plan (Corr)	0.000	o	o	o	0.000	o	o	o
Survey (rel)	57.945	37.629	-1.550	Z (Raw)	0.038				0.017			
Check (rel)	57.943	37.637	-1.568	Z (Corr)	0.037	X	o	o	0.016	o	o	o

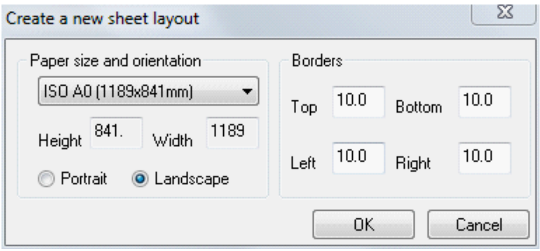
No 28 **Name** KC **Check err (plan)** 0.026 **Check err (z)** 0.000

Coordinates	E/X	N/Y	Ht/Z	Errors	Absolute	67	95	99	Relative	67	95	99
Survey (abs)	320,024.460	226,178.516	86.211	Plan (Raw)	0.025				0.038			
Check (abs)	320,024.446	226,178.537	86.185	Plan (Corr)	0.000	o	o	o	0.012	o	o	o
Survey (rel)	46.611	27.618	-1.316	Z (Raw)	0.026				0.006			
Check (rel)	46.592	27.651	-1.321	Z (Corr)	0.026	X	o	o	0.006	o	o	o

9 Plotting From SCC

There are plotting facilities in SCC for creating and editing sheet layouts. These facilities work with all Windows compatible plotters and printers, with full print preview.

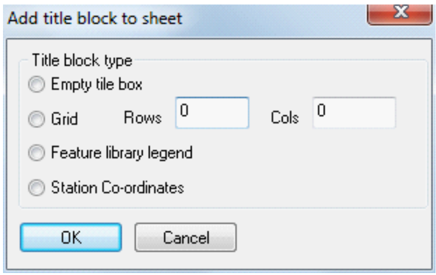
Sheet layouts can be imported from DXF or created in SCC as a model file. This file can then be added to the feature library within a project or attached to a model using the 'Attach/Detach' option under the 'FILE' menu. To create a new sheet template, go to 'FILE > Sheet Layout > Create new sheet template' and select the paper size and orientation.



Title blocks, legends and station co-ordinate boxes can be added to the template and it is then saved to the current project file.

When you have added a title block to the sheet, a dialog will be displayed. This option allows the user to add and design title blocks for a sheet template.

The box is positioned using the right mouse button; the first click should be used to position the top left corner of the data box and the second click to denote the bottom right corner of the box. When the box is drawn the following dialog is presented:



Selecting one of the options on this dialog will determine the type of data displayed. The options are as follows:

Empty Title Box

This option allows the user to add an empty rectangular box to the sheet model, which can be used for data entry, borders etc.

Grid

When selecting this option, the user also needs to enter a value for the amount of rows or columns required in the grid. The grid may be used for entering data such as 'Project Name', 'Scale' or 'Date' etc..

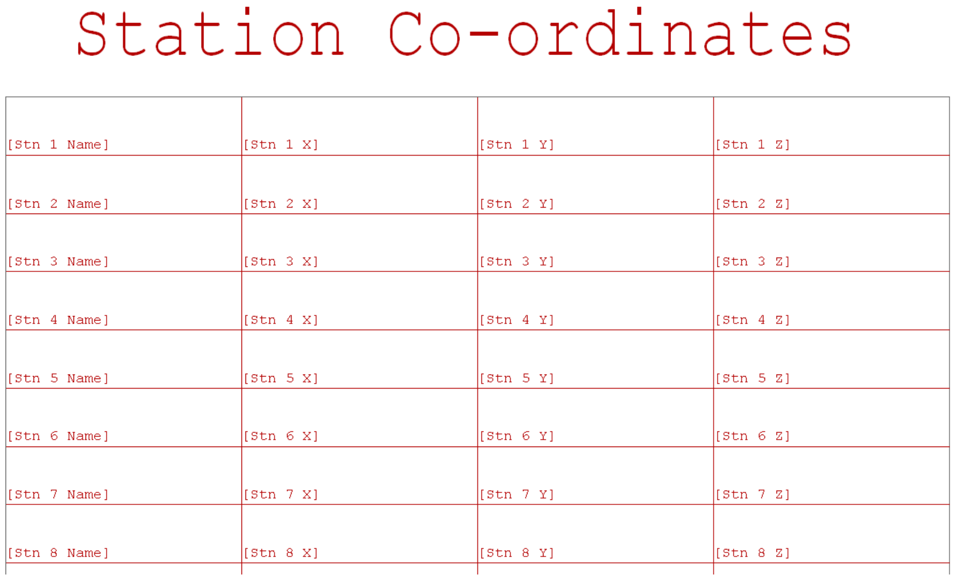
Feature Library Legend

To select this option the user must enter a value in the rows box. This value indicates the total amount of feature library entries the user would like to display in the legend when the sheet is inserted into the model. This works by taking each entry in the model in sequential record number and displaying the description and the linetype or symbol in the feature library legend. Features that are not used in the model, do not count.

Station Co-Ordinates

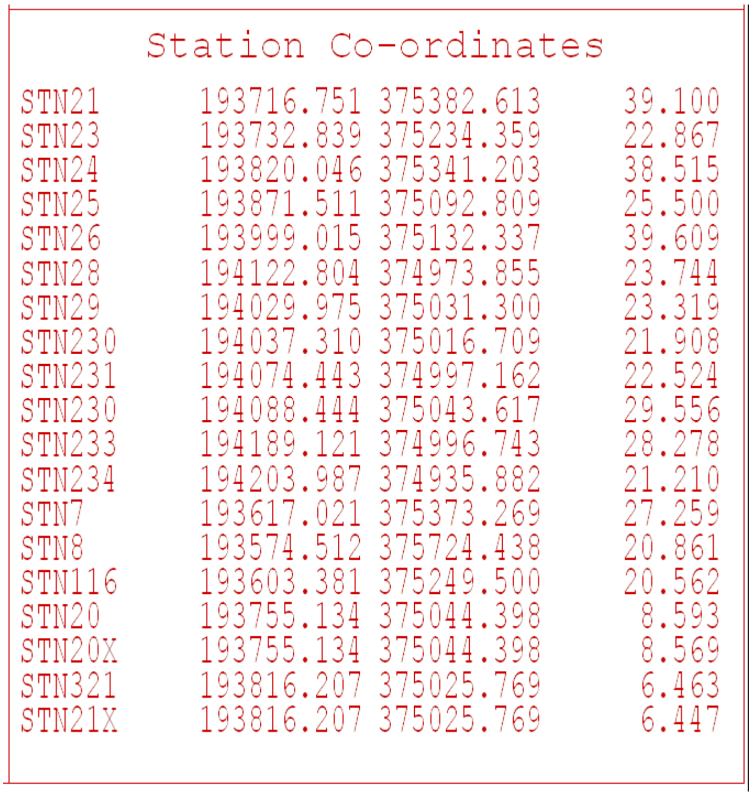
The user must also enter a value in the rows box. The value entered is the total amount of station coordinates that the user wishes to display on the sheet, where STN 1 is the first record number in the station coordinates spreadsheet.

The images below show how the station coordinate box appears both in the sheet template and in the model.



Station Co-ordinates

[Stn 1 Name]	[Stn 1 X]	[Stn 1 Y]	[Stn 1 Z]
[Stn 2 Name]	[Stn 2 X]	[Stn 2 Y]	[Stn 2 Z]
[Stn 3 Name]	[Stn 3 X]	[Stn 3 Y]	[Stn 3 Z]
[Stn 4 Name]	[Stn 4 X]	[Stn 4 Y]	[Stn 4 Z]
[Stn 5 Name]	[Stn 5 X]	[Stn 5 Y]	[Stn 5 Z]
[Stn 6 Name]	[Stn 6 X]	[Stn 6 Y]	[Stn 6 Z]
[Stn 7 Name]	[Stn 7 X]	[Stn 7 Y]	[Stn 7 Z]
[Stn 8 Name]	[Stn 8 X]	[Stn 8 Y]	[Stn 8 Z]



Station Co-ordinates

STN21	193716.751	375382.613	39.100
STN23	193732.839	375234.359	22.867
STN24	193820.046	375341.203	38.515
STN25	193871.511	375092.809	25.500
STN26	193999.015	375132.337	39.609
STN28	194122.804	374973.855	23.744
STN29	194029.975	375031.300	23.319
STN230	194037.310	375016.709	21.908
STN231	194074.443	374997.162	22.524
STN230	194088.444	375043.617	29.556
STN233	194189.121	374996.743	28.278
STN234	194203.987	374935.882	21.210
STN7	193617.021	375373.269	27.259
STN8	193574.512	375724.438	20.861
STN116	193603.381	375249.500	20.562
STN20	193755.134	375044.398	8.593
STN20X	193755.134	375044.398	8.569
STN321	193816.207	375025.769	6.463
STN21X	193816.207	375025.769	6.447

You can design the sheet template by adding your own company logo, the company feature library and legend and also additional information about stations, bench level values and location.

Below is a list of macros that can be used to create the sheet template. When the sheet is inserted into a model or section these macros will be automatically updated with the relevant job data, either from the operating system that is being used or from the data entered into the 'Titles & Grids' dialog.

Sheet Creation Macros

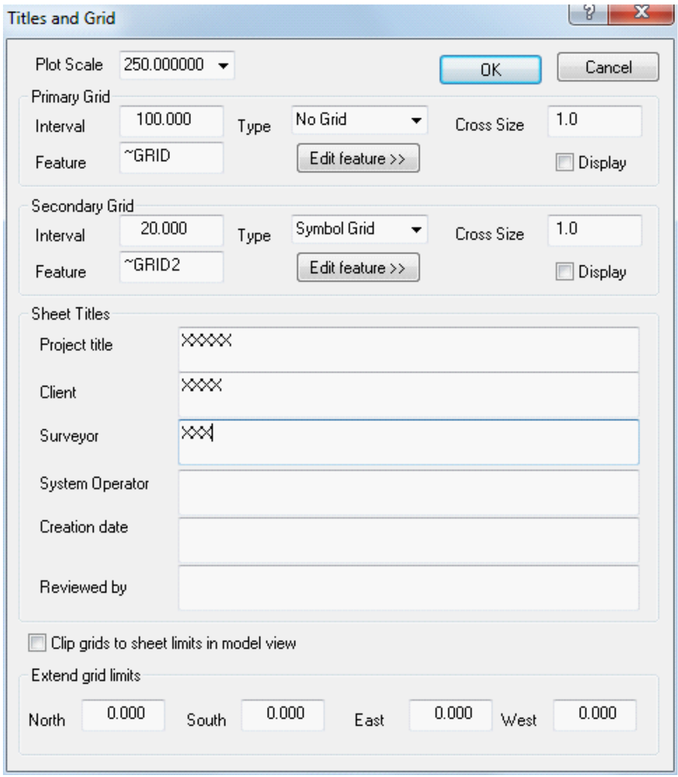
Operating System

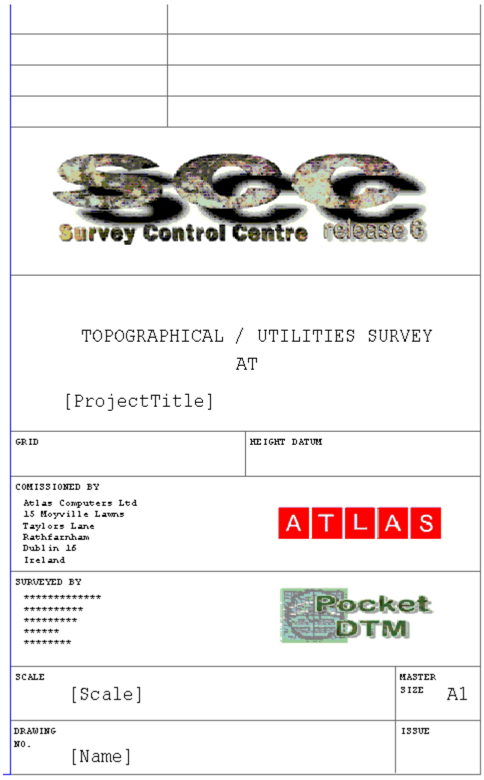
[Name}	Model / Section Name
[Path	Full Model/Section path
[Project]	Project Name
[Time]	Current time
[Version	SCC Version & Dongle Number
[Scale	Plot Scale
[Page]	Sheet Number
[Pages]	Number of Pages

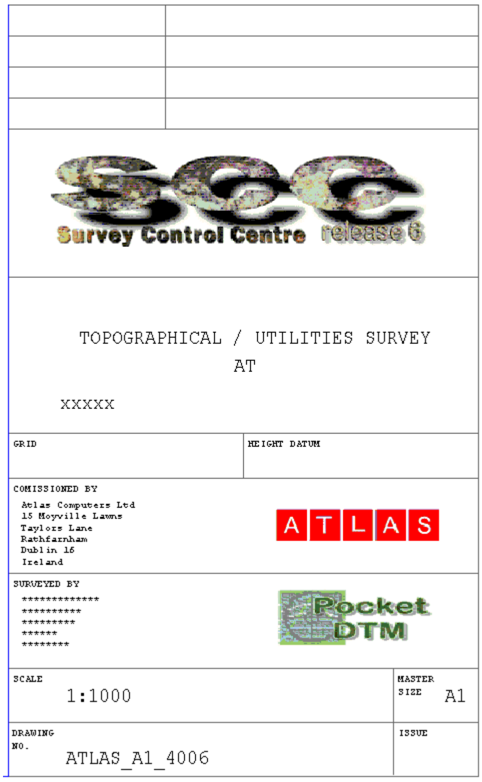
Titles & Grids Dialog

[ProjectTitle]	Job Name / Title
[Client	Client Name
[Date]	Date
[Surveyor]	Username
[Operator]	Operator

See the images below for an example of how the macros use the data entered in the ‘Titles & Grids’ dialog. The first grid box displays the macros typed in sheet creation. The second grid box show how the macros are used when inserted into the model.







Create A New Sheet Layout

Start with a blank screen

Go to 'FILE > Open'

Change FILES OF TYPE to 'Project'

Select 'Default.project'.

Go to 'FILE > Sheet Layout > create New Sheet Template'

Select the paper size and orientation.

Select OK

Select OK to view the model

Remember, when creating a new sheet template, to allow enough margin space to accommodate the printer rollers on your selected printer. These may vary across printers and though the sheet size will be correct, it may stop the print process if the margin size is not large enough.

Saving The Template

To save the sheet template, go to 'FILE > Sheet Layout > Save Sheet Template'

Enter a name for your sheet (it is good to contain the size of the sheet in the name)

Select Ok

Close the model

Go into the project file

Select 'FILE > Save'

Save the project file

Inserting Sheet Into Model

Once the template has been saved to a project file, any model created with this project will store the new sheet in the feature library. This sheet can then be inserted into the model and viewed either within the model view or by print preview. Remember, to view the layout in print preview, you must have the correct sheet size selected in the print set-up!

Inserting the sheet into the model

Open the FGL. Model file

Go to 'FILE > Sheet Layout > Insert Sheet'

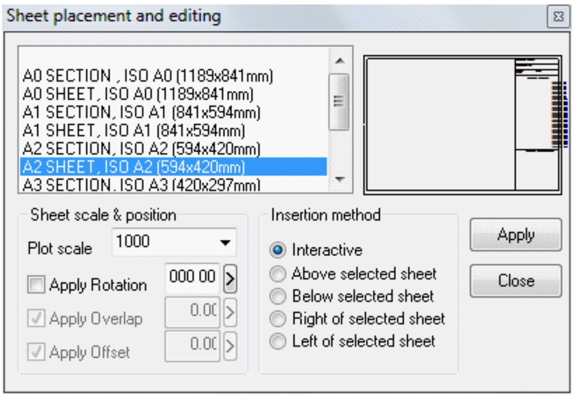
Select the sheet you wish to insert, from the list

Set the correct orientation and plot scale

Note that the plot scale effects the size of the sheet relevant to the model.

Then drag the sheet and place it over the model

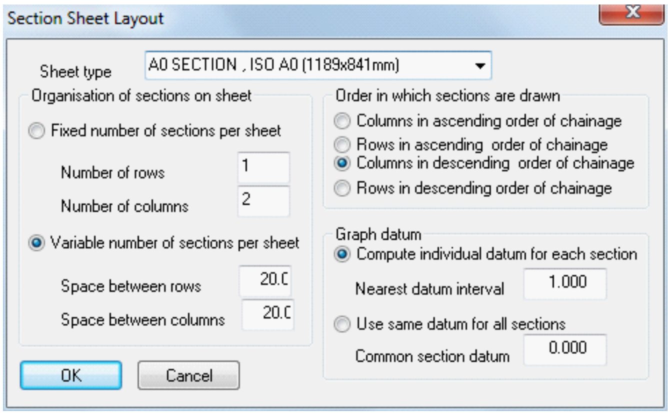
Pressing the left mouse button once will secure the sheet in position



Once the sheet is in the model, it can be rotated, moved and the plot scale changed. If there is more than one sheet in the model, it is possible to view each sheet individually by changing the view number in the control box on the Sheet Layout menu bar.

Sections

Once the sheet layouts have been saved to the feature library, these can then be used to plot sections and profiles. The method of inserting sheets into section drawings differs slightly from that of the model. Once a section has been generated, a sheet can be inserted by going to the 'VIEW' menu and selecting 'Section Sheet Layout'. You can then select the sheet of your choice and also set the way in which you sections appear on the sheet.



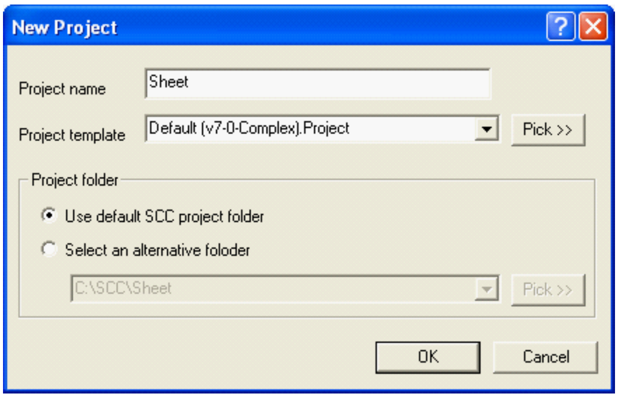
9.1 Creating Sheets in SCC

The following outlines the creation of a SCC Sheet Layout:

A.Set Up Project

Open a 'New Project' and attach the 'Default(v7-0 Complex).Project' template.

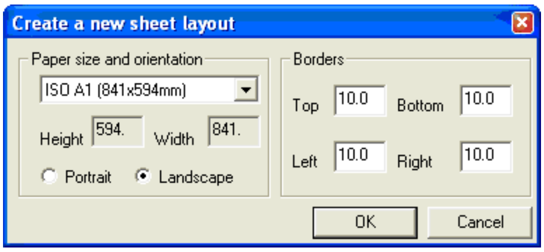
Call the project 'Sheet'



B.Creating Sheet Layout

Go to 'FILE > Sheet Layout > Create Sheet'

A dialog is displayed with a selection of sheet sizes and orientations. Select a sheet.



A model of the selected sheet is generated. The user can add text to the title blocks, creating an individual sheet style for the company. Symbols can also be added to the models. These symbols can be created from dxf files and are especially useful for inserting north arrows or company logos. See Symbols.

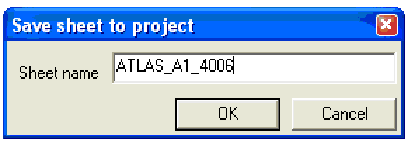
C.Save Model

Save the model 'FILE > Save As'

This means that the sheet can be edited at a later date and the previous template overwritten.

D.Save Sheet Layout

To add the template to the feature library, go to 'FILE > Sheet Layout > Save Sheet Template' and give the template a name. This template will be automatically saved to the current project library.



E.Export Sheet & Import Sheet into Default Project

In order to make this sheet available to use within other project, it is necessary to output the sheet layout and import the file into the necessary project.

Go to 'EDIT > Sheet Layout > Export Symbols to File'

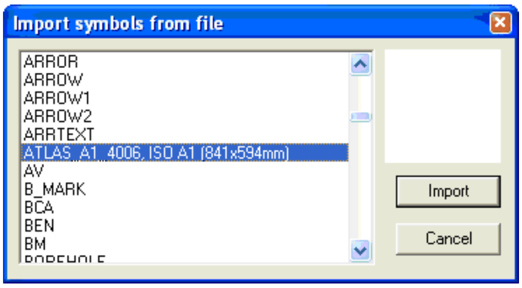
Select 'No' to 'Do you want to overwrite it'

The sheet can then be importing into the default library as follows:

Open Default Project

Select 'EDIT > Symbols > Import Symbols from File'

Select Sheet Layout to import



Select 'Import'

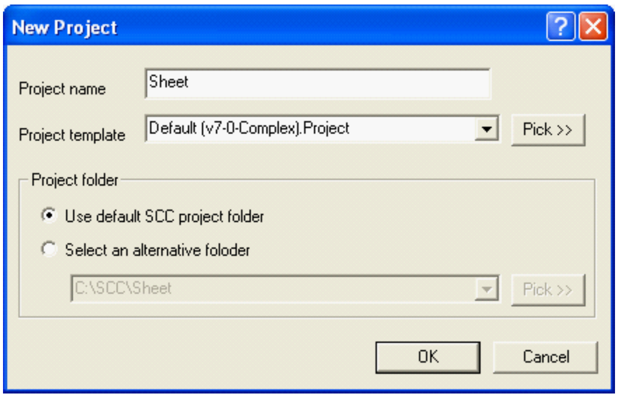
9.2 Creating a SCC Sheet Layout From a DXF/DWG file

The following outlines the creation of an SCC Sheet Layout from a given dxf file.

A.Set Up Project

Open a 'New Project' and attach the 'Default (v7-0 Complex).Project' template.

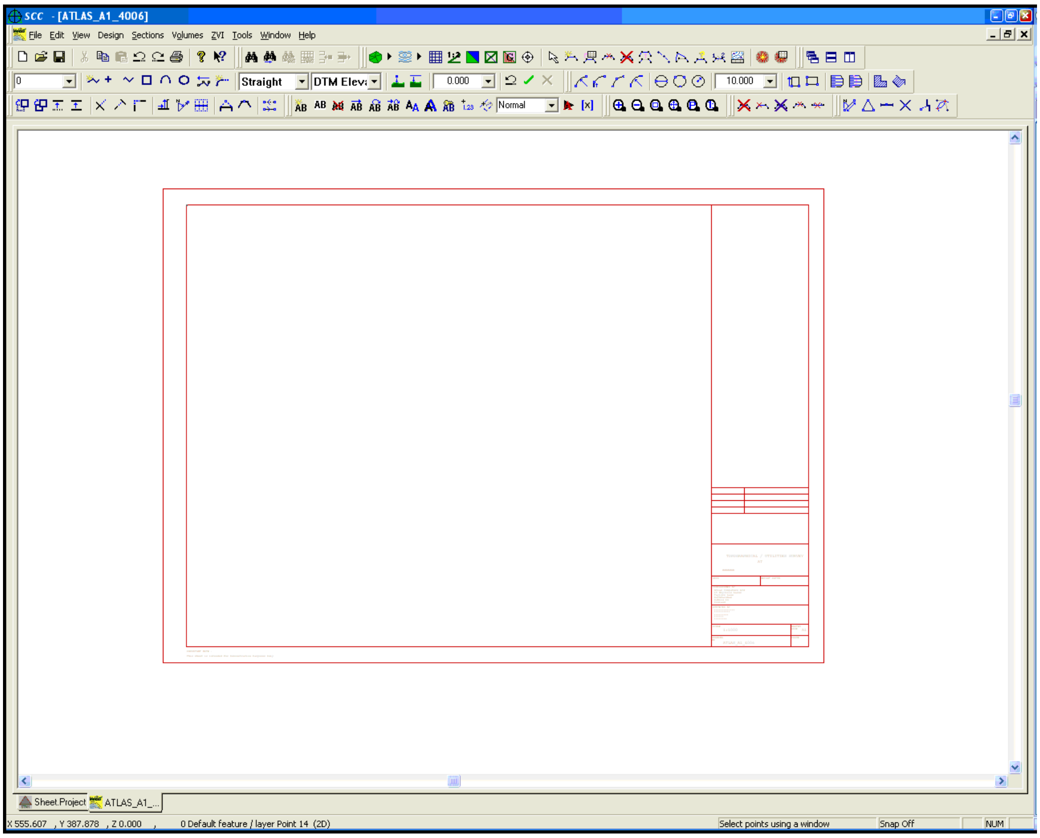
Call the project 'Sheet'



B.Model DXF Sheet

Go to 'Model > DXF file'

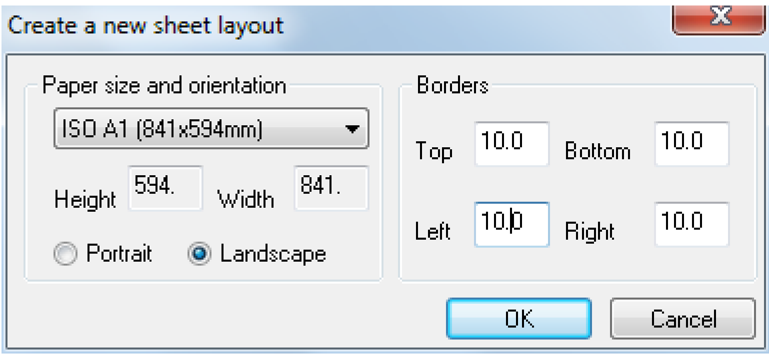
Select 'ATLAS_A1_4006.dwg'

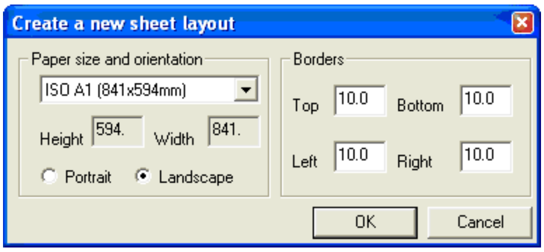


C.Creation of New Sheet Layout

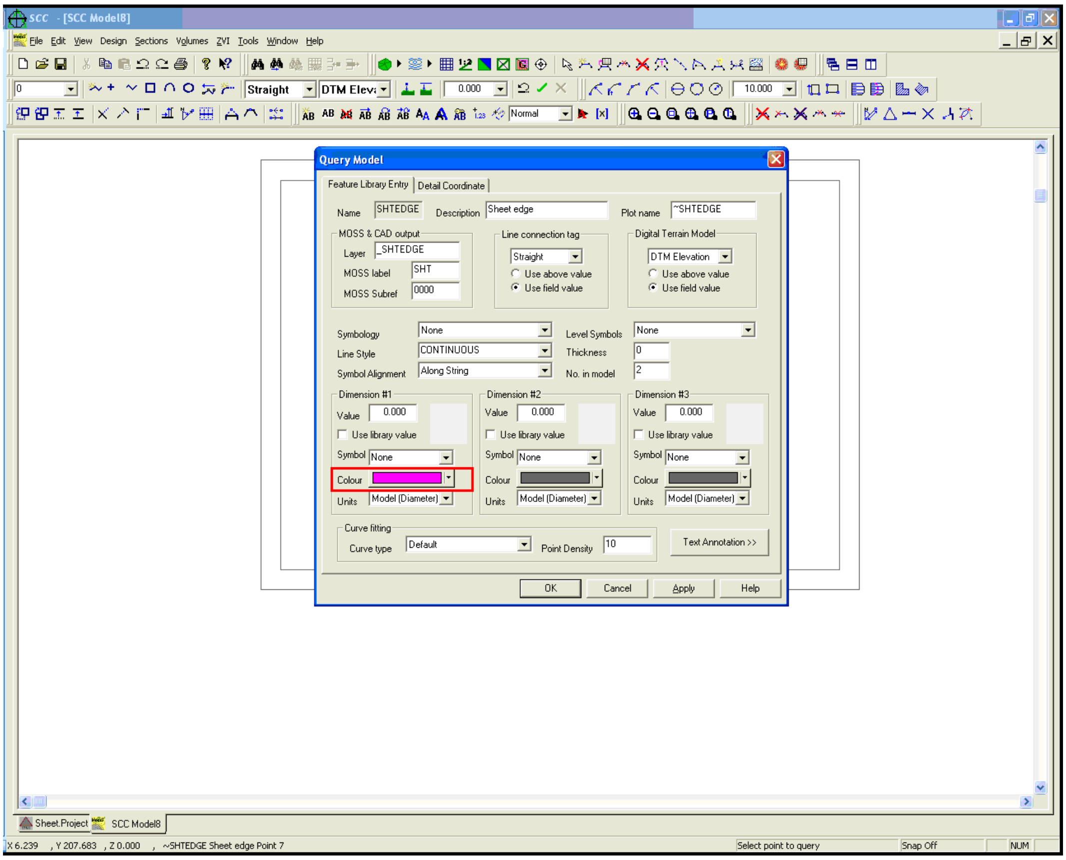
Go to 'File > Sheet Layout > Create a New Sheet Layout'

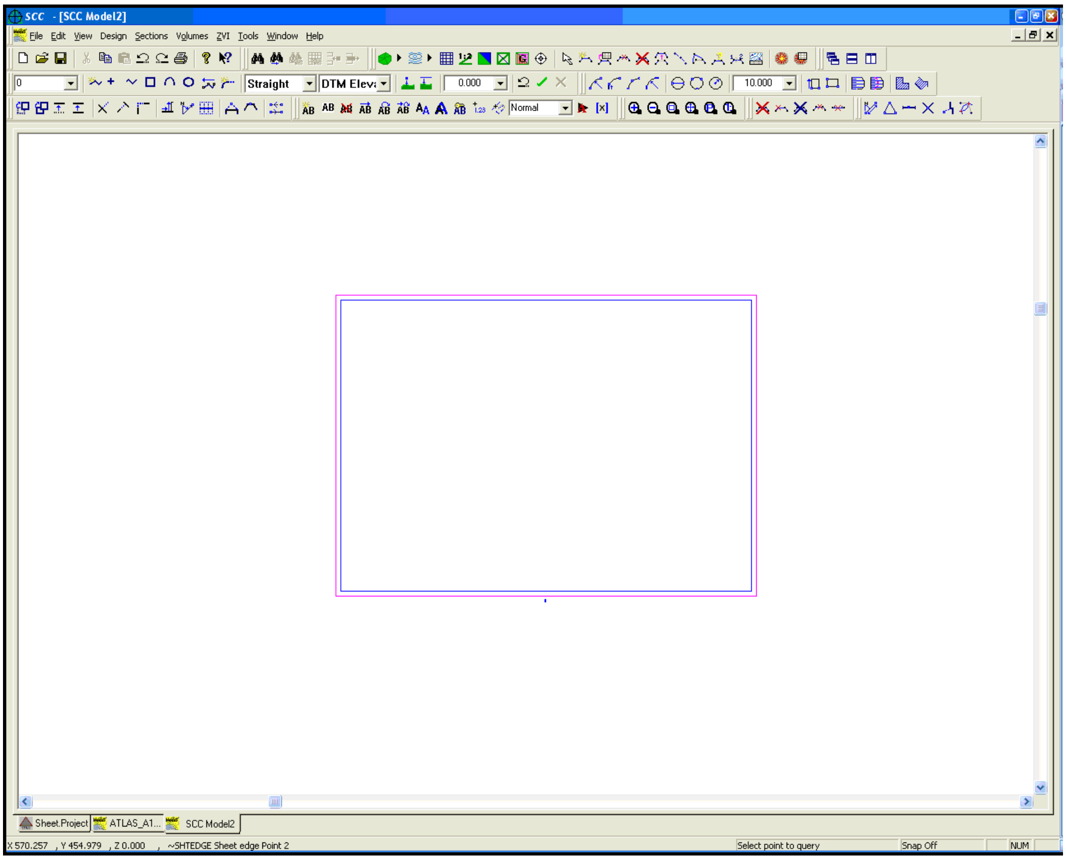
Select 'ISO A1' and enter the relevant border settings as follows:



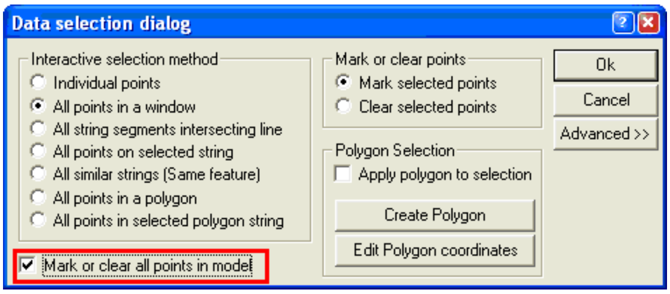


To easily identify the sheet edge and the border (clipping frame) use the 'Query and Edit' function to change the colour of each.





Goto 'Atlas_A4_4006.Model', right click to access 'Data Selection Dialog Box' and select ' Mark or clear all points in the model highlight all points



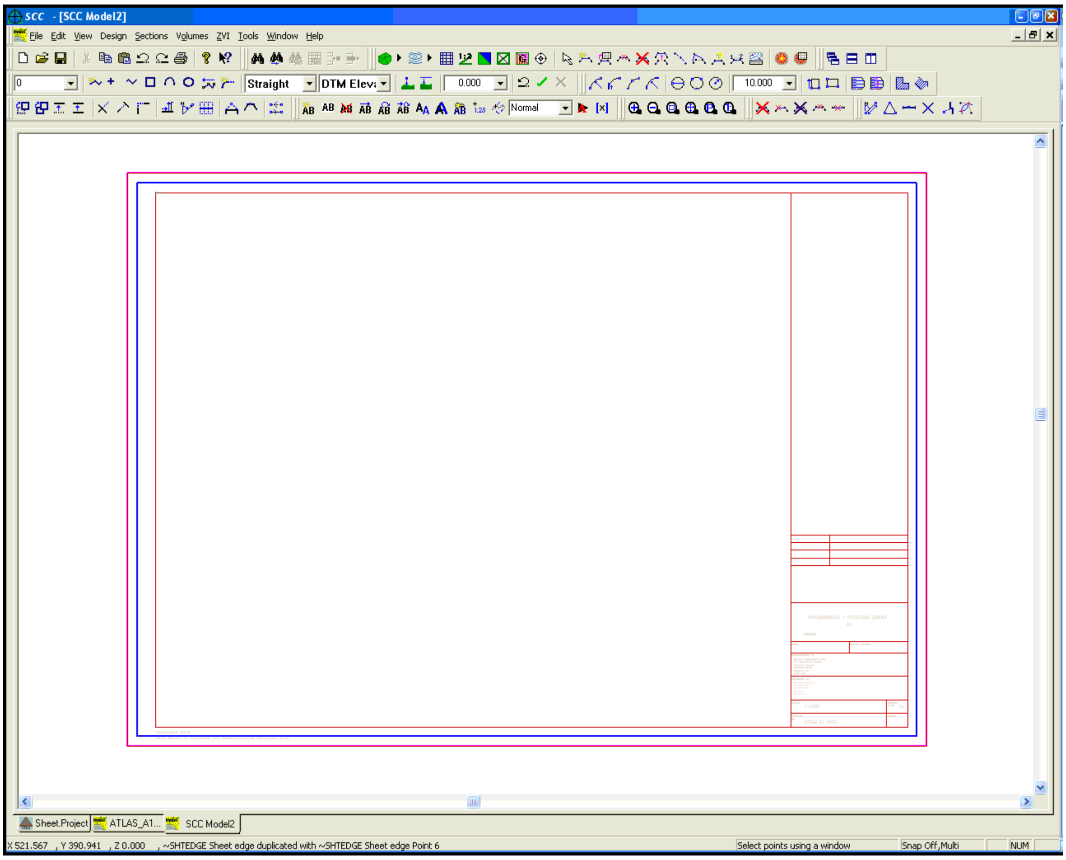
Select 'Edit > Copy to Clip Board'

Go to Sheet Layout 'ISO A1' Model and select 'Edit > Paste'

Note that the Sheet Edges coincide.

Delete the unnecessary Sheet Edge point (grey) leaving behind one Sheet Edge String (magenta)

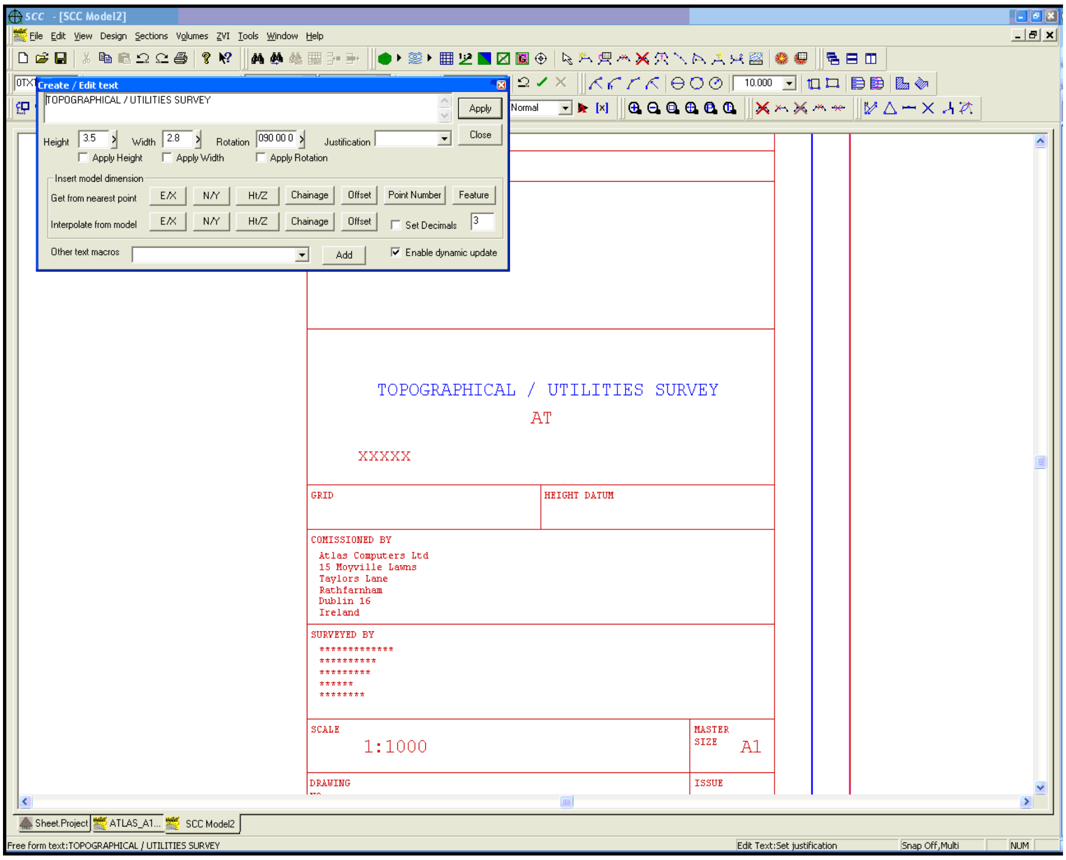
Where necessary use the string edit command, for example, Move Points, Trim, Extend



D.Adding Text & Text Macros

Text can be added to the Sheet Layout with the Text Tools

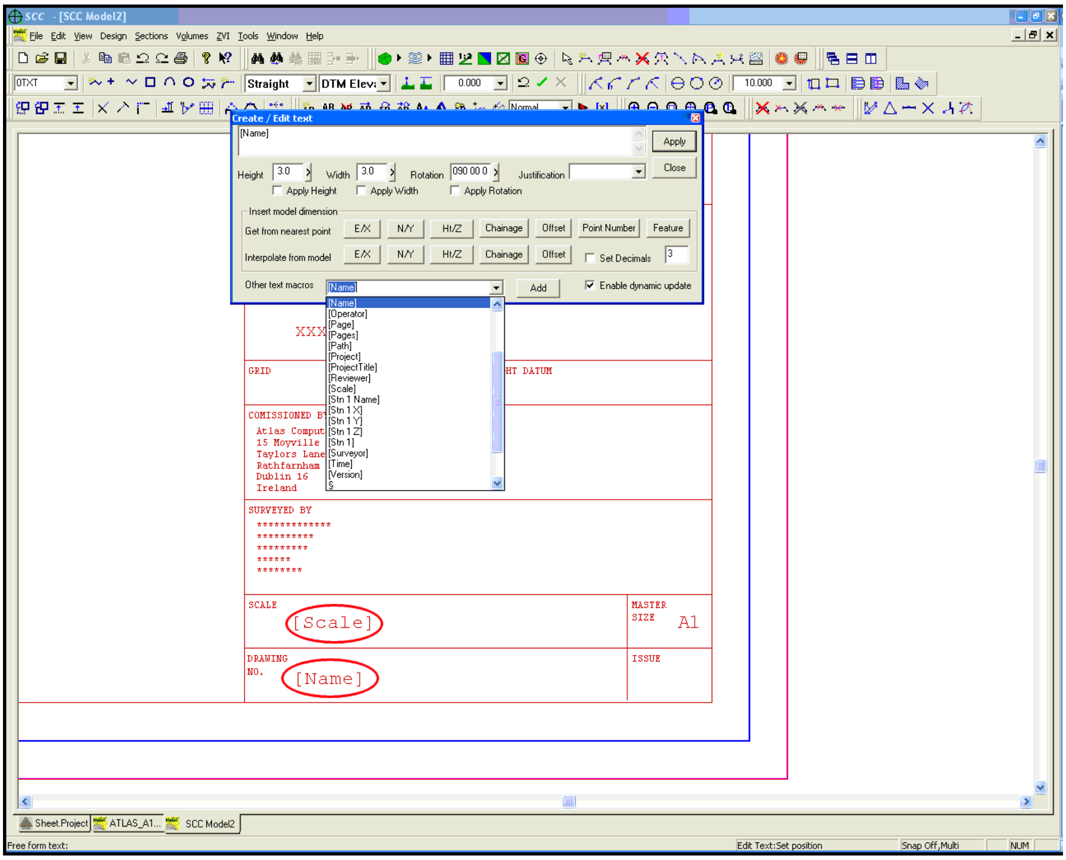
Either using the Text Toolbar or 'EDIT > Text > Add Text'



Text Macros are available within the 'Add Text' function

Select the Macro from the drop down menu

Select 'Add' and place the text in the required position



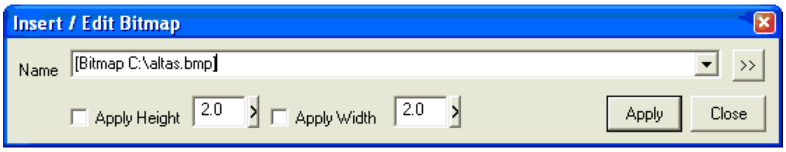
E.Bitmaps

SCC bitmap option inserts a windows bitmap (.BMP) file into the model in a given location and allows you to define its size and aspect ration. This option can be used when creating sheet layouts, where bitmap information, such as company logo, are required on the sheet.

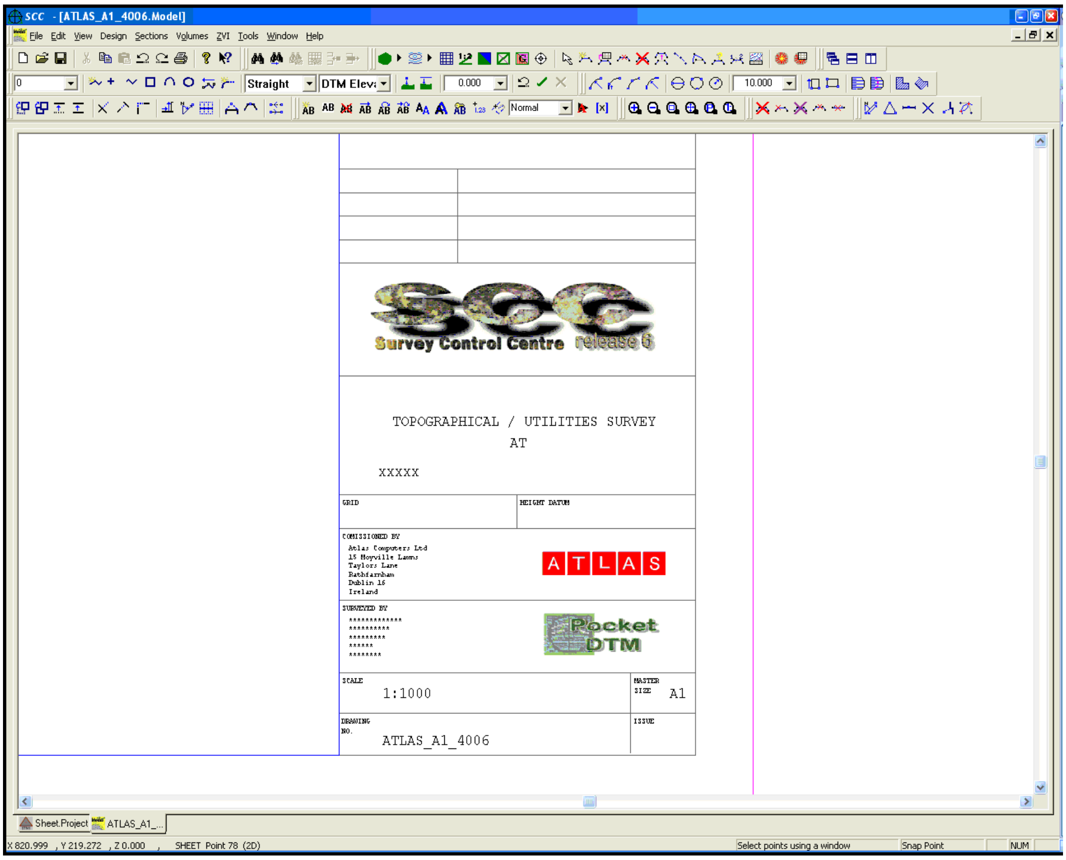
Go to 'EDIT > Bitmaps > Insert Bitmap'

Select bitmap using '>>' option

The height and width can be defined within the window or manually on screen



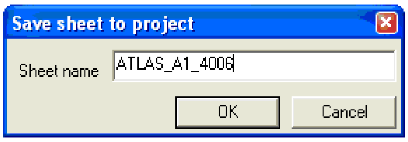
The bitmap can be resized, moved and deleted using the commands within 'EDIT > Bitmaps'



F.Save Sheet Layout

Go to 'FILE > Sheet Layout > Save Sheet Layout'

Enter Sheet Name



G.Export Sheet & Import Sheet into Default Project

In order to make this sheet available to use within other project, it is necessary to output the sheet layout and import the file into the necessary project.

Go to 'EDIT > Sheet Layout > Export Symbols to File'

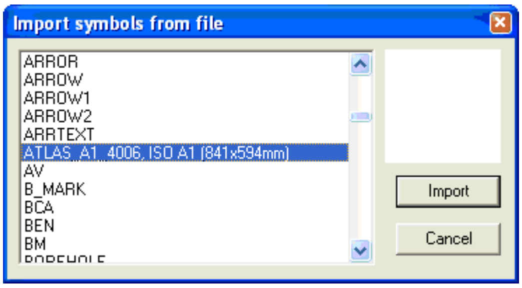
Select 'No' to 'Do you want to overwrite it'

The sheet can then be importing into the default library as follows:

Open Default Project

Select 'EDIT > Symbols > Import Symbols from File'

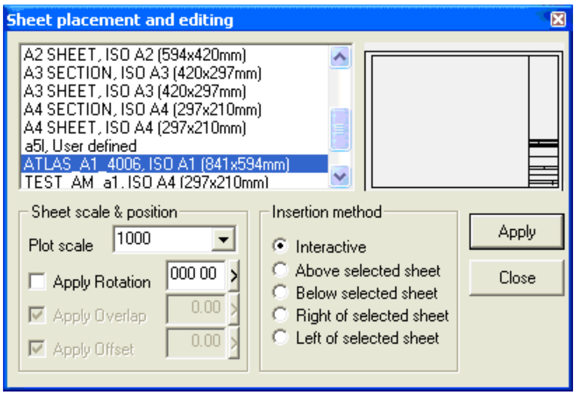
Select Sheet Layout to import



Select 'Import'

H.Inserting Sheet Layout Within A Model

Within a Model, go to 'FILE > Sheet Layout > Insert Sheet'

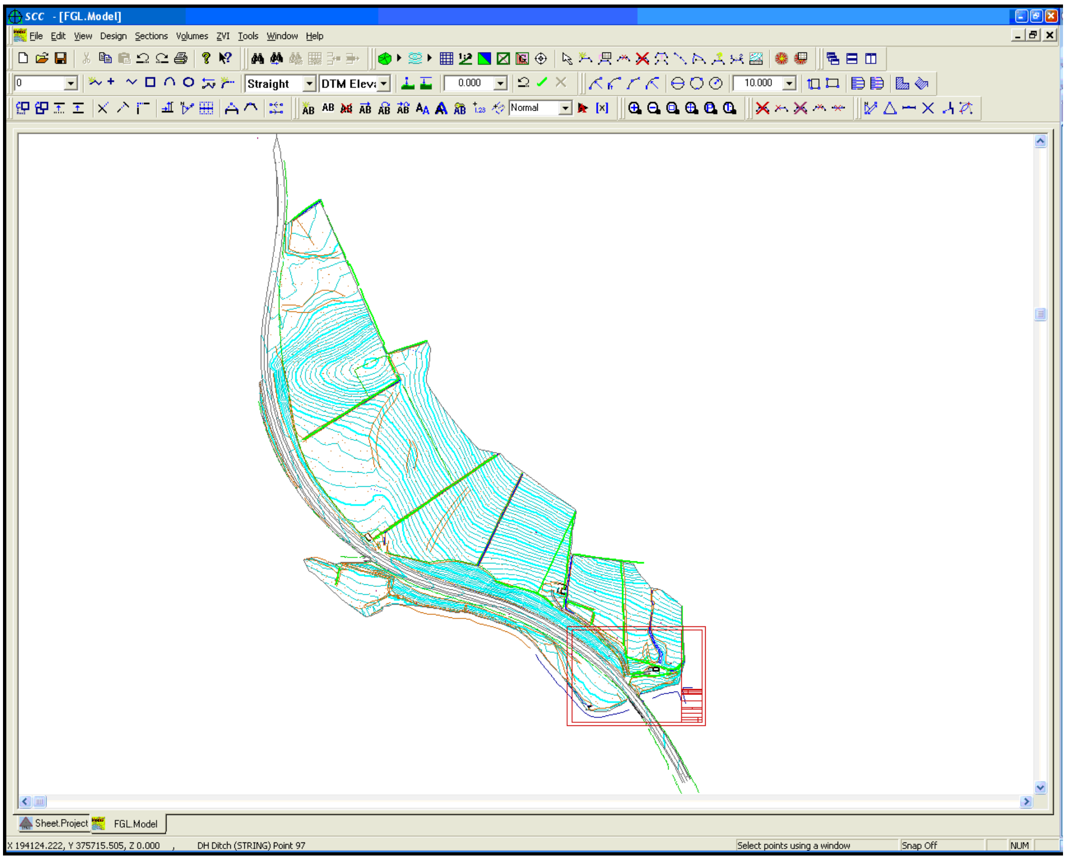


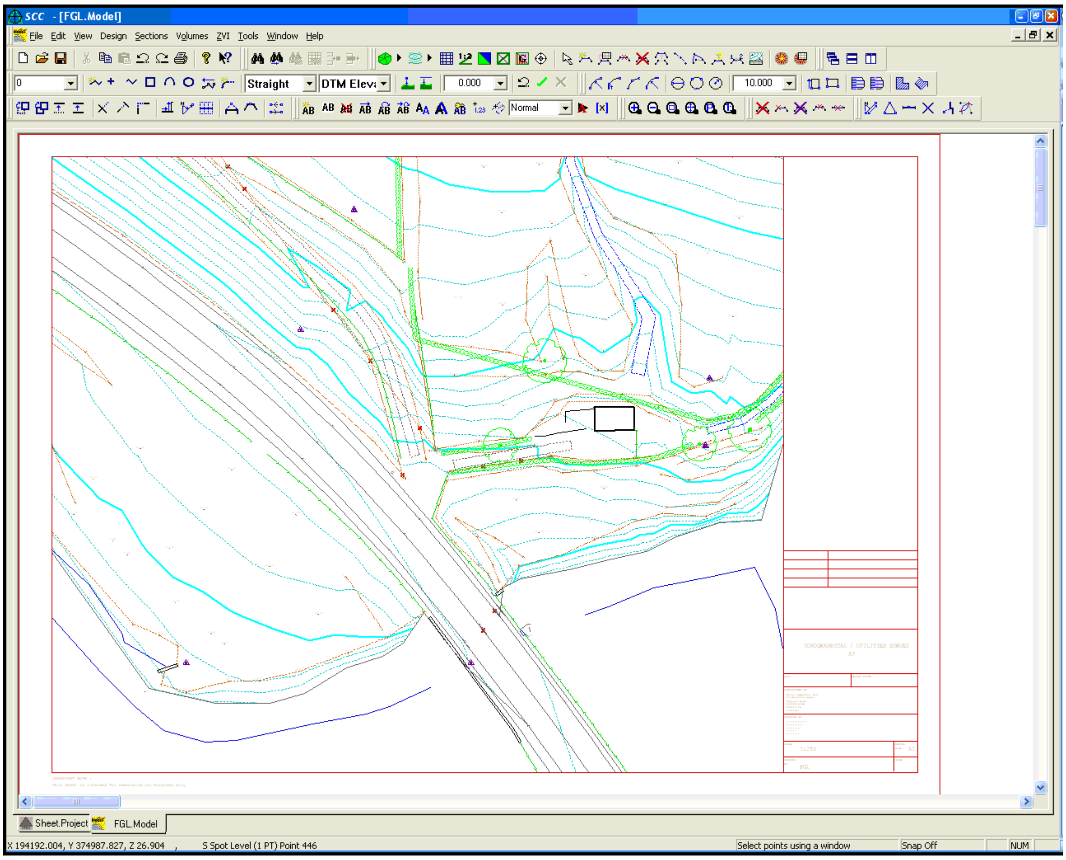
Select Sheet from list

Select Plot Scale and Insertion Method

Right click mouse to place sheet

Note: Rotation and Placement can be interactively choose on screen


SCC - [FGL.Model]
File Edit View Design Sections Volumes ZVI Tools Window Help
Straight
DTM Elev
Normal
Sheet.Project
FGL.Model
X 194124.222, Y 375715.505, Z 0.000
DH Ditch (STRING) Point 97
Select points using a window
Snap Off
NUM


SCC - [FGL.Model]
File Edit View Design Sections Volumes ZVI Tools Window Help
Straight
DTM Elev
Normal
Sheet.Project
FGL.Model
X 194192.004, Y 374987.827, Z 26.904
S Spot Level (1 PT) Point 446
Select points using a window
Snap Off
NUM

10 Transformations

SCC allows the user to create or edit a transformation from one co-ordinate system to another. The transformation editor lets the user enter any number of co-ordinates in both systems and calculates a transformation that will convert data between these systems.

It is for example possible to take a survey where the control stations have been destroyed and by surveying series of well-defined points of local detail, match up the common co-ordinates and transform the newly established stations into the old survey grid system.

Likewise, it would be possible to transform from a local or assumed grid system into the National Grid.

It is advisable to take a large number of mutual points and to have these spread over the extent of the survey. The system uses a least squares best-fit technique so that a large number of points may be used to provide the strongest transformation.

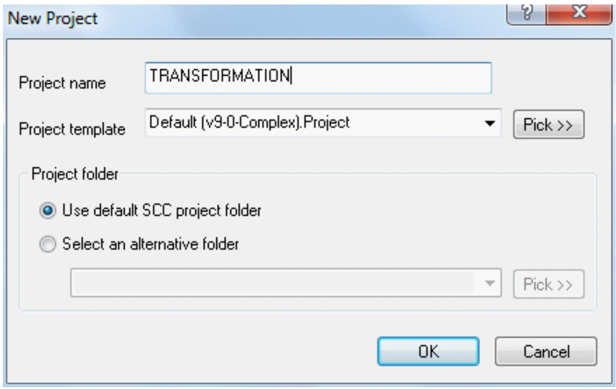
10.1 Performing A Transformation

In this specific example SCC uses an affine two-dimensional transformation with elevation datum shift. This transformation allows for rotation, translation and scaling in plan along with translation of levels.

Go into SCC.

Go to 'FILE > New Project'.

Call the project Transformation Tutorial and attach the project template Default.Project.



Go to 'FILE > Open'.

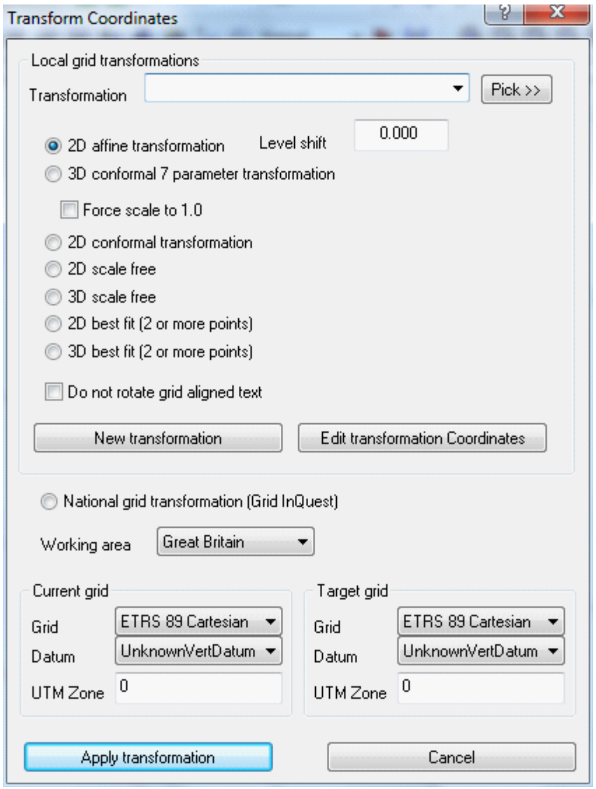
Go to the directory '\SCC\Tutorials\'.

At the bottom of the Open dialog and change the Files of Type to SCC Datasets (*.Survey) by clicking the down arrow.

Select the dataset 'Square.Survey'. The Detail Co-ordinates window.

Go to 'TOOLS > Transform Co-ordinates'.

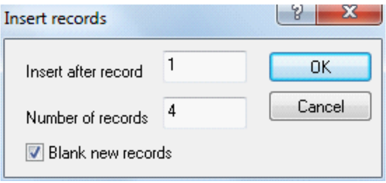
When you are creating a new transformation, just click on the New transformation option. A blank transformation spreadsheet is opened.



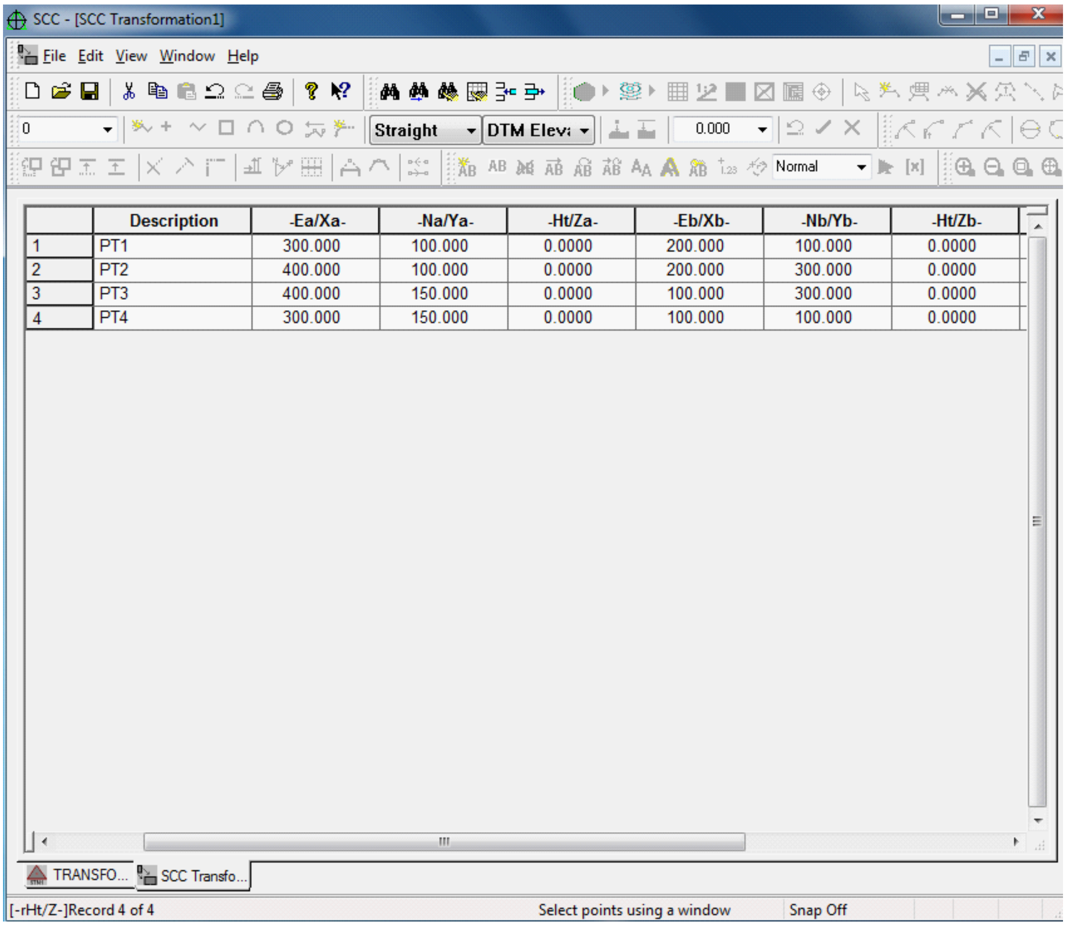
Type in the co-ordinates of the points, which you know in both grid systems.

Insert a blank record for each point known in both co-ordinate systems.

Go to 'EDIT > Insert Records'. Insert 3 new records.



Type in the co-ordinates of the points in the first grid system (Ea/Xa,Na/Ya and Ht/Za) and then their co-ordinates in the second grid system (Eb/Xb,Nb/Yb and Ht/Zb).



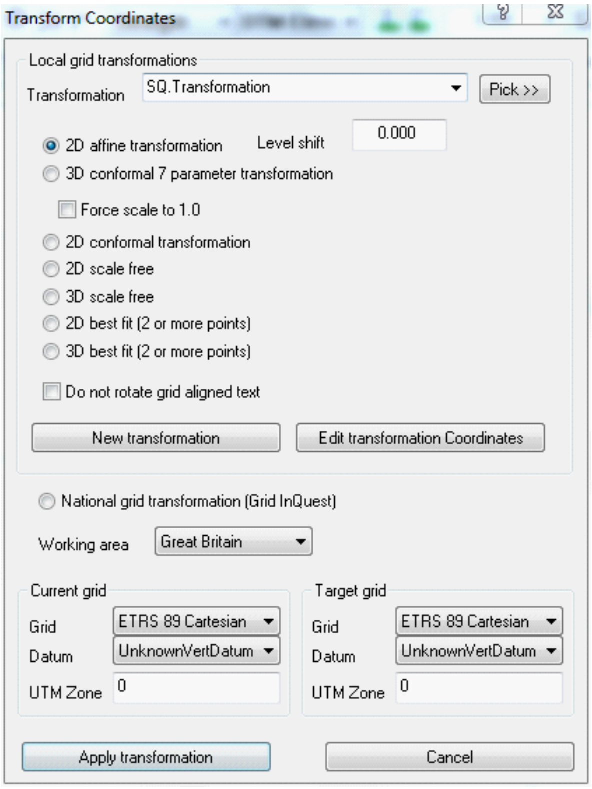
Save the Transformation as 'SQ.Transformation'.

Close the transformation spreadsheet and returned to Detail Co-ordinates window.

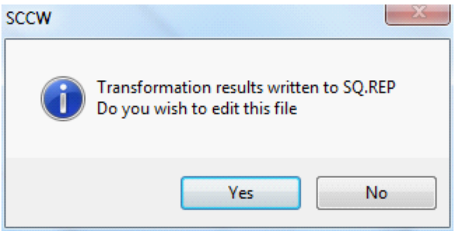
Go to 'TOOLS >Transform Co-ordinates'.

Pick the Transformation file 'SQ.Transformation'.

Apply the transformation.



When the transformation is performed a report is generated. You will be asked whether or not you wish to view this report. Choose Yes to view the report. The following report will be presented in Wordpad (or whichever Text Editor you have specified in the Directories and Files section of the General Options.).

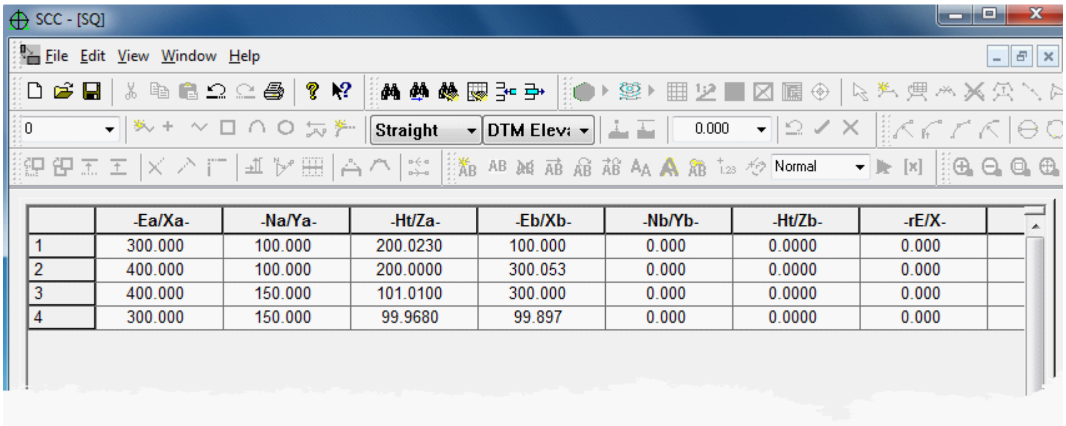


In the previous example, the points were known exactly in both co-ordinate systems therefore there were no residuals listed in the report.

```
SCC for Windows v7.8.11 (C) 1990 - 2005 Atlas Computers Ltd
    Transformation report
    Transformation name   SQ
   Date                    Wed Dec 06 09:24:02 2006
    Transformation parameters are
     a   = 0.000000
     b   = 2.000000
     c1  = 400.0000
     c2  = -500.0000
 Where  x' = ax - by + c1
        y' = bx + ay + c2
Pt   Name                 E/X(a)      N/Y(a)      E/X(b)      N/Y(b)      rE/X
rN/Y
--   ----                 ------      ------      ------      ------      ----
----
0    STNA                300.000     150.000     100.000     100.000    0.0000
0.0000
0    STNB                400.000     150.000     100.000     300.000    0.0000
0.0000
0    STNC                400.000     100.000     200.000     300.000    0.0000
```

```
0.0000
0     STND                   300.000      100.000      200.000      100.000    0.0000
0.0000
      Block shifting parameters
      (0,0) -> (400.00000,-500.00000)
      (0,1) -> (400.00000,-498.00000)
      (1,0) -> (398.00000,-500.00000)
      Block creation point 150.00000,200.000000
      Insertion point 0.00000,-200.000000
     Scale  = 2.00000
     Rotation = 090 00 00  (Counter Clockwise)
      Typical shift applied -150.00000,-400.00000
```

In the following example the co-ordinates of the points were not known exactly in the second system. Apply the following changes to the transformation.



	-Ea/Xa-	-Na/Ya-	-Ht/Za-	-Eb/Xb-	-Nb/Yb-	-Ht/Zb-	-rE/X-
1	300.000	100.000	200.0230	100.000	0.000	0.0000	0.000
2	400.000	100.000	200.0000	300.053	0.000	0.0000	0.000
3	400.000	150.000	101.0100	300.000	0.000	0.0000	0.000
4	300.000	150.000	99.9680	99.897	0.000	0.0000	0.000

Save the transformation and then Apply it. The following transformation report is generated.

Note the residuals at each of the Easting and Northings. The residuals are differences between the given co-ordinate values for the point and the co-ordinate values calculated using the transformation parameters.

Calculating the residual at the Easting of point no.1.

```
SCC for Windows v7.8.11 (C) 1990 - 2005 Atlas Computers Ltd
    Transformation report
    Transformation name   SQ_2
   Date                  Wed Dec 06 09:33:10 2006
    Transformation parameters are
     a  = 0.003859
     b  = 1.998523
     c1 = 398.7149
     c2 = -499.9900
 Where  x' = ax - by + c1
         y' = bx + ay + c2
Pt    Name                 E/X(a)       N/Y(a)       E/X(b)       N/Y(b)      rE/X
rN/Y
--    ----                 ------       ------       ------       ------      ----
----
0     STNA                 300.000      150.000       99.968       99.897    0.1262
0.2489
0     STNB                 400.000      150.000      101.010      300.000   -0.5299  -
0.0018
0     STNC                 400.000      100.000      200.000      300.005    0.4063  -
0.2001
0     STND                 300.000      100.000      200.023      100.000   -0.0026  -
0.0471
      Block shifting parameters
      (0,0) -> (398.71486,-499.98997)
      (0,1) -> (398.71872,-497.99145)
```

```
(1,0) -> (396.71634,-499.98611)
Block creation point 150.25025,199.975575
Insertion point -0.36109,-198.939574
Scale  = 1.99853
Rotation = 089 53 22  (Counter Clockwise)
Typical shift applied -150.61134,-398.91515
```

Calculating the residuals of Easting of STND Point No. 4:

where x' = ax - by + c1

x'=200.023

a =0.003764

x =300.000

b =1.998714

y =100.000

c1=398.7721

x'= (0.003764 x 300.000) - (1.998714 x 100.000) + 398.7721

x'= 1.1292 - 199.8714 + 398.7721

x'= 200.0299

The difference between the computed (200.0299) and the given (200.023) answer is 0.0069, which is displayed in the transformation spreadsheet as the residual (rE/X).

10.2 Applying A Transformation

If a drawing has been exported to CAD and subsequently requires transformation a block may be made of the original drawing. The block creation, insertion, scaling and rotation values given in the report may be used to apply the transformation to a CAD drawing.

Note:

If a significant inappropriate scale, or large residual values, is generated, check your input data. If you have a large number of points in both systems, try replacing points with large residuals with other matched points that are near to those points.

10.3 Transformation Report

Sample Tranformation Reports:

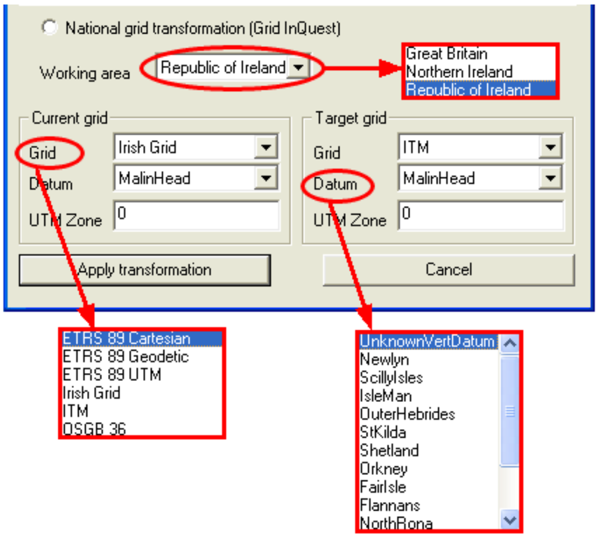
2D Affine:

```
SCC for Windows v7.8.11 (C) 1990 - 2005 Atlas Computers Ltd
    Transformation report
    Transformation name   SQ_2
   Date                   Wed Dec 06 09:38:21 2006
    Transformation parameters are
     a   = 0.003859
     b   = 1.998523
     c1  = 398.7149
     c2  = -499.9900
 Where   x' = ax - by + c1
          y' = bx + ay + c2
Pt    Name                   E/X(a)       N/Y(a)       E/X(b)       N/Y(b)      rE/X
rN/Y
--    ----                   ------       ------       ------       ------      ----
----
```

```
0    STND                 300.000     100.000     200.023     100.000   -0.0026  -
0.0471
0    STNC                 400.000     100.000     200.000     300.005    0.4063  -
0.2000
0    STNB                 400.000     150.000     101.010     300.000   -0.5299  -
0.0018
0    STNA                 300.000     150.000      99.968      99.897    0.1262
0.2489
      Block shifting parameters
      (0,0) -> (398.71486,-499.98997)
      (0,1) -> (398.71872,-497.99145)
      (1,0) -> (396.71634,-499.98611)
      Block creation point 150.25025,199.975575
      Insertion point -0.36109,-198.939574
     Scale  = 1.99853
     Rotation = 089 53 22  (Counter Clockwise)
      Typical shift applied -150.61134,-398.91515
SCC for Windows v7.8.11  7 Parameter Transformation report
No  Station  Obs     aX          aY        aZ         bX          bY         bZ

--- -------- --- ----------- ----------- -------- ----------- -----------
--------
  0 STND       0     300.000     100.000   10.000     200.023     100.000
20.000
  1 STNC       0     400.000     100.000   10.000     200.000     300.005
25.000
  2 STNB       0     400.000     150.000   15.000     101.010     300.000
30.000
  3 STNA       0     300.000     150.000   15.000      99.968      99.897
25.000
Coordinate  residuals
No  Station  Obs     dX          dY        dZ      dDist(2d)   dDist(3d)
--- -------- --- ----------- ----------- -------- ----------- -----------
  0 STND       0      0.1334      0.0846  -0.0173      0.1579      0.1589
  1 STNC       0      0.5918     -0.2313  -0.0228      0.6354      0.6358
  2 STNB       0     -0.6659     -0.1335   0.0173      0.6791      0.6793
  3 STNA       0     -0.0593      0.2802   0.0228      0.2864      0.2873
Shifts  X:399.345  Y:-499.168  Z:-5.081
Rotation X:002 49 53  Y:001 25 58  Z:089 52 30
Scale:0.50061033
```

10.4 National Grid Transformations

Support has been added for national grid transformations between ITM, Irish Grid, OSGB36 and ETRS89. These transformations utilise Grid Inquest software provided by Quest Geo Solutions.



11 Alignments

11.1 Entering & Importing Data Into An Alignment

The following briefly examines some of the features within SCC Alignment Module.

In short, SCC Alignment Modules allows for:

- the importing of alignment information from MX
- the importing of horizontal and vertical geometry information from MX
- the importing of horizontal and vertical intersection points from DOER
- the generation of intersection point information from the horizontal and vertical geometry

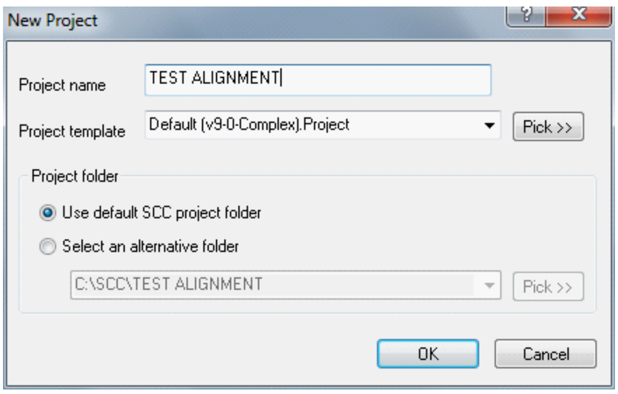
11.1.1 Getting Alignment Data From MFW into SCC

Import MX GENIO Geometry strings

Set up Project

Open a 'New Project' and attach the 'Default(v9-0-Complex).Project' template.

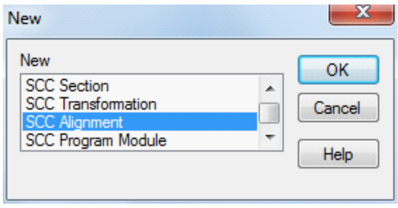
Call the project 'Test Align'.



Import MX Alignment

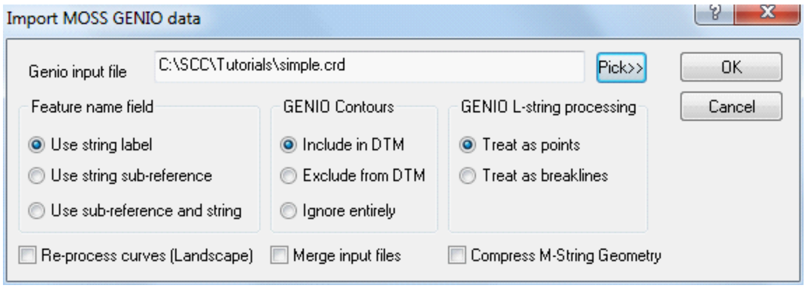
Open a blank Alignment file

Go to 'File > New > SCC Alignment'



A blank horizontal intersection sheet is opened. The alignment information is imported into this SCC alignment file.

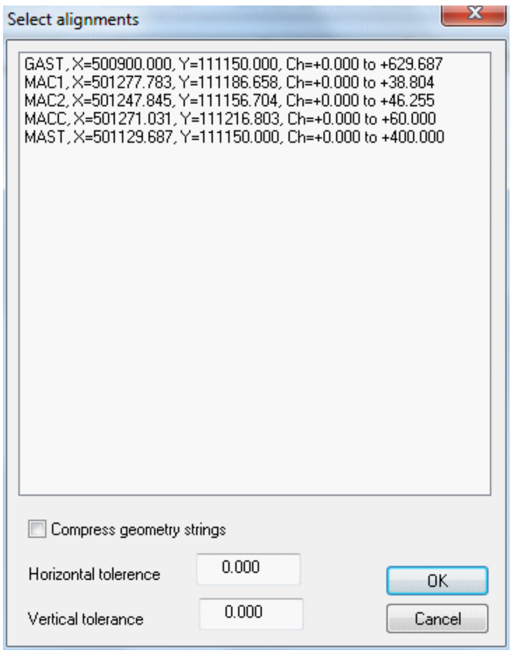
Go to 'FILE > Import > MX GENIO Geometry strings'



Go to the Tutorials directory and select the GENIO file 'SIMPLE.CRD'

This file contains horizontal and vertical geometry information.

The 'Select Alignments' dialog allows the user to select a specific alignment present in the input file



Select ' GAST' and 'OK'

The horizontal entities sheet is opened and the imported information displayed.

	No.	Type	-E/X-	-N/Y-	Chainage	Vector	Length	Radius 1	Radius 2
1	1	Straight	501517.000	111232.000	0.000	203 18 00	12.639	0.000	0.000
2	2	Spiral In	501505.392	111227.001	12.639	203 18 00	100.457	700.000	1000000000.000
3	3	Circular Arc	501412.225	111189.492	113.096	199 11 19	184.206	700.000	700.000
4	4	Spiral Out	501232.334	111152.402	297.302	184 06 41	100.457	700.000	1000000000.000
5	5	Straight	501131.928	111150.000	397.759	180 00 00	231.928	0.000	0.000

Go to 'VIEW > Vertical Entities'

	No.	Type	Chainage(1)	Length	Base Level	Gradient	Grade Diff.
1	1	Straight	10.000	0.000	47.040	+1:14.3	0.0
2	2	V.Curve	10.000	76.960	47.040	+1:14.3	-1:148.8
3	3	Straight	86.960	-0.000	52.686	+1:13.0	0.0
4	4	V.Curve	86.960	148.235	52.686	+1:13.0	+1:472.2
5	5	Straight	235.195	0.000	63.902	+1:13.4	0.0
6	6	V.Curve	235.195	118.459	63.902	+1:13.4	+1:65.2
7	7	Straight	353.654	-0.000	71.831	+1:16.9	0.0
8	8	V.Curve	353.654	46.346	71.831	+1:16.9	+1:107.9
9	9	Straight	400.000	0.000	74.363	+1:20.0	0.0

Save the alignment as 'GAST.ALIGNMENT'.

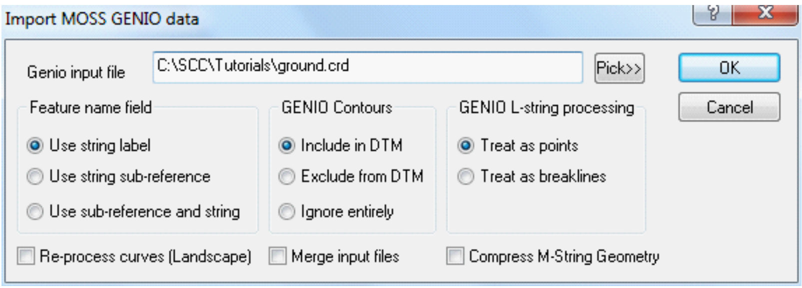
11.1.2 Attaching an Alignment To A Model

Create the MX Model

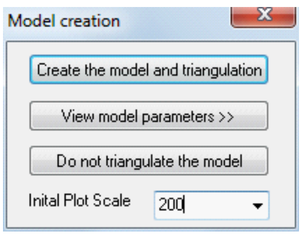
Go to 'FILE > Model > MX GENIO file'.

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'.

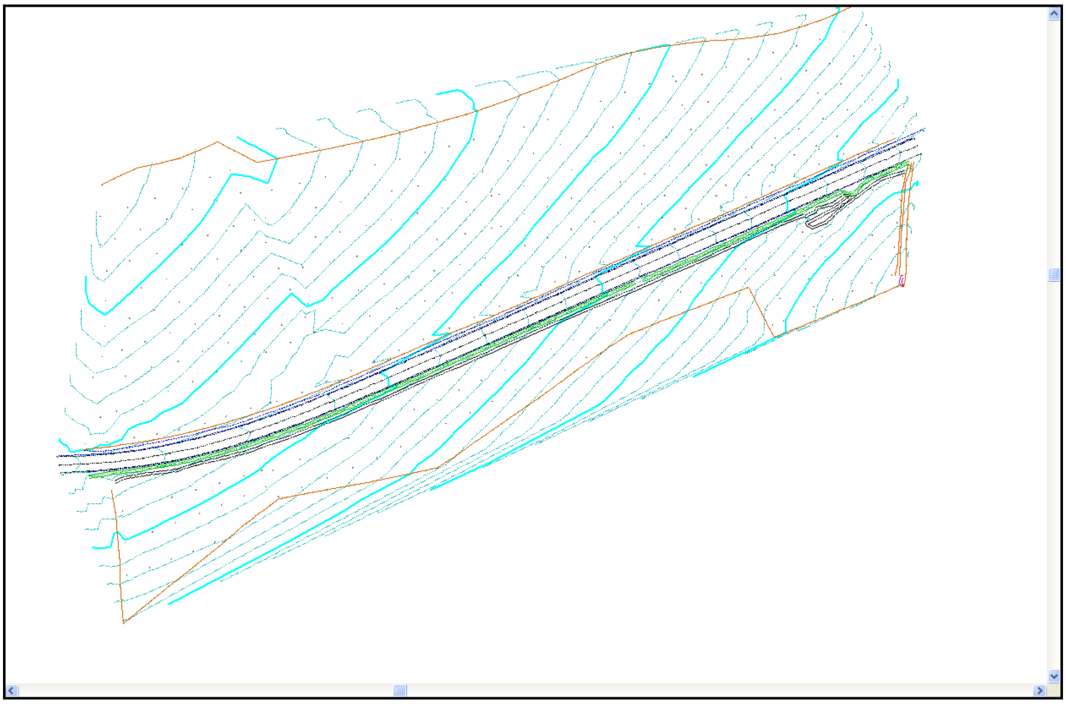


Select 'OK'



Set the Initial Plot Scale as '200'

Select 'Create the model and triangulation'



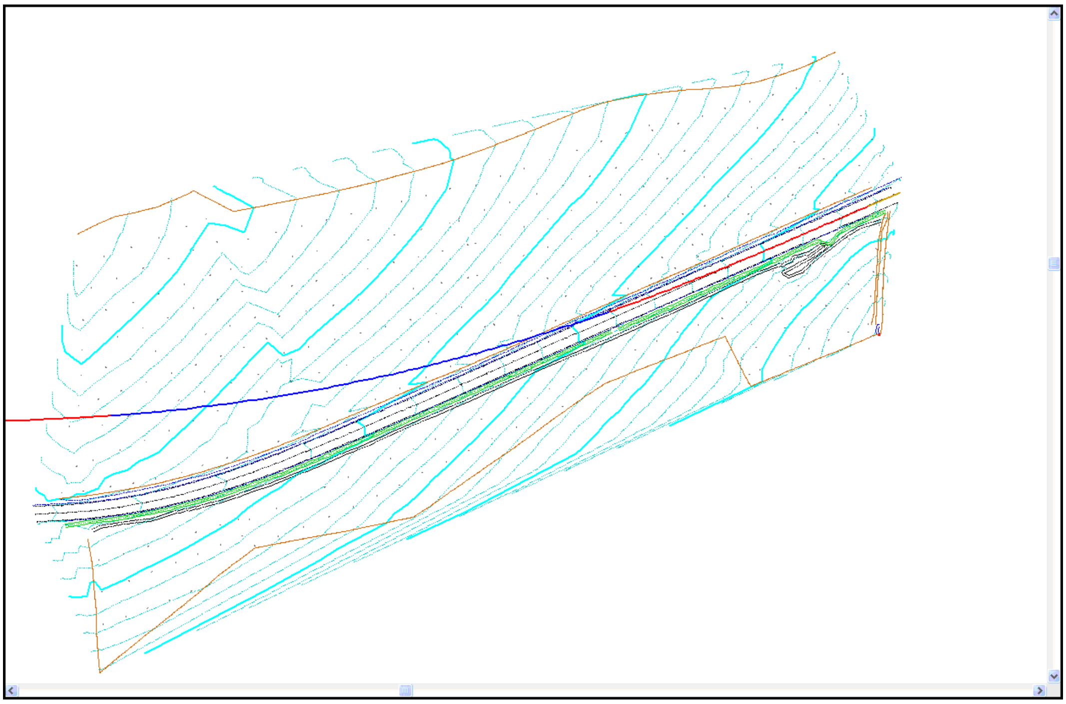
Go to ‘File > Save’

Save the model as ‘Ground.Model’

Attaching MX Alignment

Within the ground model, 'select 'FILE > Attach/Detach > Attach Alignment File'

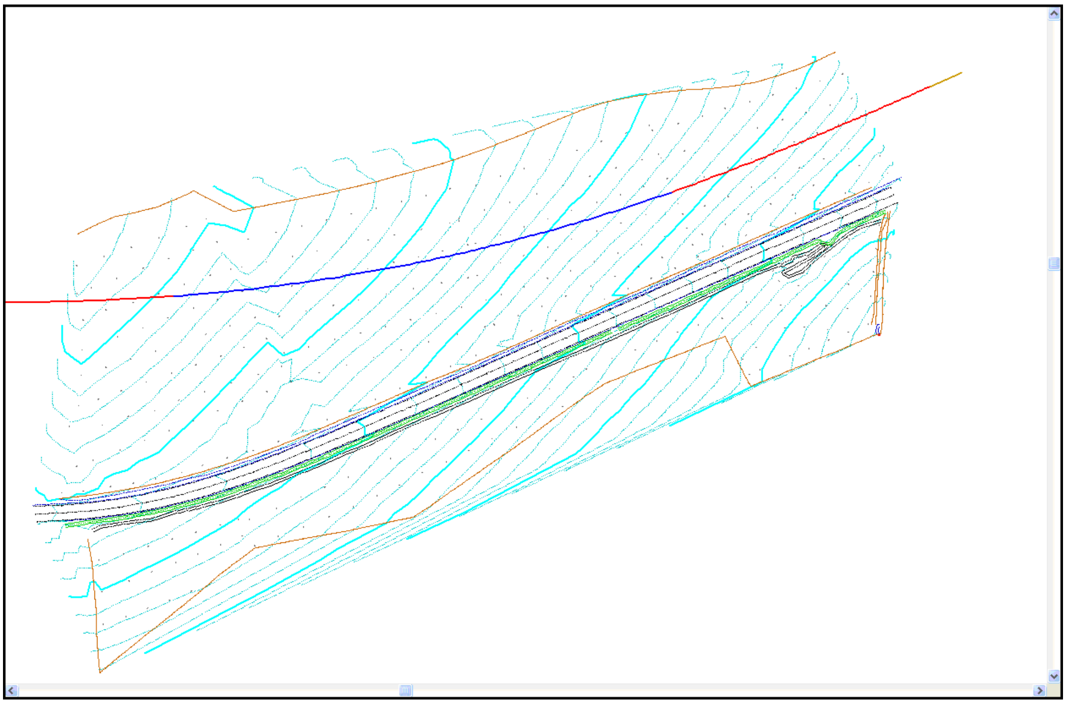
Select ‘GAST.ALIGNMENT’



11.1.3 Interactively Editing The Alignment

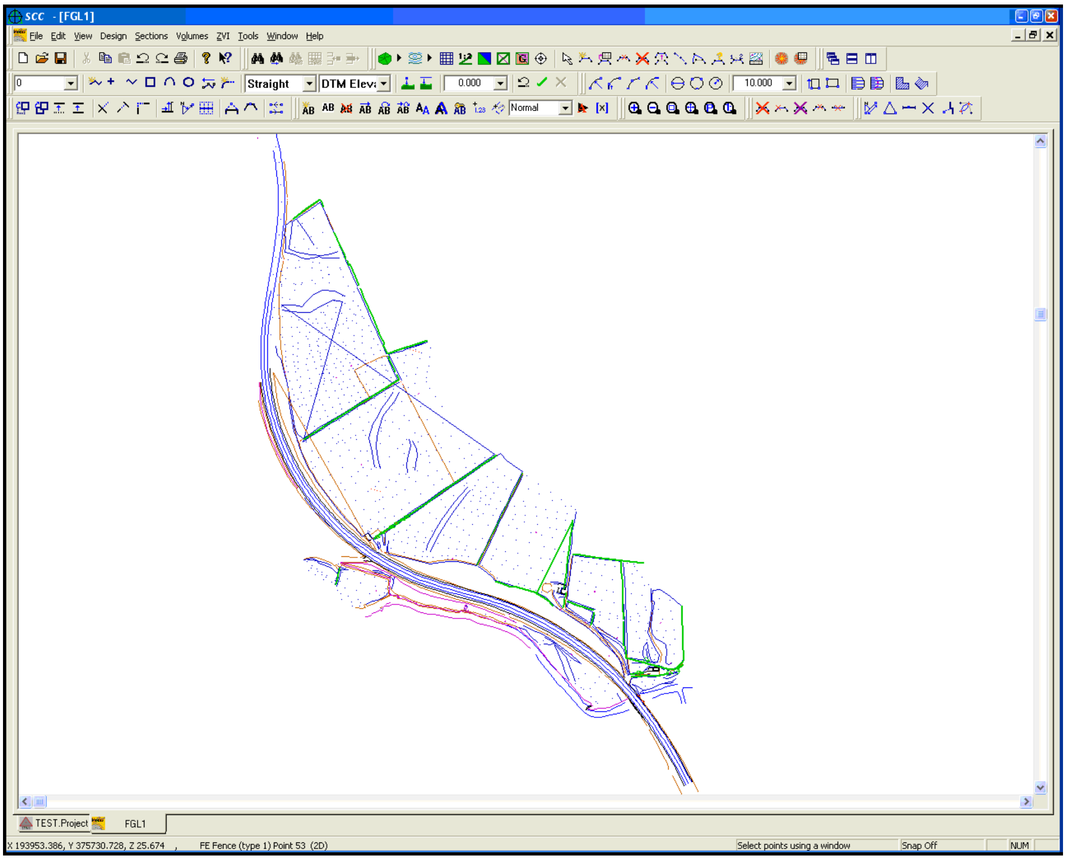
Within 'SIMPLE.Alignment', select 'DESIGN > Move Alignment'

Click on alignment string with the left mouse button and interactively move the alignment.



11.1.4 Typing Horizontal Intersection Points

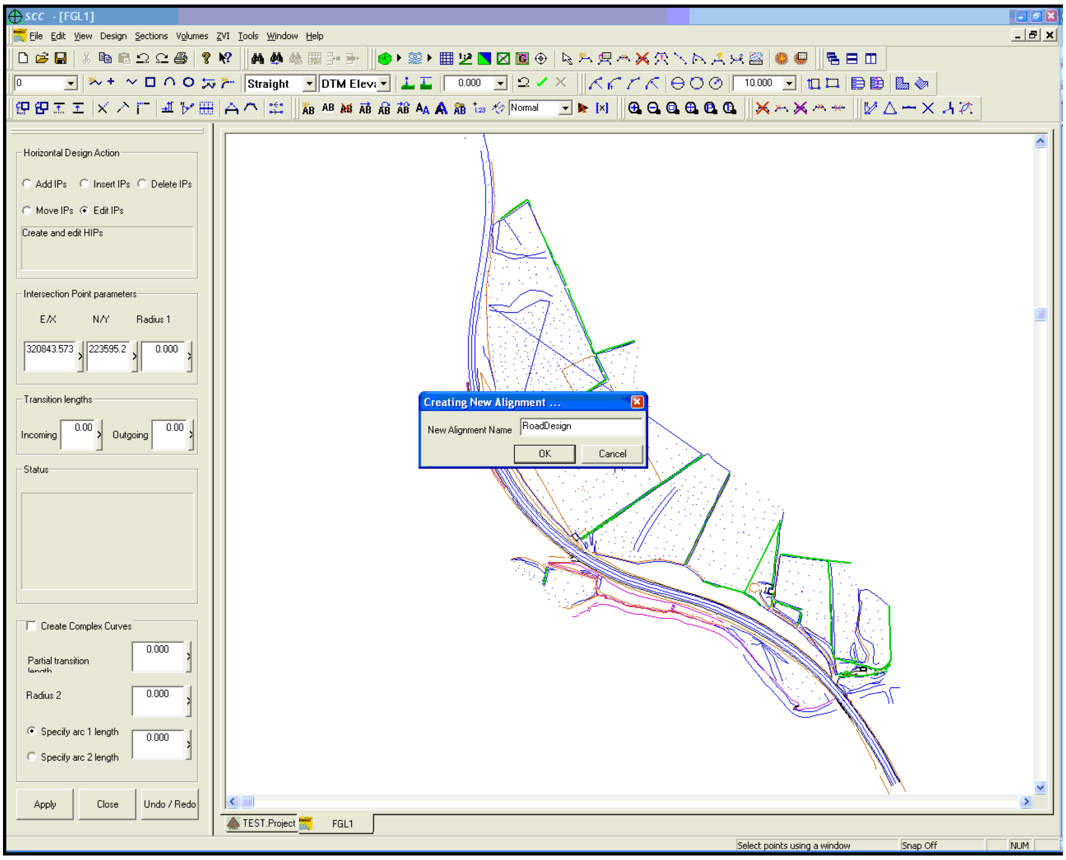
Open 'FGL.Model' from the tutorials directory.



Horizontal Intersection Points

Go to 'Design > Horizontal Alignment'

Call the new alignment 'RoadDesign.Alignment'.



The horizontal intersection point information is in a text file. This text file, 'HIPs.txt' can be found in the '\SCC\Tutorials\' directory. Open it in the text editor and print it.

Horizontal Intersection Points

Transition Lengths

E/X	N/Y	Radius 1	Incoming	Outgoing
193606.497	375687.288	0	0	0
193612.146	375437.006	400	100	100
193769.208	375136.441	300	100	100
194053.388	375030.792	0	0	0

There are 4 intersection points in this file. The Easting, Northing, and chainage of each point are defined along with the length of the radius and incoming and outgoing transitions.

Set the Horizontal Design Action to 'Add IPs'

Turn Off 'Create Complex Curves' option

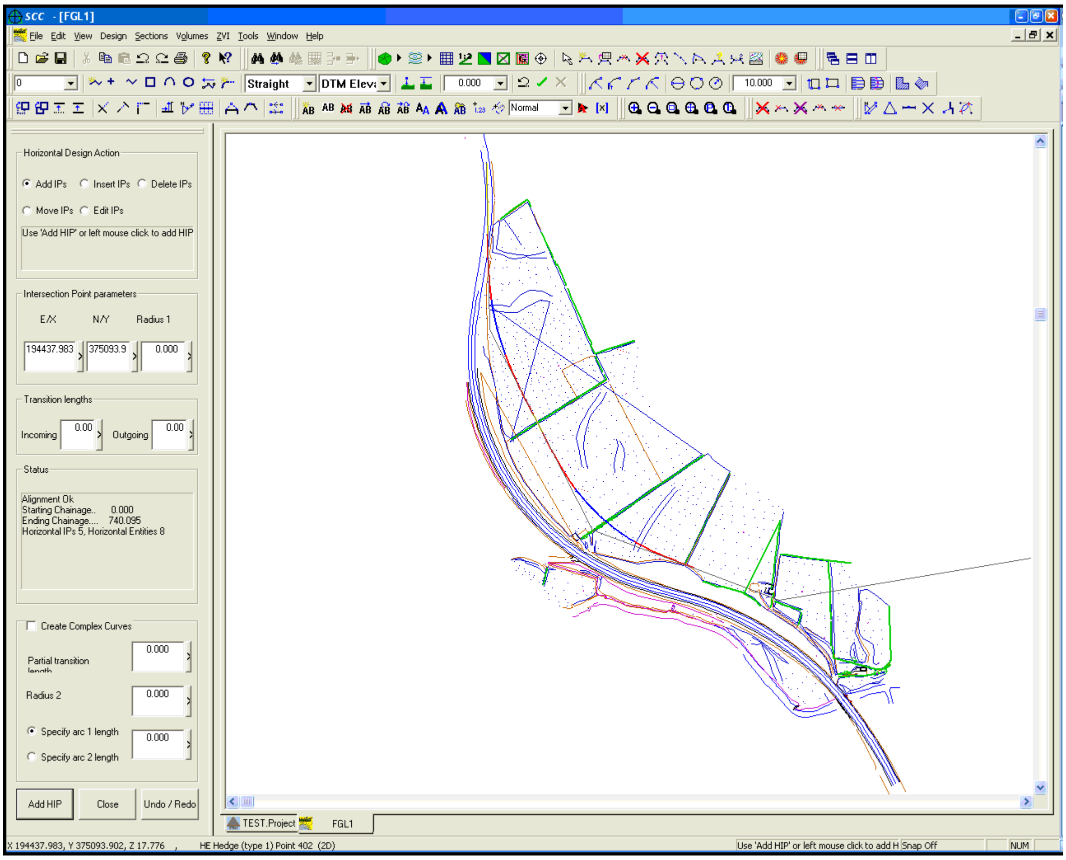
Type in the information for each of the four intersection points.

(E/X value, N/Y value, Radius 1, Incoming and Outgoing Transition Lengths)

After each point is entered select 'Add HIP' at the bottom of the dialog to add the intersection point to the alignment.

Select 'Close' after last intersection point

(By pressing the tab button, the cursor will jump to each entry box in order).



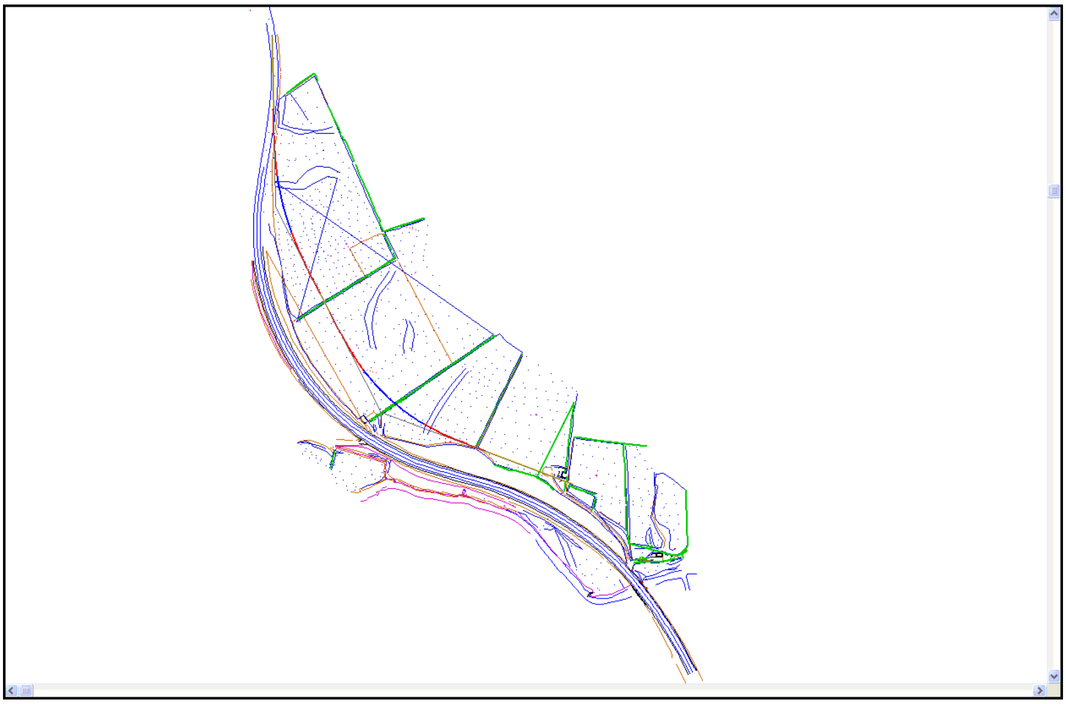
To view the horizontal intersection points,

Goto 'Design >View design sheet', then select 'Horizontal Intersection Points'.

	No.	-E/X-	-N/Y-	R1	Spiral In	Spiral Out	R2	Pivot
1	2	193606.497	375687.288	0.000	0.000	0.000	0.000	Centre
2	3	193612.146	375437.006	400.000	100.000	100.000	400.000	Centre
3	4	193769.208	375136.411	300.000	100.000	100.000	300.000	Centre
4	5	194053.388	375030.792	0.000	0.000	0.000	0.000	Centre

Save the alignment as 'RoadDesign.Alignment'

The finished horizontal alignment is shown in the diagram below.



11.1.5 Typing Vertical Intersection Points

Before creating the vertical alignment, ensure that the horizontal alignment has been created.

The vertical intersection point data can be found in the '\SCC\Tutorials' directory.

The file 'VIPs.txt' can be printed using Word or Notepad and contains all the necessary information to define a vertical alignment.

Vertical Intersection Points

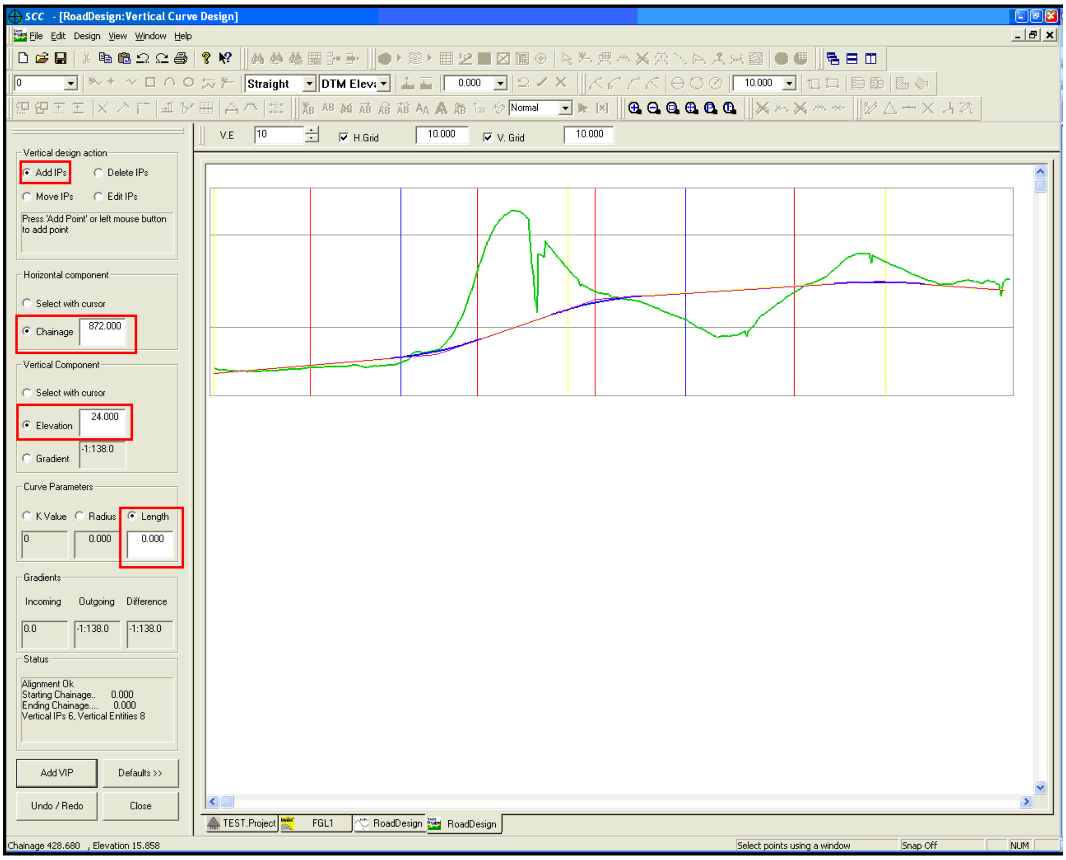
Chainage	ElevationN/Y	Length
0	15.00	0
245	17.00	100
422	23.00	100
734	25.00	100
872	24.00	0

Continuing from the Design above:

Select 'RoadDesign.Alignment' created in the earlier tutorial

From the model window, go to 'DESIGN>Vertical Alignment'

On the top menu bar set the 'V.E' or 'vertical exaggeration' to 10



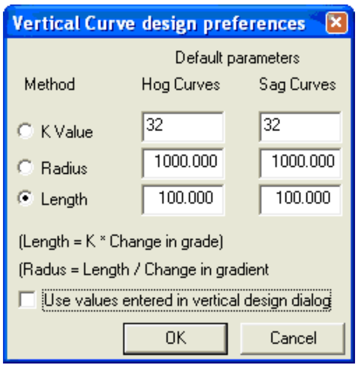
Set the 'Vertical Design Action' to 'Add IPs'

Select 'Chainage' as the 'Horizontal Component'

Select 'Elevation' as the 'Vertical Component'

Select the 'Defaults>>' option

Ensure that the method is set to 'length'



Enter '100.00' as the default values

Turn off the option to 'use values entered in vertical design dialog'

Press 'OK'

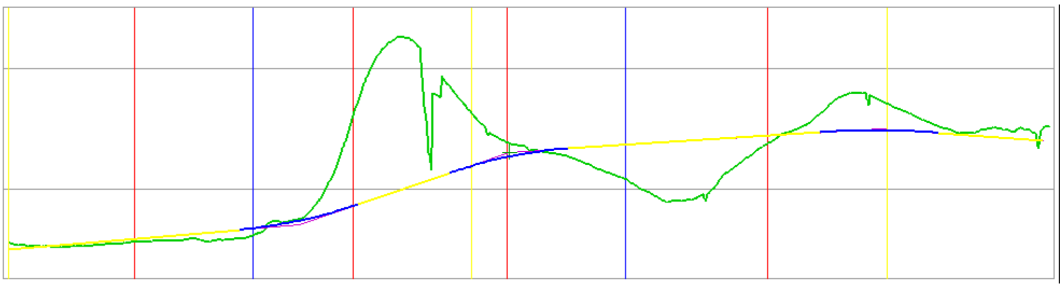
Select 'Length' as the 'Curve Parameter'.

Type in the 'Chainage', 'Elevation' of each vertical intersection point

Select 'Add VIP' at the bottom of the dialog after each vertical intersection point

The default length value of ‘100.00’ will be used to calculate the curve parameters.

The finished vertical design is displayed in the diagram below.



11.1.6 Creating Mulit-Surface Section

Applying a Second Surface to a Section Template

Having designed a horizontal and vertical alignment and a standard section template, one can now add additional surfaces to a section template.

Open the existing section template from the model ‘Design > Section template’

Select ‘New Surface’ from bottom of the side menu bar

Set up the following surfaces:

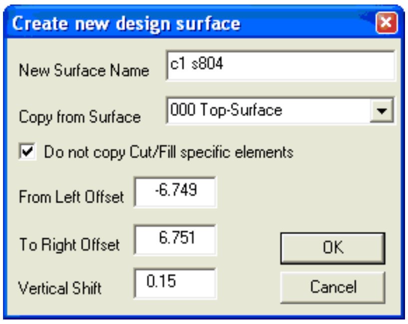
45mm Hot Rolled Asphalt Wearing Course to cl. s905
55mm Dense Bitumen Macadam Base Course to cl. s902
120mm Dense Bitument Macadam Road Base to cl. s812
150mm Minimum Granular Material Type B Sub-Base to cl 804

Within Create New Surface dialog enter surface Name ‘c1 s804’

Set ‘000 Top Surface’ as Copy from Surface

Select ‘Do not copy Cut/Fill specific elements’

Accept default ‘From Left Offset’ and ‘To Right Offset’

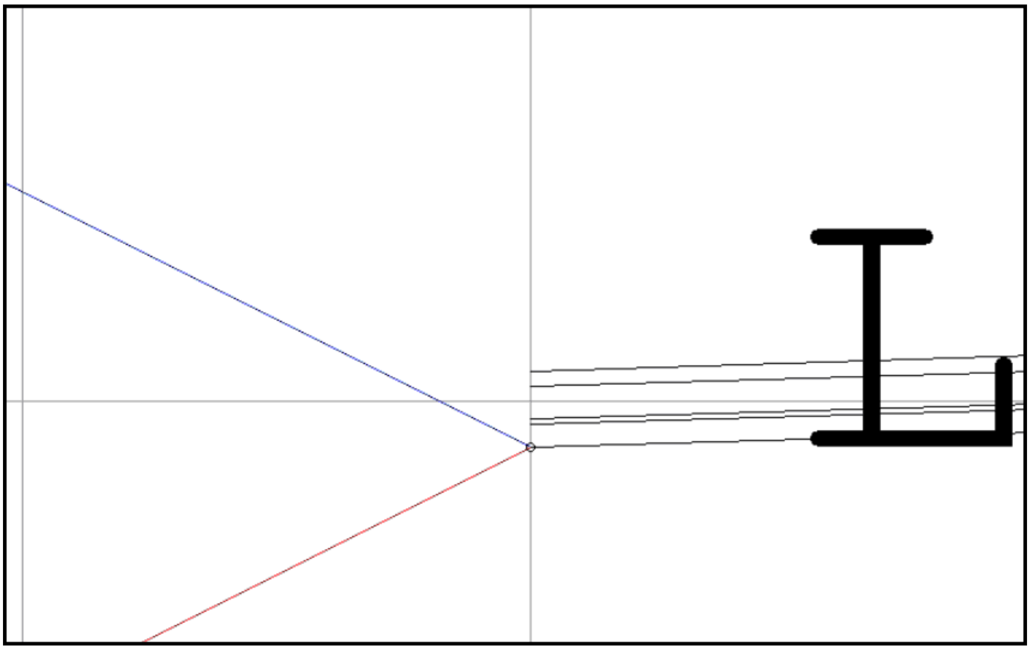


Enter the relevant ‘Vertical Shift’

Select ‘OK’

Repeat the above steps for ‘c1 s902’, ‘c1 s812’ and ‘c1 905’

Use the Zoom Functions to see the additional new surfaces.



11.2 Section Template Design On A MX Alignment

The following examines importing and modelling of MX GENIO strings into SCC. In turn allowing for the attachment of alignment data and subsequent section template design. Long Sections and Cross Sections are considered as a quality assurance means of examining the Section Template.

MX GENIO Alignment

Opening Project

Select 'FILE>Open'

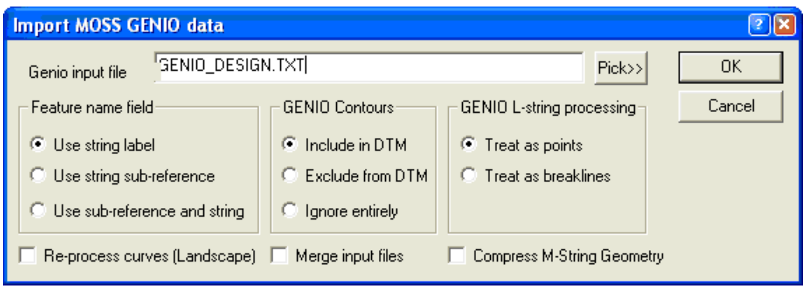
Select 'Genio-S.Project

Modeling MX GENIO File

Go to 'FILE>Model>MX GENIO file'

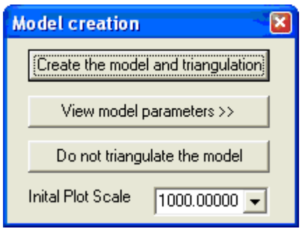
Select the file 'GENIO_DESIGN.txt'

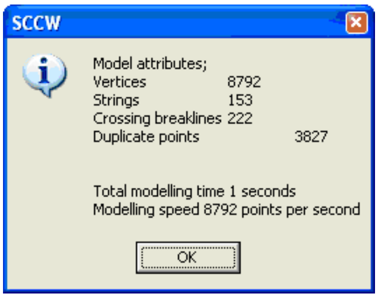
Set the Feature Name field to 'Use string label', the GENIO Contours to 'Ignore' entirely and GENIO L-string processing to 'Treat as points'.

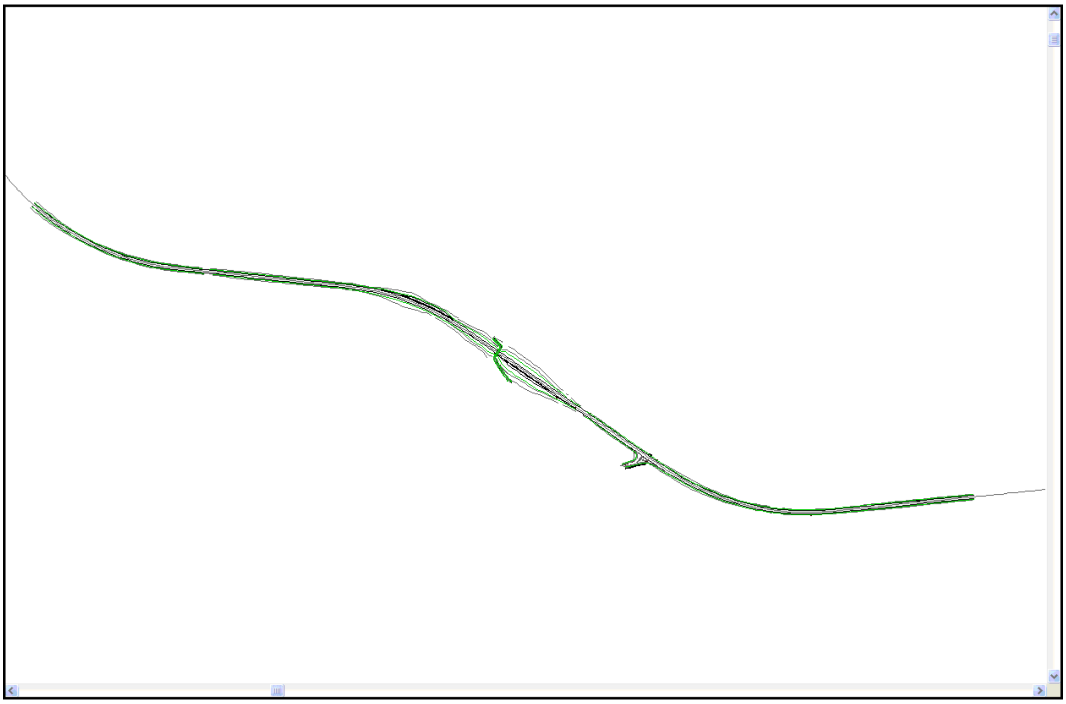


Select 'Create the model and triangulation'

Select 'OK'



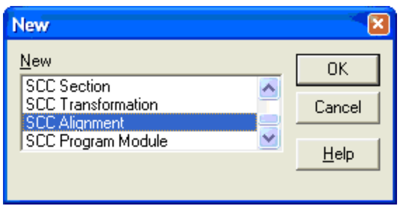




Goto 'FILE > Save As > GENIO_DESIGN.Model'

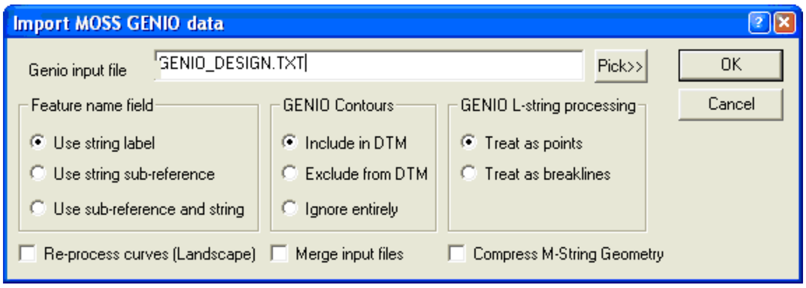
Taking MfW Geometry strings into SCC

Goto 'FILE > New > SCC Alignment'



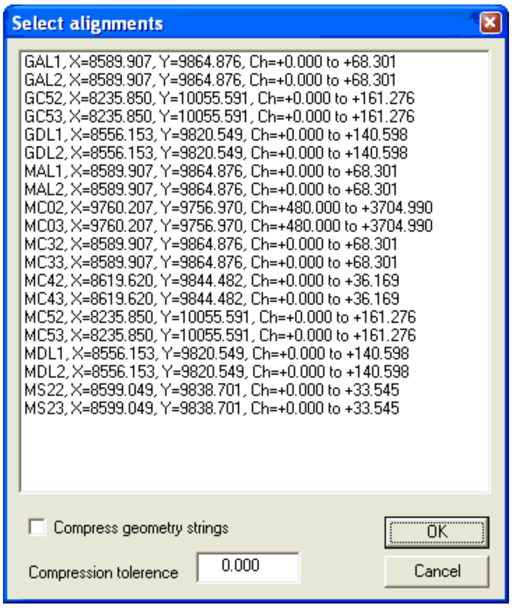
A blank horizontal intersection sheet is opened. The alignment information is imported into this SCC alignment file.

Goto 'FILE > Import > MX GENIO Geometry strings'



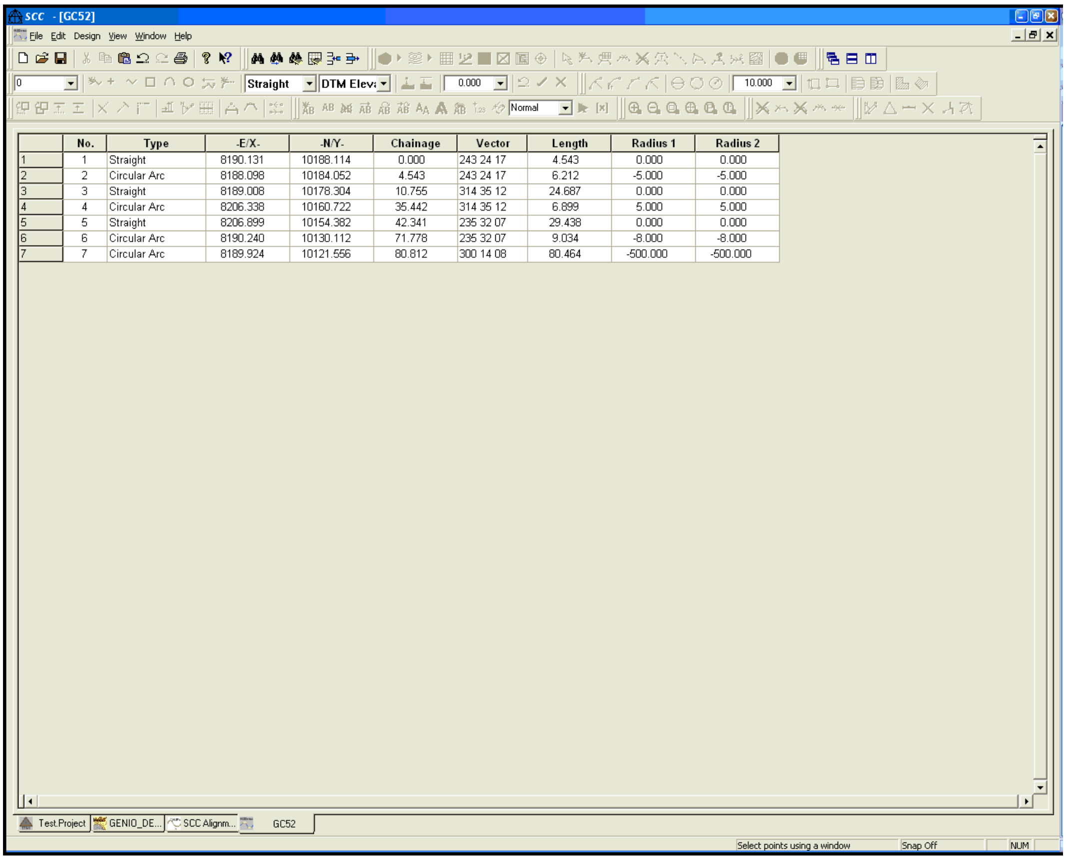
Select the file 'GENIO_DESIGN.txt'

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 'GC52.Alignment'

Alignment files contain horizontal and vertical geometry information. The horizontal entities sheet is opened and the imported information displayed.



	No.	Type	-E/X-	-N/Y-	Chainage	Vector	Length	Radius 1	Radius 2
1	1	Straight	8190.131	10188.114	0.000	243 24 17	4.543	0.000	0.000
2	2	Circular Arc	8188.098	10184.052	4.543	243 24 17	6.212	-5.000	-5.000
3	3	Straight	8189.008	10178.304	10.755	314 35 12	24.687	0.000	0.000
4	4	Circular Arc	8206.338	10160.722	35.442	314 35 12	6.899	5.000	5.000
5	5	Straight	8206.899	10154.382	42.341	235 32 07	29.438	0.000	0.000
6	6	Circular Arc	8190.240	10130.112	71.778	235 32 07	9.034	-8.000	-8.000
7	7	Circular Arc	8189.924	10121.556	80.812	300 14 08	80.464	-500.000	-500.000

Save As 'GC52.Alignment'.

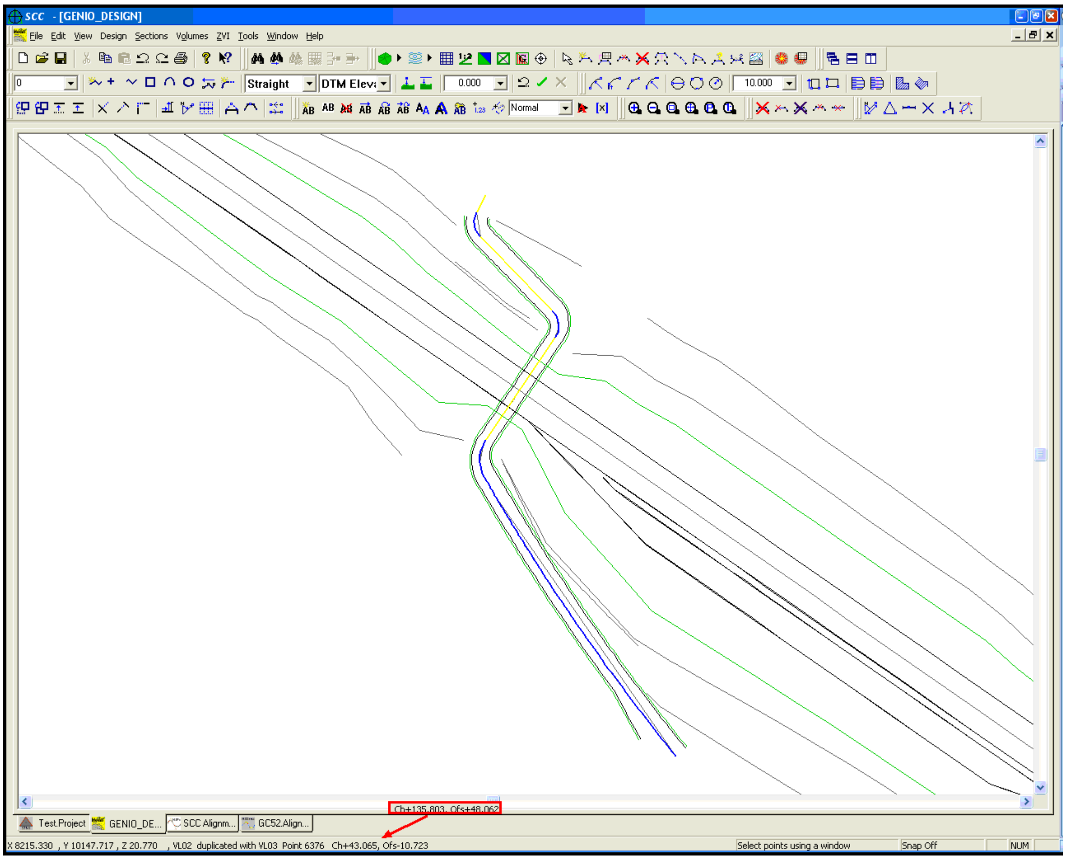
Attaching an Alignment to a Model

Go to 'GENIO_DESIGN.Model'

Select 'FILE > Attach/Detach > Attach an alignment file'

Select the alignment'GC52.Alignment

Note by holding the 'Ctrl' key allows the user to select several alignment files together

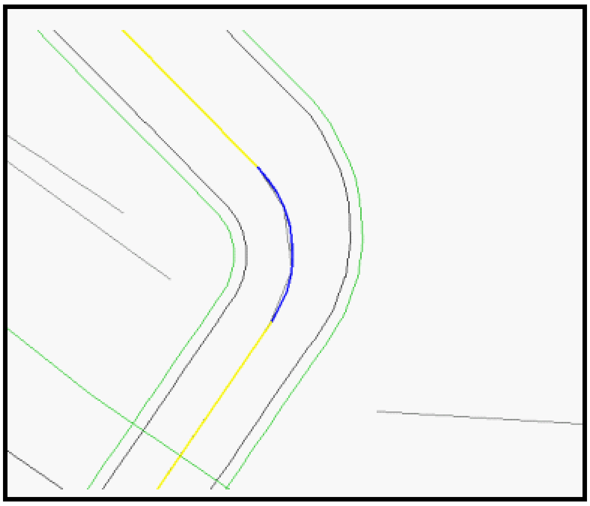


If we examine ‘GC52.Alignment’ note that the chainage system is available on the bottom toolbar as the cursor is moved along the alignment.

The option to Move/Edit Alignment under the ‘Design Menu’ is automatically activated.

Within ‘GENIO_DESIGN.Model’, select ‘DESIGN > Move Alignment'

Click on alignment string with the left mouse button and interactively move the alignment.



Original Horizontal Entities

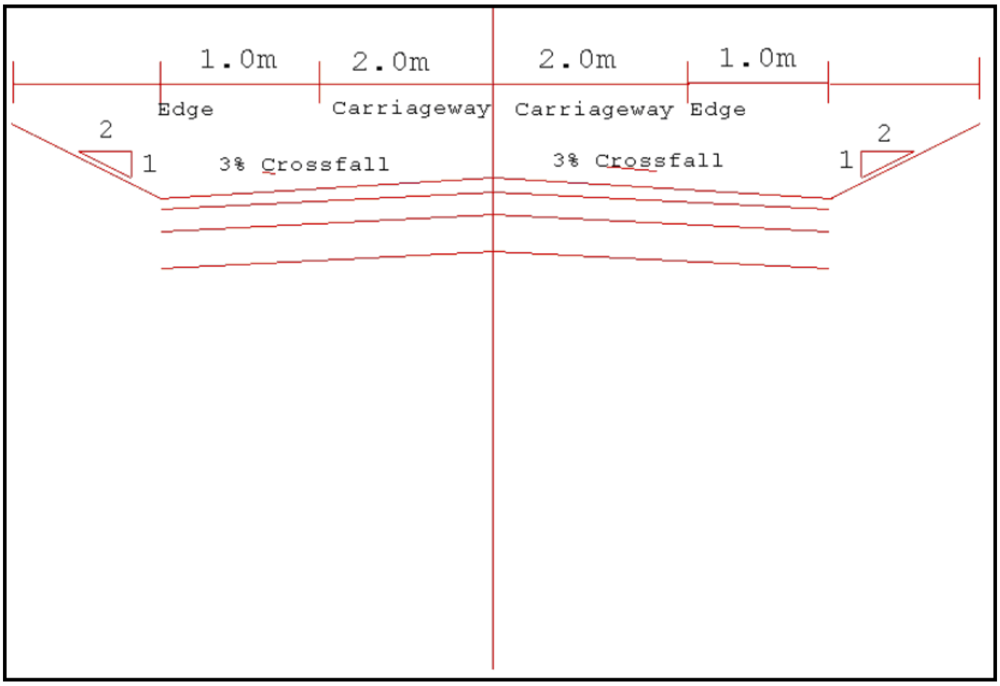
	No.	Type	-E/X-	-N/Y-	Chainage	Vector	Length	Radius 1	Radius 2
1	1	Straight	8190.131	10188.114	0.000	243 24 17	4.543	0.000	0.000
2	2	Circular Arc	8188.098	10184.052	4.543	243 24 17	6.212	-5.000	-5.000
3	3	Straight	8189.008	10178.304	10.755	314 35 12	24.687	0.000	0.000
4	4	Circular Arc	8206.338	10160.722	35.442	314 35 12	6.899	5.000	5.000
5	5	Straight	8206.899	10154.382	42.341	235 32 07	29.438	0.000	0.000
6	6	Circular Arc	8190.240	10130.112	71.778	235 32 07	9.034	-8.000	-8.000
7	7	Circular Arc	8189.924	10121.556	80.812	300 14 08	80.464	-500.000	-500.000

Automatically updated Horizontal Entities after Alignment was moved within Model

	No.	Type	-E/X-	-N/Y-	Chainage	Vector	Length	Radius 1	Radius 2
1	1	Straight	8190.759	10188.197	0.000	243 24 17	4.543	0.000	0.000
2	2	Circular Arc	8188.726	10184.135	4.543	243 24 17	6.212	-5.000	-5.000
3	3	Straight	8189.636	10178.387	10.755	314 35 12	24.687	0.000	0.000
4	4	Circular Arc	8206.966	10160.805	35.442	314 35 12	6.899	5.000	5.000
5	5	Straight	8207.527	10154.465	42.341	235 32 07	29.438	0.000	0.000
6	6	Circular Arc	8190.868	10130.195	71.778	235 32 07	9.034	-8.000	-8.000
7	7	Circular Arc	8190.552	10121.639	80.812	300 14 08	80.464	-500.000	-500.000

Typing in Section Template Points

The section template design for this tutorial is ‘SectionTemplate.Model’.



It contains the width and cross fall of each element in the template

Revert back to 'GENIO_DESIGN.Model' which has the unedited 'GC52.Alignment' attached.

Go to 'Design > Section Templates'.

Set the 'Template Design Action' to 'Add Points'.

Set Apply to 'Cut and Fill'

Set the 'Horizontal Component' to 'Width' and the 'Vertical Component' to 'Gradient'.

Set the Units of measurement for gradients to Percentage %

Ensure that the 'Unit for Gradients' is set to 'percentage %' within 'FILE >General Options > Units and Data Checking' section.

Centre Line:

Set the 'Surface' to 'TopSurface' and the Feature 'CL'

Enter a value of '0.00' for the 'horizontal and vertical component.

Leave the 'interface side slopes' turned 'off'

Select 'Add Point'

All horizontal components to the right of the centre line are positive, while all the horizontal components to the left are negative.

RHS001:

Select 'Feature > RHS001'

Set the 'width > 2.00' and the 'gradient > –3'.

'Turn on' 'Right Interface slope' and set the 'Gradient > 50%'.

Select 'Add Point'

R-EDGE:

Select 'Feature>R-EDGE'

Set the 'width > 1.00' and the 'gradient > –3'.

'Turn on' 'Right Interface slope' and set the 'Gradient > 50%'.

Select 'Add Point'

LHS001:

Select 'Feature > LHS001'

Set the 'width > -2.00' and the 'gradient > –3'.

'Turn on' 'Right Interface slope' and set the 'Gradient > 50%'.

Select 'Add Point'

L-EDGE:

Select 'Feature>L-EDGE'

Set the 'width > -1.00' and the 'gradient > –3'.

'Turn on' 'Right Interface slope' and set the 'Gradient > 50%'.

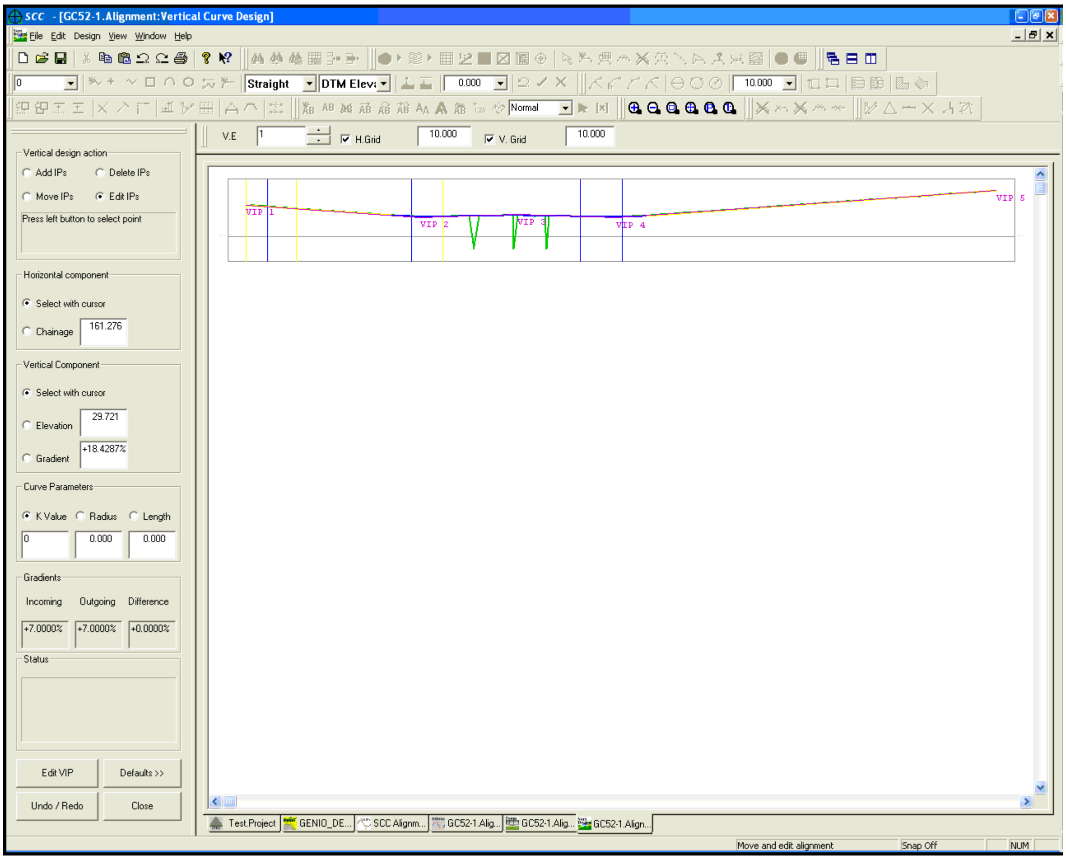
Select 'Add Point'

The Section Template should be automatically updated within the Model ' GENIO_DESIGN.Model' which has the alignment attached.

However, in this instance no such update take places. Therefore further investigation of the Vertical Alignment is necessary.

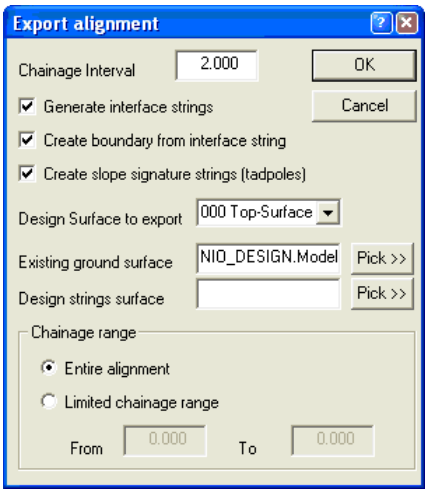
Within 'GENIO_DESIGN.Model' which has the 'GC52.Alignment' attached.

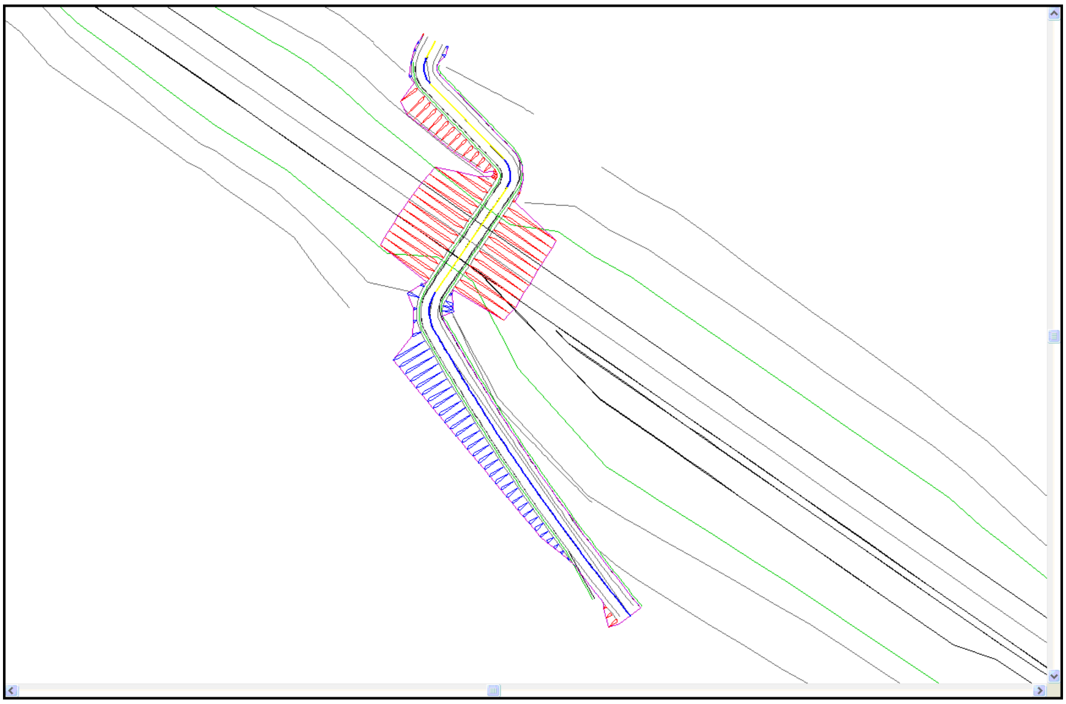
Go to 'Design > Vertical Alignment'



Select 'DESIGN > Interface And Export Parameters…'

Set up the parameters as follows:

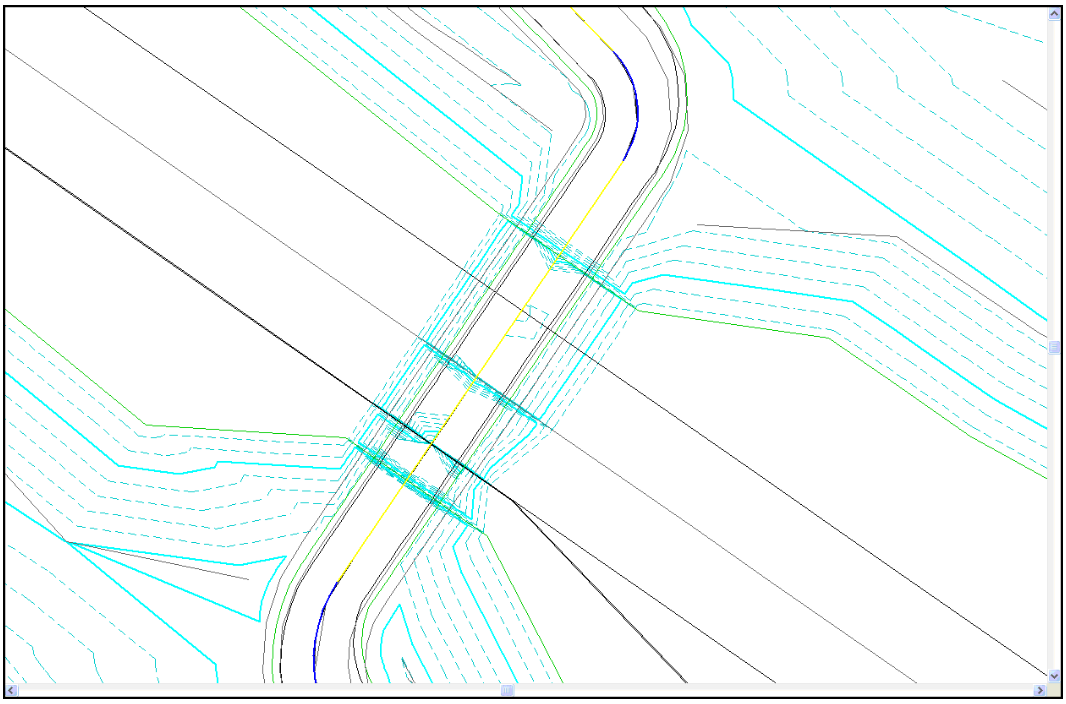




It is clear that one single Section Template is not satisfactory for this Road.

As the Road incorporates a Bridge Crossing it is perhaps more feasible to have a Section Template specifically for this area. In other words a section template, which does not have any side slopes.

Note also that from the contours one can deduce there is a need for string editing.



New Section Templates

Within 'GENIO_DESIGN.Model' place the cursor over the bridge edges in order to obtain Chainage Values (bottom toolbar) to begin Second and Third Section Templates

Go to 'Design > Section Templates'.

As before Set the 'Template Design Action' to 'Add Points'.

Set Apply to 'Cut and Fill'

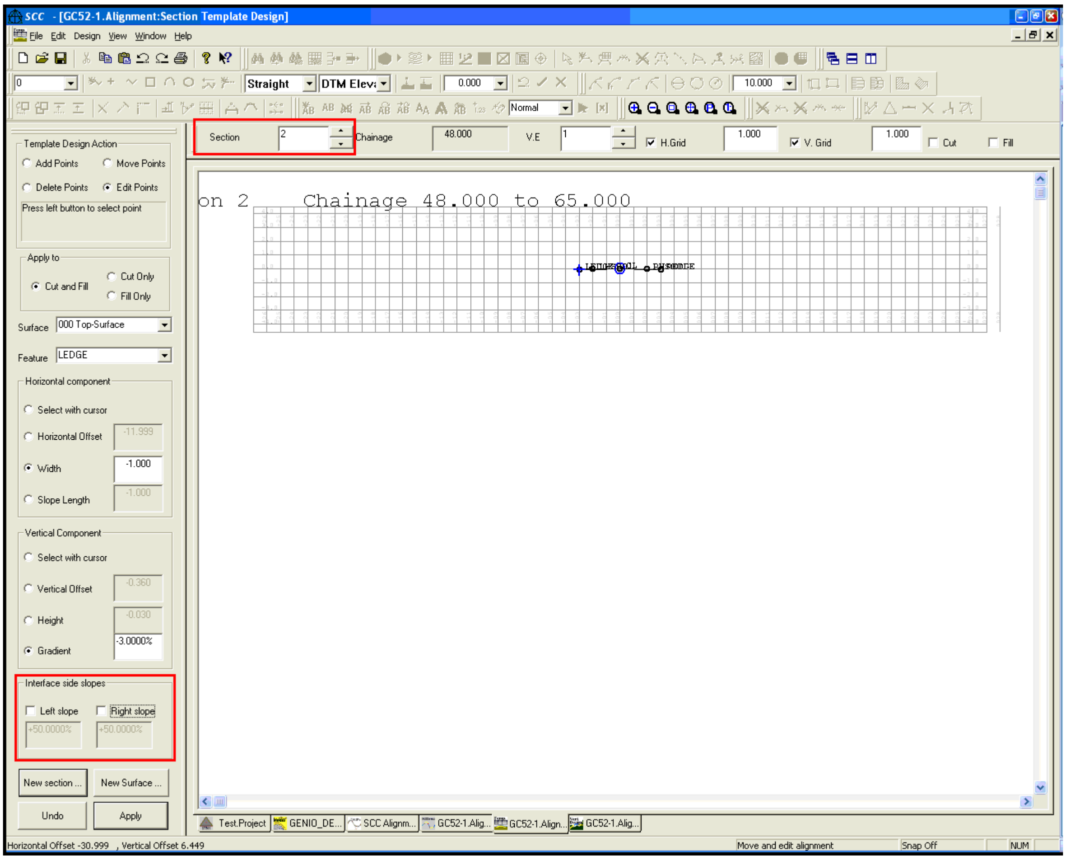
Set the 'Horizontal Component' to 'Width' and the 'Vertical Component' to 'Gradient'.

Set the Units of measurement for gradients to Percentage %

Select 'New Surface' from the bottom left of the screen

Enter the new template starting chainage '48.00'

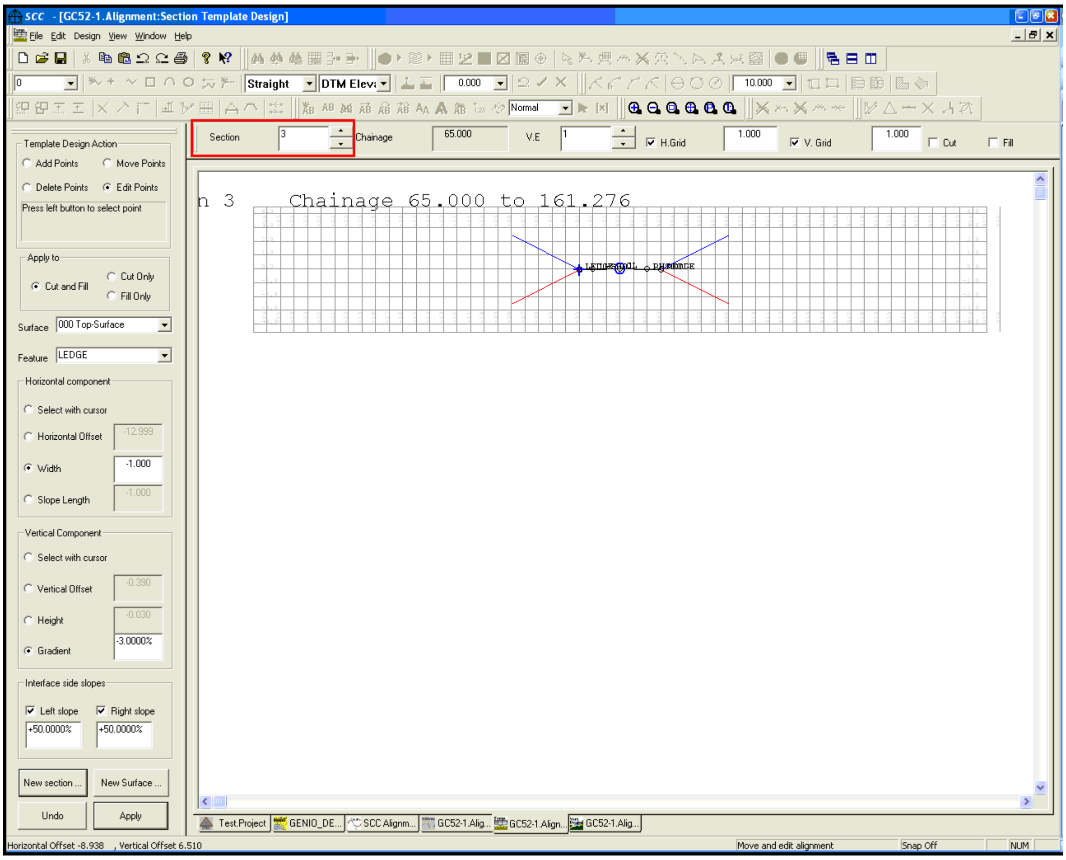
Unselect 'Left Interface Side Slope' and 'Right Interface Side Slope'

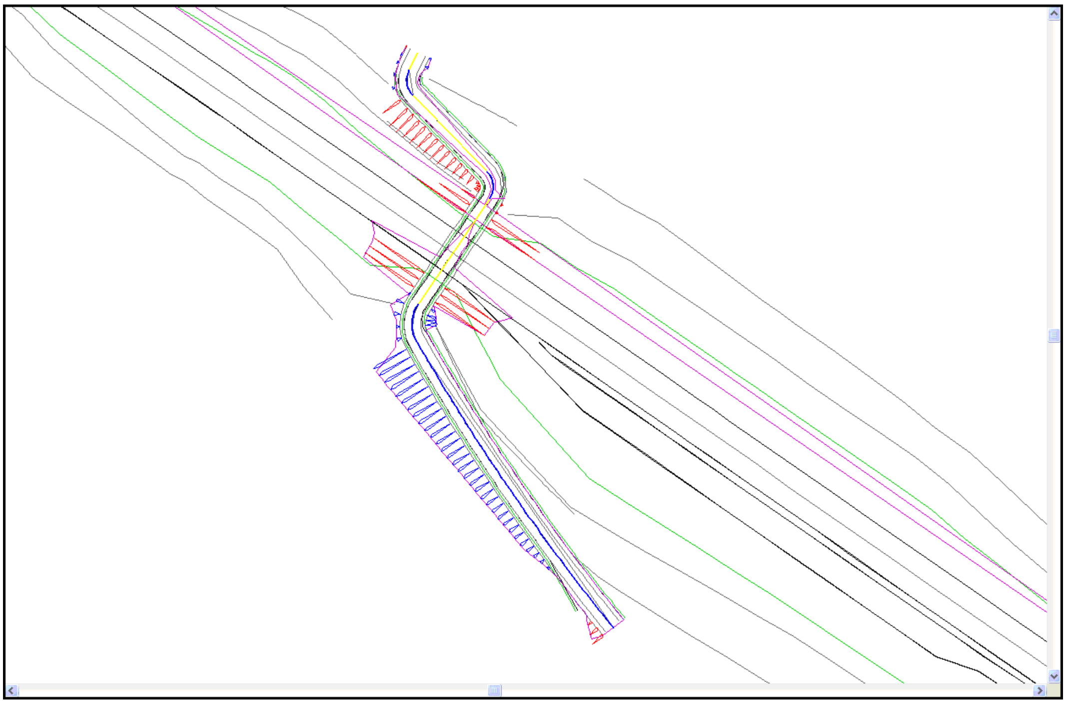


Select 'New Surface' from the bottom left of the screen

Enter the new template starting chainage '65.00'

Select 'Left Interface Side Slope' and 'Right Interface Side Slope' of 50%



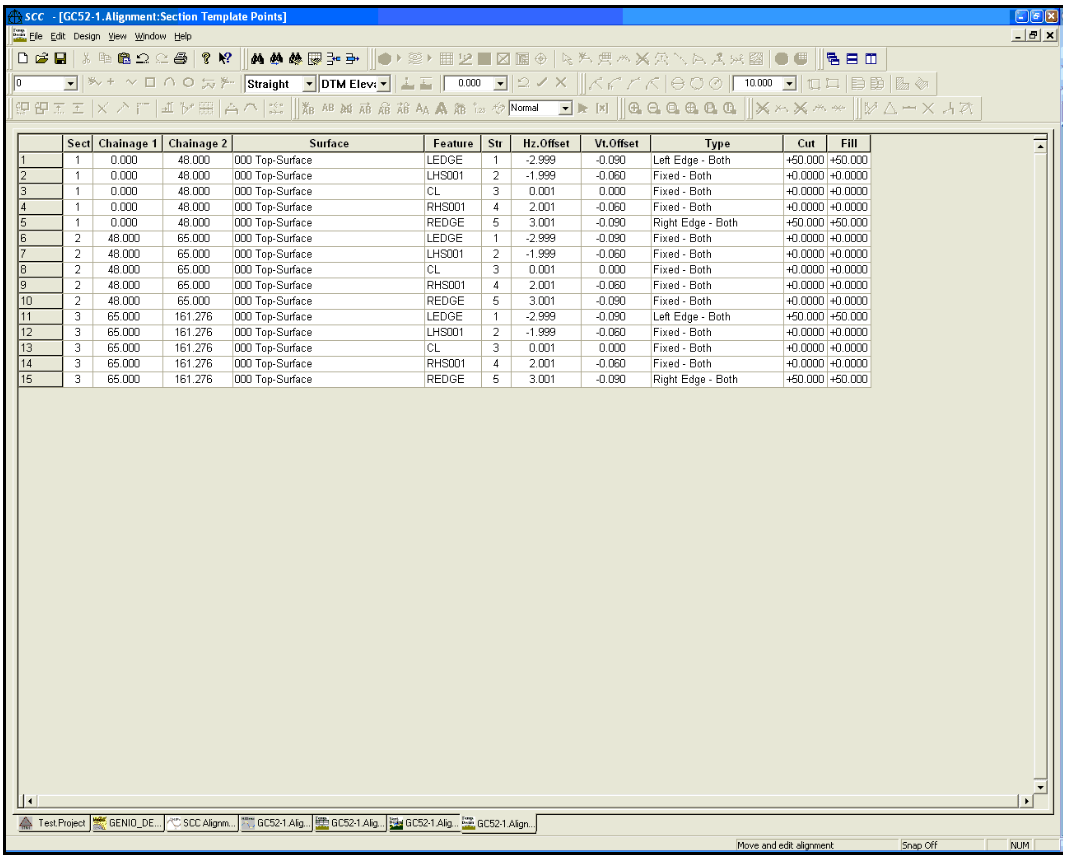


Once the section Template has been created further editing can be carried out with the Design Sheet.

For instance, editing the starting chainage of a Section Template can be carried out as follows:

Editing Section Template Points

Within 'GENIO_DESIGN.Model' select 'DESIGN > View Design Sheet > Section Template Points'



	Sect	Chainage 1	Chainage 2	Surface	Feature	Str	Hz.Offset	Vt.Offset	Type	Cut	Fill
1	1	0.000	48.000	000 Top-Surface	LEDGE	1	-2.999	-0.090	Left Edge - Both	+50.000	+50.000
2	1	0.000	48.000	000 Top-Surface	LHS001	2	-1.999	-0.060	Fixed - Both	+0.0000	+0.0000
3	1	0.000	48.000	000 Top-Surface	CL	3	0.001	0.000	Fixed - Both	+0.0000	+0.0000
4	1	0.000	48.000	000 Top-Surface	RHS001	4	2.001	-0.060	Fixed - Both	+0.0000	+0.0000
5	1	0.000	48.000	000 Top-Surface	REDGE	5	3.001	-0.090	Right Edge - Both	+50.000	+50.000
6	2	48.000	65.000	000 Top-Surface	LEDGE	1	-2.999	-0.090	Fixed - Both	+0.0000	+0.0000
7	2	48.000	65.000	000 Top-Surface	LHS001	2	-1.999	-0.060	Fixed - Both	+0.0000	+0.0000
8	2	48.000	65.000	000 Top-Surface	CL	3	0.001	0.000	Fixed - Both	+0.0000	+0.0000
9	2	48.000	65.000	000 Top-Surface	RHS001	4	2.001	-0.060	Fixed - Both	+0.0000	+0.0000
10	2	48.000	65.000	000 Top-Surface	REDGE	5	3.001	-0.090	Fixed - Both	+0.0000	+0.0000
11	3	65.000	161.276	000 Top-Surface	LEDGE	1	-2.999	-0.090	Left Edge - Both	+50.000	+50.000
12	3	65.000	161.276	000 Top-Surface	LHS001	2	-1.999	-0.060	Fixed - Both	+0.0000	+0.0000
13	3	65.000	161.276	000 Top-Surface	CL	3	0.001	0.000	Fixed - Both	+0.0000	+0.0000
14	3	65.000	161.276	000 Top-Surface	RHS001	4	2.001	-0.060	Fixed - Both	+0.0000	+0.0000
15	3	65.000	161.276	000 Top-Surface	REDGE	5	3.001	-0.090	Right Edge - Both	+50.000	+50.000

Changing Section Template 2 starting point from 48.00 to 43.00:

Select 'EDIT > Replace'

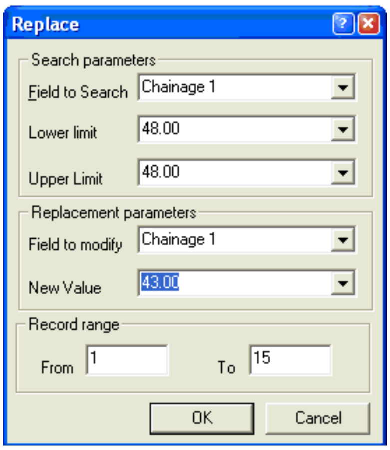
Within the Search Parameters, enter 'Field to Search' as 'Chainage 1'

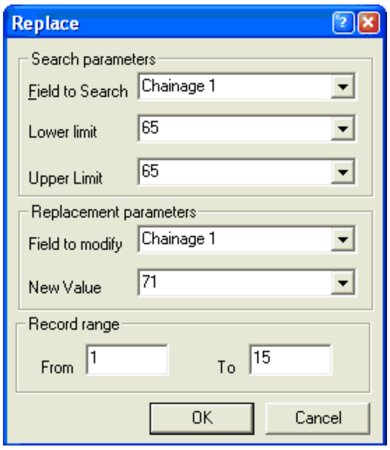
Enter existing value Lower and Upper Limit Values '48.00'

Within the 'Replacement Parameters' enter the 'Field to modify as 'Chainage 1'

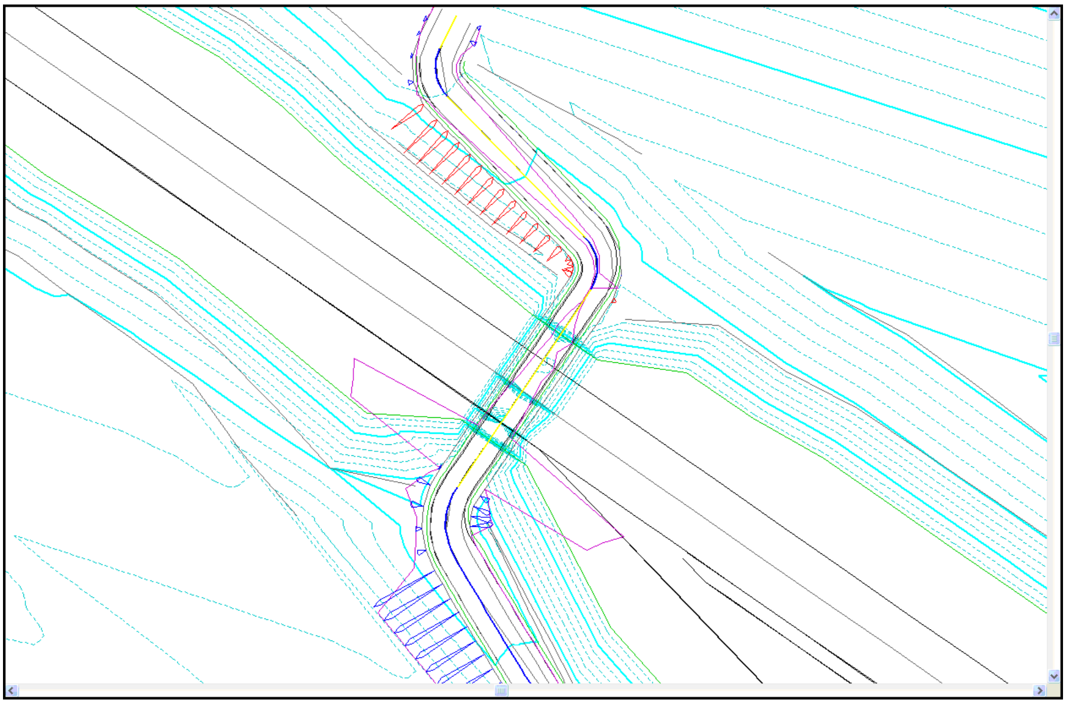
Enter 'New Value' as '43.00'4

The above commands are repeated to changing Section Template 3 starting point from 65.00 to 71.00:





	Sect	Chainage 1	Chainage 2	Surface	Feature	Str	Hz.Offset	Vt.Offset	Type	Cut	Fill
1	1	0.000	48.000	000 Top-Surface	LEDGE	1	-2.999	-0.090	Left Edge - Both	+50.000	+50.000
2	1	0.000	48.000	000 Top-Surface	LHS001	2	-1.999	-0.060	Fixed - Both	+0.0000	+0.0000
3	1	0.000	48.000	000 Top-Surface	CL	3	0.001	0.000	Fixed - Both	+0.0000	+0.0000
4	1	0.000	48.000	000 Top-Surface	RHS001	4	2.001	-0.060	Fixed - Both	+0.0000	+0.0000
5	1	0.000	48.000	000 Top-Surface	REDGE	5	3.001	-0.090	Right Edge - Both	+50.000	+50.000
6	2	43.000	65.000	000 Top-Surface	LEDGE	1	-2.999	-0.090	Fixed - Both	+0.0000	+0.0000
7	2	43.000	65.000	000 Top-Surface	LHS001	2	-1.999	-0.060	Fixed - Both	+0.0000	+0.0000
8	2	43.000	65.000	000 Top-Surface	CL	3	0.001	0.000	Fixed - Both	+0.0000	+0.0000
9	2	43.000	65.000	000 Top-Surface	RHS001	4	2.001	-0.060	Fixed - Both	+0.0000	+0.0000
10	2	43.000	65.000	000 Top-Surface	REDGE	5	3.001	-0.090	Fixed - Both	+0.0000	+0.0000
11	3	71.000	161.276	000 Top-Surface	LEDGE	1	-2.999	-0.090	Left Edge - Both	+50.000	+50.000
12	3	71.000	161.276	000 Top-Surface	LHS001	2	-1.999	-0.060	Fixed - Both	+0.0000	+0.0000
13	3	71.000	161.276	000 Top-Surface	CL	3	0.001	0.000	Fixed - Both	+0.0000	+0.0000
14	3	71.000	161.276	000 Top-Surface	RHS001	4	2.001	-0.060	Fixed - Both	+0.0000	+0.0000
15	3	71.000	161.276	000 Top-Surface	REDGE	5	3.001	-0.090	Right Edge - Both	+50.000	+50.000



Applying a Second Surface to a Section Template

Having a horizontal and vertical alignment and a standard section template, the user can now add additional surface to the section template.

The follow surfaces will be added to the Section Template:

45mm Hot Rolled Asphalt Wearing Course to cl. s905
55mm Dense Bitumen Macadam Base Course to cl. s902

120mm Dense Bitument Macadam Road Base to cl. s812
150mm Minimum Granular Material Type B Sub-Base to cl 804

Revert to the 'Section Template Design'

Select 'New Surface'

Within Create New Surface dialog enter surface Name ‘c1 s804’

Set ‘000 Top Surface’ as Copy from Surface

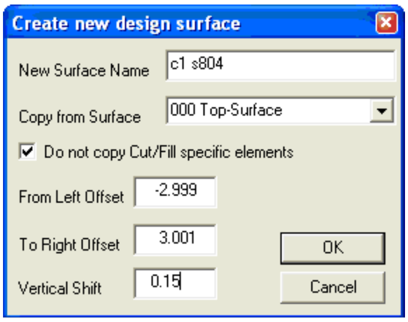
Select ‘Do not copy Cut/Fill specific elements’

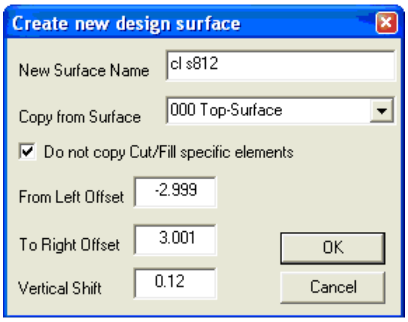
Accept default ‘From Left Offset’ and ‘To Right Offset’

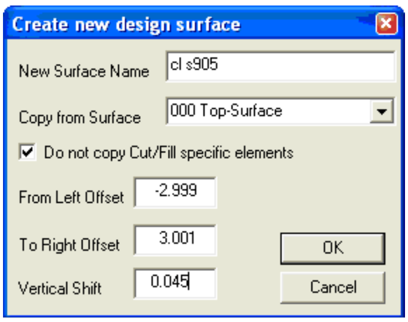
Enter the relevant ‘Vertical Shift’

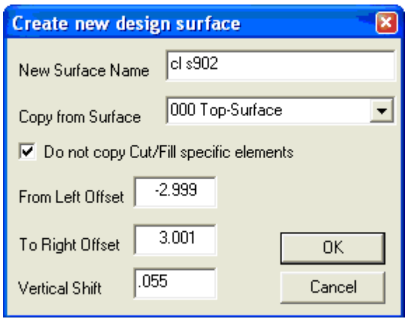
Select ‘OK’

Repeat the above steps for ‘c1 s902’, ‘c1 s812’ and ‘c1 905’

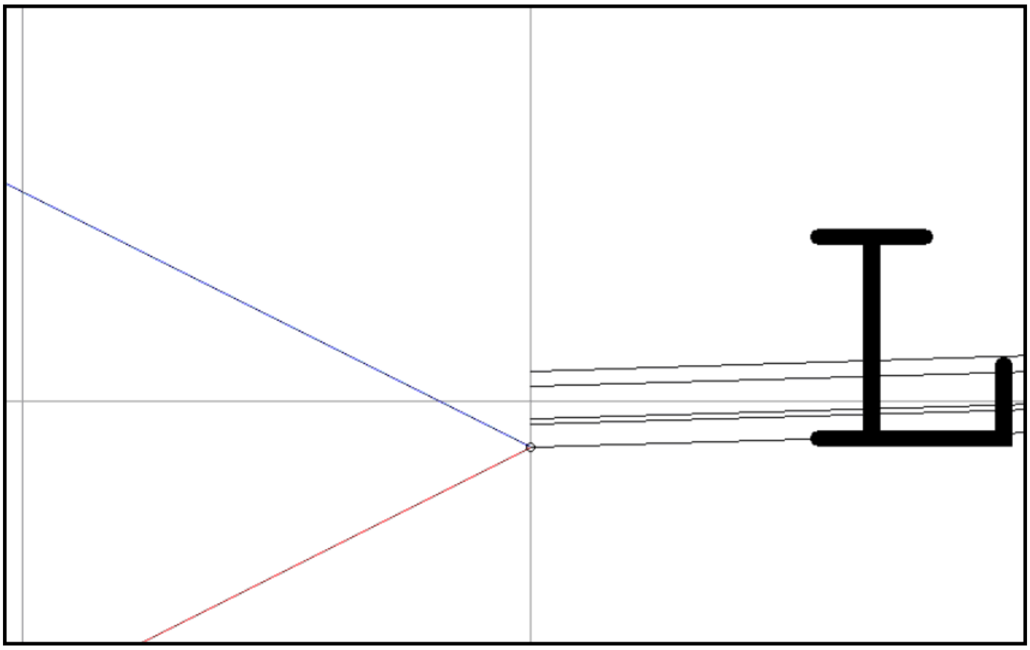








Use the Zoom Functions to see the additional new surfaces.



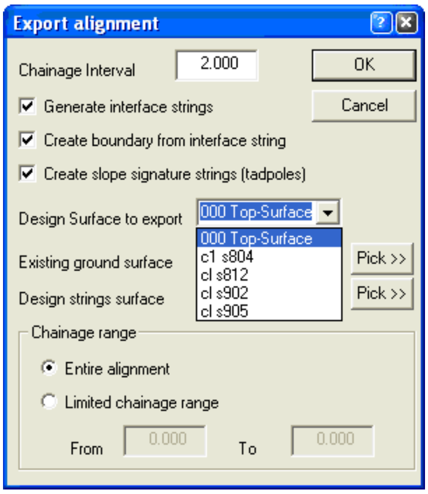
Exporting Surfaces from Section Template

Surface created within a Section Template can be export as dataset or as model.

Within 'GENIO_DESIGN.Model' which has the 'GC52.Alignment' attached.

Select 'DESIGN > Export design as model'

Set up the follow:



Set 'GENIO_DESIGN.Model' as the 'Existing Ground Surface'

Select surface from the 'Design Surface to export' Drop Down Menu

Save the Model

Repeat this step until all Surfaces are exported

'c1 804.Model', 'c1 s812.Model', 'c1s902.Model' and 'c1 s905.Model'

Sections

Sections can be used as a QA procedure when using the Section Templates.

Within 'GENIO_DESIGN.Model' which has the 'GC52.Alignment' attached.

Select 'SECTIONS > Long Section by cursor'

Left click the model to select first point of section, left click the mouse to select end point and right click mouse to finish.

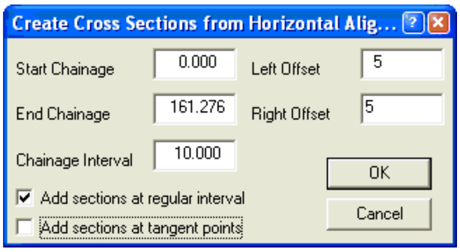
A more extensive examination of surfaces can be carried out as follows:

Cross Section From Alignment

Within 'GENIO_DESIGN.Model' which has the alignment file attached.

Select 'SECTIONS > Cross Section from An Alignment

Set up the following:



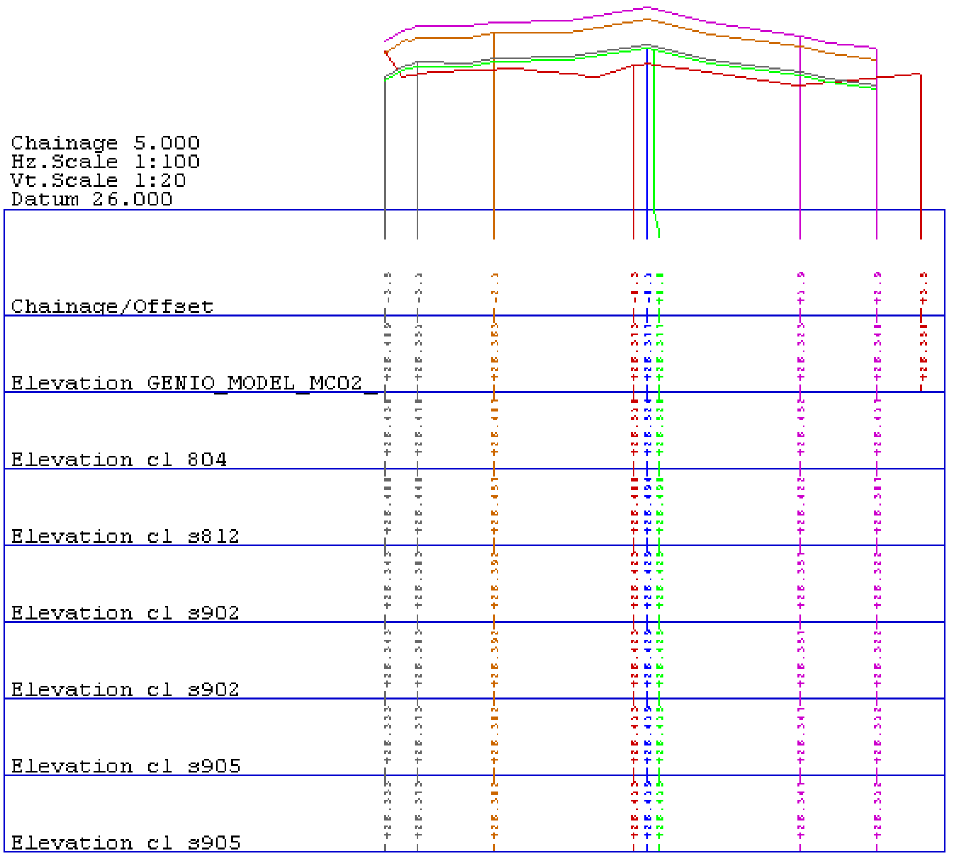
'Save As > CrossSection GC52.Section'

Please note the Section Annotation and Scale can be assigned within **'VIEW > Scale, Titles & Grids' and 'VIEW > Annotation Settings'**

Appending Surfaces to Sections

Within 'CrossSection GC52.Section' select 'EDIT > Append Surface'

Select 'c1 804.Model', 'c1 s812.Model', 'c1s902.Model' and 'c1 s905.Model' by holding 'Ctrl'



Furthermore this allows for volumes by Cross Section to be carried out:

Volumes by Cross Section

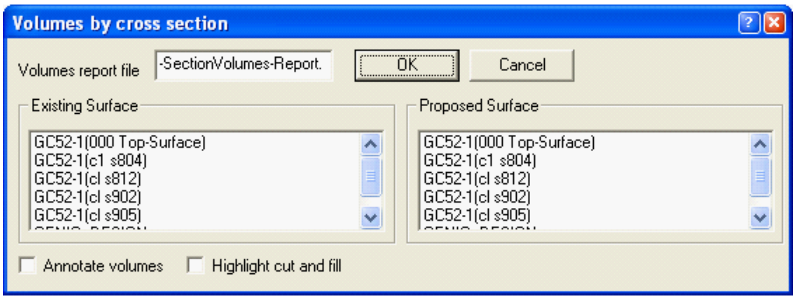
Within 'CrossSection GC52.Section' select 'EDIT > Volumes'

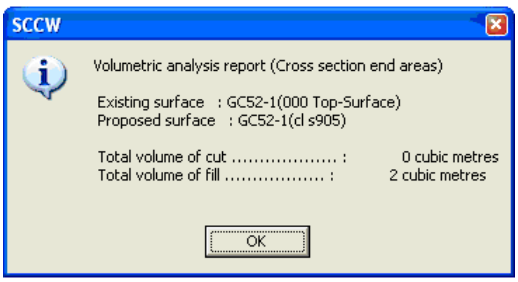
Enter a 'Volume Report File' 'c1 s902.txt'

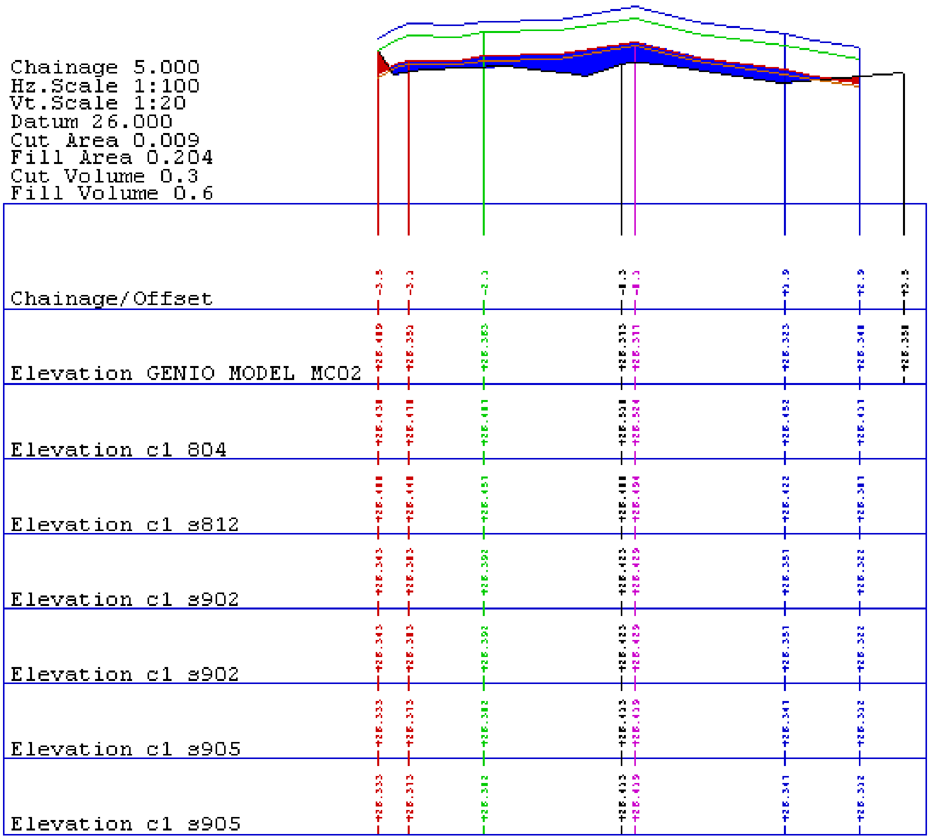
Select 'Existing Surface' 'Top Surface' and the 'Proposed Surface' 'c1 s902'

Select to 'Annotate Volumes' and 'Highlight Cut and Fill'

Select 'OK'







11.3 Getting Intersection Points from DOER

SCC can import alignment information from DOER (the Irish Department of Environment Road Design package).

11.3.1 Getting Horizontal Intersection Points from DOER

SCC imports horizontal and vertical intersection point information from DOER. Intersection point information may not be generated from geometric entities.

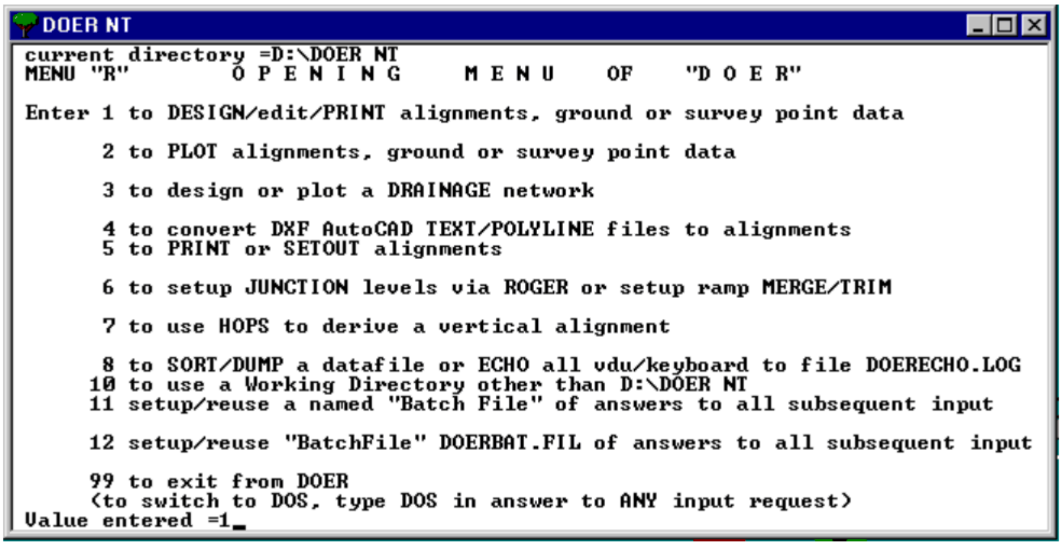
There is a DOER alignment file (BigRoad.A01) in the \SCC\Tutorials directory.

Exporting Alignment from DOER

Copy this file from this directory into the DOER directory.

From DOS or from a DOS window in NT open DOER.

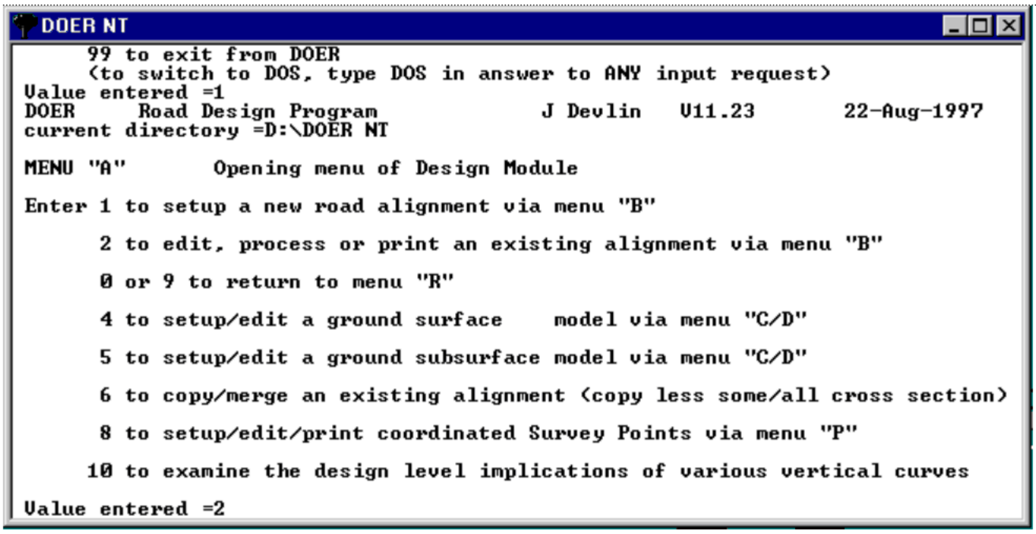
From the Opening Menu of DOER select the first option ;1 to DESIGN/edit/PRINT alignments, ground or survey point data.



```
DOER NT
current directory =D:\DOER NT
MENU "R"        O P E N I N G     M E N U    OF    "D O E R"

Enter 1 to DESIGN/edit/PRINT alignments, ground or survey point data

      2 to PLOT alignments, ground or survey point data

      3 to design or plot a DRAINAGE network

      4 to convert DXF AutoCAD TEXT/POLYLINE files to alignments
      5 to PRINT or SETOUT alignments

      6 to setup JUNCTION levels via ROGER or setup ramp MERGE/TRIM

      7 to use HOPS to derive a vertical alignment

      8 to SORT/DUMP a datafile or ECHO all vdu/keyboard to file DOERECHO.LOG
     10 to use a Working Directory other than D:\DOER NT
     11 setup/reuse a named "Batch File" of answers to all subsequent input

     12 setup/reuse "BatchFile" DOERBAT.FIL of answers to all subsequent input

     99 to exit from DOER
     (to switch to DOS, type DOS in answer to ANY input request)
Value entered =1_
```

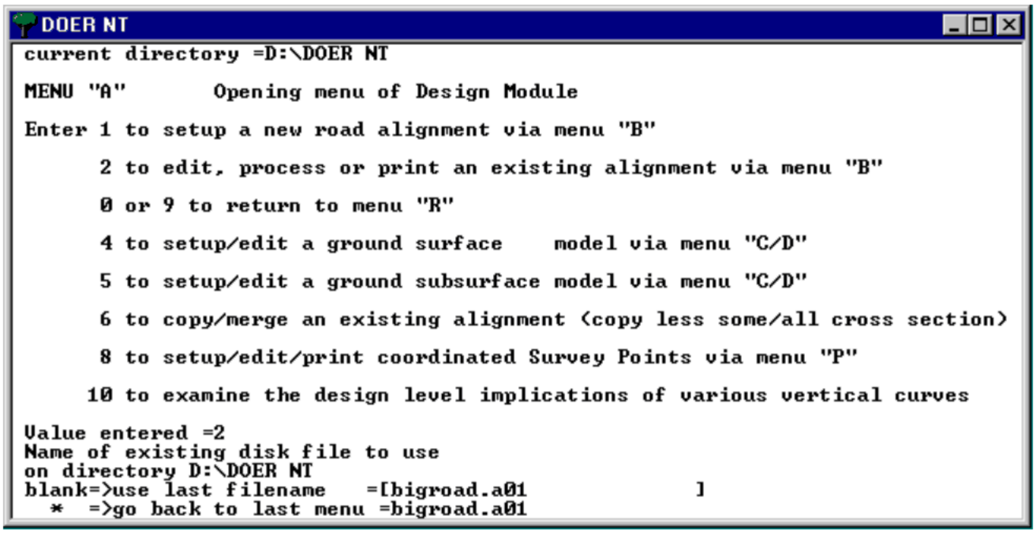
The Opening menu of the Design Module is opened.

Select option 2 to edit, process or print an existing alignment via menu “B”.



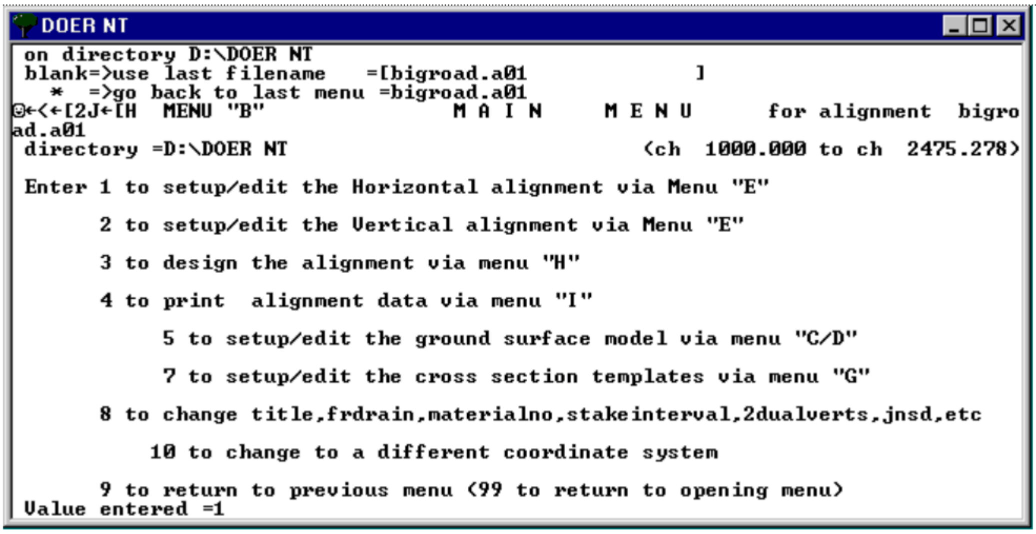
```
DOER NT
      99 to exit from DOER
     (to switch to DOS, type DOS in answer to ANY input request)
Value entered =1
DOER     Road Design Program              J Devlin    V11.23       22-Aug-1997
current directory =D:\DOER NT

MENU "A"        Opening menu of Design Module

Enter 1 to setup a new road alignment via menu "B"

      2 to edit, process or print an existing alignment via menu "B"

      0 or 9 to return to menu "R"

      4 to setup/edit a ground surface    model via menu "C/D"

      5 to setup/edit a ground subsurface model via menu "C/D"

      6 to copy/merge an existing alignment (copy less some/all cross section)

      8 to setup/edit/print coordinated Survey Points via menu "P"

     10 to examine the design level implications of various vertical curves

Value entered =2
```

You will be required to select an existing DOER alignment file. Select the file BigRoad.A01 from the current directory.



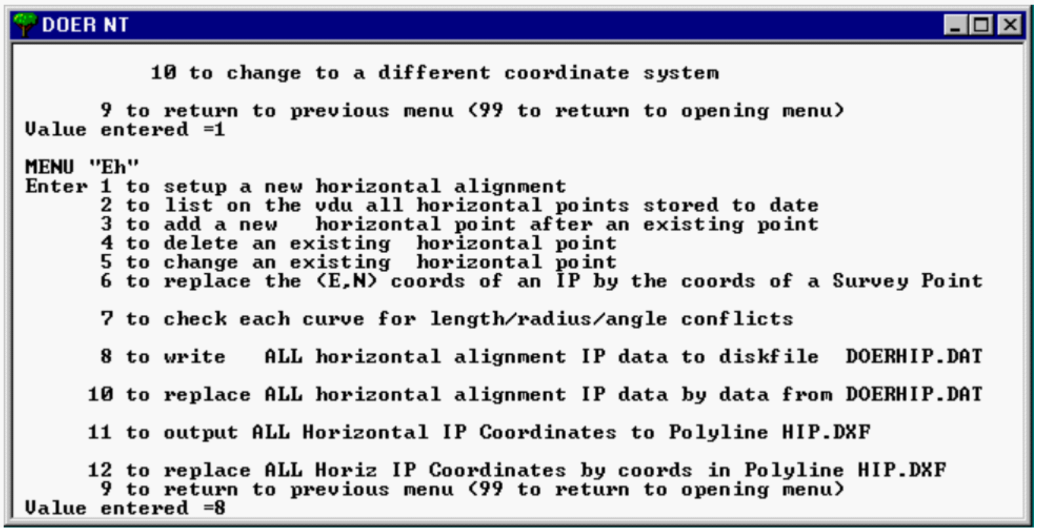
```
DOER NT
current directory =D:\DOER NT

MENU "A"        Opening menu of Design Module

Enter 1 to setup a new road alignment via menu "B"

      2 to edit, process or print an existing alignment via menu "B"

      0 or 9 to return to menu "R"

      4 to setup/edit a ground surface    model via menu "C/D"

      5 to setup/edit a ground subsurface model via menu "C/D"

      6 to copy/merge an existing alignment (copy less some/all cross section)

      8 to setup/edit/print coordinated Survey Points via menu "P"

     10 to examine the design level implications of various vertical curves

Value entered =2
Name of existing disk file to use
on directory D:\DOER NT
blank=>use last filename    =[bigroad.a01            ]
  *  =>go back to last menu =bigroad.a01
```

Once the alignment has been selected the Main Menu for the alignment is opened. Select option 1 to setup/edit the horizontal alignment via Menu "E".



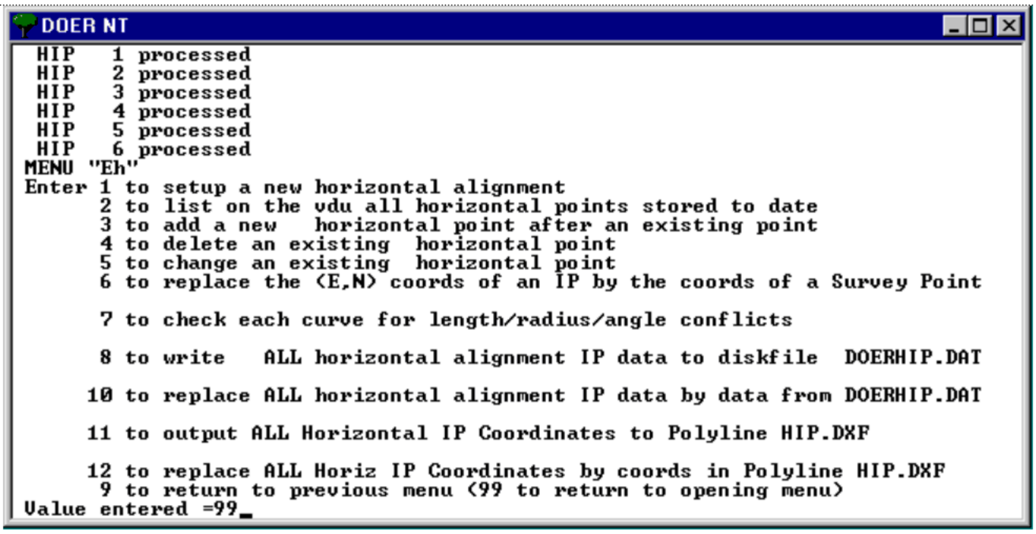
```
DOER NT
 on directory D:\DOER NT
 blank=>use last filename    =[bigroad.a01              ]
   *  =>go back to last menu =bigroad.a01
☺←<←[2J←[H   MENU "B"                M A I N     M E N U      for alignment  bigro
ad.a01
 directory =D:\DOER NT                                 (ch  1000.000 to ch  2475.278)

 Enter 1 to setup/edit the Horizontal alignment via Menu "E"

       2 to setup/edit the Vertical alignment via Menu "E"

       3 to design the alignment via menu "H"

       4 to print  alignment data via menu "I"

            5 to setup/edit the ground surface model via menu "C/D"

            7 to setup/edit the cross section templates via menu "G"

       8 to change title,frdrain,materialno,stakeinterval,2dualverts,jnsd,etc

           10 to change to a different coordinate system

       9 to return to previous menu (99 to return to opening menu)
 Value entered =1
```

Choose option 8 to write ALL horizontal alignment IP data to diskfile DOERHIP.DAT.

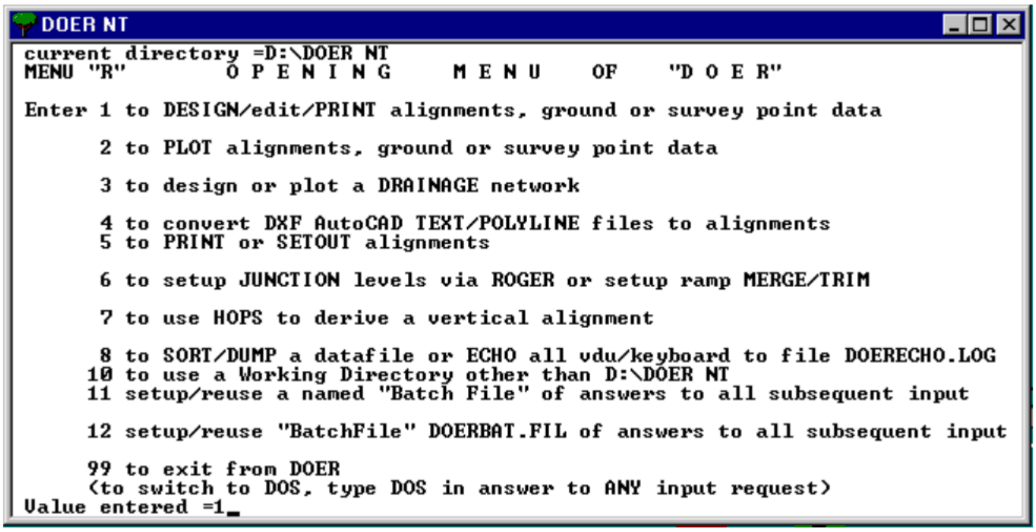


```
DOER NT
           10 to change to a different coordinate system

       9 to return to previous menu (99 to return to opening menu)
 Value entered =1

 MENU "Eh"
 Enter 1 to setup a new horizontal alignment
       2 to list on the vdu all horizontal points stored to date
       3 to add a new   horizontal point after an existing point
       4 to delete an existing  horizontal point
       5 to change an existing  horizontal point
       6 to replace the (E,N) coords of an IP by the coords of a Survey Point

       7 to check each curve for length/radius/angle conflicts

       8 to write   ALL horizontal alignment IP data to diskfile  DOERHIP.DAT

      10 to replace ALL horizontal alignment IP data by data from DOERHIP.DAT

      11 to output ALL Horizontal IP Coordinates to Polyline HIP.DXF

      12 to replace ALL Horiz IP Coordinates by coords in Polyline HIP.DXF
       9 to return to previous menu (99 to return to opening menu)
 Value entered =8
```

The DOER HIP file will be processed and saved in the DOER working directory. Type in 99, to return to the opening menu.



Exit from DOER by again typing in 99.

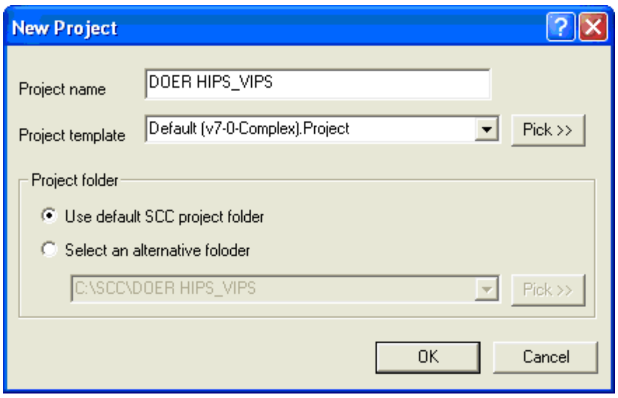


Importing DOER Alignment into SCC

Set up Project

Open a 'New Project' and attach the 'Default(v6).Project' template.

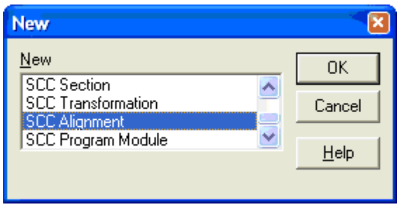
Call the project 'DOER HIPS_VIPS'.



Import DOER Alignment

Open a blank Alignment file

Go to 'FILE > New > SCC Alignment'



A blank horizontal intersection sheet is opened. The alignment information is imported into this SCC alignment file.

From the File menu, select Import DOER HIPS.

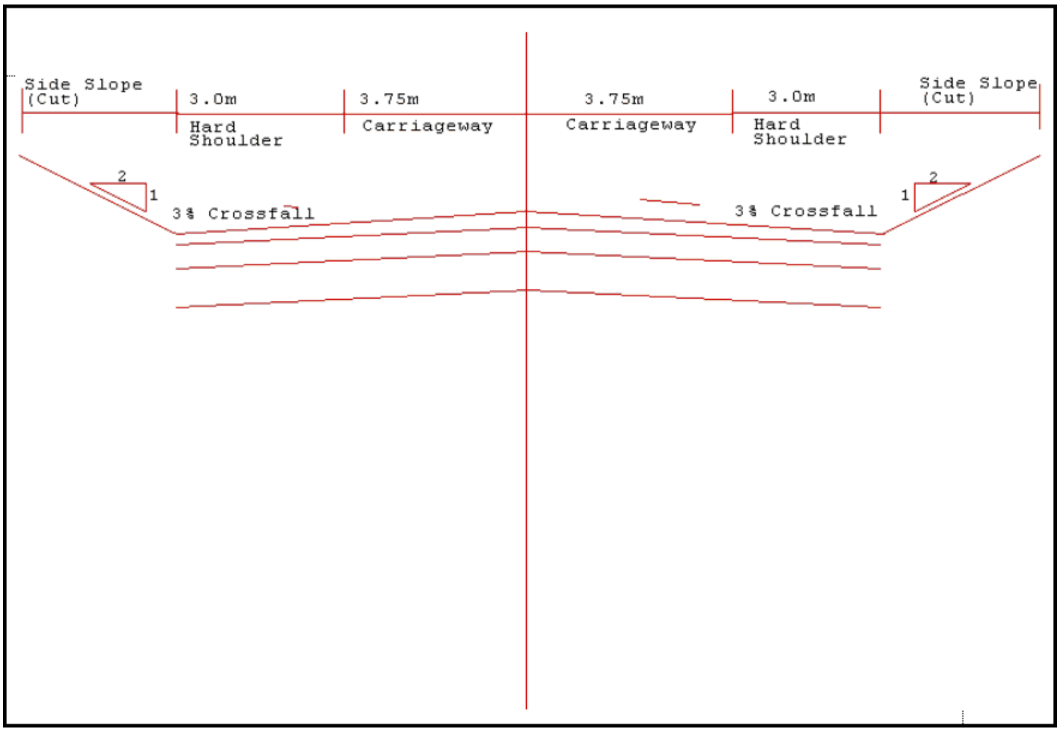
From the DOER directory select the file 'DOERHIP.dat'. The data will be downloaded directly into this spreadsheet.

11.3.2 Typing Section Template Points

Once a horizontal and vertical alignment has been created, it is then possible to design a section template.

The section template design for this tutorial may be found as a DXF file in the \SCC\Tutorials directory.

Import the *'Section Template.DXF'* file into SCC or CAD and print it.



It contains the width and crossfall of each element in the template.

Revert back to "FGL.Model' which has the unedited 'RoadDesign.Alignment' attached.

Go to 'Design > Section Templates'.

Set the 'Template Design Action' to 'Add Points'.

Set Apply to 'Cut and Fill'

Set the 'Horizontal Component' to 'Width' and the 'Vertical Component' to 'Gradient'.

Set the Units of measurement for gradients to Percentage %

Ensure that the 'Unit for Gradients' is set to 'percentage %' within 'FILE > General Options > Units and Data Checking' section

Centre Line:

Set the 'Surface' to 'TopSurface' and the Feature 'CL'

Enter a value of '0.00' for the 'horizontal and vertical component.

Leave the 'interface side slopes' turned 'off'

Select 'Add Point'

All horizontal components to the right of the centre line are positive, while all the horizontal components to the left are negative.

RHS001:

Select 'Feature > RHS001'

Set the 'width > 3.75' and the 'gradient > –3'.

'Turn on' 'Right Interface slope' and set the 'Gradient > 50%'.

Select 'Add Point'

R-EDGE:

Select 'Feature > R-EDGE'

Set the 'width > 3.00' and the 'gradient > –3'.

'Turn on' 'Right Interface slope' and set the 'Gradient > 50%'.

Select 'Add Point'

LHS001:

Select 'Feature > LHS001'

Set the 'width > -3.75' and the 'gradient > –3'.

'Turn on' 'Left Interface slope' and set the 'Gradient > 50%'.

Select 'Add Point'

L-EDGE:

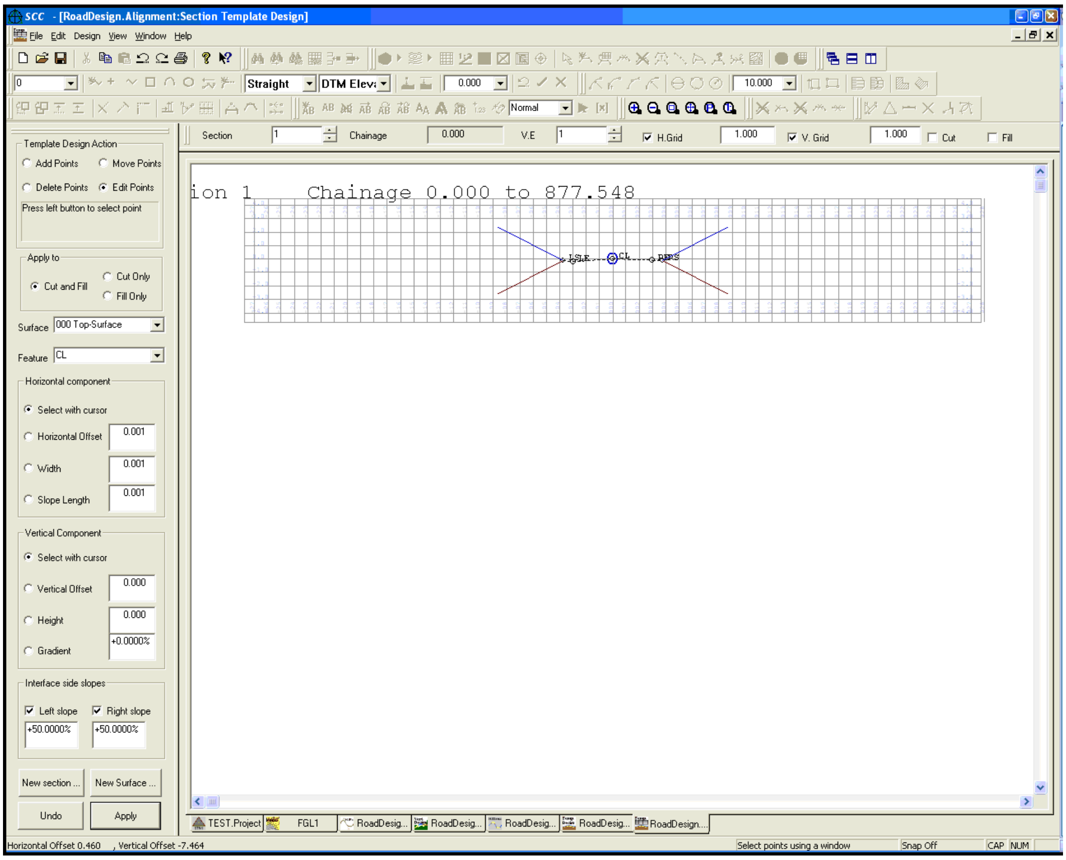
Select 'Feature > L-EDGE'

Set the 'width > -3.00' and the 'gradient > –3'.

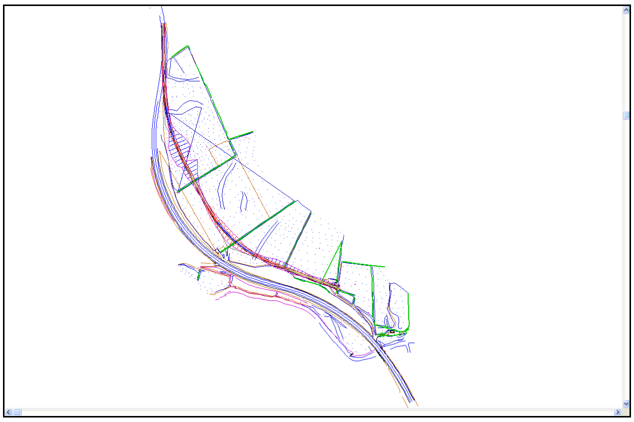
'Turn on' 'Left Interface slope' and set the 'Gradient > 50%'.

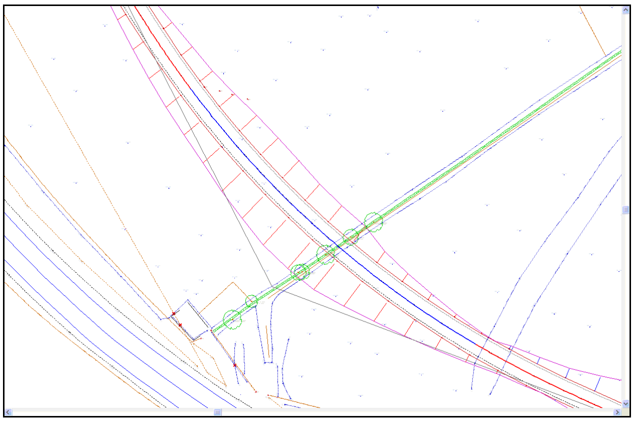
Select 'Add Point'

The following Section Template has been designed.



The Section Template should be automatically updated within the Model ‘FGL.Model’ which has the alignment attached.





11.4 Designing A Fixed Gradient Interface

The following examines the creation of a design interface with 1:3 gradient for given pond data.

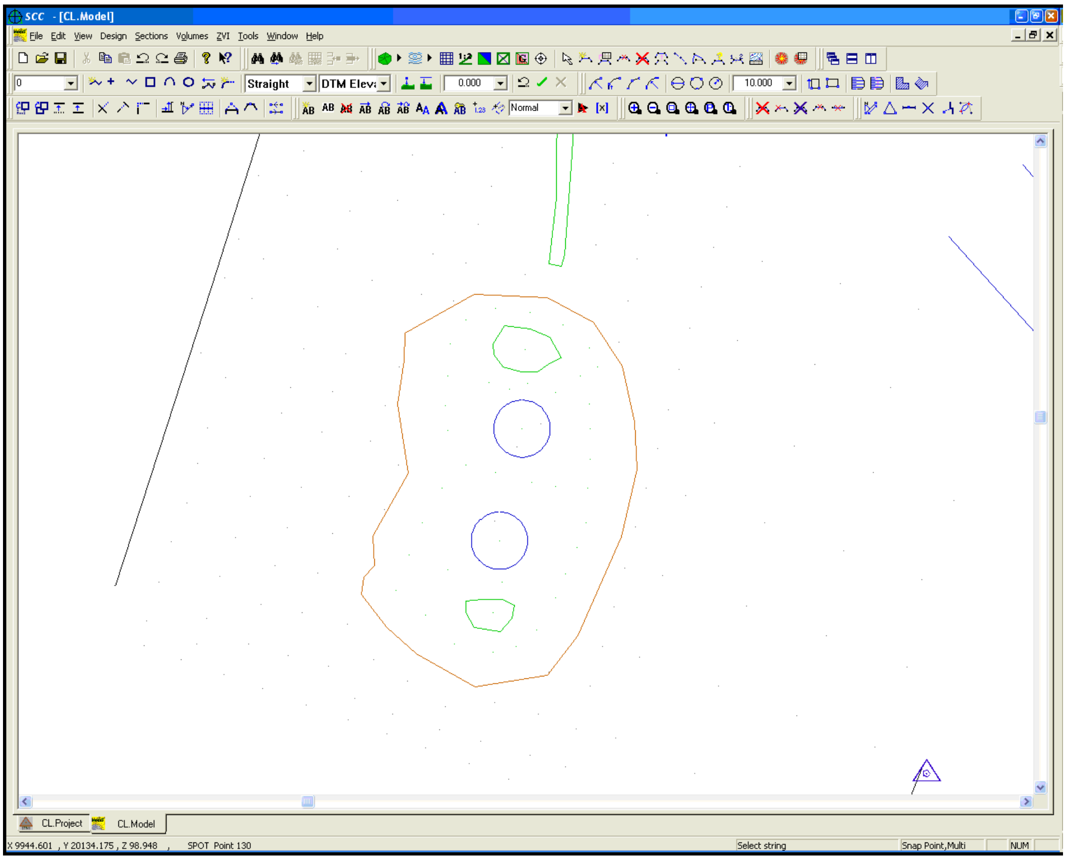
Consider that the 'CL.Model' contains the pond boundary ('WATERLINE' String) and subsequent pond islands.

A design interface is required to produce a 1:3 gradient from the water edge (boundary string) to the pond bed (96.1m).

Open Existing Files

Go to 'FILE>Open'

Open 'CL.Project' and 'CL.Model'

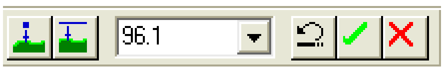


Create Pond Bed Model

Select 'O' from the Feature Drop Down Menu

Go to 'EDIT>Add String with Cursor'

Set the Elevation to '96.1'



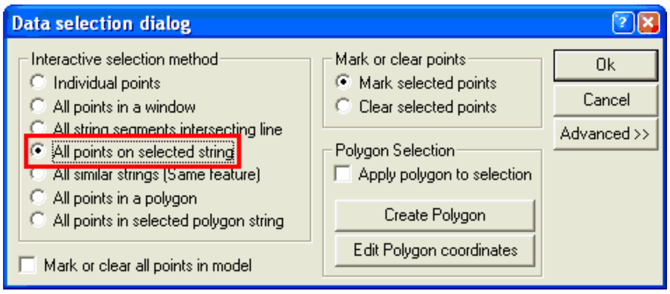
Using 'Snap Point' draw a boundary string

Right click mouse, select 'Drape Coordinates on Surface'

Right click mouse, select 'Update String in model'

Select 'Esc' to unselect command

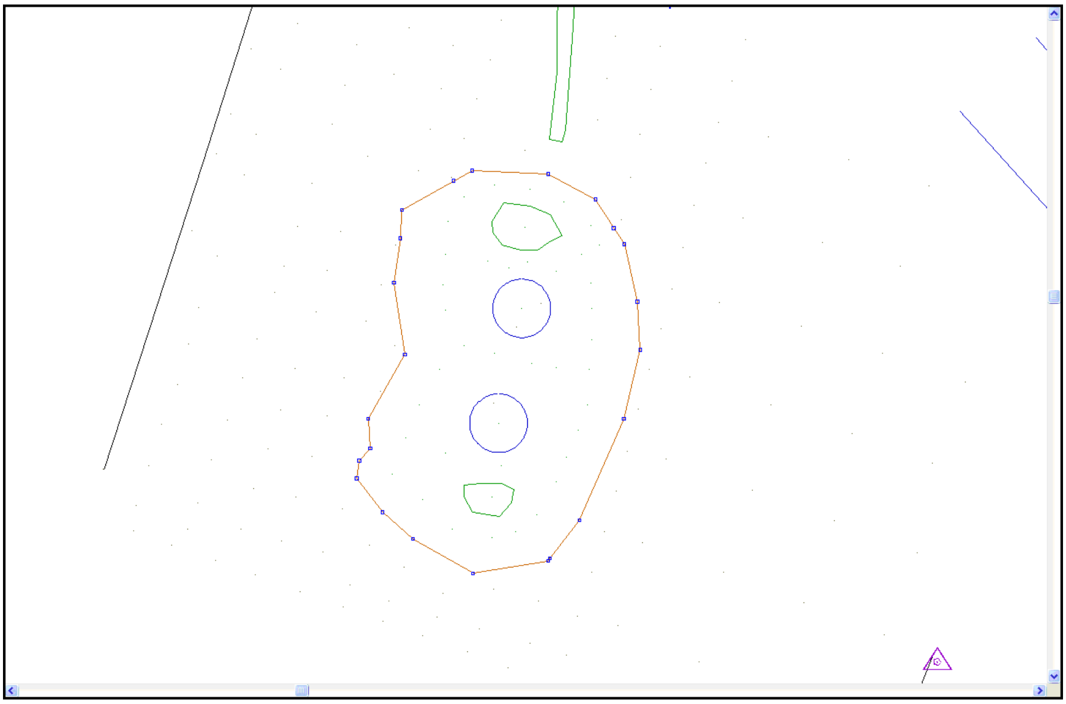
Right click mouse, to bring 'Data Selection Dialog'



Select 'All points on selected string'

Select 'OK'

Left click on newly created '0' string



Note selected points highlighted in blue, as shown above.

Go to 'EDIT > Copy > Copy to New Model'

Save Model as '96-1.Model'

This string will act as a guide boundary string

Select 'O' from the Feature Drop Down Menu

Select to draw a 'Polygon' from Toolbar

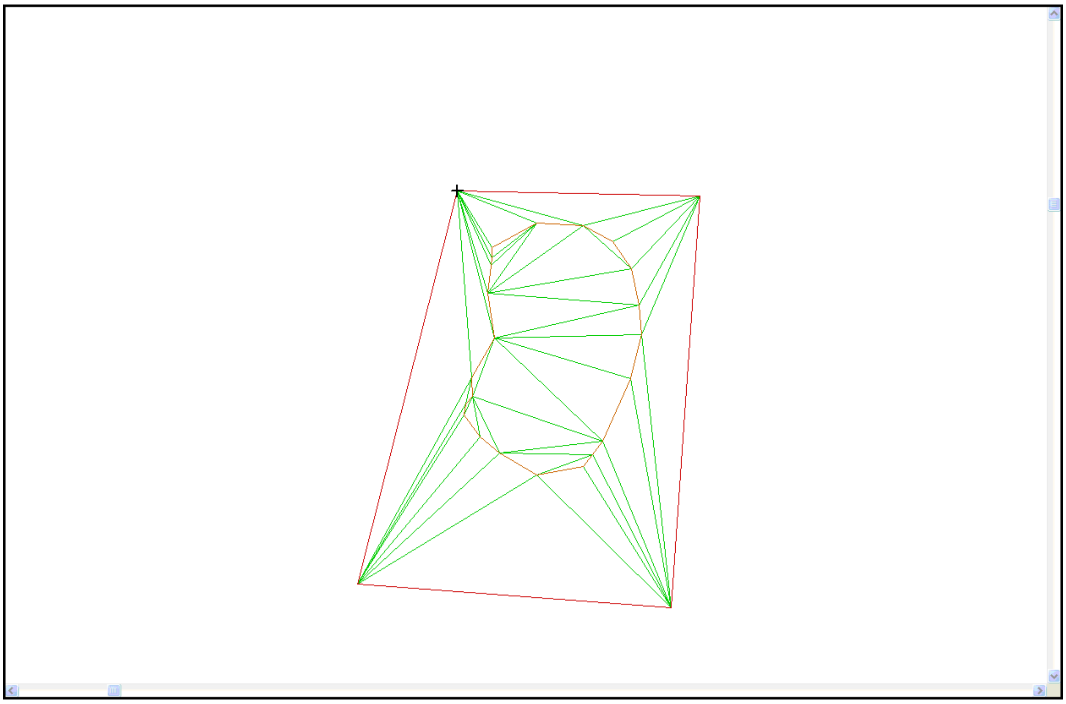
Draw a Polygon around the boundary string

Set the Elevation to '96.1'

Right click mouse, select 'Drape Coordinates on Surface'

Right click mouse, select 'Update String in model'

This creates a plan at the water level of 96.1



Save Model

Create Alignment From Pond Boundary (Waterline String)

Within 'CL.Model', go to 'DESIGN > Create Alignment from String'

Enter file name 'Interface0008' with a fillet radius of 1.000

Enter the desired gradient

Select 'OK'

Left click mouse on pond boundary 'WATERLINE' string

Save Alignment

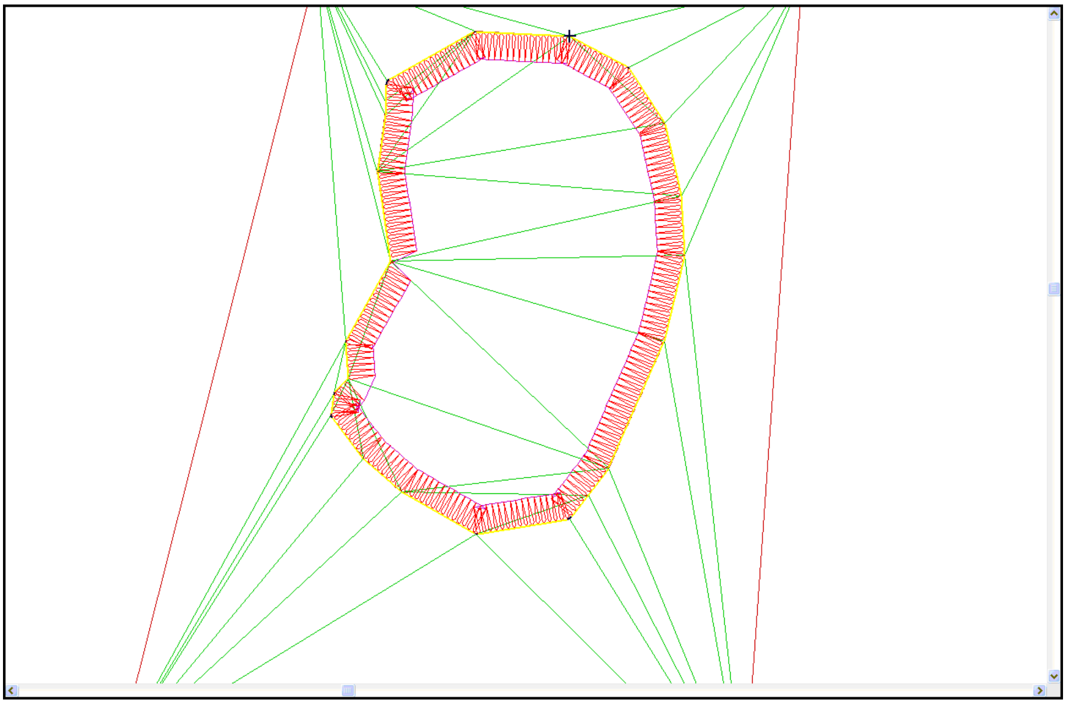
Go to 'FILE > Attach/Detach > Edit/Detach > Detach All'

Select 'OK'

Open '96-1.Model'

Go to 'FILE > Attach/Detach > Edit/Detach > Attach Alignment File'

Select 'Interface0008.Alignment'



Go to 'DESIGN > Export design as model'

Select 'Chainage Interval' as 1.000

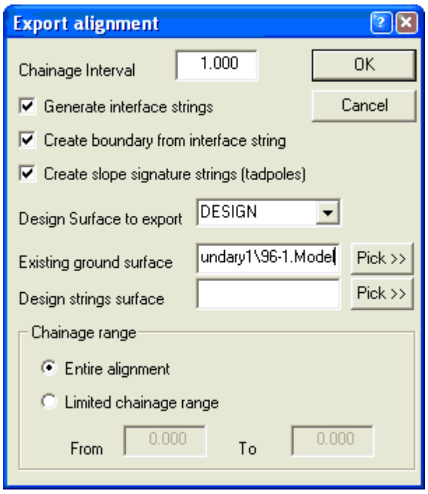
Select 'Generate interface strings', 'Create boundary from interface string' and 'Create slope signature strings (tadpoles)

Select 'Design' as the surface to export

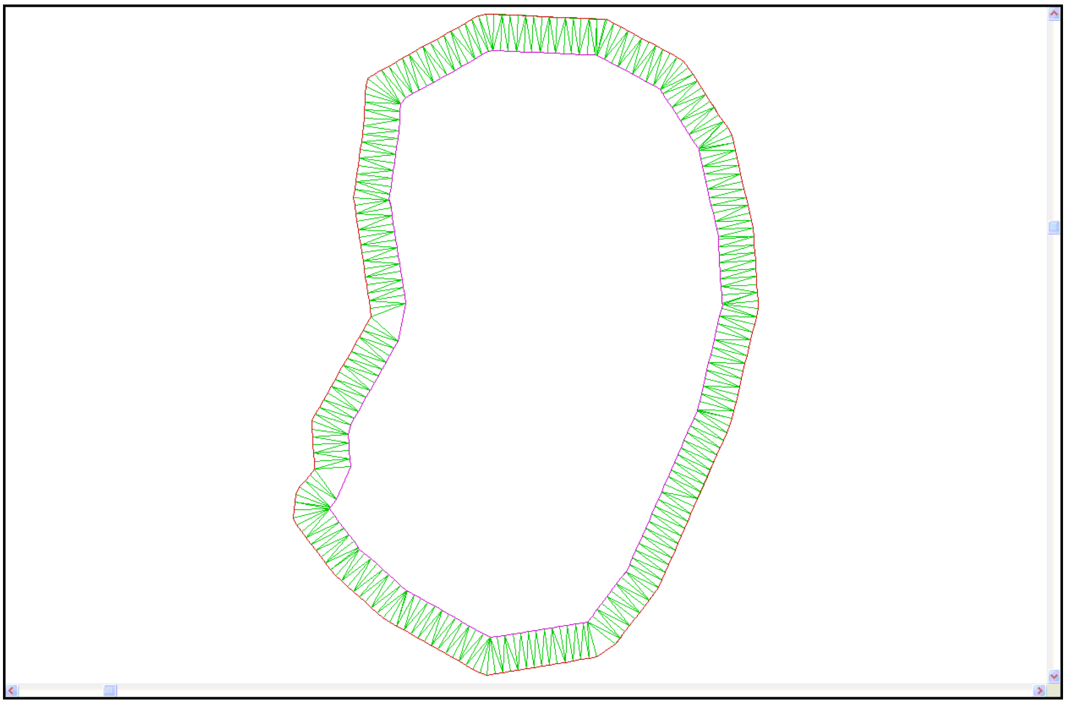
Select '96-1.Model' as the existing ground surface using 'Pick>>'

Set the 'Chainage Range' as 'Entire Alignment'

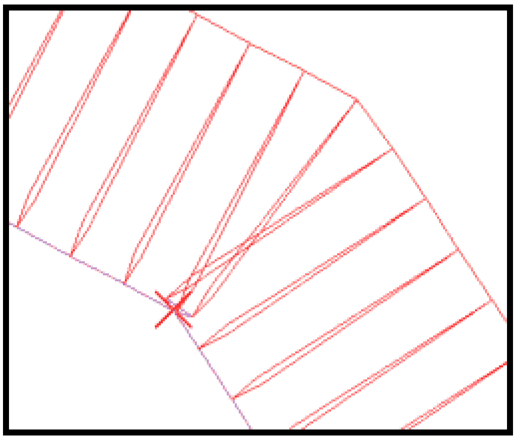
Select 'OK'



Save As 'Design.Model'



Once the design has been exported, tadpoles can be edited using ‘String Edit’ commands, for example, Move Points, Delete Points



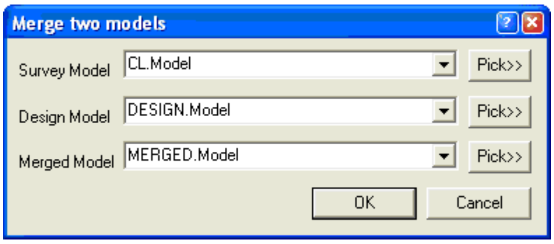
Merge Model

Open ‘CL.Model’

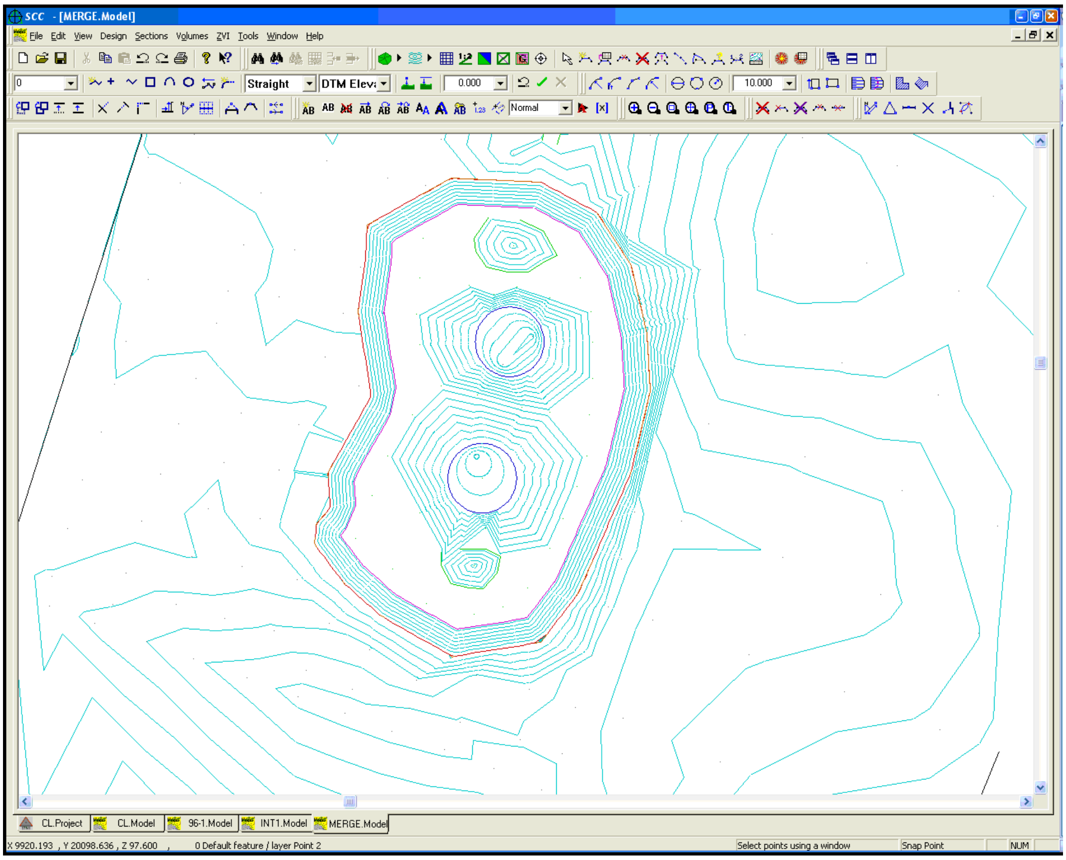
Go to ‘TOOLS > Merge two model

Using ‘Pick>>’ select the Survey and Design Model

Enter a name for Merged Model



Select ‘OK’

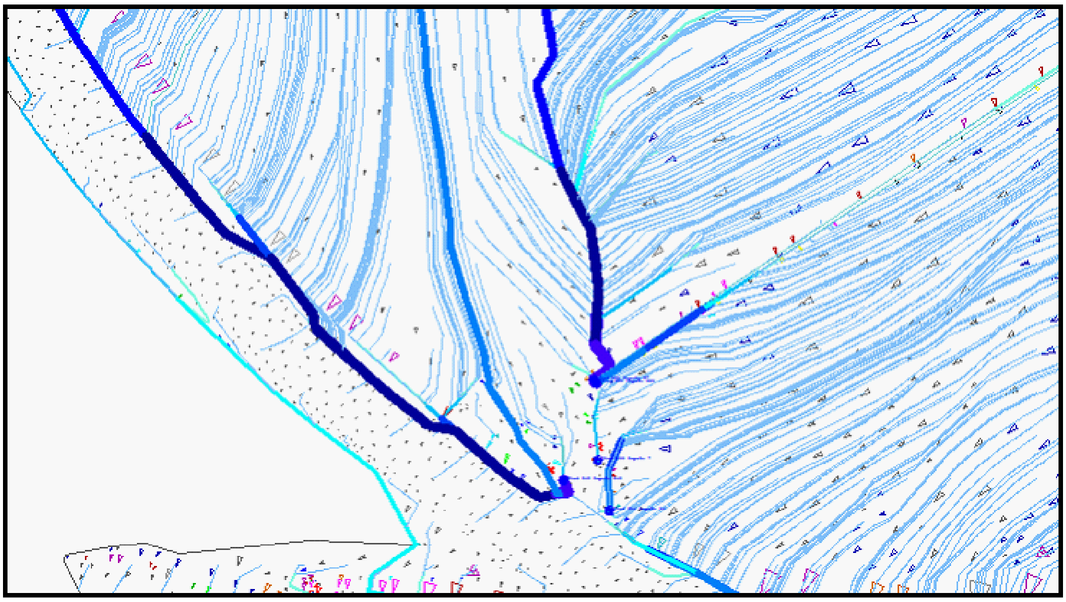


Note:

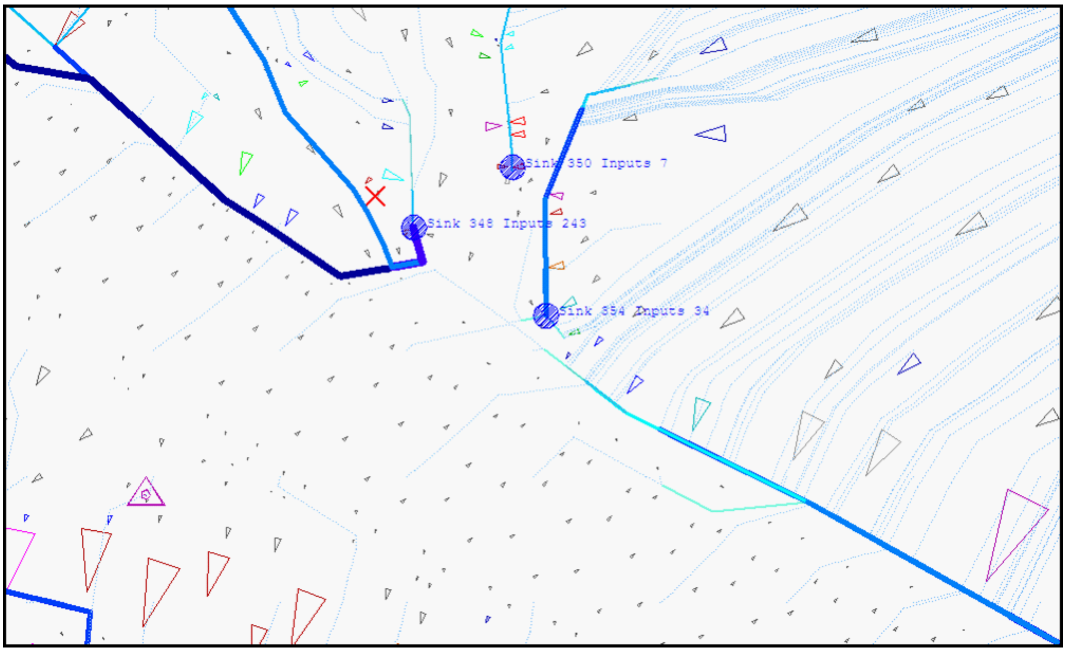
Separate Designs should be carried out for the islands in the pond, if required.

12 Flow Lines

This functionality allows the user to generate and display flow lines associate sink points from any 3d model. A flow line is a line that follows the path of steepest descent from a given source point until it either reaches a local low point or the edge of the model. Source points for flow lines can either be specified using a regular grid across the model, a coordinate file, or interactively with the cursor. In addition to generating the flow lines, SCC also identifies all the confluence points between flow lines, and counts the number of sources meeting at each junction and arriving at each sink point. This is useful for identifying natural drainage across a model and designing additional drainage. An example of flow lines based on a regular grid of source points is shown below;



Thinner lines illustrate simple flow lines connected to a source point, whereas lines of increasing thickness show the confluence of multiple flow lines culminating in a sink point. Note that in this example, slope vectors are also shown to illustrate the downhill direction.



If we zoom into a given sink point we will see it is annotated with an index and count of the number of input flow lines arrive at this sink.

Flow line functions are available from the ZVI & Flow menu, and include the following options;

Flow lines with cursor	This allows you to select flow line source points interactively with the mouse
Flow lines from grid	This creates a regular grid of flow line source points across the entire model.
Flow lines from data set	This creates flow line source points from a SCC coordinate

	file.
Flow line options	This allows you to control the features used to control flow lines based on the number of incoming flow lines. It is also used to specify the grid interval used when creating flow lines from a grid, and control whether sink points are annotated.

The flow line options are as follows;

Flow grid interval	The grid interval used when creating flow line source points at a regular interval.
Compute cumulative flows	This controls whether the number of lines that pass through a given point are counted. This is required is compound flow lines are to be drawn using different features, but is slower when generating flow lines.
Local sink feature	The feature code used to draw flow line sink points.
Annotate sinks	This controls whether sink points are annotated with an index number and counter.
Minimum line count to display	Flow lines that have less than this number of input lines passing through them will not be displayed.
Minimum sink count to display	Sink points that have less than this number of input lines reaching them will not be displayed

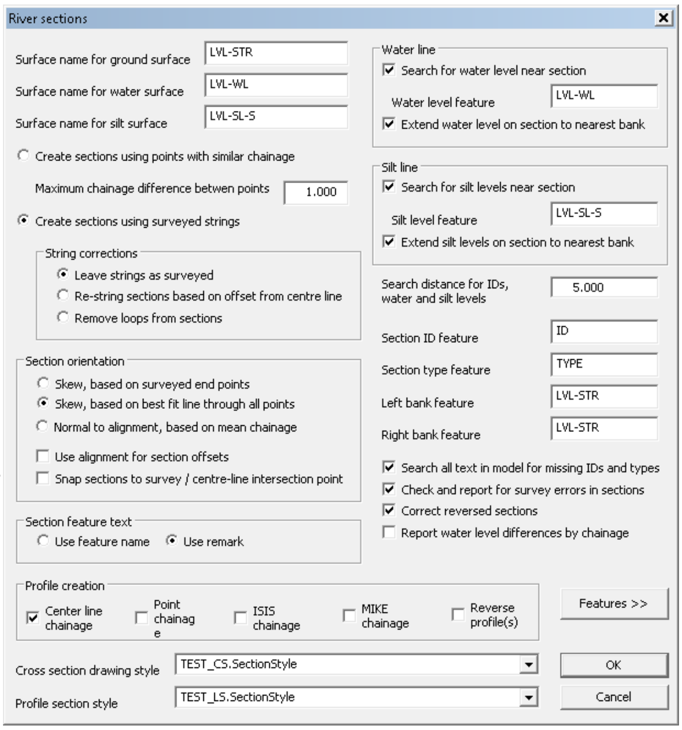
13 River Sections

The river sections module is designed to offer efficient stream-lined processing steps for surveyed river data and provides for:

- simultaneous annotation and output of sections with offsets relative to the left most point of the section, the lowest (or highest) point on the section, and the alignment centre line.
- data output to multiple modelling systems includes ISIS, MIKE, and HECRAS without having to repeat processing of the sections

The river module functionality assumes that rivers are processed as a series of sections, which can be collected as a single string per section or as discrete feature coded points. The module has been designed around the following criteria:

Ease of Use: SCC incorporates the principles river sections settings within a single dialog in order to limit the number of processing steps required to generate each river section. The single river section dialog allows for:



- ground, water and silt surface names to be defined easily
- sections generation either from points with similar chainage or using surveyed strings
- section orientation based on surveyed end points, best fit line through all points or normal to a defined alignment
- section feature text to be defined as feature name or remarks from the field
- section ID, left bank and right bank feature name search options
- water and silt line search options which can be used to annotation and/or display such surfaces
- options to extend water and silt line surfaces to the nearest banks automatically
- automatic surveyed section string direction correction
- quality controls, reporting and check options
- the selection of predefined cross section and profile drawing styles

Flexible:

New Section Coding Table allows the user the flexibility to implement existing coding systems currently in use in the field.

Specific remark codes used in the field can be set up to allow for the automatic generation of labels / text within the river sections.

Importantly, left bank and right bank can be included to control the extent of the automatic creation of water level and silt level surfaces on each river section.

Specific String Correction Options:

Automatic correction of string errors from the field provides time saving advantages during processing. Options allow for the removal of loops from surveyed section strings and/or to set a preferred string direction at a global level across all sections.

Simple River Centreline Definition:

An existing predefined river centreline or a new centreline reference string can be generated from which a chainage / offset system can be created easily. The reference string controls section orientation, section annotation on individual sections and within plan drawings and acts as an integral part of the required output to modelling systems.

Automatic Water and Silt Surface:

Search options provide for the extraction of water and silt levels which can be used to extrapolate water edges, silt edges and the ground profile.

Annotation of water and silt levels can be automatically set up and applied to all sections together with date and time stamp.

Global Section Text Annotation:

Section Annotation can be globally applied to all sections offering time saving advantages and limiting user errors.

Text can be customised to suit deliverables.

Simple Drawing Style Applications:

Section presentation can be customised to meet client needs and applied globally with the application of a drawing style reducing repetitive steps and ensuring continuity throughout a large project.

Advanced Quality Checks & Reporting:

Quality assurance checks provide invaluable tools to support consistent qualitative section files and subsequent exported deliverables. Search options for missing text within each section detail missing text elements whilst survey errors are reported for review and correction. Output of water levels differences by chainage offers further checks for blunders and gross errors.

Structure Display on Sections:

Surveyed structures can be easily selected from plan and attached to individual sections to meet specification using simple copy and paste tools.

Specific annotation and text can be inserted manually allowing for customisations.

Advanced Output of Sections to Multiple Modelling Systems:

Sections can be easily output to modelling systems includes ISIS, MIKE, and HECRAS in a single step.

13.1 Creating Project

A new project should be created before data may be downloaded into SCC or models formed.

SCC button, select 'Open'

Go to \SCC\Tutorials\River_Survey\River_Sections.Project

Select 'OK'

Note: 'River_Sections.Project' template has been set up to demonstrate the river section functionality.

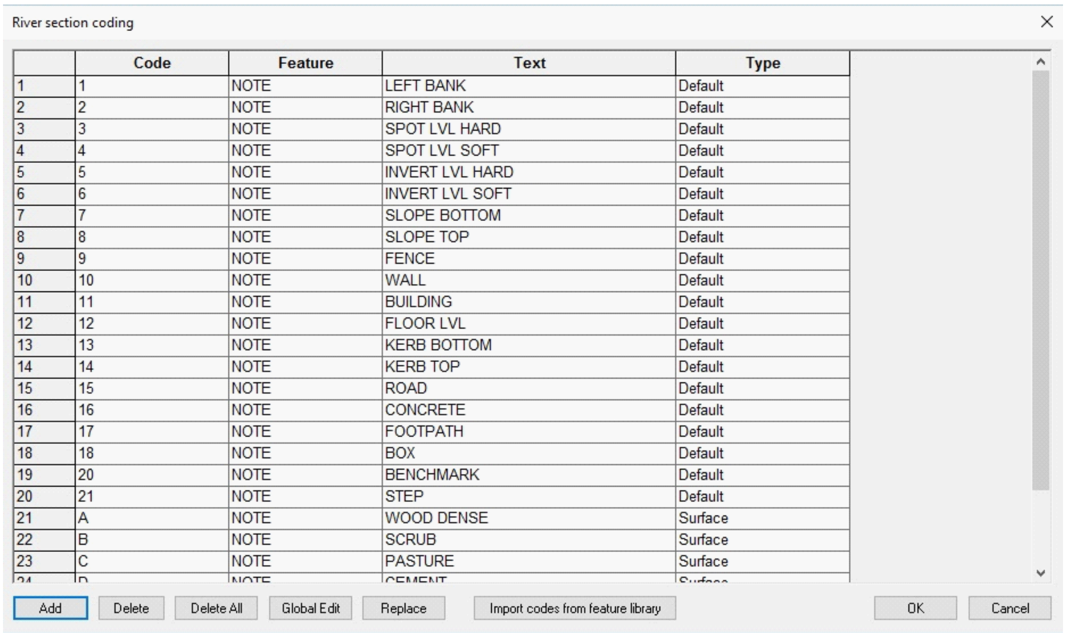
Feature Library

Select 'DATA tab > Features button'

Specific feature codes have been set up in the library which coincide with codes used in the field.

Section Coding

Select 'DATA tab > Features drop down button > Edit Section Coding'



	Code	Feature	Text	Type
1	1	NOTE	LEFT BANK	Default
2	2	NOTE	RIGHT BANK	Default
3	3	NOTE	SPOT LVL HARD	Default
4	4	NOTE	SPOT LVL SOFT	Default
5	5	NOTE	INVERT LVL HARD	Default
6	6	NOTE	INVERT LVL SOFT	Default
7	7	NOTE	SLOPE BOTTOM	Default
8	8	NOTE	SLOPE TOP	Default
9	9	NOTE	FENCE	Default
10	10	NOTE	WALL	Default
11	11	NOTE	BUILDING	Default
12	12	NOTE	FLOOR LVL	Default
13	13	NOTE	KERB BOTTOM	Default
14	14	NOTE	KERB TOP	Default
15	15	NOTE	ROAD	Default
16	16	NOTE	CONCRETE	Default
17	17	NOTE	FOOTPATH	Default
18	18	NOTE	BOX	Default
19	20	NOTE	BENCHMARK	Default
20	21	NOTE	STEP	Default
21	A	NOTE	WOOD DENSE	Surface
22	B	NOTE	SCRUB	Surface
23	C	NOTE	PASTURE	Surface

In this instance, specific remark codes used in the field have been set up to allow for the automatic generation of labels / text within the river sections. Importantly, left bank and right bank have been included to control the extent of the automatic creation of water level and silt level surfaces but also required for HECRAS, ISIS and MIKE formats.

It should be noted that the 'Type' column controls the placement of text on a section / profile:

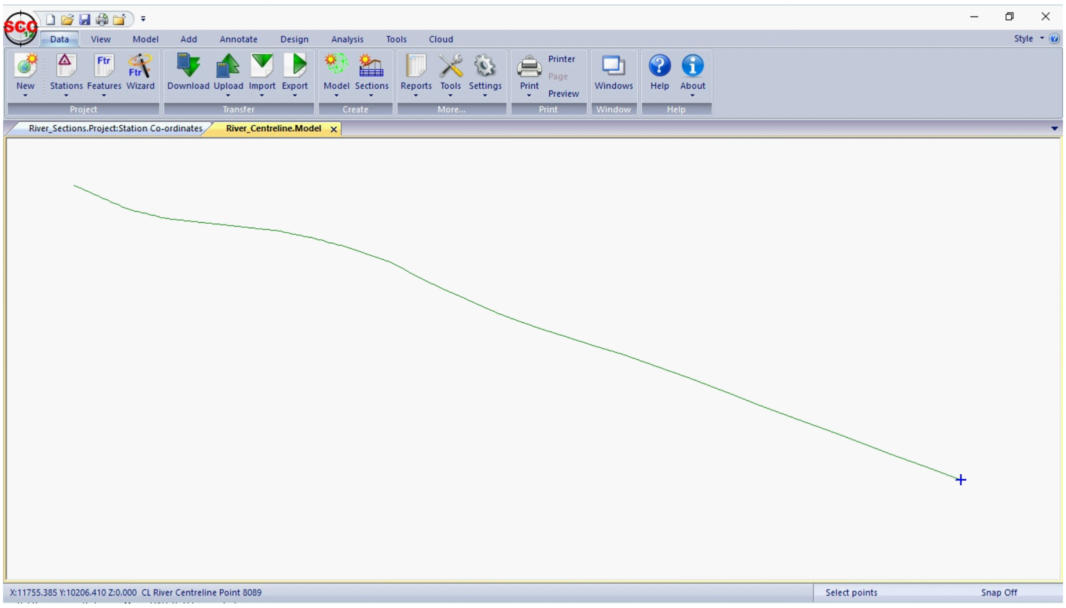
- Default - places text as a descender on the section
- Surface - places text on the surface line of the section
- Water - used to annotation the water surface within a section

13.2 Creating River Centreline Model

In order to generate the river section it is necessary to have a defined river centreline. The centreline can be generated within SCC using string creation tools or can be input from a CAD, ASCII or MX file.

SCC button, select 'Open'

Go to '\SCC\Tutorials\River_Survey\RiverCentreline.Model'



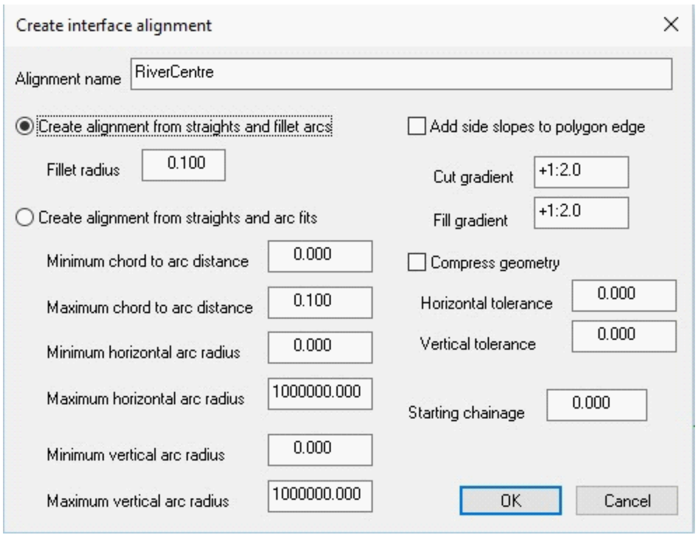
13.3 River Centreline Alignment

The river section functionality requires a horizontal alignment representing the river centre line and hence a full SCC design license. Alignments can be created as follows;

Creating Alignment from existing string

Within 'RiverCentreline.Model', 'DESIGN tab > String button'

Left click on string and enter the following:



Click 'Ok'

Chainage and offset system is generated and is visible on the base toolbar on the bottom of the screen

To save alignment, select 'DESIGN tab > View drop down button > Horizontal Entities'

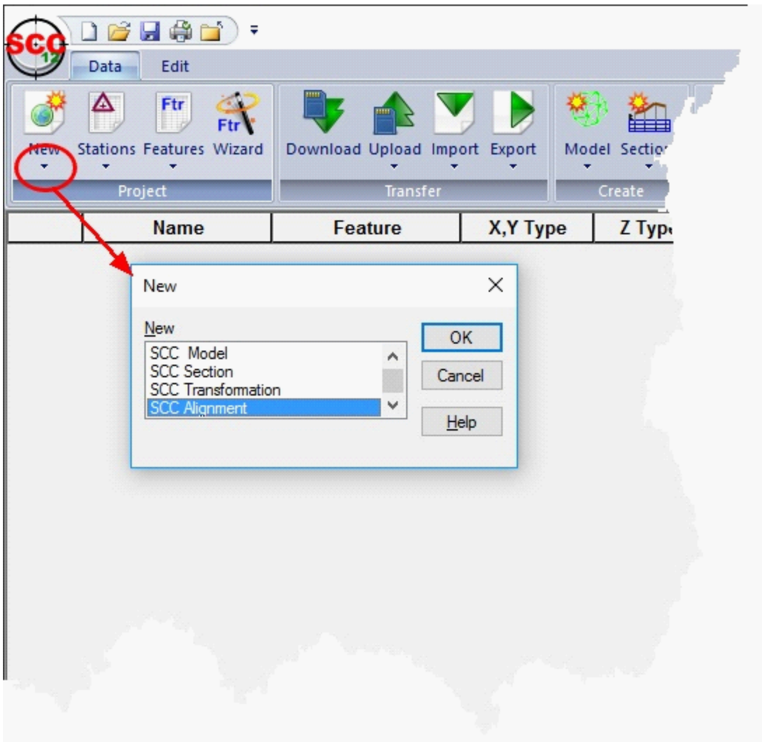
Within the Horizontal Entities sheet, pick SCC button 'Save As' and enter name

'RC.Alignment' is a sample alignment file for use within this tutorial.

Creating Alignment from CAD file or MX file

Existing alignments can be imported as follows:

Imported from a design or CAD package, 'DATA tab > New button drop down > New document > SCC Alignment'



Go to 'DATA tab > Import drop down > MOSS GENIO geometry strings', or 'DATA tab > Import drop down > Entities from DXF'

or 'DATA tab > Import drop down > LandXML'

13.4 Examination of Dataset

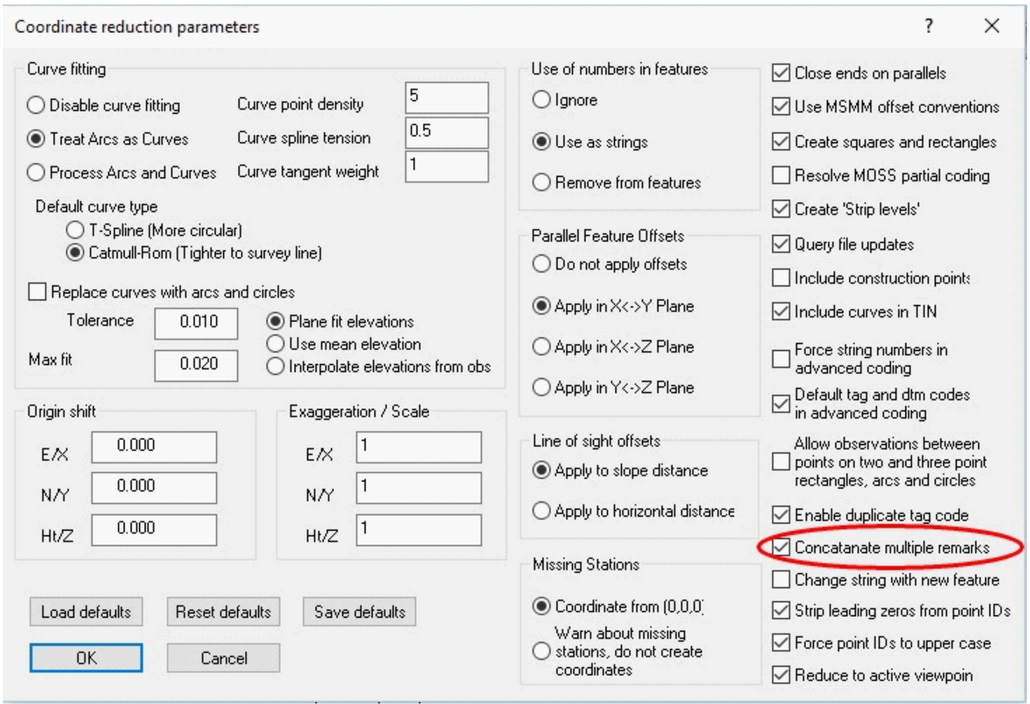
This tutorial provides a sample model. However, it is important to consider on downloading the raw file, the dataset should be examined to ensure attribute and text information has been downloaded correctly. For instance, checks should be carried out to ensure that specific section codes surveyed in the field have been downloaded in the Text Notes Sheet and match the codes set up within the Section Coding table, part of the Project file.

Concatenate Multiple Remarks

It should be noted that SCC can concatenate multiple remarks on the same survey point using the Concatenate multiple remarks tool. For example, observation 123 has two remarks noted as WALL and STONE within the text notes sheet. To concatenate the multiple text after download:

Select 'DATA tab > Settings drop down > Coordinate Reduction Options'

Tick Concatenate Multiple Remarks and Press 'OK'



If changes have been made to the dataset, go to 'SURVEY tab > Obs drop down button > Rebuild Coordinates'

Multiple remarks are text concatenated as shown below:

	Obs#	Remark	Feature	-E/X-	-N/Y-	Height
1	123	WALL	SURFACE	11662.990	9724.407	1.500
2	123	STONE	SURFACE	11662.990	9724.407	1.500

	Obs#	Remark	Feature	-E/X-	-N/Y-	Height
1	123	WALL STONE	SURFACE	11662.990	9724.407	1.500

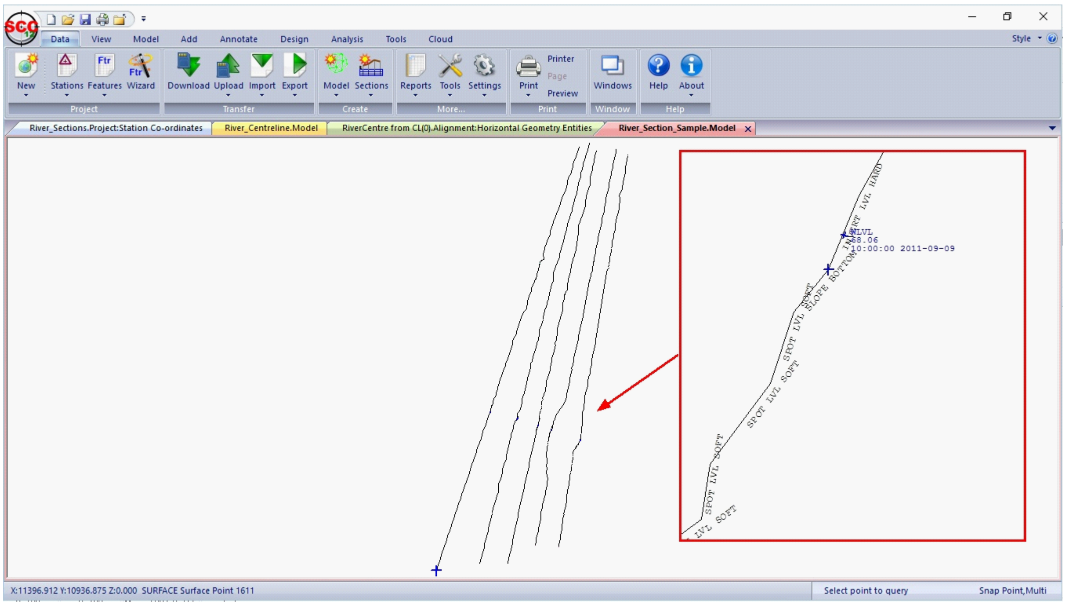
Note that the feature field on sections is limited to a total of 16 characters.

13.5 Creating Surveyed Section Data Model

The dataset containing the surveyed sections is model as follows:

SCC button, select 'Open'

Go to '\SCC\Tutorials\River_Survey\River_Section_Sample.Model'

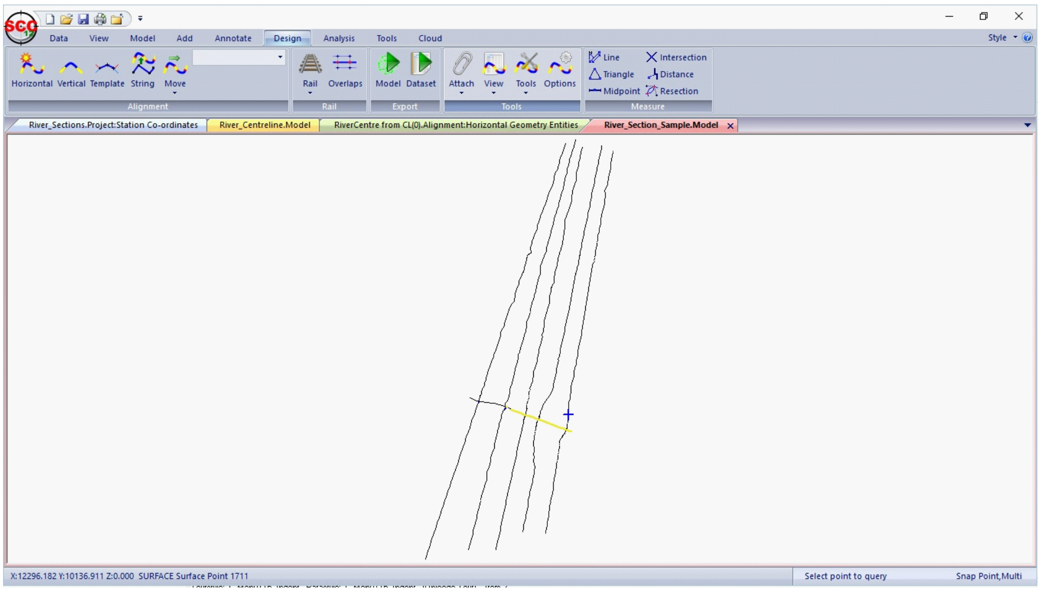


13.6 Attaching River Centreline Alignment to Survey Model

Prior to creating the river section the alignment file should be attached to the surveyed data model:

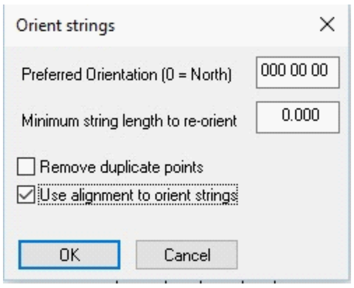
Go to 'DESIGN tab > Attach drop down > Alignment'

Pick river centreline alignment file



13.7 Setting Preferred String Direction

If the sections have been surveyed as strings, they can be re-aligned to match the centre line direction using '**TOOLS tab > Tools drop down > Set preferred string direction**', although this is not necessary for the river sections to be created.



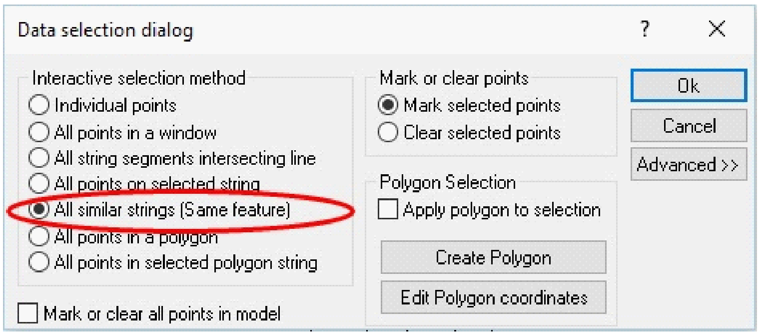
This option can be run directly from the River Sections dialog using 'Correct reversed strings'.

13.8 River Section Creation

Before creating the river sections, it is necessary to select all section data. For example, if one or more feature names have been used the data selection dialog with 'All similar strings (Same feature)' option selected should be selected.

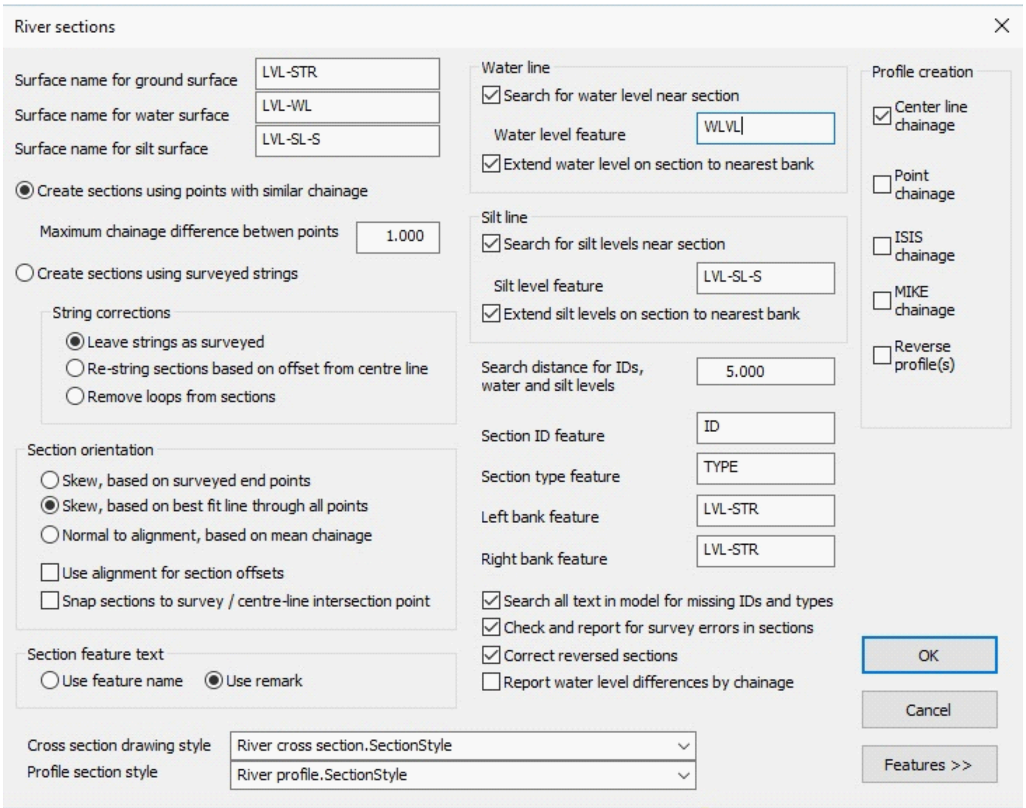
Within 'River_Section.Model' with the alignment attached, right click the mouse to bring up the 'Data Selection Dialog'

Pick 'All similar strings (Same feature)' and left click 'SURFACE' feature



Note that data that is not representative of the ground surface, such as water levels and any structures surveyed, should not be selected. As such, selecting all points in the model will typically not be appropriate when using this option. To create river sections:

'ANALYSIS > River button', set up the following options:



Specific settings are outlined as follows:

Surface Name for ground surface

This is the name displayed on the section title block for the profile line associated with the main ground surface.

Surface name for water surface

This is the name displayed on the section title block for the profile line associated with the water level and extrapolated water surface.

Create sections using points with similar chainage

This option is used when points on surveyed river sections are not collected as strings defining the section line. In this case, all points within a specified chainage range are grouped to form a section, and the points on each section are sorted by offset from the river centre line. This option has the advantage that it allows the user to collect feature names in the field, e.g. TOPBANK, BOTBANK, etc.. which will automatically be annotated on the section. It has the disadvantage that section lines should not overlap, as points may get placed on the wrong section.

Maximum chainage difference between points

This option is the maximum chainage separation allowed between points for them to be placed on the same section. For example, a value of 2m would indicate that all points on a section must be within a 2 meter chainage of one another. Note that for skew sections, i.e. sections not perpendicular to the centre line, this value should be increased to allow for the skewing effect. This value should never be greater than half the distance between adjacent section, e.g. if your sections are 10m apart, this value should not exceed 5.

Create sections using surveyed strings

This option should be used where sections have been collected as complete strings. It has the advantage that sections can overlap, which can be useful on sharp changes of direction and small radii in the river centre line.

String corrections

These only apply where the above option has been selected, and relate to automatic correction of certain survey errors.

Leave strings as surveyed

Do not make any corrections.

Re-string sections based on offset from centre line

This option re-orders the points in the string based on their offset from the centre-line. This will correct any overlaps, loops and doubling back in the section.

Remove loops from sections

This option removes any loops that occur in plan in the section.

Section Orientation

These options refers to how the section centre lines are formed from the surveyed points for a given section, which due to the natural constraints of river surveying, will rarely form an exact straight line.

Skew, based on surveyed end points

The section centre line is formed by joining the leftmost and rightmost survey points. The survey points are then snapped onto this line when forming the section. This line will typically not be at exact right angles to the river centre line.

Skew, based on best fit line through all points

The section centre line is formed by creating a best fit line through all the survey points. The survey points are then snapped onto this line when forming the section. This line will typically not be at exact right angles to the river centre line.

Normal to alignment, based on mean chainage

The section centre line is formed by computing a mean chainage from all the survey points, and going at right angles to the left and right of centre-line at that chainage to meet the leftmost and rightmost offsets of the survey points. The survey points are then snapped onto this line when forming the section. This line will be at exact right angles to the river centre line. Note that if the surveyed section is not roughly at right angles to river centre line, points are liable to be moved significant distances when snapped onto the centre line, and the section line may be significantly shorter than the surveyed line.

Use Alignment for section offsets

The sections are formed using the offset value of the alignment.

Section Feature Text

This controls how the feature name field in the sections is populated.

Use feature name

Use the feature name as entered in the survey.

Use remark

Use the remark from the associated survey observation. This is useful when surveying sections as strings, where all the points on the section have the same feature name for stringing purposes, but may refer to different items on the section, e.g. Top of bank, edge of water, etc…

Water line

This group of options refer to the extraction of water level points and extrapolation of a water surface in the sections produced. Typically this will be a single water level point per section where the water surface is being automatically extracted, or a string where water surface has been surveyed directly.

Search for water level near section

Select this option to search for water level points near the surveyed section.

Water level feature

This is the unique feature name, e.g. WLEV, used to denote water levels.

Extend water level on section to nearest bank

When a single water level has been surveyed per section, this option will extend the level left and right from the surveyed point to the ground profile on the section to form a water surface.

Silt line

This group of options refer to the extraction of silt level points and extrapolation of a silt surface in the sections produced. Typically this will be a several silt level points per section where the silt surface is being automatically extracted, or a string where silt surface has been surveyed directly.

Search for silt level near section

Select this option to search for silt level points near the surveyed section.

Silt level feature

This is the unique feature name, e.g. SILT, used to denote silt levels.

Extend silt level on section to nearest bank

When silt level points have been surveyed per section, this option will extend the levels left and right from the surveyed point to the ground profile on the section to form a silt surface.

Search distance for IDs, water and silt levels

This is the maximum allowable distance from the IDs, water and silt levels to the section it will be placed on.

Section ID feature

Section ID picked up the field are extracted and used to label individual sections.

Section Type feature

Section Type picked up in the field are extracted and used for annotation and export purposes.

Left Bank Feature

Left Bank feature is used for annotation and export purpose. It is also used to control the extent of the Water and Silt level surfaces.

Right Bank Feature

Right Bank feature is used for annotation and export purpose. It is also used to control the extent of the Water and Silt level surfaces.

Search all text in model for missing IDs and types

This quality check examines each section for missing IDs and types. Errors are reported in a text file.

Check and report for survey errors in sections

This quality check examines each section for survey errors. Errors are reported in a text file.

Correct reversed sections

This option re-aligned sections to match the centre line direction. This option overcomes issues relating to section having been surveyed in a 'zig-zag' fashion and also address problems arising from left and right bank being incorrectly surveyed.

Report water level differences by chainage

This quality check option allows the water level difference to be reported based on chainage values.

Cross Section drawing style

This option allows the user to select a predefined section style.

Profile drawing style

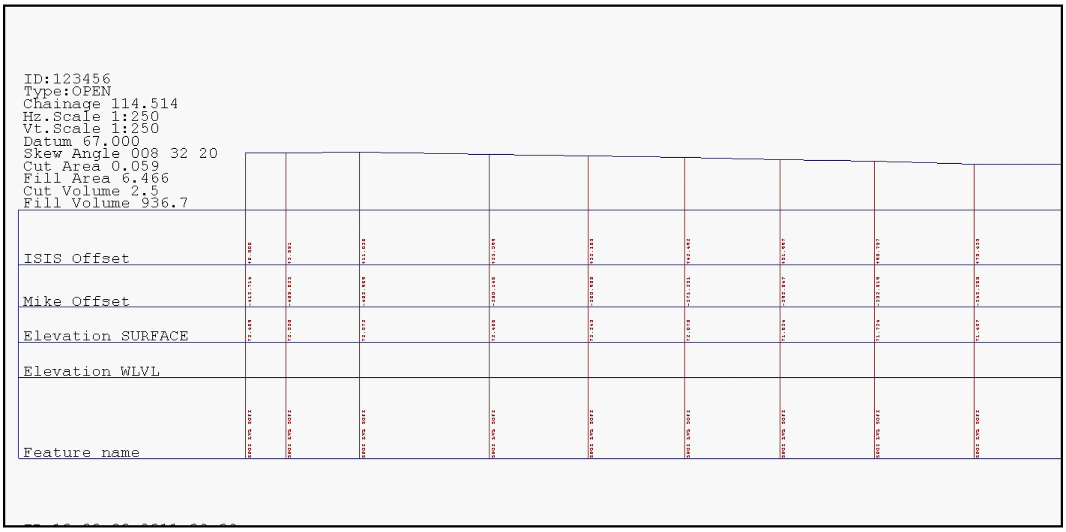
This option allows the user to select a predefined section style.

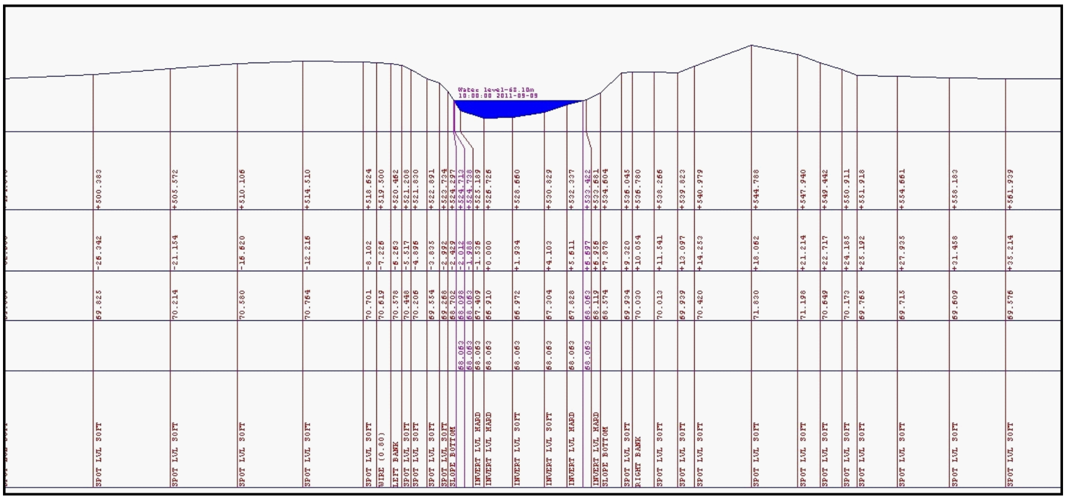
Feature >>

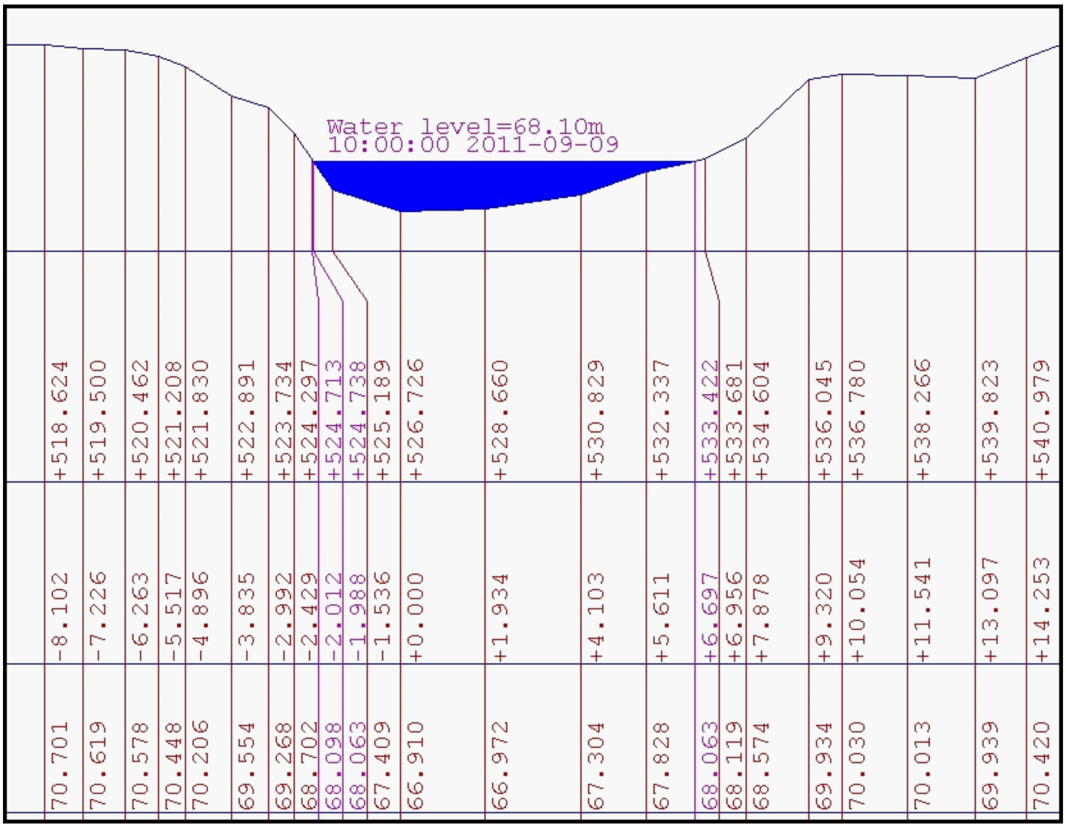
This option links to the Extended Field Code table.

The cross section and profiles are generated as shown below:

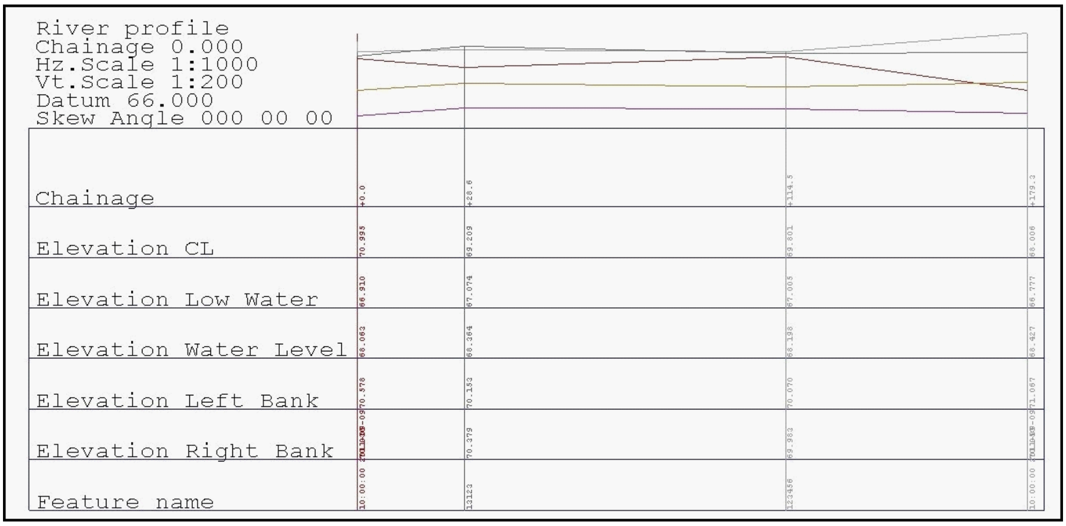
Cross Sections:







Profile:



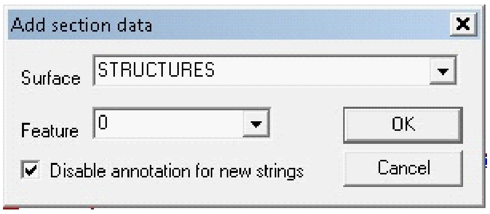
13.9 Displaying Structure On Sections

Structures and other detail can be copied from plan into section as shown below:

Select the required points to copy onto a given section using the data selection tools

Select 'EDIT > Copy > Copy to clipboard'

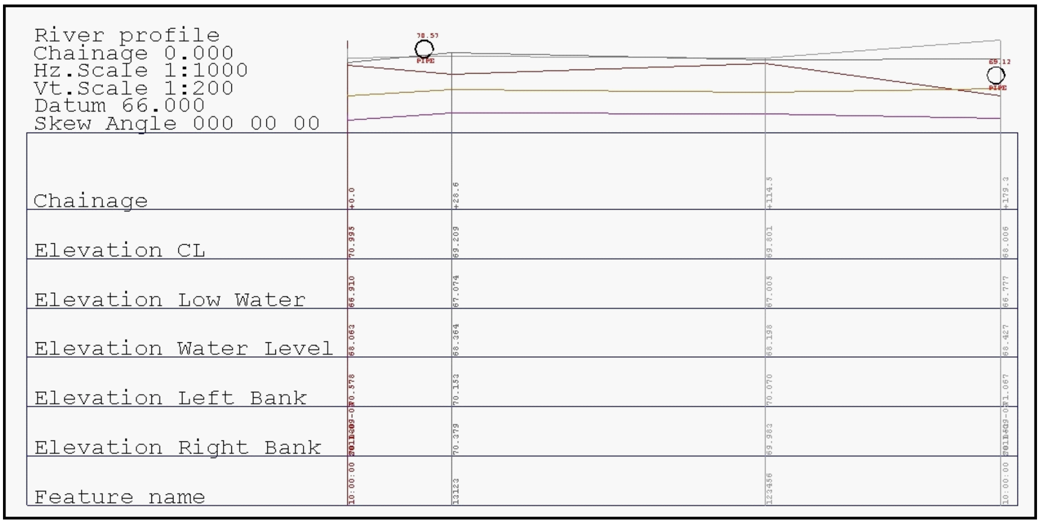
Switch to your section view



Select 'EDIT > Paste'

When prompted enter the surface name that the data will be associated with, e.g. structures, and whether or not the points will be annotated.

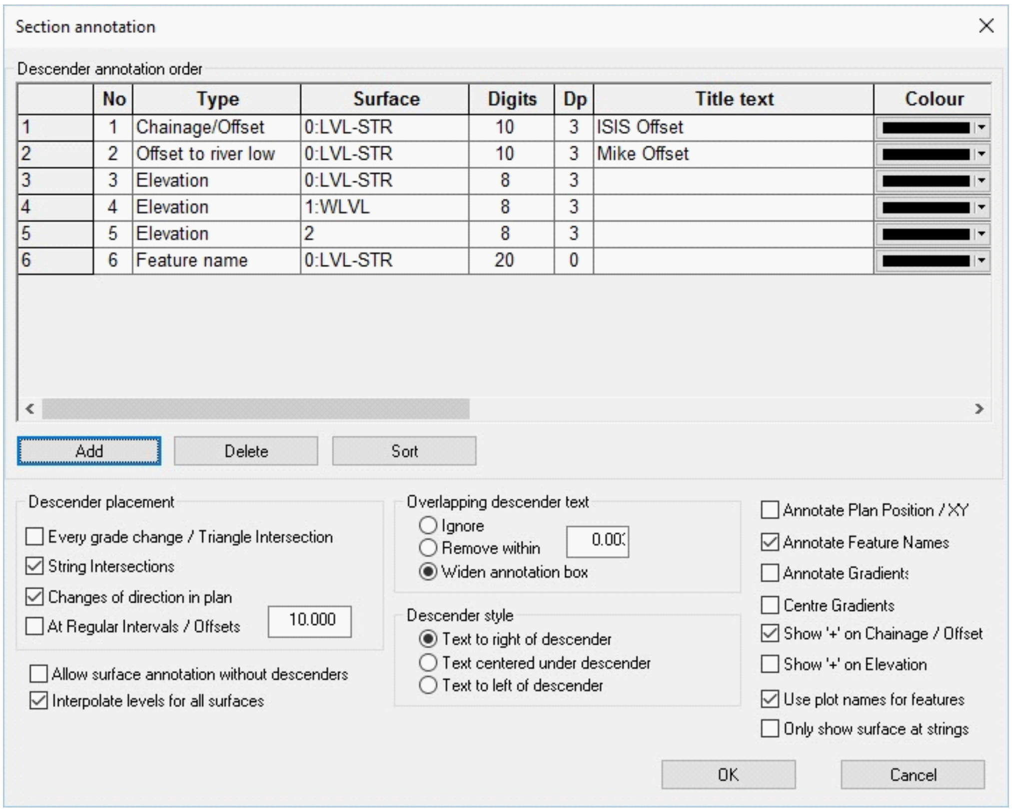
Click on the section you would like the data drawn on.



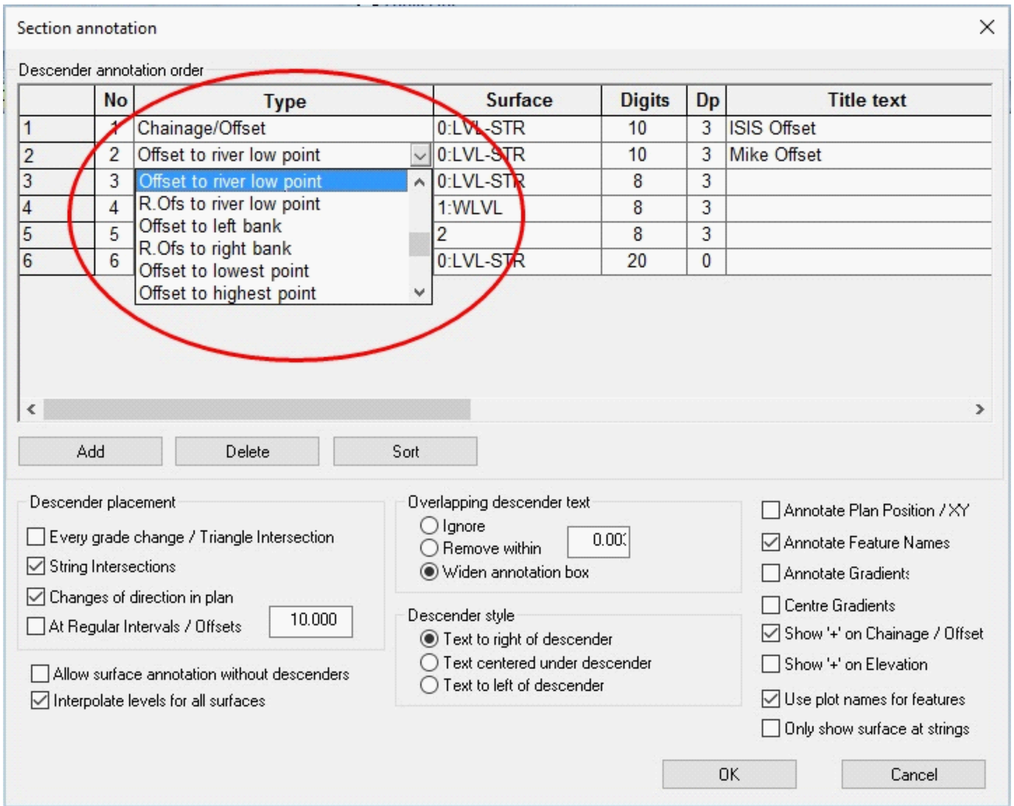
Note that data copied from plan to section in this manner is projected onto the section. Therefore if a line is copied that is not parallel to the section from plan, it will appear shorter in the section as it is the projected distance on view. The active alignment can be used to match offsets between plan and section where required, if not, the distance from the leftmost edge of the section will be used.

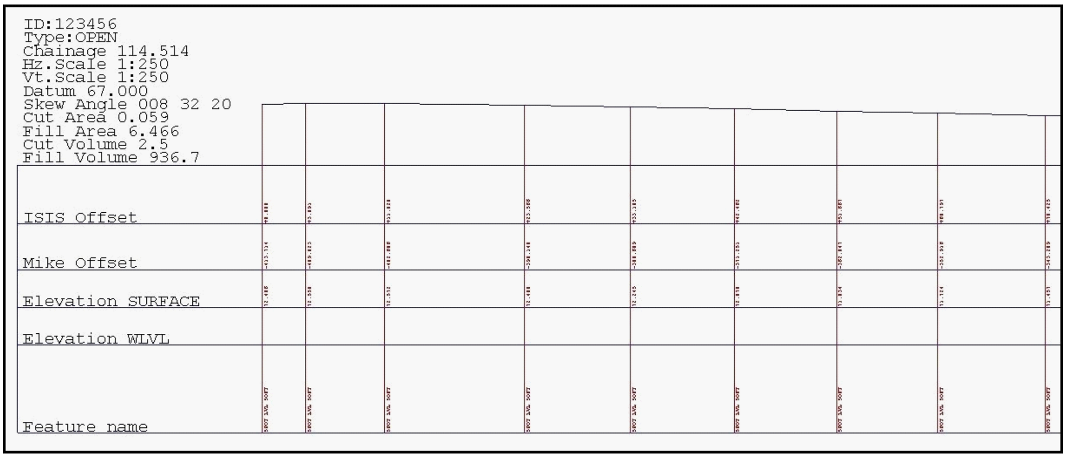
13.10 River Section Annotation

Section Annotation can be controlled within **'VIEW tab > Descender'**:



Specific settings can be selected within the Type drop down menu to suit the required output.





13.11 River Section Scale Titles & Grids

The following notes common annotator for river section. Such annotator can be selected from **'VIEW tab > Titles button'**

Chainage

The alignment chainage at the point where the river section, i.e best fit line through the survey points, cuts the alignment centre line.

River Chainage

The alignment chainage at the point where the surveyed section string cuts the alignment centre line

Diff Ch

The difference in chainage between this section and the next section (e.g. chainage value used in ISIS output)

Offset

The distance on the section from the leftmost point. Note that river sections are always displayed such that the left bank is on the left of the right bank regardless of the alignment direction or order in which the section string was surveyed. These values are always positive and always start from zero.

River offset

The distance from the current point on the section to the lowest point in the river bed, which is calculated as the point of lowest elevation between the left and right banks. Points to the left of the lowest point in the river bed have negative offsets, whereas those to the right have positive offsets.

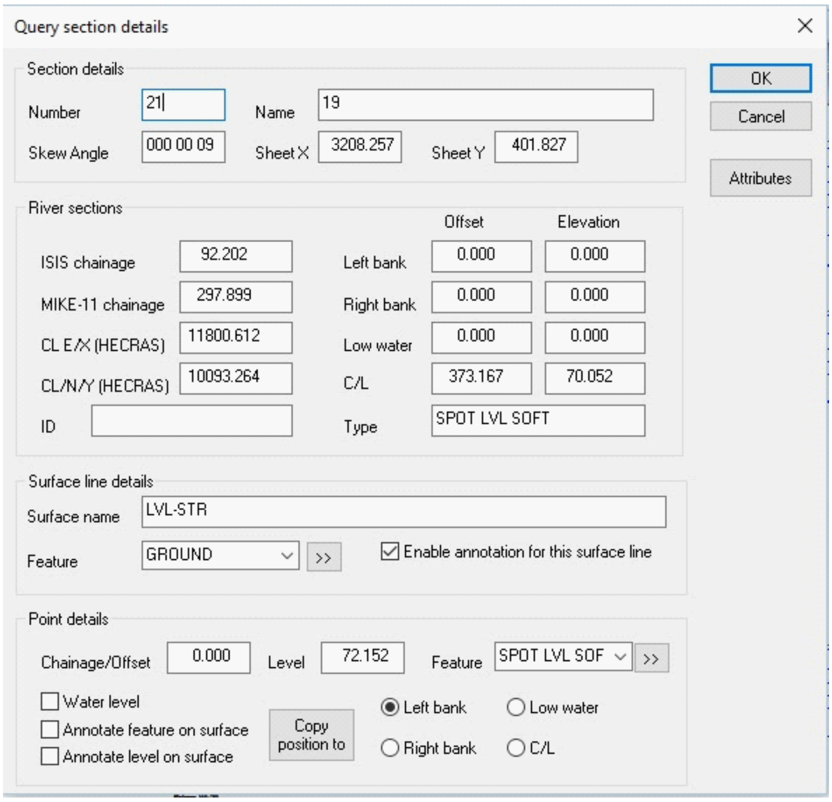
Skew angle

The angle at which the section deviates from the alignment normal.

13.12 Editing Sections Using Query & Edit Function

Sections can be manually edited using the 'EDIT tab > 'Query button'. This allows the user to set bank positions, and ISIS / MIKE & HECRAS specific values within any given section and to correct survey errors.

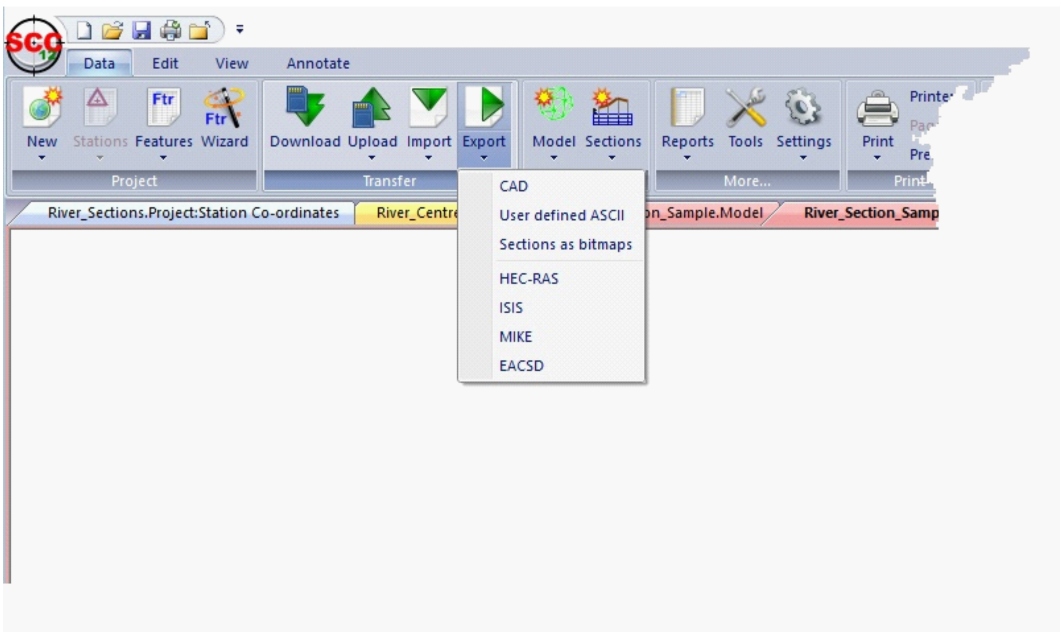
For example, specific users may require the option to define the lowest point between banks on a specific section at processing stages.



13.13 Exporting to Modelling Packages: ISIS, MIKE and HECRAS

To export data:

Go to 'DATA tab > Export drop down button' and select export format



HEC-RAS

```
BEGIN STREAM NETWORK:

   ENDPOINT: 11755.013,10465.386,0.000,1
```

```
   ENDPOINT: 11767.636,10212.144,0.000,2

REACH:
   STREAM Id: River_Section_Sample (River sections)

   REACH Id: Reach 1
   FROM POINT: 1
   TO POINT: 2
   CENTERLINE:
      11755.013,10465.386
      11534.492,10066.627
      11909.390,10161.459
      11828.978,10191.503
      11767.636,10212.144
   END:
END STREAM NETWORK:
BEGIN CROSS-SECTIONS:

CROSS-SECTION:
   STREAM ID: River_Section_Sample (River sections)
   REACH ID: Reach 1
   STATION: 0.000
   BANK POSITIONS:  0.341,0.351
   CUT LINE:
      11561.147,9726.411
      11948.879,11204.361
   SURFACE LINE:
         11561.147,    9726.411,    72.681
         11563.967,    9737.158,    72.397
         11566.441,    9746.592,    71.924
         11568.995,    9756.324,    71.616
         11571.392,    9765.463,    71.246
         11573.691,    9774.226,    71.088
         11576.402,    9784.561,    71.129
         11578.921,    9794.161,    71.132
         11581.472,    9803.885,    71.176
         11583.843,    9812.923,    71.254
         11586.344,    9822.457,    71.204
         11588.795,    9831.798,    71.034
         11591.409,    9841.761,    71.015
         11593.867,    9851.132,    70.816
         11596.305,    9860.426,    70.542
         11598.788,    9869.891,    70.612
         11601.506,    9880.251,    70.509
         11604.352,    9891.098,    70.350
.........

END   CROSS-SECTIONS:
```

ISIS

```
River_Section_Sample (River sections)
#REVISION#1
          5     0.750     0.900     0.100     0.001        12
    20.000     0.010     0.010     0.700     0.100     0.700     0.000
RAD FILE
```

```
END GENERAL
COMMENT
0
RIVER [VTX]
SECTION
10:00:00  2011-09-09
     0.000             0.0001
       175
     0.000    72.681     0.060     1.000               11561.15   9726.41
    11.111    72.397     0.060     1.000               11563.97   9737.16
    20.864    71.924     0.060     1.000               11566.44   9746.59
    30.925    71.616     0.060     1.000               11568.99   9756.32
    40.374    71.246     0.060     1.000               11571.39   9765.46
    49.434    71.088     0.060     1.000               11573.69   9774.23
    60.118    71.129     0.060     1.000               11576.40   9784.56
    70.044    71.132     0.060     1.000               11578.92   9794.16
    80.096    71.176     0.060     1.000               11581.47   9803.89
    89.440    71.254     0.060     1.000               11583.84   9812.92
    99.297    71.204     0.060     1.000               11586.34   9822.46
   108.954    71.034     0.060     1.000               11588.79   9831.80
   119.254    71.015     0.060     1.000               11591.41   9841.76
   128.941    70.816     0.060     1.000               11593.87   9851.13
   138.550    70.542     0.060     1.000               11596.31   9860.43
   148.336    70.612     0.060     1.000               11598.79   9869.89
   159.047    70.509     0.060     1.000               11601.51   9880.25
   170.261    70.350     0.060     1.000               11604.35   9891.10
   179.585    70.266     0.060     1.000               11606.72   9900.12
   182.300    70.203     0.060     1.000               11607.41   9902.74
   184.773    70.556     0.060     1.000               11608.03   9905.14
   186.689    70.598     0.060     1.000               11608.52   9906.99
   197.906    70.169     0.060     1.000               11611.37   9917.84
   210.304    69.970     0.060     1.000               11614.51   9929.83
   224.846    69.930     0.060     1.000               11618.20   9943.90
   245.081    69.969     0.060     1.000               11623.34   9963.47
   260.986    69.956     0.060     1.000               11627.37   9978.85
   273.086    70.223     0.060     1.000               11630.44   9990.56
   284.540    70.240     0.060     1.000               11633.35  10001.64
   295.899    70.253     0.060     1.000               11636.23  10012.62
   305.817    70.147     0.060     1.000               11638.75  10022.22
   316.464    70.066     0.060     1.000               11641.45  10032.52
   327.493    70.064     0.060     1.000               11644.25  10043.18
   338.876    70.058     0.060     1.000               11647.14  10054.19
   349.581    69.904     0.060     1.000               11649.86  10064.55
   360.443    69.990     0.060     1.000               11652.61  10075.06
   370.113    69.984     0.060     1.000               11655.07  10084.41
   380.416    69.885     0.060     1.000               11657.68  10094.37
   391.959    69.892     0.060     1.000               11660.61  10105.54
   402.808    70.217     0.060     1.000               11663.36  10116.03
   413.339    70.461     0.060     1.000               11666.03  10126.22
   426.395    70.087     0.060     1.000               11669.35  10138.85
   438.595    69.909     0.060     1.000               11672.44  10150.65
   449.370    69.705     0.060     1.000               11675.18  10161.07
   458.598    69.650     0.060     1.000               11677.52  10170.00
   461.879    69.629     0.060     1.000               11678.35  10173.17
   461.942    69.626     0.060     1.000               11678.37  10173.23
   467.823    69.740     0.060     1.000               11679.86  10178.92
   480.240    69.537     0.060     1.000               11683.01  10190.93
```

```
    480.300     69.542     0.060     1.000              11683.03  10190.99
    494.073     69.588     0.060     1.000              11686.52  10204.31
    500.383     69.825     0.060     1.000              11688.12  10210.42
    505.572     70.214     0.060     1.000              11689.44  10215.43
    510.106     70.580     0.060     1.000              11690.59  10219.82
    514.510     70.764     0.060     1.000              11691.71  10224.08
    518.624     70.701     0.060     1.000              11692.75  10228.06
    519.500     70.619     0.060     1.000              11692.97  10228.91
    520.462     70.578     0.040*    1.000LEFT          11693.22  10229.84
    521.208     70.448     0.040     1.000              11693.41  10230.56
    521.830     70.206     0.040     1.000              11693.57  10231.16
    522.891     69.554     0.040     1.000              11693.83  10232.19
    523.734     69.268     0.040     1.000              11694.05  10233.00
    524.297     68.702     0.040     1.000              11694.19  10233.55
    525.189     67.409     0.040     1.000              11694.42  10234.41
    526.726     66.910     0.040     1.000              11694.81  10235.90
    528.660     66.972     0.040     1.000              11695.30  10237.77
    530.829     67.304     0.040     1.000              11695.85  10239.86
    532.337     67.828     0.040     1.000              11696.23  10241.32
    533.681     68.119     0.040     1.000              11696.57  10242.62
    534.604     68.574     0.040     1.000              11696.81  10243.52
    536.045     69.934     0.040     1.000              11697.17  10244.91
    536.780     70.030     0.060*    1.000RIGHT         11697.36  10245.62
    538.266     70.013     0.060     1.000              11697.74  10247.06
    539.823     69.939     0.060     1.000              11698.13  10248.56
    540.979     70.420     0.060     1.000              11698.42  10249.68
    544.788     71.830     0.060     1.000              11699.39  10253.37
    547.940     71.198     0.060     1.000              11700.19  10256.42
    549.442     70.649     0.060     1.000              11700.57  10257.87
    550.911     70.173     0.060     1.000              11700.94  10259.29
    551.918     69.765     0.060     1.000              11701.20  10260.26
    554.661     69.715     0.060     1.000              11701.90  10262.92
........

INITIAL CONDITIONS
 label   ?      flow     stage froude no  velocity    umode    ustate
       z
10:00:00 2011-09-09 y      0.000     0.000     0.000     0.000
0.000     0.000     0.000
123456       y      0.000     0.000     0.000     0.000     0.000
0.000     0.000
13123        y      0.000     0.000     0.000     0.000     0.000
0.000     0.000
123456       y      0.000     0.000     0.000     0.000     0.000
0.000     0.000
10:00:00 2011-09-09 y      0.000     0.000     0.000     0.000
0.000     0.000     0.000
```

MIKE

```
River_Section_Sample (River sections)
River_Section_Sample (River sections)
               0.000
COORDINATES
    0
FLOW DIRECTION
    0
```

```
DATUM
      0.00
RADIUS TYPE
    2
DIVIDE X-Section
0
SECTION ID
10:00:00 2011-09-09
INTERPOLATED
    0
ANGLE
    0.00   0
RESISTANCE NUMBERS
   2  1     1.000     1.000     1.000    1.000    1.000
PROFILE        175
 -526.726    72.681     0.060     <#0>
 -515.614    72.397     0.060     <#0>
 -505.861    71.924     0.060     <#0>
 -495.800    71.616     0.060     <#0>
 -486.351    71.246     0.060     <#0>
 -477.292    71.088     0.060     <#0>
 -466.608    71.129     0.060     <#0>
 -456.682    71.132     0.060     <#0>
 -446.629    71.176     0.060     <#0>
 -437.286    71.254     0.060     <#0>
 -427.429    71.204     0.060     <#0>
 -417.772    71.034     0.060     <#0>
 -407.471    71.015     0.060     <#0>
 -397.784    70.816     0.060     <#0>
 -388.175    70.542     0.060     <#0>
 -378.390    70.612     0.060     <#0>
 -367.679    70.509     0.060     <#0>
 -356.465    70.350     0.060     <#0>
 -347.140    70.266     0.060     <#0>
 -344.426    70.203     0.060     <#0>
 -341.952    70.556     0.060     <#0>
 -340.037    70.598     0.060     <#0>
 -328.820    70.169     0.060     <#0>
 -316.422    69.970     0.060     <#0>
 -301.880    69.930     0.060     <#0>
 -281.645    69.969     0.060     <#0>
......
```

13.14 Exporting Text To GIS Attributes: Shape Files

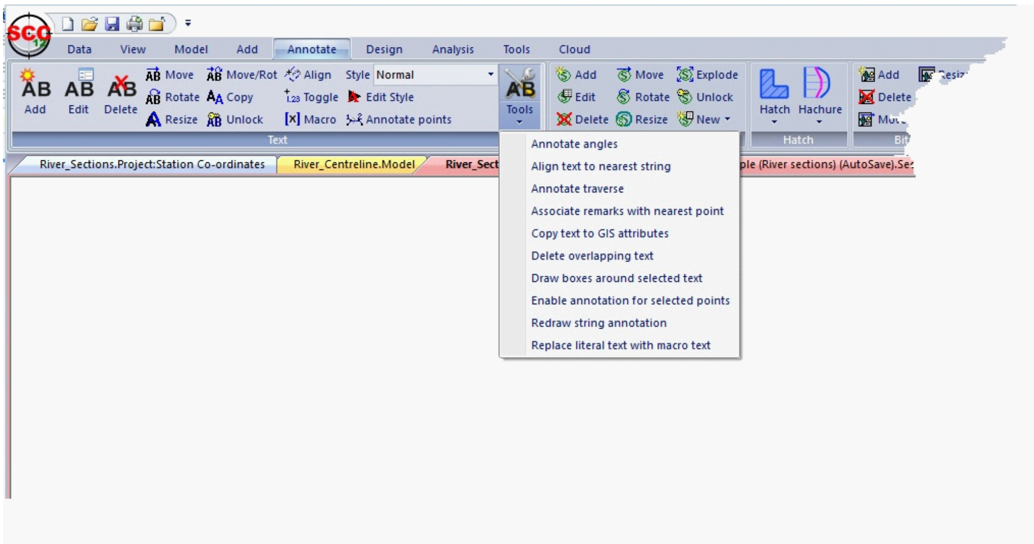
River IDs can be converted into GIS attributes which can be exported to shape files. The steps to do this are as follows;

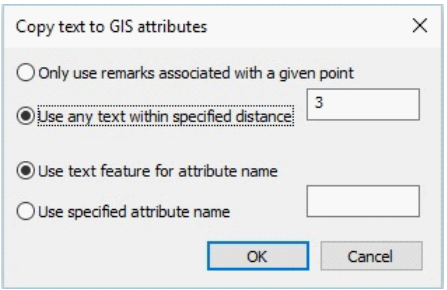
Set up your GIS layer for features which are required for export, for example, set the GIS layer for SURFACE to RIVERS.

Process the river sections as normal

Select all river sections and all ID points

'ANNOTATION tab > Tools drop down > Copy text to GIS attributes'





Go to 'DATA tab > Export drop down button > Shape File'

13.15 River Section Displayed on Model

To display the position of section lines in plan:

In the model, go to 'DESIGN tab > Attach drop down button > Section' and pick saved section.

Chainage can be annotated in plan by modifying the Chainage annotator on the '~SECT_T' feature.

Go to 'VIEW tab > List button'

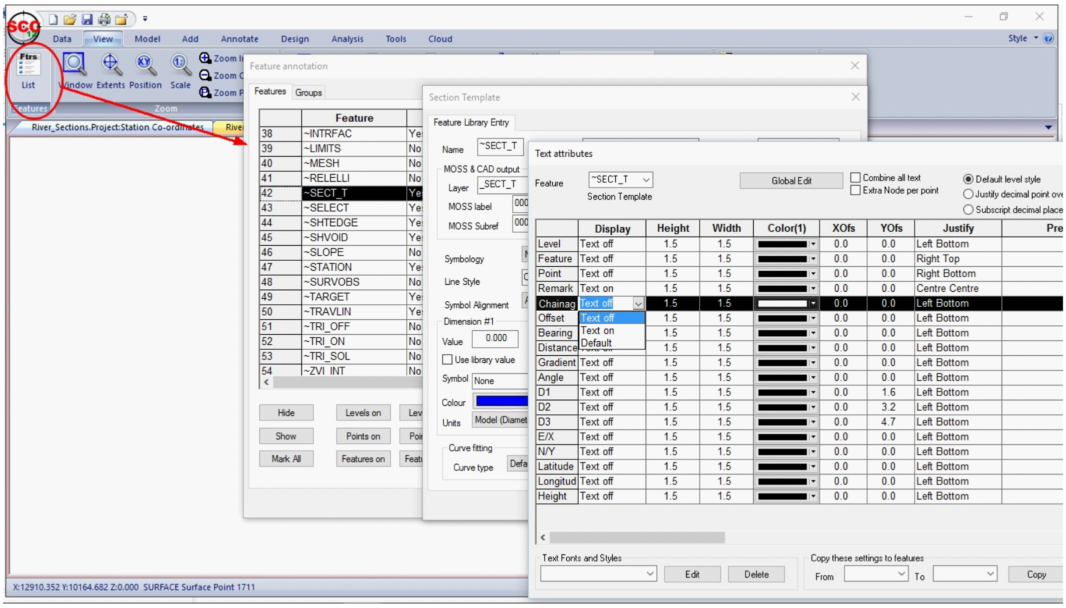
Pick '~SECT_T'

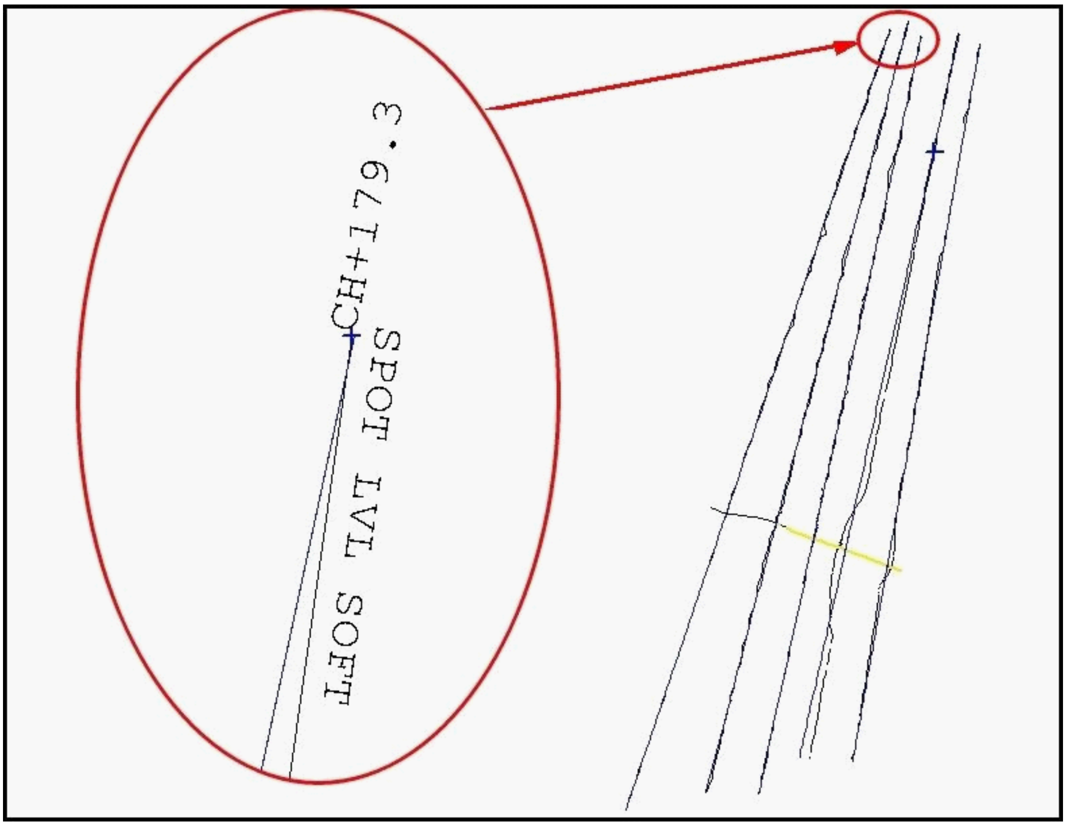
Press 'Edit Feature>>'

Press 'Text Annotation>>'

Set the value of Display, Remark and Chainage to Text On.

Alternatively, this can be set up in your feature library template, such that it is the default behaviour when attaching sections.





14 Blunder Detection And Analysis

SCC supports blunder detection and analysis in traverses and networks. This works in three stages as follows;

- Observed values, including angles and distances, are compared to computed values between known stations. For example, where you have an observed distance between two known stations, and a join distance computed from coordinates between the same stations, a difference in distance is calculated. If this difference exceeds a user defined tolerance a measurement blunder is considered to have occurred.

- Multiple observed values, including angles and distances, are compared for similarity. This could be the same observation, for example two observations from STNA to STNB, or a reverse observation, for example one from STNA to STNB and the other from STNB to STNA. Where differences between similar observations exceed a user defined tolerance a measurement blunder is considered to have occurred.

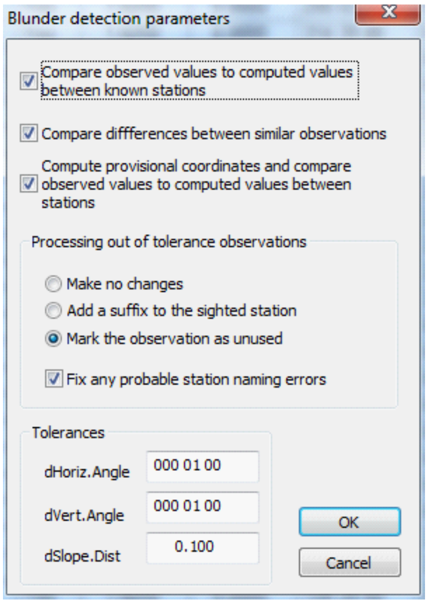
- Provisional values for unknown stations are computed, and differences between observed values and computed values are calculated for these provisional stations.

Where blunders are detected, you have three options to deal with how they are processed as follows;

- Take no action, simply highlight the blunder observations such that they can be edited manually.

- Mark the blunder observations to be excluded from the adjustment. In the case of networks or traverses with significant redundancy, this allows for the adjustment to be completed with minimal editing required.

- Rename the sighted station using a suffix, such that you will have multiple adjusted station values for blunder observations, e.g STNA, STNA(1), STNA(2), etc... This can be useful in situations where the sighted station name has inadvertently been re-used for more than one physical station.



There is also an option to automatically correct probable station naming errors, which account for a large proportion of typical blunders. This is done by comparing similar observations for a likely match, and failing that, calculating a provisional coordinate for the sighted station and comparing it to known stations.

The blunder analysis routines are available in the traverse observation view, under Edit / Blunder detection. The parameters are as described above, and on running the blunder detection and analysis, you'll be given the option to view a detailed report of the results.

Created on 07/03/2008
By SCC for Windows v10.1.4 (Network)
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ATLAS

Traverse blunder analysis

Tel:
Fax:
email:
web:

Traverse file: E:\SCC\tp-trav\ALL.Traverse

Ha tolerance: 000 01 00
Va tolerance: 000 01 00
Distance tolerance: 0.100
Corrective action: Mark obs as unused

Analysis results:

	Known co-ords	Similar Obs	Computed co-ords
Checked:	Yes	Yes	Yes
Number of errors found:	59	73	1,866
Fixed (station renamed):	2	29	850
Corrective action applied:	57	44	1,016

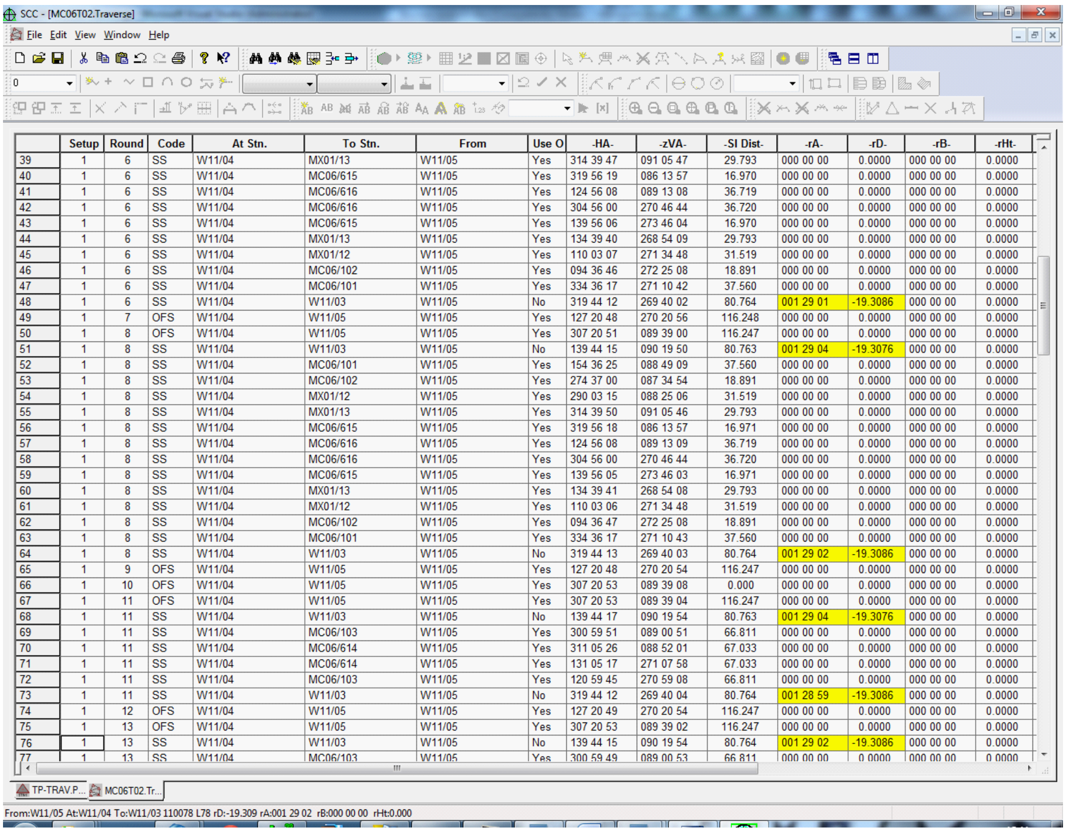
The report is broken down into a summary, comparison between observations and known coordinates, comparisons between similar observations, and comparison between observations and computed provisional coordinates.

Comparison of similar observations

At Stn: MC06/10		To Stn: W11/03						
Obs#	**Remark**	**Ha**	**Va**	**S.Dist**	**dDist**	**Angle**	**From Stn**	**dAngle**
109	**110113 L113**	**314 12 44**	**089 42 17**	**80.795**		**000 00 01**	**W11/04**	
107	110112 L112	314 12 43	089 42 17	80.795	73.003	000 00 00	W11/04	086 59 29
110	110114 L114	227 13 27	088 35 38	7.793	73.003	273 00 44	W11/04	086 59 17
113	110117 L117	227 13 17	088 35 26	7.793	73.003	273 00 37	W11/04	086 59 24
114	110118 L118	227 13 25	088 35 35	7.793	73.003	273 00 45	W11/04	086 59 16
117	110121 L121	227 13 16	088 35 27	7.793	73.003	273 00 33	W11/04	086 59 28
118	110122 L122	227 13 24	088 35 36	7.793	73.003	273 00 41	W11/04	086 59 20
121	110125 L125	227 13 16	088 35 27	7.793	73.003	273 00 34	W11/04	086 59 27
122	110126 L126	227 13 24	088 35 36	7.793	73.003	273 00 42	W11/04	086 59 19
125	110129 L129	227 13 17	088 35 28	7.793	73.003	273 00 32	W11/04	086 59 29
333	110351 L351	047 13 56	090 53 16	7.792	73.003	092 25 31	MC06/16	086 59 29
334	110350 L350	047 14 06	090 53 22	7.791	73.004	092 25 41	MC06/16	086 59 29
337	110354 L354	047 14 05	090 53 22	7.791	73.004	092 25 41	MC06/16	086 59 29
338	110355 L355	047 13 57	090 53 16	7.792	73.003	092 25 33	MC06/16	086 59 29
341	110358 L358	047 14 05	090 53 21	7.791	73.004	092 25 42	MC06/16	086 59 29
342	110359 L359	047 13 56	090 53 15	7.792	73.003	092 25 33	MC06/16	086 59 29
345	110362 L362	047 14 06	090 53 22	7.791	73.004	092 25 41	MC06/16	086 59 29
346	110363 L363	047 13 58	090 53 15	7.792	73.003	092 25 33	MC06/16	086 59 29

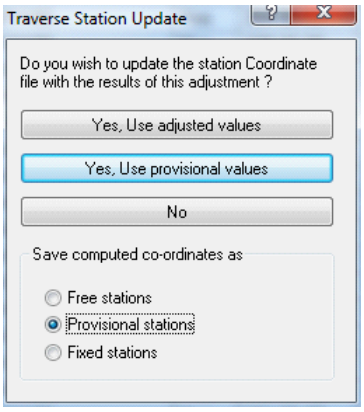
At Stn: W11/05		To Stn: MC06/103						
Obs#	**Remark**	**Ha**	**Va**	**S.Dist**	**dDist**	**Angle**	**From Stn**	**dAngle**
451	**110107 L471**	**135 21 06**	**089 30 06**	**50.400**		**008 00 12**	**W11/04**	
461	110119 L483	135 46 46	089 30 05	50.401	-0.001	008 25 52	W11/04	-000 25 40
468	110126 L490	135 46 39	089 30 03	50.401	-0.001	008 25 45	W11/04	-000 25 33
475	110133 L497	135 46 43	089 30 07	50.401	-0.001	008 25 49	W11/04	-000 25 37
482	110140 L504	135 46 39	089 30 03	50.401	-0.001	008 25 45	W11/04	-000 25 33
489	110147 L511	135 46 45	089 30 08	50.401	-0.001	008 25 50	W11/04	-000 25 38

Where the option to fix station naming errors has been selected, fixed observations will be highlighted in green. In all other cases, the differences will be written back to the traverse observation sheet in the residual columns, and the traverse observation sheet layout will be changed to show these values.



	Setup	Round	Code	At Stn.	To Stn.	From	Use O	-HA-	-zVA-	-SI Dist-	-rA-	-rD-	-rB-	-rHt-
39	1	6	SS	W11/04	MX01/13	W11/05	Yes	314 39 47	091 05 47	29.793	000 00 00	0.0000	000 00 00	0.0000
40	1	6	SS	W11/04	MC06/615	W11/05	Yes	319 56 19	086 13 57	16.970	000 00 00	0.0000	000 00 00	0.0000
41	1	6	SS	W11/04	MC06/616	W11/05	Yes	124 56 08	089 13 08	36.719	000 00 00	0.0000	000 00 00	0.0000
42	1	6	SS	W11/04	MC06/616	W11/05	Yes	304 56 00	270 46 44	36.720	000 00 00	0.0000	000 00 00	0.0000
43	1	6	SS	W11/04	MC06/615	W11/05	Yes	139 56 06	273 46 04	16.970	000 00 00	0.0000	000 00 00	0.0000
44	1	6	SS	W11/04	MX01/13	W11/05	Yes	134 39 40	268 54 09	29.793	000 00 00	0.0000	000 00 00	0.0000
45	1	6	SS	W11/04	MX01/12	W11/05	Yes	110 03 07	271 34 48	31.519	000 00 00	0.0000	000 00 00	0.0000
46	1	6	SS	W11/04	MC06/102	W11/05	Yes	094 36 46	272 25 08	18.891	000 00 00	0.0000	000 00 00	0.0000
47	1	6	SS	W11/04	MC06/101	W11/05	Yes	334 36 17	271 10 42	37.560	000 00 00	0.0000	000 00 00	0.0000
48	1	6	SS	W11/04	W11/03	W11/05	No	319 44 12	269 40 02	80.764	001 29 01	-19.3086	000 00 00	0.0000
49	1	7	OFS	W11/04	W11/05	W11/05	Yes	127 20 48	270 20 56	116.248	000 00 00	0.0000	000 00 00	0.0000
50	1	8	OFS	W11/04	W11/05	W11/05	Yes	307 20 51	089 39 00	116.247	000 00 00	0.0000	000 00 00	0.0000
51	1	8	SS	W11/04	W11/03	W11/05	No	139 44 15	090 19 50	80.763	001 29 04	-19.3076	000 00 00	0.0000
52	1	8	SS	W11/04	MC06/101	W11/05	Yes	154 36 25	088 49 09	37.560	000 00 00	0.0000	000 00 00	0.0000
53	1	8	SS	W11/04	MC06/102	W11/05	Yes	274 37 00	087 34 54	18.891	000 00 00	0.0000	000 00 00	0.0000
54	1	8	SS	W11/04	MX01/12	W11/05	Yes	290 03 15	088 25 06	31.519	000 00 00	0.0000	000 00 00	0.0000
55	1	8	SS	W11/04	MX01/13	W11/05	Yes	314 39 50	091 05 46	29.793	000 00 00	0.0000	000 00 00	0.0000
56	1	8	SS	W11/04	MC06/615	W11/05	Yes	319 56 18	086 13 57	16.971	000 00 00	0.0000	000 00 00	0.0000
57	1	8	SS	W11/04	MC06/616	W11/05	Yes	124 56 08	089 13 09	36.719	000 00 00	0.0000	000 00 00	0.0000
58	1	8	SS	W11/04	MC06/616	W11/05	Yes	304 56 00	270 46 44	36.720	000 00 00	0.0000	000 00 00	0.0000
59	1	8	SS	W11/04	MC06/615	W11/05	Yes	139 56 05	273 46 03	16.971	000 00 00	0.0000	000 00 00	0.0000
60	1	8	SS	W11/04	MX01/13	W11/05	Yes	134 39 41	268 54 08	29.793	000 00 00	0.0000	000 00 00	0.0000
61	1	8	SS	W11/04	MX01/12	W11/05	Yes	110 03 06	271 34 48	31.519	000 00 00	0.0000	000 00 00	0.0000
62	1	8	SS	W11/04	MC06/102	W11/05	Yes	094 36 47	272 25 08	18.891	000 00 00	0.0000	000 00 00	0.0000
63	1	8	SS	W11/04	MC06/101	W11/05	Yes	334 36 17	271 10 43	37.560	000 00 00	0.0000	000 00 00	0.0000
64	1	8	SS	W11/04	W11/03	W11/05	No	319 44 13	269 40 03	80.764	001 29 02	-19.3086	000 00 00	0.0000
65	1	9	OFS	W11/04	W11/05	W11/05	Yes	127 20 48	270 20 54	116.247	000 00 00	0.0000	000 00 00	0.0000
66	1	10	OFS	W11/04	W11/05	W11/05	Yes	307 20 53	089 39 08	0.000	000 00 00	0.0000	000 00 00	0.0000
67	1	11	OFS	W11/04	W11/05	W11/05	Yes	307 20 53	089 39 04	116.247	000 00 00	0.0000	000 00 00	0.0000
68	1	11	SS	W11/04	W11/03	W11/05	No	139 44 17	090 19 54	80.763	001 29 04	-19.3076	000 00 00	0.0000
69	1	11	SS	W11/04	MC06/103	W11/05	Yes	300 59 51	089 00 51	66.811	000 00 00	0.0000	000 00 00	0.0000
70	1	11	SS	W11/04	MC06/614	W11/05	Yes	311 05 26	088 52 01	67.033	000 00 00	0.0000	000 00 00	0.0000
71	1	11	SS	W11/04	MC06/614	W11/05	Yes	131 05 17	271 07 58	67.033	000 00 00	0.0000	000 00 00	0.0000
72	1	11	SS	W11/04	MC06/103	W11/05	Yes	120 59 45	270 59 08	66.811	000 00 00	0.0000	000 00 00	0.0000
73	1	11	SS	W11/04	W11/03	W11/05	No	319 44 12	269 40 04	80.764	001 28 59	-19.3086	000 00 00	0.0000
74	1	12	OFS	W11/04	W11/05	W11/05	Yes	127 20 49	270 20 54	116.247	000 00 00	0.0000	000 00 00	0.0000
75	1	13	OFS	W11/04	W11/05	W11/05	Yes	307 20 53	089 39 02	116.247	000 00 00	0.0000	000 00 00	0.0000
76	1	13	SS	W11/04	W11/03	W11/05	No	139 44 15	090 19 54	80.764	001 29 02	-19.3086	000 00 00	0.0000
77	1	13	SS	W11/04	MC06/103	W11/05	Yes	300 59 49	089 00 53	66.811	000 00 00	0.0000	000 00 00	0.0000

Pressing F4 in this view moves you to the next blunder detected, and pressing F5 brings you back to the default observation layout and may be used to cycle through other layouts. Note that each stage of the blunder detection and analysis clears down the residual values, so if you wish the view the results from any given stage, maek sure that subsequent stages are not enabled.



The blunder detection also checks that provisional values can be calculated for all sighted stations. If this is the case, it should be possible to successfully adjust the traverse, although careful attention should be paid to the output report, as a significant amount of information may have been removed.

When updating the station coordinates, you now also have the option to store the resultant stations as free, provisional, or fixed. This is useful when working with a traverse spanning multiple jobs, where you wish to carry out the blunder analysis seperately on each job, but need to carry coordinates between jobs in order to be able compute the results. The traverse report now also details how each provisional coordinate was computed, which can be either by direct trigonometry, resection, or intersecting rays.

An additional option to use high performance matrix processing libraries for working with very large networks is available. This is available under File / General options / Use high performance matrix libraries. Note that for very large networks, memory is also likely to be a limitation, as calculation involves matrices based on the square of the size of the number of observations. Thus 8,000 total station sightings would give us 8000 distances and a slightly smaller number of angles, resulting in matrix sizes of ~ 15,000 x 15,000 or ~1.8gb of memory. This would need to be either reduced or broken down into a number of smaller jobs. Networks including < 2,000 observations should be accomodated by most 32 bit PCs, and < 4,000 is advised for 64 bit PCs.

15 Rail Moudule

The following outlines the main tools and functionality within the SCC Rails Modules.

15.1 Rail Traverse

The following outlines the steps to process a Rail traverse. Error checking, the application of Centre Error Correction and the introduction of Known Stations are examined.

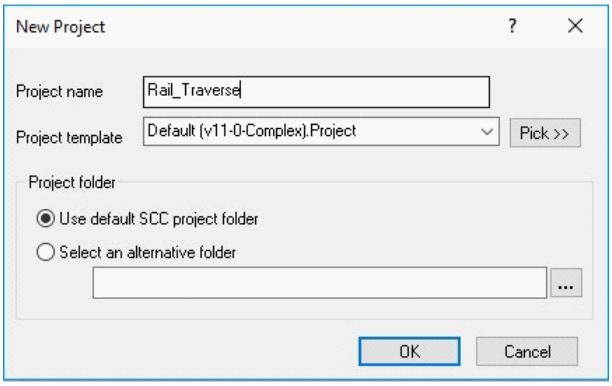
Creating A Project Directory

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

Enter in a Project/Job name 'Rail_Traverse'

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

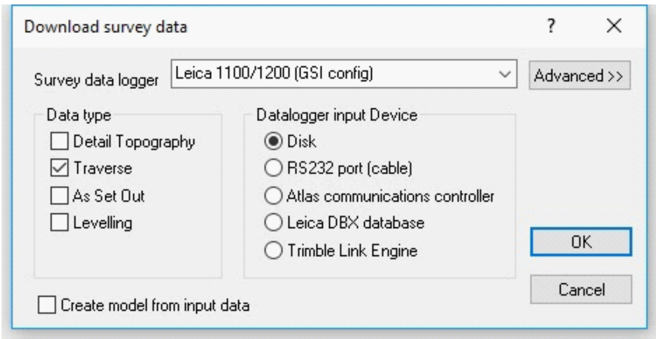
Select 'OK'



Download Raw Data

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

Set up the following:

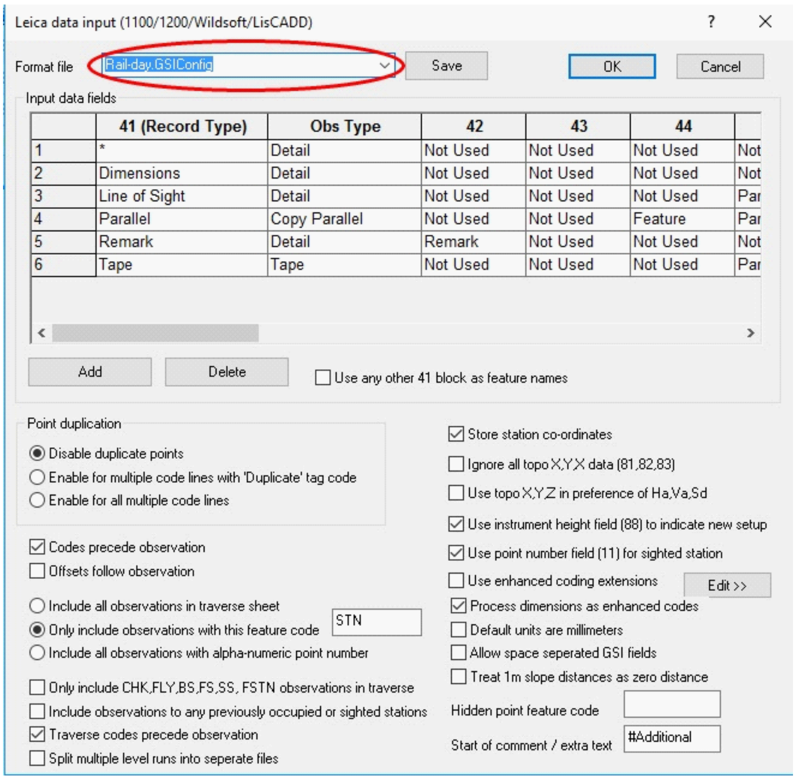


Press 'Ok'

Select raw file '\RailData\Traverse\Rail-day.GSI'

Within the Leica data input (1100/1200/Wildsoft/LisCADD) dialog, pick 'Rail-day.GSIConfig' file and Press 'Ok'

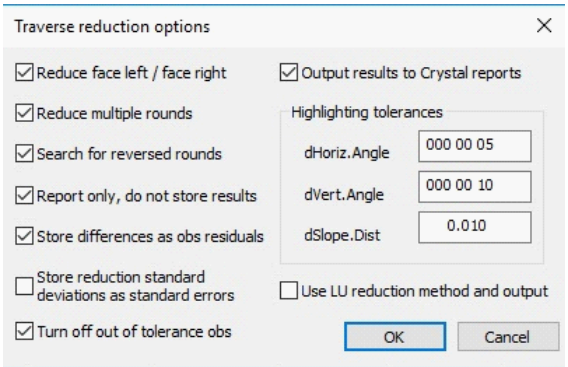
Note: this file is within the SCC folder, as a result, available on the drop down menu



Error Checking

Go to the 'TRAVERSE tab > Adjust > Reduce'

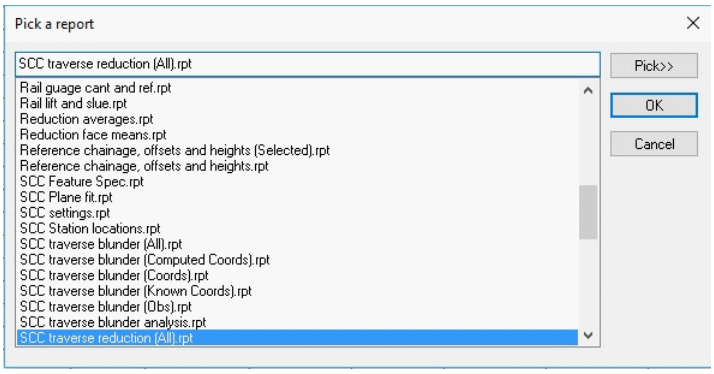
Set up the following:



Press 'Ok'

Reduction Report

From the Pick A Report dialog, select 'SCC Traverse reduction (All).rpt' and Press 'Ok'



Examine Report:

Line	To Stn	RodHt		ha	va	sd	face
:L00016 110017	CST04	1.6480		275 14 00	269 56 15	122.2010	2
:L00015 110016	CST04	1.6480		095 13 54	090 03 48	122.2010	1
			Mean	095 13 57	090 03 47	122.2010	
			Spread	-000 00 06	000 00 03	0.0000	

Reduction means and differences

Setup	At Stn	Inst. Ht
1	CST02	1.5510

At Stn	To Stn	Mean Ha	Mean Va	Mean Sd
CST02	CST01	000 00 00.0	090 31 25.5	101.2770

Line	RodHt	Ha	Va	Sd	dHa	dVa	dSD
:L00003 1100	1.5550	000 00 00.0	090 31 24.5	101.2770	+000 00 00.0	-000 00 01.0	0.0000
:L00025 1100	1.5550	000 00 00.0	090 31 27.0	101.2770	+000 00 00.0	+000 00 01.5	0.0000
:L00019 1100	1.5550	000 00 00.0	090 31 26.5	101.2770	+000 00 00.0	+000 00 01.0	0.0000
:L00013 1100	1.5550	000 00 00.0	090 31 25.5	101.2770	+000 00 00.0	+000 00 00.0	0.0000
:L00002 1100	1.5550	000 00 00.0	090 31 24.0	101.2770	+000 00 00.0	-000 00 01.5	0.0000

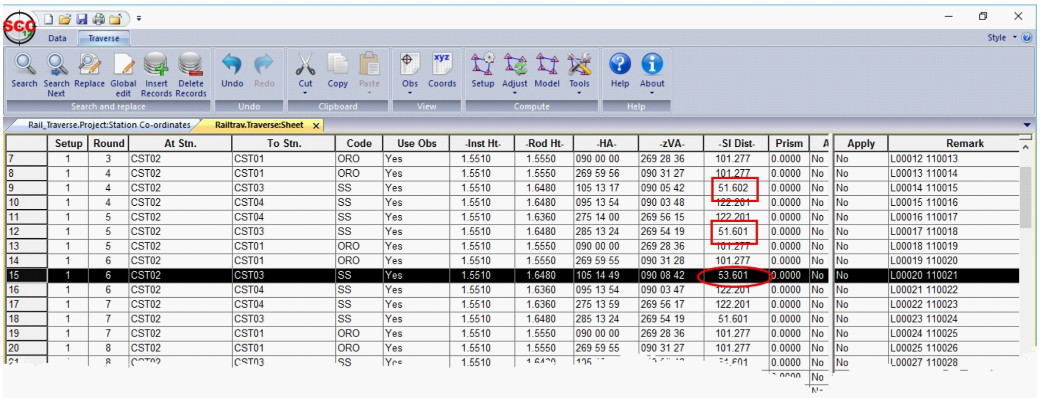
At Stn	To Stn	Mean Ha	Mean Va	Mean Sd
CST02	CST03	195 13 41.8	090 06 17.4	52.0012

Line	RodHt	Ha	Va	Sd	dHa	dVa	dSD
:L00030 1100	1.6480	195 13 27.0	090 05 41.0	51.6010	-000 00 14.8	-000 00 36.4	-0.4000
:L00023 1100	1.6480	195 13 24.0	090 05 41.5	51.6010	-000 00 17.8	-000 00 35.9	-0.4000
:L00020 1100	1.6480	195 14 51.5	090 08 42.0	53.6010	+000 01 09.7	+000 02 24.6	1.6000
:L00014 1100	1.6480	195 13 22.5	090 05 41.5	51.6020	-000 00 19.3	-000 00 35.9	-0.4000
:L00005 1100	1.6480	195 13 24.0	090 05 41.0	51.6020	-000 00 17.8	-000 00 36.4	-0.4000

At Stn	To Stn	Mean Ha	Mean Va	Mean Sd
CST02	CST04	185 13 59.6	090 03 46.0	122.2010

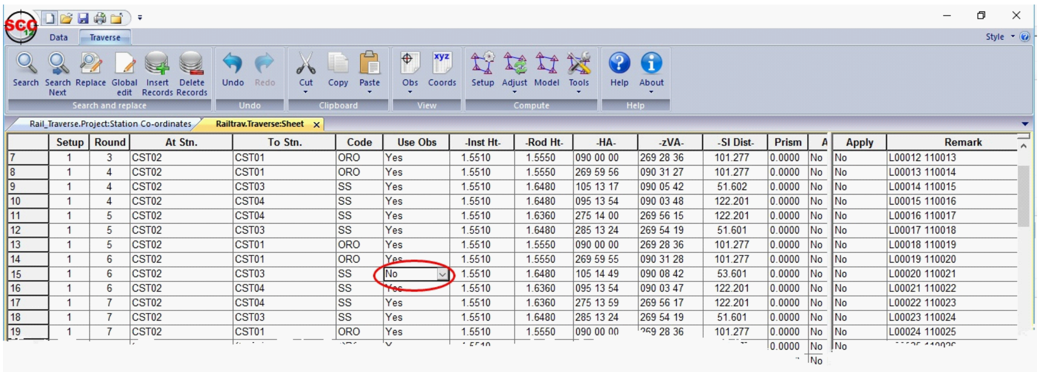
Line	RodHt	Ha	Va	Sd	dHa	dVa	dSD
:L00028 1100	1.6360	185 14 01.5	090 03 46.0	122.2010	+000 00 01.8	-000 00 00.0	0.0000
:L00015 1100	1.6360	185 13 59.0	090 03 46.5	122.2010	-000 00 00.6	+000 00 00.5	0.0000
:L00021 1100	1.6360	185 13 59.0	090 03 45.0	122.2010	-000 00 00.6	-000 00 01.0	0.0000
:L00008 1100	1.6360	185 13 59.0	090 03 46.5	122.2010	-000 00 00.6	+000 00 00.5	0.0000

There is a notable Slope Distance Error:



Removing Error from Traverse:

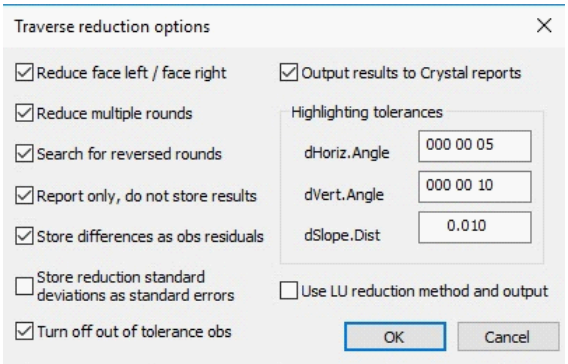
Select 'No' within 'Use Obs' column for record 15 At Stn CST02 To Stn CST03



Re-run Reduction:

Go to the 'TRAVERSE tab > Adjust > Reduce'

Set up the following:



Press 'Ok'

Reduction Report

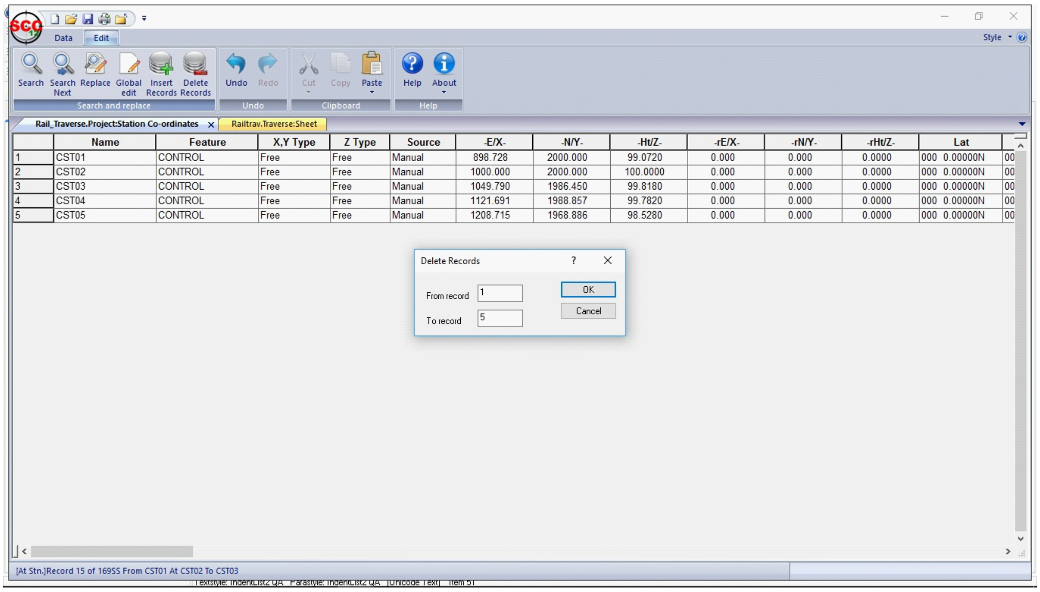
From the Pick A Report dialog, select 'SCC Traverse reduction (All).rpt' and Press 'Ok'

Review Results. Note how the Stand Deviation for Slope Distance is now 0.00

Remove Stations From the Project

Go to Project View, remove stations that have been downloaded from raw file

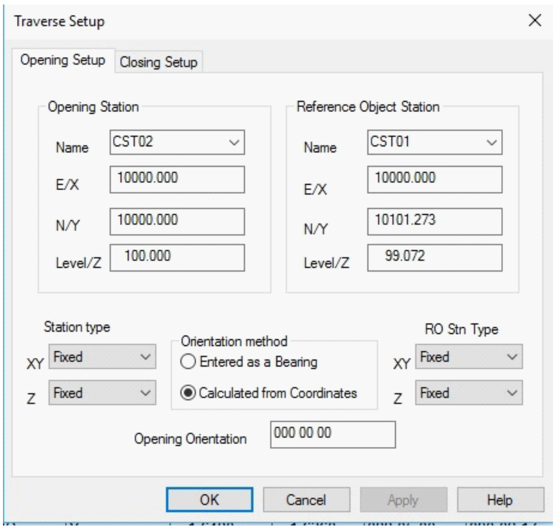
Select ''EDIT tab > Delete Records' set up the following:



Adjust Traverse Based on Fixed Base Line

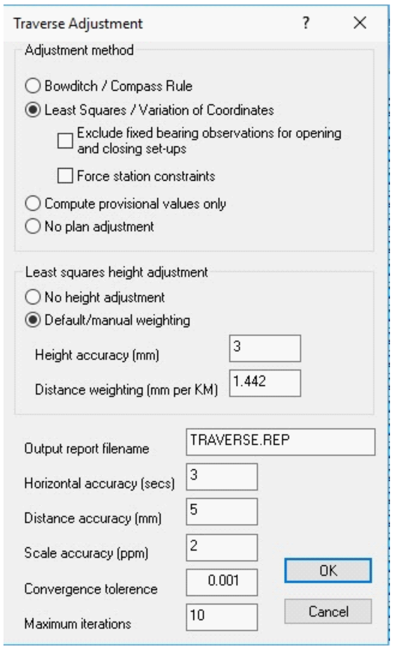
Go to 'TRAVERSE tab', Select 'Setup'

Set opening set up as shown below, allowing SCC to generate a RO values:



Press 'OK'

Select 'Adjust', set up the following and Press 'Ok'

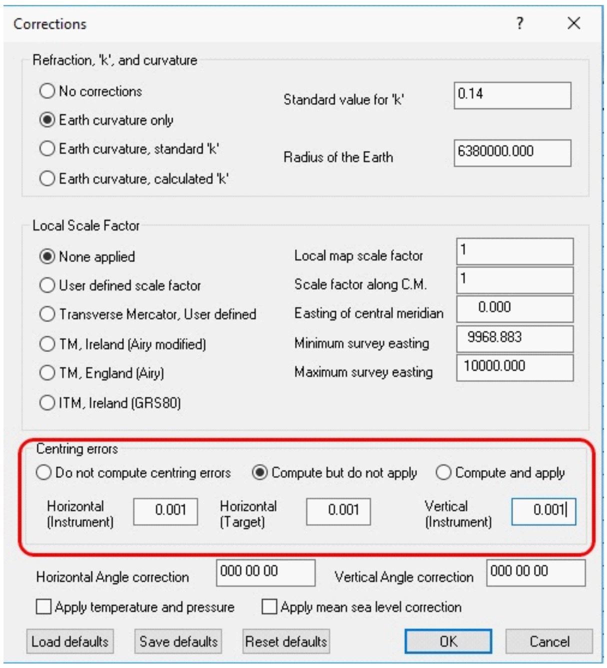


Review Results and select 'Yes, to use provisional coordinates'

Applying Corrections: Centring Error

Go to 'TRAVERSE tab', Select 'Adjust drop down > Corrections'

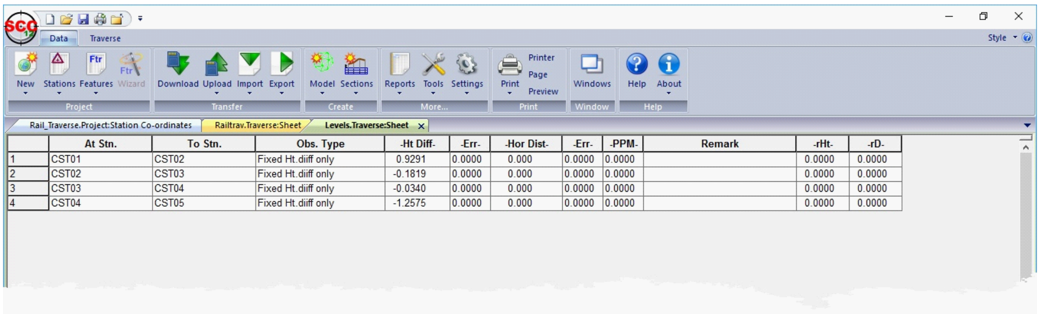
Set up Centring Errors as shown below and Press 'Ok':



Re-adjust and review report

Level Data

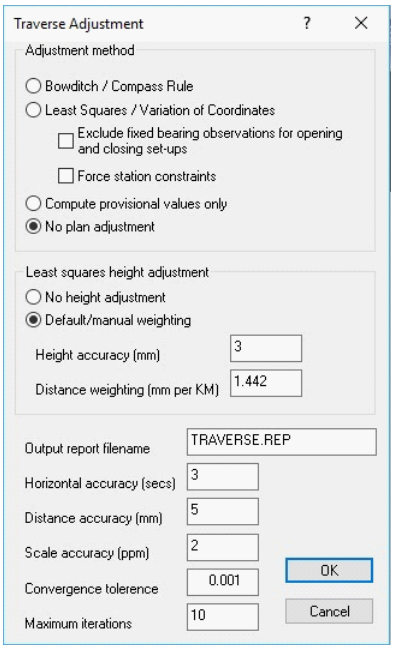
Open 'Levels.Traverse'



	At Stn.	To Stn.	Obs. Type	-Ht Diff-	-Err-	-Hor Dist-	-Err-	-PPM-	Remark	-rHt-	-rD-
1	CST01	CST02	Fixed Ht.diiff only	0.9291	0.0000	0.000	0.0000	0.0000		0.0000	0.0000
2	CST02	CST03	Fixed Ht.diiff only	-0.1819	0.0000	0.000	0.0000	0.0000		0.0000	0.0000
3	CST03	CST04	Fixed Ht.diiff only	-0.0340	0.0000	0.000	0.0000	0.0000		0.0000	0.0000
4	CST04	CST05	Fixed Ht.diiff only	-1.2575	0.0000	0.000	0.0000	0.0000		0.0000	0.0000

Go to 'TRAVERSE tab', Select 'Adjust'

Set up the following:

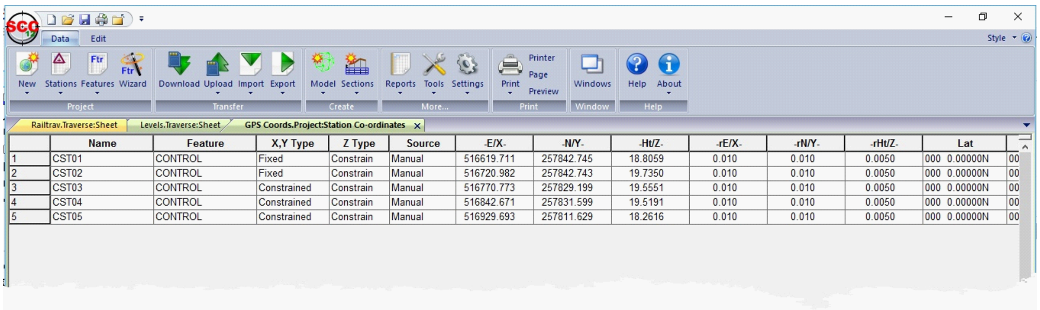


Select 'OK' and Review report

Select 'Yes, to use Adjusted Coordinates'

Known Station Values

Close existing project and open 'GPSCoords.Project'

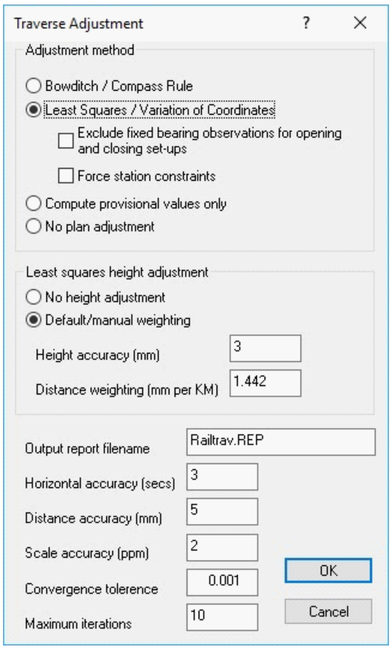


	Name	Feature	X,Y Type	Z Type	Source	-E/X-	-N/Y-	-Ht/Z-	-rE/X-	-rN/Y-	-rHt/Z-	Lat	
1	CST01	CONTROL	Fixed	Constrain	Manual	516619.711	257842.745	18.8059	0.010	0.010	0.0050	000 0.00000N	00
2	CST02	CONTROL	Fixed	Constrain	Manual	516720.982	257842.743	19.7350	0.010	0.010	0.0050	000 0.00000N	00
3	CST03	CONTROL	Constrained	Constrain	Manual	516770.773	257829.199	19.5551	0.010	0.010	0.0050	000 0.00000N	00
4	CST04	CONTROL	Constrained	Constrain	Manual	516842.671	257831.599	19.5191	0.010	0.010	0.0050	000 0.00000N	00
5	CST05	CONTROL	Constrained	Constrain	Manual	516929.693	257811.629	18.2616	0.010	0.010	0.0050	000 0.00000N	00

Note: Coordinates are constrained based on information from the GPS report (rE/X, rN.Y, rHt/Z)

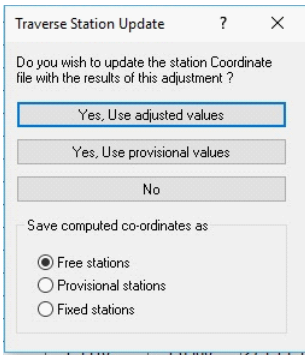
Run Adjustment

Go to 'TRAVERSE tab', Select 'Adjust'



Press 'Ok' and Review Report

Select 'Yes, Use Adjustment Values'



15.2 Rail Analysis

SCC can be used for analysis and reporting of Rail data.

15.2.1 Rail Overlap

String comparison and overlap processing option are available within the model view under **'DESIGN tab > Rail button > Compare strings and remove overlaps'**. This requires a model with one or more overlapping strings, and an alignment for reference purposes. The following is an example of the usage of this function based around the sample data provided;

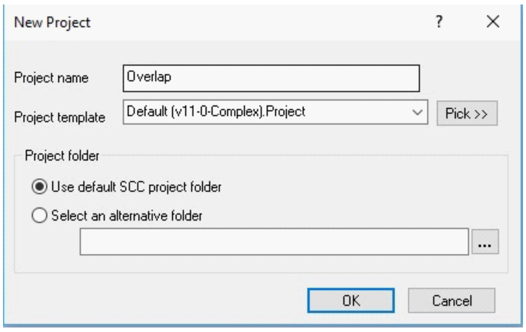
Creating A Project Directory

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

Enter in a Project/Job name 'Overlap'

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

Select ‘OK’

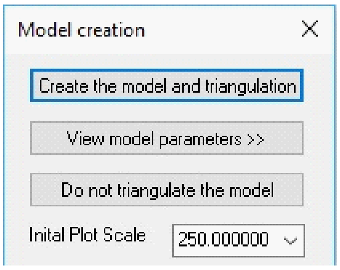


Create Model

Go to 'DATA tab > Model drop down > SCC Dataset'

Go to \RailData\Model\Biggin.Survey'

Select Initial Plot Scale of 250 and 'Create the model and triangulation'

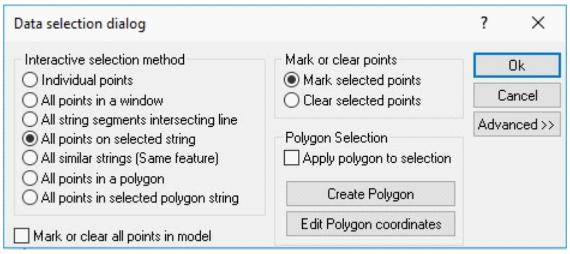


Select 'Ok' to model attribute dialog

Select RR String Information

Right click the mouse to bring up the Data Selection Dialog

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

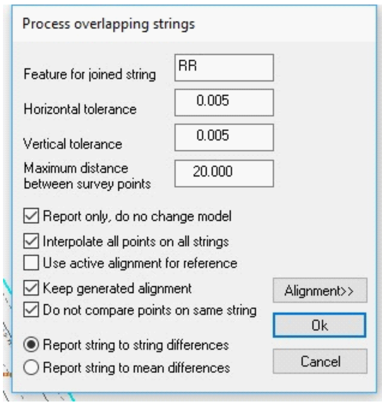


Left click mouse on RR line strings

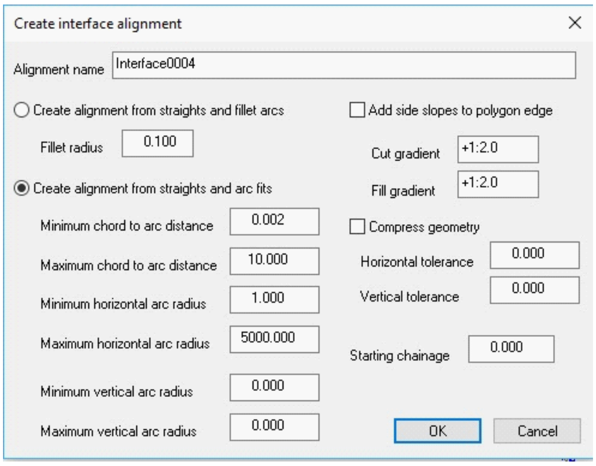
String Overlap

Go to 'DESIGN tab > Overlaps' button

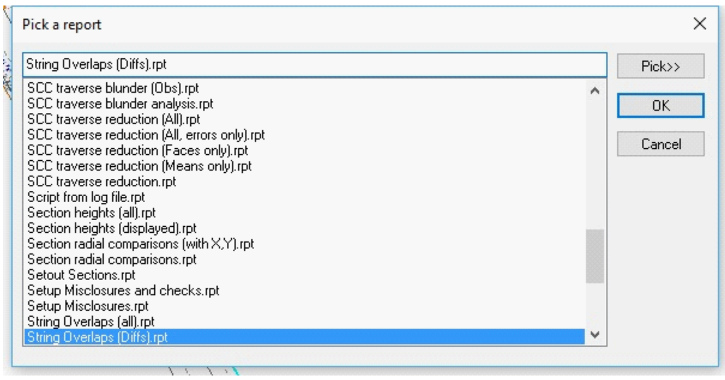
Set up the following:



Press 'Alignment>>', set up the following and Press 'OK':



Pick 'String Overlap (Diff).rpt' and Press 'OK'



Review Report

String overlap comparison

(Differences only)

Tel:
Fax:
email:
web:

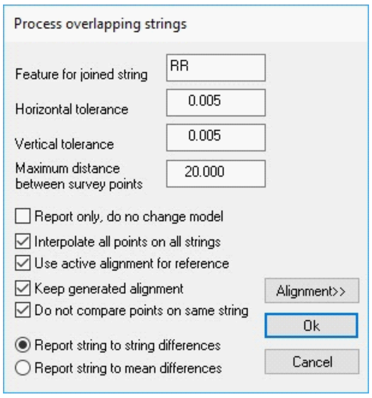
Point	Feature	Chainage	Offset	-E/X-	-N/Y-	-Ht/Z-	dDist	dZ	dOfs
9122	RR	110.670	0.000	7,767.785	8,016.056	21.577	0.001	-0.004	0.001
6131	RR	120.677	0.000	7,777.590	8,014.056	21.512	0.002	0.002	-0.002
9123	RR	120.712	-0.002	7,777.624	8,014.051	21.514	0.002	-0.002	0.002
6132	RR	130.774	-0.012	7,787.443	8,011.849	21.443	0.001	0.003	0.001
9141	RR	301.890	0.005	7,945.216	7,947.420	20.812	0.004	-0.003	-0.004
9142	RR	312.114	0.005	7,953.915	7,942.049	20.799	0.004	-0.002	-0.004
1037	RR	784.188	0.000	8,237.370	7,572.316	19.813	0.003	-0.004	0.003
2102	RR	784.192	0.002	8,237.370	7,572.311	19.810	0.005	0.004	-0.002
1036	RR	784.188	0.000	8,237.370	7,572.316	19.814	0.005	-0.004	0.002
2103	RR	794.331	0.000	8,242.384	7,563.499	19.785	0.001	0.005	0.001
1038	RR	794.352	0.001	8,242.393	7,563.481	19.790	0.001	-0.005	-0.001
1039	RR	804.406	0.001	8,247.364	7,554.741	19.766	0.001	0.000	0.000

Repeat String Overlap

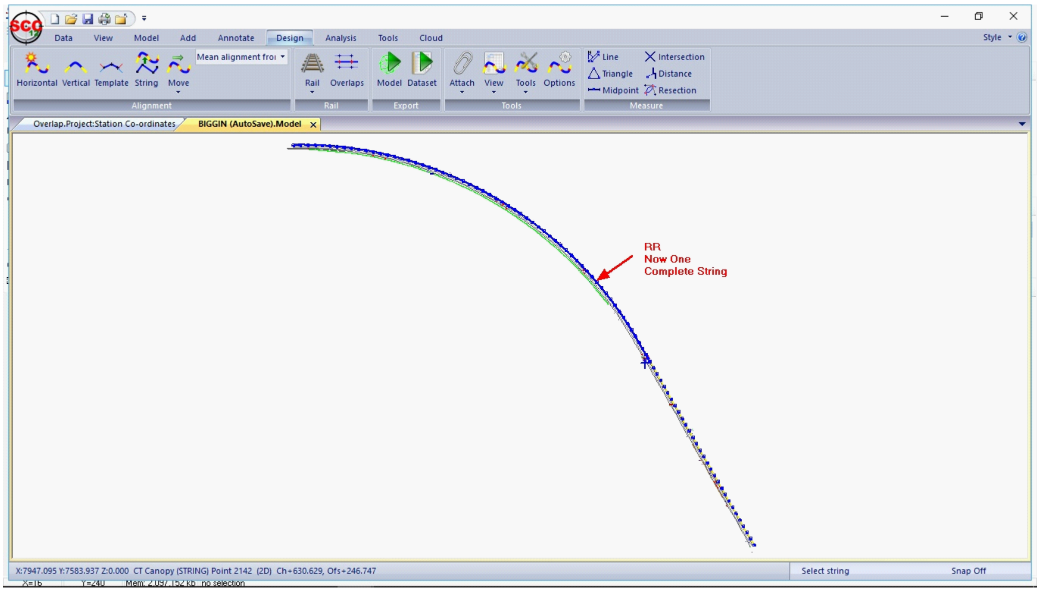
Go to 'DESIGN tab > Overlaps' button

Set up the following and Press 'Ok':

This time ensure that 'Report only, do not change model' is not selected and 'Use active alignment for reference' is selected



On completion note the RR string is one complete string



15.2.2 Cant & Gauge Reporting

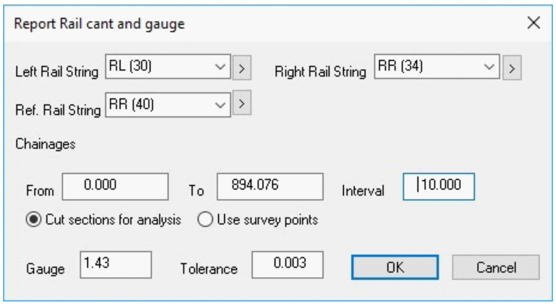
Using the opened data a Cant & Gauge report can be generated.

Reporting Cant & Gauge

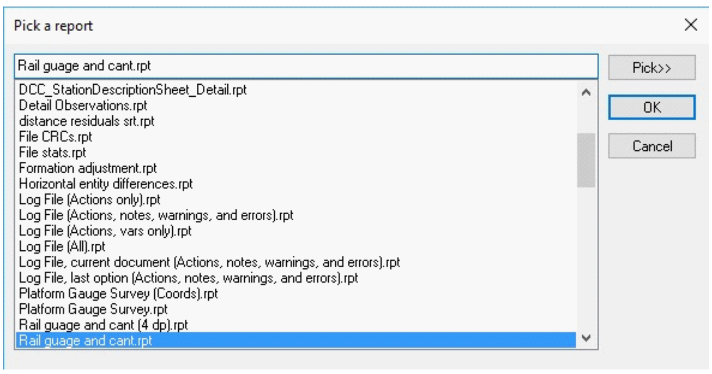
Go to 'DESIGN tab > Rail drop down menu > Report cant and gauge'

Note there must be an active alignment present

Set up the following and Press 'OK'



Pick 'Rail guage and cant.rpt'



Review Report

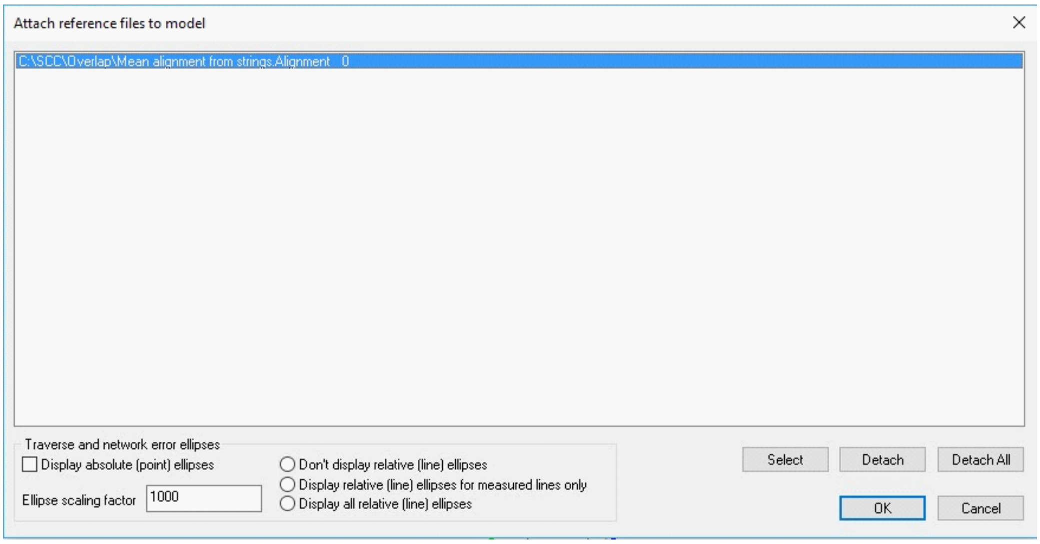
15.2.3 Lift & Slue Reporting

Using the opened data a Lift & Slue report can be generated.

Remove Existing Alignment

Go to 'DESIGN tab > Attach'

Highlight attached alignment, select 'Detach All' and 'Ok'



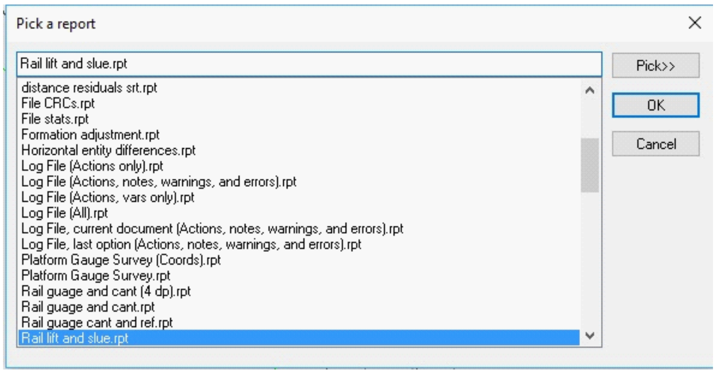
Attach Design Alignment

Go to 'DESIGN tab > Attach drop down menu > Alignment'

Select '\rail-day\Lift & Slue\MC02.Alignment'

Reporting Lift & Slue

Go to 'DESIGN tab > Rail drop down menu > Report Lift and Slue



Review Report

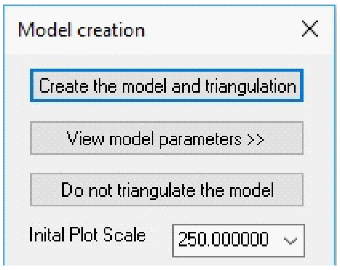
15.3 2nd Rail

Using Parallel offset options within SCC, a 2nd rail string can be generated.

Go to 'DATA tab > Model drop down > SCC Dataset'

Go to '\rail-day\2nd Rail\Rail2.Survey'

Select Initial Plot Scale of 250 and 'Create the model and triangulation'



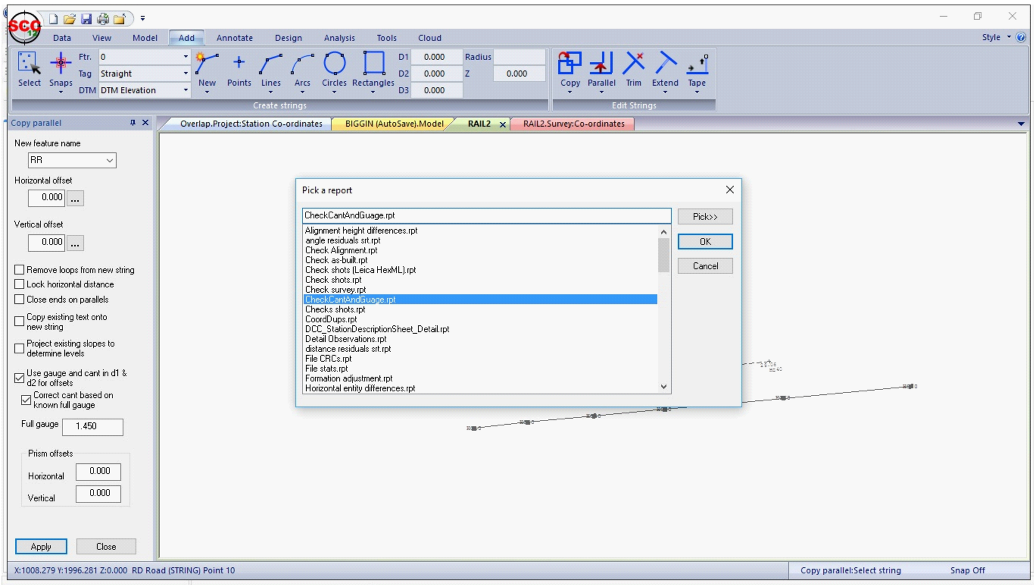
Select 'Ok' to model attribute dialog

Additional String

Go to 'ADD tab > Parallel'

Set up the following Copy Parallel Options

Pick RD string on screen and then 'CheckCantAndGauge.rpt' from dialog. Press 'Ok'



Review Report

Select Yes to 'Create rail string' and click on screen to position string

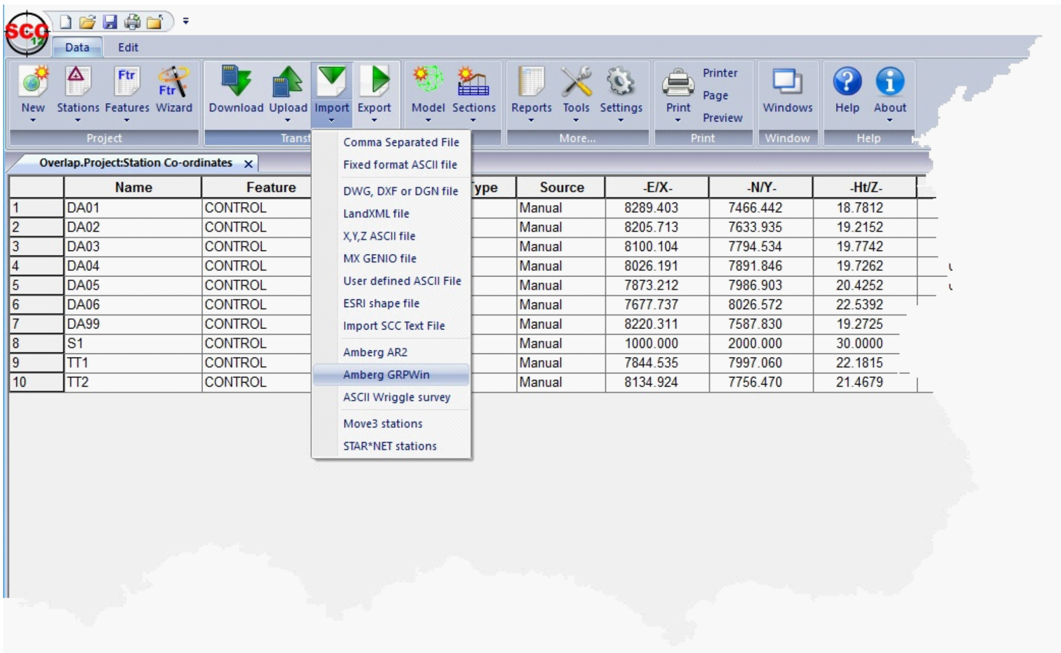
15.4 Import Amberg Data

An input routine to support the Amberg Trolley data provided. This creates two points per line, one for left rail, one for right rail, using the station for string number and ident for point number. D1,D2, and D3 are used to store odometer, gauge, and super-elevation in the input file, such that they can be annotated as required. The rail features are named LRAIL and RRAIL.

Close all dataset and models. Leave existing Project file open

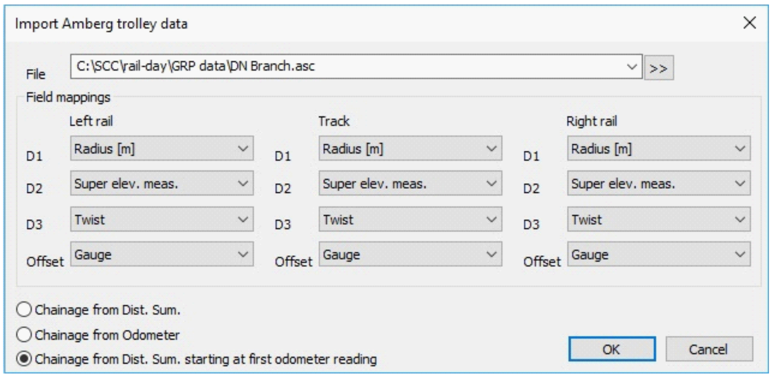
Importing Amberg Trolley Data

Go to 'DATA tab > Import drop down menu > Amberg GRPWin'

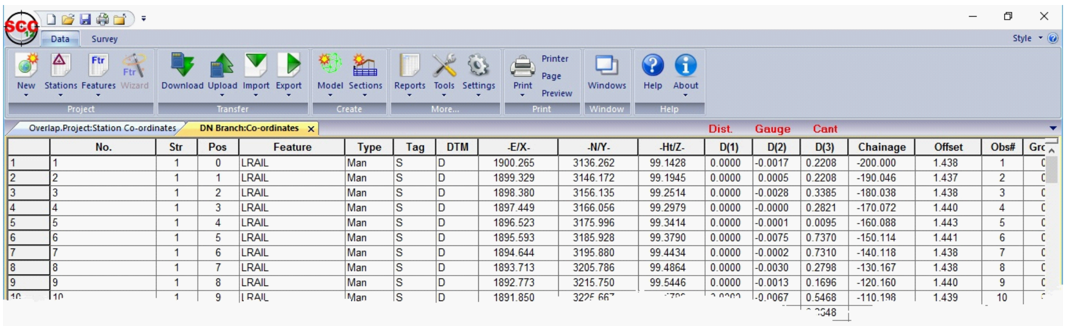


	Name	Feature	Source	-E/X-	-N/Y-	-Ht/Z-
1	DA01	CONTROL	Manual	8289.403	7466.442	18.7812
2	DA02	CONTROL	Manual	8205.713	7633.935	19.2152
3	DA03	CONTROL	Manual	8100.104	7794.534	19.7742
4	DA04	CONTROL	Manual	8026.191	7891.846	19.7262
5	DA05	CONTROL	Manual	7873.212	7986.903	20.4252
6	DA06	CONTROL	Manual	7677.737	8026.572	22.5392
7	DA99	CONTROL	Manual	8220.311	7587.830	19.2725
8	S1	CONTROL	Manual	1000.000	2000.000	30.0000
9	TT1	CONTROL	Manual	7844.535	7997.060	22.1815
10	TT2	CONTROL	Manual	8134.924	7756.470	21.4679

Pick 'DN Branch.asc', set up the following and then Press 'OK'



The dataset is present whereby the D1 is Dist, D2 is Gauge and D3 is Cant

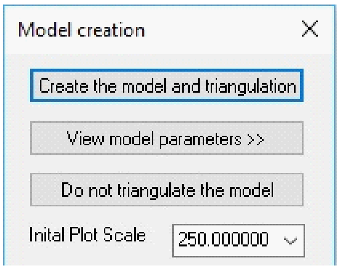


Create Model

Go to 'DATA tab > Model drop down > SCC Dataset'

Pick 'DN Branch.Survey'

Select Initial Plot Scale of 250 and 'Create the model and triangulation'



Note the Chainage/Offset system present is been read from the dataset not an active Alignment

15.5 Design From XML

The following describes how to create different surfaces in SCC from a given design and export to XML for Machine Guidance.

- Design data will be provided as an XML file with a given centreline string including cant and gauge

- Three design surfaces are generated: Rails (including gauge and cant), Ballast and Formation

- The Ballast layer will ramp down at chainage 380m and ramp up at chainage 480m

- A 0.300m gap will be maintained from the lowest sleeper end to formation

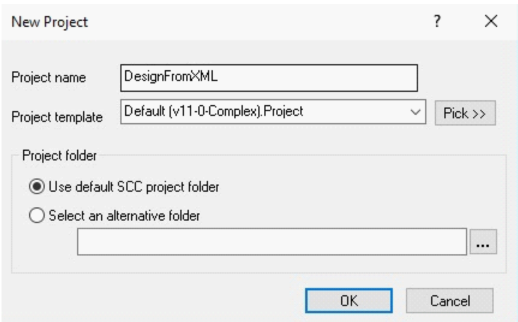
15.5.1 Create A Project Directory

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

Enter in a Project/Job name 'Design from XML

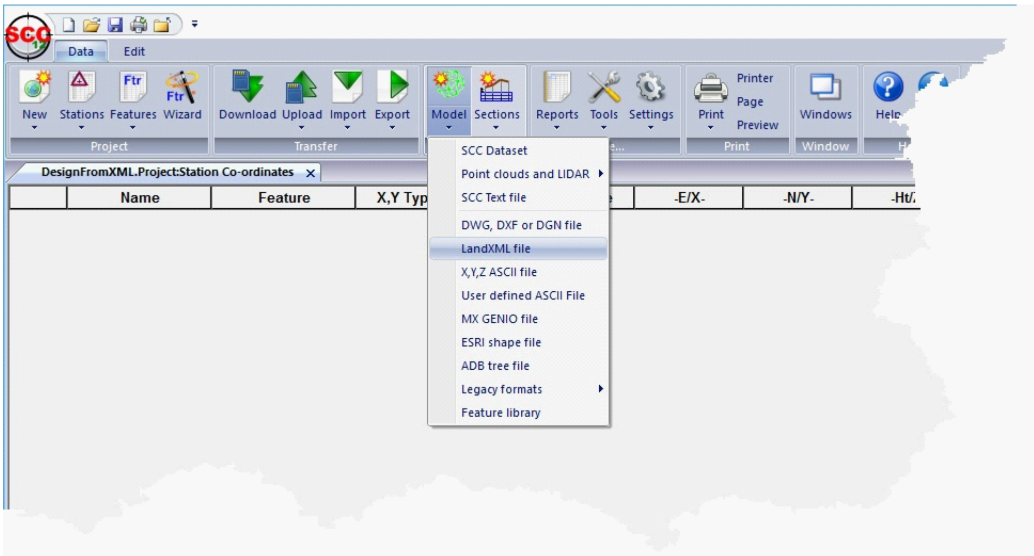
Select a Project Template from the list 'Default v11 Complex.Project'

Select 'OK'



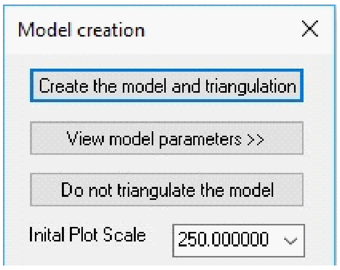
15.5.2 Modelling LandXML file

Within the 'DATA tab > Model drop down > LandXML file'



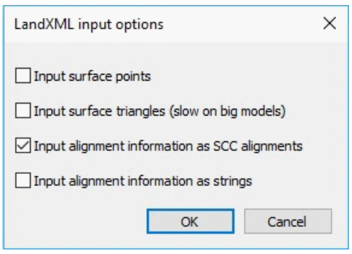
Go to '\rail-day\Design XML\Biggins v1.1.xml' and Press 'Open'

Select Initial Plot Scale of 250 and 'Create the model and triangulation'



Select 'Ok' to model attribute dialog

Set up the following and press 'Ok'



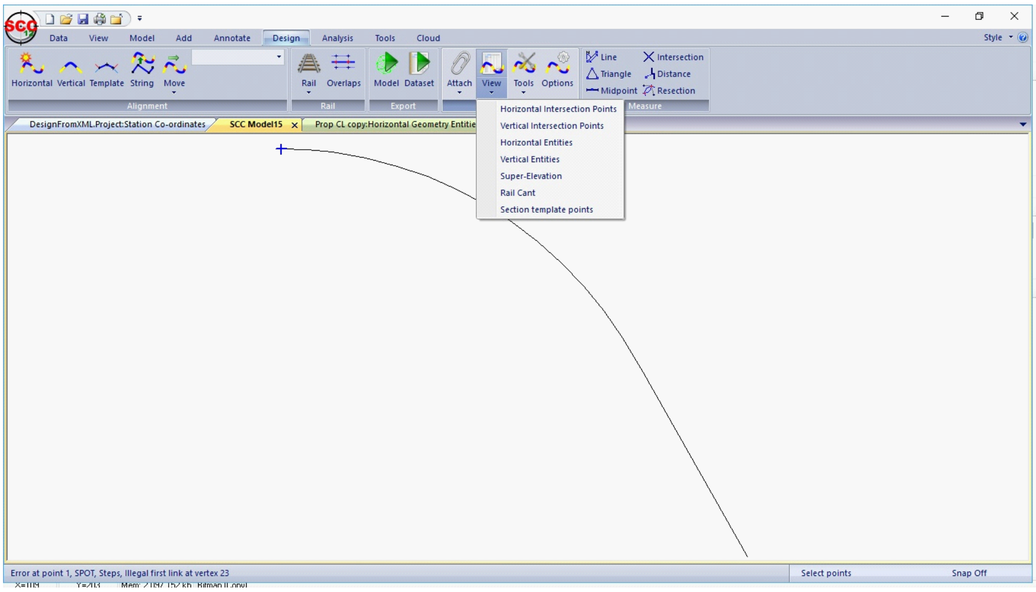
Select 'Home' within Model to Zoom Extent

15.5.3 Attach Design Alignment

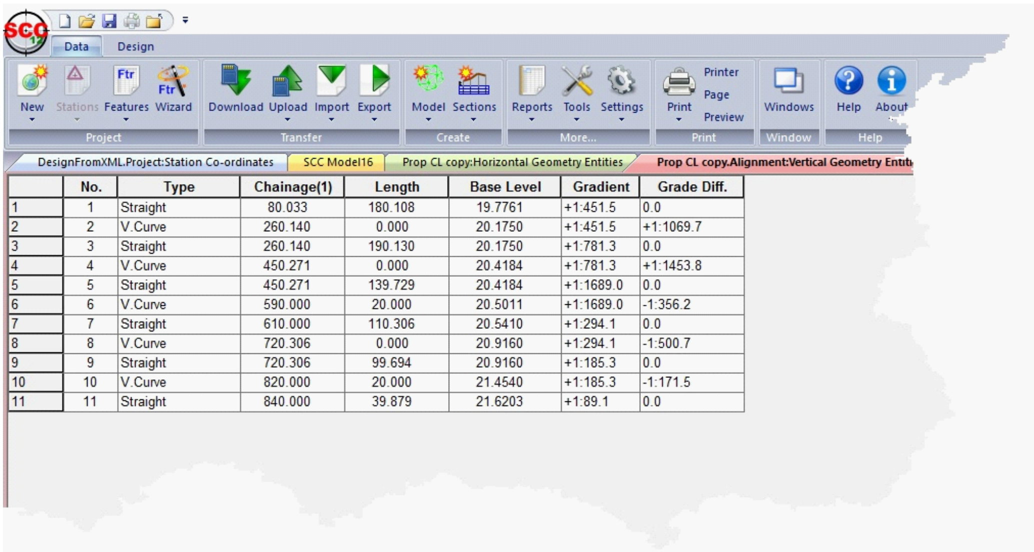
Within Model, go to 'DESIGN tab > Attach drop down menu > Alignment'

Select 'Prop CL copy.Alignment

15.5.4 View Design Information

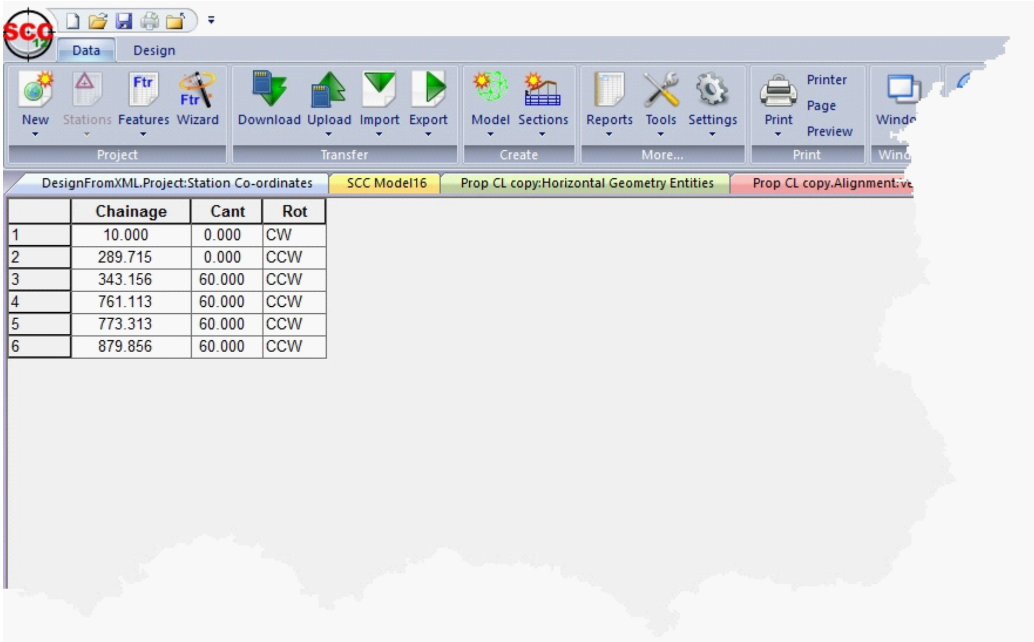


Within the 'DESIGN tab > View > Vertical Entities'



	No.	Type	Chainage(1)	Length	Base Level	Gradient	Grade Diff.
1	1	Straight	80.033	180.108	19.7761	+1:451.5	0.0
2	2	V.Curve	260.140	0.000	20.1750	+1:451.5	+1:1069.7
3	3	Straight	260.140	190.130	20.1750	+1:781.3	0.0
4	4	V.Curve	450.271	0.000	20.4184	+1:781.3	+1:1453.8
5	5	Straight	450.271	139.729	20.4184	+1:1689.0	0.0
6	6	V.Curve	590.000	20.000	20.5011	+1:1689.0	-1:356.2
7	7	Straight	610.000	110.306	20.5410	+1:294.1	0.0
8	8	V.Curve	720.306	0.000	20.9160	+1:294.1	-1:500.7
9	9	Straight	720.306	99.694	20.9160	+1:185.3	0.0
10	10	V.Curve	820.000	20.000	21.4540	+1:185.3	-1:171.5
11	11	Straight	840.000	39.879	21.6203	+1:89.1	0.0

Within the 'DESIGN tab > View > Rail Cant'



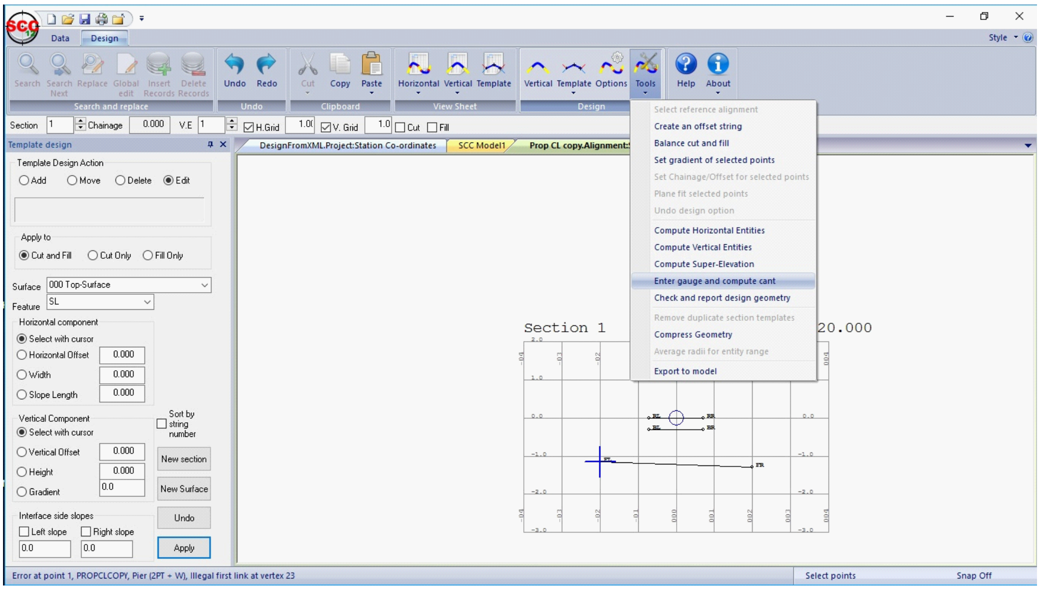
NOTE: If no Cant values where present in the XML file, values can be entered manually by viewing Rail Cant and then selecting 'DESIGN tab > Insert Records'. Cant is entered in mm. CW is Clockwise / CCW is Counter Clockwise.

Save Alignment

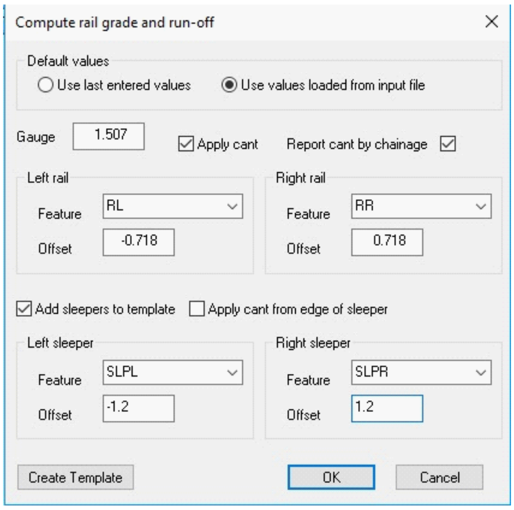
15.5.5 Creating Design Gauge & Cant

Go to 'DESIGN tab > Template button'

Then 'DESIGN tab > Tools > Enter gauge and compute cant'



Set up the following:



NOTE:

The dialog uses values from the input XML file

Enter the Cant Base

Apply cant will apply cant form Cant Station (Cant entered is mm)

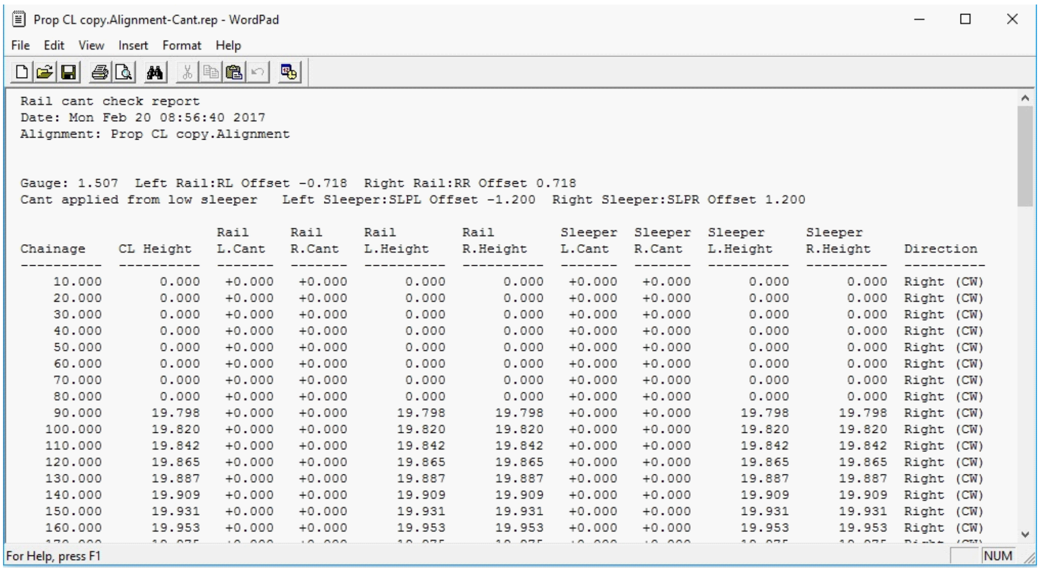
Report Cant by Chainage will give a report file showing cant, gauge and rail levels before continuing

Add Sleepers to template will include sleepers on the rail surface

Apply cant from edge of sleeper will apply cant from edge of sleeper

Select 'Create Template' which will use setting to create a section template

Press 'OK' to create a report



Prop CL copy.Alignment-Cant.rep - WordPad

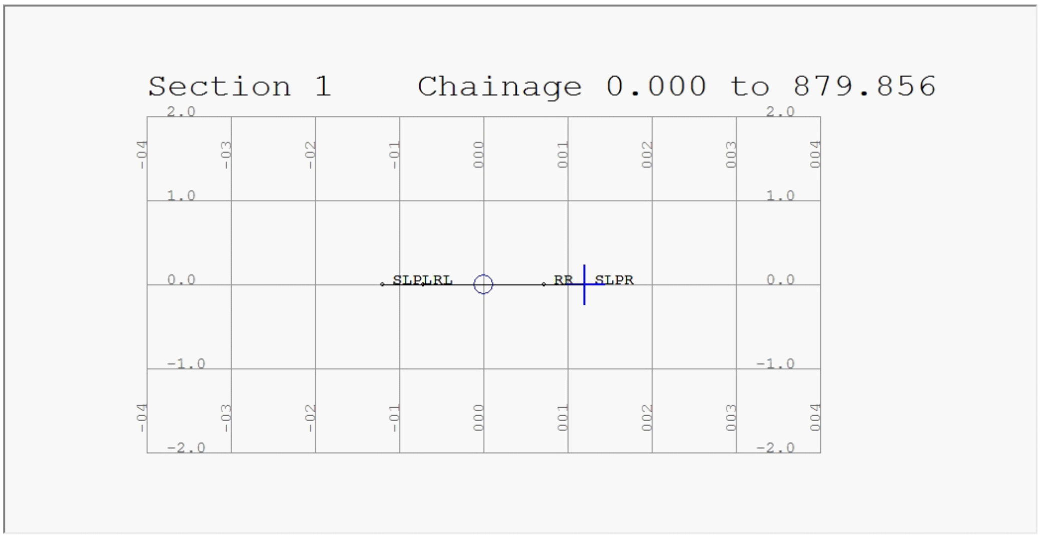
Rail cant check report
Date: Mon Feb 20 08:56:40 2017
Alignment: Prop CL copy.Alignment

Gauge: 1.507 Left Rail:RL Offset -0.718 Right Rail:RR Offset 0.718
Cant applied from low sleeper Left Sleeper:SLPL Offset -1.200 Right Sleeper:SLPR Offset 1.200

Chainage	CL Height	Rail L.Cant	Rail R.Cant	Rail L.Height	Rail R.Height	Sleeper L.Cant	Sleeper R.Cant	Sleeper L.Height	Sleeper R.Height	Direction
10.000	0.000	+0.000	+0.000	0.000	0.000	+0.000	+0.000	0.000	0.000	Right (CW)
20.000	0.000	+0.000	+0.000	0.000	0.000	+0.000	+0.000	0.000	0.000	Right (CW)
30.000	0.000	+0.000	+0.000	0.000	0.000	+0.000	+0.000	0.000	0.000	Right (CW)
40.000	0.000	+0.000	+0.000	0.000	0.000	+0.000	+0.000	0.000	0.000	Right (CW)
50.000	0.000	+0.000	+0.000	0.000	0.000	+0.000	+0.000	0.000	0.000	Right (CW)
60.000	0.000	+0.000	+0.000	0.000	0.000	+0.000	+0.000	0.000	0.000	Right (CW)
70.000	0.000	+0.000	+0.000	0.000	0.000	+0.000	+0.000	0.000	0.000	Right (CW)
80.000	0.000	+0.000	+0.000	0.000	0.000	+0.000	+0.000	0.000	0.000	Right (CW)
90.000	19.798	+0.000	+0.000	19.798	19.798	+0.000	+0.000	19.798	19.798	Right (CW)
100.000	19.820	+0.000	+0.000	19.820	19.820	+0.000	+0.000	19.820	19.820	Right (CW)
110.000	19.842	+0.000	+0.000	19.842	19.842	+0.000	+0.000	19.842	19.842	Right (CW)
120.000	19.865	+0.000	+0.000	19.865	19.865	+0.000	+0.000	19.865	19.865	Right (CW)
130.000	19.887	+0.000	+0.000	19.887	19.887	+0.000	+0.000	19.887	19.887	Right (CW)
140.000	19.909	+0.000	+0.000	19.909	19.909	+0.000	+0.000	19.909	19.909	Right (CW)
150.000	19.931	+0.000	+0.000	19.931	19.931	+0.000	+0.000	19.931	19.931	Right (CW)
160.000	19.953	+0.000	+0.000	19.953	19.953	+0.000	+0.000	19.953	19.953	Right (CW)

For Help, press F1

A Section Template is created.



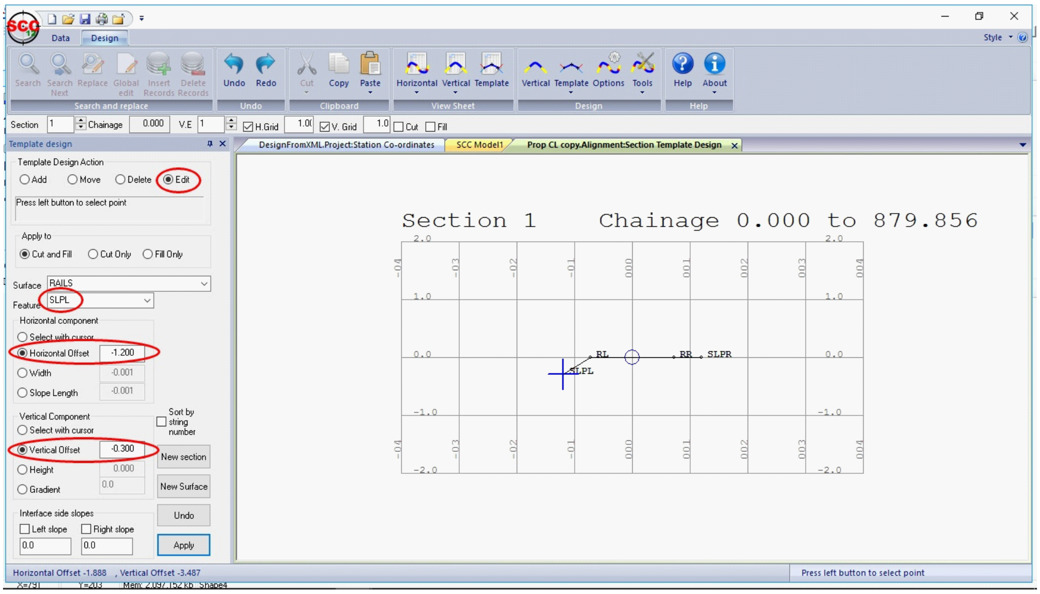
15.5.6 Applying Sleeper Vertical & Horizontal Offset

Within Template Design, select 'EDIT'

Left click mouse on 'SLPL' on screen

Set up SLPL: Horz. Offset -1.20 / Vert. Offset -0.3 (300mm lower than rails) as shown

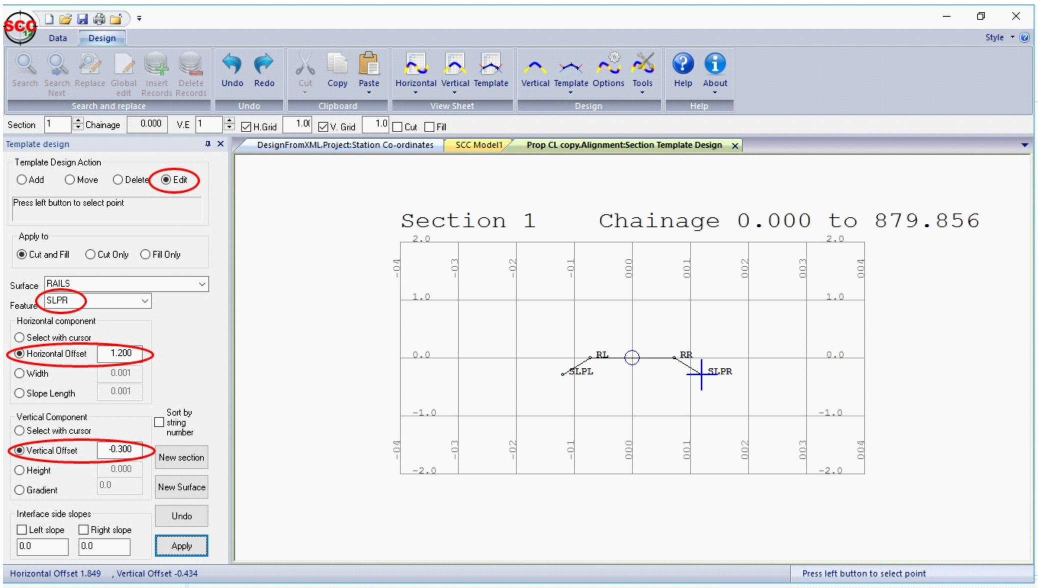
Press 'Apply'



Left click mouse on 'SLPL' on screen

Set up SLPR: Horz. Offset 1.20 / Vert. Offset -0.3 (300mm lower than rails) as shown

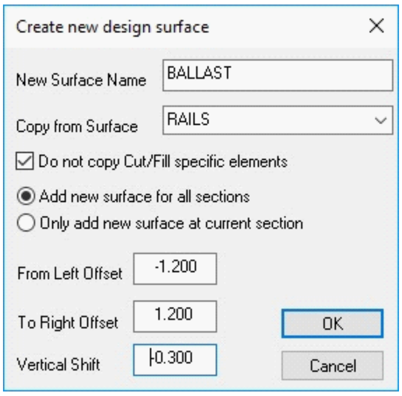
Press 'Apply'

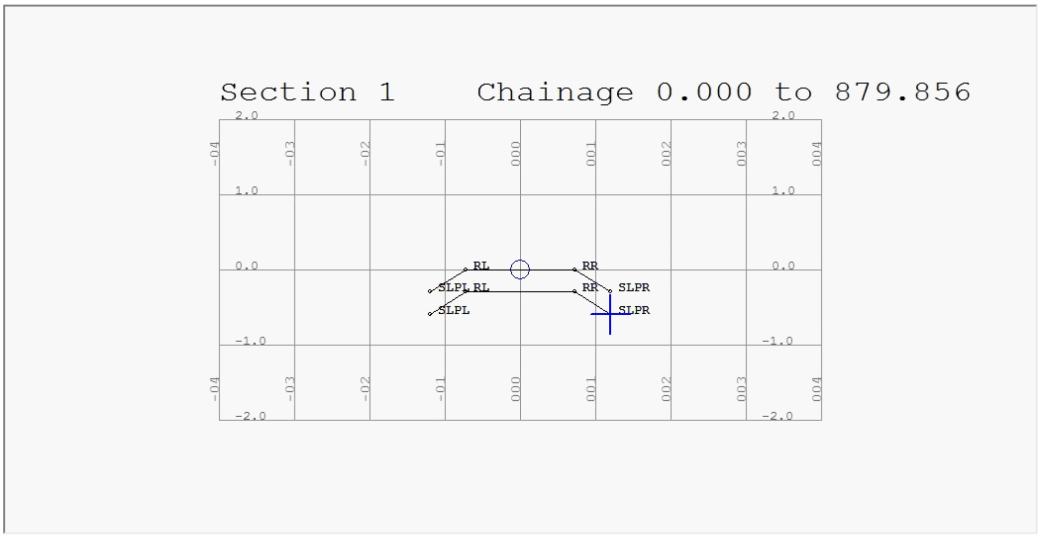


15.5.7 Add Ballast Layer

Select 'New Surface'

Set up the following and Press 'OK'



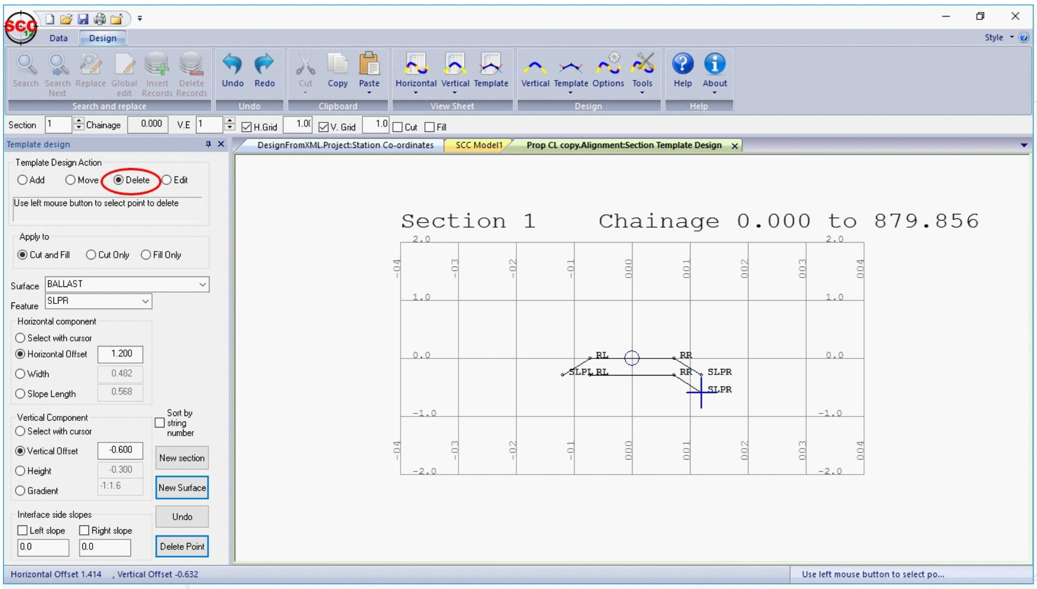


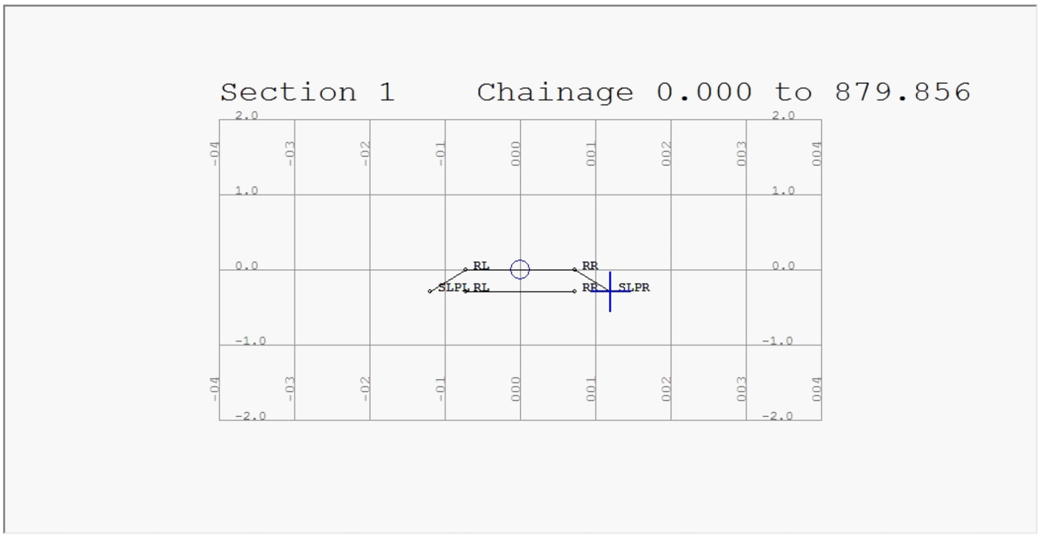
15.5.8 Removing Sleepers From Ballast Surface

Select 'Delete'

Left click mouse on 'SLPL' and then select 'Delete Point'

Left click mouse on 'SLPR' and then select 'Delete Point'





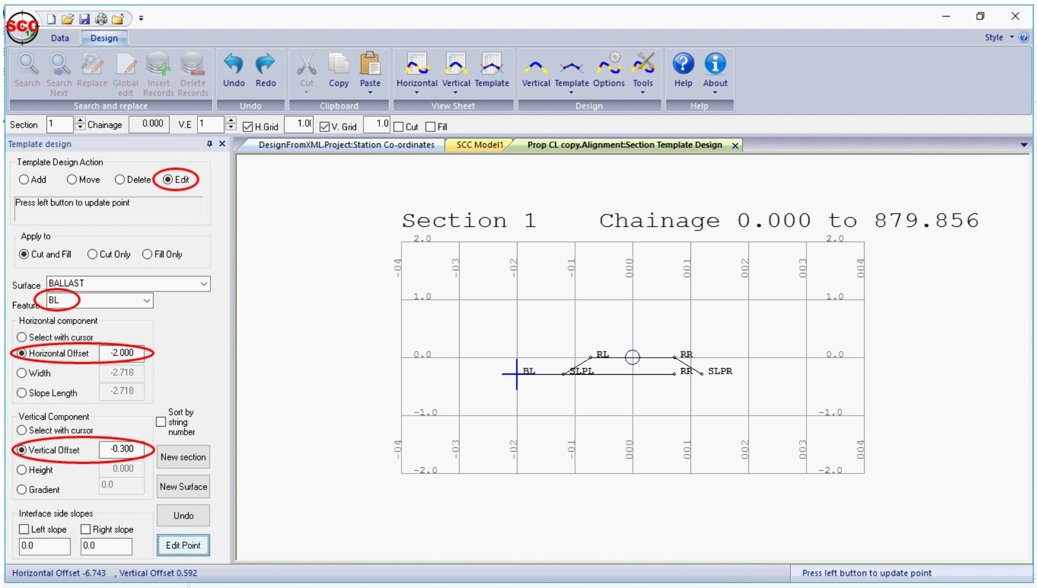
15.5.9 Editing Ballast Surface

Select 'Edit'

Left click mouse on 'BL' point

Enter Horz, Offset -0.2 and Vert. Offset -0.3

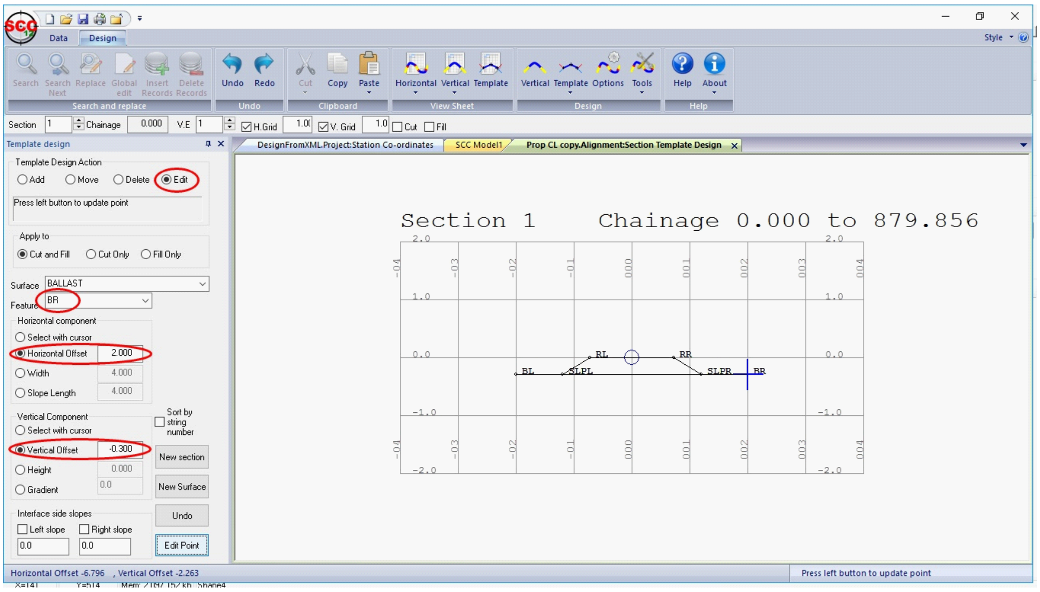
Press 'Edit Point'



Left click mouse on 'BR' point

Enter Horz, Offset 0.2 and Vert. Offset -0.3

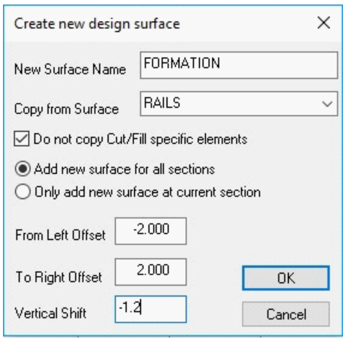
Press 'Edit Point'

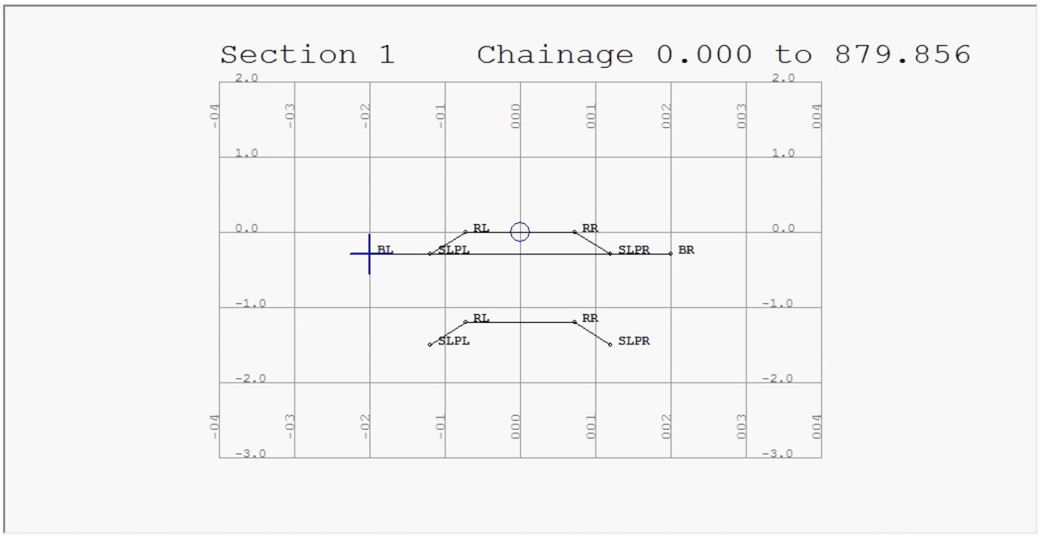


15.5.10 Add Formation Layer

Select 'New Surface'

Set up the following and Press 'OK'



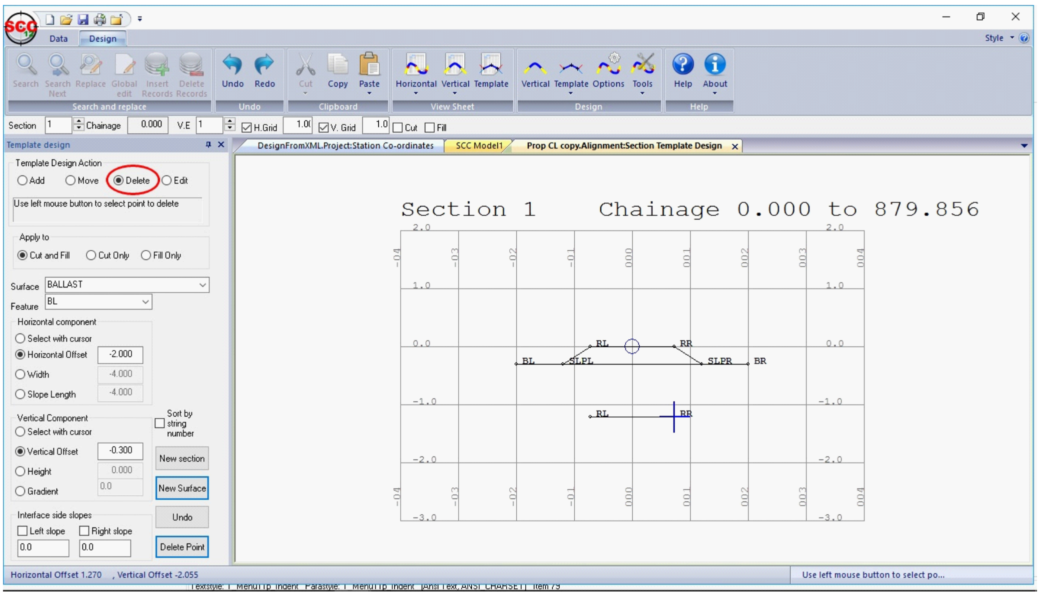


15.5.11 Removing Sleepers From Formation Surface

Select 'Delete'

Left click mouse on 'SLPL' and then select 'Delete Point'

Left click mouse on 'SLPR' and then select 'Delete Point'



15.5.12 Editing Formation Surface

Need to change Feature Codes on Formation surface and apply offset and grade change

Select 'Edit'

Left click on 'RL' on Formation Surface

Enter New feature code 'FL'

Horz, Offset -2 and Gradient +1:30

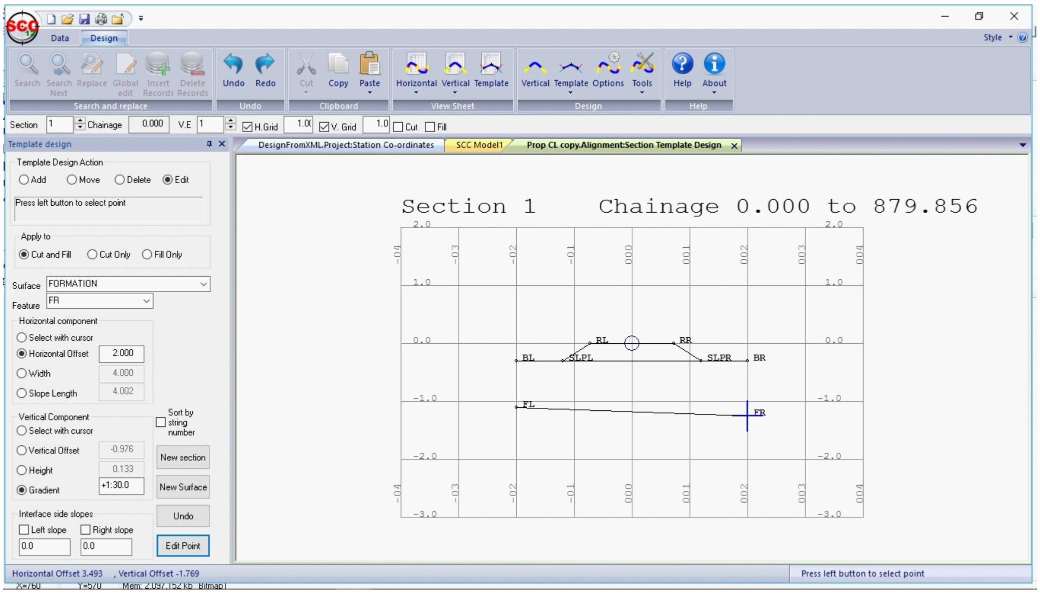
Press 'Edit Point'

Left click on 'RR' on Formation Surface

Enter New feature code 'FR'

Horz, Offset 2 and Gradient -1:30

Press 'Edit Point'

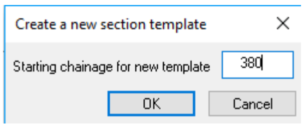


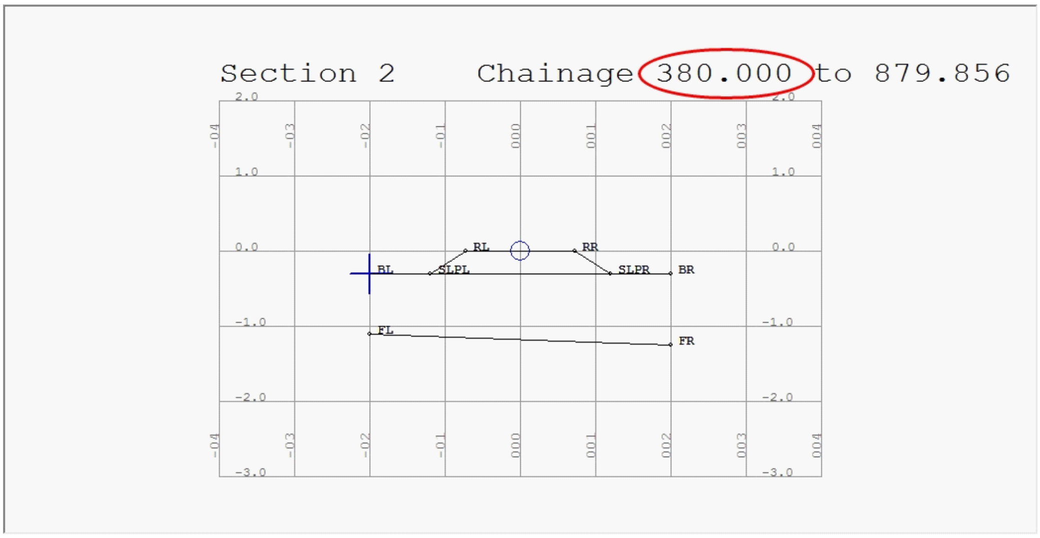
15.5.13 Adding Ramp at Chainage 380 to 480

Ramp down at Chainage 380 and ramp up at Chainage 480

Select 'New Section'

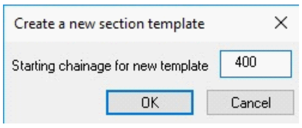
Enter Starting chainage for new template of 380 and press 'OK'





Select 'New Section'

Enter Starting chainage for new template of 400 and press 'OK'



15.5.14 Inputting Ramp Design on Ballast layer

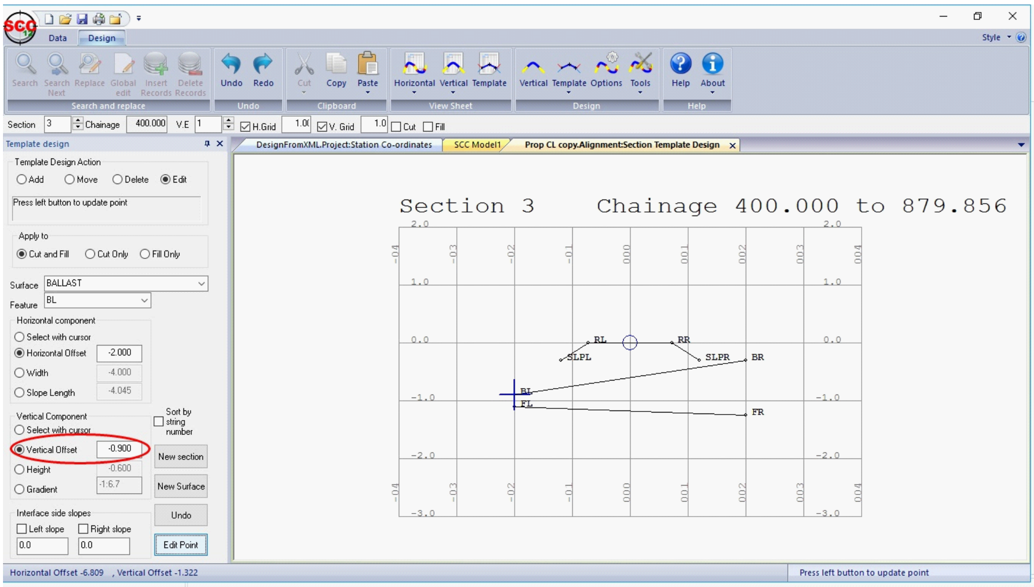
Section 3 Chainage 400

Select 'Edit'

Left click on 'BL' on Ballast Surface

Horz, Offset -2 and Vert. Offset -0.9

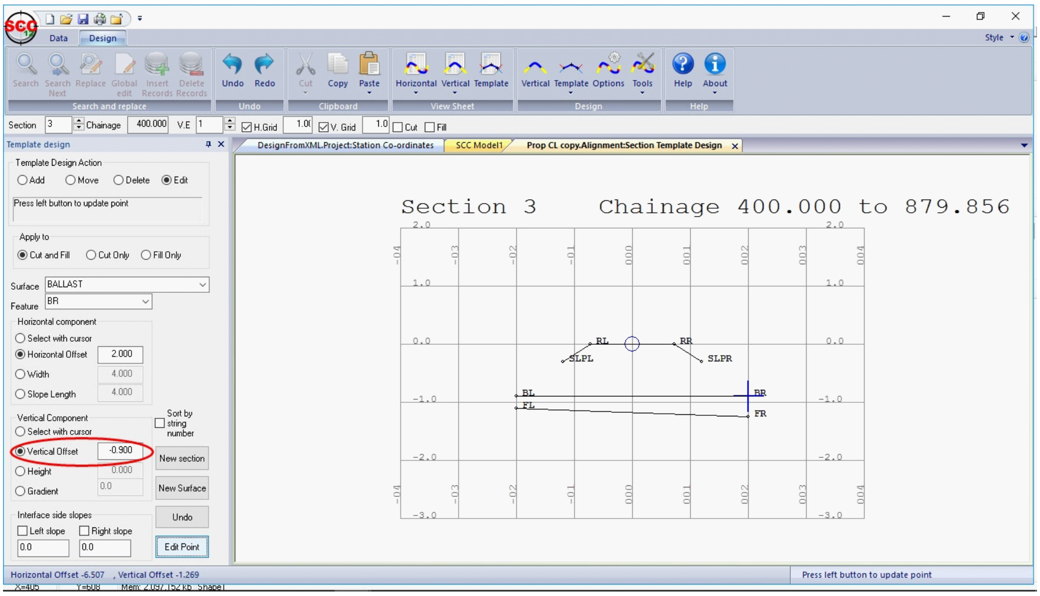
Press 'Edit Point'



Left click on 'BR' on Ballast Surface

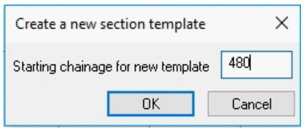
Horz, Offset 2 and Vert. Offset -0.9

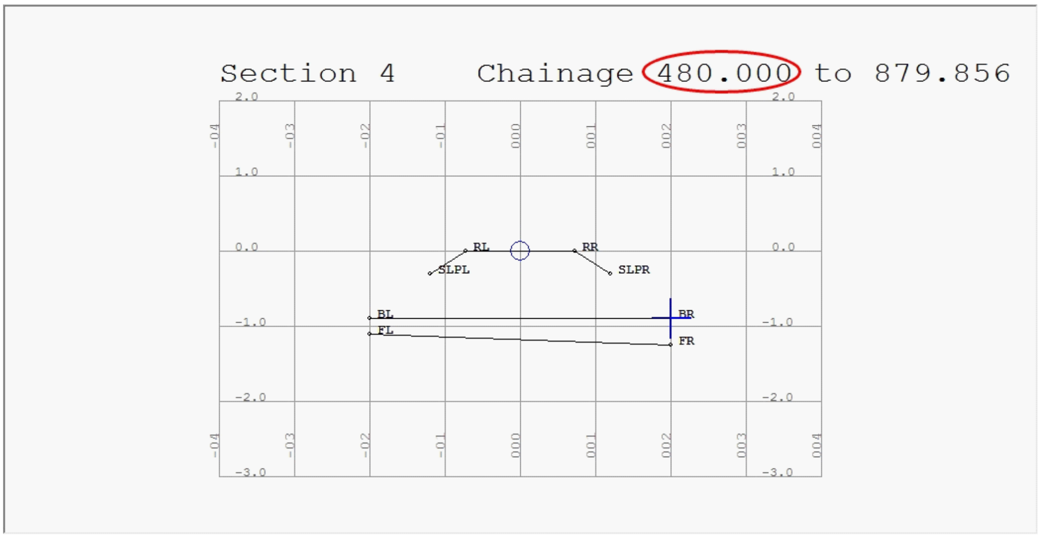
Press 'Edit Point'



Select 'New Section'

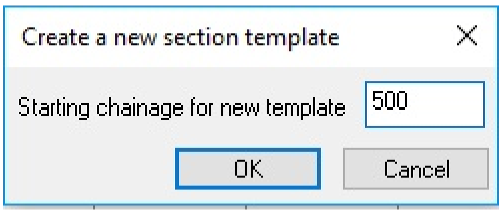
Enter Starting chainage for new template of 480 and press 'OK'





Select 'New Section'

Enter Starting chainage for new template of 500 and press 'OK'



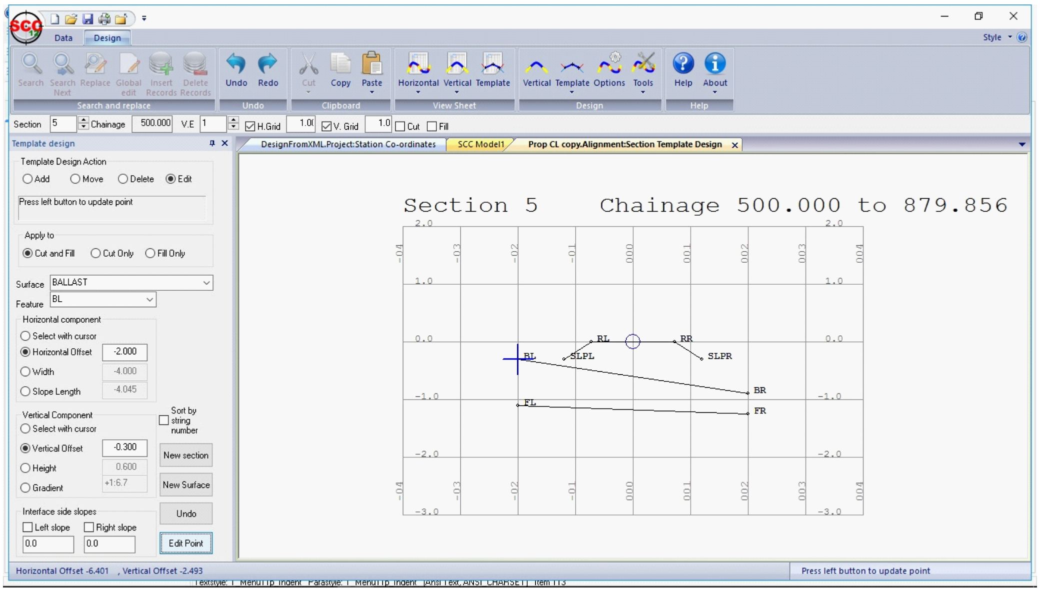
Section 5 Chainage 500

Select 'Edit'

Left click on 'BL' on Ballast Surface

Horz, Offset -2 and Vert. Offset -0.3

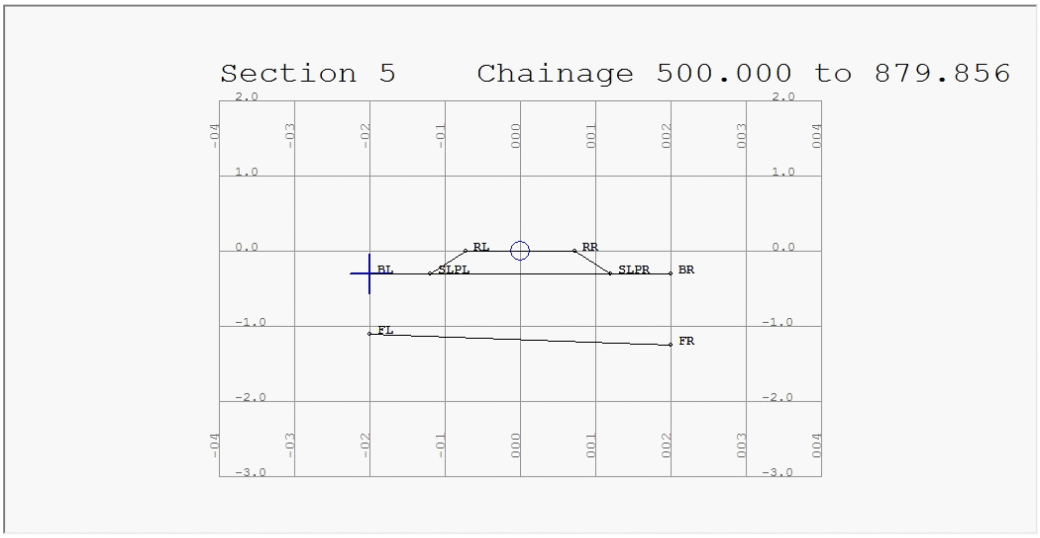
Press 'Edit Point'



Left click on 'BL' on Ballast Surface

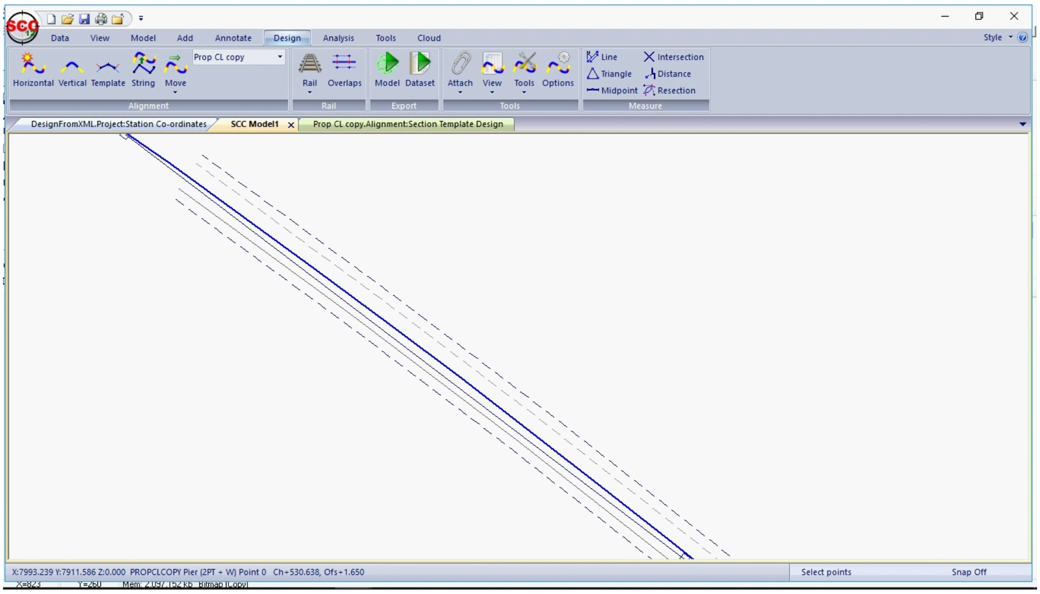
Horz, Offset 2 and Vert. Offset -0.3

Press 'Edit Point'



Save Alignment

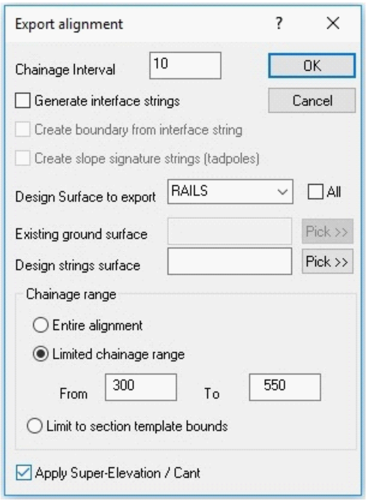
Template is visible on the model displaying the alignment



15.5.15 Export Rail Design

Go to 'DESIGN tab > Model' Export

Set up the following and press 'Ok':

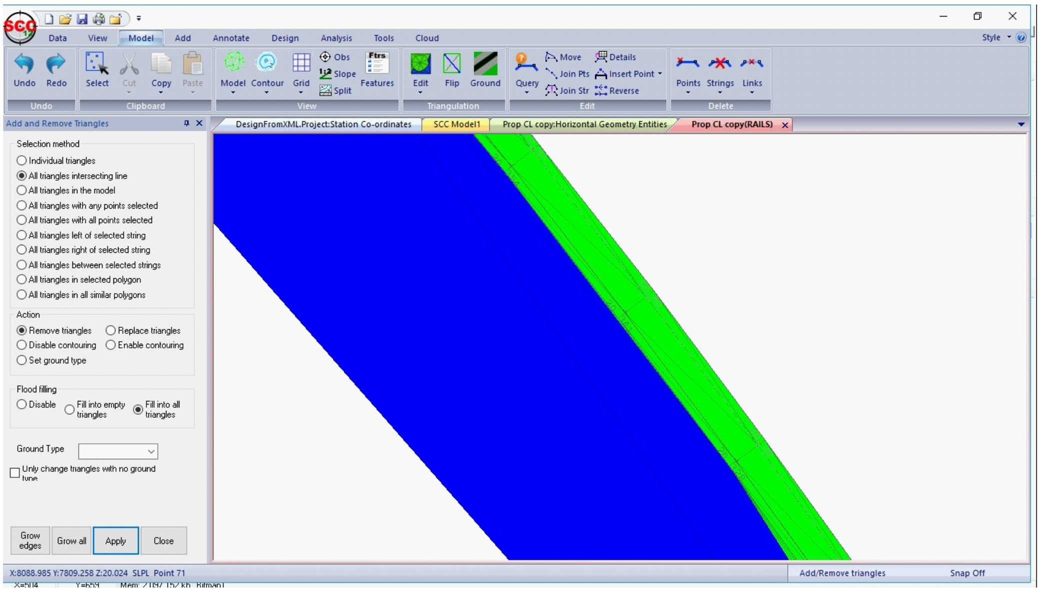


Press 'Ok' to model attribute dialog

15.5.16 Triangulate Rail Model

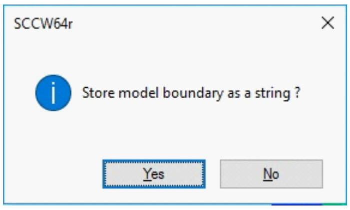
Within 'MODEL tab > Edit'

Using 'All triangles intersecting line' as the Selection Method and 'Remove triangle' as the 'Action', edit the TIN



Select 'Apply'

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



Save Model as 'RAIL.Model'

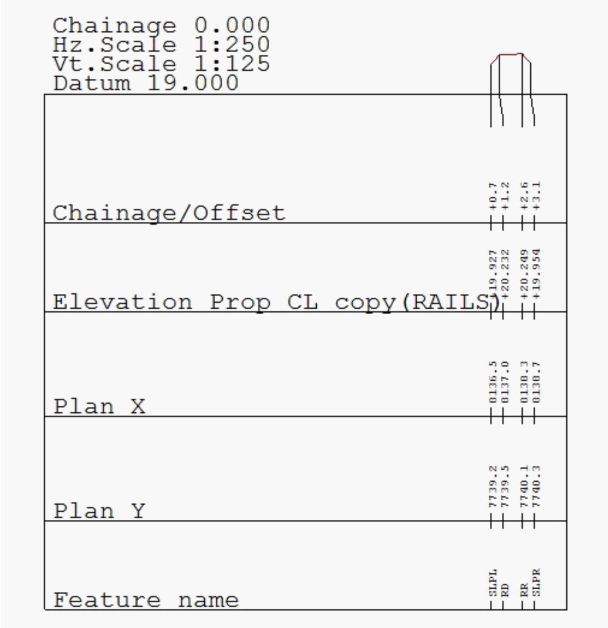
15.5.17 Long Section With Cursor

Go to 'ANALYSIS tab > L. Sect button'

Left click mouse to pick first point of section and then again to pick second

Right click mouse to finish

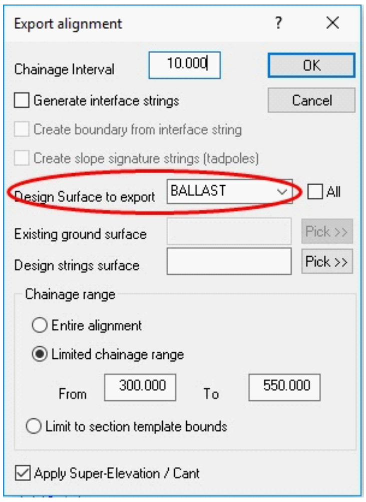
A profile of the Rail surface is created



15.5.18 Export Ballast Design

Go to 'DESIGN tab > Model' Export

Set up the following and press 'Ok':

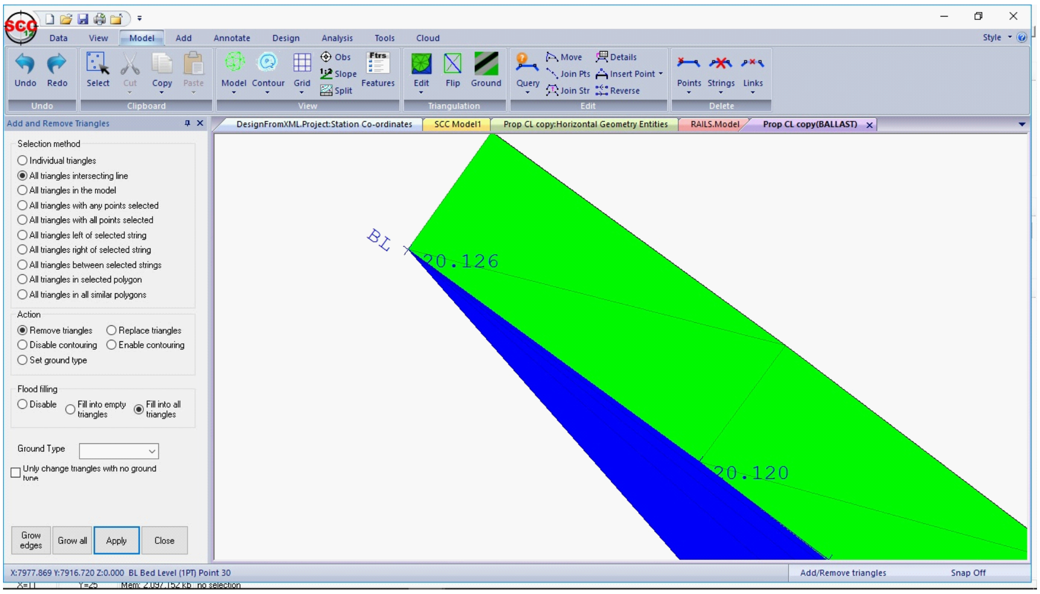


Press 'Ok' to model attribute dialog

15.5.19 Triangulate Ballast Model

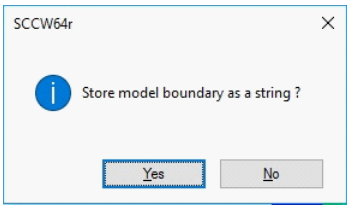
Within 'MODEL tab > Edit'

Using 'All triangles intersecting line' as the Selection Method and 'Remove triangle' as the 'Action', edit the TIN



Select 'Apply'

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

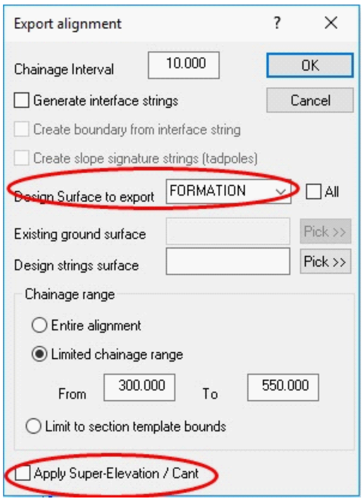


Save Model as 'BALLAST.Model'

15.5.20 Export Formation Design

Go to 'DESIGN tab > Model' Export

Set up the following and press 'Ok':



Note: Cant is not applied on Formation Level. Untick 'Apply Super-Elevation/Cant'

15.5.21 Triangulate Formation Model

Within 'MODEL tab > Edit'

Using 'All triangles intersecting line' as the Selection Method and 'Remove triangle' as the 'Action', edit the TIN

Select 'Apply'

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

Save Model as 'FORMATION.Model'

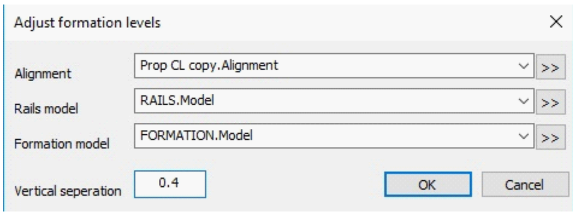
Three Triangulated Model have been created.

15.5.22 Check & Adjust Formation Levels

In order to maintain fixed depth levels between low rail and Formation, the 'Check and adjust formation levels' tool can be utilised.

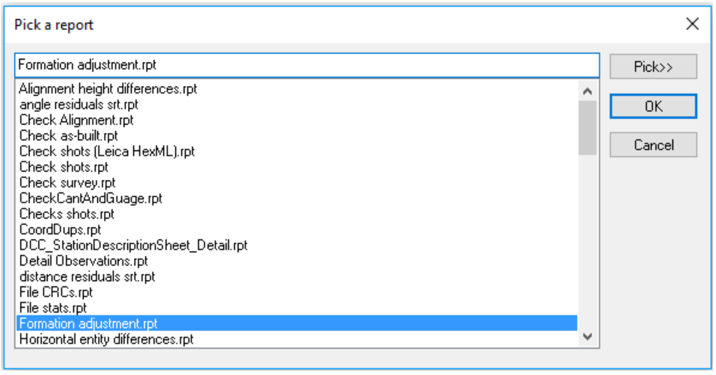
Go to 'DESIGN tab > Rail > Check and adjust formation levels'

Set up the following including required vertical seperation and press 'Ok'

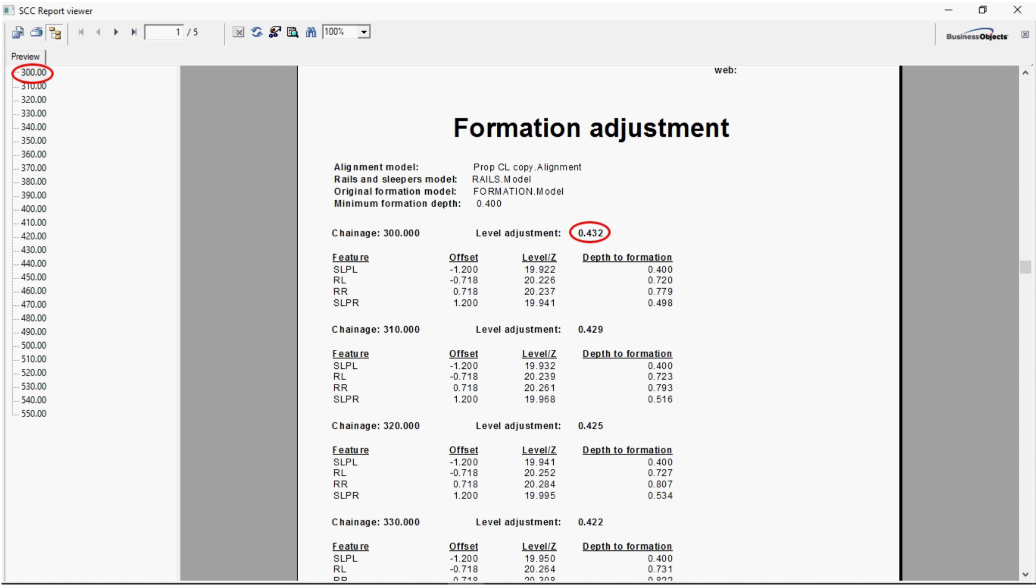


Select 'Ok' to model attribute dialog

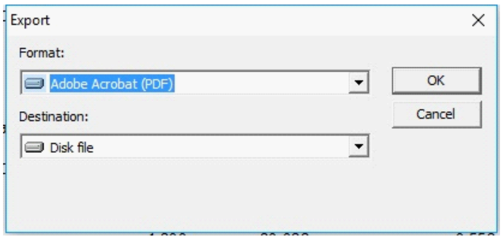
Pick 'Formation adjustment.rpt' file and press 'Ok'



The report details the Level adjustment, the exact difference in height between formation and low rail, and the chainage is note



The report can be exported to various formats



A new Adjusted Formation Model has been created.

Edit the TIN as above.

Save as 'AdjustedFormation.Model'

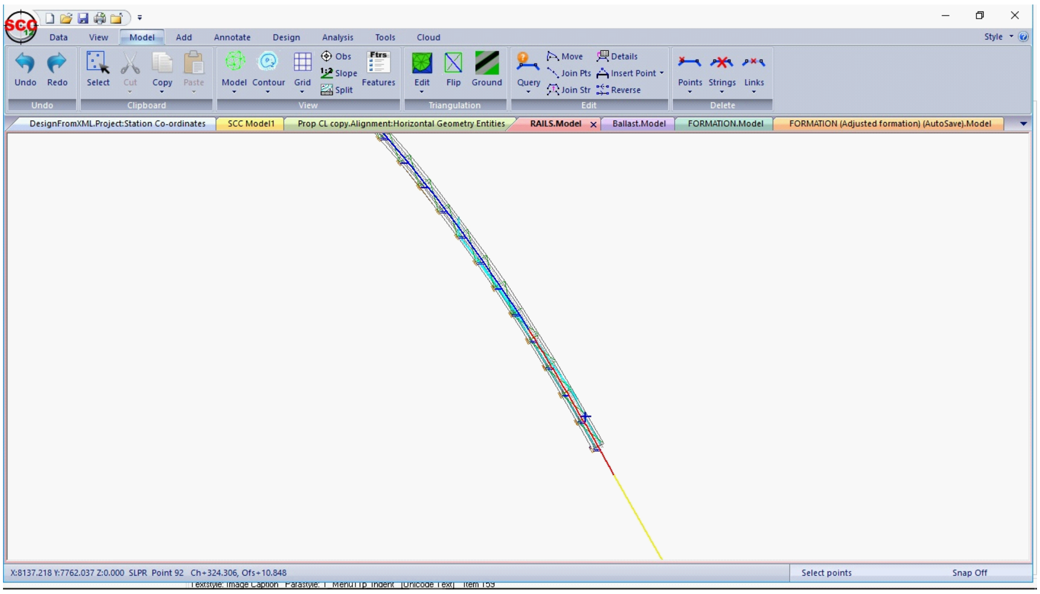
15.5.23 Combining Models & Alignment for QA puposes

As a QA check, models can be combined and section generated.

Within 'RAILS.Model', go to 'DESIGN tab > Attach drop down > Model'

Select 'BALLAST.Model' and then repeat, to select 'AdjustedFormation.Model'

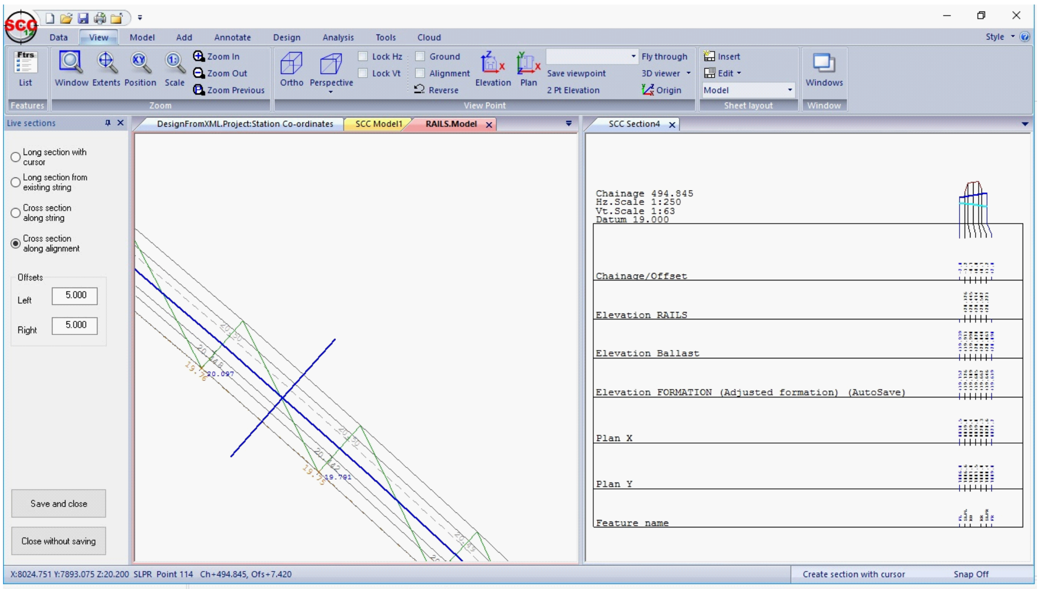
Go to 'DESIGN tab > Attach drop down > Alignment' and select Alignment file



Go to 'ANALYSIS tab > L.Sect drop down > Live Section'

Set 'Cross section along alignment' and offset left/right 5.

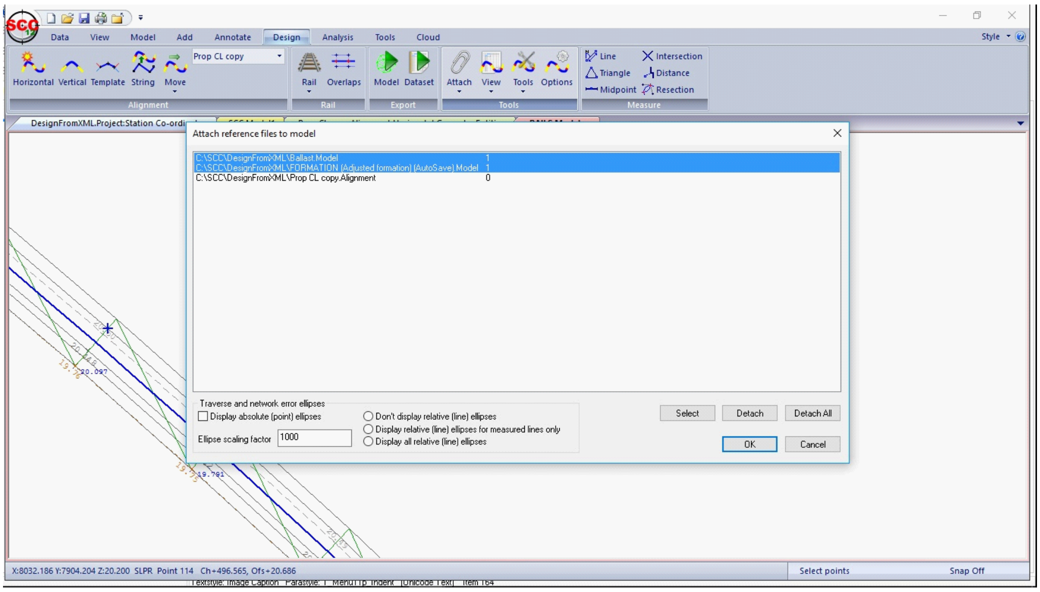
Move cursor along along alignment, left click to generate live section in sub divided screen



Close without saving

Go to 'DESIGN tab > Attach drop down > Edit/Detach'

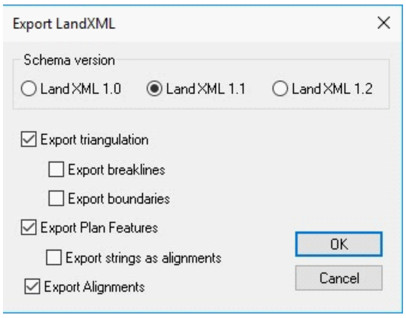
Highlight Ballast and Formation Model, select 'Detach' and 'Ok'



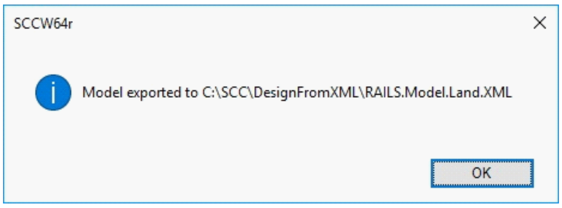
15.5.24 Exporting XML For Machine Control

Within the 'Rails.Model' which has the Alignment file attached, go to 'DATA tab > Export drop down>LandXML'

Set up the following and press 'Ok'



Select 'Ok' to model export dialog



Close 'Rails.Model' and open 'BALLAST.Model', attach alignment file and repeat export steps

Similarly, repeat for 'AdjustedFormation.Model'

15.6 Computing Platform Edge Using Bance Gauge

The following outlines the steps to compute platform edge using Bance Gauge.

Open Existing Project & Dataset

From the Main Screen, SCC button 'Open'

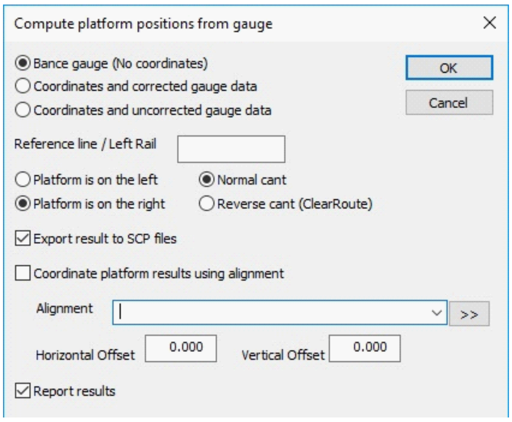
Go to 'C:\SCC\rail-day\Bance Gauge'

Open 'Platform.Project' and 'Bance Gauge test1.Survey'

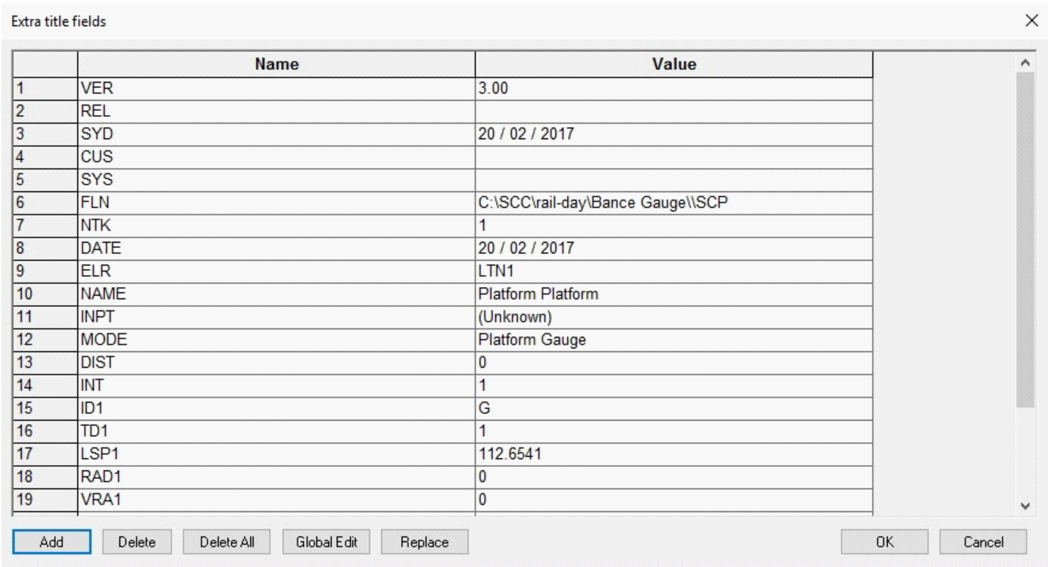
Compute Platform Position from Bance Gauge

Go to 'SURVEY tab > Tools > Compute Platform Position From Bance Gauge'

Set up the following and press 'Ok'

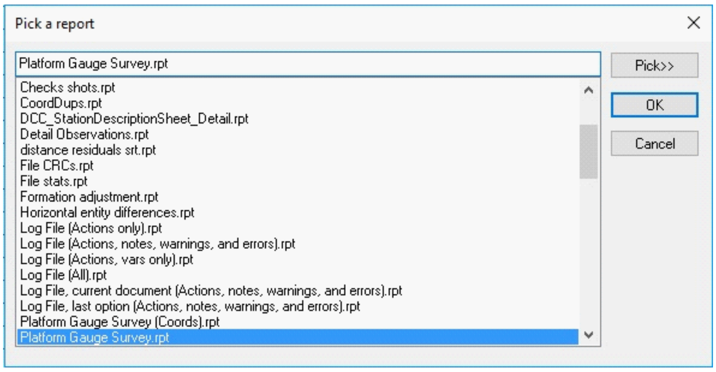


Select 'OK' to 'Extra Title Fields' dialog

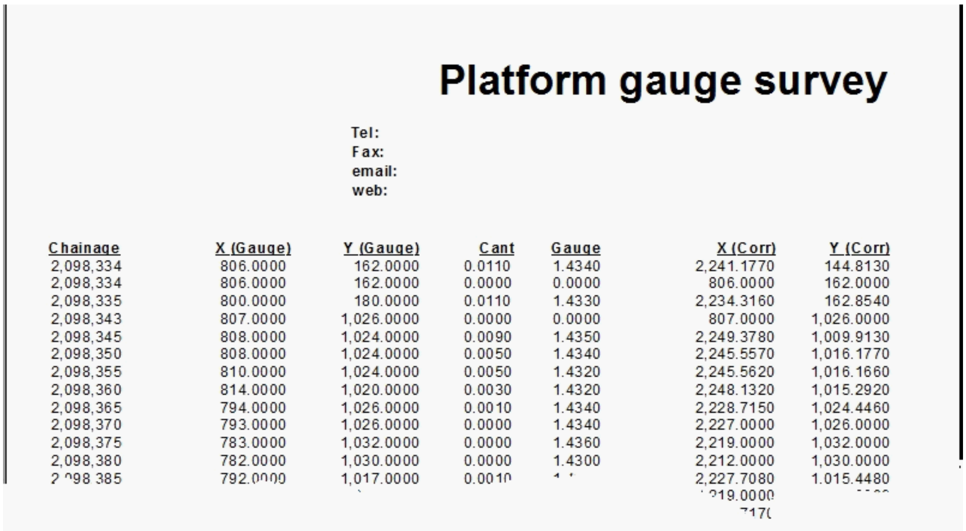


	Name	Value
1	VER	3.00
2	REL	
3	SYD	20 / 02 / 2017
4	CUS	
5	SYS	
6	FLN	C:\SCC\rail-day\Bance Gauge\\SCP
7	NTK	1
8	DATE	20 / 02 / 2017
9	ELR	LTN1
10	NAME	Platform Platform
11	INPT	(Unknown)
12	MODE	Platform Gauge
13	DIST	0
14	INT	1
15	ID1	G
16	TD1	1
17	LSP1	112.6541
18	RAD1	0
19	VRA1	0

Select 'PlatformGaugeSurvey.rpt' from Pick a Report dialog and press 'Ok'



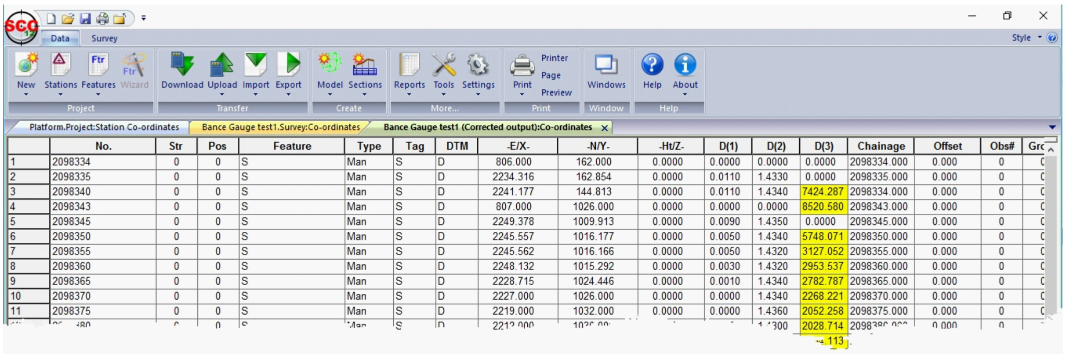
Review report



Platform gauge survey

Tel:
Fax:
email:
web:

Chainage	X (Gauge)	Y (Gauge)	Cant	Gauge	X (Corr)	Y (Corr)
2,098,334	806.0000	162.0000	0.0110	1.4340	2,241.1770	144.8130
2,098,334	806.0000	162.0000	0.0000	0.0000	806.0000	162.0000
2,098,335	800.0000	180.0000	0.0110	1.4330	2,234.3160	162.8540
2,098,343	807.0000	1,026.0000	0.0000	0.0000	807.0000	1,026.0000
2,098,345	808.0000	1,024.0000	0.0090	1.4350	2,249.3780	1,009.9130
2,098,350	808.0000	1,024.0000	0.0050	1.4340	2,245.5570	1,016.1770
2,098,355	810.0000	1,024.0000	0.0050	1.4320	2,245.5620	1,016.1660
2,098,360	814.0000	1,020.0000	0.0030	1.4320	2,248.1320	1,015.2920
2,098,365	794.0000	1,026.0000	0.0010	1.4340	2,228.7150	1,024.4460
2,098,370	793.0000	1,026.0000	0.0000	1.4340	2,227.0000	1,026.0000
2,098,375	783.0000	1,032.0000	0.0000	1.4360	2,219.0000	1,032.0000
2,098,380	782.0000	1,030.0000	0.0000	1.4300	2,212.0000	1,030.0000
2,098,385	792.0000	1,017.0000	0.0010	[illegible]	2,227.7080	1,015.4480



	No.	Str	Pos	Feature	Type	Tag	DTM	-E/X-	-N/Y-	-Ht/Z-	D(1)	D(2)	D(3)	Chainage	Offset	Obs#
1	2098334	0	0	S	Man	S	D	806.000	162.000	0.0000	0.0000	0.0000	0.0000	2098334.000	0.000	0
2	2098335	0	0	S	Man	S	D	2234.316	162.854	0.0000	0.0110	1.4330	0.0000	2098335.000	0.000	0
3	2098340	0	0	S	Man	S	D	2241.177	144.813	0.0000	0.0110	1.4340	7424.287	2098334.000	0.000	0
4	2098343	0	0	S	Man	S	D	807.000	1026.000	0.0000	0.0000	0.0000	8520.580	2098343.000	0.000	0
5	2098345	0	0	S	Man	S	D	2249.378	1009.913	0.0000	0.0090	1.4350	0.0000	2098345.000	0.000	0
6	2098350	0	0	S	Man	S	D	2245.557	1016.177	0.0000	0.0050	1.4340	5748.071	2098350.000	0.000	0
7	2098355	0	0	S	Man	S	D	2245.562	1016.166	0.0000	0.0050	1.4320	3127.052	2098355.000	0.000	0
8	2098360	0	0	S	Man	S	D	2248.132	1015.292	0.0000	0.0030	1.4320	2953.537	2098360.000	0.000	0
9	2098365	0	0	S	Man	S	D	2228.715	1024.446	0.0000	0.0010	1.4340	2782.787	2098365.000	0.000	0
10	2098370	0	0	S	Man	S	D	2227.000	1026.000	0.0000	0.0000	1.4340	2268.221	2098370.000	0.000	0
11	2098375	0	0	S	Man	S	D	2219.000	1032.000	0.0000	0.0000	1.4360	2052.258	2098375.000	0.000	0

15.7 Wriggle Survey Processing

Wriggle survey functionality which can be accessed as follows;

'DATA tab > Import > ASCII Wriggle Survey' from a project

'SURVEY tab > Tools > Compute Wriggle Survey' from the survey coordinates view'

''SURVEY tab > Tools > String using Chainage > Offset from the survey coordinates view'

This is used in conjunction with an alignment to group point data into rings.

To process the sample files 9961065.ASC, 200_UPLINE-.CAN, 200_UPLINE-.HOR and , 200_UPLINE-.VER do the following;

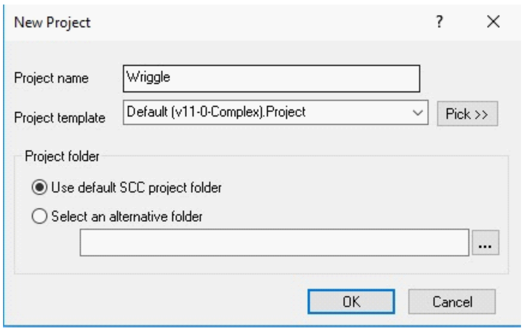
Creating A Project Directory

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

Enter in a Project/Job name 'Wriggle'

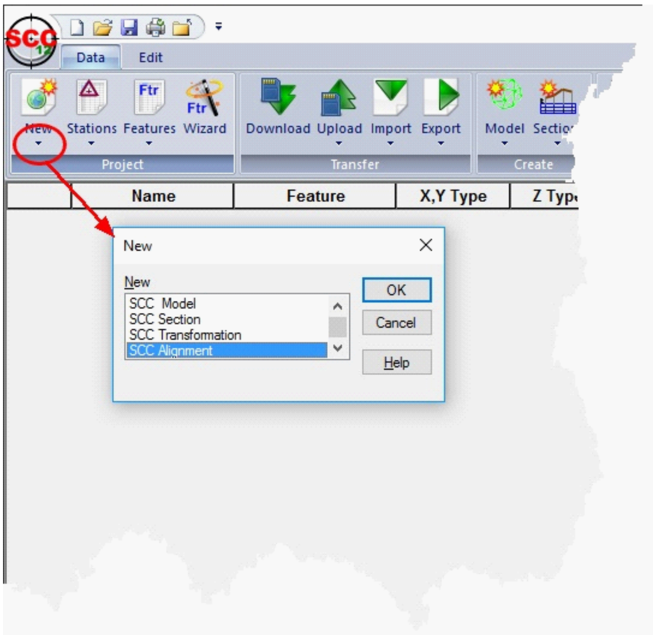
Select a Project Template from the list 'Default v11 Complex.Project'

Select ‘OK’



Create an alignment from the 200_UPLINE files

'DATA tab > New drop down > New document > SCC Alignment'



'DATA tab > Import drop down > ACT horizontal entity file, picking '200_UPLINE-.HOR'

'DATA tab > Import drop down > ACT vertical entity file, picking '200_UPLINE-.VER'

'DATA tab > Import drop down > ACT cant file, picking '200_UPLINE-.CAN'

From the Main Screen, SCC button 'Save As' 200_UPLINE.Alignment'

'SCC button > Close'

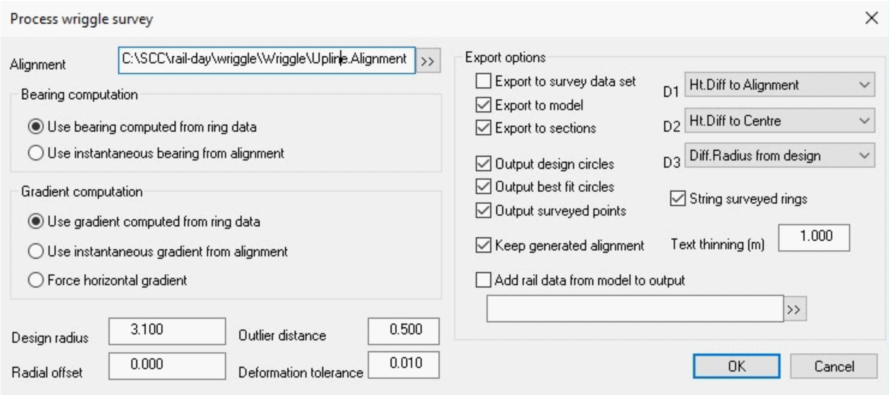
Import the ASCII survey file

'DATA tab > Import drop down > ASCII Wriggle Survey, picking '9961065.ASC'

SCC button 'Save'

Compute the wriggle survey

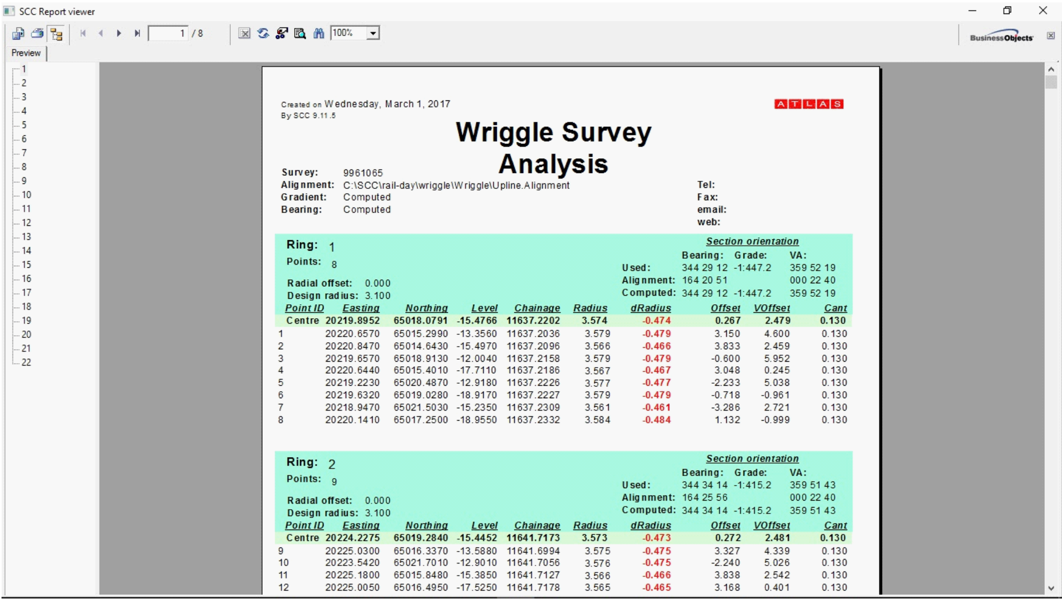
'SURVEY tab > Tools > Compute Wriggle Survey', using parameters shown and pick 'WriggleSurvey.RPT' as the report file



This will compute the wriggle survey and show the following report.

Note:

- that with bearing and gradient computed from ring data, the alignment is not used in the computations. It is still used in the report to show the difference between bearing and gradient values computed via linear regression and those computed for the alignment.
- Bearing and gradient computation determine whether the tunnel bearing and gradient is based on the alignment or the connected ring circles generated in processing
- Export options control whether in addition to the report you get a section file, model and/or survey data set on output, and whether they include the surveyed points, design circle radius and/or best fit circle radius.
- The design radius is the nominal radius of the tunnel
- The outlier distance is the distance from the design radius at which points are rejected as noise / not on the tunnel surface. The wriggle process is actually computed twice, first to remove outliers, second to get a clean result.
- The radial offset is a prism constant from observed point to tunnel face
- The deformation tolerance is the distance above which points in the survey are flagged as out of range / build tolerance / potential obstructions
- Adding an extra rail model to the output shows the rail position with respect to the tunnel



- the contact details in the report are taken from **'General Options > Module Licenses > Edit user details'.** The layout and content of the report can be modified to suit individual client needs independently of SCC using Crystal reports XI or later. Results from the SCC viewer can be saved into Microsoft Excel for further analysis by pressing the export button on the top left of the viewer. This also supports a wide range of other formats included Word, PDF and ODBC database tables.

When comparing the results with the output file provided, 9961065.out, SCC is producing identical radii, and horizontal and vertical offsets that agree to within 1mm. The easting and northing of the centres deviate by ~10mm to 30mm but looking at the radial residuals, e.g. the difference between the final computed radius and distance from computed centre to each point, which would imply that the SCC result is more accurate because the sum of the residuals in the SCC report is smaller than those in the output report provided, indicating a slightly better circle fit. For example on ring 1, both routines agree a radius of 3.574, and the residuals are as follows;

9961065.out				SCC	
Point	Radius	Residual		Radius	Residual
1099601	3.578	0.004		3.579	0.005
1099602	3.584	0.010		3.584	0.010
1099603	3.567	-0.007		3.567	-0.007
1099604	3.565	-0.009		3.566	-0.008
1099605	3.579	0.005		3.579	0.005
1099606	3.579	0.005		3.579	0.005
1099607	3.577	0.003		3.577	0.003
1099608	3.561	-0.013		3.571	-0.003
Sum of square of residuals					
		0.056			0.046

We can see from this that the SCC centre is a slightly better fit for the data provided.

Case Study Data

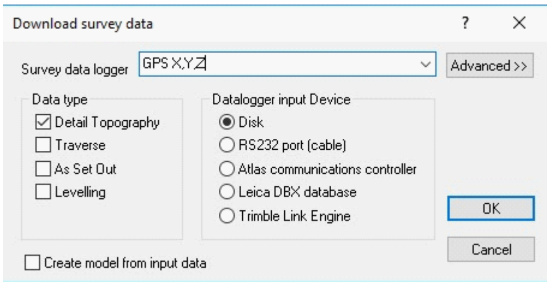
To process ascii compiler-1.csv, 300DOWNLINE-.HOR, 300DOWNLINE-.VER, and 300DOWNLINE-.CAN do the following

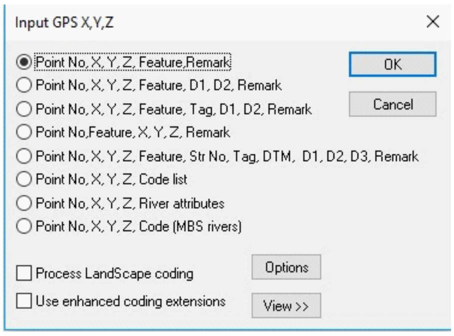
Downloading & Importing Data

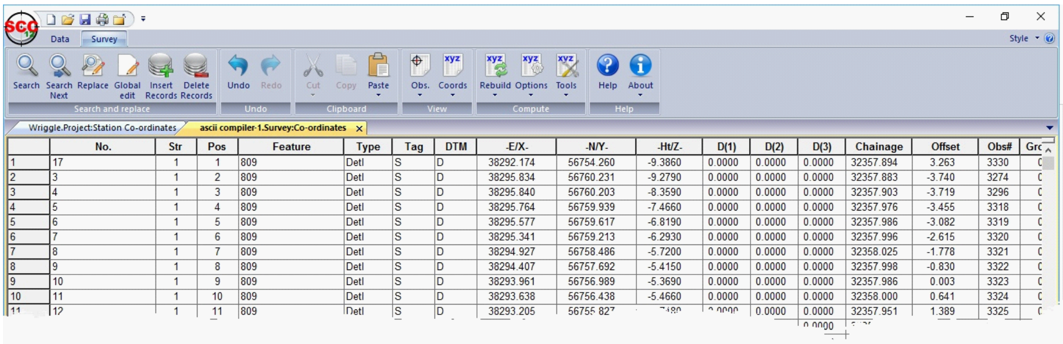
Create a new project as described previously

Import the ACT alignment files into SCC as described previously

'DATA tab > Download' picking 'ascii compiler-1.csv' using the parameters shown below



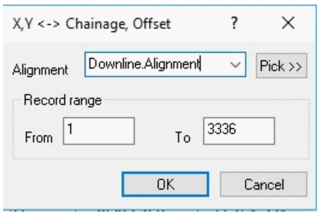




	No.	Str	Pos	Feature	Type	Tag	DTM	-E/X-	-N/Y-	-Ht/Z-	D(1)	D(2)	D(3)	Chainage	Offset	Obs#	Grc
1	17	1	1	809	Detl	S	D	38292.174	56754.260	-9.3860	0.0000	0.0000	0.0000	32357.894	3.263	3330	C
2	3	1	2	809	Detl	S	D	38295.834	56760.231	-9.2790	0.0000	0.0000	0.0000	32357.883	-3.740	3274	C
3	4	1	3	809	Detl	S	D	38295.840	56760.203	-8.3590	0.0000	0.0000	0.0000	32357.903	-3.719	3296	C
4	5	1	4	809	Detl	S	D	38295.764	56759.939	-7.4660	0.0000	0.0000	0.0000	32357.976	-3.455	3318	C
5	6	1	5	809	Detl	S	D	38295.577	56759.617	-6.8190	0.0000	0.0000	0.0000	32357.986	-3.082	3319	C
6	7	1	6	809	Detl	S	D	38295.341	56759.213	-6.2930	0.0000	0.0000	0.0000	32357.996	-2.615	3320	C
7	8	1	7	809	Detl	S	D	38294.927	56758.486	-5.7200	0.0000	0.0000	0.0000	32358.025	-1.778	3321	C
8	9	1	8	809	Detl	S	D	38294.407	56757.692	-5.4150	0.0000	0.0000	0.0000	32357.998	-0.830	3322	C
9	10	1	9	809	Detl	S	D	38293.961	56756.989	-5.3690	0.0000	0.0000	0.0000	32357.986	0.003	3323	C
10	11	1	10	809	Detl	S	D	38293.638	56756.438	-5.4660	0.0000	0.0000	0.0000	32358.000	0.641	3324	C
11	12	1	11	809	Detl	S	D	38293.205	56755.827	[illegible]	0.0000	0.0000	0.0000	32357.951	1.389	3325	C

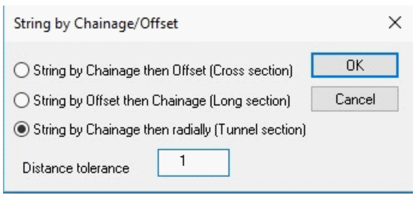
Computing Chainage Offset from X,Y

To group the data into rings, select 'SURVEY tab > Tools > Compute Chainage,Offset from X,Y'



String using Chainage Offset

Select 'SURVEY tab > Tools >String using Chainage & Offset'



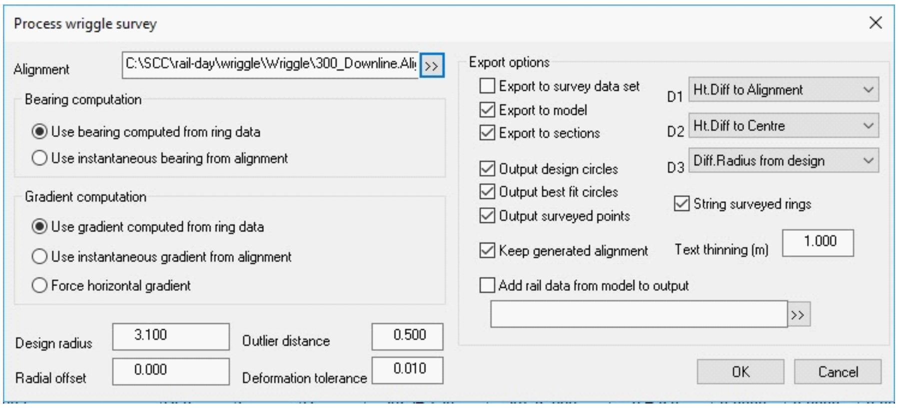
'SCC button > Save'

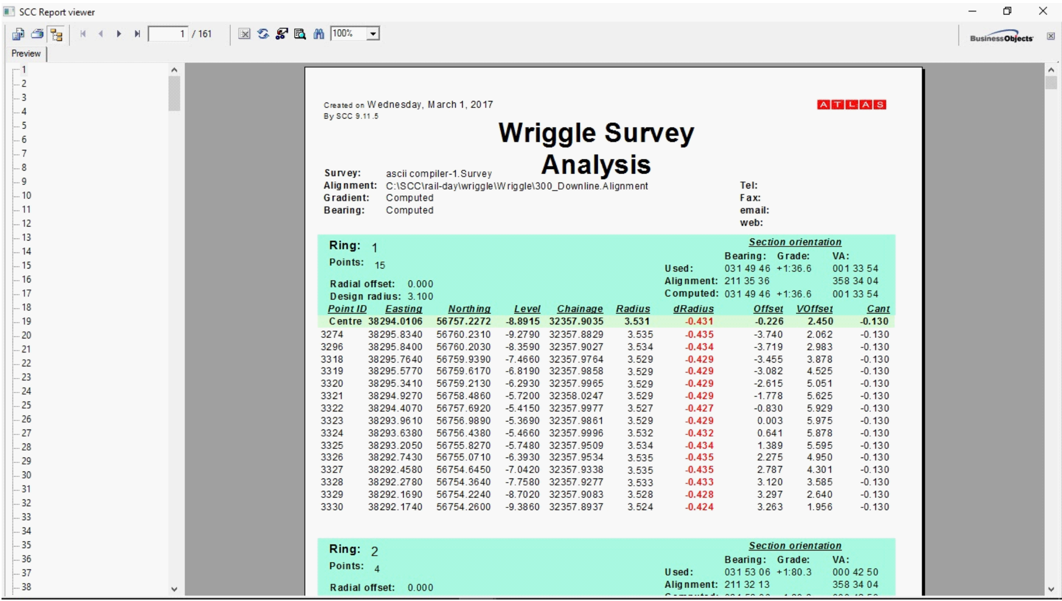
Compute the wriggle survey

'SURVEY tab > Tools > Compute Wriggle Survey', using parameters shown and pick

'WriggleSurvey.RPT' as the report file

Compute the wriggle survey as described previously, picking the 300 downline alignment file to get the following report





Created on Wednesday, March 1, 2017
By SCC 9.11.5

ATLAS

Wriggle Survey Analysis

Survey: ascii compiler-1.Survey
Alignment: C:\SCC\rail-day\wriggle\Wriggle\300_Downline.Alignment
Gradient: Computed
Bearing: Computed

Tel:
Fax:
email:
web:

Ring: 1
Points: 15
Radial offset: 0.000
Design radius: 3.100

Section orientation

	Bearing:	Grade:	VA:
Used:	031 49 46	+1:36.6	001 33 54
Alignment:	211 35 36		358 34 04
Computed:	031 49 46	+1:36.6	001 33 54

Point ID	Easting	Northing	Level	Chainage	Radius	dRadius	Offset	VOffset	Cant
Centre	38294.0106	56757.2272	-8.8915	32357.9035	3.531	-0.431	-0.226	2.450	-0.130
3274	38295.8340	56760.2310	-9.2790	32357.8829	3.535	-0.435	-3.740	2.062	-0.130
3296	38295.8400	56760.2030	-8.3590	32357.9027	3.534	-0.434	-3.719	2.983	-0.130
3318	38295.7640	56759.9390	-7.4660	32357.9764	3.529	-0.429	-3.455	3.878	-0.130
3319	38295.5770	56759.6170	-6.8190	32357.9858	3.529	-0.429	-3.082	4.525	-0.130
3320	38295.3410	56759.2130	-6.2930	32357.9965	3.529	-0.429	-2.615	5.051	-0.130
3321	38294.9270	56758.4860	-5.7200	32358.0247	3.529	-0.429	-1.778	5.625	-0.130
3322	38294.4070	56757.6920	-5.4150	32357.9977	3.527	-0.427	-0.830	5.929	-0.130
3323	38293.9610	56756.9890	-5.3690	32357.9861	3.529	-0.429	0.003	5.975	-0.130
3324	38293.6380	56756.4380	-5.4660	32357.9996	3.532	-0.432	0.641	5.878	-0.130
3325	38293.2050	56755.8270	-5.7480	32357.9509	3.534	-0.434	1.389	5.595	-0.130
3326	38292.7430	56755.0710	-6.3930	32357.9534	3.535	-0.435	2.275	4.950	-0.130
3327	38292.4580	56754.6450	-7.0420	32357.9338	3.535	-0.435	2.787	4.301	-0.130
3328	38292.2780	56754.3640	-7.7580	32357.9277	3.533	-0.433	3.120	3.585	-0.130
3329	38292.1690	56754.2240	-8.7020	32357.9083	3.528	-0.428	3.297	2.640	-0.130
3330	38292.1740	56754.2600	-9.3860	32357.8937	3.524	-0.424	3.263	1.956	-0.130

Ring: 2
Points: 4
Radial offset: 0.000

Section orientation

	Bearing:	Grade:	VA:
Used:	031 53 06	+1:80.3	000 42 50
Alignment:	211 32 13		358 34 04

Notes from the results;

The computed bearing and gradient shown by SCC are ~180 degrees off the alignment value for the same section. This could be corrected using the alignment if required. Without an alignment the orientation of the section is arbitrary and can flip by 180 degrees, which also reverses the gradient.

It doesn't affect the centre, radius or offset values.

Comparing the results to those supplied in 320 wriggle analysis.xls all the radii in SCC are exactly 50mm smaller which appears to correspond to the BFC from DTA radial value and Lining radial value in the xls file. Horizontal and vertical offsets appear to agree to with about 2mm but centres are differ by ~50-60mm. This could possibly be related to radial offsets. Re-computing using alignment bearing and gradients does not appear to make a significant difference to this, though further investigation is probably required.

The xls provided appears to have a limit of size points per ring, though this could just be a reporting anomaly.

16 Lift And Slue Reporting

This tutorial gives an example of how to use the lift and slue reporting functionality. This involves comparison of a design model with a survey model for left (vertical separation) and slue (lateral separation) on nominated left and right rails. It also computes cant a gauge between left and right rails, and reports any failures to meet tolerance in cant. To demonstrate this functionality, do the following;

Import GENIO files to create a design model, a survey model, and an alignment.

'FILE > Model > MOSS GENIO file' picking C:\SCC\Lift and Slue\Example1 - DESIGN.TXT

'FILE > Save > Design.Model'

'FILE > Model > MOSS GENIO file' picking C:\SCC\Lift and Slue\Example1 - SURVEY.crd

'FILE > Save > Survey.Model'

'FILE > New > SCC Alignment'

'FILE > Import > MOSS GENIO geometry strings' picking C:\SCC\Lift and Slue\Example1 - DESIGN.TXT

Pick MC02 as the alignment string to import

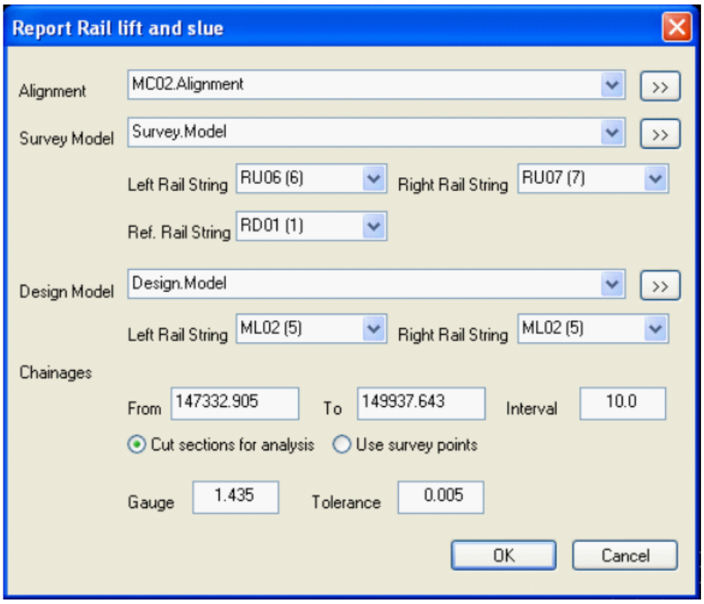
'FILE > Save > MC02.Alignment'

Rail Lift And Slue Analysis

Open the design model,

Pick 'DESIGN > Report rail lift and slue'

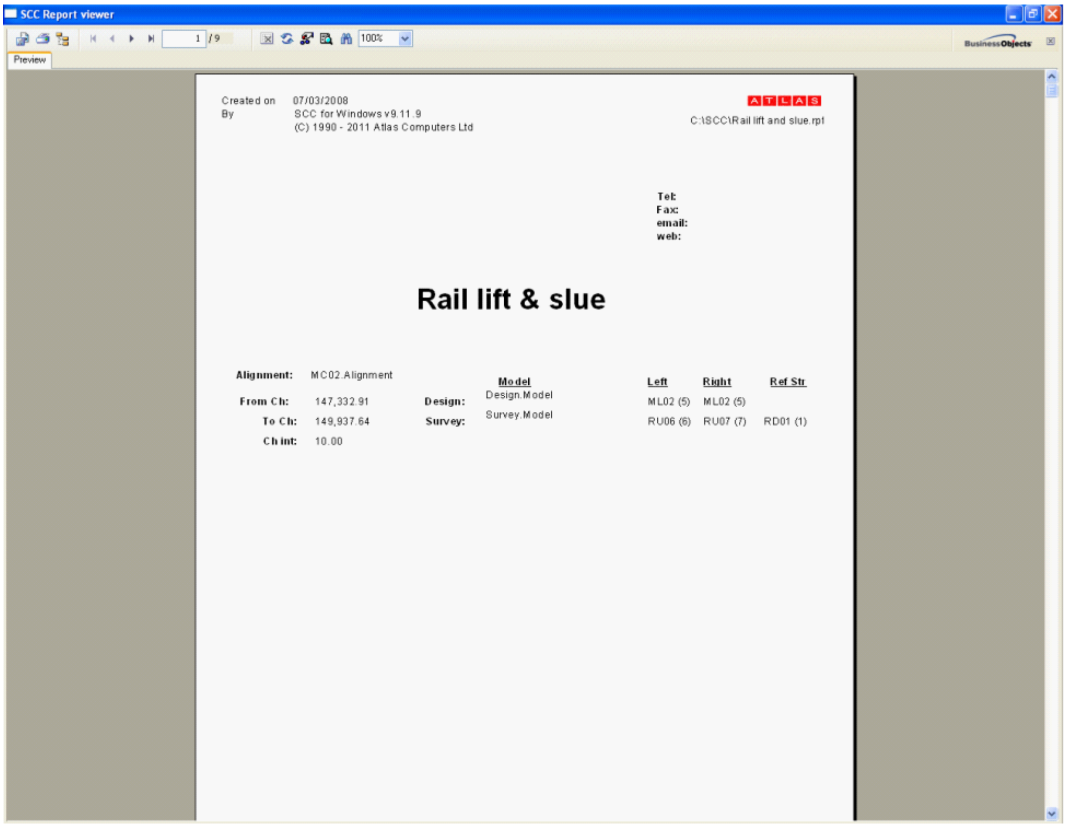
Select the files which have just been created and the design and survey strings to analyse.



Reporting Rail Lift And Slue

When prompted, pick 'Rail lift and slue.rpt' from the reports list.

This will produce a report as shown below. The report is broken down into separate sections for lift and slue values between survey and design for left and right rails, cant and gauge between rails with any values outside tolerance highlighted in red, and surveyed 6/10 foot.



17 Rail Cant Computations

Separate design sheet views for road super elevation and rail cant are available, and includes low rail cant calculations based on curve directions. This can be demonstrated using the a LandXML file including rail cant, such as readings.pax.land.xml. To process this file and check the results, do the following;

Create A New Project

Create a new SCC project

Import LandXML Files

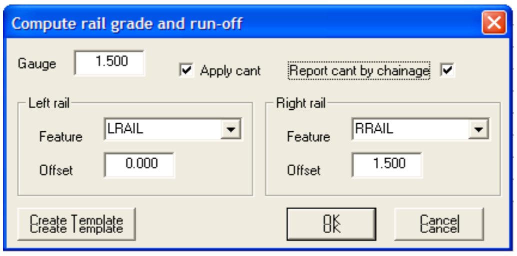
'FILE > Import > LandXML' and pick readings.pax.land.xml as the input file.

	Chainage	Cant	Rot
1	9857.035	10.669	CC
2	9864.255	8.661	CC
3	9871.057	8.010	CC
4	9884.879	0.508	CW
5	9892.152	9.086	CW
6	9898.901	19.766	CW
7	9905.943	12.978	CW
8	9912.923	19.845	CW
9	9926.657	19.614	CW
10	9933.803	21.776	CW
11	9940.840	21.292	CW
12	9954.909	16.788	CW
13	9961.805	23.564	CW
14	9968.853	22.139	CW
15	9975.754	29.744	CW
16	9982.833	31.809	CW
17	9989.718	34.964	CW
18	9996.593	31.754	CW
19	9999.818	33.451	CW
20	10004.996	34.120	CW

To view the cant stations, select VIEW > Rail Cant, which will show the following, which agrees with the LandXML values.

Checking Gauge And Cant

To check the gauge and cant, select 'DESIGN > Enter Gauge and compute Cant'. The gauge will have been read in from the LandXML file in this case, so you simply enter the feature names and offsets for left and right rails, as shown in the dialog below.



This option will also produce a report listing the cant stations, and applied cant values on either rail at a regular chainage interval. The chainage interval can be specified using '**DESIGN > Interface and export parameters**'.

```
Rail cant check report

Date: Wed Aug 11 11:54:32 2010

Alignment: base readings.pax

Gauge: 1.500   Left Rail:LRAIL Offset 0.000   Right Rail:RRAIL Offset 1.500

Chainage      CL Height    L.Cant    R.Cant    L.Height      R.Height      Direction

----------    ----------   -------   -------   ----------    ----------
----------

  9860.000       99.169    +0.000    +9.844       99.169        99.178   Left
(CCW)

  9870.000       99.126    +0.000    +8.111       99.126        99.134   Left
(CCW)

  9880.000       99.077    +0.000    +3.156       99.077        99.080   Left
(CCW)

  9890.000       99.013    +6.547    +0.000       99.020        99.013   Right
(CW)
```

9900.000	98.938	+18.707	+0.000	98.957	98.938	Right (CW)
9910.000	98.873	+16.969	+0.000	98.890	98.873	Right (CW)
9920.000	98.828	+19.726	+0.000	98.848	98.828	Right (CW)
9930.000	98.778	+20.626	+0.000	98.799	98.778	Right (CW)
9940.000	98.707	+21.350	+0.000	98.728	98.707	Right (CW)
9950.000	98.642	+18.360	+0.000	98.660	98.642	Right (CW)
9960.000	98.598	+21.790	+0.000	98.620	98.598	Right (CW)
9970.000	98.532	+23.403	+0.000	98.556	98.532	Right (CW)
9980.000	98.500	+30.983	+0.000	98.531	98.500	Right (CW)
9990.000	98.482	+34.832	+0.000	98.517	98.482	Right (CW)
10000.000	98.438	+33.475	+0.000	98.472	98.438	Right (CW)

Cant Stations

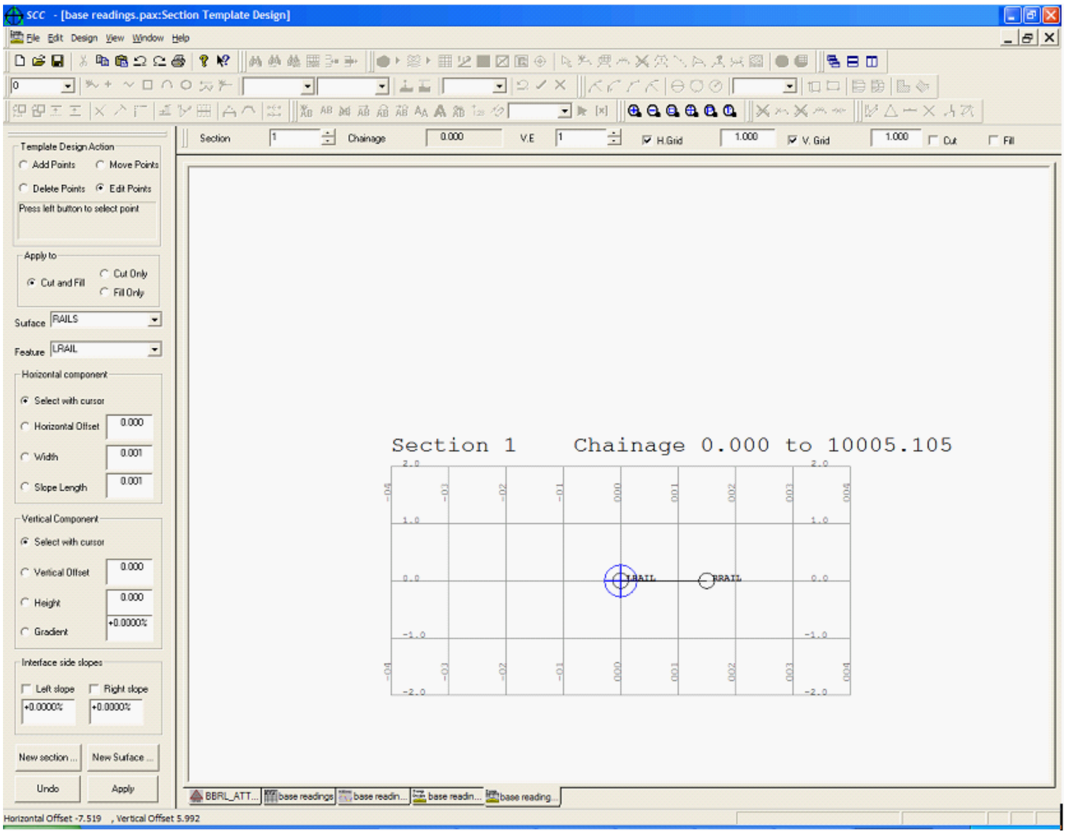
Chainage	Cant	Direction
9857.035	+10.669	Left (CCW)
9864.255	+8.661	Left (CCW)
9871.057	+8.010	Left (CCW)
9884.879	+0.508	Right (CW)
9892.152	+9.086	Right (CW)
9898.901	+19.766	Right (CW)
9905.943	+12.978	Right (CW)
9912.923	+19.845	Right (CW)
9926.657	+19.614	Right (CW)
9933.803	+21.776	Right (CW)
9940.840	+21.292	Right (CW)
9954.909	+16.788	Right (CW)
9961.805	+23.564	Right (CW)
9968.853	+22.139	Right (CW)
9975.754	+29.744	Right (CW)
9982.833	+31.809	Right (CW)
9989.718	+34.964	Right (CW)

```
  9996.593   +31.754   Right (CW)
  9999.818   +33.451   Right (CW)
 10004.996   +34.120   Right (CW)
SCC for Windows v9.10.0  (C) 1990 - 2010 Atlas Computers Ltd
```

Pressing the create template, will create a simple design template consisting of just the two rails. This can be viewed as a spreadsheet using 'VIEW > Section template points'

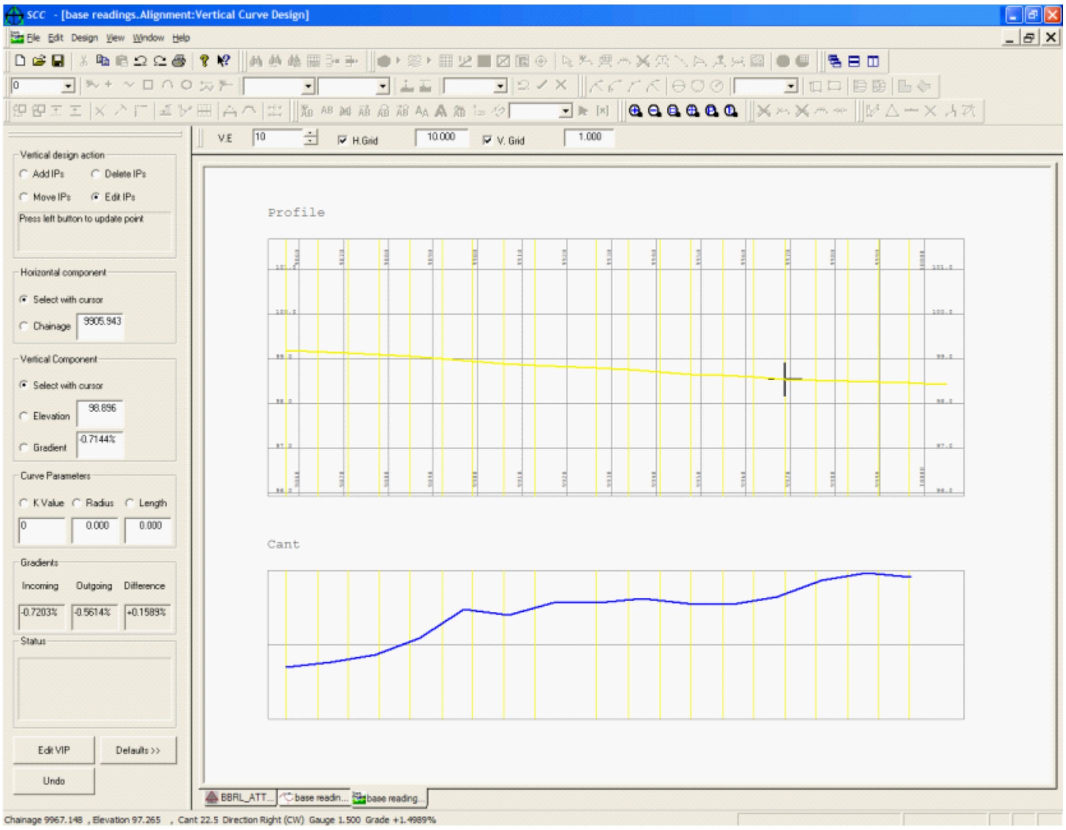
	Sect	Chainage 1	Chainage 2	Surface	Feature	Str	Hz.Offset	Vt.Offset	Type	Cut	Fill
1	1	0.000	10005.105	RAILS	LRAIL	1	0.000	0.000	Fixed - Both	+0.0000%	+0.0000%
2	1	0.000	10005.105	RAILS	RRAIL	1	1.500	0.000	Fixed - Both	+0.0000%	+0.0000%

or graphically via 'DESIGN > Section templates'



A cant graph can also be viewed with the profile using 'DESIGN > Vertical design'.

N.B. use the V/ E controls to change the vertical exaggeration.



On the vertical design view, the status bar shows instantaneous cant at the cursor position, along with chainage, profile height, gradient and curve direction.

The cant at a given chainage is linearly interpolated based on the surrounding cant stations. For a given chainage and horizontal offset, if the cant direction is right > clockwise, the cant is given as

G = Interpolated cant > gauge

C = (Right rail offset – horizontal offset)*G

If the cant direction is left > ant-clockwise, the cant is given as

G = Interpolated cant > gauge

C = (horizontal offset - Left rail offset)*G

The design height for that chainage and offset is calculated as sum of the profile height at that chainage, the vertical offset in the template string point (e.g. 0 for the rails), and the cant as computed above. This is the same for all surfaces in the alignment.

18 String Comparison & Overlap Processing

String comparison and overlap processing option are available within the model view under **'DESIGN > Compare strings and remove overlaps'**. This requires a model with one or more overlapping strings, and an alignment for reference purposes. The following is an example of the usage of this function based around the sample data provided;

Create Project And Import Data

Create a new project, via 'FILE > New Project, or open an existing project

Create a model from the DXF files provide

'FILE > Model > DWG> DXF file' and select 'DM with compensation.dxf'

'TOOLS > Add strings from file DWG > DXF file', and select 'DM without compensation.dxf'

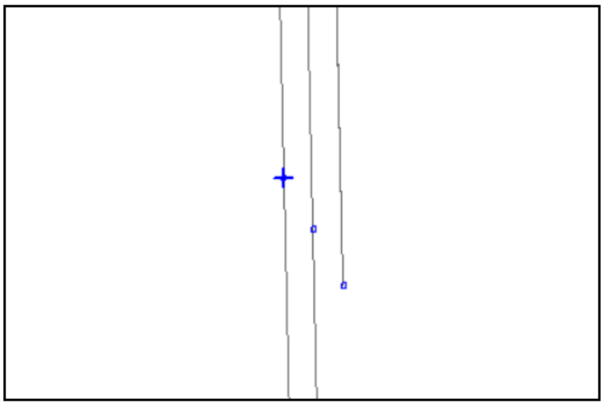
Create Alignment

Create a new alignment from existing centreline for analysis purposes

'DESIGN > Create alignment from existing string'

Pick LINTRACK, string 1

Select Create alignment from straights and fillet arcs and press Ok



String Analysis

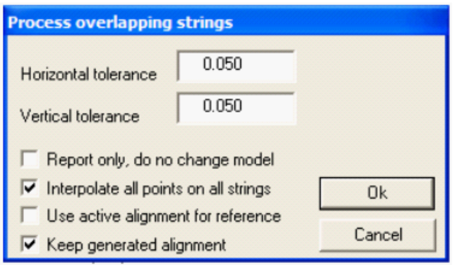
Select strings for analysis

Zoom into area 1009,1356

Right click to bring up data selection dialog

Select All points on selected string, Ok

Pick the three strings as shown



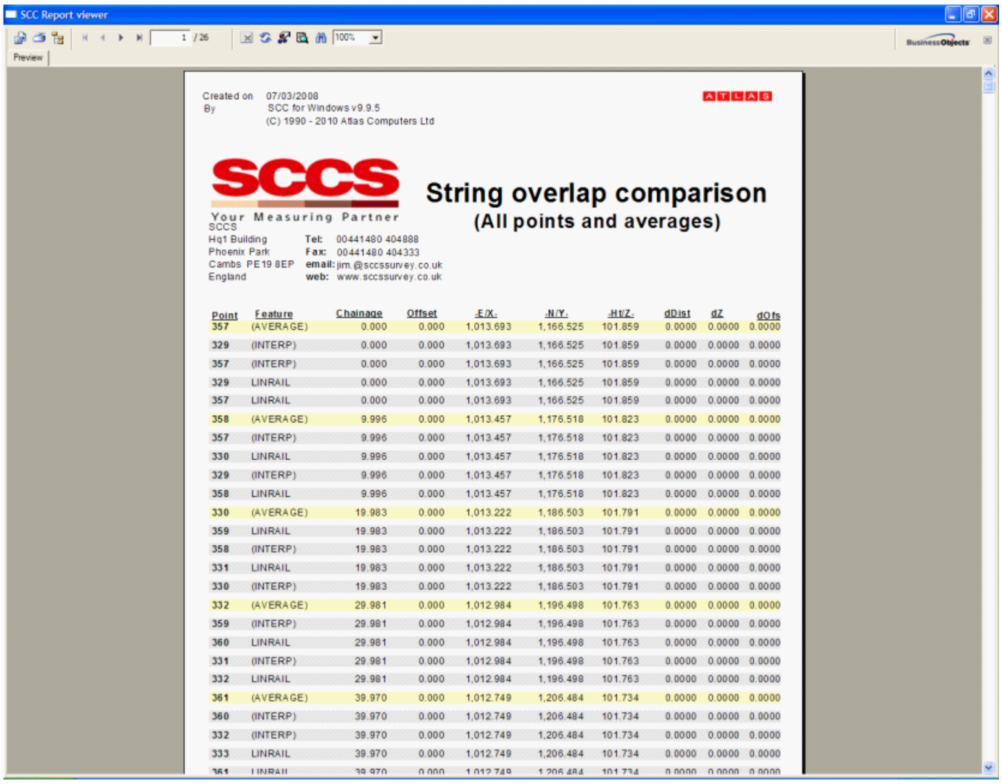
Select 'DESIGN > Compare strings and remove overlaps', using the parameters shown.

These parameters work as follows;

- Horizontal and vertical tolerances are used to determine the scope of the search.
- Points that are further away from each other that this are not considered for comparison.
- Report only is used to generate a comparison report, but will not change the model.
- Interpolate all points on all strings is use to generate additional comparison points at chainages where a point exists on one string under analysis but not others. It is typically useful where the same part of the same string has been surveyed more than once, but the surveyed points are at different locations.

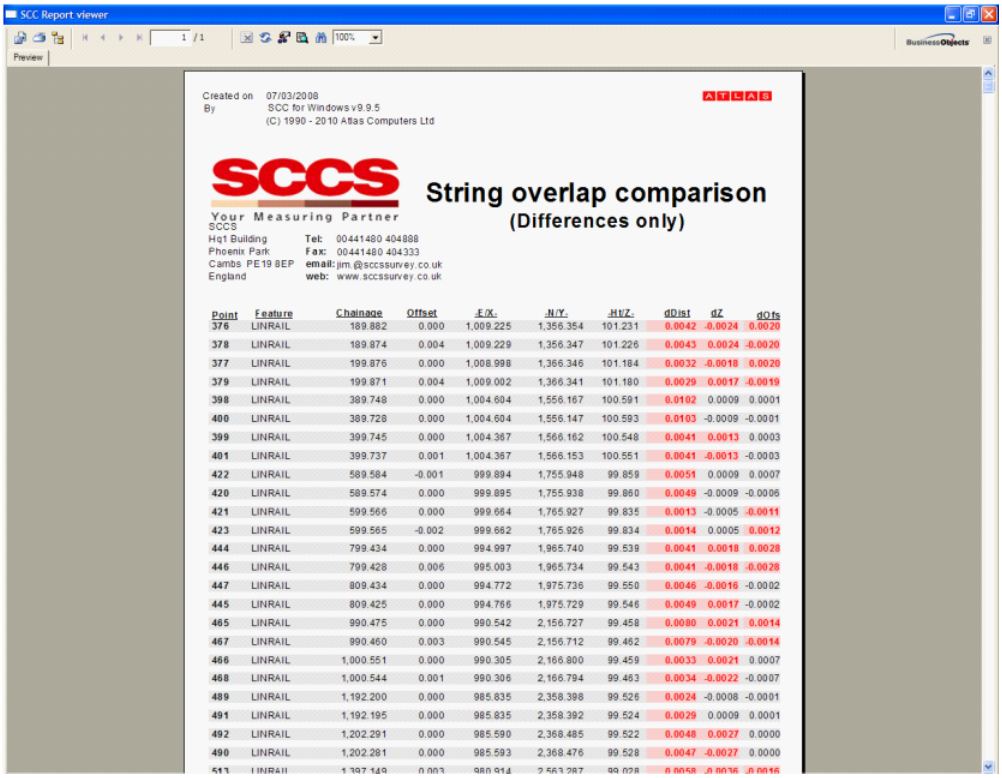
Press Ok to perform the analysis and pick a report.

Note that two standard reports have been added to SCC to support this option as follows;



Point	Feature	Chainage	Offset	E/X	N/Y	Ht/Z	dDist	dZ	dOfs
357	(AVERAGE)	0.000	0.000	1,013.693	1,166.525	101.859	0.0000	0.0000	0.0000
329	(INTERP)	0.000	0.000	1,013.693	1,166.525	101.859	0.0000	0.0000	0.0000
357	(INTERP)	0.000	0.000	1,013.693	1,166.525	101.859	0.0000	0.0000	0.0000
329	LINRAIL	0.000	0.000	1,013.693	1,166.525	101.859	0.0000	0.0000	0.0000
357	LINRAIL	0.000	0.000	1,013.693	1,166.525	101.859	0.0000	0.0000	0.0000
358	(AVERAGE)	9.996	0.000	1,013.457	1,176.518	101.823	0.0000	0.0000	0.0000
357	(INTERP)	9.996	0.000	1,013.457	1,176.518	101.823	0.0000	0.0000	0.0000
330	LINRAIL	9.996	0.000	1,013.457	1,176.518	101.823	0.0000	0.0000	0.0000
329	(INTERP)	9.996	0.000	1,013.457	1,176.518	101.823	0.0000	0.0000	0.0000
358	LINRAIL	9.996	0.000	1,013.457	1,176.518	101.823	0.0000	0.0000	0.0000
330	(AVERAGE)	19.983	0.000	1,013.222	1,186.503	101.791	0.0000	0.0000	0.0000
359	LINRAIL	19.983	0.000	1,013.222	1,186.503	101.791	0.0000	0.0000	0.0000
358	(INTERP)	19.983	0.000	1,013.222	1,186.503	101.791	0.0000	0.0000	0.0000
331	LINRAIL	19.983	0.000	1,013.222	1,186.503	101.791	0.0000	0.0000	0.0000
330	(INTERP)	19.983	0.000	1,013.222	1,186.503	101.791	0.0000	0.0000	0.0000
332	(AVERAGE)	29.981	0.000	1,012.984	1,196.498	101.763	0.0000	0.0000	0.0000
359	(INTERP)	29.981	0.000	1,012.984	1,196.498	101.763	0.0000	0.0000	0.0000
360	LINRAIL	29.981	0.000	1,012.984	1,196.498	101.763	0.0000	0.0000	0.0000
331	(INTERP)	29.981	0.000	1,012.984	1,196.498	101.763	0.0000	0.0000	0.0000
332	LINRAIL	29.981	0.000	1,012.984	1,196.498	101.763	0.0000	0.0000	0.0000
361	(AVERAGE)	39.970	0.000	1,012.749	1,206.484	101.734	0.0000	0.0000	0.0000
360	(INTERP)	39.970	0.000	1,012.749	1,206.484	101.734	0.0000	0.0000	0.0000
332	(INTERP)	39.970	0.000	1,012.749	1,206.484	101.734	0.0000	0.0000	0.0000
333	LINRAIL	39.970	0.000	1,012.749	1,206.484	101.734	0.0000	0.0000	0.0000
361	LINRAIL	39.970	0.000	1,012.749	1,206.484	101.734	0.0000	0.0000	0.0000

String Overlaps (all).rpt shows all points used in the comparison alongside their generated average positions. Any differences greater than 1mm in horizontal or vertical are highlighted in red.



Created on 07/03/2008
By SCC for Windows v9.9.5
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String overlap comparison
(Differences only)

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web: www.sccssurvey.co.uk

Point	Feature	Chainage	Offset	E/X	N/Y	Ht/Z	dDist	dZ	dOfs
376	LINRAIL	189.882	0.000	1,009.225	1,356.354	101.231	0.0042	-0.0024	0.0020
378	LINRAIL	189.874	0.004	1,009.229	1,356.347	101.226	0.0043	0.0024	-0.0020
377	LINRAIL	199.876	0.000	1,008.998	1,366.346	101.184	0.0032	-0.0018	0.0020
379	LINRAIL	199.871	0.004	1,009.002	1,366.341	101.180	0.0029	0.0017	-0.0019
398	LINRAIL	389.748	0.000	1,004.604	1,556.167	100.591	0.0102	0.0009	0.0001
400	LINRAIL	389.728	0.000	1,004.604	1,556.147	100.593	0.0103	-0.0009	-0.0001
399	LINRAIL	399.745	0.000	1,004.367	1,566.162	100.548	0.0041	0.0013	0.0003
401	LINRAIL	399.737	0.001	1,004.367	1,566.153	100.551	0.0041	-0.0013	-0.0003
422	LINRAIL	589.584	-0.001	999.894	1,755.948	99.859	0.0051	0.0009	0.0007
420	LINRAIL	589.574	0.000	999.895	1,755.938	99.860	0.0049	-0.0009	-0.0006
421	LINRAIL	599.566	0.000	999.664	1,765.927	99.835	0.0013	-0.0005	-0.0011
423	LINRAIL	599.565	-0.002	999.662	1,765.926	99.834	0.0014	0.0005	0.0012
444	LINRAIL	799.434	0.000	994.997	1,965.740	99.539	0.0041	0.0018	0.0028
446	LINRAIL	799.428	0.006	995.003	1,965.734	99.543	0.0041	-0.0018	-0.0028
447	LINRAIL	809.434	0.000	994.772	1,975.736	99.550	0.0046	-0.0016	-0.0002
445	LINRAIL	809.425	0.000	994.766	1,975.729	99.546	0.0049	0.0017	-0.0002
465	LINRAIL	990.475	0.000	990.542	2,156.727	99.458	0.0080	0.0021	0.0014
467	LINRAIL	990.460	0.003	990.545	2,156.712	99.462	0.0079	-0.0020	-0.0014
466	LINRAIL	1,000.551	0.000	990.305	2,166.800	99.459	0.0033	0.0021	0.0007
468	LINRAIL	1,000.544	0.001	990.306	2,166.794	99.463	0.0034	-0.0022	-0.0007
489	LINRAIL	1,192.200	0.000	985.835	2,358.398	99.526	0.0024	-0.0008	-0.0001
491	LINRAIL	1,192.195	0.000	985.835	2,358.392	99.524	0.0029	0.0009	0.0001
492	LINRAIL	1,202.291	0.000	985.590	2,368.485	99.522	0.0048	0.0027	0.0000
490	LINRAIL	1,202.281	0.000	985.593	2,368.476	99.528	0.0047	-0.0027	0.0000
513	LINRAIL	1,397.149	0.003	980.914	2,563.287	99.028	0.0058	-0.0036	-0.0016

String Overlaps (Diffs).rpt only shows points where the difference exceeds either 1mm in the horizontal or vertical.

Following on from the analysis, we can see that the overlapping strings have been replaced with a single averaged string.

Note:

Report titles and logo relating to user details can be controlled throughout SCC using **'FILE** > **General options** > **module licenses** > **user details**.

19 Wriggle Survey From Point Cloud Data

This note covers the steps required to create a wriggle survey from a scanned tunnel in order to ascertain the circularity of the tunnel and produce an accurate best fit alignment through the tunnel. The stages are as follows;

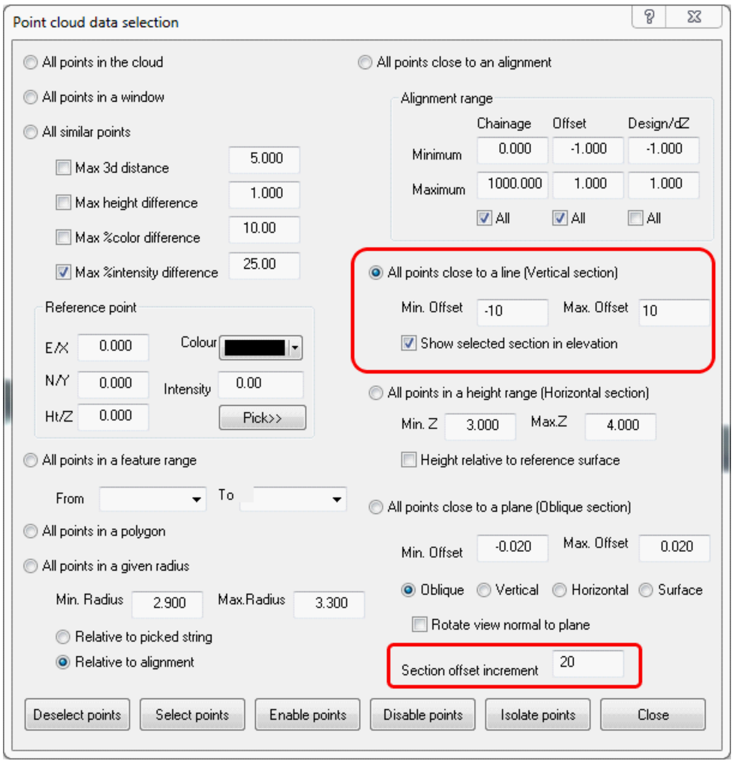
19.1 Setting Analysis Of Data

Open the tunnel project and model, and use the point cloud editing tools to separate tunnel wall data other scanned data within the tunnel. Set the analysis of data that is not part of the tunnel wall to Display only.

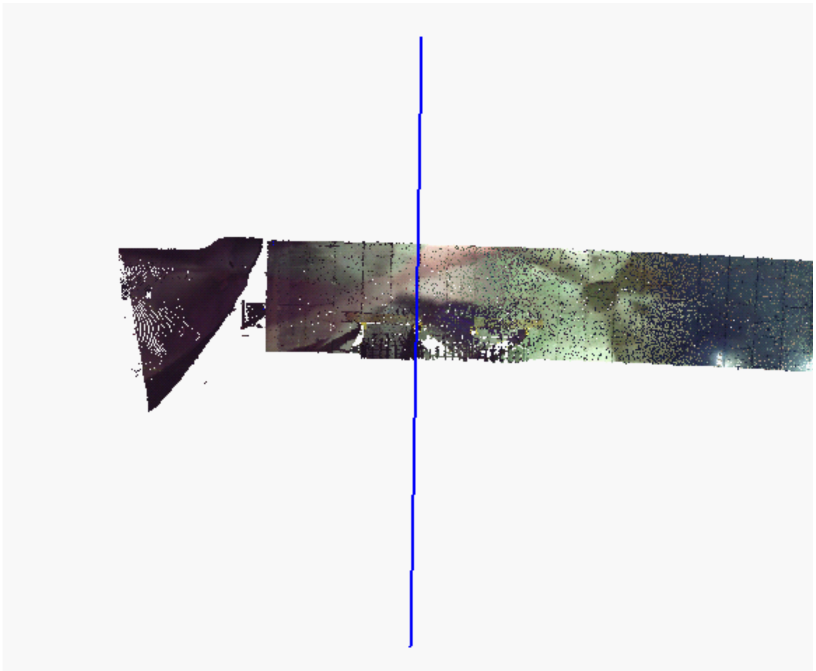
Open Existing Project & Dataset

Open 'Project' and '.Survey'

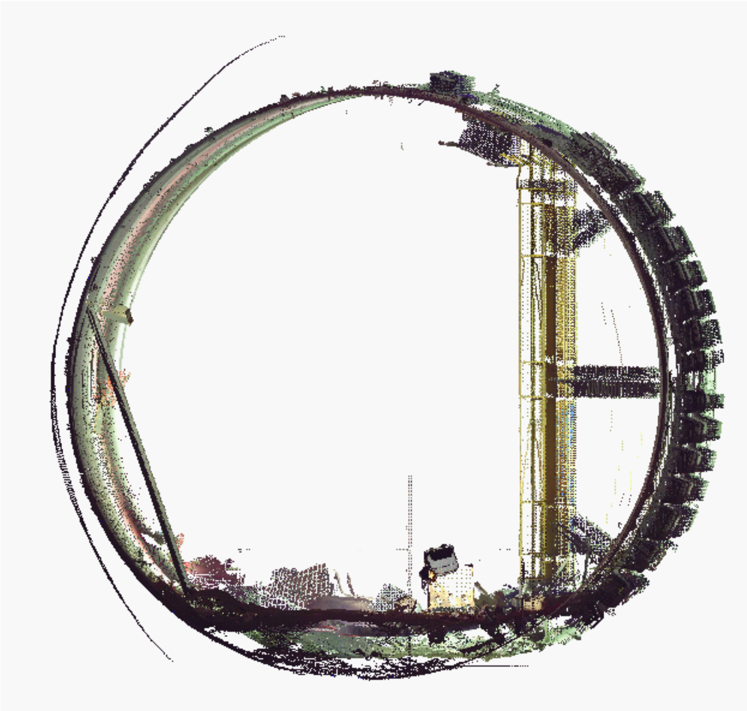
Right click to bring up the point cloud data selection dialogue, and select option to isolate an area 10 metres either side of the selected centre line. Set the section offset interval to 20m and press Isolate points



Select two points either side of tunnel roughly 90 degrees to the tunnel wall.



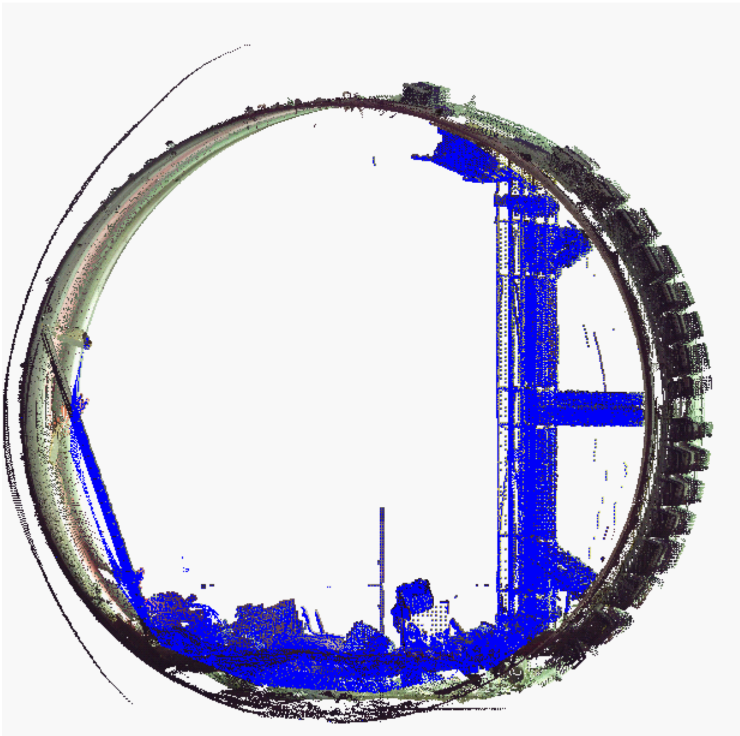
This will show an elevation through the tunnel, with a depth 10 metres either side of the centre line. The up and down arrows can be used to move the area displayed up and down the tunnel, and pressing 'P' or 'E' can be used to flip between plan and elevation.



Right click the mouse button to bring the data select dialog up again, and this time select 'All points in a polygon' and press the Select points button.

Left click to place points on a polygon that encloses the points we want to exclude from the wriggle analysis.

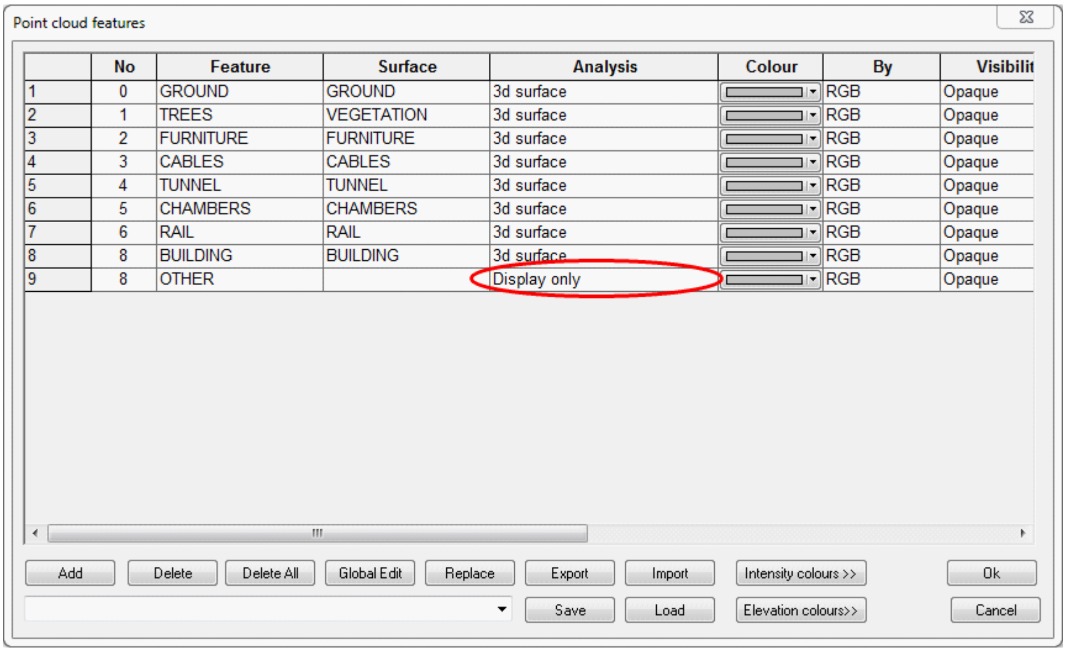
Right click to close the polygon and highlight the selected points



Use 'CLOUD > Edit selected points' to change the feature of the selected points to 'OTHER'. Repeat this to separate out all other points on the inside of the tunnel.

Use 'CLOUD > Point cloud features' to set the analysis type of 'OTHER' to be 'Display only',

such that these points will not be included when creating sections.



Use 'FILE > Save' to save this model under the new name of 'XXX (edit 1).Model'

19.2 Setting Arbitary Centreline

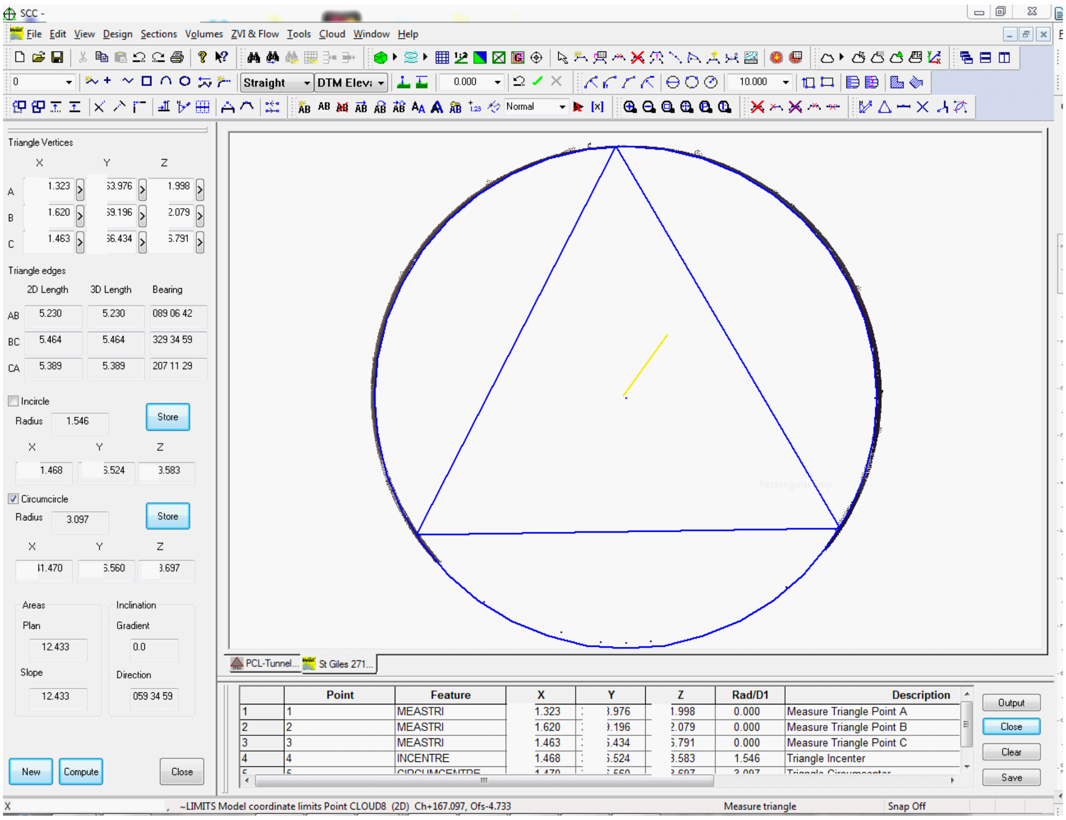
Create an arbitrary centreline through the tunnel. This will be used to cut sections through the tunnel and should roughly follow the tunnels plan position and gradient.

Select 'VIEW > Coordinate computations'

Isolate a vertical section through the tunnel at one end of the tunnel as described previously, but make the area narrower by specifying a minimum offset of -1 and a maximum offset of 1.

Select 'TOOLS > Measure > Triangle, areas, centres and gradient'

Pick three well separated points on the tunnel wall to generate a circumcircle as shown.



The coordinates for the triangle and circumcentre will be shown in a coordinate computations spreadsheet at the bottom of the screen.

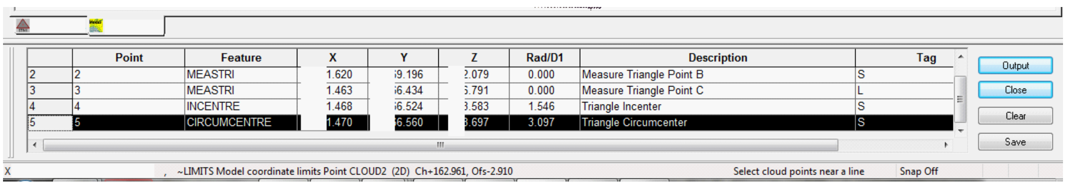
Repeat these steps for another circle at the middle of the tunnel, and a further one at the far end.

Press escape to close the triangle measurement dialog, and P to return to plan view.

Right click to bring up the data selection dialog, select All points in cloud and press Enable points to turn all the points back on again.

Select 'EDIT > Add strings with cursor'

Select the first CIRCUMCENTRE point from the computed coordinates and press Output. Repeat for the other two CIRCUMCENTRE points



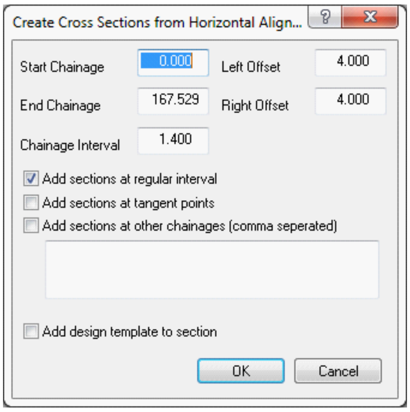
Right click and select Save string as interface from the pop-up menu. This create a 3d alignment that passes through the three points.

19.3 Cutting Sections

Cut sections at the desired interval through the tunnel, such that there is a section at every position where the tunnel changes direction or gradient. If the tunnel is not horizontal, these can be oblique sections rather than vertical cross sections

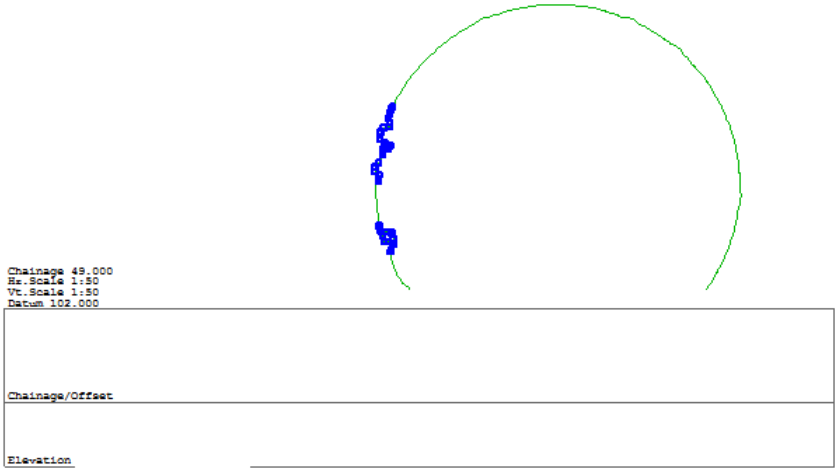
Select 'SECTIONS > Cross sections from an alignment'.

In this case, we're cutting sections every 1.4m on the basis that the tunnel direction can vary at any keystone on the tiled wall.



Visually check that the sections don't include any data that does not relate to the tunnel wall.

Use right click to use a window to select unwanted points, followed by 'EDIT > Delete / Delete points' to get rid of those points.

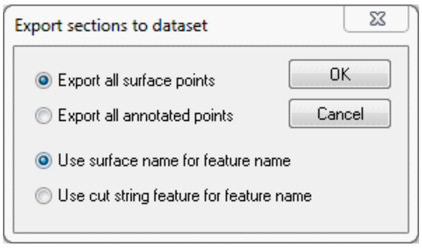


Use 'EDIT > Delete / Delete sections' to remove any sections that do not include enough data to contribute meaningful results to the wriggle survey.

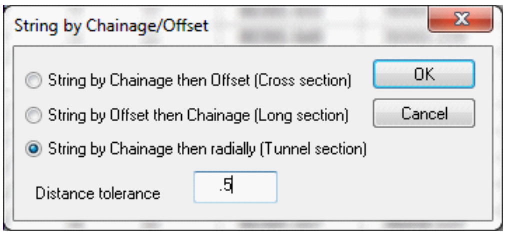
This will typically be areas that do not include enough scan data to create a section or areas where the tunnel is not circular.

Export the sections sections to a survey data set, which will be used as the input to the wriggle analysis.

Select 'FILE > Export sections > Survey data set'



In the coordinate spreadsheet, select 'TOOLS > String using chainage and offset', such that the wriggle survey will have all the contents of a single section as input for each ring.



'FILE > Save As' Wriggle input

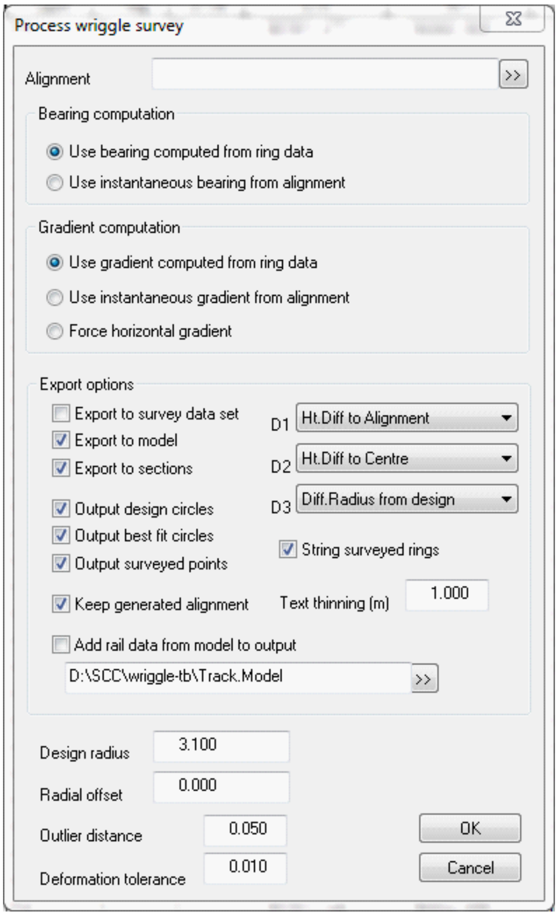
19.4 Wriggle Analysis

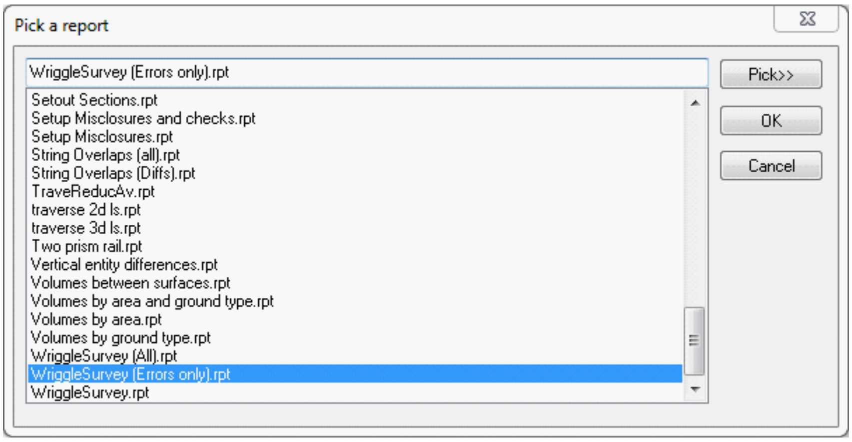
Run the wriggle analysis to produce a report, sections and new alignment.

Select 'TOOLS > Compute wriggle survey' using the parameters shown. If we do not know the initial design radius, we can enter the mean value from the circumcircles computed previously.

Providing an outlier distance means that once the analysis is initially carried out, any outliers with a distance outside the the value specified will be removed and the analysis repeated.

The deformation tolerance is used for reporting purposes, where any points with a distance outside of this range are considered out of tolerance. For scanned data with a huge number of input points we can then elect to only report out of tolerance points to provide a more manageable report.





If the difference between the design radius and computed radius is similar for each ring, and we're working off a provisional design radius, we can repeat the analysis based on a new radius.

Created or
By SCC 11.5.0

Wriggle Survey Analysis (Errors)

ATLAS

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Tel: +3531 4958714
Fax: +3531 4958717
email: sales@atlascomputers.ie
web: www.atlascomputers.ie

Survey: wriggle-input.Survey
Alignment:
Gradient: Computed
Bearing: Computed
Tolerance: 0.010

Ring: 1
Points: 222
Radial offset: 0.000
Design radius: 3.110

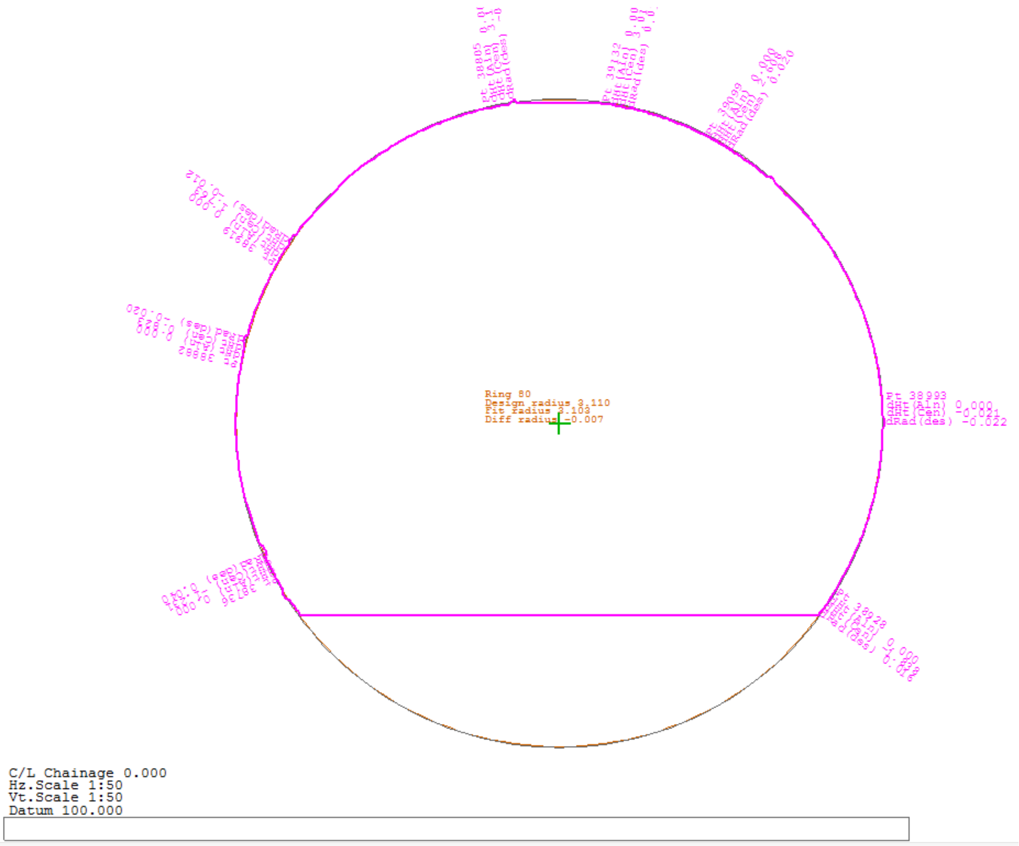
Section orientation

	Bearing:	Grade:	VA:
Used:	003 03 43	0	000 00 00
Alignment:	000 00 00		000 00 00
Computed:	003 03 43	0	000 00 00

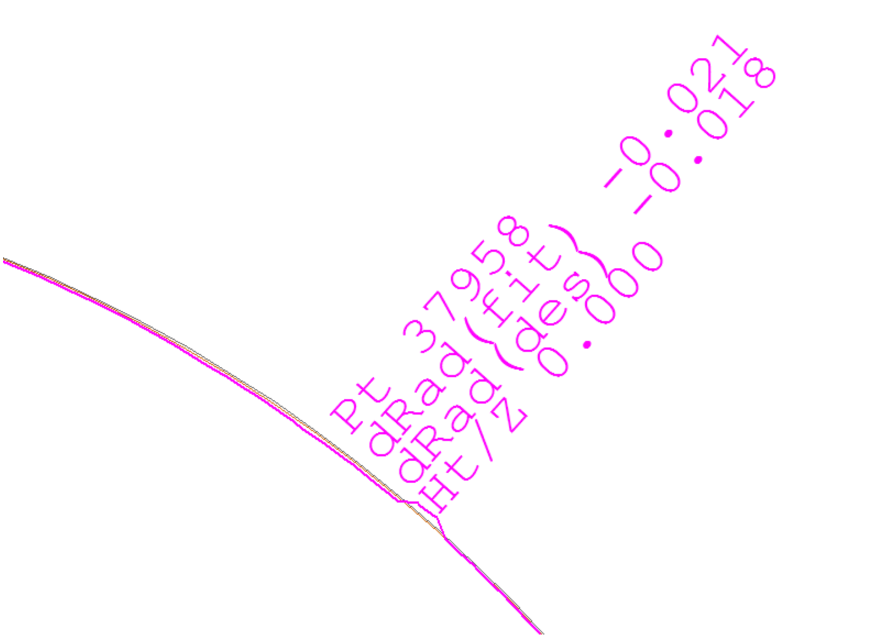
Point ID	Easting	Northing	Level	Chainage	Radius	dRadius	Offset	VOffset	Cant
Centre	1.3081	57.7346	4.4227	0.0000	3.115	-0.005	0.000	0.000	0.000
-1	1.4633	60.6366	5.5634	0.0000	3.122	-0.012	-2.503	0.000	0.000
-1	1.4534	60.4520	5.9544	0.0000	3.123	-0.013	-2.319	0.000	0.000
-1	1.4547	60.4749	5.9134	0.0000	3.123	-0.013	-2.342	0.000	0.000
-1	1.4557	60.4936	5.8779	0.0000	3.123	-0.013	-2.360	0.000	0.000
-1	1.4564	60.5071	5.8519	0.0000	3.123	-0.013	-2.374	0.000	0.000
-1	1.4571	60.5200	5.8259	0.0000	3.122	-0.012	-2.387	0.000	0.000
-1	1.4578	60.5330	5.7999	0.0000	3.122	-0.012	-2.400	0.000	0.000
-1	1.4585	60.5458	5.7734	0.0000	3.123	-0.013	-2.413	0.000	0.000
-1	1.4592	60.5587	5.7464	0.0000	3.123	-0.013	-2.425	0.000	0.000
-1	1.4598	60.5705	5.7199	0.0000	3.122	-0.012	-2.437	0.000	0.000
-1	1.4604	60.5823	5.6934	0.0000	3.122	-0.012	-2.449	0.000	0.000
-1	1.4519	60.4232	6.0044	0.0000	3.123	-0.013	-2.290	0.000	0.000

In our section view, use 'FILE > Load Save' section style and pick the Wriggle from scan style to set-up appropriate annotation and scales for wriggle survey from a scanned tunnel.

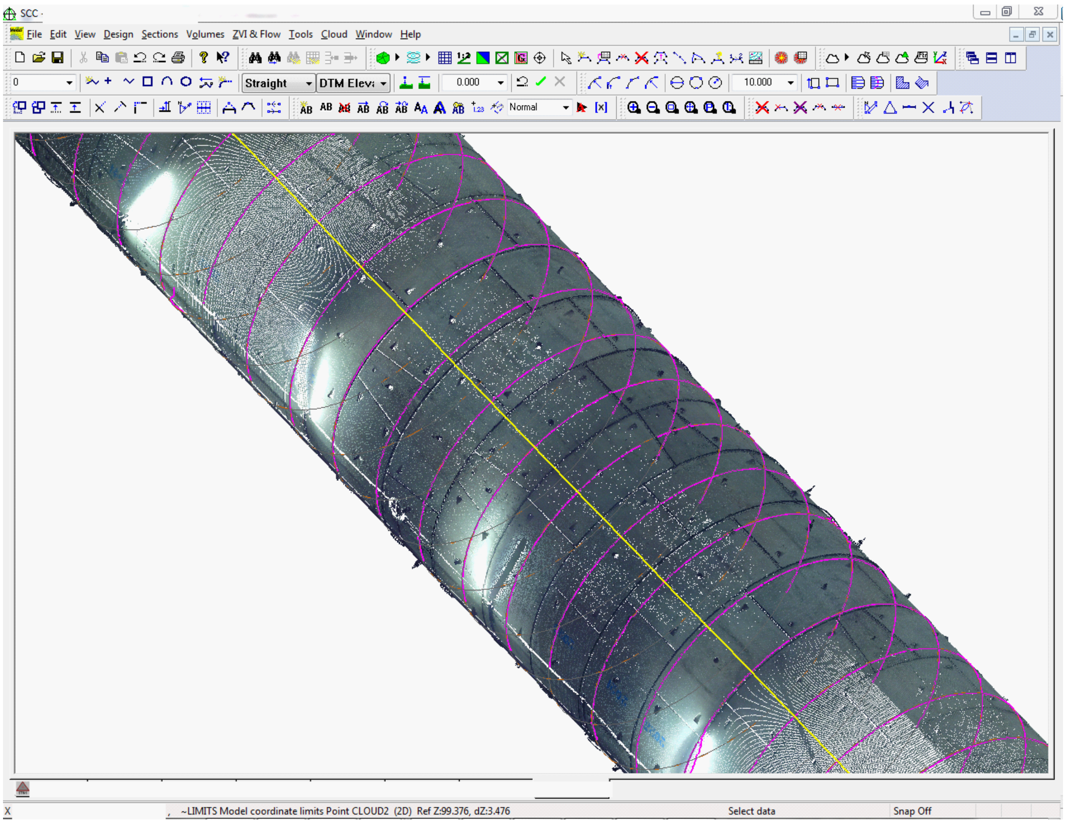
This shows us the difference between design and fit radius at each chainage, along with the worst of the out of tolerance points for each area of the section.



Zooming in we can see the scanned section overlaid with the design and best fit circles, with whatever annotators we've specified. Annotation is limited such that where it would overlap, only the annotator with the largest error is added.



The wriggle analysis will also output a model and alignment which can be saved and attached to our original scanned model for verification purposes.

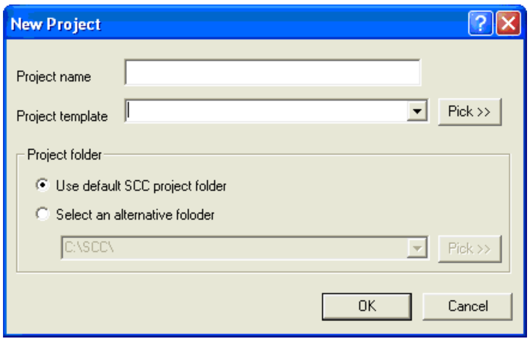


20 Processing LandXML File In SCC For Machine Control

The following text gives the steps required to import your 3d LandXML alignment into SCC, enter a type section including bottom ballast and formation surface details, and export those surfaces to Scanlaser via LandXML. The steps are as follows;

Create A New Project

Select 'FILE > New project' in SCC and enter a project name and template as shown below.

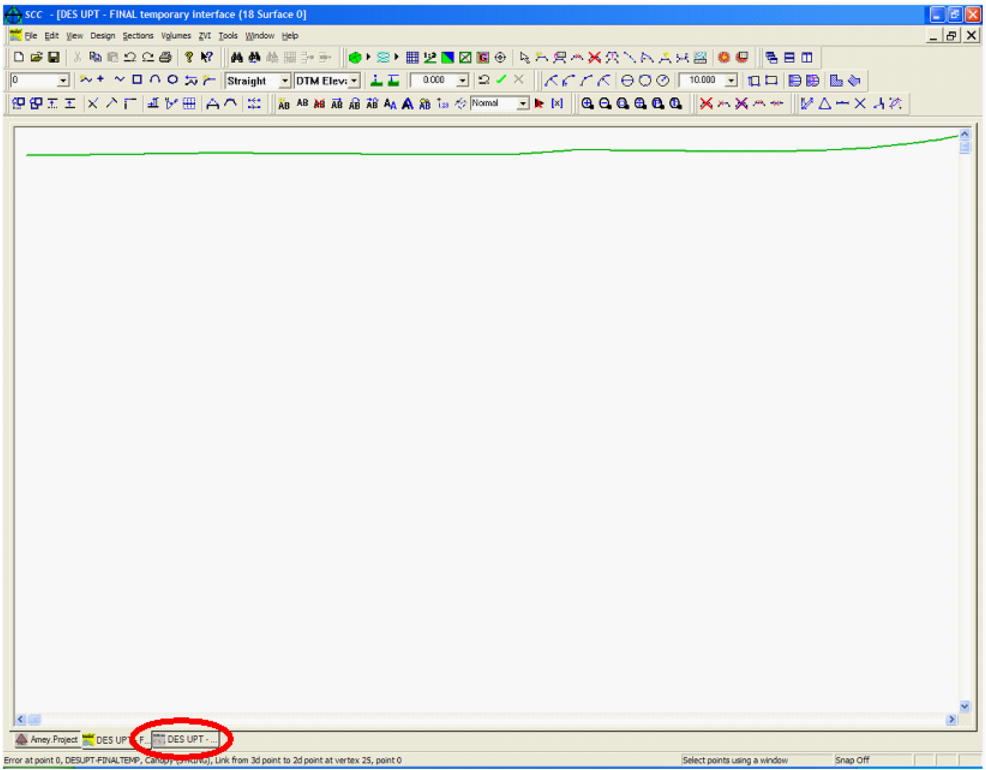


Import LandXML Files

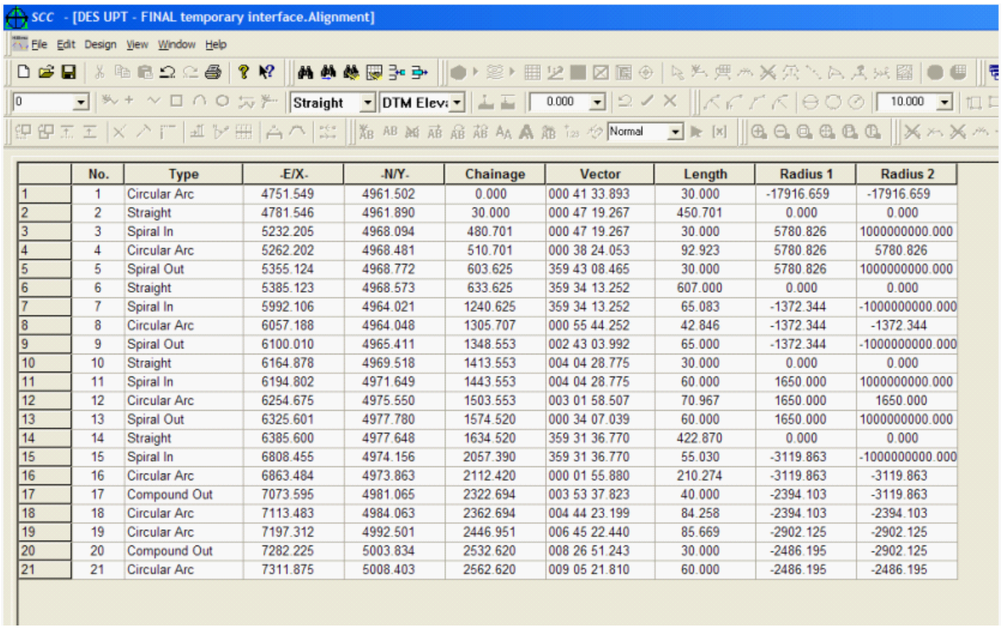
Import the alignment from LandXML and enter cant

Select 'FILE > Model > LandXML file' and pick the file DES UPT - FINAL temporary interface (18.556m - 2641.176m).xml

This will create a 3d alignment containing the horizontal and vertical entities in the XML file and 3d string model of the same. The initial view will be of the 3d string model in plan.

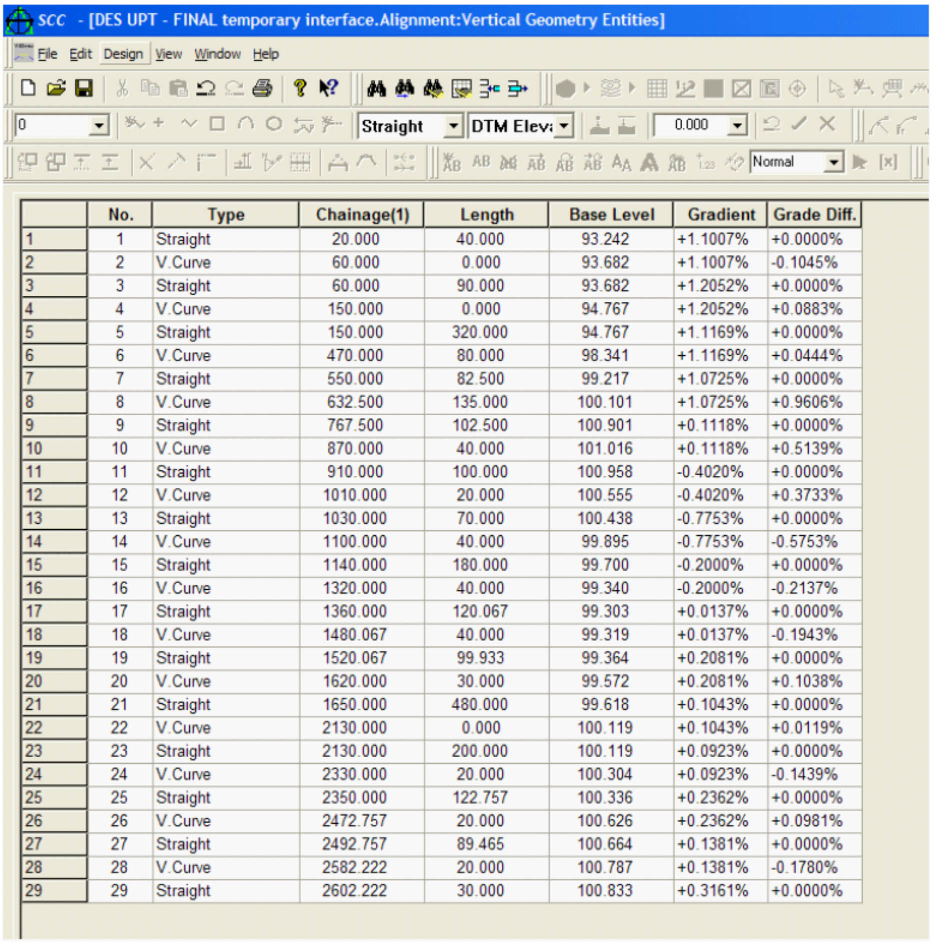


To view the horizontal entities, click the highlighted tab



	No.	Type	-E/X-	-N/Y-	Chainage	Vector	Length	Radius 1	Radius 2
1	1	Circular Arc	4751.549	4961.502	0.000	000 41 33.893	30.000	-17916.659	-17916.659
2	2	Straight	4781.546	4961.890	30.000	000 47 19.267	450.701	0.000	0.000
3	3	Spiral In	5232.205	4968.094	480.701	000 47 19.267	30.000	5780.826	1000000000.000
4	4	Circular Arc	5262.202	4968.481	510.701	000 38 24.053	92.923	5780.826	5780.826
5	5	Spiral Out	5355.124	4968.772	603.625	359 43 08.465	30.000	5780.826	1000000000.000
6	6	Straight	5385.123	4968.573	633.625	359 34 13.252	607.000	0.000	0.000
7	7	Spiral In	5992.106	4964.021	1240.625	359 34 13.252	65.083	-1372.344	-1000000000.000
8	8	Circular Arc	6057.188	4964.048	1305.707	000 55 44.252	42.846	-1372.344	-1372.344
9	9	Spiral Out	6100.010	4965.411	1348.553	002 43 03.992	65.000	-1372.344	-1000000000.000
10	10	Straight	6164.878	4969.518	1413.553	004 04 28.775	30.000	0.000	0.000
11	11	Spiral In	6194.802	4971.649	1443.553	004 04 28.775	60.000	1650.000	1000000000.000
12	12	Circular Arc	6254.675	4975.550	1503.553	003 01 58.507	70.967	1650.000	1650.000
13	13	Spiral Out	6325.601	4977.780	1574.520	000 34 07.039	60.000	1650.000	1000000000.000
14	14	Straight	6385.600	4977.648	1634.520	359 31 36.770	422.870	0.000	0.000
15	15	Spiral In	6808.455	4974.156	2057.390	359 31 36.770	55.030	-3119.863	-1000000000.000
16	16	Circular Arc	6863.484	4973.863	2112.420	000 01 55.880	210.274	-3119.863	-3119.863
17	17	Compound Out	7073.595	4981.065	2322.694	003 53 37.823	40.000	-2394.103	-3119.863
18	18	Circular Arc	7113.483	4984.063	2362.694	004 44 23.199	84.258	-2394.103	-2394.103
19	19	Circular Arc	7197.312	4992.501	2446.951	006 45 22.440	85.669	-2902.125	-2902.125
20	20	Compound Out	7282.225	5003.834	2532.620	008 26 51.243	30.000	-2486.195	-2902.125
21	21	Circular Arc	7311.875	5008.403	2562.620	009 05 21.810	60.000	-2486.195	-2486.195

To view the vertical entities, select 'VIEW > Vertical Entities'



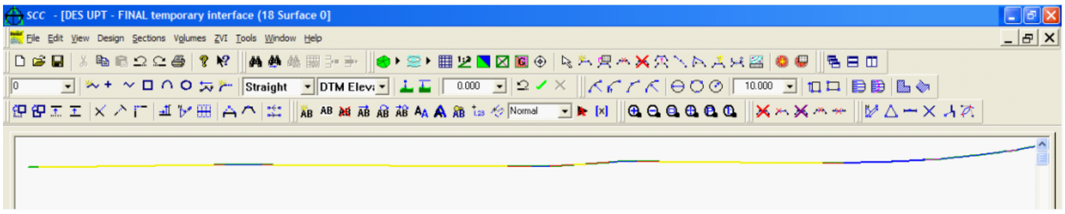
	No.	Type	Chainage(1)	Length	Base Level	Gradient	Grade Diff.
1	1	Straight	20.000	40.000	93.242	+1.1007%	+0.0000%
2	2	V.Curve	60.000	0.000	93.682	+1.1007%	-0.1045%
3	3	Straight	60.000	90.000	93.682	+1.2052%	+0.0000%
4	4	V.Curve	150.000	0.000	94.767	+1.2052%	+0.0883%
5	5	Straight	150.000	320.000	94.767	+1.1169%	+0.0000%
6	6	V.Curve	470.000	80.000	98.341	+1.1169%	+0.0444%
7	7	Straight	550.000	82.500	99.217	+1.0725%	+0.0000%
8	8	V.Curve	632.500	135.000	100.101	+1.0725%	+0.9606%
9	9	Straight	767.500	102.500	100.901	+0.1118%	+0.0000%
10	10	V.Curve	870.000	40.000	101.016	+0.1118%	+0.5139%
11	11	Straight	910.000	100.000	100.958	-0.4020%	+0.0000%
12	12	V.Curve	1010.000	20.000	100.555	-0.4020%	+0.3733%
13	13	Straight	1030.000	70.000	100.438	-0.7753%	+0.0000%
14	14	V.Curve	1100.000	40.000	99.895	-0.7753%	-0.5753%
15	15	Straight	1140.000	180.000	99.700	-0.2000%	+0.0000%
16	16	V.Curve	1320.000	40.000	99.340	-0.2000%	-0.2137%
17	17	Straight	1360.000	120.067	99.303	+0.0137%	+0.0000%
18	18	V.Curve	1480.067	40.000	99.319	+0.0137%	-0.1943%
19	19	Straight	1520.067	99.933	99.364	+0.2081%	+0.0000%
20	20	V.Curve	1620.000	30.000	99.572	+0.2081%	+0.1038%
21	21	Straight	1650.000	480.000	99.618	+0.1043%	+0.0000%
22	22	V.Curve	2130.000	0.000	100.119	+0.1043%	+0.0119%
23	23	Straight	2130.000	200.000	100.119	+0.0923%	+0.0000%
24	24	V.Curve	2330.000	20.000	100.304	+0.0923%	-0.1439%
25	25	Straight	2350.000	122.757	100.336	+0.2362%	+0.0000%
26	26	V.Curve	2472.757	20.000	100.626	+0.2362%	+0.0981%
27	27	Straight	2492.757	89.465	100.664	+0.1381%	+0.0000%
28	28	V.Curve	2582.222	20.000	100.787	+0.1381%	-0.1780%
29	29	Straight	2602.222	30.000	100.833	+0.3161%	+0.0000%

You can change gradient units between ratios, e.g. 1:2, to percentages using **'FILE > General Options > Units and data checking'**

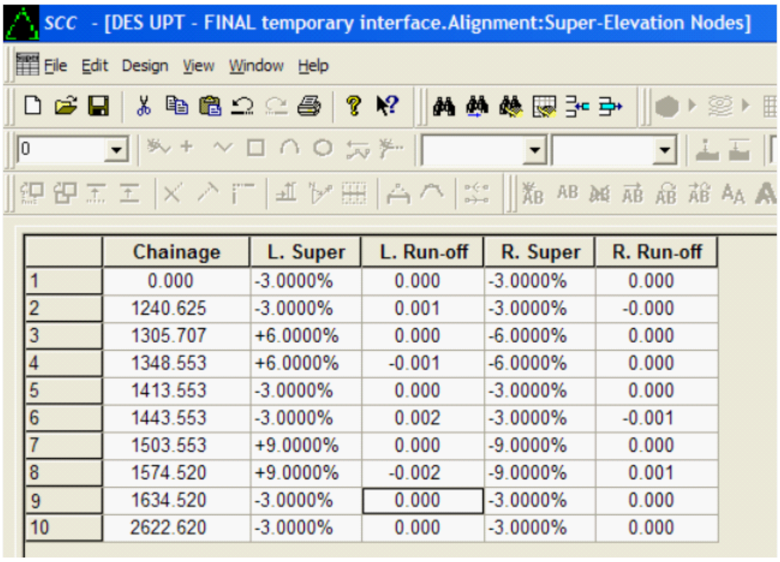
Note that in the data provided, the horizontal alignment is slightly shorter than the vertical alignment, so you may wish to edit the length of final horizontal entity. Once you are happy with the alignments, select **'FILE > Save to'** save the alignment file.

To view the horizontal entities in plan, switch back to plan view and select

'FILE > Attach> Detach > Attach Alignment File, picking the file DES DR CL - 644.Alignment



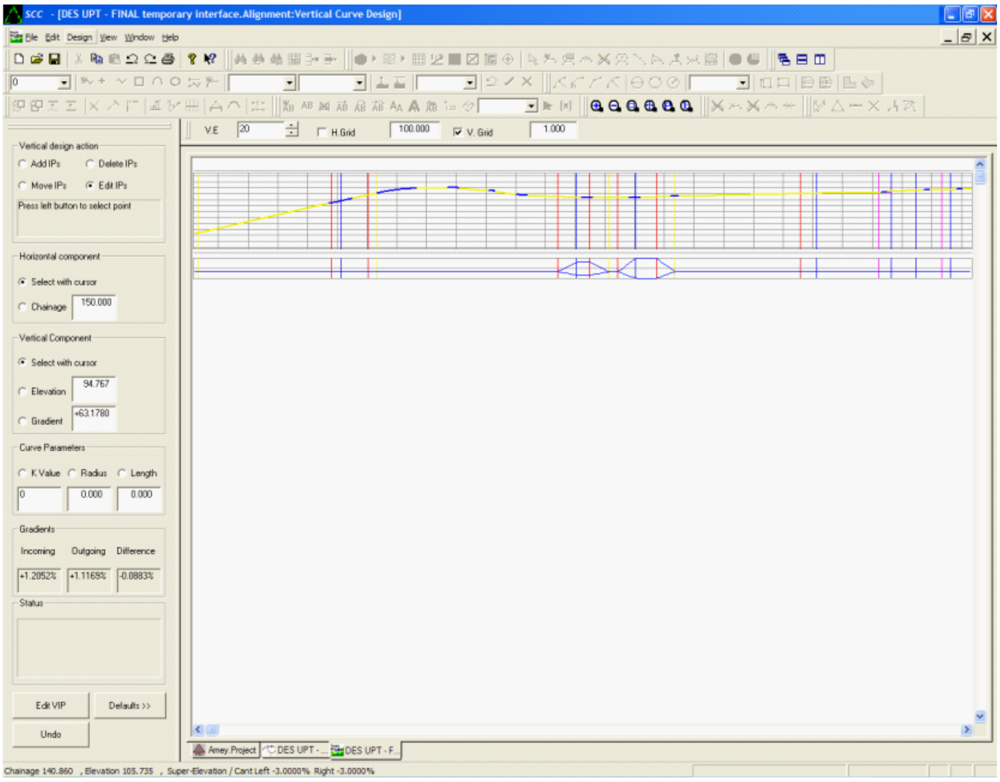
You will see the alignment drawn with straights in yellow, transitions in red, and circular arcs in blue. As you move around the screen you will also see the chainage and offset of the cursor position being updated.



	Chainage	L. Super	L. Run-off	R. Super	R. Run-off
1	0.000	-3.0000%	0.000	-3.0000%	0.000
2	1240.625	-3.0000%	0.001	-3.0000%	-0.000
3	1305.707	+6.0000%	0.000	-6.0000%	0.000
4	1348.553	+6.0000%	-0.001	-6.0000%	0.000
5	1413.553	-3.0000%	0.000	-3.0000%	0.000
6	1443.553	-3.0000%	0.002	-3.0000%	-0.001
7	1503.553	+9.0000%	0.000	-9.0000%	0.000
8	1574.520	+9.0000%	-0.002	-9.0000%	0.001
9	1634.520	-3.0000%	0.000	-3.0000%	0.000
10	2622.620	-3.0000%	0.000	-3.0000%	0.000

If you have any cant, you can enter this in using **'VIEW > Super-elevation > Cant'**. Selecting **'DESIGN > Compute super-elevation > Cant'** will place cant nodes at transitions, allowing you to enter cant values and run-off for each node.

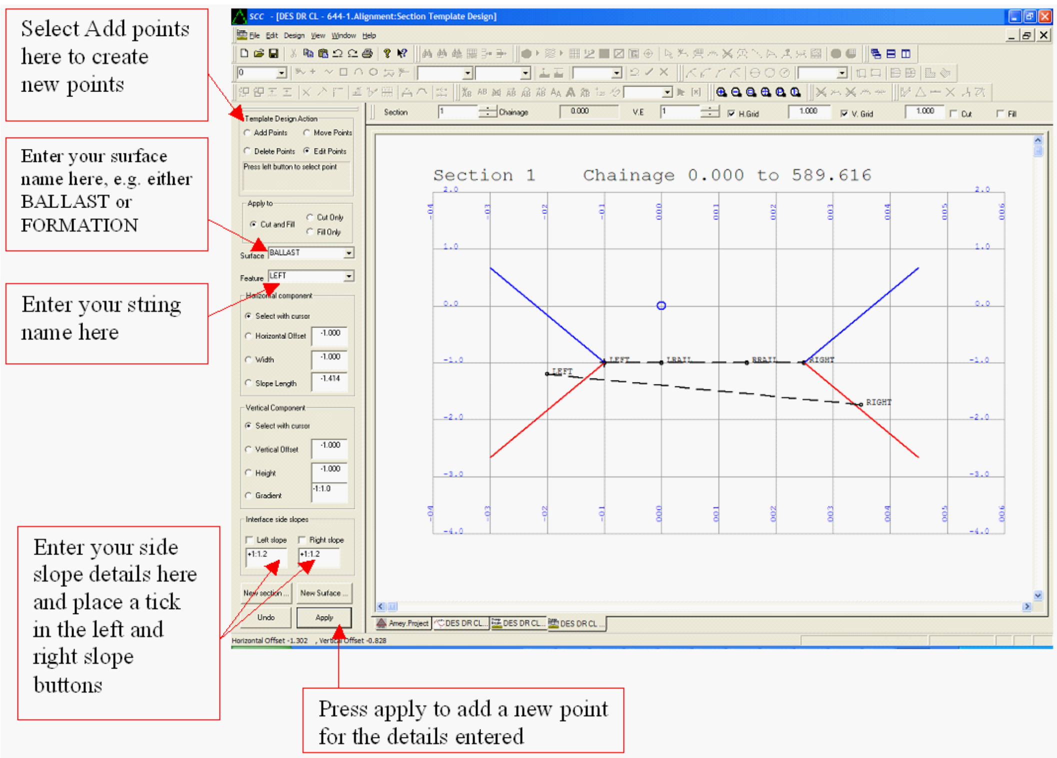
To inspect the vertical profile graphically, this can be done from plan view by selecting **'DESIGN > Vertical Alignment'**. Vertical straights are shown in yellow and parabolic curves in blue. The positions of horizontal changes are shown as yellow, red or blue vertical lines. As you move the mouse on screen, the chainage and height of the current cursor position is displayed.



Below the vertical profile you will also see a diagram showing application of cant > super-elevation by chainage. This is also interpolated and updated in the status bar for the current cursor position as you move the mouse.

Cross Section Templates

Select 'DESIGN > Section Templates' to bring up the template design screen as shown.



Enter the following points to build the section templates as shown

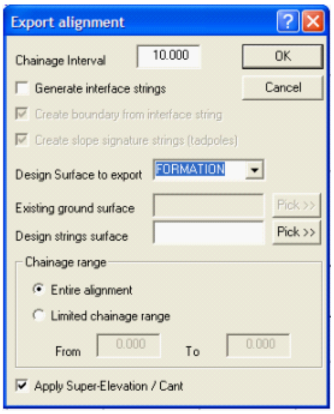
Surface	Feature	Hz.Offset	Vt.Offset
BALLAST	LEFT	-1.000	-1.000
BALLAST	LRAIL	0.000	-1.000
BALLAST	RRAIL	1.500	-1.000
BALLAST	RIGHT	2.500	-1.000
FORMATION	LEFT	-2.000	-1.200
FORMATION	RIGHT	3.500	-1.736

The values given here are arbitrary intended to illustrate the process. You can enter real values either using horizontal and vertical offsets, or any combination of offsets, height differences, widths and gradients. The small blue circle on the template indicates the position of the centerline.

Once you have entered the template points, select **'FILE > Save to'** save your work. You can also view, enter and edit these points in spreadsheet fashion by selecting **'VIEW > Section template points'**

Create the surface models

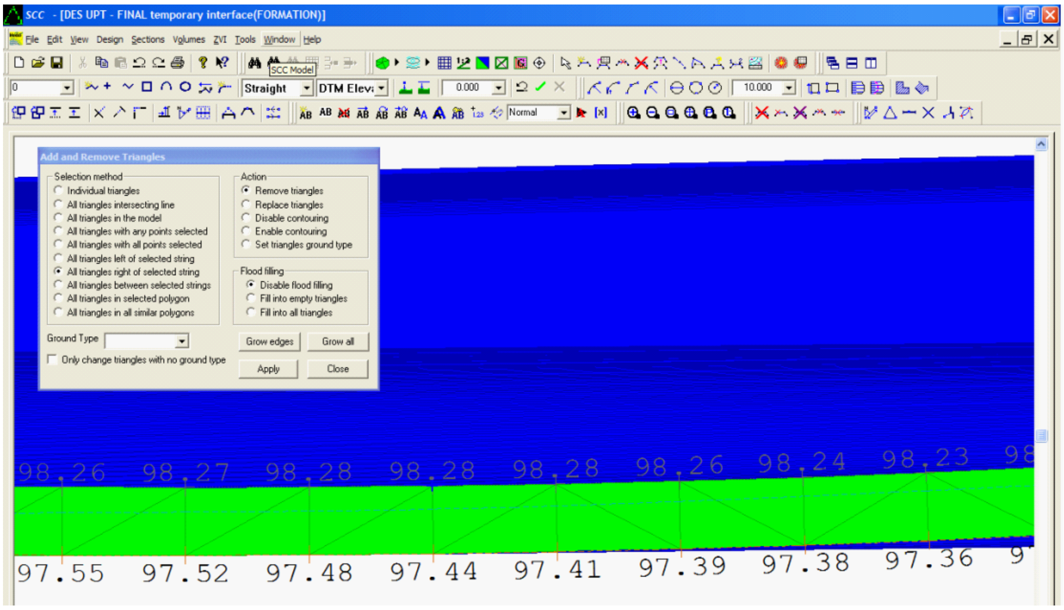
From the section template view, select **'Design > Export design as model',** and enter the following parameters to export the formation model.



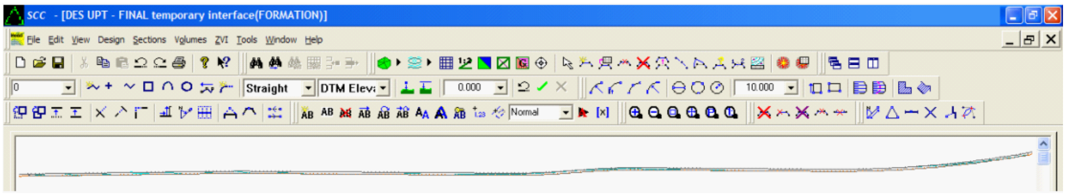
Note that the chainage interval controls the number of points that will be output to the triangulated surface. A higher number can give better representation of horizontal and vertical curves in the triangulated surface, at the expense of a larger model.

If you do not wish to apply cant to this surface your can also disable it at this point.

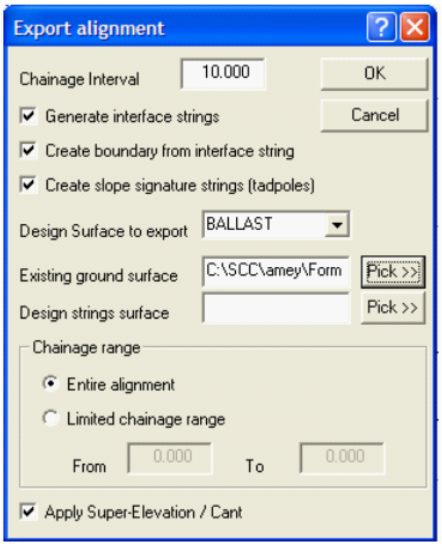
To remove any spurious triangles around the model boundary, use the Add / Remove triangles tool. Use the options to remove all triangles to the left of the left edge and to the right of the right edge (lower on screen).



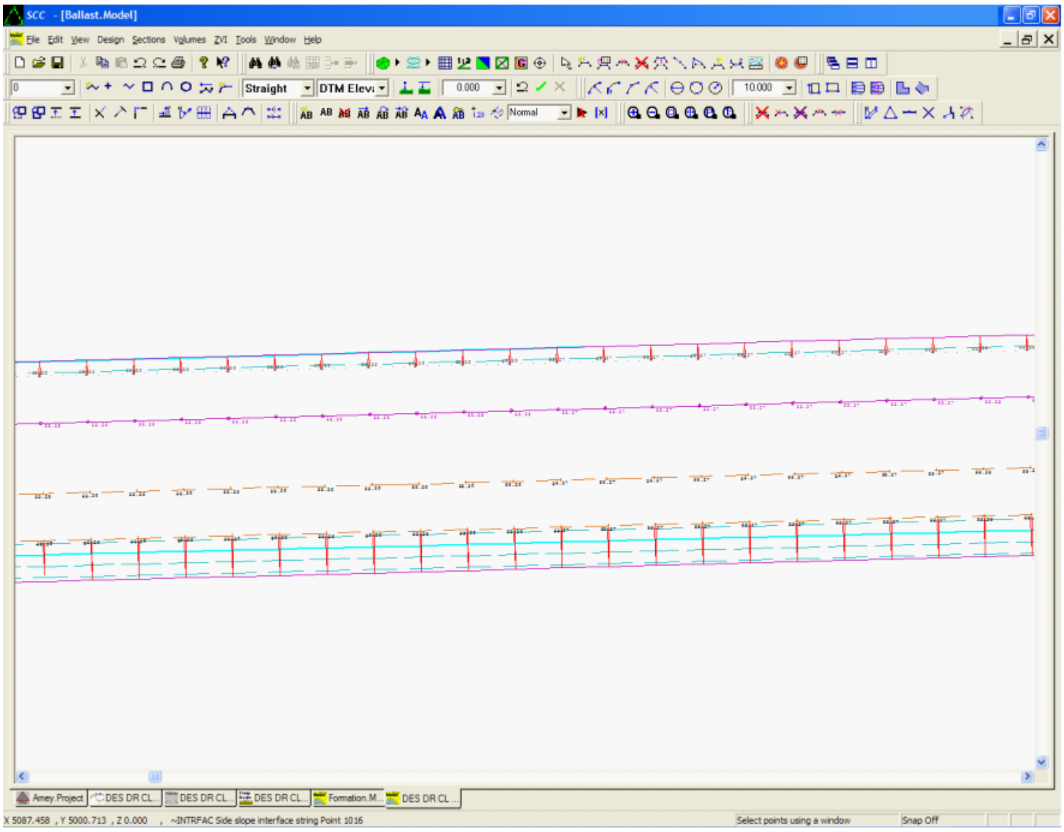
The final triangulated surface will appear as follows. Select **'FILE > Save'** once your are done, giving a name of Formation.Model



To export the bottom ballast surface, go back to the section template view and select **'DESIGN > Export design as model'** using the following parameters;

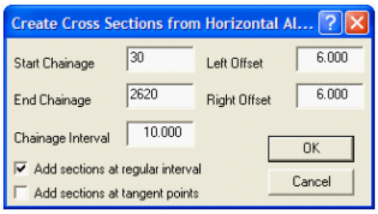


Note that we have picked the formation model as our existing ground surface and instructed SCC to generate an interface between these surfaces using the side slopes entered in the section template. When you zoom into the resulting model you will see red tadpoles connecting the edge of the ballast surface down to the formation surface.



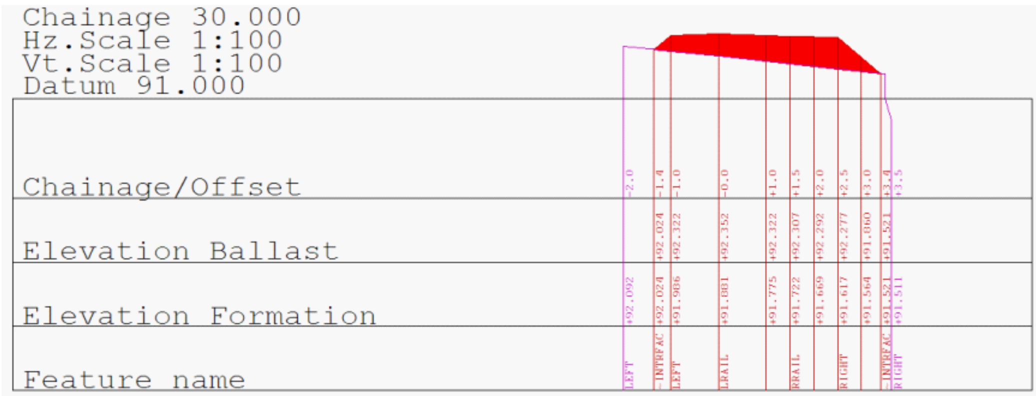
To verify the correctness of the surfaces generated we will cut some cross-sections through them.

Select 'FILE > Attach/Detach > Attach Alignment File', picking the file DES UPT - FINAL temporary interface.Alignment and then pick 'Sections > Cross sections' from an alignment using the parameters shown;



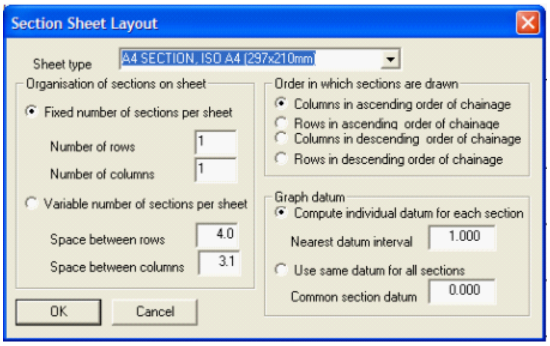
From the section view, select 'EDIT > Append surfaces' and pick the formation model.

This will result in sections as shown below:



To get an animated run through of the sections, use 'VIEW > Sheet layout' with the parameters

shown below;



Press + to move up the chainages and – to move back down. It is valuable to use this to check chainages where cant changes around transitions.

Note: If you want to apply a template position to points after cant has been applied, this can be done as follows;

- Exporting the surface with cant
- In plan view use **'Design > Create an alignment from an existing string'** to create a new alignment

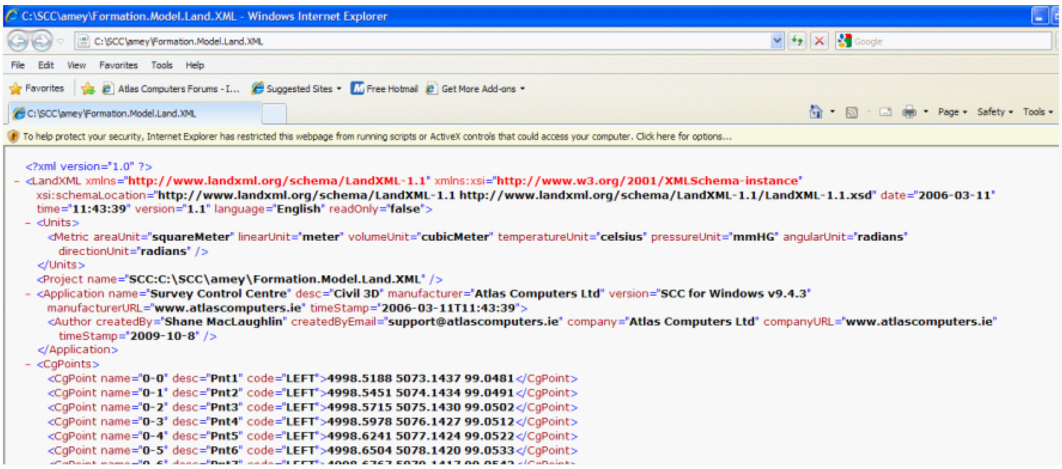
Add the second template to this alignment and proceed as described above.

Export LandXML files

To export a LandXML file for a given model, open the model and select 'FILE > Export > LandXML.'

Doing this for Ballast.Model and Formation.Model will result in the files Ballast.Model.Land.XML and Formation.Model.Land.XML.

These files can be opened in Internet explorer as shown below.

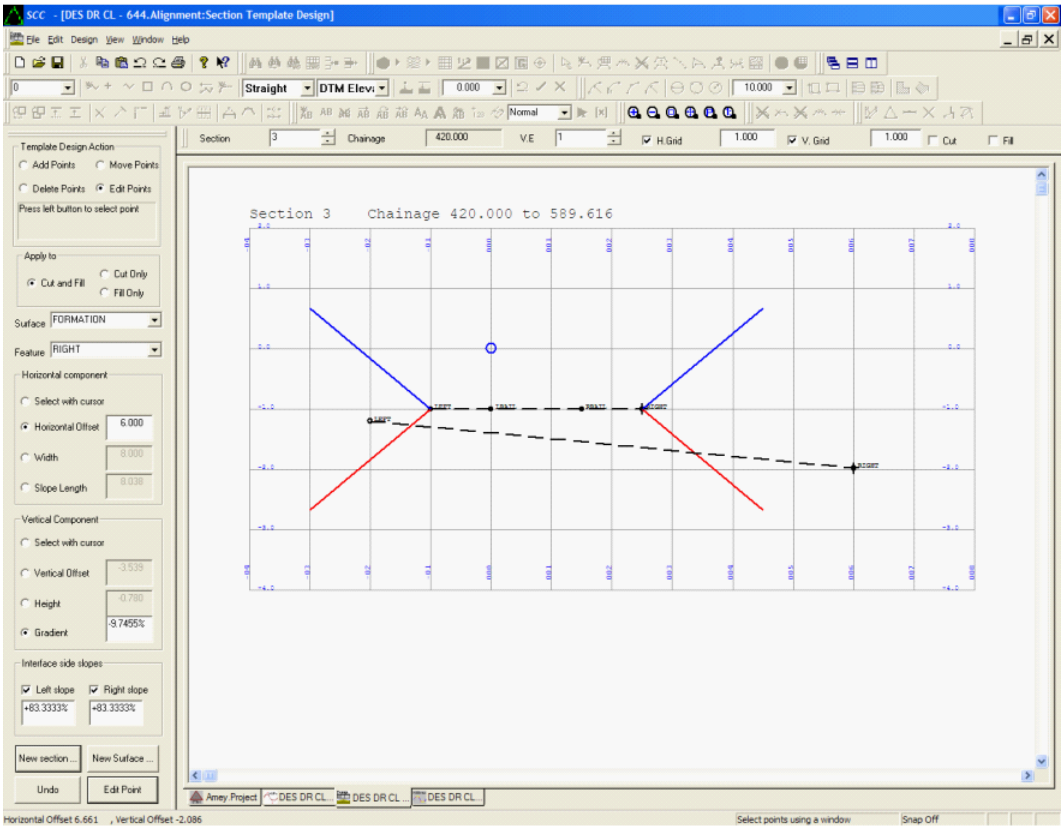


Examining the XML files shows they contain points, strings, breaklines and the triangulated surface

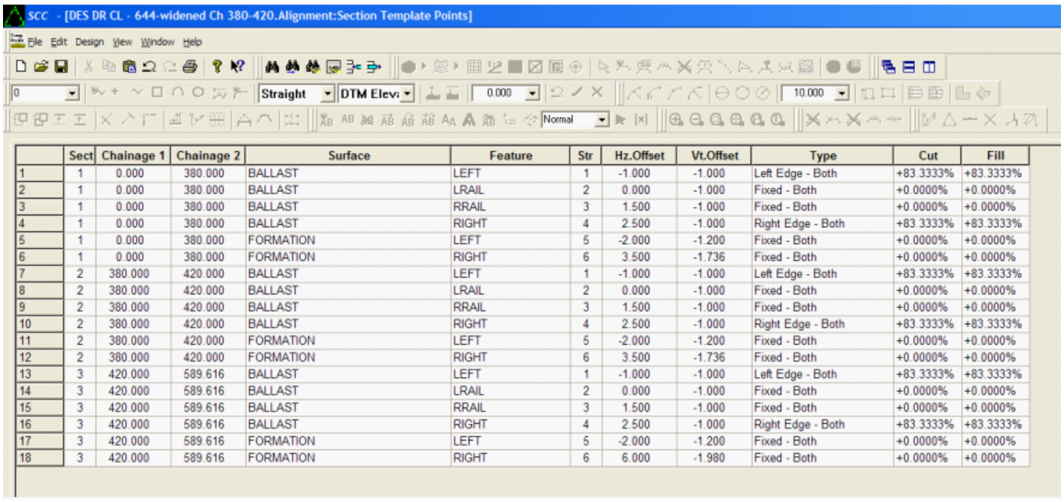
Note: Widening or narrowing at a given chainage

To widen or narrow an alignment between given chainages we need to create extra templates. For example say we wished to widen the formation surface between chainages 380 and 420, we would do the following;

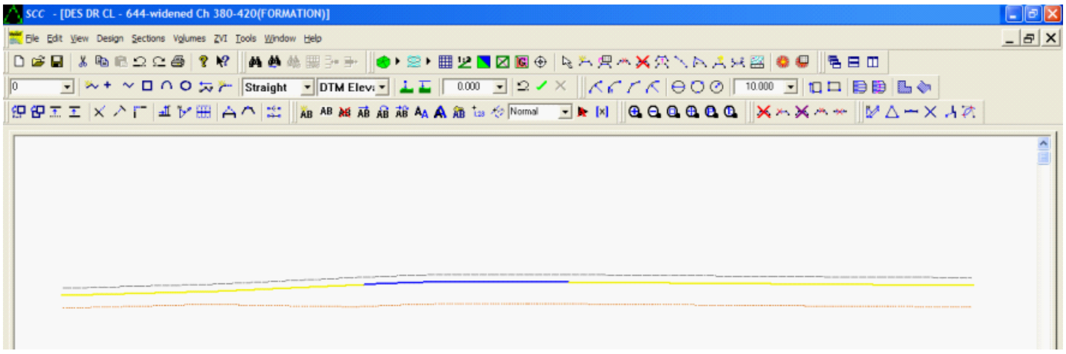
- In section template view, press the New section button and create a new section at chainage 380.
- Press the New section button again, and create another section at chainage 420.
- Edit the right formation edge to have a new offset and/ or height as required
- Export to a model as described previously.



Viewing the section template points shows we now have three sections, each containing all the strings for both surfaces. The first and second sections, starting at chainages 0 and 380, are the same indicating there is no change between these chainages. The third section, at chainage 420, has a modified height and offset values for the right formation level. This means that there will be a linear change of height and offsets between chainages 380 and 420. As there are no further sections after chainage 420, the section template at 420 will be carried to the end of the alignment.



	Sect	Chainage 1	Chainage 2	Surface	Feature	Str	Hz.Offset	Vt.Offset	Type	Cut	Fill
1	1	0.000	380.000	BALLAST	LEFT	1	-1.000	-1.000	Left Edge - Both	+83.3333%	+83.3333%
2	1	0.000	380.000	BALLAST	LRAIL	2	0.000	-1.000	Fixed - Both	+0.0000%	+0.0000%
3	1	0.000	380.000	BALLAST	RRAIL	3	1.500	-1.000	Fixed - Both	+0.0000%	+0.0000%
4	1	0.000	380.000	BALLAST	RIGHT	4	2.500	-1.000	Right Edge - Both	+83.3333%	+83.3333%
5	1	0.000	380.000	FORMATION	LEFT	5	-2.000	-1.200	Fixed - Both	+0.0000%	+0.0000%
6	1	0.000	380.000	FORMATION	RIGHT	6	3.500	-1.736	Fixed - Both	+0.0000%	+0.0000%
7	2	380.000	420.000	BALLAST	LEFT	1	-1.000	-1.000	Left Edge - Both	+83.3333%	+83.3333%
8	2	380.000	420.000	BALLAST	LRAIL	2	0.000	-1.000	Fixed - Both	+0.0000%	+0.0000%
9	2	380.000	420.000	BALLAST	RRAIL	3	1.500	-1.000	Fixed - Both	+0.0000%	+0.0000%
10	2	380.000	420.000	BALLAST	RIGHT	4	2.500	-1.000	Right Edge - Both	+83.3333%	+83.3333%
11	2	380.000	420.000	FORMATION	LEFT	5	-2.000	-1.200	Fixed - Both	+0.0000%	+0.0000%
12	2	380.000	420.000	FORMATION	RIGHT	6	3.500	-1.736	Fixed - Both	+0.0000%	+0.0000%
13	3	420.000	589.616	BALLAST	LEFT	1	-1.000	-1.000	Left Edge - Both	+83.3333%	+83.3333%
14	3	420.000	589.616	BALLAST	LRAIL	2	0.000	-1.000	Fixed - Both	+0.0000%	+0.0000%
15	3	420.000	589.616	BALLAST	RRAIL	3	1.500	-1.000	Fixed - Both	+0.0000%	+0.0000%
16	3	420.000	589.616	BALLAST	RIGHT	4	2.500	-1.000	Right Edge - Both	+83.3333%	+83.3333%
17	3	420.000	589.616	FORMATION	LEFT	5	-2.000	-1.200	Fixed - Both	+0.0000%	+0.0000%
18	3	420.000	589.616	FORMATION	RIGHT	6	6.000	-1.980	Fixed - Both	+0.0000%	+0.0000%



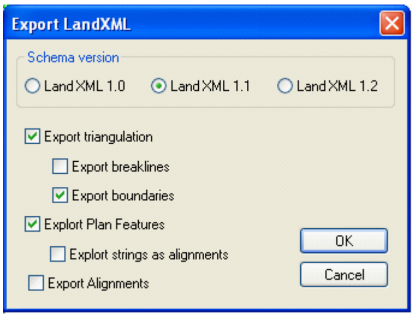
21 Working With AutoCAD Civil3D Files

21.1 Exporting TIN models from SCC to Civil 3d

The following examines how to export a triangulated surface from SCC to Civil 3d using the LandXML format. It is based around SCC 10.0.6 and Civil 3d 2013. The steps are as follows:

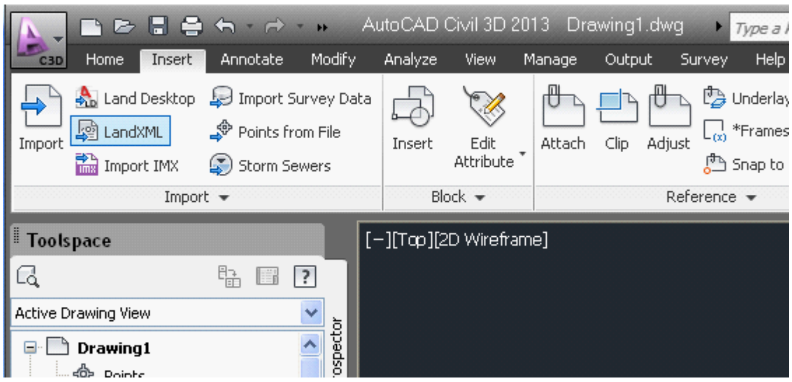
Open your model in SCC

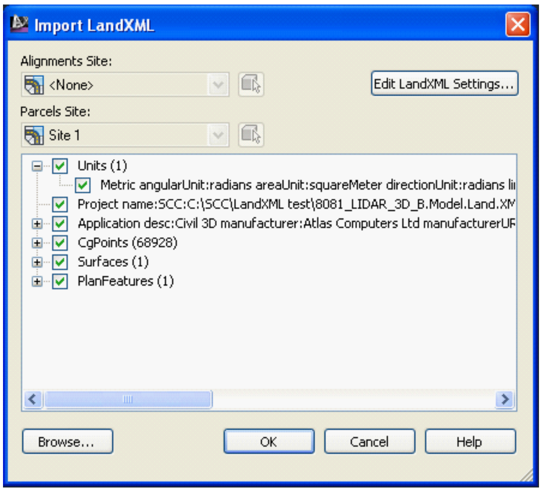
Select 'FILE > Export > LandXML' using the following parameters



Open Civil3d and start a new blank drawing

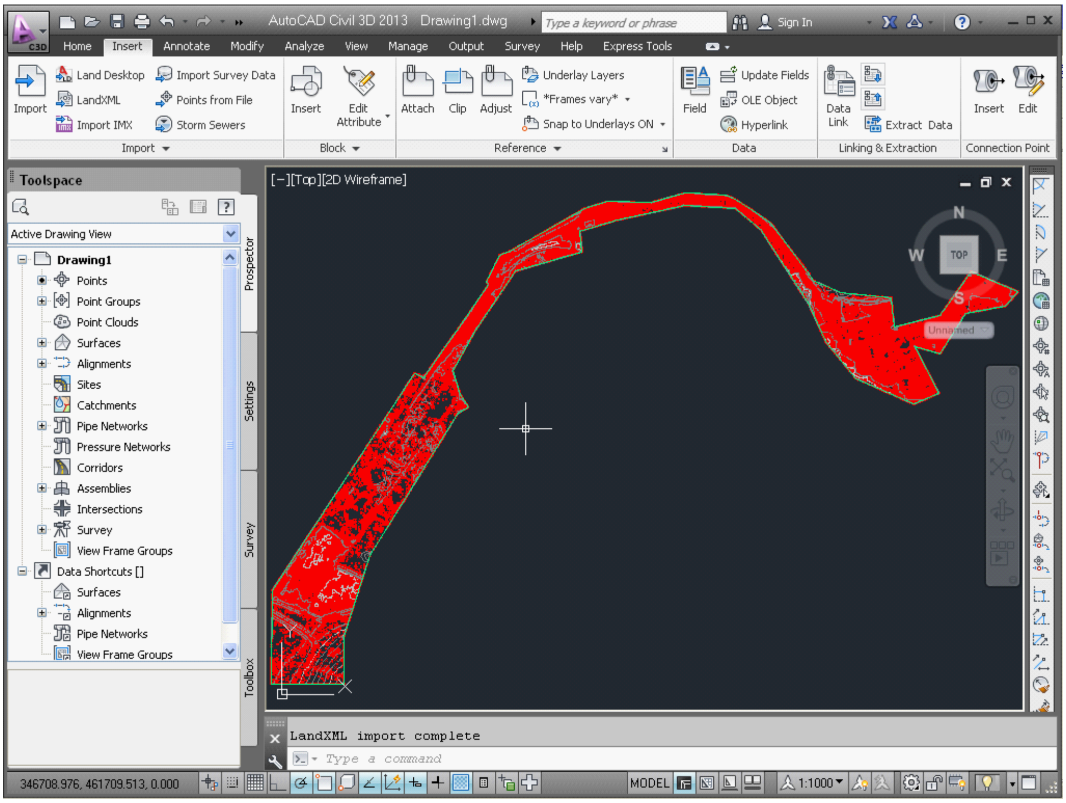
Select 'Insert > LandXML'

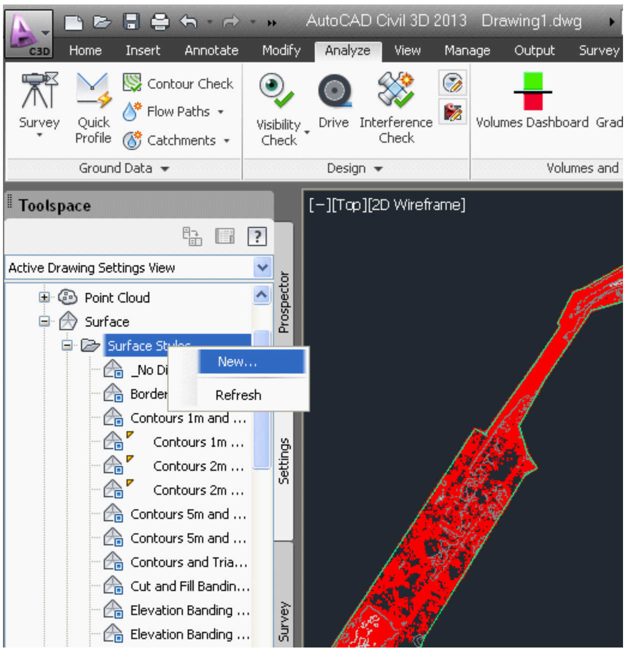




Pick the LandXML file created in SCC, the file contains a large number of points and one surface that corresponds to the TIN surface

When drawn initially in Civil3d it may not show the TIN, depending on the default surface style set in use.





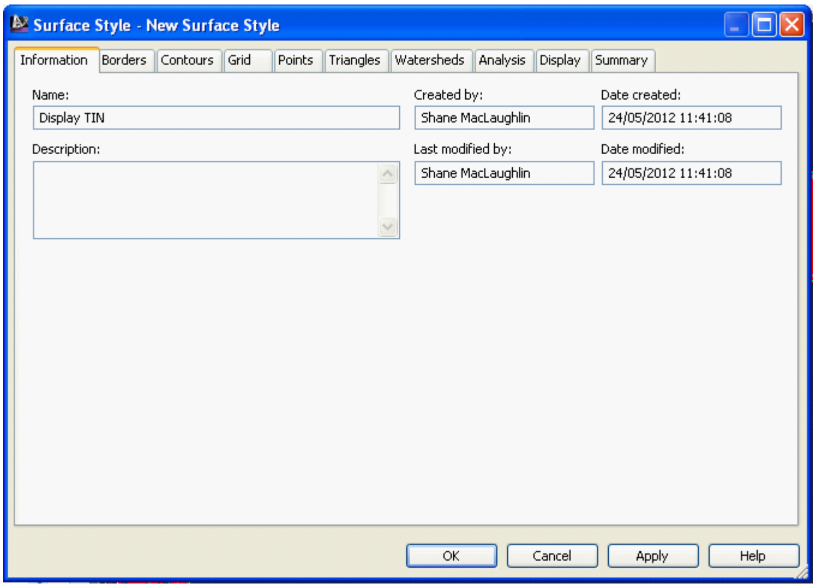
To display the TIN, first create a style set with triangles turned on as follows:

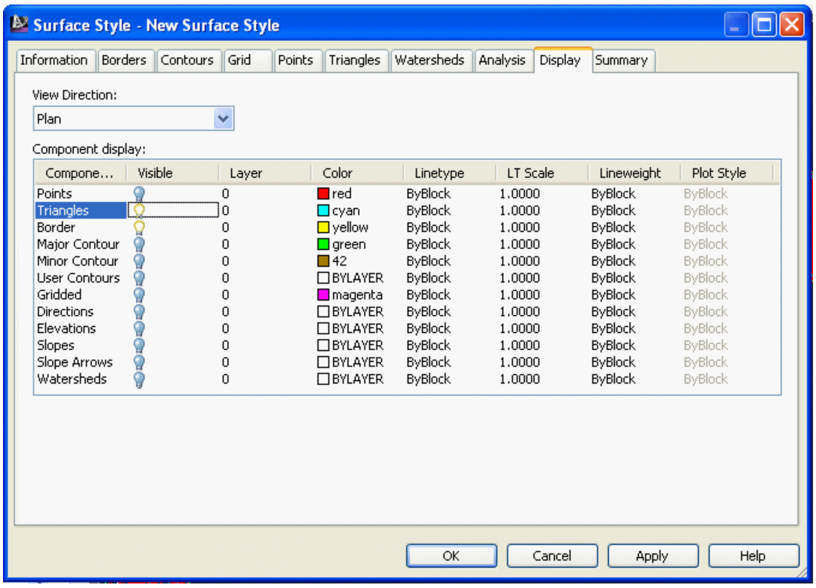
Click New in the Surfaces section of the Settings pane in the Toolspace.

Give your new surface style a name, e.g. Display TIN

In the Display tab, turn on the triangles

Press Ok to close the dialog





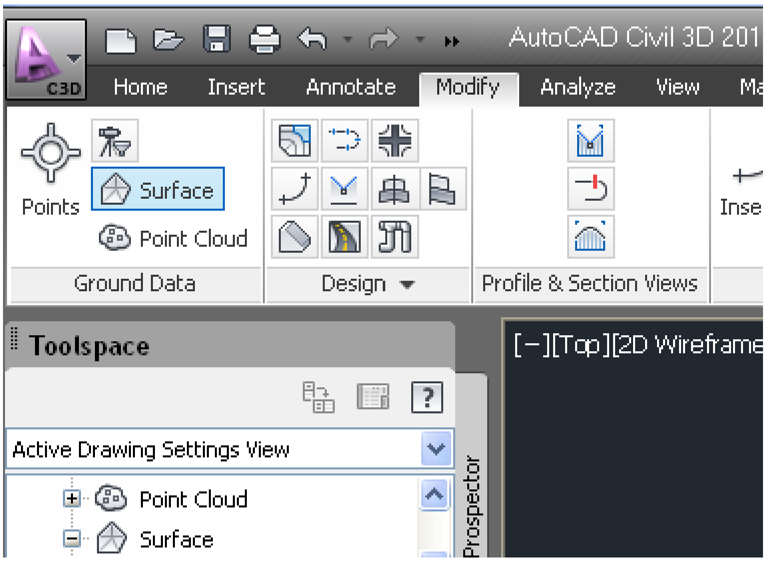
To apply the style set to the surface:

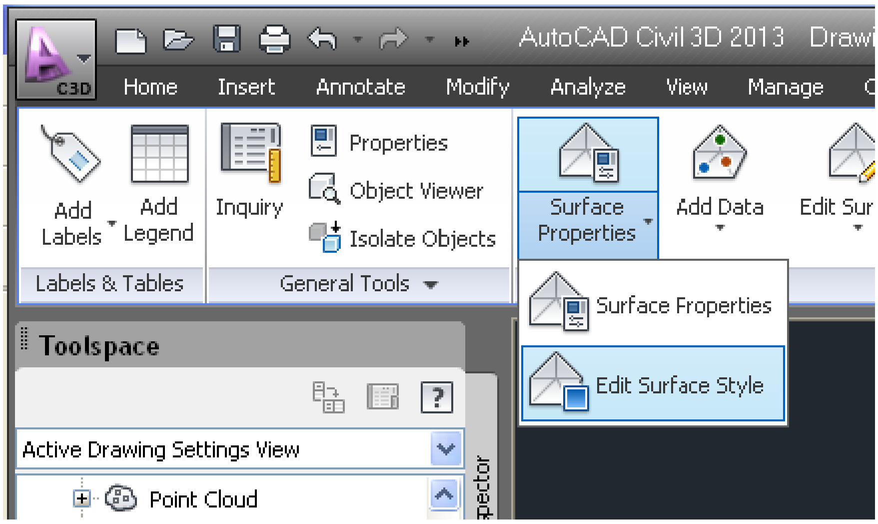
Click 'MODIFY > Surface'

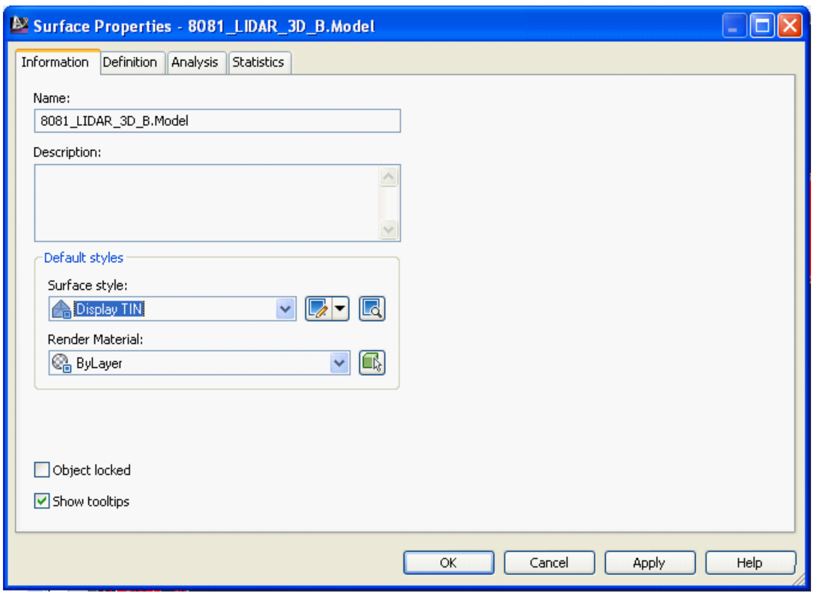
Click 'SURFACE > Properties'

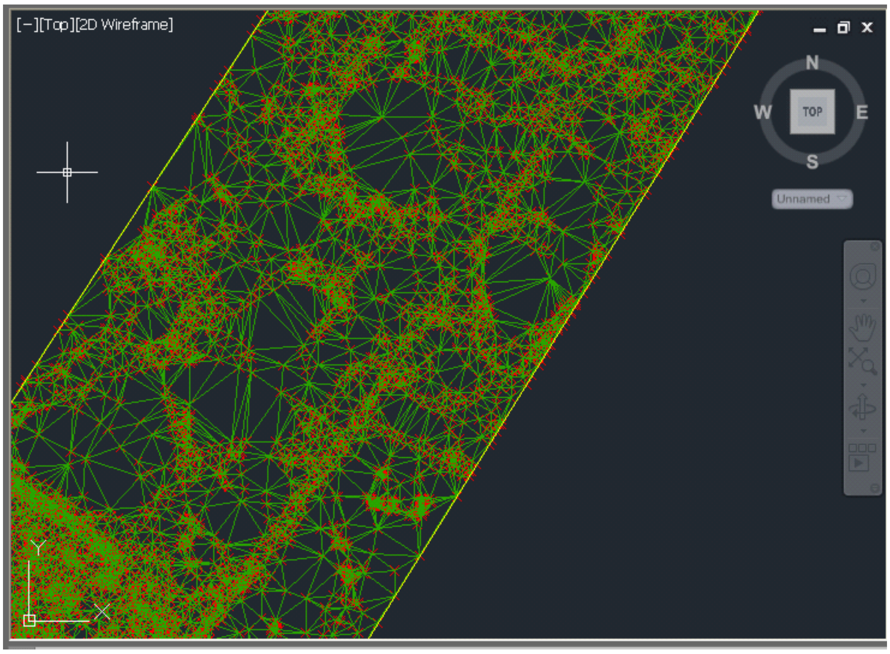
Select the appropriate style e.g. Display TIN, as the surface style

Press Ok


AutoCAD Civil 3D 201
Home
Insert
Annotate
Modify
Analyze
View
Points
Surface
Point Cloud
Ground Data
Design
Profile & Section Views
Toolspace
Active Drawing Settings View
Point Cloud
Surface
Prospector
[-][Top][2D Wireframe


AutoCAD Civil 3D 2013
Home
Insert
Annotate
Modify
Analyze
View
Manage
Add Labels
Add Legend
Inquiry
Properties
Object Viewer
Isolate Objects
Surface Properties
Add Data
Labels & Tables
General Tools
Surface Properties
Edit Surface Style
Toolspace
Active Drawing Settings View
Point Cloud


Surface Properties - 8081_LIDAR_3D_B.Model
Information
Definition
Analysis
Statistics
Name:
8081_LIDAR_3D_B.Model
Description:
Default styles
Surface style:
Display TIN
Render Material:
ByLayer
Object locked
Show tooltips
OK
Cancel
Apply
Help



Triangles are now displayed and can be used for analysis.

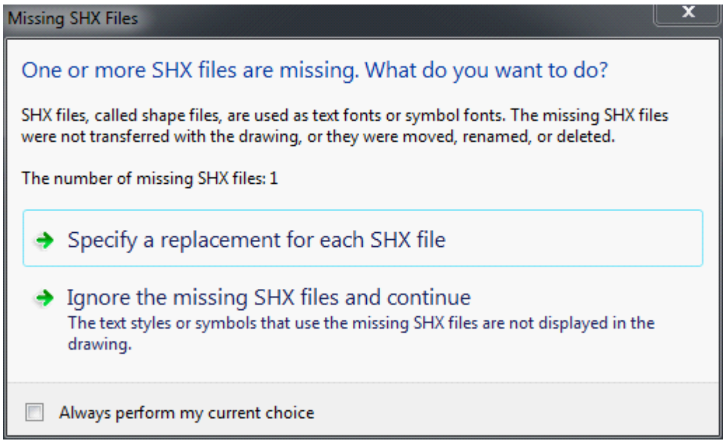
21.2 Importing AutoCAD Civil3D files into SCC

The following details the exporting of specific design entities from AutoCAD Civil3D 2013 which are then imported and modelled in SCC.

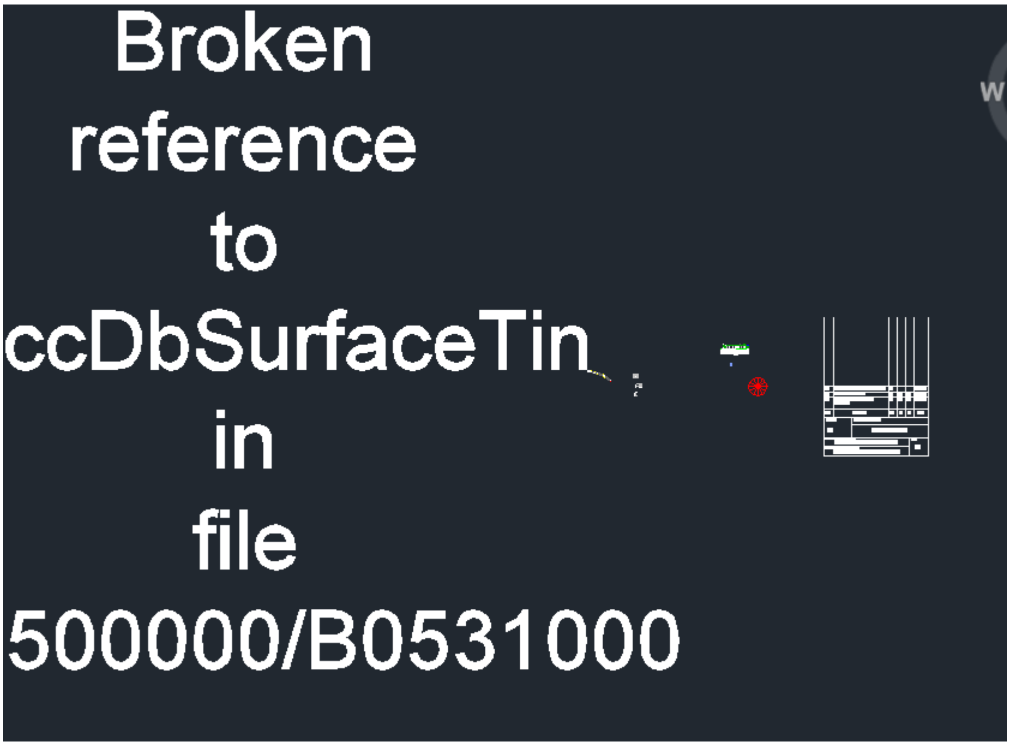
Exporting Specific Entities from AutoCAD Civil3D

Open the drawing file in AutoCAD.

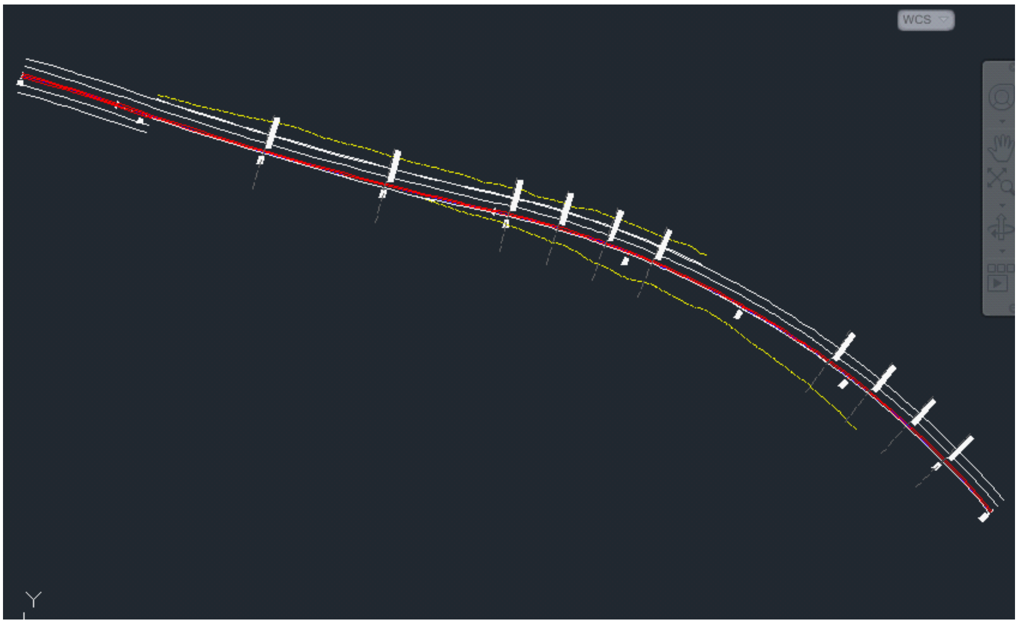
Note in some instance a message as shown below will detail that the drawing may be missing some shape files and xrefs. For the purpose of the demo this message is ignored. The error message will not appear if the file is opened on a PC where the files are available locally.



In the sample shown, the missing references appear as huge text in the drawing, where the area of interest to be exported is at the bottom right of the word Tin.



Zoom into the area of interest, and type in SAVEAS to save a copy of the file under a new name.



Type EXPLODE and select the corridor, to convert the entire C3D corridor object into an AutoCAD block.

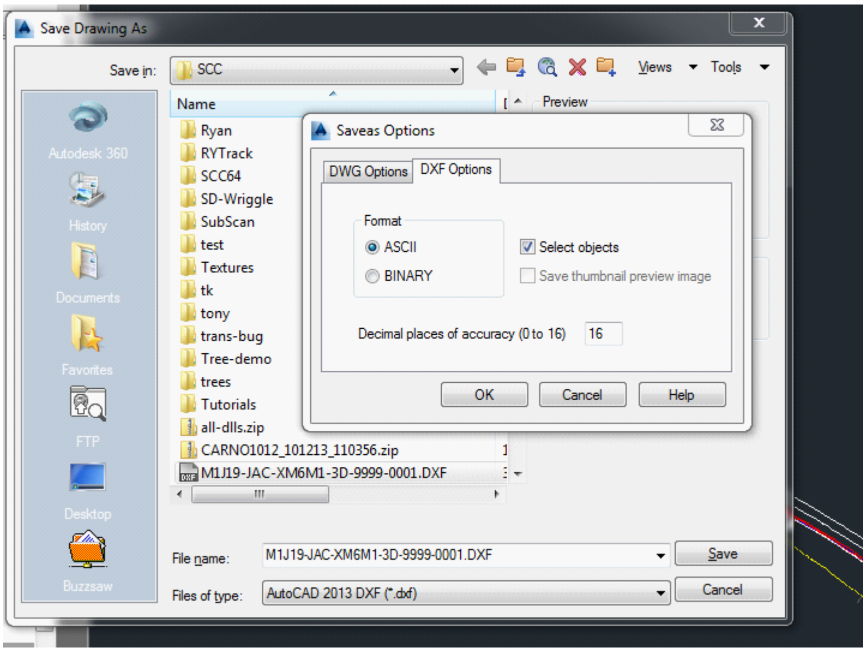
Type EXPLODE again to convert the block into simple entities.

Type DXFOUT to save these entities to a DXF file.

On the Tools menu of the Save Drawing As dialog, pick Select Entities, as this option allows for just the road corridor entities.

Enter a name and press Save.

Use the mouse to drag a window around the area of interest, and press Enter.

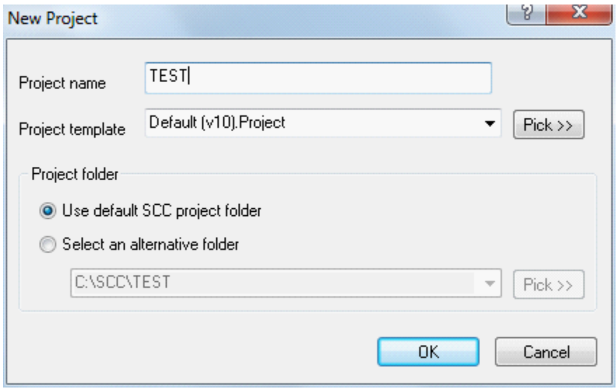


Close Civil 3d

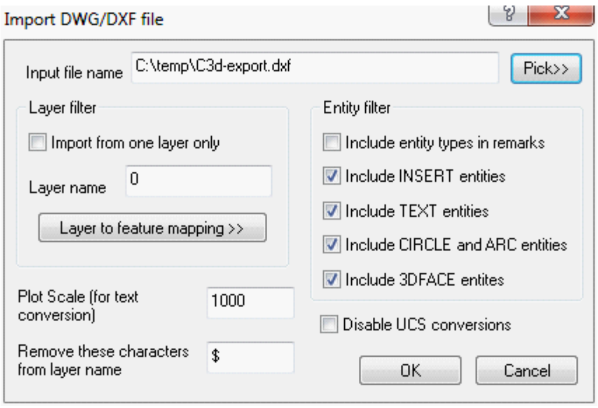
Importing Entities from AutoCAD Civil3D into SCC

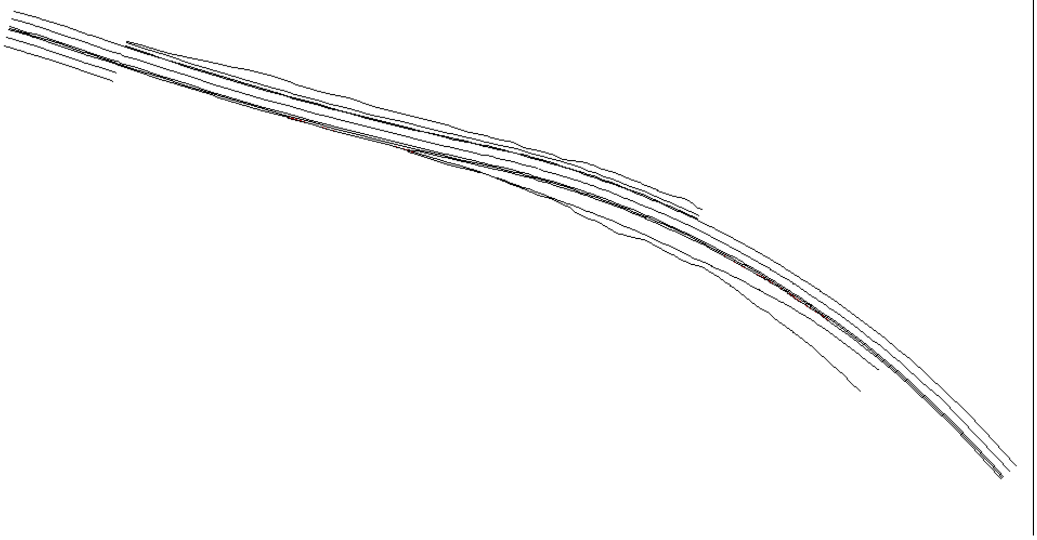
Open SCC

'FILE > New Project', to create a new project, or open an existing project



'FILE > Model > DXF or DWG' and pick the file just created

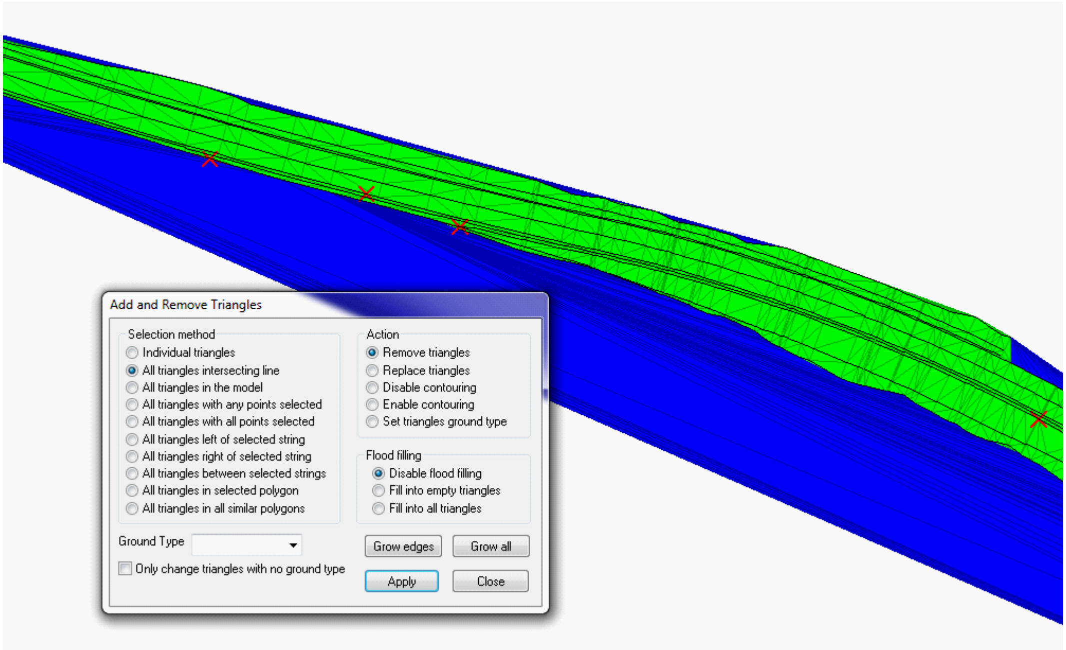




The data from Civil3d is all line segments, use 'TOOLS > Join adjacent strings (Same feature)' to convert them back to polylines.

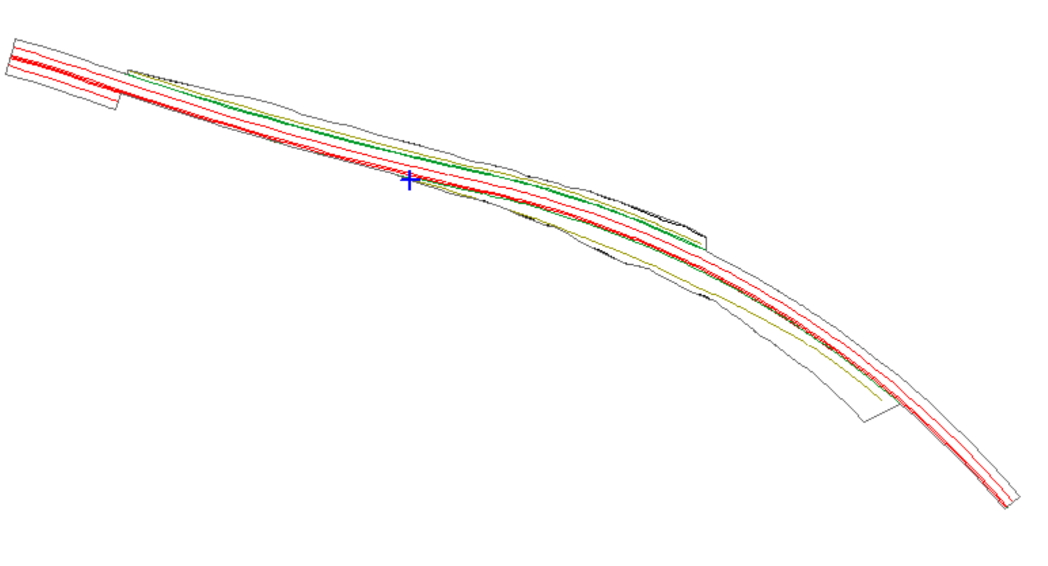
Right click to select all the points in the model, and pick a DTM code of DTM elevation to ensure all points are triangulated for contouring, sectioning, etc...

Use 'EDIT > Add/Remove triangles' to limit the extents of the triangulation and form a boundary .



Use 'EDIT > Query & edit points' to set feature colours and line styles as required.

When prompted save the changes to the feature library, such that the feature library can be used as a template for future imports, such that this step is not necessary in future.



Notes:

If specific design lines are required out of Civil3d you can export the data as polylines, as described below. This is fine for a few lines but would become cumbersome on a large design as each line has to be done individually.

Exporting Feature Lines as Polylines

Export polylines from corridor feature lines.

Use this option if you want to use the corridor geometry for another purpose, such as for drafting or for surface data.

To export corridor feature lines as polylines

1. Click Home tab ➤ Create Design panel ▾ Create Polyline From Corridor.
2. In the drawing, click the corridor feature line. If you make an ambiguous selection, the Select A Feature Line dialog box is displayed. Select a feature line from the list.

   The feature line is exported as a polyline. The feature line's point code is displayed at the command line.

Ribbon

Home tab ➤ Create Design panel ▾ Create Polyline From Corridor

Command Line

CreatePolylineFromCorrdor

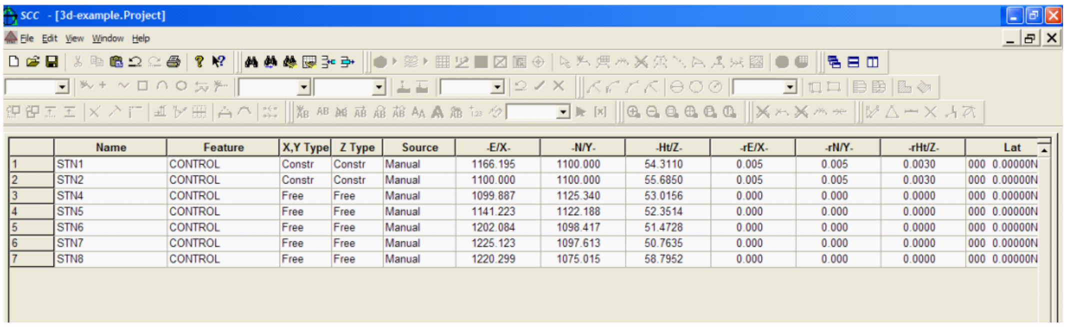
Dialog Box

Select a Feature Line

The TIN and alignments can be exported from Civil3d in LandXML as required, but this doesn't appear to create line work, so the above method give a better result.

22 Using Adjustment Constraints

Additional fields to enter coordinate constraints against station coordinates, and to include some extra adjustment options to deal with these have been added. Specifically, when you use **'VIEW > Station Coordinates'**, you will see three extra constraint fields, **rE/X, rN/Y and rHt/Z**, which correspond to the known accuracies > standard errors of the stations. You will also notice that the Type field has been broken down into two separate fields for **X,Y Type** and **Z Type**, and that a new type of **Constrained** has been added.



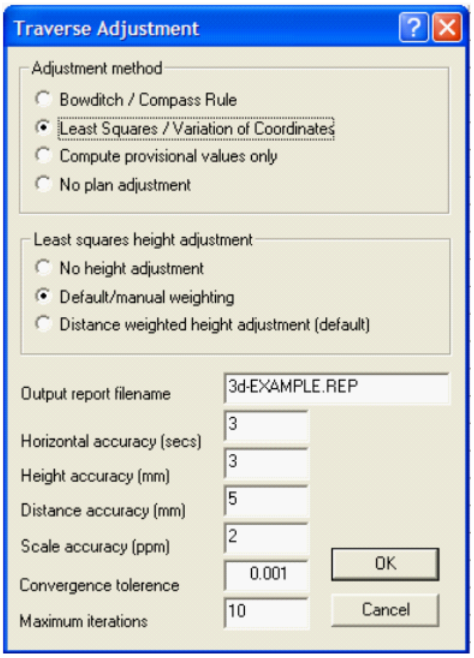
Entering a value into a constraint field, and setting the corresponding type to constrained will allow the station to be modified slightly during the course of a least squares adjustment to the limits of the constraint entered. For example, in the above spreadsheet, the X,Y, and Z coordinates have standard errors of 5mm, and hence may be adjusted by an amount that will normally be less than this value. Note that in networks with blunders and unusually large residuals, the adjustment may be greater than the standard error entered.

Open Existing Files

To illustrate the use of constraints, open 3d-example.project and 3d-example.traverse

Traverse Adjustment

Select 'EDIT > Adjust' with the following parameters.



This yields the report shown below. Note the report layout has been improved in SCC 9.9.0 to combine residual values and standard errors in with original observations and provisional coordinates, and similarly adjustments with adjusted coordinates. Note that the coordinates and elevation of STN1 and STN2 have been modified slightly in accordance with the constraints given.

```
SCC for Windows v9.9.0 (C) 1990 - 2009 Atlas Computers Ltd

    Traverse adjustment report

    Title    3d-EXAMPLE.Traverse
```

```
Date     Thu Jun 03 08:48:43 2010

Coordinate adjustment method   Variation of Co-ordinates

Height adjustment method   Least Squares (Default weighting)

Corrections applied

-------------------

Local scale factor : No local scale factor

Earth curvature and refraction : Curvature only  (Earth Radius
6380000.000)

Temperature and pressure : No

Mean sea level correction : No

Default Standard Errors

Angles (secs)              : 3.000

Distances (constant mm)    : 5.000

Distances (ppm mm)         : 2.000

Heights (mm)               : 3.000

Provisional coordinates

Name                     E> X        StdErr        N> Y        StdErr
Type        Ht> Z        StdErr  Type

----------------   --------------   ------   --------------   ------   ----
--------------   ------   ----

STN1                 1166.19500  0.0050      1100.00000  0.0050  Cons
  54.31100  0.0030  Cons

STN2                 1100.00000  0.0050      1100.00000  0.0050  Cons
  55.68500  0.0030  Cons

STN4                 1099.88478  0.0000      1125.34510  0.0000  Free
  53.02486  0.0000  Free

STN5                 1141.22028  0.0000      1122.19111  0.0000  Free
  52.35902  0.0000  Free

STN6                 1202.08301  0.0000      1098.41752  0.0000  Free
  51.47829  0.0000  Free

STN7                 1225.12102  0.0000      1097.61346  0.0000  Free
  50.76723  0.0000  Free

STN8                 1220.29787  0.0000      1075.01497  0.0000  Free
  58.79736  0.0000  Free

STN9                 1215.15799  0.0000      1142.77027  0.0000  Free
  40.62047  0.0000  Free

TEM1                 1101.17775  0.0000      1143.46424  0.0000  Free
  52.22092  0.0000  Free

TEM2                 1105.95935  0.0000      1132.62374  0.0000  Free
  52.25085  0.0000  Free

Adjusted coordinates

Name                     E> X          Adj          N> Y          Adj
Ht> Z          Adj

----------------   --------------   -------   --------------   -------
```

```
--------------   -------

    STN1                    1166.19517  +0.0002      1100.00000  +0.0000
 54.30905   -0.0019

    STN2                    1099.99983  -0.0002      1100.00000  +0.0000
 55.68695   +0.0019

    STN4                    1099.88673  +0.0019      1125.33990  -0.0052
 53.01638   -0.0085

    STN5                    1141.22332  +0.0030      1122.18748  -0.0036
 52.35103   -0.0080

    STN6                    1202.08386  +0.0008      1098.41665  -0.0009
 51.47357   -0.0047

    STN7                    1225.12161  +0.0006      1097.61285  -0.0006
 50.76387   -0.0034

    STN8                    1220.29869  +0.0008      1075.01485  -0.0001
 58.79446   -0.0029

    STN9                    1215.15749  -0.0005      1142.77221  +0.0019
 40.61866   -0.0018

    TEM1                    1101.17898  +0.0012      1143.45910  -0.0051
 52.21244   -0.0085

    TEM2                    1105.96101  +0.0017      1132.61879  -0.0050
 52.24236   -0.0085

    Bearings

    At Station     To Station      Bearing     StdErr    Residual       StdRes

     ------------   ------------   ----------   ------   -------------   ------

    STN1           STN2           270 00 00.0    0.000   -000 00 00.00    1.000
(Fixed)

    STN2           STN1           090 00 00.0    0.000   -000 00 00.00    1.000
(Fixed)

    Angles

    At Station     To Station       Angle      StdErr    Residual       StdRes

     ------------   ------------   ----------   ------   -------------   ------

    STN1           STN8           204 47 16.0    3.000   -000 00 00.56    0.190


    STN1           STN8           204 47 17.9    3.000   -000 00 02.56    0.857


    STN8           STN7           077 15 36.0    3.000   -000 00 00.61    0.206


    STN8           STN7           077 15 38.0    3.000   -000 00 02.61    0.872


    STN7           STN9           155 30 36.9    3.000   -000 00 01.07    0.358


    STN7           STN9           155 30 35.0    3.000   +000 00 00.92   -0.309


    STN7           STN6           079 57 03.9    3.000   -000 00 01.05    0.351


    STN7           STN6           079 57 05.0    3.000   -000 00 02.05    0.684
```

STN6	STN9	284 25 27.0	3.000	+000 00 00.90	-0.301
STN6	STN9	284 25 29.0	3.000	-000 00 01.09	0.365
STN6	STN5	199 20 14.0	3.000	-000 00 03.36	1.121
STN6	STN5	199 20 10.0	3.000	+000 00 00.63	-0.213
STN5	STN9	323 06 25.0	3.000	+000 00 00.91	-0.303
STN5	STN9	323 06 26.0	3.000	-000 00 00.08	0.030
STN5	STN4	163 01 38.0	3.000	-000 00 02.54	0.850
STN5	STN4	163 01 35.9	3.000	-000 00 00.54	0.183
STN4	TEM2	305 29 03.0	3.000	-000 00 00.00	0.000
STN4	TEM1	269 43 06.0	3.000	-000 00 00.00	0.000
STN4	TEM1	269 43 06.0	3.000	-000 00 00.00	0.000
STN4	TEM2	305 29 03.0	3.000	-000 00 00.00	0.000
STN4	STN2	085 23 01.0	3.000	-000 00 01.50	0.502
STN4	STN2	085 23 01.0	3.000	-000 00 01.50	0.502
STN2	STN4	269 44 39.0	3.000	+000 00 00.34	-0.115
STN2	STN1	090 15 21.0	3.000	-000 00 00.34	0.115
STN2	STN1	090 15 23.0	3.000	-000 00 02.34	0.781

Horizontal Distances

At Station	To Station	Distance	StdErr	Residual	StdRes
STN1	STN8	59.593	0.005	0.000692	-0.135
STN1	STN8	59.594	0.005	-0.000348	0.068
STN8	STN1	59.593	0.005	0.000649	-0.127
STN8	STN7	23.107	0.005	-0.000509	0.101
STN8	STN7	23.107	0.005	0.000358	-0.071
STN8	STN1	59.594	0.005	-0.000283	0.055
STN7	STN8	23.106	0.005	0.000475	-0.094

STN7	STN9	46.243	0.005	0.002698	-0.530
STN7	STN9	46.244	0.005	0.001672	-0.328
STN7	STN6	23.052	0.005	-0.000284	0.056
STN7	STN6	23.052	0.005	-0.000277	0.055
STN7	STN8	23.108	0.005	-0.001375	0.272
STN6	STN7	23.052	0.005	-0.000291	0.058
STN6	STN9	46.241	0.005	0.000829	-0.163
STN6	STN9	46.242	0.005	-0.000144	0.028
STN6	STN5	65.341	0.005	-0.003070	0.598
STN6	STN5	65.339	0.005	-0.001065	0.208
STN6	STN7	23.054	0.005	-0.002290	0.454
STN5	STN6	65.339	0.005	-0.001078	0.210
STN5	STN9	76.745	0.005	0.001273	-0.247
STN5	STN9	76.744	0.005	0.002205	-0.428
STN5	STN4	41.456	0.005	0.000916	-0.180
STN5	STN4	41.458	0.005	-0.001084	0.213
STN5	STN6	65.340	0.005	-0.002070	0.403
STN4	STN5	41.457	0.005	-0.000081	0.016
STN4	TEM2	9.480	0.005	0.000000	-0.000
STN4	TEM1	18.165	0.005	0.000000	-0.000
STN4	TEM1	18.165	0.005	0.000000	-0.000
STN4	TEM2	9.480	0.005	0.000000	-0.000
STN4	STN2	25.340	0.005	0.000528	-0.104
STN4	STN2	25.340	0.005	0.000528	-0.104
STN4	STN5	41.457	0.005	-0.000081	0.016
STN2	STN4	25.339	0.005	0.001509	-0.299
STN2	STN4	25.342	0.005	-0.001435	0.284

Number of observations : 65

Number of unknowns : 20

Number of redundant obs : 45

Reference variance : 0.15305

Reference standard deviation So : 0.41621

Failed Chi-Square test at 95% level; exceeded lower bound (0.00)

Error ellipses

		Standard		At 90% conf.		At 95% conf.		At 99% conf.	
Station	Angle (t)	Su	Sv	Su	Sv	Su	Sv	Su	Sv
--------	-----------	-------	-------	-------	-------	-------	-------		

```
-------   -------

STN1       090 00 00.0  0.00165  0.00147  0.00362  0.00324  0.00416  0.00373
0.00526   0.00470

STN2       090 00 00.0  0.00165  0.00147  0.00362  0.00324  0.00416  0.00373
0.00526   0.00470

STN4       153 35 55.0  0.00169  0.00164  0.00372  0.00360  0.00428  0.00414
0.00540   0.00523

STN5       122 51 06.3  0.00172  0.00165  0.00379  0.00363  0.00436  0.00417
0.00551   0.00527

STN6       141 06 05.8  0.00171  0.00165  0.00377  0.00363  0.00433  0.00417
0.00547   0.00527

STN7       136 49 35.9  0.00174  0.00166  0.00382  0.00366  0.00440  0.00421
0.00555   0.00532

STN8       109 06 07.7  0.00172  0.00152  0.00378  0.00335  0.00435  0.00385
0.00549   0.00486

STN9       173 25 53.7  0.00175  0.00169  0.00385  0.00372  0.00442  0.00428
0.00558   0.00540

TEM1       002 32 44.1  0.00224  0.00166  0.00493  0.00365  0.00567  0.00420
0.00715   0.00530

TEM2       038 17 50.0  0.00221  0.00168  0.00487  0.00370  0.00560  0.00425
0.00707   0.00537
```

Height residuals

At Station	To Station	HtDiff	StdErr	Residual	StdRes
STN1	STN8	4.486	0.003	0.000000	0.000
STN1	STN8	4.486	0.003	0.000945	0.315
STN8	STN1	-4.485	0.003	0.000442	0.147
STN8	STN7	-8.030	0.003	0.000000	0.000
STN8	STN7	-8.030	0.003	0.000190	0.063
STN8	STN1	-4.486	0.003	0.000475	0.158
STN7	STN8	8.030	0.003	0.001027	0.342
STN7	STN9	-10.147	0.003	-0.000752	-0.251
STN7	STN9	-10.147	0.003	-0.000607	-0.202
STN7	STN6	0.711	0.003	-0.001565	-0.522
STN7	STN6	0.711	0.003	-0.001555	-0.518
STN7	STN8	8.031	0.003	0.001349	0.450
STN6	STN7	-0.711	0.003	0.001573	0.524
STN6	STN9	-10.858	0.003	0.000161	0.054
STN6	STN9	-10.858	0.003	-0.001042	-0.347
STN6	STN5	0.881	0.003	-0.003018	-1.006
STN6	STN5	0.881	0.003	-0.003247	-1.082
STN6	STN7	-0.711	0.003	0.003264	1.088

STN5	STN6	-0.879	0.003	0.003554	1.185
STN5	STN9	-11.728	0.003	-0.001104	-0.368
STN5	STN9	-11.727	0.003	-0.001934	-0.645
STN5	STN4	0.666	0.003	0.004431	1.477
STN5	STN4	0.666	0.003	0.004954	1.651
STN5	STN6	-0.880	0.003	0.000505	0.168
STN4	STN5	-0.666	0.003	0.000537	0.179
STN4	TEM2	-0.774	0.003	-0.002581	-0.860
STN4	TEM1	-0.804	0.003	-0.000453	-0.151
STN4	TEM1	-0.804	0.003	0.000000	0.000
STN4	TEM2	-0.774	0.003	0.000000	0.000
STN4	STN2	2.671	0.003	-0.000000	-0.000
STN4	STN2	2.671	0.003	-0.000000	-0.000
STN4	STN5	-0.666	0.003	0.000480	0.160
STN2	STN4	-2.671	0.003	0.000480	0.160
STN2	STN4	-2.671	0.003	-0.000453	-0.151

Network contains 11 legs

From	To	Comp Length	Meas.Length	Difference	Comp dHt	Meas dHt	Diff dHt	Obs	Type	Bearing
----	--	-----------	-----------	----------	--------	--------	--------	---	----	-------
STN8	STN1	59.594	59.594	0.0001	4.4854	4.4859	-0.0005	4	Loose	294 47 15.4
STN8	STN7	23.107	23.107	-0.0003	8.0306	8.0301	0.0005	4	Loose	012 02 50.8
STN7	STN9	46.246	46.243	0.0022	10.1452	10.1468	-0.0016	2	Closed	347 33 26.7
STN7	STN6	23.052	23.053	-0.0008	0.7097	0.7110	-0.0013	4	Closed	271 59 53.7
STN6	STN9	46.242	46.242	0.0004	10.8549	10.8580	-0.0031	2	Closed	016 25 21.6
STN6	STN5	65.338	65.340	-0.0018	0.8775	0.8803	-0.0028	4	Closed	291 20 04.3
STN5	STN9	76.746	76.745	0.0018	11.7324	11.7277	0.0047	2	Closed	074 26 30.3
STN5	STN4	41.457	41.457	-0.0000	0.6653	0.6658	-0.0005	4	Closed	274 21 39.8
STN4	TEM2	9.480	9.480	-0.0000	0.7740	0.7740	0.0000	2	Closed	039 50 42.8
STN4	TEM1	18.165	18.165	-0.0000	0.8039	0.8039	0.0000	2	Closed	004 04 45.8
STN4	STN2	25.340	25.340	0.0003	2.6706	2.6711	-0.0005	4	Loose	179 44 39.3

Total length 434.767, total length misclosure 0.008, total height misclosure 0.0154

Length after removing fixed legs 434.767, misclosure 0.008, height misclosure 0.0154

Length after removing fixed and loose legs 326.726, misclosure 0.007, height misclosure 0.0140, equivalent linear accuracy 1:47115.3

(This result only takes into account closed loops, and legs on sections that lie between fixed stations,

It provides the best equivalent to a Bowditch adjusted result)

Relative Error ellipses and standard errors of computed quantities between points

		Ellipse details			Std Errors	
From Station	To Station	Angle (t)	Su	Sv	Direction	Dist.
------------	------------	-------------	-------	-------	-------------	-----
STN1	STN2	090 00 00.0	0.00353	0.00000	000 00 00.0	0.00353
STN1	STN4	005 25 09.0	0.00355	0.00192	000 00 06.0	0.00346
STN1	STN5	010 13 44.7	0.00300	0.00185	000 00 13.7	0.00274
STN1	STN6	014 47 45.8	0.00244	0.00194	000 00 11.2	0.00242
STN1	STN7	027 32 06.8	0.00236	0.00197	000 00 07.1	0.00229
STN1	STN8	024 41 58.0	0.00237	0.00056	000 00 01.9	0.00237
STN1	STN9	035 05 42.3	0.00253	0.00210	000 00 07.9	0.00213
STN1	TEM1	272 15 29.8	0.00405	0.00358	000 00 10.3	0.00371
STN1	TEM2	060 51 30.2	0.00456	0.00286	000 00 12.4	0.00343
STN2	STN4	270 30 28.2	0.00194	0.00020	000 00 01.6	0.00194
STN2	STN5	009 08 21.5	0.00243	0.00188	000 00 09.2	0.00224
STN2	STN6	009 12 31.4	0.00280	0.00195	000 00 03.9	0.00279
STN2	STN7	008 05 48.0	0.00307	0.00203	000 00 03.3	0.00306
STN2	STN8	001 45 45.0	0.00314	0.00111	000 00 02.0	0.00310
STN2	STN9	079 07 27.9	0.00294	0.00223	000 00 03.7	0.00292

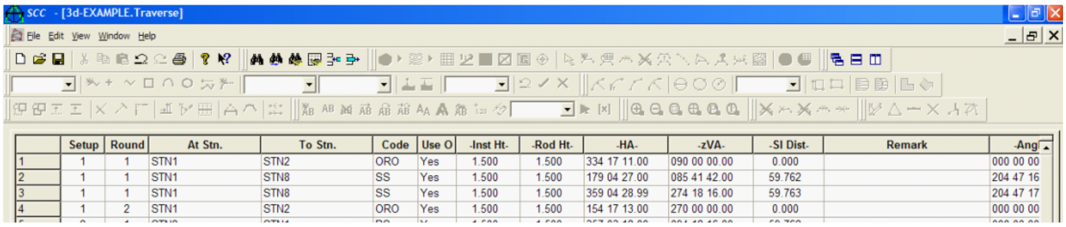
STN2 0.00405	TEM1	273 35 01.4	0.00406	0.00040	000 00 02.0
STN2 0.00363	TEM2	302 20 09.0	0.00389	0.00113	000 00 11.1
STN4 0.00242	STN5	004 19 34.1	0.00242	0.00046	000 00 02.2
STN4 0.00280	STN6	008 08 05.1	0.00281	0.00122	000 00 02.4
STN4 0.00308	STN7	008 55 15.8	0.00309	0.00141	000 00 02.2
STN4 0.00302	STN8	001 36 05.7	0.00314	0.00204	000 00 03.4
STN4 0.00290	STN9	087 59 51.4	0.00291	0.00159	000 00 02.8
STN4 0.00356	TEM1	274 04 45.8	0.00356	0.00027	000 00 03.1
STN4 0.00355	TEM2	309 50 42.8	0.00355	0.00014	000 00 03.1
STN5 0.00171	STN6	020 55 55.7	0.00171	0.00081	000 00 02.5
STN5 0.00220	STN7	016 13 45.1	0.00220	0.00103	000 00 02.4
STN5 0.00216	STN8	088 14 48.6	0.00225	0.00194	000 00 04.5
STN5 0.00193	STN9	071 16 18.2	0.00193	0.00120	000 00 03.2
STN5 0.00265	TEM1	274 38 14.7	0.00359	0.00243	000 00 15.6
STN5 0.00275	TEM2	053 07 57.5	0.00392	0.00181	000 00 18.6
STN6 0.00096	STN7	005 32 45.6	0.00096	0.00029	000 00 02.6
STN6 0.00138	STN8	287 31 10.2	0.00195	0.00100	000 00 11.8
STN6 0.00129	STN9	287 13 53.2	0.00129	0.00075	000 00 03.3
STN6 0.00299	TEM1	271 42 35.4	0.00377	0.00283	000 00 06.8
STN6 0.00303	TEM2	055 26 04.4	0.00409	0.00229	000 00 07.2
STN7 0.00195	STN8	281 15 12.8	0.00195	0.00028	000 00 02.4
STN7 0.00128	STN9	167 20 09.1	0.00128	0.00072	000 00 03.2
STN7 0.00320	TEM1	179 29 50.3	0.00384	0.00310	000 00 05.8
STN7 0.00338	TEM2	058 21 22.6	0.00421	0.00251	000 00 05.8

STN8	STN9	275 28 07.0	0.00222	0.00101	000 00 03.2	0.00219
STN8	TEM1	277 14 23.0	0.00411	0.00316	000 00 05.9	0.00332
STN8	TEM2	053 10 54.9	0.00443	0.00264	000 00 06.6	0.00308
STN9	TEM1	281 05 10.2	0.00392	0.00289	000 00 07.0	0.00293
STN9	TEM2	053 15 00.4	0.00430	0.00223	000 00 05.5	0.00385
TEM1	TEM2	291 56 08.9	0.00479	0.00156	000 01 02.6	0.00352

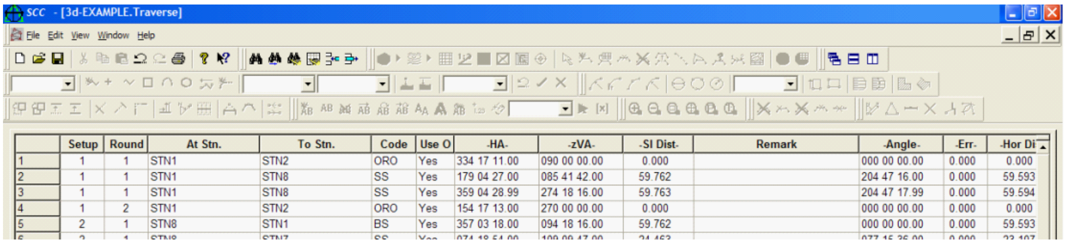
Traverse Observation Spreadsheet

You will also notice that on the View menu in the traverse observations spreadsheet, there are additional commands to better organize the spreadsheet for specific tasks. These are as follows;

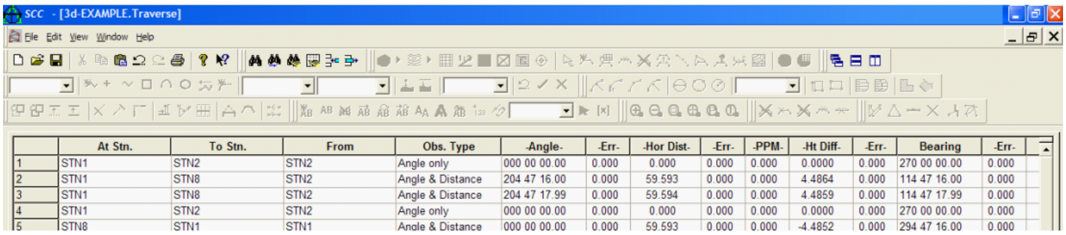
'VIEW > Layout > All observed and reduced data (3d)



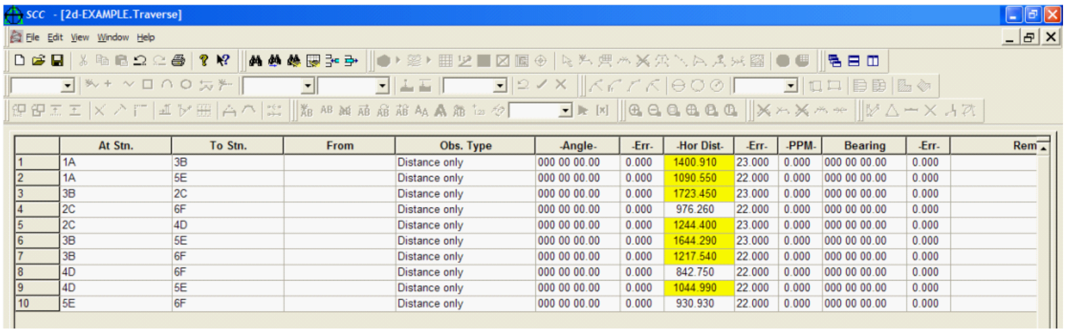
'VIEW > Layout > All observed and reduced data (2d)'



'VIEW > Layout > Reduced observations (3d)'

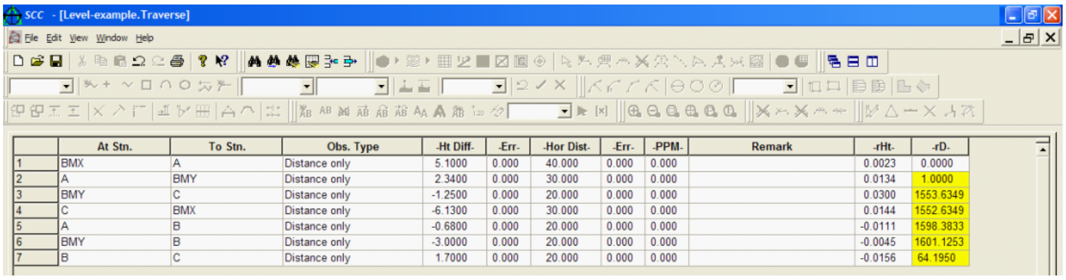


'VIEW > Layout > Reduced observations (2d)'



	At Stn.	To Stn.	From	Obs. Type	-Angle-	-Err-	-Hor Dist-	-Err-	-PPM-	Bearing	-Err-	Rem
1	1A	3B		Distance only	000 00 00.00	0.000	1400.910	23.000	0.000	000 00 00.00	0.000	
2	1A	5E		Distance only	000 00 00.00	0.000	1090.550	22.000	0.000	000 00 00.00	0.000	
3	3B	2C		Distance only	000 00 00.00	0.000	1723.450	23.000	0.000	000 00 00.00	0.000	
4	2C	6F		Distance only	000 00 00.00	0.000	976.260	22.000	0.000	000 00 00.00	0.000	
5	2C	4D		Distance only	000 00 00.00	0.000	1244.400	23.000	0.000	000 00 00.00	0.000	
6	3B	5E		Distance only	000 00 00.00	0.000	1644.290	23.000	0.000	000 00 00.00	0.000	
7	3B	6F		Distance only	000 00 00.00	0.000	1217.540	22.000	0.000	000 00 00.00	0.000	
8	4D	6F		Distance only	000 00 00.00	0.000	842.750	22.000	0.000	000 00 00.00	0.000	
9	4D	5E		Distance only	000 00 00.00	0.000	1044.990	22.000	0.000	000 00 00.00	0.000	
10	5E	6F		Distance only	000 00 00.00	0.000	930.930	22.000	0.000	000 00 00.00	0.000	

'VIEW > Layout > Reduced levels only'

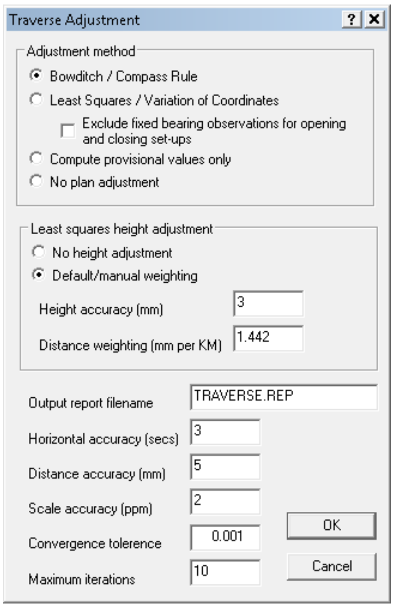


	At Stn.	To Stn.	Obs. Type	-Ht Diff-	-Err-	-Hor Dist-	-Err-	-PPM-	Remark	-rHt-	-rD-
1	BMX	A	Distance only	5.1000	0.000	40.000	0.000	0.000		0.0023	0.0000
2	A	BMY	Distance only	2.3400	0.000	30.000	0.000	0.000		0.0134	1.0000
3	BMY	C	Distance only	-1.2500	0.000	20.000	0.000	0.000		0.0300	1553.6349
4	C	BMX	Distance only	-6.1300	0.000	30.000	0.000	0.000		0.0144	1552.6349
5	A	B	Distance only	-0.6800	0.000	20.000	0.000	0.000		-0.0111	1598.3833
6	BMY	B	Distance only	-3.0000	0.000	20.000	0.000	0.000		-0.0045	1601.1253
7	B	C	Distance only	1.7000	0.000	20.000	0.000	0.000		-0.0156	64.1950

The observed options correspond to the layout available in previous versions of SCC, where the 2d option removes the instrument height, rod height and height difference fields. The reduced observations options show forward measured angles, horizontal distances, height differences, known bearings, and their corresponding standard errors. The reduced level option only shows height and distance information, again with standard errors, where distances may be used to calculate relative weights as an alternative to entering standard errors.

Constraint Adjustment

Standard errors in any of these views correspond to observation weights or accuracies, thus if I know a height difference is good to +> - 3mm I enter 3.0 in the **–Err-** field that follows the **–Ht Diff-** field. I can also use the modify the **Obs. Type** field to fix a height difference, horizontal distance, angle or bearing to further constrain the adjustment. For example, in the report above, you will notice a fixed bearing between **STN1** and **STN2** of 270 degrees, such if the coordinates are moved during the adjustment, the bearing between them will be fixed at 270 degrees.



The content of the report will also be modified by the type of adjustment selected. For example, if we open 2d-example.project and 2d-example.traverse, and adjust using the parameters given, we get the report shown below.

```
SCC for Windows v9.9.0 (C) 1990 - 2009 Atlas Computers Ltd

    Traverse adjustment report

    Title    2d-EXAMPLE.Traverse

    Date     Thu Jun 03 10:25:59 2010

    Coordinate adjustment method   Variation of Co-ordinates

    Corrections applied

    -------------------

    Local scale factor : No local scale factor

    Earth curvature and refraction : Curvature only  (Earth Radius
6380000.000)

    Temperature and pressure : No

    Mean sea level correction : No

     Default Standard Errors

     Angles (secs)              : 3.000

     Distances (constant mm)    : 5.000

     Distances (ppm mm)         : 2.000

     Heights (mm)               : 3.000

     Provisional coordinates

     Name                          E> X       StdErr        N> Y        StdErr
Type

     ----------------   --------------   ------   --------------   ------   ----

     1A                      10000.00000   0.1800      10000.00000   0.1800   Cons

     2C                      12487.08000   0.1800      10528.65000   0.1800   Cons
```

3B	10862.48000	0.0000	11103.93000	0.0000	Prov
4D	11990.88000	0.0000	9387.46000	0.0000	Prov
5E	10948.55000	0.0000	9461.90000	0.0000	Prov
6F	11595.22000	0.0000	10131.56000	0.0000	Prov

Adjusted coordinates

Name	E> X	Adj	N> Y	Adj
1A	9999.99844	-0.0016	9999.99967	-0.0003
2C	12487.08156	+0.0016	10528.65033	+0.0003
3B	10862.48289	+0.0029	11103.93327	+0.0033
4D	11990.88203	+0.0020	9387.46189	+0.0019
5E	10948.54878	-0.0012	9461.89972	-0.0003
6F	11595.22309	+0.0031	10131.56264	+0.0026

Horizontal Distances

At Station	To Station	Distance	StdErr	Residual	StdRes
1A	3B	1400.910	0.023	0.000000	-0.000
1A	5E	1090.550	0.022	-0.000030	0.001
3B	2C	1723.450	0.023	-0.002524	0.110
2C	6F	976.260	0.022	0.003354	-0.152
2C	4D	1244.400	0.023	-0.002556	0.111
3B	5E	1644.290	0.023	-0.002432	0.106
3B	6F	1217.540	0.022	0.003779	-0.172
4D	6F	842.750	0.022	0.002603	-0.118
4D	5E	1044.990	0.022	-0.002160	0.098
5E	6F	930.930	0.022	0.002896	-0.132

Number of observations : 14

Number of unknowns : 12

Number of redundant obs : 2

Reference variance : 0.00995

Reference standard deviation So : 0.25426

Failed Chi-Square test at 95% level; exceeded lower bound (0.99)

Error ellipses

		Standard		At 90% conf.		At 95% conf.		At 99% conf.	
Station	Angle (t)	Su	Sv	Su	Sv	Su	Sv	Su	Sv

```
1A         168 00 00.0  0.04577  0.03262  0.19417  0.13841  0.28212  0.20111
0.64398  0.45906

2C         168 00 00.0  0.04577  0.03262  0.19417  0.13841  0.28212  0.20111
0.64398  0.45906

3B         065 31 18.2  0.04029  0.03284  0.17093  0.13931  0.24835  0.20241
0.56690  0.46203

4D         049 54 36.3  0.04407  0.03298  0.18696  0.13993  0.27164  0.20331
0.62006  0.46410

5E         110 24 33.2  0.03931  0.03297  0.16680  0.13986  0.24235  0.20321
0.55321  0.46386

6F         017 58 02.5  0.03427  0.03289  0.14538  0.13956  0.21123  0.20277
0.48217  0.46286

Network contains 10 legs

From     To          Comp Length  Meas.Length  Difference  Comp dHt  Meas
dHt  Diff dHt  Obs  Type    Bearing

----     --          -----------  -----------  ----------  --------
--------  --------  ---  ----    -------

1A       3B           1400.910     1400.910     -0.0000    0.0000
0.1538   -0.1538  1    Closed  038 00 00.0

1A       5E           1090.550     1090.550     -0.0000    0.0000
0.0932   -0.0932  1    Closed  119 33 56.3

3B       2C           1723.448     1723.450     -0.0025    0.0000
0.2328   -0.2328  1    Closed  109 29 58.0

2C       6F            976.263      976.260      0.0034    0.0000
0.0747   -0.0747  1    Closed  245 59 58.7

2C       4D           1244.397     1244.400     -0.0025    0.0000
0.1214   -0.1214  1    Closed  203 30 00.0

3B       5E           1644.288     1644.290     -0.0025    0.0000
0.2119   -0.2119  1    Closed  176 59 58.6

3B       6F           1217.544     1217.540      0.0038    0.0000
0.1162   -0.1162  1    Closed  143 00 00.0

4D       6F            842.753      842.750      0.0026    0.0000
0.0557   -0.0557  1    Closed  331 59 57.0

4D       5E           1044.988     1044.990     -0.0021    0.0000
0.0856   -0.0856  1    Closed  274 05 05.3

5E       6F            930.933      930.930      0.0029    0.0000
0.0679   -0.0679  1    Closed  043 59 58.1

Total length 12116.073, total length misclosure 0.022, total height
misclosure 1.2131

Length after removing fixed legs 12116.073, misclosure 0.022, height
misclosure 1.2131

Length after removing fixed and loose legs 12116.073, misclosure 0.022,
height misclosure 1.2131, equivalent linear accuracy 1:543380.1

(This result only takes into account closed loops, and legs on sections
that lie between fixed stations,

 It provides the best equivalent to a Bowditch adjusted result)

       Relative Error ellipses and standard errors of computed quantities
```

```
between points

                                Ellipse details            Std
Errors

From Station  To Station      Angle (t)      Su        Sv        Direction
Dist.

------------  ------------  -------------  -------  -------  -------------
-----

1A           2C             168 00 00.0  0.25456  0.03248   000 00 20.6
0.03248

1A           3B             037 35 51.5  0.14265  0.02294   000 00 21.0
0.02296

1A           4D             287 21 04.3  0.21004  0.03043   000 00 20.7
0.03045

1A           5E             299 58 18.0  0.11276  0.02195   000 00 21.3
0.02197

1A           6F             175 23 29.0  0.16214  0.03288   000 00 20.8
0.03289

2C           3B             289 39 00.5  0.17420  0.02189   000 00 20.8
0.02190

2C           4D             023 17 43.6  0.12781  0.02187   000 00 21.1
0.02188

2C           5E             145 13 31.4  0.18896  0.02576   000 00 20.8
0.02576

2C           6F             156 01 43.1  0.10082  0.01989   000 00 21.3
0.01989

3B           4D             056 44 21.1  0.20791  0.02565   000 00 20.8
0.02565

3B           5E             086 56 01.1  0.16688  0.02192   000 00 20.9
0.02192

3B           6F             053 02 37.5  0.12493  0.01934   000 00 21.1
0.01934

4D           5E             274 15 14.6  0.10831  0.02117   000 00 21.3
0.02117

4D           6F             062 14 51.0  0.08875  0.02078   000 00 21.7
0.02078

5E           6F             043 47 19.3  0.09675  0.02043   000 00 21.4
0.02044
```

Similarly, to adjust a level network we can turn off the horizontal adjustment. For example, if we open Level-example.project and Level-example.traverse, and adjust using the parameters given, we get the report shown below.

```
SCC for Windows v9.9.0 (C) 1990 - 2009 Atlas Computers Ltd

    Traverse adjustment report

    Title    LevelAdjust.Traverse

    Date     Thu Jun 03 10:30:03 2010

    Height adjustment method   Least Squares (Default weighting)

    Corrections applied
```

```
-------------------

Local scale factor : No local scale factor

Earth curvature and refraction : Curvature only  (Earth Radius
6380000.000)

Temperature and pressure : No

Mean sea level correction : No

Default Standard Errors

Heights (mm)             : 2.000

Provisional heights

Name                    Ht> Z       StdErr  Type

----------------  --------------  ------  ----

BMX                     100.00000  0.0050  Cons

BMY                     107.50000  0.0000  Fix

A                       105.10000  0.0000  Prov

C                       106.25000  0.0000  Prov

B                       104.42000  0.0000  Prov

Adjusted heights

Name                    Ht> Z         Adj

----------------  --------------  -------

BMX                     100.07566  +0.0757

BMY                     107.50000  +0.0000

A                       105.17338  +0.0734

C                       106.22004  -0.0300

B                       104.50447  +0.0845

Height residuals

At Station    To Station      HtDiff    StdErr   Residual   StdRes

------------  ------------  ----------  ------  ----------  ------

BMX           A                  5.100   0.002    0.002282   1.141

A             BMY                2.340   0.002    0.013378   6.689*

BMY           C                 -1.250   0.002    0.029957  14.978*

C             BMX               -6.130   0.002    0.014387   7.193*

A             B                 -0.680   0.002   -0.011096  -5.548*

BMY           B                 -3.000   0.002   -0.004473  -2.237

B             C                  1.700   0.002   -0.015570  -7.785*
```

In all of the least square adjustment reports, we will see equations listed in the form Stations used, observed value, standard error, observation residual, and standard residual. The standard error equates to how accurate you thought the observation was (e.g. a-priori value), whereas the residual corresponds to how much the observation was actually changed to reflect the adjusted station values (e.g. a-posteriori value). The standard residual is obtained by dividing the standard error by the observation residual, and as such should be close to one if the standard errors given match the residuals produced. High values for the standard residual are flagged with an asterisk, indicating lack of agreement between observations and standard errors given. Fixed observations will be marked as (Fixed) in the report and the standard residual forced to one.

If the average value of the standard residuals is more than 1, your observations are not as accurate as stated. If one observation has a particularly high standard residual, it should be checked. If the average values of all standard residuals are much less than one, the standard errors entered are two high, which in turn means the adjustment has been given too much freedom to move the stations. Either of these events will tend to trigger a failure to pass the chi-squared test, which is essentially a statistical analysis of the standard residuals.

Traverse And Error Ellipse Annotation

'VIEW > Station coordinates'

'FILE > Export > Station Coordinates as dataset'

'FILE > Save As', and give the stations a name, typically corresponding to the project name

'FILE > Model > SCC dataset', picking the dataset produced

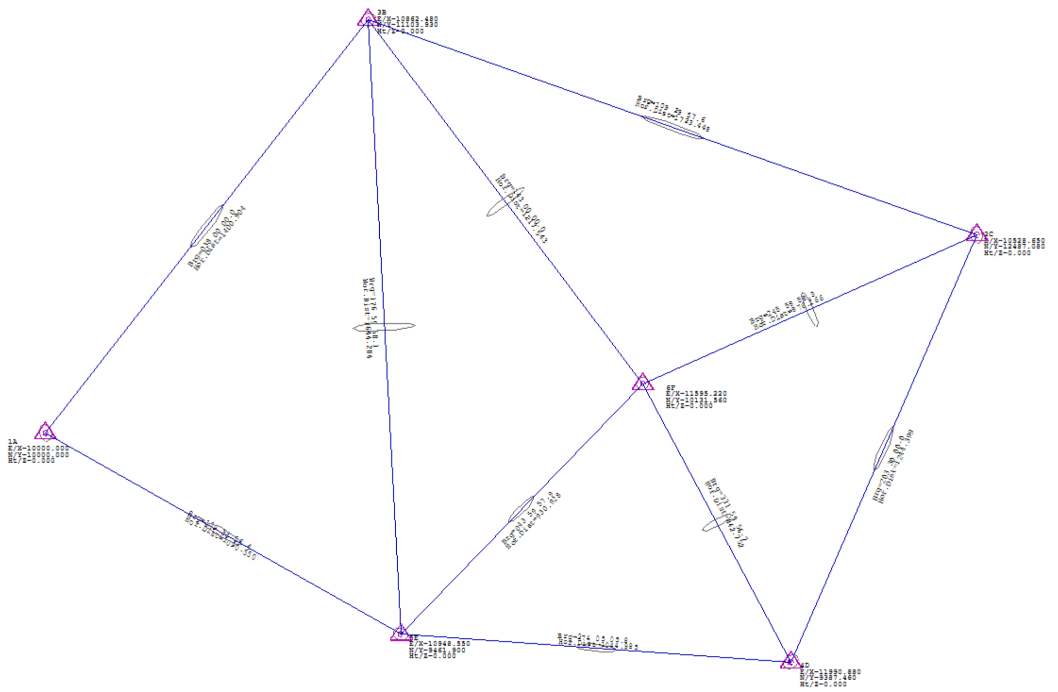
'FILE > Attach> Detach > Attach traverse'

'EDIT > Text > Annotate traverse', to add annotation for stations and legs as required. You will need to use this command twice if you wish to annotate both station and traverse leg information

The following features are used to control display of ellipses

~RELELLI Corresponds to relative ellipses drawn along legs

~ERRELLI Corresponds to error ellipses at stations



Ellipse scale and relative ellipse content can be set using **'FILE > Attach/ Detach'**

23 Working With Trimble Data

The following tutorial provides information relating to the downloading and processing of Trimble data within SCC.

23.1 Create A Project

A new project should be created before data may be downloaded into SCC or models formed.

From the Main Menu Bar, select 'FILE>New Project'

Enter in a Project/Job name

Select a Project Template from the list

Select 'OK'

23.2 Download Trimble Data from ACU

Trimble ACU Output

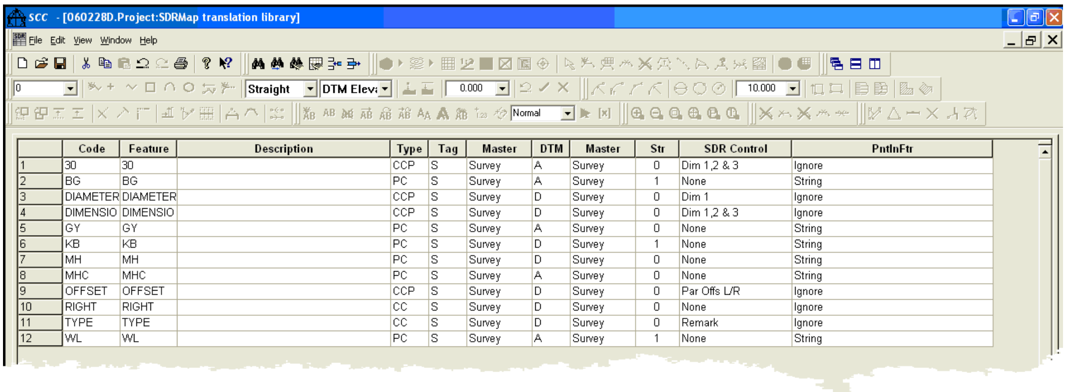
SCC support downloading files from the Trimble ACU, running Tsce software, using the SDR33 output format. These attributes can be used to describe dimensions, offsets, parallel features, and all other items available through the SCC extended coding library. We will demonstrate the use of this facility 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
03NM1.70000000000000
09F1         9020             9021
12.874430000000088.109739263113027.9001854376857STN
09F1         9020             1001
18.593340000000088.669171829746923.1694290000000BG
13ATOffset                0.30000000000000
09F1         9020             1002
17.165240000000088.759832243491514.1117367500000BG
```

To process this file in SCC, amendments must be made to the default project template as follows;

From within the Project, select Import / View SDR translation table

Add a record for each attribute type present in the Tsce format being used. 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
1	30	30		CCP	S	Survey	A	Survey	0	Dim 1,2 & 3	Ignore
2	BG	BG		PC	S	Survey	A	Survey	1	None	String
3	DIAMETER	DIAMETER		CCP	S	Survey	D	Survey	0	Dim 1	Ignore
4	DIMENSIO	DIMENSIO		CCP	S	Survey	D	Survey	0	Dim 1,2 & 3	Ignore
5	GY	GY		PC	S	Survey	A	Survey	0	None	String
6	KB	KB		PC	S	Survey	D	Survey	1	None	String
7	MH	MH		PC	S	Survey	D	Survey	0	None	String
8	MHC	MHC		PC	S	Survey	A	Survey	0	None	String
9	OFFSET	OFFSET		CCP	S	Survey	D	Survey	0	Par Offs L/R	Ignore
10	RIGHT	RIGHT		CC	S	Survey	D	Survey	0	None	Ignore
11	TYPE	TYPE		CC	S	Survey	D	Survey	0	Remark	Ignore
12	WL	WL		PC	S	Survey	A	Survey	1	None	String

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.

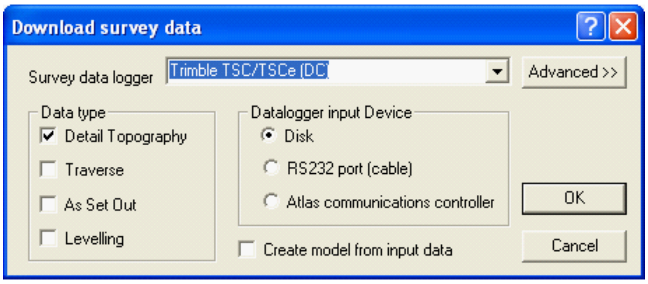
Once you have completed editing this translation table, you should save the project as a new template in the SCC folder, such that you do not have to repeat this exercise.

From the Main Menu Bar, select ‘FILE > Download Survey Data’

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

Highlight ‘Detail Topography’ as the Data Type

Set Input Device to 'Disk'

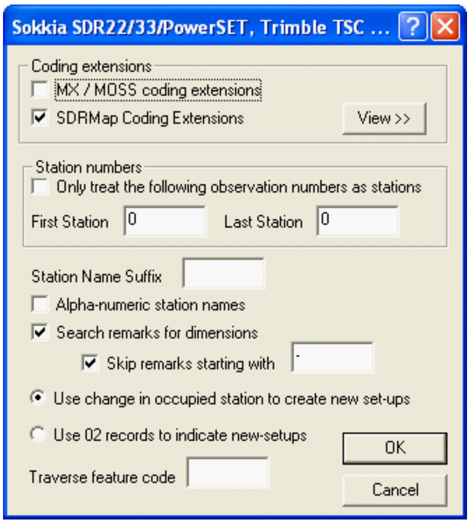


Select 'OK'

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

Select 'Open'

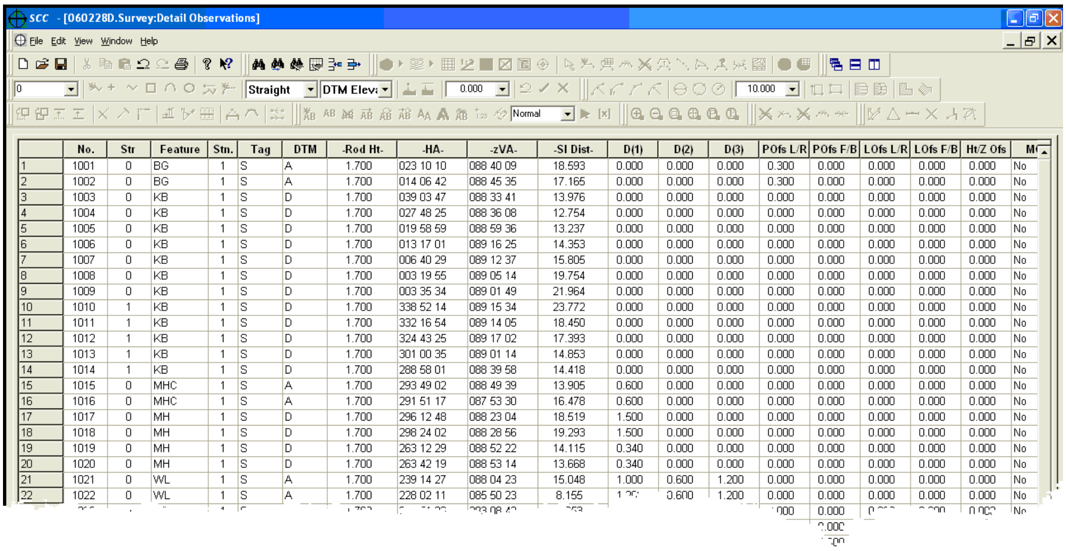
Select 'OK'



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-	-zVA-	-Sl Dist-	D(1)	D(2)	D(3)	POfs L/R	POfs F/B	LOfs L/R	LOfs F/B	Ht/Z Ofs	M
1	1001	0	BG	1	S	A	1.700	023 10 10	088 40 09	18.593	0.000	0.000	0.000	0.300	0.000	0.000	0.000	0.000	No
2	1002	0	BG	1	S	A	1.700	014 06 42	088 45 35	17.165	0.000	0.000	0.000	0.300	0.000	0.000	0.000	0.000	No
3	1003	0	KB	1	S	D	1.700	039 03 47	088 33 41	13.976	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	No
4	1004	0	KB	1	S	D	1.700	027 48 25	088 36 08	12.754	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	No
5	1005	0	KB	1	S	D	1.700	019 58 59	088 59 36	13.237	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	No
6	1006	0	KB	1	S	D	1.700	013 17 01	089 16 25	14.353	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	No
7	1007	0	KB	1	S	D	1.700	006 40 29	089 12 37	15.805	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	No
8	1008	0	KB	1	S	D	1.700	003 19 55	089 05 14	19.754	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	No
9	1009	0	KB	1	S	D	1.700	003 35 34	089 01 49	21.964	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	No
10	1010	1	KB	1	S	D	1.700	338 52 14	089 15 34	23.772	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	No
11	1011	1	KB	1	S	D	1.700	332 16 54	089 14 05	18.450	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	No
12	1012	1	KB	1	S	D	1.700	324 43 25	089 17 02	17.393	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	No
13	1013	1	KB	1	S	D	1.700	301 00 35	089 01 14	14.853	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	No
14	1014	1	KB	1	S	D	1.700	288 58 01	088 39 58	14.418	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	No
15	1015	0	MHC	1	S	A	1.700	293 49 02	088 49 39	13.905	0.600	0.000	0.000	0.000	0.000	0.000	0.000	0.000	No
16	1016	0	MHC	1	S	A	1.700	291 51 17	087 53 30	16.478	0.600	0.000	0.000	0.000	0.000	0.000	0.000	0.000	No
17	1017	0	MH	1	S	D	1.700	296 12 48	088 23 04	18.519	1.500	0.000	0.000	0.000	0.000	0.000	0.000	0.000	No
18	1018	0	MH	1	S	D	1.700	298 24 02	088 28 56	19.293	1.500	0.000	0.000	0.000	0.000	0.000	0.000	0.000	No
19	1019	0	MH	1	S	D	1.700	263 12 29	088 52 22	14.115	0.340	0.000	0.000	0.000	0.000	0.000	0.000	0.000	No
20	1020	0	MH	1	S	D	1.700	263 42 19	088 53 14	13.668	0.340	0.000	0.000	0.000	0.000	0.000	0.000	0.000	No
21	1021	0	WL	1	S	A	1.700	239 14 27	088 04 23	15.048	1.000	0.600	1.200	0.000	0.000	0.000	0.000	0.000	No
22	1022	0	WL	1	S	A	1.700	228 02 11	085 50 23	8.155	[illegible]	0.600	1.200	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

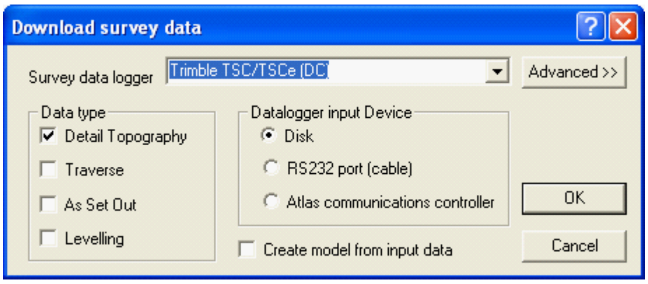
```
09F1          S4                1871
19.485780000000086.2995339500897308.269300500000SL
09F1          S4                1872
20.122220000000086.2101823251036306.161937000000HE3
13NMOFFSET HE3 2.0M LEFT
09F1          S4                1873
26.350400000000086.0417014778084314.111125500000HE3
09F1          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
```

From the Main Menu Bar, select ‘FILE > Download Survey Data’

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

Highlight ‘Detail Topography’ as the Data Type

Set Input Device to 'Disk'

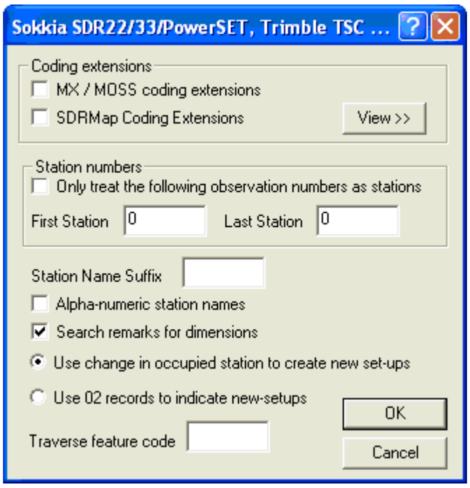


Select 'OK'

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

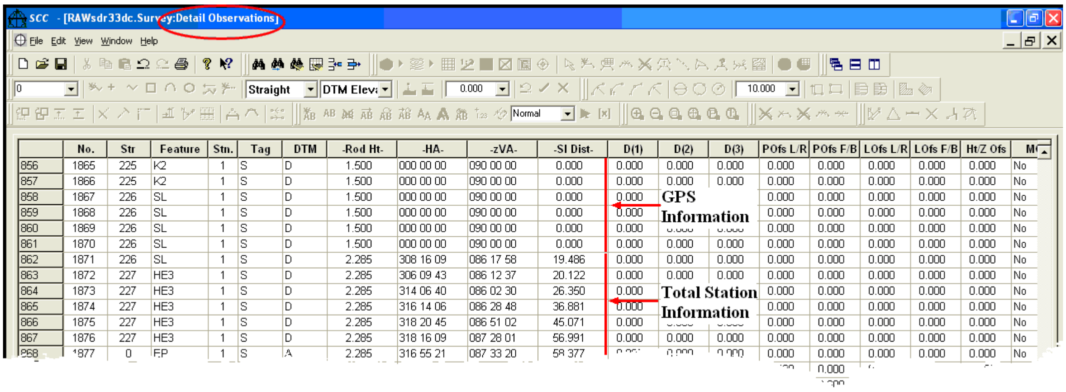
Select 'Open'

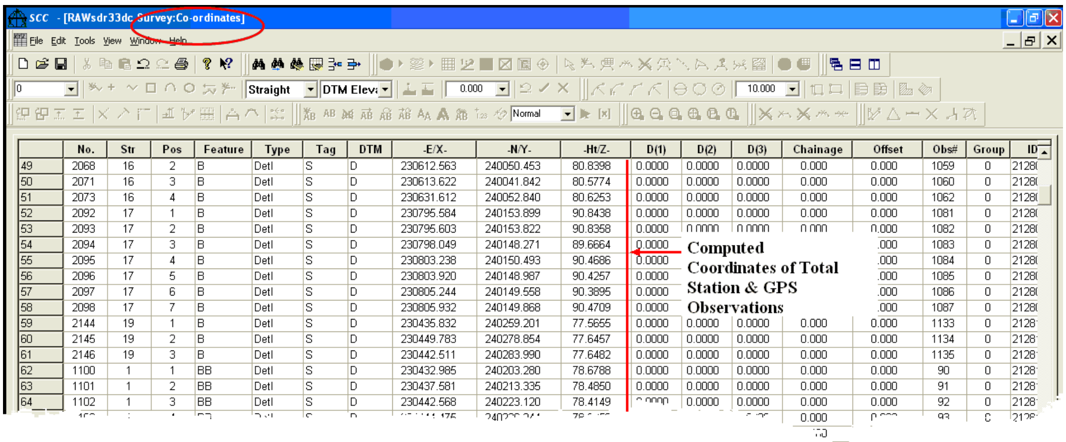
Select 'OK'



Set 'Search remarks for dimensions'

Select 'OK'





Note that the option to strip string numbers from field codes has bee selected with the 'Coordinate Reduction Options'.

Trimble DC Format

SCC also supports the direct download of DC format as follows:

```
D2NM1021.70000000000                    0.14200000000000
       69FD           S22       137412.769000000253513.23000000046.1450000000000CON
          11
       E0NM          S22       1.620000000000001.000000000000001
       E1NM         S22              S21                        190.187083794199
```

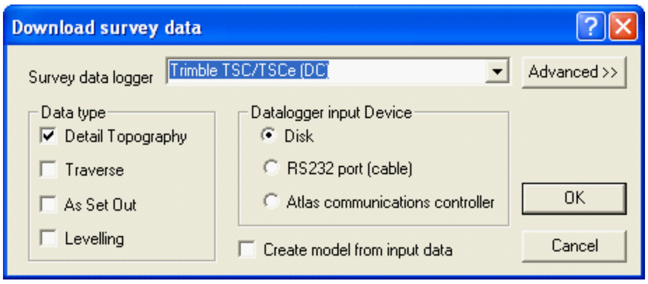
```
           77NM1.500000000000002.000000000000000.00000000000000
       D9F1        S22              S21
91.250749347157591.8136377610403190.187083794199CON
50.003182501540000.001388888888890.00138888888889
       A6F1                      -0.00090101528280.00846784874555
       D9F1        S22              1
90.790027562819091.9271004383258190.244880000000S
10.010181580100000.001388888888890.00138888888889
       D9F1        S22              2
90.795487574480291.9263806245318190.249560000000S
10.010181591020000.001388888888890.00138888888889
           77NM2.000000000000002.000000000000000.00000000000000
           10.010192322360000.001388888888890.00138888888889
       D9F1        S22              8001
86.761130395951992.3277570859462213.880050000000HEC1
10.010173522320000.001388888888890.00138888888889
       D9F1        S22              8002
77.753634782899292.0915956056461219.797010000000HEC1
10.010155507320000.001388888888890.00138888888889
           77NM1.500000000000002.000000000000000.00000000000000
       D9F1        S22              8003
73.815260826027192.3056179106150224.597520000000HEC1
10.010147630580000.001388888888890.00138888888889
       D9F1        S22              8004
68.620739011095391.8354586405055234.321300000000HEC1
10.010137241520000.001388888888890.00138888888889
       D9F1        S22              8005
64.289547497628291.1620741098151249.494310000000HEC1
    10.010128579120000.001388888888890.00138888888889
```

From the Main Menu Bar, select ‘FILE > Download Survey Data’

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

Highlight ‘Detail Topography’ as the Data Type

Set Input Device to 'Disk'

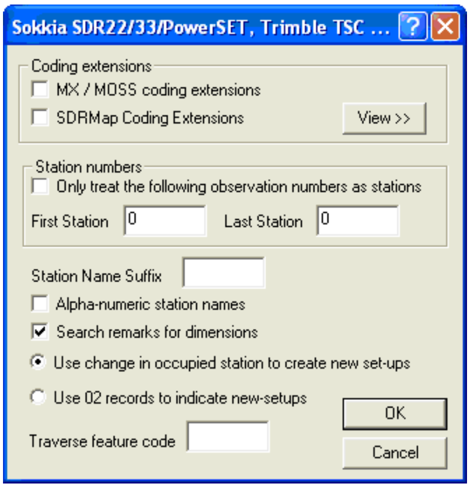


Select 'OK'

Select File

Select 'Open'

Select 'OK'



Set 'Search remarks for dimensions'

Select 'OK'

Trimble/Geodimeter UDS

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

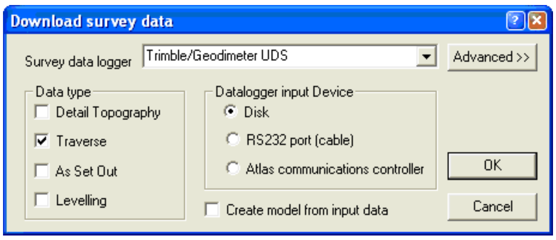
From the Main Menu Bar, select ‘FILE > Download Survey Data’

Set Survey Data Logger to 'Trimble/Geodimeter UDS'

Highlight ‘Traverse’ or ‘Detail Topography’ as the Data Type

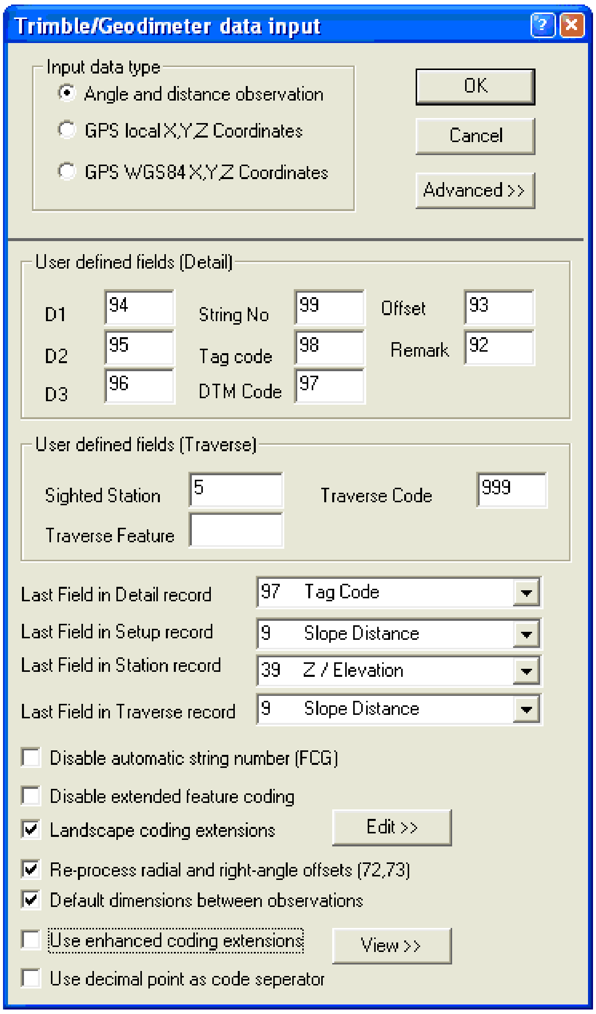
Set Input Device to 'Dsk', 'RS323 port (cable) 'or 'Atlas communications controller' as required

Select ‘OK’

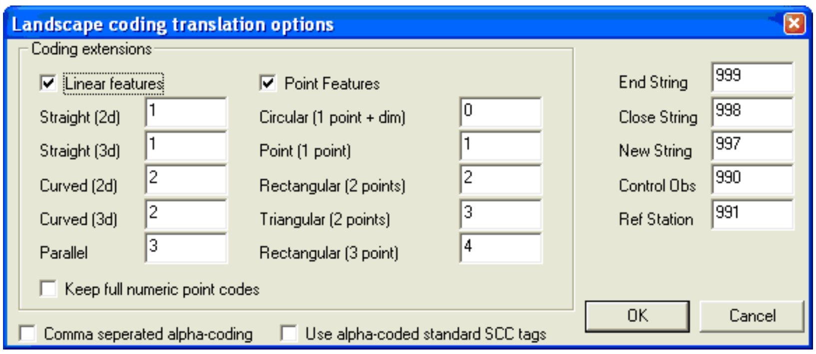


Select the file you require and ‘OK’

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.



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.



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.

Transferring survey data from a Geodimeter CU

Connect the Geodimeter instrument/keyboard to the PC with the appropriate cable and through the correct communications port. Enter program 54, for data transfer.

Choose from which device the data will be transferred from Internal memory (2. Imem) or Serial (3. Serial). Select internal memory (2. Imem).

Select the file type for transfer from 1. Job (file), 2. Area (file), 3. U.D.S. Choose option number 1 - Job file, and type in the job file number in which the observed data is stored.

Choose destination device for the job file from 2. Imem (internal memory) and 3. Serial (serial device - PC). Select 3 - Serial and accept or enter the correct serial parameters, which are Com=1.8.0.9600. Prepare SCC(PC) before accepting the serial parameters because once the serial parameters have been accepted then the data will be transferred.

The display on the Geodimeter/keyboard shows 'Wait' during the data transfer. When the data transfer is finished the Geodimeter/keyboard will exit from program 54 and return to program 0.

Transferring Setting Out and Control data to a Geodimeter CU

Connect the Geodimeter instrument/keyboard to the PC with the appropriate cable and through the correct communications port. Enter program 54, for data transfer.

Choose from which device the data will be transferred from Internal memory (2. Imem) or Serial (3. Serial). Select Serial (3. Serial) and accept or enter correct serial parameters, which are Com=1.8.0.9600

Select file type for the data to be saved as from 1. Job (file), 2. Area (file), 3. U.D.S. Choose option number 2 - Area file, and type in the area file number in which the data is to be stored.

The display on the Geodimeter/keyboard shows "Wait" and is now ready to receive data. Start the data transfer from SCC. When the data has been transferred the Geodimeter/keyboard will exit from program 54 and return to program 0.

23.3 Examination of Sample Code List For Trimble Unit

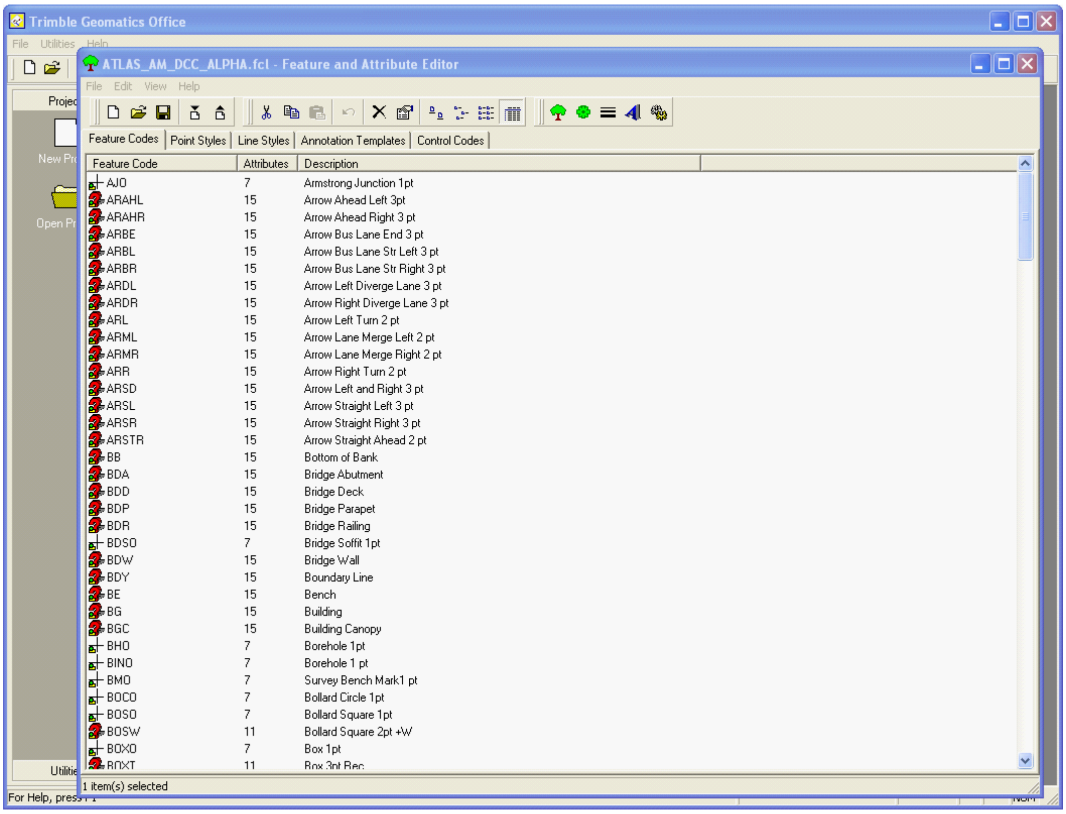
A sample feature code list 'ATLAS_AM_DCC_ALPHA.fal' is availalbe for use with Survey Pro onboard software. This codelist contains attributes such as dimensions, offsets, parallel features. The 'ATLAS_AM_DCC_ALPHA.fal' codelist should be used in conjunction 'Trimble_TSCE_ALPHA.Project' feature library in which all features coincide.

The following examines the feature library 'ATLAS_AM_DCC_ALPHA.fcl' within Trimble Geomatics Office:

Open Trimble Geomatics Office Software, select 'Utilities > Feature and Attribute Editor'

Within the Feature and Attribute Editor' dialog, select 'FILE > Open'

Select 'ATLAS_AM_DCC_ALPHA.fcl'



Template Features

5 specific template features have been set up within Trimble Geomatics Office which all other features are based. As a result, the library can be quickly edited by amending or changing the 5 main features on which all other features are based.

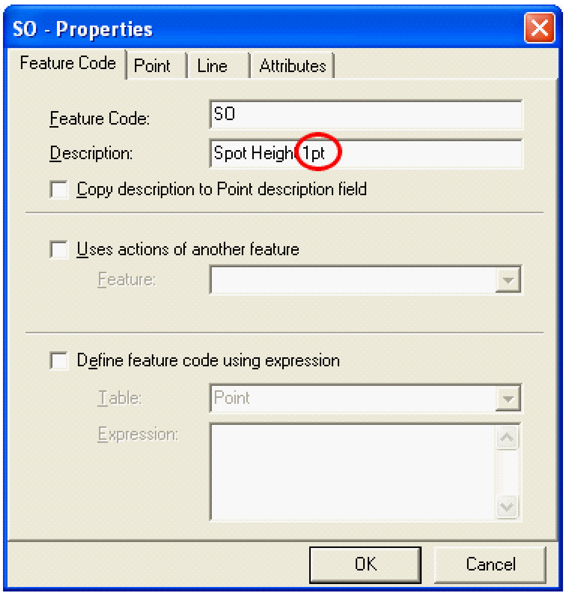
The following outlines each and details the attributes assigned:

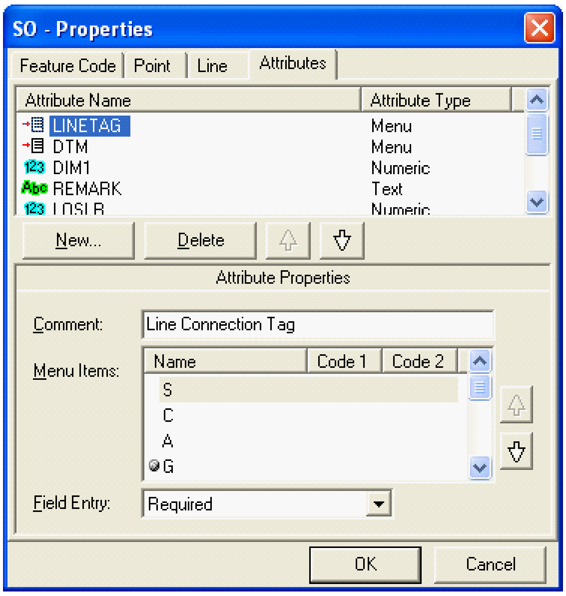
'SO' Spot Height Feature set up as a 1pt Feature:

FEATURE	DESCRIPTION	ATTRIBUTES	DEFAULT VALUES
SO	Spot Height	LINETAG	G
		DTM	D
		DIM1	
		REMARK	
		LOSLR	
		LOSFB	
		ZOFSUD	

NOTE:

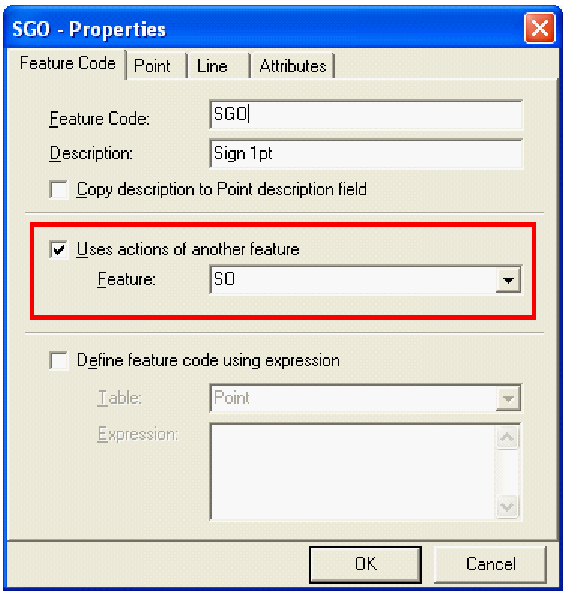
LINETAG - Line Connection Tag, DTM - DTM Status, DIM1 - Dimension 1, LOSLR - Line Of Sight Offset Left / Right, LOSFB - Line Of Sight Offset Forward / Back, ZOFSUD - Elevation Offest Up / Down



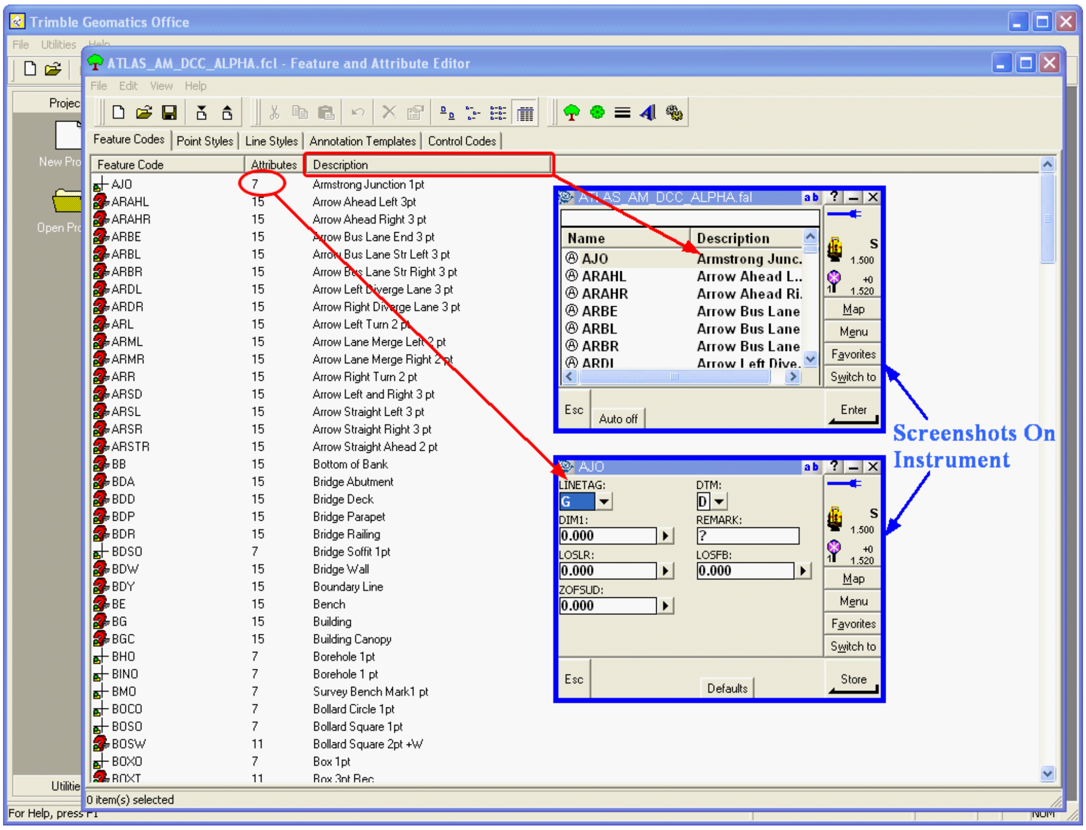


All other 1 point Features have been set up based on 'SO'.

Therefore, if you double click on a 1 point feature in the Feature and Attribute Editor or right click mouse on 1 point feature and then select 'Properties' you can see the 'Uses actions of another feature' is set to 'SO'. In the example below, Sign 1 point 'SGO' uses 'SO' :



The following diagram demonstrates the relationship of the attributes within Trimble Geomatics Office 'Feature and Attribute Editor' dialog and the actually screens from the instrument showing the attribute:



To globally edit all 1 point feature the feature 'SO' can be modified.

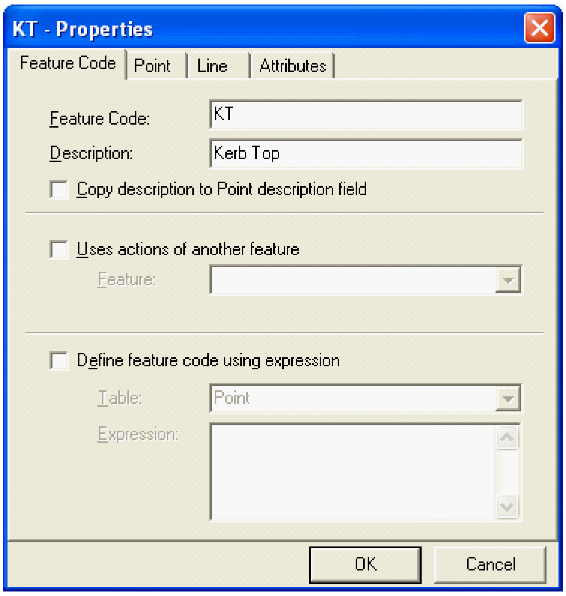
For instance, if you do not wish to have specific attributes assigned to a 1 point feature, the feature 'SO' can be edited and in turn, all 1 point features based on 'SO' will be modified.

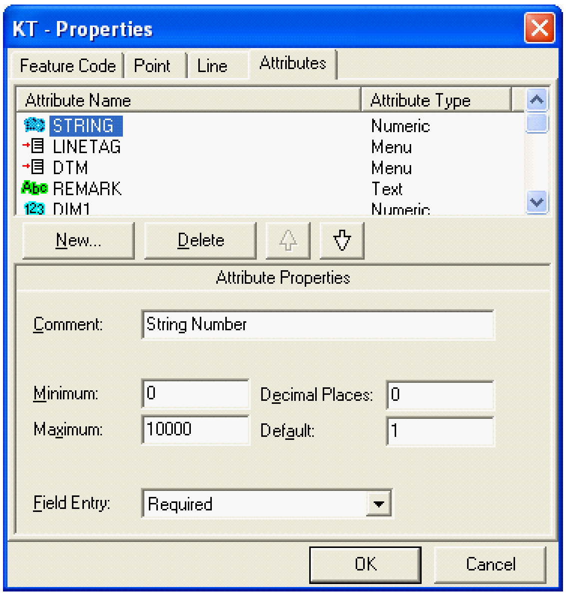
'KT' Kerb Top Feature set up as a String:

FEATURE	DESCRIPTION	ATTRIBUTES	DEFAULT VALUES
KT	Kerb Top	STRING	1
		LINETAG	S
		DTM	D
		REMARK	
		DIM1	
		LOSLR	
		LOSFB	
		ZOFSUD	
		PARLR	
		PARFB	
		TAPELR	
		TAPEFB	
		COPYFEAT	
		COPYLR	
		COPYUD	

NOTE:

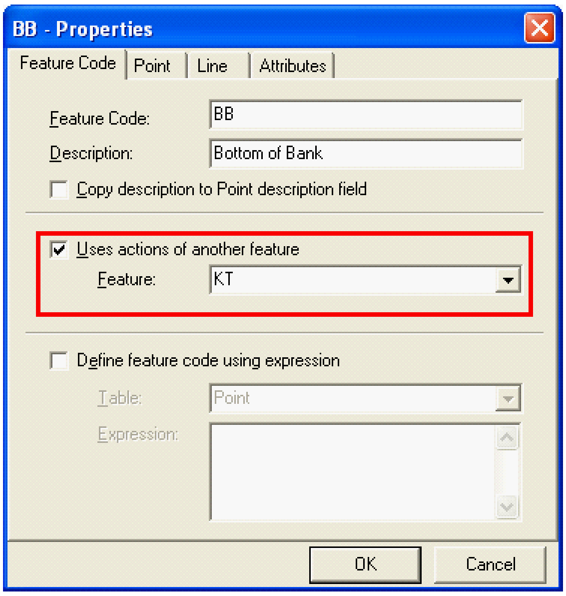
STRING - String No., LINETAG - Line Connection Tag, DTM - DTM Status, REMARK - Remark / Note, DIM1 - Dimension 1, LOSLR - Line Of Sight Offset Left / Right, LOSFB - Line Of Sight Offset Forward / Back, ZOFSUD - Elevation Offest Up / Down, PARLR - Parallel Offset Left / Right, PARFB - Parallel Offset Forward / Back, TAPELR - Tape Offset Left / Right, TAPEFB - Tape Offset Forward / Back, COPYFEAT - Copy Feature, COPYLR - Copy Feature Left / Right Offset, COPYFB - Copy Feature Forward / Back Offset



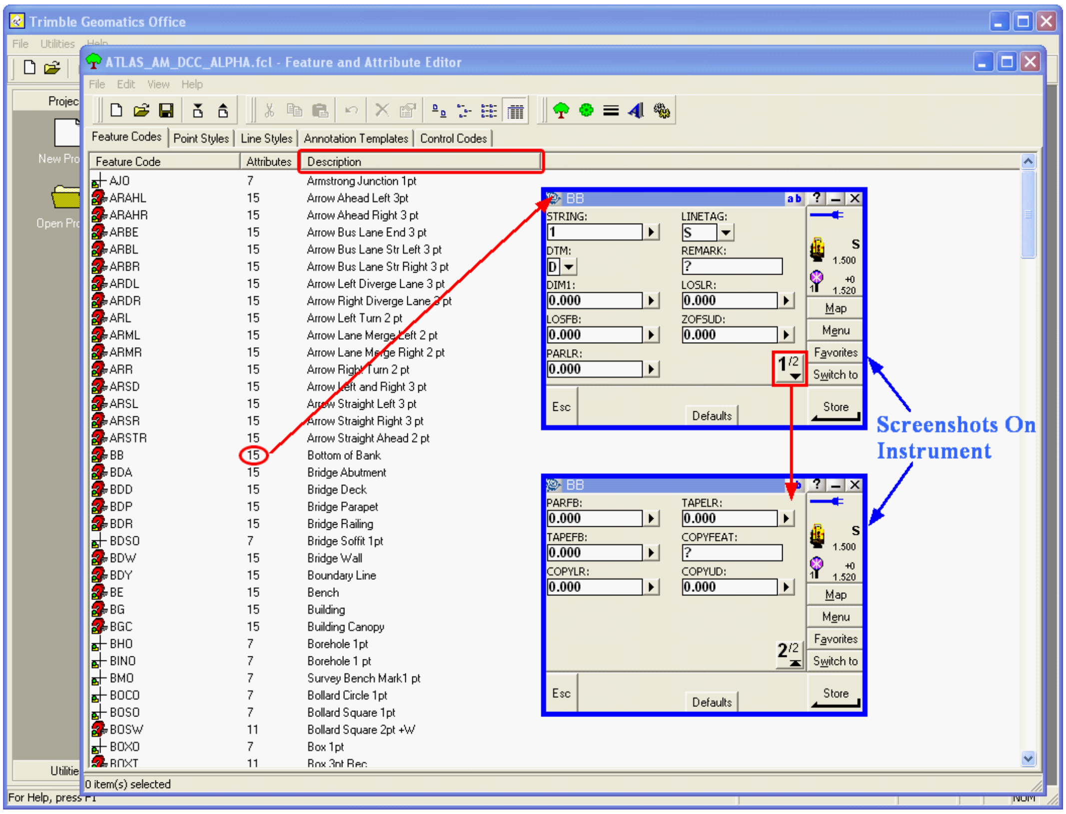


All other strings have been set up based on 'KT'.

Therefore, if you double click on a string feature in the Feature and Attribute Editor or right click mouse on string feature and then select 'Properties' you can see the 'Uses actions of another feature' is set to 'KT'. In the example below, Bottom of Bank string 'BB' uses 'KT' :



The following diagram demonstrates the relationship of the attributes within Trimble Geomatics Office 'Feature and Attribute Editor' dialog and the actually screens from the instrument showing the attribute:



To globally edit all string features, the feature 'KT' can be modified.

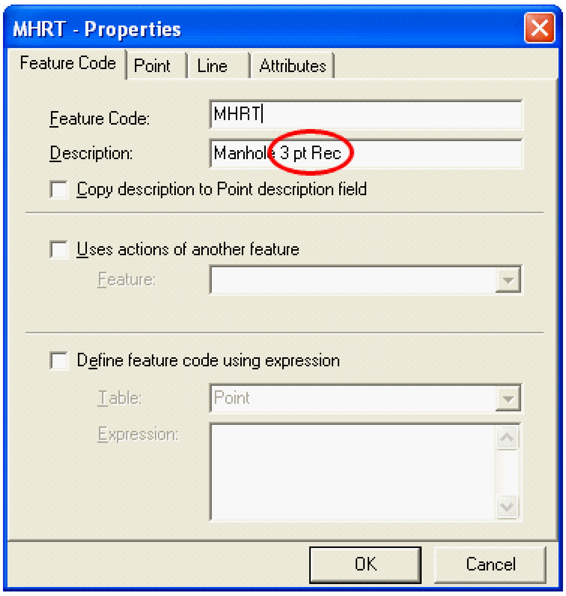
For instance, if you do not wish to have specific attributes assigned to a string, the feature 'KT' can be edited and in turn, all stings based on 'KT' will be modified.

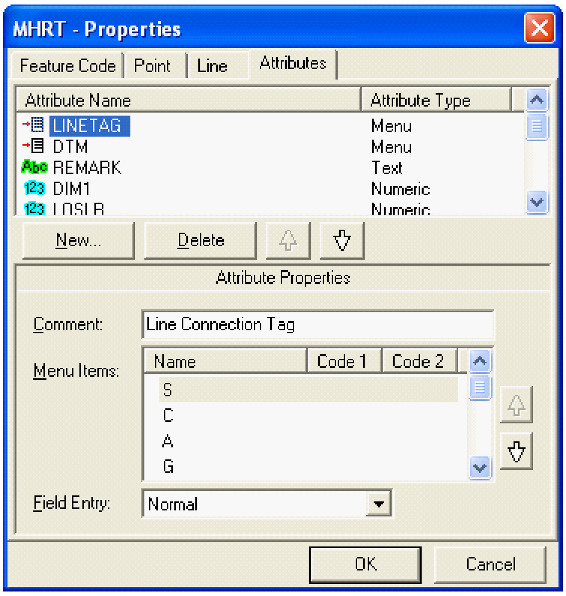
'MHRT' Manhole Feature set up as a 3 Point Rectangular:

FEATURE	DESCRIPTION	ATTRIBUTES	DEFAULT VALUES
MHRT	Manhole 3pt Rec	LINETAG	Rec3
		DTM	D
		REMARK	
		DIM1	
		LOSLR	
		LOSFB	
		ZOFSUD	
		PARLR	
		PARFB	
		TAPELR	
		TAPEFB	

NOTE:

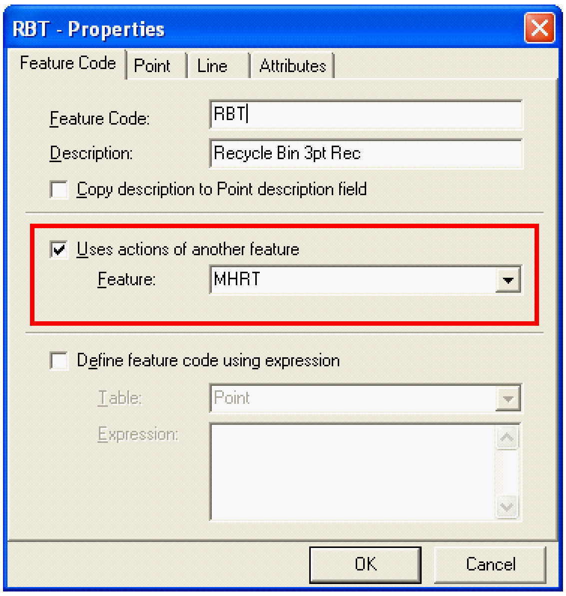
STRING - String No., LINETAG - Line Connection Tag, DTM - DTM Status, REMARK - Remark / Note, DIM1 - Dimension 1, LOSLR - Line Of Sight Offset Left / Right, LOSFB - Line Of Sight Offset Forward / Back, ZOFSUD - Elevation Offest Up / Down, PARLR - Parallel Offset Left / Right, PARFB - Parallel Offset Forward / Back, TAPELR - Tape Offset Left / Right, TAPEFB - Tape Offset Forward / Back





All other 3 point rectangles have been set up based on 'MHRT'.

Therefore, if you double click on a 3 point rectangles feature in the Feature and Attribute Editor or right click mouse on a 3 point rectangles feature and then select 'Properties' you can see the 'Uses actions of another feature' is set to 'MHRT'. In the example below, Recycle Bin 3 point rectangle 'RBT' uses 'MHRT' :



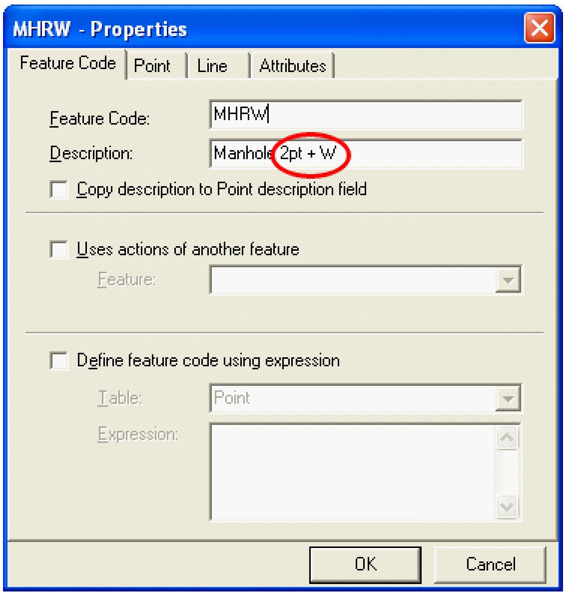
To globally edit all 3 point rectangles features, the feature 'MHRT' can be modified.

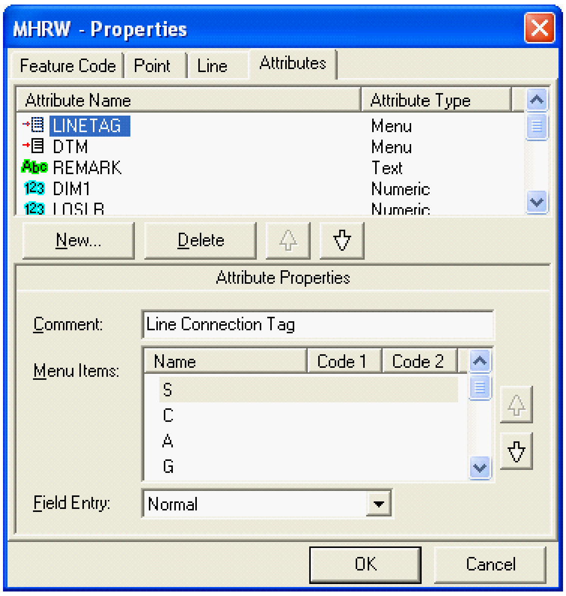
'MHRW' Manhole Feature set up as a 2 Points plus Width:

FEATURE	DESCRIPTION	ATTRIBUTES	DEFAULT VALUES
MHRT	Manhole 3pt Rec	LINETAG	Rec2
		DTM	D
		REMARK	
		DIM1	
		LOSLR	
		LOSFB	
		ZOFSUD	
		PARLR	
		PARFB	
		TAPELR	
		TAPEFB	

NOTE:

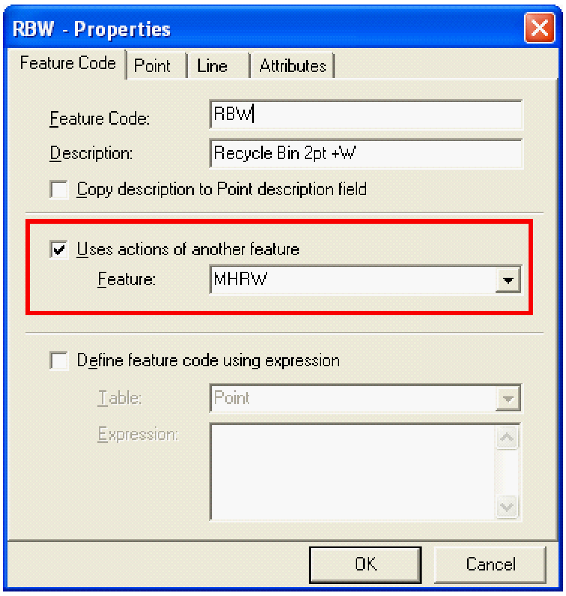
STRING - String No., LINETAG - Line Connection Tag, DTM - DTM Status, REMARK - Remark / Note, DIM1 - Dimension 1, LOSLR - Line Of Sight Offset Left / Right, LOSFB - Line Of Sight Offset Forward / Back, ZOFSUD - Elevation Offest Up / Down, PARLR - Parallel Offset Left / Right, PARFB - Parallel Offset Forward / Back, TAPELR - Tape Offset Left / Right, TAPEFB - Tape Offset Forward / Back





All other 2 point plus width have been set up based on 'MHRW'.

Therefore, if you double click on a 2 point plus width feature in the Feature and Attribute Editor or right click mouse on 2 point plus width feature and then select 'Properties' you can see the 'Uses actions of another feature' is set to 'MHRW'. In the example below, Recycle Bin 3 point rectangle 'RBW' uses 'MHRW' :



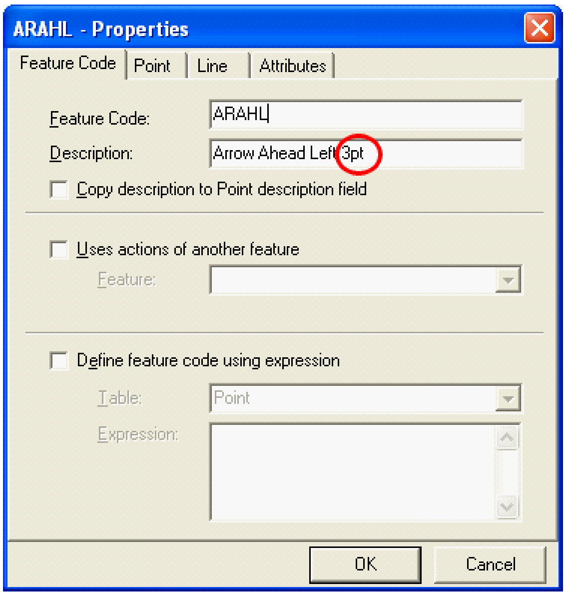
To globally edit all 2 point plus width features, the feature 'MHRW' can be modified.

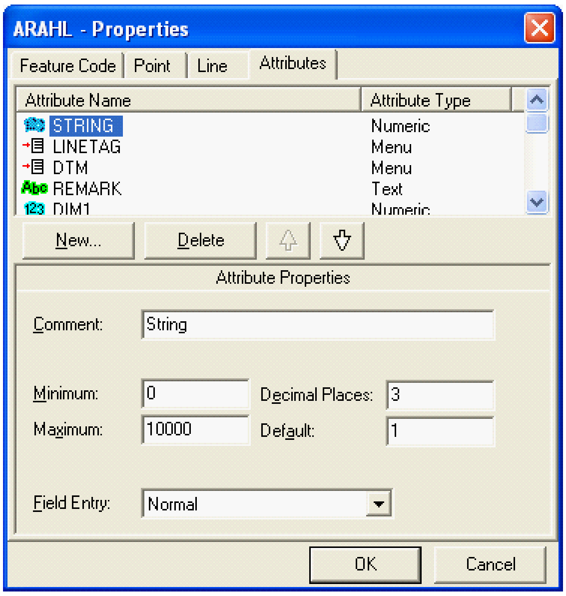
'ARAHL' Arrow Ahead Left Feature set up as a 3 Points:

FEATURE	DESCRIPTION	ATTRIBUTES	DEFAULT VALUES
ARAHL	Arrow Ahead Left	STRING	1
		LINETAG	S
		DTM	D
		REMARK	
		DIM1	
		LOSLR	
		LOSFB	
		ZOFSUD	
		PARLR	
		PARFB	
		TAPELR	
		TAPEFB	
		COPYFEAT	
		COPYLR	
		COPYUD	

NOTE:

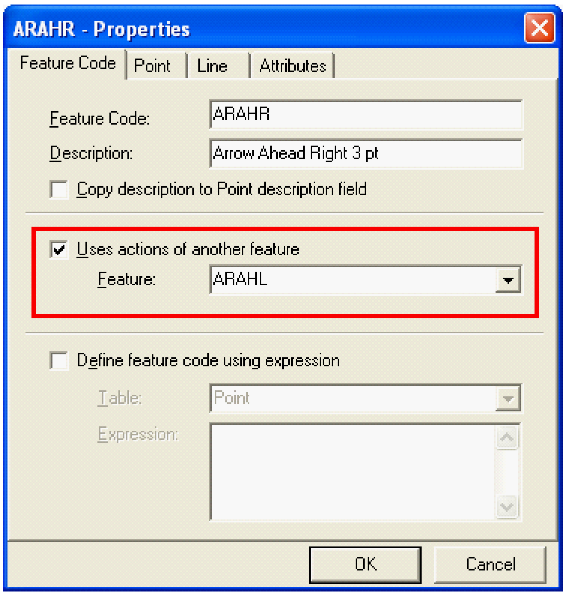
STRING - String No., LINETAG - Line Connection Tag, DTM - DTM Status, REMARK - Remark / Note, DIM1 - Dimension 1, LOSLR - Line Of Sight Offset Left / Right, LOSFB - Line Of Sight Offset Forward / Back, ZOFSUD - Elevation Offest Up / Down, PARLR - Parallel Offset Left / Right, PARFB - Parallel Offset Forward / Back, TAPELR - Tape Offset Left / Right, TAPEFB - Tape Offset Forward / Back, COPYFEAT - Copy Feature, COPYLR - Copy Feature Left / Right Offset, COPYFB - Copy Feature Forward / Back Offset





All other 3 point features have been set up based on 'MHRW'.

Therefore, if you double click on a 3 point feature in the Feature and Attribute Editor or right click mouse on a 3 point feature and then select 'Properties' you can see the 'Uses actions of another feature' is set to 'ARAHL'. In the example below, Arrow Ahead Right 3 point rectangle 'ARAHR' uses 'ARAHL :



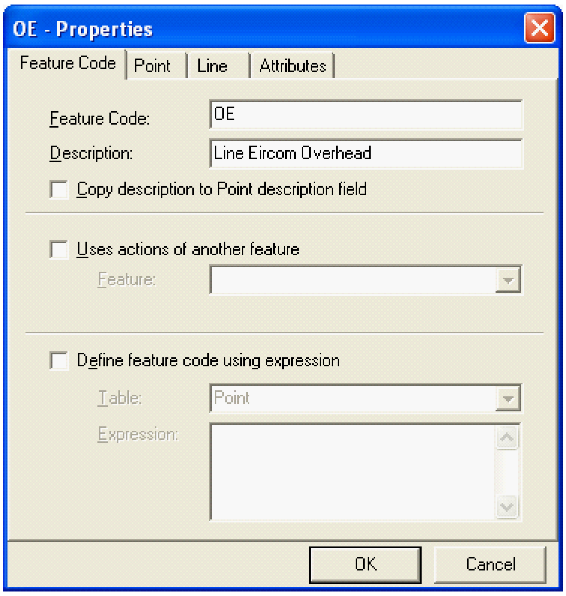
To globally edit all 3 point features, the feature 'ARAHL' can be modified.

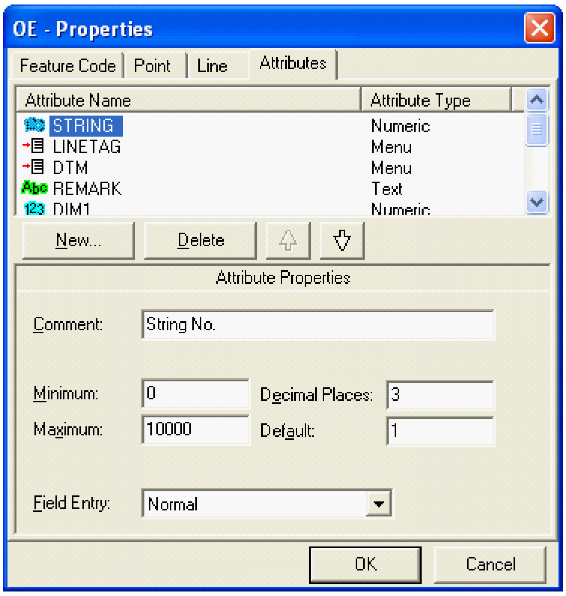
'OE' Line Eircom Overhead Feature set up as a 2D (Approx Elevation) String:

FEATURE	DESCRIPTION	ATTRIBUTES	DEFAULT VALUES
OE	Eircom Overhead	STRING	1
		LINETAG	S
		DTM	A
		REMARK	
		DIM1	
		LOSLR	
		LOSFB	
		ZOFSUD	
		PARLR	
		PARFB	
		TAPELR	
		TAPEFB	

NOTE:

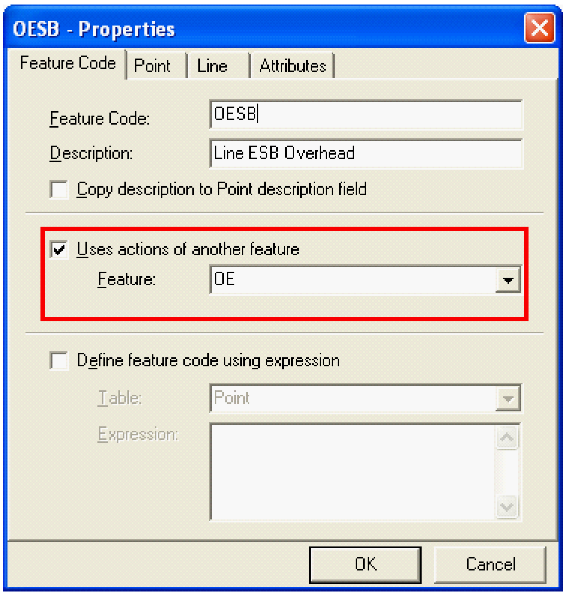
STRING - String No., LINETAG - Line Connection Tag, DTM - DTM Status, REMARK - Remark / Note, DIM1 - Dimension 1, LOSLR - Line Of Sight Offset Left / Right, LOSFB - Line Of Sight Offset Forward / Back, ZOFSUD - Elevation Offest Up / Down, PARLR - Parallel Offset Left / Right, PARFB - Parallel Offset Forward / Back, TAPELR - Tape Offset Left / Right, TAPEFB - Tape Offset Forward / Back





All other 2D string features have been set up based on 'OE'.

Therefore, if you double click on a 2D string feature in the Feature and Attribute Editor or right click mouse on a 2D string feature and then select 'Properties' you can see the 'Uses actions of another feature' is set to 'OESB'. In the example below, ESB Overhead 'OESB' uses 'OE' :



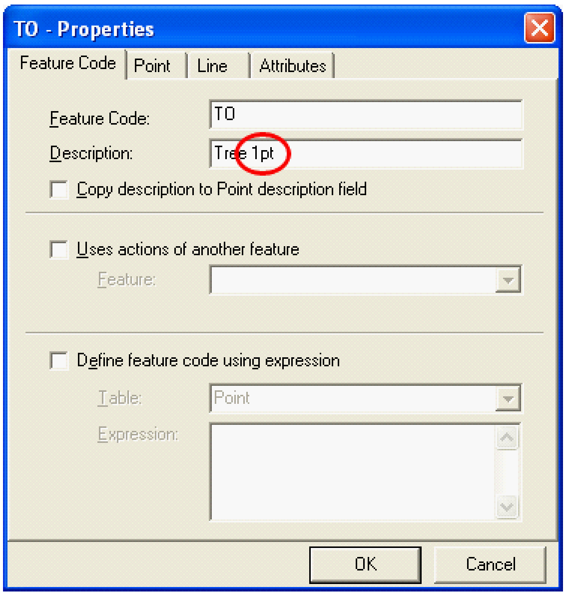
To globally edit all 2D string features, the feature 'OE' can be modified.

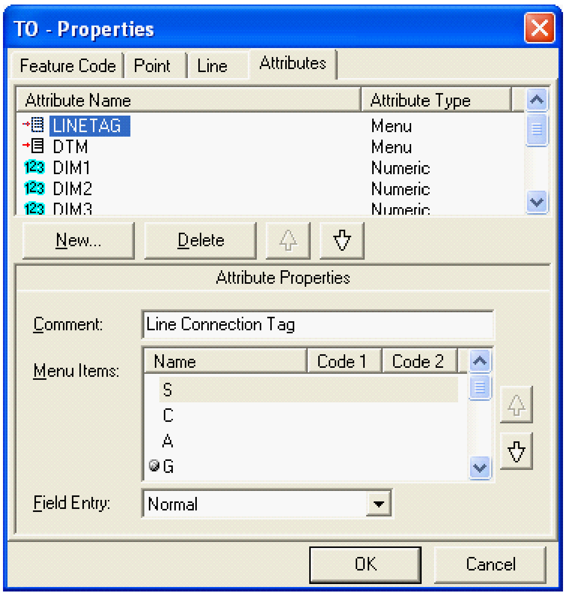
'TO' Tree Feature set up as a 2D (Approx Elevation) 1 point feature with specific Dimension Attributes for Canopy and Trunk Size:

FEATURE	DESCRIPTION	ATTRIBUTES	DEFAULT VALUES
TO	Tree	LINETAG	G
		DTM	A
		DIM1	
		DIM2	
		DIM3	
		REMARK	
		LOSLR	
		LOSFB	
		ZOFSUD	

NOTE:

LINETAG - Line Connection Tag, DTM - DTM Status, DIM1 - Dimension 1, DIM2 - Dimension 2, DIM3 - Dimension 3, REMARK - Remark / Note, LOSLR - Line Of Sight Offset Left / Right, LOSFB - Line Of Sight Offset Forward / Back, ZOFSUD - Elevation Offest Up / Down

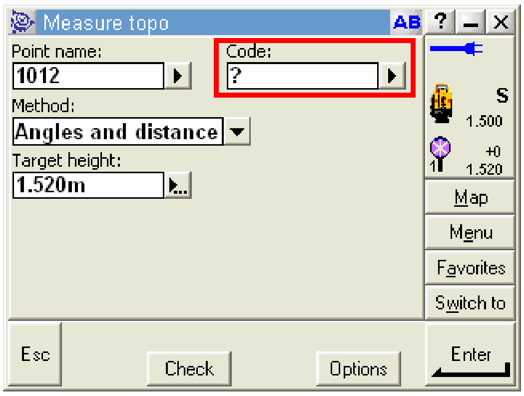


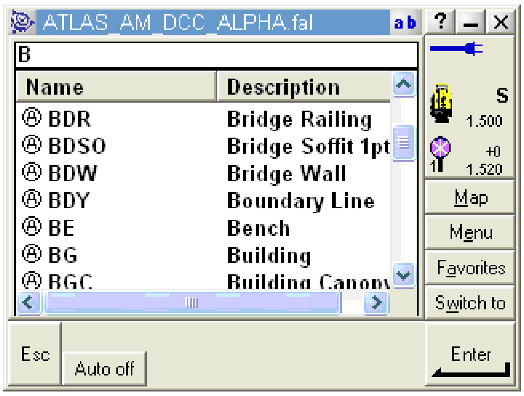


Examination of Feature File and Raw Data within SurveyPro software

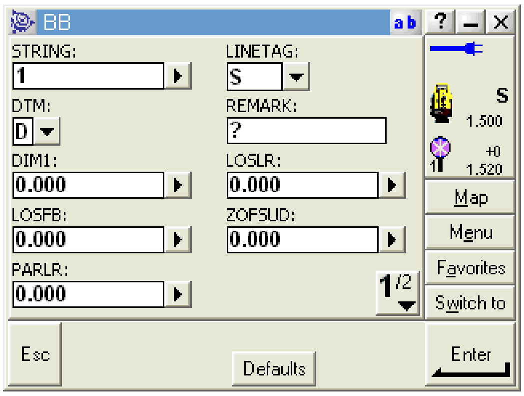
The following screenshots have been captured from Survey Pro to demonstrate the attributes set up in 'ATLAS_AM_DCC_ALPHA.fal'. Three common survey field codes have been examined 'BB' Bottom of Bank, 'SO' Spot Height and 'TO' Tree. In turn, extracts from raw survey data are displayed. Note that, Tsce attributes are stored in 13AT records.

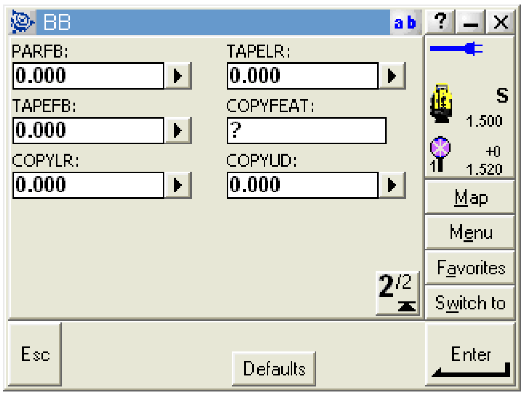
The drop down code list can be accessed within the main 'Measure Top' screen





'BB' Bottom Of Bank String Feature and Attributes:

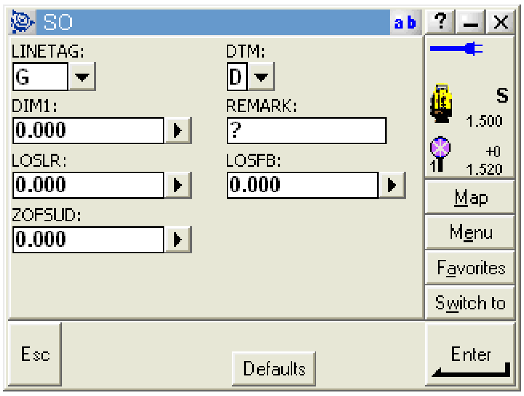





```
09F10003100034.698000090.7002777159.380833BB
13ATSTRING                 1.00000000000000
13ATLINETAG               S
```

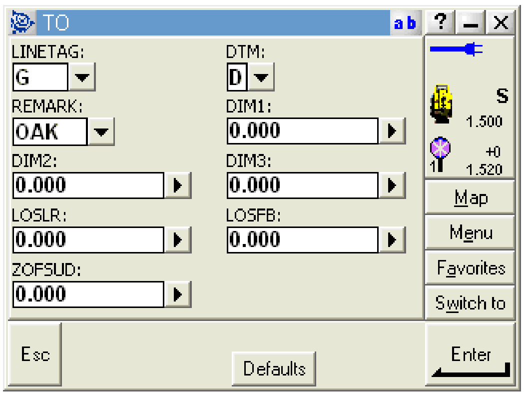
```
13ATDTM                  A

13ATREMARK
13ATDIM1                 0.00000000000000
13ATLOSLR                0.00000000000000
13ATLOSFB                0.00000000000000
13ATZOFSUD               0.00000000000000

13ATPARLR                0.00000000000000
13ATPARFB                0.00000000000000
13ATTAPELR               0.00000000000000
13ATTAPEFB               0.00000000000000
13ATCOPYFEAT
13ATCOPYLR               0.00000000000000
13ATCOPYUD               0.00000000000000
```

'SO' Spot Height Point Feature and Attributes:




```
09F10450106819.867000090.5027777255.889444SO
13ATLINETAG              G
13ATDTM                  E
13ATDIM1                 0.00000000000000
13ATREMARK
13ATLOSLR                0.00000000000000
13ATLOSFB                0.00000000000000
13ATZOFSUD               0.00000000000000
'
```

TO' Tree Point Feature and Attributes:

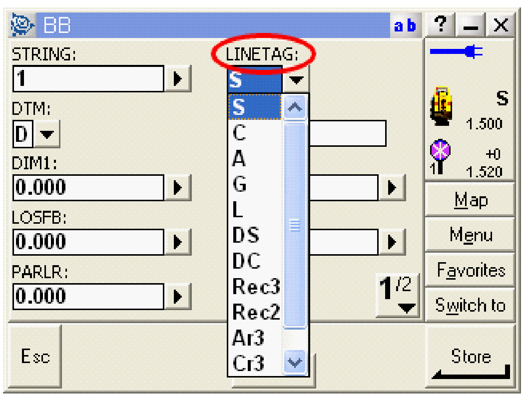


```
09F10450106738.205000090.0836111263.203611TO
13ATLINETAG            G
13ATDTM                A
13ATREMARK             OAK

13ATDIM1               10.0000000000000
13ATDIM2               0.75000000000000
13ATDIM3               1.00000000000000
13ATLOSLR              0.00000000000000
13ATLOSFB              0.00000000000000
13ATZOFSUD              0.00000000000000
```

Note:

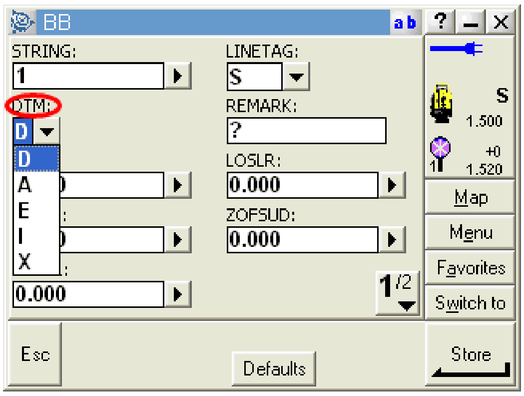
Many attributes contain drop down menus. For instance, several line connection tags (tabulated below) which determines the connective geometry and specifies how the current point on the string will be connected to the next point on the string are included as a drop down menu.

Alpha Code	**Description**
S	Straight
C	Curve
A	Arc
G	Gap
L	Link Back To First Point on the String
DC	Discontinuous Curve (Non-Tangential Incoming Tangent from Straight to Curve)
DS	Discontinuous Straight (Non-Tangential Outcoming Tangent from Straight to Curve)
Ar3	Three Point Arc
Cr3	Three Point Circle
Cr2	Two Point Circle
C1R	Radius and Centre Circle
Rec3	Three Point Rectangle
Rec2	Two Point and Width Rectangle



In the same manner, common DTM (Digital Terrain Model) status code which determines the significance of the point of the surface model / digital terrain model are set up (tabulated below). As such DTM controls whether the point is 2D or 3D, whether it should be used in surface model generation and subsequent contouring and other surface analysis, and whether it lies on a string forming the model boundary.

Alpha Code	Description
D	DTM Elevation
A	Approximate Elevation (2D Point)
E	Non DTM Elevation
I	Ignore
X	DTM Elevation with text turned off on download



23.4 Download Trimble Data with Specific Attributes

Processing & Download Steps:

To process a file containing information based 'ATLAS_AM_DCC_ALPHA.fal' within SCC:

From the Main Menu Bar, select 'FILE > New Project'

Enter in a Project/Job name

Select a Project Template from the list 'Trimble_TSCE_ALPHA.Project'

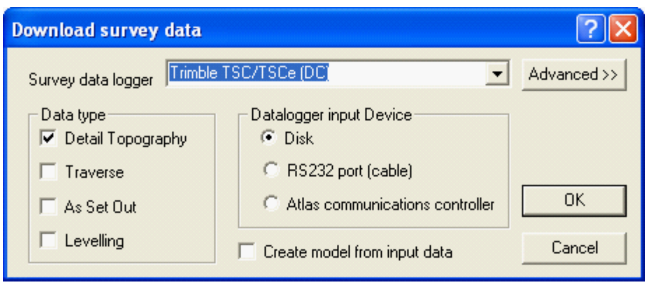
Select 'OK'

From the Main Menu Bar, select 'FILE > Download Survey Data'

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

Highlight 'Detail Topography' as the Data Type

Set Input Device to 'Disk'

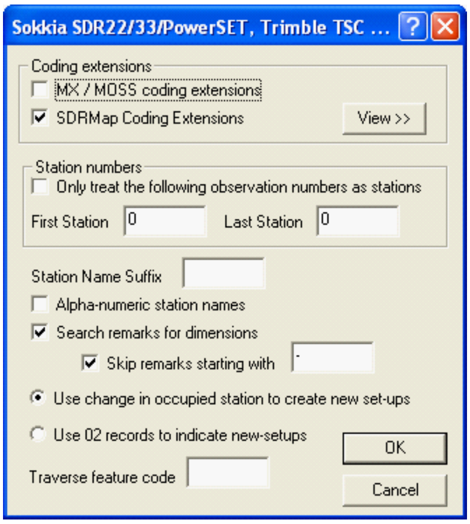


Select 'OK'

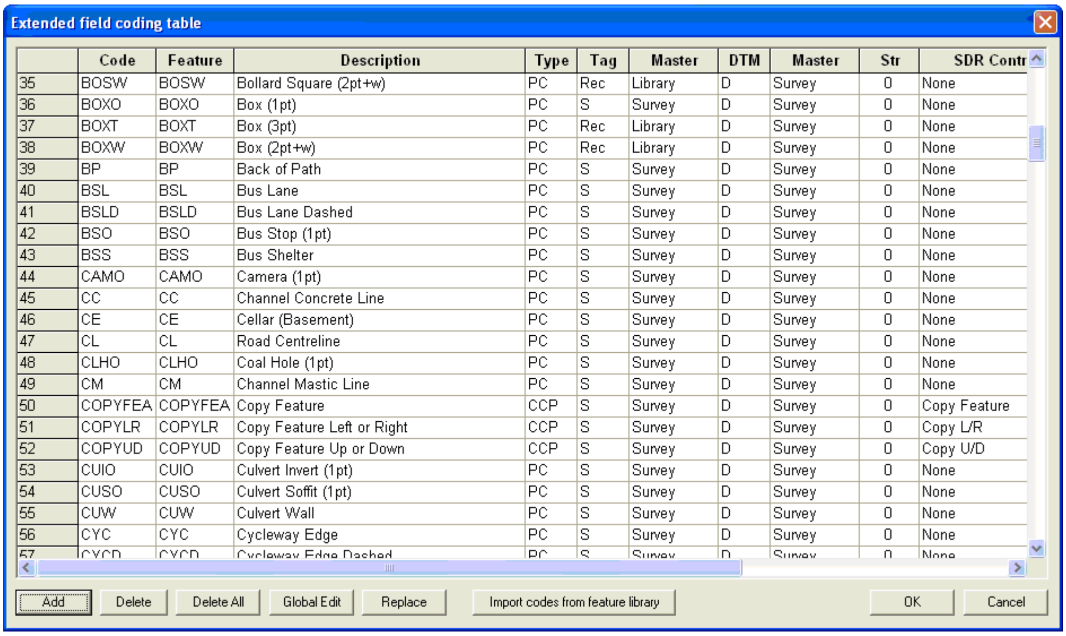
Select file

Select 'Open'

Select 'OK'



Select 'View>>' beside 'SDRMap Coding Extensions'



	Code	Feature	Description	Type	Tag	Master	DTM	Master	Str	SDR Contr
35	BOSW	BOSW	Bollard Square (2pt+w)	PC	Rec	Library	D	Survey	0	None
36	BOXO	BOXO	Box (1pt)	PC	S	Survey	D	Survey	0	None
37	BOXT	BOXT	Box (3pt)	PC	Rec	Library	D	Survey	0	None
38	BOXW	BOXW	Box (2pt+w)	PC	Rec	Library	D	Survey	0	None
39	BP	BP	Back of Path	PC	S	Survey	D	Survey	0	None
40	BSL	BSL	Bus Lane	PC	S	Survey	D	Survey	0	None
41	BSLD	BSLD	Bus Lane Dashed	PC	S	Survey	D	Survey	0	None
42	BSO	BSO	Bus Stop (1pt)	PC	S	Survey	D	Survey	0	None
43	BSS	BSS	Bus Shelter	PC	S	Survey	D	Survey	0	None
44	CAMO	CAMO	Camera (1pt)	PC	S	Survey	D	Survey	0	None
45	CC	CC	Channel Concrete Line	PC	S	Survey	D	Survey	0	None
46	CE	CE	Cellar (Basement)	PC	S	Survey	D	Survey	0	None
47	CL	CL	Road Centreline	PC	S	Survey	D	Survey	0	None
48	CLHO	CLHO	Coal Hole (1pt)	PC	S	Survey	D	Survey	0	None
49	CM	CM	Channel Mastic Line	PC	S	Survey	D	Survey	0	None
50	COPYFEA	COPYFEA	Copy Feature	CCP	S	Survey	D	Survey	0	Copy Feature
51	COPYLR	COPYLR	Copy Feature Left or Right	CCP	S	Survey	D	Survey	0	Copy L/R
52	COPYUD	COPYUD	Copy Feature Up or Down	CCP	S	Survey	D	Survey	0	Copy U/D
53	CUIO	CUIO	Culvert Invert (1pt)	PC	S	Survey	D	Survey	0	None
54	CUSO	CUSO	Culvert Soffit (1pt)	PC	S	Survey	D	Survey	0	None
55	CUW	CUW	Culvert Wall	PC	S	Survey	D	Survey	0	None
56	CYC	CYC	Cycleway Edge	PC	S	Survey	D	Survey	0	None
57	CYCD	CYCD	Cycleway Edge Dashed	PC	S	Survey	D	Survey	0	None

Note:

The default library 'Trimble_TSCE_ALPHA.Project' already contains existing field codes within the Extended field coding table.

The dataset will be presented.

23.5 Creating A Model

Goto 'FILE > Model > SCC Dataset'

Select 'Create the model and triangulation' and set Initial Plot Scale of 250

Select 'FILE > Save As'

24 Working With Leica Data

The following tutorial provides information relating to the downloading and processing of Leica data within SCC.

24.1 Create A Project

A new project should be created before data may be downloaded into SCC or models formed.

From the Main Menu Bar, select 'FILE>New Project'

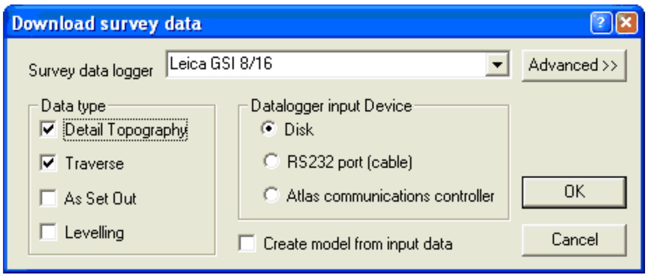
Enter in a Project/Job name

Select a Project Template from the list

Select 'OK'

24.2 Download 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.



Downloading Leica Data

From the Main Menu Bar, select 'FILE>Download Survey Data'

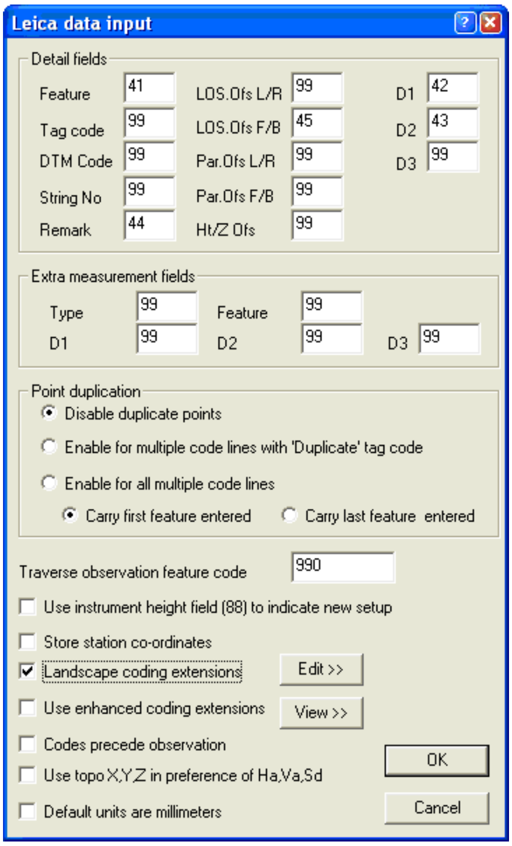
Set Survey Data Logger to 'Leica GS1 8/16'

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'

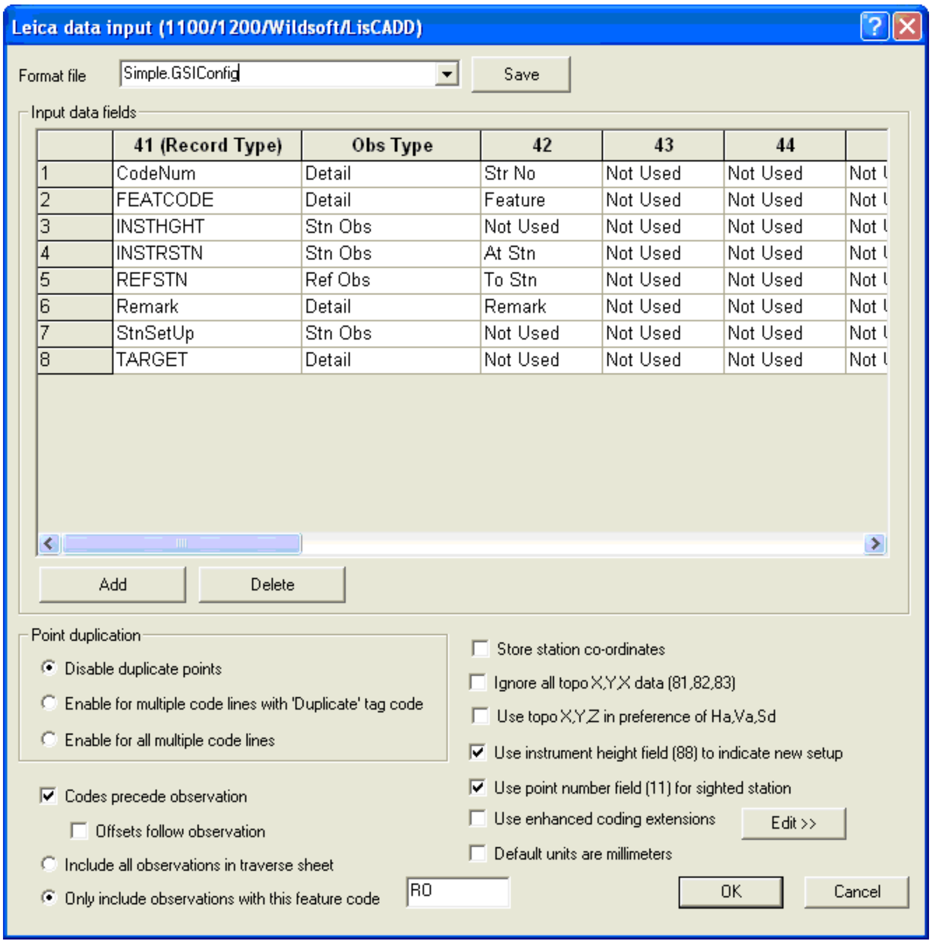
Select the file you require and 'OK'



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.



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.

Leica 1200 Data Input

The following outlines the transfer of format files on to a Leica1200 system and the use of the 'SCC Sys1200.FRT' file. Download steps into SCC are noted. The use of extra measurements such as 'Line of Sight offsets, Tape Offsets, Parallel Offsets, Dimensions and Remarks are examined.

A. Files for SCC Coding on Leica TPS1200 Series instruments:

SCCSys1200.FRT	Format File (*.FRT) generated in Leica GEO Office to a System 1200 sensor
badleyt_0405_211712.xcf badleyt_0405_211712.x23 badleyt_0405_211712.x06	Parameter Files

B. Setting up Coding on the TPS1200:

a)Transfer of Format Files on PC:

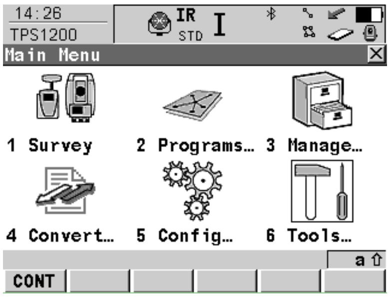
- **Copy Format Files to the Convert Directory on the Compact Flash [CF] Card**
- **Copy the *.xcf, *.x23 and *.x06 files into the Code Directory on the Compact Flash [CF] card**

Note:

The Compact Flash card must always be “Stopped” before removing it from your computer. The System 1200 sensor must always be switched off before removing the Compact Flash.

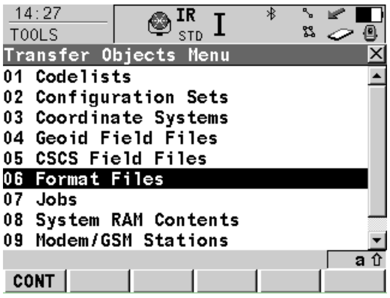
b)PC Card in the instrument – Format File:

- **Select option 6 Tools… from the Main Menu**

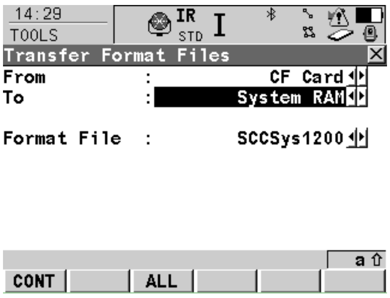


This option can be selected by pressing the number 6 key, or by navigating to 6 Tools... and pressing the Enter key, or by touching the Tools… icon when using an active touch screen

- **Select option 2 Transfer Objects… from the Tools Menu.**
- **Select option 6 Format Files from the Transfer Objects Menu**



- **Select the Format File (SCCSys1200.FRT) you wish to transfer, from the CF Card, to the SystemRAM, in the Transfer Format Files screen.**



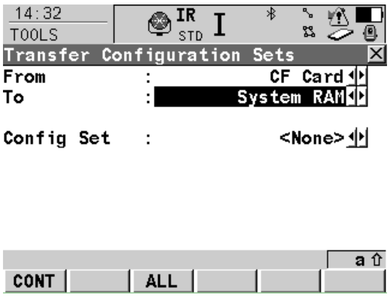
- **Select CONT [F1]**

The System 1200 sensor will return to the Main Menu once the Format File transfer is completed.

c)PC Card in the instrument – Transfer Configuration Sets:

- **Select option 6 Tools… from the Main Menu**
- **Select option 2 Transfer Objects from the Tools Menu**
- **Select option 2 Configuration Sets from the Transfer Objects Menu**

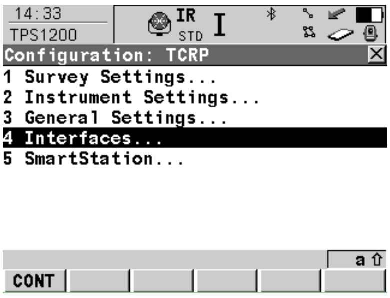
- **Set up appropriately (TC, TCRP RCS etc.):**



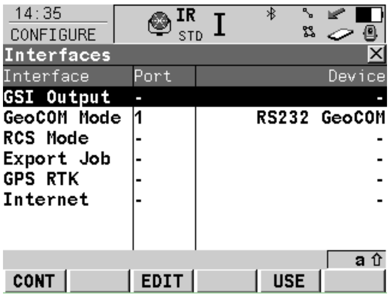
- **Select 'F3 – ALL'**

d)PC Card in the instrument – Configuration:

- **Select option 5 Configuration… from the Main Menu**
- **Select option 4 Interfaces from the Configuration: TC Menu**



- **Select GSI Output**



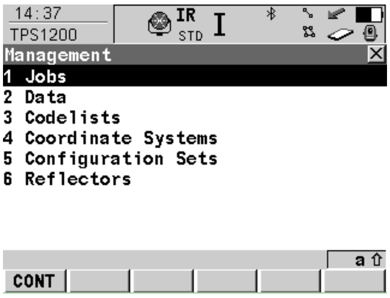
- **Select 'F1 – CONT'**

C. Setting up Survey

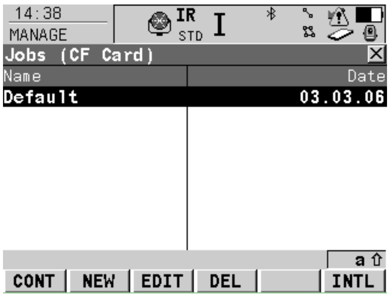
a)PC Card in the instrument – Management:

Select option 3 Management… from the Main Menu

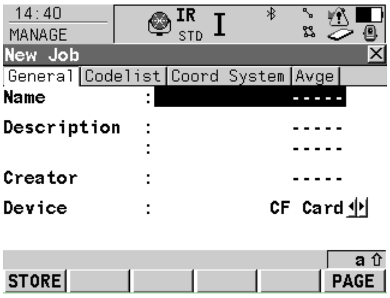
Select 1 Job from Management Menu



- **Select F2 New from Job (CF Card) Menu**

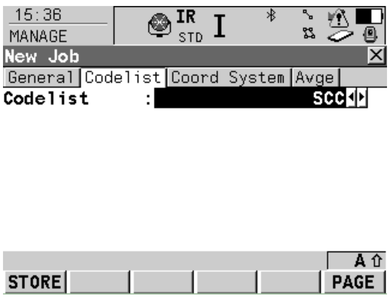


- **Within General Tab enter relevant details:**

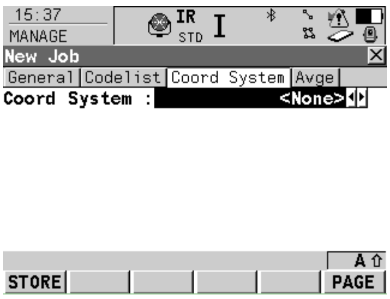


- **Tab to Codelist and ensure that the setting assigned in Step C d**

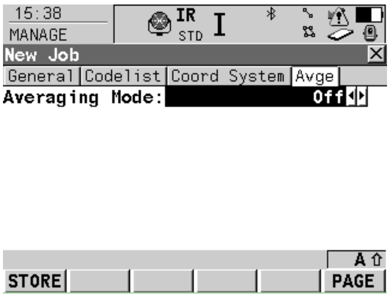
(Transfer Codelist) have been attained



- **Within Tab Coord System select None**



- **Within Avge Tab select Off**

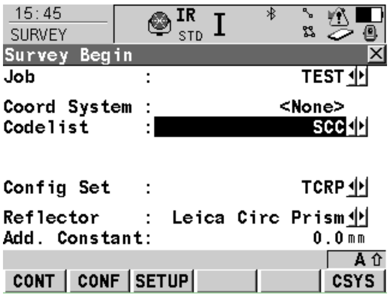


- **Select F1 Store**
- **Within Main Job Screen select F1 CONT with TEST highlighted**

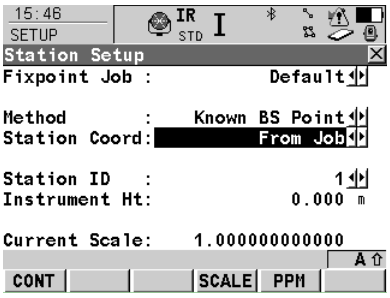
D. Setting up Stations within 1200 Series:

(Known Azimuth)

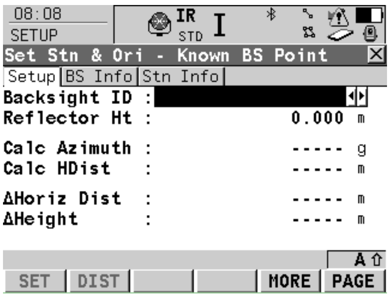
- **Select option 1 Survey… from the Main Menu**



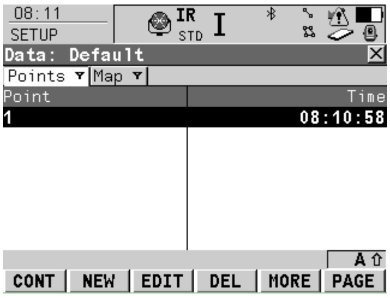
- **Set up the appropriate Reflector**
- **Set Method to Known BS**
- **Select Frm Fixpoint Job as Station Coord**



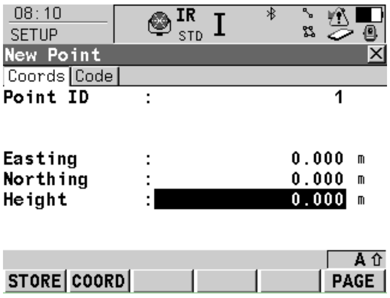
- **Select F1 CONT to access the Station Setup Panel**

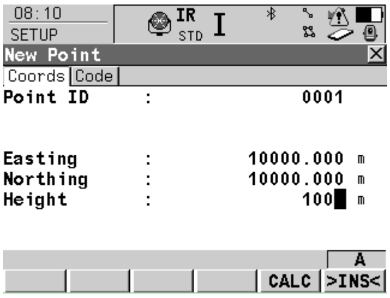


- **With Station ID highlighted select Enter (or Tap on Station ID focus)**

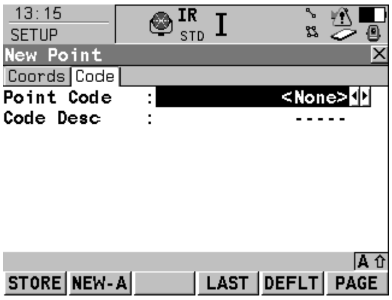


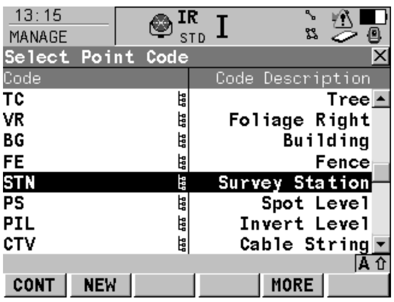
- **Select F2 NEW**
- **Enter Coords**

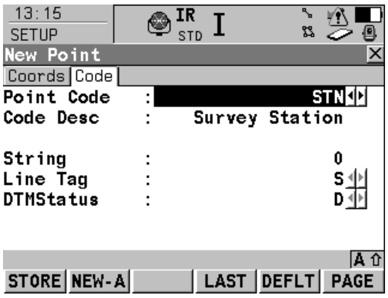




- **Within Code Tab**







- **Select F1 STORE**
- **Select F1 CONT twice to return to Select Station Dialog**
- **Select Station ID and enter Instrument Height**
- **Select F1 CONT**
- **Enter A Backsight ID and set Azmuith**

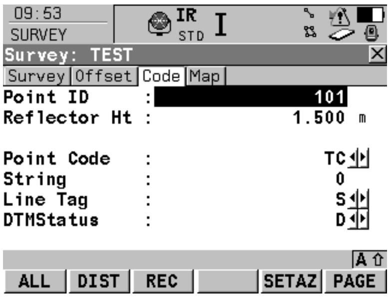
E. Surveying Detail with SCC Codelist:

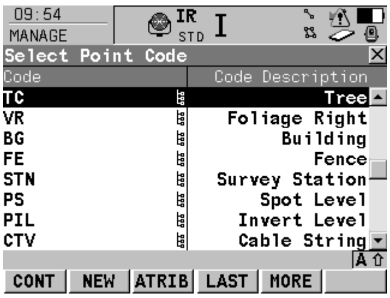
Leica TPS1200 Coding

- **After Station Set up select 1 Survey from Main Menu**
- **4 tabs are available**
- **For Example**

Go to Code tab:Enter Reflector Ht.

Assign Point Code either using arrows or double click to view Code and Code Description Dialog





- **Assign String, Line Tag and DTM Status appropriately**

Offsets are available from either the offset Tab or by within the Free Codes ‘F7’.

Extra Measurements have also been set up within the Free Codes ‘F7’.

F. SCC Settings for Leica coding using Leica TPS1200 Instruments

Open SCC and set up Project

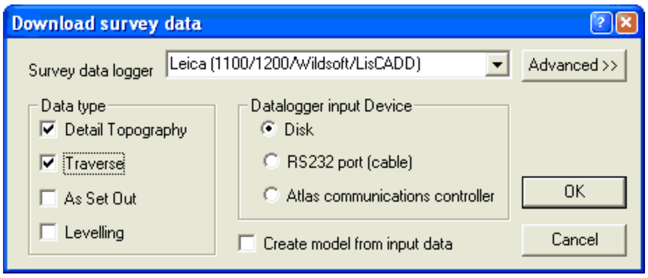
Select 'FILE>Download Survey'

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

Select the required 'Data Type'

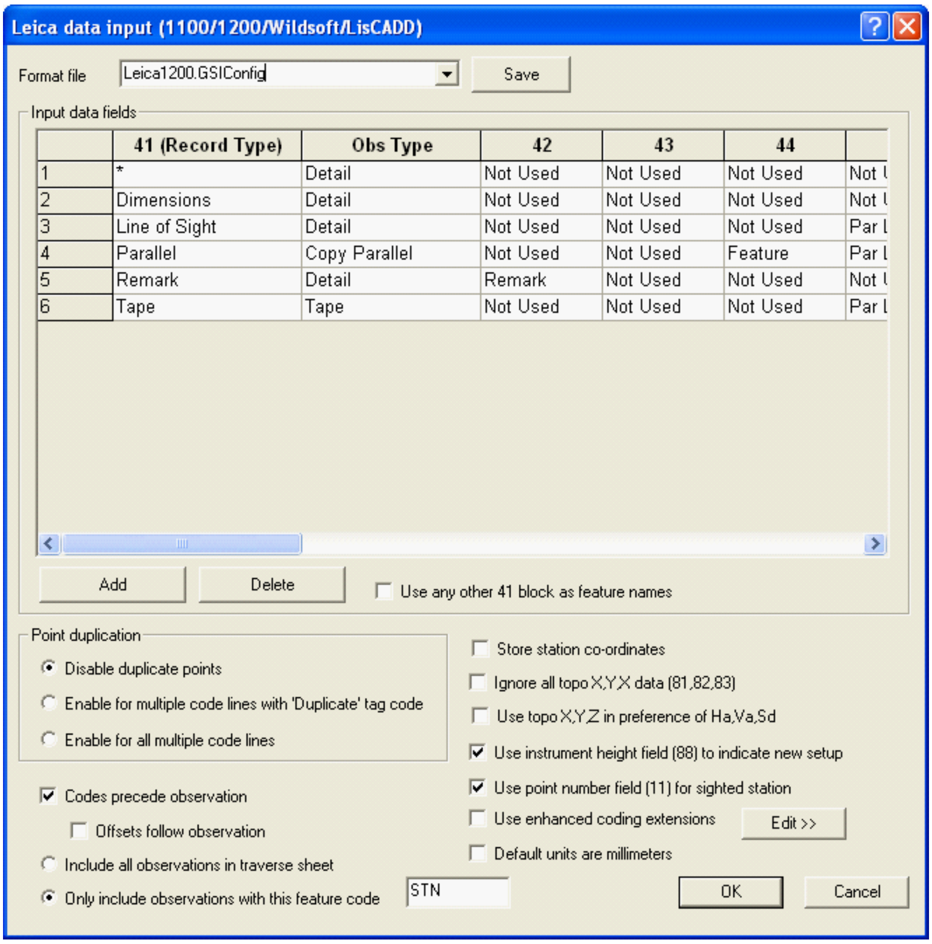
Select 'Data logger input Device'

Select 'OK'



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.

Always include the decimal point when inputting any number so that SCC knows the units i.e. 12.0 or 0.25

G. Tag Codes

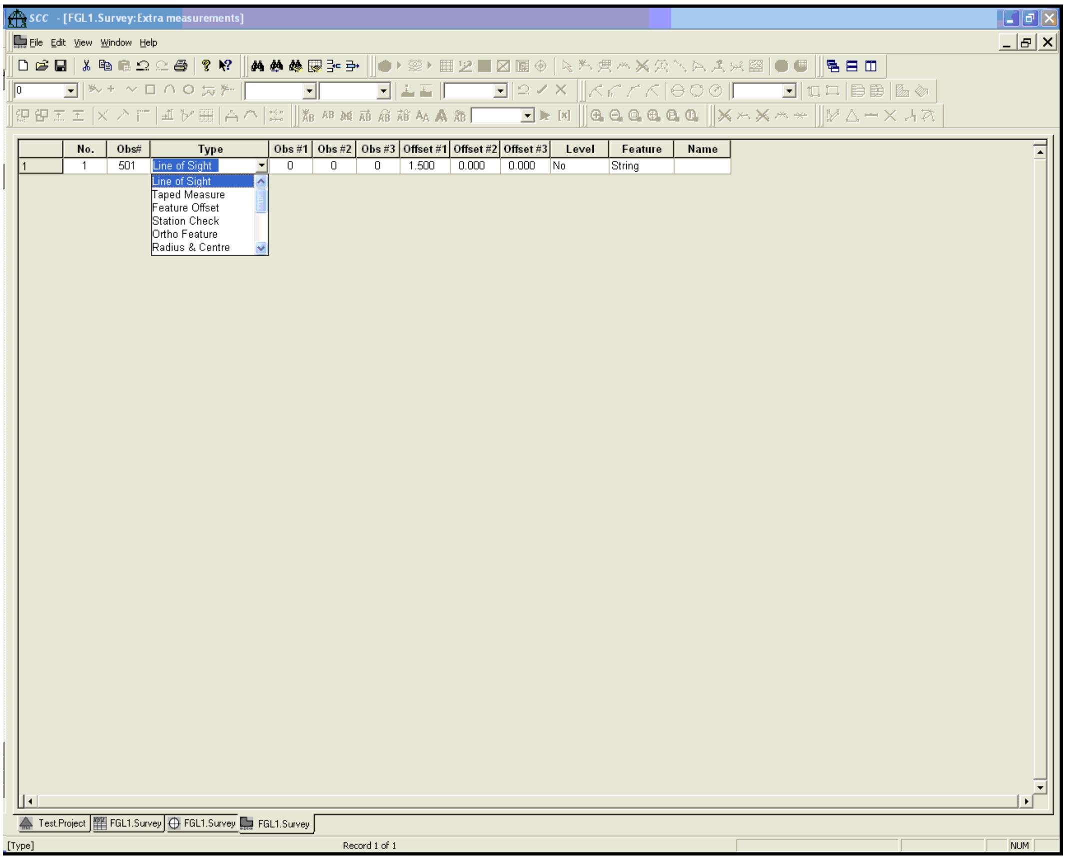
The tag code determines the connective geometry and specifies how the current point on the string will be connected to the next point on the string. This can be used to specify straight lines, curves, arcs, and squared up pieces of geometry in a string. The tag codes may be entered either in numeric or alpha-numeric format.

H. DTM Tag Code

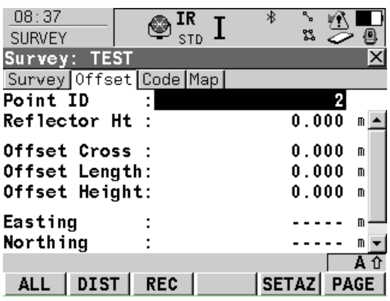
The DTM (Digital Terrain Model) status code determines the significance of the point of the surface model / digital terrain model being generated. The DTM codes may be entered either in numeric or alpha-numeric format

I. Extra measurement fields

Extra user defined GSI fields may be used to collect extra measurement information corresponding to the SCC extra measurement sheet.



Several offsets are available as part of the main interface:

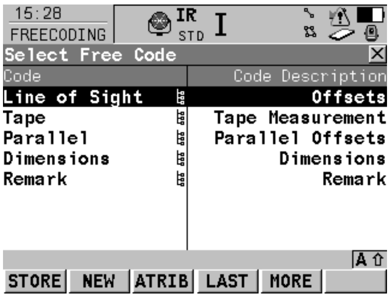


The Offsets are as follows:

Offset Cross:	Line Of Sight L/R (Radial Offset)
Offset Length:	Line Of Sight F/B (Lateral Offset)
Offset Height:	Elevation offset.

Additional Extra Measurements have been set up as part of the Free Codes (F7):

Free Code:

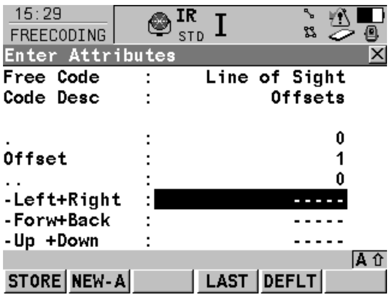


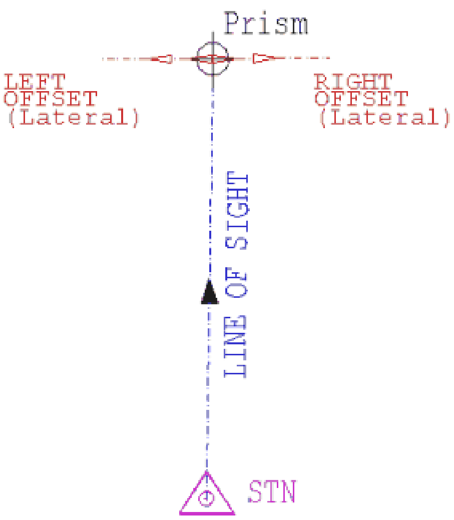
Line OF Sight

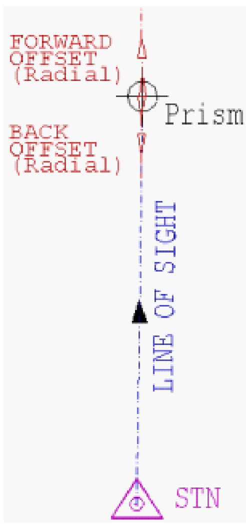
The **'-Left+Right'** offset corresponds to the distance left or right along the line of sight between the instrument and the target.

The **'–Forward+Back'** offset corresponds to the distance forward or back along the line of sight between the instrument and the target.

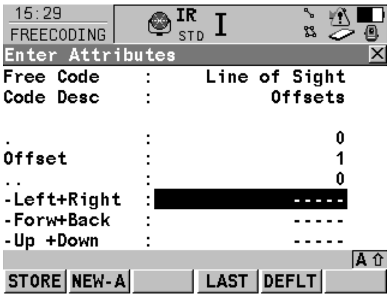
The **'–Up+Down'** offset corresponds to the elevation offset.





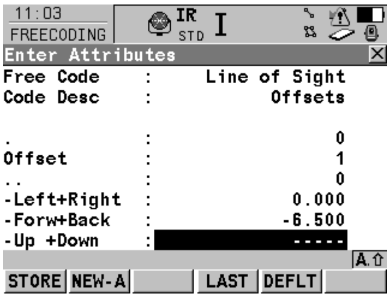


Point 101: **Line of Sight Offset to the left –3.500**



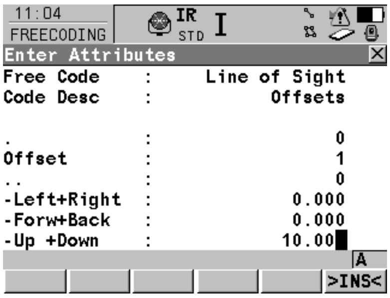
*110017+0000000000000**101** 21.044+0000000008100000 22.044+0000000008100000
31..00+0000000000010000 51....+000000000000+000 87....+0000000000001500
71....+00000000000000PS 72....+0000000000000000 73....+000000000000000S
74....+000000000000000D ***410018+000Line of Sight** 42....+0000000000000000
43....+0000000000000001 44....+0000000000000000 **45....+0000000000-3.500**
46....+0000000000000000 47....+0000000000000000 48....+0000000000000000
49....+0000000000000000

Point 102: Line of Sight Offset to the Forward -6.500



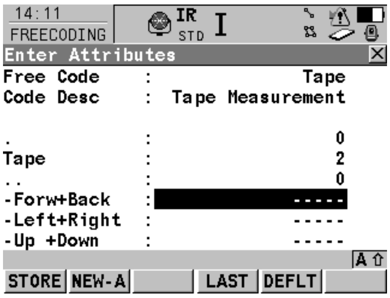
*110019+0000000000000**102** 21.044+0000000008100000 22.044+0000000008100000
31..00+0000000000010000 51....+000000000000+000 87....+0000000000001500
71....+00000000000000PS 72....+0000000000000000 73....+0000000000000000
74....+0000000000000000 ***410020+000Line of Sight** 42....+0000000000000000
43....+0000000000000001 44....+0000000000000000 45....+000000000000.000
46....+0000000000-6.500 47....+0000000000000000 48....+0000000000000000
49....+0000000000000000

Point 103: Line of Sight Offset to the Down +10.00



*110021+0000000000000**103** 21.044+0000000008100000 22.044+0000000008100000
31..00+0000000000010000 51....+000000000000+000 87....+0000000000001500
71....+00000000000000PS 72....+0000000000000000 73....+0000000000000000
74....+0000000000000000 ***410022+000Line of Sight** 42....+0000000000000000
43....+0000000000000001 44....+0000000000000000 45....+000000000000.000 46....+000000000000.000
47....+000000000010.000 48....+0000000000000000 49....+0000000000000000

Tape

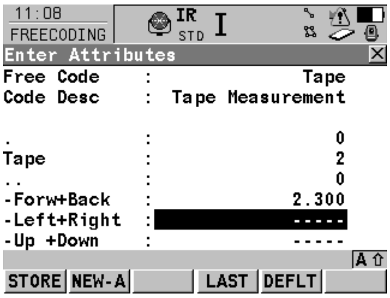


The**'–Forward+Back'** offset corresponds to the distance forward or back along the line (Baseline) connecting the last two survey points.

The **'-Left+Right'** offset corresponds to the distance left or right along the line (Baseline) connecting the last two survey points.

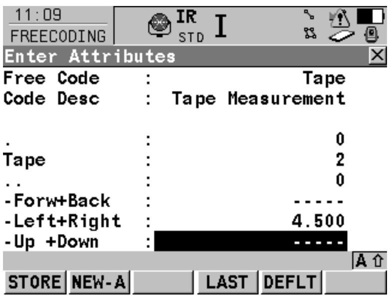
The **'–Up+Down'** offset corresponds to the elevation offset.

Point 201: Tape Offset to the Back +2.300



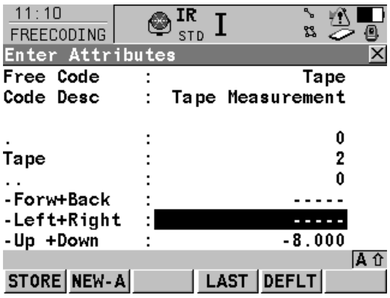
*110026+0000000000000**201** 21.044+0000000008100000 22.044+0000000008100000
31..00+0000000000010000 51....+000000000000+000 87....+0000000000001500
71....+0000000000000PST 72....+0000000000000000 73....+000000000000000S
74....+000000000000000D ***410027+000000000000Tape** 42....+0000000000000000
43....+0000000000000002 44....+0000000000000000 **45....+000000000002.300**
46....+0000000000000000 47....+0000000000000000 48....+0000000000000000
49....+0000000000000000

Point 202: Tape Offset to the Right +4.500



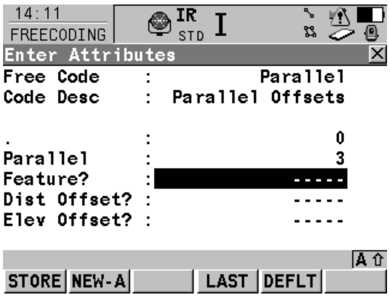
*110028+0000000000000**202** 21.044+0000000008100000 22.044+0000000008100000
31..00+0000000000010000 51....+000000000000+000 87....+0000000000001500
71....+0000000000000PST 72....+0000000000000000 73....+000000000000000S
74....+000000000000000D ***410029+000000000000Tape** 42....+0000000000000000
43....+0000000000000002 44....+0000000000000000 45....+0000000000000000
46....+000000000004.500 47....+0000000000000000 48....+0000000000000000
49....+0000000000000000

Point 203: Tape Offset to the Up -8.000



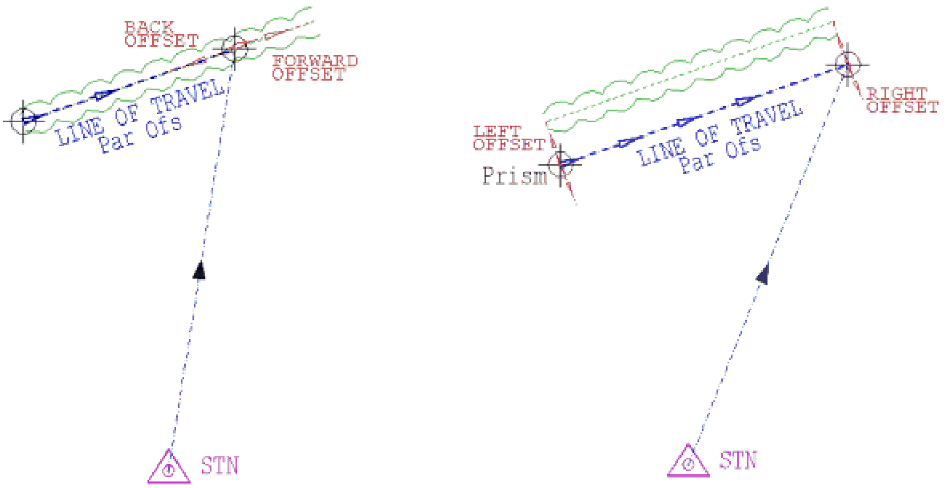
*110030+0000000000000**203** 21.044+0000000008100000 22.044+0000000008100000
31..00+0000000000010000 51....+000000000000+000 87....+0000000000001500
71....+0000000000000PST 72....+0000000000000000 73....+000000000000000S
74....+000000000000000D ***410031+000000000000Tape** 42....+0000000000000000
43....+0000000000000002 44....+0000000000000000 45....+0000000000000000
46....+0000000000000000 **47....+0000000000-8.000** 48....+0000000000000000
49....+0000000000000000

Parallel Offset

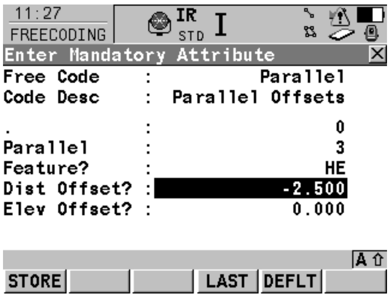


'**Dist Offset'** corresponds to the distance between the observed feature line and the generated feature line (Feature?).

'Elev Offset' corresponds to the elevation offset.

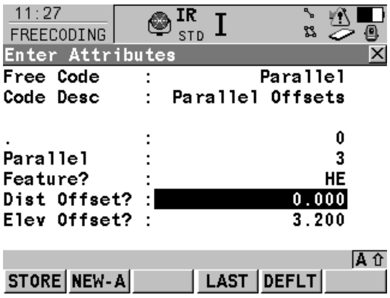


Point 302: **Parallel Offset – Offsetting HE Left -2.500 from TB Feature**



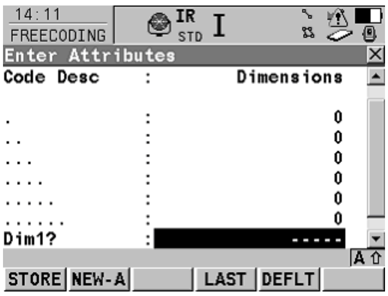
*110035+0000000000000**302** 21.044+0000000008100000 22.044+0000000008100000
31..00+0000000000010000 51....+000000000000+000 87....+0000000000001500
71....+0000000000000TB 72....+0000000000000056 73....+000000000000000S
74....+000000000000000D ***410036+00000000Parallel** 42....+0000000000000000
43....+0000000000000003 **44....+00000000000000HE 45....+0000000000-2.500**
46....+000000000000.000 47....+0000000000000000 48....+0000000000000000 49....+0000000000000000

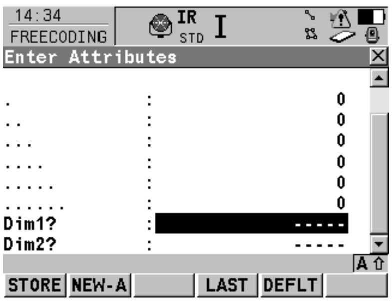
Point 302: Parallel Height Offset – Offsetting HE in Z +2.500 from TB Feature



*110037+0000000000000**303** 21.044+0000000008100000 22.044+0000000008100000
31..00+0000000000010000 51....+000000000000+000 87....+0000000000001500
71....+0000000000000TB 72....+0000000000000056 73....+000000000000000S
74....+000000000000000D ***410038+00000000Parallel** 42....+0000000000000000
43....+0000000000000003 **44....+00000000000000HE** 45....+000000000000.000
46....+000000000003.200 47....+0000000000000000 48....+0000000000000000
49....+0000000000000000

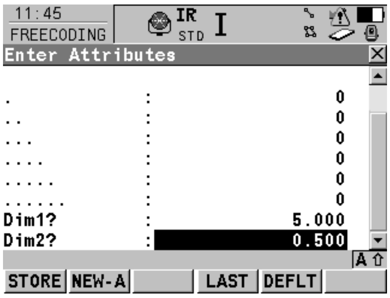
Dimension





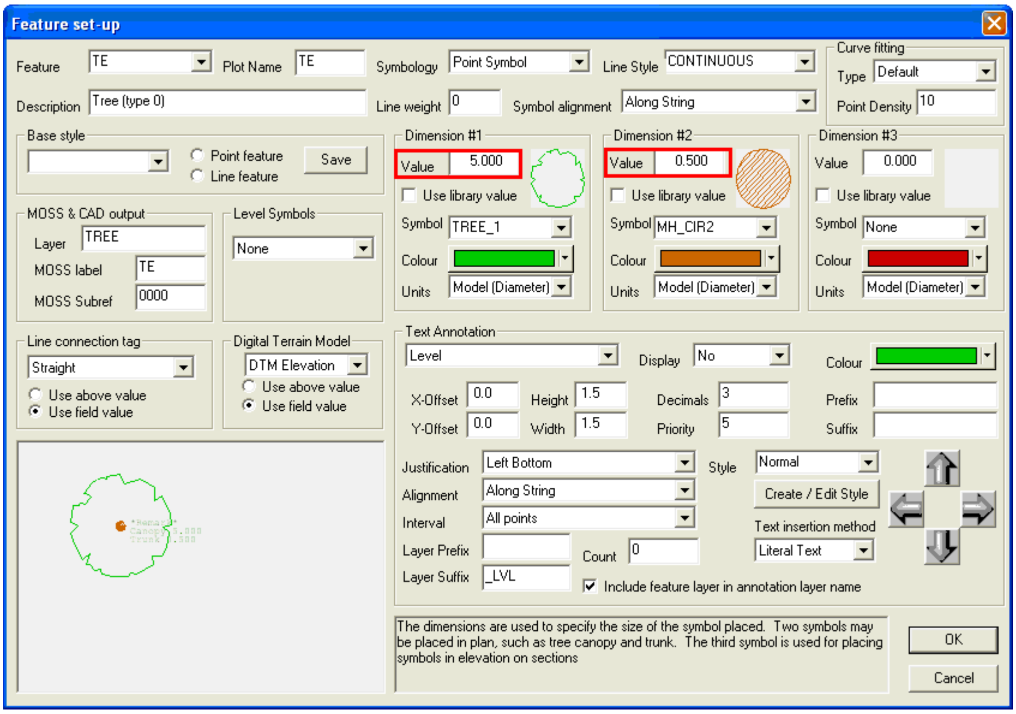
This option allows the user to manually input a Dimension 1 and Dimension 2 value.

Point 401: **TC feature with assigned D1 of 5.0 and D2 of 0.500**

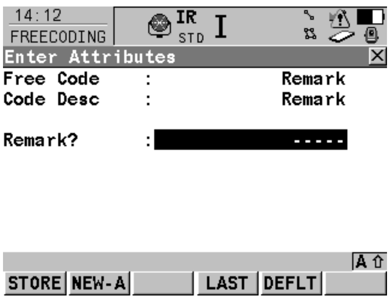


*110040+0000000000000**401** 21.044+0000000008100000 22.044+0000000008100000
31..00+0000000000010000 51....+000000000000+000 87....+0000000000001500
71....+0000000000000TC 72....+0000000000000000 73....+000000000000000S
74....+000000000000000D ***410041+000000Dimensions** 42....+0000000000000000
43....+0000000000000000 44....+0000000000000000 45....+0000000000000000 46....+0000000000000000
47....+0000000000000000 **48....+000000000005.000** **49....+000000000000.500**

For example, Feature 'Tree' may have a Dimension 1 value denoting the Canopy size and also a Dimension 2 referring to Tree Trunk size.

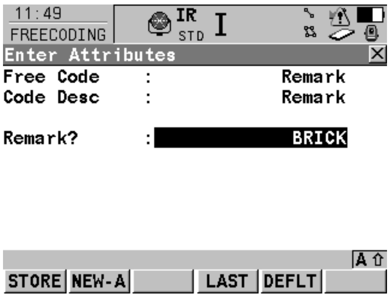


Remarks



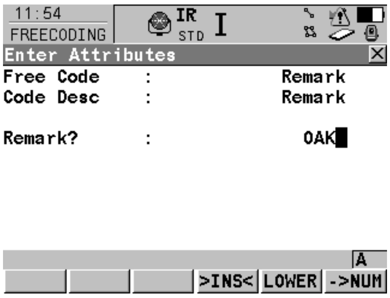
Additional annotation can be assigned to a specific point with 'Remarks'.

Point 95: **WALL feature with assigned Remark 'BRICK'**

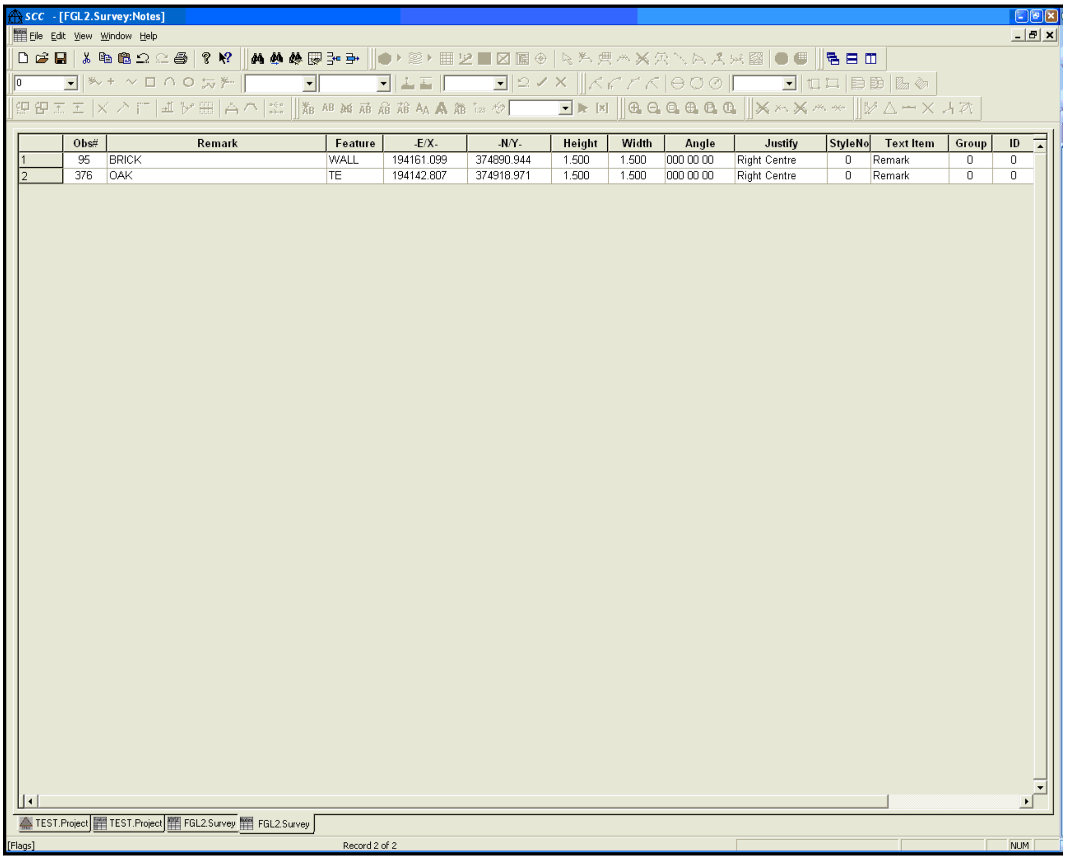


*110043+00000000000000**95** 21.044+0000000008100000 22.044+0000000008100000
31..00+0000000000010000 51....+000000000000+000 87....+0000000000001500
71....+000000000000WALL 72....+0000000000000001 73....+000000000000000S
74....+000000000000000D ***410044+0000000000Remark 42....+00000000000BRICK**
43....+0000000000000000 44....+0000000000000000 45....+0000000000000000 46....+0000000000000000
47....+0000000000000000 48....+0000000000000000 49....+0000000000000000

Point 376: TC feature with assigned Remark 'OAK'



*110045+0000000000000**376** 21.044+0000000008100000 22.044+0000000008100000
31..00+0000000000010000 51....+000000000000+000 87....+0000000000001500
71....+00000000000000TC 72....+0000000000000000 73....+0000000000000000
74....+0000000000000000 ***410046+0000000000Remark 42....+0000000000000OAK**
43....+0000000000000000 44....+0000000000000000 45....+0000000000000000 46....+0000000000000000
47....+0000000000000000 48....+0000000000000000 49....+0000000000000000



J. Traverse observation feature code (not specific to 1200)

An extra user defined feature code may be used to signify a control observation. This observation will be used as a reference observation in the instrument set-up sheet and as a traverse observation in the traverse sheet. This facilitates combined detail and traverse surveys using the GSI format. If this field is left blank, and tag codes are not being collected, all observations will be output to the traverse sheet. If this field is left blank and tag codes are being collected, observations with tag codes of FS, BS, and SS will be output to the traverse sheet.

K. Store Station co-ordinates (not specific to 1200)

Tick this field if you want to store station coordinates present in the input file, in fields 84 to 86, in the SCC project control file.

L. Codes precede observations (not specific to 1200)

This option controls whether a code block is associate with the preceding observation, or the following observation. For example, in the input below the code block precedes the data block

410006+000000KB 48....+0000000S 47....+0000000D 49....+00000002 110007+00000169
21.304+12359530 22.304+09515230 31...0+00003502

M. Use Topo X,Y,Z in preference to HA,Va,Sd (not specific to 1200)

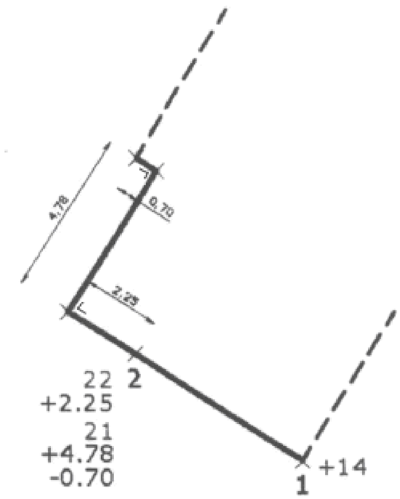
This option allows the computed X,Y,Z positions in the GSI input file to be stored in the SCC observation sheet rather than the Ha,Va,Sd values, where both occur in a single data line. This is useful if the GSI file does not include all of the survey observations, such as observed back-sights, as shown in the example below;

```
*110001+000000000000GR0A    84..10+0000000320728329
85..10+0000000376869559    86..10+0000000000099259
```

```
*110002+000000000000GR01    81..00+0000000320715339
82..00+0000000376754428    83..00+0000000000100000
*110003+000000000000GR0A    84..10+0000000320728329
85..10+0000000376869559    86..10+0000000000099259
87..10+0000000000001500    88..10+0000000000001602
79....+000000000000GR01
*110004+0000000000000066    21.324+0000000018626250
22.324+0000000008940550    31..00+0000000000115851
87..10+0000000000001500    71....+0000000000000000
72....+0000000000000000    73....+0000000000000000
74....+0000000000000000    81..00+0000000320715334
82..00+0000000376754441    83..00+0000000000100005
*110005+0000000000000067    21.324+0000000015216010
22.324+0000000008744130    31..00+0000000000074790
87..10+0000000000001500    71....+00000000000000SC
72....+0000000000000000    73....+0000000000000000
74....+0000000000000000    81..00+0000000320763106
  82..00+0000000376803412    83..00+0000000000102315
```

Case Study

Case 1: Tape Offset



*110015+0000000000000001 21.324+0000000001732120 22.324+0000000008645360
31..00+0000000000030223 81..00+0000000000109092 82..00+0000000000128773
83..00+0000000000013208 87..10+0000000000000000 71....+00000000000000BG
72....+0000000000000020 73....+000000000000000S 74....+000000000000000D

*110015+0000000000000002 21.324+0000000001732120 22.324+0000000008645360
31..00+0000000000030223 81..00+0000000000109092 82..00+0000000000128773
83..00+0000000000013208 87..10+0000000000000000 71....+00000000000000BG
72....+0000000000000020 73....+000000000000000S 74....+000000000000000D

*110016+0000000000000003 21.324+0000000000927290 22.324+0000000008548510
31..00+0000000000030413 81..00+0000000000104984 82..00+0000000000129919
83..00+0000000000013720 87..10+0000000000000000 71....+00000000000000BG
72....+0000000000000020 73....+000000000000000S 74....+000000000000000D

*410017+0000000000000003 42....+0000000000000000 43....+0000000000000002
44....+0000000000000000 45....+0000000000000000 **46....+000000000002.250**
47....+0000000000000000 48....+0000000000000000 49....+0000000000000000

*410017+0000000000000004 42....+0000000000000000 43....+0000000000000002
44....+0000000000000000 **45....+000000000004.760** 46....+000000000000000
47....+0000000000000000 48....+0000000000000000 49....+0000000000000000

*410017+0000000000000005 42....+0000000000000000 43....+0000000000000002
44....+0000000000000000 45....+0000000000000000 **46....-000000000000.700**
47....+0000000000000000 48....+0000000000000000 49....+0000000000000000

Tape Offset Pt. 3: Longitudinal Offset of +2.250

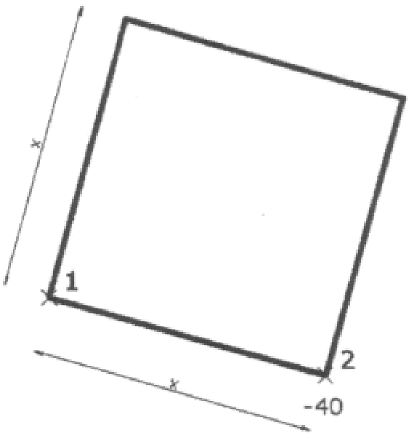
New Baseline is now Pt. 2- Pt. 3

Tape Offset Pt. 4: Lateral Offset of +4.760m (+Right)

Baseline now Pt. 3 – Pt. 4

Tape Offset Pt. 5: Lateral Offset of -0.700m (-Left)

Case 2: 2 Point Symbol OR 2 Point + Width

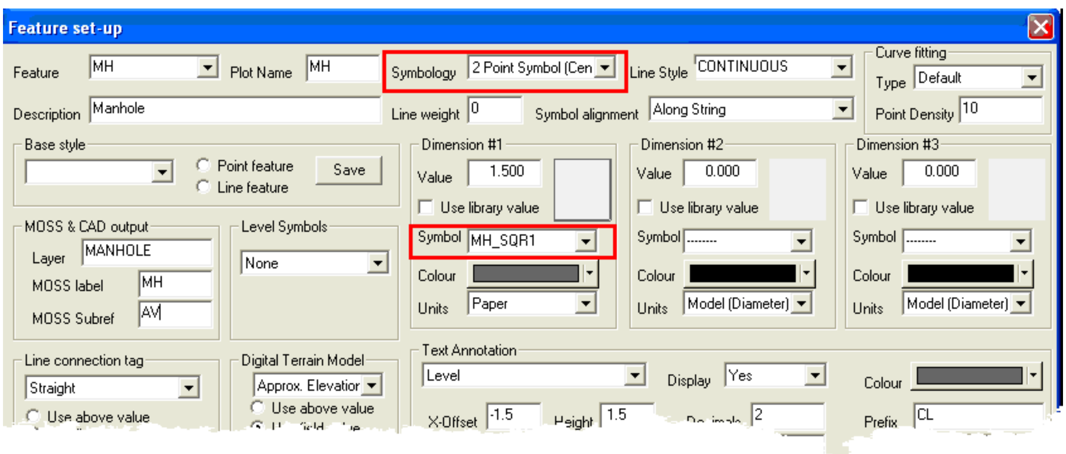


2 Point Symbol

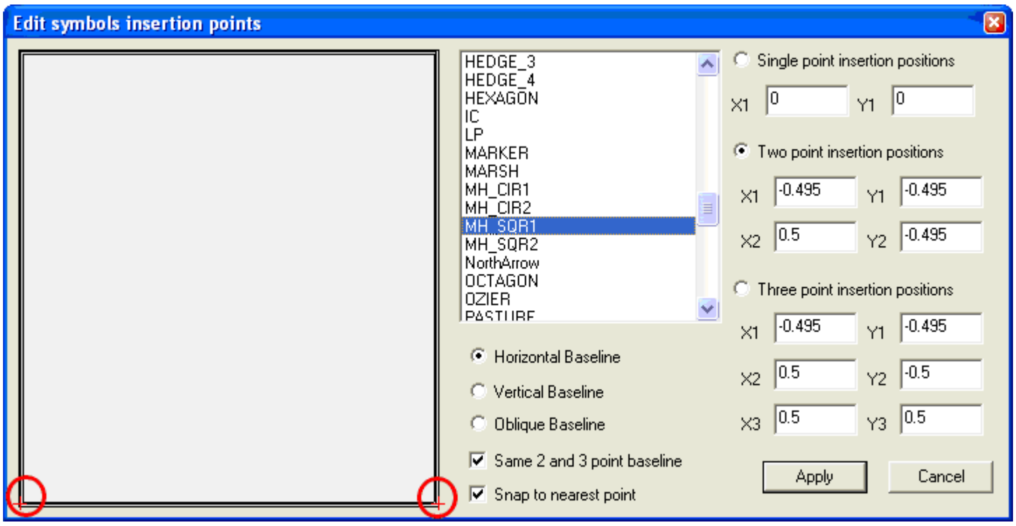
*110015+00000000000000**01** 21.324+0000000001732120 22.324+0000000008645360
31..00+0000000000030223 81..00+0000000000109092 82..00+0000000000128773
83..00+0000000000013208 87..10+0000000000000000 71....+00000000000000MH
72....+0000000000000030 73....+000000000000000S 74....+000000000000000D

*110016+00000000000000**02** 21.324+0000000000927290 22.324+0000000008548510
31..00+0000000000030413 81..00+0000000000104984 82..00+0000000000129919
83..00+0000000000013720 87..10+0000000000000000 71....+00000000000000MH
72....+0000000000000030 73....+000000000000000S 74....+000000000000000D

Within the Project File assign '2Point Symbol (Side)' Symbology and select a Dimension 1 symbol which has side intersection points.

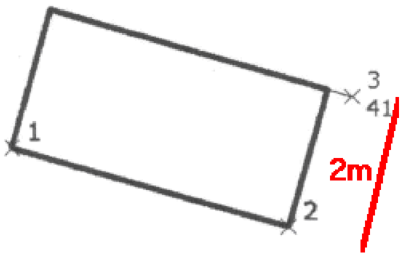


Within the Project select 'EDIT > Symbols > Edit symbols insert point'



Case 3: 2 Point + Width

Manhole / Utility Cover

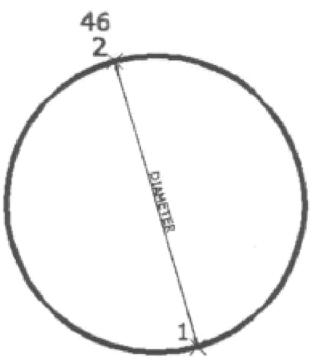


*110015+0000000000000001 21.324+0000000001732120 22.324+0000000008645360
31..00+0000000000030223 81..00+0000000000109092 82..00+0000000000128773
83..00+0000000000013208 87..10+0000000000000000 71....+00000000000000MH
72....+0000000000000020 **73....+0000000000000R2W** 74....+000000000000000D

*110016+0000000000000002 21.324+0000000000927290 22.324+0000000008548510
31..00+0000000000030413 81..00+0000000000104984 82..00+0000000000129919
83..00+0000000000013720 87..10+0000000000000000 71....+00000000000000MH
72....+0000000000000020 **73....+0000000000000R2W** 74....+000000000000000D

***410041+000000Dimensions** 42....+0000000000000000 43....+0000000000000000
44....+0000000000000000 45....+0000000000000000 46....+0000000000000000
47....+0000000000000000 **48....+000000000002.000** 49....+0000000000000000

Case 4: 2 Point Circle



*110015+0000000000000001 21.324+0000000001732120 22.324+0000000008645360

31..00+00000000000302238 1..00+00000000001090928 2..00+0000000000128773
83..00+00000000000132088 7..10+0000000000000000 71....+00000000000000BG
72....+0000000000000020 73....+00000000000000**C2** 74....+000000000000000D

*110016+0000000000000002 21.324+00000000009272902 2.324+0000000008548510
31..00+00000000000304138 1..00+00000000001049848 2..00+0000000000129919
83..00+00000000000137208 7..10+0000000000000000 71....+00000000000000BG
72....+0000000000000020 73....+00000000000000**C2** 74....+000000000000000D

24.3 Creating A Model

Go to ‘FILE > Model > SCC Dataset'

Select ‘Create the model and triangulation’ and set Initial Plot Scale of 250

Select 'FILE > Save As'

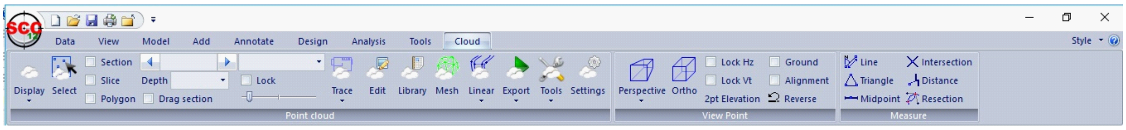
25 Point Cloud Module

The following outlines some of the tools and functionality available within SCC Point Cloud Module.

To start using this functionality the user must have the point cloud module licensed.

Tutorials are based on sample files available within the SCC folder.

Point cloud functionality is accessed in the model via the CLOUD tab.



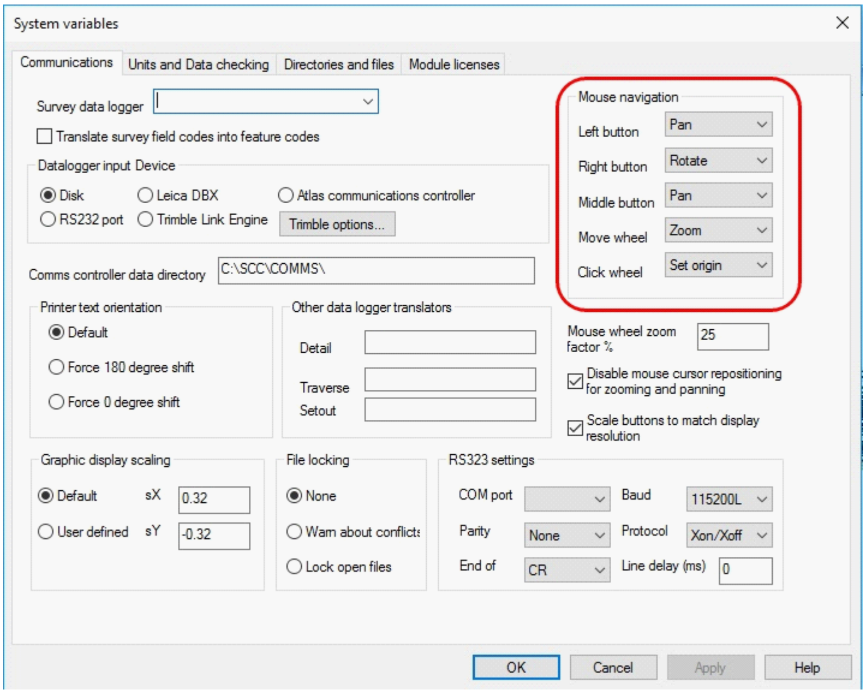
25.1 Cloud Mouse Navigation & Settings

The mouse can be used to navigate the cloud data. 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.

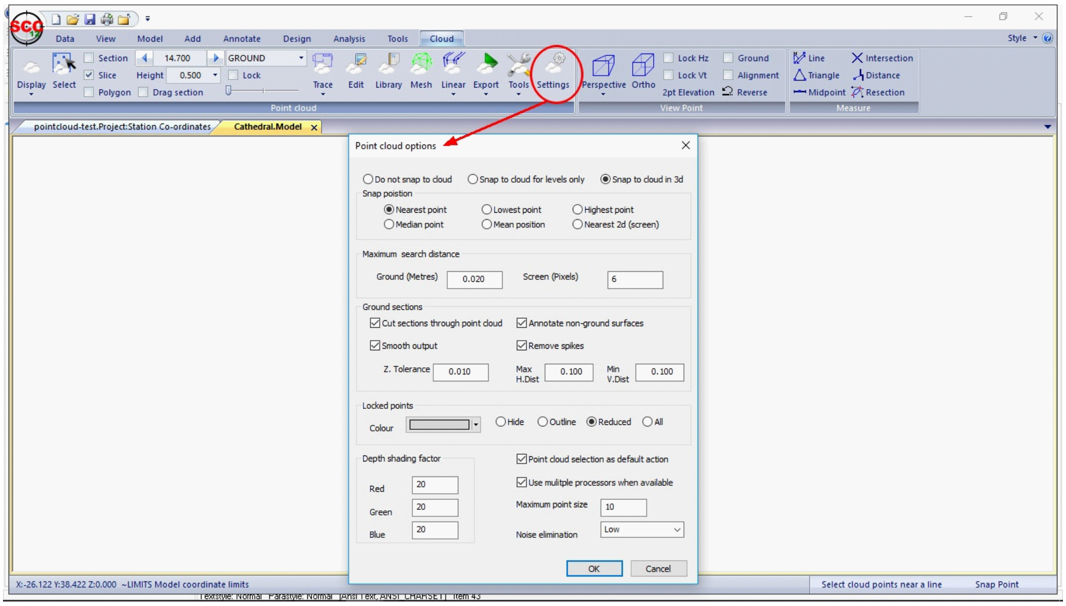
This coincides with other general SCC keyboard zoom controls such as Home (Zoom Extent), Page Up/ Page Down (Zoom In/Zoom Out), Space Bar (Pan).

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.

Settings

The control settings are available within '**Cloud tab** > **Settings**' and controls how the cloud is treated as a surface for section and volume analysis.



Note that only active points are used for snapping, and other operations such as data selection, and export. This allows the user to first select an area of interest for analysis purposes and hide all other parts of the cloud, and then select further points from that area of interest for editing.

Using The Cloud with other SCC Model Options

Most SCC options can interact with the cloud in a similar manner to the TIN surface generated from a traditional total station or GPS survey. This is largely controlled by use of the point snapping and sections mechanisms in **'Cloud tab > Setting'**. The following snaps are available;

- Do not snap to cloud – The cloud is not used with other SCC string creation functions.
- Snap to cloud for levels only – The cloud is used in plan view for interpolating elevations only.
- Snap to cloud in 3d – The cloud is snapped to in full 3d, regardless of the viewpoint.

When using could snaps, and interpolating from the cloud as a surface in general, a search radius is used. If a cloud point is not found within this radius, the cloud snap fails. When interpolating levels, the underlying TIN is used in place of the cloud in this circumstance. This allows us to seamlessly mix TIN and cloud interpolation in a single model.

Given that we're searching for cloud points in a given radius, we can also control how the selected point or points are determined and used as follows;

- Nearest point – The nearest point to the desired position, e.g. mouse cursor position, is used
- Lowest point – The point with the lowest elevation of the points in range is used. This can be very useful for manually tracing lines such as bottom of kerb, where bottom of kerb and top of kerb are very close and difficult to distinguish. If is also very useful for extracting grids of elevations over ground that may include vegetation and other spurious high points on the ground such as lamp posts. Note that this option is best selected with small search radii, and used judiciously.
- High point - The point with the lowest elevation of the points in range is used. This can be very useful for manually tracing lines such as top of kerb.
- Median point – The point nearest the mean position of all the points in the selection radius is picked. This can be useful for drawing strings represented by dense linear groups of points in the cloud, such as walls shown in the slice taken from the cathedral model previously.
- Mean point - The mean position of all the points in the selection radius is picked. This will not

correspond to any one point.

- Nearest 2d (Screen) – The point drawn on screen nearest the mouse cursor is picked.

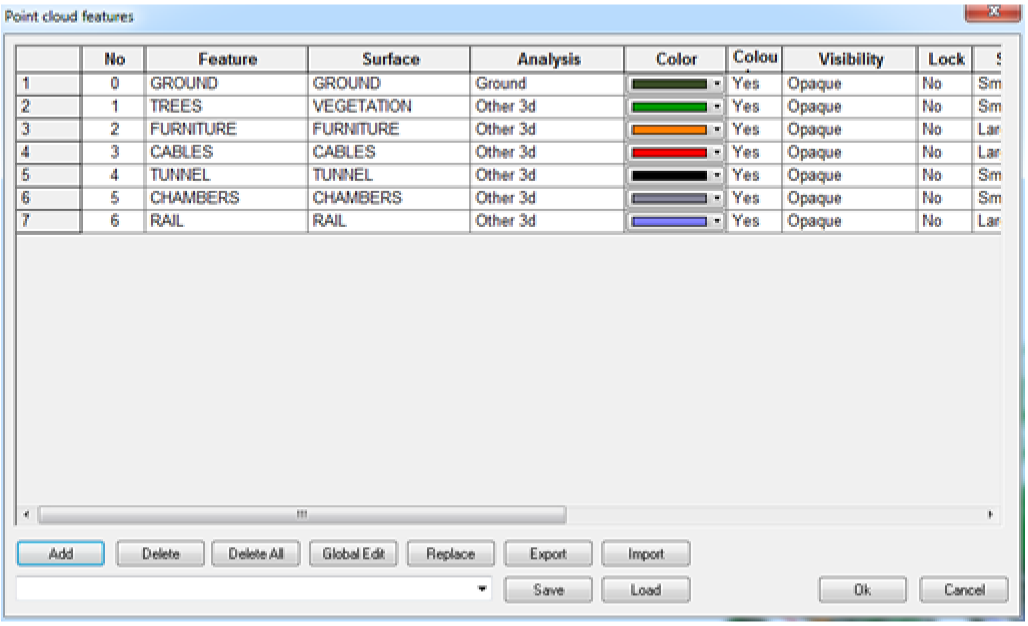
For options such as sectioning, volumes, extraction of grids, draping of 2d data to extract levels, etc… the option to **Cut sections through the point cloud** must be selected. This allows the cloud to be used in a similar manner to a TIN surface for most SCC surface analysis operations. Interpolation is limited to points with a feature **Analysis** set to **Ground**, so it is very important to change the feature of all other cloud data, such as vegetation, buildings and overhead lines, prior to interpolating from the cloud in this manner.

For sectional analysis, we can also specify a level tolerance for smoothing, and horizontal and vertical tolerances for removing spikes from the section. This is necessary as cloud data is far denser than conventional survey data and is prone to include a significant amount of noise. Smoothing and spike removal also greatly reduces the size of the data extracted, which is also typically beneficial.

Other options on the same dialog control how the point cloud is visualized. These control whether the display is clipped behind and in front of the viewing plane, typically when using two point elevations, and how isolated points are displayed. Note that clipping the view has no effect on point selection in the way that isolating or disabling points would. Displaying Inactive points allows you to see where your active points are in relation to the rest of the cloud. Inactive points are always transparent and typically drawn in a lighter colour. Displaying a reduced number or outline of isolated points will reduce display clutter and improve display speed on larger clouds.

25.2 Point Cloud Feature Library

The point cloud feature library is used to break down the cloud into groups of points on similar feature, for example, all points corresponding to vegetation, all points corresponding to the road surface. This allows the user to fine tune how analysis operations work, as this will change significantly based on the type of feature. For instance, how sections are cut through the ground will be different to how sections are cut through more complex 3d features such as buildings.



The point cloud feature fields are as follows;

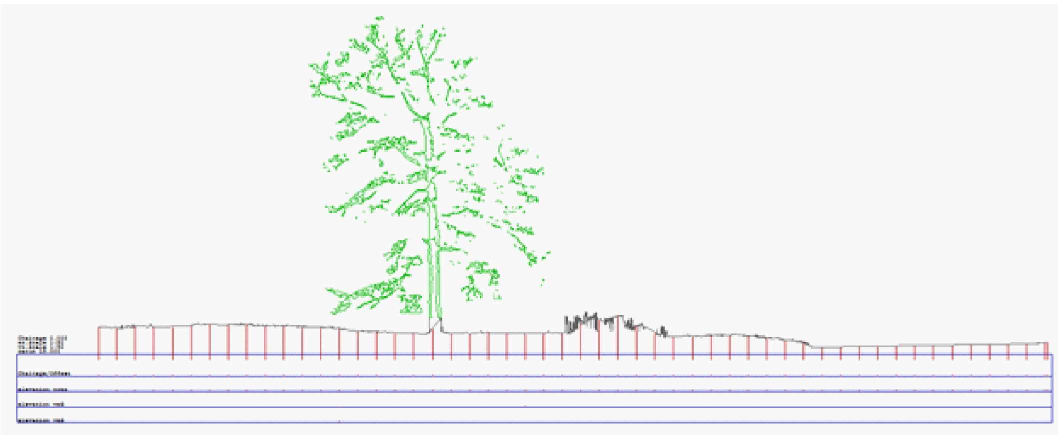
- Feature – The name of the feature

- Surface – The surface on which the feature is placed. Note that you can have multiple features placed on the same surface, e.g. trees and bushes might both go on a vegetation surface

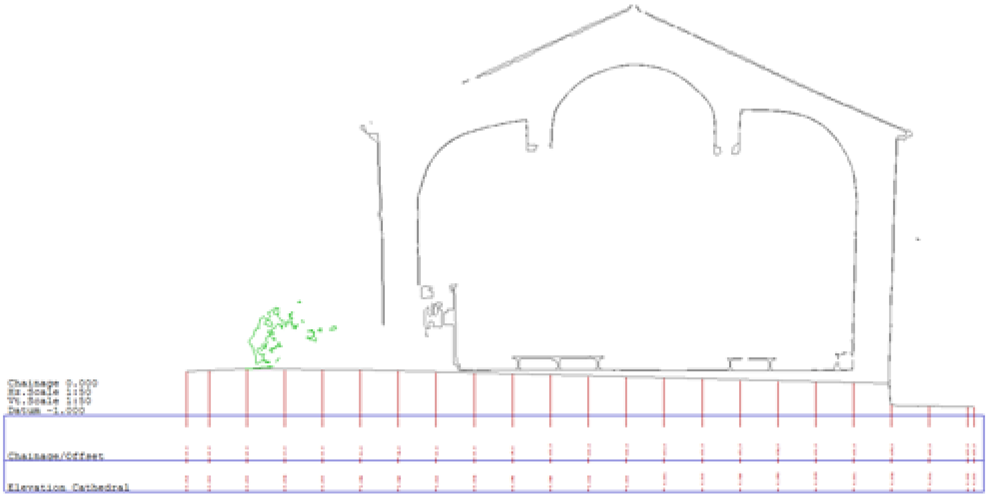
- Analysis – This controls how SCC interprets these points for surface analysis purposes. Options are
    - Display only – The points are displayed only, but not subject to analysis
    - Ground – The points are treated in the same way as the triangulation surface in a normal SCC model, from the point of view of sections, volumes, draping points, extracting levels, etc…
    - Other surface – The points are treated in a similar manner as an additional triangular surface, such as a reference model.
    - Other 3d – The points are treated as a non-mappable 3d surface, not suitable for surface analysis operations. Sectioning through 3d surfaces will be considerably slower than ground / mappable surfaces.
- Colour – The default colour of this feature when not coloured by point
- Colur by point – Whether points on this feature have individual colours or the same colour
- Visibility – Controls whether or not these points are displayed, and if they are displayed whether they are considered opaque or transparent.
- Lock – Whether or not these points are included in analysis
- Size – The size of displayed points
- Sect. Width – The search corridor width used when cutting sections through this feature. Note this will typically be small for ground surfaces, e.g. 10mm, and larger for 3d surfaces, e.g. 100mm – 500mm. The larger this value, the more 3d data will get projected onto a section and analysed. This in turn can slow down processing and significantly increase the size of sections produced.
- Max Dist. – For 3d features, the maximum distance to which points will be connected.
- Trace Dist. – For 2d features extracted by tracing selected points, the maximum distance between adjacent points
- Min. Length – For all traced output, the minimum total string length allowed for a string to be included in the output.

The cathedral and topo models (from the SCC tutorials folder) already have some features applied. Thus is a sections is cut through the data, the varies features will appear.

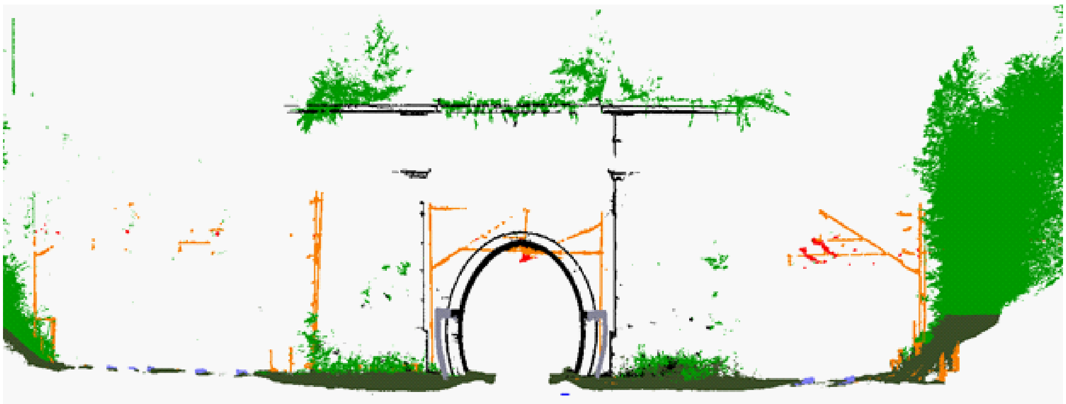
. For example, select **'ANALYSIS tab > L.Sect'** and generate a section through 'Topo.Model' taking in the tree:



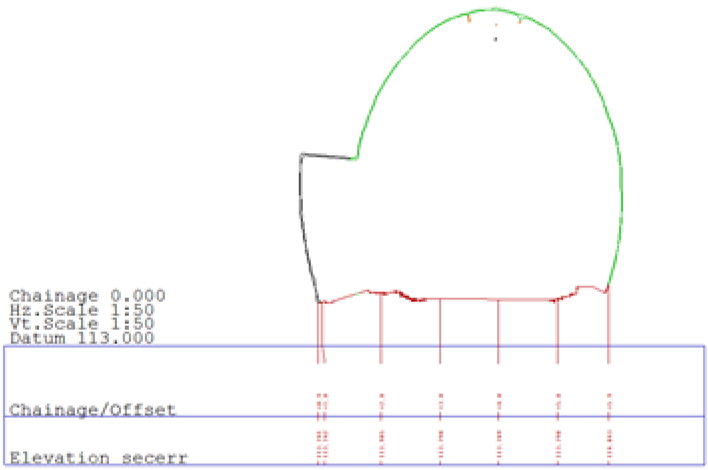
And similarly for the Cathedral.Model;



The feature library is also very useful for quickly colouring and analysing monochrome point clouds, as shown in the model below (Tunnel 950-1050 (edited).Model)



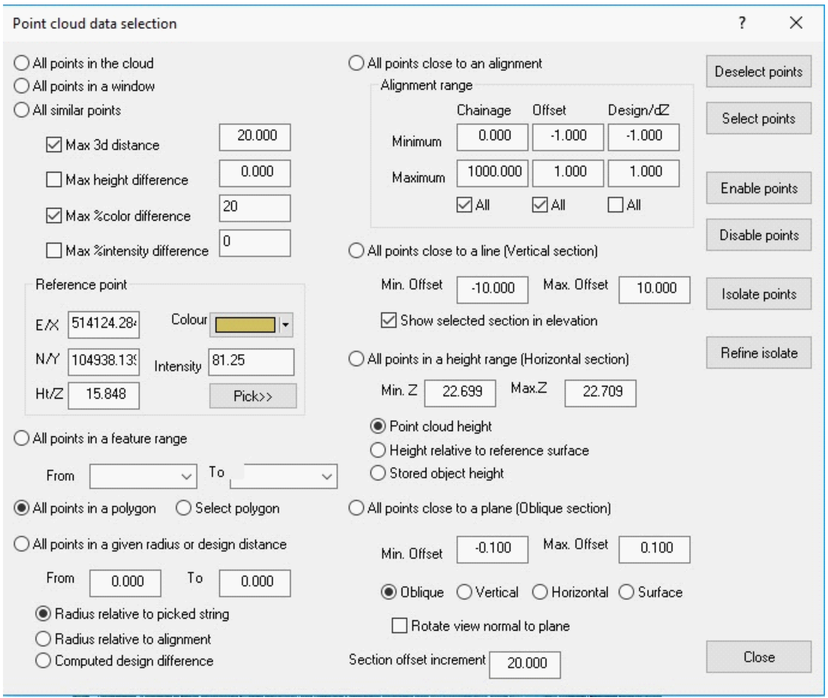
By selecting and isolating appropriate elevation and sectional areas, the user can quickly differentiate the tunnel, cabling, rails, and foliage. This in turn allows the user to cut complex sections, develop a ground surface and isolate features of interest.



25.3 Selecting And Isolating Parts of the Cloud

Data Selection Dialog

The most commonly used option will be data selection, which shows the point cloud selection dialog. The allows the user to control how data is selected (i.e. points in a window, points in a polygon, using a horizontal or vertical section / slice, relative to an alignment, points similar to a given reference point, points close to another SCC surface) and what to do with picked data.



This includes selecting and deselecting data as per typical SCC usage, locking and unlocking data which hides the data and prohibits it from being used in future operations, and isolating data which is the same as locking everything except the picked points.

This option is available by Right Clicking mouse within a point cloud or within 'Cloud tab > Select' button

Additional Tools can be used to control selected data from the Cloud Toolbar

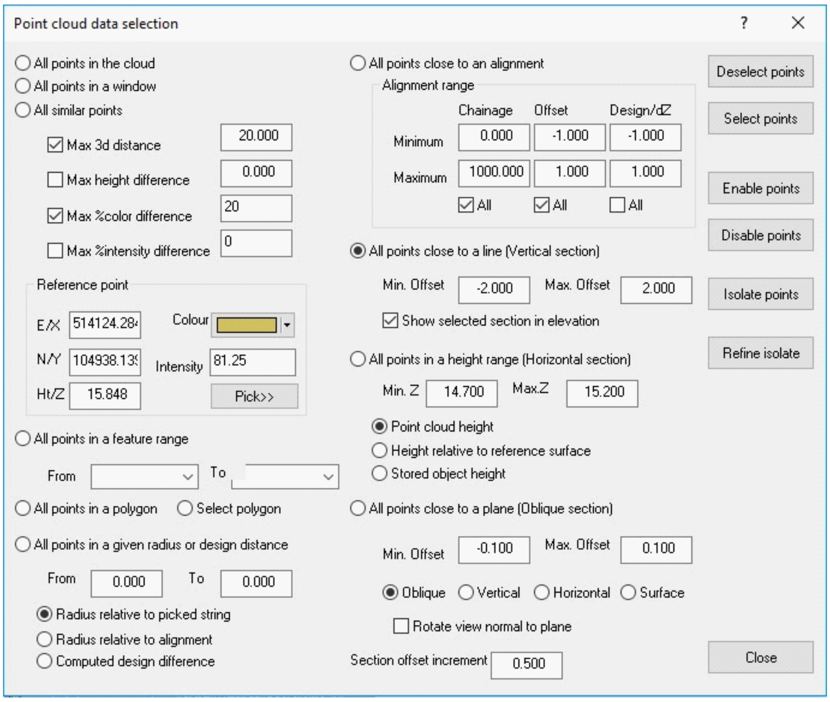
Isolating Data

Open Sample file 'Cathedral. Model' from tutorials folder

Right click mouse to bring up 'Data Selection Dialog'

Select 'All points close to a line (Vertical section), set Min Offset -2 and Max Offset 2

Tick 'Show selected section in elevation'



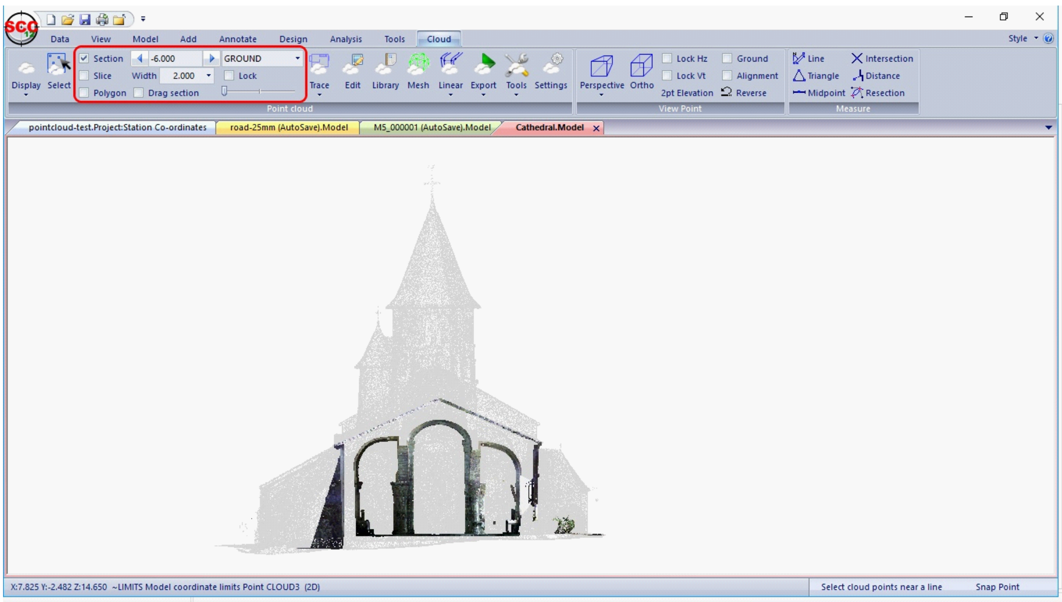
Pick 'Isolate Data' and the dialog closes

Left click on model to pick first point on centreline and a second time to pick last point

This highlights the area of interest as an elevation and switches the colour of all the locked points to light gray.

Pressing 'P' and 'E' we can move between plan and elevation view to get a better idea of what has just happened.

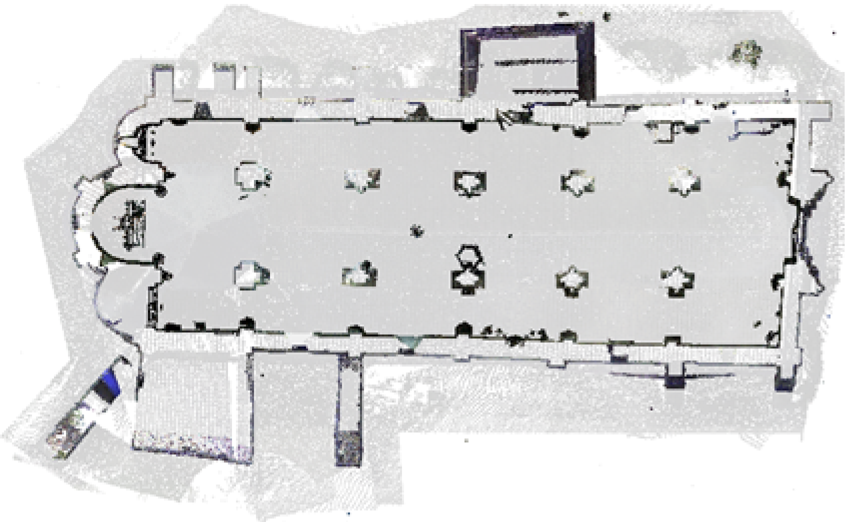
Alternatively use the toolbar to change selection as shown below:

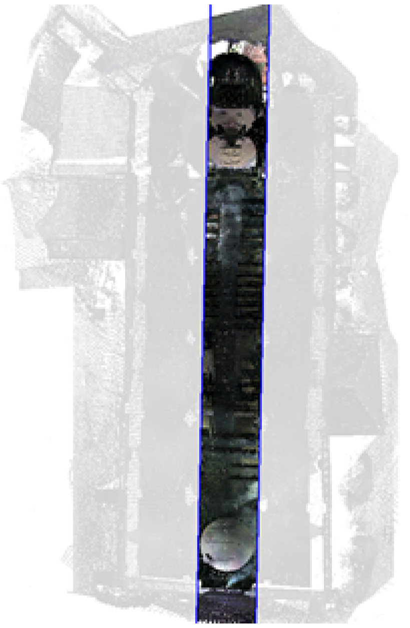


The up, down, left and right arrows to advance and move the section relative to the direction of view.

The distance here is based on the Section offset increment in the data selection dialog, which can also be brought up using the right mouse button.

From plan view use the mouse at any stage to pick an alternate section as shown below;



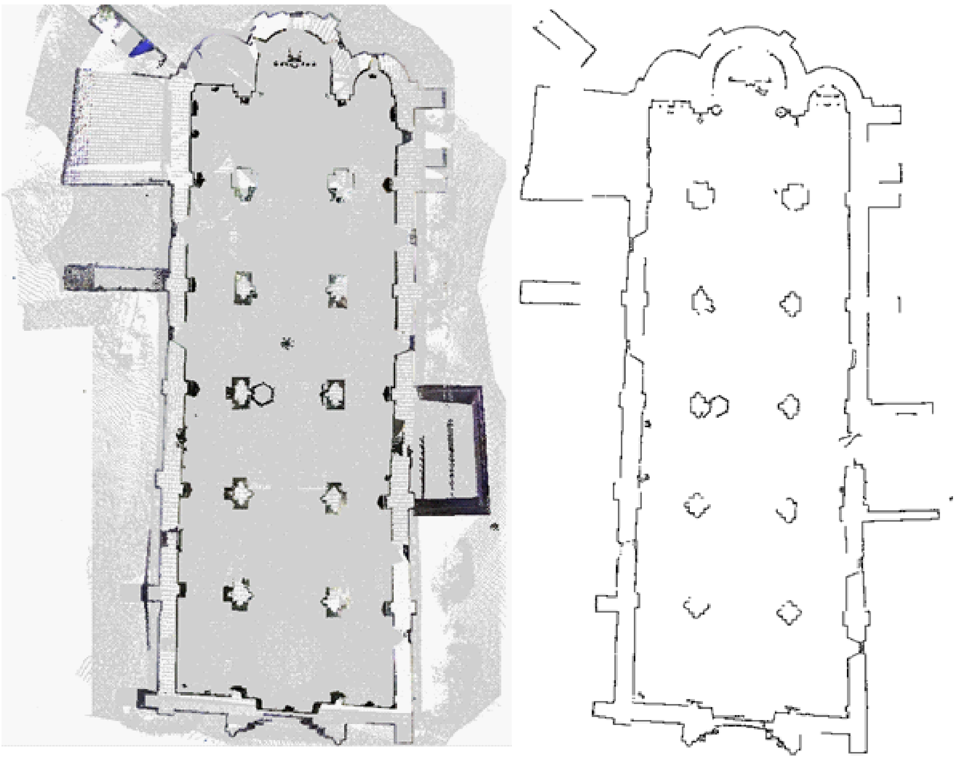


Other keyboard options are + and – to widen or narrow the area of interest, and L and X to move between long section and cross section related view when selection a sectional area relative to an alignment.

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.

25.4 Tracing Sections and Slices

In addition to cutting sections there are a number of other ways to extract linear data and analyse cloud surfaces. The simplest of these is via **'CLOUD tab > Trace drop down > Trace outlines from slice'**, which will draw outlines based on an isolated sectional area. This can be either from plan, elevation or based on an oblique viewpoint.



The results can then be exported to other packages, such as CAD, in 2d or 3d, and multiple slices can be used to build-up a wire frame model from your cloud. The cloud feature library determines how the data is analyses, where the centre of the displayed section or slice is used as the centre-line for sectioning.

25.5 Extracting A TIN Surface From The Cloud

Within 'Topo.Model' available from SCC\Tutorials directory, a selected area can be triangulated for further analysis and export to a software that does not support point clouds.

In this case, a small alignment is created and selected points in an area 7.4m either side of the centre line is isolated and used to generate a TIN, as shown below.

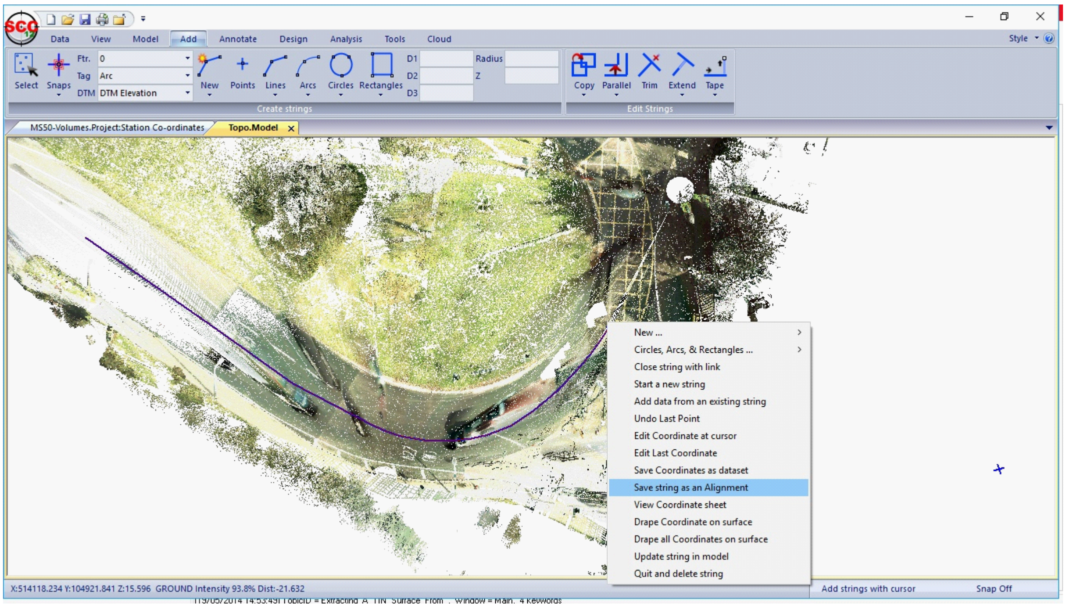
Set up Project

Open 'Topo.Model' from SCC\Tutorials folder

Go to 'ADD tab > New'

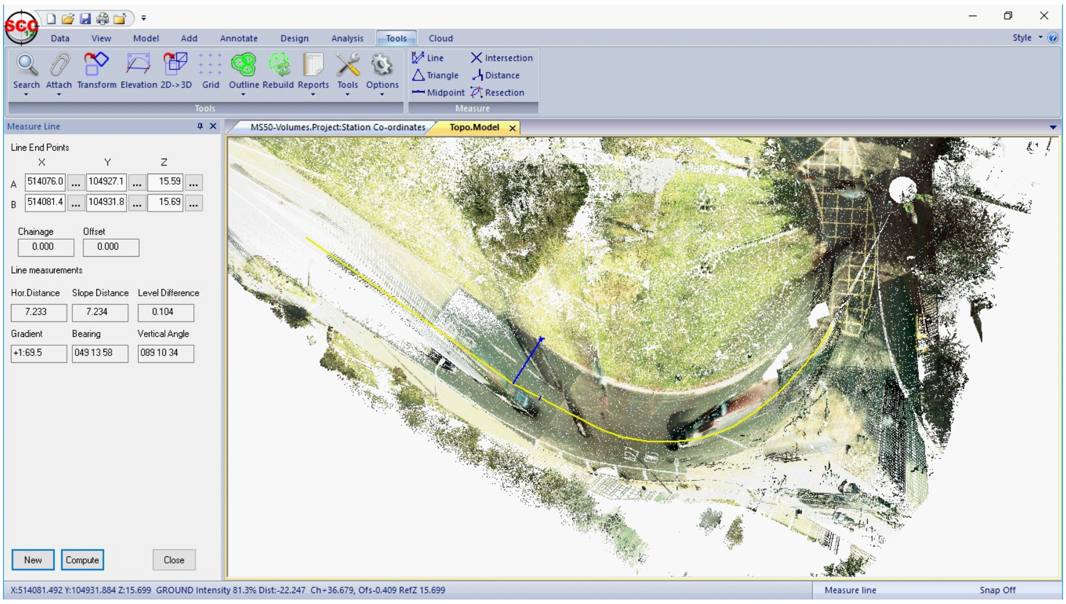
Left click mouse on screen to begin centre line, change the geometry as the line process to Arc tag and then finishing with Straight

Right click mouse on screen, select 'Save string as an Alignment'



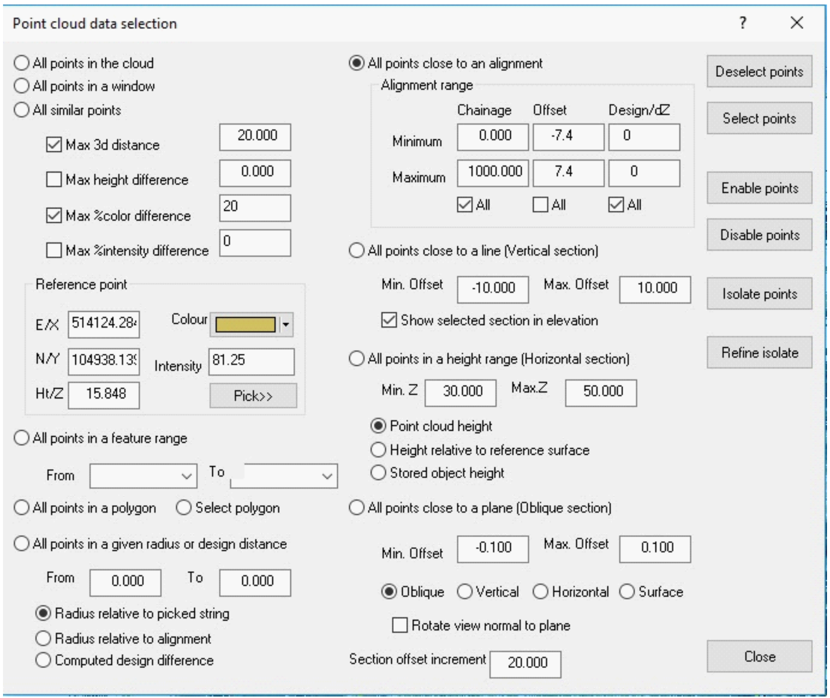
Select 'TOOLS tab > Line' button and measure from centreline to edge of road

Approx 7.233m

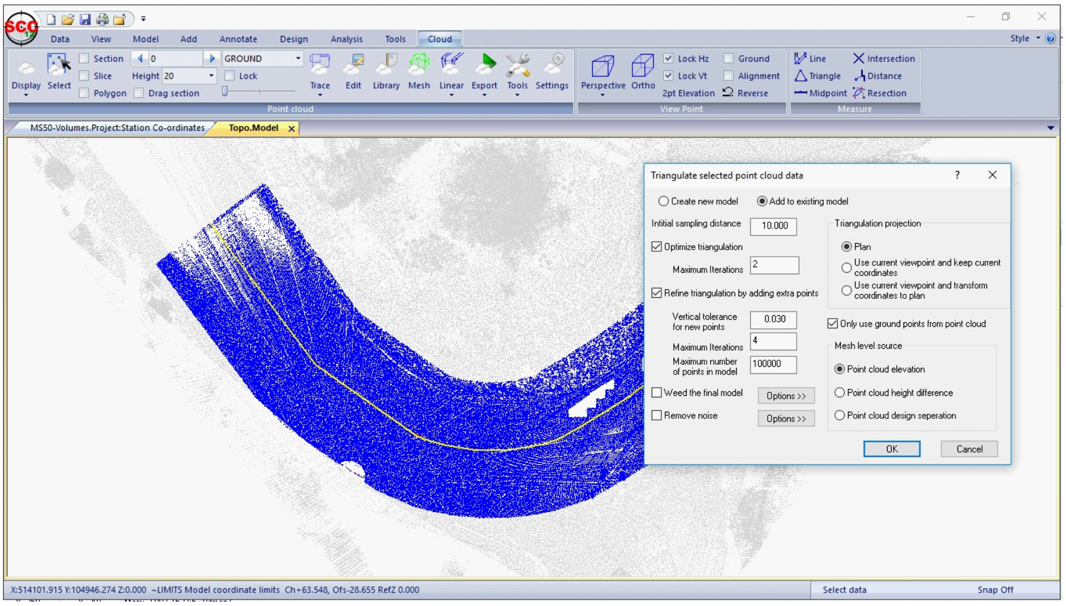


Right click mouse to bring up 'Data Selection Dialog' set up the following 'All point close to an alignment', then select 'Isolate Points'

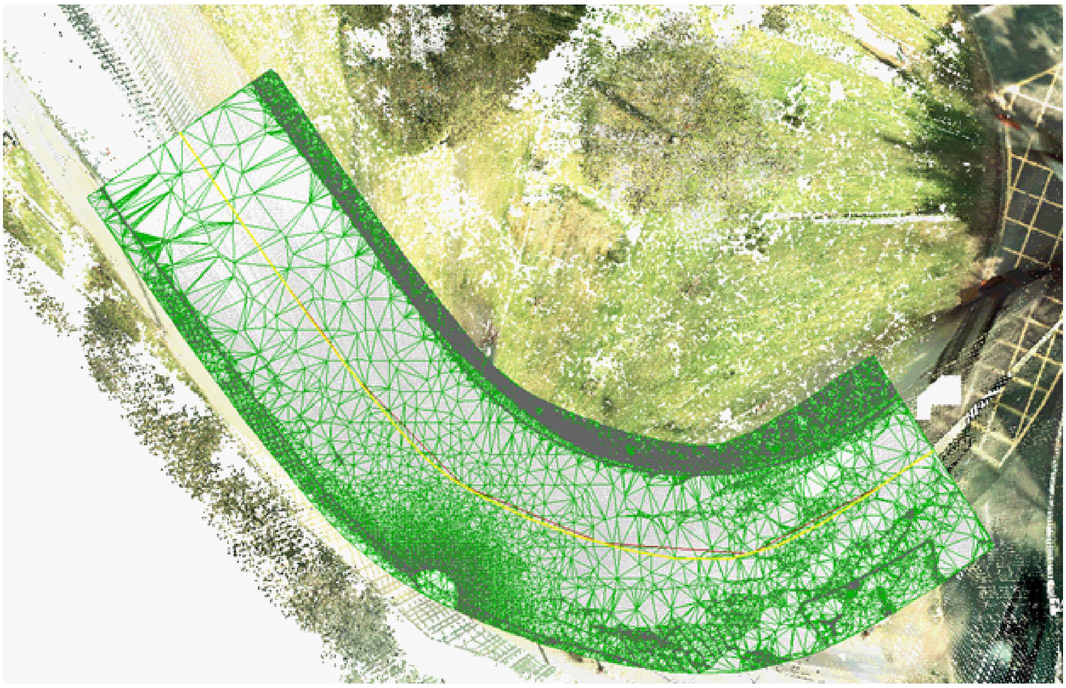
Re-enter and then, select 'Select Points'



To triangulate, select 'CLOUD tab > Mesh' button and set up the following:



Note, this option can be slow depending on the parameters and the number of points selected. To improve performance and final result remove or isolate noisy features such as grass, trees, cars, street furniture and overhead cables prior to running this option. Only selected points whose features have an analysis type of Ground are considered when running this option, so simply changing the feature of such points to any other feature will accomplish this.



Other options relating to point cloud processing include linear feature extraction, density based feature extraction (stringing clumps of points), tracing string manually in conjunction with cloud snap, and use of other surface based tools in conjunction with the point cloud ground surface rather than the TIN.

To add further information to our TIN model, from coarser areas of the model that may have lower accuracy requirements, Extract a grid of levels can be used, and add the generated data to the TIN created above, along with traced linear features such as kerbs described earlier. Note that when extracting a grid of levels, it is best to select the option to snap to the level of lowest point in the defined snap search radius, as this will tend to generate a more uniform surface, skipping small vegetation and similar items.

25.6 Tracing 2D Features Such As Road Markings

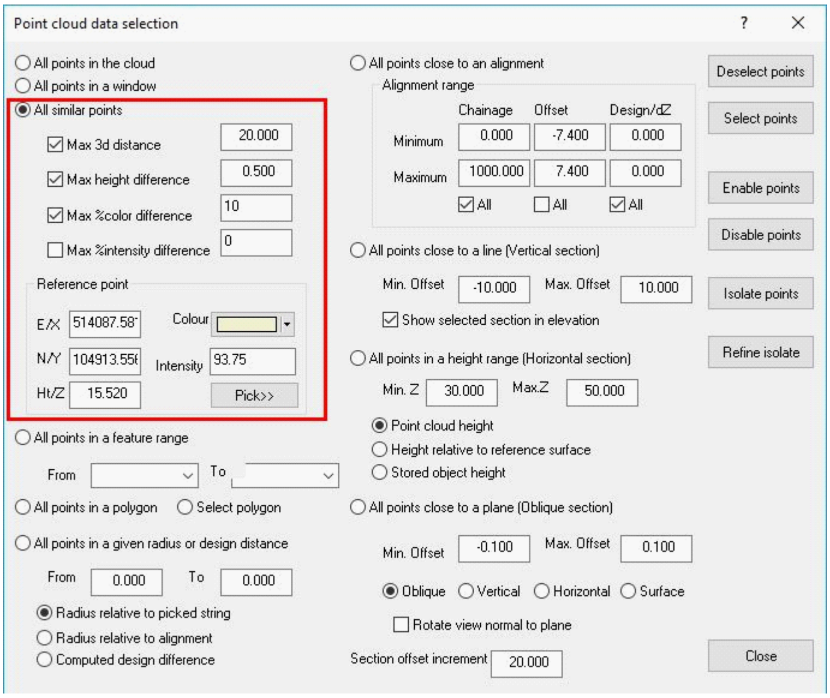
SCC point cloud module can be used to trace outlines of features using a combination of colour / intensity difference, height difference and distance from a reference point. For example, road markings.

Open 'Topo.Model' from SCC\Tutorials folder

Zoom to Road Markings of interest

Right click mouse to bring up 'Data Selection Dialog'

Select 'All similar points' set up the following:

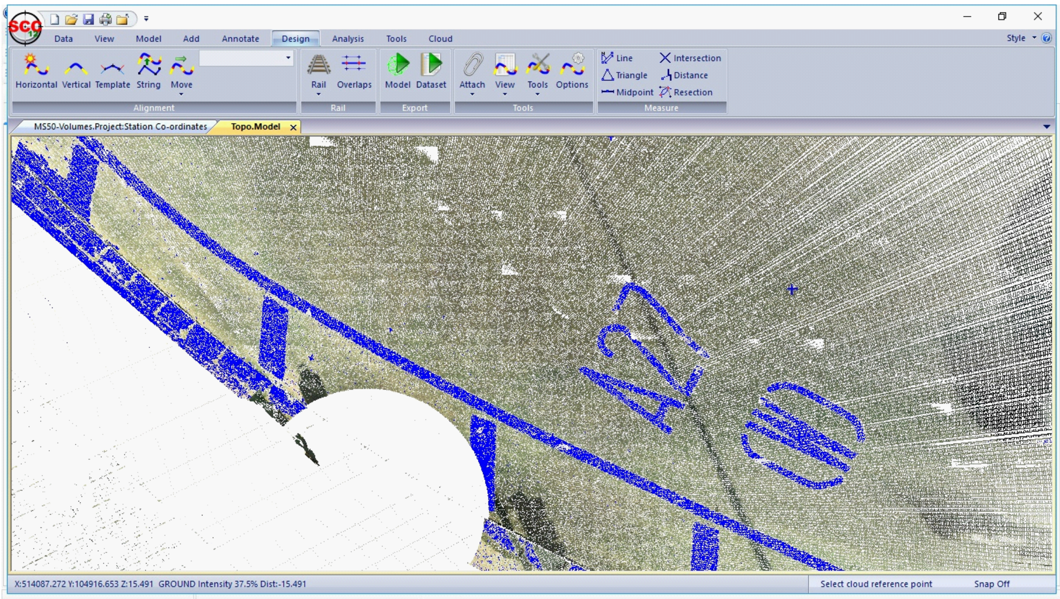


Press 'Pick>>' button and then left click on select a reference point for colour and position

Within the 'Data Selection Dialog' pick 'Select points' to highlight all the points that are similar to that reference point.

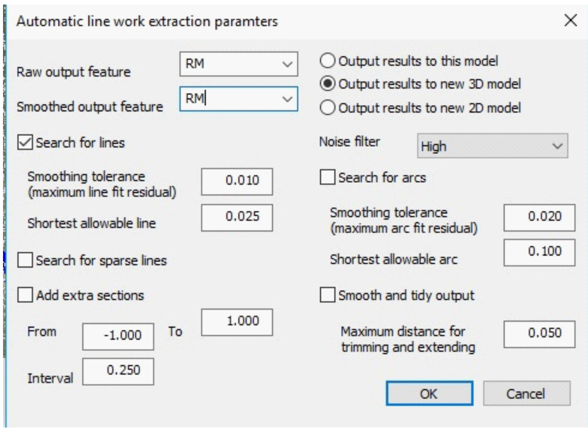
Note that if we were trying to pick up road markings we could first isolate the road area using a chainage / offset or polygon selection first.

The selected data will appear as shown below

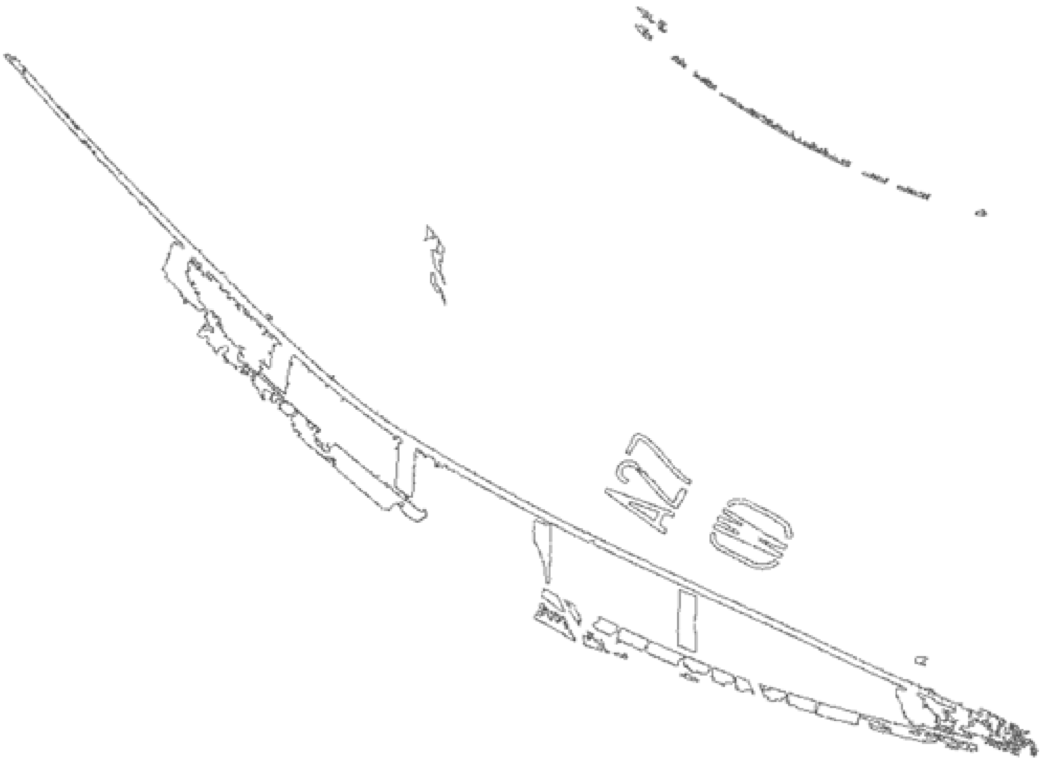


Additional reference points can be selected to add more data, and polygon based de-selection of any areas that were included but not required. Removing points in this many will also speed up the tracing process, and reduce the size of the output model.

Selecting 'CLOUD tab > Trace drop down menu > Trace selected points' set the following;



Which produces:



25.7 Extracting Line Work & DTM from Mobile Lidar Data

The following tutorial explores the extract of linear features from Mobile Lidar Data using an alignment and the generation of a TIN. Tools to highlight non ground points by Height are examined and finally, addition of point features are created in the model.

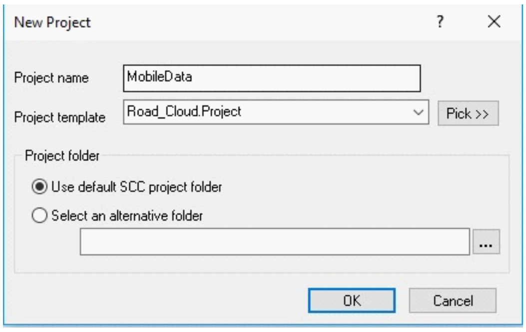
25.7.1 Create New Project

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

Enter in a Project/Job name 'MobileData'

Select a Project Template from the list 'Road_Cloud.Project'

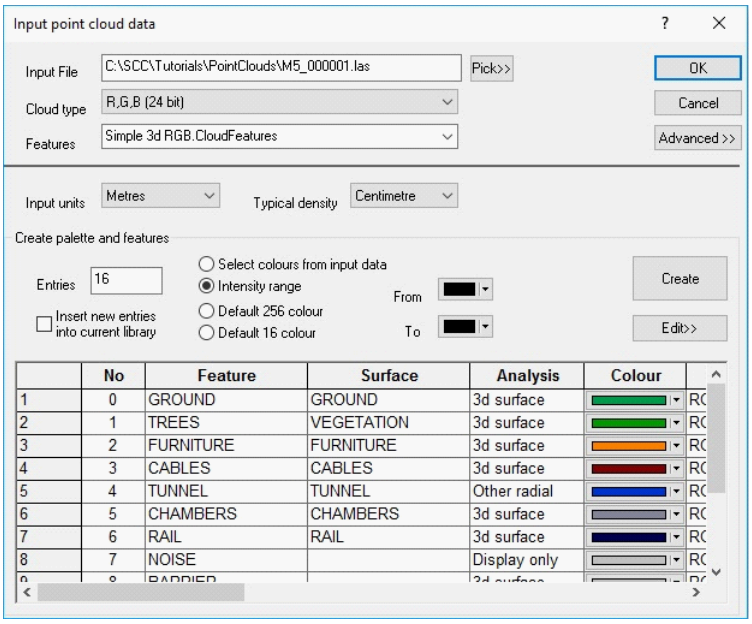
Select ‘OK’



25.7.2 Importing Sample Data

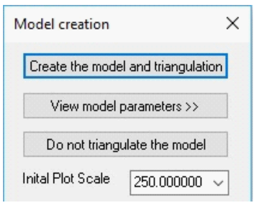
To start, select 'Model Tab > Point clouds and LIDAR > LAS or LAZ file' and pick the appropriate input format.

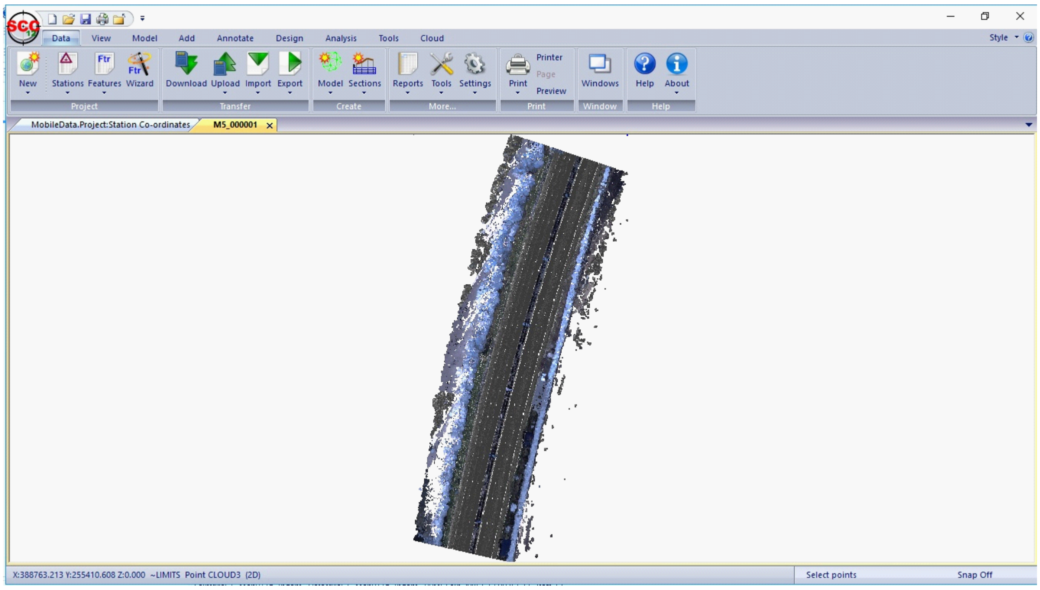
Pick 'M5_000001.las' from Tutorials directory and set up the following;



Press 'Ok'

Select 'Ok' to Model Creation and Raw cloud creation dialog



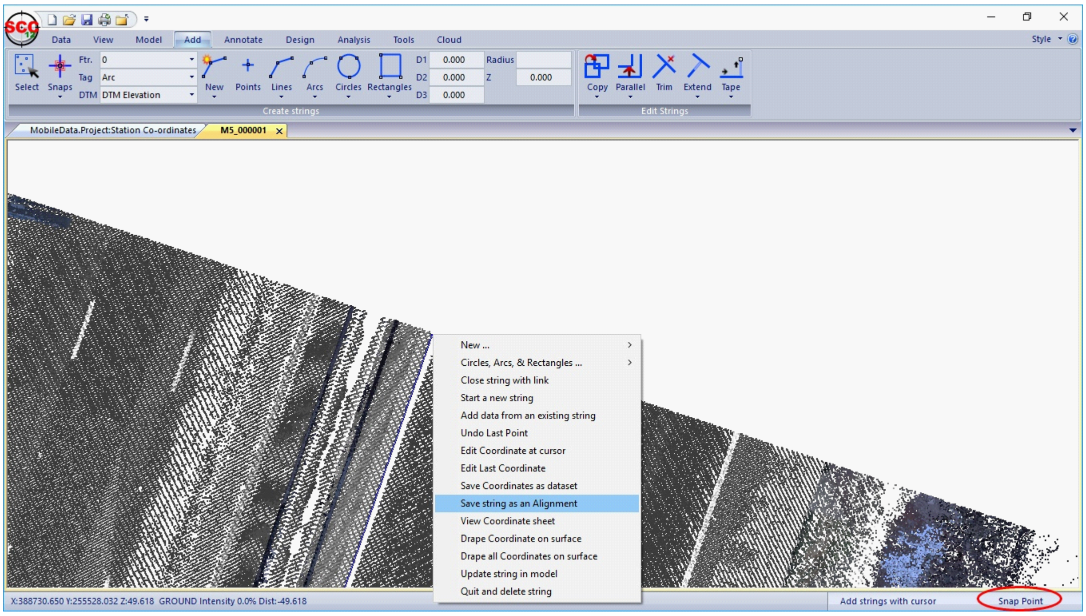


25.7.3 Create A Simple Alignment

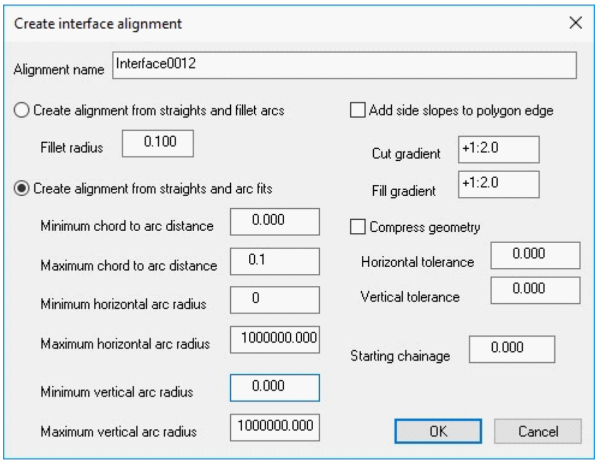
Go to 'ADD tab > New > Arc'

Left click mouse on screen to begin centre line, change the geometry as the line process to Arc tag and then finishing with Straight

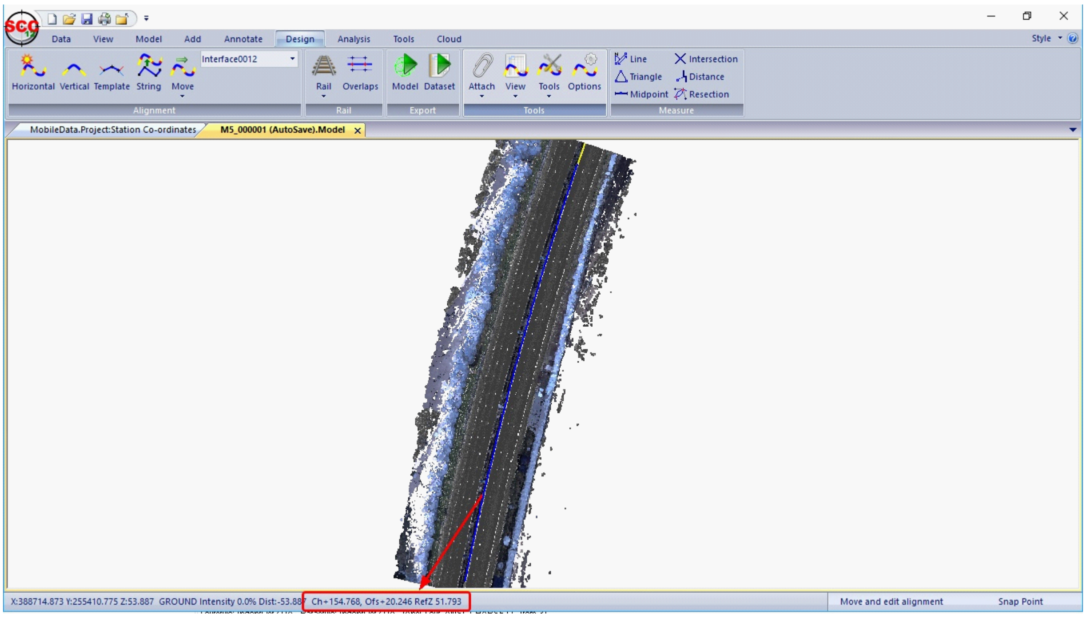
Right click mouse on screen, select 'Save string as an Alignment'



Set up the following and press 'Ok'

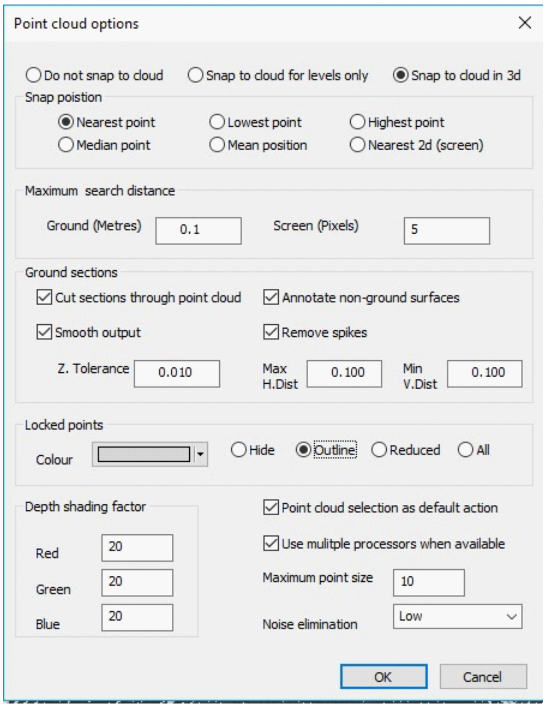


An alignment is now present, note Chainage/Offset system



25.7.4 Settings

Go to 'Cloud tab > Settings', set up the following and press 'Ok'



25.7.5 Trace Linear Features: Road Edge, Batter Rail and Channel

First pick template points: Road Edge, Batter Rail and Channel

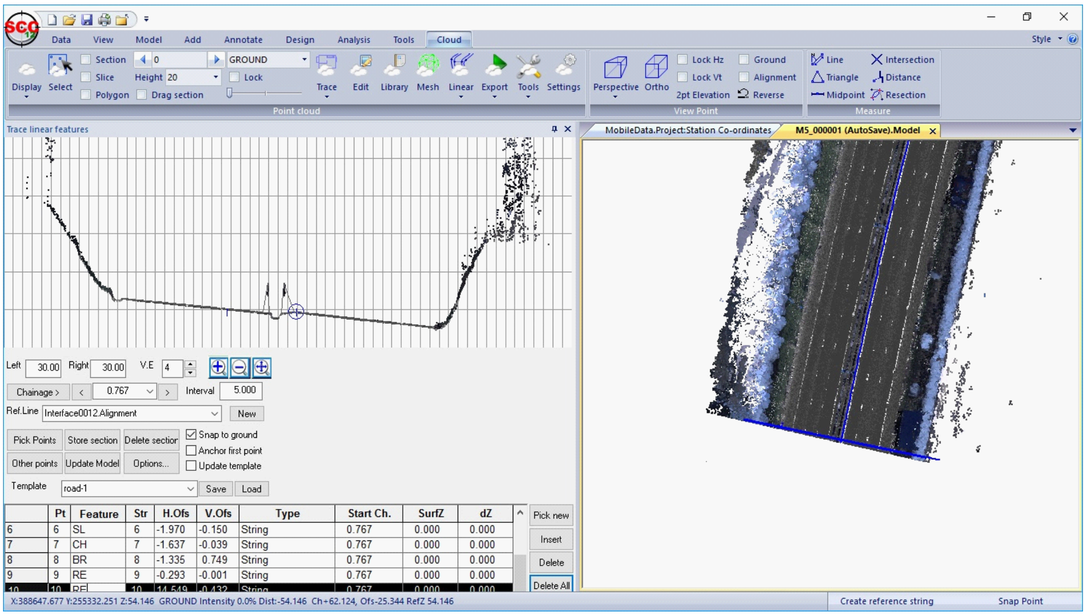
Left click on model to position at a given chainage, for example 0.767

Pick first point RE on Trace Linear Feature screen by left clicking on section

New Pt is listed below. Change Feature to RE and then continue to pick additional points on section

Set up the following: RE, RE, BR, CH, SL, SL, CH, BR, RE, RE as shown below

Click 'Store Section'

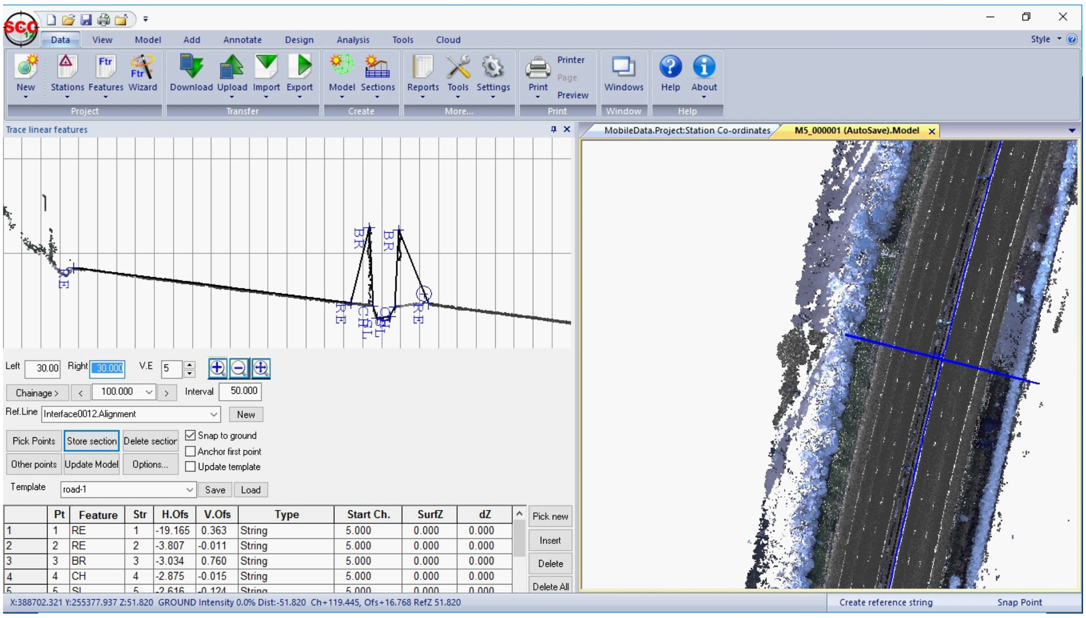


Set the chainage interval to 50

Select Chainage '>' button to move to chainage 50

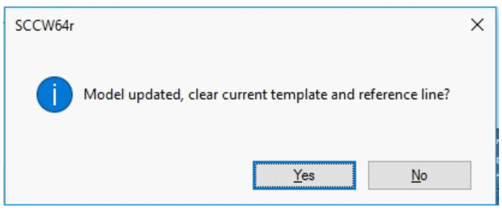
Begin to pick points at chainage 50 by left clicking on section at the position of each feature

Each time select 'Store Section' to save and then move to the next chainage interval



The user can pan back through the model using the chaiange button to check if additional points are required

Select 'Update Model' and pick 'No' to 'Model updated, clear current template and reference line'



Enter Template Name 'RD' and pick 'Save'

Then press 'Delete All'

25.7.6 Trace Linear Features: White Lines

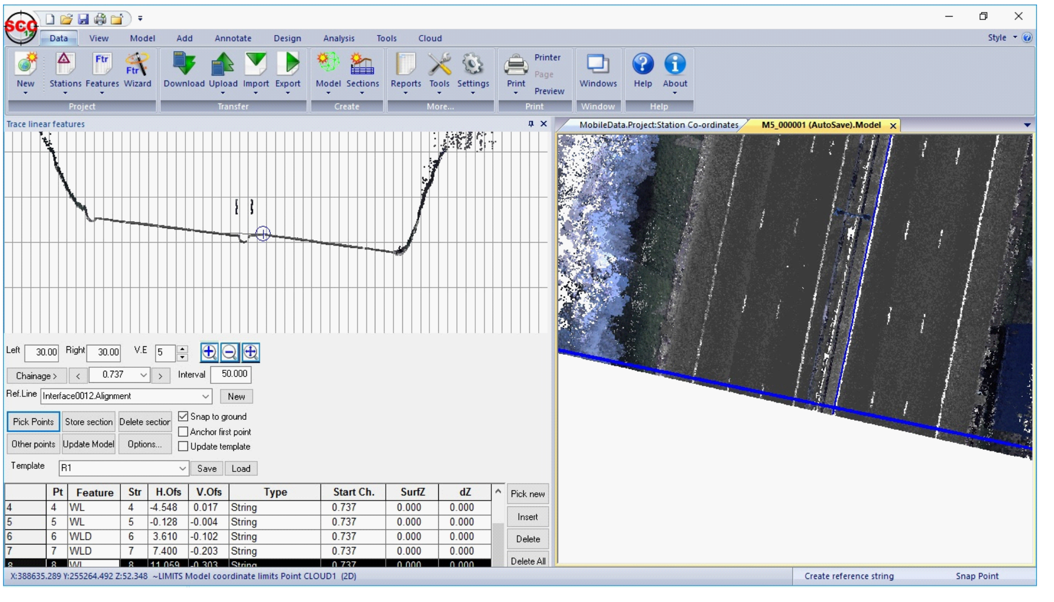
Left click on model to position at a given chainage, for example 0.767

Pick first point WL on Model by left clicking on section

New Pt is listed below. Change Feature to WLD and then continue to pick additional points on section

Set up the following: WL, WLD, WLD, WL, WL, WLD, WLD, WL as shown below

Click 'Store Section'

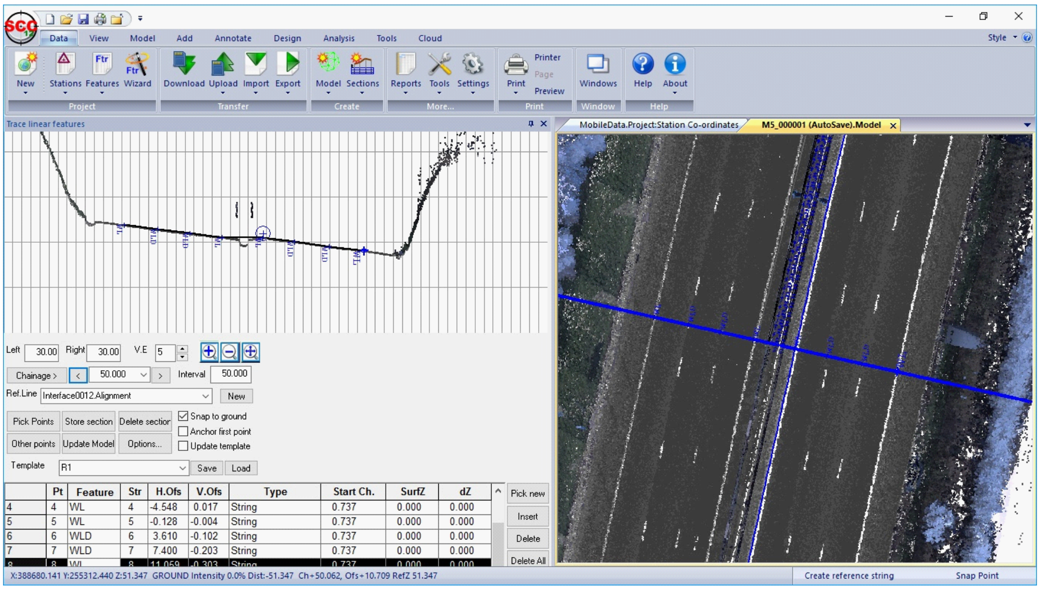


Set the chainage interval to 50

Select Chainage '>' button to move to chainage 50

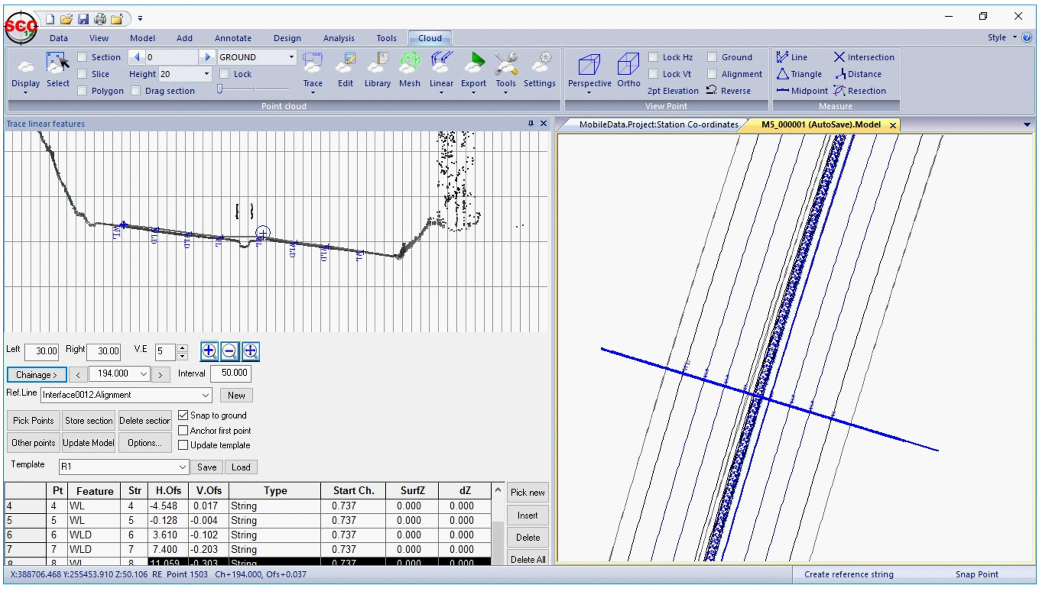
Begin to pick points at chainage 50 by left clicking on Model at the position of each feature

Each time select 'Store Section' to save and then move to the next chainage interval



The user can pan back through the model using the chaiange button to check if additional points are required

Within the 'CLOUD tab > Display'



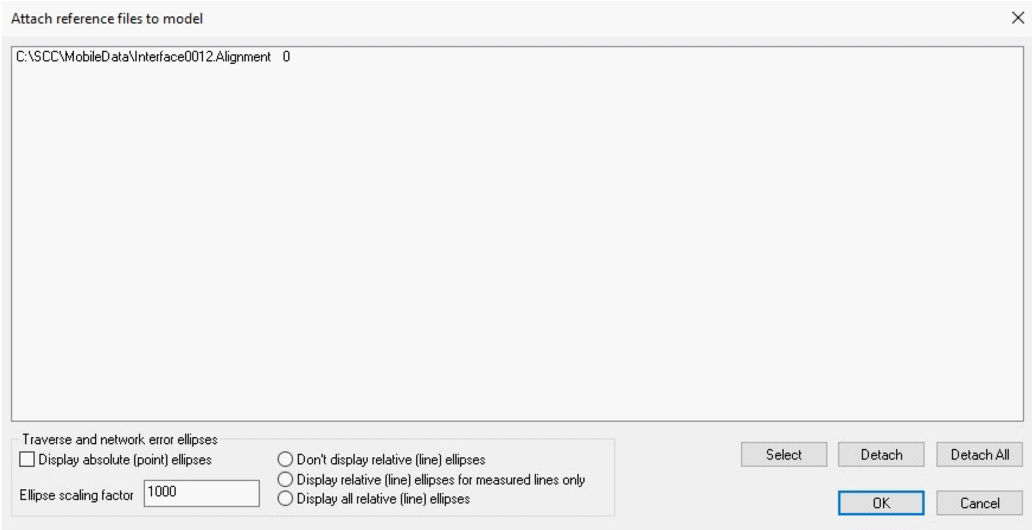
Select 'Update Model' and pick 'Yes' to 'Model updated, clear current template and reference line'

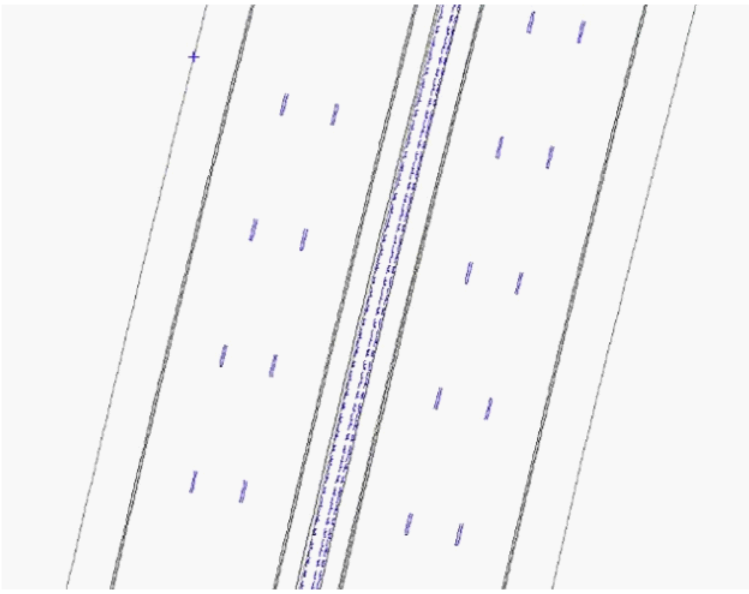
Select 'Close' on the Trace Linear Feature dialog

25.7.7 Detach Alignment

Go to 'DESIGN tab > Attach button'

Select 'Detach All' and 'Ok'

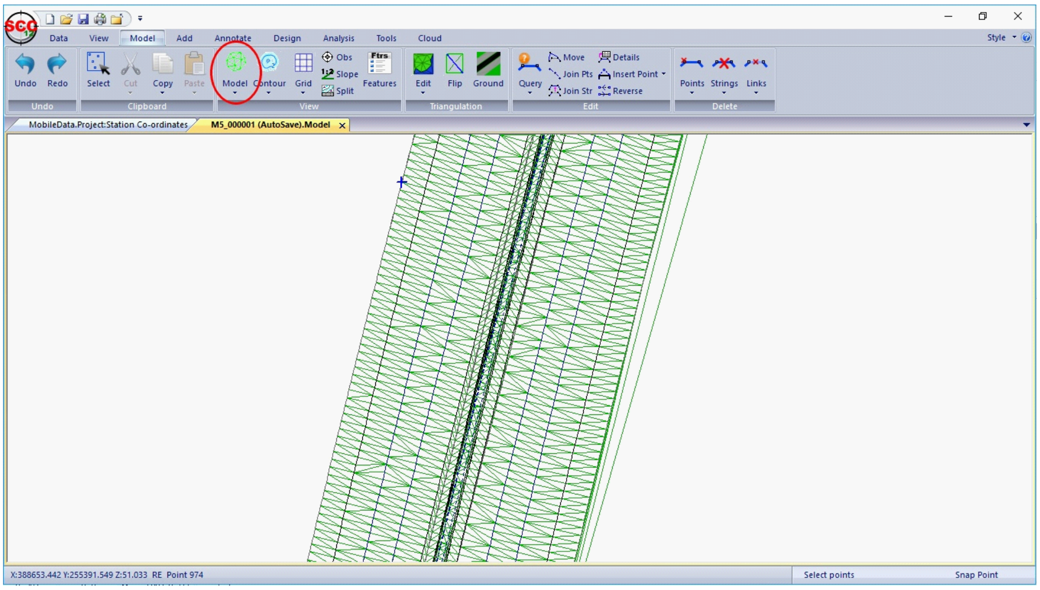




25.7.8 Check Model

Go to 'MODEL tab > Model Button'

Check Triangulation



25.7.9 Rotate Model

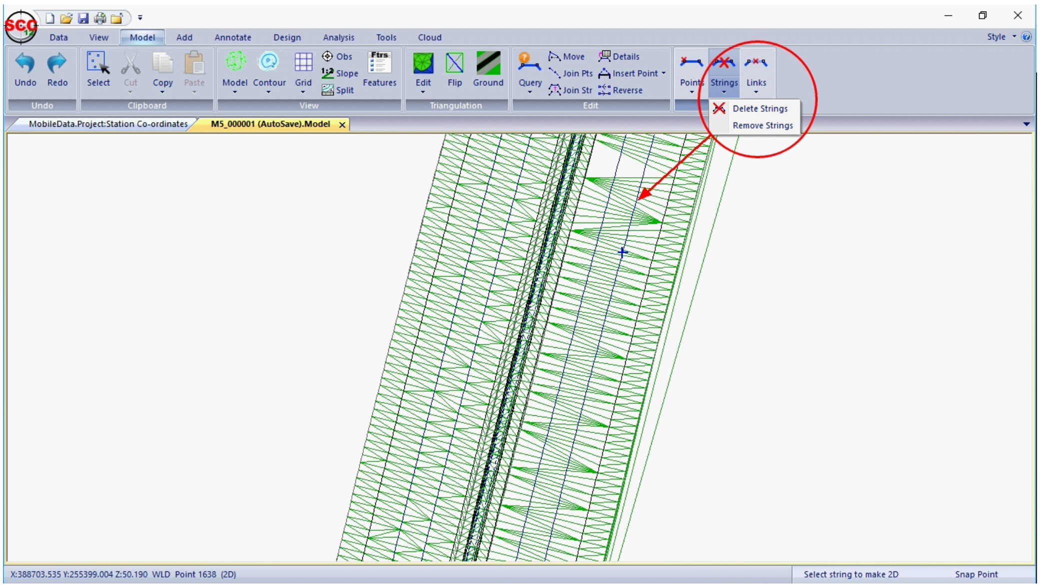
Rotate model, press Mouse Wheel at rotate origin point

Press Right Mouse Button down and move cursor to pivot model

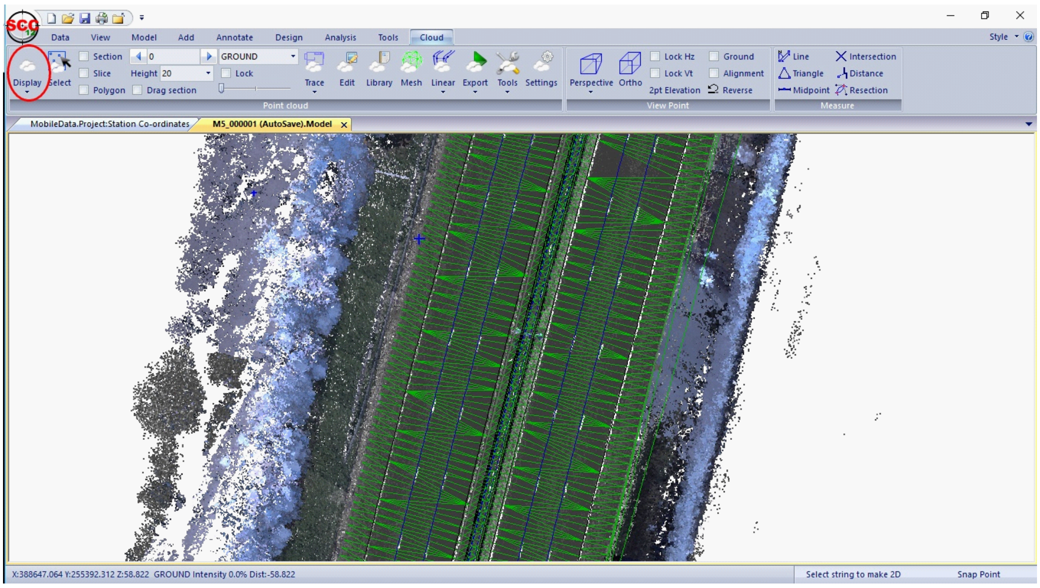
25.7.10 Remove White Lines From TIN

Go to 'MODEL tab > String > Remove Strings'

Left click mouse on WL and WLD strings to remove from TIN

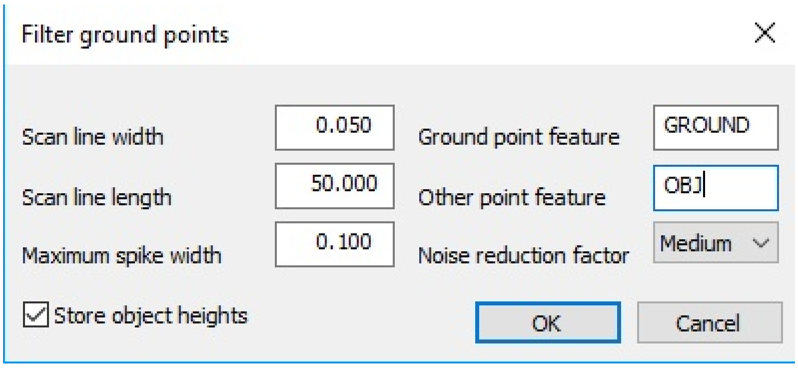


Having remove strings from TIN, select 'Display' from 'CLOUD tab'



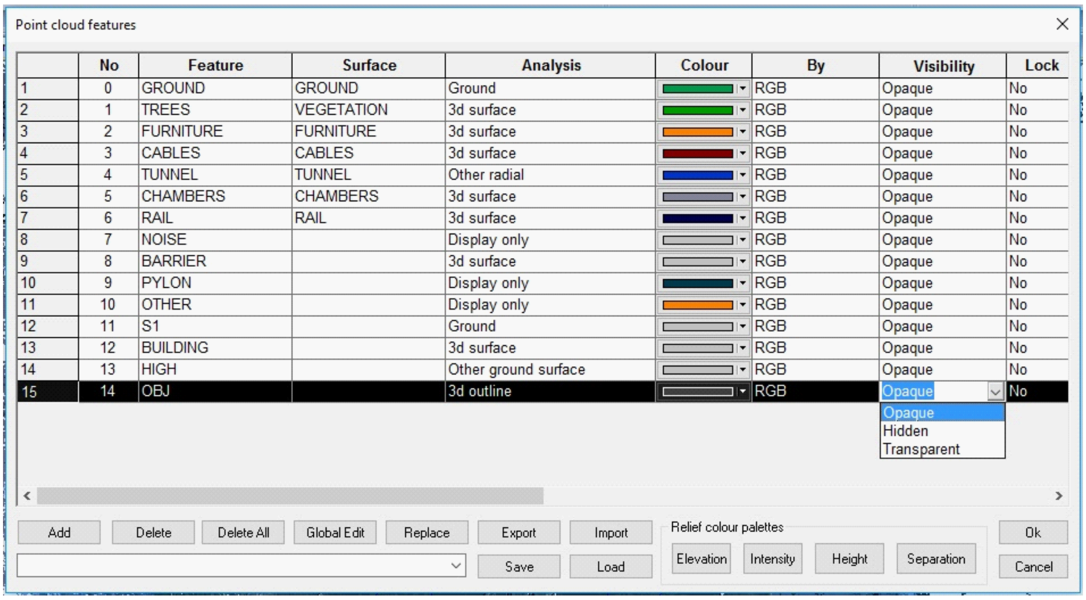
25.7.11 Filter the Ground to Identify Lamp Posts , Trees etc. from Main Ground

Go to 'CLOUD tab > Tools > Filter Ground' set up the following and pick 'OK'



Go to 'CLOUD tab > Library' button

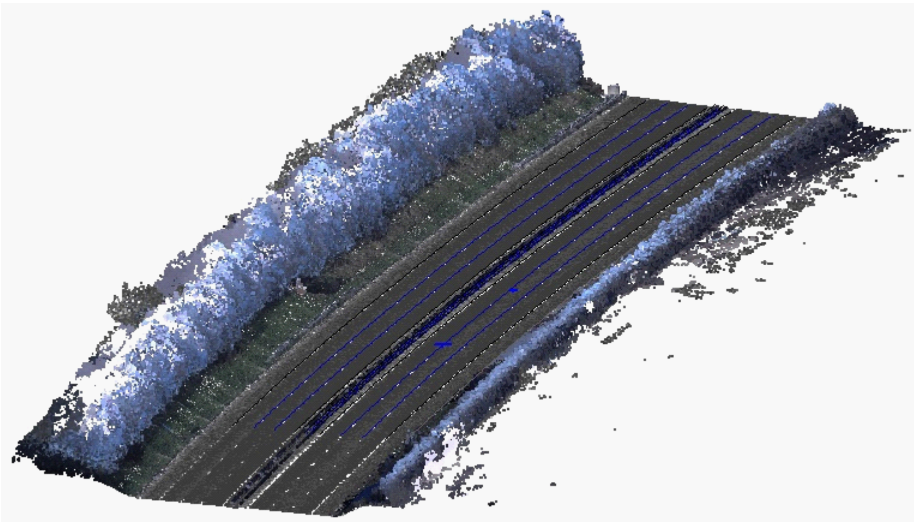
Set 'OBJ' visibility to 'Hidden' and pick 'OK'

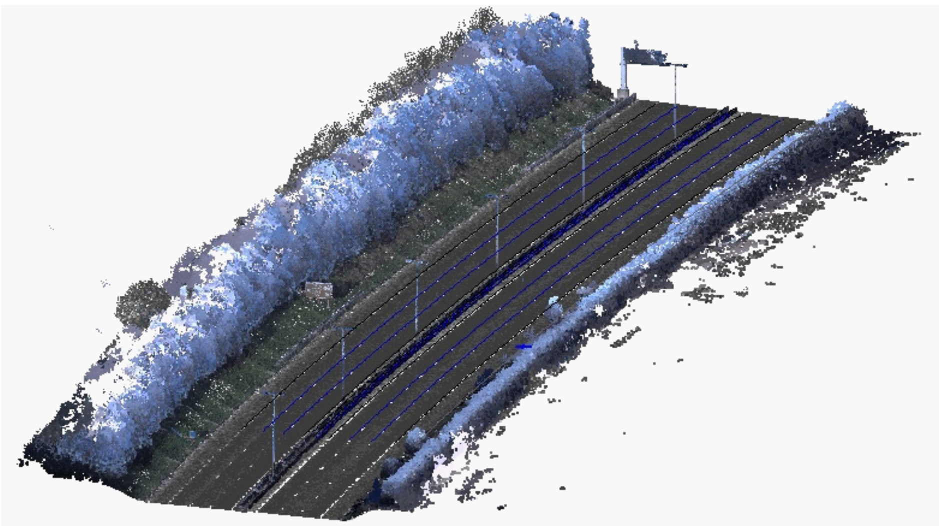


Point cloud features

	No	Feature	Surface	Analysis	Colour	By	Visibility	Lock
1	0	GROUND	GROUND	Ground		RGB	Opaque	No
2	1	TREES	VEGETATION	3d surface		RGB	Opaque	No
3	2	FURNITURE	FURNITURE	3d surface		RGB	Opaque	No
4	3	CABLES	CABLES	3d surface		RGB	Opaque	No
5	4	TUNNEL	TUNNEL	Other radial		RGB	Opaque	No
6	5	CHAMBERS	CHAMBERS	3d surface		RGB	Opaque	No
7	6	RAIL	RAIL	3d surface		RGB	Opaque	No
8	7	NOISE		Display only		RGB	Opaque	No
9	8	BARRIER		3d surface		RGB	Opaque	No
10	9	PYLON		Display only		RGB	Opaque	No
11	10	OTHER		Display only		RGB	Opaque	No
12	11	S1		Ground		RGB	Opaque	No
13	12	BUILDING		3d surface		RGB	Opaque	No
14	13	HIGH		Other ground surface		RGB	Opaque	No
15	14	OBJ		3d outline		RGB	Opaque	No

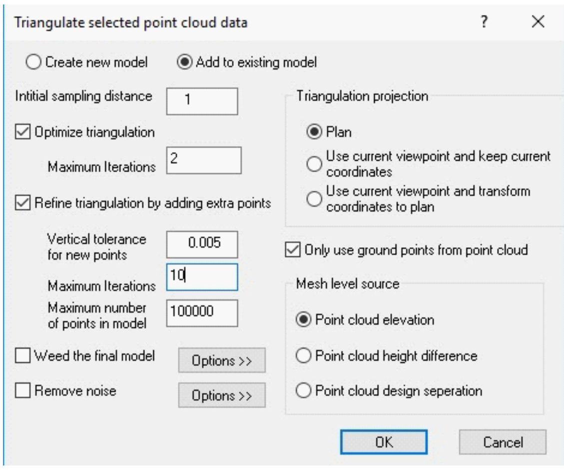
Notice the difference when OBJ is set to Opaque and Hidden





25.7.12 Create TIN

To triangulate, select 'CLOUD tab > Mesh' button and set up the following:



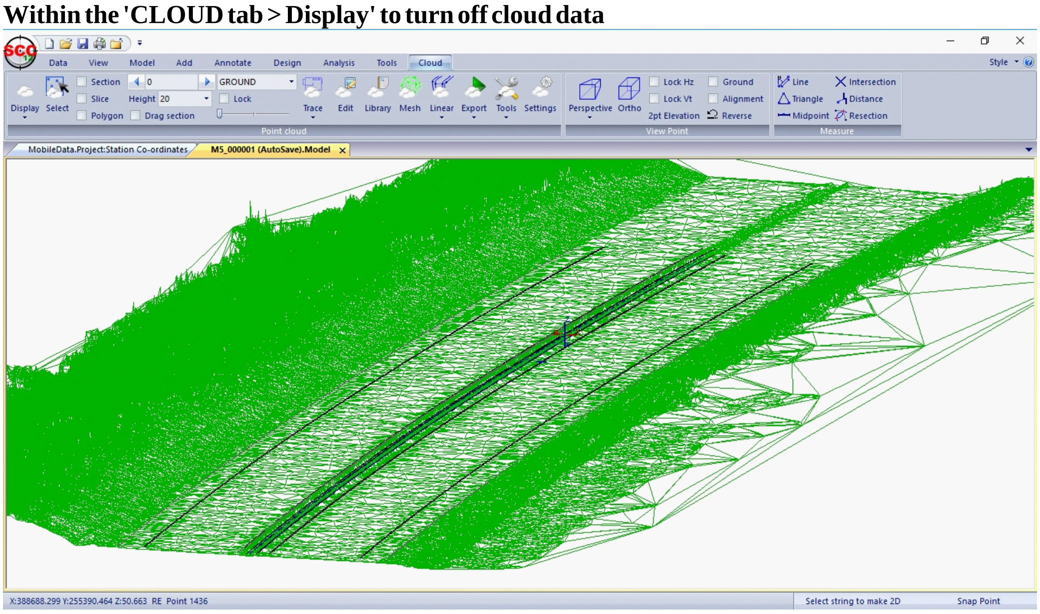
Press 'Ok'

Go to 'MODEL tab > Model button' to turn on TIN

Rotate model, press Mouse Wheel at rotate origin point

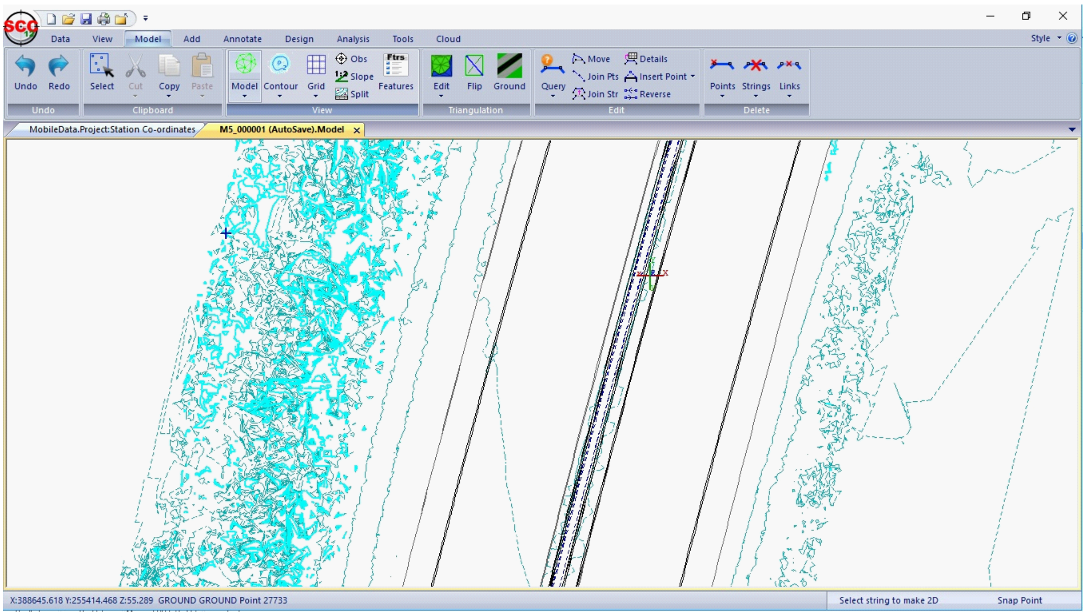
Press Right Mouse Button down and move cursor to pivot model

Within the 'CLOUD tab > Display' to turn off cloud data



Go to 'MODEL tab > Model button' to turn off TIN

Go to 'MODEL tab > Contour button' to turn on contours

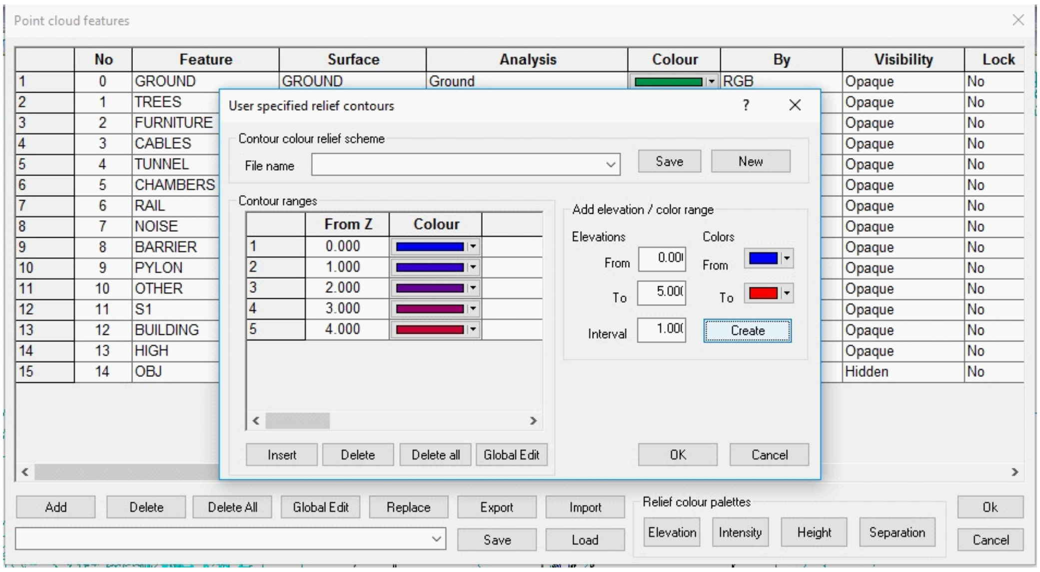


25.7.13 Highlight Non-Ground Points By Height

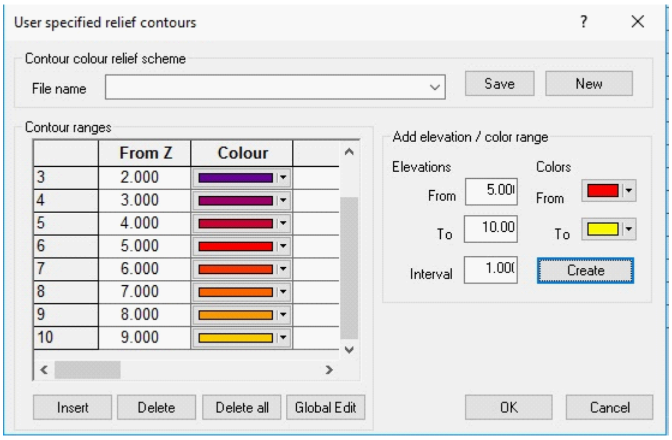
Go to 'CLOUD tab > Library' button

Pick 'Height' as the Relief Colour Palettes

Set up the following 'Add Elevation/color range' for 0 -5 range

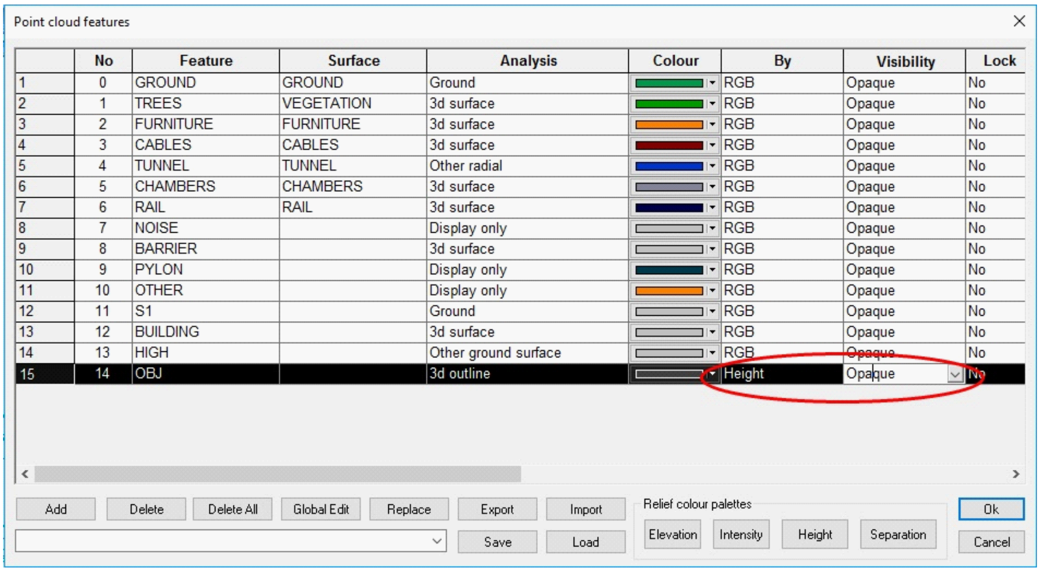


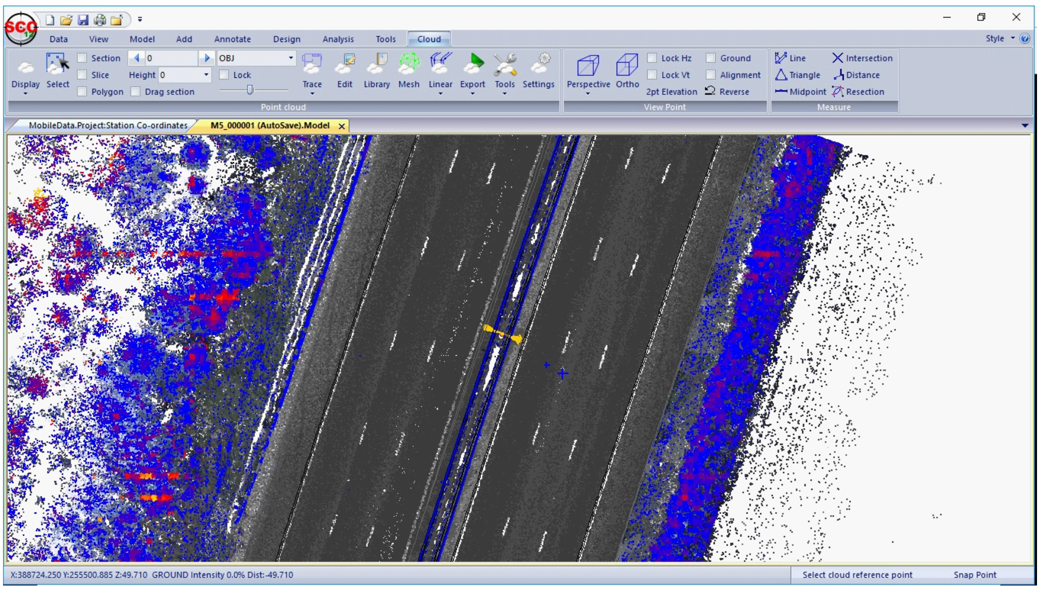
Set up the following 'Add Elevation/color range' for 5-10 range



Select 'OK'

Set By as 'Height' for OBJ and Visibility to 'Opaque', then press 'OK'

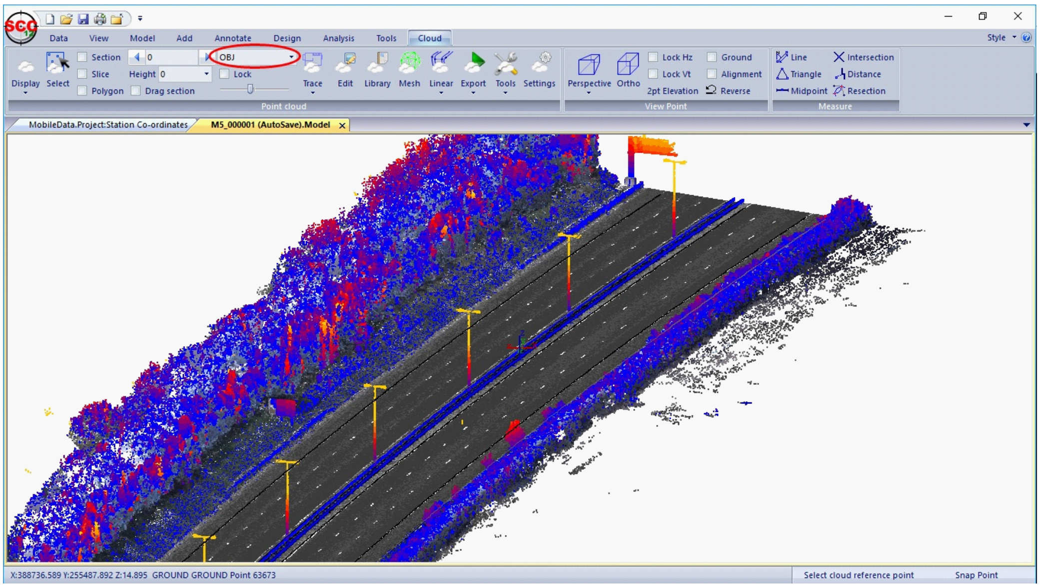


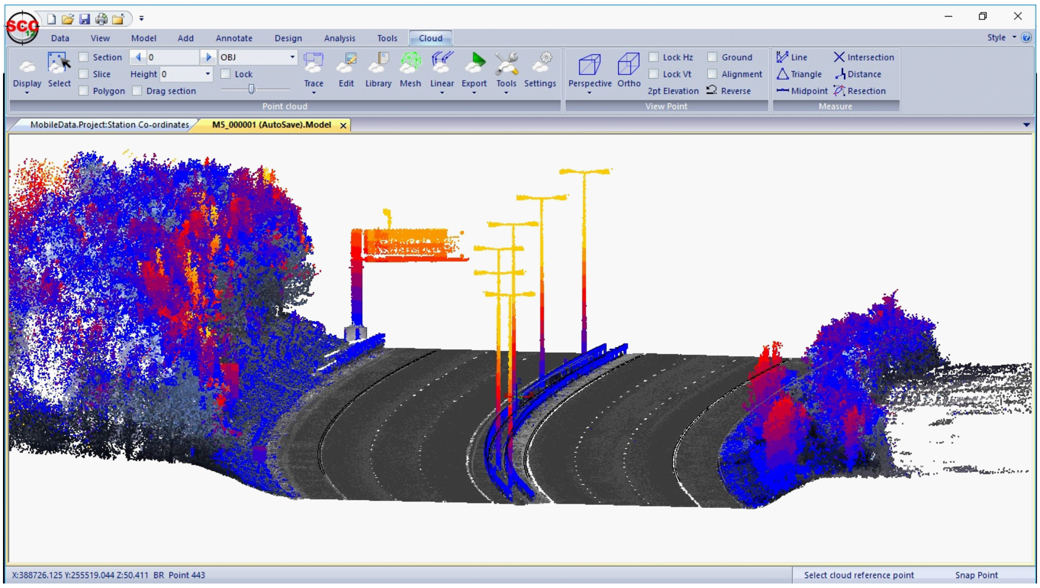


Rotate model, press Mouse Wheel at rotate origin point

Press Right Mouse Button down and move cursor to pivot model

Pick 'OBJ' within Selection toolbar from 'CLOUD tab'

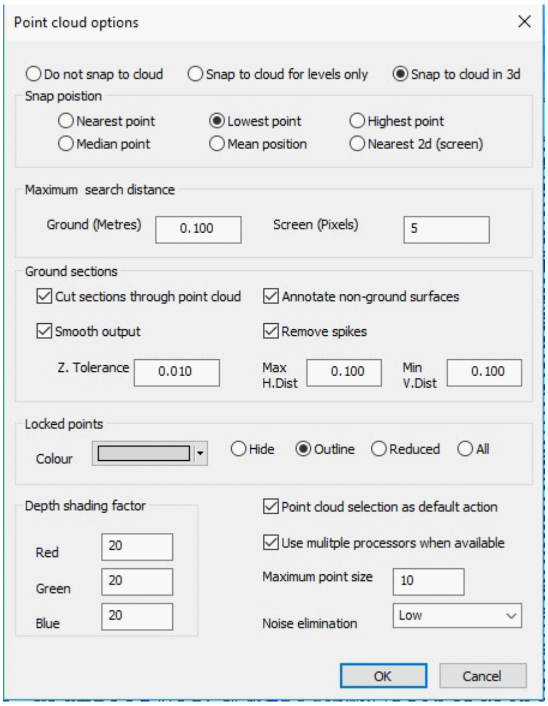




25.7.14 Add Features

Go to 'Cloud tab > Settings', set up the following and press 'Ok'

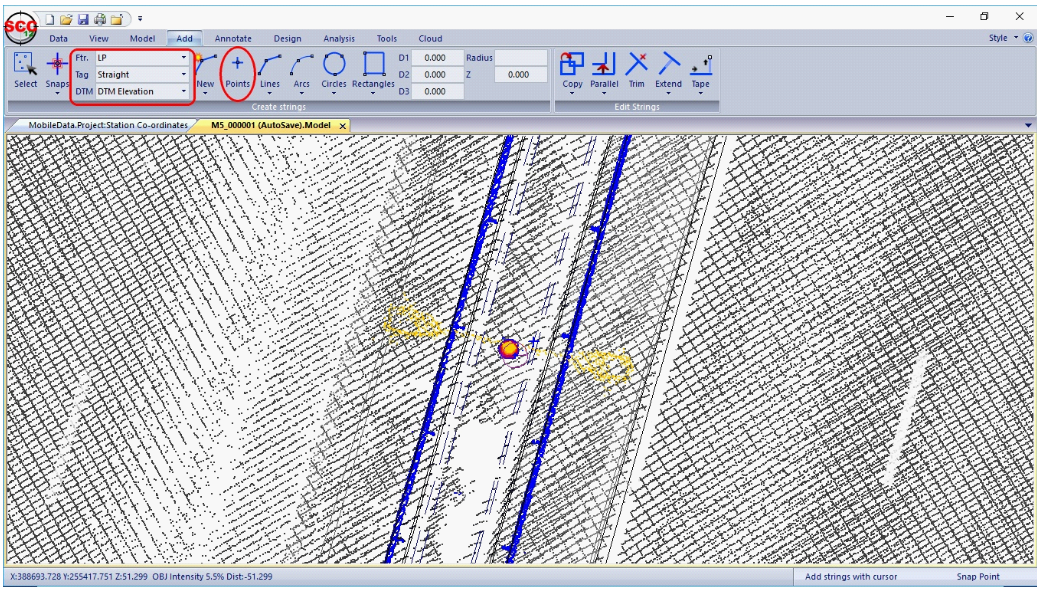
Ensure that 'Lowest point' is selected



Go to 'ADD tab' set LP as feature and pick 'Point'

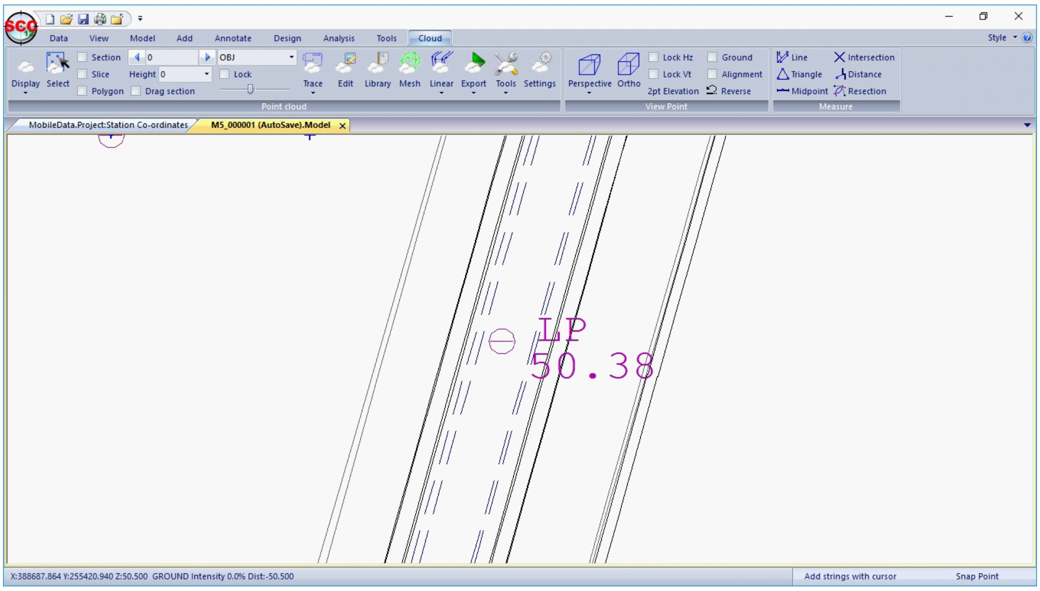
Left click on model, to place lamp post

Right click mouse and select 'Update string in model'



Select 'CLOUD tab > Display' to turn on cloud

LP is visible



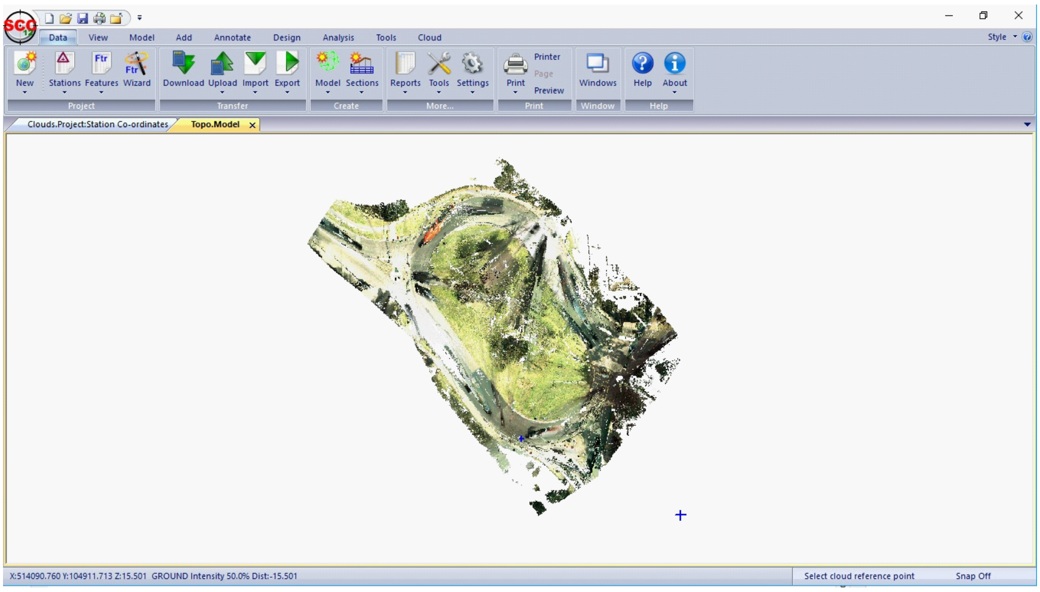
25.8 Cloud Volumes

This tutorial examines sample data 'Topo.Model' in order to calculate volumes of the roundabout island.

25.8.1 Open Existing Project & Model

Open 'Cloud.Project' from SCC\Tutorials\PointClouds folder

Open 'Topo.Model' from SCC\Tutorials\PointClouds folder



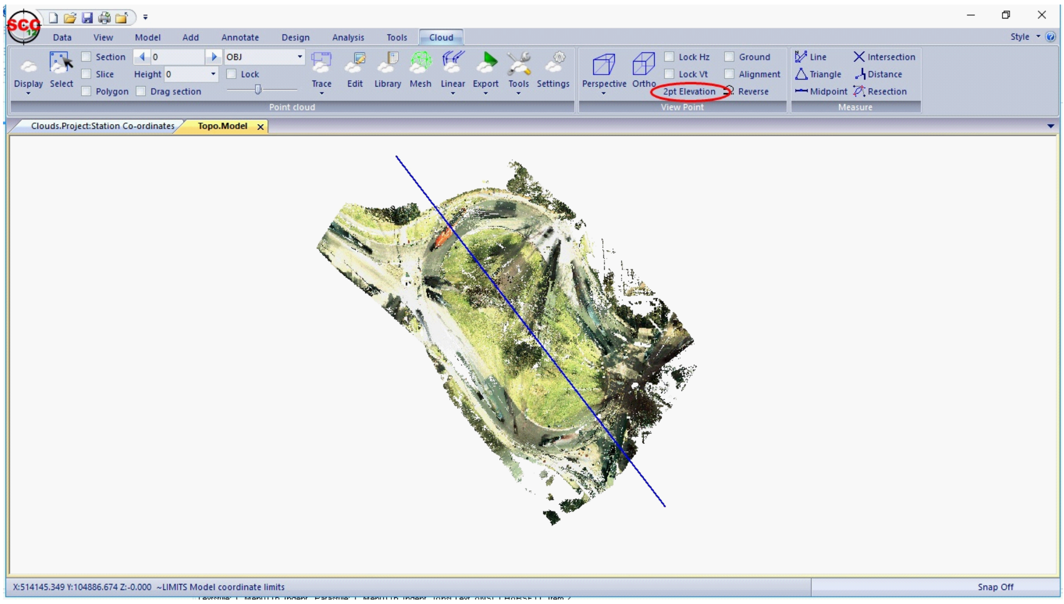
25.8.2 Rotating Viewpoints

The most important step computing volumes from point clouds is to ensure the cloud model is free from data not related to the measurement such as vegetation, street furniture, etc..

Select such data en-masse and change its feature.

Go to 'CLOUD tab > 2pt Elevation'

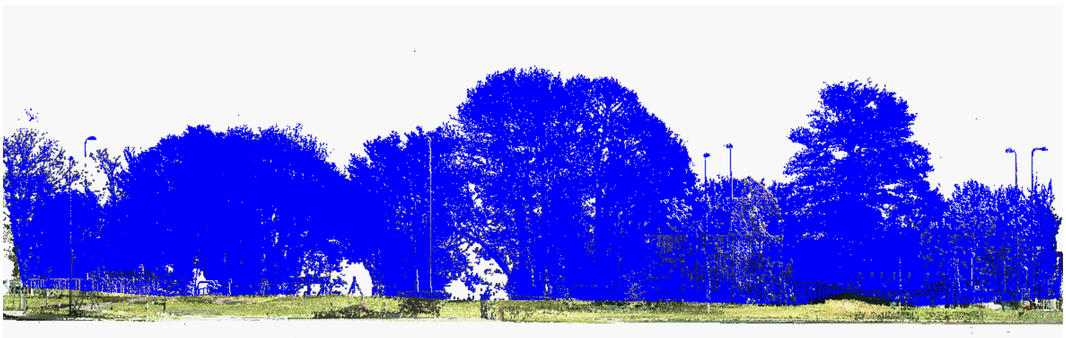
Select a line running through the area of interest, left click mouse on screen to pick first point and then left click on last point to finish



25.8.3 Cloud Data Selection & Editing

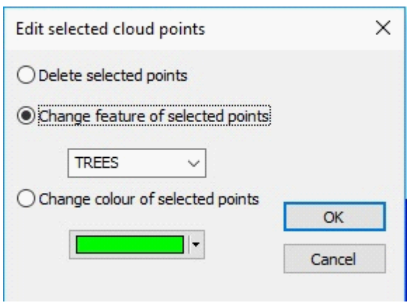
To select data, right click to bring up the Data selection dialog, followed by picking 'All points in a polygon' and press Select data

On the model to select points for exclusion from the measure, press left click on mouse to pick points on the polygon followed by right click to close it.



Go to 'CLOUD tab > Edit'

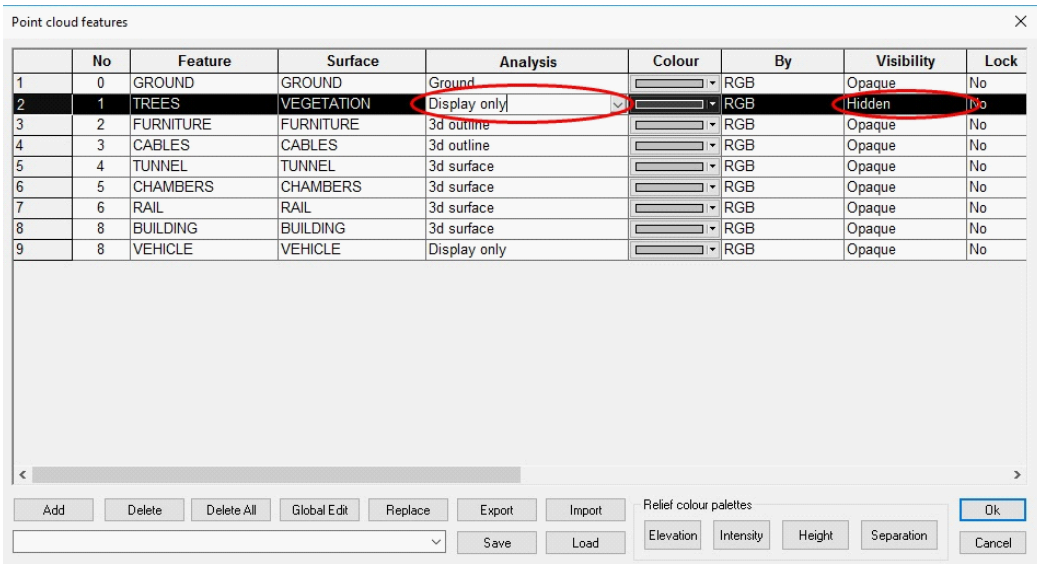
Set up the following and press 'Ok'



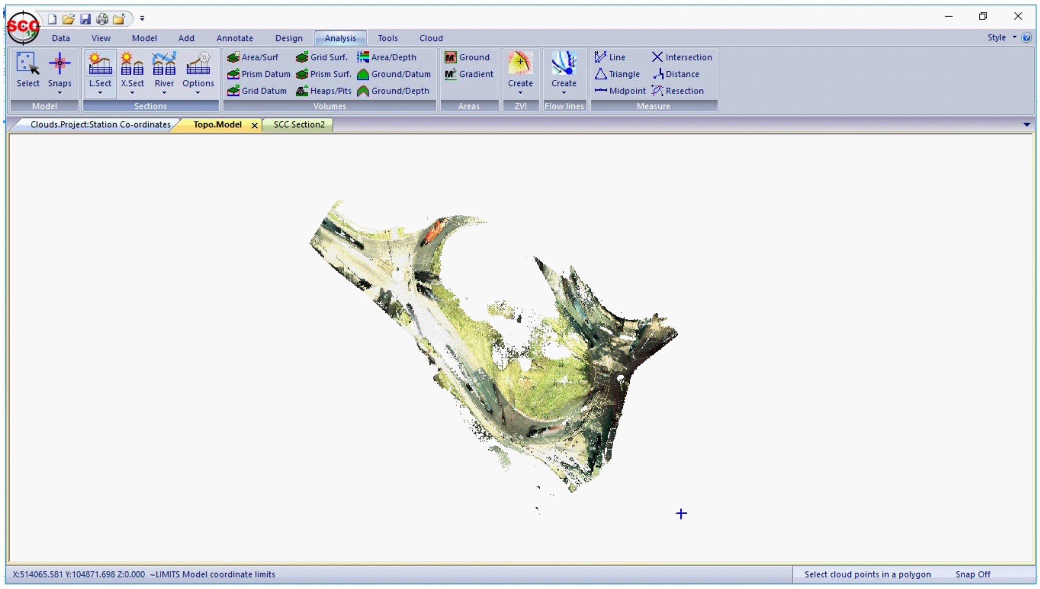
For volumes one feature in addition to GROUND will suffice. For more complex analysis this method can be use in conjunction with the isolate points option to break a model down into multiple features as has been done on the TOPO model.

25.8.4 Check Cloud Surface Data

Select 'CLOUD tab > Library button', and change the analysis type for excluded features TREE to 'Display only', and the Visibility to 'Hidden'.

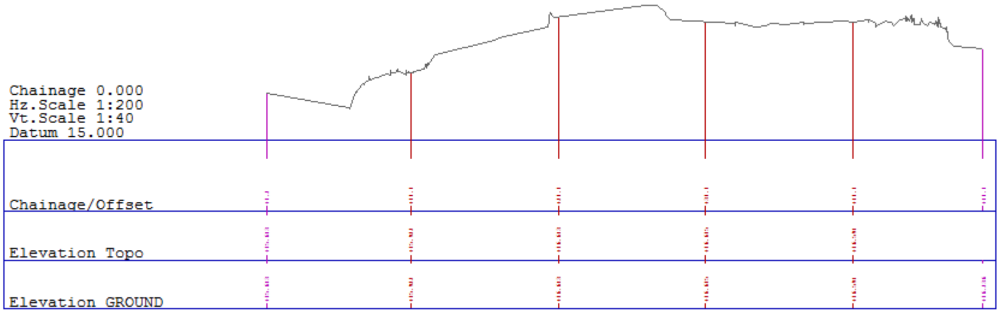


Select 'P' to change to Plan view



To check the surface is as intend, select ' ANALYSIS tab > L. Section button' and take a section through a vegetated area of the traffic island

Left click mouse on model for first point, then again for second and right click to finish



Use 'FILE > Save As' to save a copy of our edited model.

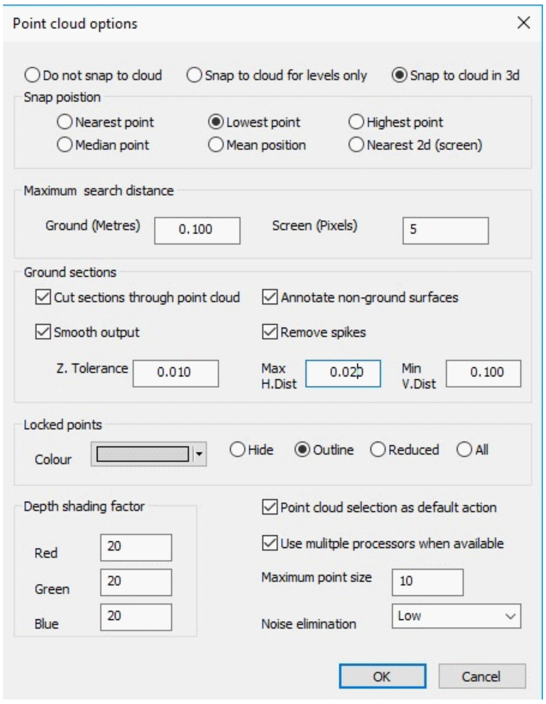
25.8.5 Creating Base Model

On order to compute volumes, a base model is needed. The easiest way to create one is to simply draw a polygon around the area of interest, interpolating levels from the cloud, and saving it as a new surface. This can be done as follows;

'CLOUD tab > Settings' set up the following

Ensure 'Lowest point' is selected.

This has the effect that levels will be taken based on the lowest point within the given radius of the plan point, thus avoiding any noise than may have been left in the model during the editing process.



Go to 'ADD tab > New > Lines'

Left click mouse on screen to begin line and continue to place points

Change geometry from Straights to Arc when required

Finish by using Link tag to join end to start point

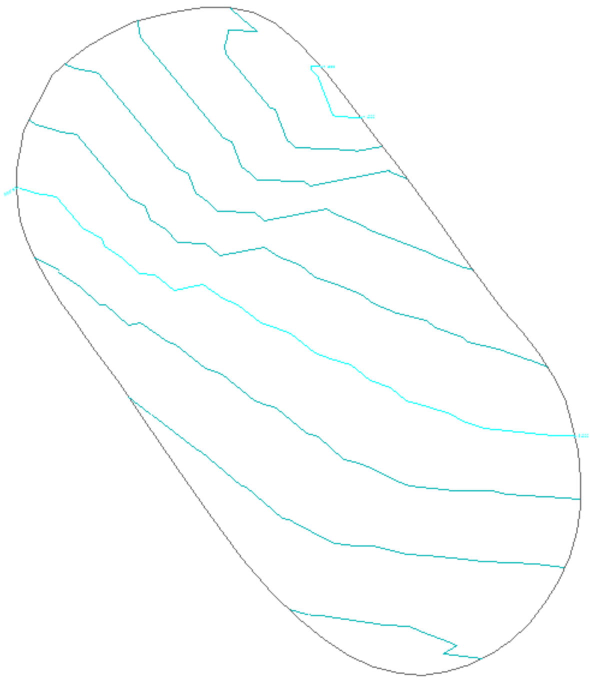
Right click mouse on screen select 'Drape All points on surface'

Right click mouse on screen select 'Save coordinates as dataset' to save the 3d outline of the base model

Save Dataset as 'TOPO_Base.Survey'

Go to 'MODEL tab > Model button' pick 'TOPO_Base.Survey'

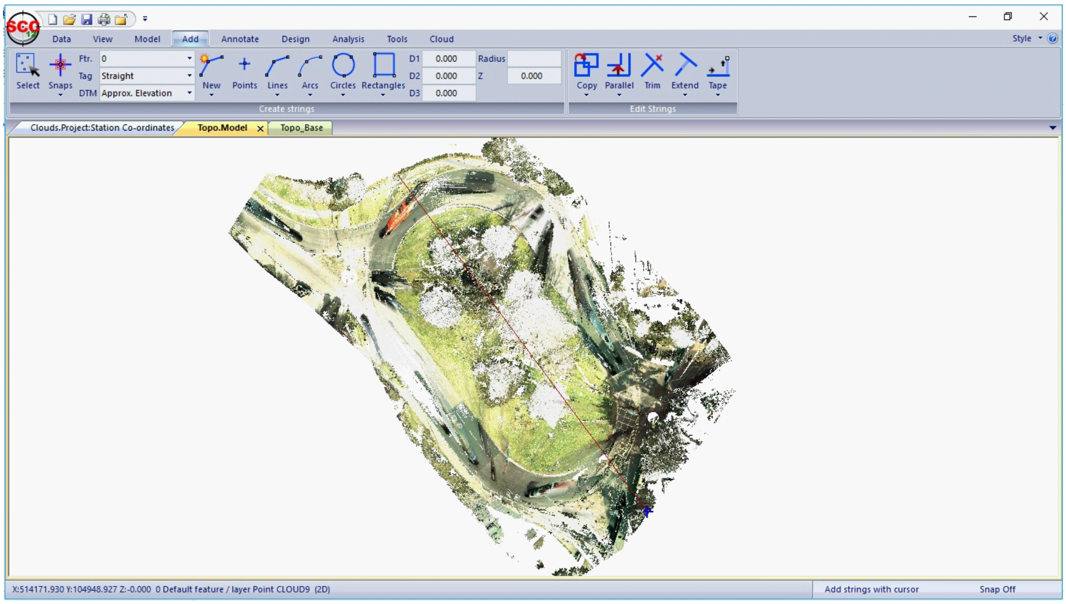
Model at 1:250



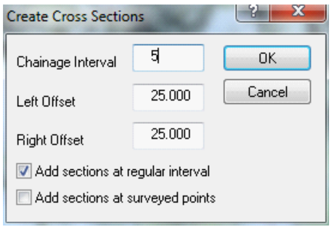
25.8.6 Volumes By Average End Method

Go to 'ADD tab > New > Lines'

Create a new string along the centre of the traffic island with a DTM code of Approximate that can be used as a base line.



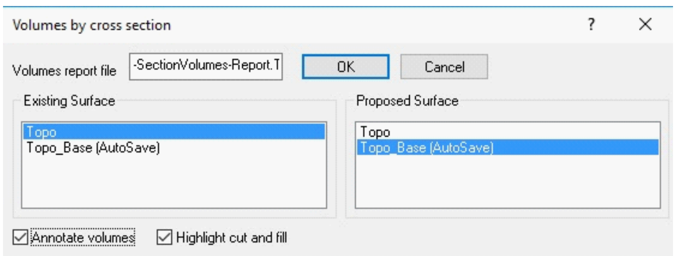
Select 'ANALYSIS tab > X.Sect button, set up the following and press 'Ok'

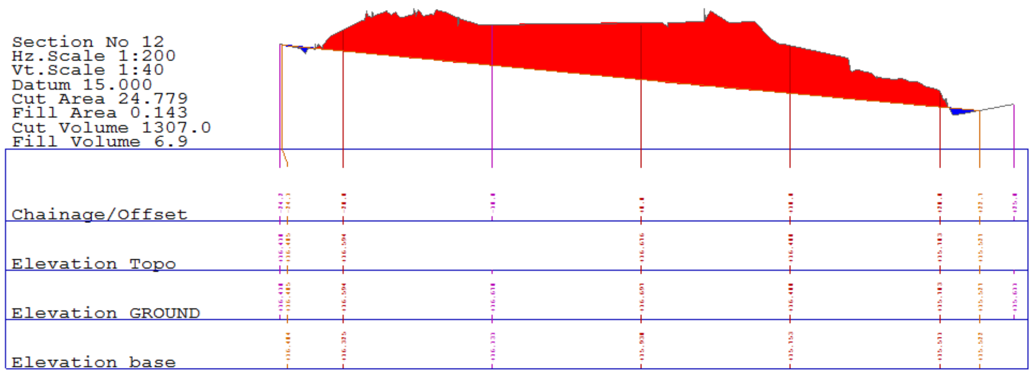


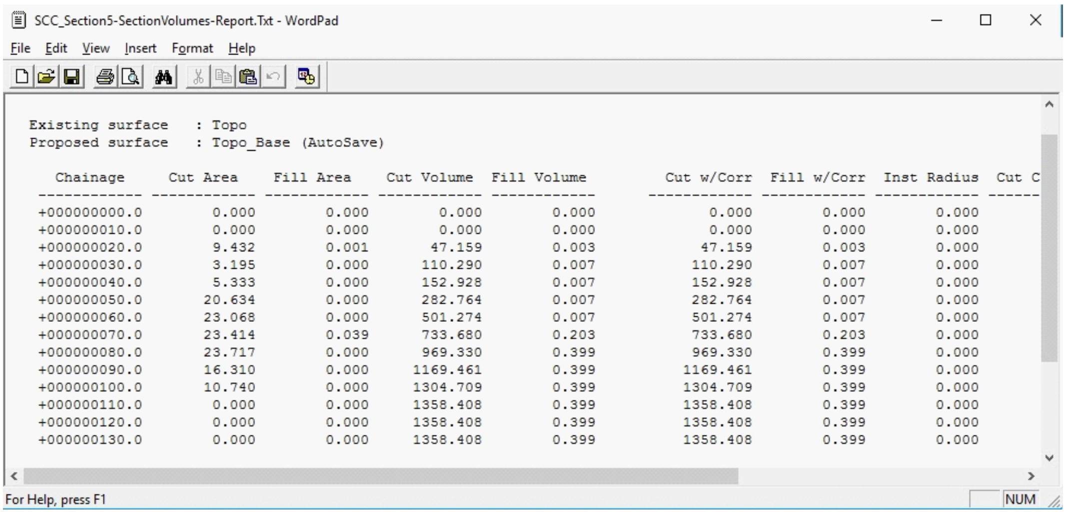
Pick the selected centre line

In the sections, select 'EDIT tab > Append button' and pick the base model

Select 'EDIT tab > Append drop down > Volumes' to compute the volumes







Existing surface : Topo
Proposed surface : Topo_Base (AutoSave)

Chainage	Cut Area	Fill Area	Cut Volume	Fill Volume	Cut w/Corr	Fill w/Corr	Inst Radius	Cut C
+000000000.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
+000000010.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
+000000020.0	9.432	0.001	47.159	0.003	47.159	0.003	0.000	
+000000030.0	3.195	0.000	110.290	0.007	110.290	0.007	0.000	
+000000040.0	5.333	0.000	152.928	0.007	152.928	0.007	0.000	
+000000050.0	20.634	0.000	282.764	0.007	282.764	0.007	0.000	
+000000060.0	23.068	0.000	501.274	0.007	501.274	0.007	0.000	
+000000070.0	23.414	0.039	733.680	0.203	733.680	0.203	0.000	
+000000080.0	23.717	0.000	969.330	0.399	969.330	0.399	0.000	
+000000090.0	16.310	0.000	1169.461	0.399	1169.461	0.399	0.000	
+000000100.0	10.740	0.000	1304.709	0.399	1304.709	0.399	0.000	
+000000110.0	0.000	0.000	1358.408	0.399	1358.408	0.399	0.000	
+000000120.0	0.000	0.000	1358.408	0.399	1358.408	0.399	0.000	
+000000130.0	0.000	0.000	1358.408	0.399	1358.408	0.399	0.000	

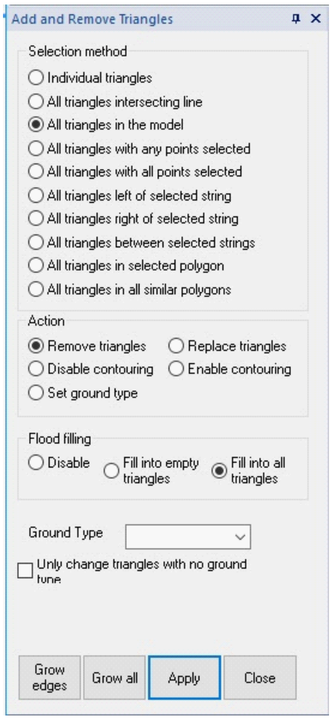
25.8.7 Volumes By Prismoidal Method

To compute the volume using an isopachyte method, do the following;

Go to 'MODEL tab > Edit button' to turn off any triangles in the TOPO model.

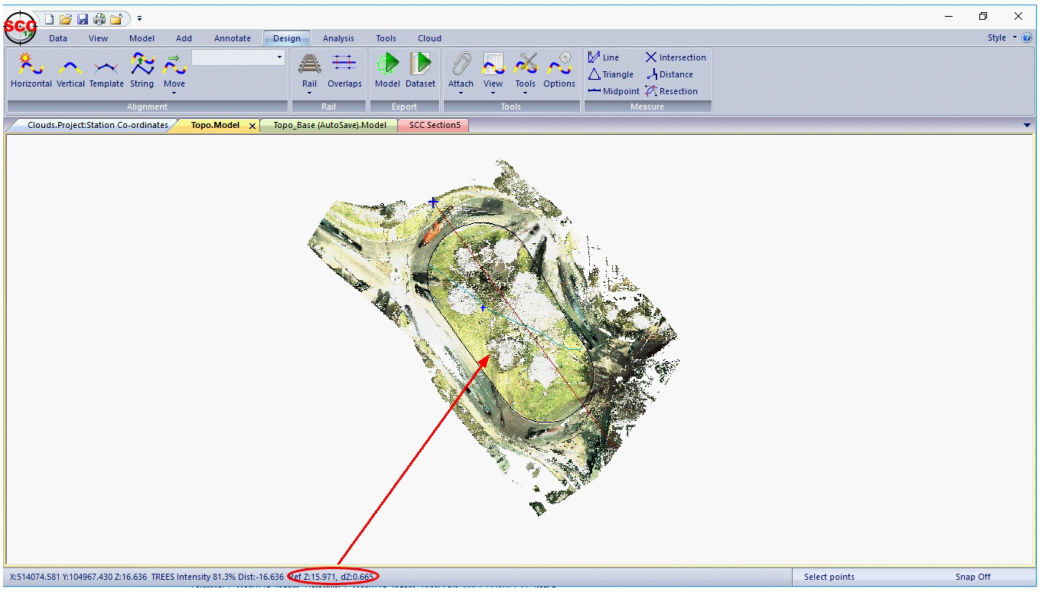
Select 'No' to Store Model Boundary

The reason for this is that SCC allows combined TIN and point cloud surface models, where levels will be interpolated from the TIN model if they are not found in the point cloud.

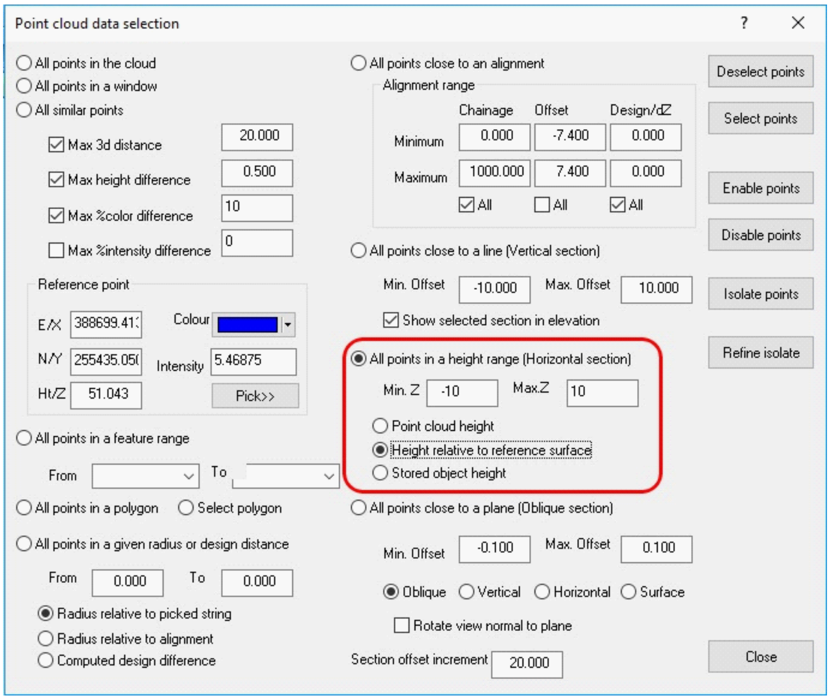


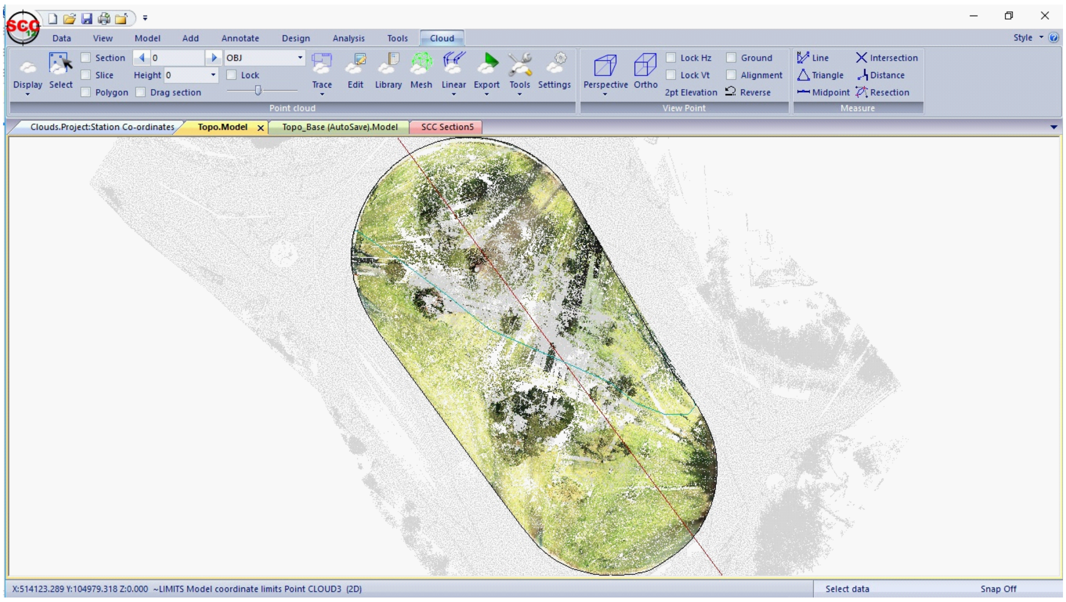
Select 'DESIGN tab > Attach button > Model', and attach the base model to the point cloud.

As the cursor is moved over the traffic island, x,Y,Z and dZ can be seen to the base surface.

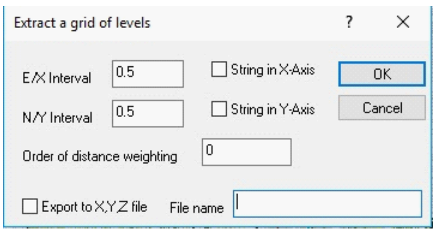


Right click to bring up the data selection dialog and isloate all the points in the cloud relative to the base model as shown;





Select 'TOOLS tab > Tools drop down > Extract a grid of levels' to take a 0.5m grid across the island, and save the resultant data set.

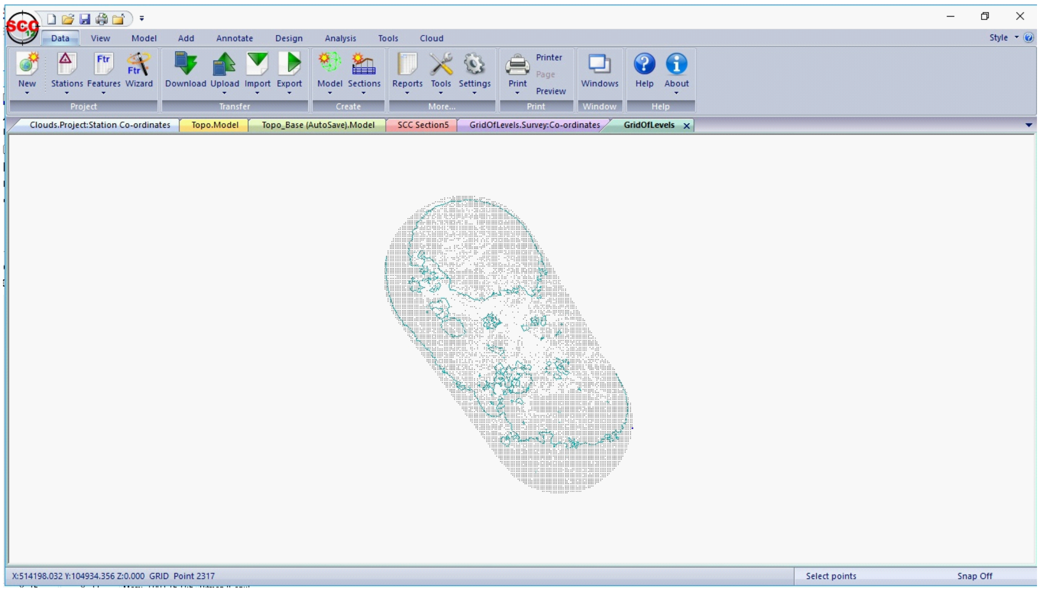


Save Dataset 'GRID.Survey'

Go to 'MODEL tab > Model button' pick 'GRID.Survey'

Model at 1:250

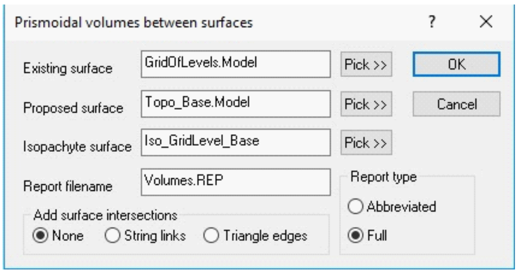
Save Model



Save Model

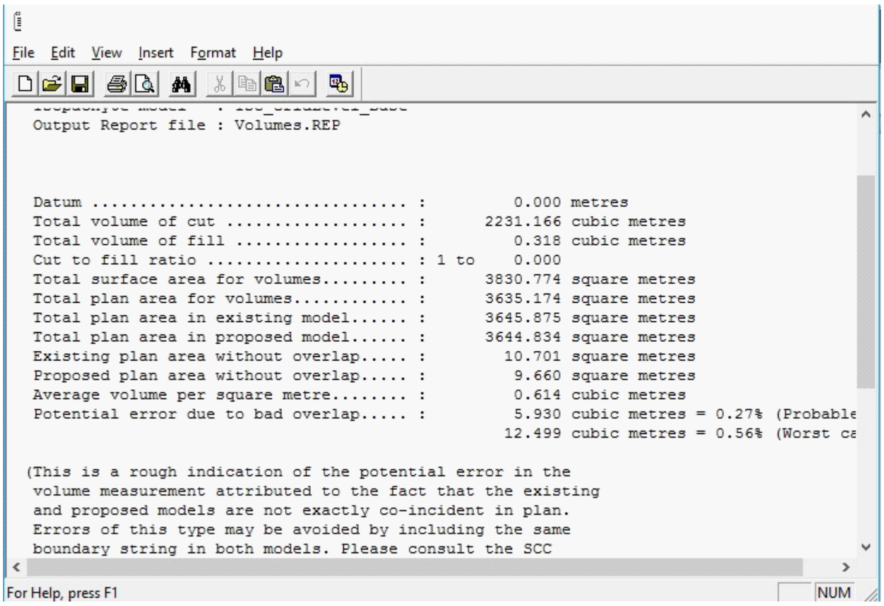
Select 'ANALYSIS tab > Prism Surf.' to compute the volume between the base and island

Set up the following and press 'Ok'

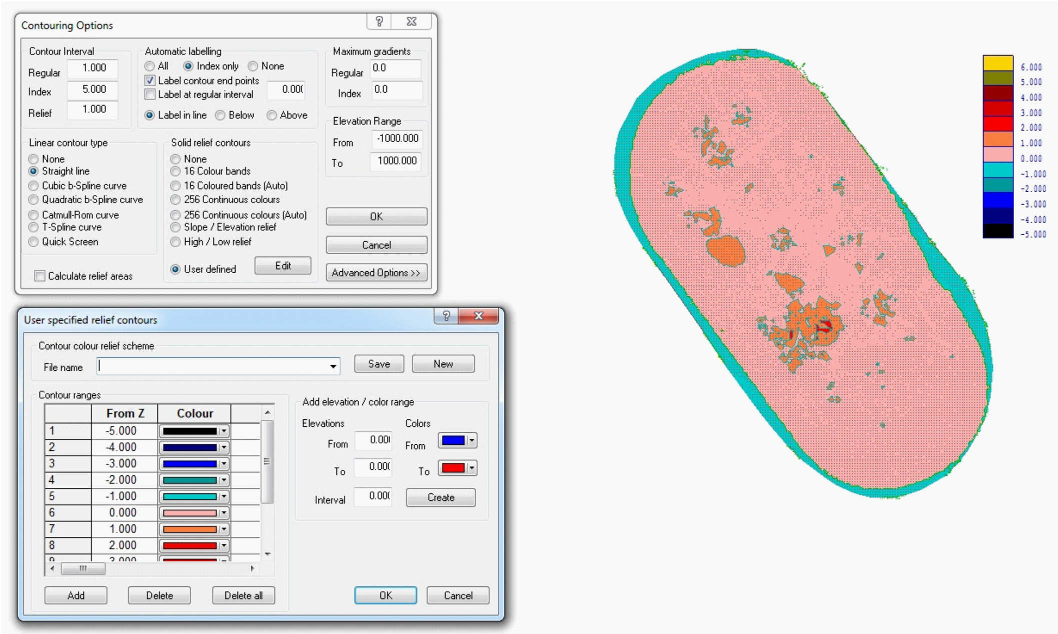


Model at 1:250

Review Report

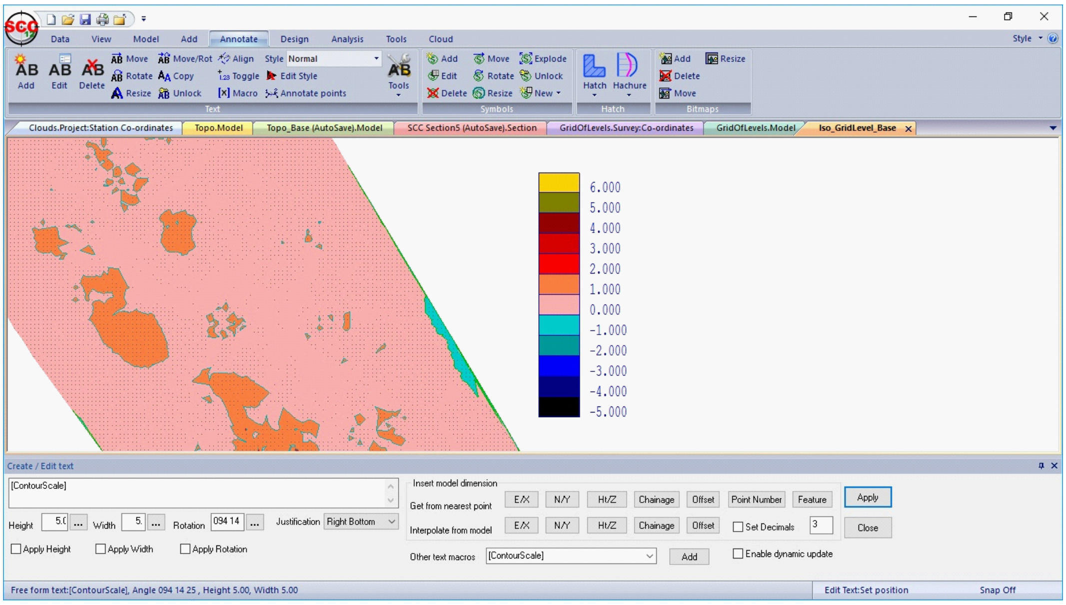


By applying a relief scheme in plan via our contouring options the cut and fill can be visualised.



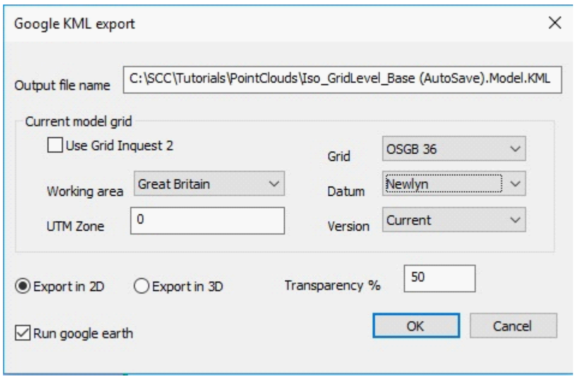
Using 'ANNOTATION tab > Add button' set up the following:

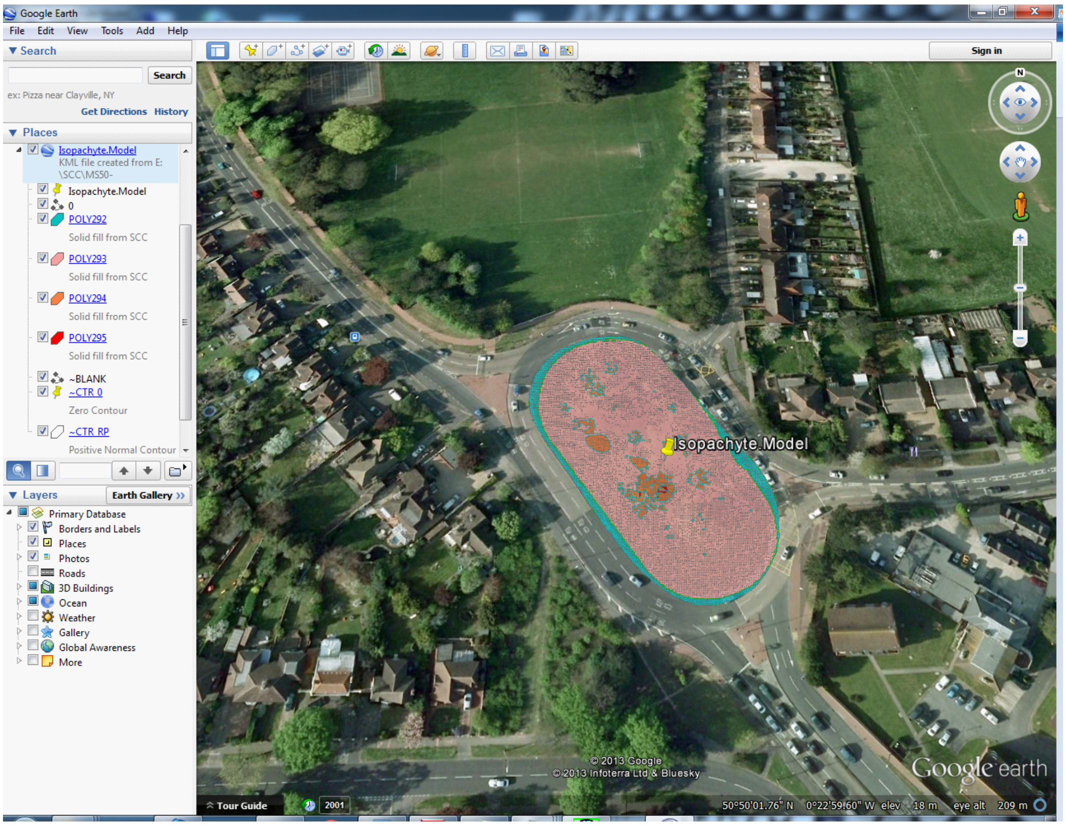
A scale to the relied scheme can be added to show how depths are coloured.

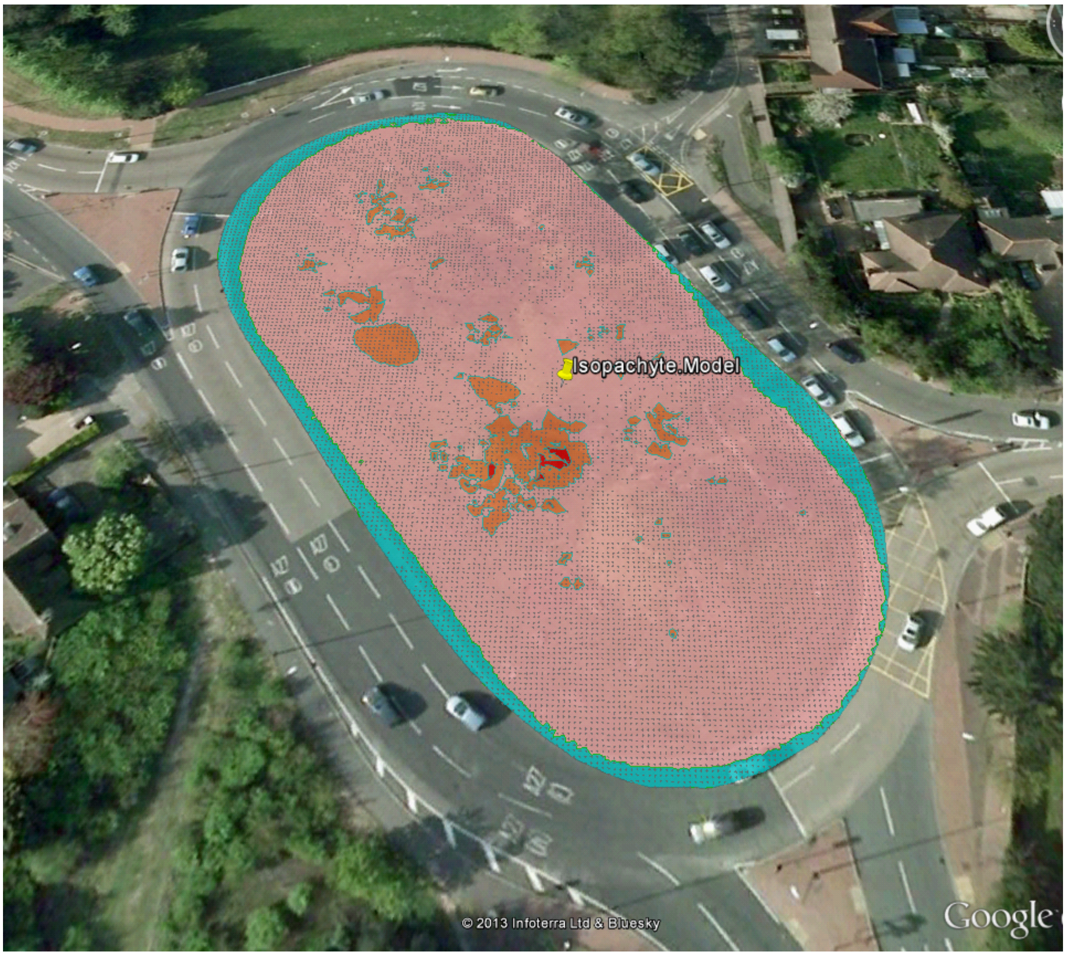


25.8.8 Export To Google Earth

If the model is in national grid, which will typically be the case using the MS50 with GPS, a quick visualise of result can be viewed in Google earth by selecting **'DATA tab > Export > Google Earth KML'**


Google KML export
Output file name
C:\SCC\Tutorials\PointClouds\Iso_GridLevel_Base (AutoSave).Model.KML
Current model grid
Use Grid Inquest 2
Grid
OSGB 36
Working area
Great Britain
Datum
Newlyn
UTM Zone
0
Version
Current
Export in 2D
Export in 3D
Transparency %
50
Run google earth
OK
Cancel


Google Earth
File Edit View Tools Add Help
Search
Search
ex: Pizza near Clayville, NY
Get Directions History
Places
Isopachyte.Model
KML file created from E:\SCC\MS50-
Isopachyte.Model
0
POLY292
Solid fill from SCC
POLY293
Solid fill from SCC
POLY294
Solid fill from SCC
POLY295
Solid fill from SCC
~BLANK
~CTR 0
Zero Contour
~CTR RP
Positive Normal Contour
Layers
Earth Gallery
Primary Database
Borders and Labels
Places
Photos
Roads
3D Buildings
Ocean
Weather
Gallery
Global Awareness
More
Sign in
Isopachyte.Model
© 2013 Google
© 2013 Infoterra Ltd & Bluesky
Google earth
Tour Guide
2001
50°50'01.76" N 0°22'59.60" W elev 18 m eye alt 209 m



26 Transforming A Cloud To Show Differences To A Template Or Cylinder

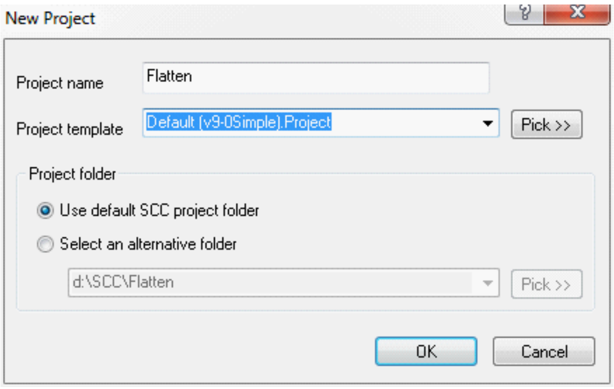
This note covers the steps required in importing a scanned tunnel job in LAS format into SCC and developing it into a plan model showing separation from a template design or cylinder.

The steps are as follows;

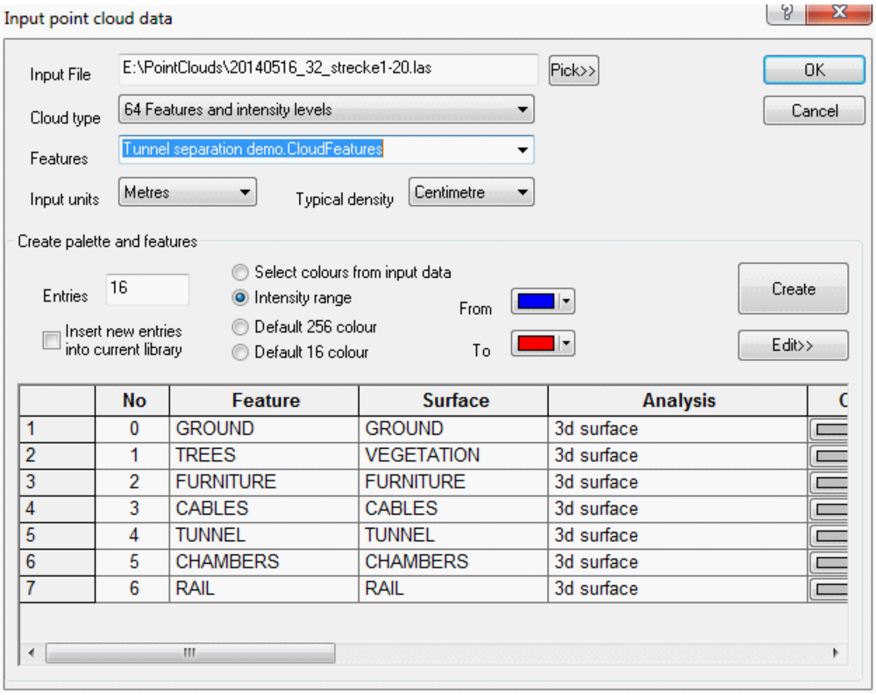
'FILE > New Project' entering a name for the new project and selecting a default template.

The project template contains the naming conventions, symbols, and drawing conventions that will be used when creating models.

Creating a new project also creates a folder in which all project items, such as models and drawings will be stored.

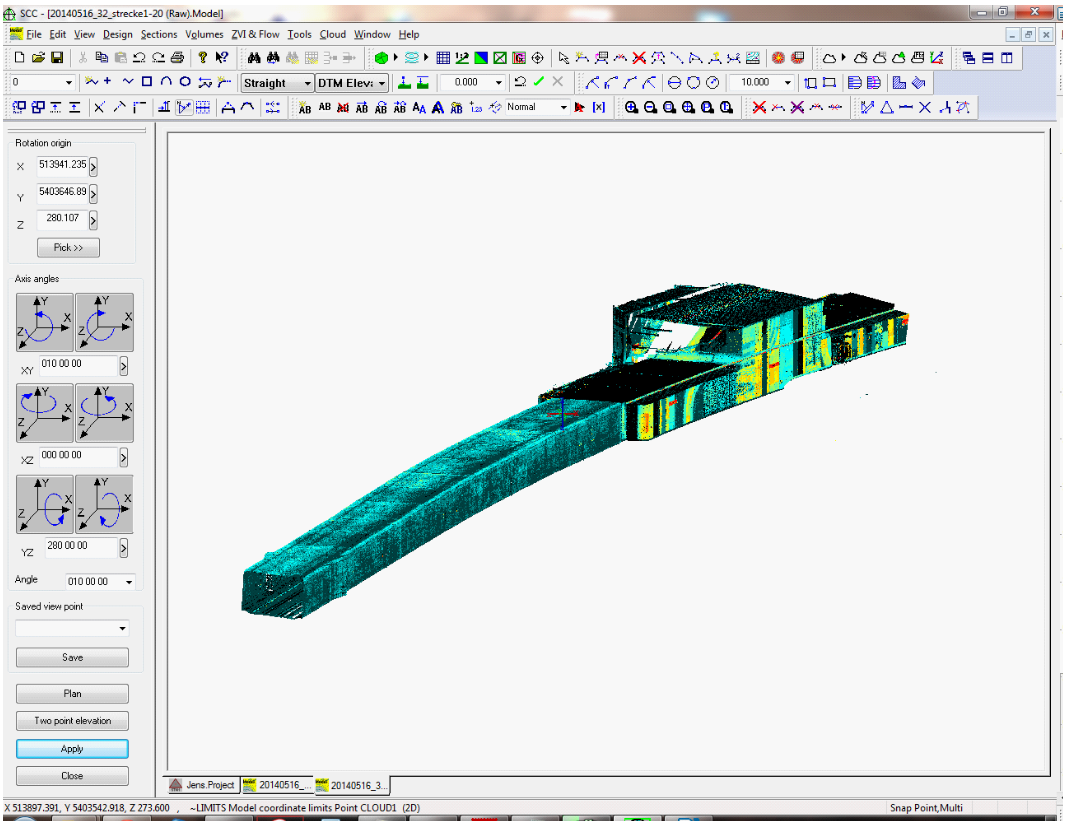


'FILE > Model > Point clouds & LIDAR > file', picking the sample file provided, followed by creating the model at 1:100 scale when prompted.



This creates the following model, containing ~145 million points from the 657mb LAS file and resulted in a 100mb SCC model using 64 intensity levels. On an 8 core AMD processor at 4ghz this takes ~37mins. The 64 features + intensity layout is both compact and quite flexible in terms of what you can do.

The default rendering for the library used is by intensity, where a palette has been selected that corresponds the height range in the scan. Turning the mouse wheel can be used to zoom in and out, and holding the wheel down and moving the mouse to pan. Alternatively, the **PgUp** and **PgDn** buttons can be used to zoom, and space bar to centre around the cursor. We can also rotate the view in 3d, using **'VIEW > Rotate ViewPoint'**

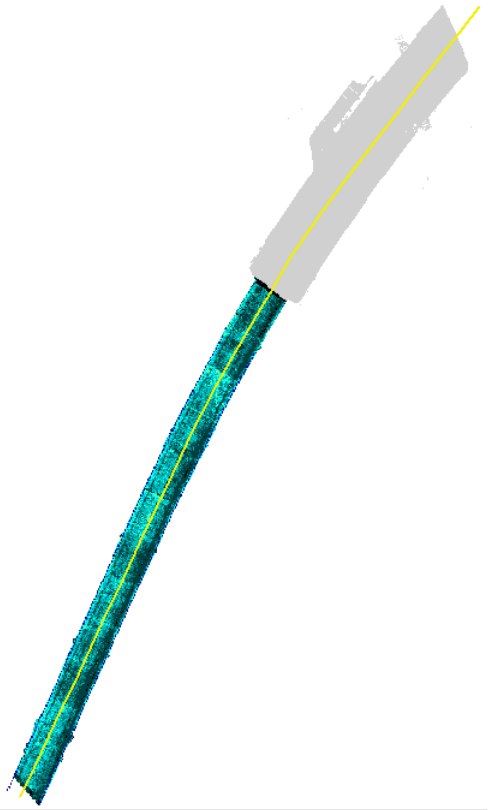


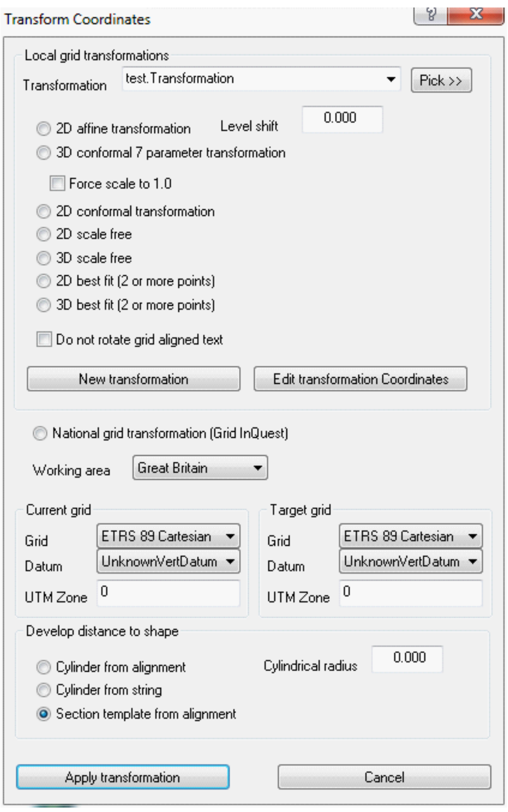
In order to unwrap the model, i.e. transform it such that x,y,z model coordinates become chainage (distance along a centreline), offset (lateral distance away from a centre line) and separation (perpendicular distance from a design surface), we need a design centreline, and one or more section templates. The centre line can be be imported from LandXML, DXF or Bentley MX, or manually created.

In this case we have a design centreline and templates which can be attached to our scanned model using '**FILE > Attach/Detach > Attach Alignment**' and picking CL with Template.Alignment. Details on how this alignment was created are given further on in this tutorial.

We can limit the area of the model being processed by right clicking to bring up the point cloud selection dialog, selecting 'All points in a polygon', followed by Isolate Points. Left click to pick points on the polygon, and right click to close the polygon and isolate an area of interest.

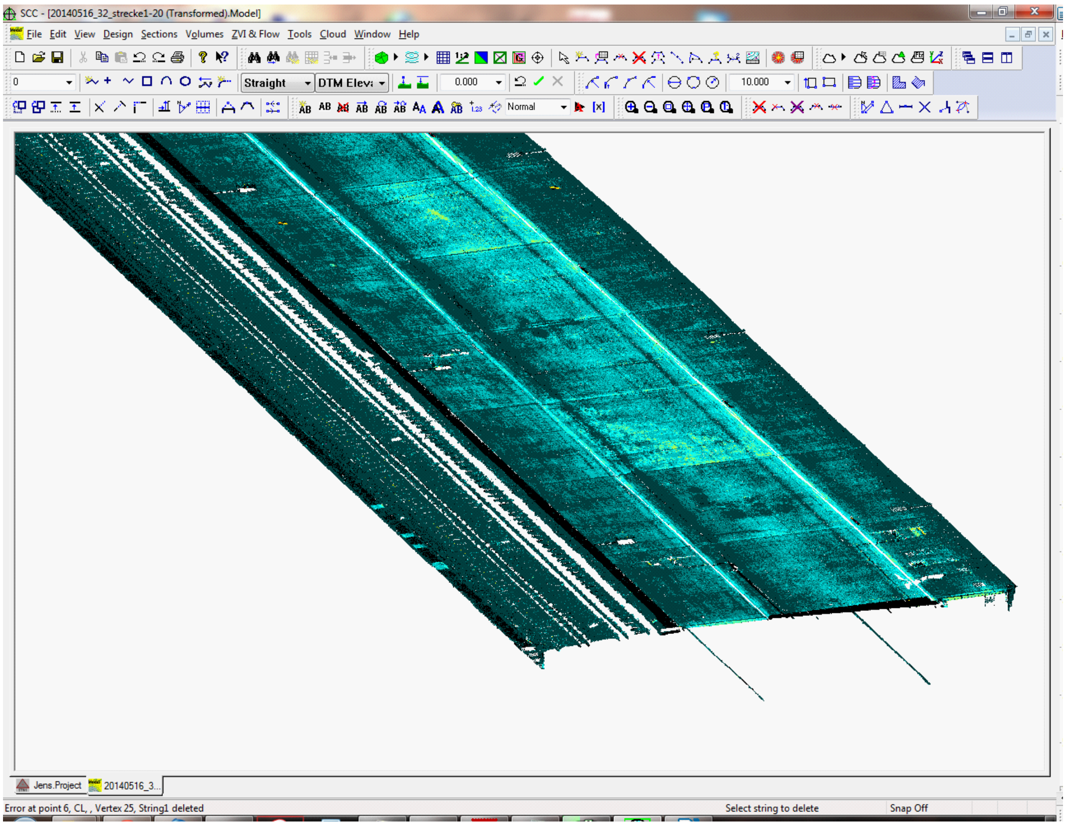
To unwrap the selected area, use '**TOOLS > Transform Coordinates**' with the following parameters. This is computation intensive operation that takes approx 4 minutes on this model, where the time taken is based on the total number of points being processed, to number points on the centreline, the number of section templates, and the number of points on each template.



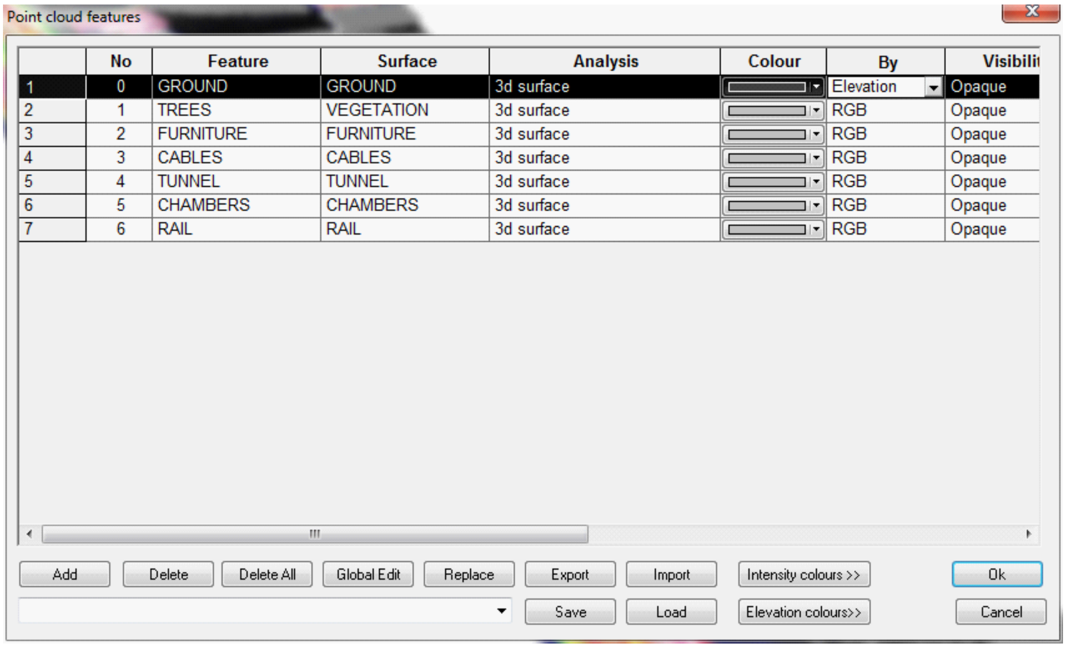


If we were working with a circular tunnel, we would not need a section template and could select either **Cylinder from Alignment or Cylinder from string along** with a design radius to create a model based on cylindrical separation rather than template separation.

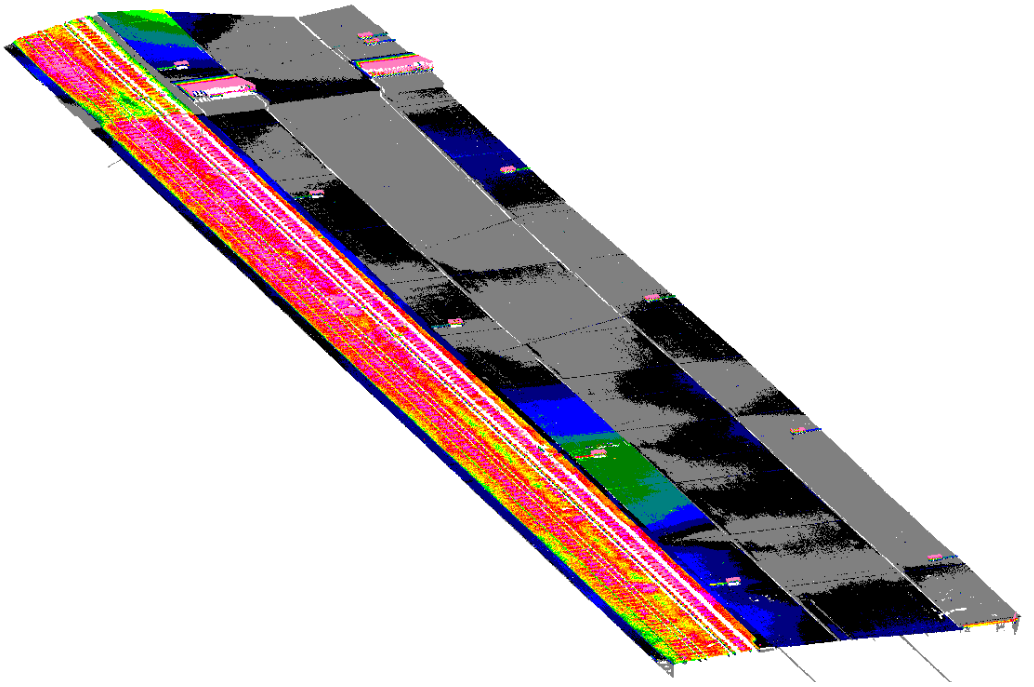
Rotating this model we can see the effect of the transformation more clearly.



To render out model based on separation distance, select 'CLOUD > Point Cloud' features, and change the By field to Elevation for the GROUND feature. Specific colours and ranges can be changed by pressing the Elevation Colours button.


Point cloud features

	No	Feature	Surface	Analysis	Colour	By	Visibili
1	0	GROUND	GROUND	3d surface		Elevation	Opaque
2	1	TREES	VEGETATION	3d surface		RGB	Opaque
3	2	FURNITURE	FURNITURE	3d surface		RGB	Opaque
4	3	CABLES	CABLES	3d surface		RGB	Opaque
5	4	TUNNEL	TUNNEL	3d surface		RGB	Opaque
6	5	CHAMBERS	CHAMBERS	3d surface		RGB	Opaque
7	6	RAIL	RAIL	3d surface		RGB	Opaque

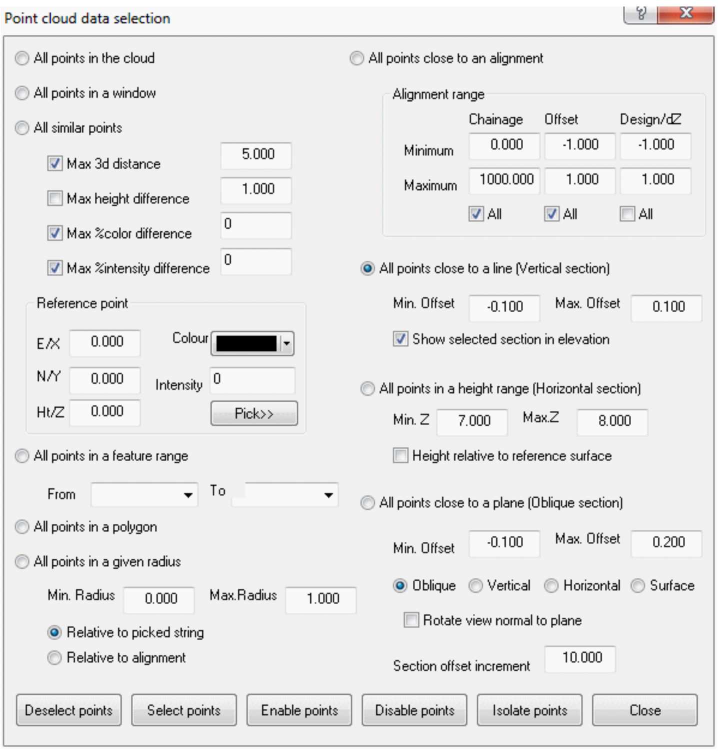


26.1 Creating A Centreline Template

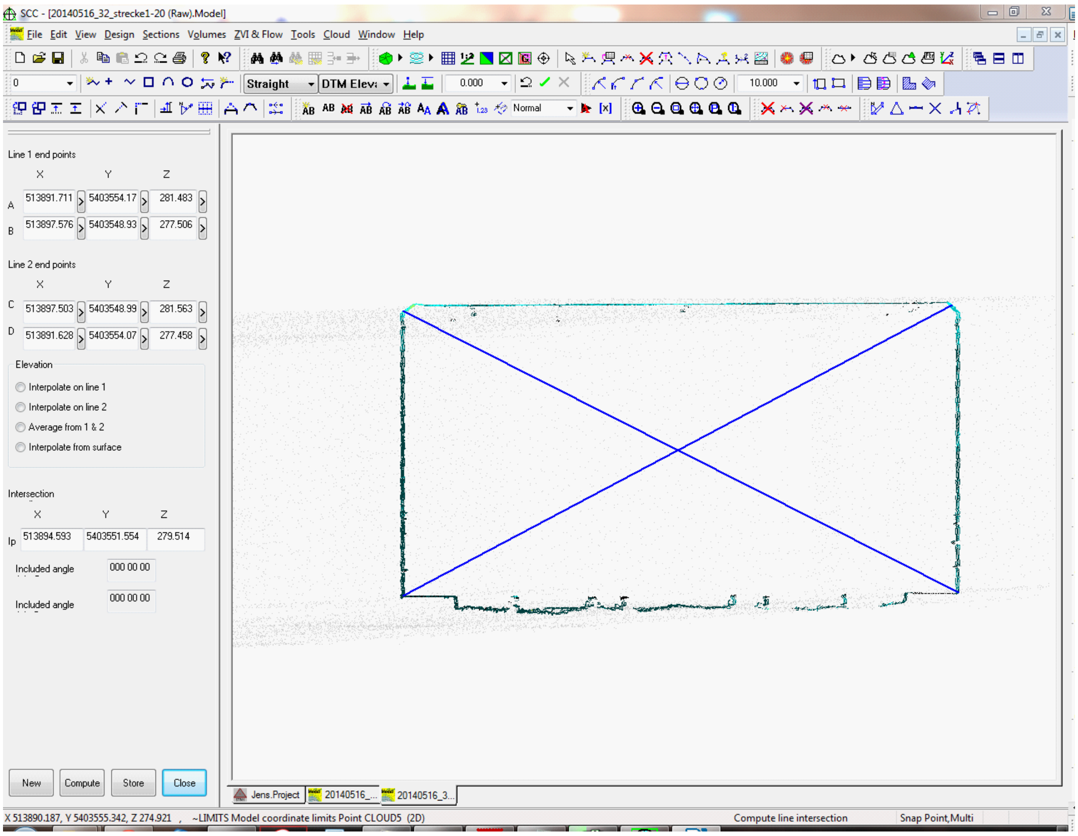
If we do not have a design centreline and template for our model we can create them as follows:

Right click to bring up the point cloud selection dialog. Select 'All points close to a line (Vertical section)' and press 'Isolate points'.

Click two points in plan to draw a line at right angles to the tunnel close to the start of the tunnel. This will show an isolated section of the start of the tunnel in elevation.



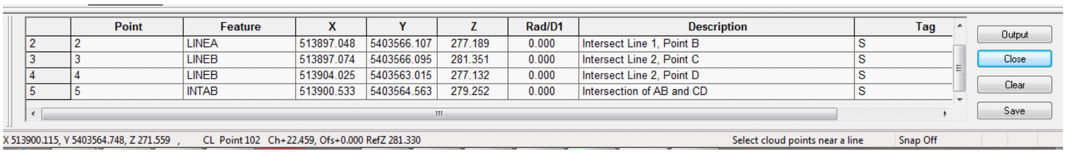
Select 'TOOLS > Measure > Intersect lines', and pick four points to create two intersecting diagonals at the edge of the tunnel.



Select Close, press P to move from elevation back to plan, and repeat the above steps to create additional centreline points.

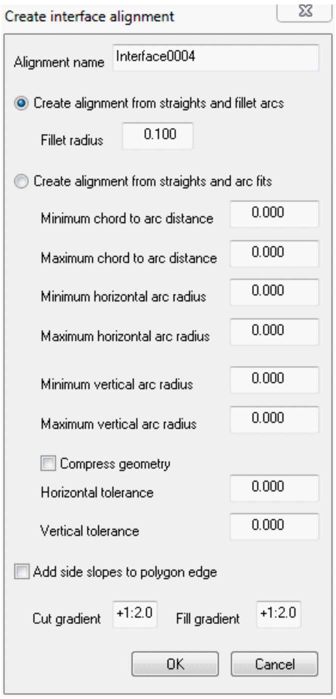
Select 'VIEW > Coordinate computations', to get a list off all generated intersection points.

Select 'EDIT > Add strings with cursor' to start creating a new string. For each intersection point, select it, and press Output to add it to the new string.

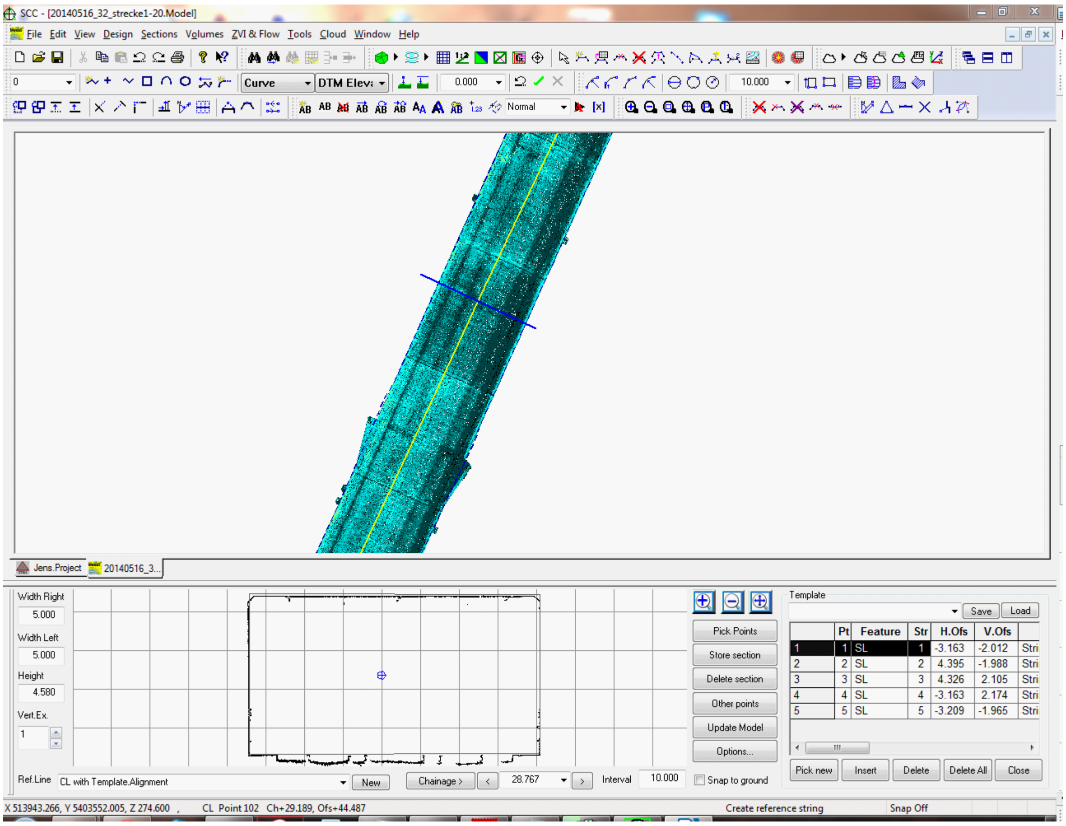


	Point	Feature	X	Y	Z	Rad/D1	Description	Tag
2	2	LINEA	513897.048	5403566.107	277.189	0.000	Intersect Line 1, Point B	S
3	3	LINEB	513897.074	5403566.095	281.351	0.000	Intersect Line 2, Point C	S
4	4	LINEB	513904.025	5403563.015	277.132	0.000	Intersect Line 2, Point D	S
5	5	INTAB	513900.533	5403564.563	279.252	0.000	Intersection of AB and CD	S

Right click the mouse, and select 'Save string as interface'.



Select 'CLOUD > Trace linear features > Manual', which will show the split screen view below



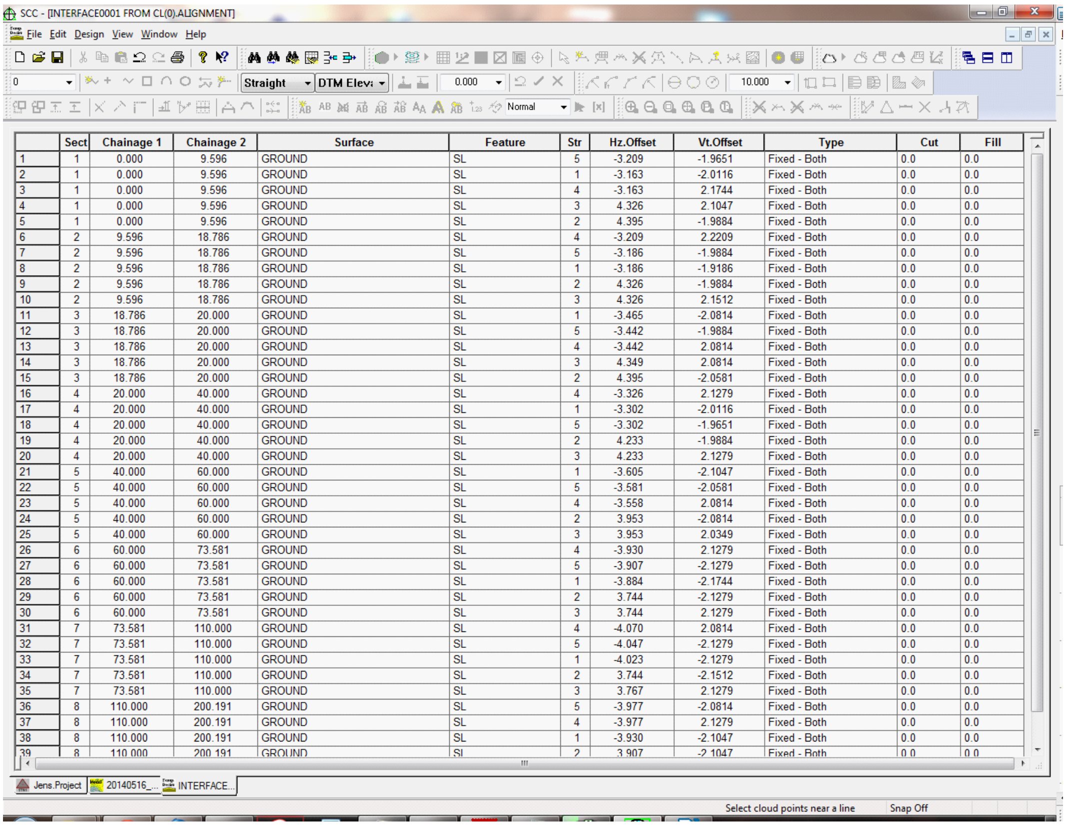
As we move the mouse in plan, we will see a section of scan at the current cursor position. In this case, we're tracing from the raw scan based on a 0.2m extract of points, which doesn't require any editing of the scan prior to using it. We've also selected to display a section for the current chainage 5m either side of the centre line. We can use the zoom in / out and extents keys to navigate the section, as well as changing the vertical exaggeration to allow for more accurate selection of levels, and dragging with the mouse wheel.

To start creating a design template, left click on points in section or plan, edit point details such as feature name and string number, and repeat for the number of template points required. In this case, we'll pick five points representing the tunnel walls where the last point is the same as the first. If we know exact horizontal and vertical offsets to the design centreline we can enter them here.

To create section templates at specific chainages, select Pick Points, and select the highlighted point in plan or section for each point on the template. This allows us to vary the template by chainage, to accommodate changes in width of the tunnel and possible inaccuracies in the centreline.

Once enough sections have been entered, you can investigate the behaviour of the interpolated strings between chainages, by pressing the Chainage button. As you move the mouse around screen in plan, you will see the interpolated section along with the scanned points in the section view. Pressing the left mouse button locks the chainage and lets you enter an additional section where required.

Selecting 'DESIGN > View Design sheet > Section template points' shows us the points created.

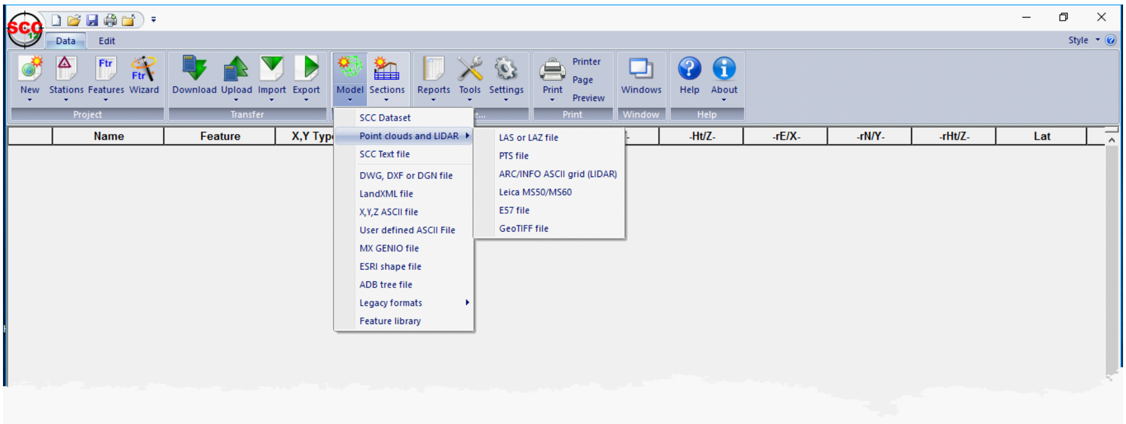


	Sect	Chainage 1	Chainage 2	Surface	Feature	Str	Hz.Offset	Vt.Offset	Type	Cut	Fill
1	1	0.000	9.596	GROUND	SL	5	-3.209	-1.9651	Fixed - Both	0.0	0.0
2	1	0.000	9.596	GROUND	SL	1	-3.163	-2.0116	Fixed - Both	0.0	0.0
3	1	0.000	9.596	GROUND	SL	4	-3.163	2.1744	Fixed - Both	0.0	0.0
4	1	0.000	9.596	GROUND	SL	3	4.326	2.1047	Fixed - Both	0.0	0.0
5	1	0.000	9.596	GROUND	SL	2	4.395	-1.9884	Fixed - Both	0.0	0.0
6	2	9.596	18.786	GROUND	SL	4	-3.209	2.2209	Fixed - Both	0.0	0.0
7	2	9.596	18.786	GROUND	SL	5	-3.186	-1.9884	Fixed - Both	0.0	0.0
8	2	9.596	18.786	GROUND	SL	1	-3.186	-1.9186	Fixed - Both	0.0	0.0
9	2	9.596	18.786	GROUND	SL	2	4.326	-1.9884	Fixed - Both	0.0	0.0
10	2	9.596	18.786	GROUND	SL	3	4.326	2.1512	Fixed - Both	0.0	0.0
11	3	18.786	20.000	GROUND	SL	1	-3.465	-2.0814	Fixed - Both	0.0	0.0
12	3	18.786	20.000	GROUND	SL	5	-3.442	-1.9884	Fixed - Both	0.0	0.0
13	3	18.786	20.000	GROUND	SL	4	-3.442	2.0814	Fixed - Both	0.0	0.0
14	3	18.786	20.000	GROUND	SL	3	4.349	2.0814	Fixed - Both	0.0	0.0
15	3	18.786	20.000	GROUND	SL	2	4.395	-2.0581	Fixed - Both	0.0	0.0
16	4	20.000	40.000	GROUND	SL	4	-3.326	2.1279	Fixed - Both	0.0	0.0
17	4	20.000	40.000	GROUND	SL	1	-3.302	-2.0116	Fixed - Both	0.0	0.0
18	4	20.000	40.000	GROUND	SL	5	-3.302	-1.9651	Fixed - Both	0.0	0.0
19	4	20.000	40.000	GROUND	SL	2	4.233	-1.9884	Fixed - Both	0.0	0.0
20	4	20.000	40.000	GROUND	SL	3	4.233	2.1279	Fixed - Both	0.0	0.0
21	5	40.000	60.000	GROUND	SL	1	-3.605	-2.1047	Fixed - Both	0.0	0.0
22	5	40.000	60.000	GROUND	SL	5	-3.581	-2.0581	Fixed - Both	0.0	0.0
23	5	40.000	60.000	GROUND	SL	4	-3.558	2.0814	Fixed - Both	0.0	0.0
24	5	40.000	60.000	GROUND	SL	2	3.953	-2.0814	Fixed - Both	0.0	0.0
25	5	40.000	60.000	GROUND	SL	3	3.953	2.0349	Fixed - Both	0.0	0.0
26	6	60.000	73.581	GROUND	SL	4	-3.930	2.1279	Fixed - Both	0.0	0.0
27	6	60.000	73.581	GROUND	SL	5	-3.907	-2.1279	Fixed - Both	0.0	0.0
28	6	60.000	73.581	GROUND	SL	1	-3.884	-2.1744	Fixed - Both	0.0	0.0
29	6	60.000	73.581	GROUND	SL	2	3.744	-2.1279	Fixed - Both	0.0	0.0
30	6	60.000	73.581	GROUND	SL	3	3.744	2.1279	Fixed - Both	0.0	0.0
31	7	73.581	110.000	GROUND	SL	4	-4.070	2.0814	Fixed - Both	0.0	0.0
32	7	73.581	110.000	GROUND	SL	5	-4.047	-2.1279	Fixed - Both	0.0	0.0
33	7	73.581	110.000	GROUND	SL	1	-4.023	-2.1279	Fixed - Both	0.0	0.0
34	7	73.581	110.000	GROUND	SL	2	3.744	-2.1512	Fixed - Both	0.0	0.0
35	7	73.581	110.000	GROUND	SL	3	3.767	2.1279	Fixed - Both	0.0	0.0
36	8	110.000	200.191	GROUND	SL	5	-3.977	-2.0814	Fixed - Both	0.0	0.0
37	8	110.000	200.191	GROUND	SL	4	-3.977	2.1279	Fixed - Both	0.0	0.0
38	8	110.000	200.191	GROUND	SL	1	-3.930	-2.1047	Fixed - Both	0.0	0.0
39	8	110.000	200.191	GROUND	SL	2	3.907	-2.1047	Fixed - Both	0.0	0.0

SCC uses linear interpolation between sections templates to calculate horizontal and vertical offsets for arbitrary chainages. We can save our design for re-use simply by selecting 'FILE > Save As' from this view.

27 Importing Point Cloud Data

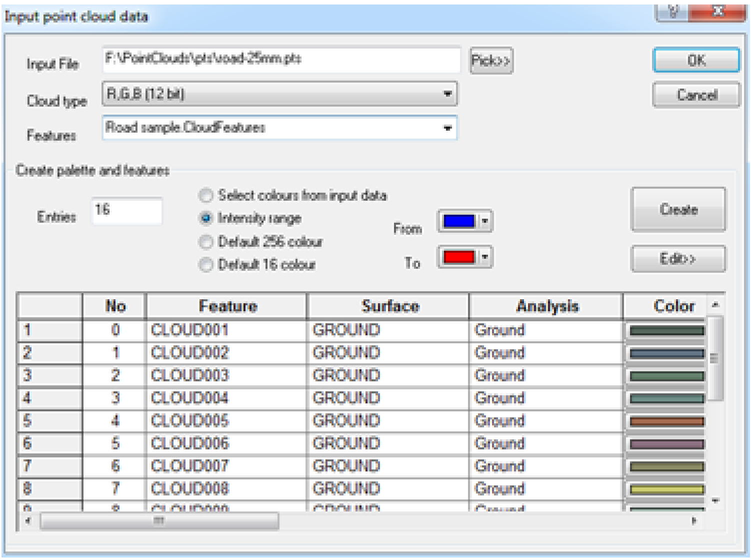
To create a new point cloud model you need data in either PTS, LAS, LAZ, or ESRI ASC format.



Importing PTS file

To start, select 'Model Tab > Point clouds and LIDAR > LAS or LAZ file' and pick the appropriate input format.

Pick 'road-25mm.pts' from Tutorials directory. This will show the following screen;



Colour Usage

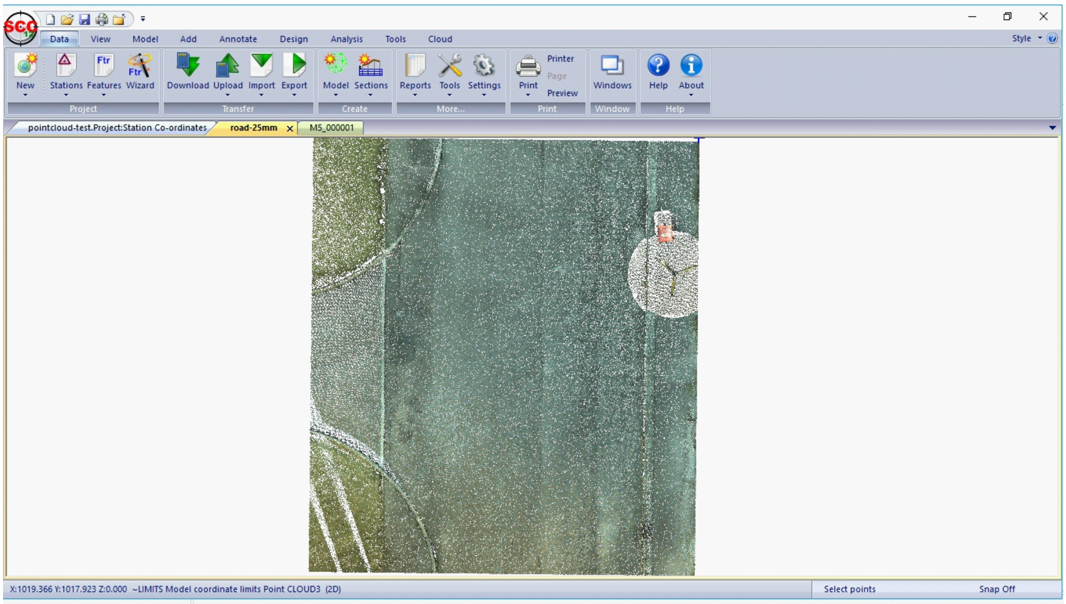
The colour usage option controls how much space is used per point, where RGB12 allows about 100 million points on a system with 1GB available memory. Palette colouring is slower to import data, but more efficient at the loss of some colour resolution.

Create Palette

Selecting the Create palette option builds a palette and cloud feature library, based on paramers selected. This can be an optimized palette from the cloud RGB data, a colour range corresponding to intensities, or the standard AutoCAD 256 colour or VGA 16 colour palettes.

Edit>>

Pressing the Edit button allows the user to make further edits to the point cloud feature library, and save it for re-use on other point clouds.

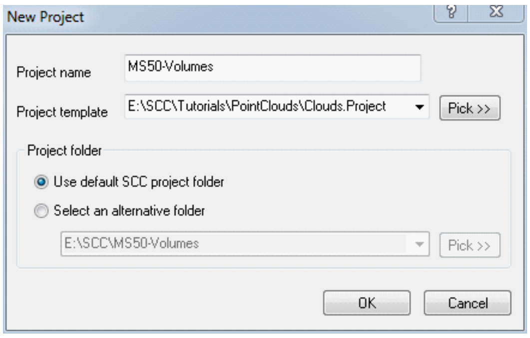


28 Cutting Sections From MS50 Data

This tutorial examines the use of the SCC survey, point cloud and sections modules to model scanned using the Leica MS50, and cut sections from it.

28.1 Create New Project

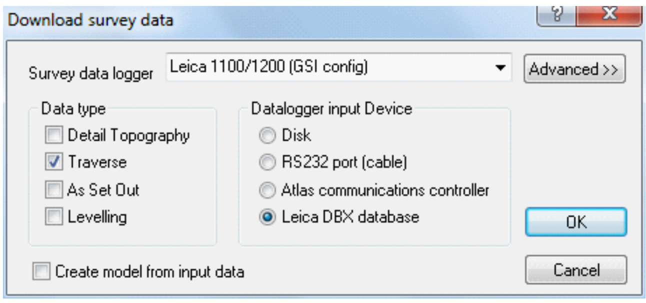
'FILE > New Project' as shown below:



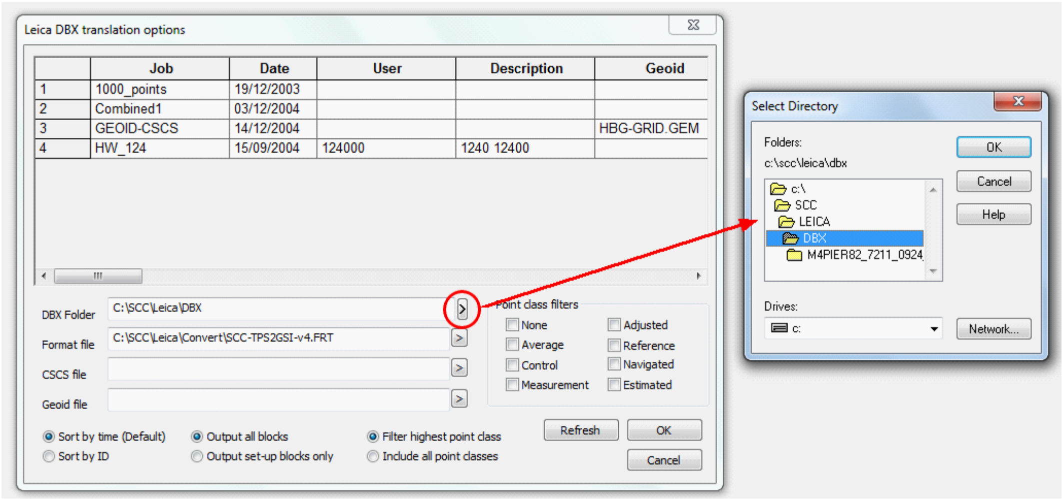
28.2 Downloading Control Data

'FILE > Download Survey'

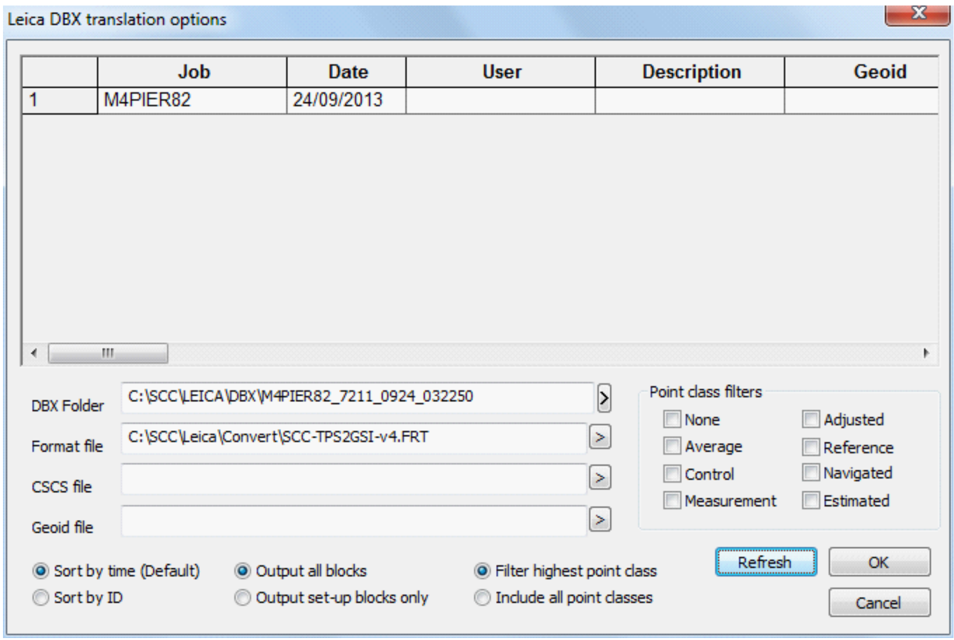
Pick the Leica 1100/1200 logger and DBX as the input device.



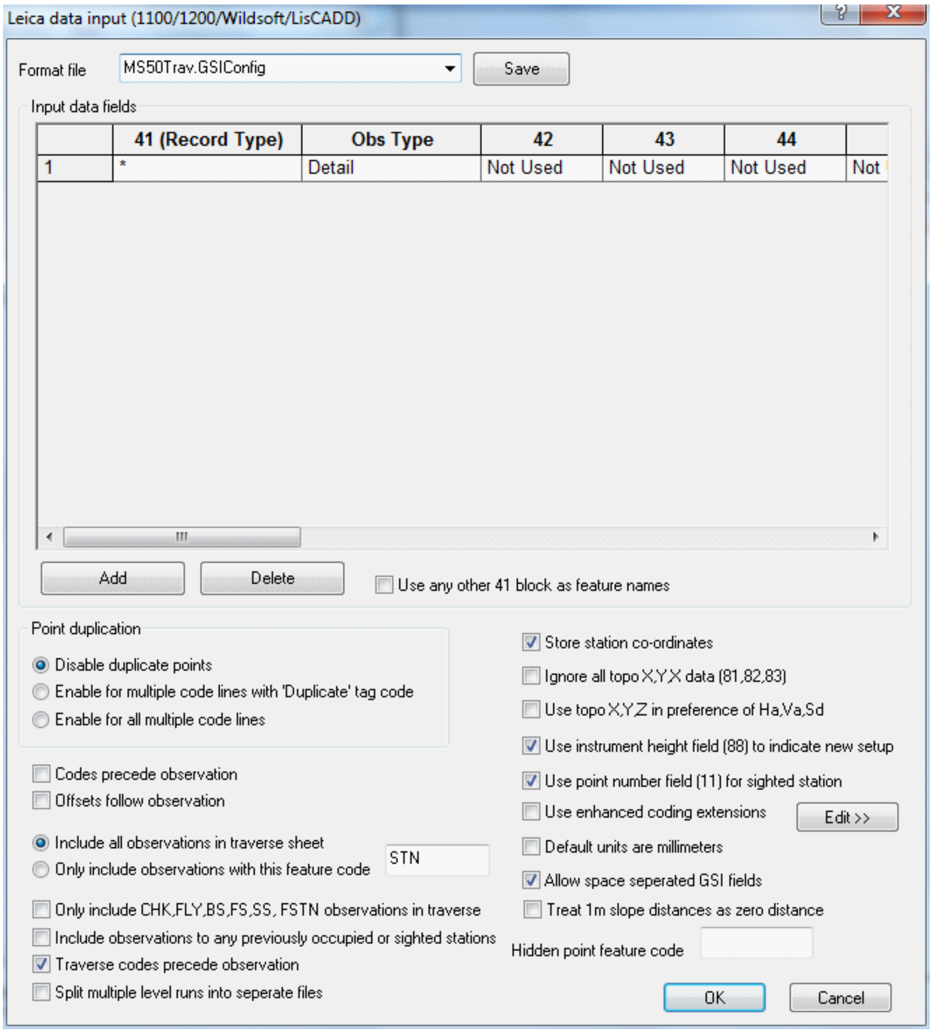
When the DBX translation dialog is shown change the DBX folder to point to the location in which the MS50 scan data is stored and press 'Refresh' to update the dialog.



Select 'SCC-TPS2GSI-v4.frt' as the format file, click on the job file name and press 'OK'



Select 'MS50Trav.GSICONFIG' in the Leica data input dialog and press 'OK' to download and import the survey data into SCC.



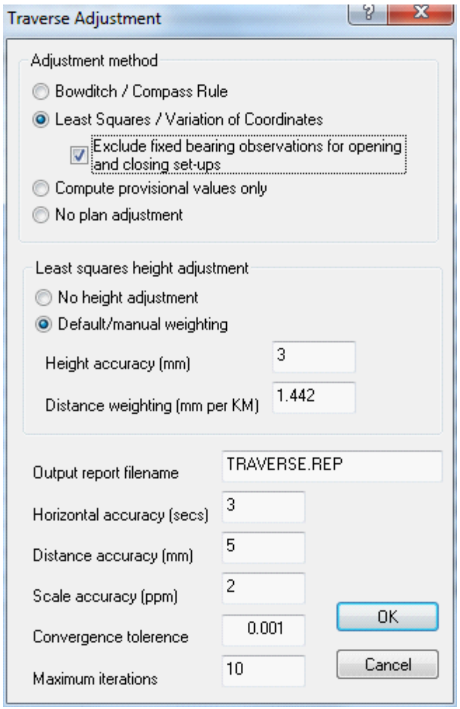
This will download control observations into the traverse spreadsheet, and any known entered station coordinates into the project station coordinates sheet.

28.3 Processing Traverse

Switch to the station coordinates sheet, and change the type of any known coordinates to either 'Fixed' or 'Constrained 'in both XY and Z, and edit any changes to position or elevation as required.

Switch back to the traverse observation view, and select 'EDIT > Adjust'.

If initial occupied stations are unknown (i.e. computed by resection or free station) make sure the option to exclude fixed bearings for opening and closing set-ups is ticked, as the opening orientation will not be known. Instrument accuracies for height, angle and distance should be entered based in the stated accuracy of the instrument in use, number of rounds of measurement taken, and anticipated standard errors.



Check the traverse report to ensure that the errors reported and station positions and heights are all within an acceptable tolerance. Specific attention should be paid to chi-squared pass/fail results, error ellipses and height errors, and observation residuals. Where scanning is being carried out at the same time as control measurement, the absolute accuracy of any scanned point will be based around the station accuracy and standard error of the scanner EDM.

If the adjustment results are acceptable, update the project station values.

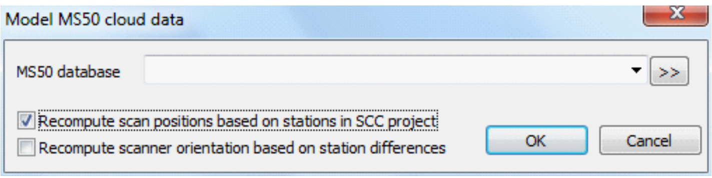
28.4 Reprocessing Scan Data Based On New Station Values

To reprocess the scan data based on the updated station values, select 'FILE > Model > Point Clouds & LIDAR > Leica MS50'.

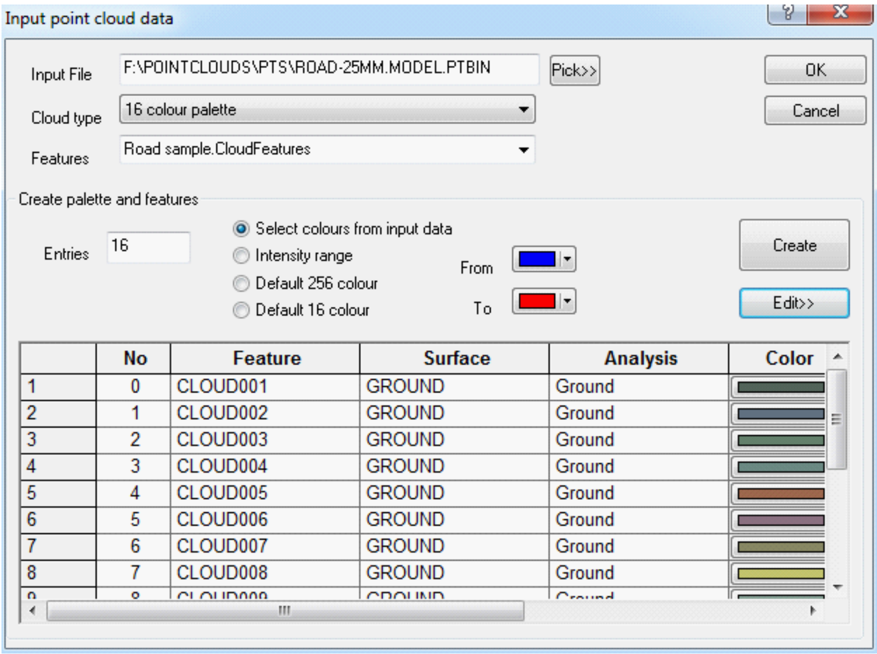
Pick the scanned project file

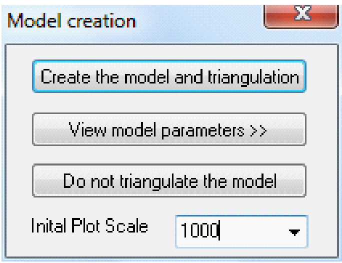
Pick 'Recompute scan positions based on stations in SCC project'

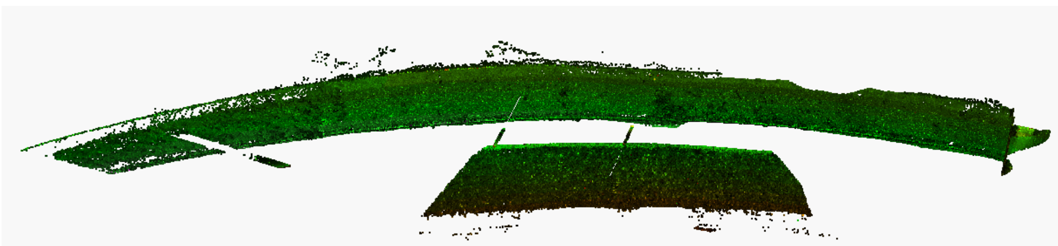
Note that 'only recompute scanner orientation' is selected when moving between grid systems, as any transformation residuals are liable to reduce rather than improve overall accuracy.



Press 'OK' on the point cloud, and create the model.







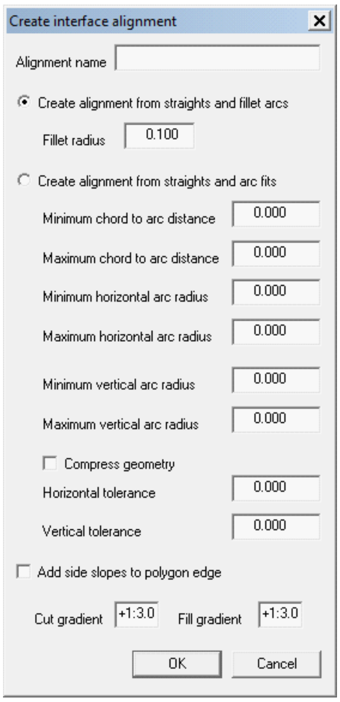
28.5 Creating Cross Sections For Comparison

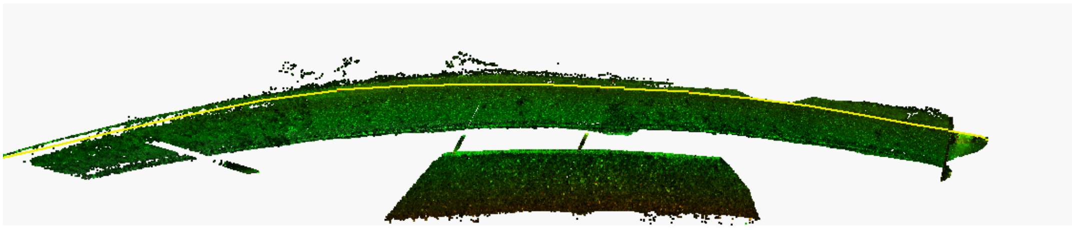
To create cross sections for a comparison, an alignment centre line is needed. This can be imported from DXF/DWG, LandXML, or GENIO as requied. In this case, a centre line manually is manually drawn.

Press the curve button on the tool bar and left click on all three or more points representing your centre line.

Press the right mouse button to bring up a pop-up menu.

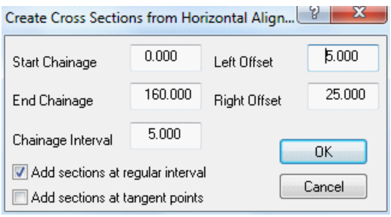
Select 'Save string as interface' and enter new alignment name

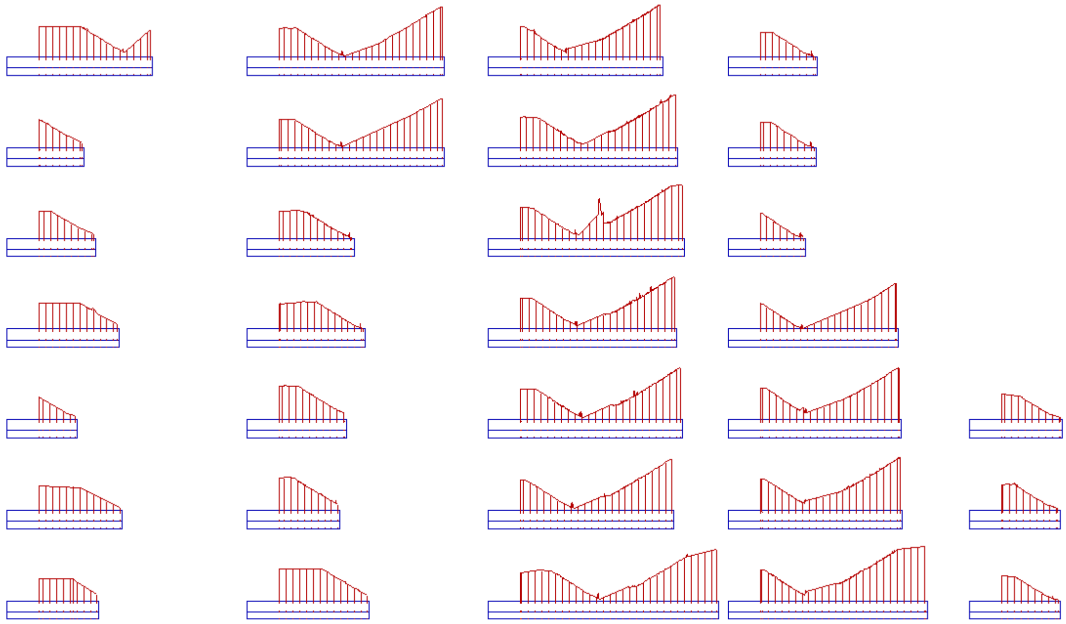




A chainage, offset and centre line height for the tunnel is drawn as a yellow line in the model. As the mouse is moved around the screen, a chainage and offset is reported in the status bar in addition to X,Y,Z.

To cut some cross sections, select 'SECTIONS > Cross sections from an alignment' using the values given.

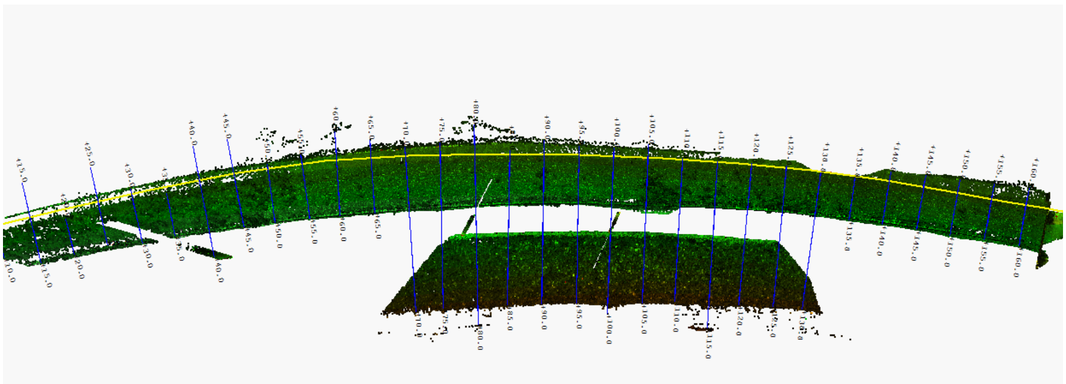




Save sections, 'FILE > Save As'

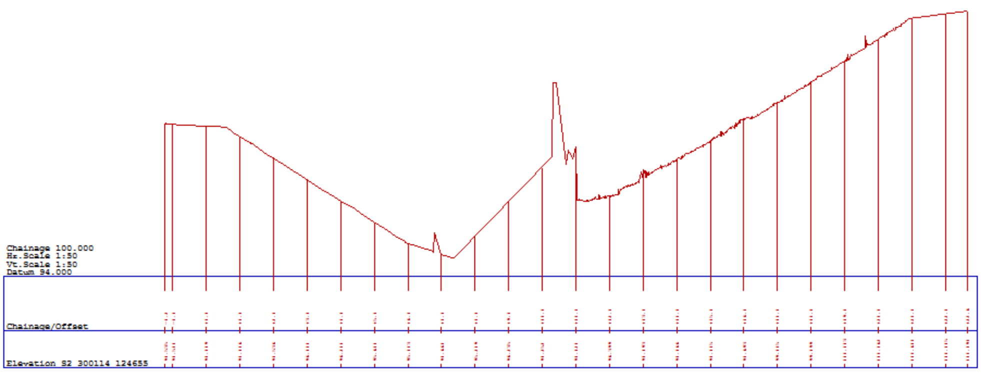
Sections can be displayed in plan:

'FILE > Attach/Detach > Attach sections'



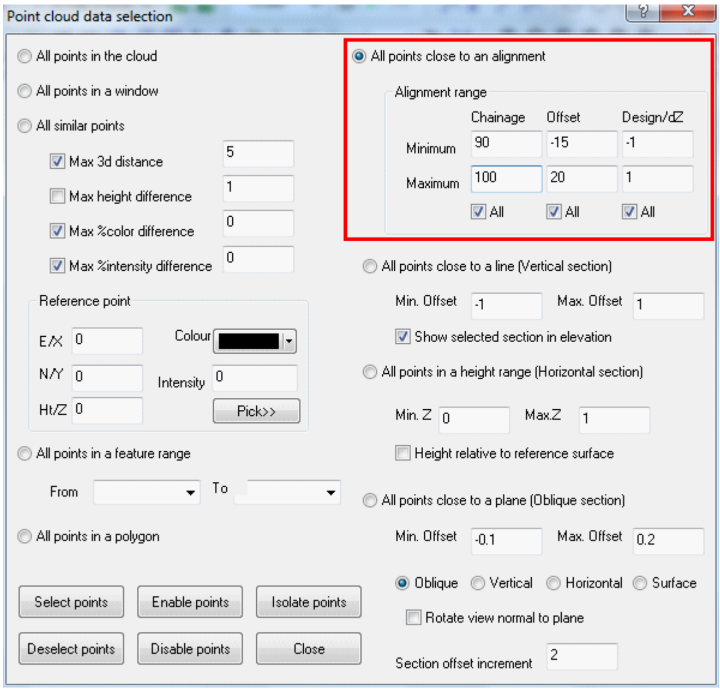
28.6 Editing Scan Data Using Sections

In the event of the sections containing unwanted data, such as structures, overhead lines, noise from vegetation, etc. the scan can be edited as required and the sections re-cut. For example, at chainage 100 there is an obvious spike as shown below;

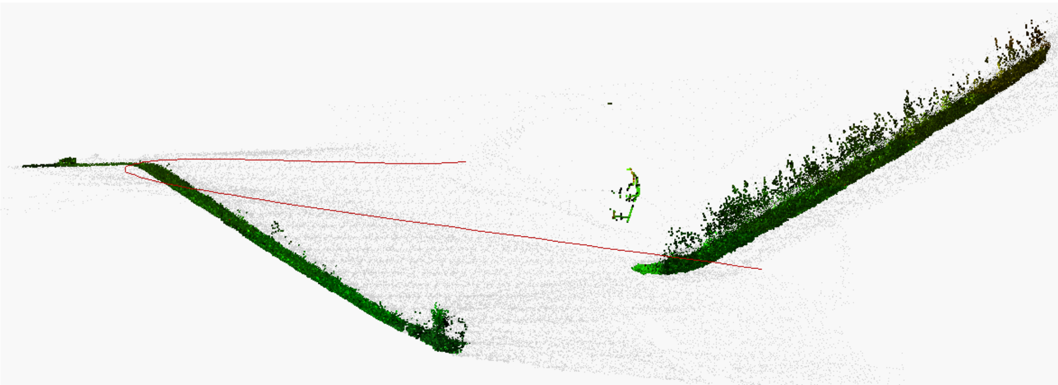


To edit sections, select 'FILE > Attach/Detach > Edit detach', pick section file.

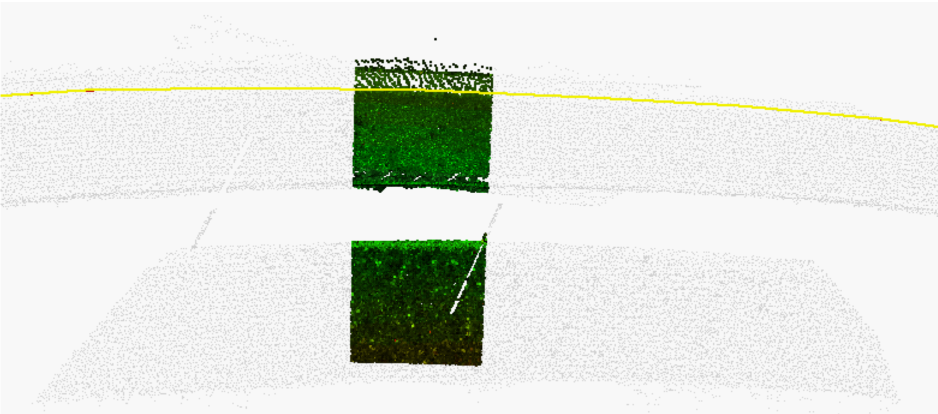
Right click to bring up the cloud selection dialog, and isolate all points in the chainage 90-110 range as shown.



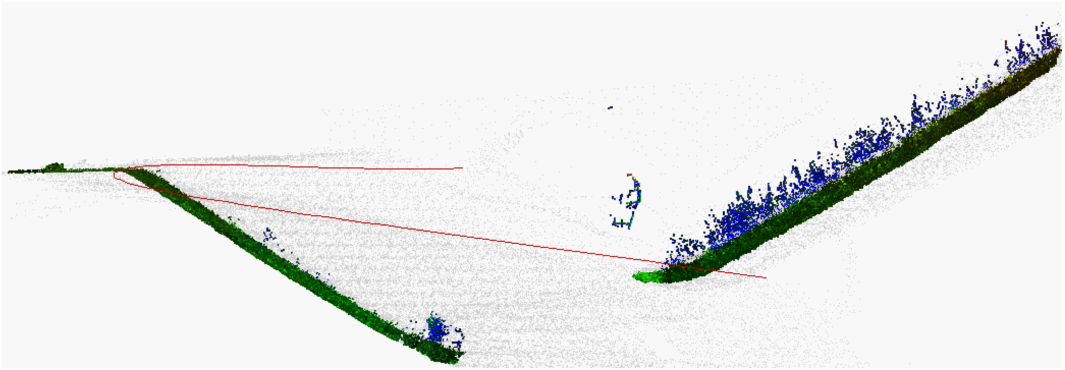
This highlights the area of the scan in elevation as shown.



Press 'P' or 'E' to move between plan and elevation, and use the up and down arrows to move between chainages for the area isolated.



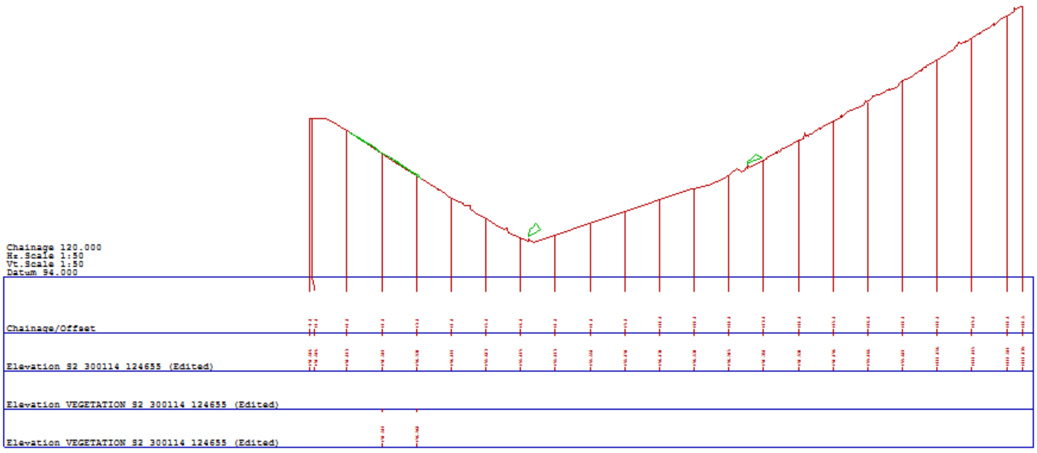
Move back to elevation view, press right click to bring up the 'Data Selection Dialog', tick 'All points in a polygon' and press 'Select points'. Use the left click button on mouse to draw a polygon around the area of the scan to exclude from the sections as shown, and right click to close the polygon.

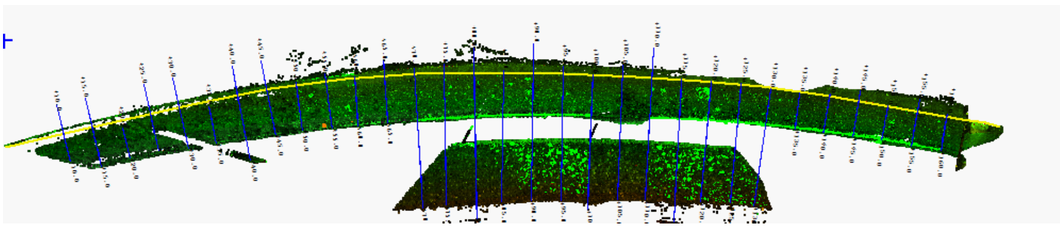


Select 'CLOUD > Edit selected points', and change the feature of the selected points to NOISE, TREES, etc. as appropriate.

Repeat this process throughout the model, and re-cut the sections.

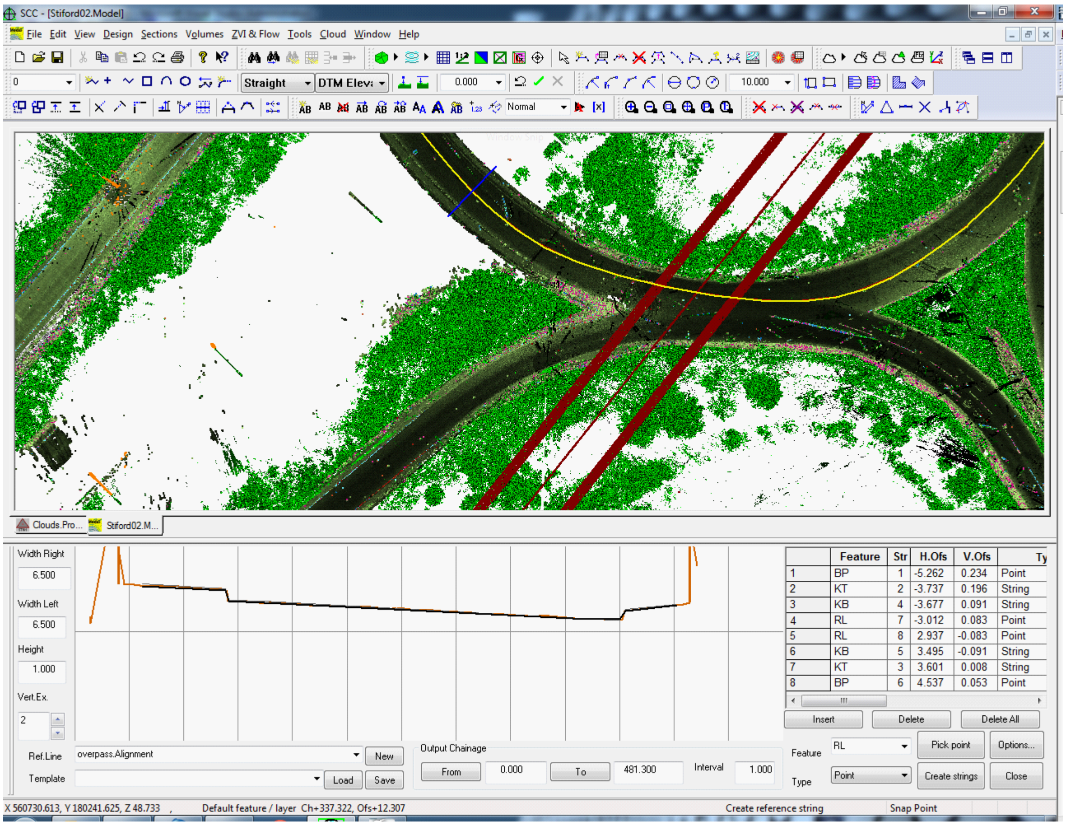
A tidier surface line is achieved with any additional features outlined in 3d.





29 Tracing Linear Features On A Point Cloud

The option '**CLOUD tab > Trace drop down > Trace Linear Features**' allows the user to trace linear features contained in a point cloud by matching points on a section template to points in the cloud at regular chainages along an alignment. This is done in a split screen view, with the template details shown below the model, updated in real time as the template is developed.

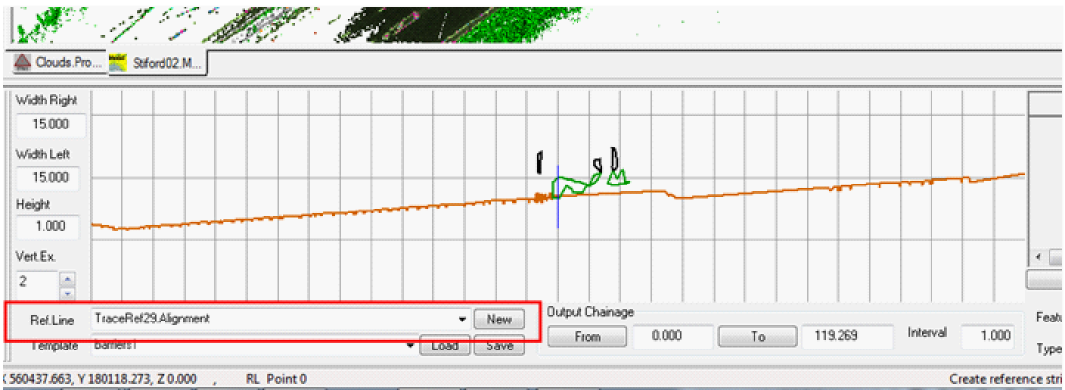


The stages involved are as follows;

29.1 Select Or Create A Reference Alignment

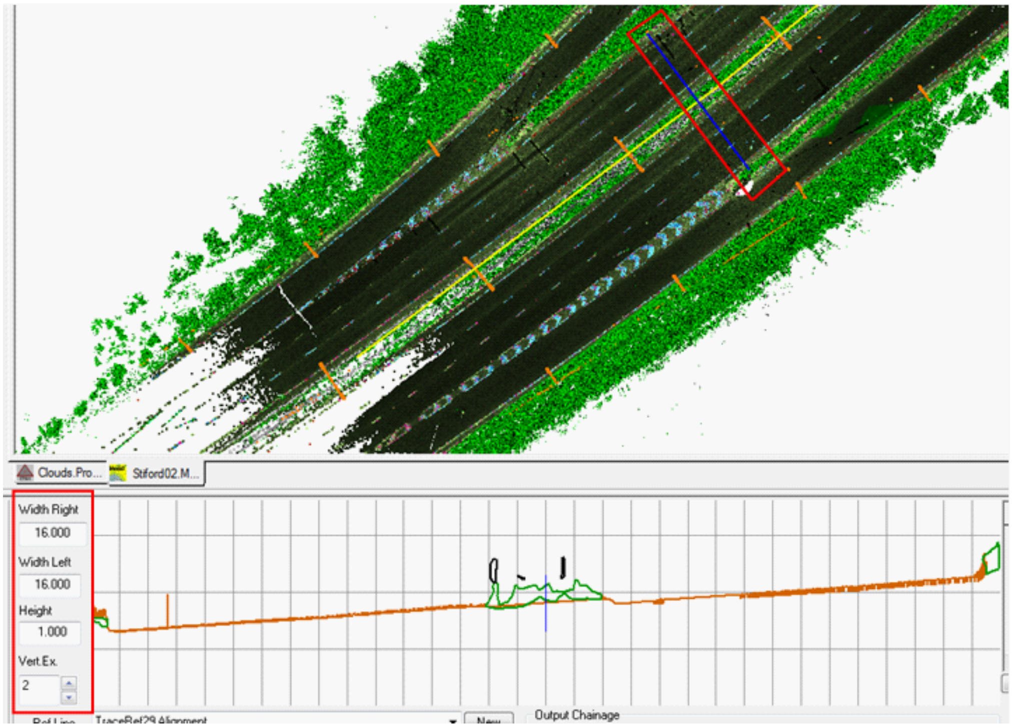
This is a design line running roughly parallel to the features you want to extract. If you already have a suitable alignment attached, you can pick it using the Ref Line drop down. You can also interactively draw a new alignment as follows;

- Select an active tag code of Curve or Straight as require.
- Zoom into the area of interest in the model.
- Press New to create a new reference string.
- Left click on two or more points on the desired reference string.
- Right click to finish creating the reference string and start creating the template.
- The reference line will be saved such that it can be re-used later as required.



29.2 Enter Template Size & Parameters

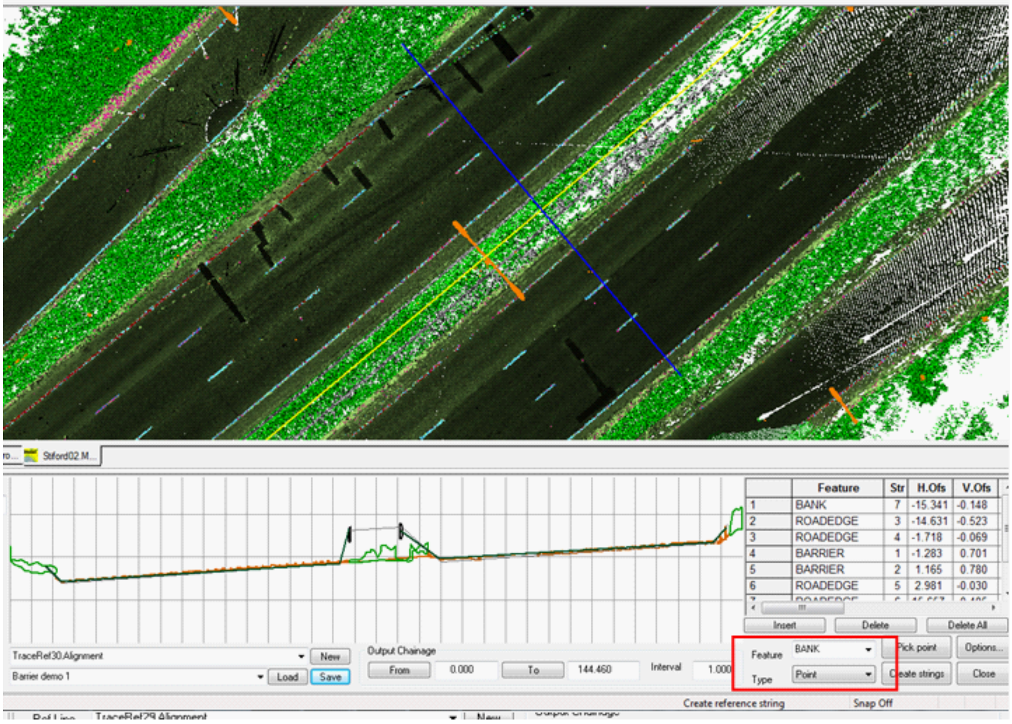
Before creating our template we need to enter its width and height in reference to the centre line. We can also enter a vertical exaggeration to make it easir to find features such as kerbs.



Having entered width, height, and vertical exaggeration, as we move the mouse along the alignment in plan, we see a section cut through the cloud at the chainage corresponding to the mouse position. Pressing the left mouse button will lock the chainage to the current position, in order to allow us to create template points, pressing the right button unlocks the chainage to examine sections at other chainages. It is important that the widths specified are large enough to encompass the features being sought at all required chainages.

29.3 Creating Points On The Template

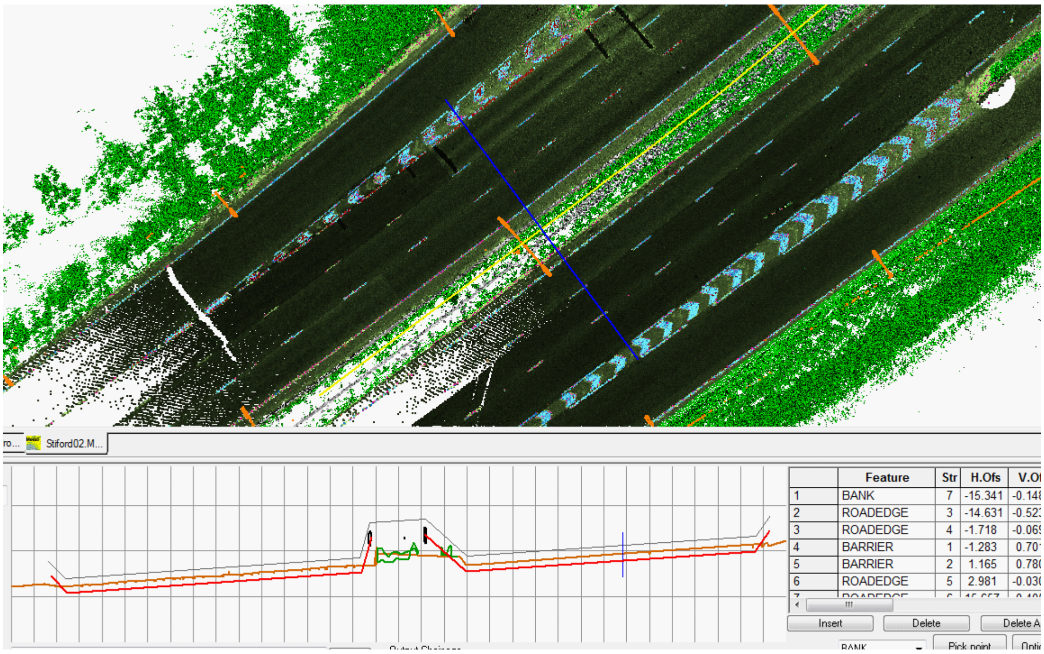
Once we have locked the section at a given chainage position, we can add points to the template either by left clicking on the section or the plan. This has the effect of adding points to the section template overlaying the cut section, and showing the details of those points in the accompanying spreadsheet to the right of the section drawing.



Newly created points are given a feature name and type based on values entered. The types are as follows;

- String – A string line will be output to the model based on this section template point. For any given chainage, a point in the cloud corresponding to this point on the template must be found for the template to valid.
- Point – A point will be output at each chainage to the model based on this section template point. As per the string, this point is required for the template to be valid.
- Reference – Nothing is output to the model, but a point corresponding to this point is required for the template to be valid.
- String (Opt) – A string line will be output to the model based on this section template point, but it is not required for the template to be valid.
- Point (Opt) – A point will be output to the model based on this section template point, but it is not required for the template to be valid.

Once the template points have been entered, right clicking the mouse allows us to unlock the chainage and test how well the template matches the points in the cloud at differing positions along the alignment.

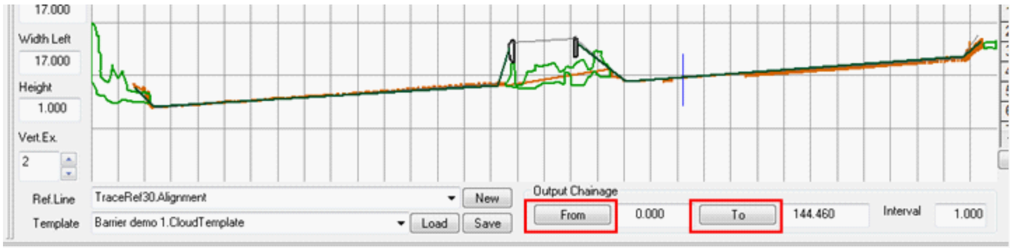


If the template is not valid at the current chainage, it is drawn in bright red. For example, in the case above the left and right road edges don't exist so a match to the template is not found. If those template points were optional, i.e. They had a type of String (Opt), the section would still be valid.

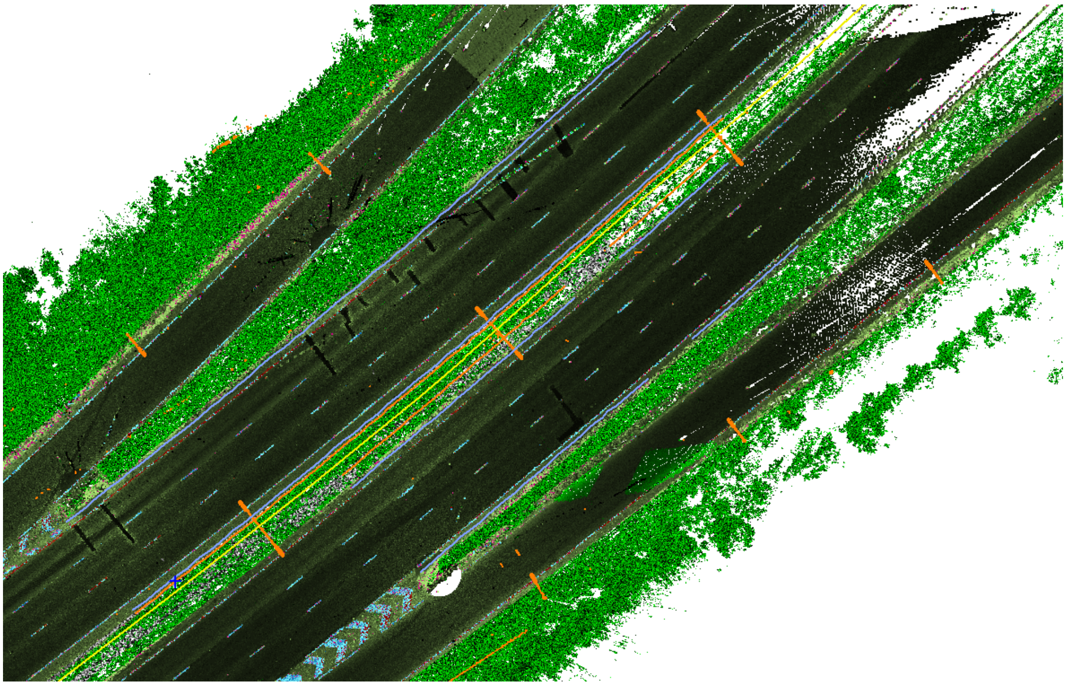
We can also save our template to file once created, such that it can be re-used elsewhere in this point cloud and future point clouds, simple by entering a template name and pressing Save.

29.4 Creating Strings

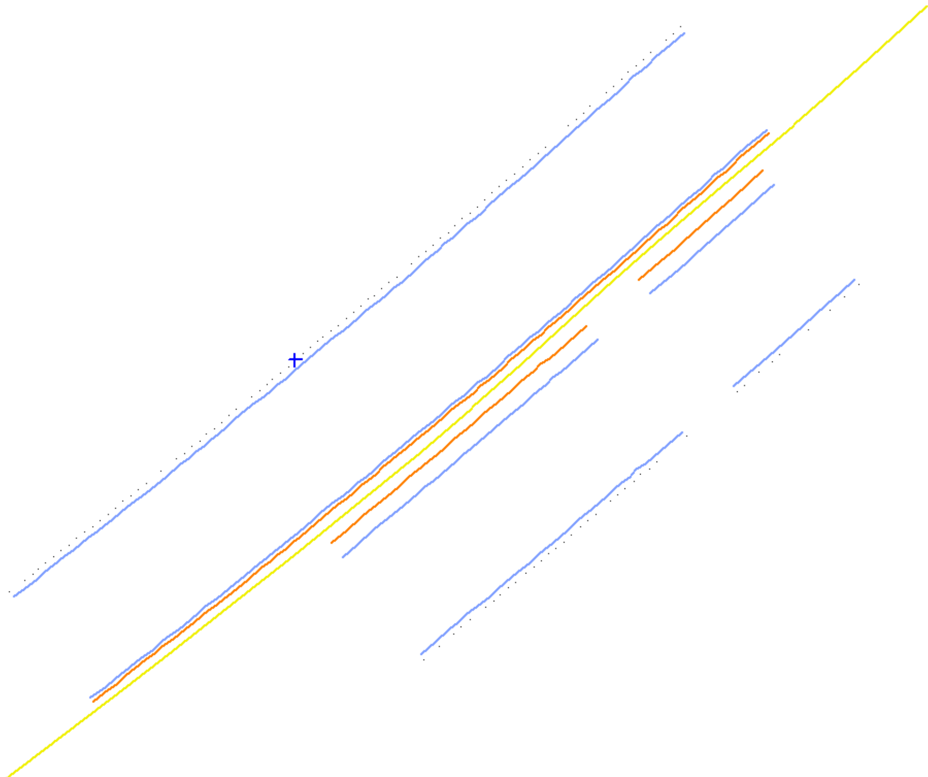
Once we have created our template, we can generate our model by entering a chainage range and interval, and pressing **Create strings**. To pick a **From** or **To** chainage simply lock the section at the desired chainage by pressing the left mouse button and then clicking on the required From or To chainage button.



Created strings seen here with the cloud turned on

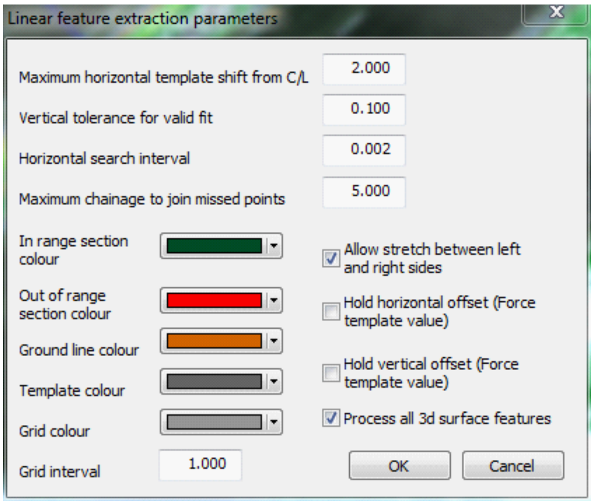


And below with the cloud turned off. Note the gaps in the strings at certain positions where an acceptable match to the template could not be found. This will typically be due to an interference factor, such as a car on the road obscuring the required point, or a required template point not existing on the ground at a given chainage.



29.5 Linear Feature Extraction Parameters

Pressing the options button from the linear feature extraction dialog brings up an additional parameters dialog that allows us to fine tune how the extraction process works. These parameters are as follows;



Maximum horizontal template shift from C/L

This controls how far the entire template can be shifted from the design centre line and still remain valid. Larger values enable the same template to be used over a wider range of conditions, but can also introduce incorrect data into the output.

Vertical tolerance for valid fit

This value, typically a few centimetres, is how close the relative height difference between points on the ground and points on the template must be to be considered valid.

Horizontal search interval

This value, typically a few millimetres, is the search interval used when matching template sections to cloud sections. The smaller the value, the better the probability of finding a fit, and the improved accuracy of the fit, at a cost of processing speed.

Maximum chainage to join missed points

When the template does not match the ground at a given chainage no points are output. Where the chainage distance between successive points on the same string fall above this value, a gap is introduced into the string.

Allow stretch between left and right sides

This switch allows the left and right points on the template to be treated as separate templates. This allows horizontal and vertical shift between left and right hand sides, while still holding the template valid. It also allows strings on one side of the template to be valid, even if the other side is not valid.

Hold horizontal offset (Force template value)

This forces the horizontal section template position to be held for all chainages

Hold vertical offset (Force template value)

This forces the height difference between section template points to be held for all chainages. The default is that the output height is based on the cloud values where other tolerances are met.

Process all 3d surface features

This controls whether analysis is limited to cloud points on the primary ground feature, or whether all 3d feartures are analysed as in the example above. Analysing all features is significantly slower than limiting the analysis to ground features.

Grid colour

The colour of grid lines in the section display

Ground line colour

The colour of the interpolated ground line at the current chainage in the section display. Note that other 3d features take their colours from their point cloud feature library entries.

In range section colour

The colour used to draw the template as fitted to the ground at the current chainage, when the fit produces valid output based on the tolerances given.

Out of range section colour

The colour used to draw the template as fitted to the ground at the current chainage, when the fit does not produce valid output based on the tolerances given. The details drawn are based on the best fit found.

Template colour

The template line, not fitted to the ground, as it was originally entered

Grid interval

The horizontal and vertical grid interval on the section.

30 PTS Point Cloud Data

PTS data can be reduce, processed and compared within SCC. Additional options are also available to extract linear features such as kerb lines from the data.

30.1 Extracting Linear Features From PTS Point Clouds

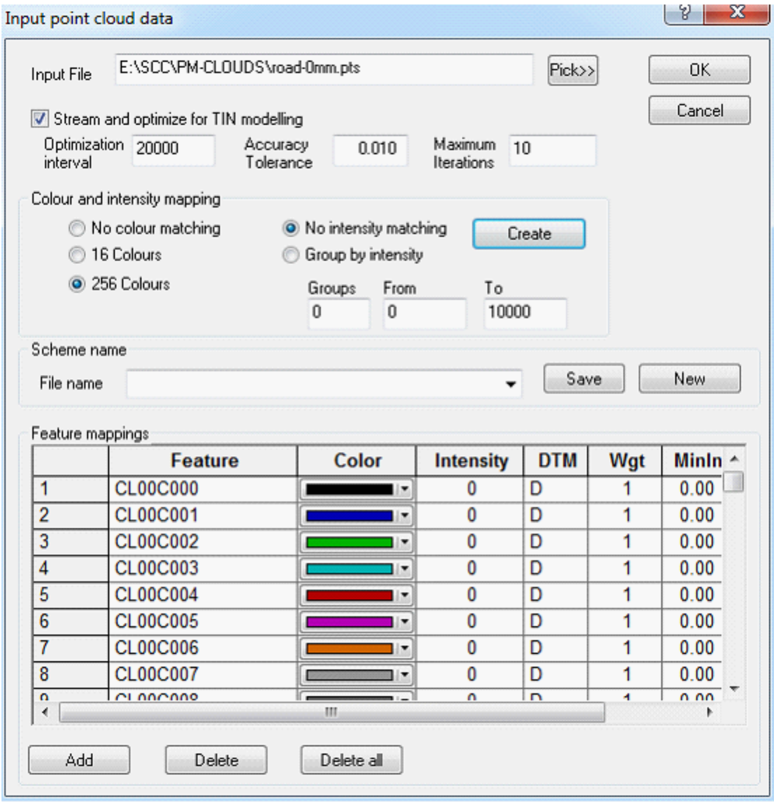
SCC can reduce, process and extract linear features such as kerb lines from PTS cloud data. The steps are as follows:

Create a new project, or open an existing one

'FILE > Open > SCC Project' and pick 'PM-Clouds.Project'

Model PTS File

Select 'FILE > Model > Point clouds & LIDAR > PTS file' which will show the following dialog:



The default options shown above stream in a RGB file which is mapped to a palette of 256 colours to an accuracy of 10mm. The fields are used as follows;

Stream and optimize for TIN modelling

Selecting this option inputs processes the point cloud in smaller sections such that SCC can handle very large point clouds relatively quickly. As data is input it is optimized to the specified vertical tolerance, and any points that would not make a change to the final surface are discarded. This eliminates vast number of co-planar points where they exist, leading to a much smaller, faster and more efficient TIN model without sacrificing any accuracy as would be the case with simpler decimation techniques.

Accuracy Tolerance

This is the vertical accuracy to which the TIN model is optimized. All points that would not affect the final surface by more than this amount are removed.

Maximum Iterations

This specifies the maximum number of times the optimization process is repeated. If no changes are made on any given iteration, the optimization is halted.

Optimization interval

This is the number of points at any given time that are held in memory when streaming and optimizing.

Colour and intensity mapping

These fields control how the RGB colours and intensities in the input data are mapped onto SCC features. Default colour mappings are No colour matching, 16 Colours, and 256 Colours.

Intensity Matching

Intensity matching is either off (No intensity matching), or grouped into a number of equal ranges (Group by intensity), controlled by the Groups, From and To fields.

Create

Pressing Create will generate a list of features for the number of colours multiplied by the number of intensity ranges. Each feature is mapped to the nearest SCC palette colour and named based on colour and intensity. The scheme also includes a DTM field to allow certain points to be either excluded from the surface or removed entirely. For example, setting the DTM code to IGNORE for all colours that represent a shade of green would strip most vegetation from the input data. Similarly points with low intensity values could be easily excluded.

Scheme Name

File name, Save, New

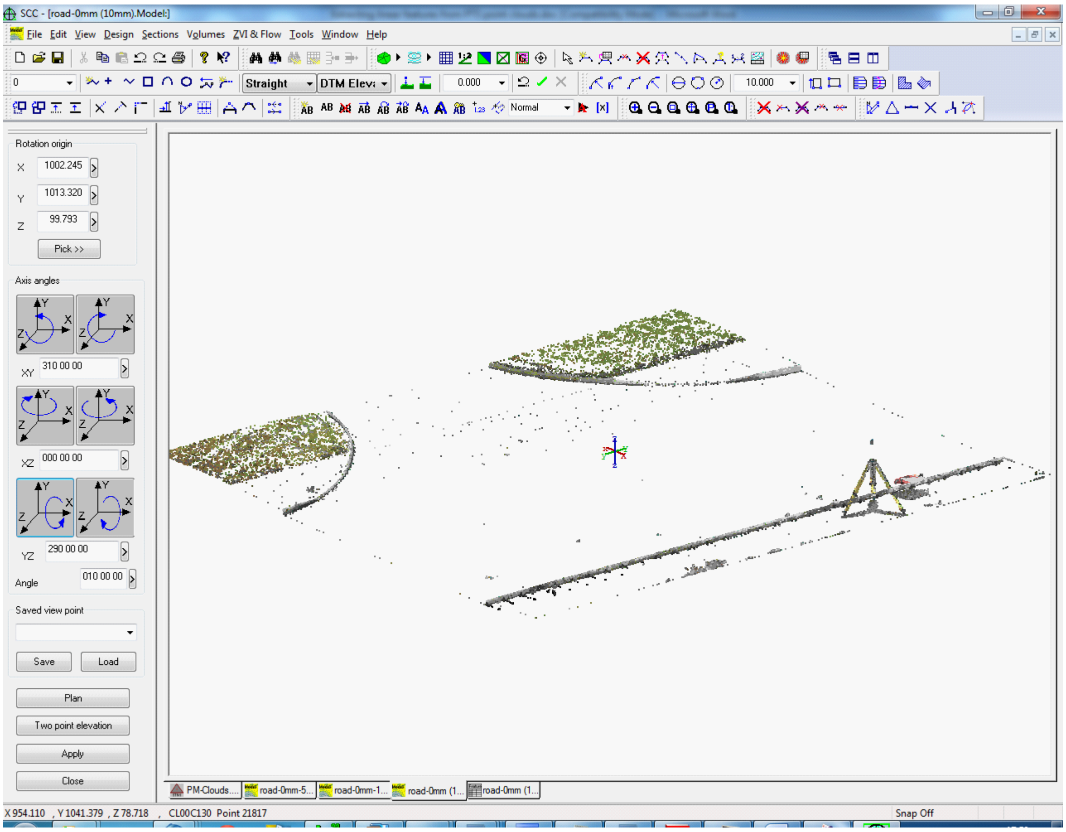
Feature Mapping

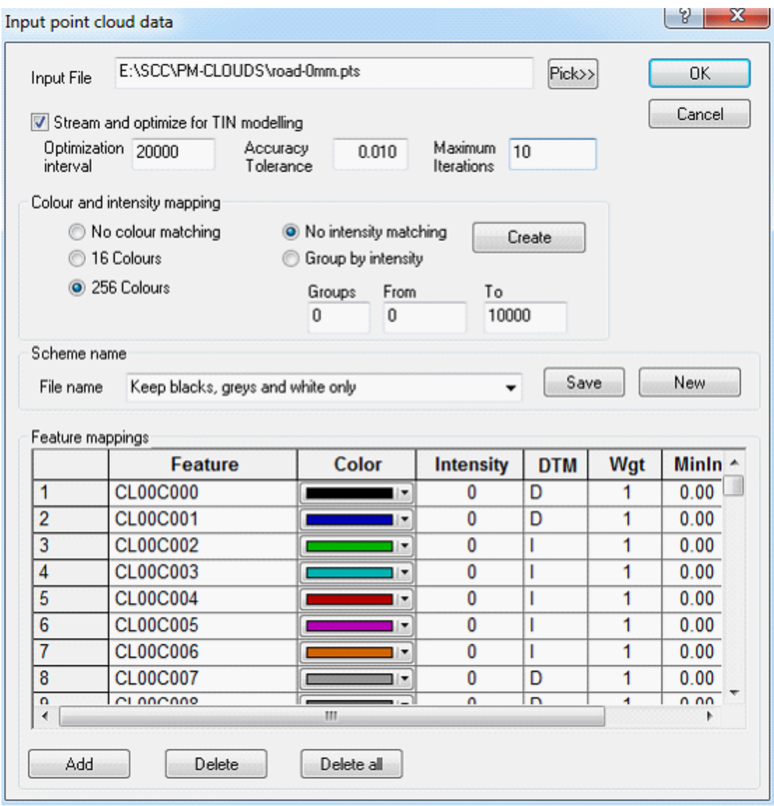
These fields allow colour and intensity schemes to be saved and loaded to and from file such that they can be re-used.

Using the 2.6 million point file available from the SCC Tutorials folder, 'ROAD-0mm.PTS' yielded the following results on an older 2ghz Athlon based PC under XP with 2GB of memory.

Vertical tolerance set to 10mm, 256 colour processing took 7 minutes and resulted in an optimized TIN model of 47 thousand points taking 12mb on disk. The model is shown below in plan, where we can see that the bulk of the points relate to the grass, the kerb edges, and the instrument box and tripod.

Using '**VIEW > Rotate viewpoint**' the model can be viewed in perspective, as shown below;



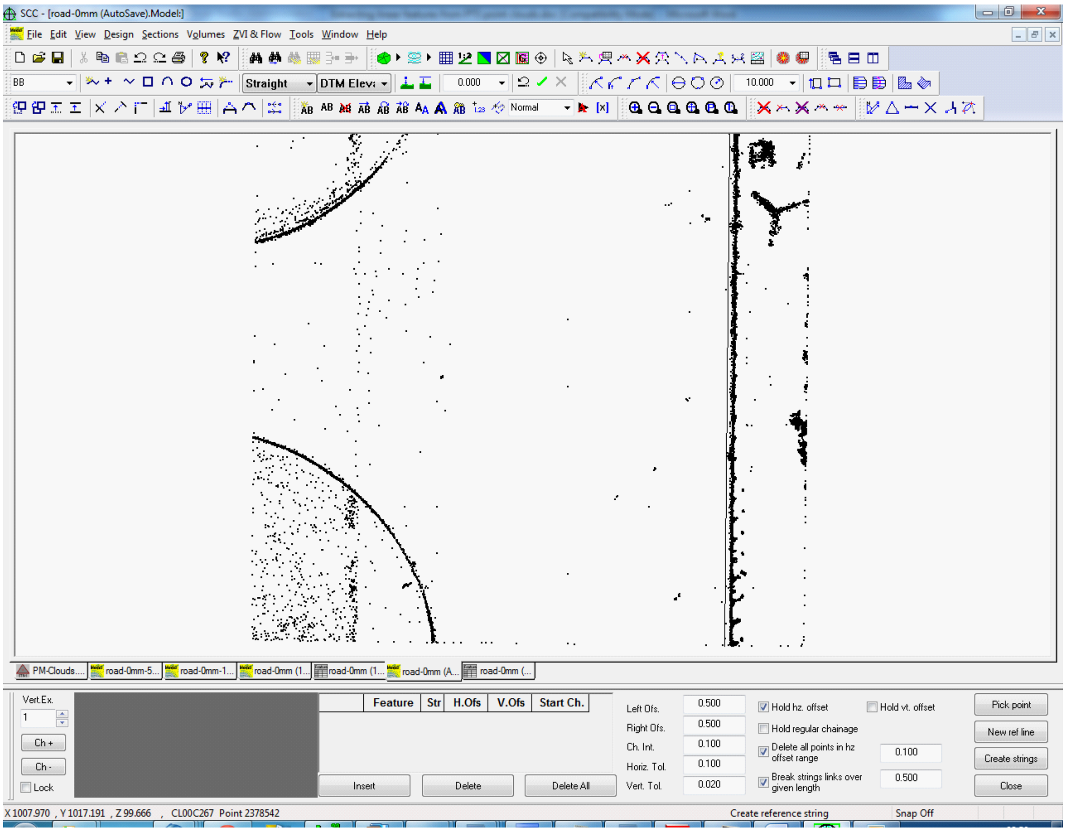


By re-running to input with all colours except blacks and greys and very dark shades filtered out as shown, we further automatically reduce the base model size to slightly over 27 thousand points.

This corresponds to automatic elimination of 99% of the input points to create a model with a vertical accuracy of within 10mm of the original data.

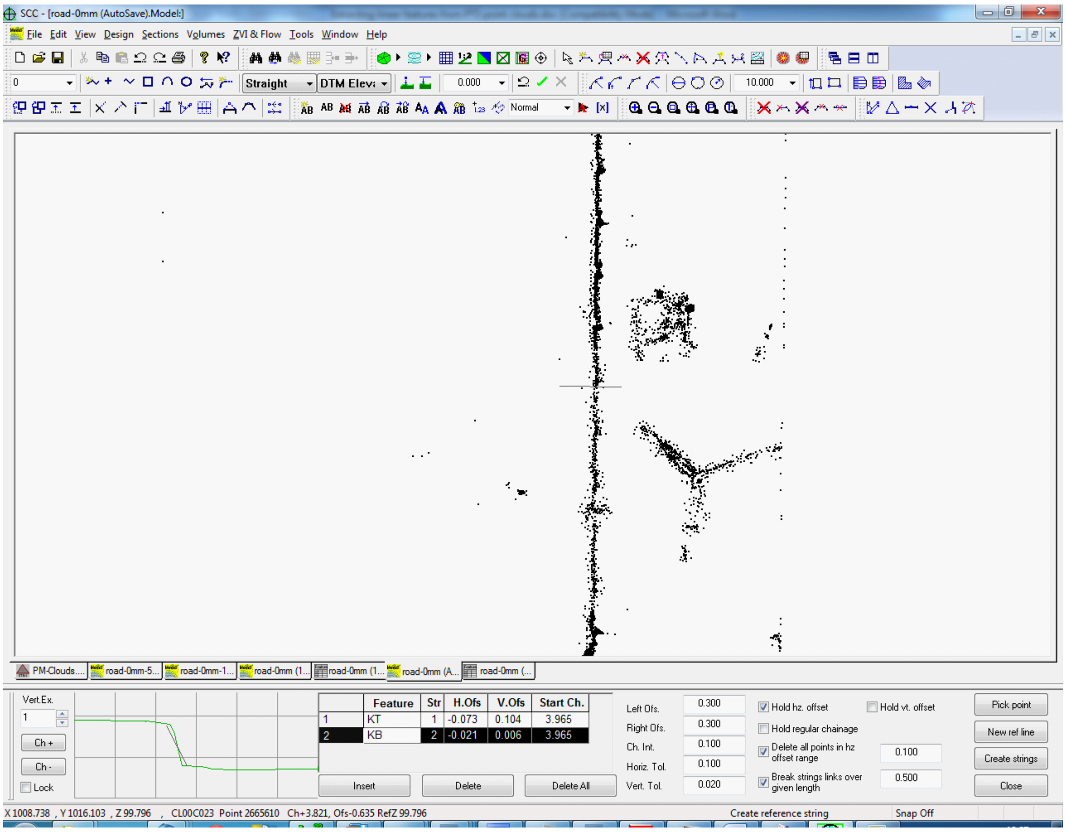
To start creating strings, select '**TOOLS** > **Point Cloud Trace linear features**' which will split the screen with a new dialog on the bottom as shown. Tracing linear features is broken down into two stages;

- Creating a reference line which involves drawing a polyline roughly parallel to the features you wish to extract. For example on the drawing below, we created a reference line by left clicking on the road beside kerb bottom at the top left hand corner of the drawing and again at the bottom left hand corner of the drawing. Right clicking closes the reference line, and switches to string selection mode. You can also change geometry when creating curved or angled reference lines by picking the appropriate tag code or geometry icon. So for example, the quickest way to create a reference line for the curved sections in the model is to use a 3 point arc. All points on the reference string should lie on the model, as this is a 3d entity corresponding to a simple alignment string.



To start a new reference line, simply press the New ref line button, which is also useful if you have made a mistake on your current reference line. Note that the reference line should lie entirely on one side or another of the set of features we wish to extract.

- Selecting strings to extract. Once you right click when creating a reference line, you can start selecting strings. As you move the mouse around the screen, you'll notice a sample section line in plan and in section on the bottom of the screen. The width of this section is controlled by the Left Ofs and Right Ofs fields. Pressing the left button again locks the chainage of the section, and as you move the mouse you will now see a vertical line in on the section corresponding to the mouse offset position in plan. Pressing the left mouse button again creates a point at the current offset, and adds it to the spreadsheet beside the section. The feature name and position can be edited in this sheet.



Pressing the right mouse button unlocks the chainage and allows you to move the section along the reference line, showing the selected points with the cut surface at varying chainages.

Pressing the create button creates the selected strings based on the parameters given. These are as follows;

Ch. Int.

This is the interval at which points will be created on the new string

Horiz. Tol.

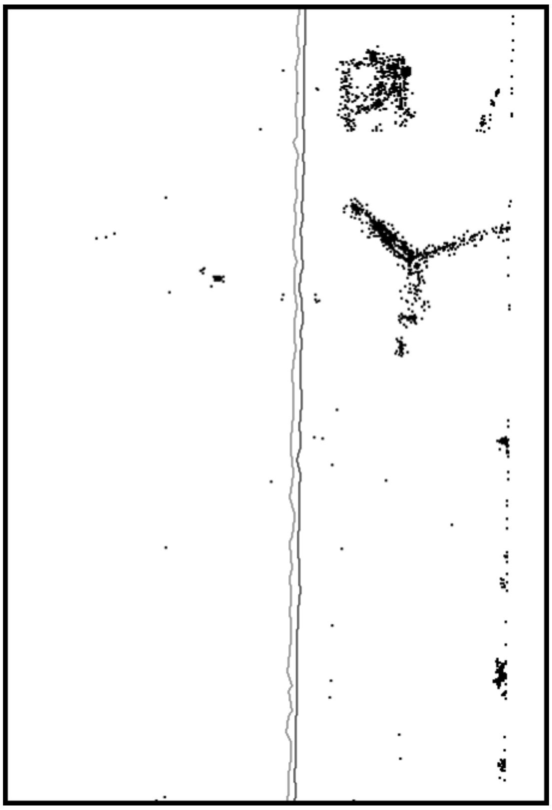
This is the horizontal search distance that will be used to find a point from the cloud data to add to the new string at the current chainage. The distance is an offset distance from the reference point, and all points are searched within this distance and half the chainage interval along the line.

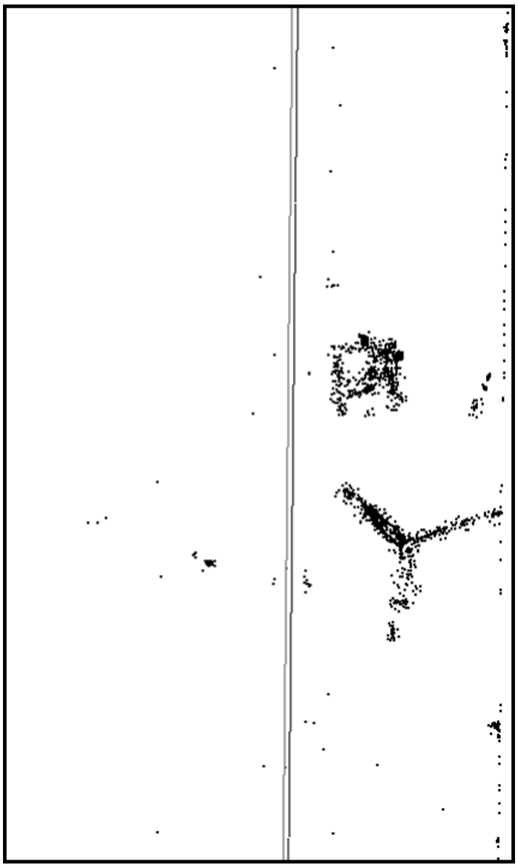
Vert. Tol.

This is the vertical search distance that will be used to find a point from the cloud data to add to the new string at the current chainage. The distance is a height difference from the reference point, and all points are within the defined horizontal tolerance are search. Where multiple points are found, the nearest point is selected.

Hold Hz Offset

If this option is selected, the new point is placed at the specified horizontal offset rather than the offset of the nearest point found. The effects of this can be seen on the pictures below





Hold Vt Offset

If this option is selected, the new point is placed at the specified vertical offset rather than the offset of the nearest point found.

Hold regular chainage

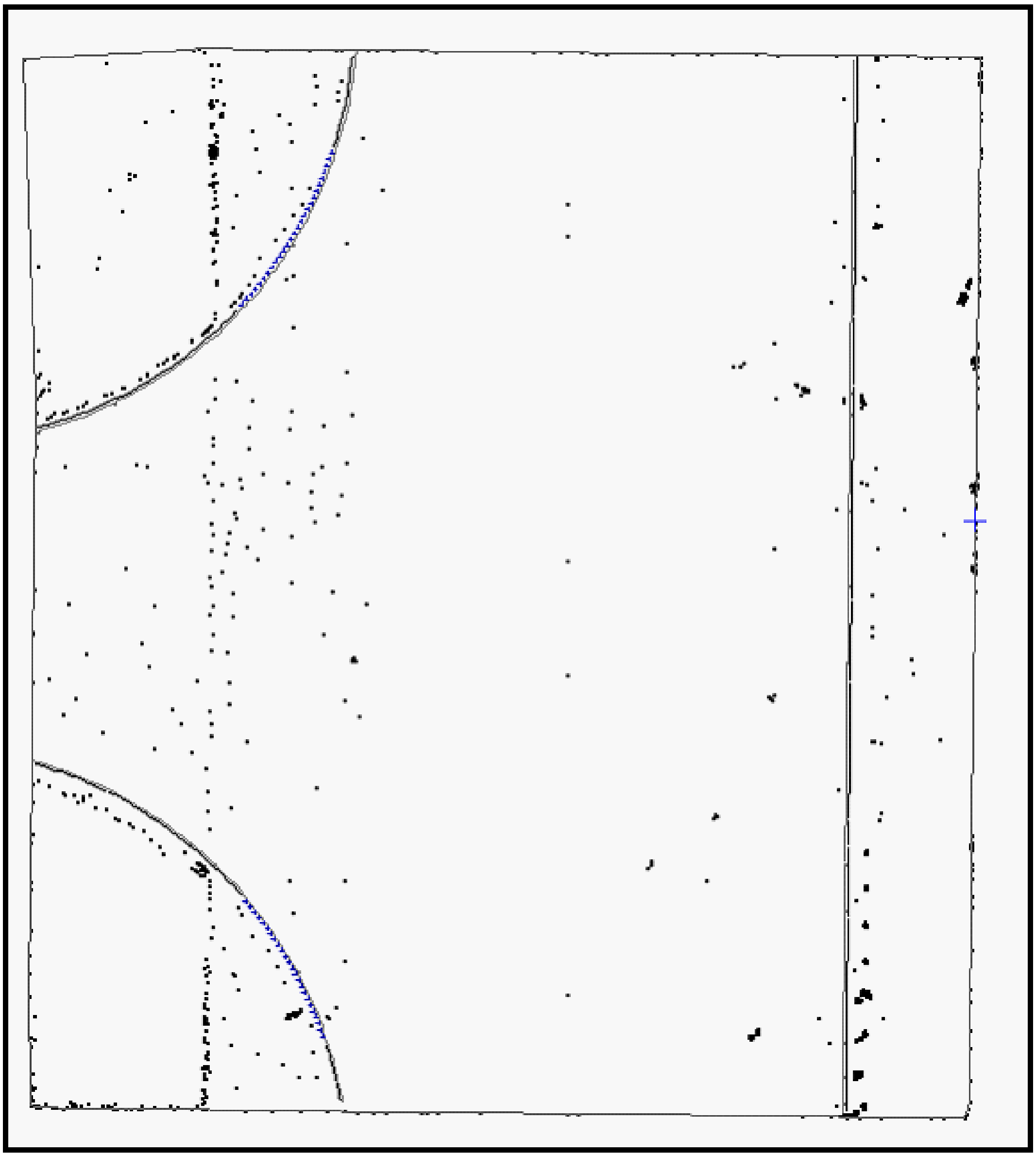
If this option is selected, the new point is placed at the current chainage rather than the chainage of the nearest point found.

Delete all points in hz offset range

This option deletes all the point cloud data within the specified horizontal distance of the points created for the chainage ranges along the alignment where new points are added.

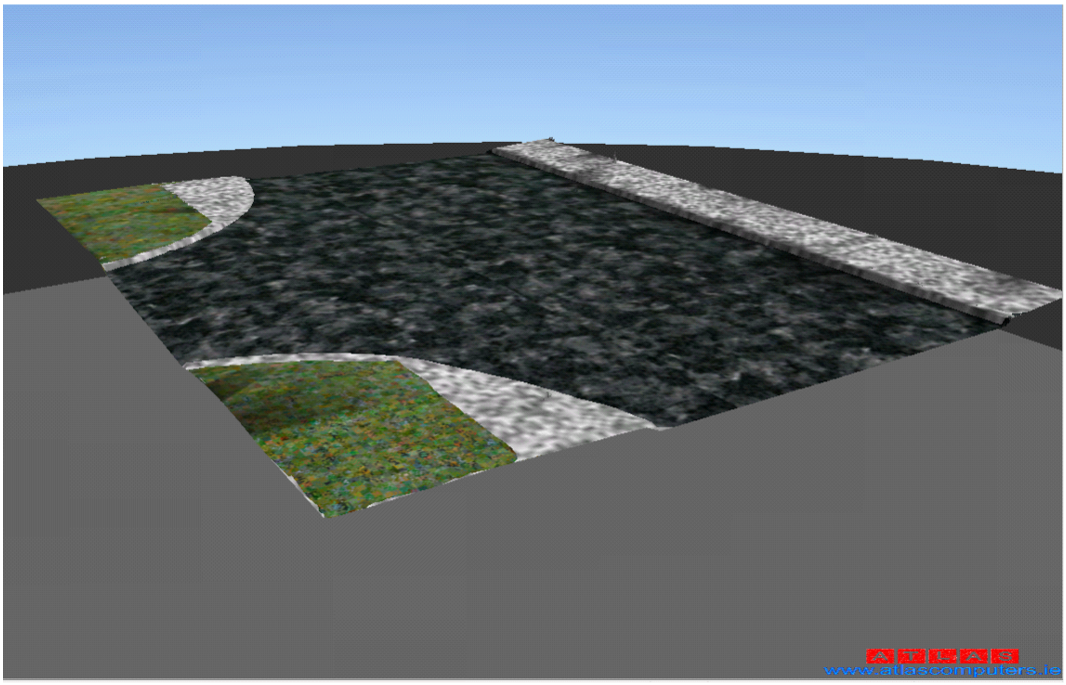
Break string links over given length

This option forces the output strings to be broken between chainages over the specified length where not suitable cloud points are found for the new strings. In this case, extra spot levels are added at the chainage interval and offset with heights interpolated from the model, thus allowing deletion of extra unwanted points while maintaining the shape of the surface. This can be seen in the drop kerbs in the circular sections of the example below.



Extracting the linear features using the parameters given, and using the polygon selection options to delete the unnecessary grass points, tripod and instrument box, further reduces the final model down to approx two thousand point. This string model is now usable in most

CAD, engineering, and visualisation packages with very little overhead, and represents a reduction in size by a factor of over a thousand from the original input data.



30.2 Processing PTS Point Clouds

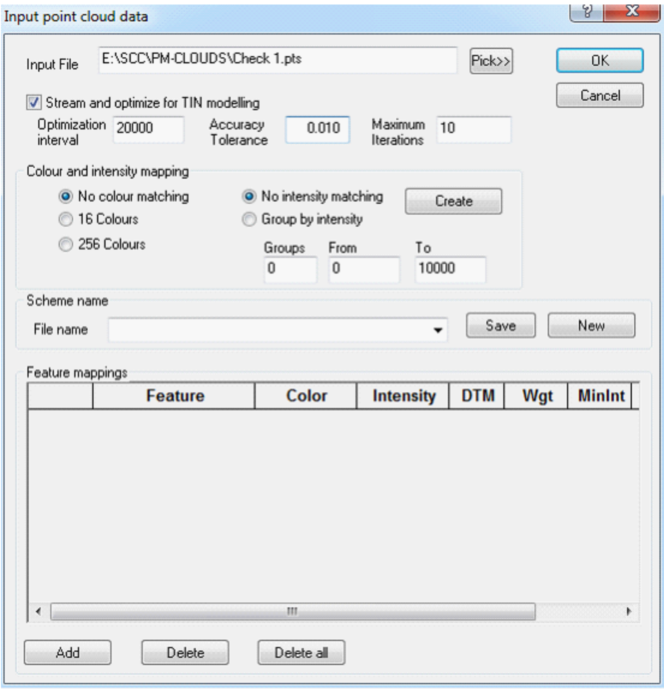
SCC can reduce, process and compare point clouds in PTS format using SCC. The steps are as follows;

Create a new project, or open an existing one

'FILE > Open > SCC Project' and pick 'PM-Clouds.Project'

Model PTS File

Select 'FILE > Model > Point clouds & LIDAR > PTS file' which will show the following dialog;



The default options shown above stream in a file in monochrome to an accuracy of 10mm. The fields are used as follows;

Stream and optimize for TIN modelling

Selecting this option inputs processes the point cloud in smaller sections such that SCC can handle very large point clouds relatively quickly. As data is input it is optimized to the specified vertical tolerance, and any points that would not make a change to the final surface are discarded. This eliminates vast number of co-planar points where they exist, leading to a much smaller, faster and more efficient TIN model without sacrificing any accuracy as would be the case with simpler decimation techniques.

Accuracy Tolerance

This is the vertical accuracy to which the TIN model is optimized. All points that would not affect the final surface by more than this amount are removed.

Maximum Iterations

This specifies the maximum number of times the optimization process is repeated. If no changes are made on any given iteration, the optimization is halted.

Optimization interval

This is the number of points at any given time that are held in memory when streaming and optimizing.

Colour and intensity mapping

These fields control how the RGB colours and intensities in the input data are mapped onto SCC features. Default colour mappings are No colour matching, 16 Colours, and 256 Colours.

Intensity Matching

Intensity matching is either off (No intensity matching), or grouped into a number of equal ranges (Group by intensity), controlled by the Groups, From and To fields.

Create

Pressing Create will generate a list of features for the number of colours multiplied by the number of intensity ranges. Each feature is mapped to the nearest SCC palette colour and named based on colour and intensity. The scheme also includes a DTM field to allow certain points to be either excluded from the surface or removed entirely. For example, setting the DTM code to IGNORE for all colours that represent a shade of green would strip most vegetation from the input data. Similarly points with low intensity values could be easily excluded.

Scheme Name

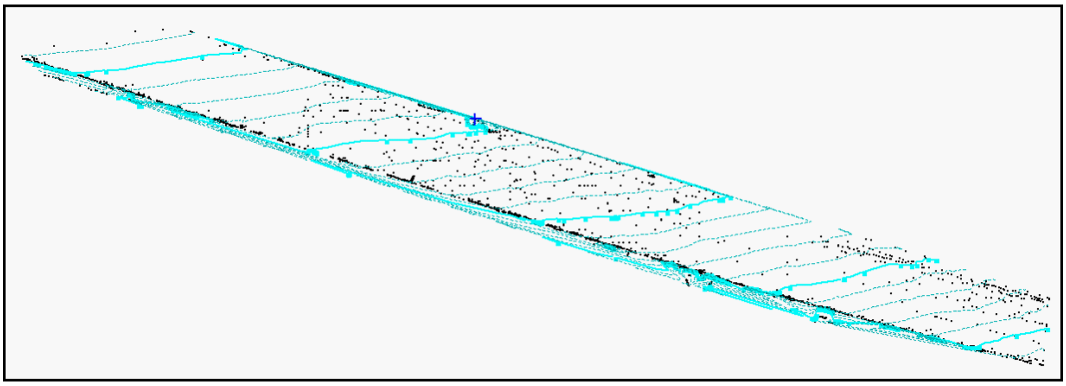
File name, Save, New

Feature Mapping

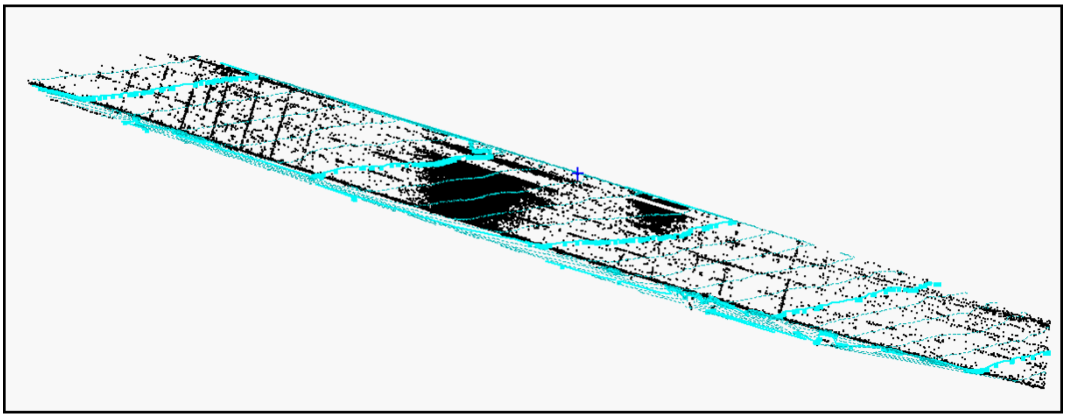
These fields allow colour and intensity schemes to be saved and loaded to and from file such that they can be re-used.

Using the 16 million point file available from the SCC tutorials folder, 'CHECK1.PTS' yielded the following results on an older 2ghz Athlon based PC under XP with 2GB of memory.

Vertical tolerance set to 10mm, monochrome, processing took 29 minutes and resulted in an optimized TIN model of 32 thousand points taking 4.6mb on disk. The model is shown below with 0.1 meter contours;



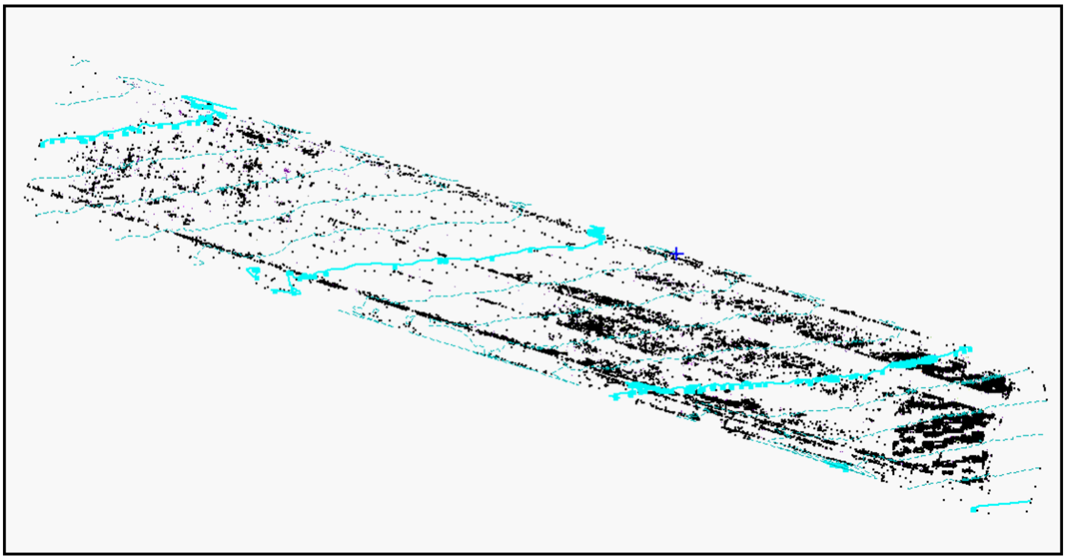
Vertical tolerance set to 5mm, monochrome, processing took 42 minutes and resulted in an optimized TIN model of 242 thousand points taking 25.5mb on disk. The model is shown below with 0.1 meter contours;



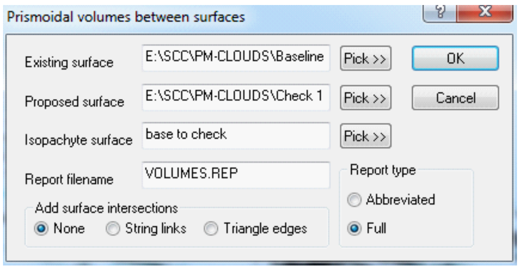
While contours and sections from these models look almost identical, the higher resolution model shows up line work relating to very shallow (<10mm) depressions in the surface that may be of value to the client. There is also a dark patch near the centre of the model, which is not present in the 10mm model, which correlates to the scanner position. This suggests that the scanner is slightly less accurate or prone to interference at very close ranges (e.g. ~5mm of noise at less than 10 meters range in this case).

Vertical tolerance set to 2mm, monochrome, processing took just under 4 hours and resulted in an optimized TIN model of 2.3 million points taking 362mb on disk.

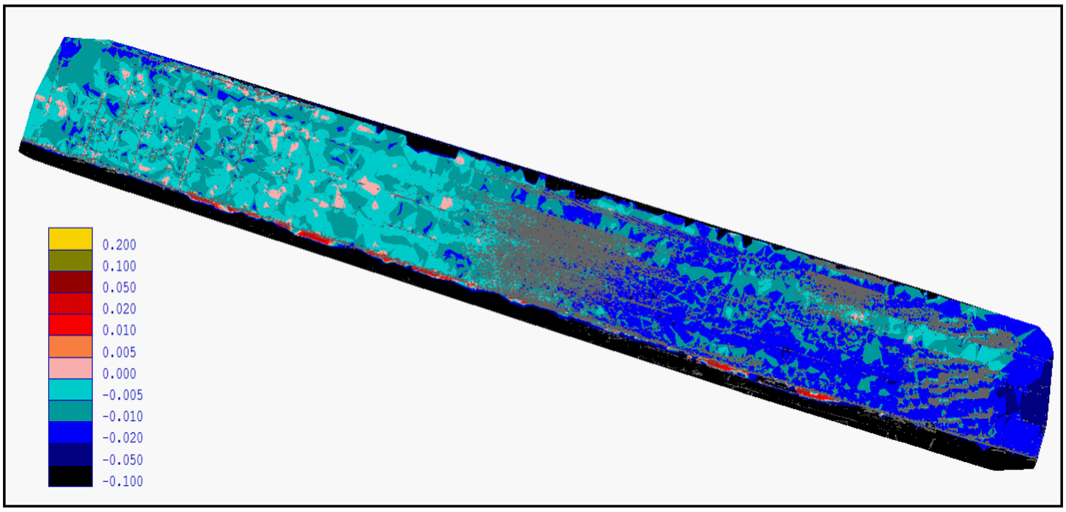
For the purposes of this exercise a 5mm vertical tolerance was used throughout. The same process was applied to BASE1.PTS which yielded a 48 thousand point model based on 5mm optimization as shown below.



To compare the base and check models, use **'VOLUMES > Volumes between surfaces (prismoidal)'** using the default values, as shown below;



This generated an isopachyte (height difference) model shown below, which can be coloured using relief contours as shown.

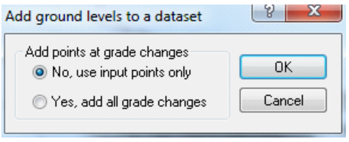


To take the test points in select 'FILE > Import > ASCII X,Y,Z' and pick the text file provided, Laser Scan Pointstxt.txt.

The file will initially have the levels in the text file.

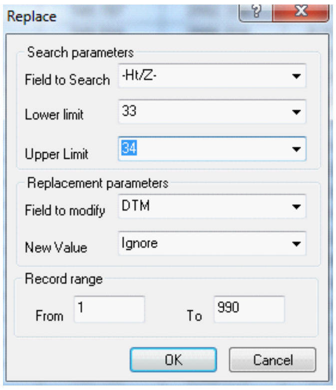
Select 'FILE > Save' to save this to disk as an SCC dataset.

To extract height differences for the points in the text file, go back to the isopachyte model and select 'TOOLS > Add ground levels to a dataset picking the dataset just saved and the parameters shown.



Going back to the dataset view, it can be seen that any points that overlaid the two models now have a height difference in the Z column.

To remove all the other points, select 'EDIT > Replace' with the values shown below, followed by 'TOOLS > Delete ignored points'



Columns can then be copied and pasted to other programs such as Excel, Word, Notepad, etc… as required. The values below have been copied from SCC;

Extract of file:

95	654.559	3009.412	-0.1127
99	655.153	3011.322	-0.0074
103	655.748	3013.231	-0.0017
107	656.342	3015.141	-0.0027
109	656.468	3008.818	-0.1453
112	656.937	3017.051	-0.0076
114	657.063	3010.727	-0.0060
117	657.531	3018.960	-0.0106

31 Radial Comparison From Point Cloud Data

Support has been added for radial analysis of point clouds based on alignment, for the purpose of creating tunnel sections directly from scanned data with no additional interpolation.

This tutorial covers the use of the SCC survey, point cloud and sections modules to compare tunnels models, scanned using the Leica MS50, for deformation monitoring purpose.

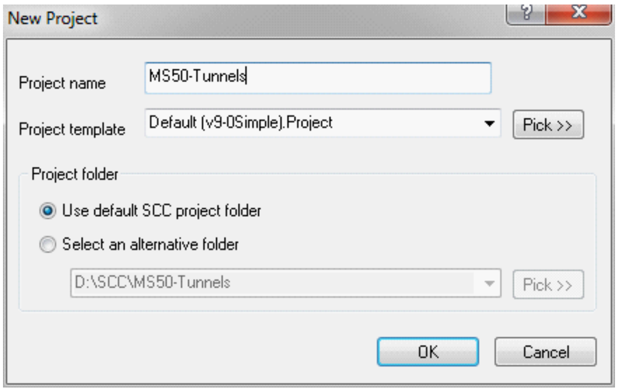
Control and scan information for the tunnel is collected using the MS50. Control Observations from the MS50 is downloaded SCC using DBX.

31.1 Project Creation & Data Download

Create New Project

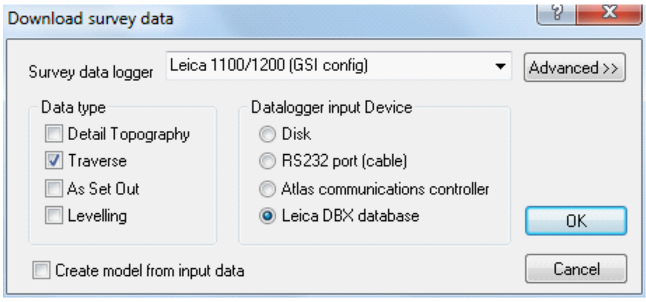
'FILE > New Project'

Pick a appropriate project name and template

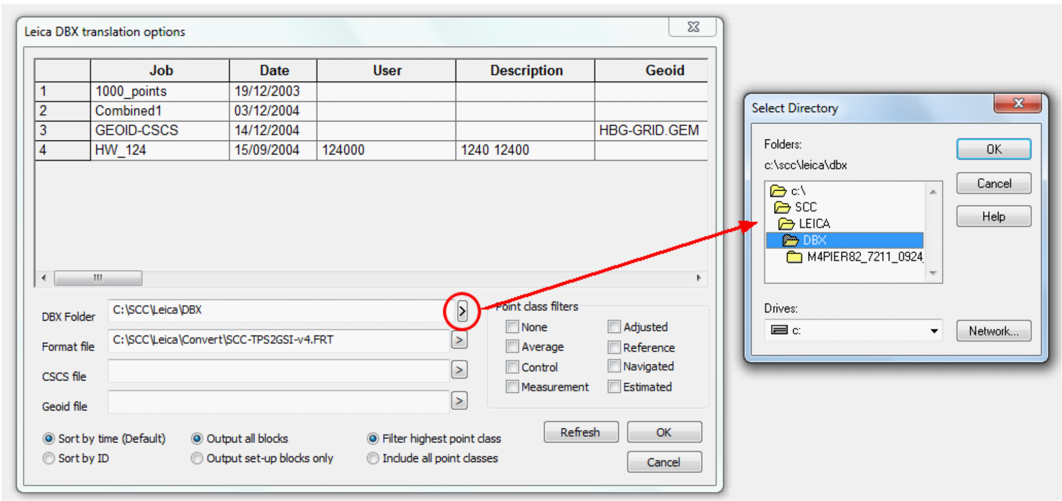


Download Survey Data

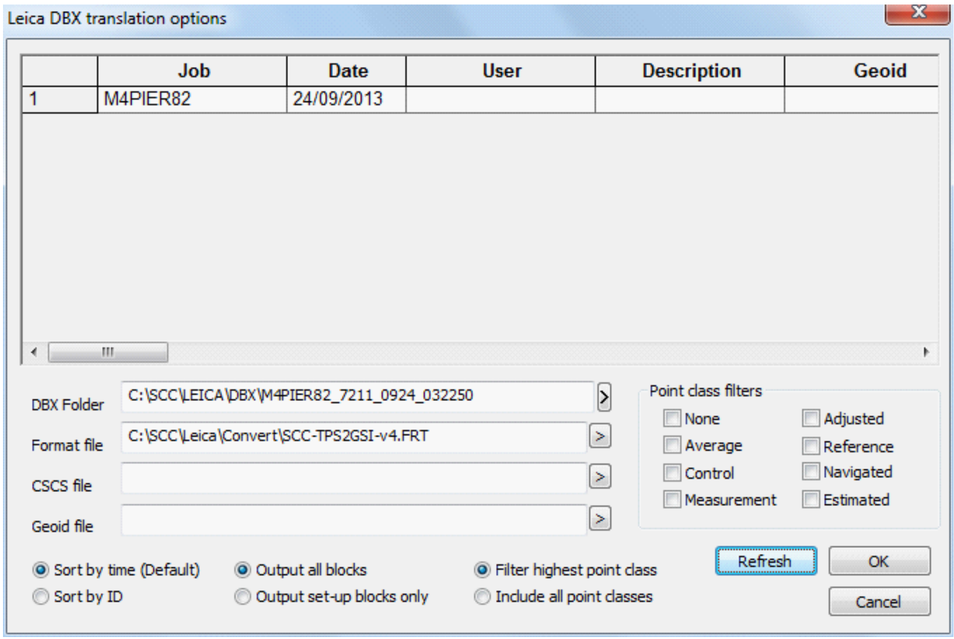
'FILE > Download Survey', pick the Leica 1100/1200 logger and DBX as the input device.



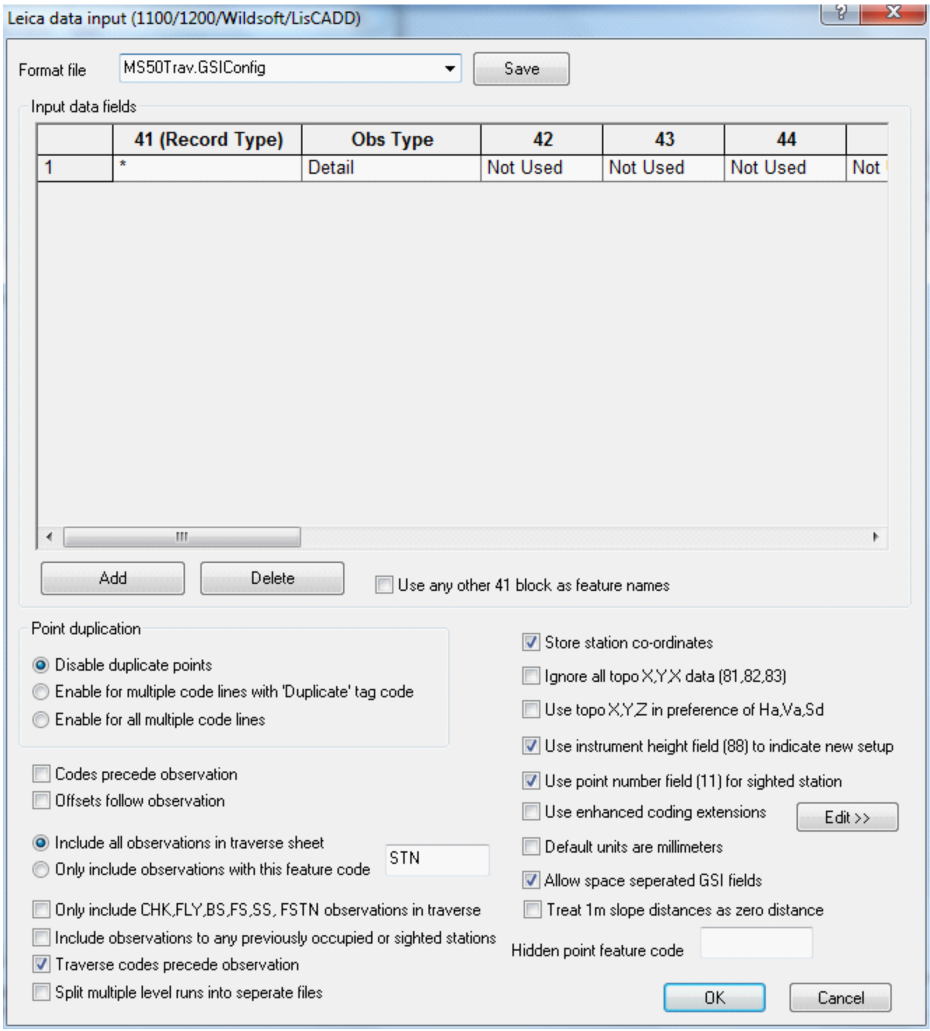
When the DBX translation dialog is shown change the DBX folder to point to location in which your MS50 scan data is stored and press Refresh to update the dialog.



Select SCC-TPS2GSI-v4.frt as your format file, click on your job file name (e.g. M4PIER82 in this case) and press OK.



Select MS50Trav.GSICONFIG in the Leica data input dialog and press Ok to download and import the survey data into SCC.



This will download control observations into the traverse spreadsheet, and any known entered station coordinates into the project station coordinates sheet.

	Setup	Round	At Stn.	To Stn.	Code	Use O	-Inst Ht-	-Rod Ht-	-HA-	-zVA-	-Sl Dist-	Remark	-Angle-
1	1	1	T1	S3	ORO	Yes	0.0000	1.8000	322 59 04	088 32 01	14.063	110006 L20	000 00 00
2	1	1	T1	S4	SS	Yes	0.0000	1.8000	279 47 53	089 40 48	28.199	110007 L21	316 48 49
3	1	1	T1	S8	SS	Yes	0.0000	1.8000	318 37 11	089 46 51	38.876	110008 L22	355 38 07
4	2	1	T2	S3	BS	Yes	0.0000	1.8000	017 52 40	088 23 15	16.764	110011 L30	000 00 00
5	2	1	T2	S4	SS	Yes	0.0000	0.0000	303 52 09	089 06 19	0.000	110012 L31	285 59 29
6	2	1	T2	S1	SS	Yes	0.0000	1.8000	072 57 18	088 54 21	11.982	110013 L32	055 04 38
7	3	1	T3	S1	BS	Yes	0.0000	1.8000	072 34 08	088 55 40	22.384	110016 L40	000 00 00
8	3	1	T3	S3	SS	Yes	0.0000	1.8000	038 10 23	088 26 53	24.362	110017 L41	325 36 15
9	3	1	T3	S4	SS	Yes	0.0000	1.8000	341 27 00	088 02 47	13.418	110018 L42	268 52 51
10	4	1	T4	S4	BS	Yes	0.0000	1.8000	084 46 02	089 03 11	5.216	110021 L50	000 00 00
11	4	1	T4	S1	SS	Yes	0.0000	0.0000	100 10 43	089 55 13	0.000	110022 L51	015 24 41
12	4	1	T4	S8	SS	Yes	0.0000	2.0000	016 20 02	089 23 18	25.894	110023 L52	291 34 00
13	5	1	T5	S1	BS	Yes	0.0000	1.8000	174 42 10	090 56 57	15.516	110026 L59	000 00 00
14	5	1	T5	S3	SS	Yes	0.0000	1.8000	238 18 37	090 09 46	5.733	110027 L60	063 36 27
15	6	1	T6	S4	BS	Yes	0.0000	1.8000	219 05 35	089 31 37	28.457	110030 L67	000 00 00
16	6	1	T6	S3	SS	Yes	0.0000	1.8000	174 58 49	088 24 42	15.721	110031 L68	315 53 14
17	7	1	T7	S3	BS	Yes	0.0000	1.8000	130 29 10	088 26 47	19.818	110034 L75	000 00 00
18	7	1	T7	S4	SS	Yes	0.0000	1.8000	192 26 31	089 01 23	19.762	110035 L76	061 57 21
19	8	1	T8	S3	BS	Yes	0.0000	1.8000	105 39 44	088 44 43	29.768	110038 L83	000 00 00
20	8	1	T8	S4	SS	Yes	0.0000	1.8000	147 10 34	088 30 03	17.221	110039 L84	041 30 50

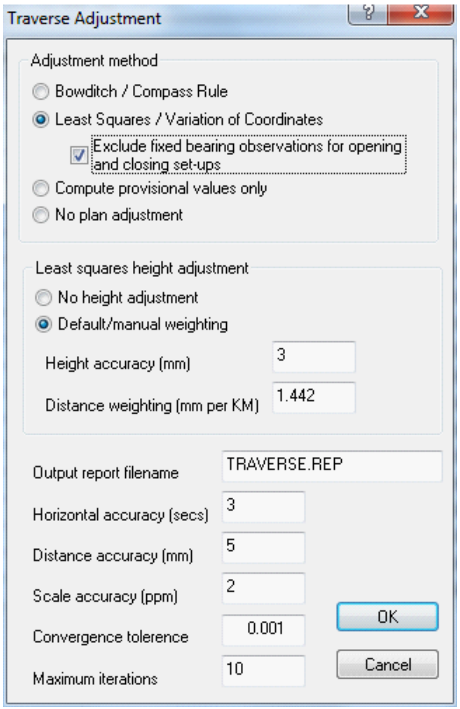
31.2 Traverse Adjustment

Switch to the station coordinates sheet, and change the type of any known coordinates to either Fixed or Constrained in both XY and Z as required.

	Name	Feature	X,Y Type	Z Type	Source	-E/X-	-N/Y-	-Ht/Z-	-rE/X-	-rN/Y-	-rHt/Z-	Lat
1	S1	CONTROL	Fixed	Fixed	Manual	517770.081	178259.432	11.5990	0.000	0.000	0.0000	000 0.00000N
2	S3	CONTROL	Fixed	Fixed	Manual	517763.764	178271.872	11.8410	0.000	0.000	0.0000	000 0.00000N
3	S4	CONTROL	Fixed	Fixed	Manual	517744.439	178265.439	11.6400	0.000	0.000	0.0000	000 0.00000N
4	S8	CONTROL	Fixed	Free	Manual	517746.527	178289.827	11.6330	0.000	0.000	0.0000	000 0.00000N
5	T1	CONTROL	Free	Free	al	517772.227	178260.648	13.2830	0.000	0.000	0.0000	000 0.00000N
6	T2	CONTROL	Free	Fixed	al	517758.624	178255.924	13.1710	0.000	0.000	0.0000	000 0.00000N
7	T3	CONTROL	Free	Constrained	al	517748.716	178252.730	12.9820	0.000	0.000	0.0000	000 0.00000N
8	T4	CONTROL	Free	Provisional Prov.Trig	al	517739.245	178264.971	13.3550	0.000	0.000	0.0000	000 0.00000N
9	T5	CONTROL	Free	Prov.Resect	al	517768.647	178274.883	13.6570	0.000	0.000	0.0000	000 0.00000N
10	T6	CONTROL	Free	Free	Manual	517762.386	178287.526	13.2050	0.000	0.000	0.0000	000 0.00000N
11	T7	CONTROL	Free	Free	Manual	517748.696	178284.734	13.1040	0.000	0.000	0.0000	000 0.00000N
12	T8	CONTROL	Free	Free	Manual	517735.108	178279.906	12.9890	0.000	0.000	0.0000	000 0.00000N

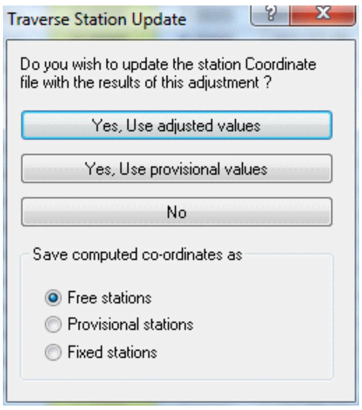
Switch back to the traverse observation view, and select 'EDIT > Adjust'

If the initial occupied stations are unknown (i.e. computed by resection or free station) make sure to have the option to exclude fixed bearings for opening and closing set-ups ticked, as the opening orientation will not be known. Instrument accuracies for height, angle and distance should be entered based in the stated accuracy of the instrument in use, number of rounds of measurement taken, and anticipated standard errors.



Check the traverse report to ensure that the errors reported and station positions and heights are all within an acceptable tolerance. Specific attention should be paid to chi-squared pass/fail results, error ellipses and height errors, and observation residuals. Where scanning is being carried out at the same time as control measurement, the absolute accuracy of any scanned point will be based around the station accuracy and standard error of the scanner EDM.

If the adjustment results are acceptable, update the project station values as shown.



31.3 Reprocessing Scan Data

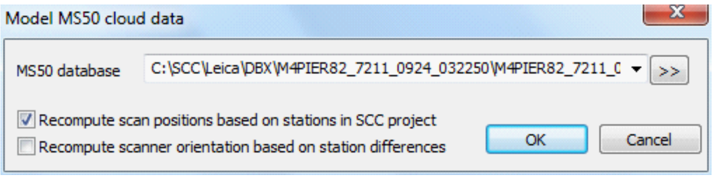
To reprocess the scan data based on the updated station values, select 'FILE > Model > Point Clouds & LIDAR > Leica MS50'.

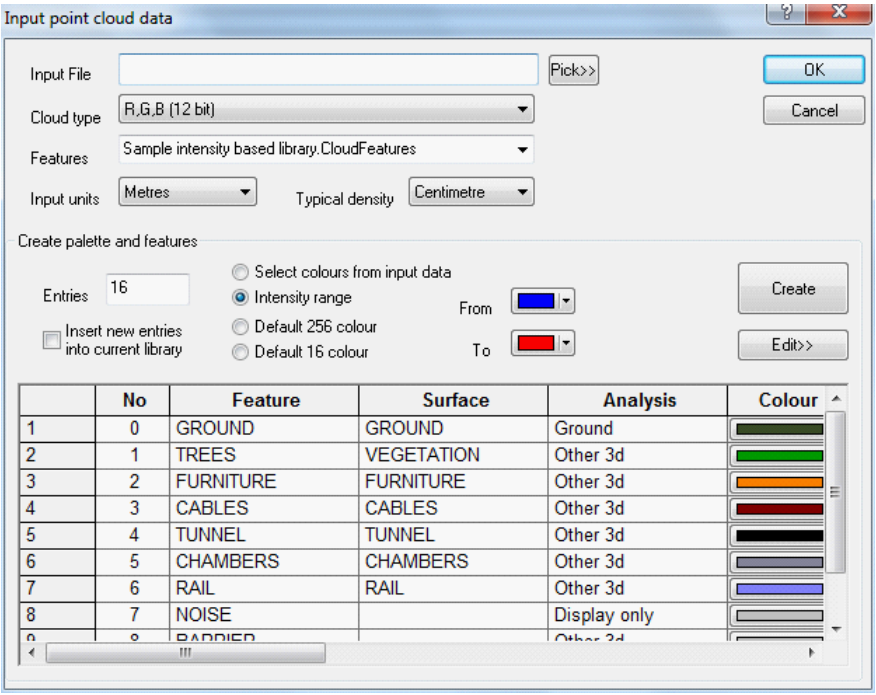
Pick your scanned project file, and tell SCC to recompute the scan positions based on the SCC stations.

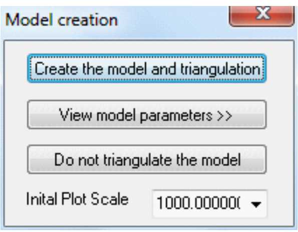
Note that we only recompute scanner orientation when moving between grid systems, as any transformation residuals are liable to reduce rather than improve overall accuracy.

Press OK on the point cloud, and create the model.

You will need to repeat this process for each survey.


Model MS50 cloud data
MS50 database
C:\SCC\Leica\DBX\M4PIER82_7211_0924_032250\M4PIER82_7211_C
>>
Recompute scan positions based on stations in SCC project
Recompute scanner orientation based on station differences
OK
Cancel

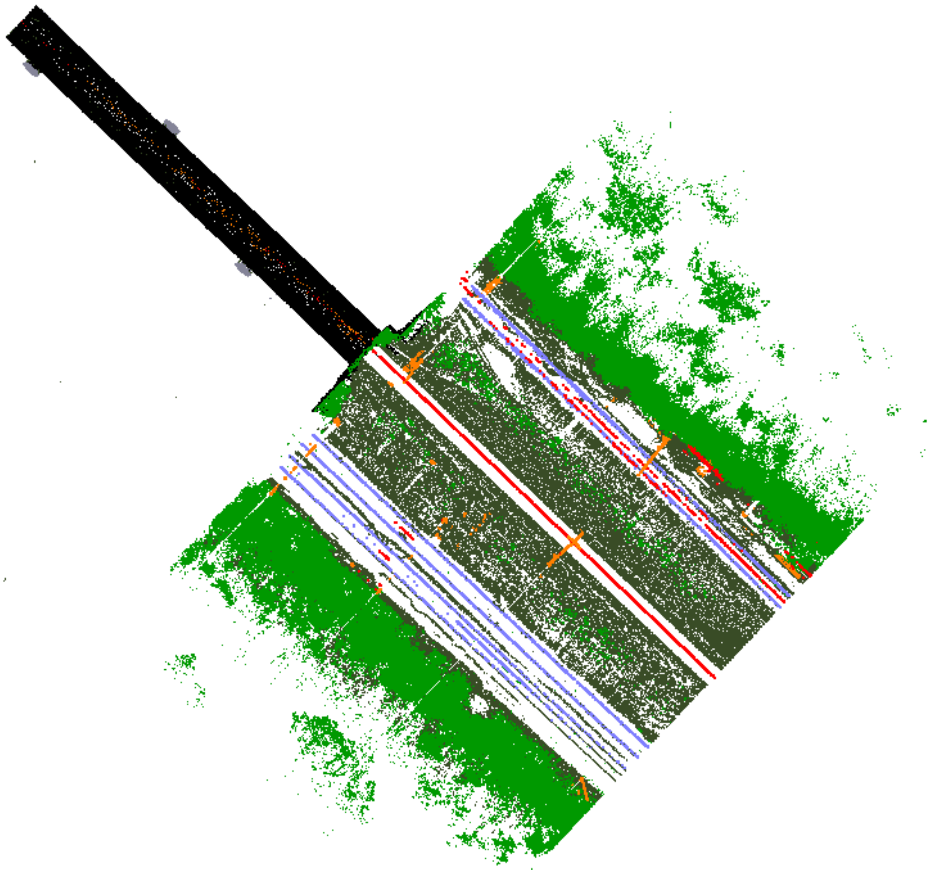

Input point cloud data
Input File
Pick>>
OK
Cancel
Cloud type
R,G,B (12 bit)
Features
Sample intensity based library.CloudFeatures
Input units
Metres
Typical density
Centimetre
Create palette and features
Entries
16
Insert new entries into current library
Select colours from input data
Intensity range
Default 256 colour
Default 16 colour
From
To
Create
Edit>>
No
Feature
Surface
Analysis
Colour
1 0 GROUND GROUND Ground
2 1 TREES VEGETATION Other 3d
3 2 FURNITURE FURNITURE Other 3d
4 3 CABLES CABLES Other 3d
5 4 TUNNEL TUNNEL Other 3d
6 5 CHAMBERS CHAMBERS Other 3d
7 6 RAIL RAIL Other 3d
8 7 NOISE Display only


Model creation
Create the model and triangulation
View model parameters >>
Do not triangulate the model
Inital Plot Scale
1000.00000(

Once we have two models created of the same tunnel in the same grid system we can compare them as follows

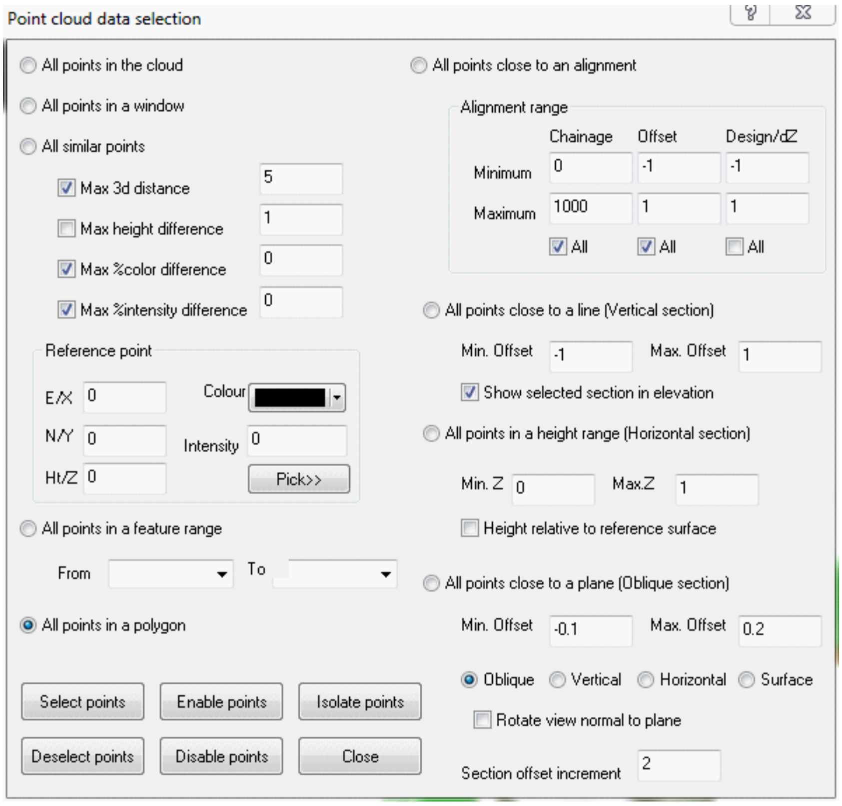
31.4 Comparison of Two Models

Open your base survey model 'Tunnel (Edited).Model' from \SCC\Tutorials\Point Clouds

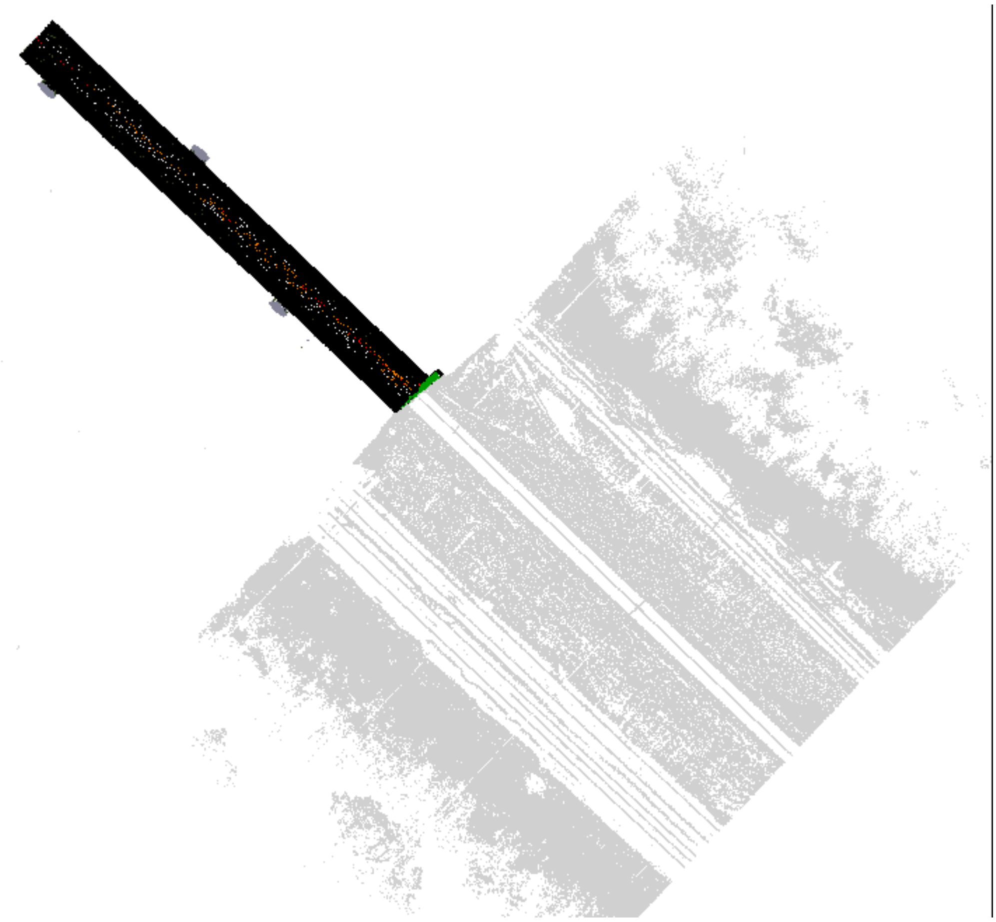


For the purposes of this tutorial, we're only interested in the tunnel itself.

Press right click to bring up the point cloud data selection dialog, select 'All points in polygon' and press 'Isolate points'.

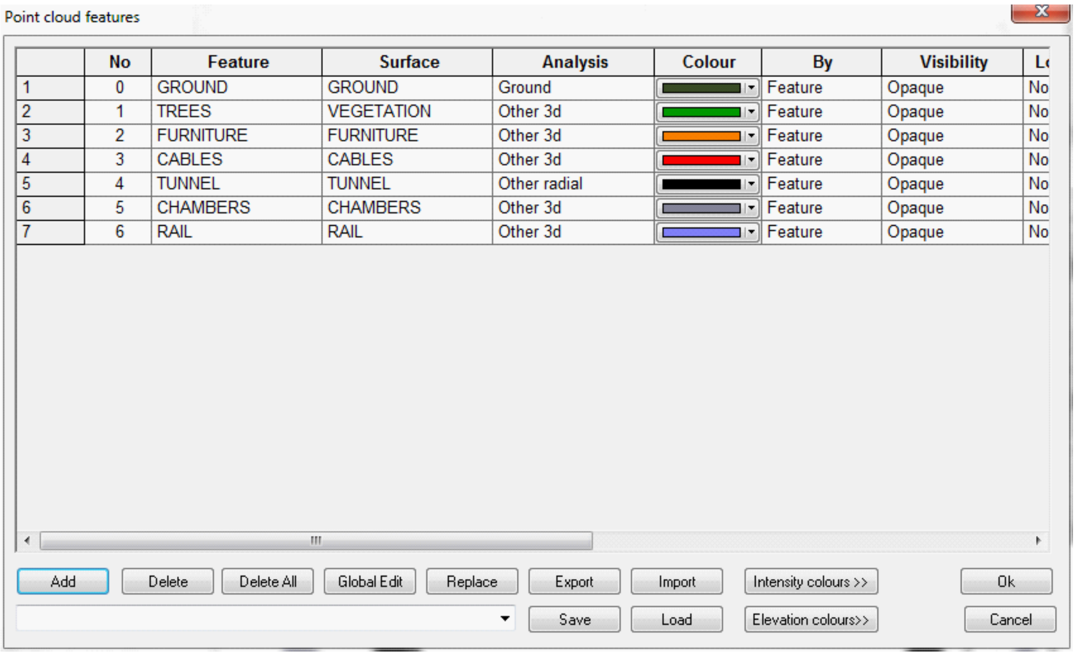


Left click on four or more points to form a polygon around the tunnel, and right click to turn off all points not inside that polygon.



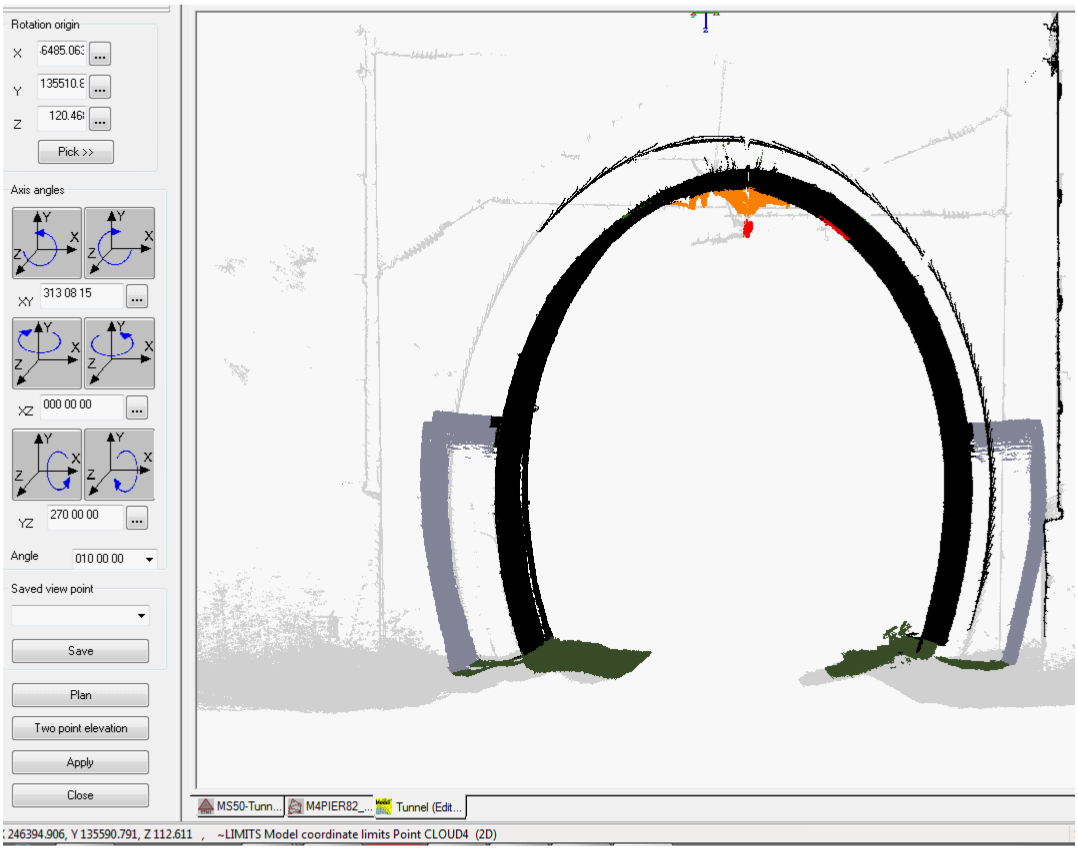
Select 'CLOUD > Point cloud features', and change the Analysis of Tunnel from Other 3D to Other Radial.

This means that section points on this feature will be connected radially from the alignment centre line.



Select 'VIEW > Rotate Viewpoint, followed by Two point elevation to create a view point that looks down the tunnel.

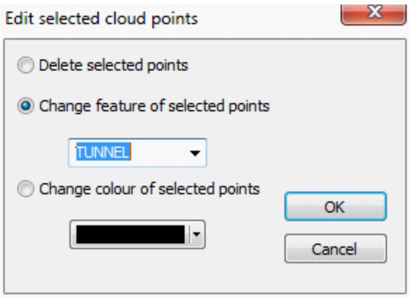
Note that by changing the angle in the rotation side bar dialog to a small value, e.g. 1 degree, we can make fine adjustments to this view as required.



To set the feature of any group of points, right click to bring up the point cloud data selection dialog, select 'All points in a polygon' and press 'Select points'.

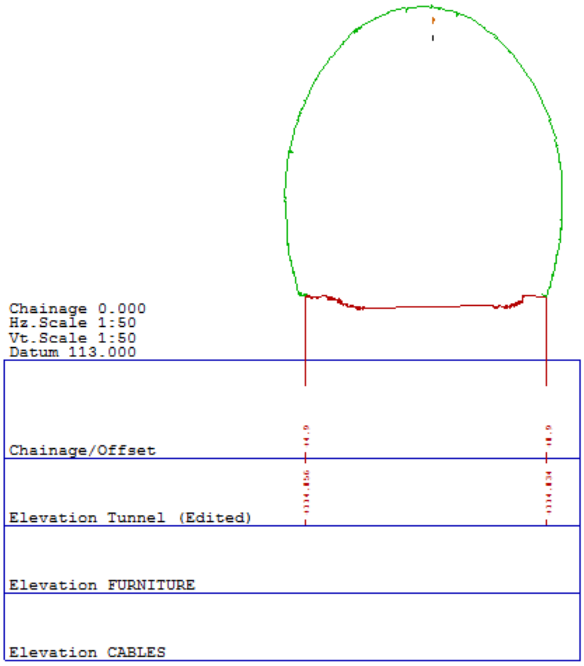
Left click on all the polygon points, and right click to select / highlight all the scanned points inside that polygon.

Select 'CLOUD > Edit Selected points', and change the feature of the selected points as required. Repeat this process to edit the cloud such that tunnel walls and ground are separated, and any spurious information is set to another feature such that it can be easily identified in section.



Press 'P' to return to a plan view, and 'SECTIONS >Long section with cursor' to verify the model is correct.

To create the section left click on two points, one on each side of the tunnel, and right click to finish.

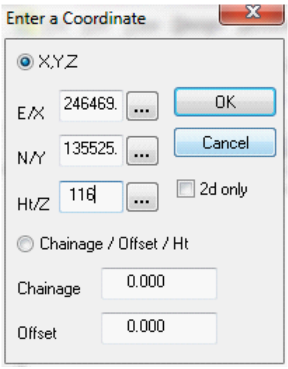


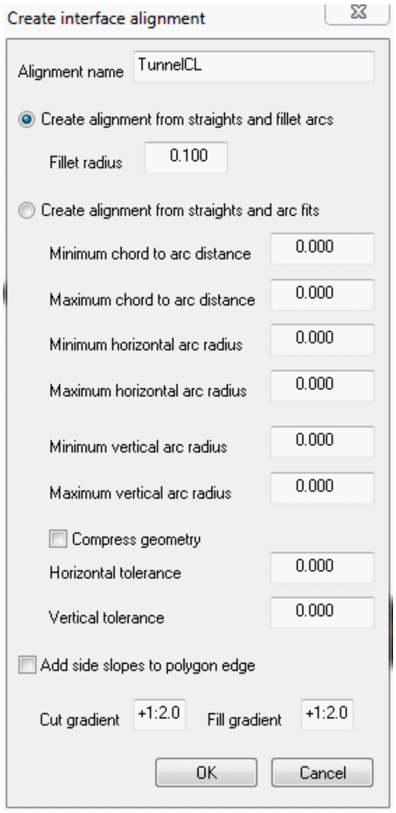
To create cross sections for a comparison, an alignment centre line is needed.

This can be imported from DXF/DWG, LandXML, or GENIO as requied. In this case, draw the centre line manually.

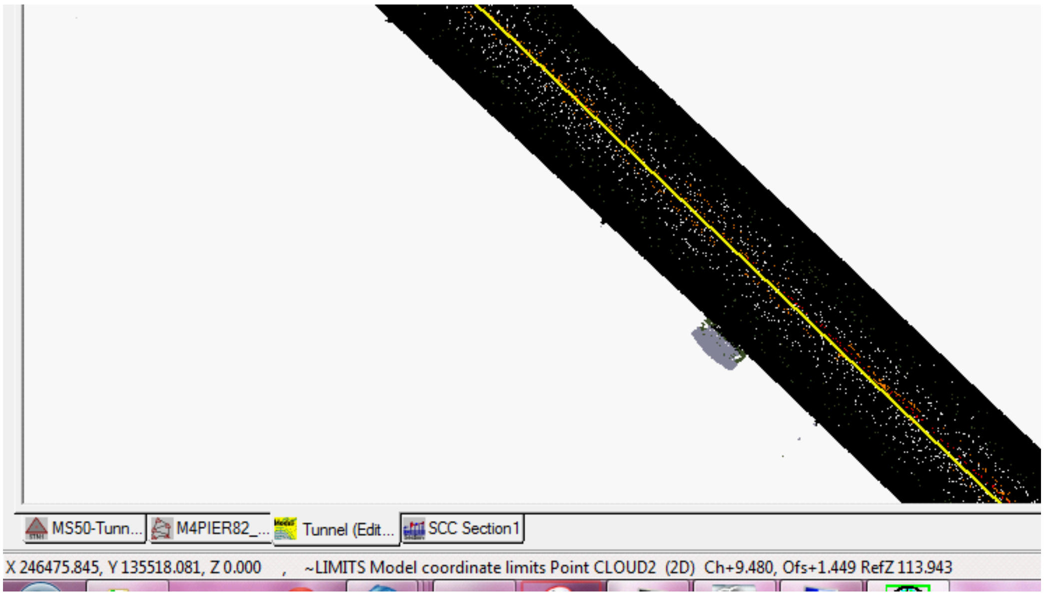
Select 'EDIT > Add strings with cursor'.

Place the mouse over the centre of the tunnel in plan and press enter. This will show a dialog with the current mouse position. Enter a height of 116 for this point and press ok. Repeat for a point at the other end of the tunnel, and press the right mouse button to bring up a pop-up menu. On this menu, select Save string as interface, as give this new alignment a name as shown.

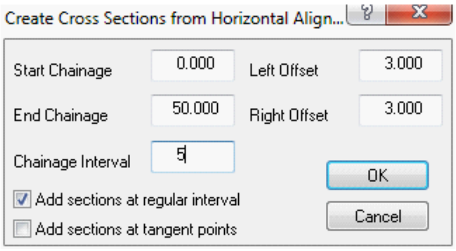


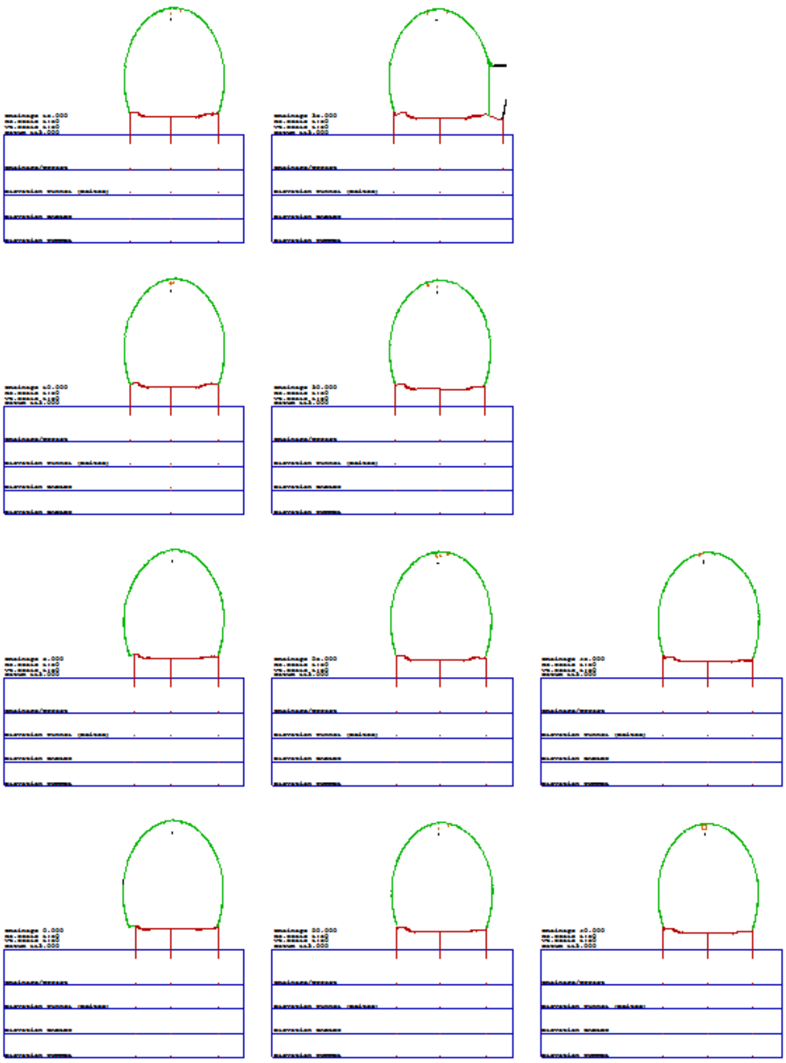


A chainage, offset and centre line height for the tunnel have been achieved, which are draw as a yellow line in the model. As the mouse cursor is moved around the screen, the chainage and offset is reported in the status bar in addition to X,Y,Z.

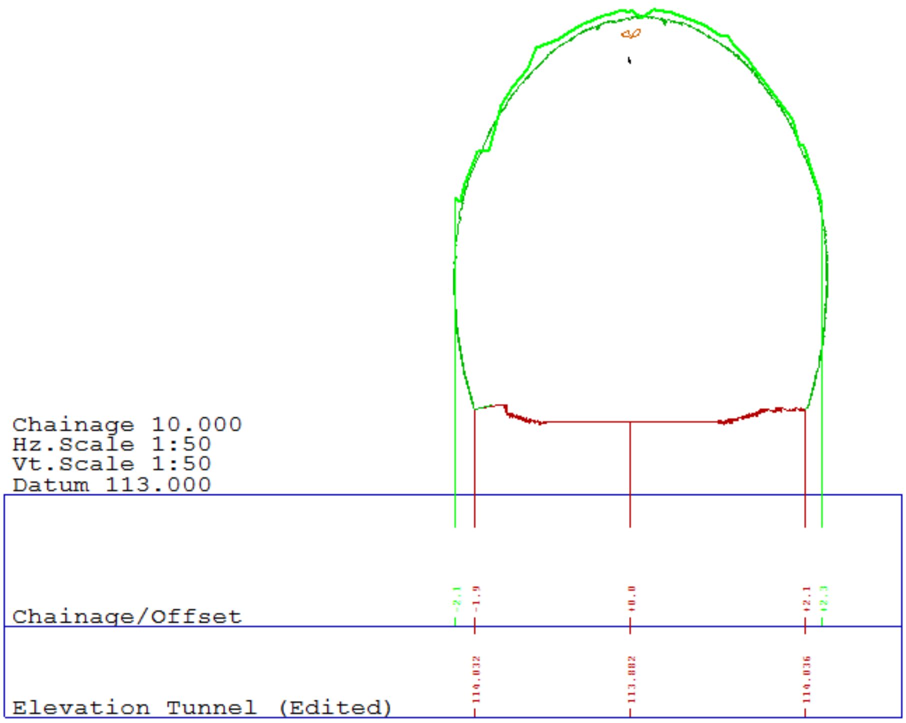


To cut some cross sections, select 'SECTIONS > Cross sections from an alignment' using the values given.



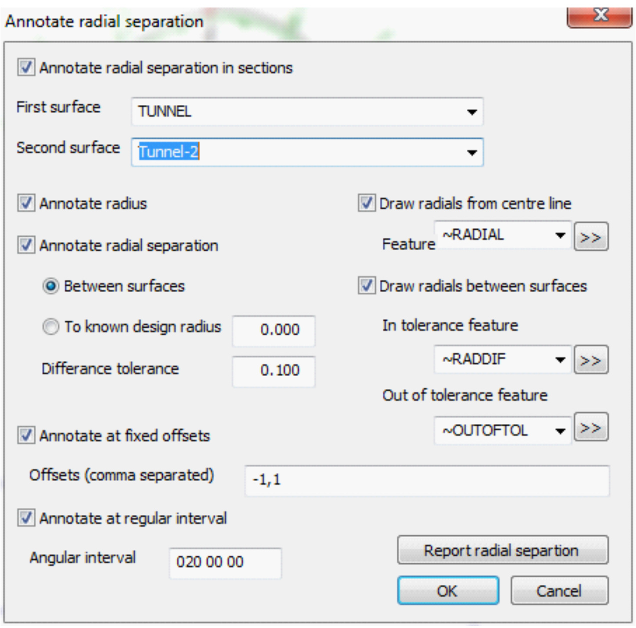


To add another survey model onto these sections, use 'EDIT > Append surfaces' and pick your second model.



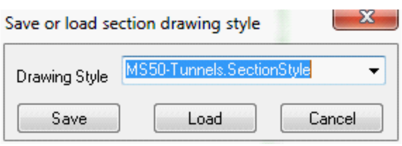
Select View / Radial annotation to show the radial separation between the two surfaces.

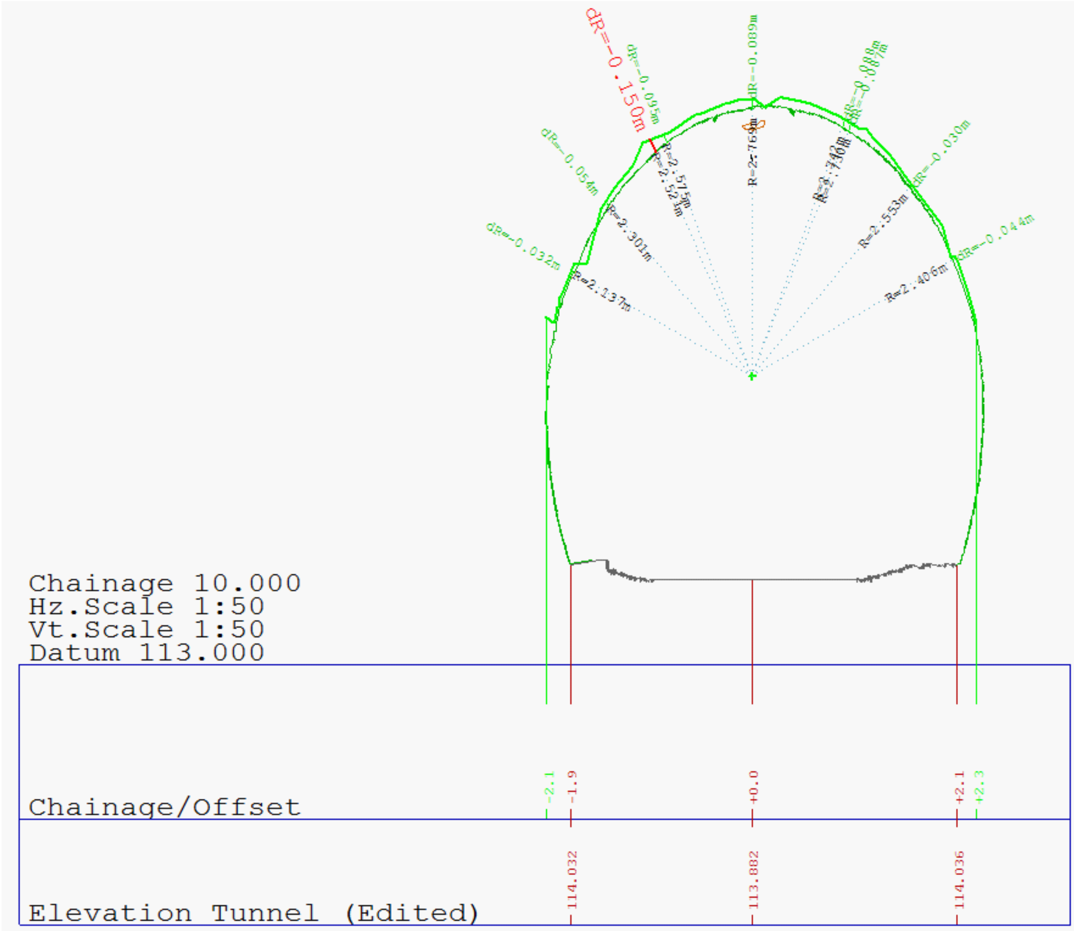
In this case, the radius of the base model is annotated and the difference in radius at offsets -1 and 1 and at every 20 degrees from the centre line.



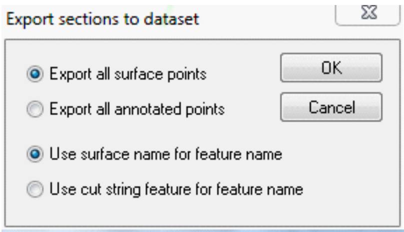
Separate features are used to show radial lines, differences and out of tolerance points.

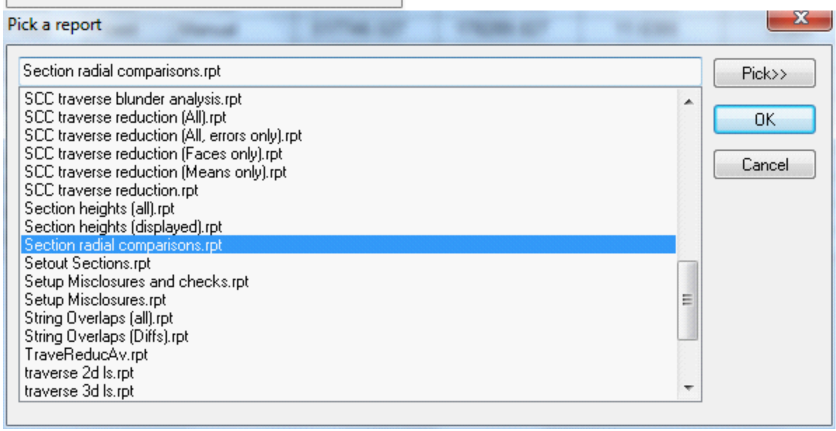
A sample section style is also available to highlight these features, which can be loaded using 'FILE > Load save section style', and picking MS50-Tunnels.SectionStyle



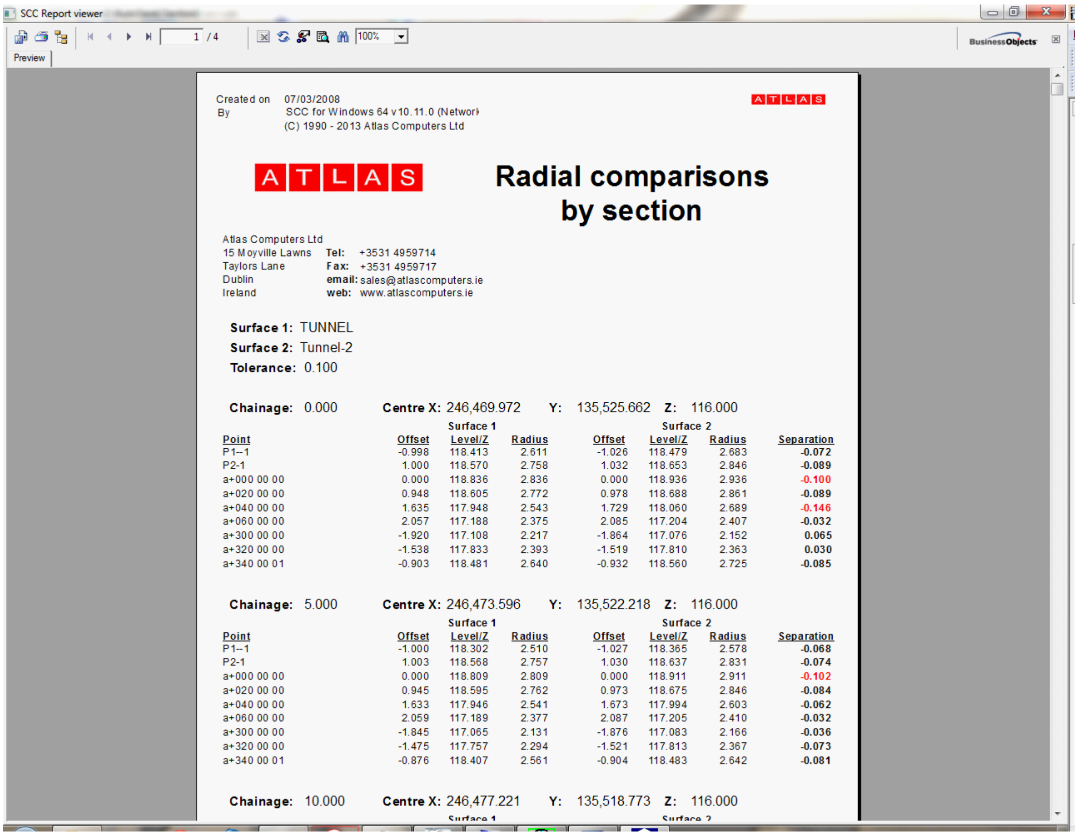


To export the differences in report format, select 'FILE > Reports' and pick 'Section radial comparisons.rpt'.





Pressing the top left button in the report viewer can be used to export the report to other formats such as Excel or PDF for analysis and archive purposes.



SCC Report viewer

Created on 07/03/2008
By SCC for Windows 64 v10.11.0 (Network
(C) 1990 - 2013 Atlas Computers Ltd

ATLAS

Radial comparisons by section

Atlas Computers Ltd
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Taylors Lane
Dublin
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Tel: +3531 4959714
Fax: +3531 4959717
email: sales@atlascomputers.ie
web: www.atlascomputers.ie

Surface 1: TUNNEL
Surface 2: Tunnel-2
Tolerance: 0.100

Chainage: 0.000 **Centre X:** 246,469.972 **Y:** 135,525.662 **Z:** 116.000

	Surface 1			Surface 2			
Point	**Offset**	**Level/Z**	**Radius**	**Offset**	**Level/Z**	**Radius**	**Separation**
P1--1	-0.998	118.413	2.611	-1.026	118.479	2.683	**-0.072**
P2-1	1.000	118.570	2.758	1.032	118.653	2.846	**-0.089**
a+000 00 00	0.000	118.836	2.836	0.000	118.936	2.936	**-0.100**
a+020 00 00	0.948	118.605	2.772	0.978	118.688	2.861	**-0.089**
a+040 00 00	1.635	117.948	2.543	1.729	118.060	2.689	**-0.146**
a+060 00 00	2.057	117.188	2.375	2.085	117.204	2.407	**-0.032**
a+300 00 00	-1.920	117.108	2.217	-1.864	117.076	2.152	**0.065**
a+320 00 00	-1.538	117.833	2.393	-1.519	117.810	2.363	**0.030**
a+340 00 01	-0.903	118.481	2.640	-0.932	118.560	2.725	**-0.085**

Chainage: 5.000 **Centre X:** 246,473.596 **Y:** 135,522.218 **Z:** 116.000

	Surface 1			Surface 2			
Point	**Offset**	**Level/Z**	**Radius**	**Offset**	**Level/Z**	**Radius**	**Separation**
P1--1	-1.000	118.302	2.510	-1.027	118.365	2.578	**-0.068**
P2-1	1.003	118.568	2.757	1.030	118.637	2.831	**-0.074**
a+000 00 00	0.000	118.809	2.809	0.000	118.911	2.911	**-0.102**
a+020 00 00	0.945	118.595	2.762	0.973	118.675	2.846	**-0.084**
a+040 00 00	1.633	117.946	2.541	1.673	117.994	2.603	**-0.062**
a+060 00 00	2.059	117.189	2.377	2.087	117.205	2.410	**-0.032**
a+300 00 00	-1.845	117.065	2.131	-1.876	117.083	2.166	**-0.036**
a+320 00 00	-1.475	117.757	2.294	-1.521	117.813	2.367	**-0.073**
a+340 00 01	-0.876	118.407	2.561	-0.904	118.483	2.642	**-0.081**

Chainage: 10.000 **Centre X:** 246,477.221 **Y:** 135,518.773 **Z:** 116.000

31.5 Additional Radial Reports

Additonal Reports are available such as 'Section radial comparisons (with X,Y).rpt' which will produce the following;

Created on 07/03/2008
By SCC for Windows v10.16.1 (Workstatio
(C) 1990 - 2013 Atlas Computers Ltd

ATLAS

Radial comparisons by section

Atlas Computers Ltd
15 Moyville Lawns
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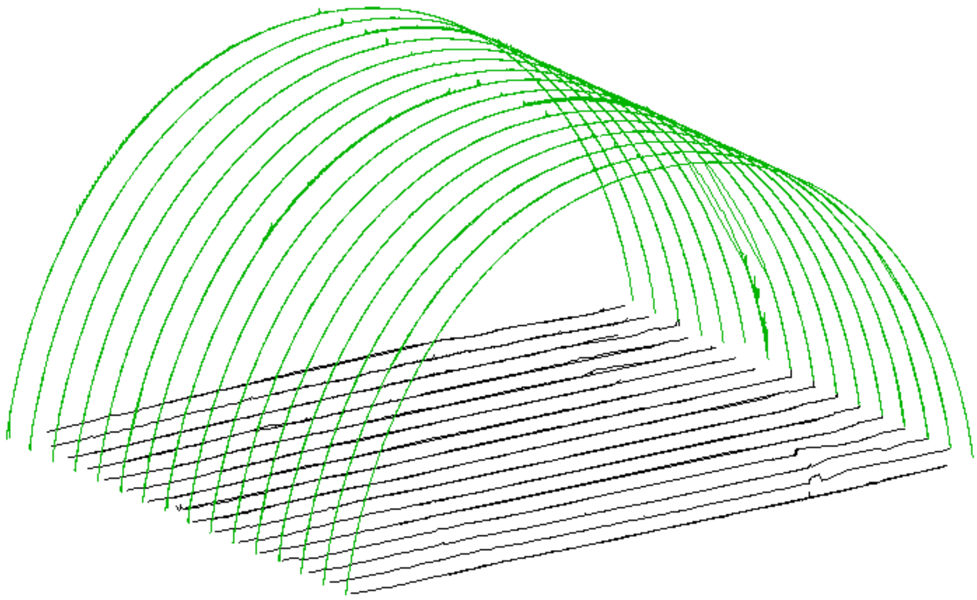
Fax: +3531 4958717
email: sales@atlascomputers.ie
web: www.atlascomputers.ie

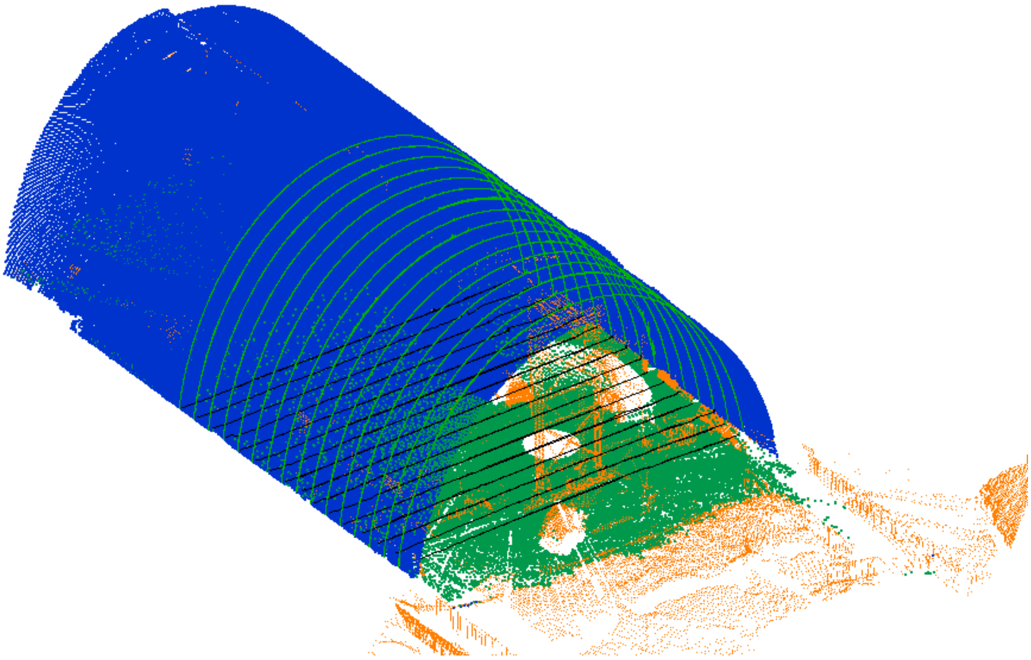
Surface 1: TUNNEL CARNO0412 1 041213 102745
Surface 2: TUNNEL CARNO1012 101213 110356
Tolerance: 0.020

Chainage: 15.000 **Centre X:** 26,441.228 **Y:** 12,720.337 **Z:** 358.279

	Surface 1					Surface 2					
Point	X	Y	Offset	Level/Z	Radius	X	Y	Offset	Level/Z	Radius	dRad
a+010 00 00	26,436.869	12,720.586	1.602	367.366	9.227	26,438.493	12,720.493	1.601	367.357	9.218	0.009
a+017 00 00	26,436.455	12,720.609	2.677	367.035	9.155	26,437.380	12,720.557	2.688	367.072	9.194	-0.039
a+019 00 00	26,436.559	12,720.604	2.980	366.934	9.153	26,437.103	12,720.573	2.989	366.960	9.181	-0.028
a+020 00 00	26,436.611	12,720.601	3.132	366.884	9.157	26,436.964	12,720.580	3.139	366.905	9.179	-0.022
a+030 00 00	26,435.786	12,720.648	4.539	366.142	9.079	26,435.726	12,720.651	4.537	366.139	9.075	0.004
a+040 00 00	26,434.587	12,720.716	5.758	365.142	8.958	26,434.421	12,720.726	5.757	365.140	8.956	0.002
a+050 00 00	26,432.624	12,720.828	6.775	363.964	8.844	26,433.590	12,720.773	6.778	363.967	8.848	-0.005
a+060 00 00	26,433.032	12,720.805	7.600	362.667	8.775	26,432.916	12,720.811	7.603	362.669	8.779	-0.003
a+070 00 00	26,432.430	12,720.839	8.254	361.284	8.784	26,432.464	12,720.837	8.248	361.282	8.778	0.006
a+080 00 00	26,432.383	12,720.842	8.725	359.818	8.859	26,432.184	12,720.853	8.723	359.818	8.858	0.001
a+280 00 00	26,448.735	12,719.909	-8.512	359.781	8.644	26,449.231	12,719.880	-8.577	359.792	8.709	-0.065
a+290 00 00	26,448.929	12,719.898	-8.130	361.239	8.652	26,448.876	12,719.901	-8.144	361.244	8.667	-0.015
a+300 00 00	26,447.662	12,719.970	-7.505	362.613	8.666	26,448.176	12,719.941	-7.516	362.619	8.679	-0.013
a+310 00 00	26,447.078	12,720.003	-6.694	363.896	8.738	26,447.295	12,719.991	-6.708	363.908	8.756	-0.018
a+320 00 00	26,445.794	12,720.076	-5.700	365.072	8.867	26,445.864	12,720.072	-5.709	365.083	8.882	-0.015
a+330 00 01	26,444.856	12,720.130	-4.504	366.081	9.008	26,444.708	12,720.138	-4.507	366.086	9.015	-0.006
a+340 00 01	26,442.682	12,720.254	-3.120	366.851	9.122	26,443.268	12,720.221	-3.121	366.854	9.125	-0.003
a+350 00 01	26,441.276	12,720.334	-1.597	367.336	9.196	26,441.781	12,720.306	-1.597	367.339	9.199	-0.003

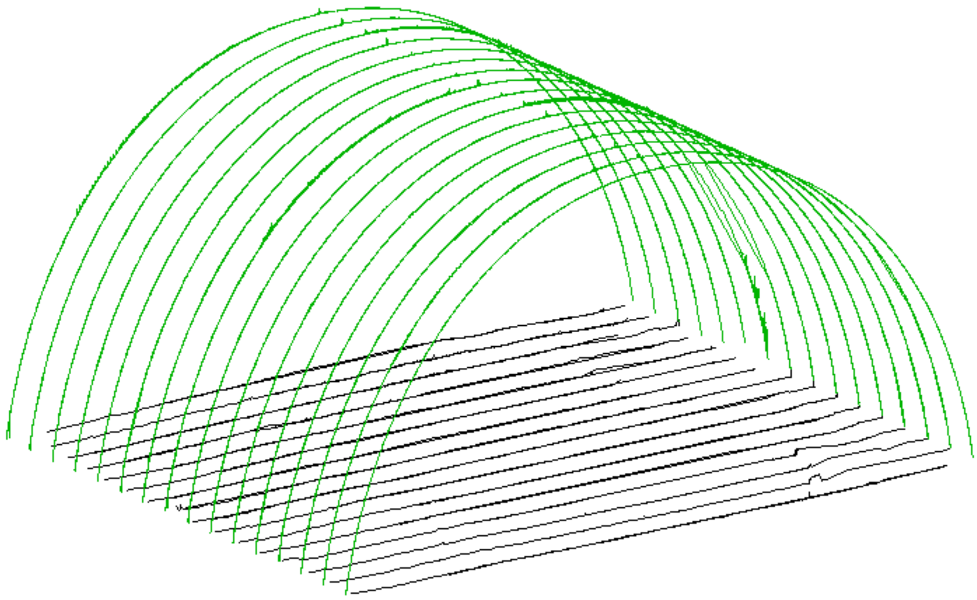
Note that you can also use File / Export / Export sections to a survey dataset, and model this dataset to get a further visual, e.g.



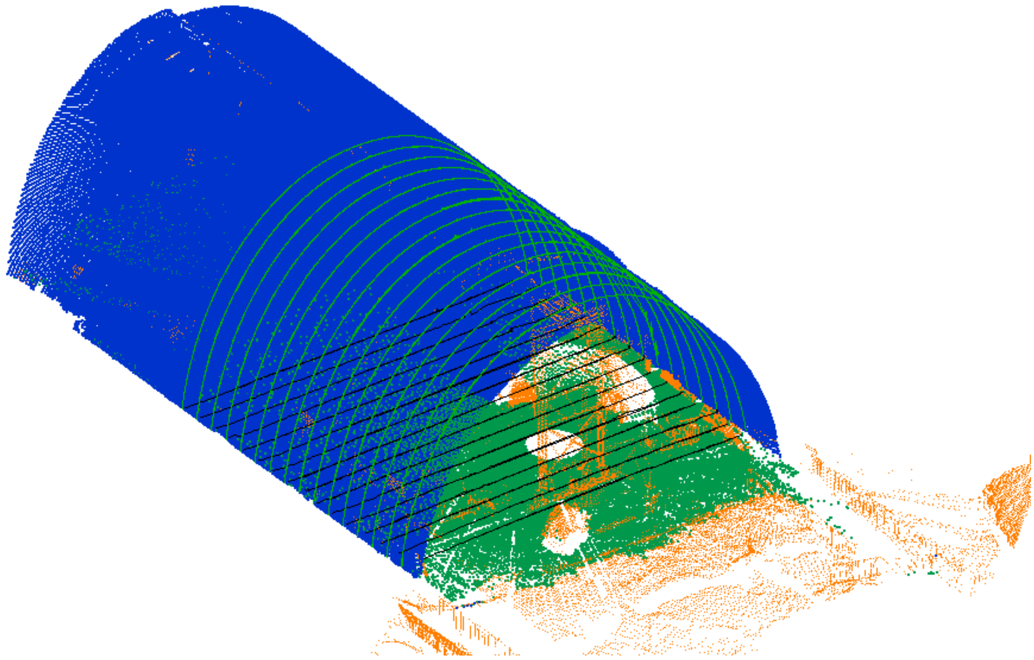


31.6 Further Visualisations

Note that using 'FILE > Export > Export sections to a survey dataset', and then modelling this dataset further visualisations can be achieved:



In addition the original point cloud can be attached.

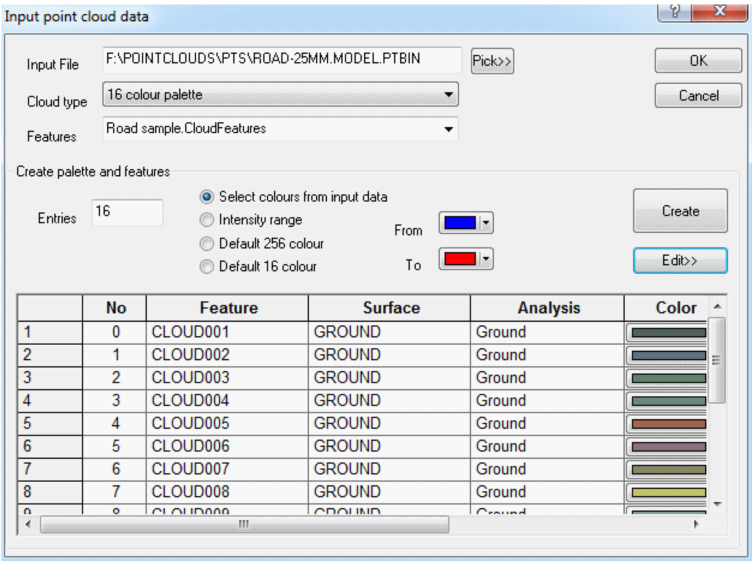


32 Point Cloud Volumes By Area

This tutorial can be implemented using either the user own point cloud models or the samples provided (Cathedral, Topo, and Bridge). To create a new point cloud model you need data in either PTS, LAS, LAZ, or ESRI ASC format. LAS and LAZ are significantly quicker to import than the ASCII based PTS format.

32.1 Importing Point Cloud Data

To start select **'FILE > Model > Point Clouds & LiDAR'** and pick the appropriate input format. This will show the following screen;

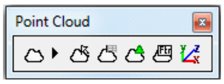


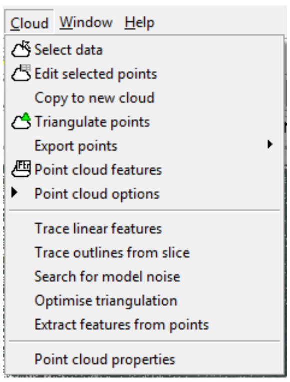
The colour usage option controls how much space is used per point, where RGB12 allows about 100 million points on a system with 1GB available memory. Palette and grey scale systems are slower to import data, but more efficient at the loss of some colour resolution. Selecting the Create palette option builds a palette and cloud feature library, based on paramers selected. This can be an optimized palette from the cloud RGB data, a colour range corresponding to intensities, or the standard AutoCAD 256 colour or VGA 16 colour palettes.

32.2 Point Cloud Data Selection

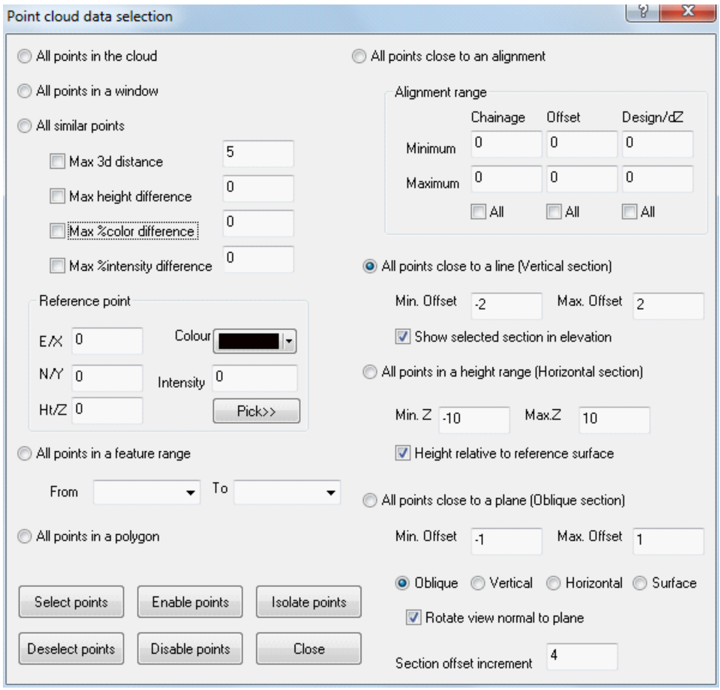
Pressing the edit button allows the user to make further edits to the point cloud feature library, and save it for re-use on other point clouds.

Point cloud functionality is accessed in the model via the **'Cloud menu'** and / or 'Point Cloud' tool bar.





The most commonly used option will be data selection, which shows the point cloud selection dialog. The allows you to control how you are going to pick data (i.e. points in a window, points in a polygon, using a horizontal or vertical section / slice, relative to an alignment, points similar to a given reference point, points close to another SCC surface) and what to do with picked data. This includes selecting and de-selecting data as per typical SCC usage, locking and unlocking data which hides the data and prohibits it from being used in future operations, and isolating data which is the same as locking everything except the picked points.

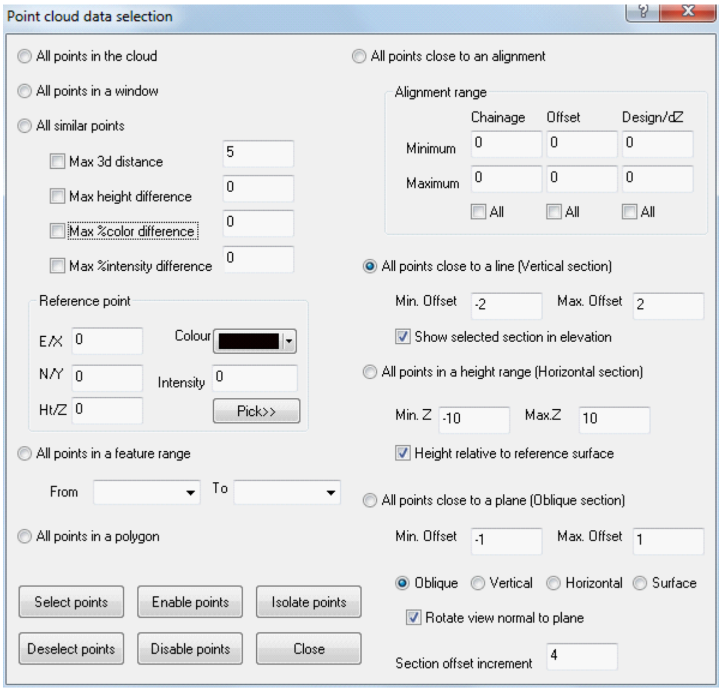


32.3 Isolating Area Of Interest

Open the Cathedral model from the tutorials directory

Isolate an area of interest by right clicking the mouse to bring up the Data Selection dialog.

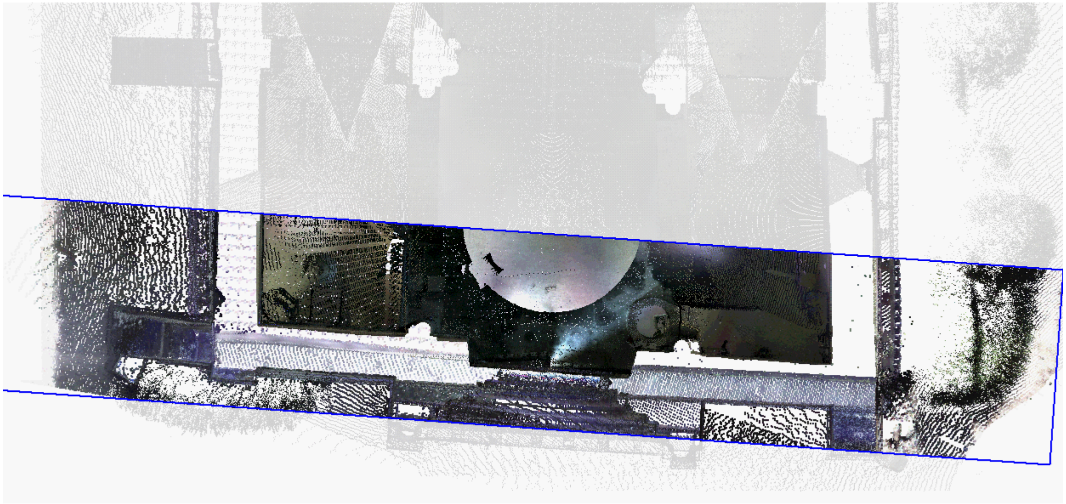
Set up the following parameters:



After pressing 'All points close to a line' and 'Isolate Data', select 'Close'

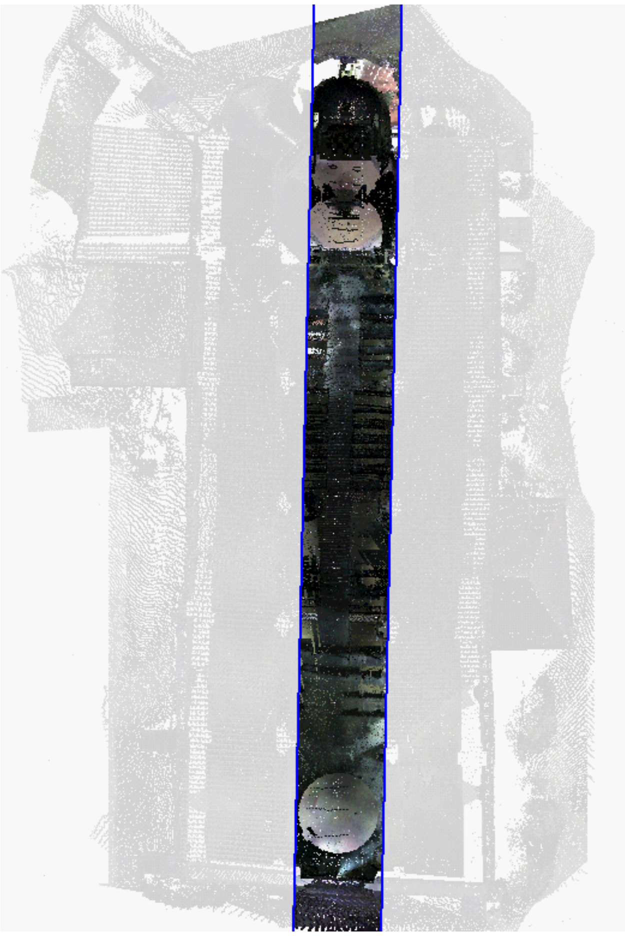
Draw the centre line of the section line of interest by left click on the model (first point and last point of line).

This highlights the area of interest as an elevation and switches the colour of all the locked points to light gray. Pressing 'P' and 'E' will move between plan and elevation view to get a better idea of what has just happened.

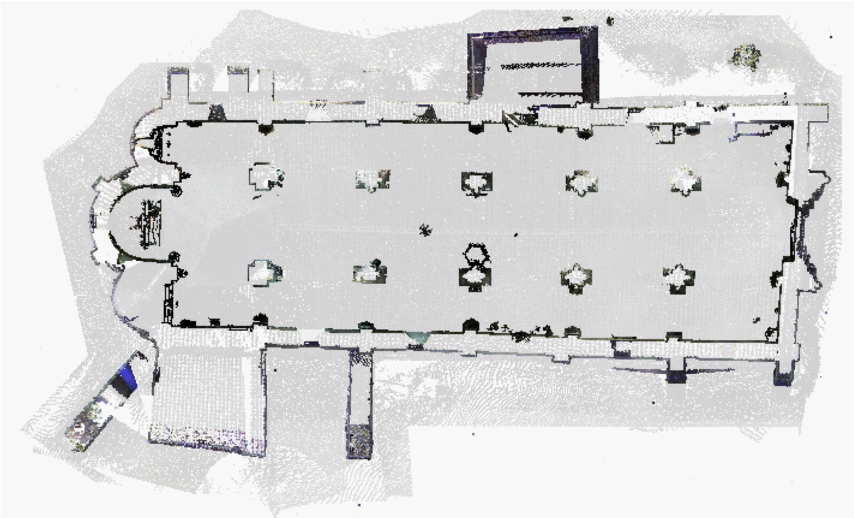


the up, down, left and right arrows are used to advance and move the section relative to the direction of view. The distance here is based on the Section offset increment in the data selection dialog, which can also be brought up using the right mouse button. From plan view we can also use the mouse at any stage to pick an alternate section as shown below;

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.



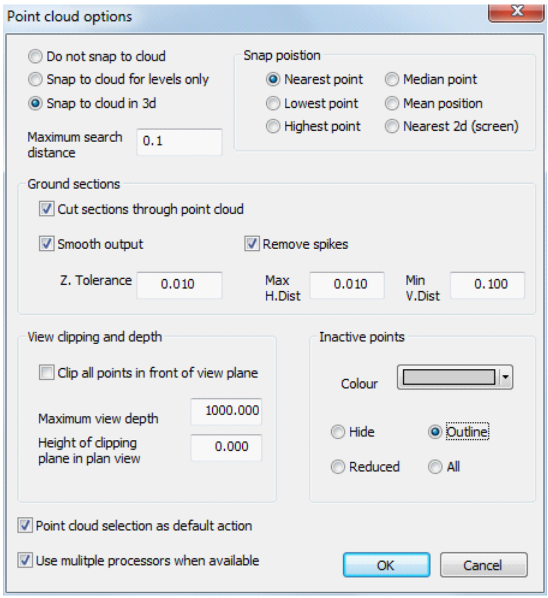
When a horizontal section / area of interest is in use the arrow keys may be used to raise or low the elevation of the section.

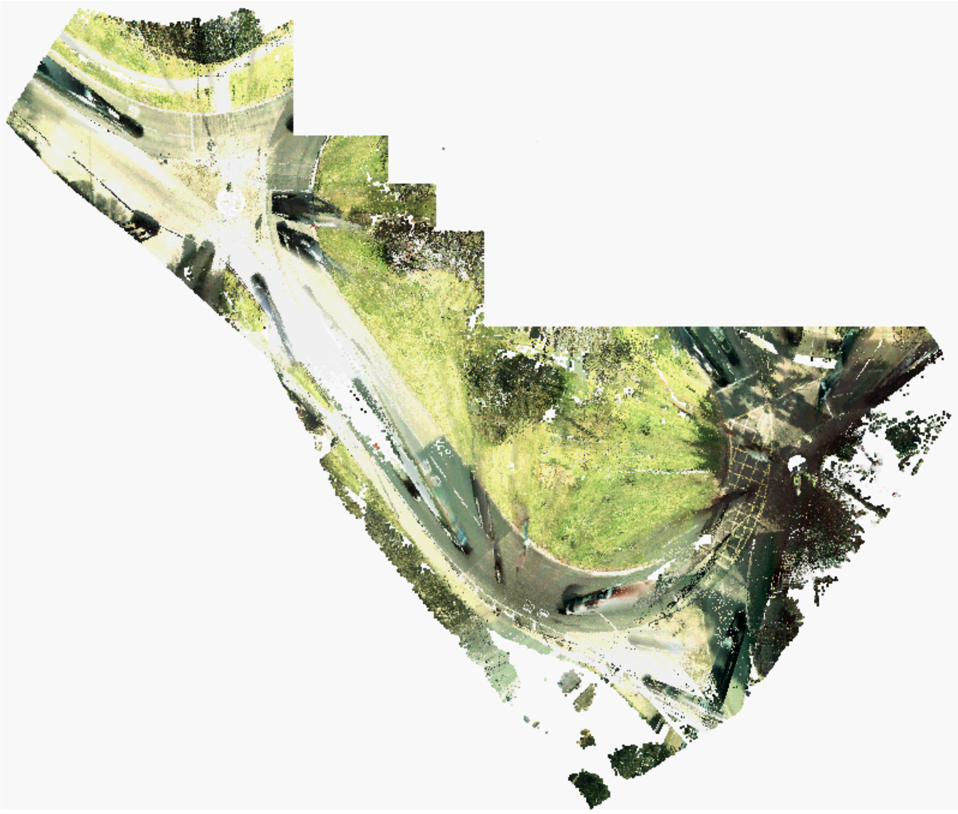


Note that as the cursor is moved around in the cloud, either in plan or another view, the x,y,z position of the cursor in the cloud can be seen, and cloud positions can be snapped to as in any other survey point.

How this works is controlled via Cloud Options, which also helps control how the cloud is treated as a surface for section and volume analysis.

Note that only active points are used for snapping, and other operations such as data selection, and export. This allows the user to first select an area of interest for analysis purposes and hide all other parts of the cloud, and then select further points from that area of interest for editing. To illustrate this better TOPO.Model from the SCC tutorials directory. When viewed in elevation the model can be seen to contain a lot of trees and street furniture that can be exclude from any surface analysis such as sections, volume, and contours.



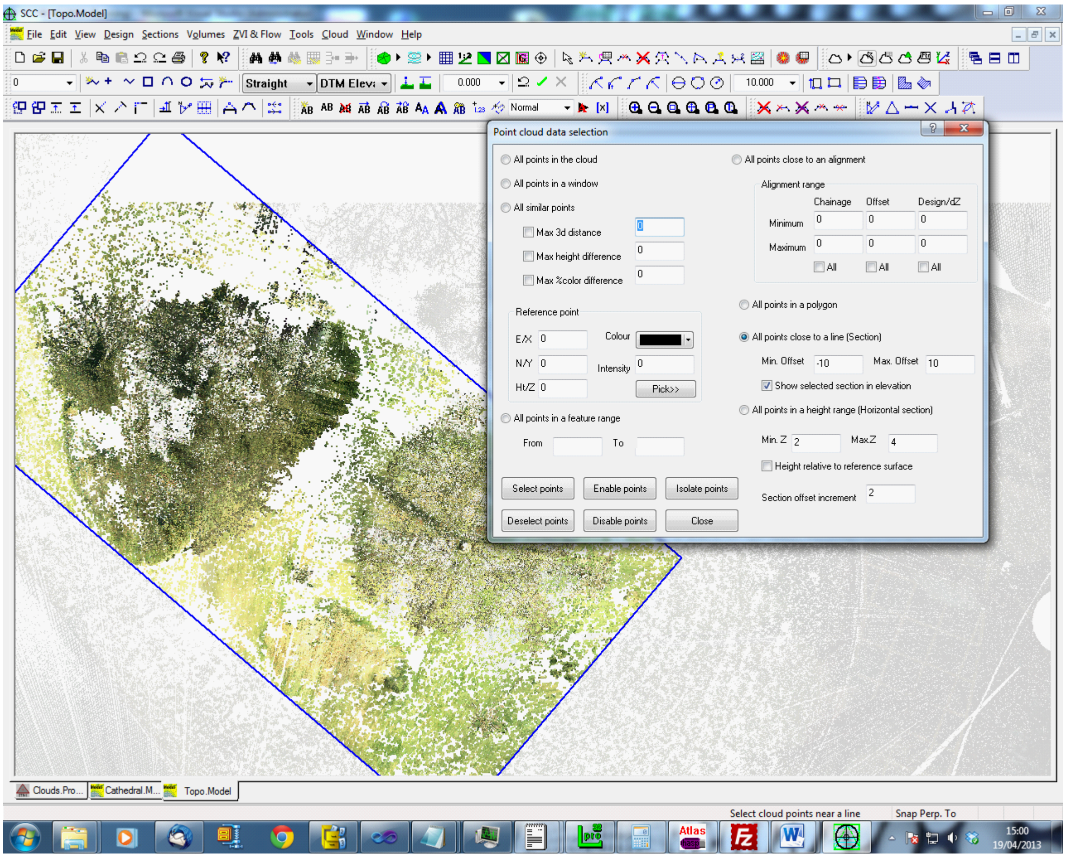


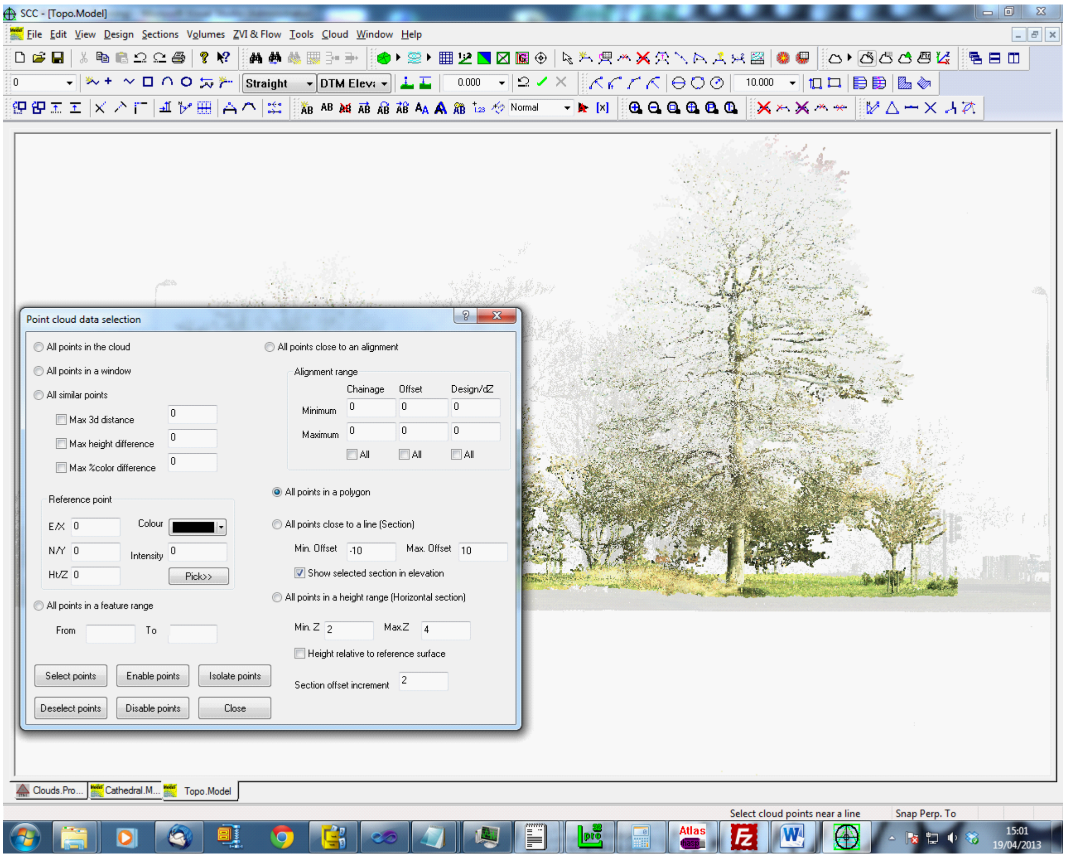
32.4 Rotating Viewpoint

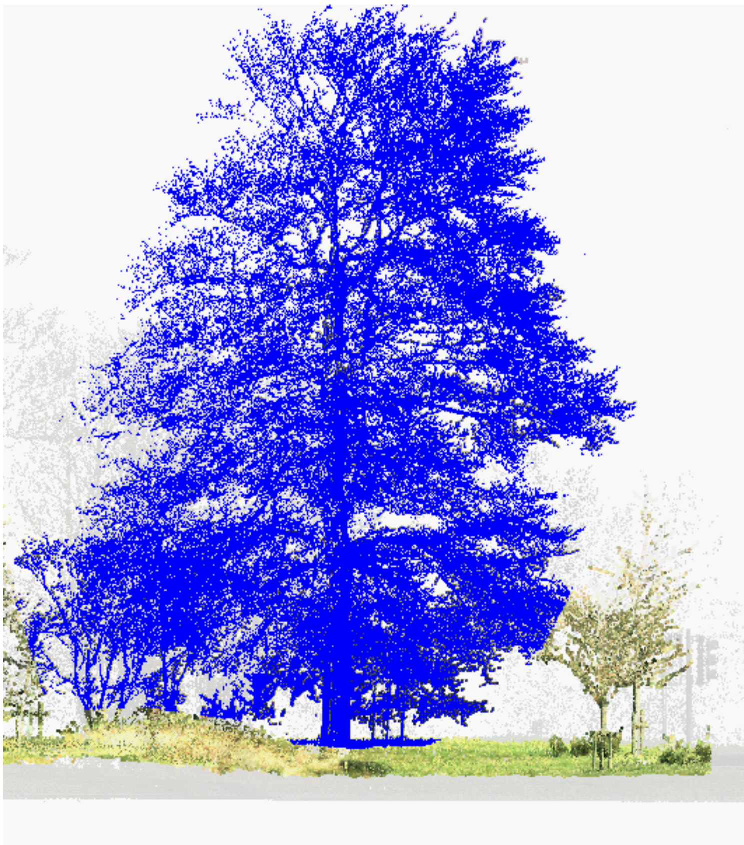
To get an elevation of the entire cloud, select 'VIEW > Rotate Viewpoint > Two point elevation', picking points at either end of the road.

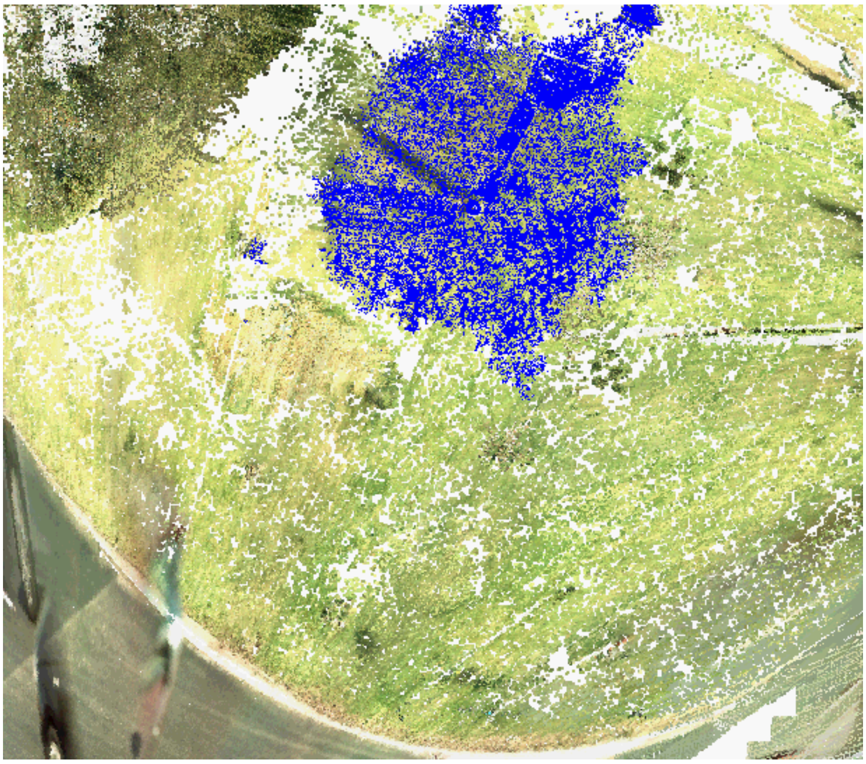
All of the upper foliage can be obtained using a polygon selection method, trimming the trunks closer to the ground is more problematic, as some are hidden behind hills, fences or in dips in the ground.

The solution here is to first isolate an area of interest, and then select from within that area, e.g.


SCC - [Topo.Model]
File Edit View Design Sections Volumes ZVI & Flow Tools Cloud Window Help
Straight
DTM Elev
Normal
Point cloud data selection
All points in the cloud
All points in a window
All similar points
Max 3d distance
Max height difference
Max %color difference
Reference point
E/X 0
N/Y 0
Ht/Z 0
Colour
Intensity 0
Pick>>
All points in a feature range
From
To
All points close to an alignment
Alignment range
Chainage
Offset
Design/dZ
Minimum
Maximum
All
All points in a polygon
All points close to a line (Section)
Min. Offset -10
Max. Offset 10
Show selected section in elevation
All points in a height range (Horizontal section)
Min. Z 2
Max Z 4
Height relative to reference surface
Section offset increment 2
Select points
Enable points
Isolate points
Deselect points
Disable points
Close
Clouds.Pro...
Cathedral.M...
Topo.Model
Select cloud points near a line
Snap Perp. To
15:00
19/04/2013


SCC - [Topo.Model]
File Edit View Design Sections Volumes ZVI & Flow Tools Cloud Window Help
Straight
DTM Elev
Normal
Point cloud data selection
All points in the cloud
All points in a window
All similar points
Max 3d distance
Max height difference
Max %color difference
Reference point
E/X 0
N/Y 0
Ht/Z 0
Colour
Intensity 0
Pick>>
All points in a feature range
From
To
All points close to an alignment
Alignment range
Chainage
Offset
Design/dZ
Minimum
Maximum
All
All points in a polygon
All points close to a line (Section)
Min. Offset -10
Max. Offset 10
Show selected section in elevation
All points in a height range (Horizontal section)
Min. Z 2
Max Z 4
Height relative to reference surface
Section offset increment 2
Select points
Enable points
Isolate points
Deselect points
Disable points
Close
Clouds.Pro...
Cathedral.M...
Topo.Model
Select cloud points near a line
Snap Perp. To
15:01
19/04/2013



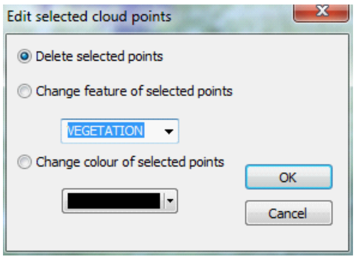


Note:

The option to allow setting a view point origin and orientation using the mouse and keyboard has been made optional, such that those primarily working in plan can't inadvertently change their viewpoint. This is controlled within **'FILE > General Options > Units & Data Checking > Allow mouse to be used to rotate'**

32.5 Analysis Of Surfaces

Note that one of the quickest ways of carrying out this type of analysis on a large topographic model is to develop a rough SCC TIN model based on a sample of spot levels taken from the cloud, and selecting all the points a set distance above this model, by ticking Height relative to selected surface in the data selection dialog.



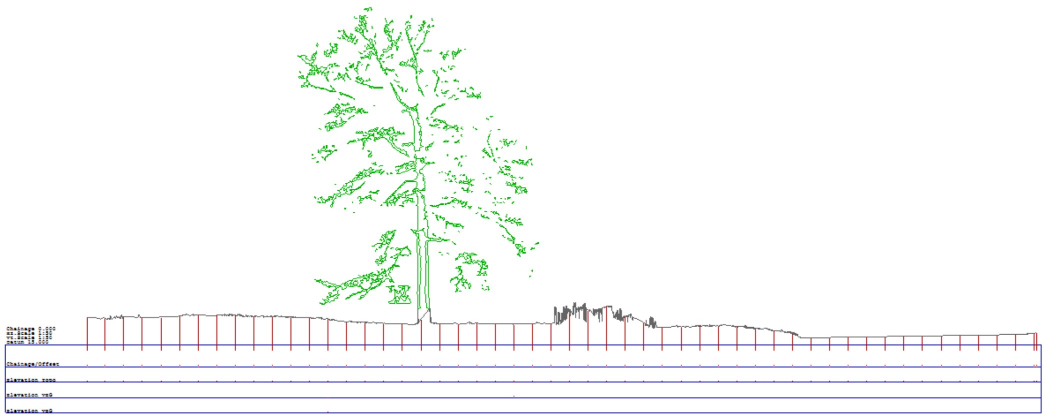
Once data is selected, it can be copied, deleted, re-coloured, and most importantly grouped by feature using Cloud / Edit selected points.

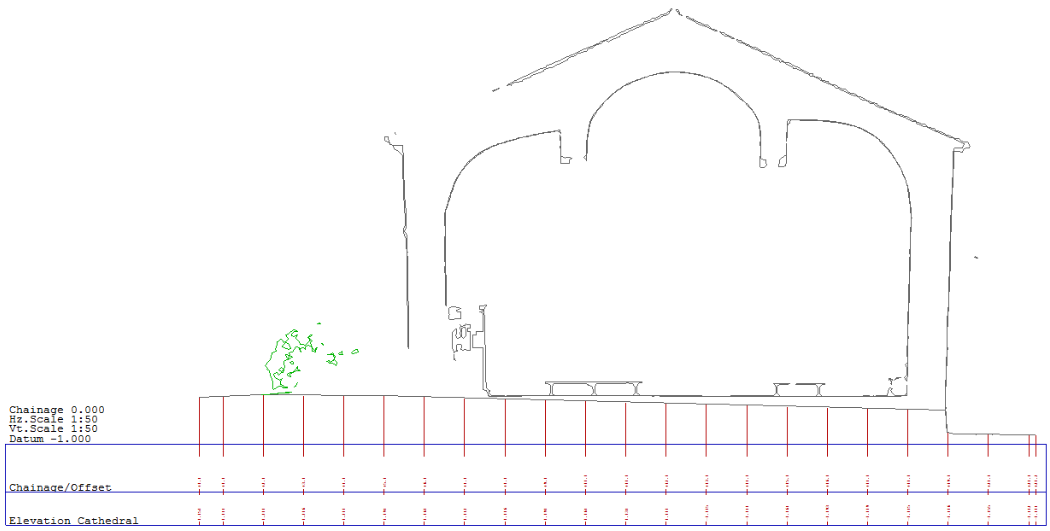
When features are assigned to groups of points, the groups can then be processed and different types of analysis applied. This is done using Cloud / Point cloud features, which shows the following dialog. The point feature fields are as follows;

- Feature – The name of the feature
- Surface – The surface on which the feature is placed. Note that you can have multiple features placed on the same surface, e.g. trees and bushes might both go on a vegetation surface
- Analysis – This controls how SCC interprets these points for surface analysis purposes. Options are
  - Display only – The points are displayed only, but not subject to analysis
  - Ground – The points are treated in the same way as the triangulation surface in a normal SCC model, from the point of view of sections, volumes, draping points, extracting levels, etc…
  - Other surface – The points are treated in a similar manner as an additional triangular surface, such as a reference model.
  - Other 3d – The points are treated as a non-mappable 3d surface, not suitable for surface analysis operations. Sectioning through 3d surfaces will be considerably slower than ground / mappable surfaces.
- Colour – The default colour of this feature when not coloured by point
- Colour by point – Whether points on this feature have individual colours or the same colour
- Visibility – Controls whether or not these points are displayed, and if they are displayed whether they are considered opaque or transparent.
- Lock – Whether or not these points are included in analysis
- Size – The size of displayed points
- Sect. Width – The search corridor width used when cutting sections through this feature. Note this will typically be small for ground surfaces, e.g. 10mm, and larger for 3d surfaces, e.g. 100mm – 500mm. The larger this value, the more 3d data will get projected onto a section and analysed. This in turn can slow down processing and significantly increase the size of sections produced.

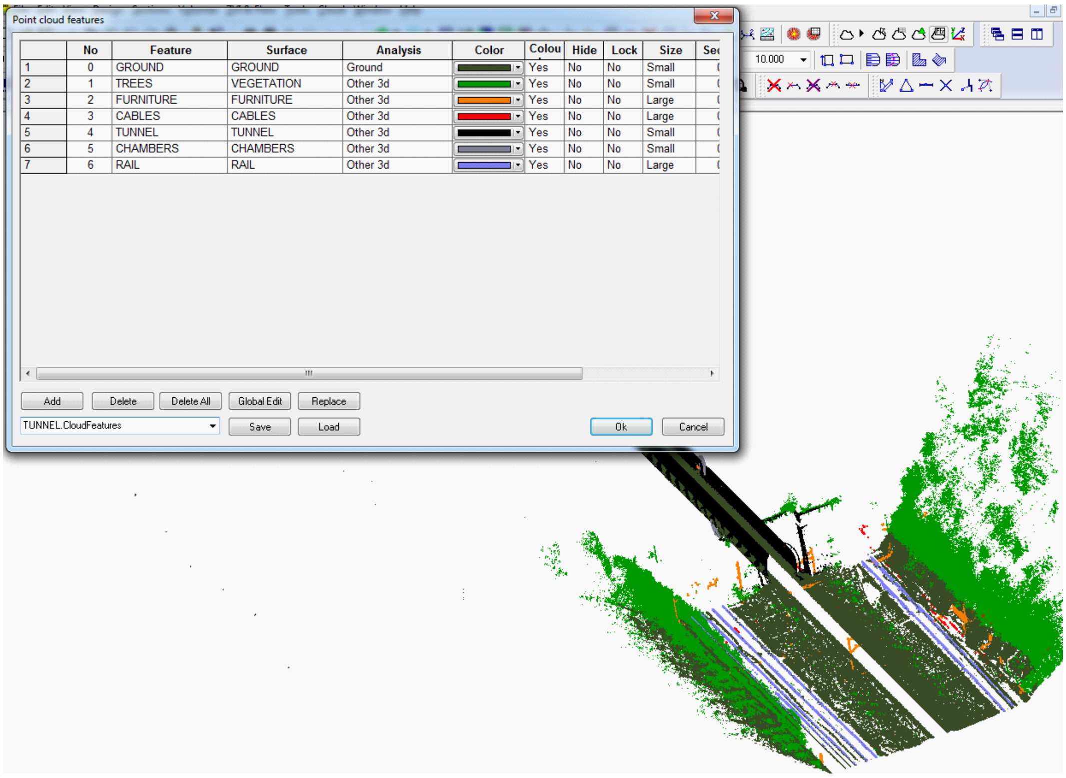
- Max Dist. – For 3d features, the maximum distance to which points will be connected.

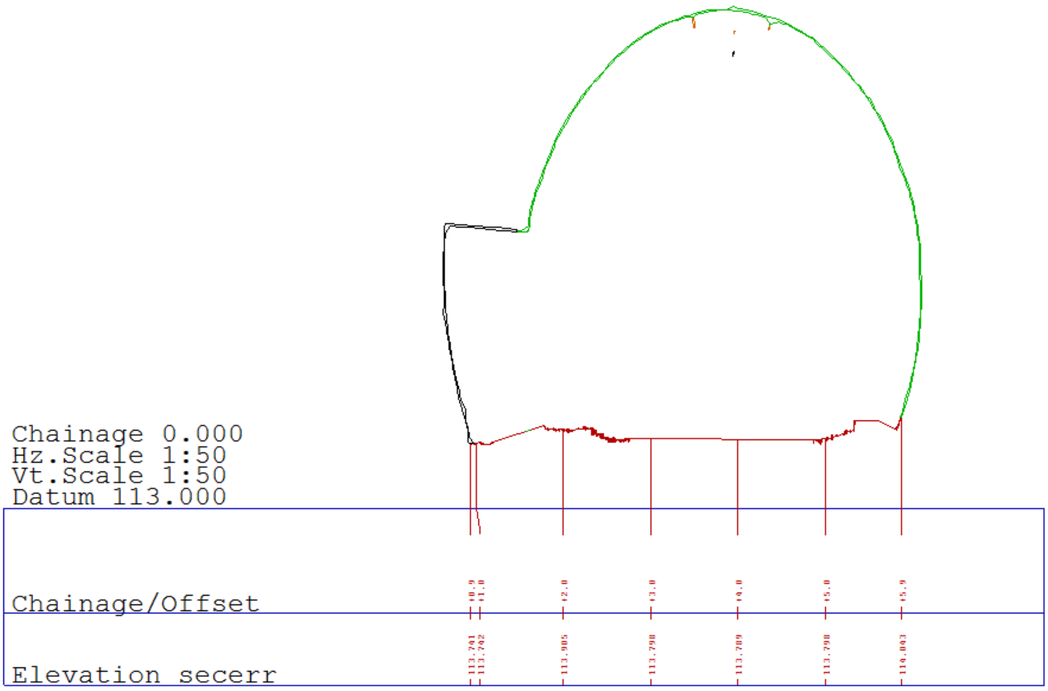
The sample models 'Cathedral.Model' and 'Topo.Model' already have some features applied. Different items appearing when displayed in section. As shown in the examples below:



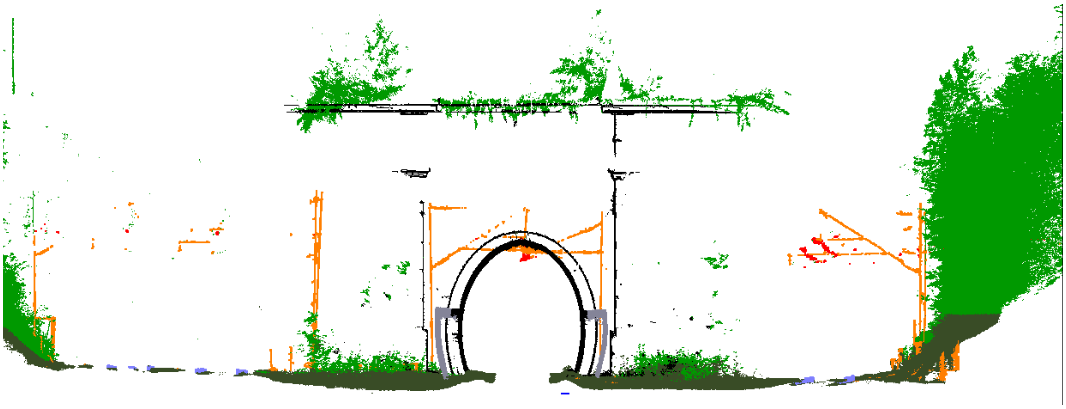


The feature library is also very useful for quickly colouring and analysing monochrome point clouds, as shown in the model below (Tunnel 950-1050 (edited).Model)



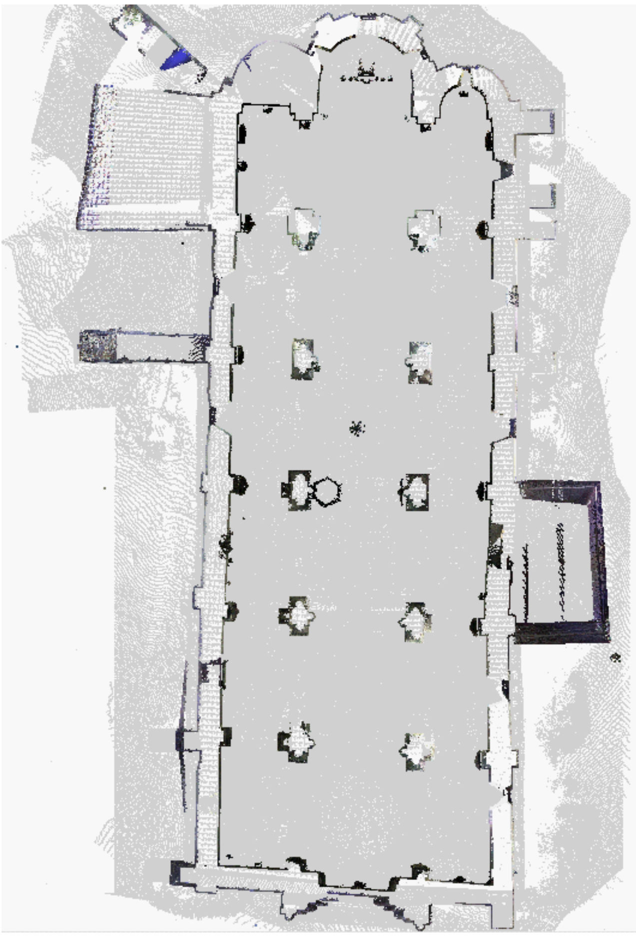


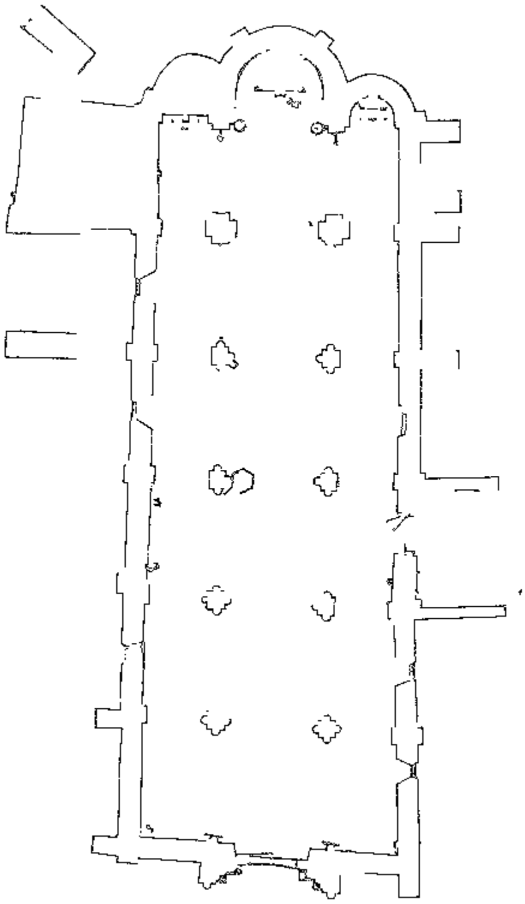
By selecting and isloting appropriate elevation and sectional areas, data can be quickly differentiated the tunnel, cabling, rails, and foliage. This in turn allows the user to cut complex sections, develop a ground surface and isolate features of interest.



32.6 Trace Outline From Slice

In addition to cutting sections there are a number of other ways to extract linear data and analyse cloud surfaces. The simplest of these is via **'CLOUD > Trace outlines from slice'**, which will draw outlines based on an isolated sectional area. This can be either from plan, elevation or based on an oblique viewpoint.

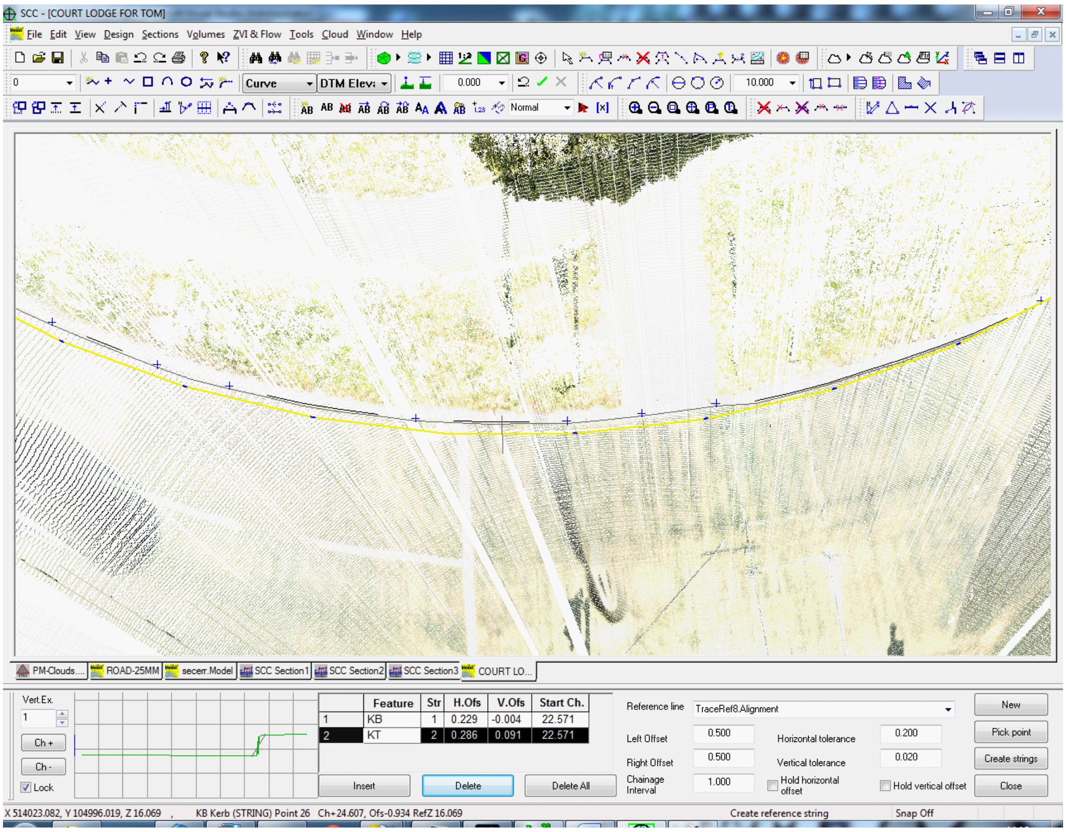




The results can then be exported to other packages, such as CAD, in 2d or 3d, and multiple slices can be used to build-up a wire frame model from the cloud. The cloud feature library determines how the data is analyses, where the centre of the displayed section or slice is used as the centre-line for sectioning.

To extract linear features, sure as kerb lines, from the cloud, use **'CLOUD > Trace linear features'**. This function allows the user to create or select a reference line, which is a line running roughly parallel to the desired features, and create strings based on similarity to a given section template. To demonstrate this, do the following;

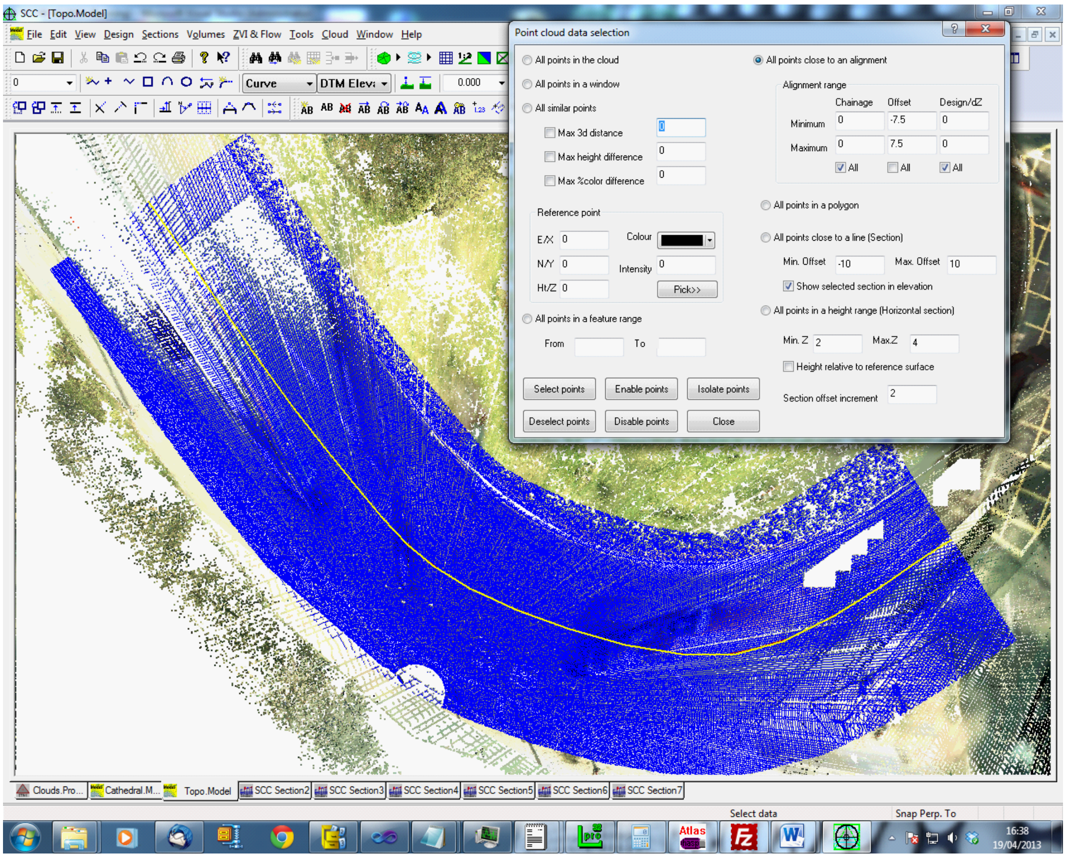
- Select an active tag code of Curve
- Zoom into the area of Topo.Model shown below
- Left click on three or more points within half a metre of the kerb to generate our reference string. Right clicking finishes the reference string and start analysing the data. Select any other active alignment to use as our reference string, or press New to create a new reference string.
- Once a reference string is defined, moving the mouse in the model cuts a cross section through the cloud at the chainage nearest the cursror, which is shown on the bottom left of the screen.
- Left clicking again freezes the position of this section, and further left clicks let us to pick sample template points. Pressing right click unfreezes the section position.



* Once points are selected, change the feature names and adjust the position in the section template sheet at the bottom of the screen.
* Pressing create, generates strings based on this template, with points at the specified chainage interval.

The horizontal tolerance controls how much the template can move along the section, from chainage to chainage, to find a best fit with points from the cloud. The vertical tolerance controls the maximum difference in relative vertical separation between points on the template and corresponding points on the cloud for the cloud points to be considered acceptable as string points. Where the vertical tolerance is not met, spot level points are out in place of string points at the correct horizontal position and cloud elevation. This helps identify areas such as drop kerbs, and positions where the feature has been occluded from the scanners line of sight.

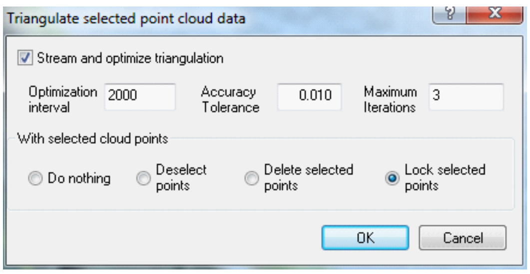
The user can also triangulate selected areas of interest for further analysis and export to software that does not support point clouds. In this case create a small alignment and select points in an area 7.5M either side of the centre line as shown below.

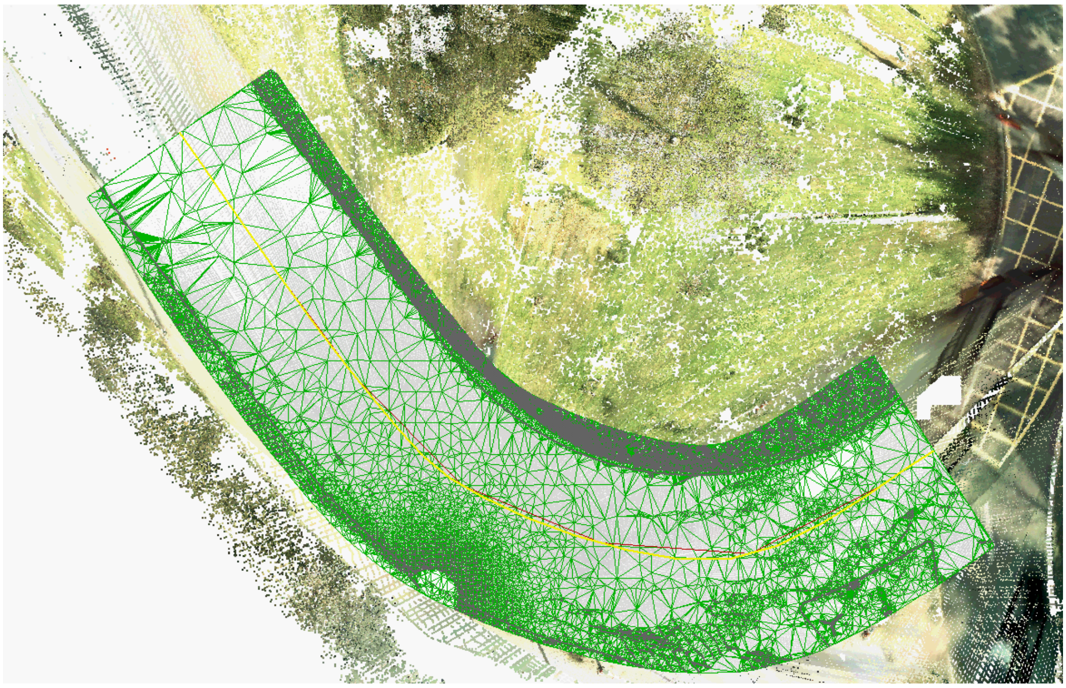


32.7 Triangulate Points

To triangulate the data, select 'CLOUD > Triangulate points', which gives the option of producing an optimized triangulation of the selected data.

This reduces the amount of points used from the selected points in the cloud to just those required to achieve the stated vertical tolerance, in this case 10mm. Note, this option can be slow depending on the parameters and the number of points selected. To improve performance and final result remove or isolate noisy features such as grass, trees, cars, street furniture and overhead cables prior to running this option. Only selected points whose features have an analysis type of Ground are considered when running this option, so simply changing the feature of such points to any other feature will accomplish this.





Other options relating to point cloud processing include linear feature extraction, density based feature extraction (stringing clumps of points), tracing string manually in conjunction with cloud snap, and use of other surface based tools in conjunction with the point cloud ground surface rather than the TIN.

To add further information to our TIN model, from coarser areas of the model that may have lower accuracy requirements, use **'TOOLS > Extract a grid of levels'**, and add the generated data to the TIN created above, along with traced linear features such as kerbs described earlier.

Note that when extracting a grid of levels, it is best to select the option to snap to the level of lowest point in the defined snap search radius, as this will tend to generate a more uniform surface, skipping small vegetation and similar items. This is set under **'CLOUD > Point cloud options'**.

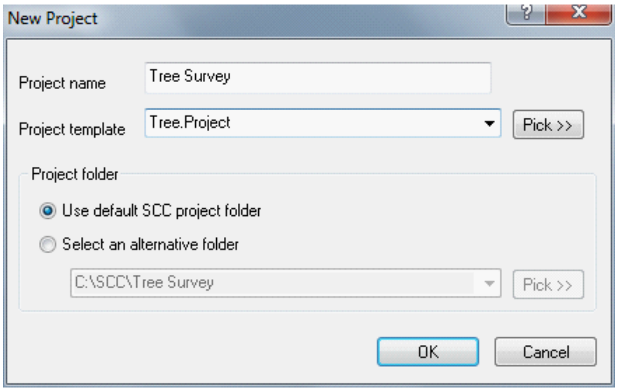
33 Tree Survey

This tutorial covers the steps required in processing a tree survey in ADB format in SCC and producing CAD drawings.

33.1 Create New Project

'FILE > New Project', entering a name for the new project and selecting 'Trees.Project' as the template.

The project template contains the naming conventions, symbols, and drawing conventions that will be used when creating models. Creating a new project also creates a folder in which all project items, such as models and drawings will be stored.

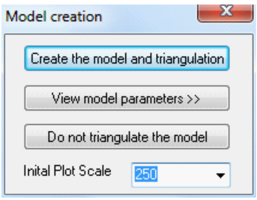


33.2 Model ADB Tree

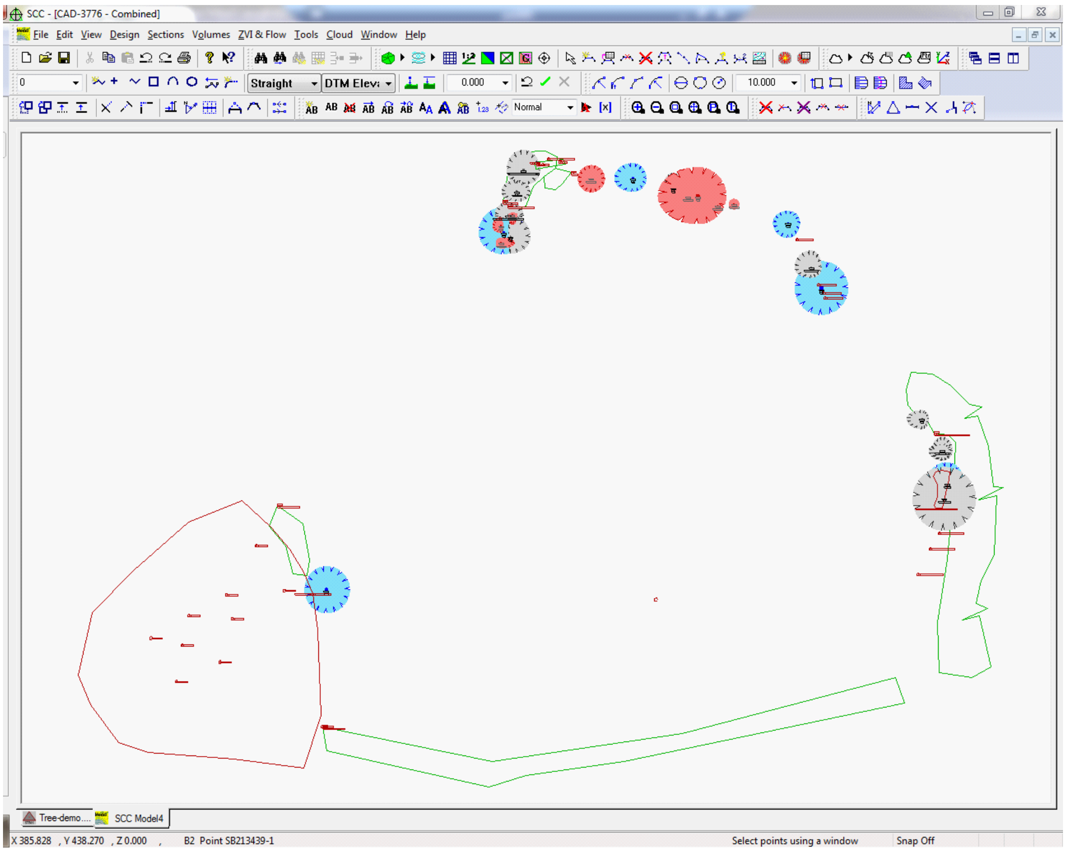
'FILE > Model > ADB tree file'

Pick the sample

Select Initial Plot Scale 250 and press 'Create the model and triangulation'

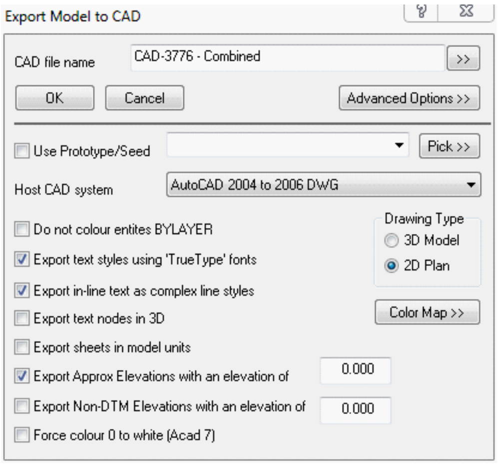


This creates the following model;



33.3 Exporting To CAD

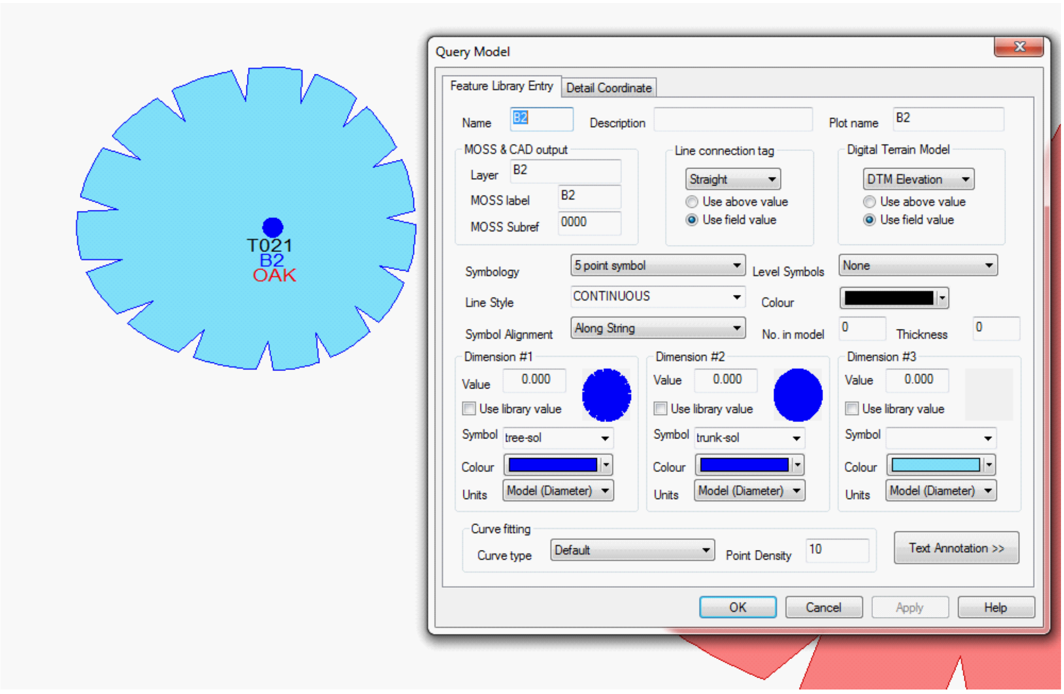
To create an AutoCAD drawing of this model, select 'FILE > Export model > CAD drawing', using the settings as given below.



33.4 Tree Symbols

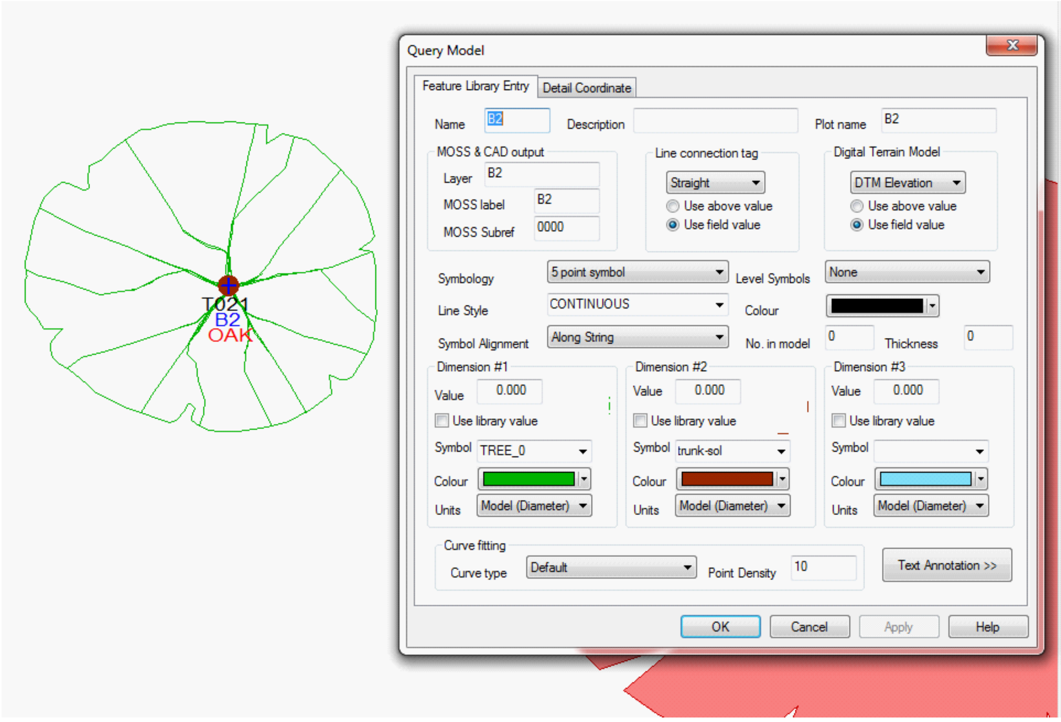
Note that tree symbols taken in ADB format are represented by five points, corresponding to a point at the trunk, and four points on the edge of the canopy. Colour, symbols and annotation are determined by feature name, which corresponds to the category field in the ADB file.

To examine this a bit further, select 'EDIT > Query and edit points' and click on tree T021.

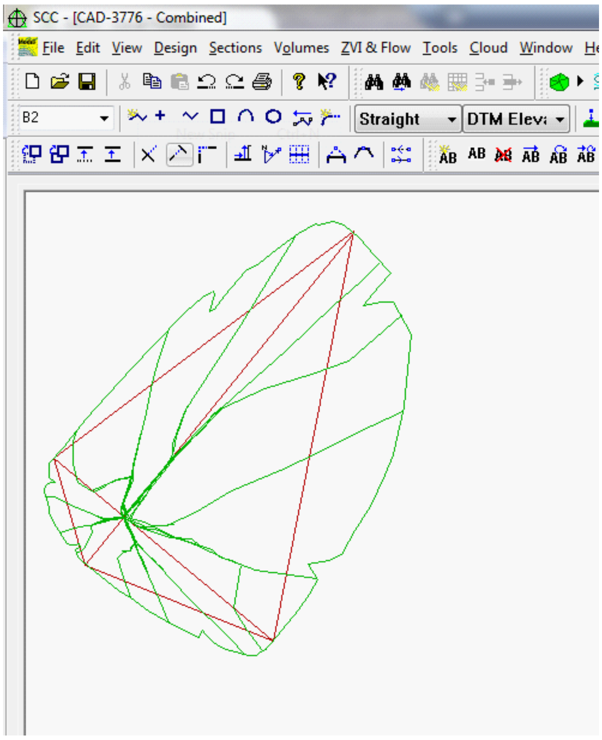


The feature B2 is set up to draw a five point symbol using tree-sol for the canopy and trunk-sol for the canopy, with draw blue used the outline and trunk, and light blue for the fill. The layer on which data will be exported can also be entered with the Query Model Feature Library Entry screen.

To illustrate how this works, change symbol 1 TREE_0, the colours to brown and green, and press ok. When prompted do not update the project library with these changes.



To create a new tree, or any other feature, select the feature name in the drop down box in the top left of the screen, and use 'EDIT > Add strings with cursor', and click five times on the screen on points corresponding to the trunk and four canopy points. Note that the four canopy points do not have to correspond to compass positions and can also be used to align the tree canopy, such that they form a rough kite shape as shown below.



'EDIT > Edit Strings > Move points can also be used to change any point on an existing string.