Leica iCON office
User Manual

version 2016.1
english

- when it has to be right

Leica Geosystems

User Manual

iCON office

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1 Leica iCON office

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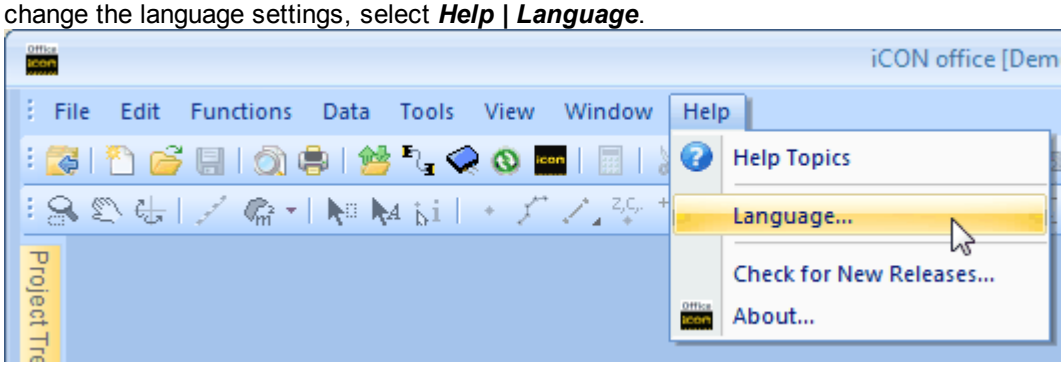
Version 2016.1

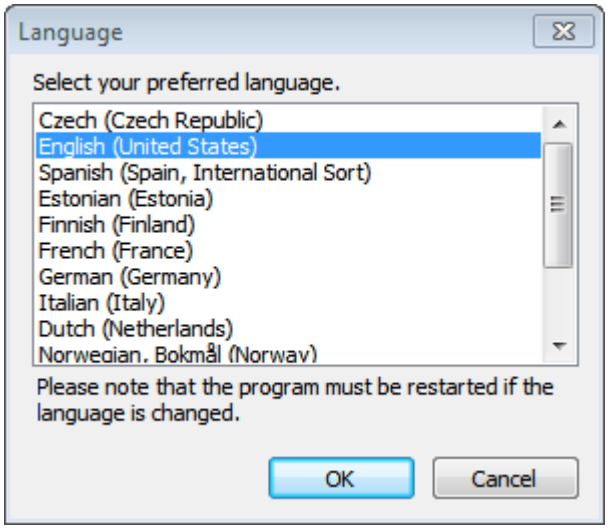
2 Working with iCON office

2.1 Language and Information about iCON office

Language

When you start iCON office for the first time on a computer, an English version of the program opens. To change the language settings, select ***Help | Language***.

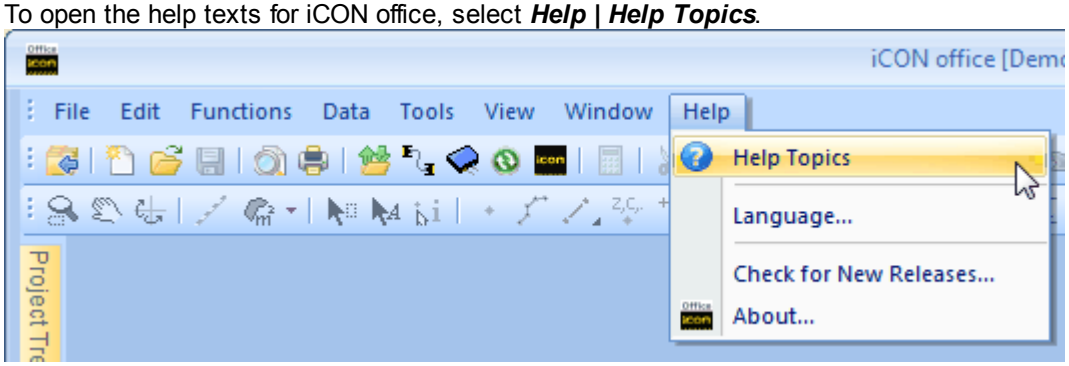




To start iCON office in a different language version, you select the desired language and restart the iCON office program. If you have selected Swedish for example, all menus, dialogs and help texts will appear in Swedish after you have restarted iCON office.

Help text

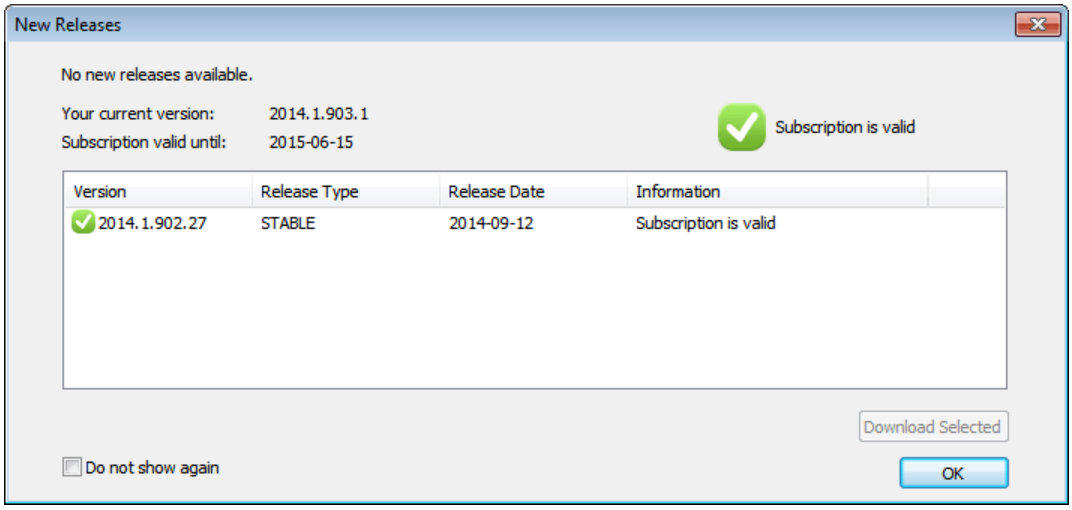
To open the help texts for iCON office, select ***Help | Help Topics***.



Check for New Releases...

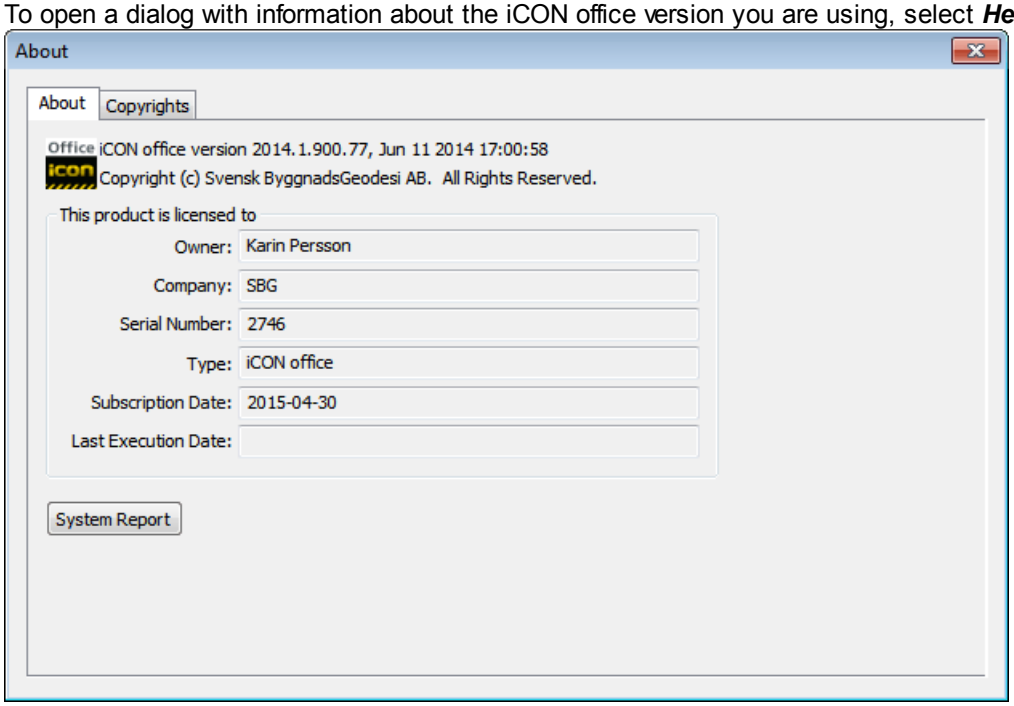
Select ***Help | Check for New Releases...*** to check if there are any new iCON office versions available for upgrading. To upgrade:

- Select the version you want to install.
- Click **[Download Selected]** to download the selected version.



System Report

To open a dialog with information about the iCON office version you are using, select ***Help | About***.



Information on the iCON office version, serial number and subscription dates, etc. are listed. Click **[System Report]** to open a text document with iCON office system report. In the system report you can i.e. see the path to the configuration folder, this path is also displayed in the System tab in the input/output window 107.

2.2 Project

2.2.1 Project

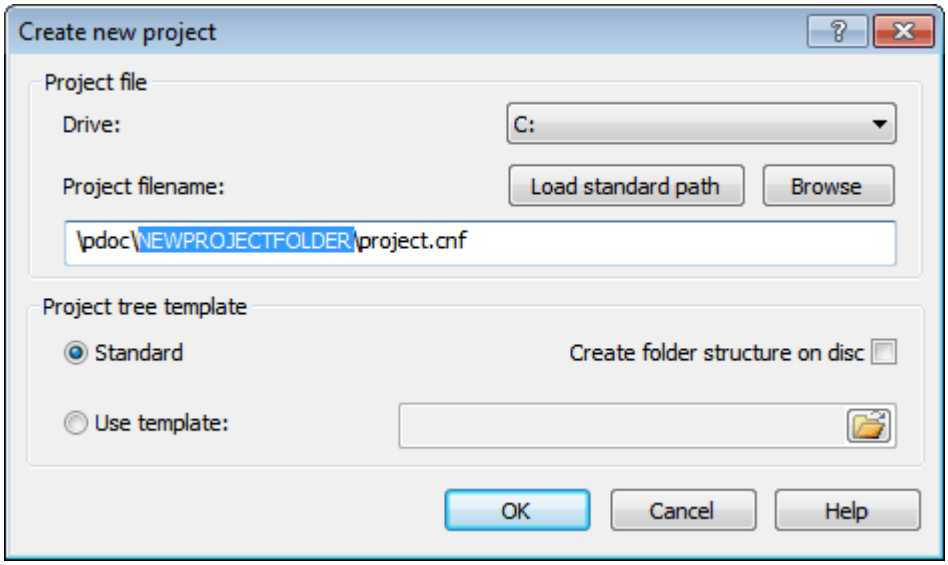
In order to keep files belonging to a particular work area or job together, you use projects in iCON office. You store information in each project that applies to the geographical area, such as the relevant polygon points, and the current coordinate system, etc. Typically, projects are placed in separate folders on a storage medium, but it is also possible to place a number of projects in the same folder. Each project is defined by a cnf file.

Project files (cnf)
A project actually consists of a cnf file, and the default name when creating a new project is **project.cnf**. The majority of the project settings 16 are stored in the cnf file. The files that are part of a project are not stored (even if the project tree is capable of this) but the files that are opened in iCON office will be handled according to the current project and its settings. A project file can be placed anywhere on a disk although the file is usually placed in a folder along with the other files that are related to the work area. iCON office creates links to all projects that are open which makes it easy to choose between projects regardless of the disk drive and the folder in which they are placed. The list of these links is personal.

See also: Create Project 5 , Open Project 7 , Delete Project 9 , Project Settings 16 , Project Tree 10

2.2.2 Create Project

There must always be an active project 4 in iCON office. To create a new project, select ***File | New Project***, or ***File | Open Project*** and click **[New Project]**.



Project file

In the dialog that appears, you can select the disc drive, path and name of the project file 4 (cnf). The path automatically proposes a name and path for the project file, e.g. "\pdoc\NEWPROJECTFOLDER \project.cnf". The text NEWPROJECTFOLDER is highlighted in order to easily replace with a real folder name. Enter the name of the new project.

In addition to the project file a blank polygon point file 186 is also created, pp.geo, along with a project tree 10 in the current folder. In addition, a link is created to the project in the registry in Windows®, see Open Project 7 .

Load standard path

If you have made changes to the path and want to bring back the originally proposed path, you can click here. E.g. "\pdoc\NEWPROJECTFOLDER\project.cnf" will then pop up again and the text NEWPROJECTFOLDER will again be highlighted.

Browse

You can also browse to the folder and file name that you want to use for the new project. Remember that you must create any new folders as you scroll in the file dialog that appears when you set this option.

Structure of project folders

The factor that determines how the proposed path to a new project appears is the underlying structure of the current disc drive. The underlying structure can be edited by selecting ***Edit | Preferences | Folders***. In the fields for the project folders, you can specify the structure of each drive, e.g. "\pdoc*" for c: and "\projects* \xyz" for d:. The asterisk (*) indicates the project location and it is this part that is substituted for the text NEWPROJECTFOLDER in the dialog for new project. These preferences are stored in the file **geo.dir** which is in the configuration folder 107.

Create multiple projects in the same folder

Sometimes there may be a need to create multiple project files in the same folder, for example, if several people are working in the same project but want different project settings. Change the project name NEWPROJECTFOLDER to the existing folder name and then change the name of the project file from project.cnf to something else. You can also select **[Browse]**, skip to the active project folder by pressing the button in the dialog that appears, and enter a new file name. **Note:** Remember to keep the file type cnf.

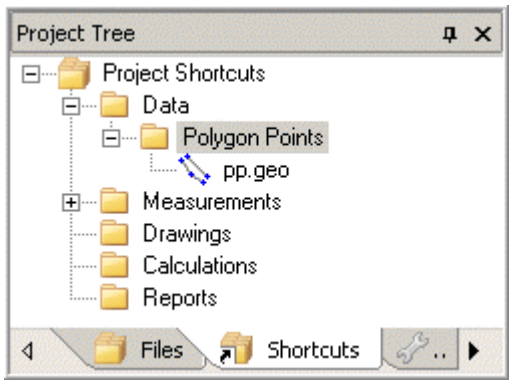
Project tree template

A project tree is created whenever you create a new project. If you have previously saved a template for your own project tree, you can select the project tree you want to use in your new project.

To create a project template, right-click the project tree root, *Project Shortcuts*, in the Shortcuts 14 tab, and select **[Create template...]**. If you do not click on the root, the menu remains disabled. When creating a template, it is automatically saved with the file extension pft in the global folder 17. If you wish to save the template in a different folder you can set the path there.

Standard

If **[Standard]** is checked, a project tree is created with the five default folders: Data, Measurements, Drawings, Calculations and Reports.



Use template

If you check this option you can select a template that the project tree is to be created from. Select a project template, pft file, Project File Tree, from which the tree will be created.
The project tree templates can either be stored in the global folder or in a specific project.
There will also be a dialog where you can specify whether you want the file name that is in the template to accompany the new project. Please note that the file names are copied to the new project, but the files will not contain any data.

Create folder structure on disk

If the box is checked, a folder is created on your hard disk with the same path as the project file, *project.cnf* above. This can be done regardless of whether you select **[Standard]** or **[Use template]**.

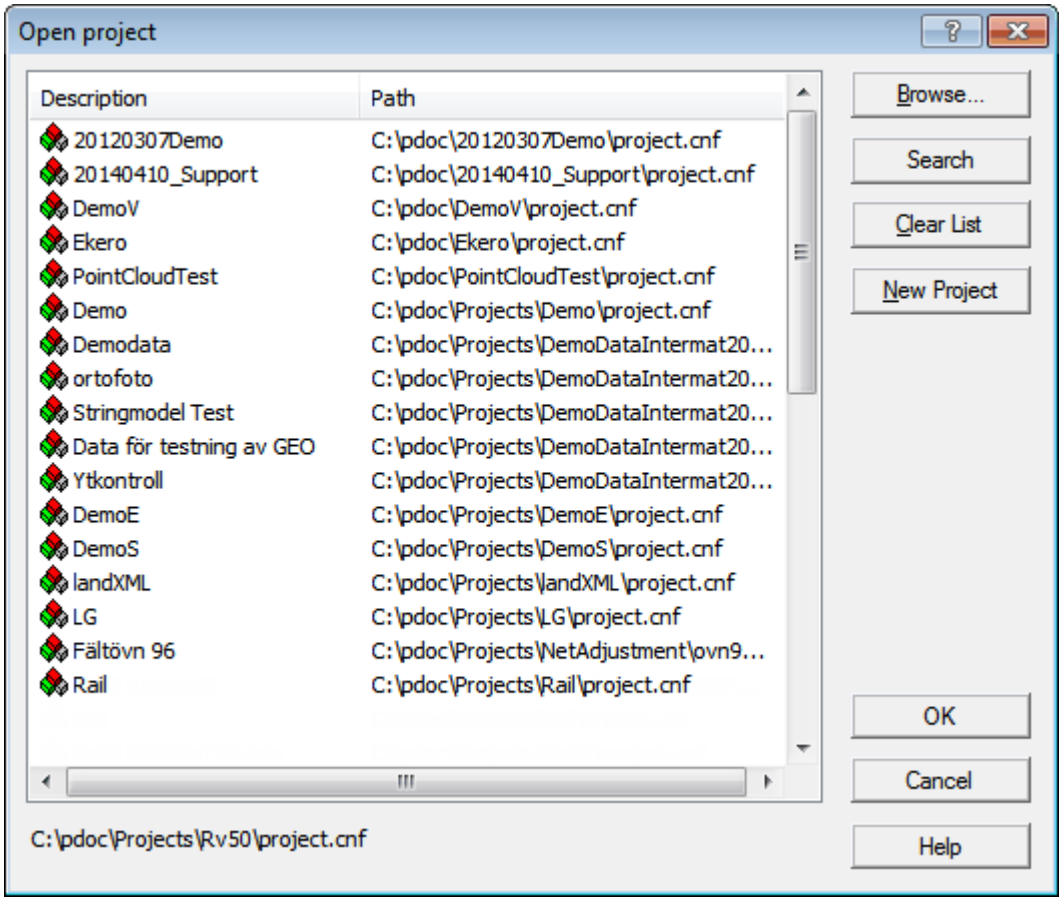
Project settings

When a new project is created you can click on the Settings 16 tab in project view 16 in order to get an overview of the program and project settings.

See also: Project 4 , Open Project 7 , Delete Project 9 , Project Settings 16 , Project Tree 10

2.2.3 Open Project

Select ***File | Open Project*** to switch to another project.



Each time a project is opened, a link is added to its project file (cnf) in the Windows registry. When the dialog to open the project is displayed, all the links are loaded and the corresponding project is displayed in the list of available projects. This means that you do not have to choose from all the existing projects. In addition, it will be easy to choose from projects regardless of the disk drive and the folder they are located in. The list is added to the personal section of the registry enabling different users to add different lists of projects.

Hint. To switch between the ten most recently used projects select ***File | Recent Projects***.

Dialog description

Open a project in the list
The description appears in the list of projects to the left and the path to the right. Select the desired project and click **[OK]** to open it.

Add a project link
Click **[Browse]**. Locate the desired project file (cnf), and click **[Open]**. You can now see the project in the list, click **[OK]** to open it.

Search for projects to add
By clicking the button **[Search]** you can add the links to several projects on a drive or in a path simultaneously. When you click the button, a dialog appears where you select the paths to be searched for project files, such as "C:\" or "O:\ pdoc\". Sub-folders to the specified path are also searched. When the search is complete, the new links are added to the list. Click **[Cancel search]** to quit a search in progress.

The links that have already been created will remain.

Delete project link
By selecting one or more links and **right clicking** in the list you can choose to delete the links. This does **not** delete projects but only removes the link.

Delete all project links
If you have many links which are no longer relevant or do not link to an existing project, you can choose to remove all links by clicking **[Clear List]**. This does **not** delete projects but only removes the link.

New Project
Click **[New Project]** to create a new project, see also Create Project 5 .

Missing links
Since the list of projects is generated from shortcuts, it is not certain that all projects listed in the dialog really exist. If you point to a project that has a missing link you will get the message: *cannot find project file "project.cnf". Do you want to delete the link from your personal list?* If you select yes, the link will no longer appear in the dialog. If the project has been moved, you can either find it manually by selecting **[Browse]** or by searching the drive, **[Search]**.

See also: Project 4 , Create Project 5 , Open Project 7 , Delete Project 9 , Project Settings 16, Project Tree 10

2.2.4 Delete Project

As a project is only really defined by the actual project file, e.g. project.cnf, it is this file that is to be deleted if you want to remove a project. There is no special function or menu option to physically delete a project from a disk drive, which means this must be done using Windows Internet Explorer. If you are only interested in deleting a project link[8] from the list of available projects, it is possible to do this in the dialog to open projects.

See also: Project[4] , Create Project[5] , Open Project[7] , Project Settings[16], Project Tree[10]

2.2.5 Files in the Project

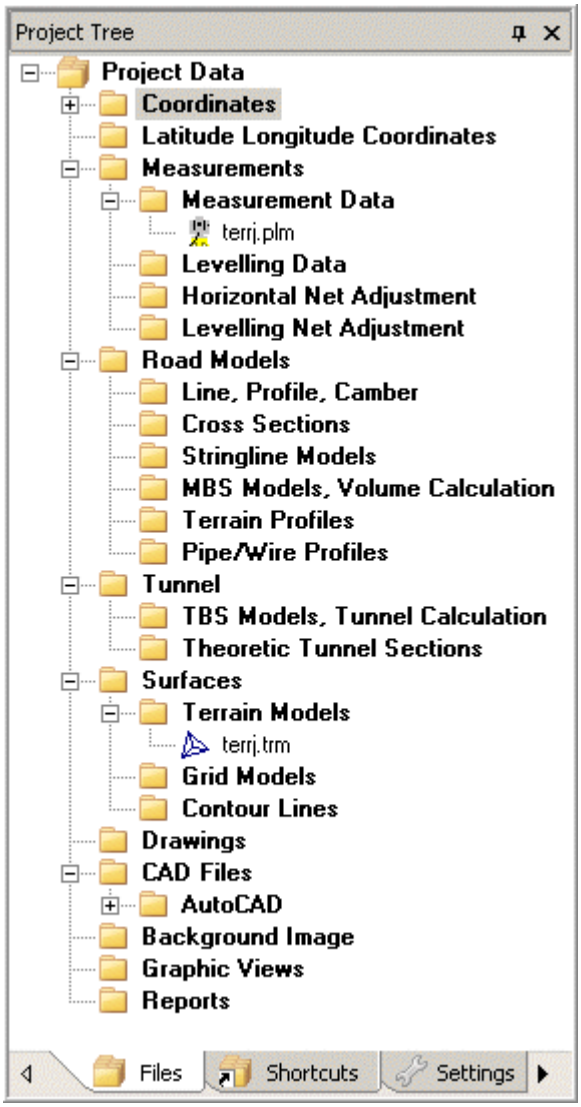
The Project View is divided into three tabs, one showing files in the project, one tab to add shortcuts 14 to files, and one that contains project-related settings 16. The **Files** tab gives an overview of all the files in the project. By right-clicking on the nodes in the tree you can select a number of special functions, e.g. to open a file.

The window can easily be switched on or off by selecting ***View | Project Tree*** or select the icon .

The window is dockable 40, which means that it can be 'snapped' in place to a border. Read more about the window which is also dynamic, in General about windows, views, and toolbars 40. When iCON office closes, the position of the window is saved so it appears in the same place and has the same size the next time iCON office is started.

Files

The dynamic project tree automatically displays all files in the current project folder and its sub-folders. iCON office monitors changes to these folders so that you can immediately see if files have been added or cleared. The files are grouped by file type, making it easy to open them without using the usual Open dialog; simply double click on the desired file. By right clicking on the files, you can, for example, create new files of a certain type, give the files new names, toggle the display on and off, send emails and archive 36 etc.



Tree Structure

All files included in the project are located under an appropriate node in the project tree. In this way the files are grouped into a tree regardless of their location in the project. The structure of the tree consists of a number of folders and in some cases a number of sub-folders as a way of grouping the files logically. This grouping makes it easy for the user to locate the project files. When you open a project, the nodes expand to display the input files. If a node contains more than 20 files, or more than the number under Tree expanding options 12, the node is closed until you open it.

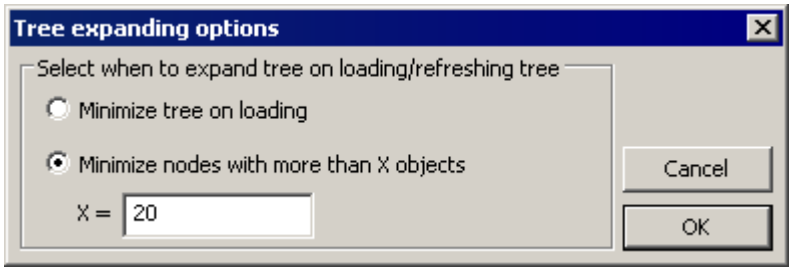
Working with files from the tree

Using the tree you can open files in various ways:
Right-click a file and select **[Open file in a new window]** or **[Open file in an active window]** to open a file.

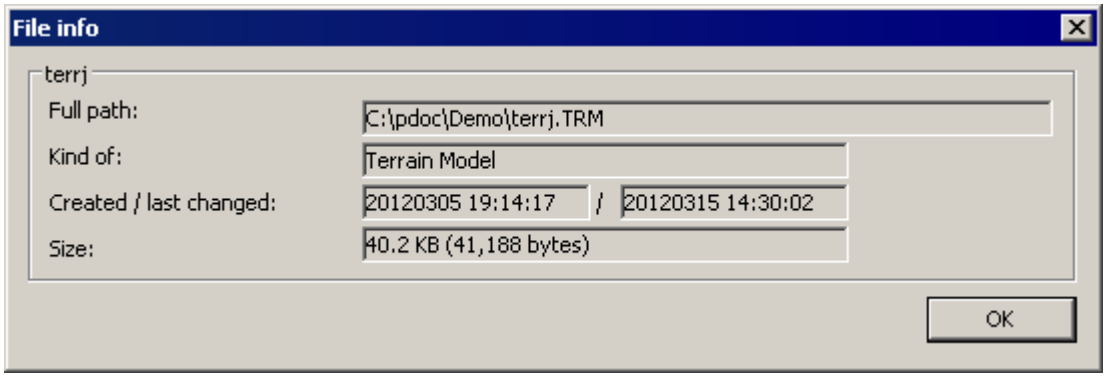
Double-click a file to open the file in the active view.
Select one or more files and drag them to the iCON office-window - if you drop the file in an existing window it will open here, otherwise in a separate window. You can also drag the file from the project tree to an e-mail. By right-clicking a file, you can choose to open the file in the active or new window.

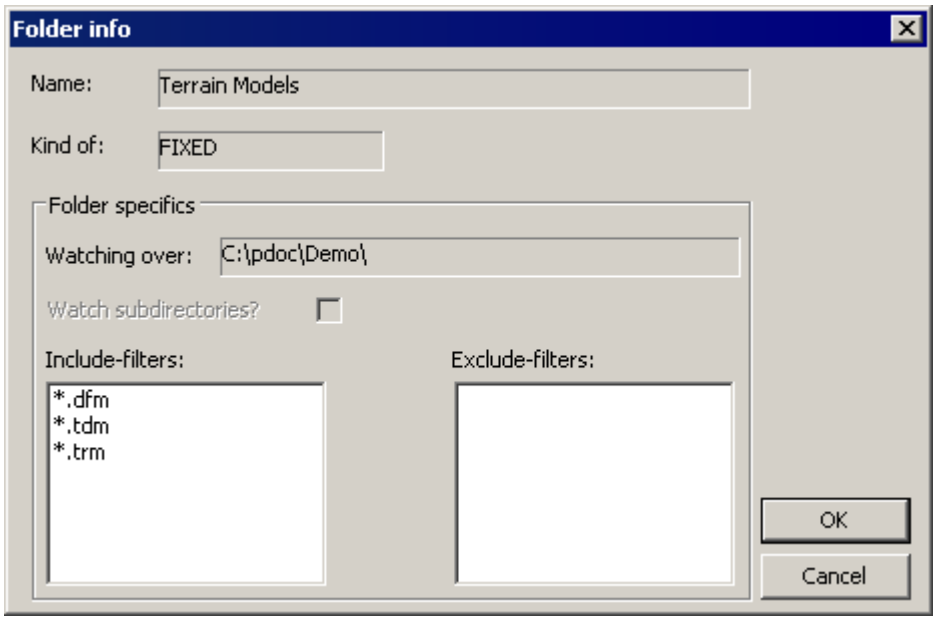
Right-click the nodes in the tree
Depending on the file or folder you right-click, different options appear in the menu.

- Create new document
  Creates a new blank document of the selected type.
  If, for example, you select the Coordinates folder, and select *Create new document*, a new blank coordinate file opens.
- Open File in the Current Window
  Opens the selected file in the active window.
- Open File in a New Window
  Opens the selected file in a new window.
- Toggle visible
  This makes the file visible/invisible in the graphic view. Only selectable if the file is open.
- Delete File
  This option deletes the file permanently from the project. Not possible to undo.
- Rename File
  Allows you to rename a selected file.
- Show File on Disk
  Opens Windows® Explorer with the current folder as default.
- Send as e-mail
  The file is attached to a new e-mail message.
- Create archive
  The user must choose a name for the archive where the zipped files are stored, see also Archiving 36 .
- Update tree
  If the project is on a computer/server running Windows, the tree is automatically updated when any change is made to the disk.
  Manual update of the tree is only required if the project is not on a Windows computer or if File Watch is disabled, see Toggle File Watch On/Off 12.
  To update the project tree manually, right click and select **[Update tree]**.
- Toggle Project Tree On/Off
  Make the project tree visible or disable the tree.
- Toggle File Watch On/Off
  When file watch is enabled, the project tree is automatically updated with files that have been added or removed from the project.
  If the file watch is disabled, the project tree is only updated if the user selects **[Update tree]**, see Update tree 12.
- Toggle common view of the associated files
  Activate common view to display associated files grouped together, eg. line files will be grouped together with associated profile and camber, if any.
- Tree expanding options
  There is an option here to minimize the tree when starting iCON office.
  The user can define when the nodes are to be minimized and opened.



- Properties…
  Information about the file or folder.





Hint Double-click a file in the project tree to open the file immediately.

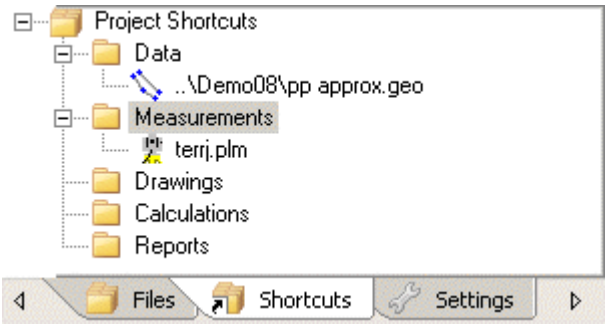
See also: Project 4 , Create Project 5 , Open Project 7 , Delete Project 9 , Background image 219

2.2.6 Shortcuts in the Project

The Project View is divided into three tabs, one showing files 10 within the project, one tab where you can enter shortcuts to files, and one that contains project-related settings 16. Under the **Shortcuts** tab you can group the files that you want to include in the project. By right-clicking the nodes in the tree you can select a number of special functions, e.g. to open a file.

Shortcuts

Here you can add shortcuts to files that you open frequently. Unlike the dynamic tree in the files 10 tab, you make all changes manually. Another difference is that you can link to files located in folders other than the current project. Examples include create shortcuts to files in the global folder 17 or other folders that contain files that are common to several projects.

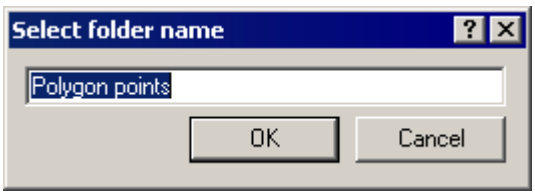


Nodes in the tree

The top node in the tree always matches the file containing the project tree, usually **project.pft**. Under the top node you can then either create folders or files in the same way as on a disk drive. The first time a project is opened, a basic structure is created with a number of folders under the top node. These folders can be edited freely and you can add new folders and files indefinitely. It is important to remember that the structure of the tree need not correspond to the structure of the disc drive. This means that files can be grouped quite freely in the tree, regardless of whether they are in the same folder or not. This makes it easier to keep track of the files in the project. All files that are added to the tree get an icon indicating the file type.

Add new folders

New *folders* are added to the tree by right-clicking the node in which you want the new folder. Select **[New Folder]** and enter the name of the folder.



Add Files to Folder

To add *files* in the tree, right-click on the node in which you want the new files. Select **[Add Files to Folder]** and then select the files to be included.

Add Folder

Right-click a folder in the tree and select **[Add Folder]** to add an existing folder to the tree.

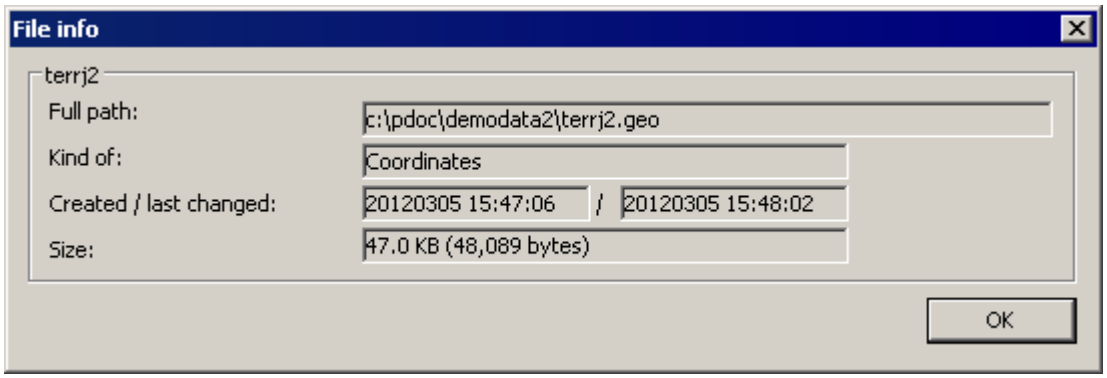
Delete node

Right-click the node and select **[Delete node]** to delete a file or folder from the tree. If a folder is deleted this is also removed from the underlying nodes. Note that you only delete the files or folders from the project tree, but they remain in the project.

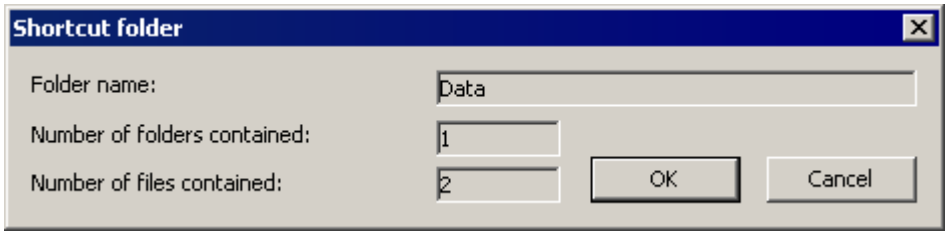
Open file
Using the tree you can open files in various ways:
Right-click a file in the tree and select **[Open file in a New Window]** or **[Open file in a Current Window]** to open a file.
Double-click a file to open the file in the active view.
Select one or more files and drag them to the iCON office-Window - if you drop the file in an existing window it will open here, otherwise in a separate window. You can also drag the file from the project tree to an e-mail. By right-clicking on a file, you can choose to open the file in the active or new window.

Open file in a Current Window
Valid when files are displayed graphically. Right-click and select this option to open the file in the active graphic window.

Properties
Right-click a file or folder in the tree and select **[Properties]** to display information about the node.



Examples of properties for a file.



Examples of properties for a folder.

Read more about projects in Create Project 5 .

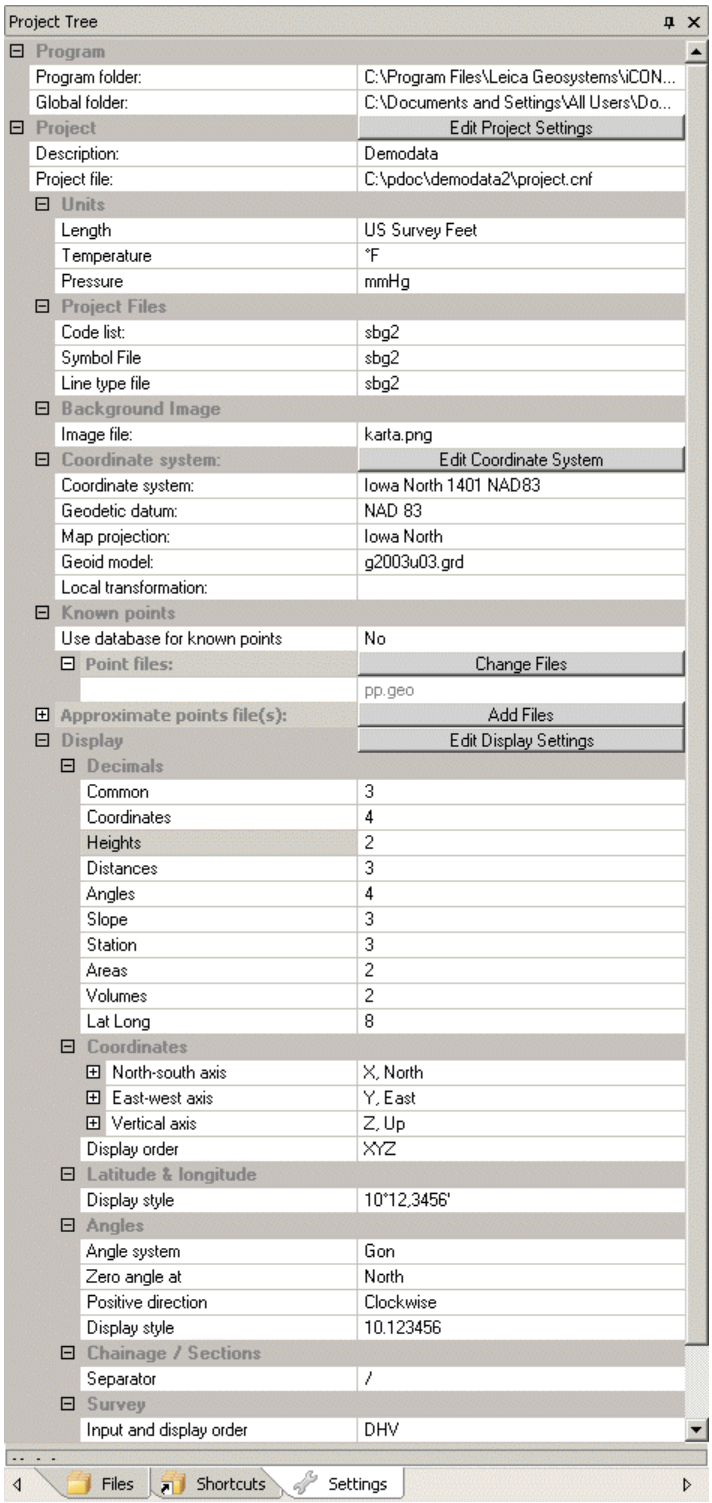
See also: Project 4 , Create Project 5 , Open Project 7 , Delete Project 9

2.2.7 Settings in the Project

The Project View is divided into three tabs, one showing files 10 within the project, one tab where you can enter shortcuts 14 to files, and one that contains project-related settings. The **Settings** tab gives an overview of the program and project settings.

Settings

All program and project specific settings are listed here in a common view.



The tab with settings is divided into two parts, program and project related settings. The program-related settings will not change when switching between different projects.

Program settings

- **Program folder**
  Specifies the folder where iCON office is installed. This cannot be changed.

- **Global folder**
  This folder contains files that may be needed regardless of the project and user, for example, code list, localization files, coordinate system definitions and plot panels. To change the global folder, select the row for the Global folder, click ... and change the path.

Project Settings

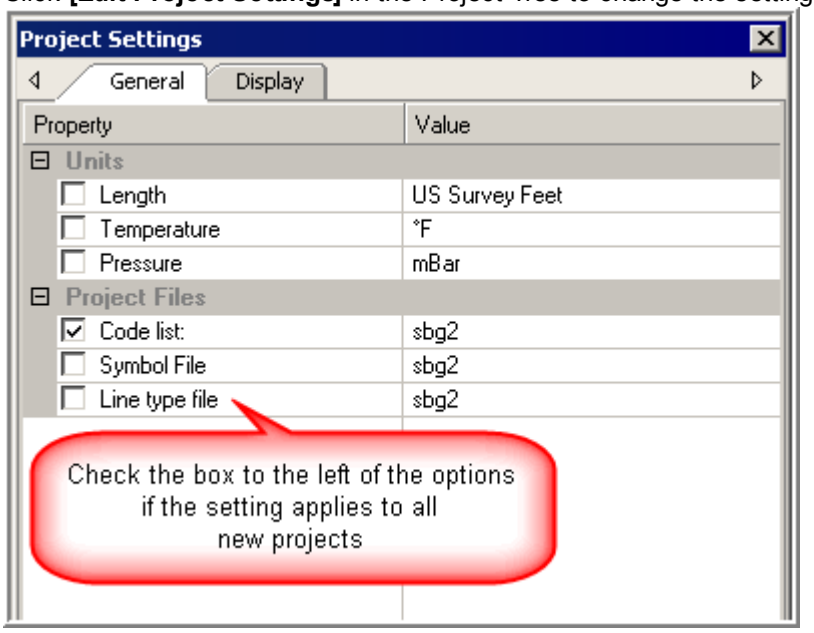
Click **[Edit Project Settings]** to change the settings for *Units* or *Files in the Project*, see below.

- **Description**
  This is the project name. The name is also in square brackets top left of the program's title bar. To change this, click the name field in the description and enter the new name.
  The name appears in ***File | Open Project...*** 7 when you scroll between existing projects, and it will also appear in the margin for prints and drawings.

- **Project file**
  Specify the file where the project is stored. The project file (cnf) contains settings for the current project. The format of the cnf file is shared with GeoPad, and the file can be transferred between systems. The default name when creating a new project 4 is *project.cnf*. When creating a new project, however, you can give the project file a different name, for example, if you want multiple sets of settings for the same data folder.

❑ **Units**

The settings for units of length, temperature and air pressure in the project appear here.
The settings follow into the input windows, dialogs, and prints. The settings do not affect how data is written to the file.
Click **[Edit Project Settings]** in the Project Tree to change the settings for *Units*.



- **Length**
  Select from Meter, International Feet or US Survey Feet.
- **Temperature**
  Select from Celsius, Fahrenheit or Kelvin.
- **Air Pressure**

Select from mBar, Pa, mmHg, inHg and psi.

Check the box to the left of the options if the setting applies to all *new projects* 5 created by iCON office.

❑ **Files in the project**

Enter active code list, symbol file and line type file here 203. iCON office comes with a standard code list and a file each containing a standard library of symbols and line types. To open a dialog that allows you to change the settings, click **[Edit Project Settings]** in the Project Tree or **[Edit Display Settings]** further down in the Project Tree, see below.
Users can create their own code lists, symbol files and line type files, to be saved in the Global folder 17. If you create your own files, save these with new names because otherwise they will be overwritten with the default files' content when you install a new version of iCON office.

- **Code list**
  The appearance and function of a point is determined in iCON office by its code. Data for these codes is in the code lists (*cod files*). Only one code list is active at any one time.

  To change the code list, select the row and click ... and select another code list from the Global folder.
- **Symbol file**
  Specify the file containing the symbol library to use. Symbols are associated with point codes through the code list.

  To change the symbol file, select the row and click ... and select another symbol file from the Global folder.
- **Line type file**
  Specify the file containing the line types to use. Line types are associated with point codes through the code list.

  To change the line type file, select the row and click ... and select another line type file from the Global folder.

Check the box to the left of the options if the setting applies to all *new projects* 5 created by iCON office.

Read more about Code lists, symbols and line types 203.

❑ **Background image**

Here you can specify the file name of an image, for example, an orthophoto or a map that you want to use as a background in the iCON office graphics window.
The most commonly used raster image formats are supported. To display the image, a transformation context must be created. See Background image 219 for information on how to orient the image.
ESRI® world files can be used directly as oriented background images, as iCON office uses the associated text file with the parameters, see also Background image 221 .
Select the row and click ... to select the image.
Click the arrow ▸ to open a dialog that allows you to create a transformation for the image.
In order to enable or disable the background image in the graphic, select ***View | Show Background Image*** or click .

❑ **Coordinate system**

Here you select the coordinate system for the project. If a coordinate system is used, the selected details for the geodetic datum and map projection, and more appear here.
iCON office needs a coordinate system to be active if the latitude and longitude are to be displayed graphically or to calculate the projection correction of measurements.
Click the button **[Edit Coordinate system]** to open the dialog with the options for coordinate system. See Select coordinate system 124 for further information.

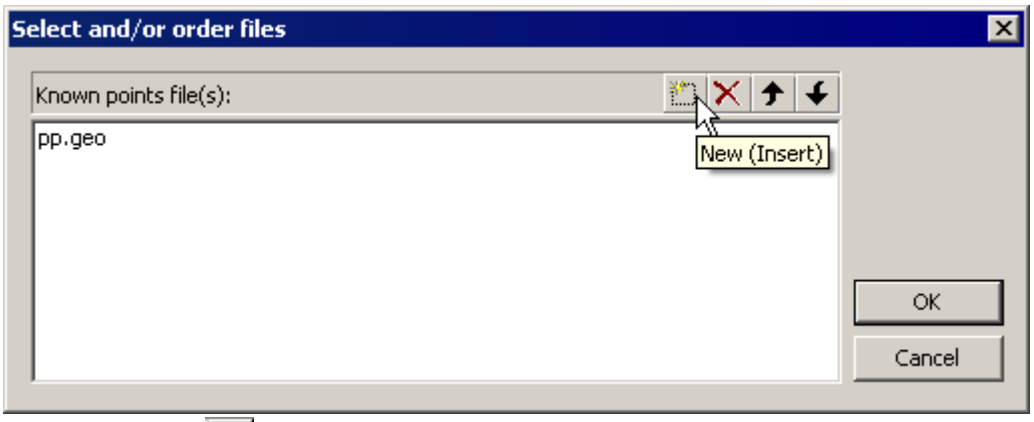
❑ **Known points**

This specifies the file or files where iCON office searches for known coordinates. iCON office needs known points for coordinate calculation[335] of the measurement files, for example, for the calculation of free station, net adjustment and traverses.

- **Use the database for known points**
  Only Point database users can use the database for known points.
  Select the row and use the arrow ▸ to select *Yes* or *No*, if iCON office is to search for known coordinates in the point database.

- **Point files**
  Here you specify the file or files where iCON office searches for known coordinates, typically PP.geo.
  You can have multiple files selected here, but iCON office searches for points in the order the files are listed. If a polygon point appears in more of the files and /or several times in one file, the coordinates will be retrieved from the first occurrence of the point in the file that is listed first.

  Click **[Change files]** to change or add files with known coordinates.



  Using the button you can specify multiple files.

❑ **Files with approximate points**
Here you specify the files that contain points with approximate coordinates. These files supplement the files with known points in functions in which accuracy may be lower, for example, for Correction calculation of measurement data[333] and the approximate coordinates for Net adjustment[810].

Click **[Add Files]** or **[Change files]**, if additional files are to be used.

❑ **Format**
The settings appear here for the display of coordinates and angles, etc. Click **[Edit Display Settings]** to change the settings.
Changing the settings on units and code lists can also be done using this dialog. Click **[Edit Display Settings]** and the **General**tab. See also above[17].

The selected settings control printing in numerical documents, iCON office's input and output windows and in the dialogs and prints. The settings do *not* affect how data is written to file.

Check the box to the left of the options below if the setting applies to all *new projects*[5] created by iCON office.

- **Decimals**
  Specifies how many decimal places to display for the entries with numeric values.
  The settings for numerical display of the document in the project appear here. The settings control printing in numerical documents and in iCON office's input and output windows[107]. The list shows the number of decimal places for different units. Click **[Edit Display Settings]** to change the display format. Select the row where the display of the number of decimal places is to be changed, and use

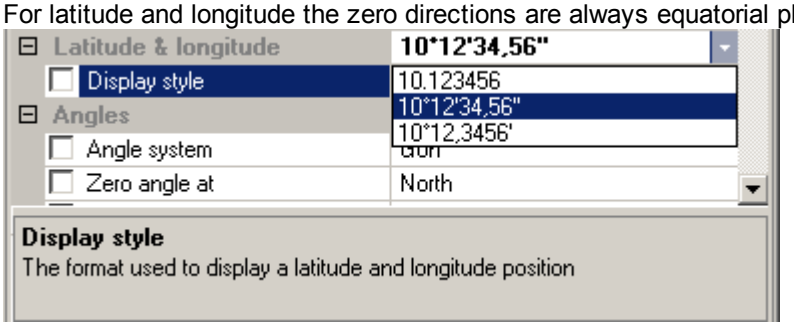
the arrows to set the number of decimal places to display.

The number of displayed decimal places *never* affects any coordinate calculation.

- **Coordinates**
  The names of the coordinate axes and the direction of the positive axis appear here. The names may have one character.
  Click **[Edit Display Settings]** to edit the name or direction of the axes. Choose a positive direction for the north-south axis and the east-west axis as well as the height axis, up or down.

- **Display order**
  Here it is possible to change the order of the axes for input and output.

- **Latitude and longitude**
  How latitude and longitude are reported is shown here.
  Click **[Edit Display Settings]** to change the display format. Select to show as *decimal numbers* or *(degrees/minutes/decimal seconds)* or *(degrees/decimal minutes)*.
  For latitude and longitude the zero directions are always equatorial plane and Greenwich.



- **Angles**
  Angle system
  The angle system used in iCON office is specified here.
  Three angle systems are predefined: Gon *(400 a u)*, Degrees *(360 a u)* and Radians *(2pi a u)*.
  Zero direction
  Set cardinal points for the 0 angle.
  Positive direction
  Indicate whether the angle reading increases clockwise or counterclockwise.
  Display format
  Select to show as *decimal numbers* or *(degrees/minutes/decimal seconds)*. The last option should only be used when the angles are specified in degrees.

- **Stations / Chainage**
  The characters to be used as a station or kilometer delimiter are specified here.
  - Separator with Station Equations
    Enter character to be used as kilometer delimiter in documents that contain Station Equations.
  - Separator without Station Equations
    Enter character to be used as kilometer delimiter in documents that do not contain Station Equations.

  Hint For example, if the character '/' is specified here, you can use '/' to enter angles as degrees/minutes/seconds in the input field. For example, enter 59/06/47.5678 to input 59d 6m 47.5678s.

- **Survey**
  The order of measurement data is specified here for distance (D), horizontal (H) and vertical angle (V). These settings follow into the input windows, dialogs, and prints. The settings do not affect how data is written to file.

See also: Project 4 , Create Project 5 , Open Project 7 , Delete Project 9 , Code list 203 , Coordinate system 120 , Select coordinate system 124 , Background image 219 , Files in the project 10, Shortcuts in the project 14

2.3 Files and Documents

2.3.1 Working with Files and Documents

iCON office is primarily a file-based system, which means that most data is processed by reading and writing separate files to the disc drive. A **file** that is opened for editing is often called a **document**. For each document, one or more **views** are opened. A view is actually a window to display the document's data. iCON office has a very wide range of views, such as numerical and graphical views (input) views. The views that are available for a given document depend on its type. The contents of menus and toolbars changes depending on the type of document opened.

Select ***File | New*** to create a new document or ***File | Open*** to open a document for editing.
Changes to a document are not saved on the disc drive until you explicitly specify that this should be done (by selecting ***File | Save*** or ***File | Save as***, see Save documents 30).

How data is retrieved from files and documents

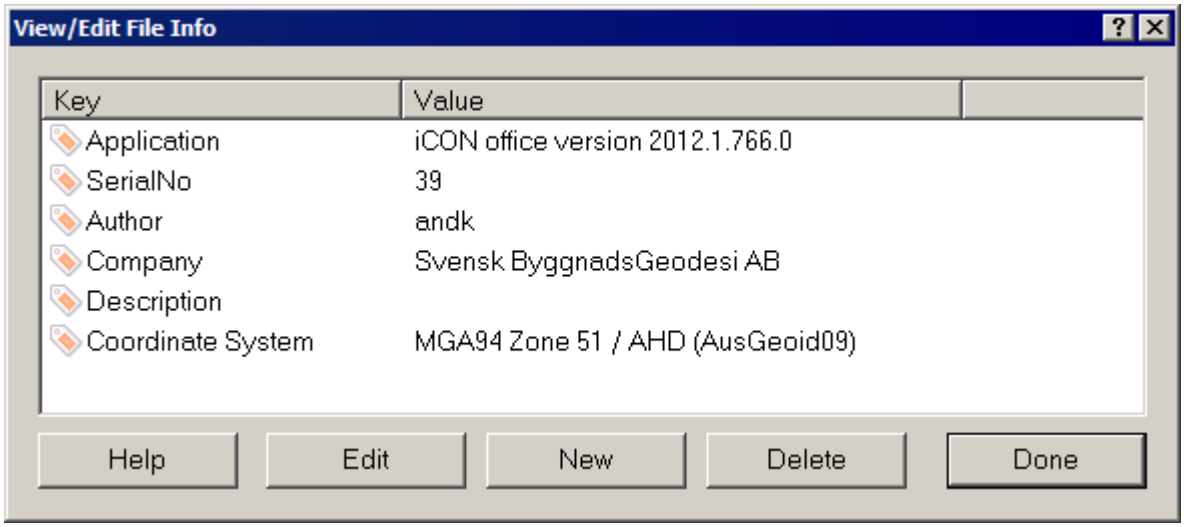
Functions with documents as input and output data
Many functions in iCON office work with documents instead of files as input and output data. This means that input data is taken from the active document ("file in the memory"). Output data is created in a new blank document. You have to make sure you save the document. The advantage is that you can then view and adjust the results before you save or print.

Functions with files as input data
Some functions take input data from files that are on the disc drive. If, while in a function of this type, you choose to work with a file that is already open for editing (i.e. a document), the program will retrieve data from the document instead.

Functions with files as output data
The results of some functions are stored in files. If you try to store data to a file that is already open for editing, the program will prompt you for another name for the file.

Edit or view the file information

For many types of files in iCON office some extra information is saved in the file header, such as the creator of the file, company name, description, coordinate system. To view or modify such information, select ***File | View/ Edit File Info***. A dialog opens where the attributes that are set for the file appear.



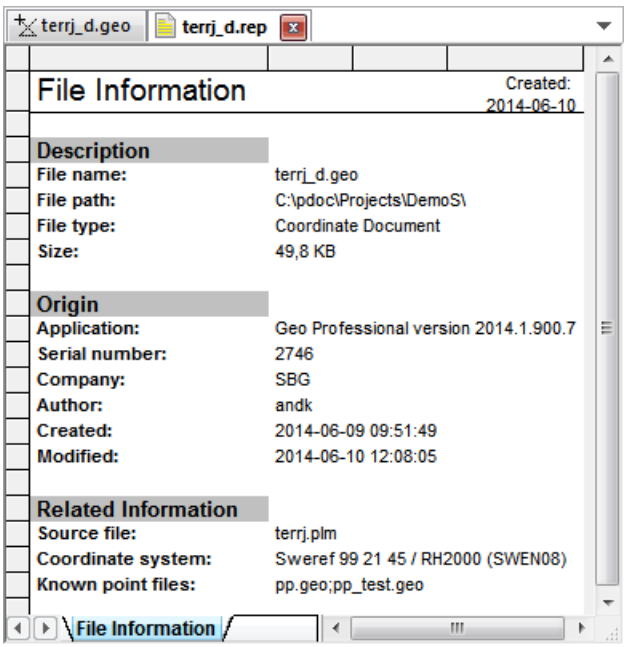
- **Create Report**

To create a report displaying the information in the dialog **View/Edit File Info** above, click the button **[Create Report]**.

- **Edit**
  Select an attribute and click at **[Edit]** to change the value of the selected attribute.
- **New**
  Add a new attribute to the file.
- **Delete**
  Delete selected attribute.
- **Done**
  Click **[Done]** to save any editing.

File Information Report

Click **[Create Report]** to create a report displaying the information shown in the dialog above. Thanks to the report, the traceability for coordinate files increases.



Example of a file information report.

Example of the contents of the report:

Description	
File name	Name of the coordinate file.
File path	Path to the file.
File type	File type
Size	The size of the file.
Origin	
Application	The iCON office version that was used to create the file.
Serial number	The file was created by iCON office with the specified serial number.
Company	The company which is registered owner of the <iCON office> license.
Author	Name of the registered user of the iCON office license.
Created	Date and time when the file was created.
Modified	Date and time when the file was modified.
Related Information	

Source file	Source file that has been used to calculate the current file. Note source file is not specified for coordinate files created in a network adjustment.
Coordinate system	Coordinate system used to calculate the current file.
Known point files	Name of the coordinate files containing known points at the time of calculation.

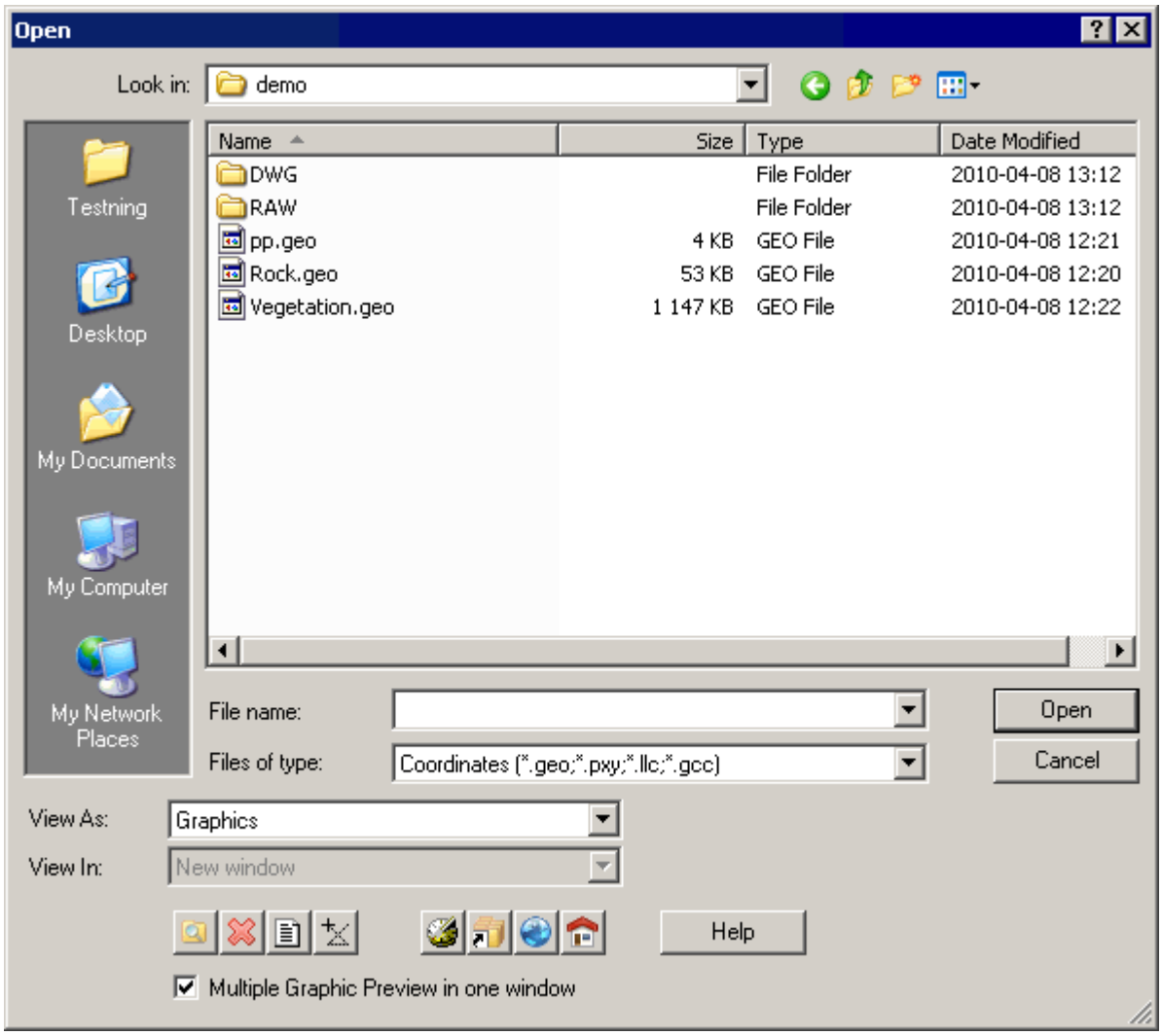
Note, the report displays information that is stored in the header of the active file. Manually changes in the dialog above will not be visualized in the report, eg any changes of information by the buttons **[Edit]** or **[New]** will not be transferred to the report.

See also: Open and select documents 25 , Create documents 28 , Save documents 30

2.3.2 Opening or Selecting Documents

The Opening Dialog

The dialog used to open or select documents is the same as that used in most other Windows® programs. Depending on the context in which the dialog is shown, it may have a varying appearance. At the top there is always a list for navigation to the right disc drive and folder, under this there is a list of the files that are in the current folder. The files that appear also depend on the filter selected in the file types field. The field for the filename shows the name of the file or files selected in the list above, and you can also enter the filename directly.



Selection Filter

In the 'File Types' list there are a number of predefined filters for the file types that are to appear in the file list. The groupings of the filters are created according to how you normally work with the different parts of iCON office, for example, the Line Data group shows the project's lines, profiles and cross slope data. You can also enter your own filters in the filename field. Separate file types with semicolons, for example, show all coordinates and line files while you can also enter "geo;lin" in the field.

Selecting multiple files

When multiple files are to be selected from the file list you use **the shift** and **control keys**. Shift is used to select the entire range of files that are next to each other, while Ctrl is used to toggle the selection of individual files. To select a number of files scattered in the list, hold down Ctrl and click on the required files

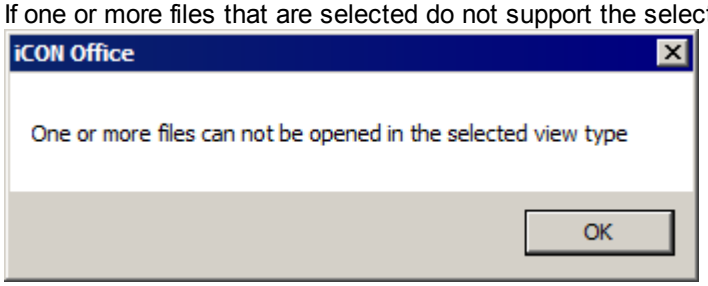
(click again to deselect). In order to select multiple contiguous files, point to the first file and then on the last while holding the Shift key down. You can now use Ctrl of course to supplement the selections. If none of the keys are held down, all the previous selections are cleared when next you press the mouse. You can also enter the filenames in the filename field, each filename will then be enclosed by quotation marks.

Previous Filename
When you start to enter a filename, a pop-down list of previous entries will appear whose initial part is consistent with the characters entered.

View Type
When the dialog is used to open a document, you can select the view type to be used to view the document. Many files can be displayed either graphically or numerically. The view types that are available depend on the chosen file type filter:

- **Default**
  The document will open with the view type that is set by default for the file type.
- **Graphics**
  The document will be displayed graphically, either in a new window or in an existing one depending on what is specified in the 'View In'.
- **3D graphics**
  The document will be displayed with 3D graphics, either in a new window or in an existing one depending on what is specified in the 'View In'.
- **Input**
  The document will be opened for numeric editing in an input window.
- **Tree**
  The document will be open for numeric editing in a hierarchical tree window.

If one or more files that are selected do not support the selected view type, an error message will appear.



Regardless of which view type is chosen from the beginning, you can always switch to another via the Views menu.

View In
When the dialog is used to open the document you can decide if it should appear in a new window or if it is added to the active window. This only applies to documents that can be viewed graphically.

Special functions

- **Explore**
  This is a highly practical function that opens Windows® Explorer with the current folder as default, which is handy when you want to copy files to the project folder.

- **Delete**
  Deletes the selected files from the disc drive.

- **Explore as Text**
  Opens the selected files in Windows® Notepad.

- **Graphic Preview**
  This function is very useful when you want to locate a specific file in the file list or need to quickly see how a file looks graphically. If the 'graphic preview in the same window' box is not checked, the files are shown in separate windows.

- **Recently used files**
  Press the button to bring up a menu where you can directly select any of the ten most recently used files.

- **Files in the Project Tree**
  Press the button to bring up a menu where you can directly select any of the files you have linked to the tab Shortcuts14 in the Project Tree.

- **Swap to the global folder**
  Click the button to change the file list to view the contents of the global folder.

- **Swap to project folder**
  Click the button to change the file list to view the content of the project folder.

Filename Controls in Dialogs

Many dialogs contain fields where a filename is to be specified. Enter either the filename directly in the field or click the Browse button ... to the right of the field, which will display the dialog for opening documents.

Project Tree

From the Project Tree10 files can be opened by double clicking or right clicking them.

Drag and drop from other programs

You can open files listed in other programs (e.g. Windows® Explorer), by pressing down the left mouse button and dragging them over to iCON office and dropping them into the main window and the file will open in a new window. You can also open them in the existing graphics or 3D window by dropping them in that window.

Main Menu

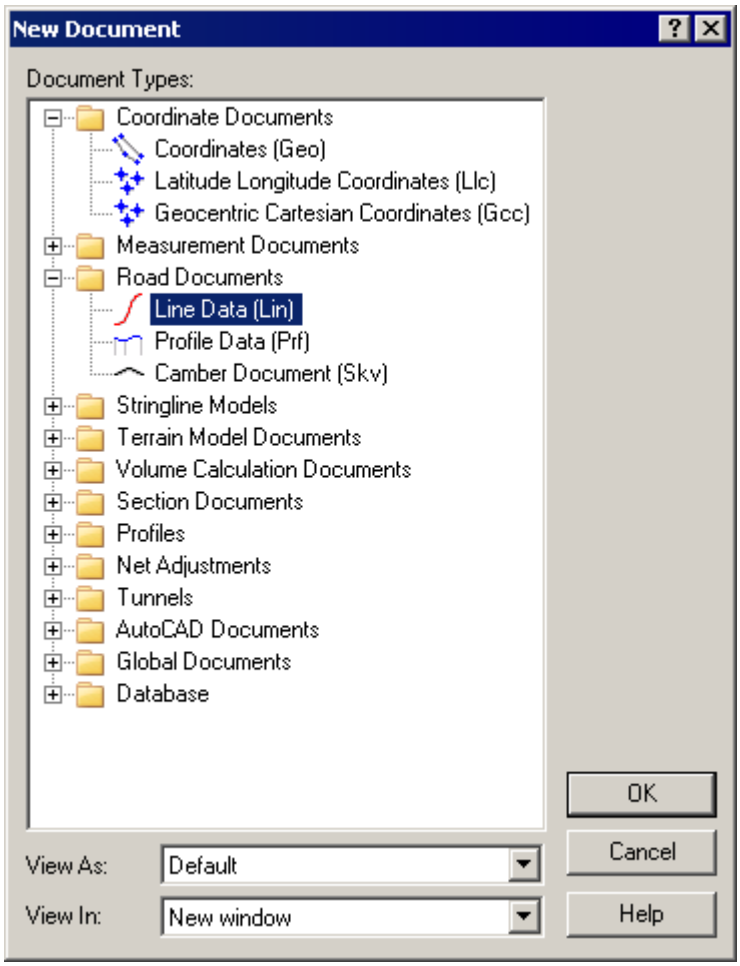
You can open the most recently used documents by selecting from the menu **File | Recent Files**.

See also: Working with files and documents22, Create documents28, Save documents30

2.3.3 Create Document

To create a new (blank) document, select ***File | New***. A new document can be opened either in its own window or, if there is a graphic document, in an existing window. The document name is set to *"Untitled x'* where x is an index that increments for each new document created. The document is not created physically on the disc drive until you choose to save it and give it a proper name.

The dialog for creating documents



Document Types
The dialog for the new document is a tree structure where the different types of documents that can be created by iCON office are divided into groups. Double-clicking or selecting the desired document type and then clicking **[OK]** will open the new document.

View type
Many files can be viewed either graphically or numerically, the view types that are available depends on the selected file type filter:

- **Default**
  The document will be created with the view type that is set by default for the file type.
- **Graphics**
  The document will be displayed graphically, either in a new or existing window depending on what is specified in 'View in'.
- **Graphics 3D**

The document will be displayed with 3D graphics, either in a new or existing window depending on what is specified in 'View in'.

- **Input**
  The document will be created for numeric editing in an input window.
- **Tree**
  The document will be created for numeric editing in a hierarchical tree window.

If one or more files that are selected do not support the selected view type, an error message will appear.

Regardless of which view type is chosen from the beginning, you can always switch to another from the menu **Views**.

View in
For documents that can be displayed graphically, you can choose whether it is to be created in a new window or if it is added to the active window.

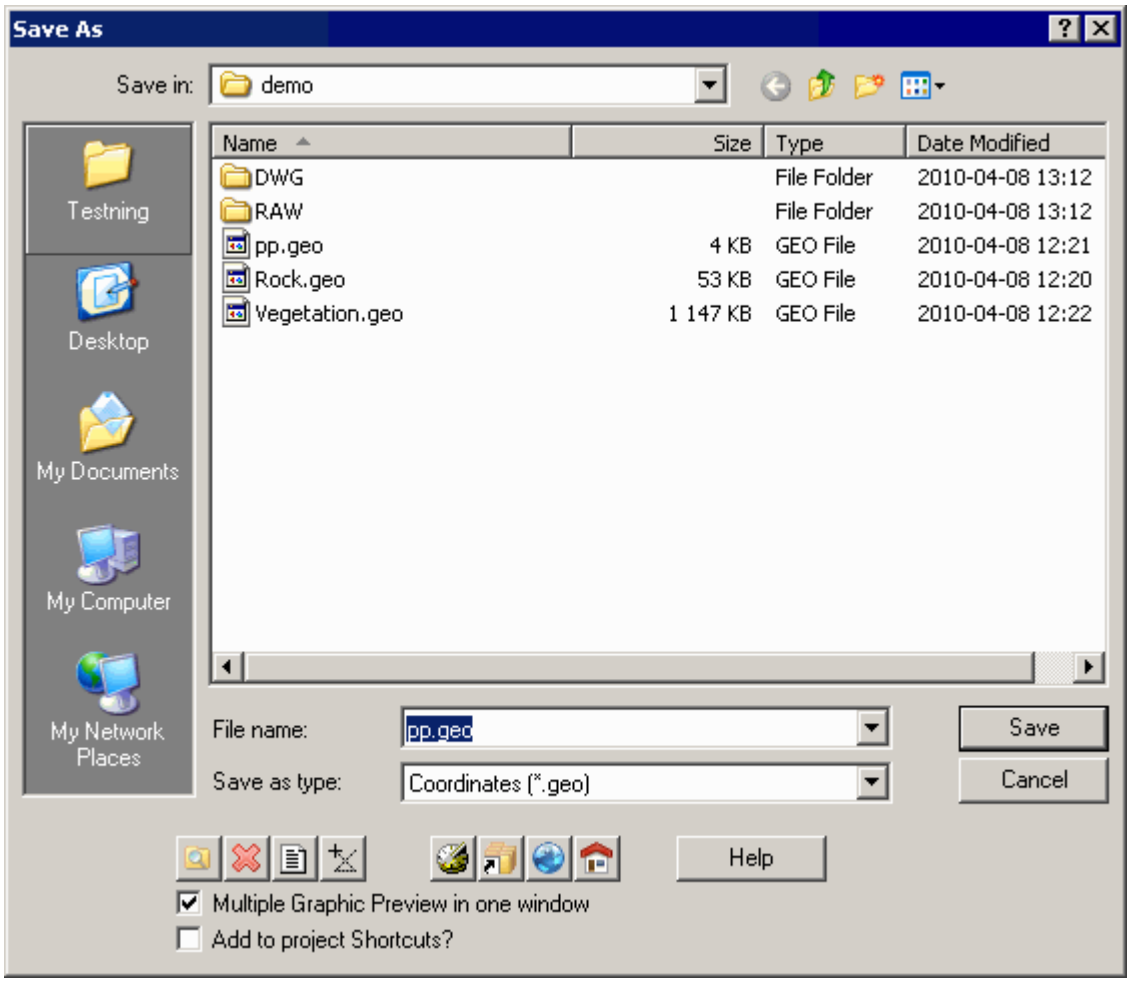
See also: Working with files and documents 22 , Open and select documents 25 , Save documents 30

2.3.4 Save document

To save an open document that has been changed, select ***File | Save***. If a modified document is about to be closed, the program will ask if changes should be saved. If it is a new document, a dialog appears to select the filename and file type. To save an open document with a different name, select ***File | Save As*** and enter the new name.

The Saving Dialog

The dialog used to save documents is the same as that used in most other Windows programs. At the top there is always a list for navigation to the right drive and folder, and under this there is a list of the files that are in the current folder. The files that appear depend on the filter selected in the file types field. The field for the filename shows the name of the file or files selected in the list above, edit the field to enter a new name. If no file type is specified after the file name, the name selected in the 'save as file type' field applies.



Previous Filenames

When you start to enter a file name, a pop-down list of previous entries will appear whose initial part is consistent with the characters entered.

Save as File Type

Some documents can be saved in several formats; the coordinate document for example can be saved with the file extension geo or pxy.

Special Functions

- **Explore**
  This is a highly practical function that opens Windows Explorer with the current folder as default, which is handy when you want to copy files to the project folder.

- **Delete**
  Deletes the selected files from the disc drive.

- **Explore as Text**
  Opens the selected files in Windows Notepad.

- **Graphic Preview**
  This function is very useful when you want to locate a specific file in the file list or need to quickly see how a file looks graphically. If the 'Multiple Graphic Preview in one window' box is not checked, the files are shown in separate windows.

- **Recently used files**
  Press the button to get a menu where you can directly select any of the ten most recently used files.

- **Files in the Project Tree**
  Press the button to get a menu where you can directly select any of the files you have linked to the tab Shortcuts 14 in the Project Tree.

- **Go to the Global Folder**
  Click the button to change the file list to view the contents of the global folder.

- **Go to the Project Folder**
  Click the button to change the file list to view the contents of the project folder.

- **Add to project Shortcuts?**
  If the box is checked, a link to the file is added into the shortcut tree 14.

Save using existing name

When you choose to save a document with a new name and there is already a file on the disk drive with that name, a dialog with three options appears:

- **Overwrite Existing File**
  Select this option to replace the information in the existing file with the open document's data.

- **Add data to Existing File**
  In some document types, such as coordinate files, it is possible to add data to an existing file.

- **Update Existing Data with the Same Point Numbers**
  This option means that the information in a file is supplemented with data from the active document, for example, heights in a coordinate document can be transferred to another file without the plane coordinates being changed.

See also: Working with files and documents 22, Open and select documents 25, Create documents 28, Project Tree 10, Archiving 36

2.3.5 File Types

iCON office uses a variety of file types for different purposes. Some can be opened and edited directly, such as coordinate files. Others are created by certain functions, such as tpf files created by the transformation function.

These file types are used by iCON office:

ACI Initialization data for statistical acceptance control.

ALZ Profile format in Clip[387] format that is converted to and from profile, prf, with iCON office.

APA iCON office can convert coordinate and survey files to and from APA[379] format.

BAS Coordinate file in Clip[387] format that can be converted to and from coordinate format, geo, with iCON office.

BMP Raster image. Can be used as background image[219].

CFM Cross Fall Model[536]. Replaces the earlier ***SKV*** format.

CNF Project file[4] . Contains definitions for a iCON office project.

COD Code list[203] .

DBX Raw data from Leica[427] instruments

DC File format from Trimble[440] , for transferring files between Trimble instruments and iCON office.

DFM Difference model[675] . Height differences between two terrain models.

DFN Difference contour lines[657] . Contour lines are created from a difference model.

DPL Profile file in DRD[388] format that is converted to and from profile, prf, with iCON office.

DRA Drawing file[255].

DT iCON office can be used to convert coordinate files to and from Atlas 2000[380] files, DT format.

DVL Line file in DRD[388] format that can be converted to and from line, lin, with iCON office.

DWG Drawing file for AutoCAD[289]® format, can also be handled by iCON office.

DWT AutoCAD[313]® file format, used mainly as a file format for base drawings[313].

DXF Drawing file for AutoCAD[289]® format, can also be handled by iCON office.

GDT Raw data from Geodimeter[483]® instruments.

GEO Coordinate file[153] with coordinates and attributes. Replaces the earlier ***PXY*** format.

GLT Line type file[203] .

GRE Raw data from Leica[427] Instruments.

GSI Raw data from Leica[427] Instruments.

GTR Global translation and rotation. Used for global transformation[142] .

HNA Net adjustment,[810] leveling. Replaces the previous ***HNI***- and ***HNO*** formats

HNI Input data for net adjustment,[810] leveling. Older format. Can be opened and handled as a ***HNA*** file for compatibility.

IMP Import filters for text import[449] .

INH Line file from 10 table[448] , can be converted to line file, lin, with iCON office.

INM Polar survey data[318] . Older format. Can be opened and handled as a ***plm*** file for compatibility.

INV Profile from 10 table[448] , can be converted to profile, prf, with iCON office.

JBX Reference file for a Leica[427] job

JPG Raster image. Can be used as background image[219].

JR File type from AnPakke.

K File format for AutoKa-PC and GTRANS[384], that can be converted to and from coordinate files with iCON office.

KDB Used by KF85[397] .

KOF File format used to convert data to and from KOF[400] format.

KSD Complete section data[627]. Older format. Can be opened and handled as a ***sec*** file for

compatibility.

L3D Road Line in 3D[503]. Replaces the older LIN and PRF formats.

LEV Leveling data[361]. Older format. Can be opened and handled as a ***lvt***file for compatibility.

LIN Line data in plane[521]. Road lines. Older format. Can be opened and handled as a ***L3D*** file for compatibility.

LLC Coordinate file with latitude longitude[185]. Otherwise the same as ***geo***.

LNA Net adjustment.[810] horizontal. Replaces the previous ***LNI***- and ***LNO***formats.

LNI Input data for horizontalnet adjustment[810]. Older format. Can be opened and handled as a ***LNA***file for compatibility.

LPL File type from AnPakke, that is converted to profile format, prf in iCON office.

LSD Local section data[627]. Older format. Can be opened and handled as a ***sec***file for compatibility.

LVT Leveling data[361]. The LVT files work like .LEV files, but points in LVT files have better precision.

MBS Mass description data[689].

NIV Contour lines[657].

NSD Standard section data, used in mass descriptions[689].

NYL Profile from 10 table[448], can be converted to profile, prf, with iCON office.

OTL Object type list used by Geosis[392]. Can be handled by iCON office.

PBQ Results file from database searching[934].

PCX Can be used as background image[219].

PDF Graphical and numerical views can be saved in PDF format (by printing with an external PDF printer). However, iCON office cannot open PDF files.

PLA Line file in Clip[387] format that can be converted to and from line format, lin, with iCON office.

PLM Polar survey data[318]. Replaces the earlier ***inm***format.

PNG Raster image. Can be used as background image[219].

PRF Profile data[525] for (road) line. Vertical line file. Older format. Can be opened and handled as a ***L3D*** file for compatibility.

PRO Terrain profile data[661]. Replaces the earlier ***TPD***format.

PRW Pipe profile[634].

PSN Raw data from Psion[497] Instruments.

PTG Survey data for traverses[354].

PXY Coordinate file[153]. Older format. Can be opened and handled as a ***geo***file for compatibility.

RBB Coordinate file from SNRA (Vägverket) DRD[388] format that can be transformed to and from coordinate format, geo, with iCON office.

REP Report files[35]. Generated by a variety of functions in iCON office. Cannot be edited.

SDR Raw data from Sokkia[496] instruments.

SEC Section data[627]. Replaces the older formats ***KSD***, ***TSD*** and ***LSD***

SKV Cross slope diagram[540]. Older format. Can be opened and handled as a ***CFM*** file for compatibility.

SOS File format for Sosi[438] files.

SOT Drawing panel[286].

SYM Symbol file[203].

TBS Tunnel description file[862].

TCN Raw data from Topcon[439] Instruments.

TDM Tunnel difference model[887]. Replaces the earlier TTM format.

TGA Can be used as background image[219].

TIF Raster image. Can be used as background image[219].

TIT Line file from 10 table[448], can be converted to line file, lin, with iCON office.

TPD Terrain profile data[661]. Older format. Can be opened and handled as a ***PRO***file for compatibility.

TPF	Transformation parameters. Used by the transformation function 188 .
TRM	Terrain model 638.
TSD	Crosssection data 627 . Older format. Can be opened and handled as a ***sec***file for compatibility.
TTM	Tunnel 887 terrain model. Older format.
TTS	Tunnelcross section data. Older format. Can be opened and handled as a ***sec***file for compatibility.
TUN	Theoretical tunnel 852 section.
TVV	File type from AnPakke , that is converted to cross slope file, skv or section file, sec in iCON office. Also used for cross sections from 10 table 448 , can be converted to cross slope file, skv, with iCON office.
TXT	Text file 108 . The file format is also used to convert coordinate files to and from Bever 386 format.
VL1	File type from AnPakke , that is converted to line format, lin in iCON office.
XML	LandXML 410 file type used by Autodesk®, Bentley, Leica and ViaNova and others. Can be converted to and from iCON office.
XYZ	File type used by Kartbas 399 . Files can be converted to and from iCON office.
ZSS	Raw data from Zeiss 500 Instruments.

See also: Working with Files and Documents 22.

2.3.6 Reports

A number of functions and calculations in iCON office generate reports as results. These reports are saved using the file type rep.

Calculation of coordinates					Created: 2010-05-06
File Name:	terrj.plm				
Station	**Backsight**	**Station height**	**Theoretic dist.**	**Measured dist.**	**Difference**
E. C. corr.	**Ang. diff**		**Theoretic height**	**Measured height**	**Difference**

A report header is at the top of the report. This is always at the top in the report window, and displayed at the top of each page when printing. At the top right of the header is the date the report was created.

P4331	P4324	44,07	283,694	283,698	0,004
Ein	-0,0001 (1/4)		0,00	0,01	0,01
P4331	P4332	44,07	86,107	86,107	0,000
Ein	-0,0000 (2/4)			0,00	

The report data follows below the header. The content can be scrolled up and down with the scrollbar without touching the report header so you always see the column headers, etc.

One or more tabs are found at the bottom of the window. Certain types of reports divide up their results into multiple tabs, and you can toggle the content by clicking on the corresponding tab.

Coordinate File Report

To create a coordinate file report, including polylines and points:

- Open a coordinate file and select **Data | Coordinate File Report**.
- Save the report in the format *.rep and choose if you also want to export it to Microsoft® Office Excel format, see below 35.
- Choose if you want to print the report.

Exporting Reports

If you need to send a report to someone who does not have iCON office, you can choose to save it in Microsoft® Office Excel format. Select ***File | Save As*** and change the file type to *xls*. You should also save reports in iCON office's own report format, rep, since iCON office cannot open a saved xls file.

Write protection

Reports are write protected when they are created. If you want to edit a report, select ***Edit | Read Only***. To make an editable report write protected select ***Edit | Read Only*** again.

See also: Working with files and documents 22 .

2.3.7 Archiving

It is possible to create and open archives in iCON office. An archive contains compressed files and folders, if any. iCON office uses archive files in zip format, compatible with PKZIP® and WinZip®. An archive can be created directly from an open document in iCON office. It is also possible to directly send an archive file to an e-mail recipient.

Create Archive

To create a new archive, select ***File | Archive | Create Archive***. If there is an open file, the file will automatically be added to the archive. In addition, any related files will be added as well. If there are any related files depends on the type of document that is open. Below are the related files that come with the different types of documents.

Line files

Associated profiles and cross slopes

Volume calculations

Main line with profile and cross slope
Side lines with profiles and cross slopes
Models
Border polygons for calculation and top soil stripping
Standard sections
Superstructure types

Tunnel calculations

Main line with profile
Models
Theoretical tunnel files

Drawings

All files included in the drawing
Plot panels with logotype files, if any
Current code list, and line type file and symbol file

Plot panels

Logotype files

Survey files, leveling files and traverses

Current files with known points

Net adjustment files

Current files with known points
Current files with approximate points

Point cloud files

Point cloud files (*.gpc)
All files included in the point cloud, e.g. *.pci or *.pts.

Once you have chosen to create a new archive you must first choose a name for it. If you have a document open, a suggested name will appear with the extension zip. After you have selected the filename for the

archive along with its location, the dialog with the list of files to archive comes up. For a description of the dialog, see the Archive dialog below.

Create Archive From Window

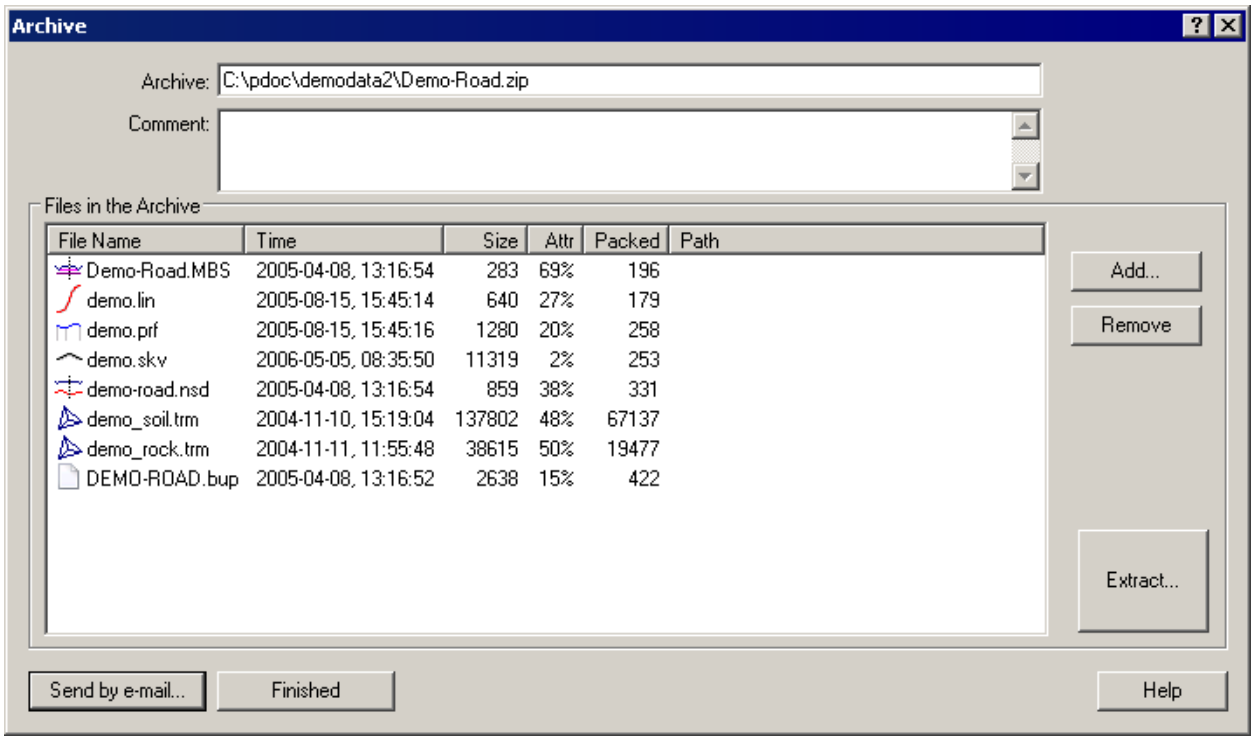
This option creates an archive containing all the files that are in the active window. If the window contains a file, which also has a relationship to other files, you will be asked if these files should also be included. Otherwise the process is the same as above.

Open Archive

If you have an existing archive with files you can choose to open it in iCON office. Select ***File | Archive | Open Archive***. The dialog with the files in the archive is displayed, see Archive dialog below.

Archive Dialog

When an archive is opened or created a dialog appears. From here you can add and delete files, extract files from the archive and send the archive by e-mail.



When a file is added to the archive, the relative path is saved in comparison to where the actual archive is located. This means that you can choose to extract the files to another location without having to have the same folder structure there. iCON office recreates the folders if they do not exist.

When you choose to place files in the current global folder or configuration folder, this is flagged in the archive. This means the receiver of the archive does not need to have the same path to global files or configuration files. In the column for the path in the file list, it says ***Global folder*** or ***Configuration folder*** instead of a specific path.

Archive

Displays the name and path for the archive

Comment

Here you have the opportunity to comment or add a memo about the archive.

Add...
Click here to add one or more files to the archive where necessary.

Remove
Select one or more files from the list to delete from the archive.

Extract...
Select one or more files to extract from the archive. Now select the folder in which to do this. Any paths that are specified in the archive will be created if they do not already exist.

Send by e-mail
Click the button to send the archive as an attachment to an e-mail message.

See also: Files and Documents 22 , Save document 30

2.4 Windows, Views and Toolbars

2.4.1 Windows, Views and Toolbars in General

Window and Views

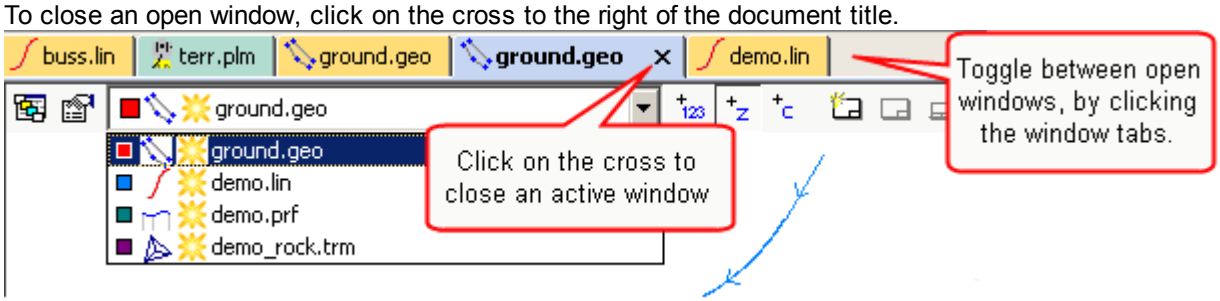
When you open the document in iCON office these are displayed in windows (or views). The maximum they can occupy is the free area of the iCON office-window.

Changing size

To change the window size, press down the left mouse button and drag one of the edges. A window's maximum size is limited partly by the size of the iCON office-window and by the toolbars and dockable windows that 'snap in place' at the edge.

Documents opened in one or more windows

You can choose to open multiple documents simultaneously, either in separate windows or in a single graphical window, see General about graphical 2D views 47 .
Only one window can be active at a time. Toggle windows by clicking the window tab. The tabs have different colors depending on the document and if the display view is graphical or numerical.
To close an open window, click on the cross to the right of the document title.



Tip! You can press **Ctrl-Tab** to toggle between open windows in iCON office.

Dockable windows and dynamic windows

Dockable windows can be "snapped in place" or "docked" to one edge of the iCON office-window. iCON office has two dockable windows, the Project Tree 10 and the input/output window 107 . As these windows are normally displayed all the time, it is convenient to always have the same location. Dockable windows can never be obscured by an ordinary window. A 'docked' window can be moved and made 'floating' by left clicking on the line with the 'thumbtack ' and dragging the window to where you want it.

To dock a window that is floating, click and hold down the left mouse button on the title bar, then drag the frame to the edge you want to dock to. The window then resumes its docked location. The shaded part changes position when an accepted location is found. Release the mouse button to dock.

Left clicking the thumbtack makes the window dynamic, which means that the window is hidden most of the time. If you want to open the dynamic window, move the cursor over the text *Project Tree* or *Input/Output window*, and the dynamic window will then pop up again.

You may have several windows docked on the same edge. If the windows are dynamic, the windows are pushed back and forth over each other.

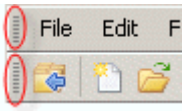
The button with a cross closes the window.

Dockable windows can be opened and closed by selecting ***View | Project Tree***, or ***View | Input/Output Window***, or ***View | Attribute View***, .

The position of the dockable windows is automatically saved when iCON office is closed.

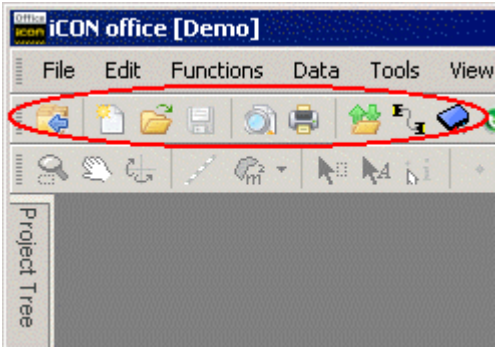
Toolbars

The menu bar and toolbars with buttons can also be 'snapped in place' or 'docked' to any edge in the iCON office-window. This is done much in the same way as with dockable windows in that you drag the part indicated by short horizontal lines. You can also double-click on the line to get a floating toolbar. If you double-click on the menu bar for a floating toolbar, the toolbar returns to its docked location.

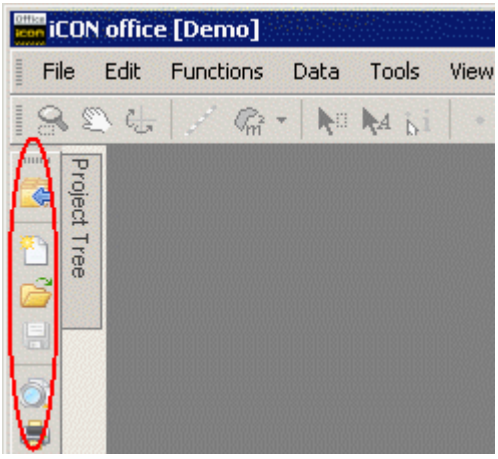


Dockable part of toolbar.

Floating part of toolbar.



Horizontal docking of toolbar.



Vertical docking of toolbar. The dynamic project tree is inset.

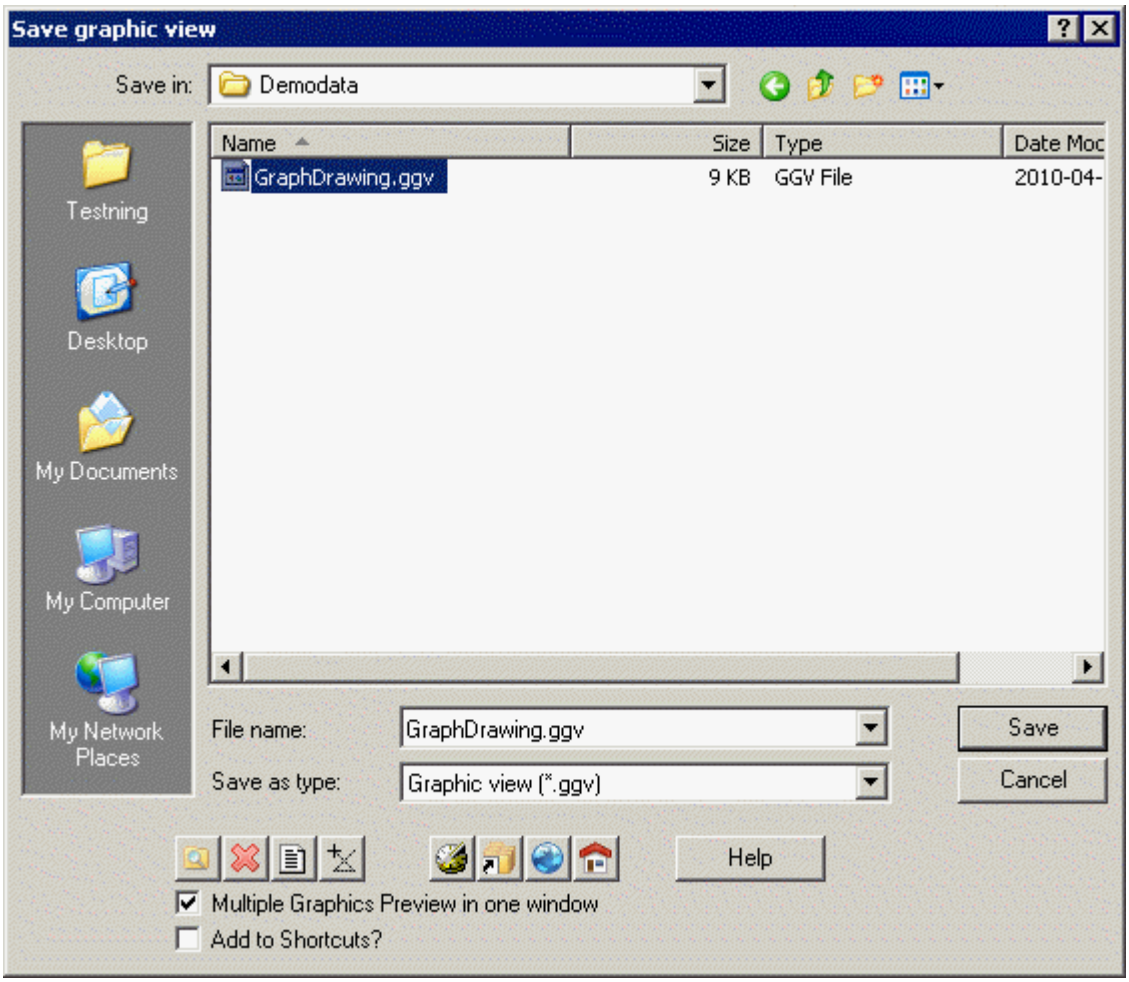
See also Files in the Project 10, Input and output windows 107.

2.4.2 Save graphic view

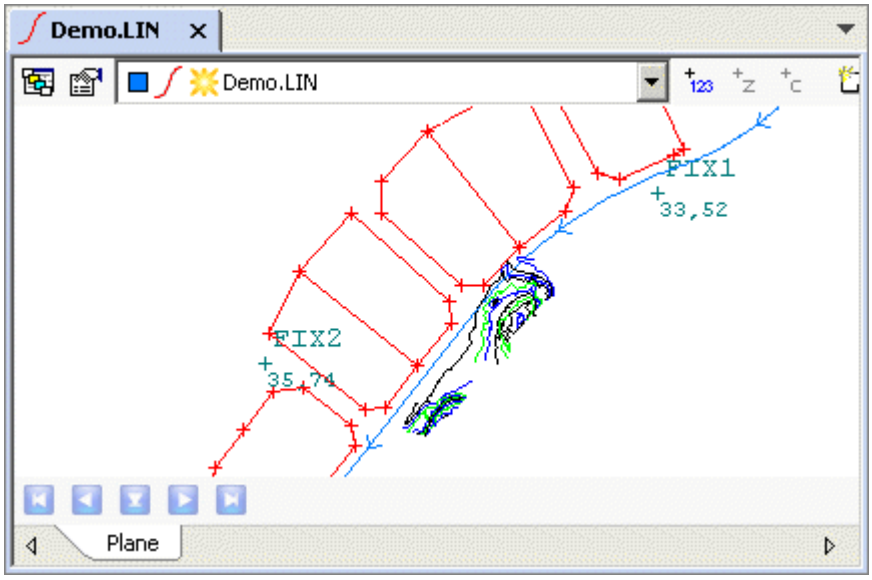
To save an open graphical window, select ***File | Save graphic view***. All files that are open in the current window are saved with the settings that are currently selected for each of the files. The graphic file is saved with the extension ggv.

When you open a graphic file, you will see all the files that are included, with the colors, symbols, texts point and zoom modes, etc., that were selected when the graphic file was saved.

If you have added your graphic view to the Project Tree 10 you can open all the files contained in the graphic file with the default colors, etc. with a single double-click. You can open and continue to work with a saved graphic view, for example, to make a drawing of it.



However, you save the actual files in a graphic file. This means that a graphic view can change its appearance if you have edited a file that is part of a graphic file.



Example:

Assume that the image above is a graphic file, ggv, which contains a line file, a contour line document and two coordinate files.
Also assume that new points are added to the coordinate file including the points FIX1 and FIX2. Now save and close the file.

The next time you open your graphic file, the graphics will have been updated with the points and point numbers that you added to the edited coordinate file.

A graphic file can be viewed as a file that contains links to a number of different files, where each of the input files can have their own settings.
Almost all files that can be displayed graphically can be saved as a graphic view, except for files opened in split windows such as survey files, plm, volume calculations, mbs and tunneling calculations, tbs. It is also not possible to save drawings, dra as graphic views.

See also: Working with files and documents 22, Open and select documents 25, Create document 28, Project Tree 10

2.4.3 Save view

To save a file that is opened in iCON office in a different format, select ***View | Save view as***. Depending on the opened file's format, there are different options.

Save view as AutoCad® file

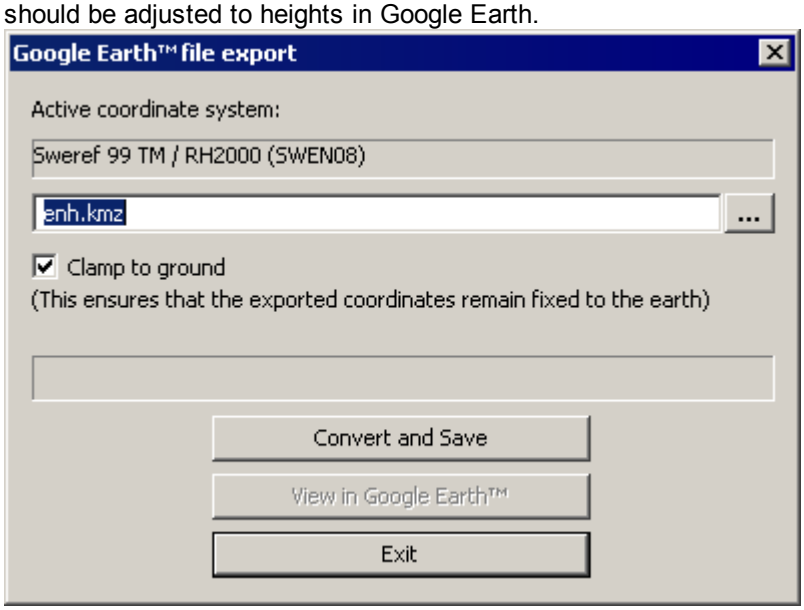
Open the file in the graphical view and select ***View | Save view as | AutoCAD®* file**.
See Export to AutoCAD Drawings, Dwg and Dxf 300 for information on various types of files that can be saved to AutoCad® format, by ***View | Save view as***.
Save view as AutoCad® file works for the following file formats:

Coordinate files (geo, pxy) 303
Lines (lin) 306
Profiles (prf) 306
Terrain profiles (pro) 307
Pipe profiles (prw) 307
Cross section files (sec) 309
Terrain models (trm) 311
Drawings (dra) 312
AutoCad 312® 312 files 312

Save view as Google Earth™ file

Select ***View | Save view as | Google Earth™ file***. All files that can be displayed in the two dimensional graphical view in iCON office can be saved to a Google Earth™ file. The exported file is saved in the Google Earth™ format kmz.

During the exportation a dialog opens, in which you must specify how the heights of the files in iCON office should be adjusted to heights in Google Earth.



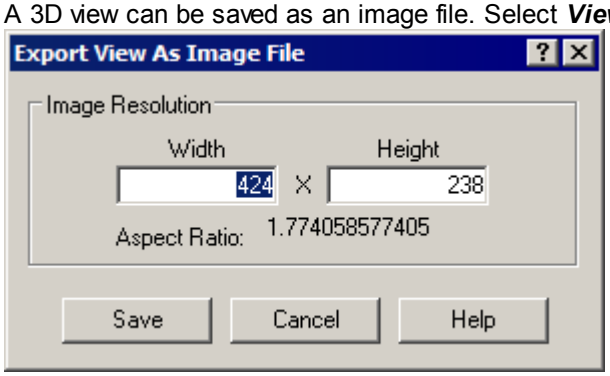
Clamp to ground

In the dialog, select if heights should appear like real altitudes or if they should appear as fixed on Google's elevation model. When heights are fixed, variations in the Google global elevation model do not affect the visibility of your model.
Check the box **[Clamp to ground]** to make the height of exported points and lines follow the geoid model in Google Earth as if they were draping the surfaces in Google Earth. If you choose *not* to check this box, all or parts of the exported data may fall below the geoid model in Google Earth, and thus these lines and points will be hidden by the surface of Google Earth.
Whatever the settings, point heights will always be stored in the exported files.

To export a file at a time select ***File | Import/Export | Google Earth***, see Google Earth 396.

Save view as bitmap

A 3D view can be saved as an image file. Select ***View | Save view as | Image File***.

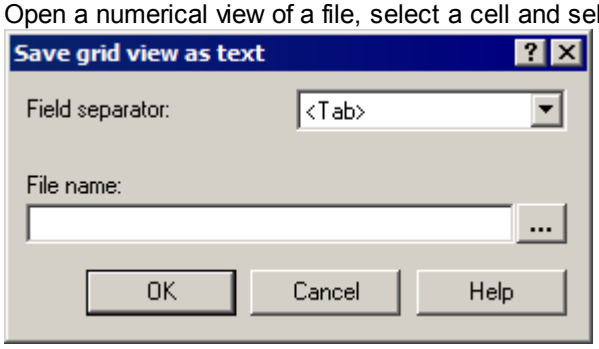


The ratio of width to height is constant in the image file. In the dialog above, you can specify the desired

width or height of the created bitmap file.

Save view as field delimited text

A numerical view can be saved as a text file with the extension txt.
Open a numerical view of a file, select a cell and select ***View | Save view as | Field delimited text***.



Field separator:
Use the drop list to select which character will be used to separate the fields in the text file.
Choose between <Tab>, <Space>, <Comma>, <Semicolon> or <Colon>.

File name:
Enter a name of the text file you will create.

See also General on numerical views 94.

Save view as MS Excel file

Select ***View | Save view as | MS Excel file*** to save the contents of an input view to an Excel® file. You can use the file to make your own calculations or send the file to people who do not have iCON office.
Please note, if the numerical view has multiple tabs in iCON office, like for example a net adjustment file, hna, each tab has to be saved separately to get all the tabs to Excel® files.

See also: Export to AutoCAD Drawings, Dwg and Dxf 300, Google Earth 396, General on numerical views 94

2.4.4 Graphical 2D views

2.4.4.1 General about graphical 2D views

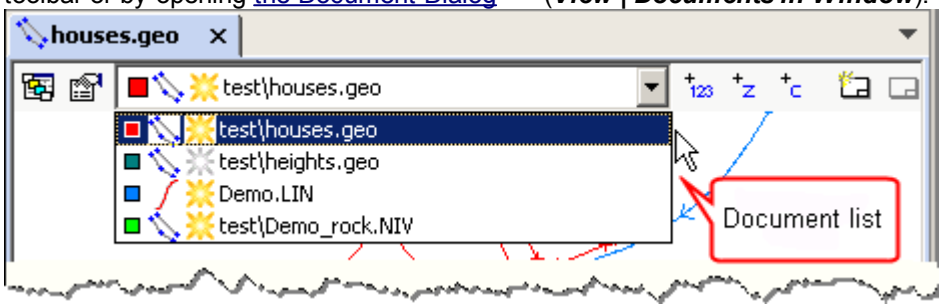
All files that can be presented graphically (including coordinate, line, profile and terrain model files) are displayed by default in a graphical window when opened. In this window you can edit the document data in different ways.

Several documents in the same window

You can choose to open multiple documents in a single graphical window. This can be done in several ways:

- Select multiple files in the open dialog.
- Select *'Active window'* in the box **[View in]** in the open dialog.
- Select ***View | Documents in Window*** to display the dialog with the current document in the window. From here you can open and close the document.
- Double-clicking a file in the project tree will open it in the active window. You can also right-click the file and select ***Open file in the active window***.

You can view the files that are open in a graphical window, either by clicking on the document list in the toolbar or by opening the Document Dialog 50 (***View | Documents in Window***).



Document list in the toolbar.

Active document

When multiple documents are opened in a graphical window, one of them is always active, which is actively displayed in the document list in the toolbar. By selecting from the list you can set another document as active. It is the active document that is affected by most of the menu options. For example: if you select ***View | Numerical view*** an input window for the active document will be opened. If a new document is opened, it will be active. Another way to change the active document is to right click in the graphical window and then select from the list of *Active documents*. To close one or a number of open documents in a window, select ***View | Documents in Window*** and then **[Close Files]**, see Documents in the graphical view 51.

Graphical tools

There is always a graphics tool[223] active. You select it either from the toolrows or from the Tools menu. Only one tool at a time can be active.

View orientations

By selecting ***View | View orientation*** you can select from four different view orientations:

- **Plane**
  Displays plane data with northern coordinates vertically and eastern coordinates horizontally in the window.
- **Section, offset**
  This orientation "straightens out" a line, with the length of sections horizontally and offset vertically in the window.
- **Profil**
  Shows profile data with length of section horizontally and height vertically in the window.
- **Cross section**
  Shows one cross section at a time, offset horizontally and height vertically in the window.

Commands and menu options

Input view
Opens a numerical view for the active document in the window.

Graphical view
Opens a graphic view for the active document.

Graphical 3D View
Opens a graphical 3D view for the active document in the window.

Zoom limits
Zooms the window so that all information is visible.

Zoom in
Zooms in one step with the window's current center point as the base.

Zoom out
Zooms out one step with the window's current center point as the base.

Tip! By using the Page Up and Page Down buttons, you can zoom in and out at the cursor's current position. This means that you can also pan the image while zooming.
If you have a mouse with a **scroll wheel** you can also use this to zoom in and out at the cursor's current position.

Zoom mode 1
Loads saved zoom mode 1.

Zoom mode 2
Loads saved zoom mode 2.

Help layers

Displays or hides help layers in the window.

Scalebar
Shows or hides the scalebar[249] in the window.

Background Picture
Displays or hides the project's background image[219] in the window.

Point Number
Shows or hides point numbers for active documents in the window.

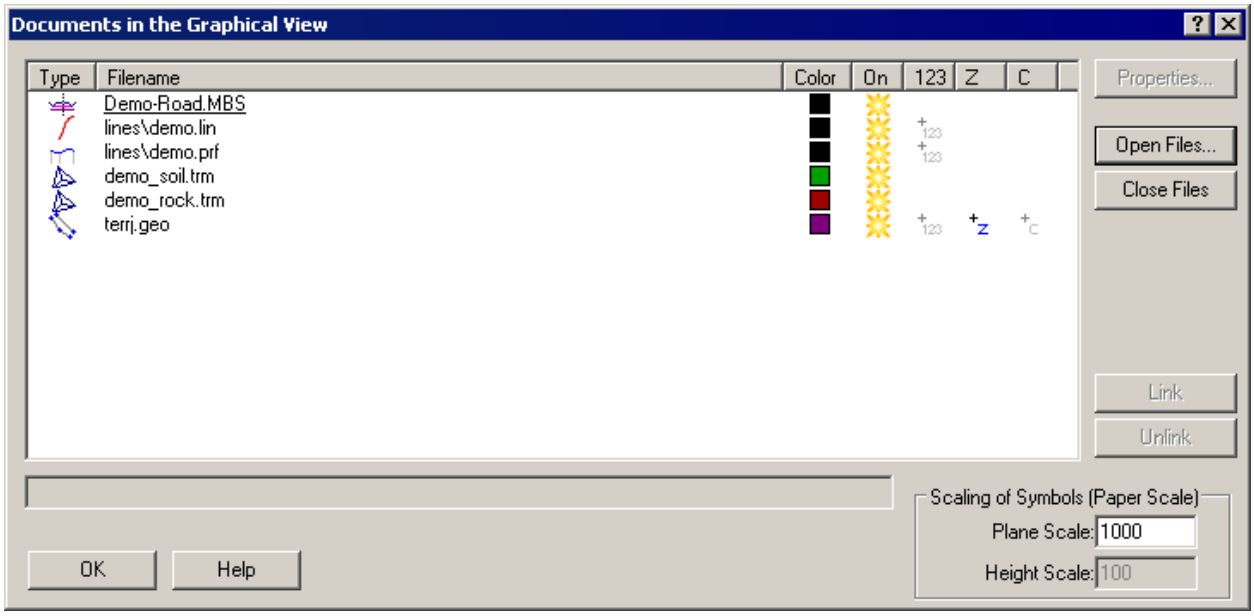
Heights
Shows or hides heights for active documents in the window.

Section stepping
Use the keys to step between the cross sections in a section document. Click to search for a section.

See also: Document in graphical windows[50], Graphical tools[223]

2.4.4.2 Documents in the graphical view

Select ***View | Documents in Window...*** or click to display the dialog of the constituent documents in the graphical view. From here you can add and delete documents in the window, control color settings, etc.



Note: The dialog can be opened by right-clicking in the graphical window and selecting ***Documents in Window...***

Filename
The list shows the documents that are open in the graphical window. The path to the files located in sub folders is also displayed. Icons for file type appear to the left of the filename. The active document is underlined.
If the file name is preceded by the, #, sign, this means that the document has been imported into a drawing.

Colors
The icon shows the color the document has in the window.
Use the button to change the basic color of each document.

On
A yellow sun means that the file is clearly visible in the graphics. Click on the yellow sun to make it gray, which indicates that the file is not visible. Sometimes it may be necessary to temporarily reduce the amount of information on screen without closing the document, it can then be handy to temporarily turn off one or several files in this way.

123
Click to switch on/off point numbers.

Z
Click to switch on/off heights.

C
Click to switch on/off the code for the points included in the file.

Properties...
Select the document whose properties you wish to edit and click the **[Properties]** button, the dialog for document properties 52 opens. The dialog may also be opened directly from the graphics window by

selecting ***View | Document Properties*** or by clicking the button .

Open files...
By clicking the button **[Open files]** opens Open dialog 25 where you can add more files to the graphical window.

Close files
Removes the selected documents from the graphical view.

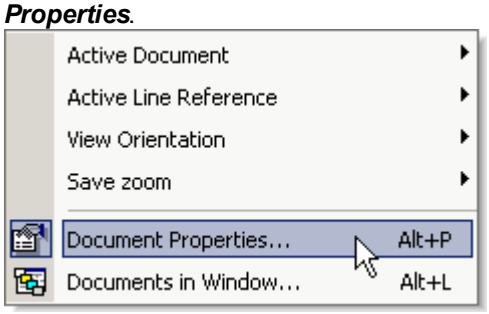
Link/Unlink
These buttons are active when a drawing 255 is open. The documents included in the drawing can either be imported into the drawing, or there is a link to the file on the disk.
Click **[Link]** to unlink the selected (and imported) document and instead create the file on the disk, while linking to it.
Click **[Unlink]** to import a document to the drawing. The sign, #, is displayed before the file name in the list.

Scaling of Symbols
The value indicates the scale of symbols to be drawn. If a drawing is open, you cannot change the value directly, but the drawing scale is shown in the dialog.

See also: Graphical views 47, Drawings 255

2.4.4.3 Graphical Document Properties

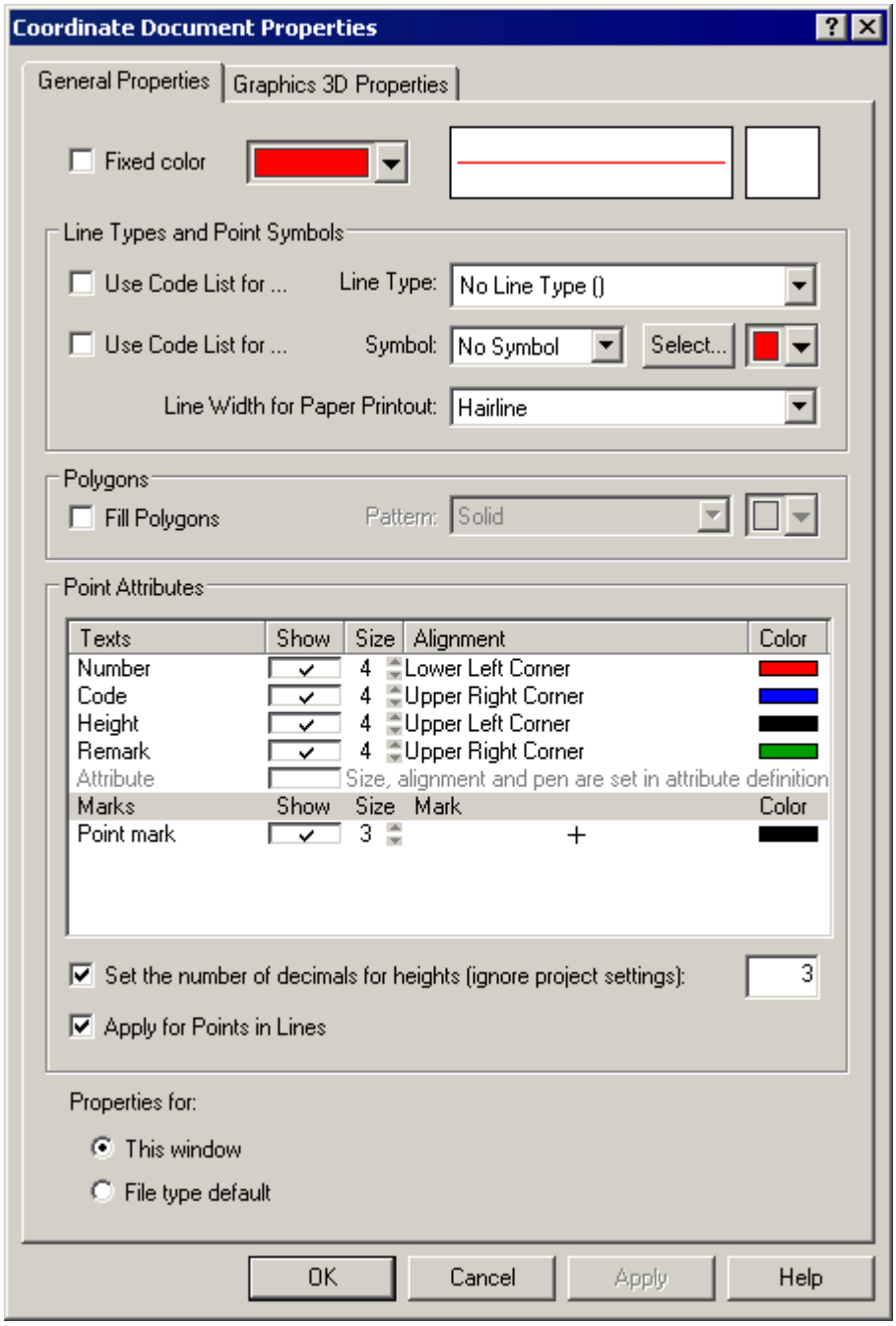
All graphical documents have a number of settings that govern things like colors, line types, text etc. These settings are edited in the document properties dialog that you open by selecting ***View | Document Properties***, in the menu, or by right-clicking in the graphical window and selecting ***Document Properties***.



The text below describes:

- Coordinate Document Properties (geo, pxy) 53
- Line, inclding horizontal and vertical geometries, Properties (l3d) 56
- Profile Properties (prf) 56
- Help Point Properties (gft) 56
- Terrain Model Properties (trm, dfm) 57
- Contour Lines Properties (niv) 58
- Difference Contour Lines Properties (dfn) 59
- Stringline Properties (lmd) 60
- Section Properties (sec) 62
- Section Reference Properties (sec) 64
- Volume Calculation Document Properties (mbs) 66
- Properties for Tunnel Calculation Document (tbs) 67
- Theoretical Tunnel Section Properties (tun) 68
- Terrain Profile Properties (pro) 69
- Measurement Document Properties (plm) 70
- Properties for Net Adjustment Documents (hna) 71
- AutoCAD Drawing Properties (dwg, dxf) 73

Coordinate Document Properties (geo, pxy)



Fixed color
Select the color the information in the document is to be drawn with. If the box **[Fixed Color]** is checked, this means that everything is redrawn with the selected color. Use the drop list to select color. If the box is not checked other colors can be set, for example, symbols, texts and markings, see Point Attributes54 further down in the dialog.

Line Types
Line types will be retrieved from the active code list203 if the option **[Use code list for]** is selected. The corresponding code from the code list is retrieved from the points' code field.

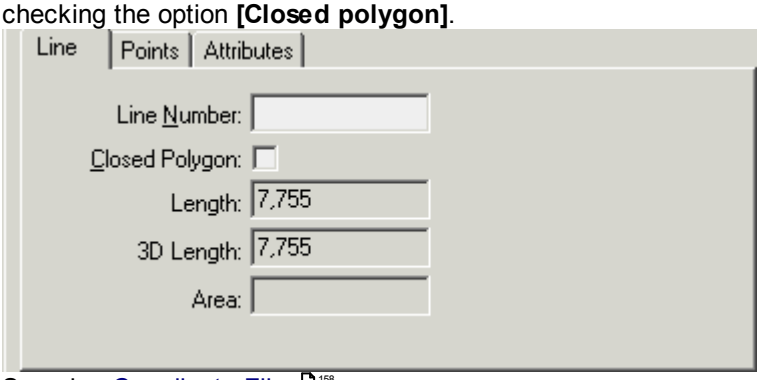
You can also use the dropdown menu to select a line type for lines in the document. The line types shown in the list are retrieved from the current line type file[203]. See also Project Settings[16] for the selection of line type file.

Point Symbols
Controls the symbol to be plotted at points in the document.
Point symbols will be retrieved from the active code list[203] if the option **[Use code list for]** is selected. The corresponding code from the code list is retrieved from the points' code field.
You can also select symbols for points by using the dropdown menu or by clicking the button **[Select...]**. The symbols shown in the list are retrieved from the current symbol file[203]. By clicking the button **[Select...]** you open a window with the symbols available for selection. If the option **[Fixed Color]** is selected, the main color is used for the document, otherwise you can select the colors of the symbols.
See also Project Settings[16] for the selection of symbol file.

Line Width for Paper Printout
Controls the line width that the lines in the current document are to be drawn with. Note that the line widths do not have any effect on the screen, but are only used for printing. The *'Hairline'* option means that the line is always drawn as thin as possible.
In print preview you can see the line widths before printing.

Fill Polygons
By checking the box **[Fill polygons]**, lines (polygons) that are closed can be filled with a pattern. The patterns available are shown in the list **Pattern**. If the option **[Fixed Color]** is not checked, you can select a separate color for the pattern.
You can make a line in a coordinate document closed by:

- selecting the line and choosing to view its properties
- checking the option **[Closed polygon]**.



See also Coordinate Files[158].

Point Attributes
Check the buttons under **[Show]** to display point attributes, such as point numbers, codes, heights, remarks, attributes and point marks.

Texts
In most documents, you can choose to display texts associated with objects, such as point numbers, codes and heights etc. Check the boxes in the column **[Show]** to activate the relevant texts.

Size
Specifies the size factor of the text or symbol.

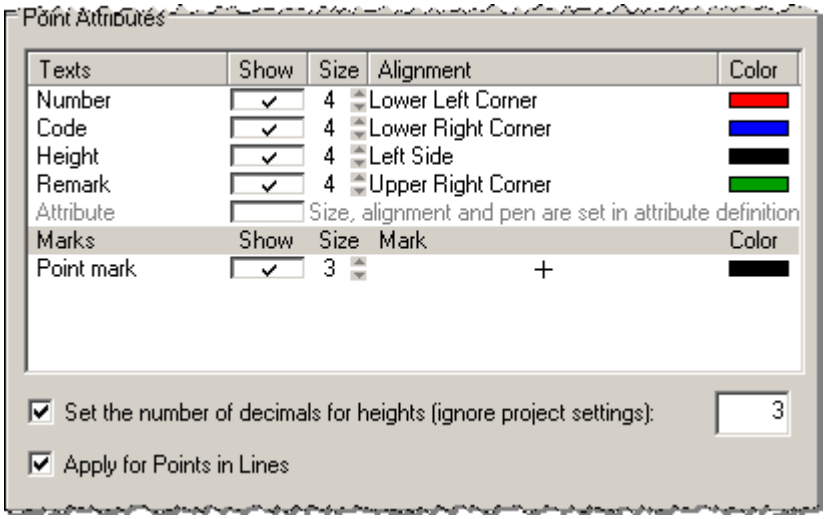
Alignment
Specifies the insertion point for the text, the selection determines what part of the text is linked to the point.

Colors
Text or symbol color. If the option **[Fixed Color]** is selected in the upper part of the dialog, the main color is used for the document. If the option **[Fixed Color]** is not selected, you can select different colors for

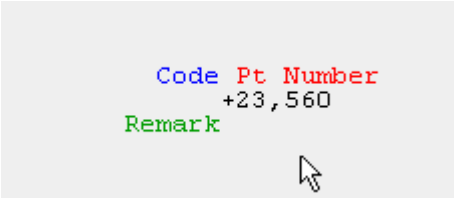
symbols, texts and point marks e.g.

Attribute
Check the box to view the attributes that are associated with the point. Size, location and pen are set in the attribute definition file 113.

Point Mark
Check the box to display a point mark at each object.
If you click at the displayed point mark, you can select symbol for the point mark from a number of different symbols.



Examples of settings.

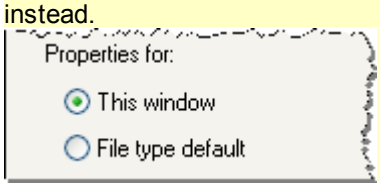


Results for a point on the screen.

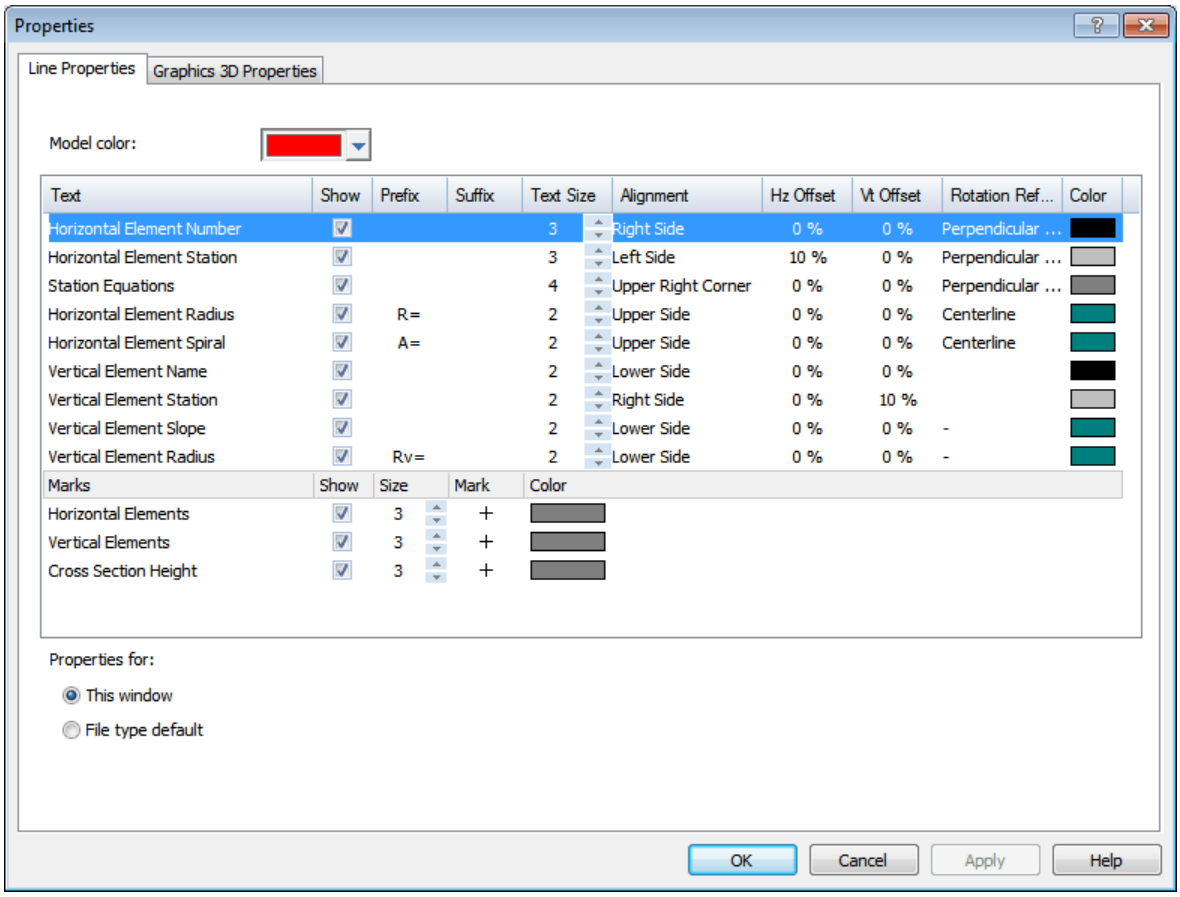
Set the number of decimals for heights (ignore project settings)
Regardless of the project settings for the number of decimals 19 for height readings, you can here specify how many decimal places to be displayed in the graphics.

Apply for Points in Lines
When the box **[Apply for Points in Lines]** is checked, selected settings for point attributes are valid for both single points as for points included in lines.
If this box is not checked, this means that the settings for the point attributes only apply to single points in the document. You can therefore choose to view point numbers for single points while not displaying point numbers included in lines.

Tip!
If you want the settings to apply generally for a particular document type, check the box **[File type default]** under **[Properties for]**. The settings will then be saved and used each time a document of the current type is opened. If you only want the changes to apply in the open window, check the box **[This window]** instead.



Line Properties (lin)



See Coordinate Document Properties 53 .

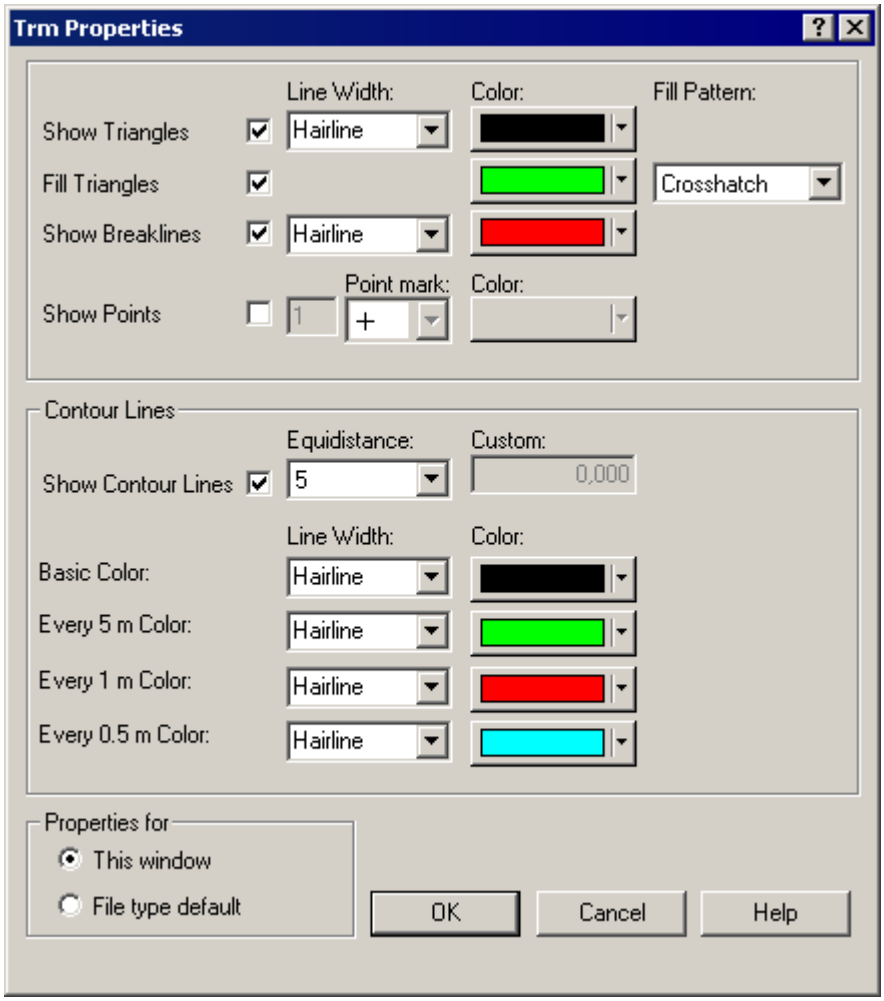
Profile Properties (prf)

See Coordinate Document Properties 53.

Help Point Properties (gft)

See Coordinate Document Properties 53.

Terrain Model Properties (trm, dfm)



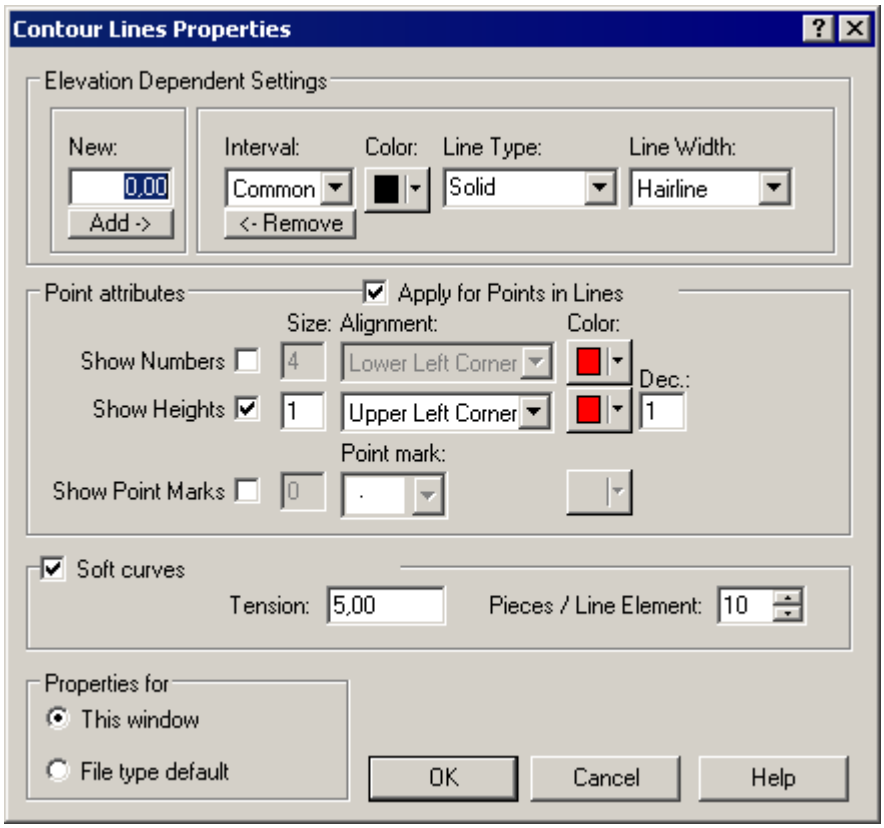
Triangles and Breaklines
Select the information to be displayed and also the line width and colors to use.

Fill Triangles
If this box is checked, you can choose the triangles to be drawn using the colors and pattern of your choice.

Show Points
If this box is checked, the point marks are shown with the selected mark, color and size.

Contour Lines
If the box **[Show contour lines]** is selected, the contour lines are calculated and drawn for the relevant model. Select the desired height interval in the **Equidistance** box. It is also possible to specify any interval by selecting 'Custom' and then entering the value in the box **Custom**. Colors and line widths for the different height intervals can also be defined.
You can also create and store contour lines 657 separately.

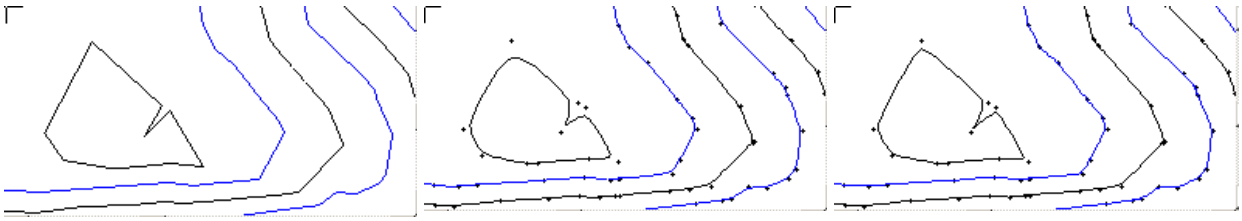
Contour Lines Properties (niv)



Elevation Dependent Settings
It is possible to specify separate settings for different height intervals in the document. In the list **[Interval]** the current intervals are displayed. The intervals 1m, 5m and 10m are the defaults. There is also the option, *'General'*, which is used if there is a height interval in the document that is not listed. New intervals are added by entering the value in **New** and then clicking the button **[Add->]**. To remove current intervals, select from the list and click **[Remove]**.
For each interval you can set **color**, **line type** and **line width**.

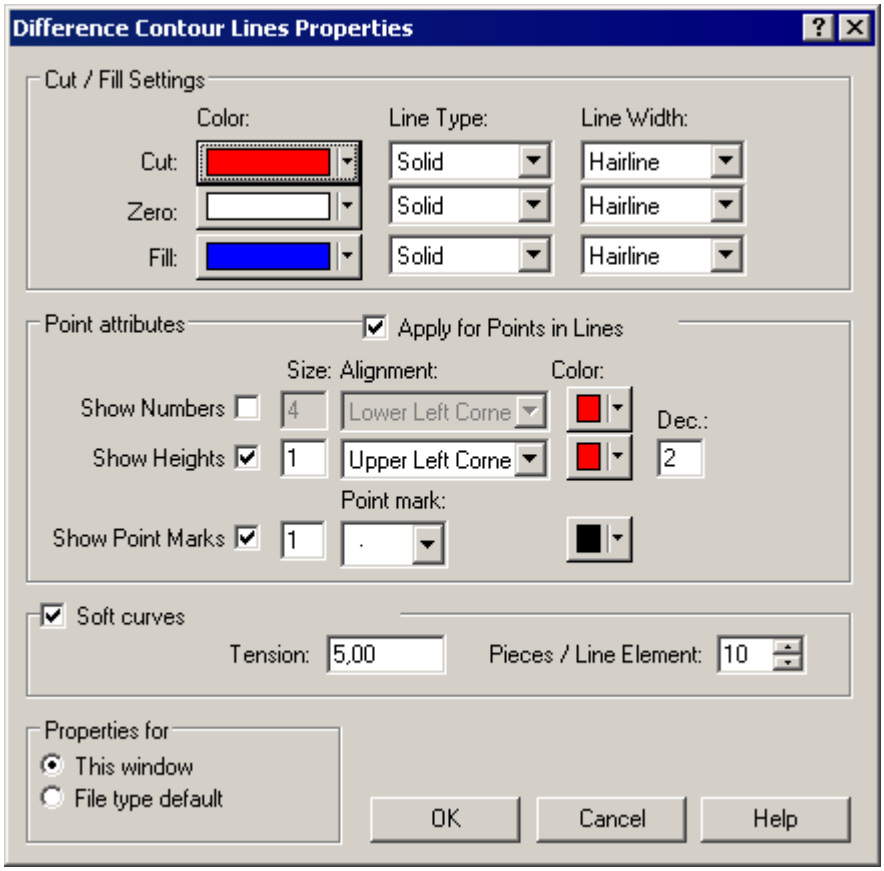
Point Attributes
See Coordinate Document Properties 53.

Soft curves
With this box checked, you can contour lines with rounded corners to get better-looking drawings and maps. The original data is not affected. Note that the soft curves do not pass through the original points and the curves may cut each other. The latter can be solved by removing or adding points to the curves, or by adjusting the tension for rounding. **Tension** means how hard the curves are to be drawn to the original points, the greater the tension, the closer, but less smooth the curves, see the example below. For the sake of clarity, the original points have also been drawn. You can also choose how many parts each element should be divided into, with **Segment/Line element**. What you choose here depends on how fast your computer is. More elements mean slower rendering, but less hacking. At least 10 is appropriate.



Without soft curves | Tension = 5 | Tension = 20

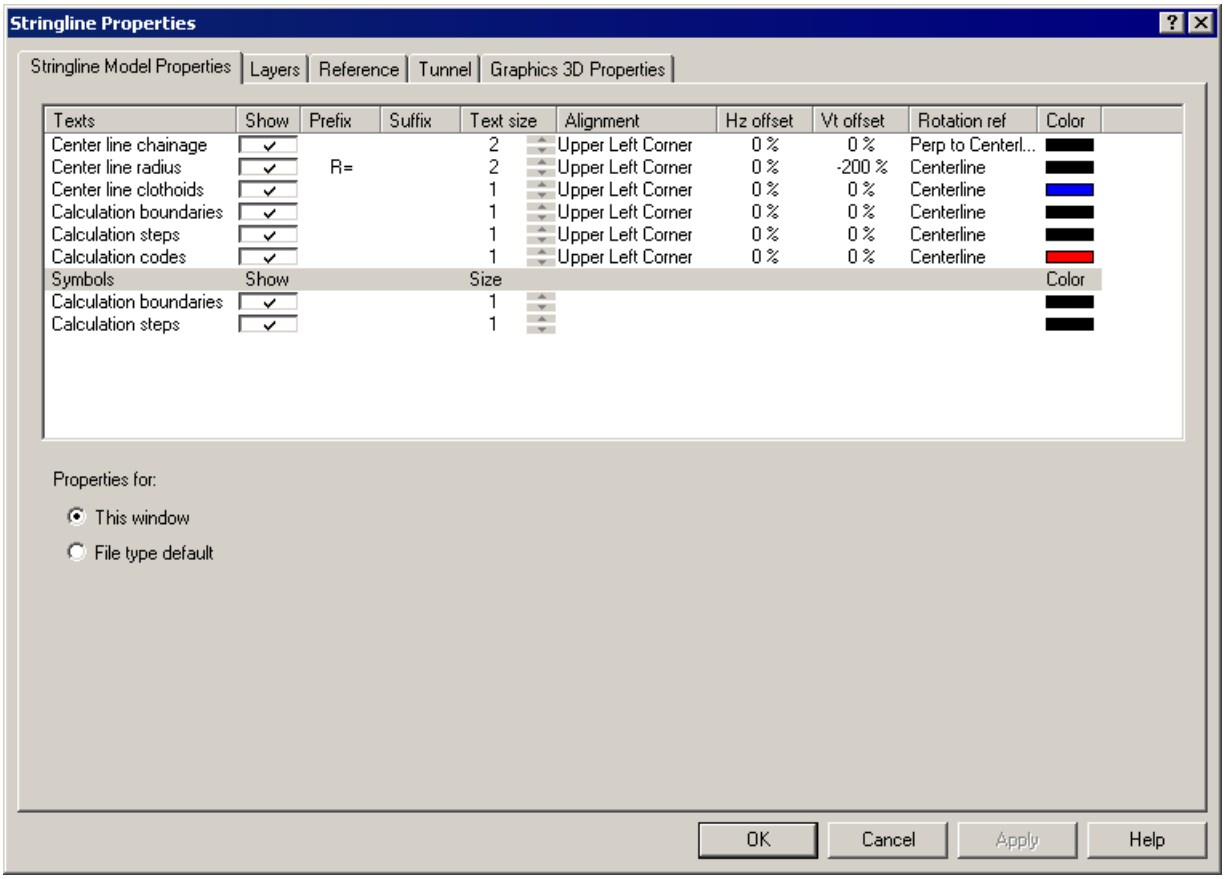
Difference Contour Lines Properties (dfn)



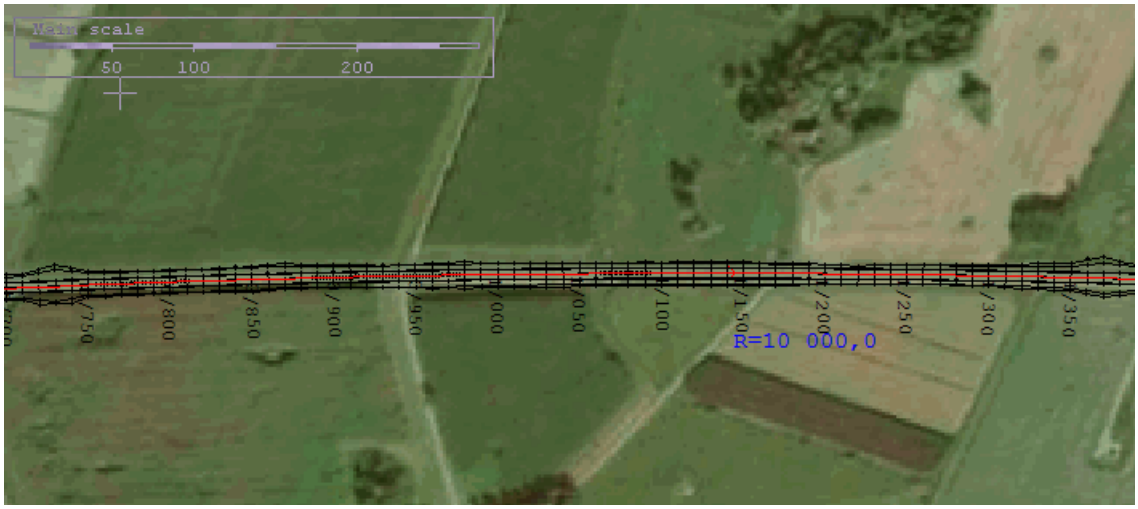
Cut and Fill
Select the **color**, **line type** and **line width** to be used for the three different height intervals: cut, fill and zero levels.

Soft curves
See contour lines 58 above.

Stringline Properties (lmd)



Exemples of settings for stringlines.



Exemples of the appearance of a stringline model with the settings shown in the properties dialog above.

Show texts and symbols

In column **[Show]**, check the texts and symbols to be displayed for the stringline model.
The displayed number of decimals in the graphics is controlled from the Project settings 19, e.g. the setting for 'Distance' control the displayed center line chainage and radius, the setting for 'Station' controls the number of decimals for calculation boundaries and calculation steps.

Number of decimals for:	**... is controlled by Settings in the project**[19]**:**
Center line chainage	Distance
Center line radius	Distance
Calculation boundaries	Station
Calculation steps	Station

Prefix
In the column for **[Prefix]**, you can specify a prefix to be displayed with the selected text.
Highlight the current line and enter any prefixes.

Suffix
In the column for **[Suffix]** you can specify a suffix to be displayed with the selected text.
Highlight the current line and enter any suffixes.

Text size/Size
Specifies the size factor on the text or symbol.

Alignment
Specifies the insertion point for the text, the selection determines what part of the text is linked to the point.

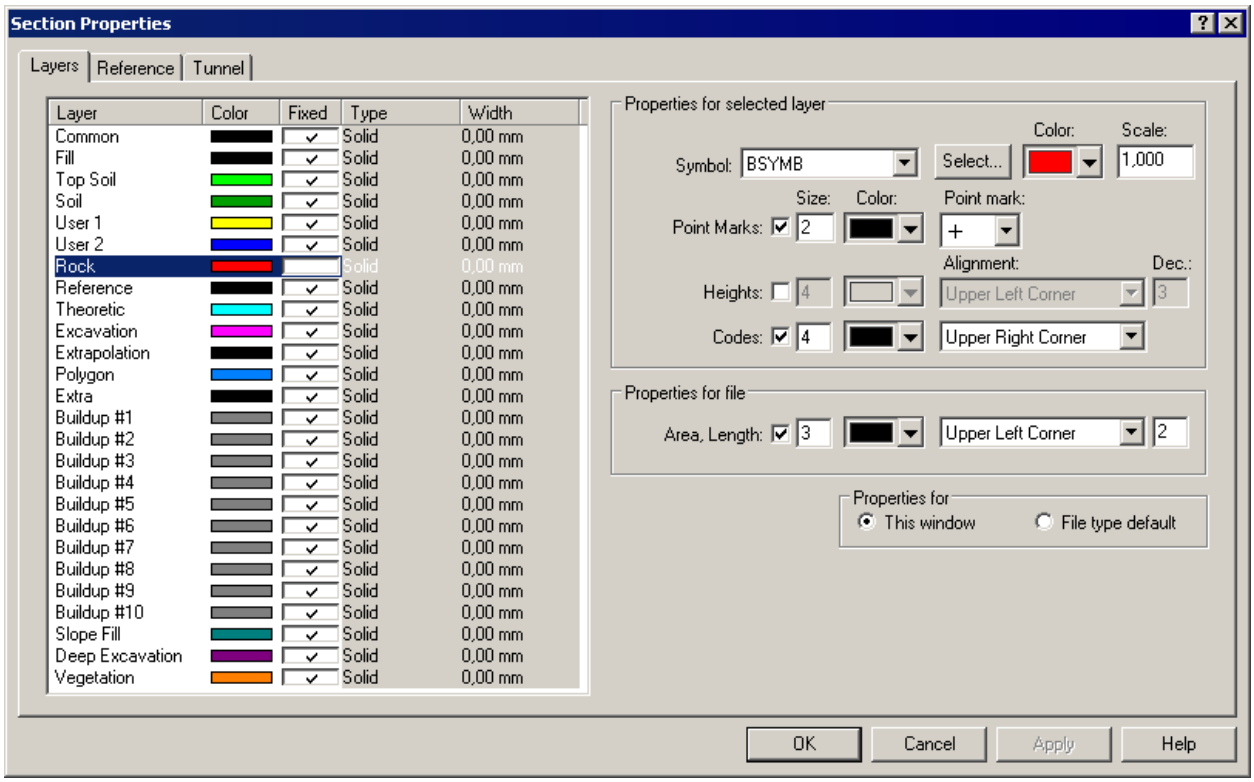
Horizontal offset
Here you can specify the percentage you want to move the text to the side. 100% means that you move the text over its entire length to the right. Specify -100% to move the text over its entire length to the left.

Vertical offset
Here you can specify the percentage you want to move the text vertically. 100% means that you move the text its entire width upwards. Specify -100% to move the text accross its entire width downwards.

Rotation ref
Specify whether the text should be printed parallel to the centerline or perpedicular to it.

Section Properties (sec)

The properties dialog for the sections is divided into three tabs, one for layers in the file and one that controls the reference lines of the sections. The third tab displays tunnel specific settings.



Layer

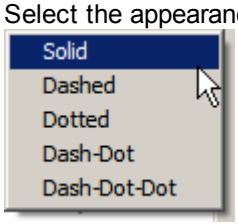
The list shows all the different layers that may exist in a section file.

Color

Shows the color used to draw the line for the layer. If the box **[Fixed]** is checked, all other information in the selected layer will also be drawn in the selected color.

Type

Select the appearance of drawn lines.



Left click at a row in the column **[Type]** to change line type for the selected layer.

Width (for Paper Printout)

Controls the line width that the lines in the current layer are to be drawn with. Note that the line widths do not have any effect on the screen, but are only used for printing. The *'0.00'* option means that the line is always drawn as thin as possible.
In print preview you can see the line widths before printing.

Properties for selected layer

The properties displayed to the right in the dialog are valid for the layer that is selected in the left part of the dialog.

Symbol
A symbol can be drawn for the points in a layer. Select the desired symbol from the list or click the button **[Select...]** to open a window with the possible symbols drawn. The symbols that can be selected depends on the current symbol file, see also Project Settings 16 for the selection of symbol file. The symbol's color and scale factor can also be set.

Point Marks
Check the box to display a point mark at each object in the line.
If you click at the displayed point mark, you can select symbol for the point mark from a number of different symbols. You can also select size and color.

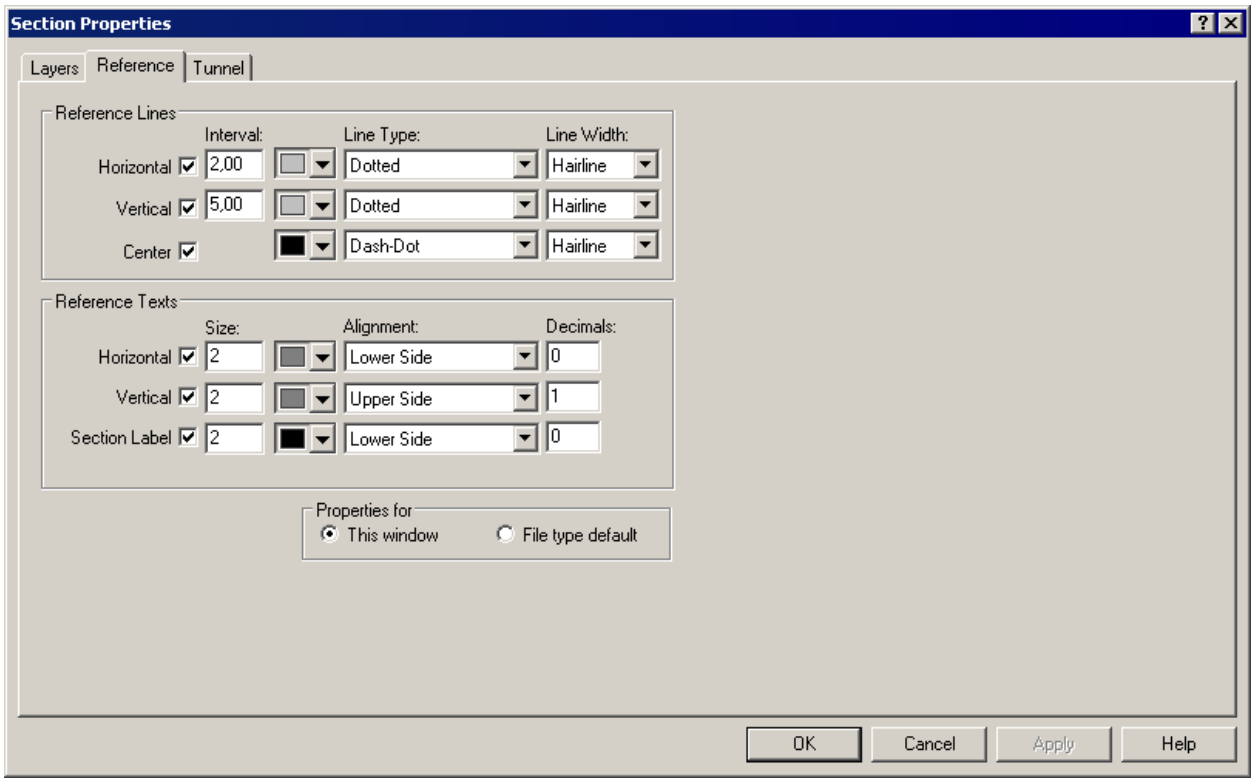
Heights/Codes
Check the boxes if you want to display heights and codes. The alignment specifies the insertion point for the text, the selection determines what part of the text is linked to the point.
For heights, you can specify the number of decimals to be displayed.

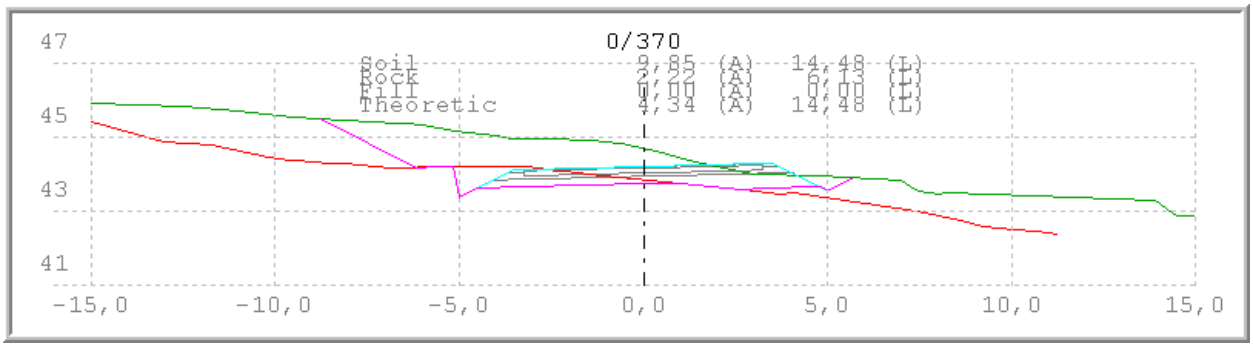
Area, Length
A section file that is calculated by a volume calculation contain area and length information. This information is printed if the box is checked. The alignment of the text applies relative to the center line's top point.

For tunnel sections, see also Tunnel description 862 .

Section Reference Properties (sec)

The settings in the dialog control how the reference information for sections is to be drawn.





Horizontal Reference Lines

If this box is checked, this means that the horizontal reference lines will be drawn at selected intervals for each section in the document. Also select the color, line type and line width for the lines.

Vertical Reference Lines

If this box is checked, this means that the vertical reference lines will be drawn at selected intervals for each section in the document. Also select the color, line type and line width for the lines.

Center

If the box is checked, this means that the section's center will be marked with a vertical dash. Also select the color, line type and line width for the line.

Horizontal Reference Texts

If this box is checked, this means that the horizontal reference texts will be printed in connection to the reference lines. Also select the size factor, color, alignment, and number of decimals for the texts. The

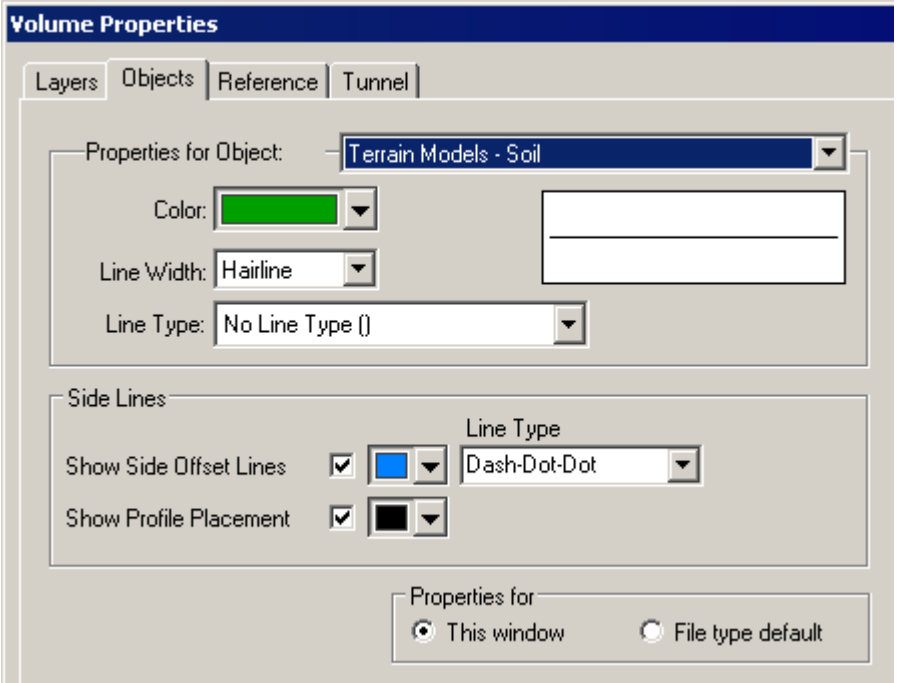
insertion point for the text is in relation to the linet s' left starting points.

Vertical Reference Texts
If the box is checked, this means that the vertical reference texts will be printed in connection to the reference lines. Also select the size factor, color, alignment, and number of decimals for the texts. Insertion point for the text is in relation to the lines' lower starting points.

Section text
Means the length section for each section will be printed. Also select the size factor, color, alignment, and number of decimals for the text. The insertion point for the text is the upper end point of the center line.

Volume Calculation Document Properties (mbs)

The dialog for volume calculation documents is divided into four tabs, one for file layers, one for file objects and one that controls the section reference lines. The fourth tab controls tunnel specific settings. See 'Section Properties 62' and 'Section Reference Properties 64', and 'Graphical Tunnel Properties 867' for a description of the properties in these tabs. The properties edited under the tab "Object" are used primarily in the plane views and cross sections views of the volume calculation.



Properties for Objects

The list shows all the different objects that can be included in a volume calculation. The properties shown in the dialog apply to the selected object.

Colors

Shows the color used to draw the object/objects.

Side Lines

If the boxes are checked, side lines and profiles, if any, will be visible in the cross section views.

Show Side Offset Lines

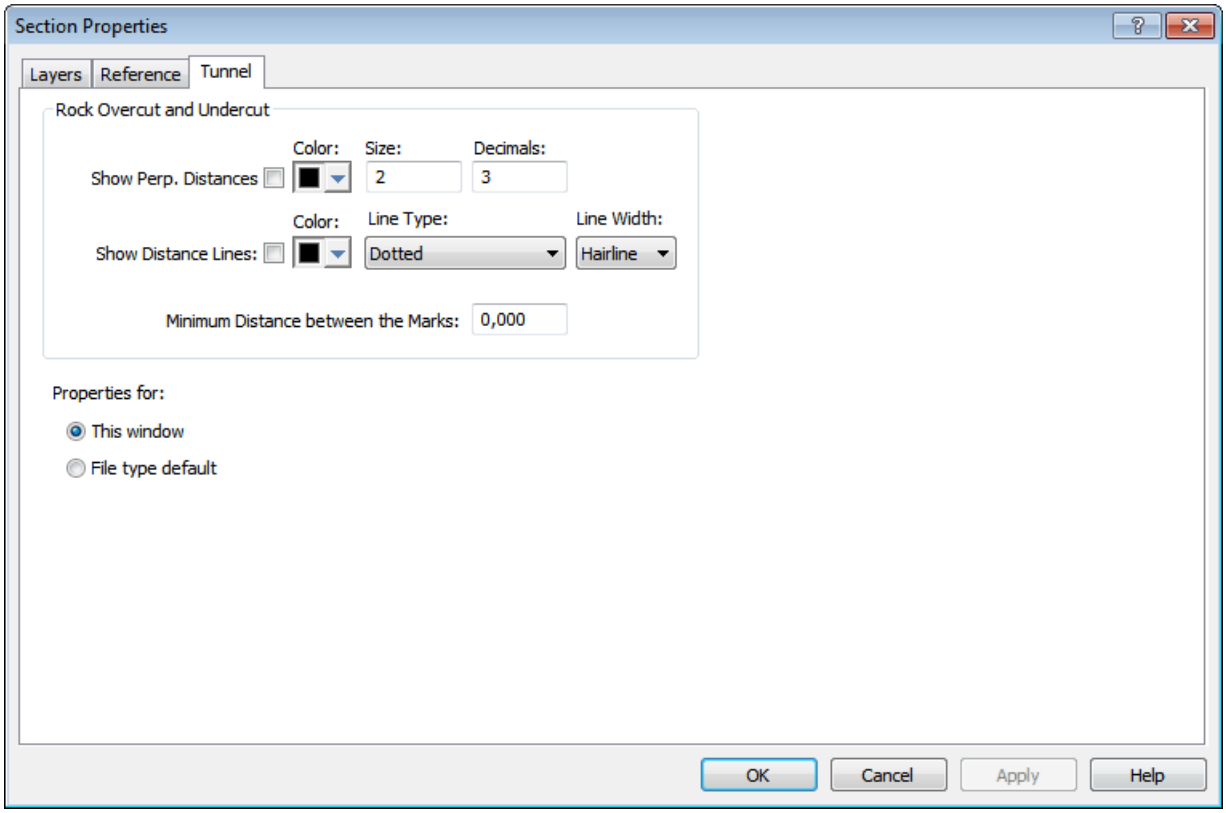
Check the box if side offset lines should be displayed in the cross section views.
Select color and line type for the side lines, if any, in the volume calculation. Please note, side lines will only be visible if they are created as line files 503, lin. That is, side lines that have been created only by an alternative distance 692 in the volume calculation document, mbs, will not be visible.

Show Profile Placement

Check the box if the position of the side line's profile should be visible in the cross section views.

Properties for tunnel calculation document (tbs)

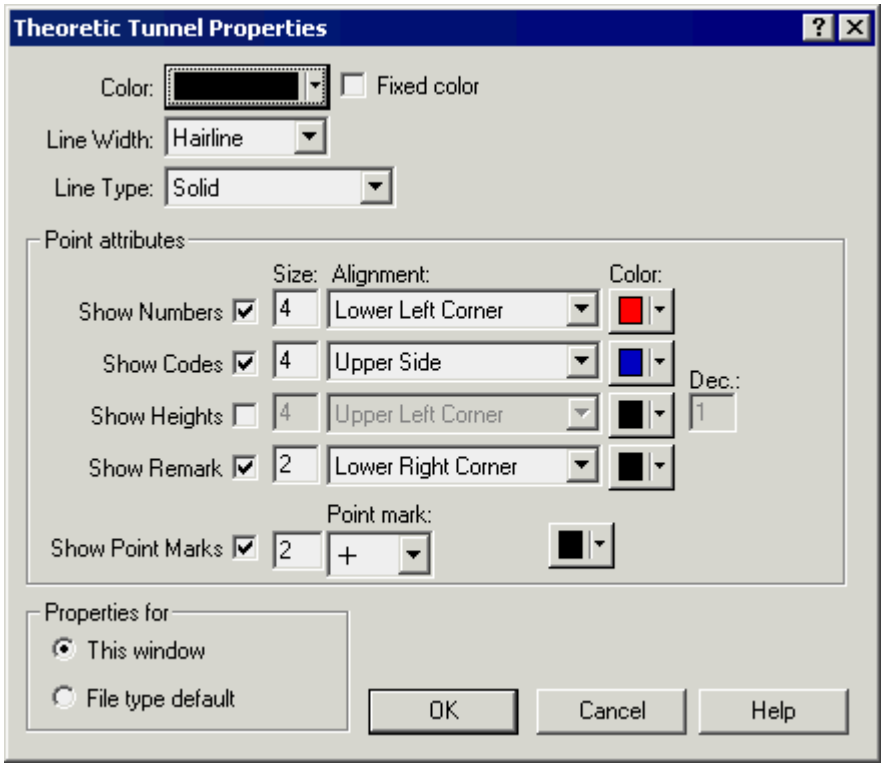
The properties dialog for tunnel calculation documents is divided into four tabs, one for file layers, one for file objects, one that controls the section reference lines and one for tunnel specific settings. See 'Section Properties 62 ', 'Volume Calculation Document Properties 66 ', 'Section Reference Properties 64 ', and 'Graphical Tunnel Properties 867' for a description of the characteristics in these tabs.



See Tunnel Description 867 for these settings.

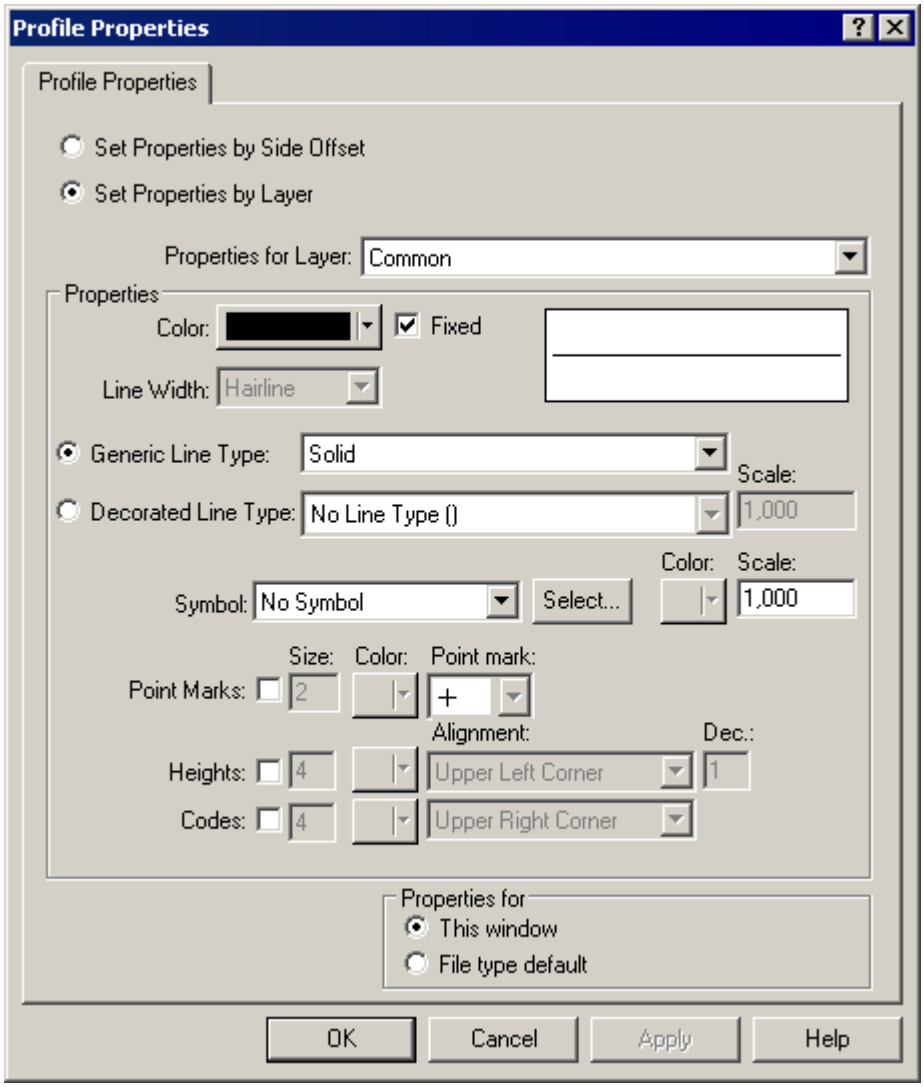
Theoretical Tunnel Sections Properties (tun)

The settings in the dialog control how the theoretical tunnel sections (tun) are to be drawn. This does not apply to the calculated tunnel sections, as the properties are then controlled in the same way as for 'Section Properties 62' and 'Section Reference Properties 64'.



See general properties 53.

Terrain Profile Properties (pro)



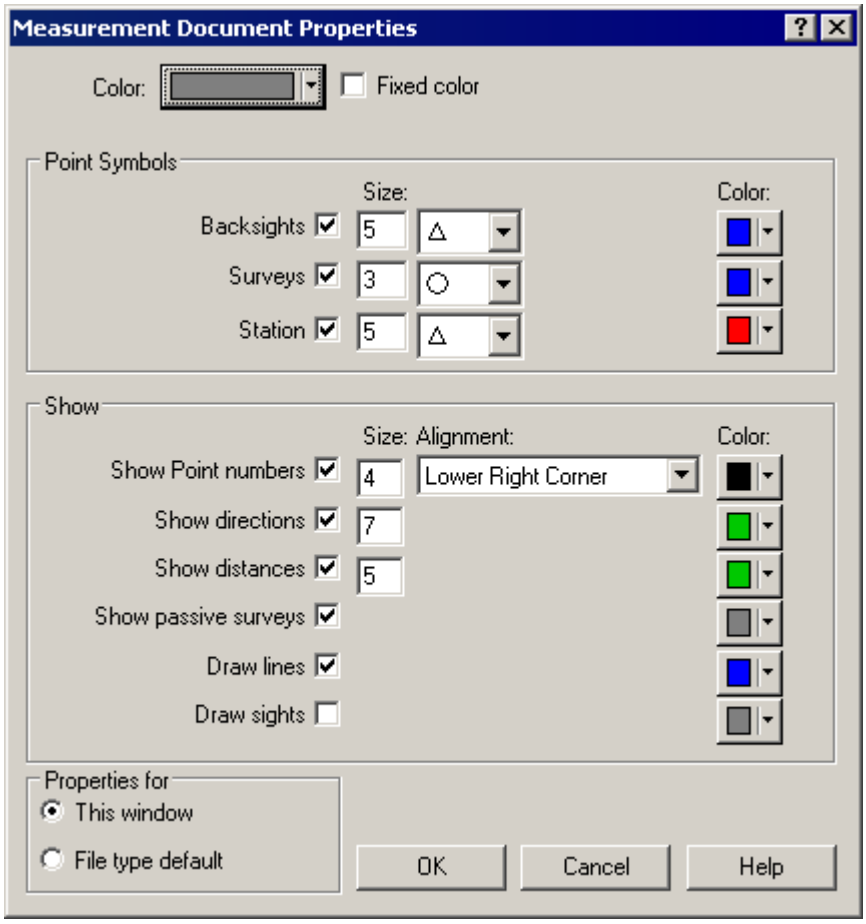
Profile properties
You can choose to set properties based on either the side dimensions or layers in the terrain profile. By selecting side dimensions you can set different colors to profile lines which run along the left side, right side and in the center. If you select layers, you can set different colors for different layers such as soil and rock. The list shows the lines that may occur in the terrain profile depending on the selection above. The properties displayed in the dialog apply to the selected line/layer in the list.

Colors
Shows the color used to draw the line. If the box **[Fixed]** is checked, all other information will also be drawn in the selected color.

Symbol
A symbol can be drawn at the points in a layer. Select the desired symbol in the list or click the button **[Select...]** to open a window with the possible symbols drawn. The symbols that can be selected depend on the current symbol file, see also Project Settings 16 for the selection of symbol file. The symbol's color and scale factor can also be set.

Line Type
Choose between single or decorated line type. Within each line type there are a number of different line types to choose from.

Measurement Document Properties (plm)



Point Symbols
Point symbols can be activated for backsights, surveys and stations. Also select symbol, size and color of the mark.

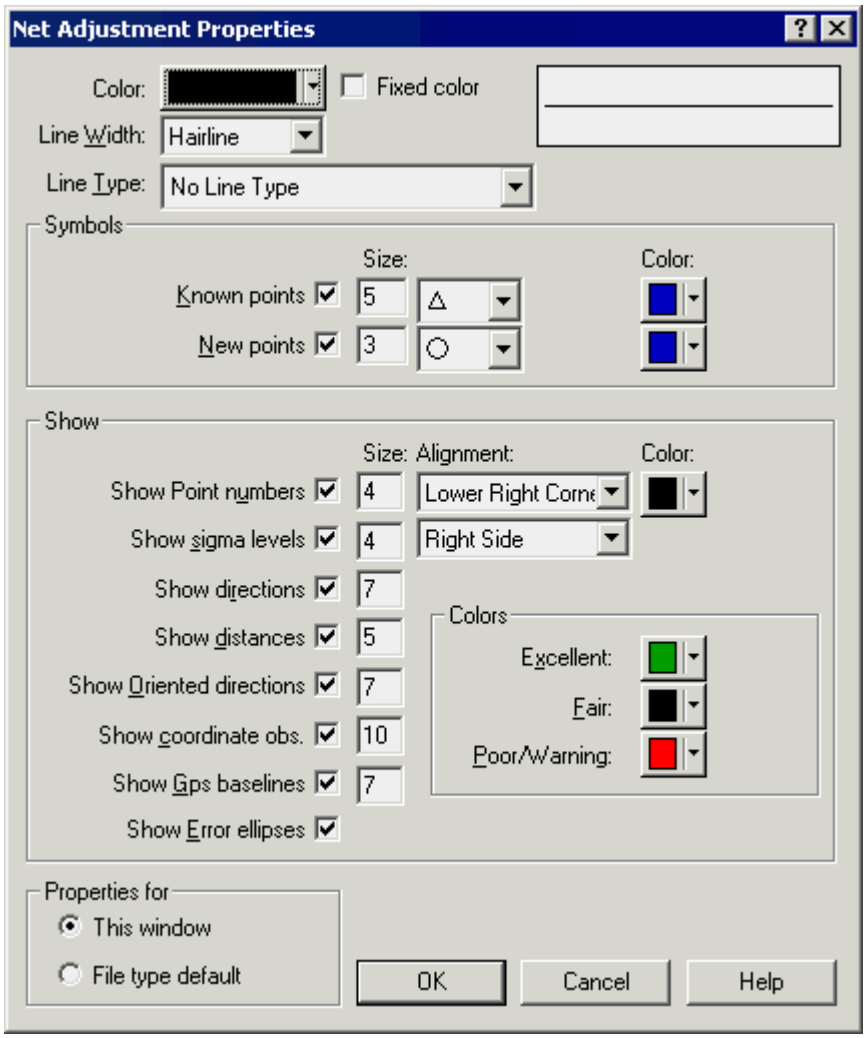
Directions and lengths, sight lines
Here, you can switch the symbols on and off for measured directions and lines. These are only displayed if *Draw sights* has been checked.

Measured direction

Measured distance

Draw measured lines
If this option has been checked, measured lines are drawn as a connected line, otherwise only as single points.

Properties for Net Adjustment Documents (hna)



Show Sigma Levels
If this option is checked and the net has been calculated, each measurement's sigma level (standardized residual) will be indicated by a number next to the point.

Standardized residual below 1 results in sigma level 1, between 1 and 2 results in sigma level 2, between 2 and 3 results in sigma level 3, and over 3 results in 3+.

Show Directions

If this option is checked, surveyed directions will be displayed with the symbol . The symbol's color depends on the sigma level, see below 72.

Show Distances

If this option is checked, surveyed lengths will be displayed with the symbol . The symbol's color depends on the sigma level, see below 72.

Show Oriented Directions/Bearings

If this option is checked, surveyed bearings will be displayed with the symbol . The symbol's color depends on the sigma level, see below 72.

Show coordinate observations
If this option is checked, surveyed coordinates or coordinate differences will be displayed with the following symbol . The symbol's color depends on the sigma level, see below 72.

Show GPS baselines

If this option is checked, surveyed GPS baselines will be displayed with the symbol . The symbol's color depends on the sigma level, see below 72.

Show Error ellipses
If this option is checked and the net has been calculated, error ellipses for computed new points will be displayed. Note that the scale of the error ellipses will be enlarged.

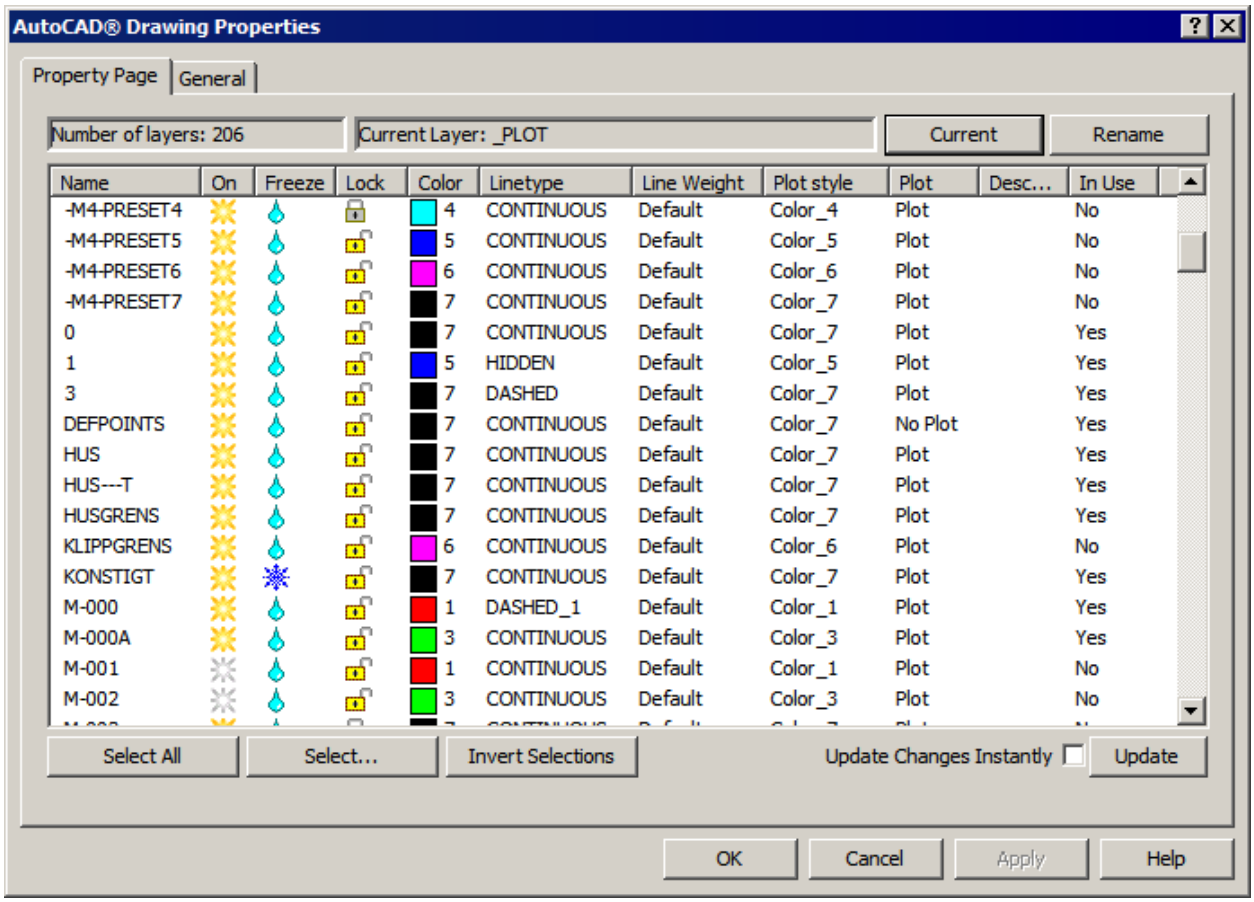
Colors
Objects and text are drawn with different colors depending on quality. Three levels are available.

- **Excellent**
  Graphic symbols for surveys with controllability above 0.71.
  Rows in the observation tab of the input view where the sigma level is below 1.
  Sigma level text in the graphics where the survey sigma level is below 1.

- **Fair**
  Graphic symbols for surveys with controllability between 0.35 and 0.71.
  Rows in the observation tab of the input check view where the sigma level is between 1 and 2.
  Sigma level text in the graphics where the sigma level of the survey is between 1 and 2.

- **Poor/Warning**
  Graphic symbols for surveys with controllability below 0.35.
  Rows in the observation tab of the input check view where the sigma level is above 2.
  Sigma level text in the graphics where the survey sigma level is above 2.

AutoCAD Drawing Properties (dwg, dxf)

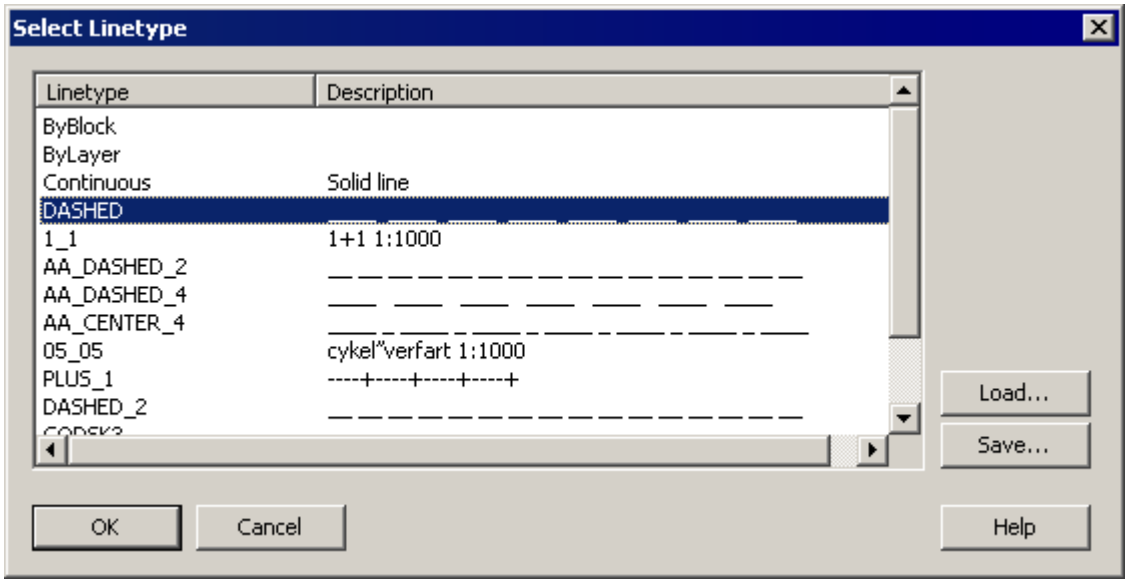


Properties

The list shows the layers that can be found in an AutoCAD® file. The symbols after the layer name indicate whether the layer is visible or hidden, if it is frozen, locked and its color. The active layer appears in the upper section of the dialog. To activate a different layer, select it and click the button **[Current]**. If data is copied to the document, the information appears in the active layer.

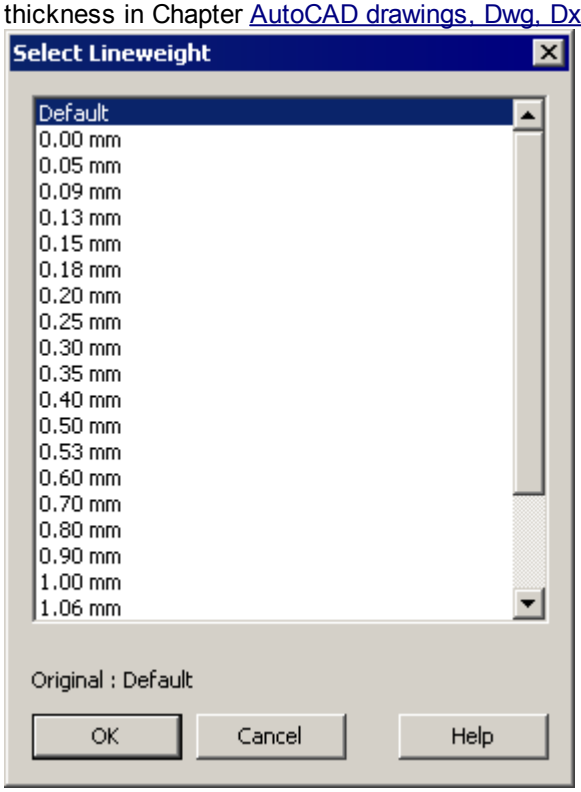
The columns, for example, for line type and line thickness work in the same way as in the AutoCAD software. The properties of a layer can be changed by clicking the symbol to be changed. If you select multiple layers, you can change the properties for all these layers simultaneously.

Clicking a line type means you can change the line type for the selected layer or layers by selecting the line type in the dialog below.



Click **[OK]** to set the new line type.

If you want to change a particular line thickness, click it and select the desired line thickness in the dialog below. If you select **Default** the value of the line thickness that you have set as Default is retrieved, see Line thickness in Chapter AutoCAD drawings, Dwg, Dxf 292 .



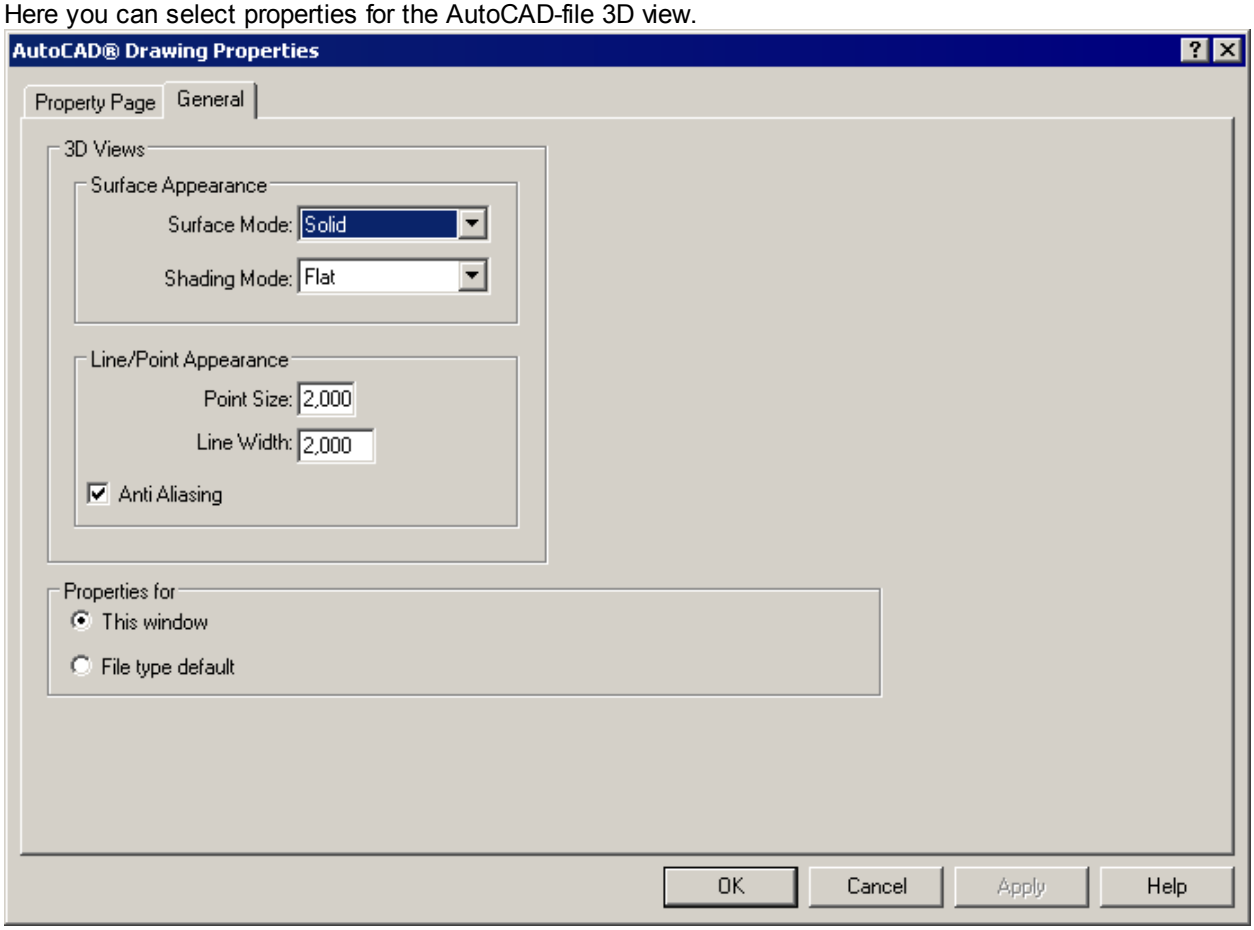
Settings and buttons in the dialog 'AutoCAD Drawing Properties':

Number of layers	Specified number indicates the total number of layers that the AutoCAD file consists of.
Current Layer	Specified layer indicates the active layer in the AutoCAD file.
[Current]	To put a certain layer active, select a layer in the list and click the button **[Current]**.
[Rename]	To rename a layer, select a layer in the list and click the button **[Rename]**.
[Select All]	Click **[Select All]** to select all layers in the list.
[Select]	Click the button to get three choices: • **Select layers of the currently selected objects** - layers represented among the

	selected objects in the graphics will be selected. • **Select visible layers** - only layers marked with in the list will be selected. • **Select hidden layers** - only layers marked with or in the list will be selected.
[Invert Selections]	Click **[Invert Selections]** to deselect selected layers in the list and vice versa.
Update Changes Instantly	Check this box if you want the graphics to be updated immediately when you make changes to the list about how layers are displayed
[Update]	The graphics will be updated when you click the button **[Update]**, if you have made changes to the list regarding the layers to be displayed.

Tip!
In the AutoCAD Drawing Properties dialog you can select the layers you are interested in, and turn off (hide) the other layers. If you want to continue to work with the reduced AutoCAD file, you can select **Data | Clean for Field**. See Import of AutoCAD Drawings, Dwg and Dxf 294 .
Please note, if you choose 'Clean for Field', only objects and layers that are visible in the AutoCAD file are saved, everything else is removed, therefore the file size will also be reduced.

General
Here you can select properties for the AutoCAD-file 3D view.



For terrain model in dwg format, you can select if the surface is to appear as a wire frame or solid surface and how the shading is to be simulated, see also Properties in the 3D window 87.

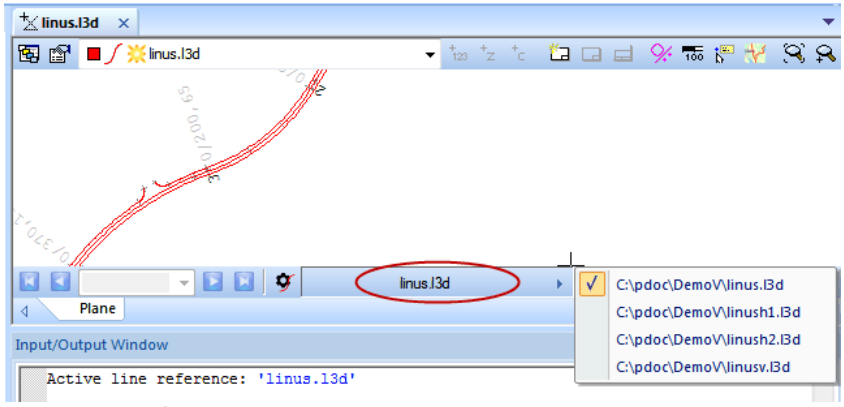
See also: Graphical editing 206 , Graphical views 47, Properties in the 3D window 87

2.4.4.4 Line reference in graphic views

A line reference in the graphic views is used to recalculate the world coordinates for the station/offset measures and vice versa. Using this, coordinate files can be recalculated for display in the cross section views. The line reference is a line file (l3d) which must be open in the current view. If you have multiple line files you select one of them as active.

Active line reference

When you open a line file graphically, it automatically becomes the active line reference in the window, unless there is already one or more line files open. The name of the active line reference is displayed below the graphical window. To toggle the active line, click the arrow next to the active line reference and select a line from the menu.

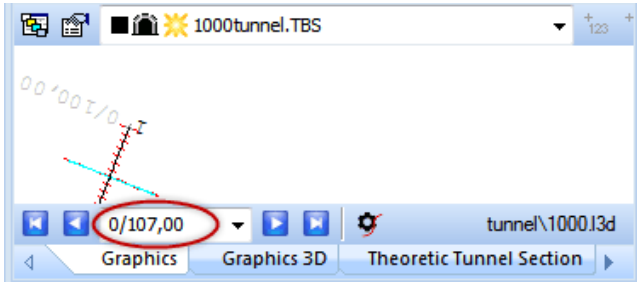


Active Line Reference

Current Cross Section

Some files, for example volume calculations, mbs, and tunnel descriptions, tbs, can be visualized in cross section views, where you can go back and forth between stations.

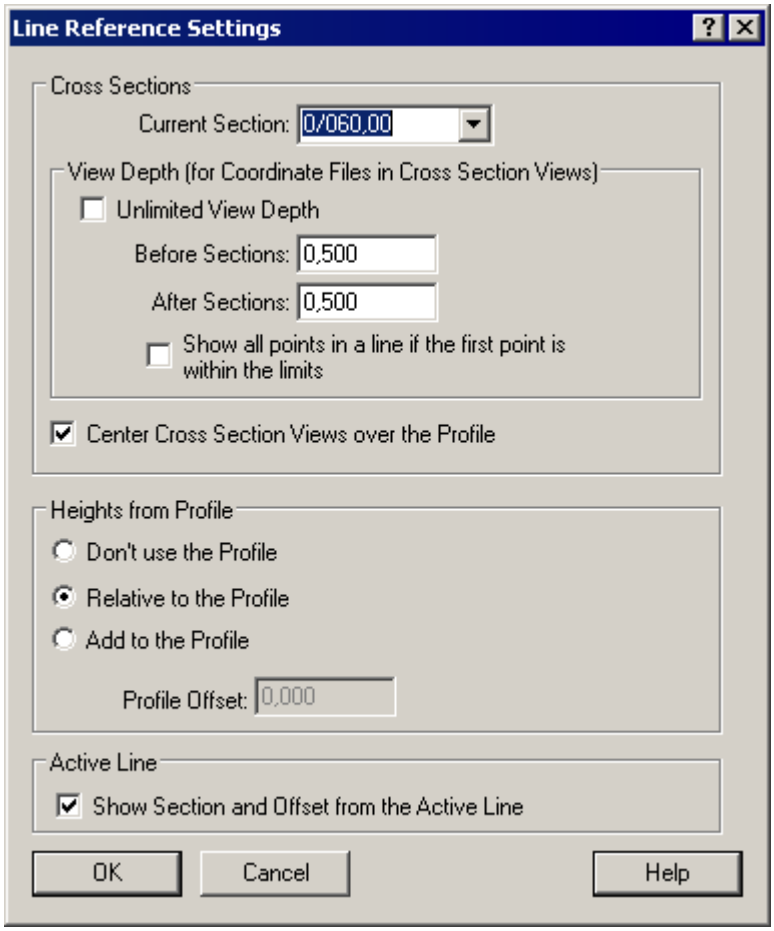
Here you specify the current length section in the graphical view. If the view depth is unlimited, this field is blank.



Current Cross Section

Settings for line reference

There are a number of different settings that affect how the active line is used. In order to open the dialog for the active line reference settings, click the icon just below the graphical window.



Cross sections
These settings affect the graphical views that are shown in cross section.

View depth
View depth means how long before and after the actual length of the station in the view, that data from the coordinate files is to be displayed.

- If you set unlimited depth this means that there are no limits, but all the information in the coordinate file is displayed regardless of the length of the station there.
- View depth can be very useful when you have measured cross section data. The information is often not accurate in even length section intervals. By setting a depth, you can 'group' together points in the station and view them as if they were in the same length station.

The view depth only affects coordinate files in the cross section views, while cross section files are unaffected.

Before current Station / After current Station

- Specify how long before and after each given station that the view depth is to apply.
- Both dimensions are entered without signs.
- If you have a total depth of 1m, you set 0.5m in both fields.

Show all points in a line if the first point is within the limits
This option means you can let the first point's position govern if the line is to be displayed or not. This is especially useful if you have coordinate lines that run along the reference line, i.e. 'into the image', and where the ends of the lines overlap. It may then be difficult to set a view depth. One example of this is injection screens in tunnels 907.

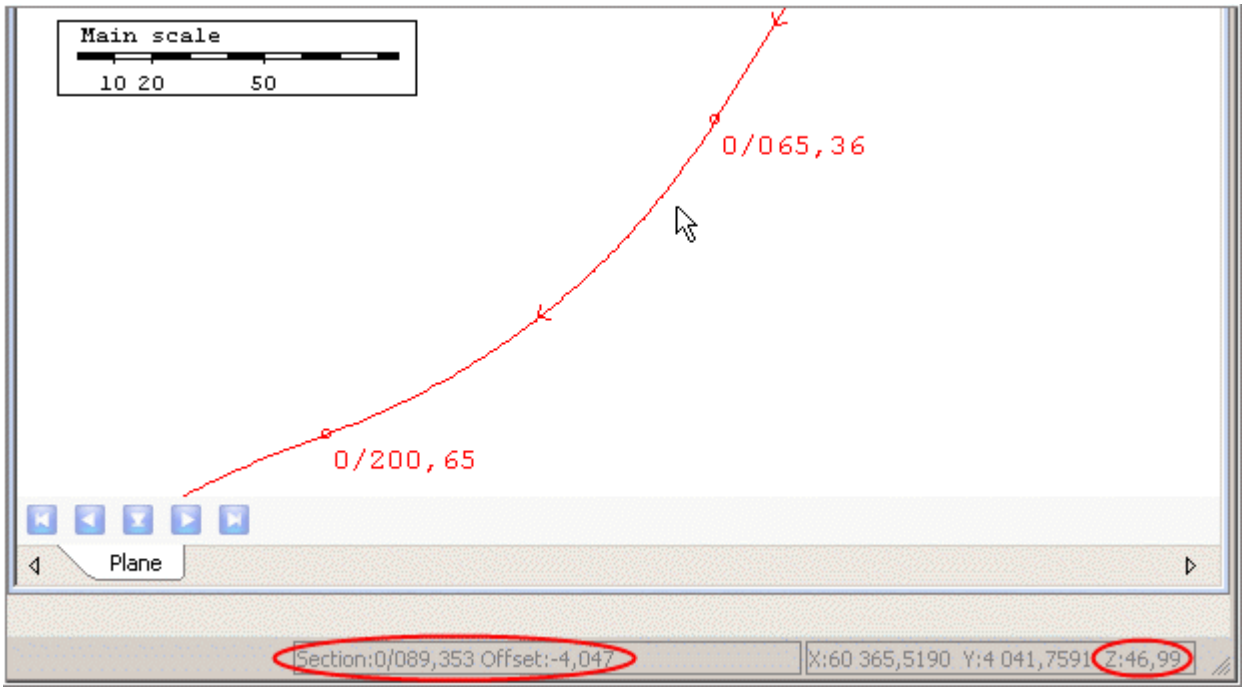
Center the cross section views over the profile

Check this if the cross section view is to be centered over the profile.

Heights from profile
These settings affect how the line reference profile (vertical geometry), if present, is to be handled. Profile offset can be set to move the profile up or down.

- Do not use the profile
  Means that no heights are calculated, whether the profile exists or not.
- Relative to the profile
  The profile height will be deducted from all heights in the calculated data.
- Add to the profile
  The profile height will be added to all heights in the calculated data.

View Station and Offset from the Active Line
This means that the cursor position in the graphics window (in plane position) is shown with both plane coordinates and section/offset measures from the active line.



Displayed height of the cursor in the graphics depends on the line's vertical geometry.

See also graphic views 47 , graphic editing 206 .

2.4.5 Graphical 3D views

2.4.5.1 General about graphical 3D views

iCON office has the option to view objects in a three dimensional perspective view. Objects can be viewed from any angle, and colors and shading can be varied and terrain models overlaid with a background image 219.
Files such as terrain model (trm), difference model (dfm), coordinate file (geo, pxy), contour lines (niv) and level difference contour lines (dfn) can be displayed in 3D windows. Multiple files can be viewed in the same window.

Tools
Zoom Rectangle
Move/Pan
Rotate
Select Object

View
Zoom limits
Zoom in
Zoom out
Load zoom mode 1
Load zoom mode 2
Top View
Right View
Left View
Front View
Rear View
Perspective View Southwest
Perspective View Southeast
Perspective View Northeast
Perspective View Northwest

Settings
Settings that affect all files in a 3D window. The dialog is divided into tabs with different categories of settings:

- General Settings 84
- Light Source 85
- Reference Surface 86

See also: 3D Tools 81

2.4.5.2 3D Tools

Rotate
Rotation in 3D means that all objects are rotated around the same point in the 3D view. Keep the left mouse button pressed and move the mouse to rotate the objects. If the option ***Hide objects when rotating and moving*** is selected in General Settings 84 the objects will be hidden during movement, and only one box describing the distribution of objects is displayed.
The center of rotation can be selected in General Settings 84 .
When the rotate tool is selected, you can also use the right mouse button to move objects, see ***Pan*** below.

Zoom
Zooming can be done in several ways:

- **From the Keyboard**
  Use **[Page Up]** to zoom in and **[Page Down]** to zoom out. The center of the zoom will be around the position of the mouse cursor, which means that you can choose any part of the window to be zoomed by pointing to it with your mouse when zooming.
- **Scroll wheel**
  You can use the mouse with scroll wheel for zooming. Scroll the wheel backward to zoom in and forward to zoom out. Here too the image is centered around the cursor.
- **Zoom Rectangle**
  Click and drag a rectangle over the area to be zoomed.
- **Toolbar Buttons**
  Use to zoom in and to zoom out.

Pan
Panning in 3D means that the objects are moved in the window using the mouse. Click on a location in the window with the left mouse button, keep the button pressed and drag the objects to the desired position and then release the button again.
If the option ***Hide objects when rotating and moving*** is selected in General Settings 84 the objects will be hidden during movement, and only one box describing the distribution of objects is displayed.

See also: 3D Graphics 80

2.4.5.3 View Fly-Through

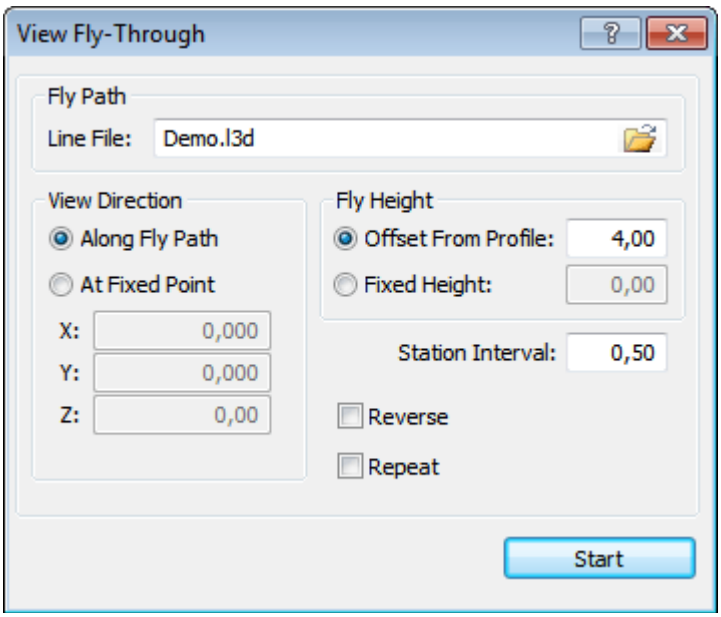
View Fly-Through

In iCON office you can create something similar to a simple movie, where the user gets an impression that you fly along a selected line.

- You select flight altitude and speed relative to the selected line.
- If you for example have a terrain model open, in the graphical 3D view, , the Fly-Through will take you over (through or below) this model like a movie.
- You can to select ***View | Fly-Through*** in all file types that can be opened in a graphical 3D view.

View Fly-Through

Open a graphical 3D view, , and select ***View | View Fly-Through***.



Fly Path

- **Line File** - select which line you want to fly along.

View Direction

Select how you want to fly along the line; **Along Fly Path** of **At a Fixed Point**.

Fly height

- **Offset From Profile** - select altitude as an Offset From Profile / Offset From the Line's Vertical Geometry.
- **Fixed Height** - select a Fixed Height, the altitude is then unaffected by the line's vertical geometry.

Station Interval - the interval affects flight speed.

- A more sparse interval, gives an impression of a fast flight.
- A denser interval results in a slower flight impression.

Reverse - check the box if you want to visualize the fly-through from the line's end point to its start point.

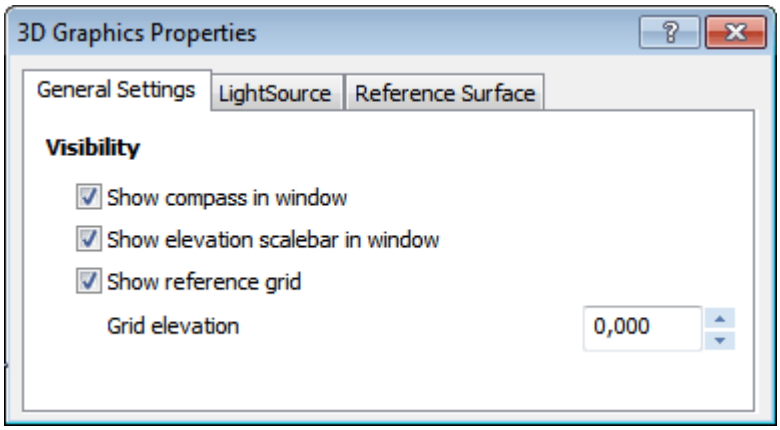
Repeat - check the box if the fly-through should continue until you exit by

pressing **[Stop]**. In this case, the "Fly-Through movie" will continue, until you stop it.

See also: General about graphical 3D views 80 , 3D lines 505

2.4.5.4 General settings for 3D graphics

Select **View | 3D Views | 3D Graphics Properties** and select the tab **General Settings**.



Show compass in window
Select this option to display a graphical representation of a compass in the upper left corner of the window. The compass facilitates the orientation of objects in a 3D window. North is marked by a red tip.

Show elevation scale bar in window
Select this option to show a graphical scale bar in the lower left corner of the window. Heights are represented by colors from blue to red, where blue represents the lowest height and red the highest. The lowest height means the lowest height in the files opened in the window. The maximum height means the greatest height that occurs in the window. Maximum and minimum height need not originate from the same object, and the heights are subject to change if files are added or removed from the window. The colors in the elevation scale correspond to the colors that can be assigned to terrain models, when the function ***Color by Level*** is active, see properties for terrain models 87.

Show reference grid
Select this option to display a reference surface, as a grid.
The reference surface will be displayed in the 3D graphics.

Grid elevation
Enter the elevation of the reference surface.

Rotation Center
All objects in a 3D-window are rotated around the same center. This center is displayed by a small dot in the graphical window.

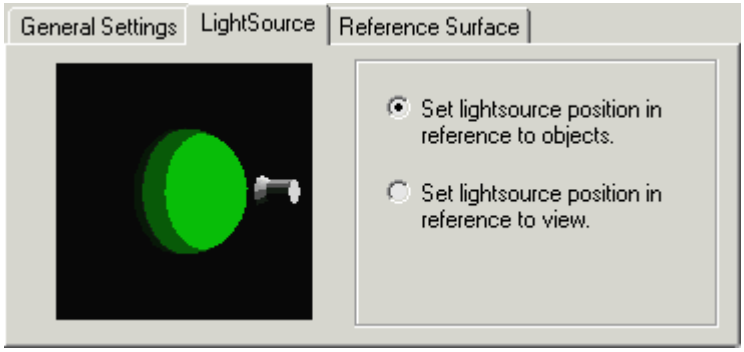
Tip! Right click and move the 3D view with the mouse, if you want to move the object to or from the rotation center.

See also: 3D Graphics 80

2.4.5.5 Light Source

In a 3D window surfaces are shaded as if they were illuminated by a distant light source with parallel incident light. This is to simulate the terrain illuminated by the sun. Select **View | 3D Views | 3D Graphics Properties** and select the tab **Light Source**.

The incident light direction can be set using the control in the image:



The control represents a green ball illuminated by a light source that hovers at a fixed distance from the ball's surface. To move the light source click on the desired position using the left mouse button. The button can also be held down while moving the mouse. Move the lamp and the shading of the surfaces in the 3D window will be updated continuously. This is a function that requires hardware with a good performance in order to function properly, especially when large objects are opened in the window.

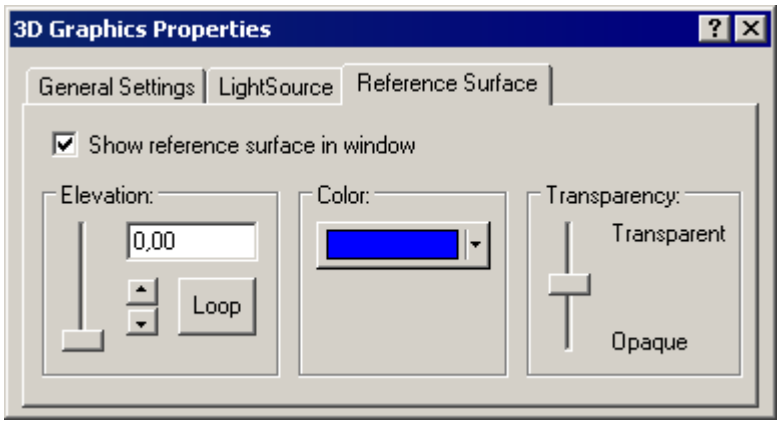
Set light source position in reference to objects
When this option is selected, the light source's set position is fixed to the objects in the 3D window. Upwards in the control corresponds to positive X-axis in the object's coordinate system, etc. The direction of incidence of the light relative to the objects does not depend on how the objects are rotated in the window. Use this option to see the objects lit from a particular known direction, for example from the south.

Set light source position in reference to view
When this option is selected, the light source's set position is fixed to the actual 3D window. The direction of incidence of the light relative to the objects depends on how the objects are rotated in the window.

See also: 3D Graphics 80

2.4.5.6 Reference Surface

A reference surface can be placed at any elevation in a 3D window. The surface can, for instance, be used to simulate a water surface over a terrain model that describes a lake bottom. Select **View | 3D Views | 3D Graphics Properties** and select the tab **Reference surface**.



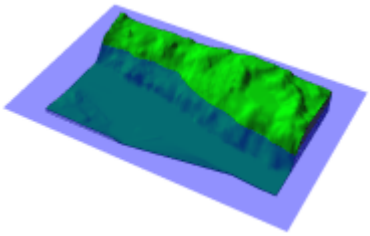
Show reference surface in window
Select to display a reference surface in the active 3D window. The controls for the surface will now be available.

Elevation
Enter the elevation the surface is to be placed on, either by moving the control or entering a value in the box. By clicking on Loop, the reference surface will move from the lowest height in the model to the highest.

Colors
Select the color of the reference surface.

Transparency
The surface can be displayed with varying degrees of transparency. Move the bar to change the level of transparency.

Terrain model with simulated water surface

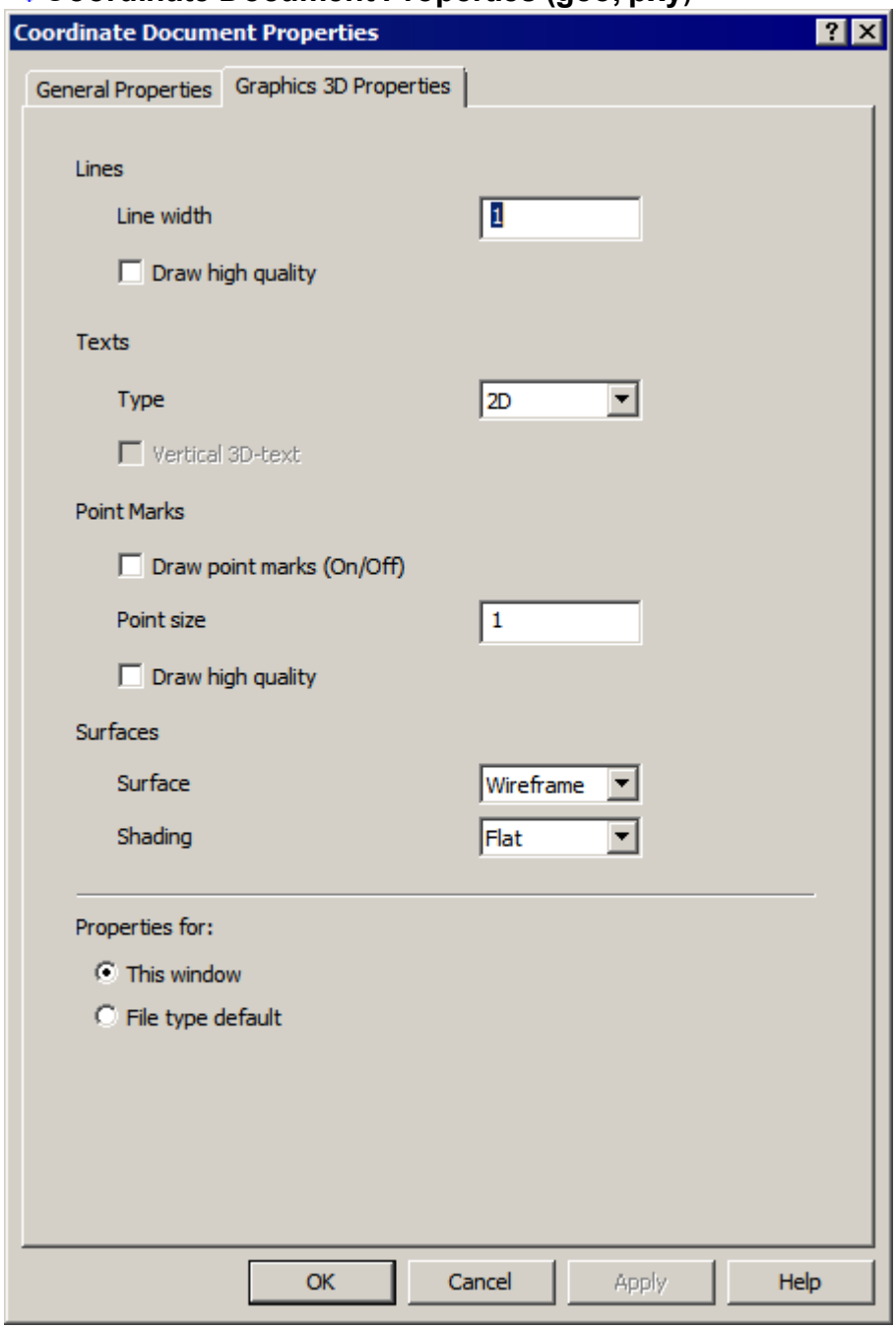


See also: 3D Graphics 80

2.4.5.7 Properties in 3D windows

Select ***View | Document Properties*** to view the properties of the active document in a 3D view. Depending on the file type that is active, different property dialogs are shown.

Coordinate Document Properties (geo, pxy)



Lines

- **Line width**
  Specify line width. The line width will be visible in the graphics.

- **Draw high quality**
  Check the box to give lines a smoother appearance in the graphics.

Uncheck the box if you want lines to be drawn more distinctly.

Texts

- **Type**
  Use the drop list to select if text should be displayed as a two or three dimensional text in the three dimensional graphics.

- **Vertical 3D text**
  Check the box if you want three dimensional texts to be displayed vertically.
  If you do not check the box, texts will be displayed horisontally.

Point Marks

- **Draw point marks (On/Off)**
  Check the box to display point marks.
  Note, the shape and size is controlled by the selected point mark in the two dimensional graphics, see Graphical Document Properties 55. Points in lines are only visible if the box **[Apply for Points in Lines]** is selected in the two dimensional graphics, see Graphical Document Properties 55.
  Uncheck the box to draw points that are not affected by the selected point mark in the two dimensional graphics. The appearance of the points is then controlled by the settings at **[Draw high quality]**.

- **Point size**
  Specify point size.

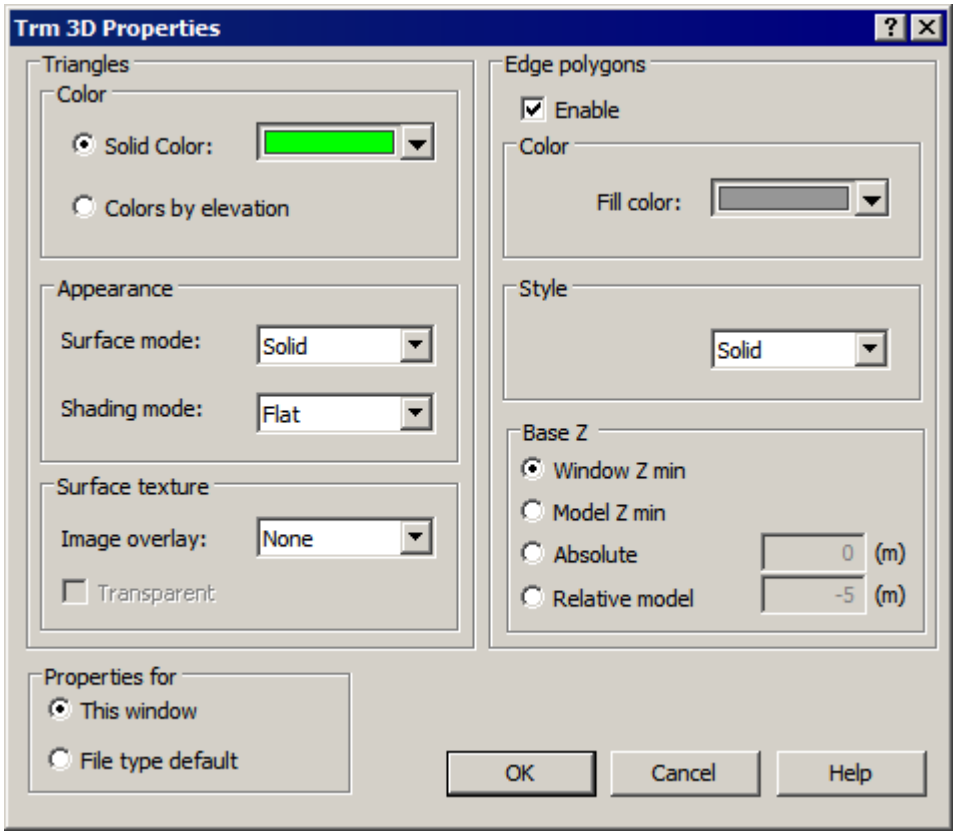
- **Draw high quality**
  Check the box to display points in the 3D graphics as filled circles.
  Uncheck the box to display points in the 3D graphics as squares.

Surfaces

- **Surface**
  Select whether surfaces should be displayed as a wire frame or as a solid surface.
  The wire frame means only square edges are shown as lines, and no surfaces are visible. This could be useful if you want to view any other objects that may be obscured by a surface, see also Appearance 89 below.
  For solid surfaces, all the squares are filled with non transparent surfaces.

- **Shading**
  The square surfaces are shaded to simulate the effect of incident light. This shading can be done in two ways: *Flat* or *Smooth.* See also Appearance 89 below. Flat shading gives each square a certain degree of shading all over the surface. The image gets a somewhat angular appearance where each square can be distinguished. Smooth shading generates a surface on which the shading varies gradually. Smooth shading gives the image a smoother appearance but may look a bit odd at sharp crests and edges.

Terrain Model Properties (trm, dfm)



Triangles

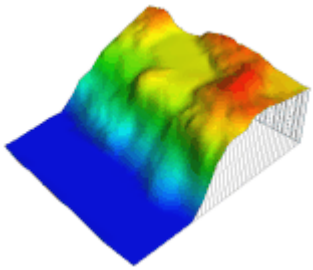
Properties of triangle surfaces in a terrain model.

Color

- **Solid color**
  All triangles will have the same color.

- **Colors by elevation**
  The terrain model color is dependent on the height, with the lowest height being represented by the color blue, and the highest by red.

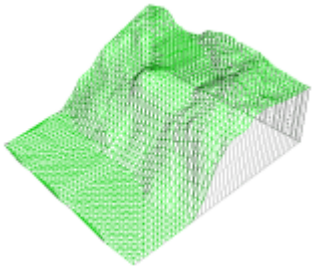
Model colored by height level



Appearance

- **Surface mode**
  The terrain model surface can be viewed in two ways, as *Wire frame* or as *Solid* surface. The wire frame means only the triangles edges are shown as lines, and no surfaces are visible. This could be useful if you want to view any other objects that may be obscured by the terrain model surfaces.

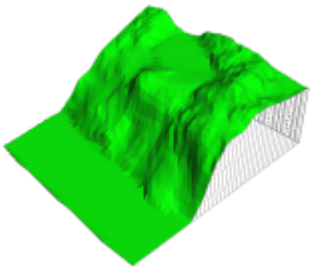
Wire frame



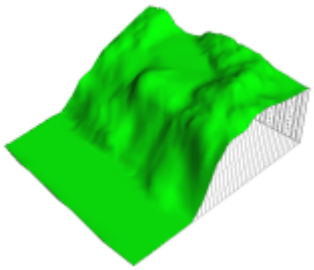
For solid surfaces, all the triangles are filled with non transparent surfaces.

- **Shading**
  The triangle surfaces are shaded to simulate the effect of incident light. This shading can be done in two ways: *Flat* or *Smooth*. Flat shading gives each triangle a certain degree of shading all over the triangle surface. The terrain model gets a somewhat angular appearance where each triangle can be distinguished. Smooth shading generates a surface on which the shading varies gradually. Smooth shading gives the terrain model a smoother appearance but may look a bit odd at the sharp crests and edges.

Flat shading



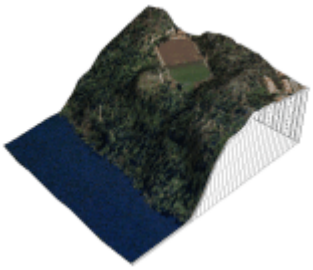
Smooth shading



Texture

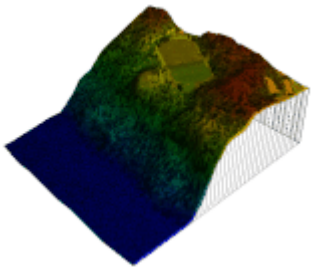
- **Image overlay**
  In the event that the project has a background image this can be overlaid on the terrain model. The image is stretched so that the flat coordinates in the image correspond to the flat coordinates in the terrain model.

  Model overlaid with a background image



  By selecting the option transparent the background image and the color settings can be combined, see above under the heading Colors 89 .

  Model colored by height level with background image overlay

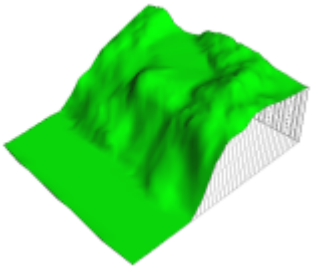


Edge polygons
Vertical surfaces can be displayed along the outer edges of the terrain model. The edge polygons make it easier to see the relation between the terrain model and the horizontal plane. This is particularly useful if the model covers undulating terrain.

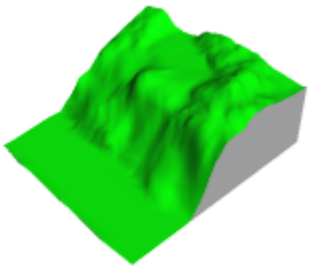
Colors
Select the color of the edge polygons.

Style
Edge polygons may appear as *Wire frame* or *Solid.* The wire frame displays edge polygon lines, whereas in a solid surface the polygons are non transparent.

Model of edge polygon wire frame



Model with solid edge polygons



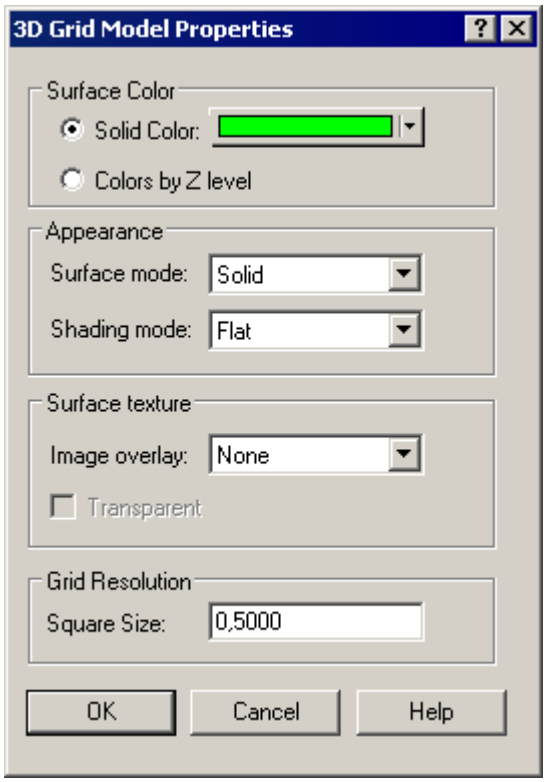
Base Z (Height)
The height of the edge polygons bottom edges can be set according to four different principles

- **Window Z min (Lowest in window)**

The height is set to the lowest level in any file open in the current window.

- **Model Z min (Lowest in model)**
  The height is set to the lowest height in the current terrain model.
- **Absolute**
  The height can be set to an optional value.
- **Relative**
  The height is set to any value under the terrain model's outer edges which makes the edge polygons follow the shape of the terrain model. This is the only setting where the bottom of the edge polygons are not at a level height.

Grid Model Properties (gdm)



Surface Color

- **Solid Color**
  See Color above 89 .
- **Colors by Z level**
  See Color above 89.

Appearance

- **Surface mode**
  The grid model surface can be viewed in two ways, as *Wire frame* or as *Solid* surface. The wire frame means only squares edges are shown as lines, and no surfaces are visible. This could be useful if you want to view any other objects that may be obscured by the grid model surfaces, see also Appearance above 89.

  For solid surfaces, all the squares are filled with non transparent surfaces.
- **Shading**
  The square surfaces are shaded to simulate the effect of incident light. This shading can be done in

two ways: *Flat* or *Smooth*. See also Appearance above 89. Flat shading gives each square a certain degree of shading all over the surface. The grid model gets a somewhat angular appearance where each square can be distinguished. Smooth shading generates a surface on which the shading varies gradually. Smooth shading gives the grid model a smoother appearance but may look a bit odd at the sharp crests and edges.

Texture

- **Image overlay**
  See Texture above 91.

Grid Resolution

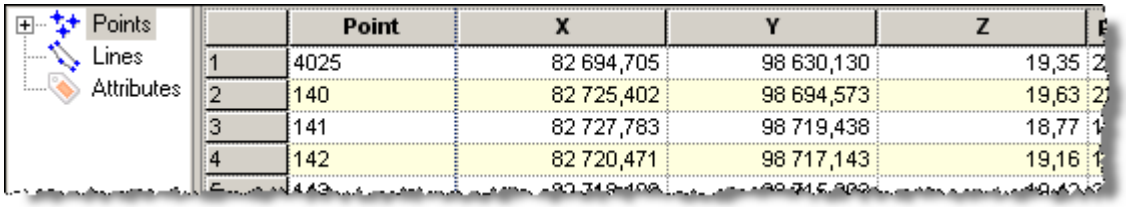
- **Square Size**
  Enter the size of each grid cell 643 in the grid model. The selected square size only affects the graphical appearance of the grid model.

See also: 3D Graphics 80, Create Grid Model 642

2.4.6 Numerical views

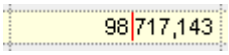
2.4.6.1 General on numerical views

Input views or windows are subdivided into columns, rows and cells, just like in spreadsheets such as Microsoft Excel®. Each row represents an entry in the file and each column represents a field in the entry. The individual cells show a value from the file.

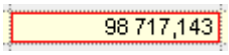


Editing the contents of a cell

To activate a cell you point to, or next to, the actual text within the cell. In the first case, the cursor will be placed at the location in the text where you pointed, while in the second case, the cell is marked with a thin frame and the text entered replaces the previous one.



Selecting in the Text

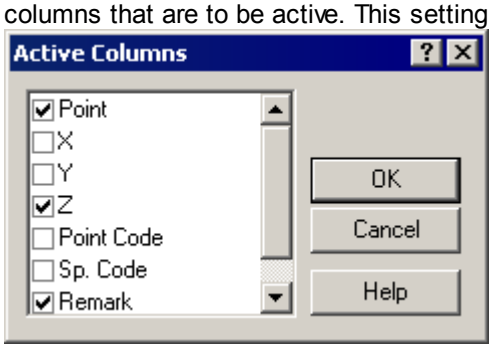


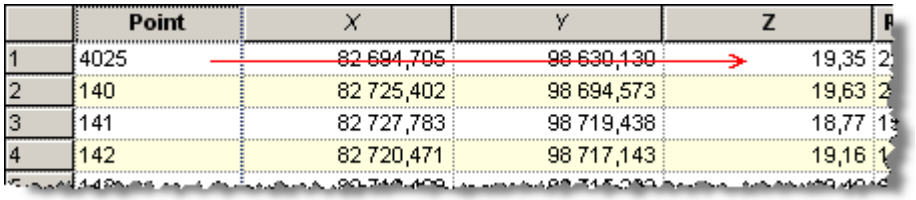
Selecting next to the Text

The text is highlighted by double-clicking the text in a cell. You can also press down the left mouse button and move the cursor over the text to select it. If you start inputting text when a selection is visible, the selected text is then replaced.

Active Columns

When you edit values you can either use the Enter or Tab keys to select to move to the next cell. It is possible to check the columns you plan to switch between by specifying 'active columns'. This may be useful if, for example, you just want to enter Z values in the coordinate file. You set active columns by selecting ***Edit | Active Columns***. The dialog has a list of column headings in the document type. Check the columns that are to be active. This setting is automatically saved by default for the document type.





	Point	X	Y	Z
1	4025	82 694,705	98 630,130	19,35
2	140	82 725,402	98 694,573	19,63
3	141	82 727,783	98 719,438	18,77
4	142	82 720,471	98 717,143	19,16

The columns that are active have their headings in **bold** while those that are not active are in *italics* .

You can also use the arrow keys to change cells, which means the settings for active columns are not used.

Changing column widths and row heights

To change the width of a column, drag the cursor to the edges along the column in the column header, and the cursor will change to a double-headed arrow. Now, holding the left mouse button down, drag the edge to its new location. To change the row heights you do the same in the row header.

Change Text Size

To change text size, you need a mouse with a scroll wheel. Hold down the Ctrl key while rotating the scroll wheel to resize the text.

Swapping Column Places

By first pointing to a column header and then pointing the mouse button again and holding it in this position, you can drag a column to a new location. A red line shows the new location before you drop.

Selecting Cells

To copy data from an input window to the clipboard, first select the required cells.

Selecting Columns

Columns are selected by clicking on the column header. To select several adjacent columns, press the left mouse button and drag the cursor over the columns you want to select. To select multiple individual columns, hold down the ***Ctrl***key while clicking them.

	Point	X	Y	Z	P
1	4025	82 694,705	98 630,130	19,35	22
2	140	82 725,402	98 694,573	19,63	22
3	141	82 727,783	98 719,438	18,77	15
4	142	82 720,471	98 717,143	19,16	14
5	143	82 718,498	98 715,203	19,42	34

Selecting Rows

Rows are selected by clicking the row number. To select multiple adjacent rows, press the left mouse button and drag the cursor over the required rows. To select multiple individual rows, hold down the ***Ctrl***key while clicking them.

	Point	X	Y	Z	P
1	4025	82 694,705	98 630,130	19,35	22
2	140	82 725,402	98 694,573	19,63	22
3	141	82 727,783	98 719,438	18,77	15
4	142	82 720,471	98 717,143	19,16	14
5	143	82 718,498	98 715,203	19,42	34

Selecting Separate Cells

Cells are selected by clicking the cell (next to the text). To select multiple adjacent cells, press the left mouse button and drag the cursor over the required cells. To select multiple individual cells, hold down the ***Ctrl***key while clicking them.

	Point	X	Y	Z	P
1	4025	82 694,705	98 630,130	19,35	22
2	140	82 725,402	98 694,573	19,63	22
3	141	82 727,783	98 719,438	18,77	15
4	142	82 720,471	98 717,143	19,16	14
5	143	82 718,498	98 715,203	19,42	34
6					

Selecting All

If you click the cell at the top left in an input window, all cells will then be selected.

	Point	X	Y	Z	P
1	4025	82 694,705	98 630,138	19,354	
2	140	82 725,402	98 694,573	19,630	22
3	141	82 727,783	98 719,438	18,772	22
4	142	82 720,471	98 717,143	19,156	15
5	143	82 718,498	98 715,203	19,424	15

Copying, pasting, cutting and deleting

Copy

To copy data to the clipboard you first select a cell or cells and then click the button or select ***Edit | Copy***. When you copy from an input window, the text information is loaded from the cells, which means that only numerical values are copied with the exact amount of decimals as shown on screen.
You can also copy whole rows or columns by selecting them.

Paste

If there is some information in the clipboard you can paste it in a numerical window. Point to the cell where the pasting is to start (point to the side of the text in the cell) and then click the button or select ***Edit | Paste***. If the source information contains data for more cells, the contents in the cells to the right or below the active cell will then be replaced. If the number of rows in the source information is more than there is within the active row, the excess rows will then be created automatically. However, if the number of columns is insufficient, not all data will be pasted.
If you select ***Edit | Insert Row*** new rows will be added directly below the active row and the information will be pasted in these rows.

If you select a cell by pointing to the text so the cursor is shown, pasted data will then appear in the current cell.

Cut

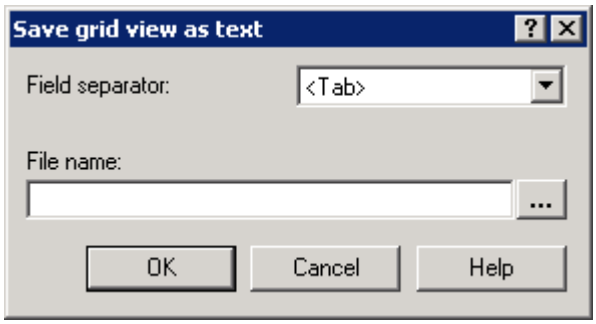
When you cut, the selected information is copied to the clipboard and then deleted. Cutting can only be performed for whole rows in an input window. Select the relevant rows and select ***Edit | Cut*** or click the button .

Delete

To delete the information from an input window, you select the cells and then click ***Edit | Delete*** or click the button . If you have selected whole rows, these rows will, be completely removed.

Save grid view as text

Select ***View | Save view as | Field delimited text*** to save the contents of an input view to a plain text file.



Field separator:
Here you select the character to separate the fields in the text file.

Filename:
Here you select a name in the text file you create.

Save view as MS Excel file

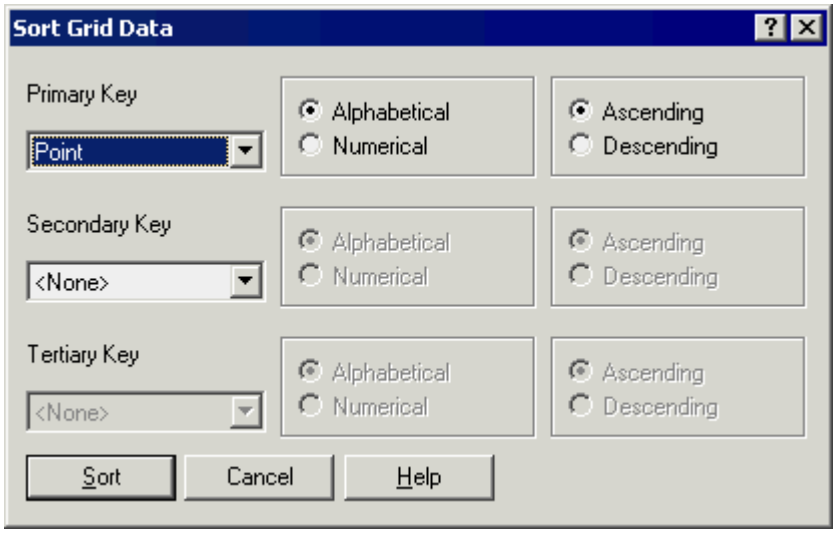
Select ***View | Save view as | MS Excel file*** to save the contents in an input file an Excel® file if you want to do your own calculations or send data to people who do not have iCON office.

See also: Editing in input views 99, Input check 103

2.4.6.2 Editing in numerical views

Sorting

The contents of all input views can be sorted, select ***Edit | Sort ...*** to open the dialog for sorting.
First select the field that the sort should be based on, and also if the values should be sorted in ascending or descending order. It is also possible to specify how the fields are to be interpreted; numerically or alphanumerically. In addition to the primary key you can also set secondary and tertiary keys if there are similar values that need to be distinguished.



Key Field
The list shows the current columns headings in the input view. Select the column for the primary key and if necessary the secondary and tertiary.

Alphabetical Key
The comparison is made character by character, from left to right. E.g.: A, Aa, B and for numerical characters 1,10,2.

Numerical Key
Numerical comparison. E.g.: 1, 2, 10.

Key Order
Select if the values are to be sorted in ascending or descending sequence.

Automatic increment of point numbers

In documents containing point numbers, the point numbers can be set automatically for each new row that is added. Select ***Data | Automatic Point Numbering/Element Data*** in the menu for the current document. Once the data is entered into one of the other fields in a new row, the point number is automatically entered.

See also: Input Views 94, Search and Modify 100.

2.4.6.3 Search and Modify

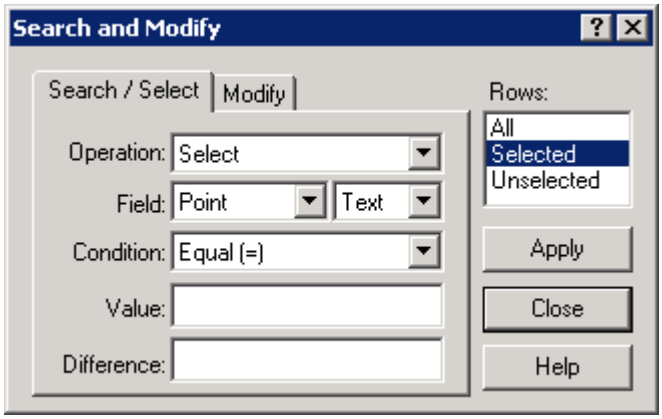
By selecting ***Edit | Search/Modify*** or clicking the button when an input view is active, this will bring up the Search and Modify dialog. Using this dialog you can search for, select/deselect and modify fields. This function is useful when you want to find fields that have a certain content or when you want to modify more than one field at a time.

Search and Modify in the Coordinate Documents
It is important to remember that modifications can only be made in the part of a document that is shown in the numerical view, in coordinate files, for example, each line is shown in its own view. If you want to execute operations for a complete coordinate file, you can use the function Modify Points166. You can also select ***Data | Explode Lines***161 to create single points of all lines in a coordinate file, then you can 'Search and Modify' on the entire document. Now select ***Data | Generate Lines***161 to re-create the lines again (this assumes that the point numbers in the file have not been modified as they are used in the generation of lines).

The operations listed below can be performed on either all rows or only on the selected or deselected rows in the view.

The Search/Select Page

Use this page to search for fields and then select rows with a certain content.
It is possible to combine operations such as to select the rows with a field within a certain range (for example, by combining the selected fields greater than a minimum value, and deselecting the fields greater than a maximum value). The existing selection is not removed before the operation is executed, so if you want to deselect all rows you must click with the mouse in the check window.



Operations on this page do not change the field contents as only the selection or cursor position is change.

Operation

- Find Next
  Places the cursor on the next field that satisfies the condition.
- Find Previous
  Places the cursor on the previous field that satisfies the condition.
- Select
  Selects the rows whose fields satisfy the condition.
- Deselect
  Deselects the rows whose fields satisfy the condition.
- Toggle Selection
  Toggles the selection of the rows whose fields satisfy the condition.

Fields
Fields the condition is to be used on. Also indicate if the field is to be considered as text or numerical for comparisons.

Conditions
Conditions that determine which fields the operation is to apply to. NOTE: The conditions give different results for text fields and numerical fields. For text fields and conditions *Equal (=)* and *Not Equal (<>)* you can use wild cards.

Wild card:
Wild card characters are equivalent to one or more arbitrary characters.

?	An arbitrary character.
*****	An arbitrary number of arbitrary characters.

Example

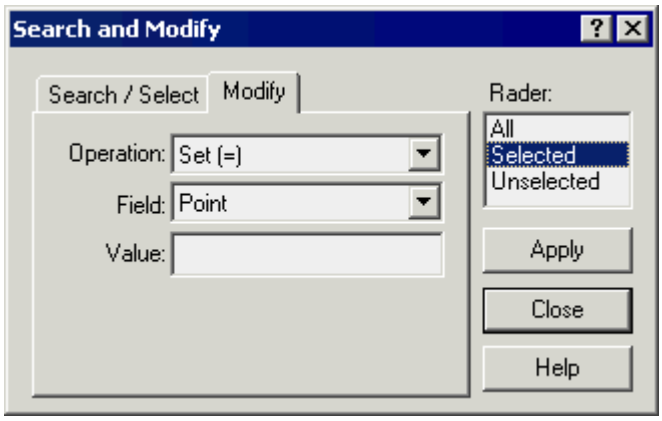
*****	All texts.
a??	All texts, consisting of three characters, beginning with lower case 'a'.
a	All texts containing at least one lower case 'a'.

Value
Value for the condition.

Difference
When executing a numerical comparison with the conditions equal or not equal, you can enter the accuracy of the comparison, for example, 100.1 is regarded to be equal to 100.2 if the difference is 0.1 or greater.

The Modify Page

Use this page to change the contents of the fields.



Operation

- Set
  The field is set to the entered value.
- Prefix
  The value is added to the beginning of the field.
- Suffix
  The value is added to the end of the field.
- Remove text
  The first occurrence of text in the **[Value]** is removed from the field.
- Add
  The value is added to the existing value in the field. Enter a negative value for subtraction.
- Multiply
  The value of the field is multiplied by the specified value. Enter -1 to change sign.
- Divide
  The value of the field is divided by the specified value.
- Renumber
  The first point in the list is given the specified value, the remaining points are then incremented by one.

Field

The field the operation is executed on.

Value

Value specified for the operation (see above).

See also numerical views 94, editing in numerical views 99.

2.4.6.4 Input check

When entering data manually it is often advisable to check that you have entered the correct values. This check is called input check in iCON office, and is done by all values being re-entered.

Input check

To start the input check in an input view, select **Data | Input Check** from the menu after having entered the data for the first time. All cells in the view now turn **gray** and the input values become invisible. You now enter the values one more time. If the second value is not the same as the initial one, you will be asked if you want to keep the first value or replace it with the new one. In both cases, the value is considered to be unchecked and the cell remains gray. If you enter the same value the cell turns **green** and the value is visible, and the value is now considered to be checked. In other words a value is considered to be checked if you enter the same value in the cell twice.

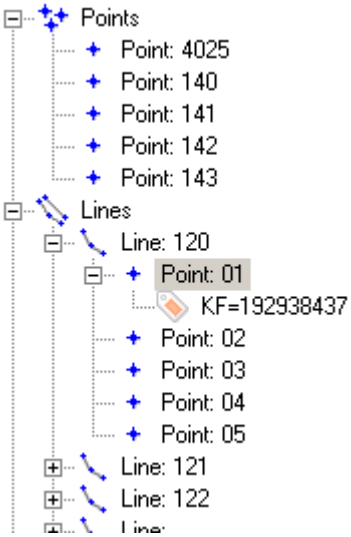
If you exit the input check by clicking **Data | Input Check** this brings you back to the normal checking mode, but the checked data remains. The values that you add or change in the normal view will be marked as unchecked if you return to input checking. **Note:** *If you close the window completely or change data in it, for example, by changing the active station in the survey document or change the active line in a coordinate document the checked data will be lost!*

Tip: You can punch and input check simultaneously. If you add a new row at the bottom of the input check view, data is added in the regular way and the cells are marked as unchecked in the view. Enter the data one more time to check it.

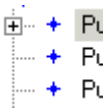
See also: Numerical views 94

2.4.7 Tree Views

Tree views are used to display hierarchical object structures. An object in the structure appears as a node in the tree. Different symbols are used for different object types.

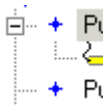


Expanding nodes
If an object contains other objects this is indicated by a special symbol; a plus sign indicates that the node is expandable and a minus sign means that the node is expanded.



Expandable node.

Click the plus sign or double-click the node text in order to expand a node.



Expanded node.

Click the minus sign or double click the node text to collapse a node.

Editing nodes
By right-clicking a node with the right mouse button a menu appears containing specific object options. Select ***Properties...*** to edit the object in the properties dialog 106 .

See also windows and views 40, graphical views 47, numerical views 94.

2.4.8 Dialog Views

A dialog view is a view that contains a number of fields and controls in the same way as in a dialog. Station data for a survey file is displayed in a dialog view.

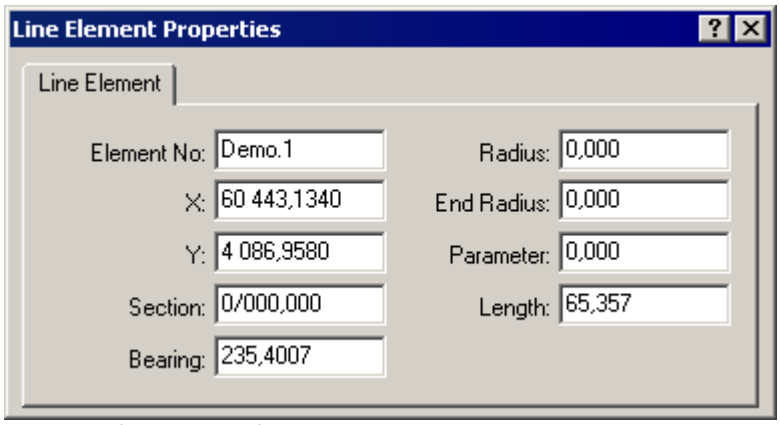
Editing
The field is edited as in a dialog. Right-clicking in an input field brings up a menu where you can paste, copy, cut and delete text.

See also Windows and views 40 .

2.4.9 Property Dialogs

The properties of the objects displayed in the different views can be edited in the Properties Dialog. The dialog can be viewed by right-clicking the object and selecting ***Properties...***

You do not need to close the dialog after you have reviewed or edited the properties, as pointing to a new object will bring up the properties of the object to be displayed instead. The position of the dialog is saved so that it appears in the same place when you open it again. For many objects, this dialog is divided into a number of tabs.



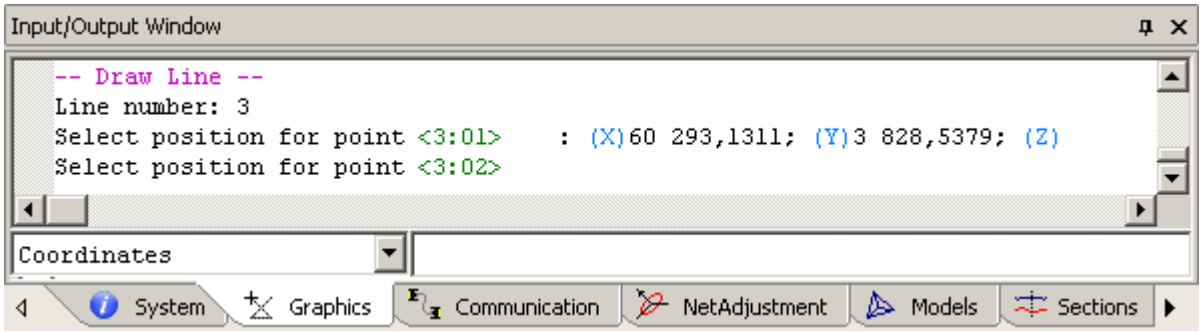
Example of properties file.

Tip! Use the question mark button to display help on a specific field in the dialog.

See also Windows and views 40 .

2.4.10 Input and Output Windows

The Input and output windows are used to display results from various functions, and to enter values for graphical tools. To enter values for graphical tools you use the lower input line in the window.



The window can be easily switched on or off by selecting ***View | Input/Output window*** or select the icon .

The window is dockable[40], which means that it can be 'snapped' in place to a border. Read more about the window which is also dynamic, in General about windows, views, and toolbars[40]. When iCON office closes, the position of the window is saved so it appears in the same place and has the same size the next time iCON office is started.

The window is divided into a number of different tabs. Different program sections in iCON office produce output data that appear in these tabs.

System
Here you can see the details on the software version, path to the global file, path to the configuration file, current projects, the files opened, etc.
In the System tab in you can see how the current configuration folder is set. The path to the configuration folder is also displayed in the system report that you open by selecting ***Help | About*** and clicking the **[System Report]**button.

Graphics
The output data from all graphical tools appears under 'Graphics'. You can also enter data into the tools here as there is a special input field in the window. The list to the left of the field shows the type of information expected. See also graphical tools[223] .

Communications
When loading from instruments, raw data information is displayed in the window.

Net Adjustment
Here you can view data from the net calculations.

Models
Here information on terrain models is displayed, such as when a model is created.

Sections
Here you can see information about the cross section shown in the graphic.

See also Windows, views and toolbars[40], Graphical tools[223].

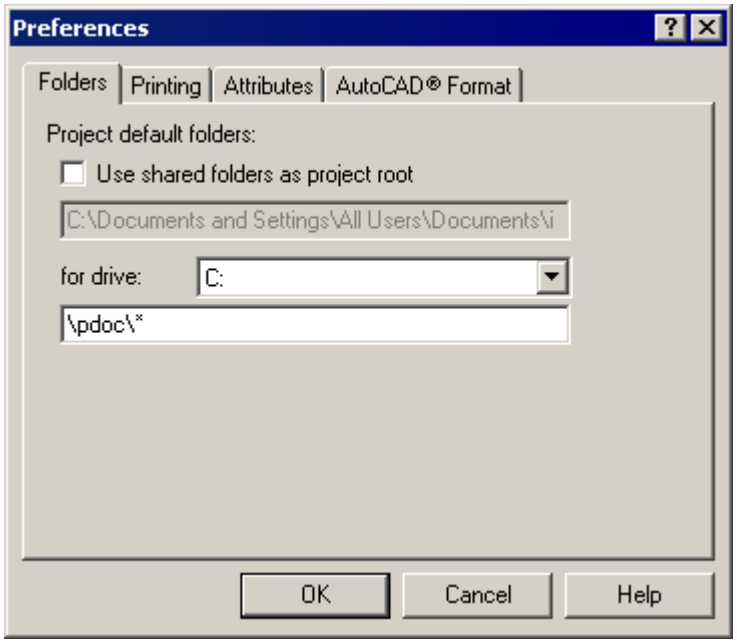
2.4.11 Text Editing

iCON office can open and edit plain text files, txt. When you select a text file in Open-dialog 25 the text document is displayed in an editing view, where you can edit the text in the same way as, for example, in Windows® Notepad. Standard functions like cut, paste, copy and search are all available.

2.5 Program Settings

Select ***Edit*** | ***Preferences*** to change program settings.

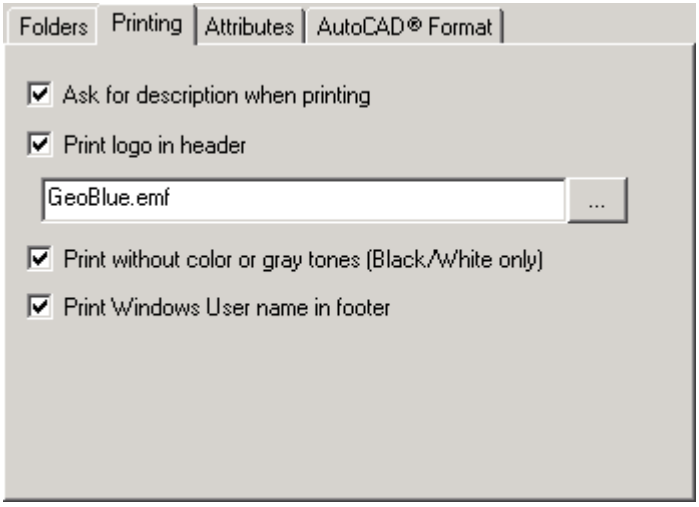
Folders



Project folders
Check the box to use the suggested path for the new projects that are created.
If you uncheck the box, you can specify a default path for projects on different drives. The path must begin with a '\' and contain a wild card '*'. When you select to create a new project 5 this path will be suggested and you will have the opportunity to replace the '*' with a text unique to the project. For example, if you enter the following line: "\pdoc*" on drive C: this means that the project file name "C:\pdoc \NEWPROJECTFOLDER\project.cnf" will be suggested. NEWPROJECTFOLDER is selected to be easily overwritten with the folder name you prefer. There is a default path for each drive (C:, D:, etc.) and you can change the drive in the drop-down list to notify for which drive the default path is to be specified. The drive that is active in the list when the settings are saved will also be suggested when creating a new project. Paths are stored in the 'Geo.dir' file in the configuration folder.

In the System tab in the input/output window 107 you can see how the current configuration folder is set. The path to the configuration folder is also displayed in the system report that you open by selecting ***Help*** | ***About*** and clicking the **[System Report]** button.

Printing



Here you can choose some additional information which will be printed in the header of numerical documents and reports.

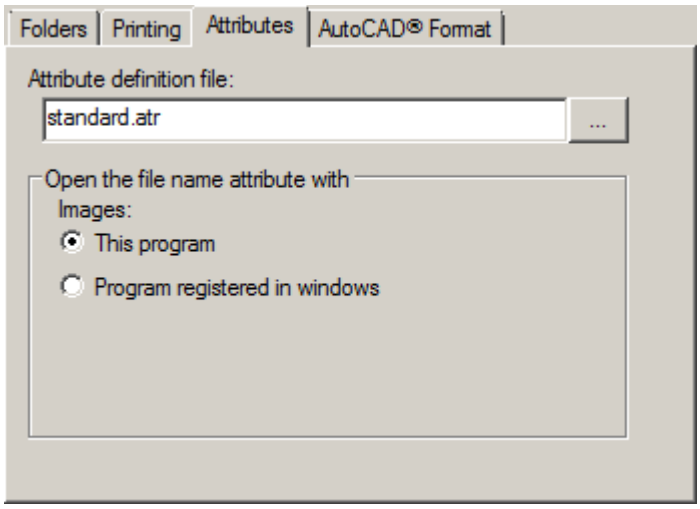
Ask for description when printing
With this box checked, iCON office will prompt for an optional text row when printing a document. The text will be printed in the headers on all pages.

Print logo in header
With this box checked, a logo will be printed in the page header. The logo must be in an emf file or in a bitmap file (bmp, jpg, pcx, tga, tif, gif, png), and the file must be in the folder for global files 17. Enter the name of the file to use or press the button ... to browse.

Print without color or gray tones (Black/White only)
Select this option to get prints that contain only black and white, and have a better contrast for, a fax or similar, for example.

Print Windows user name in footer
With this box checked, the name that is entered as the Windows user name will be included in the footer for each print.

Attributes

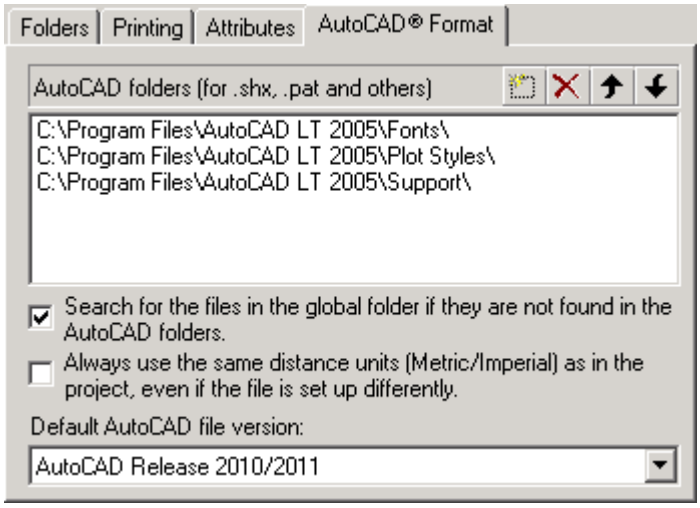


Attribute definition file:
Here you select the active attribute definition file, from the global folder. This affects the optional attributes that you can create and edit for the various object types. If you want to make your own attribute definitions, you should make a copy of the attribute definition file and save it with a different name, as *standard.atr* is overwritten when you reinstall iCON office.

Open the file name attribute with:
You can open attributes with the filename format by pressing the button in the attribute object's properties dialog. Here you select if the file is to be opened with iCON office or the program that Windows® suggests.

Attribute handling is described more in the Optional Attributes 113 section.

AutoCAD® Format



The AutoCAD® program uses support files to display information in a dwg file (or dxf). Support files here means files for fonts, line styles, hatches, etc. Shx files are used for the fonts and line styles and pat files for the hatches. The required support files are shown in the dwg file. If the AutoCAD program cannot locate the associated support files, the display of the file will not be exactly as the designer of the file saw it. The font is replaced with a similar one, and line styles will be displayed in a simpler design. You can define where the AutoCAD program is to look for support files.
iCON office works in the same way as AutoCAD when a drawing is opened and displayed on screen. You can set in iCON office too where the program is to look for the AutoCAD support files that a dwg file uses.

The support files that iCON office cannot find when loading a dwg or dxf file are shown in the output window 107 in iCON office. Example:
Cannot find the AutoCAD support file: ISO.shx
Cannot find the AutoCAD support file: ltypeshp.shx

AutoCAD folders (for shx, pat, etc.)

Enter one or more paths to the support files. If you have the AutoCAD® program installed, it is worthwhile specifying the same paths here that are in the AutoCAD program. If you do not have the AutoCAD program, you can specify other source folders for the support files.

Search for the files in the global folder if they are not found in the AutoCAD folders

Here you can control iCON office to look for support files for AutoCAD® drawings in iCON office's global folder. However, if the file is found in one of the AutoCAD folders, this file will be used.

Always use the same distance unit (Metric/Imperial) as in the project, even if the file is set up differently

Here you can check the box if you want all AutoCAD® files that are opened in the project to use the distance unit selected in Project Tree Settings 17. If you do not check the box, you will be prompted on which length unit the AutoCAD file is to use, if there is a difference between the file's unit length and length specified in the project settings.

Default AutoCAD file version

Here you can also select the AutoCAD® version of the files that are created by iCON office. This applies to dwg and dxf files that are created by iCON office.

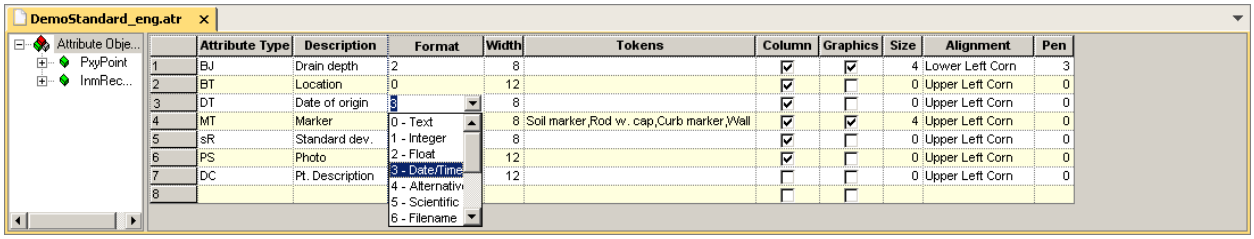
See also: Project Settings 16

2.6 Optional attributes

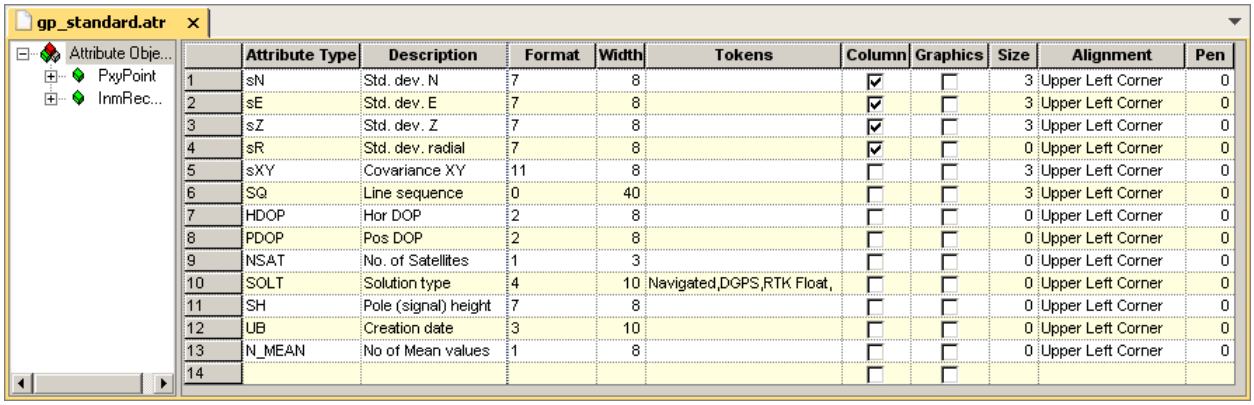
Some file and object types in iCON office can be supplemented with optional attributes. This means that you as a user can add further storage fields for the object types, in addition to those that are standard. If, for example, you measure a lot of wells you can supplement the measure and coordinate format with a field for well depth to be able to enter this in the field and save the value with your coordinates. The value of the attribute can then be printed together with data lists and graphics, and be used with functions like *Search and Modify* 100 and *Modify points* 166 . You define the attributes in an attribute definition file, and this could, for example, be shared within a company or group. You select the attribute definition file that is currently active with Program settings 109 , the file must be in the global folder. If you want to create your own attribute definition file, the easiest way is to make a copy of *standard.atr*, give it a different name and then edit it as you want it. *Standard.atr* is overwritten when you install new versions of iCON office. Attributes can be managed in survey document 318 (plm) and coordinate document 153 (geo, pxy and llc) and in pipe profiles 634 (prw). The attributes are automatically moved over when making coordinate calculations.

Attribute definition file

Here you define the attributes for different object types. In the tree view to the left the objects you can associate attributes to are listed, at present the attribute management works for "PxyPoint" (point in coordinate file, geo and llc files) and "InmRecord" (survey data post in survey file) and "PrwProfilePoint" (point in pipe profile). In the input section, enter the type, value lists and presentation settings for the attribute.



Example of attribute file.



Example of attribute file for GPS survey.

Attribute type

Here you give the attribute type a short identification. You specify this identification in the field to give the attribute its value, and you save this together with the value in the file. Depending on which instrument you use, it may be appropriate to give the type a numerical identification for easier input in the instrument.

Description

Here you give the attribute type a longer description. This may vary between different iCON office installations, for example when translating the attribute definition file.

Format

An attribute type can have different formats, depending on the type of data you want to enter. The input field and text format are adapted to the selected type, for example, an attribute with the type date/time can be edited by clicking forward to the required date in the calendar. The following formats are available.

Text	The value may contain any text.
Integer	The value must be an integer.
Float	The value is a float in the format 1.234
Date/Time	The value is a time reference with date and time.
Alternative	The value is one of a number of options available.
Scientific	Same as float, but in the format 1.234 e-4. Suitable for very small or large numbers.
Filename	The value is a filename or a URL. iCON office has special functions to view or open files specified in this way. URLs must begin with "http://"

Width
Enter here the width of the column for the attribute in the input view, in the number of characters.

Status values
If the format is 4 = Alternative you enter the available alternatives, separated by a comma, for example "red,green,yellow". You enter the value of the incremental attribute in the field with its serial number with 0 as the first alternative. For example, you must enter "0" for red and "2" for yellow.

Column
Check the alternative if you want the attribute type to have its own column in the input view, see also editing below.

Code	Remark	Drain dep	Location
		1,3200	Left of door

The columns of the attribute are added after the standard columns.

Graphics
Check this alternative if you want the attribute text to be printed as a point text in the graphic window and on drawings. NOTE: Here you only select the attributes to show. You turn on and off the display of the checked attributes here, as specified in Graphic document properties. 52.

12
Curb marker

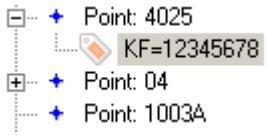
Size
Font size for graphic drawing.

Adjustment
Text placement for graphic drawing.

Pen
Pen/color for graphic drawing.

Edit attributes

Only attribute types that are active in the attribute definition file can be edited. If you have a file with other attributes, these are shown in the tree view, but cannot be edited.



Editing in the numeric view

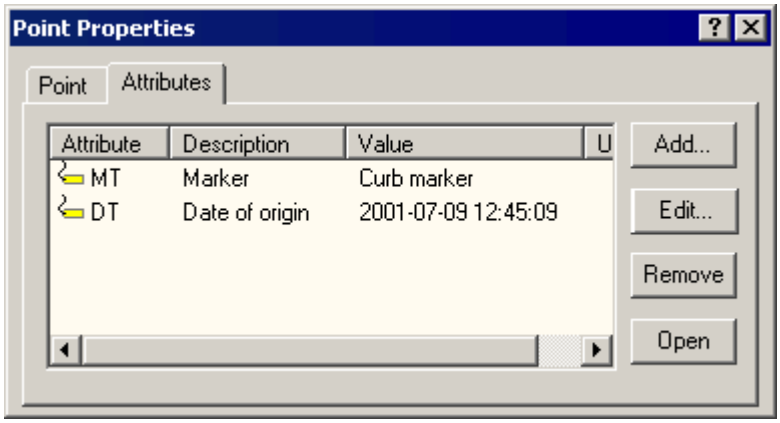
If you have specified that the attribute type is to have a column on its own in the attribute definition file, then you can edit the value in the input view for the file. What the input field looks like depends on the format of the attribute.

Example of input field for attribute.

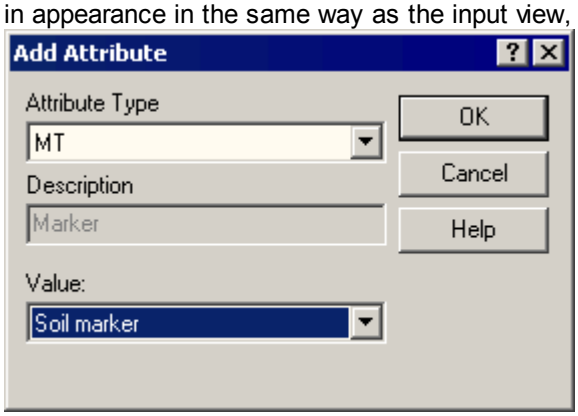
Text	Left of door	
Integer	23	
Float	1,32	
Date/Time	2002-07-29 00:00:00 jul 2002 sö må ti on to fr lö	Click the large down arrow to select a date from the calendar. You can use the small arrows to increase or decrease the value of the selected unit. (days, hour, etc.)
Alternative	Soil marker Rod w. cap Curb marker Wall marker	Select one of the alternatives listed. No other value can be specified.
Scientific	1.23e-4	
Filename		Enter a filename or click the down arrow to select a file in Open dialog 25.

Editing in properties dialog

To edit the attributes for an object you select to show the properties for the object, either by right clicking the object in the tree view and selecting properties, or by marking the object in the graphics, right clicking and selecting properties. In the 'Attribute' tab the defined attributes are shown for the object.



- Click the button **[Add]** to add new attributes.
  In the dialog you select the attribute type and value for the attribute. The input field for the value varies in appearance in the same way as the input view, see above.



- Select **[Edit]** to edit an attribute value.
- Select **[Remove]** to delete the selected attribute from the list.
- Select **[Open]** to open the file with the program registered in Windows for the file type. This is only valid if the attribute has the filename format and the value is a valid filename or URL.

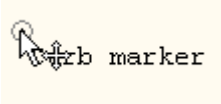
Attribute view

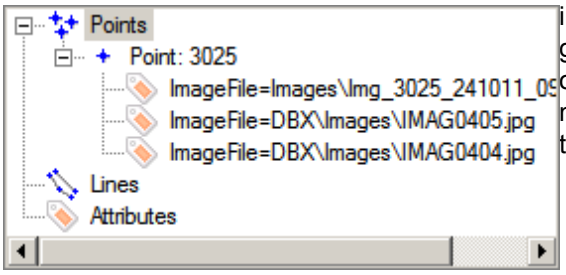
The window for the Attribute View can be easily switched on or off by selecting ***View | Attribute View*** or select the icon .

The window is dockable 40 , which means that it can be 'snapped' in place to a border. Read more about the window which is also dynamic, in General about windows, views, and toolbars 40 . When iCON office closes, the position of the window is saved so it appears in the same place and has the same size the next time iCON office is started.

If you have attributes with the format 113 *Filename* these are automatically shown in the attribute view when the object is selected in a tree view or the graphic window. The files that can be shown automatically are images (jpg, tif, bmp, pcx, tga, png) for example images taken with total stations, but also audio and video clips (mp3, wav, mid, midi, mpg, mpeg, avi) and web documents (htm, html, dhtml, shtml, php, asp).

Photos taken with a total station will automatically be associated to the point from which they have been taken. These images will be saved as attributes of their respective point and will appear in the attribute view.

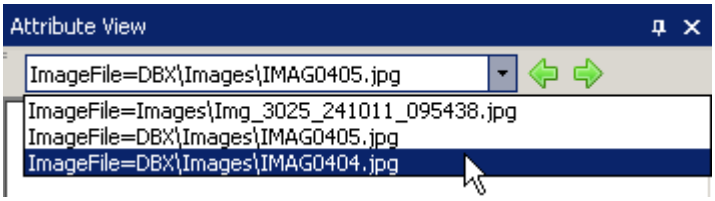




Mark the point in the graphics or in the numerical tree.

When a point that has an attribute is selected, images that are stored as attributes will appear in the attribute view.

If there are multiple attribute types with the format *filename* linked to the same object type (e.g. coordinate point), you select the attribute types to be displayed by clicking the arrows at the upper part of the attribute view.



See also: Coordinate Files 153 , Survey Files 318 , Graphic Document Properties 52 , Program Settings 109

3 Coordinate Handling

3.1 Coordinate Handling in General

Some kind of coordinate file is used for all coordinate handling, which usually has the geo file format or the older pxy format. The geo file type is more flexible, and includes a point and line structure that is completely independent of the point numbers and supports the optional attributes for points and lines. The pxy file is still supported by iCON office for backward compatibility and to facilitate communication with other programs. This chapter is divided into the following sections.

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Global Transformation, advanced 142

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3.2 Coordinate Systems

3.2.1 Coordinate Systems in General

iCON office handles coordinates in multiple coordinate systems. Geocentric coordinates (XYZ), longitude and latitude, projected coordinates in a known projection or totally local coordinates. To transform between different coordinate functions you have the functions Transformation 188 and Global Transformation 142.

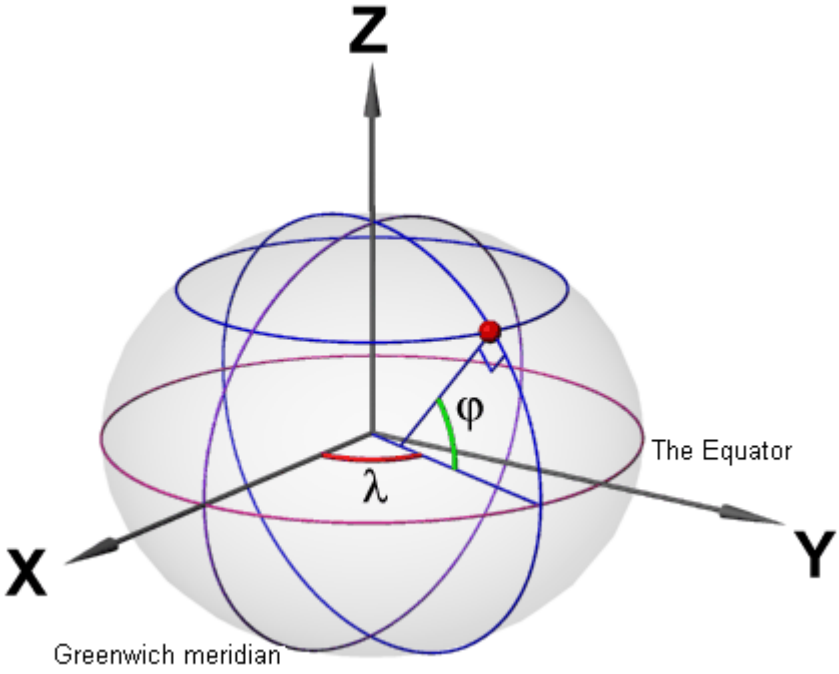
Global Coordinate System

The global coordinate system refers to coordinate systems that are well defined in relation to the earth. Coordinates in global systems can be specified in several ways, and transformation between them can be done using Global transformation 142.

Geocentric Coordinates (Cartesian)

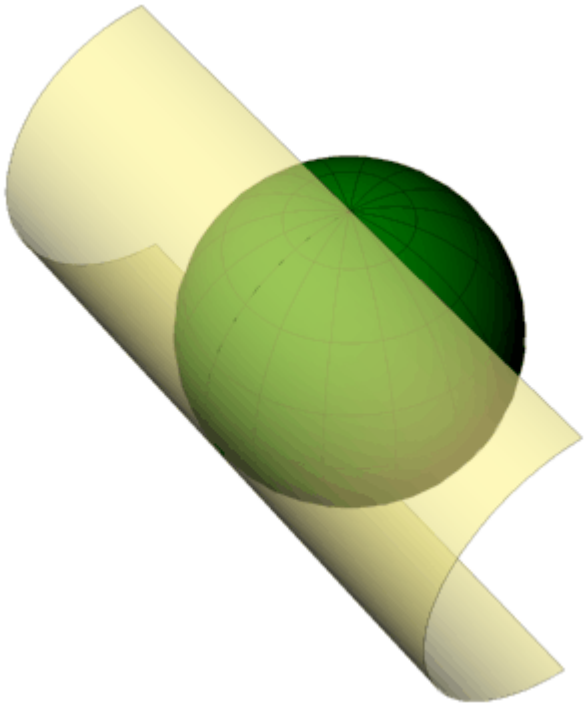
Here you specify a point's coordinates as X,Y and Z in a perpendicular right-handed system with the origin in the center of the earth. The Z-axis is the same as the earth's rotation axis with the direction through the north pole treated as positive, the X-axis runs through the Greenwich-meridian and the Y-axis perpendicular to the other two. Different systems may have different definitions of the earth's center and axis of rotation.

Latitude and Longitude (Geographic Coordinates)
Here you specify a coordinate as two angles and a height over a reference ellipsoid. *The Ellipsoid* has the same center as the geocentric coordinate system, and the size and flattening of the ellipsoid are selected to ensure that it is as consistent as possible with the *Geoid*. The geoid is the undisturbed mean sea level and its proposed extension over land, i.e. a surface that depicts the earth's gravity field so that the gravitational potential over the whole geoid is the same as it is for the undisturbed sea level. The gravity field, and hence the geoid is irregular so a different ellipsoid is chosen in different parts of the world to ensure the best possible local consistency. The GRS 80 ellipsoid is used in Sweden. Longitude is the angle along the equatorial plane from Greenwich to the searched point and the latitude is the angle at which a line perpendicular to the surface of the ellipsoid passes through the point that crosses the equatorial plane. The ellipsoid height is the point's height above the surface of the ellipsoid, and differs from the height of the geoid, which is obtained when leveling, for example. The difference between the geoid and ellipsoid is called *Geoid Height*, and varies in Sweden between -10 and +10 m. The figure below illustrates the relationship between Cartesian and geographic coordinates.

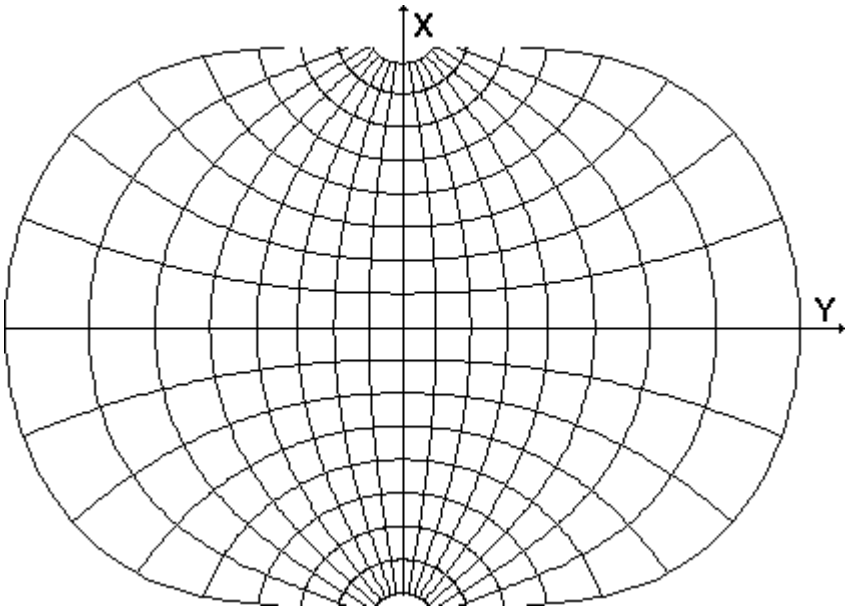


Projected Coordinates

The projected coordinate system is a mapping of points on the ellipsoid on a plane surface. As the surface you want to depict bulges, the image will never be perfect, which is why different projections are used in different parts of the world. The Gauss-Krüger projection is used in Sweden. This is a transversal Mercator that is correctly angled and has a longitudinal north to south line, the mean meridian. The projection is made by the map plane being placed as a cylinder around the ellipsoid and along the mean meridian (see image). Coordinates are then projected on the map plane.



When a grid of latitudes and longitudes is projected (see image), it is clear that nothing but the mean meridian is depicted correctly. Projection errors are least closest to the mean meridian, which is why this projection is well suited for elongated countries such as Sweden. The image below has lines depicted at 10 degree intervals.



Sweden uses the reference system SWEREF 99 with 13 different plane coordinate systems of which SWEREF 99 TM is nationwide and the other 12 are local. Plane coordinates are entered as **X** *(positive north, based on the equator)* and **Y** *(Positive westward based on the mean meridian)* and these are called complete coordinates. The Y addition is positive to avoid dealing with negative coordinates west of the mean meridian, which would otherwise have Y = 0.

Local Coordinate System

In addition to a globally defined system, entirely local coordinate systems are often used, e.g. a building site net. These cover smaller areas and therefore take no account of projection errors and earth bending. To convert between local systems or between one local system, a Helmert transformation is frequently used, see Transformation 188. Some older projected systems such as ST 74 in Sweden contain distortions and errors that make it appropriate to treat them as local for things like GPS surveys.

See also: Global Transformation 142, Transformations 188, Project Settings 16, Selecting Coordinate System 124

3.2.2 Selecting Coordinate System

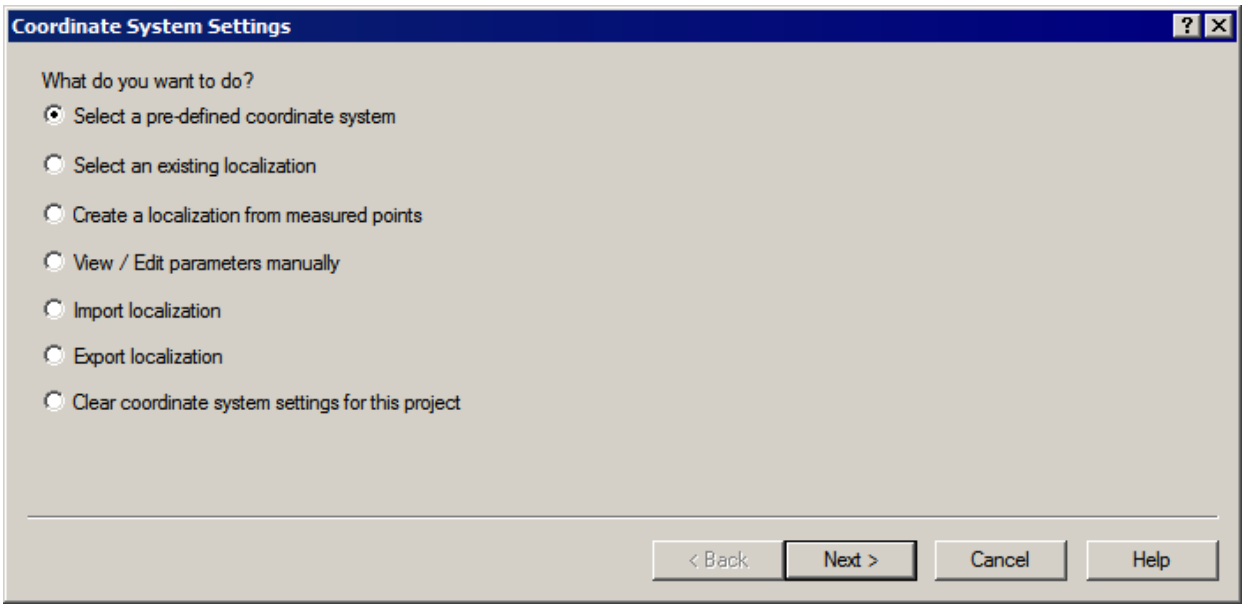
iCON office handles coordinates in multiple coordinate systems. Geocentric coordinates (XYZ), longitude and latitude, projected coordinates in a known projection or totally local coordinates. To transform between different coordinate functions you have the functions Transformation 188 and Global Transformation 142.

The coordinate system is used by the functions Projection correction of measurements 333 and Import of GPS baseline to a net adjustment 820. You can also open a llc file 185 and transform to geo-format and vice versa. If you do not plan on using any of these functions you do not need to specify a coordinate system.

Some localization files and coordinate systems are predefined, and the files for these (lok, gtr, csd, grd) can be downloaded from https://myworld.leica-geosystems.com/. Downloaded files are stored in iCON office's Global folder.

How to select a coordinate system

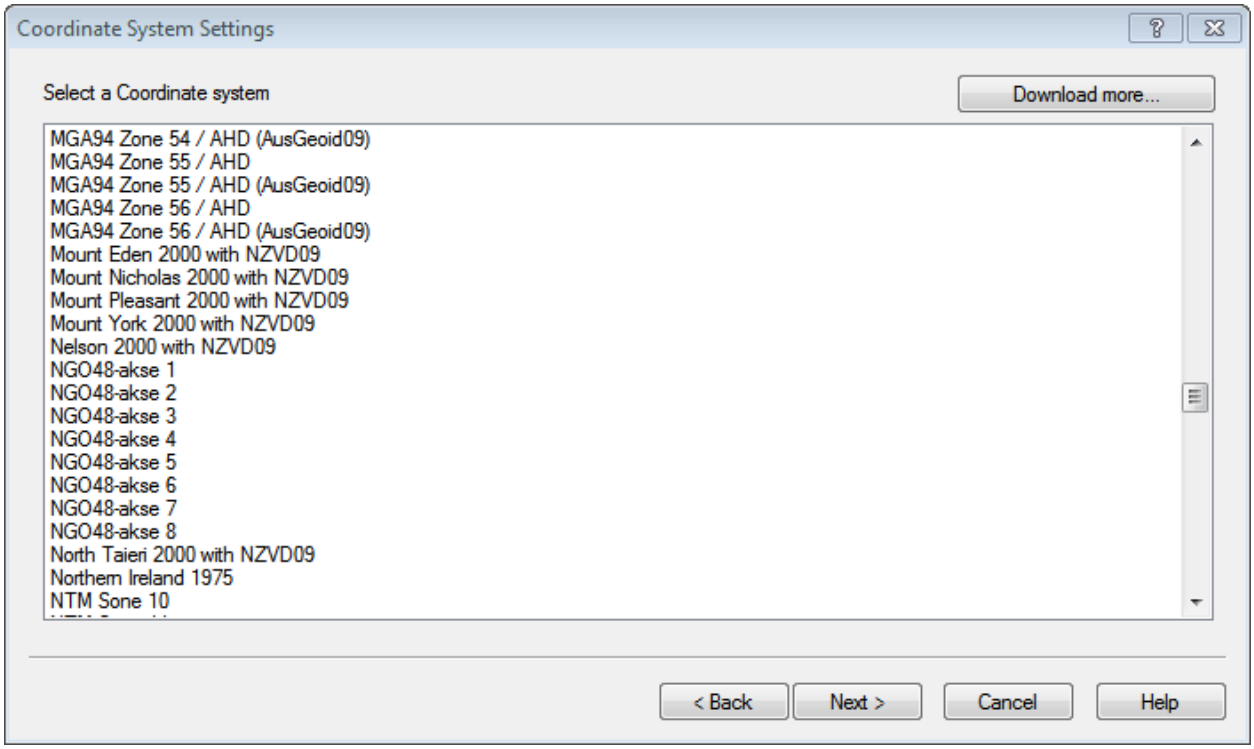
To be able to view the longitude and latitude, or to be able to transform them into geocentric coordinates (XYZ), you have to define a coordinate system for the project. This is done from the tab Settings 16 in the Project Tree. The Wizard for coordinate system settings makes it possible to select or create a localization file, lok, which contains all the parameters and settings, such as geodetic datum, map projection and local transformation. The file is saved in the project but it is possible to reuse the localization for other projects. Click **[Edit Coordinate System]** in the project tree to open a dialog with the coordinate system settings.



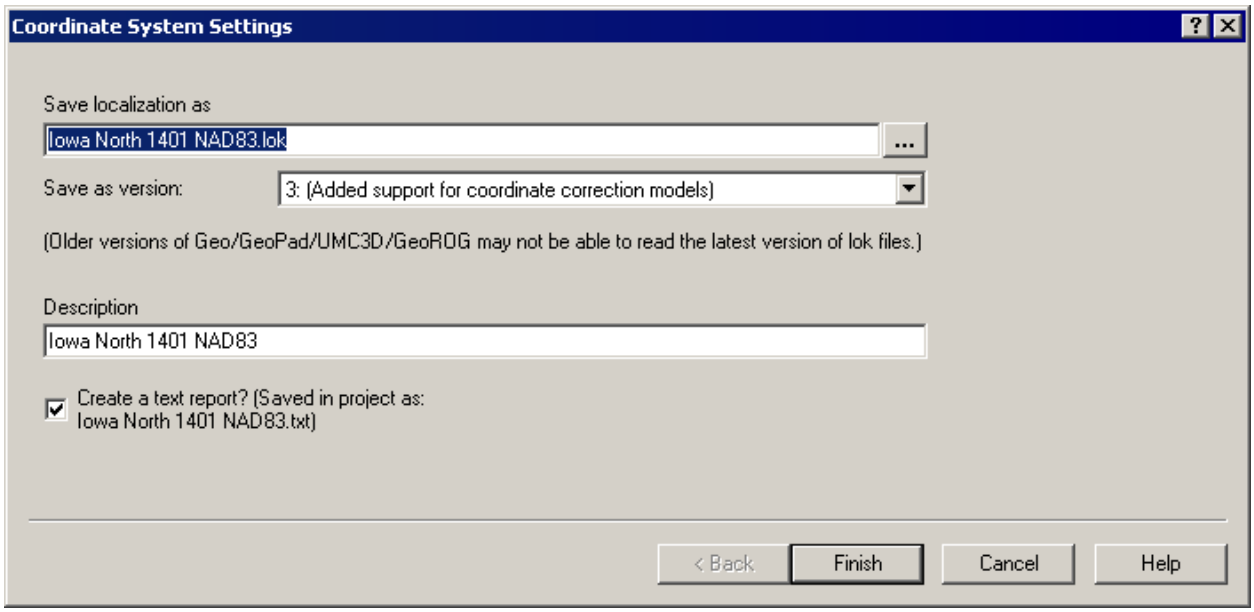
Select what you want to do:

- **Select a pre-defined coordinate system** 125
- **Select an existing localization** 127
- **Create a localization from the measured points** 127
- **View/Edit parameters manually** 131
- **Import localization** 137
- **Export localization** 138
- **Clear coordinate system settings for this project**
  Select this option and then **[Next]** to remove all coordinate system settings in the project.

Select a pre-defined coordinate system
Here you can select a pre-defined coordinate system from the global folder[17]. The localization will be enabled in the current project.



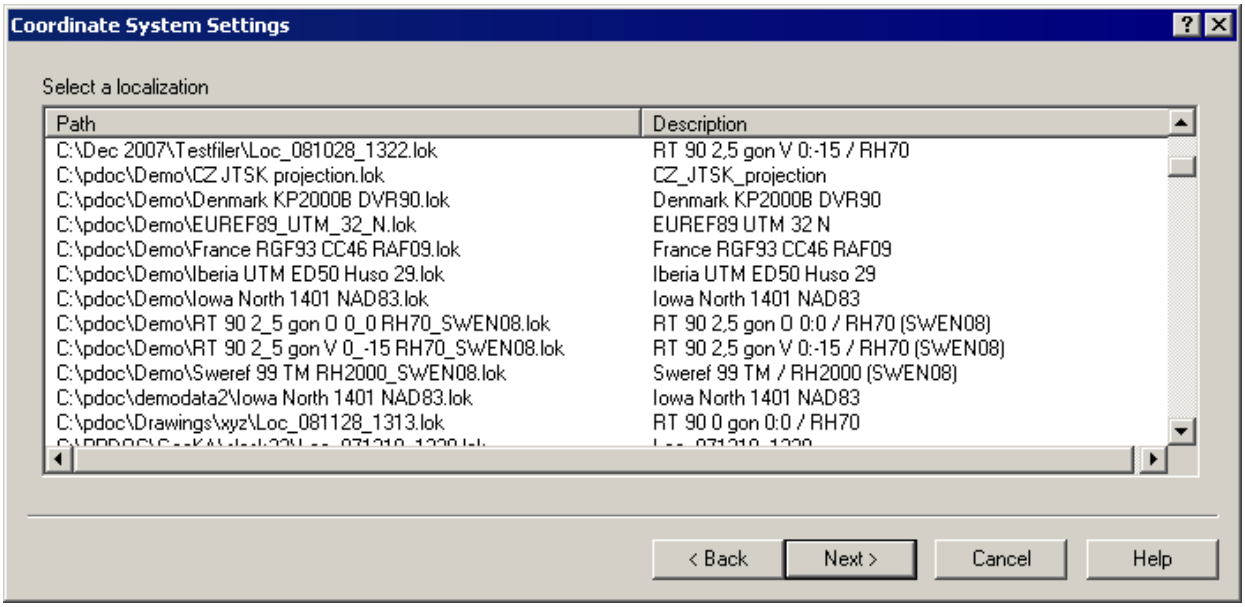
- Select a coordinate system from the list.
- **[Download more...]** If you cannot find the coordinate system you need, click **[Download more...]** to see if there is a zipped file with the coordinate system for your area included in the global folder.
  - Select the file you want to download.
  - The content of the zipped file will be extracted and saved in your global folder[17]. In this way, you will immediately get access to the downloaded coordinate systems.
- When you have selected a coordinate system, click **[Next]**.



iCON office suggests a name for the localization based on the predefined coordinate system (localization file). If the localization has been created manually, a unique name based on the date and time when it was created, will be suggested. Change the name and description where necessary. If you want to create a text report, check the box.
Now click the button **[Finish]**. The specified coordinate system now applies to the current project.

Select an existing localization

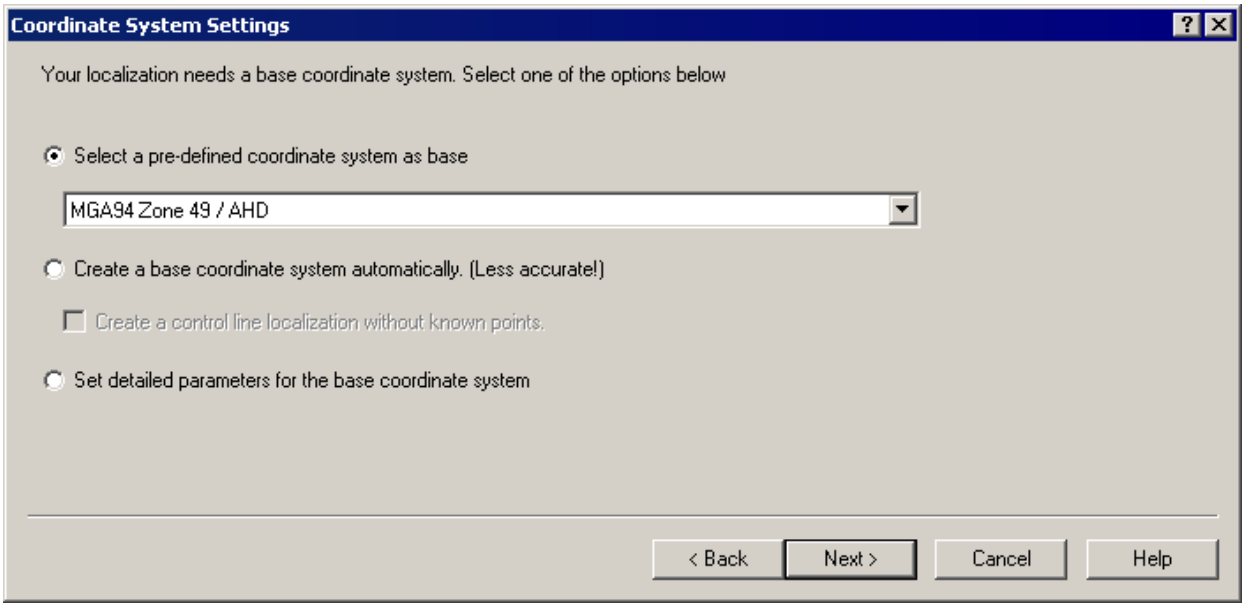
This option is used when you already have a localization (lok file) saved.



The list above shows the localizations previously used for both the current project and others. Select the appropriate file. The following page of the dialog shows the name of the new lok file, see above. In this case, the lok file is copied to the project, which means any editing does not affect the original file.

Create a localization from the measured points

This is used to create a local transformation in a given area. If, for example, you have used GeoPad and measured known points to get longitude and latitude, iCON office can adjust these coordinates to suit the known points.



There are three ways to create coordinate systems from measured points.

- Select a pre-defined coordinate system as base

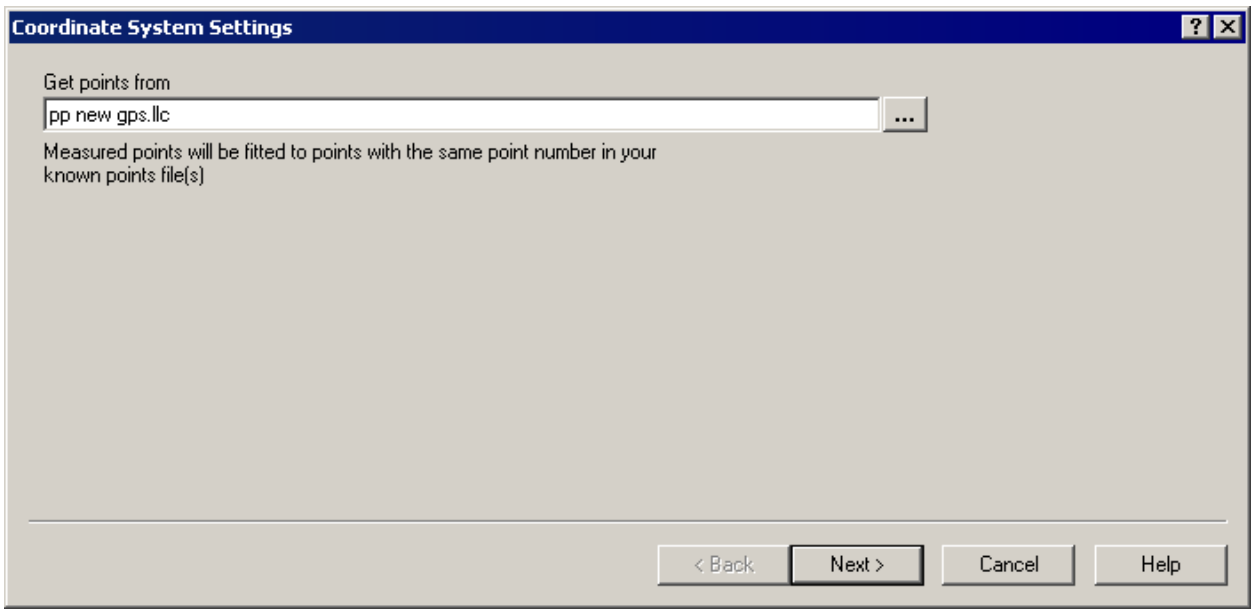
A pre-defined base coordinate system uses parameters from the pre-defined system and matches the points with a local transformation.

- Create a base coordinate system automatically. (Less accurate!)
  If the coordinate system is created automatically it will be less accurate, as iCON office then uses points from the transformation to create a mean TM zone. A global height transformation will not be used either.

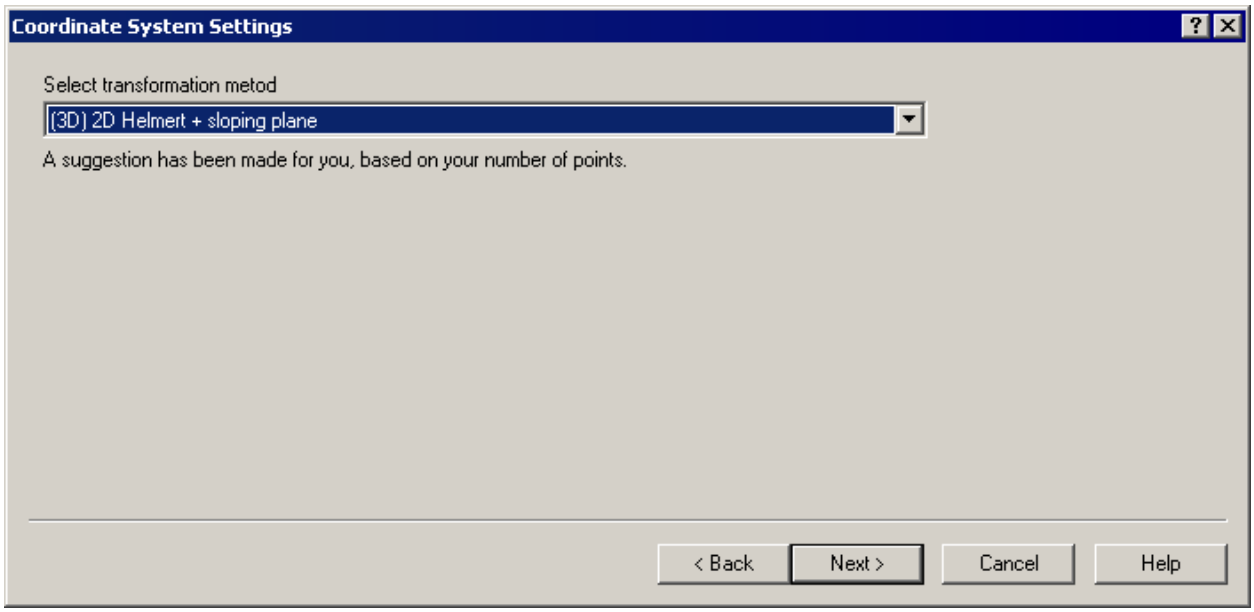
  - Create a control line localization without known points
    You can create a localization by giving two measured points fictitious coordinates. Give the first point coordinates (0, 0, 0) and the second point coordinates (0, length, 0). Thus, the first point will create the origin of the local coordinate system and the second point defines the local zero direction.

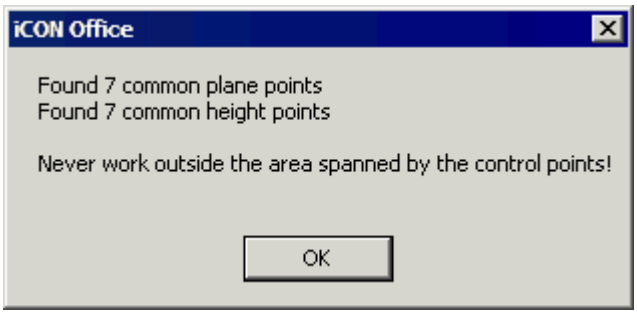
- Set detailed parameters for the base coordinate system
  A third way of creating a localization is to set detailed parameters for the coordinate system, which are geodetic datum 131 , global height transformation 133 , map projection 135 and transformation method 136 .

In all cases, a coordinate file with latitude and longitude (llc) file is specified.

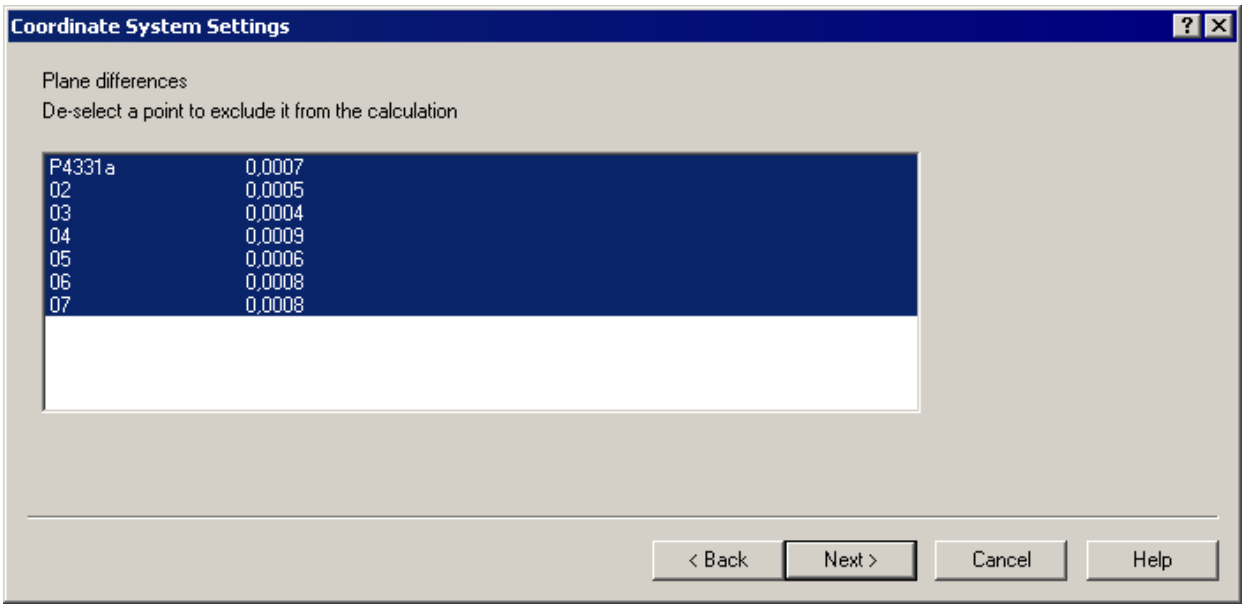


Points from the llc-file will be compared with points with the same point numbers as the files specified in files with known points 18. Depending on the number of points and how many points have height coordinates, a suitable transformation is suggested.





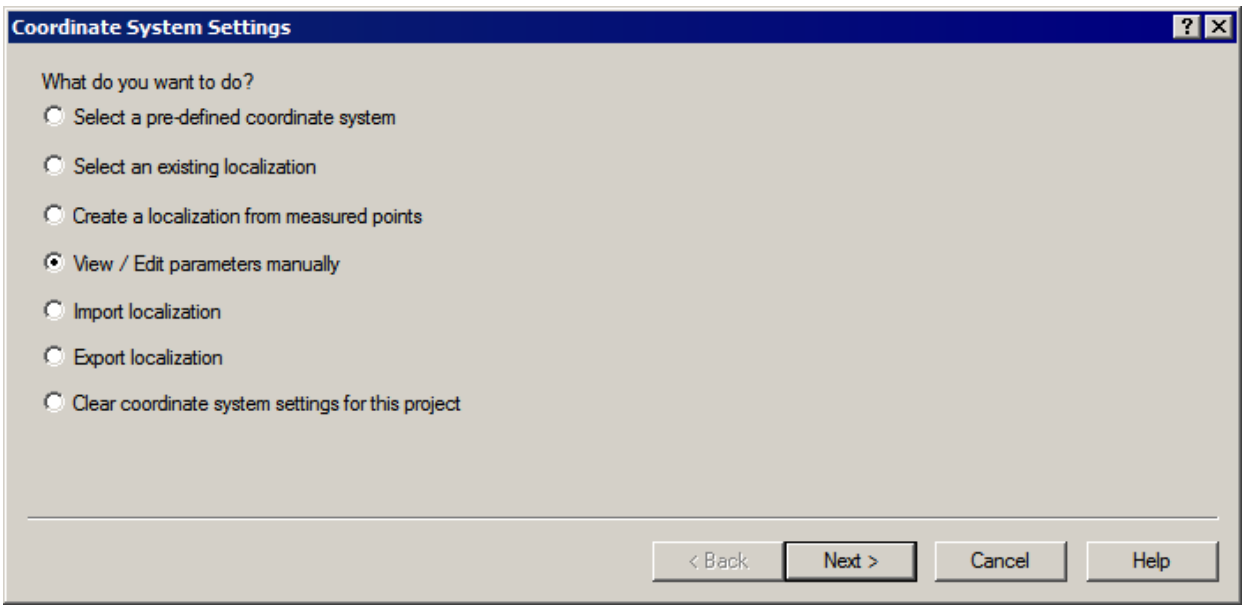
iCON office presents the number of points found in plane and height.



Here the differences in plane are shown. If it is possible to transform in height, you will see height differences when you click **[Next]**.
If any of the points cause major errors in the transformation, you can click on the row to deselect it from the calculation.
After this you come to the dialog where you are given suggestions for the name of the localization as above.

Once a coordinate system has been chosen, the parameters are displayed in the tab Settings 16 in the Project Tree. If a local transformation has been selected it will also appear, such as 2D Helmert + sloping plane.

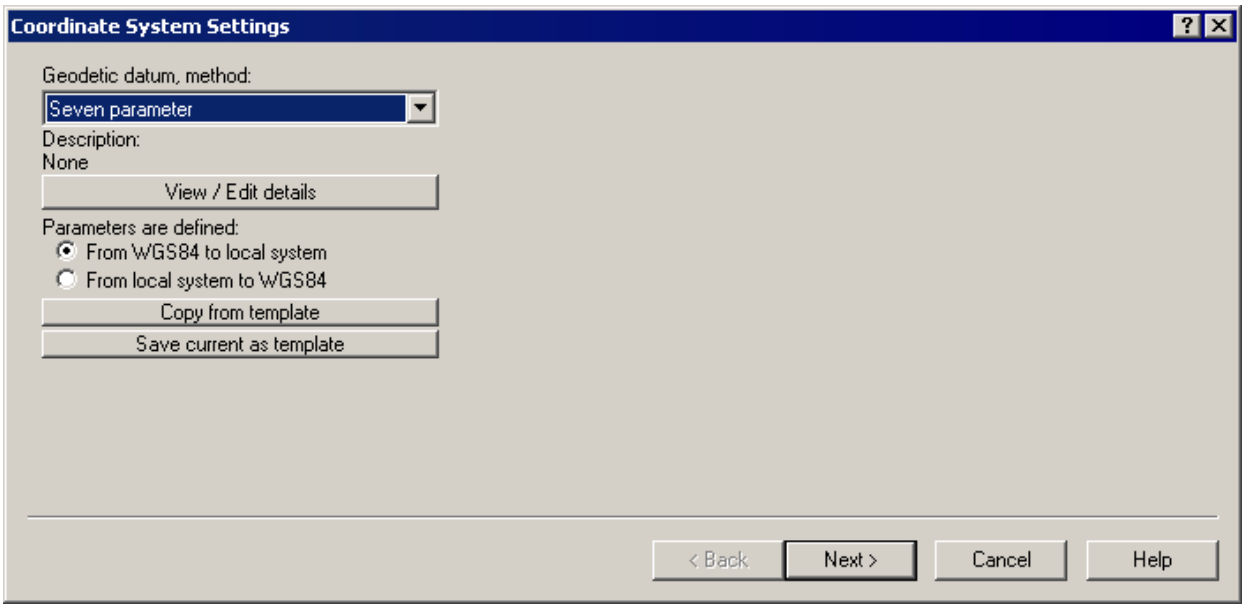
View/Edit parameters manually
On the first page in the dialog with the settings for coordinate system, you can select **[View/Edit parameters manually]**.



In the following pages, it is possible to view and edit the current parameters for geodetic datum 131, global height transformation 133, map projection 135 and local transformation 136.

Geodetic datum
Since different systems may have different definitions of the earth's center and axis of rotation (geodetic datum), a transformation between the GPS system (WGS 84) and the local system must be specified. The parameters describe the relationship between the centers and orientations of the ellipsoids and are stored in a gtr file.

Select method for geodetic datum: Datum shift grid or Seven parameter.
If you select datum shift grid, you choose a datum shift grid file, gcg, and then you select global height transformation 133.
If you select the method seven parameter, you select parameters by following the instructions below:



- Click **[View/Edit details]** to view the details for the current geodetic datum.

- **Copy from template**
  To change the geodetic datum, select **[Copy from template]** and select the appropriate gtr file.

- **Save current as a template**
  If you want to save the changes to be able to use the template later, click **[Save current as a template]**. Otherwise, parameters are only stored in the lok file.

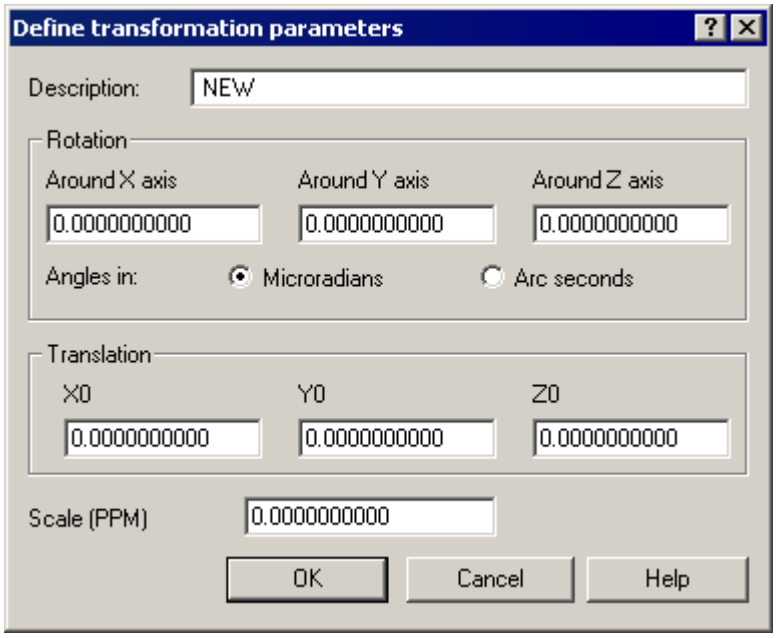
- **Parameters are defined**
  You must also state whether the parameters are defined to or from the local system. All pre-installed gtr files are defined *to* a local system.

Under https://myworld.leica-geosystems.com/ there are ready-to-use gtr files for download.

None.gtr **Sweref99_TM.gtr**	No transformation. Can be used where the map projection is applied directly to the WGS 84 or GRS 80, such as UTM projections and SWEREF 1999 TM.
Wgs2rt.gtr	Transformation from WGS 84 (SCANDOC 87) to RT 90. Previously used in translating the GPS measured points to the Swedish system.
Sweref93_RT90.gtr	Transformation from SWEREF 93 to RT 90. Now replaced by SWEREF 99.
Sweref99_RT90.gtr	Transformation from SWEREF 99 to RT 90. Use this file instead of Sweref99_RT90.gtr.

NOTE: In Sweden there are three different relationships used for GPS measurements, and the coordinates between the relationships may differ by up to one meter. Be sure to check if you have coordinates for the starting points in SWEREF 99, SWEREF 93 or WGS 84 (SCANDOC 87).

- When you select **[View/Edit details]** you bring up the following dialog. The parameters are initialized for the system that may have been selected before, which can be used to create similar systems.

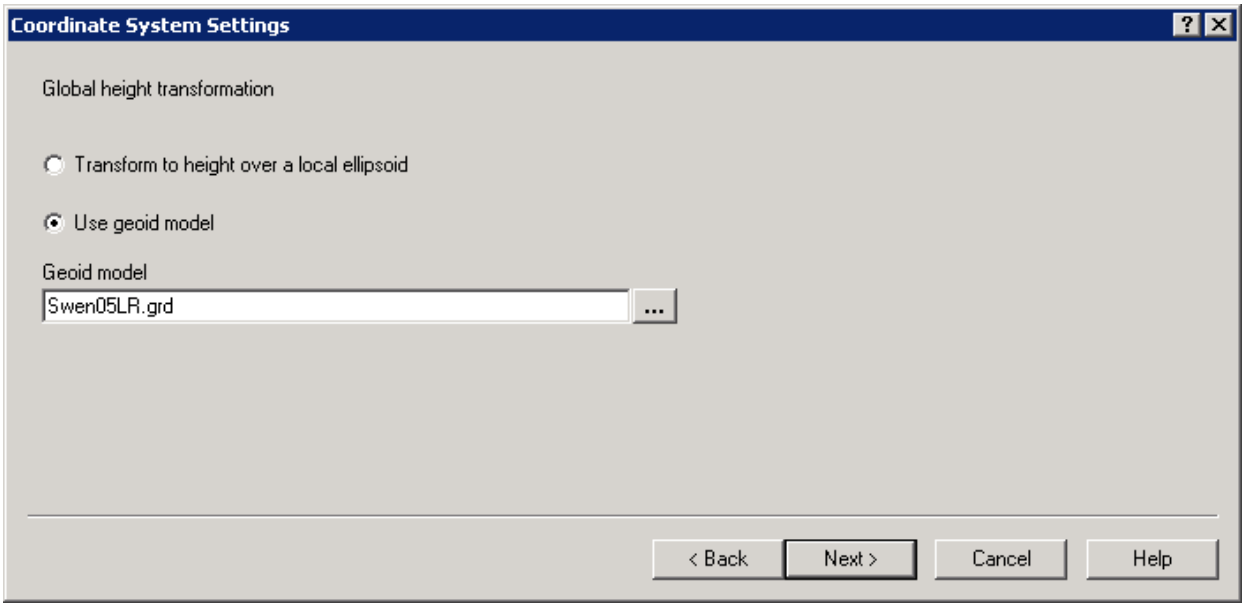


In the above dialog you can edit the parameters for the geocentric 3D Helmert transformation that need to be done.

- **Description** Enter optional text in this row. The text should be a description of the transformation relationship. The text will be printed in reports etc.
- **Rotation** Specify the rotation around geocentric X, Y and Z axes between the systems. Since rotations are very small, the units used are microradians or arcseconds. Specify which.
- **Translation** Specify geocentric movement between the systems.
- **Scale** Enter a scale change between the systems in ppm (parts per million). 0 ppm gives the same scale.

Global height transformation

Here you select the heights to be transformed from the global to the local system. Select if the height is calculated as the height of the local ellipsoid, or if a geoid model, grd, is to be used. If a geoid model is used the current values are downloaded from the grd file in the global folder.
The localization file, lok, includes the parameters for everything but the geoid model.

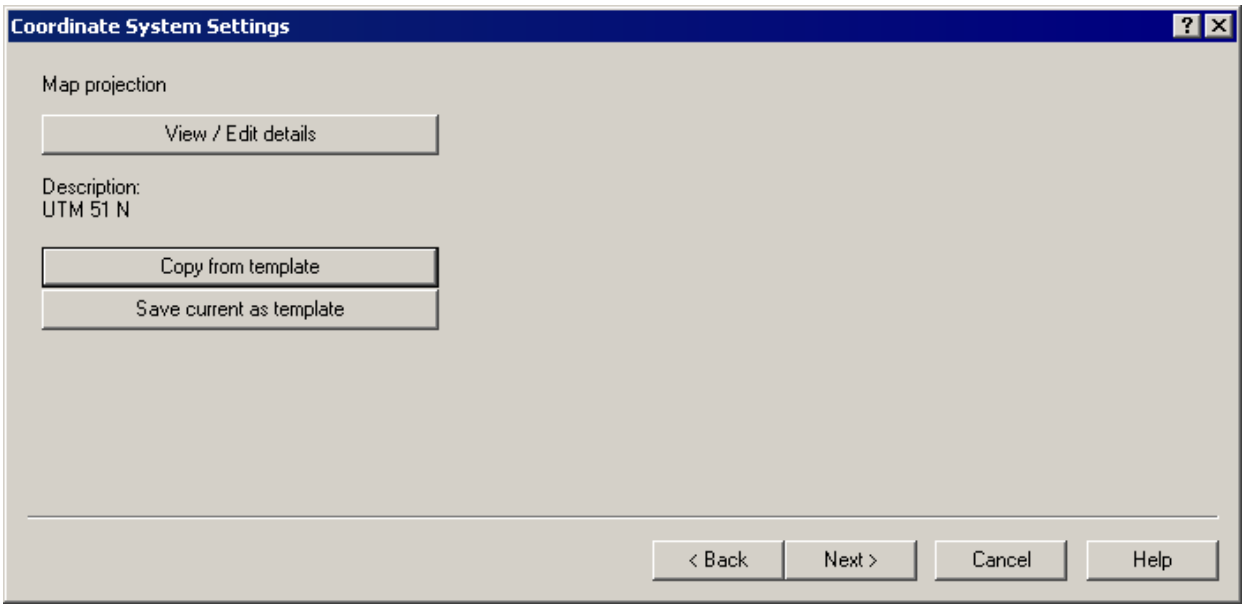


- Transform to height over a local ellipsoid
  The height over the ellipsoid in the GPS coordinate system (WGS 84) is transformed to the height over the ellipsoid in the local system. This height transformation uses parameters from the selection

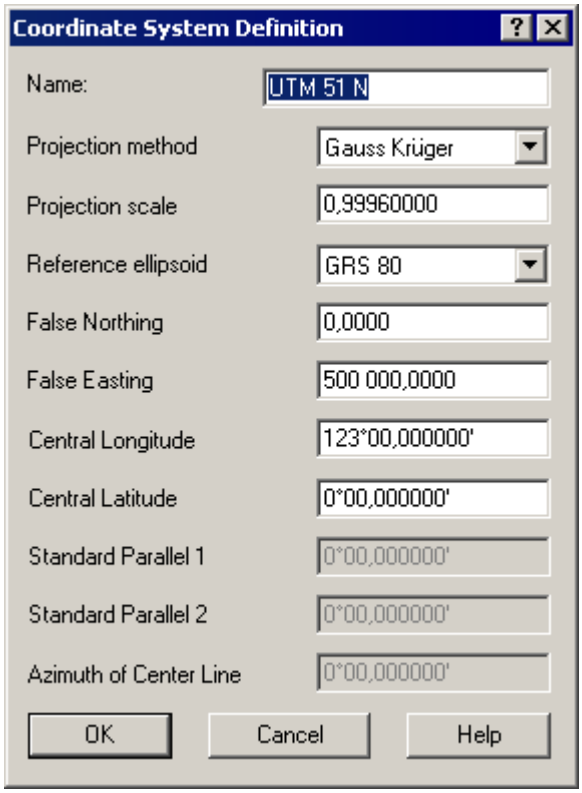
of geodetic datum, the gtr file.

- Use geoid model
  If you select a grd file, the height over the ellipsoid in the GPS's coordinate system (WGS 84) is transformed directly to the height of the geoid in the local height system (height over the geoid is obtained by leveling, for example).
  You can use any geoid model in the GRAVSOFT grd format. A number of geoid models can be downloaded from https://myworld.leica-geosystems.com/.

Map projection
The map projection contains parameters that describe the projection of the coordinates in longitude and latitude of the local ellipsoid to the local map plane. The most common coordinate systems are available for download from https://myworld.leica-geosystems.com/. Downloaded csd files are saved in iCON office's global folder.



Click **[View/Edit details]** to see (and edit) the current parameters.

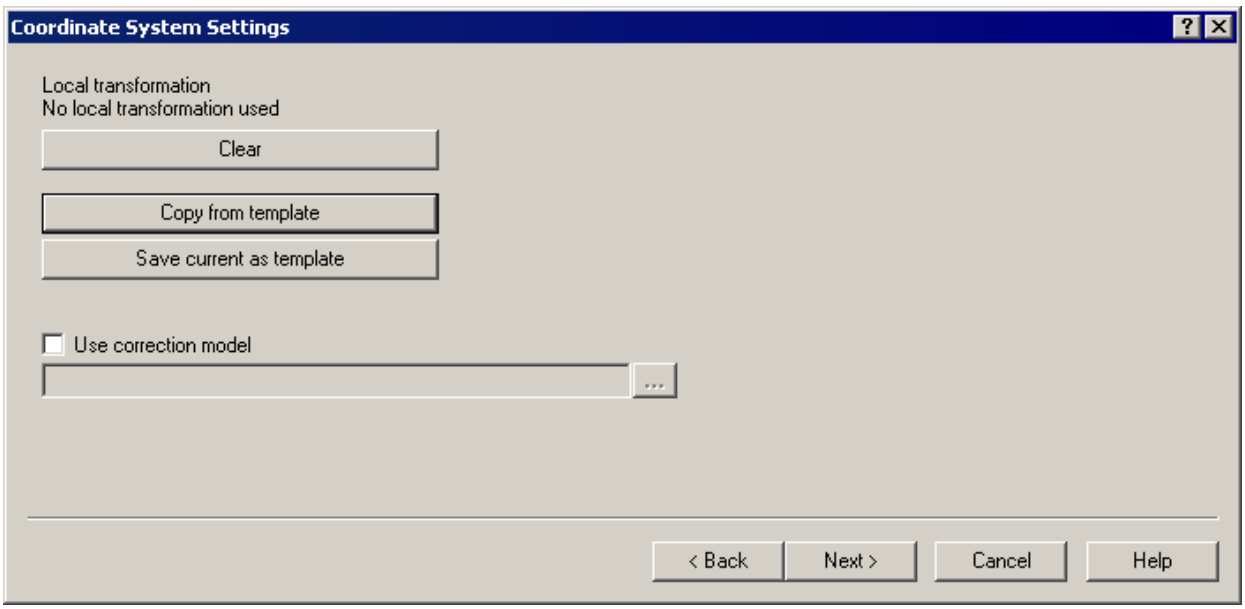


Click **[Copy from template]** to download a csd file with predefined parameters. If you make any changes to the above parameters, these are used in the localization file, lok. If you select **[Save active as a template]** instead, a new csd file is created.

- **Name** Enter any name for the coordinate system.
- **Projection Method** Enter the projection method to be used.
- **Projection Scale** Scale for the projection.
- **Reference Ellipsoid** Enter the reference ellipsoid to be used.
- **False Northing** Additional value to the true Northing coordinate. False Northing often aims to have fewer figures in the coordinates.
- **False Easting** Additional value to the true Easting coordinate. False Easting is specified to avoid dealing with negative coordinates west of the mean meridian.
- **Central Longitude** Longitude of central point of the project, i.e. the central meridian of the projection. For a transverse Mercator projection, the projection systems are often named after their mean meridian.
- **Central Latitude** Latitude of the central point of the project.
- **Standard Parallel 1 and 2** These are only used in Lambert Conical projection. The parallels describe the first and the second intersection line between the projection plane and the ellipsoid.
- **Azimuth of Center Line** If the center line is oblique relative to the North direction, the deviation can be indicated here.

Local Transformation
In addition to a globally defined system, entirely local coordinate systems are often used, e.g. building site net. These cover smaller areas and therefore take no account of projection errors and earth bending. To convert between local systems, a Helmert transformation is generally used, see Transformation 188. Some older projected systems such as ST 74 in Sweden also contain distortions and errors that make it appropriate to treat them as local such as GPS measurements.

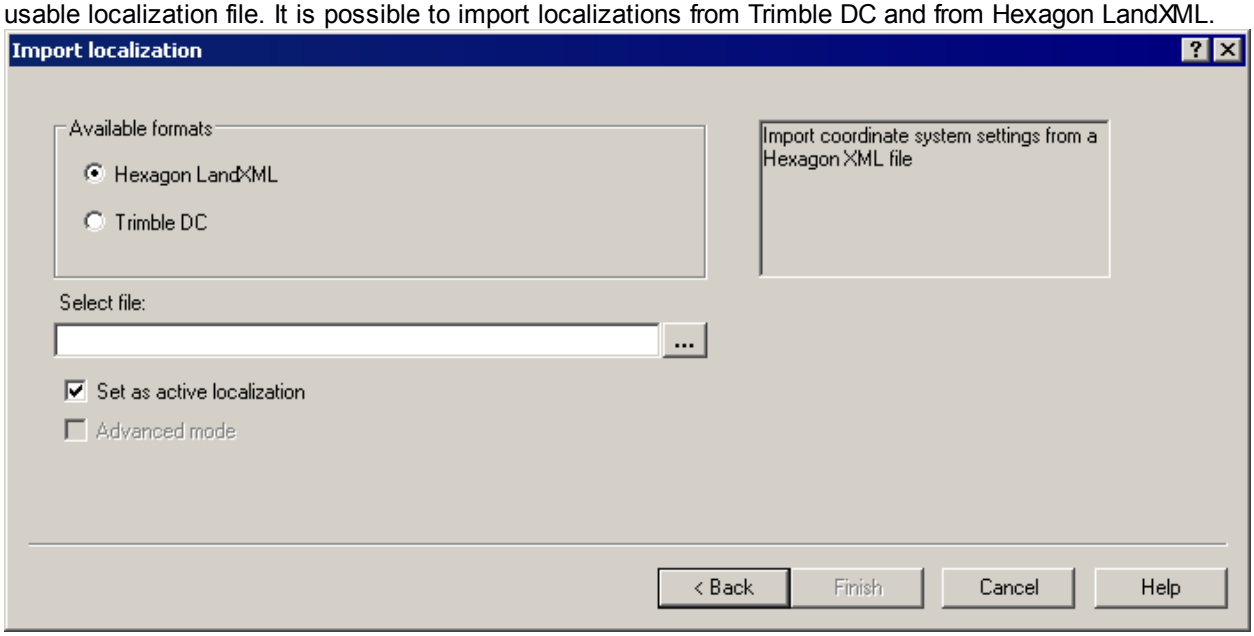
Typically, you create a local transformation relationship (***Functions|Transformation***), in the form of a tpf file which you then select here. For further information on the transformation, see Transformation 188.



If a local transformation is used, the transformation method appears here.
By selecting **[Clear]** it is possible to delete the settings for the transformation parameters, but first make sure that a template has been saved.
The templates have the tpf format. They are thereby the same file format as all local transformations in iCON office, for example, background images and transformations calculated under ***Functions | Transformation***.

Click **[Copy from template]** to download a tpf file with predefined parameters. If you make any changes to the parameters, these are used in the localization file, lok. If you select **[Save current as a template]** instead a new lok file is created.
Check **Use correction model** and select one if it is used.

Import localization
Use this option if you have access to a localization in a format that can be imported to the program as a usable localization file. It is possible to import localizations from Trimble DC and from Hexagon LandXML.



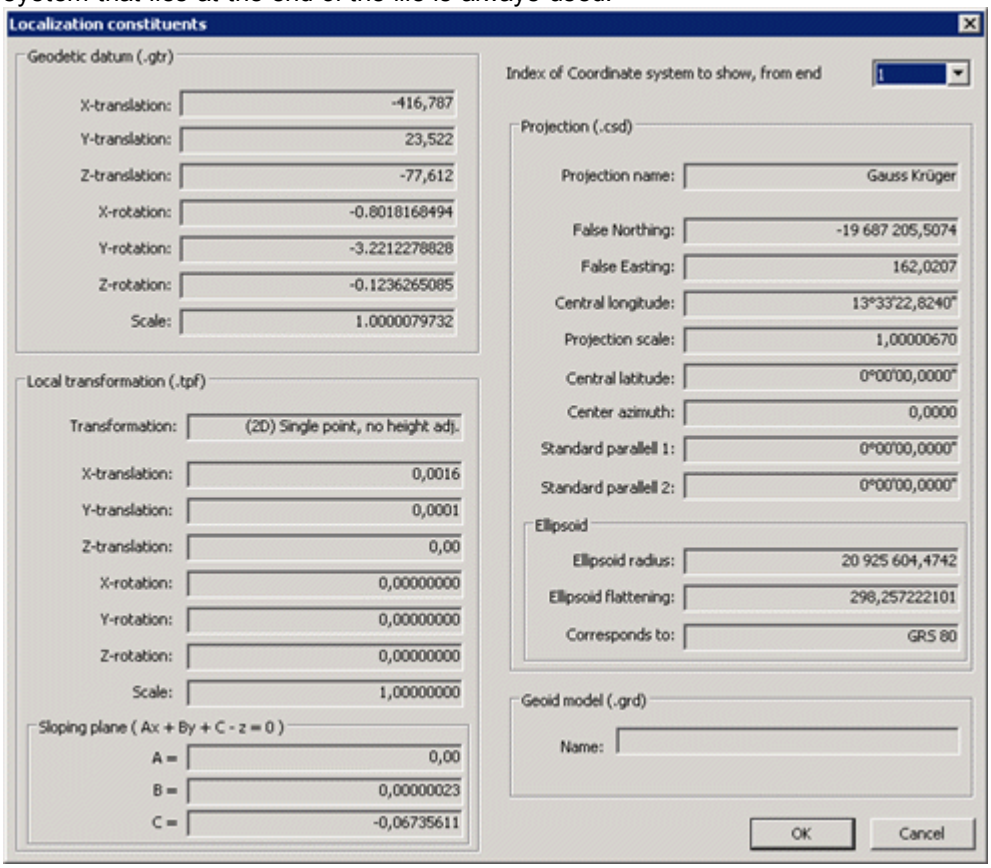
Available formats
Select the format that is available for importing coordinate system settings.

Select file:
Use the scroll button ... to select the file to be imported. The coordinate system settings in the selected file will be converted to a format that can be used by iCON office, and the settings are saved in a localization file, lok.

Set as active localization
Select **[Set as active localization]** for the selected coordinate system to be set as active in the current project.

Advanced mode

The alternative **[Advanced mode]** will only be selectable if **Trimble DC** has been selected under **[Available formats]**. Select **[Advanced mode]** and click **[Finish]** to open a dialog that shows all the parameters that the selected coordinate system file contains. You can then see all the details before you accept the settings. If the coordinate system file contains more than one coordinate system, you can use the box in the upper right corner in the dialog to choose whichever you want. Otherwise the coordinate system that lies at the end of the file is always used.

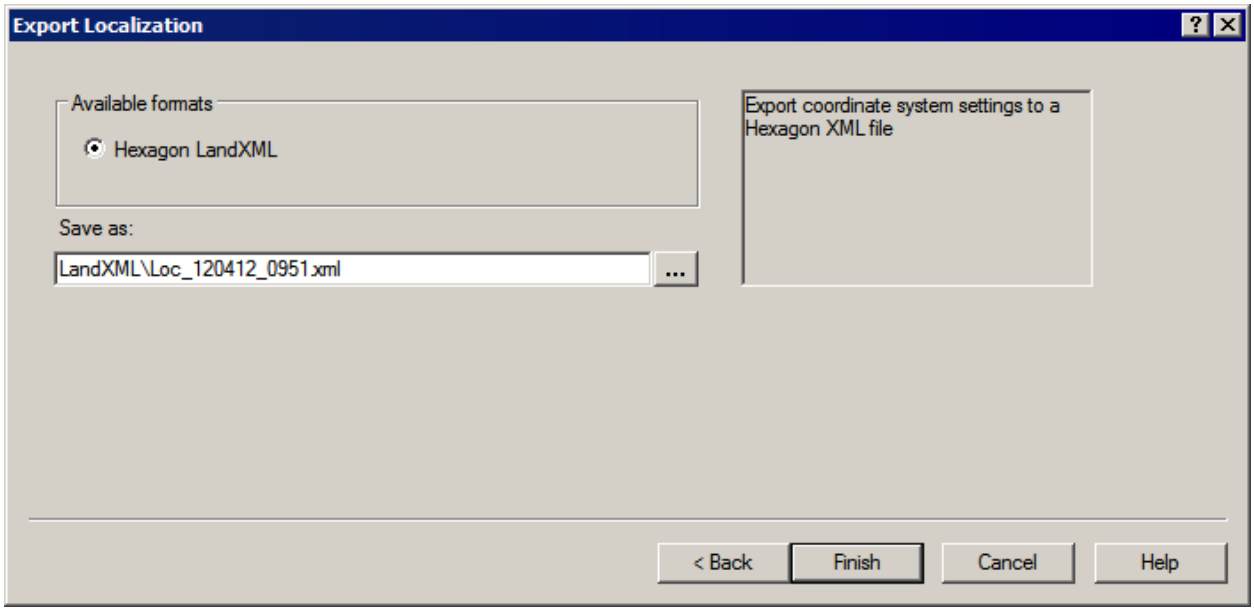


The dialog shows the localization parameters.

Click **[Cancel]** to come back to the dialog Import localization 137, or click **[OK]** to save the new localization file (lok).

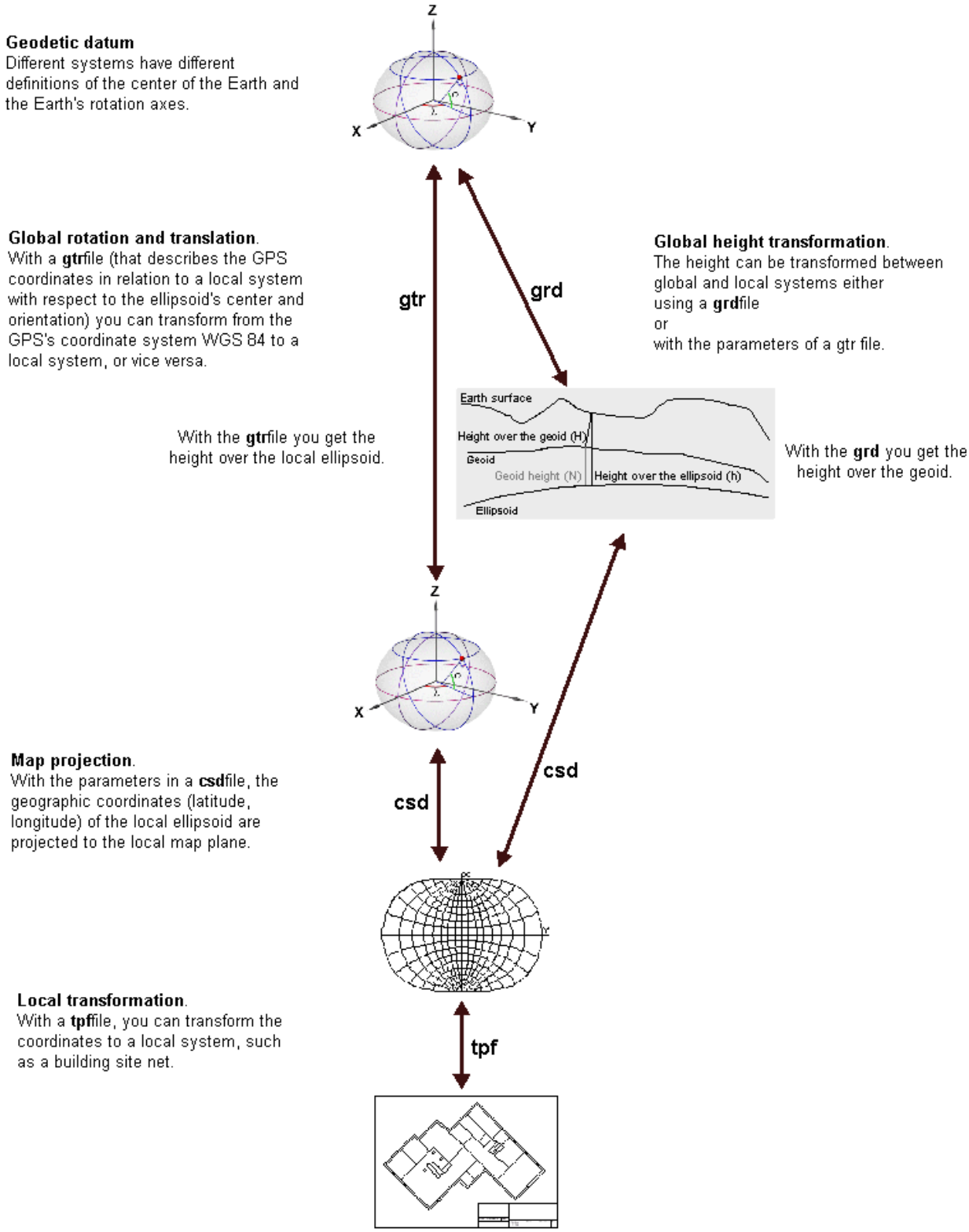
Export localization

Select **[Export localization]** to export a localization file to the Hexagon LandXML format.


Export Localization
Available formats
Hexagon LandXML
Save as:
LandXML\Loc_120412_0951.xml
...
Export coordinate system settings to a Hexagon XML file
< Back
Finish
Cancel
Help

Summary coordinate system settings:

With the correct settings for coordinate systems it is possible to transform between GPS coordinates in latitude and longitude (geographic coordinates) and local coordinates systems.



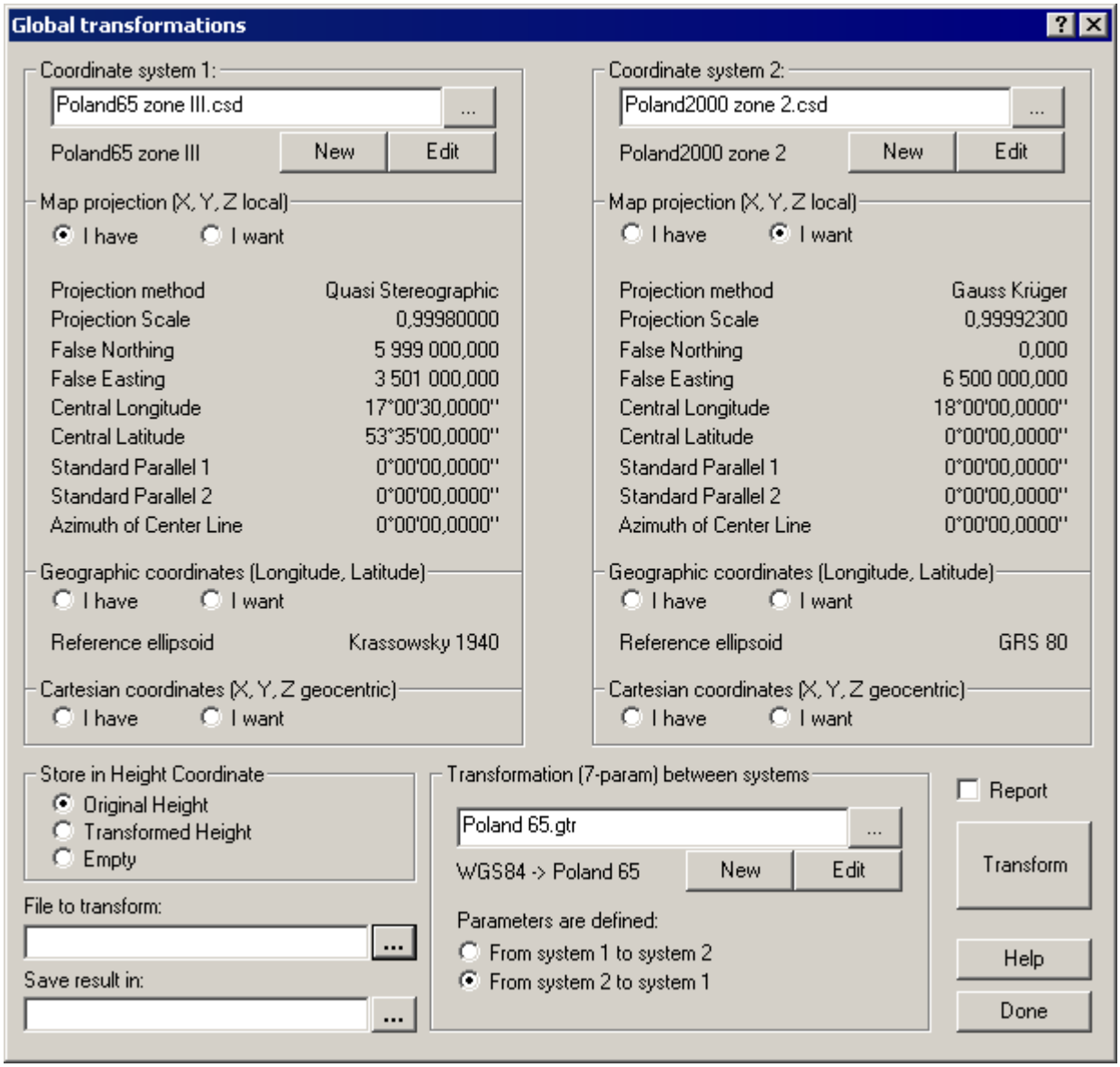
See also: Global Transformation 142, Transformations 188, Project Settings 16

3.2.3 Global Transformation, advanced

For the transformation of coordinates between two global coordinate systems[120] select ***Global Transformation, advanced***. Use this transformation if you want to transform to or from geographic coordinates (latitude and longitude) or, to or from geocentric Cartesian coordinates (XYZ).

Select ***Functions | Global Transformation, advanced*** to open the dialog below. If you have previously used the function, the selections you made for the global transformation will be the default. The dialog is divided into Coordinate System 1 and Coordinate System 2. You can transform between local, geographic or Cartesian coordinates in the two systems. Click the "I have" or "I want" according to the calculation to be performed.

Note! To transform between two local coordinate systems (xyz), the function Global Transformation, Local to Local[147] is recommended.



Coordinate System 1

Specify the type of coordinates that you have or want; Local Map Projection (X, Y, Z), Geographical coordinates (Longitude, Latitude) or Geocentric Cartesian coordinates (X, Y, Z).

If you enter a csd file for Coordinate system 1, the selected parameters for the map projection are displayed.

Coordinate System 2

Here you can make the same selections as Coordinate system 1. If you select a csd file, the associated parameters are shown under the Map projection.

Map Projection (X, Y, Z Local)

Select "I have" or "I want" if you want local or projected coordinates X, Y and Z.

A csd file contains parameters that describe the projection of the coordinates in longitude and latitude of the local ellipsoid for the local map level. The user can select a pre-defined csd file, or create his own relationship, with keys **[New]** or **[Edit]**. Read more about the transformation relationship and different settings in Project Settings 16.

- **New**
  Creates a new coordinate system 120.
- **Edit**
  To edit an existing relationship, click **[Edit]**. The previously selected system relationship will then appear, which can be used to create similar systems.
  - **Name** Enter any name for the coordinate system.
  - **Projection Method** Enter the projection method to be used.
  - **Projection Scale** The scale for the projection.
  - **Reference Ellipsoid** Enter the reference ellipsoid to be used.
  - **False Northing** Additional value to the true Northing coordinate. False Northing often aims to obtain less numerous figures in the coordinates.
  - **False Easting** Additional value to the true Easting coordinate. False Easting is specified to avoid dealing with negative coordinates west of the mean meridian.
  - **Central Longitude** Longitude of central point of the project, i.e. the central meridian of the projection. For a transverse Mercator projection, the projection systems are often named after their mean meridian.
  - **Central Latitude** Latitude of the central point of the project.

Geographic Coordinates (Longitude, Latitude)

Specify whether you have or want geographic coordinates in longitude and latitude.

If you select a csd file, the selected reference ellipsoid is presented here.

Cartesian Coordinates (X, Y, Z Geocentric)

Specify whether you have or want geocentric Cartesian coordinates in X, Y and Z.

Save In Height Coordinate

If you transform to projected coordinates or latitude and longitude, you can select what to enter for the height coordinate.

Original Height	Leaves height unchanged. For example, this may be useful in the transformation of GPS surveys in the subsequent correction of Geoid separation and the geoid model is based on ellipsoid heights in WGS 84.
Transformed Height	The height is also transformed. The heights in both the source and destination systems are treated as ellipsoid heights over their respective ellipsoids.
Empty	The height field in the storage file is left blank.

Transformation (7-Param) Between Systems

Since different coordinate systems may have different definitions for the center of the Earth's axis of rotation, a transformation between the center of the ellipsoids and orientation must be specified. These parameters are stored in gtr files.

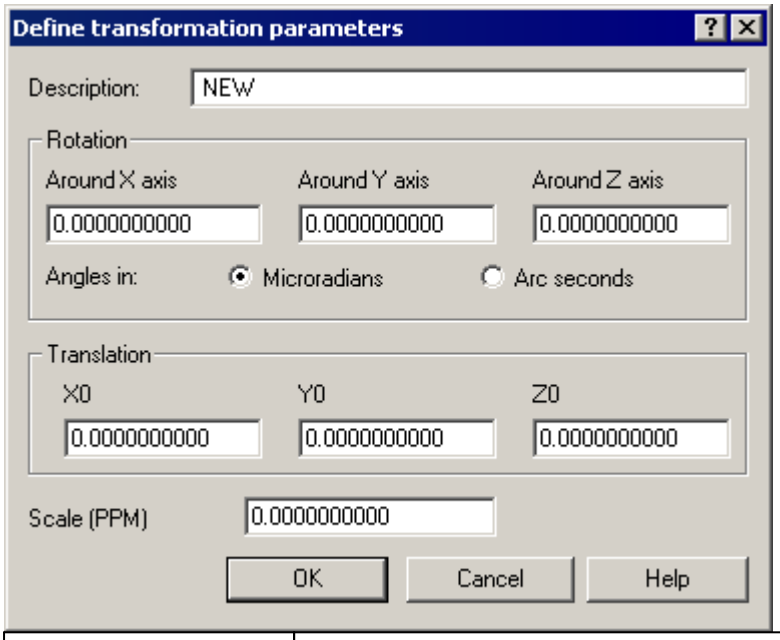
Examples of Swedish gtr files that come with iCON office:

None.gtr	No transformation. Used, for example, for transformation between different mean meridians in RT 90 in which the same reference ellipsoid has been used in both systems.
Swerefe93_RT90.gtr	Transformation from SWEREF 93 to RT 90. Can be used to transform the GPS measured points in Sweden.
Swerefe99_RT90.gtr	Transformation from SWEREF 99 to RT 90.
Wgs2Rt.gtr	Transformation from WGS 84 (SCANDOC 87) to RT 90.

Note that the parameters in the gtr-file are defined for the translation and rotation in the direction the name suggests. The transformation parameters are thereby independent of the choices you have made in Coordinate Systems 1 and 2. Once you have selected a gtr file, or created a gtr file, you must check the appropriate box under the file name to specify the direction in which the transformation is defined.

Note: There are different relationships used in GPS surveys and coordinates differ by up to one meter between the relationships. In Sweden, be sure to check if the coordinates you are given are in SWEREF 99, SWEREF 93 or SCANDOC 87.

Create or change transformations
In addition to the transformation relationships that came with the delivery, you can create your own. To create or change a relationship, click **[New]** or **[Edit]**. Read more about the transformation relationship and different settings in Project Settings[16] . In the dialog that appears, you can specify the required parameters for the geocentric 3D helmert transformation.



Description	Enter a description of the transformation relationship. The text will be printed in reports etc.
Rotation	Specify the rotation around geocentric X, Y and Z axes between the systems.
Angles in	As rotations are very small, the units used are microradians or arcseconds. Specify which here.
Translation	Enter the geocentric movement between systems.
Scale	Enter a scale change between systems in ppm (parts per million). 0 ppm gives the same scale.

File to transform
Specify here the file to be transformed. Files of type geo, pxy, llc, and gcc can be opened. If no file extension is specified the file is assumed to be a geo file. Geo or pxy files are used for projection and geocentric coordinates. For latitude and longitude the file type is llc[185] . Gcc files are used for the geocentric Cartesian coordinates.

Save results in
Specify here the file in which the results are to be stored.

When all fields have been correctly entered, click **[Transform]**.

Example 1: You want to calculate from the coordinates in your project located in RT 90 0 Gon 0:0, to RT 90 2.5 Gon V 0:0. First select RT 90 0 Gon 0:0 in coordinate system 1. Set RT 90 Gon 2.5 V 0:0 as system 2. For Transformation (7-param) between the systems select 'None.gtr' as both systems use the same geocentric reference. In 'Save in Height Coordinates', you can specify the Original Height or Transformed Height. Both choices produce the same result, since the height is specified over the same reference ellipsoid in both systems and therefore is not affected by the transformation.

Example 2: You have X, Y and Z coordinates in SWEREF 99 TM and want to include them into your project in RT 90 2.5 Gon V 0:-15. Select RT 90 2.5 Gon V 0:-15 in system 1. Select SWEREF 99 TM in

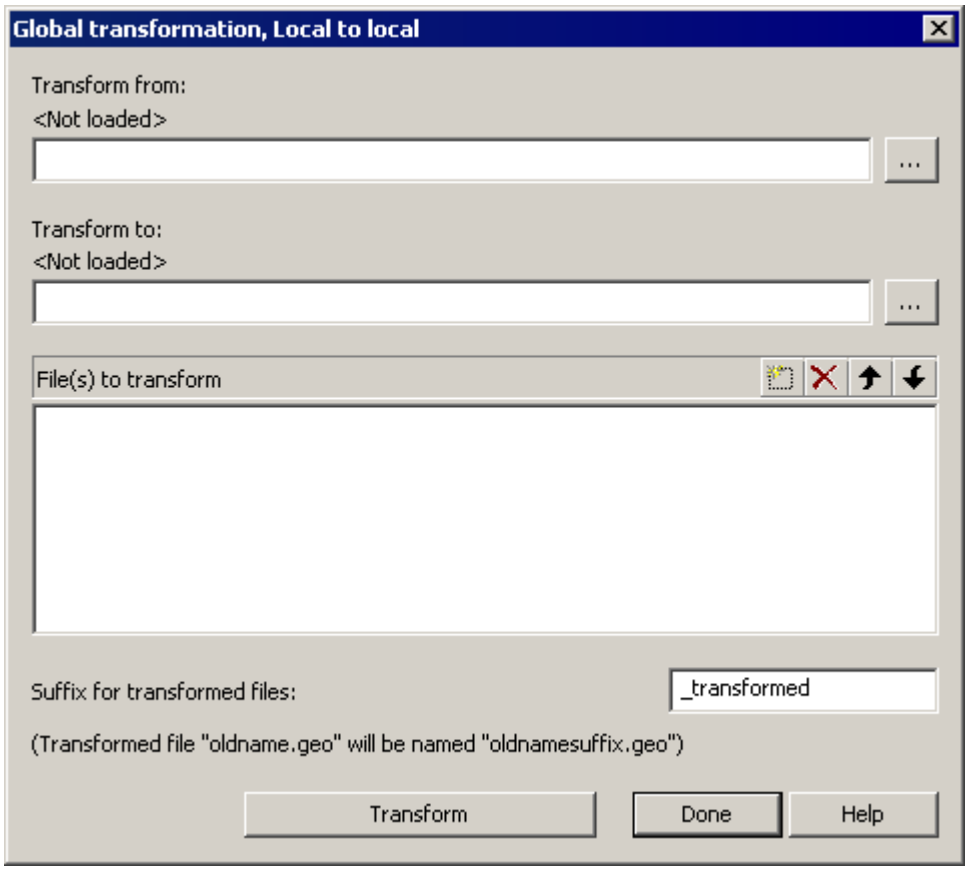
system 2. The projection parameters for each system are displayed. RT 90 uses Bessel 1841 as reference ellipsoid, while GRS 80 is used by SWEREF 99 TM. For Transformation (7-param) between systems, select 'Sweref99_RT90.gtr'. Remember to specify that the parameters for the transformation relationship are defined from system 2 to system 1. In this case you cannot transform heights, therefore, choose to store the original height.

See also: Coordinate Systems 120, Transformations 188, Project Settings 16

3.2.4 Global Transformation, Local to Local

For the conversion of coordinates from one coordinate system to another, select ***Functions | Global Transformation, Local to Local***. Use this transformation to transform between two local coordinate systems (xyz). The transformation includes parameters for the goedetic datum, global height transformation, map projection and local transformation.

If the transformation includes geographic coordinates (latitude and longitude) or geocentric Cartesian coordinates (XYZ) you choose Global Transformation, Advanced 142 instead.



- **Transform from:** Click the button to select the coordinate system you want to transform from, see Transform from/to 148.

- **Transform to:** Click the button to select the coordinate system you want to transform to, see Transform from/to 148.

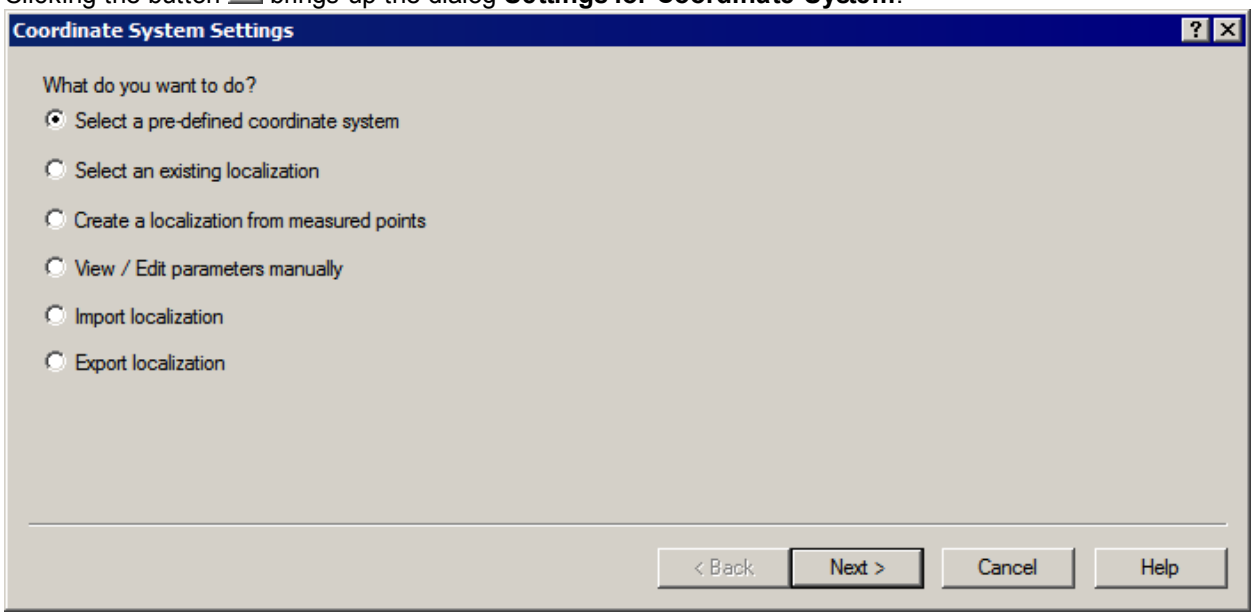
- **File(s) to transform:** Click to select one or more files to be transformed. Click to delete any file from the list that is not to be transformed.
  Coordinate files (geo, pxy) and terrain models (trm) can be transformed.

- **Suffix for transformed files:** Enter an optional suffix, which will be added to the name of the transformed files.

Click **[Transform]** to perform the transformation, click **[Done]** to close the dialog.

Transform from/to:

Clicking the button ... brings up the dialog **Settings for Coordinate System**.



Follow the instructions in Selecting Coordinate System 124 to select the coordinate system.

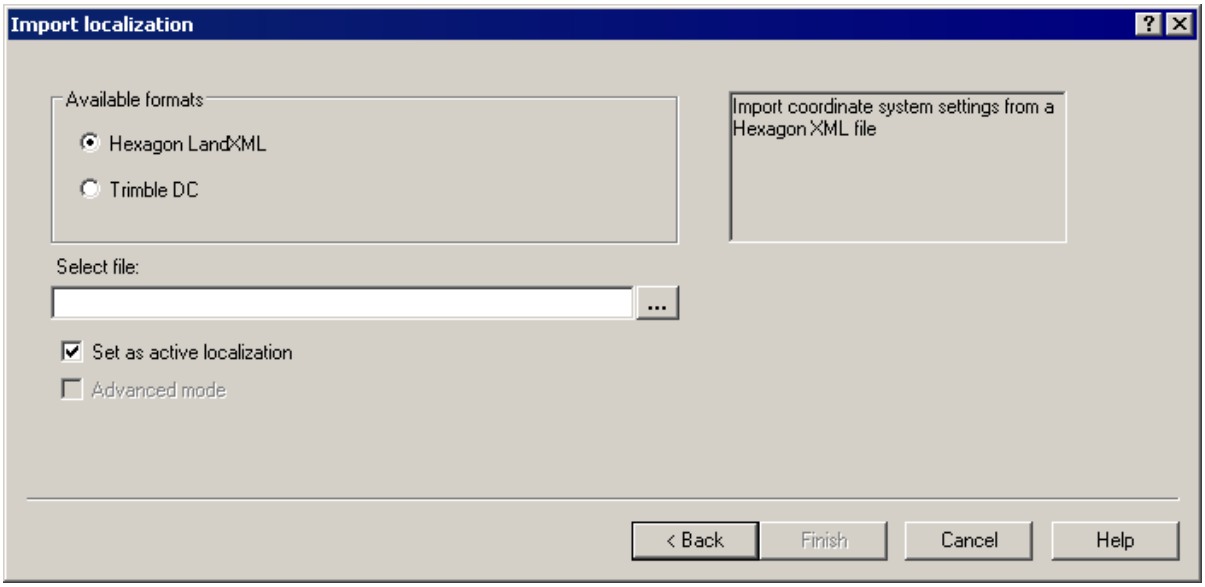
- **Select a pre-defined coordinate system**
  Use this if there is a predefined coordinate system in the Global folder that is suitable. See also Selecting Coordinate System 125.

- **Select an existing localization**
  Use this option when a localization file (lok file) is already saved in some of your projects. See also Selecting Coordinate System 127.

- **Create a localization from measured points**
  Use this option to create a local transformation in a given area. If, for example, you have used GeoPad and measured known points to get longitude and latitude, the software can adjust these coordinates to suit the known points. See also Selecting Coordinate System 127.

- **View/Edit Parameters Manually**
  Use this option to click through the dialog where you can edit the parameters for geodetic datum, global height transformation, map projection and local transformation. See also Selecting Coordinate System 131.

- **Import localization**
  Use this option if you have access to a localization in a format that can be imported to the program as a usable localization file. It is possible to import localizations from Trimble DC and from Hexagon LandXML.



Available formats
Select the format that is available for importing coordinate system settings.

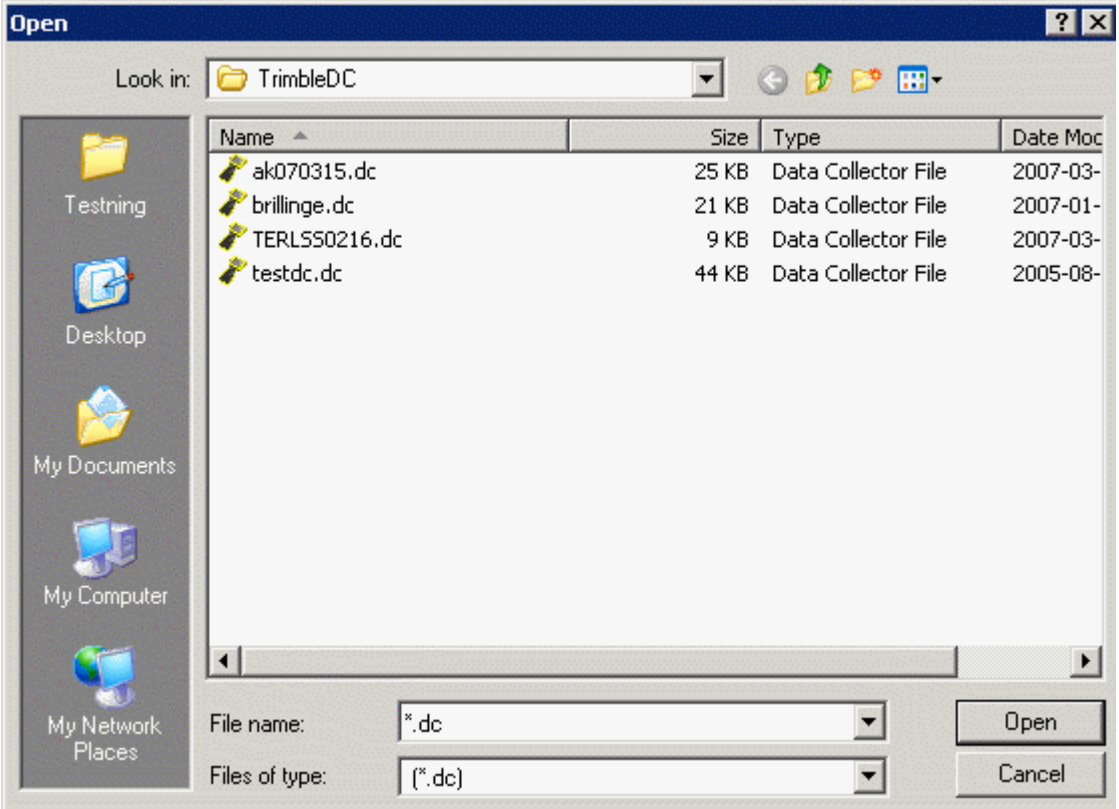
Select file:

Use the scroll button ... to select the file to be imported. The coordinate system settings in the selected file will be converted to a format that can be used. Click **[Finish]** to save the settings in the imported localization file, lok. You are now ready to transform the selected file, see File(s) to transform 148 .

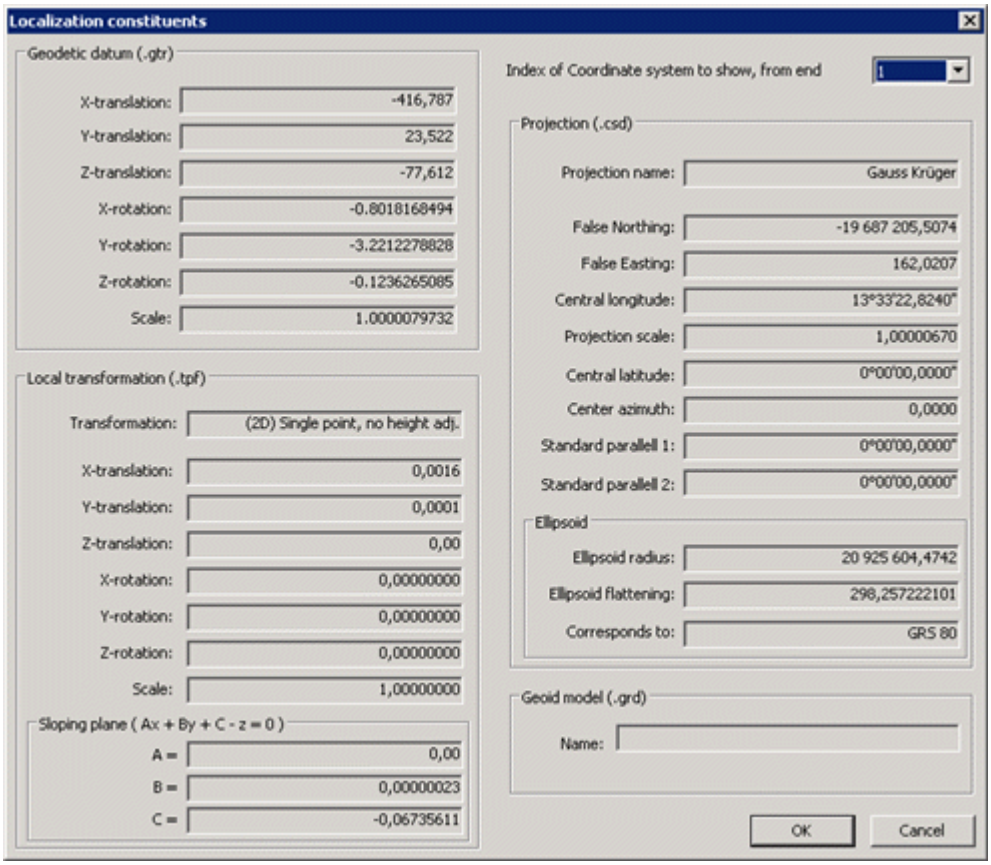
Advanced mode
The alternative **[Advanced mode]** will only be selectable if **Trimble DC** has been selected under **[Available formats]**.

More information about Advanced mode.

- Select a Trimble-DC-file, select **[Advanced mode]** and click **[Finish]** to display the parameters of the file.



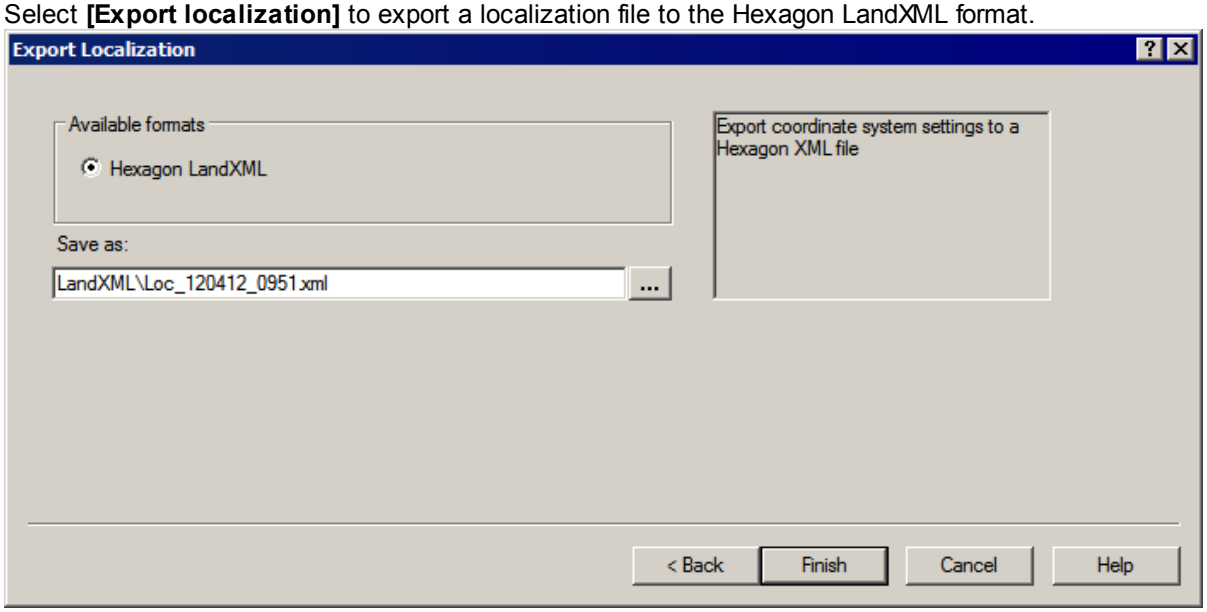
Select a Trimble-DC-file, select **[Advanced mode]** and click **[Finish]** to open a dialog that shows all the parameters in the selected coordinate system file. You can then see all the details before you accept the settings. If the coordinate system file contains more than one coordinate system, you can use the box **[Index of Coordinate system to show, from end]** in the upper right corner in the dialog to choose whichever you want to use. Otherwise the coordinate system that lies at the end of the file is always used.



The dialog displays the localization parameters.

Click **[Cancel]** to return to the dialog Import localization 148 . If you have changed **[Index of Coordinate system to show, from end]**, in the upper right box and want to save the new localization file (lok), you click **[OK]**. You are now ready to select file to be transformed, see File(s) to transform 148 .

- **Export localization**
  Select **[Export localization]** to export a localization file to the Hexagon LandXML format.



See also: Coordinate Systems 120 , Transformations 188 , Project Settings 16 , Global Transformation, Advanced 142 , Selecting Coordinate System 124

3.3 Coordinate Files

3.3.1 Coordinate Files, Geo and Pxy in General

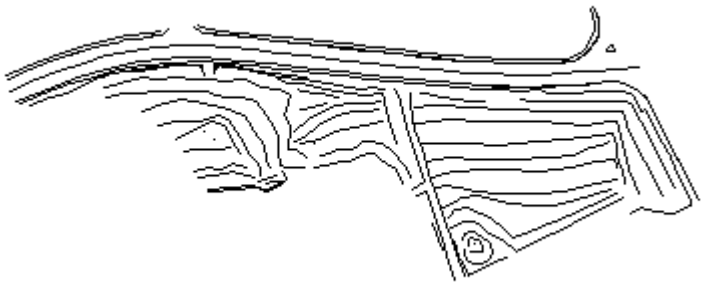
Coordinate files contain three-dimensional points that are identified by a point number. A number of codes and attributes are associated with each point. The files may contain both free points and lines. Coordinate files are usually saved in the geo file format, but the older pxy format can also be used. The geo format has line numbering separate from point numbering.

Views

Coordinate files can be displayed in different views. The normal view for coordinate files is the graphical view.

Graphical view

The normal view for coordinate files is the graphical view. See also graphical views 47 and graphical editing 206. To open a graphical view for a coordinate document from another coordinate view you select ***View | Graphical view***, .



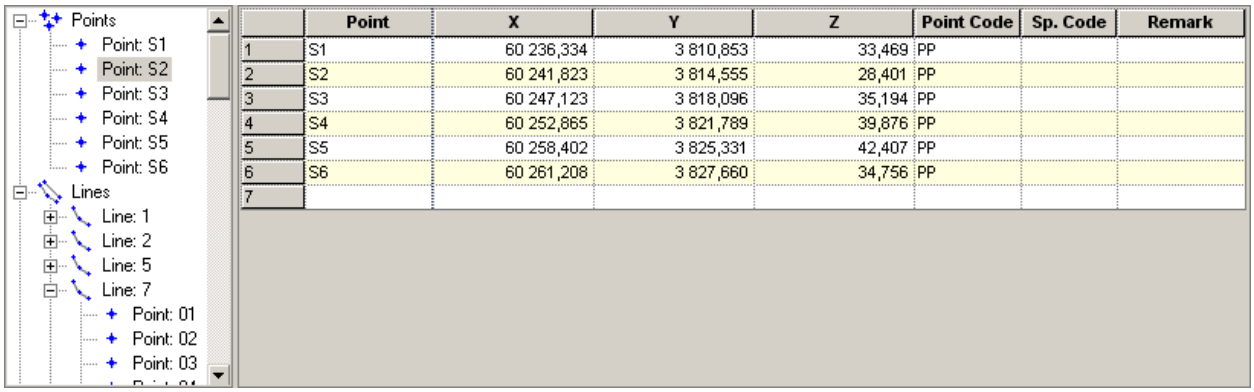
Graphical 3D View

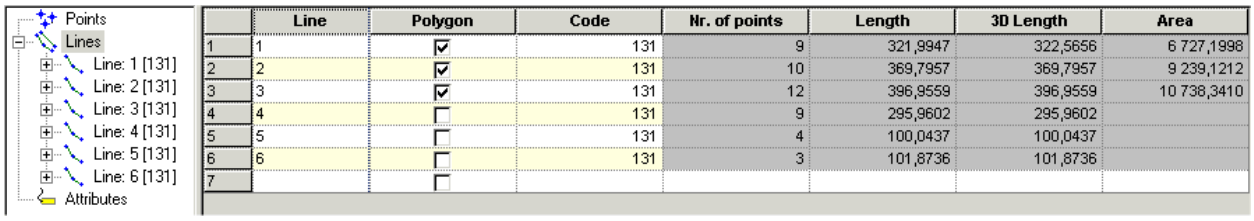
Here the coordinate file's content is displayed in a three dimensional perspective view. Select 'Graphics 3D' in the open dialog, or select ***View | Graphical 3D View***, , from another coordinate view.

Numeric view (tree view)

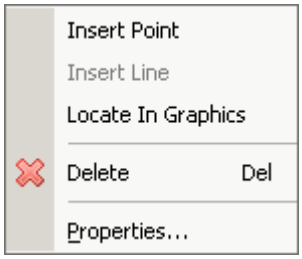
Use the numeric view to edit specific data in the document. The window is divided into a tree view showing points and lines and an input view showing current points in the selected part of the tree. Under the 'Points node in the tree, all the free points (not related to the lines) are displayed in the document. All lines in the document can be found under the 'Lines' node and if selected displays a summary of input lines in the document. The summary presents information in the form of line number, line code, if the line is closed or not, number of points, length and area if applicable. By selecting one of the lines, the points in the line in the input section of the window are shown.

To open a coordinate document in numeric mode select 'tree' in the open dialog or ***View | Numerical View***, , from another coordinate view.





Right-clicking in the tree brings up a menu:



- Insert point
  Inserts a new point before the selected point. If the 'Points' node is selected, the point is placed last among the single points. If a line is selected, the point appears last in the line.

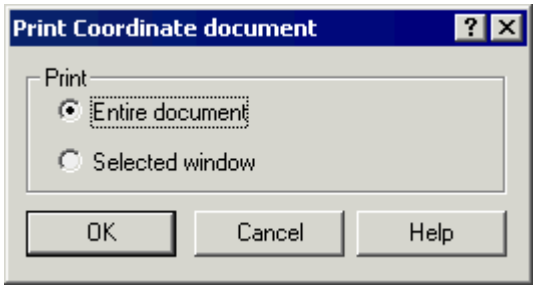
- Insert line
  Inserts a new line before the selected line. If the 'Lines' node is selected, the line is placed last among the lines.

- Localize graphically
  Select a point or line in the numerical view and select "Localize graphically '. iCON office automatically switches to the graphical 2D view where the chosen point or line is selected.

- Delete
  Deletes the selected point or line.

- Properties
  Opens the dialog with properties for the selected point or line.

Print
When printing from the numerical view, a dialog appears where you can select what to print. You can choose to print the entire document (all single points and lines), or the active window (single points or the active line), i.e. data displayed in the input section.



See also Input Views 94 .

Create report
To create a coordinate file report, including polylines and points:

- Open a coordinate file and select **Data | Coordinate File Report**.
- Save the report in the format *.rep and choose if you also want to export it to Microsoft® Office Excel format.
- Choose if you want to print the report.

See also Reports 35.

Points

Information in a point in a coordinate file:

- Point number
  The point number that identifies the point may contain a maximum of 12 characters and can be both numeric and alphanumeric (colon,:, is not permitted). A point number need not be unique in a file. Blank point numbers are allowed.

- Plane Coordinates
  All points must contain plane coordinates. The number of decimal places displayed is determined by Project Settings 16.

- Height coordinates
  A height can be entered for each document. A blank value means that the height information is missing (in pxy files, however, zero is entered as the height of these points).

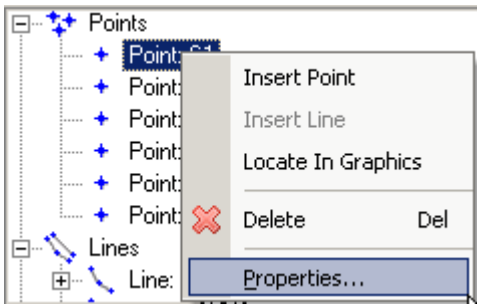
- Point Code
  The point code may contain a maximum of eight characters and can be both numeric and alphanumeric. Symbols and line types can be determined via the point code when drawing.

- Special code
  You use the special code with the Remarks column to define extra information about a point. A maximum of two characters (numeric or alphanumeric).

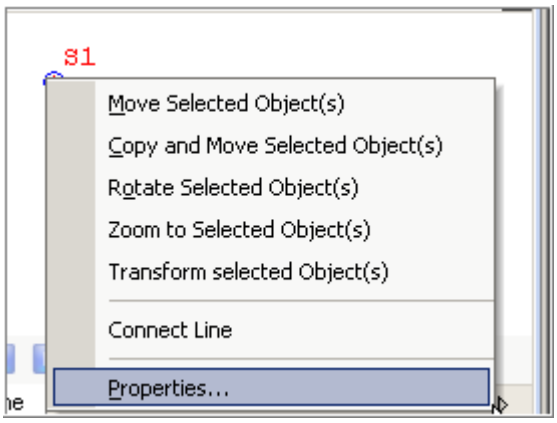
- Remark
  The remark column is a free field at 12 characters (numeric or alphanumeric) and is often used in combination with the special code.

Edit the point's properties

By selecting and right-clicking on an point, either in the graphical view or in the tree view, and then selecting properties you can view the properties of a point.

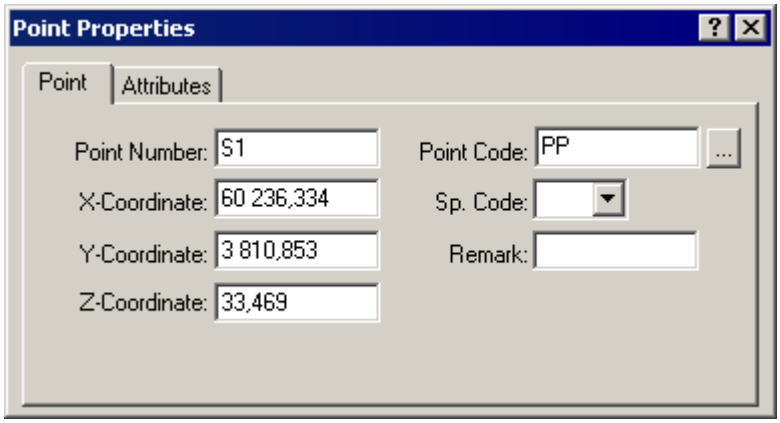


View point properties from the tree view



View point properties from the graphical view.

The properties dialog has two tabs (see also the Attributes tab in 'Attributes' below).

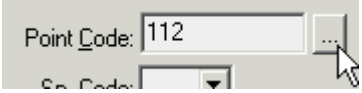


The values can be changed directly in the dialog.

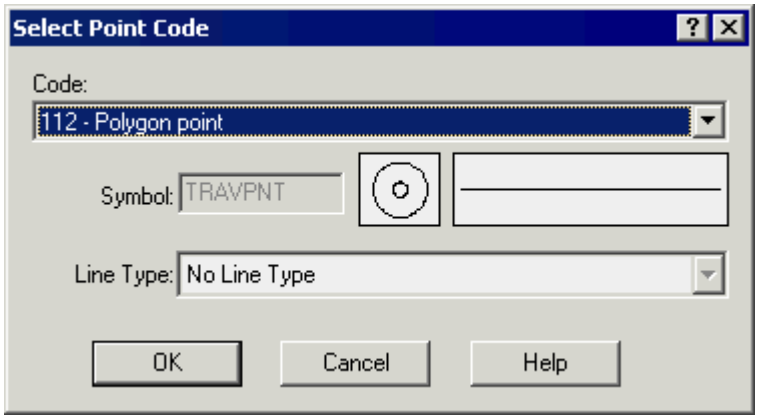
Point Codes

Each point in a coordinate file has a code field of eight characters. By using a code list, the point code can determine a number of properties of a point, e.g. the symbol to be drawn.

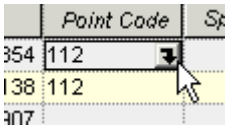
Tip! In the properties dialog you can click the select button, ..., to select the code for the point.



A dialog appears with the codes that are included in the active code list, see Project Settings 16.



The dialog also displays the symbol and line type the current code is linked to in the code list, see also code lists 203. You can also use the numerical view to open the point code dialog by clicking on the button to the right of the point code field that looks like an arrow.



Special code and remark

You use the special code with the Remarks column to define extra information about a point.

Special Code	*Remark*	*Function*
R	Radius	Draws a radius from the point to the next point. Note: There must be a line connection to the next point.
C	Radius	Draws a circle with its center in the point.
PV	Offset	Indicates that a parallel line is to be calculated to the left. See Parallel Lines 171.
PH	Offset	Indicates that a parallel line is to be calculated to the right. See Parallel Lines 171.
B	Bearing	Specifies line bearing if the point is calculated along a line (lin file). Can be used to turn the symbols 283 along a line. See also Sections along Lines 557.
CF	Cross Fall	Specifies the cross fall if the point is calculated along a line (lin file). See also Sections along Lines 557.

Rotate symbols in the graphical view

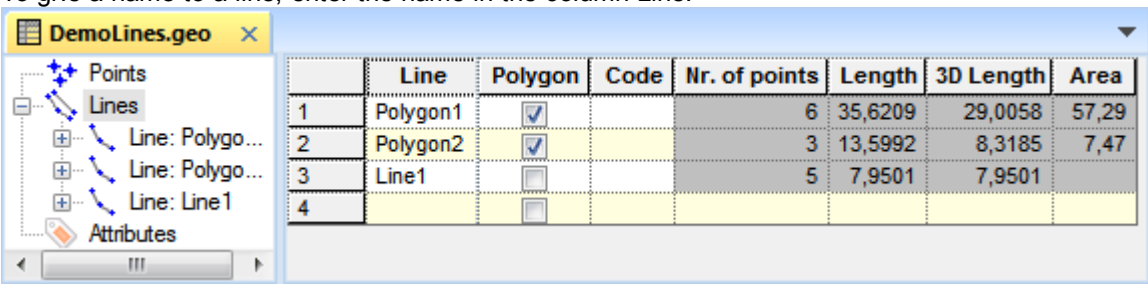
To rotate symbols in a coordinate file, use the special code 157 for bearing, B, together with the Remarks column.

- To determine the bearing for a line, you can use the distance tool 225 while you select the points in the graphics. The bearing will be displayed in the Input and Output window 107.
- In the numerical view, enter the desired point code, the special code B, and the point's bearing in the Remarks column.

Lines

In geo format, information can also be added at line level, this is not possible in pxy format.

- Line Number
  The line number identifies the line and can be numeric or alphanumeric.
  The line number does not need to be unique in the file.
  The line number can be blank.
  To give a name to a line, enter the name in the column Line.



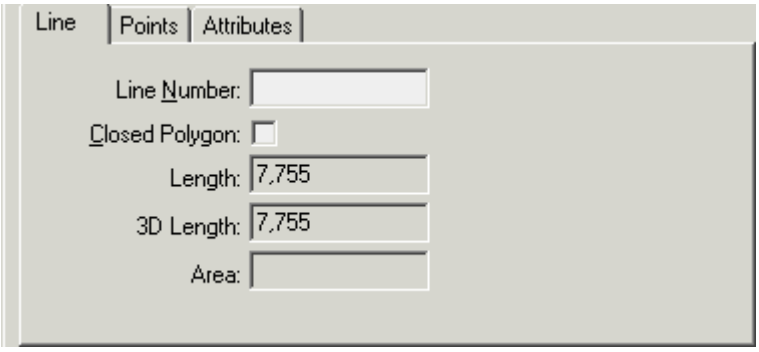
- Polygon / Closed polygon
  By ticking the box under the column Polygon you can specify if a line should be drawn encircled. This means that the line's first and last point are drawn together.
  In addition, the polygon is filled with an optional color/pattern, see also coordinate document properties 52.

Not closed *Closed* *Filled*

Edit the line properties

By selecting and right-clicking on a line, either in the graphical view or in the tree view, and selecting properties, you can view the properties of a line.

The properties dialog has two tabs (see also the Attributes tab in 'Attributes' below).



- Line number
  Identification of the line.
  For more information, see Line Number above.

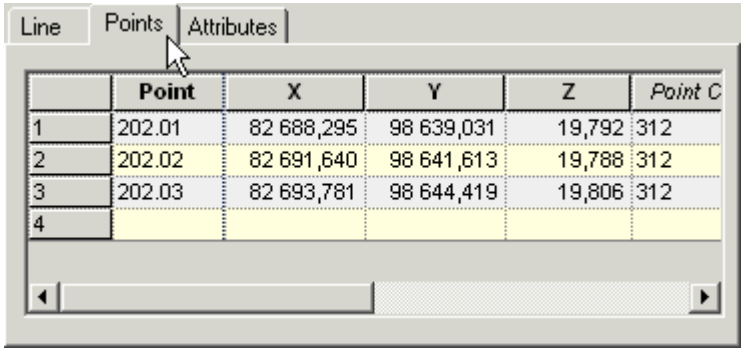
- Closed polygon
  Check the box if the line should create a closed polygon 158.

- Length
  Displays the line's horizontal length.

- 3D Length

Displays the line's three-dimensional length.

- Area
  If the polygon is closed, the area is displayed.

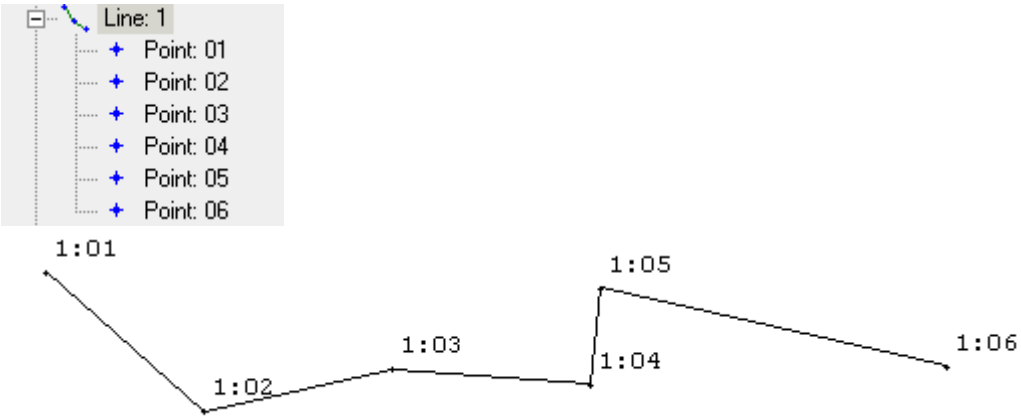


In the 'Points' tab the points included in the line are reviewed/edited in an input window.

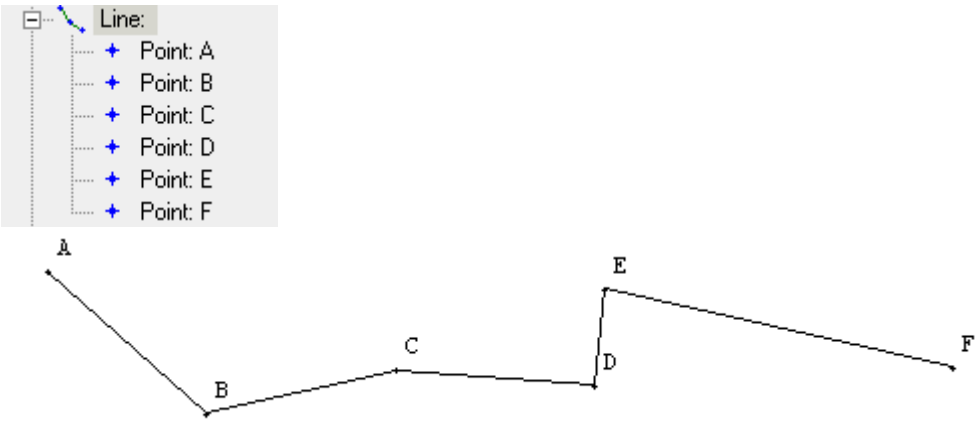
Point and line numbering

Geo format

In geo format, the numbering of points and lines is completely free, i.e. the numbering of the points does not determine how lines are drawn. All points belonging to a certain line are below the line. A point cannot belong to more than one line.



Example 1.



Example 2.

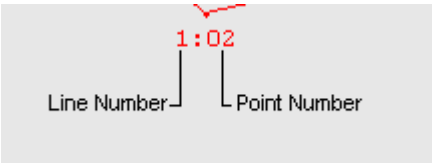
Pxy format

In pxy format there is no separate line number as it is part of the point number. In addition, all points are in an unbroken sequence in a pxy file.

A line in a pxy file is defined by a sequence of points that have the same line number embodied in the point number and separated by a point. Three points numbered 1.01, 1.02 and 1.03 will be interpreted as one line while three points numbered 101, 102 and 103 will be interpreted as single points. When loading a pxy file, the point numbers will be assigned to line points, which for the above line means that a line with number 1 will be created and will consist of points 01, 02 and 03.

When saving a coordinate file as pxy, the line numbers will be joined with the point numbers to ensure the lines are correctly linked. Note, however, that point numbers can contain up to 12 characters in a pxy file.

Display of point numbers
A colon, **:**, is used to display point numbers as separator for line numbers and point numbers. The character only appears on screen and is therefore not stored in files.

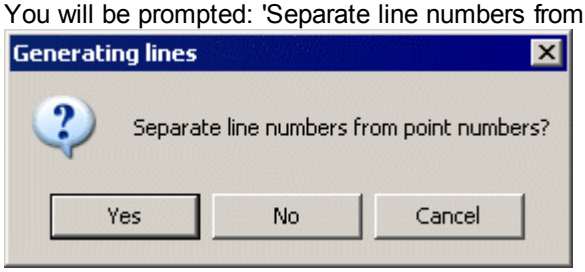


Explode Lines
Once you have loaded a coordinate file containing lines the points are sorted for each line in this file. This means that you cannot get a numerical input view of all points in the document. By selecting ***Data | Explode Lines*** you can create single points for all line points in the document.
You will be prompted: 'Merge line numbers to point number?'

- If you answer 'yes' the line number will be entered in the point number separated by a period (the numbering will be 1.01, 1.02 and so on for the points in the above line).
- If you answer 'no the line number will not be used (numbering will be 01, 02 and so on for the points in the above line).

Generate Lines
This function creates lines from single points in a coordinate document. This generation is based on the pxy numbering of lines, i.e. with a period as a separator for line numbers. You use this function primarily to restore lines exploded using the function 'Explode Lines'.

By selecting ***Data | Generate Lines*** you can create lines from single points in the document.
You will be prompted: 'Separate line numbers from the point numbers?'



- If you answer 'yes' the line section of the point number will be entered as line number for the lines (the line will be called 1 and points 01, 02, etc. in the above example).
- If you answer 'no' the line numbers will not be set and point numbers will remain unchanged in the lines (the line number will be blank and the points numbered 1.01, 1.02 and so on in the above example).

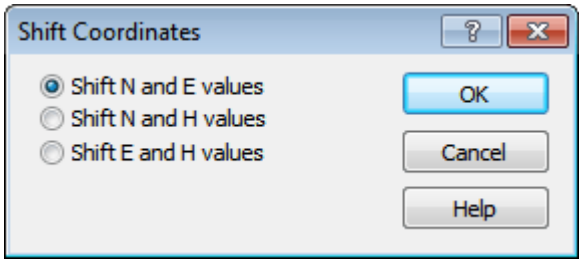
Tip! If you want to use 'Search and modify', for example, for all points in a coordinate document with lines, you can first choose to explode the lines to get a numerical view with *all* points in the document. You can now modify points in the desired manner. Now select the 'Generate lines' to recreate the line structure again. Note: This will not work if you change the point numbering (before the point separator), or the internal order of the points.

Attributes
The geo format has the option of setting attributes for points and lines. An attribute can, for example, define a point's KF85 code or date for the point's measurement. Note: if you save a coordinate document in pxy format, any attributes will disappear. Attributes are described in the section Optional Attributes 113.

See also: Coordinate Handling 118, Graphical Editing 206.

3.3.2 Shift Coordinates

This function changes the place of the coordinate values in a coordinate file. This can sometimes be useful if you have a file in which the coordinate values of the Northing and Easting axes have been defined in another direction, or to switch between right and left-handed systems. The names of the coordinate axes can be changed from the tab Settings 20 in the Project Tree.
Open a coordinate file and select ***Data | Shift Coordinates*** to open the dialog.

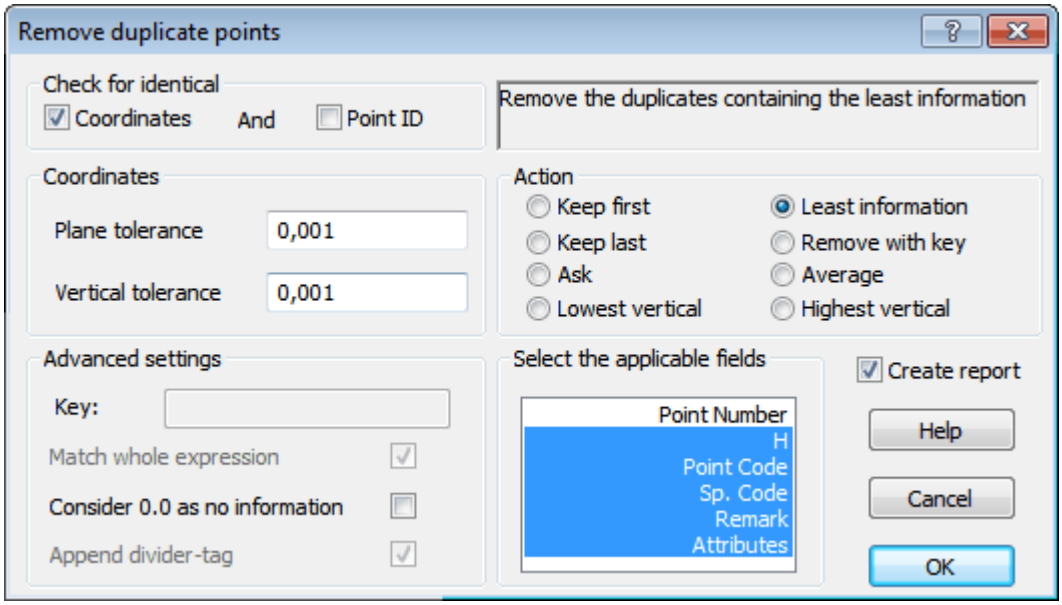


- **Shift N and E values**
  Shift the values in the N (Northing) column with the values in the E (Easting) column.
- **Shift N and H values**
  Shift the values in the N (Northing) column with the values in the H (height) column.
- **Shift E and H values**
  Shift the values in the E (Easting) column with the values in the H (height) column.

See also: Coordinate Handling 118 , Coordinate Files 153

3.3.3 Remove Duplicate Points

This is a tool to remove points that occur more than once in a file. You can search for identical coordinates and identical point numbers. Select ***Data | Remove Duplicate Points***.



Check for identical:
The search can be done for both coordinates and point numbers. Choose one or both options. If both options are checked, both conditions must be satisfied to remove the point.

- **Coordinates**
  Delete points with the same Northing, Easting and height coordinates.
- **Point ID**
  Delete items with the same point numbers.

Action:
Here you indicate what happens when a duplicate is found.

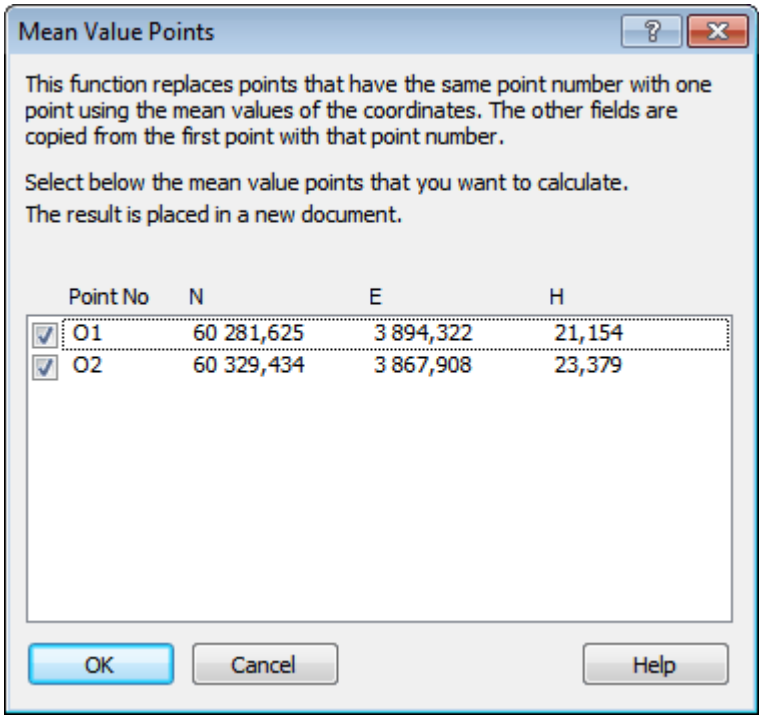
- **Keep first**
  Saves the first point if duplicate points are identified.
- **Keep last**
  Saves the last point if duplicate points are identified.
- **Ask**
  Shows information for both points, and if a duplicate is found you will be asked which point to keep.
- **Lowest vertical**
  Deletes the point with the lowest height coordinate, H.
- **Least information**
  If the amount of data differs between the points, the one with the least information will be removed. Here you can also choose to treat 0.0 as no information.
- **Remove with key**
  Enter the keywords that are then matched with the duplicates. Select any keyword to match exactly.
- **Average**
  Creates average point from the duplicates and adds, if chosen, a suffix to the point number, /x, where x is the number of duplicates used when creating mean values.

- **Highest vertical**
  Deletes the point with the highest height coordinate, H.

See also: Coordinate Handling 118 , Coordinate Files 153

3.3.4 Mean Value Points

You use this function to create mean value points that have the same point and line number. Select ***Data | Mean Value Points*** in a coordinate view to open the dialog.



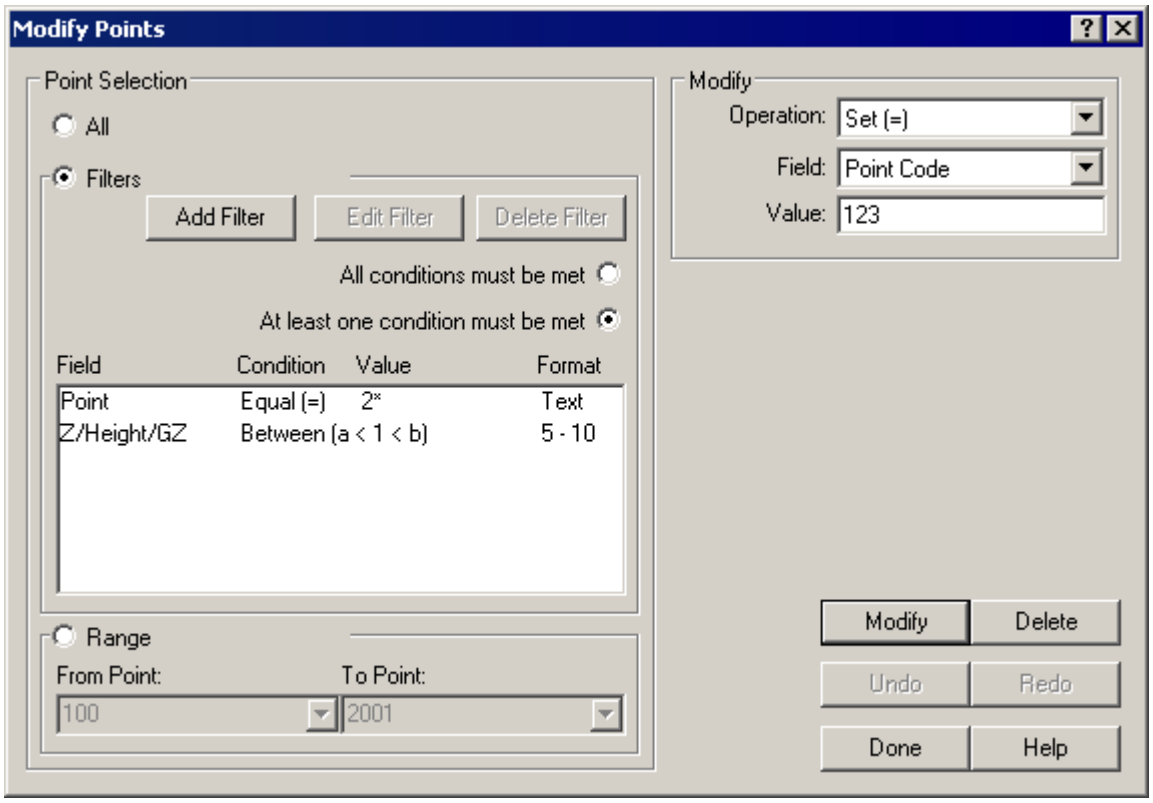
This will display a list of the points that occur more than once in the document, along with the mean value of the coordinates. Uncheck the points you do not want to calculate the mean value for. When you click **[OK]** you will create a new document in which the checked points have mean values, while other points are unchanged.

To calculate mean value points the general information (e.g. code, remark, attribute etc.) is derived from the first occurrence of the point, and when the mean value of a point has been calculated, the point is placed in the same position in the point/line structure as the first occurrence, while other occurrences are removed. If this means that all points in a line are removed, the entire line will be deleted.

See also: Coordinate Handling 118, Coordinate Files 153

3.3.5 Modify Points

You use this function to modify or delete points with certain special properties. This function works with the entire active document. If you just want to change the current input view (e.g. a line), use Search and Modify 100. Select ***Data | Modify Points*** to open the dialog.



Point Selection

Here you select the points to be modified or deleted. The selection can be made in three ways.

All:
All points in the document will be deleted/modified.

Filters:
Set up filters for the points that will be deleted/modified.

- **[Add filter]**
  Click here to create a new filter. A dialog for defining filters 168 opens.
- **[Edit filter]**
  Click here to edit the filter that is selected in the filter list. This opens the dialog for the filter definition 168.
- **[Delete filter]**
  Click here to delete the filter that is selected in the filter list.
- **Filter list:**
  Here you see the filters you have created.

- **All conditions must be met**
  This allows filtering at multiple levels. If you specify several filters, the conditions must be met in all the filters for the point to be processed.
- **At least one condition must be met**

This allows filtering at multiple levels. If you specify several filters, at least one condition must be met for the point to be processed.

Range:
Enter the first and last point in the document to be deleted/modified. All points in the interval are processed. The interval is defined by the order of the points in the file.

Modify

Enter here the modification to be made of the points that meet the criteria in *Point Selection*.

Operation:
Enter the operation to be performed on the points. For enumerated fields only Set (=) is possible.

- **Set**
  Set the selected field to a new value. If the value is shown as * in numeric fields, the point number value will be set.
- **Add**
  Numeric value to add to existing value.
- **Multiply**
  Numeric value to multiply the existing value with. -1 to change sign.
- **Divide**
  Numeric value to divide the existing value with.
- **Prefix**
  Enter a text to add before existing data. Does not work on numeric fields.
- **Suffix**
  Enter a text to add after existing data. Does not work on numeric fields.
- **Delete text**
  Enter a text to delete from existing data. Does not work on numeric fields.

Fields:
Specify the fields in the points to be modified.

Value:
Enter new value or the value for the selected operation.

Buttons

[Modify]:
Perform the selected change on the points in the selection.

[Delete]:
Delete points in the selection.

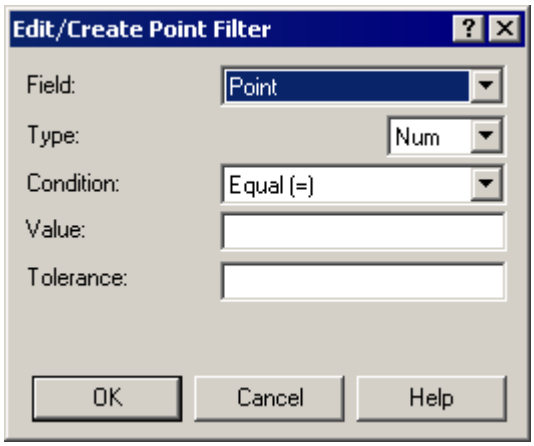
[Undo] and [Redo]:
These have the same function as the normal buttons in the toolbar, but as these cannot be accessed with the dialog open, we can use these instead.

[Done]:
Closes the dialog.

See also: Coordinate Handling 118 , Coordinate Files 153 , Search and Modify 100

3.3.6 Point Filters

Point filters are used by the functions Modify Points 166, Extract Points 172 and Modify Cross Sections 550 and is a way to indicate a selection of points from one or more files. From these functions, you can create or edit point filters and a dialog then opens for the filter properties.



Filter Dialog:

- **Fields:**
  Here you define the fields in the document to be filtered.
- **Type:**
  Here you define how the field should be interpreted, numeric or as text. Some fields (e.g. coordinates) can only be interpreted numerically. If you choose to interpret as text you can use wild cards (? and *) for *Value*.
- **Condition:**
  Here you enter the field conditions which are to be compared with *Value*.
- **Value:**
  Here you enter the value the content in the *Fields* is to be compared with. For text fields and conditions *Equal (=)* or *Not Equal (<>)* you can use wild cards.
- **Tolerance:**
  Here you enter a tolerance that can be used in combination with numeric values. Can only be selected for Conditions: Equal (=). E.g. 100.1 is considered to be equal to 100.2 if the tolerance is 0.1.

Wild card:
For some filters you can use wild cards, i.e. characters corresponding to one or more arbitrary characters.

?	An arbitrary character.
*****	An arbitrary number of arbitrary characters.

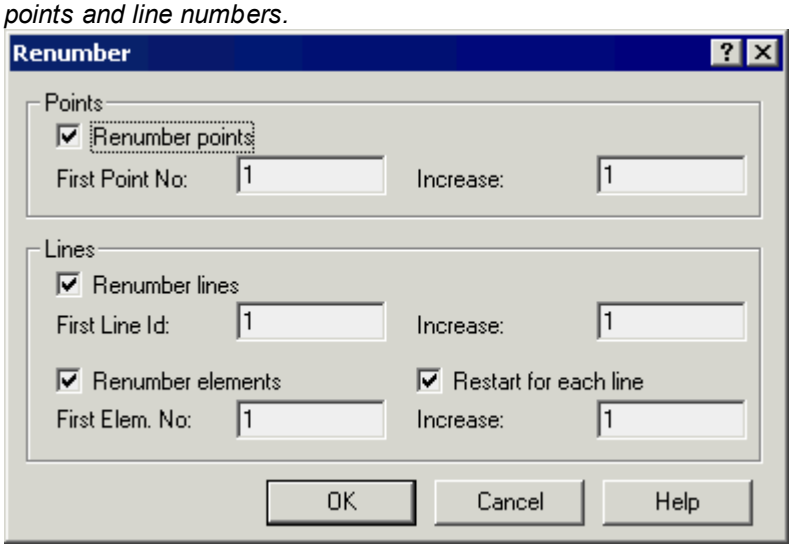
Example

*****	All texts.
a??	All texts, consisting of three characters, beginning with lower case 'a'.
a	All texts containing at least one lower case 'a'.

See also: Coordinate Handling 118 , Coordinate Files 153 , Modify Points 166 , Extract Points 172 , Modify Cross Sections 550

3.3.7 Renumber Points

Select this function to renumber points in a coordinate file. The function renumbers single points, lines and elements in lines. Select ***Data | Renumber*** to open the dialog. *The function can only generate numeric points and line numbers.*



Renumber points:
Check this option if you want to renumber single points in the active file.

- **First Point No**
  Enter the point number for the first single point.
- **Increase by**
  Enter how much the point number is to be increased by for each point.

Renumber lines:
Check this option if you want to renumber the lines in the active file.

- **First Line ID**
  Enter the line number of the first line.
- **Increase by**
  Specify how much the line number is to be increased by for each line.

Renumber elements:
Check this option if you want to renumber the elements in each line in the active file.

- **Restart for each line**
  Select this option to restart the renumbering for each line, otherwise the renumbering will continue. E.g.: 1:1, 1:2 .. 2:1, 2:2 and 1:1, 1:2 .. 2:3, 2:4. The latter option may be useful if you want each element number to be unique.
- **First Elem. No**
  Enter the point number for the first element.
- **Increase by**
  Enter how much the element number is to be increased by for each point.

See also: Coordinate Handling 118 , Coordinate Files 153

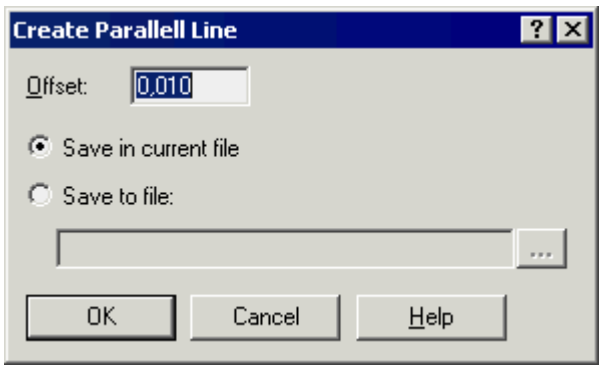
3.3.8 Clean up lines containing one or no points

This function moves the points in lines that contain only one point to points, and removes lines with no points. Select ***Data | Clean up empty or 1-point lines***.

See also: Coordinate Handling 118, Coordinate Files 153

3.3.9 Parallel Lines

You use this function when you have applied special codes to the measurement of such items as curbs **PV** (**p**arallel **l**eft) or **PH** (**p**arallel **r**ight) to create parallel lines with a specific lateral movement, offset. In the Remarks field you specify the height difference for the new line if, for example, you want a line 10 centimeters above the original, you enter 0.1 in the column *Remark* in the coordinate file. Select ***Data | Parallel Lines*** from an active coordinate document to use this function.



Offset:
Enter the offset movement of the line.

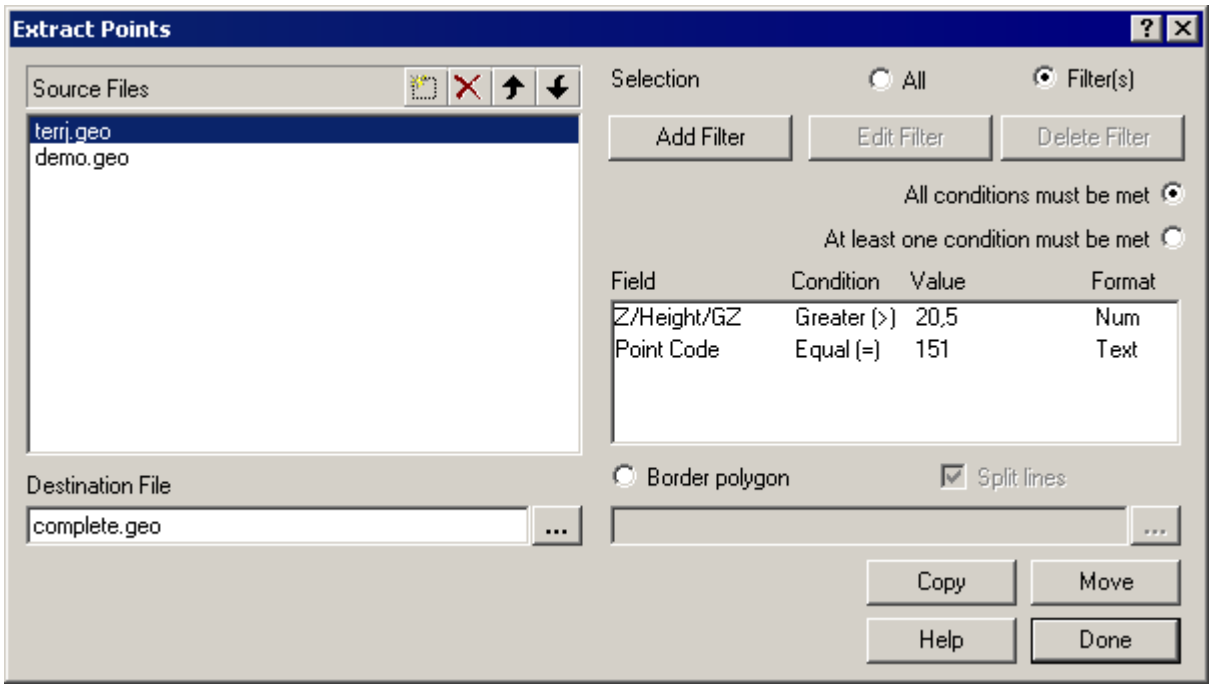
Save in current file:
Check this box if the line is to be saved in the active file.

Save to file:
Check this box if the line is to be saved in another file and enter the filename in the input field.

See also: Coordinate Handling 118 , Coordinate Files 153

3.3.10 Extract Points

This function moves or copies points from one or more source files to a destination file. Different filters can be set up for the points to be moved/copied, or you can choose to move/copy all the points inside one or more border polygons. Select ***Functions | Extract Coordinates*** to open the dialog. The function works directly with files on disk and therefore cannot be undone.



Files

Source files:
Specify the files you want the function to look for points in.

Destination file:
Specify the file in which the extracted points are to be saved.

Options

All:
Select this option to move/copy all the points in the source files to the destination file.

Filters:
Select this option to filter the points to be moved/copied.

- **[Add filter]**
  Click here to create a new filter. A dialog for defining filters 168 opens.
- **[Edit filter]**
  Click here to edit the filter that is selected in the filter list. This opens the dialog for the filter definition 168 .
- **[Delete filter]**
  Click here to delete the filter that is selected in the filter list.
- **All conditions must be met**
  This allows filtering at multiple levels. If you specify several filters, the conditions must be met in all

the filters for the point to be processed.

- **At least one condition must be met**
  This allows filtering at multiple levels. If you specify several filters, at least one condition must be met for the point to be processed.

- **Filter list:**
  Here you see the filters you have created.

Border Polygon:
Select this option to move/copy all the points inside one or more border polygons. Each line in the polygon file is regarded as a polygon, and points that are within any of the polygons will be moved/copied.

- **Split lines:**
  If you choose this option, a new point will be interpolated both in the source file and the destination file in the places where the lines in the source file cross the border polygon.

- **Polygon file:**
  Enter the name of the file that contains one or more border polygons.

Function keys

[Copy]:
Click here to copy the point selection from the source files to the destination file.

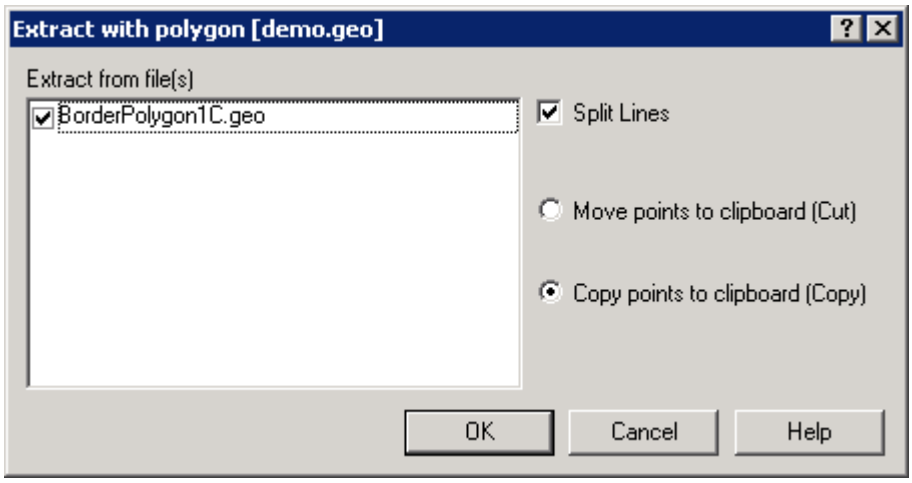
[Move]:
Click here to move the point selection from the source files to the destination file. Points will then be removed from the source files.

[Done]:
Closes the dialog.

See also: Coordinate Handling 118, Coordinate Files 153, Extract with Polygon 174.

3.3.11 Extract with Polygon

You use this function to copy or move points within one or more areas enclosed by polygons, such as to eliminate contour lines through buildings. The cut or copied points are stored in the internal clipboard and can then be pasted into another document. Select ***Data | Extract with Polygon*** from a graphical view to open the dialog. The limit polygons must be present in the active document.



Extract from file:
All files in the active graphics window are listed here. All boxes are checked when the dialog opens, and you need to uncheck the documents you do not want to move/copy points from.

Split lines:
If this option is selected, new points are interpolated, where the limit polygons cross the lines in the source files. The height is calculated along the line in the source file. If you choose to copy the points, the intersection points are added to the clipboard, whereas if you choose to move points the intersections are also added to the source file.

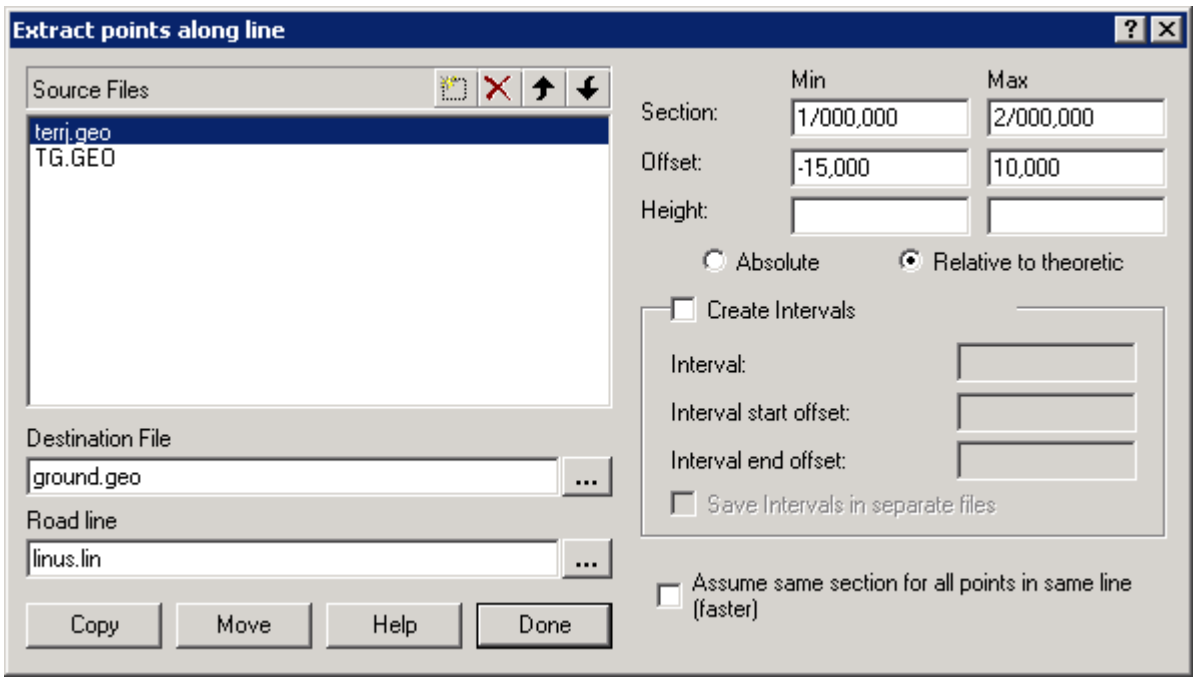
Move points to the clipboard:
Select this option to move the circled points to the clipboard and delete them from the source files.

Copy points to the clipboard:
Select this option to copy circled points to the clipboard. The source files remain intact.

See also: Coordinate Handling 118 , Coordinate Files 153 , Extract Points 172 .

3.3.12 Extract Coordinates along Line

This function moves or copies points from one or more source files to a destination file, where conditions can be defined in terms of section and offset along a designated road line. Select ***Functions | Extract Coordinates along Line*** to open the dialog. The function works directly with files on disk and therefore cannot be undone.



Files

Source files:
Specify the files where the function is to look for points.

Destination file:
Specify the file in which the extracted points are to be saved.

Road line:
Specify the road line to be used as a reference for the selection criteria.

Selection

Specify here the conditions in the form of minimum and maximum dimensions for section, offset and height along a given road line.

Section:
Specify minimum and/or maximum section dimensions along the road line for the points to be included.

Offset:
Specify minimum and/or maximum offset from the road line for the points to be included. Offset is indicated as negative to the left, and positive to the right, of the road line.

Height:
Specify minimum and/or maximum height for the points you want to include. This may be given as the absolute or relative road line.

- **Absolute:**

The specified height limits are matched against the point's Z coordinate.

- **Relative to theoretic:**
  If the specified road line has an associated profile and/or cross slope, the height restrictions will be applied relative to the theoretical road model, for example, you can specify a minimum height of 0 to ensure you have points above the road surface.

Create interval:
Here you can choose to only include points in a certain interval between the start and stop sections.

- **Interval:**
  Here you specify how long it will be between each main section in the interval. If you select start section = 1000, stop section = 2000 and interval = 100, points will then be extracted around the sections 1000, 1100 etc. Note that it is enough that the main section lies between the start and stop section in order for all the points between the start and stop offset (see below) are extracted. If in the example above, the stop offset = 10, points with section measurements up to 2010 will appear in the last interval.

- **Interval start offset:**
  Here you specify how long before or after the main section each interval is to start. Enter a negative sign if the interval is to start before the main section.

- **Interval stop offset:**
  Here you specify how long before or after the main section each interval is to stop. Enter a negative sign if the interval is to stop before the main section. Example: Start offset = -10 and stop offset = 10 will extract the points in corridors 10 meters backward and forward relative to the main sections. Start offset = -5 and stop offset = 105 will create 110 meter long intervals with 10 meter overlaps over the main sections. The overlap is frequently used with the option **Save interval in separate files**, see below.

- **Save intervals in separate files:**
  If you choose this option, each interval is saved in a separate file. For example, if you have given the destination file the name mark.geo and set the interval to 100, the files mark_1000.geo and mark_1100.geo and so on will be created instead .

Assume same section for all points in same line:
If the points have been measured in a way that connects them in lines for each section, you can select this option to speed up the extraction process. A check is now made for the min/max section of the first point of the line only, and if this meets the criterion the whole line is included without any further verification. This speeds up processing.

Function keys

[Copy]:
Click here to copy the point selection from the source files to the destination file.

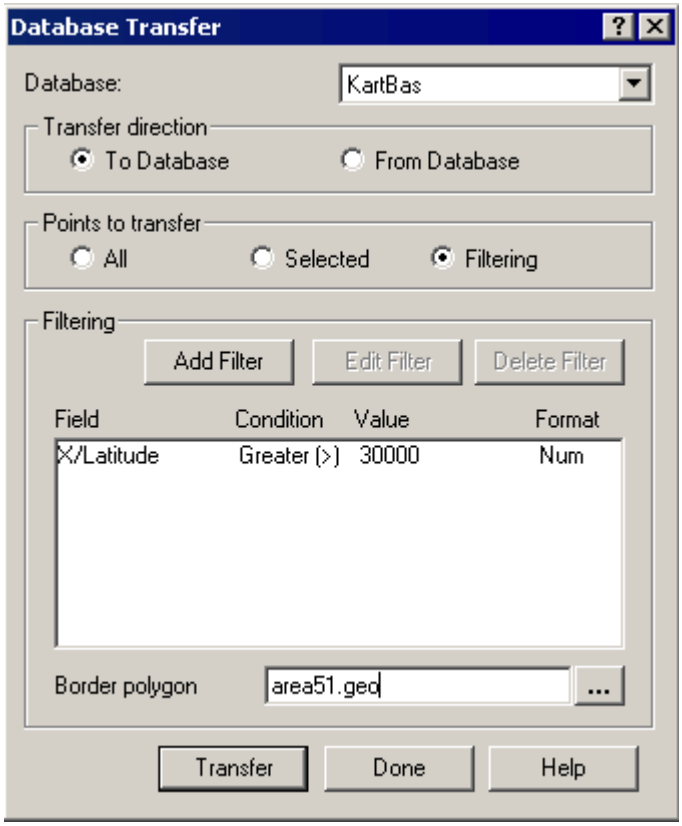
[Move]:
Click here to move the point selection from the source files to the destination file. Points will then be removed from the source files.

[Done]:
Closes the dialog.

See also: Coordinate Handling 118 , Coordinate Files 153 , Extract with Polygon 174 .

3.3.13 Database Transfer

This function downloads points from or writes points to a database. Select ***Data | Database Transfer*** to open the dialog. This function works with the active coordinate document.



Database:
Here you specify the database to download points from, or write points to.

Transfer direction:
Specify whether the points are written to, or downloaded from, the database.

Points to Transfer

All:
Select this option to copy all the points in the active document to the database.

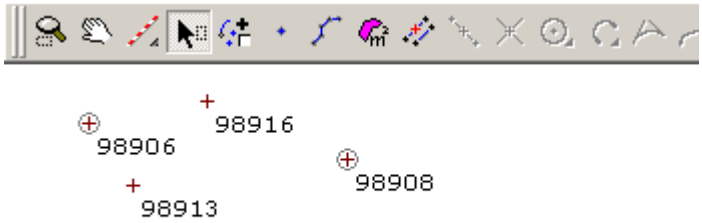
Selected:
Select this option to transfer selected points to the database. A numerical view 94 or a graphical view 47 must be active.

- **Numerical view**

	Point	X	Y	Z	Point Code	Sp. Code	Remark
1	93026	6 152 866,21500	-13 075,11700	0,00000	PP		
2	9201417	6 152 993,88000	-13 559,80700	0,00000	PP		
3	98906	6 152 392,27200	-10 902,80900	0,00000	PP		
4	98908	6 152 258,75200	-10 147,77300	0,00000	PP		
5	98913	6 152 028,60900	-8 538,14100	0,00000	PP		
6	98916	6 151 826,27900	-7 515,79200	0,00000	PP		
7	98923	6 151 416,24500	-5 009,11100	0,00000	PP		

Select the rows you want to transfer to the database. In the graphic, points 9201417, 98906 and 98913 will be transferred.

- **Graphical view**



Use the select tool to select the points you want to transfer. In the graphic, points 98906 and 98908 will be transferred.

Filtering:
Select this option to filter the points to be written or loaded. If you specify several filters, the conditions must be met in all the filters for the point to be processed.

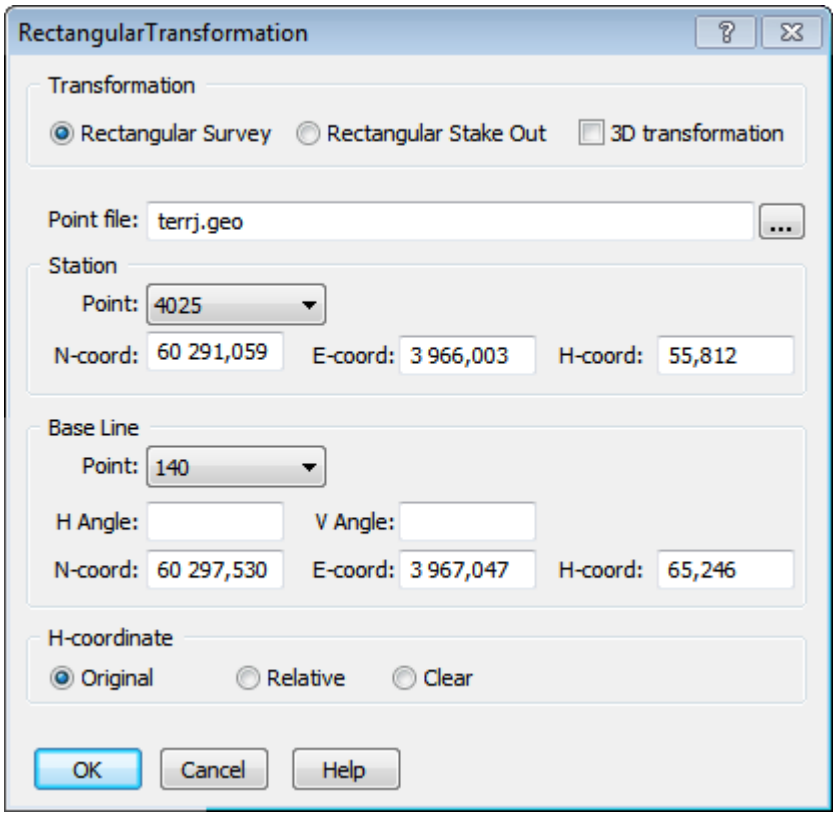
- **[Add filter]**
  Click here to create a new filter. A dialog for defining filters 168 opens.
- **[Edit filter]**
  Click here to edit the filter that is selected in the filter list. This opens the dialog for the filter definition 168 .
- **[Delete filter]**
  Click here to delete the filter that is selected in the filter list.
- **Filter list:**
  Here you see the filters you have created. A point must meet all these conditions in order to be processed.

Border Polygon:
Here you can specify a coordinate file with one or more polygons. Only the points enclosed by a polygon will be transferred.

See also: Coordinate Handling 118 , Coordinate Files 153 .

3.3.14 Rectangular Transformation

You use this function to convert points in a coordinate document[153] between local and global coordinate systems. The dialog is opened by selecting ***Data | Rectangular Transformation*** with a coordinate document active. This function is similar to Rectangular transformation 3D[181], but in the latter the reference surface is a *base plane* that is fixed by three points instead of as here, a horizontal or sloping baseline.



Points in the document are copied and transformed into a new coordinate document, and the transformation can be made in 2 or 3 dimensions. For the transformation in 2 dimensions, you do not need to enter the vertical coordinates for the station point, backsight baseline or vertical angle to the baseline.

Transformation:

- **Rectangular Survey**
  Transform from local to global coordinate system. This is useful if you have surveyed points relative to a local baseline.
- **Rectangular Set Out**
  Transform from global to local coordinate system. This is useful if you have set out points relative to a local baseline.
- **3D transformation**
  Check this box if you want to transform in 3 dimensions.

Point File:
File containing station and backsight objects. If you enter the coordinates of the station and the base line, you do not need to enter anything in this field. NOTE: The points that are transformed are downloaded from the active coordinate document and not from this file.

Station:
The station is the global coordinates for the origin of the local coordinates.

- **Point**

If the station point is saved in the point file mentioned above, you can then enter the point number for the station here. Coordinates are loaded automatically.

- **Coordinates**
  If you have loaded a station point, these fields contain the global coordinates of the selected point. You can also enter the coordinates directly if you wish.

Baseline:
The baseline is the distance axis for the local coordinate system. Enter either a point, or the coordinates for it, at the baseline, or horizontal and vertical angles relative to the global distance axis.

- **Point**
  If the backsight object is saved in the point file mentioned above, you can then enter the point number for the station here. Coordinates are loaded automatically.

- **Angles**
  Enter the horizontal and vertical angles between the global and local distance axes. This is an alternative to specifying a point on the baseline. You cannot specify both point and angles.

- **Coordinates**
  If you have loaded a backsight object, these fields contain the selected point's global coordinates. You can also enter the coordinates directly if you wish.

H-coordinate:
Enter how the vertical coordinate is calculated for the 2-dimensional transformations.

- **Original**
  The same value as the original point.

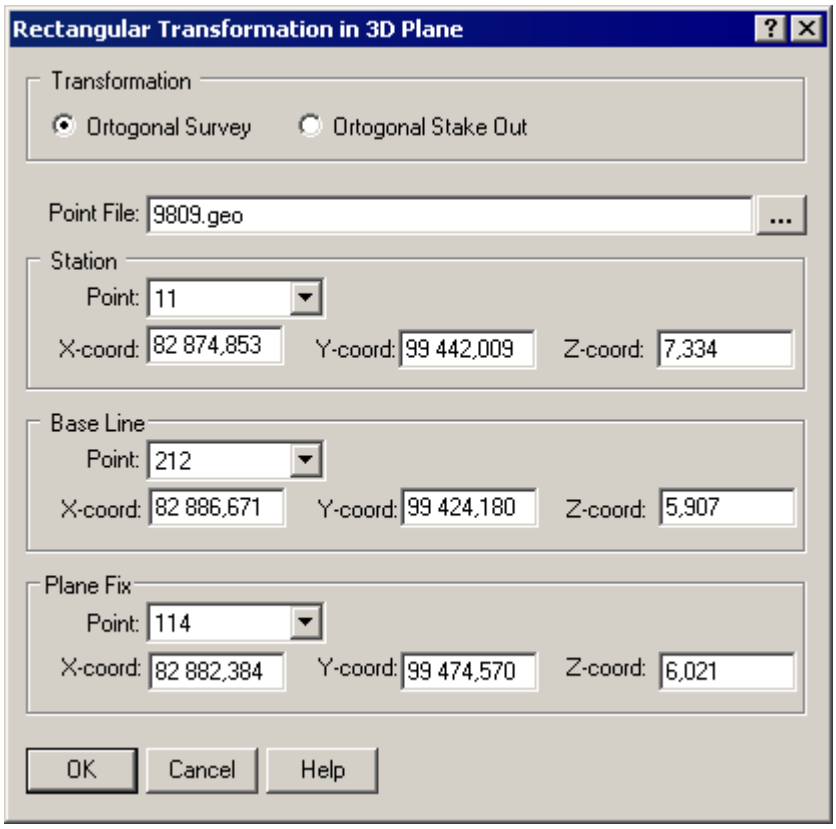
- **Relative**
  The value is relative to the station point’s vertical coordinate.

- **Reset**
  The value is blank.

See also: Coordinate Handling 118 , Rectangular Transformation 3D 181

3.3.15 Rectangular Transformation 3D

You use this function to convert points in a coordinate document[153] between local and global coordinate systems. The dialog is opened by selecting ***Data | Rectangular transformation in 3D Plane*** with a coordinate document active. This function is similar to Rectangular transformation[179], but in the latter the points refer to a horizontal or sloping baseline instead of as here, a *base plane* that is fixed by three points.



Points in the document are copied and transformed into a new coordinate document.

Transformation:

- **Rectangular Survey**
  Transform from local to global coordinate system. This is useful if you have measured points relative to a local base plane.
- **Rectangular Set Out**
  Transform from global to local coordinate system. This is useful if you have set out points relative to a local base plane.

Point file:
File containing station and backsight objects. If you enter the coordinates for the station, base line and plane fix, you do not need to enter anything in this field. NOTE: The points that are transformed are downloaded from the active coordinate document and not from this file.

Station:
The station is the global coordinates for the origin of the local coordinates.

- **Point**
  If the station point is saved in the point file mentioned above, you can then enter the point number for the station here. Coordinates are loaded automatically.
- **Coordinates**

If you have loaded a station point, these fields contain the global coordinates of the selected point. You can also enter the coordinates directly if you wish.

Baseline:
The baseline is the distance axis for the local coordinate system. Specify a point or the coordinates for it.

- **Point**
  If the backsight object is saved in the point file mentioned above, you can then enter the point number for the station here. Coordinates are loaded automatically.

- **Coordinates**
  If you have loaded a backsight object, these fields contain the selected point's global coordinates. You can also enter the coordinates directly if you wish.

Plane fix:
Here you enter an additional point that together with the first two fixes the local system's Northing-Easting plane.

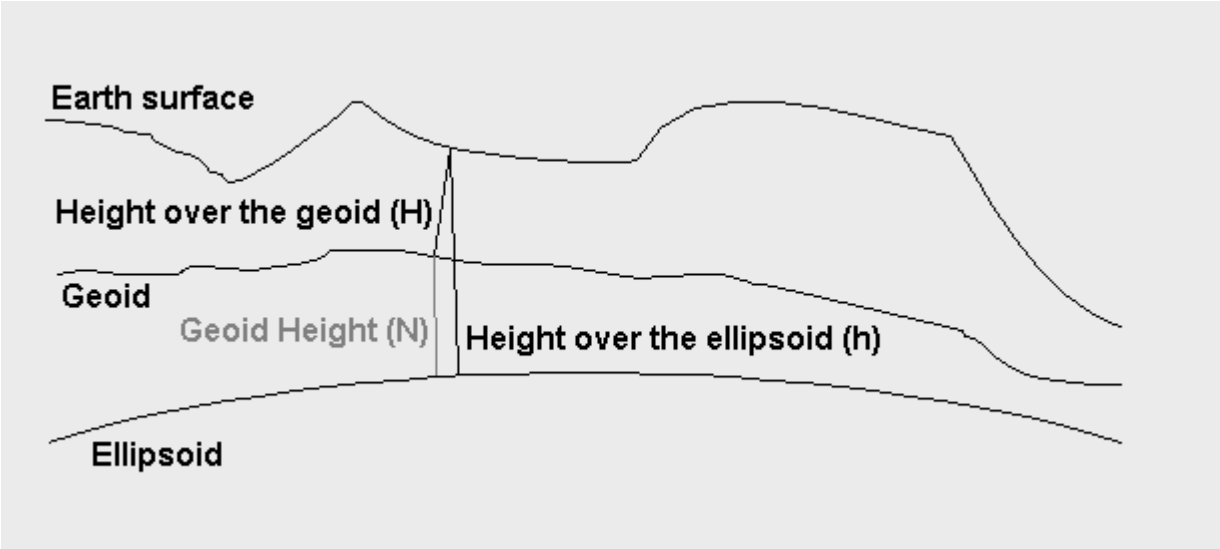
- **Point**
  If the backsight object is saved in the point file mentioned above, you can then enter the point number for the station here. Coordinates are loaded automatically.

- **Coordinates**
  If you have loaded a backsight object, these fields contain the selected point's global coordinates. You can also enter the coordinates directly if you wish.

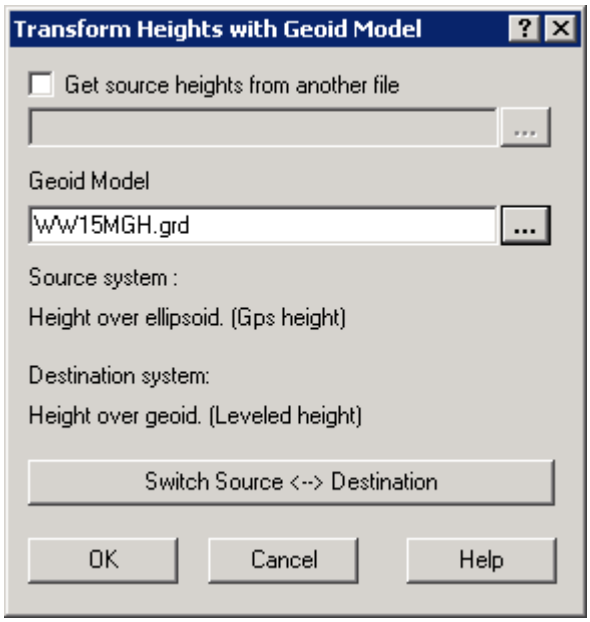
See also: Coordinate Handling 118 , Rectangular Transformation 179

3.3.16 Correct Heights for Geoid Separation

You use this function is to convert heights between the heights over the geoid and heights over the ellipsoid. The geoid is the undisturbed mean sea level and its proposed extension of land, and the reference surface is used for leveling and trigonometric height measurement. Because of irregularities in the earth's gravitational field, the geoid also has an irregular shape. An ellipsoid is a mathematical reference surface that is adapted to conform as closely as possible with the geoid. For GPS measurements, for example, heights are indicated in relation to an ellipsoid. This function uses what is known as a geoid model to convert between the two height systems. The geoid model contains geoid heights, also known as geoid separation, that are values of the distance between the geoid and the ellipsoid at different points.



For transformation of GPS measured data in three dimensions, you start by using global transformation to calculate the plane coordinates (choose to keep the original height) and then select to convert the heights using this function. However, for more accurate measurement you should make a local adaptation of heights instead. Select ***Data | Correct Heights for Geoid Separation*** from an active latitude and longitude coordinate document to open the dialog.



Get source heights from another file:
You can choose to download the heights of points from another file, correct them and then save the heights

in the active document. Select this option and then enter a name for the file where the heights are located in the source system.

Geoid model:
Here you select the geoid model to be used for the conversion.

Source system:
Here you specify the system in which the height display must be in the active document before correction.

Destination system:
Specify here the system in which the heights are to be calculated.

[Switch Source <-> Destination]
Click here to change places for the Source and Destination systems.

See also: Coordinate Handling 118, Coordinate Files 153, Global Transformation 142.

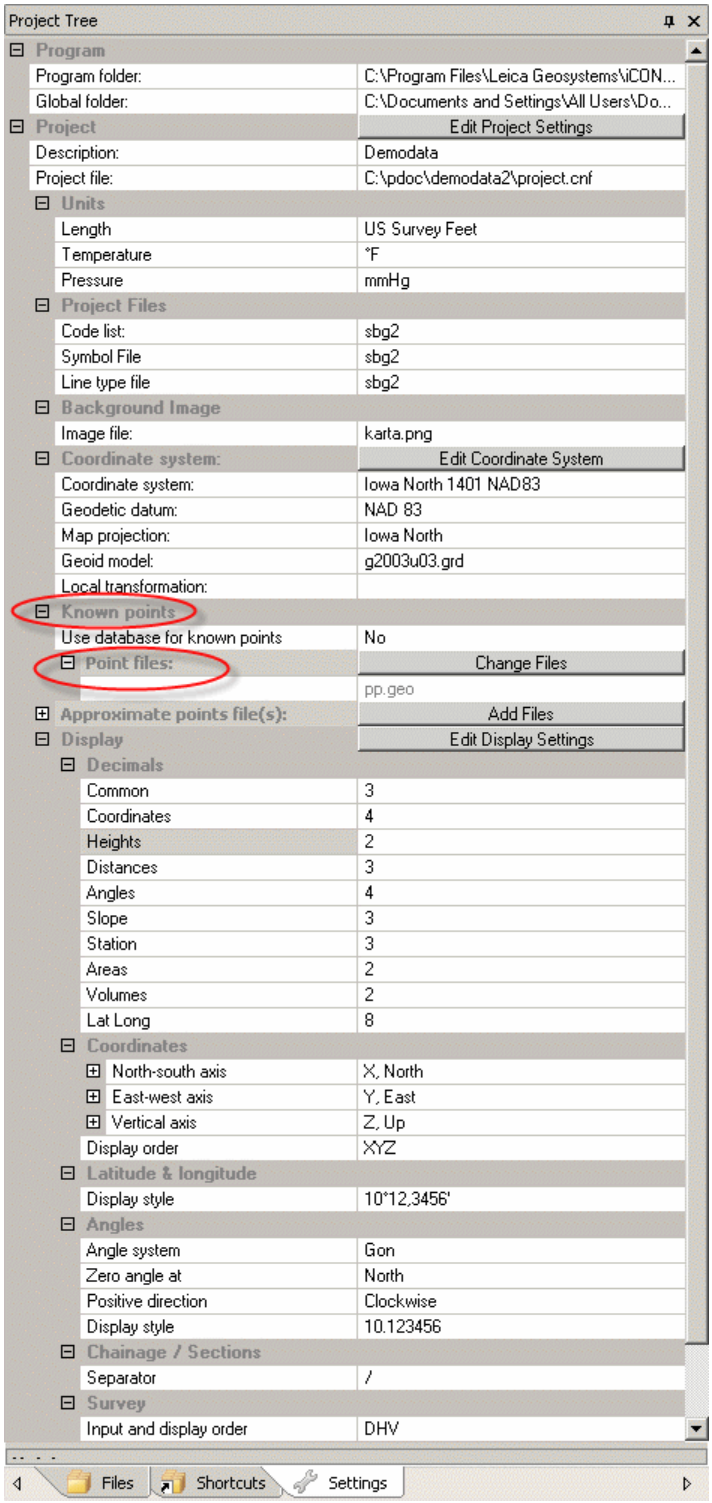
3.4 Latitude/Longitude Files

These files have the extension llc and contain longitude, latitude and ellipsoid height. The file type is constructed in the same manner, and contains the same attributes as normal coordinate files 153 (geo, pxy). The files are displayed either in a window with a tree view 104 and a numerical view 94 or graphically, although this requires that a coordinate system is selected in the tab Project Tree Settings 16 in order for the llc file to be displayed graphically. Coordinates in this format are used primarily in connection with the function Global Transformation 142 .

See also: Coordinate Systems 120 , Global Transformation 142

3.5 Polygon Points

Select the tab ***Settings***[16] in the project tree to select a file with known polygon points. The polygon point files are used by functions in iCON office that require known coordinates, including calculate coordinates. The pp.geo file is usually selected as a pp file, at known points/point files. Selected pp files are saved per project. More files can be specified, and you can also specify the approximate pp files used by the functions where the accuracy requirement for the position is less, for example, correction calculations. Keep in mind that if a polygon point is present in several of the files and/or appears several times in one file, the coordinates will be loaded from the first occurrence in the files that are listed first.



See also: Project Settings 16, Calculate Coordinates 335

3.6 Transformation

Transformation (***Function | Transformation***) involves conversion of coordinate files between two different coordinate systems. The relationship between the coordinate systems can be characterized by different transformation methods where you can select from two and three dimensions. All transformations, apart from "Point and direction" are created with the least square method if more fitting points are given than is required to resolve the relationship. The transformation calculation is made in a number of steps. Use the **[Next]**- and **[Last]**- buttons to change sides in the dialog.

Step 1. Select the parameter file and transformation method 188

Step 2. Select Files to Load Points from 191

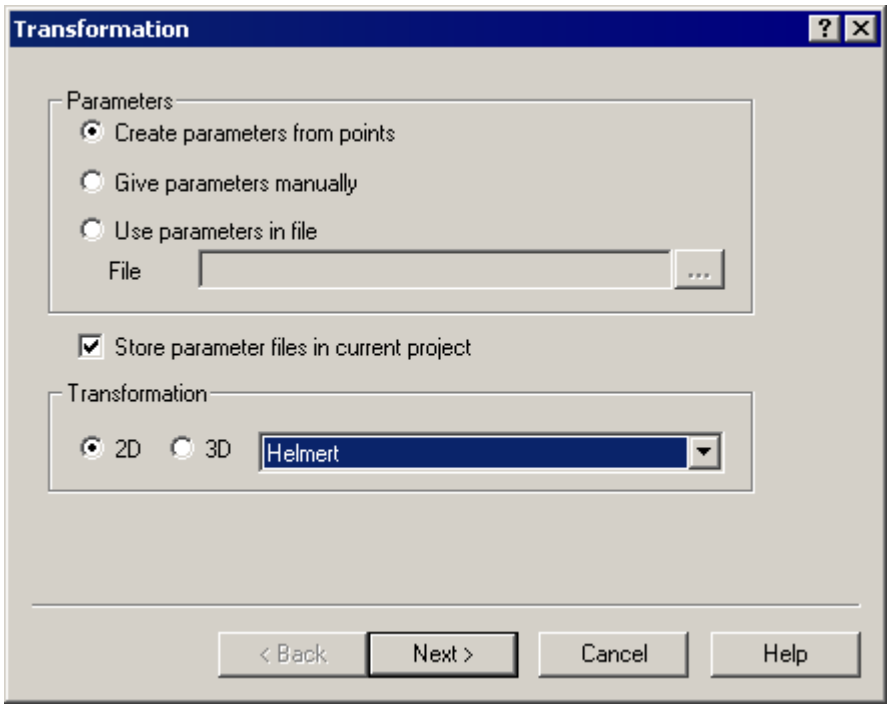
Step 3. Select Transformation Points 191

Step 4. Differences 192

Step 5. Parameters 193

Step 6. Perform Transformation 196

Step 1. Select the parameter file and transformation method



Parameters:
You can save the transformation parameters in a transformation file, tpf, for reuse. In this window you can select whether the parameters are to be loaded or created, and the following options are available.

Create Parameters from Points	Select this option if you want to calculate the parameters from fitting points that can be loaded from file or specified manually.
Give Parameters Manually	Select this option to enter the parameters manually, see below for the parameters contained in the various transformations.
Use Parameters in File	If the parameters from a previously executed transformation are saved in a tpf file, you specify the filename here.

If you select any of the latter two options, the window with parameters appears at once, step 5, otherwise

you must specify the type of transformation to be created.

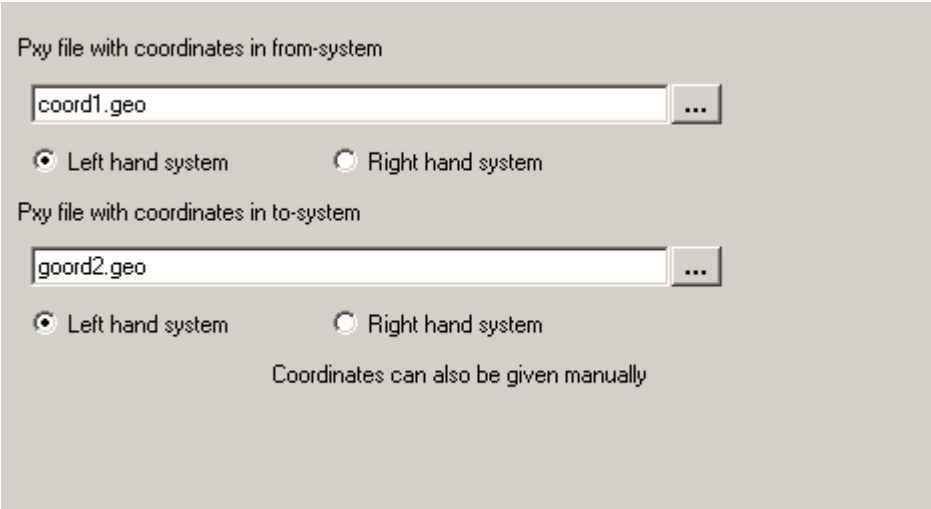
Store parameter file in current project	Check the box if the transformation file, tpf, is to be saved in the current project.

Transformation
There are a number of different ways to calculate the transformation. Enter the type of transformation to be made here and if it is to be defined in two or three dimensions.

Translation	Only movement between systems.
Point and direction	Movement and rotation between the systems, but with the same scale. Created with two points, one fitting point and one direction point. Retained position for point 1. Only possible in 2D.
Basic	Movement and rotation between the systems, but with the same scale.
Helmert	Movement and rotation and scaling between systems, use if there is a scale difference between the systems.
Affine	Movement, different scale along different axes and the lack of orthogonality between the axes, used for example for the transformation from paper copies such as maps where paper shrinkage may vary in different directions.
2D Helmert + sloping plane	Uses a 2D-Helmert for the plane coordinates, and customizes a sloping plane for the height difference between the systems. Suitable, for example, to create a local transformation file (tpf) for measurement using GPS . If your measuring area is larger than some kilometers, you should include a geoid model 133. This is the most common local transformation method. Please, make sure that the measured points, you use to create the transformation file, encircle your measuring area, as you should always work inside this area.
2D-Helmert + differential model	Uses a 2D-Helmert for the plane coordinates, and customizes a triangle difference model for the height difference between the systems. Suitable, for example, for detailed measurement using GPS over larger areas, where there is no geoid model. NOTE: The accuracy is very difficult to check, which places high demands on the point data.
2D Helmert + correction grid	Uses a 2D-Helmert for the plane coordinates, and a grid model 642 from which the heights for each plane coordinate are interpolated. Suitable to use when you have developed, or have access to, a good grid model which is used for interpolation.
2D Helmert + height difference	Uses a 2D-Helmert for the plane coordinates, and calculates the height difference between the systems as a constant. If more than one point is set as height in both systems, the height difference is calculated as a mean value. Suitable, for example, for detailed measurement using GPS where there are no suitable points to make a 2D Helmert + sloping plane.

If you choose to define the relationship in two dimensions only the plane coordinates are transformed with the height retained. Transformation can also be defined in three dimensions in which all coordinates are transformed.

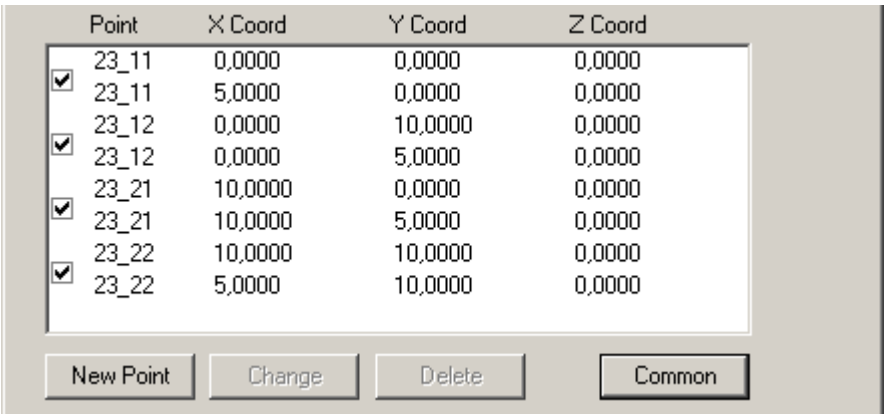
Step 2. Select Files to Load Points from



If the points with coordinates in the source and destination systems are in coordinate files, these files are listed here. Keep in mind that it helps the input if the points have the same point number in both files. If no files are specified here, you can enter the coordinates directly in the next window. Also indicate if the coordinates are in a left or right-handed system. The geodetic plane coordinates (latitude and longitude) are usually in a left-hand system, while the geocentric coordinates (XYZ) are in a right-hand system.

Note: All transformations and parameters are created in left-hand systems. If the source or destination system is right-handed, the X and Y coordinates are switched before and after transformation.

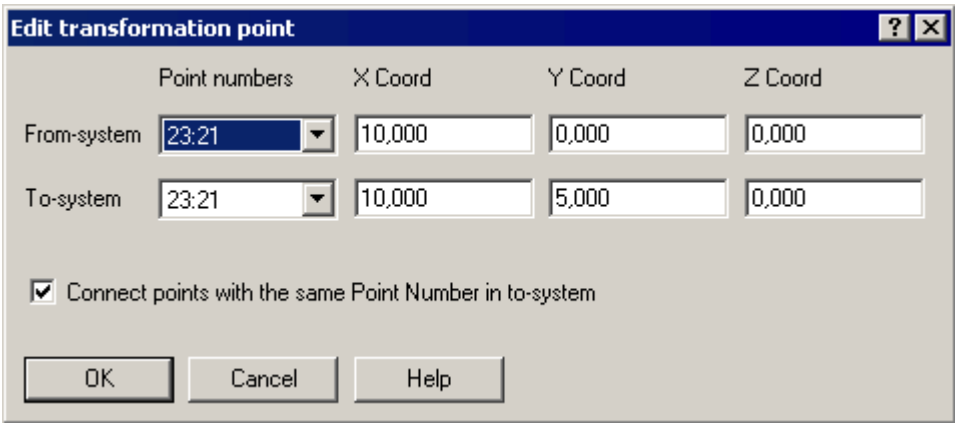
Step 3. Select Transformation Points



You specify the coordinates in the source and destination systems here. The translation must have at least one point, while 2D simple transformation and 2D Helmert require at least two points. The affine 2D, 3D simple and 3D Helmert need at least three points and the 3D affine at least four points. Choose one of the following to edit the coordinate pairs (one point in the source system and one point in the destination system) from the list.

[New Point]	Click here to add a new new pair of coordinates. The dialog to enter transformation points opens.
[Change]	Click to change the coordinate pair that is selected in the list. The dialog to enter transformation points opens.
[Delete]	Click to delete the pair of coordinates that is selected in the list.
[Common]	Click here to load all points that are common in the two systems, i.e. the points that have the same point numbers. This button is only active if you select the files for both systems.

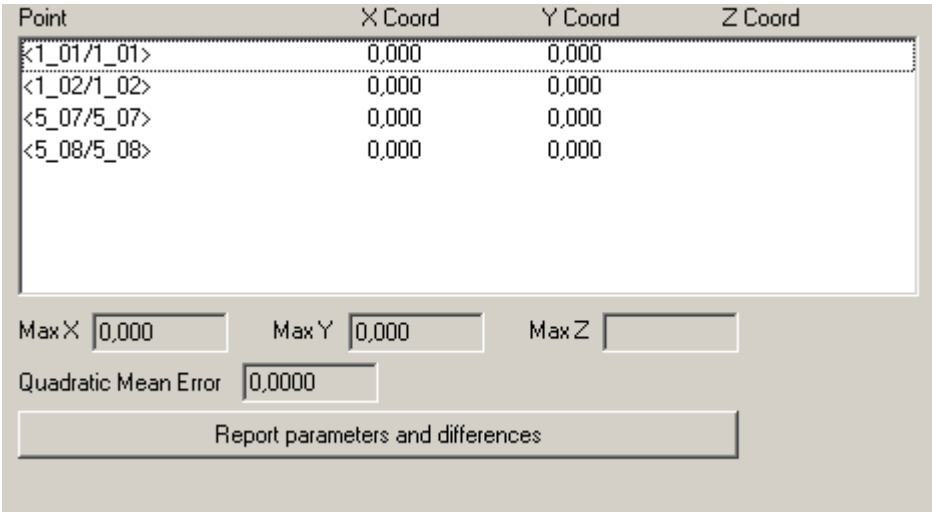
Dialog for entering transformation points:



Enter a corresponding point in the source and destination systems. If files with points are available, the point numbers will be included in the lists under point numbers. If the option "Join the points with the same point number in the destination system" is selected, iCON office automatically looks up the destination point when a source point is specified.

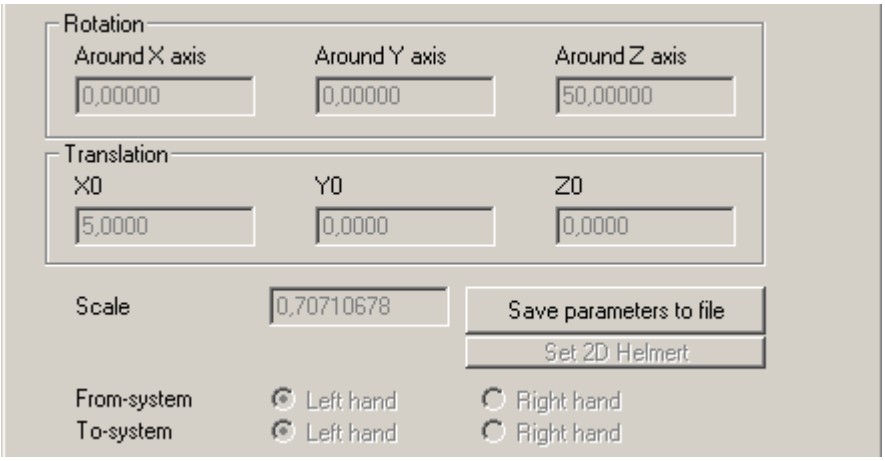
Point Number	Select the point from the list (if no file is specified, you cannot choose a point, but you can enter a point number).
Coordinate	If the point number is selected the coordinates will automatically appear, otherwise you can enter them in the field.

Step 4. Differences



This window shows the differences in the x, y and z axes between points in the destination system and the transformed points in the source system, as well as extreme values for these differences. Differences reported in the destination system's scale and orientation. A quadratic mean error (RMS) is are also presented for the errors. To create a report with parameters and differences, press **[Report parameters and differences]**.

Step 5. Parameters



This window shows the parameters for the transformation. The parameters that appear depends on the transformation method. It also shows if the source and destination system is a left or right-handed system. If you want to save parameters to make further transformations at a later time, press **[Save parameters to file]**. The file has the tpf format. For the transformation methods *2D Helmert + sloping plane* and *2D-Helmert + difference model* a page initially appears with parameters and possible differences for the height transformation.

Translation:
Movement in X, Y and Z. Z only for 3D transformation (***Xo***, ***Yo, Zo***).

Formulas 2D:

$$X = X_0 + x$$
$$Y = Y_0 + y$$

Formulas 3D:

$$X = X_0 + x$$
$$Y = Y_0 + y$$
$$Z = Z_0 + z$$

Simple transformation:
Movement in X, Y and Z. Z only for 3D transformation (***Xo***, ***Yo, Zo***). Gradual rotation around coordinate axes X, Y, Z (***omega, fi, kappa***). In 2D only around the Z axis.

Formulas 2D:

$$X = X_0 + x * \cos(\kappa) - y * \sin(\kappa)$$
$$Y = Y_0 + x * \sin(\kappa) + y * \cos(\kappa)$$

Formulas 3D:

$$X = X_0 + x * \cos(\kappa) * \cos(\varphi) + y * (\cos(\kappa) * \sin(\varphi) * \sin(\omega) - \sin(\kappa) * \cos(\omega)) + z * (\cos(\kappa) * \sin(\varphi) * \cos(\omega) + \sin(\kappa) * \sin(\omega))$$
$$Y = Y_0 + x * \sin(\kappa) * \cos(\varphi) + y * (\sin(\kappa) * \sin(\varphi) * \sin(\omega) + \cos(\kappa) * \cos(\omega)) + z * (\sin(\kappa) * \sin(fi) * \cos(\omega) - \cos(\kappa) * \sin(\omega))$$
$$Z = Z_0 - x * \sin(\varphi) + y * \cos(\varphi) * \sin(\omega) + z * \cos(\varphi) * \cos(\omega)$$

Helmert transformation:
Movement in X, Y and Z. Z only for 3D transformation (***Xo***, ***Yo, Zo***). Gradual rotation around coordinate axes X, Y, Z (***omega, fi, kappa***). In 2D only around the Z axis. Scale between systems (***s***).

Formulas 2D:

$$X = X_0 + s * (x * \cos(\kappa) - y * \sin(\kappa))$$
$$Y = Y_0 + s * (x * \sin(\kappa) + y * \cos(\kappa))$$

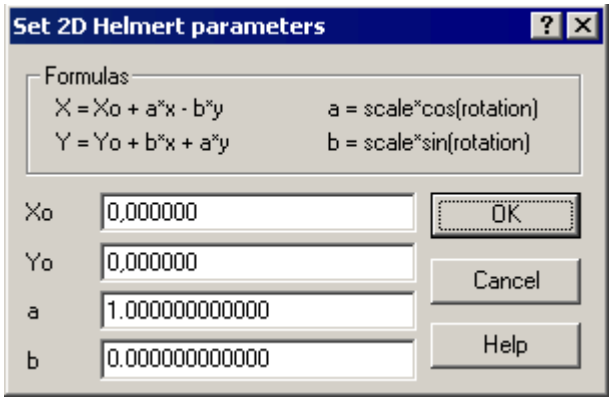
The correlation can also be given as:

$$X = X_0 + a * x - b * y$$
$$Y = Y_0 + b * x + a * y$$

where

$$a = s * \cos(\kappa)$$
$$b = s * \sin(\kappa)$$

To specify the parameters in this alternative way, click **[Set 2D Helmert]**



Formulas 3D:

$$X = X_0 + s * (x * \cos(\kappa) * \cos(\varphi) + y * (\cos(\kappa) * \sin(\varphi) * \sin(\omega) - \sin(\kappa) * \cos(\omega)) + z * (\cos(\kappa) * \sin(\varphi) * \cos(\omega) + \sin(\kappa) * \sin(\omega)))$$
$$Y = Y_0 + s * (x * \sin(\kappa) * \cos(\varphi) + y * (\sin(\kappa) * \sin(\varphi) * \sin(\omega) + \cos(\kappa) * \cos(\omega)) + z * (\sin(\kappa) * \sin(fi) * \cos(\omega) - \cos(\kappa) * \sin(\omega)))$$
$$Z = Z_0 + s * (- x * \sin(\varphi) + y * \cos(\varphi) * \sin(\omega) + z * \cos(\varphi) * \cos(\omega))$$

Affine transformation:

Affine parameters a1 .. c3. In addition to the direct parameters, medium scale, medium rotation and lack of angularity are also reported. (For 3D only medium-scale)

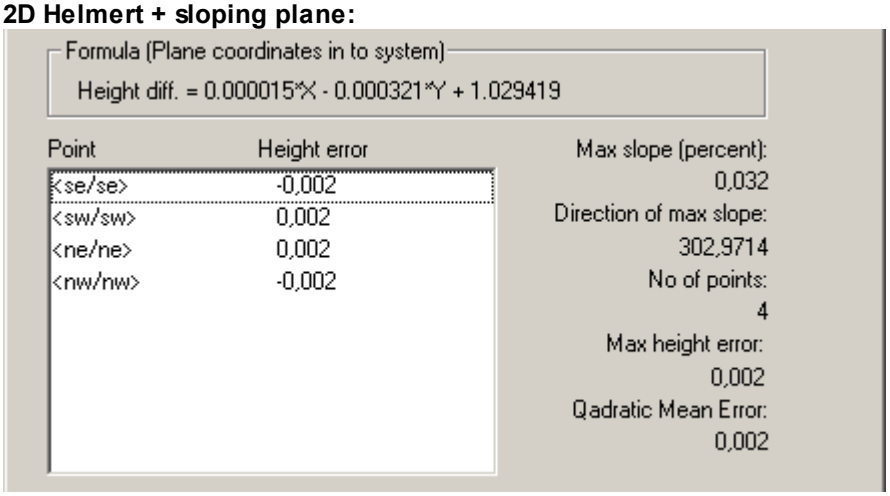
Formulas 2D:

$$X = X_0 + x * a1 + y * a2$$
$$Y = Y_0 + x * b1 + y * b2$$

Formulas 3D:

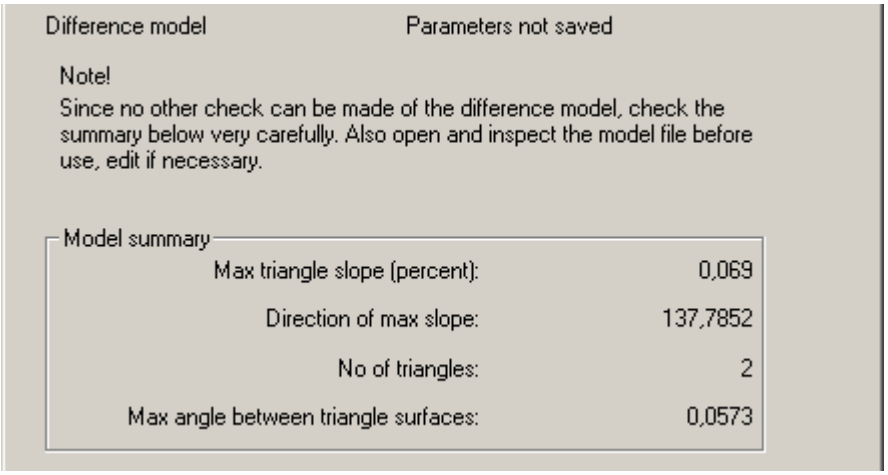
$$X = X_0 + x * a1 + y * a2 + z * a3$$
$$Y = Y_0 + x * b1 + y * b2 + z * b3$$
$$Z = Z_0 + x * c1 + y * c2 + z * c3$$

2D Helmert + sloping plane:



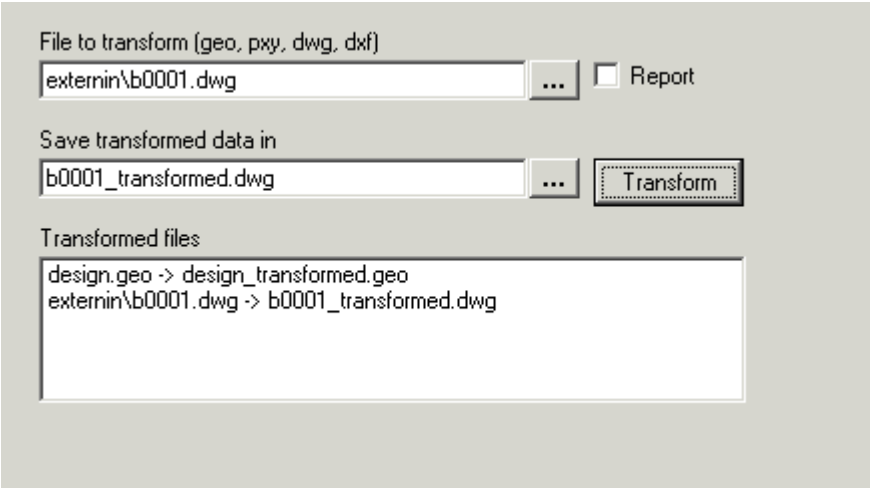
Here you can see the formula relationship for the height difference between the systems, the maximum slope of the height difference and the direction in which this occurs. If the transformation has recently been created from points, the number of points, maximum fitting error, square mean error for the fitting, and fitting error for each point are presented. At least four points are needed to be able to report the fitting error.

2D-Helmert + difference model:



Here you can see a summary of the difference model that describes the height difference between the systems. Read the summary carefully and determine whether it seems reasonable. Since all points are used in the triangulation, no differences can be presented. Keep in mind that the cut-off angles between adjacent triangles will cause the equivalent cut-off for a planned profile line for a transformation. The difference model is saved in dfm format, and should be opened, checked and if necessary edited before using. Bear in mind, for example, how triangles are linked between points; turn them if necessary.

Step 6. Perform Transformation



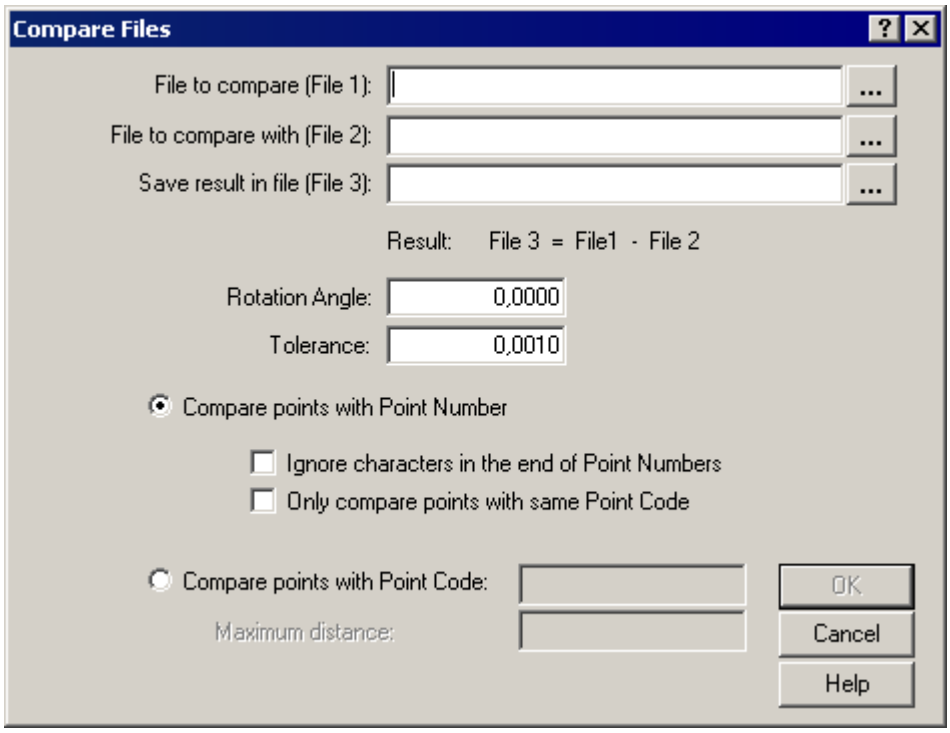
You can transform coordinate files (geo, pxy), AutoCad® files (dwg, dxf), and terrain models (trm). Select the source file and destination file and then click **[Transform]**. Check **[Create Report]** if you want a report with the transformation data to be created. As you transform, the files are added to the list, under "Transformed files". Click **[Cancel]** when you have finished.

See also: Coordinate Systems 120, Global Transformation 142

3.7 Special Functions

3.7.1 Comparing Files

You use this dialog to compare values in two coordinate files. If you want the result saved in a coordinate file, a report containing a list of differences is always created. Open the dialog with ***Function | Comparing Files***.



The results of the comparison are: **File 1 - File 2**

Remember that if the same point number occurs several times in file 2, the value in file 1 will then be compared with *the first occurrence*.

File to compare (file 1):
Enter the name of the file you want to compare.

File to compare with (file 2):
Enter the name of the file you want to compare with.

Save results to file (file 3):
Specify the file that will contain the differences between the source files. If no filename is specified, only one report is created.

Rotation Angle:
Set this value to get the differences reported in a local system. Set the rotation angle relative to the coordinate system's 0-direction.

Tolerance:
The report generated highlights the point comparisons with a number of asterisks (*). If the points are equal, no asterisks appear. The greater the difference between the points, the more asterisks are displayed. Set the amount of difference each asterisk represents.

Compare point numbers

- Ignore the letters at the end of the point number.
  This makes it possible to compare points called 10A, 10B, 10C etc.
- Only compare points with the same point code.
  If several points in the same file have the same point number, you can separate them with the point code.

Compare point codes

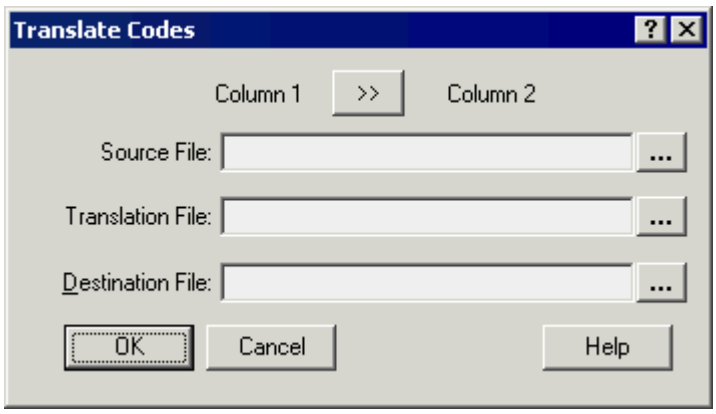
Select this if the point number is irrelevant and the comparison is made via the point code instead.

- Maximum distance
  Defines a radial distance between points to be used for comparison. If the points are outside this area, they will not be compared with the point in question.

See also: Coordinate Handling 118 .

3.7.2 Code Translation

You use this function to convert point codes in coordinate files or survey files using a translation table. The table consists of a text file in which the codes are listed in two columns with matching codes on the same line. If no corresponding code is present in one of the systems, it will be left blank. You enter the description of the code system in the first line of the file. Commas are used as delimiters between the columns. Open the dialog with ***Function | Code Translation***.



Source File:
Select the file to download points from.

Translation File:
Specify the translation table in the form of a text file with the codes for the systems in two columns with commas between them.

Destination File:
Enter the filename for the new file with the new codes.

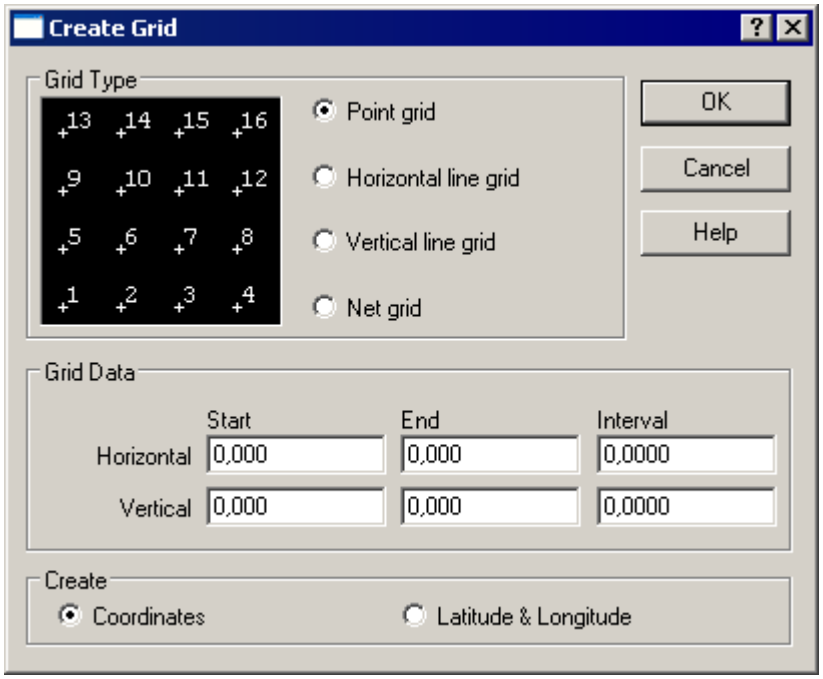
[>>] or [<<]:
Enter the translation direction by clicking the button; when you make the change the button symbol will show the new direction.

Example of translation table:
SBG code, BV type code
13,MKP
41,VKT
97,PP

See also: Coordinate Handling 118 , Code Lists, Symbols and Line Types 203 .

3.7.3 Creating Coordinate Grids

This function creates a grid of points in a coordinate file 153 or latitude and longitude file 185. Open the dialog with ***Functions | Create Coordinate Grid***. This function creates a new untitled file.



Grid type
Here you define the grid you want to create. The dialog figure shows what the appearance of the grid.

- **Point Grid**
  Creates a rectangular grid consisting of single points.
- **Horizontal Line Grid**
  Creates a grid consisting of horizontal lines.
- **Vertical Line Grid**
  Creates a grid consisting of vertical lines.
- **Net Grid**
  Creates a grid consisting of lines with points only at the outer frames.

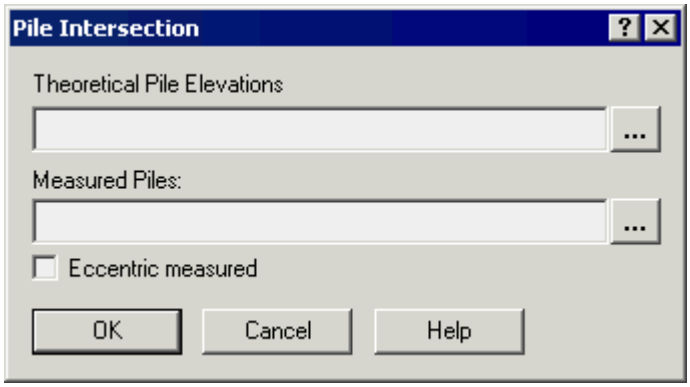
Grid Data
Here you set the limits and ranges for the coordinates of the grid. You enter these as coordinates or coordinate angles depending on the choice in **Create**.

Create
Here you define the grid you want to create, coordinates (geo, pxy) or longitude and latitude (llc).

See also: Coordinate Handling 118

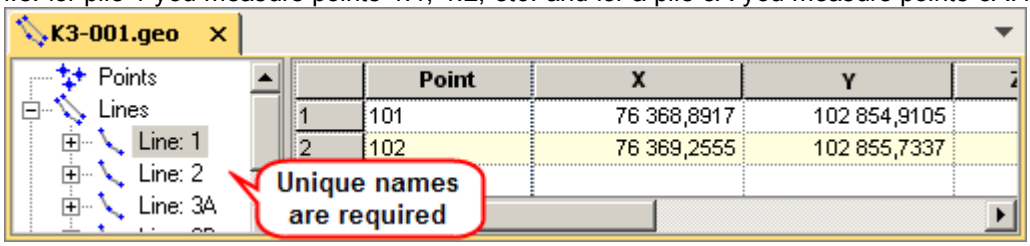
3.7.4 Pile Intersection

You use this function to calculate the coordinates of a pile intersection. Open the dialog with ***Functions | Pile Intersection***.

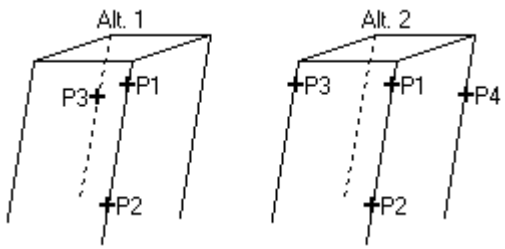


Theoretical Pile Elevation:
Specify the coordinate file with the pile numbers and the elevation of the intersection plane.
In the coordinate file there must be a line for each pile with the pile number and the elevation (in the Z-column) for which the coordinates are to be calculated.

Measured Piles:
Enter a coordinate file with surveyed pile points.
For each pile, there must be two surveyed points and, if necessary, additional points if it is an eccentric measurement (see below). **Points should be measured as lines with the pile number as line number**, i.e. for pile 1 you measure points 1.1, 1.2, etc. and for a pile 3A you measure points 3A:1, 3A:2 etc.



Eccentric measured:
Click if the piles have been measured with additional determination points in order to obtain the calculation of the pile's center in the interception plane, otherwise you calculate the point in the line between the two measured points (P1 and P2). One of the following measuring options can be used for the eccentric measurement:



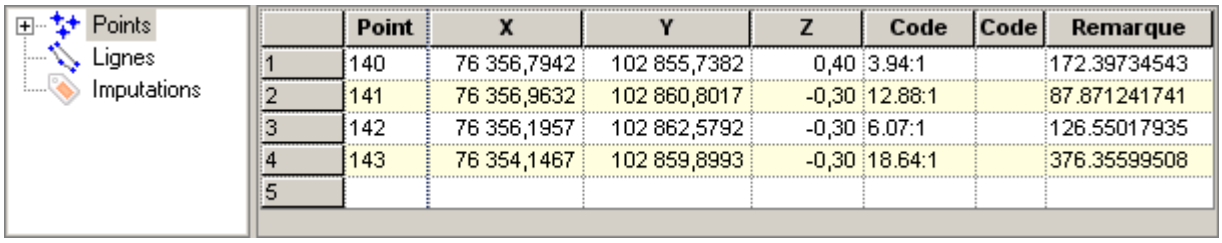
- **Option 1**
  Measure the two points on one edge and then a point on the diagonally opposite edge. Measure the points as a line X (X.1, X.2 and X.3) where X stands for the name of the pile.
- **Option 2**
  If it is not possible to measure the diagonal edge, you can measure a point on each side edge

instead. Measure the points as a line X (X.1, X.2, X.3 and X.4) where X stands for the name of the pile.

The coordinates of the pile intersection are calculated as follows:
In a coordinate file with theoretical data, a line is added for each pile with the pile number and the elevation (in the Z-column) for which the coordinates are to be calculated.

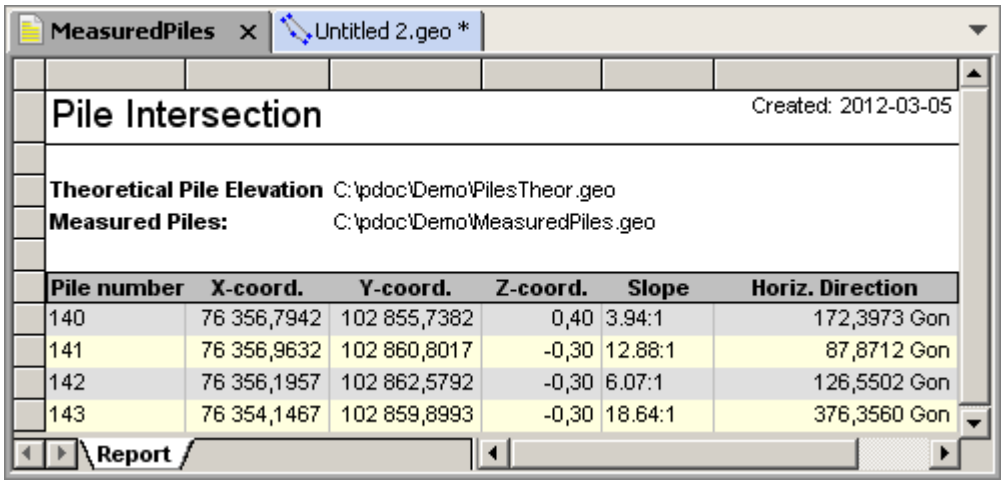
The survey pile data must be input in another coordinate file.

The program then goes through the surveyed piles and calculates their coordinates in the intersection plane for the theoretical elevation. The results are held both in a coordinate document and in a text report. Besides the intersection coordinates, the pile slope and the horizontal direction between point one and two are also calculated (given in the column for point code and remark in the coordinate file).



	Point	X	Y	Z	Code	Code	Remarque
1	140	76 356,7942	102 855,7382	0,40	3.94:1		172.39734543
2	141	76 356,9632	102 860,8017	-0,30	12.88:1		87.871241741
3	142	76 356,1957	102 862,5792	-0,30	6.07:1		126.55017935
4	143	76 354,1467	102 859,8993	-0,30	18.64:1		376.35599508
5							

Coordinate document with calculated coordinates, slope and horizontal direction.



Pile number	X-coord.	Y-coord.	Z-coord.	Slope	Horiz. Direction
140	76 356,7942	102 855,7382	0,40	3.94:1	172,3973 Gon
141	76 356,9632	102 860,8017	-0,30	12.88:1	87,8712 Gon
142	76 356,1957	102 862,5792	-0,30	6.07:1	126,5502 Gon
143	76 354,1467	102 859,8993	-0,30	18.64:1	376,3560 Gon

Report with calculated coordinates, slope and horizontal direction for the piles.

See also: Coordinate Handling 118

3.8 Code Lists, Symbols and Line Types

Code Lists

Each point in a coordinate file contains a code field used to indicate what type the point is. The code may, for example, determine the symbol to be drawn or the line type to be used when connecting points to a line. You specify these connections in the code list for each code. Only one code list can be active at any one time, this is determined from the Settings tab 16 in the Project Tree.

The code lists have the extension cod and are to be placed in the global folder in order for the program to find them. When you open a code list, an input window appears with a line for each code.

Sbg1_eng.cod

	Code	Description	Function	Line Type	LPen
1	111	Triangel point			1
2	112	Polygon point	PP		1
3	113	PikT	PI		1
4	114	Benchmark point			1

Standard Code Lists

iCON office has some standard code lists that you can use. Keep in mind that if you edit these, you should save them with other names as they will otherwise be overwritten next time you install iCON office.

- sbg.cod
  Contains two digit codes for common survey objects. Used together with the symbol file sbg.sym and the line type file sbg.glt.

- sbg1.cod
  Contains three digit codes for common survey objects. Used together with the symbol file sbg.sym and the line type file sbg.glt.

- sbg2.cod
  Contains codes specified in the SNRA (Vägverket) handbook (Publ. 2000:5B). Used together with the symbol file sbg2.sym and the line type file sbg2.glt if you want to view symbols and line types in iCON office. Do not use these files for export to AutoCAD/NovaPOINT.

  Code classification for sbg2.cod

Code	Group name	Group contents
100-149	ADM	Administration, control point net, limits
150-199	BYGG	Constructions, art structures
200-249	TERR	Terrain lines, terrain points
250-299	VEG	Vegetation
300-399	ANL	Plant areas, plant equipment
400-499	VAG	Street, road
500-599	JVG	Railway
600-699	VA	Water, waste, district heating
700-749	EL	Electricity
750-799	TELE	Telecom
800-899	GEO	Geo technology
900-999	VA SPECIAL	VA detail measurements

- sbg2z.cod
  Contains the same codes as sbg2.cod but controls other layers and symbols when exporting to AutoCAD/NovaPOINT. The code lits is used when point heights are to be presented for a height plane,

for example.

- bv.cod
  Contains codes for measurement for Swedish railways. Used together with the symbol file bv.sym and the line type file bv.glt.

Fields in the code list

- Code
  Point code. Must be identical with what is in the points' code field in a coordinate file. Empty this filed to delete the code from the code list.

- Description
  Brief description of the code. Maximum 25 characters.

- Function
  You can connect survey functions to the codes, most of these are taken care of when calculating coordinates of a survey file, see Survey Files 318 for a description of the functions. There are two different ways of using these functions, either with a point code/remark or with a special code/remark. If you use the special code, you enter the two-digit codes directly below. It is easier to use the special code but in some instruments this cannot be set, and some instruments cannot handle alphanumeric characters. In these cases a point code/remark must be used.
  The functions that can be specified are:

F2	Rectangle from two points
F3	Rectangle from three points
C2	Circle from two points
C3	Circle from three points
R2	Radius from two points
R3	Radius from three points
E	Extrapolation
PP	Polygon point
PI	Temporary known point
KP	Control point

- Line Type
  The name of the line type to be used; the line type is loaded from the active line type file. <None> means that no line will be drawn.

- LPen
  Number of the pen/color to be used to draw the line. See also View Settings 251.

- LScale
  The scale factor of the line type. 1 for normal size.

- Symbol
  The name of the symbol to be drawn; the symbol is loaded from the active symbol file. <None> means that no symbol will be drawn.

- SPen
  Number of the pen/color to be used to draw the symbol. See also View Settings 251.

- SScale
  Scale factor for the symbol. 1 for normal size. For the graphics it is also possible to set different scale factors for different drawing scales. This means that you can ensure that the symbol is drawn with a reasonable size regardless of the size it has in the symbol file. See also View Settings 251.

- Rotation reference

M	Drawing. The rotation of the symbol follows the rotation of the drawing.
C	Coordinate system. The symbol is drawn parallel to the coordinate system's east-west axis.

P	Point code. The symbol is drawn perpendicular to the bearing of the point code.
R	Road. The symbol is drawn according to the bearing in the remark about the special code being set to B. (This information can be set by certain road functions).

- Rotation
  The symbol's rotation relative to the reference.
- AutoCAD® Layer
  The name of the AutoCAD® layer where the points will appear. See also AutoCAD drawings 289.
- AutoCAD® Line Type
  The AutoCAD® line type to be used for lines between points.
- AutoCAD® Block
  The name of the AutoCAD® block/symbol for the points.
- AutoCAD® Attributes

  By using one or more of the following attribute flags, the corresponding information is entered in the AutoCAD® block's attribute field.

P/S	Point number
X	X coordinate
Y	Y coordinate
Z	Z coordinate
K/C	Point code
R	Remark

- The KF85 code applies when importing and exporting KF85 397 and Geosis 392.
- The AutoKa-PC code applies when importing and exporting AutoKa-PC 384 .
- The Kordab code is used when exporting to Kordab 401 format (.242 and .243).

Symbols

Symbols in iCON office are stored in files of the sym type. These files must be placed in the global folder. Only one symbol file list can be active at any one time, this is determined by the Settings tab 16 in the Project Tree.

Line types

Line types in iCON office are stored in files of the glt type. These files must be placed in the global folder. Only one line type file can be active at any one time, this is determined by the Settings tab 16 in the Project Tree.

See also Project Settings 16.

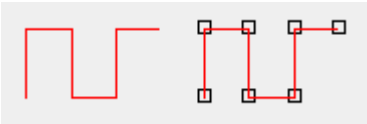
4 Graphical Editing

4.1 Graphical Editing in General

Many graphical operations are performed by first selecting one or more objects with the select tool. You can then select from a number of different operations for the object/objects, e.g. moving, copying, deleting etc.

Selecting Objects

Use the Select tool to select one or more objects , ***Tools | Select Objects***. When an object has been selected, this is shown by one or more grip icons that are outlined on the object.



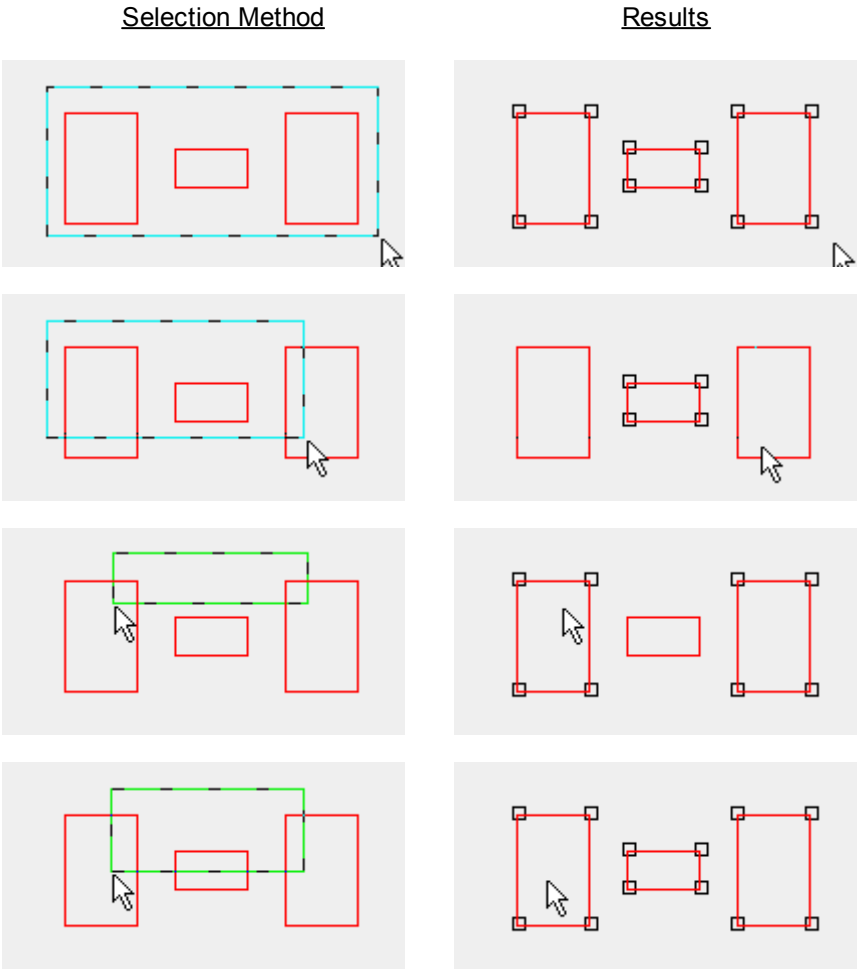
There are two ways to select objects, either by directly pointing to any part of the object or by enclosing the object with a rectangle, see Selection box 207.

If the tool "Select Object" is activated and the user clicks in a 2D view on a place where one or several points have the same horizontal coordinates, or if the points in the graphical view look like they are close together, a list with the points will be visible in the view. In this list it is possible to select one of the points. The selected point can be edited in the normal way, for example it is possible to change its coordinates or move it graphically etc. See also Graphical Tools 225.

Selection by pointing directly to objects

Each new object you point to will be highlighted while previously selected points are automatically deselected. If you want to retain the previous selections, hold down the **Ctrl** or **Shift**key while clicking an object.

Selection with 'Selection box'
If you do not point directly at an object, a rectangle is drawn at the cursor when you drag it. The direction in which the rectangle is drawn is important, if it is from left to right this means that all objects that are **completely** inside the rectangle will be selected. If, on the other hand, it is drawn from right to left, all objects that are **partly** inside the rectangle will be selected. Note that the color of the rectangle changes to indicate direction.



Only objects in the active document can be selected with the select tool.

Grip icons
The selection symbols that are drawn for the selected objects have different appearances depending on the type of object. For example, a point that is selected is given a grip icon other than a text or symbol. Most grips also have a quick tool linked to them that is enabled when you point to the grip. If you click on a grip using the right mouse button, a menu appears that is specific to the current object type.

Copy, Paste, Cut and Delete

Copy

When you copy data in the graphical views, the result is stored in an internal clipboard, as opposed to copying text that is sent to the Windows clipboard. To copy data to the clipboard you first select the desired object and then ***Edit | Copy*** or click the button .

Paste

If there is any information held in the internal clipboard you can paste it into a graphical window. The insertion point for the object will be downloaded from the copied object. Select ***Edit | Paste*** or click the button . For some document types, a dialog will appear where you can specify additional parameters, see the relevant document type.

Copy to active document

Select ***Tools | Copy to Active Document | Point/Element*** or ***Tools | Copy to Active Document | Line***, to copy points/elements respectively lines between documents that are simultaneously opened in the same graphical view. Activate the document to which data is to be copied and select one of the two tools ***Copy to Active Document***. Then click on the objects to be copied to the active document.
Please note, this tool is also used to copy objects that are only visible in the Help Layer 216, see also Help Layers, Gft Files 218.

Cut

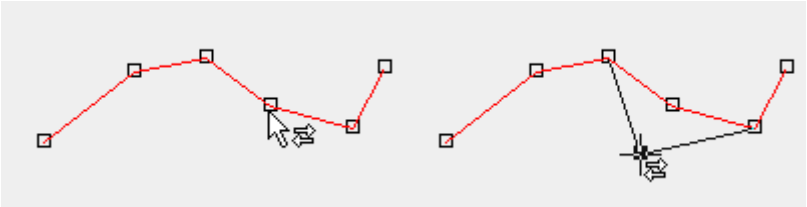
When you cut data, the selected information is first copied to the internal clipboard and then deleted. Select the relevant objects and select ***Edit | Cut*** or click the button .

Delete

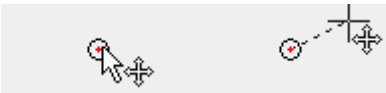
To delete the selected objects in a graphical window, select ***Edit | Delete*** or click the button . You can also press the **Del** key on the keyboard.

Tool Linked to Grip

When the cursor is placed on a grip, the icon changes to show the tool to be activated if you click on the grip. For a line this means, for example, that the tool 'move point' is enabled. All tools can also be selected from a menu by right-clicking on the grip, see under 'Menus in the Graphics' below 210.

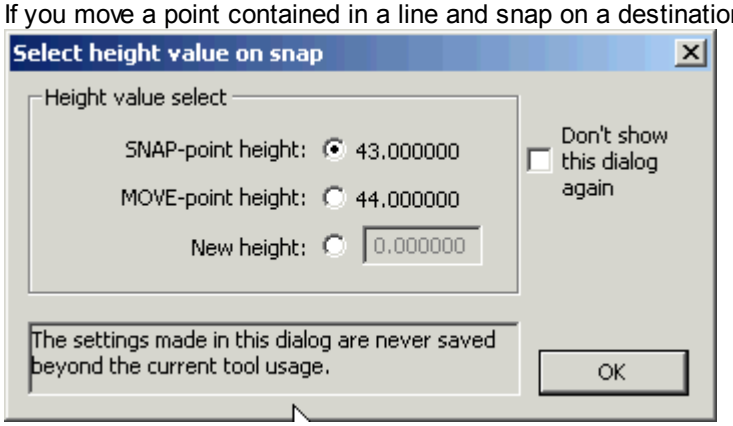


Move point
To move a single point you start by selecting the point, and then click it and drag it to the new location. You can also enter the coordinates in the input field 107.



To move a point in a line, you start by selecting the first line and then point to the point to be moved. You can also enter the coordinates in the input field 107.

Tip! You can point out the new location by using a snap tool 246.
If you move a point contained in a line and snap on a destination point, you can set the height of the point.



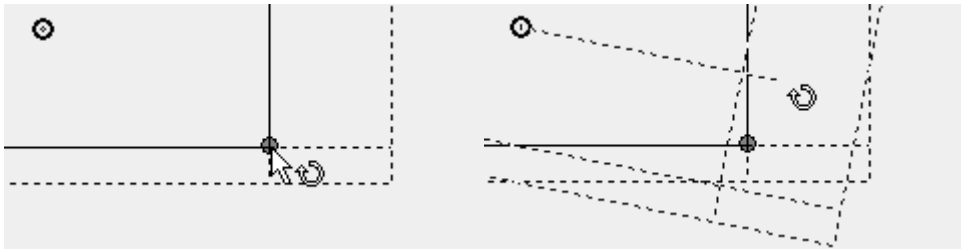
- Snap point height
  The moved point is given the height from the point you snap on to.
- Moved point height
  The moved point retains its original height.
- New height
  Enter the height for the point.

Move elements
Element points, circles, etc. are moved in the same way as single points.

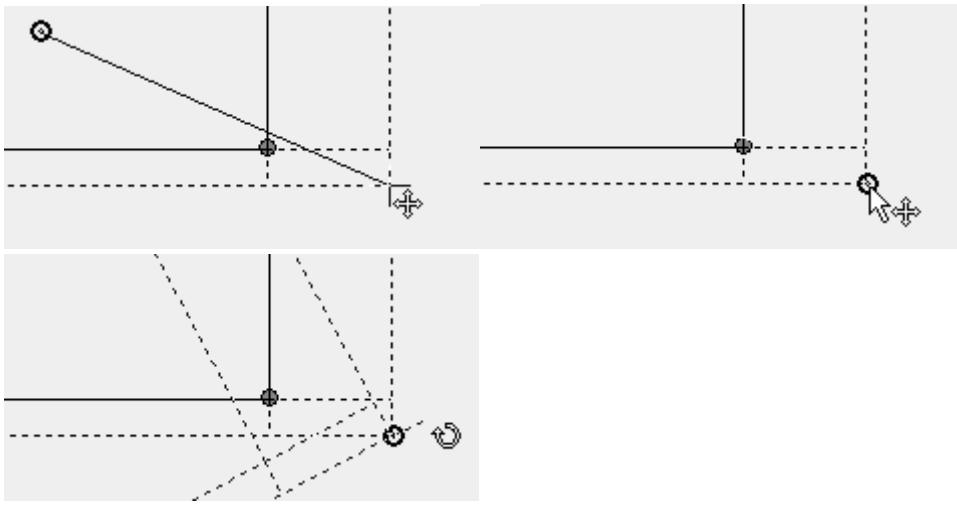
Rotate object
Some points, such as drawing frames and points/lines in the coordinate document, can be rotated. This can be done in different ways.

Tip! It is also possible to enter the angle in the input field.

Rotation of drawing frame
A rotation symbol appears when the mouse is over the grip. Click and drag your mouse to rotate the object. A shaded image is displayed to show the new position of the object.



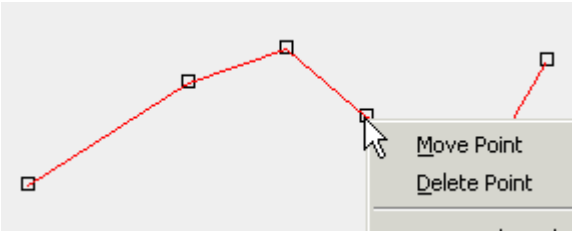
You can also change the rotation center by pointing to the grip with double rings as a symbol. Click and drag to change position.



Rotation in the coordinate document
Here you first select the objects you want to rotate using the Select tool. Right-click on any of the grips and select ***Rotate Selected Objects***. Now select the center of rotation, the point to rotate around, and remember to use the snap tools. You can now either specify a rotation angle, or enter a source and destination point for the rotation. The selected points will be rotated equal to the angle between the source and destination points.

'Menus in the Graphics'

Right-clicking in the graphical window will bring up a menu that is specific to the object you are pointing to. If you have not pointed to any object, a general menu appears with the option of toggling the active document. On the other hand, pointing to a grip opens a menu that includes the operations that can be performed on that particular object.

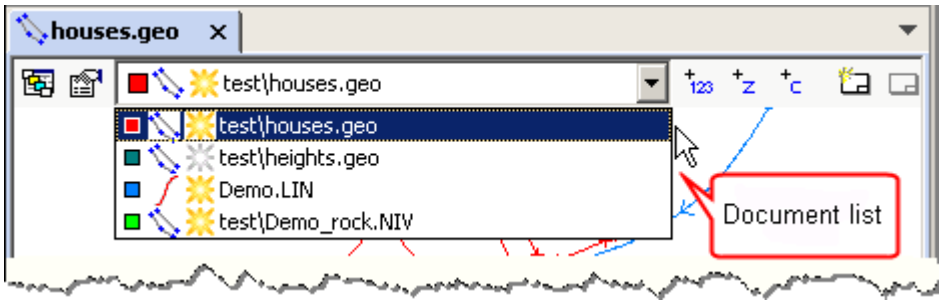


Right-clicking on the side of a grip brings up a general menu instead. The menu always includes the option ***Document Properties...*** that opens the dialog for document properties 52, and the option ***Documents in Window...*** that opens the dialog for documents in the graphical view 50.

If there are objects selected, the option ***Deselect all*** is available, which means that all the selected items

are deselected.

You can change the active document in the view by selecting ***Active document | <document.typ>***or by clicking the arrow in the document list, and then clicking the document to be made active.



Object Properties

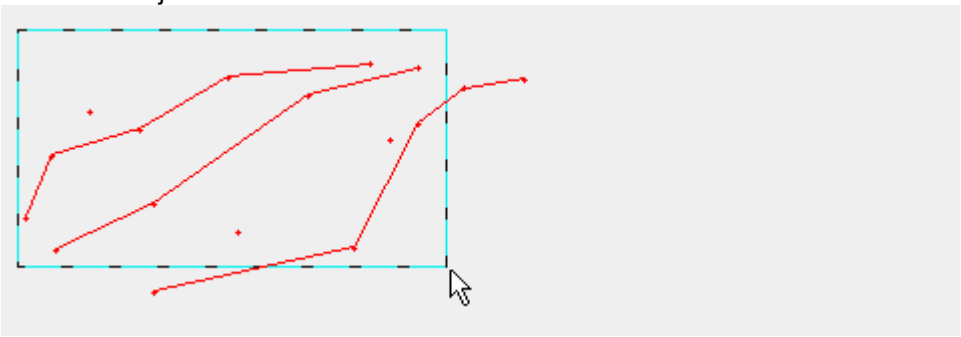
By selecting ***Properties...*** in the menu that appears when you right-click a grip the properties dialog 106 opens for the selected object.

Move Objects Graphically

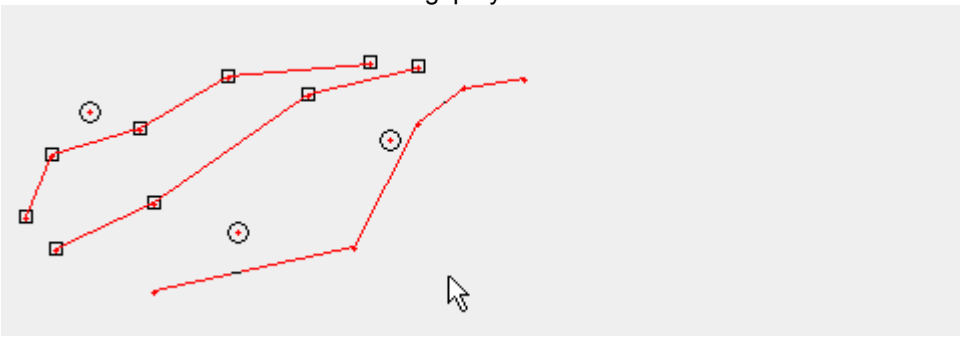
Move one or more objects

These can be moved by selecting one or more objects. This is done by selecting the desired object and right-clicking one of the grips. The chosen grip will be the base point for the movement.

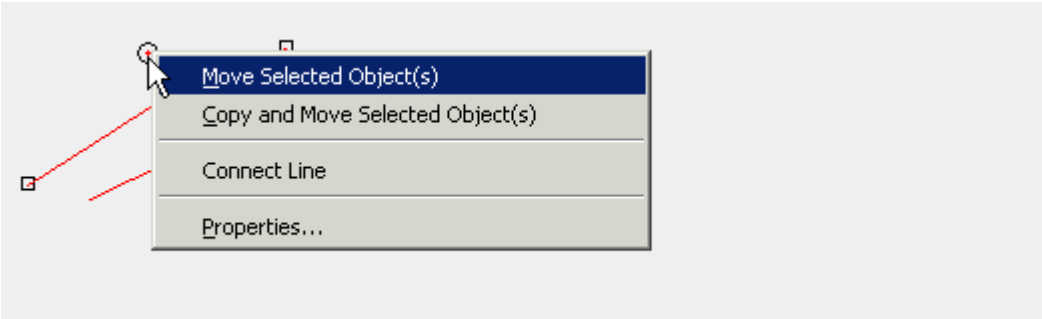
1. Select the objects



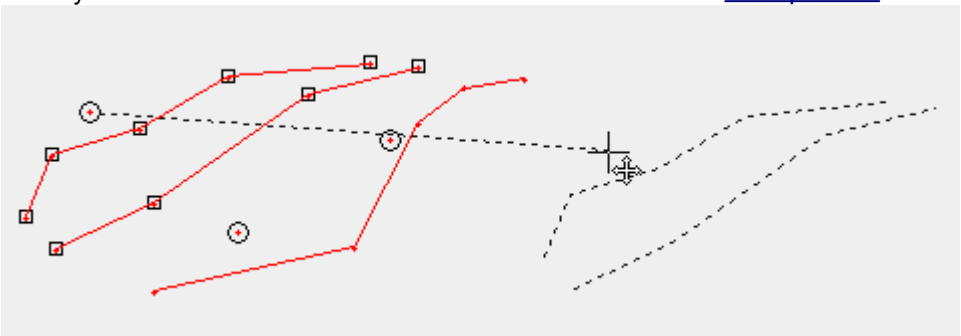
2. The selected items are marked with grip symbols



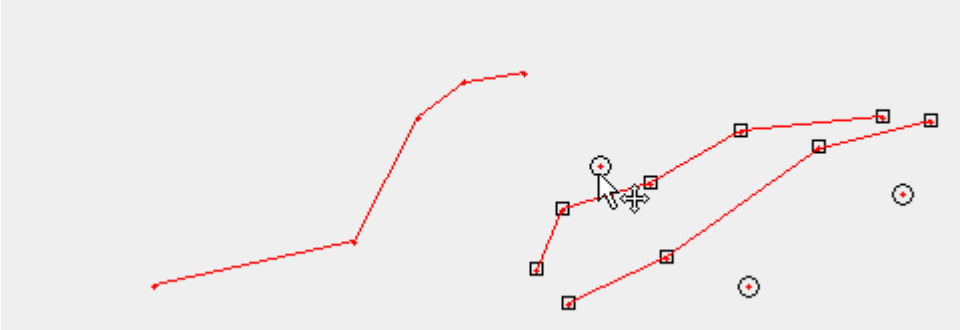
3. Right-click on one of the grips and select ***Move Selected Objects***, the selected point is the base point for the movement.



4. Move your cursor to a new location or enter the coordinates in the input field 107.



5. The objects are moved

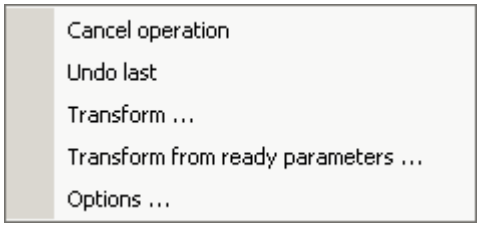


Copy and move objects
If you want to move copies of the objects, select the menu option ***Copy and Move Selected Objects***. Otherwise as above.

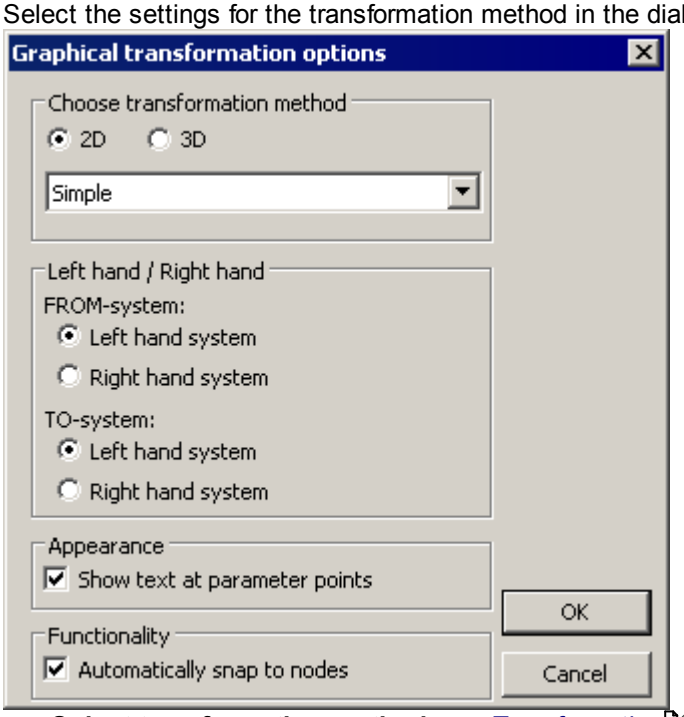
Rotate Selected Objects
See description under Tool Linked to Grips 208.

Zoom to Selected Objects
Zooms the graphical window so that the size of the selected objects is adapted to fit the screen.

Transform Selected Objects
See instructions in iCON office's output window 107 for the function.
This function is optional for the coordinate files (geo, pxy, llc) and the AutoCAD files (dwg, dxf).
Click on a source point and then to the destination point. To get the snap tools to work, you need to remember to change the active document as normal, depending on the document in which the source and destination points are saved.
Continue to choose the source and destination points to be used.
Right-click in the graphic to get additional options.



- **Cancel transformation**
  Cancels the transformation.
- **Undo last**
  Deselects the last selected source or destination point.
- **Transform**
  Executes the transformation.
  The file with the selected source points must be active.
- **Transform with finished parameters**
  A dialog opens where you can select a previously saved transformation file, tpf.
- **Settings**
  Select the settings for the transformation method in the dialog that opens.



  - **Select transformation method**, see Transformation 190 .
    If you choose to define the relationship in two dimensions only the plane coordinates are transformed with the height retained. Transformation can also be defined in three dimensions in which all coordinates are transformed.
  - **Left hand/Right hand**
    Specify if the coordinates are in a left or right-handed system. The geodetic plane coordinates (latitude and longitude) are usually in a left-hand system, while the geocentric coordinates (XYZ) are in a right-hand system.
  - **Appearance**
    Select to view text at the transformation points. The source points appear as FX and the destination points as TX, in which X is replaced by an incrementing number.
  - **Functionality**
    Select in order for the function to automatically snap to points in the active document.

Line Tools

All these tools can be accessed by selecting a line, right-clicking one of the grips and selecting from the menu.

Move point

Moves a single point in the line, see Tool Linked to Grips 208 .

Delete point

Deletes the point you pointed to from the line. The point before and after are then connected.

Split line at node

The line is split at the point you clicked on, and the point is copied so that it appears in the two new lines. The line after the break is treated as new and therefore gets a new line number.

Break line after node

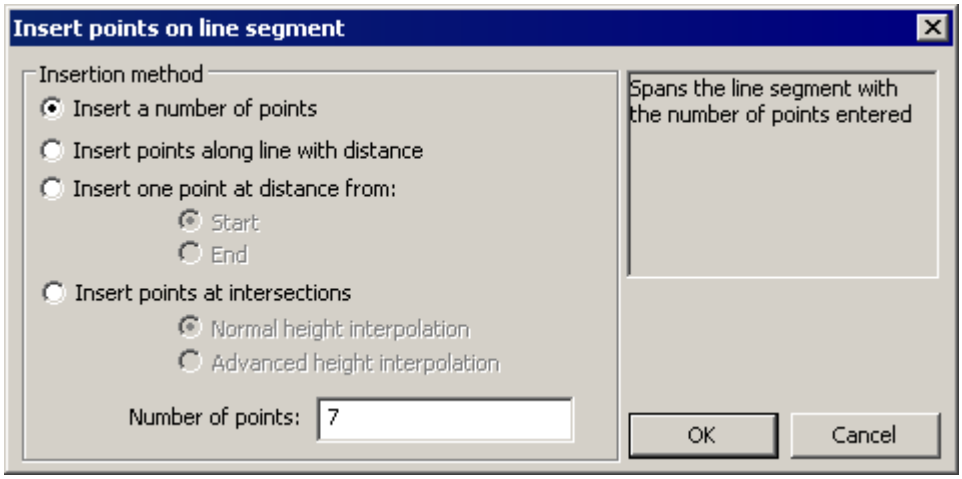
The line is split at the point you clicked on, and the connection between the next point is lost. The line after the break is treated as new and therefore gets a new line number.

Connect line

You use this tool to connect a line/point with another line/point. Point to a point or to a line end to connect with. The line to connect to will get the same line number as the starting line, although the point number remains unchanged. If two single points are connected, a new line is created.

Insert points after node

Use this tool to insert one or more new points in a line. The points are added after the selected point.



Insert a fixed number of points: The distance between the points is determined by the selected number of points.

Insert points with a fixed distance along the line: The number of points is determined by the selected distance.

Insert a point with distance from the start/end: Enter the distance and select either the start or end.

Insert points at intersections with normal or advanced height interpolation: A point is inserted where other lines cross the selected line and the height is interpolated from either the selected line (*Normal height interpolation*) or as a mean value between the selected line and the intersecting line (*Advanced height interpolation*).

Explode Line

Deletes the line connection from the points in a line. The points will be given new numbers, line number +

the point's previous number. E.g.: For a line with line number 113 that has the points 1 and 2, the points after the explosion will have the numbers 113.1 and 113.2.

Reverse line
A line in a coordinate file 153 or in a line file 503, can be reversed.

Reverse line in a coordinate file:
- Click the line, to get all nodes in the line selected.
- Put the pointer at one of the line's nodes.
- Right click on the mouse and select ***Reverse Line***.

Reverse line in a line file:
- Open a line file, l3d, and select ***Data*** | ***Reverse Line***.
- Please note, a line including station equation 515 cannot be reversed.

This happens when you reverse a line in a coordinate file:
  - The direction of the line will be changed.
  - The order of the points in the line will be reversed, but the point number for a given coordinate will not change.

For more information about reversing a line in a line file, see Line, Graphical View 520.

Point Tools

Connect line
See description for line points 214 .

Rotate symbols in the graphical view
To rotate symbols in a coordinate file, use the special code 157 for bearing, B, together with the Remarks column.
- To determine the bearing for a line, you can use the distance tool 225 while you select the points in the graphics. The bearing will be displayed in the Input and Output window 107 .
- In the numerical view, enter the desired point code, the special code B, and the point's bearing in the Remarks column.

See also Graphical Views 47 , Graphical Tools 223 .

4.2 Help Layers, Gft Files

When you graphically interpret points and lines using some of the graphical tools, the objects created are saved in a special document (or layer) called help layers. The help document is the gft type, and is created automatically by iCON office in the current work area. You can regard the help layer as a sort of temporary storage area where you can try different options before selecting to copy the points and lines to other document types, such as coordinate documents or line documents. Data created using the help layer is automatically saved by iCON office, which means you can continue to work with previous help objects when you restart iCON office. You should consider the contents of the help layer as temporary, however, and choose to save in other formats as soon as the desired result has been achieved.

When you open the help layer, the graphical tools are enabled that create help points and help lines. These tools are disabled again as soon as the help layer is closed. See more under Graphical Tools 223 for a description of how the various tools work.

The contents of the help layer are stored in the file *project.gft* in the current project.

Activate Help Layer

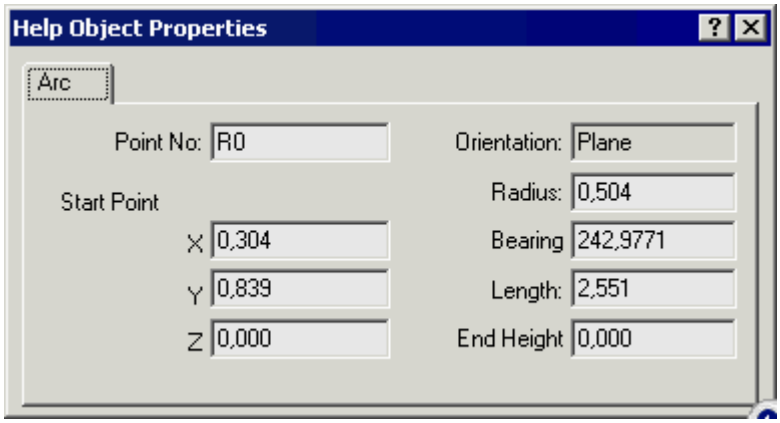
Select ***View | Show Help Points*** or click the button , to activate the help layer. The contents of the layer appear on screen unless the window's current coordinate range matches with the object's coordinates in the layer. If you choose to zoom to the limits, the help layer's object will also influence the outcome. The graphical tools that create help files are enabled when the help layer is opened.
The tools that apply are:

- Midpoint
- Intersection Point
- Circles
- Arcs
- Tangent Points
- Spirals, Spiral Curves
- Baseline
- Parallel lines
- Customize elements using the Least Squares method

To close the help layer you choose the same options as when you opened it. The contents are automatically saved to the file *project.gft*.

Help Layer Objects

A number of different objects can be created by the various tools. The help layer is divided into sections for different view orientations, which means that the objects that are created in a plane view are separated from those created in a profile view. By right-clicking on an object selected using the select tool, and then selecting ***Properties...*** in the menu, you can edit its properties in the properties dialog 106 . The appearance of the dialog depends on the object type, see the relevant point below.



Points
Points can be created by the tools for midpoint and intersection point. You can change the name and coordinates in the properties dialog. The point can also have a radius linked to it. The radius is set if the point is created when interpreting the arc element. This makes things much easier if the point is to be used for further interpretation or when copying to a coordinate file.

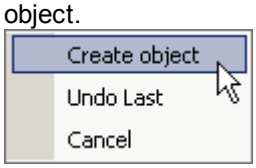
Lines
Lines in the help layer are created either by selecting the Parallel Lines tool or by selecting the Draw Line tool with the help layer active.

Arcs
An arc in the help layer is an element with a starting point and a distribution, length. In addition to point name and coordinates, you can also edit the radius, start bearing, length and end height of the element in the properties dialog.

Spirals, Spiral Curves
Spirals are created by one of the spiral tools. Besides the actual spiral, tangent points are also created. To select a spiral you point to anywhere on the line, while if you point to the endpoints, these will be selected instead. In addition to point name and coordinates, you can also edit the radius, start bearing, length and spiral parameters of the element in the properties dialog.

Baseline
Once a baseline has been defined with the baseline tool, it is also stored in the help layer. You can only work with one baseline at a time, if a new one is defined the old one is automatically deleted.

Fit elements using the LS method
These tools make it possible to adapt a line, an arc or a plane to a number of scattered points, using the least squares method. Click on the points to be included in the element and then right-click to create the object.



Please note, all selected points will be included in the least squares calculation, but the length of the line will always be dependent on the first selected point and the last selected point.

- **Fit 2D/3D Line**
  Fits a 2D or a 3D line to the selected points, see Graphical Tools 243.

- **Fit Circle Arc**
  Fits an arc to the selected points, see Graphical Tools 243.

- **Fit Plane**
  Fits a sloping plane to the selected points, see Graphical Tools 244.

Created lines, arcs and planes are always displayed in the help layer. If you want to save these, to be able to work with them later, you need to copy the objects to another file type, for example a coordinate file, see Copying Objects 218 below. If you have copied a plane to a coordinate file, you can use it to create a terrain model, see Create Terrain Models 639 .

Copying Objects

When you interpret objects in the help layer, and you want to copy these to other documents, there are two different options:

- **Copy to Active Document**
  Activate the document to which data will be copied and select ***Tool | Copy to Active Document | Point/Element*** or ***Line***, or click . Now click in turn to the objects to be copied.

- **Copy** and **Paste**
  Select the object or objects to be copied and select ***Edit | Copy***, . Now activate the document to which data will be copied and select ***Edit | Paste***, .

Clear the Help Layer

Select ***Data | Clear Help Layer*** or click the button to delete all data from the help layer.

See also Graphical Tools 223 , Graphical Editing 206 , Graphical Views 47 .

4.3 Background Image

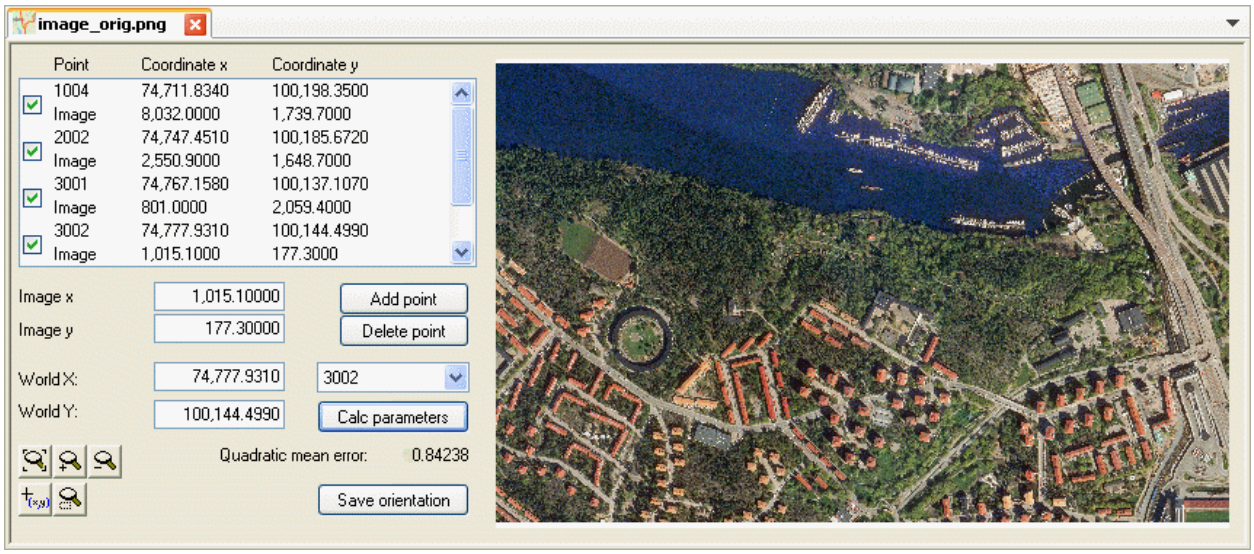
General

For each project in iCON office, a background image can be linked, for example, a map image or orthophoto. This image appears as a background in 2D graphics 47 and can be draped to Terrain Models 638 in 3D graphics 80. Images in the formats ***bmp, tif, jpg, png, pcx*** and ***tga*** can be used.

Tif files with Unisys compression (LZW) are unfortunately not supported. In most image editing programs you can choose the compression format and then a different format should be selected.

The text below will give you information about:

- How to create a transformation relationship used for a background image in iCON office.
- How to specify a background image in your project.



Create transformation relationship

For the image to be displayed, a transformation relationship between image and world coordinates is created. This is done by specifying coordinates for at least three points in both the image and world coordinates.

- Open the image in the usual manner with ***File | Open File*** 25.
- The image will now appear in a dialog view with editing options for fitting points. Depending on the type of image, there are different approaches for specifying fitting points, see Scanned maps of photographs 219 or Digital maps of orthophotos 220 below. The relationship created is an affine transformation 188 and the transformation relationship is saved in a file named as the image file but with the file extension .tpf.

Tools in the graphical view

Zoom limits

Zoom in

Zoom out

Tools to define image coordinates for the fitting point

Zoom rectangle

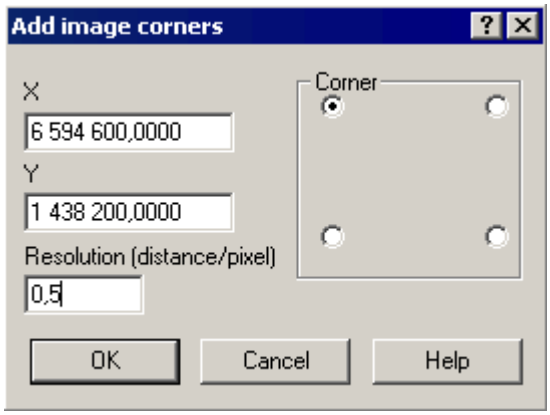
Scanned maps or photographs

Load world coordinates by selecting the point in the list that appears below the button **[Delete point]**. A list of all points in the files placed under the known points appear in the **Settings tab** 16 in the Project Tree.

Coordinates can also be entered directly in the fields *World X* and *World Y*. Select the pointer tool in order to identify the point in the graphical window. If there are coordinates in both systems, choose **[Add point]** to add the point to the list. At least three points must be in the list and be checked in order to create the transformation relationship.

Digital maps or orthophotos

These images often already have a known position and resolution, and this can then be used. The image/photo must be North/South oriented. Select ***Data | Add Corner Points***.



In the dialog that appears, you can enter coordinates for any of the four corners of the image and enter the resolution (one pixel size at the ground). When you select **[OK]** this information is used to calculate both image and world coordinates for all four corners, and the points are added to the list. The relationship can then be created as described below.

Create and save the relationship

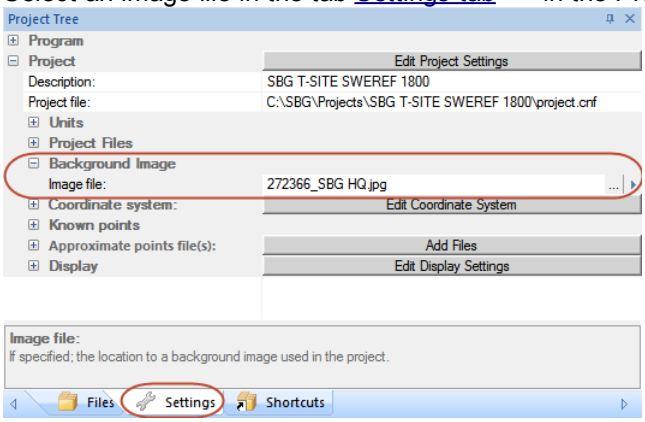
When at least three points in the list are checked, the transformation relationship can be created. Click **[Calculate parameters]** to solve the relationship. If more than three points are used, a mean fitting error now appears below the button (Square mean error). If you are not satisfied with the results, you can try checking the box of a point you think is wrong and recalculate. Note that the mean error is always 0 with three points as there is no redundancy. When you are satisfied with the results, click **[Save orientation]** to save the relationship.

Choose background image

You can create transformation relationship to several images in your project, but only one background image can be active at a time.

There are two options for selecting the active background image

- Once you have the image open, select ***Data | Set as project background***.
- Select an image file in the tab Settings tab 16 in the Project Tree



Select a background image.

In both cases, the transformation relationship must have been created first, thus there must be a transformation file, .tpf connected to the active file. If you choose an image that was formerly used as the background, the old relationship remains. In the graphics window, you turn the display of the background image on and off using the button or ***View | Show Background Image***.

If you have an image with an accompanying text file containing parameters for the image, iCON office can use this text file to orient the background image. If, for example, you are working with ESRI® World files and have an image file image.jpg and an accompanying text file named image.jpgw or image.jgw, you do not need to create a transformation relationship in iCON office, as iCON office uses the text file with parameters.

There are two ways of naming files with parameters for orientation; the most widely used method is to take the first and last letters of the extension and then add w, for example, the extension .xyz becomes .xzw. Text files with parameters for orientation can also have the image file's extension with a suffix w, for example, the file extension. xyz becomes .xyzw. See the table below for suggestions for the images that can be loaded as a background image, if there is a text file that already exists that orients the background image.

Image file	Example of text file with parameters	Example of text file with parameters
.bmp	.bpw	.bmpw
.tif	.tfw	.tifw
.jpg	.jgw	.jpgw
.png	.pgw	.pngw
.pcx	.pxw	.pcxw
.tga	.taw	.tgaw

The first column corresponds to the extension of the image file, while the following two columns to the file extension of the text file, if any, with parameters.

See also: Project Settings 16, Transformations 188

4.4 Graphical Tools

4.4.1 Graphical Tools

Tool Input

Input data for the graphical tools is provided either by pointing to the graphic or by inputting from the keyboard. In the input/output window 107 a text describing the next steps to be taken appears and in the input field the current data type that is expected displays. You can often select more than one option from the list. The following data types may occur:

Data Type	From mouse click	From the keyboard
Coordinates	X (2D)	X
Relative Coordinates		X
Polar Coordinates		X
Distance/Bearing/Slope	(X)	X
Radius	(X)	X
Spiral Parameters		X
Section		X
Point/Line numbers		X
Height		X
Code		X
General Values		X

When more than one sub-values are to be specified, use a **semicolon**, **;**, to separate them. Decimal separators are determined by settings in Windows® (national settings), usually with a comma or period. A sub-value can be left blank if not needed.
Example of inputs (with comma as decimal separator):

Data Type	Value	Input Syntax
Coordinates (North, East)	(N1,23 E4,56)	1,23;4,56
Coordinates (North, East, Height)	(N1,23 E4,56 Z7,89)	1,23;4,56;7,89
Polar coordinate (Distance, Bearing)	(L1,23 B4,56)	1,23;4,56

Tool Output

The intermediate and final results from the tools are shown in the output window 107 . In the graphical window the temporary results appear with dashed lines.

Tools

Only one graphical tool can be used at any one time. In general, the last selected tool remains until you select another. Some tools produce objects that appear in the help layer[216]. You should consider the contents of the help layer as temporary and choose to save in other formats as soon as the desired result has been achieved.

Below, the following graphical tools are described:

Zooming[224]
Panning[225]
Distance[225]
Selecting[225]
Selecting Texts[226]
Copy to Active Document | Point / Element[226]
Copy to Active Document | Line[226]
Draw Point[226]
Draw Line[226]
Text[227]
Symbol[227]
North Arrow[227]
Coordinate List[227]
Area Tool[227]
Set Point Info[228]
Create Road Line[229]
Info[229]
Split Lines[229]
Connect Polylines (Merge Lines)[229]
Trim Line[230]
Extend Line[232]
Auto Join Lines[232]
Explode Object[235]
Linear Dimensioning[235]
Aligned Dimensioning[235]
Midpoint (H)[237]
Intersection Point (H)[237]
Circles (H)[237]
Arcs (H)[237]
Tangent Point Tools (H)[238]
Spirals (H)[239]
Baseline (H)[239]
Parallel Lines (H)[242]
Fit elements using the Least Squares method (H)[243]
Fit 2D line[243]
Fit 3D line[243]
Fit arc[243]
Fit plane[244]

Zooming

Used to zoom in, point out the coordinates of the corner points of the rectangle in which the zoom is made.

In addition to zooming using the window, as above, it is possible to zoom in stages. The magnifying glass marked with a plus sign zooms in and the one with a minus sign zooms out. This is done with a window

center as base point. It is also possible to save two zoom modes, which you will be able to toggle between. A current zoom mode can be saved using any of the buttons in either of the following ways:

- Go to ***View | Zoom*** and select *Save Zoom 1* (or 2).
- Right-click in the graphic and select *Save Zoom 1* (or 2).

To view/go back to a saved zoom mode, do so in either of the following ways:

- Go to ***View | Zoom*** and select *Load Zoom 1* (or 2).
- Click the magnifying glasses marked with a 1 or a 2 in the tools menu.

Tip: You can also use the Page Up and Page Down keys to zoom in and out. If your mouse has a wheel, this can also be used for zooming in and out.

Panning

You use this tool to move the focus of the graphical view without changing the zoom mode. First click on a reference point and then point to its new location.

Distance

The distance tool is used to measure distances and angles between points. First, click on the starting point and then on the points to be measured.
It is also possible to snap points in place using the various snap tools while the distance tool is active.
The output window displays horizontal and sloped distances, both between the last two points and cumulatively. The bearing and vertical angles between points are also shown.
If you want to determine the bearing for a certain point in a coordinate file, use this distance tool, see also Coordinate Files, Geo and Pxy in General 157.

Selecting

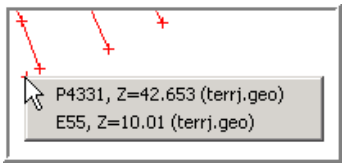
You use this tool to select one or more objects in the active document for further modification, such as deletion, movement or rotation. There are two ways to select objects, either by directly pointing to any part of the object or by enclosing the object with a selection box 207. When an object has been selected, this appears in the graphic with symbols for break points/insertion points.

When selecting with a selection box you draw a rectangle with the cursor. The direction in which the rectangle is drawn is important, if it is from left to right this means that all objects that are inside the rectangle will be selected. If, on the other hand, it is drawn from right to left, all objects with any part inside the rectangle will be selected. Note that the color of the rectangle changes to indicate direction.

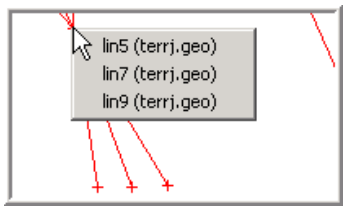
See also 'Selecting Objects' in Graphical Editing 206.
The selection symbols that are drawn for the selected objects have different appearances and different menus associated with them depending on the object type. For example, a point that is selected is given a selection symbol and menu other than a text or symbol. Most selection symbols also have a quick tool linked to them that is activated when you left-click on the symbol. A point can, for example, be moved when you left-click. Right clicking activates the object specific menu.

Only objects in the active document can be selected with the tool.

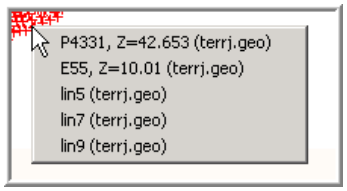
By clicking at a point in the graphics where two or several points are situated, a dialog appears where the user can select one of the points. For each point the list displays point name, line name, or an invented number if the point is nameless, and the height of the point (no height is displayed for points in lines) and also the name of the file.



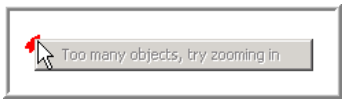
Example where two points have the same plane coordinates. The two points differ in heights, and they are stored in the same coordinate file, terrj.geo.



Example where three lines intersects. The line number and the active coordinate file are displayed in the dialog.



Example where it is hard to distinguish points and lines due to the zooming. You do not need to zoom to select point or line, as you can use this dialog instead. Point numbers, heights and line numbers are displayed.



If there are more than 25 points close together, a dialog appears recommending zooming.

Selecting Texts

This tool serves as the standard selection tool with the difference being that only texts are located and selected. This applies exclusively to single texts such as separate objects, e.g. in drawings.

Copy to Active Document

This is a very useful tool when you have interpreted the points in the help layer 216 for example. Activate the document to which objects are to be copied and then point out the objects in sequence which will then be copied to the document. Point to the beginning of the element you want to copy. If the element is turned the other way, it will be turned before it is pasted. Depending on the target document type, different dialogs appear in which additional information can be edited, such as heights when you copy points to a coordinate document. Help points may also contain radii that can be used by the target document.

Copy to Active Document | Point/Element	Used to copy single points to active document.
Copy to Active Document | Line	Used to copy lines to active document.

Draw Point

You use this tool to create a point in the active document. Either click on the desired position on screen or enter the coordinates in the input field. You can also use the snap tools to determine the position. You can enter **point number**, **height** and **point code** for the new point by selecting from a list in the input window 107 and then entering the desired value. Remember that this must be done before specifying the point location.

Draw Line

You use this tool to create a new line consisting of one or more points. Either click on the desired position on screen for the first point or enter coordinates in the input field 107. You can also use the snap tools to determine the position. After the first point has been determined there are a number of options available by right-clicking:

- End Line
  Select this option to terminate the line at the last point
- End Polygon
  Select this option to terminate the line while dragging the last point to the starting point to create a closed polygon
- Undo Last
  Deletes the last specified point

- Cancel Line
  Cancels the tool without creating any line.

The options list in the input window has several options for the line:

- Relative Coordinates
  To enter the next point relative to the previous.
- Distance
  To set a fixed distance to the next point, the direction can be determined graphically.
- Bearing
  In order to define a fixed direction to the next point, the distance can be determined graphically.
- Polar Coordinates
  To enter the next polar point.
- Radius
  To specify that the line element has a radius.
- Point Number
  Enter the next point number/name.
- Line Number
  Enter the line number/name.

Text

You use this tool to enter texts in drawings. Text content can be entered in the input window by selecting 'Value' and then entering the text. You then click on the desired position for the text or enter the coordinates in the input window. The text is then automatically selected and its properties displayed in the properties dialog. See also Objects in Drawings 276 .

Symbol

You use this tool to insert symbols in drawings. The symbol to be inserted can be specified in the input window by selecting 'Value' and then entering the symbol name. The symbol name must be present in the active symbol file 203 . the text. You then click on the desired position for the symbol or enter the coordinates in the input window. The symbol is then automatically selected and its properties displayed in the properties dialog. From here you can easily change the symbol by clicking the button **[Select...]**. See also objects in drawings 276 .

North arrow

See objects in drawings 276.

Coordinate list

See objects in drawings 276.

Area Tool

You use this tool to measure areas in the graphic. A menu with a number of options appears when you click the button: Select Area. This option is selected first, and gives you the option to either point to a line or single points. If you point to a line, the area the line encloses will be shaded. However, if you point to a point you will gradually need to point out more points to define the area. When an area is available, you can choose one of several options by right-clicking or clicking the toolbar button again:

- Create Area Report
  Displays a report with the area and circumference of the current surface.
- Save Polygons
  This option allows you to save the specified polygons in a new coordinate file.
- Delete Last Point

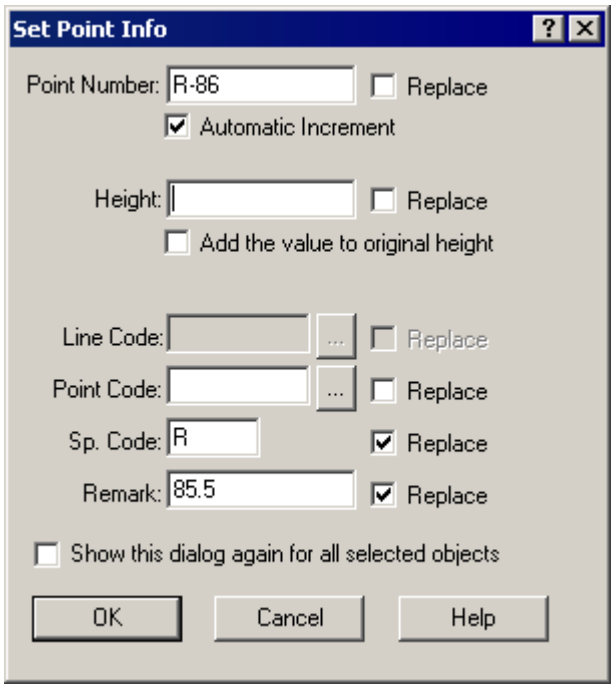
To re-select the last point.

- Delete Last Area
  To delete the last area.

- Delete All Areas
- To delete all selected areas.

Set Point Info

You use this tool to set point number, height, code, special code and remarks for points in a coordinate file. First point out a point to be changed.



A dialog appears where point information can be changed. Point numbers are automatically incremented if you check the box **[Automatic increment]** and then click on the points to be renumbered. For height, you can also choose to add a value to the original height.

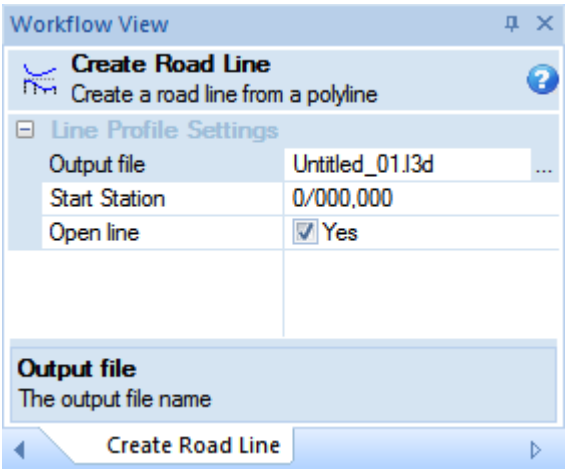
The **[Replace]** option must be checked to set each value.

Create Road Line (l3d)

Use this tool to create a line[505] (l3d) including horizontal and vertical geometry, from either:

- a line in a coordinate file (geo)
- a line in an AutoCAD® file (dxf, dwg)
- a line in a terrain profile document (pro)

Select ***Tools | Create Road Line***, or press the button in the toolbar.



Settings in the Workflow View to create a road line (l3d).

Use the Workflow View to create the line:

- **Output file:** Type a name of the new line. It is also possible to change the path to where the resulting file will be saved.
- **Start Station:** A start stationing for the length measurement can be entered.
- **Open line:** Check the box **[Yes]** if the converted line should be displayed in the graphical view.
- In the graphical view, select the line by clicking it. This will create the road line file!
- If you select several lines, the name of each line will automatically be updated with a numerical suffix. Of course, you also have the possibility to enter a new name before you click on the next line.

Info

By pointing to an object with this tool selected, the information about the object will appear in the output window.

Split Lines

You use this tool to split polylines.
Point to the line element that you want to remove, the line will be divided into two parts comprising the points before and after the element you pointed out. If you do not point directly to a line element, you can draw a polyline instead and choose to split all the lines that cross it. When you have drawn the full polyline, click the right mouse button and select 'Split with Polyline' to complete the command. Wherever lines cross the drawn polyline, a new split will now be made.

Connect Polylines (Merge Lines)

The tool is used for connecting polylines.
Point first to the end point of the line you want to connect to another, and then point to the end point of the second line. If you point to a single point instead, the tool is activated again and you can directly point to the next point to connect to the line.
When connecting lines, the new connected line will be given the line number from the first selected line. Point numbering remains unchanged.

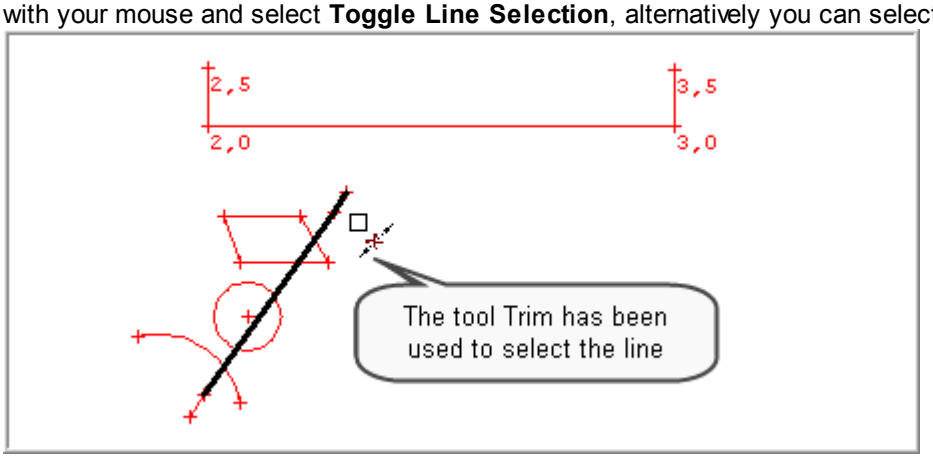
Trim Line

This tool can be used to cancel lines that cross each other or their proposed extension.

Start by clicking on the line or lines that are to remain. Now click on the lines that you want to cancel and delete.

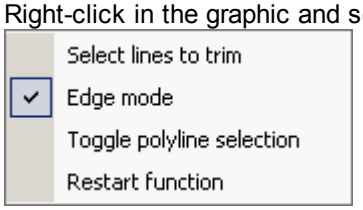
Function of Trim Line in brief:

1. Select the lines or line elements to be used as delimiting lines (for breaking another line or polygon).
   If you click on a line, the line element is selected. If you want the whole line to be selected, right click with your mouse and select **Toggle Line Selection**, alternatively you can select several line elements.



   If you have incorrectly selected a line, deselect the line by left clicking on the line again.

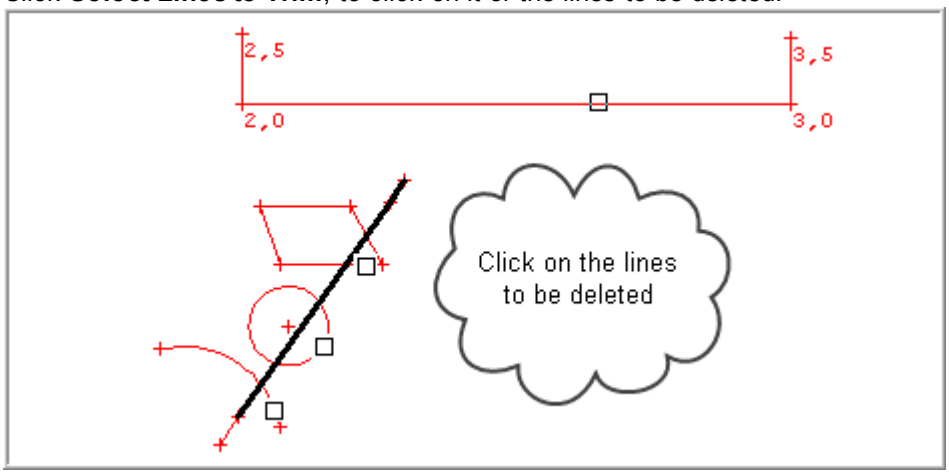
2. Right-click in the graphic and select **Select lines to trim** and make any selections where necessary.



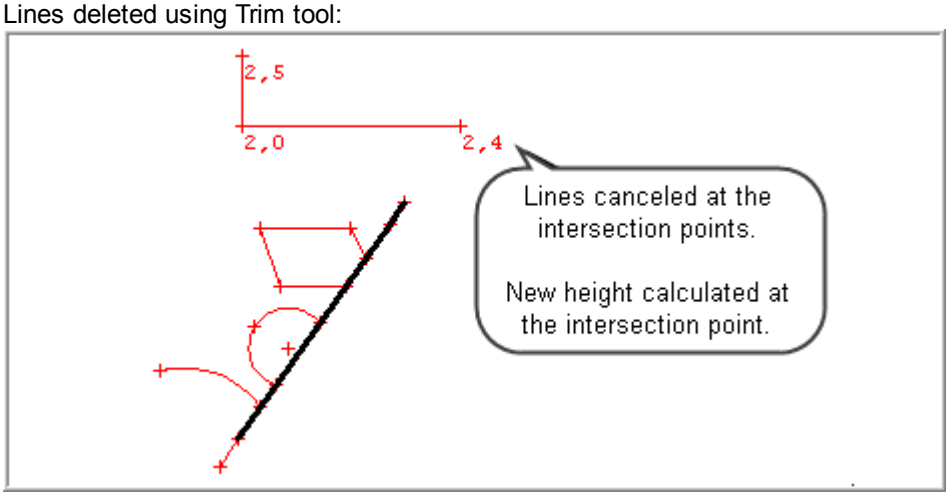
   Select lines to trim - select this option to cancel and delete lines you do not want.

   When **Edge mode** is checked, iCON office searches for a planned intersection with the selected line element.
   If Planned Intersection is not checked, only lines that cross each other physically are deleted.
   Toggle Line Selection - select this option to toggle between selecting only line elements or full line.
   Restart function - deselects all lines in the graphic, and restore the dialog above so that only *Edge mode* is checked.

3. Click **Select Lines to Trim**, to click on it or the lines to be deleted.



4. Lines deleted using Trim tool:



A new point is created at each intersection.
Lines canceled using the Trim tool are given a new height calculated at the new intersection point.

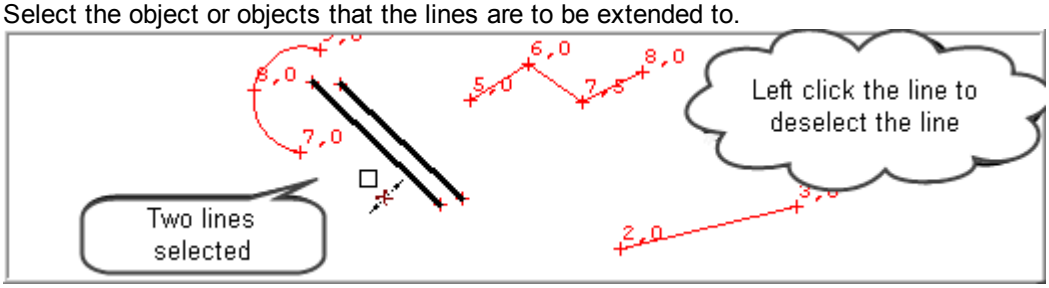
Note that you can change a circle to an arc using the Trim line tool.

Extend Line

You use this tool to extend an existing line in a coordinate file. The polyline is extended until the line meets another line or a planned extension of another line.
Lines and arcs can be extended, until they meet the object they are to be extended to.

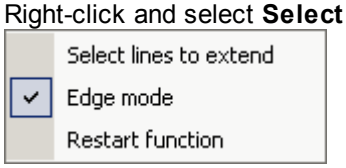
Function of Extend Line in Brief:

1. Select the object or objects that the lines are to be extended to.



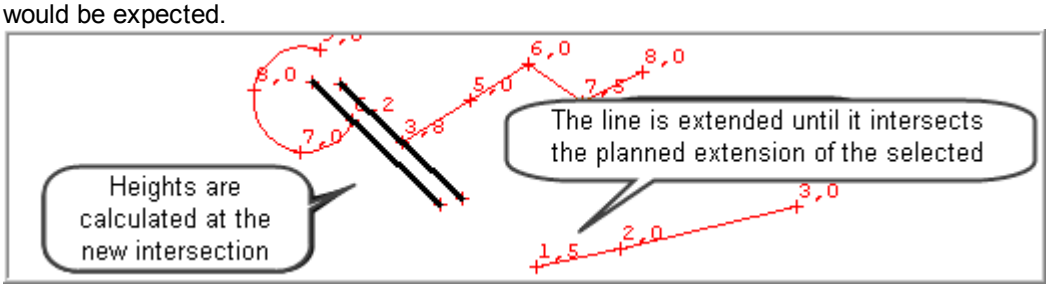
If you have incorrectly selected a line, deselect the line by left clicking on the line again.

2. Right-click and select **Select lines to extend**.



If **Planned Intersection** is checked, you can extend lines until they intersect the planned extension of the selected line or lines.
Restart - all selected lines are deselected.

3. Click on the objects to be extended.
Lines are extended until they meet the limit objects. A new point is created at the intersection point as would be expected.



Auto Join Lines

When you select this tool, iCON office helps you to join several short line segments into one single polyline in a coordinate file.

- This tool is used to merge several short line segments into one longer line. Suppose for example that you have a coordinate file with several short line segment where the distance between two line segments is less than 0.001 m. By the help of the tool Auto Join Line, these line segments can be connected to one single line. See also Merge 233 below for additional information regarding merging lines.

- In the Workflow View 233 you select settings that should apply to the tool.

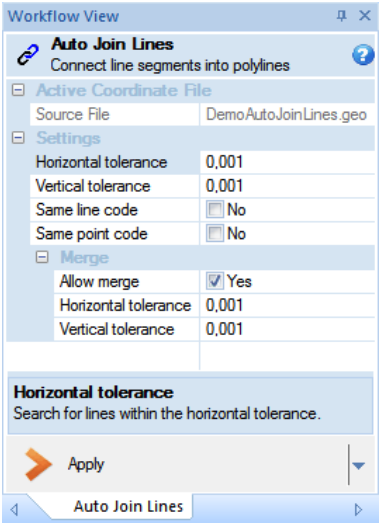
- In the Graphical View 234 you merge lines by clicking them.

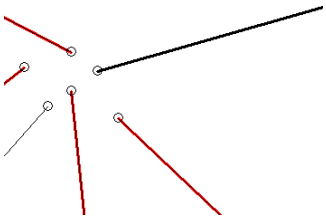
• Select ***Tools | Split / Connect Lines |***	

Auto Join Lines, .

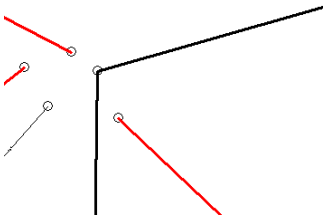
- In the workflow view:
  - Select **Settings** regarding
    - Horizontal tolerance
      - specify maximum horizontal distance to a line.
    - Vertical tolerance
      - specify maximum vertical distance to a line.
    - Same line code
      - check the box if only lines with identical line code should be possible to join.
    - Same point code
      - check the box if only lines with identical point code should be possible to join.
  - **Merge**
    - Allow merge
      - Here you specify how to merge lines.
      - Check the box **[Yes]** if points in lines within the horizontal and vertical tolerance should be merged.
      - The setting **[Yes]** is default in iCON office.

      - Deselect the box to activate **[No]**. A short line segment will be added between the lines that are about to be merged. All start and end points for all line segments will be saved.
    - Horizontal tolerance
      - Only selectable when you have checked Allow merge 233 **[Yes]**.
      - Points in lines within the given horizontal tolerance will be merged.
      - Specify maximum horizontal distance between two line segments to be merged, where the first point in the merged line should be merged previous line's end

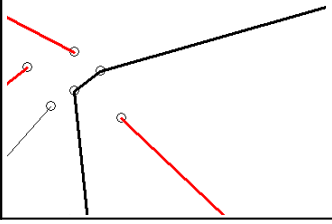




Here you can select one of the red lines to be merged with the black line.



Merge: Yes
The start point of the selected line will be removed at merging, thus no "duplicate points" in the line.



point. If the distance to the line exceeds the tolerance but is still within the given horizontal tolerance 233 above, an extra line segment will be added between the two original line segments. **Note!** The maximum length of this horizontal tolerance should be lower or equal to the horizontal tolerance 233 under Settings above. ▪ Vertical tolerance - Only selectable when you have checked Allow merge 233 **[Yes]**. - Points in lines within the given vertical tolerance will be merged. - Specify maximum vertical height difference to get the first point in the merging line to be merged with the end point of the previous line. If the height difference between the lines exceeds the tolerance, but is still within the given vertical tolerance 233 above, an extra line segment will be added between the two original line segments. **Note!** The maximum height of this vertical tolerance should be lower or equal to the vertical tolerance 233 under Settings above. • Click the button **[Apply]**, at the bottom of the workflow view, to save the settings. The settings are stored until you press **[Apply]** the following time.	**Merge: No** **A short line segment will be added between the two original lines. If the tolerance is set to 0.001m, there is a risk that these points can be interpreted as duplicate points.**
In the graphical view: • Click the line in the graphics and then you will be able to "manually help" the tool when it encounters any conflicts: ○ The selected line will be displayed with a wider black line. ○ If the tool encounters any conflicts, these possible extensions of the line will be displayed by wide red lines. The user clicks the correct line segment in the graphics. • Right click in the graphics and select **[Restart]**: ○ The merged line will become deselected.	➢ In the graphics the line will be displayed, thus you'll be able to check its appearance before you save the file. ➢ If two line segments are within the given tolerance, they will automatically be merged into one line, taking into account the given preferences under Allow merge 233 . ➢ Note, if there is a conflict between several ways of joining line segments, the user easily solves the problem by clicking the correct line segment in the graphics. ➢ The new line will get its name from the name of the first selected line segment. ➢ A merged point will get the height from the end point that

○ You can now use the tool to select other lines to be merged. • To undo the last selected line, select the button in the menu of iCON office.	retains its original position. ➢ In the Input/Output window 107, information about the procedure of the tool Auto Join tool is displayed. The information will tell you what you are expected to do, and also inform you how line segments are connected.

Explode Objects

You use this tool in AutoCAD files 289 to explode objects and works in a similar way to the tool ***Data | Explode Selected Objects***. Point either directly to the object you want to explode, or encircle multiple objects by pointing to an empty area and draw a rectangle around them, by pressing the left mouse button on the same time as you move the cursor.
You can explode the following objects:

- Polylines:
  Broken down so that each line segment becomes a separate object.
- Multiline Texts (MTEXT):
  Broken down so that each text line becomes a separate object.
- Block:
  A block is a composite object composed of other objects, such as lines and texts. In order to snap on individual objects in a block you must first unlock the objects, i.e. explode the block. A block can consist of other blocks and therefore may need to be exploded in several steps to access a particular object.

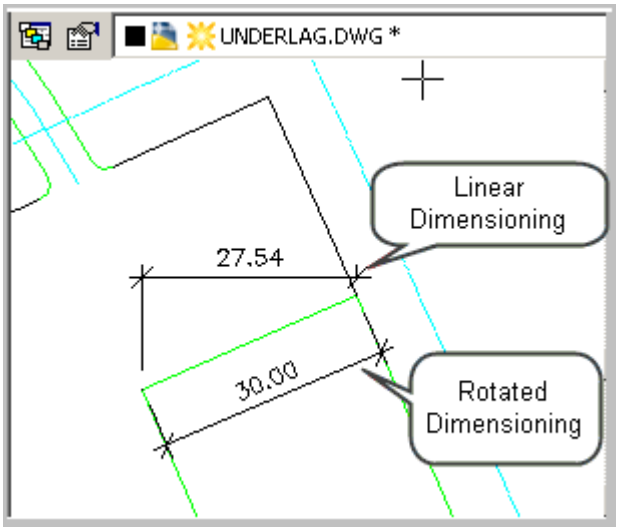
Other AutoCAD® objects may also be affected by exploding them. This is exactly the same as in AutoCAD.

You enter information in the output window in iCON office about the exploding procedure.

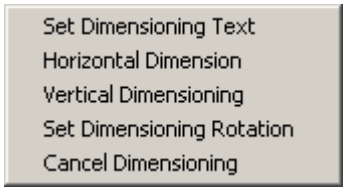
Linear/Aligned Dimensioning

If you enable this tool you will be able to perform and store dimensioning in AutoCAD® files. Dimensioning can be done with or without snap.
For selecting the font size and font, see the AutoCAD drawings 293 .

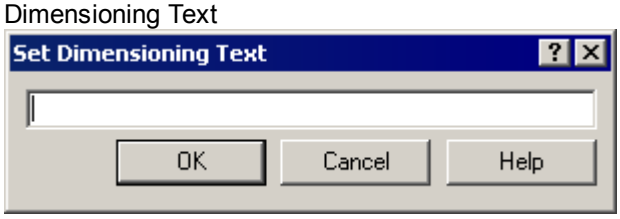
- Linear Dimensioning
  Select the start and end points of the dimensioning. Finally, select the position of the text. The linear distance is printed.
- Aligned Dimensioning (Rotated Dimensioning)
  Select the start and end points for the dimensioning and the position of text. The rotated distance is printed.



When the start point is selected, you can right-click the mouse button to bring up a dialog with choices for specific dimensions.



- Dimensioning Text

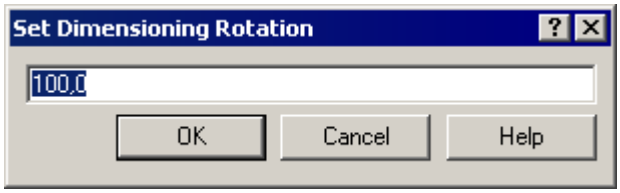


  Enter the required text for dimensioning. This could, for instance, be used to clarify that a certain length applies.

- Horizontal Dimensioning
  The text is printed horizontally.

- Vertical dimensioning.
  The text is printed vertically.

- Set Rotation

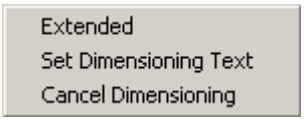


  The text is printed with the rotation specified by the user. The angle unit in iCON office can be checked and if necessary modified under ***Edit | Preferences***.

- Cancel Dimensioning
  Dimensioning is interrupted and the user has the option of selecting other points or another function.

For rotated dimensioning there is the option of creating an extended line that follows the rotation of a

particular object. When the end point is selected, you right-click the mouse to bring up a dialog where you can select Extended. Now you click on a new end point and finish by selecting the position of the dimensioning line, whereby the rotated distance is presented. There are two starting points that determine the rotation of the dimensioning.



Tip: If you use the snap function when dimensioning, remember to *disable snap* if you want to be able to place the text freely anywhere!

Midpoint (H)

This tool calculates the midpoint between two other points. Point either to a line element or to two points. The point is marked with an M.

(H - the element will be created in the Help Layer216.)

Intersection Point (H)

This tool calculates the intersection between two lines. The lines can be pointed out either directly or by pointing to two points. Even intersections in the lines' extension can be calculated, i.e. the intersection can always be calculated if the lines are not parallel. The calculated intersection is marked with an S.

(H - the element will be created in the Help Layer216.)

Circles (H)

You can create circles in two ways:

- Center point and radius
  Enter the first center of the circle and then either a point that the circle is to cross or enter the radius in the input field.
- Circle through three points
  Point out or specify three points that the circle is to cross.

The tools create a point at the circle center indicated with a C, and two arcs marked with an R.

(H - the element will be created in the Help Layer216.)

Arcs (H)

You can create arcs as follows:

- Two points and radius
  Start by pointing out or specifying the start and end points of the arc. Now point to a point that the arc is to cross or enter the radius in the input field.
- Crossing through three points
  Point out or specify three points that the arc is to cross.
- Center point, point and angle
  Start by entering the center point of the arc. Now point out the start point of the arc. Then either point out the end point or enter the arc angle in the input field; enter a negative angle to change the direction of the arc. When you point out the arc it will never be longer than a semicircle.

The tools create a point at the circle center indicated with a C, an arc indicated with RX and a point at the end of the arc indicated with R-X, where X is set to the arc radius (rounded down to the nearest whole number).

(H - the element will be created in the Help Layer 216.)

Tangent Point Tools (H)

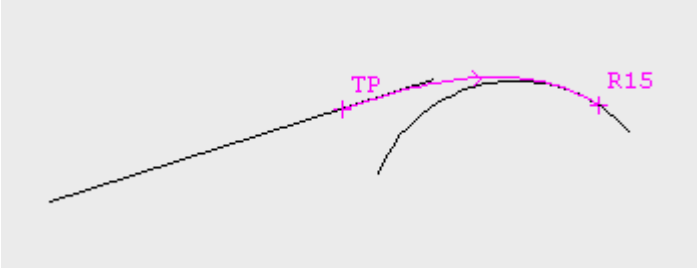
You use this tool to interpret an arc between two elements, straight line or arcs. Start by pointing somewhere at the beginning of the first element. Now repeat this for the second connecting element. You can also give the connecting elements by first pointing to the start point and then the end point and then give a radius or forced point. You now specify the middle element by either entering the radius or by pointing to a forced point through which the radius is to run. If you want to draw a straight line between the two arcs, specify the radius as 0. This tool creates an arc (or straight line) and two tangent points. Tangent points are marked with TP if the arc connects to a straight line, and RX where X is set to the connecting element radius (rounded down to the nearest whole number) if the arc connects to another arc. These points also contain radius information and are used for interpretation of road lines etc.

(H - the element will be created in the Help Layer 216.)

Spirals (H)

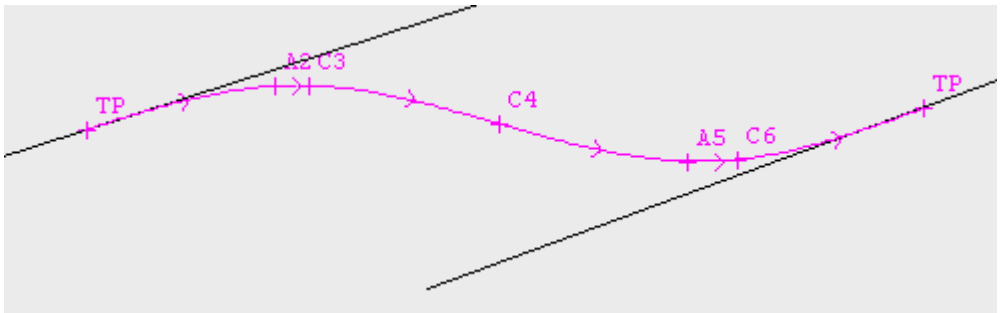
You use this tool to interpret different spiral combinations between two elements, straight line or arcs. Point the two connecting elements in the same way as explained when fitting arcs above. You can create three different spiral combinations. Depending on the combination to be created, you need to provide additional data in the input window or with the mouse.

- Spiral



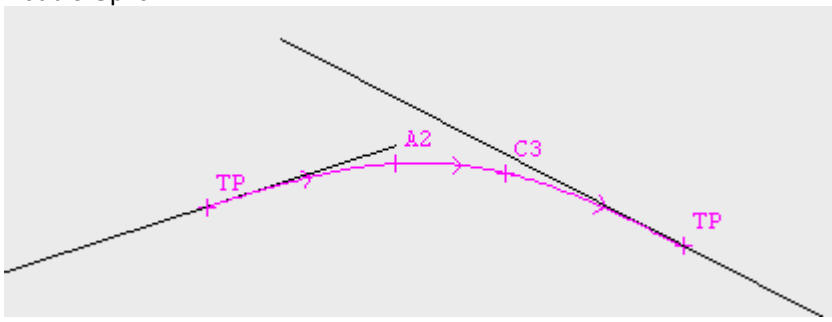
This function calculates a spiral that connects to the designated elements. Only connecting elements must be given. This tool creates a spiral and two tangent points in the same way as when fitting arcs.

- Inflection



This function calculates an s-curve consisting of spiral, arc, spiral, spiral, arc, spiral between two straight lines. After that straight lines have been pointed out, you enter the following in order in the input window: *length or parameter for spiral 1, radius of arc 2, length or parameter for spiral 3, length or parameter for spiral 4, radius of arc 5, length or parameter for spiral 7*. After this you need to point out and enter the tangent point at the first straight line. The tool creates elements and two tangent points TP.

- Double Spiral



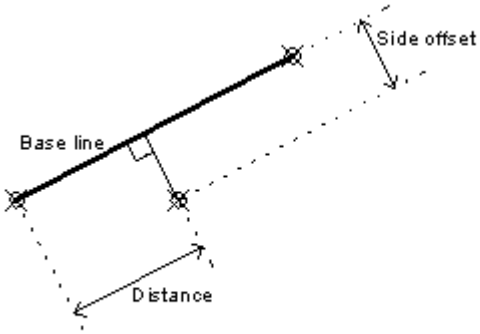
This function calculates a curve consisting of two spirals and an intermediate arc between two elements. After that straight lines have been pointed out, you enter the following in order in the input window: *length or parameter for spiral 1, length or parameter for spiral 3, radius of the intermediate arc 2*. You can also start by entering the radius and then specifying a forced point that the curve must go through. This tool creates the elements and two tangent points in the same way as when fitting arcs.

(H - the element will be created in the Help Layer 216.)

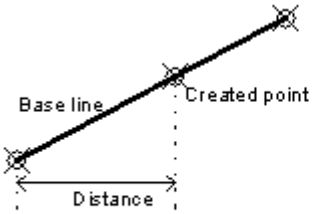
Baseline (H)

You use these tools to calculate the points and measurements relative to a baseline.

- Define
  Select this option to create the baseline. Point to its start and end points. Note: use a snap tool to find a precise point.
- Delete
  Deletes the baseline from the screen.
- Ortho In 2D



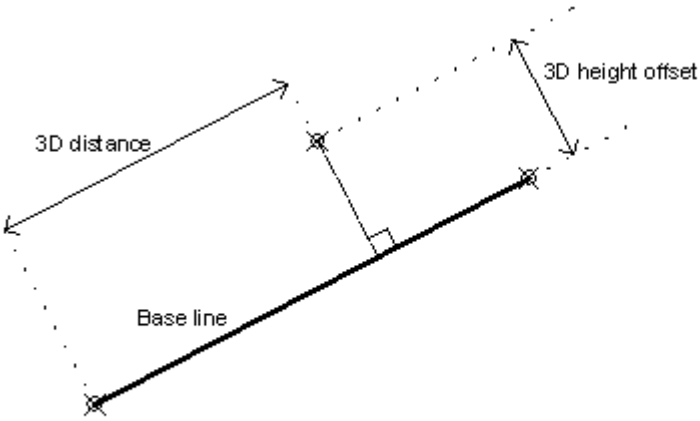
Bottom view.
Bottom view with base line. Point created with ortho in 2D.



Lateral view.
Lateral view with base line. Point created with ortho in 2D.

Calculates a point based on the horizontal length from the first point of the baseline and the offset from the baseline. Values are entered in the input field, where the numbers for the new point can also be given. The point that is created gets its height from the baseline, if the baseline has a slope.

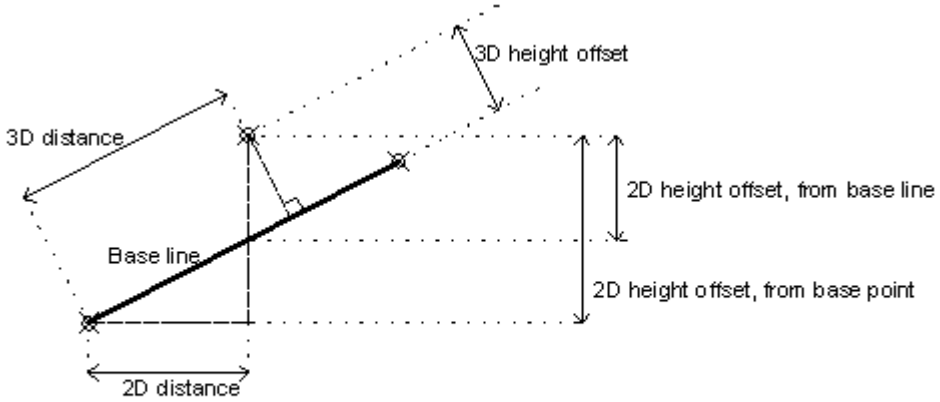
- Ortho In 3D



Lateral view.
Lateral view with base line. Point created with ortho in 3D.
The side offset positions the point in space, perpendicular to the viewing angle.

Calculates a point based on the sloping length along the baseline, offset from the baseline and a height offset from this. The height offset is specified as a height perpendicular to the baseline, as shown in the figure above. Values are entered in the input field, where the point numbers for the point can also be given.

- Ortho Out

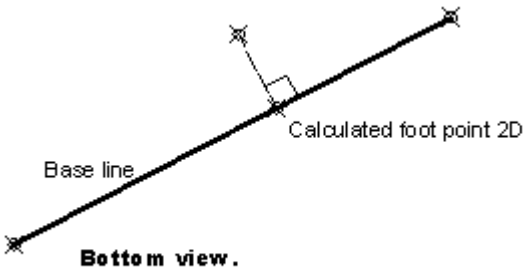


Lateral view.
Lateral view with base line.
Distance and height offset in 2D and 3D, calculated for ortho out.

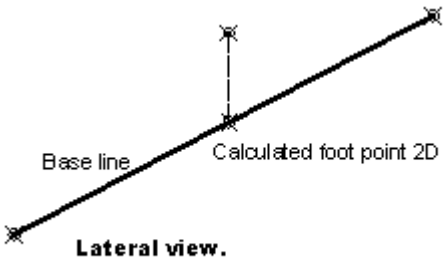
Calculates the distance, lateral offset and height offset of a point relative to the baseline. The results are given for both 2D and 3D (horizontal and sloping baseline). Point to the point to view the results.

  - The 2D results indicate the horizontal distance from the base point to the current point. The lateral offset is at right angles in the figure or out towards the viewer. Ortho Out presents both the height offset from the base point to the height offset from the baseline. The height offset from the base point gives the height of the point in relation to the height of the first point of the baseline, see the figure above.
  - The 3D results indicate the sloping distance along the baseline. The lateral offset is at right angles in the figure or out towards the viewer. The presented sloping height offset represents the perpendicular height over the baseline, as shown in the figure above.

- Foot Point 2D



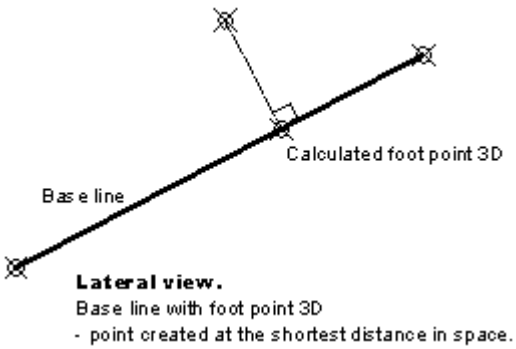
Bottom view.
Base line with calculated foot point 2D
- point created at the shortest distance in alignment.



Lateral view.
Base line with calculated foot point 2D
- point created at the shortest distance in alignment.

Point to a point to view the results. Foot point 2D calculates the plane and height coordinates for a new point on the baseline. The position of the new point is calculated to the point on the baseline that is closest in plane to the point that you want to point to. The Z coordinate presents the baseline height for the calculated point.

- Foot Point 3D



Point to a point to view the results. Foot Point 3D calculates the plane and height coordinates of the point on the baseline that in space is closest to the point that you want to point to. The shortest distance in space is the perpendicular distance to the baseline. The Z coordinate presents the baseline height for the calculated point.

(H - the element will be created in the Help Layer216.)

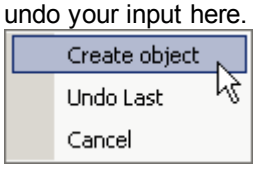
Parallel Lines (H)

You use these tools to create parallel lines or line elements:

- Parallel line - moves an entire line in parallel
  First point to a line. Now specify the dimension of the side offset in the input field. Then point out which side the movement should be made; a shaded line is drawn to demonstrate the results.
- Parallel line through point - moves an entire line in parallel
  First point to a line. Now point out a point through which the line moved in parallel is to run; a shaded line is drawn to demonstrate the results.
- Parallel line element - moves a line element in a line in parallel
  First point out a line element. Now specify the dimension of the side offset in the input field. Then point out which side the movement should be made, a shaded line is drawn to demonstrate the results.
- Parallel line element through point - moves a line element in a line in parallel
  First point out a line element. Now point out a point through which the line moved in parallel is to run; a shaded line is drawn to demonstrate the results.

(H - the element will be created in the Help Layer216.)

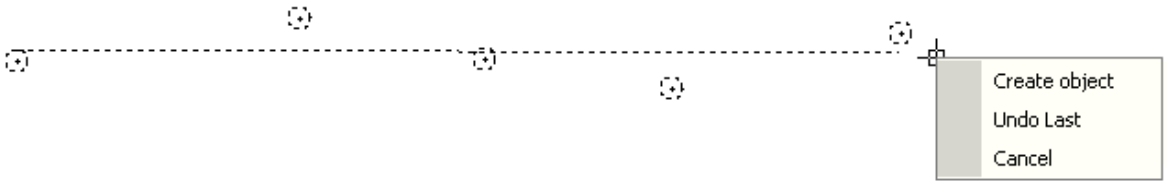
Fit elements using the Least Squares method (H)
You use these tools to create a line, an arc or a plane from scattered points that are not aligned with the desired object. This function will use the least squares method to find the best solution based on the selected points.
Click on the points to be included in the element and then right-click to create the object. You can also undo your input here.



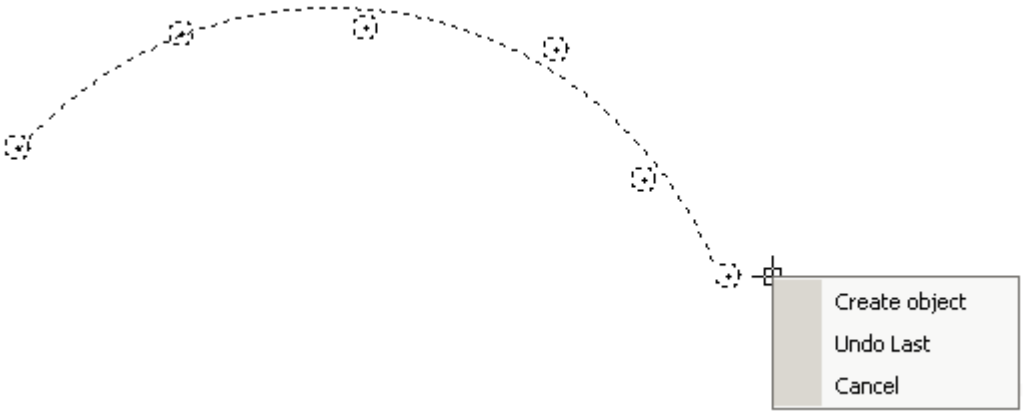
Created lines, arcs and planes are always displayed in the help layer216.

Please note, all selected points will be included in the least squares calculation, but the length of the line will always be dependent on the first selected point and the last selected point.

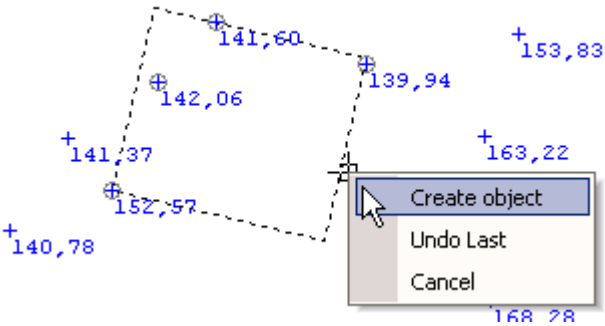
- **Fit 2D/3D line**
  Fits a 2D or a 3D line to the selected points.
  Select the items to be included in the line and right click the mouse to bring up the menu and select **[Create Object]**.
  The difference between a 2D and 3D line is that the 3D line also includes the height of the calculation of the line position. The height of the 2D line will be calculated as a mean value dependent on the heights of the selected points.



- **Fit Arc**
  Fits an arc to the selected points.
  Select the points to be included in the circle arc. Three of these produces an arc that runs exactly through all points. It is only the fourth that may cause deviations. Right-click the mouse to bring up the menu and select **[Create Object]**.
  The height of the arc will be calculated as a mean value dependent on the heights of the selected points.



- **Fit Plane**
  Fits a sloping plane to the selected points.
  Select the points to be included in the plane and right click the mouse to bring up the menu and select **[Create Object]**. In the help layer, a rectangle will be created, whose edges will represent the maximal slope.



When you have selected one of these tools, you can either use it directly in the help layer 216, or you can activate the document where the points are located. In the latter case, you can draw a rectangle around the points that are to be fitted to a line, an arc or a plane. Please note, when drawing a rectangle you do not have the opportunity to determine the start- and endpoint of the line, arc, or plane.

Created lines, arcs and planes are always displayed in the help layer 216. If you want to save these, to be able to work with them later, you need to copy the objects to another file type, for example a line file or coordinate file, see Copying Objects 218. If you have copied a plane to a coordinate file, you can use it to create a terrain model, see Create Terrain Models 639.

See also: Graphical Views 47, Graphical Editing 206, Help Layers, Gft Files 216, Edit section file graphically 245.

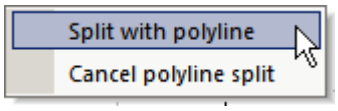
4.4.2 Edit section file graphically

Edit section file, sec, graphically

If you open a section file, sec, you can graphically edit the file using the graphical tools that draw lines and split lines, Graphical Tools 223.

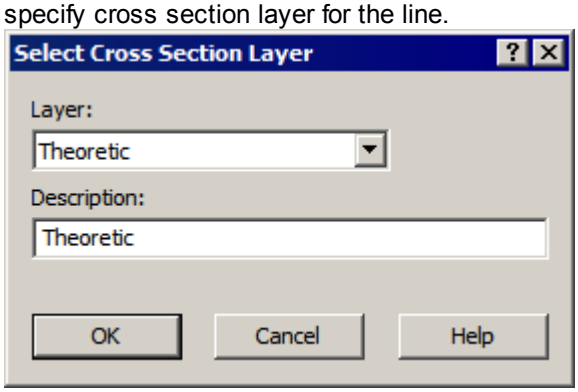
Split and connect lines

- To split one or several lines, select ***Tools | Split / Connect lines | Split lines*** and draw a polyline. When you have drawn the polyline, **click the right mouse button** and select **'Split with polyline'** to complete the command. Wherever lines cross the drawn polyline, a new split will now be made.



- To connect lines, select ***Tools | Split / Connect lines | Connect lines*** and click the lines you want to connect. Note, to be able to connect lines, the lines must be stored in the same cross section layer.

- To add new lines in a cross section, select ***Tools | Draw Line*** and draw the line. When you have drawn the polyline, click the right mouse button and select **'End Line'**. To complete the command, use the dropdown menu to specify cross section layer for the line.



See also: Graphical Tools, 223 Cross Section Files, Sec 627

4.4.3 Snap Tools

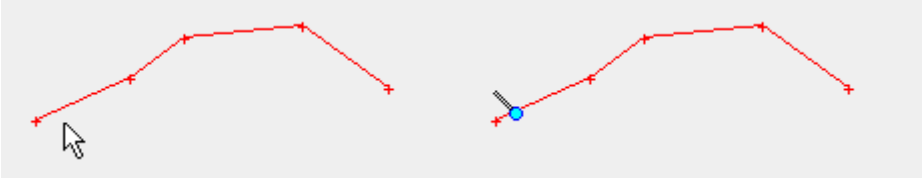
You use snap tools in graphics when you want to point to objects, instead of clicking free-hand you can "snap" to a fixed point. By way of example, to draw a line between a number of existing points, you can use the snap tools to locate the points.

When the cursor is close enough to an object or point that you can snap to, the symbol changes to indicate that it will snap to the object/point. If you have chosen a snap tool, you cannot click on a position that does not have a snap location.

Height data is also collected for points to snap to.

Snap to Point
You use this tool to snap to the nearest point, either single points or points in lines.

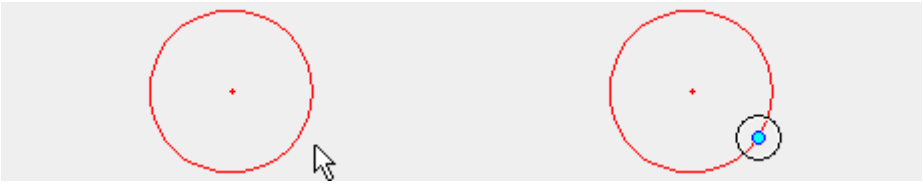
Snap to Endpoint
Snaps to the endpoint, including to the line element that is part of a polyline. You do not need to point close to the line end as you can point anywhere on the line. You can also snap to contours. Otherwise the tool works the same as "Snap to Point".



Snap to Midpoint
Snap to the midpoint of a line or contour.

Snap to Intersection Point
Snaps to the intersection point between two lines, between a line and a contour or between two contours.

Snap to Center Point
Snaps to the center point of a circle, an arc or a spiral (for spirals the radius is loaded from the endpoint that is closest to the cursor).

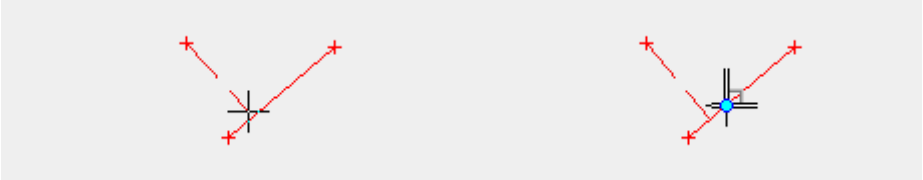


Snap to Object

Snaps to any object. You use this tool when you want to snap to an object, but are not looking for a specific point along the object in question.

Snap Perpendicular

Snaps at right angles to a line, arc or circle.

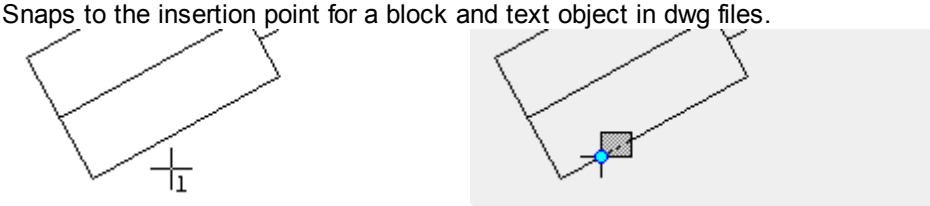


Snap to Tangent Point

Snaps to the tangent point of a circle or arc.

Snap to Insertion Point

Snaps to the insertion point for a block and text object in dwg files.



Multi-snap, Snap Lock

With multi-snap enabled, you can choose to have several snap tools active at any one time to easily snap in different ways at different times. As the cursor appearance changes when a snap location has been identified, you can be sure that the right point has been found before you click.

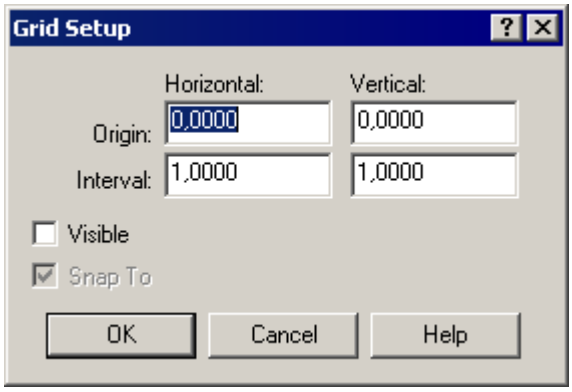
Floating Snap

When you are using multi-snap, this means that the tools expect to find a snap location, otherwise it produces an error signal and you may need to try pointing again. Sometimes you might want to point anywhere without it being necessary to disable all the snap tools. You can then use floating snap, which means you can point anywhere as if no snap tools were enabled, however, if you point to a location that enables a tool, the indicated snap location will be used.

See also Graphical Tools 223, Graphical Editing 206 and Graphical Views 47.

4.5 Graphic Grid

You use graphic grid when you want to point on screen and always have the positions at a given range. This may be useful, for example, when drawing horizontal or vertical lines. Using the grid makes it easier to get even coordinates for the points by snapping to the grid. You can use it in a drawing to draw texts with even lateral or vertical adjustment. Select ***View | Grid Setup*** to open the dialog.



Origin
Enter the horizontal and vertical position for the base point of the grid.

Interval
Enter the horizontal and vertical range of the grid.

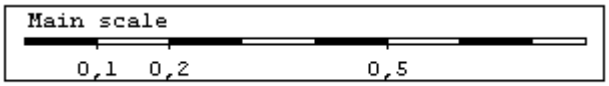
Visible
Check this box to make the grid visible.

Snap to
Check this box to snap to the grid points.

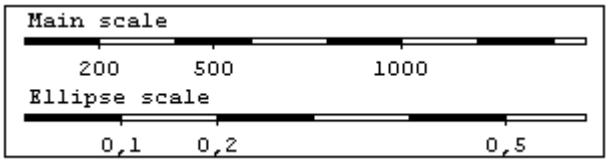
See also Graphical Editing 206.

4.6 Scale Bar

In the graphic window, you can choose to display a scale bar to get a better idea of the size of the area on display in the view. The scale bar in this case will also be included in any printouts. Usually, only one main scale is shown.

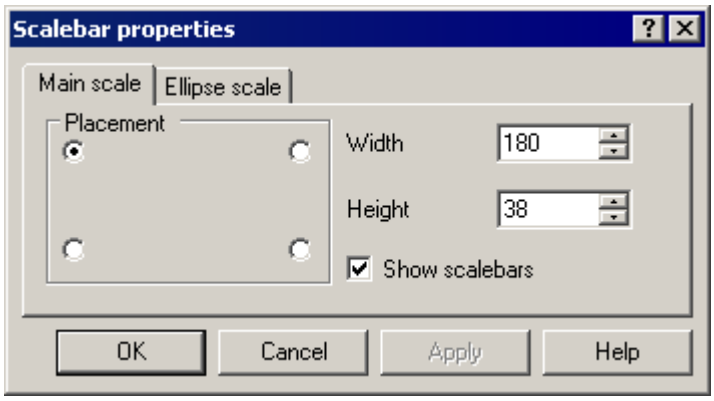


Some documents, such as net adjustments, have details in the graphical view that are drawn using a different scale than other objects. In this case, in addition to the main scale, additional scale bars are shown for different detail types.



Settings

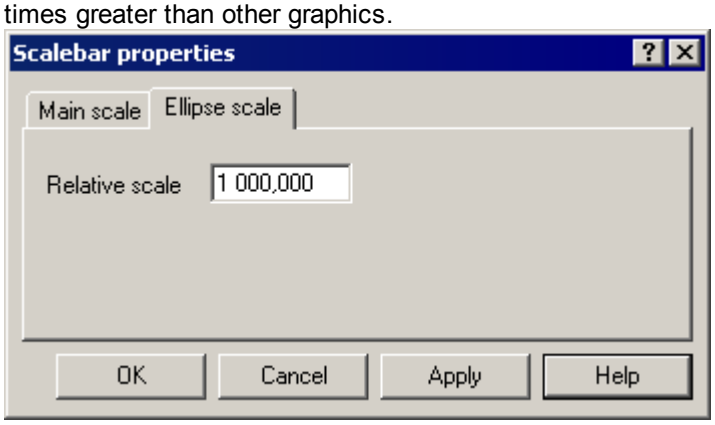
To change the settings for the scale bar, open the Settings dialog with ***View | Scale Bar Properties***. The dialog is divided into tabs, one for the main scale, and one for each additional scale.



Main scale:
Here you define general settings for the scale bar.
Note that the settings below do not affect the scale bar that you might display in a drawing. See Drawing Settings to get more information about scale bar in drawings.

- **Location:**
  Specify the corner of the graphical window in which the scale bar is to appear.
- **Width:**
  Enter the scale bar width in pixels.
- **Height:**
  Enter the scale bar height in pixels. This is the height of each scale bar, if there are additional scales the total height will then be multiples of this value. This also affects the font size, which is about one-third of each scale bar height.
- **Show Scale Bar:**
  Here you can toggle the display of scale bar on of off. This can also be done with ***Views | Show Scale Bar*** or the button in the toolbar.

Additional Scales:
An extra tab appears for each additional scale. Here you set the scale of the specific objects relative to the main scale. (Magnified or reduced). For example, a relative scale of 1,000 makes the details drawn 1,000 times greater than other graphics.

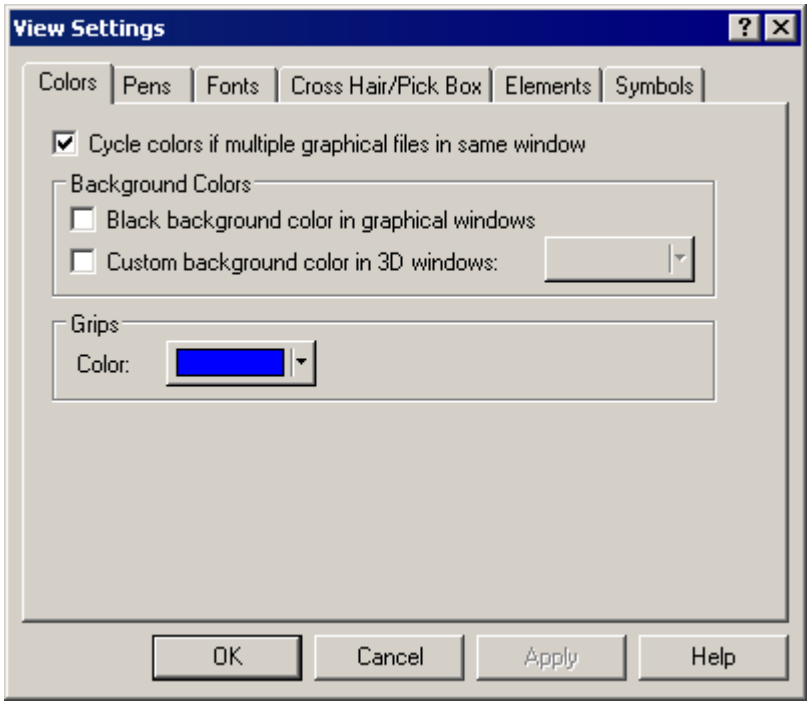


See also: Graphical Views 47

4.7 View Settings

Selecting ***View | Options*** brings up the dialog for view settings. The window is divided into a number of different tabs.

Colors



Cycle colors if multiple files in the same window
If the box is checked, each new document that opens in a graphic window is given a different color, otherwise the default color is set for the document. See also Graphical Document Properties 52 .

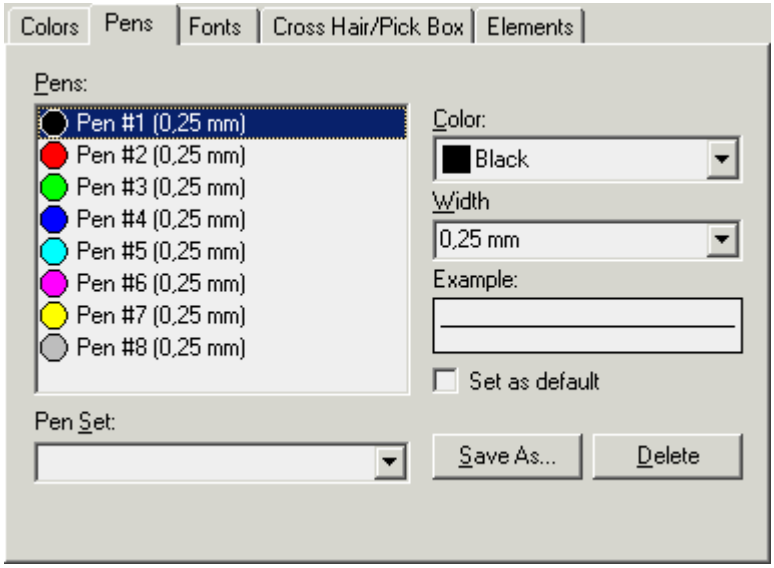
Black background in graphical windows
Check the box to use a black background color in the graphical windows. If the box is not checked, the color that is selected as the window background color in Windows® is used.

Custom background color in the 3D windows
Check the box to select a background color for windows with 3D graphics.

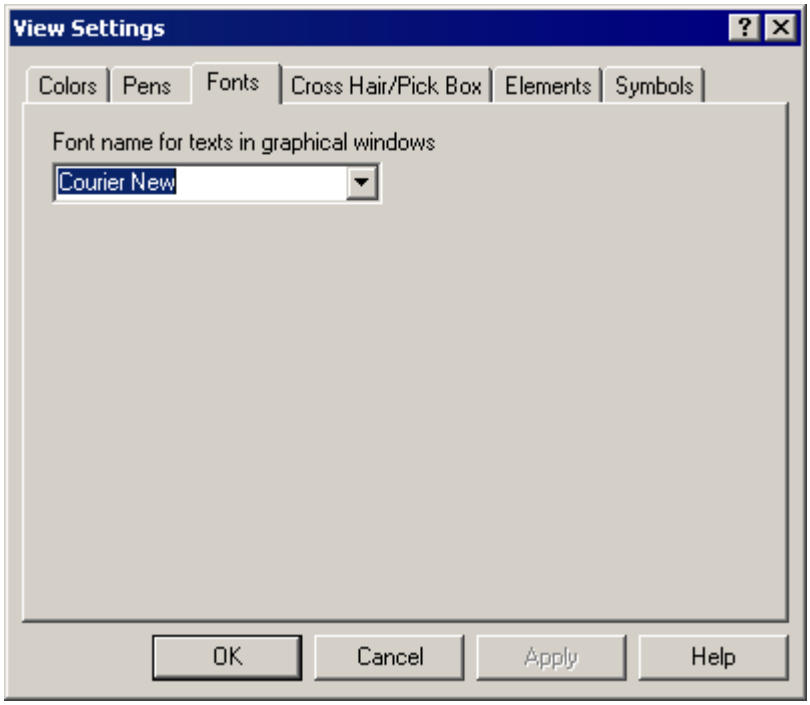
Grips
Select the color for grips in the graphical windows, see also Graphical Editing 206.

Pens

Here you define the colors and line widths for the various pens. Each pen has a number that is used in the code list to refer to a particular pen. It is possible to define a number of different pen sets that you can then select from. If, for example, you do a lot of plotting on both an ink jet and a pen plotter, it is easy to switch pens in using this option.



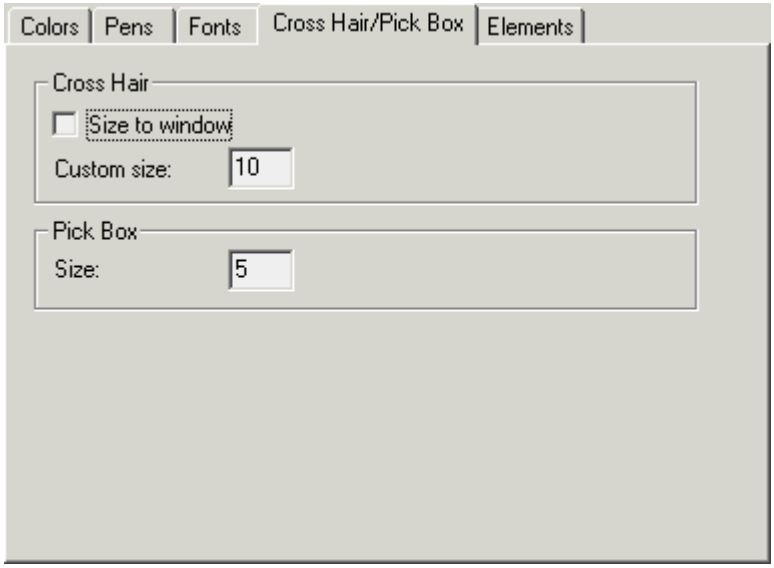
Fonts



Fonts for texts in graphical views

Select fonts for texts that are drawn in graphical windows, such as for displaying point numbers. The options that are available, are downloaded from the Windows® operating system settings.

Cross Hair/Pick Box



Cross Hair

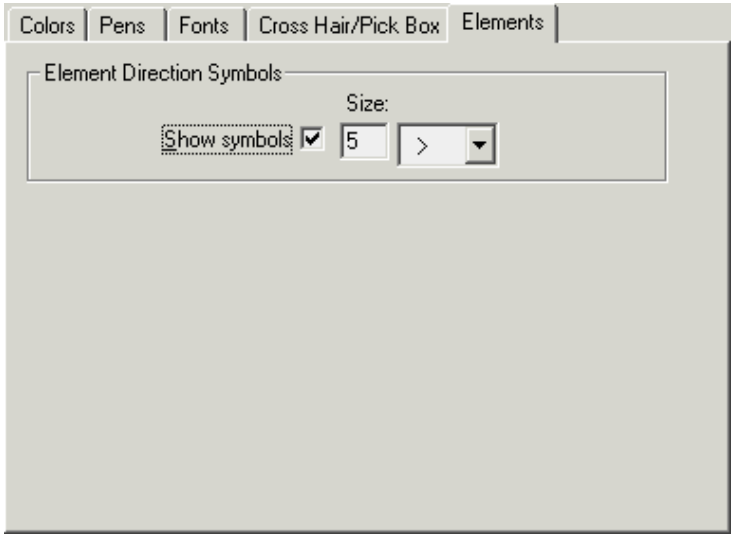
- Size to window
  Indicates that the cross hair is to be drawn across the whole window.
- Custom size
  Specifies the size for each cross hair.

Pick Box

- Size
  Enter the size of the box within which you search for objects for graphic editing.

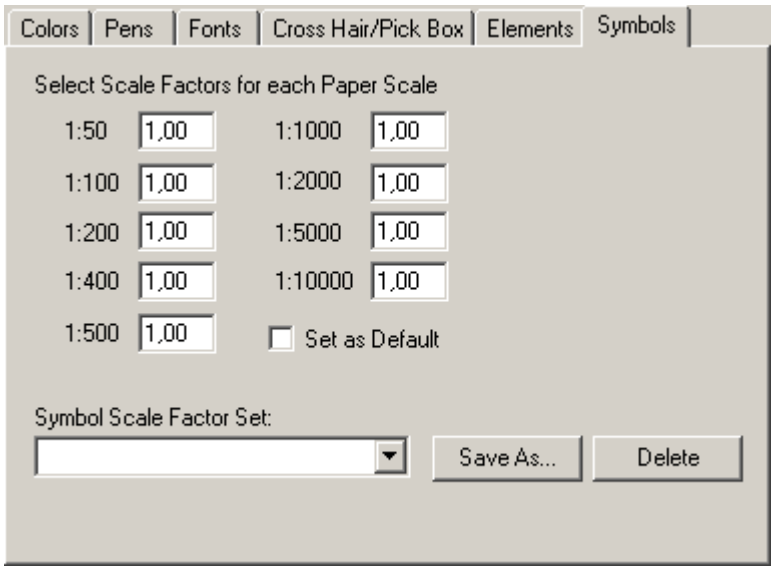
Elements

Symbols for element direction



If the ***Show symbols*** box is checked, the symbols are drawn on elements in the line document and help layers. This facilitates the graphical interpretation of the lines. Also select the size and appearance of the symbol.

Symbols



Here you can set the relative scale factor for the symbols in the various drawing scales. This makes it possible to customize the symbol size for drawings in different scales. Set scale factor 1 for the drawing scale that the current symbol file is designed for, and then define how the scale is to be changed for other drawing scales. If, for example, you have a symbol file that is customized to the scale 1:100, the symbols are probably slightly too small in a scale of 1:1000 and you can then correct this by changing the scale factor to 1:1000.

You can save all the scale factors using one name making it easy to switch between different symbol files that are designed for different drawing scales. See also Symbol Files 203 .

See also Graphical Views 47, Graphical Editing 206 .

5 Drawings

5.1 Drawings in General

Drawing documents have the file type **dra**. These files contain links to the data files they are constructed from. It is also possible to break the links and import the files into the drawing instead. The drawings may also include other objects such as texts, symbols, lists, etc. There are different types of drawings for different orientations of the data files they show.

Note that you must set the unit as meters in the Project Tree Settings tab 17 to ensure it is possible to open or create a drawing, dra, in iCON office.

Drawing Types

Plane Drawing
In this type of drawing, files that describe the plane data can be added to coordinate files, road lines, terrain models and contours etc.

Cross Section Drawing and Tunnel Section Drawing
This type of drawing shows the range of cross sections from one or more section files.

Profile Drawing
The drawing shows profile data, both theoretical and survey, with full profile forms and with the option of letting the profile line cover multiple drawing sheets. The profile drawing may show a road profile/rail profile 260 or pipe profile 260 .

Links and imported files

When you create a new drawing, the input data files will be linked to the drawing. This means that changes to the data files will also be reflected in the drawings that link to them. If you do not want this to happen, you can choose to import the file into your drawing instead. The information in the data file cannot be changed. It is also possible to recreate a link to a file that is imported into a drawing; if there is no original file remaining, it will be recreated. Linking and importing files in the drawing is controlled from the Document Dialog 51.

See also Creating New Drawings 257 , Documents in the Graphical View 50 .

5.2 Drawing Views

When a drawing is open in a graphical window this is divided into a number of additional tabs; one tab for each drawing sheet. The first tab is the same as for other graphics except for the fact that the drawing frame is displayed in the window. The other tabs show the different drawing sheets one after the other. You switch views by clicking on the tabs on the left below the window.

Drawing Views

World View/Placing View

When a drawing is open, the first view is oriented in world coordinates. For those who are accustomed to working in the AutoCAD® program, you can compare this view with 'Model space'. The orientation of the drawing sheet is also displayed in the window, with dashed lines for the overall width of the paper (minus margins) and the solid line for the part of the paper being used to display data. The contours of the drawing panel are shown with dashed lines. By pointing to the frame with the select tool223 you can perform various operations such as moving or rotating the frame relative to world data.

All objects entered in the drawing from the world view get world coordinates, which, for example, means that if the drawing is rotated or re-scaled, objects will remain relative to the world view.

Side Views

A side view shows one of the sheets in a drawing. The side views are always oriented in the paper coordinates, compare with 'Paper Space' in the AutoCAD® program. The paper's bottom left corner represents the origin.

All objects entered in the drawing from a paper view get local paper coordinates and are only visible in the view where they are entered.

Toolbar

Documents in the drawing
View | Documents in Window shows the dialog with documents in the graphical view. From here you can link to or insert documents in the drawing etc. See also Documents in the Graphical View50.

Document Properties
View | Document Properties, if the drawing is active in the graphics window, the dialog for Drawing Settings266 opens.

Show Drawing Properties
View | Show Drawing Properties, shows the properties dialog for the drawing frame270.

Show Drawing Panel Properties
View | Show Drawing Panel Properties, shows the properties dialog for the panel275 in the drawing.

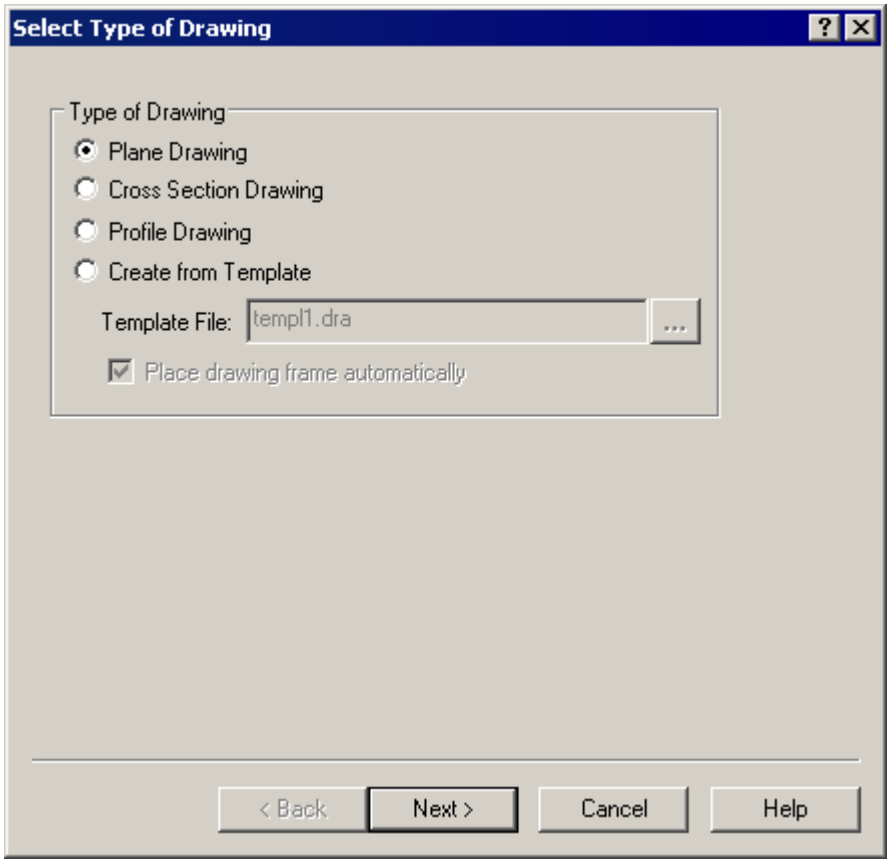
See also Drawings255, Objects in Drawings276.

5.3 Creating New Drawings

To create a new drawing, select ***File | New*** and then 'Drawing' in the dialog for new document.

Note that you must set the unit as meters in the Project Tree Settings tab 17 to ensure it is possible to open or create a drawing, dra, in iCON office.

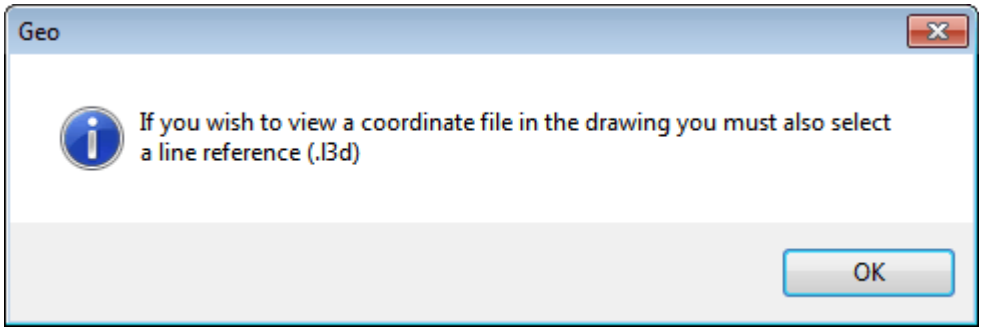
Dialog for new drawing



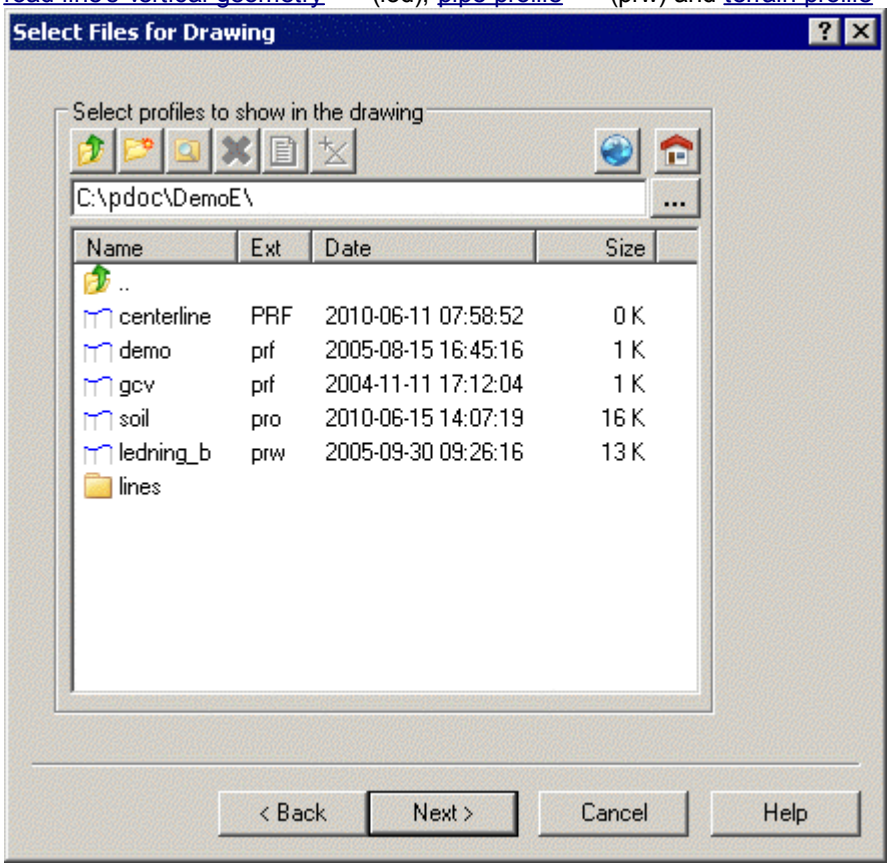
Type of Drawing
First select the type of drawing to be created:

- **Plane Drawing**
  In this type of drawing, files that describe the plane data can be added to coordinate files, road lines, terrain models and contour lines etc.

- **Cross Section Drawing**
  This type of drawing shows the range of cross sections from one or more section files (sec). Tunnel section drawings are also created in this way.
  Once you have selected one or more section files, click on through the dialog with **[Next]**. If you want to add a coordinate file (geo) for the section drawing, you need to select a line file 503 (l3d), for conversion from NEH to offset and height.



- **Profile Drawing**
  The drawing shows profile data, both theoretical and survey, with full profile forms and with the option of letting the profile line cover multiple drawing sheets. You may select the type of profile drawing; road profile/rail profile or pipe profile. Road profile is adapted for l3d documents. Pipe profile is adapted for prw documents. However, it is perfectly feasible to add multiple profiles to the same drawing, both road line's vertical geometry 503 (l3d), pipe profile 634 (prw) and terrain profile 662 (pro).



  Once you have selected one or more profiles, click on through the dialog with **[Next]**. If you want to add a coordinate file (geo) to your profile drawing, you also need to select a line file 503 (l3d), for conversion from NEH to section and height.

- **Copy from Template**
  This function allows you to create new drawings by expanding a previously created drawing. In this way, you can create drawings with special settings and configurations that you always use. You can, for example, create templates that suit a particular printer or those that apply to a particular work project where you often want to retain the information in panels, etc. The template can also contain data and linked files.
  - **Template**
    Specify the file that the new drawing is to be based on.
  - **Place drawing frame automatically**
    This option means that the scale and position of the drawing frame will be adapted to suit the files selected in the drawing. Do not check the box if the template's scale and position is to be retained.

Files in the drawing
Select the file or files to be included in the drawing. Select the files you want to include and click **[Finish]** to open the graphical window with the drawings and component files.

Tip for creating plane drawings. When a graphical window is open, you can create a drawing directly in the window using the current files. Click the button or ***View | Create Drawing***.

See also Drawings 255, Drawing Views 256, Profile Drawings 260

5.4 Creating Profile Drawings

To create a new profile drawing, select ***File | New*** and then 'Drawing' in the dialog for new document, see also Creating New Drawings 257.

Note that you must set the unit as meters in the Project Tree Settings tab 17 to ensure it is possible to open or create a drawing, dra, in iCON office.

Type of Profile Drawing
First select the type of profile drawing to be created; Road / Rail profile or Line / Pipe profile. The selection of drawing type determines the type of information printed in the profile drawing.
Road profile is customized for road line and cross fall documents. Pipe profile is customized for prw documents. However, it is perfectly feasible to add multiple profiles to the same drawing, including road profile (l3d), pipe profile (prw) and terrain profile (pro),

- **Road Profile/Rail Profile**
  Choose to load one or more cross fall models 536 (cfm) or road profiles 503 (l3d) for the drawing. If more than one profile is selected, a dialog comes up where you choose the input files that are to be the main profile. The information printed in the profile drawing is loaded from the selected main profile.
  It is also possible to add terrain profiles 662 (pro) and pipe profiles 634 (prw) to a road profile drawing.
  Once you have selected one or more profiles, click on through the dialog with **[Next]**. If you want to add a coordinate file (geo) to your profile drawing, you also need to select a line file including horizontal geometry 503 (l3d), for conversion from NEH to section and height.

- **Pipe Profile**
  Choose to load one or more pipe profiles 634 (prw) for the pipe profile drawing. If more than one pipe profile is selected, a dialog comes up where you choose the input file that is to be the main profile. This file is connected to a pipe form and is printed in the drawing.
  It is also possible to add terrain profiles 662 (pro) and road line profiles 529 (l3d) to a pipe profile drawing. Once you have selected one or more profiles, click on through the dialog with **[Next]**. If you want to add a coordinate file (geo) to your pipe profile drawing, you also need to select a line file including horizontal geometry 503 (l3d) for conversion from NEH to section and height.

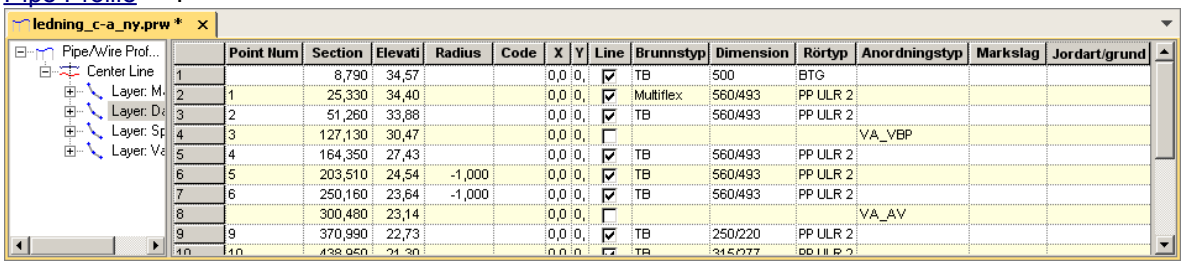
Road Profile/Rail Profile
To edit the properties of the profile drawing, select ***View | Show Drawing Properties*** or click the button.

- **Profile Drawing**
  The drawing shows profile data, both theoretical and survey, with full profile forms. The form fields that appear in the profile drawing depend on the settings described in Drawing Frame Settings 273.

Pipe Profile Drawings

- **Numerical view for drawing with pipe profile**

Set the prw file as active and enter the appropriate information in the pipe profile document, see also Pipe Profile[634] .



	Point Num	Section	Elevati	Radius	Code	X	Y	Line	Brunnstyp	Dimension	Rörtyp	Anordningstyp	Markslag	Jordart/grund
1		8,790	34,57			0,0	0,	☑	TB	500	BTG			
2	1	25,330	34,40			0,0	0,	☑	Multiflex	560/493	PP ULR 2			
3	2	51,260	33,88			0,0	0,	☑	TB	560/493	PP ULR 2			
4	3	127,130	30,47			0,0	0,	☐				VA_VBP		
5	4	164,350	27,43			0,0	0,	☑	TB	560/493	PP ULR 2			
6	5	203,510	24,54	-1,000		0,0	0,	☑	TB	560/493	PP ULR 2			
7	6	250,160	23,64	-1,000		0,0	0,	☑	TB	560/493	PP ULR 2			
8		300,480	23,14			0,0	0,	☐				VA_AV		
9	9	370,990	22,73			0,0	0,	☑	TB	250/220	PP ULR 2			
10	10	438,950	21,30			0,0	0,	☑	TB	315/277	PP ULR 2			

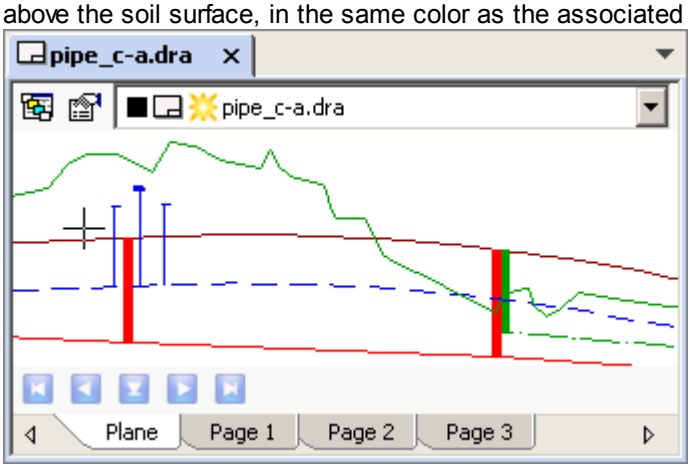
Note: The columns for attributes vary depending on the attributes[113] definition file the user has selected. Read more about attribute columns in pipe profile[634] .

- Well Type
  In order for a well to be displayed graphically, a text must be entered in the column for type of well.

- Dimension
  Enter the pipe dimension.

- Type of Pipe
  Enter an appropriate text.

- Device Type
  Enter the name of a symbol, for example, fire hydrant or service valve, from the active symbol file[203]. If sbg2.cod is used, the symbols for fire hydrant and service valve are drawn if VA_VBP and VA_VSV are entered. This is drawn as vertical lines with the selected symbol, immediately above the soil surface, in the same color as the associated pipe.



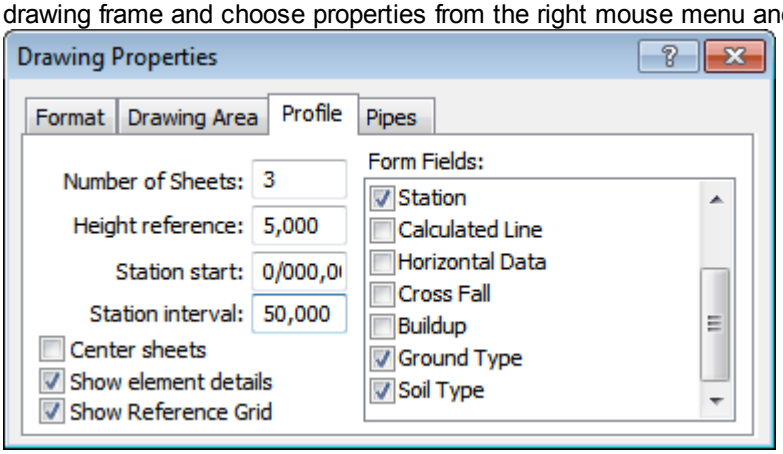
  You can change the scale of the symbols in the dialog that opens by selecting ***View | Document Properties***, click the icon or right-click in the graphic and select ***Document Properties***.

- Ground Type
  Is linked to Ground level in the pipe profile document (prw). Enter the appropriate description, meadow, road or similar in the prw file.

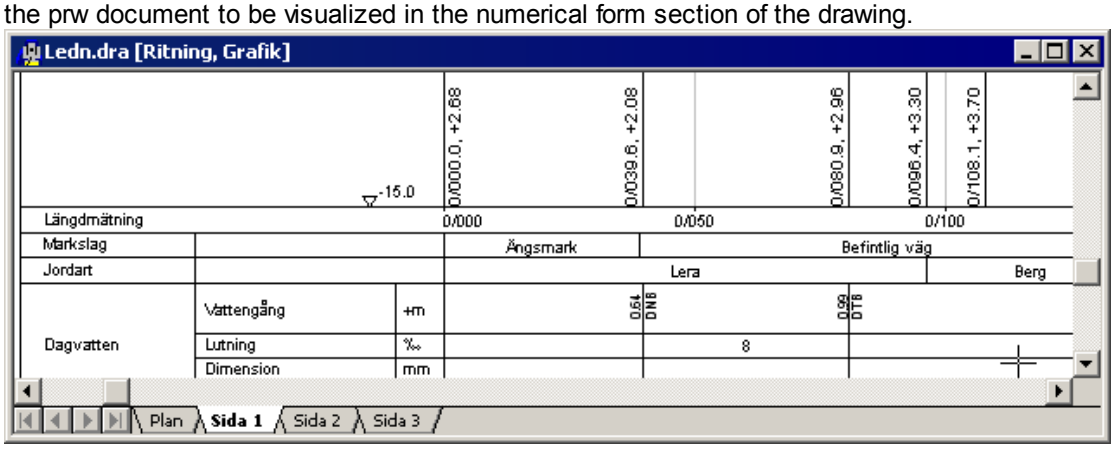
- Soil type/foundation
  Is linked to Ground level in the pipe profile document (prw). Enter the appropriate description,

e.g. clay or rock in the prw file.

In order to visualize the ground type and soil type/foundation in the drawing, set the drawing (dra) as active and select ***View | Show Drawing Properties***, click the button or select the drawing frame and choose properties from the right mouse menu and then select the Profile tab.

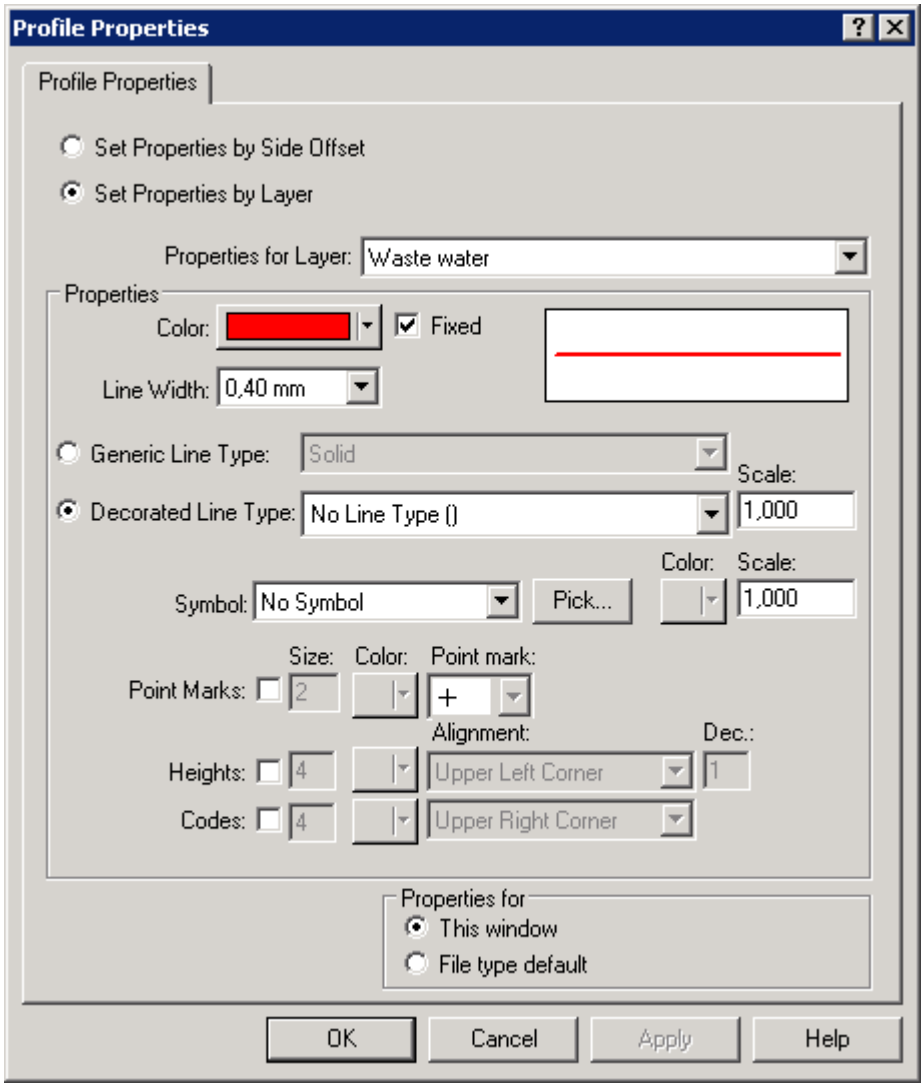


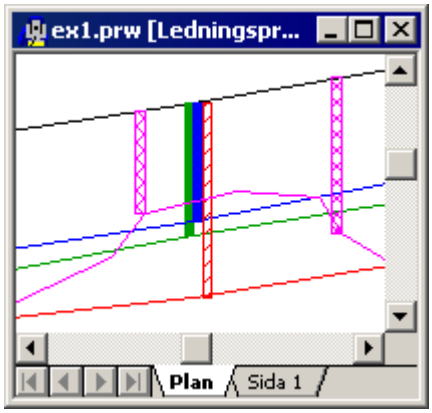
Check the Ground Type and Soil Type/Foundation boxes in order for the related information from the prw document to be visualized in the numerical form section of the drawing.



- **Graphical View of the pipe profile document**
  When a drawing is open, you can choose Plane view or Side view, see also Drawing Views[256]. When you are in the plane view, you can select among the constituent files in the drawing for the file to be made active. Set the pipe profile (prw) as active, go to ***View | Document Properties***, click the icon or right-click in the graphic and select ***Document Properties***. Select the properties to be visualized as per offset or layer. In the latter case different layers are drawn in different colors. Wells are drawn at ground level with colors from the pipe from which they originate. Read more about graphical properties for Pipe Profile, Prw[634].

Projected Well	Filled
Existing Well	Slash lines
Wells to be removed (discontinued)	Checked



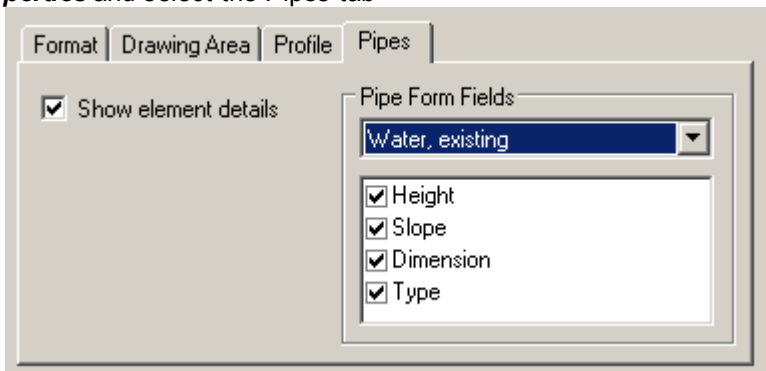


Detail from drawing with wells, two projected wells (filled), existing well (slash lines) and two wells to be removed (crossed).

Wells are automatically drawn next to each other if they are close enough to each other. This is called a well group - in the figure above, the existing and the projected wells make up one well group. The graphic display of the wells is influenced by the order of the constituent layers in the pipe profile document. If the projected surface water is at the top of the list, the corresponding wells will be drawn to the left of the insertion point, where each well in the graphic is drawn with corresponding 1 m wide symbols, according to the applicable scale. If several wells, in the same or other layers, are within + / -3 m of the first drawn well, these nearby wells will be drawn immediately to the right of the first well.

In the drawing, a vertical line to the right of the first well in a well group is drawn, if **Show element details** is checked, see figure below. The vertical line is at the top of the drawing in which the well's point number is printed, the number is loaded from the point number at the first well to be found in a well group. At the bottom in the graphical portion of the drawing, the well name and height of the invert level for the well can be visualized. This mark is automatically set in the exact section where the well is located. This means that the graphical presentation of the wells is presented with a 3 m tolerance, since each well is drawn as if it were 1 m wide, while the exact position is shown in the numerical form section of the drawing.

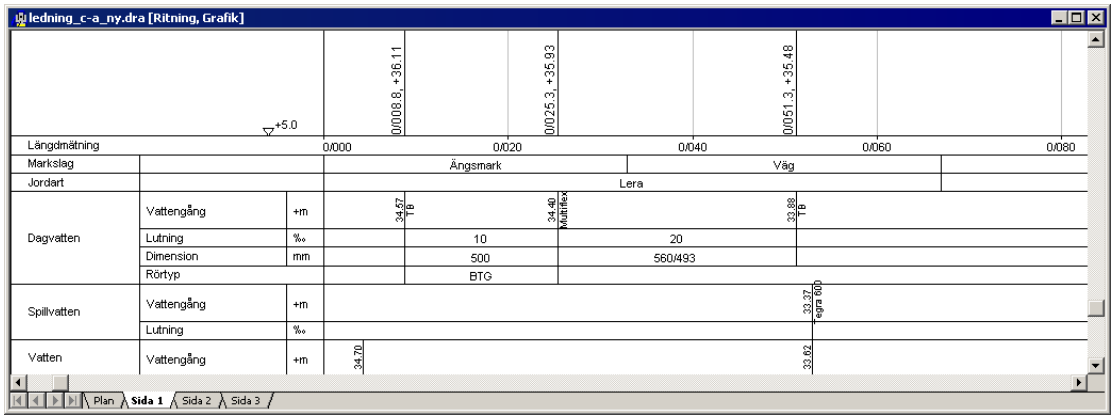
- In the numerical form section of the drawing, specific information for the pipes included in the drawing can be visualized. Set the drawing (dra) as active and select ***View | Show Drawing Properties*** and select the Pipes tab



From the drop-down menu to the right of the dialog, choose the information to display in the drawing; surface water, wastewater, water and combined. See also Pipe Profile634. These four pipe types can also be selected as existing and discontinued pipes.
Check the information box displayed for each individual pipe.

Height	Height of invert level shown in the drawing. Heights are shown for wells located along the specific pipe.
Slope	The slope of the pipe is shown.
Dimension	Pipe size is shown if the information is entered in the pipe profile (prw) attribute field for dimension.

Type	Types of pipe are shown if the information is entered in the pipe profile (prw) attribute field for pipe types.



The contents of the form field for the pipe profile drawing depend on the active sot file. iCON office automatically selects a sot file for the pipe profile drawings in which the slope is shown as part per thousand and the dimension in millimeters. If you want another text in the form field, you can edit the sot file. Select **View | Document Properties** and select the 'Panels and form' tab to view the sot file used by the profile drawing document. If editing the file, you should save as using a new name, as otherwise it will be overwritten when updating by iCON office, read more about sot editing in Drawing Panels 286 .

See also Drawings 255 , Drawing Views 256 , Drawing Frame Settings 270 , Pipe Profile 634

5.5 Drawing Settings

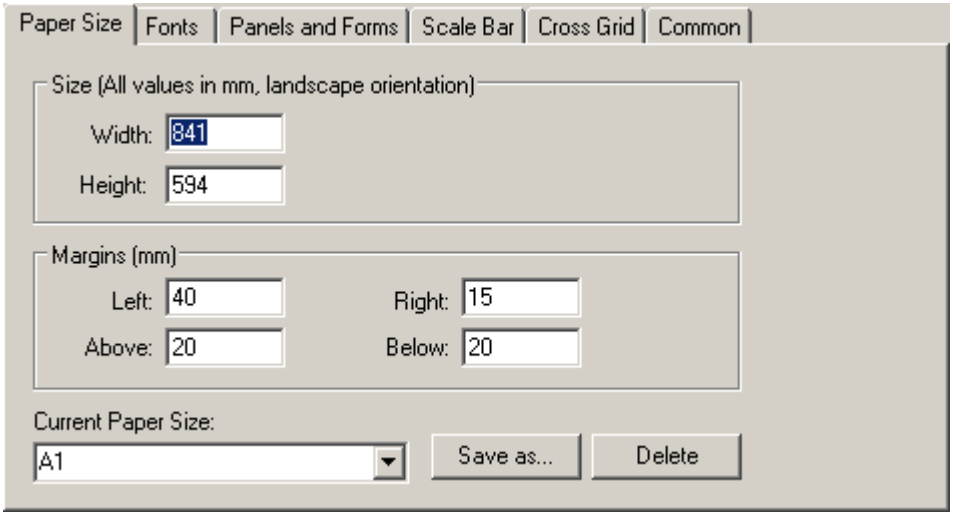
Drawing Settings

There are a number of different settings that you can make for a drawing. To edit these, you select ***View | Document Properties*** or click the button when the drawing file is active in the graphics window.

Note that you must set the unit as meters in the Project Tree Settings tab17 to ensure it is possible to open or create a drawing, dra, in iCON office.

Paper Size

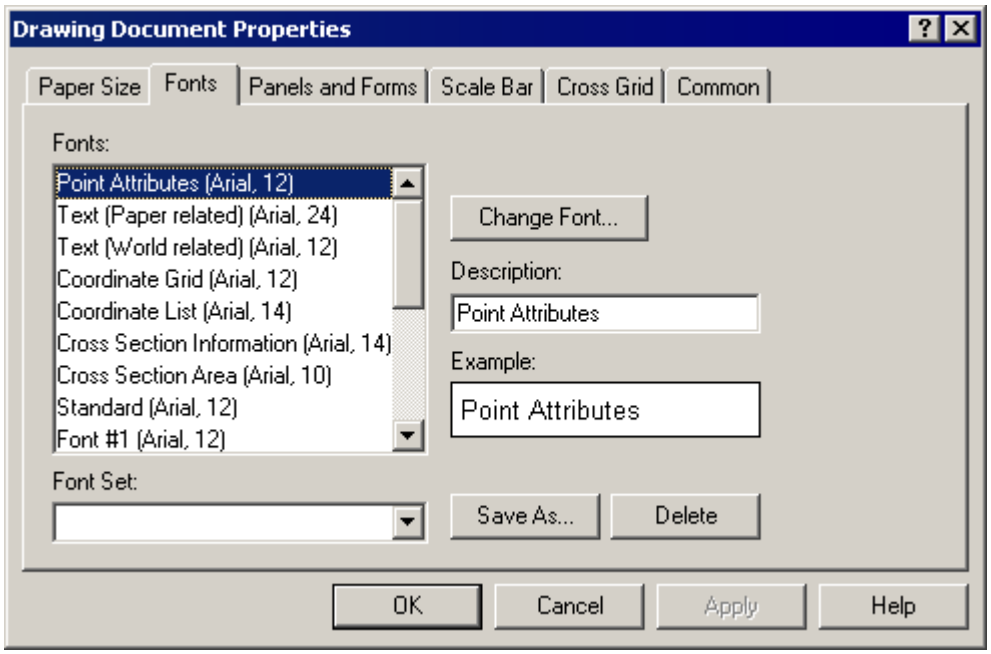
Here you can modify the current paper size. Remember that any information is entered in a landscape sheet, regardless of whether you plan to plot a portrait format. Specify the paper size and margins. The drawing frame will be equal to the size minus the margins.



You can save a format by clicking **[Save As...]**. Now enter a name for the format. Enter this name if you want to replace any of the default formats. To delete a format, click the **[Delete]**button. If there is a standard format, its default values will be reset (the format does not disappear).

Fonts

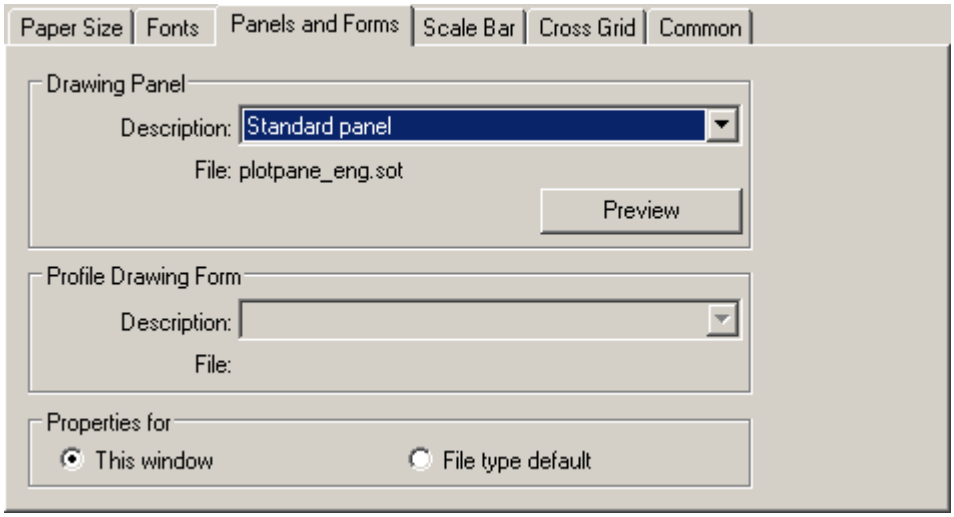
Here you specify the font and text size for the different types of text that may appear in the drawing. By defining a number of suitable fonts and then saving them as a font set that you can easily switch between them.



When selecting fonts for different objects in the drawing, it is the same list that appears in the properties dialog.

Panels and Forms

Specify the panel type you want, or if you do not want to use a panel. A panel is defined in a special file of the SOT type. See also Drawing Panels 286. The file contains information that determines the appearance of the panel defined by lines, text input field, and images (logos) if any. All dimensions are in meters. Panel files must be in the global folder in iCON office. iCON office includes some standard panels. A logo is added to a panel with WMF format (Windows Meta File) or EMF (Enhanced Meta File), which is the format for line graphics that is supported by most programs.

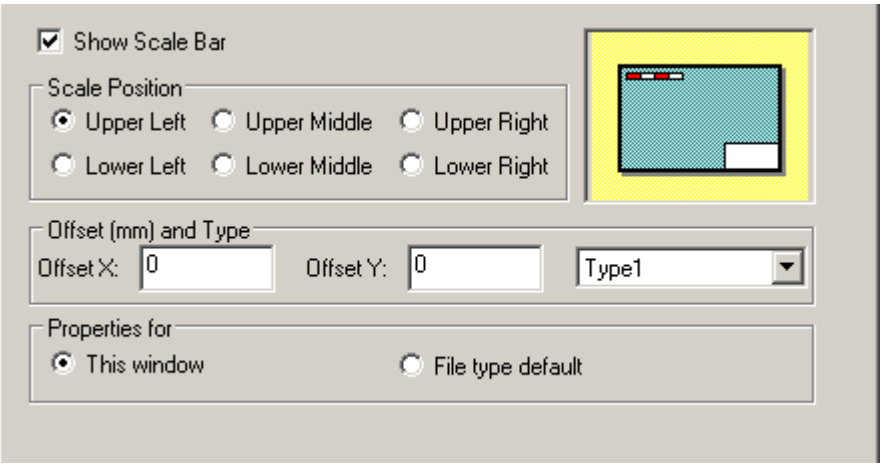


To enter text in a panel in the drawing - select the panel and change in the properties dialog, see Panel Properties 275 .

See Drawing Panels 286 for information on how to create your own panels with iCON office.

Scale Bar

Here you can choose to insert a scale bar in the drawing.



You may select from a number of predefined positions for the placement of the scale bar in the drawing view. You can place the scale bar to the left, or right or in the middle of the drawing. You place the scale bar within the free space between the left and right edge of the drawing, if a panel is inserted, the free space is used for the panel at the bottom. The predefined placements can be adjusted further by entering the Offset for X and Y in the dialog. These values move the scale bar by the number of millimeters that you specify.

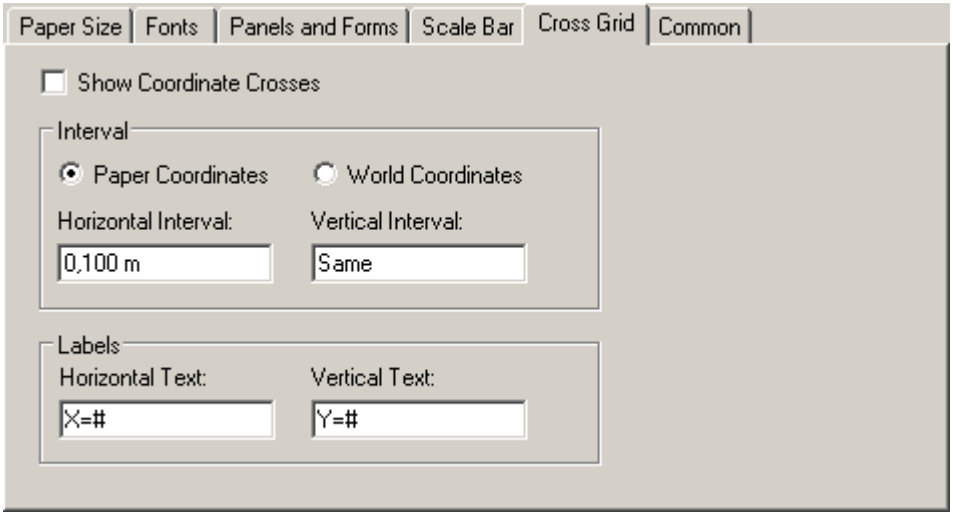
You can choose between two types of graphic scale bar; "*Ruler*" or "*Scale Bar*".

Note: As the offset moves the scale bar, you should be aware that the offset is indicated in millimeters. An offset of 150 mm has different affects of course if the drawing is created in paper format A4 or A1. Too much offset can move the scale bar outside of the paper sheet.

If you want the settings to apply generally to all drawings check the box **[File type default]** under **[Properties for]**. The settings will then be saved and used each time a drawing is created. If you only want the scale bar to be shown in the current drawing, check the **[Properties for this window] instead**.

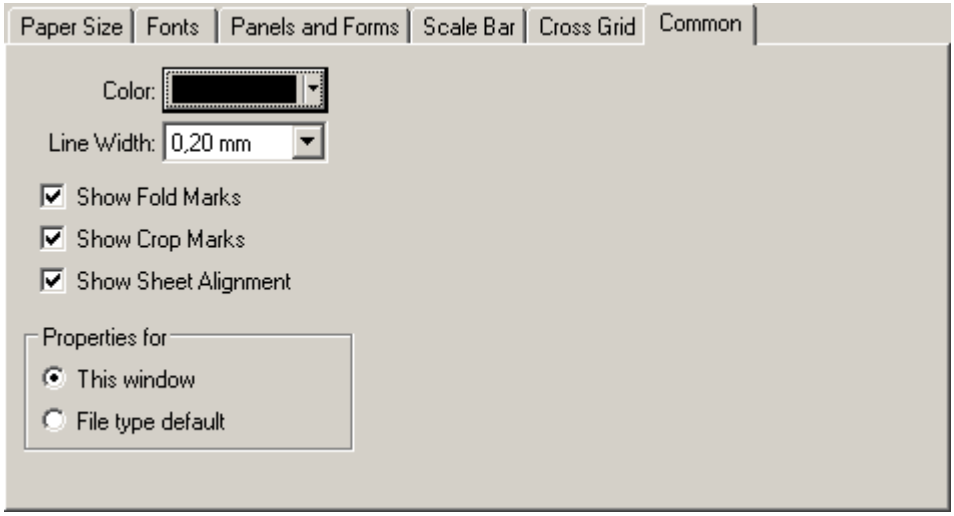
Cross Grid

Here you select whether the cross grid is to be drawn and at what interval. The interval can be specified in the world or paper coordinates. In addition, you enter the text that is to precede the coordinate information. The sign, #, is replaced with the current coordinate value in a grid.

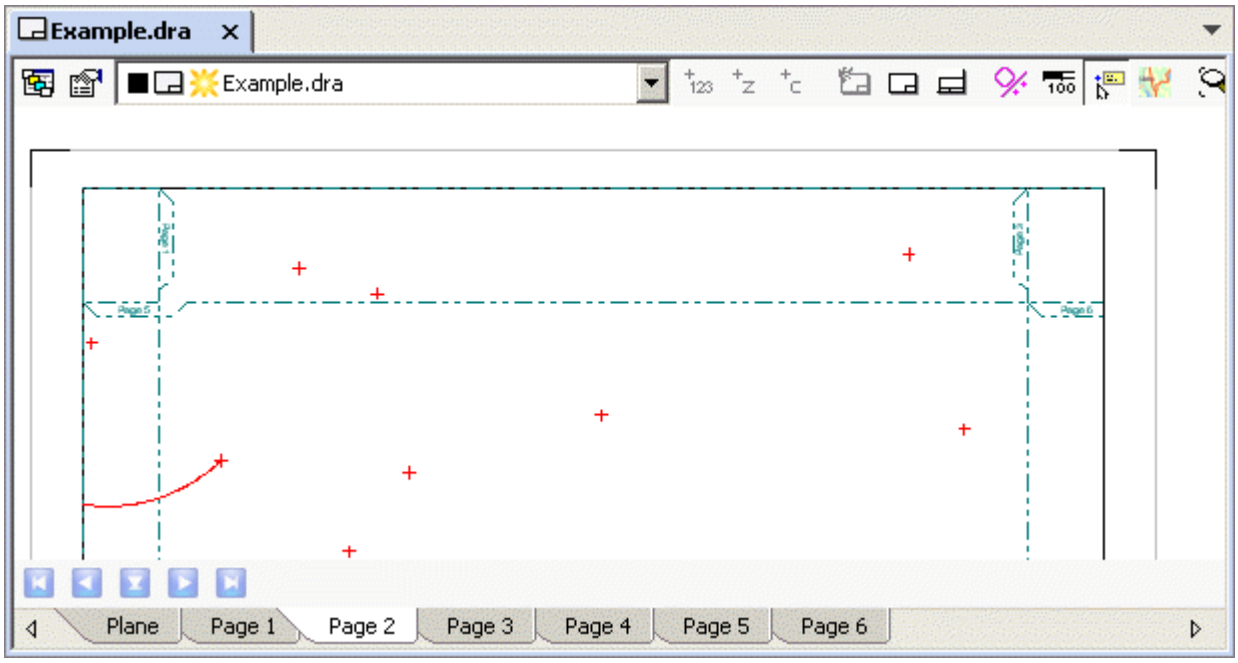


General

Here you can select if and how you show fold marks, crop marks and sheet alignments in the drawing.



The lines for sheet alignment show how much the drawing sheets are to overlap each other. You set horizontal and vertical overlaps in ***View | Show Drawing Properties*** under the tab Arrange, see also Drawing Frame Properties[270].



Example of drawing where lines for sheet alignments are displayed.

See also Drawings[255], Drawing Panels[286].

5.6 Drawing Frame Properties

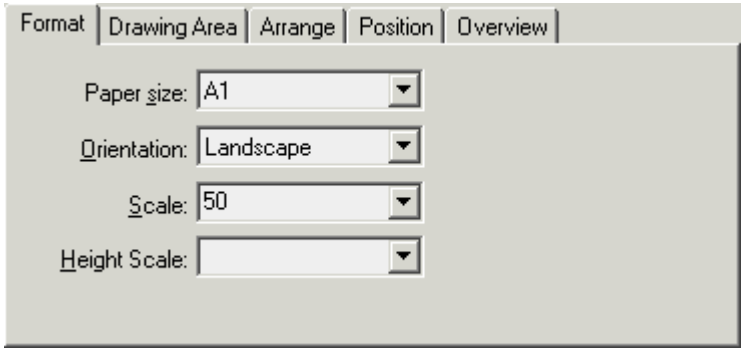
You edit the drawing's basic properties in the properties dialog for the drawing frame, where you can set the paper size, scale, orientation etc.

There are several ways to edit the properties for the drawing frame: select ***View | Show Drawing Properties***, click the button, or select the frame with the select tool and then select properties from the right mouse menu.

The properties dialog is divided into a number of different tabs. The tab depends on the drawing type.

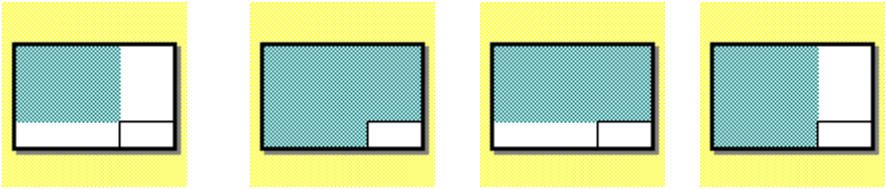
Format

Here you enter the paper's **size**, **orientation** (portrait/landscape) and at what **scale** the data is drawn. For the section and profile drawing you can also change **the height scale** separately. The list with **paper sizes** contains the formats that are stored. These formats are edited in the preferences dialog for a drawing, see Drawing Settings 266. If the list shows a blank field, this means that the current format is not a default format. To make this format a default format, it must be saved in the Preferences dialog.



Drawing Area

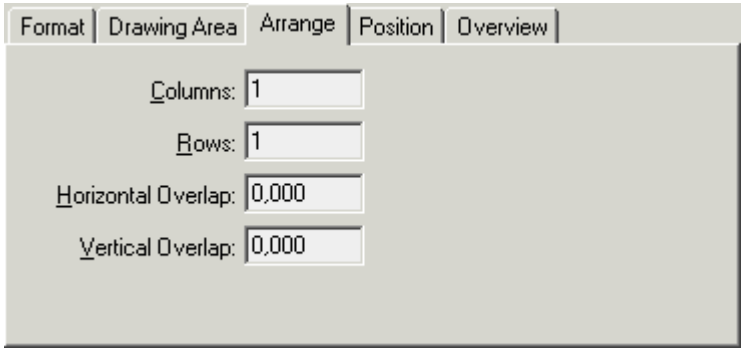
Specify on which part of the paper (in relation to the panel) that data from the input data files is to be drawn. Other information such as texts and north arrow can be placed irrespective of this limitation.



Panel Corner | Complete Sheet | Horizontal | Vertical

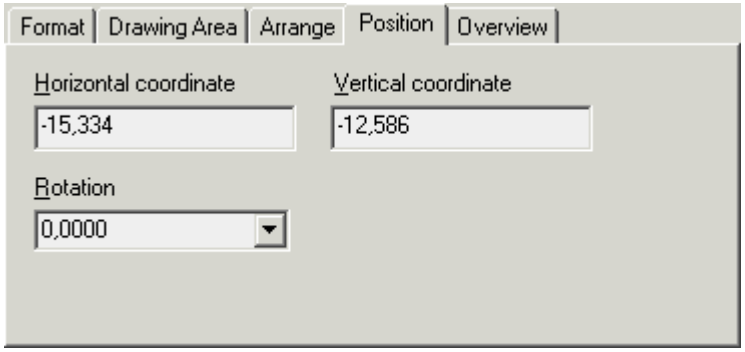
Arrange

Here you specify how many sheets the drawing is to consist of. Enter the number of rows and columns. Overlap here means how much of the paper is to overlap the adjacent sheet, the dimensions are given in meters. This function is useful when you want to avoid important information ending up in a joint between two sheets. Sheet alignments for overlapping sheets can be displayed, see Drawing Settings 268.



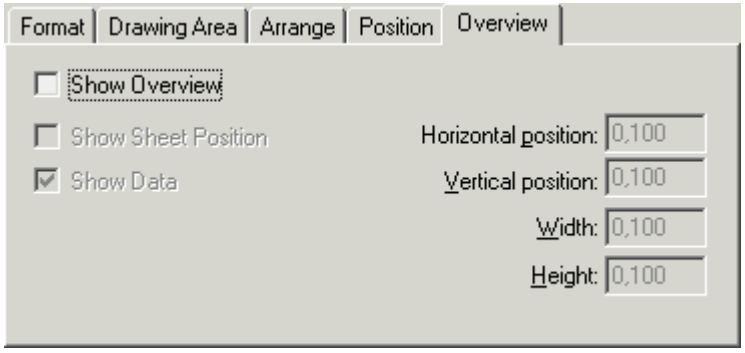
Position

This tab is only for plane drawings. It specifies the frame's position (in the first page window's lower left corner) and the rotation relative to the coordinate system. Position and rotation can be changed using the select tool, ***Tools | Select Objects***. See also Drawing Views 256.



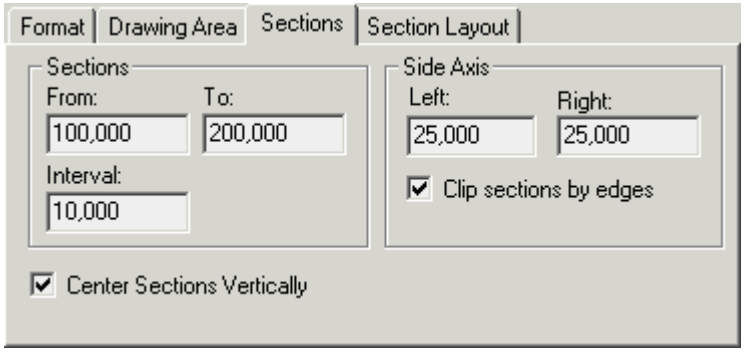
Overview (orientation image)

This tab is only for plane drawings. If you check **[Show Overview Image]** this inserts an overview of what is seen in the world view in the side views. The option **[Show Sheet Position]** means that the location of the drawing sheet shown in the image. **[Show Data]** means that information from the input data files is displayed. In addition, you have the option of controlling the positioning and size of the overview image. These values are given in the paper coordinates and are relative to the bottom left corner of the paper. The dimensions are given in meters.



Sections

This window is available when a cross section drawing is open. You specify here which cross sections to draw. Enter **Start Section**, **Stop Section** and **Interval**. If no values are given, all cross sections are drawn in the file.

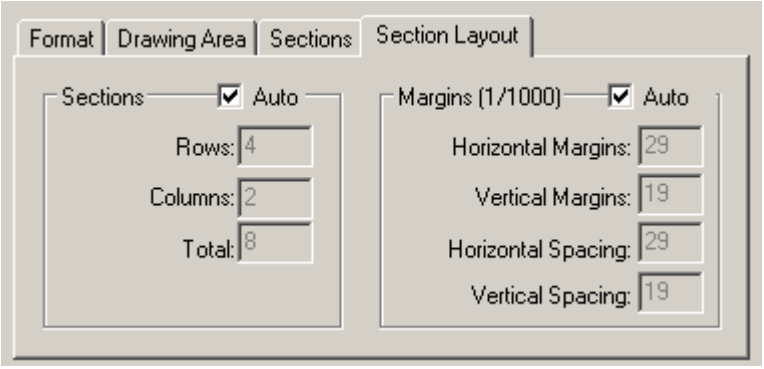


The values of the axes are the real meters for the left and right side of the center. The suggested values are calculated from the maximum distribution on each side.

If the option **[Center Sections]** is checked, the sections in height around the center of gravity are centered for each section. If the box is not checked, the reference axes will have the same height orientation for all cross sections in the file.

Section Layout

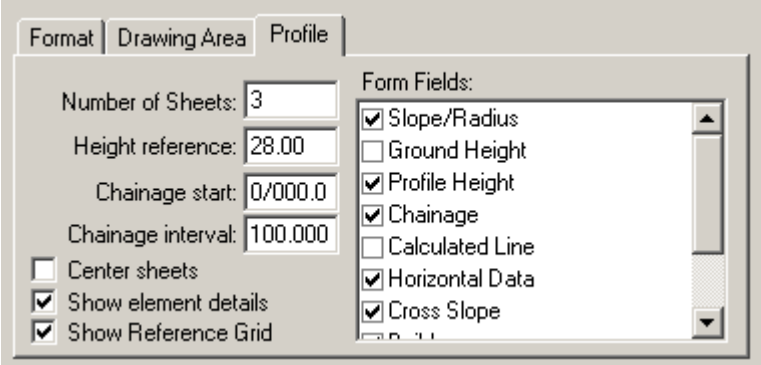
Section layout is automatically calculated when a drawing is created in order to fit all cross sections as well as possible. If changes are made to the paper size, the section layout is automatically adjusted. To create this layout manually, you have to uncheck the selection for **[Auto]** which means you have changed from automatic to manual control. Under **Sections** you can specify the number of **Rows** and **Columns** that each side in the section drawing is to contain. You specify the **total** number of sections for each drawing page. Example: Rows 4, Columns 2 and Total 8 will mean that each side in the drawing will have four rows with two columns, and thereby a total of eight sections will appear on each page.
Under **Margins** you specify the margins (in mm on paper), and between the sections and towards the paper's edge.



Sometimes sections appear behind the drawing panel. This can be rectified by specifying the number of sections manually and retaining this setting. In this way you can also prevent the sections from ending up above the panel if you want to keep this area clear. Start by selecting the settings that look correct apart from one column row above the panel. Now either reduce the number of columns by one or the number of sections per page by the number of sections in the last column.

Profile

Here you define the number of drawing sheets for the profile. In addition, you specify the bottom left corner's section and height (orientation height/length). Note: If you select more than one drawing sheet, you must also specify the section interval between the drawing sheets. If you select centering from the second sheet, the drawing sheets are centered around the profile, except for the first sheet where the previously specified measurements apply.
Number of drawing sheets. Specify how many pages the drawing is to be divided up into.
Reference height. Enter the lowest height shown in the profile drawing.
Start Section. Enter the start section for the profile drawing.
Section Interval. Specify if more than one drawing sheet is selected. If you create a drawing with three drawing sheets; start section 0/000 and section interval 100, this means that the first page of the drawing will start at section 0/000, the second page will start at section 0/100 and the third page will start at section 0/200.

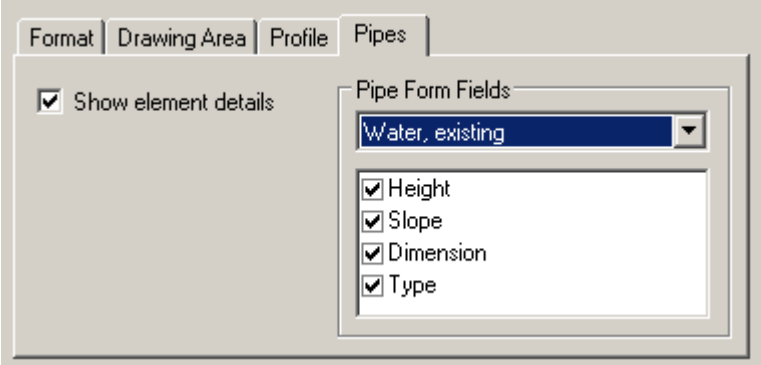


You can also use the dialog to select the form fields to display in the profile drawing. You select the fields required in the form. The frame displays the current drawing area for data, i.e. you do not need into take account whether the profile sheet fits the drawing. The **[Show Element Details]** option controls if the vertical lines of data elements are to display or not. This can be useful if you have a profile where it is very close between the element points. The **[Show Grid]** option controls whether the reference lines are to be drawn or not.

Some information in the profile form, such as plane data and cross fall is loaded from the road line's horizontal geometry503 (l3d) and the cross fall model536 (cfm). If these files are missing, the form will not include this information.

Pipes

Here you can specify the fields to be included in a pipe profile drawing.



If you check **Show element details** this clarifies each well with a vertical line in the drawing. From the drop-down menu to the right of the dialog, choose the information to display in the drawing; surface water, wastewater, water and combined. See also Pipe Profile 634 and Creating Profile Drawings 260 . These four pipe types can also be selected as current and discontinued pipes, such as surface water (cur), wastewater (cur (and so on), and surface water (discontinued), wastewater (discontinued), water (discontinued) and combined (discontinued). For each pipe you must check the box for information to be presented in the numerical form part of the drawing.

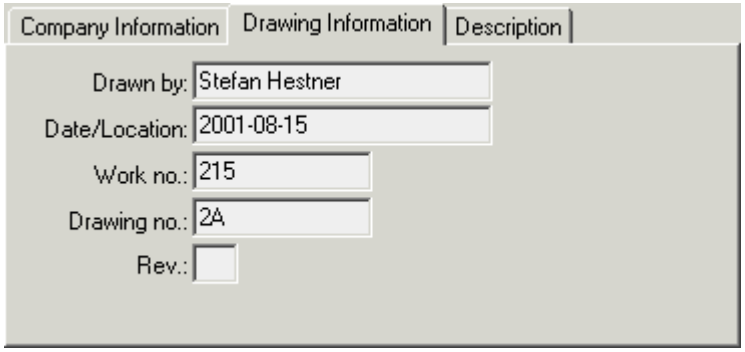
- Height
  Height of invert level shown in the drawing. Heights are shown for wells located along the specific pipe.
- Slope
  The slope of the pipe is shown.
- Dimension
  The dimension of the pipe is shown.
- Type
  Pipe types are shown.

See also Drawings 255 , Creating New Drawings 257, Drawing Views 256

5.7 Drawing Panel Properties

The information in the drawing panel (drawing header), e.g. description of the drawing content, is edited in the properties dialog for the drawing panel. The layout of the drawing panels is stored in the sot format, in the global folder 16.

There are several ways to edit the properties for the panel: select ***View | Show Drawing Panel Properties***, click the button or select the panel with the select tool from a side view and then select Properties from the right mouse menu.



The panel properties dialog is divided into three different tabs: Company information, Drawing information and Description. All fields are free text fields.

When the drawing contains multiple drawing sheets, the panel information is displayed on all pages, which is indicated by an asterisk, *, in the fields. To add another text, delete the star and enter the desired text.

You choose the panel to be used in a drawing by selecting ***View | Document Properties***, see Drawing Settings 267 .

If you want to use the content in the panel for other drawings, you can create a drawing template with the desired panel data. You then use this template when creating the other drawings, see also Creating New Drawings 259 .

See also Drawings 255 , Creating New Drawings 257, Drawing Views 256 , Drawing Settings 267

5.8 Objects in Drawings

A drawing may contain many different types of objects, in addition to the data files included in the drawing. You can add objects to the drawing in various ways, such as by a tool or by pasting from the clipboard.

It is of great significance which view you use to add the objects to a drawing; you can either place them with world coordinates or with paper coordinates. If you add them in the world view, they appear in the drawing with world coordinates and if you add them to one of the side views they are given paper coordinates. Objects with world coordinates are independent of the paper's placement and rotation, while objects with paper coordinates are located in the same place on paper regardless of how you move and rotate them. Remember that changing the paper size could change an object's location. It is therefore useful to begin by creating paper settings and then selecting the individual objects.

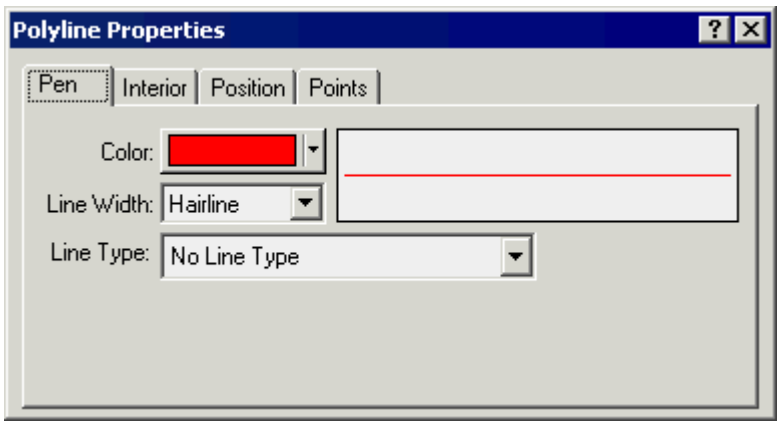
By selecting an object with the Select Object tool or selecting a text with the Select Text tool you can perform different operations. Right-clicking with your mouse on one of the selection symbols will bring up a menu with several options for the object. Select ***Properties...*** to view the properties dialog for the current object. See also Graphical Tools 223.

Polyline

Select the line tool, ***Tools | Draw Line***, to draw a line in a drawing.

One particular application for polylines is when you set heights for contour lines 279.

Polyline Properties



- You can set color, line type and line width for each polyline in a drawing.
- A closed polygon means that the first and last points in the line are connected. You can also fill the polygon with the color and/or patterns you prefer.
- You can edit the coordinates of the line's points in the 'Points' tab.

Texts

Select the text tool, ***Tools | Text***, to add a text to a drawing.

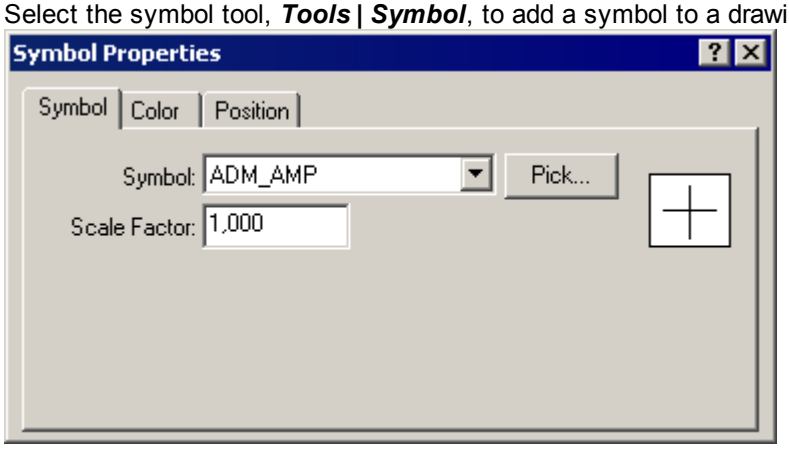
Text Properties

- The text can be printed on one or more lines. You can paste the text from the clipboard.
- The choice of insertion point determines how the text is to be adjusted, the insertion point also determines the part of the text that connects to the coordinates specified in the placement window and if the text is to be left aligned, centered or right aligned. If the text contains multiple lines you can only select the 'Upper left corner'.
- Fonts
  Select the font to use for the text. The list shows the fonts that are included in the drawing, see also Drawing Settings 266.
- Colors

- Text placement and rotation.

Symbols

Select the symbol tool, ***Tools | Symbol***, to add a symbol to a drawing.



Symbol Properties

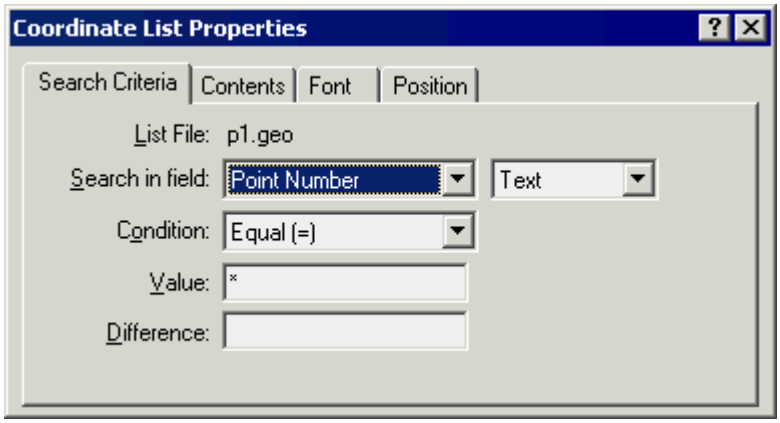
- The symbol to be displayed is selected from either the scroll bar or by clicking on the **[Select...]** button in the properties dialog. The symbols that are available depend on the active symbol file 203.
- You can set a scale factor for the symbol.
- Colors
- Text placement and rotation

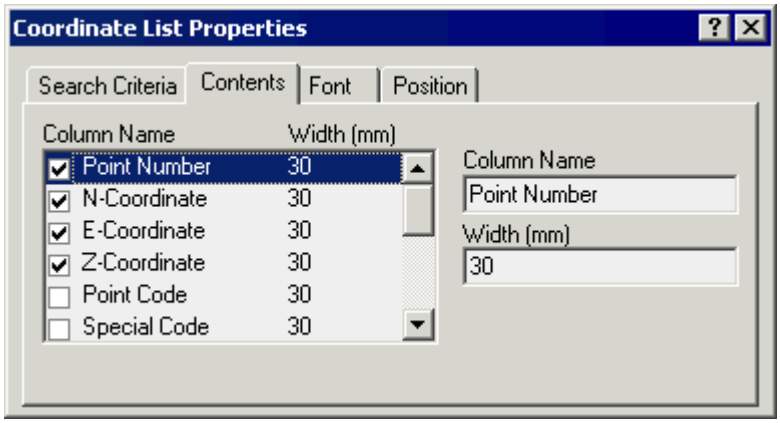
North arrow

Select the north arrow tool, ***Tools | North Arrow***, to add a north arrow to a drawing. North Arrows are treated like other symbols except for the fact that they are automatically rotated to display the north direction in the drawing. They can only be added to the drawing's side views.

Coordinate List

Selecting ***Tools | Coordinate List*** in the menu allows you to add a coordinate list to the side view that is open. The name 'coordinate list' is somewhat misleading as the contents of most file types can be displayed, not just the coordinates. The file whose coordinate list is displayed must be included in the drawing but need not be visible. (Select ***View | Documents in Window*** to make a file invisible, see Documents in the Graphical View 50). The coordinate list is placed by clicking the desired position or entering the coordinates in the input window 107. You can also move it later by dragging it.





Coordinate List Properties

- Search Criteria
  These settings are used to limit the information in the coordinate list. Select the field, the criteria, and the value that are to limit the selection. If you want all items in the file, you specify an asterisk, *. If the operator is set to equals with(=), a difference can be set that indicates how much a value may deviate from the specified value to be included in the selection.

- Contents
  Here you describe the information from the source file to be included in the coordinate list by checking the columns you want. In addition, you specify the field's width in millimeters. The column header can be changed to any text.

- Fonts
  Select the font to use for the coordinate list. The list shows the fonts that are included in the drawing, see also Drawing Settings 266.

- Colors
- Placement
  Enter the coordinates for the upper left corner of the list.

Symbol Description (Legend)

When adding a coordinate list from a coordinate file, you have the option of loading the point's description from the code list along with its graphic symbol. You can use this to create a symbol description or legend. Create a coordinate file with a point for each desired code and add this file as the coordinate list. If you do not want the file to be visible in the drawing, set the file as hidden, see Documents in the Graphical View 50 . Whether the file is visible or hidden in the drawing, you can still get a visual list of the code descriptions with the symbols next to them.

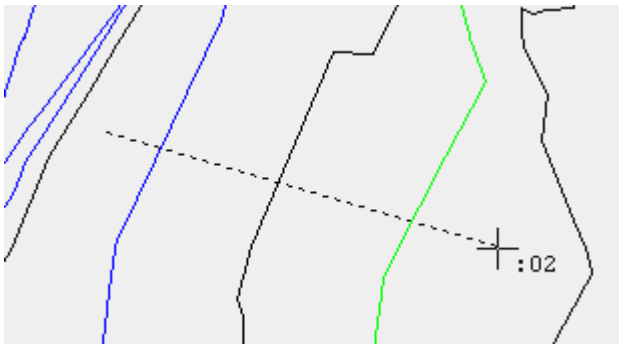
5.9 Insert Contour Heights

Inserting contour heights (also called altitude contours) means that you insert height texts next to the lines in a drawing containing contours. You do this by specifying above which contour line the texts are to be displayed.

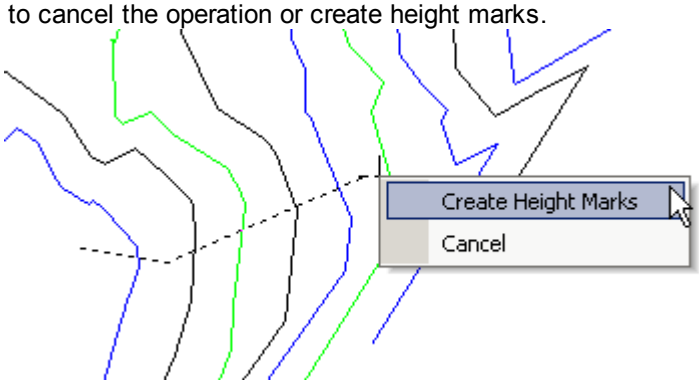
Note that you must set the unit as meters in the Project Tree Settings tab 17 to ensure it is possible to open or create a drawing, dra, in iCON office.

Start by opening the contour lines and create a drawing. Make sure your drawing is active in the graphical window and the world view is selected. Now select the **Contour line numbering** tool with which you draw a line above the contour lines to be numbered. At each intersection between the line and a contour, a text with the contour height will be created. The line may contain any number of sub-elements. The best results are obtained if you draw lines where the contours are somewhat straight and they are not too tightly packed. The program tries to rotate the texts so that they are read in ascending order. Sometimes, however, the text appears on the "wrong" side of the line which can be corrected by rotating the text, select ***Tools | Select Text***, 4.

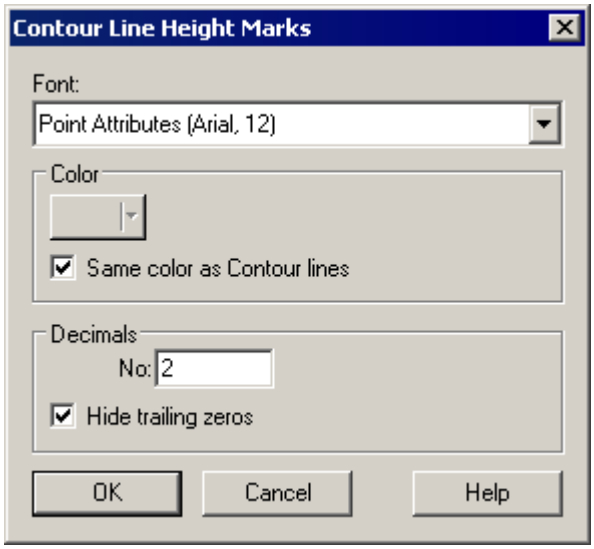
1. Draw a line over the contour lines to be numbered.



2. When you have drawn the line you want, right-click your mouse. In the menu you can either choose to cancel the operation or create height marks.



3. Decide how the texts are to be displayed in the dialog.

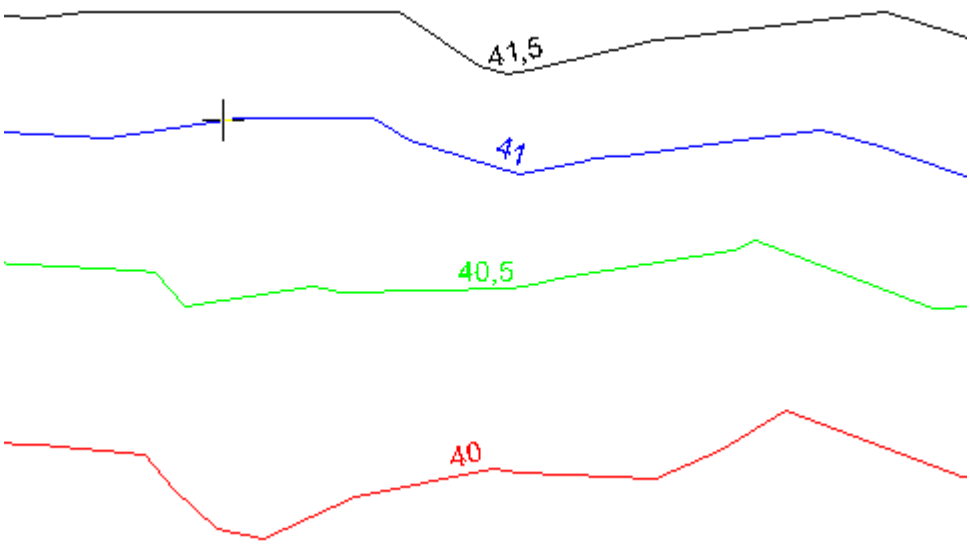


Fonts
Select Fonts (see also Drawing Settings[255]).

Colors
The option of 'same color as the contour lines' means that each text mark has the same color as the relevant contour. Otherwise, select a single color for each text.

Decimals
Choose how many decimal places the heights are to have. By checking 'hide zeros at the end' you can choose not to show trailing zeros in decimals, i.e. the height of 20.500 displays as 20.5 and 20.000 displays as 20.

4. Select OK in the dialog to create texts.



See also Drawings[255] , Objects in Drawings[276] , Contour Lines[657] .

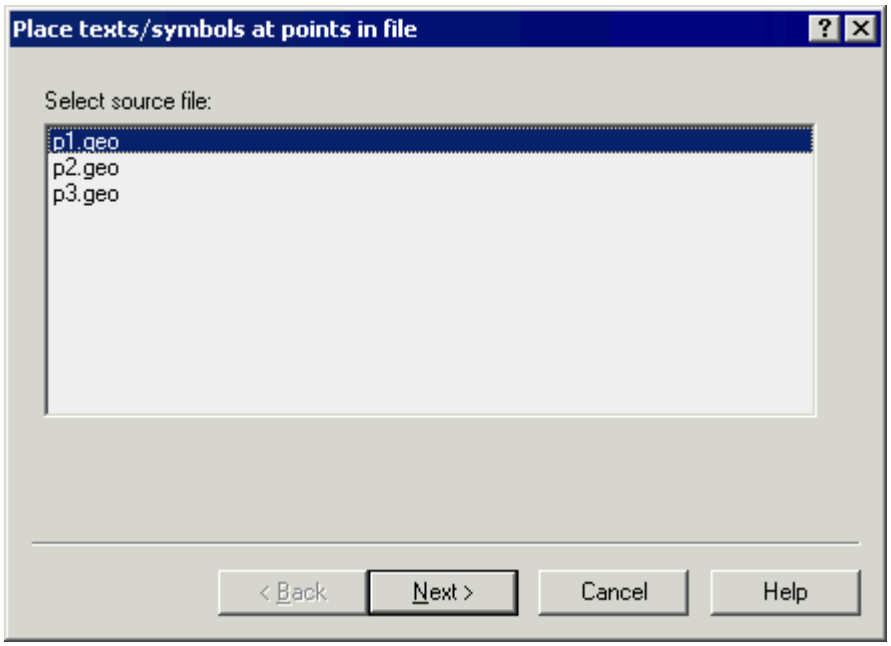
5.10 Place Texts and Symbols at Points in File

You use these functions to place texts and symbols relative to points in the files included in the drawing. These texts and symbols will be added as individual objects in the drawing and, once inserted, there will be no link to their respective points of origin, but this tool should only be regarded as a means to place objects in a very effective way.
You access the functions from the Data menu for the drawing, ***Data | Insert Texts...*** and ***Data | Insert Symbols...***, and this operates in a similar way whether you are inserting texts or symbols.

Before you start, zoom in to an appropriate point in the drawing so that you can see the results as you work in the dialog. If you have already inserted the objects that you cannot view closely enough, close the dialog, select Undo in the menu and try again using a better Zoom mode.

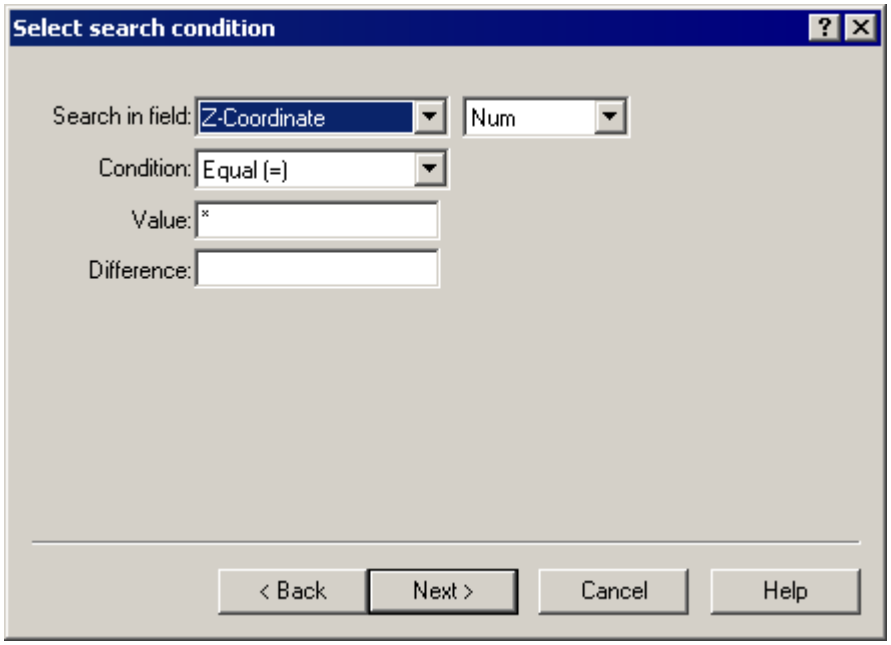
Step 1 - Select File

Select the file that the data is to be loaded from. For the placement of symbols, it is only the location and not the symbol type that is loaded from the file.



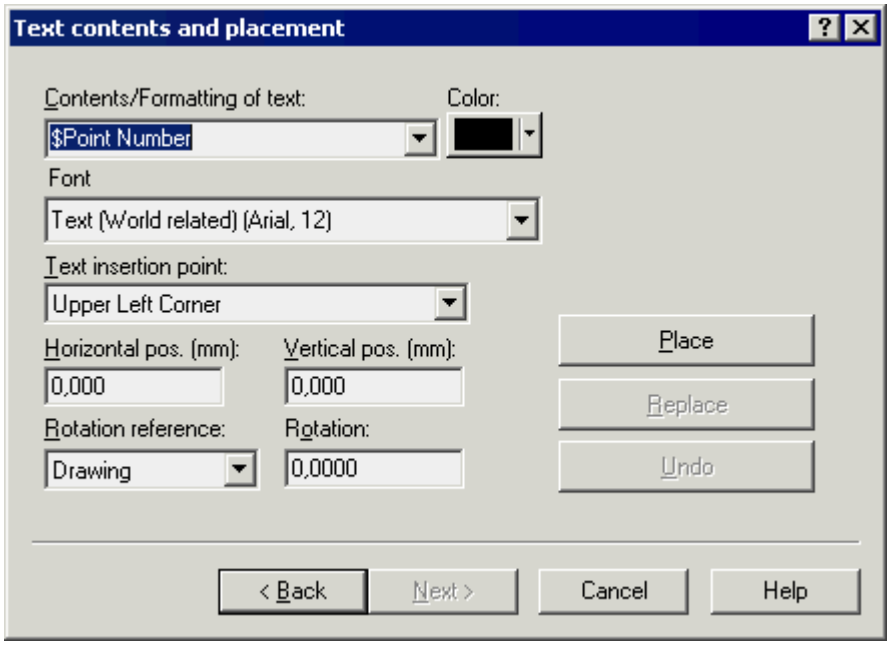
Step 2 - Search Criteria

Enter a selection or search procedure to select certain points in the file. Select the field, the operator, and the value that are to limit the selection. If you want all
items in the file you specify an asterisk, *. If the operator is set to equal (=), a difference can be set that indicates how much a value may deviate from the specified value to be included in the selection.



Step 3 - Set Out Texts

You use this window to specify the formatting and content of the text.



Content/Formatting of Text

Specify the field or fields in the file to be loaded and printed out at the point. Load the field name by selecting from the list or enter manually. It is important to remember that the field name must be preceded by a dollar sign, $. You can also specify your own prefix or suffix.

Example of formatting:

1. **Select from the list**
   Contents in the field to print the point number for a coordinate file
   $Point Number

2. **Select from the list and edit**
   Contents in the field to print the print codes with the prefix KOD: (E.g. KOD:531)
   KOD:$Point code (select the code field from the list and enter KOD before it).

3. **Several fields in the same text**
   Contents in the field to print the element number of a line file followed by a comma and then the radius with the prefix R =.
   Select the element number field from the list ($Element number). Now enter R = $Radius after this in the input field, i.e.:
   $Element number, R=$Radius

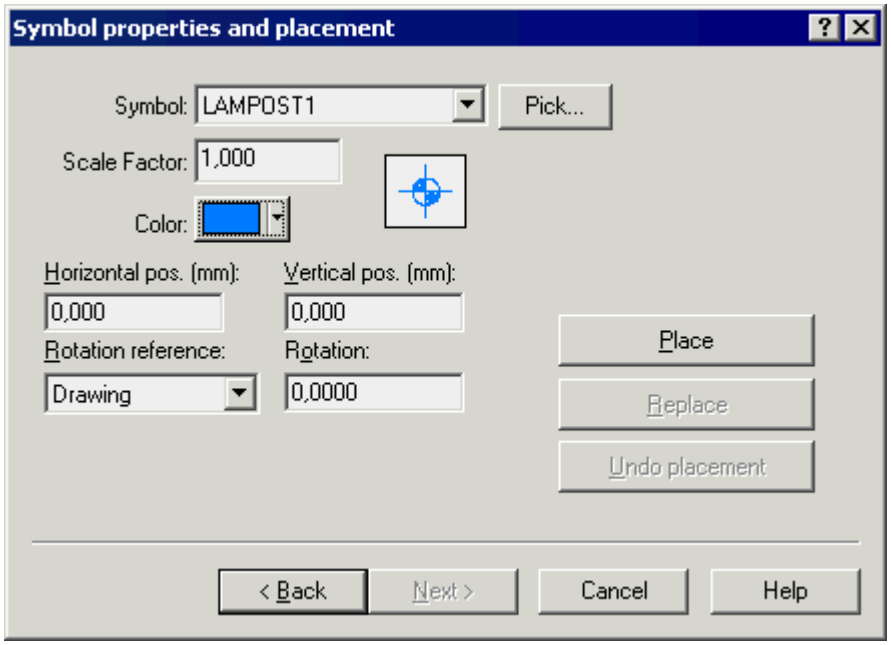
Horizontal and vertical positions
Specify the displacement in millimeters relative to the insertion point as required. This is useful if it gets cramped for space around a point and texts need to be moved a little. However, keep in mind that changing the insertion point for the text allows you to place text in different ways around the point. This method often produces good results.
If the rotation reference is set to the line bearing, the two values will be calculated in the bearing direction. This allows you, for example, to move texts when numbering a line file that are perpendicular to the line with a particular offset.

Insertion point for the text
The insertion point determines the part of the text that is connected to the coordinates of the current point (and with the specified displacement) and if the text is left-aligned, centered or right-aligned.

Rotation reference and rotation
The rotation reference is used to determine the coordinate system in which the texts are to be oriented. You then specify the rotation relative to the coordinate system.

- Drawing
  You specify the rotation relative to the drawing's horizontal edge. At a zero angle the text is drawn horizontally on the paper.
- Coordinate Systems
  You specify the rotation relative to the coordinate system (same as above if the drawing is not rotated).
- Line Bearing
  You specify the rotation relative to a line bearing. If there is a coordinate file, you load the bearing from the remark field. This is useful when you want to have section markers with a certain spacing along a line. First run the sections in the center line function557 (save bearings) with a coordinate file obtained with the bearing in the remark column, and then open a drawing file with the line file and coordinate file.

Step 4 - Symbol Placement
You specify the symbol to be placed and its location in this window.



Symbol
Select from the list, or click [Select ...] to display a graphical overview of all the symbols from which you can select the symbols you want.

Scale factor
Enter a scale factor relative to the normal size.

Horizontal and vertical positions
Specify the displacement in millimeters relative to the insertion point as required.

Rotation reference and rotation
The rotation reference is used to determine the coordinate system in which a symbol is to be oriented. You then specify the rotation relative to the coordinate system. See the description for rotation reference above.

Step 5 - Placing Objects

It is now time to place the texts/symbols. Click **[Place]**. If the selection has resulted in a few points, the objects will now be placed and marked in the drawing behind the dialog.
If the objects are as they should be, you can choose to close the dialog or make a new selection and place new objects. You do not need to close the dialog until you have placed all the required objects. Sometimes it may be the case that you have not zoomed in enough to see where the objects have landed. Close the dialog, select Undo in the menu and run again using a better Zoom mode.

If the objects are not positioned as required, see step 6.

Step 6 - Reposition Existing Objects

If the objects ended up in the wrong place or did not contain the right information, simply change the settings and click **[Replace]** instead of **[Place]**. The last placed objects will now be repositioned. You can also do this by clicking the button **[Cancel]** to delete the last operation. Remember that when you close the dialog, you cannot reposition the object. If you are not satisfied, use the Undo menu and run again.

See also Drawings 255, Drawing Views 256, Objects in Drawings 276.

5.11 Number Pages

You use this function to number pages or drawing sheets in a drawing. It is available in ***Data | Number Pages*** with a drawing as active document.

From Page
Specify from which page the numbering should be made.

To Page
Specify to which page the numbering should be made.

Page Number
Specify the first page number.

Incrementation
Specify how the page numbers are to be incremented (numerically only).

Example

Page Number	Incrementation	Results
1	1	1, 2, 3...
AB-01	1	AB-01, AB-02, AB-03...
A01x	1	A01x, A02x, A03x...

See also: Drawings 255

5.12 Drawing Panels

Drawing panels are loaded from SOT files in the global folder. The panel file contains simple commands for drawing the panel.

Commands

- **DrawMoveTo** *x,y*
  moves the current position to the specified coordinate
- **DrawLineTo** *x,y*
  draws a line to the specified coordinate
- **DrawText** *text, font, size*
  draws a row of text
- **DrawImage** *filename, width, height*
  draws a bitmap file in the formats bmp, png, jpg, pcx, tga, tif and gif. (See Custom logos below)
- **DrawMetaFile** *filename, width, height*
  draws a WMF file (see Custom logos below)
- **DrawEnhMetaFile** *filename, width, height*
  draws an EMF file (see Custom logos below)

Coordinates

All coordinates and sizes are specified in meters. The origin (i.e. coordinate 0,0) is in the panel's lower left corner. Texts and meta files are drawn down to the right from the current position.
Note that you must set the unit as meters in the Project Tree Settings tab 17 to ensure it is possible to open a panel file, sot, in iCON office.

Variables

In the panel dialog you can enter the values that are specific to the drawing that affect its appearance. To draw out one of these values, you use the Draw Text command. Before drawing the text, you replace some specific strings (surrounded by $-signs) with variable values. The following variables are available:

- **$DRAWER$**
  Name of the person who draws
- **$WORKNO$**
  Work number
- **$DATEANDPLACE$**
  Date/Place
- **$SCALE$**
  Scale
- **$HEIGHTSCALE$**
  Height scale
- **$DRAWNO$**
  Drawing number
- **REV**
  Revision number
- **$COMP1$**
  Company details row 1
- **$COMP2$**

Company details row 2

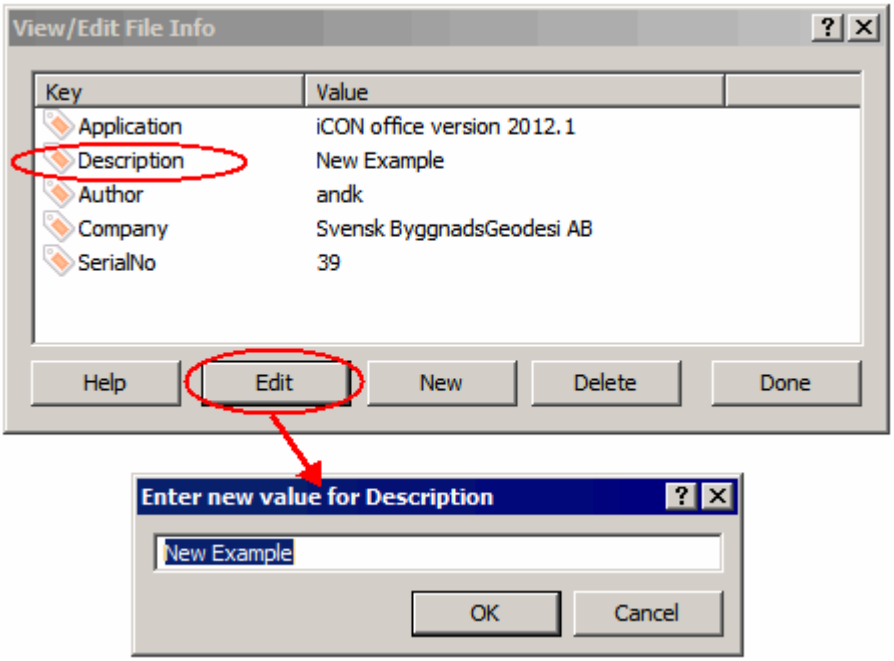
- **$COMP3$**
  Company details row 3
- **$COMP4$**
  Company details row 4
- **$MAINDESC$**
  Drawing title
- **$DESC1$**
  Drawing description row 1
- **$DESC2$**
  Drawing description row 2
- **$DESC3$**
  Drawing description row 3
- **$DESC4$**
  Drawing description row 4

Panel name

The panel name is the same as the file's description. This is at the beginning of the file on the row that starts with File Info "Description" - please note that this information is only visible if you open the SOT file in any text editor. To be able to separate the panels from iCON office each file should have a unique description.

The easiest way to edit the SOT file description is to follow the following description:

- When the SOT file is active, select ***File | View/Edit File Info***.
- Select the row Description, in the dialog that opens, and click the button **[Edit]**.
- Enter any description for the SOT file.



- Click **[OK]** and **[Done]** to close the dialogs.
- Save the SOT file.

You choose the panel to be used in a drawing by selecting ***View | Document Properties*** or click the button when the drawing file is active in the graphics window, see Drawing Settings 266.

Custom Logos

You can add your own logo to the panel. The format should be the EMF vector format (Enhanced Meta File) or any kind of bitmap format (BMP, PNG, JPG, PCX, TGA, TIF, or PIF). The advantage with EMF is that the vector format makes it possible to rescale the image without making it coarse.

The command for drawing logos in EMF format is **DrawEnhMetaFile** *filename, width, height*
This draws the EMF file *filename* at the current position in the file (use DrawMoveTo) and with the specified *width* and *height*.

The command for drawing logos in bitmap format is **DrawImage** *filename, width, height*
This draws the image *filename* at the current position in the file (use DrawMoveTo) and with the specified *width* and *height*.

Create a Panel

The easiest way to create a new panel is to copy an existing panel file and edit it. For example, start by removing the commands that draw out the lines that you do not want to include. It makes things much easier if you have a sketch of the panel where you can measure the dimensions that are to apply. Enter a new name for the sot-file along with the description ensuring the panel appears in the list of panels in ***View | Document Properties***, in the tab **Panels and Forms**, in iCON office.

See also: Drawings 255 , Drawing Settings 266

5.13 Managing AutoCAD drawings, dwg and dxf

iCON office can display drawings created with the AutoCAD® software in both the dwg and dxf formats. When you open a dwg or dxf file, you can choose to display them in a graphical 2D view, or in a graphical 3D view.

iCON office is compatible with the DWG file format. DWG is the native file format for Autodesk's AutoCAD® software and is a trademark of Autodesk, Inc.

Managing drawings in DWG format

Drawings in AutoCAD® file format are opened as other files in iCON office, i.e. by selecting ***File | Open...*** and then 'AutoCAD® drawings" in the file type. Also select the document to be displayed in 2D or 3D. Dwg and dxf files may contain data in two different coordinate systems, "Model Space" and "Paper Space". 3D views are always shown in "Model Space".

An AutoCAD® drawing contains data divided into different layers, each layer can control the colors and line types etc. You can edit these layer settings by selecting ***View | Document Properties***, , which opens the dialog for document properties 52.

Edit Data

With the Select tool you can select objects in a dwg file. You can then delete or copy these objects to the active file.

You can also use the tools ***Copy to Active Document | Point/Element*** 226 and ***Copy to Active Document | Line*** as well as ***Create Line and Profile*** 229.

Menu options specific for AutoCAD drawings

When a dwg or dxf file is active, you see their specific options for AutoCAD® files by going to the **Data** menu.
The following menus are available:

- Data | Set Active Layout 289
- Data | Extract Coordinates from AutoCAD® 296 drawing 296
- Data | Extract Faces from AutoCAD® 298 drawing 298
- Data | Vectorize to Coordinates 299
- Data | Explode Selected Objects 290
- Data | Transform 290
- Data | External References 291
- Data | Lineweight Settings 292
- Data | Dimensions 293
- Data | Audit Drawing 294
- Data | Clean for field 294
- Data | Purge 295
- Data | AutoCAD® 295 file version 295

Set Active Layout

Data | Set Active Layout, select this option to switch the active layout in AutoCAD® file.

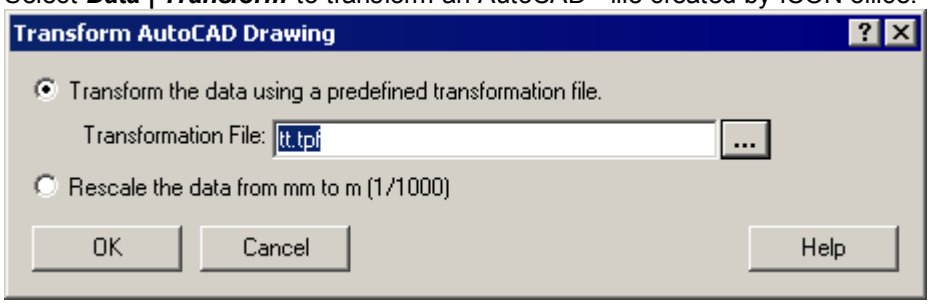
An AutoCAD file may contain one or more layouts. Each layout represents a separate view of the contents of the file. A special layout displays the contents of the Model Space. This layout is usually called 'Model'. Other layouts mostly show Paper Space, with its objects (e.g. a drawing frame) and one or more windows (MVIEW) to model space. This window indicates the relationship between model and paper space with a scaling and rotation.
When you export a drawing 255 (these have the dra file extension) that is created in iCON office to AutoCAD format, a layout is created for each sheet in the drawing.

Explode Selected Objects

Works in the same way as the explode objects tool , see Graphical Tools 235 , but with the difference that you first select the objects to be exploded and then select ***Data | Explode Selected Objects***. In this way, you can explode, for example, polylines, multiline texts (MTEXT) and blocks.
You enter information about the exploding procedure in the output window 107 in iCON office.

Transform

Select ***Data | Transform*** to transform an AutoCAD® file created by iCON office.



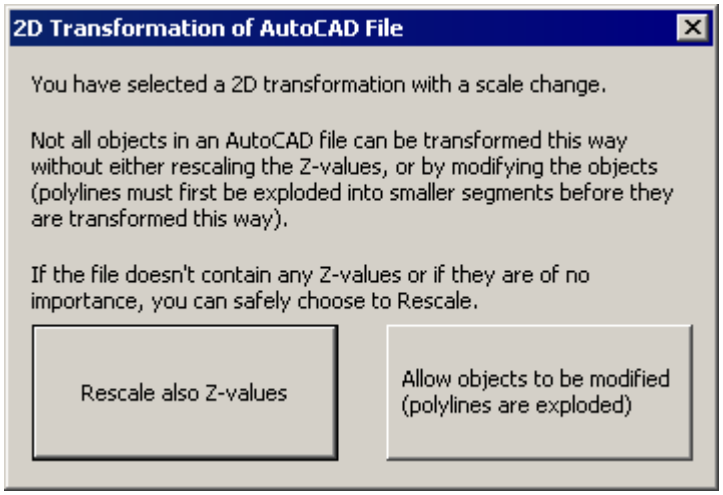
- Transform data according to a predefined transformation file

  Click ... to access the Global Folder where you can select a transformation file, TPF. The transformation is then performed using a transformation file containing the parameters for the calculation. This file must have previously been created using the Transformation function, see Transformation 188 .
- Rescale from millimeters to meters
  All coordinates and dimensions in the dwg drawing are transformed from millimeters to meters.

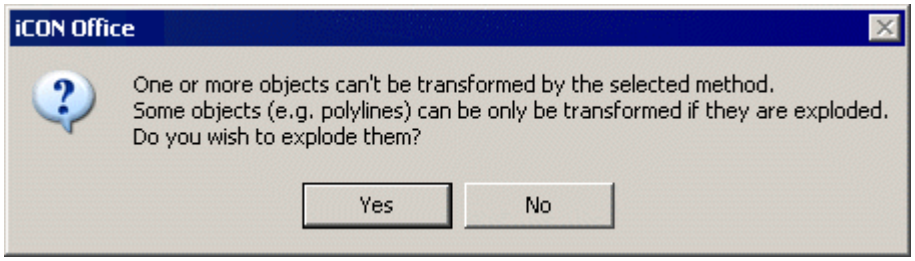
There are a number of different ways to calculate transformations. Predefined tpf files that are created by one of the following types of transformations can be used for the transformation of AutoCAD files. For further information, see Transformation 188 .

Translation	Only movement between systems.
Point and direction	Movement and rotation between the systems, but with the same scale. Created with two points, one fitting point and one direction point. Retained position for point 1. Only possible in 2D.
Basic	Movement and rotation between the systems, but with the same scale.
Helmert	Movement and rotation and scaling between systems; use if there is a scale difference between the systems.
Affine	Movement, different scale along different axes and the lack of orthogonality between the axes, used for example for the transformation from paper copies such as maps where paper shrinkage may vary in different directions.

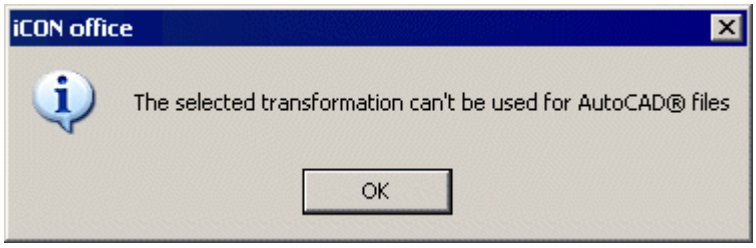
Warning messages will appear if the transformation with the selected transformation file cannot be executed.



When using a transformation file in 2D with scale changes, the user selects whether the Z values are to be rescaled, or whether certain objects are to be allowed to be modified.



Polylines contain X, Y and Z coordinates and therefore cannot be transformed in only the XY axis with retained Z values.
Transformation that corrects for any lack of orthogonality between the axes means that any arcs that are to be transformed must first be divided into ellipses. Arcs will therefore have to be exploded.



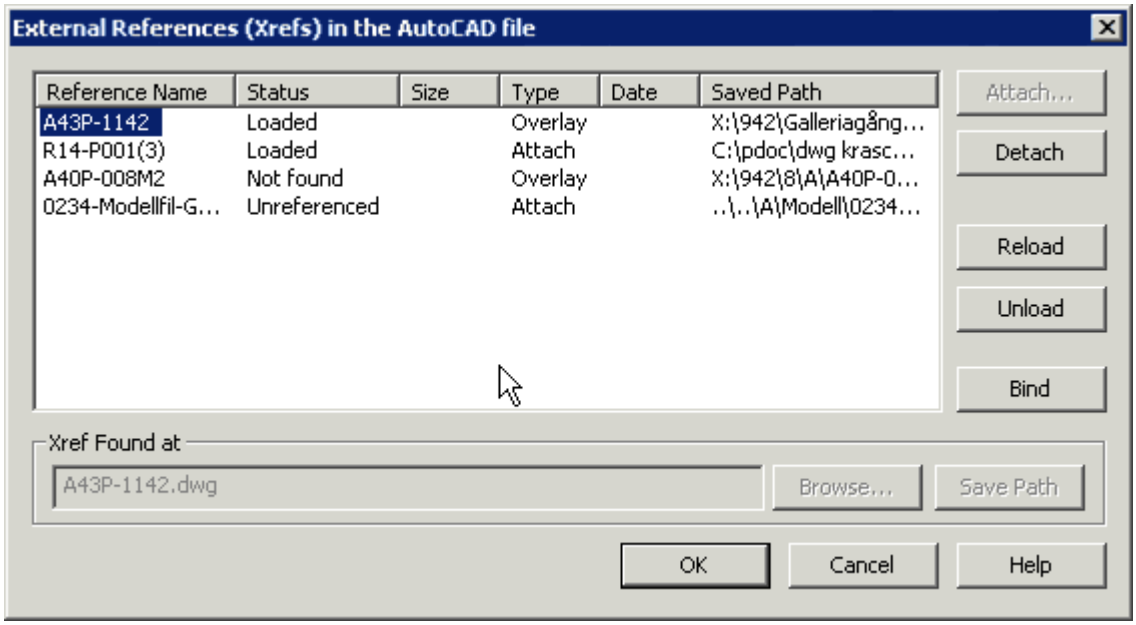
Some transformation relationships cannot be used for AutoCAD files.

External References

Data* | *External References opens a dialog that shows any dwg files that are linked to the active dwg file. If you select any of the linked files in the dialog, the path is written to the file in **Reference found at**. The status of the linked files is shown in the **Status**column. A visible file has the status *View* while *Hidden* means that it is not visible. If you select a file and click **[View]** or **[Hide]** the status will change to *View* or *Hide,* the command is executed by clicking **[OK]**.

Click **[Detach]** to remove an external reference from an AutoCAD® file.

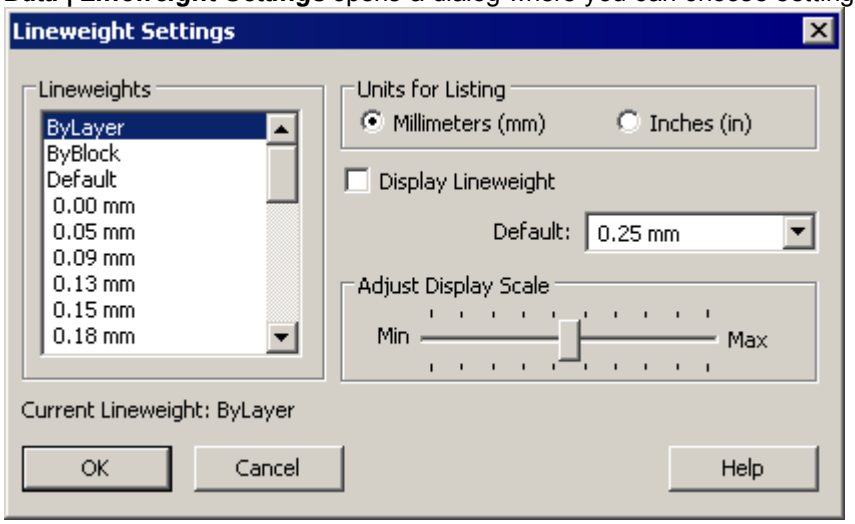
Select a file and click **[Bind]** to add the information contained in the external reference to the active dwg file.



When you open dwg files with links to other files, the information about the files appears in iCON office's output window[107]. External references in the first instance are searched for using the path specified in the dwg file, or alternatively iCON office searches among the project's local files. If the linked file is not found, this appears in red text in the output window[107] .

Lineweight Settings

Data | Lineweight Settings opens a dialog where you can choose settings for the lineweight.



In **Lineweight Settings** all available lineweight settings are shown.

Current Lineweight:
Displays the active lineweight.

Units for Listing
Select if the lineweight settings are to be in millimeters or inches.

Display Lineweight
If this box is checked the lineweights are shown in the active drawing.

Default:
Here you can change the default value of the lineweight.

Layers that have the "Default" lineweight use the value specified here.

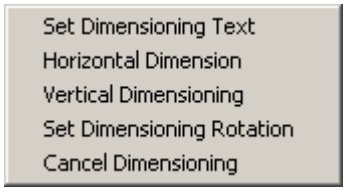
Adjust Display Scale
By dragging the cursor for the display scale, you can control how the lineweight is shown in the active drawing and on printouts.
Note that the display of wider lines may increase the time needed to regenerate the image. To optimize the regeneration rate you can adjust the display scale to the smallest value or choose not to display the lineweight (do not check the box **[Display Lineweight]**).
Note that the box **[Display Lineweight]** has to be checked if the adjusted display scale should be visible in the graphics.

Dimensions

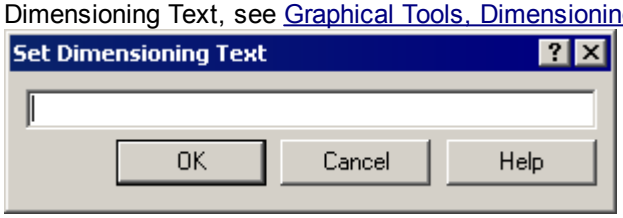
Data | Dimensions opens a dialog that allows you to change the dimensions in AutoCAD® files.

In order to enter dimensions in the AutoCAD file, you must first choose a dimensioning tool for linear or rotated dimensions235 from the toolbar, see Graphical Tools235. If you enable this tool you will be able to perform and store dimensioning in AutoCAD® files. Dimensioning can be done with or without snap.

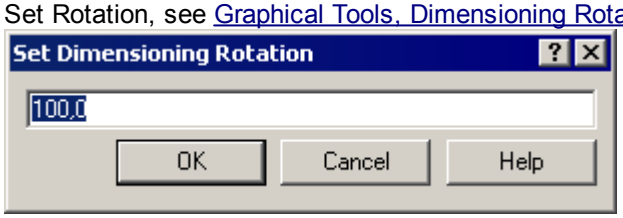
When the start point is selected, you can right-click the mouse button to bring up a dialog with choices for specific dimensions.



- Dimensioning Text, see Graphical Tools, Dimensioning Text236.

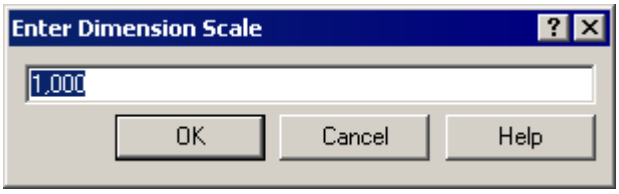


- Set Rotation, see Graphical Tools, Dimensioning Rotation236.



For additional choices, select ***Data | Dimensions***, see below:

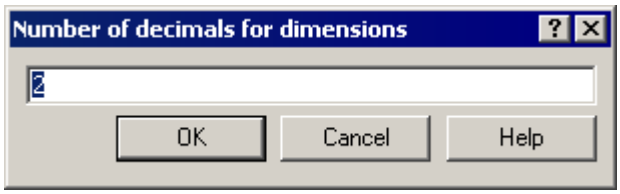
- **Dimension Scale...**



Select ***Data | Dimensions | Dimension Scale...***

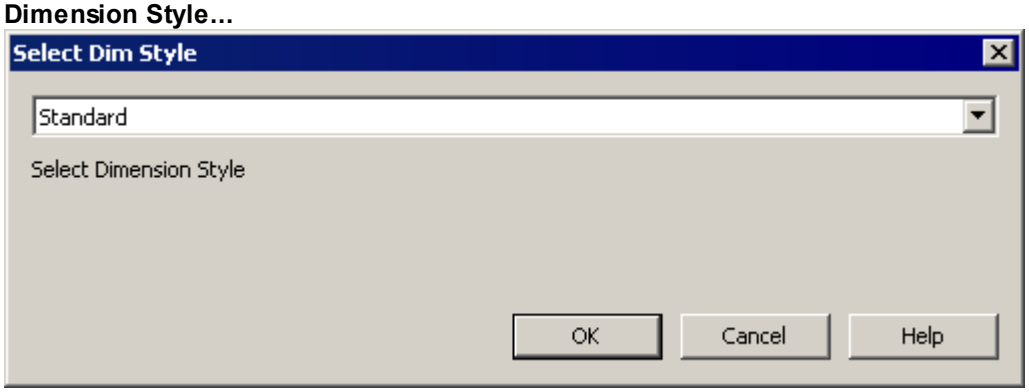
Enter the scale for the font size for the dimensions.
Enter a larger or smaller value for larger or smaller fonts.
A negative number means the dimensions will be inverted.

- **Dimension Precision...**



Select ***Data | Dimensions | Dimension Precision...***
Select the precision for the dimensions.

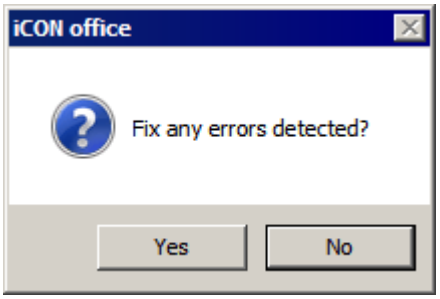
- **Dimension Style...**



Select ***Data | Dimensions | Select Dimension Style...***
Select how the dimensions are presented. Different styles are optional, depending on the text styles contained in the AutoCAD file.

Audit Drawing

Data | Audit Drawing, this function corresponds to Audit in the AutoCAD® program. The function searches for any structural errors in the dwg file, e.g. a block linked to a layer that does not exist.



Any errors that are corrected are displayed in the output window 107.

Clean for field

Data | Clean for field, this function removes everything in the AutoCAD® file that is not visible in the graphics.
Exemples of objects that are removed:
- Unused objects, blocks and layers
- Hidden or frozen layers
- XREF
- Layout views

Visible objects and layers in the AutoCAD file are saved, everything else is removed, thus the file size is reduced.
See Graphical Document Properties 74 for tips on how to choose interesting layers from an AutoCAD file.

Purge

Data | Purge, this function clears the AutoCad® file from unreferenced objects, blocks or layers. Can be useful if you have a base drawing with layers of all possible object instances.

All - clears all unreferenced objects in the AutoCAD file.

Blocks - clears all unreferenced objects in the AutoCAD file.

Layers - clears all unreferenced layers in the AutoCAD file.

If the file contains nested blocks (blocks within blocks) and layers, it may be necessary to run the function several times as iCON office clears one level at a time. The output window 107 names the files that are deleted by the function.

AutoCAD File Version

As the dwg format changes with new versions of the AutoCAD® program, the version of the files is of great importance when exporting data. You can edit the version settings for a dwg or dxf file by selecting ***Data | AutoCAD File Version***. If the file is to be loaded by an AutoCAD system, you should select the same or an elder version from the list before you save the file.

Current Version
The version that the active AutoCAD file was last saved as.
Saving as Version
When saving an AutoCAD file in iCON office, the file is saved in the version given here.
Always save as this version
Check the box in order for iCON office to always save the AutoCAD file in the selected AutoCAD version.

See also Graphical Views 47, Graphical Editing 206, Export to AutoCAD Drawings, Dwg and Dxf 300.

5.14 Import of AutoCAD Drawings, Dwg and Dxf

Extracting data from AutoCAD format

There are several ways to import data in AutoCAD® files, dwg and dxf, to iCON office format. You can import points and lines, or surfaces. You can also vectorize the content of the AutoCAD file to coordinates.

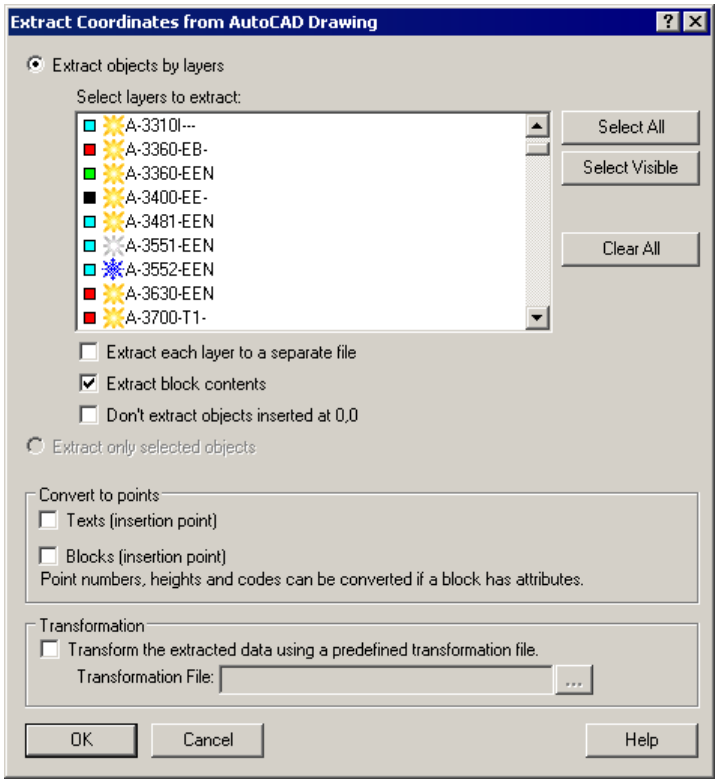
Select method of importation

Open an AutoCAD dwg or dxf file and select:

Import method	Resulting file in iCON office
Data | Extract Coordinates from AutoCAD® drawing	Coordinate file(s)
Data | Extract Faces from AutoCAD® drawing	Terrain model (trm)
Data | Vectorize to Coordinates	Coordinate file (geo)

Extract Coordinates from AutoCAD drawing

Select ***Data | Extract Coordinates from AutoCAD drawing*** to convert the contents of an AutoCAD® file to a coordinate file. The dialog contains a list of the layers found in the file. In front of each layer name, there is a symbol displaying if the layer is visible, hidden or frozen.



- Extract objects by layers

Select layers to be extracted. You can select the layers manually or use some of the buttons in the dialog.

The button **[Select All]** selects all layers, whether they are lit (visible), frozen or hidden.
The button **[Select Visible]** selects all lit layers but not frozen nor hidden layers.

The button **[Clear All]** deselects all layers.

A visible layer in the graphics is displayed by a yellow sun in the list.
A hidden layer is (de)selected with a gray sun.
A frozen layer is selected with a blue snowflake.
A layer that is hidden or frozen is not visible in the graphic, see also Graphical Document Properties 73.

- Extract each layer to a separate file
  Each extracted layer creates a new coordinate file (geo) file, thereby this choice will create an equal number of coordinate files as the number of layers you have selected from the list.

- Extract blocks contents
  This means the content of the blocks is also extracted, as opposed to only loading the insertion point.
  All extracted layers are saved in a single coordinate file.

- Don't extract objects inserted at 0.0
  This option prevents points being created from objects with the insertion point at the origin and thereby avoids erroneous points and a huge zoom limit.

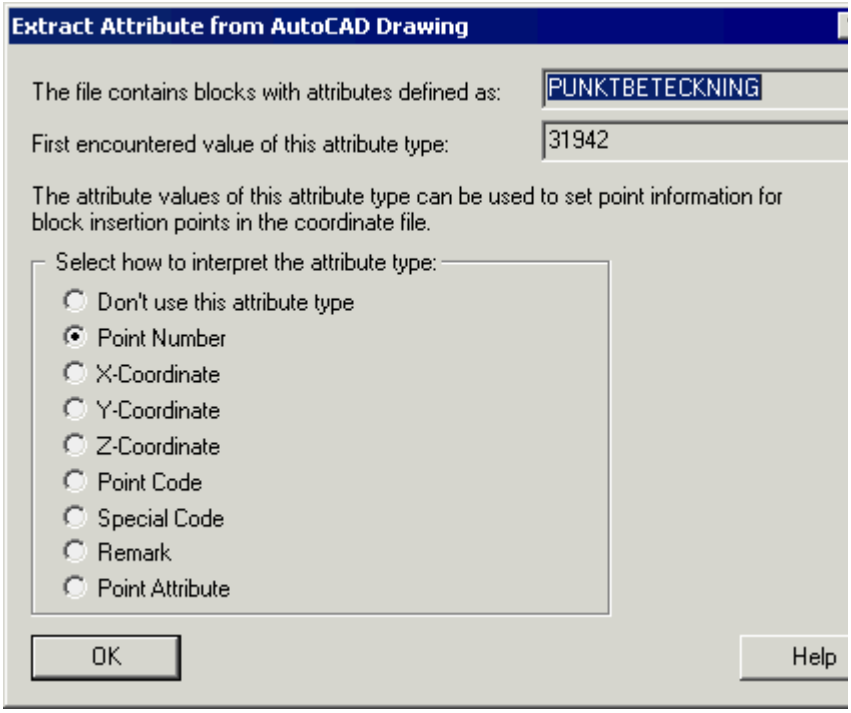
- Extract only selected objects

This option is only enabled if you have selected one or more objects in the graphic. You can select objects in the graphic by pointing to an object or by using the select tool and drawing a rectangle around the objects to be selected.

- Convert to points
  - Texts (insertion point)
    Convert the insertion point for texts to points.
    Select if the insertion point for texts is to be created in the coordinate file. The text content is set as point number.

  - Blocks (insertion point)
    Convert the insertion point for texts to points.
    Select if the insertion points for blocks are to be created in the coordinate file. If the block contains attributes, a dialog will open where you can select how the attributes that belong to the blocks to be handled.

    - **Conversion of attributes from blocks**
      By checking the box for conversion of blocks, you can also handle the attributes that belong to the blocks, if any. For example, if point numbers, heights or codes have been assigned to a point through attributes in the AutoCAD® file, this means you can handle these attribute values and set them to the corresponding points in a coordinate file. For each new attribute type you encounter in the AutoCAD file, a dialog appears where you can choose if and how the attribute type is to be interpreted.



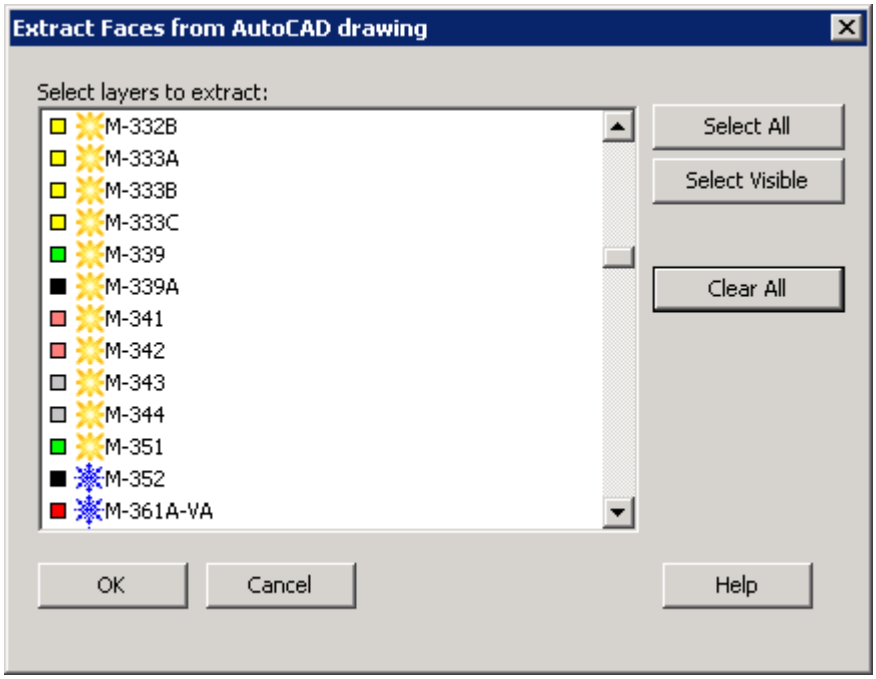
The dialog displays the attribute type and the first attribute value found for that particular type. Select how the attribute type is to be handled. The dialog will only appear once per attribute type, i.e. you cannot handle the same attribute type in more ways than one.

- Transformation

You can choose to transform the extracted information immediately. The transformation is then performed using a transformation file containing the parameters for the calculation. This file must have previously been created using the Transformation function, see Transformation 188.

Extract Surfaces from AutoCAD Drawing

Select ***Data | Extract Faces from AutoCAD Drawing*** you can convert surfaces (3D faces) in an AutoCAD® file to a terrain model. The dialog contains a list of layers just as in the dialog ***Extract Coordinates from the AutoCAD drawing*** 296.



The button **[Select All]** selects all layers, whether they are lit (visible), frozen 296 or hidden 296 .
The button **[Select Visible]** selects all lit layers but not frozen nor hidden layers.
The button **[Clear All]** deselects all layers.

Vectorize to Coordinates

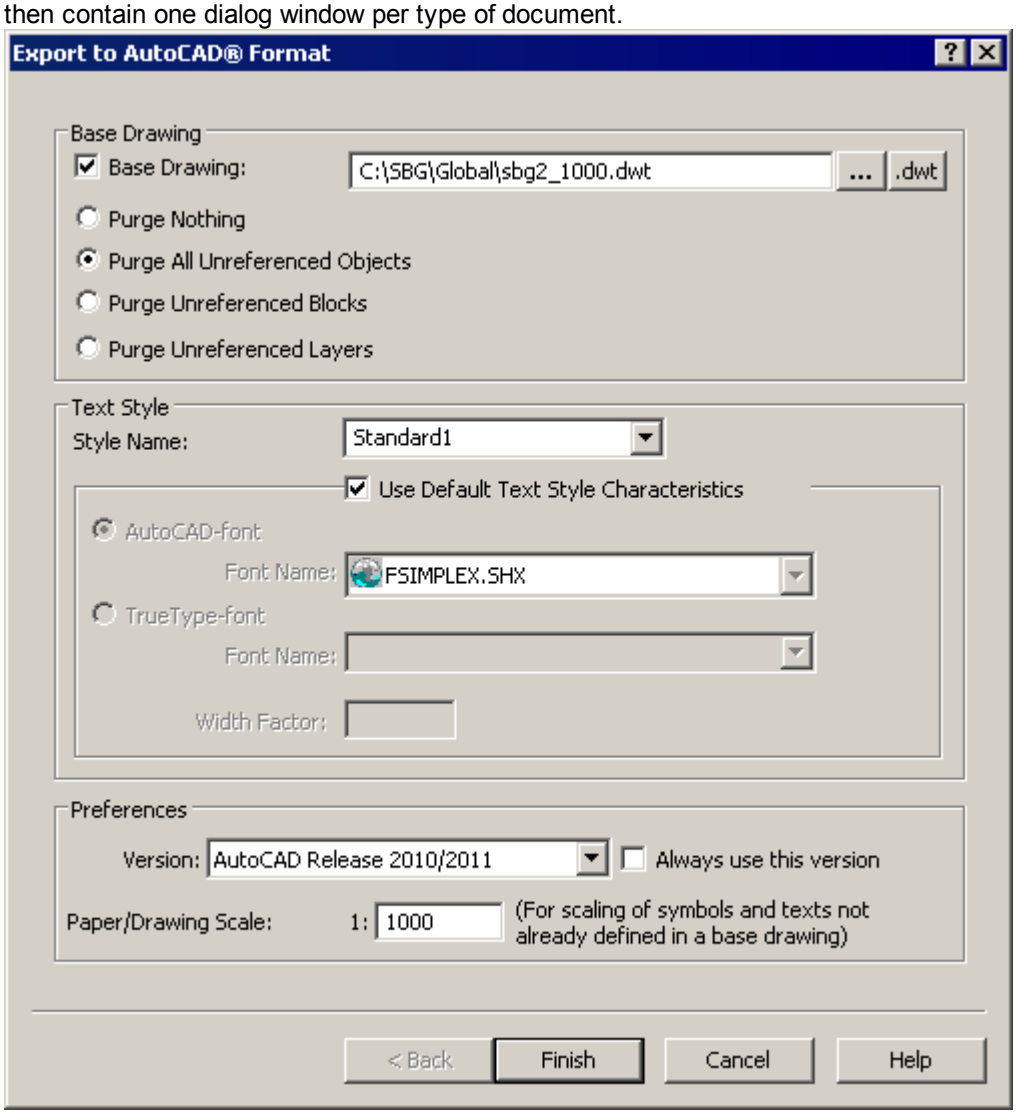
Select ***Data | Vectorize to Coordinates*** to create a coordinate file where all the contents in the dwg file have been vectorized. Since everything visible in the AutoCAD® file is vectorized, any texts and objects (such as ellipses, splines) will be visible in the coordinate file. The vectorized coordinate file could be used as a background image, for example.

See also Export to AutoCAD Drawings, Dwg and Dxf 300 , Graphical Document Properties 74

5.15 Export to AutoCAD Drawings, Dwg and Dxf

Export data

To save a graphical view in iCON office to an AutoCAD® file, you select ***View | Export View As | AutoCAD file***. You will then come to a dialog where you can choose settings for the dwg file to be created. The first window of the dialog is shown in the figure below. Clicking the button **[Next]** takes you to a dialog that is specific to the document type to be exported. If you have multiple types of documents open in the same graphical windows, e.g. coordinate file, line file and section file, you can click through the dialog that will then contain one dialog window per type of document.



First window in dialog for export to AutoCAD format.

Export with base drawing

Check the **[Base Drawing]** box if this is to be used when exporting to AutoCad® format. Clicking the button .dwt brings up the predefined base drawings 313 in dwt format that come with the iCON office installation, along with any other dwt files that you have saved in the global folder.

The advantage of the base drawing is that you can determine in advance exactly how the point texts, symbols and lines are presented in the AutoCAD program. The current contents of the graphical window will be supplemented with information from the specified base drawing. If the recipient of the AutoCAD file has a standard for the symbols and layers to be used, you can tailor the transfer with, for example, layers, colors, symbols and line types.

Read more about Base Drawing, Text Style and Preferences in Export to AutoCAD Drawings in General 313 .

When transferring a base drawing, you can choose to delete information that is not being used. For example, the predefined base drawings that are customized to suit the code file 203 sbg2.cod contain layer definitions for all codes in the code list. It may be preferable to remove the layers belonging to codes that do not occur in the original files. Note that you can also purge after creating the dwg file , see Purge in the chapter Import of AutoCAD Drawings, Dwg and Dxf 295 .

- Purge Nothing
  Nothing is deleted from the generated drawing.
- Purge All Unreferenced Objects
  All unreferenced objects in the drawing will be deleted, e.g. layers, blocks, text styles and dimension styles.
- Purge All Unreferenced Blocks
  Removes blocks that have not been inserted in the drawing.
- Purge All Unreferenced Layers
  Removes layers that have no reference from any object.

Export without base drawing

The advantage of transferring using the graphical view, without the base drawing, is its flexibility. You simply select from time to time the information you want to transfer to the dwg file. What you see on screen is transferred to the AutoCAD® file.

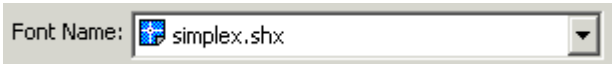
Text Style

All texts in the AutoCAD® program are linked to a text style. The text style specifies the font to use, along with the width factor and other text properties. There is a special text style in the AutoCAD program called Standard that is used for all texts unless otherwise indicated. The text style is always in a dwg file (but may be connected to any font).

You can specify any name for the text style when exporting. The text style will be created if it does not already exist (i.e. if you have selected a base drawing). If you are using a base drawing and set the text style as standard, you do not need to select a special font as the settings in the base drawing are used. The same applies if you select a different text style that you already know is used in the base drawing.

Read more about point texts in AutoCAD Drawings in General[314].

- Style Name
  Select the text style to use for the texts from iCON office. You create a new text style by unchecking the option "Use Default Text Style Characteristics" and selecting the properties you want for the new text style. These settings only apply if the selected text style does not already exist in a selected base drawing.
  - **AutoCAD font**
    AutoCAD font refers to a font that is defined by a shx file. The list of AutoCAD fonts is compiled by iCON office looking for shx files in the folders chosen in the "AutoCAD" tab under ***Edit | Preferences***, see Program Settings[111]. If the AutoCAD program is installed on your computer, you can use iCON office to look for shx files in the AutoCAD folders. iCON office always looks firstly in the selected AutoCAD folders and lastly in the global folder. The icons in the list show where iCON office found the shx files. A globe indicates that the file is located in the global folder. An AutoCAD symbol indicates that the file is located in one of the specified AutoCAD folders.



    Note that not all shx files contain fonts; the format is also used for line styles etc. Be sure to choose the correct shx file.

  - **TrueType font**
    As an alternative to a shx font, you can select a TrueType font. The list shows the fonts that are installed in Windows.

  - **Width Factor**
    The width factor indicates how much each letter is expanded laterally across the font's basic design. The value 1.0 means that no adjustment to the width occurs. If you want a narrower text, you enter a value less than one, while for a wider text a higher value applies.

Version

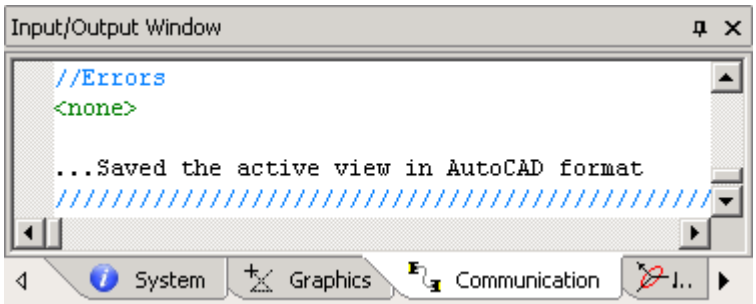
Here you can also select the AutoCAD® version of the files that are created by iCON office. This applies to dwg and dxf files that are created by iCON office.

Paper/Drawing Scale

Here you can specify a scale to assign a suitable size to point texts and symbols for transfer to AutoCAD® format. You can only change the value if the graphical window does not contain a drawing (dra) as the drawing already has a scale with which the texts and symbols will be drawn. Enter a scale value that is appropriate taking into account the coordinate range that the objects have in the current graphical window. Note that the scale value does not affect the size of texts and symbols that are loaded from a base drawing. Read more about the transfer of texts and symbols in Export to AutoCAD Drawings in General[313].

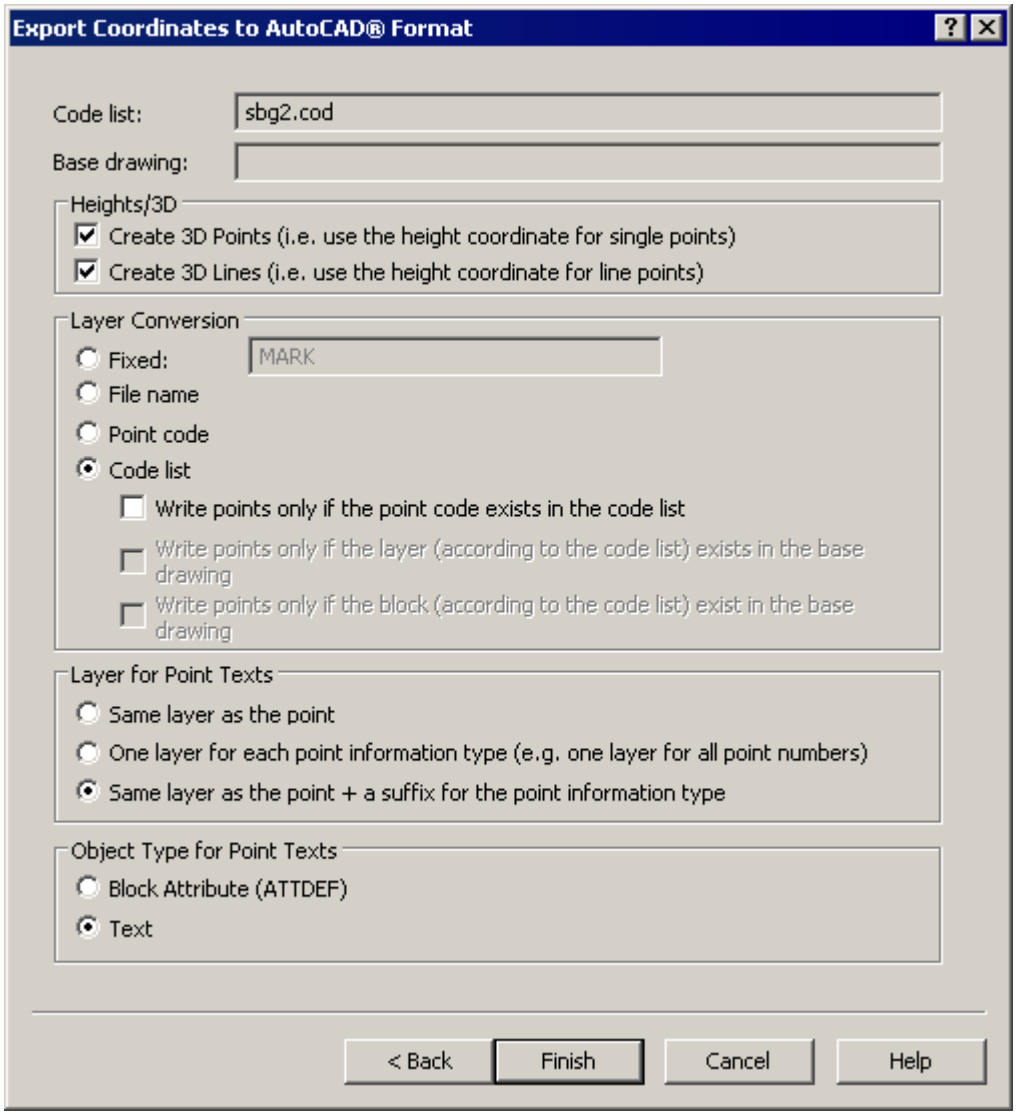
Export to AutoCAD format

In terms of export to AutoCAD® format, a report is also generated on the transfer in iCON office's Input and output windows 107. Lastly, you enter any errors in the dialog affecting the results of the exported file.



Export coordinate files (geo, pxy) to AutoCAD format

When exporting one or more coordinate files the following dialog appears.



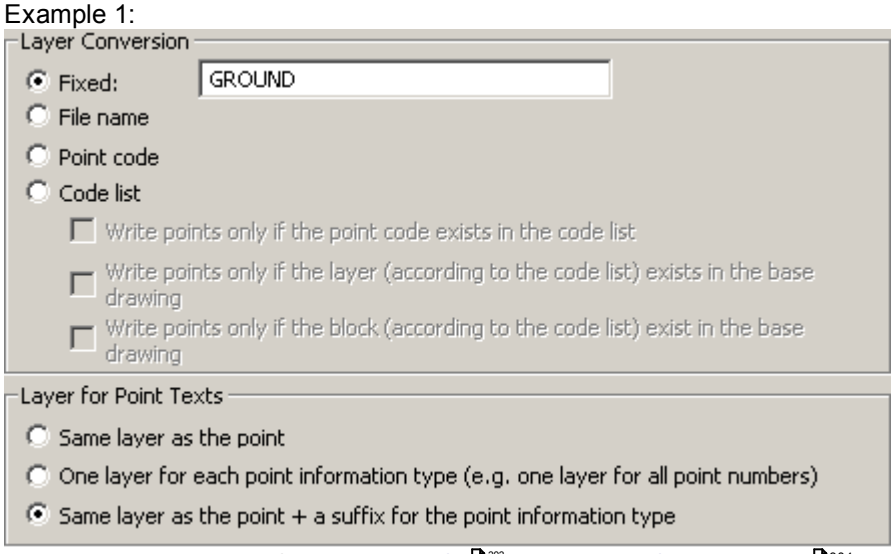
- Heights/3D Points/3D Lines
  If this box is checked, the height coordinates for single points and points in lines are transferred.
- Layer transfer
  This option determines how layers are to be entered in the AutoCAD® file.

- **Fixed**
  All data is placed in the designated layer.
- **Filename**
  All data is placed in a layer with the same name as the file.
- **Point code**
  The point code determines which layer the point is added to.
- **Code list**
  The point code is matched with the active code list to determine which layer is to be added. See also Code Lists 203 .
  - **Write points only if the point code exists in the code list**
    Only points whose point code is in the current code list are transferred.
  - **Write points only if the layer (according to the code list) exists in the base drawing**
    Only points whose AutoCAD layers (according to code list) are in the selected base drawing are transferred.
  - **Write points only if the block (according to code list) exists in the base drawing**
    Only points whose AutoCAD block (according to code list) are in the selected base drawing are transferred.

- Layers for point texts
  This option controls how layers are to be created the point texts (point numbers, point codes, heights and remarks).
  For example, to be able to create a layer for point numbers, the point numbers must be turned on in the coordinate file when saving the view. In the AutoCAD® file, a layer is created that can be turned on or off.
  - **Same layer as the point**
    The texts are saved in the same layer as the point.
  - **One layer for each point information type**
    A layer is created for each text type, i.e. all point numbers appear in a layer, point codes in another and so on.

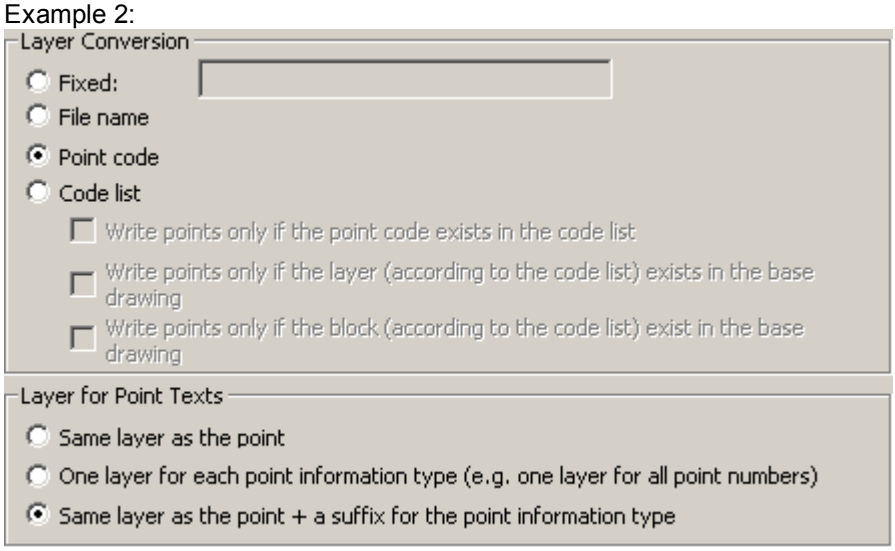
- **Same layer as the point + a suffix for point information type**
  In this way, you can create different layers in the AutoCAD file whereby each layer is named with a suffix.
  Used suffix:
  Point number/Element Directory "PTEXT"
  Code "CTEXT"
  Height "ZTEXT"
  Remark "RTEXT"
  Attribute "ATEXT"

  Naming layers is controlled partly by the choice of Layer transfer 303 and selection of Layers for point texts 304 .
  Example 1:



  With the above options for Layer transfer 303 and Layers for point texts 304 a layer MARKPTEXT will be created for point numbers and MARKZTEXT for height texts and so on.

  Example 2:



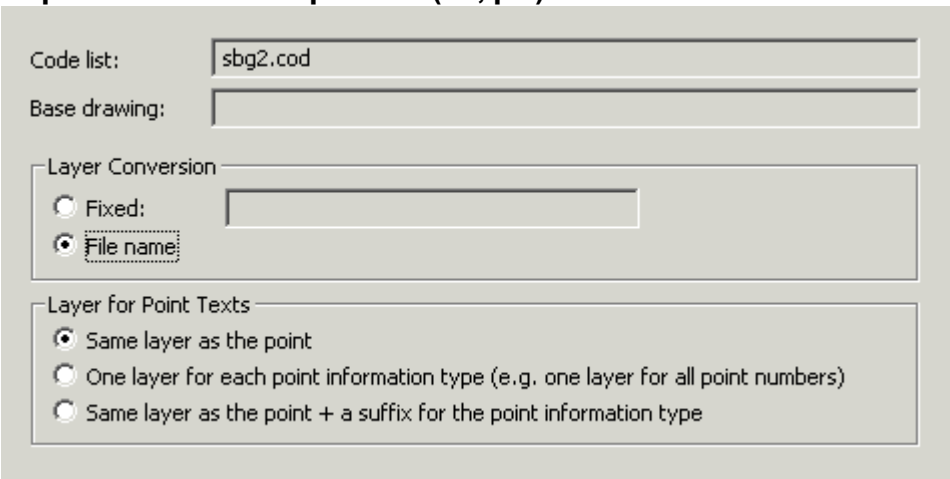
  Assume you have a coordinate file where you have coded the points as 100 and 103. With the above options for Layer transfer 303 and Layers for point texts 304 the following layers will be created: 100PTEXT and 103PTEXT for point numbers and 100ZTEXT 103ZTEXT for height texts and so on.

- Object types for point texts
  Here you select how the point texts are to be represented in the AutoCAD file.
  - **Attributes for block (ATTDEF)**

A block definition is created for the coordinate file where point texts are added as attribute definitions (AutoCAD object type ATTDEF). A block insertion is made for each point in the coordinate file with point texts as attributes when transferring. The advantage of this method is that it is subsequently possible to determine the significance of each text, for example, what the point number is and what the height text is etc.

- **Text**
  For each point text in the coordinate file a separate text object is created in the AutoCAD file. The advantage of this method is that it is easier to edit these texts in the AutoCAD program, for example, moving a text.

Export line files and profiles (lin, prf) to AutoCAD format



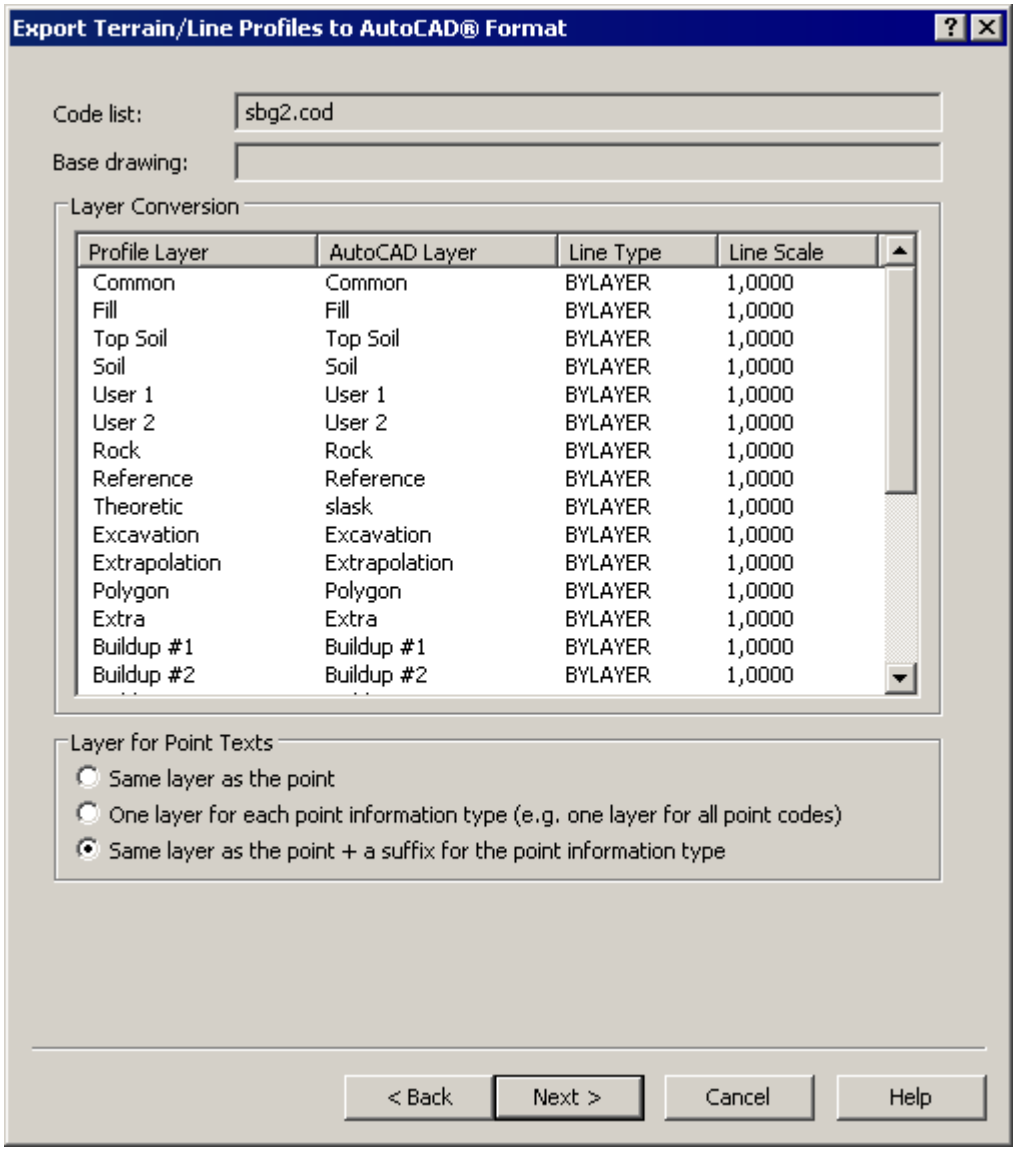
- Layer transfer
  This option determines how layers are to be entered in the AutoCAD® file.
  - **Fixed**
    All data is placed in the designated layer.
  - **Filename**
    All data is placed in a layer with the same name as the file.
- Layers for point texts
  This option determines how layers are set for point texts
  For lines you can get layers for element number, section and radius.
  For profiles you can get layers for element number, section, height and radius.
  - **Same layer as the point**
    The texts are saved in the same layer as the point.
  - **One layer for each point information type**
    A layer is created for each text type, i.e. all element numbers appear in a layer, sections in another and so on.
  - **Same layer as the point + a suffix for point information type**
    This means that the point's layers are joined with a suffix to form the layer name.
    Used suffix:
    Element number "PTEXT"
    Radius "RDTEXT"
    Section "STEXT"
    Height "ZTEXT" (only for profiles)

Note: As spirals are not represented in AutoCAD® format, these contours are divided into several straight elements.

Export terrain and pipe profiles (pro, prw) to AutoCAD format

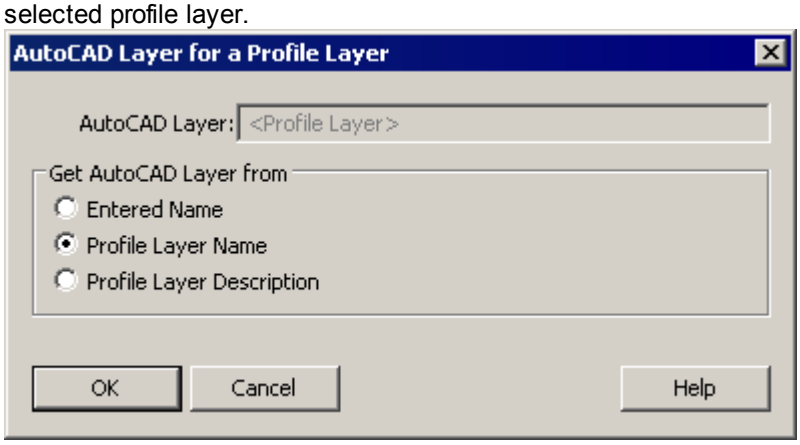
If you have selected profile properties in the graphics as per the offset, the AutoCAD® file will have different layers for the center line and side lines.

If you have selected profile properties in the graphics as per the layer, the AutoCAD® file will have different layers for the profile layer that the terrain or pipe profile contains.



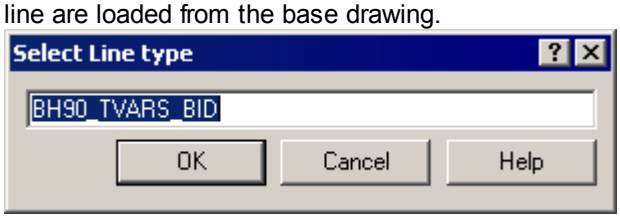
- Layers for point texts
  This option controls how layers are to be created for the point texts (point codes and heights).
  - **Same layer as the point**
    The texts are saved in the same layer as the point.
  - **One layer for each point information type**
    A layer is created for each text type, i.e. all heights appear in a layer and point codes in another.
  - **Same layer as the point + a suffix for point information type**
    This means that the point's layers are joined with a suffix to form the layer name.
    Used suffix:
    Height "ZTEXT"
    Code "CTEXT"

If you left click on a text in the *AutoCAD layer column* in the dialog above, you can select layers for the selected profile layer.



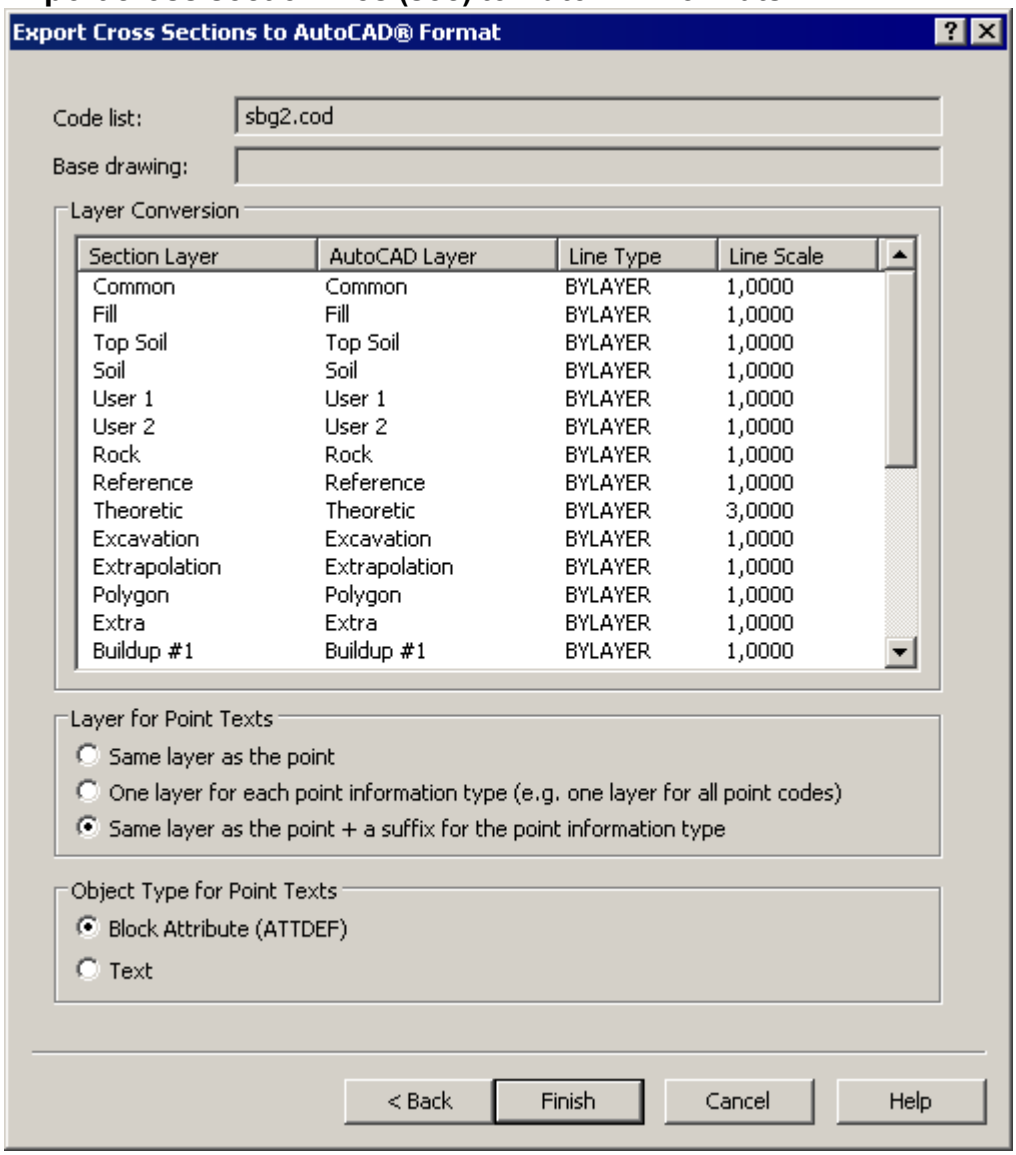
- Download AutoCAD layers from
  - **Entered Name**
    On the *AutoCAD layer row* you can enter a new name for the layer in the AutoCAD file that is created.
  - **Profile Layer Name**
    The layer gets its name from the profile layer.
  - **Profile Layer Description**
    The layer gets its name from the description of the profile layer, which is entered in the terrain profile or pipe profile.

If you left click on a text in the *AutoCAD column Line Type* you can select the line type for the selected profile layer. Provided that the name of the line type is in the selected base drawing, the properties for the line are loaded from the base drawing.



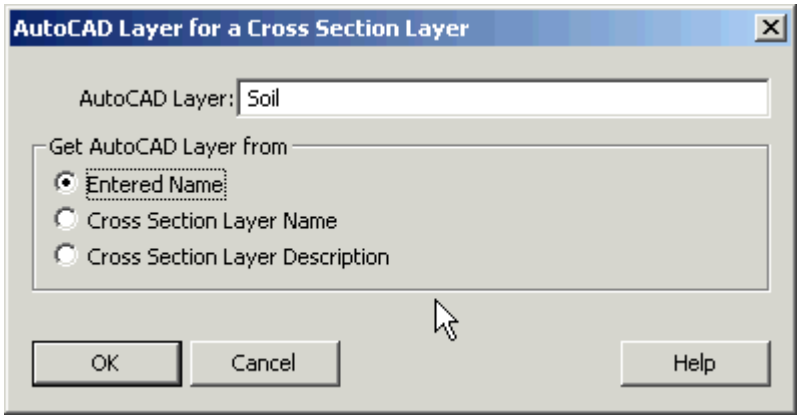
If you left click on a row in the *AutoCAD column Line Scale* you can change the line type scale.

Export cross section files (sec) to AutoCAD formats



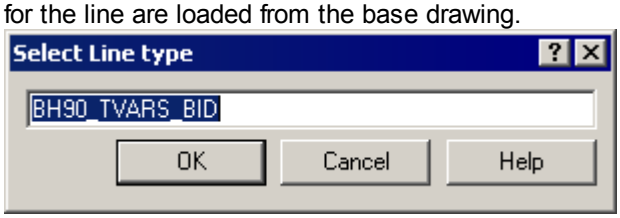
- Layers for point texts
  This option controls how layers are to be created for the point texts (point numbers and heights).
  - **Same layer as the point**
    The texts are saved in the same layer as the point.
  - **One layer for each point information type**
    A layer is created for each text type, i.e. all heights appear in a layer and point codes in another.
  - **Same layer as the point + a suffix for point information type**
    This means that the point's layers are joined with a suffix to form the layer name.
    Used suffix:
    Height "ZTEXT"
    Code "CTEXT"

If you left click on a text in the *AutoCAD layer row* in the dialog above, you can select layers for the selected cross section layer.



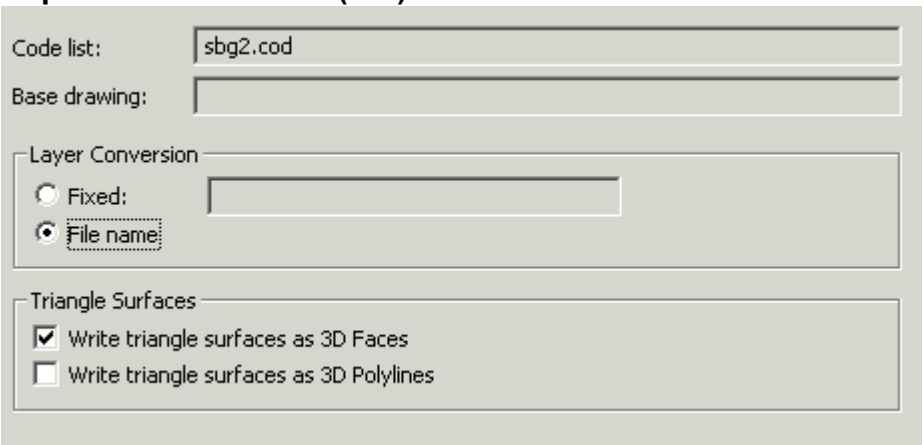
- Download AutoCAD layers from
  - **Entered Name**
    On the *AutoCAD row Layer* you can enter a name if you want to rename the layer in the AutoCAD file that is created.
  - **Cross Section Layer**
    The layer gets its name from the cross section layer.
  - **Profile Layer Description**
    The layer gets its name from the description of the cross section layer, which is entered in the cross section file.

If you left click on a text in the *AutoCAD column Line Type* you can select the line type for the selected cross section layer. Provided that the name of the line type is in the selected base drawing, the properties for the line are loaded from the base drawing.



If you left click on a row in the *AutoCAD column Line Scale* you can change the line type scale.

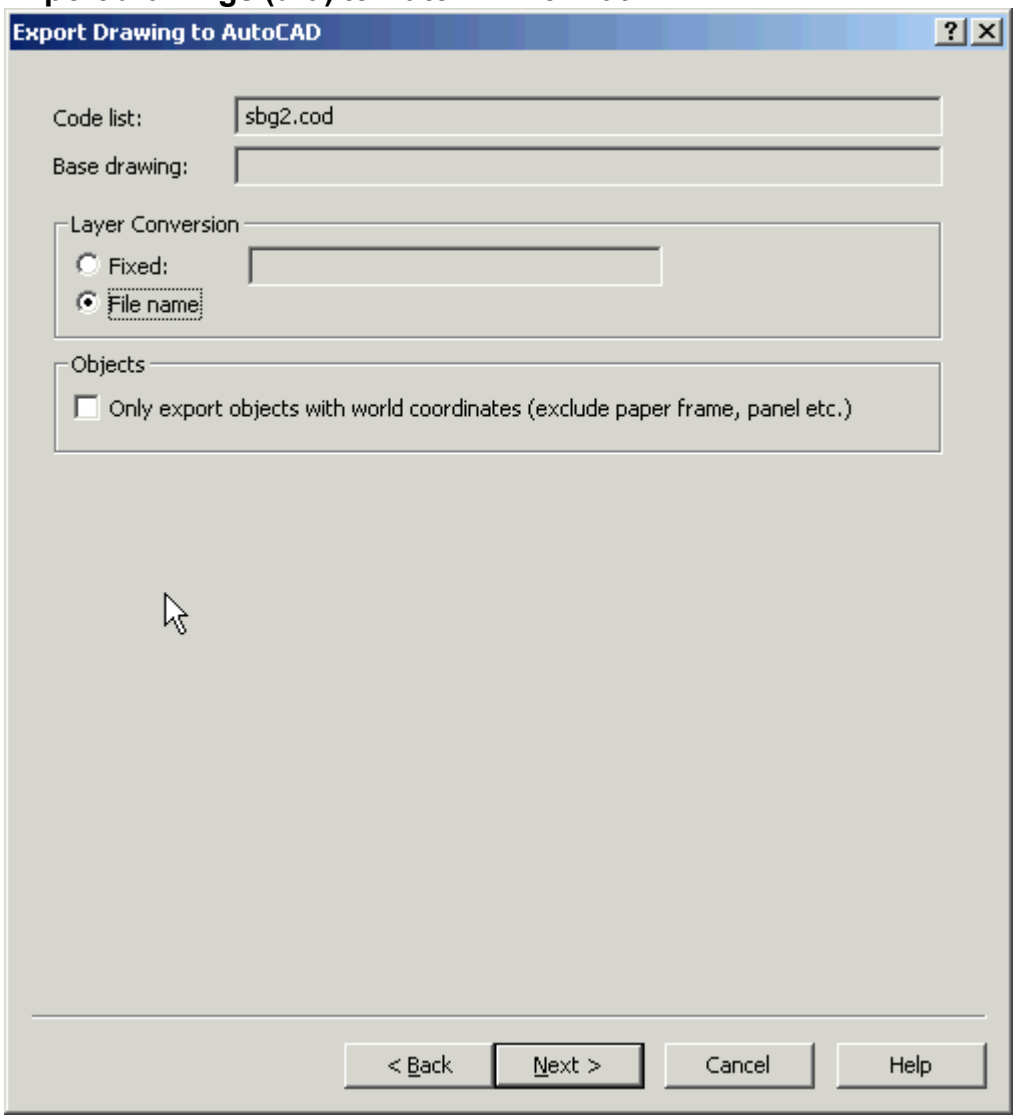
Export terrain models (trm) to AutoCAD format



- Layer transfer
  This option determines how layers are to be entered in the AutoCAD file.
  - **Fixed**
    All data is placed in the designated layer.
  - **Filename**
    All data is placed in a layer with the same name as the file.
- Triangle Surfaces
  When exporting terrain models to AutoCAD® format you can choose to transfer triangles both as surfaces (3D Faces) and lines (3-D Polylines).
  - **Write triangle surfaces as 3D Faces**
    If you choose surfaces (3D Faces) an AutoCAD object of the 3D Face type is generated for each triangle. Surfaces are written to the layer that is selected during layer transfer.
  - **Write triangle surfaces as 3D Polylines**
    If you select lines, an AutoCAD object is created in the 3D polylines style for each side of each triangle (i.e., three lines per triangle). Lines are written to the layer that is selected under layer transfer + the suffix _POLY. If, for example, you have selected the layer name MODEL, the lines will be placed in the layer MODEL_POLY.

Break Lines
Break lines in a terrain model are always saved as 3D polylines in the dwg file. Lines are written to the layer that is selected under layer transfer + the suffix _BREAK. If, for example, you have selected the layer name MODEL, the lines will be placed in the layer MODEL_BREAK.

Export drawings (dra) to AutoCAD format



- Layer transfer
  This option determines how layers are to be entered in the AutoCAD file.
  - **Fixed**
    All data in the drawing is added to the specified layer.
  - **Filename**
    All data in the drawing is added to a layer that has the same name as the drawing.
- Object
  If the box is checked, only that which is in the plane view of the drawing is transferred to the AutoCAD drawing (but not that which is only in the drawing's side views).
  Do not check the box if the paper frame, drawing panel etc. are to be visible in the AutoCAD drawing.

Export dwg files to AutoCAD format

If you have a dwg file open in the graphics in iCON office when choosing ***View | Export View As | AutoCAD file*** the file will be linked to an external reference (Xref) to the new dwg file that is created.

See also Graphical Views 47 , Graphical Editing 206 , Export to AutoCAD Drawings in General 313 , AutoCAD Drawings 289 .

5.16 Export to AutoCAD Drawings in General

Most file types in iCON office can be converted into AutoCAD® format (dwg or dxf). You do this by first opening the files to be converted in a graphical window. In this way you can transfer the information in several files into a single AutoCAD® file. The configuration of each file type in the window determines which information is transferred and how this takes place. If, for example, you want to transfer point numbers from a coordinate file to a dwg file, you open the coordinate file and turn on the point numbers graphically before exporting.

Base Drawing

You can choose to have an existing AutoCAD® file as a base when converting information in a graphical window. This base file, which can be any other AutoCAD file, is called a base drawing and has two main applications:

- to supplement an existing AutoCAD drawing with new information. Nothing that is already present in the base drawing is deleted or overwritten when you choose to save a graphical window as AutoCAD format. It is therefore very easy to add a file by selecting it as the base drawing.
- to use existing templates containing configurations in AutoCAD format to control how new information is created. This may apply to layer classification, colors, symbols (i.e. block definitions), line styles, fonts, etc. No matter what type of file is to be converted, you can choose the AutoCAD layer or layers to which the information is to be attached. By using a base drawing with the desired layers already defined, you can control how information is displayed in a flexible way, for example, the color and line style for an object in an AutoCAD file is often based on the layer in which the object is placed. The template files often have the dwt extension instead of dwg to indicate that the drawing is a template.

Code list connection to base drawing

The iCON office installation includes a number of predefined AutoCAD® templates that are designed to be used in conjunction with the code list 203 sbg2.cod, which means that they observe the standard in the Swedish **SNRA (Vägverket) Handbook**. By coding points according to the code list **sbg2.cod** and selecting one of these predefined templates when exporting, you get an AutoCAD file directly with the correct layers, line types and symbols as specified in the Handbook. The templates are called **sbg2_200.dwt**, **sbg2_500.dwt**, **sbg2_1000.dwt** and **sbg2_2000.dwt**. The name indicates the drawing scale the symbols are designed for, otherwise they are identical. There is also a template with the name sbg2z.dwt designed for code list sbg2z.cod and it is only used when you want to show the heights, for example, a height plane. You can of course also create your own templates.

The actual link between the code list and the templates is in the four AutoCAD fields in the code list.

Sbg1_eng.cod

	Code	Description	AutoCAD Layer	AutoCAD LType	AutoCAD Block	AutoCAD Attrib
1	111	Triangel point	ADM_TRI		ADM_TRI	S
2	100	Polygon point	ADM_PP		ADM_PP	S
3	113	PikT	ADM_PIK		ADM_PIK	S
4	114	Benchmark point				

- AutoCAD Layers
  In the 'layer' field you specify the layers in AutoCAD file that the point is to appear in, for example, in the example above a point with code 100 (polygon point) appears in a layer called ADM_PP. Usually the layer controls the color and line type that an object is to be drawn with. You can utilize this by specifying a layer name that is present in the base drawing you are using. If the layer name is in the base drawing, you can choose to create that layer.

- AutoCAD Line Type (Line Style)
  You enter the name of the AutoCAD line type in the line type field that applies to the code. If you have a base drawing where each layer determines the line type that the objects in the layer are to be drawn

with (e.g. sbg2 templates) it is simply enough to enter BYLAYER in this field. If you are using a base drawing that does not have pre-defined layers, but does have predefined line types, a new layer will be created and connected to the line type that is specified. The same is true if the layer name specified in the AutoCAD layer column is not in the base drawing.

- AutoCAD block
  In 'block' you enter the name of the AutoCAD blocks to be drawn for the object. Note that the blocks must be defined in the base drawing that is used.

- AutoCAD Attributes
  The attribute field is used to enter the attribute or attributes that are to be transferred to the block specified in the previous column. An attribute provides additional information about a block. For example, this could be a point number or height of a point. The information is printed as text in connection with the block. Note that it is the actual block in the AutoCAD file that defines the attributes that are present. You do this by creating the block in the AutoCAD file with one or more connections to ATTDEF entities. This definition specifies where, relative to the block insertion point, the attribute is to be printed. Each attribute has a name or 'tag' that identifies the attribute. It is this name that iCON office looks for when an attribute is defined in the code list. Each desired attribute is specified with a letter in the attribute field as below. In order to transfer the attribute texts, the attribute definition (ATTDEF) must have one of the names listed in the table.

Attributes	Letters in the code list	Attribute Names in AutoCAD that iCON office looks for
Punktnr	S or P	NR, ID, BET, PUNKTNR
X	X	X, X_KOORD
Y	Y	Y, Y_KOORD
Z	Z	Z, Z_KOORD, GEO_Z, HÖJD
Code	K or C	KOD, CODE
Remark	R	REMARK, INFO
Point Attributes	A	Attribute type for the attribute (e.g. UB for the attribute formation date)

If more than one attribute is to be used, several letters without spaces are specified in the code list, such as SZ for point number and height.

Point Texts

For the transfer of symbols and point texts (e.g. point number and height texts) to an AutoCAD® file, the procedure depends on whether a base drawing is used or not.

Point texts in a base drawing (only applies to coordinate files geo, pxy)

One advantage of base drawings is that you can determine in advance exactly how the point texts are to be presented in an AutoCAD® drawing. This could be the position relative to a symbol, the layer in which the text is placed, the text size it should have, the font, the color, etc. You can have different base drawings for different purposes, or for different recipients of the AutoCAD file.

Preconditions:

- The points are coded according to a code list.
- The code list is customized to suit a base drawing in AutoCAD format and contains predefined blocks (symbols) with the attributes for point numbers/height texts. (For example, sbg2.cod in combination with sbg2_1000.dwt).

Procedure:

1. Set the current code list as active, see also Code Lists 203.
2. Open the coordinate files to be saved as AutoCAD format.
3. Point texts should not be turned on in the graphics when you save the view as AutoCAD format. Size,

color, layer and more are pre-determined in the base drawing. If the point numbers or heights are shown using attributes (i.e. with S/P or Z in the code list's attribute fields), these text views must also be turned off in the graphics in order to avoid the duplication of texts, i.e. if, for example, you have chosen to show the point numbers on screen while exporting points with an AutoCAD symbol showing point numbers, you will get two point number texts in the dwg file.

4. Select ***View | Export View As | AutoCAD File*** to save the view to AutoCAD format.
5. Select the required base drawing.
6. Select the "Code List" option for the layer transfer.
7. As the texts belong to a block in the base drawing, it is the scale of the block that determines the text size. The main scale of the main block is predefined in the base drawing. Different base drawings may have different scales 313 for the blocks that are designed for different scales of paper (this is the case for the base drawings that are connected to sbg2.cod). In addition, you can use two additional scale factors. The code list has a scale factor for the symbol for each code. In the ***View | Options*** menu, you can set a scale factor for symbols 254 for different paper scales.

Point texts in the graphical view

One advantage when transferring in the graphical view is that it is very flexible. You simply select from time to time the information you want to transfer to an AutoCAD® file. What you see on screen is transferred to the AutoCAD file.

Preconditions:

- No special settings are needed in iCON office for the transfer of the point texts to AutoCAD format.

Procedure:

1. Open the coordinate files to be saved as AutoCAD format.
2. Turn on the desired point texts in the graphic. Go in to ***View | Document Properties*** for the current document and turn on the required texts. Also set the text sizes and colors.
3. Select ***View | Export View As | AutoCAD File***.

For each point that is transferred, you can choose between two options for point texts: either create an AutoCAD block using the selected point texts as attributes 305 or also transfer each point text as a detached text object 305. You can choose in which layer the attributes/text objects are to be placed. The same layer as the point, one layer for each type of point text or a combination of both. Layer classification makes it possible in the AutoCAD program to turn on and off individual point texts in a similar manner to iCON office.
Text size: The size of the texts that are transferred in the graphical view is determined by the size you set in the document settings 52 for the file. As a guide, the size of the text you enter is about equal to the size in millimeters on paper if the AutoCAD drawing is printed. In order to control this, use the "Paper/Drawing Scale 302 " field in the dialog to save the view as an AutoCAD file. If it is a drawing (dra) that is saved, this value does not change as it is then the drawing's scale that is used.

Symbols

When transferring symbols to an AutoCAD® file, the procedure depends on whether you use a base drawing or not.

Symbols in a base drawing (only applies to coordinate files geo, pxy)

One advantage of symbols in the base drawing is that you can use the existing symbols in AutoCAD® format. If the recipient of the AutoCAD file has a standard for the symbols and layers to be used, it is simple to customize the transfer.

Preconditions:

- The points are coded according to a code list.
- The code list is customized to suit a base drawing in AutoCAD format and contains predefined blocks (symbols). (For example, sbg2.cod in combination with sbg2_1000.dwt).

Procedure:

1. Set the current code list as active, see also Code Lists 203.
2. Open the coordinate files to be saved as AutoCAD format.
3. Symbols should not be turned on in the graphic when you save the view as an AutoCAD file.
4. Select ***View | Export View As | AutoCAD File***.
5. Select the required base drawing.
6. Select the "Code List" option for the layer transfer.

Symbol scale:

The main scale of the main block is predefined in the base drawing. Different base drawings may have different scales for the blocks that are designed for different paper scales (this is the case for the base drawings that are connected to sbg2.cod). In addition, you can use two additional scale factors:

- The code list has a scale factor 204 for the symbol for each code.
- In the ***View | Options*** menu, you can set a scale factor for symbols 254 for different paper scales

Line types/Line styles (glt)

Line Types (Line Styles) in line type files 205 (glt format) cannot be converted to AutoCAD® format. You can use a base drawing instead where line styles are defined in advance.

Text styles

All texts in dwg files are connected to a Text Style. The text style specifies the font to use, along with the width factor and other text properties. There is a special text style in AutoCAD® format called *Standard*. This is used for all texts unless otherwise indicated. The text style is always in a dwg file (but may be connected to any font).

When exporting, you can enter any name for the text style. The text style will be created if it does not already exist (i.e. if you have selected a base drawing). If you are using a base drawing and set the text style as *Standard* you do not need to select a special font as the settings in the base drawing are used. The same applies if you select a different text style that you already know is used in the base drawing.

See also Export to AutoCAD Drawings 300 , AutoCAD Drawings 289

6 Surveying and Setting Out

6.1 Surveying and Setting Out in General

This chapter describes the functions for surveying and setting out, as well as the processing of documents for survey data 318 (plm, inm), traverses 354 (ptg) and level run data 361 (lvt, lev).

Survey data can be pre-processed using the functions correction of measurements 333 and rounds of measurement 338 and then calculated using coordinate calculation 335, free station calculation 341 and intersection 364. Level run data is calculated using the function level run calculation 362.

From the survey data you can create a traverse using the function defining traverses 352, which can then be calculated using coordinate calculation of traverses 358.

It is also possible to create setting out data from the coordinates using the functions radial set out and radial road set out 365 and set out control 368.

Several survey and set out functions use polygon point files 186.

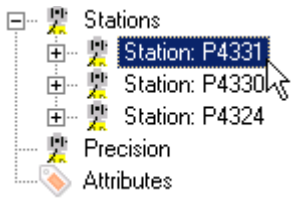
Traceability in measuring data
When coordinates are calculated, information such as used coordinate system and known points is stored in the header of the coordinate file. This information can be saved in a report file, if you select ***File | View/ Edit File Info...***, see Working with Files and Documents 22.

6.2 Survey Files

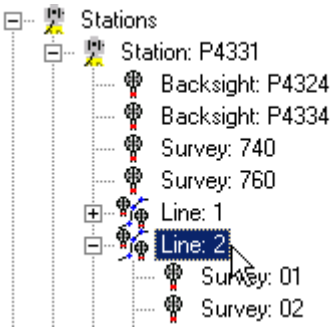
Survey Files contain polar survey data for multiple stations, and appear in a window that contains four different views, a tree view, a station view, an input view 94 and a graphic view 47. You can move the separators between the views. A data menu is also linked to the document.

Tree View

This view shows a tree with nodes for each station that are in the document and the sub-nodes for these for survey data. Click on a station node to select the station to be displayed in the other three views (active station). Surveyed lines typically appear as gray lines in the input view. If you want to see the contents of a line, expand the station and select the line in the tree view.

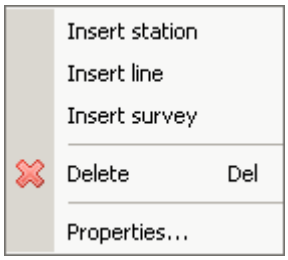


Select active station



View the contents of a measured line

Right-clicking in the tree brings up a menu:

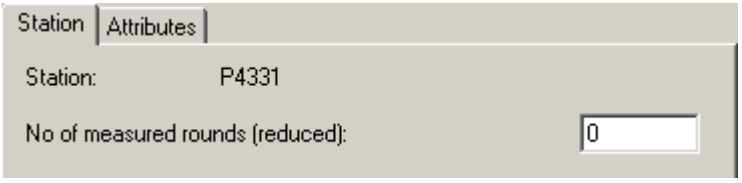


- Insert station
  Adds a new station before the active station. If the 'Stations' node is selected, the station is placed last.
- Insert line
  Inserts a new line before the selected measurement. If the 'Station: X' node is selected, the line appears last in the station.
- Insert measurement
  Inserts a new survey data post before the selected measurement. If the 'Station: X ' node is selected, the survey data post appears last in the station, or if a line is active, last in the line.
- Delete
  Deletes the selected station, line or measurement or survey data post.
- Properties
  Opens the properties dialog for the selected object, see below.

Properties

By right-clicking and selecting properties you can edit stations, lines, survey data posts and precision data for the survey file. Note that the properties dialog can also be opened by selecting the object in the graphical view.

- Stations

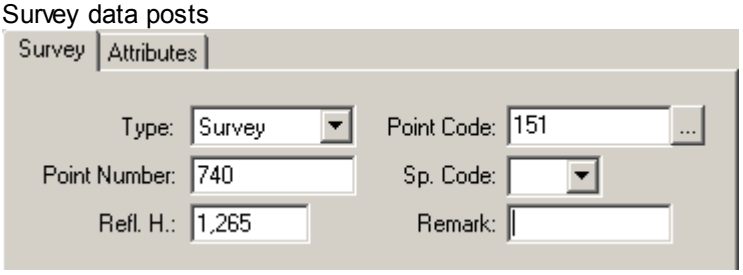


If the file has been created using the rounds of measurements function 338 in iCON office, the number of rounds originally measured is displayed here, and the value can also be entered manually. This value can be used as the basis for the weighting in net adjustment.

- Lines

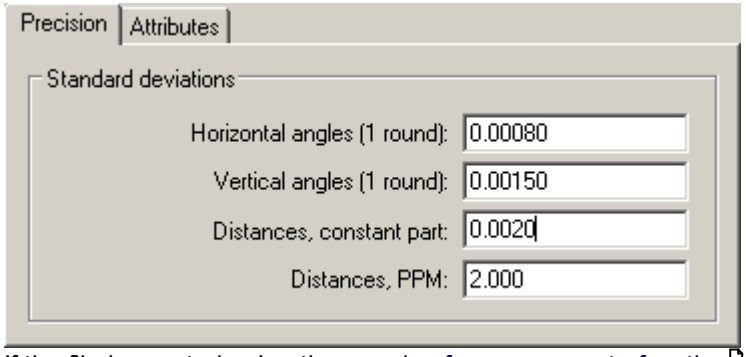
Here you can change the name and code for a surveyed line, and specify whether the line should be a closed polygon. These properties are automatically included with the coordinate when calculating.

- Survey data posts



Here you can edit the same data for a survey data post as you can for an input view, and also edit the surveyed point's attributes. See the section Optional Attributes 113 . These are automatically moved over to the coordinate file for calculation.

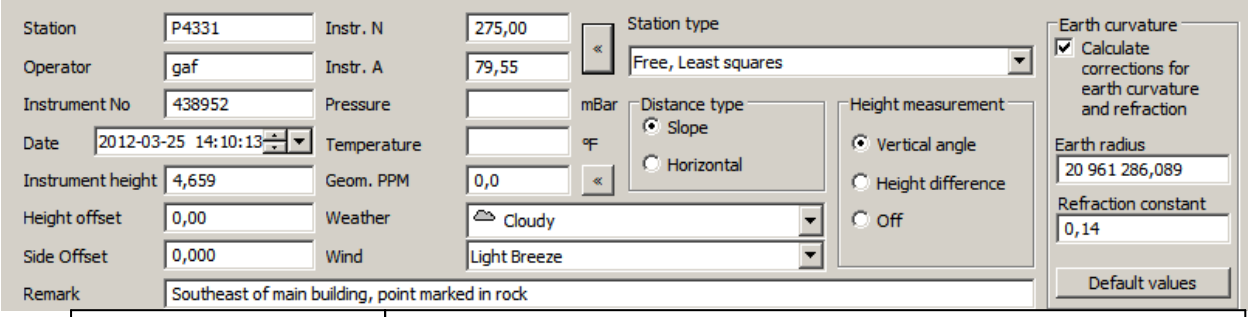
- Precision Data

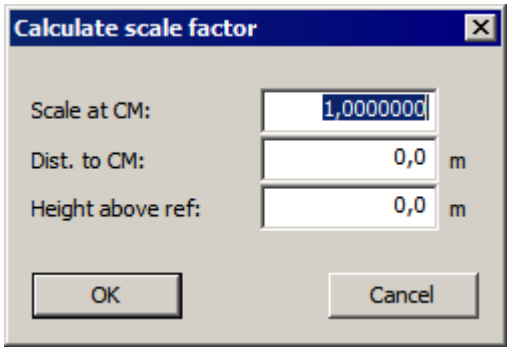


If the file is created using the rounds of measurements function 338 in iCON office and you have sufficient output data, the instrument's precision is also estimated, and these values are already entered. Values can also be given manually. The precision data can be used as the basis for weighting in net adjustment.

Station View

You use this view to edit a surveyed station's general data.



Station	Point number of the station point.
Operator	Administrative data.
Instrument no.	Administrative data.
Date	Administrative data.
Instrument Height	The instrument height above the station point.
Height offset	Allows you to specify the distance between the center of the sight line and the center of the length reader for use by the retroactively fitted Electronic Distance Meter, EDM. Note that the prism system normally compensates for this distance. This offset is often only used to measure without a prism.
Side Offset	Only used when the center of the EDM is on either side of the line of sight.
Remark	Here there is space for a descriptive text about the station.
Instrument N and Instrument A	Atmospheric correction can only be calculated if you enter the correct parameters N and A. Click the button « to enter the parameters, see also Correction of Measurements 333.
Pressure	Administrative data. Also used in the calculation of atmospheric correction 333. The unit is selected in the project tree's Settings tab 17.
Temperature	Administrative data. Also used in the calculation of atmospheric correction 333. The unit is selected in the project tree's Settings tab 17.
Geom. PPM	The scale factor for geometric PPM corrects the measured lengths in the calculation. Calculation of geom. PPM is primarily used when you cannot make a correction calculation using Correction of Measurements 333, for example when when you are using some other projection than Transversal Mercator. Click the button « to calculate the scale factor that may affect your measurements.  Enter the known scale at the central meridian, the distance to the central

	meridian, and height above the ellipsoid. Note that geom. PPM is already completed if you have entered the corresponding information in field when measuring with GeoPad.
Weather and Wind	Here it is easy to select the weather and wind from a list of options.
Station type	Here you specify which station type you have established, and thus the type of calculation to be performed. See also Free Station 341 . ***On known point***: The station is established over a known point. ***Free, Least squares***: Calculate free station with the least square method. ***Free, Resection and transformation***: Calculate free station with Resection and transformation. ***Free, GNSS aided***: Calculate free station using GNSS backsights measured with the software GeoPad. See also Free station, GNSS aided 327 . ***Control line anywhere***: If you have a survey file from iCON build or iCON site, you can get a station type called 'Control line anywhere'. iCON office recognizes the input, but the program generates an error message with information that the station type cannot be calculated in iCON office. The total station can be placed anywhere. Measure a start point of the control line and a direction point, see also Free Station Calculation 350 . ***Control line over first point***: If you have a survey file from iCON build or iCON site, you can get a station type called 'Control line over first point'. iCON office recognizes the input, but the program generates an error message with information that the station type cannot be calculated in iCON office The total station is placed at the start point of the control line. Measure a direction point, see also Free Station Calculation 350 .
Distance Type	Enter how the distance has been measured. Either sloping or horizontal length.
Height Measurement	Enter how the heights have been measured. Either vertical angles or height differences. Enter ***Off*** if the heights have not yet been measured.
Earth Curvature	Check the box to perform corrections for earth radius and refraction at coordinate calculation 335 .
Earth Radius	Because the earth flattens at the poles, the earth radius varies depending on where you are. The unit for the radius depends on the selected unit in the project tree's Settings tab 17 . Enter the radius of the current location. Approximations of the earth radius in Sweden: Southern section: 6,386,000 m Middle section: 6,389,000 m Northern section: 6,392,000 m
Refraction constant	Defines the relationship between earth surface curvature and a light beam's deflection through air. The normal value in Sweden is approximately 0.14.
Default values	Click to load the SBG recommended default values for the earth radius and refraction of central Sweden.

Note that settings for earth curvature 321 need to be entered for each station in the survey file.
(If the survey files from older versions of iCON office are opened, the earth curvature is automatically pre-checked regardless of the settings that existed in the project when the survey file was transferred to iCON office.)

Input view

This view shows the station's surveyed points and lines. Lines appear as a gray line, and you can only edit the line number and code. Click the line in the tree to open it and see the constituent measurements.

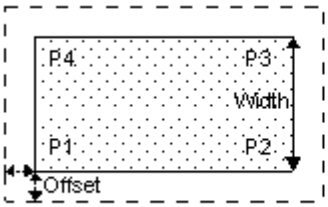
	Type	Point	H Angle	V Angle	Distance	Refl. h	Prism.	Pt. Code	Sp. Code	Remark
1	Backsight	3311075	157,2257	111,2503	99,14500	0,00000	0,00000	PP		
2	Survey	740	376,2344	113,2018	60,56600	0,33500	0,00000	151		
3	Survey	760	374,4020	114,2361	40,57600	0,33500	0,00000	152		
4	Survey	780	368,8922	117,2601	20,67200	0,33500	0,00000	153		
5	Line	1								
6	Line	3								
7	Survey	820	269,4700	117,7069	19,52200	0,33500	0,00000	153		
8	Line	2								
9										

Input Columns:
The headings and order of the distance and angle columns may vary depending on the settings made in the project tree's Settings tab 19 and how the heights have been measured.

Type	Specifies the type of point. ***Backsight*** Backsight object for the station point. ***Survey*** Surveyed point. ***Passive*** Inactive point. ***GNSS Backsight*** Point measured as a GNSS aided free station 956 , ie combined GNSS and total station surveying. Note, it is required that you have used the software GeoPad when you have established a GNSS aided free station, to be able to get measurements of type 'GNSS backsight'.
Point	Point name, or line name, maximum 12 characters.
Distance	Measured distance. Inclined or horizontal depending on the station data.
H angle	Horizontal angle for the point.
V angle	Vertical angle for the point. Available only when the station data indicates that the heights are vertical angles.
H diff	Height difference for the point. Available only when the station data indicates that the heights are height differences.
Refl. h	Reflector height above the point selection.
Prism Constant	The prism constant when measuring in relation to the object, if the instrument does not take account of this.
Point code	Point code. Maximum 8 characters. You can connect the point code to symbols and line types and define them in the code list 203 .
Sp.Code	Special code. Maximum 2 characters. View special codes 323 below.
Remark	Comments. Used in combination with point code or special code, see above. Maximum 12 characters.

Special Codes:
There are a number of different code functions taken into account when calculating coordinates. These functions are specified with special codes or are linked to the point code via the code list 203. Any conditions for the functions are specified in the remark field. Special codes are taken into account for coordinate calculation 335.

F2 — **Rectangle from two points**

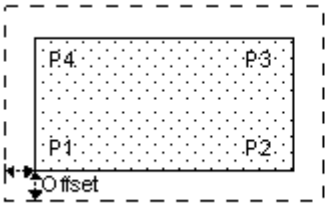


Measured	Special Code	Remark
P1	'F2'	Width*
P2		(Offset)
Calculated		
P3		
P4		

* Positive clockwise (negative in figure)

You use this function when you want to measure a rectangle, but are only able to measure two points. The width is then given in the remark field for the first surveyed point. The width is specified as positive if the measurement points are clockwise, otherwise negative. In addition, you can specify an offset (see figure) in the remark field for point 2.

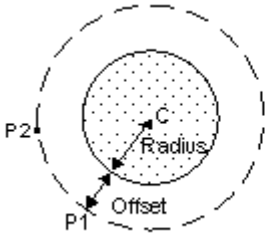
F3 — **Rectangle from three points**



Measured	Special Code	Remark
P1	'F3'	(Offset)
P2		
P3		
Calculated		
P4		

You can use this function when you want to measure the three points of a rectangle, and have the fourth calculated. An offset can be specified in the remark field for the first surveyed point. Points should be measured in order, i.e. no diagonal jumps between the corners.

C2 — **Circle from two points**

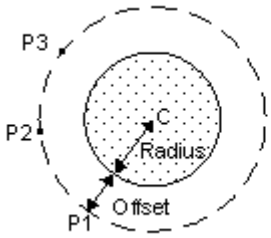


Measured	Special Code	Remark
P1	'C2'	Radius*
P2		(Offset)
Calculated		
C	'C'	Radius

* Positive to the right

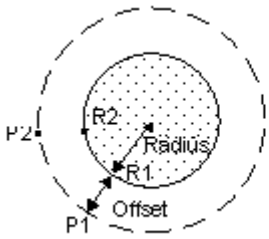
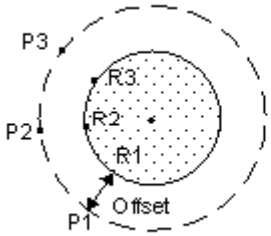
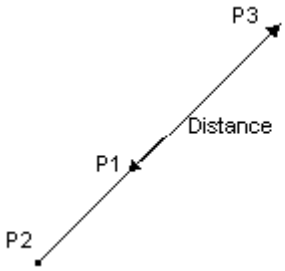
If you know the radius of a circular object that is to be measured, you can measure two circular points using this function. You enter the radius (positive when "turning right" from point one to point two) in the remark field for the first point and any offset is entered in the remark field for the second point. The center point of the circle is calculated for coordinate calculation.

C3 — **Circle from three points**



Measured	Special Code	Remark
P1	'C3'	(Offset)
P2		
P3		
Calculated		
C	'C'	Radius

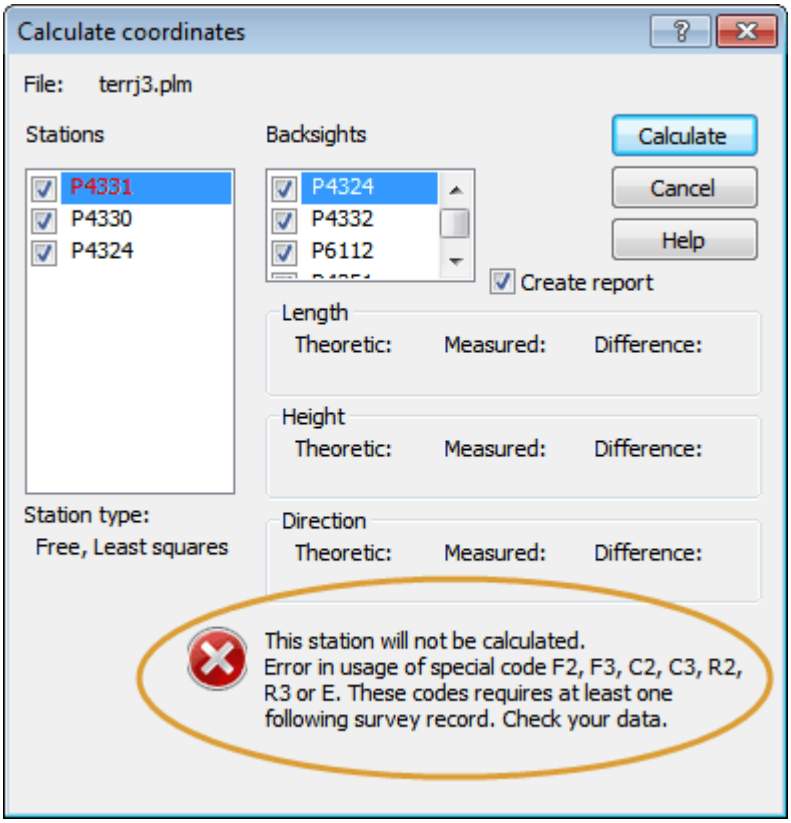
For surveying circular objects you can use the C3 function whereby three points of the circle are

	measured. Any offset (see figure) is specified in the remark field for point one. The center point of the circle is calculated for coordinate calculation.
R2	**Radius from two points**  Measured / Special Code / Remark P1 / 'R2' / Radius P2 / (Offset) Calculated R1 / 'R' / Radius R2 You use this function for coordinate calculation to obtain two points with a known radius. Two points on the radius (or with an offset from it) are measured and the radius is entered in the remark field for the first point. Any offset is entered in the remark field for the second point. The center point is not calculated for coordinate calculation. Remember that the radius points must belong to the same line in order to draw the radius.
R3	**Radius from three points**  Measured / Special Code / Remark P1 / 'R3' / (Offset) P2 P3 Calculated R1, R2 / 'R' / Radius R3 You use this function when measuring the radius based on three points. You can enter any offset (see figure) in the note field for the first point. The radius is calculated and added to the coordinate file. The center point is not calculated. Remember that the radius points must belong to the same line in order to draw the radius.
E	**Extrapolation (eccentric point)**  Measured / Special Code / Remark P1 / 'E' / Distance P2 Calculated P3 You use this function when it is not possible to measure the desired point directly. In this case you can measure two points on a bar and set the distance from the first point to the point to be calculated in the remark field for point one. Note that the points should be measured as shown in the figure (first surveyed point closest to the desired point).
PI	**Piqué Point / Temporary Known Point** A temporary known point. The point is stored temporarily and may be the station point later in the survey file.
PP	**Polygon Point** This point will be stored in the PP file 186 for coordinate calculation. If you enter more than one PP file under known points 18 you will be asked in which of them you want to save points when calculating coordinates.
KP	**Check Point** Measurement in relation to known point. The difference is presented in the report when calculating.
LL	**Sloping Length Addition**

	Used to specify the sloping length addition. You enter the value in the remark field.
LH and HL	**Horizontal Length Addition** Used to specify the horizontal length addition. You enter the value in the remark field.
SM	**Offset** Used to specify the desired point to be calculated with an offset from the surveyed point. The distance is specified at right angles to the line of sight to the surveyed point and is positive to the right. You enter the offset in the remark field.
RF	**Reverse Face** Used in circle position two when measuring Geotronics 468 where you can now measure past the handle. The code is taken into account for coordinate calculation 335 and means that you change the sign for the side and height offsets.
Z+	**Height/depth** Is used when eco-sounder measuring with the software GeoPad. If the special code contains Z+, the contents in the remark field are added to the height for coordinate calculation 335 (i.e., a minus sign is to be entered in Remarks).
ZC	**Height Check/Adjustment** The station height is compared with the surveyed point and then corrected. You can use this function to load the station height from a height fix. The correction is presented in the report.
ZM	**Mean value of height updating** If you have a survey file from iCON build or iCON site, special code ZM can have been uesd. iCON office recognizes the input, but the program generates an error message with information that the special code cannot be calculated in iCON office. Special code ZM is used with ZC if you want to calculate an average of several measured points. The first measured point should have special code ZC, the following points should have special code ZM.
ZS	**Height updating** If you have a survey file from iCON build or iCON site, special code ZS can have been uesd. iCON office recognizes the input, but the program generates an error message with information that the special code cannot be calculated in iCON office.

Calculation Problem with incorrect use of special codes

If you have used special codes incorrectly when measuring, the station will be highlighted in red, to prevent erroneous points to be calculated, see Calculate Coordinates 336 .



The special codes F2[323], F3[323], C2[323], C3[323], R2[324], R3[324] and E[324] require that you have measured at least one point after the point with the special code, see above[323].

Graphical view

Displays a graphical representation of the data measured from the active station. Symbols show the measurements made. The view is always oriented with the instrument's zero reading up, and with the station point in the coordinate (0,0). The contents that are drawn can be changed with ***View | Document Properties***[52]. The graphical view must be active. If it is not, click once in it, or right-click and select ***Document Properties*** directly.

Data Menu

Add station:
Creates an empty station in the document.

Delete station:
Deletes the station that is selected in the tree view.

Generate lines from point numbers:
Creates lines from single points in a survey file, if this file contains points that have the line number embedded in the point number separated by a dot. See Generate lines[328].

Modify surveys:
Allows you to edit data in the active survey file. See Modifying Surveys[330].

Calculate Coordinates:
Coordinate Calculation of surveyed points. See Calculate Coordinates[335].

Correction of Measurements:
Correcting atmospheric measurements and projection. See Correction of Measurements[333].

Rounds Measurement:
Reduction of the rounds measurement data. See Rounds Measurement 338 .

Free Station, Least Square method:
Perform a free station calculation for the station selected in the tree view with the least square method. See Free Station 341 .

Free station, GNSS aided:
Perform a free station calculation for the station selected in the tree view based on simultaneous measurements using GNSS and total station. The backsights must be measured with GeoPad. See GNSS Aided Free Station 956 .

Free station, resection and transformation:
Perform a free station calculation for the station selected in the tree view with resection and transformation. See Free Station 344.

Free station, eccentric points:
Perform a free station calculation for the station selected in the tree view with eccentric points. See Free Station 350 .

Intersection:
Use intersection to calculate the points measured only with direction. See Intersection 364 .

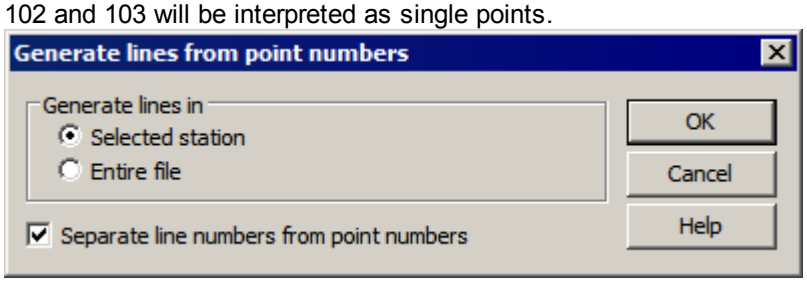
Define Traverses:
Defines a traverse from the measurements in the file. See Define Traverses 352.

Create Distance Report:
Creates a report that presents the mutual distance between all points that are measured from one station. See Distance Report 340 .

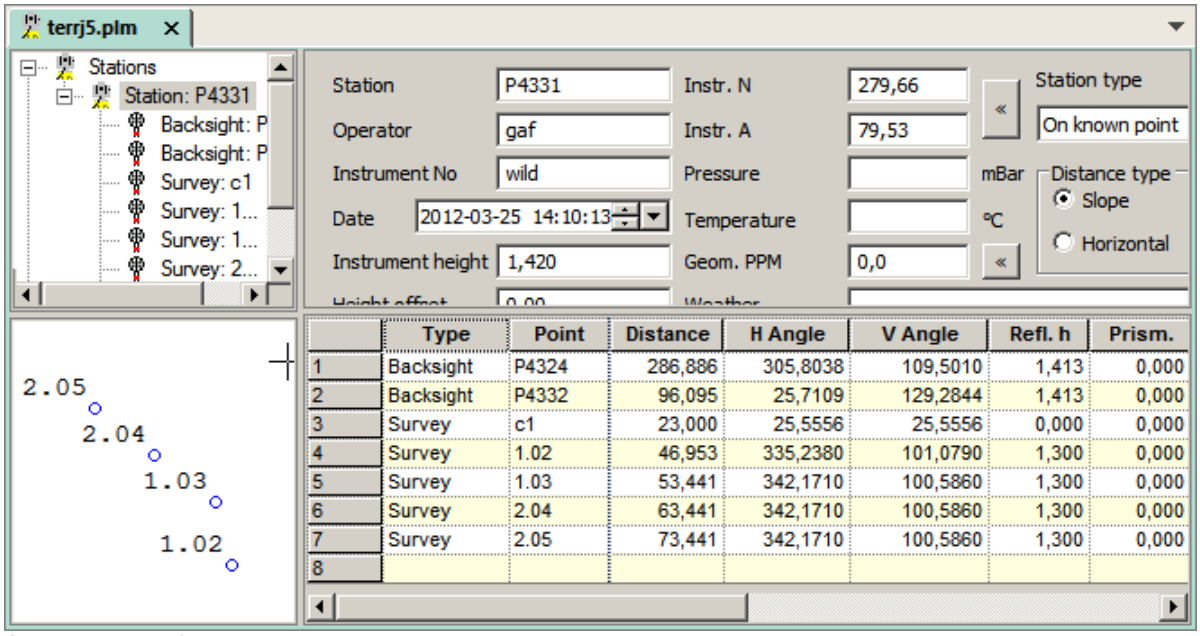
See also: Surveying and Setting Out 317, Calculate Coordinates 335 , GNSS Aided Free Station 956

6.3 Generate Lines

Use this function to create lines from single points in a survey file[318], plm, if this file contains points that have the line number embedded in the point number separated by a dot. Select ***Data | Generate lines*** to open the dialog.
Four points numbered 1.02, 1.03, 2.04 and 2.05 will generate two lines, while three points numbered 101, 102 and 103 will be interpreted as single points.



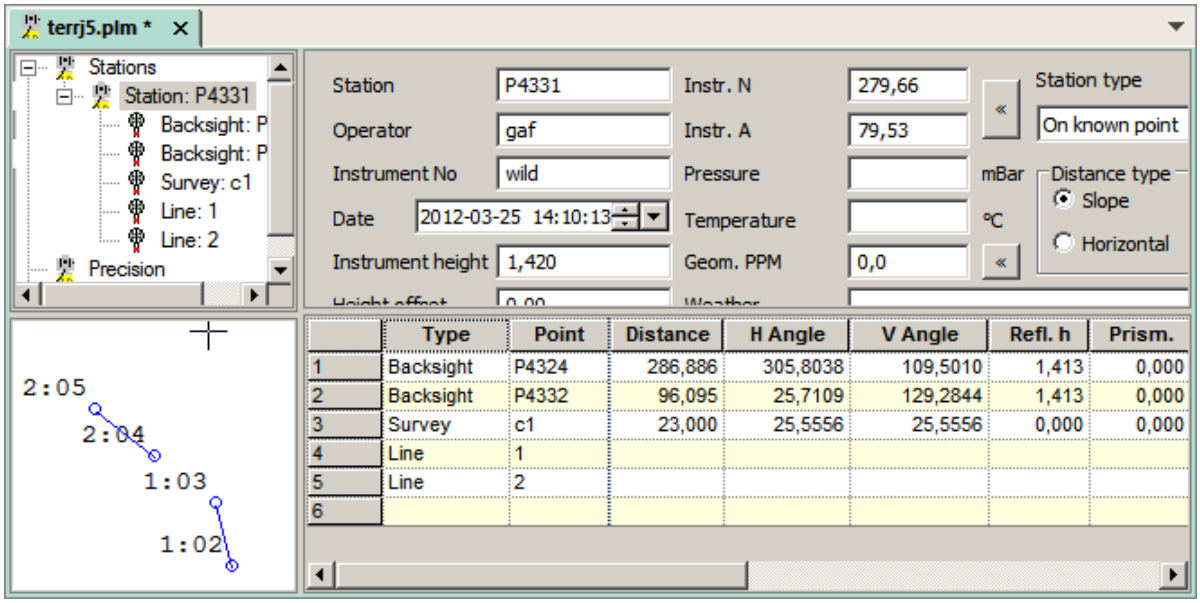
Choose if lines should be generated from the selected station or from the entire file.



Original survey file.

Select **[Separate line numbers from point numbers]** if the point name should be divided into one part naming the line and the other part naming each point.

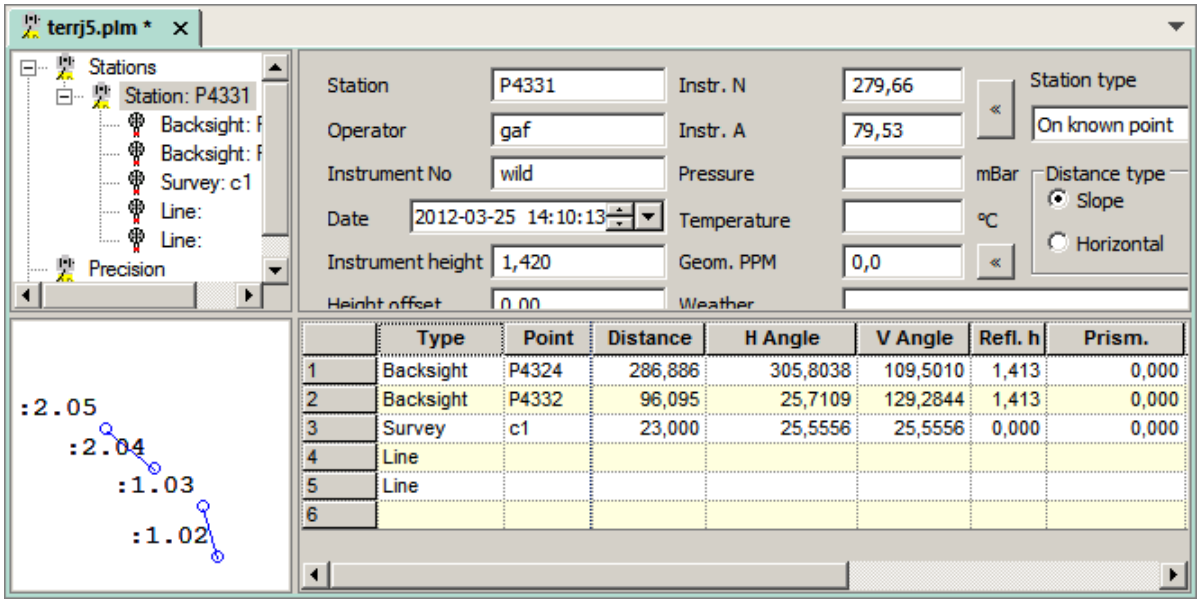
- Lines will be named according to the character(s) before the dot in the point name.
  In the example above, the lines will be named 1 and 2.
- Points included in lines will be named according to the character(s) after the dot in the point name.
  In the example above, the points in line 1 will be named 02 and 03, and in line 2 they will be named 04 and 05.



Survey file where the line numbers have been separated from the point numbers.

If you do *not* select **[Separate line numbers from point numbers]** lines will not be named.

- The lines will not get any names.
- Points included in the lines will retain their original names.
  In the example above, the points of the unnamed lines retain their original names; 1.02, 1.03, 2.04 and 2.05.

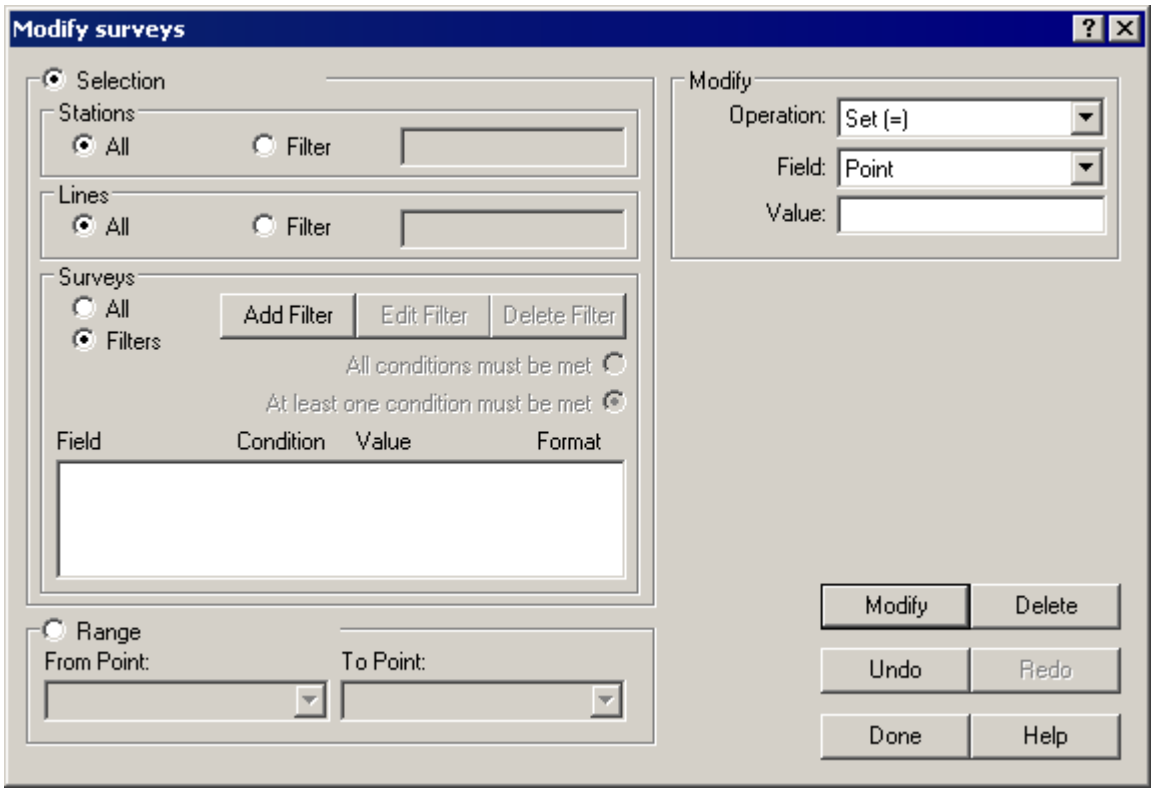


Survey file where the original names of the points in lines remain.

See also: Survey Files 318

6.4 Modifying Surveys

You use this function to modify or delete the measured data items with certain special properties. This function works on the entire active document. If you just want to change the current input view (e.g. a line), use Search and Modify 100. Select ***Data | Modify Surveys*** to open the dialog.



Options

Here you only select the measured data items to modify or delete.

Selection:
If **All** are selected, all stations, lines and measurements will be deleted/modified.
Select **Filters** to set up filters for the stations, lines and measurements to be deleted/modified.

For filter functions for text fields you can use wild cards which are characters that are equivalent to one or more arbitrary characters.

? An arbitrary character.

***** An arbitrary number of arbitrary characters.

Example

***** All texts.

a?? All texts, consisting of three characters, beginning with lower case 'a'.

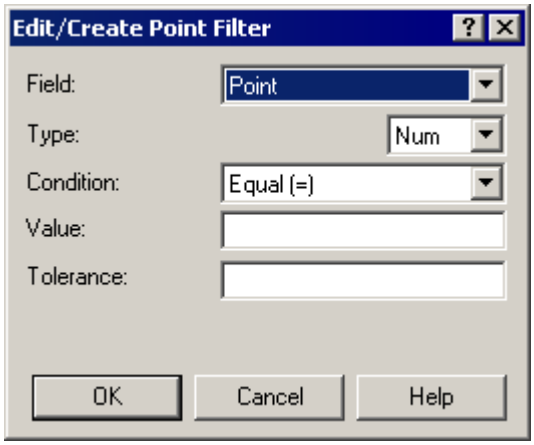
a All texts containing at least one lower case 'a'.

Stations and lines can be filtered with a text that matches the wild card characters as described above. You can create more advanced filters for measurements. Use the buttons to create and edit filters.

- **[Add filter]**
  Click here to create a new filter. A dialog opens for the filter definition.

- **[Edit Filter]**
  Click here to edit the filter that is selected in the filter list. This opens the dialog for filter definition.
- **[Delete Filter]**
  Click here to delete the filter that is selected in the filter list.
- **Filter list:**
  Here you see the filters you have created.

When you create or edit a filter, the dialog for filter definition opens.



- **Fields:**
  Specify the fields in the document that are to be modified.
- **Type:**
  Specify how the field should be interpreted, as numerical or text. Some fields (e.g. coordinates) can only be interpreted numerically. If you decide to interpret as text, you can use wild cards for *Value*.
- **Conditions:**
  Specify the conditions the field is to be compared with *Value*.
- **Value:**
  Enter the value of the contents of the *Fields* to be compared. For text fields and with conditions *Equal (=)* or *Not Equal (<>)* wild cards can be used.

Range:
Enter the first and last point in the document to be deleted/modified. All points in the interval are processed. The interval is defined by the order of the points in the file.

Modify

Enter here the modification to be made of the points that meet the criteria in *Options*.

Operation:
Enter the operation to be performed on the points. For incremental fields only Set (=) is possible.

- **Set**
  Set the selected field to a new value.
- **Add**
  Numeric value to add to existing value.
- **Multiply**
  Numeric value to multiply the existing value with. -1 to change sign.
- **Divide**

Numeric value to divide the existing value with.

- **Prefix**
  Enter a text to add before existing data. Does not work on numeric fields.
- **Suffix**
  Enter a text to add after existing data. Does not work on numeric fields.
- **Delete text**
  Enter a text to delete from existing data. Does not work on numeric fields.

Fields:
Specify the fields in the document that are to be modified.

Value:
Enter new value or the value for the selected operation.

Buttons

[Modify]:
Perform the selected change on the points in the selection.

[Delete]:
Delete points in the selection.

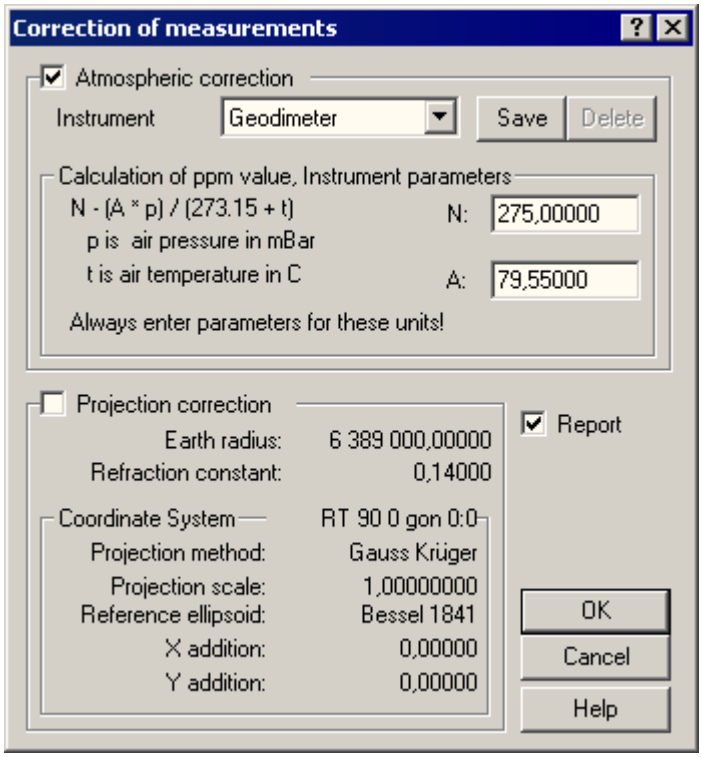
[Undo] and [Redo]:
These have the same function as the normal buttons in the toolbar, but as these cannot be accessed with the dialog open, you can use these instead.

[Done]:
Closes the dialog.

See also: Survey Files 318, Search and Modify 100

6.5 Correction of Measurements

You use this function to perform corrections to the measured data. First open the survey file to be corrected and then select ***Data | Correction of Measurements***. The corrections you can make here are partly atmospheric and partly coordinate system corrections. A new survey document will now be created where the surveyed lengths are corrected according to the parameters. If the projection correction is performed, the corrected file will contain recalculated horizontal lengths. If the prism constant is set the lengths will then compensate for this, and the prism constant will be set to 0 in the new survey document. If an atmospheric correction is made, the fields for pressure and temperature are set as blank in order to avoid accidentally correcting an already corrected file. A report with correction data is generated when implementing if the **Report** box has been checked.



Atmospheric Correction

The Atmospheric Correction is performed for the length measurement reading and is affected by pressure and temperature. Different instruments are affected differently and therefore have different correction parameters. You can select a pre-defined instruments, or define your own. The parameters are in the instrument manual or are obtained by the instrument manufacturer.

- **Atmospheric Correction**
  Check the box if you want the atmospheric correction to be carried out.

- **Instrument**
  Each instrument includes a set of parameters N and A. If you select the instrument you measured from the list, the correct parameters will be loaded. You can also create new instruments by entering the parameters, press **[Save]** and enter a name for the instrument. Keep in mind that the parameters for temperature and pressure must always be expressed in degrees Celsius and mBar whatever units you have chosen to use the program under Settings 17 in the Project Tree. If you want to delete the instrument that is selected in the list, press **[Delete]**. Predefined instruments cannot be overwritten or deleted.

- **Calculation of ppm value**
  Here you can see how the correction's ppm value is calculated from the parameters.

- **Instrument Parameters**
  When you select an instrument from the list above, the parameters are automatically entered. You can also set your own parameters if your instrument is not listed.

Coordinate System Correction

This correction is performed for the measurements that are made and are performed on the earth surface and not in the mapping plane that the coordinate system is located in.

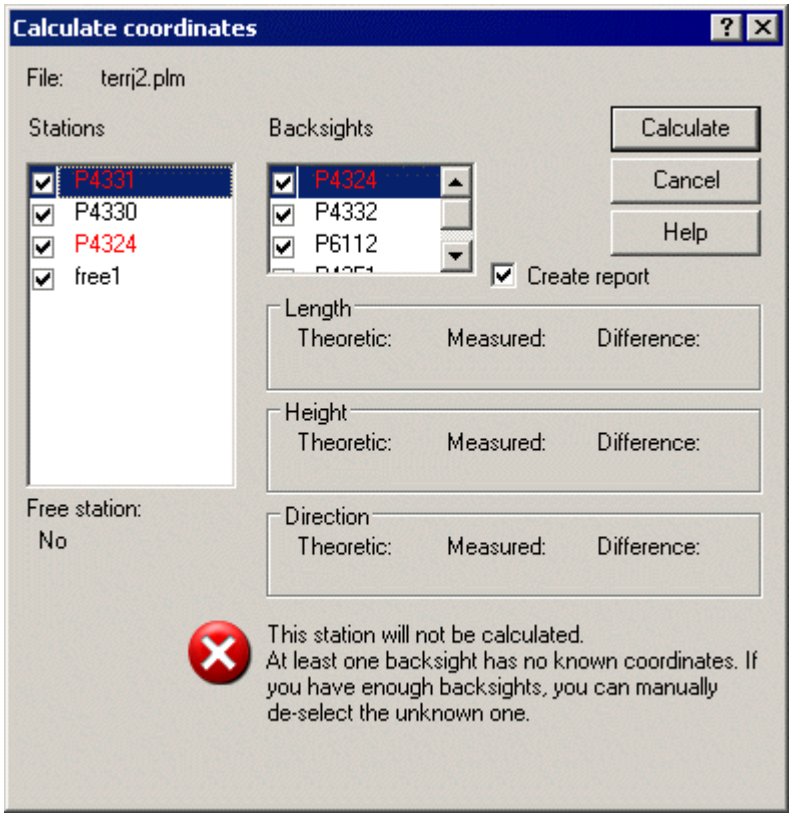
- **Coordinate System Correction**
  Check the box if you want the coordinate system correction to be performed. Here you see the parameters that the chosen coordinate system contains. If no coordinate system 120 has been specified in the project settings 16 it is not possible to choose this option. In order to be able to calculate the coordinate system correction, there must be coordinates at all station points and backsight objects in the files specified as known or approximate pp files 186, in the project tree tab Settings 18.

See also: Surveying and Setting Out 317, Survey Files 318, Coordinate Systems 120, Net Adjustment 810

6.6 Calculate Coordinates

Select ***Data | Calculate Coordinates*** from an input window to calculate the NEH coordinates from surveyed stations. The dialog displays information about the station and backsight objects used in the coordinate calculation, as well as the stations that can be calculated and those that will be calculated. There are a number of different code functions that are taken care of during coordinate calculation. These codes are given in the columns for point code / special code / remarks and are detailed below under Survey Files 323 .

If a station is highlighted in red, this means that it cannot be established. Either the coordinates are missing for the station or for one of the files in the backsight object that has been specified for known points in the Project Settings 18 tab. In the lower part of the dialog a text appears describing why the station cannot be established.



Stations

Here the list shows the stations that can be found in the survey file. Initially, all station boxes are checked, if there is any station you want to exclude, simply uncheck it.

Tip 1: You can reestablish a station by adding an extra backsight object lower down in the file. The measurements that are before the new backsight object are calculated in relation to the original backsight object, while those that come after are calculated in relation to the new backsight object. This is used, for example, for track measurement.

Tip 2: To change the order in which stations are calculated, you can drag and drop them in the list, e.g. if a temporary known point has been used before being measured.

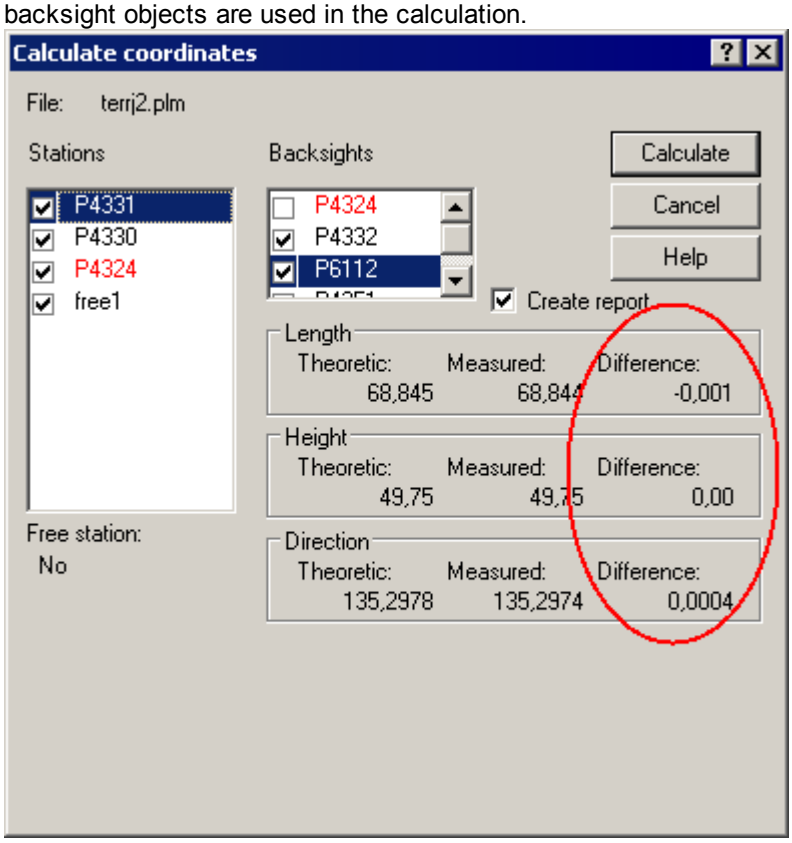
Tip 3: Stations can be calculated without a backsight object. iCON office then assumes that all the surveyed directions are oriented.

Free Station

Here you indicate whether the selected station is calculated as free or not. This is specified in the survey file 321 .

Backsights

When you select a station from the station list, the backsight object is presented for the station here. If a backsight object is marked in red, this means that no coordinates have been found for the point. Differences are reported for the selected backsight object. If you have more than one backsight object, you can choose the backsight object or objects to use by checking or unchecking them. An mean value for the pre-checked backsight objects are used in the calculation.

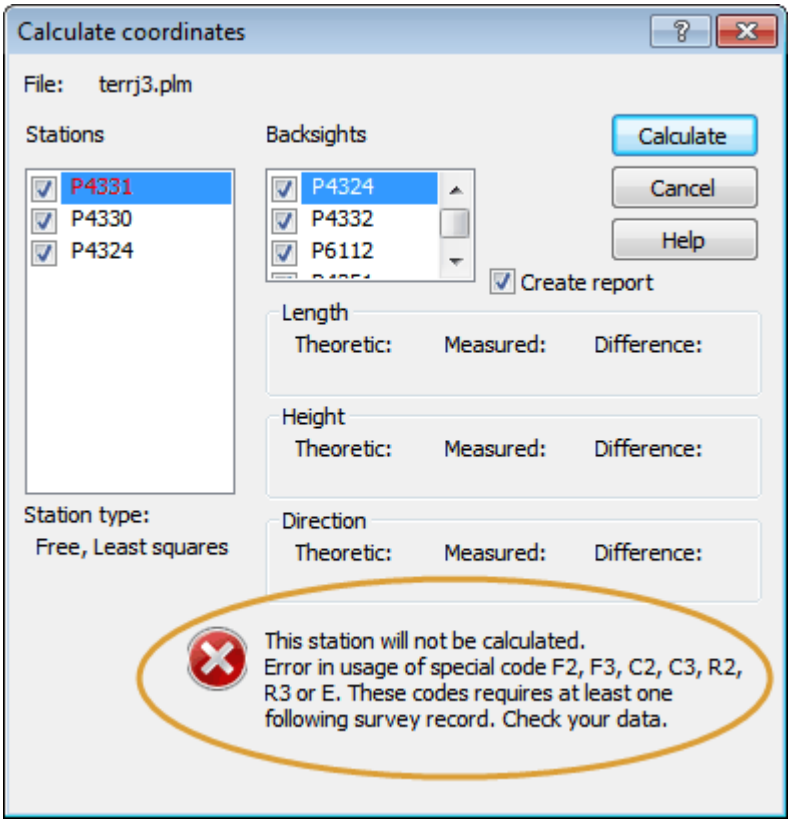


The differences are shown here for measurements from the selected station to the selected backsight object. Theoretical values are calculated from the known points and compared with measured values. Go through all stations and backsight objects and study the differences before making the calculation.

When all stations have been reviewed, click **[Calculate]** and the calculated coordinates will open in a new document. Click **[Create report]** to create a report with data about the calculation.

Calculation Problem with incorrect use of special codes

If you have used special codes incorrectly when measuring, see Survey Files 323, the station will be highlighted in red, to prevent erroneous points to be calculated.

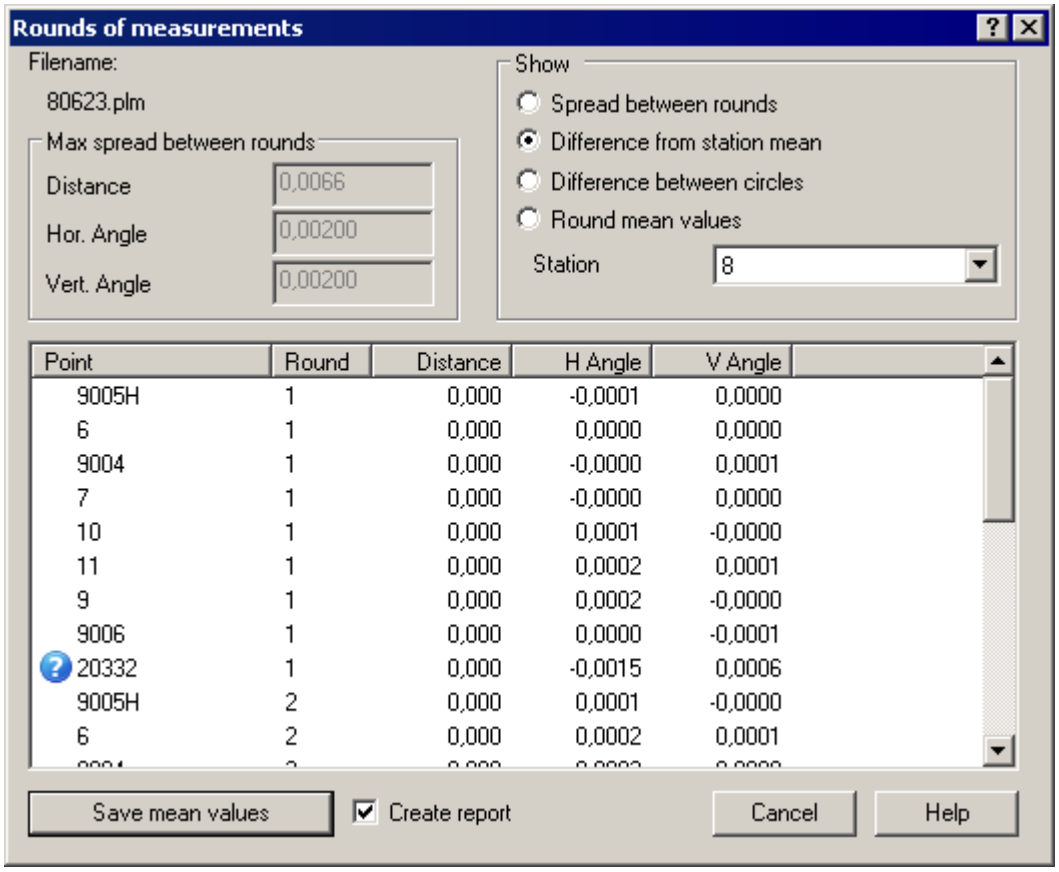


The special codes F2[323], F3[323], C2[323], C3[323], R2[324], R3[324] and E[324] require that you have measured at least one point after the point with the special code, see Survey Files[323]. Check the input data, a point with any of these special codes should not be placed last in a station or immediately before a measured line, for example.

See also: Surveying and Setting Out[317], Survey Files[318], Project Settings[16]

6.7 Rounds of Measurements

For rounds of measurements, the mean value for repeated measurements is calculated in the instrument's two circle positions. This is used when higher demands are placed on accuracy, e.g. when measuring control point nets such as triangle nets and traverses. The result comes in the form of reduced lengths between points and directions to these. Selecting ***Data | Rounds of Measurements*** from a survey window opens the dialog for rounds of measurements. If there is enough data, an estimate of the instrument's precision is also made in terms of standard deviations of the survey data. These can then be used for weighting in net adjustment. The precision is saved together with the reduced data. In order for a precise estimate to be made, a minimum of eight measured objects are required in the file, measured in at least four complete rounds. For smaller amounts of data, the estimate is unreliable.



Data

Filename:
Here you specify the survey file to be reduced in terms of rounds.

Show:

Spread between rounds	Shows the maximum spread between the measured rounds in distance, horizontal angle and vertical angle, for each station.
Difference from station mean	Shows how much each complete round differs from the station mean value.
Difference between circle positions	Shows the difference between the circle position 1 and 2
Round mean value	Shows mean values for measurements in each complete round.
Station	Enter the station for which data is to be displayed.

Go carefully through all the data and all the stations before saving the results.

Save

Click **[Save mean values]** to save the results as a new survey file. This file will also be saved with the precision of the measurement values, if there is enough data to estimate this. Warning! Do not overwrite the original survey file. iCON office suggests that the survey file to be reduced in terms of rounds has the same name as the original file but with the prefix 'r_. The name of the survey file XXX.plm is therefore proposed as r_XXX.plm.

Report

Click **[Create report]** to create a report on the rounds of measurements. The report contains a tab with a summary and a tab for each station.

Summary Report	A summary of station mean values for all measurements. Here you can also see the precision of the measurement values, if there is enough data to estimate this.
Station Report	A report for each station with all the data, read, rounds, stations, differences and spread.

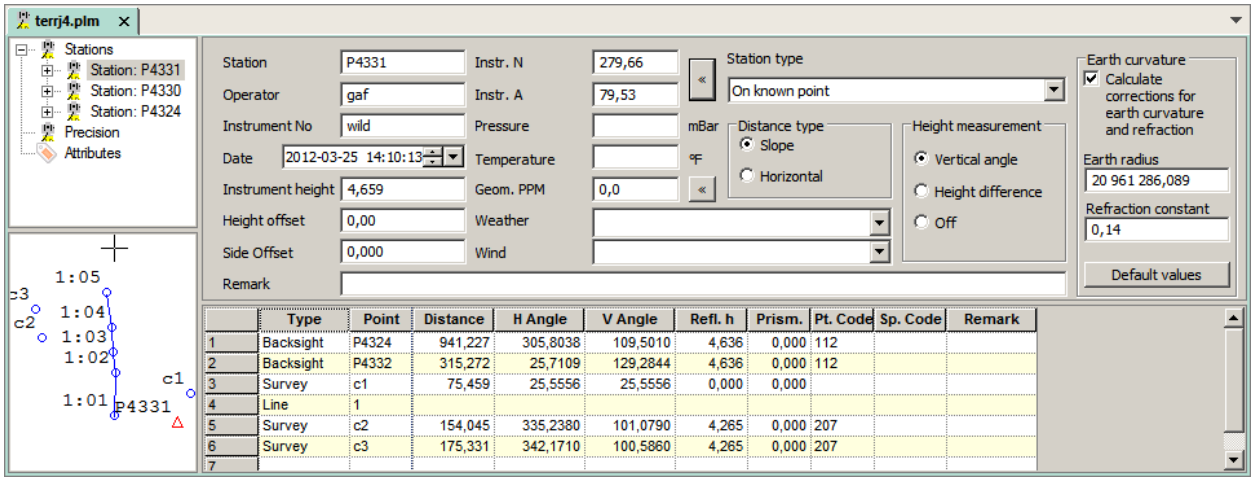
See also: Surveying and Setting Out 317, Survey Files 318, Net Adjustment 810

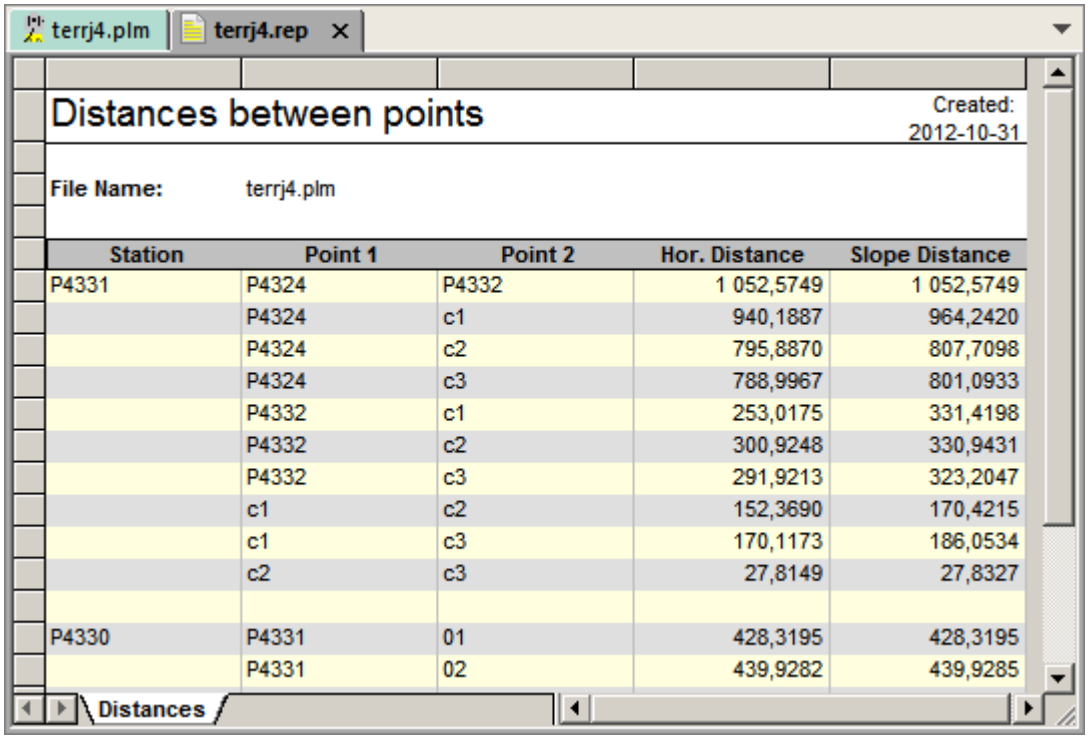
6.8 Create distance report from measured data

Open a survey file (plm) and select ***Data | Create distance report***.

The software creates a report which shows the distance between measured points in the surveying file. All distances are displayed, regardless if the points have been stored as backsights or surveyed points.

The figures below show an example of a survey file and the associated distance report.





The report presents the mutual distance between all measured points.

See also: Survey Files 318

6.9 Free Station Calculation

A free station is a measurement station without known coordinates (i.e. not stored in a polygon point file 186). To calculate these coordinates, survey data is needed to other points (backsights) whose coordinates are already stored in a file, e.g. pp.geo. The file with known points must be named in Settings 18 in the Project Tree. You need at least two backsights to calculate a free station, but more are preferable.
The station can be calculated in different ways giving different results:

- least square method 341
- resection and transformation 344
- eccentric points 350
- GNSS aided free station

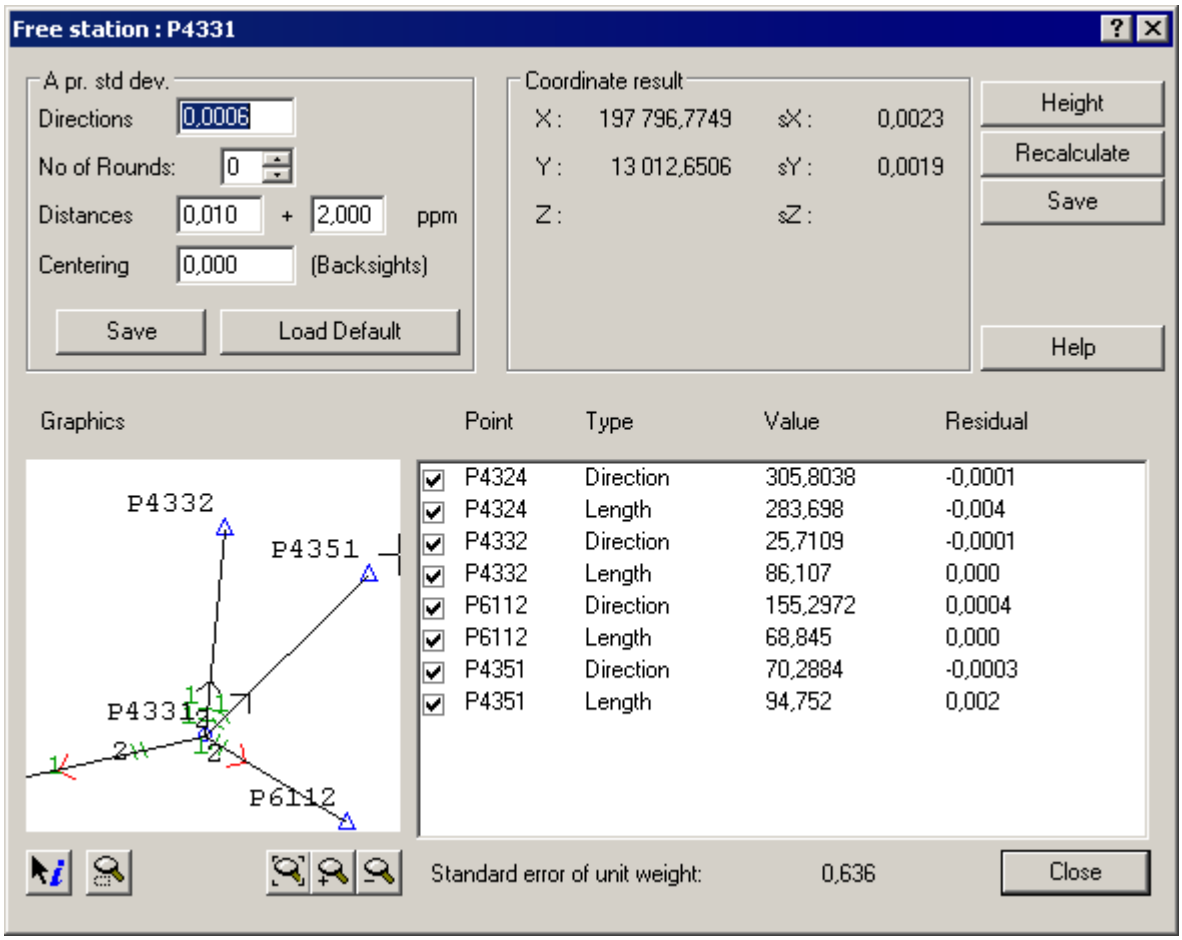
All these calculations can also be made automatically during coordinate calculation, see Survey Files 318 .

In some field computers, a station can also be calculated from:

- control line anywhere 350
- control line over first point 350

Free station with the least square method

Select ***Data | Free Station, Method of least squares*** to open the dialog for this calculation. This method uses the same calculation used in net adjustment 810 .



A priori standard deviation:
Here you specify the accuracy with which different data is measured. This determines how different measurements are to be weighted against each other, and also affects the base mean error. The accuracy can be obtained from the instrument manual or manufacturer.

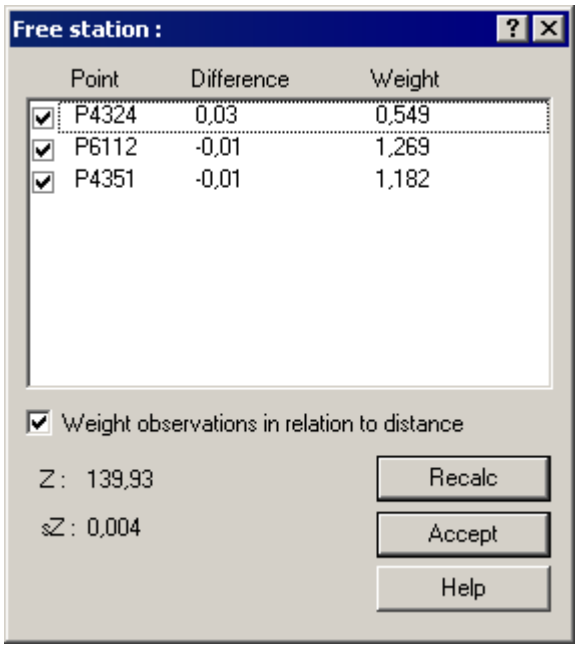
- **Directions, Number of Rounds**
  Here you specify the instrument's direction accuracy measured in a complete round and how many rounds are measured. If the directions are not measured in rounds, enter 0.
- **Distances**
  Here you enter the length accuracy of the instrument. The error consists of a fixed and a distance dependent part.
- **Centering**
  Here you specify the accuracy of the centering for the measured backsights. The station point is assumed to have centering error 0.0.
- **Save**
  If you change the settings of a priori standard deviation, you can click on **[Save]**, to store them. Next time you open a free station, your stored mean errors will be displayed.
- **Default values**
  Click **[Default Values]** to load the settings for the a priori standard deviation delivered with iCON office.

Coordinate Results:

- **Coordinates**
  The X, Y and after height calculation (see below), even the Z coordinates are shown here for the calculated station point.
- **Standard Deviations**
  sX, sY and sZ are the standard deviations for each coordinate. The true value lies with a 95 % probability within two standard deviations from the result.

Heights:

The station height is calculated separately as a mean value of all vertical measurements with backsights. The mean value can be weighted. It is stored together with the plane coordinates. Press the **[Height]** button to open the height calculation dialog.



- **Case List**
  All the calculation cases are listed here. Each line represents one case and is split into several columns. Each case in the list can be activated or deactivated by checking or unchecking the box for measurement. Click **[Recalculate]** to update the results.

- **Point**
  Specify the backsight with which the measurement has been made.
- **Difference**
  The height difference compared to the Z mean value, or how much the height difference in relation to this backsight is adjusted in the calculation.
- **Weight**
  Specify the measurement's weight in the calculation. The higher the weight, the more impact this measurement has on the results. If the measurements are not weighted, all the measurements are given weight 1.

- **Weight observations in relation to distance**
  Check this box if you want to weight the measurements. The backsight closest to the station point has a greater impact on the results. Click **[Recalculate]** to update the results.
- **Results**
  The mean value of the active height calculations and a standard deviation for the height. These values will be transferred to the free station dialog, if you close the dialog with **[Accept]**.
- **Recalculate**
  Click here to update the results if the measurements are activated/deactivated or if the weighting is changed.

  Click **[Accept]** to transfer the calculated height to the free station dialog.

Recalculate:
Click **[Recalculate]** to update the results of the free station. You must do this when measurements are activated/deactivated in the measure data list or the a priori standard deviation is changed.

Save:
Click **[Save...]** to save the results of the free station. Select a file name where you want to store the calculated coordinates. If the file exists, you get to choose to add the point last in the file or replace any existing point with the same number. When the point is saved, a report is also generated with backsights, resections, transformations and heights.

Graphical view:
In addition to the numerical results, there is a graphical representation of the calculations. The measurements that are made are shown here, and using an information tool you can generate detailed data for each measurement and input points. The graphical window is of the same type as the graphical preview; use the mouse wheel or the buttons in the window to zoom.

Measured Direction

Measured Distance

Backsight

Station Point

Click to select the information tool. See also Net Adjustment, Graphic View 833.

Measure Data List:
All measure data to the free station is shown here. Each measurement in the list can be activated or deactivated by checking or unchecking the box for measurement. Click **[Recalculate]** to update the results.

- **Point**
  Specify the backsight with which the measurement is made.
- **Type**

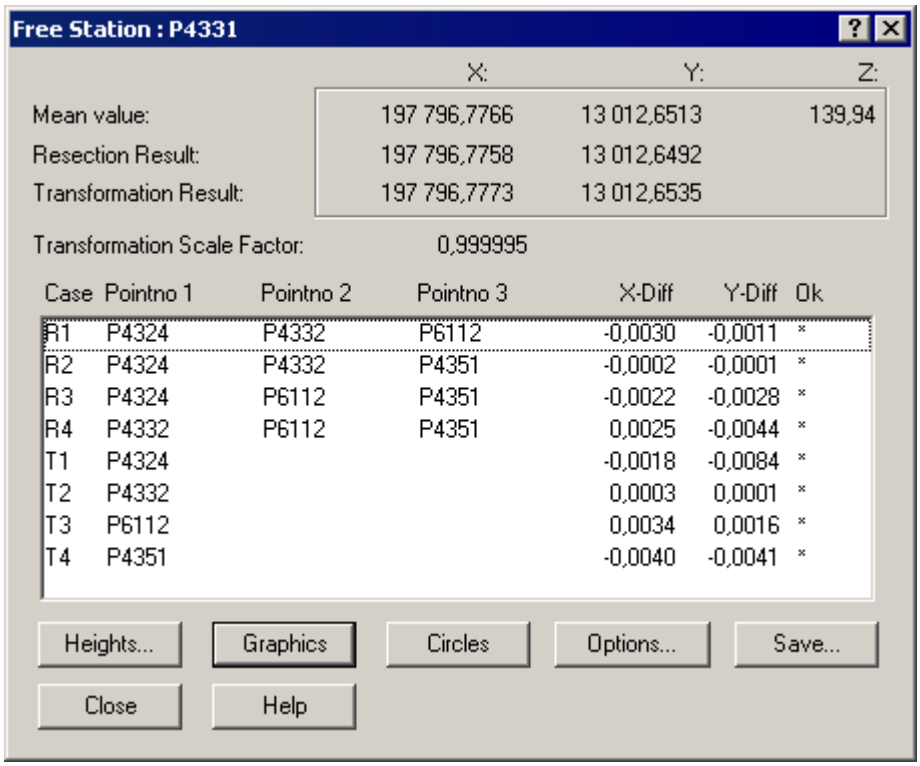
Specifies the type of measurement made, distance or direction.

- **Value**
  Indicates the measured value of the measurement.
- **Residual**
  Specifies how much the measure value has been adjusted in the calculation.

Standard mean error:
In a least square calculation the standard mean error will be close to or slightly above 1, if no serious errors have been made. A standard mean error of 1 means that the measurements have been shown to have the accuracy indicated in the a priori standard deviation. If the error is well below one, the a priori standard deviation is probably too generous. If the error is well above 1, troubleshooting must be done.

Free station with resection and transformation

Select ***Data | Free Station, Resection and Transformation*** to open the dialog for this calculation. Two different calculation methods, resection and transformation, are used.



Results:

- **Mean Value**
  The overall mean value of the resection results and transformation results. The height coordinates are calculated separately. These coordinates are stored later in a selected file.
- **Resection Results**
  The mean value of the active resection calculations are left blank if all the resections are inactive. Resection calculations use three backsights at a time. All possible combinations of three backsights are used and a mean value is calculated; the resection mean value. Only measured angles, no lengths, are used. The calculations result in two circles, the intersection point of one represents the position of the free station. A small intersection angle gives a result with low precision, and therefore resections with small cutting angles are screened out.
- **Transformation Results**

The result of the transformation calculation is left blank if all transformations are inactive. The transformation calculation uses all available measure data at the same time to produce a transformation mean value. A transformation involves scaling and rotation with the mean position of the backsights as the origin. Each transformation case represents a backsight. The backsight's survey data (distance and bearing) is used to calculate the measured position of backsights in local coordinates, with the free station as the origin. The bearing is compensated for bearing mean error, calculated from all measure data for the transformation calculation. These local coordinates are added to the overall mean value and are compared with the backsight's real coordinates, loaded from the pp-file (with the known coordinates).

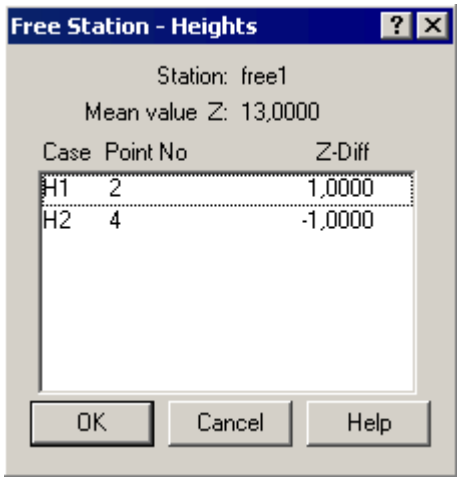
- **Scale factor for transformation**
  The scale factor used when calculating the transformation.

Case List:
All the calculation cases, both resections and transformations are shown here. Each line represents one case and is split into different columns.

- **Case**
  Contains an R for resections and a T for transformations, followed by an index.
- **Point no. 1-3**
  Resections: Point numbers for the constituent backsights.
  Transformations: a single point number that represents a backsight which is part of the transformation calculation.
- **N/E Diff**
  Coordinate differences compared with the overall mean value. No differences are shown for inactive cases.
- **OK**
  The status of each case:
  * = OK
  S = Angle too small between two backsights (only resections)
  D = Intersection angle too small between the resection circles (only resections)
  N = Calculation is not possible.

Each case in the list can be activated or deactivated. Only active cases are used in the calculations or have a coordinate difference presented. A case can be activated/deactivated by selecting it from the list and clicking the right mouse button or double clicking the left mouse button. Several cases can be selected and activated/deactivated simultaneously. The results in the upper part of the dialog and the coordinate differences in the list are immediately changed.

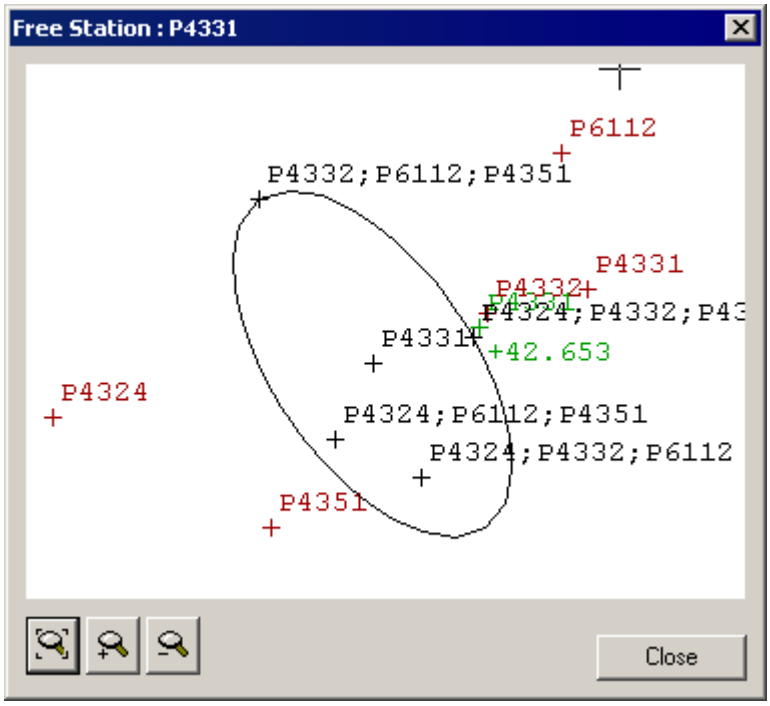
Heights:
The station height is calculated separately as a mean value of all vertical measurements in relation to the backsights. This is stored together with the plane coordinates. Note: Only survey posts of the "Backsight" type are included in the calculations. Press the **[Heights...]** button to open the height calculation dialog.



- **Station**
  The point number for the station that is calculated.
- **Mean Value H**
  The mean value of the active height calculations. This value will be transferred to the free station dialog, if you close the dialog with OK.
- **Case List**
  All the calculation cases are listed here. Each line represents one case and is split into several columns. Each case in the list can be activated or deactivated in the same way as the plane coordinates, see above. The results in the upper part of the dialog and the H differences in the list are immediately changed.
  - **Case Column**
    Contains an H, followed by an index.
  - **Point No.**
    The point number of the current backsight.
  - **H Diff**
    The height difference compared with the H mean value. No difference is shown for inactive cases.

  Click **[OK]** to transfer the calculated height to the free station dialog. **[Escape]** closes the dialog without transferring anything.

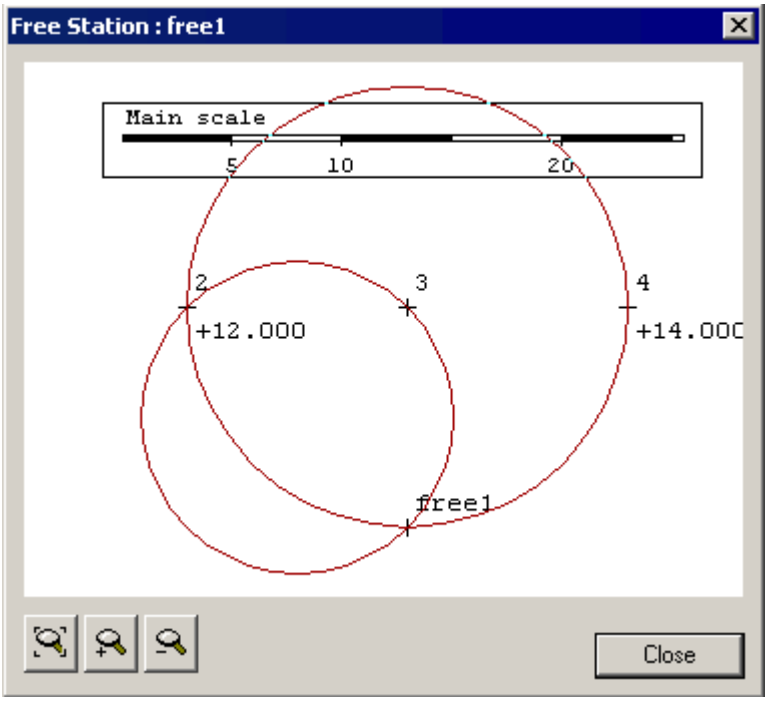
Graphic:
Click **[Graphic]** to get a graphical representation of the calculations for a free station.



Explanation of the graphical window. The graphical window is of the same type as the graphical preview; use the mouse wheel or the buttons in the window to zoom.

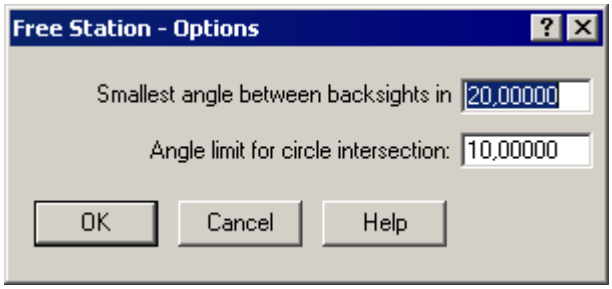
- **Green Point**
  Represents the overall mean value including the calculated height, if any.
- **Black Points**
  Represents the different resection cases. Only active resections are shown. The point numbers for all constituent backsights are shown in the form backsight1; backsight2; backsight3. The resection results (mean value) is also black, with the same point number as the calculated free station.
- **White Ellipse**
  The "Error Ellipse" for the resection calculations. The minimum possible ellipse that encloses all the resections. Indicates the uncertainty in the resection results. Only drawn if there are two or more active resections.
- **Red Points**
  Represent the transformation cases. The points are drawn at the same distance from the overall mean value (green point), as the transformation differences, as shown in the case list. The points have the same point numbers as the backsights they represent in the transformation calculation. The transformation results are also red, with the same point numbers as the calculated free station.
- **Blue Points**
  Backsights, with coordinates from the pp files.

Circles:
Three backsights are included in the resection calculation along with their measured bearings from the free station. The angle between two of these backsights provides a solution circle of possible coordinates for the free station, if the backsight positions are known (usually loaded from the pp files). As three backsights can be combined in two different pairs, two different solution circles can be created, and their intersection point indicates the position of the free station. See also Free Station Settings 349, below.



The two circles, the current backsights, and the resulting position of the free station can be seen graphically by clicking **[Circles]** after selecting a resection case from the free station dialog. The graphical window is of the same type as the graphical preview; use the mouse wheel or the buttons in the window to zoom.

Settings:
In the resection calculations for free stations, two limit angles are used that can be set by the user. Values less than these limit angles indicate poor precision in the calculations, and corresponding calculation cases should not be included. To change these settings, click the **[Settings...]**button.

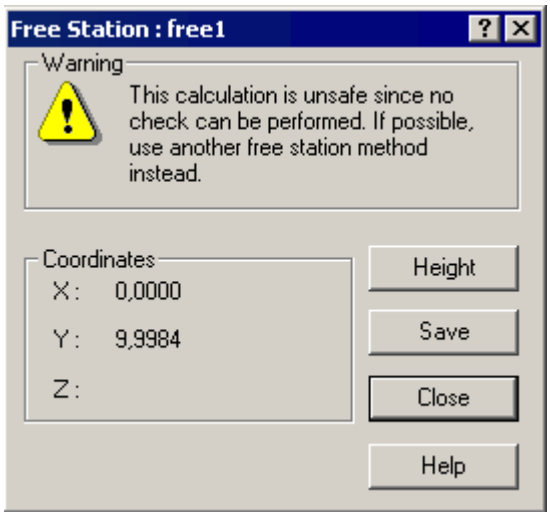


- **Minimum angle between the backsight in the resection**
  The minimum permitted angle between two backsights for a resection calculation. If the intermediate angle is too small in two backsights in a resection calculation, this is marked with an 'S' in the list in the free station dialog.
- **Limit angle of intersection between the circles**
  The minimum permitted intersection angle between the two circles in a resection calculation. If this angle is too small, the corresponding cases are marked with a 'D' in the list in the free station dialog. You get a graphical view of the resection circles by clicking **[Circles]**.

Save:
Click **[Save...]** to save the results of the free station. Select a file name where you want to store the calculated coordinates. If the file exists, you get to choose to add the point last in the file or replace any existing point with the same number. When the point is saved, a report is also generated with backsights, resections, transformations and heights.

Free station with eccentric points

Select ***Data | Free Station, Eccentric Points*** to open the dialog for this calculation.



The station point coordinates are calculated with the two top backsights in the data set. The break angle between backsights and the distance to the first backsight is used to solve the coordinate.

Height:
Click **[Height]** to get a height for the station point. This height is calculated from the measure data in relation to the first backsight.

Save:
Click **[Save...]** to save the results of the free station. Select a file name where you want to store the calculated coordinates. If the file exists, you get to choose to add the point last in the file or replace any existing point with the same number.

This method is very uncertain. No checks can be made, and minor errors in the input data can cause major errors in the coordinates. If possible, use a different method.

Station type: Control line anywhere

Some field software, like iCON site and iCON build can create a station type called "Control line anywhere". If you obtain a survey file (plm) with such a station type, iCON office will display the measurements from this station:

- angles and distances
- station type "Control line anywhere"

The station type "Control line anywhere" can not be calculated by iCON office. If you do try to calculate such a station in iCON office, a dialog will appear informing that the station cannot be calculated.

Station type: Control line over first point

Some field software, like iCON site and iCON build can create a station type called "Control line over first point". If you obtain a survey file (plm) with such a station type, iCON office will display the measurements from this station:

- angles and ditances
- station type "Control line over first point"

The station type "Control line anywhere" can not be calculated by iCON office. If you do try to calculate such a station in iCON office, a dialog will appear informing that the station cannot be calculated.

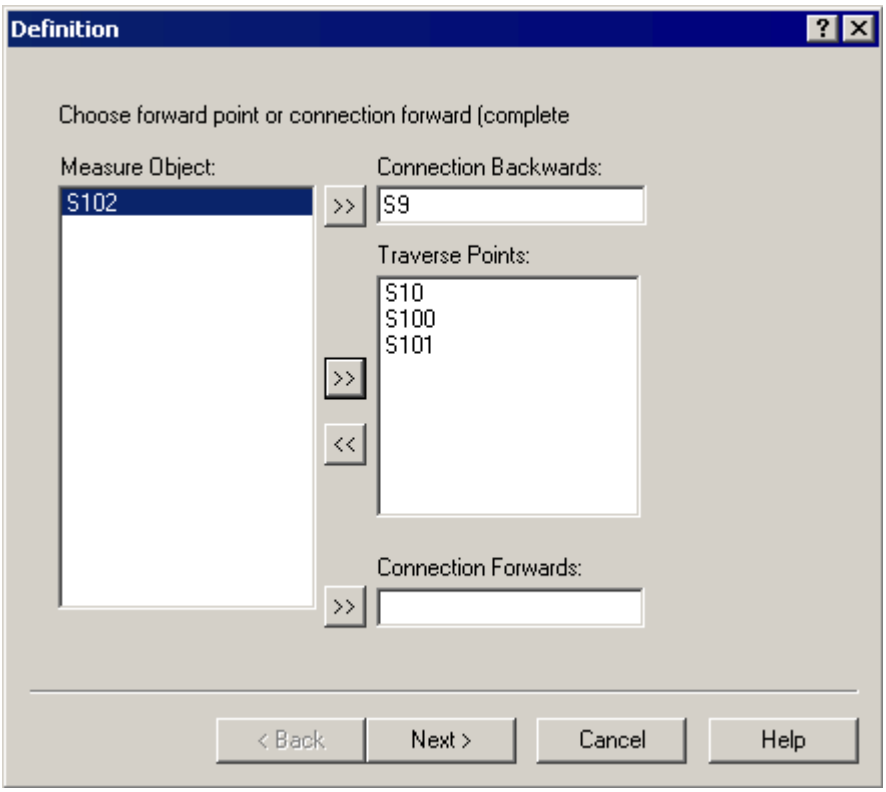
See also: Surveying and Setting Out 317, Survey Files 318

6.10 Define Traverse

This function creates a traverse document 354 based on survey data in a survey document 318 . Select ***Data | Define Traverse*** from a survey document to open the dialog. All survey data posts to be used in the survey file must be of the *Backsight* type. Each station point may only appear once in the traverse, however, the start and end station may be the same.

Defining

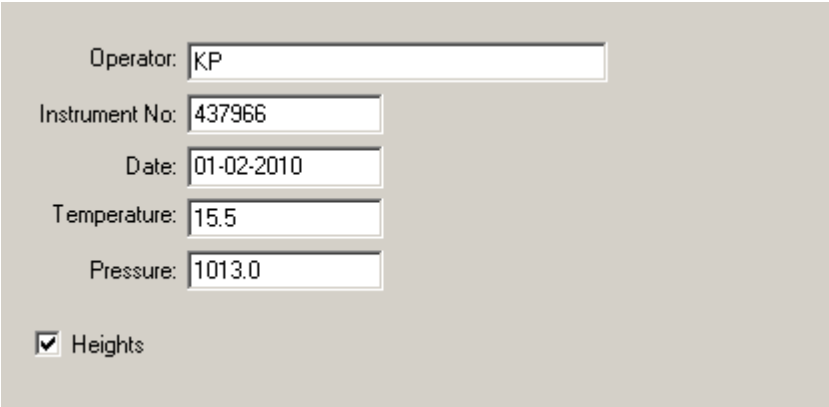
Start by selecting a starting point for the traverse by selecting a point in the measure object list and then click the **[>>]** button to add the point to the list with *traverse points*. You then *select Connection* Backward. You do this in the same way except that you now click the top button **[>>]**. When the backward connection is selected, you fill the list with traverse points from the list of measure objects, and finish by adding the traverse connection in*Connection Forward* with the bottom button **[>>]**. The list of measure objects always contains the measurements from last saved station only.



- **Measure Objects**
  This is a list of points measured from the last selected station, i.e. the points that could be the next station.
- **Connection Backward**
  The backsight for the first station in the traverse. This point is mandatory.
- **Traverse Points**
  This is a list of the station points contained in the traverse.
- **Connection Forward**
  The frontsight for the last station in the traverse; necessary if the traverse is to be calculated with a complete connection.

When the traverse is complete, click **[Next>>]** to come to the common data.

Common data



Here you enter data for the traverse's administrative fields, and the option of specifying whether to calculate the traverse with heights.

- **Administrative data**
  Here you can enter the operator, instrument number, date, pressure and temperature for the traverse file.
- **Heights**
  Check this option if you want the traverse to be calculated with heights. This can also be changed later in the traverse file.

After entering the data you want, click **[Finish]**, to create a new traverse document in the background, see Traverse Files 354.

See also: Surveying and Setting Out 317, Survey Files 318, Traverse Files 354,

6.11 Traverse Files

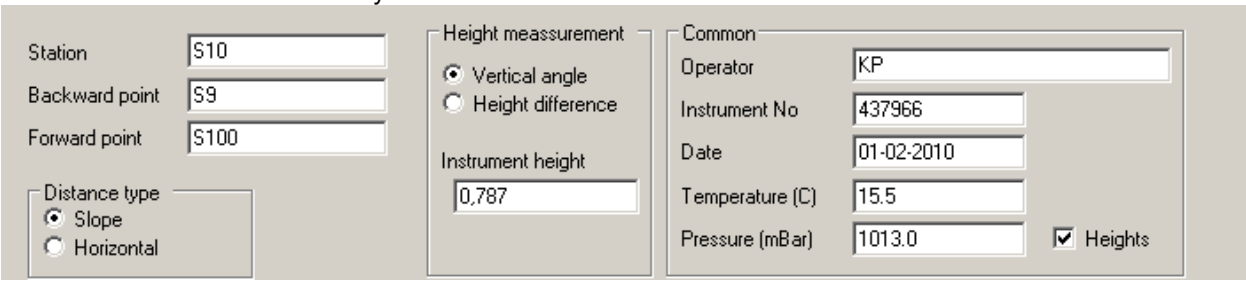
Traverse files contain a number of traverse stations defined by the Define Traverse 352 function, and displays in a window that contains four different views; a tree view, a station view, an input view 94 and a graphic view 47. You can move the separators between the views. Specific options also belong to the document in the **Data**.

Tree View

This view shows a tree with nodes for each station that are in the document and the sub-nodes for these for survey data. Click on a station node to select the station to be displayed in the station view and the input view.

Station View

You use this view to edit a surveyed station's data.



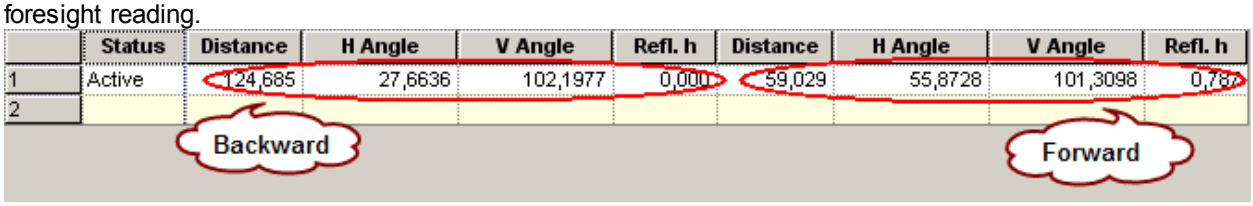
Station	Point number of the station point.
Note backward	Point number of the backsight.
Note forward	Point number of the foresight.
Distance Type	Enter how the distance has been measured. Either sloping or horizontal length.
Height Measurement	Enter how the heights have been measured. Either vertical angles or height difference.
Instrument Height	The instrument height above the point selection.

The view also contains *Common data* that applies to the whole traverse file.

Operator	Administrative data.
Instrument number	Administrative data.
Date	Administrative data.
Temperature	Administrative data.
Pressure	Administrative data.
Heights	Check this box if you want the heights calculated for the traverse.

Input View

This view shows the station's records, consisting of survey data backward and forward. The columns below are repeated twice in the input view. The first set belongs to the backsight reading, the second to the foresight reading.



	Status	Distance	H Angle	V Angle	Refl. h	Distance	H Angle	V Angle	Refl. h
1	Active	124,685	27,6636	102,1977	0,000	59,029	55,8728	101,3098	0,787
2									

Columns in input view:

The titles and order of the distance and angle columns may vary depending on the settings in the Project Tree Settings tab 19 and how the heights have been measured.

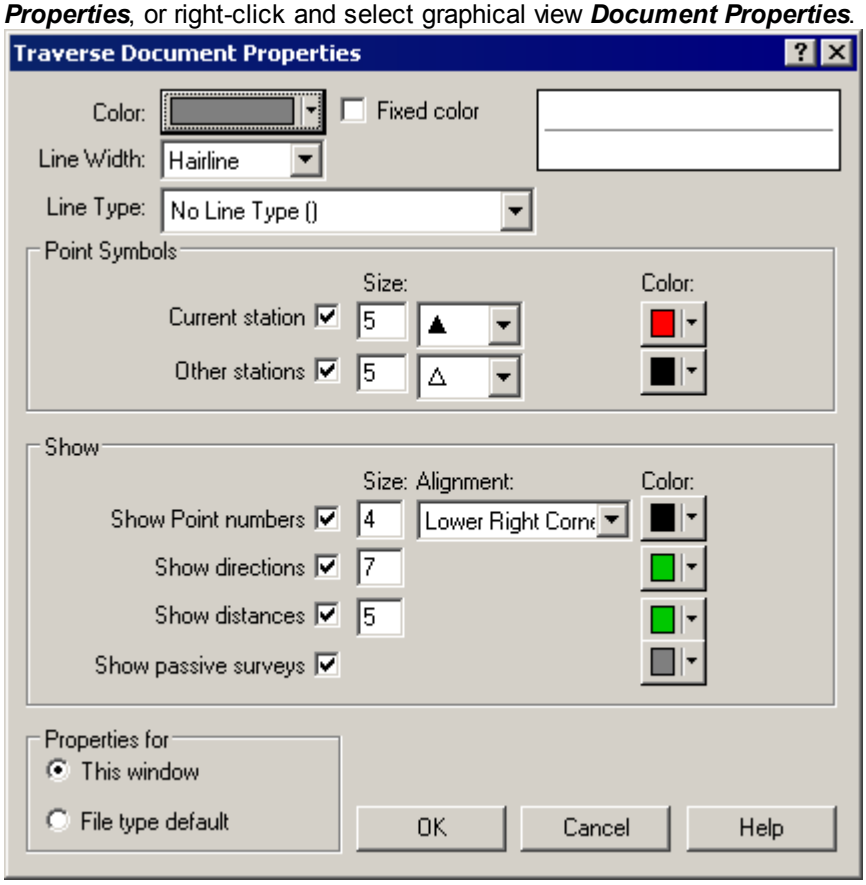
Status	Indicates the calculation status of the measurement. ***Active***: Measured record, used in the calculation. ***Passive***: Inactive record, not used in the calculation.
Distance	Measured distance. Sloping or horizontal depending on the station data.
H angle	Horizontal angle for the point.
V angle	Vertical angle for the point. Available only when the station data indicates that the heights are vertical angles.
H diff	Height difference for the point. Available only when the station data indicates that the heights are height differences.
Refl. h	Reflector height above the point selection.

Graphical view

Displays a graphical representation of the entire traverse. Symbols show the measurements made. Passive measurements appear in gray.

- Measured direction.
- Measured distance.
- Station points, the active station is highlighted in red.

These default settings can be changed if you click in the graphical view and select ***View | Document Properties***, or right-click and select graphical view ***Document Properties***.



Check the box to be visible and select the size, symbol and color. You can also select the line width and line type.

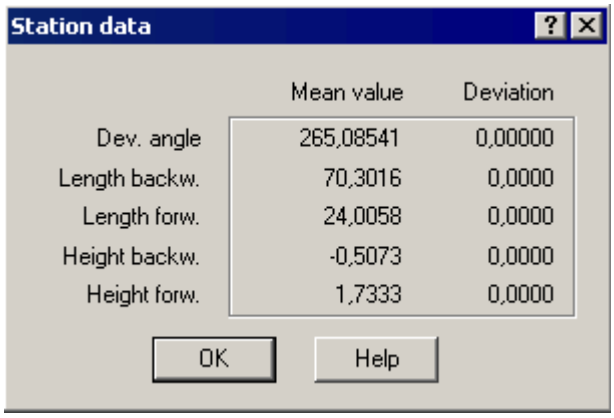
Data Menu

When a traverse document is active there are specially designed menu options in the **Data** menu.

***Data | Add Station*:**
Creates an empty station in the document.

***Data | Delete Station*:**
Deletes the station that is selected in the Tree View 354 .

***Data | Station Mean Values*:**



Select this option to open a dialog that shows mean values and deviations for the current station; the column shows the greatest deviation from the mean value. The values are only calculated based on the measurements that have an active status in the input view 354 .

***Data | Calculate Traverse*:**
Select this option to calculate the traverse. See Coordinate Traverse Calculation 358 .

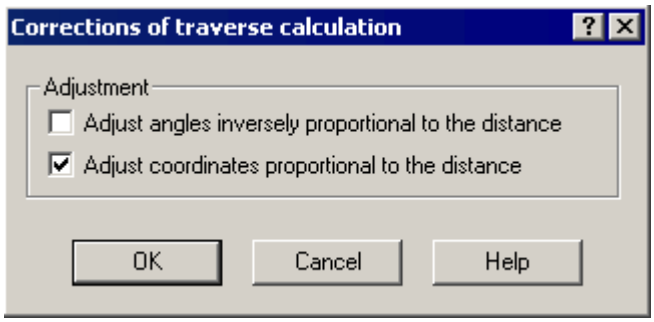
See also: Surveying and Setting Out 317, Define Traverse 352, Coordinate Traverse Calculation 358 .

6.12 Coordinate Traverse Calculation

This function calculates the coordinates for a traverse document354. Select ***Data | Calculate Traverse***, or click when a traverse document is active. The results of the calculations are a text report and a new coordinate document153.

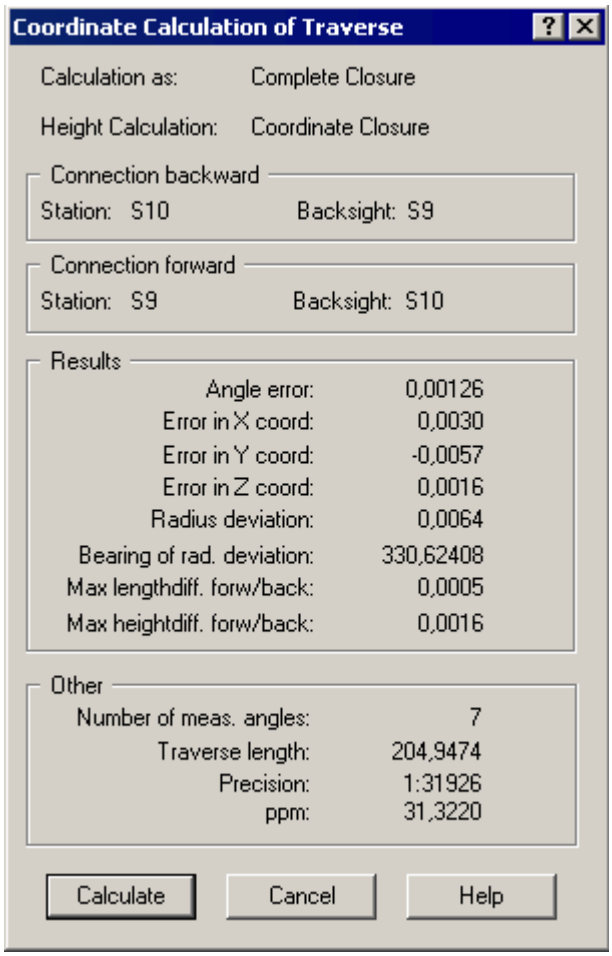
Correction of Traverse Calculation

This dialog is displayed before the actual calculation dialog and provides the option of influencing how the traverse points are to be corrected for the traverse's closing error when calculating.



- **Adjust angles inversely proportional to the distance:**
  The angle closure error for traverses with complete closure is distributed over all stations. If you select this option, angles measured at stations with short sight distances are influenced more, otherwise the error is spread equally for all stations.
- **Adjust coordinates proportional to the distance:**
  The coordinate closure error for complete closure or coordinate connected traverses is distributed over all stations. If you select this option, distances measured at stations with long sight distances are influenced more, otherwise the error is spread equally for all stations.

Coordinate Calculation



Calculation method:
There are three kinds of calculations that depend on the known points in the traverse:

- **Complete closure:**
  The last point of the traverse is known and also measured in relation to a known backsight. In this case, both the angle error and coordinate error will be corrected. Heights cannot have complete closure.

- **Coordinate closure:**
  The last point of the traverse is not known but measured in relation to a known backsight. Coordinate differences will be corrected.

- **Hanging:**
  The last point of the traverse is unknown. No improvements are possible.

Results:

Angle error	The closure error of the whole traverse at an angle relative to known points.
Error in N coord	The closure error of the whole traverse relative to known points in X coordinate.
Error in E coord	The closure error of the whole traverse relative to known points in Y coordinate.
Error in H coord	The closure error of the whole traverse relative to known points in Z coordinate.
Radius deviation	The length of the closure error in the coordinate plane.
Bearing for radial deviation	The direction of the closure error in the coordinate plane.
Max length diff. forward/ backward	The greatest difference of measured length for a distance measured as backward and forward point.
Max height diff forward/ backward	The greatest difference of measured height difference for a distance measured as backward and forward point.

Other:

Number of measured angles	Number of measured break angles in the traverse.
Traverse length	The overall length of the traverse.
Precision	The closure error relative to the length of the traverse.
ppm	Same as above, i.e. the closure error relative to the length of the traverse, but expressed in ppm (parts per million).

When the results are satisfactory, click **[Calculate]** whereby a coordinate file and a report with data from the calculation are generated.

See also: Surveying and Setting Out 317, Define Traverse 352, Traverse Files 354.

6.13 Level Run Files

Leveling documents, lvt, contain survey data for level runs, and are created for communications with instruments or by manual input. Specific options also belong to the document in the **Data**menu. The file appears in an input view 94.

Input View

Input Columns:
This view shows the station's surveyed points. Each row contains a pole reading or level run start. The columns that can be specified depend on the type of point.

Point Point number. Maximum 12 characters.

Type Specifies the type of point.
Level run start: Specifies the start point for the level run and gives the option of setting the height of the start point.
Backward: Read pole height backward.
Forward: Read pole height forward.
Detail: Read pole height forward to the detail point, i.e. points not included in the level run.

Backward Read pole height backward. Can be specified if the type is *Backward*

Forward Read pole height forward. Can be specified if the type is *Forward* or *Detail.*

Distance Distance from the pole when reading.

Height Point height, can be specified if the type is *level run start* and can then be used instead of the height from pp files 186 when calculating

Code Point code. Maximum 8 characters.

Data Menu

***Data | Calculate Level Run*:**
Creates a coordinate document 153 with the heights of the surveyed points and a report showing closing error etc. See Leveling 362.

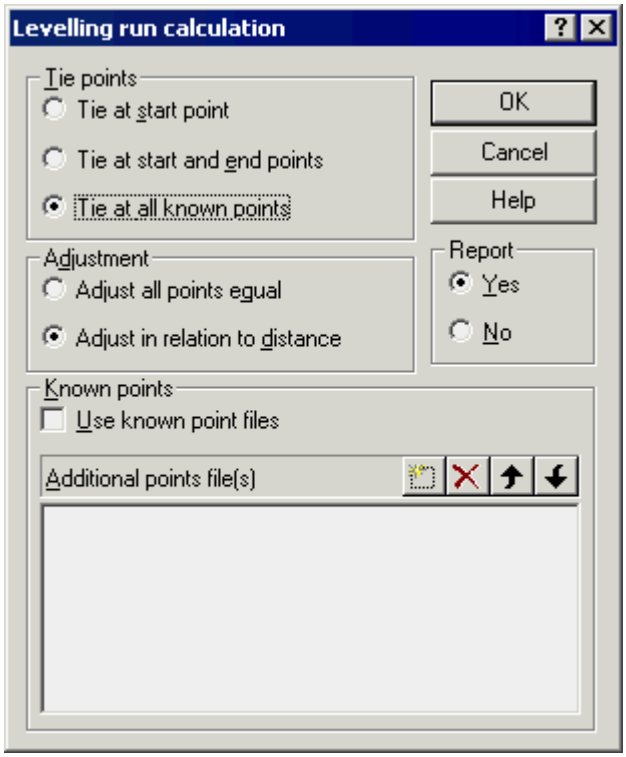
***Data | Reduce Surveys*:**
Reduce double-leveled measurements to single levelings for further calculation or as input data for net adjustment. See Leveling 362.

See also: Surveying and Setting Out 317, Leveling 362

6.14 Level Run

Calculate Level Run

This function calculates the level run for a level data file[361]. Select ***Data | Calculate Level Run*** from a level data document to calculate the level run. You use this dialog to specify whether/how the calculation and the adjustment are to be made. The results are given in a coordinate file with move points (points in the level run) and a coordinate file with detail points. You can also have the results presented in a report with a general summary.



Tie Points:

Here you specify how the level run is to be connected to known points

Tie at start point	The level run is tied at the heigth stated at the start point.
Tie at start and end points	The level run is tied at the start and end points and the closing error is adjusted.
Tie at all known points	If more points than the start and end points are known, the level run is also tied at these points. If this option is not selected, intermediate points are considered as new points.

Adjustment:

Here you specify how the closing error is to be distributed for the measurements

Adjust all points equally	The closing error is distributed in equal shares for all measurements.
Adjust in relation to distance	The closing error is distributed among the measurements in relation to the sight distance readings.

Report:

Choose if you want to create a report with the move and detail points, closing error etc.

Known points:

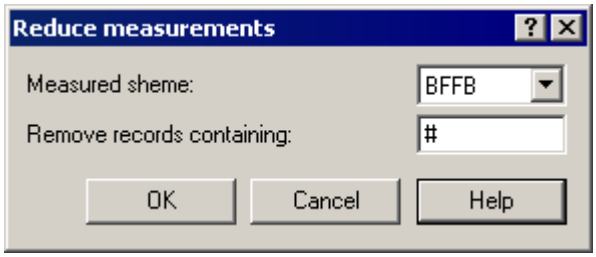
Enter where iCON office is to look for known heights when calculating. If no file is specified or if no points are found in the fixing point file, the level run is calculated as hanging, i.e. without checking. The starting point heights are taken from the leveling file's *level run start*field if no other height is found.

- **Use PP file**
  Check this option if you want the known heights to be loaded from the files specified for the known points in Project Settings 18.

- **Additional Fixing Point Files**
  Here you have the option of entering more files for iCON office to look in for points with known heights.

Reduce Surveys

To increase the accuracy and checks, you should frequently measure with double-leveling when you want to ensure high precision. In order to calculate a level run or used data in a net adjustment, the data must be reduced to only a backward-forward loading for each layout, which corresponds to the round measurement for angle measurement. The reduced measurements end up in a new file and the original file is left untouched. ***Data | Reduce Surveys*** opens the dialog.



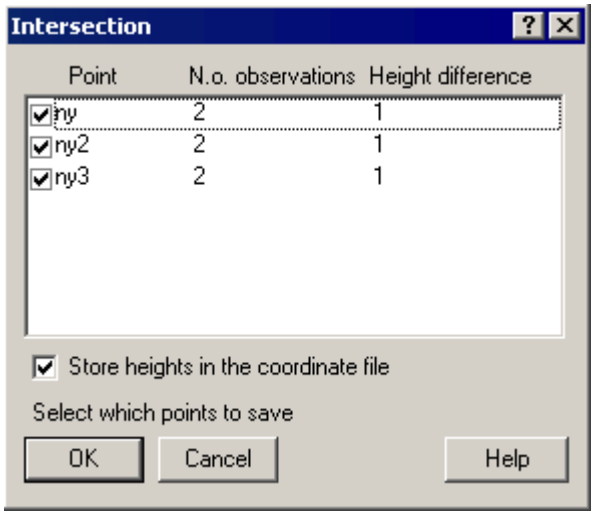
Survey order:
Here you define the patterns to use for the measurements at each layout, e.g. backward, forward, forward, backward.

Delete measurements that contain:
Some instruments require a sign in front of the point number to disregard the data post to notify that it must not be used. You can enter this character here.

See also: Surveying and Setting Out 317, Leveling Files 361

6.15 Intersection

You use intersection to calculate the points measured only with direction. The method is mainly used when it is difficult to measure lengths. To carry out the calculation, there must be a survey file[318] where the points you search for have been measured from known stations (should be in the pp file[186]). Each point must be measured from at least two stations. Open a survey file (plm) and select ***Data | Intersection*** to carry out the calculation.



If you have measurements that are in more than one survey file, these must be merged into a single file. This can be done in the following way:

1. Select the file to be the destination file.
2. Now open the other files and select ***File | Save As***.
3. Enter the name of the destination file for each file and select "Add data to existing file". It will now be filled with other measurements.

Point list:
Uncheck the points in the list that you do not want in the new file.

- **Point**
  The point number for the points to be calculated.
- **Number of observations**
  Number of measurements to the point. There must be at least two measurements to each point for the calculation to be performed.
- **Height Difference**
  Shows how much the height differs between measurements to the point.

Store heights in coordinate file:
Check this option if you want to include heights in the new coordinate file.

Click **[OK]** to create a new untitled document with the calculated points.

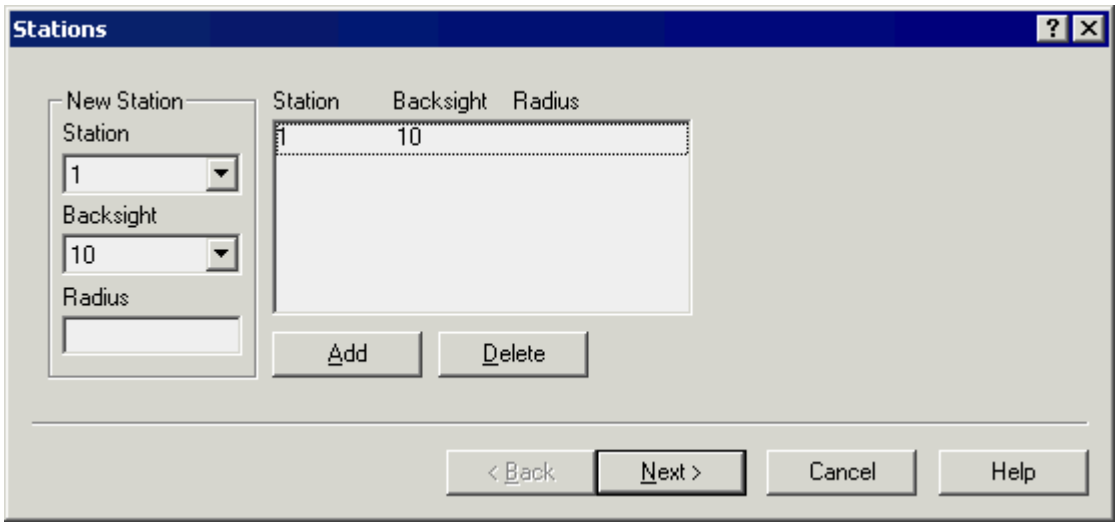
See also: Surveying and Setting Out[317]

6.16 Radial Set Out and Radial Road Set Out

This dialog calculates the radial set out data for points from station points; the set out is presented in the form of a report document. Select ***Functions | Stake Out | Radial*** or ***Functions | Stake Out | Radial Road*** to open the dialog. In *set out* the set out data is calculated for points, in *road set out* the set out data is calculated for sight rods along a road line. In the latter case the points have been created with the function Sections Along Lines[557] , select ***Data | Sections Along Lines...*** with a line file active.

Stations

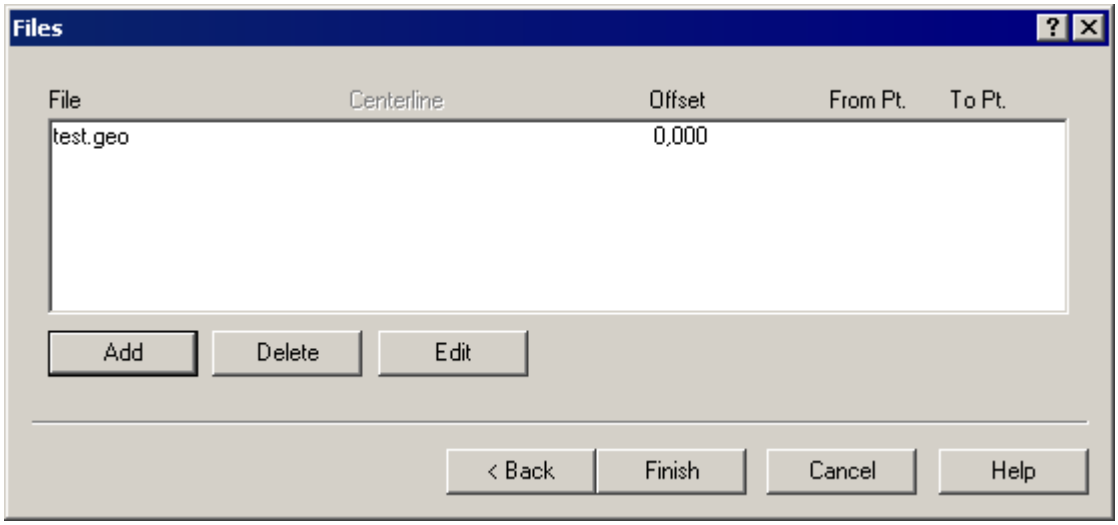
Here you enter the points the set out is based on. Each station must have a backsight. Station points and backsights are loaded from the polygon point file[186] . You must specify at least one station.



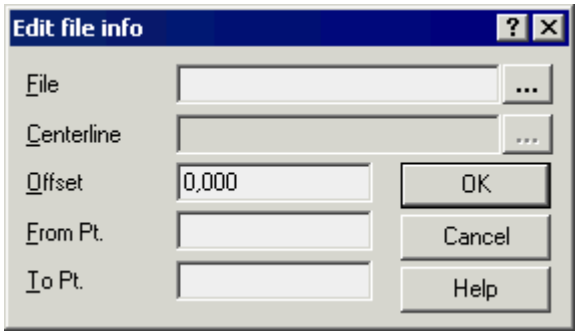
- **Station and backsight**
  In these fields there is a list of the points contained in the pp files[186], choose a station point and a backsight.
- **Radius**
  Here you can limit the points to set out. Points where the distances to the station point is greater than this value are not set out from this station.
- **Station List**
  A list of the stations appears here from which the set out will be made. First select the station point, and backsight and if applicable the radius in the fields to the left, then click **[Add]** to add the station to the list to the right of the dialog. Click **[Delete]** to delete a selected station.

After you select the stations you want, press **[Next]** to go to the page's files.

Files



Here you enter the coordinate files to be set out. You must specify at least one file. Click **[Add]** to bring up a dialog where you can specify a file and its properties.



- **Filename**
  Enter the coordinate file to be set out; for road set out you can also specify cross section files 629 .
- **Center Line**
  Road set out only. Specify towards which center line the sight rods are to be calculated. For cross section files you do not need to specify a center line.
- **Offset**
  Enter here if you want a side offset for the point which is moved orthogonally in the direction of the tangent with a positive direction from the road. This function is used primarily for road sections. For road set out, the tangent direction is taken from the road line, otherwise it must be present in the code or remark field for the point to be set out. If the point code is negative, the point is to the left of the center line, otherwise to the right of it. The tangent bearing is taken from the point's remark field if the special code is "B", otherwise from the point code. It should be specified in gon with a zero angle to the north and a positive direction clockwise.
- **From point**
  Name of the first point to set out. Leave this field blank to use the points from the first point in the file.
- **To point**
  Name of the last point to set out. Leave this field blank to use the points from the last point in the file.

If you want to change something or delete a file you can use **[Edit]** and **[Delete]** buttons to delete or edit in the file that is selected in the list.

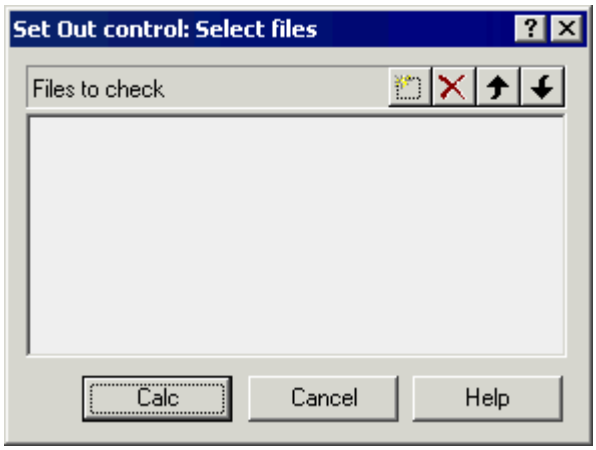
Click **[OK]** to create a report with set out data. If any row now turns red, the input data is incorrect, check

the file properties, edit and try again.

See also: Surveying and Setting Out 317, Set Out Control 368

6.17 Set Out Control

Use this dialog to create data for control measurement of a set out. From the coordinates the set out functions[365] can calculate the distance and bearing between the station and set out points. This control function, calculates the distance and bearing between two adjacent set out points instead. By going around the set out points in order, and measuring the distance and/or bearing to the adjacent points and then compare the results with the theoretical values this function gives, you can easily check that the set out has been correctly executed. Open the dialog with ***Functions | Stake Out | Control***.



Select the files you want to calculate the control data for in the file list and then select **[Calculate]** to create a report.

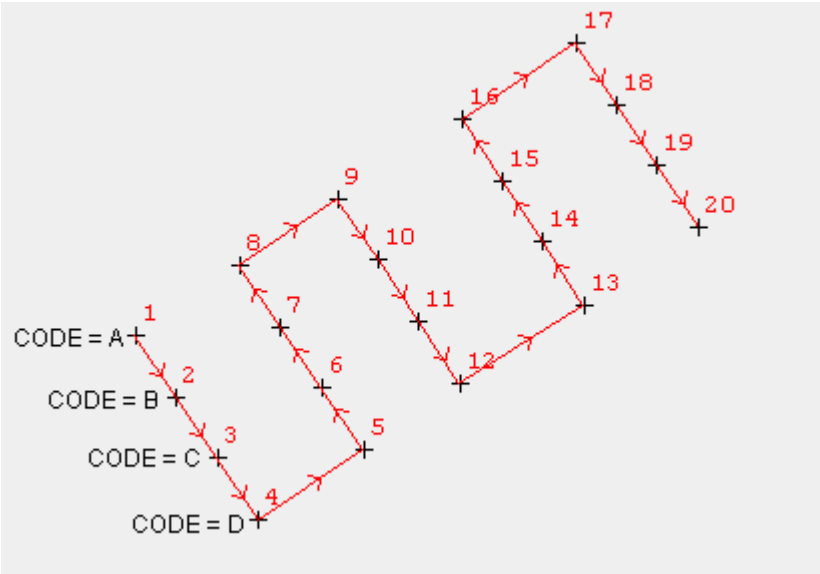
See also: Surveying and Setting Out[317], Radial Set Out and Radial Road Set Out[365]

6.18 Sequence Measurement

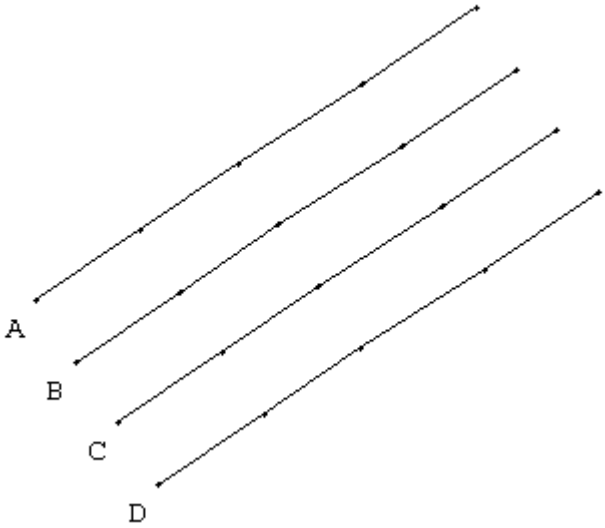
General

You use sequence measurement to measure a number of longitudinal lines by recording transverse measurement sequences. You can use this method, for example, for surveying curbs, which you can then measure points for both up and down on the stone without having to cover the distance twice. Another application could be the surveying of roads based on the measurement of each cross-section measuring such things as a slope crest, ditch bottom, roadway curb (right), road center, roadway curb (left) etc. When the measurement is purged in iCON office the measured transverse sequences are converted into longitudinal lines so that you get one line for the slope crest, one for the ditch bottom and so on.

In the example below, the line with code A will consist of points 1, 8, 9, 16, 17 and the line with code B of points 2, 7,10 and so on.



Surveying of four lines, coded A - D



Results after loading in iCON office.

Note: You must measure the same number of points for each line in a sequence measurement.

Surveying

Sequence measurements in the field can be performed using two different methods. One is based on a special coding and can only be used when surveying with Geodimeter/Trimble instruments. The second method is based on attributes and can be used with any instrument where attributes can be given.

Surveying using attributes

To make a sequence measurement, you set the attribute "SQ" in the survey file. The values for this attribute are the codes for each line separated by a comma or period. The whole sequence is measured as a continuous line (1:01 .. 1:02, etc.) and the attribute is set for the first point in the line. The actual rehashing of points is then done in the pre-calculated coordinate file with the menu option ***Data | Convert Sequence Measurement*** .

How you add attributes differs in different instruments: (see also separate description for each instrument).

- Specific to Geodimeter CU (old panel):
  The attribute is entered with label 100. The attribute name and value are specified here separated by a comma or period. For example, press [F] 100 and set the attribute "SQ, 23,24,17" to measure three lines with the codes 23, 24, and 17 in sequence.

- Specific to Leica:
  The attribute is entered with code -11. Press [CODE] on the instrument, set the code to "-11", info1 to "SQ" and info2 to, for example, "23,24,17".

- Specific to Trimble ACU:
  Attributes are linked to codes in the ACU code list. You must add a code "SQ" with the attribute "SQ" of the text type in the code list you are using. Now enter code "SQ" for the first point whereupon ACU will ask for the value of attribute "SQ", which is to be, for example, "23,24,17" as above.

Surveying using coding via labels (Geodimeter / Trimble)

Each sequence measurement begins by notifying which codes to assign to the lines to be measured. This code definition is made up of a sequence type (or a sequence block) and is defined by a numeric index that makes it easy to continue with a certain sequence type after a station change.

Sequence measurements with Geodimeter are coded using F4 (Pkod)=2. Otherwise, you can use the same UDS program for conventional surveying.

Start by entering the next point number (for line) in sequence followed by F4 (Pkod) = 2. The number for the sequence type is specified with F98 (Remark). Now press F4 to enter in sequence the code for the lines to be included in the sequence, as well as the signal height with F6 too where necessary. If you enter a number for the sequence, you do not need to enter the codes that are included the next time you have the same sequence type in the same survey file, as it is sufficient to indicate the sequence measurement F4=2 and remark F98=... (the sequence type you defined the first time).

Now simply measure and record and let the instrument calculate the point numbers as usual.

Example for the start of a sequence measurement:

5=1000 1	*Point number for the first point in the first line.*
4=2	*Indicates the start of the sequence measurement*
98=1	*Number for sequence type*
4=401	*Code for line 1*
4=402	*Code for line 2.*
4=403	*Code for line 3.*
6=2	*Signal height*
7=399. 3845	*Measurement*

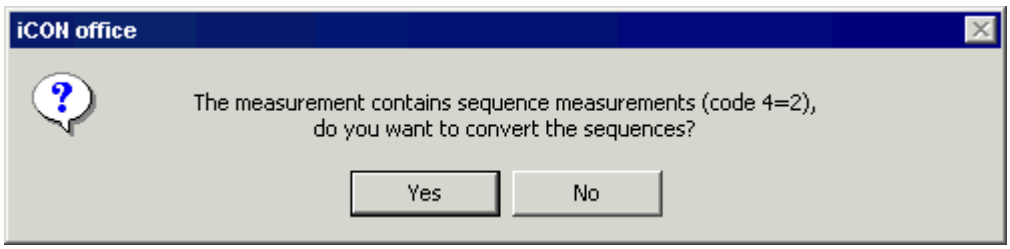
8=98.4
81
9=187.
34
5=1000
2
...

Example of new measurements with the same sequence type

5=2000 Point number for the first point in the first line.
1
4=2 Indicates the start of the sequence measurement
98=1 Number for sequence type
6=2 Signal height
7=398. Measurement
4575

8=97.6
91
9=182.
14
5=2000
2
...

When you "purge" the job file in iCON office, a dialog box appears announcing that the measurement contains the sequence measurement (4=2) and you will be asked if you want to prepare for the conversion of the sequences.



This preparation means that 'SQ' attributes will be created in each line that has been measured in sequence. This means that after the coordinate calculation, the procedure for converting the sequence lines into separate lines is identical to if the attributes had been specified directly in the instrument.

iCON office Handling

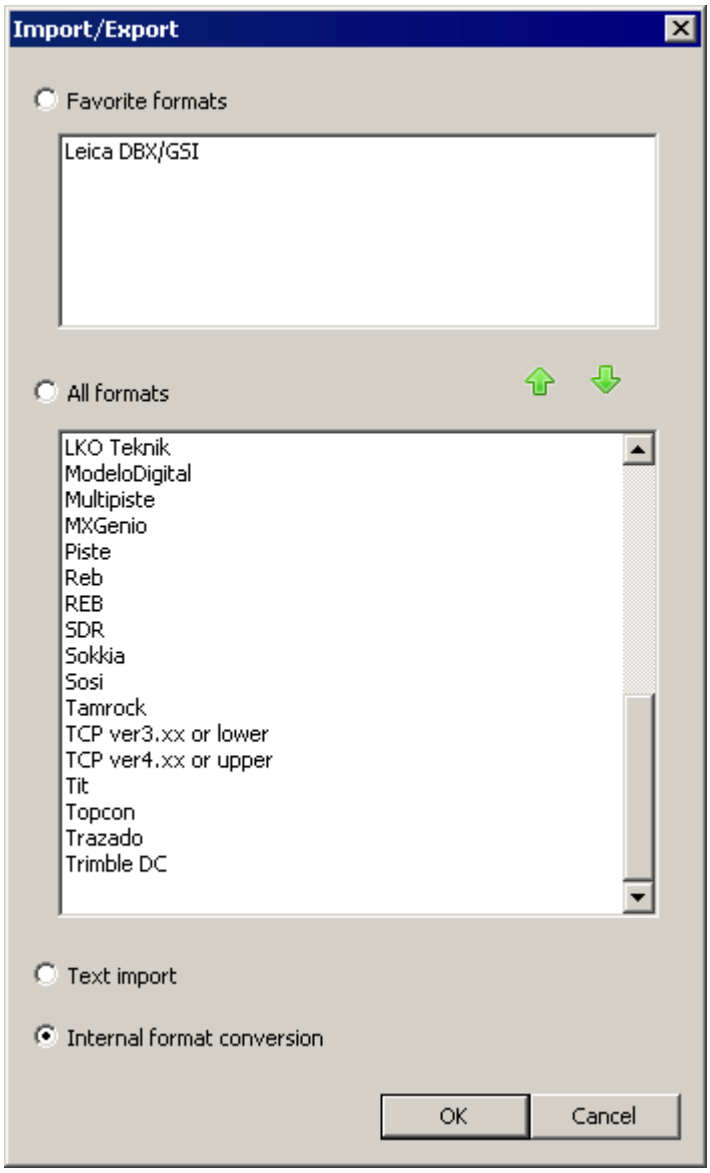
Sequence measured lines are converted using the 'SQ' attribute. Each whole line to be converted to a number of separate lines must have this attribute assigned to the first point of the line. To perform the conversion of all lines that have been sequence measured in a coordinate file, you select ***Data | Convert Sequence Measurement***. This applies regardless of whether the survey has been made using label coding 4=2 (Geotronics), registration of attributes in fields (instrument independent) or if the attributes have been entered manually after surveying.

See also: Communication 455, Geodimeter 483

7 Import and export

7.1 Import Export Dialog

The transfer dialog is a general dialog that is used for import/export communications. Open the dialog by selecting ***File | Import/Export*** or click the button in the toolbar.



The lower box under "All Formats" in the dialog shows a list of all formats. Place the frequently used formats in the top box under "Favorite Formats", making them quick and easy to locate. Select a format in the lower box and click the button to move the format up to the upper box. The button with a down arrow is used in a similar way to remove a format from the list of favorite formats.

Select a format and click **[OK]**, or double-click the format in the list. You will then open the transfer dialog, connected to the selected format. Some formats use the general transfer dialog 376. Note, there are also some formats that use for them more specific transfer dialogs. See the help text for each specific format.

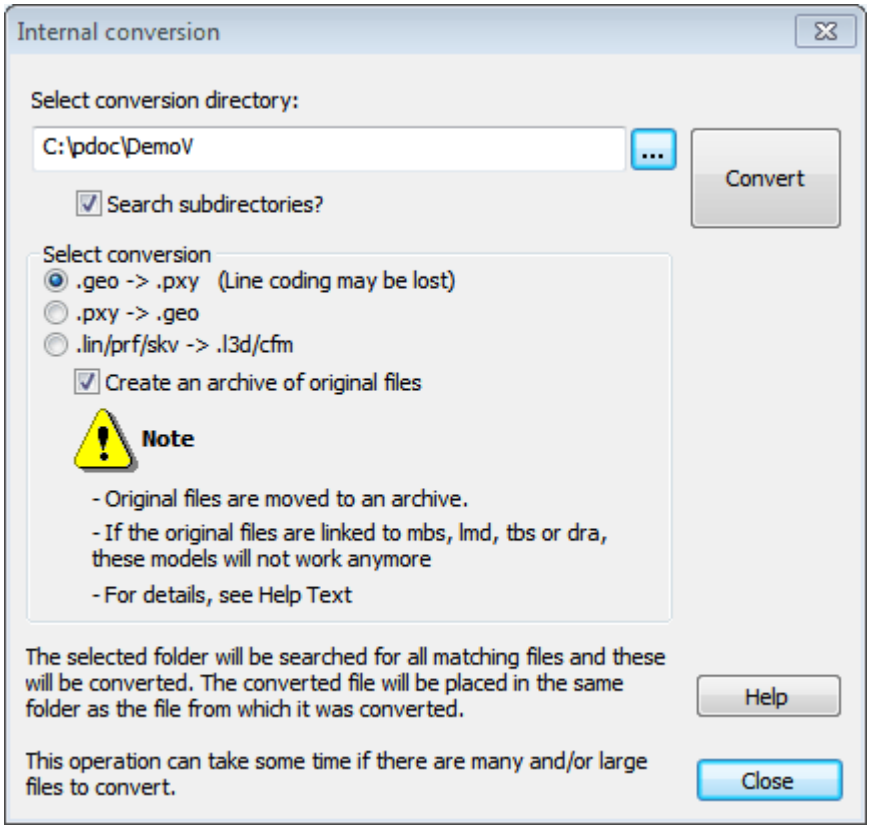
Import text

Select **Import text** to import data from file format that is unknown to iCON office, for further information, see Import text files 449.

Internal format conversion

Select **Internal format conversion** to convert

- all coordinate files in a folder from geo format to pxy format and vice versa
- all lines, lin, profiles, prf and camber files, skv, to the formats road line, l3d, and cross fall model, cfm



- Use the ... button to select the folder to search.
- Check the box **Search subdirectories?** if files in any sub-folders are also to be converted.
- Select conversion direction:

.geo -> .pxy	Conversion direction from geo format to pxy format. Note, in the pxy format 160 each line requires a line number in the point name, but in the geo format no line number is required. Thus, lines that don't have a line number in the geo format will be stored as single points in the converted pxy format. Lines with no line numbers in geo file -> Single

	points in pxy file, as the line disappear.
.pxy -> .geo	Conversion direction from pxy format to geo format.
.lin/prf/skv -> .l3d/cfm	Lines, profiles and camber files will be converted to the road line format .l3d respectively cross fall model, cfm.
Create an archive of original files (Checkbox)	Check the box if you want to move the original line files to a zipped folder in the project folder. If you don't check the box, both the converted files and the original line files (.lin/prf/skv) will remain in their folders.

- Click the **[Convert]** button to start the conversion.
  The converted files will be placed in the same folder as the original file.

Note that the function can take a long time if there are many files and/or if there are large files to convert.

Functions using the transfer dialog through the Import/Export dialog

Apa 379
Atlas 2000 380
AutoCad DXF/DWG 381
AutoKa-PC/GTRANS 384
Avance
Bever 386
Cartomap ver3.xx or lower
Cartomap ver3.xx or upper
Clip 387
DRD 388
FARO
GEOSIS 392
GradeSmart
Inroads Gons
Ispol
Kartbas 399
KF85 397
KOF 400
Kordab 401
LandXML 410
Leica DBX/GSI 427
LKO Teknik
ModeloDigital
Multipiste
MXGenio
Piste
Reb
REB
SDR
Sokia
Sosi 438
Tamrock
TCP ver3.xx or lower
TCP ver3.xx or upper
Tit
Topcon
Trazado
Trimble DC 440

10-Tabell 448

See also: Communication 455 , Transfer Dialog, in General 376

7.2 Transfer Dialog, in General

Open the transfer dialog

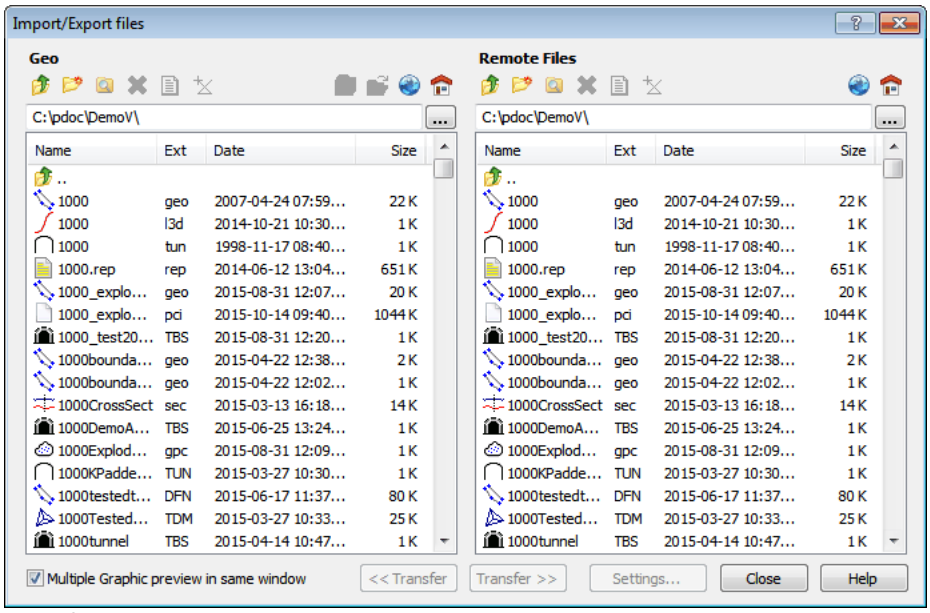
The transfer dialog is a general dialog that is used for certain import/export and communication functions[455] (including GeoPad and iCON[462]). The dialog has two columns, the left for iCON office files (Local Files), the right for files in other formats. Each column has a set of controls and a file list.

To open the dialog, select

- ***File | Communication | File Transfer*** or the icon in the toolbar. For more information, see File Transfer to Removable Storage Device[458].
- ***File | Communication | Windows CE Device*** or click the icon in the toolbar.
- ***File | Import/Export*** or click the icon in the toolbar.
  Depending on selected format, you will often end up in the transfer dialog described below.
  Please note, there are also formats that use other transfer dialogs, see the help text for the specific format.

Appearance of the transfer dialog

The appearance of the dialog differs slightly depending of the entrance. It is the suggested paths that differs, but otherwise the dialog works similarly.



Transfer dialog

Note, if a file is open in the graphical or numerical view, when you open the transfer dialog, it is only the active file that will be visible in the left column in the dialog. Click the icon to make all selectable files visible in the left column. Alternatively; close all open files in the project, before you open the transfer dialog.

Buttons in the transfer dialog

Change active folder (to parent folder)

Create new folder

Explore active folder in Windows Explorer

Delete selected files

Preview selected files as text
Preview selected files graphically
Change active folder to the global folder
Change active folder to the active project's folder

Folder Field
The path to the file list's active folder is shown here. Enter a path and press **[Enter]** or browse with ... to change active folder. You can also double-click on a sub-folder in the list to switch to it.

Pop-up menu
Right-clicking in the file list brings up a menu for the contents. This contains all the options available as buttons, and also the option *Reload*. Use this to reload the contents of the folder if it has changed outside of iCON office.

Other controls

Multiple Graphical preview in the same window
If more than one file is selected when you select the graphical preview, they open in the same window if this option has been checked.

Transfer buttons:
To transfer files, select the files you want to transfer and then click **[Transfer>>]** to convert files from iCON office or **[<<Transfer]** to convert files to iCON office. The transferred files are then added to the second file list. The selected files will be transferred. If a file already exists in the other window, a *Save As* dialog appears where you have the option of renaming the file or overwrite the existing file.

Settings:
You can configure certain transfer functions. See the relevant sections for details.

Functions using the transfer dialog

Import and Export:
Apa 379
Atlas 2000 380
AutoCad DXF/DWG 381
AutoKa-PC/GTRANS 384
Bever 386
Clip 387
DRD 388
GEOSIS 392
Kartbas 399
KF85 397
KOFF 400
Kordab 401
LandXML 410
Leica DBX/GSI 427
Sosi 438
Topcon 439
Trimble DC 440
10-Tabell 448

Communication:
File Transfer 458

iCON Field transfer 462
Windows CE transfer 460

See also: Communication 455

7.3 Apa

This function converts data to and from Apa format. Select ***Import/Export | Apa*** to open the transfer dialog 376.

Convertible File Formats

iCON office**:**
Coordinate Files: (geo, pxy)
Survey files: (plm)

Apa:
Apa files: (apa)

Settings

No special settings can be made for this function.

See also: Import and Export in General, Transfer Dialog 376

7.4 Atlas 2000

This function converts data to and from Atlas 2000. Select ***Import/Export | Atlas 2000*** to open the transfer dialog[376].

Convertible File Formats

iCON office:
Coordinate Files: (geo, pxy)

Atlas 2000:
Atlas 2000 files: (DT)

Settings

No special settings can be made for this function.

See also: Import and Export in General, Transfer Dialog[376]

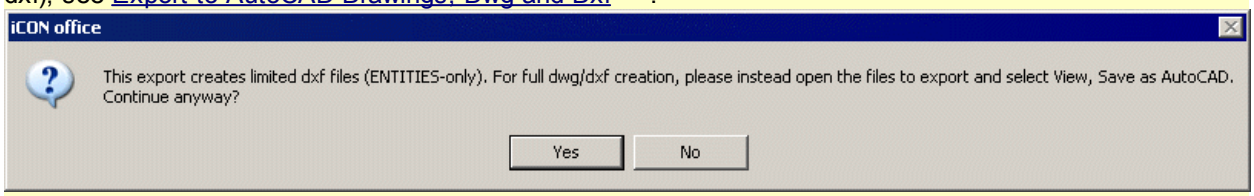
7.5 AutoCad DXF

This function converts data to and from AutoCAD® dxf format. Select ***Import/Export | AutoCAD DXF*** to open the transfer dialog[376] .

You can also open dwg and dxf files as documents in graphical views, see AutoCAD files[289] .

Note that there are more advanced transfer options between AutoCAD® formats (dwg and dxf) and iCON office format if, instead of this function, you use either of the following methods:

View | Export View As | AutoCAD file to save a file in iCON office format as AutoCAD® format (dwg or dxf), see Export to AutoCAD Drawings, Dwg and Dxf[300] .



Warning message if the transfer from iCON office format to AutoCAD® format can be done in another way.

See Import of AutoCAD Drawings, Dwg and Dxf[289] , for information on how to import files in AutoCAD® formats (dwg and dxf) to iCON office format, using ***Data | Extract Coordinates from AutoCAD Drawing*** or ***Data | Extract Faces from AutoCAD Drawing***.

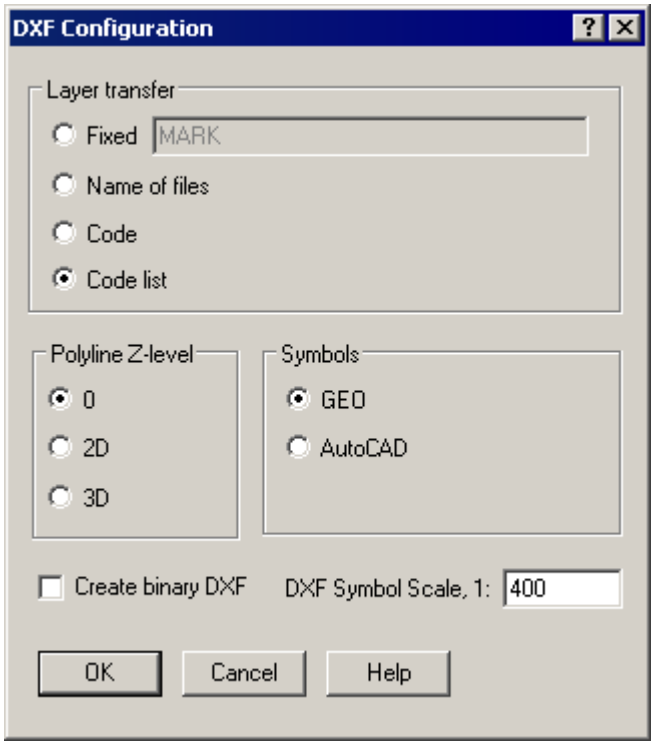
Convertible File Formats

iCON office:
Coordinate Files: (geo, pxy)
Line Files: (l3d)
Contour Lines: (niv)
Terrain Models: (trm)

AutoCAD® DXF:
DXF files: (dxf)

Settings

Click **[Settings]** in the transfer dialog[376] to open a dialog where you can set parameters for how the transfer is to take place.



Layer transfer:

- **Fixed:**
  All data is placed in the designated layer.
- **Filename:**
  The file name determines the name of the layer.
- **Code:**
  The point code determines the layer the point is added to. However, this does not apply to line files 503, which are added to the layer using the file name.
- **Code list:**
  The point code is matched against the active code list to determine the layer the point is added to. See also Code Lists 203.

Polyline Z-level:

- **0:**
  All height coordinates in polylines get the height 0.
- **2D:**
  All polylines get the same height coordinate as the first point in the line.
- **3D:**
  All polylines are 3D polylines. In AutoCAD® format, a 3D polyline does not have any line type and the functions *trim* and *break* cannot be used.

Symbols:

- **iCON office:**
  Use iCON office's symbols.
- **AutoCad:**
  Use AutoCAD® symbols.

Create binary DXF:

The binary format is more compact than text format, but should only be used with AutoCAD® R10 386 or later versions.

DXF symbol scale

Specifies the scale for the symbols in the DXF file.

Transfer

When you transfer to DXF and have selected multiple files, you will be asked if you want all data to be saved in the same file.

- **Transfer each file individually**

  This option means that each file is transferred separately. The AutoCAD® files will have the same name as the original files, but with the extension DXF.

- **Transfer to a file:**

  This means that all selected files are transferred to the same DXF file. You must then give a name for the file the data is to be saved in.

See also: Import and Export in General, Transfer Dialog 376, Import of AutoCAD Drawings, Dwg and Dxf 289, Export to AutoCAD Drawings, Dwg and Dxf 300

7.6 AutoKa-PC

This function converts data to and from AutoKa-PC, the Swedish Lantmäteriets (Land Surveying) system for mapping and to GTRANS, a program developed by Lantmäteriet for coordinate transformations. Select ***Import/Export | AutoKa-PC*** to open the transfer dialog376.

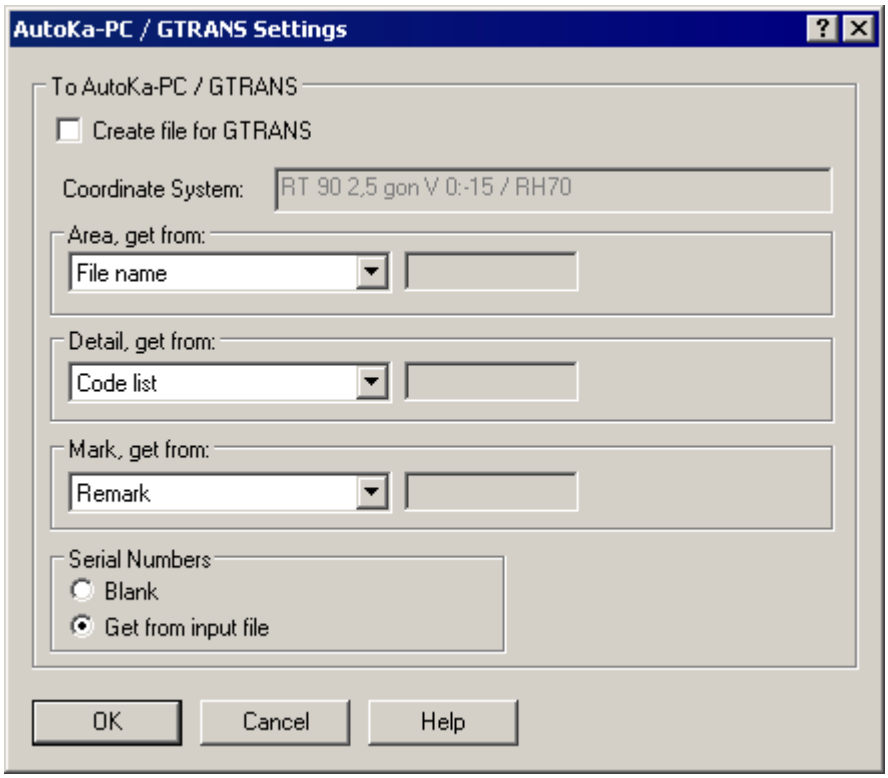
Convertible File Formats

iCON office:
Coordinate Files: (geo, pxy)

AutoKa-PC:
AutoKa files: (.K, *.*)

Settings

The settings in this dialog apply to transfer to AutoKa-PC/GTRANS.



Transfer to GTRANS
If the **[Create file for loading in GTRANS]** box is checked the k file will be customized for loading in GTRANS. This includes that a row with the current coordinate system is written to the file etc. If the current project in iCON office has a special coordinate system set, see Project Settings16, the description of this will be automatically entered in the field **[Coordinate system]**. The contents in the field can be edited freely.

Area, Detail Type and Selection
You can choose to download data for 'Area', 'Detail Type' and 'Selection' from various sources:

- Free text
  Means you can enter an optional text in the field to the right.
- Filename
  The file name from the selected source file is used.

- Point code
  The coordinate file's point codes are loaded.
- Special code
  The coordinate file's special codes are loaded.
- Remark
  The coordinate file's remark fields are loaded.
- Code list
  The contents of the 'AutoKa-PC' column in the active code list are loaded by using the point code in the coordinate file. Note: Remember to set the correct code list 16 as active. If no AutoKa-PC code can be found (either due there being no iCON office code or that the field AutoKa-PC in the code list is blank) the point code is used instead. See also code lists 203 .

Serial number
Serial numbers can either be set as blank or loaded from the input data.

See also: Transfer Dialog, in General 376 , Project Settings 16

7.7 Bever

This function converts data to and from Bever format. Select ***Import/Export | Bever*** to open the transfer dialog[376].

Convertible File Formats

iCON office:
Coordinate Files: (geo, pxy)

Bever:
Bever files: (tli)

Settings

For conversion of coordinates to Bever, a special code is used and remarks for the cross fall. The special code must be CF (or CS). You can add this information by using the function Sections Along Lines[557].

See also: Import and Export in General, Transfer Dialog[376]

7.8 Clip

This function converts data to and from Clip format. Select ***Import/Export | Clip*** to open the transfer dialog 376. Remember that lines and profiles must be checked 517 after transfer to iCON office.

Convertible File Formats

iCON office:
Coordinate Files: (geo, pxy)
Line files: (lin)
Profile files: (prf)

Clip:
Coordinate Files: (bas)
Line files: (pla)
Profile files: (alz)

Settings

No special settings can be made for this function.

See also: Import and Export in General, Transfer Dialog 376

7.9 DRD

This function converts data to and from Trafikverket's (Swedish Transport Administration) DRD format. Select ***Import/Export | DRD*** to open the transfer dialog 376.

Convertible File Formats

iCON office:
Coordinate Files: (geo, pxy)
Line files: (lin)
Profile files: (prf)

DRD:
Coordinate Files: (rbb)
Line files: (dvl)
Profile files: (dpl)

Settings

No special settings can be made for this function.

See also: Import and Export in General, Transfer Dialog 376

7.10 ESRI Shapefiles

This function converts data to and from ESRI Shapefiles format. Select ***Import/Export | ESRI Shapefiles*** to open the transfer dialog[376] .

ESRI Shapefile format requires that points, lines and polygons are stored in separate files. When exporting a coordinate file that contains all these types of objects, a file for each layer will be created. Similarly, data imported from ESRI Shapefiles will be stored in separate coordinate files.

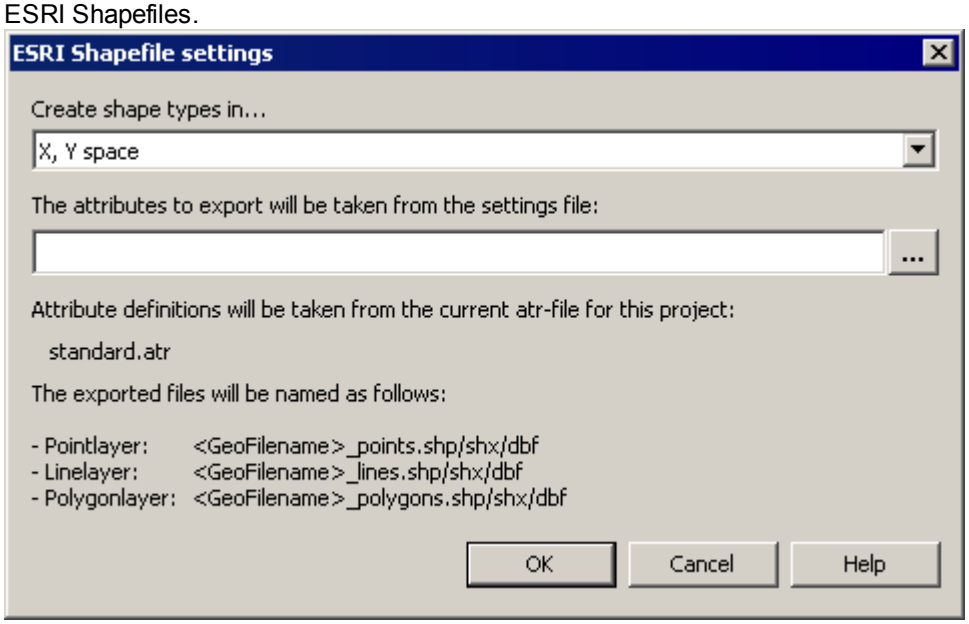
Convertible File Formats

iCON office
Coordinate files: (geo, pxy)
Latitude longitude files: (llc)

ESRI Shapefiles:
ESRI Shapefiles: (shp)

Settings

Click **[Settings]** in the transfer dialog[376] and select how attributes should be treated at the exportation to ESRI Shapefiles.



Create shape types in...
Use the drop list to select whether exported ESRI Shapefiles should contain coordinates for two or three dimensions (X and Y, or X, Y and Z) also expressed as (N and E, or N, E and H), see Settings in the Project[20] .

The attributes to export will be taken from the settings file:

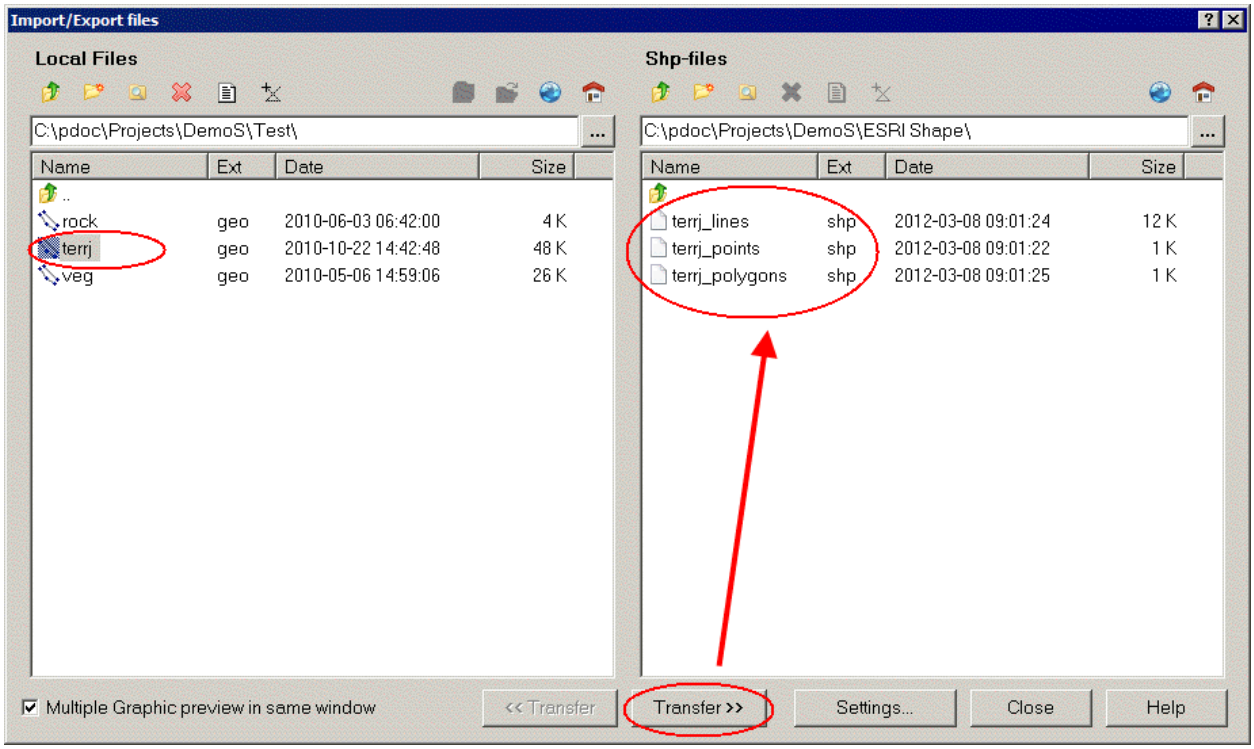
Click the browse button ... to select a settings file for attributes, from the global folder[17]
The settings file makes it possible to transfer attributes in iCON office files to ESRI Shapefiles.

Attribute definitions will be taken from the current attribute file for this project:
The name of the attribute file that has been selected in the project is shown.
The attribute file determines which attributes are possible to save.
To choose attribute file, select ***Edit | References***, see Program Settings[111] .
For information about attribute files, see Optional attributes[113] .

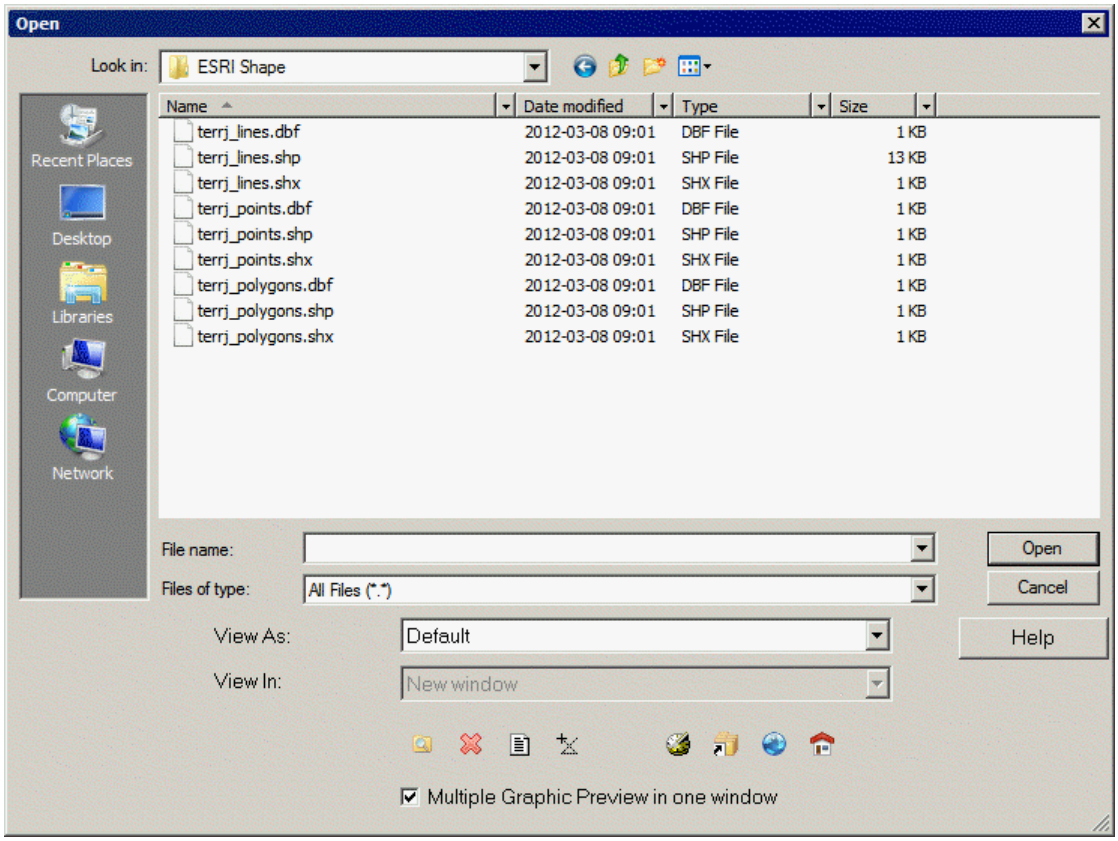
Naming of exported iCON office files to ESRI Shapefiles:
If you export a coordinate file containing single points, lines and polygons to ESRI Shapefiles, three shp-files will be created:

Filname incl. suffixes	File format	Contents
<iCON office Filename>_points	shp, shx, dbf	Points
<iCON office Filename>_lines	shp, shx, dbf	Lines
<iCON office Filename>_polygons	shp, shx, dbf	Polygons

The exported files get a suffix (_lines, _points or _polygons) which shows the file's contents. For each shp file a dbf and a shx file will also be created.



Example of a coordinate file that has been exported to ESRI Shape format.



A coordinate file containing single points, lines and polygons is divided into nine files in ESRI Shape format. A file in the format of dbf, shp and shx will be created for each layer (line, point and polygon) in the exported file.

See also: Transfer Dialog, in General, 376 Program settings 109, Import Export Dialog 372

7.11 GEOSIS

This function converts data to and from GEOSIS format. Select ***Import/Export | Geosis*** to open the transfer dialog[376].

Convertible File Formats

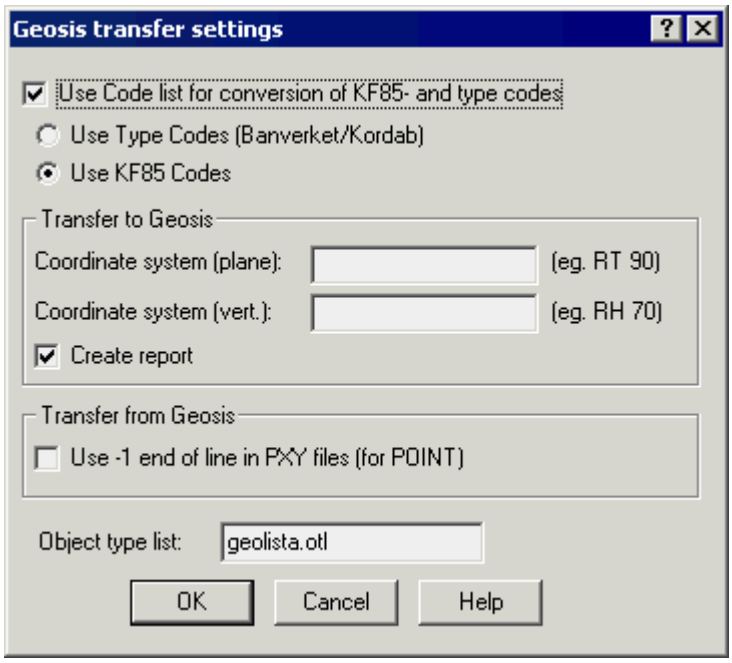
iCON office:
Coordinate Files: (geo, pxy)
Line Files: (lin)
Profile files: (lin)
Terrain Models: (trm, dfm)
Line Files: (lin)
Section Files: (sec)

GEOSIS:
GEOSIS files: (*)

Instructions when exporting to Geosis

If the export is to Trafikverket (Swedish Transport Administration), see BVH584.25 (formerly Banverket [Rail Administration]) or "Transfer of planning information in Vägverket [Road Administration]" for additional information including demands on coding of objects.

Settings for transfer to GEOSIS:



- **Use the code list for the conversion of KF85 and type codes:**
  Click the codes to be translated (applies to export of pxy, geo and trm files).
- **Use Type Codes:**
  If the code list[203] fields for type codes are to be used, select this option. The selection also determines the code type of the line geometries (lin/prf).
- **Use KF85 Codes:**
  If the code list[203] fields for KF85 codes are to be used, select this option. The selection also determines the code type of the line geometries (lin/prf).

- **Coordinate System (Plane):**
  Information to the receiving system on the applicable coordinate system, for example, Sweref 99.
- **Coordinate System (Vert.):**
  Information to the receiving system on the applicable height system, for example, RH00.
- **Create Report:**
  Check this box for a report on the exported data (recommended).
- **Object Type List:**
  Current object type list, the default setting is recommended.

General:
Clicking **[Transfer>>]** brings up a dialog in which the following information is specified:

- **Geosis filenames:**
  Choose a unique name for the Geosis file to be created. Specify the file type. There is no general standard for Geosis file types but these are most common: GTA (Vägverket), GVL (road line Vägverket), GPL (profile line, Vägverket), OTL (object type list), GSI (Banverket) and SIS.
- **Project name, Name of measurement site, Project number, Operator, Organization:**
  General information to the recipient.
- **Date:**
  Date for data in the file.
- **Remarks 1 and 2:**
  Optional.
- **Remarks 3-5:**
  Clicking the **[Status/Created...]** button fills the fields automatically with information about the file contents as follows:
  Remark 3 is set to AR = yymmdd, where yymmdd is the date for the change.
  Remark 4 is set to ST = status where the status may be Unknown, Present, Project, Will be removed, Planned or Disabled.
  Remark 5 is set to TT = created where created can be Unknown, Calculated, Geodetically surveyed, Digitized, Photogrammetrically surveyed, GPS, Scanned or Other.

Landscape data (geo, pxy):
Start by deciding what type of point codes to use and follow the instructions below:

- **KF85 codes:**
  If KF85 Codes are to be written, the corresponding fields in the code list203 must include the KF85 Code, under the Transfer tab. The code for electric poles, for example, has the code 221 in the standard code list sbg1.cod and the corresponding KF85 code, 400141210, is then written into the code list for code 221. Export can be made when all codes are linked in this way.
  Click **[Settings...]** and ensure that the selections **Use Code List...** and **Use KF85 Codes** are checked. When these settings are made, the program will load all KF85 codes from the code list for each point. If the KF85 code is missing, the point code is written directly instead although this will not be interpreted as a KF85 code by the receiving system as there will be no identification that it is a particular KF85 code and no other code type.
  If the code list203 is used, the object type **map objects, KO**, in Geosis will be coded with the KF85 code. Make sure the correct code list is active!
- **Type code (Banverket/Kordab):**
  If type codes are to be written, the corresponding fields in the code list203 must contain the type code, under the Transfer tab. The code for electric poles, for example, has the code 221 in the standard code list sbg1.cod and the corresponding type code such as ETP will then be entered in the code list for code 221. Export can be made when all codes are linked in this way.
  Click **[Settings...]** and ensure that the selections **Use Code List...** and **Use Type Codes** are checked. When these settings are made, the program will load all type codes from the code list for

each point. An alternative way is to use the point code as type code directly (i.e. specify ETP in the geo file). This is done by not using the code list or by making sure the codes are not linked as described above. However, be aware that no identification of the codes is entered in this case.
If the code list is used, the object type **map objects, KO**, will be coded in Geosis with the type code. Make sure the correct code list is active! Any line type codes will be loaded from bvtypkod.txt in the global folder and can also be written to the Geosis file. This is done by loading the bvtypkod.txt file that is in the global folder.

- **Other codes:**
  If the code list is not used as above, the point code will be written unconverted to the Geosis file. In this case, no map objects, KO, will be written.

Terrain models (trm):
Terrain models in iCON office contain no codes, but only triangles. When exporting terrain models to Geosis format you can choose to load codes from the coordinate file used to create the model. This choice is made after you have started the transfer. As regards the actual code handling, the same thing applies as it does for landscape data as described above. The object type for terrain models is **DTM**. It is possible to define **layer code** for the model. The client and vendor must agree on valid values for the code.

Horizontal Geometry (lin):
The object type for horizontal geometries is **HG**. You can enter the object code after starting the transfer. The code type is set in **[Settings...]** to either **KF85** or **type code**. You can enter the codes for points in the geometry as well as for the entire object.

Vertical Geometry (prf):
The object type for vertical geometries is VG. You can enter the object code after starting the transfer. The code type is set in **[Settings...]** to either **KF85** or **type code**.

Track Geometry (lin + prf) with length table:
This option is used when there are track geometries where the length table for connections is used. You then transfer **all lines and profiles** to a single Geosis file. The object type horizontal geometry is **HGS** (Horizontal Geometry Track) and **VG** for Vertical Geometry. You can set the code for the object when the transfer has started. The length table is calculated from the lines included in the transfer, which means that there must be no errors in the lines. They must therefore be checked 517 beforehand. There should be a line file for every kilometer that is not exactly 1000 meters. In addition, both the tangent point before and after the kilometer change must appear in both files. (i.e. tangent points adjacent to connections are represented twice, although with different length measurements). In the report generated when exporting, the length table is written where you can check if the kilometer lengths are correct.

Ground sections (sec):
The item type for ground sections is **MS**.

Instructions for the import of Geosis

Settings for transfer from GEOSIS:

- **Use the code list for the conversion of KF85 and type codes:**
  Click the codes to be translated (applies to import of landscape data).
- **Use -1 as the line end in coordinate files:**
  With this setting, lines in coordinate files are given -1 in the special code at line ends. This option can be used if the pxy file is to be used in POINT.
- **Use KF85 Codes:**
  If the code list 203 fields for KF85 codes are to be used, select this option. The selection also determines the code type of the line geometries (lin/prf).
- **Coordinate System (Plane):**

Information to the receiving system on the applicable coordinate system, for example, RT90.

- **Coordinate System (Vert.):**
  Information to the receiving system on the applicable height system, for example, RH00.
- **Create Report:**
  Check this box for a report on the exported data (recommended).
- **Object Type List:**
  Current object type list, the default setting is recommended.

General:
Select the desired Geosis file on the right side and select **[<<Transfer]**. First, a dialog comes up with information about what is in the file. You will then get to choose the file names of the iCON office-files to be created according to the contents of the Geosis file. Because the data can be mixed in a Geosis file, this may result in you having to specify different file types.

Import of landscape data (KO, SP) and terrain models (DTM):
Landscape data and terrain models are saved as coordinate files. If the Geosis file contains type codes or KF85 codes and the active code list contains these codes, the conversion will be made to iCON office codes. If the codes are not found, or if no code list is used, the codes are written directly in the coordinate file, although the KF85 codes have nine positions that do not fit in the coordinate file's point code, which only has room for eight characters.

Import of horizontal geometry (HG):
Saved as line file, lin.

Import of vertical geometry (VG):
Saved as profile, prf.

Import of horizontal geometry track (HGS) with associated vertical geometry (VG):
This object type contains a length table for connections. For imports, this means that the horizontal geometry and vertical geometry will be divided so that you get a line file and a profile for each kilometer that does not measure exactly 1000 meters, according to the length table. The file names will have an index corresponding to the current kilometer. For example, if you choose 02N1 as file name the line file for kilometer 3 will be called 02N1_3.LIN and the profile for kilometer 3 02N1_3.PRF.

See also: Import and Export in General, Transfer Dialog 376

7.12 Google Earth

This function converts data from iCON office format to Google Earth™ format. A graphic view in iCON office will be exported to Google Earth format. Select ***Import/Export | Google Earth*** to open the transfer dialog 376.

Convertible File Formats

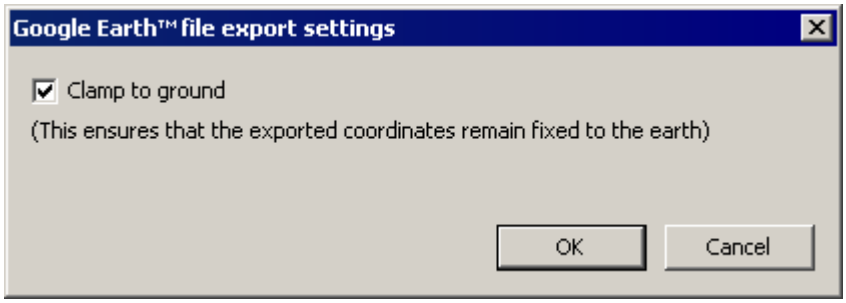
iCON office:
Coordinate Files: (geo, pxy)
Latitude longitude files: (llc)
Terrain models: (trm)

Google Earth:
Google Earth file: (kmz)

Note, there must be a coordinate system selected in the active project to make it possible to export a coordinate file or terrain model to Google Earth. To select a coordinate system, see Selecting Coordinate System 124. The coordinate system indicates the transformation relationship to WGS 84.
Since the latitude and longitude files are listed with coordinates in WGS 84, this type of files (llc) are exported even if the project lacks a defined coordinate system.

Settings

Click **[Settings]** in the Import/Export dialog 376 to select how exported files should appear on the earth's surface.



Clamp to ground
In the dialog, select if heights should appear like real altitudes or if they should appear as fixed on Google's elevation model. When heights are fixed, variations in the Google global elevation model do not affect the visibility of your model.
Check the box **[Clamp to ground]** to make the height of exported points and lines follow the geoid model in Google Earth as if they were draping the surfaces in Google Earth. If you choose *not* to check this box, all or parts of the exported data may fall below the geoid model in Google Earth, and thus these lines and points will be hidden by the surface of Google Earth.
Whatever the settings, point heights will always be stored in the exported files.

If you have Google Earth installed on your computer, the program will automatically switch to Google Earth and display your model there.

See also Save view as 45 to export a graphical view to Google Earth™ format.

See also: Import 372, Transfer Dialog, in General 376, Save view as 45

7.13 KF85

This function converts data to and from KF85 format. Select ***Import/Export | KF85*** to open the transfer dialog[376].

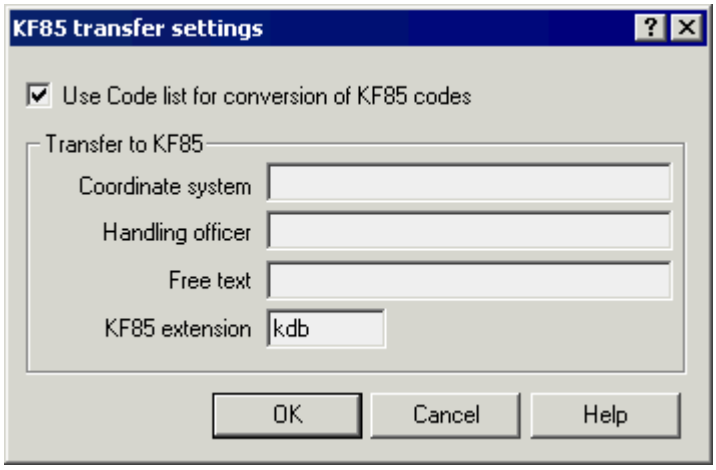
Convertible File Formats

iCON office:
Coordinate Files: (geo, pxy)
Line files: (lin)

KF85:
KF85 files: (*)

A coordinate file (geo) is always created when importing. When exporting, you can select coordinate and line files (i.e., geo, pxy and lin).

When importing into iCON office, the point number is initially loaded from the name of the point. If this does not exist, the Internal point number (index) in the KF85 file is used instead.



Settings

- **Use Code List:**
  Check this box if you want to convert to and from the KF85 code. The code list gives you the option of setting the corresponding KF85 code for each code. When exporting files, this means that the code of the points is checked against the active code list, and then the value of each code for KF85 is loaded and entered in the file. When importing, the codes in the active code list are loaded to find the KF85 code, and if a code is found, it is used. If the corresponding code is not found when transferring from KF85, the code will be copied as it is. Note that the point code is only eight characters long in iCON office format, which means that the KF85-code does not fit and the last position disappears.
  If you are not using the code list, the codes are transferred directly without conversion.

- **Coordinate System:**
  Specify any name or designation for the coordinate system that applies to data in the files when transferring to KF85.

- **Handling Officer:**
  Here you specify the person who creates the file when transferring to KF85.

- **Free Text:**
  Enter a description, if necessary, for the transfer to KF85.

- **KF85 file type:**

When exporting to KF85 this file type is set. The default type is kdb (map data bank).

Error Messages

- **Cannot import the KF85 file:**
  Make sure there is enough disk space and the destination file is not write-protected. There may also be a problem with the file, either a purely structural error or that it has been damaged in some way so that parts of it are missing.
- **One or more line points could not be found in the KF85 file. (import):**
  This means that it is not possible to connect certain lines to points, probably because they have been connected in a way that iCON office does not recognize. Check with the provider of the file if there is any way of processing the lines in a different way. It is only the line points that are not found that are not included in the transfer, all other information is handled normally.
- **Cannot export the KF85 file:**
  Make sure there is enough disk space and the destination file is not write-protected.

See also: Import and Export in General, Transfer Dialog 376

7.14 Kartbas

This function converts data to Kartbas format. Select ***Import/Export | Kartbas*** to open the transfer dialog[376]
.

Convertible File Formats

iCON office:
Coordinate Files: (geo, pxy)

Kartbas:
Kartbas files: (xyz)

Settings

No special settings can be made for this function.

See also: Import and Export in General, Transfer Dialog[376]

7.15 KOF

This function converts data to and from KOF. Select ***Import/Export | KOF*** to open the transfer dialog 376 .

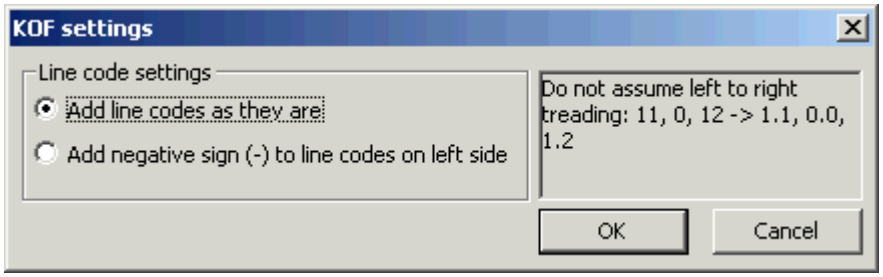
Convertible File Formats

iCON office:
Coordinate Files: (geo, pxy)
Survey files: (plm)

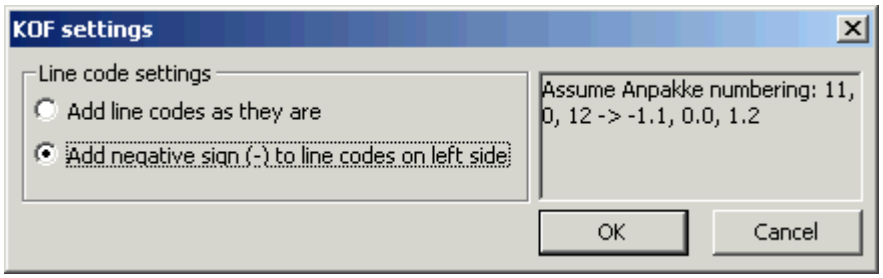
KOF:
KOF-files: (kof)

Settings

The settings for KOF import/export only affect line code handling; if it should be Anpakke numbering or not. For Anpakke coding the lines that run from left to right apply. For example: Three lines coded 11, 0 and 12 become -1.1, 0.0 and 1.2 with Anpakke numbering, where -1.1 is the roadway line on the left side, 0.0 corresponds to the set out line and 1.2 is the roadway line on the right side.



If conversion is not used, the lines will have the same code as before.



With line conversion, the results comply with AnPakke numbering.

See also: Import and Export in General, Transfer Dialog 376

7.16 Kordab

This function converts data to and from Kordab. Select ***Import/Export | Kordab*** to open the transfer dialog 376.

Convertible File Formats

iCON office:
Coordinate Files: (geo, pxy)
Line files: (lin)
Profile files: (prf)

Kordab:
Coordinate Files: (0, 242, 243)
Line files: (41)
Profile files: (51)

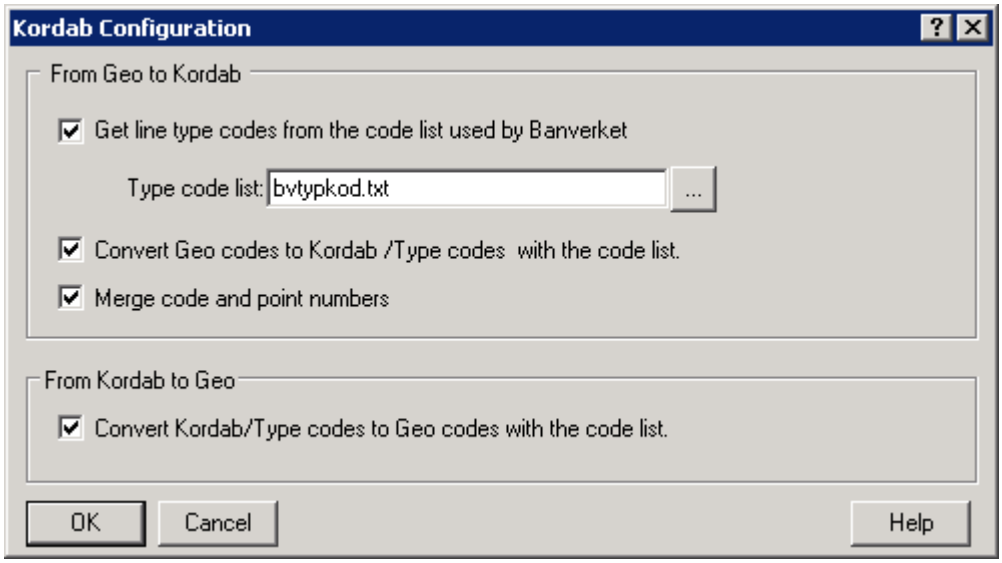
From Kordab

When loading from Kordab, .0,. Krd, .242 and .243 files are converted to coordinate files, geo. .41 are loaded as line files and .51 as profile lines. It is possible to combine .242 and .243 files. iCON office asks if this is to be done if there are files with the same name but with different extensions.

To Kordab

When exporting to Kordab, coordinates such as .242 or .243 are exported, lines such as .41 and profiles such as .51. Single points in a coordinate file end up in a .243 file (detail points) and lines in a coordinate file end up in a .242 file (traverse lines).

Settings:



- **Convert iCON office codes to Kordab/Type codes with the code list:**
  If this option is checked, it means that the program loads the iCON office code from the code field of the coordinate file and matches this against the active code list 203. From the code list, the contents are loaded from the field for type code.

- **Download Banverket's (Swedish Rail Administration) line type codes from their type code list:**
  If the line codes from Banverket's line type code list is to be transferred, select this option. The line

type code is loaded from the file that you select from the stored "Type code lists". The selectable type code lists must be saved in the global folder. The point type code, which is used to find the line type code, must either be directly in the coordinate file's code field or if the option above is used, the point type code is loaded from the code list's field for the Kordab code. This option only applies to .242 files. Please note: BVTYPKOD.TXT is simply an example file that comes with the program, it might not be up to date. The user can edit BVTYPKOD.TXT, whereby the file should also be saved with a **new name**. When updating iCON office, BVTYPKOD.TXT is updated with SBG AB's version of the file.

- **Merge code and point number**
  This option means that the code and point number are merged.
- **Convert Kordab/Type codes to iCON office codes through the code list:**
  If this option is checked , it means that the program loads the type code and matches it against the contents in the column for the type code in the active code list[203]. The corresponding iCON office code is then set in the coordinate file. If the type code is not in the code list, it will be listed in the Communications tab in the output window[107] .

Tip: It is possible to replace the codes in the coordinate file directly by running the function for translating the codes between the different systems. This is an alternative to using the code list field for the Kordab code. The easiest way is to vary from time to time.

See also: Import and Export in General, Transfer Dialog[376]

7.17 LandXML

LandXML

LandXML is a data format used by, among others, Autodesk, Bentley, Leica and ViaNova. The format is intended for the exchange of data between applications.

- LandXML files can include, for example, coordinates, terrain models, lines and profiles.

LandXML RR (RoadRunner) Stringlines, sometimes abbreviated to LandXML Stringlines, is a supplement to LandXML, used by eg Visual Machine, NovaPoint, Gemeni and Leica.

- LandXML Stringlines files contain longitudinal lines using codes that describe surfaces.

LandXML-files in iCON office:

- In the graphical view, the appearance of the LandXML file is displayed. You can zoom and rotate the file.
- In the workflow view, information about the LandXML file is displayed. This information is primarily used at importation 403 into iCON office.

Convertible file formats: LandXML format to iCON office format

iCON office can import the following file formats from LandXML files.

LandXML and LandXML RR Stringlines:
XML files (xml)

iCON office:
Coordinate files (geo, pxy)
Line files (l3d)
Terrain models (trm)
Volume descriptions (mbs)
Stringline models (lmd)
Cross sections (sec)

Note that a LandXML file can contain multiple elements of the same kind. Thus, an imported LandXML file can be saved as multiple files in iCON office; such as several line files (l3d) and several coordinate files (geo).

Import LandXML files to iCON office

To import data from LandXML files, there are two alternative ways:

- Use the workflow view. See Import xml file with Workflow View 405.
  - Open the LandXML file in iCON office and use the workflow view to import data.
  - In the graphical view the LandXML file is visible, and in the workflow view the import options are displayed: In this way, the user gets information about the xml file even before the import has begun.
  - Only one file at a time can be imported.

- Select ***File | Import/Export | LandXML*** 410.
  - One or several files can be imported at the same time.
  - The name of the xml file is displayed, the user doesn't get any information about the content of the file.

Convertible file formats:

iCON office can export the following file formats to LandXML format 421.

iCON office format to LandXML format	**iCON office:** Coordinate files (geo, pxy) Line files (lin) Profiles (prf) Terrain models (trm) Volume descriptions (mbs) **LandXML:** XML files (xml)
Export iCON office files to LandXML format	At exportation, the user selects • ***File* | *Import/Export* | *LandXML***, see Export to LandXML format421 .

See also: Transfer Dialog, in General 376 , Import xml file with Workflow View 405 , Importing LandXML files using the menu 410 , Export to LandXML format 421

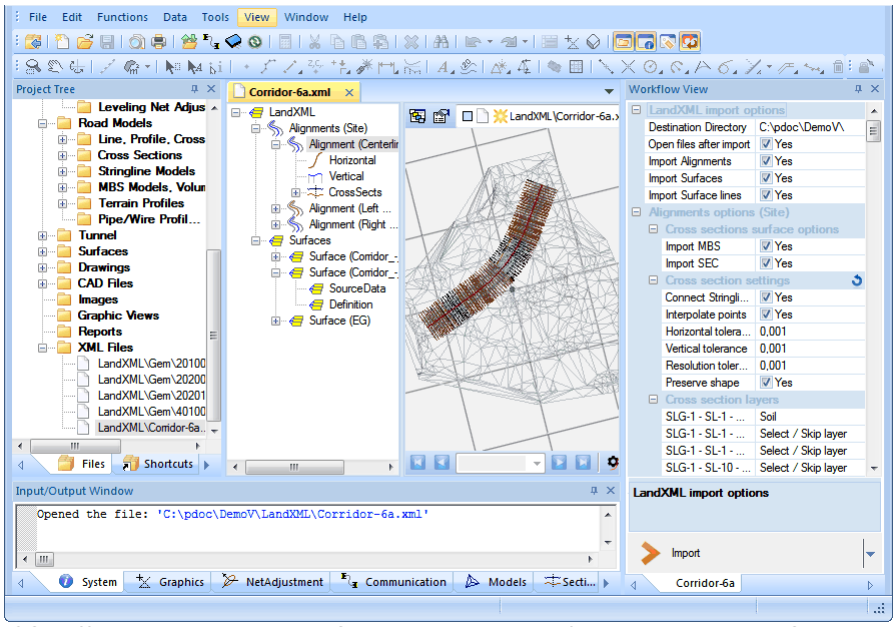
7.17.1 Import xml file with Workflow View

Import alternative

This text describes the import of LandXML files, by the use of the **Workflow View**.

Open a LandXML file in iCON office:

- The appearance of the file is displayed in the graphical view.
- In the Workflow View, the LandXML tree is displayed. Use it to:
  - Click a node in the tree to highlight the corresponding object in the graphics.
  - Change the import options for the file.
  - Click **[Import]** to import data into iCON office-format.



iCON office with Project Tree, Graphical View, Workflow view and Input/Output Window

An alternative import procedure is described in Importing LandXML files using the menu 410.

Convertible file formats: LandXML format to iCON office format

iCON office can import the following file formats from LandXML files.

LandXML and LandXML RR Stringlines:
XML files (xml)

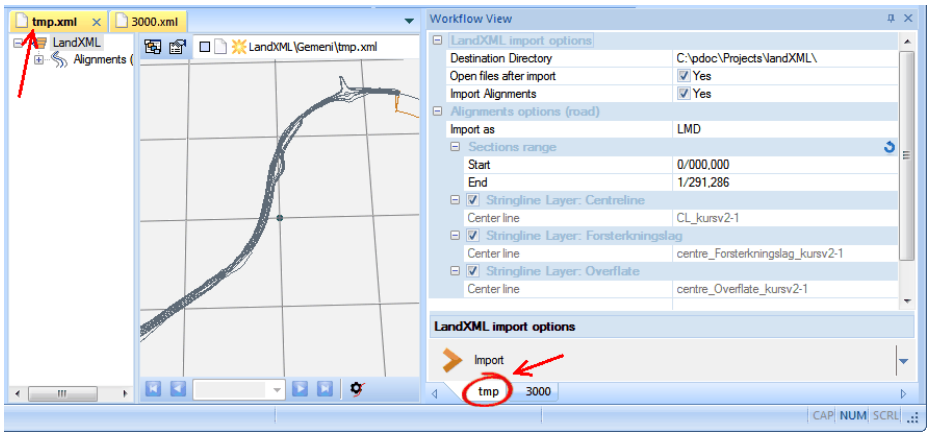
iCON office:
Coordinate files (geo, pxy)
Line files (l3d)
Terrain models (trm)
Volume descriptions (mbs)
Stringline models (lmd)
Cross sections (sec)

Graphical view

In the graphical view, the user can select one or several object. Choose the tool Select Object and select objects in the graphics.

Workflow view

Information about the active file is displayed in the workflow view. The appearance of the workflow view varies depending on the contents of the active LandXML file.
If you have opened several LandXML files in the graphical view, switch to the correct workflow view by using the tabs at the bottom edge of the workflow view.



Graphical view and workflow view.
Select appropriate workflow view.

LandXML import options

- **Destination Directory**

  The specified path shows where the imported files are saved.
  Change the path if necessary.

- **Open files after import**

  Check the box if imported files should be opened in iCON office after import.

- **Import Alignments**

  Check the box to import alignments as lines (lin) and profiles (prf).
  Disable the import if no lines or profiles should be saved.

  Depending on the LandXML file contents, one or several line files are created. If the line contains a length table (railways and some high ways) the line will be cut into sections. Thus may for example imported lines consist of many short elements, as one road line can be divided into several (lin)-files.
  Just like several line files can originate from one line, a profile can also be cut into several files.

- **Import points and lines**

  Check the box if imported points and lines should be saved in a coordinate file (geo).
  Disable the import if no coordinate files should be saved.

- **Import Surfaces**

  Check the box to import surfaces as terrain models (trm).
  Disable the import if no terrain models

should be saved.

- **Import Surface lines**

  Check the box if imported break lines, contours and boundaries should be saved in coordinate files (geo).
  Disable the import if no surface lines should be saved.

- **Import PipeNetworks**

  Check the box to import pipes as coordinate files (geo).
  Disable the import if no pipes should be saved.
  Importing pipes creates two coordinate files (geo); one will contain lines representing pipes, and the other will include structure types such as wells and valves etc.
  For more information about the import, see Importing LandXML files using the menu 413.

Alignments options

- **Import as**

  Use the dropdown menu to choose between the import options Stringline Model, LMD 541 , or Volume description, MBS 689 .

  - **Sections range**

    Here you can change the line's start and end sections. Press to reset the default parameter values.
    After import, the calculation interval can be changed in the usual manner in the stringline model or in the volume description.

  - **Stringline Layer**

    A LandXML file can include several layers, and each layer consists of lines describing the surface. All layers together with associated center lines are displayed here.
    Check the layers for which you want to create a volume description (mbs) or a stringline model (lmd).

    For each layer there is an associated center line. If the LandXML file lacks information about the associated center line, the user can use the dropdown menu to select center line.

    For each selected layer in the LandXML file, a volume description (mbs) or a stringline model (lmd) is created. Note, iCON office can not create one single volume description or stringline model where all layers are included.
    The imported volume descriptions /

	stringline models are named as follows: xml file name_center line name_stringline layer's name.mbs/lmd.
• **Cross sections surface options**	
○ **Import SEC**	Check the box to import cross sections as cross sections files (sec). Disable the import if no cross sections should be saved.
• **Cross section settings**	
○ **Connect Stringlines**	If the LandXML file contains cross sections with codes, these codes can be used to connect points to lines. Check the box to connect points with the same code to longitudinal lines between cross sections. These lines will be saved in coordinate files (geo).
○ **Interpolate points**	Check the box to interpolate additional points on the stringlines. These points will be used to create curve structures along the side lines with respect to the specified tolerance (both in plane and elevation).
○ **Horizontal / Vertical tolerance**	Points and lines within the specified tolerances are considered belonging to the same line, when interpolating new points.
○ **Resolution tolerance**	Original points and lines locations are considered to be the same below this tolerance. The resolution tolerance affects the interpretation of the geometry and should be slightly larger than the smallest structures that are of importance.
○ **Preserve shape**	Check the box to preserve the shape of straight cross sections. Original points, located on straight lines in the cross sections, get interpolated height to maintain the straight shapes in cross sections.
• **Cross section layers**	Select a description for the cross section layers in the LandXML file that should be imported. Use the dropdown menu to choose between the predefined layers: Common, Soil, Rock, Theoretic, Excavation, User 1, User 2, Top Soil, Polygon and Extra. If you do not want to import a layer, choose **Select / Skip layer**.

[Import]	Click **[Import]**, at the bottom of the workflow view, to import the LandXML file according to the settings.
[Import selection]	Right click the **[Import]** button to get the option **[Import selection]**. **[Import selection]** is enabled only if one or several objects are selected in the graphical view. Click **[Import selection]** to import only selected objects, according to the settings in the workflow view.

See also: Transfer Dialog, in General 376 , Importing LandXML files using the menu 410

7.17.2 Importing LandXML files using the menu

Import alternative

This text describes the import of LandXML files, by selecting ***File | Import/ Export | LandXML***.

An alternative import procedure is described in Import xml file with Workflow View 405.

Convertible file formats: LandXML format to iCON office format

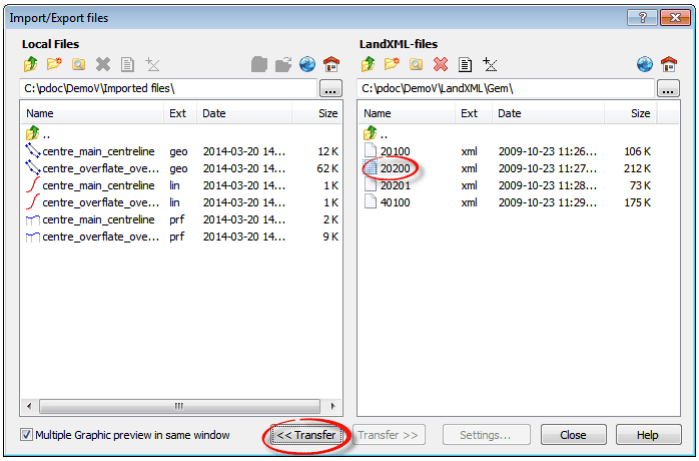
iCON office can import the following file formats from LandXML files.

LandXML and LandXML RR Stringlines:
XML files (xml)

iCON office:
Coordinate files (geo, pxy)
Line files (l3d)
Terrain models (trm)
Volume descriptions (mbs)
Stringline models (lmd)
Cross sections (sec)

Approach

- Select ***File | Import/Export | LandXML*** or click and select ***LandXML*** to open the transfer dialog 376.
- Select one or several LandXML files.
  The LandXML files are shown to the right in the transfer dialog.



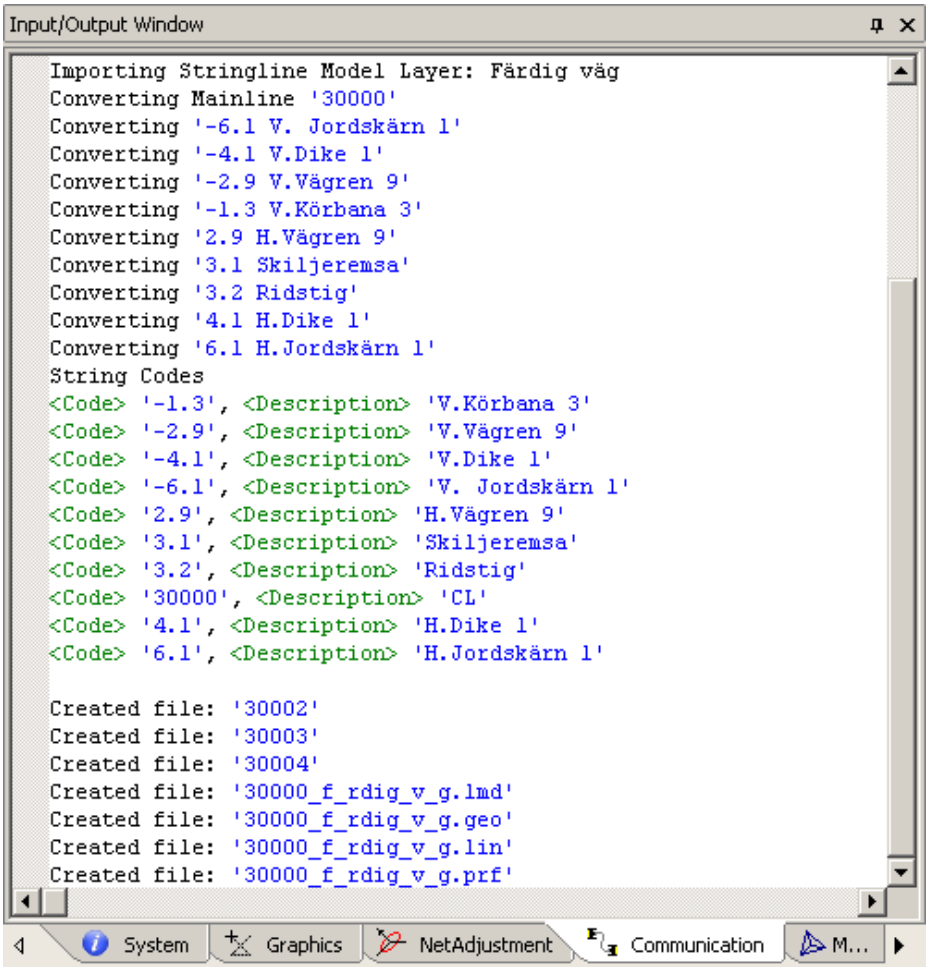
Transfer dialog

- Click **[<< Transfer]**, to import selected files.
- Depending on the contents of the Land XML file(s), dialogs can open where the user may do various settings, see the table below 410.

Information in the Input/ Output Window

The Input/Output Window 107 display information about the importation, for example names of created files and code descriptions.

If any problems occur during the importation, they will be described in the Input/ Output Window. Example of messages might be that imports discontinued for some reason, or some expected data was missing.



Examples of information that can appear in the Input/Output Window when importing.

LandXML format and iCON office format

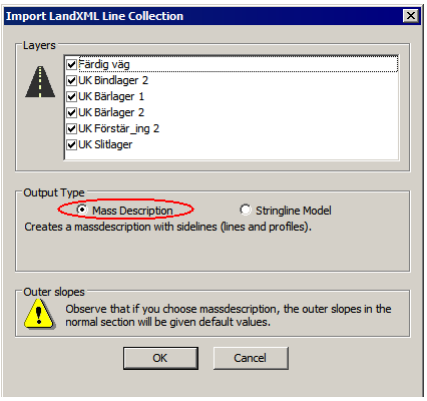
The LandXML format consists of information which is divided into one or several main groups and sometimes even in sub groups, see examples in the table below.

LandXML format		iCON office format
Main group	*Sub group*	
PlanFeatures		coordinate files (geo) 412
CgPoints		coordinate files (geo) 412
Alignments		
	Alignment	lines (lin) 412
	Profile	profiles (prf) 412
	CrossSect	cross section files (sec) and stringline mo 412
	DesignCrossSectSurf	standard sections (nsd) 412
	RR Stringlines	volume description (mbs) or stringline mo 412
Surfaces		
	Surface	terrain model (trm) 413
	Breaklines	coordinate files (geo) 413
PipeNetworks		coordinate files (geo) 413

The above table displays examples of groups with information that might be include LandXML files.
The right column of the table displays the corresponding iCON office format, after im

When importing LandXML files, all information is converted into appropriate file formats that can be used by iCON office. The content of the LandXML file controls the appearance of the imported files in iCON office. See below.

Import <PlanFeatures> and <CgPoints> to (geo)	When importing LandXML <PlanFeatures> or <CgPoints> the files are saved as coordinate files (geo) by iCON office.
Import <Alignment> to (lin)	When importing LandXML <Alignments> <Alignment> the files are saved as lines (lin) by iCON office. Depending on the LandXML file contents, one or several line files are created. If the line contains a length table (railways and some high ways) the line will be cut into sections. Thus may for example imported lines consist of many short elements, as one road line can be divided into several (lin)-files.
Import <Profile> to (prf)	When importing LandXML <Alignments> <Profile> the files will be saved as profiles (prf) by iCON office. Just like several line files can originate from one line, a profile can also be cut into several files.
Import <CrossSect> to (sec)	When importing LandXML <Alignments> <CrossSect> iCON office the files are saved as cross section files (sec) by iCON office. If the LandXML file contains encoded cross sections, a stringline model (lmd) can be imported. For information about the import, see Import LandXML <CrossSect> to iCON office (sec) 414 .
Import <DesignCrossSectSurf> to (nsd)	When importing LandXML <Alignments> <DesignCrossSectSurf> the files are saved as standard sections (nsd) by iCON office. If the LandXML file contains relative height and lateral dimensions, iCON office will create standard sections with direction type dZdY (for example imported files from NovaPoint). • Note, imported standard sections can also originate from LandXML <Alignments> <RR Stringlines>-files. These standard sections will always get the direction type "Unknown" and stop against a specified line with its associated profile. See Import LandXML <RR Stringlines> to iCON office (mbs) or (lmd) 418 .
Import <RR Stringlines> to (mbs) or (lmd)	When importing LandXML <Alignments> <RR Stringlines> the files are saved as either volume descriptions (mbs) 418 or stringline models (lmd) 419 . The user is asked to specify the type of output, see Import LandXML <RR Stringlines> to iCON office (mbs) or (lmd) 417 .



Import <Surface> and <Breaklines> to (trm) and (geo)

When importing LandXML <Surfaces> <Surface> and <Breaklines>, terrain models (trm) respectively coordinate files (geo) are created by iCON office.

A terrain model (trm) is a model created by triangles. Please note that any <Breaklines> are saved as coordinate files (geo) by iCON office, which imply that they will not be included in the terrain model.
Check the terrain model in iCON office after the import. If necessary, the editing tools[653] can be used to edit the terrain model.

Import <PipeNetworks> to (geo)

LandXML files including <PipeNetworks> contain pipes.
When importing LandXML <PipeNetworks> the files are saved into two coordinate files (geo) for each type of pipe. One of the coordinate files will include pipes and the other one will include wells or valves.

If you for example import a PipeNetwork file including pipes for wastewater and surface water, four coordinate files will be created:
Wastewater_pipes.geo, Wastewater_structs.geo and also Surface water_pipes.geo and Surface water_structs.geo
The files XXX_pipes.geo include lines representing the pipes.
The files XXX_structs.geo include structure types such as wells and valves etc.

The following attributes can be stored in the coordinate files:

- Pipe diameter
- Pipe height
- Pipe length
- Pipe material
- Pipe type
- Pipe slope
- Pipe structure type
- Pipe wall thickness

See also: Transfer Dialog, in General[376], Coordinate Files, Geo and Pxy in General[153], Import xml file with Workflow View[405]

7.17.2.1 Import LandXML <CrossSect> to iCON office (sec)

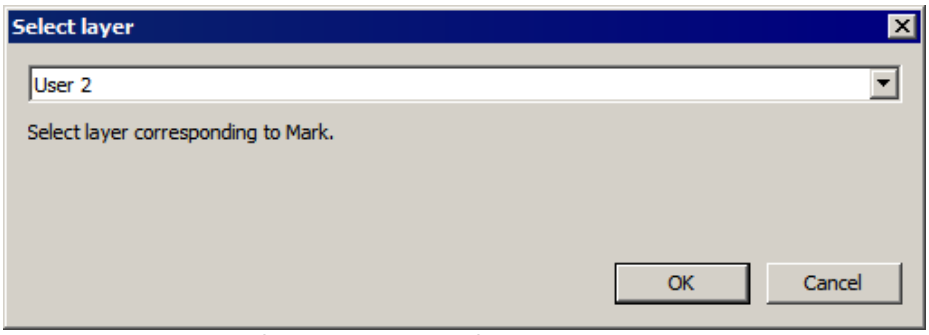
Import to iCON office format Cross Section (sec)

When importing LandXML <Alignments> <CrossSect> to iCON office, the files are saved as cross section files (sec).

Each layer in the LandXML-file is saved as one layer in the cross section file (sec).

Dialog; Select layer

When you import a LandXML file containing <Alignments> <CrossSect> a dialog is opened when you press **[Transfer]** in the transfer dialog 410. Select one iCON office layer for each LandXML layer.

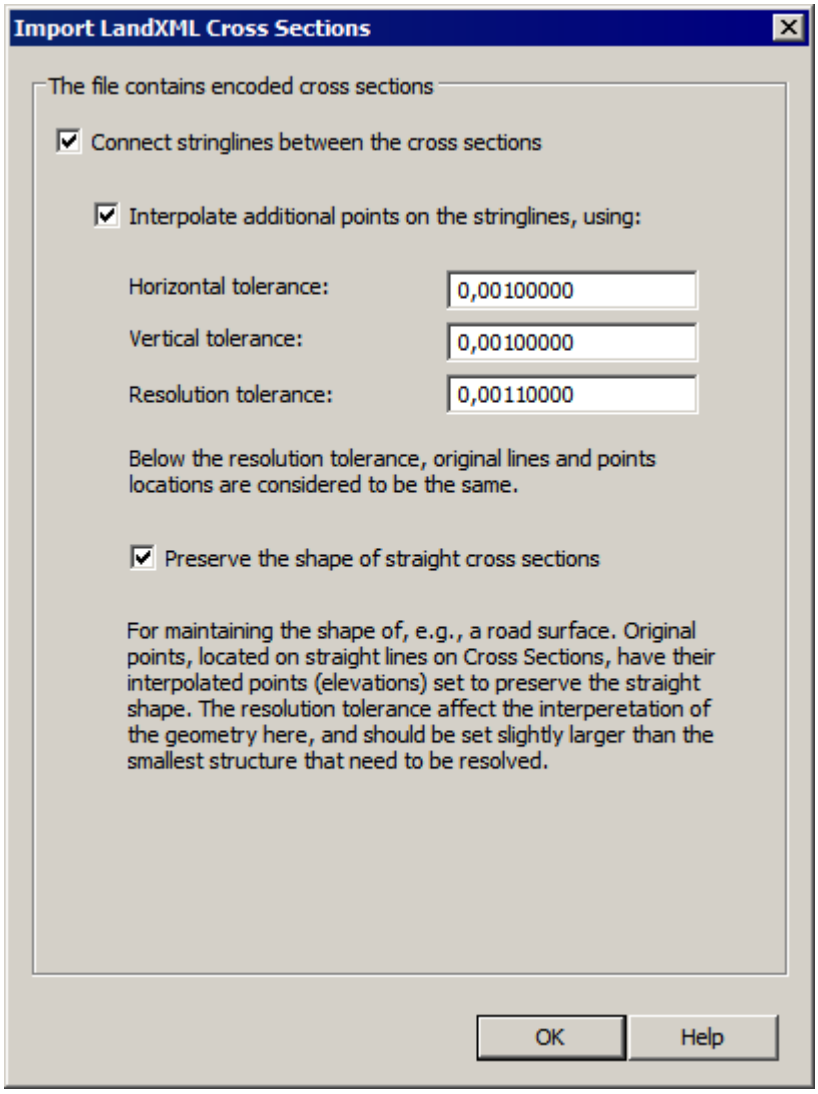


In the numerical view of the cross section file (sec) that is about to be created, the description 'Mark' will describe layer 'User 2'.

- Use the dropdown menu to choose between the predefined layers: Common, Soil, Rock, Theoretic, Excavation, User 1, User 2, Top Soil, Polygon and Extra.

Import to iCON office format Stringline Model (lmd)

If the LandXML file contains encoded cross sections, these codes can be used to connect points to lines.
A dialog will open.



- **Connect stringlines between the cross sections**
  Check the box to connect points with the same code to longitudinal lines between the cross sections.
  These lines will be saved in a coordinate file (geo).
  If you do not check the box, no coordinate files will be created.
- **Interpolate additional points on the stringlines, using:**
  - **Horizontal and Vertical tolerance:**
    Check the box to interpolate additional points that are used to create curves along the side lines, with respect to the specified tolerance (both in plane and height). Points and lines within the specified tolerances are considered belonging to the same line.
  - **Resolution tolerance:**
    If the new interpolated points are within the specified tolerance, ie very close together, these points will not be stored in the coordinate file. Original points and lines locations are considered to be the same below this tolerance.
    The resolution tolerance affects the interpretation of the geometry and should be slightly larger than the smallest structures that are of importance.
  - **Preserve the shape of straight cross sections**
    Check the box to preserve the shape of cross sections and interpolated points.

Along with the center line, these coordinate files with lines will create a stringline model (lmd).

See also: LandXML 410, Import xml file with Workflow View 405

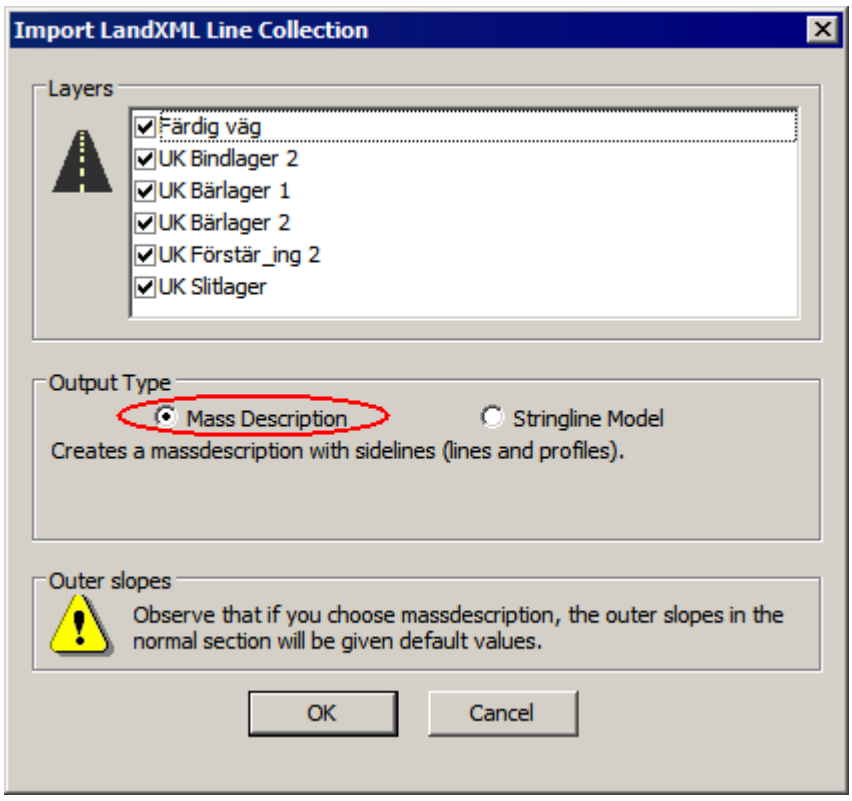
7.17.2.2 Import LandXML <RR Stringlines> to iCON office (mbs) or (lmd)

Import to iCON office format (mbs) or (lmd)

When importing a LandXML file containing <Alignments> <RR Stringlines>, imported files can be saved as volume descriptions[418] (mbs) or stringline model[419] (lmd).

Import alternative

When importing a LandXML file that can be saved as volume descriptions (mbs) or as a stringline model (lmd), a dialog opens when you click the button **[Transfer]** in the transfer dialog[410] .



- **Layer**

A LandXML file can include several layers, and each layer consists of lines describing the surface. All layers together with associated center lines are displayed here.
Check the layers for which you want to create a volume calculation (mbs) or a stringline model (lmd).

For each layer there is an associated center line. If the LandXML file lacks information about the associated center line, the user can use the drop down list to select center line.

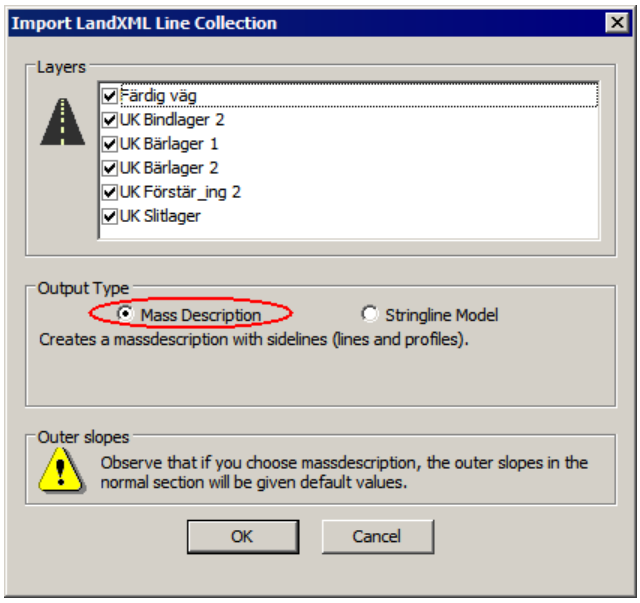
For each selected layer in the LandXML file, a volume calculation (mbs) or a stringline model (lmd) is created. Note, iCON office can not create one single volume calculation or stringline model where all layers are included.
The imported volume calculations / stringline models are named as follows: xml file name_center line name_stringline layer's name.mbs/lmd.

- **Output Type**
  Choose between the import options volume description[418] (mbs) or stringline

model[419] (lmd).

(mbs) **Output Type - Volume Description (mbs)**

Select **[Volume Description, (mbs)]**, and click **[OK]** to start the import.

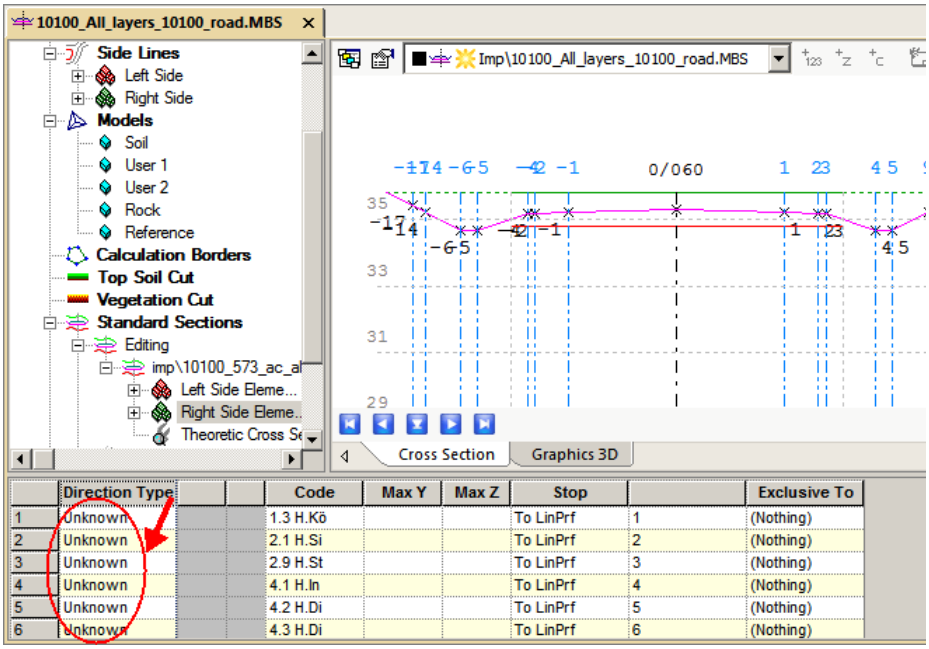


Each volume description file, imported from LandXML, consists of:

- a center line with an associated profile
- possibly also side lines with associated profiles
- standard sections (nsd)
  The imported standard sections are encoded using the information in the La file. These standard sections always get the direction type "Unknown" and s against a specified line with its associated profile.

  - Note: Imported standard sections (nsd) can also originate from LandXML f containing <Alignments> <DesignCrossSectSurf>. If the LandXML file cor relative height and lateral dimensions, iCON office will create standard sec with direction type dZdY (for example files imported from NovaPoint).
    For further information on imported standard sections, see Importing Land files using the menu[412].

For each selected layer in the LandXML file, one volume description file (mbs) wi created, at importation.



Example of a volume description (mbs), imported from a LandXML Stringlines file. Note the direction type "Unknown" in the standard section.

For additional information about volume descriptions (mbs) in iCON office see Vo description, MBS 689.

Note!

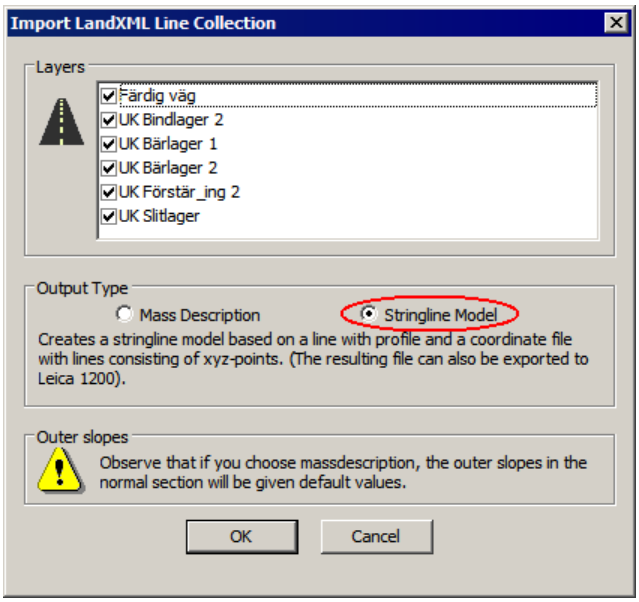
The following applies to all volume descriptions (mbs) imported from LandXML:

- A volume description that has been created from LandXML Stringlines never contains any cross slope file. Instead, the profile for each line gives the longitudinal slope.
- Outer slopes, in the standard sections (nsd), get default values.

(lmd)

Output Type - Stringline model (lmd)

Select **[Stringline model (lmd)]**, and click **[OK]** to start the import.



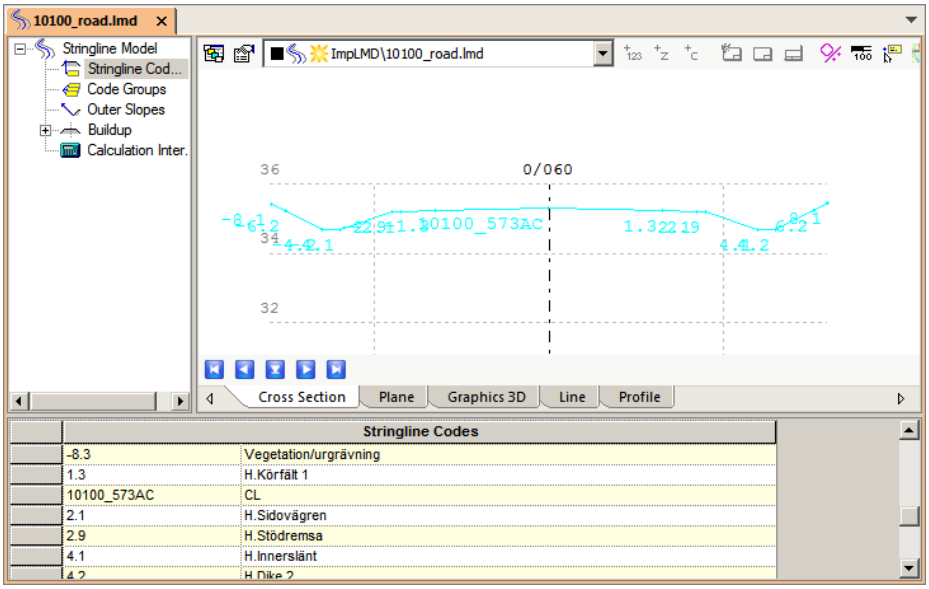
For each selected layer in the LandXML Stringlines file, one stringline model (lmd) will be created, at importation.
Thus, the number of selected layers determines the number of lines, profiles and coordinate files to be created.

Each stringline model, imported from LandXML, consists of:

- a center line with an associated profile
- a coordinate file
  This imported coordinate file can be exported to Leica 1200 as a stringline model.

Note, the stringline model uses the profile for longitudinal slope (required by some machines). All other heights in the stringline model are controlled by each layer's coordinate file.

For additional information about stringline models in iCON office see Stringline models, LMD 541 .



Example of a stringline model after import from a LandXML Stringlines file.

See also: LandXML 410 , Importing LandXML files using the menu 410

7.17.3 Export to LandXML format

Export from iCON office format to LandXML format

To export files from iCON office select

- ***File | Import/Export | LandXML***

-

Convertible file formats: iCON office format to LandXML format

iCON office can export the following file formats to LandXML format.

iCON office:
Coordinate files (geo, pxy)
Line files (l3d)
Line files (lin)
Profiles (prf)
Terrain models (trm)
Stringline Models (lmd)

LandXML:
XML files (xml)

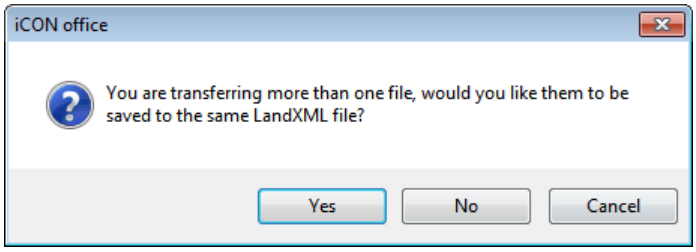
Approach

Save exported iCON office files as one or several LandXML files

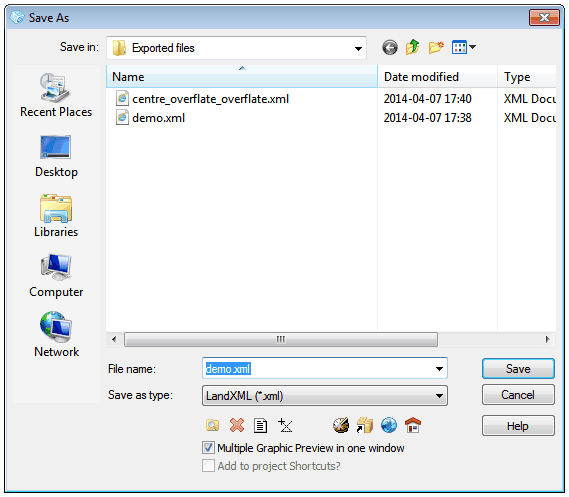
- Select ***File | Import/Export | LandXML***, or click the icon .
- Select the file or files to be exported.
  - Note, if a file is open in the graphical or numerical view, it is only the active file that will be visible under ***Local files*** in the transfer dialog 376. Click the icon to make all selectable files visible under **Local Files**.
    Alternatively; close all open files in the project, before you open the transfer dialog 376.

- If a file associates to other files, the associated files are transferred automatically.

- If you select multiple files, or if one file associates to other files, a dialog will open asking you to confirm if data should be saved into one single LandXML file.



  - **Click the button [Yes] to export data to one file**
    All selected files will be exported to one single LandXML file.
    A dialog opens where you can give the LandXML file a name and choose where to save it.

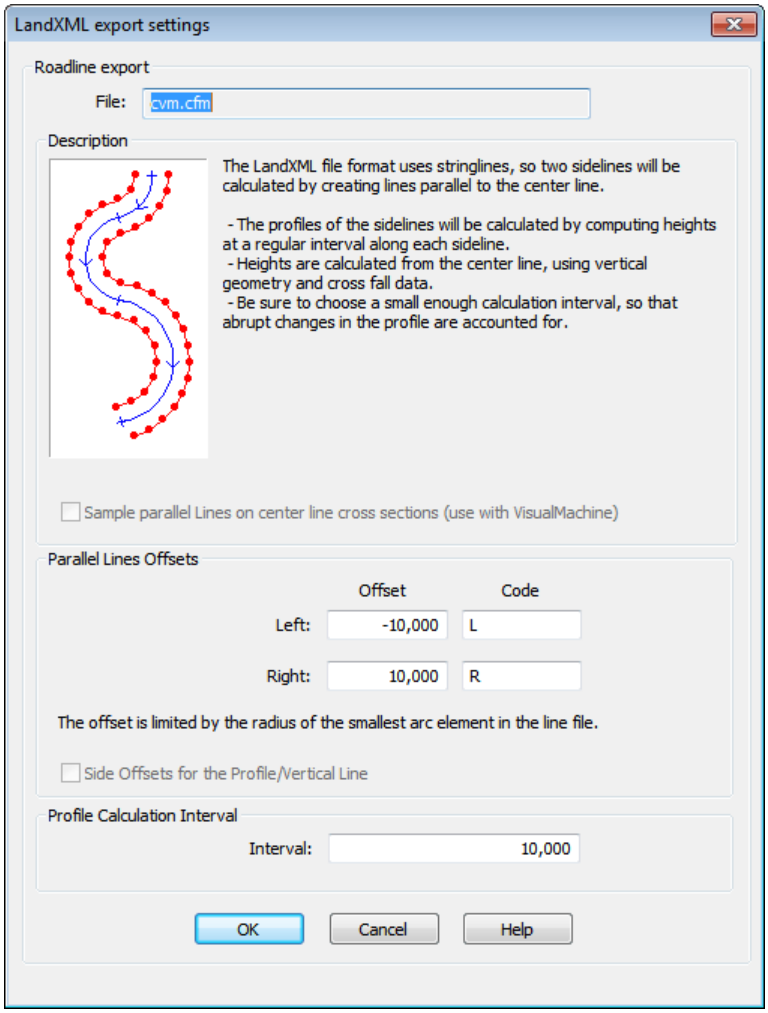


- **Click the button [No] to export each file individually**
  This option means that each file is transferred separately.
  The LandXML files will get the same names as the original files, but with the file extension xml.

- The Input/Output Window 107 displays information about the transfer.

Export a cross fall model, cfm

- Select ***File | Import/Export | LandXML*** to export a cross fall model, cfm, which associates to a line file, l3d 503, including horizontal and vertical geometry.
- As the LandXML file format uses stringlines, the exported information will be stored as parallel lines to the center line.



Export a cross fall model.

Parallel Lines Offset

Suggested side offsets are limited by the radius of the smallest arc element in the line file.

- Enter **offset** and **code** for left and right side lines.
  The function calculates points with the specified offsets for left and right side.
  - Enter negative values for the left side and positive for the right side of the center line.
  - Enter offsets with the same signs to calculate points on the same side of the center line.
  - Note, the left and right codes need to be different from each other.

Side Offsets for the Profile/Vertical Line

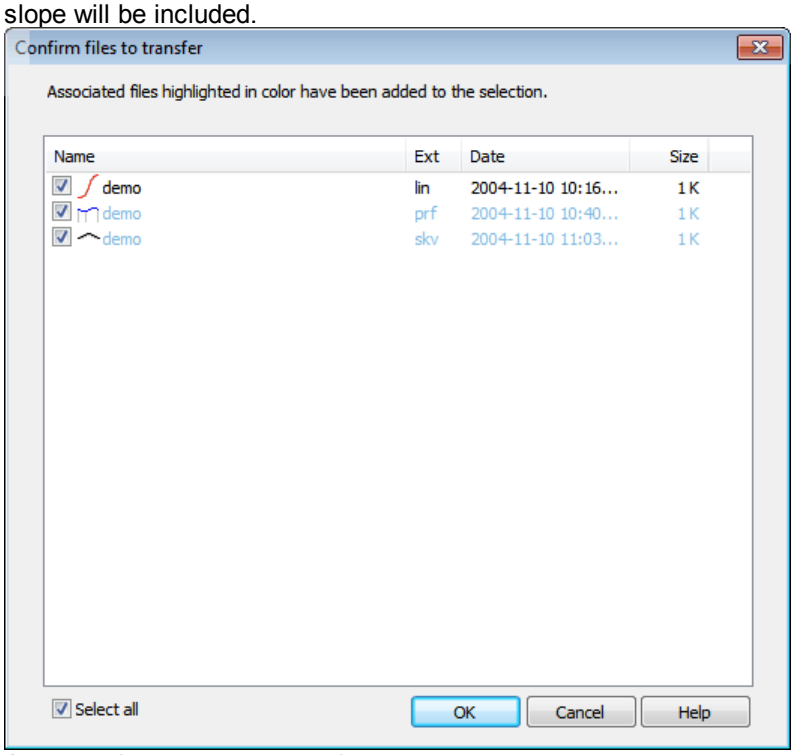
- Check the box to consider offsets in the profile document.
  - A displaced profile implies that you have used offsets to move out the line's vertical geometry (profile) and the rotation point of the cross slope from the center line, see Cross Fall Model, cfm 537.
  - If you have a displaced profile, some other values than zero for left and right offsets, have been used in the profile document.

Profile Calculation Interval

Choose to use a small enough profile interval, so that abrupt changes in the profile are accounted for.

Export a line file in the older line format .lin, with associated files

When exporting a line file in the older line format .lin, with associated profile and cross slope, using ***File | Import/Export | LandXML*** the LandXML file will only contain information from the line and the profile, **no** information from the cross slope will be included.



Older line file with associated files. Please note, the cross slope, skv, will not be exported.

See Export a cross fall model, cfm 422 for information about exportation of a cross fall model which associates to a roadline file, l3d.

See also: Transfer Dialog, in General 376, LandXML 403, Importing LandXML files using the menu 410

7.17.4 Code in LandXML files

The following text provides basic description of how LandXML files can be constructed.

Name files on import to iCON office

When you import LandXML files, the files will be named in the way the corresponding elements in the LandXML file are arranged hierarchically. For example, if a LandXML file called ***models.xml*** contains the following element hierarchy:

```
<LandXML...>
  <Surfaces name="Large>
    <Surface name="surface">
      <Definition surfType="TIN">
        <Pnts>...</Pnts>
        <Faces>...</Faces>
      </Definition>
    </Surface>
  </Surfaces>
</LandXML>
```

the result will then be a terrain model called ***models_Large_surface.trm***. Note that a LandXML file may contain several elements of the same kind. This means that multiple files can be created.

Elements

- **IrregularLine**
  As elements of this type are found in ***CoordGeom*** in ***Alignment***, a line file is generated for each individual occurrence. For example, if a LandXML file called ***soccer.xml*** contains the following element hierarchy:

  ```
  <LandXML ...>
    <Alignments>
      <Alignment name="left">
        <CoordGeom>
          <IrregularLine>...</IrregularLine>
          <IrregularLine>...</IrregularLine>
        </CoordGeom>
      </Alignment>
    </Alignments>
  </LandXML>
  ```

  two line files will then be created: ***soccer_left.lin*** and ***soccer_left_2.lin***.

- **ProfAlign**
  Each occurrence of ***ProfAlign*** is handled in much the same way as ***IrregularLine***. A new profile is generated for each new ***ProfAlign***, in the same ***Profile***. For example, if a LandXML file called ***soccer.xml*** contains the following element hierarchy:

  ```
  <LandXML ...>
    <Alignments>
      <Alignment name="left">
        <Profile>
          <ProfAlign>...</ProfAlign>
          <ProfAlign>...</ProfAlign>
        </Profile>
      </Alignment>
    </Alignments>
  ```

```
</LandXML>
```

two profiles will then be created: ***soccer_left.prf*** and ***soccer_left_2.prf***.

- **ParaCurve**
  This element describes a parabola in a profile. These are not supported directly by the software so they are replaced when loading radii. This occurs when an error that is less than 1/10 mm at one-meter intervals evenly distributed over the sections where the parabola applies.

- **RR Stringline Layers**
  Leica has created an add-on for LandXML which is useful when describing the road models. For elements of the ***Alignments*** type there may be elements of the ***Feature***type. When an ***Alignments*** element contains definitions for the road model when importing, one or more volume descriptions689 is created. To clarify with an example: if the LandXML file contains the following element hierarchy:

```
<LandXML ...>
  <Alignments>
    <Alignment name="left">...</Alignment>
    <Alignment name="right">...</Alignment>
    <Alignment name="center">...</Alignment>
    <Feature code="RR Stringline Layers">
      <Feature code="RR Stringline Layer">
        <Property value="soccer" label="name" />
        <Property value="center" label="Centerline" /
    </Feature>
  </Alignments>
</LandXML>
```

  a volume description will then be created called ***soccer.mbs***. The side lines consist of ***left.lin*** and ***right.lin***. This way of describing the road models is used by, for example, Novapoint.

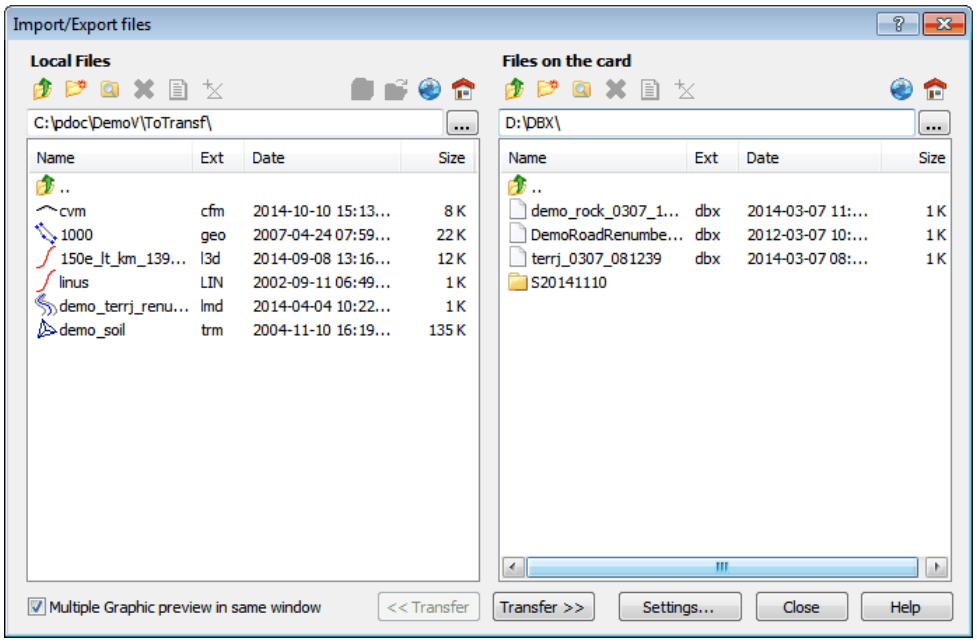
See also: LandXML 403

7.18 Leica

There are two ways of communicating with Leica instruments, either using the memory card (or USB stick) or directly with the instrument. The memory card uses the transfer dialog[376] and direct communications are made using the Communication Dialog[456].

Transfer to/from

This function converts data to and from Leica format. Select ***File | Import/Export | Leica DBX/GSI*** to open the transfer dialog[376]. To the left of the dialog you can see the files in the active project and to the right you see the files on the card.



DBX format is used for transferring files to or from Leica TPS/GPS 1200.
Convertible File Formats[427] from iCON office (see below) are first transferred to LandXML[410] -format with *.Net Framework*, after which the files are converted to DBX format, with the help of the add-on programs RoadRunnerAddOn and Printf PC-Engine.

GSI format is used for transferring files to or from older Leica Instruments.

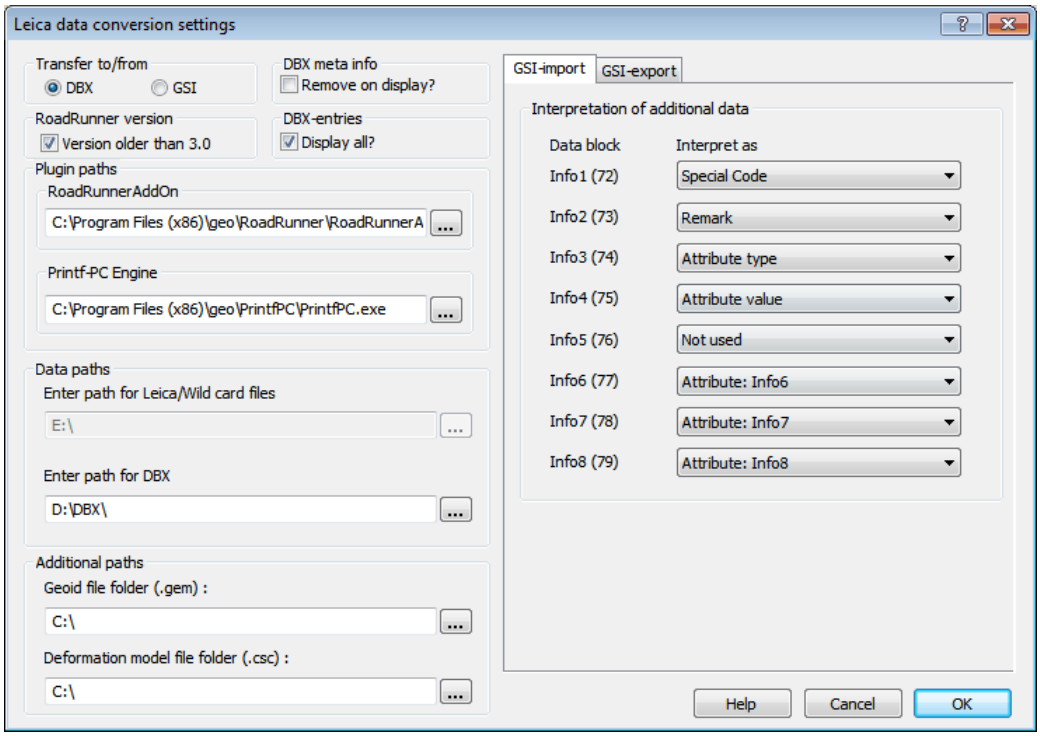
Convertible File Formats:

- **iCON office to/from GSI format:**
  Coordinate files: (geo, pxy)
  Measuring files: (plm)
  Terrain models: (trm)

- **iCON office to/from DBX format:**
  Coordinate files: (geo, pxy)
  Road line files: (l3d)
  Cross fall models (cfm)
  Terrain models: (trm)
  String line models: (lmd)
  Line files: (lin) (older format)

- **Leica:**
  Leica files: (gsi, gre, dbx)
  Reference file to a Leica job: (jbx)

Settings:
Click **[Settings]** in the transfer dialog[376] and select if the transfer is to happen with DBX format or GSI format.



- **Transfer to/from**
  Select if transfer applies to DBX or GSI format.

- **DBX meta info**
  Select if you want to add meta info as a suffix to the original name of the transferred file.
  If you do not check the box, the suffix will be displayed. For the file's original name, the suffix *_MMDD_HHMMSS* is added, that is month and day and also hour, minute and second that refer to the date and time on which the database was created.
  If you check the box, the suffix will not be displayed for the file that is transferred.

- **RoadRunner version**
  This box must be checked if you use RoadRunnerAddOn version 3.0 or later.

- **DBX entries**
  This box must be checked if all DBX entries are to be displayed.

- **Plugin paths**
  If the transfer is made to or from Leica's DBX format, which is used by TPS/GPS 1200, the transfer is made using Leica modules *RoadRunnerAddOn* and *Printf-PC Engine*. In order for transfers to happen this also requires *.Net Framework* to be installed on your computer. These can be downloaded from Leica's website. The path to the executable modules are automatically set when you have installed the modules.

- **Data paths**
  Enter path for Leica/Wild card files
  (Activated when transferring files in GSI format.)
  The card reader must be installed so that it has a path in Windows standard file system. Typically the drive comes directly after the last hard drive, i.e. if you have a **C**and a **D**drive, the card will appear under **E:**. You can also read and write the Leica-file on standard hard and floppy disks without having a card reader.

- **Enter path for DBX**
  (Activated when transferring files in DBX format.)
  Enter the path to DBX on the card, for example D:\DBX. Files with file type .DBX will then appear.

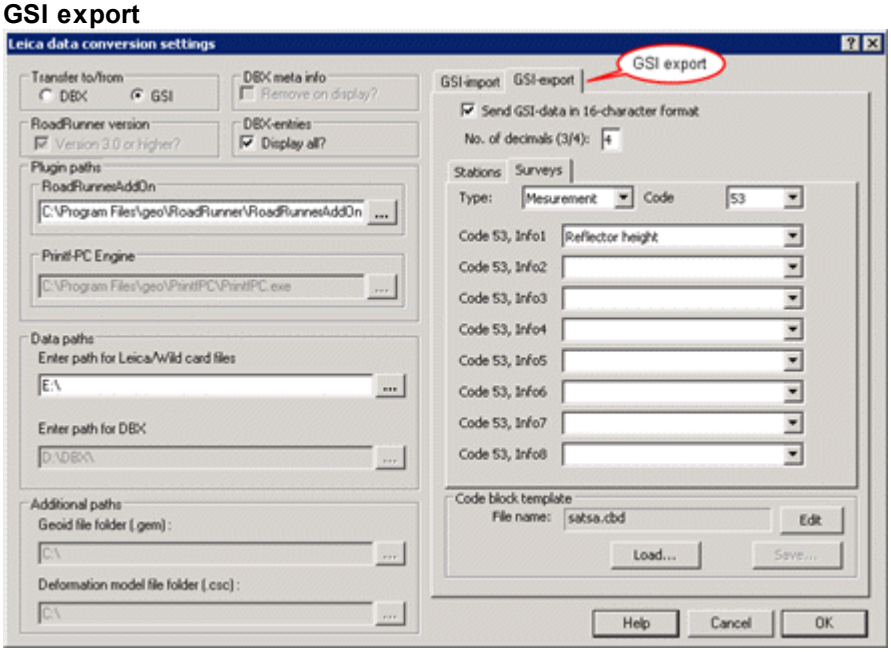
- **Additional paths**
  Geoid file folder (.gem)
  Enter the path to the geoid model (gem), which may have been used for GPS surveying. If no geoid model has been used in the instrument, it will not be needed in iCON office either.

- **Deformation model file folder (.csc)**
  Enter the path to the deformation model (csc), which may have been used for GPS surveying. If no deformation model has been used in the instrument, it will not be needed in iCON office either.

- **GSI import**
  Interpretation of supplementary information:
  (Activated when transferring files in GSI format.)
  Here you specify how to handle the point code's additional fields Info1 to Info8.

Attributes: InfoX	The value is added to an attribute of the InfoX type
Special code	The value is entered in the coordinate (geo) or survey (plm) file's field for special code.
Remark	The value is entered in the coordinate (geo) or survey (plm) file's field for remark.
Attribute type	The attribute type is paired with the closest attribute value within the same data block, and when combined creates an attribute.
Attribute value	The attribute value is paired with the closest attribute type within the same data block, and when combined creates an attribute.
Not used	Data is ignored.

- **GSI export**



Send data in 16-character format:
(Activated when transferring files in GSI format.)
Check this box if GSI data is to be sent with 16 characters in each post. Some older instruments cannot handle 16 characters. If this box is not checked, the GSI data is sent with eight characters in each post.

- **GSI export**
  Number of Decimals (3/4):
  (Activated when transferring files in GSI format.)
  Enter the number of decimals the data is to be entered with in the Leica device. If data is sent with eight characters, the space may be limited accommodating only three decimal places.

- **GSI export**
  Code block template
  (Activated when transferring files in GSI format.) Click **[Load]** , to select a different code block template. Click **[Edit]** to edit the code block template; the Stations and Surveys tabs will then be active for editing. Click **[Save]** to save an edited template.
  iCON office comes with the code block templates sbg.cbd and satsa.cbd. Sbg.cbd is used for general survey data export. Satsa.cbd is used for the export of data measured in rounds.

Transfer to/from Leica 1200

Convertible File Formats[427] from iCON office (see above) are first transferred to LandXML[410] -format with *.Net Framework*, after which the files are converted to DBX format using *RoadRunnerAddOn* and *Printf-PC Engine*.

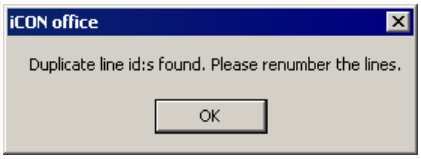
For the instruments associated with Leica System 1200 (GPS and total station) there are a number of code lists and format files (also called export filters) to facilitate communications with iCON office. The code blocks described below, under Data storage and field coding for measurement using Leica instruments[491], and that are used by the older Leica instruments can also be used in system 1200, although many of the functions, such as station establishment can be done in another way using the Leica software. Both versions work in these cases. Code lists with these code lists defined are used for help.

Code Lists:
Two code lists are included in your iCON office installation.

SBGCTRL	This code list contains free control codes as described below.
SBG2CTRL	This code list contains the free control codes, and the whole point code list SBG2.

Code lists are in the global folder, and each list consists of three files with the same name but different file extensions (xcf, x23, x06). Transfer all three files to the sub-folder "Code" on the data card with iCON office. Note, this must be done with GSI transfer, not DBX. When you have moved the card to the instrument, select ***<Tools/Transfer Objects/Code Lists>*** from the main menu in the instrument to load the code list into the internal memory enabling you to use it.

Transfer of files from iCON office to Leica TPS/GPS 1200
When transferring files that contain coordinates or survey data, such as coordinate files (geo) or survey files (plm), files are created in DBX format.

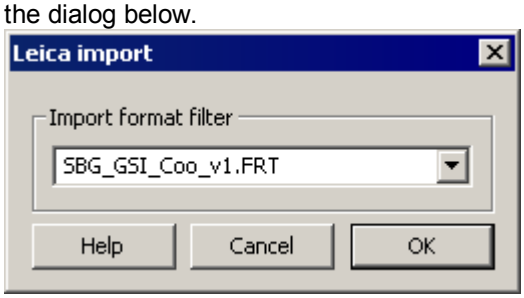
Transfer of geo-files	For conversion of coordinate files, you get a warning message if the file contains points with the same point number. In order to carry out the transfer, each point number must be unique.  *Warning message that the transferred file has duplicate point numbers.*
Transfer of cfm (or older lin, prf and skv)	When you transfer a cross fall model (or an older line file which has an associated profile and cross slope), it will calculate side lines when transferring in the same way as Sections along Lines[557] , and you therefore get files in LandXML[410] format. The Leica 1200 instrument uses stringline models, which is why two side lines will be calculated in parallel with the main line. The vertical geometry for the side lines are calculated with heights at a constant interval. The heights are calculated from the main line using the profile and cross slope, which is why you should choose a sufficiently short calculation interval for the profile, so as to take account of any transverse changes.

Transfer of files from Leica TPS/GPS 1200 to iCON office
Files in JBX format contain no real survey data but refer to other files in DBX format where data is stored. For the user, however, it is sufficient to see the JBX files. By selecting the JBX file or files to be transferred, the correct DBX files are converted into a readable format in iCON office.

Format files, for importing files from Leica 1200 to iCON office
Format files are used in the instrument to read out data from the database to files that can be loaded into iCON office. Two types of export filters are included in your iCON office installation - filters for coordinates files and filters for measured survey data.
The filter is used to convert data from DBX-format to GSI-format, and finally data will be imported into iCON office format.

Please note, the format of the GSI files will never be visible, for the user, at import, it is only the name of the filter that indicates that GSI is involved.

When transferring DBX files from Leica to iCON office you select the format filters when transferring using the dialog below.



SBG_GSI_Coo_v1.FRT	• Used with Leica System 1200. • The software reads the DBX files. • This filter is used for importing files with points and lines to iCON office. • You can use the filter for both total station and gps. The number at the end is a series version number. A newer version has a higher number. A filter with lower version number is mainly used in combination with older instruments.
SBG_GSI_Coo_v2.FRT	• You can use this filter for importing files from Leica Viva to iCON office. • Any images from Leica Viva will be transferred as attributes. Otherwise, the filter works in the same way as SBG_GSI_Coo_v1.FRT 432 .
SBG_GSI_Pol_v1.FRT	• Used with Leica System 1200. • The software reads the DBX files. • You can use this filter to import survey data such as lengths and angles to iCON office. • You can use the filter for files from a total station. The number at the end is a series version number. A newer version has a higher number. A filter with lower version number is mainly used in combination with older instruments.
SBG_GSI_Pol_v2.FRT	• You can use this filter for importing files from Leica System 1200 to iCON office.

	Otherwise, the filter works in the same way as SBG_GSI_Pol_v1.FRT 432.
SBG_GSI_Pol_v3.FRT	• You can use this filter for importing measuring files from Leica Viva to iCON office. • Any images from Leica Viva will be transferred as attributes. Otherwise, the filter works in the same way as SBG_GSI_Pol_v1.FRT 432.

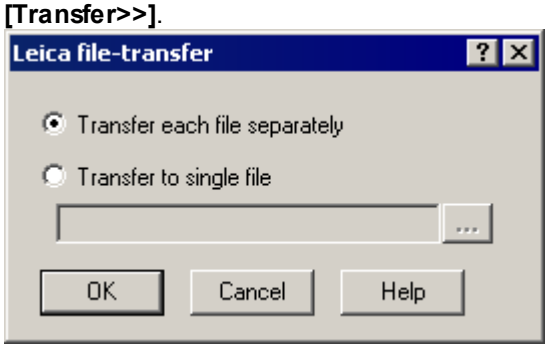
The number at the end of the file name is a series version number. A newer version has a higher number. A filter with lower version number is mainly used in combination with older instruments.

Please note:
- You have to transfer the images manually.
- The file .frt will only take care of the attribute, which includes the link to a specific point.

The format files can be found in the global folder in iCON office. Transfer the filters to the "Convert" sub-folder on the data card with iCON office. When you have moved the card to the instrument, select ***<Tools/ Transfer Objects/Format Files>*** from the main menu in the instrument to load the filters into the internal memory.

Transfer of files from iCON office to older Leica instruments

Check the box for the transfer to take place using the GSI format in the communication dialog.
If more than one file is selected for transfer from iCON office to Leica, you get the option of saving data in separate files on the card or all the data in one file. A dialog for the selection appears when you click **[Transfer>>]**.



Transfer to Leica RoadPlus

In Leica RoadPlus you have the option of defining five different types of files to describe a road. These files begin with three characters that indicate what type of information is stored in them.
- ALN, Horizontal geometry.
- PRF, Vertical geometry.
- CRS, Cross Section data, describes how the sections look.
- STA, Assignment data for sections, describes where, along a road line, the sections apply.
- EQN, Station equation file (not used by iCON office).

Transfer of lines including horizontal and vertical geometries (l3d)

If you transfer a line file, l3d, from iCON office, an ALN file for the horizontal geometry, and a PRF file for the vertical geometry, are created on the card.

Transfer of cross fall models (cfm)

There is no direct equivalent to cross fall models in Leica's road program RoadPlus. Instead, a cross section is calculated with offset/height in accordance with the cross fall model. When you send a cross fall model,

both a CRS and a STA file are created. The CRS file stores all the different cross fall specifications in the cross fall model as cross sections calculated with 50m offset in both directions. The STA file specifies the length station each CRS station applies to.

For each unique cross fall pair (left + right side) in the cross fall model, a name is created which you refer to in the STA file. The name is constructed from the cross fall information that applies to the station. Depending on if you use 8 or 16 character format, this name has a slightly different appearance.

For **16** character format, the first four characters are used to specify any profile offset, i.e. that the cross fall is not based on the line center, but on a certain profile offset. The remaining 12 characters are used to describe the cross fall. This name may appear as follows: +2.500-2.500 which means +2.5 on the left side and -2.5 on the right side. Because all instruments cannot handle the characters '+', '-', and ',' these are changed to 'P' for positive, "N" for negative, and 'C' for comma when transferring.

A definition of 2.5 % cross slope without profile offset will then have the following name:
0000N2C500P2C500

2.5 % cross slope and profile offset of 2.0m on both sides will have the name: **2020N2C500N2C500**

If you use **8**character format, there is no space for the profile offset. You are then restricted to using the same profile offset along the entire length of the aln file to avoid naming conflicts. In addition, there is only one decimal place for the cross slope; you cannot distinguish between 2.25 % and 2.20 %, as both will be named P2C2.

The above naming method means there may be cases in which sections with different cross falls or profile offset values will still generate the same name. iCON office will then give a warning of this naming conflict and instead create a name where the length section is included.

Transfer of standard sections (nsd)
It's the same with standard sections as it is with cross slopes, the only elements that work when transferring elements are fixed, i.e. dZ/dY elements in the nsd format. CRS data is created/loaded when transferring. When you transfer a standard section file a CRS file is created on the card but without an assignment file, STA, which indicates the applicable length sections. This must be created manually in the instrument.

Transfer of cross sections (sec)
An alternative to using cross slopes or standard sections is to transfer calculated cross sections. These can come from ordinary road line calculations or from a volume calculation. In the latter case, you can choose which layers are to be transferred (e.g. upper surface or excavation bottom,). The choice of layer is made when transferring. The same GSI files are created as when you transfer cross slopes (CRS and STA files). The instrument interpolates linearly between points in the sections. For the interpolation to work, it is important to remember that all sections must contain the same number of points on the left and right sides.

See also: Communication 455 , Communication Dialog 456 , Import/Export Dialog 376

7.19 MicroStation DGN

Import MicroStation DGN files

You can use iCON office to import MicroStation dgn files from the softwares InRoad and InRail.

The import is divided into two steps:

- first you import *.dgn files into AutoCAD® DWG format
- in the second step you import the *.dwg file into coordinate files (geo) and terrain models (trm).

MicroStation DGN (*.xml) -> AutoCAD format (*.dwg) -> iCON office format (*.geo and *.trm)

Convertible File Formats:

iCON office can import the following file formats from MicroStation DGN files (xml) to AutoCAD® DWG files.

MicroStation DGN:
DGN files (xml)

iCON office:
Coordinate files (geo, pxy)
Terrain models (trm)

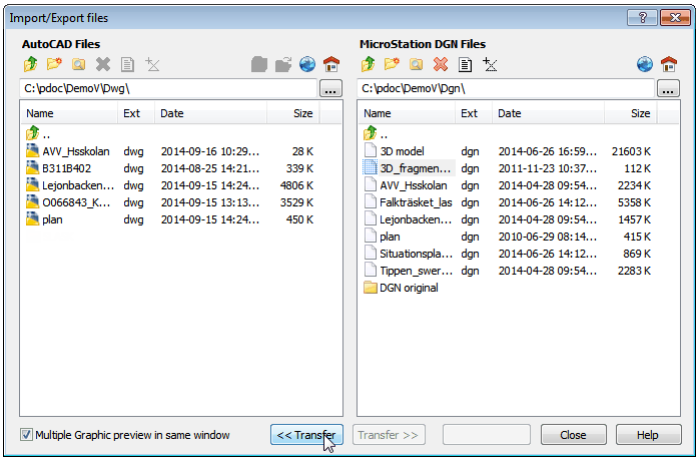
Importing DGN files with iCON office:

DGN file (xml) with:	Content in the imported DWG file:	Content in the imported iCON office file:
Single points	Single points	Single points in coordinate file (geo)
Poly lines	Poly lines	Polylines in coordinate file (geo)
Surfaces	Surfaces	Surfaces as terrain model (trm)

Importing MicroStation DGN

This text describes importation of MicroStation dgn files to AutoCAD dwg format.

- Open the Import Export dialog 372 by selecting ***File | Import/Export*** or click .
- Select ***MicroStation DGN to AutoCAD DWG*** and clic **[OK]** to open the transfer dialog 376 .
- Select one or serveral DGN files from the right part of the transfer dialog.



The transfer dialog

- Click at **[<< Transfer]**, to import the selected files.
- The imported files will be saved in the AutoCAD dwg format.

Information in Input- and Output Window

Information about the import, such as code descriptions and names of created files, will be displayed in the Input- and Output Window[107].

Any problems occurring during the importation will also be displayed in the Input- and Output Window. For example if the importation has been interrupted.

Link to import AutoCAD files

Eventually, the imported dwg files need to be imported to iCON office format.

- Open the imported dwg file and select between:
  - Data | Extract Coordinates from AutoCAD drawing[296]
  - Data | Extract Faces from AutoCAD drawing[298]
  - Data | Vectorize to Coordinates[299]

Information about the importation is described in Import of AutoCAD Drawings, Dwg and Dxf[296]

Summary of imports

The import, step by step:

- Import MicroStation DGN files to AutoCAD DWG format.
- Import the dwg files to iCON office format, coordinate files and terrain models.

See also: Import of AutoCAD Drawings, Dwg and Dxf[296], Input- and Output Window[107], [107] Transfer Dialog, in General[376]

7.20 Sokkia

This function imports data files from Sokkia instruments to iCON office format. Select ***Import/Export | Sokkia*** to open the transfer dialog 376.

Convertible File Formats

Sokkia levelers:
Sokkia files: (cs1)

Settings

No special settings can be made for this function.

See also: Import and Export in General, Transfer Dialog 376

7.21 Sosi

This function converts data to and from Sosi. Select ***File | Import/Export | Sosi*** to open the transfer dialog 376.

Convertible File Formats

iCON office:
Coordinate Files: (geo)

Sosi:
Sosi files: (sos)

Settings

Select the appropriate settings.

See also: Import and Export in General, Transfer Dialog 376

7.22 Topcon

There are two ways of communicating with Topcon instruments, either using a memory card (or USB stick) or directly with the instrument. Transfer with a memory card uses the transfer dialog 376 and direct communication is made with the Communication Dialog 456.

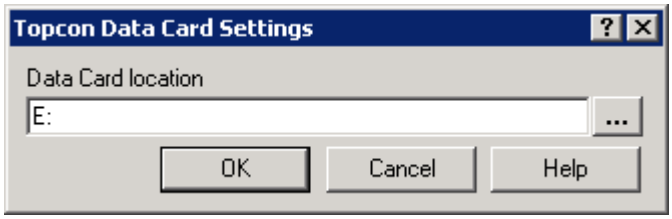
Transfer to/from memory card

This function converts data from Topcon levelers. Select ***File | Import/Export | Topcon*** to open the transfer dialog 376. If several files are selected for transfer at the same time, you may choose to store data in separate files or all data in one file. A dialog for the selection appears when you press **[Transfer>>]**.

Convertible File Formats:

- **iCON office:**
  Leveling data: (lvt, lev)
- **Topcon:**
  Topcon files: (tcn)

Settings:



- Enter the path to the Topcon memory card:
  Typically the drive comes directly after the last hard drive, i.e. if you have a **C**and a **D**drive, the memory card will appear under **E:**. You can also read and write the file on standard hard and floppy disks.

See also: Communication 455, Communication Dialog 456, Import/Export Dialog 376

7.23 Trimble

7.23.1 Trimble DC

Data exchange with Trimble instruments and PDAs can be made directly through a serial port or through Trimble's communications program 'Data Transfer'. In the latter case the transfer is done through Trimble's DC format.

Trimble DC and Data Transfer

Trimble's *DC format* is used to transfer data to and from instruments and PDAs using the software *Survey Controller*. iCON office reads and writes DC format and converts the content for the exchange of the required information. The transfer of the DC file is handled by Trimble's communication program *Data Transfer.*

iCON office handles DC files for Survey Controller version 7.50 or later. Older versions may also work depending on the contents of the files. Examples of data devices from Trimble that run Survey Controller include *TSC1*, *TSCe* and *ACU*.

The following information can be transferred via the DC format:

- Survey data, plm
- Coordinates, geo
- GPS data, llc
- Cross Fall Model (cross fall model, cfm, and associated line files, l3d, and also the older file formats line, lin, profile, prf, and cross slope, skv. Please note, associated files are transferred automatically.)
- Line data, l3d and also lin
- Cross sections, sec
- Terrain models, trm

Data Transfer

- You use Data Transfer to transfer DC files to and from an instrument. The software Data Transfer must be installed on the computer where the transfer is made.
- Data Transfer can be downloaded from the Trimble website.
- Data Transfer can also be used for communication with other instruments that are not based on Survey Controller, for example Geotronics instruments.
- The conversion of the DC format in iCON office can be done without Data Transfer being available.

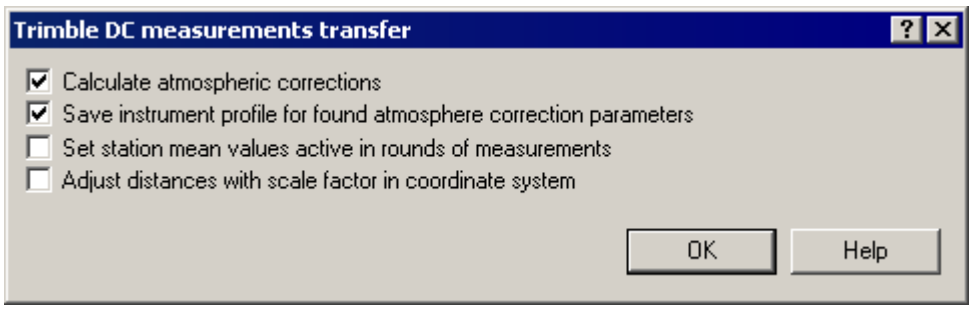
Conversion to and from DC format

To convert Trimble DC files, you go to ***File | Import/Export*** and select ***Trimble DC***. This will open a transfer dialog 376 with iCON office files on the left, and DC files on the right. The DC files are normally handled in a sub-folder named 'TrimbleDC'.

You transfer files by selecting the desired file and then clicking **[Transfer]**.

Survey data (plm)

Survey data can only be transferred from DC format to iCON office, and then becomes a plm file. When transferring, a dialog appears where the user can make certain settings.



- Calculate atmospheric corrections
  Even if you set the air pressure and temperature in Survey Controller, data is always saved uncorrected in the DC file. Check this option if you want to correct the measurements directly when loading so they are ready for coordinate calculation. Otherwise, you can do this manually in iCON office when the survey file is active, using ***Data | Correction of Measurements*** 333 .

- Save instrument profiles for the found parameters for atmospheric correction
  The DC file contains information about how data from the instrument is to be corrected for atmosphere. If you want to use this information in the iCON office function "Correction of Measurements", check this option. You can then choose your instrument from a list when you use this function.

- Set station mean values as active in the rounds of measurements
  If your DC file contains data measured in rounds, you can save this in two ways:
  - With this option checked, the mean values that have been calculated in the instrument are set as active, and measured raw data is set as passive. The file is then ready for use directly in traverses and net adjustment etc.
  - If you want to make a rounds reduction in iCON office to get a detailed report, you uncheck this option instead. Raw data is set as active and the instrument's mean values as passive.

- Adjust the lengths with the scale factor in the coordinate system
  In Trimble instruments you can specify a scale factor for the projection. This is typically used for GPS measurement, but can also be used when measuring with total station.

Coordinate files (geo, pxy)
Local coordinates (N, E, H) can be transferred both to and from DC format. On the iCON office side, the transferred files are saved as coordinate files (geo).

GPS data (llc, geo)
GPS data can only be transferred from DC format to iCON office. DC files can contain two types of GPS data, vectors from the base station or coordinates such as latitude/longitude.

- Coordinates describing latitude and longitude are used for network RTK etc.
  If the DC file contains latitude/longitude, you will get an llc file with the original coordinates and a geo file with the coordinates converted to (N, E, H) in the local coordinate system as described in the DC file.
- If the DC file contains vectors from the base station, you only get (N, E, H) for surveyed points, however, you still get the base station coordinates in llc format. Note that the base station and any transformation points may occur several times in the DC file, and thereby also in the files that you receive as a result. This is then the last occurrence of the point that will fit in your coordinate system.

Cross Fall Model and Road Line data (cfm and l3d)
You can transfer cross fall models, cfm, and also road lines, l3d, to Trimble DC format.

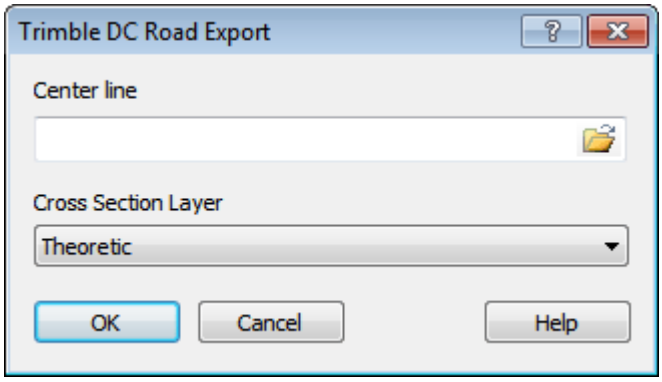
- When you transfer a cross fall model, cfm, an associated road line, l3d, will always be transferred automatically.

- When you transfer a road line, l3d, the DC file will automatically include the horizontal and vertical geometry of the line.

Please note the difference in how profiles are written in DC format and in iCON office format:

- Profiles in the DC format are represented with the coordinates of the vertices.
- Profiles in the iCON office format are instead represented by specifying tangent points (tangent points are stored).
- The conversion of the vertices' tangent points are handled by iCON office.

Cross Section Data (sec)



When you transfer cross section files, sec, a dialog will open where you can choose:

- Center line, l3d or lin
- Layer, choose which layers to transfer
  In this way you can choose to transfer the theoretical surface from a volume calculation. The cross section files that are transferred must contain the theoretical profile height. Most calculation routines in iCON office enter this height in the file.

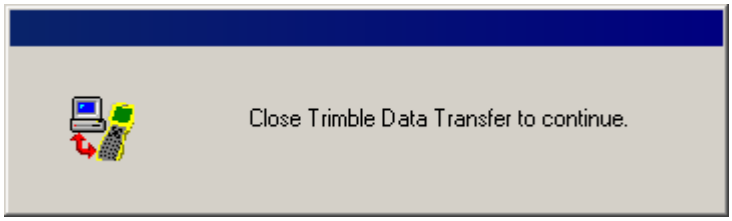
Line data (lin, prf, skv, sec)
When transferring older line data to DC, the line file (lin) contains the main information. You can then connect any profiles, cross slopes, and cross sections to the line. To transfer an entire road to DC, you select the desired line and click **[Transfer]**. iCON office then checks the associated files and transfers them as well.

Please note the difference in how profiles are written in DC format and in iCON office format:

- Profiles in the DC format are represented with the coordinates of the vertices.
- Profiles in the iCON office format are instead represented by specifying tangent points (tangent points are stored).
- The conversion of the vertices' tangent points are handled by iCON office.

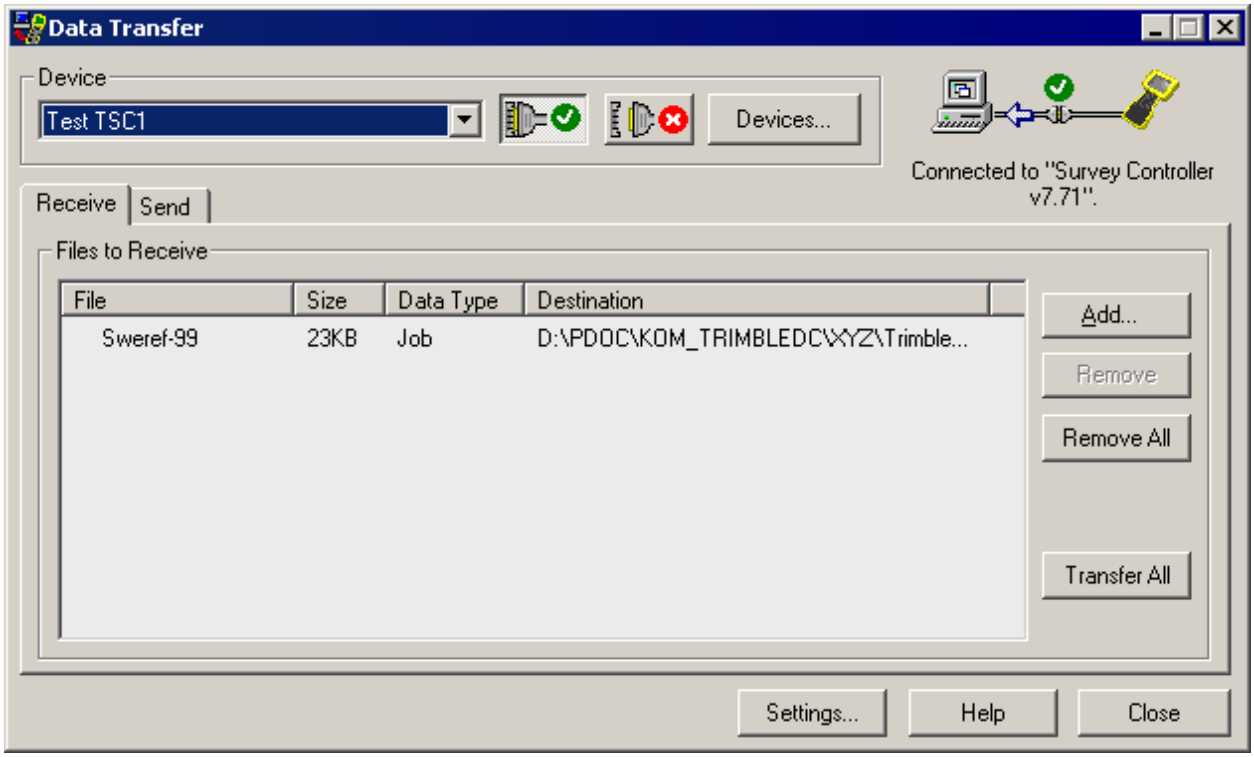
The transfer of DC files to the data device using Trimble Data Transfer

Ensure that the DC file or files to transfer to a computer device are in the right-hand list in the transfer dialog. Now click the **[Data Transfer...]**button. Now iCON office will attempt to start Trimble Data Transfer.

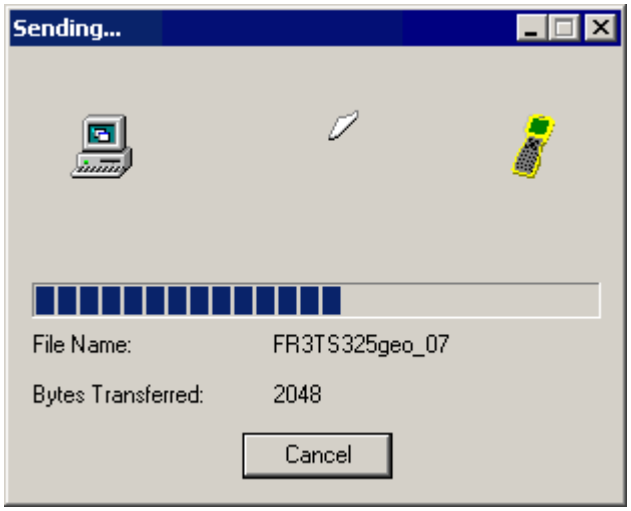


If successful, a message will appear and iCON office will now wait until the transfer is complete and Data Transfer closes.

When Data Transfer is started, a dialog box appears. Select the desired communication device from the list or click **[Devices ...]** to create a new device. When contact with the device is established, this appears top right in the dialog. Select the 'Send' tab and then click the **[Add...]**button. The files in the Trimble iCON office folder can now be selected for transfer. Once the desired file is selected, choose **[Transfer All]** to start the transfer to the device.



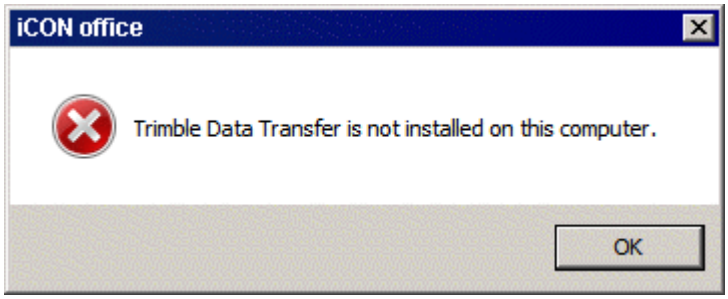
A new dialog will appear to indicate the transfer process.



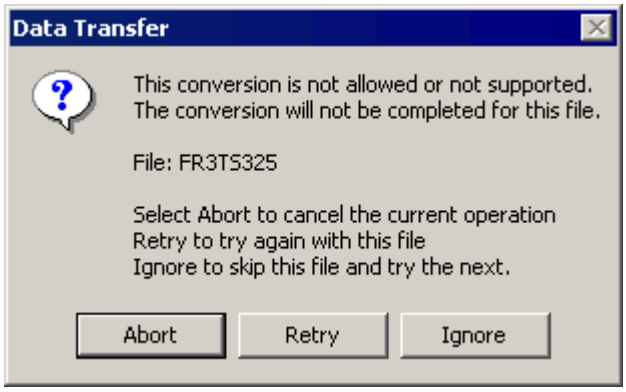
Once the files have been transferred, you simply close Data Transfer and return to iCON office.

Error messages

If Data Transfer is not installed, an error message appears when you click **[Data Transfer]**. In this case, install the program (available on Trimble's website) and check that you can start it separately (i.e. outside of iCON office).



If the following error message comes up during the transfer, this may be because the software version of Survey Controller on the device is older than the version on the DC file. Start by trying to upgrade the software in the device.



Transfer of DC files from the data device using Trimble Data Transfer

The initial steps for transferring data from a data device is the same as previously described. After Data Transfer has started, you select the 'Receive' tab and then **[Add...]**. Select the file or files to transfer to iCON office. When these files are listed, click **[Transfer All]**. Now close Data Transfer and return to iCON office. The new DC files are now in the right list and can be converted to iCON office format.

See also: Communication 455, Communication Dialog 456, Import/Export Dialog 376,

7.23.2 Trimble JobXML

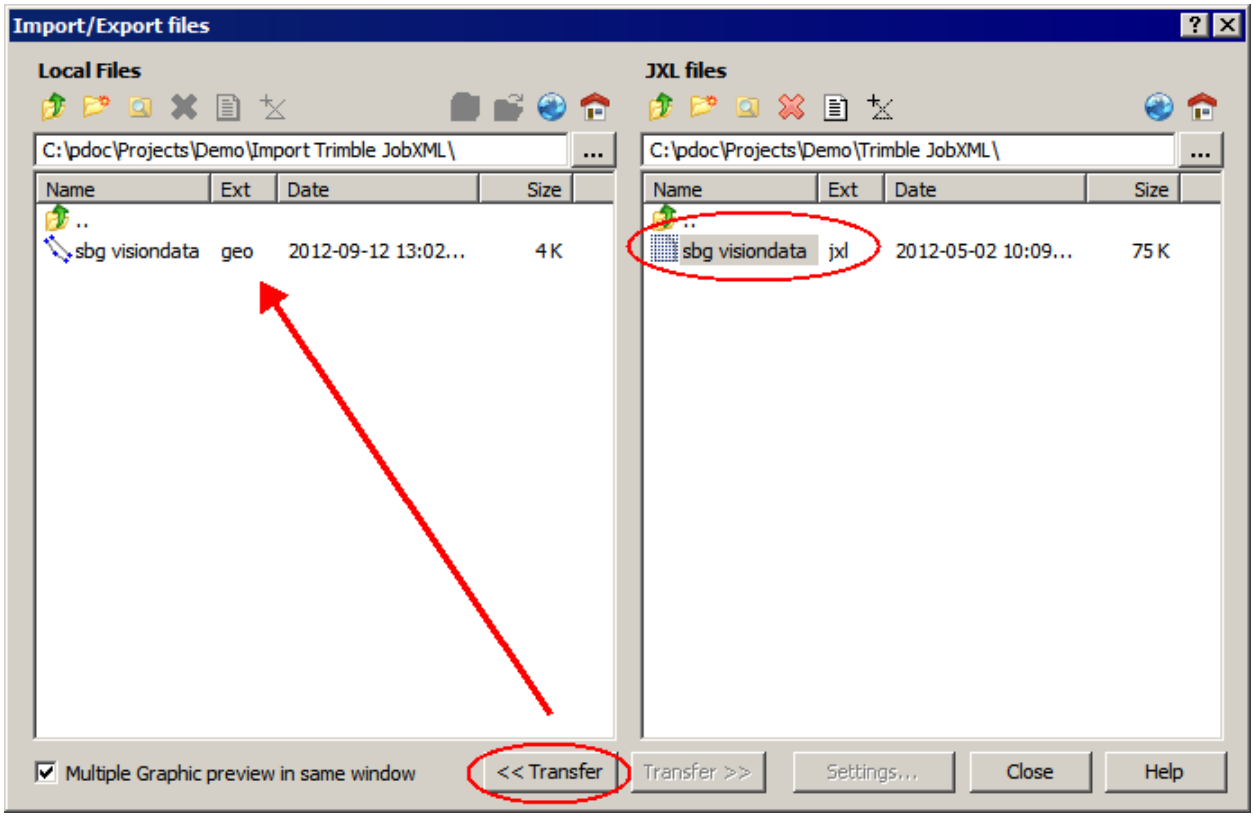
This function imports data from Trimble JobXML files to iCON office format.

Convertible File Formats

Trimble JobXML:
Trimble JobXML files: (jxl)

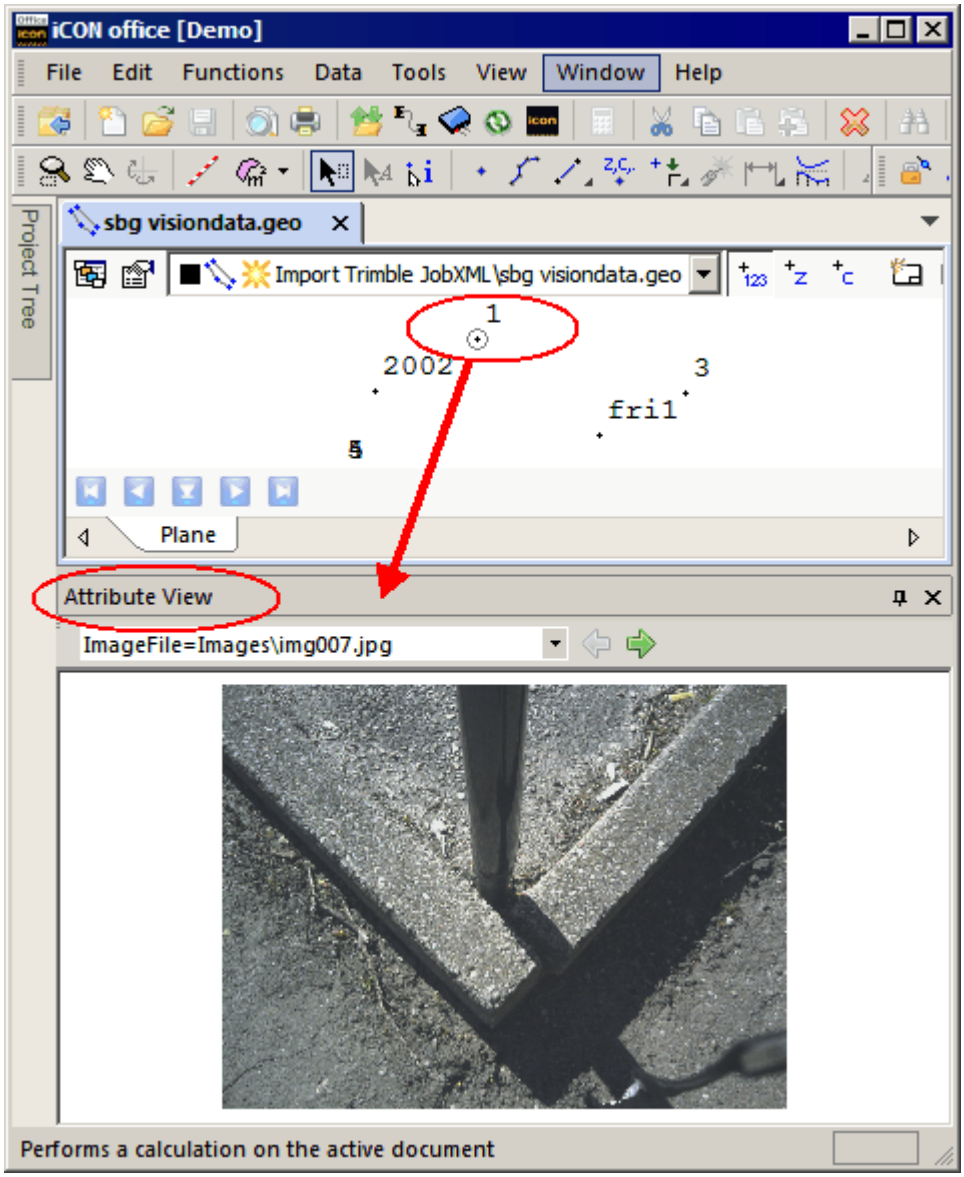
iCON office:
Coordinate files: (geo)

Select ***File | Import/Export | Trimble JobXML*** to open the transfer dialog.



When importing Trimble JobXML files to iCON office a coordinate file (geo) is always created. If the Trimble JobXML file includes photos taken with the total station, they will also be imported. A photo related to a point number, will be shown as an attribute[113] in the attribute view.

Please note, any images associated with the job must be *saved in the same folder* as the Trimble JobXML file, so they can be imported to iCON office.



Point 1 in the image, has a photo as an attribute - displayed in the Attribute View.

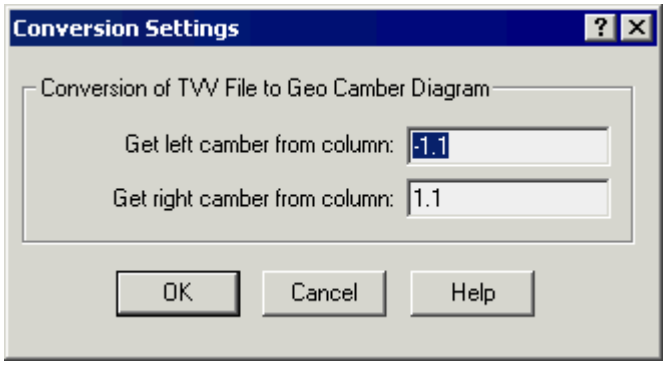
See also: Transfer Dialog, in General 376, Optional attributes 113

7.24 10-Tabell

This function converts data from 10-tabell. Select ***Import/Export | Tit*** to open the transfer dialog[376] . Remember that lines must be checked[517] after transfer to iCON office.

Convertible File Formats

10-tabell:
Line files: (inh, tit)
These file types are converted to horizontal line format[503] , l3d, in iCON office. Remember that the files must be checked[517] after transfer.
Profile files: (inv, nyl)
These file types are converted to vertical line format[503] , l3d, in iCON office. Remember that the files must be checked[517] after transfer. Vertical radii in these files are assumed to have opposite signs in relation to iCON office.
Cross sections: (tw)
This file type actually describes the projected cross sections, but are converted to Cross Fall Models[536] , cfm, in iCON office. By clicking the settings button you can control the columns from which the cross slope is calculated, see below.



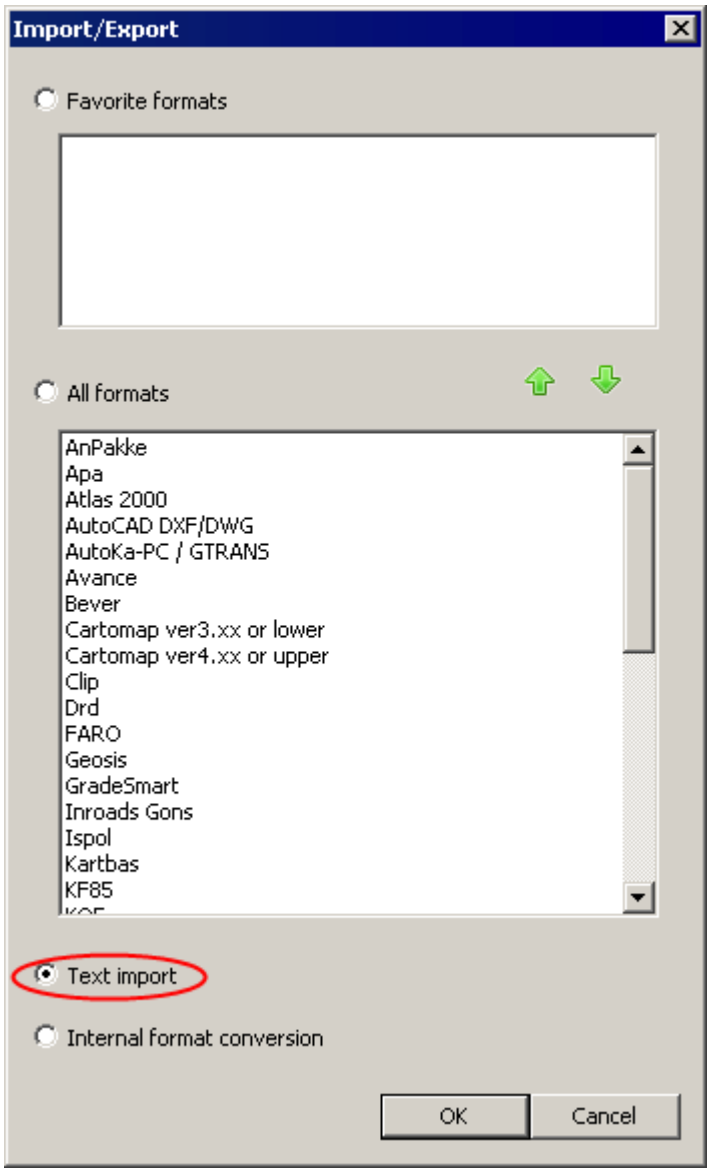
Settings

These settings only apply to transfers of TVV files to cross fall models, cfm, in iCON office. The normal setting is that the left side is taken from the column -1.1, and the right side from the column 1.1, which means that the offset and height are loaded from these columns and the cross slope is then calculated relative to the height specification in the adjacent column, nearest to the center line (i.e. on the left side the next column is loaded and on the right side the previous column is loaded). By changing these codes you can download the height for any limit type. If you want to only download the cross slope for one side and automatically set the corresponding (without break) cross slope on the other side, you enter the same code, for example, -1.1 In both fields means that the left side's cross slope at the roadway curb is also set on the right side.

See also: Import and Export in General, Transfer Dialog[376]

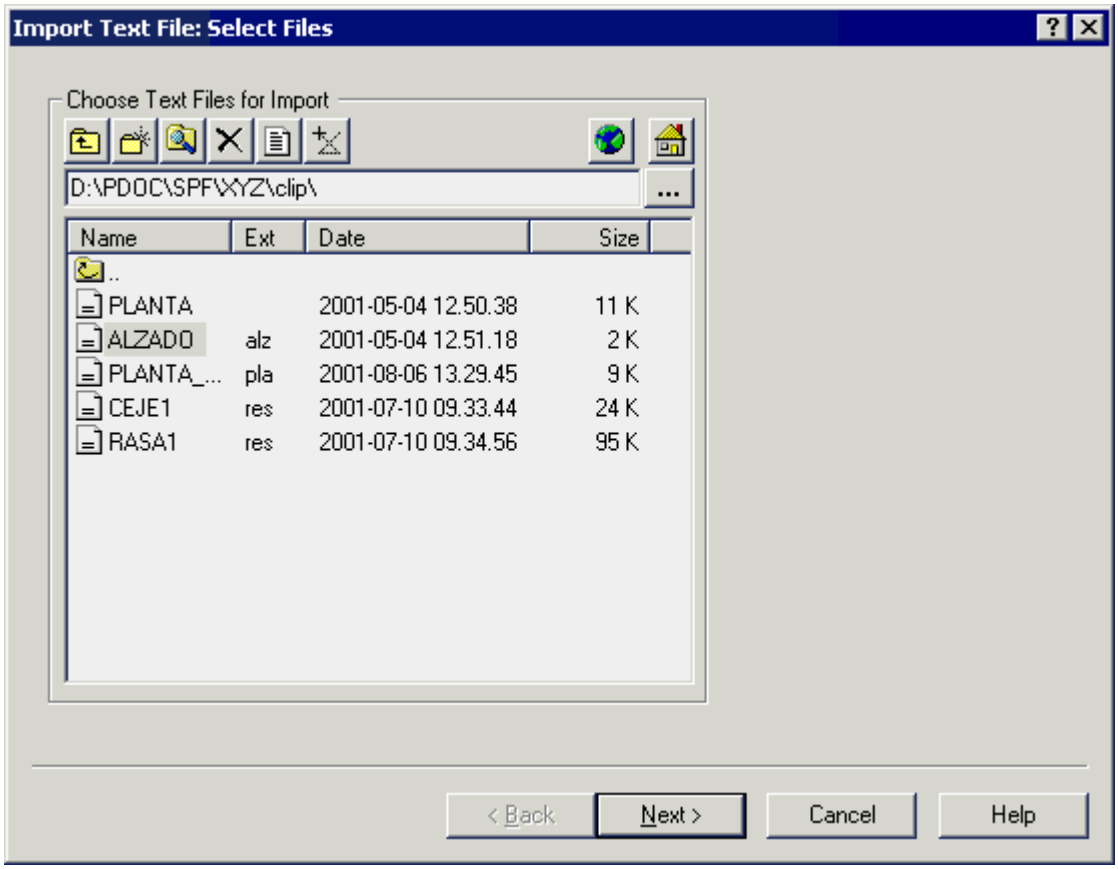
7.25 Import Text Files

You use this function to import data from file formats that are unknown to iCON office. Select ***File | Import/ Export*** and select Import Text.



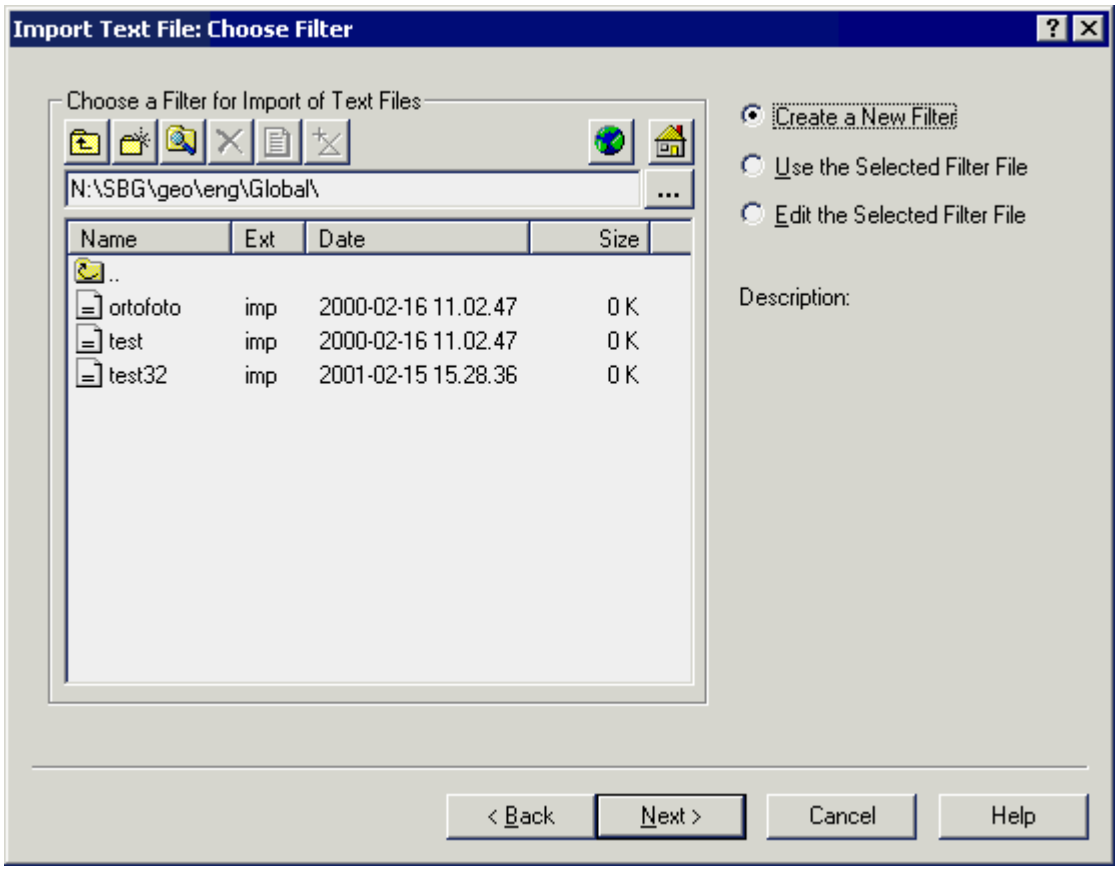
Step 1: Select Files to Import

Select the file or files you want to import.



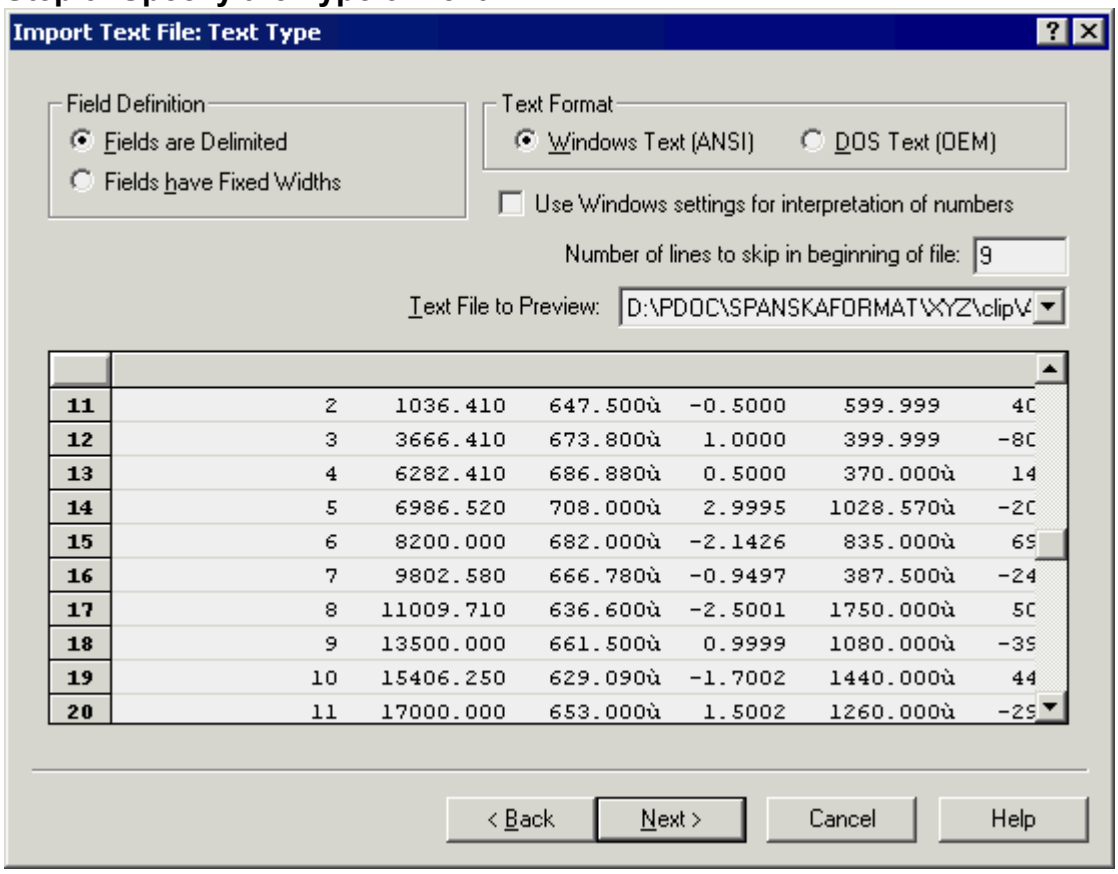
Step 2: Select Import Filter

An import filter is a file that indicates how the text files are formatted. Once installed iCON office adds an import filter for Atlas 2000 files in the global folder (global:atlas.imp).



- **Create New Import Filter**
  If you import a new file format, select this option to create a new filter.
- **Use the Selected Filter**
  If you have imported a text file in the same format previously and saved the filter, you can choose this option and select the filter from the list.
- **Edit the Selected Filter**
  If you have imported a text file in a similar format previously and saved the filter, you can choose this option and select the filter from the list. You will then be able to edit the text filter to make the necessary changes.

Step 3: Specify the Type of Text



- **Field Limitations**
  Here you enter if the fields in the text file have a fixed width or if they are separated by one or more special formatting characters. This choice determines how step 4 looks.

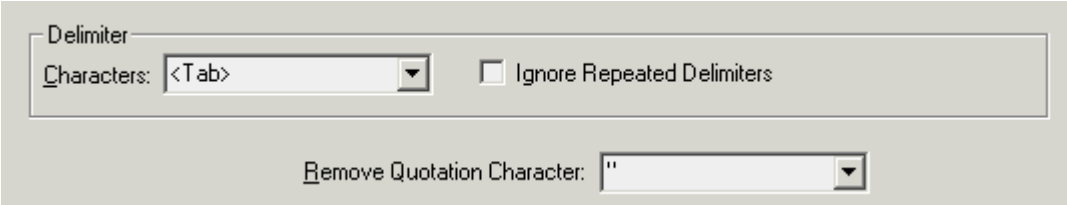
- **Text Format**
  Here you enter if the file is created in DOS or Windows. This will have an effect on characters such as Å, Ä and Ö.

- **Use the Windows settings for the interpretation of numbers**
  Check this option if you want numbers to be interpreted according to your Windows settings. In this case, for example, 1,234.567 is interpreted in line with the American Standard if this is set in Windows. For example, 1 234,567 (Swedish Standard) cannot be interpreted without this option checked as the figure contains a blank space between thousands. Otherwise, figures must be specified with numbers without spaces and a delimiter (decimal delimiter, ',' or '.').

- **Number of lines to skip in the beginning of the file**
  If the file has a file header, you enter the number of lines that are not to be interpreted here.

- **Text File to Preview**
  If you entered multiple files to import here, you can specify what is to be previewed in the window below.

Step 4: Set Delimiter

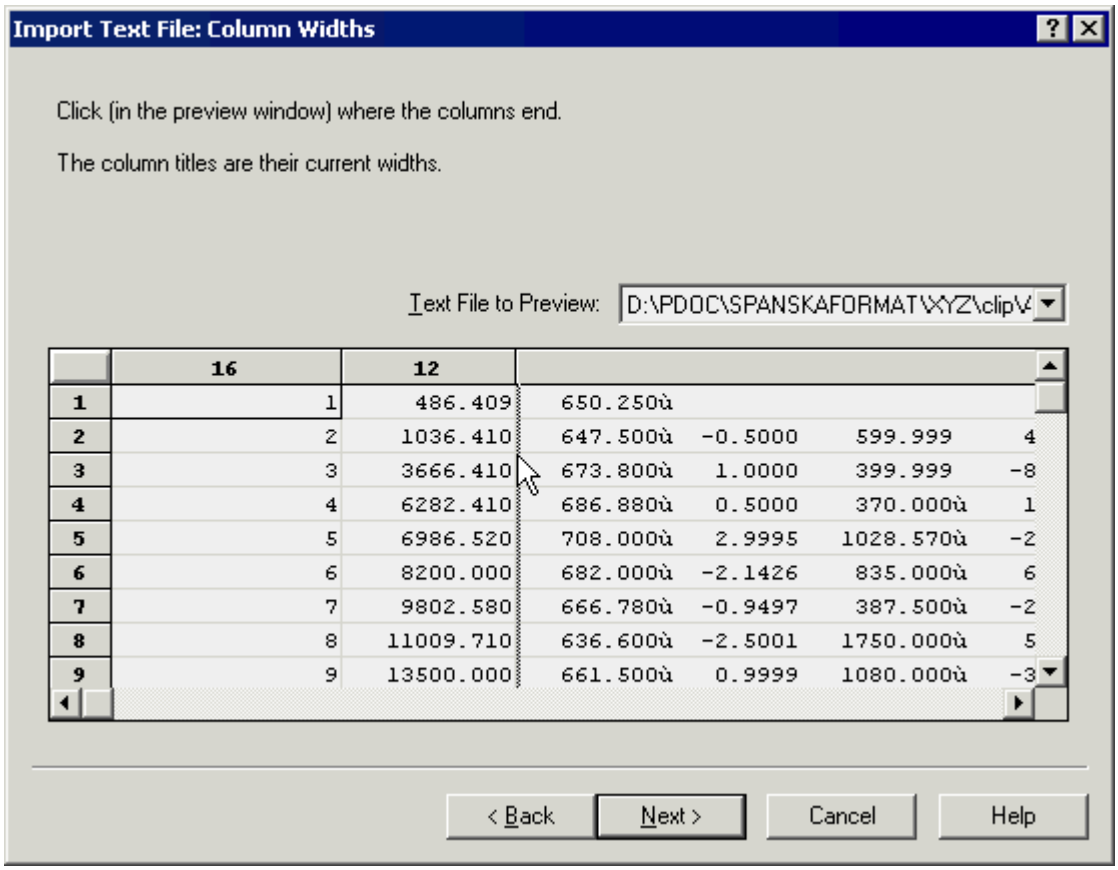


- **Characters**
  Here you enter the character to be used as delimiter in the data fields.
- **Ignore Repeated Delimiters**
  If you select *Ignore Repeated Delimiters* several characters can be used to delimit a single field, which is common if a space is used as delimiter.
- **Remove Quotation Character**
  Select this option to remove quotes from the text, e.g. for point numbers.
- **Text File to Preview**
  If you entered multiple files to import here, you can specify what is to be previewed in the window below.

In the preview window you can see how the fields look with the current settings.

Step 4: Specify Column Widths

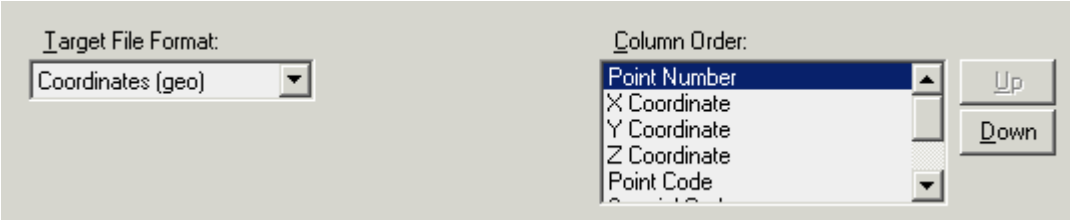
Text File to Preview: If you entered multiple files to import here, you can specify what is to be previewed in the window below.



For file formats with fixed column widths you can enter the column widths by clicking (in the preview

window) where the column limits run. If you want to delete a column limit, simply click once more at the same position.

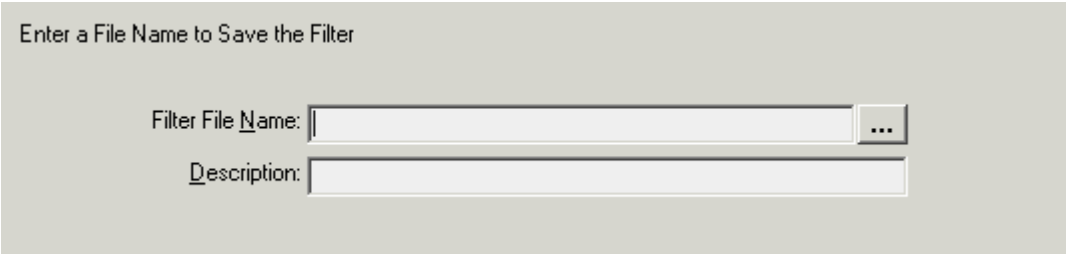
Step 5: Interpreting Fields



- **Target File Format**
  Specify the type of file you want to create.
- **Column Order**
  Specify the order in which columns are to appear in the text file. Select a column in the list and use the [Up] and [Down] keys to change the order of the columns. Column headers in the preview are changed immediately. At the bottom of the list field, you will find a field named **<Unused Column>**. Use this field to indicate that a column in the text file does not correspond to any value in the iCON office-file.
- **Text File to Preview**
  If you entered multiple files to import here, you can specify what is to be previewed in the window below.

Step 6: Save the Import Filter

If you plan to import multiple files with the same format, it is advisable to save the filter so you avoid having to re-define it. Filter files are to have the same file type (imp). If you do not want to save the filter but still want to import the files, leave the Name field of the import file blank and press **[Finish]**. Note: If you press **[Cancel]** no text files are imported.



See also: Import and Export in General. 376

8 Communication

8.1 Communications in General

There are a number of different types of computers and data stacks on the market today and more are appearing all the time. iCON office can handle most of these whatever the model and manufacturer. All data stack manufacturers have designed their own devices according to their own specifications. This might be how long point numbers can be, or whether the operator's name can be specified. There are transmission systems in iCON office for most of the frequently used data stacks. However, some are programmable which allows the operator to create his own data transmission format, which also includes programmable calculators. The use of the word instrument in this chapter refers to both survey instruments and data stacks.

Communication can be made through Windows CE transfer (ActiveSync[460] ®/Sync Center)[460] , or by the Communication Dialog[456]. For the communications dialog to work, the correct Instrument Settings[501] must be made. Instruments with plug-in cards can also use the Transfer Dialog Import/Export[376] .

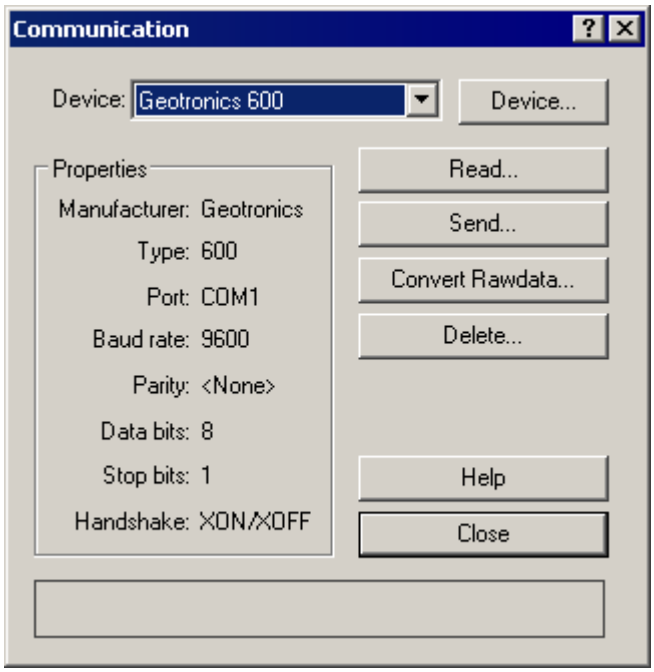
iCON office can communicate with the following devices:

GeoPad[460]
LeicaWild[489]
Geotronics/Trimble5600[483]
Sokkia[496]
Geodos[497]
Topcon[499]
Zeiss/TrimbleDiNi[500]

See also: Import and Export in General[376]

8.2 Communication Dialog

This dialog handles communications with the Geotronics/Trimble Geodimeter CU, Geodos, Sokkia, Topcon DL, Zeiss/Trimble DiNi, and Wild/Leica devices. Open the dialog with ***File | Communication | Communication***.



Communication

Before you begin, check that:

- The instrument is connected to the port that appears in the box for properties.
- The port settings are the same in both iCON office and the communications device.

If a problem occurs, try restarting the device and/or communication dialog.

The bar at the bottom shows the data sent between iCON office and the communication device.

You can always press **<ESC>** to cancel the transmission.

Device:
Communication devices installed in the system that allow you to store the port settings even when you have multiple devices from the same manufacturer. This makes handling much easier when you use several different devices. The devices installed are listed below. Select the device you want to communicate with from the list, or install a new one by clicking **[Device ...]**, see below.
In the properties box you will see the type of device and the current port settings for the selected device.

[Device ...]:
Click here to change the settings for the selected device or to install a new one. Clicking the button opens the dialog for Instrument Settings 501 where you can create, modify and delete the communication.

[Read ...]:
Click here to load the data from the instrument. The results appear in a raw data file that is located in the /RAW/ folder in your project folder. The filename is suggested as *'Poldata.xxx'* with different file extensions (*xxx*) for different instruments. Enter another name if you want to keep the raw data as this file is usually overwritten each time. Once loaded the function **Convert raw data** is executed, which creates new documents with the data in iCON office format.

Depending on the instrument you are communicating with, you may be prompted to start the data transfer from the instrument, see the section for the relevant instrument.

[Send...]:
Click here to transfer the data to the instrument. A dialog opens where you can select the files to transfer.

Depending on the instrument you are communicating with, you may be prompted to start the data reception in the instrument, see the section for the relevant instrument.

[Convert Raw Data ...]:
If raw data has been previously transmitted, or by a different application, you can execute the conversion to iCON office files directly using this function. A file dialog opens where you can specify the raw data files to be converted. The files that can be converted depend on the instrument you select. Depending on the instrument you are communicating with and the data the file contains, you may be prompted to take additional actions, see the section for the relevant instrument.

[Delete...]:
Select this option to delete the data in the instrument. Only some instruments support this, see more in the sections for the relevant instrument.

[Close]:
Quits the communication dialog.

Functions using the communication dialog

Leica/Wild 489
Geotronics/Trimble5600 483
Sokkia 496
Geodos 497
Topcon 499

See also: Communications 455

8.3 Transfer Files to Removable Device

General about Transfer Dialogs

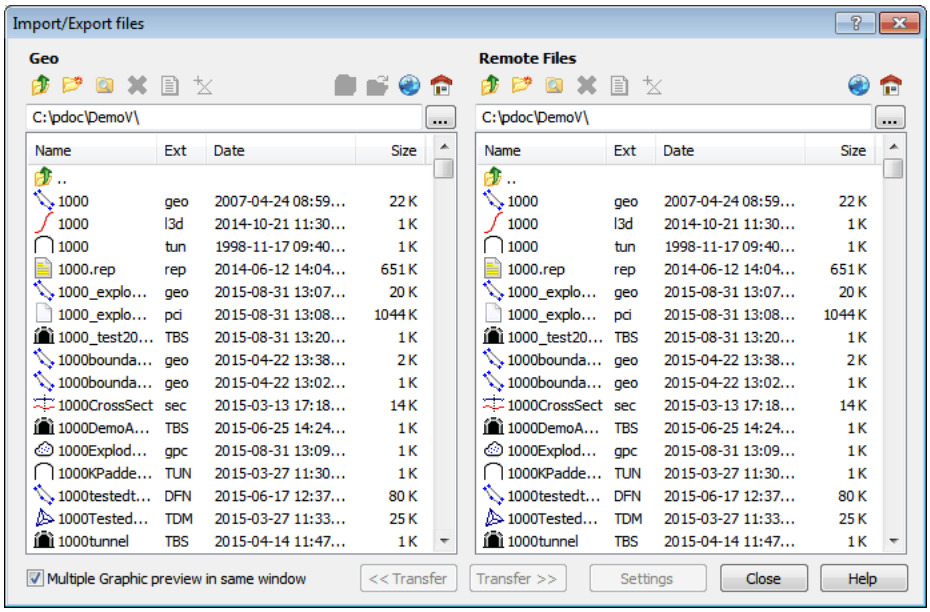
The transfer dialog is a general dialog that is used to import and export files. The dialog has two columns:

- the left for iCON office files (Local Files)
- the right for files in other devices.

Open Transfer Dialog

To transfer files between iCON office and any removable device, select ***File | Communication | File Transfer*** or the icon in the toolbar. A dialog will open where you can specify the path to any removable device, e.g. a USB stick or card.

File Transfer Dialog



Each column has a set of controls and a file list, see Transfer Dialog, in General 376.

Paths to Files in the File Transfer Dialog

Select ***File | Communication | File Transfer*** to open the dialog above.

- iCON office
  The path above the left column is set to the active project directory.
- Remote Files
  The very first time you open this dialog, the path above the column to the right is set to the active project.
  - The user can browse to any path of his choice, e.g. to a USB device.
  - Transfer one or several files.
  - The next time this file transfer dialog is used, the path to the latest used device will be selected automatically.
  - If the last used path is not available, the path will be set to
    1. the first available device with removable storage
    2. the active project (if no removable storage has been found).

Associated Files

Select one or several files to be transferred.

- Associated files will be included in the transfer. This relates to:

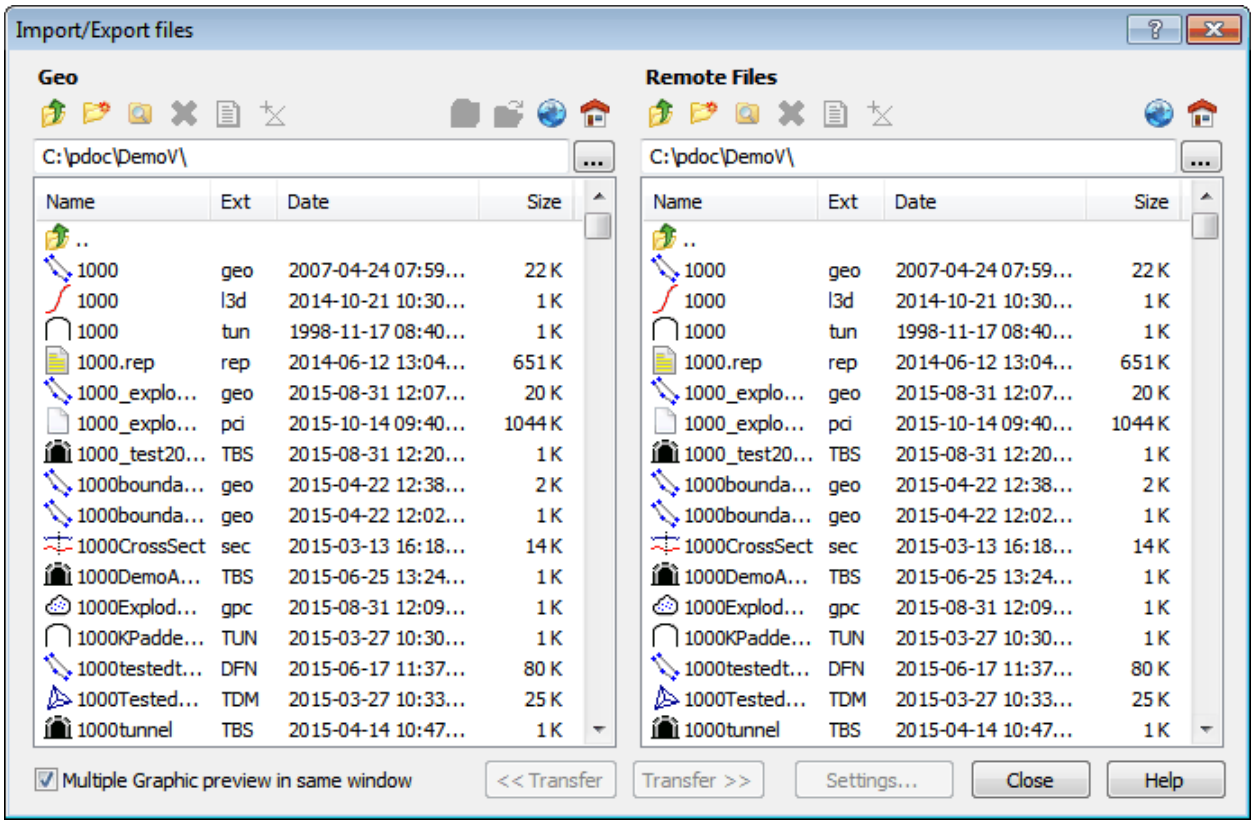
Transferred file	Associated file
Cross fall model, cfm 536	Line file l3d
Stringline model, lmd 541	Line file l3d, coordinate file geo
Volume description, mbs 689	Line file l3d, cross fall model cfm, standard sections nsd, terrain models trm
Tunnel description, tbs 862	Line file l3d, design sections tun or dwg
Line file, lin 521 (older format)	Profile and cross fall (prf, skv)

See also: Transfer Dialog 376

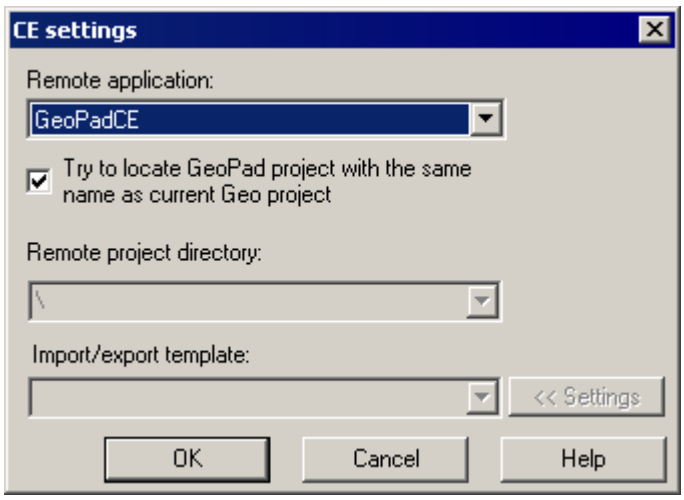
8.4 Windows CE Transfer

To communicate with GeoPadCE you require Active Sync or Windows Mobile Device Center if you run Windows Vista or Windows 7. If you do not already have ActiveSync or Windows Mobile Device Center installed, you can download it from Microsoft webpage.

Open the dialog with ***File*** | ***Communication*** | ***Windows CE Device*** or click the button in the toolbar. With this dialog you can use ActiveSync/SyncCenter to transfer files between iCON office and GeoPad or any other PDA. If you choose to transfer iCON office files to or from a device other than GeoPad, you can use a format template to select which data format to use.
The transfer dialog is a general dialog with two windows, the left for iCON office files, the right for files in other formats. Each window has a file list.



Settings:
Click **[Settings]** to open the CE transfer dialog.



CE Settings

Remote application:
Select if the transfer is to be made to GeoPadCE, GeoPad v4 (i.e. older versions of GeoPad), Leica, Leica Viva or to another device.
If you choose a device other than GeoPad, you also have the option of selecting the Import/Export template, see below.

Try to localize the GeoPad project with the same name as the current iCON office project
You can only check this box if you have selected GeoPad as the application.
If there is no information available on the last used GeoPad project in your PDA, iCON office tries to localize a GeoPad project in your PDA that has the same name as an active iCON office project.

Remote project directory:
Here you can choose from a number of predefined paths or define your own. If you manually enter a folder that does not already exist, you will come to the root of your PDA.

Import/Export template:
Only active if you have chosen a device other than GeoPad in *Remote application*.
Choose a format template to directly convert iCON office files when transferring to, for example, LandXML format or DXF format, and vice versa.

Select *no template*, to transfer a file without changing the file format.

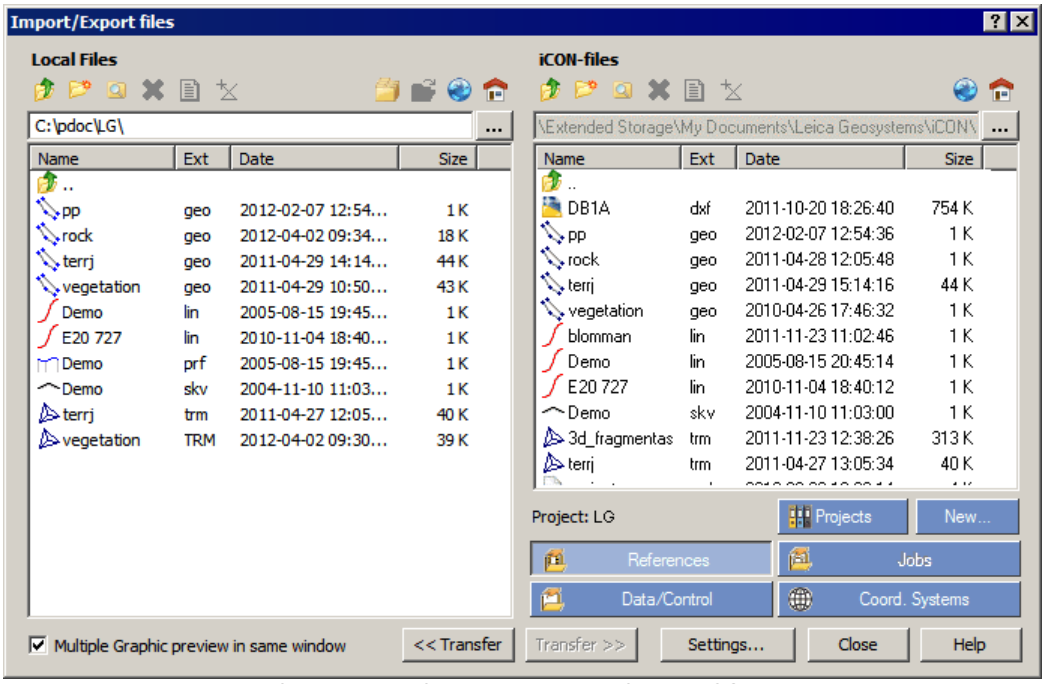
Settings
Click **[Settings]** to edit the template. If Leica is selected as the *Remote application* you will come to a dialog where you may choose between transferring to/from DBX or GSI, see also Leica/Wild 427 .

See also: Communication 455 , Transfer Dialog 376

8.5 iCON Field

iCON Field

With this dialog, files can be transferred between the office software to the left and iCON field software to the right.



The dialog displays local files to the left, and to the right files in iCON device are displayed.

The buttons on the iCON device side of the dialog are used for navigation between folders of a project. By default the **[References]** button is selected.

Open the dialog

To communicate with iCON device your computer must have, depending on used operative system, Active Sync or Mobile Device Center installed.

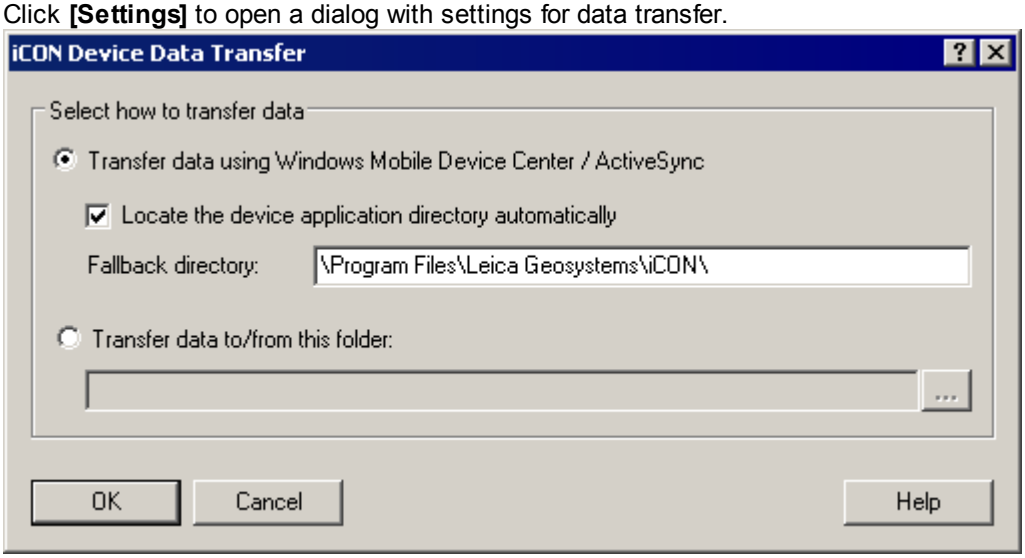
Open the dialog with ***File | Communication | iCON Field***.

When you open the dialog the active project in the office software will be displayed to the left and iCON device will try to locate a project with the same name. If a match is not found, the latest used project in the iCON application will be displayed to the right.

Buttons

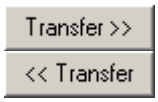
- Change active folder (to parent folder)
- Create new folder
- Explore active folder in Windows Explorer
- Delete selected files
- Preview selected files as text
- Preview selected files graphically
- Change active folder to the global folder
- Change active folder to the active project's folder

Click **[Settings]** to open a dialog with settings for data transfer.



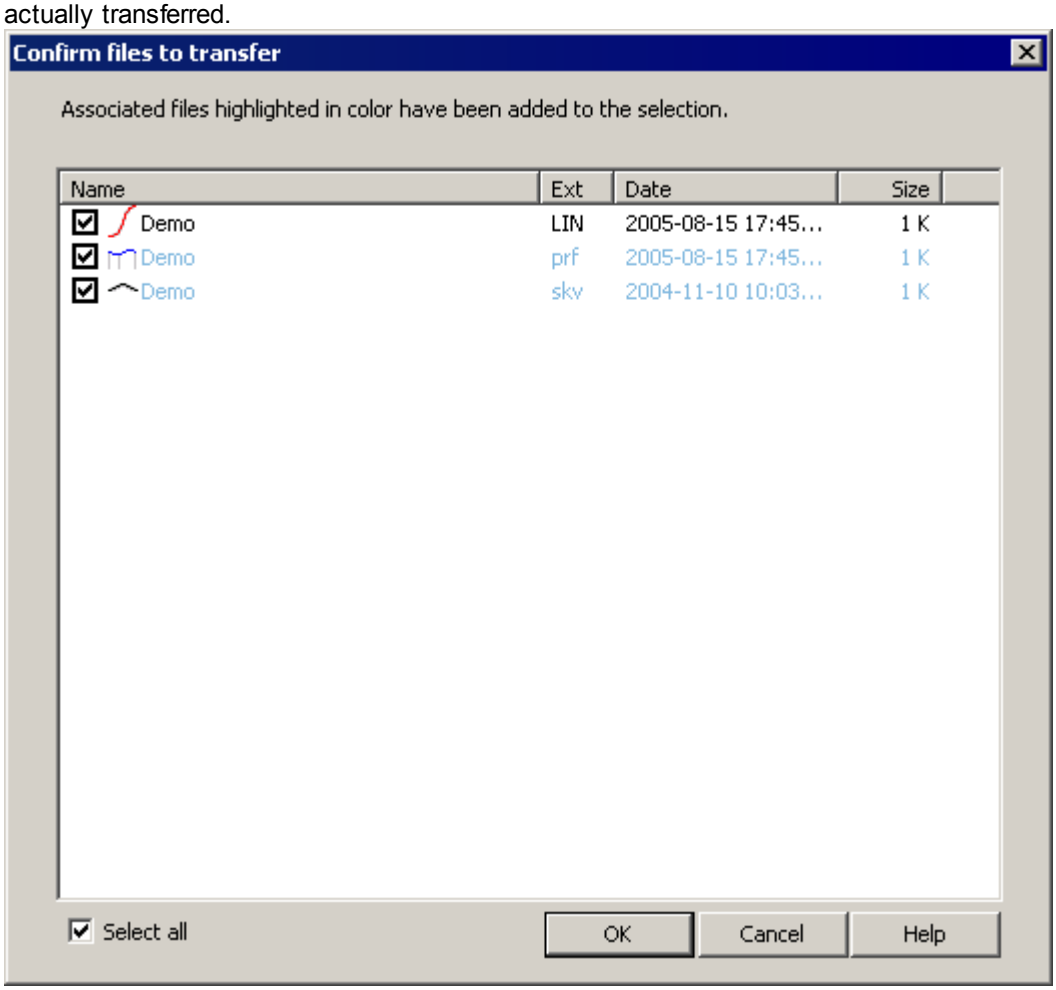
The image shows settings for the iCON device data transfer dialog.

- **Transfer data using Windows Mobile Device Center / Active Sync**
  If this alternative is selected, you need Windows Mobile Device Center or Active Sync to transfer data.
- **Locate the device application directory automatically**
  Select this alternative if you want the program to automatically locate the iCON application.
- **Fallback directory**
  You can set an alternative path if the automatic search of the application would fail.
- **Transfer data to/from this drive**
  Click the browse button ... to select path to a folder or external memory, for example your USB disc.



To transfer data select the file to transfer and press the correct transfer button. A selected file will be exported to iCON device with **[Transfer>>]** or to the office software with **[<<Transfer]**.

If the selected reference file has associated files, e.g. a horizontal alignment might have a vertical profile and cross slope data, these files will be transferred automatically. There is a possibility for the user to deselect associated files in the next step, before the files are actually transferred.



Associated files are displayed with an alternative color in the dialog.

Press **[Projects]** and all available projects on the iCON device are listed. Select a project from the list and press the **[References]**, **[Jobs]** or **[Coordinate Systems]** button depending on what kind of files you want to transfer.

If a new project on the iCON device is going to be created, press **[New]** and give the project an arbitrary name. The new project is the active project and the name is displayed on the right side of the dialog. The path is set to the reference folder of this project and ready to import reference files.

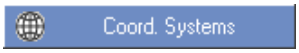
When **[References]** is selected available reference files on both sides of the dialog are listed and can be transferred. Coordinate files, terrain models and horizontal alignments are examples of reference files.

Press **[Jobs]** to
- list available jobs on the iCON application side of the dialog.
- display coordinate files (geo) and measurement data files (plm and llc) on the office software side.

If you select a job to transfer, all measured data in this job is transferred to the active project in iCON office, both measured data and coordinate files.

In the iCON application there is a folder called **Data** and when the button **[Data/ Control]** is selected the path is set to this directory. All projects in the iCON software have access to the data folder.

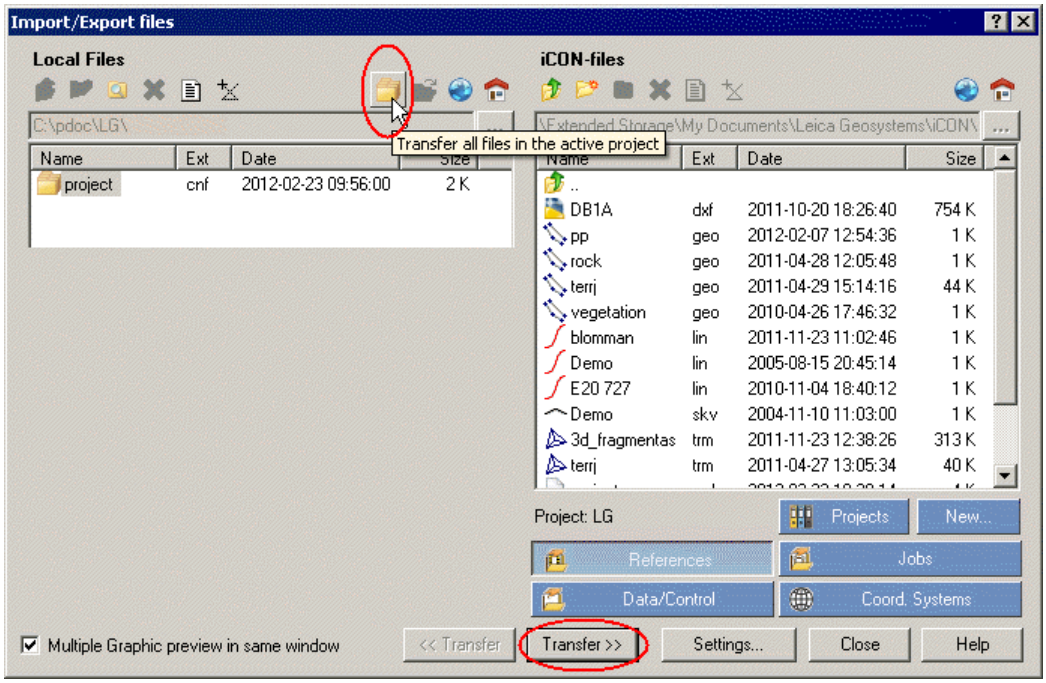
If a control point file is going to be transferred to a project, that coordinate file must be transferred to the Data folder. It is important, because when a control point file is selected for a project in the iCON application, only coordinate files in the data folder are possible to select.



Press **[Coordinate systems]** to
- list available coordinate systems files (lok) on the office software side.
- set the path to the coordinate systems folder of the project on the iCON application side.

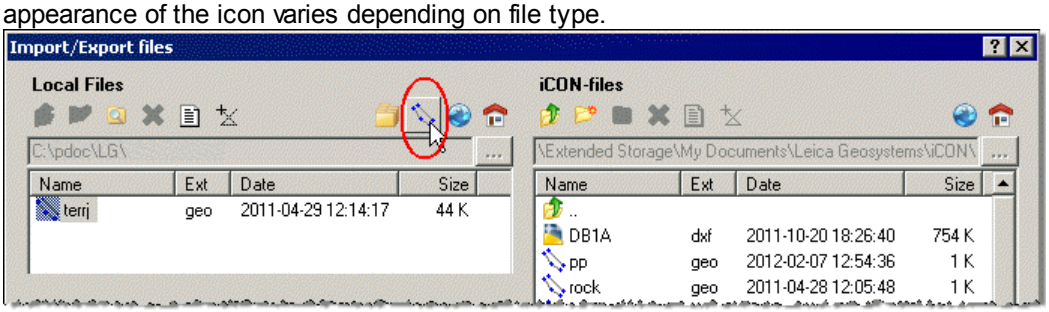
Transfer the coordinate system file you want to use to this folder in the iCON device. The coordinate system will be imported to the project and selectable for all jobs in this project.

The icon **Transfer all files in the active project** is available in the toolbar of the office software side of the dialog. It is a shortcut to select all compatible files in the active project and export them to the iCON device, instead of export them one by one. Press the icon and then the button Transfer >> to transfer all files.



Transfer active file

The icon **Transfer active file** is available in the toolbar at the office software side of the dialog.
The icon is only available if you already have opened a file in the office software. The appearance of the icon varies depending on file type.



If you want to transfer the file to iCON device, click the icon and then the button Transfer >>.

If the selected file has associated files, e.g. a horizontal alignment might have a vertical profile and cross slope data, these files will be transferred automatically.

The icon **Global folder** is available on both sides of the dialog. On the office software side it is a shortcut to the global folder of iCON office. In this folder predefined coordinate systems, geoid models, correction grids and code lists etc are saved. It is useful if e.g. predefined coordinate systems or geoid models are going to be exported to the global coordinate system folder in the iCON device.

On the iCON device side of the dialog the icon is a shortcut to the global coordinate systems folder. In this folder predefined coordinate systems, geoid models and correction grids are saved and available for all projects in the iCON software

The icon **Go to project folder** is available on both sides of the dialog. Use it as a shortcut to get back to the active project. Useful if you have been browsing for files in the global map or in other directories.

See also: Communication 455, Transfer Dialog, in General 376

8.6 UMC 3D/GeoROG

These instructions apply to communication with **UMC 3D** and **GeoROG version 6** or later.

There are several ways of transferring data to/from UMC 3D/GeoROG. iCON office is used in almost all communication and therefore must be configured correctly in both iCON office and UMC 3D/GeoROG.

The facts mentioned below about UMC 3D also apply to GeoROG version 6 and later versions.

UMC 3D supports communication with:

- GSM modem (cell phone)
- Serial cable
- TCP/IP (network cable, crossed network cable and WLAN)
- Communications server
- USB flash drive

To come to the transfer menu, click Tools in the main menu and then

.

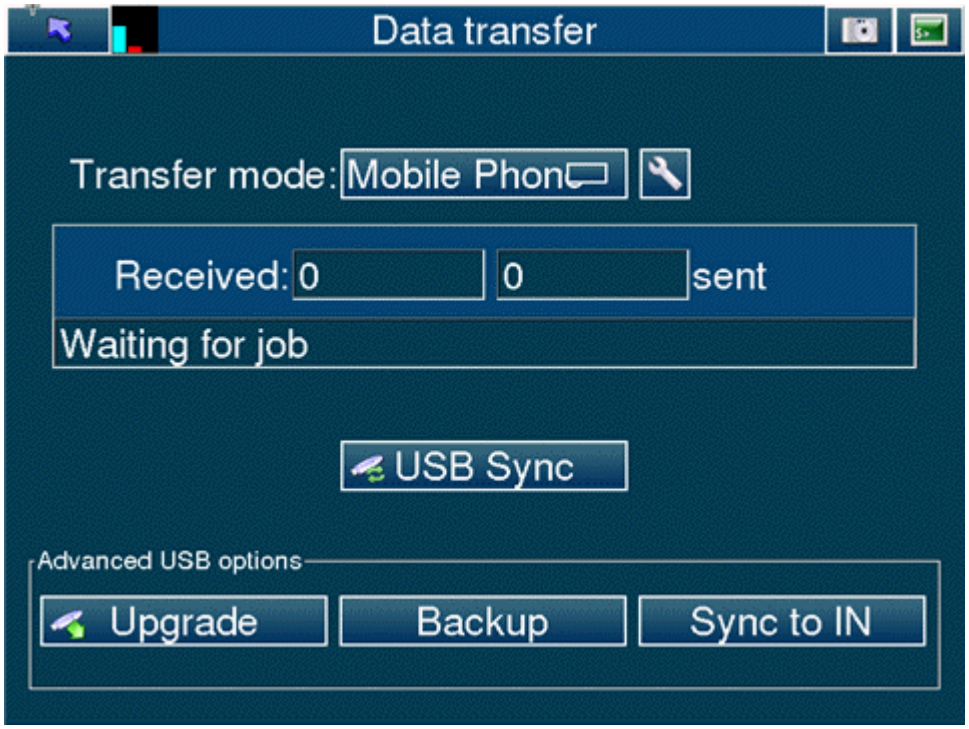
In order to transfer files, this menu must be open throughout the whole transfer. It is therefore not possible to transfer files when you are in *Run control* mode or when selecting references in the *Settings*menu.

However, when transferring by USB flash drive to UMC 3D the above does not apply, see USB flash drive transfer below.

Data transfer

To transfer files between iCON office and UMC 3D you use the transfer dialog 376. Click the button in Tools in the main menu in UMC 3D, and then

.



You use this menu to decide how to transfer data. Point to the button to the right of *Transfer mode* to be able to choose from the Mobile Phone, Serial or TCP/IP options.

The boxes *Received* and *sent* are common to the various options.

Received
The number of blocks received from iCON office are shown during file transfer.

Sent
The number of blocks transferred to iCON office are shown during file transfer.

Mobile Phone

Note that you must initialize and unlock the modem before using it. You do this in the setup menu, see below. Make sure you are in the menu for data transfer during file transfer.

SBG AB provides a GSM modem that is ready for use. Any SIM cards used must support GSM data transmission. Note that the modems are supplied without SIM cards; the user must supply these. SBG AB provides other equipment such as cables, etc.

Settings in UMC 3D
Press to select the settings for the UMC 3D modem.

Before you can use your modem (and all settings are made according to the text below) you need to unlock and initialize it.

Press Unlock to unlock the SIM card with the PIN code (see below).

Press Init to activate the modem and prepare it for data transfer.

Press Hang up to close the communication when the transfer is complete. Do this **before** you close the dialog. *Import/Export Files* (File **|** Communication **|** UMC 3D / GeoROG **|** Data Transfer) in iCON office.

Signals
The number of tones before the modem answers the call. You cannot set this to zero as the modem will then never answer. You normally set this as one.

PIN code
Enter your PIN code for the SIM card in the modem. The PIN code is supplied with the SIM card. If the modem does not use a PIN code, you can leave this box blank.

Channel
Use the drop-down menu to select the port that the modem in UMC 3D uses.

Speed
Select one of the options listed for the modem. Note that the same speed must be set in iCON office.

Fargo Maestro 100 GSM/GPRS modem

Speed
115200

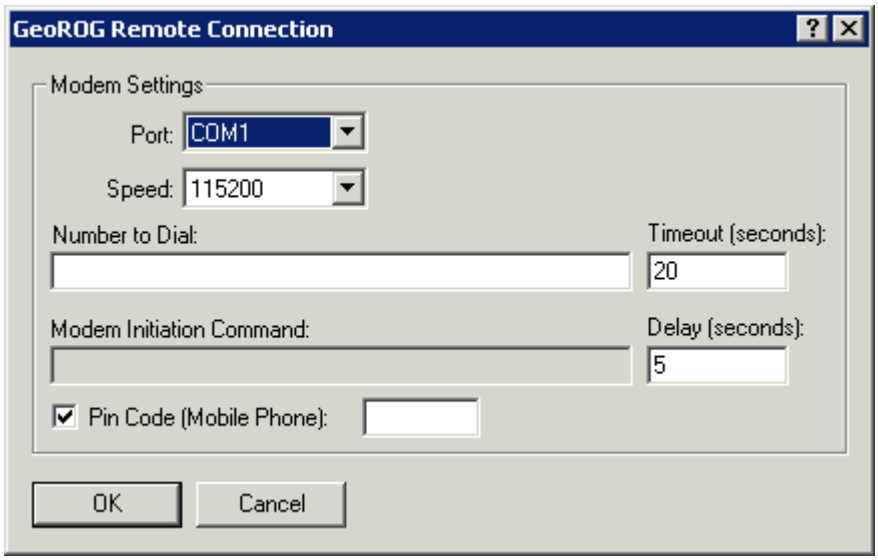
Explanation for LED

- Constant Light = Power is connected
- Flashing slowly (every two seconds) = Contact with the user
- Flashing quickly (once per second) = Connected

Fargo Maestro 20 GSM/GPRS modem

Speed
9600

Settings in iCON office for GSM modems
In iCON office select *File* | *Communication* | *UMC 3D / GeoROG* | *Remote Connection*.



When all the settings have been made and you have pressed **[OK]** the modem will try to connect to the other modem. The dialog for *Import/Export Files* opens automatically when the connection is established (see below). Before you close the dialog, you have to close the connection in the modem settings for UMC 3D.

Port
The port on the server to which the modem is connected, usually one of the serial ports (COM).

Speed
Use the drop-down menu to select the communication speed of the modem. Note that the speed must be selected in both iCON office and UMC 3D.

Number to call
Enter the number to the UMC 3D modem.

Timeout (seconds)
Number of seconds that the modem will try to connect to the UMC 3D before it gives up.

Pin code (cell phone)

Key in the pin code to the modem's SIM card. The PIN code is supplied with the SIM card. If the modem does not use a PIN, you can leave this box blank.

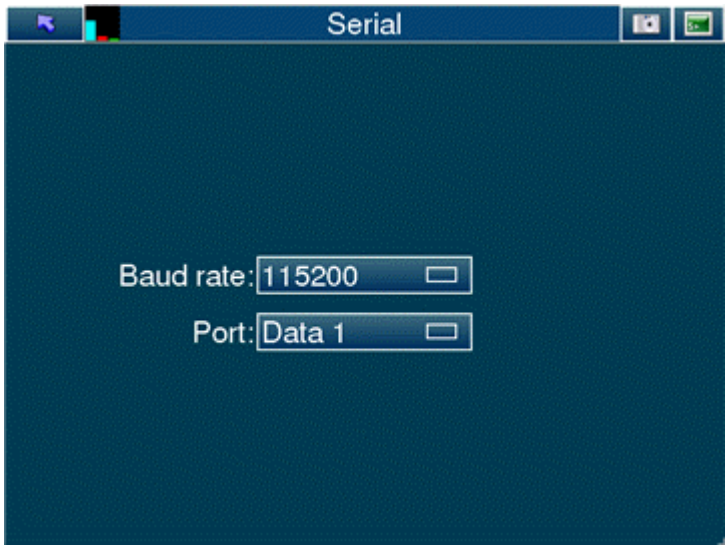
Serial

Make sure you are in the menu for data transfer during file transfer.

UMC 3D comes with a cable for serial communication. Use the cable to connect *Data 1* to UMC 3D with *COM 1* on the server for serial data transfer.

Settings in UMC 3D

Press to select the settings for serial transfer.

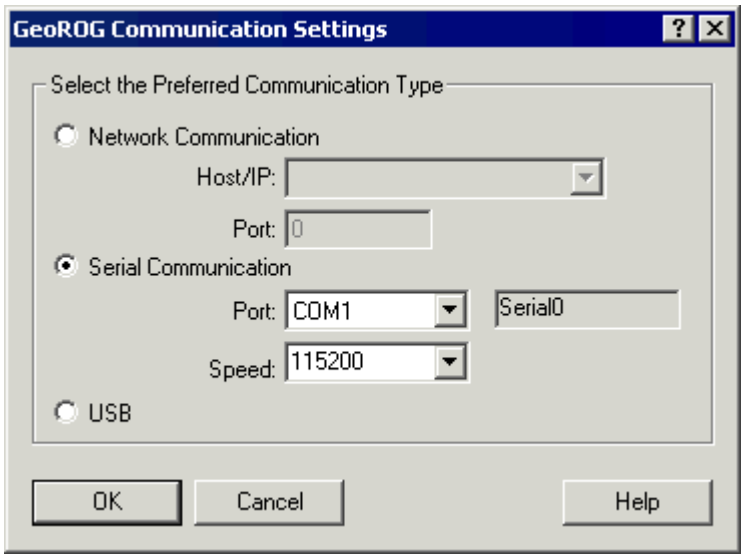


Baud rate
Select communication speed from the drop-down menu. Note that the same speed must be set in iCON office.

Channel
Port in UMC 3D to which the serial cable is connected (*Data 1, 2 or 3*).

Settings in iCON office for serial communication
In iCON office select *File* | *Communication* | *UMC 3D / GeoROG* | *Settings*.

Once you have chosen the settings and pressed **[OK]** you can start the file transfer by clicking the icon in the iCON office toolbar. See below in the Import/Export files dialog in iCON office.



Select the option *Serial transfer.*

Port
COM port on the server to which the cable is connected.

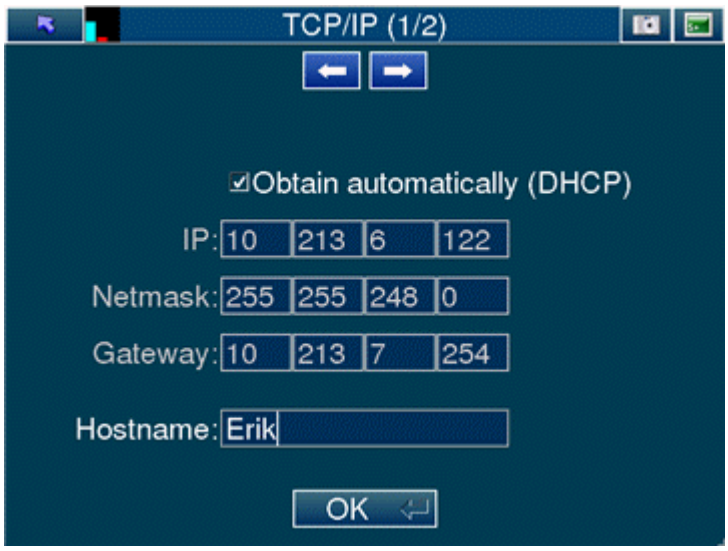
Speed
Select communication speed from the drop-down menu. Note that the same speed must be set in UMC 3D.

TCP/IP, network cable

In order for the file transfer to work, you must first have gone into the data transfer menu.

Connect the cable *before* turning on UMC 3D. Use the cable to connect *LAN* to UMC 3D and the network. UMC 3D has a port designed for standard network cables.

How to create an IP address in UMC 3D
Follow the instructions in the main menu: *Setup* > *Other* > *Data IO*

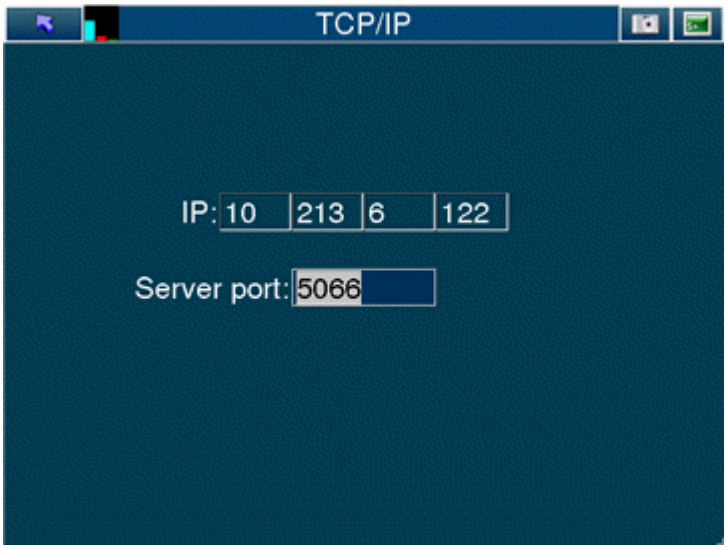


You use the IP address to identify your computer in the network. The system can either create a dynamic IP address for UMC 3D, if the network you have connected UMC 3D to distributes these dynamically, or the user can also enter a specific address.

Check the box *Obtain automatically (DHCP)* to get a dynamic IP address or enter a specific address (contact the network manager) and press OK. Return to the menu by using Data IO and check the settings.

If the network cable is inserted *after* GeoROG has been turned on, you must restart GeoROG - note that this only applies to versions older than GeoROG version 6.

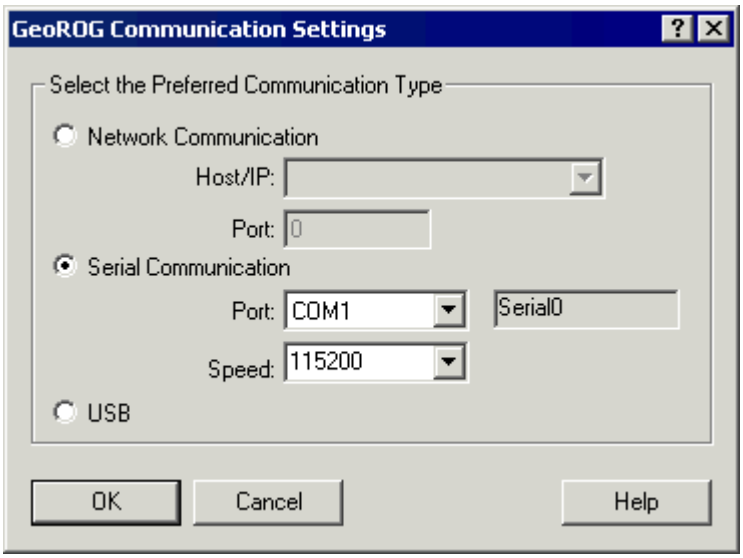
Settings in UMC 3D
Press to come to the settings for network communications



Server port
Communications port on the server, this will normally be 5066.

Settings in iCON office with network cable
In iCON office select *File* | *Communication* | *UMC 3D / GeoROG* | *Settings*.

When the settings are entered and accepted by pressing **[OK]** you can start the file transfer by clicking the button in the iCON office toolbar. See the Import/Export files dialog below.



Select the option *Network Transfer*.

Host/IP

Enter the IP address for UMC 3D, see above how you obtain this.

Port
The communication port on the server (usually 5066), must be the same as the settings in UMC 3D.

Wireless LAN (TCP/IP)

SBG AB provides GeoSite Link, a WLAN for wireless communication with UMC 3D. You can use GeoSite Link to communicate with UMC 3D out in the field directly from the office, without taking it inside.

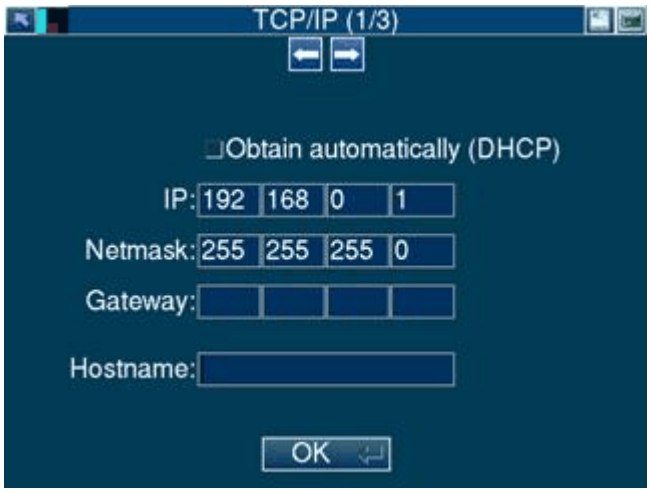
You use exactly the same settings in UMC 3D for WLAN as when you use network cable.

Crossed network cable directly connected to the server (TCP/IP)

Note that you must be in the menu for data transfer during file transfer. Select the option *TCP/IP*.

This cable allows you to connect directly to UMC 3D with your PC. Connect the cable before turning on UMC 3D, connect it to the LAN on UMC 3D and to the Ethernet port on the server. You can order the crossed network cable from SBG.

How to create an IP address in UMC 3D
Follow these steps in the main menu: *Setup* > *Other* > *Data IO*



You use the IP address to identify UMC 3D. The IP address must be the specified one, which is why the *Obtain automatically (DHCP)* box must not be checked.

IP
Set the IP address to 192.168.0.1

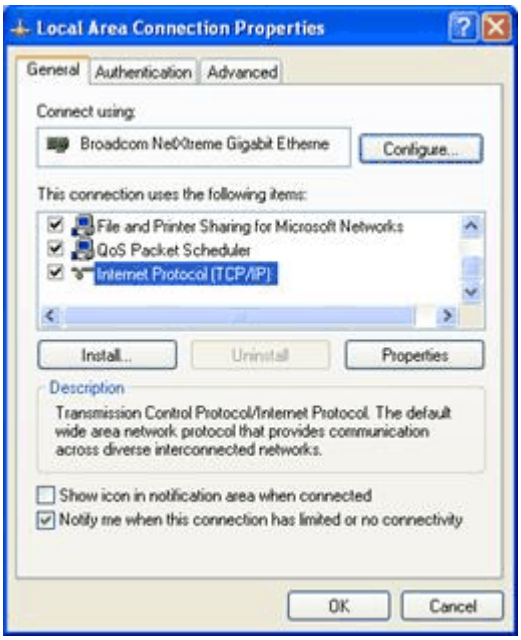
Net mask
Set the net mask to 255.255.255.0

Gateway and *Host name* has no significance and can be left blank.

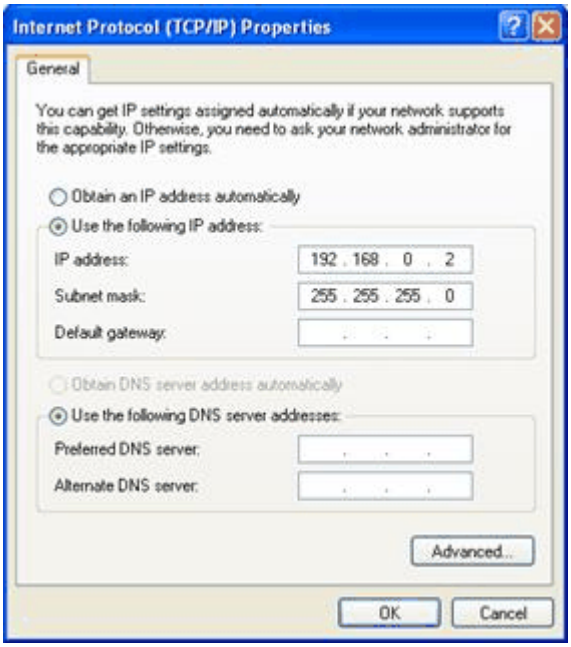
Press OK to confirm the settings.

How to create an IP address on the server
Make sure that all other network connections are closed.

- Open Explorer
- Right-click *My network places* and select *Properties*
- Right-click *Local Area Connection* and select *Properties*



- Select *Internet Protocol (TCP/IP)* and click **[Properties]**.



- Select the option *Use the following IP address*

IP address
Set the IP address to 192.168.0.2.

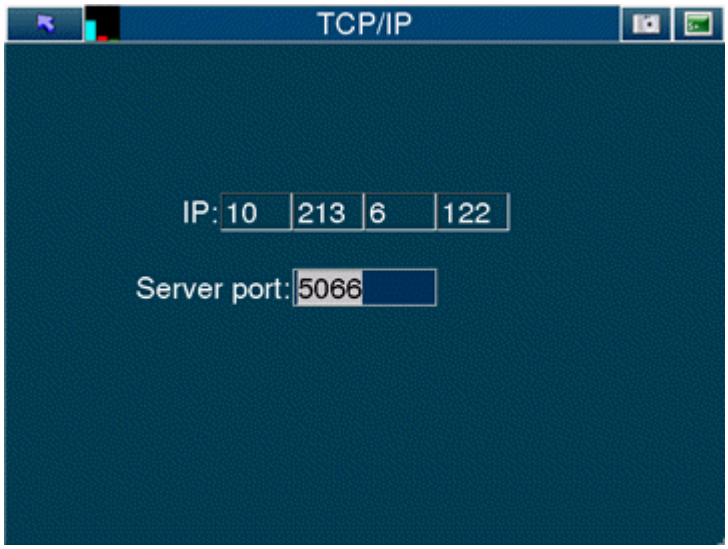
Subnet mask
Set the subnet mask to 255.255.255.0.

Default gateway
Has no effect and can be left blank.

- Click **[OK]** twice.

Settings in UMC 3D

Press to select the settings for network communications

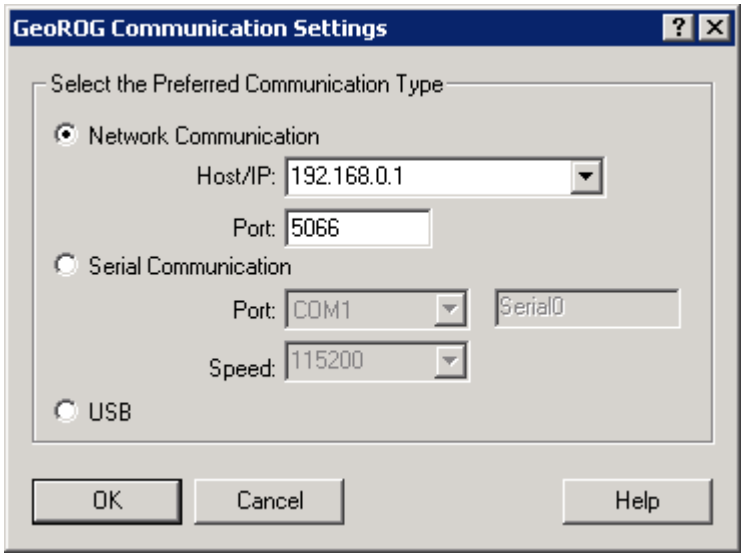


Server port

- The communications port on the server, this will normally be 5066.

Settings in iCON office for crossed network cable

In iCON office select *File* | *Communication* | *UMC 3D / GeoROG* | *Settings*.



Select the option *Network Transfer*.

Once the settings have been made and you have pressed **[OK]** you can start the file transfer by clicking the button in the iCON office toolbar. See the dialog Import / Export Files in iCON office below.

Host/IP

Enter the IP address for UMC 3D, 192.168.0.1

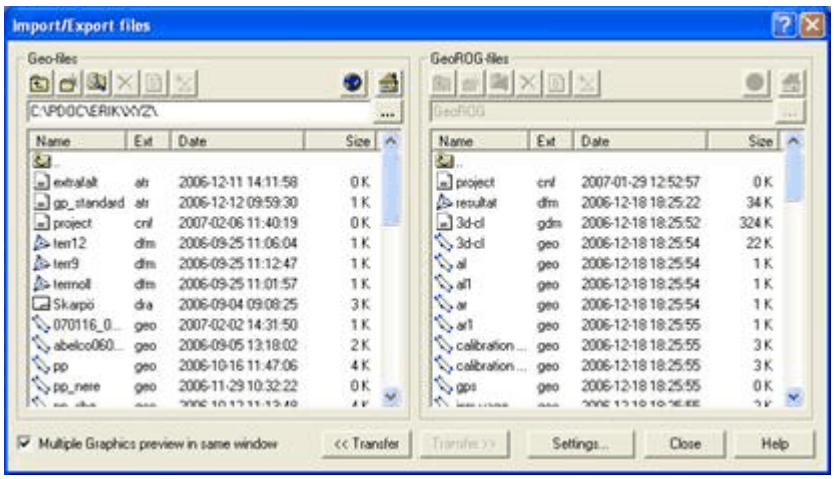
Port

The communication port on the server (usually 5066) must be the same as the settings in UMC 3D.

Import/Export dialog in iCON office

When all communication settings have been made in iCON office and in UMC 3D, click in the iCON office toolbar to start the file transfer. The dialog has a similar appearance for the different methods.

Note that the text below only contains the dialog's basic functions see Transfer Dialog, in General 376 for a more complete description.



The dialog is divided into two sections.

- To the right of the dialog you see the files in the active iCON office project (on the server). It is possible to modify the project by double clicking .. and selecting a different project folder from the list using the scroll button ...
- To the right you see the files in the project that are active in UMC 3D. By clicking in the list you can go up a step in the structure and therefore all projects in UMC 3D will appear as folders in the list. Select the desired project by double clicking it.

You can only transfer files between the projects that are shown as active in the lists.

Transfer

To transfer files to UMC 3D, you select one or more files on the left side and click **[Transfer>>]**. Select the files on the right side and click **[<<Transfer]** to transfer files from UMC 3D to iCON office. By holding down the *Ctrl*key while selecting files, it is possible to select multiple files at once.

During the file transfer, a dialog in iCON office shows the number of blocks that have been transferred. When the transfer is complete, the dialog disappears. This is also shown in the *Received* box in UMC 3D.

Associated files

If you transfer a file that has a connection to other files (volume descriptions 689 , road lines, etc.) the associated files are transferred automatically. When you transfer a lin file or mbs file, iCON office will ask *Do you want to Include associated files?* (If available). If you answer *Yes all* then all the available associated files to be transferred (if they observe the naming convention i.e. the same name but different file format). In this way you reduce the risk of important files not being included with the model.

Synchronization with USB flash drive

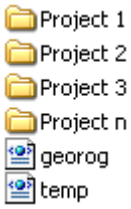
As UMC 3D has a USB port, it is possible to synchronize UMC 3D with a USB flash drive. You can transfer both projects folders and individual files.

To be able to work with a project in UMC 3D, the file *project.cnf* must be present. This file is automatically generated when creating a new project in UMC 3D. A project that has been created in iCON office also contains this cnf file and therefore the cnf file must not be created in UMC 3D if you transfer an entire project.

Data structures

UMC 3D

Illustration of the root structure in UMC 3D



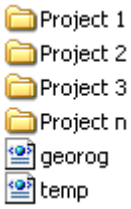
where the project folder contains project-specific files. The project folder cannot contain sub-folders.

USB

the USB flash drive must contain the folders *IN* and *OUT* in the root for the USB synchronization to work. The folders *IN* and *OUT* can be created by the user in the root of the USB flash drive.

IN

Files and folders in the *IN* folder can be transferred **to UMC 3D**. *The IN* folder must be at the same level as the root in UMC 3D. The structure must be the same as in UMC 3D with project folders and configuration files (if any).



OUT

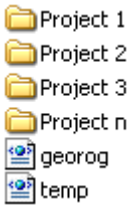
All project folders and configuration files in UMC 3D can be copied from UMC 3D to the *OUT* folder on the USB flash drive. The structure is the same as in UMC 3D.

Tip!

- Create your project in UMC 3D.
- Synchronize the USB flash drive in UMC 3D. In this way you can copy the project in UMC 3D to the *OUT* folder on the USB flash drive.
- Copies the project from the *OUT* folder to the *IN* folder. In this way you get a project with the associated *cnf* file with the correct name.
- Copy the files you want to transfer to UMC 3D to the project in the project folder in the *IN* folder in the USB flash drive.

Server

If you are working on multiple projects, it may be appropriate to create a folder on the server, for example, where all projects are stored, and name it *OUT*. Create the same structure with the project folders and names as in UMC 3D, in this folder.



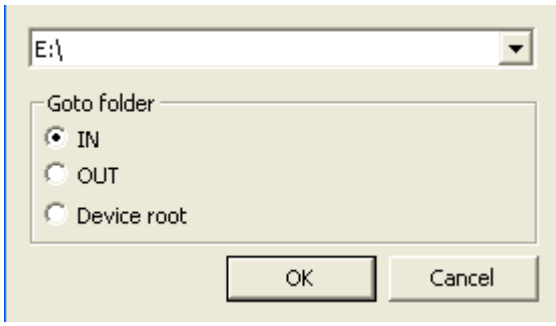
Note that the configuration files are not needed here.

Transfer files/projects from iCON office to the USB flash drive

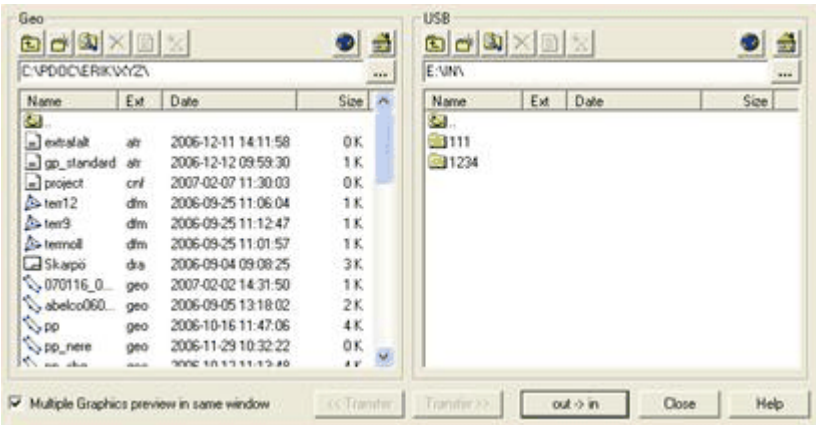
To transfer files to a project that is already created in UMC 3D, do as follows.

- Create a folder in the *IN* folder on the USB flash drive and give it the same name as the project folder in UMC 3D. Transfer files to this folder, as described below.
- If you are working in an *OUT* folder on the server, you can copy files to their corresponding project folder in the *OUT* folder.

In iCON office, go to *File* | *Communication* | *UMC 3D / GeoROG* | *File Transfer USB*.



Select the USB drive and folder to be used. Note that *IN* is the folder where you put files and folders for transfer to UMC 3D.



The dialog is divided into two sections.

- The list on the left shows the files in the active iCON office project (on the server). You can change the project by double clicking ..and selecting the project folder from the list, or with the scroll button ...
- To the right you see the files and folders in the folder in which you selected the USB flash drive in the dialog previously. You can change the project by double clicking .. and selecting the project folder from the list, or with the scroll button ...

- Open the project you want to transfer files to/from.
- Select the files to be transferred and use one of the buttons **[<<Transfer]** or **[Transfer>>]** to start the transfer.

You can only transfer files between the active projects that are listed.

- If you have created an *OUT* folder on the server, as described above, you can use the **[out -> in]** button. Go to the level where you can see the *OUT* folder in the left list.
- Go to the *IN* folder on the right side.
- Click **[out -> in]**. All project folders in the *OUT* folder on the server are copied to the *IN* folder in the USB flash drive.
- By building up the UMC 3D structure in the *OUT*folder on the server, it is sufficient to transfer data to the USB flash drive and then to UMC 3D.

Synchronize USB – UMC 3D

When you synchronize USB with UMC 3D, files are copied to the *IN* folder's project folders in the USB flash drive to the project folders with the same name in UMC 3D. If there is no project folder with the same name as in the *IN* folder, it will be created automatically in UMC 3D.

If a project folder has no *project.cnf*file, you will not be able to work on this project. However, you can create this cnf file in UMC 3D, see the UMC 3D Manual, Chapter 4.1 Projects.

A project folder that contains a *project.cnf* file can be directly used in UMC 3D.

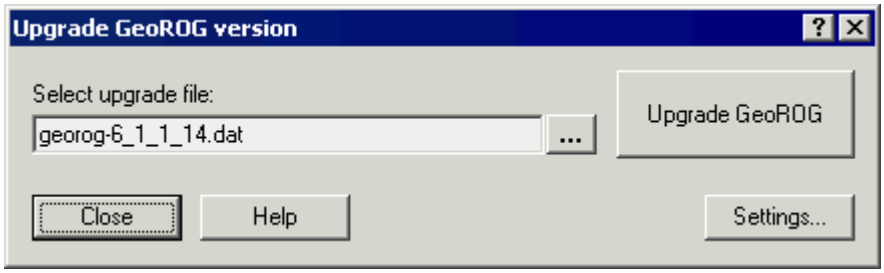
- Insert the USB flash drive in UMC 3D.
- Open the File Manager from the main menu, .
- Press USB sync.
- All files in the project folder in the *IN* folder in the USB flash drive will be copied to the project folder with the same name in UMC 3D.

Note:
If you transfer a file that has the same name as a file that already exists in UMC 3D, UMC 3D will ask if you want to overwrite the file.

- All project folders and configuration files in the root on UMC 3D will be copied to the OUT folder on the USB flash drive. The data structure is the same as in UMC 3D.

Upgrade UMC 3D Version

You can upgrade both the UMC 3D software and operating system (kernel) from iCON office. First go to ***Data transfer*** in the UMC 3D device. Now select ***File | Communication | UMC 3D / GeoROG | Upgrade*** in iCON office. Make sure the port settings are correct by selecting **[Settings...]**.



Now select the upgrade file (dat) and click the **[Upgrade]**button. During the transfer, the transferred blocks are indexed in the UMC 3D window.

The transfer will be done either with serial or network communications (TCP/IP). You set this by clicking **[Settings...]**.

Note: Upon completion of the transfer you should wait at least **10 seconds** for the upgrade to be completed properly.

If the operating system is upgraded, you must exit the UMC 3D program and then turn the device off and restart. If only UMC 3D software has been upgraded, it is sufficient to exit the program and restart.

See also: Communication 455, Import/Export Dialog 376

8.7 Geotronics, General

Communication Dialog

You use this dialog to manage communication directly with Geodimeter instruments. Select ***File | Communication | Communication*** to open the dialog.

[Read ...]:
When loading a file from a Geodimeter device, first select if you want to load Job, Area or UDS. Now specify the file you want to load into iCON office. If this is supported by the model used, a list appears with the files in the larger of the boxes. If there is a UDS, the results appear in the global folder with the name n.UDS where n is the number of the UDS. The file type for Geodimeter raw data files is gdt. The function is executed after the raw data has been loaded **Convert Raw Data**button.

[Send...]:
First you select to transfer an Area or a UDS. If you select Area you must also choose the storage name. Now select one or more files that you want to transfer.

[Convert Raw Data ...]:
This function creates new documents with data in iCON office format from the gdt file you specify.

[Delete...]:
Delete Job and Areas in the Geodimeter device if this is supported by the model.

File Dialog

This dialog shows files in the instrument's memory when you choose to load from the instrument. Enter the name of the file you want to load. For instruments 402 and up, you can also choose one of the files from the list.

Data Types

The types of iCON office files you can save depend on the types of data being transferred. The types that can be transferred are:
Polar survey data: (plm, only transfers from stacks/instruments)
Coordinate Files: (pxy, geo)
Section Files: (sec)
Road Line: (l3d. Please note, station equation is not supported, and thus cannot be transferred to Geodat.)
Line Data: (lin)
Profile Data: (prf, vertical radii are indicated with the opposite character in Geodat)
Cross Fall Models: (cfm and also skv. Please note, associated road line, l3d or lin, is automatically transferred to iCON office.)

Good to know when measuring with Geodimeter

Backsight:
The first survey point after the station establishment will be used as the backsight!

Line Numbering:
Geotronics can only increment with whole numbers. To obtain iCON office's line numbering, you can set an integer >= 1000 when measuring, with the third digit from the right = 0. This zero will be replaced by a decimal point if you choose to *convert to line no. + order no.* when transferring. Another method is to set 1,01 in comma separated format when inputting. Geodat perceives this as two whole numbers and the last one can be incremented/decremented. iCON office replaces the comma with a decimal point when transferring.

To be able to use the iCON office plm format with Special code and Remark fields, you can use functions 99

and 98.

Transfer of Line Data
In Geodat, a line cannot begin or end with a curve (radius or spiral). If you are trying to transfer a line of this type, iCON office will ask if additional elements should be inserted at the beginning and end of the line. These additional elements will have the same coordinates as the real element. If the line begins with a spiral two additional elements are added. If the line ends with a spiral, the line must be extended manually in iCON office before transfer.

Some combinations of spiral elements are not supported in Geodat. Where this occurs you must then modify the line in iCON office before transferring it. The best method is to insert short straight elements (millimeters in length) between the curves where the problems lie.

Please note, lines with station equations[515] are not supported by Geodat. Please renumber your line before transfer.

Program 39 - Roadline3D
When using program 39 in the instrument, the names of the area file for line and profile must be supplemented with a file extension. The horizontal line should have the extension #1 and the vertical line #2. iCON office suggests these extensions automatically. When using in other applications (such as P29) you can remove these extensions.

For the transfer of cross slope files, five area files are automatically generated for use in program 39. The following area files are created:

- Cross section definition (extension #3)
- Cross sections of right road half (extension #4)
- Cross sections of left road half (extension #5)
- Cross slope right road half (extension #6)
- Cross slope left road half (extension #7)

Files 3-5 describes an element that is 50 meters from the main line and the files 6 and 7 describe the cross slope of this structure along the road. Note that any profile offset will not be included in this handling. You cannot therefore let the cross slope begin a little from the main line. You cannot transfer these files back to iCON office either.

Sequence Measurement
When measuring with Geodimeter, you can choose to survey the lines using Sequence Measurement[369].

Advanced Settings
Geodimeter 600, 4X00[485]

See also: Communication[455], Communication Dialog[456]

8.7.1 Geodimeter 600, 4X00, Advanced Settings

Labels and UDS

Before surveying you must define a measurement program, UDS, using program 40 in Geodimeter, or you can transfer and use the UDSs installed with iCON office, *1.uds* and *11.uds*. iCON office only handles a subset of the labels that can be used in Geodimeter. The following labels are used by iCON office:

0 = Info
2 = Station
3 = Instrument height
4 = Point code
5 = Point number
6 = Signal height
7 = Horizontal angle
8 = Vertical angle
9 = Slope length
15 = Area
21 = Hv. reference
37 = X-coordinate
38 = Y-coordinate
39 = Z-coordinate
50 = Job No
51 = Date
52 = Time
53 = Operator
54 = Project ID.
55 = Instrument ID.
56 = Temperature
62 = Ref. Object
64 = Radius
72 = Abskissa
73 = Ordinata
74 = Air pressure
80 = Section
81 = A-parameter
82 = Section range
83 = Offset
98 = Remark
99 = Special code
101 = New line, no
102 = End line
103 = Single free point
104 = Optional attribute

Proposal for UDS (program 40)

Prog.No	Name	Lead text	Label	Type	Remark
1	Stn-estab.	Logon		(10)	
		STN	2	1	
		IH	3	1	
		DATE	51	1	
		INSTR.ID.	55	1	
		OPERATOR	53	1	
		TEMP	56	1	
		PRESS	74	1	
		END	79	7>11	Connect to program 11
11	INM-XYZ	PNO	5	4	Countdown (and up)
		PCODE	4	3	Repeat
		SH	6	3	Repeat
		PNO	5	8	View/Change
		PCODE	4	8	View/Change
		SH	6	8	View/Change
		HA	7	0	From instrument
		VA	8	0	From instrument
		SD	9	0	From instrument
		END	79	5	Loop

These UDSs are held in a global folder with the file names 1.uds and 11.uds and can be transferred to the instrument. Note that iCON office's UDS format is not the same as in Geotronics own software (e.g. Terramodel) even if they have the same file extension. You must therefore transfer these enclosed UDSs to the instrument using iCON office.

Line Handling

You handle line measurement in-field either through point numbering or by adding labels for line start and end. When you load data from Geodimeter you are asked about how you want to measure lines.

- **Labels**
  Use the control codes below to indicate how the lines are measured. You enter the control codes and their values with the **F**key in the field. You can use program 41 in the instrument to create a label for these functions, so that, for example, "LINE =" is inserted instead of "F101 =" when inputting. This is not necessary for it to work, but looks more presentable.

  NOTE: NOTE: NOTE: When entering a function code and value, the instrument displays the previously suggested value, but if you just confirm this with <ENT> the label will NOT be saved. You MUST therefore set the value again, even if this is the same as before. The instrument does not save the label either if no value has been specified, which means you must enter a value, for example 1, for the labels in the table below where the value has no function and is optional.

Label	*Function*	*Value*
F101	Starts a new line, automatically closes previous line if any.	Line no
F102	Closes the line and returns to single point measurement. Note that a line can also be closed by starting a new line with F101.	Optional
F103	Resumes the last line closed with F102, this and the following points appear at the end of the line.	Optional
F104	This measurement is a single free point. The next measurement will continue automatically with the current line.	Point code for the free point, or 1

- **Point numbers (1.01, 1.02..)**
  You measure the lines by entering both line number and serial number in the point number field, separated by points. Lines are created when loading data.

- **Point numbers (1001, 1002..)**
  You measure the lines by entering the line number as a 1000 series. Each new thousand begins a new line, the 100s digit is 0, and the last two are used for series numbering. Lines are created when loading data.

Attribute Handling

Attributes are added with label 100 and are entered as <name> <separator> <value> where <separator> is a comma or point. Label 100 can either be added to the UDSs if you plan to use the attributes often, or can be used occasionally with F100. "TS, -1.23" would give the TS attribute the value -1.23. To avoid having to switch between numeric and alpha-input in the display, you may want to give your attributes reference numbers in the attribute definition file, for example, you would instead enter "34.-1:23" which would give the attribute 34 the value -1.23. Also note that the attributes of the type referred to as Alternative are entered as an index starting at 0, i.e. the value 4 will give the fifth alternative for the TS attribute. Read more in general about attributes in Optional Attributes 113.

Rounds of Measurements

Rounds of Measurements should be performed using program 32 to facilitate loading in iCON office. Before you start a station, you should specify pressure and temperature and then set atmospheric correction to zero, ensuring the latter can be executed in iCON office. The best way of doing this is by running a UDS before program 32.

Prog.No	Name	Lead text	Label	Type	Remark
2	JOB-SET	Logon		(10)	
		DATE	51	3	
		INSTR.ID.	55	3	
		OPERATOR	53	3	
		TEMP	56	1	
		PRESS	74	1	
		PPM	30	1	Enter PPM = 0 !
		Offset	20	1	Set offset = 0 !
		PrismK	33	1	Enter correct prism constant.
		END	79	6	

The UDS is held in the global folder with the filename 2.uds, and can be transferred to the instrument.

Protocol

Measures in Geodat 4X00/600 for communication with iCON office

1. Press the Menu button [MNU]
2. Select "Data Com." (alt 4)
3. Choose "Select Device" (alt 1)
4. Select "Serial" (alt 2)
5. Select "Serial On" (alt YES)

You will now see the communication settings:

COM = Stopbits.Databits.Parity.Baudrate
(Parity 0 = none, 1 = odd, 2 = equal)

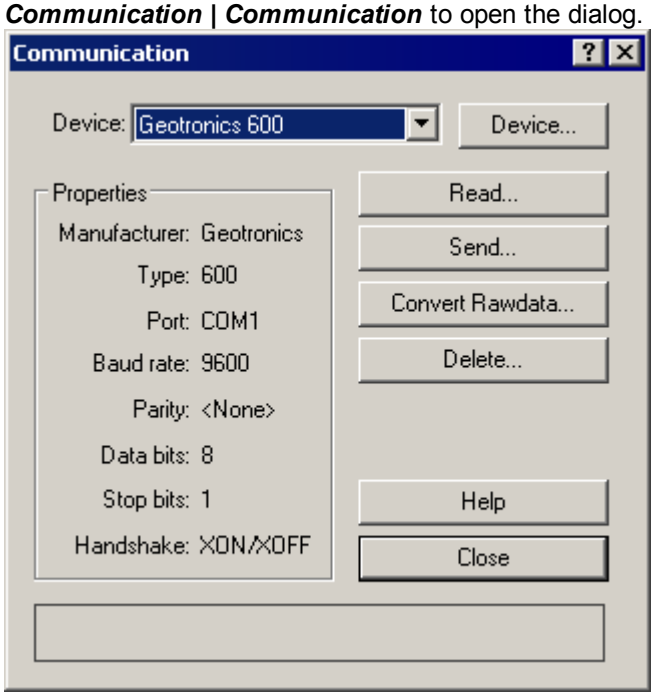
For recommended settings enter 1.8.0.9600
Handshake is always XON/XOFF

See also: Communication 455, Communication Dialog 456, Geodimeter 483

8.8 Leica Wild

Communication Dialog

You use this dialog to manage communication directly with Wild/Leica instruments. Select ***File*** | ***Communication*** | ***Communication*** to open the dialog.



[Device ...]:
Change the port settings for communication. Note that the models supported here all work with seven data bits, which is why this cannot be changed for Wild. For GRE-34 check that the three switches inside interface GIF 2 are set correctly.

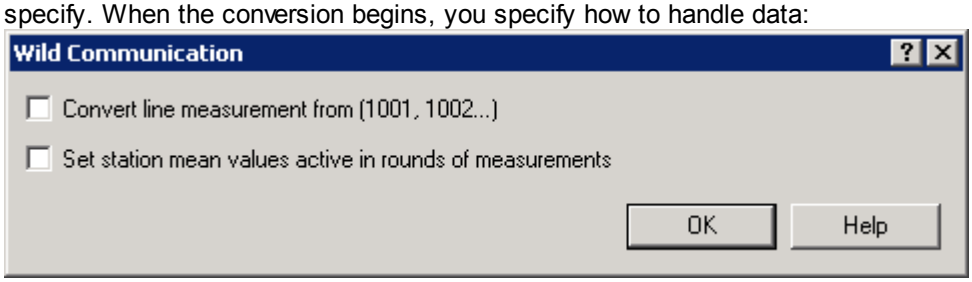
[Read ...]:
When you start to load data from a Leica instrument, you will be asked which file number to load. Survey data is always stored in file 1. You can also specify the starting block and number of blocks to be loaded. If the number of blocks is not entered, iCON office loads all available blocks. The file type for Leica raw data files is .gre or .gsi. The function is executed after the raw data has been loaded **Convert raw data**.

For conversion directly from Leica levelers, the transfer must begin in the instrument. First press **[Read ...]** in iCON office, and then **PROG/REC-M/SEND/YES** on the leveler.

For Leica TC X05, you respond to what is to be loaded; survey data or coordinates.

[Send...]:
First select one or more files that you want to transfer followed by the file number in the Leica instrument. Coordinates for transfer to the instrument are usually stored in file 2.

[Convert Raw Data ...]:
This function creates new documents with data in iCON office format from the raw data file (.gre, .gsi) you specify. When the conversion begins, you specify how to handle data:



- **Convert line measurement from (1001, 1002 ..)**
  As an alternative to handling line numbering with line numbering codes, you can specify points as whole number> = 1000 when measuring with the third digit from the right = 0. This zero will be replaced by a decimal point if you check this box.

- **Set the station mean values as active in the rounds of measurements**
  If this option is selected when transferring rounds of measurement data, the station mean values will become active in the survey file (plm). Survey points and whole rounds become passive. If this box is not selected, the survey points become active and the whole rounds and station mean values are passive.
  The box is only selectable if the file to transfer contains rounds of measurement data.

[Delete...]:
Deletes a file in the Leica drive.

Warnings

- **Non-numerical data:**
  Only the latest Leica instruments can handle alphanumeric characters. If you are not sure if the instrument can handle this, you can cancel the transfer.

- **Data field too long:**
  A data field in a transfer record has too many characters or digits. For example, if you have coordinate values with too many figures, the transfer will fail.

Data storage and field coding with Leica instruments when measuring

Storage and transfer are in the form of two block types; code blocks and data blocks. Some data may either be stored in the data block or the code block, and is then entered in two different ways.

- **Data block:**
  Data block may contain polar survey data, coordinates, leveling data, instrument status etc. The data block consists of 2-12 "Wild-words" each of 16 characters, where each Wild-word begins with a type designation which indicates the contents of the word, along with a format definition. A block of data always starts with the numbers 11, and the first Wild-word also contains a serial number for stored blocks. See below for the type designations used and what they mean.

- **Code block:**
  The code block is constructed in the same way as the data block with 1-8 Wild-words of 16 characters each. A code block begins with the numbers 41, and also a code number. The initial Wild-word can then be followed by up to seven Wild-words, known as "info-fields" containing information related to the code. How these codes and "info-fields" are used in relation to iCON office is defined below.

Station establishment

Station establishment can be done using code 4 if you want to create a quick establishment for the storage of survey data only. Leica's program is also excellent for establishing a known point or free station, which also gives the possibility of using coordinates.

In order to take care of the survey data, a station establishment (code 4, see below) must first be identified in the data set. Note that all data blocks that lie before a station establishment are ignored! If there is a free station, you must first enter the code -4, otherwise you lose the backsight as the instrument stores backsight before the station establishment.

Line Handling

You can carry out Point/Line control with either code 6 and 7 as per Line Handling 494 below, or with the instrument's custom routines. In the former case the mergers are only shown when the file has been purged to iCON office, not in the instrument's graphical view. In the latter case, there are certain restrictions when exporting survey data, but the coordinates work correctly.

Field handling, data block

A data block is stored on the card for each survey point and consists of polar survey data and/or coordinates, leveling data, etc. The type codes to be stored are determined by a rec-template. How you create and use rec-templates is described in Leica's manuals. In addition to Leica's standard type designations for this data, there are a number of designations that can be used in a way of your choice. Some of these have special functions in iCON office and are listed below. Note that this data can also be specified using code blocks, see below.

Type designation	iCON office data
71	Point code in survey file or coordinate file.
72-79	Used for attributes, special codes or remarks, see above. See also Attribute Handling 113 for a description of optional attributes.

Field handling, code block

For iCON office to interpret data correctly, codes should be added as shown below. The code block is entered in the instrument by pressing ***Code*** and entering the code and additional data.

Common data:

Enter these first in the file.

Code No.	Info 1	Info 2	Info 3	Info 4
1	Date	Operator	Instrument no.	-
2	Job	-	-	-
3	Temp	Pressure	-	-

Station establishment:

A *station layout of known points* begins with a code block as shown below; the first subsequent measurement is the backsight, the others will be measurements.

Code No.	Info 1	Info 2	Info 3	Info 4
4	Stn No.	Instr.hght.	-	-

If you use the *Leica program for free station* you must add a block of -4, without info, before you start the free station program.

Code No.	Info 1	Info 2	Info 3	Info 4
-4	-	-	-	-

After you run the program, you must add a code block 4 with details as above and measure in relation to the backsight again.

When surveying:

Ignore the previous measurement

Code No.	Info 1	Info 2	Info 3	Info 4
5	-	-	-	-

Length extension

Code No.	Info 1	Info 2	Info 3	Info 4
8	Length extension in mm.	-	-	-

Temporary length extension (used only once)

Code No.	Info 1	Info 2	Info 3	Info 4
-8	Length extension in mm.	-	-	-

Reflector height

Code No.	Info 1	Info 2	Info 3	Info 4
9	Pole height in mm	-	-	-

Temporary reflector height (used only once)

Code No.	Info 1	Info 2	Info 3	Info 4
-9	Pole height in mm	-	-	-

Special code/Remark

Code No.	Info 1	Info 2	Info 3	Info 4
-10	Special code	Remark	-	-

General point coding

Code No.	Info 1	Info 2	Info 3	Info 4
10-9999	-	-	-	-

Optional Attributes:

Set to -11, see Attribute Handling 113 for a description of optional attributes

Code No.	Info 1	Info 2	Info 3	Info 4
-11	Attribute type	Value	-	-

Line Handling:

In order to handle lines in fields, you use code 6 to turn on and off line measurement, and select line numbering type. Code 7 is used to start a new line. The automatic line numbering process as described below creates point numbers in the format 1:01, 1:02 .. when loading, and this is then converted to lines. You can also renumber your points in this way manually without specifying the line numbering code. You can also number lines with (1001, 1002...). Each new thousand begins a new line, the 100s digit is 0, and the last two are used for series numbering. Lines are created when loading data if you check the option box *Convert line measurements from (1001, 1002 ..)* in the dialog that appears when transferring, see Convert raw data 490.

Line numbering code

Code No.	Info 1	Info 2	Info 3	Info 4
6	Line no. type (See below)	Number of dec.	-	-

Line numbering type:

0 = No line numbering
1 = Line no as per code 7 info 1, sequence number = point number specified in stack, separator = decimal point.
2 = Line no = point code, sequence number = point number specified in stack, separator = decimal point.
3 = Line no = point code, sequence number = point number specified in stack, no separator.
4 = = Line no as per code 7 info 1, sequence number automatically incremented = number of decimals as per info 2. If no line number is specified, line numbers are automatically incremented.

Line Code

Code No.	Info 1	Info 2	Info 3	Info 4
7	line number (See below)	Number of dec. default value=2	-	-

If only code 7 is entered, but no line number, the line number will be automatically incremented each time code 7 is used.

Rounds of Measurement/Traverses:

Code No.	Info 1	Info 2	Info 3	Info 4
50	File	Date	Temp	Pressure
51	Operator	Instr.no.	-	-
52	Station	Instr.height	-	-
53	Reflector height	-	-	-
54	Tolerance HA	Tolerance VA	Number of sounds	Number of objects

It is important that you do not omit any of these codes. With a correct rec template and Leica's rounds of measurement program, this data is created automatically. In the dialog that appears when transferring, you can check the option *Set station mean value as active in the rounds of measurements*, which will mean that additional data will be set as passive in the survey file. Otherwise, the raw data is set as active and the rounds and station mean value as passive, which is appropriate if you want to perform rounds reduction with iCON office.

The pressure and temperature specified in the SATSA program (code 50 above) is only submitted as information and does not affect the measurement. Correction must be done later in iCON office. Remember to set the atmosphere correction to zero PPM in the instrument before the rounds of measurement.

Settings in GRE 3/4:

mode 70
mode 71
mode 72 = 0
mode 73 = 1
mode 74 = 1

Common errors when transferring:

No station establishment made!
Switches in interface GIF two incorrectly set.
Faulty cable.
Oxide on the contacts between GRE and Interface.

See also: Communication 455 , Communication Dialog 456 , Import/Export Dialog 376

8.9 Sokkia

Communication Dialog

You use this dialog to manage communication directly with Sokkia total stations. iCON office supports Sokkia SDR 2, SDR 3 and SDR 33. Select ***File | Communication | Communication*** to open the dialog.

[Read ...]:
The file type for Sokkia raw data files is sdr. The function is executed after the raw data has been loaded **Convert raw data**.

[Send...]:
First select one or more files that you want, and then the storage name in the Sokkia instrument.

[Convert Raw Data ...]:
This function creates new documents with data in iCON office format from the raw data file (sdr) you specify.

See also: Communication 455, Communication Dialog 456

8.10 Geodos

Communication Dialog

You use this dialog to manage communication with Geodos. Select ***File | Communication | Communication*** to open the dialog.

[Read ...]:
The file type for Geodos raw data files is psn. The function is executed after the raw data has been loaded **Convert raw data**.

Press **arrow up**, select **COMMS**, check the communication parameters (see below). Select **TRANSMIT**, **FILE**, and enter the name of the file you want to transfer. Change the unit in Geodos with **<MODE>**.

[Send...]:
Set the Geodos unit to receive mode and select one or more files that you want to transfer to the field memory.
Measures in Geodos: Press **arrow up**, select **COMMS**, check the communication parameters (see below). Select **RECEIVE**, **FILE**, and enter the name of the file you want to transfer. Change the unit in Geodos with **<MODE>**.

[Convert Raw Data ...]:
This function creates new documents with data in iCON office format from the raw data file (psn) you specify.

Good to know when measuring with Psion

Backsight:
The first survey point after the station establishment will be used as the backsight!

Line numbering:
Use the **USER** function to set the value for the increment, or enter *1.01>0.01* when you start the measurement of line one (*>0.01* enter the increment with 0.01)

Handling of special code/remark.
To enter the special code and remark, use position 6. First you enter the special code (maximum of two characters), followed by a slash (/) and then the remark. If no slash is entered, the whole field is interpreted as a remark. E.g. *C2/5.8* means the circle function from two points (C2) and a radius of 5.8. See also code lists 203 for more information about the functions.

Transfer of line data:
In Psion a line cannot begin or end with a spiral; several spirals cannot follow each other either. To address this, you should complement the line in iCON office with short intermediate elements before transferring.

Common errors when communicating with Psion:
Parameters incorrectly set; double-check that all parameters are set correctly. Psion communication parameters are automatically reset when communicating with instruments, and therefore need to be checked before each transfer.

When starting up Psion, this sometimes generates a check digit that appears as the first character in the data file. This means that a survey file will not be recognized as a survey file. Fix this by either editing out the character in the received raw data file in the sub-library, RAW, or by simply resending the file.

Data types:
The types of iCON office-files you can save depends on the types of data you transfer. The types that can

be transferred are: *polar surveying data* (only transfer from Psion), *coordinate Files*, *local section data*, *line data* (the file transferred from Geodos must be checked[517] before using in iCON office), *profile data* (vertical radii are indicated with a reverse character in Geodos).

Advanced settings

Recommended settings in Psion are:
2400 baud, no parity, 8 data bits, 1 stop bit, RTS/DTR handshake.

Set these by pressing the arrow up, select **COMMS**, **SETUP**. Set the communication parameters as you would in iCON office by selecting the parameter with the arrow up/down, and selecting the setting with arrow right/left. Finish with **<MODE>**, **EXIT** or **SAVE**. You can save the settings under one name.
Note: Max baud rate from Psion: = 9600, to Psion = 2400.

See also: Communication[455], Communication Dialog[456], Import/Export Dialog[376]

8.11 Topcon instrument

There are two ways of communicating with Topcon instruments, either using the memory card (or USB flash drive) or directly with the instrument. When transferring with memory cards you use the transfer dialog 376 and direct communication is made with the Communication Dialog 456.

Communication Dialog

You use this dialog to manage communication directly with Topcon instruments. Select ***File* | *Communication* | *Communication*** to open the dialog.

[Read ...]:
The file type for Topcon raw data files is .tcn. The function is executed after the raw data has been loaded **Convert raw data**.

[Send...]:
Select one or more files that you want to transfer.

[Convert Raw Data ...]:
This function creates new documents with data in iCON office format from the raw data file (.tcn) you specify.

See also: Communication 455, Communication Dialog 456, Import/Export Dialog 376

8.12 Zeiss

iCON office can transfer leveling data from Zeiss DiNi 10/20 with direct communication.

Convertible File Formats:

- **iCON office:**
  Leveling data: (lvt, lev)
- **Zeiss:**
  Zeiss files: (zss)

Communication Dialog

You use this dialog to manage communication directly with Zeiss instruments. Select ***File | Communication | Communication*** to open the dialog.

[Read ...]:
The file type for Zeiss raw data files is zss. The function is executed after the raw data has been loaded **Convert raw data**.

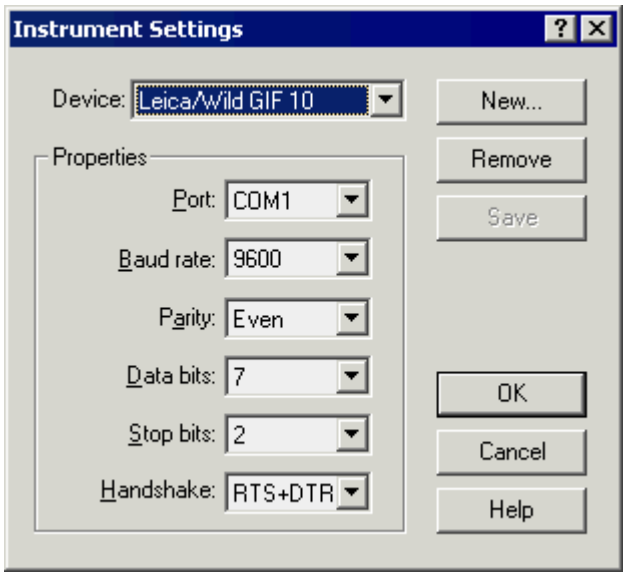
[Send...]:
Select one or more files that you want to transfer.

[Convert Raw Data ...]:
This function creates new documents with data in iCON office format from the raw data file (zss) you specify.

See also: Communication 455, Communication Dialog 456, Import/Export Dialog 376

8.13 Instrument Settings

Device:
Communication devices installed in the system that allow you to store the port settings even when you have multiple devices from the same manufacturer. This makes handling much easier when you are using several different devices. The devices installed are listed below. Select the device you want to edit the settings for from the list, or install a new one by clicking **[New ...]**, see below. If you are unsure about which communication parameters to use, consult the instrument manual and/or help section for the relevant instrument.



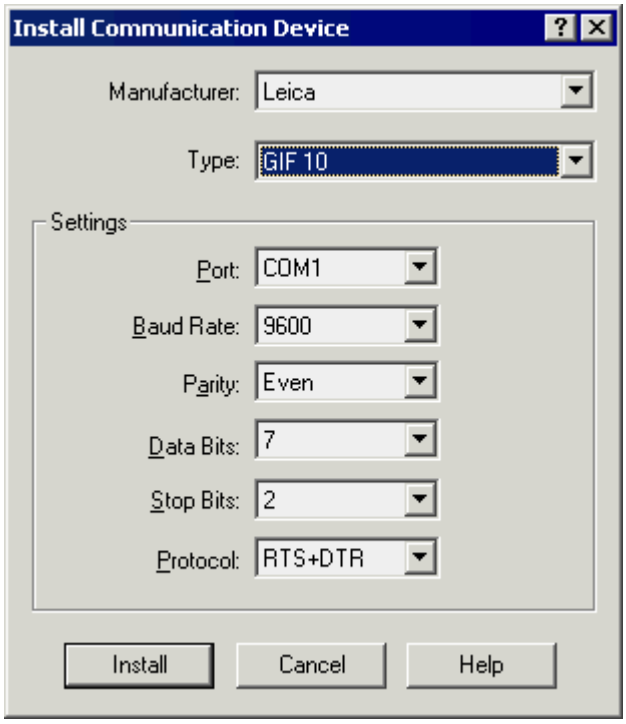
Properties:
Here you see the current port settings for the selected device. When you change a parameter the **[Save]** button illuminates. Do not forget to save before you exit the dialog with **[OK]**.

[New ...]:
Click here to install a new device. Clicking on the button opens the installation dialog, see below.

[Delete]:
Click to delete an installed instrument from the list.

[Save]:
If you have changed one or more parameters, click here to save the settings and exit with **[OK]**.

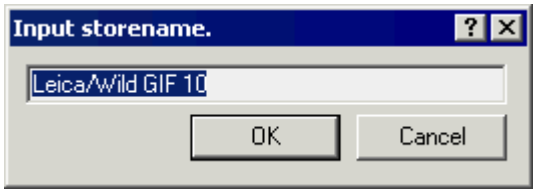
Installation Dialog
You install a new communications device here.



Manufacturer:
First select the make of your instrument. Depending on the make, the various models that are supported by iCON office are listed below.

Model:
After selecting the make of the list above, select a model here. iCON office automatically loads the communication settings for the instrument recommended by us.

[Install]:
After selecting the make and model, as well as the parameters you want, click here. When you press **[Install]** you will be prompted to enter a storage name. Here you should enter a name that you can easily associate with the instrument in question.



See also: Communications 455, Communication Dialog 456

9 Road

9.1 Lines in Three Dimensions

Line handling

Line handling in iCON office includes all functions needed to describe and calculate lines. The line document describe a line horizontally and vertically.

- The file type l3d contains the line's horizontal and vertical geometry.
- The file type cfm is a cross fall model containing the cross fall perpendicular to the center line.
- The older line styles (lin, prf and skv) can of course also be used in iCON office.

line style	corresponds to	older format
horizontal geometry, l3d		line, lin
vertical geometry, l3d		profile, prf
cross fall model, cfm		camber/cross fall, skv

The line style, l3d, horizontal geometry

The line style l3d includes two tabs, describing the line's horizontal and vertical geometry.
Information about the older format, lin, is described in Line Data, lin 521 .

Demo.l3d

	Element Num	N	E	Chainage	Type	Radius	End Radius	Parameter	Bearing	Length
1	Demo.1	60 443,134	4 086,95	0/000,00	Line				235,4007	65,36
2	Demo.2	60 387,624	4 052,45	0/065,36	Circle Arc	200,00			235,4006	135,29
3	Demo.3	60 304,529	3 948,96	0/200,65	Circle Arc	-300,00			278,4646	169,50
4	Demo.4	60 207,239	3 812,91	0/370,15	Line				242,4947	220,05
5	Demo.4	60 034,419	3 676,69	0/590,20	Point				242,4947	
6										

Horizontal Geometry | Vertical Geometry

See also Line Numerical View 507 .

The line style, l3d, vertical geometry

Select the tab Vertical Geometry to display the the line's vertical geometry.
For information about the older format prf, see Profile data, prf 525 .

Demo.l3d

	Element Num	Chainage	Z	Type	Radius	Parameter	Start Slope	Length
1	Demo.1	0/000,00	49,71	Line			-5,97	25,89
2	Demo.2	0/025,89	48,16	Circle Arc	600,00		-5,97	31,69
3	Demo.3	0/057,58	47,11	Line			-0,68	55,51
4	Demo.4	0/113,09	46,73	Circle Arc	-800,00		-0,68	41,12
5	Demo.5	0/154,21	45,39	Circle Arc	1 000,00		-5,83	61,49
6	Demo.6	0/215,70	43,70	Line			0,33	205,50
7	Demo.7	0/421,20	44,37	Circle Arc	-3 000,00		0,33	48,93
8	Demo.8	0/470,13	44,13	Circle Arc	3 000,00		-1,37	122,05
9	Demo.9	0/592,18	44,94	Point			2,70	
10								

Horizontal Geometry | Vertical Geometry

See also Line Numerical View 508 .

Cross fall model, cfm

A cross fall model is used to describe the cross fall from a road line, that is, the perpendicular slope from the center line.

The Cross Fall Model, cfm, replaces the older file format, skv.

The Cross Fall Model always associates to a certain road line, l3d.

You'll find more information about the cross fall model in Cross Fall Model, cfm 536 .

For information about the older Cross Slope Files, see Cross slope Files, Skv 540.

Line function

When a line file has been opened, line specific functions will be available.

You will find lines useful when you are working with e.g. roads, pipes and tunnels.

When a line document has been opened, you will find the following line specific functions under the Data menu.

- Insert Station Equations 515
- Cross Sections along Line 557
- Correction of Points to Sections 576
- Coordinates to section and offset 580
- Correction of Points to Sections 584
- Correction of Points to Profiles 586
- Create cross slope file from coordinate file 588
- Automated line survey 589

The Function menu also includes Radial Stake Out and Radial Road Stake Out 365.

Older formats, lin prf skv

Previous versions of iCON office created line, lin, profile, prf and cross slope/ camber, skv. You can still open and use these files in iCON office, but if you open one of these files in the numerical view, the appearance of the file will be influenced by the file format for road line, l3d, or cross fall model, cfm.

The older file format and their counterparts in the format for road line and cross fall model:

- Line Data, lin
  Corresponds to the tab Horizontal Geometry in the Road Line, l3d.
- Profile Data, prf
  Corresponds to the tab Vertical Geometry in the Road Line, l3d.
- Cross Slope File, skv
  Corresponds to the file format Cross Fall Model, cfm

When you save a file originating from any of the older formats, you get the choice to save it in the older format or to save it as a Road Line, l3d, or a Cross Fall Model, cfm.

Note, a line file in the older format .lin associated to a profile and a cross slope file if the files had the same names. For example, the files demo.lin, demo.prf and demo.skv were associated as only the file extensions differentiate the files.

A cross fall model, cfm, can be linked to a center line, regardless of file names.

See also 3D lines 505, Cross Fall Model, cfm 536

9.2 3D lines

One line in each l3d file

Files in the line style l3d contain:

- horizontal and vertical information about lines
- one line in each file

Information about the cross fall (in earlier version of this software also called camber) of the line, is described in a cross fall model, cfm.

Views

When you have opened a line, you can switch views by selecting:

- ***View | Numerical View***,
- ***View | Graphical View***,
- ***View | Graphical 3D View***,

Numerical view

The line's numerical view can be divided into two or three tabs:

- coordinates describing the horizontal geometry (line)
- coordinates in height, describing the vertical geometry (profile)
- a third tab can be added to the file, containing station equation, select ***Data | Insert Station Equation***.

Station Equation

Station equations are used at construction sites where a kilometer can be shorter or longer than 1000 m.
Station equations are used primarily for the measurements of Railways.
For more information about station equation, see Station Equation 515.

Save the line style l3d as line and profile (older format)

Select ***File | Save As***, to save an open line file, l3d, to the previous line format; line (lin) and profile (prf).
In the drop down menu, *Save as type*, select Line data (*.lin)

line in the file format L3D	line (lin)	profile (prf)
l3d file without station equation	one .lin file	one .prf file
l3d file with station equation	several .lin files*	several .prf files*

* If you save a line file, l3d, with station equation to the previous format, line and profile, the number of created lines and profiles is determined by the number of new kilometers included in station equations.

Save line and profile (older format) as line file l3d

Select ***File | Save as***, to save an open line (lin) or profile (prf) to the line format l3d.
In the drop down menu, *Save as type*, select Line data (*.l3d).

If the line (*.lin) has an associated profile, the line file, l3d, will have two tabs; one for the horizontal geometry and another for the vertical geometry.

Import Land XML file including station equation

When you receive a LandXML file including lines, you import it to iCON office in the normal way, either by:

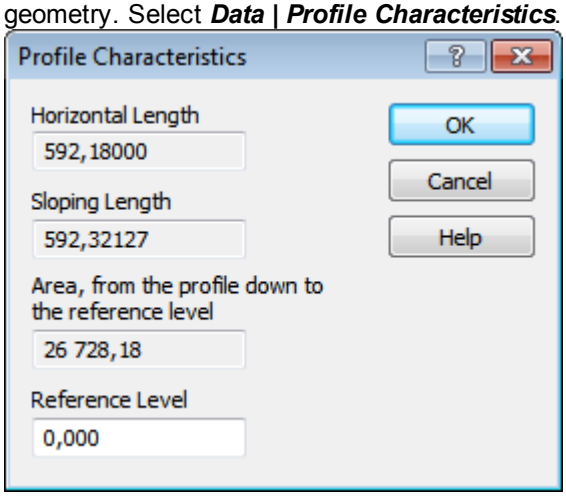
- Open the LandXML file and use the workflow view. See Import xml file with Workflow View 405 .

- Select ***File | Import/Export | LandXML***, see Importing LandXML files using the menu 410

See also LandXML 403.

Profile Characteristics

When the road line is active, you can display information about the vertical geometry. Select ***Data | Profile Characteristics***.



See also: Import xml file with Workflow View 405 , Importing LandXML files using the menu 410, LandXML 403 , Station Equation 515

9.2.1 Line Numerical View

Numerical View

To switch from the graphical to the numerical view, select ***View | Numerical View***, .

The line's numerical view can be divided into two or three tabs:

- coordinates describing the horizontal geometry (line)
- coordinates in height, describing the vertical geometry (profile)
- a third tab can be added to the file, containing station equation, select ***Data | Insert Station Equation***.

The horizontal line geometry can include:

- line
- circle arc
- spiral curve
- point - the very last element in a line is always a point

The vertical line geometry, in previous software versions also called profile, can include:

- line
- circle arc
- parabola
- point - the very last element in a line is always a point

Horizontal geometry

150e_lt_km_139-162.l3d | 150e_lt_km_139-162.l3d

	Element Num	N	E	Chainage	Type	Radius	End Radius	Parameter	Bearing	Length
1	1	647 600,678	511 682,804	149+774,4	Circle Arc	724,00			365,0505	126,41
2	2	647 713,705	511 626,567	149+900,8	Clothoid	724,00	0,00	294,75	376,1653	120,00
3	3	647 827,611	511 588,928	150+020,2	Line				381,4413	492,19
4	4	648 299,037	511 447,468	150+512,4	Clothoid	0,00	406,00	152,13	381,4416	57,00
5	5	648 353,989	511 432,371	150+569,4	Circle Arc	406,00			385,9099	32,47
6	6	648 385,916	511 426,517	150+601,9	Clothoid	406,00	0,00	152,13	391,0016	57,00
7	7	648 442,649	511 421,137	150+658,9	Line				395,4702	257,33
8	8	648 699,331	511 402,842	150+916,2	Clothoid	0,00	-575,00	171,25	395,4701	51,00
9	9	648 750,138	511 398,465	150+967,2	Circle Arc	-575,00			392,6469	198,35
10	10	648 939,375	511 342,411	151+165,4	Point				370,6867	
11										

Horizontal Geometry | Vertical Geometry | Station Equations

Example, the tab Horizontal Geometry.

The horizontal geometry in a line file, l3d, is described by:

Name	Description
Element Number	Identifies the element.
Plane coordinates N, E	Horizontal coordinates of the element's start point.
Station	Length station of the element's start point.
Type	Type of element. Select between the following alternatives: Line - A straight line. Circle Arc - Specify Radius to create a Circle Arc. Spiral curve - Specify Radius, End Radius and Parameter to create a Spiral Curve. Point - Always the last element in a line.
Radius	Radius of the element's start point; circle arc or spiral curve. Positive value for right contours in the line's direction, and thus negative value for left contours.
End Radius	Radius of the spiral element's end point. Positive value for the right contours in the line's direction.
Parameter	Parameters for spiral element, without sign.
Bearing	The direction of the element's start point.
Length	Specifies the element's length.

Vertical geometry

150e_lt_km_139-162.l3d | 150e_lt_km_139-162.l3d

	Element Num	Chainage	Z	Type	Radius	Parameter	Start Slope	Length
1	1	149+738,5	80,73	Line			0,17	216,60
2	2	149+955,1	81,10	Circle Arc	-15 000,00		0,17	91,50
3	3	150+046,3	80,98	Line			-0,44	146,33
4	4	150+192,6	80,34	Circle Arc	20 000,00		-0,44	78,00
5	5	150+270,6	80,14	Line			-0,05	64,00
6	6	150+334,6	80,11	Circle Arc	-15 000,00		-0,05	27,00
7	7	150+361,6	80,07	Line			-0,23	75,96
8	8	150+437,6	79,90	Circle Arc	15 000,00		-0,23	52,50
9	9	150+490,1	79,87	Line			0,12	99,04
10	10	150+589,1	79,99	Circle Arc	-30 000,00		0,12	30,00
11	11	150+619,1	80,01	Line			0,02	193,00
12	12	150+812,1	80,05	Line			-0,03	113,50
13	13	150+925,6	80,02	Line			0,01	162,61
14	14	151+088,0	80,03	Line			-0,01	242,54
15	15	151+330,6	80,01	Circle Arc	-20 000,00		-0,01	28,00
16	16	151+358,6	79,98	Line			-0,15	53,57

Horizontal Geometry | Vertical Geometry | Station Equations

Example, the tab Vertical Geometry.

The vertical geometry in a line file, l3d, is described by:

Name	Description
Element Number	Identifies the element.
Station	Length station of the element's start point.
Height, Z	Height of the element's start point.
Type	Type of element. Select between the following alternatives: Line - A straight line. Circle Arc - Specify Radius to create a Circle Arc. Parabola - Specify Parameter to create a Parabola. Point - Always the last element in a line.
Radius	Radius in the circle arc's start point. • Positive radius gives a line that has its center point over the arc. • Negative radius gives a line that has its center point below the line. *Tip: a positive radius for a contour is in the form of a "happy mouth", while negative curvature is a "sad mouth".*
Parameter	Parameters for parabola.
Start Slope	Slope of the element's start point.
Length	Specifies the element's length.

Station Equation

The length of a kilometer can be shorter or longer than 1000 m. Station Equations 515 in the numerical view shows in which section the next kilometer begins.

See also: Lines in Three Dimensions 503, Station Equation 515

9.2.2 Create a Road Line, L3d

Alternatives to create road line, l3d

There are several ways to create a road line, l3d:

- Enter[510] the information from a drawing or a paper original
- Graphical Interpretation of horizontal line geometry[510]
- Graphical Interpretation of vertical line geometry[511]
- Create from a line in a coordinate file or AutoCAD[512] ®[512] file[512]
- Copy line from a coordinate file[513]
- Save a line in the old format (*.lin) as (*.l3d)[513]

Numeric Input

One way to create a three dimensional line is to enter information from a drawing or a paper original. A line may contain elements of different types;

Horizontal line	Vertical line
straight line	straight line
circle arc	circle arc
spiral curve	parabola

Each of these elements is self-supporting, i.e. they can describe a line and do not need any additional elements in order to work. As each element is self-supporting, the line is over defined. When you enter a line, you can skip a lot of the information that the program automatically calculates. This also means that the line is checked and any errors are displayed. By way of example, the length section need only be given for the first element.

To create a new line numerically:

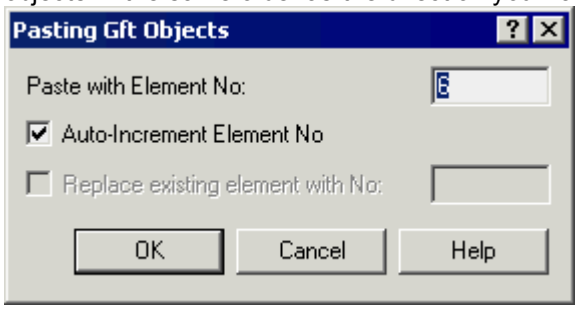
- Select ***File | New*** and select ***Road Documents | Line Data (l3d)*** from the tree.
- If the file is opened graphically, go to the input view by selecting ***View | Numerical view***, .
- To enter horizontal and vertical information about the line, select the tab *Horizontal Geometry* respectively *Vertical Geometry*.
- Select ***Edit | Active Columns*** to disable the columns that are not needed, see also Active Columns[95].
- Enter the required information in the road line.
- Select ***Data | Check Line*** to check the line geometry[517].

Graphical Interpretation of horizontal line geometry

In order to graphically create a horizontal line with straight lines, circle arcs and spiral curves, you use the tools that are linked to the help layer[216]. Generally, you use points in a coordinate file as the basis for interpreting the line geometry.

- First open the file or files that contain the base data to create the new line.
- Open the help layer by clicking the button to enable the various line tools. The way in which the various graphical tools work is described under the heading Graphical Tools[223]. Graphical tools for line interpretation (e.g. circle arcs), in addition to creating the actual element, also create the two help points, tangent points. These points are given the name TP or RXX where XX is the radius of the *connecting* element. *Only two of these three objects are to be copied to the new line*; which two depends on which way the line is to run, see below.

- When the desired tangent points, arcs and spirals have been created, it is time to save them to the line document. Select ***File | New | Road Documents | Line Data (I3d)*** and select the document to be displayed in the active window.
- To save the information to the line, it is simplest to use the tools 'Copy point/element to the active document' and 'Copy line to active document', see Graphical Tools[224]. You can also copy and paste data. Point to the objects one at a time. It is important to point out the objects in the same order as the direction you want for the line.



When copying arcs and spirals, you should start by pointing anywhere on the actual line (i.e. not on one of the end points) and always on the side of the element's midpoint closest to the starting point (usually TP1). Checking the box **[Show symbols]** under ***View | Options | Elements*** selects all the midpoints for the elements, which makes it easier to point to the 'correct' side of the element line. Now point to the end point (usually TP2). Conversely, you can create a line in the other direction by first pointing to *the end of the element* (not the end point) and then the start point. Always bear in mind to copy the files containing the correct information for *radius, parameter and coordinate for the start point*. Help points with the name TP have no radius, while those with the name RXX contain the radius XX (rounded off to a whole number). Elements like arcs and spirals provide information on the nearest end point and radius/parameter towards the other end point.

- After all element points have been copied, you should check the line to complete the line elements' other data by selecting ***Data | Check Line***.

Graphical Interpretation of vertical line geometry

In order to graphically create a vertical line geometry with straight lines, circle arcs and parabolas, you use the tools that are linked to the help layer[216]. Generally, you use a terrain profile as output data for interpreting the line's vertical geometry.

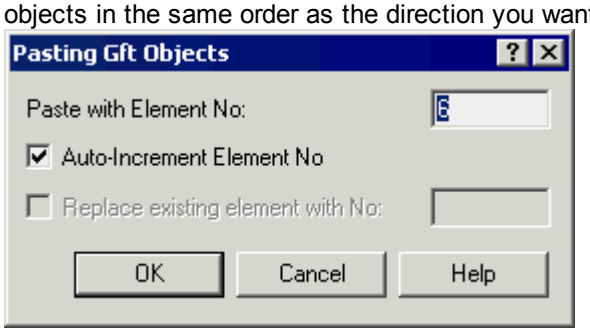
- First open the file or files that contain the base data to create the new vertical line geometry.
- Open the help layer in the window that contains the output data for the interpretation, to enable the various line tools. The way in which the various graphical tools work is described under the heading Graphical Tools[223]. Graphical tools for line interpretation (e.g. arcs), in addition to creating the actual element, also create the two help points, tangent points. These points are given the name TP or RXX where XX is the radius of the *connecting* element. *Only two of these three objects are to be copied to the new line*; which two depends on which way the line is to run, see below.
- You can adjust the height scale by selecting ***View | Distort Height Scale***.
- Start by defining the straight line using the line tool, .
- To draw a line with a particular slope, you select the option 'Slope' in the

input window 107 and enter the value in percent. You can experiment with different slopes before you point to the end point of the line.

- Radii can be interpreted using the tangent point tool , start by pointing anywhere at the start of the first line (not at the start point) and then at the start of the second line. Now select the radius by either entering it or by pointing to it.

When the desired lines with tangent points and structures have been interpreted, it is time to save them to the vertical line document:

- Select ***File | New | Road Documents | Line Data (l3d)*** and select the document to be displayed in the active window.
- To save the information to the vertical line, it is simplest to use the tools 'Copy point/element to the active document' and 'Copy line to active document' . , see Graphical Tools 224 . You can also copy and paste data. Point to the objects one at a time. It is important to point out the objects in the same order as the direction you want for the line.



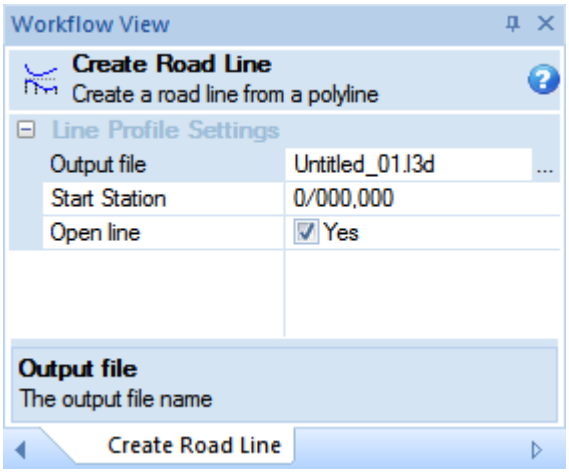
When copying arcs, you should start by pointing anywhere on the line (i.e. not on one of the end points) and always on the side of the element's midpoint closest to the starting point (usually TP1). Checking the box **[Show symbols]** under ***View | Options | Elements*** selects all the midpoints for the elements, which makes it easier to point to the 'correct' side of the element line. Now point to the end point (usually TP2). Conversely, you can create a line in the other direction by first pointing to *the end of the element* (not the end point) and then the start point. Always bear in mind to copy the files containing the correct information for *radius and coordinates for the start point*. Help points with the name TP have no radius, while those with the name RXX contain the radius XX (rounded off to a whole number). Elements like arcs provide information on the nearest end point and radius towards the other end point.

- After all element points have been copied, you should check the line to complete the vertical line elements' other data by selecting ***Data | Check Line***.

Create l3d line from a terrain profile, coordinate file or AutoCAD file

If you have a line in a terrain profile (pro), coordinate file (geo) or AutoCAD® file, you can use the tool ***Create Road Line***, to create a line (l3d) including horizontal and vertical line geometry.

Select ***Tools | Create Road Line***, or press the button in the toolbar, see Graphical Tools 229 .



Settings in the Workflow View to create a road line (l3d).

Use the Workflow View to create the line:

- **Output file:** Type a name of the new line. It is also possible to change the path to where the resulting file will be saved.
- **Start Station:** A start stationing for the length measurement can be entered.
- **Open line:** Select if the converted line should be displayed in the graphical view.
- In the graphical view, select the line by clicking it. This will create the road line file!
- If you select several lines, the name of each line will automatically be updated with a numerical suffix. Of course, you also have the possibility to enter a new name before you click on the next line.

Copy from a coordinate file to a line, l3d

To copy a line from a coordinate file:

- Open the coordinate file.
- Select ***Tools | Select Object***, or click the button , and point to the line.
- Copy the line by selecting ***Edit | Copy*** .
- Open the line document the line is to be copied to and select ***Edit | Paste*** .
- This procedure works for both horizontal and vertical line geometry.

Save line and profile as Road Line l3d

If you have a line in the older line style, with horizontal information in the line format lin and associated vertical information in the format prf, you can open and save the file in the file format l3d.

Select ***File | Save as***, to save an open line (lin) or profile (prf) to the line format l3d.
In the drop down menu, *Save as type*, select Line data (*.l3d).

If the line (*.lin) has an associated profile, the line file, l3d, will have two tabs; one for the horizontal geometry and another for the vertical geometry.

Spara en linjefil, l3d, som linje och profil

You may also save a line in the l3d format to the older format line (lin) and profile (prf).

Open a road line file, l3d.
Select ***File | Save As***, to save an open line file, l3d, to the previous line format; line (lin) and profile (prf).

In the drop down menu, *Save as type*, select Line data (*.lin)

line in the file format L3D	line (lin)	profile (prf)
l3d file without station equation	one .lin file	one .prf file
l3d file with station equation	several .lin files*	several .prf files*

* If you save a line file, l3d, with station equation to the previous format, line and profile, the number of created lines and profiles is determined by the number of new kilometers included in station equations.

See also:

9.2.3 Station Equation

Station Equation

Station equations can be used to correct length measurement when one kilometer is not always 1000 m.

Station equations are used

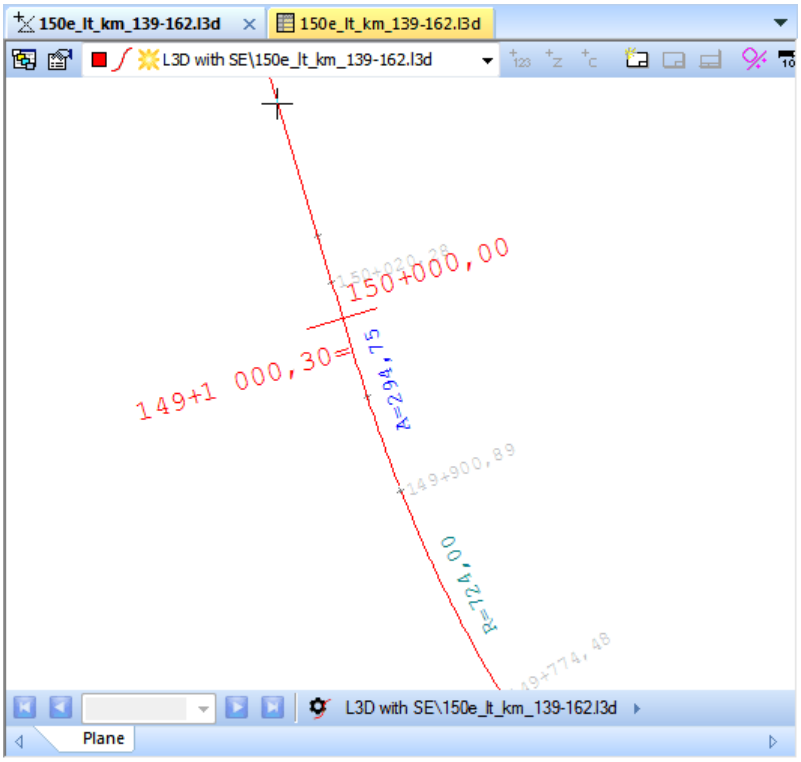
- primarily at railways
- in some countries such as Germany, USA and China, they are also used in building highways.

150e_lt_km_139-162.l3d | 150e_lt_km_139-162.l3d

	Label	Station Back	=	Station Ahead	Signpost X	Signpost Y	Description
1		140+000,00	=	140+000,00			
2		140+1 001,76	=	141+000,00			
3		141+999,08	=	142+000,00			
4		142+999,81	=	143+000,00			
5		143+992,70	=	144+000,00			
6		144+1 007,13	=	145+000,00			
7		145+1 000,67	=	146+000,00			
8		146+1 000,23	=	147+000,00			
9		147+1 000,13	=	148+000,00			
10		148+1 000,29	=	149+000,00			
11		149+1 000,30	=	150+000,00			
12		150+1 000,22	=	151+000,00			
13		151+996,63	=	152+000,00			
14		152+999,89	=	153+000,00			
15		153+999,29	=	154+000,00			
16		154+999,53	=	155+000,00			
17		155+1 000,54	=	156+000,00			

Horizontal Geometry | Vertical Geometry | Station Equations

Example, Station Equation



Example, Station Equation in graphical display.

Content of Station Equations

The length of a kilometer can be shorter or longer than 1000 m. The numerical view shows in which section the next kilometer begins.

Content of station equation:

Name	Description
Label	Name of the point.
Station Back	The line's real position information, with respect to the distance from the previous kilometer target.
Station Ahead	Station indication that starts at the current kilometer board.
Signpost X	Optional to enter coordinates here.
Signpost Y	Optional to enter coordinates here.
Description	Optional text.

Import LandXML file including Station Equation

If you import a LandXML file including Station Equations, the Station Equation will automatically be added to the road line file.
For information about the import, see 3D lines 505 and LandXML 403.

Tip!

- If you are about to manually enter a length table:
  - Always start to enter station equation, before you enter horizontal and vertical data.
- The first point in a station equation document should always have the same station, as the first point in the horizontal geometry.

See also: 3D lines 505, Line Numerical View 507, LandXML 403

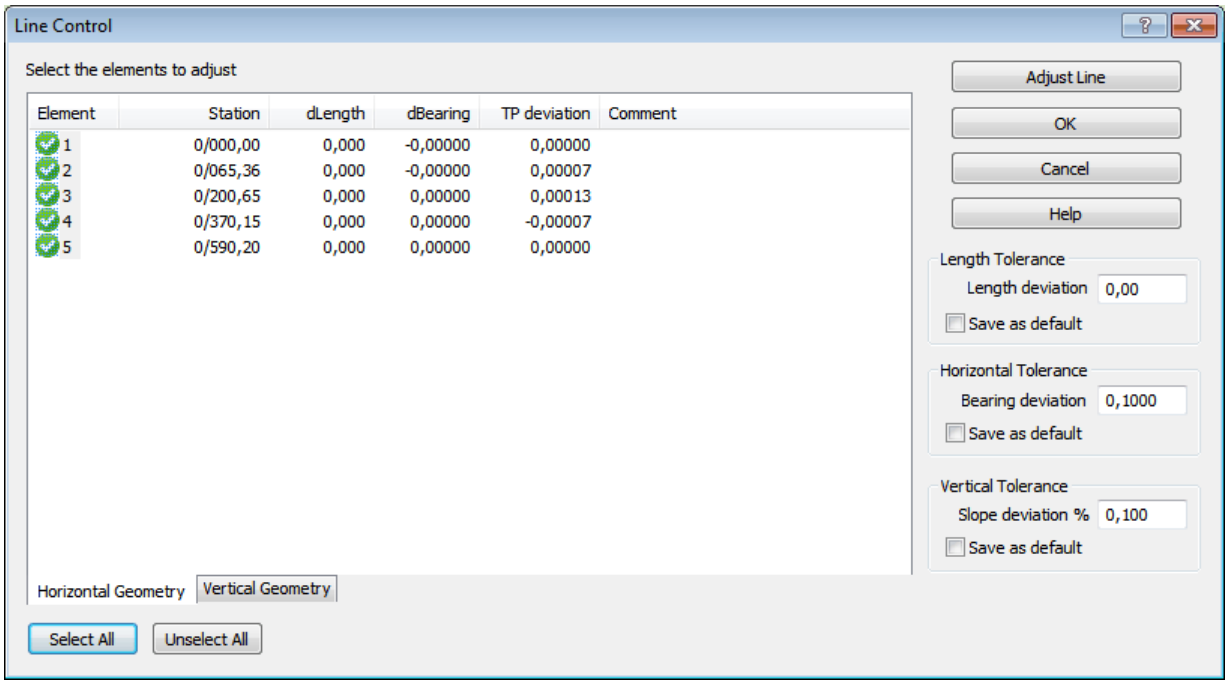
9.2.4 Check Line

The horizontal and vertical geometry of a line contain element points that specify start coordinates, stations, starting direction, element length and contour information. As all values are free values, there is no guarantee that each element connects to the next in the correct manner. You can check the elements in a line and get a measure of the discrepancies in length and bearing along with the deviation in the tangent points of the line. You can perform the check for both horizontal and vertical lines. Furthermore, some of the 'errors' in the line are corrected following the check.

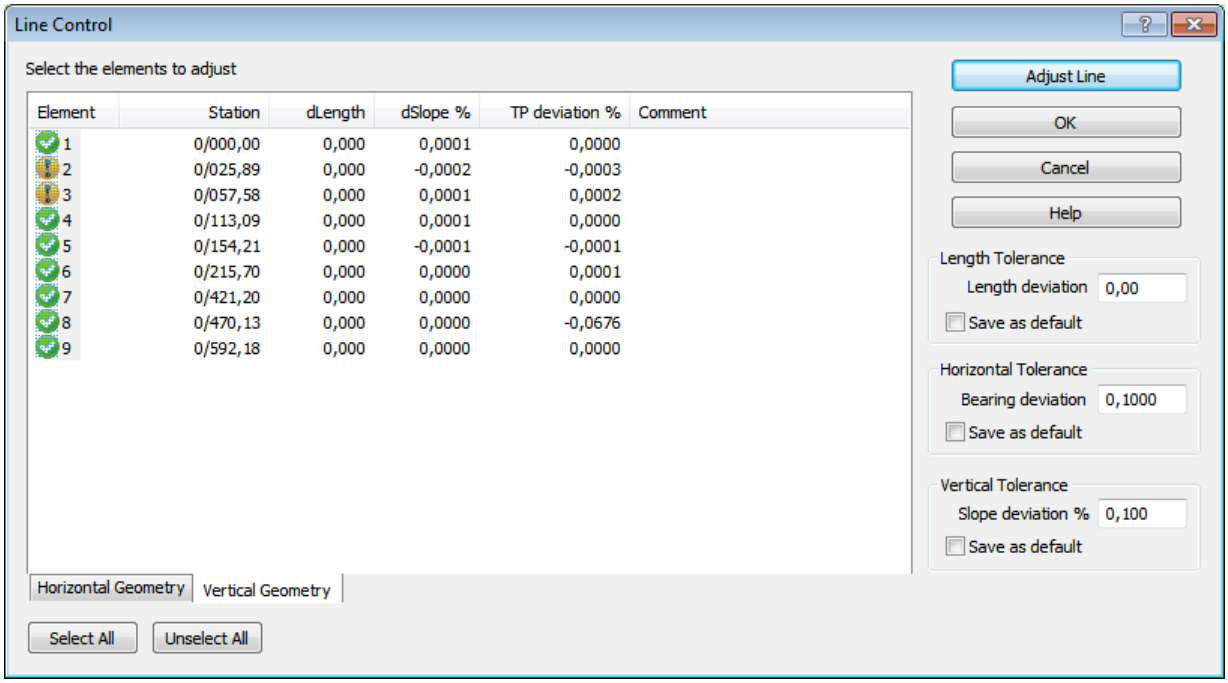
The horizontal and vertical geometry is controlled separately.

- The control of the horizontal geometry is specified in distances and angles, where the angle unit is given by Settings in the Project 20.
- The control of the vertical geometry is specified in distances and per cent (the vertical slope is given in %).

Select ***Data | Check Line*** for the horizontal and also for the vertical geometry.



Check Line, horizontal geometry.



Check Line, vertical geometry.

Element List

This list includes information about deviations for each element.

- Element
  Specifies the number of elements. The symbol indicates the element's status:
  Element deviations are within the tolerances.
  Element deviations are outside the tolerances.
  The element's geometry is incorrect, see the remark for a description of the error.

- Station
  Start station of the element.

- dLength
  Deviation in length of the element. This can be corrected.

- dBearing (horizontal line)
  The element's bearing has not been adapted, this means that the element doesn't end at the starting point for the next element. This can be corrected.

- dSlope % (vertical line)
  The element's slope has not been adapted, this means that the element doesn't end at the starting point for the next element. This can be corrected.

- TP deviation (TP = tangent point)
  The deviation shows if the line "cracks" in the joint between two elements. This error cannot be corrected by the program. Check the tangent points and radii.
  In the horizontal geometry, deviations are given as an angel.
  In the vertical geometry, deviations are given in per cent.

- Remark
  Descriptions of errors in the line's geometry that mean the line cannot be calculated/corrected. Check the tangent points and radii.
  Keep in mind that you must specify the end radius for spirals!

Click **[Select All]** to select all elements from the list and **[Deselect]** to deselect all elements in the list. You

can also select items by clicking on them. Holding down the [Ctrl] or [Shift] key while clicking allows you to select multiple elements.

Length Tolerance
Specify the maximum deviation allowed.
If the box **[Save as default]** is selected, the value will be saved as default value.

Horizontal Tolerances
Specify the maximum bearing deviation allowed.
Bearing is specified as an angel.
Bearing is used to identify too large angles of tangent points.
If the box **[Save as Default]** is selected, the value will be saved as default value.

Vertical Tolerances
Specify the maximum deviation allowed in element slope.
The slope is given in %.
The tolerance is used to identify major breaks in the tangent points
If the box **[Save as Default]** is selected, the value will be saved as default value.

Adjust Line

- Select one or several elements in the list.
- Tip! Click the button **[Select All]** to select all elements in the list.
- Click the button **[Adjust Line]** to adjust the selected element in the list.

See also Lines in Three Dimensions 503, Line Numerical View 507

9.3 Line, Graphical View

Graphical view, 2D or 3D

You can view a line, in the line style l3d, both two and three dimensionally.

- 2D view: Select ***View | Graphical View***,
- 3D view: Select ***View | Graphical 3D View***,

2D View Orientation

Select ***View | View Orientation*** and select between:

- Plane
- Top
- Profile
- Cross Section

Fly-Through

If you have opened any file type in a graphical 3D view, , you can select ***View | View Fly-Through***.

- Fly-Through means that you can create something like a movie, where it looks like you are flying along a selected line.
- For example, if you have opened a terrain model in a graphical 3D view, the Fly-Through can give an impression that you are flying over the terrain.
- For more information, see View Fly-Through 82.

Reverse Line

You can reverse the direction of a line file, l3d.

- Open a line file, l3d, and select ***Data | Reverse Line***.

or

- Click the line, to get a node in the line selected.
- Put the pointer at the selected node.
- Right click on the mouse and select ***Reverse Line***.

This happens when you reverse a line:

- The direction of the line will be changed.
- The order of the points in the line will be reversed, but the point number for a given coordinate will not change.
- The stations for all points in the line will be changed.
- Both the horizontal and the vertical geometry of the line will be reversed.

Please note, a line including station equation 515 cannot be reversed.

For more information about reversing a line in a coordinate file, see Graphical Editing in General 215.

See also: 3D lines 505, Line Numerical View 507, Graphical Editing in General 206

9.4 Line Data, Lin

9.4.1 Line Data, Lin

Line Data Files, or lin files, contain horizontal information of a line. The line is divided into elements that describe straight lines, arcs or spirals. A profile is often linked to the line file that describes the vertical line geometry.

Demo.l3d

	Element Num	N	E	Chainage	Type	Radius	End Radius	Parameter	Bearing	Length
1	Demo.1	60 443,134	4 086,95	0/000,00	Line				235,4007	65,36
2	Demo.2	60 387,624	4 052,45	0/065,36	Circle Arc	200,00			235,4006	135,29
3	Demo.3	60 304,529	3 948,96	0/200,65	Circle Arc	-300,00			278,4646	169,50
4	Demo.4	60 207,239	3 812,91	0/370,15	Line				242,4947	220,05
5	Demo.4	60 034,419	3 676,69	0/590,20	Point				242,4947	
6										

Horizontal Geometry | Vertical Geometry

Structure

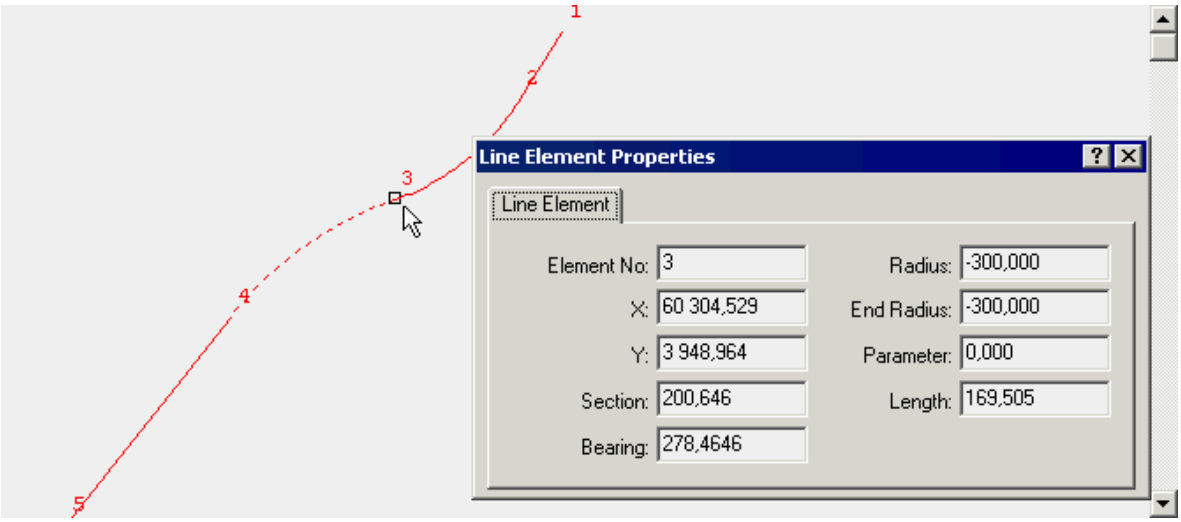
Each element in the line file contains the following data:

- Element Number
  Identifies the element.
- Start Point
  Horizontal coordinates of the element's start point.
- Section
  Length section of the element's start point.
- Radius
  Radius of the element's start point. Positive value for right contours in the line's direction.
- Bearing
  The direction of the element's start point.
- Parameter
  Parameters for spiral element, without sign.
- End Radius
  Radius of the element's end point, must be set for the spiral element. Positive value for the right contours in the line's direction.
- Length
  Specifies the element's length.

Views, Editing

When you open a line file, you can select three different view types:

- Graphical View
  Shows the line graphically, this is the default display for line documents.



- Graphical 3D View
  If there is a profile linked to the line, you can view the line three dimensionally.

- Numerical View
  Shows an input window with the line's element represented on individual lines.

See also Lines, Profiles, Cross Slopes 503 .

9.4.2 Create Road Line

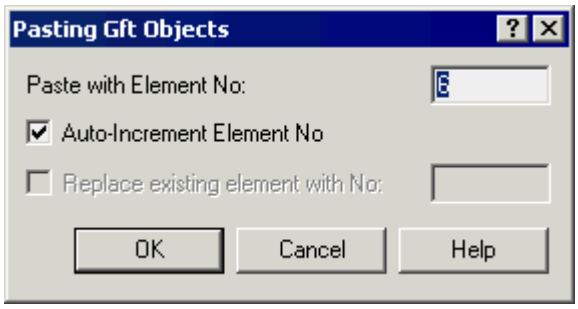
There are a number of different options to choose from if you want to create a horizontal line geometry (road line).

Numeric Input
One way of creating a horizontal line is to enter the information from a drawing or a paper original. A line may contain elements of three different types; *straight line*, *arc* and *spiral*. Each of these elements is self-supporting, i.e. they can describe a line and do not need any additional elements in order to work. As each element is self-supporting, the line is overdefined. When you enter a line, you can skip a lot of the information that the program automatically calculates. This also means that the line is checked and any errors are displayed. By way of example, the length section need only be given for the first element.

To create a new line, you select ***File | New*** and select the line data from the tree. If the file is opened graphically you then go to the input view by selecting ***View | Numerical view***. Go in to ***Edit | Active Columns*** and disable the columns that are not needed. Now enter the required information in the road line. Select ***Data | Check Line*** to check the line geometry.

Graphical Interpretation
In order to graphically create a horizontal line with straight lines, arcs and spirals, you use the tools that are linked to the help layer216. Generally, you use points in a coordinate file as the basis for interpreting the line geometry. First open the file or files that contain the base data to create the new line. Now open the help layer by clicking the button to enable the various line tools. The way in which the various graphical tools work is described under the heading Graphical Tools223. Graphical tools for line interpretation (e.g. arcs), in addition to creating the actual element, also create the two help points, tangent points. These points are given the name TP or RXX where XX is the radius of the *connecting* element. *Only two of these three objects are to be copied to the new line*; which two depends on which way the line is to run, see below.

When the desired tangent points, arcs and spirals have been created, it is time to save them to the line document. Select ***File | New | Line Document*** and select the document to be displayed in the active window. To save the information to the line, it is simplest to use the tools 'copy point/element to the active document' and 'copy line to active document'. You can also copy and paste data. Point to the objects one at a time. It is important to point out the objects in the same order as the direction you want for the line.



When copying arcs and spirals, you should start by pointing anywhere on the actual line (i.e. not on one of the end points) and always on the side of the element's midpoint closest to the starting point (usually TP1). Checking the box **[Show symbols]** under ***View | Options | Elements*** selects all the midpoints for the elements, which makes it easier to point to the 'correct' side of the element line. Now point to the end point (usually TP2). Conversely, you can create a line in the other direction by first pointing to *the end of the element* (not the end point) and then the start point. Always bear in mind to copy the files containing the correct information for *radius, parameter and coordinate for the start point*. Help points with the name TP have no radius, while those with the name RXX contain the radius XX (rounded off to a whole number). Elements like arcs and spirals provide information on the nearest end point and radius/parameter towards the other end point.
After all element points have been copied, you should check the line to complete the line elements' other data by selecting ***Data | Check Line***.

Create from coordinate line

If you want to create a line geometry from a line in a coordinate file, first select the line in the coordinate file and choose the tool 'select object' and point to the line. Then copy the line by selecting ***Edit | Copy***.

Now open the line document the line is to be copied to and select ***Edit | Paste***. This procedure also works if you want to create a vertical line geometry (profile).

You can also select ***Tools | Create Line and Profile,*** or by clicking the button in the toolbar to create a line and profile from a line in a coordinate document or AutoCAD document, see Graphical Tools 229.

See also Graphical Tools 223, Help Layers 216, Graphical Editing 206, Numerical Editing 94.

9.5 Profile Data, Prf

9.5.1 Profile Data, Prf

Profile Data Files, or prf files, contain vertical information on a line. The line is divided into elements that describe straight lines or circle arcs. The profile is usually connected to a horizontal line file to describe a line three-dimensionally.

linus.prf

	Element Numb	Section	Elevation	Start Slope	Radius	Length	Left Offset	Right Offset
1	1	0,000	49,710	-5,975	0,000	25,889	0,000	0,000
2	2	25,889	48,163	-5,975	600,000	31,690	0,000	0,000
3	3	57,579	47,109	-0,683	0,000	55,516	0,000	0,000
4	4	113,094	46,730	-0,683	-800,000	41,119	0,000	0,000
5	5	154,213	45,392	-5,833	1 000,000	61,491	0,000	0,000
6	6	215,705	43,700	0,326	0,000	205,496	0,000	0,000

Structure

Each element in the profile contains the following data:

- Element Number
  Identifies the element.
- Section
  Length section of the element's start point.
- Elevation
  Height of the element's start point.
- Start slope
  Slope of the element's start point.
- Radius
  Radius of the element's start point. Positive radius gives a line that has its center point over the arc , while a negative radius gives correspondingly a center point below the line .
  Tip: a positive radius for a contour is in the form of a "happy mouth", while negative curvature is a "sad mouth".
- Length
  Specifies the element's length.
- Offset left/right
  These measurements can be used to "move out" the profile from the center line in the calculation, for example, highways.

Views, Editing

When you open a profile, you can select three different view types:

- Graphical View
  Shows the profile graphically, this is the default display for profile documents.
- Graphical 3D View
  If an associated horizontal line file exists, this is shown three-dimensionally with height information from the profile.
- Numerical View
  Shows an input window with the profile's element represented on individual lines.

See also Lines, Profiles, Cross Slopes503 .

9.5.2 Create Profile Line

There are a number of different options to choose from if you want to create a vertical line geometry (profile line).

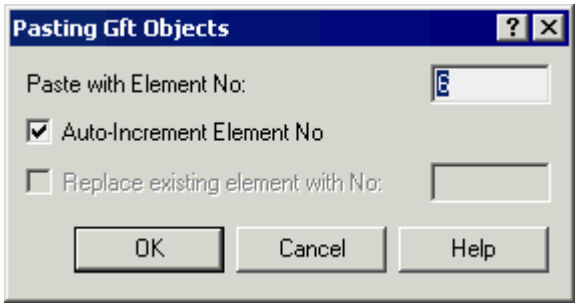
Numeric Input
In the same way as you create a horizontal line you can enter the information from a drawing or a paper original. A profile may contain elements of two different types; *straight lines* and *circle arcs.* Each of these elements is self-supporting, i.e. they can describe a line and do not need any additional elements in order to work. As each element is self-supporting, the line is overdefined. When you enter a profile, you can skip a lot of the information that the program automatically calculates. This also means that the profile is checked and any errors are displayed. The data that needs to be entered for each element is element number, section, height and, if applicable, the radius.

To create a new profile, select ***File | New*** and select the profile data from the tree. If the file is opened graphically you then go to the input view by selecting ***View | Numerical view***. Select ***Edit | Active Columns*** and disable the columns that are not needed, see also Active Columns 95 . Now enter the required information in the profile. Select ***Data | Check Line*** to check the profile line's geometry.

Graphical interpretation
In order to graphically create a vertical line geometry with straight lines and circle arcs, you use the tools that are linked to the help layer. Generally, you use a terrain profile as output data for interpreting the profile geometry. Opening the help layer in the window that contains the output data for the interpretation enables the various line tools. The way in which the various graphical tools work is described under the heading Graphical Tools 223 . Graphical tools for line interpretation (e.g. arcs), in addition to creating the actual element, also create the two help points, tangent points. These points are given the name TP or RXX where XX is the radius of the *connecting* element. *Only two of these three objects are to be copied to the new line*; which two depends on which way the line is to run, see below. You can adjust the height scale by selecting ***View | Distort Height Scale***.

Start by defining the straight line using the line tool, . To draw a line with a particular slope, you select the option 'Slope' in the input window 107 and enter the value in percent. You can experiment with different slopes before you point to the end point of the line. Radii can be interpreted using the tangent point tool , start by pointing anywhere at the start of the first line (not at the start point) and then at the start of the second line. Now select the radius by either entering it or by pointing to it.

When the desired lines with tangent points and structures have been interpreted, it is time to save them to the profile document. Select ***File | New | Profile Document*** and select the document to be displayed in the active window. To save the information to the line, it is simplest to use the tools 'copy point/element to the active document' and 'copy line to active document' . You can also copy and paste data. Point to the objects one at a time. It is important to point out the objects in the same order as the direction you want for the line.



When copying arcs, you should start by pointing anywhere on the line (i.e. not on one of the end points) and always on the side of the element's midpoint closest to the starting point (usually TP1). Checking the box **[Show symbols]** under ***View | Options | Elements*** selects all the midpoints for the elements, which makes it easier to point to the 'correct' side of the element line. Now point to the end point (usually TP2).

Conversely, you can create a line in the other direction by first pointing to *the end of the element* (not the end point) and then the start point. Always bear in mind to copy the files containing the correct information for *radius and coordinates for the start point*. Help points with the name TP have no radius, while those with the name RXX contain the radius XX (rounded off to a whole number). Elements like arcs provide information on the nearest end point and radius towards the other end point.
After all element points have been copied, you should check the line to complete the profile elements' other data by selecting ***Data | Check Line***.

Create from coordinate line
If you want to create a profile from a line in a coordinate file, first select the line in the coordinate file and choose the tool 'select object' and point to the line. Then copy the line by selecting ***Edit | Copy***.
Now open the profile document the line is to be copied to and select ***Edit | Paste***. This procedure also works if you want to create a horizontal line geometry.
You can also select ***Tools | Create Line and Profile,*** or click the button in the toolbar to create a line and profile from a line in a coordinate document or AutoCAD® dwg file, see Graphical Tools 229

Create from cross sections
You can also create profile lines from the cross section data. You select in this case the offset or offsets the profiles are to be calculated for. iCON office calculates the height of the offset in the preferred layer in the section file. First open the cross-section file and then select ***Data | Calculate Profile for Offset***, see Calculate Profiles from Cross Sections 632.

See also Graphical Tools 223, Help Layers 216, Graphical Editing 206, Numerical Editing 94, Calculate Profiles from Cross Sections 632.

9.5.3 Offset in Profile Document

The profile document has columns for left and right offset. These offsets move out the profile and the rotation point of the cross slope from the center line.

Offset 0 means the cross slope starts at the center line.
The left offset indicates that the cross slope for the left lane starts at the specified distance from the center line. Similarly, the right offset indicates the distance from the center line where the cross slope for the right lane starts.

The cross slope is calculated from the offsets specified in the profile document. A negative offset moves the rotation point of the cross slope to the left of the center line, while a positive offset moves it to the right of the center line. The offset is therefore usually set to zero or a negative value.

The cross slope is extended from the offset specification to the outer edges of the lane and in toward the center line.

The height profile is shown for the specified distances from the center line. Normally the height profile is also set exactly on the center line.

The black filled circles in the figures below show the heights included in the calculated cross section. Non-filled circles with heights are shown as help points. Help points are drawn where the cross slope for the left and right lane meet if these points have different heights. If the left or right offset is not zero, the help points are normally also shown on either side of the center line.

The following cases are presented below:

- The cross slope for both left and right lane starts at offset 0, i.e. the center line.
  See figure 1 530 .
- The cross slope for the left lane begins to the left of the center line, while the cross slope for the right lane begins to the right of the center line.
  See figure 2 530 .
- The cross slope for the left lane starts at the center line while the cross slope for the right lane begins to the right of the center line.
  See figure 3 531 .
- The cross slope for the left lane begins to the left of the center line, while the cross slope for the right lane begins in the center line.
  See figure 4 531 .
- Both the cross slope for the left and right lanes start either to the left or right of the center line, but at different offsets.
  See figure 5 532 .
- Both the cross slope for the left and right lanes start at the exact same point either to the left or right of the center line.
  See figure 6 532 .

  In all the figures below, a cross slope of -2.5 % has been used for both left and right lanes.

Figure 1:

Offset left 0, right 0: "Normal case", cross line starts at the center line.

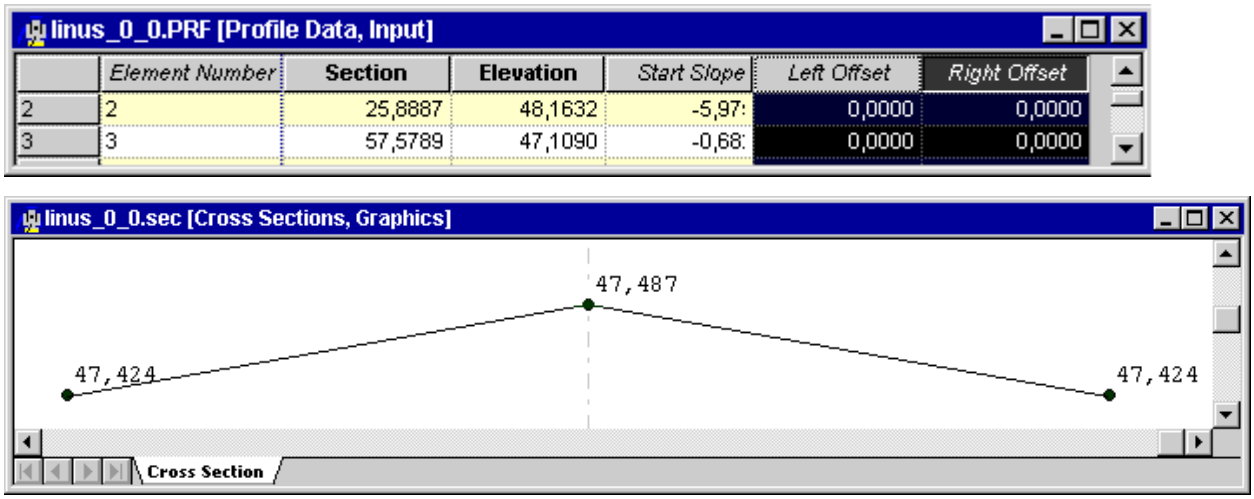
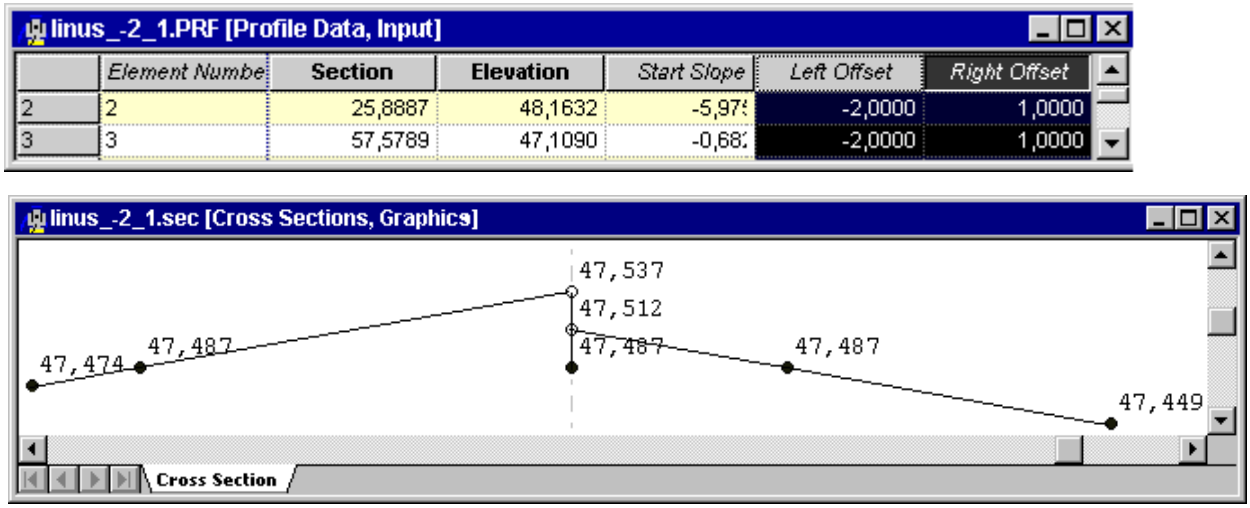


Figure 2:

Offset left -2, right 1: The cross slope for the left lane begins 2 m to the left of the center line, while the cross slope for the right lane begins 1 m to the right of the center line.



The figure above shows a cross section view and associated profile.
The cross slope is extended in toward the center line from both left and right lane. The graphical help points appear on each side of the center line that correspond to the meeting points for the cross slope for the two lanes.

Reported profile heights:

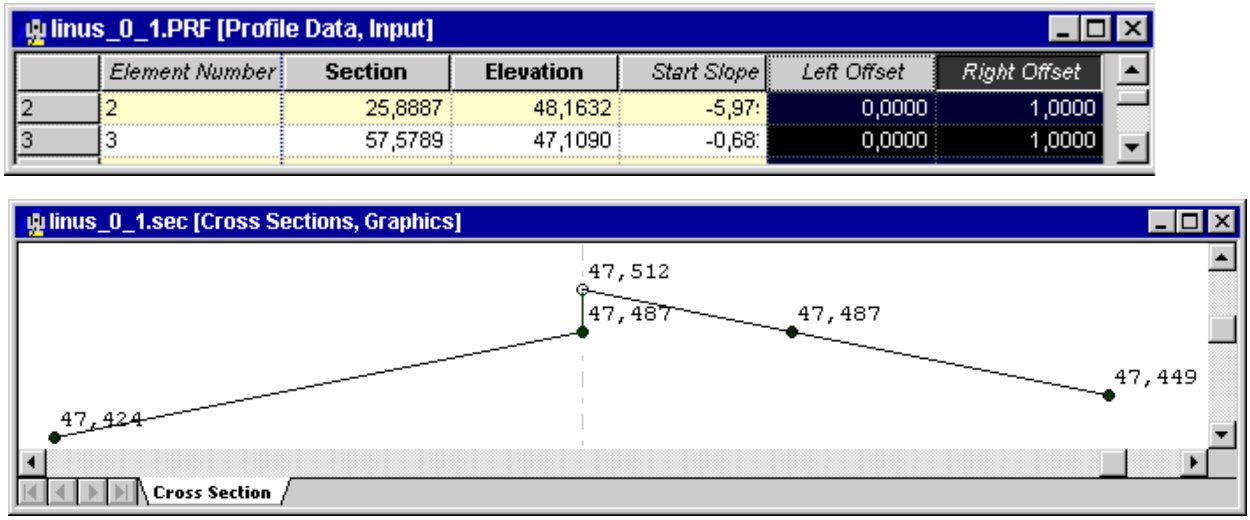
- left offset = -2 m gives profile height = 47.487 m
- center line gives profile height = 47.487 m
- right offset = 1 m gives profile height = 47.487 m

The height profile is specified exactly on the center line, that is with the offset set to 0, regardless of the

cross slope. When measured along a road, the height profile is set relative to the cross slope. The profile height at exactly 47.487 m precisely on the center line in the example above, will be difficult to achieve in practice. The minimum movement from the center line means that the height is reported in relation to the cross slope.

Figure 3

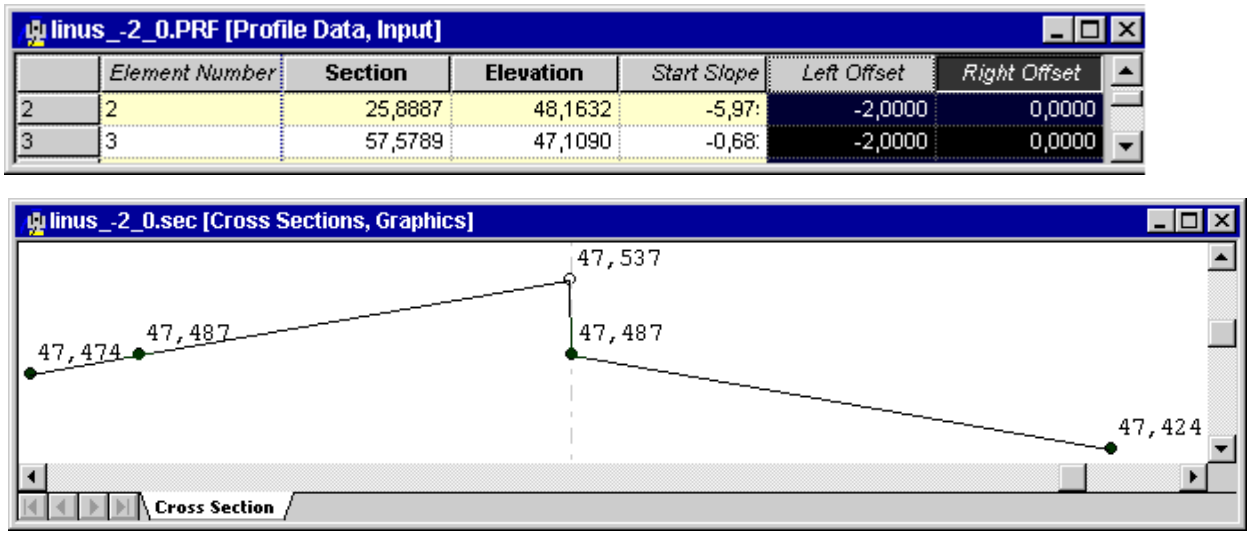
Offset left 0, right 1: The cross slope for the left lane starts in the center line, while for the right lane the cross slope begins 1 m to the right of the center line.



	Element Number	Section	Elevation	Start Slope	Left Offset	Right Offset
2	2	25,8887	48,1632	-5,97:	0,0000	1,0000
3	3	57,5789	47,1090	-0,68:	0,0000	1,0000

Figure 4

Offset left -2, right 0: The cross slope for the left lane starts 2 m to the left of the center line. The cross slope for the right lane begins at the center line.



	Element Number	Section	Elevation	Start Slope	Left Offset	Right Offset
2	2	25,8887	48,1632	-5,97:	-2,0000	0,0000
3	3	57,5789	47,1090	-0,68:	-2,0000	0,0000

Figure 5

Offset left -2, right -1: The cross slope for the left and right lanes start to the left of the center line, but at different offsets.

linus_-2_-1.PRF [Profile Data, Input]

	Element Number	Section	Elevation	Start Slope	Left Offset	Right Offset
2	2	25,8887	48,1632	-5,97	-2,0000	-1,0000
3	3	57,5789	47,1090	-0,68	-2,0000	-1,0000

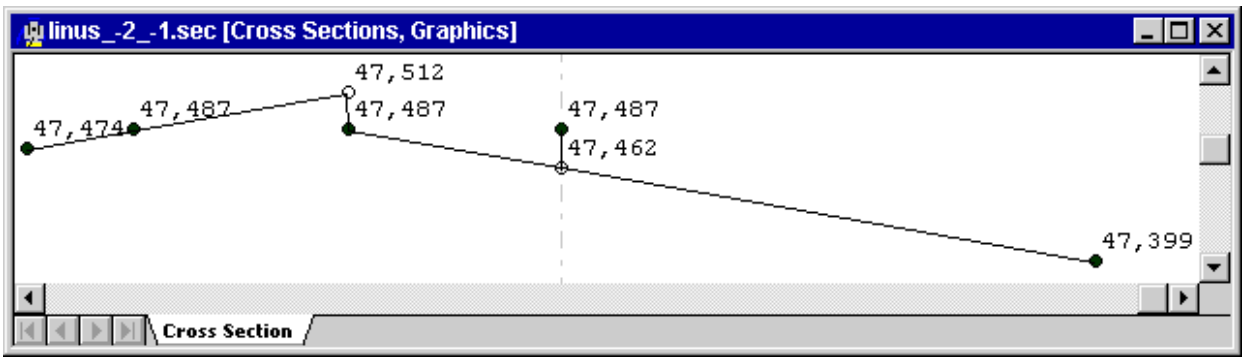
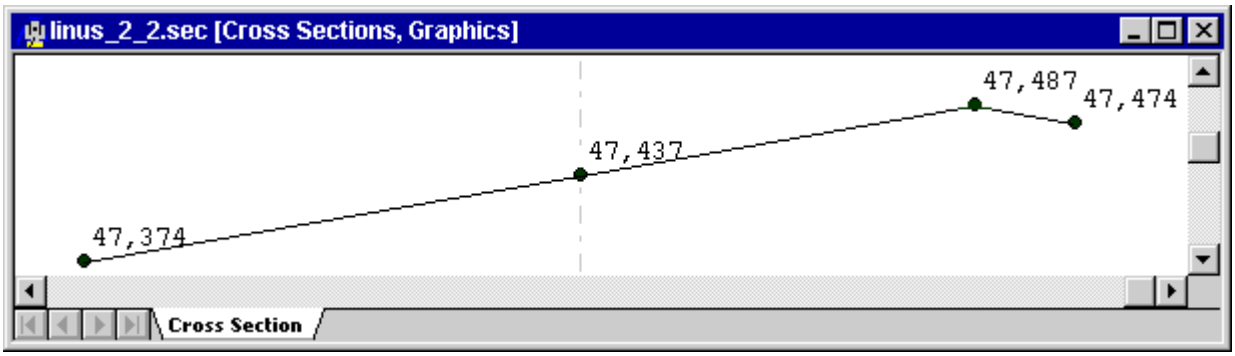


Figure 6

Offset left 2, right 2: The cross slope for the left and right lanes start at the same point to the right of the center line.

linus_2_2.PRF [Profile Data, Input]

	Element Number	Section	Elevation	Start Slope	Left Offset	Right Offset
2	2	25,8887	48,1632	-5,97	2,0000	2,0000
3	3	57,5789	47,1090	-0,68	2,0000	2,0000

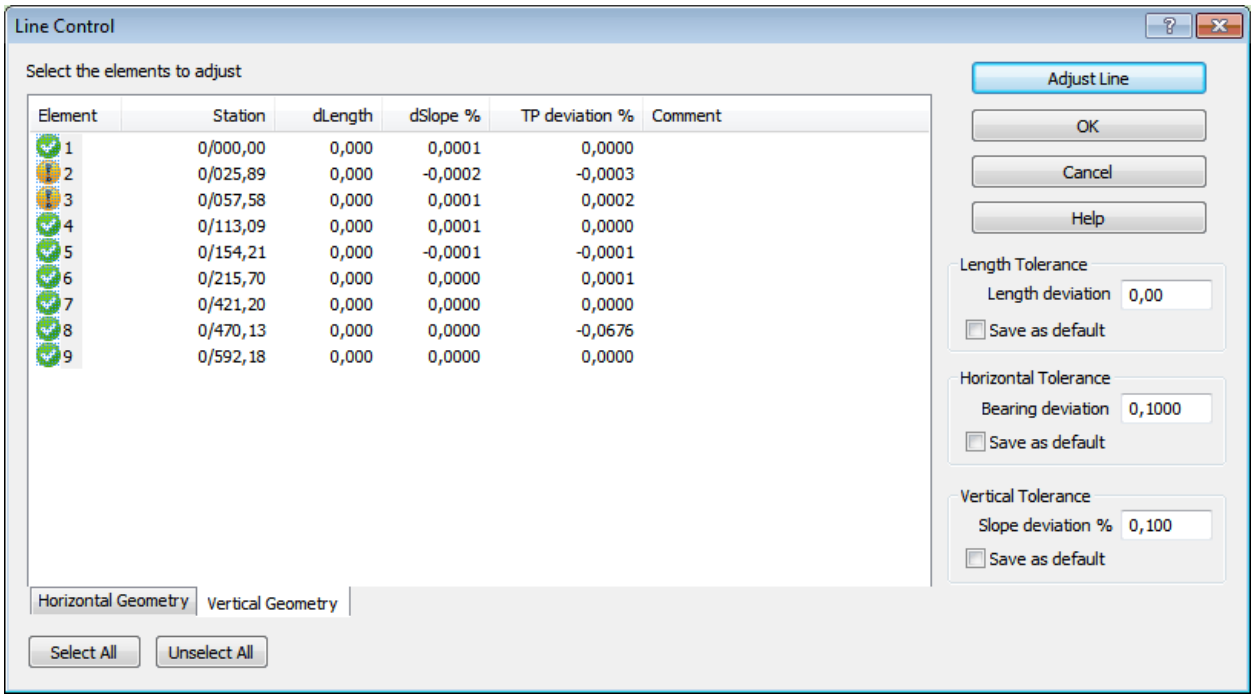


If the cross slope for both the left and right lanes starts at the same point (in this case 2 m to the right of the center line) only the cross slope is presented depending on the profile height of the center line.

See also Lines, Profiles, Cross Slopes 503 .

9.5.4 Check Profile

Line data and profile data contain element points that specify start coordinates, length of a section, starting direction, element length and contour information. As all values are free values, there is no guarantee that each element connects to the next in the correct manner. You can check the elements in a line and get a measure of the discrepancies in length and bearing along with the deviation in the tangent points of the line. You can perform the check for both horizontal and vertical lines. Furthermore, some of the 'errors' in the line are corrected following the check. Activate the desired line or profile document,and select ***Data | Check Line***.



Element List

This list includes information about deviations for each element.

- Element
  Specifies the number of elements. This symbol indicates the element's status:
  Element deviations are within the tolerances.
  Element deviations are outside the tolerances.
  The element's geometry is incorrect, see the remark for a description of the error.
- Section
  Start section of the element.
- dLength
  Deviation in length of the element. This can be corrected.
- dSlope % (vertical line)
  The element's slope has not been adapted meaning the element ends at the starting point for the next element. This can be corrected.
- TP % deviation
  This shows the if the line "cracks" in the joint between two elements. This error cannot be corrected by the program. Check the tangent points and radii.
- Remark
  Below are descriptions of the errors in the line's geometry that mean the line cannot be calculated/ corrected. Check the tangent points and radii.

Click **[Select All]** to select all elements from the list and **[Deselect]** to deselect all elements in the list. You can also select items by clicking on them. Holding down the Ctrl or Shift key while clicking allows you to select multiple elements.

Display Precision
Choose how many decimal places the dialog should have. The default box indicates that the general settings are loaded.

Tolerances
Specify the tolerance for deviations to the tangent points. If the box **[Save as Default]** box is checked, the value will then be saved as the default.

Adjust Line
Click the button to adjust the selected element in the list.

Tip! Click **[Select All]** to adjust the whole line.
See also Lines in Three Dimensions 503, Line Data 521, Profile Data 525.

9.6 Cross Fall Model, general

The cross fall model associates to a road line

A cross fall model is used to describe the cross fall from a road line, that is, the perpendicular slope from the center line[503].

The Cross Fall Model[536], cfm, replaces the older file format, skv.

9.6.1 Cross Fall Model, Cfm

The cross fall model associates to a road line

A cross fall model is used to describe the cross fall from a road line, that is, the perpendicular slope from the center line.

The Cross Fall Model, cfm, replaces the older file format, skv.

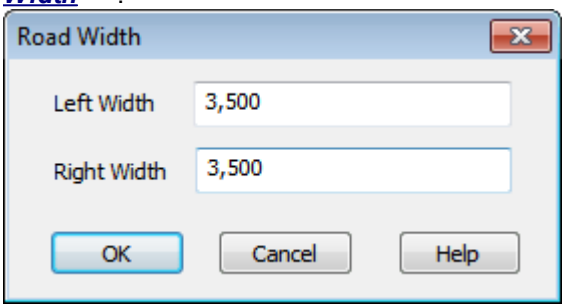
- The Cross Fall Model always associates to a certain road line, l3d[507].
- The Cross Fall Model is always edited numerically.
- When you switch to the graphical view, ***View | Graphical view***, the associated road line, l3d, will be displayed.
  - Select active file in the upper part of the graphical window, or right click in the graphics to change between active files; cross fall model or road line.
  - Graphical display, see Graphical View[538].

Numerical view

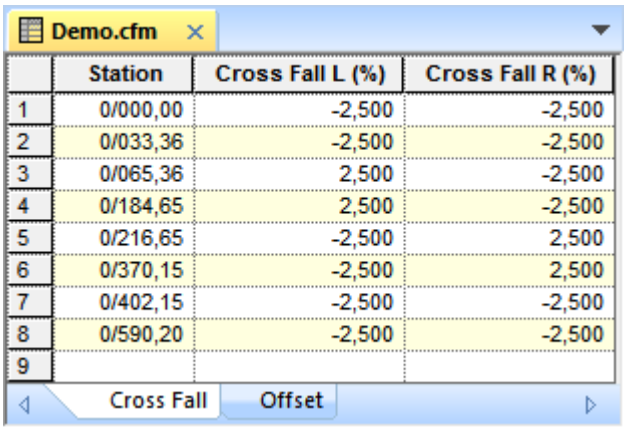
The numerical view of the cross fall document has two tabs:

- The tab ***Cross Fall***[536] displays the cross fall, expressed in percent, for the left and right road line.
- In the tab ***Offset***[537] you can move the start point of the cross fall from the center line[505].

To add a limitation to the width of the road in the cross fall model, see ***Road Width***[537].



The tab Cross Fall



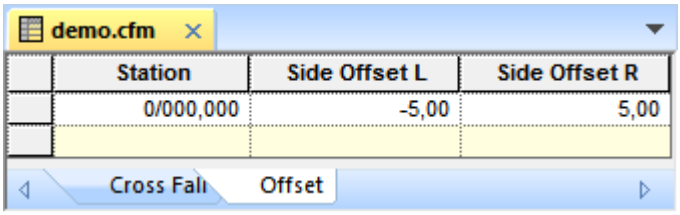
	Station	Cross Fall L (%)	Cross Fall R (%)
1	0/000,00	-2,500	-2,500
2	0/033,36	-2,500	-2,500
3	0/065,36	2,500	-2,500
4	0/184,65	2,500	-2,500
5	0/216,65	-2,500	2,500
6	0/370,15	-2,500	2,500
7	0/402,15	-2,500	-2,500
8	0/590,20	-2,500	-2,500
9			

The tab Cross Fall in the Cross Fall Model.

The cross fall is described by:

Name	Description
Station	Length station of the element's start point.
Cross Fall L.(%)	Left cross fall, specified in %.
Cross Fall R.(%)	Right cross fall, specified in %.

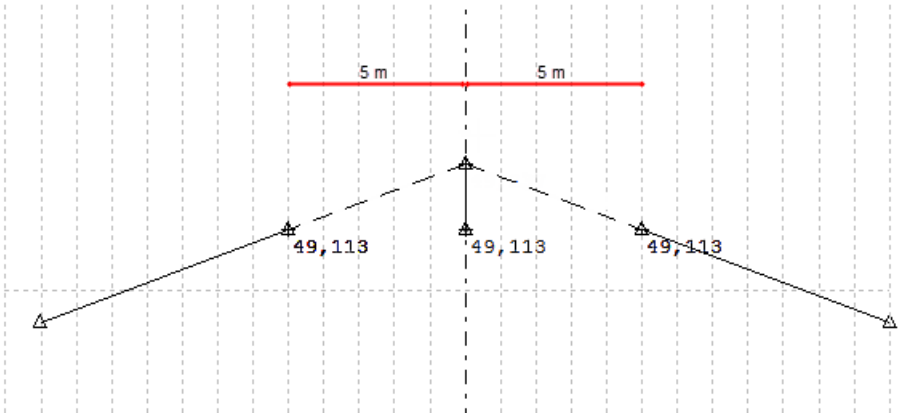
The tab Offset



The tab Offset in the Cross Fall Model.

In the tab **Offset** you enter right and left offset. These offsets move the rotation point of the cross fall from the center line.

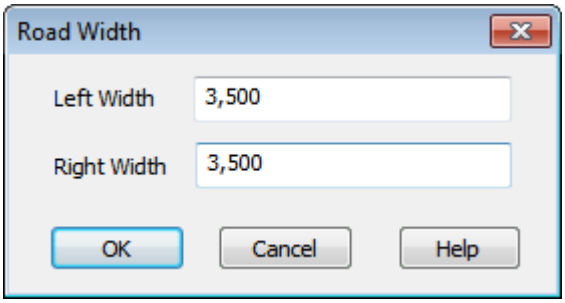
- **Offset 0** means that the cross fall starts at the center line.
- If the cross fall model includes side offset 0 for all stations, no values will be displayed in this tab.
- Stated offsets display the distance to the center line.
- Offsets move the rotation points of the cross fall from the center line.
- For **side offsets distinguished from zero**, the cross fall starts at the specified offsets.
- The start points of the cross fall get the heights from the center line, but will be moved with the specified offset.
- A negative offset moves the rotation point of the cross slope to the left of the center line. Thus, left offset is usually set to zero or a negative value.
- A positive offset moves the rotation point of the cross slope to the right of the center line. Thus, right offset is usually set to zero or a positive value.
- The cross fall extends from the specified offset inwards towards the center line and outwards.



Example of a cross fall model with offset, and distorted height scale.
The cross fall start 5 m to the left respectively to the right of the center line.
The dashed line displays the extended cross fall.

Width

To add road width to the cross fall model, select **Data | Set Road Width**.



Enter any road width in the dialog.

In ***Road Width*** the width of the cross fall model can be given.

- The distance is given perpendicular to the center line.
- Enter positive distance for the road width, both to the left and the right.
- The same width applies to the whole center line. All stations along the road line gets the same width in the cross fall model.
- The slope of the cross fall model continues even after the given distance.

Graphical view,

When the numerical cross fall model is active, you can switch to the graphical 2D view, select ***View | Graphical View***.

- In the plane view you will see the associated center line.

Create a new cross fall model

To create a new cross fall model numerically:

- Select ***File | New*** and select ***Road Documents | Cross Fall Model (Cfm)*** in the tree.
- In the tab ***Cross Fall*** enter stations and cross fall for left and right lane. The cross fall is given in %.
- In the tab ***Offset*** you can enter left and right rotation points of the cross fall, by giving stations and side offsets.
- In the tab Width you can enter the maximal width of the lanes, perpendicular to the road line. Enter width for left and right lane.
  The road width is constant, meaning that the width is valid along the whole cross fall model.

Link to center line

- Select ***Data | Set Center Line*** to associate the cross fall model to a road line.

Save older cross slope file, skv, as a cross fall model, cfm

To save an older cross slope file, skv, to the file format cross fall model:

- Open the cross slope file.
- Select ***File | Save as***.
- In the drop down menu at *Save as type*, select Cross Fall Model (*.cfm). You can change the name and then click the button **[Save]** to save the file in the file format cfm.
- If there is a line file with the same name as the cross slope file, skv, a dialog will open asking you to save the line file in the file format, road line l3d 503.

Save cross fall model, cfm, as line, profile and cross slope

To save a cross fall model, cfm, to the older file formats line, profile and cross slope (lin, prf, skv):

- Open the cross fall model, cfm.
- Select ***Data | Export as lin/prf/skv***.
- In the dialog ***Save as***, accept the proposed line file name (*.lin), or edit the file name. Click the button **[Save]**.

- As the line file (*.lin) is saved, a profile and a cross slope file (*.prf and *.skv) will automatically be saved on the same time.

See also: Lines in Three Dimensions 503, 3D lines 505, Save document 30

9.6.2 Cross slope Files, Skv

Cross slope files are used to describe the cross slope from the profile line. Each change to the cross slope along a line adds a post in the cross slope document.

Structure

Each element of the cross slope file contains the following data:

- Point
  Identifies the element.
- Section
  Start section for a cross slope description.
- Slope left/right
  Specifies the slope in percent on either side of the center line.

linus.SKV

	Point	Section	Cross Slope l.(%)	Cross Slope r.(%)
1	1	0,000	-2,500	-2,500
2	2	33,357	-2,500	-2,500
3	3	65,357	2,500	-2,500
4	4	184,647	2,500	-2,500
5	5	216,647	-2,500	2,500
6	6	370,152	-2,500	2,500
7	7	402,151	-2,500	-2,500
8	8	590,201	-2,500	-2,500
9				

Views, Editing

The Cross Slope Document is always edited numerically.

See also Lines, Profiles, Cross Slopes 503 .

9.7 Stringline model, LMD

9.7.1 Stringline model, LMD

Stringline model, LMD

The stringline model is primarily intended for in-field use with GeoPad or UMC 3D/GeoROG. The stringline model is a model type that is based on longitudinal lines and is often used for roads and other longitudinal projects. The stringline model can also contain a simple structure of buildup layers.

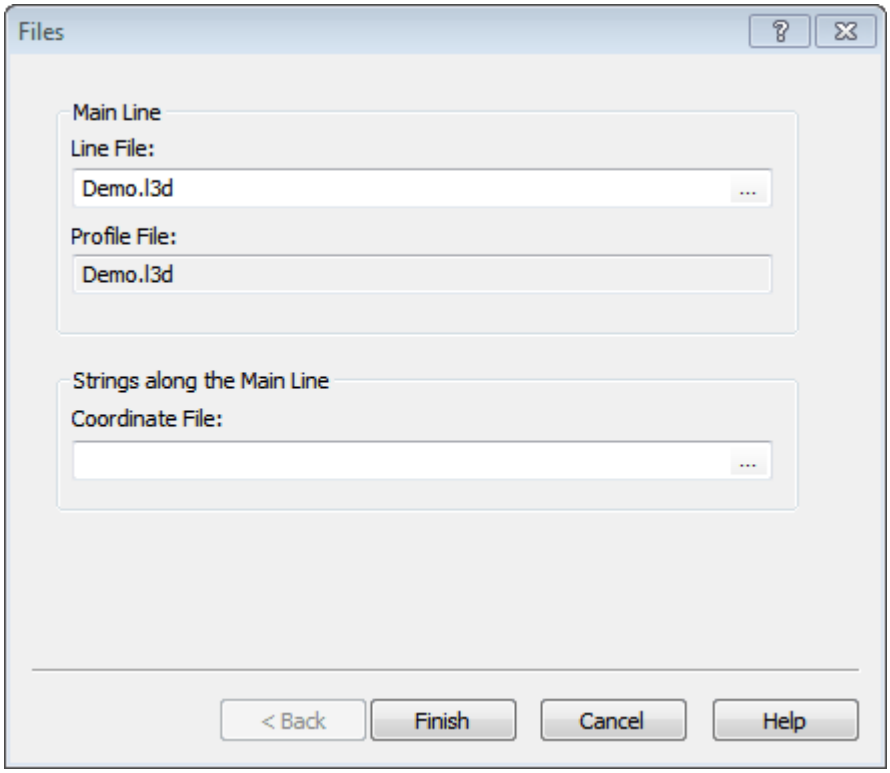
Normally, the theoretical top surface of the road is imported from LandXML or created using the volume calculation document MBS689 in iCON office.

The stringline model is a file format (lmd) that is built up by horizontal and vertical line data (l3d or lin and prf), and a coordinate file (geo) where all side lines are represented as break lines. **Each break line in the coordinate file (geo) must have its own unique line code.** These codes are used to find the correct line. Any point codes in the coordinate file will not be used by the stringline model.

If you create a stringline model from a volume calculation document MBS, the element codes will be used to create the line codes that are to be used in the stringline model.

When you import a stringline model from LandXML that comes with Leica's RRString feature, this creates automatically a stringline model with three dimensional line data, and a coordinate file (geo) with line codes. Note that this only applies to LandXML files that come with Leica's RRString feature, such as Novapoint, Gemini, iCON office, etc.

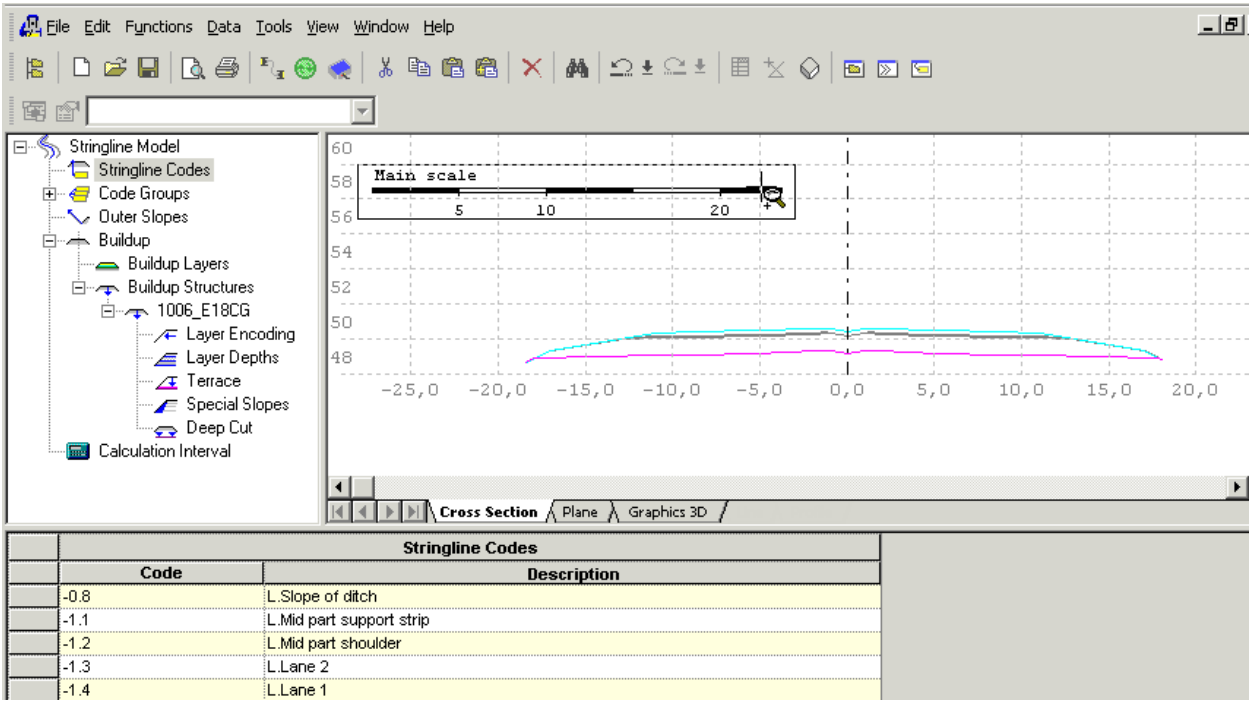
When creating a stringline model in another way, you must specify a file with three dimensional line data and a coordinate file (geo).



It is also possible to import buildup information from an OVB file. An OVB file can be created in Novapoint or

Anpakke. ***Data | Import OVB Buildup Data***.

A stringline model contains several component parts and relationships. To get an overview of these, there is a tree structure for help when entering and editing.



LMD window

Views

The screen is divided into a number of views when editing a stringline model:

- LMD tree view
  Here you can see all components and relationships in the stringline model.
- Graphic view
  The graphic view is divided into tabs that show cross-section data, plane graphics and 3D graphics.
- Data view
  Below the tree view and the graphic view you can see the data view that displays a numeric presentation of the selected object in the tree view.

LMD tree

Here you can see all components and relationships in the stringline model. The entire stringline model is administered through the tree. By clicking the tree you enable input and editing of details in the description.

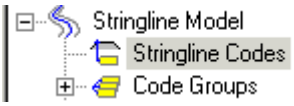
Navigation in the tree

- Left clicking on the + sign expands a node in the tree.
- Left clicking on the - sign reduces a node in the tree.
- Left clicking a component, a layer thickness, terrace settings etc opens and activates the data view for the corresponding components for input and editing.

See also Tree Views 104 .

LMD Objects

Stringline Codes

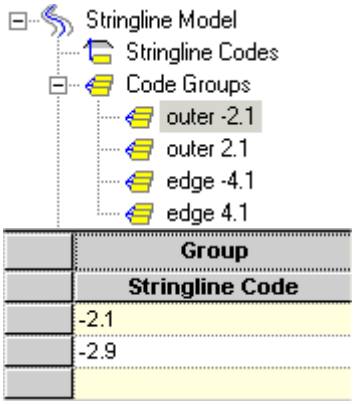


Stringline codes are created automatically when importing a LandXML file to show the line codes that are represented in the LandXML file. This list is not linked to any functions.

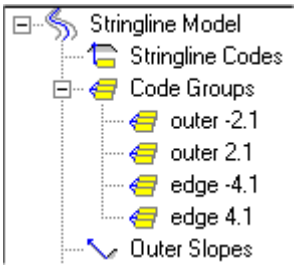
	Stringline Codes	
	Code	Description
	-0.8	L.Slope of ditch
	-1.1	L.Mid part support strip
	-1.2	L.Mid part shoulder
	-1.3	L.Lane 2
	-1.4	L.Lane 1
	-2.1	L.Shoulder
	-2.9	L.Support strip
	-4.1	L.Ditch6m 1:6
	-4.2	L.Ditch 2

Code Groups

When importing LandXML, it is normal for inner slopes, for example, to have different stringline codes. Code groups are used to control the various stringline codes (elements) to connect to the buildup layers.

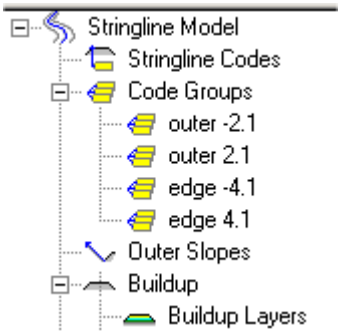


Outer Slope Gradients



The outer slope gradients function is not currently implemented.

Buildup Layer

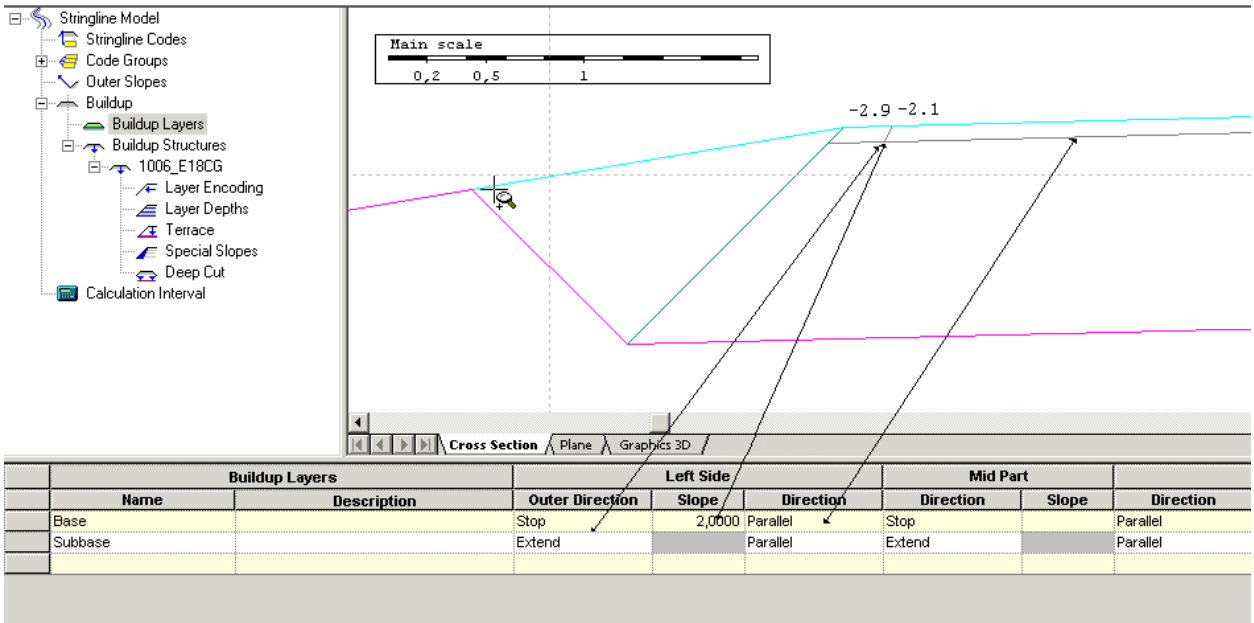


Here you have the option of adding and removing buildup layers.

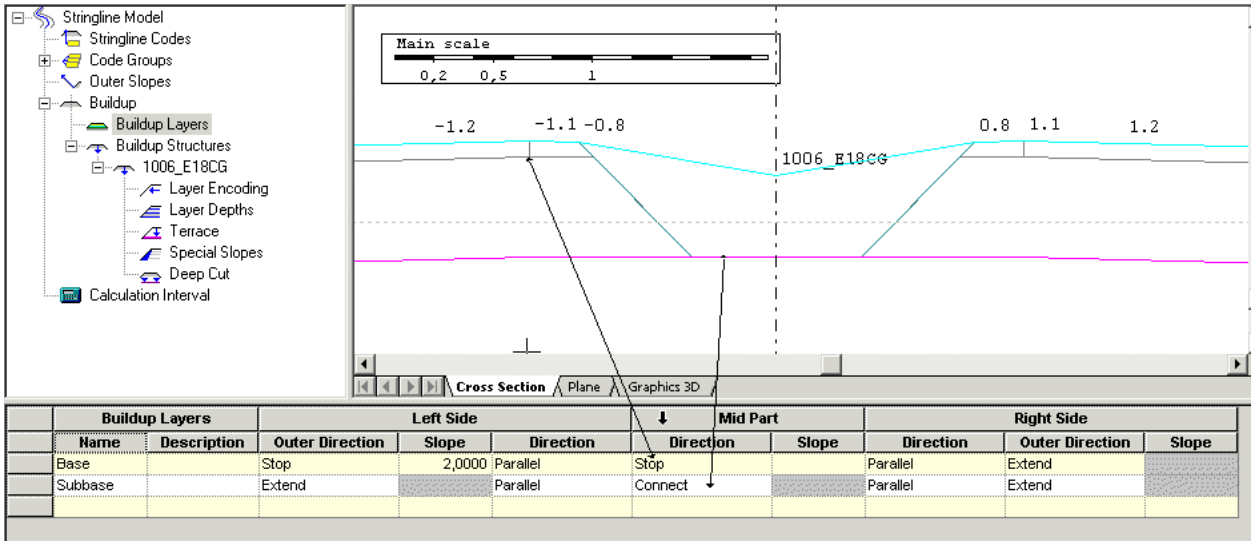
Buildup Layers		Left Side			Mid Part		Right Side		
Name	Description	Outer Direction	Slope	Direction	Direction	Slope	Direction	Outer Direction	Slope
Wearing course		Extend		Parallel	Extend		Parallel	Extend	
Base		Extend		Parallel	Extend		Parallel	Extend	
Subbase		Stop	4,0000	Parallel	Extend		Parallel	Extend	

You define outer direction if the buildup layer is to be extended to, for example inner slope, or is stopped at the outer code set during layer coding. It is also possible to specify a gradient at the end. Direction is used

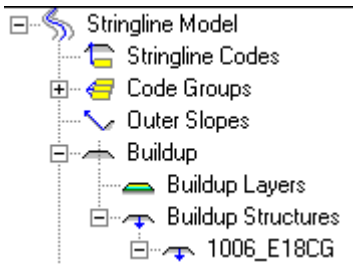
to describe if the buildup is to be parallel to the surface or if it is to be connected directly between the outer code and inner code specified in layer coding.



The mid part is defined if the buildup layer should stop at the inner code, or if it should be connected to the inner code on the other side of the mid part, or if the build up layer should be parallel to the buildup or be extended to the center line.



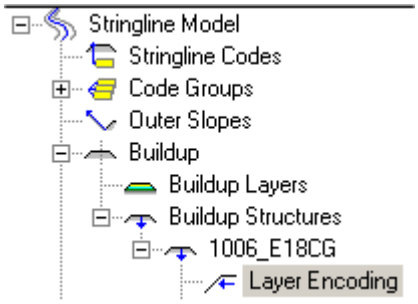
Buildup Structures



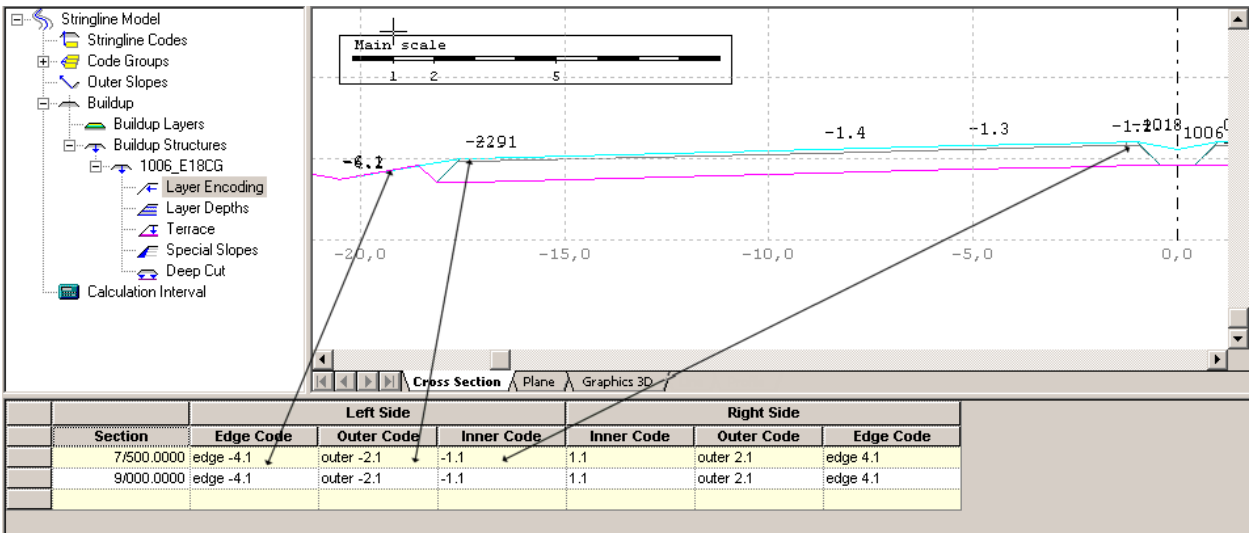
	Buildup Structures
	Base Code
	1006_E18CG

Here you must specify the stringline code that is in the center. When importing LandXML, the center code is normally the same code as the LandXML model's name. The stringline model can handle a buildup that applies to the entire section.

Layer Coding



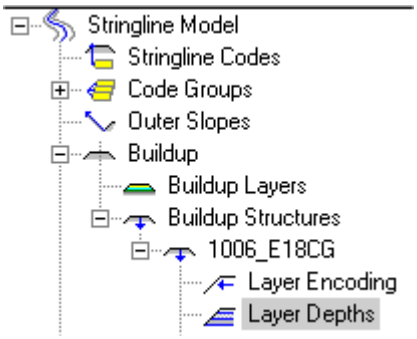
The stringline model has the option of controlling the buildup handling through stringline codes.
Edge code is the code or code group to which you want the buildup to connect.
Outer code is the code or code group where you want the buildup to stop.
Inner code is the code or code group where you want the buildup in the mid part to stop.



		Left Side			Right Side		
	Section	Edge Code	Outer Code	Inner Code	Inner Code	Outer Code	Edge Code
	7/500.0000	edge -4.1	outer -2.1	-1.1	1.1	outer 2.1	edge 4.1
	9/000.0000	edge -4.1	outer -2.1	-1.1	1.1	outer 2.1	edge 4.1

Here you have the option of adding more stations (length measurement) to handle such things as different layer thicknesses as well as start and end of special slopes.

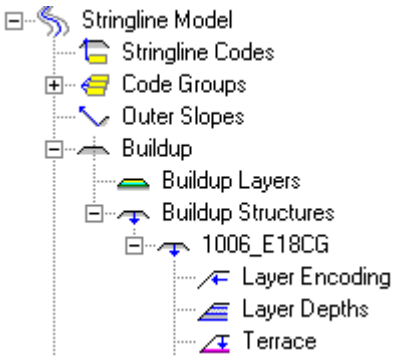
Layer Depths



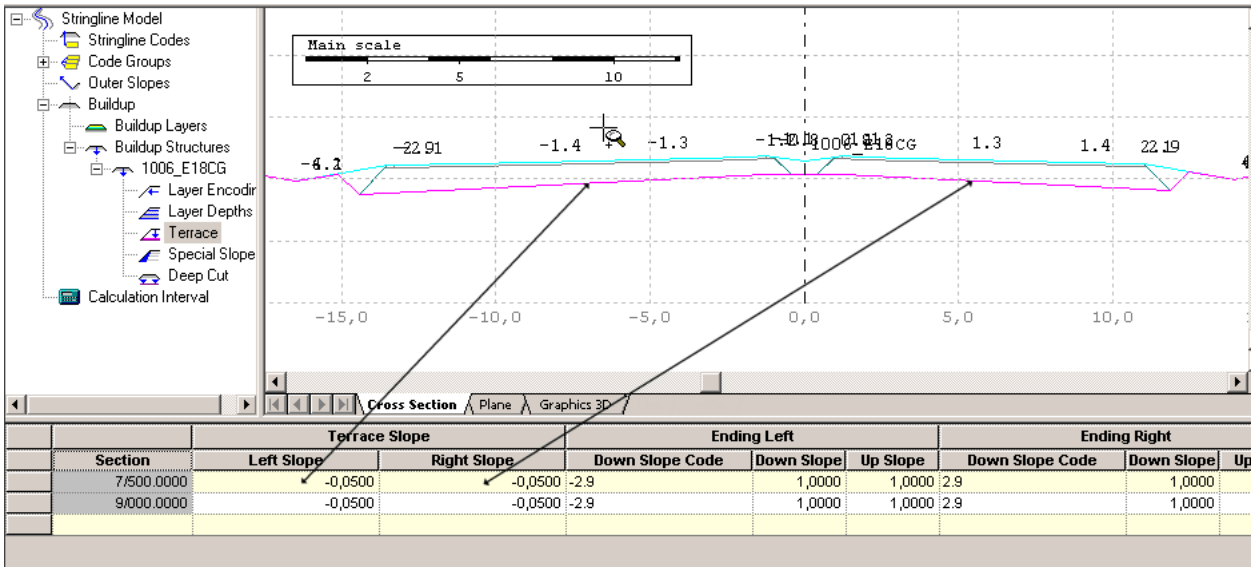
Here you specify the different layer thicknesses for the buildup. Layer thicknesses are interpolated between the different stations so that there can be a transition section between different layer thicknesses.

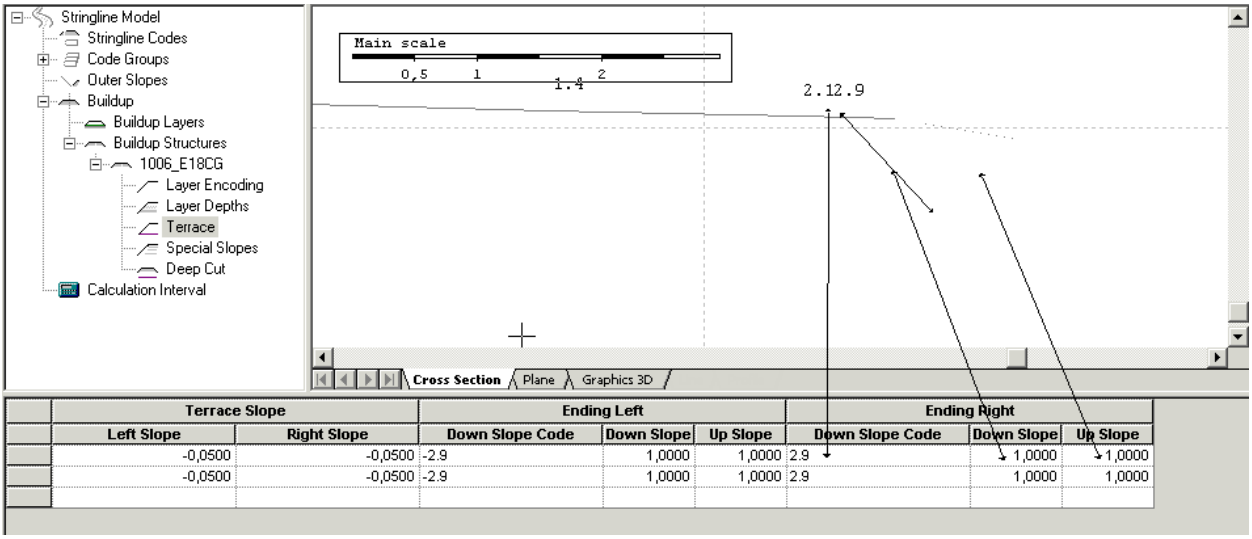
		Layer Depths	
	Section	Base	Subbase
	7/500.0000	0,0800	0,5000
	9/000.0000	0,0800	0,5000

Terrace



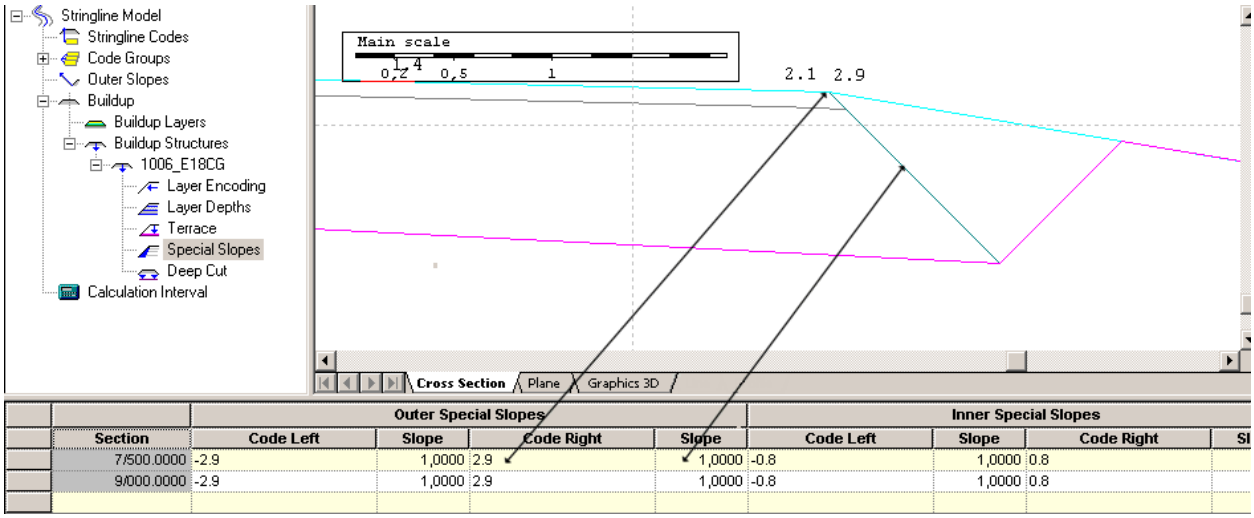
Here you can specify a slope other than the buildup terrace as well as having the option of specifying parameters for the terrace limitations. The terrace slopes are interpolated between the different stations.

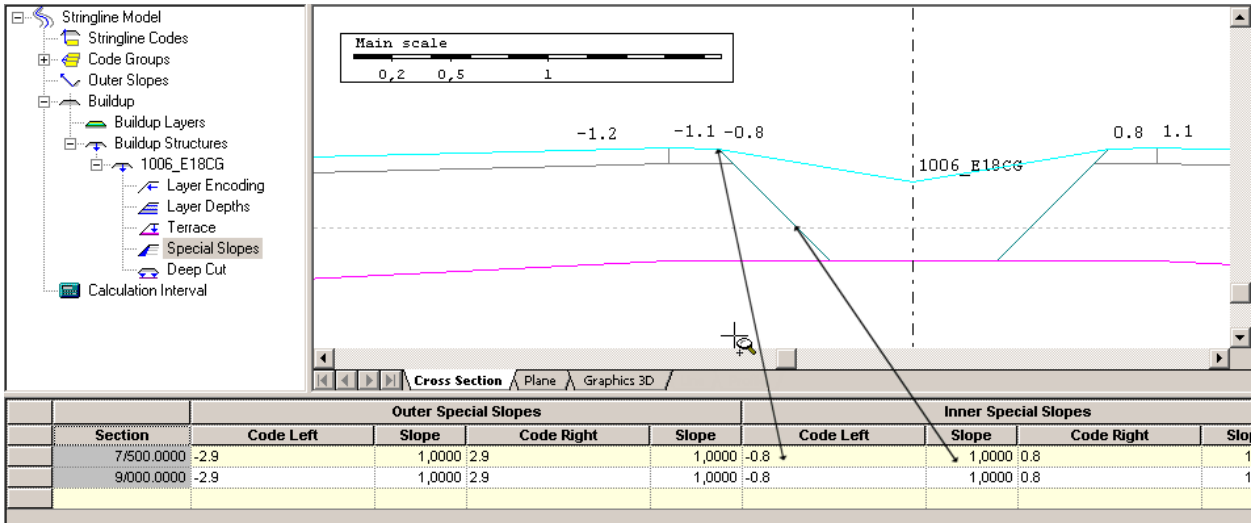




Special Slopes

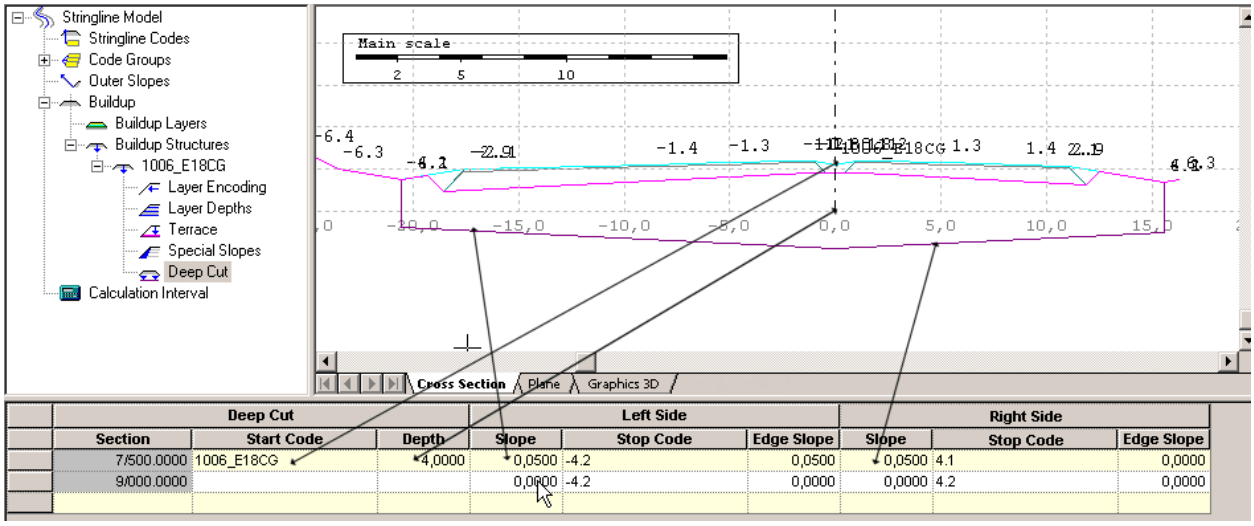
Enter the code for start and slope of the inner or outer special slope.





Deep Cut

Enter the start code, depth under start code, stop code and the slope of the deep cut (depth explosion). The slopes are interpolated between different stations.



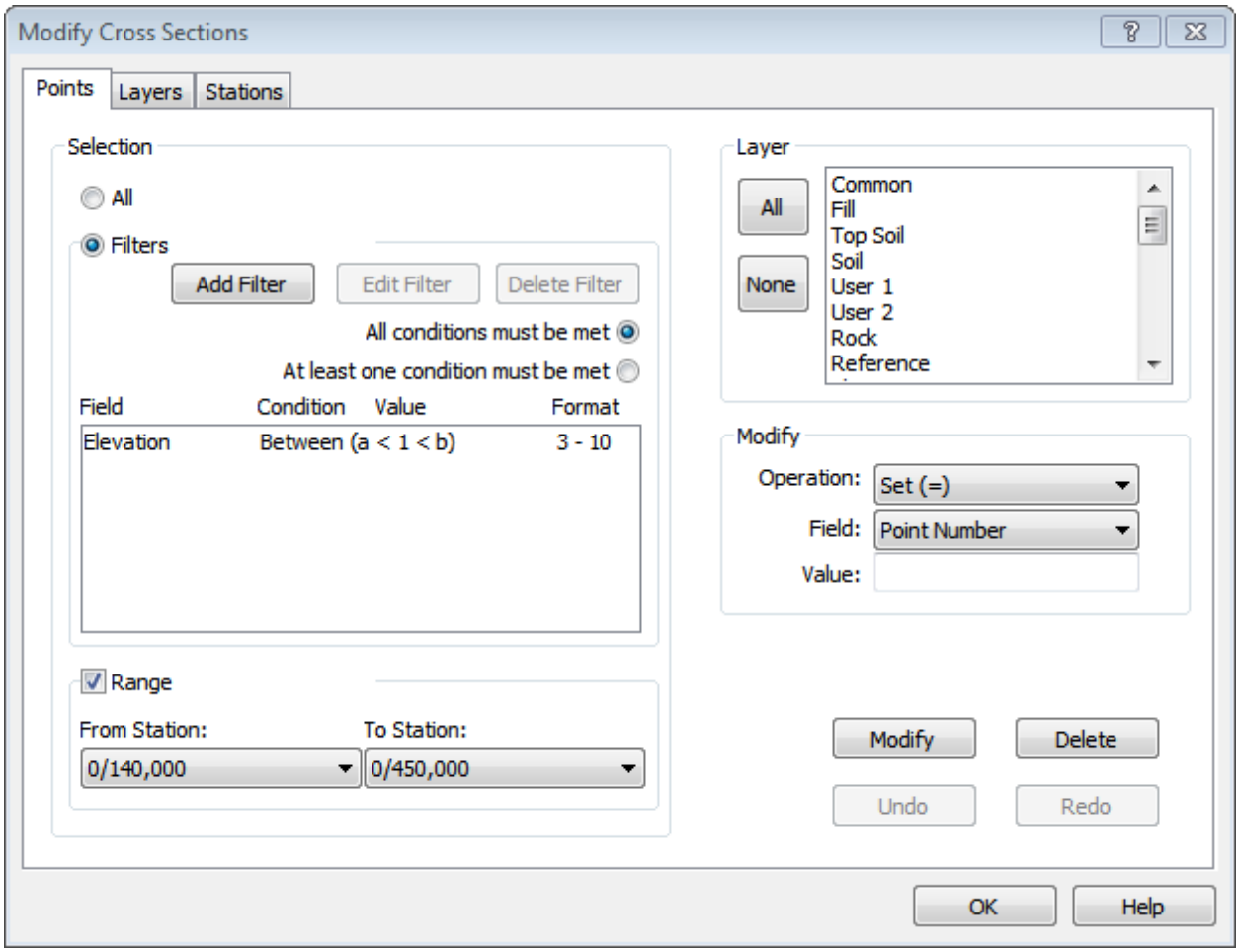
Calculation Interval

Enter the start station and end station of the stringline model. Also indicate the range to be displayed in the cross section view. The calculation Interval has no function in GeoPad.

9.8 Modify Cross Section File

9.8.1 Modify Points in Cross Section File

Use this function to change or delete points with certain special properties. This function works on the entire active document, or parts thereof. Open a cross section file, .sec, and select ***Data | Modify Cross Sections*** to open the dialog.



Point Selection

Here you select the points to be modified or deleted. The selection can be done in three ways.

All:
All points in the document will be deleted/modified.

Filters:
Set up filters for the points that will be deleted/modified.

- **[Add Filter]**
  Click here to create a new filter. A dialog for defining filters 168 opens.
- **[Edit Filter]**
  Click here to edit the filter that is selected in the filter list. This opens the dialog for the filter definition 168 .
- **[Delete Filter]**
  Click here to delete the filter that is selected in the filter list.

- **Filter list:**
  Here you see the filters you have created.

- **All conditions must be met**
  This allows filtering at several levels. If you specify several filters, the conditions must be met in all the filters for the point to be handled.

- **At least one condition must be met**
  This allows filtering at several levels. If you specify several filters, at least one condition must be met for the point to be handled.

Range:
Enter the first and last station in the document to be deleted/modified. All points in the interval are handled.

Layer:
Enter the layer or layers where points are to be deleted/modified.

Modify
Enter here the modification to be made of the points that meet the criteria in *Point Selection*.

Operation:
Enter the operation to be performed on the points. For incremental fields only Set (=) is possible.

- **Set**
  Set the selected field to a new value. If the value is shown as * in numeric fields, the point number value will be set.

- **Add**
  Numeric value to add to existing value.

- **Multiply**
  Numeric value to multiply the existing value with. -1 to change sign.

- **Divide**
  Numeric value to divide the existing value with.

- **Prefix**
  Enter a text to add before existing data. Does not work on numeric fields.

- **Suffix**
  Enter a text to add after existing data. Does not work on numeric fields.

- **Delete text**
  Specify a text to delete from existing data. Does not work on numeric fields.

Fields:
Specify the field in the cross sections that is to be modified.

Value:
Enter new value or the value for the selected operation.

Buttons

[Modify]:
Perform the selected change on the points in the selection.

[Delete]:
Delete points in the selection.

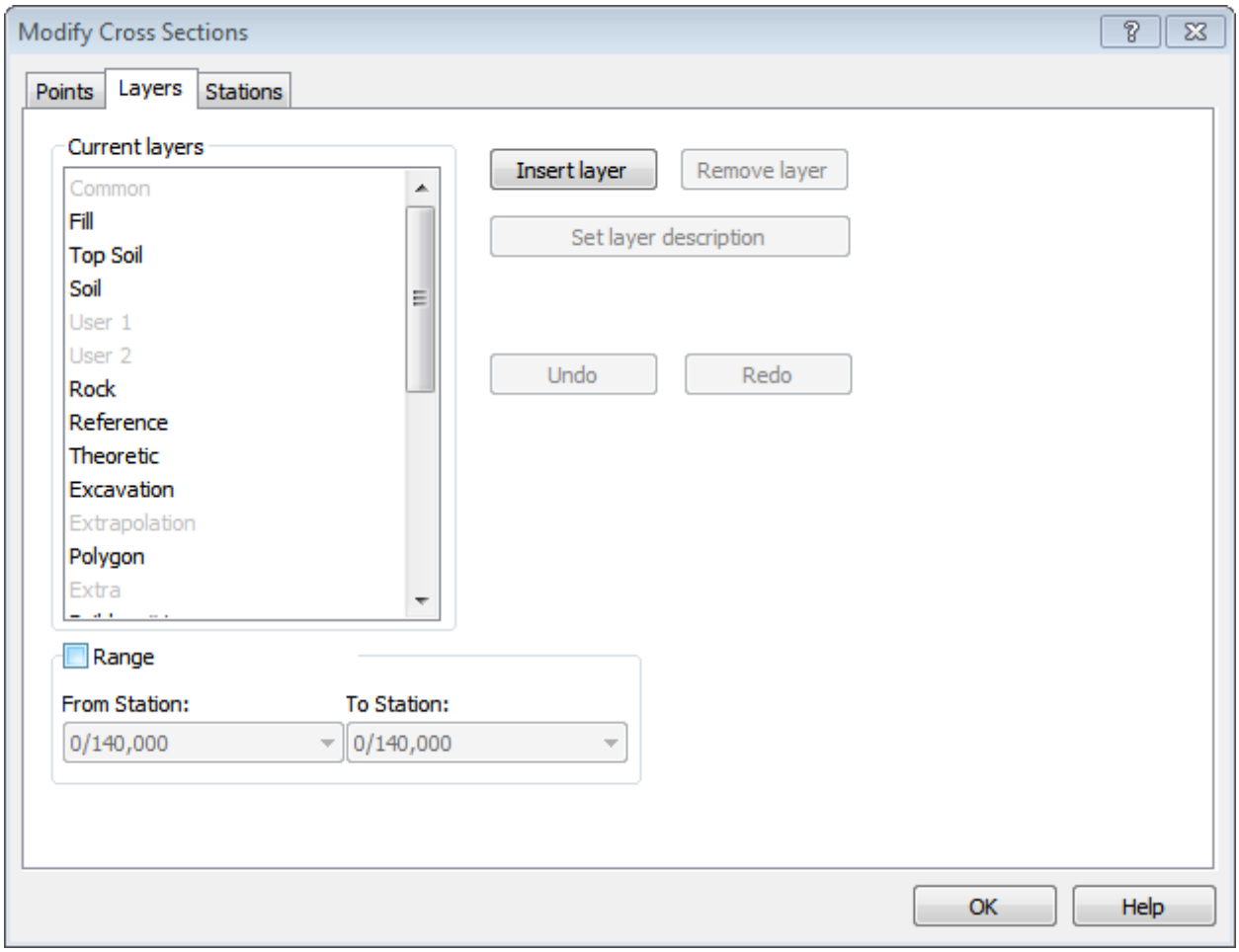
[Undo] and [Redo]:
Undo or redo last change. These have the same function as the normal buttons in the toolbar, but as these cannot be accessed with the dialog open, you can use these instead.

[OK]:
Closes the dialog.

See also: Coordinate Handling 118, Coordinate Files 153, Search and Modify 100, Modify Layers in Cross Section File 553, Modify Stations in Cross Section File 555

9.8.2 Modify Layers in Cross Section File

You use this function to modify or delete layers in the active section file. This function works on the entire active document, or a selected range. Open a cross section file, .sec, and select ***Data | Modify Cross Sections*** to open the dialog.



Current Layer

Here you only select the layers to modify or delete. If the name of the layer is in gray, this layer is not in the active document. If you have selected a range, the layer is only searched for in the selected interval.

Range

Here you select from the stations you want to modify. If not selected this means you work with the entire document.

Buttons

[Insert Layer]:
Inserts the selected layer.

[Delete Layer]:
Deletes the selected layer.

[Add Layer Description]:
Displays a dialog where you can enter a new description for the selected layer.

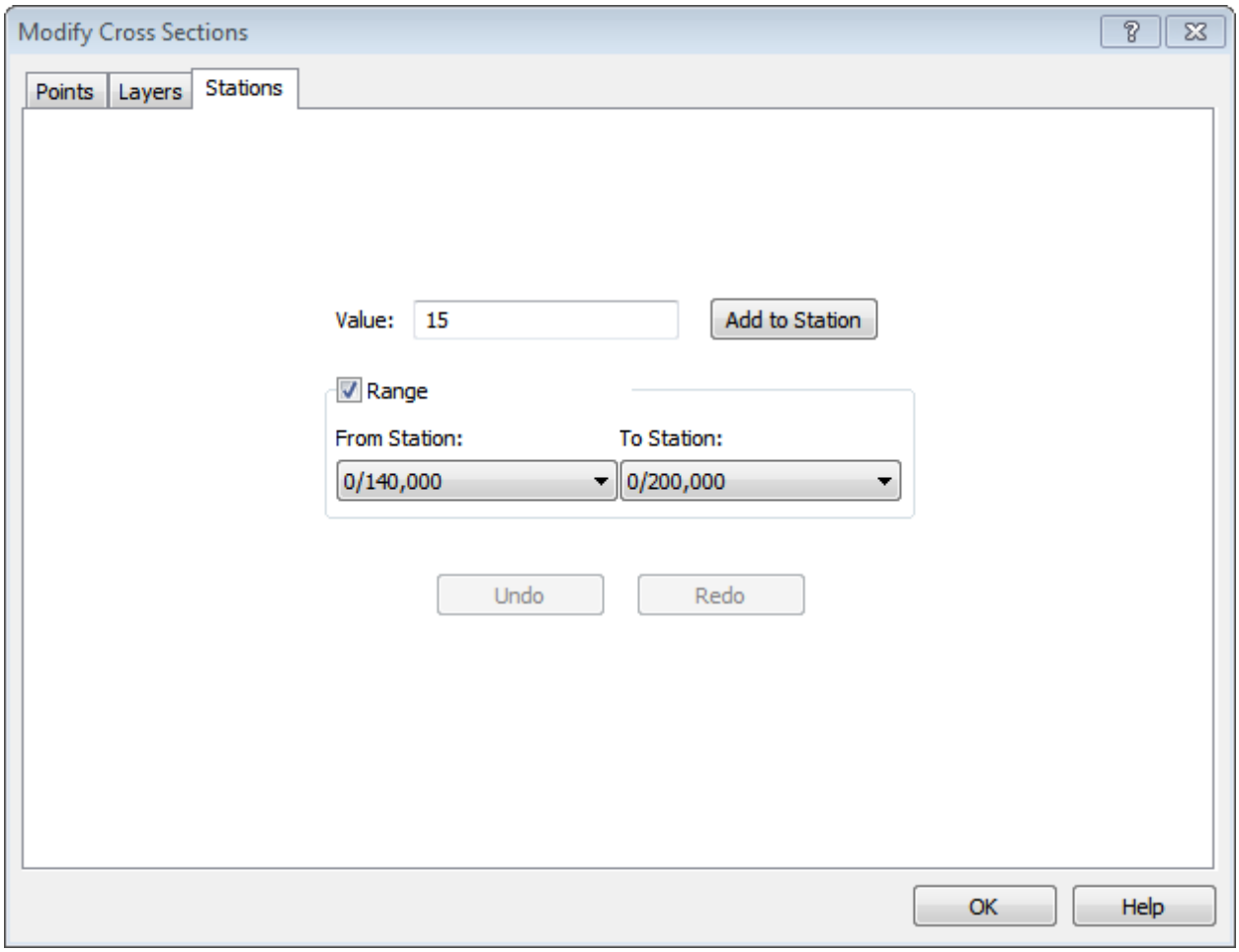
[Undo] and [Redo]:
Undo or redo last change. These have the same function as the normal buttons in the toolbar, but as these cannot be accessed with the dialog open, you can use these instead.

[OK]:
Closes the dialog.

See also: Coordinate Handling 118, Coordinate Files 153, Search and Modify 100, Modify Points in Cross Section File 550, Modify Stations in Cross Section File 555

9.8.3 Modify Stations in Cross Section File

You use this function to modify stations in a cross section file. This function works on the entire active document.
Open a cross section file, .sec, and select ***Data | Modify Cross Sections*** to open the dialog.



Value
Here you enter the value to be added to each station.

Range
Here you select from the stations you want to modify. If not selected this means you work with the entire document.

Buttons

[Add to Station]:
Adds the value to the selected stations.

[Undo] and [Redo]:
Undo or redo last change. These have the same function as the normal buttons in the toolbar, but as these cannot be accessed with the dialog open, you can use these instead.

[OK]:
Closes the dialog.

See also: Coordinate Handling 118 , Coordinate Files 153 , Search and Modify 100 , Modify Points in Cross Section File 550 , Modify Layers in Cross Section File 553

9.9 Cross Sections Along Line

You use this function to calculate the cross section points in a given range along a line.

Select the origin of the calculation:

- Road line, l3d
  The calculation results depend on the line's horizontal and vertical geometry.

  Note, If you use the older line style, .lin, the calculated resulting file will include information from the line's horizontal and vertical geometry (that is, the line's horizontal and vertical coordinates, *.lin and *.prf).

- Cross fall model, cfm
  The calculation results depend on the cross fall model and the line's geometry.

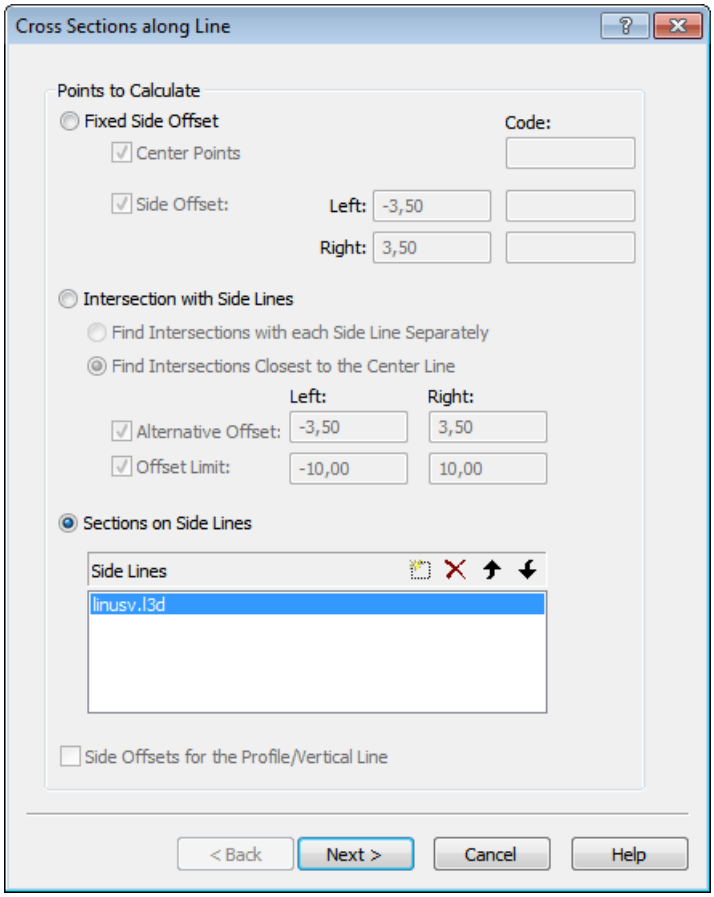
  Note, If you use the older line styles (line, *.lin, profile, *.prf and camber/cross slope *.skv) you need to open the camber document, *.skv, if the calculated resulting file should include information from both the cross fall model (previously called camber) and the line's horizontal and vertical geometry.

When you select the calculation ***Cross Sections Along Line*** you can:

- calculate points with a fixed offset
- calculate intersection points with side lines
- calculate cross sections on side lines
- save the results as coordinates or as cross sections
- save the results in a report

Open a cross fall model, cfm, or a line file, l3d, and select ***Data | Cross Sections Along Line*** to use the function.

Note: If you use the older line styles; line (*.lin), profile (*.prf) and camber (*.skv), please see the text above 557.



Note, Depending on the origin of the calculation, the calculated heights will originate from either a cross fall model or from the line's vertical geometry.

Please note that the calculation does not include any vertical geometry that might be associated to the side line.

In the dialog, select how points are to be calculated:

- Fixed Offset[559]
- Intersection with Side Lines[560] (allowing varying offsets)
- Cross Sections on Side Lines[561]

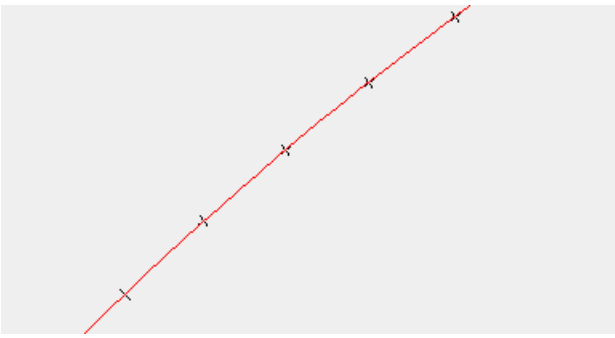
Fixed Offset

The height of the calculated points depend on the origin of the data, either

- the road line's vertical geometry, l3d
- the cross fall model, cfm

Center Points

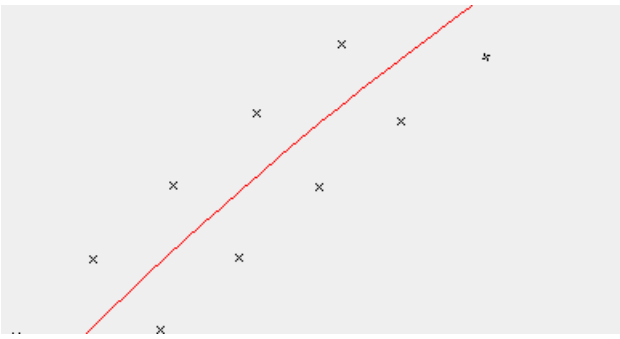
Calculates the points in the center line (i.e. offset = 0). Points will be numbered with the length section (applies if you save[572] as coordinates).



Center Points.

Offset

Calculates the points with the specified offsets for left and right side. Enter negative values for the left side and positive for the right side of the center line (by entering offsets with the same signs you can calculate points on the same side of the center line). Points will be numbered with the length section and as a prefix a minus sign is set for the left side and a plus sign for the right side (applies when saving[572] as coordinates).



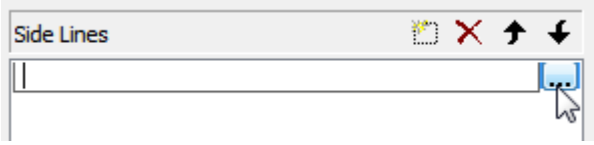
Points with fixed offsets.

Intersection with side lines

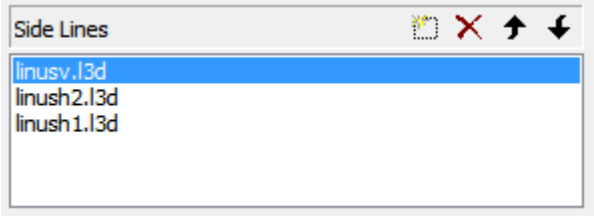
The points on the center line that create tangential orthogonal intersections with the side lines determine the interval between the calculated points along the side lines.
All calculated points on the side lines, will get the height coordinates from the origin data, either:

- the center line's vertical geometry, l3d
- the cross fall model, cfm

To select the side lines, click the button . In the line that illuminates you can either enter the filename directly or click the select button to the right, .

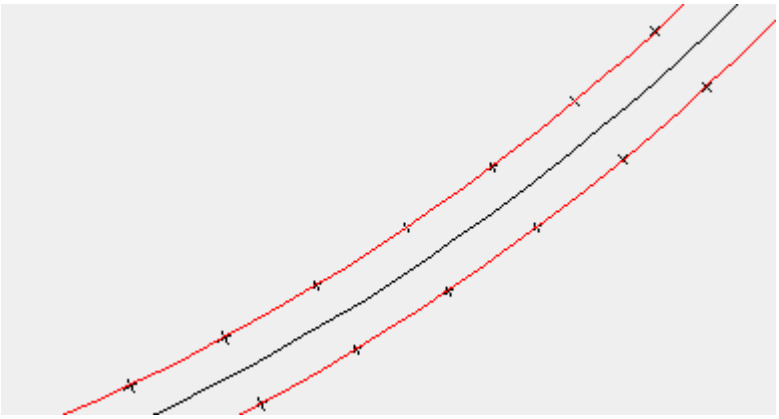


You can select multiple files directly by selecting them in the file dialog (click the select button,).



Find Intersections with each Side Line Separately

This function calculates the intersection points for all side lines that are selected. Intersections are calculated in the range[562] indicated. Points will be numbered with the length section and as a prefix a minus sign is set for the left side and a plus sign for the right side (applies when saving as coordinates).



Intersection with side lines.

Find Intersections Closest to the Center Line

This function calculates the intersection points for all side lines chosen but only presents the point closest to the center line. Intersections are calculated in the range indicated. Points will be numbered with the length section and as a prefix a minus sign is set for the left side and a plus sign for the right side (applies when saving as coordinates).

Alternative Offset and Offset Limit

Offset Limit specifies the offset within which the program searches for an intersection with the side lines. If the program cannot find an intersection within this offset, the alternative offset is used instead. Use negative values for the left side of the center line in the line direction.

Cross Sections on Side Lines

This function calculates points on the side lines, where the points are separated by sections of the specified range[562] .

All calculated points on the side lines, will get the height coordinates from the origin data, either:

- the center line's vertical geometry, l3d
- the cross fall model, cfm

You can use the result from *Cross Sections on Side Lines* in situations where it is desirable to have cross sections of a specified range on the side line, that are *not* determined by the center line.

The difference between "Intersection with Side Lines" and "Cross Sections on Side Lines"

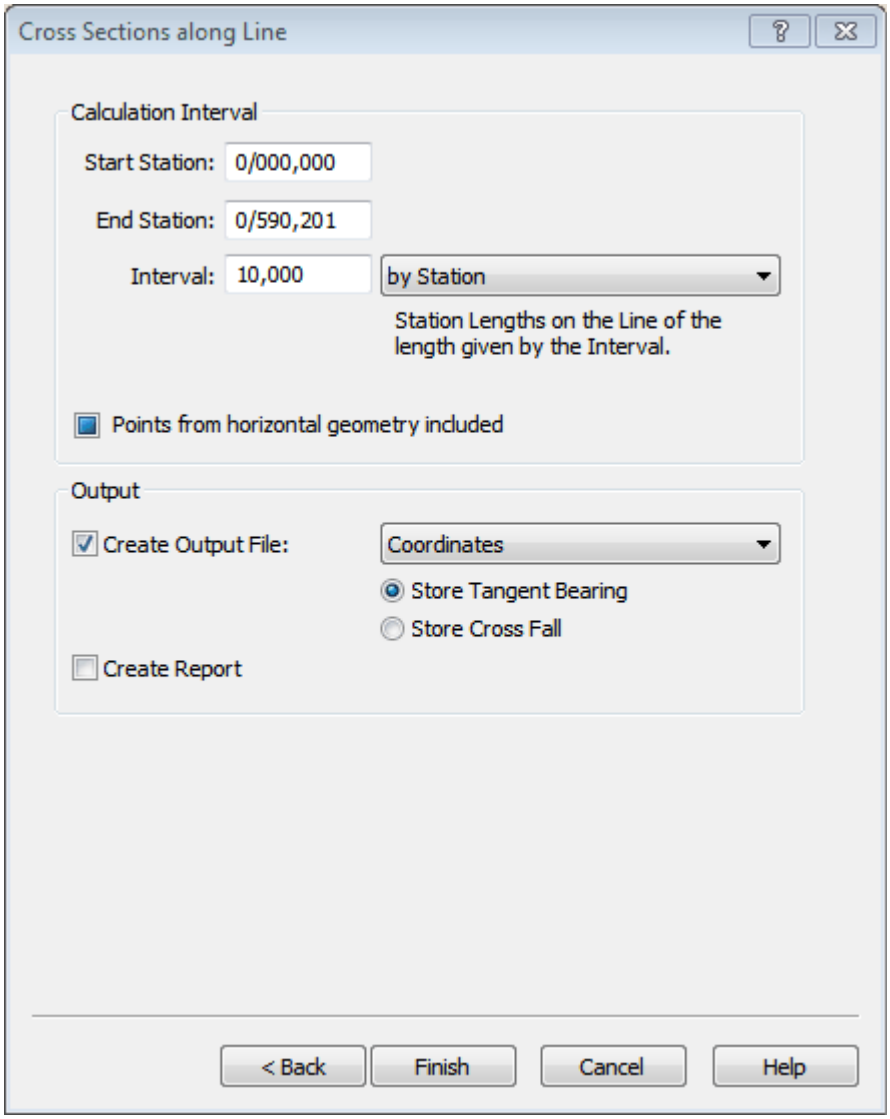
Intersection with Side Lines	The interval between the calculated points along the side lines is determined by the points on the center line that create tangential orthogonal sections on the side lines. The center line determines the interval.
Cross Sections on Side Lines	The interval between the calculated points along the side lines is determined as a fixed length along the side line, i.e. the interval is *not* determined by the center line. The side line determines the interval.

Side Offsets for the Profile/Vertical geometry

This box will be activated when the calculation originates from a cross fall model, cfm. If the cross fall model includes offset, distinguished from 0, the cross fall does not start at the center line, but at the stated offset.

Check the box if the calculation should take account of offset in the cross fall model[537] .

Calculation Interval (Range)



Start Station and End Station
Enter the length stations in which the calculation will be made.
You may change the start and/or end station. Note, the calculation will remember your changes, thus it is easy for you to recalculate the cross sections. If you want to calculate cross sections along the whole line again, you will need to specify the true end station again, or enter a value that is larger than the end station.

Interval (Range)
Enter the station interval to calculate the points.
In the drop down list you can select the length range to be calculated.

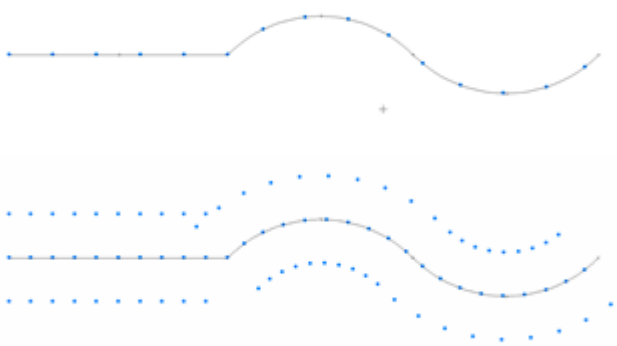
- by Station 563 — *Station lengths on the line, of the length given by the range.*
- by Vertical Chord 567 — *Chord lengths on the vertical line (but bent along the horizontal line), of the length given by the range.*
- by 3D Arc 568 — *Arc lengths on the 3D line, of the length given by the range. (True arc length, in three dimensions.)*
- by 3D Chord 570 — *Chord lengths on the 3D line, of the length given by the range. (Chords in three dimensions.)*

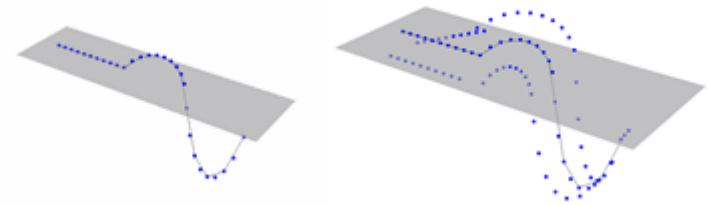
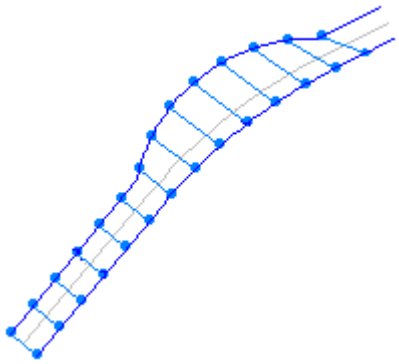
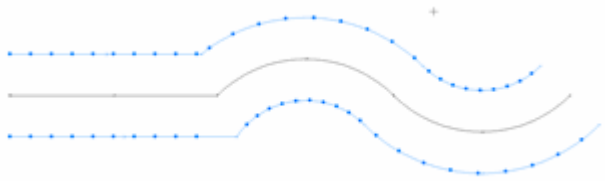
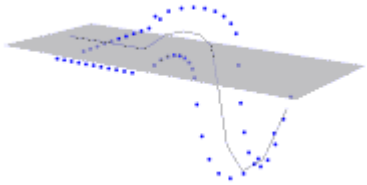
Element Points
Select which element points should be included in the calculation. You can choose between points included in the cross fall model, and points included in the road line:

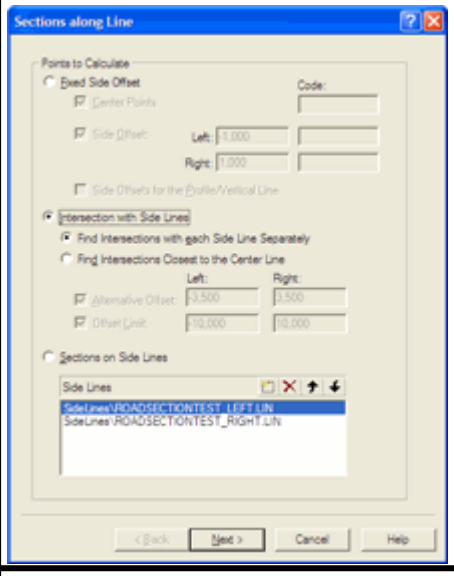
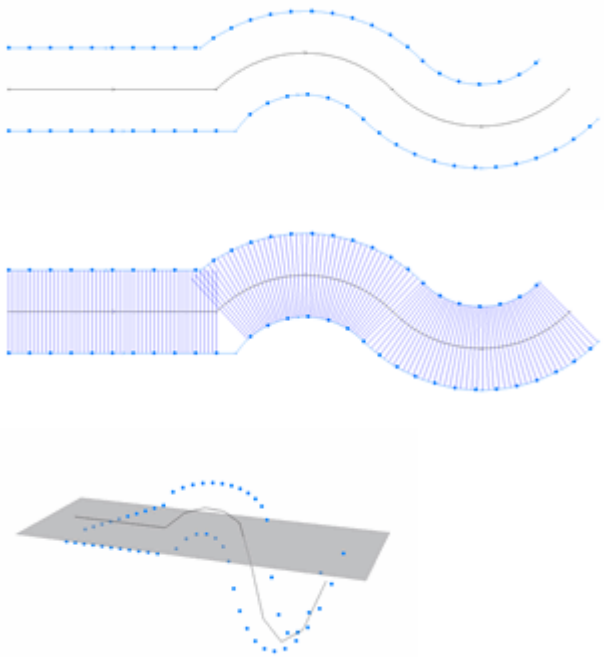
• Points from horizontal geometry included.	Element Points from the horizontal geometry of the Center Line included.
• Points from all geometries included, except side lines.	Element Points that are included: ○ points in the cross fall model ○ points from the horizontal and vertical geometry of the Center Line (No element points from Side Lines will be included.)
• Points from geometries not included	No points from the Center Line's geometry will be included. (Only points from the selected interval will be included.)

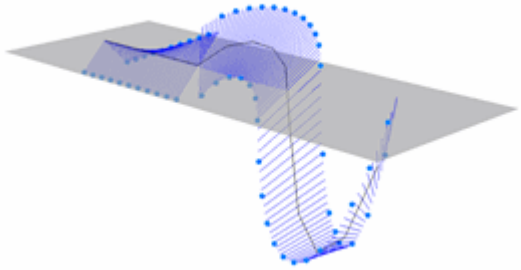
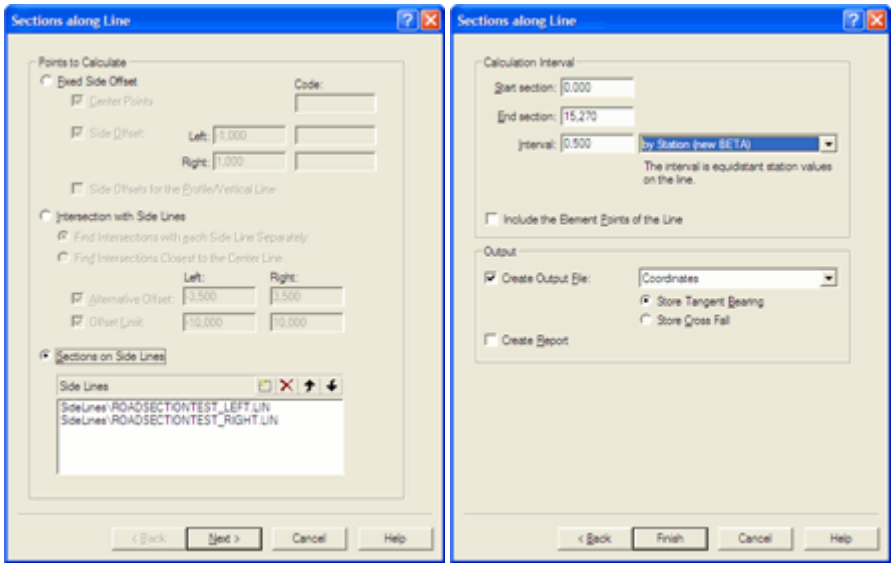
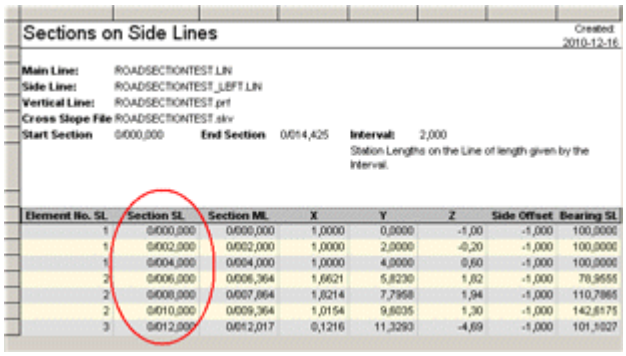
If element points are included in the calculation, the output file will include coordinates of the specified range, and also coordinates for the element points specified by the selected alternative.

If your line include station equation515, the calculated files will include calculated stations named according to station equation.

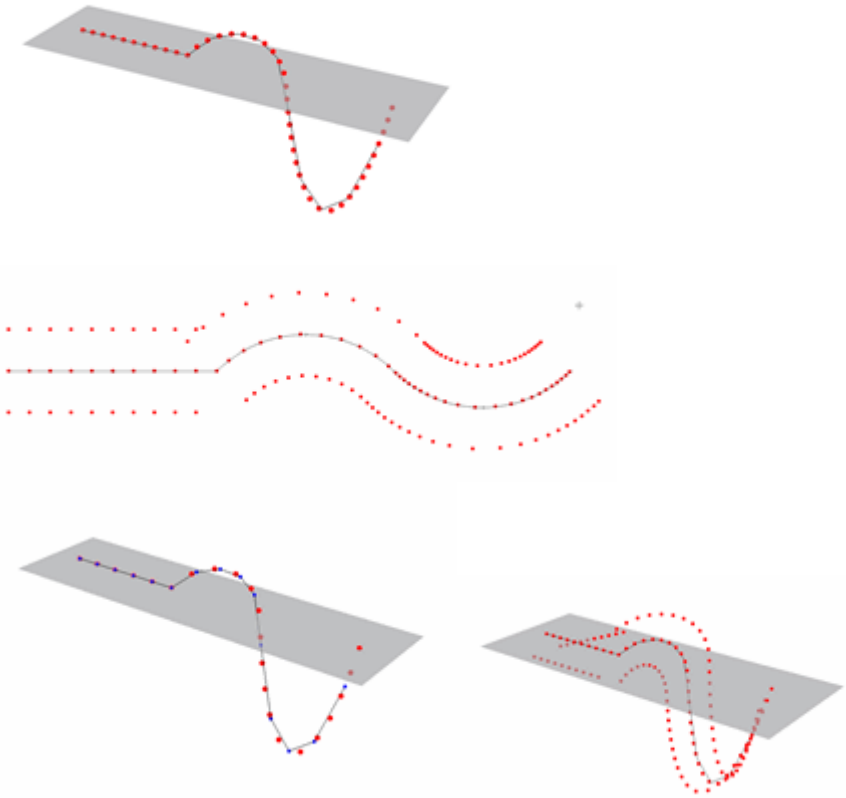
By Station	*Station lengths on the line, of the length given by the range.*
Center Points and Fixed Side Offset	Points on the center line, that are station-wise spaced by the given range, determine the tangential orthogonal offset. The range calculated from the horizontal geometry of the *center line* (i.e. no influence from the vertical geometry). The same amount of points along the fixed offset curve are created along the outside curve (longer intervals between the points) as the corresponding inside curve (shorter intervals). The height coordinates for all points along the center line and/or along the fixed side offset, will be calculated using the center line's vertical line geometry and the cross fall model if it is used. *Traditional calculation of cross sections, where the cross sections are created at perpendicular positions to the center line.* 

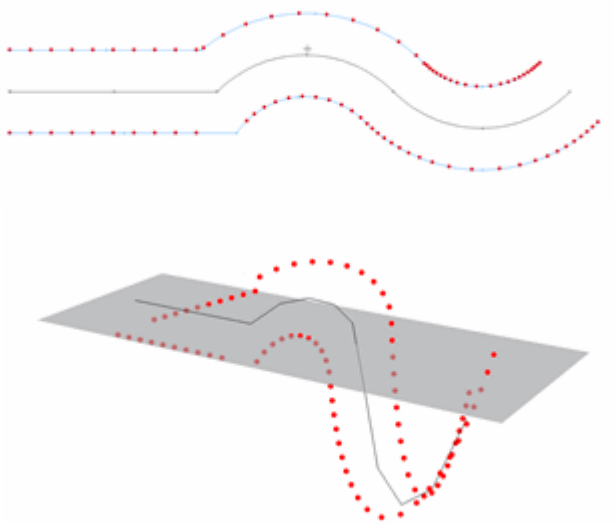
By Station	*Station lengths on the line, of the length given by the range.*
	
Intersection with Side Lines	The range calculated from the horizontal geometry of the *center line*, where the points on the center line create cross sections that intersect the side lines. Thus, the points are orthogonal placed along the side lines, where the range is determined by the point range on the center line. The same amount of points are created along the side line's outside curve (longer intervals between the points) as the corresponding inside curve (shorter intervals). The height coordinates for all points along the side lines will be calculated using the centerline's vertical geometry and cross fall model if it is used. Please note, no consideration will be taken to the side lines's vertical geometry (if any).  **Example of a side line with varying offset.**  

By Station	*Station lengths on the line, of the length given by the range.*
	
Sections on Side Line (side line without vertical geometry)	The range calculated from the horizontal geometry of the *side line*. The points along the side lines, will be placed at the specified range. The outside of a curve will therefore have more points along the line compared to the corresponding inside curve. The height coordinates for all points along the side lines will be calculated using the center line's vertical geometry and from the cross fall model if it is used. Please note, no consideration will be taken to the side lines's vertical geometry (if any). 

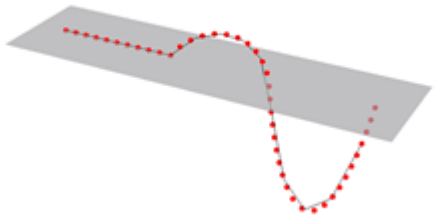
By Station	*Station lengths on the line, of the length given by the range.*
	   All points along the side line are placed at the specified range, with regard to the side line.

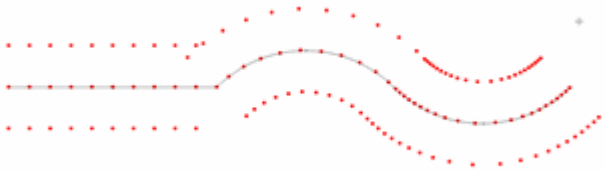
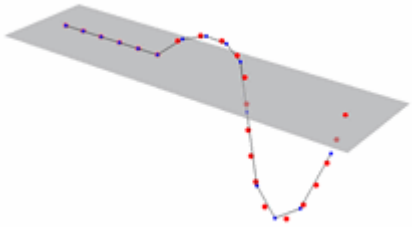
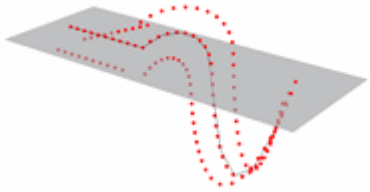
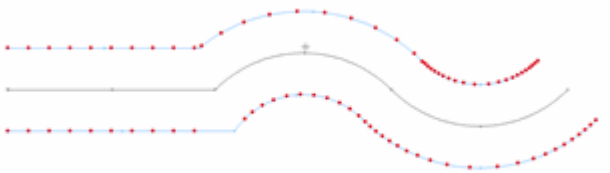
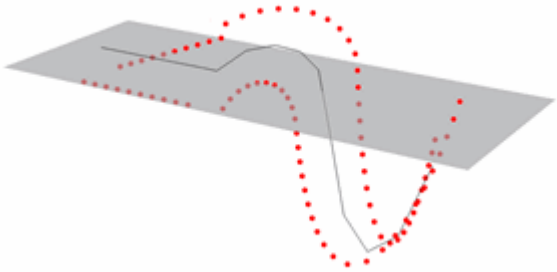
Calculation interval: By Station

By Vertical Chord	Chord lengths on the vertical line (but bent along the horizontal line) of the length given by the range.
Center Points and Fixed Side Offset	The range is calculated from the horizontal geometry of the *center line*, and follows a chord 572 on the vertical geometry of the center line. Depending on the origin of the calculation, the calculated height coordinate for all points along the center line and/or along the fixed side offset originate from either: • the center line's vertical geometry, l3d • the cross fall model, cfm (the cross fall model is always linked to a center line with horizontal and vertical geometry) *Generally, when the length of the center line along the profile will be different from the station-wise distance, i.e. for steep slopes.* 
Intersection with Side Lines	The range is calculated from the geometry of the *center line*, where points on the center line create tangential orthogonal intersections to the side lines. The length of the interval is calculated with reference to the chord 572 of the center lines's profile. The height coordinates for all points along the side lines will be calculated using the center line's profile and cross slope. Please note, no consideration will be taken to the side lines's profile (if any). *Generally, when the length of the center line along the profile will be different from the station-wise distance, i.e. for steep slopes.*

By Vertical Chord	Chord lengths on the vertical line (but bent along the horizontal line) of the length given by the range.
	 *The points are orthogonally projected on the side lines, the range calculated from the center line.*
Sections on Side Line (without profile)	Currently there is no known application for this. The calculation is not implemented.

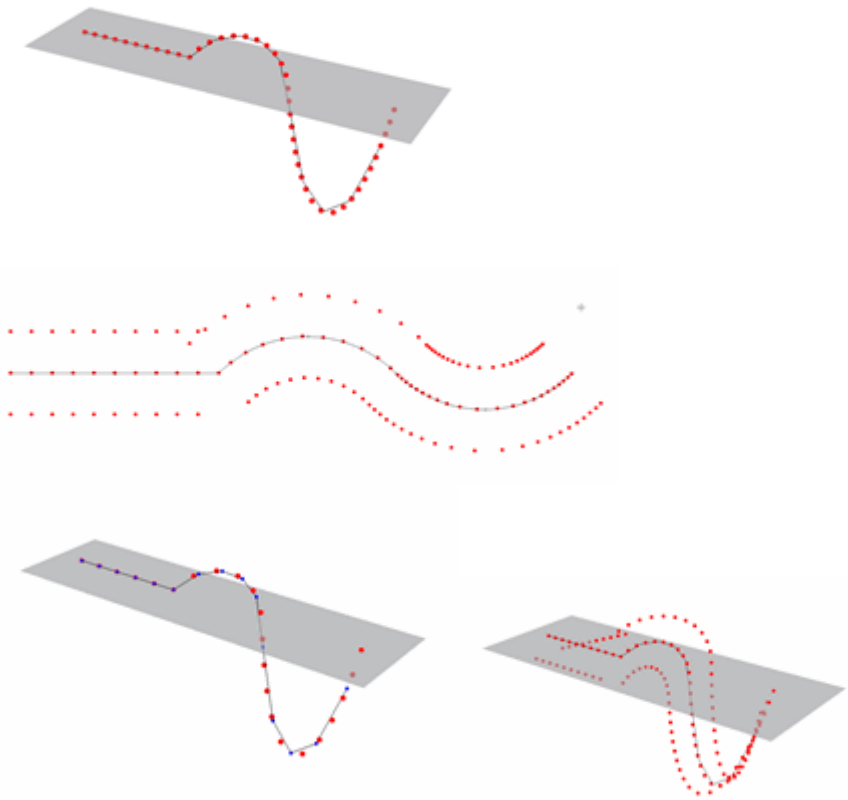
Calculation interval: By Profile Chord

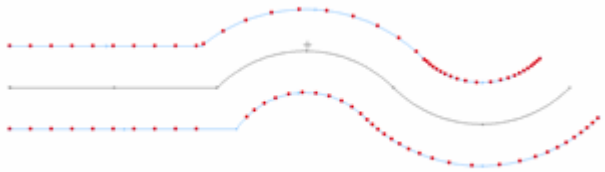
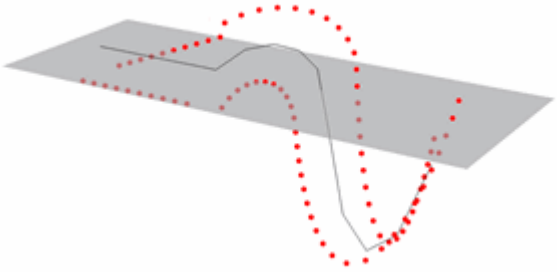
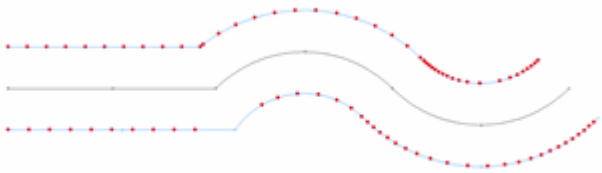
By 3D Arc	*Arc lengths on the profile and the line, of the length given by the range. (True arc length, in three dimensions).*
Center Points and Fixed Side Offset	The range calculated from the geometry of the *center line*, with reference to the 3D arc length 572 of the center line, i.e. the length of the interval is calculated with reference to both the radius of the line and the radius of the profile. The height coordinates for all points along the center line and/or along the fixed side offset, will be calculated using the center line's profile and cross slope. *Can be used when you want to follow the profile of the center line, exactly. You will get the sloping distance in a curve, with regard to both the radii of the line and the heights in the profile, for example in a mine.* *Generally, when the length of the center line along the profile will be different from the station-wise distance, i.e. for steep slopes.* 

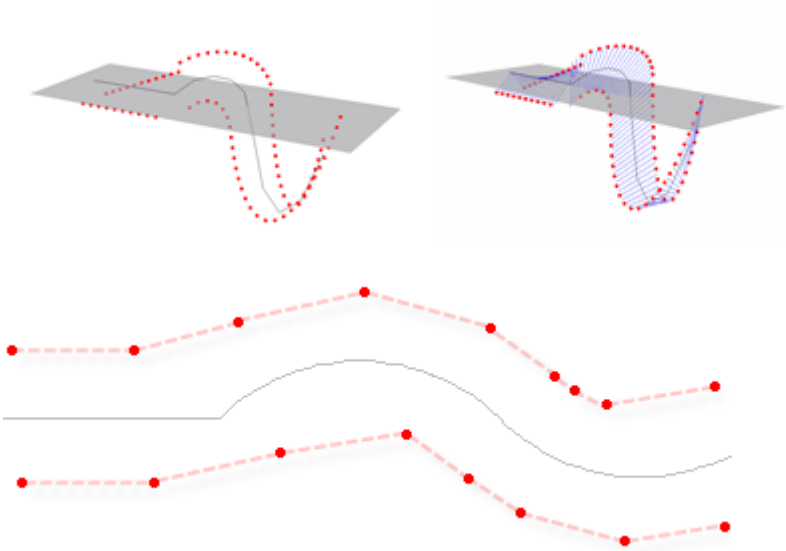
By 3D Arc	*Arc lengths on the profile and the line, of the length given by the range. (True arc length, in three dimensions).*
	   The differences to points calculated by Profile Chord 567 are too small to be visible in these images.
Intersection with Side Lines	The range is calculated from the geometry of the *center line*, where points on the center line create tangential orthogonal intersections to the side lines. The length of the interval is calculated with reference to the 3D arc length 572 of the center lines's profile, i.e. the length of the interval is calculated with reference to both the radius of the line and the radius of the profile. The height coordinates for all points along the side lines will be calculated using the center line's profile and cross slope. Please note, no consideration will be taken to the side lines's profile (if any). *Generally, when the length of the center line along the profile will be different from the station-wise distance, i.e. for steep slopes.*   The differences to points calculated by Profile Chord 567 are too small to be visible in these images.

By 3D Arc	*Arc lengths on the profile and the line, of the length given by the range. (True arc length, in three dimensions).*
	The points are orthogonally projected on the side lines, the range calculated from the center line.
Sections on Side Line (without profile)	Currently there is no known application for this. The calculation is not implemented.

Calculation interval: by 3D Arc

By 3D Chord	*Chord lengths on the profile and the line, of the length given by the range. (Chords in three dimensions.)*
Center Points and Fixed Side Offset	The range calculated from the geometry of the *center line*, with reference to the chord of the center line and the chord of the profile, i.e. the interval length related to the line's radius and the profile's slope (radius) is calculated as the chord[572]. The height coordinates for all points along the center line and/or along the fixed side offset, will be calculated using the center line's profile and cross slope. *Generally, when the length of the center line along the profile will be different from the station-wise distance, i.e. for steep slopes.*  The differences to points calculated by Profile Chord[567] are too small to be visible in these images.
Intersection with Side Lines	The range calculated from the geometry of the *center line*, where points on the center line create tangential orthogonal intersections to the side lines. The points along the side lines, will be placed at the specified ranges with reference to the 3D chords[572] of the center line, i.e. both the chord in the center line's curve (radius) *and* profile slope (radius) have influence.

By 3D Chord	*Chord lengths on the profile and the line, of the length given by the range. (Chords in three dimensions.)*
	The height coordinates for all points along the side lines will be calculated using the center line's profile and cross slope. Please note, no consideration will be taken to the side lines's profile (if any). *Generally, when the length of the center line along the profile will be different from the station-wise distance, i.e. for steep slopes.*   The differences to points calculated by Profile Chord[567] are too small to be visible in these images.
Sections on Side Line (without profile)	The range calculated from the geometry of the *side line*. The points along the side lines, will be placed at the specified range with reference to the chord[572] of the side line's radius. The height coordinates for all points along the side lines will be calculated using the center line's profile and cross slope, thus the slopes of the side lines are also determined. *The sloping length will always correspond to the specified ranges.* The range is calculated from the geometry of the *side line*, thus there are more points where the slope is steeper. Please note, no consideration will be taken to the side lines's profile (if any). 

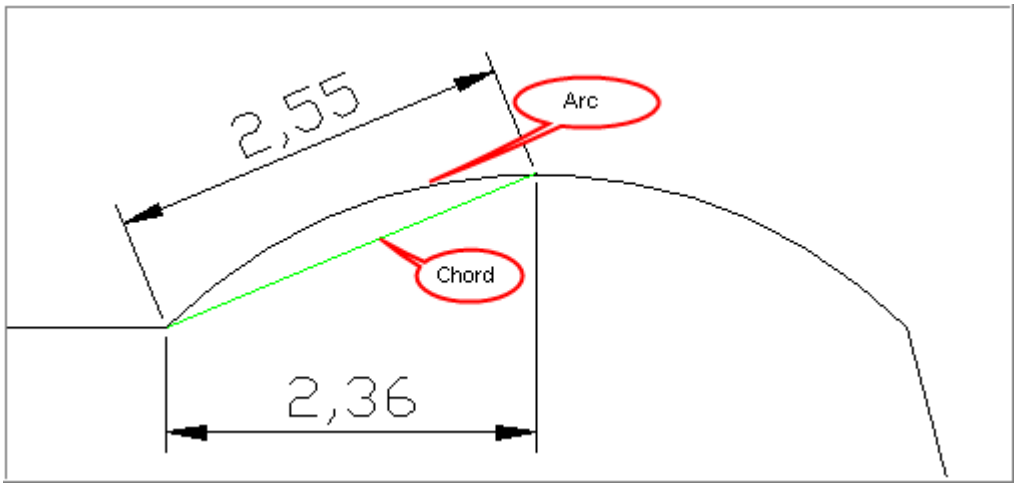
By 3D Chord	*Chord lengths on the profile and the line, of the length given by the range. (Chords in three dimensions.)*
	 Graphically the plane distance may look irregular, but the measuring tool will always display an invariable sloping distance.

Calculation interval: by 3D Chord

The difference between the chord and the arc:
A chord is a straight line segment joining two points on a curve.
An arc is a segment of a differentiable curve, i.e. an arc follows the radius of a curve.

Example: In a profile (line's vertical geometry) with difference of altitude, the sloping length (the chord) will always be longer than the length on the plane surface, compare Pythagorean theorem.

The chord is always shorter than the arc length.



Report

Results file
You can choose to store the calculated points either as coordinates or as cross sections. The geo format is

used for coordinates while the sec format is used for cross sections. See also Coordinates[153] and Cross sections[627].

When you save as coordinates, you can choose to either save tangent bearing or cross fall. This information appears in the special code and remarks fields.

- Tangent Bearing
  The center line bearing is added to the remark column and the special code is set to **B**. You can use this information to turn the symbols and texts around a line. See, for example, insert text/symbol in the drawing[281].

- Cross Fall
  The cross fall is loaded from the cross slope file (cfm) which is to have the same name as the line; the special code is set to **CF**. If the left and right sides have different cross slopes, no value is entered.
  For exports to Bever format, the cross fall information is used, see also Bever[386].

Reports
Check the box **[Create report]** to generate a report of the calculated points.

The contents of the report depend on the method of calculation.

- **Report from calculation with Fixed Side Offset**
  This report presents sections, offsets, coordinates, bearings and cross slopes.

Section Coordinates from Line — Created: 2010-05-20

Horizontal Line: linus.lin
Vertical Line: linus.prf
Cross Slope File: linus.skv
Start Section 0/000,00 **End Section** 0/590,20 **Interval:** 10,000
Station Lengths on the Line of length given by the Interval.

Section	Side Offset	X	Y	Z	Bearing	Cross Slope
0/000,00	-3,500	60 441,287	4 089,931	49,622	235,4007	-0,025
0/000,00	0,000	60 443,134	4 086,958	49,710	235,4007	
0/000,00	3,500	60 444,981	4 083,985	49,622	235,4007	-0,025
0/010,00	-3,500	60 432,793	4 084,652	49,025	235,4007	-0,025
0/010,00	0,000	60 434,641	4 081,679	49,113	235,4007	

Report from the calculation with fixed offset[559] .

- **Report from calculation of Intersections with each Side Line Separately**
  A report is generated with a tab for each side line. The report presents (for each intersection point) element number, length section and bearing for both the main line (ML) and side line (SL). Also displayed are the offsets and the coordinates for the points.

linus.rep

Intersection with Side Line — Created: 2010-05-20

Main Line: linus.lin
Side Line: linush1.LIN
Vertical Line: linus.prf
Cross Slope File linus.skv
Start Section 0/000,00 **End Section** 0/590,20 **Interval:** 10,000
Station Lengths on the Line of length given by the Interval.

Element No. ML / Element No. SL	Section ML / Section SL	Bearing ML / Bearing SL	Distance / X	Y	Z
1	0/000,00	235,4007	3,500		
1	0/000,00	235,4007	60 444,981	4 083,985	49,623
1	0/010,00	235,4007	3,500		
1	0/010,00	235,4007	60 436,488	4 078,707	49,025

linush1.LIN linusv.LIN

Report from intersections with each side line separately[560] .

- **Report from the calculation with the Intersection Closest to the Center Line, with activated alternative offset and offset limits**

Section Coordinates from Intersection with Side Lines

Created: 2010-05-20

Horizontal Line: linus.LIN
Vertical Line: linus.prf
Cross Slope File linus.skv
Start Section 0/000,00 **End Section** 0/590,20 **Interval:** 10,000
Station Lengths on the Line of length given by the Interval.

Alt. Side Offset Left: -3,500 **Right:** 3,500
Side Offset Limit Left: -10,000 **Right:** 10,000

Section	Side Offset	X	Y	Z	Bearing
0/000,00	-2,500	60 441,814	4 089,081	49,647	
0/000,00	0,000	60 443,134	4 086,958	49,710	235,4007
0/000,00	3,500	60 444,981	4 083,985	49,622	235,4007
0/010,00	-2,500	60 433,321	4 083,803	49,050	

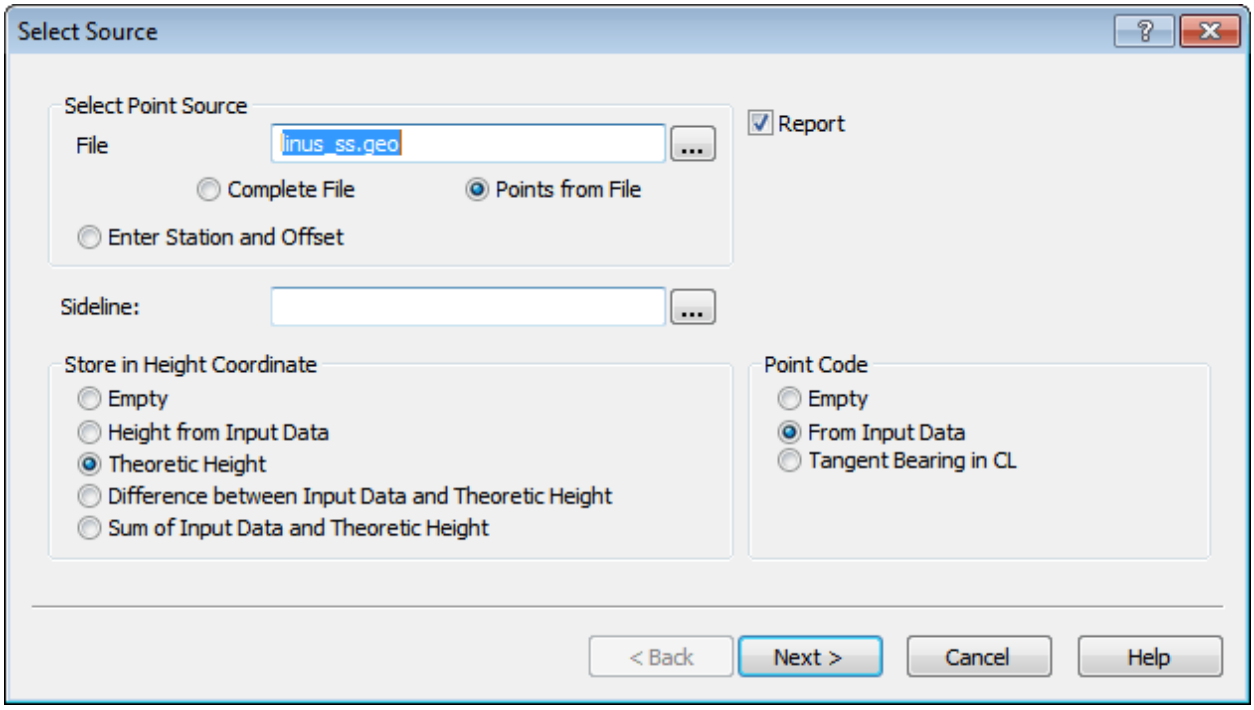
Report from the calculation with the intersection closest to the center line, with activated alternative offset and offset limits.

See also: Cross Fall Model, cfm536, Lines in Three Dimensions503

.

9.10 Station and Offset to Coordinates

You use this function to calculate the coordinates from the points described with station and offset from a line. The input data to the function can either be a coordinate file, a cross section file or manual input. The results are presented in a report and a coordinate file. Open the cross fall model, cfm, or the road line document, l3d, from which the calculation is to be made and select ***Data | Station and Offset to Coordinates***.



Input data

Choose the type of input data for the calculation:

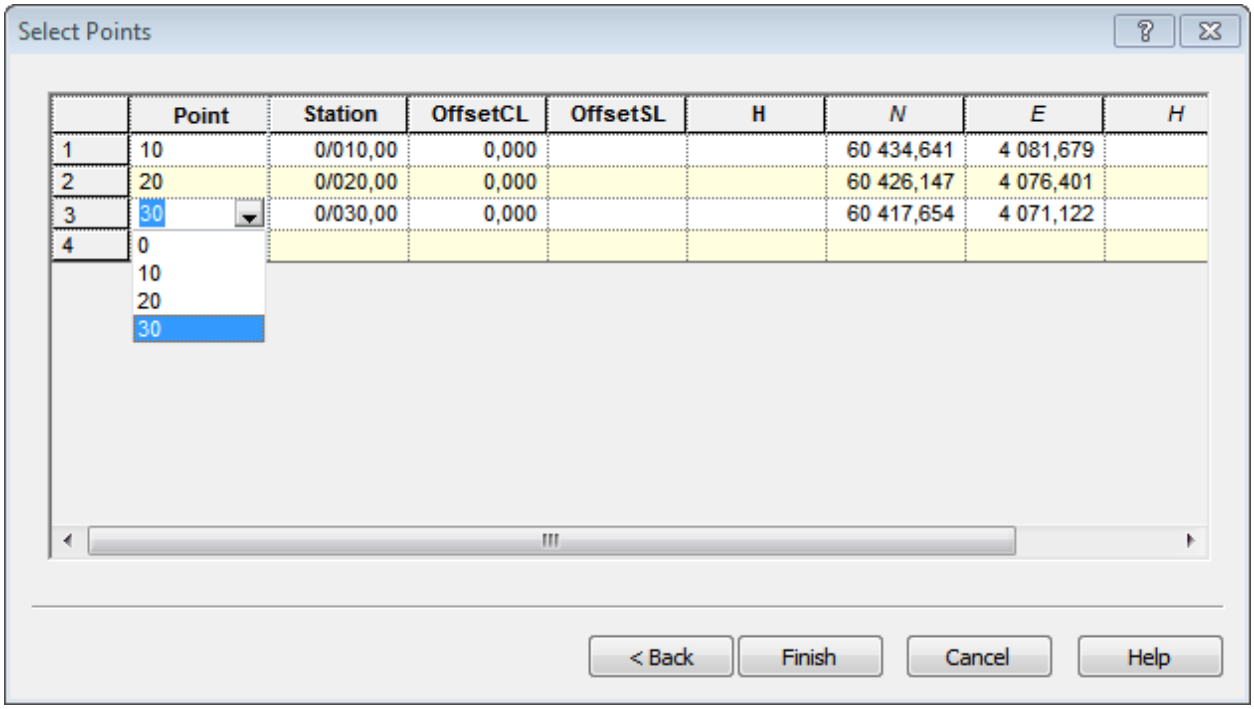
Full file

All points in the specified file will be calculated. Both coordinate files (geo or pxy) and cross section files (sec, lsd, tsd, ksd, tts) can be used as input data. Click the Select button, ..., to select the file.

Points from File

This option means that you choose to calculate a selection of points from a file. Both coordinate files (geo or pxy) and cross section files (sec, lsd, tsd, ksd, tts) can be used as input data. Click the Select button, ..., to select the file.

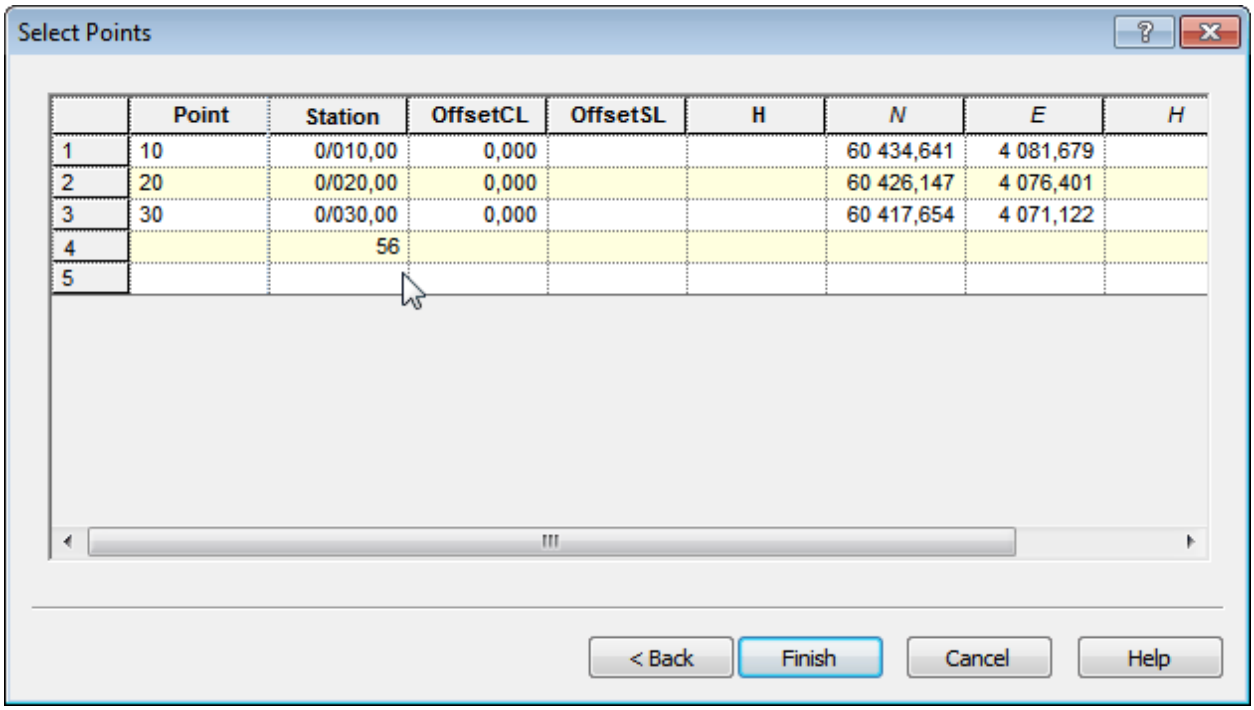
Select the points to calculate by clicking on the button **[Next]** - to toggle page in the dialog. This displays an input form for points. Enter the desired point number or choose from the list by clicking the arrow to the right in the point number field.



The coordinates fields are automatically entered when a point has been selected.

Enter Station and Offset

This option means that you enter data for the points. Click the button **[Next]** to toggle the page in the dialog, which shows the input form for station and offset.



If a side line is selected, the offset can either be given relative to the center line or the side line.

Side Line

You can choose to relate the offsets to a side line instead of the center line. Enter the name of the side line or click the select button, ...

Heights

- Heights are calculated from the line's vertical geometry if a line file, l3d, is used as the source in the calculation.
- If the calculation starts from a cross fall model, cfm, calculated heights will depend on the cross fall model and the line's vertical geometry.
- If the calculation originates from the older line format, .lin, heights are calculated from profile data, prf, and cross slope data, skv, if there is a profile (prf) and cross slope file (skv) with the same name as the line file, (lin) in the project.

There are a number of different options for calculating heights for the points.

- Empty
  No heights are calculated.
- Height from Input Data
  The heights are loaded from the input data file.
- Theoretical Height
  Heights are set to the calculated theoretic heights of the specified station/offset taking into account the cross fall model.
- Difference between input data and theoretic height
  The height coordinates are set as the difference between the height coordinate in the input data file and the theoretical height.
- Sum of the input data and the theoretical height
  The height coordinates are set as the sum of the height coordinate in the input data file and the theoretical height.

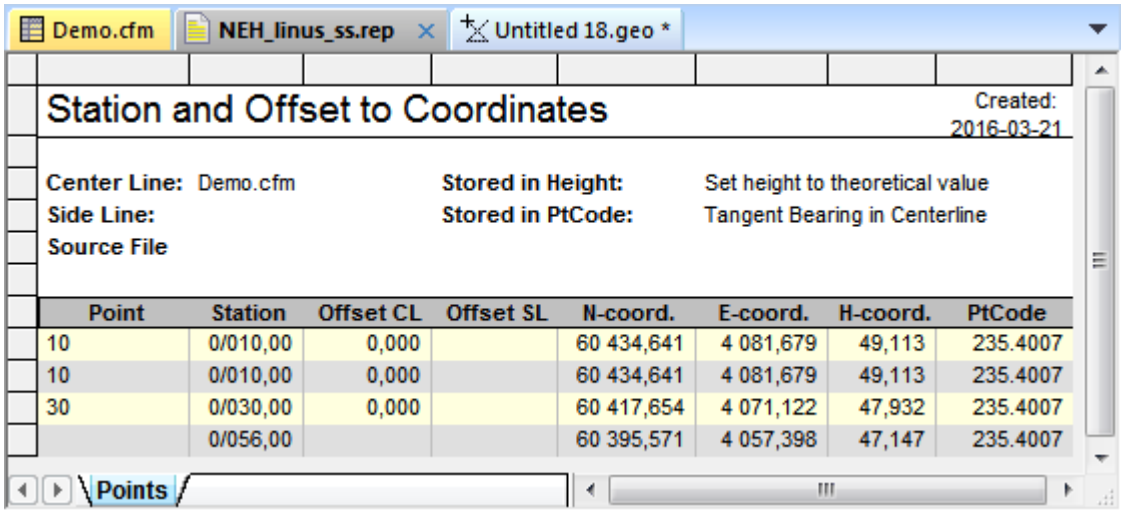
Point Code

Select the point code to be set for the calculated points.

- Empty
  Code field left blank.
- From Input Data
  The code is copied from the points in the input data file.
- Tangent Bearing in CL
  The center line's bearing is set into the field for point code.

Report

In addition to a coordinate file with calculated points, you can also create a report.



Demo.cfm | NEH_linus_ss.rep | Untitled 18.geo *

Station and Offset to Coordinates

Created: 2016-03-21

Center Line: Demo.cfm
Side Line:
Source File

Stored in Height: Set height to theoretical value
Stored in PtCode: Tangent Bearing in Centerline

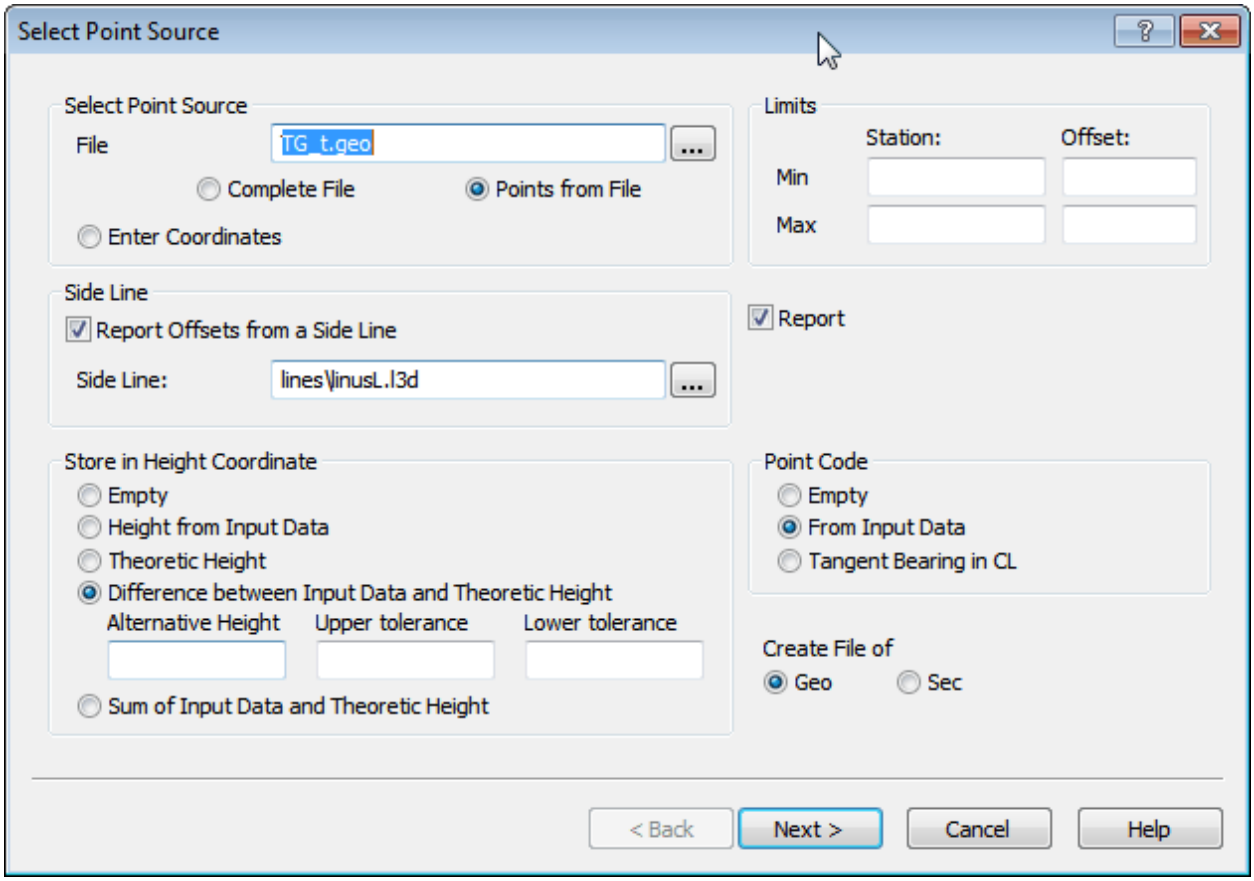
Point	Station	Offset CL	Offset SL	N-coord.	E-coord.	H-coord.	PtCode
10	0/010,00	0,000		60 434,641	4 081,679	49,113	235.4007
10	0/010,00	0,000		60 434,641	4 081,679	49,113	235.4007
30	0/030,00	0,000		60 417,654	4 071,122	47,932	235.4007
	0/056,00			60 395,571	4 057,398	47,147	235.4007

Points

See also Cross Fall Model, cfm 536, Lines in Three Dimensions 503 .

9.11 Coordinates to Station and Offset

You use this function to calculate the section and offset relative to a line from coordinates. The input data to the function is either given as a coordinate file or through manual input. The results are presented in a report and a coordinate or cross section file. Open the cross fall model or the line document from which the calculation is to be made and select ***Data | Coordinates to Station and Offset***.



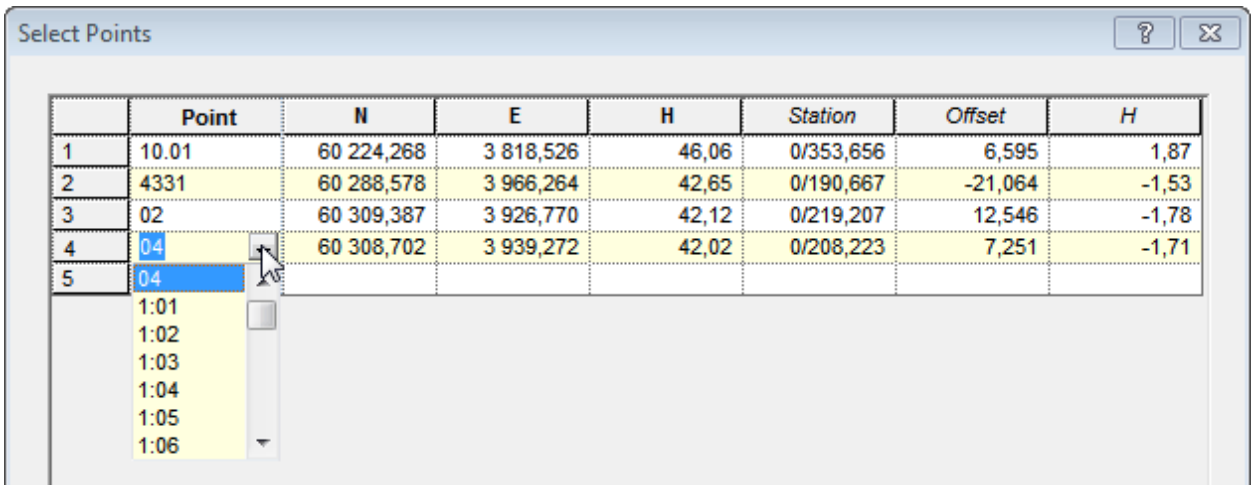
Input data

Choose the type of input data for the calculation:

Full file

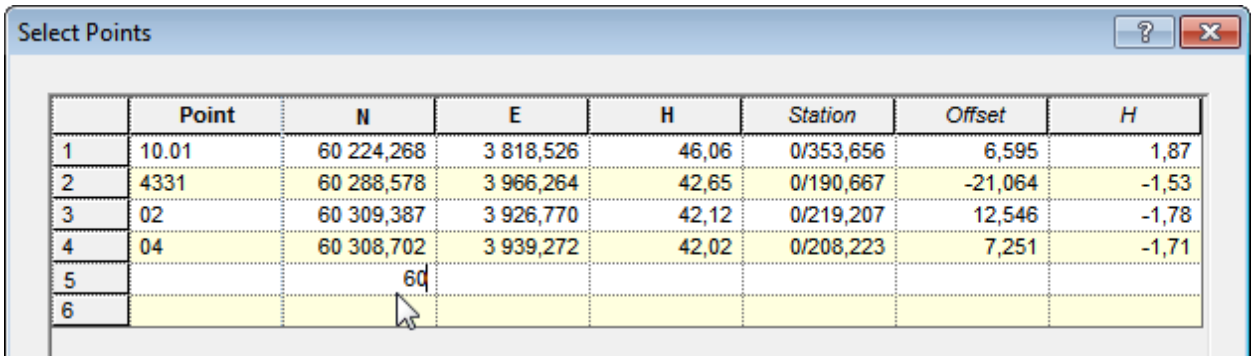
All points in the specified coordinate file (geo or pxy) will be calculated. Click the Select button, ..., to select the file.

Points from File
This option means that you choose to calculate a selection of points from a coordinate file (geo or pxy).
Click the Select button. ..., to select the file.
Select the points to calculate by clicking on the button **[Next]** - to toggle page in the dialog. This displays an input form for points. Enter the desired point number or choose from the list by clicking the arrow to the right in the point number field.



The station coordinates are automatically entered when a point has been selected.

Enter coordinates
This option means that you enter data for the points. Click the **[Next]** button to toggle the page in the dialog, which shows the input form for the coordinates.



Side Line
If a side line has been selected the offset is presented both from the center line and the side line in the report.

Limits
Here you select the points to calculate relative to the center line using limited dimensions. Only the points that fall within the limits will be calculated. Note that the dimensions on the left side should be negative.

Heights

- Heights are calculated from the line's vertical geometry if a line file, l3d, is used as the source in the calculation.
- If the calculation starts from a cross fall model, cfm, calculated heights will depend on the cross fall model and the line's vertical geometry.
- If the calculation originates from the older line format, .lin, heights are calculated from profile data, prf, and cross slope data, skv, if there is a profile (prf) and cross slope file (skv) with the same name as the line file, (lin) in the project.

There are a number of different options for calculating heights for the points.

- Empty
  No heights are calculated.
- Height from Input Data
  The heights are loaded from the input data file.
- Theoretical Height
  Heights are set to the calculated theoretic heights of the specified section/offset taking into account the cross slope.
- Difference between input data and theoretic height
  The height coordinates are set as the difference between the height coordinate in the input data file and the theoretical height.
- Sum of the input data and the theoretical height
  The height coordinates are set as the sum of the height coordinate in the input data file and the theoretical height.

Tip! 'Difference between input data and theoretical height' is very useful when you want to check a surveyed area in relation to a theoretical position. By providing an alternative height for the profile you can compare the points' heights with a level relative to the theoretical profile. Enter the relative dimensions for profile height (zero gives the profile height).
You can also set tolerances for the points' deviations in height. The tolerances are specified with an absolute amount. The report presents the mean height (for the differences), standard deviation and the proportion of points that are outside the tolerance. These points are shown with an exclamation point in the report.

Coding

Select the point code to be set for the calculated points.

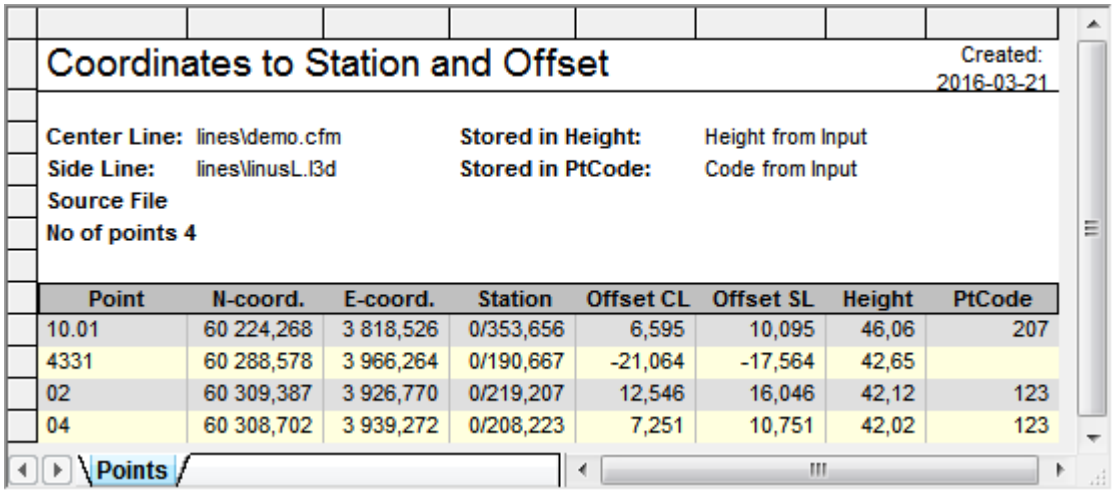
- Empty
  Code field left blank.
- From Input Data
  The code is copied from the points in the input data file.
- Tangent Bearing in CL
  The center line's bearing is set in the field for point code.

Create File Type

Select whether the calculated points are saved as coordinates (geo format), or cross section data (sec format).

Report

In addition to a coordinate file with calculated points, a report is also generated if you check the **[Create report]**box.



Coordinates to Station and Offset

Created: 2016-03-21

Center Line: lines\demo.cfm **Stored in Height:** Height from Input
Side Line: lines\linusL.l3d **Stored in PtCode:** Code from Input
Source File
No of points 4

Point	N-coord.	E-coord.	Station	Offset CL	Offset SL	Height	PtCode
10.01	60 224,268	3 818,526	0/353,656	6,595	10,095	46,06	207
4331	60 288,578	3 966,264	0/190,667	-21,064	-17,564	42,65	
02	60 309,387	3 926,770	0/219,207	12,546	16,046	42,12	123
04	60 308,702	3 939,272	0/208,223	7,251	10,751	42,02	123

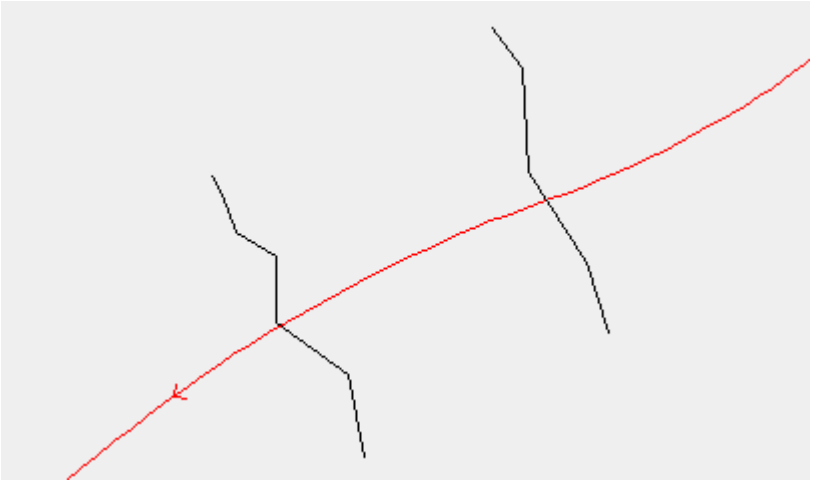
Points

See also Cross Fall Model, cfm 536, Lines in Three Dimensions 503

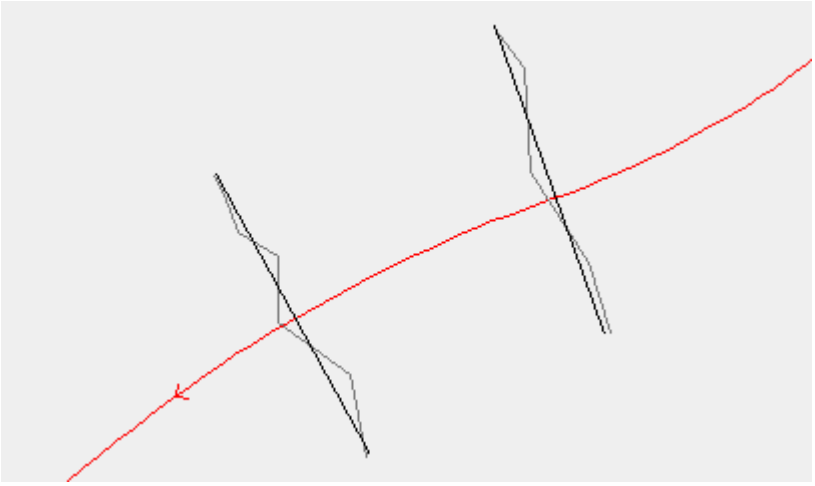
9.12 Correction of Points to Stations

You use this function to correct station points measured along a line to even length stations. By specifying a corridor, you control by how much the position of a point may deviate from the intended length station for it to be considered to be part of it. The calculated points can be saved either as cross sections or as coordinates. In previous versions of iCON office this function was called "Tachymetry". A prerequisite for this function to work is that the points occur at fairly regular intervals, otherwise you may have to run the function several times for different parts of the survey.

Open the line document from which the calculation is to be made and select ***Data | Correction of Points to Stations***.

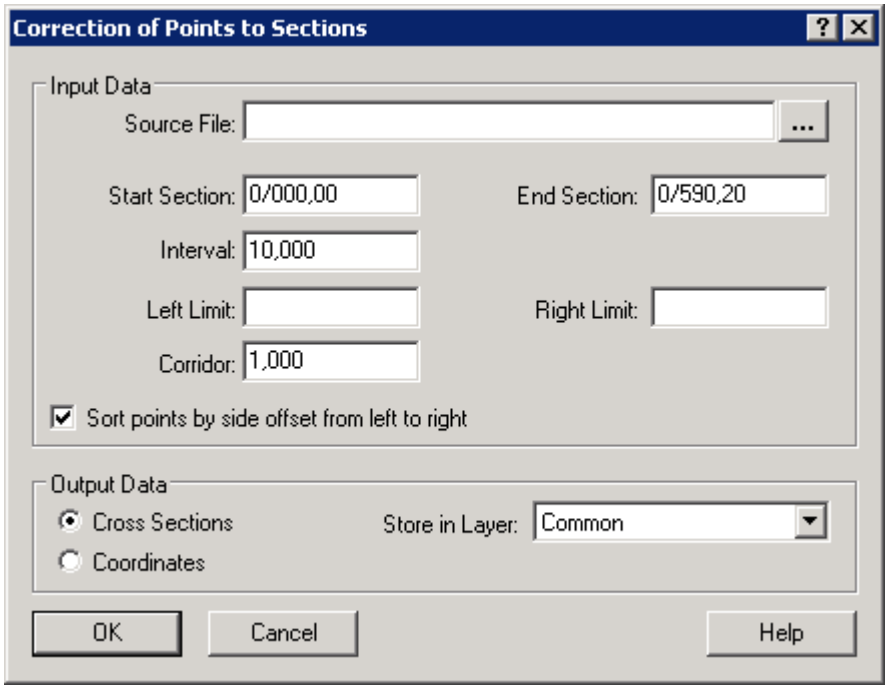


Measured points along a line.



Corrected position to even length stations for the points.

In addition to the corridor you can also specify side limits for points to calculate.



Source File
Enter the coordinate file containing the points to be corrected to even stations.

Start Station
Enter the start station for correction.

End Station
Enter the end station for correction.

Range
Specify the range the points are to be corrected with.

Max left/right
Enter the side limits of the points to be calculated. Enter a negative offset for the left side of the line. Leave the fields blank to include all points.

Corridor
Enter how much the position of the points may deviate laterally from the desired length station.

Half of the offset is used in each direction, i.e. a corridor of 1 m means that the points can have 0.5 m errors in both directions in order to still be corrected to the required station.

Sort points according to offset, left to right
If this option is selected, the points will be sorted from left to right according to offset. Otherwise, points are presented in the order they are measured.

Output data
You can choose to save the calculated points either as coordinates or as cross sections. The geo format is used for coordinates while the sec format is used for cross sections. See also Coordinates[153] and Cross sections[627].

When you save as sections you can also control the layer in which the points appear.

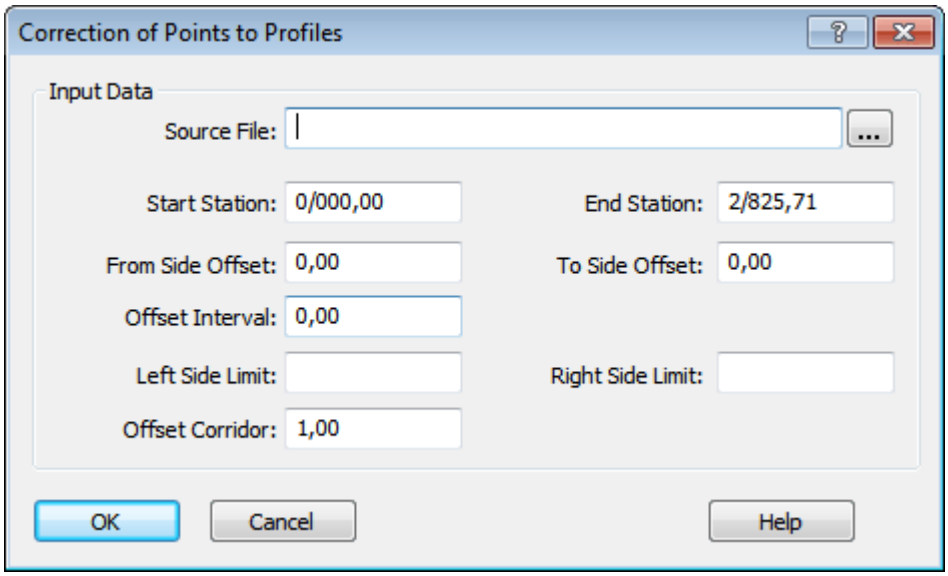
See also Correction of Points to Profiles[586], Lines in Three Dimensions[503]

9.13 Correction of Points to Profiles

You use this function to correct points measured along a line to parallel profiles (terrain profiles). The function works in a similar way to Correction of Points to Stations584. By specifying a corridor for the offsets you control by how much the position of an offset may deviate laterally from the intended profile for it to be considered to be part of it. If you want to 'move' all points to the center line, you specify a corridor large enough to cover all points.

As a result from the calculation you will create a terrain profile document including one or several terrain profiles in the file format .pro.

Open the line document from which the calculation is to be made and select ***Data | Correction of Points to Profiles***.



Source File
Enter the coordinate file containing the points to be corrected into the side profiles.

Start Station
Enter the start station for correction.

End Station
Enter the end station for correction.

From Side Offset
Enter the offset of the first profile to be created.

To Side Offset
Enter the offset of the last profile to be created.

Offset Interval
Specify the interval the side profiles are to be created with.

Left/Right Side Limit
Enter the side limits of the points to be calculated. Enter a negative offset for the left side of the line. Leave the fields blank to include all points.

Offset Corridor

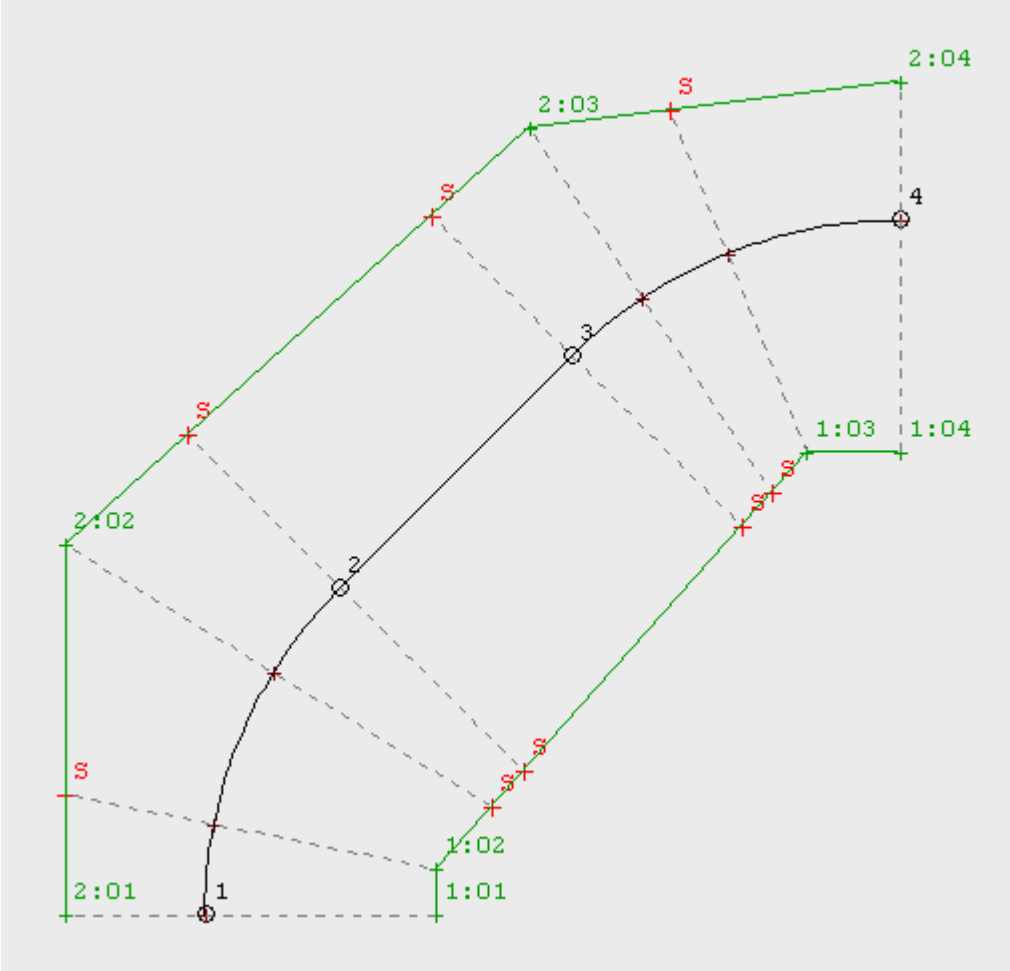
Enter how much the position of the points may deviate from the required side profile.

Half of the offset is used in each direction, i.e. a corridor of 1 m means that the points can have 0.5 m errors in both directions in order to still be corrected to the required profile.

See also Correction of Points to Stations 584, Lines in Three Dimensions 503

9.14 Create Cross Fall Model File from Coordinate File

From a line file you can use this function to create a cross fall model through calculations from a specified coordinate file[153]. Note that the coordinate file must have height coordinates and that the line file must include both horizontal and vertical geometries. Open a line file[503] and select ***Data | Create Cross Fall from Coordinates***. An Open dialog[25] appears where you choose the coordinate file to calculate the cross slope from.



Before calculating the cross fall model, the points will be sorted on each side of the line in section order. *It does not matter if the points in the coordinate file are single points or if the points are connected to lines.* In order to improve the accuracy in the cross fall model, several points are interpolated on the sides before the cross fall is calculated. Points are interpolated in the stations where the horizontal and/or vertical geometries of the line break *(points 1-4 on the horizontal line in the figure above, the vertical geometry is not shown here)* and for every point in the coordinate file, a "twin point" is interpolated on the opposite side of the line. Interpolated points in the figure are marked with a red **S**. The points are interpolated between the nearest surrounding points in the station on the same side of the line *regardless of the point/line structure in the coordinate file*. Despite this, the result may be misleading if the radii are in the horizontal or vertical line, or in side lines, as you should then tighten the points in these areas before the calculation. The cross fall is then calculated as the slope from the vertical geometry of the line to the points on each side.

See also Lines in Three Dimensions[503], Cross Fall Model, cfm[536]

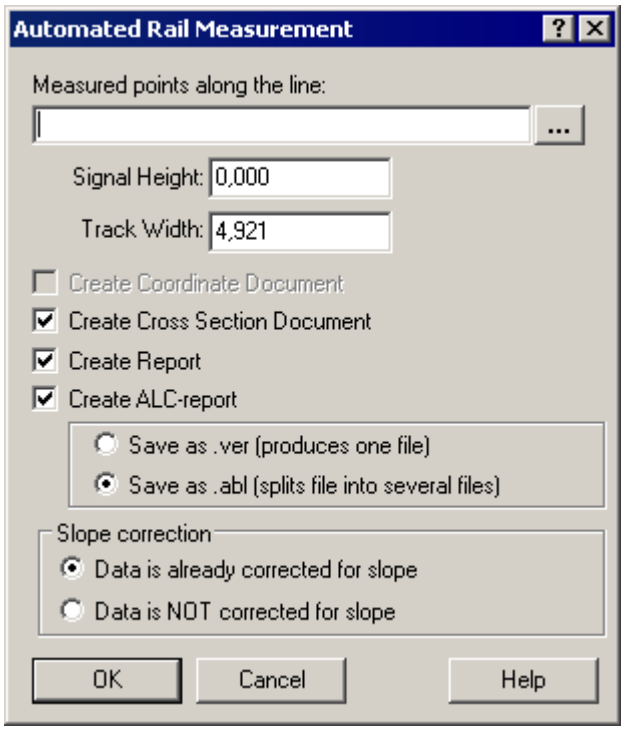
9.15 Automated Line Measurement

General

In some machine control systems there is the option of automatically measuring railroads or roads. The idea behind this is to be able to roll a wagon or drive a car along the object you want to survey, and automatically record the measurements at an even interval. You can also use the function to control machinery run on rails, for example, a track laying train or a gage setting machine.

This function requires that the machine control system has a cross fall sensor connected that continually records the slope of the wagon/car at the current point. This information is stored together with other survey data, i.e. length, horizontal angle, vertical angle and code, if any. You also required a theoretical road line that describes the object. This is used both for the automatic recording (the length measurement in the line controls the frequency of the recording) and for correcting the survey point for the slope of the prism pole using the slope from the cross fall sensor. When surveying railroads, you must also have a current profile line as this also affects the plane position calculation. This is not necessary for road surveying.

When the machine control system is running, the section of the survey points, offset and height deviation in relation to the theoretical line are displayed continuously. The prism pole slope is then corrected in real time. This calculation must also be made retrospectively, and this is done using the function ***Data | Automated Line Measurement***.



Railroad

Output Data

Start by calculating the coordinates of the survey file (see coordinate calculation 335). Make sure that the current slope is recorded in the remarks column and the **TF** (cross fall) is recorded in the special code column. Save the results in a file of your choice. The results obtained after the coordinate calculation are not the final outcome as they have not yet taken into account the slope of the prism pole.

Open and check both the horizontal and the vertical line geometries (3D line, .l3d, or plane line, .lin and profile, .prf) for the distance where the measurement is made. Make sure that the line geometries cover the distance surveyed. Save the files after any changes.

Calculation
Make sure that the line is open in a graphic window and is active. Go to ***Data | Automated Line Measurement | Rail***.

- Measured Points Along Line
  Here you specify the name of the file containing the survey points along the line. The coordinates have already been calculated, and the file is therefore a coordinate file (geo or pxy).

- Signal height
  Since the survey points must be corrected depending on whether the prism pole may have tilted when measuring, you need to specify the height of the pole at the time of surveying. Only one signal height can be specified per file. The calculation takes into account the slope value that is in the remarks column in the coordinate file.

- Track Width
  For track surveying the plane position varies for where the profile is to be calculated from. For radii, you always specify the profile height at the inner rail and for straight sections at the left rail in the longitudinal direction of the track. In the dialog, the track gage is proposed for a wagon designed for the standard gage with a centrally mounted prism pole, but the value can be easily edited.

- Create Coordinate Document
  If you choose to check this box when calculating, this will create a coordinate document where the calculated points are exactly in the center of the track and with an absolute calculated height. (Compare with the coordinate file generated in the normal coordinate calculation). The document will be of the geo type.

- Create Cross Section Document
  If you choose to check this box when calculating, this will create a cross section document that contains points with coordinates relative to the track line. The result is therefore a file containing the length section, offset and relative height (from the theoretical profile) for all survey points. The X-coordinate and Y-coordinate are also stored. The document will be of the sec type.

- Create Report
  If you choose to check this box when calculating, this will create a text report that contains both relative coordinates (length section, offset, deviation from the theoretical profile) and absolute coordinates (N, E, H). You can use this report, for example, as supporting data for track direction, or as a presentation of the final surveying of a track. The document will be of the rep type.

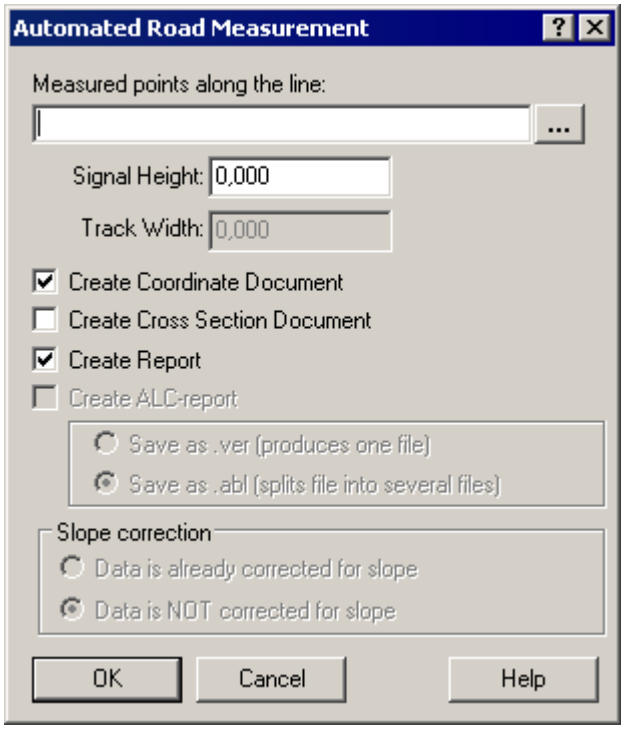
- Slope Correction
  Select if the survey (the file with the survey points along the line) has been corrected or not taking into account the slope of the prism pole.

Road

Output Data
Start by calculating the coordinates of the survey file (see coordinate calculation 335). Make sure that the current slope is recorded in the remarks column and the **TF** (cross fall) is recorded in the special code column. Save the results in a file of your choice. The results obtained after the coordinate calculation are not the final outcome as they have not yet taken into account the slope of the prism pole.

Open and check both the current plane line and the profile, if any, for the distance where the measurement is made. Make sure that they both cover the distance surveyed. If the profile is to be used it must have the same name as the plane line. Saving the files after any changes.

Calculation
Make sure that the current plane line is open in a graphic window and is active. Go to the ***Data | Automated Line Measurement | Road***.



- Measured Points Along Line
  Here you specify the name of the file containing the survey points along the line. The coordinates have already been calculated, and the file is therefore a coordinate file (geo or pxy).

- Signal Height
  Since the survey points must be corrected depending on whether the prism pole may have tilted when measuring, you need to specify the height in meters of the pole at the time of surveying. Only one signal height can be specified per file. The calculation takes into account the slope value that is in the remarks column in the coordinate file.

- Track Width
  When surveying roads no track gage is used (see Rail[589]) but the value is set to 0 and a profile, if any, is assumed to be in the same plane position as the plane line. To reduce the risk of error, this value cannot be changed.

- Create Coordinate Document
  If you choose to check this box when calculating, this will create a coordinate document where the calculated points are exactly in the extension of the prism pole and with an absolute calculated height. (Compare with the coordinate file generated in the normal coordinate calculation). The document will be of the geo type.

- Create Cross Section Document
  In order for this function to produce results, there must be a profile line. If you choose to check this box when calculating, this will create a cross section document that contains points with coordinates relative to the theoretical road line. The result is therefore a file containing the length section, offset and relative height (from the theoretical profile) for all survey points. The X-coordinate and Y-coordinate are also stored. The document will be of the sec type.

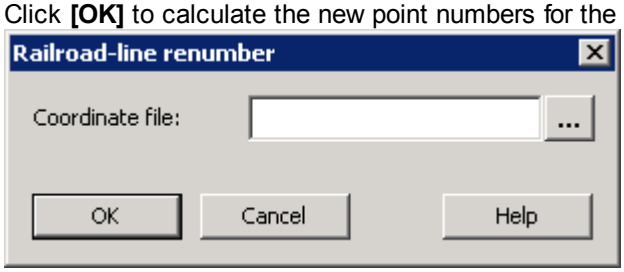
- Create Report
  If you choose to check this box when calculating, this will create a text report that contains both relative coordinates (length section, offset, deviation from the theoretical profile) and absolute coordinates (N, E, H). The document will be of the rep type.

See also Lines, Profiles and Cross Slopes in General[503] .

9.16 Railroad Renumbering

The track line numbering function makes it possible to set new point numbers for points in a coordinate file. The new point numbering represents the section each point has in relation to a particular line file[503].

Set the current line file as active in a graphic window. Select ***Data | Automated Line Measurement | Track Line Numbering*** to open the dialog. Enter the name of the coordinate file to calculate, or use the ... button to select the coordinate file. Please note that points to be renumbered must be surveyed in lines in order for this function to work.
Click **[OK]** to calculate the new point numbers for the selected coordinate file.



The coordinate file that is created when you click **[OK]** contains lines where each input point has been assigned a point number that represents the section that the point has in relation to the current line file. Section decimals are not used, which means that a point in section 1/100.2 has point number 1100 and a point in section 1/110.9 has point number 1110.
The coordinate file's original line name is not affected, i.e., if there are lines labeled A, B, A1, B1, etc. these line names will remain after calculation. Only the input points in lines are assigned new point numbers.

See also Lines in Three Dimensions[503], Coordinate Files, Geo and Pxy in General[158].

9.17 Tamping

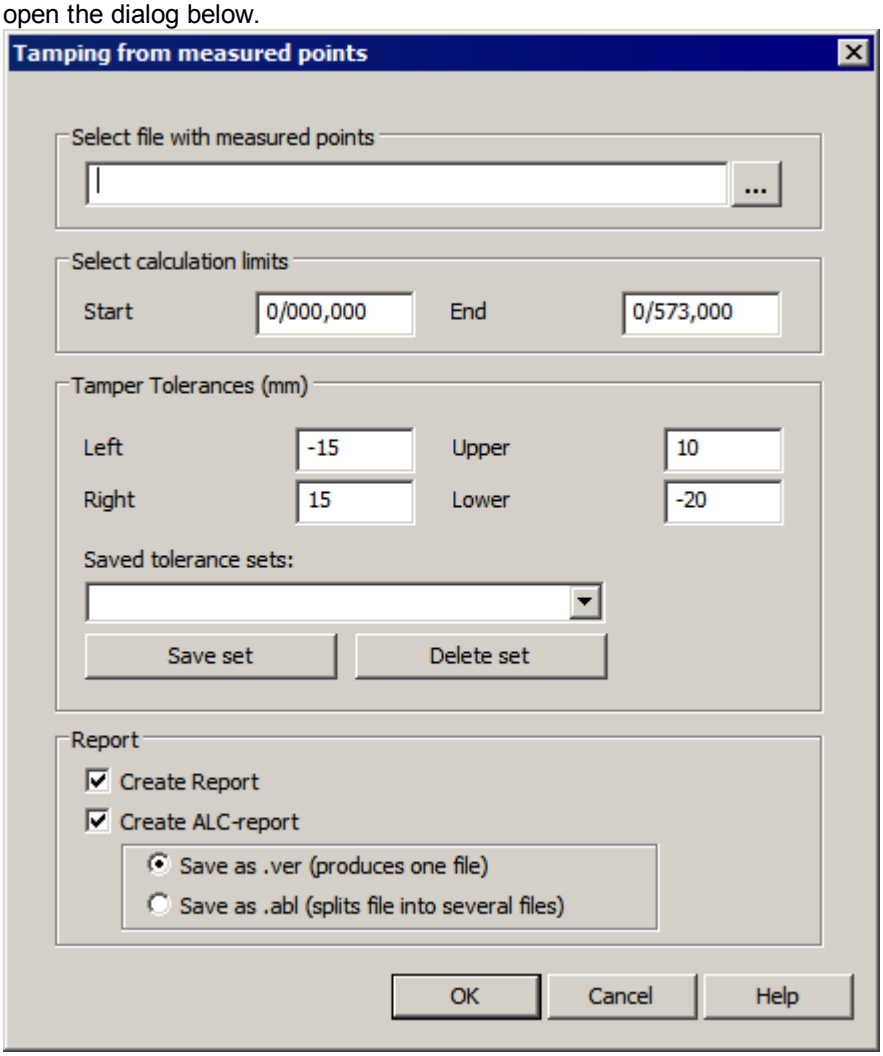
Introduction

The tamping function makes it possible to calculate displacement of a railroad track, in order to position right and left rails correctly in side offset and vertically.

The function will produce a report showing left, right and vertical displacements of the railroad's centerline.

Open the dialog

Open a line describing the railroad and select ***Data | Railroad | Tamping***, to open the dialog below.



Select file with measured points

Select the coordinate file with measured points.
The points can be measured in any order, in the final report, the points will be sorted according to their length section.

Select calculation limits

Enter calculation limits for start and end section.
If you do not specify any calculation limits, the report will include all measured points along the line.

Tamper Tolerances (mm)

Enter tolerances for lateral and vertical deviations. Note that the upper and lower tolerances have reversed signs to the lift value. Accordingly:

- a measured point that is above its zero level should be lowered.
- a measured point that is below its zero level should be raised.

If you have saved parameters for calculating tolerances, you can use the dropdown menu to reuse saved tolerances.

- Click the button Save set to save the parameters for calculating tolerances.
- Click the button Delete set to delete a set of saved parameters for calculating tolerances.

- ⊞ Example of side offset tolerance
  If you enter a tolerance left -15 mm and tolerance right 15 mm, this means that the railroad can be shifted up to 15 mm to the left or right of its zero position and still be within tolerance.

- ⊟ Example of vertical tolerance
  If you enter an upper tolerance of 10 mm, this means the railroad track can be shifted up to 10 mm above the zero level and still be within tolerance.
  If a measured point is situated 11 mm above the zero level, this means the point is out of tolerance, and the railroad track needs to be lowered 11 mm.

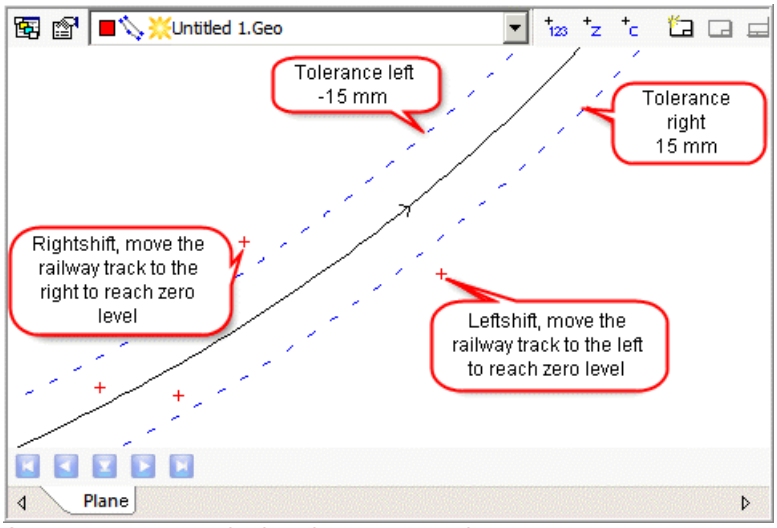
  A lower tolerance of -20 mm means that the railroad track can be shifted up to 20 mm below the zero level and still be within tolerance.

Reports

The report presents measured points with point number, section and shift. All points are presented according to their length section.

- Create report
  Select **[Create report]** if you want to create a report in the format .rep.
- Create ALC-report
  Select **[Create ALC-report]** if you want to create an ALC-report, and choose if the report should be saved as one file in the format .ver or whether the report should be divided into several files in the format .abl. These ALC-reports can be directly transferred to a tamping machine.

- ⊟ Example of results in the report, regarding side shift of railroad track
  Suppose that the report shows that left and right tolerances are set to 15 mm.
  In the column for **Leftshift**, the given distance shows how much the railroad track should be shifted to the left to reach zero level.
  In the column for **Rightshift**, the given distance shows how much the railroad track should be shifted to the right to reach zero level.



Graphical example of leftshift and rightshift.

- Example of results in the report, regarding vertical shift of railroad track
  Suppose that the report shows that upper tolerance is set to 10 mm and lower tolerance is set to -20 mm.
  See column **Vertshift** in the report.
  Negative values in the column **Vertshift** means that the railway track should be lowered to reach zero level.
  Positive values in the column **Vertshift** means that the railway track should be raised to reach zero level.

Tamping

Created: 2012-10-16

Center Line: rail.lin
Measurement: surveys1.geo

Tolerances (mm)			
Left	-15	**Upper**	10
Right	15	**Lower**	-20

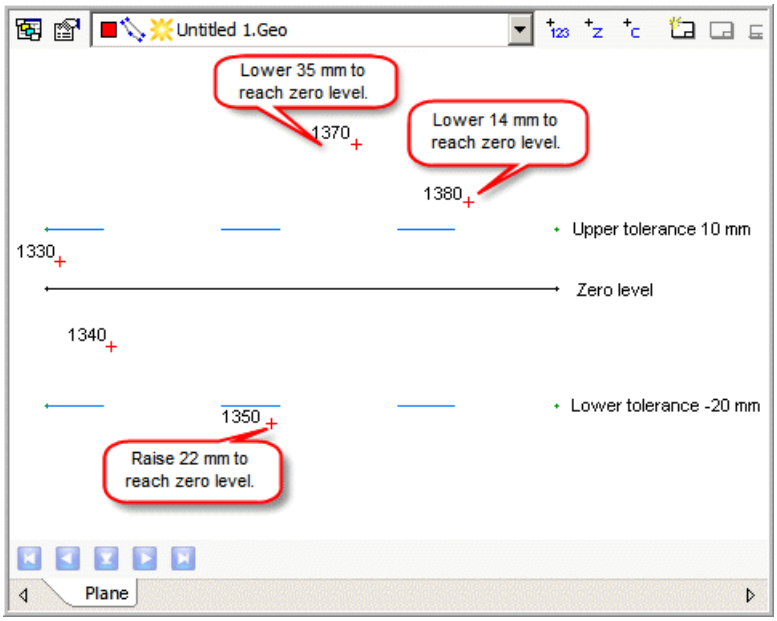
Note that upper and lower tolerances have reversed signs with respect to lift direction

Startsec 1+089,885
Endsec 1+371,886

Point	Section	Leftshift (mm) Left translation to reach zero level	Rightshift (mm) Right translation to reach zero level	Vertshift (mm) Vertical translation to reach zero level	Code	Remark
1330	1+167,863	5		-5		
1340	1+173,816	3		11		
1350	1+179,857	2		22		
1360	1+185,892	2		-4		
1370	1+191,898	0		-35		
1380	1+197,876		2	-14		
1390	1+203,890		4	-4		

Result

Example of Tamping report.



Graphical example of vertical shift.

See also Lines in Three Dimensions[503], Coordinate Files, Geo and Pxy in General[158].

9.18 Surface Statistics

With Surface Statistics height differences of measured points relative to a certain level are calculated. You can calculate surface statistics from mass descriptions (mbs)[599], stringline models (lmd)[608], terrain models (trm)[617] and cross fall models (cfm)[622].

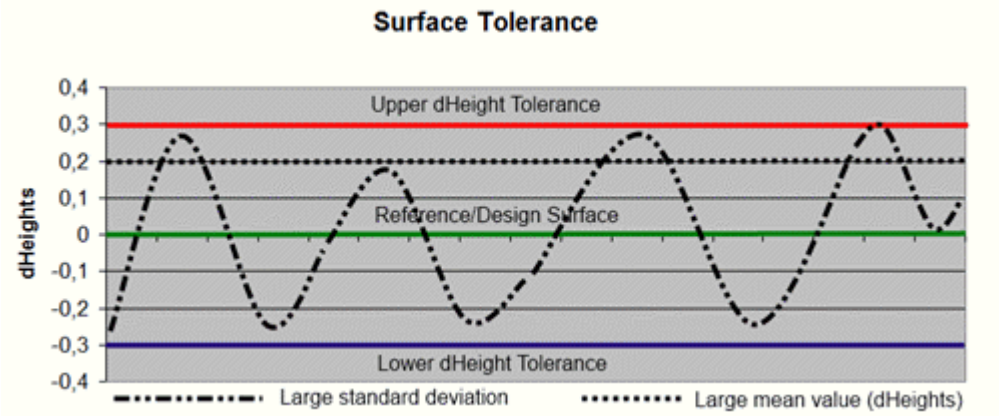
When a file type representing a theoretical surface is open in the graphical window, the surface statistics function can be found by selecting ***Data | Surface statistics***.

The measured point's elevation is compared against a selected layer. The results are presented in a surface statistics report and a coordinate file. In the report the measured points will be compared to a defined maximum standard deviation and a defined mean value tolerance.

The surface statistics report presents
- tolerances and statistics according to the parameters that Swedish Transport Agency uses for Statistical Acceptance Control, SAK
- serious errors (absolute deviation from the reference surface).

The coordinate file presents
- coordinates
- graphical color coding of the measured points that clarify the height of each point in relation to the specified level.

Effect of tolerance settings: Max standard deviation and Mean value tolerance



The dashed curve illustrates a surface represented by measured points and all points are within the upper and lower tolerance, but the heights are very scattered. The standard deviation for the measured height differences is of course quite big and the *Max standard deviation* setting can prevent such a surface to pass the check surface statistics test.

The dotted line illustrates a build surface and all points are within the upper and lower tolerance. The mean value of the measured height differences is 0.20 and the constructed surface requires more material then the theoretical reference surface. The *Mean value tolerance* can prevent such a surface to pass the check surface statistics test.

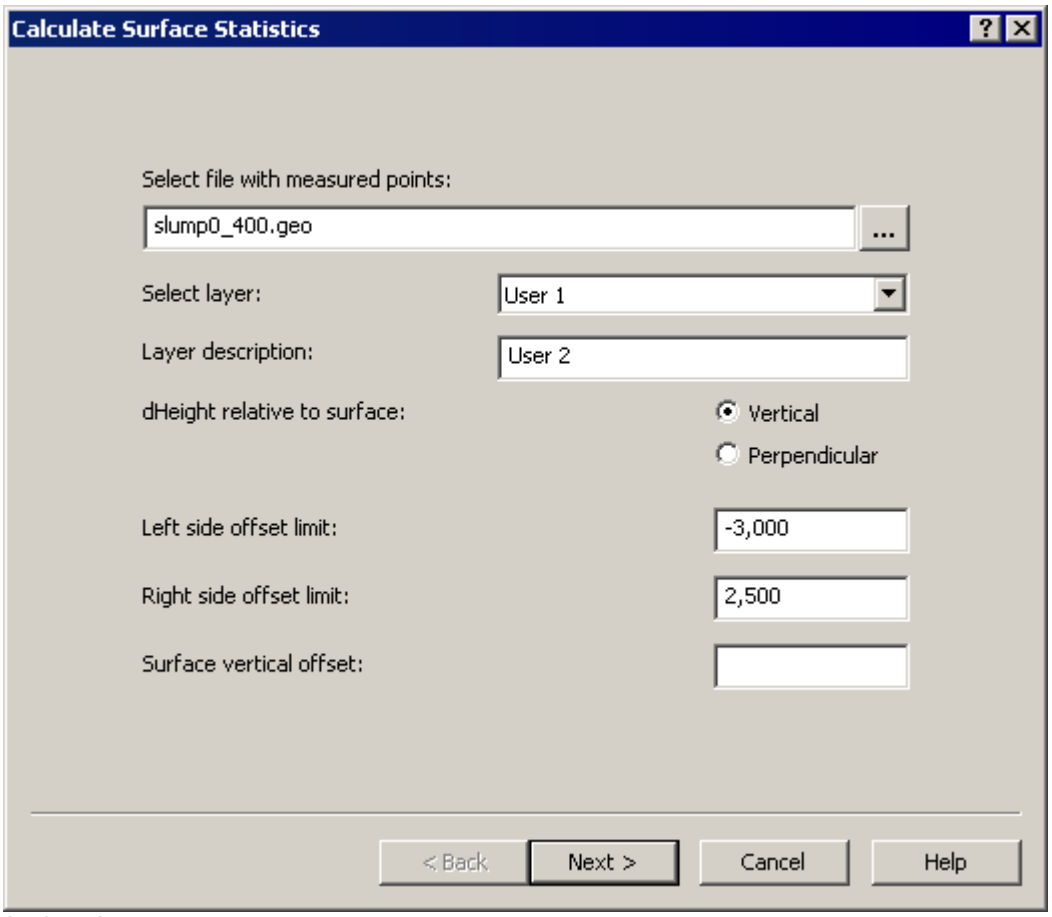
Example, how 'Mean value tolerance' can be used

If the 'Upper dHeight tolerance' is set to 0.030 and you measure a surface where the mean value of the measured points' height difference is 0.028, the surface statistics check is OK, regarding the mean value tolerance. But still the level of the built surface, represented by the measured points, is approximately 0.028 m above the theoretical surface and a lot of extra material has been used. With a lower value of 'Mean value tolerance', the created surface would not pass the surface statistics check.

See also Surface Statistics with mass description, mbs[599], Surface Statistics with stringline model, lmd[608], Surface Statistics with terrain model, trm[617], Surface Statistics with line, profile and cross slope[622]

9.18.1 Surface Statistics with mass description, mbs

Use Surface Statistics to calculate height differences for measured points in relation to a certain level in a mass description[689] , mbs. Open a mass description and select ***Data | Surface Statistics***.
The surface statistics report presents statistics and absolute deviations from the reference surface. The estimated height differences are also presented graphically with color coding showing the height of each point with respect to a given layer.

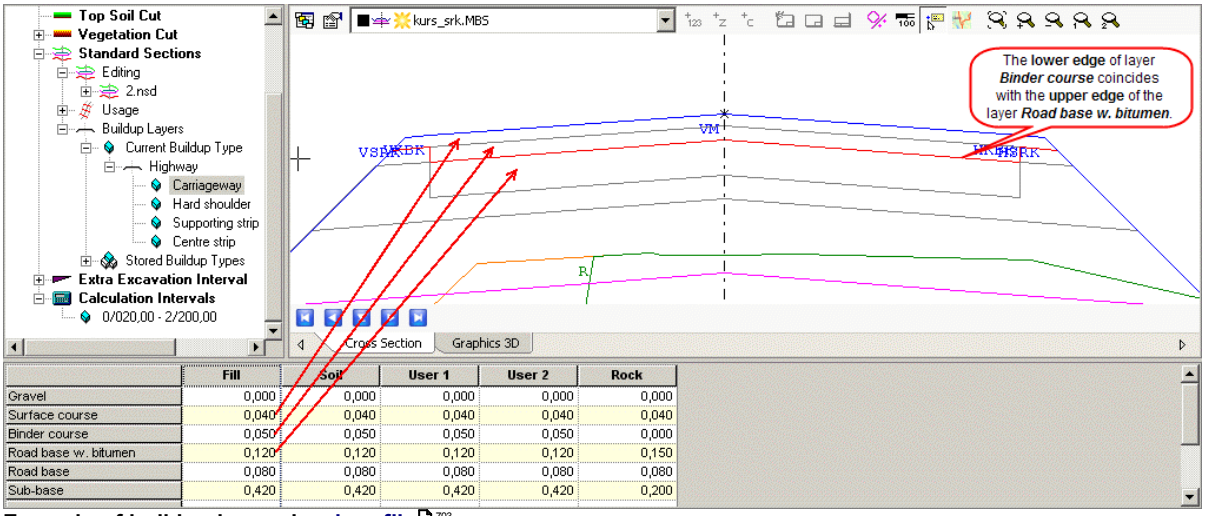


Surface Statistics with active mass description.

- **Select file with measured points:**
  Select the coordinate file to be compared with the active mass description. Enter the file name or click the browse button ... to select file.

- **Select layer:**
  Use the dropdown menu to select layer for which you want to calculate surface statistics.
  When choosing a layer that is located in a bup[703] file and have a certain depth, the program calculates heights relatively the lower edge of the selected layer, see an example in the image below.
  If you calculate surface statistics against a layer that in not in the bup file, and thus has no known depth, you select the layer directly in the dialog, e.g. rock and soil.

  The image below shows an example of buildup layers.



Example of buildup layers in a bup file [703] **.**
Note that the lower edge of layer *Binder course* coincides with the upper edge of the layer *Road base w. bitumen*.

Note: When a buildup layer has a certain depth and is stored in a bup-file, surface statistics will be calculated regarding the selected layer's lower edge.

The surface statistics report presents heights relative to the lower edge or the selected layer, along with an optional layer description. Note, in the report the layer description is showed, *not* the name of the selected layer. It is important that you enter a layer description describing the layer immediately below the selected layer, as you always want the heights to be specified in relation to the upper edge of the layer description showed in the report.

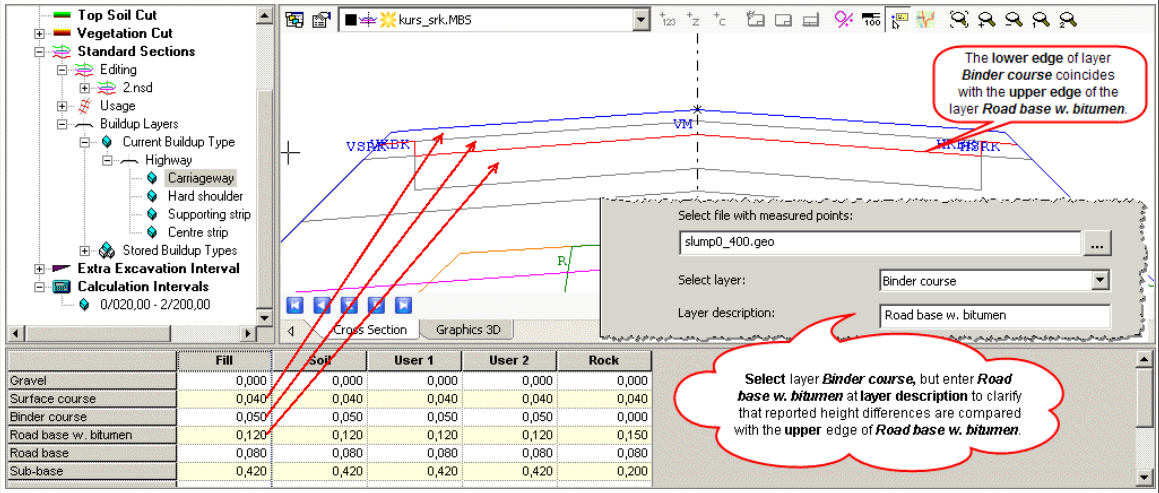
If you calculate surface statistics against a layer that is not in the bup file, and thus has no known depth, you select the layer directly in the dialog, e.g. rock and soil, and then you do not need to change the layer description.

Note that the choice of layer is important for the reported element code for each individual point in the surface statistics report, see **Points in the selected rows will be included in the report** [603] .

- **Layer description**
  Enter optional layer description. The text will be displayed in the surface statistics report. The text shows for which layer in the mass description, surface statistics have been calculated.

Example 1: How to select layer (with known depth) and layer description

Task	Calculate differences in height for measured points, in relation to a buildup layer with known depth (given in a bup [703] file). Differences in height should be calculated in relation to the upper edge of layer Road base w. bitumen.
Select layer	Select layer Binder course.
Layer description	Enter *Road base w. bitumen,* which is the layer immediately below the selected layer, and its upper edge coincides with the selected layer's bottom edge.



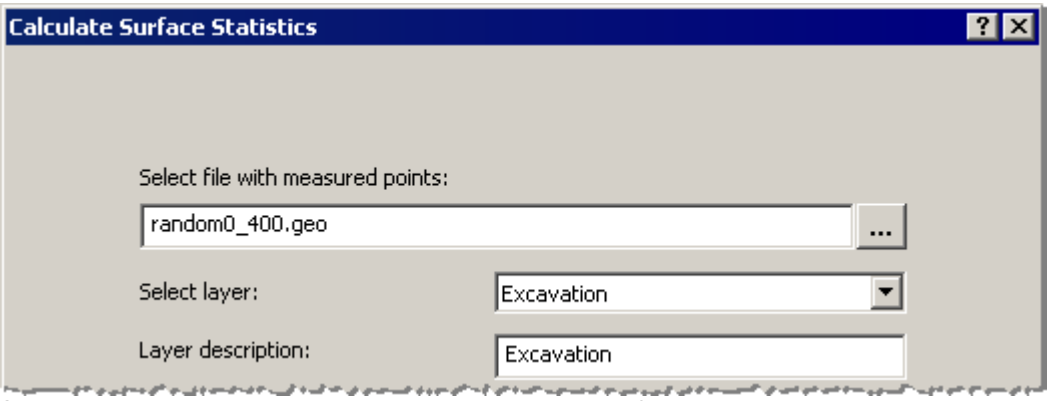
	Fill	Soil	User 1	User 2	Rock
Gravel	0,000	0,000	0,000	0,000	0,000
Surface course	0,040	0,040	0,040	0,040	0,040
Binder course	0,050	0,050	0,050	0,050	0,000
Road base w. bitumen	0,120	0,120	0,120	0,120	0,150
Road base	0,080	0,080	0,080	0,080	0,080
Sub-base	0,420	0,420	0,420	0,420	0,200

At layer description, enter the name of the layer immediately below the selected layer.

With the choices made above, you get a surface statistics report that presents height differences for measured points in relation to the bottom of the selected layer (Binder course), which coincides with the upper edge of the layer Road base w.bitumen.

Example 2: How to select layer (with unknown depth) and layer description

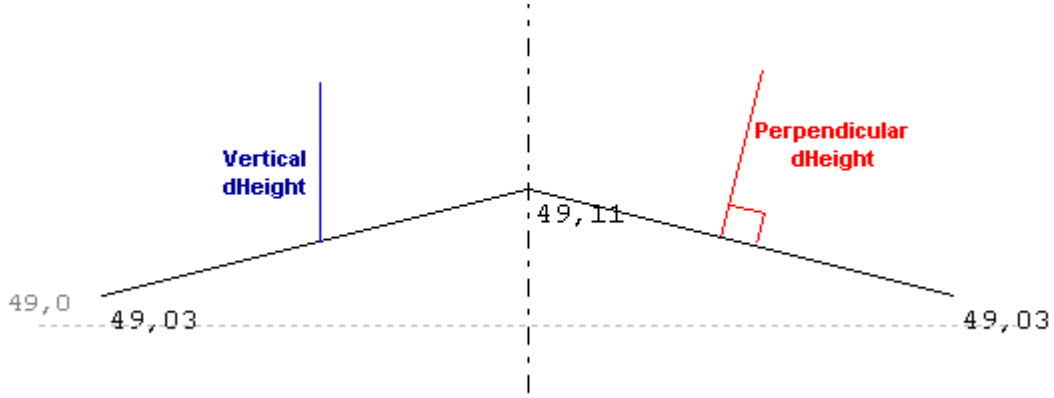
Task	Calculate differences in heights for measured points in relation to a buildup layer where the depth is not determined by any indication in a bup 703 file. Differences in heights should be calculated in relation to the (upper edge of) layer Excavation.
Select layer	Select layer Excavation.
Layer description	Enter *Excavation*.



Selected layer and layer description are usually the same for layers that are not stored in a bup file.

With the choices made above, you get a surface statistics report that presents height differences for measured points in relation to the selected layer.
For layers that do not have a predetermined depth (according to a bup 703 file) the name of the selected layer is usually also used as layer description. This applies for example to the layers excavation and rock.

- **dHeight relative to surface:**
  Choose if height differences should be reported vertical or perpendicular to the surface.
  Select **[Vertical]** to report vertical height differences (dHeight) relative to the surface.
  Select **[Perpendicular]** to report perpendicular height differences (dHeight) relative to the surface.
  This can be applicable, for example, when measuring surfaces in slopes.

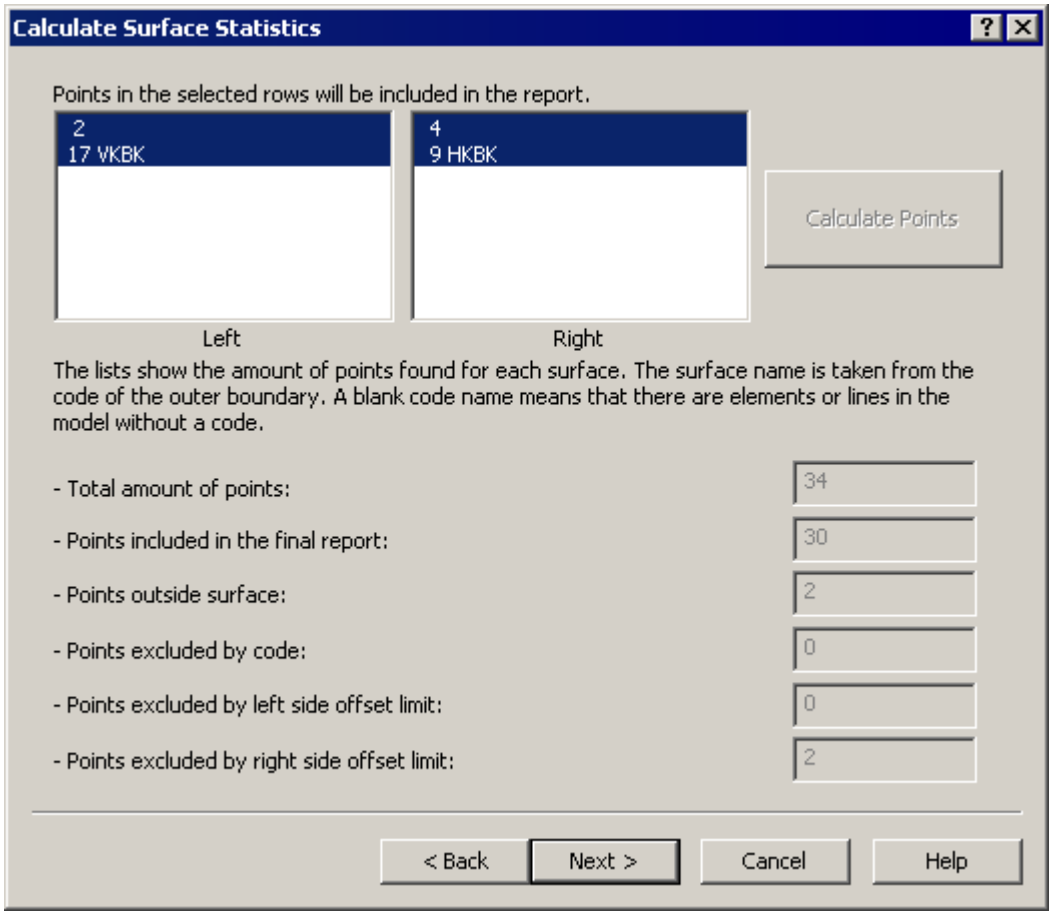


Example of the difference between vertical and perpendicular height calculation.

- **Left side offset limit / Right side offset limit:**
  Enter side offset limit, negative for the left side and positive for the right side of the centerline. Side offset limit excludes points that are outside the specified distance. If no side offset limit is specified, the program calculates height differences for all measured points599.

- **Surface vertical offset:**
  Here you can specify a vertical displacement of the surface (see Select layer599). This can be useful for example if you only have one layer in your mass description file, mbs, but want to get all height differences in relation to another level.

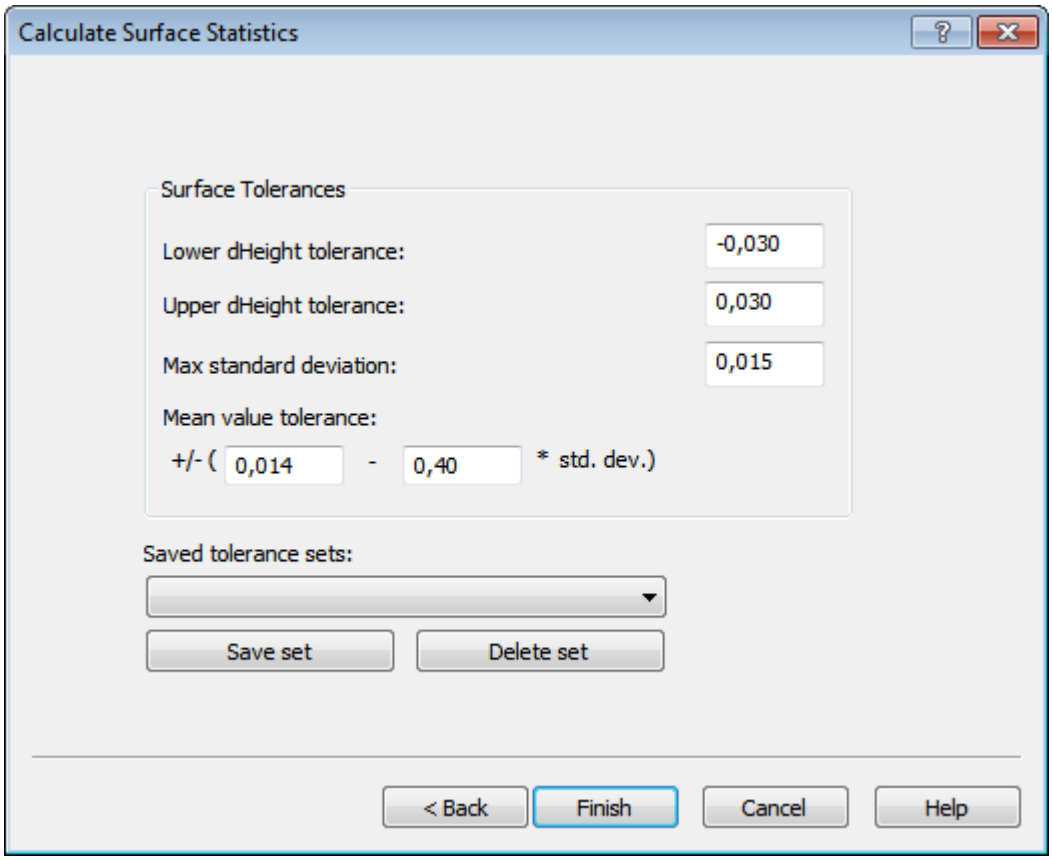
Click **[Next]** to get to the second side of the dialog, where points included in the surface statistics can be calculated.



The second side of the dialog "Calculate Surface Statistics".

- **Calculate Points**
  Click the button **[Calculate Points]** to calculate height differences for measured points relative to a selected layer. Codes from the mass description will also be displayed.
- **Points in selected rows will be included in the report**
  Deselect codes that should not be included in the surface statistics.
  If you, for example, want to create a report for points located on the left lane, you simply select codes that represent the left lane. Note that this requires that you have coded the mass description, see Mass descriptions, MBS 700 .
  The reported codes are retrieved from the current mass description. Depending on the lateral location for each of the measured points 599 , the current code for each point is retrieved. The selection of layer, see Select layer 599 , affects the codes to appear. The codes are reported in the surface statistics report 606 .
- **- Total amount of points**
  Shows the total number of measured points 599 .
- **- Points included in the final report**
  Shows the number of measured points 599 which are within the area covered by the mass description. Points will be reported in the surface statistics report.
- **- Points outside surface**
  Shows the number of measured points 599 which are outside the area covered by the mass description. These points will not be reported in the surface statistics report.
- **- Points excluded by code**
  Shows the number of points excluded from the surface statistics report because they have been deselected in the left/right box 603 in the upper part of the dialog.
- **- Points excluded by left side offset limit**
  Shows the number of points excluded from the calculation because of left side offset limit 602.
- **- Points excluded by right side offset limit**
  Shows the number of points excluded from the calculation because of right side offset limit 602.

Click **[Next]** to get to the third side of the dialog, where values for surface tolerances can be set.



Example settings for surface tolerances.

Surface Tolerances

- **Lower dHeight tolerance**
  Enter approved height difference for points located below the selected layer 599 .
- **Upper dHeight tolerance**
  Enter approved height difference for points located above the selected layer.
- **Max standard deviation**
  Enter the maximum standard deviation of the measured height differences.
  This is a measure of the variance of measured points. Even if all height differences are within the defined lower and upper tolerance, the check of the surface statistics can fail if the measured height differences are too scattered. See also Surface Statistics 597 .
  If you leave this field blank, maximum standard deviation will not be used in the surface statistics check.
- **Mean value tolerance**
  The mean value tolerance indicates how large the mean value of the height differences is allowed to be, i.e. how much the measured surface may deviate from the theoretical surface.
  Enter constants in the formula to calculate the mean value tolerance. The default values are recommended by the Swedish road authorities.
  If you leave these fields blank, mean value tolerance will not be used in the surface statistics check.

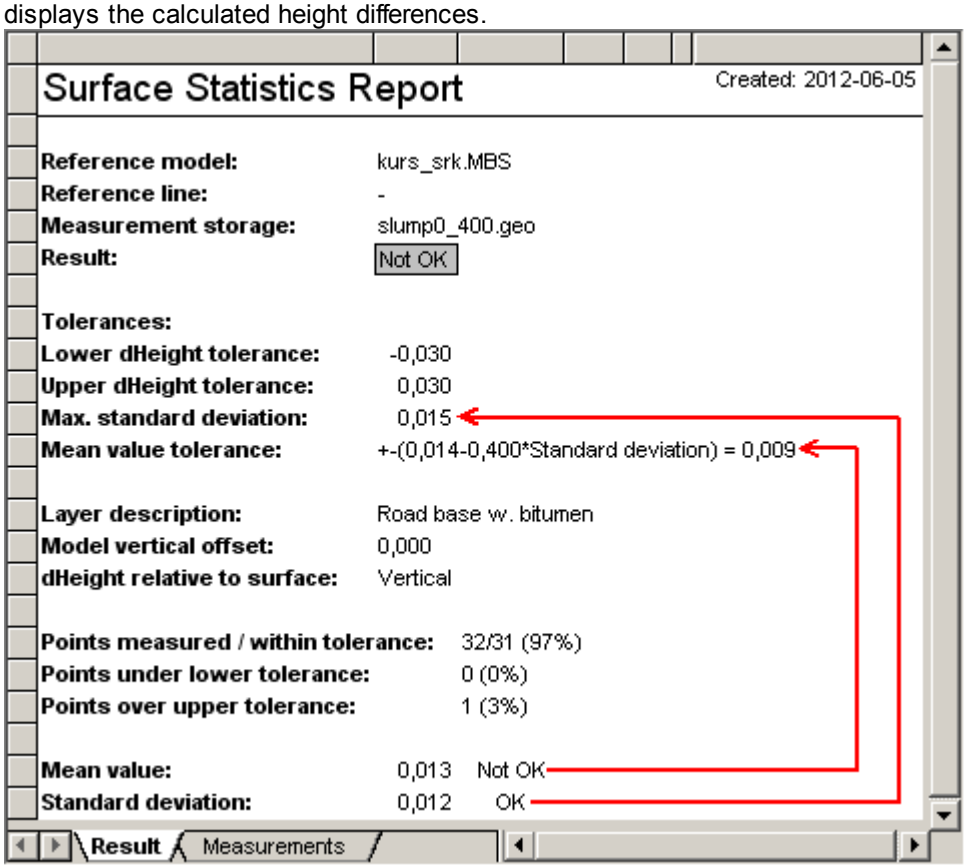
  For more information about max standard deviation and mean value tolerance, see Surface Statistics 597 .

- **Saved tolerance sets**
  If you have saved parameters for calculating surface tolerances you can use the dropdown menu to reuse saved tolerances.
  Click the button **[Save set]** to save the parameters for calculating surface tolerances.
  Click the button **[Delete set]** to delete a set of saved parameters for calculating surface tolerances.

Click the button **[Finish]** to calculate surface tolerances.

Surface Statistics Report

The program creates a surface statistics report and a coordinate file that graphically and numerically displays the calculated height differences.



The tab Result in the Surface Statistics Report.

The report is divided into two tabs, where the first tab [Result] shows a summary of the surface statistics. The result from the surface statistics is accepted only if all the points in the surface statistics are approved.

Reference model	Name of the file with the theoretical surface from which surface statistics have been calculated.
Reference line	Can only be used for Surface statistics with terrain model 617 .
Measurement storage	Name of the file with the measured points.
Result	The result of surface statistics is only approved if all measured points are within the tolerance.
Tolerances	If you have used a calculation formula for tolerances, which you have named, the name of the used tolerance set is displayed here.
Lower dHeight tolerance	Specifies the lower maximum tolerance in height for measured points.
Upper dHeight tolerance	Specifies the upper maximum tolerance in height for measured points.
Maximum standard deviation	Specifies the selected standard deviation.
Mean value tolerance	Specifies the selected mean value tolerance.
Layer description	Surface statistics is calculated against the layer you have selected, and here your description 600 of the layer is specified.
Model vertical offset	Specifies any selected height displacement 602 of the surface.
dHeight relative to surface	Specifies whether height differences 601 have been calculated vertically or perpendicular to the reference surface.
Points measured / within tolerance	Total number of measured points, relative to the number of points within

	the specified tolerance. These points are marked with green icons in the graphics.
Points under lower tolerance	Number of points below the specified tolerance. These points are marked with blue icons in the graphics.
Points over upper tolerance	Number of points above the specified tolerance. These points are marked with red icons in the graphics.
Mean value	Specifies the calculated mean value for measured height differences. The value is compared to the specified *Mean value tolerance*.
Standard deviation	Specifies the estimated standard deviation for measured height differences. The value is compared to the specified *Max. standard deviation*.

Description of information in the first tab of the surface statistics report; Result.

Surface Statistics Report

Created: 2012-06-05

Reference model: kurs_srk.MBS
Reference line: -
Measurement storage: slump0_400.geo
Result: Not OK

Point	Chainage	Side Offset	dHeight	Element code	N	E	H	Result
1	0/058,45	0,880	0,029	HKBK	64 985,674	54 326,784	48,787	OK
2	0/067,15	0,550	0,003	HKBK	64 986,333	54 335,463	48,456	OK
3	0/074,92	-0,110	0,010	VKBK	64 987,287	54 343,203	48,193	OK
4	0/090,15	2,090	0,007	HKBK	64 985,665	54 358,500	47,620	OK
5	0/117,73	-0,495	0,024	VKBK	64 989,293	54 385,971	46,933	OK
6	0/124,25	1,980	0,023	HKBK	64 987,067	54 392,579	46,757	OK
7	0/128,56	1,540	0,022	HKBK	64 987,670	54 396,864	46,683	OK
8	0/136,06	-0,825	0,014	VKBK	64 990,317	54 404,268	46,562	OK
9	0/144,97	0,220	0,021	HKBK	64 989,610	54 413,217	46,452	OK
10	0/150,05	-0,880	0,022	VKBK	64 990,902	54 418,247	46,374	OK
11	0/158,62	-1,980	0,002	VKBK	64 992,326	54 426,774	46,239	OK
12	0/158,82	-0,715	0,014	VKBK	64 991,070	54 427,023	46,281	OK
13	0/174,50	-1,155	0,037	VKBK	64 992,103	54 442,675	46,196	Not OK
14	0/181,73	0,275	0,018	HKBK	64 990,948	54 449,952	46,144	OK
15	0/182,40	-1,045	0,025	VKBK	64 992,292	54 450,566	46,128	OK

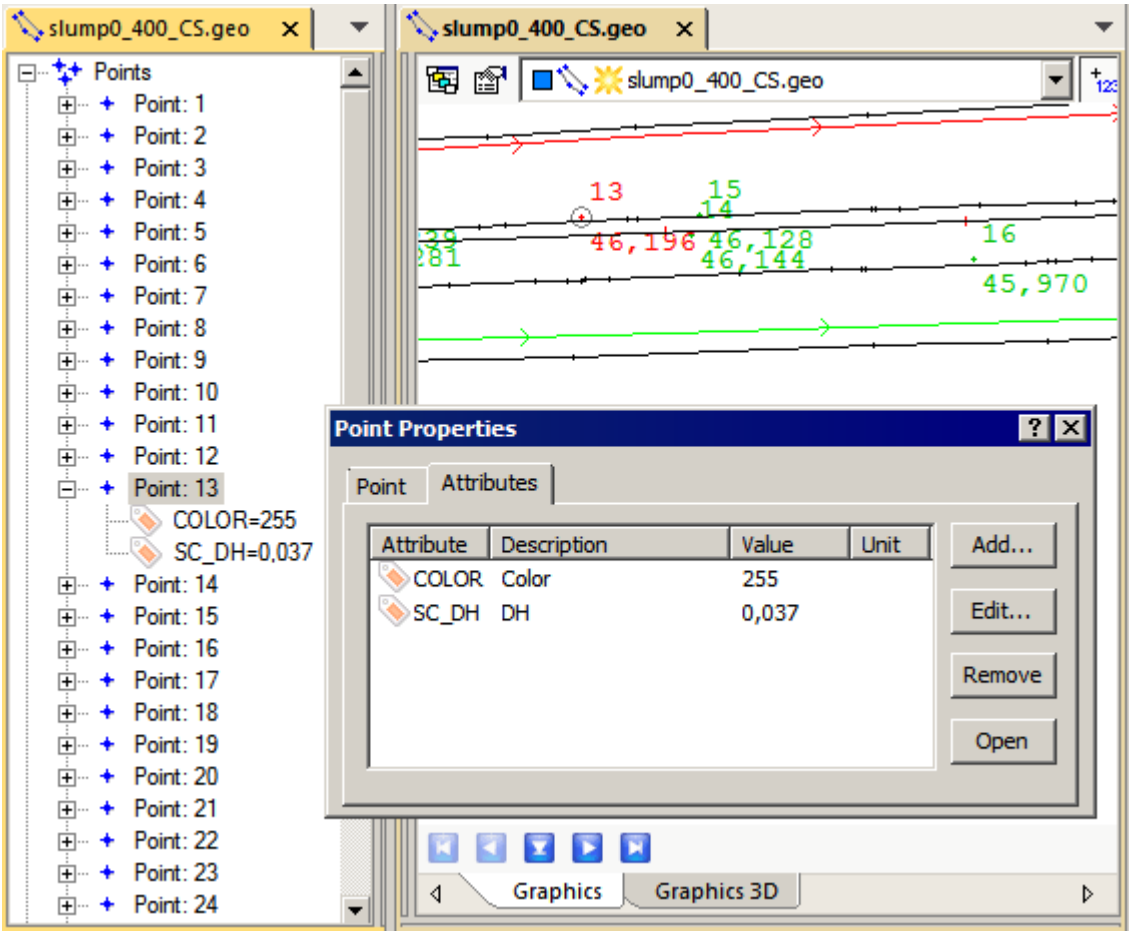
Result | Measurements

The tab Measurements in the Surface Statistics Report displays measuring results for the measured points.

The tab **[Measurements]** in the report displays for each point chainage, side offset, and height difference in relation to the selected reference layer599. The element codes fetched from the mass description show each point's position in relation to the width of the road.

Coordinate file

The program creates, in addition to a surface statistics report, a coordinate file for the measured points599. All points in the coordinate file get attributes with information about the height difference to the selected layer and also a color code based on the specified tolerance604.



Coordinate file created from the surface statistics calculation.
The Point Properties dialog displaying a point's attributes is opened if you select a point in the graphics view, right click and select [Properties].

Height difference, measured point is located ...	Color
... too low	blue
... within the tolerance	green
... too high	red

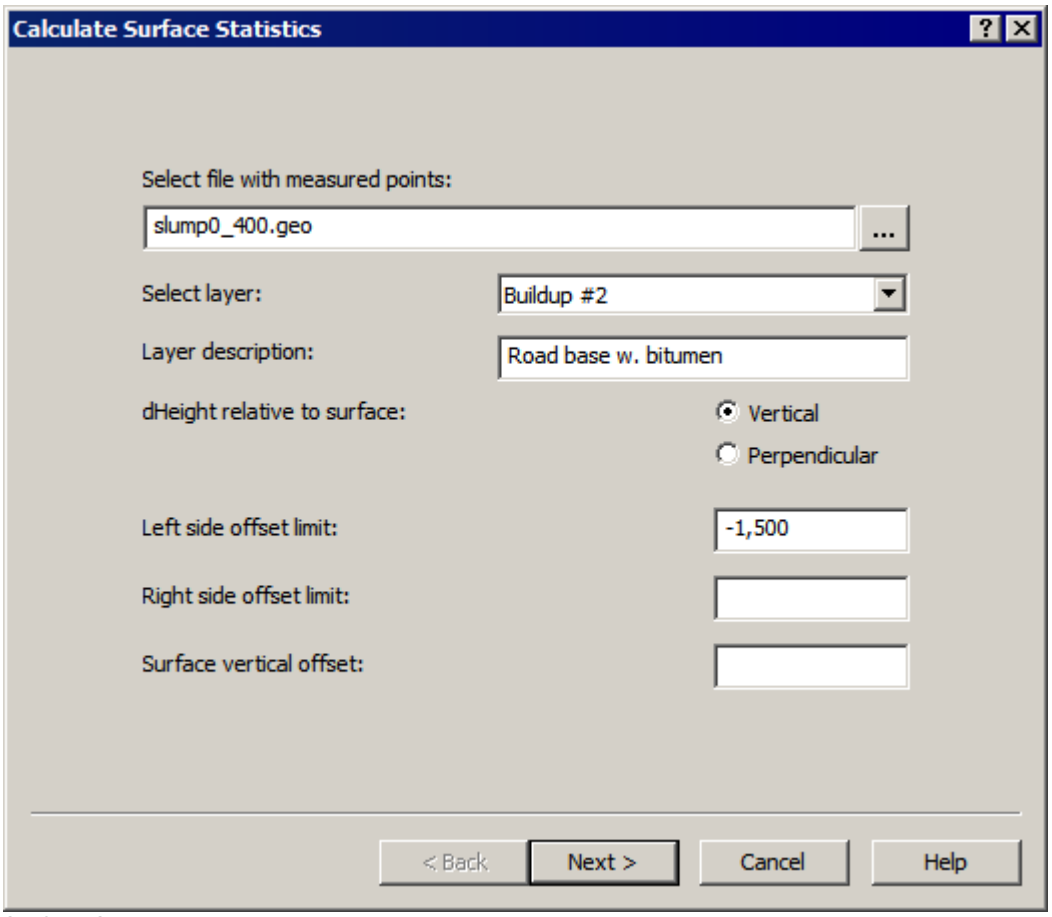
Each measured point obtains a certain color, based on the height difference.

To display the attributes in the coordinate file, select a point in the graphical view, right click on the point and select **[Properties]** or display the attributes in the Attribute view, see Optional attributes 117. See Program Settings 111 for information about selecting an attribute definition file.

See also: Optional attributes 113, Program Settings 109, Mass Descriptions, MBS 689, Surface Statistics 597

9.18.2 Surface Statistics with stringline model, lmd

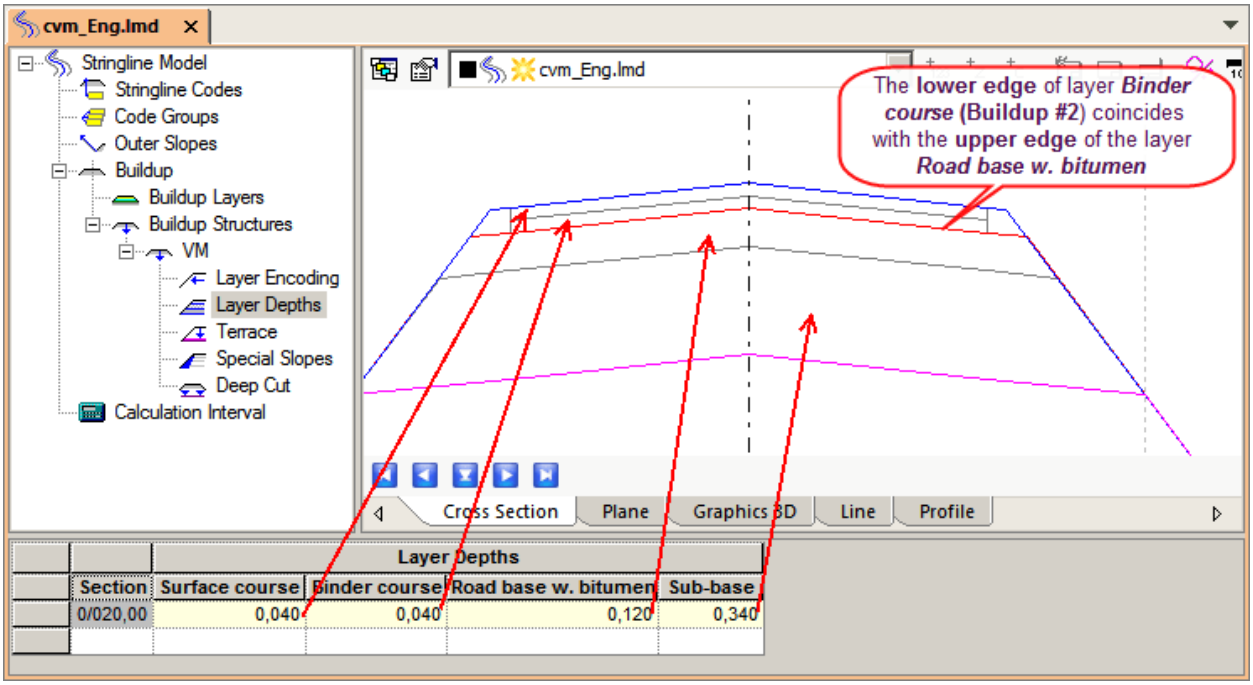
Use Surface Statistics to calculate height differences for measured points in relation to a layer in a stringline model[541] , lmd. Open a stringline model and select ***Data | Surface Statistics***.
The surface statistics report presents statistics and absolute deviations from the reference surface. The estimated height differences are also presented graphically with color coding showing the height of each point with respect to a given layer.



Surface Statistics with active stringline model.

- **Select file with measured points:**
  Select the coordinate file to be compared with the active stringline model. Enter the file name or click the browse button ... to select file.

- **Select layer:**
  Use the dropdown menu to select layer for which you want to calculate surface statistics.
  Note:
  - the program calculates heights relatively the lower edge of the selected layer, if the layer has a certain depth. See example in the image below.
  - in the report, heighs will be displayed along with an optional layer description[609], *not* the name of the selected layer.



Example of buildup layers in a stringline model.
Note that the lower edge of layer *Binder course* coincides with the upper edge of the layer *Road base w. bitumen*.

Note: For all buildup layers with a certain depth, surface statistics will be calculated regarding the selected layer's lower edge.

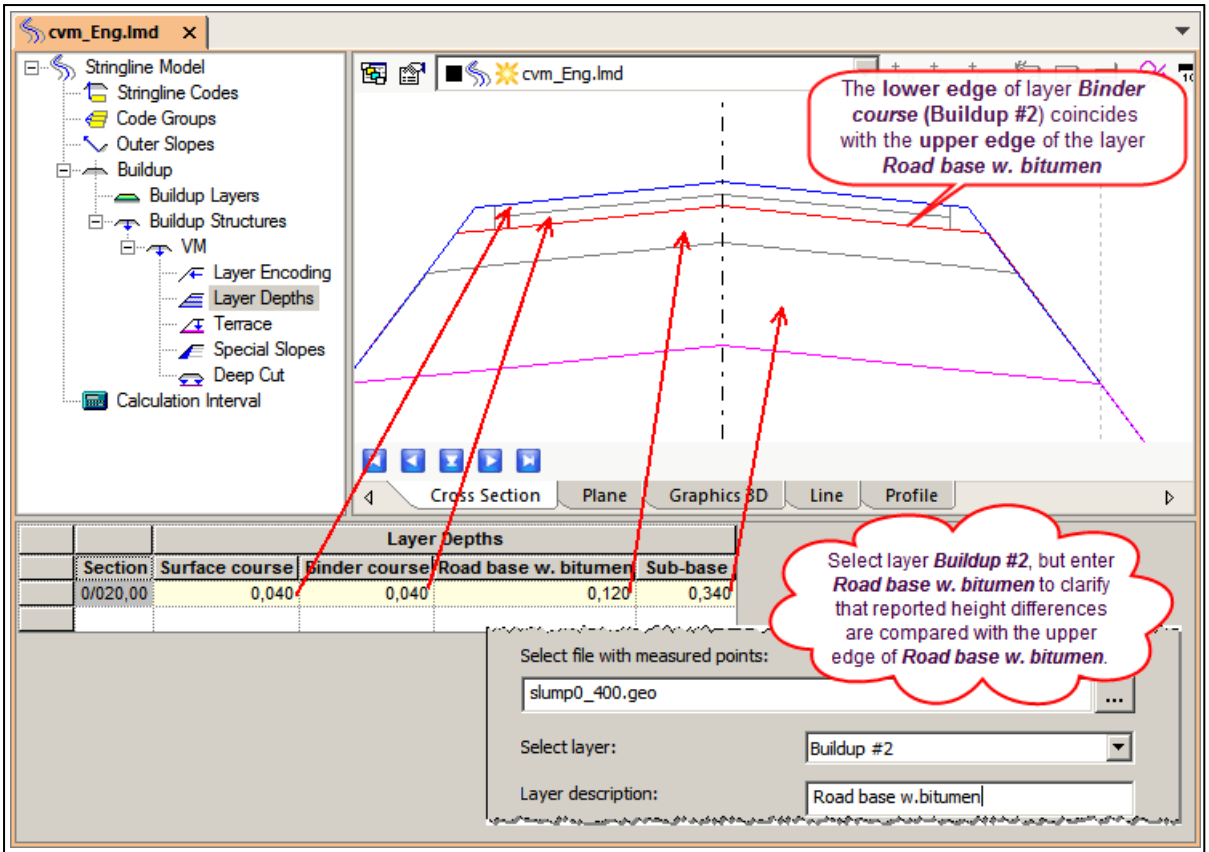
The surface statistics report 614 presents heights relative to the lower edge of the selected layer, along with an optional layer description 609. Note, the layer description will be displayed in the report, *not* the name of the selected layer. Thus it is important that you enter a layer description describing the layer immediately below the selected layer, as you want the heights to be related to the *upper edge* of the layer description displayed in the report.

If you calculate surface statistics against a layer that has no known depth, as the top or bottom layer e.g. the layer theoretic or excavation, you select the layer directly in the dropdown menu and you will not need to change the layer description.

- **Layer description**
  Enter optional layer description. The text will be displayed in the surface statistics report. The text shows for which layer in the stringline model, surface statistics have been calculated.

Example 1: How to select layer (with a known depth) and layer description

Task	Calculate differences in height for measured points in relation to the upper edge of the layer Road base w. bitumen. Note, that the build up layer has a known depth.
Select layer	Select layer Buildup #2 which, in the image below, is the same as layer Binder course.
Layer description	Enter Road base w. bitumen as layer description, as this layer is situated immediately below the selected layer, and its upper edge concides with the selected layer's bottom edge.

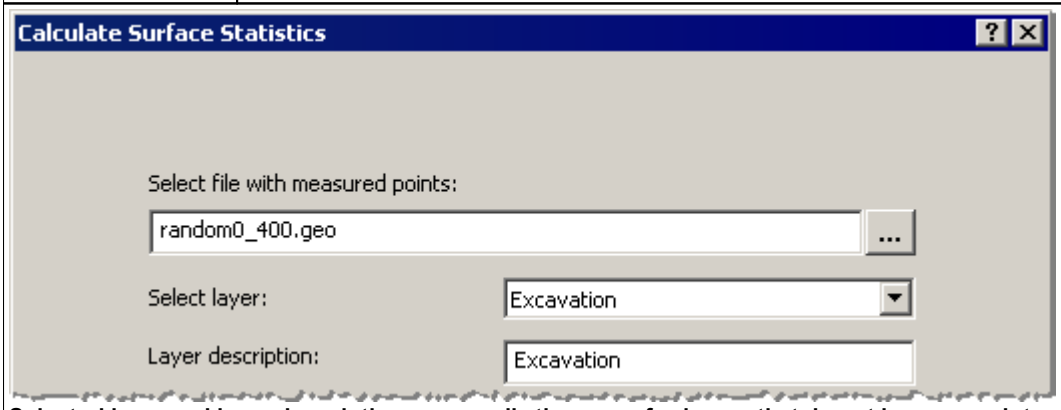


At layer description, enter the name of the layer that is located immediately below the selected layer.

With the choices made above, you get a surface statistics report that presents height differences for measured points in relation to the lower edge of the selected layer (Buildup #2), which coincides with the upper edge of layer Road base w. bitumen.

Example 2: How to select layer (with unknown depth) and layer description

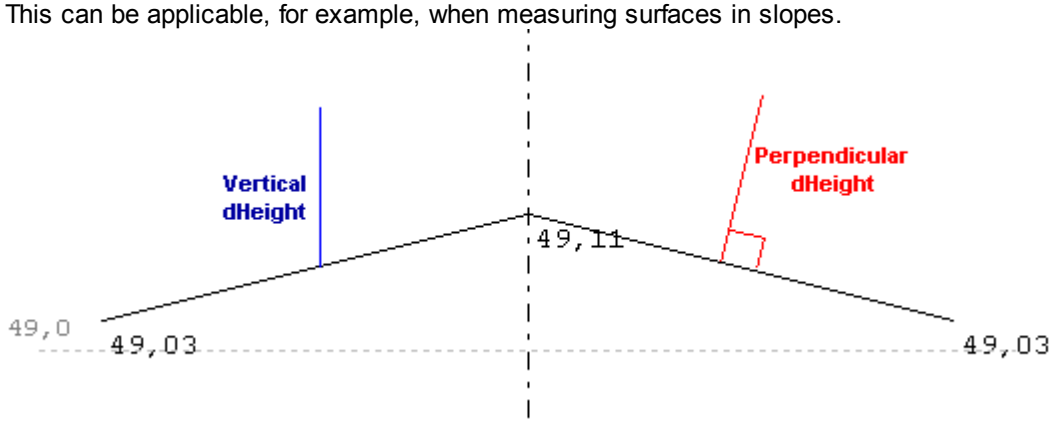
Task	Calculate differences in height for measured points in relation to a buildup layer with unknown depth. Differences in height should be calculated in relation to (the upper edge of) layer Excavation.
Select layer	Select layer Excavation.
Layer description	Select *Excavation.*



Selected layer and layer description are usually the same for layers that do not have a predetermined depth.

With the choices made above, you get a surface statistics report that presents height differences for measured points in relation to the selected layer.
For layers that do not have a predetermined depth the name of the selected layer is usually also used as layer description. This applies for example to the layers theoretic and excavation.

- **dHeight relative to surface:**
  Choose if height differences should be reported vertical or perpendicular to the surface.
  Select **[Vertical]** to report vertical height differences (dHeight) relative to the surface.
  Select **[Perpendicular]** to report perpendicular height differences (dHeight) relative to the surface.
  This can be applicable, for example, when measuring surfaces in slopes.

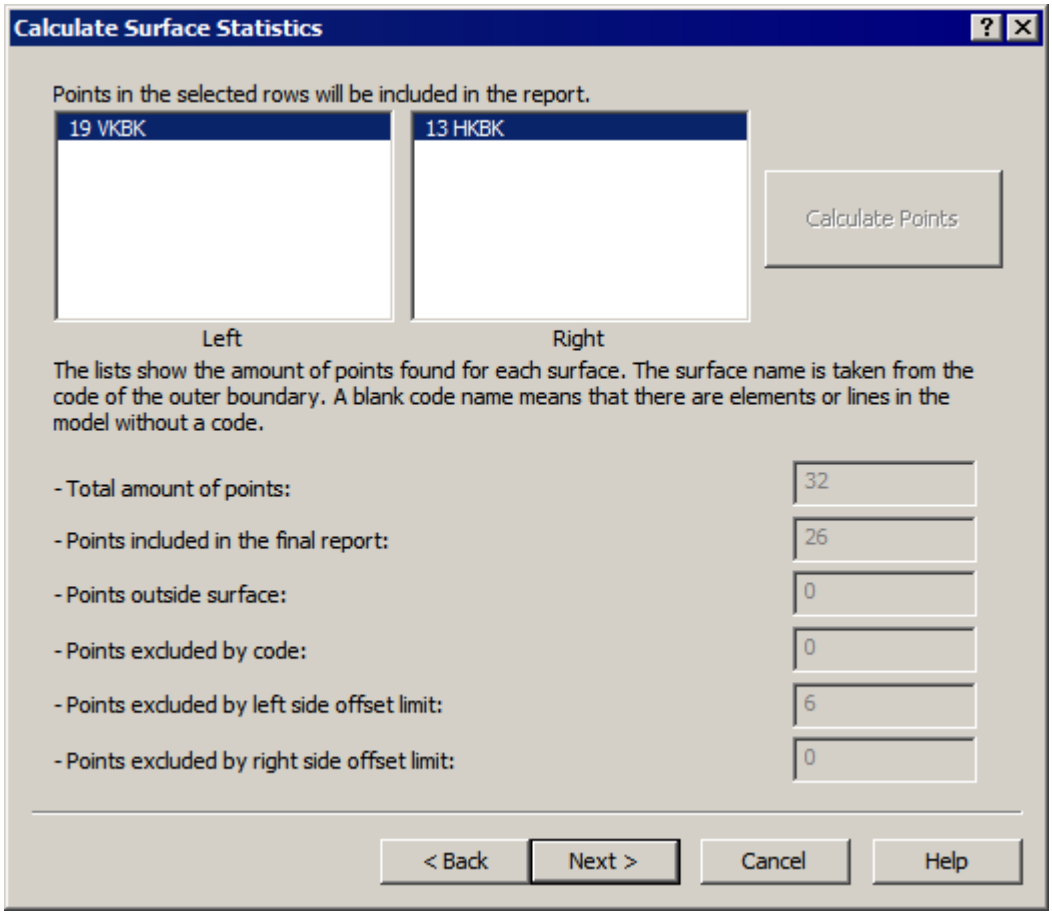


Example of the difference between vertical and perpendicular height calculation.

- **Left side offset limit / Right side offset limit:**
  Enter side offset limit, negative for the left side and positive for the right side of the centerline.
  Side offset limit excludes points that are outside the specified distance. If no side offset limit is specified, the program calculates height differences for all measured points608 .

- **Surface vertical offset:**
  Here you can specify a vertical displacement of the surface (see Select layer608). This can be useful for example if you only have one layer in your stringline model, lmd, but want to get all height differences in relation to another level.

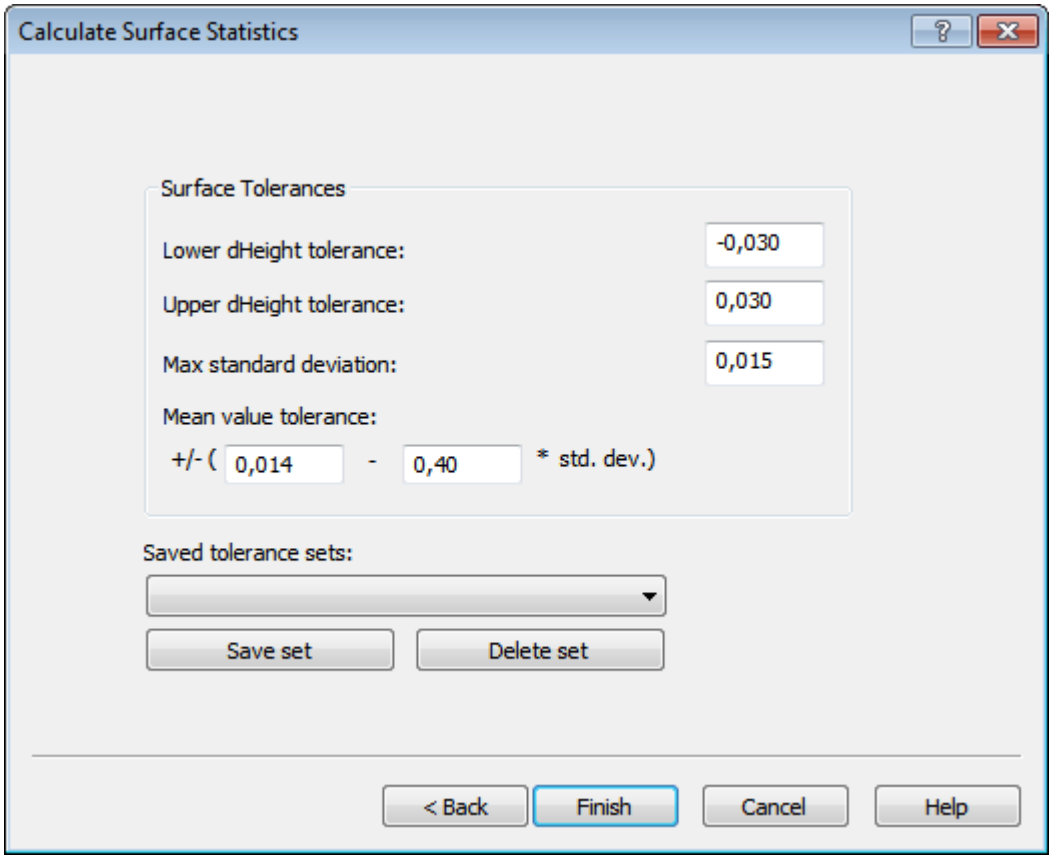
Click **[Next]** to get to the second side of the dialog, where points included in the surface statistics can be calculated.



The second side of the dialog "Calculate Surface Statistics".

- **Calculate points**
  Click the button **[Calculate Points]** to calculate height differences for measured points relative to a selected layer. Codes from the stringline model will also be displayed.
- **Points in selected rows will be included in the report**
  Deselect codes that should not be included in the surface statistics.
  If you, for example, want to create a report for points located on the left lane, you simply select codes that represent the left lane.
  The reported codes are retrieved from the current stringline model. Depending on the lateral location for each of the measured points 608, the current code for each point is retrieved. The codes are reported in the surface statistics report 615.
- **- Total amount of points**
  Shows the total number of measured points 608.
- **- Points included in the final report**
  Shows the number of measured points 608 which are within the area covered by the stringline model. Points will be reported in the surface statistics report.
- **- Points outside surface**
  Shows the number of measured points 608 which are outside the area covered by the stringline model. These points will not be reported in the surface statistics report.
- - **Points excluded by code**
  Shows the number of points excluded from the surface statistics report because they have been deselected in the left/right box 612 in the upper part of the dialog.
- **- Points excluded by left side offset limit**
  Shows the number of points excluded from the calculation because of left side offset limit 611.
- **- Points excluded by right side offset limit**
  Shows the number of points excluded from the calculation because of right side offset limit 611.

Click **[Next]** to get to the third side of the dialog, where values for surface tolerances can be set.



Example settings for surface tolerances.

Surface Tolerances

- **Lower dHeight tolerance**
  Enter approved height difference for points located below the selected layer 608.
- **Upper dHeight tolerance**
  Enter approved height difference for points located above the selected layer.
- **Max standard deviation**
  Enter the maximum standard deviation of the measured height differences.
  This is a measure of the variance of measured points. Even if all height differences are within the defined lower and upper tolerance, the check of the surface statistics can fail if the measured height differences are too scattered. See also Surface Statistics 597.
  If you leave this field blank, maximum standard deviation will not be used in the surface statistics check.
- **Mean value tolerance**
  The mean value tolerance indicates how large the mean value of the height differences is allowed to be, i.e. how much the measured surface may deviate from the theoretical surface.
  Enter constants in the formula to calculate the mean value tolerance. The default values are recommended by the Swedish road authorities.
  If you leave these fields blank, mean value tolerance will not be used in the surface statistics check.

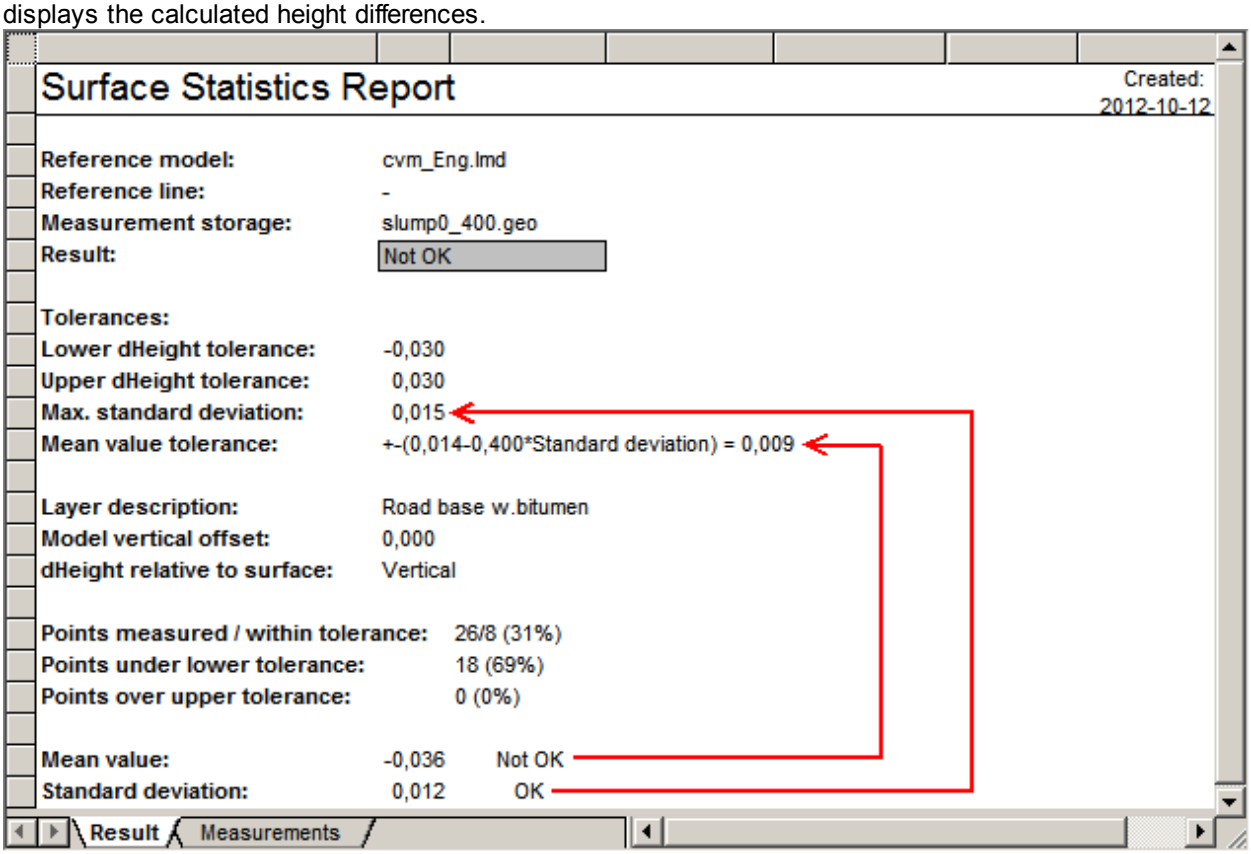
  For more information about max standard deviation and mean value tolerance, see Surface Statistics 597.

- **Saved tolerance sets**
  If you have saved parameters for calculating surface tolerances you can use the dropdown menu to reuse saved tolerances.
  Click the button **[Save set]** to save the parameters for calculating surface tolerances.
  Click the button **[Delete set]** to delete a set of saved parameters for calculating surface tolerances.

Click the button **[Finish]** to calculate surface tolerances.

Surface Statistics Report

The program creates a surface statistics report and a coordinate file that graphically and numerically displays the calculated height differences.



Surface Statistics Report — Created: 2012-10-12

Reference model:	cvm_Eng.lmd
Reference line:	-
Measurement storage:	slump0_400.geo
Result:	Not OK
Tolerances:	
Lower dHeight tolerance:	-0,030
Upper dHeight tolerance:	0,030
Max. standard deviation:	0,015
Mean value tolerance:	+-(0,014-0,400*Standard deviation) = 0,009
Layer description:	Road base w.bitumen
Model vertical offset:	0,000
dHeight relative to surface:	Vertical
Points measured / within tolerance:	26/8 (31%)
Points under lower tolerance:	18 (69%)
Points over upper tolerance:	0 (0%)
Mean value:	-0,036 Not OK
Standard deviation:	0,012 OK

Result / Measurements

The tab Result in the Surface Statistics Report.

The report is divided into two tabs, where the first tab **[Result]** shows a summary of the surface statistics. The result from the surface statistics is accepted only if all the points in the surface statistics are approved.

Reference model	Name of the file with the theoretical surface from which surface statistics have been calculated.
Reference line	Can only be used for Surface Statistics with terrain model 618 .
Measurement storage	Name of the file with the measured points.
Result	The result of the surface statistics is only approved if all the measured points fall within the specified tolerance.
Tolerances	If you have used a calculation formula for the tolerances, which you have named, the name of the used tolerance set is displayed here.
Lower dHeight tolerance	Specifies the lower maximum tolerance in height for measured points.
Upper dHeight tolerance	Specifies the upper maximum tolerance in height for measured points
Max. standard deviation	Specifies the selected standard deviation.
Mean value tolerance	Specifies the selected mean value tolerance.
Layer description	Surface statistics is calculated against the layer you have selected, and here your description 609 of the layer is specified.
Model vertical offset	Specifies any selected height displacement 611 of the surface.
dHeight relative to surface	Specifies whether height differences 611 have been calculated vertically or perpendicular to the reference surface.

Points measured / within tolerance	Total number of measured points relative to the number of points within the specified tolerance. These points are marked with green icons in the graphics.
Points under lower tolerance	Number of points below the specified tolerance. These points are marked with blue icons in the graphics.
Points over upper tolerance	Number of points above the specified tolerance. These points are marked with red icons in the graphics.
Mean value	Specifies the calculated mean value for measured height differences. The value is compared to the specified *mean value tolerance*.
Standard deviation	Specifies the estimated standard deviation for measured height differences. The value is compared to the specified *Max. standard deviation*.

Description of information in the first tab of the surface statistics report; Result.

Surface Statistics Report

Created: 2012-10-12

Reference model: cvm_Eng.lmd
Reference line: -
Measurement storage: slump0_400.geo
Result: Not OK

Point	Chainage	Side Off	dHeight	Element	N	E	H	Result
1	0/058,45	0,880	-0,021	HKBK	64 985,674	54 326,784	48,787	OK
2	0/067,15	0,550	-0,047	HKBK	64 986,333	54 335,463	48,456	Not OK
3	0/074,92	-0,110	-0,040	VKBK	64 987,287	54 343,203	48,193	Not OK
4	0/090,15	2,090	-0,044	HKBK	64 985,665	54 358,500	47,620	Not OK
5	0/117,73	-0,495	-0,029	VKBK	64 989,293	54 385,971	46,933	OK
6	0/124,25	1,980	-0,031	HKBK	64 987,067	54 392,579	46,757	Not OK
7	0/128,56	1,540	-0,030	HKBK	64 987,670	54 396,864	46,683	OK
8	0/136,06	-0,825	-0,040	VKBK	64 990,317	54 404,268	46,562	Not OK
9	0/144,97	0,220	-0,033	HKBK	64 989,610	54 413,217	46,452	Not OK
10	0/150,05	-0,880	-0,028	VKBK	64 990,902	54 418,247	46,374	OK
12	0/158,82	-0,715	-0,038	VKBK	64 991,070	54 427,023	46,281	Not OK
13	0/174,50	-1,155	-0,003	VKBK	64 992,103	54 442,675	46,196	OK
14	0/181,73	0,275	-0,032	HKBK	64 990,948	54 449,952	46,144	Not OK
15	0/182,40	-1,045	-0,025	VKBK	64 992,292	54 450,566	46,128	OK
16	0/200,47	2,530	-0,034	HKBK	64 989,404	54 468,757	45,970	Not OK

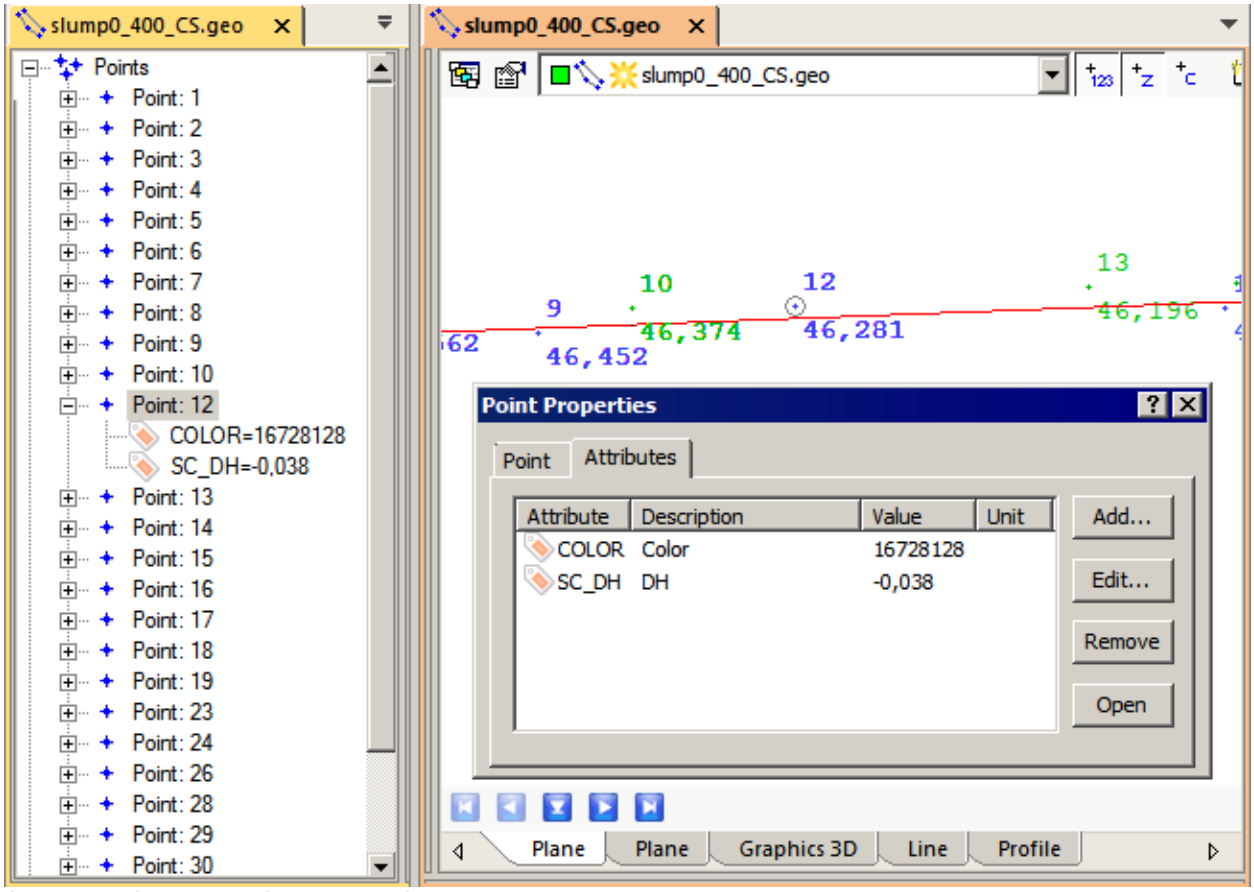
Result | Measurements

The tab Measurements in the Surface Statistics Report displays measuring results for the measured points.

The tab **[Measurements]** in the report displays for each point chainage, side offset, and height difference in relation to the selected reference layer608. The element codes fetched from the stringline model show each point's position in relation to the width of the road.

Coordinate file

The program creates, in addition to a surface statistics report, a coordinate file for the measured points608. All points in the coordinate file get attributes with information about the height difference to the selected layer and also a color code based on the specified tolerance613.



Coordinate file created from the surface statistics calculation.
The Point Properties dialog displaying a point's attributes is opened if you select a point in the graphics view, right click and select [Properties].

Height difference, measured point is located ...	Color
... too low	blue
... within the tolerance	green
... too high	red

Each measured point obtains a certain color, based on the height difference.

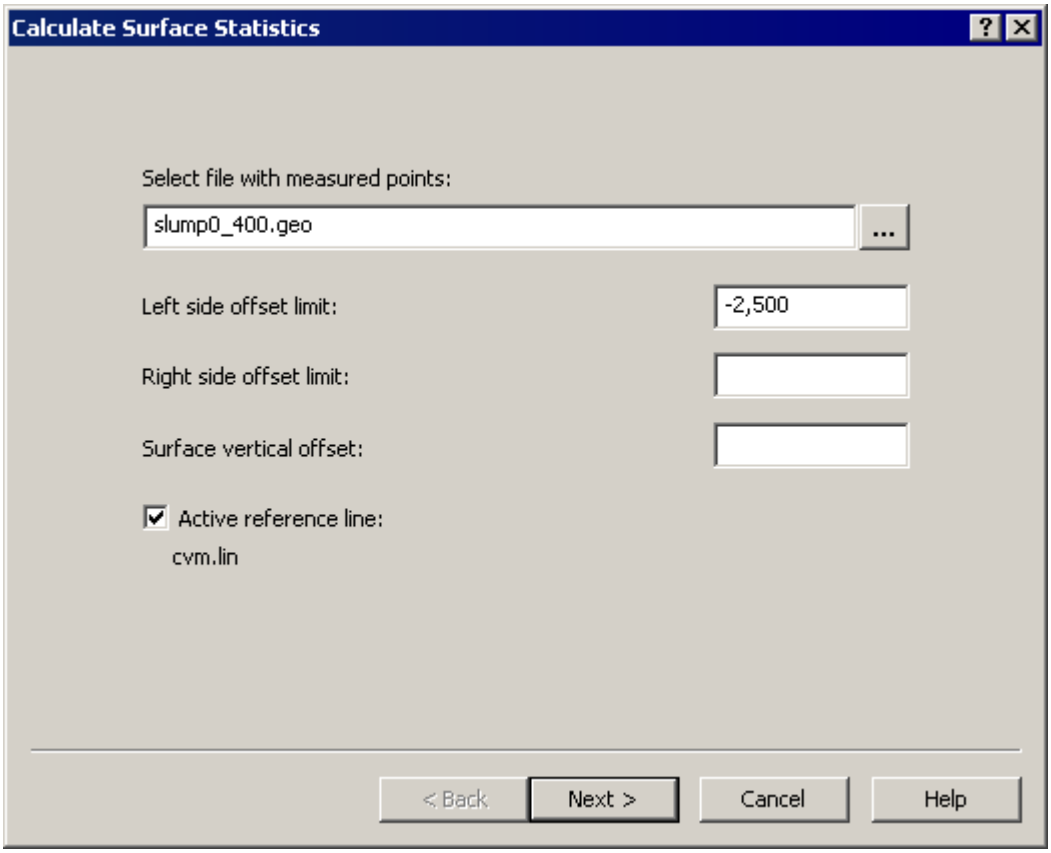
To display the attributes in the coordinate file, select a point in the graphical view, right click on the point and select **[Properties]** or display the attributes in the Attribute view, see Optional attributes 117. See Program Settings 111 for information about selecting an attribute definition file.

See also: Optional attributes 113, Program Settings 109, Stringline model, LMD 541, Surface Statistics 597

9.18.3 Surface Statistics with terrain model, trm

Use Surface Statistics to calculate height differences for measured points in relation to a terrain model[638] (trm). Open a terrain model and select ***Data | Surface Statistics***.
The surface statistics report presents statistics and absolute deviations from the reference surface. The estimated height differences are also presented graphically with color coding showing the height of each point with respect to the active terrain model.

When calculating surface statistics based on a terrain model[638] (trm) you get vertical height differences relative to the current surface.
If you open a line file[503] in the same graphical window as the terrain model, you will achieve a surface statistics report presenting differences in height relative to the terrain model and side offsets in relation to the reference line.



Surface Statistics with terrain model.

- **Select file with measured points:**
  Select the coordinate file to be compared with the active terrain model. Enter the file name or click the browse button ... to select file.

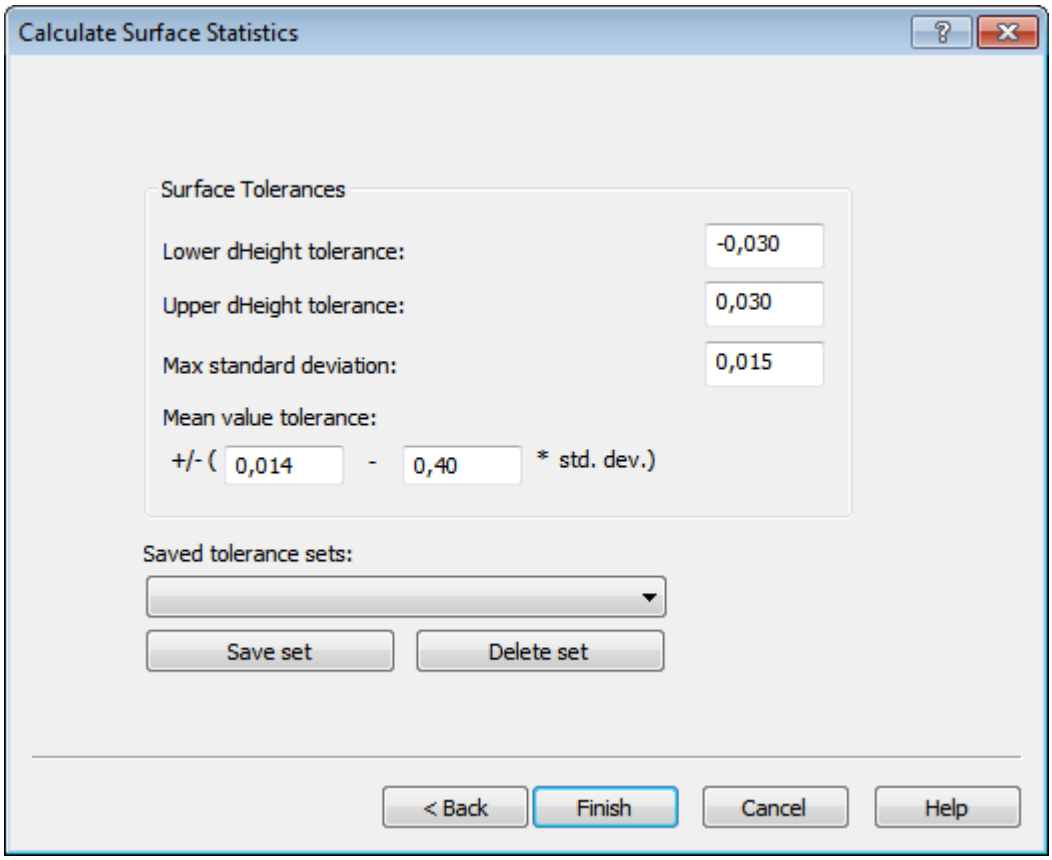
- **Left side offset limit / Right side offset limit:**
  Can only be defined if a reference line (see Line Data[503]) has been opened together with the terrain model in the graphical window. Enter side offset limit, negative for the left side and positive for the right side of the reference line. Side offset limit excludes points that are outside the specified distance.
  If no side offset limit is specified, the program calculates height differences for all measured points[617]
  .

- **Surface vertical offset:**
  Here you can specify a vertical displacement of the surface of the terrain model, see also Modify

terrain model[686]. This can be useful if you want to specify all height differences in relation to a another height level.

- **Active reference line:**
  This option is only active if a line reference is opened in the same graphical window as the terrain model. If this option is selected, height differences are shown along with chainage and side offsets in relation to the reference line, in the final surface statistics report.

Click **[Next]** to get to the second side of the dialog, where values for surface tolerances can be set.



Example settings for surface tolerances.

Surface Tolerances

- **Lower dHeight tolerance**
  Enter approved height difference for points located below the theoretical surface.
- **Upper dHeight tolerance**
  Enter approved height difference for points located above the theoretical surface.
- **Max standard deviation:**
  Enter the maximum standard deviation of the measured height differences.
  This is a measure of the variance of measured points. Even if all height differences are within the defined lower and upper tolerance, the check of the surface statistics can fail if the measured height differences are too scattered. See also Surface Statistics[597].
  If you leave this field blank, maximum standard deviation will not be used in the surface statistics check.
- **Mean value tolerance:**
  The mean value tolerance indicates how large the mean value of the height differences is allowed to be, i.e. how much the measured surface may deviate from the theoretical surface.
  Enter constants in the formula to calculate the mean value tolerance. The default values are recommended by the Swedish road authorities.
  If you leave these fields blank, mean value tolerance will not be used in the surface statistics check.

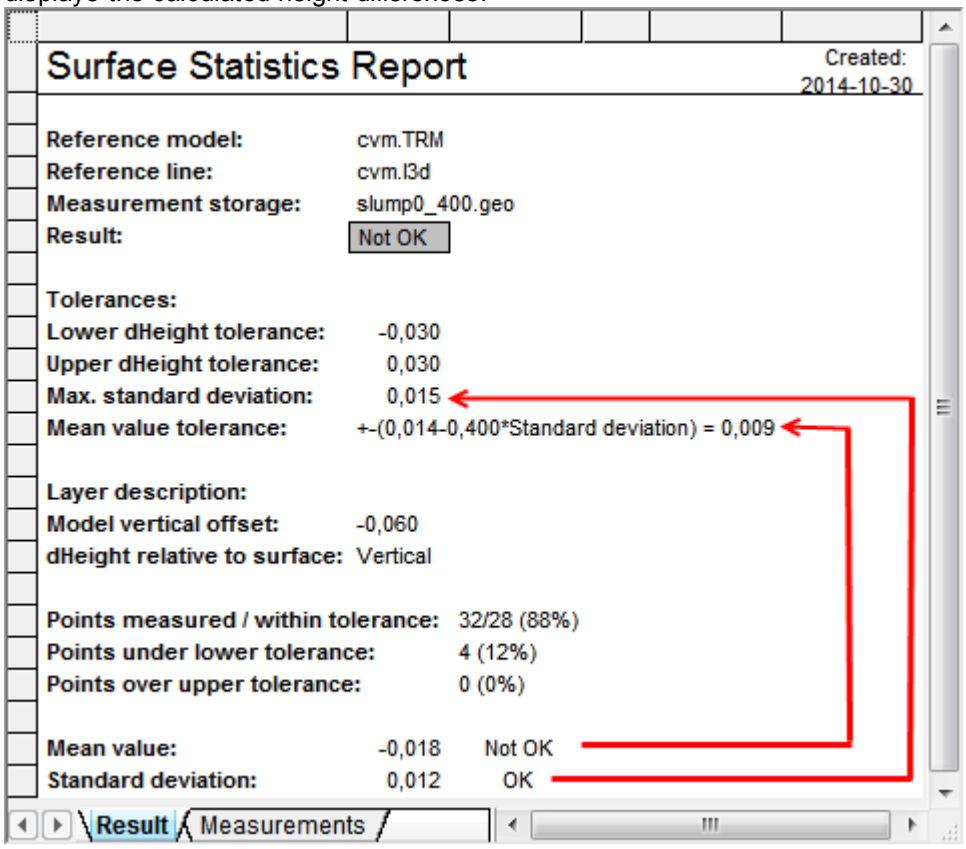
For more information about max standard deviation and mean value tolerance, see Surface Statistics 597.

- **Saved tolerance sets:**
  If you have saved parameters for calculating surface tolerances you can use the dropdown menu to reuse saved tolerances.
  Click the button **[Save set]** to save the parameters for calculating surface tolerances.
  Click the button **[Delete set]** to delete a set of saved parameters for calculating surface tolerances.

Click the button **[Finish]** to calculate surface tolerances.

Surface Statistics Report

The program creates a surface statistics report and a coordinate file that graphically and numerically displays the calculated height differences.



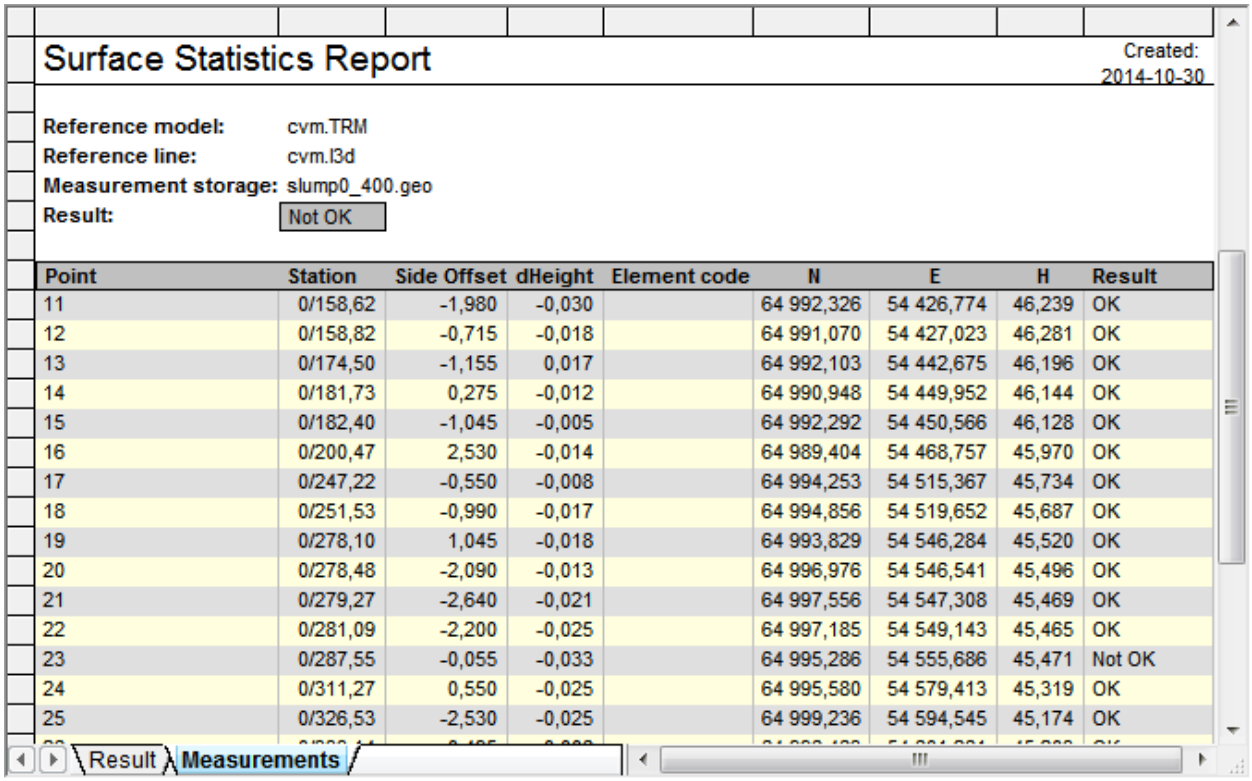
The tab Result in theSurface Statistics Report.

The report is divided into two tabs, where the first tab [Result] shows a summary of the surface statistics. The result from the surface statistics is accepted only if all the points in the surface statistics are approved.

Reference model	Name of the file with the theoretical surface from which surface statistics have been calculated
Reference line	If you have selected a reference line 618, the name will be displayed here.
Measurement storage	Name of the file with the measured points.
Result	The result of surface statistics is only approved if all measured points are within the tolerance.
Tolerances	If you have used a calculation formula for tolerances, which you have named, the name of the used tolerance set is displayed here.
Lower dHeight tolerance	Specifies the lower maximum tolerance in height for measured points.

Upper dHeight tolerance	Specifies the upper maximum tolerance in height for measured points.
Max. standard deviation	Specifies the selected standard deviation.
Mean value tolerance	Specifies the selected mean value tolerance.
Layer description	Not used for terrain models. Only used when calculating surface statistics for mass descriptions[600] and string line models[609].
Model vertical offset	Specifies any selected height displacement[617] of the surface.
dHeight relative to surface	Height differences are always calculated vertical to the reference surface at terrain models.
Points measured / within tolerance	Total number of measured points, relative to the number of points within the specified tolerance. These points are marked with green icons in the graphics.
Points under lower tolerance	Number of points below the specified tolerance. These points are marked with blue icons in the graphics.
Points over upper tolerance	Number of points above the specified tolerance. These points are marked with red icons in the graphics.
Mean value	Specifies the calculated mean value for measured height differences. The value is compared to the specified *Mean value tolerance*.
Standard deviation	Specifies the estimated standard deviation for measured height differences. The value is compared with the specified *Max. standard deviation*.

Description of information in the first tab of the surface statistics report; Result.



Surface Statistics Report

Created: 2014-10-30

Reference model: cvm.TRM
Reference line: cvm.l3d
Measurement storage: slump0_400.geo
Result: Not OK

Point	Station	Side Offset	dHeight	Element code	N	E	H	Result
11	0/158,62	-1,980	-0,030		64 992,326	54 426,774	46,239	OK
12	0/158,82	-0,715	-0,018		64 991,070	54 427,023	46,281	OK
13	0/174,50	-1,155	0,017		64 992,103	54 442,675	46,196	OK
14	0/181,73	0,275	-0,012		64 990,948	54 449,952	46,144	OK
15	0/182,40	-1,045	-0,005		64 992,292	54 450,566	46,128	OK
16	0/200,47	2,530	-0,014		64 989,404	54 468,757	45,970	OK
17	0/247,22	-0,550	-0,008		64 994,253	54 515,367	45,734	OK
18	0/251,53	-0,990	-0,017		64 994,856	54 519,652	45,687	OK
19	0/278,10	1,045	-0,018		64 993,829	54 546,284	45,520	OK
20	0/278,48	-2,090	-0,013		64 996,976	54 546,541	45,496	OK
21	0/279,27	-2,640	-0,021		64 997,556	54 547,308	45,469	OK
22	0/281,09	-2,200	-0,025		64 997,185	54 549,143	45,465	OK
23	0/287,55	-0,055	-0,033		64 995,286	54 555,686	45,471	Not OK
24	0/311,27	0,550	-0,025		64 995,580	54 579,413	45,319	OK
25	0/326,53	-2,530	-0,025		64 999,236	54 594,545	45,174	OK

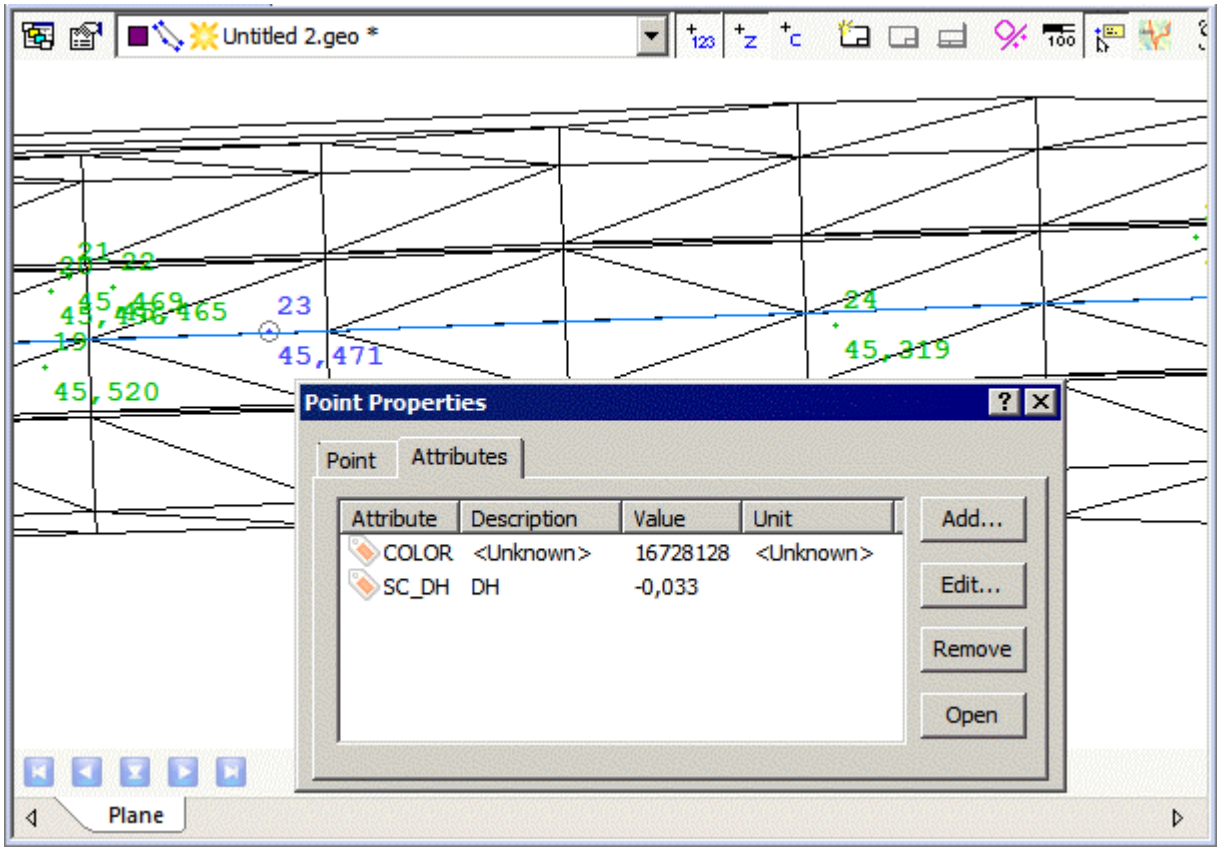
Result | Measurements

The tab Measurements in the Surface Statistics Report.

The tab **[Measurements]** in the report displays for each point the vertical height difference in relation to the terrain model. If a reference line[618] has been selected, chainage and side offset will be displayed.

Coordinate file

The program creates, in addition to a surface statistics report, a coordinate file for the measured points[617]. All points in the coordinate file get attributes with information about the height difference to the selected reference layer and also a color code based on the specified tolerance[618].



Coordinate file created from the surface statistics calculation.
The Point Properties dialog displaying a point's attributes is opened if you select a point in the graphics view, right click and select [Properties].

Height difference, measured point is located ...	Color
... too low	blue
... within the tolerance	green
... too high	red

Each measured point obtains a certain color, based on the height difference.

To display the attributes in the coordinate file, select a point in the graphical view, right click on the point and select **[Properties]** or display the attributes in the Attribute view, see Optional attributes[117]. See Program Settings[111] for information about selecting an attribute definition file.

See also: Optional attributes[113], Modify Terrain Model[686], Program settings[109], Terrain Models in General[638], Surface Statistics[597]

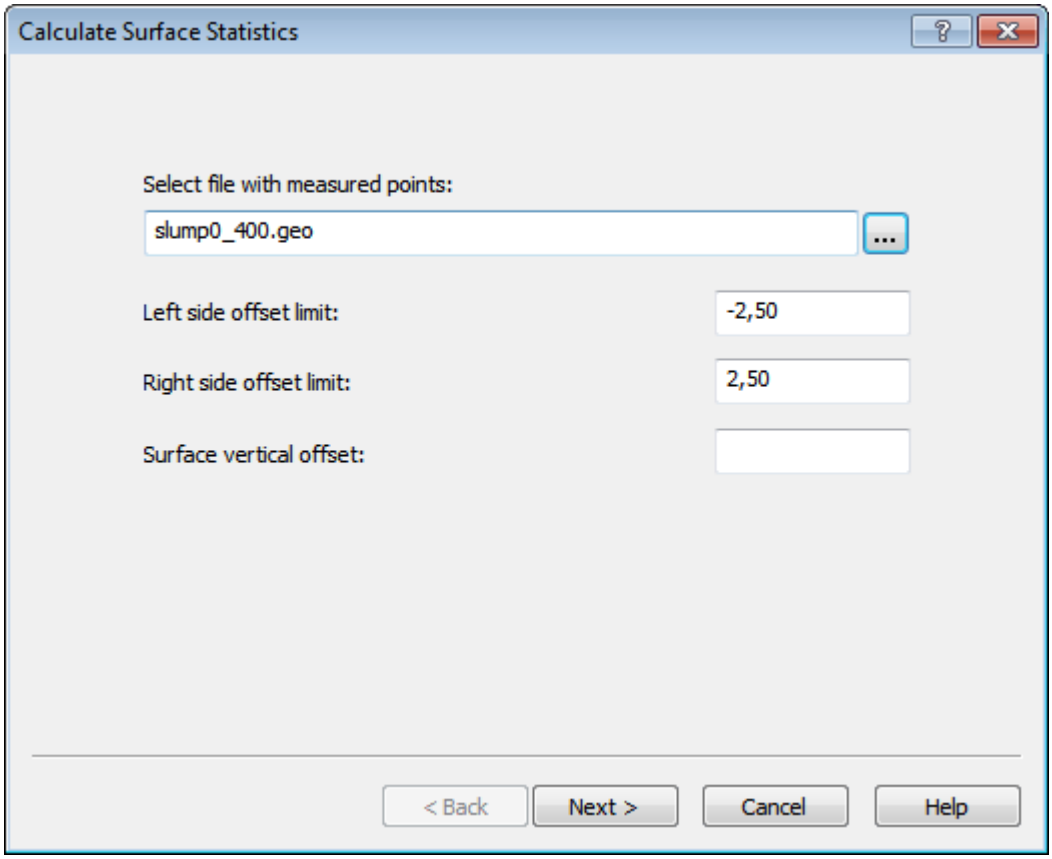
9.18.4 Surface Statistics with cross fall model, cfm

Use Surface Statistics to calculate height differences for measured points in relation to a cross fall model, cfm, and its connected road line. Open a cross fall model and select ***Data | Surface Statistics***.

When calculating surface statistics based on a cross fall model referencing to a center line, you get:

- vertical height differences relative to the theoretical cross fall model
- side offsets in relation to the associated road line

The surface statistics report presents statistics and absolute deviations from the reference surface. The estimated height differences are also presented graphically with color coding showing the height of each point with respect to the height of the cross fall model.



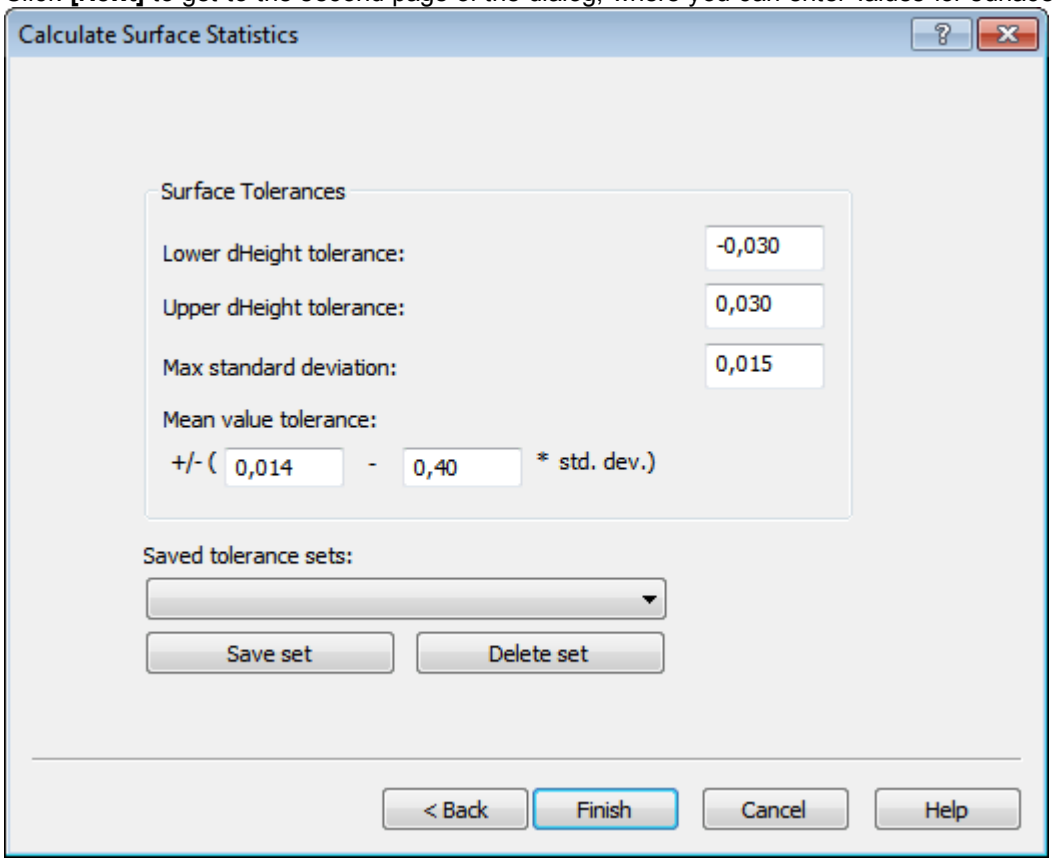
Surface statistics with cross fall model active.

- **Select file with measured points:**
  Select coordinate file to be compared with the active cross fall model. Enter the file name or click the browse button ... to select file.

- **Left side offset limit / Right side offset limit:**
  Enter side offset limit, negative for the left side and positive for the right side. Side offsets relate to the center line associated by the active cross fall model.
  Side offset limit excludes points that are outside the specified distance.
  If no side offset limit is specified, the program calculates height differences for all measured points622
  .

- **Surface vertical offset:**
  Here you can specify a vertical displacement of the surface of the road. This can be useful if you want to specify all height differences with a specific offset compared to the height given by the cross fall model.

Click **[Next]** to get to the second page of the dialog, where you can enter values for surface tolerances.



Example settings for surface tolerances.

Surface Tolerances

- **Lower dHeight tolerance:**
  Enter approved height difference for points located below the road structure level.
- **Upper dHeight tolerance:**
  Enter approved height difference for points located above the road structure level.
- **Max standard deviation:**
  Enter the maximum standard deviation of the measured height differences.
  This is a measure of the variance of measured points. Even if all height differences are within the defined lower and upper tolerance, the check of surface statistics can fail if the measured height differences are too scattered. See also Surface Statistics 597.
  If you leave this field blank, maximum standard deviation will not be used in the surface statistics check.
- **Mean value tolerance:**
  The mean value tolerance indicates how large the mean value of the height differences is allowed to be, i.e. how much the measured surface may deviate from the theoretical surface.
  Enter constants in the formula to calculate the mean value tolerance. The default values are recommended by the Swedish road authorities.
  If you leave these fields blank, mean value tolerance will not be used in the surface statistics check.

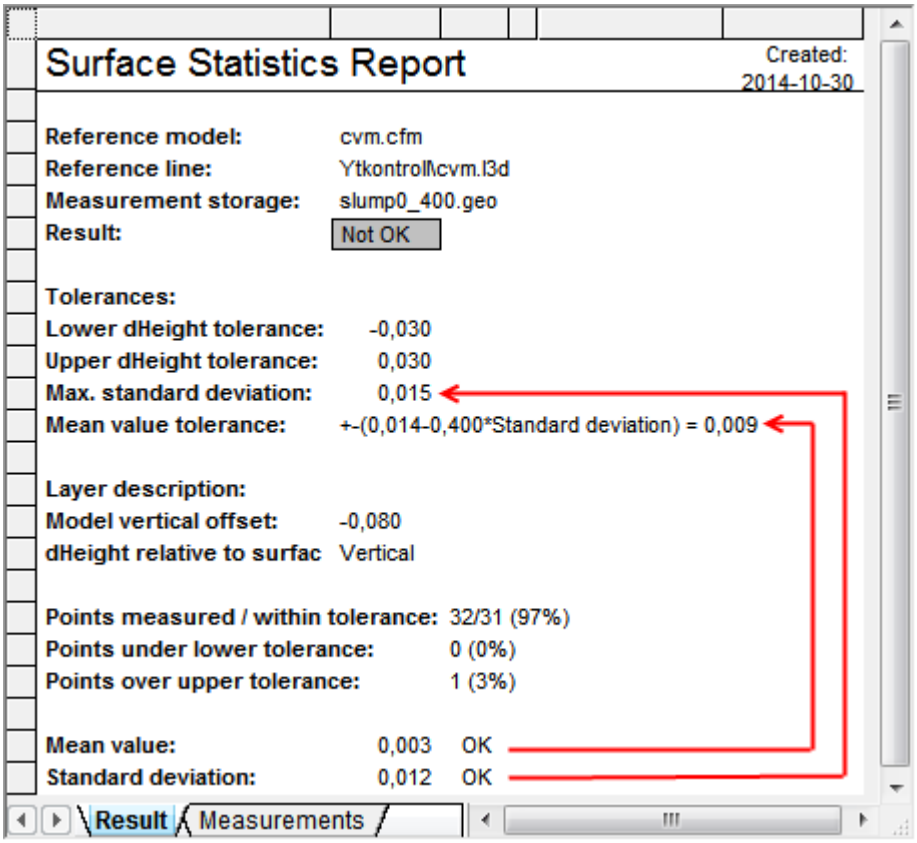
  For more information about max standard deviation and mean value tolerance, see Surface Statistics 597.

- **Saved tolerance sets:**
  If you have saved parameters for calculating surface tolerances you can use the dropdown menu to reuse saved tolerances.
  Click the button **[Save set]** to save the parameters for calculating surface tolerances.
  Click the button **[Delete set]** to delete a set of saved parameters for calculating surface tolerances.

Click the button **[Finish]** to calculate surface tolerances.

Surface Statistics Report

The program creates a surface statistics report and a coordinate file that graphically and numerically displays the calculated height differences.



The tab Result in the Surface Statistics Report.

The report is divided into two tabs, where the first tab [Result] shows a summary of the surface statistics. The result from the surface statistics is accepted only if all the points in the surface statistics are approved.

Reference model	Name of the file with the theoretical surface from which surface statistics have been calculated.
Reference line	Stated line is linked from the cross fall model.
Measurement storage	Name of the file with the measured points.
Result	The result of surface statistics is only approved if all measured points are within the tolerance.
Tolerances	If you have used a calculation formula for tolerances, which you have named, the name of the used tolerance set is displayed here.
Lower dHeight tolerance	Specifies the lower maximum tolerance in height for measured points.
Upper dHeight tolerance	Specifies the upper maximum tolerance in height for measured points.
Max. standard deviation	Specifies the selected standard deviation.
Mean value tolerance	Specifies the selected mean value tolerance.
Layer description	Not used for surface statistics with cross fall model. Only used when calculating surface statistics for mass descriptions 600 and stringline models 609 .
Model vertical offset	Specifies any selected height displacement 622 of the surface.

dHeight relative to surface	Height differences are always calculated vertical to the reference surface created by a cross fall model.
Points measured / within tolerance	Total number of measured points, relative to the number of points within the specified tolerance. These points are marked with green icons in the graphics.
Points under lower tolerance	Number of points below the specified tolerance. These points are marked with blue icons in the graphics.
Points over upper tolerance	Number of points above the specified tolerance. These points are marked with red icons in the graphics.
Mean value	Specifies the calculated mean value for measured height differences. The value is compared to the specified M*ean value tolerance*.
Standard deviation	Specifies the estimated standard deviation for measured height differences. The value is compared to the specified *Max. standard deviation*.

Description of information in the first tab of the surface statistics report; Result.

Surface Statistics Report

Created: 2014-10-30

Reference model: cvm.cfm
Reference line: Ytkontroll\cvm.l3d
Measurement storage: slump0_400.geo
Result: Not OK

Point	Station	Side Offset	dHeigh	Element code	N	E	H	Result
1	0/058,45	0,880	0,019		64 985,674	54 326,784	48,787	OK
2	0/067,15	0,550	-0,007		64 986,333	54 335,463	48,456	OK
3	0/074,92	-0,110	0,000		64 987,287	54 343,203	48,193	OK
4	0/090,14	2,090	-0,003		64 985,665	54 358,500	47,620	OK
5	0/117,73	-0,495	0,014		64 989,293	54 385,971	46,933	OK
6	0/124,25	1,980	0,013		64 987,067	54 392,579	46,757	OK
7	0/128,56	1,540	0,012		64 987,670	54 396,864	46,683	OK
8	0/136,06	-0,825	0,004		64 990,317	54 404,268	46,562	OK
9	0/144,97	0,220	0,011		64 989,610	54 413,217	46,452	OK
10	0/150,05	-0,880	0,012		64 990,902	54 418,247	46,374	OK
11	0/158,62	-1,980	-0,008		64 992,326	54 426,774	46,239	OK
12	0/158,82	-0,715	0,004		64 991,070	54 427,023	46,281	OK
13	0/174,50	-1,155	0,037		64 992,103	54 442,675	46,196	Not OK
14	0/181,73	0,275	0,008		64 990,948	54 449,952	46,144	OK

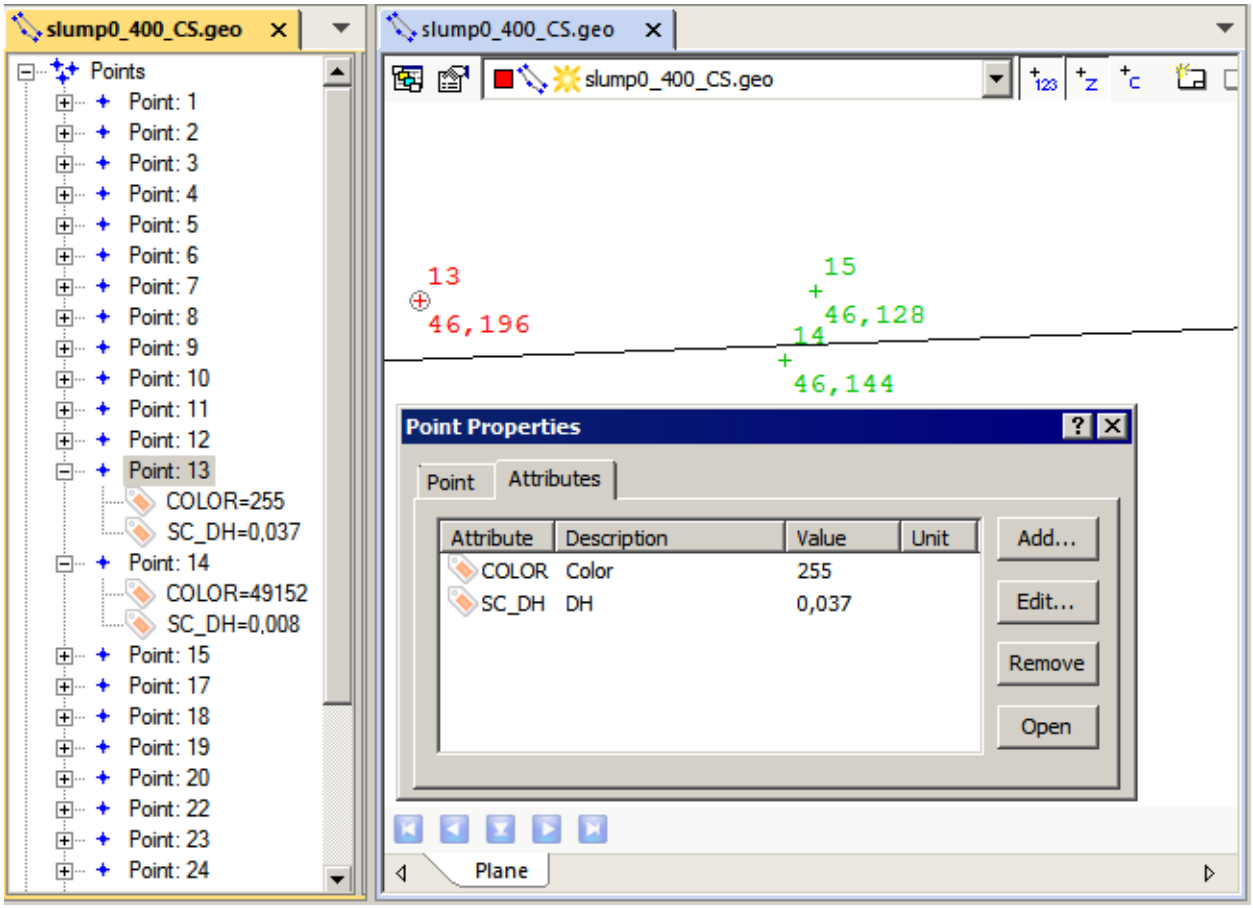
Result | Measurements

The tab Measurements in the Surface Statistics Report displays measuring results for the measured points.

The tab **[Measurements]** in the report displays for each point station, side offset and height difference in relation to the height of the road.

Coordinate file

The program creates, in addition to a surface statistics report, a coordinate file for the measured points[622] . All points in the coordinate file get attributes with information about the height difference to the selected layer and also a color code based on the specified tolerance[623] .



Coordinate file created from the surface statistics calculation.
The Point Properties dialog displaying a point's attributes is opened if you select a point in the graphics view, right click and select [Properties].

Height difference, measured point is located ...	Color
... too low	blue
... within the tolerance	green
... too high	red

Each measured point obtains a certain color, based on the height difference.

To display the attributes in the coordinate file, select a point in the graphical view, right click on the point and select **[Properties]** or display the attributes in the Attribute view, see Optional attributes 117 . See Program Settings 111 for information about selecting an attribute definition file.

See also: Optional attributes 113 , Program settings 109 , Surface Statistics 597 , Lines in Three Dimensions 503

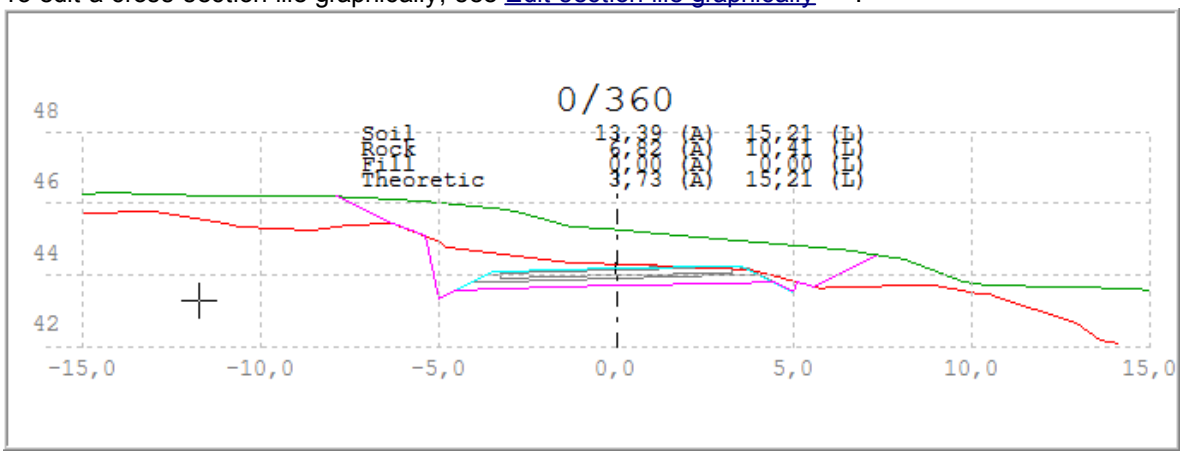
9.19 Cross Section Files, Sec

Cross Section Files is a format that can store all types of cross-sectional data. Cross section files, with the format sec, may contain information that comes from a volume calculation, terrain-sectioning or road line calculation.

A cross section document contains a section object for each cross section in the file. Each section object can be divided into one or more layers, for example, soil and rock. The division into multiple layers is used primarily if the section document has been created from a volume calculation689, otherwise only one layer per section is often used.
Each layer may contain a number of section points including defining the offset, height and code.

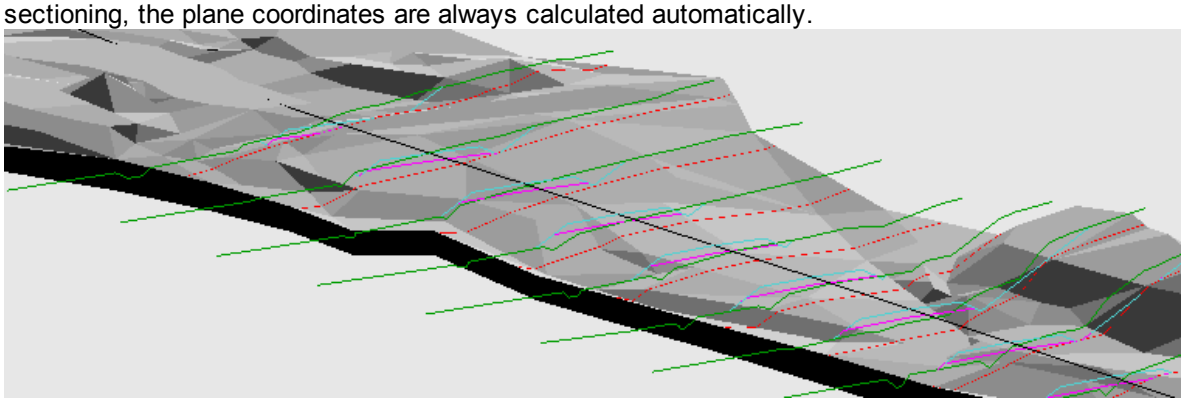
Section files can be displayed in a number of different views:

- Graphical view
  This is the standard view for cross sections. In the graphical view, one of the cross sections of the document is shown. You can move between sections by using the buttons for section stepping, .
  To edit a cross section file graphically, see Edit section file graphically245.

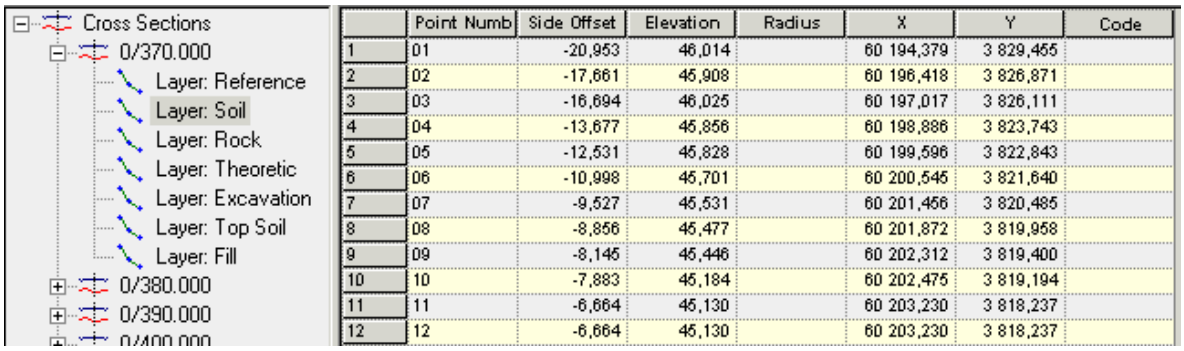


  If the plane coordinates are available in the document, the sections can also be displayed along with the plane data.

- Graphical 3D View.
  Here you can see the cross sections three-dimensionally in the document. A prerequisite for this view is that the plane coordinates are available in the document. For volume calculation and terrain sectioning, the plane coordinates are always calculated automatically.



- Numerical view (tree view)
  Use the numerical view to edit specific data in the document. The window is divided into a tree view showing the available cross sections with the layers and an input view showing the section points in the selected layer in the tree view.



	Point Numb	Side Offset	Elevation	Radius	X	Y	Code
1	01	-20,953	46,014		60 194,379	3 829,455	
2	02	-17,661	45,908		60 196,418	3 826,871	
3	03	-16,694	46,025		60 197,017	3 826,111	
4	04	-13,677	45,856		60 198,886	3 823,743	
5	05	-12,531	45,828		60 199,596	3 822,843	
6	06	-10,998	45,701		60 200,545	3 821,640	
7	07	-9,527	45,531		60 201,456	3 820,485	
8	08	-8,856	45,477		60 201,872	3 819,958	
9	09	-8,145	45,446		60 202,312	3 819,400	
10	10	-7,883	45,184		60 202,475	3 819,194	
11	11	-6,664	45,130		60 203,230	3 818,237	
12	12	-6,664	45,130		60 203,230	3 818,237	

Older formats
Previous versions of iCON office create cross-sectional files of different types at different times. These files will be treated as sec files when loading:

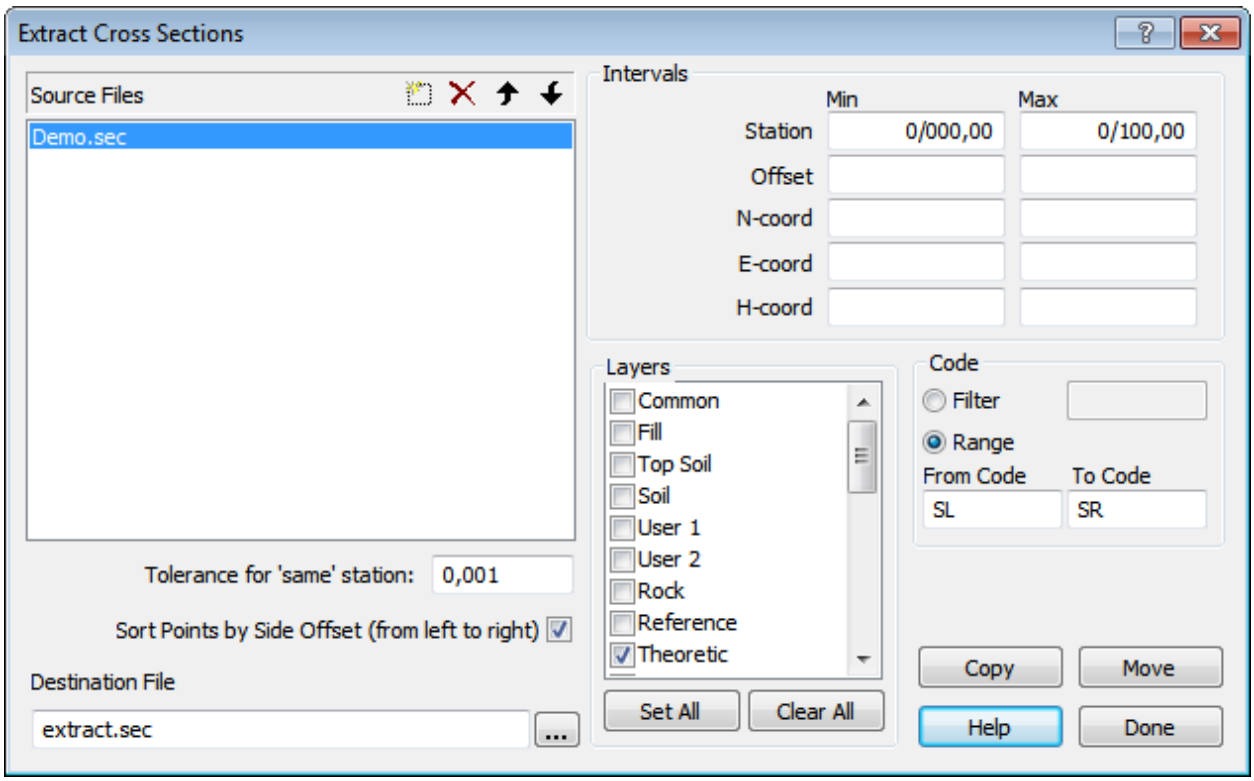
- Complete section data, ksd files
  Created for volume calculation.
- Terrain sections, tsd files
  Created for sectioning of a terrain model.
- Local section data, lsd files
  Created from certain road line functions etc.
- Tunnel terrain sections, tts files
  Contains surveyed tunnel sections.

When you choose to save a cross section file, you can select to save it in one of these older formats. However, this means that some information will be lost.

See also Graphical Views 47 , Edit section file graphically 245 .

9.20 Extract Cross Sections

This function moves or copies points from one or more source files to a destination file. Different filters can be set for the points to be moved/copied. Select ***Function | Extract Sections*** to open the dialog. The function works directly with files on the hard drive and therefore cannot be undone.



Files

Source files:
Specify the files you want the function to look for points in..

Tolerance for the "same" section:
Specify how much distance a point may be from a given section to still be included.

Sort points according to offset (from left to right)
If this option is selected, the points will be sorted from left to right according to offset. Otherwise, points are presented in the order they are measured.

Destination file:
Enter the file in which the extracted points are to be saved.

Point Selection

Interval:
Here you can specify the maximum and minimum values for the point's section dimension, offset and coordinates. Unless otherwise specified, all points are included.

Layer:
Check the layers to be included in the extract. The button **[Set All]** selects all layers and the button

[Deselect all] deselects all.

Code

Filters:
Filters items by code, wild cards such as * and ? can be used. If no code is specified, all points are included.

Range:
Here you can load the points that lie between certain codes in each section; enter the limit codes. The function starts from the left of each section and extracts points from the point that has the code specified under 'Source Code' and ends when the point with the code specified under 'Destination Code' is found.

If in a standard section you have coded elements such as roadside with SL (RoadSide Left) and SR (RoadSide Right) and you then want to extract everything that lies within the roadway, you can set SL 'as FromCode and VKH as 'To Code / Destination Code' in order to achieve this. You can also enter the same code in both fields if the code is used on both sides.

Function keys

[Copy]:
Click here to copy the selected point from the source files to the destination file.

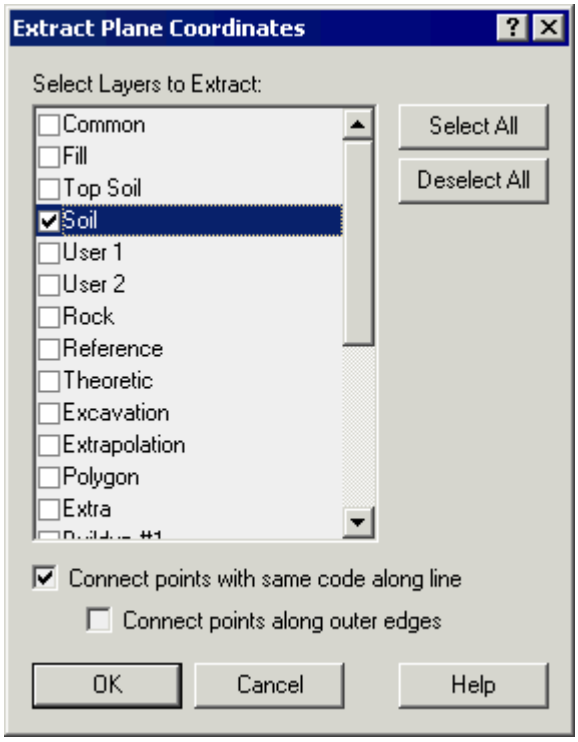
[Move]:
Click here to move the selected points from the source files to the destination file. Points will then be deleted from the source files.

[Done]:
Closes the dialog.

See also: Cross Section Files, SEC 627

9.21 Extract Plane Coordinates from Cross Sections

This function extracts the plane coordinates from a cross section file. The file must contain the calculated plane coordinates. Plane coordinates are obtained when calculating the volume of a mass calculation, mbs file, and when calculating cross sections from a terrain model. Open the cross section file and select ***Data | Extract Plane Coordinates*** to open the dialog.



Layers to extract
Check the layer or layers from which the plane coordinates are to be loaded from.

Connect the points using the same code along a line
This option means that the points with the same code are connected together longitudinally between the sections. By setting codes for the elements in the standard section in a mass calculation, you can use this function to get longitudinal lines for objects such as roads. Lines are connected separately for the left and right side, i.e. even if the same point code is used on both the left and right sides, the lines that cross the center line are not connected. If a certain code is temporarily missing in a section, there will be a break in the line.

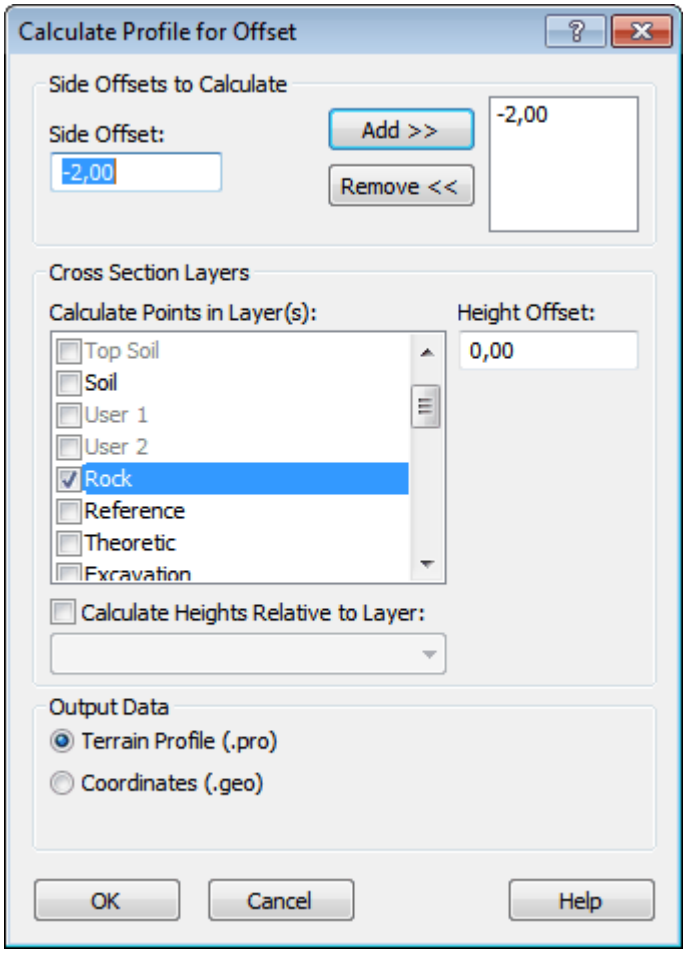
Connect the points along the outer edges
Connecting the outer points of each station.

If the plane coordinates are to be used to create a terrain model for a given layer in the cross section file, you may want to interconnect the points in the longitudinal direction as this will eliminate the irregular triangles that cut across the stations. By connecting the outer edges, you can eliminate the triangles outside the area in question. By using the function Extract Cross Sections 629 you can extract a portion of the cross sections.

See also: Cross Section Files, SEC 627 and Extract Cross Sections 629 .

9.22 Calculate Profiles from Cross Sections

You use this function to calculate one or more profile lines from cross-sectional data. You decide at which offset or offsets the calculation is to be made and through which layer in the section file you want to have the profile. iCON office calculates the height of the intersection between the layer and offset. Open the cross section file from which the calculation is to be made and select ***Data | Calculate Profile for Offset***.



Side Offsets to calculate through

You select here the offset or offsets the calculation is made from.

Offset

Enter the offset, negative for the left side and positive for the right side of the center line. Click **[Add >>]** to add the offset to the calculation list. Delete offset from the list using the button **[Remove <<]**.

Cross section layer

Calculate points from the layer

Select the layer or layers calculation is to be made from. iCON office calculates the intersection with these layers for the selected offset. If you select more than one layer, you can only save the results as terrain profile data.

Height offset

By specifying a height offset, you can displace the profile vertically.

Calculate the heights relative to another layer

You have the option of calculating the difference between the two layers, specify the second layer here in this case. The result then is the height of the first layer (+offset) - the height of the second layer.

Output data

Enter the format for output data. If you select terrain profile or coordinates, multiple profiles can be calculated simultaneously to a file for different offsets.

See also Cross Section Files, Sec 627 , Terrain Profile, Pro 662 , Coordinate Files, Geo and Pxy in General 153

10 Pipe

10.1 Pipe Profile, PRW

Pipe profile data files, prw files, contain vertical information on pipes. The pipes are divided into elements that describe straight lines or arcs. This document may contain one or more lines (center line and several side lines). Each line may contain several layers, where each layer is a line representing the ground surface or a pipe for example, water or gas.

Structure

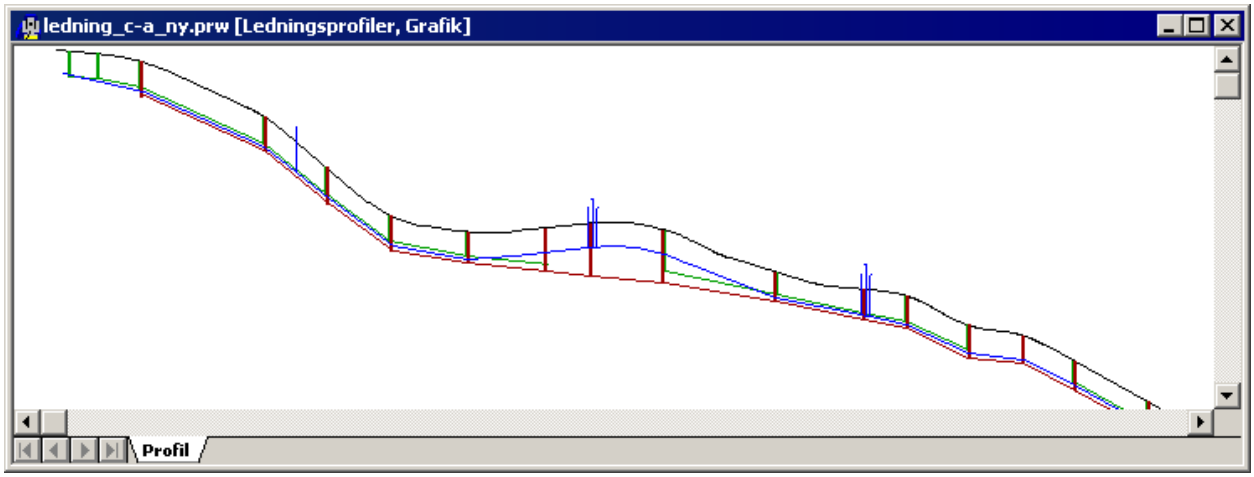
Each element in the pipe contains the following data:

- Point number
  Identifies the element.
- Station
  Length station of the element's start point.
- Height
  Height of the element's start point.
- Radius
  Radius of the element's start point. Positive radius gives a line that has its center point over the arc , while a negative radius gives correspondingly a center point below the line .
  Tip: a positive radius for a contour is in the form of a "happy mouth", while negative curvature is a "sad mouth".
- Code
  Code for the point.
- N
  Specifies the point's N coordinate.
- E
  Specifies the point's E coordinate.
- Line
  Draws a line from each checked point to the next point. If the box is not checked, this is shown graphically as a break in the line.
- and a number of attributes
  The columns for attributes vary depending on the attributes 113 definition file the user has selected. Using the attribute definition file *standard.atr* you gain access to the attributes Well Type, Dimension, Pipe Type, Device Type, Ground Type and Soil Type/Foundation.

Select ***Edit | Preferences*** to select an attribution definition file. If you want to make your own attribute definitions, you should make a copy of the attribute definition file (for example, *standard.atr*) and save it with a different name, as the predefined attribute definition files are overwritten every time you reinstall iCON office.

The figure below shows a pipe profile with wells and valves.
Wells are colored and drawn up to the surface based on the layers to which they belong.
Device Types such as valves and fire hydrants are drawn as thin lines just above the ground surface. If you have the code file *sbg2.cod* selected and enter the code VA_VBP in the column for the device, the associated symbol for the fire hydrant will be drawn.

If you add the pipe profile to a pipe profile drawing you can print Dimension, Pipe Type, Ground Type and Soil Type/Foundation in the drawing form, see also Create Pipe Profile Drawing 260.



Examples of pipe profile with wells and valves.

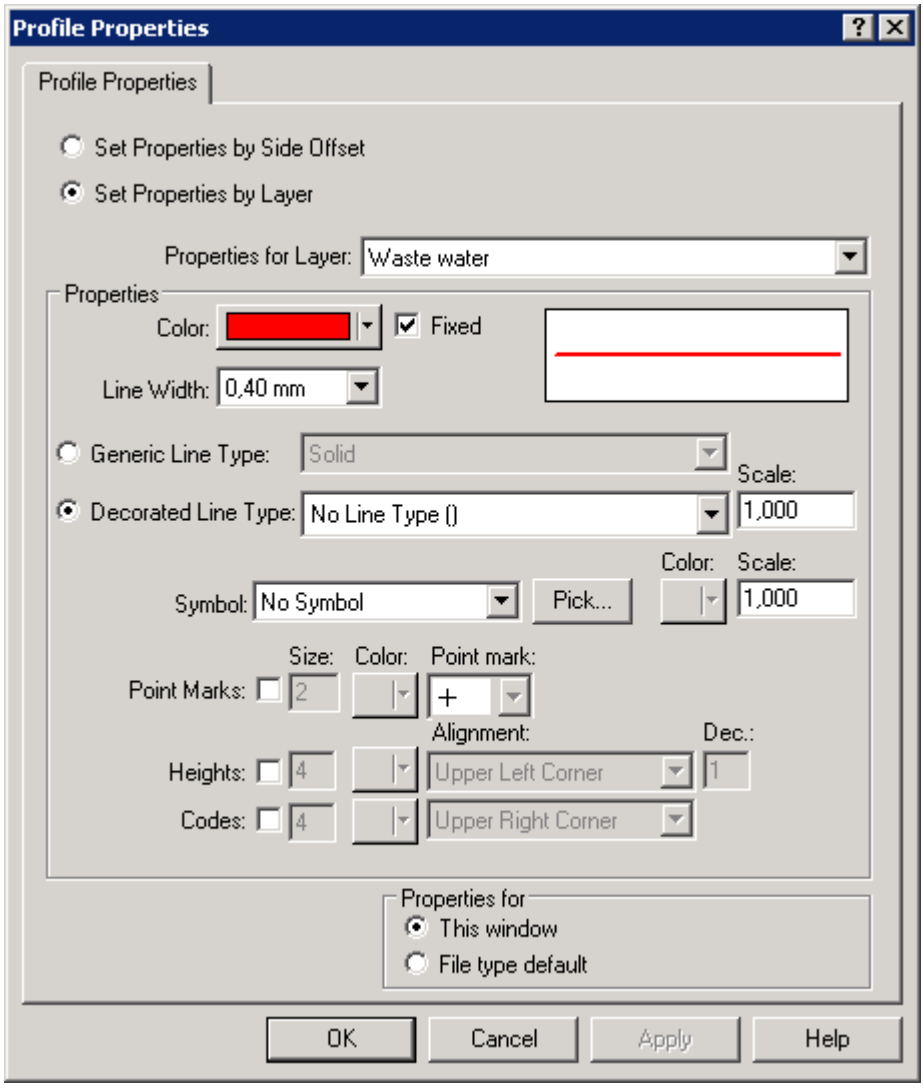
Views

To toggle between the graphical and numerical views for pipe profiles, go to ***Views | Graphical view*** or ***View | Numerical View*** or use the icons or .

- Graphical View
  Shows the pipe profile graphically with its constituent lines, this is the default view for the pipe profile document. If the pipe profile contains plane coordinates (N, E), you can also visualize it in the plane view.
  - Plane
    Only visible if the line contains plane coordinates.
  - Profile View
    Default view for the pipe profile.
- Numerical View
  Shows an input window with the pipe profile's element represented on individual lines.

Edit, Graphical view

Click or select ***View | Document Properties*** to edit the graphic display of the pipe profile.



- Set properties for offset
  Properties for the graphics depend on the offset; the center line is drawn in one color and the side lines in other colors.

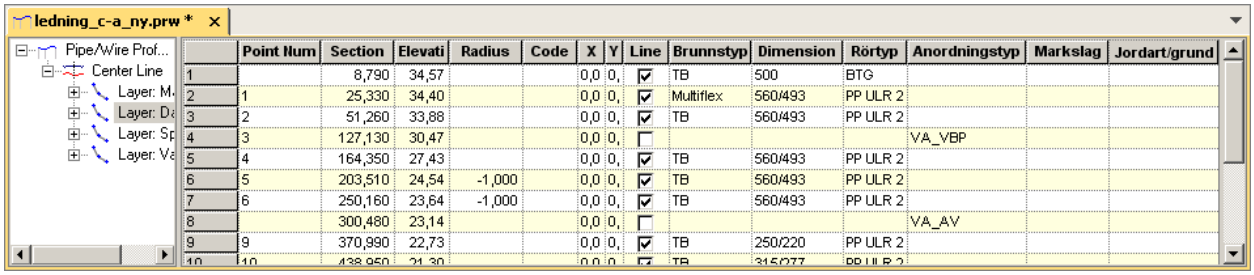
- Set properties for layers
  Properties for how the graphics are drawn will vary depending on the layer the points are in. Constituent layers are shown in different colors.

- Properties
  - Colors
    Select color.
  - Line Width
    Determines the line width of the drawn lines. Note that the line widths do not have any effect on the screen but are only used for printing.
  - Single line type
    Select line type. With this option you can get the graphical layout of the line to be clearly visible on your computer screen.
  - Decorated Line Type, Scale
    Choose from predefined line types that may also consist of symbols. Scale for the line type is

used primarily for printing.
Pre-defined line types for pipe profiles are available, see Project Settings 16 to select, for example, *sbg2_proj.glt* as active line type file.

- Symbol Color, Scale
  Here you can select the symbol for the points included in the pipe profile.
- Point Marks
  Check this box to graphically visualize the points included in the pipe profile.
- Heights
  Check this box to graphically visualize the heights entered in the pipe profile.
- Codes
  Check this box to graphically visualize the codes entered in the pipe profile.

Numerical View



	Point Num	Section	Elevati	Radius	Code	X	Y	Line	Brunnstyp	Dimension	Rörtyp	Anordningstyp	Markslag	Jordart/grund
1		8,790	34,57			0,0	0,	☑	TB	500	BTG			
2	1	25,330	34,40			0,0	0,	☑	Multiflex	560/493	PP ULR 2			
3	2	51,260	33,88			0,0	0,	☑	TB	560/493	PP ULR 2			
4	3	127,130	30,47			0,0	0,	☐				VA_VBP		
5	4	164,350	27,43			0,0	0,	☑	TB	560/493	PP ULR 2			
6	5	203,510	24,54	-1,000		0,0	0,	☑	TB	560/493	PP ULR 2			
7	6	250,160	23,64	-1,000		0,0	0,	☑	TB	560/493	PP ULR 2			
8		300,480	23,14			0,0	0,	☐				VA_AV		
9	9	370,990	22,73			0,0	0,	☑	TB	250/220	PP ULR 2			
10	10	438,950	21,30			0,0	0,	☑	TB	315/277	PP ULR 2			

By right-clicking a layer in the tree you can change the layer and also the text that defines the layer. In the figure above you can, for example, change the text *Line 1* to *gas pipeline*.

Edit, numerical view

- Add to pipe profile line
  From the pipe profile tree, you can add side lines to the center line.
  Right-click 'Pipe Profiles' at the top of the tree and select "Add Pipe Profile Line...". Enter an offset for the new pipe profile. You can add an unlimited number of side lines.
- Add layer
  Right-click a file in the tree and select "Add layer". Specify for which layers the line is to apply: Ground Level, Surface Water, Wastewater, Water, Combined. The four types of water pipelines are divided into three groups; projected and existing pipes and pipes to be removed (discontinued).
  You can also name your own layers that are entered in the document, such as gas pipeline.
- Add attribute
  Enter directly in the column, or right-click on a point number in the tree and select "Properties".

For each line contained in a document for pipe profiles, iCON office automatically creates a layer representing the surface.

See also Program Settings 109, Attributes 113, Graphical Document Properties 52, Creating Profile Drawings 260.

11 Terrain Model

11.1 Terrain Models in General

A terrain model is a digital representation of an area, such as a land surface, an excavation bottom, a lake bed or similar. A terrain model consists of an irregular network of triangles between points where each triangle is considered as a plane surface. Points, together with lines between points, are input data when creating the terrain model. Points can be measured in the terrain, for example, with a total station or echo sounder, but can also be theoretical points from a drawing or suchlike. Terrain Models in iCON office are the file type trm.

Applications
You can use the terrain model to calculate areas and volumes for different objects using the function Volume Calculation, Terrain Model[667]. Using this function you can also create difference models[675] . The difference model[675] is a terrain model that describes the difference between two other models.
Other applications for terrain models are the creation of contour lines[657] , terrain sections[659] and terrain profiles[661] .
The terrain model is also useful for the visualization of various objects, such as the display of the terrain in a 3D window[80].

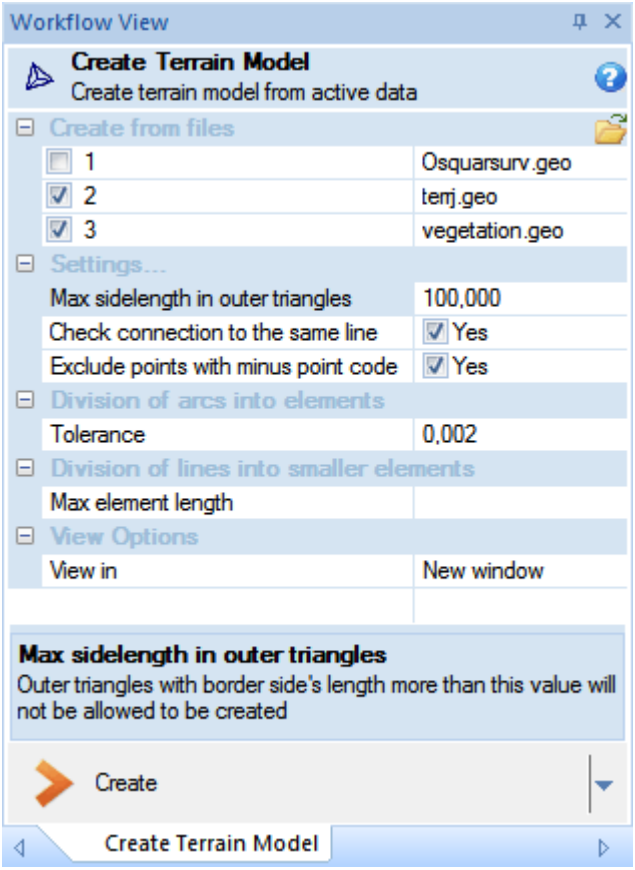
Input data
The terrain model is created from points and lines from one or more Coordinate Files[153] . The model's consistency with the objects it is to describe is entirely dependent on these points and lines. As the points are connected to plane surfaces, the terrain model is a simplification of the described object, and only in the points can you be certain that the model corresponds exactly to the object. It is therefore important to select the positions and number of the points to ensure that they correctly represent the object in question. In areas with many variations in height, the points should be placed closer together, while the planer surfaces can be represented adequately using only a few points. Points should always be placed in the object's extreme points, such as ridges, tops, bottoms, and pits.

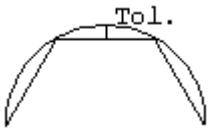
Break Lines
An additional method of controlling terrain models that better represent objects is to use break lines[650]. All lines in the used coordinate documents are considered in the calculation as break lines[650] which affects the calculation to the extent that lines will always be triangle sides in the terrain model. This means that the lines appearance is guaranteed to be preserved in the model.
The lines must be located to ensure they describe the line shaped phenomenon of the objects, such as road curbs, slope crests and ditch bottoms. The use of break lines[650] prevents faults in the model that might otherwise be difficult to predict, such as triangle surfaces that cut across a ditch, or long smooth slopes that are broken down. As the break lines[650] become visible in the finished terrain model, it will be even easier to identify with the model.

See also: Creating Terrain Models[639] , Volume Calculation, Terrain Model[667], Difference Models[675] , Contour Lines[657] , Terrain Sections[659], Terrain Profiles[661]

11.2 Create Terrain Models

To create a new terrain model select ***File | New | Terrain Model Documents | Terrain Model (TRM)***.
You can also create a terrain model from an open coordinate file[118], select ***Data | Create Terrain Model***.
Use the workflow view to select settings for the terrain model.



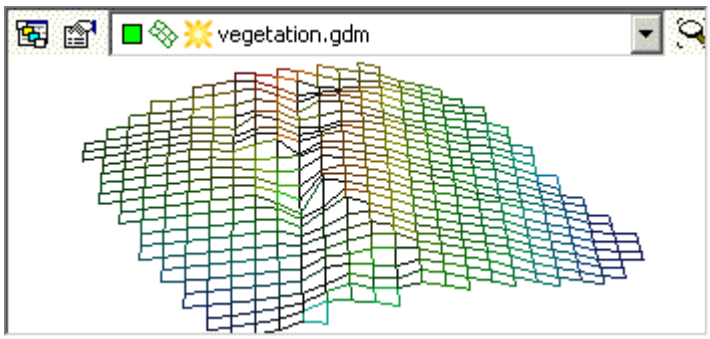
Create Terrain Model	You create a terrain model from one or more Coordinate Files[118] .
Create from files	If one or several coordinate files are opened in the graphical view, these files will be displayed here, otherwise the list will be empty initially. Click to add files to the list. You can select coordinate files of the type geo and pxy for this calculation. Select the files that should be used to create the terrain model. Disable any files that should be excluded from the calculation. Note that points with no height coordinate will be excluded from the terrain model.
Settings	
Max side length in outer triangles	You can use this function to create a terrain model from the data that describes an area where the outer edges curve inwards. Triangles that have a side longer than the specified value and where one side constitutes the outer edge of the terrain model will be removed. The process is repeated until the model's outer edge is made up exclusively of triangles with all three sides shorter than the specified value. By selecting an appropriate value, most triangles that cross the inward bends, and therefore lie outside the actual model area, will be removed when calculating. You can remove any unwanted triangles remaining in the terrain model manually using the Editing Tools[653]. If no value is entered, the terrain model is left untouched.
Check connection to the same line	If you select this function when creating the terrain model, no triangles where all three points have the same break line[650] will be created. Note, however, exceptions can be made if there are no other options, such as a triangle will be created from three points on the same break line if there would be a hole in the terrain model otherwise.
Exclude points with minus point code	If you check the box **[Yes]**, points in coordinate files with a point code beginning with a minus sign (-) will be excluded from the terrain model. Deselect the box **[Yes]**, to activate **[No]**. All points with a height coordinate will be included in the terrain model, regardless a minus sign in the point code.
Division of arcs into elements	As the terrain model only contains straight lines, circles and arcs must be divided up into a number of shorter, straight elements. This is done automatically.
Tolerance	The tolerance indicates the maximum permitted difference between the position of the arc and the straight sections that are created. The smaller the tolerance you set, the more straight sections there are. See the figure below, where the tolerance is set using **Tol.** 
Division of lines into smaller elements	
Max element length	To avoid very long and narrow triangles being formed, you can set a maximum dimension for the length of the elements in the break lines. If any element is longer, it will automatically be split into several sections.
View options	
View in	Use the dropdown menu to select if the new terrain model should be displayed in: ○ Active window - same window as the coordinate file(s) ○ New window - new window opens, separated from the coordinate file(s)

See also: Terrain Models in General[638]

11.3 Create Grid Models

Grid Model, short description

A grid model (sometimes also called "modify model") can be said to be a copy of a terrain model, where the surface is represented by many grid cells with heights.



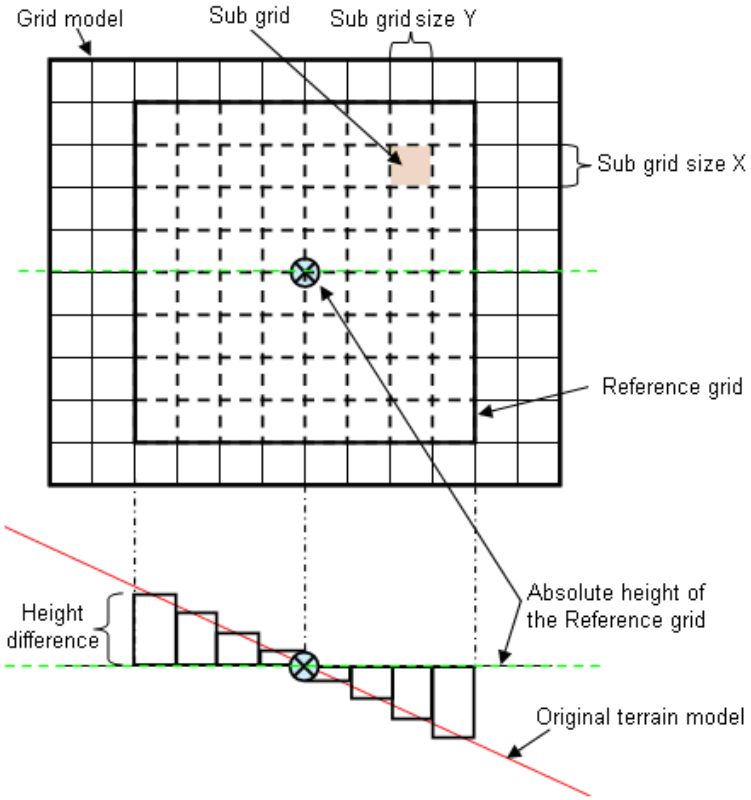
Grid models are mainly used by iCON 3D, UMC3D and GeoROG, where they can be applied as modification models.

- A grid model can be seen as a record of the surface created by a machine.
- A grid model is often updated in real time while the machine is working.
- In most cases the lowest height in each grid cell is updated.

Read the text below to get information about:

- the differences between grid cells, reference grids and grid model 643
- how to create a grid model from a terrain model 643
- reduce the storage size 646 of a grid model
- how to create a point cloud from a grid model 646
- how to use a grid model in a volume calculation, terrain model 646

Grid model and grid cells

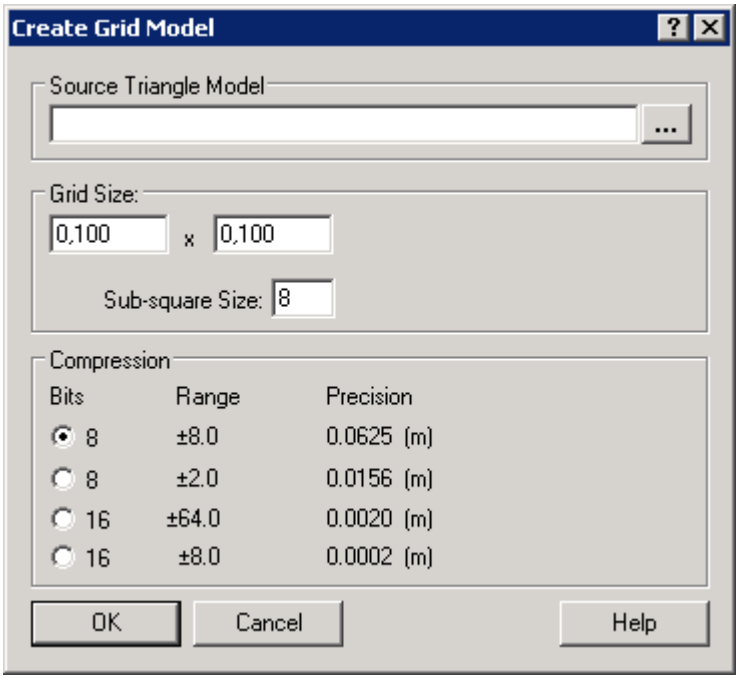


A grid model is constructed from a number of reference grids, which in turn are made up of several grid cells:

- The absolute height of the reference grid is stored in the reference center point.
- Each grid cell has a a delta height value related to the absolute height of the reference grid.
- Each grid cell is only included in one reference grid.

Create a Grid Model from a Terrain Model

To create a grid model from a terrain model, go to ***File | New | Terrain Model Documents | Grid Model (gdm)***.


Create Grid Model
Source Triangle Model
...
Grid Size:
0,100
x
0,100
Sub-square Size:
8
Compression
Bits
Range
Precision
8
±8.0
0.0625 (m)
8
±2.0
0.0156 (m)
16
±64.0
0.0020 (m)
16
±8.0
0.0002 (m)
OK
Cancel
Help

Select Terrain Model	Select terrain model that the grid model should be created from. Use the browse button ... to select file.
Grid size	Enter the side length of each grid cell in the grid model. - Smaller grid cells give a closer range of heights, but the lager amount of data makes the model more heavy to calculate in iCON 3D, UMC3D and GeoROG. - If the model is to be used by an excavator, you should take into account the size of the bucket, when selecting the size for the grid cells, to avoid creating grid models with unnecessarily many grid cells.
Grid cells in each reference grid	Enter how many grid cells each reference grid 643 is to be made up of. If the value 8 is specified, this means that each reference grid will contain 8x8 grid cells.
Compression	Select Range and Precision to compress the grid model, in order to create a model that is not too complex to handle. Note, the unit of Range and Precision is always given in meters, no matter selected unit of length in Project Settings 17 in the Project Tree.
Range	Specifies how much the height in each grid cell may differ from the reference grid's absolute height in the grid model. If for example, the range is set to ± 8.0 m, this means that the maximum height difference in the 'small grids cells' that are included in the reference grid can be eight meters higher or lower than the absolute value of the current reference grid. If nevertheless a point is higher than permitted by the range, the height will still be limited by the selected range.
Precision	Specifies the height difference at which the height is updated for each grid cell. If the precision is set to 0.0625 m, for example, this means that the height of the grid cell will be updated each time the height difference is multiples of 6.25 cm.

Reduce the size of a grid model	A large grid model can be heavy to handle and calculate. You can reduce the size of a grid model if you: • Select larger size of each grid cell. • Include several grid cells in each reference grid. The more grid cells included in each reference grid, the fewer reference surfaces are needed to be created and thereby fewer absolute values need to be stored. • Select a suitable compression method: The lower the precision, the smaller the grid model, i.e. a 0.0625 m precision gives a smaller model to calculate than if the precision is set to 0.0002 m. For the range 8.0 m, the heights can differ ± 8.0 m from the absolute value of each reference grid, and this gives a smaller model to calculate than if the range is set to ± 64.0 m.
Create a point cloud from a grid model	It is possible to create a point cloud from a grid model, see Create Point Cloud 759. Then you can use all tools and filter options that are available for point clouds on your data.
Grid model in Volume Calculation, Terrain Model	See Volume Calculation, Terrain Model 667 for details on how a grid model can be used for volume calculation.

See also: Terrain Models in General 638, Project Settings 16, Creating Terrain Models 639, Volume Calculation, Terrain Model 667, Create Point Cloud 759

11.4 Convert and Export Grid Models

Grid Model Conversion

A grid model (sometimes also called "modify model") used in iCON office is saved in our internal format, gdm.
Read the text below to get information about:

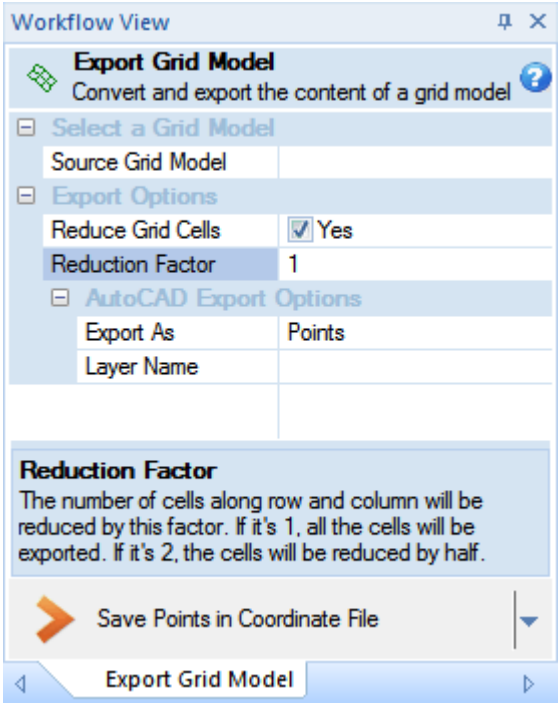
- How to convert a grid model to a coordinate file, geo.
- How to convert a grid model into a more common format, e.g. AutoCAD® file format dwg or dxf.
  You can then send the converted file to external stakeholders that might not be iCON office users.

Open Workflow View to convert a Grid Model

To convert a grid model:

- Select ***Functions | Grid Model Conversion***.
- In the workflow view, you can:
  - Select if you want to reduce some of the grid cells 647 .
  - Select AutoCAD export options 648 .
    - Note, the selected alternative only affects the resulting AutoCAD file.
  - Select format of the resulting file 648 .
    - You can save points from the grid model in a coordinate file.
    - If you save the grid model in AutoCAD file format, you have the option to export points either as points, triangle surface or grid surface.

Workflow View



Workflow View, Select a Grid Model

Select a grid model to be converted.

Workflow View, Export Options, Reduce Grid Cells

As a grid model consists of several reference grids 643 , where each reference grid includes several grid cells and each grid cell has its own height difference value, the amount of data in a grid model can be quite heavy.

If you want to reduce the size of the resulting file[648], e.g. the coordinate file, you can reduce the number of grid cells[648].
Select if you want to reduce grid cells or not.

- ☐ No
  If the alternative **[No]** is selected, all grid cells in the grid model will be included in export.
  If the grid size is set to 0.100 m and all grid cells have their own height value, that is no grid cells are reduced, the resulting file can be very large.

- ☑ Yes
  Check the box **[Yes]** if you want to reduce some of the grid cells. The reduction factor[648] is given in the next row in the workflow view. Thus the size of the exported file will be reduced.

Workflow View, Export Options, Reduction Factor

If you want to reduce the size of the converted file, select an appropriate number of cells to be reduced.
The option ***[Reduction Factor]*** is only activated if you have selected the option reduce grid cells[647].

- Enter a positive integer.
  If Reduction Factor [1] is selected, all cells will be exported.
  If Reduction Factor [2] is selected, half of the grid cells will be reduced, along row and column.

Workflow View, AutoCAD Export Options, Export as

If you use the workflow view to convert the grid model into AutoCAD file format, here you can specify how you want to export the grid model:

- Points
  Points from the grid model are exported as single points.

- Triangle Surface
  The grid model is exported as a triangle surface, TIN.

- Grid Surface
  The grid surface in iCON office format is exported into AutoCAD format. The appearance of the grid model will not change.

Please note:

- These options only affect a grid model that is exported to AutoCAD file format dwg/dxf.
- No impact if you export the grid model into a coordinate file[648].

Workflow View, AutoCAD Export Options, Layer name

If you enter a layer name here, exported data in the resulting AutoCAD dwg/dxf file will be saved in a layer with the given name.
If no name is entered, data will be saved in layer 0.

Please note, layer name does not have any impact if you export the grid model into a coordinate file[648].

Workflow View, Select Resulting File Format

Use the drop down list at the bottom of the workflow view to select what you want to save.

- **Save Points in Coordinate File**
  Points from the grid model are saved in a coordinate file.
  If the coordinate file seems to be very large, you might consider to reduce

some grid cells[647] .

- **Save as AutoCAD DXF/DWG**
  Depending on selected AutoCAD export option[648] , the saved AutoCAD file can include either points, triangle surface or a grid surface.

Resulting Files	When you have created an AutoCAD file or coordinate file in the workflow view, you give the file a name, and it will be saved. The new file will not open automatically. You have to open it yourself, in the software of your choice.

See also: Create Grid Models[642]

11.5 Edit Terrain Models

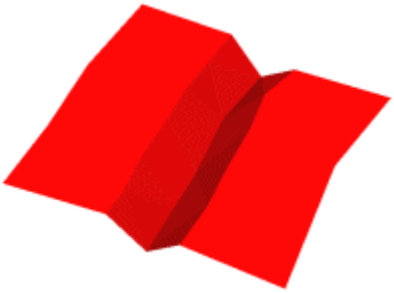
11.5.1 Break Lines

Break lines are used to control the appearance of the finished terrain model. By describing terrain structures using lines, the user can ensure the terrain model is created correctly.

Triangulation
For the calculation of the terrain model, an optimized triangle structure is created without regard to any break lines. The result of this type of calculation is very difficult for the user to predict, the risk is high that unwanted triangles are created, such as triangle sides that cut across a ditch instead of along it. Therefore, new points are introduced for all intersections between the triangle sides and break lines. The height of these points is set to the height of each break line height in the current position in question. The surrounding triangle sides thereby connect to the break line which means that the original appearance of the break line is preserved in the model.

Terrain model of ditch without break lines

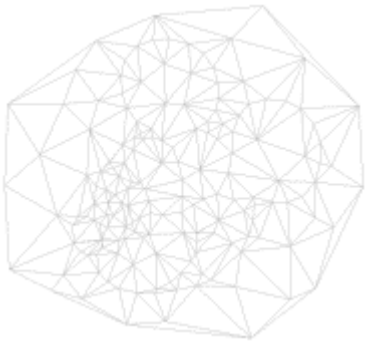
Terrain model of the same ditch with the break lines along the ditch bottom and borders



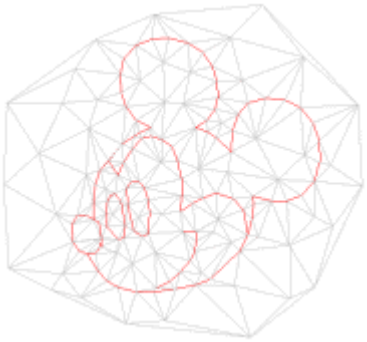
Surveying
When surveying an area for the purpose of creating a terrain model, you should aim to describe the structures in the terrain by means of lines. Roadsides, ditch bottoms and slope tops are suitable candidates for measurement lines. To improve the ability to produce a terrain model that complies well with the terrain, the user should try to visualize the appearance of the finished model. This is facilitated if you describe the terrain with lines, as the terrain model, somewhat simplified, will be formed as flat surfaces that connect the lines. Trying to imagine how the triangles will be created between a collection of single points is very difficult.

Graphics
Break lines in a terrain model will be drawn in a contrasting color on screen. This means that even when the model is created, break lines can be useful as they help the user to become familiar with the terrain model. A model created exclusively from single points can be easily perceived as a jumble of triangles, where individual objects are difficult to identify.

Terrain model without break lines



The same terrain model with visible break lines



Input data
All lines in the coordinate files used in the calculation will be regarded as break lines.

See also: Terrain Models in General[638], Create Terrain Model[639]

11.5.2 Stop Lines

Stop Lines is an editing tool used to remove unwanted triangles from a terrain model. Lines are drawn on screen and all triangles crossed by lines are removed. This tool is especially convenient when you want to remove many triangles in one go. You can save the stop lines in a separate coordinate file[153] and import them into other terrain models, which allows for rational work when creating multiple terrain models of the same area.

Tool

Enable the Tool *Draw Stop Line* by selecting ***Tools | Terrain Model | Draw Stop Line*** oruse the button in thetoolbar. Use the left mouse button to specify the starting point for the stop line. Move the cursor to the next desired point. A dashed line shows the position of the stop line at all times. Use the left mouse button to place the next point in the line. A line is drawn and all the triangles that are crossed by the line are removed. Continue to enter the points with the left mouse button until the desired results are achieved. Finish the line by pressing the right mouse button. A new stop line can now begin.
The undo option allows you to avoid any mistakes when drawing the stop lines. End the current stop line with the right mouse button and select ***Edit | Undo***.

Load the stop lines

Stop lines can be imported from Coordinate Files[153]. Select ***Data | Load Stop Lines***. You can select any coordinate file[153] . The file could be stop lines exported from a different terrain model, but you can also use files created in other ways. The selected coordinate file[153] lines are added to the terrain model's stop lines and all triangles crossed by any line are removed. This action can be undone with ***Edit | Undo***.
The function is very useful when working with multiple terrain models over the same area, where the triangles are to be removed in the same places in all models.

Save Stop Lines

You can save stop lines created in a terrain model in a coordinate file[153]. Select ***Data | Save Stop Lines***. You use this function when applying the terrain model's stop lines for another terrain model over the same area. Compare *Load the stop lines* above.

Viewing

Stop lines are viewed on screen when the tool *Stop Lines* is enabled. To hide the stop lines select any other tool.

See also: Terrain Models[638] , Editing Tools[653]

11.5.3 Graphic Tools for Terrain Models

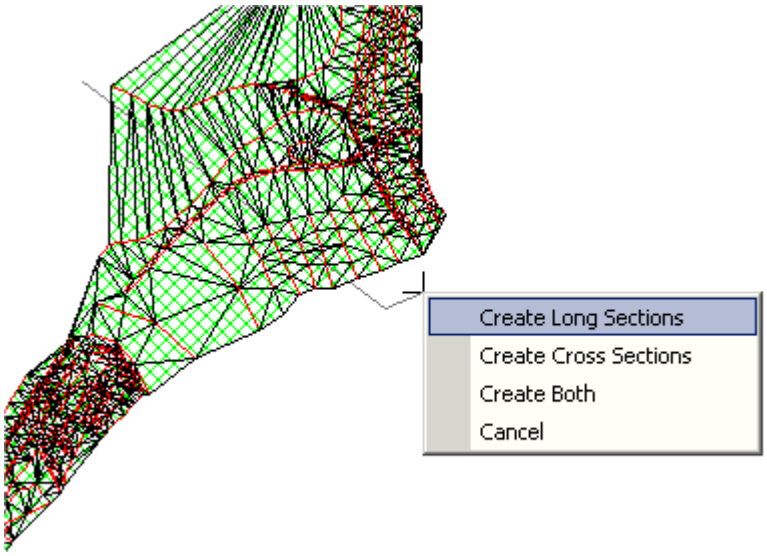
Create Triangle
Used to create new triangles along the terrain model's outer borders. Select points to form the new triangle. You cannot create triangles that overlap or enclose other triangles.
Enable the Tool *Create a triangle* by selecting ***Tools | Terrain Model | Create Triangle*** or use the button in the toolbar.

Rotate Triangle
Used to rotate the triangle sides inside the terrain model. Select two adjacent triangles whose common side is to be rotated.
Enable the Tool *Rotate the triangle* by selecting ***Tools | Terrain Model | Rotate Triangle*** or use the button in the toolbar.

Draw Stop Lines
Used to draw Stop Lines 652 in the terrain model.
Enable the Tool *Draw Stop Line* by selecting ***Tools | Terrain Model | Draw Stop Line*** or use the button in the toolbar.

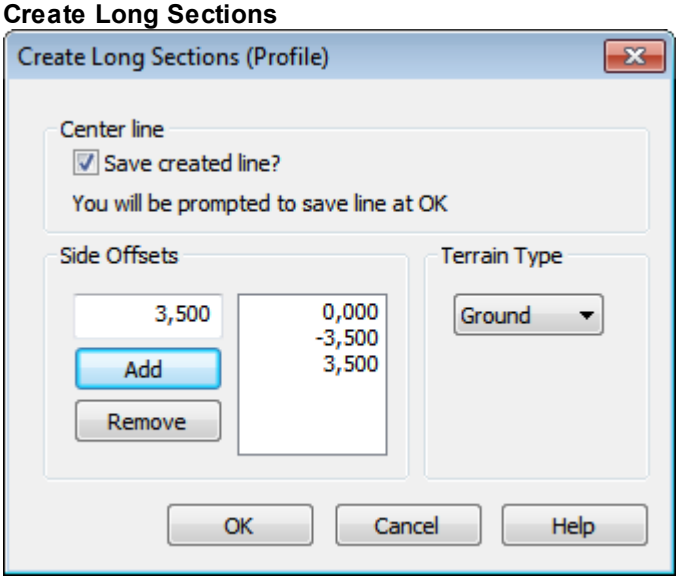
Creating Cross Sections
Enable the Tool *Create Long/Cross Sections* by selecting ***Tools | Terrain Model | Create Long/Cross Sections*** or use the button in the toolbar.

- Used to create long sections 654 and/or cross sections 655 using a line drawn by freehand.
- Draw a polyline in the graphics, right click and then select what you want to create. The line drawn can be saved as a line file (l3d) 503 .



Create Long Sections and *Create Cross Sections* work in a similar way as the functions Create Terrain Profile 661 and Create Terrain Sections. 659

Create Long Sections



Center Line
Check the box to save the drawn line as a line file[503] (l3d), and when you then select **[OK]** an additional dialog opens where you enter the name of the line.

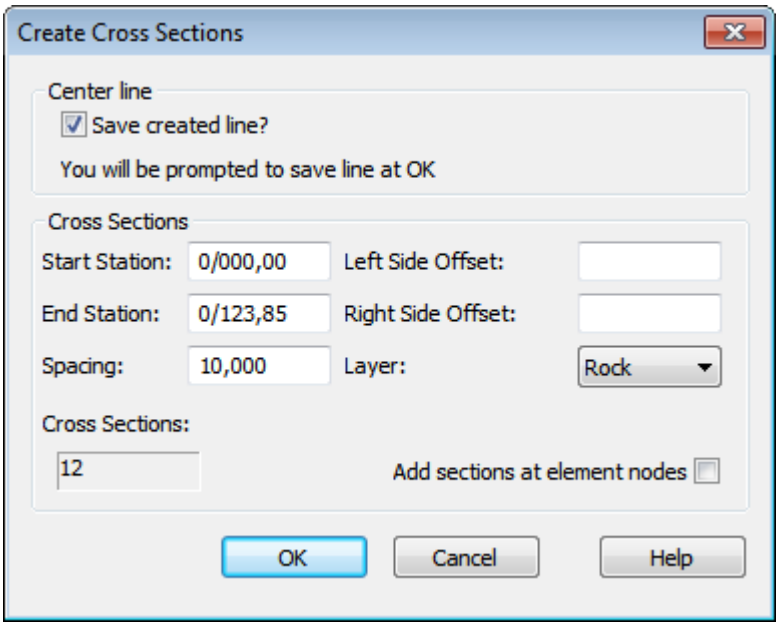
Side Offsets
When calculating you have the option of creating long sections parallel to the center line. Enter the offset to parallel long sections. From the beginning, only the offset 0.000 is available from the list, this corresponds to a long section in the center line.

- **Add offset**
  Enter the desired offset in the left box, and press **[Add]**. The value is transferred to the list of offsets to the right which is used in the calculation. You enter the offset with a positive direction to the right, while you use negative values to enter offset to the left of the center line. You can specify an unlimited number of offsets.

- **Remove offset**
  Select the offset to remove from the list to the right and press **[Remove]**. The selected offset will then disappear from the list. Note that you can even remove offset 0.000, as it is possible to create a long section document without a long section in the center line. If the list is completely empty, no calculation will be performed.

Terrain type
Select the type of terrain the long sections represents.

Create Cross Sections



Center Line
Check the box to save the drawn line as a line file[503] (l3d), and when you then select **[OK]** an additional dialog opens where you enter the name of the line.

Start Station
Enter the station dimension for the first cross section.

Stop Section
Specify the maximum station dimension for the last cross section.

Spacing
Specify the spacing the cross sections are to be created with.

Offset left, Offset right
Enter the maximum permitted offset for the left and right endpoints of the cross sections. If any value is excluded, the corresponding side of the cross sections will go to the outer border of the terrain model. You enter the offset with a positive direction to the right, while you use negative values to enter offset to the left of the center line.

Layer
Select the layer the cross section document represents.

Sections
Enter the number of sections to be created based on the start point from the specified start and end station and spacing.

Add cross sections at element nodes

- If this function is selected when calculating, cross sections will also be created at the center line's tangent points. This means that the cross section document may have irregular spacing with additional cross sections between those set by the specified station spacing.
- Without this function, cross sections are created with constant spacing without regard to the appearance of the center line between these spacings.

Other editing functions in the terrain model

Delete Triangle

Use the tool *Select Object* to select the triangles to delete. Press the button *Delete* in the toolbar or the ***Delete*** key on the keyboard.

Move point

Use the tool *Select Object* to select the point to be moved. Position the cursor on the point, the cursor changes appearance and it is then possible to *Move Objects* by holding down the left mouse button while moving the cursor. You can now move the point to a new position. Press the left mouse button again to select the desired position. The point is moved and the surrounding triangles are adapted to suit the new location of the point.

Display information

Select any point or triangle using the tool *Select Object*. Place the cursor over the object, press the right mouse button and select ***Properties***. The object details are then displayed.

Edit height

Select the point whose height is to be changed and display the details of the point as above 656. You can enter the required height value in the field for the Z-coordinate.

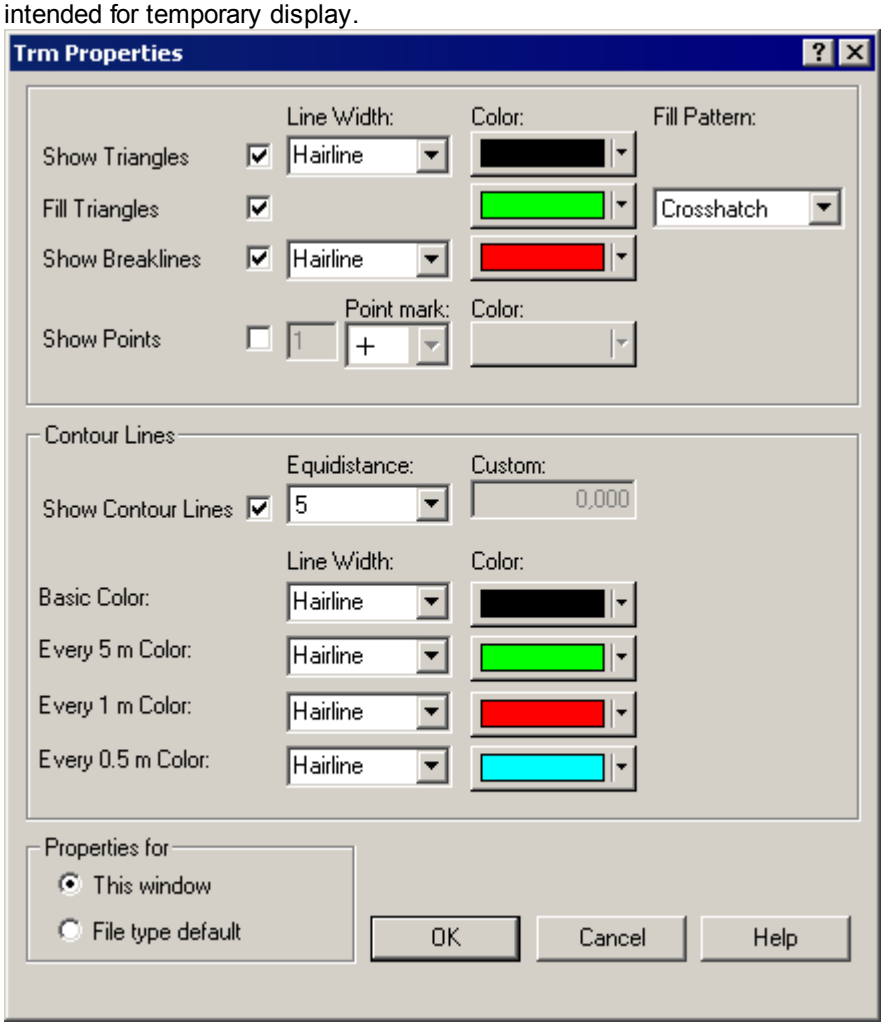
See also: Terrain Models 638, Create Terrain Profile 661, Create Terrain Sections 659, Stop Lines 652

11.6 Contour Lines

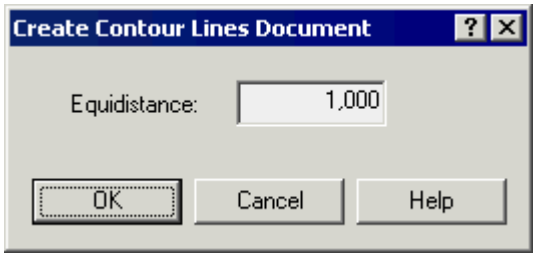
Contour lines, also called altitude contours, are a collection of lines describing the topography of a surface. The lines have the property that any given line follows the terrain at a specific constant height. The lines occur at a constant interval for the entire file, called *Equidistance*. The contour lines make it possible to visualize the topography of an area on a plane image, such as a drawing, see also Insert Contour Heights 279. Height differences can be estimated by counting the number of contours between two points, multiplied by the equidistance to give the distance. You can also estimate the shape of the terrain; in an area with short distances between the curves, the slope is greater than an area where the contours are sparse.

iCON office has two methods of creating contour lines:

- **Temporary**
  Open the current terrain model 638. Select ***View | Document Properties*** to open the dialog that allows you to select ***Show Contour Lines***, see Graphical Document Properties 57. You can now select the equidistance and colors of the specified intervals. Press **[OK]** to close the dialog. The contour lines with the selected equidistance are displayed on screen. These contours cannot be saved, but are only intended for temporary display.



- **Permanent**
  Open the current terrain model 638. Select ***Data | Create Contour Lines***.



A dialog will open where you can enter any equidistance. Enter an equidistance and press **[OK]** to start the calculation. The contour lines are created in a coordinate file[153] of the niv type and will open in a new window. If the contour lines are created from a difference model[675], difference contour lines are created, and the file type is then dfn.

If you create a drawing, it is possible to insert height texts next to the contour lines, see Insert Contour Heights[279] .

See also: Terrain Models[638] , Difference Models[675] , Insert Contour Heights[279]

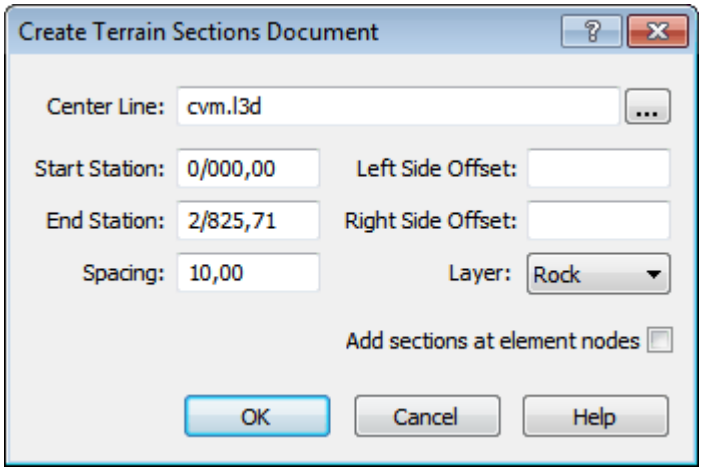
11.7 Create Terrain Sections

Creates terrain sections from a terrain model along a specified center line.

From an open terrain model, select ***Data | Create Terrain Sections***. In the dialog select:

- center line
- any limitations in station and offset
- spacing
- layer

Press **[OK]** to start the calculation. A new terrain profile document, with the file extension sec, will open in a separate window.



Center Line
Specify the file containing the center line along which the terrain sections are to be calculated.

Start Station
Enter the station dimension for the first terrain section.

End Station
Specify the maximum station dimension for the last terrain section.

Spacing
Specify the spacing the terrain sections are to be created with.

Offset Left, Offset Right
Enter the maximum permitted offset for the left and right endpoints of the terrain sections. If any value is excluded, the corresponding side of the sections will run to the outer border of the terrain model.
You enter the offset with:

- positive values to enter offset to the right of the center line
- negative values to enter offset to the left of the center line

Layer
Select the layer the terrain section document represents.

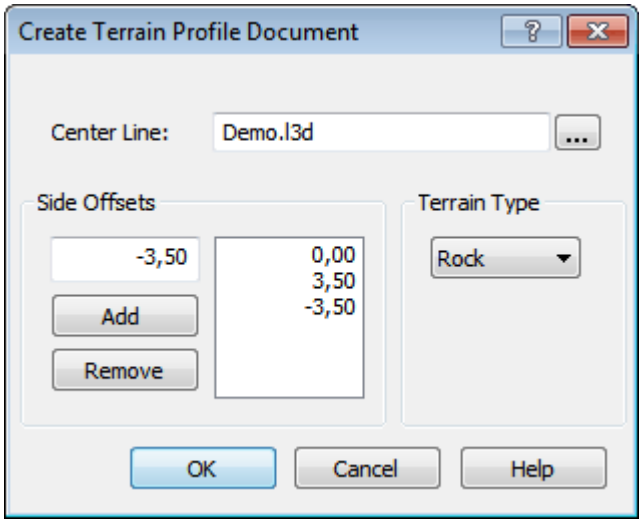
Add sections at element nodes
If this box is selected when calculating, terrain sections will also be created at the center line's tangent points. This means that the terrain sections may have irregular spacing with additional sections between those set by the specified station spacing.
If the box is not selected, sections are created with constant spacing without regard to the appearance of the center line between these spacings.

See also: Terrain Models 638 , Create Terrain Profile 661 , Graphic Tools for Terrain Models 653 , Road Lines 503

11.8 Create Terrain Profiles

Creates a terrain profile from a terrain model along a specified center line.

From an open terrain model, select ***Data | Create Terrain Profile***. Enter the required center line and press **[OK]**. The calculation is carried out and a new terrain profile document will open in a separate window. This file is of the pro type.



Center Line
Specify the file containing the center line along which the terrain profile is to be calculated.

Offset
When calculating you have the option of creating terrain profiles parallel to the center line. Enter the offset for parallel terrain profiles, if any. From the beginning, only the offset 0.000 is available from the list, this corresponds to a terrain profile in the center line.

- **Add Offset**
  Enter the desired offset in the small box, and press **[Add]**. This transfers the value to the list of offsets that is used in the calculation. You enter the offset with a positive direction to the right, while you use negative values to enter offset to the left of the center line.
  You can specify an unlimited number of offsets.

- **Remove offset**
  Select the offset to remove from the list and press **[Remove]**. The selected offset will then disappear from the list. Note that you can even remove offset 0.000, as it is possible to create a terrain profile document without a profile in the center line. If the list is completely empty, there is no calculation.

Terrain type
Select the type of terrain the terrain profile represents.

See also: Terrain Models 638, Create Terrain Sections 659, Graphic Tools for Terrain Models 653, Road Lines 503

11.9 Terrain Profile, Pro

Terrain profile data files, or pro files, contain vertical information on the terrain along a line. The line is divided into elements that describe straight lines.

The iCON office user can create terrain profiles from a terrain model 661 (trm file) by selecting ***Data | Create Terrain Profile*** or from cross section data 632 (sec file) by selecting ***Data | Calculate Profile for Offset***.

Structure

Each element in the terrain profile contains the following data:

- Point number
  Identifies the element.
- Section
  Length section of the element's start point.
- Height
  Height of the element's start point.
- Radius
  Radius of the element's start point. Positive radius gives a line that has its center point over the arc , while a negative radius gives correspondingly a center point below the line .
  Tip: a positive radius for a contour is in the form of a "happy mouth", while negative curvature is a "sad mouth".
- Code
  Enter a code where appropriate.
- X
  Specifies the point's X coordinate.
- Y
  Specifies the point's Y coordinate.
- Line
  The box must be checked for a line to be drawn from this point to the next point in the line. If the box is not checked, this is shown as a break in the graphical line.

Views

Choose view for terrain profile:

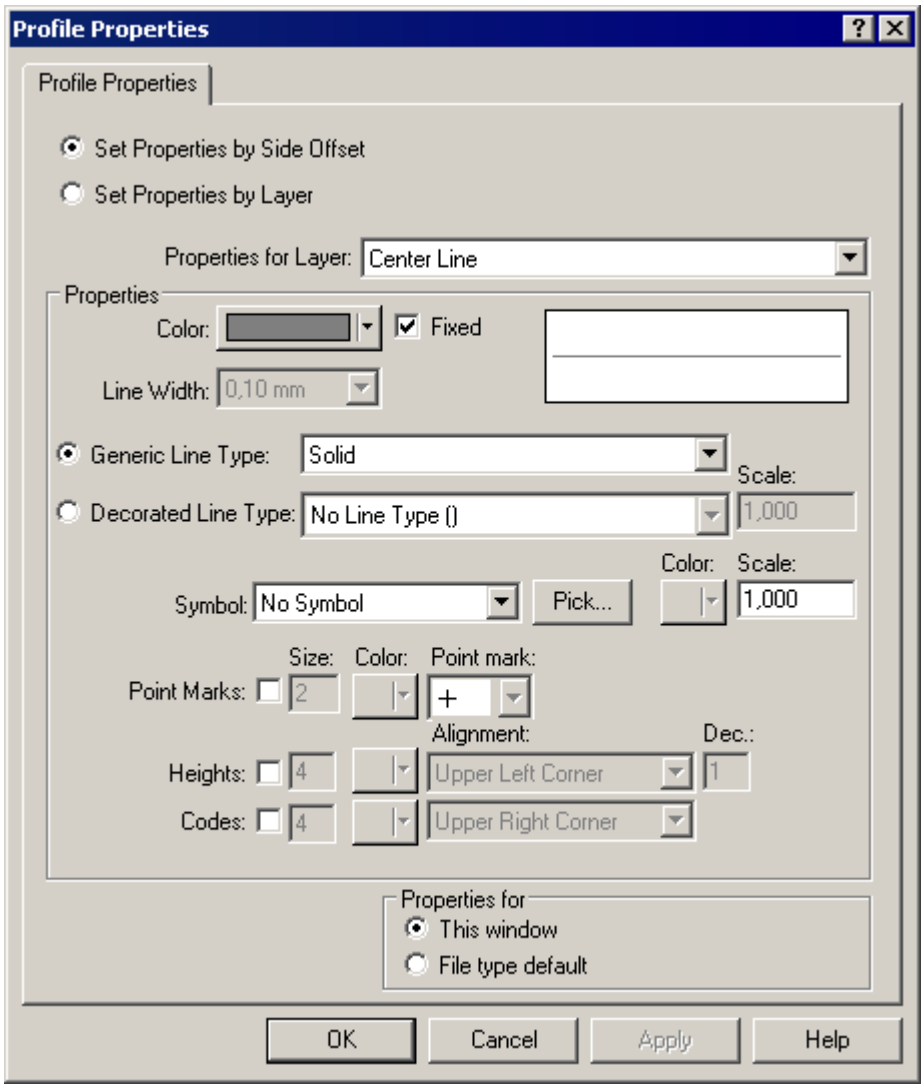
- Graphical View
  Shows the profile graphically, this is the default display for terrain profile documents. Choose from the viewing orientations: Section, Offset, Profile or Cross-section. If the terrain profile contains plane coordinates (X, Y), you can also visualize it in the plane view.
- Numerical View
  Displays an input window with the terrain profile elements.

Edit, numerical view

- From the terrain profile tree you can add side lines to the active document. Right-click on "Terrain profile" at the top of the tree and select"**Add Profile Line**". Enter an offset for the new side line. You can add an unlimited number of side lines. How the terrain profiles are created is described in Create Terrain Profiles 661.
- Add Layer
  Right-click a file in the tree and select "**Add Layer**". The user can specify the layers to which the line is to apply. Each line can be split into multiple layers such as soil, rock and theoretical layers.

Edit, Graphical view

Click or select **View | Document Properties** to edit the graphic display of the terrain profile.



- Set properties for offset
  Properties for the graphics are dependent on the offset.
- Set properties for layers
  Properties for the graphics are dependent on layers. The same layers that are present for cross section files 627, can be selected for the terrain profile.
- Properties
  - Colors
    Select color.

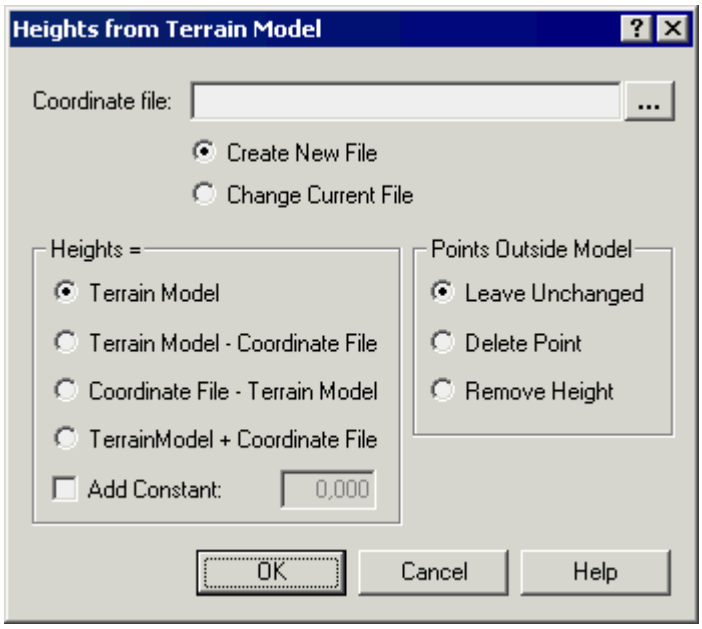
- Line Width
  Control the line width of the drawn lines. Note that the line widths do not have any effect on the screen but are only used for printing.
- Single line type
  Select line type. With this option the graphical layout of the line is clearly visible on your computer screen.
- Decorated line type. Scale.
  Choose from predefined line types that may also consist of symbols. Scale for the line type is used primarily for printing.
- Symbol. Scale.
  Here you can select the symbol for the points included in the terrain profile.

See also Create Terrain Profile 661 , Graphical Document Properties 52.

11.10 Heights from Model

This function allows a coordinate file[153] to load heights from a terrain model.

Open the terrain model from which the heights are to be loaded. Select ***Data | Heights***.



Coordinate File
Enter the coordinate file[153] to use in the calculation.

Create New File
If this option is selected, a new file will be created, in which the results of the calculation appear.

Change Current File
The results of the calculation are saved in the original coordinate file[153]. **Warning!** Previous data in the file is permanently lost. The calculation cannot be undone.

Heights=
You can change the heights of the coordinate file[153] using the terrain model in a number of ways:

- **Terrain model**
  Heights calculated from the terrain model.
- **Terrain model - Coordinate file**
  Height coordinates are set to the height calculated from a terrain model, minus the initial height.
- **Coordinate file - Terrain model**
  Height coordinates are set to the original value of each point minus the height calculated from the terrain model.
- **Terrain model + Coordinate file**
  The height coordinates are set as the sum of the original height calculated from the terrain model.

Add Constant
Select this function and specify a value. This value is added to all heights.

Points outside the model
For points outside the terrain model, no heights can be calculated from the model. These points can be handled as follows:

- **Leave Unchanged**

Points outside the terrain model retain their original height.

- **Delete Point**
  Points outside the terrain model are removed from the file.
- **Remove Height**
  Points outside the terrain model are given no height.

See also: Terrain Models 638

11.11 Model Calculation, Terrain Model

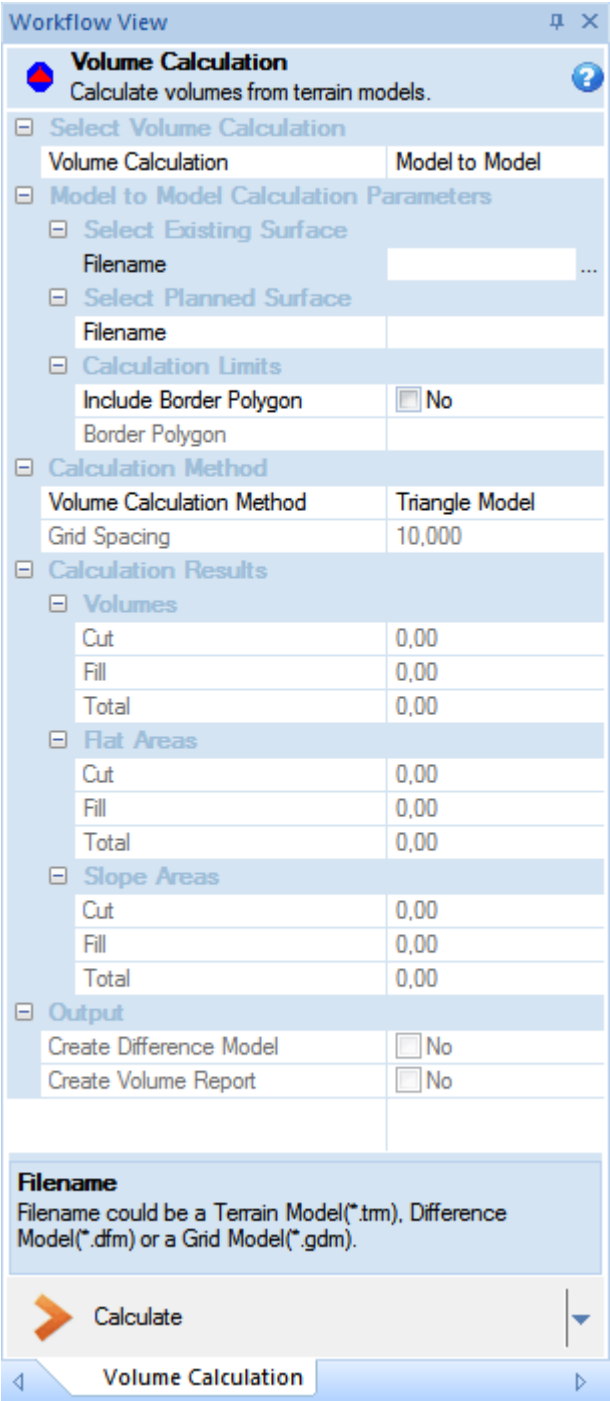
Volume Calculation, Terrain Model

In volume calculation, terrain model, you calculate volumes and areas from terrain models[638] in relation to each other or in relation to a reference level.

Select ***Function | Volume Calculation, Terrain Model*** to perform the calculation.

- The workflow view will open.
- In the workflow view, use the drop down list to select calculation method:
  - Model to Model[669]
  - Reference Level[668]
  - Stockpile[671]
- In the workflow view, you can change settings that applies to the selected calculation.
- The appearance of the workflow view depends on the selected calculation method.

Workflow View



The appearance of the workflow view.

Volume Calculation, Reference Level

To calculate volumes and areas between a terrain model and a reference level:

- Select Volume Calculation, Reference Level.
  - Select Existing Surface
    Select a terrain model that describes the existing surface. This can be:
    - a terrain model, trm
    - a difference model, dfm
    - a grid model, gdm
  - Select Planned surface
    Select a reference level.
- Optional to select Calculation Border[671] .
- Select Calculation Method[671] .

Volume Calculation, Model to Model

To calculate volumes and areas between two terrain models:

- Select Volume Calculation, Model to Model
  - Select existing[670] and planned terrain models, see table[670] below.
  - The calculation starts by creating a difference model[675].
  - The difference model is a kind of a terrain model. The surface of the difference model describes the difference between the two selected surfaces, existing and planned. These may be
    - two terrain models
    - one terrain model and a flat reference level.
  - The difference model is then used to calculate areas and volumes, in the same way as in the case for terrain model to reference level[668] but with the reference level set to zero. This can be performed using two different principles:

▪ **By splitting triangles, Triangle Model**	▪ The difference model is created as a new terrain model containing all the points and lines from the two initial models, as well as all the points where the two models' triangle sides intersect. ▪ The method provides results with very high accuracy, but the method is complicated and may not work.
▪ **Grid Model, Grid With Spacing**	▪ The difference model is created as a grid of points where the height of each point is the difference in height between the two models. The spacing of the grid is optional. ▪ The accuracy of the method is entirely dependent on the selected spacing. If the grid is too sparse, there is an apparent risk that important information will be missed in the initial models. A reduction in the spacing always means the results are closer to the true value, although reduced spacing also increases calculation time. ▪ The method is intended to be used when the method using the Triangle Model fails and should be regarded as an approximate estimate of volumes and areas.

Workflow View, Model to Model, Select Existing Surface

- Select a terrain model that describes the existing surface. This can be:
  - a terrain model, trm
  - a difference model, dfm
  - a grid model, gdm

Workflow View, Model to Model, Select Planned Surface

- Select planned surface.
  Selectable terrain models under Planned Surface depend on the selected terrain model under Existing Surface. You can also select a reference level to be used as the planned surface.
  The table below describes possible combinations:

Existing Surface - before processing	Planned Surface - after processing	Remarks
Terrain Model, trm	Terrain Model, trm	Calculates the volume between two terrain models.
Terrain Model, trm	Difference Model, dfm	Calculates the volume between a terrain and a difference model.
Terrain Model, trm	Reference Level	Calculates the volume of a terrain model in relation to a particular reference level.
Grid Model, gdm	Grid Model, gdm	Calculates the volume between two grid models.
Grid Model, gdm	Reference Level	Calculates the volume of a grid model in relation to a particular reference level.
Difference Model, dfm	Terrain Model, trm	Calculates the volume between a difference model and a terrain model.
Difference Model, dfm	Difference Model, dfm	Calculates the volume between two difference models.
Difference Model, dfm	Reference Level	Calculates the volume of a difference model in relation to a particular reference level.

  - **Terrain model / Grid Model / Difference Model**
    Select the planned terrain model that describes how the surface should look like after processing, for example a model of an excavation bottom with varying levels and shapes.
    This can be a terrain model, trm, a grid model, gdm or a difference model, dfm.
  - **Reference Level**
    Enter a reference level when the surface after processing is a surface at a specific height, such as a smooth excavation bottom.

Workflow View, Model to Model, Calculation Limits

- To limit the calculation, see Calculation Limits 671.

.

Volume Calculation, Stockpile

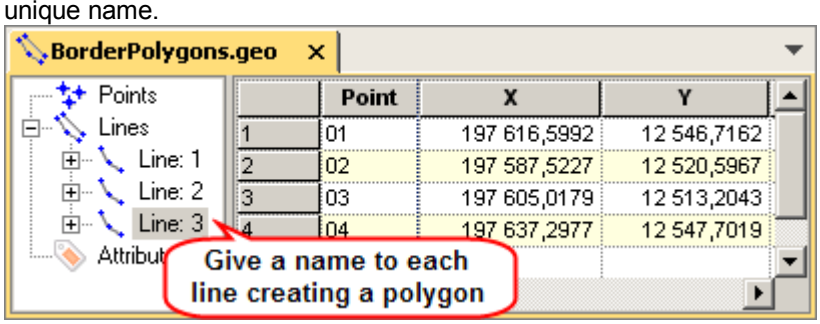
To calculate volumes and areas of a stockpile:

- Select Volume Calculation, Stockpile.
  - Select a terrain model describing a stockpile.
  - The terrain model can be in the shape of a hole below the surface or a pile above the surface.
  - The outer edge of the terrain model will be used as the calculation border, both in width and in height.
  - The outer edge can vary in height, otherwise this calculation resembles volume calculation in relation to a plane reference level[668] .
- Select calculation method[671] .

Workflow View, Calculation Limits

You can use a coordinate file[153] with one or several border polygons to limit the calculation, when you calculate Model to Model[669] or Reference Level[668].

- Enter the name of a coordinate file containing one or several polygons.
- Volume and area within the polygons will be calculated.
- Areas outside the polygons will be excluded from the calculation.
- In order to distinguish different volumes when calculation results are presented, it is important that each line creating a border polygon has a unique name.



- If you leave the field for border polygon blank, the calculation is made without any limits.

Workflow View, Calculation Method

The text below shortly describes how volumes are calculated for a terrain model with a reference level, a stockpile and also for model to model.

Calculation method regarding Terrain model with reference level and also Stockpile.

- In the case where a terrain model is compared to a reference level, the areas and volumes are calculated for each triangle and the results are totaled. Areas and volumes are divided into two categories, cut and fill, depending on whether they occur above or below the reference level. See also Calculation Results[673] .

Calculation method regarding Model to Model
When areas and volumes between two terrain models[638] are to be compared, a more advanced calculation will be performed.

- The calculation starts by creating a difference model[675] .
  - The difference model is a terrain model where the surface describes the difference between two surfaces.
  - A difference model will be created in the background, whether you choose to create the model or not.
- The difference model is then used to calculate areas and volumes, in the

same way as in the case for terrain model to reference level 671 but with the reference level set to zero. This can be performed using either Triangle Model 672 or Grid Spacing 672 .

- **Triangle Model, splitting triangles**
  - The difference model is created as a new terrain model containing all the points and lines from the two initial models, as well as all the points where the two models' triangle sides intersect.
  - The method provides results with very high accuracy, but the method is complicated and may not work.
- **Grid Spacing, grid model**
  - The difference model is created as a grid of points where the height of each point is the difference in height between the two models.
  - The spacing of the grid is optional.
  - The accuracy of the method is entirely dependent on the selected spacing. If the grid is too sparse, there is an apparent risk that important information will be missed in the initial models. A reduction in the spacing always means the results are closer to the true value, although reduced spacing also increases calculation time.
  - The method is intended to be used when the method using the Triangle Model 672 fails and should be regarded as an approximate estimate of volumes and areas.

Workflow View, Calculation Results

At the bottom of the workflow view, you can select to calculate the volumes and areas. The results will be displayed in the workflow view.

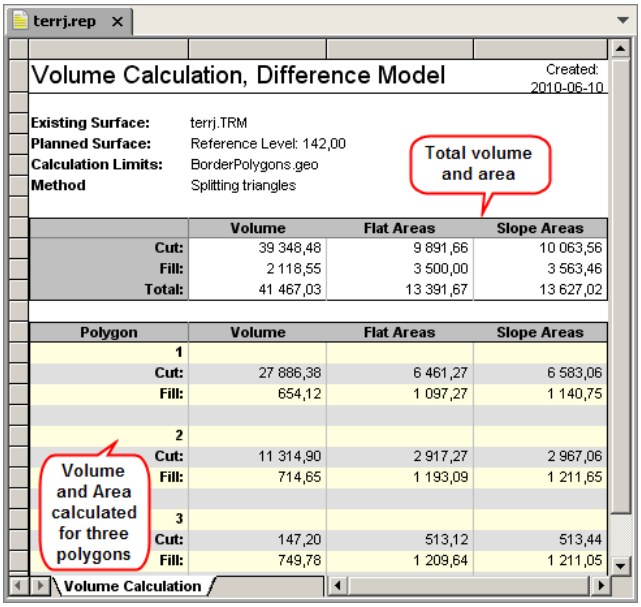
Cut and Fill

Areas and volumes are divided into two categories, *cut* and *fill*. The areas where the surface after processing is below the surface before processing are called cut. Fill denotes the opposite. The total of cut and fill is also reported. Areas are presented in two ways:

- **Flat areas**
  Each triangle is projected into a two-dimensional plane perpendicular to the Z axis, and the projected area of the triangle is calculated.
- **Slope areas**
  Each real area of each triangle is calculated, independent of the triangle slope.

Border Polygon

If the calculation has been limited by a file with a border polygon, the volume and surface area are both presented separately for each input polygon along with the total.



Workflow View, Output, Create Difference Model, Create Volume Report

When you calculate volumes and areas, you can choose which results you want to present:

- Only present the calculated results in the workflow view.
- Create a difference model.
- Create a volume report.

Workflow View, Calculate volumes

At the bottom of the workflow view, there is a drop down menu.

- Click the button ***[Calculate]*** in the drop down menu.
  - Calculated volumes and areas will be displayed in the workflow view, see Calculation Results 673 .
  - If you change something in the workflow view, regarding the calculation parameters, the calculated volumes will be removed, and you have to redo the volume calculation with the changed input.

See also: Difference Models 675, Terrain Models 638, Coordinate Files 153

11.12 Difference Models

A difference model is a terrain model that describes the difference between two areas, either two terrain models, or a terrain model and a reference plane.

To create a difference model, select ***Function | Volume Calculation, Terrain Model***667

Cut and Fill
The surface of the difference model describes the difference between *surface before processing* and *surface after processing*, at any given point in the model the height is equal to the height of the *surface before processing* minus the height of the *surface after processing in the same position.* This means that in areas where the *surface before processing* is higher than the *surface after processing* the difference model has a height that is greater than zero and vice versa.
In areas where the difference model's height is equal to zero the *surface before processing* and *surface after processing*match. The calculated areas and volumes are separated into two categories, cut and fill, where cut represents the area and volume of the areas where the height of the difference model is greater than zero. This is because going from *surface before processing* to *surface after processing* requires that excavated materials must be removed. Similarly, fill represents the areas where the height of the difference model is less than zero, as in these areas you must fill with material to go from the *surface before processing* to *surface after processing*.

Difference contour lines
If you create Contour Lines657 from a difference model, you get *Difference contour lines*, and the file type is then dfn. Difference contour lines only differ from the usual contour lines in the way they are drawn on the screen. Instead of different colors representing different height ranges, three different colors are used representing cut, fill and zero level. This makes it easy to see in which areas you need to cut or fill to achieve the desired results. Contours representing the zero level are also interesting as they mark the boundary between cut and fill, which is handy if, for example, you want to set out a cut area at the work site. To customize the colors choose ***View | Document Properties***, *see Graphical Document Properties* 59.

See also: Volume Calculation, Terrain Model667, Contour Lines657, Terrain Models638

11.13 Create a Cut and Fill Map from a Difference Model

Cut and Fill Map from a Difference Model

A difference model is the calculated result from two surfaces that have been compared, for example an existing surface and a road design.

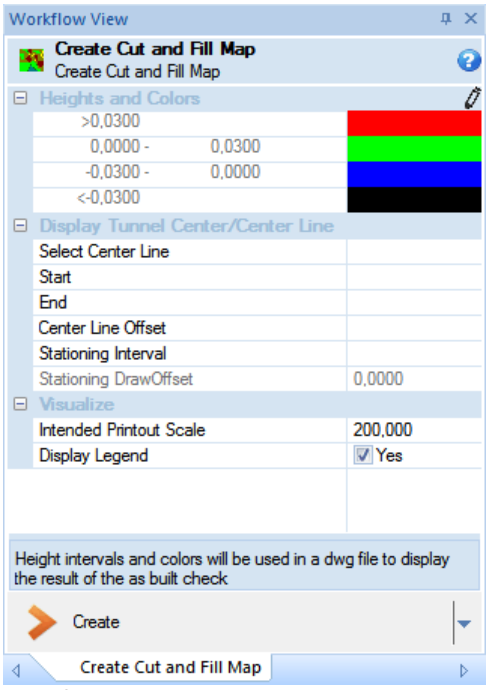
If you have a difference model, you can easily create a cut and fill map that illustrates areas within and outside tolerance.
Advantages of a cut and fill map:

- Colors and intervals can be user defined
- The result can be saved in an AutoCAD dwg file, that can be used in most third party software.

Open the Workflow view

To create a cut and fill map:

- Open a difference model.
- Select ***Data | Create Cut and Fill Map***.



Workflow view.

Settings in the Workflow View

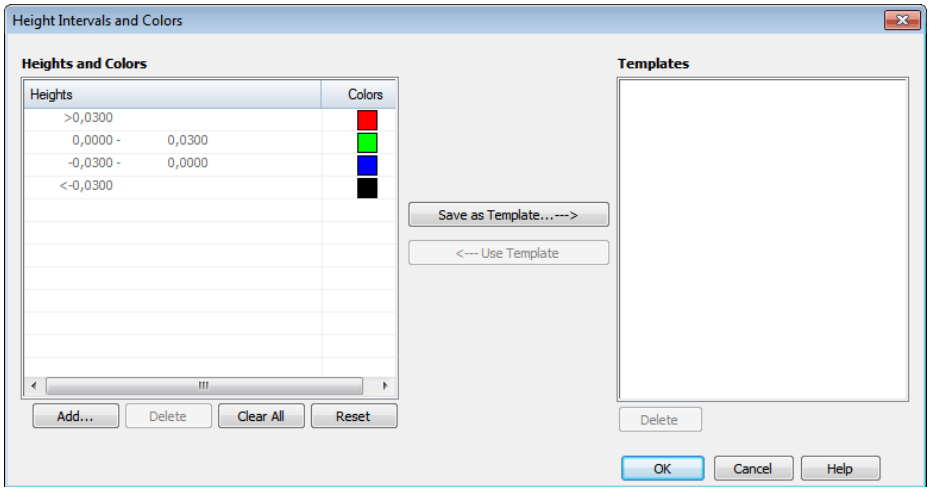
In the workflow view you can change settings that applies to the cut and fill map:

- Heights and Colors 676
- Visualization 678
- Display Lines 678

Workflow view, Heights and Colors

Height ranges and colors displayed in the workflow view, will be used in the resulting 2D and 3D colored difference models.
These colors display height differences between the models that have been used to create the difference model.

Click the button to open a dialog where you can edit height ranges and colors.



You can use the dialog to

- Edit height intervals and colors.
- Create user defined templates.
- Save your templates.

Buttons to be used in the dialog:

Heights and Colors	Specify height intervals and colors.
[Add...]	• Click the button **[Add...]** to add a height to the intervals displayed. The intervals will be adjusted automatically, for each added height.
[Delete]	• This button is only activated, when you have selected a height interval in the list. • Click the button to delete the selected height interval. • Note, if one interval is deleted, all related intervals will be adjusted automatically.
[Clear All]	• The button **[Clear All]** deletes all displayed intervals and colors, only the heights > 0 and < 0 will be displayed.
[Reset]	• Press the button **[Reset]** to get back to the set of intervals and colors stored as default by iCON office.
Templates	You can save height intervals and colors in named templates.
[Delete]	• Select a template and press the button **[Delete]** to delete the selected template. • Please note, templates are stored in the registry of iCON office. This implies that if you remove a template in one project, this specific template will be removed from all your projects.

[Save as Template... --->]	• Press the button **[Save as Template... ->]** to save a template that includes the height intervals and colors displayed to the left in the dialog. • Give the template an optional name. • Note, it's optional to save templates. Height intervals and colors that are displayed in the workflow view will be used, even if they are not saved as a template.
[<---Use Template]	• If you have saved one or several templates, you can select one of them and click the button **[Use Template]** to activate the template's height intervals and colors.
[OK]	• Press the button **[OK]** to confirm your selected choices.

Workflow View: Center Line

Select Center Line	Select a line file to display it with the difference model. In the resulting AutoCAD dwg file, the center line will be stored in a layer named "Center Line". The whole line will be displayed in the resulting dwg file, but if you want to delimit the length of the line, just enter start and end station.
Start	To delimit the displayed center line, you can enter start station.
End	To delimit the displayed center line, you can enter end station.
Center Line Offset	Enter an offset to create a line parallell to the center line.
Stationing Interval	Enter station interval to be displayed along the center line. The text will be displayed to the right of the line, in the line's direction.

Workflow View: Visualize

In the workflow view, you set settings regarding the resulting 2D cut and fill map.

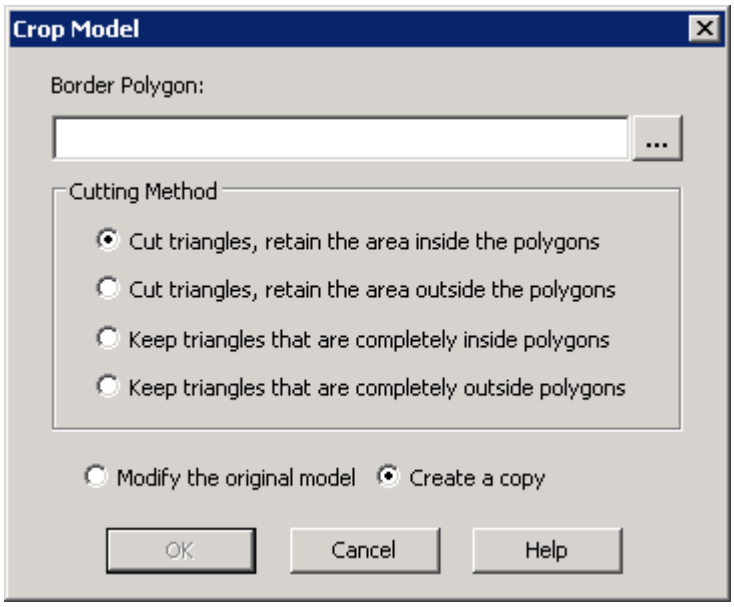
Intended Printout Scale	• Set the printout scale to be used. • This scale will be used for: - color legend - stationing

Display Legend	• Check the box **[Yes]**, if a legend with used height intervals and colors should be displayed.

See also: Volume Calculation Terrain Model 667, Difference Models 675

11.14 Crop Terrain Model

If you have a terrain model active that needs cropping with the help of a border polygon in a coordinate file, you select ***Data | Crop Model*** to open the dialog for cropping this terrain model.

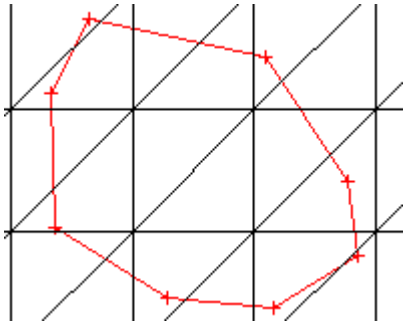


Border Polygon

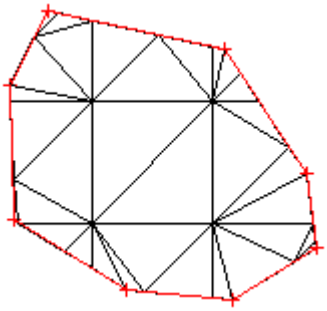
Enter the name of the coordinate file, or click the ... button to select a coordinate file that contains a border polygon used for cropping the active terrain model.

Cutting Method

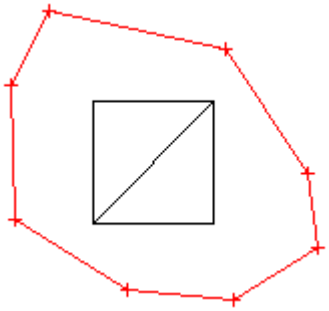
Here you select the triangles to be cut, and the triangles to be saved:



Triangles together with a polygon



Cut triangles with the polygon



Triangles completely inside the polygon

- Cut triangles, retain the area inside the polygon
  Cut triangles by introducing nodes where the triangles intersect the polygon. Triangles inside the polygon are retained.
- Cut triangles, retain the area outside the polygon
  Cut triangles by introducing nodes where the triangles intersect the polygon. Triangles outside the polygon are retained.
- Keep triangles that are completely inside the polygon
  Triangles must be completely inside the polygon in order to be saved. Triangles that cross the polygon are removed.
- Keep triangles that are completely outside the polygon

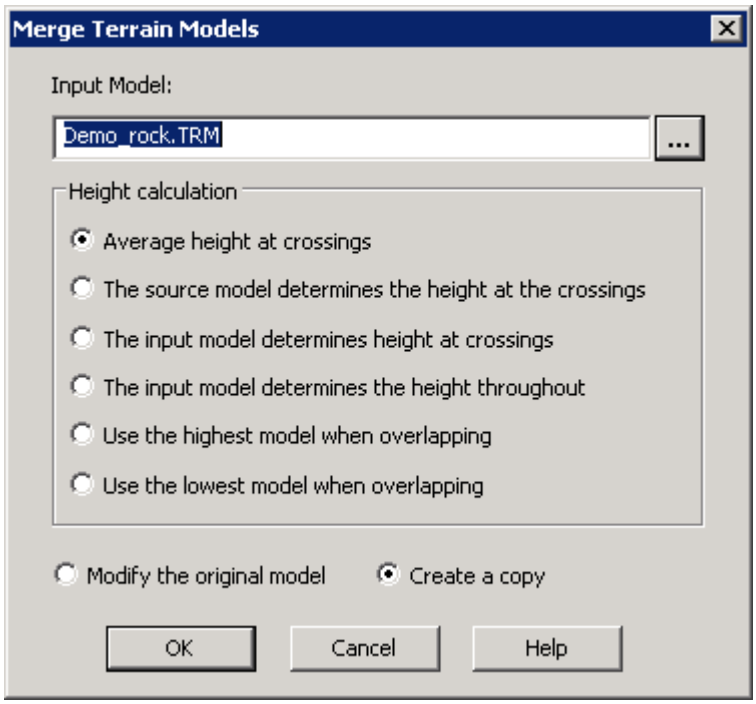
Triangles must be completely outside the polygon in order to be saved. Triangles that cross the polygon are removed.

- Modifying the original model
  Modifying the original file directly without creating a copy.
- Create a copy
  Creating the merged model as a new file.

See also Merge Terrain Models 682 .

11.15 Merge Terrain Models

To merge two terrain models select ***Data | Merge Models***. Note that one of the terrain models must be active in the graphical view in iCON office in order to select this function.

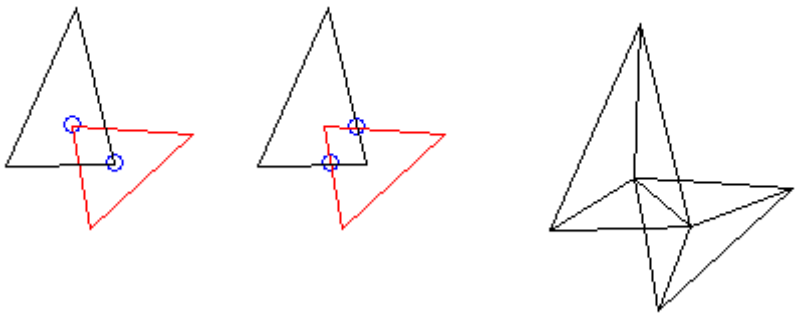


Choose a model to merge with

Enter the name of a terrain model, or click the ... button to select a terrain model to be merged with the terrain model that is active in the graphical view.

Height Calculation

Here you select how to calculate the heights in nodes and crossings, and how to create the new file:



Nodes Crossings Merged

- Average height at crossings
  The height at the nodes is retained in both models and the height at crossings is the average height of the two models.
- The source model determines the height at the crossings
  The height at the nodes is retained in both models and the height at crossings is taken from the source model.
- The selected model determines the height at the crossings

The height at the nodes is retained in both models and the height at the crossings is taken from the selected model.

- The selected model determines the height throughout
  The height at the nodes and crossings is taken from the selected model.
- Use the highest model when overlapping
  Lift up the overlapping surfaces to the level of the highest model.
- Use the lowest model when overlapping
  Lower the overlapping surfaces to the level of the lowest model.
- Modifying the original model
  Modify the original model directly without creating a copy.
- Create a copy
  Creating the merged model as a new file

See also Crop Terrain Model 680 .

11.16 Export Points and Lines

You can save the points and lines of a terrain model as a new coordinate file.

Select ***Data | Export Points and Lines*** when the terrain model is active in the graphics window.
A new coordinate file[153] is created and opens in a new window. Terrain model points and break lines are saved in the file. Each break line forms a separate line.
This function is useful if the coordinate files that the model is created from are missing and you need coordinate data, for example, when you want to merge several terrain models into one.

See also: Terrain Models[638], Coordinate Files[153], Export Edges[685]

11.17 Export Edges

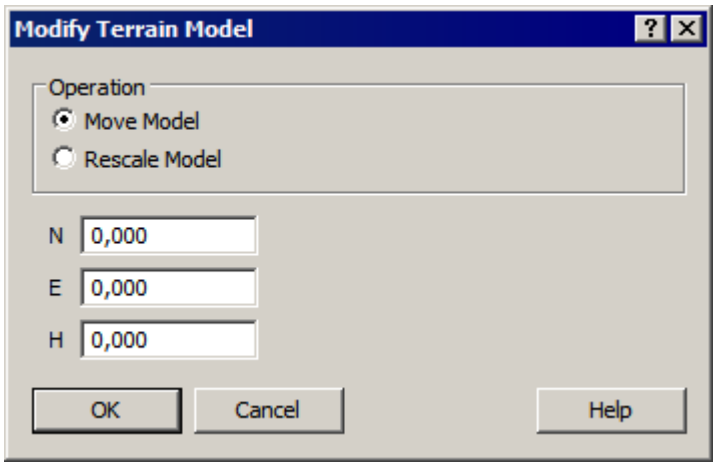
You can save the outer edges of a terrain model as a new coordinate file[153] .

Select ***Data | Export Edges*** when the terrain model is active in the graphics window.
A new coordinate file[153] is created and opens in a new window. The outer limit lines of the terrain model form separate lines in the file. Even the outer edges inside the model (holes) form lines. The lines are saved in the form of closed polygons.
This function is useful when analyzing the extension of the terrain model or for allowing control of another operation, such as Extract with Polygon[174] .

See also: Terrain Models[638] , Coordinate Files[153], Export Points and Lines[684]

11.18 Modify Terrain Model

A terrain model can be modified in the graphical view. Open a terrain model, trm, and select ***Data | Modify Model***.



- Move Model
  To move the terrain model laterally and/or vertically, enter appropriate values for the displacement.
- Rescale Model
  In order to scale the terrain model laterally or in height, enter appropriate values for scaling laterally and/or vertically. 1 means no scaling.

See also: Terrain models 638 , Surface Statistics with terrain model, trm 617

12 Volume Calculation

12.1 Volume Calculation in General

Two entirely different calculation methods can be used, the terrain model method and the section method. The terrain model method is best suited for excavation pits, landfills, etc. while the section method is best suited for roads and similar objects.

The terrain model method.

This calculation method is part of the terrain model module and is accessible under the heading ***Function***, see Volume Calculation, Terrain Model 667 .

Volumes and surfaces can be calculated in two ways, either as triangle models, or as grid models. However, both methods use the triangle model as initial data.

Volumes can be calculated as the differences between two models or from one model to an optional reference height. Limit polygons can be used to calculate sub-areas.

For calculation as triangle models, the calculation is made as a summation of the upright prisms after the lowest common triangles have been created in both models. This calculation technique gives mathematically precise results. However, you should keep in mind that the basis for the models is often founded on inaccurate descriptions of reality, e.g. a measured line is usually an approximate description of the terrain shape between two measured points.

When calculating as grid models, a grid is generated with an optional spacing from triangle models, the volume is then calculated as upright square columns. This does not give precise mathematical results as there may be triangle sides and corners within a square that are not included in the calculation. Moreover, sections smaller than half squares are not calculated in the outer edge of the models.

For the volume calculation between models, a new model can be created; a difference model that presents the difference between the models. This can be regarded as a cut and fill level, and the difference contours can be created from this.

Section Method

This calculation method is included in the volume calculation module.

The section method has been accepted as a way of presenting for a very long time and is easy to control manually with samples. The disadvantage is that the volume is not calculated completely accurately when the calculation is based on interpolation between the sections. The result can be easily improved by the calculation being performed at a more frequent interval. This method is also used for volume calculation of tunnels.

For volume calculation using the section method, several cross sections are placed through the area in which mass calculation is made. These cross sections are related to a 3-dimensional line described by a horizontal line calculation lin) in plane, and a profile (prf) in height. Cross sections are to cross through at least two layers ensuring the enclosed figures in the section can be created. A section in one layer can be created in several ways, such as from a standard section, as a section from a terrain model or directly from a traditional sectioning. The sections can lie at an optional interval.

In each cross section an area is calculated for each material to be processed, for example, earth excavation, rock excavation, fill, road base, etc., required to obtain the desired geometric shape.

The volume between two adjacent sections is calculated as the average area of the sections multiplied by the distance in the center line between the two sections. (Area 1 + Area 2) / 2 * L. The total volume is equal to the sum of all sub-volumes between the calculated sections.

For some components in a mass calculation, volumes are not reported but horizontal areas are such as rock overburden removal, asphalt surfaces, etc. In this case, the horizontal dimension of each surface is presented as a horizontal length in each cross section. The total area is calculated as (length 1 + length 2) /

2 * L.

No compensation for radii for differences in length to the right and left sides have been made (as we observe traditional handling in the industry).

A mass calculation using the section method needs a number of components as input data , e.g. road line, standard section, etc. All component parts must be specified in a mass description, stored in a file of the type .mbs. In the mass description all connections between the components, e.g. placement of the standard sections, section spacing, etc. are also specified.

A mass calculation can be a very complex calculation with many component parts and relationships. To get an overview of these, there is a tree structure for help when entering and editing.

See also Mass Descriptions 689 .

12.2 Mass Descriptions, MBS

A mass calculation using the section method needs a number of components as input data, e.g. road line, standard section, etc. All component parts must be specified in a mass description, stored in a file of the type .mbs. In the mass description all relationships between the components, e.g. placement of the standard sections, station spacing, etc. are also specified.

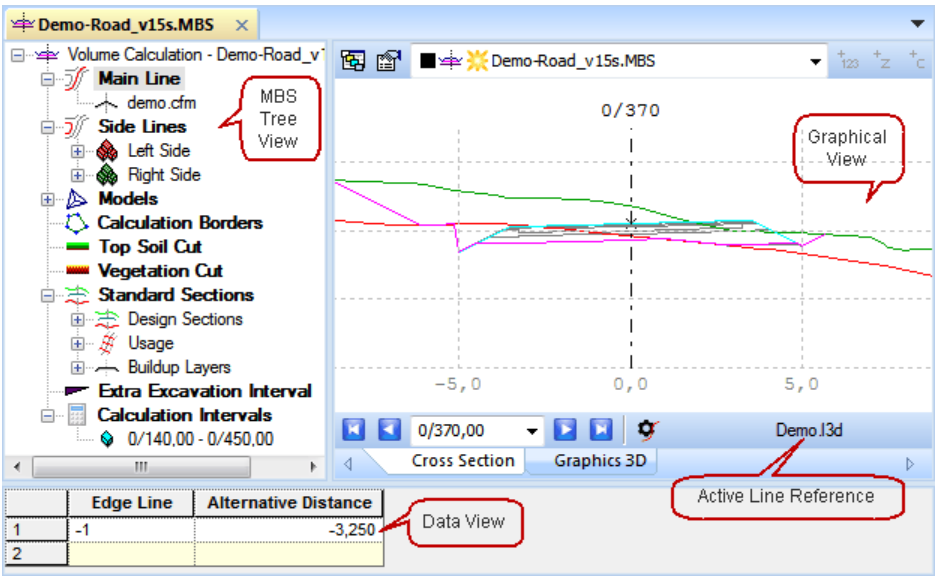
A mass calculation can be a very complex calculation with many component parts and relationships. To get an overview of these, there is a tree structure to help you when entering and editing.

MBS Window

View

The screen is divided into a number of views when editing a mass description:

- MBS Tree View
  Here you can see all components and relationships that are included in the mass description
- Graphical View
  The graphical view is divided into two tabs; one tab shows plane, profile or cross section data and the other tab shows the mass calculation in 3D graphics.
- Data View
  Under the tree view and graphical view you can see the data view that displays a numeric representation of selected objects in the tree view.
- Properties Dialog
  You can edit a range of settings in the properties dialog 106.



MBS Tree

Here you can see all components and relationships that are in the mass description. The entire mass calculation is administered via the tree, and provides support when composing the mass description. By clicking the tree you enable input and editing of the details in the description. You can also choose what is displayed in the graphical window.

Navigation in the tree

- Left clicking on the + sign expands a node in the tree.

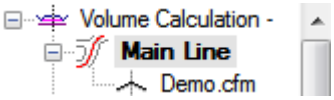
- Left clicking on the - sign reduces a node in the tree.
- Left clicking a component, a line, a terrain model, a section element etc opens and activates the data view for the corresponding components for input and editing.
- Right clicking the tree gives you the option of choosing ***Properties...*** and what is to be displayed in the view: plane data, cross section data or profile data.
- Right clicking the main line, models, types or buildup types or a standard section allows you to view and edit properties for each component.

See also Tree Views 104 .

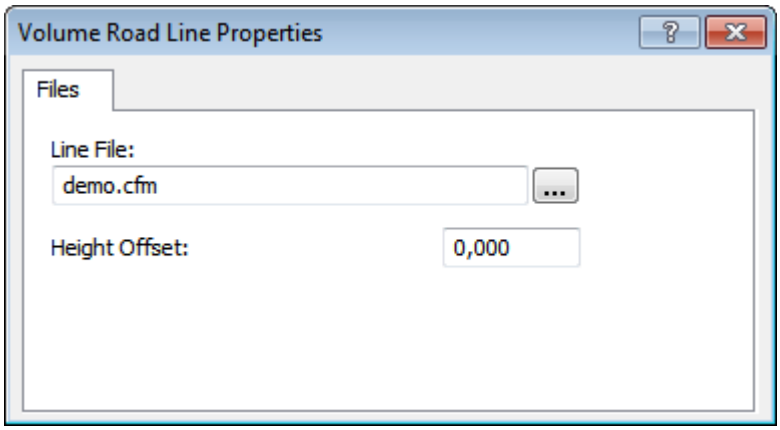
Objects in the mass description

Main line

Clicking the + sign or double-clicking the main line expands the main line to show the selected file name of the cross fall model 536 or the line 503.



Right-clicking Main line and selecting ***Properties...*** displays the properties dialog. Here you can enter the name of a cross fall model or line, or click the Select button ... to the right and select from the available files.



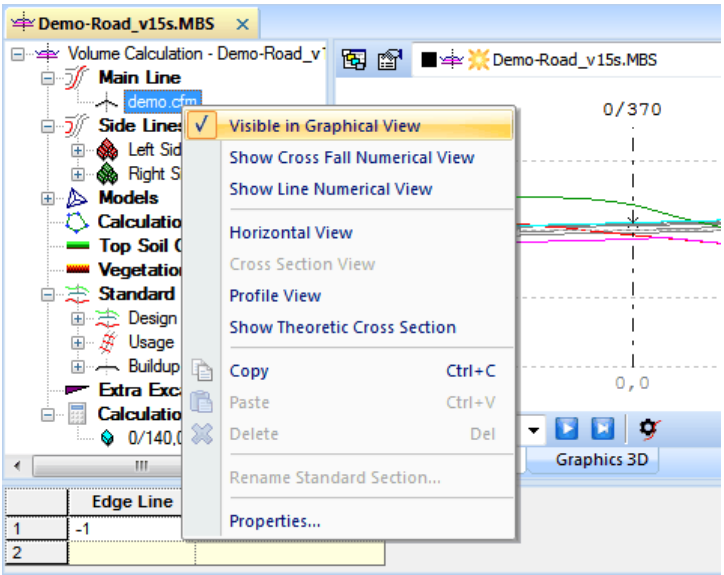
Editing cross fall model or line data

Right click on the file name in the tree view to:

- Display the cross fall numerically. Numerical editing possible.
- Display the line numerically. Numerical editing possible.

  The numerical file will open in a new window. For information about the files, see cross fall model 536 respectively line data 503 .

By right-clicking on the cross fall model (or the line) you can decide whether the line is to be visible in the graphical window or not.

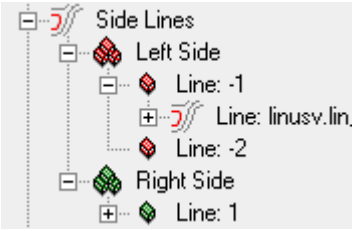


The base line is usually number 0 (zero) in the standard section.

Sidelines

If the standard section requires sidelines these are entered under this heading.

A sideline can consist of several different line files that follow each other.



The numbering of the sidelines must be identical to the sideline numbering in the "input elements" in standard sections.

Left Side/Right Side

To edit the sidelines you must choose the side, "Left Side" or "Right Side" in the tree view that is to be edited.

When the side is highlighted in the tree view, you can define the sidelines in the field for the data view.

	Edge Line	Alternative Dis
1	-1	-3,500
2	-2	-3,501
3		

- Edge Line
  You enter all the numbers for the component sidelines in the standard sections for each side in this column. This number is connected to the line to the corresponding number in the standard section.

- Alternative Distance
  Alternative distance must be given for sidelines. This distance is used when no sideline is found. NOTE: These lines and alternative distances are very important for the standard section. The alternative distance is used, for example, for the joint between two lines that are part of the same sideline or where a sideline deviates, for example, at an intersection.

You can specify an optional number of sidelines.

When one or more sidelines are entered under Left and Right, the Left Side/Right Side of the tree view expands to display the specified sidelines.

Lines on each page

For each of the constituent sidelines there is the option of entering a cross fall model536 or a line file503 to be linked to the specified number. Intersections with the connected file will be calculated. If no intersection is found, the alternative distance for the line is used instead.

Point to a line to edit the constituent files for each sideline. A button appears to the right of each field which gives the option of browsing through available files.

	Line	Height Offset
1	linus.cfm	0,000
2		

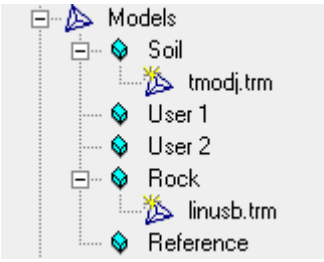
- Line
  You enter the file name for the desired cross fall model or line in this column. You can specify an optional number.

- Height Offset
  Specifying a height offset changes the height of the cross fall model or the profile height of the

sideline. A positive (+) value moves the cross fall model or the profile up and a negative (-) value down.

Models

You specify the models to use for the calculation under this heading. You can use terrain model files and cross section files.
The various beds for the models are located under the heading 'Models' in the tree. You can select several models for each bed which is why you do not need to aggregate model data for a project into a single model file, but instead you can specify all the files along the project, with the specification for the length range to use for each model.



You can use the reference model when a reference surface (finished road or the like) cannot be easily described using one standard section. The reference model can partly replace the standard section, but not completely, as the function of the standard section to create closed shapes between beds of the section must be used. You can use the reference model, for example, to indicate the excavation bottom in a house foundation with varying heights, or a gravel pit that is to be presented with stations.

Editing Model Files

Click the bed in the tree view (Soil, Rock, User1, User2) to be edited to open the correct input view.

	Model	Alternative Height	Start Station	End Station
1	demo_soil.trm			
2				

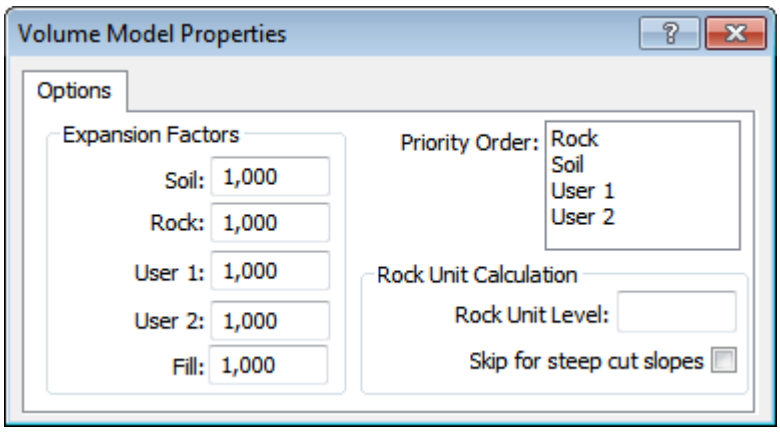
- Model
  Enter the model to use for this layer and interval. You can use terrain model files, trm, as a model, or cross section files, sec. The cross sections are then used as a simpler type of model. The cross section file can be created from a coordinate file, geo, whereby the lines should lie roughly perpendicular in relation to the sections.

- Alternative Height
  Specifying an alternative height in this column changes the height of the bed temporarily. A positive (+) value indicates that the bed moves up and a negative (-) value down. The purpose of this function is to simulate alternative positions for the bed.

- Start Station
  Enter here the start station for the terrain model or cross section file. If nothing is specified, the calculation uses the first model it encounters, i.e. the model at the lowest station. The start station for the model that comes lies after the first model can be specified with the same station as the first model's end station.

- End Station
  Enter here the end station for the terrain model or cross section file. If you do not specify an end station, the volume is calculated until the end of the model.

Properties for models in the calculation
Right-click the 'Models' node and select ***Properties...*** to edit expansion factors and the priority in the properties dialog etc.



- Expansion factors
  Specify the expansion factors to use when calculating volumes.

- Priority
  When surveying models, the models may intersect each other, for example, a rock model protrudes out through the soil model. The volume calculation cannot handle this which is why this problem should be corrected before the calculation is carried out. The action is automatic, but you can choose how to perform the operation by specifying the priority for each bed. For example, if rock has a higher priority than soil, the soil surface will be modified so that it always lies below rock where conflicts occur. However, if soil has a higher priority than rock, the rock will be cut off so that it always lies under soil.

- Rock Unit Level
  In some cases, you may need to divide a rock excavation into high and low rock, to regulate the compensation in a reasonable manner. Put simply, you could say that it is just as expensive to blast a square meter of rock at 0.1m depth as it is to blast a square meter with a 1 meter depth. If you calculate the square meters with a low excavation depth and cubic meters with large excavation depths, you can calculate Units = square meters + cubic meters. These units have given their name to the function to divide the calculation into square rock and cubic rock. Unit level refers to the excavation depth at which you want to separate area from cubic. If you specify the unit level you have the option of reporting the volumes in the volume report.

Calculation Limits / Border Polygons

To be able to calculate the subsets of a mass calculation, e.g. volumes within a building or excavation carried out at a certain time, you can specify one or more polygons that limit the area or areas to be calculated. The polygon's intersection with the sections are shown in the section as vertical lines. The reported volumes and areas are calculated from the areas lying between the intersections with the polygon. If several intersections occur in a section, the volume between each intersection pair is calculated, i.e. between intersection 1 and 2, 3 and 4, and so on. In this way, a polygon that encloses another is used to exclude an area in the middle.
Each border polygon is a line with at least three points in a coordinate file of the geo or pxy type. The line need not be closed because iCON office always calculates a planned line between the line's start and end points. You can only select one coordinate file in the calculation but the file may contain any number of border polygons (lines).

Top soil stripping / vegetation stripping

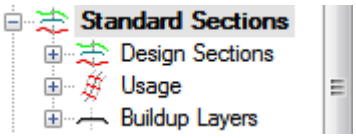
Top soil stripping and vegetation stripping are calculated in the same way. What is described as top soil below also applies to vegetation stripping. Note that you cannot calculate the stripping of both top soil and vegetation in the same section.

	Borders	Thickness	Embankment Height
1	veg.geo	0.250	1.50
2			

Top soil stripping reduces the soil surface in an area bounded by the polygon specified in the first column by the value given in the column thickness. You define the polygon as a coordinate file (geo or pxy). The calculation is the same as for border polygons, i.e. within each line in the coordinate file, the lines do not need to be closed as the first and last point are considered to be connected. If several intersections occur in a section, the volume between each intersection pair is calculated, i.e. between intersection 1 and 2, 3 and 4, and so on.
To calculate **general top soil stripping** , i.e. without border polygons, you do not specify any file name. The soil surface is then lowered within the range covered by the processed surface in the mbs. You cannot specify general stripping of both top soil and vegetation.
If the embankment height is entered, the top soil stripping will not be calculated in cases where the embankment height exceeds this height in the center line.

Standard Sections

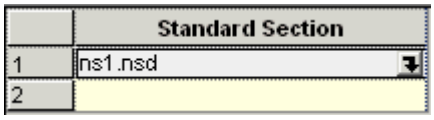
The 'Standard Sections' heading in the tree is divided into three sub-levels:



- Design Sections
  Here you add the standard sections to use in the calculation. You can also edit and create new standard sections from here.
- Usage
  Here you determine where along the main line the different standard sections are to be used, interpolation between standard sections and the lateral limits.
- Buildup Types
  You determine from here the stratification of the buildup in the standard sections.

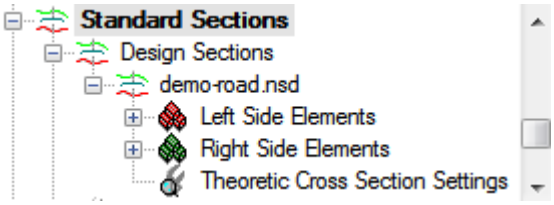
Editing Standard Sections

In the 'standard sections' nodes you specify all the standard sections to include in the calculation. Click the node Design Sections, to display a list of filenames of standard sections in the data view. To select an existing standard section in the calculation you can either enter the filename or click the arrow on the far right in the filename field.



To create a new standard section you enter a new (not existing) name in the field.

The standard sections that are entered in the list are also displayed in the tree structure.

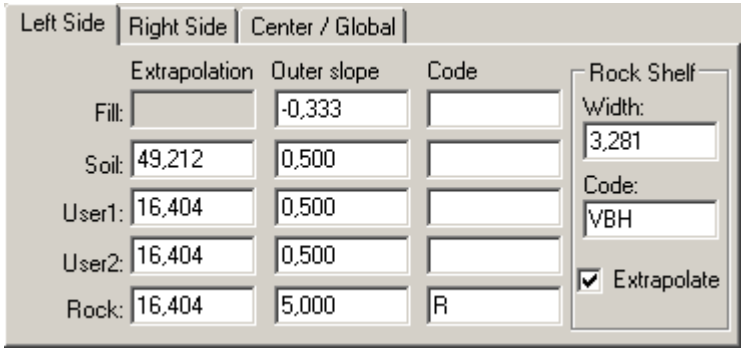


Standard Section Properties

Right-click a standard section in the tree and select ***Properties...*** to view the properties dialog. This contains three tabs: Settings for left and right side, and center/global.

Settings left/right side

The values entered in the left tab only apply to the left side of the standard section, and vice versa for the right.



- Extrapolation
  Maximum permissible extrapolation length (horizontal measurement). You use this value when the bed's extension is too narrow laterally, i.e. the model or sections do not cover the area needed to create the closed sections. Extrapolation refers to the extension of the bed to enclose the area in the section. If the figure cannot be closed within the specified maximum dimension, the program will try to enclose the area with a horizontal extension from the bed's outer edge. If you still cannot enclose the area within the specified maximum dimension, the area will be enclosed with a vertical line. Extrapolated lines are normally drawn as dashed lines in the section.

Default values	
Soil	15m.
User1	5m.
User2	5m.
Rock	5m. Should never exceed the extrapolation for soil.

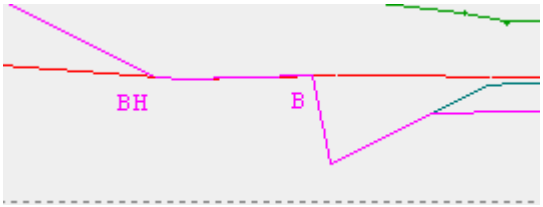
- Outer Slope
  Here you specify the slope gradients that the program uses to connect the various surfaces in the section. These slopes are applied from the outermost defined elements on each side with the slope in each material type in accordance with the selected values.

  Default Values

Filling	-0.33	(Slope 1:3 down)
Soil	0.5	(Slope 1:2 up)
User1	1.0	(Slope 1:1 up)
User2	1.0	(Slope 1:1 up)
Rock	5	(Slope 5:1 up)

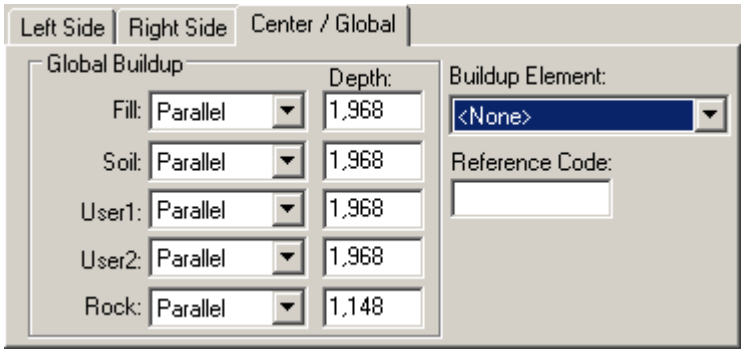
- Code
  Enter the code to be set for different slope gradients in the point where the slope meets the current layer. The code is set in the theoretical layer and in the excavation bottom and in all the buildup layers used.

- Rock Shelf
  If a rock shelf is to be calculated outside the rock slope, you specify the width and any code for the point where the rock shelf ends. The code is set in the theoretical layer and in the excavation bottom and in all the buildup layers used.



Center/Global

You can use the Center/Global tab to determine the settings for the buildups. You can select the type of buildup, depth and buildup section, i.e. the part of the road the selected settings are to apply to, in the center line and the elements in the standard section where you specify the 'global' option for the buildup.



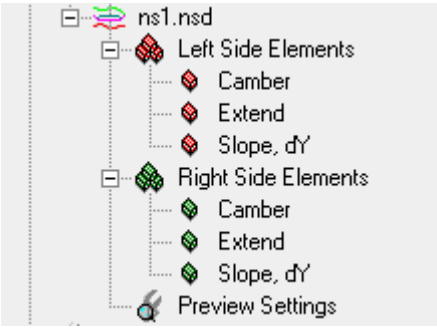
- To determine the buildup depth, three types can be selected:
  Parallel
  The bottom border of the buildup is parallel to the element’s top border with the thickness as per the specified buildup depth. The lateral extension of the buildup is determined by the intersection with the next element's buildup depth.

  Fixed
  A fixed vertical dimension under the element's end determines the depth. This means that the bottom border of the buildup must not be parallel to the element's top border.

Unknown
If the buildup depth is unknown, this means that the bottom border of the buildup crosses this element without affecting the buildup depth.

- Depth
  Specifies the depth (or thickness) of the buildup.
- Buildup Element
  Used if the layer (or bed) of the buildup is to be calculated. This option specifies the part of the current buildup type that applies in the center line.
- Reference code/code at center
  Enter the code to be set at the center of the standard section. The code is set in the theoretical layer and in the excavation bottom and in all the buildup layers used. If a **reference model** is used, all points in the layer will also be assigned this code.

Inputting/Editing
To edit an individual standard section, click on the desired standard section in the tree view and expand it to *Left Side Elements, Right Side Elements* and *Preview Standard Section*. Each side can then be expanded to display each element.



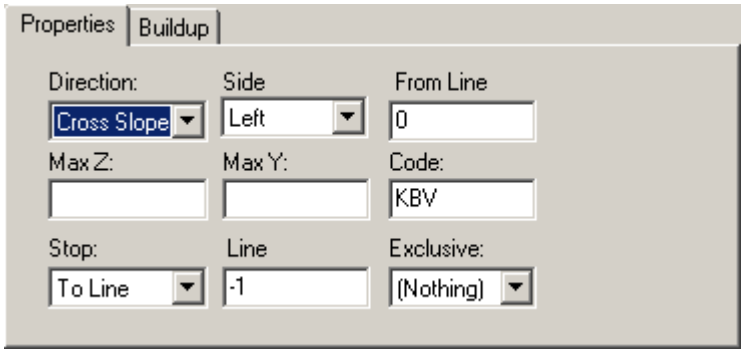
By right-clicking on the standard section of the tree and then choosing ***Section view*** in the menu switches the graphical view to show the cross section orientation with the current section visible. When an element is selected in the tree, a selection also displays in the graphical view. Note that the graphical view must be set to display a section covered by the standard section the elements of which are highlighted in the tree in order for the selection to be visible in the graphical view.
You can also select the option ***Preview Standard Section*** which means that the standard section is shown in its theoretical location.

The input elements can be edited in the data view as well as in the properties dialog for an element.

- Data View
  Editing takes place in the data view by first pointing to the left or right side of the tree which brings up element information in the data view.

	Direction Type			Code	Max Y	Max Z	Stop		Exclusive To
1	Camber (from side, from line)	Left	0	KBV			To Line	-1	(Nothing)
2	Extend (dZ, dY)		0,2500	SR			(Nothing)		(Nothing)
3	Slope, dY	-0,5000	-1,5000	DS			(Nothing)		(Nothing)
4									

- Properties Dialog
  You edit the properties dialog by right-clicking on the desired element in the tree and selecting ***Properties…***, the dialog contains two tabs: Properties and Buildup.



Direction:
Select a direction definition for the element. You select parameters in the data view for the chosen definition in the two columns to the right of the direction type. For example, if you select 'dZ, dY', you specify the dZ dimension in the first column and the dY dimension in the second column.

- Unknown
  The direction of the element varies and is determined in height and laterally by a line and profile.

- dZ, dY
  Enter a fixed definition of the element by describing the change in height (dZ) and side (dY) from the beginning to the end of the element. If a "Stop" is specified, the element's height and offset will only be seen as an indication of direction rather than an absolute measurement.

- Slope%,dY
  Enter a percentage and a horizontal dimension for the extension. If no horizontal dimension is given, you must use a "Stop". Note that "no dimension" is specified by leaving the field empty.
  Do not use 0 (zero) as this means zero extension!

- Slope, dY
  Enter an R number in decimal format, and a horizontal dimension for the extension. R number refers, for example, to 1:3 = decimal 0.333, negative numbers relate to downward slopes. If no horizontal dimension is given, you must use a "Stop". Note that "no dimension" is specified by leaving the field empty.
  Do not use 0 (zero) as this means zero extension!

- Follow layer, dY
  This type is used to follow an existing bed, such as a rock shelf with a given horizontal extension.

- Cross slope (from side, from line)
  This element is used for roadways and suchlike. The element slope is loaded from the cross slope file for each calculated section that is connected to the selected line. From the side, you normally specify left for elements on the left side, and right for elements on the right side, but it is possible to use the cross slope value that applies to the right line on the left side of the element and vice versa. Enter the line (number, see sidelines 692) from which the cross slope is to be loaded. The center line number is normally 0 (zero).

- Extend (dZ, dY)
  Select this element when the element is to continue in the same direction as the previous element. dZ and/or dY can be specified or left blank. If you specify both values, the value that complies first has the highest priority . If no value is specified, you must specify a "Stop".

- Special Slope
  You use this element when you want to have a steeper slope to the road structure compared to the slope. You then get a wedge in the slope which enables you to calculate the volume of the flat slope separately. Enter the slope coefficient to apply (R number 699 as above). The special slope element should be seen as a temporary break in the construction of the theoretical surface. After this element, the program jumps back to the starting point for the special slope where you can then complete with the remaining elements for the theoretical surface (i.e. the flat top of the slope). The downward extent of the special slope is calculated automatically, i.e. you do not specify any length for the element.

The length depends on whether you are in an intersection or in a filling. In the intersection, the special slope is extended so that it meets the terrace. The appearance of the terrace is then determined as usual using the buildup thickness. However, for the filling the special slope is extended automatically down to the uppermost model bed. The terrace will then be broken in relation to the special slope, and then follow the current bed until it meets the theoretical surface again. However, you can also set an element to stop "against the terrace". In this case, the special slope runs down to the terrace and then you determine the appearance of the terrace in the normal way using the buildup thickness.
Any buildup layer is always calculated in relation to the special slope if it exists.
If you use the special slope element type, a special layer is created for this in the cross section. Only one special slope element per side can be used in a standard section.

Code
Enter the code for selecting the element. If the code is given, the resulting file will contain this code. You can use this to distinguish different types of data for further processing, such as excavation borders and ditch bottoms, and some reports are also based on coding. However, the code is not mandatory. The code is set in the theoretical layer and in the excavation bottom and in all the buildup layers used.

Tip! By setting codes for the elements in the standard section, you can calculate the horizontal or sloping area in any part of the mass calculation. See ' Area calculation of plane surfaces from cross sections 714'.

Max Y
A maximum permissible horizontal extension can be given. If the maximum dimension is exceeded the element is rejected.

Max Z
A maximum permissible vertical extension can be given. If the maximum dimension is exceeded the element is rejected.

Stop
Choose the type of "Stop" for an element. This must be selected if you have not selected a fixed dimension for the element before!

- (Nothing)
  No stop.
- To Line
  The element stops when it meets a line in plane.
- To Profile
  The element stops when it meets a profile in height.
- To linPrf
  The element stops at a line with profile. Both the height and side are controlled by the line and profile. The type of direction is unknown.
- To linCLPrf
  The element stops at a sideline laterally but at the main line's profile in height. Both the height and side are therefore fixed, the type of direction is unknown. This element can be useful when you want to start from the profile height even though it is an element that does not start at the center of the standard section.
- To Layer
  The element stops *when* it meets the layer that is selected. A meeting with a layer is expected to occur. The direction of the element is determined by the direction type values.
- Break at Layer
  The element stops *if* it meets the layer that is selected. If there is no meeting, the element runs as far out as is specified for the direction type.
- To terrace

The element stops at the terrace surface.

In the next column/field, depending on the type of stop, you select the object the stop applies to:

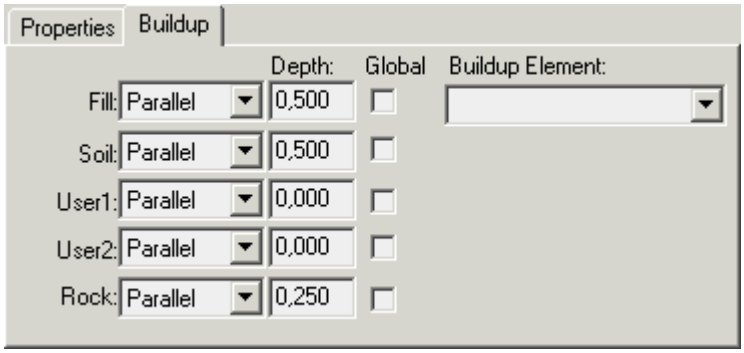
- Line number (see sidelines[692])
- Layer (see models[693])

Exclusive

Here you have the option of only letting the element apply to a specific bed. The element will be included in the standard section if the starting point lies in the current bed. If this is not the case, the next element in the standard section will automatically be used. Select from 'Fill', 'Soil', 'User1', 'User2' and 'Rock'.

Buildup

The buildup's total depth for each type of material can be specified here.



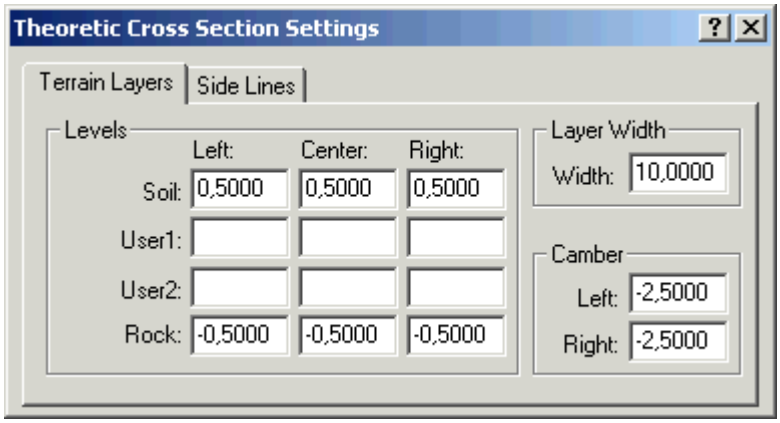
If the **[Global]** box is checked, the depth and control will be loaded from the standard section's general settings, see Standard Section Properties[696].

- For control of the buildup depth, three types can be selected:
  - Parallel
    The bottom border of the buildup is parallel to the element's top border with the thickness as per the specified buildup depth. The lateral extension of the buildup is determined by the intersection with the next element's buildup depth.
  - Fixed
    A fixed vertical dimension under the element's end determines the depth. This means that the bottom border of the buildup must not be parallel to the element's top border.
  - Unknown
    If the buildup depth is unknown, this means that the bottom border of the buildup crosses this element without affecting the buildup depth.
- Buildup Depth
  Right-click the element in the tree to view the element's properties and select the buildup depth for the element.
- Buildup Element
  If a bed (layer division) of the buildup is used you can also select the buildup element here. This option specifies the part of the current buildup type that applies for the element. Editing of the bed takes place under the heading Buildup Types[703] in the tree.

Theoretic Standard Section Settings

If the model is missing, you can use the default values for the various layers to test how the section will behave in different situations. These fictitious layers can be designed appropriately by entering numerical values for the extension and level. This is done under levels. A fictional cross slope can also be defined for the standard section. These settings affect the graphical view if the option ***Show Theoretic Standard Section*** is selected in the menu when you right click the tree.

You edit the settings by right-clicking on the heading "Theoretic Standard Settings' ' in the standard section and select ***Properties...*** from the menu.

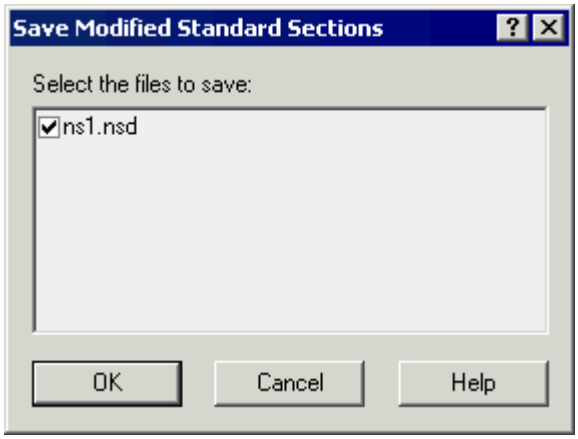


- Levels
  Enter a +height for each layer for left, center and right edge of the bed. The height specified refers to a height relative to the profile height in each section. The center refers to the height in the center line. Left and right refers to half the layer width on each side of the center line.
- Layer Width
  The fictitious bed width is specified here.
- Cross Slopes
  Enter values for cross slopes when previewing a standard section, without selecting line calculation. Enter the fictitious cross slope in percent for each side.

Under the *Sidelines* tab it is possible to determine the position of a number of sidelines on the left and right side.

Save Standard Sections

After a standard section has been edited, you can save it by selecting ***Data | Save Standard Sections***.



Usage

Here you determine where along the main line the different sections are to be used, interpolation between standard sections and the lateral limits.

	Standard Section	Start Section	Interpolation	Max Left	Max Right
1	demo-street.nsd	400,000	No		100,000
2	demo-street2.nsd	1 345,000	Yes		100,000
3	demo-street_interpol.nsd	1 377,000	No		100,000

- Standard Section
  Select standard section by clicking in a field in the column for the standard section and click on the arrow to the right in the field. The standard sections specified must be listed under the heading Editing 698. The file type for standard sections is nsd.

- Start Section
  Specifies where the use of the standard section starts. The section applies up to the definition of the next standard section if no interpolation is specified. Enter the start section for the section where a change occurs. The change may be the replacement of the standard section, or that an interpolation is to start or end.

- Interpolation
  If interpolation is specified, the standard section will be interpolated elements by element to the next specified standard section.
  Note that there must be exactly the same number of elements in the two sections for which interpolation occurs in order for the interpolation to work properly.

- Max left/right
  Specifies the maximum extension to the left and right for the mass calculation. If you have a wide model, the drawing of sections can be limited using this dimension.

Buildup Types

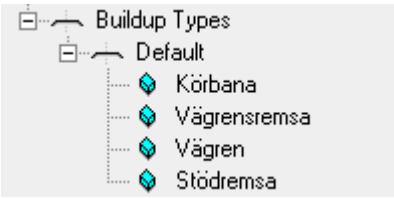
Buildup types and buildup files (bup)

Under this heading, you determine the stratification of the buildup in different layers. A buildup type describes the layers/beds to include in the buildup, and their use in various sections of the road. You can create several types of buildup, but only one can be active at a time for a mass calculation. Buildup types are saved in a special file of the 'bup' type. The buildup type used in a specific volume calculation is saved locally in the same project as the mbs file. Normally, this also has the same name as the mbs file, but with the bup file type. In the local bup file you can have one buildup type at a time. In a global bup file, however, you can store any number. It is therefore possible to use the global file (or files) as a kind of library for different types of buildup.

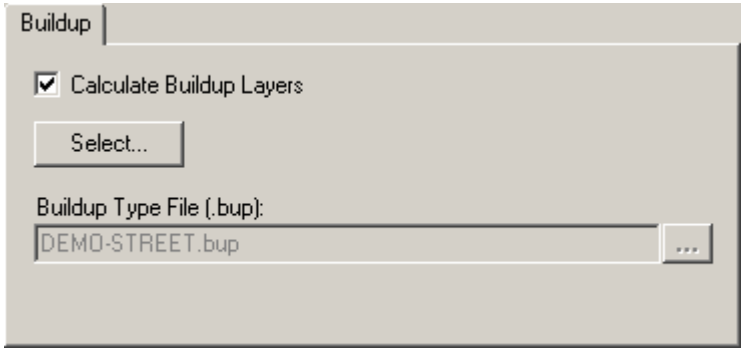
Buildup Elements

In order to be able to specify different layer thicknesses for different parts of, for example, a road structure, the buildup type is divided into different buildup elements. Lane, shoulder and slope are examples of what can be said to be different buildup elements. You can define any number of parts and you can call them what you want. In the standard section you talk about the buildup element that applies in the center and for each element on the left and right side. In this way you can determine the layer thicknesses that vary between different parts of the cross section. For example, you can specify that the wearing course should have a certain thickness for the lane and another for the shoulder. You then set the wearing course thickness of the slope to zero to prevent the calculation being carried out there. Having to set the thickness to zero depends on you not being able to remove a particular bed for a part of the cross section; all the beds that are defined in the buildup type will appear above the whole surface. You can also set the buildup element for a particular element to 'none' to prevent the calculation of the bed happening there. If you want the same layer thickness throughout the cross section, it is sufficient to specify a buildup element.

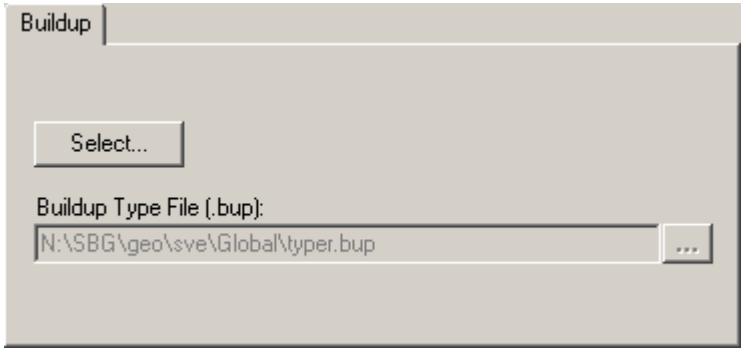
Buildup Tree
The tree structure shows the buildup types that are entered. Under the heading '*Current buildup type*' you will find the buildup type that will be used in the calculation. It is also this that will be stored in the local bup file when the volume calculation is closed. Under the heading '*Saved Buildup Types*' you will find the buildup types belonging to the selected global bup file.



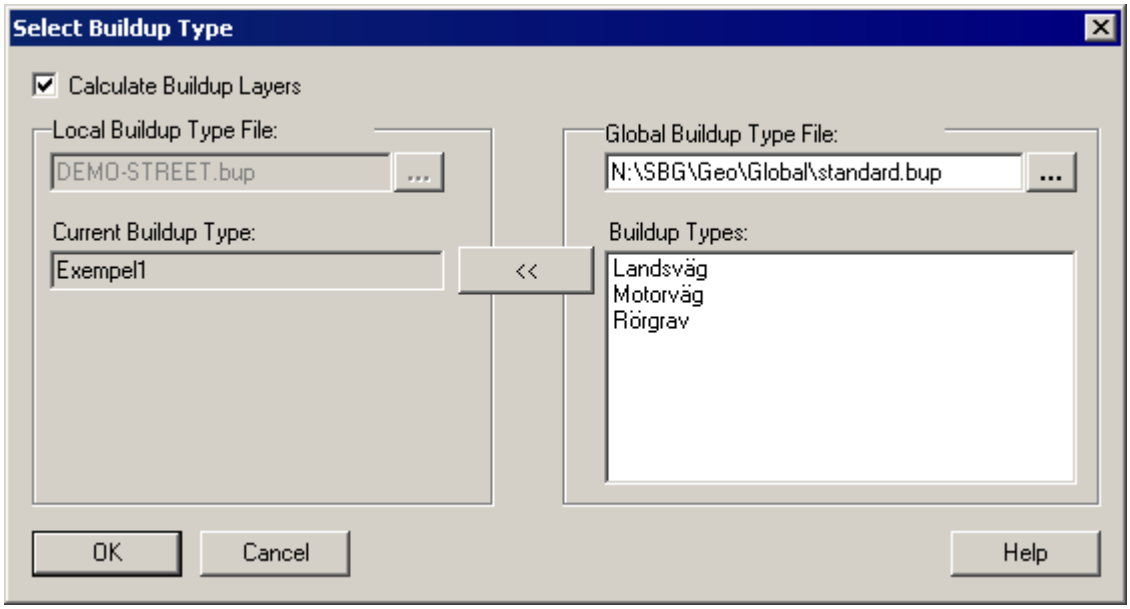
By right-clicking on the heading '*Current Buildup Type*' and selecting ***Properties...*** you can see the *local* file with the buildup types that are used.



By right-clicking on the heading *Saved Buildup Types*' and selecting ***Properties...*** you can see the *global* file with the buildup types that are used.



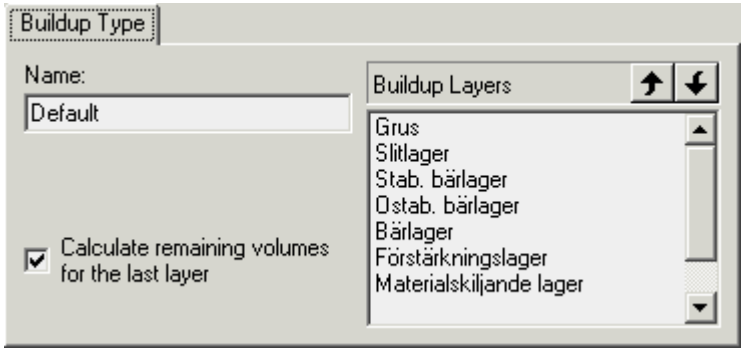
Select Active Buildup Type
In order to determine the bup files to use and to select the current buildup type, you go to ***Data | Buildup Layer | Select Buildup Type*** or click the **[Select]** button in the dialogs above.



- **Calculate Buildup Layers**
  This option determines whether to calculate buildup layers or not.
- **Local file with buildup types (bup)**
  Here you can see the filename of the file that contains the current buildup type. The file is created when the mbs file is saved. If the field is blank, the file has not yet been created.
- **Current Buildup Type**
  Here you see the name of the buildup type that is used to calculate the layers in the buildup. To select a different buildup type, you select the desired type from the list on the right and then click the **[<<]**button.
- **Global file with buildup types**
  Here you see the filename of the file with available buildup types (bup).
- **Buildup Types**
  The list shows the buildup types contained in the selected global bup file.

Edit Buildup Types
You can edit buildup types in the numerical data view689 and in the properties dialog by right-clicking on the desired object in the tree and selecting *Properties*.

When the heading 'Current Buildup Type' is selected, the name and description of the data view appears. You cannot change anything here as you have to use the properties dialog instead.



In the properties dialog for a buildup type you determine which layers to include.

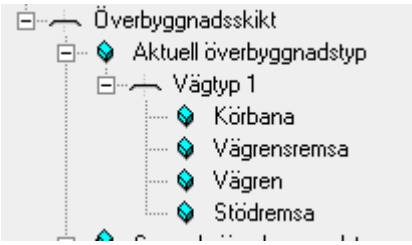
- Name
  You can enter the buildup type name here.
- Description
  You can enter a descriptive text about the type here.
- Buildup Layers
  You can edit the layers to use in the buildup here. Double-click a row to edit the name of a layer. Use the arrows to determine the order for the different layers.
- Calculate the remaining volumes for the last layer
  This option means that the lowest layer is calculated in relation to the excavation bottom.

When the heading 'Current Buildup Type' is selected, the available types also appear in the data view.

	Buildup Type	Description
1	Default	
2		

- Buildup Type
  Enter a name for the buildup type.
- Description
  You can enter a description here.

Each buildup type is divided into a number of segments (buildup elements) in order to be able to specify different bed depths for different parts of the cross section.



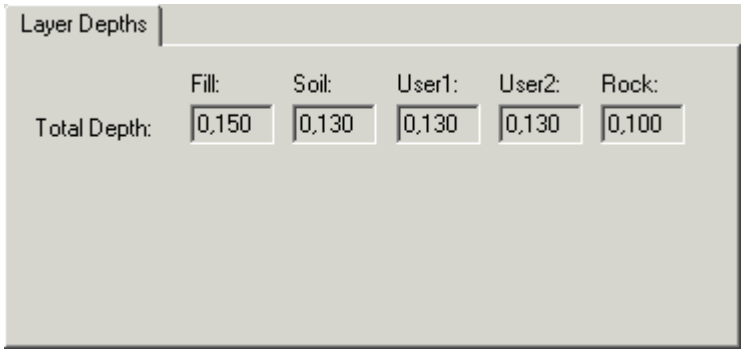
You can add, delete and edit buildup elements in the data view.

	Buildup Segment	Description
1	Körbana	
2	Vägrensremsa	
3	Vägren	
4	Stödremsa	
5		

You can edit the different layer depths for different soil beds and buildup elements in the data view by selecting the desired buildup element from the tree. An asterisk, *, after the layer name indicates that the depth is calculated to the excavation bottom and the depth values therefore have no effect on the layer. If you enter 0 or blank in a field, the bed will not have a thickness for this element and therefore the volume is not calculated here either.

	Fill	Soil	User 1	User 2	Rock
Grus	0,020	0,020	0,020	0,020	0,020
Slitlager	0,030	0,030	0,030	0,030	0,030
Stab. bärlager	0,100	0,080	0,080	0,080	0,050
Ostab. bärlager					

Note that the sum of the layer depths for a soil bed cannot exceed the total depth of the buildup. In the properties dialog for a buildup element, the total depth of the buildup in the different soil beds is shown.



- Total depth
  Specifies the depth of the buildup element in different soil beds.

Copying buildup types
By selecting a buildup type in the tree you can copy it using ***Edit | Copy***. You can then paste a copy of it using ***Edit | Paste***. You can copy from the local file to the global one as well as within the global file. However, you cannot copy a buildup type from the global file to the local file, as you then have to choose an active local buildup type instead in the manner previously described.

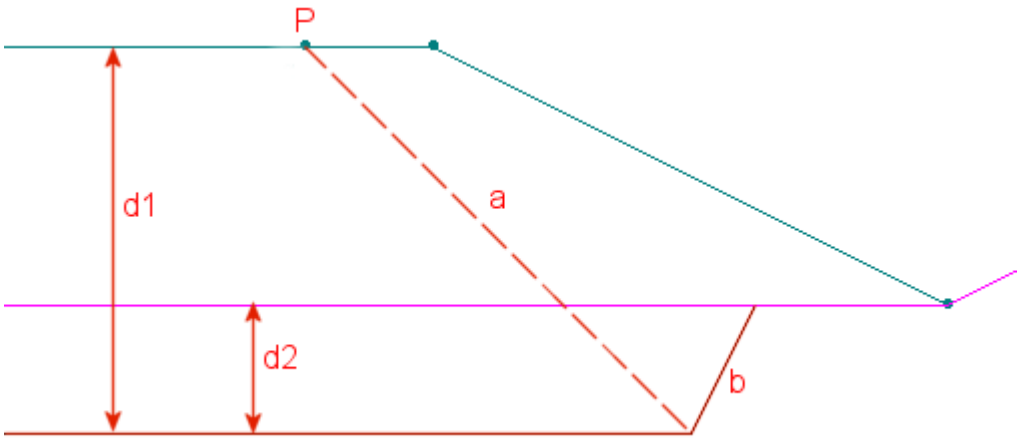
Transition sections and soil replacement

Transition sections and soil replacement are calculated under the corresponding heading in the volume tree.

Please note, to insert transition sections and soil replacement in a volume calculation document, a buildup depth must be at least 0.001 see below 709.

You enter a start section and an end section for each section interval where transition sections/soil replacement are to be calculated. The depth at the start section and the end section is also specified. In the column '*Relative* ' you enter the depth to be calculated from the surface (theoretical, measurement ***d1*** in the image) or from the terrace (excavation bottom, measurement ***d2*** in the image). Laterally, the excavation is limited based on a point at the surface. The desired limit point (e.g. road curb, point ***P*** in the image) must be assigned a code in the standard section. This code is entered in the columns for *'code left/right'* in the table. The extension laterally is then determined by a planned line (***a*** in the image) from the limit point down to the bottom of the excavation. You enter the slope coefficient for this line in the *'Limit Slope'* column. The standard slope is 1:1. The slope back up to the standard terrace (**b** in the image) is specified in the *'Outer Slope'*column. Here the default value is 2:1.

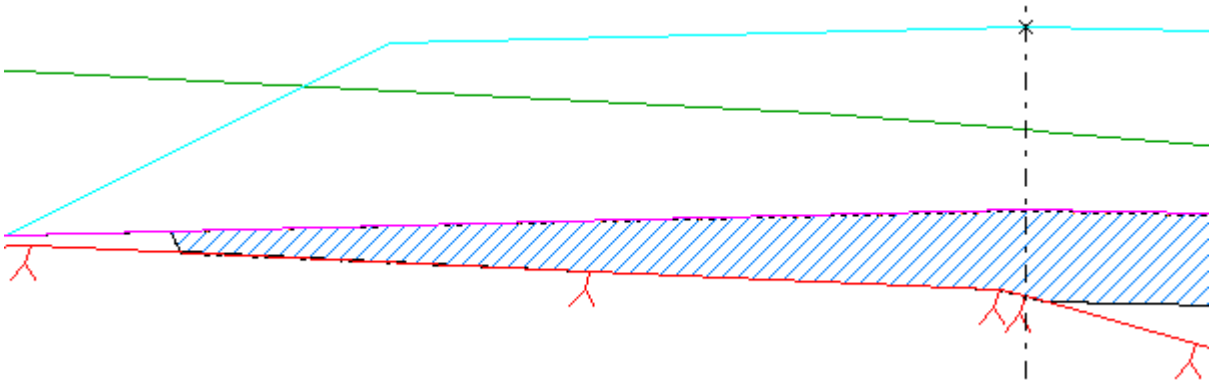
	Start Section	Depth	End Section	Depth	Relative	Code Left	Code Right	Limit Slope	Edge Slope	Rock Cut
1	620,000	6,500	633,000	6,500	Excavation	VKA	VKA	1,000	2,000	☑
2										☐



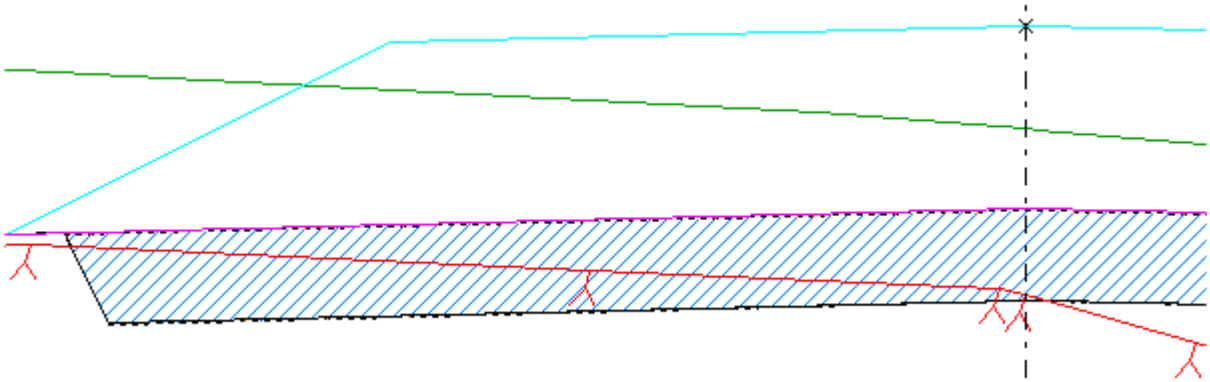
Part of cross section. Measurements for calculating the transition sections.

The depth of excavation interpolated linearly between the start and end sections. To create a transition wedge you enter different depths at the start and end sections. If the depth is given relative to the surface, the dimension must be at least equal to the depth of the buildup.

The *'Rock Cut* field determines whether the transition section is to stop at the rock or not.



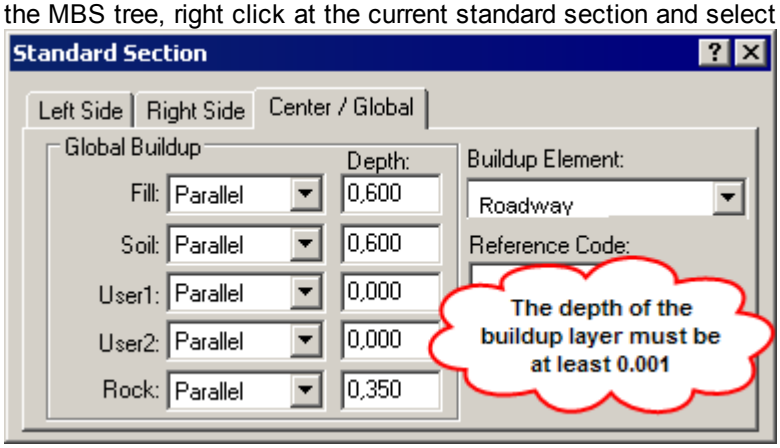
No Rock Cut



Rock Cut

The volume for transition sections/soil replacement is calculated between the normal excavation bottom and the bottom border for the additional excavation. If the entire terrace lies in the filling in a section, no calculation is made for transition sections/soil replacement there. If parts of the terrace are in the filling, transition sections are calculated up to the soil layer.

Please note, to insert transition sections or soil replacement in a volume calculation document, some thickness of the buildup layer must have been entered. The buildup layer depth must be at least 0.001. In the MBS tree, right click at the current standard section and select *Properties*.



Calculation Interval

Here you specify the start and end point and the interval for the calculation. This means that you can calculate a part of the mass calculation you have created without changing the mass description in general. You can also choose different intervals for different parts of the calculation, without any regard to the location of the different standard sections.

	Start	End	Interval
1	370,000	450,000	10,000
2			

- Start
  Enter the first section to be calculated. The calculation will be performed using the interval that is on the line up to the end section of the line or to the start section on the next line.

- End
  Enter the last section to be calculated. If you specify several lines for the calculation, you can leave this blank, whereby the change of interval occurs at the start section specified on the next line. You can create breaks in the calculation by entering an end section, and on the next line entering a start section which is located further in in the mass calculation.

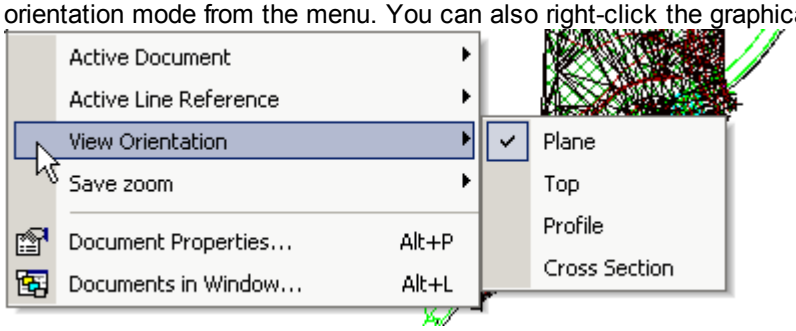
- Interval
  Enter the interval for the part of the calculation that lies between the start and end sections on the same line, or if no end section is indicated, the start section on the line and the start section on the next line.

Graphical View

By clicking in the graphical view, you gain access to the graphical tools and can edit the data in the same way as in a standard graphical view. See also Graphical Views 47.

All the files included in the mass calculation (and that can be displayed graphically) are automatically entered in the graphical view when an mbs file is opened. This allows you to switch active documents as in other graphical views and edit data.

Orientations
There are three orientation modes that are selected by right-clicking in the tree and selecting the desired orientation mode from the menu. You can also right-click the graphical view and select ***View Orientation***.



- Plane
  Displays a plane view of the mass calculation.
- Section, offset
  Displays the section and offset as well as polygons for the calculation limits, and top soil stripping and vegetation stripping. Use the buttons to scroll forward and backward .
- Profile
  Displays a profile view of the mass calculation.
- Section view
  Displays a cross section view for the current length section. The section that is current is determined either by using the buttons to scroll, , or by clicking in the tree at the start of a calculation interval or the start of a standard section interval. You can also select the option ***Preview Standard Section*** which means that the standard section is shown in its theoretical location.

Section stepping
If you select the section view and the mbs document is active, you can step through the mass description without the previous calculation. The selected calculation interval is used to choose the section forward or backward step by step. A mass calculation is carried out for the selected section, each time changing section to see exactly how the outcome will be when you make the mass calculation. Volumes and areas are shown in the input/output window 107.

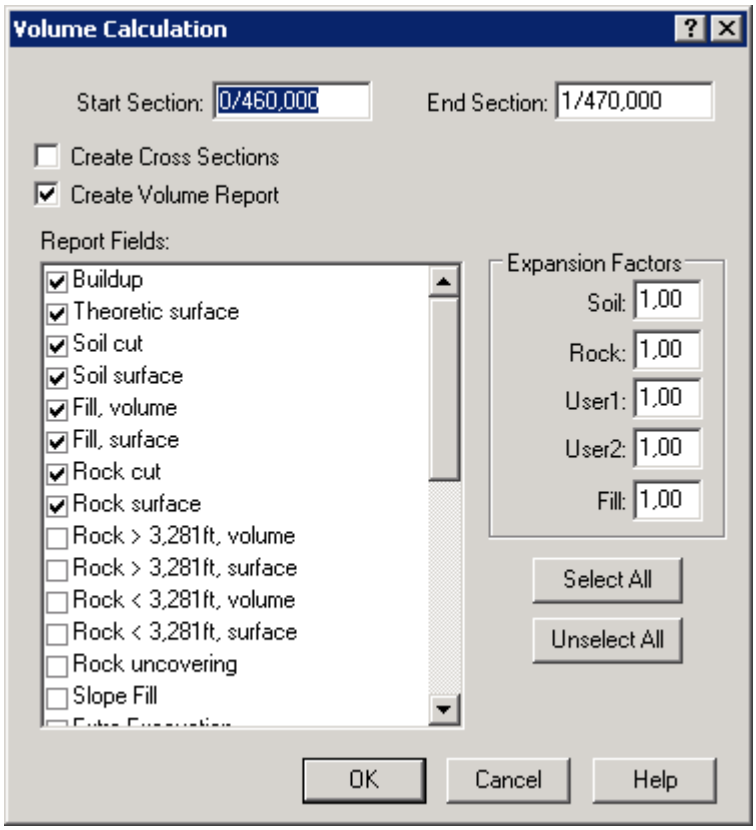
Use the buttons to step to first, previous, next or last cross section in the calculation interval. Click to go to a specific section.

Graphical 3D View
In a separate tab in the graphical part of the mbs window, 3D graphics are always available. Here is a presentation of the entire mass calculation in a three dimensional perspective view. See also 3D Graphics 80.

Calculation of volumes

To perform a calculation of the volumes you select ***Data | Calculate Volumes…***.

A dialog shows the choices made for the calculation.



You can temporarily change the scope of the calculation here by selecting sections other than those proposed.

Check the box if sections are to be created (for drawing/review) and if a report is to be generated, and if so, the content required in the report.

Report Field

- The volume field reports the cross section area of the current bed in each section. In addition, the volume is calculated using the mean area between two sections and the distance between the sections. The volumes are summarized at the end.
- The area field shows the horizontal length from left to right for the active bed in each section. In addition, the flat area is calculated using the mean length between two sections and the distance between the sections. The areas are summarized at the end.

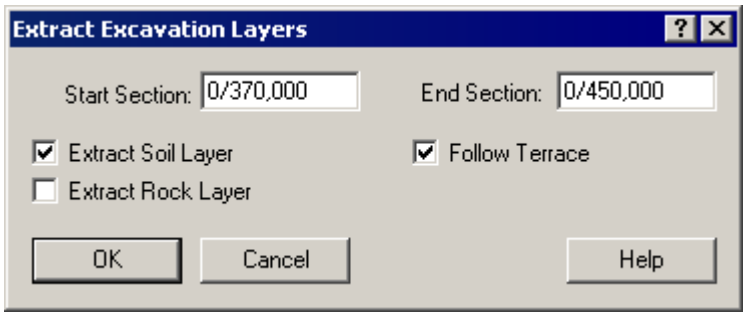
Fields	Type	Description
Buildup	Volume	The volume and cross section area for the buildup between the theoretical surface (upper surface) and excavation bottom/terrace. If a special slope has been used, the buildup is only calculated for the part that is inside the special slope layer. The sum of this volume and the volume of the special slope (see below) represents the total buildup volume.
Processed surface	Area	The horizontal length and area of the entire area affected by the calculation.
Soil excavation	Volume	Volume and cross section area for the excavation of soil down to the terrace.
Soil surface	Area	The horizontal length and area for the ground covered by soil excavation.
Fill	Volume	Volume and cross section area for the infill up to the terrace.
Fill	Area	The horizontal length and area of the area covered by the filling.
Rock excavation	Volume	Volume and cross section area for the excavation of rock down to the terrace.
Rock surface	Area	The horizontal length and area for the ground covered by rock excavation.
Rock excavation > unit height	Volume	Volume and cross section area for the excavation of rock down to the unit height above the terrace.
Rock excavation > unit height	Area	The horizontal length and area for the ground covered by rock excavation above the unit height.
Rock excavation < unit height	Volume	Volume and cross section area for the excavation of rock from the unit height down to the terrace.
Rock excavation < unit height	Area	The horizontal length and area for the ground covered by rock excavation below the unit height.
Rock overburden removal	Area	The horizontal length and area for the ground covered by the rock excavation and overburden removal/clearing of rock.
Special slope	Volume	The volume and cross section area of the part of the buildup which lies outside the road structure bounded by the special slope layer.
Transition sections	Volume	Volume and cross section area for transition sections and soil replacement. The calculation is made up of standard terrace surfaces if this is not in the filling. The calculation is then made up to the soil (i.e. in this volume there is never any fill volumes).
Excavation User 1/2	Volume	The volume and cross section area of the excavation of layers for user 1 and 2 down to the terrace.
Surface User 1/2	Area	The horizontal length and area for the ground covered by the excavation for user 1 and 2.
Topsoil/Vegetation	Volume	The volume and cross section area for top soil/vegetation stripping.
Topsoil/Vegetation	Area	The horizontal length and area for the ground covered by top soil/ vegetation stripping.
Beds in the buildup	Volume	The volume and cross section area for the different beds in the buildup. If the horizontal/sloping length and area area required instead, these values

		are obtained by selecting the "Area Calculation of Surfaces".

The created section file (sec) and the report file (rep) are displayed when the calculation is finished.

Extract excavation bottom

You use this function to pick out the calculated surface of the soil excavation and/or rock excavation. The results are obtained as a cross section file, sec. For soil excavation you can also choose that the surface follows the terrace.



Start section/End section

Enter the sections within which the extraction is to be done.

As the codes and plane coordinates from the mass calculation are included with the section file, you can proceed with the Extract Plane Coordinates 631 function if a terrain model is to be created for the current excavation layer.

See also Volume Calculation in General 687.

12.4 Area calculation of plane surfaces from cross sections

You use this function to calculate plane surfaces along a cross section calculation. The calculation can be done either directly from a mass calculation (mbs) file or from a calculated cross section file (sec file). The surfaces may be limited laterally by points coded in the standard section. The result is given in the form of a report as the aggregated areas and sub-areas along the calculation range. You can use the function, for example, to calculate the area for the asphalt or road slopes along a stretch of road. Other applications could be to calculate the surface area for grass seeds or rock overburden removal.

Sloping surfaces
The method for calculating the area means the sloping length of the desired surface (i.e., the sloping length between two points in a given layer in a section) is calculated in each section of the calculation interval. The area between the two sections is set as the product of the distance between the sections and the average length of the desired surface in the two sections. The distance between the two sections is determined by the calculation range in the volume calculation. In a section file, the range is determined for the cross sections contained in the file. By setting the start and end section of the calculation, a subset can be calculated but the only way of changing the calculation frequency is to change the interval in the mbs file.

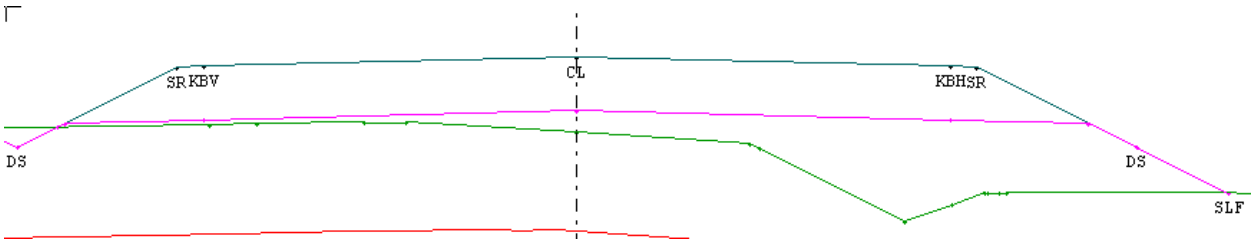
Horizontal surfaces
The method of calculation is the same as above but instead of sloping lengths, horizontal lengths are calculated.

The desired surface can be limited using the code for points in the cross sections. The code is set easiest directly in the standard section in the volume calculation. In this way points are automatically assigned with the correct code in the finished cross section. You can also edit the code for the points in a cross section file later. If you want to calculate the whole area for a specific layer, you do not specify any limit codes. The program goes through the points for each layer in the cross section from left to right and adds up the sloping length from the point of the first code and then to the point with the second code. You can also specify a secondary calculation interval. This may be useful if, for example, you want to calculate the slope areas on the left and right side. In this case enter the codes for the left slope points in the first code pair and codes for the right slope points in the second code pair. If you want to calculate a continuous length that begins on the left side but ends on the right side, it is sufficient to specify a code pair with the limit points' codes.

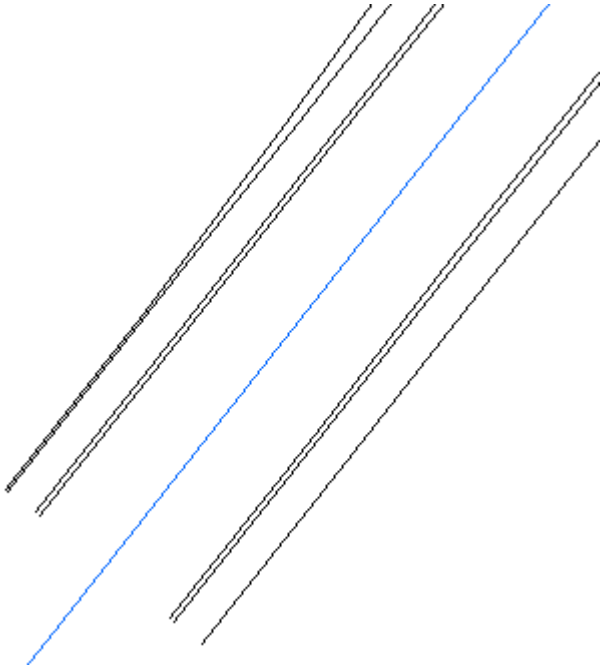
For each surface to calculate, you indicate in which layer the surface is and the codes that limit the surface. In addition you enter a description, e.g. asphalt, for the surface. Each set of this type can also be stored by iCON office in the Windows registry where you can easily calculate the same areas on several occasions.

Example

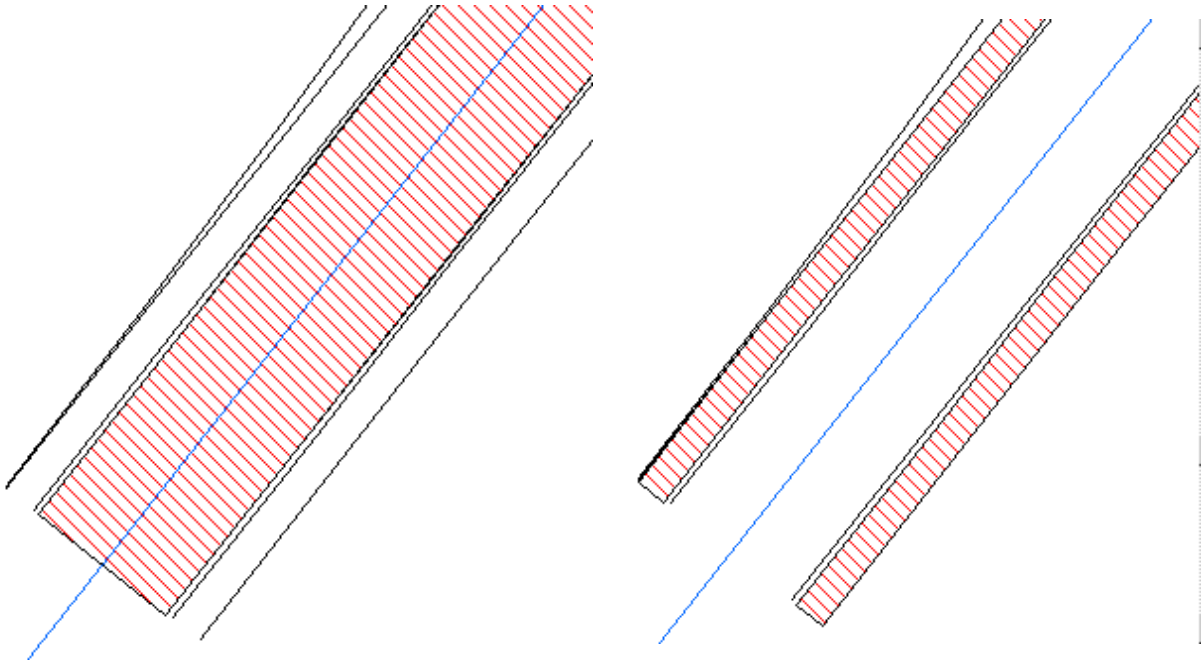
The example below shows how to calculate the areas of various surfaces along a section of road described in a volume calculation (mbs file).



The road section in the cross section, with the codes from the standard section printed.



Road section from above.

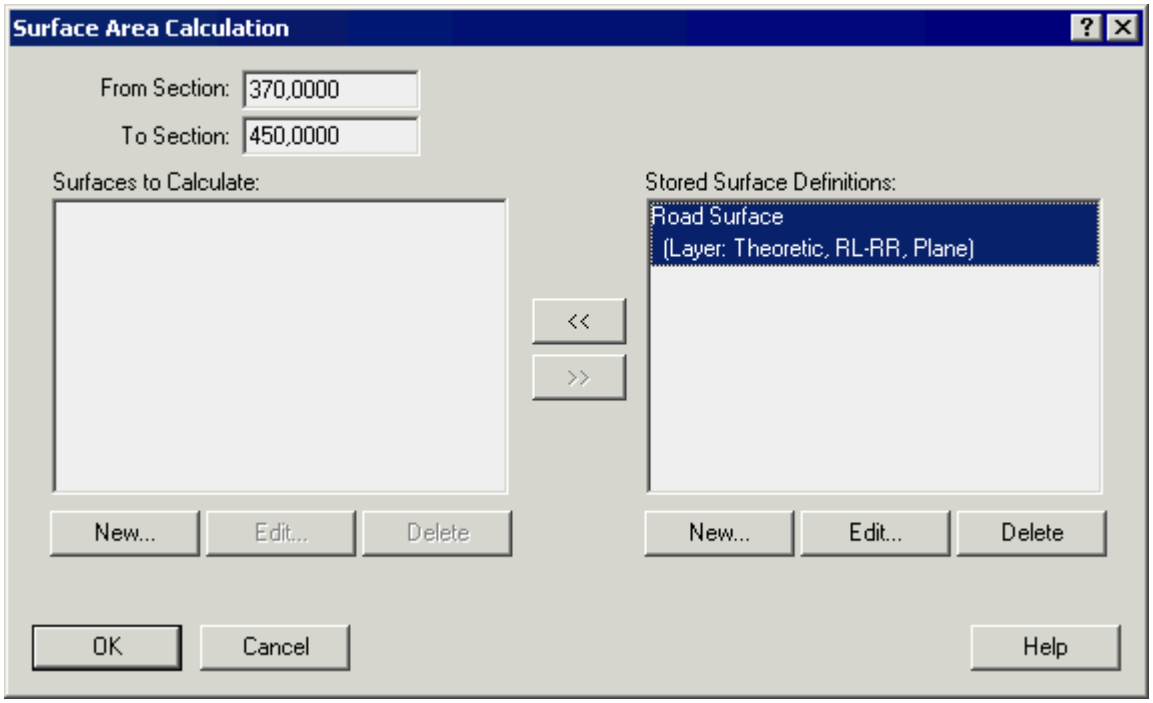


E.g.1: Calculation of the roadway between codes KBV and KBH

E.g.2: Calculation of the slopes between the codes DS-SR and SR-DS

Procedure

Open either an mbs or a sec file and select ***Data | Area calculation of Surfaces*** to carry out the calculation.



From section/To section

Enter the sections between which the calculation is to be made. Based on a mass calculation, the calculation interval in the .mbs file is used.

Surface to Calculate

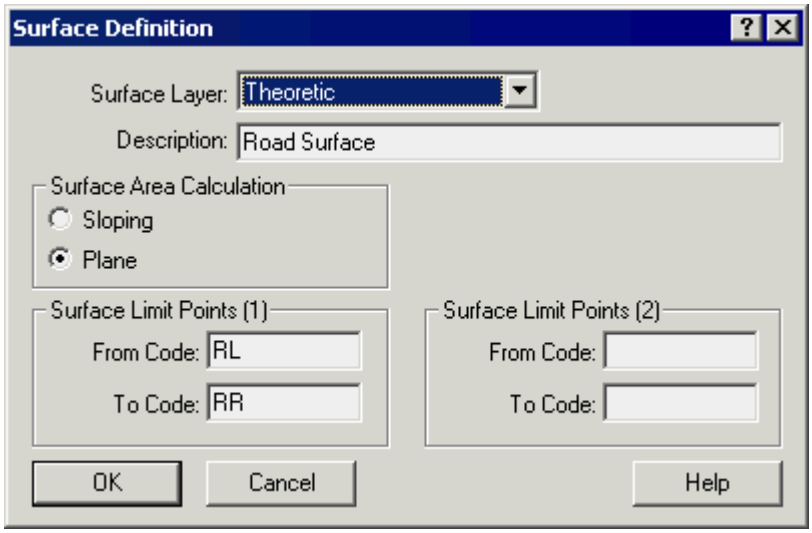
The list shows the surfaces that will be calculated. Complete either from the saved surface definitions by clicking the **[<<]** button or selecting **[New…]** to create new definitions. You can also edit and delete surfaces from the list.

Stored Surface Definitions

The list shows the definitions that are saved in the Windows registry for use on several occasions. Select **[New…]** to create new definitions. You can also edit and delete surfaces from the list. Use the **[>>]** button to move an area over from the current calculation.

Surface Definitions

When you create a new surface or edit an existing one, a dialog appears with the surface's definition data.



Layer for the surface
Indicate in which layer the actual surface exists.

Description
Enter a description for the surface. This name must be unique among the surfaces. The name will be visible in the area report.

Sloping or plane areas
Specify if sloping or plane (horizontal) surfaces are to be calculated.

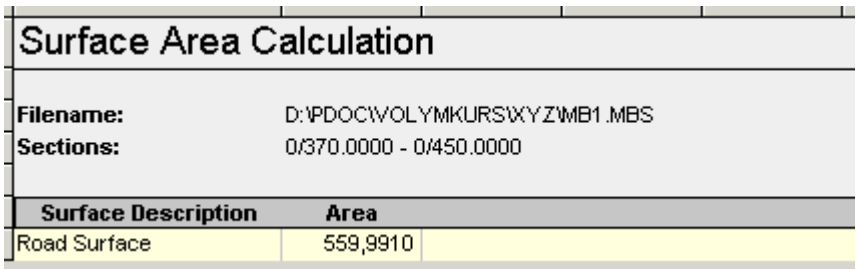
Limit points for the surface (1 and 2)
Interrelated code pair for limiting the surface. Limit pair 2 is only used if the surface is divided into two halves as shown in example 2 above.

From code
Enter from which code (i.e. first point with this code in the section) the surface begins. Leave this field empty if the surface begins at the first point furthest to the left of the section.

To code
Enter at which code (i.e. the first point with this code in the section, after the from code is found) the surface ends. Enter blank if the surface ends at the last point furthest to the right of the section.

Results/Report

After the calculation has been made, a report is presented with the selected surface areas.



Surface Area Calculation

Filename: D:\PDOC\VOLYMKURS\XYZ\MB1.MBS
Sections: 0/370.0000 - 0/450.0000

Surface Description	Area
Road Surface	559,9910

The report contains a summary page and additional pages that show each sub-surface separately.

Section	Road Surface Length	Road Surface Area
0/370.00	7,0000	
		69,9999
0/380.00	7,0000	
		69,9996
0/390.00	6,9999	
		69,9993
0/400.00	6,9999	
		69,9990
0/410.00	6,9999	
		69,9987

If a question mark, ?, is shown in the report, this means that the current section cannot be calculated. This is because one of the expected codes is missing from the section.

See also Volume Calculation in General 687, Mass Descriptions 689.

12.5 Orthogonal Points Report

You use this function to create a report to show points from a mass calculation or cross section file. Select ***Data | Orthogonal Points Report*** to open the dialog, see below. For each point you can choose to report the offset, height and cross fall. You can calculate the points directly from a mass calculation but also from a cross section file., sec, assuming that it has coded points.

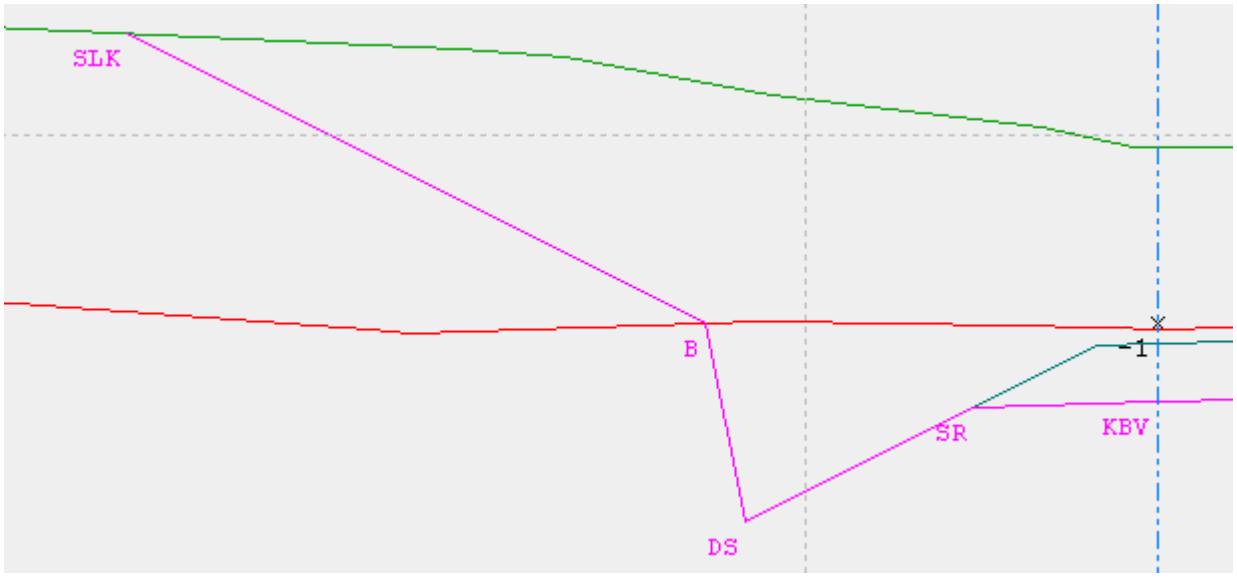
Orthogonal Cross Section Points Created: 2010-09-28

File Name: C:\sbg\geo\DemoE\demo-street.mbs
Sections: 0/140,000 - 0/450,000

	Center Line		Roadway curb Left		Slope crest			Slope staking
Section	Side Offset	Height	Side Offset	Height	Side Offset	Height	Side Offset	Height
0/370.00			-3,500	43,866	-7,883	45,434	-8,500	45,742
					5,919	43,882	6,500	44,173
0/380.00	0,000	43,737	-3,500	43,649	-8,002	44,913	-9,000	45,412
					5,662	43,729	6,500	44,148
0/390.00	0,000	43,769	-3,500	43,682	-7,732	44,666	-8,500	45,051
0/400.00	0,000	43,802	-3,500	43,714	-6,572	44,119	-7,500	44,583

Coding points

The points to be presented in the report are identified by the code they have. This function is therefore based on you having a mass calculation of coded elements in the standard section or cross section file, sec, with coded points. If the cross section file comes from a mass calculation, any codes accompany the cross section file.



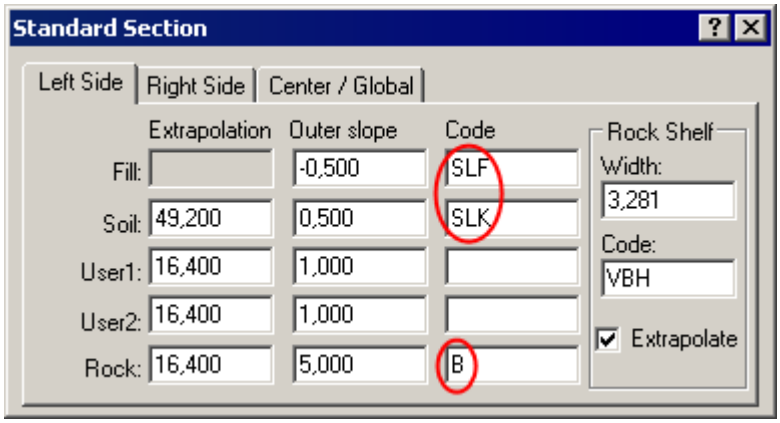
A cross section of coded points in the layer for the excavation bottom.

Coding in mass calculation, mbs

The mbs file is given different code elements either in the data view or in the properties dialog[700] for each individual element.

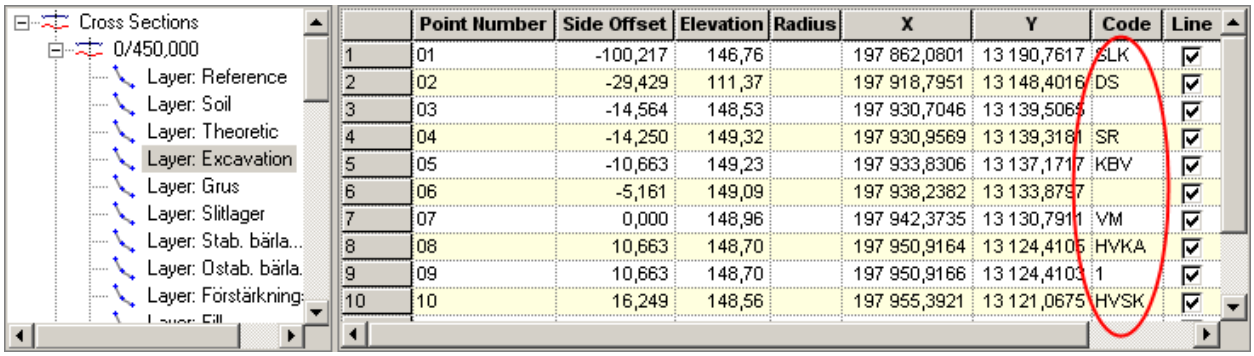
	Direction Type			Code
1	Cross Slope (from side, from line)	Left	0	KBV
2	Extend (dZ, dY)		0,8200	SR
3	Slope, dY	-2,5000	-4,9000	DS
4				

Coding of the outer slope points is done in the properties dialog for the standard section by right-clicking on the standard section name in the tree and selecting ***Properties***.



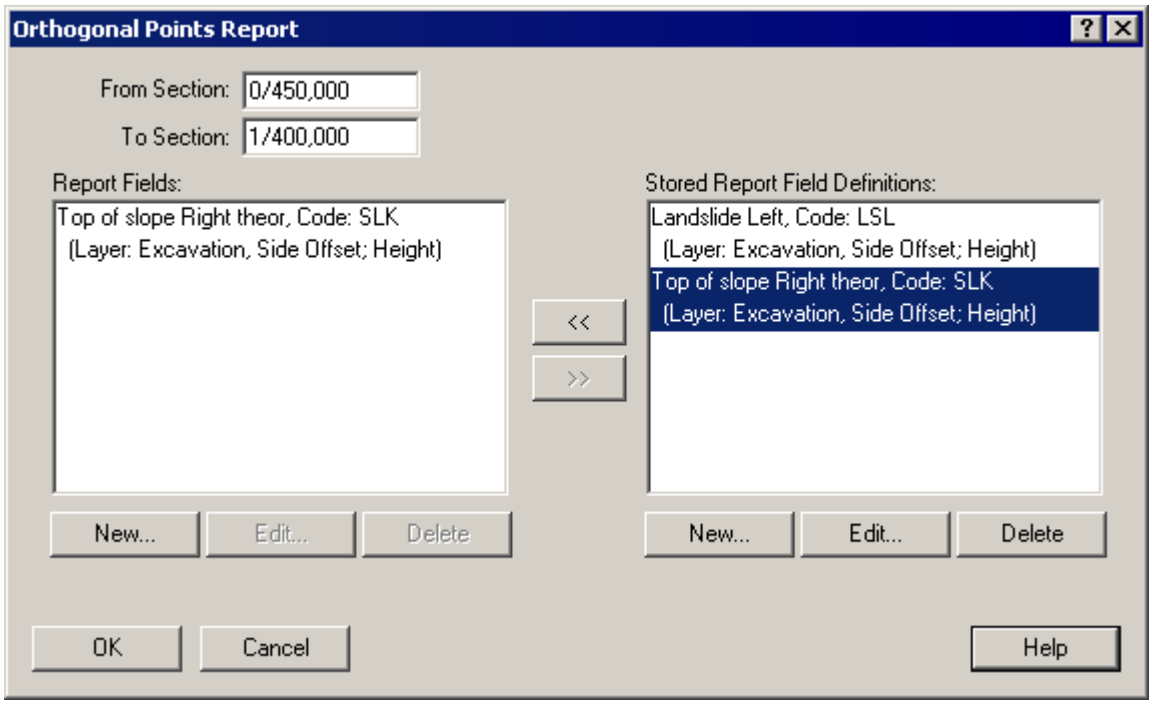
Coding of cross section file, sec

In a cross section file, the code is available for each individual point in the different layers.



Create Report

When a mass calculation, mbs, or cross section file, sec, is active, you select ***Data | Orthogonal Points Report***.



The dialog has two lists with definitions of the report fields. The left-hand list is used to notify the fields to be used for the report you want to create, and the right-hand list contains the fields that are already saved. By compiling different fields with the points in the cross section that you are interested in, you can create wholly customized reports.

From section/To section

Enter the sections between which the calculation is to be made. Based on a mass calculation, the calculation interval in the .mbs file is used.

Report Field

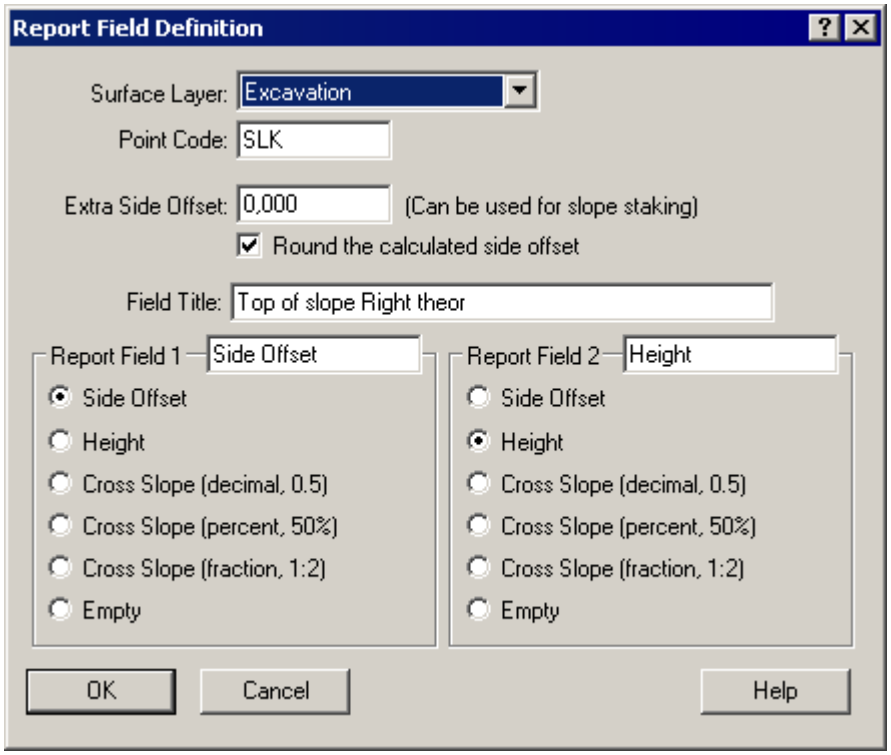
The list shows the points that will be calculated. Complete either from the saved surface definitions by clicking the **[<<]** button or selecting **[New…]** to create new definitions. You can also edit and delete fields in the list.

Stored Report Field Definitions

The list shows the definitions that are saved in the Windows registry for use on several occasions. Select **[New…]** to create new definitions. You can also edit and delete fields from the list. Use the **[>>]** button to move a field over from the current calculation.

Report Field Definitions

When you create a new field or edit an existing one, a dialog appears with the field's definition data.



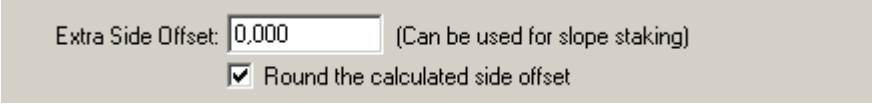
Layer for the surface
Select from the dialog the layer from which the points are to be loaded.

Point code
Enter the code to search for.

Field heading
You can enter any main heading for the field.

Sub-heading 1/2
Specify the information to be printed in the report and the heading to be used. For each report field, two values are printed, e.g. offset and height.

Offset extension. This can be used, for example, to show the slope layer
To calculate the set out data for the slope layer, you can use an offset extension. The dimensions you specify are added to the offset of the identified point (or subtracted if negative, and must be used for the slope layer at the toe of the slope). The height is calculated with the same cross fall that applies to the identified point. If you want to have the point reported as an even offset, you can check the box for rounding.



See also Volume Calculation in General 687 and Volume Descriptions 689 .

12.6 Extract excavation bottom, MBS

A mass calculation using the section method needs a number of components as input data, e.g. road line, standard section, etc. All component parts must be specified in a mass description, stored in a file of the type .mbs. In the mass description all relationships between the components, e.g. placement of the standard sections, station spacing, etc. are also specified.

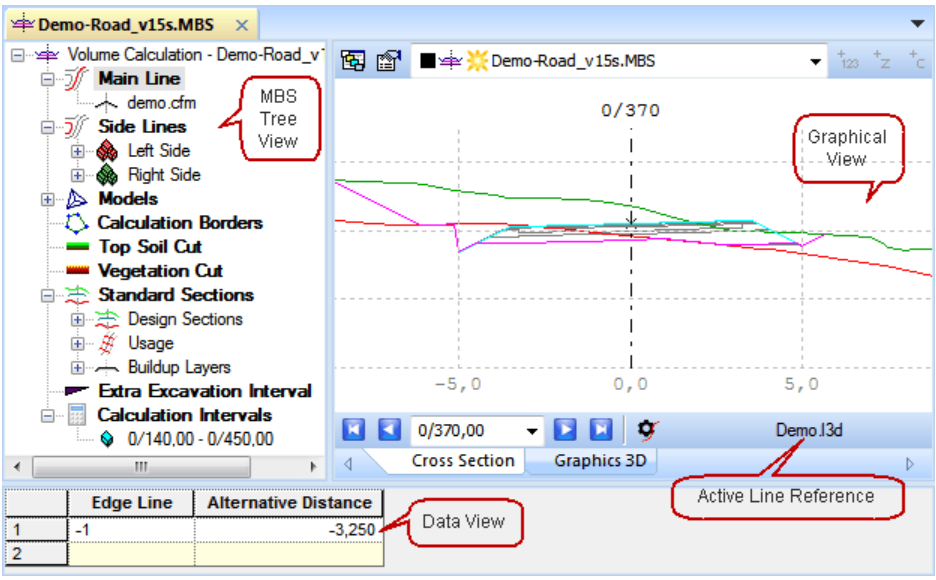
A mass calculation can be a very complex calculation with many component parts and relationships. To get an overview of these, there is a tree structure to help you when entering and editing.

MBS Window

View

The screen is divided into a number of views when editing a mass description:

- MBS Tree View
  Here you can see all components and relationships that are included in the mass description
- Graphical View
  The graphical view is divided into two tabs; one tab shows plane, profile or cross section data and the other tab shows the mass calculation in 3D graphics.
- Data View
  Under the tree view and graphical view you can see the data view that displays a numeric representation of selected objects in the tree view.
- Properties Dialog
  You can edit a range of settings in the properties dialog 106.



MBS Tree

Here you can see all components and relationships that are in the mass description. The entire mass calculation is administered via the tree, and provides support when composing the mass description. By clicking the tree you enable input and editing of the details in the description. You can also choose what is displayed in the graphical window.

Navigation in the tree

- Left clicking on the + sign expands a node in the tree.

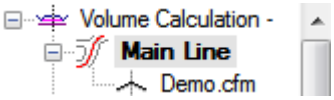
- Left clicking on the - sign reduces a node in the tree.
- Left clicking a component, a line, a terrain model, a section element etc opens and activates the data view for the corresponding components for input and editing.
- Right clicking the tree gives you the option of choosing ***Properties...*** and what is to be displayed in the view: plane data, cross section data or profile data.
- Right clicking the main line, models, types or buildup types or a standard section allows you to view and edit properties for each component.

See also Tree Views 104 .

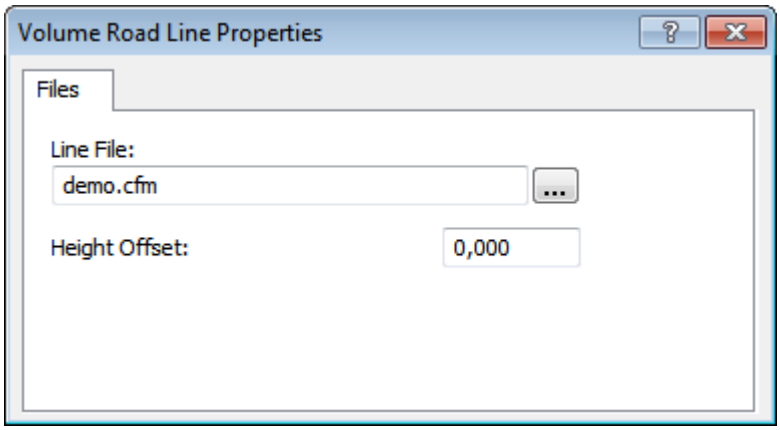
Objects in the mass description

Main line

Clicking the + sign or double-clicking the main line expands the main line to show the selected file name of the cross fall model 536 or the line 503.



Right-clicking Main line and selecting ***Properties...*** displays the properties dialog. Here you can enter the name of a cross fall model or line, or click the Select button ... to the right and select from the available files.



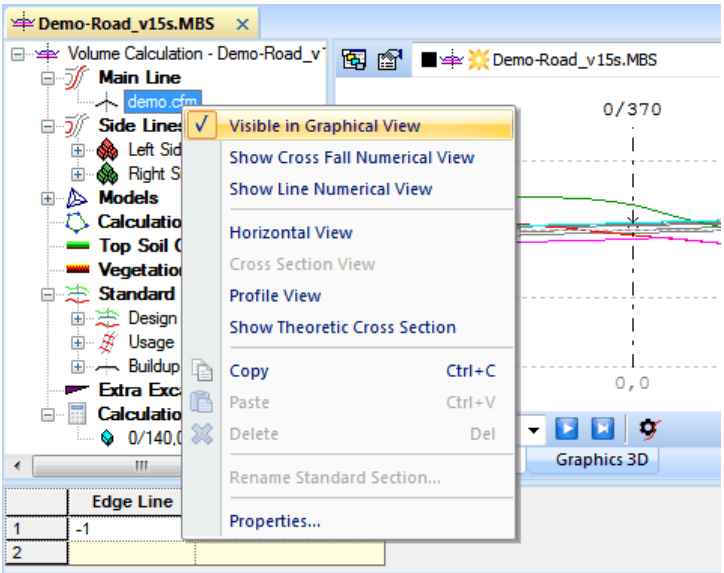
Editing cross fall model or line data

Right click on the file name in the tree view to:

- Display the cross fall numerically. Numerical editing possible.
- Display the line numerically. Numerical editing possible.

  The numerical file will open in a new window. For information about the files, see cross fall model 536 respectively line data 503 .

By right-clicking on the cross fall model (or the line) you can decide whether the line is to be visible in the graphical window or not.

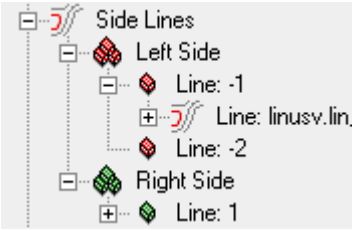


The base line is usually number 0 (zero) in the standard section.

Sidelines

If the standard section requires sidelines these are entered under this heading.

A sideline can consist of several different line files that follow each other.



The numbering of the sidelines must be identical to the sideline numbering in the "input elements" in standard sections.

Left Side/Right Side

To edit the sidelines you must choose the side, "Left Side" or "Right Side" in the tree view that is to be edited.

When the side is highlighted in the tree view, you can define the sidelines in the field for the data view.

	Edge Line	Alternative Dis
1	-1	-3,500
2	-2	-3,501
3		

- Edge Line
  You enter all the numbers for the component sidelines in the standard sections for each side in this column. This number is connected to the line to the corresponding number in the standard section.

- Alternative Distance
  Alternative distance must be given for sidelines. This distance is used when no sideline is found. NOTE: These lines and alternative distances are very important for the standard section. The alternative distance is used, for example, for the joint between two lines that are part of the same sideline or where a sideline deviates, for example, at an intersection.

You can specify an optional number of sidelines.

When one or more sidelines are entered under Left and Right, the Left Side/Right Side of the tree view expands to display the specified sidelines.

Lines on each page

For each of the constituent sidelines there is the option of entering a cross fall model536 or a line file503 to be linked to the specified number. Intersections with the connected file will be calculated. If no intersection is found, the alternative distance for the line is used instead.

Point to a line to edit the constituent files for each sideline. A button appears to the right of each field which gives the option of browsing through available files.

	Line	Height Offset
1	linus.cfm	0,000
2		

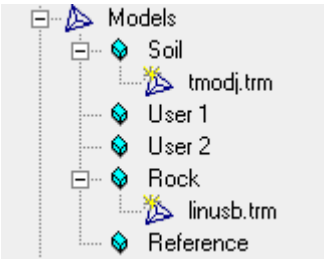
- Line
  You enter the file name for the desired cross fall model or line in this column. You can specify an optional number.

- Height Offset
  Specifying a height offset changes the height of the cross fall model or the profile height of the

sideline. A positive (+) value moves the cross fall model or the profile up and a negative (-) value down.

Models

You specify the models to use for the calculation under this heading. You can use terrain model files and cross section files.
The various beds for the models are located under the heading 'Models' in the tree. You can select several models for each bed which is why you do not need to aggregate model data for a project into a single model file, but instead you can specify all the files along the project, with the specification for the length range to use for each model.



You can use the reference model when a reference surface (finished road or the like) cannot be easily described using one standard section. The reference model can partly replace the standard section, but not completely, as the function of the standard section to create closed shapes between beds of the section must be used. You can use the reference model, for example, to indicate the excavation bottom in a house foundation with varying heights, or a gravel pit that is to be presented with stations.

Editing Model Files

Click the bed in the tree view (Soil, Rock, User1, User2) to be edited to open the correct input view.

	Model	Alternative Height	Start Station	End Station
1	demo_soil.trm			
2				

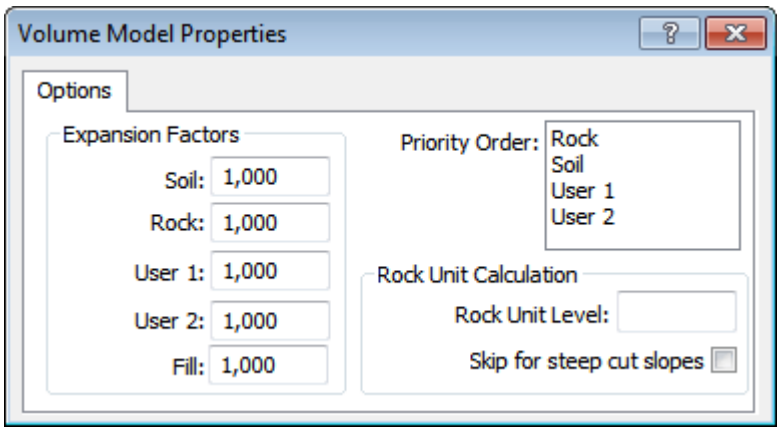
- Model
  Enter the model to use for this layer and interval. You can use terrain model files, trm, as a model, or cross section files, sec. The cross sections are then used as a simpler type of model. The cross section file can be created from a coordinate file, geo, whereby the lines should lie roughly perpendicular in relation to the sections.

- Alternative Height
  Specifying an alternative height in this column changes the height of the bed temporarily. A positive (+) value indicates that the bed moves up and a negative (-) value down. The purpose of this function is to simulate alternative positions for the bed.

- Start Station
  Enter here the start station for the terrain model or cross section file. If nothing is specified, the calculation uses the first model it encounters, i.e. the model at the lowest station. The start station for the model that comes lies after the first model can be specified with the same station as the first model's end station.

- End Station
  Enter here the end station for the terrain model or cross section file. If you do not specify an end station, the volume is calculated until the end of the model.

Properties for models in the calculation
Right-click the 'Models' node and select ***Properties...*** to edit expansion factors and the priority in the properties dialog etc.



- Expansion factors
  Specify the expansion factors to use when calculating volumes.

- Priority
  When surveying models, the models may intersect each other, for example, a rock model protrudes out through the soil model. The volume calculation cannot handle this which is why this problem should be corrected before the calculation is carried out. The action is automatic, but you can choose how to perform the operation by specifying the priority for each bed. For example, if rock has a higher priority than soil, the soil surface will be modified so that it always lies below rock where conflicts occur. However, if soil has a higher priority than rock, the rock will be cut off so that it always lies under soil.

- Rock Unit Level
  In some cases, you may need to divide a rock excavation into high and low rock, to regulate the compensation in a reasonable manner. Put simply, you could say that it is just as expensive to blast a square meter of rock at 0.1m depth as it is to blast a square meter with a 1 meter depth. If you calculate the square meters with a low excavation depth and cubic meters with large excavation depths, you can calculate Units = square meters + cubic meters. These units have given their name to the function to divide the calculation into square rock and cubic rock. Unit level refers to the excavation depth at which you want to separate area from cubic. If you specify the unit level you have the option of reporting the volumes in the volume report.

Calculation Limits / Border Polygons

To be able to calculate the subsets of a mass calculation, e.g. volumes within a building or excavation carried out at a certain time, you can specify one or more polygons that limit the area or areas to be calculated. The polygon's intersection with the sections are shown in the section as vertical lines. The reported volumes and areas are calculated from the areas lying between the intersections with the polygon. If several intersections occur in a section, the volume between each intersection pair is calculated, i.e. between intersection 1 and 2, 3 and 4, and so on. In this way, a polygon that encloses another is used to exclude an area in the middle.
Each border polygon is a line with at least three points in a coordinate file of the geo or pxy type. The line need not be closed because iCON office always calculates a planned line between the line's start and end points. You can only select one coordinate file in the calculation but the file may contain any number of border polygons (lines).

Top soil stripping / vegetation stripping

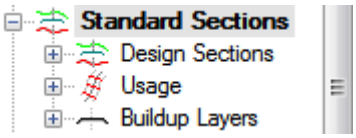
Top soil stripping and vegetation stripping are calculated in the same way. What is described as top soil below also applies to vegetation stripping. Note that you cannot calculate the stripping of both top soil and vegetation in the same section.

	Borders	Thickness	Embankment Height
1	veg.geo	0.250	1.50
2			

Top soil stripping reduces the soil surface in an area bounded by the polygon specified in the first column by the value given in the column thickness. You define the polygon as a coordinate file (geo or pxy). The calculation is the same as for border polygons, i.e. within each line in the coordinate file, the lines do not need to be closed as the first and last point are considered to be connected. If several intersections occur in a section, the volume between each intersection pair is calculated, i.e. between intersection 1 and 2, 3 and 4, and so on.
To calculate **general top soil stripping** , i.e. without border polygons, you do not specify any file name. The soil surface is then lowered within the range covered by the processed surface in the mbs. You cannot specify general stripping of both top soil and vegetation.
If the embankment height is entered, the top soil stripping will not be calculated in cases where the embankment height exceeds this height in the center line.

Standard Sections

The 'Standard Sections' heading in the tree is divided into three sub-levels:



- Design Sections
  Here you add the standard sections to use in the calculation. You can also edit and create new standard sections from here.
- Usage
  Here you determine where along the main line the different standard sections are to be used, interpolation between standard sections and the lateral limits.
- Buildup Types
  You determine from here the stratification of the buildup in the standard sections.

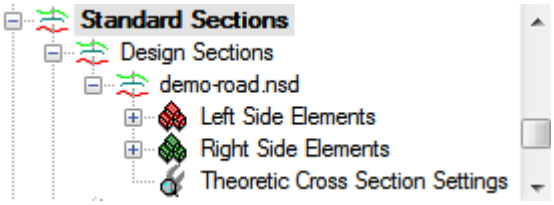
Editing Standard Sections

In the 'standard sections' nodes you specify all the standard sections to include in the calculation. Click the node Design Sections, to display a list of filenames of standard sections in the data view. To select an existing standard section in the calculation you can either enter the filename or click the arrow on the far right in the filename field.

	Standard Section
1	ns1.nsd
2	

To create a new standard section you enter a new (not existing) name in the field.

The standard sections that are entered in the list are also displayed in the tree structure.



Standard Section Properties

Right-click a standard section in the tree and select ***Properties...*** to view the properties dialog. This contains three tabs: Settings for left and right side, and center/global.

Settings left/right side

The values entered in the left tab only apply to the left side of the standard section, and vice versa for the right.

Left Side | Right Side | Center / Global

	Extrapolation	Outer slope	Code
Fill:		-0,333	
Soil:	49,212	0,500	
User1:	16,404	0,500	
User2:	16,404	0,500	
Rock:	16,404	5,000	R

Rock Shelf
Width: 3,281
Code: VBH
☑ Extrapolate

- Extrapolation
  Maximum permissible extrapolation length (horizontal measurement). You use this value when the bed's extension is too narrow laterally, i.e. the model or sections do not cover the area needed to create the closed sections. Extrapolation refers to the extension of the bed to enclose the area in the section. If the figure cannot be closed within the specified maximum dimension, the program will try to enclose the area with a horizontal extension from the bed's outer edge. If you still cannot enclose the area within the specified maximum dimension, the area will be enclosed with a vertical line. Extrapolated lines are normally drawn as dashed lines in the section.

  Default values

Soil	15m.
User1	5m.
User2	5m.
Rock	5m. Should never exceed the extrapolation for soil.

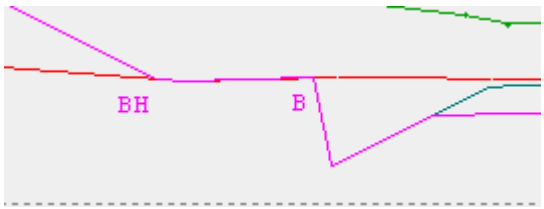
- Outer Slope
  Here you specify the slope gradients that the program uses to connect the various surfaces in the section. These slopes are applied from the outermost defined elements on each side with the slope in each material type in accordance with the selected values.

  Default Values

Filling	-0.33	(Slope 1:3 down)
Soil	0.5	(Slope 1:2 up)
User1	1.0	(Slope 1:1 up)
User2	1.0	(Slope 1:1 up)
Rock	5	(Slope 5:1 up)

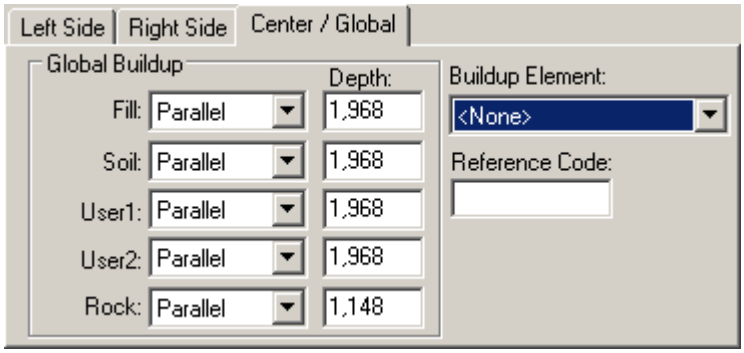
- Code
  Enter the code to be set for different slope gradients in the point where the slope meets the current layer. The code is set in the theoretical layer and in the excavation bottom and in all the buildup layers used.

- Rock Shelf
  If a rock shelf is to be calculated outside the rock slope, you specify the width and any code for the point where the rock shelf ends. The code is set in the theoretical layer and in the excavation bottom and in all the buildup layers used.



Center/Global

You can use the Center/Global tab to determine the settings for the buildups. You can select the type of buildup, depth and buildup section, i.e. the part of the road the selected settings are to apply to, in the center line and the elements in the standard section where you specify the 'global' option for the buildup.



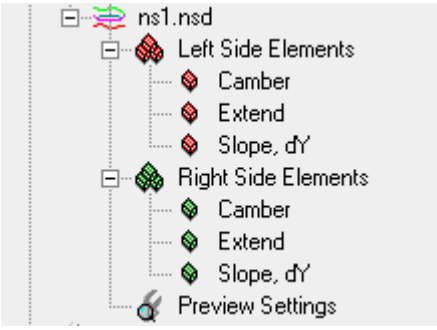
- To determine the buildup depth, three types can be selected:
  Parallel
  The bottom border of the buildup is parallel to the element’s top border with the thickness as per the specified buildup depth. The lateral extension of the buildup is determined by the intersection with the next element's buildup depth.

  Fixed
  A fixed vertical dimension under the element's end determines the depth. This means that the bottom border of the buildup must not be parallel to the element's top border.

Unknown
If the buildup depth is unknown, this means that the bottom border of the buildup crosses this element without affecting the buildup depth.

- Depth
  Specifies the depth (or thickness) of the buildup.
- Buildup Element
  Used if the layer (or bed) of the buildup is to be calculated. This option specifies the part of the current buildup type that applies in the center line.
- Reference code/code at center
  Enter the code to be set at the center of the standard section. The code is set in the theoretical layer and in the excavation bottom and in all the buildup layers used. If a **reference model** is used, all points in the layer will also be assigned this code.

Inputting/Editing
To edit an individual standard section, click on the desired standard section in the tree view and expand it to *Left Side Elements, Right Side Elements* and *Preview Standard Section*. Each side can then be expanded to display each element.



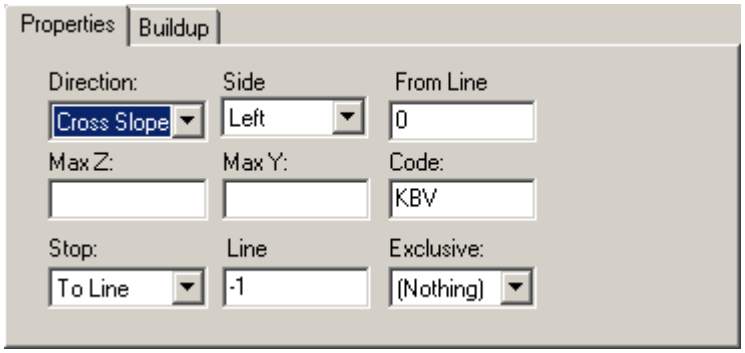
By right-clicking on the standard section of the tree and then choosing ***Section view*** in the menu switches the graphical view to show the cross section orientation with the current section visible. When an element is selected in the tree, a selection also displays in the graphical view. Note that the graphical view must be set to display a section covered by the standard section the elements of which are highlighted in the tree in order for the selection to be visible in the graphical view.
You can also select the option ***Preview Standard Section*** which means that the standard section is shown in its theoretical location.

The input elements can be edited in the data view as well as in the properties dialog for an element.

- Data View
  Editing takes place in the data view by first pointing to the left or right side of the tree which brings up element information in the data view.

	Direction Type			Code	Max Y	Max Z	Stop		Exclusive To
1	Camber (from side, from line)	Left	0	KBV			To Line	-1	(Nothing)
2	Extend (dZ, dY)		0,2500	SR			(Nothing)		(Nothing)
3	Slope, dY	-0,5000	-1,5000	DS			(Nothing)		(Nothing)
4									

- Properties Dialog
  You edit the properties dialog by right-clicking on the desired element in the tree and selecting ***Properties…***, the dialog contains two tabs: Properties and Buildup.



Direction:
Select a direction definition for the element. You select parameters in the data view for the chosen definition in the two columns to the right of the direction type. For example, if you select 'dZ, dY', you specify the dZ dimension in the first column and the dY dimension in the second column.

- Unknown
  The direction of the element varies and is determined in height and laterally by a line and profile.

- dZ, dY
  Enter a fixed definition of the element by describing the change in height (dZ) and side (dY) from the beginning to the end of the element. If a "Stop" is specified, the element's height and offset will only be seen as an indication of direction rather than an absolute measurement.

- Slope%,dY
  Enter a percentage and a horizontal dimension for the extension. If no horizontal dimension is given, you must use a "Stop". Note that "no dimension" is specified by leaving the field empty.
  Do not use 0 (zero) as this means zero extension!

- Slope, dY
  Enter an R number in decimal format, and a horizontal dimension for the extension. R number refers, for example, to 1:3 = decimal 0.333, negative numbers relate to downward slopes. If no horizontal dimension is given, you must use a "Stop". Note that "no dimension" is specified by leaving the field empty.
  Do not use 0 (zero) as this means zero extension!

- Follow layer, dY
  This type is used to follow an existing bed, such as a rock shelf with a given horizontal extension.

- Cross slope (from side, from line)
  This element is used for roadways and suchlike. The element slope is loaded from the cross slope file for each calculated section that is connected to the selected line. From the side, you normally specify left for elements on the left side, and right for elements on the right side, but it is possible to use the cross slope value that applies to the right line on the left side of the element and vice versa. Enter the line (number, see sidelines 692) from which the cross slope is to be loaded. The center line number is normally 0 (zero).

- Extend (dZ, dY)
  Select this element when the element is to continue in the same direction as the previous element. dZ and/or dY can be specified or left blank. If you specify both values, the value that complies first has the highest priority . If no value is specified, you must specify a "Stop".

- Special Slope
  You use this element when you want to have a steeper slope to the road structure compared to the slope. You then get a wedge in the slope which enables you to calculate the volume of the flat slope separately. Enter the slope coefficient to apply (R number 699 as above). The special slope element should be seen as a temporary break in the construction of the theoretical surface. After this element, the program jumps back to the starting point for the special slope where you can then complete with the remaining elements for the theoretical surface (i.e. the flat top of the slope). The downward extent of the special slope is calculated automatically, i.e. you do not specify any length for the element.

The length depends on whether you are in an intersection or in a filling. In the intersection, the special slope is extended so that it meets the terrace. The appearance of the terrace is then determined as usual using the buildup thickness. However, for the filling the special slope is extended automatically down to the uppermost model bed. The terrace will then be broken in relation to the special slope, and then follow the current bed until it meets the theoretical surface again. However, you can also set an element to stop "against the terrace". In this case, the special slope runs down to the terrace and then you determine the appearance of the terrace in the normal way using the buildup thickness.
Any buildup layer is always calculated in relation to the special slope if it exists.
If you use the special slope element type, a special layer is created for this in the cross section. Only one special slope element per side can be used in a standard section.

Code
Enter the code for selecting the element. If the code is given, the resulting file will contain this code. You can use this to distinguish different types of data for further processing, such as excavation borders and ditch bottoms, and some reports are also based on coding. However, the code is not mandatory. The code is set in the theoretical layer and in the excavation bottom and in all the buildup layers used.

Tip! By setting codes for the elements in the standard section, you can calculate the horizontal or sloping area in any part of the mass calculation. See ' Area calculation of plane surfaces from cross sections 714'.

Max Y
A maximum permissible horizontal extension can be given. If the maximum dimension is exceeded the element is rejected.

Max Z
A maximum permissible vertical extension can be given. If the maximum dimension is exceeded the element is rejected.

Stop
Choose the type of "Stop" for an element. This must be selected if you have not selected a fixed dimension for the element before!

- (Nothing)
  No stop.
- To Line
  The element stops when it meets a line in plane.
- To Profile
  The element stops when it meets a profile in height.
- To linPrf
  The element stops at a line with profile. Both the height and side are controlled by the line and profile. The type of direction is unknown.
- To linCLPrf
  The element stops at a sideline laterally but at the main line's profile in height. Both the height and side are therefore fixed, the type of direction is unknown. This element can be useful when you want to start from the profile height even though it is an element that does not start at the center of the standard section.
- To Layer
  The element stops *when* it meets the layer that is selected. A meeting with a layer is expected to occur. The direction of the element is determined by the direction type values.
- Break at Layer
  The element stops *if* it meets the layer that is selected. If there is no meeting, the element runs as far out as is specified for the direction type.
- To terrace

The element stops at the terrace surface.

In the next column/field, depending on the type of stop, you select the object the stop applies to:

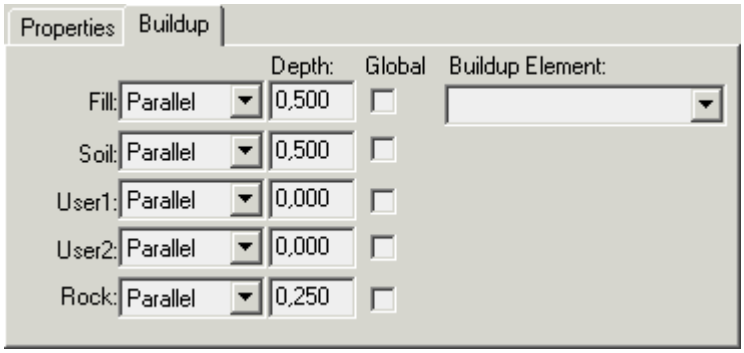
- Line number (see sidelines[692])
- Layer (see models[693])

Exclusive

Here you have the option of only letting the element apply to a specific bed. The element will be included in the standard section if the starting point lies in the current bed. If this is not the case, the next element in the standard section will automatically be used. Select from 'Fill', 'Soil', 'User1', 'User2' and 'Rock'.

Buildup

The buildup's total depth for each type of material can be specified here.

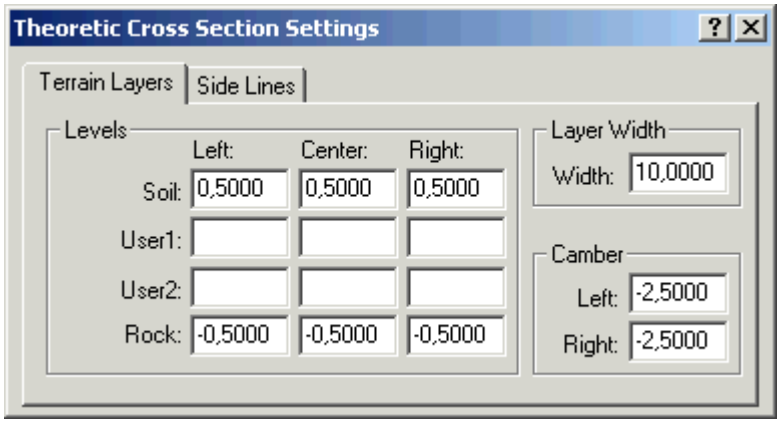


If the **[Global]** box is checked, the depth and control will be loaded from the standard section's general settings, see Standard Section Properties[696].

- For control of the buildup depth, three types can be selected:
  - Parallel
    The bottom border of the buildup is parallel to the element's top border with the thickness as per the specified buildup depth. The lateral extension of the buildup is determined by the intersection with the next element's buildup depth.
  - Fixed
    A fixed vertical dimension under the element's end determines the depth. This means that the bottom border of the buildup must not be parallel to the element's top border.
  - Unknown
    If the buildup depth is unknown, this means that the bottom border of the buildup crosses this element without affecting the buildup depth.
- Buildup Depth
  Right-click the element in the tree to view the element's properties and select the buildup depth for the element.
- Buildup Element
  If a bed (layer division) of the buildup is used you can also select the buildup element here. This option specifies the part of the current buildup type that applies for the element. Editing of the bed takes place under the heading Buildup Types[703] in the tree.

Theoretic Standard Section Settings
If the model is missing, you can use the default values for the various layers to test how the section will behave in different situations. These fictitious layers can be designed appropriately by entering numerical values for the extension and level. This is done under levels. A fictional cross slope can also be defined for the standard section. These settings affect the graphical view if the option ***Show Theoretic Standard Section*** is selected in the menu when you right click the tree.

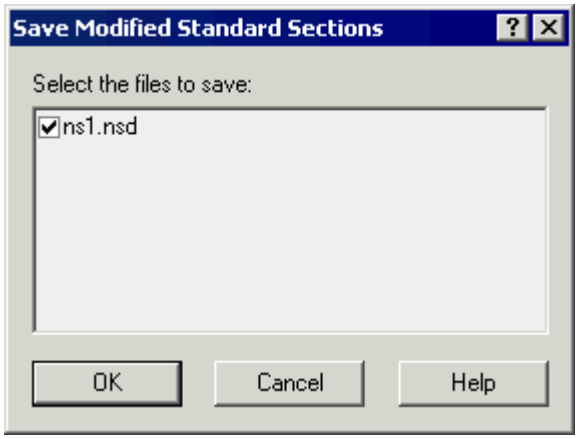
You edit the settings by right-clicking on the heading "Theoretic Standard Settings' ' in the standard section and select ***Properties...*** from the menu.



- Levels
  Enter a +height for each layer for left, center and right edge of the bed. The height specified refers to a height relative to the profile height in each section. The center refers to the height in the center line. Left and right refers to half the layer width on each side of the center line.
- Layer Width
  The fictitious bed width is specified here.
- Cross Slopes
  Enter values for cross slopes when previewing a standard section, without selecting line calculation. Enter the fictitious cross slope in percent for each side.

Under the *Sidelines* tab it is possible to determine the position of a number of sidelines on the left and right side.

Save Standard Sections
After a standard section has been edited, you can save it by selecting ***Data | Save Standard Sections***.



Usage

Here you determine where along the main line the different sections are to be used, interpolation between standard sections and the lateral limits.

	Standard Section	Start Section	Interpolation	Max Left	Max Right
1	demo-street.nsd	400,000	No		100,000
2	demo-street2.nsd	1 345,000	Yes		100,000
3	demo-street_interpol.nsd	1 377,000	No		100,000

- Standard Section
  Select standard section by clicking in a field in the column for the standard section and click on the arrow to the right in the field. The standard sections specified must be listed under the heading Editing 698. The file type for standard sections is nsd.

- Start Section
  Specifies where the use of the standard section starts. The section applies up to the definition of the next standard section if no interpolation is specified. Enter the start section for the section where a change occurs. The change may be the replacement of the standard section, or that an interpolation is to start or end.

- Interpolation
  If interpolation is specified, the standard section will be interpolated elements by element to the next specified standard section.
  Note that there must be exactly the same number of elements in the two sections for which interpolation occurs in order for the interpolation to work properly.

- Max left/right
  Specifies the maximum extension to the left and right for the mass calculation. If you have a wide model, the drawing of sections can be limited using this dimension.

Buildup Types

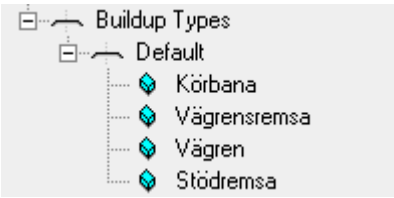
Buildup types and buildup files (bup)

Under this heading, you determine the stratification of the buildup in different layers. A buildup type describes the layers/beds to include in the buildup, and their use in various sections of the road. You can create several types of buildup, but only one can be active at a time for a mass calculation. Buildup types are saved in a special file of the 'bup' type. The buildup type used in a specific volume calculation is saved locally in the same project as the mbs file. Normally, this also has the same name as the mbs file, but with the bup file type. In the local bup file you can have one buildup type at a time. In a global bup file, however, you can store any number. It is therefore possible to use the global file (or files) as a kind of library for different types of buildup.

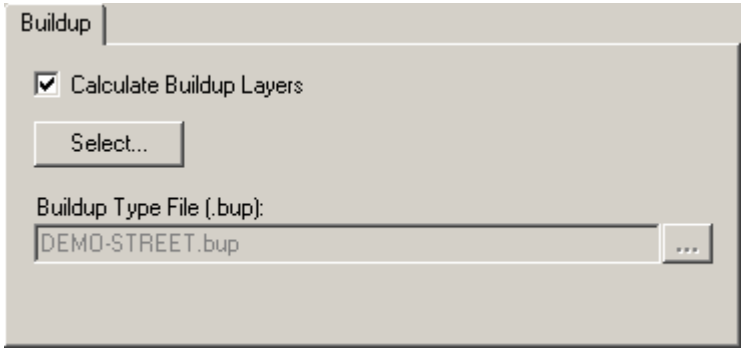
Buildup Elements

In order to be able to specify different layer thicknesses for different parts of, for example, a road structure, the buildup type is divided into different buildup elements. Lane, shoulder and slope are examples of what can be said to be different buildup elements. You can define any number of parts and you can call them what you want. In the standard section you talk about the buildup element that applies in the center and for each element on the left and right side. In this way you can determine the layer thicknesses that vary between different parts of the cross section. For example, you can specify that the wearing course should have a certain thickness for the lane and another for the shoulder. You then set the wearing course thickness of the slope to zero to prevent the calculation being carried out there. Having to set the thickness to zero depends on you not being able to remove a particular bed for a part of the cross section; all the beds that are defined in the buildup type will appear above the whole surface. You can also set the buildup element for a particular element to 'none' to prevent the calculation of the bed happening there. If you want the same layer thickness throughout the cross section, it is sufficient to specify a buildup element.

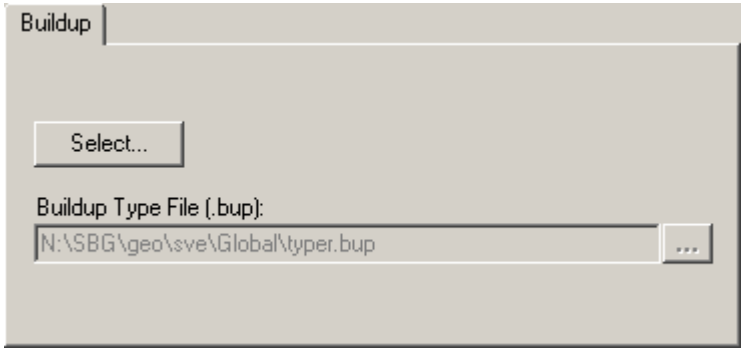
Buildup Tree
The tree structure shows the buildup types that are entered. Under the heading '*Current buildup type*' you will find the buildup type that will be used in the calculation. It is also this that will be stored in the local bup file when the volume calculation is closed. Under the heading '*Saved Buildup Types*' you will find the buildup types belonging to the selected global bup file.



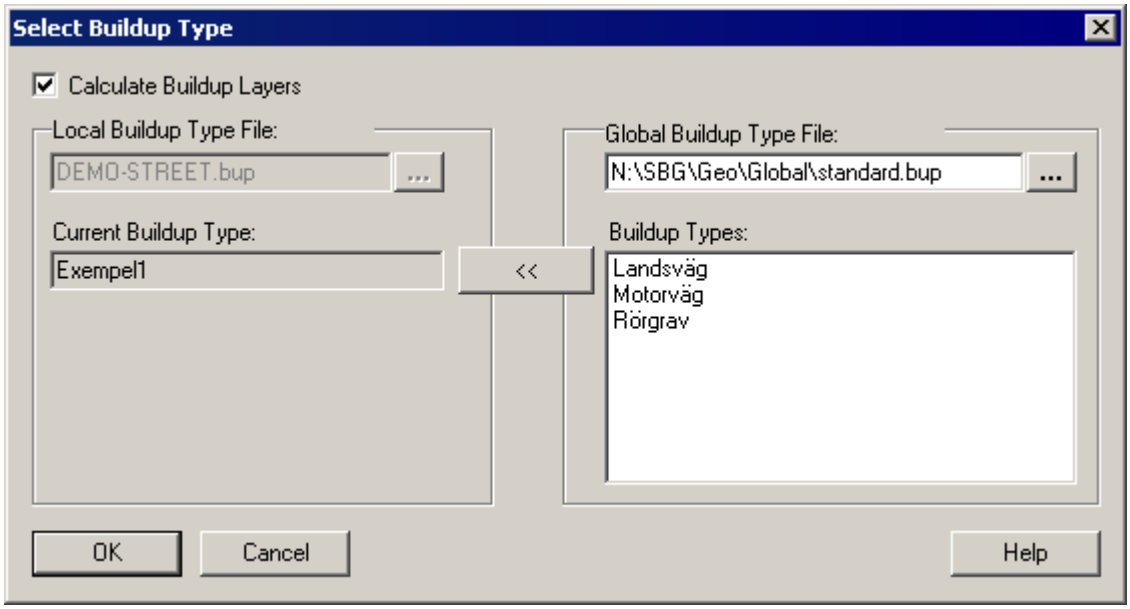
By right-clicking on the heading '*Current Buildup Type*' and selecting ***Properties...*** you can see the *local* file with the buildup types that are used.



By right-clicking on the heading *Saved Buildup Types*' and selecting ***Properties...*** you can see the *global* file with the buildup types that are used.



Select Active Buildup Type
In order to determine the bup files to use and to select the current buildup type, you go to ***Data | Buildup Layer | Select Buildup Type*** or click the **[Select]** button in the dialogs above.

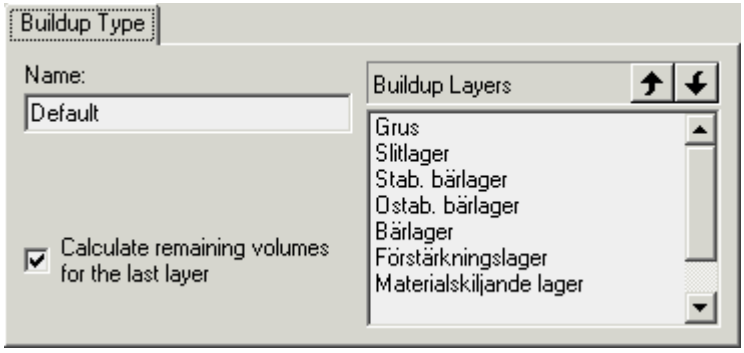


- **Calculate Buildup Layers**
  This option determines whether to calculate buildup layers or not.
- **Local file with buildup types (bup)**
  Here you can see the filename of the file that contains the current buildup type. The file is created when the mbs file is saved. If the field is blank, the file has not yet been created.
- **Current Buildup Type**
  Here you see the name of the buildup type that is used to calculate the layers in the buildup. To select a different buildup type, you select the desired type from the list on the right and then click the **[<<]**button.
- **Global file with buildup types**
  Here you see the filename of the file with available buildup types (bup).
- **Buildup Types**
  The list shows the buildup types contained in the selected global bup file.

Edit Buildup Types
You can edit buildup types in the numerical data view689 and in the properties dialog by right-clicking on the desired object in the tree and selecting *Properties*.

When the heading 'Current Buildup Type' is selected, the name and description of the data view appears. You cannot change anything here as you have to use the properties dialog instead.

	Buildup Type	Description
	Exemple1	



In the properties dialog for a buildup type you determine which layers to include.

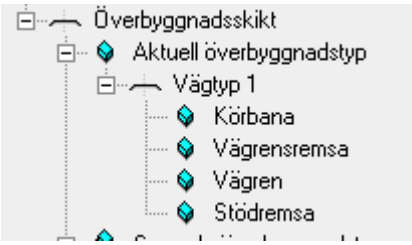
- Name
  You can enter the buildup type name here.
- Description
  You can enter a descriptive text about the type here.
- Buildup Layers
  You can edit the layers to use in the buildup here. Double-click a row to edit the name of a layer. Use the arrows to determine the order for the different layers.
- Calculate the remaining volumes for the last layer
  This option means that the lowest layer is calculated in relation to the excavation bottom.

When the heading 'Current Buildup Type' is selected, the available types also appear in the data view.

	Buildup Type	Description
1	Default	
2		

- Buildup Type
  Enter a name for the buildup type.
- Description
  You can enter a description here.

Each buildup type is divided into a number of segments (buildup elements) in order to be able to specify different bed depths for different parts of the cross section.



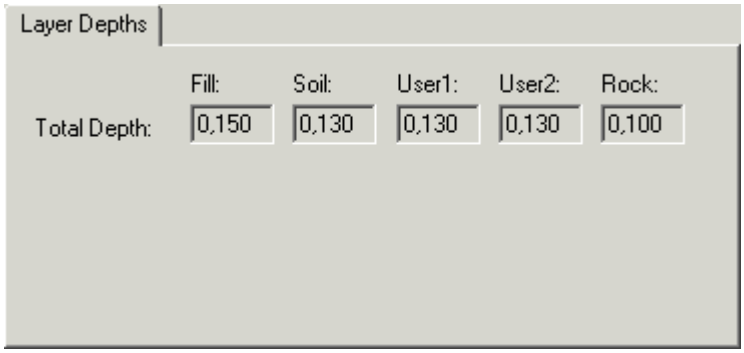
You can add, delete and edit buildup elements in the data view.

	Buildup Segment	Description
1	Körbana	
2	Vägrensremsa	
3	Vägren	
4	Stödremsa	
5		

You can edit the different layer depths for different soil beds and buildup elements in the data view by selecting the desired buildup element from the tree. An asterisk, *, after the layer name indicates that the depth is calculated to the excavation bottom and the depth values therefore have no effect on the layer. If you enter 0 or blank in a field, the bed will not have a thickness for this element and therefore the volume is not calculated here either.

	Fill	Soil	User 1	User 2	Rock
Grus	0,020	0,020	0,020	0,020	0,020
Slitlager	0,030	0,030	0,030	0,030	0,030
Stab. bärlager	0,100	0,080	0,080	0,080	0,050
Ostab. bärlager					

Note that the sum of the layer depths for a soil bed cannot exceed the total depth of the buildup. In the properties dialog for a buildup element, the total depth of the buildup in the different soil beds is shown.



- Total depth
  Specifies the depth of the buildup element in different soil beds.

Copying buildup types
By selecting a buildup type in the tree you can copy it using ***Edit | Copy***. You can then paste a copy of it using ***Edit | Paste***. You can copy from the local file to the global one as well as within the global file. However, you cannot copy a buildup type from the global file to the local file, as you then have to choose an active local buildup type instead in the manner previously described.

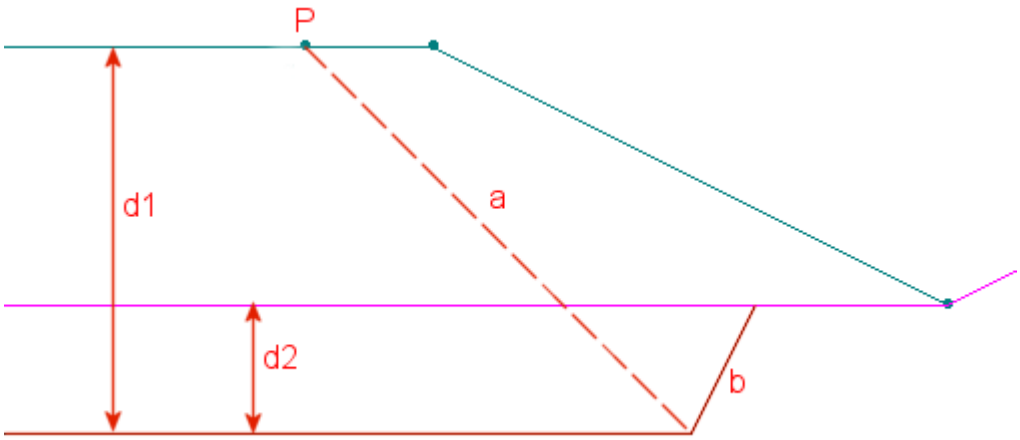
Transition sections and soil replacement

Transition sections and soil replacement are calculated under the corresponding heading in the volume tree.

Please note, to insert transition sections and soil replacement in a volume calculation document, a buildup depth must be at least 0.001 see below 709.

You enter a start section and an end section for each section interval where transition sections/soil replacement are to be calculated. The depth at the start section and the end section is also specified. In the column '*Relative* ' you enter the depth to be calculated from the surface (theoretical, measurement ***d1*** in the image) or from the terrace (excavation bottom, measurement ***d2*** in the image). Laterally, the excavation is limited based on a point at the surface. The desired limit point (e.g. road curb, point ***P*** in the image) must be assigned a code in the standard section. This code is entered in the columns for *'code left/right'* in the table. The extension laterally is then determined by a planned line (***a*** in the image) from the limit point down to the bottom of the excavation. You enter the slope coefficient for this line in the *'Limit Slope'* column. The standard slope is 1:1. The slope back up to the standard terrace (**b** in the image) is specified in the *'Outer Slope'*column. Here the default value is 2:1.

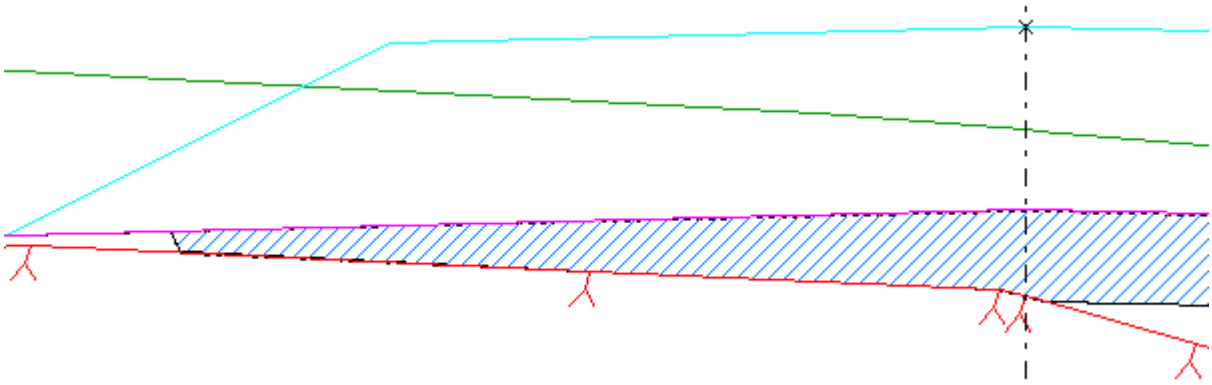
	Start Section	Depth	End Section	Depth	Relative	Code Left	Code Right	Limit Slope	Edge Slope	Rock Cut
1	620,000	6,500	633,000	6,500	Excavation	VKA	VKA	1,000	2,000	☑
2										☐



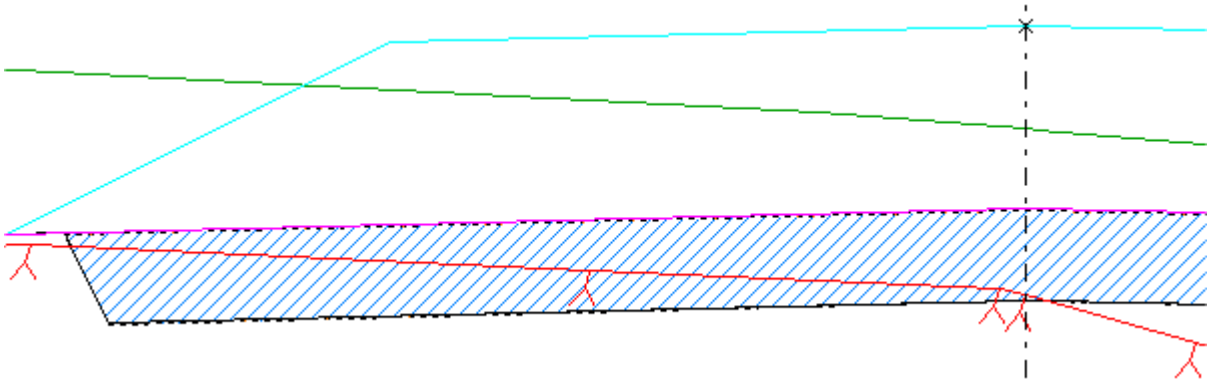
Part of cross section. Measurements for calculating the transition sections.

The depth of excavation interpolated linearly between the start and end sections. To create a transition wedge you enter different depths at the start and end sections. If the depth is given relative to the surface, the dimension must be at least equal to the depth of the buildup.

The *'Rock Cut* field determines whether the transition section is to stop at the rock or not.



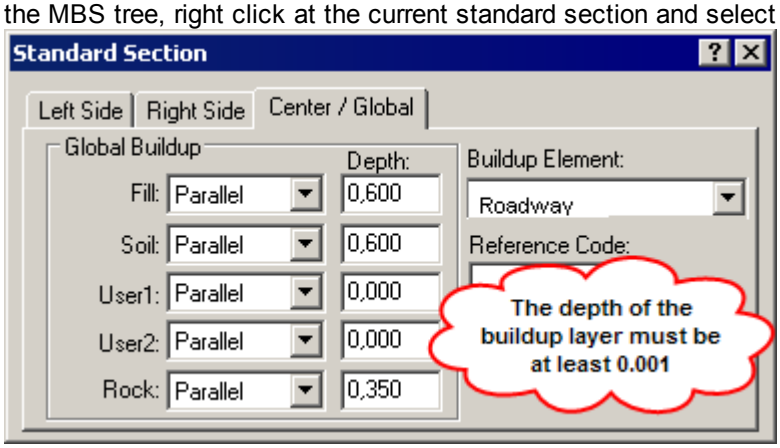
No Rock Cut



Rock Cut

The volume for transition sections/soil replacement is calculated between the normal excavation bottom and the bottom border for the additional excavation. If the entire terrace lies in the filling in a section, no calculation is made for transition sections/soil replacement there. If parts of the terrace are in the filling, transition sections are calculated up to the soil layer.

Please note, to insert transition sections or soil replacement in a volume calculation document, some thickness of the buildup layer must have been entered. The buildup layer depth must be at least 0.001. In the MBS tree, right click at the current standard section and select *Properties*.



Calculation Interval

Here you specify the start and end point and the interval for the calculation. This means that you can calculate a part of the mass calculation you have created without changing the mass description in general. You can also choose different intervals for different parts of the calculation, without any regard to the location of the different standard sections.

	Start	End	Interval
1	370,000	450,000	10,000
2			

- Start
  Enter the first section to be calculated. The calculation will be performed using the interval that is on the line up to the end section of the line or to the start section on the next line.

- End
  Enter the last section to be calculated. If you specify several lines for the calculation, you can leave this blank, whereby the change of interval occurs at the start section specified on the next line. You can create breaks in the calculation by entering an end section, and on the next line entering a start section which is located further in in the mass calculation.

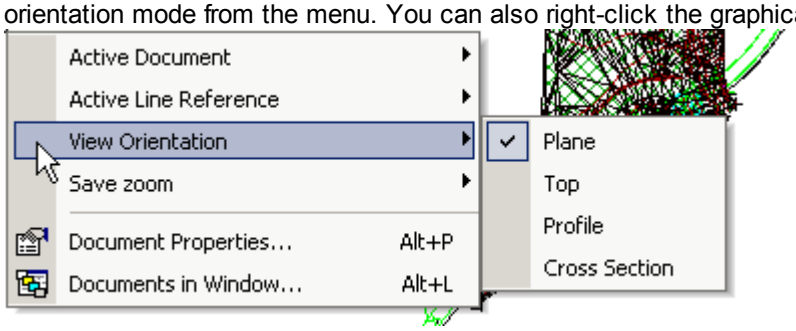
- Interval
  Enter the interval for the part of the calculation that lies between the start and end sections on the same line, or if no end section is indicated, the start section on the line and the start section on the next line.

Graphical View

By clicking in the graphical view, you gain access to the graphical tools and can edit the data in the same way as in a standard graphical view. See also Graphical Views 47.

All the files included in the mass calculation (and that can be displayed graphically) are automatically entered in the graphical view when an mbs file is opened. This allows you to switch active documents as in other graphical views and edit data.

Orientations
There are three orientation modes that are selected by right-clicking in the tree and selecting the desired orientation mode from the menu. You can also right-click the graphical view and select ***View Orientation***.



- Plane
  Displays a plane view of the mass calculation.
- Section, offset
  Displays the section and offset as well as polygons for the calculation limits, and top soil stripping and vegetation stripping. Use the buttons to scroll forward and backward .
- Profile
  Displays a profile view of the mass calculation.
- Section view
  Displays a cross section view for the current length section. The section that is current is determined either by using the buttons to scroll, , or by clicking in the tree at the start of a calculation interval or the start of a standard section interval. You can also select the option ***Preview Standard Section*** which means that the standard section is shown in its theoretical location.

Section stepping
If you select the section view and the mbs document is active, you can step through the mass description without the previous calculation. The selected calculation interval is used to choose the section forward or backward step by step. A mass calculation is carried out for the selected section, each time changing section to see exactly how the outcome will be when you make the mass calculation. Volumes and areas are shown in the input/output window 107.

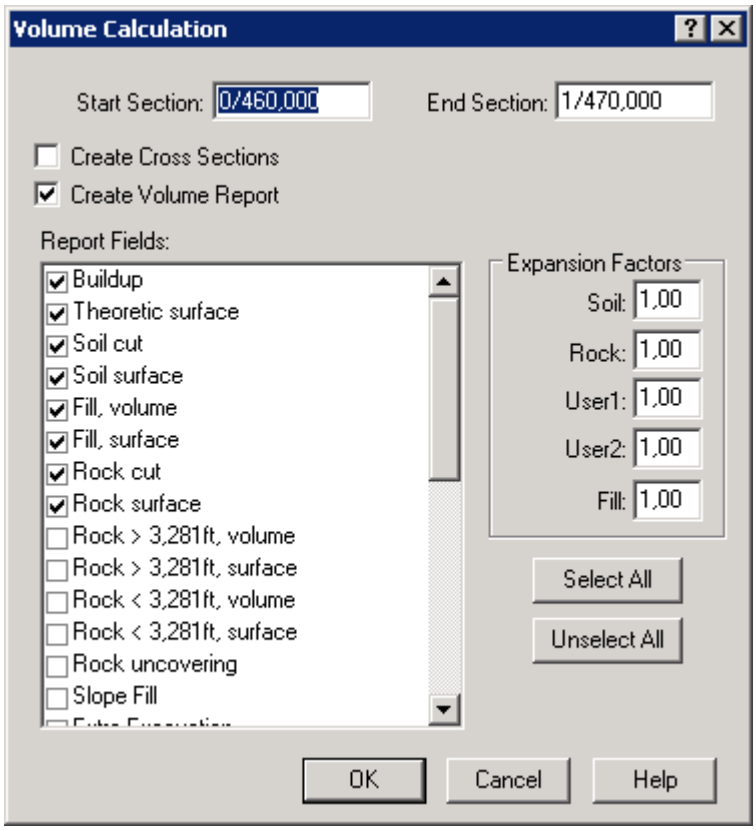
Use the buttons to step to first, previous, next or last cross section in the calculation interval. Click to go to a specific section.

Graphical 3D View
In a separate tab in the graphical part of the mbs window, 3D graphics are always available. Here is a presentation of the entire mass calculation in a three dimensional perspective view. See also 3D Graphics 80.

Calculation of volumes

To perform a calculation of the volumes you select ***Data | Calculate Volumes…***.

A dialog shows the choices made for the calculation.



You can temporarily change the scope of the calculation here by selecting sections other than those proposed.

Check the box if sections are to be created (for drawing/review) and if a report is to be generated, and if so, the content required in the report.

Report Field

- The volume field reports the cross section area of the current bed in each section. In addition, the volume is calculated using the mean area between two sections and the distance between the sections. The volumes are summarized at the end.
- The area field shows the horizontal length from left to right for the active bed in each section. In addition, the flat area is calculated using the mean length between two sections and the distance between the sections. The areas are summarized at the end.

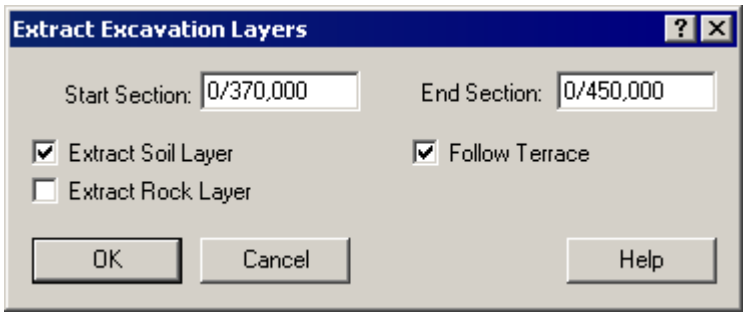
Fields	Type	Description
Buildup	Volume	The volume and cross section area for the buildup between the theoretical surface (upper surface) and excavation bottom/terrace. If a special slope has been used, the buildup is only calculated for the part that is inside the special slope layer. The sum of this volume and the volume of the special slope (see below) represents the total buildup volume.
Processed surface	Area	The horizontal length and area of the entire area affected by the calculation.
Soil excavation	Volume	Volume and cross section area for the excavation of soil down to the terrace.
Soil surface	Area	The horizontal length and area for the ground covered by soil excavation.
Fill	Volume	Volume and cross section area for the infill up to the terrace.
Fill	Area	The horizontal length and area of the area covered by the filling.
Rock excavation	Volume	Volume and cross section area for the excavation of rock down to the terrace.
Rock surface	Area	The horizontal length and area for the ground covered by rock excavation.
Rock excavation > unit height	Volume	Volume and cross section area for the excavation of rock down to the unit height above the terrace.
Rock excavation > unit height	Area	The horizontal length and area for the ground covered by rock excavation above the unit height.
Rock excavation < unit height	Volume	Volume and cross section area for the excavation of rock from the unit height down to the terrace.
Rock excavation < unit height	Area	The horizontal length and area for the ground covered by rock excavation below the unit height.
Rock overburden removal	Area	The horizontal length and area for the ground covered by the rock excavation and overburden removal/clearing of rock.
Special slope	Volume	The volume and cross section area of the part of the buildup which lies outside the road structure bounded by the special slope layer.
Transition sections	Volume	Volume and cross section area for transition sections and soil replacement. The calculation is made up of standard terrace surfaces if this is not in the filling. The calculation is then made up to the soil (i.e. in this volume there is never any fill volumes).
Excavation User 1/2	Volume	The volume and cross section area of the excavation of layers for user 1 and 2 down to the terrace.
Surface User 1/2	Area	The horizontal length and area for the ground covered by the excavation for user 1 and 2.
Topsoil/Vegetation	Volume	The volume and cross section area for top soil/vegetation stripping.
Topsoil/Vegetation	Area	The horizontal length and area for the ground covered by top soil/ vegetation stripping.
Beds in the buildup	Volume	The volume and cross section area for the different beds in the buildup. If the horizontal/sloping length and area area required instead, these values

		are obtained by selecting the "Area Calculation of Surfaces".

The created section file (sec) and the report file (rep) are displayed when the calculation is finished.

Extract excavation bottom

You use this function to pick out the calculated surface of the soil excavation and/or rock excavation. The results are obtained as a cross section file, sec. For soil excavation you can also choose that the surface follows the terrace.



Start section/End section

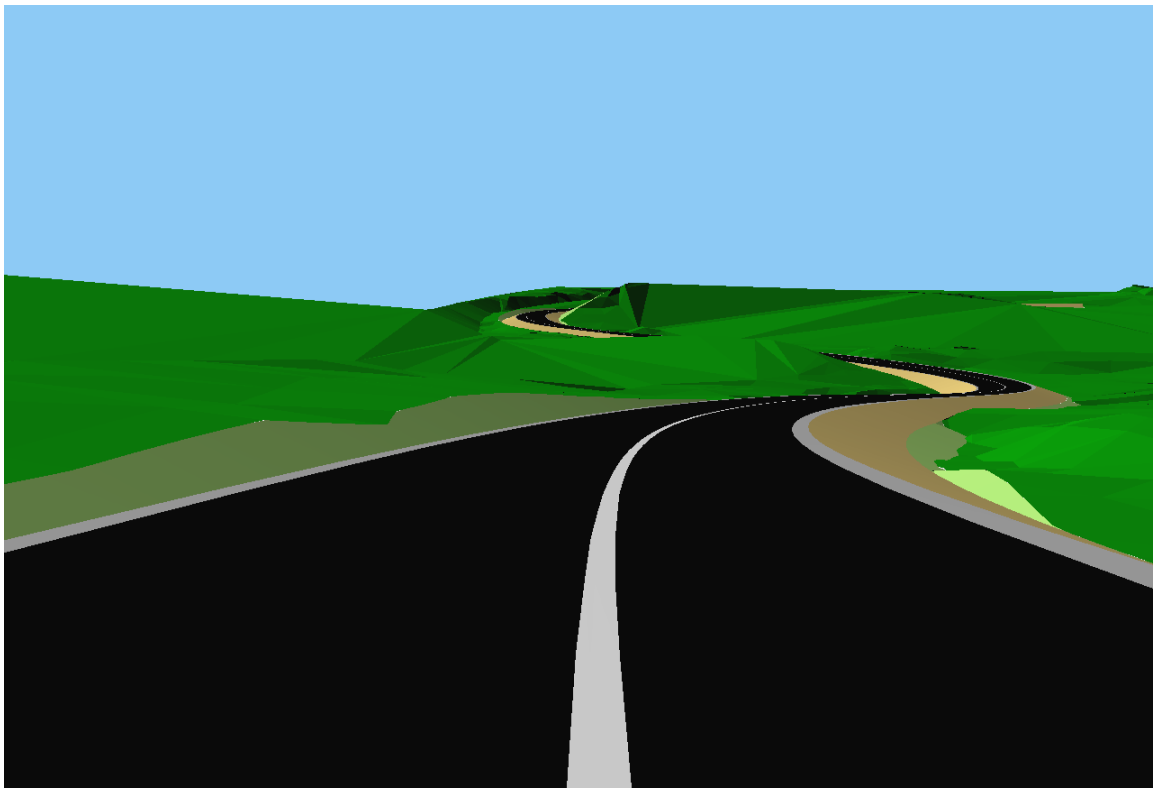
Enter the sections within which the extraction is to be done.

As the codes and plane coordinates from the mass calculation are included with the section file, you can proceed with the Extract Plane Coordinates 631 function if a terrain model is to be created for the current excavation layer.

See also Volume Calculation in General 687.

12.7 Visualization of Volume Calculation

Visualization here means the creation of a three dimensional image from a volume calculation, with colored surfaces of various objects in the calculation. The color scheme is made possible through the individual elements of the calculation being assigned a code.



Visualization is built up of both existing and theoretical models from the volume calculation. Existing here means models for soil, rock, user1 and user2 as specified in the mbs file. The theoretical models are created when calculating the mbs file. This is done by iCON office making a volume calculation in the background, thereby creating cross sections with set length intervals. From these cross sections iCON office then generates longitudinal lines for each surface to be calculated. The lines are based on the codes 700 that can be set in the standard section. Triangle models are generated using lines, and surfaces are picked from these by specifying the codes between which the data is loaded. The denser the calculation interval setting, the more triangles you get and this in turn makes the visualization more even and less 'jerky'.

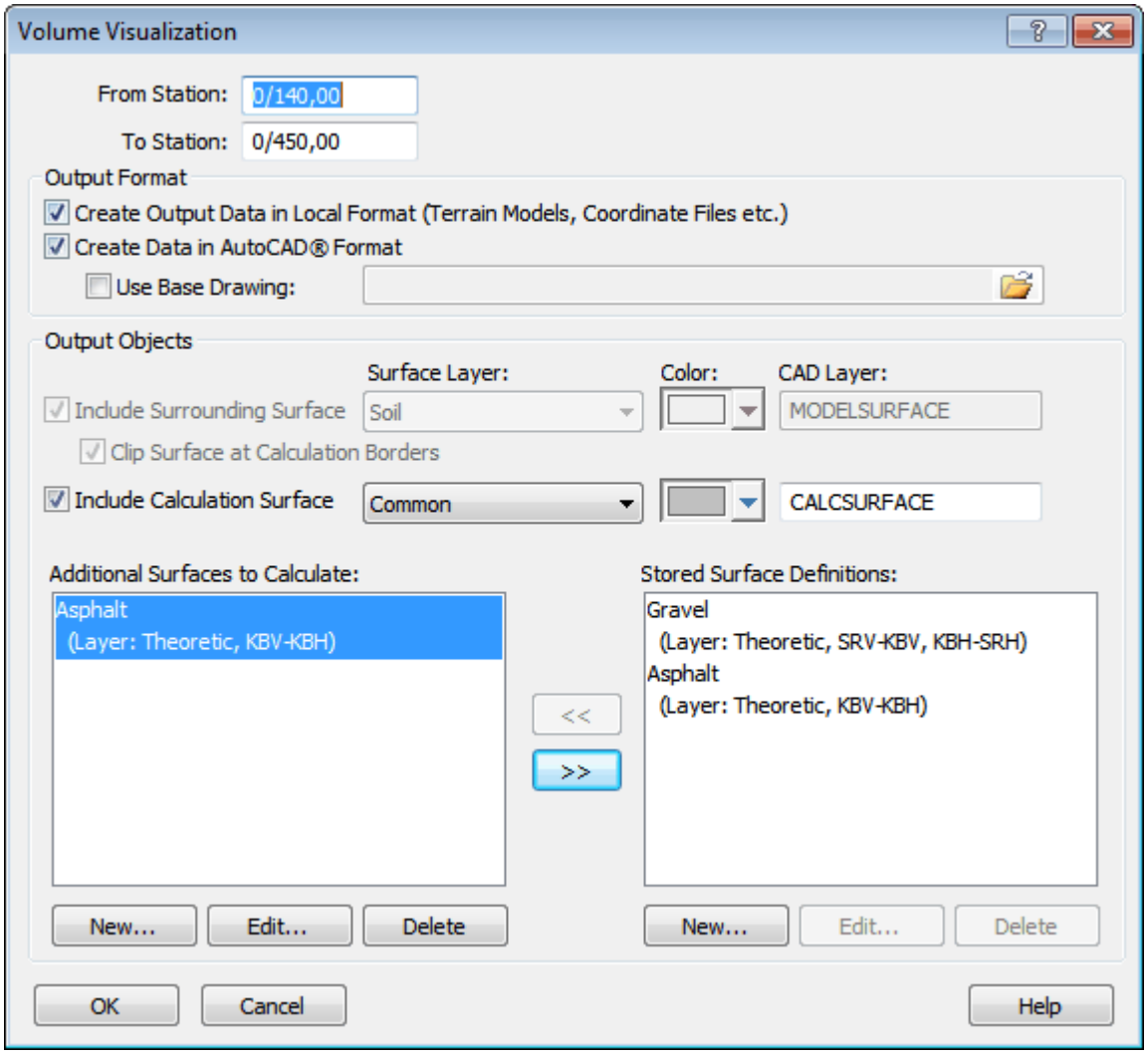
You can cut away the parts of the existing models that are within the calculation area but you can also choose to keep them in place in order to visualize where along a distance the rock model stands out from a theoretical surface.

The result can be created both as coordinate files and terrain models in iCON office format and dwg files in AutoCAD® format. In the latter case, you can choose to supplement an existing file.

Visualization can be done both from a volume calculation file (MBS) and from a calculated cross section file (sec).

Procedure

Open either an mbs or a sec file and select ***Data | Visualize*** to execute the function.



From section/To section

Enter the sections between which the calculation is to be made. The original values are loaded from the current file. From this you also determine the calculation interval[709].

Format for output data

Choose how the calculated surfaces are to be represented. Local format means terrain models and coordinate files. Terrain models are created for the areas selected, and coordinate files are created if you also selected to load lines that form the basis for the creation of triangle models.

If you select AutoCAD®format, a dwg file is created where different surfaces can be placed in different layers. You can also choose a base drawing that will be filled with data. In this way you can run the function several times but always put the results together in a file. You can also use the base drawing to determine the properties for the various layers in advance (primarily with respect to color and line type). You do this by specifying an existing layer in the base drawing when you select a layer in the **[AutoCAD® layer]** box (to the right) in the dialog.

Objects in output data

Here you determine all the different objects to include in the visualization. *Surrounding model* can only be selected if the function is run from an mbs file.

For all objects you can set **color** and **AutoCAD® layer** . The selected color is used both for output data created in iCON office format and in AutoCAD® format. The selected color in iCON office format is only temporary in the graphical window that opens after the calculation. After the files are closed and opened again, the colors appear as usual. In AutoCAD® format, however, you also specify a layer for the AutoCAD® file and the layer gets the color that is set. The selected color has no effect if you save as a base drawing and refer to an existing layer in it, in which case the original color of the layer is used.

Include Surrounding Surface
Choose a surrounding model to be included in the results. Surrounding model here means an existing model for soil, rock, user1 or user2 as specified in the current mbs file.

Clip Surface at Calculating Borders
Select the parts of the existing models that are within the calculation area to cut. If you choose to keep them in place, you can, for example, visualize where along a stretch the rock model stands out from the theoretical surface. See the illustrations below.

Original Rock Model

Cut Rock Model

Calculation Model
Choose a surface to be created for one of the calculation layers in the file. The surface is based on the full extension of the selected layer in the cross section.

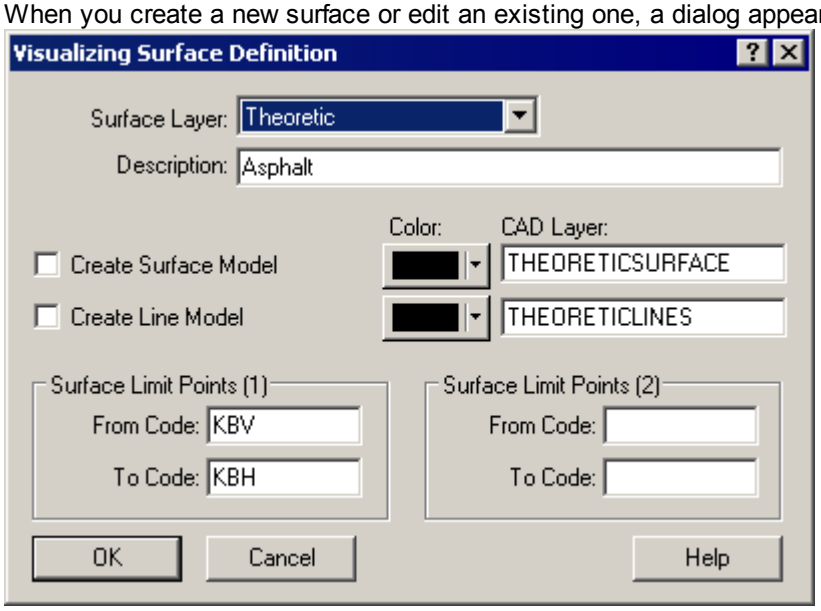
Additional Surfaces to Calculate
In addition to existing models and calculation models, surfaces for parts of the calculation models can be included. You can limit the desired surface by using the code for points in the cross sections. The choice of surfaces, and the codes between which they apply, are stored in the surface definitions. See more under 'Surface Definitions 752', below.

The list shows the surfaces that will be calculated. Complete either from the saved surface definitions by clicking the **[<<]** button or selecting **[New…]** to create new definitions. You can also edit and delete surfaces from the list.

Stored Surface Definitions
The list shows the definitions that are saved in the Windows registry for use on several occasions. Select **[New…]** to create new definitions. You can also edit and delete surfaces from the list. Use the **[>>]** button to move an area over from the current calculation.

Surface Definitions

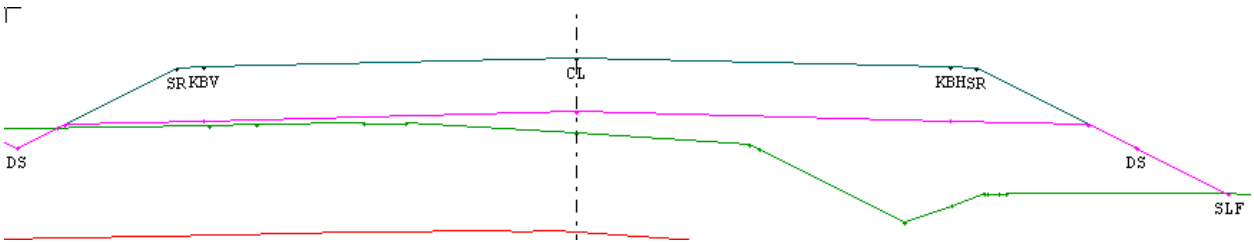
When you create a new surface or edit an existing one, a dialog appears with the surface's definition data.



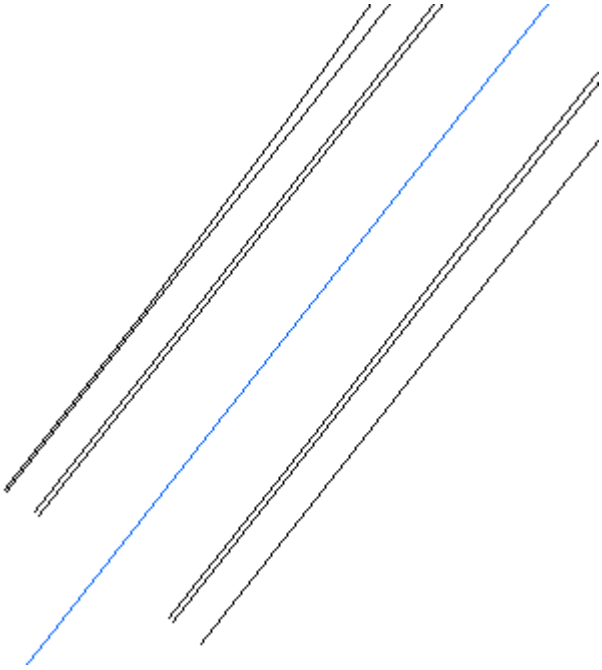
You can limit the desired surface by using the code for points in the cross sections **[Limit points for the surface points (1)]**. The code 700 is set easiest directly in the standard section in the volume calculation. In this way points are automatically assigned the correct code in the finished cross section. You can also edit the code for the points in a cross section file later. If you want to calculate the whole surface for a specific layer, you do not specify any limit codes. The program goes through the points for each layer in the cross section from left to right and loads the points that are within the code interval. You can also specify a secondary calculation interval **[Limit points for the surface points (2)]**. This may be useful if, for example, you want to view slope surfaces on the left and right side. In this case enter the codes for the left slope points in the first code pair and the codes for the right slope points in the second code pair. Be aware that the area between the surfaces will be covered by the interpolated triangles and it will therefore be viewed graphically. It may be better to define the unique codes on the left and right sides, and calculate these surfaces separately to avoid this. If you want to calculate a continuous length that begins on the left side but ends on the right side, it is sufficient to specify a code pair with the limit points' codes.

Example of coding

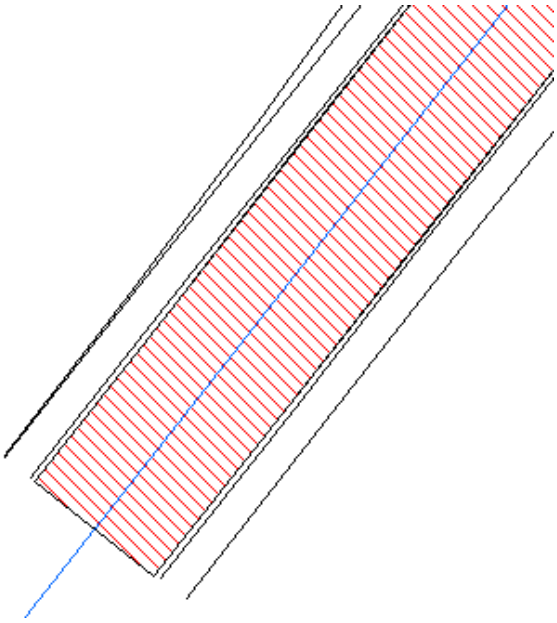
The example below shows how to code various points in the cross section of a volume calculation (mbs file).



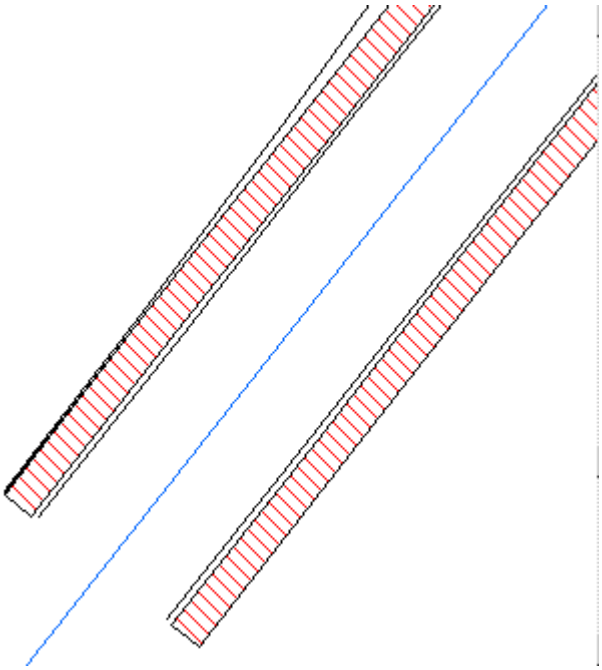
The road section in the cross section, with the codes from the standard section printed.



Road section from above.



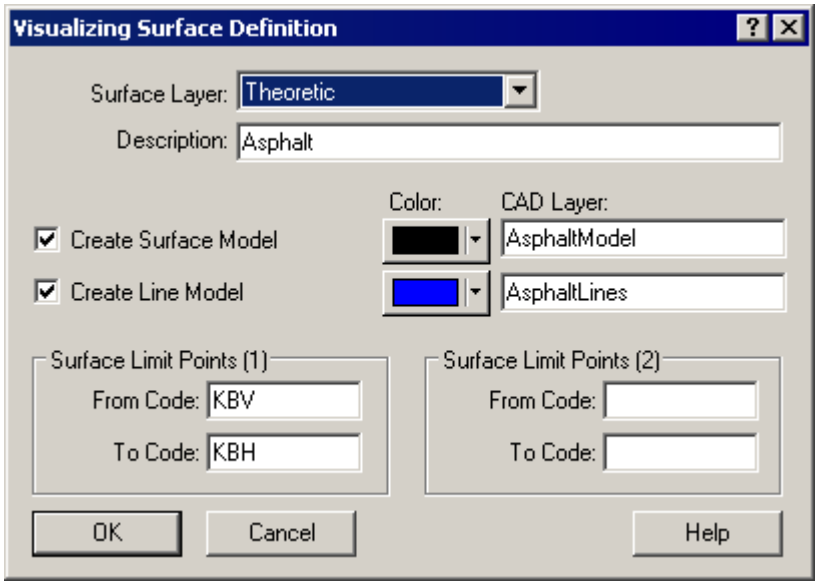
E.g.1: Calculation of the roadway between codes KBV and KBH



E.g.2: Calculation of the slopes between the codes DS-SR and SR-DS

Dialog

For each surface to calculate, you indicate in which layer the surface is and the codes that limit the surface. In addition you enter a description, e.g. asphalt, for the surface. Each set of this type can also be stored by iCON office in the Windows registry where you can easily visualize the same surfaces on several occasions.



Layers for the surface
Indicate in which layer the actual surface exists.

Description
Enter a description for the surface. This name must be unique among the surfaces.

Create Surface Model
Check this box if a triangle model is calculated for the current surface. The model is saved in output data as a terrain model (trm) in iCON office format and/or as 3d-faces in a dwg file in AutoCAD® format. Also select a color and name for the layers in the AutoCAD® file.

Create Line Model
The lines generated by the codes can be included in the output data. You can use this, for example, to visualize painted lines along a road. The lines are saved in the output data as coordinate files (geo) in iCON office format and/or as 3D lines in a dwg file in AutoCAD® format. Also select a color and name for the layers in the AutoCAD® file.

Limit points for the surface (1 and 2)
Interrelated code pair for limiting the surface. Limit pair 2 is only used if the surface is divided into two halves as shown in example 2 above.

From code
Enter from which code (i.e. first point with this code in the section) the surface begins. Leave this field empty if the surface begins at the first point furthest to the left of the section.

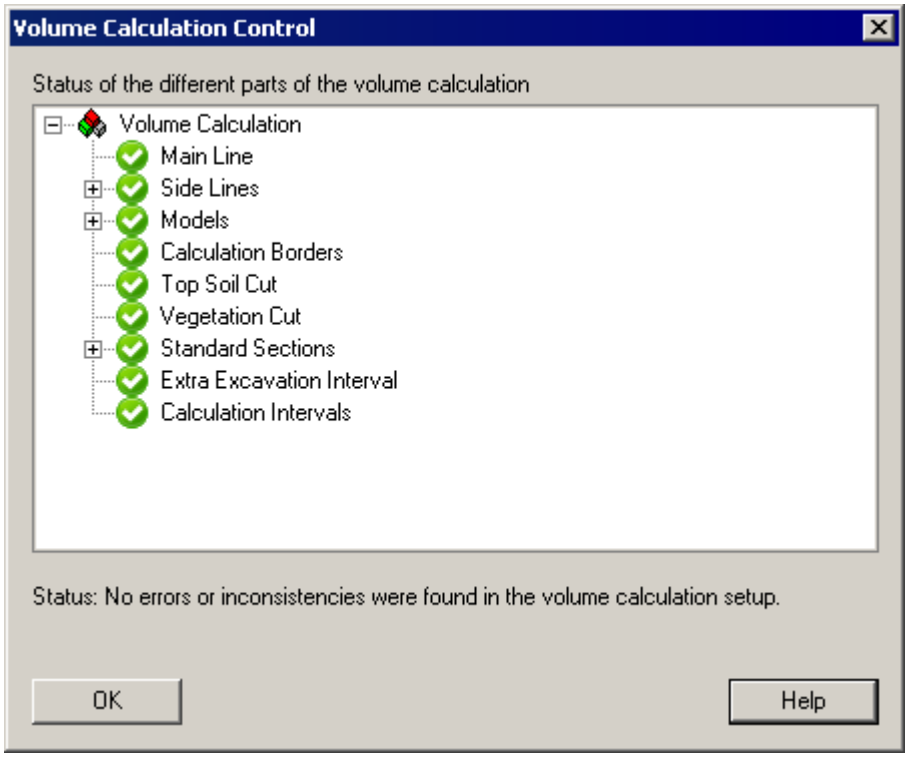
To code
Enter at which code (i.e. the first point with this code in the section, after the from code is found) the surface ends. Enter blank if the surface ends at the last point furthest to the right of the section.

See also Volume Calculation in General 687 and Volume Descriptions 689 .

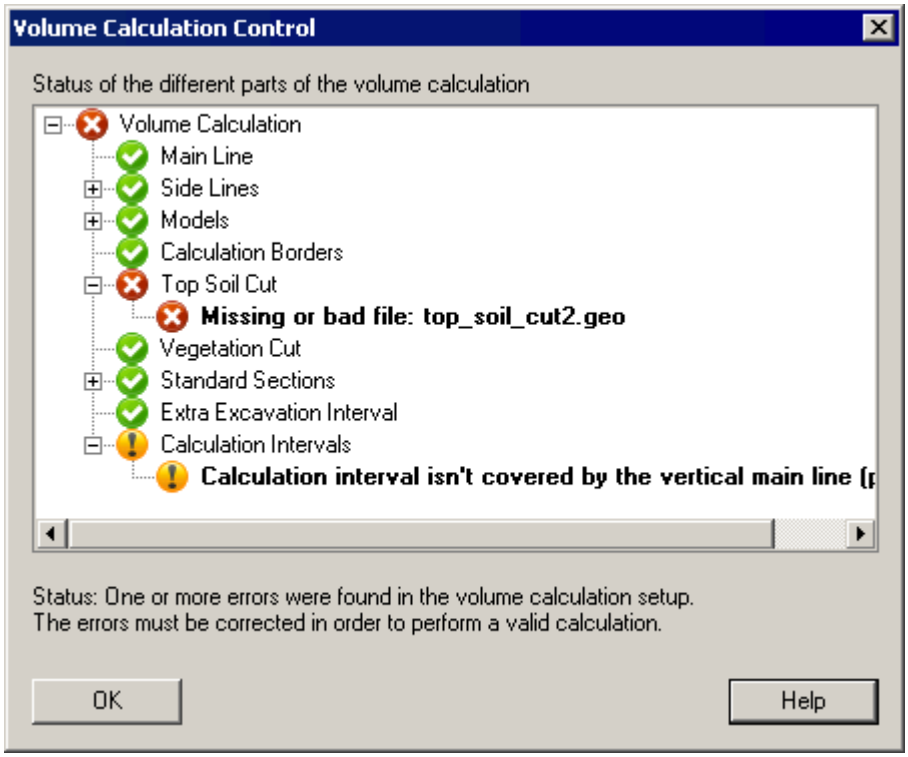
12.8 Check Volume Calculation

When you have a volume calculation, mbs file, active, you can check the construction of the volume calculation. Select ***Data | Check Volume Calculation***. This check adds together all the major components of the calculation, and verifies that the specified files are in place and that the settings made are operable, e.g. for standard sections and the calculation interval.

Note that green checks signify that the volume calculation can be calculated, not that it is necessarily the correct amounts.



If there are red circles with a cross or yellow circles with exclamation points instead of green checks, this means that there are errors or warnings concerning the construction of the volume calculation. In this case there is also an explanatory text informing you what is wrong, e.g. *the calculation interval is not covered by the main line's profile*. In this case, it means that the main line profile starts after or ends before the current calculation interval.



See also: Volume Descriptions, MBS 689 , Volume Calculation in General 687 , Check Tunnel Calculation 876

13 Point Cloud

Point Cloud in General

When you open a point cloud file (gpc) in iCON office, the scanned points will be displayed in a 3D view.

iCON office point cloud module is using a data base which is indexing the points for fast data access. The point cloud module can work with heavy data set and render up to 8 million points on the screen. The point cloud file (GPC) links to the file or files that are included in the point cloud. iCON office supports many common scanning formats e.g. PCI, LAS, PTS, E57 and others. If you are working with Leica Nova MS50 [760] , iCON office can be integrated in the data flow and it can handle both scanning data and traditional surveyed data from the instrument.

The point cloud module has different filter functions [766] to clean the data set from e.g. trees, buildings or noise. The filter functions make it possible to extract only the required data. An easy way to create a terrain surface from a point cloud is to a use a tool and define a grid and extract the lowest or highest point in each cell. The points can be used to generate a terrain model (trm) and the resulting model can be saved and used as it is, or it can be used as a filter surface with a possibility to add an offset to the surface. There are also tools for creating cross sections directly from the point cloud, then there is no need to start by creating a terrain model.

When exporting a point cloud there is a possibility to sparse out [766] the number of points to be exported. The user can define a minimum allowed spacing, before the point cloud is exported to either of the following formats:

- Coordinate File (*.geo)
- LiDAR Data (*.las)
- Leica PCI Indexed Point Format (*.pci)
- PTS ASCII Unordered Interchange Format (*.pts)

Rotate a Point Cloud Graphically

To rotate a point cloud graphically:

- Click in the graphics.
- Press the **[space key]**.
- Move the mouse to rotate the point cloud.

Point Cloud Information

Select ***Data | Display Point Cloud Information*** to display information about the point cloud in the Input/Output Window [107].

Archiving Point Cloud

It is possible to archive point cloud files, by creating a zipped file:

- Open a point cloud file, gpc.
- Select ***File | Archive | Create Archive From Window***.

The zipped file will contain the point cloud file, gpc, and all linked files. Thus it facilitate the exchange of point cloud files between iCON office users.
See also Archiving [36].

Links

- Create Point Cloud [759]
- Point Cloud Properties [764]
- Filter Point Clouds [766]
- Export Filtered Point Cloud [779]

- Create Cross Sections in Point Cloud 802

See also: Create Point Cloud 759, Point Cloud Properties 764, Filter 766, Export Point Cloud 779, Create Cross Sections 802,

13.1 Create Point Cloud

Point Cloud to iCON office

A point cloud can be created and imported to iCON office in the following way:

- Create Point Cloud (gpc) 759
- Import from Leica SmartWorx DBX 760
- Transform Point Cloud from Leica SmartWorx DBX 761
- Import Measurement Data for the Stations from Leica SmartWorx DBX 763

File types

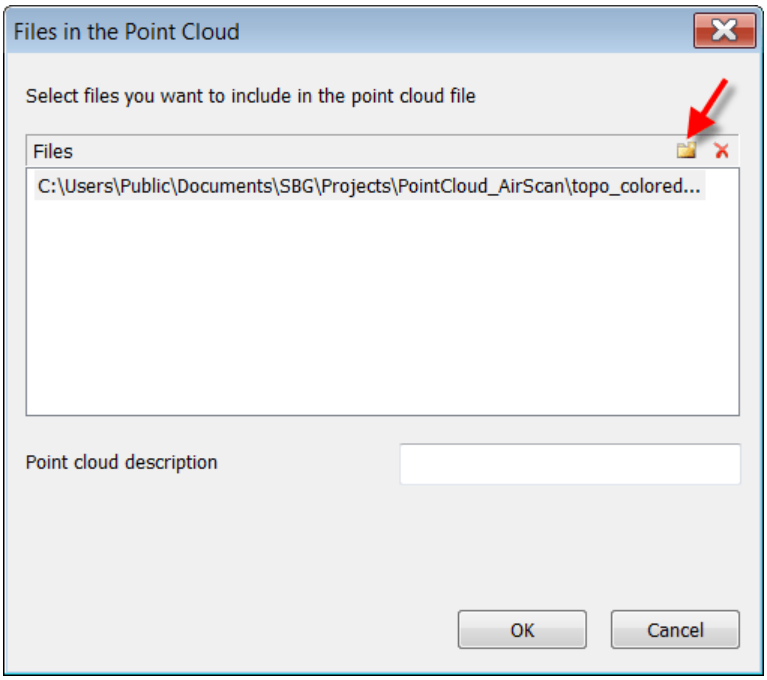
The following file types can be included in a point cloud:

- Leica format (*.pci, *.pcit, *.pcix, *.pcs, *.pcst, *.pcsx)
- PTS ASCII Unordered Interchange format (*.pts)
- Leica SmartWorx DBX (*.xcf)
- Zoeller and Freulich ZSF Uncompressed Scan Data (*.zfs)
- iCON office coordinate file (*.geo)
- E57 Cloud (*.e57)
- LAS (*.las)
- iCON office grid model (*.gdm)
- ESRI grid ASCII file (*.asc)

Create Point Cloud (GPC)

To create a new point cloud file, there are two alternatives:

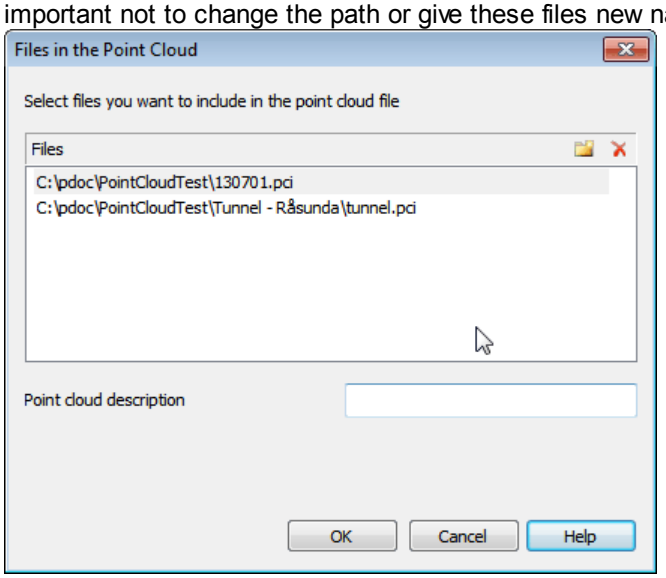
- Go to ***File | New*** and select Point Clouds (gpc).
- Right click on the header **Point Clouds** in the Project Tree 10 and select **Create new document**.



Use the dialog to select files for the point cloud and add a possible description

- Click to add a file.
- Click the browse button to select correct file type and select the file or files that should be included in the point cloud. Confirm with **[Open]**.
- Now the search path is displayed in the dialog **Files in the Point Cloud**.
- It's possible to add a description.
- Confirm with **[OK]** to open the point cloud in iCON office.

If needed it's easy to add files to the point cloud later, just go to ***Data | Edit Point Cloud File*** and select additional files. As the point cloud file (gpc) contains the path to the file or files that are included in the point cloud, it's important not to change the path or give these files new names.

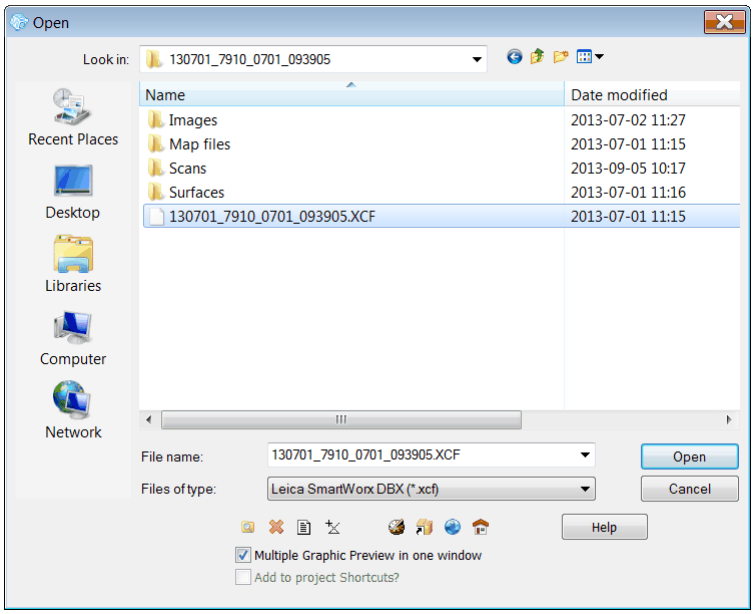


Files in the point cloud.

Import from Leica SmartWorx DBX

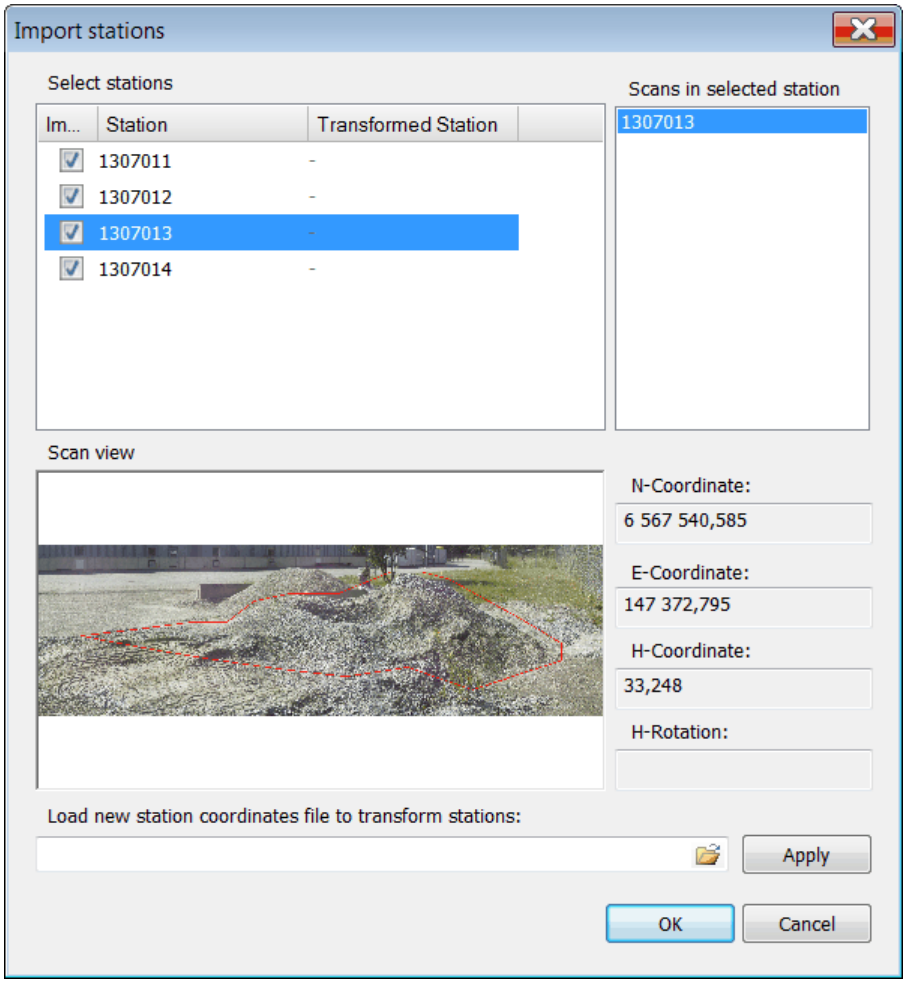
The workflow to import a point cloud from SmartWorx DBX, e.g. from Leica Nova MS50, is done in the following way:

- Copy the job containing the scanning data, it is saved in the DBX folder, to your computer, e.g. to active iCON office project folder.
- Open a new point cloud document, go to ***File*** | ***New*** and select Point Cloud (gpc) or right click on **Point Clouds** in the project tree and select **Create new document**.
- Click the browse button ..., and set the file type to Leica SmartWorx DBX (*xcf) and select the job you want to import to the point cloud. Confirm with **[Open]**.



Set the correct file type and browse to the job that will be imported.

- Now the search path is displayed in the dialog **Files in the Point Cloud**, confirm with **[OK]**.
- In the next dialog all stations in the scanning job are displayed.
  - Select one station to display its coordinates.
  - For point clouds imported from Leica SmartWorx DBX there is a possibility to transform the stations before import, see Transform Point Cloud from Leica SmartWorx DBX 761.



Select stations to import

- Select stations to be imported by checking the boxes below **Import** and confirm with **[OK]** to generate a point cloud.

The dialog above is only used for importing scanning data. If measurement data for the station setups will be imported or if the job contains traditional surveyed data as well, this data must be imported the normal way using the Leica DBX/GSI import, ***File | Import/Export | Leica DBX/GSI*** 427. If the station coordinates will be transformed, it is important to import the measurement data for the station setups.

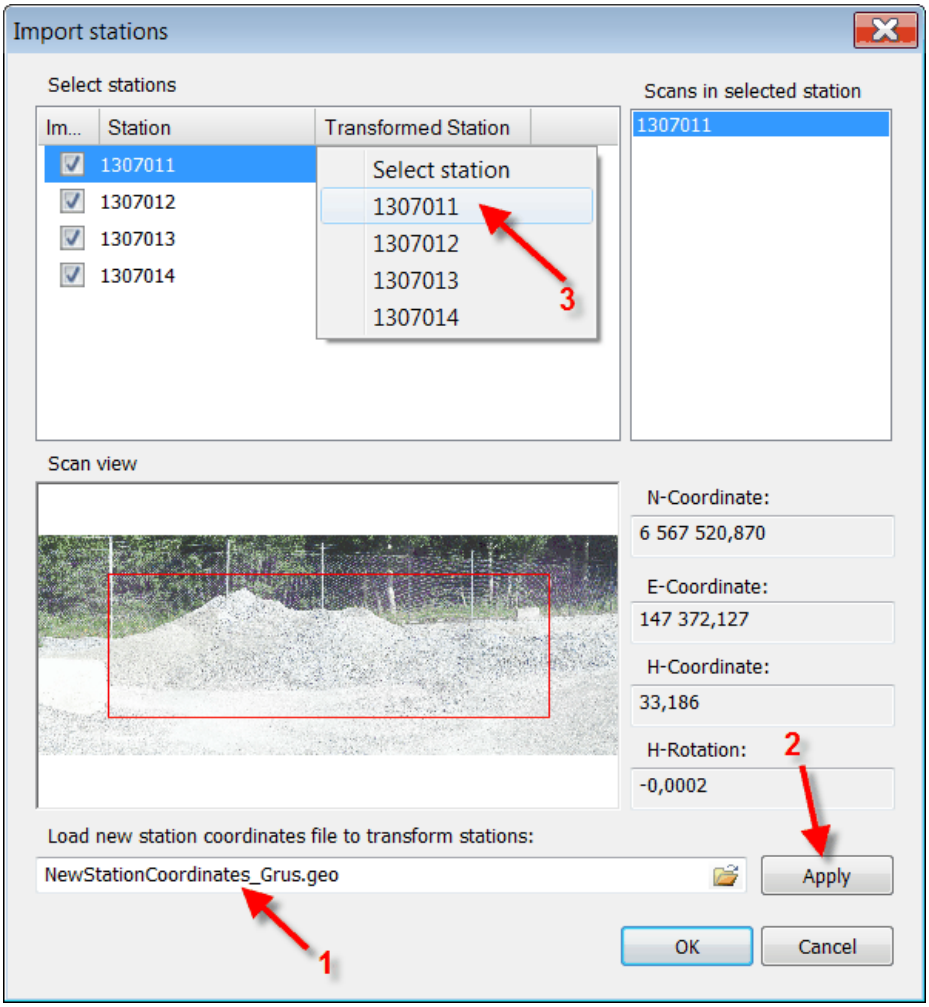
Transform Point Cloud from Leica SmartWorx DBX

When a point cloud is imported from Leica SmartWorx DBX it's possible to transform the point cloud if a coordinate file, containing the new station coordinates and rotation angle, is selected in the import dialog. In order to create this coordinate file, the measurement data for the station setups must be imported to iCON office, see Import Measurement Data for the Stations from Leica SmartWorx DBX 763, and new coordinates for the stations must be calculated:

- Open the measurement data file (plm) and select correct **Station Type** for each station, define the measured control points as **Backsights** and save the file. The reason why this must be done is that this information is not included in the GSI import.
- Make sure the correct control point file is selected as known point file in the project settings 18, ***Settings*** | ***Known Points***.
- Go to ***Data*** | ***Save stations for point cloud*** and the stations are calculated and a coordinate file with the station coordinates is generated.

The resulting coordinate file contains the new station coordinates and information about rotation angle. It's important that the function **Save stations for point cloud** is used, because the normal coordinate calculation does not generate a rotation angle. The file can be used to transform the point cloud when it is imported. The steps are described below:

- In the dialog **Import Stations** the coordinate file with new station coordinates is selected. (1)
- Press **[Apply]** (2)



Select the file with new station coordinates and confirm that the right station names
are matched

- If the original and transformed stations have the same name, iCON office can automatically match the stations. If it's not possible, do it manually in the **Transformed Station** column. (3)

- Check the boxes below **Import** to select which stations to import and confirm with **[OK]** and a point cloud with transformed coordinates is created.

Import Measurement Data for the Stations from Leica SmartWorx DBX

- Import the measurement data for the station setups using the normal Leica DBX/GSI import. Click on the icon in the toolbar or go to ***File*** | ***Import/ Export*** | ***Leica DBX/GSI***.
- In the Import/Export dialog select the correct job (*.dbx) and press **[<<Transfer]**.
- Select the filter for import of measurement data (SBG_GSI_Pol_vX.FRT) and a measurement data file (PLM), with angles and distances, is generated.

13.2 Point Cloud Properties

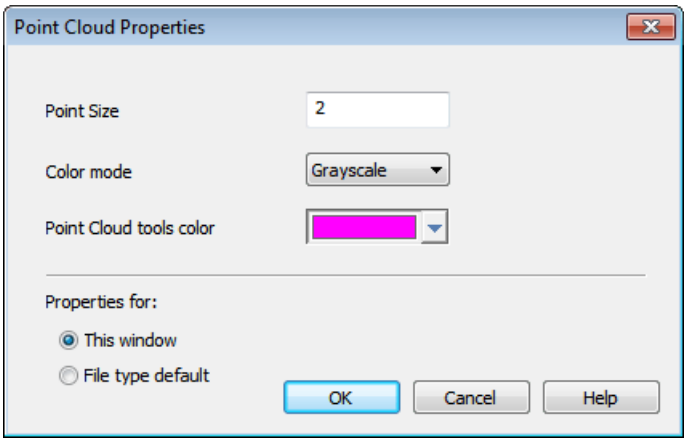
Properties for Point Cloud documents

When you have opened a point cloud file, some properties for the point cloud can be changed:

- Document Properties Point Cloud 764
- 3D Graphics Properties 764

Document Properties Point Cloud, gpc

Select ***View*** | ***Document Properties*** or press the icon to display point cloud properties. The following settings can be changed:



Select properties for the point cloud file.

Point Size
The size of the points in the point cloud.

Color Mode
Available color modes depend on the information stored in the imported scanning data. The choices can be different for different point cloud files, eg:

- Color
- Intensity
- Classification
- Grayscale
- Elevation
- Source (Please note, not obtainable if you import directly from MS50 SmartWorx)

Point Cloud Tools Color
The selected color will be used for point cloud tools.

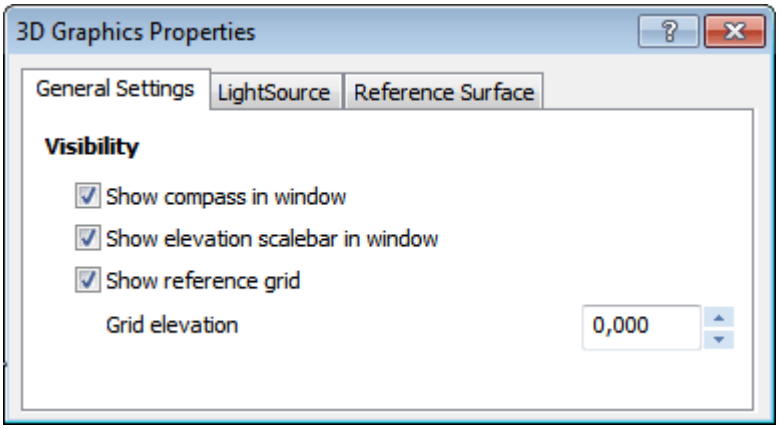
Properties for:

- This window
- File type default

Select if the settings should be applied to the open window, or if they should apply generally for this particular document type. See also Graphical Document Properties 52.

3D Graphics Properties

To modify the 3D graphics properties, select ***View*** | ***3D Graphics Properties*** or click at



Show compass in window
Check this option to display a compass in the bottom right corner. The axes are named according to Settings in the Project 20.

Show elevation scalebar in window
Check this option to display a height scale in the lower left corner.
For point cloud with Color mode By Elevation 764, the elevation scalebar is shown with colors.
Heights correspond to colors from blue to red, where blue represents the lowest height and red the highest.

Show reference grid
Check this option to display a reference surface in the shape of a grid.
The reference surface is shown along with the 3D graphics.

Grid elevation
Here you can adjust the height of the reference grid.

For additional information about the tabs in the dialog, see General settings for 3D graphics 84, Light Source 85 and Reference Surface 86.

See also: Point Cloud 757, Settings in the Project 16, General settings for 3D graphics 84

13.3 Filter Point Clouds

Filter Point Cloud

When working with point cloud files (gpc) there are both 2D and 3D filter functions to clear the data set from unwanted data. You can use one or several filters.

When you apply a filter to a point cloud, you hide some of the points. The points are always there, it is just the filter settings that change. Using filters, it's possible to:

- Enable and disable filters.
- Add one or several filters to a point cloud.

Simplifying during exportation	2D filters	3D filters
Simplify Point Cloud 766	2D Point Cloud Filter 767	3D Point Cloud Filter 770
	Surface Filter using a terrain model 768	(Points by Grid Tool) 771
	Intensity Filter 768	
	Classification filter 769 (only for LAS data)	

Select ***Data*** | ***Edit Point Cloud Filters*** to display all filters for the active point cloud, see Edit Point Cloud Filters 775 . In this workflow view it is possible to change settings for filters, enable or disable and also remove filters.

The tool Find Points by Grid 771 , is not a filter, but this tool can be used to find the lowest or highest points in a point cloud by using a grid.

Even if you have selected a filter tool, it's still possible to rotate the view by clicking the **[space key]** while moving the mouse, see Point Cloud 757 .

Simplify Cloud

When a point cloud is exported it can be simplified based on a user defined spacing threshold. A minimum distance between points is specified in the export dialog, see **Export Point Cloud** 779 for more information.

See also: Point Cloud 757, Export Point Cloud 779 , 2D filters 767, 3D filter and the Grid Tool 770 , Edit Point Cloud Filters 775

13.3.1 2D filters

Filter point cloud

Below, 2D filter functions are described, that are used to clear the data set from unwanted data or to extract only required data from a point cloud file (gpc). You can use one or several filters in a single point cloud file.

When you apply a filter to a point cloud, you hide some of the points. The points are always there, it is just the filter settings that change. Using filters, it's possible to:

- Enable and disable filters.
- Add one or several filters to a point cloud.

Select ***Data*** | ***Edit Point Cloud Filters*** to display all filters for the active point cloud, see Edit Point Cloud Filters 775 . In this workflow view it is possible to change settings for filters, enable or disable and also remove filters.

2D filters	
2D Point Cloud Filter 767	***Tools	2D Point Cloud Filter***
2D Border Polygon Filter 768	***Data	Create 2D Border Polygon Filter***
Surface Filter using a terrain model 768	***Data	Create Surface Filter***
Intensity Filter 768	***Data	Create Intensity Filter***
Classification filter 769 (only for LAS data)	***Data	Create/Edit Classification FIlter***

Create 2D filters to be used on point clouds.

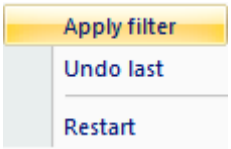
Even if you have selected a filter tool, it's still possible to rotate the point cloud by pressing the **[space key]** and moving the mouse, see Point Cloud 757 .

2D Point Cloud Filter

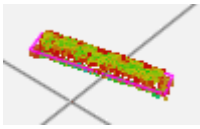
- create a polygon in the point cloud

The 2D Point Cloud Filter filters the point cloud by a user defined boundary (polygon). You create the polygon in the point cloud view.
If you already have a saved coordinate file with border polygons, it is possible to use a 2D Border Polygon Filter 768 instead.

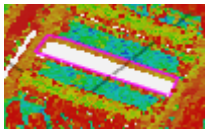
- Select the tool or ***Tools | 2D Point Cloud Filter*** and define a boundary in the point cloud. If you are not satisfied with your selection, right click and select **Undo last** or **Restart**.
- Right click and select **Apply filter**.



- When the filter is applied, only the part of the cloud inside the boundary is displayed.
  - Enable the filter editor 776 to display points outside the boundary instead.



Point cloud where points outside the boundary (polygon) are hidden.



Point cloud where points inside the boundary (polygon) are hidden.

2D Border Polygon Filter - select a coordinate file including polygon(s)

You can use the 2D Border Polygon Filter to filter points in a point cloud. This filter uses an already saved coordinate file with one or several closed polygons 158.
The filter works in a similar way as the 2D Point Cloud Filter 767 .

- Open a point cloud and select ***Data*** | ***Create 2D Border Polygon Filter***.
- Select a coordinate file with polygons.
  If you have given names to the polygons 158 , theses names will be displayed in the workflow view, if you open the filter editor 776 .
- Confirm with **[OK]** to implement the filter.

Enable the filter editor 776 to change settings for the surface filter. For example, you can enable or disable a filter, and you can select to hide points within or outside a border polygon.

Surface Filter - select a terrain model

If you have a terrain model, you can use it as a surface filter.
You can use your own terrain model, or you can create it with the Grid Tool; Find Points by Grid. 771

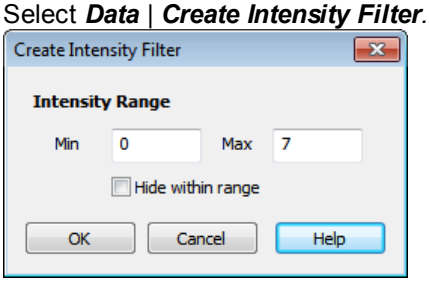
- Select ***Data*** | ***Create Surface Filter***.
- Select a terrain model (trm) in the dialog.
- Confirm with **[OK]** to implement the filter.

Enable the filter editor 775 to change settings for the surface filter. For example, if you change the offset, the height of the surface filter changes and you can choose to hide points above or below this level.

Intensity Filter

If the points in the point cloud have distinct differences in intensity value, you can use an intensity filter.

- Select ***Data*** | ***Create Intensity Filter***.



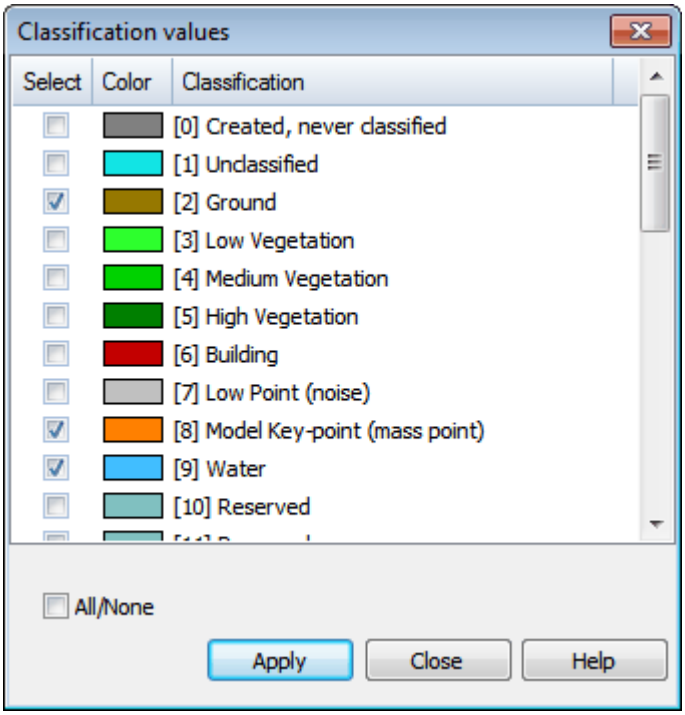
- Specify the minimum and maximum intensity value for the points to be filtered.
- **[Hide within range]**, check the box if points within the interval should be hidden.
  If the box is not checked, only points within the interval will be displayed.
- Confirm with **[OK]** to implement the filter.

Enable the filter editor 776 to change settings for the intensity filter.

Create/Edit Classification Filter

If the imported scanning data is classified there is a possibility to create a filter based on the classification and only display certain classes. This is only implemented for LAS data.

- Select ***Data*** | ***Create/Edit Classification Filter***.
- Select the classes you want to display. Use **[All/None]** to select or deselect all classes at once.
- Select **[Apply]** to enable the filter.



Select the classes to be displayed.

Enable the filter editor 777 to enable and disable the classification filter. If you want to change classes to display, go to ***Data*** | ***Create/Edit Classification Filter***.

See also: Point Cloud 757, Export Point Cloud 779, Filter Point Clouds 766, 3D filter and the Grid Tool 770

13.3.2 3D filter and the Grid Tool

Filter point cloud

To filter points within a certain height level in a point cloud, you can
- create a 3D Point Cloud Filter 770
- work with the grid tool 771 to create a terrain model that can be used as a 2D surface filter 768 .

You can use one or several filters in a single point cloud file..

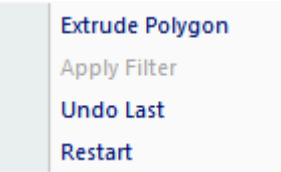
Select ***Data*** | ***Edit Point Cloud Filters*** to display all filters for the active point cloud, see Edit Point Cloud Filters 775 . In this workflow view it is possible to change settings for filters, enable or disable and also remove filters.

Even if you have selected a filter tool, it's still possible to rotate the point cloud by pressing the **[space key]** while moving the mouse, see Point Cloud 757 .

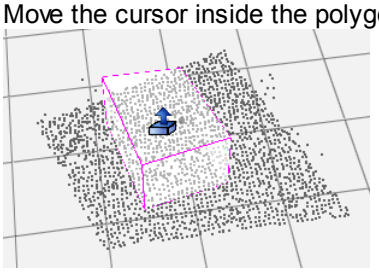
3D Point Cloud Filter

The three dimensional point cloud filter is a 3D filter that filters the point cloud with a 3D boundary polygon.

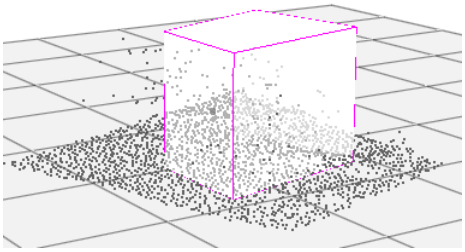
- Open a point cloud file (gpc).
- If you have selected a filter tool, for example it is still possible to rotate the point cloud by pressing the **[space key]** while moving the mouse.
- Select ***Tools*** | ***3D Point Cloud Filter*** or click .
  - Create a boundary polygon by clicking in the point cloud graphics.
  - If you are not satisfied with your selection, right click and select **Undo last** or **Restart**.



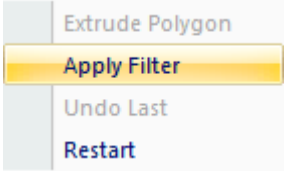
- Right click and select ***Extrude Polygon***, to confirm the selected polygon.
- Move the cursor inside the polygon. The mouse cursor will change to .



- Left click and move the cursor up or down to determine the height of the 3D polygon.



- Right click and select **[Apply Filter]**.



- When the filter is applied, only the point cloud inside the polygon will be displayed.

- Enable the filter editor 777 to change settings for the 3D filter.
  Remember to create the filter **[Apply Filter]**, before you edit it. In the workflow view, you can choose to display points inside or outside the filter boundaries

- Several 3D filters can be added to one single point cloud, to clear the data set from unwanted data.

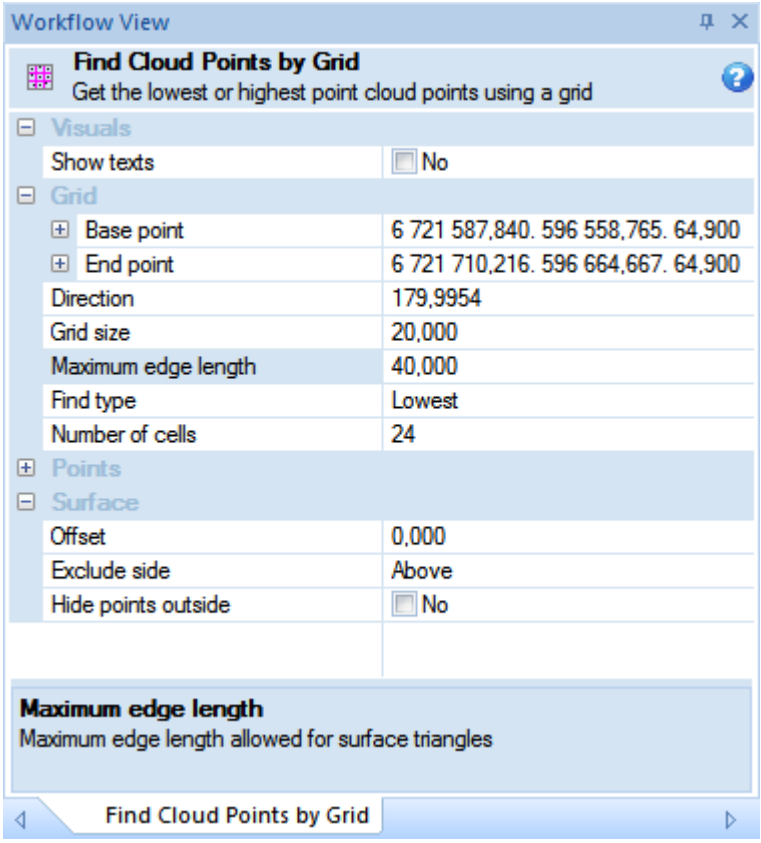
Grid tool

In a point cloud, you can use the grid tool to find the highest or lowest point in each square. In this way, the grid tool can be used almost as a 3D filter:

- The user defines a grid in the point cloud.
  - define a base point, direction and end point.
- The grid is used to find the lowest or the highest point in each square.
- Extract these points.
- The extracted points can:
  - be saved as a coordinate file (geo).
  - be triangulated and saved as a terrain model (trm). This terrain model will be created by the lowest or the highest points in the point cloud, regarded to the position of the grid.
- You can use the terrain model as a filter to find all points above or below the filter surface, see 2D surface filter 768 .

Using the grid tool in the workflow view and in the graphical view

Settings for the grid tool are made in the workflow view. Select size for the squares (grid size) and if the lowest or highest point in each cell should be found.

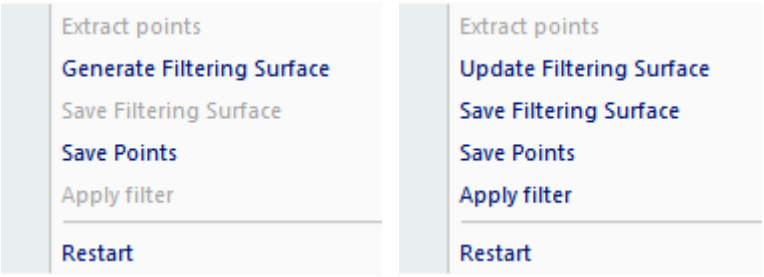


Change settings for the grid tool in the Workflow View.

- Open a point cloud file (gpc).
- Select the grid tool or select ***Tools | Find Points by Grid***.
- Define a grid by selecting a base point, direction and end point in the point cloud. The number of cells found are displayed in the workflow view.
- In the workflow view the following information is displayed:

Visuals	
Show texts	Choose if text for extracted points should be displayed. ☑ Yes Text is displayed. ☐ No No text is dispalyed.
Grid	
Base point	Coordinates for the base point of the grid.
End point	Coordinates for the end point of the grid.
Direction	The grid direction.
Grid size	Define the size of the cells in the grid.
Maximum edge length	Maximum edge length allowed for surface triangles.
Find type	Specify if lowest of highest point in each cell should be found.
Number of cells	The total number of cells in the grid.
Points	The extracted points are displayed here, including their coordinates.
Surface	
Vertical Offset	Vertical offset, related to theoretical surface.
Exclude Above/Below	Exclude points below or above the surface filter. Below Points below the surface filter are excluded. Above Points above the surface filter are excluded.
Hide points outside	Select if points outside the boundary of the surface filter should be hidden. ☑ Yes Points in the point cloud outside the boundary of the surface filter are hidden. ☐ No The point cloud is visible.

- Right click in the graphical view and select **[Extract points]** to extract the lowest/highest point in each cell.
  - Extracted points with heights are displayed under **Points** in the workflow view. To deselect a point, deselect the point in the list or press **[Ctrl]** simultaneously as you click the point in the graphical view.
    If you want to add points manually, press **[Ctrl]** and click the points in the graphical view.
- Right click again to select:
  - **[Generate Filtering Surface]**, to create a surface as a terrain model. Points can be added and removed manually, as described above, then right click to select **[Update Filtering Surface]**. This Filtering Surface can be used for filtering in 3D.
  - **[Save Points]**, to save the extracted points in a coordinate file.



Right click to open a menu for the grid tool.

- Under **Surface** in the workflow view, you select settings for the surface filter:
  - **Vertical offset** Vertical offset to raise or lower the theoretical surface.
  - **Exclude points**. Select if points above or below the surface should be hidden.
  - **Hide points outside**. Select if points outside the boundary of the surface filter shold be hidden.
- If you want to save the filter surface, right click and select **[Save Filtering Surface]**.
  - Save the terrain model (trm).
  - With the grid tool, you will be able to create a terrain model based on the lowest of highest points found in the point cloud.

- Right click to select **[Apply filter]** to clear the point cloud from unwanted points regarding the settings in the workflow view. The calculation time, depends on the size of the point cloud and the capacity of the computer.
- The created surface filter can for example be used as a 2D surface filter 768,

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See also: Point Cloud 757, Export Point Cloud 779 , Filter Point Clouds 766, 2D filters 767

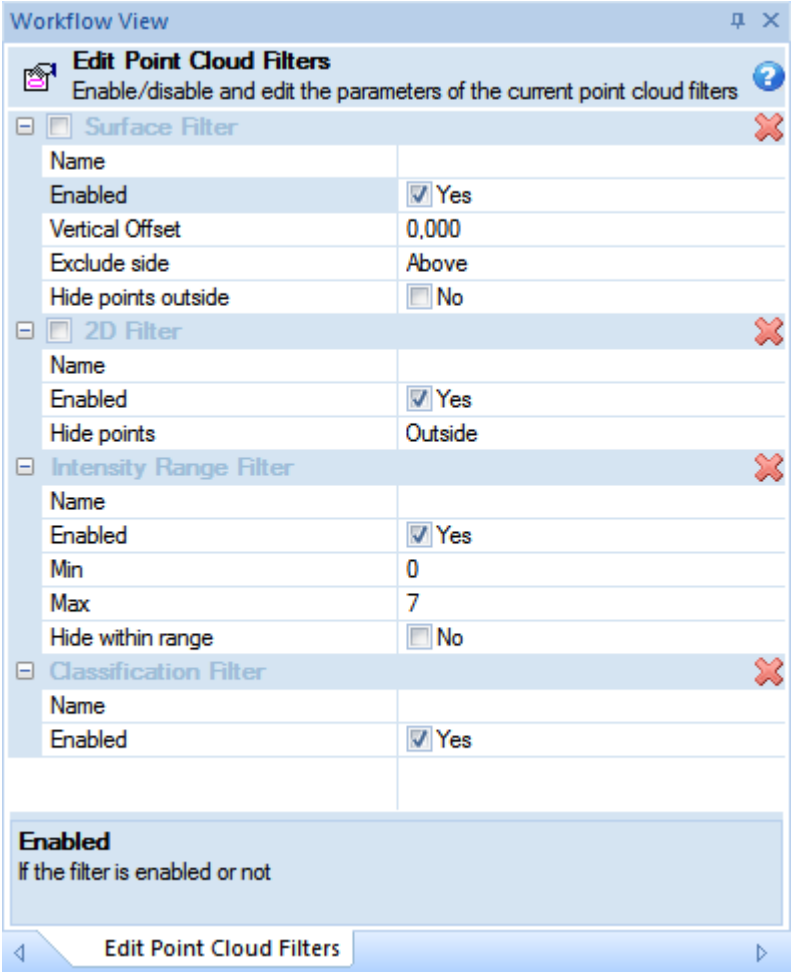
13.3.3 Edit Point Cloud Filters

Edit Point Cloud Filter

If you open a point cloud file (gpc), it makes sense to open the filter editor to see if there are some implemented filters.

Select ***Data*** | ***Edit Point Cloud Filters*** to display filters related to the point cloud. There are different settings for different filters.

Examples of settings regarding 2D filters:



2D filter settings to be edited.

Surface Filter

Surface Filter	Check the box if the terrain model that creates the surface t be displayed with the point cloud.
	Delete a filter by selecting . A dialog appears, asking you to confirm that the filter shoul
Name	Give the filter a name, optional option.
Enabled	Enable/disable filters. Yes Enable the filter. No Disable the filter.
Vertical Offset	Enter a vertical offset to raise or lower the level of the surfac (terrain model).
Exclude points	Select to exclude points below or above the surface filter. Below Points below the surface filter are excluded. Above Points above the surface filter are excluded.

Hide points outside	Select if points outside the boundaries of the surface filter s hidden. ☑ Yes Points outside the boundaries of the surface filter are ☐ No Point cloud is displayed.

Use the surface filter to clear the point cloud from objects, noise and points above or certain level.

Tip! Use the surface filter to find objects between specified levels:

- Import the same terrain model, as a surface filter, twice.
- Enter vertical offsets to put them at different levels.
- Use the filter to hide points above the upper vertical offset.
- Use the filter to hide points below the lower vertical offset.

2D Filter

2D Filter	Check the box if the boundary polygon should be displayed with the point cloud. ☑ 2D filter Checked box for 2D filter. Deselect the box if the filter shouldn't be used.
✖	Delete a filter by selecting ✖. A dialog appears, asking you to confirm that the filter should be deleted.
Name	Give the filter a name, optional option. If you have selected a coordinate file as a 2D border polygon filter where the closed polygons 158 are already named, these names will automatically be displayed here.
Enabled	Enable/disable filters. ☑ Yes Enable the filter. ☐ No Disable the filter.
Hide points	Select to hide points outside or inside the boundary polygon. Inside Hide points inside. Outside Hide points outside.

When you use a 2D point cloud filter 767 or a border polygon filter, all points within the boundaries of the polygon are removed, regardless their height.

Intensity Range Filter

Intensity Range Filter	
✖	Delete a filter by selecting ✖. A dialog appears, asking you to confirm that the filter should be deleted.
Name	Give the filter a name, optional option.
Enabled	Enable/disable filters. ☑ Yes Enable the filter. ☐ No Disable the filter.
Min. intensity	State the minimum intensity in the range.
Max intensity	State the maximum intensity in the range.
Hide within range	Select if points within the intensity range should be hidden. ☑ Yes Points within the intensity range are hidden. ☐ No Points within the intensity range are displayed.

You can use the intensity range filter if the points in the point cloud have distinct differences in intensity value.

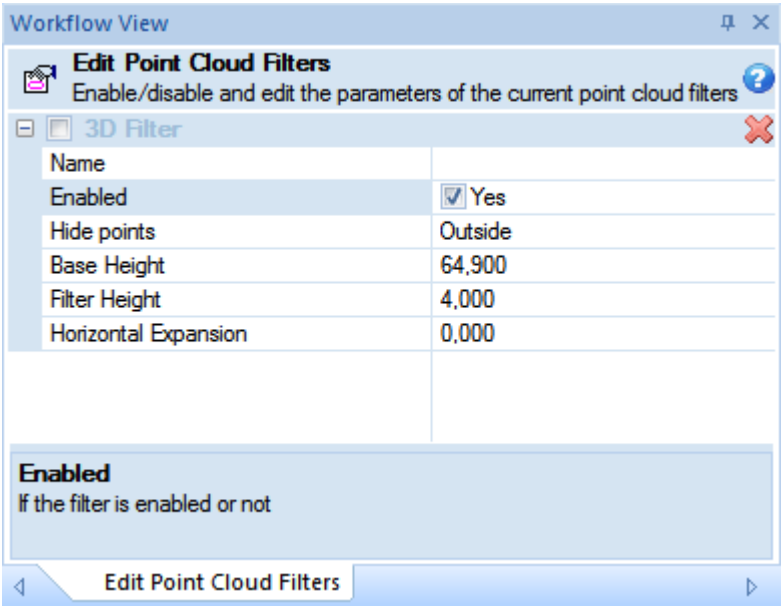
Classification Filter

Classification Filter	
	Delete a filter by selecting . A dialog appears, asking you to confirm that the filter should be deleted.
Name	Give the filter a name, optional option.
Enabled	Enable/disable filters. ☑ Yes Enable the filter. ☐ No Disable the filter.

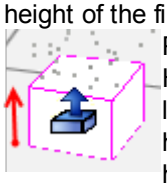
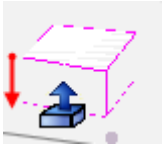
If the points in the point cloud are classified, you can use the classification filter. If you want to change classes to display, go to ***Data*** | ***Create/Edit Classification Filter***.

Edit 3D Point Cloud Filter

Examples of settings regarding 3D filters:



3D filter settings to be edited.

3D Filter	Check the box to display the boundary polygon with the point cloud.
	Delete a filter by selecting . A dialog appears, asking you to confirm that the filter should be deleted.
Name	Give the filter a name, optional option.
Enabled	Enable/disable filters. Yes Enable the filter. No Disable the filter.
Hide points	Select to hide points outside or inside the boundary polygon. Inside Hide points inside. Outside Hide points outside.
Base Height	The base height of the filtering boundary.
Filter Height	The height of the filtering boundary.  Positive height indicates that the Base Height of the polygon represents the lowest part of the 3D polygon. (The user has created a volume above the base height.)  Negative height indicates that the Base Height of the polygon represents the highest part of the 3D polygon. (The user has created a volume below the base height.)
Horizontal Expansion	Horizontal expansion of the boundary polygon.

With this 3D filter you create a 3D boundary polygon and use it to hide points in a point cloud.

See also: Point Cloud 757, Filter Point Clouds 766, 2D filters 767, 3D filter and the Grid Tool 770

13.4 Export Point Cloud

Export Format

A point cloud can be exported in the following formats:

- Coordinate File (*.geo)
- LiDAR Data (*.las)
- Leica PCI Indexed Point Format (*.pci)
- PTS ASCII Unordered Interchange Format (*.pts)

Export Point Cloud

Go to ***Data | Export Point Cloud*** to export a point cloud in

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In the export dialog there are export options called **Simplify cloud**

s and **Removed** **duplicates**.

Output file

- By default, the filtered point

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See also: Point Cloud 757, Filter Point Clouds 766

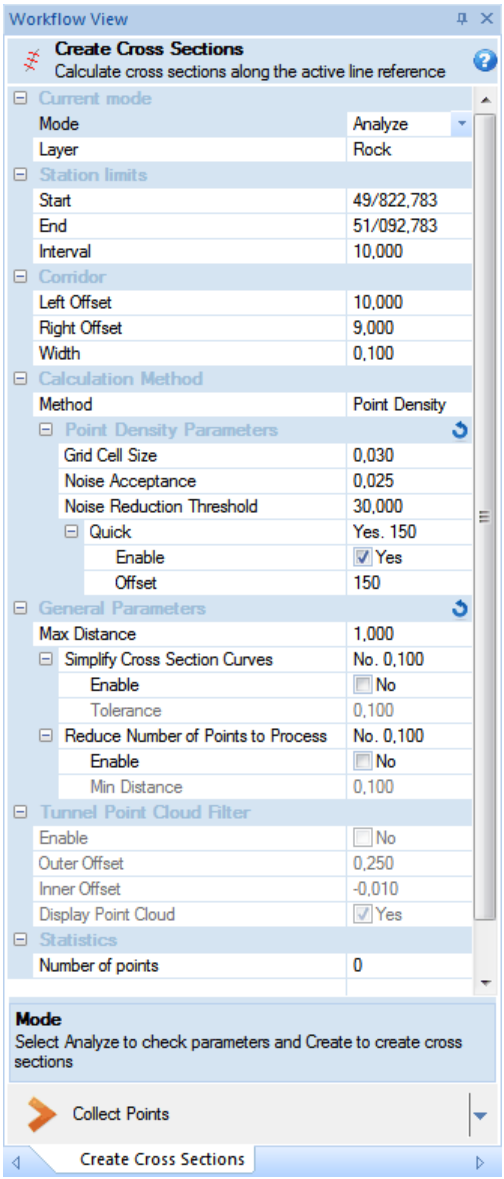
13.5 Create Cross Sections

Create Cross Sections

If a reference line (l3d or lin) is open in the same window as the point cloud, it is possible to create cross sections directly from a point cloud - you do not need to create a terrain model first.

- Set the point cloud file (gpc) active.
- Go to ***Data*** | ***Create Cross Sections*** to create cross sections directly.
- There are two calculation methods[804] to generate cross sections; point density[804] and triangulation[805].
- In the workflow view station limits and calculation method can be selected, and if needed, different parameters can be changed. At the bottom of the workflow view there is an arrow with a dropdown menu. Depending how far you are in the process, different options are available.
  - In the first step you can collect points.
  - Then it is possible to create cross sections from the collected points.
  - Eventually, you can save the cross sections in a cross section file (sec) or points in a coordinate file (geo).

  For more information about these steps, see Current Mode[803] below.

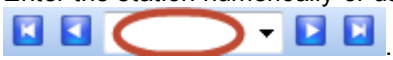


The workflow view to create cross sections when the method point density is selected

Current Mode

When cross sections are generated there are two different modes that can be selected: **Analyze** and **Create**.

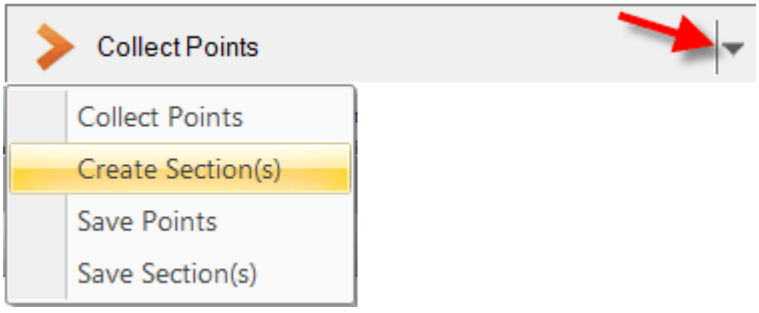
- **Analyze** means that only a cross section in the selected stationing is created. This mode is suitable to start with and you can test a calculation method and try different parameters to find out which combination that works best for a certain point cloud.

  - Step forward to the stationing where the cross section will be created. Enter the station numerically or use the arrows  .
  - Select calculation method. In general it's best to start with the default values for the different parameters.
  - Select **Collect Points** (at the lower part of the workflow view) to get the points in the defined corridor. The number of collected points will be displayed under **Statistics**.
  - Select **Save Points** if you want to save the collected point in a coordinate file.
  - Select **Create Cross Section(s)** to generate a cross section.
  - Select **Save Cross Section(s)** to save the cross section file (sec), with one single cross section.

If you are not satisfied with the result, you can change calculation method and/or try with new parameter values. Use the icon to reset the parameter values to default values.

- **Create** means that cross sections are created for the whole calculation interval and not just for one stationing. Be aware that this process might take a while, depending on the size of the point cloud and the selected distance between cross sections.

  - Define the calculation interval, i.e. start and end stations, and interval.
  - Select **Collect Points** to get the points in the defined corridors. The number of collected points will be displayed under **Statistics**.
  - Select **Create Cross Section(s)** to generate cross sections for the whole calculation interval.
  - Select **Save Cross Section(s)** and a cross section file (sec) is created with all cross sections within the calculation interval.



The dropdown menu to create cross sections

Station Limits

Here the calculation interval is defined, i.e. start and end stationing and interval are selected. The settings here define both the calculation interval when cross sections are generated and how you can step through the point cloud in the graphical view.

Corridor

The corridor defines a crosscut of the point cloud where the cross section will be created.

- **Left Limit**
  Left limit defined perpendicular to the reference line. Points outside the specified distance are excluded.
- **Right Limit**
  Right limit defined perpendicular to the reference line. Points outside the specified distance are excluded.
- **Depth**
  The depth of the crosscut corridor in the point cloud. The value selected here should have a connection to how dense the point cloud is. The denser the cloud is, the smaller depth can be used. If you change this value and select **Collect Points**, the number of collected points is changed and in the graphical view it's possible to see how the corridor in the point cloud is updated.
- **Lower Limit**
  The lower limit refers to the vertical geometry of the center line. Points below the specified height offset will be excluded. If you enter 0, all points below the center line will be excluded.
  You can leave the field empty if you don't want to use any lower limit.

Calculation Method

There are two different methods available for generating cross sections directly from the cloud.

- **Point Density**
  This is an image analysis method where the cloud is divided into a grid of cells, like pixels in an image, and each cell has a field strength value depending on the point density in the cell and surrounding cells. The center points in the cells with highest field strength values will be a part of the cross section.
- **Triangulation**
  This is a cluster analysis method which uses a triangulation technique to connect line segments to a line.

Point Density Parameters

The following parameters can be changed if **point density** is selected to generate cross sections:

- **Grid Cell Size**
  The length of the cells that build up the grid.
- **Noise Acceptance**
  How much single outliers from surrounding cells can affect a cell's value. This parameter has no unit, but a greater value increases the contrast and noise. A lower value gives a smoother curve.
- **Noise Reduction Threshold**
  Each cell in the grid has a value depending on point density. The value defined here is in percent, and cells with a point density value lower than this percent of the grid's maximum value are removed. The percentage generates a threshold value and cells with low point density values can be removed.
- **Quick**
  A filter matrix is used to increase the speed of the process to generate cross sections. When a cell is assigned a point density value, only cells within the filter matrix will affect the cell's value. The size of the matrix is defined by the offset value.
  - **Enable**

The faster method can be activated or deactivated.

- **Offset**
  Size of the filter matrix in number of cells. For example, if the value of 50 is specified, a 50x50 matrix is swept across the grid.

Use the icon to reset to default values.

Triangulation Parameters

The following parameters can be changed if the triangulation method is selected for generating cross sections:

- **Edge Length**
  Maximum allowed length of the triangle edges used in the triangulation, when cross sections are created. This value depends on the density of the point cloud.
- **Radius**
  This value is used when line segments will be connected to a line. The radius is used to analyze if surrounding line elements will be connected to the line. The value should not be less than the width of the corridor.

Use the icon to reset to default values.

General Parameters

The following parameters are used for both methods when cross sections are generated:

- **Max Distance**
  Maximum allowed distance between points that can be connected.
- **Simplify Cross Section Curves**
  Method for reducing the number of points that are potential candidates to be a part of the cross section. The purpose of the algorithm is; given a curve composed of line segments, find a similar curve with fewer points. The output data is reduced.
  - **Enable**
    The simplified method can be activated or deactivated.
  - **Tolerance**
    Maximum allowed lateral deviation used in the algorithm to create a smoother cross section. Points within the tolerance are ignored and will not be a part of the cross section.
- **Reduce Number of Points to Process**
  The number of points are reduced, based on a minimum allowed distance, before the process to generate cross sections starts. The input data is reduced.
  - **Enable**
    The reducing method is activated or deactivated.
  - **Min Distance**
    Minimum allowed distance between points.

Use the icon to reset to default values.

Tunnel Point Cloud Filter

Please note, you need the Tunnel Module to be able to use and edit these settings, see Tunnel with Point Cloud 882.

Statistics

Number of Points
Number of points that are collected when [**Collect Points**] has been used.

See also: Point Cloud 757, Tunnel with Point Cloud 878

14 Digitizing

14.1 Digitizing

You use digitizing to transfer coordinates from paper to your computer. You use a digitizing instrument to implement this. The digitizing functions in iCON office are under ***File | Digitizer.***

Digitizing Tools

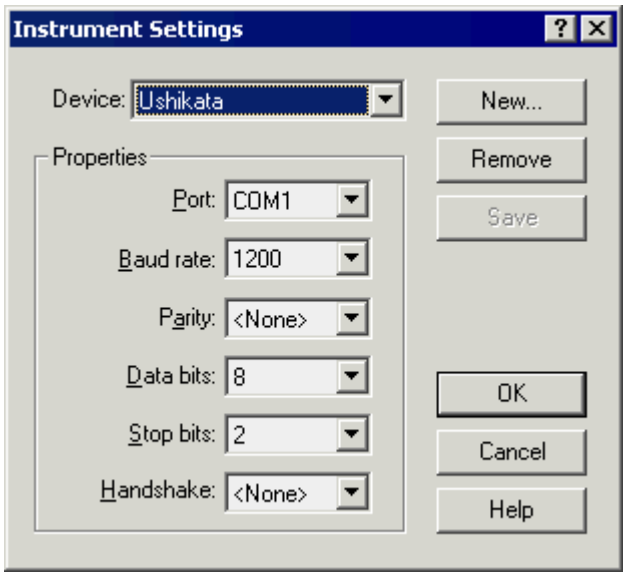
These functions can be accessed via ***File | Digitizer***. Select ***View | Toolbar | Digitizer*** to get icons for the digitizer tool.

Digitizing on/off:

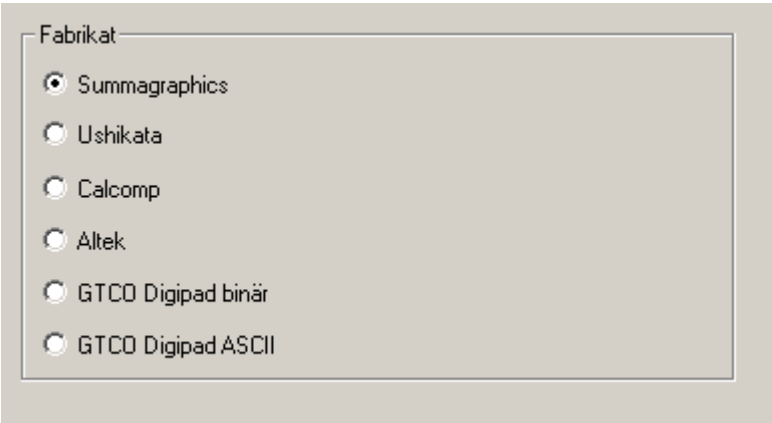
Select this option to begin or end digitization. If digitization starts without a digitizing instrument already installed, the installation dialog automatically opens.

Install:

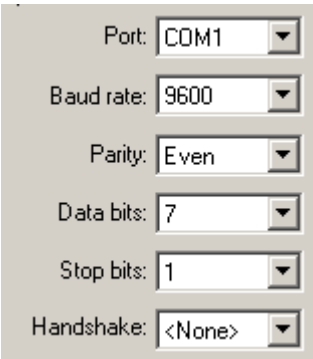
Click here to install the new digitizing instrument, or to change the communication parameters for the current instrument. An installation dialog will open from which you can select an already installed instrument, or install a new one.



Click **[New]** to install a new instrument. Enter the make and then press **[Next]**.

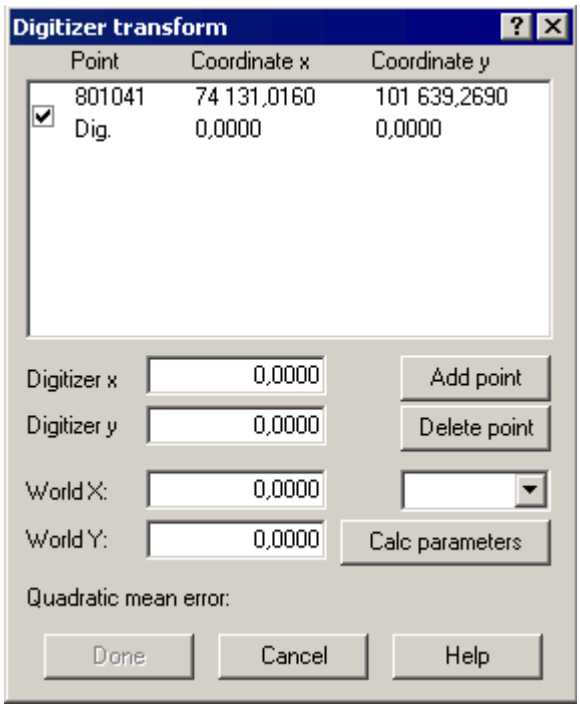


The settings listed here are the ones that we recommend. Make sure the device settings match these. Click **[Finish].**



Transformation:

In order to digitize, a transformation relationship between the digitizing device and world coordinates must be created. This is done by specifying coordinates for at least three points in both the digitization and world coordinates. When you select this command, a dialog opens with the editing options for transformation points. The relationship created is an affine transformation 188 .

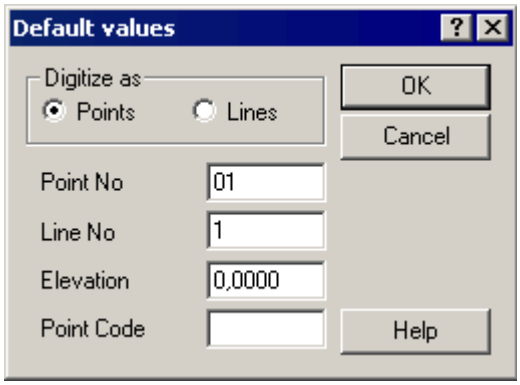


Load world coordinates by selecting the point in the list that appears below the **[Delete point]**button. A list of all points in the files placed under the known points appears in the ***Project Settings*** 18. Coordinates can also be entered directly in the fields *World X* and *World Y.* Point with digitization device to complete the fields *Digitizer X* and *Digitizer Y*. If there are coordinates in both systems, choose **[Add point]** to add the point to the list. At least three points must be in the list and be checked in order to create the transformation relationship.

When at least three points in the list are checked, the transformation relationship can be created. Click **[Calc parameters]** to solve the relationship. If more than three points are now used, a square mean error appears below the **[Calc parameters]**button. If you are not satisfied with the results, you can try checking the box of a point you think is wrong and recalculate. Note that the mean error is always 0 with three points as there is no redundancy. When you are satisfied with the results, click **[Done]** to save the relationship and close the dialog.

Point Properties:

Here you enter the values for point number, elevation and point code for the points you point out.



- **Digitize As:**
  Specify whether the digitized points are to be stored as single points or as a continuous line.
- **Point No:**
  Enter the point number for the first point or first node of each line to be digitized. The point number is then calculated automatically.
- **Line No:**
  Enter the line number of the first line to be digitized. The line number is then calculated automatically.
- **Elevation:**
  Enter the height for the digitized points.
- **Code:**
  Enter the point code for the digitized points.

New Line:

Press here to commence a new line. The line number is calculated and the point number is reset.

Sound:

When this option is selected, you will hear a sound for each point received from the digitizing device.

Results

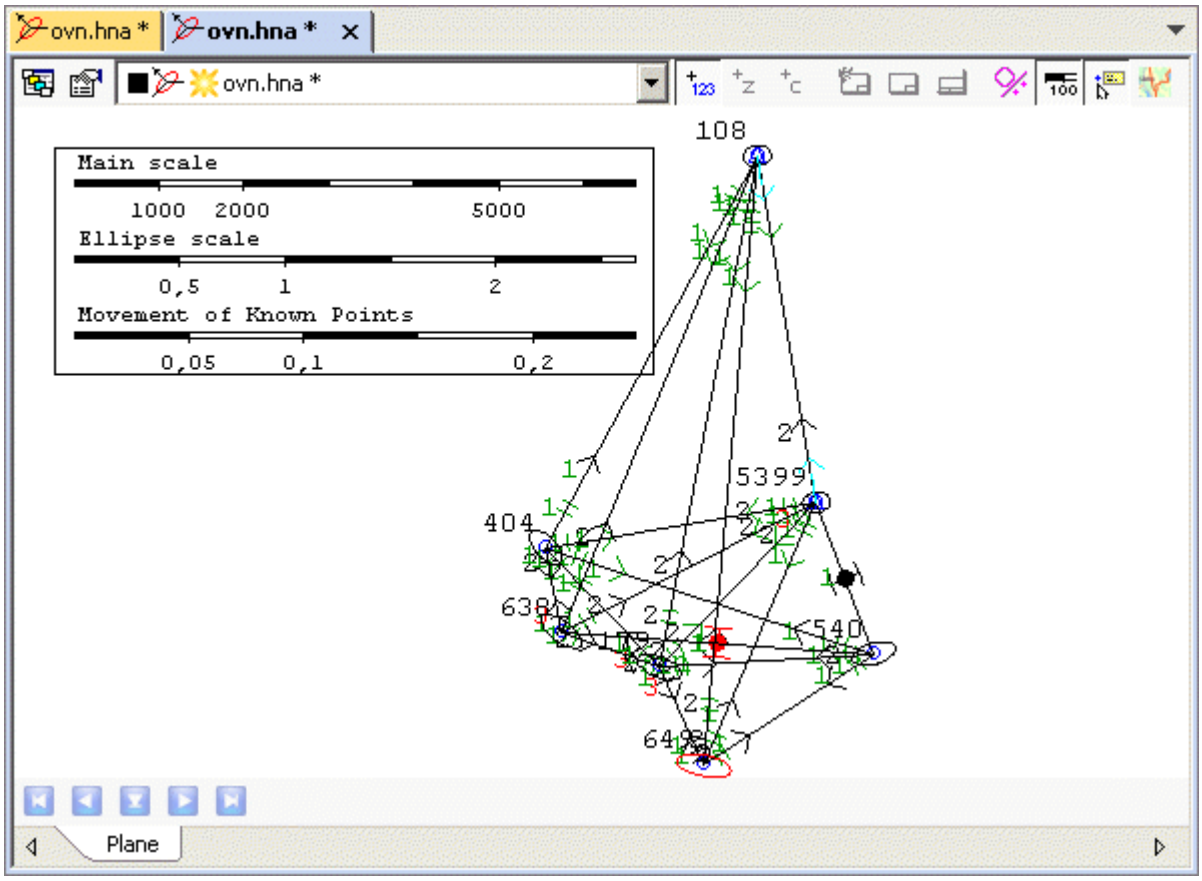
When a point is received, it will be placed last in the coordinate document that is active. It is usual perhaps to open a new blank coordinate document and then to start digitizing. If no coordinate document is open, the points are not taken care of.

Tip: An alternative to digitization is to scan the original and set it as the background image in the graphical window, which means you can then easily draw points with the image as a background, see Background Image 219 .

See also: Communication 455 , Background Image 219

15 Net Adjustment

15.1 Net Adjustment



Net Adjustment in General

Net Adjustment History 812

How the Nets are Used Today 813

iCON office Net Adjustment Introduction 815

Horizontal Net Adjustment 816

Leveling Net Adjustment 817

Net adjustment with Known Points 818

Net Adjustment, Step by Step 819

Net Adjustment, Data Menu 820

Net Adjustment, Input View 825

Net adjustment, Select Adjustment Model 830

Net Adjustment, Calculation 832

Net Adjustment, Graphic View 833

Leveling Net Adjustment, Graphic View 836

Leveling Net Adjustment, Control Loops 838

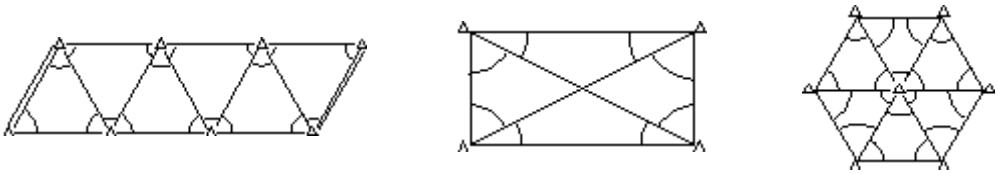
Net Adjustment, Report 841

15.2 Net Adjustment in General

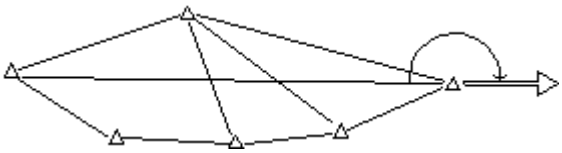
15.2.1 Net Adjustment, History

In the past, calculations for net adjustment involved a large complexity of problems. To begin with you calculated the data manually, which took a long time, and then you had difficulty dealing with, among other things, cross measurements (which meant that the net contained a number of redundancies). Cross measurements caused disorder in the clean geometric figures that the method was based on. The calculation was complicated. The redundancies gave, and still give, positive opportunities as you can check the net and detect any errors.

The basic net figures that were previously used, were generally based on *triangle net models*, angle measurement combined with the determination of a single distance. The distance was the basis for the net's scale. With the help of the accurate measurement angle, the measured distance could then be transferred to other distances through, for example, the sine theory. The results gradually deteriorated. Long chains were formed, but without verification of the new base distances. The new base distances, in turn, formed the basis for new chains. Certain net types used at the time were the equilateral triangle, quadrilateral with cross measurement and the Berliner net, i.e. a hexagon with a central point. Below is a schematic diagram of their design.



In connection with the evolution of EDM instruments (Electronic Distance Measurement), the technology for net structure underwent a renaissance. At the same time, computers began to be used extensively and it was possible to calculate complex nets with many redundancies. EDM instruments meant that lengths could be measured and it produced better results than angle measurements. Most nets were then only constructed with measured lengths as their basis. These nets are called trilateration nets, illustrated below.



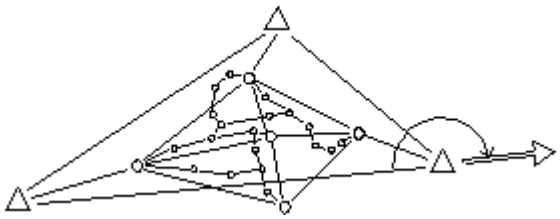
Angle measurements were composed exclusively of connecting measurements at the fixed points and where eccentric signals occurred. This technique has long been the preferred method, although it is now being replaced by satellite measurement.

See also: Net Adjustment 810, Net Adjustment Today 813

15.2.2 How the Nets are Used Today

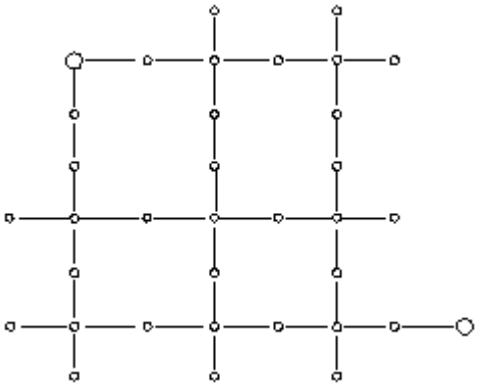
Connection net and traverse net

The purpose of the connection net is to create a basic net that the municipal industrial net can be connected to and to provide good basic accuracy. The connection net can be designed as a traverse net, where the possibilities for over-defining the measurements of angles and distances is to be used as far as considered possible. The distances between the points are usually between 2-5 km, but are obviously dependent on the terrain, the need for tower constructions, etc. Below is a schematic figure showing how to connect a nationwide net, connection net and industrial net.



Industrial Net

The municipal setting-out grid has been renamed to industrial net, and the method of adjusting these has been changed retrospectively. Previously, certain points were assigned as important nodes and they were given a form of "higher order" in the net. Today the nets are adjusted as a whole, based on national points and connecting nets where applicable. A higher or lower order no longer exists. Industrial nets in urban areas generally follow the streets where visibility allows. The structure is therefore similar across the country.

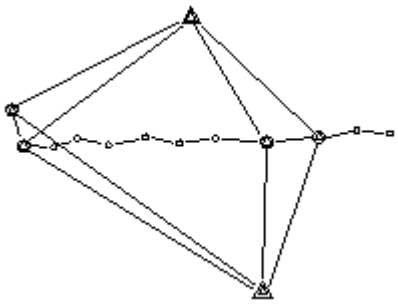


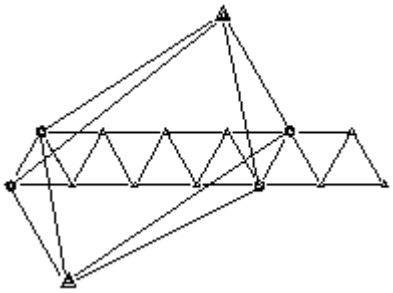
Construction Nets, Local Nets

In the construction industry there is usually a need for a high level of local accuracy, especially between neighboring points used, for instance, for free stations for surveying and setting out. The design and performance of the nets are determined by the type and design of the project.

For these nets, you would not normally include external errors as they may be in the starting points, which the nets are connected to. For this reason there is a connection to *one* point and *one* original orientation, the measurements then determine the scale and quality of the net. Measurements are usually checked in relation to other known points to ensure that no serious errors have been introduced.

Small nets are usually made as local, plane nets, i.e. without introducing projection corrections 333 . Construction nets used in elongated projects (such as roads and railways) are usually executed using other methods. Two models are mainly used: one model is a traverse with additional satellite measurements, while the other is an elongated net of complementary satellite measurements. (So far, satellite measurements have been a way of transferring connection points to appropriate locations along the project, in the form of double points).





See also: Net Adjustment[810], Net Adjustment History[812]

15.3 Net Adjustment Introduction

15.3.1 Net Adjustment Introduction

Net adjustment is difficult to handle when calculating manually, which is why there has been increased use due to the capacity for handling calculations by computers. Following discussions among experts in net adjustment, the conclusion has been fairly consistent; at the present time the best way of handling net adjustment is in separate horizontal[816] and leveling nets[817]. Measurements in plane and height can be carried out independently of each other. It may otherwise be difficult to weight plane and height in a uniform manner in order to ensure the computer equations are in accord. Net adjustment in iCON office therefore consists of two parts, horizontal net adjustment and leveling net adjustment.

In rough terms you could say that net adjustment in iCON office is calculated in four steps:

1. Surveying[317], creation of plm file[318] (replaces the older format inm file)
2. Rounds of measurement calculation[338], creation of new reduced plm file
3. Correction of measurement data[333], creation of plm file
4. Net adjustment calculation based on the plm file

The results are printed and tests performed in different ways for assessing measurement accuracy and reliability, etc.
For both horizontal and leveling nets, your computer's capacity is the only thing that limits the size of the net.

Horizontal Net Adjustment[816]

Leveling Net Adjustment[817]

Net Adjustment with Known Points[818]

See also: Net Adjustment[810]

15.3.2 Horizontal Net Adjustment

In the plane component you calculate everything from a free station or a flying traverse to a complicated net with many redundancies. In the iCON office net adjustment you can also simulate the planned net, provide responses to expected results and recommend additional measurements where required, etc. The system also has the option of giving survey observations such as coordinate differences that are useful for GPS and settlement measurements. GPS baselines can also be calculated from WGS 84. The program also has Helmert transformations built in. Assessments of the results can be displayed both graphically[833] and in a Data View[825]. It is possible to turn individual measurements on and off in order to improve the results. Possible Survey Correction[333] is performed after calculating the Rounds of Measurement[338], although before you load the measurement data for the net adjustment.

See also: Net Adjustment[810], iCON office Net Adjustment Introduction[815]

15.3.3 Leveling Net Adjustment

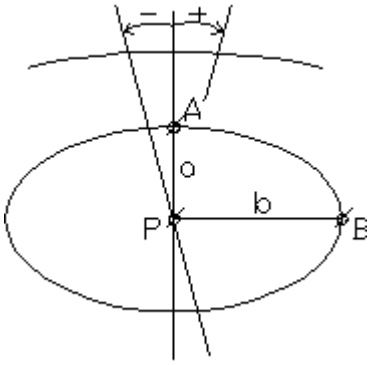
In leveling net adjustment, input data is made up of height differences between points. Height differences can be measured trigonometrically or leveled. All calculations are made using the least square method. All measurements are weighted, where individual specifications or measurements (as a whole) can be handled. Where there is a need for projection corrections, these are calculated in advance and are given as corrections to the measurements.

See also: Net Adjustment 810, iCON office Net Adjustment Introduction 815

15.3.4 Net Adjustment with Known Points

To perform the calculation with known points, the data for the known points must be held in a separate file under known points in the tab Project Settings 18. As part of the calculation, the program matches the points appearing in the surveys with those entered under known points.

For a special type of calculation (elastic connection), the fixed point P is given a freedom of movement based on the point's accuracy. This is specified as the standard deviation of X and Y and a covariance between them (sX, SY, sXY) or as an error ellipse at a sigma level 1 (a, b, angle) so that the point lies inside the ellipse with 67 % probability. If rotation is not desired, enter the angle as 0. The accuracy is specified in the Data View 825 tab for known coordinates. The Data Menu 820 has a tool for recalculation between the two types of error specifications.



Connection of the net can also be made to a point with a locked direction to another. Both points must be known and there must be direction measurements between them.

The net can also be adjusted completely free from the known points and then be transformed with movement, movement and rotation or movement, rotation and scale.

See also: Net Adjustment 810, iCON office Net Adjustment Introduction 815, Net Adjustment, Calculation 832

15.4 Net Adjustment, Step by Step

15.4.1 Net Adjustment, Step by Step

1. Plan and simulate the net. If you do not want to do this in iCON office, go to point 2. Simulation is done by opening the coordinate file with starting points in a graphical window. You then create a new net adjustment in the active window ***File | New | Horizontal Net Adjustment (or Leveling Net Adjustment)***. Now use the simulation tool to add new points, and then to add the planned measurements, see Graphical view 833 for details on simulation tools. Now calculate an analysis of the net and complement the measurement plane as needed.
2. After measurement, load the raw data from the instrument using instrument communications 455.
3. Edit the survey data if necessary, this may need to be "cleaned" before proceeding. Save the file, for example, as *'xx.plm'*.
4. Reduce the rounds data using the rounds of measurement function 338 if this has not already been done in the instrument, save the file *'r_xx.plm'*. If you do not plan to execute projection correction 333, go to point 7.
5. Get the approximate coordinates for all new points, **both in plane and in height**. These are needed to make the projection correction. The coordinates need not be accurate, but only be in the vicinity of 10 meters or so. You can access them in various ways, such as measuring approximately on a map and checking the height of the contours, or make a temporary net adjustment with *'r_xx.plm'*. Save the approximate coordinates in, for example, *'approx.geo'*.
6. Go in to project settings 16 and specify *approx.geo'* as the file with approximate coordinates.
7. Correct the survey data 333, for pressure and temperature, and if necessary for projection. Save the results in *'ca_r_xx.plm'.*
8. Create a new blank net adjustment with create document 28.
9. Load *'ca_r_xx.plm'* to the net adjustment, study the values in the input view 825.
10. Start the calculation and select the adjustment model 830.
11. Perform the calculation 832.
12. Study the results in the graphical view 833, where the color coding makes it easy to identify any errors. Also study the results in the input view 825.
13. Create a report 841 and go through the results, then save the new coordinates.
14. If the net is also calculated in height, you can load the same file '*ca_r_xx.plm'* into a blank leveling net adjustment that is calculated in a similar way to the plane net. When you save the results, save in the same file as the results from the plane net and select the option "update existing data with the same point number" to only update the height coordinates.

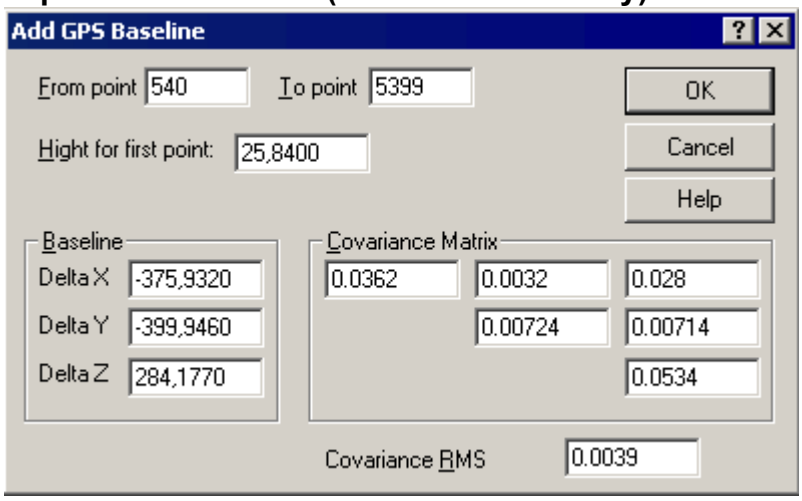
See also: Net Adjustment 810

15.4.2 Net Adjustment, Data Menu

Load Survey File

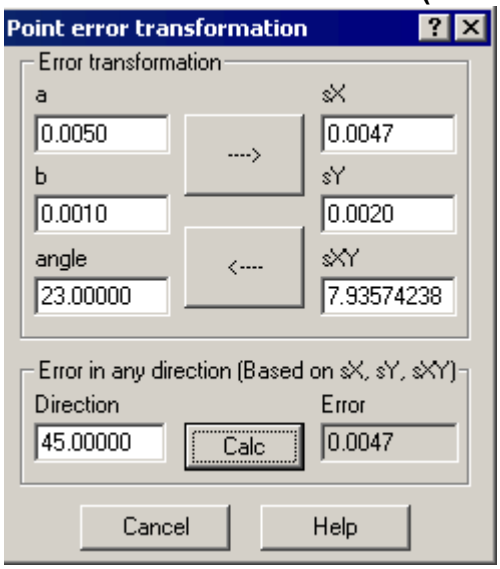
You can create a survey file[318] through communication[455] with the measuring devices, handheld computers such as GeoPad, Psion, Geodat or Leica stacks/REC module, or enter in a new survey file. Survey data should be reduced before use in the net adjustment for several reasons. First, to reduce the amount of data and produce a better overview, and second because the measurements would otherwise be regarded as independent and the large amount of data would create a false impression of a very high level of verifiability in the net. The reduction is preferably done using the function rounds of measurements[338] that reduces the survey data, calculates the rounds and station, prints reports, and allows for reduced data storage in a new survey plm file. (Warning, do not overwrite the original plm file.) It is also possible to load non-reduced survey files, but this is not recommended. If corrections are calculated, this is done before the survey file is loaded in the net using the function survey correction[333] . When you have prepared the file, select ***Data | Load Survey File*** to load the survey file. You can load multiple survey files simultaneously. If no settings[821] *(see below)* have been previously set, iCON office will prompt you for these before loading the survey.

Import GPS Baseline (horizontal nets only)



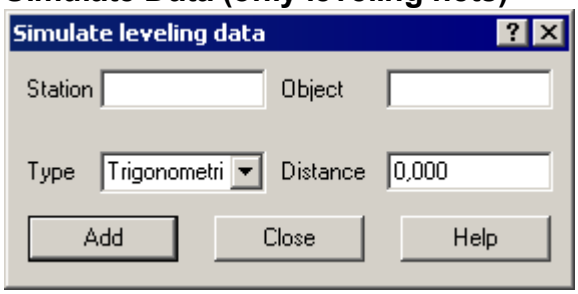
You can also obtain survey data from base vectors in WGS 84. Select ***Data | Import GPS Baseline***, enter the baseline XYZ components and covariance matrix. For the baseline to be handled correctly, the height of one of the points must be set. This information can, for example, be loaded from the report from the baseline calculation program that came with your GPS receiver. If the covariance matrix is not known, you can put ones (1) in the diagonal of the matrix and enter a basic mean error, e.g. 3 mm. The baseline will be recalculated for the bearing and length and be added to the input data view[825] .

Point Error Transformation (horizontal nets only)



Select ***Data | Point Error Transformation*** to be able to transform point errors between error ellipses and mean errors for the X and Y coordinates and covariance, see also Net adjustment with Known Points 818 . Enter the point error as error ellipse on the left side or as covariance matrix on the right side and click the arrow to recalculate. If the covariance matrix is valid, you can use the function to calculate the mean error in an arbitrary direction, which may be useful for bridge or tunnel construction etc. Enter the desired bearing and click calculate.

Simulate Data (only leveling nets)



Select ***Data | Simulate Data*** to simulate data in a leveling net. In the dialog that appears, enter the station and objects (point to measure against), type of measurement (trigonometric height difference, leveled height difference, height observation) and the distance for the leveling/measurement. A simulated data post will be added to the data and appear in the data view 825 in gray. Simulated data is included in the calculation analysis. In the column for remark states that the survey is simulated.

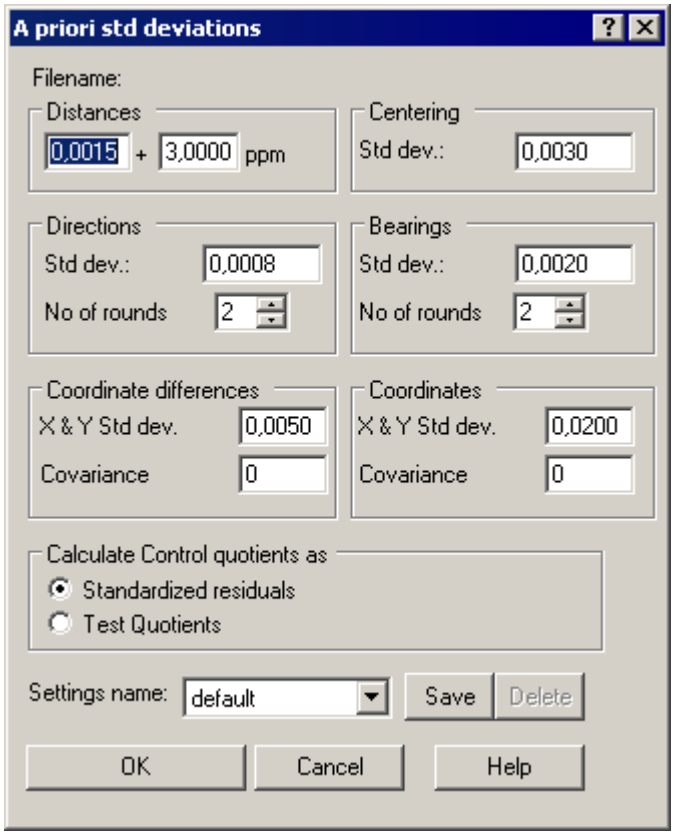
Settings

Select ***Data | Settings*** to specify the a priori standard deviation for your measurements. These form the basis of the weighting between different measurements and the results analysis. This dialog is displayed when loading the survey file 318. You can also change the settings at any time by selecting ***Data | Settings***. A change to the settings affects the survey file that is loaded or the measurements are selected in the Data tab when the command is executed. NOTE: A change to the centering error affects all measurements to or from points for which an individual centering error has not been specified. Individual centering errors can be given in the calculation dialog, see Net Adjustment, Input View 826 .

You have the option of downloading, saving and deleting predefined settings. The default settings that are always loaded for a new net can be overwritten with your own parameters, but not deleted. Predefined settings cannot be changed or deleted. To save or change parameter settings, edit parameters, press **[Save]** and enter the required name. To delete settings, select settings from the list and press **[Delete]**. The default will be loaded instead. It is also possible to go in and adjust individual measurements in the

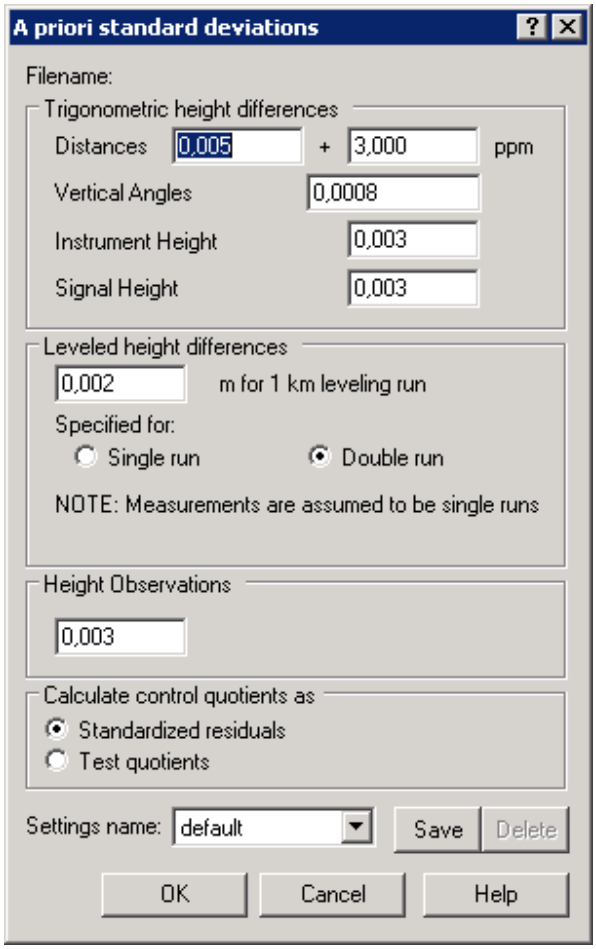
Data tab[825] after loading.

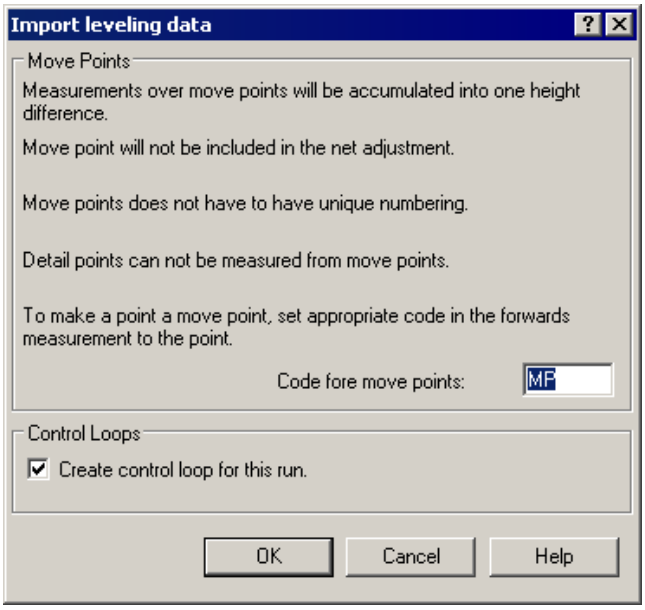
If the survey file contains precision information, such as if it has been created using the rounds of measurements function[338] or if you have manually edited the precision parameters, these parameters will be proposed instead of the default values.



You can specify the following parameters for horizontal nets:

Lengths	The length error consists of two parts, a fixed component and a distance dependent.
Centering	Specifies the default value for centering error. The centering error for individual points may be specified in the calculation dialog, Net Adjustment, Input View[826]. In Sweden, the recommendation is often *0.0030 m.*
Directions	The standard deviation of angles measured in a complete round. **Remember to include the correct number of rounds, the specified direction error applies for a complete round.**
Bearings	A priori standard deviation for bearings measured using, for example, gyro or GPS.
Coordinate Differences	Covariance matrix for the coordinate difference observations.
Coordinates	Covariance matrix for the coordinate observations. Also used known points for elastic connection if the accuracy has not been specified in the data view[825].
Calculate control quotients as	Select to calculate control quotients as standardized residuals or as test quotients, see also Standard Residual[849].
Settings name	Select a predefined setting, or create a new one.





Move points can be coded to be treated specially when loading leveling data for a leveling net adjustment. This dialog is displayed when loading. This is useful for reducing the number of points in the adjustment and to facilitate the reporting of double-adjusted (or multiple-adjusted) distances, see Net Adjustment, Report[841] . Check the "Create control loop for this traverse" to automatically create a control loop for the leveling traverse.

You can specify the following parameters for leveling nets:

Lengths	A priori standard deviation of the lengths for trigonometric leveling measurement. The length error consists of two parts, a fixed component and a distance dependent.
Vertical Angles	A priori standard deviation of the vertical angles for trigonometric leveling measurement
Instrument Height and Signal Height	The a priori standard deviation of the instrument height and signal height for trigonometric leveling measurement
Adjusted Height Differences	The a priori standard deviation of the leveling data. For a standard dual measured leveling in Sweden the measure is often recommended as *0.0050 m* $\sqrt{km}$ and for a fine adjustment *0.0015 m* $\sqrt{km}$
Specified for:	Instrument precision for levelers is often given for the mean value of a double leveling, but can also be given for a single leveled traverse, see the specification for the instrument. However, the program requires that you always load the two traverses separately if you have run a double leveling, without first establishing a mean value.
Height Observations	A priori standard deviation of height observations, if these are added as survey data.
Calculate control quotients as	Select to calculate control quotients as standardized residuals or as test quotients, see also Standard Residual[849].
Settings name	Select a predefined setting, or create a new one.

For trigonometric measurement, the height difference's mean error is calculated from the mean error for the vertical angles, lengths, instrument height and signal height.

Note: We recommend that you first use the accuracy specifications for the instrument given by the instrument manufacturer or listed in the instrument's manual. Different parameters can give different results when troubleshooting and for quality control.

Calculate

Select ***Data | Calculate...*** to calculate or analyze[832] a net.

Automatic Recalculation

You can select the ***Data | Automatic Recalculation*** option when at least one calculation has been performed. If this option is checked, the net will be automatically recalculated when observations are switched on/off and when input data is changed. The calculation is performed using the same procedure as the previous one. (Adjustment/analysis, Absolute/elastic/.....)

Tip! Use this function to troubleshoot by turning the measurements off and on in the observation tab, or in the graphical window. Sigma levels that are printed next to the symbols are updated immediately. The function is also suitable for the simulation and planning of nets. Add simulated measurements until no red symbols are left; all measurements will then have verifiability.

Save New Coordinates

Select ***Data | Save New Coordinates*** to save the result points to a coordinate file. If you choose to save to an existing file, you get three options.

Save Over	Replaces the existing file with the new points from the net adjustment.
Add	Adds the new points at the end of the existing file.
Update existing data	Saves over X and Y coordinates (horizontal nets) or Z-coordinate (leveling nets) for the point if it already exists in the file, and adds the point if it does not exist.

Create Report

Select ***Data | Create Report*** to create a report[841] containing all the data related to the last net calculation.

See also: Net Adjustment[810], Net Adjustment, Step by Step[819]

15.4.3 Net Adjustment, Input View

Data

Input data for horizontal net adjustments consists of horizontal angles, horizontal distances and possibly starting points and/or provisional calculations for the new points to be calculated. The input view can also have oriented directions, coordinates and coordinate differences specified and include calculated Gps data 820. The input data for a leveling net adjustment consists of height differences from levelers or total station.

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	Station	Object	Length	Direction	Or. Dir	X/dX	Y/dY	sLength	sDir	sOrDir	sX	sY	sXY	Remark
21	540	179	770,7369	33,0891				0,0073	0,0008					
22	540	404	1 237,1067	57,0178				0,0087	0,0008					
23														
24	638	108	1 847,5830	0,0000				0,0105	0,0008					
25	638	5399	1 025,9247	45,2670				0,0081	0,0008					
26	638	179	374,6229	97,2485				0,0061	0,0008					
27	638	404	306,9435	363,5656				0,0059	0,0008					
28														
29	649	179	387,5552	0,0000				0,0062	0,0008					
30	649	108	2 197,2375	32,6522				0,0116	0,0008					
31	649	5399	1 026,6530	52,7707				0,0081	0,0008					
32	649	540	729,4281	90,0273				0,0072	0,0008					
33														
34	5399	108		0,0000					0,0008					
35	5399	649	1 026,6323	236,3839				0,0081	0,0008					
36	5399	179	816,3930	259,1453				0,0074	0,0008					

Data | Known | Approx | Observations | New

Management of data for the net adjustment is done through HNA documents *(Horizontal Network Adjustment)* for horizontal net adjustments and LNA documents *(Leveling Network Adjustment)* for leveling net adjustments. You can save the net adjustment and re-open at any stage of the process you want. Survey data can be from a rounds of measurement program, entered data or be made up of a survey file 318 in plm format. In other words, you open an existing one HNA/LNA document or create a new one and then load the survey data from a survey file, plm. The view that appears for an HNA/LNA document is divided into a number of tabs, partly for data entry or editing of information before calculation of the net 832 is commenced, and partly for the results from the calculation.

NOTE: Before performing the net adjustment calculation, there should be a rounds of measurement calculation 338 followed by a correction of survey data 333.

Survey data, columns

The HNA document, for horizontal net adjustment, contains the following columns in the Data tab.

Station	You enter the point name for the station point here.
Object	You enter the point name for the measured point here.
Length	Set if the length is measured between the station point and survey point.
Direction	Set if the direction is measured between the station point and survey point.
Or. Direction	Set if the oriented direction, for example from gyro, is measured between the station point and survey point.
X/dX, Y/dY	Set if the coordinates are measured for the station point or the coordinate differences are measured between the station point and survey point. Note that values are required in both fields for the measurement to be included in the calculation.

A priori standard deviation
The input data must contain a priori standard deviation for the measurement. These may be adjusted

according to needs and performance. We recommend that you get these from the instrument manufacturer's specifications. Note that every observation can be given a specific single value, for example, for a bad observation.

sLength	Set if the length has been specified. This is the length's a priori standard deviation.
sDir	Set if the direction has been specified. This is the direction's a priori standard deviation.
sBearing	Set if the bearing has been specified. This is the bearing's a priori standard deviation.
sX, sY, sXY	Set if X/dX and Y/dY have been specified. These are the coordinates' or coordinate differences' a priori standard deviations. sXY is a measure of dependence between X and Y.
Remark	There is space here for manually entered remarks. When loading or simulating data, the origin is automatically entered in the field.

GPS Baselines have Direction, Length, sDir, sLength and sXY specified. However, these are not entered directly into the input view, but are calculated using the import tool in the data menu 820 .

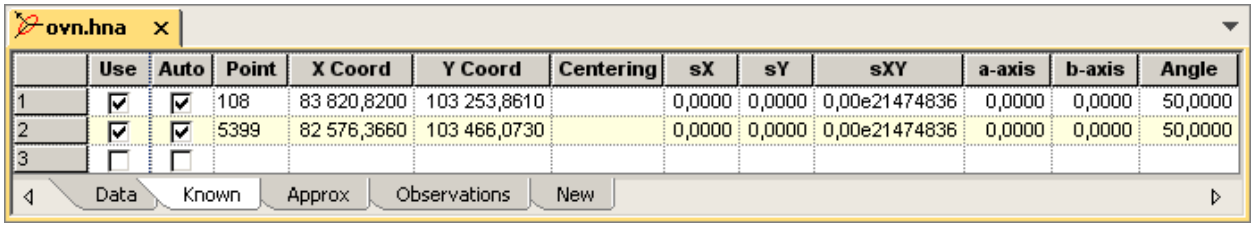
The LNA document, for leveling net adjustment, contains the following columns in the Data tab.

Obs.typ	Observation type. The origin may be Trigonometric; Leveling or Height.
Station	You enter the point name for the station point here.
Object	You enter the point name for the survey point here.
Delta Z	Specifies the height difference between the station point and survey point.
Length	Specifies the distance between the station point and survey point.
A pr. StdDev	Specifies the a priori standard deviation.
Remark	There is space here for manually entered remarks. When loading or simulating data, the origin is automatically entered in the field.

Survey data, data capture

- Option 1: Enter the survey data directly in the view.
- Option 2: Load the survey (s) from file using the menu command ***Data | Load the Survey File*** 820
- Option 3: Calculate the GPS baselines using the menu command ***Data | Import GPS Baseline*** 820 (horizontal nets only).

Known Coordinates



	Use	Auto	Point	X Coord	Y Coord	Centering	sX	sY	sXY	a-axis	b-axis	Angle
1	☑	☑	108	83 820,8200	103 253,8610		0,0000	0,0000	0,00e21474836	0,0000	0,0000	50,0000
2	☑	☑	5399	82 576,3660	103 466,0730		0,0000	0,0000	0,00e21474836	0,0000	0,0000	50,0000
3	☐	☐										

For a net adjustment to be performed, a number of known coordinates are required. The program searches for them in the file or files specified in Known points 18 in the project tree's Settings tab each time changes are made to the input data. The coordinates for these points appear in the view. If you uncheck the **Use** box this means that the point is not considered to be known, but is treated as a new point instead. If the **Auto** box is checked, iCON office will load the point in the pp files each time a change is made to the net, or delete the point if it is no longer included in the 'Data' tab. You can enter known coordinates for multiple points and enter a known accuracy for the points, which can be used in elastic connection 830 , which is a basis for the 2D Helmert correction made after any of the free adjustments 830 . You can specify the centering error for individual points in the Centering column. The accuracy can be specified in two ways, either as an error ellipse (a, b, angle) or as a covariance matrix (sX, sY, sXY). A conversion tool to convert between formats is included in ***Data | Point Error Transformation*** 820 .

Approximate coordinates

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	Auto	Point	X Coord	Y Coord	Centering	X Diff	Y Diff
1	☑	179	81 984,7060	102 903,5260			
2	☐	404	82 413,9223	102 495,6075		0,0000	0,0000
3	☑	540	82 033,3787	103 672,7373	0,0020		
4	☑	638	82 112,0503	102 551,2236			
5	☑	649	81 631,8318	103 063,7858			
6	☐						

Data | Known | Approx | Observations | New

For the net adjustment to be performed, you need approximate coordinates for all points that are not known. These are loaded primarily from the file or files specified in Files with approximate points 16 in the Project Tree. If the coordinates are not available for all new points, the approximate coordinates are calculated automatically. This calculation is performed with polar surveying, intersection, resection and eccentric points. For large numbers of measurements or complex geometries this may take some time. The program has minor requirements on the approximate coordinates, but the calculation runs faster the better the coordinates are. It is also possible to enter the approximate coordinates manually. If the **Auto** box is checked, iCON office will download the point or recalculate it each time a change is made to the net, or delete the point where it is no longer included in the data. If you choose to change the coordinates, the value **Auto** is deselected, and the difference to the automatically calculated coordinates is presented. In order to allow iCON office check to coordinates again, check the **Auto**box again.

Plane

In the leveling net adjustment there is the Plane tab. Here you can view the plane coordinates for the points included in the leveling net adjustment. You can load the plane coordinates for the file or files specified in Known points 16 in the Settings tab in the project tree, or from the file with approximate coordinates. You can also enter plane coordinates manually.

Plane coordinates are needed for graphical reporting and editing of the leveling net.

Observations

Here you can see the observations contained in the net. However, station orientations and an orientation parameter for GPS are hidden. Before the calculation is made, the difference in relation to the value calculated from the approximate coordinates in the **<residual>**column is shown. This can be used for a quick check of the survey data before making the calculation. The observation tab contains both input data and results.

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	Activ	Obs Type	Station	Object	Value	A pr. StdDev	A pr. SD+C	Residual	Adj. value	Std Dev	Std Residual	R number	MDE	ER
53	☑	Length	649	540	729,4281	0,0072	0,0076	-0,0091	729,4190	0,0039	-1,3444	0,7459	0,0233	0,0059
54	☑	Direction	5399	108	0,0000	0,0008	0,0008	-0,0012	399,9988	0,0006	-1,9347	0,5554	0,0030	0,0013
55	☑	Direction	5399	649	236,3839	0,0008	0,0008	-0,0005	236,3834	0,0005	-0,7027	0,7105	0,0027	0,0008
56	☑	Length	5399	649	1 026,632	0,0081	0,0086	0,0066	1 026,6389	0,0038	0,8219	0,8194	0,0250	0,0045
57	☑	Direction	5399	179	259,1453	0,0008	0,0008	-0,0008	259,1445	0,0004	-1,1142	0,7471	0,0026	0,0007
58	☑	Length	5399	179	816,3930	0,0074	0,0080	0,0152	816,4082	0,0033	2,0056	0,8423	0,0227	0,0036
59	☑	Direction	5399	638	280,8504	0,0008	0,0008	0,0014	280,8518	0,0004	1,9077	0,7527	0,0026	0,0006
60	☑	Length	5399	638	1 025,931	0,0081	0,0086	0,0005	1 025,9315	0,0033	0,0592	0,8589	0,0244	0,0034
61	☑	Direction	5399	404	300,1909	0,0008	0,0008	0,0011	300,1920	0,0004	1,5561	0,7458	0,0026	0,0007
62	☑	Length	5399	404	983,9660	0,0080	0,0085	-0,0059	983,9601	0,0036	-0,7468	0,8292	0,0245	0,0042
63	☑	Gps Direction	540	5399	376,8476	0,0004	0,0005	0,0002	376,8478	0,0004	0,7933	0,3857	0,0018	0,0011
64	☑	Gps Length	540	5399	581,0075	0,0020	0,0032	-0,0006	581,0069	0,0030	-0,4012	0,1786	0,0133	0,0109
65	☑	Gps Direction	638	540	104,4599	0,0004	0,0004	-0,0002	104,4597	0,0004	-0,7944	0,2930	0,0021	0,0015
66	☑	Gps Length	638	540	1 124,277	0,0040	0,0047	-0,0011	1 124,2766	0,0032	-0,3106	0,5597	0,0150	0,0066
67	☐													

Data | Known | Approx | Observations | New

Active Specifies if the observation is to be included in the calculation. For X/Y coordinates or coordinates from GPS data, the associated measurements are turned on/off if this is changed.

Obs.typ Specifies the type of observation.

Station Station point for the observation.

Object Survey point for the observation.

Value Observation value before calculation.

A pr. StdDev The a priori standard deviation for the observation.

A pr.SD+C The a priori standard deviation for the observation where the centering error is also taken into account.

Residual The observation's improvement in the calculation. Before the calculation is performed, the difference from the value calculated from the approximate coordinates is shown.
The color is controlled by the residual size:
Green: The residual is less than 1 a priori standard deviation.
Black: The residual is less than 2 a priori standard deviation.
Red: The residual is greater than 2 a priori standard deviation, the measurement is likely to contain errors.

Adj. Value Observation value after adjustment.

Std Dev The standard deviation of the adjusted observation.

Std Res Standardized residual. Residual divided by its standard deviation. Used for troubleshooting and quality control. The standardized residual is normally distributed N (0,1) which means that if no serious errors occur they will have the following distribution:

< 1 : 67 % of the measurements
< 2 : 95 % of the measurements
< 3 : 99.5 % of the measurements

This can be interpreted that measurements with a standardized residual greater than 2 are verified. If no error source can be found, measurements using a standardized residual of less than 3 can still be used, but if it is higher the measurement is excluded.
The color is determined by the size of the Standard residual:
Green: The standard residual is less than 1.
Black: The standard residual is less than 2.
Red: The standard residual is greater than 2, the measurement may be inaccurate and should be checked.

Please note that the Std Res can be replaced by Test Quotients 828 depending on the selected settings for the a priori standard deviation for your measurements, see Net Adjustment, Data Menu 821 .

Test Quotient Compare the measurement results only with the specified a priori accuracy. See also Standard Residuals 849 .

Please note that the Test Quotient can be replaced by the Std Res 828 depending on the selected settings for the a priori standard deviation for your measurements, see Net Adjustment, Data Menu 821 .

R number The redundancy (verifiability) of the observation or individual redundancy. A number between 0 and 1 indicates how well the observation can be verified in relation to other observations. The value 0 means that no check can be made, for example for a temporary known point. A value of 1 means that the observation is fully verifiable, such as the length between two known points. Usually, in Sweden the R number should be above 0.35 for all the measurements.
The color is controlled by the size of the R number:
Green: The R number is greater than 0.71, a theoretical limit to ensure the identification of the value as incorrect when troubleshooting.
Black: The R number is less than 0.71 but greater than 0.35.
Red: The R number is less than 0.35, the lower limit of the control point measurement.

MDE The minimum detectable error. This is a measure of how large an error in this measurement must be to ensure identification, and depends on instrument accuracy and verifiability.

ER External Reliability. This value indicates how large the error is in the adjusted value that can

be caused by an undetected error of the MDE size, see above[828] .

New points

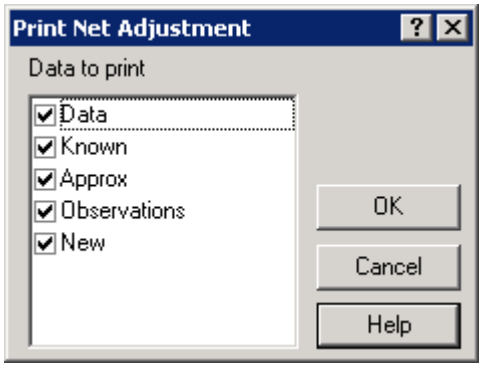
ovn.hna *

	Point	X Coord	Y Coord	sX	sY	sXY	a-axis	b-axis	Angle
1	179	81 984,6968	102 903,5359	0,0040	0,0054	-1,20e-5	0,0060	0,0030	133,7256
2	404	82 413,9141	102 495,6158	0,0058	0,0040	-9,44e-6	0,0062	0,0035	174,2346
3	540	82 033,3604	103 672,7448	0,0037	0,0052	9,89e-6	0,0057	0,0030	68,8720
4	638	82 112,0512	102 551,2254	0,0056	0,0049	-1,79e-5	0,0068	0,0031	156,6162
5	649	81 631,8262	103 063,7935	0,0041	0,0077	-1,42e-5	0,0080	0,0035	118,5506
6									

Data | Known | Approx | Observations | New

Here you see the coordinates for all points calculated, which may vary depending on the selected adjustment method. The accuracy of the points is specified as an error ellipse and covariance matrix, see Known Coordinates[826] above.

Print

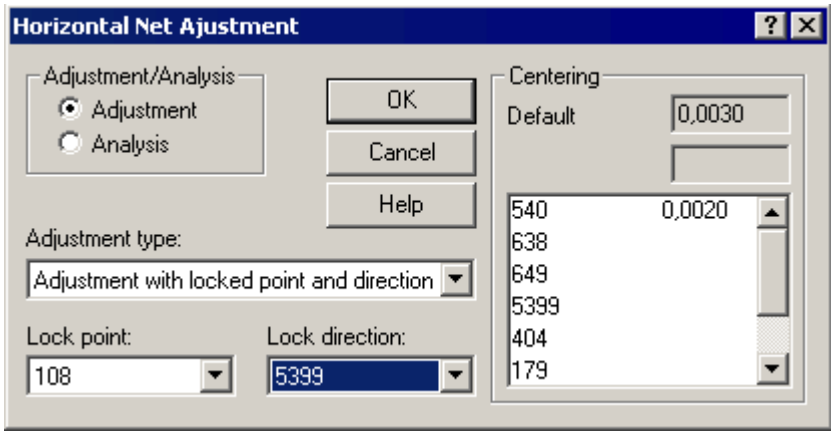


Go to ***File | Print***. When printing from the numerical view of the net adjustment, a dialog appears where you can select what to print. You can choose from printing all the tabs, or select freely the tabs to be printed.

See also: Net Adjustment[810], Net Adjustment, Step by Step[819]

15.4.4 Net Adjustment, Select Adjustment Model

When you select ***Data | Calculate*** or press the calculator in the toolbar, the dialog for selecting the method of calculation appears. The first thing to do when you calculate a net adjustment, is to calculate a free adjustment in order to eliminate any contradictions in the fixed points. You can choose to execute with only one fixed point and direction or any of the free adjustments. This initial calculation gives a result that is exclusively dependent on the quality and accuracy of the measurements. The errors that arise are not affected by the location of the known points, and you can now make the assessment if any measurement needs to be retaken in full or if additional measurements are needed. Check the new coordinates of the known points to get an idea of how the new net "suits" the old net. In order to make the final adjustment calculation832 there are several options to choose from.



Strict Adjustment

This means that the net deforms to fit exactly to the known points, which retain their old coordinates. Study the differences in relation to the free calculation. Differences may be due to a poor inter-relationship between known points. Should differences exist in the same direction, it may be that the orientation in the free execution needs adjusting.

Elastic Adjustment

Here the known points are allowed to move slightly in accordance with the accuracy specified in the tab for the known points or in the settings. The points will not be regarded as known, but are added as point observations with known accuracy in the calculation. This is the most accurate method, but because the accuracy data from the previous calculation of the known points is often missing and you are reluctant to specify new coordinates for known points, strict adjustment is frequently used.

Free Adjustment with Translation

The net is calculated initially as fully free and is then connected with a transformation. The net fits the known points through the movement in the X and Y axes. The orientation is determined from the survey data through oriented directions. Input data must contain at least one bearing

Free Adjustment with Translation and Rotation

The net is calculated initially as fully free and is then connected with a transformation. The net fits the known points through the movement in the X and Y axes and a rotation.

Free Adjustment with Translation, Rotation and Scale

The net is calculated initially as fully free and is then connected with a transformation. The net fits the known points through the movement in the X and Y axes, rotation and a scale. You can use this method, for example, for angle nets.

For all free adjustments, the shape of the net is not affected. New coordinates can also be given for known

points.

See also: Net Adjustment 810, Net Adjustment, Step by Step 819, Net Adjustment, Calculation 832

15.4.5 Net Adjustment, Calculation

When you select ***Data | Calculate*** or press the calculator in the toolbar, the dialog for selecting the method of calculation appears. After selecting the adjustment model 830 the net can be calculated. There are two ways to calculate a net; Adjustment or Analysis. The results are printed and tests performed as a basis for assessing measurement accuracy and reliability, etc.

Centering Error

In the calculation dialog it is possible to specify centering errors individually for points in the adjustment, e.g. for both polygon instruments and tripods used in the same net. Click the point in the list and enter the centering error to use. If no centering error is entered here, the one specified in settings 820 is used.

Adjustment

A full calculation is performed. Improvements to observations and coordinates for new points are calculated with various quality measures such as standardized residuals, mean errors, R numbers, error ellipses etc. Simulated data will not be included in the calculation. All quality checks made in the analysis are also made here.

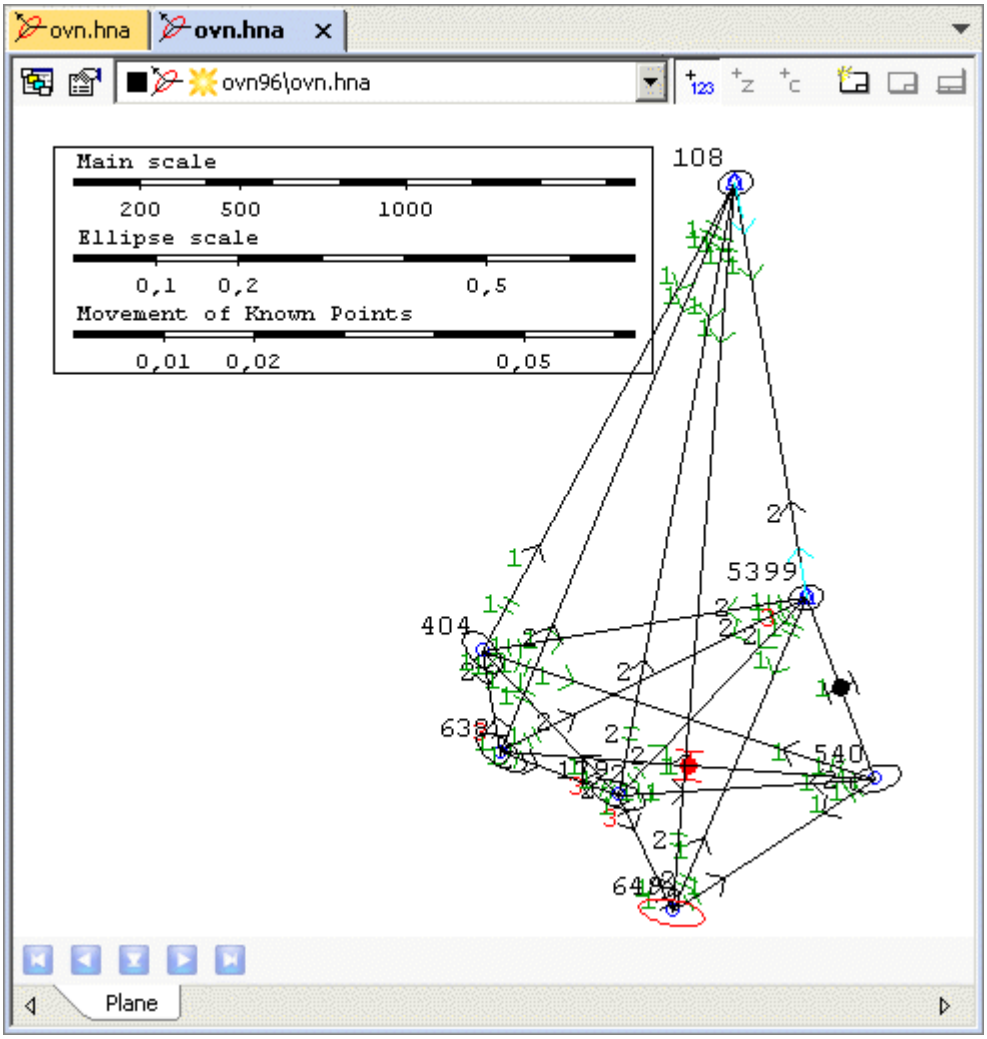
Net Analysis

Makes a simulation of the net. This may include both simulated ("prospective") measurements and real data. It need not have the survey values, however, there must be an a priori standard deviation and approximate coordinates of new points. The result provides an analysis of net geometric quality, but no new points and improvement are calculated. The calculated mean error and ellipses are based on a basic mean error of 1 being achieved. You can now study the verifiability of the observations and the shape of the error ellipses to determine if further testing is needed. For example, you can supplement an existing calculated net with simulated data and analyze it to see if additional setups/measurements could help the net's verifiability and geometry.

See also: Net Adjustment 810 , Net Adjustment, Step by Step 819 , Net adjustment, Select Adjustment Model 830

15.4.6 Net Adjustment, Graphic View

When a horizontal net adjustment is calculated, a graphic window for the net will open, if not already open.



Objects in Graphics

Different objects are drawn in different colors depending upon the quality and verifiability. Different symbols are used for different data types. If the net is not calculated, all the symbols will be blue.

Verifiability

The symbol's color depends on the verifiability of the observation and tones from red at 0, black at 0.5 and green at 1. (The colors can be changed using ***View | Document Properties***[71].)

Quality

Next to the symbol, a figure can show the measurement's sigma level, which corresponds directly to the absolute value of the standardized residual. The standard residual 0-1 gives sigma level 1, 1-2 gives 2, 2-3 gives 3 and above 3 gives sigma level 3+. The sigma level is also indicated by the color of the text.

Error ellipses

An error ellipse is drawn around all the points that have been given new coordinates. This is obviously not drawn to scale and the scale may be modified using ***View | Scale Bar Properties***, see Scale Bar[249]. Error ellipses show the calculated standard deviation as per 1 sigma principle (67 % probability that the point lies within the ellipse). Red ellipse indicates b/a < 0.4. The error ellipse corresponds to the standard deviation in two dimensions, X and Y. Ellipse data can be shown in the output window[107] using ***Tools | Info*** or the

button .

Symbols

Measured Direction

Measured Length

Measured Oriented Direction (Bearing)

GPS Baseline

Measured Coordinate Difference or Coordinate

Known Point

New Point

Toolbars

The following toolbars include functions that are specific to net adjustment:

Display

View Scale Bar. Scale bar preferences and relative scale error ellipses can be given in ***View | Scale Bar Properties***.

View Error Ellipses

View Sigma Levels

View Directions

View Lengths

View Oriented Directions

View Coordinate Differences and Coordinate Observations

View GPS Baselines

View Movement of Known Points. With this function enabled, vectors are drawn that show the differences for known point positions before and after adjustment. Does not work with strict adjustment, as the known points are then not moved.

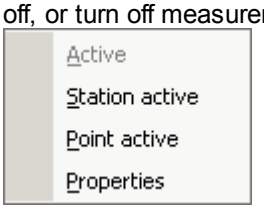
View difference vectors in relation to any coordinate file. An "Open File" dialog allows you to select a coordinate file and the difference between the point coordinates in the file and the net are shown as vectors in the graphics. This can be used, for example, for repeated deformation measurements.

Tools

Calculate Net.

Information Tool[229] .
Click on the measurement or point you want to know more about. The information is printed in iCON office's Input and output windows[107] .

Select Objects.
Click the measurement or point.
Right-click over the selected point to bring up a menu where you can turn the measurements on or off, or turn off measurements from an entire station or enable/disable a point.



Right-click a point to get a dialog in which all measurements from and to the selected point can be set to active or passive.
Right-click a measurement to set a particular measurement as active or passive.

Simulation Tool. Adds a simulated length and direction in the data set. First, click the station point, and then the survey points you want to simulate. Right-click to quit the station and start a new one.

Simulation Tool. Adds a simulated direction to the data set[825].

Simulation Tool. Adds a simulated length to the data set[825].

Simulation Tool. Adds a simulated oriented direction to the data set[825].

Simulation Tool. Adds a simulated coordinate difference to the data set[825].

Simulation Tool. Adds a simulated coordinate to the data set[825].

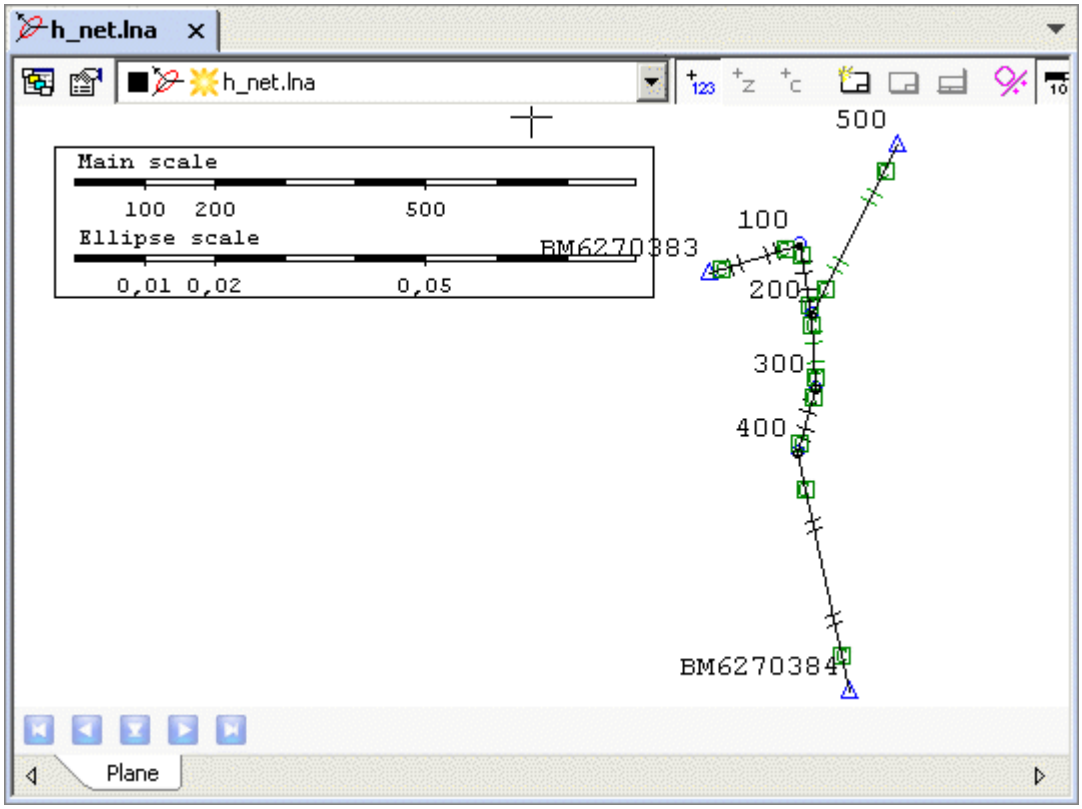
Simulation Tool. Adds a new point among approximate coordinates[825].

Tool for copying the known points from the coordinate document to known coordinates[825].

See also: Net Adjustment[810], Net Adjustment, Step by Step[819], Net Adjustment, Input View[825]

15.4.7 Leveling Net Adjustment, Graphic View

When a leveling net adjustment is calculated, a graphic window for the net will open, if not already open.



Objects in Graphics

Different objects are drawn in different colors depending upon the quality and redundancy. Different symbols are used for different data types. If the net is not calculated, all the symbols will be blue.

Redundancy

The symbol's color depends on the redundancy/verifiability of the observation as follows:

0≤R<0.35	Red
0.35≤R<0.71	Black
0.71≤R≤1	Green

(The colors can be changed using ***View | Document Properties***[71] .)

Quality

Next to the symbol, a figure can show the measurement's sigma level, which corresponds directly to the absolute value of the standardized residual. The standard residual 0-1 gives sigma level 1, 1-2 gives 2, 2-3 gives 3 and above 3 gives sigma level 3+. The sigma level is also indicated by the color of the text.

Error Circle

In a leveling net the standard deviation is illustrated by the calculated height with a circle. An error circle is drawn around all the points that have been given new coordinates. This is obviously not drawn to scale and the scale may be modified using ***View | Scale Bar Properties***, see Scale Bar[249] . The radius of the circle corresponds to a standard deviation for the calculated height (1sigma, 67 %). The data can be shown in the output window[107] using ***Tools | Info*** or the button .

Symbols

Trigonometric Measured Distance

Adjusted Distance

Known Point

New Point

Toolbars

The following toolbars include functions that are specific to a leveling net adjustment:

Display

View Scale Bar. Scale bar preferences and relative scale error circles can be given in ***View | Scale Bar Properties***

View Error Circle

View Sigma Levels

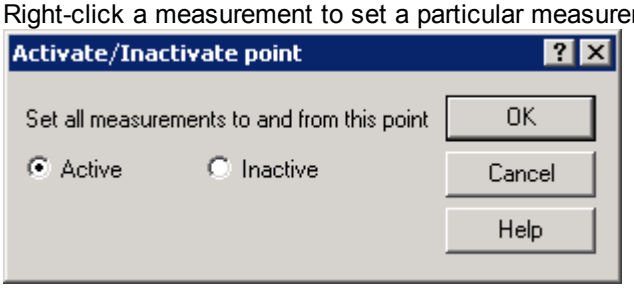
View Control Loops

Tools

Calculate Net

Information Tool[229].
Click on the measurement or point you want to know more about. The information is printed in iCON office's Input and output windows[107].

Select Objects.
Click the measurement or point.
Right-click a point to get a dialog in which all measurements from and to the selected point can be set to active or passive.
Right-click a measurement to set a particular measurement as active or passive.



Simulation Tool. Adds a simulated trigonometric height difference to the data set[825].

Simulation Tool. Adds a simulated leveling to the data set[825].

Simulation Tool. Adds a new point among approximate coordinates[825].

Tool for copying the known points from the coordinate document to known coordinates[825].

Tools that make it possible to create a control loop graphically by clicking on the items included on a leveling net.

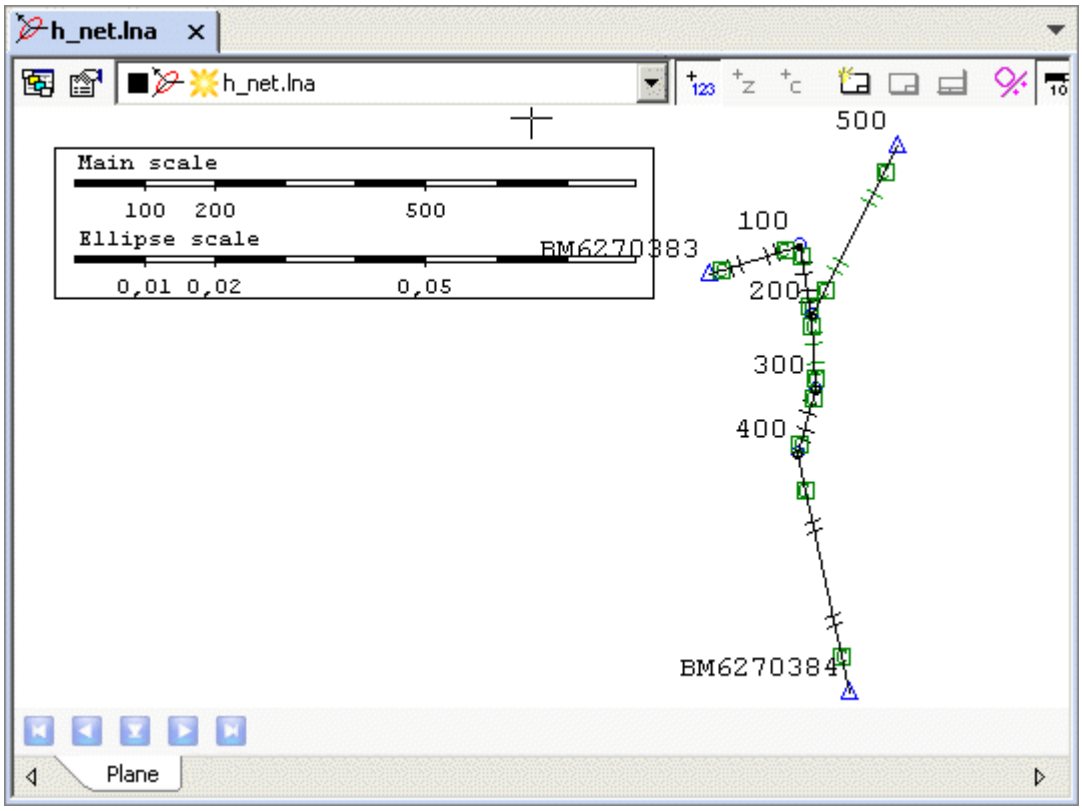
See also: Net Adjustment[810], Net Adjustment, Step by Step[819], Net Adjustment, Input View[825]

15.4.8 Leveling Net Adjustment, Control Loops

When calculating a leveling net adjustment you can create control loops.

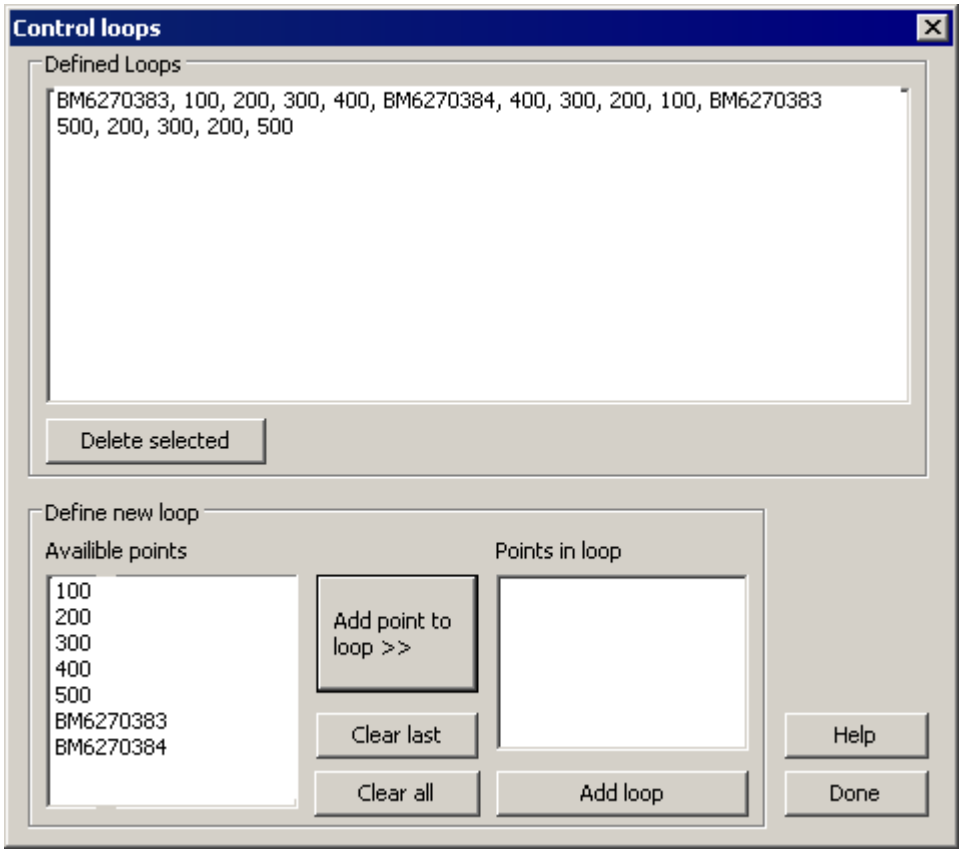
The loading of the input file brings up a dialog in which the user can check the box *Create control loop for this traverse*.

If you have already begun a leveling net adjustment and the document for leveling net adjustment (lna) is active, you can select ***Data | Control Loops***.



Control Loop

When calculating the height net ***Data | Calculate*** opens a graphical window for the net. If you have selected to check *Create control loop for this traverse* when loading survey files, see Net Adjustment, Data Menu 820, this creates a control loop for each traverse in the loaded files.
User-defined control loops can always be created by selecting ***Data | Control Loops***. From a graphical perspective, user-defined control loops are created by selecting ***Tools | Net Adjustment | Create Control Loop***, .



Delete selected	Deletes the selected control loop.
Available points	Here you see the points from which you can create a control loop.
Points in the loop	Here you see the points that you add to a control loop.
Add point to loop	Click the button to transfer an available point to a control loop.
Delete last	Click to delete the last point of the transferred point in the control loop.
Delete all	Click to delete the entire control loop.
Add loop	When you have added points to a control loop, click here to add the loop to the calculation.

Create control loop step by step:

Select a starting point for the control loop from *Available points*. Click **[Add point to loop >>]**.

The available points are updated as you add points to the loop. If, as in the example above, you start a control loop that begins with point 500, you can choose point 200 as the next move point, and then you can choose from points 100, 300 or 500, see the graphics in the figure above. In this way, selectable move points will be updated continuously, as long as you click **[Add point to loop >>]**.

When the loop is finished, click **[Add loop]**. In order to be able to calculate a control loop in an adjustment, it must be closed (start and end points are the same), or pass between two known points.

Any number of loops can be defined.

Click **[*Done*]** to quit.

When the leveling net adjustment is calculated, ***Data* | *Calculate***, the control loops are also calculated. Select ***Data* | *Create Report***. The results of the calculated control loops are shown in the tab control loops

in the report file, see Net Adjustment, Report 841

Create control loop step by step, graphically:

Select ***Tools | Net Adjustment | Create Control Loop***, , and click the points to include in the control loop.

Right-click to finish the control loop.

The control loops are calculated in the same manner as mentioned above, with ***Data | Calculate***.

See also: Net Adjustment 810 , Net Adjustment, Step by Step 819 , Net Adjustment, Input View 825

15.4.9 Net Adjustment, Report

The report in iCON office net adjustment consists of four or more tabs, depending on the input data in the net.

Net

This section is a compilation tab of data on the entire net.

ovn.rep

Horizontal Net Adjustment Created: 2010-08-11

Net adjustment file:	C:\sbg\geo\Ovn96V\ovn96\ovn.hna			
Calculation:	Adjustment	Method	Strict adjustment	
No of observations:	66		Reliability:	0,73
No of unknown:	18		Min allowed (HMK):	0,50
Rank defect:	0			
Redundancy:	48		Std error of unit weight:	1,04
			Max allowed (HMK):	1,17

A priori std deviations:

(Please note: These are the last used standard settings, values can differ for individual measurements)

Directions:	0,0008		No of Rounds:	1
Oriented directions:	0,0020		No of Rounds:	1
Distances:	0,0050	+ 3,0000 ppm		
			Coordinates	0,0200
Centering:	0,0030		Coordinate differences:	0,0050

Distribution of Std Residual

Sigma level:	Value	No of observations	Accumulated (%)	Theoretical (%
1	0.0 - 1.0	57	86,36	67,61
2	1.0 - 2.0	6	95,45	95,14
3	2.0 - 3.0	3	100,00	99,58
3+	3.0 -	0	100,00	100,00
?	no valid value	0	100,00	

Net | Known Points | New Points | Directions | D

The following data is presented:

- Filename for the net adjustment.
- Number of observations, unknown, rank defect and redundancy.
- Total verifiability of the net.
- The basic mean error of the net.
- The a priori standard deviation specified in the settings821. *Keep in mind that these can be changed for individual measurements.*
- Distribution of standard residuals: The distribution of the measurements across various sigma levels, and what it theoretically should be if no major mistakes have been made.
- Distribution of test quotients: Distribution of test quotients is displayed, instead of standard residuals, if you have selected to calculate control quotients as test quotients instead of standardized residuals, see also Net Adjustment, Data Menu822.

Known points

The known points in the tab presents the known starting points used in the net, the centering errors used for each point and the error ellipse specified for the point. (The error ellipse is only used in free adjustments and elastic adjustment).

ovn.rep

Horizontal Net Adjustment, Known Points

Created: 2010-08-11

No of points 2

Point	X	Y	a-axis	b-axis	Angle
Centering err.			sX	sY	a/b
108	83 820,8200	103 253,8610	0,0000	0,0000	50,0000
0,0030			0,0000	0,0000	
5399	82 576,3660	103 466,0730	0,0000	0,0000	50,0000
0,0030			0,0000	0,0000	

Net | Known Points | New Points | Mc

The following is presented for each point:

Point name	
Coordinates	
a-axis, b-axis, angle	Point mean error as error ellipse
sX, sY	Mean error in the X and Y coordinates
a/b	The format of the error ellipse, should be greater than 0.4
Centering	Centering[821] used for the point in question

New points

This tab presents coordinates for the calculated points, the calculated point accuracy and the centering error used.

Horizontal Net Adjustment, New Points

Created: 2010-08-11

No of points 5

Point	X	Y	a-axis	b-axis	Angle
Centering err.			sX	sY	a/b
179	81 984,6968	102 903,5359	0,0060	0,0030	133,7256
0,0030			0,0040	0,0054	0,4936
404	82 413,9141	102 495,6158	0,0062	0,0035	174,2346
0,0030			0,0058	0,0040	0,5603
540	82 033,3604	103 672,7448	0,0057	0,0030	68,8720
0,0020			0,0037	0,0052	0,5183
638	82 112,0512	102 551,2254	0,0068	0,0031	156,6162
0,0030			0,0056	0,0049	0,4555
649	81 631,8262	103 063,7935	0,0080	0,0035	118,5506
0,0030			0,0041	0,0077	0,4410

Net | Known Points | New Points | Dire

The following is presented for each point.

- See known points above.

Movement

This tab is only for free nets and elastic adjustment where the known points are given new coordinates. The differences for known point coordinates before and after adjustment are presented here.

Horizontal net adjustment, Movement of known points

Created: 2010-08-11

No of points 2

Point	X Horizontal net adjustm	Y Horizontal net adj	New X	New Y	X diff	Y diff
108	83 820,8200	103 253,8610	83 820,8160	103 253,8617	-0,0040	0,0007
5399	82 576,3660	103 466,0730	82 576,3700	103 466,0723	0,0040	-0,0007

Known Points | New Points | **Movement** | Direct

The following is presented for each point.

- Coordinates before and after adjustment, and differences.

Directions

This tab is included in the report if directions appear in the input data.

Horizontal net adjustment, directions

Created: 2010-08-11

		From point	To point
Max residual:	0,0015	638	404
Max Std Residual:	-2,0378	404	638

No of stations: 7

No of directions: 32

Type	From point / To point	Value / A pr. Std dev / A pr. SD+C	Residual / Adj. Std dev / MDE	Adj Direction / Oriented Dir / ER	Std Residual / R number
Direction	404	120,1506	0,0005	120,1512	0,7754
	179	0,0008	0,0007	151,6193	?? 0,5059
		0,0009	0,0031	0,0016	
Direction	404	156,9345	-0,0014	156,9330	?? -2,0378
	638	0,0008	0,0009	188,4011	?? 0,3891

Net | Known Points | New Points | **Directions** | D

The following data is presented:

- The largest residual, and the measurement in which it occurs.
- The largest standard residual, and the measurement in which it occurs.
- The largest test quotient is displayed instead of the largest standard residual, if you have selected to calculate control quotients as test quotient, see also Net Adjustment, Data Menu 822 .
- The number of station setups and the number of measured directions.

The following is presented for each measurement:

Type	Direction or bearing.
Source point, destination point	Station and objects for the measurement.

Value	The original survey value.
Residual	The improvement added to the measurement. ?? : The residual exceeds 2 a priori standard deviation and should be checked. !! : The residual exceeds 3 a priori standard deviation, the measurement is probably incorrect.
Adj. Direction	Direction after adjustment.
Std. Residual	Standardized improvement, used for quality control. ?? : The standard residual exceeds 2 and the measurement should be checked. !! : The standard residual exceeds 3 and the measurement must be rejected. If no error can be found, the measurement is rejected.
Test Quotient	Identifies serious errors in relation to a pre-set absolute level of a priori standard deviation, seeStandard Residual[849] . Test quotients will be displayed instead of Std. Residual[844] if you have selected to calculate control quotients as test quotient, see also Net Adjustment, Data Menu[822] .
A pr. std.dev	Estimated accuracy of the measurement before adjustment, the basis for weighting.
Adj. std.dev	Standard deviation of the adjusted measurement.
Oriented Dir	Adjusted bearing between the source and destination points.
R number	Tells you how redundant the measurement is. ?? : The redundancy/verifiability is less than 0.71 which means that troubleshooting may be difficult. !! : The redundancy/verifiability is less than 0.35, limits of verifiability of the control point net.
A pr. SD+C	The total of the a priori standard deviation and centering error.
MDE	The minimum detectable error. This is a measure of how large an error in this measurement must be to ensure identification, and depends on instrument accuracy and verifiability.
ER	External Reliability. This value indicates how large the error is in the adjusted value that can be caused by an undetected error of the MDE size, see above.

Lengths

This tab is included in the report if lengths appear in the input data.

Horizontal net adjustment, distances — Created: 2010-08-11

		From point	To point
Max residual:	-0,0156	649	5399
Max Std Residual:	-1,9019	649	5399
No of distances:	30		

From point / To point	Value / A pr. Std dev / A pr. SD+C	Residual / Adj. Std dev / MDE	Adj Value / ER	Std Residual / R number
649	1 026,6530	-0,0156	1 026,6374	-1,9019
5399	0,0081	0,0036		0,8379
	0,0086	0,0247	0,0040	
649	729,4281	-0,0096	729,4185	-1,4000
540	0,0072	0,0040		0,7490
	0,0076	0,0233	0,0058	

New Points | Directions | **Distances** | Gps

The following data is presented:

- The largest residual, and the measurement in which it occurs.
- The largest standard residual, and the measurement in which it occurs.
- The largest test quotient is displayed instead of the largest standard residual, if you have selected to calculate control quotients as test quotient, see also Net Adjustment, Data Menu 822 .
- The number of measured lengths.

The following is presented for each measurement:

Source point, destination point	Station and objects for the measurement.
Value	The original survey value.
Residual	The improvement added to the measurement. ?? : The residual exceeds 2 a priori standard deviation and should be checked. !! : The residual exceeds 3 a priori standard deviation, the measurement is probably incorrect.
Adj. Value	Length after adjustment.
Std Residual	Standardized improvement, used for quality control. ?? : The standard residual exceeds 2 and the measurement should be checked. !! : The standard residual exceeds 3 and the measurement must be rejected. If no error can be found, the measurement is rejected.
Test Quotient	Identifies serious errors in relation to a pre-set absolute level of a priori standard deviation, see Standard Residual 849 . Test quotients will be displayed instead of Std. Residual 844 if you have selected to calculate control quotients as test quotient, see also Net Adjustment, Data Menu 822 .
A pr. std.dev	Estimated accuracy of the measurement before adjustment, the basis for weighting.
Adj. std dev	Standard deviation of the adjusted measurement.
R number	Tells you how redundant the measurement is. ?? : The redundancy/verifiability is less than 0.71 which means that troubleshooting may be difficult. !! : The redundancy/verifiability is less than 0.35, limits of verifiability of the control point net.
A pr. SD+C	The total of the a priori standard deviation and centering error.
MDE	The minimum detectable error. This is a measure of how large an error in this measurement must be to ensure identification, and depends on instrument accuracy and verifiability.
ER	External Reliability. This value indicates how large the error is in the adjusted value that can be caused by an undetected error of the MDE size, see above.

Gps

This tab is included in the report if GPS data appears in the input data.

Horizontal net adjustment, Gps observations

Created: 2010-08-11

		From point	To point
Max length residual:	-0,0012	540	5399
Max Std Residual:	-0,7755	540	5399
Max dir. residual:	0,0002	540	5399
Max Std Residual:	-0,6783	638	540

No of baselin	2
Deviation from local north:	0,0000

Type	From point / To Point	Value / A pr. Std dev / A pr. SD+C	Residual / Adj. Std dev / MDE	Adj Value / ER	Std Residual / R number
Direction	540	376,8476	0,0002	376,8478	0,6756
	5399	0,0004	0,0004		?? 0,3883
		0,0005	0,0018	0,0011	
Length	540	581,0075	-0,0012	581,0063	-0,7755
	5399	0,0020	0,0030		!! 0,1993
		0,0032	0,0125	0,0100	

New Points | Directions | Distances | Gps

The following data is presented:

- The largest residual in length and direction, and the measurement in which it occurs.
- The largest standard residual in length and direction, and the measurement in which it occurs.
- Number of baselines.
- Difference between the north bearing in the local system and in WGS 84. Any difference may be due to the convergence of meridians or rotation in the local system.

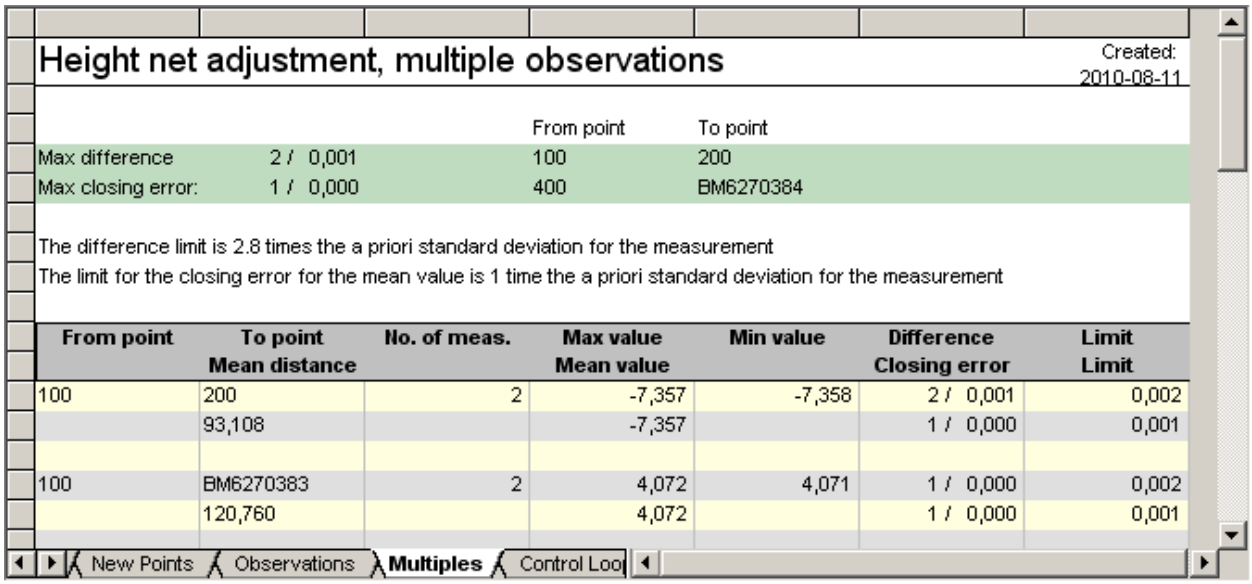
The following is presented for each measurement.

Type	Direction or length
Source point, destination point	Station and objects for the measurement
Value	The original measurement value
Residual	The improvement added to the measurement. ?? : The residual exceeds 2 a priori standard deviation and should be checked. !! : The residual exceeds 3 a priori standard deviation, the measurement is probably incorrect.
Adj. Value	Value after adjustment
Std. Residual	Standardized improvement, used for quality control. ?? : The standard residual exceeds 2 and the measurement should be checked. !! : The standard residual exceeds 3 and the measurement must be rejected. If no error can be found, the measurement is rejected.
A pr. std.dev	Estimated accuracy of the measurement before adjustment, the basis for weighting
Adj. std.dev	Standard deviation of the adjusted measurement
R number	Tells you how redundant the measurement is. ?? : The redundancy/verifiability is less than 0.71 which means that troubleshooting may be difficult. !! : The redundancy/verifiability is less than 0.35, limits of verifiability of the control point net.

MDE	The minimum detectable error. This is a measure of how large an error in this measurement must be to ensure identification, and depends on instrument accuracy and verifiability.
ER	External Reliability. This value indicates how large the error is in the adjusted value that can be caused by an undetected error of the MDE size, see above.

Multiple measurements (leveling nets only)

Here a summary shows all measurements, and how many times each height difference is measured. To get the greatest benefit from this report you should code move points, see Net Adjustment, Data Menu 820.



Height net adjustment, multiple observations

Created: 2010-08-11

		From point	To point
Max difference	2 / 0,001	100	200
Max closing error:	1 / 0,000	400	BM6270384

The difference limit is 2.8 times the a priori standard deviation for the measurement

The limit for the closing error for the mean value is 1 time the a priori standard deviation for the measurement

From point	To point Mean distance	No. of meas.	Max value Mean value	Min value	Difference Closing error	Limit Limit
100	200	2	-7,357	-7,358	2 / 0,001	0,002
	93,108		-7,357		1 / 0,000	0,001
100	BM6270383	2	4,072	4,071	1 / 0,000	0,002
	120,760		4,072		1 / 0,000	0,001

New Points | Observations | **Multiples** | Control Loo

The following data is presented:

- The largest spread between the two measurements with the same height difference, and the measurement in which this occurs.
- Largest closing error for individual height differences established from mean values between the adjusted heights, and the measurement in which this occurs.

The following is presented for each measurement.

Source point, destination point	Station and objects for the measurement.
Number of measurements	Number of measurements made between objects, regardless of direction.
Maximum value	Maximum measured height difference between the objects.
Minimum value	Minimum measured height difference between the objects.
Spread	The difference between the maximum and minimum measured height differences. The figure above specifies the sigma level of the spread in line with the normal distribution curve.
Limit value	Limit value for the spread of the 2-sigma level in line with the normal distribution curve.
Mean value	Mean value of measured height differences between the points.
Closing error	Mean closing error between adjusted heights for the points. The figure above specifies the sigma level of the closing error in line with the normal distribution curve.
Limit value	Limit value for the spread of the 2-sigma level in line with the normal distribution curve.

See also: Net Adjustment 810, Net Adjustment, Step by Step 819

15.4.10 Standard Residual

Standard residual and test quotient

iCON office includes a number of dialogs with the option of selecting between calculating the standard residual and test quotient. These are used for troubleshooting and quality control. The following explains the difference between them:

Standard Residual

- Standard Residual is the quotient between *(residual)/(standard deviation of the residual)*. The results are calculated using general statistical methods.
- Identifies measurements that are significantly worse than other measurements in the net, regardless of the absolute level of the a priori standard deviation.
- This therefore shows that a measurement is worse than the others, but it may still be good enough.
- Compares the relative quality of the measurements.
- The standard residual is normally distributed N (0,1) which means that if no serious errors occur they will have the following distribution:

  < 1 : 67 % of the measurements
  < 2 : 95 % of the measurements
  < 3 : 99.5 % of the measurements

  this can be interpreted as that measurements with a standard residual greater than 2 are verified. If no error source can be found, measurements using a standard residual of less than 3 can still be used, but if it is higher the measurement is excluded.
  Reports from iCON office net adjustment use colors to illustrate the size of the standard residual:
  Green: The standard residual is less than 1.
  Black: The standard residual is less than 2.
  Red: The standard residual is greater than 2, the measurement may be inaccurate and should be checked.
- See also Net Adjustment, Input View 828 .

Test quotient

- Test quotient is the quotient between *residual/(a priori standard deviation for the measurement)*.
- Identifies serious errors in relation to a pre-set absolute level of a priori standard deviation.

Comparison between standard residual and test quotient

- In large nets, it is very difficult if not impossible, to maintain uniform accuracy. External conditions such as the weather changes from location to location and day to day. This in turn means that it can be tricky to exclude all 3+ as specified in the first method. When a measurement has been excluded and the conversion made, a new measurement such as 3+ is flagged instead as this is significantly worse in the remaining set. You must therefore interpret the standard residual together with the actual improvement.
- According to the first method with a standard residual, you cannot "hide" non-homogeneous accuracy by setting a sufficiently high a priori standard deviations.
- According to the second method with test quotient, all measurements that are "good enough" compared to the a priori standard deviation are approved.
- The fact that a measurement is flagged in method simply means that you have shown that the instrument can be improved through other measurements, *not that the measurement at an absolute level is too poor.*

16 Tunnel

Tunnel Description - description of a designed tunnel

In iCON office, when you are about to work with calculations related to tunnels, you usually start by creating a tunnel description, tbs. A tunnel description describes a designed tunnel, where it is possible to add data from a measured tunnel.

The content of a tunnel description

A tunnel description, tbs, can include

- Line, l3d
- Tunnel Design Sections, tun,
  - file describing the designed tunnel
- Design Surfaces, AutoCAD® file dwg or dxf
  - file describing the designed tunnel
- Calculation Borders
  - polygon that limits calculation surface
- Models in the shape of:
  - measured point cloud, gpc
  - calculated tunnel difference model, tdm
- Calculation Intervals
  - determines how tight tunnel sections will be created

Why creating a tunnel description?

When you have created a tunnel description you will be able to:

- visualize the design tunnel together with measured data
- visualize the distance between design and measured tunnel
- the ratio of measured data and design tunnel can be compared, and you might find e.g. intrusion into the tunnel
- calculate volumes
- calculate and visualize tunnel cross sections
- filter points from the point cloud

You can visualize distance lines between measured rock and design tunnel, and also for measured rock to over profile.

Note!
Calculation of tunnel difference models before iCON office 2016

Please note, the calculation of tunnel difference models has partly been updated in iCON office 2016 and later versions. If you are about to work with a tunnel description including a tunnel difference model created in an older version than 2016, please be aware of the following:

- If the tunnel difference model is created from tunnel design section files, .tun, that include the point code TC 852 describing the tunnel center, you can use the tunnel difference model as usual.
- You have to **recalculate the tunnel difference model**, if it has been created from tunnel design section files, .tun, that do not include the point code TC, tunnel center.
- If you use iCON office 2016 or a later version, the calculations of tunnel difference models always start in the point where the center line intersects the cross section.

Se also: Tunnel Design Sections, tun 852, Tunnel Difference Models 887

16.1 Tunnel Design

Tunnel Design in Tunnel Description

A tunnel description file, tbs, in iCON office always include one or several files describing the tunnel design along the road line. The tunnel design can be created by:

- One or several Design Tunnel Section, tun 852
- Design mesh i AutoCAD 855 ® 855 formaten dwg eller dxf. 855

Tunnel Design

A tunnel description, tbs, can include several tunnel section files and design meshes.

You add files describing the designed tunnel in the tunnels description tree, under ***Tunnel Design | Design Sections*** and ***Tunnel Design | Design Surfaces***.

Further down in the tunnel description tree you can enter which Tunnel Design object should be used at which station, see Usage 872 in Create New Tunnel Description, tbs 872 .

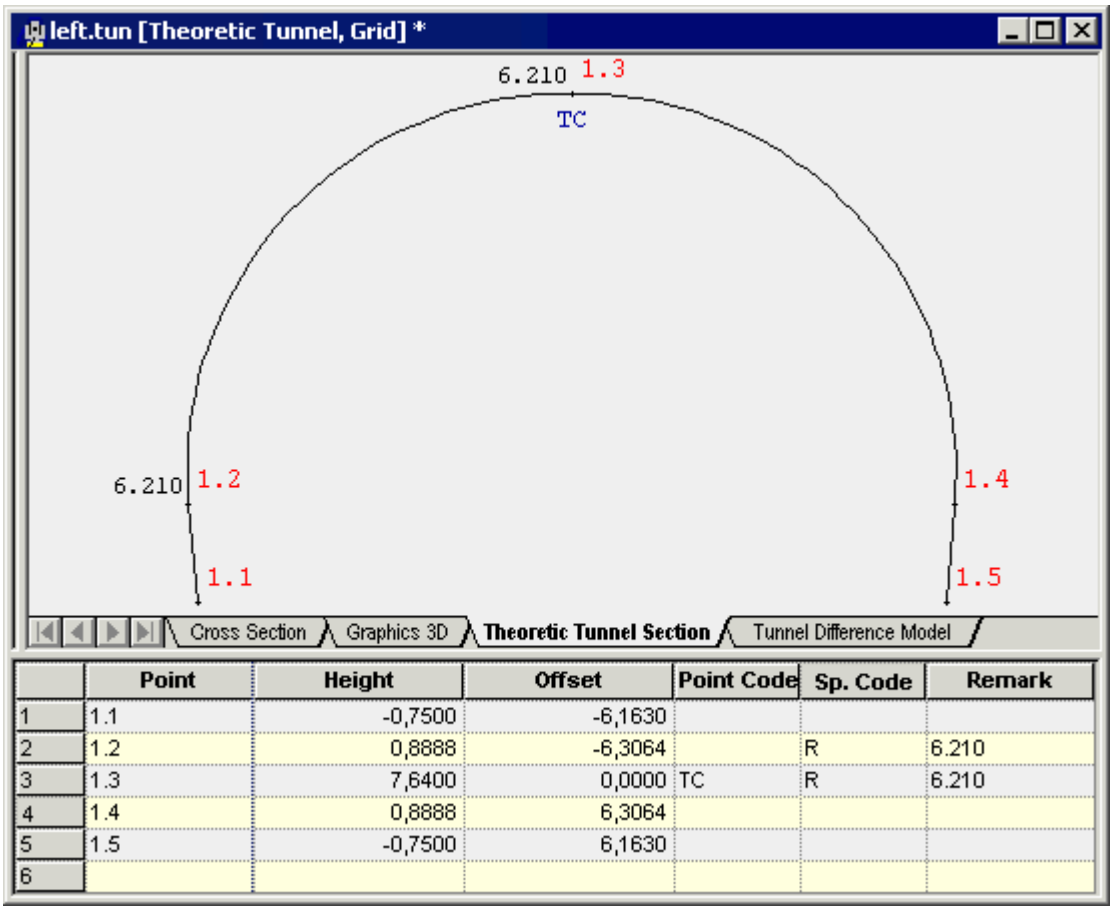
See also: Tunnel Design 852 , Tunnel with Design Mesh 855

16.1.1 Tunnel Design Sections, tun

A tunnel design section, tun, describes the shape of a tunnel cross section.

The tun format

The tunnel design section is always described from left to right with all break points along the section. For each point you specify point number, height above the profile, offset from the line, code, special code, and remark.



	Point	Height	Offset	Point Code	Sp. Code	Remark
1	1.1	-0,7500	-6,1630			
2	1.2	0,8888	-6,3064		R	6.210
3	1.3	7,6400	0,0000	TC	R	6.210
4	1.4	0,8888	6,3064			
5	1.5	-0,7500	6,1630			
6						

Numbering

Usually the points are numbered as a line (1.1, 1.2, 1.3 ... etc ...) but this is not a requirement.

Tunnel Center

When you create a tunnel model, the points are related to the dimension along the theoretical tunnel. This length measurement is calculated from the point in the tunnel design file (tun) that has a zero offset, i.e. in the tunnel center. If there is no point with this offset, the length measurement will start from the first point in the tunnel design file (tun) instead. You can also determine the length measurement to another point by entering the point code **TC**. All points in the model that are to the left of the TC point (or zero offset, tunnel center) will have a negative value in the E coordinate. See also Tunnel Difference Models 887 .

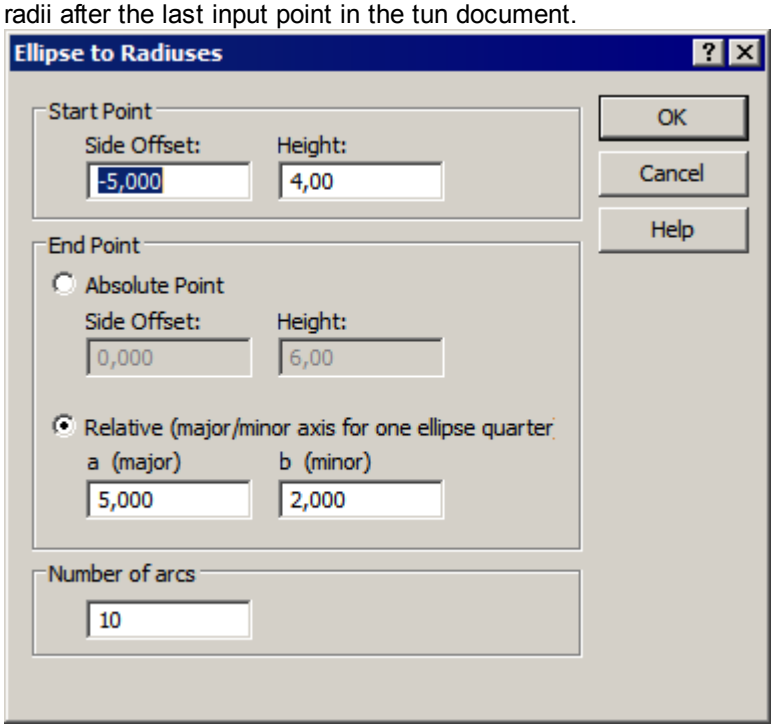
Radii

If the theoretical tunnel contains elements with a radius, the start point of the element is described by giving the special code **R**. The radius is given in the remark field.

Ellipses

The program does not handle ellipses in the actual tunnel calculation. However, there are two different methods of converting ellipses to a number of radii to describe the same shape.

- ***Method 1:*** By selecting ***Data | Ellipses | Add Radii for One Ellipse*** you can incorporate a number of radii after the last input point in the tun document.

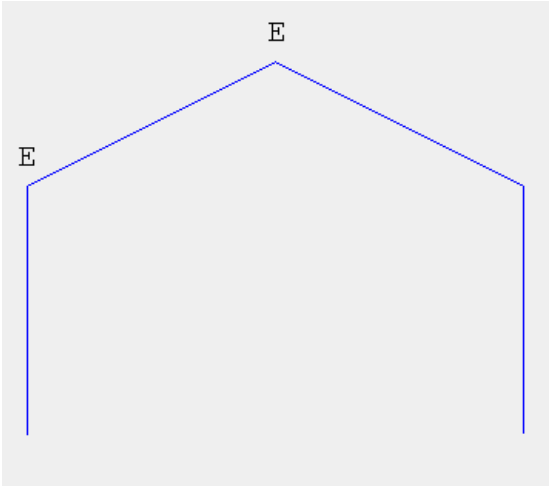


Start Point
Enter the start point's coordinates; side offset and heigh.

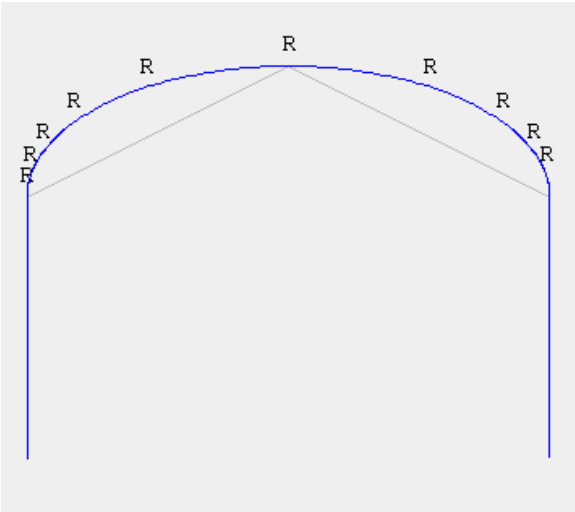
End Point
The last point in the file is automatically suggested.
You can either enter a specific end point (side offset and height) or specify a and b dimensions for the ellipse, where these dimensions represent half the length of the major and minor axes.

Number of arcs
Enter the number of arcs that will create the ellipse. The program suggests 10 by default.

- ***Method 2:*** If you already have data for all points in the tunnel section, you can choose to convert all the ellipses in one go instead.
In the numerical view, the ellipses in this case must be marked with the special code "E" and in the remarks column you should indicate how many arc elements with radii to be created. If you do not specify any number, ten new point that have special code R (radius) will be created. ***Select Data | Ellipses | Convert Ellipses ('E'-points) for Radii***. All ellipse points are then replaced with radii instead.



Tunnel section with ellipse points

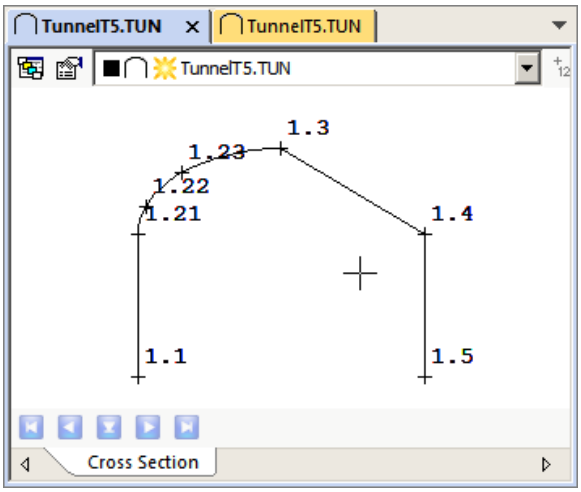


Ellipse points replaced by radii

TunnelT5.TUN | TunnelT5.TUN

	Point	Height	Offset	Point Code	Sp. Code	Remark
1	1.1	-5,000	-5,000			
2	1.21	0,000	-5,000		R	2.011262
3	1.22	0,982	-4,725		R	3.600168
4	1.23	2,162	-3,467		R	7.646284
5	1.3	3,000	0,000		E	5
6	1.4	0,000	5,000			
7	1.5	-5,000	5,000			
8						

Numerical tunnel section where ellipse point (1.3) will be replaced by 5 arc elements with radii (Special Code E together with Remark 5 will generate 5 arc elements.)



Graphical tunnel section corresponding to the numerical tunnel section to the left.

Point codes in tunnel design sections, tun

The following point codes can be used in a tunnel design section file, tun:

TC	Sets tunnel center in a tunnel design section, tun.
A1	Abutment point, point where wall and ceiling meet.
A2	Abutment point, point where wall and ceiling meet.

Create tunnel difference model, tdm

A tunnel difference model is a calculated model, that describes the differences between the measured and the designed tunnel.

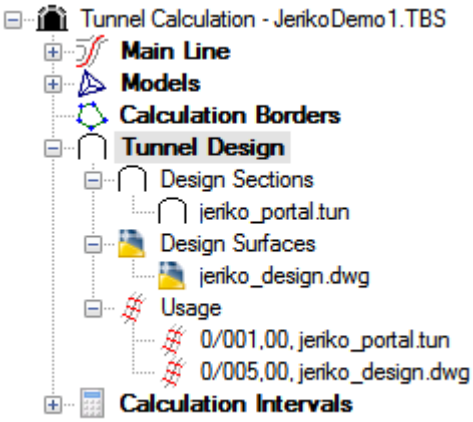
To create a tunnel difference model, tdm, you select ***Data | Create Tunnel Model*** from the tunnel description document, tbs862. For more information, see Create Tunnel Difference Model892.

See also Tunnel Description862, Tunnel Difference Models887, Tunnel Design851.

16.1.2 Tunnel Design Surfaces, Design Mesh

Design surfaces as design mesh

Design mesh in AutoCAD® dwg or dxf files describe the surface of the tunnel design.
Design mesh is used in a similar way as design sections, tun 852.



Tunnel description with Design Mesh.

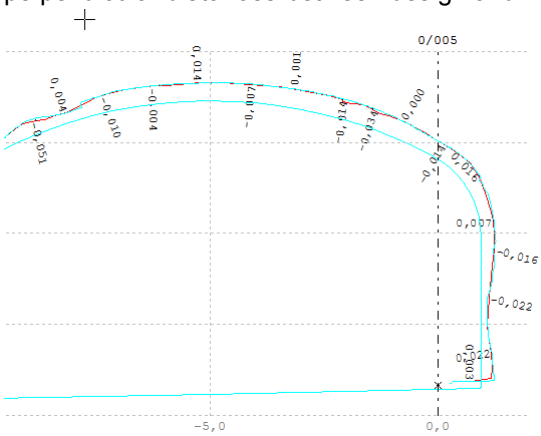
Design mesh in tunnel description

You add Design Mesh under **Tunnel Design | Design Surfaces** in the tunnel description tree.

If the dwg/dxf file that is used as design mesh includes several layers, you can select active layer in a drop down menu.

Design mesh in the cross section view

When you have a tunnel description with design mesh, you can visualize it in the cross section view. If you also have added measured data, you can display perpendicular distances between design and measured tunnel.



Cross section view displaying design mesh and measured data.

Create tunnel difference model, tdm

You create a tunnel difference model, tdm, by calculating the difference between design tunnel and measured data.

To create a tunnel difference model, select ***Data | Create Tunnel Model***. For more information, see Create Tunnel Difference Model 892.

Correction of points into tunnel sections, using a

A tunnel description with design mesh can be used to calculate "Correction of

tunnel description with design mesh

points into tunnel sections". The calculation will give you a tunnel cross section file, sec, including both measured points and design mesh points. In the cross section file you can display perpendicular distances between design mesh and measured tunnel.
See also Correction of Points into Tunnel Sections 908 .

See also Tunnel Description 862, Tunnel Difference Models 887 .

16.2 Handling Tunnel Data

Before you can use survey data for the tunnel in a calculation you normally have to edit it.

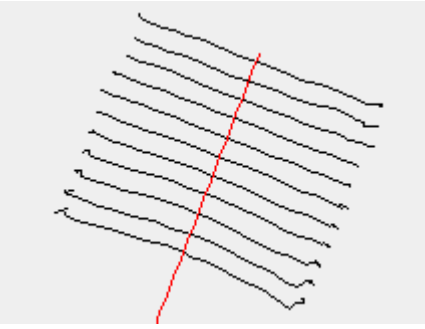
The text below refers to:

Graphical editing of Tunnel Data 857

Tunnel scanning 859

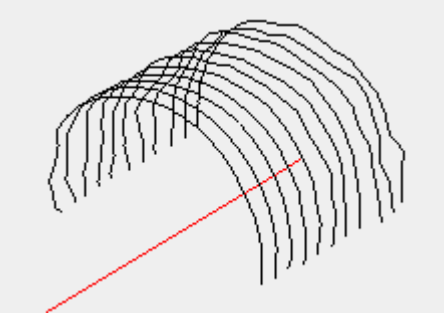
Graphical editing of tunnel data

Before you can calculate a difference tunnel model (tdm) from a coordinate file (geo), any erroneous points must first be corrected. This may include points originating from adjacent tunnels or from unwanted objects such as emergency exits or ventilation ducts. If points of this type are not removed there is a risk that the tunnel difference model will not be accurate. The usual plane view of the coordinate file could be difficult to see if there are erroneous points.



Surveyed coordinates in plane view.

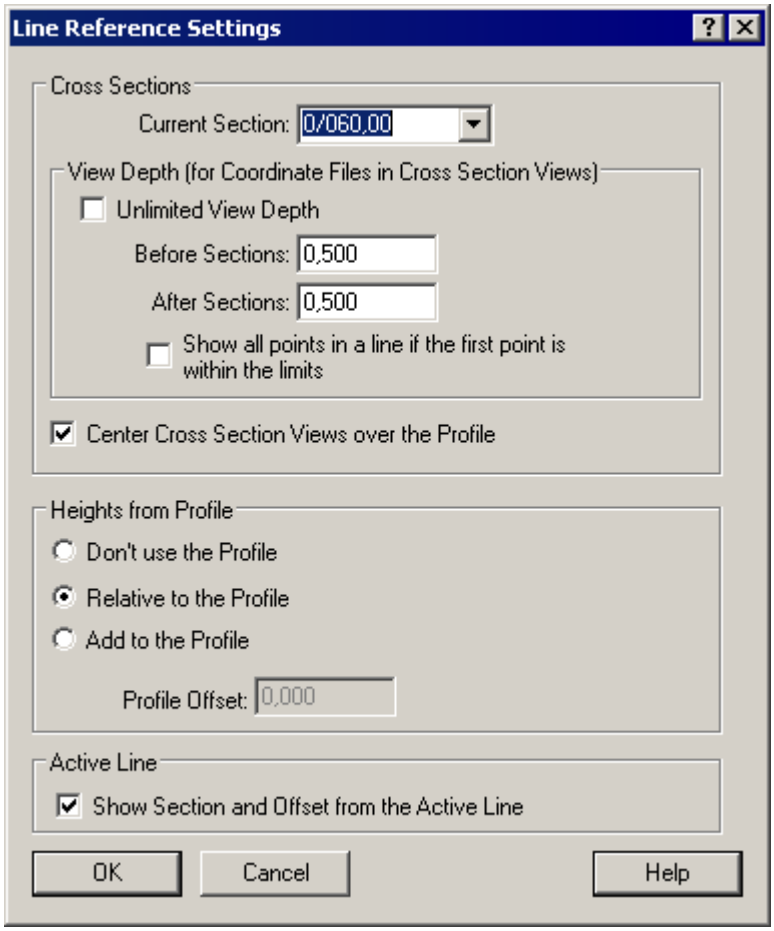
A simple way to control surveying is to open the 3D view of the file. Here you see immediately if there are points that differ from the others. Since the tunnel difference model is based on heights perpendicular to the theoretical tunnel, it is particularly important to check that there are points that are aligned at right angles out from the tunnel. Points that are lower than the theoretical tunnel may also create problems for the triangulation.



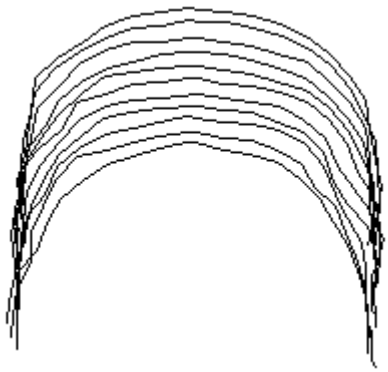
Surveyed coordinates in 3D view together with a line reference.

If you need to edit the file, the easiest way is to use the option to display the coordinate file in cross section with the help of a reference line:

- In order to open the dialog for line reference settings, click the icon just below the graphical window, see Line Reference in Graphical Views 76.
- By setting an unlimited viewing depth, you can view all sections in the file.
- If the actual heights change a lot between sections, it may be difficult to visualize the file. You can opt to reduce the heights relative to the profile / vertical geometry.



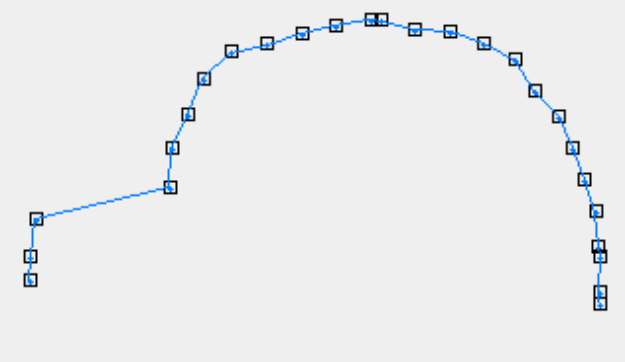
Unlimited viewing depth, heights relative to the profile



Unlimited viewing depth, real heights

In order to edit a certain section, you may only want to view the current section. In the settings dialog for the line reference, you can choose the section you want to view and the 'corridor' that is needed for all points in the section to be included. If you set 0.5 meters before and after, this means that the corridor will be about 1 meter around the section. You can also choose to view all the points included in a section if the first point lies within the interval, by checking the box **[Show all points in a line if the first point is within the limits]**.

To edit the tunnel section, you can use the usual editing tools, for example, to delete a part of a line.

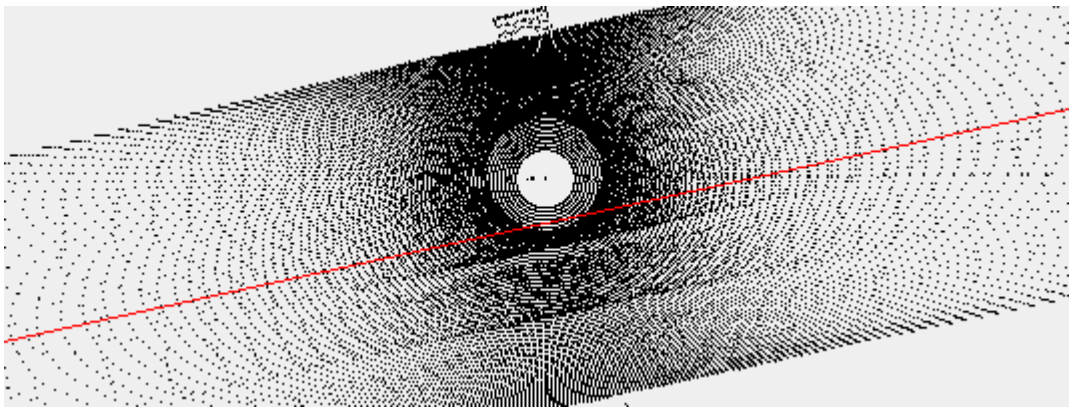


Tunnel sections marked with the selection tool

Unwanted points deleted.

Tunnel scanning

A tunnel scan normally produces a very large amount of data because the points are tightly packed. In addition, you often get unwanted objects in the tunnel.



Edit Data

To edit the scanning data, you can use the same method as previously described. All points that do not belong to the actual tunnel must be removed. If the 'floor' has also been measured, these points should normally be deleted.

Unedited tunnel data

Unwanted points deleted.

Another way of dealing with unwanted data is to filter out points using the Extract Points along Line 175 function. With this function, for example, you can choose to filter out all points that are below a certain level, either absolute height or relative to the profile.

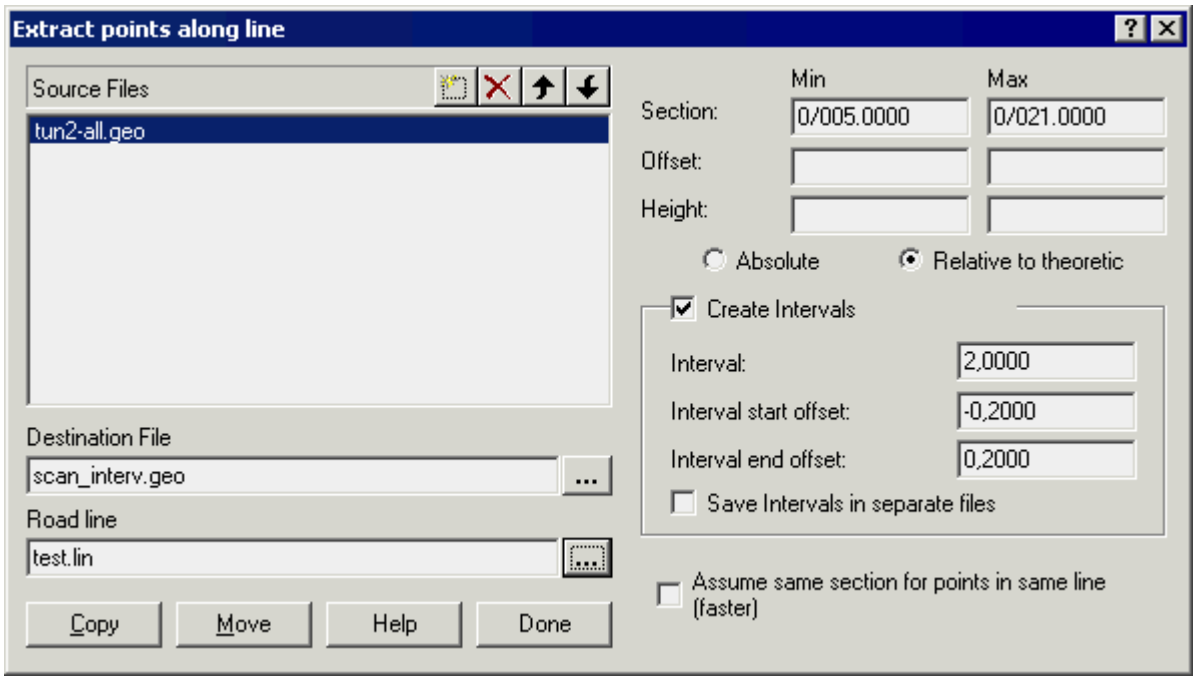
Manage large data sets
Since a tunnel scan can produce millions of points, this means that a tunnel difference model can be difficult to handle if the data set is not reduced.

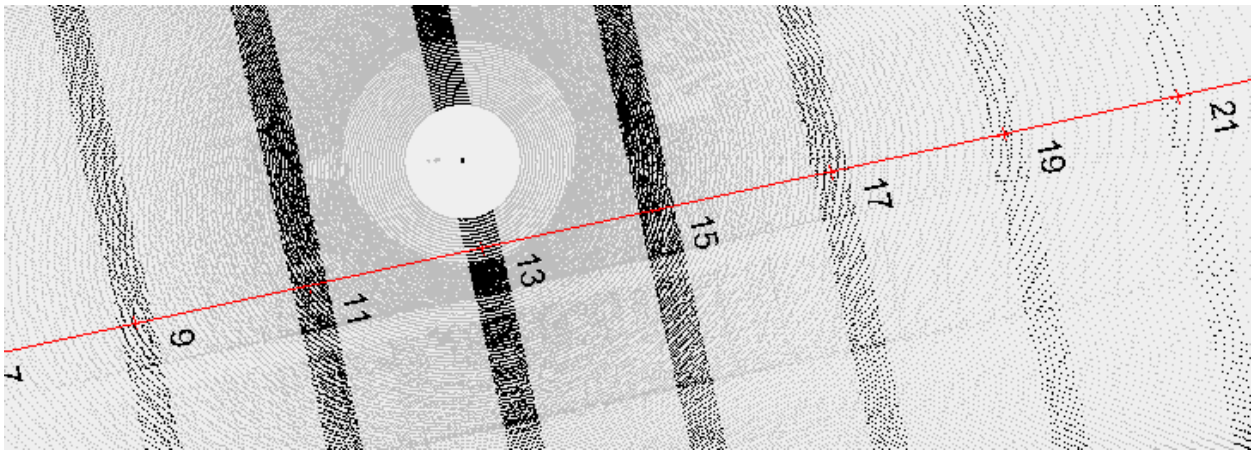
Note, you can add a point cloud directly to a tunnel description. Then you usually use some filtering functions. If you filter your point cloud, you usually don't need to reduce the data set according to the method below. See Tunnel with Point Cloud 878 .

- One way is to divide the original data set into subsets.

- You could also choose a data set that is already 'thinned out' before you load it into iCON office.

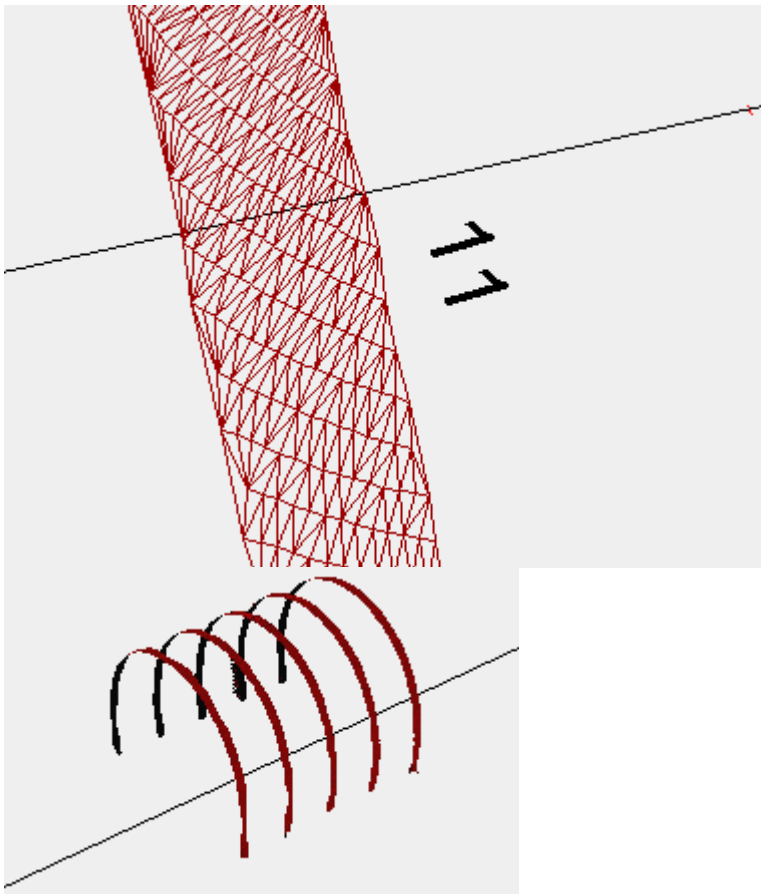
- Another option is to simply create the tunnel model around the tunnel section to be calculated. If, for example, you are to calculate sections at two meter intervals, it is probably enough to cut out the 'strips' around the desired sections from the output data. The width of the strips required will depend on how close together the points are; the closer the points the narrower the strips you can select. In order to cut out the strips, you can use the Extract Points along Line 175 function.



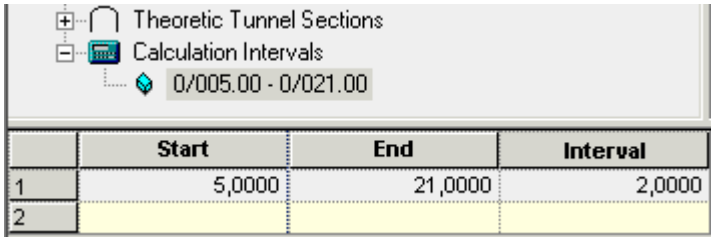


In this example, a strip of 0.4m is extracted at two-meter intervals from the line. When you then create the tunnel difference model 892 you can restrict the maximum length of the outer edge of the triangles to this

interval, the minimum point distance between the intervals will in this case be 1.6m (2 - 0.4) and you can then set a maximum length of 1.5m for example. You will then have the same strips in the tunnel model.



In the tunnel description (tbs), you then set the same calculation interval that the model has been created with, see also Tunnel Descriptions 862.



	Start	End	Interval
1	5,0000	21,0000	2,0000
2			

This method of course assumes that you do not need to calculate some sections between the strips, in which case a new model with points around the desired section is created first.

See also: Tunnel Descriptions, tbs 862

16.3 Tunnel Descriptions, tbs

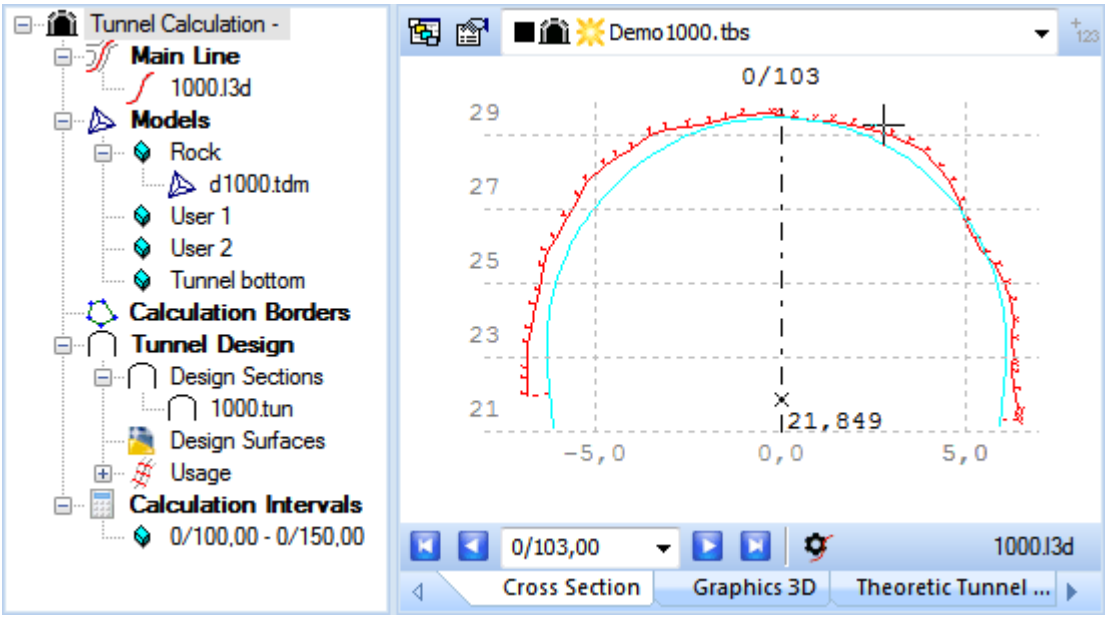
In order to perform calculations of a tunnel you use a tunnel description file, TBS. This contains all the components needed for the tunnel, such as:

- center line with horizontal and vertical geometry
- model data, that describe the tunnel using measured points
- tunnel design[851]

The tunnel description includes all relationships between the components.
In the tunnel description you specify the calculation limits, intervals and other requirements for the calculation.

The text below concerns:

Components in a tunnel description[862]
Tbs window[863]
Tbs-tree[863]
Graphical view[864]
    Graphical 3D view[866]
    Tunnel Design Section view[866]
    Tunnel Difference Model[866]
Graphical Settings Tunnel[867]



Components in a tunnel description

Line data
A line file[503] (l3d) describes the horizontal and vertical position of the tunnel.
You can specify a height offset to regulate the line's height position.
For more information, see Create New Tunnel Description, tbs[869] .

Models

A model in a tunnel description is created by measured points.
You can use either a tunnel difference model or a point cloud as a model in a tunnel description, tbs:

- Coordinate files (geo, pxy) with measuring data from a tunnel can be used to calculate a tunnel difference model, tdm[887].
- A point cloud, gpc, can be added directly into the tunnel description.

For more information, see Create new Tunnel Description, tbs[870]

Calculation Borders
A calculation border polygon limiting the calculation borders can be added to remove information in cross sections that is not of any interest. Points outside the limiting polygon will not be included in the tunnel calculation.
Note, calculation borders in the shape of a polygon has higher priority than any min and max values that might have been used when the tunnel difference model was calculated.
For more information, see Create New Tunnel Description, tbs[871]

Tunnel Design
Tunnel design sections, tun, and / or design mesh in AutoCAD® format dwg or dxf can be used in the same tunnel description file, to describe the surface of the designed tunnel.

- Design Sections
  One or several design section files[852] (tun) describe the shape of the designed tunnel along the road.
- Design Surfaces
  Design mesh in the AutoCAD® format dwg or dxf describe the surface of the tunnel design.
- Usage
  Specify stations for each used design section and / or design mesh.

For more information, see Create new Tunnel Description, tbs[872].

Calculation Intervals
Specify intervals for calculated stations in the tunnel calculation.
For more information, see Create new Tunnel Description, tbs[873].

TBS window

Views
The screen is divided into a number of views when editing a volume calculation:

- TBS Tree View
  To get an overview of these components, there is a tree structure for help when entering and editing. Here you can see all components and relationships that are in the tunnel description.
- Graphical View
  The graphical view is divided into tabs that show plane, profile or cross section data, 3D graphics, tunnel design section and tunnel difference model.
- Data View
  In the tree view and graphical view you can see the data view that displays a numeric representation of selected objects in the tree view.
- Properties Dialog
  You can edit a range of settings in the properties dialog[106].

TBS Tree
To get an overview of the tunnel description, there is a tree view.

- Here you can see all components and relationships that are in the tunnel description.
- The entire mass calculation is administered via the tree, and provides support for composing the tunnel description.

- By clicking the tree you enable input and editing of the details in the description.
- You can also choose what is displayed in the graphical window.

Navigation in the tree

- Left clicking on the + sign expands a node in the tree.
- Left clicking on the - sign reduces a node in the tree.
- Left clicking a component, a section element or calculation interval etc opens and activates the data view for the corresponding components for input and editing.
- Right clicking the tree gives the option of choosing ***Properties...*** and what is to be displayed in the view: plane data, cross section data or profile data.
- Right clicking the main line or models allows you to view and edit properties for each component.

See also Tree Views 104 .

Graphical View

By clicking in the graphical view, you gain access to the graphical tools and can edit the data in the same way as in a standard graphical view. See also Graphical Views 47 .

All files included in the tunnel calculation (and that can be displayed graphically) are automatically entered in the graphical view when a tbs file is opened. This allows you to switch active documents as in other graphical views and edit data.

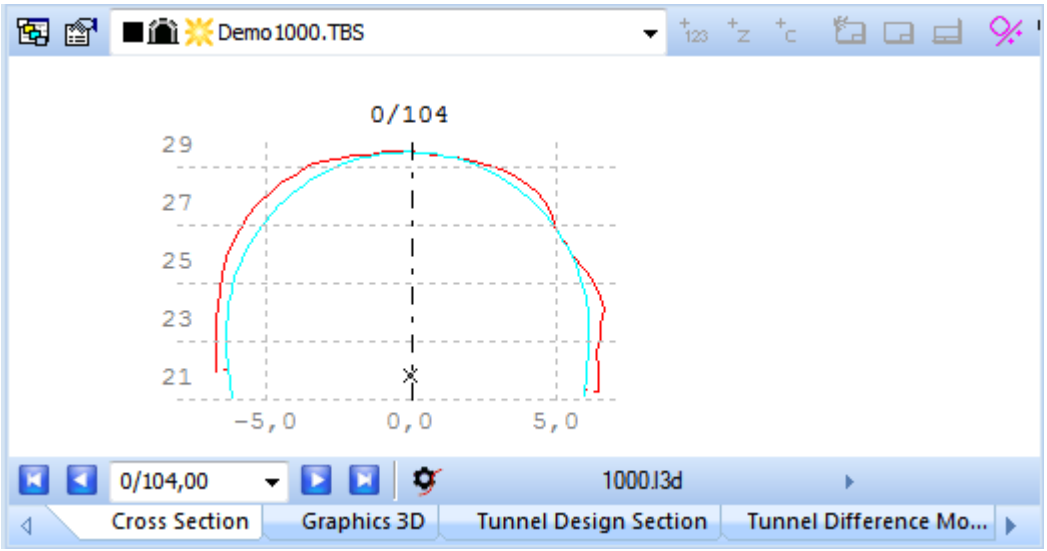
Orientations

There are three orientation modes that are selected by right-clicking in the tree and selecting the desired orientation mode from the menu. You can also select ***Views | View Orientation***.

- Plane View
  Displays a plane image of the tunnel calculation.
- Profile View
  Displays a profile view of the tunnel calculation.
- Cross Section View
  Displays a cross section view for the current length section. The section that is current is determined either by
  - using the buttons to scroll, ,
  - entering the station in the box ,
  - clicking in the tree at the start of a calculation interval or the start of a tunnel section interval.

Cross Section Stepping

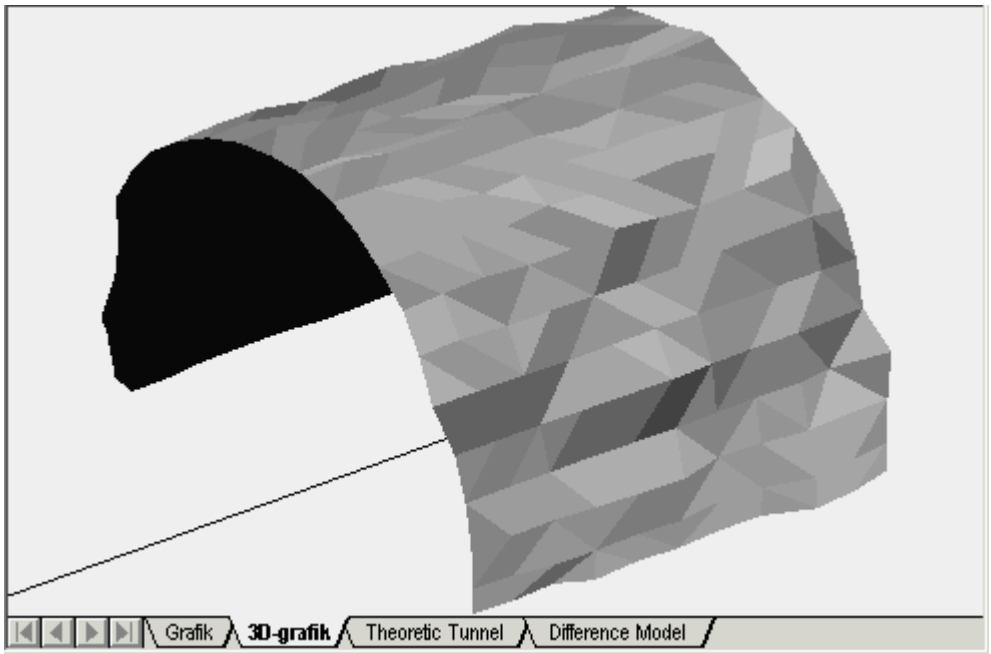
If you select the cross section view and the tunnel description (tbs) document is active, you can step through the tunnel description without the previous calculation. The selected calculation interval 863 is used to choose the station forward or backward step by step. A tunnel calculation is carried out for the selected station, each time changing station to display exactly how the outcome will be when you calculate the volume. Volumes and areas are shown in the input/output window 107 .



Use the buttons to step to first, previous, next or last cross station in the calculation interval. Enter a station and click **[Enter]** to go to a specific station.

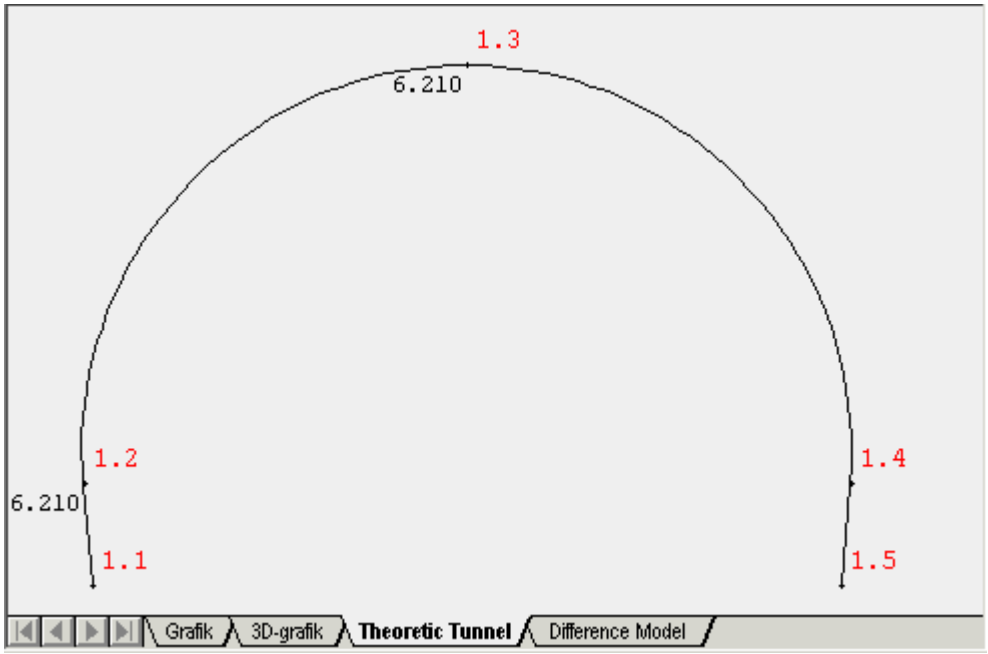
Graphical 3D View

In a separate tab in the graphical part of the tbs window, 3D graphics are always available. The entire volume calculation is presented here in a three dimensional perspective view. See also 3D Graphics 80.



Tunnel Design Section View

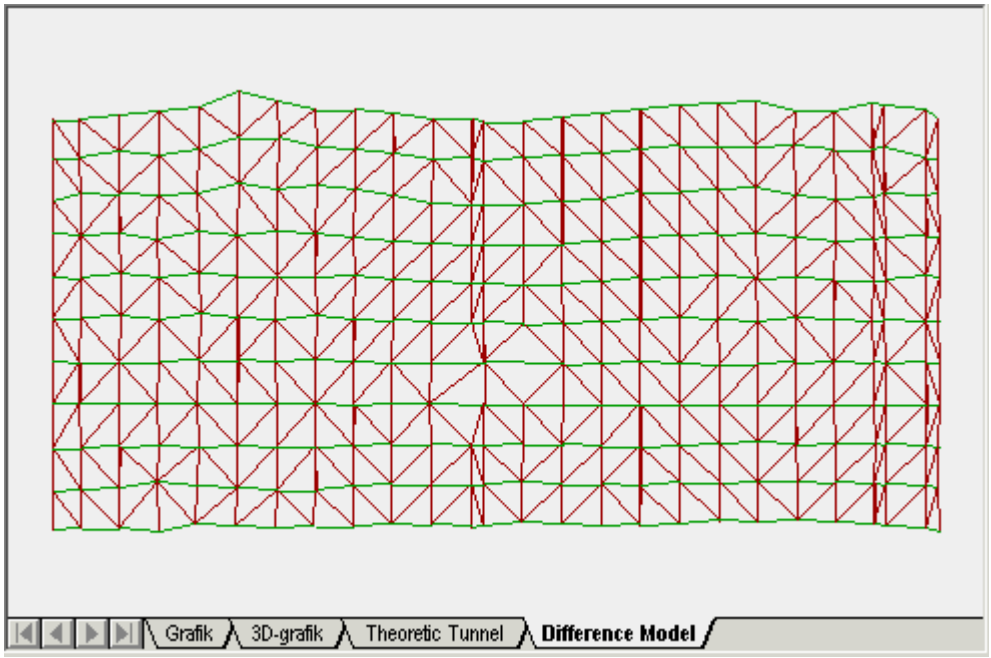
All tunnel design sections that have been entered in the tunnel description document are displayed graphically in this view.



Remember that the tunnel difference model 887 is created based on the theoretical structure of the tunnel. If you change anything in the tun file 852 you must recreate the tunnel difference model.

Tunnel Difference Model View

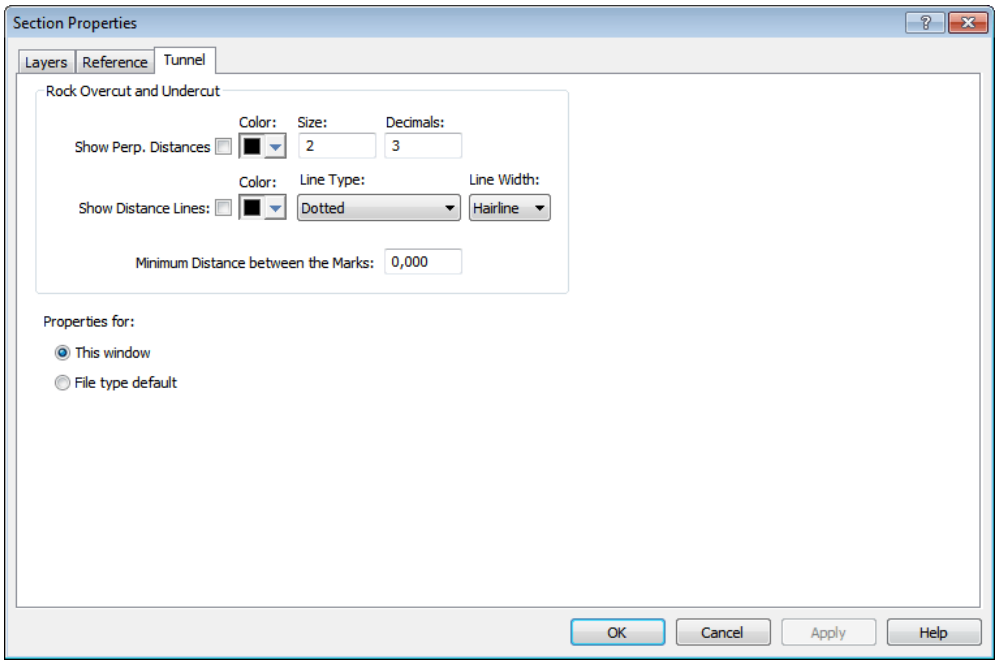
This view shows the tunnel difference models for the tunnel. The orientation mode is a plane view with length section vertically and dimensions along the tunnel wall horizontally in the window.



See Tunnel Difference Models, tdm887, for information how to create a tunnel difference model.

Graphical Tunnel Properties

By selecting document properties, ***View | Document Properties***, for either a tbs document or a calculated cross section file (sec) you can set various graphical parameters in the 'Tunnel' tab.



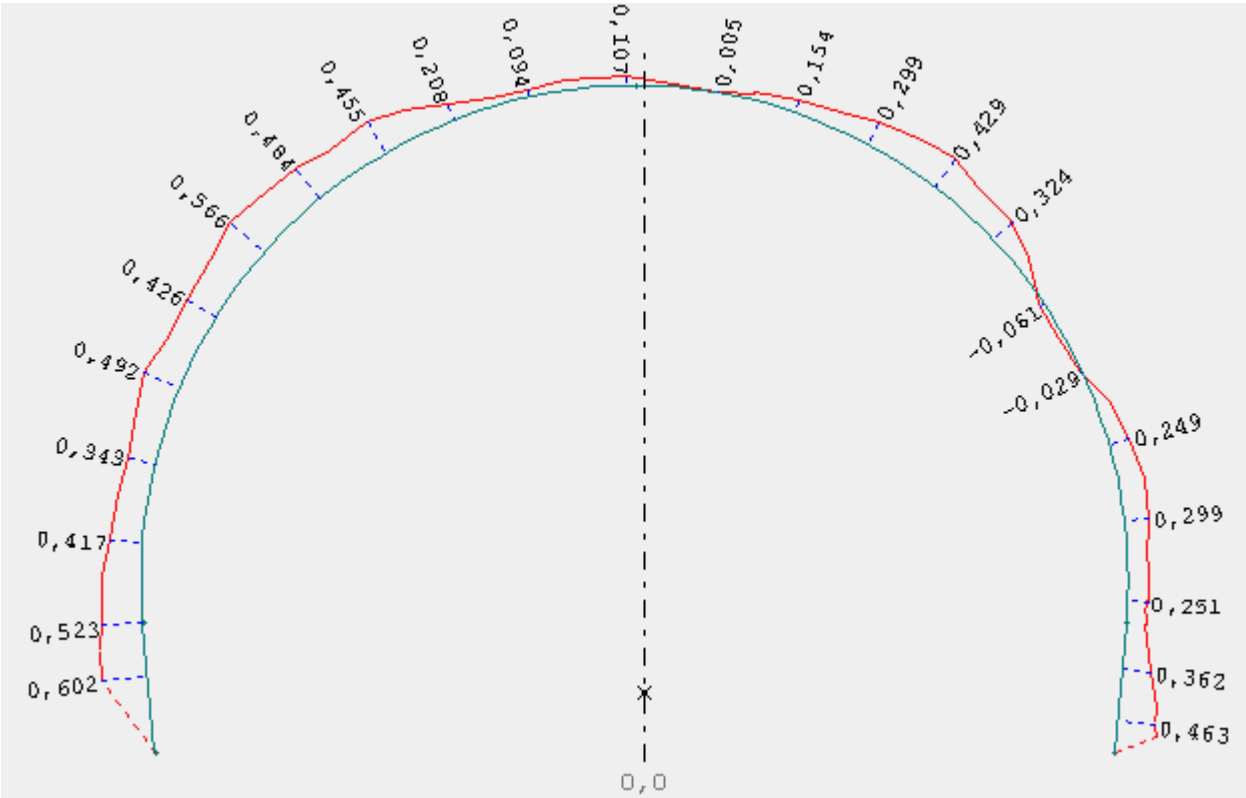
Rock overcut and undercut

Show perpendicular distances

Here you can choose to display the perpendicular distance between the rock and the tunnel design. The overcut will be marked outside the rock contour and the undercut inside. Also select font size, color and number of decimals.

Show distance lines
Here you can select to clarify the selection by drawing a line between the selected point and the tunnel. Also select the line color, line type and line width.

Minimum distance between marks
This option determines the minimum distance between two marks, so that the spacing between the texts is not too close. The dimension is calculated along the rock contour.



Other tunnel functions:

Calculation of Theoretical Tunnel Area[901].

Create Tunnel Model[892]

Points Relative to the Tunnel[903]

Calculate Tunnel Contours[906]

Tunnel Grouting[907]

See also Tunnel Difference Models[887].

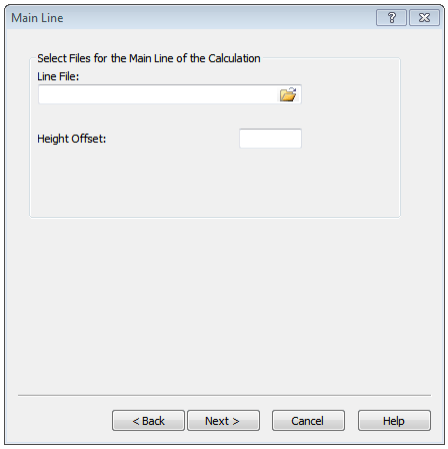
16.3.1 Create New Tunnel Description, tbs

Create new tunnel description

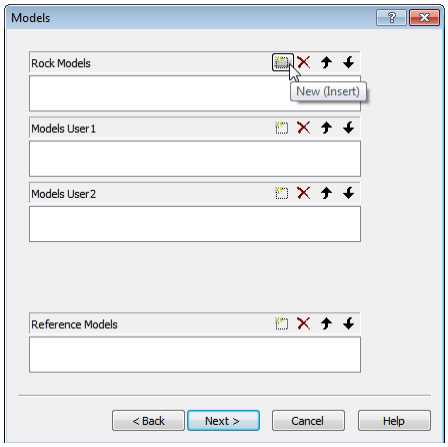
Select ***File | New | Tunnels | Tunnel Calculation (Tbs)*** to create a new tunnel description, tbs, document.
In the dialog select:

- Line File
- Tunnel Difference Models (if they are already calculated, otherwise you can create them later) or Point Cloud.
- Tunnel Design Sections and / or Design Mesh.

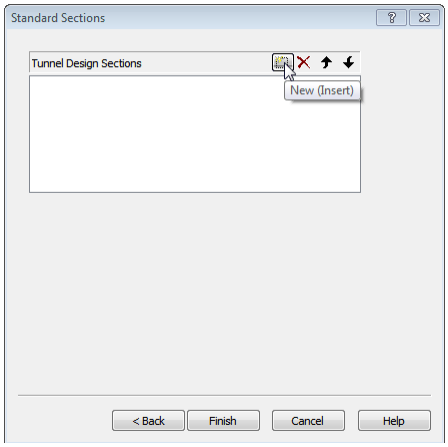
All these components can also be selected in the tbs document later.



Select a main line.



Possible to select a point cloud file or one or several tunnel difference models.



Possible to select one or several tunnel design sections.

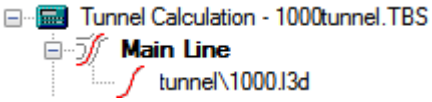
When you have created a tunnel description file, it will be opened in iCON office.

In the tree view of the tunnel description 863 you will see all components in the tunnel description. Click the tree to edit components, see also below.

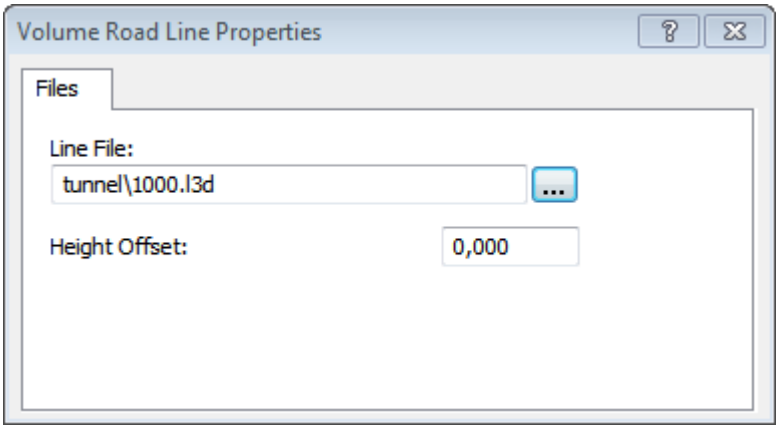
Select main line

In the tunnel description tree view, clicking the + sign or double-clicking the **Main Line** expands the main line to show the file name for the line.

Note, the line's horizontal and vertical geometries are used in a tunnel description, but cross fall models 536 are **not** used.



Right-clicking the Main line and selecting ***Properties...*** displays the properties dialog. Here you can enter the name of the center line or click the Select button ... to the right and select from the available files.



By right-clicking on the line in the tree, you can decide whether the line is to be visible in the graphical window or not.

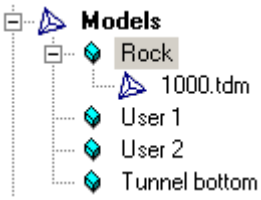
Models

You specify the tunnel difference models or point cloud to use for the calculation under this heading.

Note, a tunnel description can include

- one or several tunnel difference models, tdm
- a point cloud, gpc

The various beds for the models are located under the heading 'Models' in the tree. You can select several models for each bed which is why you do not need to aggregate the model data for a project into a single model file, but instead you can specify all the files along the project, with the specification for the length interval to use for each model.



In the tunnel bottom, you can specify a standard terrain model (trm), to visualize the contour of the floor in the tunnel. This model does not affect the volume calculation.

Edit tunnel difference model files
Click in the tree view on the bed (Rock, User1, User2, Tunnel Bottom) to be edited to open the correct input view.

	Model	Alternative Height	Start Station	End Station
1	tunnel\1000.tdm			
2				

- Model
  - Enter the model to use for this layer.
  - For the beds rock, user 1 and user 2 you use tunnel difference model (tdm) or point cloud.
  - For the tunnel bottom you use terrain models (trm).
  - Instead of models you can also use cross section files (sec files), in this case the calculation interval must match the interval in the cross section file, see also Handling Tunnel Data 860.
- Alternative Height
  Specifying an alternative height in this column temporarily changes the position of the layer in relation to the tunnel wall. A positive (+) value indicates that the bed moves out from the wall and a negative (-) value in to the wall. The purpose of this function is to simulate alternative positions for the bed.
- Start Station
  Here you enter the start station for the model. If nothing is specified, the calculation uses the first model it encounters, i.e. the model at the lowest station. The start station for the model that comes after the first model can be specified with the same station as the first model's end station.
- End Station
  Here you enter the end station for the terrain model. If you do not specify an end station, the volume is calculated until the end of the model.

Calculation Borders

A calculation border polygon limiting the calculation borders can be added to remove information in cross sections that is not of any interest. Points outside the limiting polygon will not be included in the tunnel calculation. Only points inside the polygon will be used in the tunnel calculation.

Note:

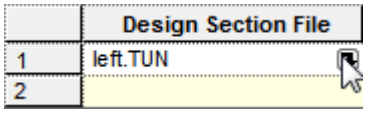
- A calculation border polygon has higher priority than any max left / right values that can be added under Usage 872, Tunnel Design Surface, regarding Design Mesh.
- Calculation border polygon, as well as calculation limits regarding left / right max values see Usage 872, only affect the calculation when design mesh is used, tunnel design section files, tun, are not affected by the borders.

Tunnel Design Sections and Design Mesh

Tunnel design sections in the shape of tun files 852 and tunnel design surfaces 855 in the shape of AutoCAD® files can be used in the tunnel calculation.

- Design Sections
  Specify the tunnel design sections that should be used in the calculation.
  For more information see Design Section 872 below.
- Design Surfaces
  Specify design mesh, that is surfaces that describe the three dimensional surface of the tunnel.
  A design mesh is usually an AutoCAD® file, either as a dwg or dxf file.
  For more information see Design Surfaces 872 below.
- Usage
  Specify stations along the main line for all included design sections and design surfaces. You also need to specify if interpolation between sections should be performed.
  For more information see Usage 872 below.

Design sections
Under the heading 'design sections' all design section files included in the tunnel calculation should be listed. In the data view, you can display a list with names of all tunnel design sections.
To add a design section to the tunnel calculation, write the file name or click the arrow on the far right in the file name field.



The design sections that have been added to the list are also displayed in the tree structure.

Inputting / Editing
When you point to a design section in the tree view this brings up the file in the numerical window, the data view. You can also see this file graphically in the 'tunnel design section' tab, in the graphical view.

See also Tunnel Design Sections, tun 852 .

Design Surfaces
Under the heading 'Design Surfaces' you add surfaces, design meshes, either dwg- or dxf files, that describe the three dimensional shape of the tunnel.

Se also Tunnel Design Surfaces, Design Mesh 855 .

Usage
Here you determine where along the main line the various design sections and design surfaces are to be used and if interpolation is to take place between them.

	Tunnel Design Section	Start Station	Interpolation	Max Left	Max Right	Source Layers
1	jeriko_portal.tun	0/100,000	No			
2	jeriko_design.dwg	0/125,000	No	-5,500	5,000	THEOSURFACE
3	1000.tun	0/150,000	No			
4						

- Tunnel Design Section
  - Select design section file or design surface file by clicking the arrow to the right in the field.
  - The files specified must be listed under either of the headings *Design Sections* or *Design Surface*.
  - The file type for tunnel design sections is tun. The file type for design surfaces, design mesh, is dwg or dxf.

- Start Station
  Specify start station for each tunnel design section and/or design surface. The specified tunnel design applies up to the definition of the next tunnel design if no interpolation is specified. Enter the start station for the tunnel design where a change occurs. The change may be the replacement of the tunnel design section, or that an interpolation is to start or stop.

- Interpolation
  If interpolation is specified, the tunnel design section will be interpolated elements by element to the next specified design section.
  Note that there must be exactly the same number of elements in the two design sections for which interpolation occurs in order for the interpolation to work properly.

Calculation Interval

Here you specify the start and end point and the interval for the calculation. This means that you can calculate a part of the tunnel description you have created without changing the description in general. You can also choose different intervals for different parts of the calculation, without any regard to the location of the different tunnel sections.

	Start	End	Interval
1	370,000	450,000	10,000
2			

- Start
  Enter the first station to be calculated. The calculation will be performed using the interval that is on the line up to the end station of the line or to the start station on the next line.

- End
  Enter the last station to be calculated. If you specify several lines for the calculation, you can leave this blank, whereby the change of interval occurs at the start station specified on the next line. You can create breaks in the calculation by entering an end station, and on the next line entering a start station which is located further in in the tunnel calculation.

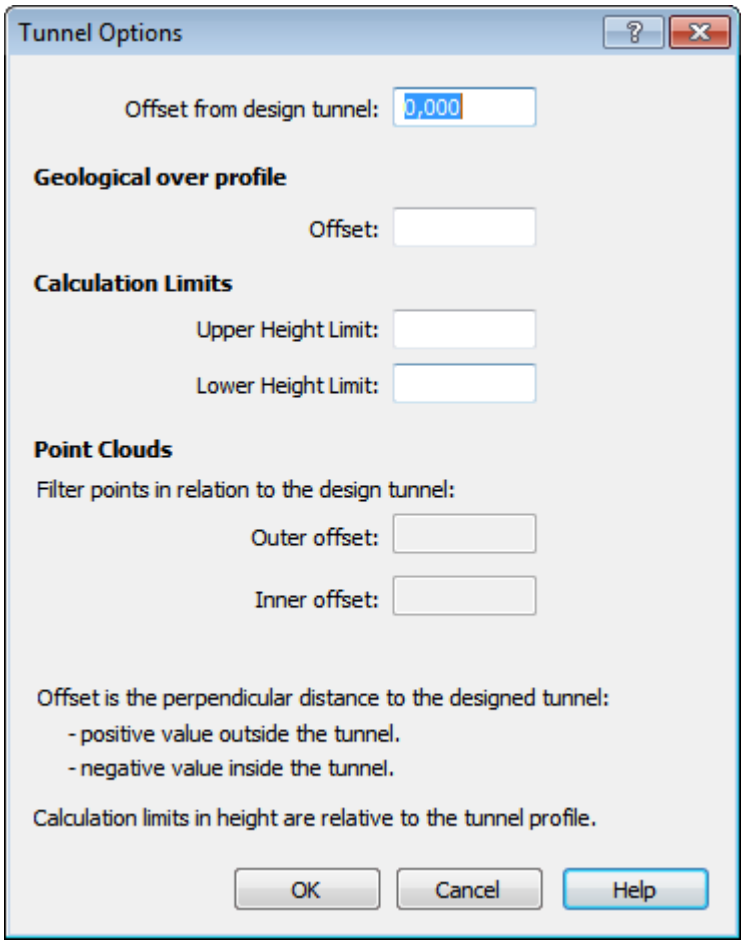
- Interval
  Enter the interval for the part of the calculation that lies between the start and end stations on the same line, or if no end station is indicated, the start station on the upper line and the start station on the next line.

Tunnel Options, Geological over profile etc

When the tunnel description, tbs, is active select ***Data*** **|** ***Options*** to open a dialog where:

- you can make a number of choices for the tunnel volume calculation.
- you can also use this function to display a graphical reference level in the

tunnel sections.



Offset from design tunnel
Enter a dimension to move the design tunnel in parallel inward or outward (negative dimensions inward in the tunnel). The volume calculation is made in relation to the moved tunnel design section.

Geological over profile
Enter an offset regarding the designed tunnel, if you want the calculated volume report to include information about "Geological over profile".
For information regarding geological over profile, see Tunnel calculation 884.

Calculation Limits in height
Here you can select to add height limits regarding calculation of tunnel volumes. Specify limit levels relative to the tunnel's vertical geometry (profile).
You can leave the fields blank if you do not want to use the limits, or enter a limit in just one of the fields.
The function can also be used to graphically display a reference level in calculated tunnel cross sections:

- Enter limit 0 to create a line displaying the height of the tunnel profile.

Point Cloud
By specifying an outer and inner offset relative to the design tunnel model, you can remove points by the use of a filter.

Tip: To filter points that are derived from eg. a pipe or a vehicle, enter an outer

and inner offset.

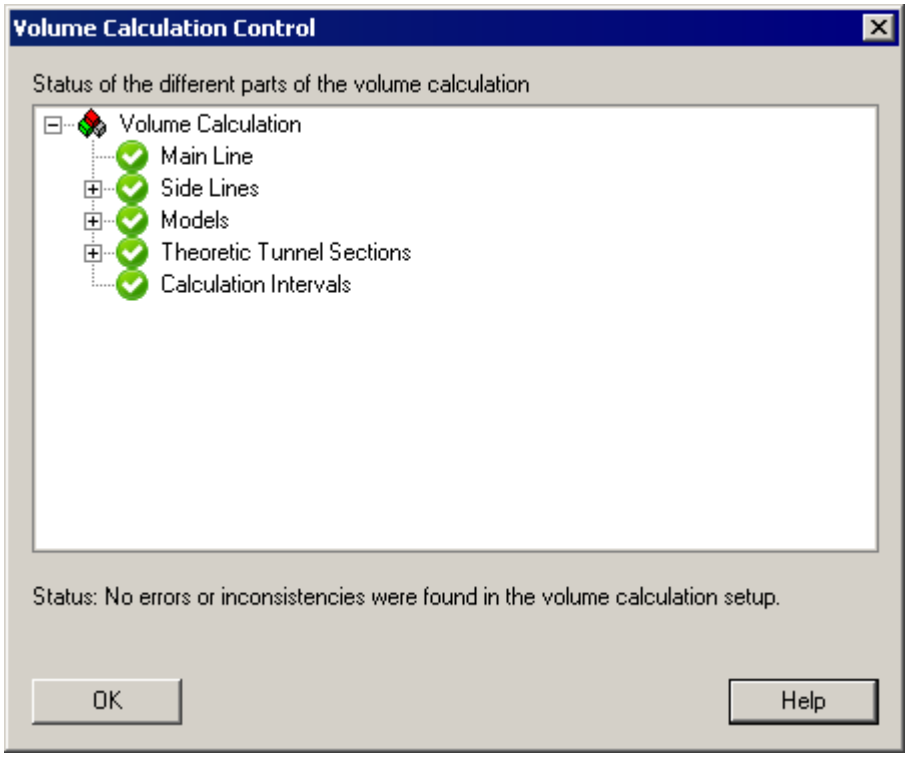
- Negative offsets remove points inside the design tunnel.
- Positive offsets remove points outside the design tunnel.
- For example; Outer offset -0.1 and Inner offset -0.6 will remove points according to the specified distance, parallel to the designed tunnel.

See also: Tunnel Descriptions, tbs 862, Check Tunnel Calculation 876

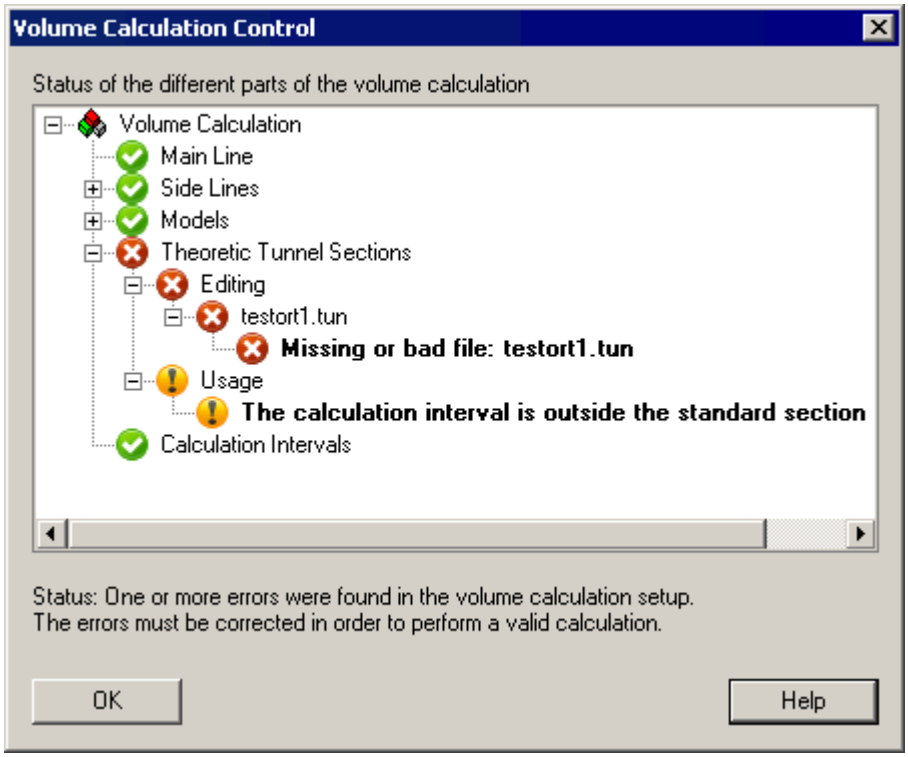
16.3.2 Check Tunnel Calculation

When you have a tunnel calculation, tbs, file active, you can check the construction of the tunnel calculation. Select ***Data | Check Tunnel Calculation***. This check adds together all the major components of the calculation, and verifies that the specified files are in place and that the settings made are operable, e.g. for theoretical tunnel sections, and the calculation interval.

Note that green checks signify that the tunnel calculation can be calculated, not that it is necessarily the correct amounts.



If there are red circles with a cross or yellow circles with exclamation points instead of green checks, this means that there are errors or warnings on the construction of the tunnel calculation. In this case there is also an explanatory text informing you what is wrong, e.g. *Invalid calculation interval*. You can then correct the error in the tunnel description.



See also: Tunnel Descriptions 862, Check Volume Calculation 755

16.4 Tunnel with Point Cloud

Tunnel Description with Point Cloud

When you have a point cloud file, gpc, describing a tunnel, you can clear the data set from unwanted data by using filter functions in the point cloud module 766, or by using the tunnel description file, tbs.

The text below describes how you can use a tunnel description with a point cloud to:

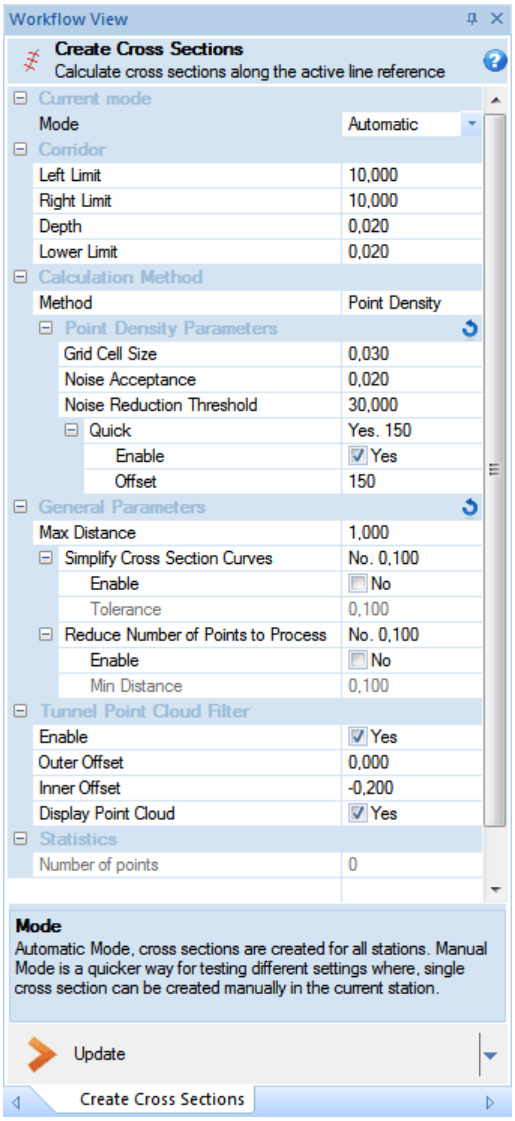
- Create cross sections, sec
- Filter the point cloud by using the tunnel design

The process to create cross sections from a point cloud in a tunnel description is very similar to Create Cross Sections 802 from a point cloud (where you only have a line and a point cloud file).

Open workflow view to create cross sections

- Open a tunnel description file that includes a point cloud.
- Select ***Data | Point Cloud Cross Sections***.
  - Note, the active tunnel description, tbs, has to include a point cloud, otherwise ***Data | Point Cloud Cross Sections*** won't be selectable.
- In the graphics, select ***View | View Orientation | Cross Section*** to visualize the cross section view.

Workflow view



Select *Data | Point Cloud Cross Sections* to open the workflow view above.

Create cross sections from tunnel description with point cloud

To create cross sections, sec, from a tunnel description with a point cloud, select ***Data | Point Cloud Cross Sections***.

- The workflow view will open.
- In the workflow view you can change settings that applies to the cross sections.
- The calculations resemble to a large extent to the corresponding calculation when cross sections are created from a point cloud 802, but this calculation is made when the point cloud is opened via a tunnel description.

Settings in the Workflow View: Current mode

When you want to create cross sections, you can select between the two modes: **Automatic** and **Manual**. Automatic is preselected.

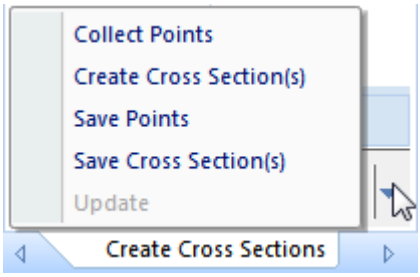
- **Automatic** is preselected.
  - In Automatic mode, cross sections for the whole calculation interval will be calculated.
  - The size of the point cloud and the calculation interval may affect the time for the calculation.
  - The calculation interval, that is start and end station and also the cross

section interval, is given by the calculation interval in the tunnel description[873].
  - If you change some of the parameters in the workflow view, the entire tunnel will be recalculated when you press **[Update]** at the bottom of the workflow view.
  - Press **[Update]**, at the bottom of the workflow view, to save the settings for the parameters. At upcoming tunnel calculation, the point cloud will be filtered according to the saved settings.

- **Manual** You can change to Manual mode, which will reduce the time of calculation.

  - Select manual mode when you want to do deeper analysis of the settings in the workflow view.
  - In manual mode, only points in the active station are selected from the point cloud and a cross section is only created in the active station.
  - The manual calculation is faster than the automatic calculation, as you only calculate a cross section of the current station, not the entire point cloud.
  - This is a quicker method to test different parameters in the workflow view.
  - In the graphical view of the tunnel calculation file, tbs, use the arrows to go to the station where you want to test different calculation parameters.
  - Select calculation method[881] . You are suggested to start with the preset default values for the various parameters.
  - Click the arrow at the bottom of the workflow view to open a drop down menu. Once you have selected Manual mode, the options in the drop down menu depend on how far you have come in the process:
    - Step 1: **Collect points**.
      - Under **Statistics**, in the lower part of the workflow view, the number of collected points will be displayed. Thus, these points will be used in the cross section calculation.
      - The collected points will be displayed in a coordinate file.
    - Step 2: **Save Points**. Click this option to save the collected points in a coordinate file. Note, you can create a cross section, see step 3, even if you haven't saved these points.
    - Step 3: **Create Cross Section(s)**. When you have collected points, you can use them to create a cross section file, sec. Note, the cross section file will only include data for the current station.
    - Step 4: **Save Cross Section(s)**. Click to save the cross section in a cross section file (sec).

  - If you are not satisfied with the result, you can switch Calculation Method and / or change parameter values. Press to reset the default parameter values.



Menu, in the work flow view, to create a cross section file.

Corridor

The corridor defines a crosscut of the point cloud where the cross section will be created.

- **Left Limit**
  Left limit defined perpendicular to the reference line. Points outside the specified distance are excluded.
- **Right Limit**
  Right limit defined perpendicular to the reference line. Points outside the specified distance are excluded.
- **Depth**
  The depth of the crosscut corridor in the point cloud. The value selected here should have a connection to how dense the point cloud is. The denser the cloud is, the smaller depth can be used. If you change this value and select **Collect Points**, the number of collected points is changed and in the graphical view it's possible to see how the corridor in the point cloud is updated.
- **Lower Limit**
  The lower limit refers to the vertical geometry of the center line. Points below the specified height offset will be excluded. If you enter 0, all points below the center line will be excluded.
  You can leave the field empty if you don't want to use any lower limit.

Calculation Method

There are two calculation methods 804 to generate cross sections from a point cloud, Point Density 881 and Triangulation 805. In the workflow view, you can select method and change related parameters. There are also a number of general parameters 882 that are valid for both calculation methods.

- **Point Density**
  This is an image analysis method where the cloud is divided into a grid of cells, like pixels in an image, and each cell has a field strength value depending on the point density in the cell and surrounding cells. The center points in the cells with highest field strength values will be a part of the cross section.
- **Triangulation**
  This is a cluster analysis method which uses a triangulation technique to connect line segments to a line.

Point Density Parameters

The following parameters can be changed if **point density** is selected to generate cross sections:

- **Grid Cell Size**
  The length of the cells that build up the grid.
- **Noise Acceptance**
  How much single outliers from surrounding cells can affect a cell's value. This parameter has no unit, but a greater value increases the contrast and noise. A lower value gives a smoother curve.
- **Noise Reduction Threshold**
  Each cell in the grid has a value depending on point density. The value defined here is in percent, and cells with a point density value lower than this percent of the grid's maximum value are removed. The percentage generates a threshold value and cells with low point density values can be removed.
- **Quick**
  A filter matrix is used to increase the speed of the process to generate cross sections. When a cell is assigned a point density value, only cells

within the filter matrix will affect the cell's value. The size of the matrix is defined by the offset value.

- **Enable**
  The faster method can be activated or deactivated.
- **Offset**
  Size of the filter matrix in number of cells. For example, if the value of 50 is specified, a 50x50 matrix is swept across the grid.

Use the icon to reset to default values.

Triangulation Parameters

The following parameters can be changed if the triangulation method is selected for generating cross sections:

- **Edge Length**
  Maximum allowed length of the triangle edges used in the triangulation, when cross sections are created. This value depends on the density of the point cloud.
- **Radius**
  This value is used when line segments will be connected to a line. The radius is used to analyze if surrounding line elements will be connected to the line. The value should not be less than the width of the corridor.

Use the icon to reset to default values.

General Parameters

The following parameters are used for both methods when cross sections are generated:

- **Max Distance**
  Maximum allowed distance between points that can be connected.
- **Simplify Cross Section Curves**
  Method for reducing the number of points that are potential candidates to be a part of the cross section. The purpose of the algorithm is; given a curve composed of line segments, find a similar curve with fewer points. The output data is reduced.
  - **Enable**
    The simplified method can be activated or deactivated.
  - **Tolerance**
    Maximum allowed lateral deviation used in the algorithm to create a smoother cross section. Points within the tolerance are ignored and will not be a part of the cross section.
- **Reduce Number of Points to Process**
  The number of points are reduced, based on a minimum allowed distance, before the process to generate cross sections starts. The input data is reduced.
  - **Enable**
    The reducing method is activated or deactivated.
  - **Min Distance**
    Minimum allowed distance between points.

Use the icon to reset to default values.

Tunnel Point Cloud Filter

Here you can select to use a point cloud filter.

- **Enable**
  Check the box **[Yes]** if you want to enable a filter to the point cloud.

- **Outer Offset**
  Specify a perpendicular offset related to the designed tunnel
  A positive value will filter points outside the tunnel.
- **Inner offset**
  Specify a perpendicular offset related to the designed tunnel
  A negative value will filter points inside the tunnel.
- **Display Point Cloud**
  Check the box **[Yes]** to display the point cloud graphically.

Statistics

Number of Points
Number of points that are collected when [**Collect Points]** has been used.

See also: Tunnel Descriptions, tbs 862 , Point Cloud 757, Create Cross Sections (from a point cloud) 802

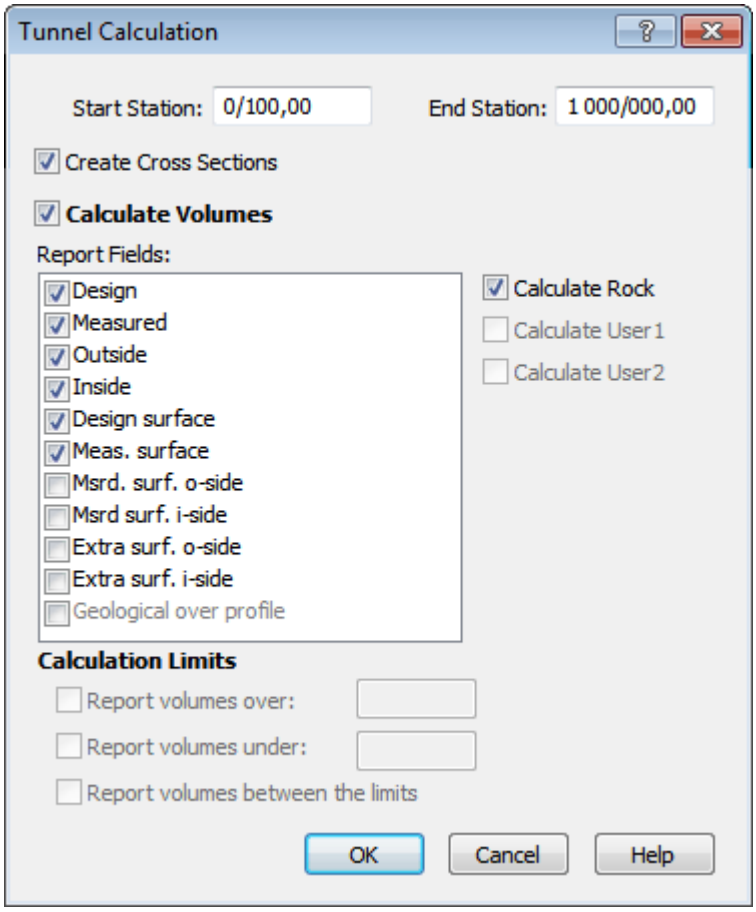
16.5 Tunnel Calculation

When you have created a tunnel description, tbs, file[862], you can use this file to calculate tunnel volumes.

- If you want the volume calculation to include volumes regarding geological overprofile, you need to give related offset. Select ***Data | Options***, for more information regarding these settings, see Create New Tunnel Description, tbs[874].

To perform a calculation of tunnel volumes, set the tunnel description file[862] active and select ***Data | Tunnel calculation...***.

A dialog shows the choices made for the calculation.
You can edit the settings in the dialog.



Start station / End station
Specified stations are taken from the calculation interval[873] in the active tunnel calculation, tbs.
You can temporarily change the scope of the calculation by selecting stations other than those proposed by iCON office.

Create Cross Sections
Check the box if cross sections are to be created (for drawing/review).
You can add these cross sections, sec, to a drawing file[257].

Calculate Volumes
Check the box if cross sections are to be created (for drawing/review) and if a report is to be generated, and if so, the content required in the report.

If you have chosen to use additional models (user1 and user2), you can also have these volumes/areas presented in the report. Check the boxes **[Calculate User 1]** and **[Calculate User 2]**.

Report fields:

- Area and volume for designed and measured tunnel section
- Area and volume outside and inside designed tunnel section
- Length and area for designed and measured surface of the tunnel
- Length and area for measured surface outside and inside designed tunnel
- Length and area for extra surface outside and inside designed tunnel
- Geological over profile. Note, to enter an offset, select ***Data | Options*** from the tbs-document, see Create New Tunnel Description, tbs 874.

Calculation Limits

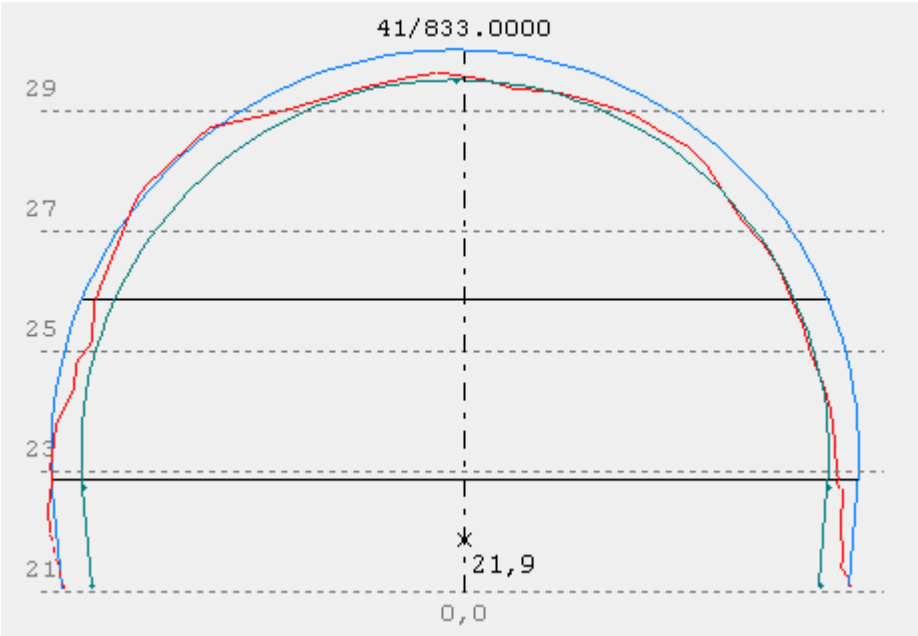
You can choose to have the calculation divided up by limit lines in height. You set these limits by selecting ***Data | Options*** from the tbs document, see Create New Tunnel Description, tbs 873.

Report Fields

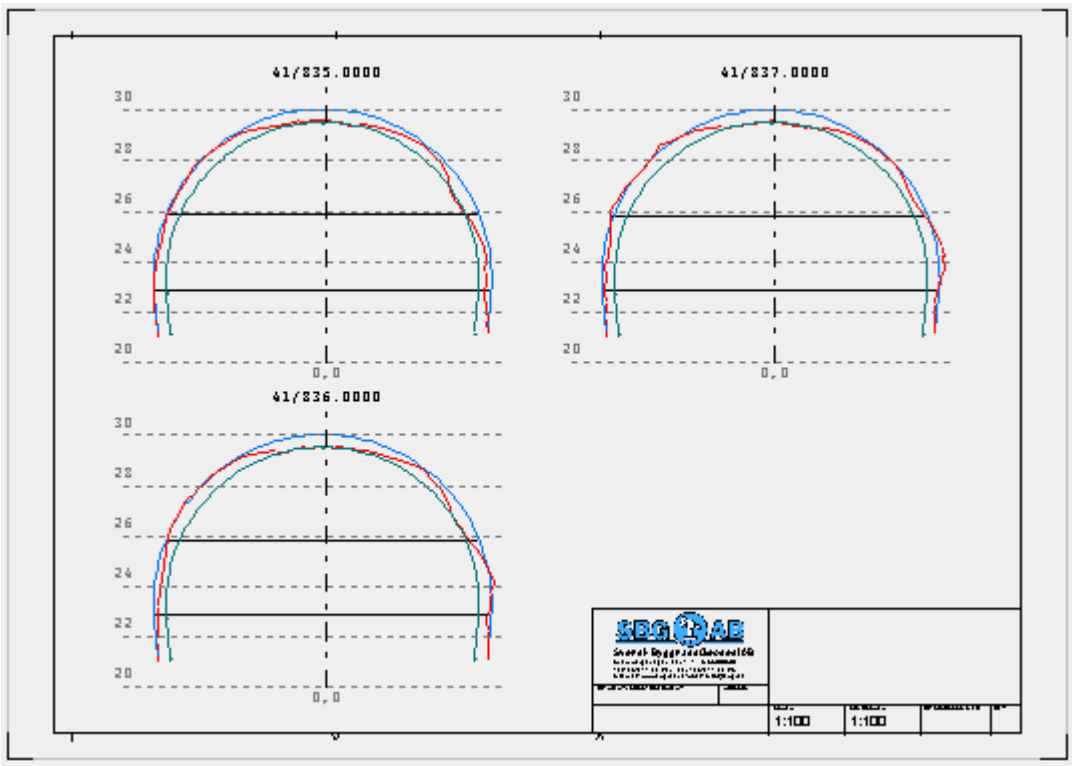
- The volume field reports the cross section area of the current bed in each station.
  In addition, the volume is calculated using the mean area between two cross sections and the distance between the stations. The volumes are summarized at the end.
- The area field shows the length from left to right for the current bed in each cross section.
  In addition, the surface area is calculated using the mean length between two cross sections and the distance between the stations. The areas are summarized at the end.

Fields	Type	Description
Design	Volume	Volume and cross section area for the tunnel design section.
Measured	Volume	Volume and cross section area for the surveyed tunnel section.
Outside	Volume	Volume and cross section area of the portion of the surveyed section that is outside the designed section.
Inside	Volume	Volume and cross section area of the portion of the surveyed section that is inside the designed section.
Design surface area	Area	Cross section length and surface area for the designed tunnel.
Measured surface area	Area	Cross section length and surface area for the surveyed tunnel.
Measured surface outside	Area	Cross section length and surface area of the portion of the surveyed section that is outside the design section.
Measured surface inside	Area	Cross section length and surface area of the portion of the surveyed section that is inside the design section.
Extra surface outside	Area	Cross section length and surface area outside the design section for the projecting part of the surveyed section compared to the design section.
Extra surface inside	Area	Cross section length and surface area inside the design section for the projecting part of the surveyed section compared to the design section.
Geological over profile	Volume	Volume regarding geological over profile.

The created cross section file (sec) and the report file (rep) are displayed when the calculation is finished.



Using the calculated tunnel cross section file, sec-file, it is easy to create a tunnel cross section drawing [257].



Tunnel Cross Section Drawing

16.6 Tunnel Difference Models

Tunnel Difference Model (tdm)

The tunnel difference model, tdm, is a terrain model that describes the differences between the measured and the designed tunnel.

- The measured tunnel can consist of points in
  - coordinate files, geo
  - point cloud, gpc
- The designed tunnel can consist of
  - tunnel design sections 852 , tun files
  - design mesh 855 , AutoCAD® files dwg or dxf

Tunnel difference models can be created from:

- a tunnel description + measured tunnel in a coordinate file -> tunnel difference model, tdm. See text below. 887
- a tunnel description + measured tunnel in a point cloud - > difference model, dfm, and also 2D and 3D colored difference models, dwg or dxf. See Create Colored Difference Model 895 .

Note

Please note, the calculation of tunnel difference models has partly been updated in iCON office 2016 and later versions. If you are about to work with a tunnel description including a tunnel difference model created in an older version than 2016, please be aware of the following:

- If the tunnel difference model is created from tunnel design section files, .tun, that include the point code TC 852 describing the tunnel center, you can use the tunnel difference model as usual.
- You have to **recalculate the tunnel difference model**, if it has been created from tunnel design section files, .tun, that do not include the point code TC, tunnel center.
- If you use iCON office 2016 or a later version, the calculations of tunnel difference models always start in the point where the center line intersects the cross section.

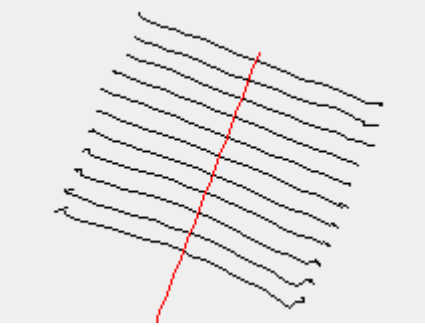
Output Data

The tunnel difference model is created from a coordinate file with surveyed points in the tunnel. You create the model by calculating the equivalent length section along the main line (N), measured along the designed tunnel (E) and difference perpendicular to the designed tunnel (H) for each surveyed point.

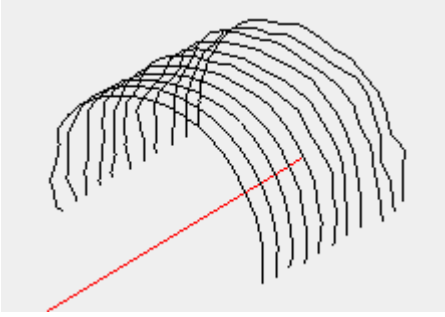
In order to calculate a tunnel difference model you create a tunnel description (tbs) 862 including links to:

- tunnel design, tunnel design sections, tun 852, or design mesh, dwg/dxf 855
- line 503 (l3d) with horizontal and vertical geometry

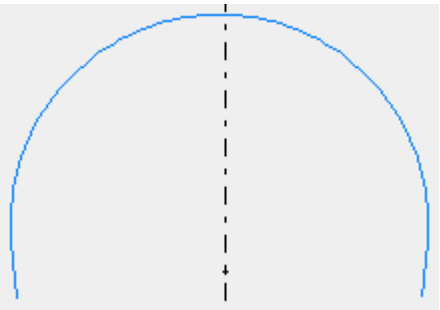
The tunnel difference model structure is therefore dependent on how the tunnel description is represented at a particular time. If you change anything, such as the tunnel design section (tun), it is very important to remember that the model no longer corresponds to the tbs file.



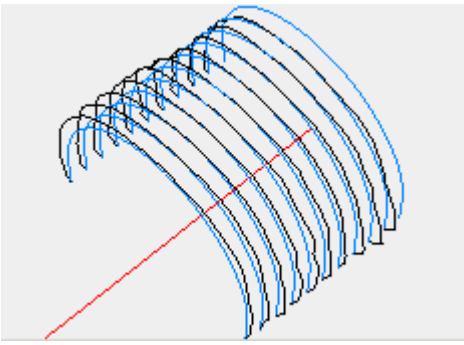
Surveyed coordinates in plane view.



Surveyed coordinates in 3D view

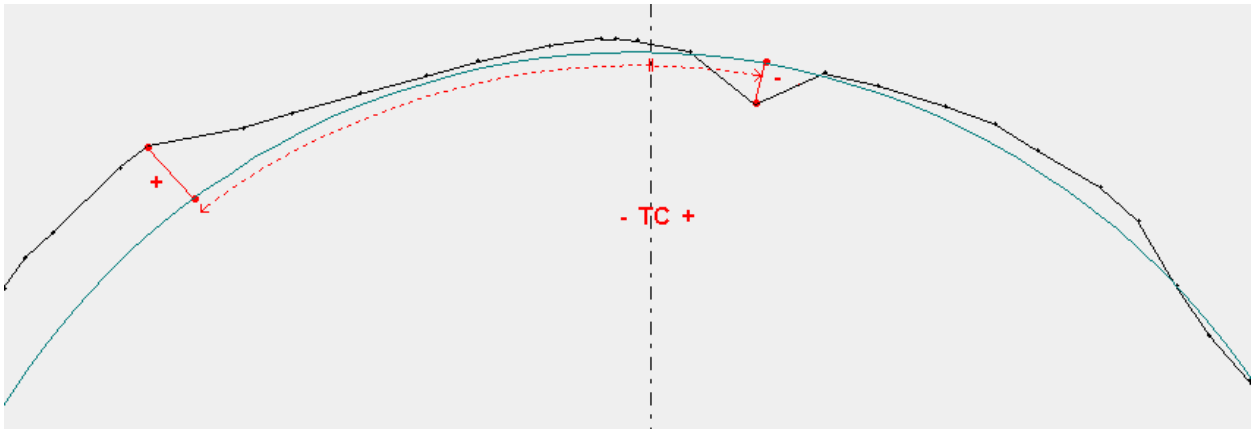


Tunnel design section, tun



Surveyed and designed tunnel

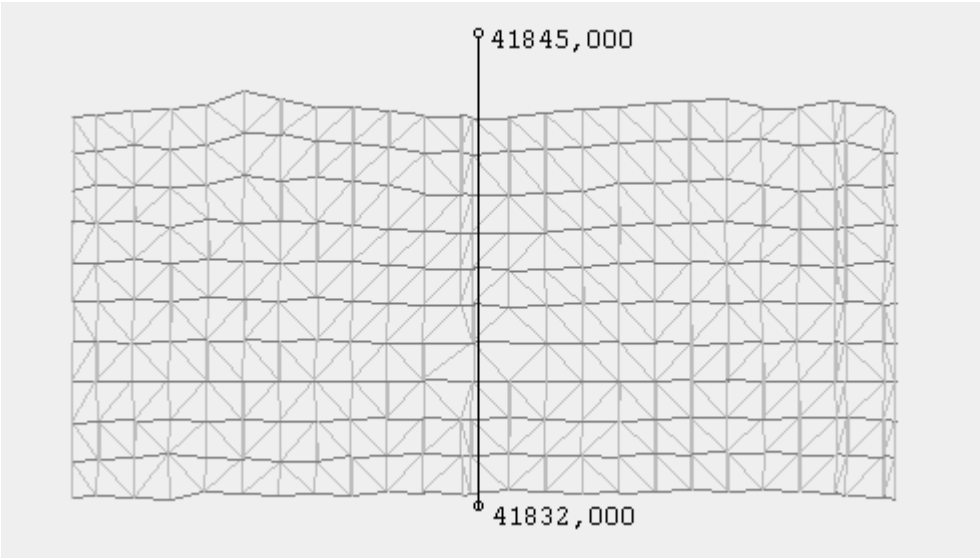
The dimension along the designed tunnel is calculated from the point in the tunnel design file, .tun, that has a zero offset, i.e. in the tunnel center. If there is no point in the tunnel design file with this offset, the length measurement will start from the first point in the tunnel design file instead. You can also determine the length measurement to another point by entering the point code TC in the tunnel design file. All points in the model that are to the left of the TC point (or zero offset, tunnel center) will have a negative offset coordinate. See also Tunnel Design Sections 852 .



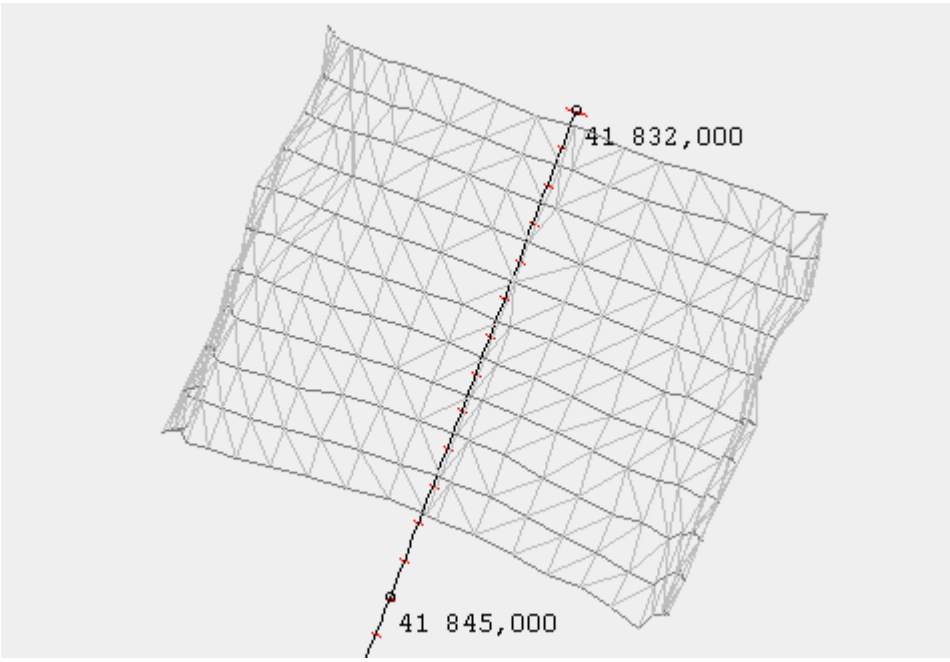
The difference perpendicular to the tunnel represents the Z value in the tunnel difference model; a negative value means that the point is inside the designed tunnel and a positive value means that the point is outside.

Graphical presentation

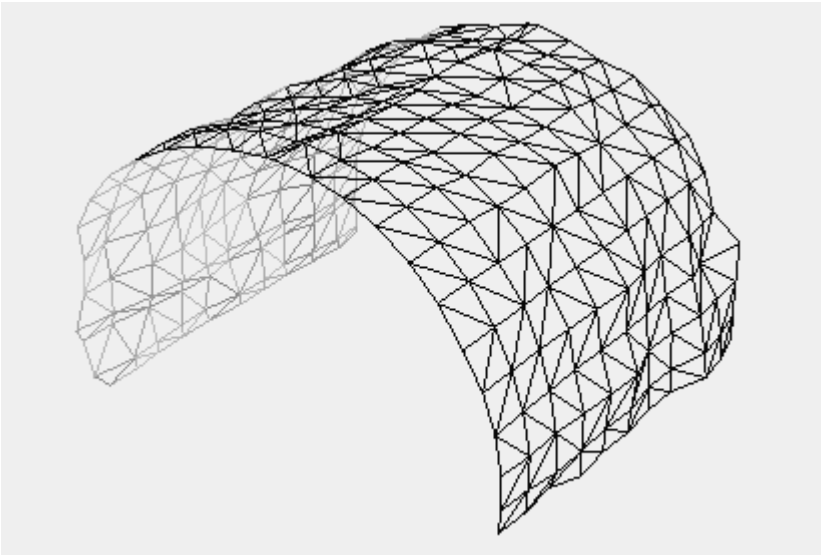
When you open a tunnel difference model, it normally appears in a 'flat' view with length stations such as vertical axis and dimensions along the design tunnel such as horizontal axis.



The tunnel difference model in a 'flat view' with length stations vertically and dimensions along the designed tunnel horizontally.



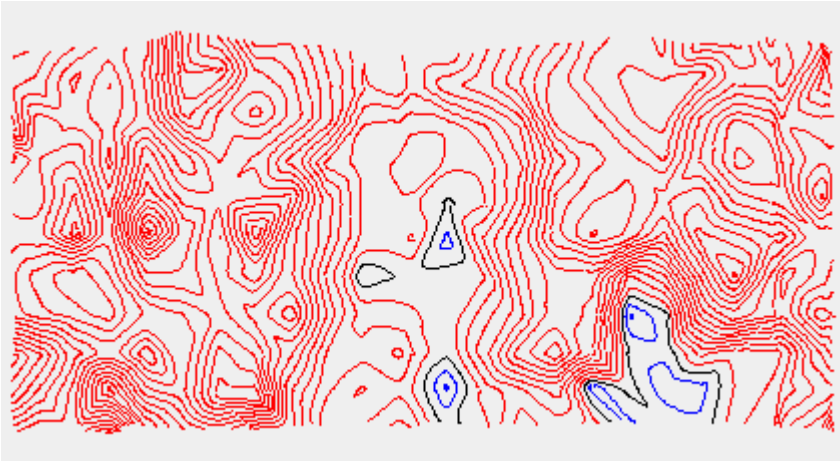
The tunnel difference model in a plane view with world coordinates.



The tunnel difference model in a three-dimensional view.

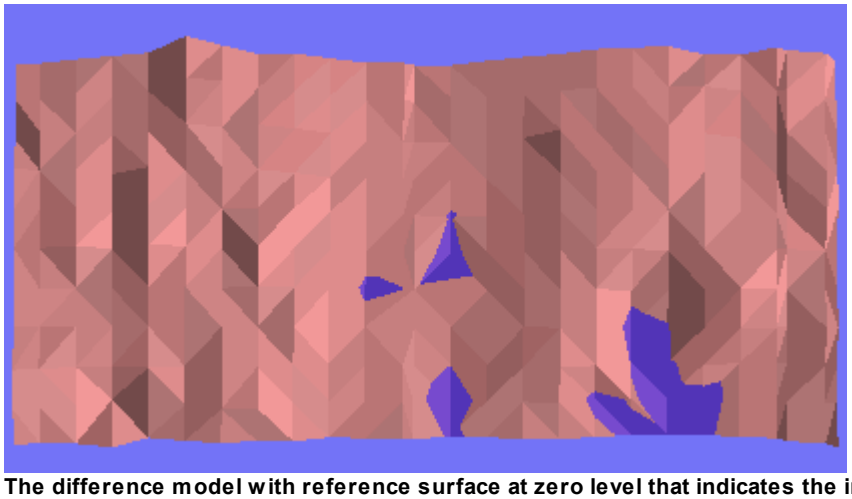
As the tunnel difference model is a triangle model, it is perfectly fine to create and display contour lines from the model. The heights in the model represent the difference in the designed tunnel and therefore the height curves are also related to the designed tunnel. This can be useful to visualize the intrusion in the tunnel following, for example, blasting.

When creating contour lines from the tunnel difference model, a window opens with the difference contour lines (.dfn file). In this view, the lines are color coded depending on if the height level is above zero (red in the figure), below (blue), or zero (black).



Difference contour lines showing the intrusion into the tunnel.
Blue contour lines display intrusion.

Another way to view the intrusion is to open the model in a 3D view and add a reference surface at the zero level. The image shows the same model in this display mode.



The difference model with reference surface at zero level that indicates the intrusion into the tunnel.

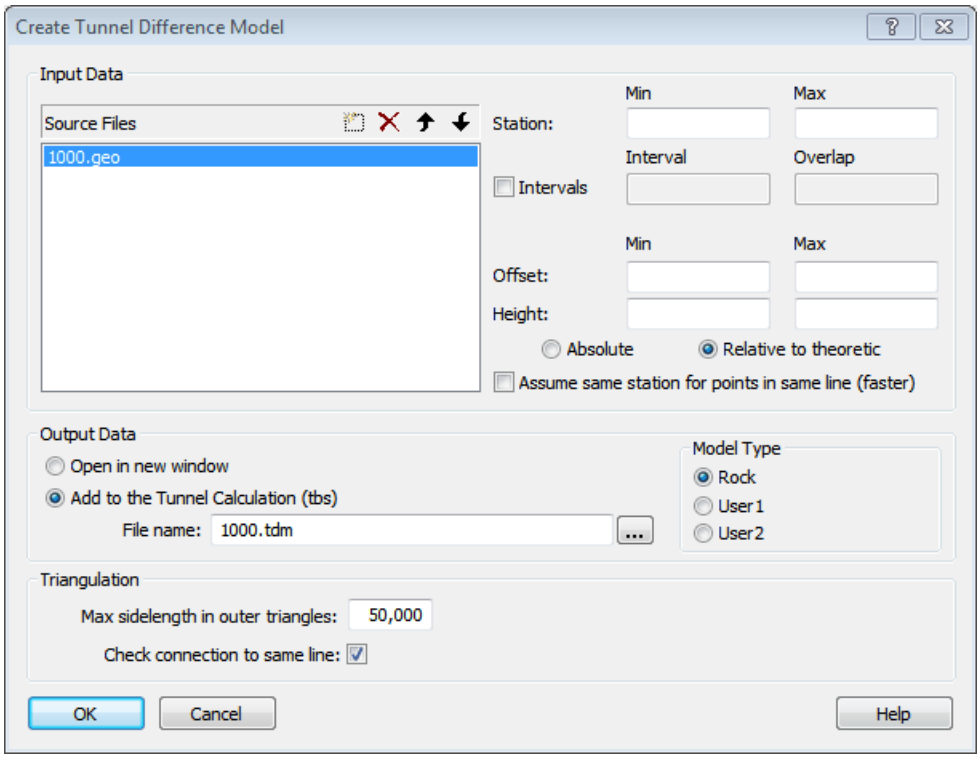
See also: Tunnel Descriptions, tbs 862

16.6.1 Create Tunnel Difference Model

The tunnel difference model, tdm, is a terrain model that describes the differences between the measured and the designed tunnel, see Tunnel Difference Models[887] . The designed tunnel can consist of:

- tunnel design sections[852] , tun files
- design mesh[855] , AutoCAD® files dwg or dxf

To create a tunnel difference model, tdm, you select ***Data | Create Tunnel Model*** from the tbs document. In the dialog you select one or more coordinate files with surveyed tunnel points. You have the option of choosing a selection[892] of points to calculate.



Input data

Source files:
Specify the files you want the function to look for points in.

Selection

Specify here the conditions as minimum and maximum dimensions for station, offset and height along the road line given in the tunnel description.

Station:
Specify the minimum and/or maximum station dimensions along the road line for the points you want to include.

Interval:
Here you can choose to split the results into several destination files, divided into different station intervals. For example, if you have given the destination file the name mark.dfm (under Output data)[893] and set the start section to 1000 and the interval to 100, the files mark_1000-1100.dfm and mark_1100-1200.dfm and so on will be created instead.

- **Interval:**
  You enter the length of each sub-interval you require here. Each sub-interval results are saved in a separate file.

- **Overlap:**
  Here you enter the amount the intervals are to overlap each other. For example, if you set the interval to 100 and the overlap to 10, the file for each interval starts 10m before and stops 10m after the actual interval limits, for instance 90-210, 190-310.

Offset:
Specify the minimum and/or maximum offset from the road line for the points you want to include. Offset is indicated as negative to the left, and positive to the right, of the road line.

Elevation:
Specify minimum and/or maximum height for the points you want to include. This may be given as the absolute or relative line.

- **Absolute:**
  The specified height limits are matched against the point's height (Z) coordinate.
- **Relative to theoretic:**
  If the specified road line has associated vertical geometry (profile), the height limits will be applied relative to the theoretical road model. For example, you can specify a minimum height of 0 to ensure you only have points above the road surface.

Assume the same station for all points in one line (quicker):
If you have measured the points in a way that connects them in lines for each station, you can select this option to speed up the extraction process. A check is now made for the min/max station of the first point of the line only, and if this meets the criterion the whole line is included without any further verification. This speeds up processing.

Output data

Specify the name of the tunnel difference model you are about to create.

Open in new window
The tunnel difference model will open in a separate window.
You can then add it to the tunnel description file, .tbs, later.

Add to tunnel calculation (tbs)
The specified tunnel difference model will be created and added to 'models' in the tunnel calculation. Specify the type of model you want to create under **[Model Type]**, Rock, User1 or User2.
See also Create New Tunnel Description, tbs 869 .

Note, if the following relates to your tunnel description, tbs, you might need to recalculate your tunnel difference model(s):
Please note, the calculation of tunnel difference models has partly been updated in iCON office 2016 and later versions. If you are about to work with a tunnel description including a tunnel difference model created in an older version than 2016, please be aware of the following:

- If the tunnel difference model is created from tunnel design section files, .tun, that include the point code TC 852 describing the tunnel center, you can use the tunnel difference model as usual.
- You have to **recalculate the tunnel difference model**, if it has been created from tunnel design section files, .tun, that do not include the point code TC, tunnel center.
- If you use iCON office 2016 or a later version, the calculations of tunnel difference models always start in the point where the center line intersects the cross section.

Triangulation

Max length in outer triangles
You can use this function to create a terrain model from the data that describes an area where the outer

edges curve inwards. Triangles that have a side longer than the specified value and where one side constitutes the outer edge of the terrain model will be removed. This process is repeated until the model's outer edge is made up exclusively of triangles with all three sides shorter than the specified value. By selecting an appropriate value, most triangles that cross the inward bends, and therefore lie outside the actual model area, will be removed when calculating.
You can remove any unwanted triangles remaining in the terrain model manually using the Editing Tools[653].
If no value is entered, the terrain model is left untouched.

Check connection of each line
If you select this function when creating the terrain model, the triangles, where all three points have the same break line[650] and where a side constitutes the outer edge of the terrain model, will be removed.
You use this function when the data contains break lines[650] that represent the outer limit lines of the desired model area. Triangles outside these lines are removed.

See also: Tunnel Descriptions, tbs[862], Tunnel Difference Model, tdm[887]

16.6.2 Create Colored Difference Model

Visualize height differences in Auto CAD® file format

With a tunnel description file, tbs, and a point cloud, you can graphically display height differences between designed and scanned tunnel, by creating 2D and 3D Colored Difference Models, in AutoCAD® DWG file format.

Use a point cloud to create colored difference models in 2D and 3D

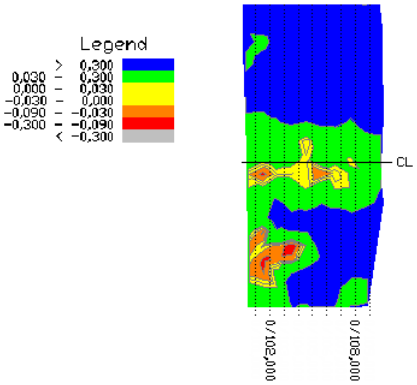
A tunnel description with a point cloud can give you:

- a coordinate file with points describing height differences between designed and as built tunnel.
- a tunnel difference model, dfm.
- a 2D colored difference model, which displays the tunnel as it has been folded out, thus a flat tunnel. Different colors represent different height levels. File format, AutoCAD DWG.
- a 3D colored difference model, displaying undercut and overbreak areas in the tunnel. File format, AutoCAD DWG.

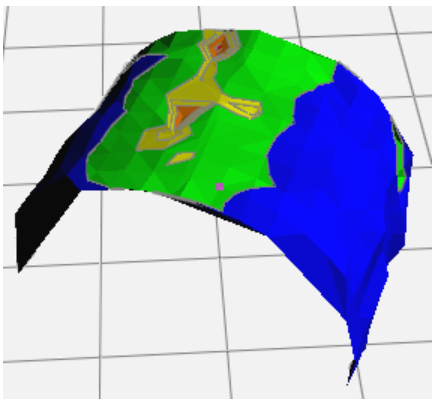
Compare the as-built survey to the tunnel design

To create files that describe height differences:

- Open a tunnel description file, tbs, including a point cloud.
- Select ***Data | Compare Survey to Design***.
  - Please note, the active tunnel description, tbs, has to include a point cloud, otherwise ***Data | Compare Survey to Design*** won't be selectable.
- The workflow view will open.
- In the workflow view, you can change settings that applies to the calculation.

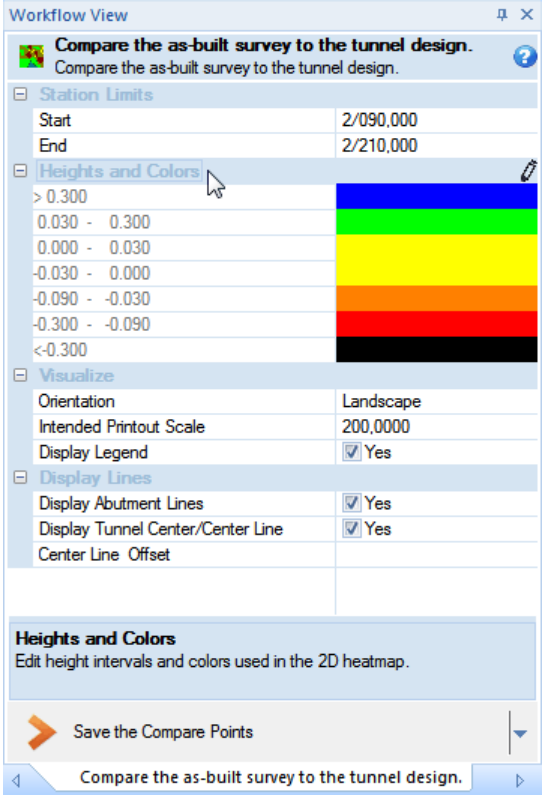


Tunnel, colored by level.
2D colored difference model.



3D colored difference model.

Workflow View



The appearence of the workflow view.

Settings in the Workflow View

In the workflow view you can set settings regarding:

- Station Limits 896
- Heights and Colors 896
- Visualization 898
- Display Lines 898

Workflow View: Station Limits

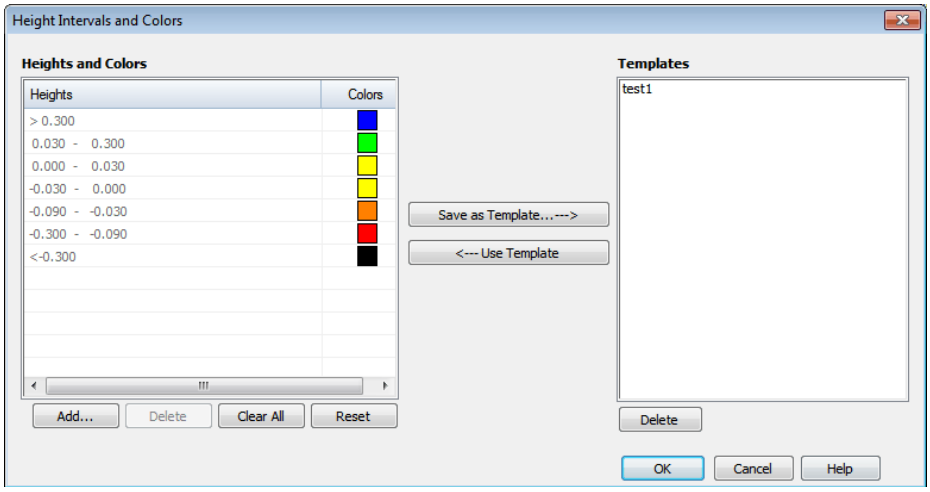
Stations given here, will be used to limit the length of the colored difference model.

- Indicated start and end stations are taken from the calculation interval given in the tunnel description, tbs.
- You may edit the given station limits, in order to limit the size of the point cloud data to be processed.

Workflow View: Heights and Colors

Height ranges and colors displayed in the workflow view, will be used in the resulting 2D and 3D colored difference models.
These colors display height differences between tunnel design and scanned tunnel.

Click the button to open a dialog where you can edit height ranges and colors.



You can use the dialog to

- Edit height intervals and colors.
- Create user defined templates.
- Save your templates.

Buttons to be used in the dialog:

Heights and Colors	Specify height intervals and colors.
[Add...]	• Click the button **[Add...]** to add a height to the intervals displayed. The intervals will be adjusted automatically, for each added height.
[Delete]	• This button is only activated, when you have selected a height interval in the list. • Click the button to delete the selected height interval. • Note, if one interval is deleted, all related intervals will be adjusted automatically.
[Clear All]	• The button **[Clear All]** deletes all displayed intervals and colors, only the heights > 0 and < 0 will be displayed.
[Reset]	• Press the button **[Reset]** to get back to the set of intervals and colors stored as default by iCON office.
Templates	You can save height intervals and colors in named templates.
[Delete]	• Select a template and press the button **[Delete]** to delete the selected template. • Please note, templates are stored in the registry of iCON office. This implies that if you remove a template in one project, this specific template will be removed from all your projects.

[Save as Template... --->]	• Press the button **[Save as Template... ->]** to save a template that includes the height intervals and colors displayed to the left in the dialog. • Give the template an optional name. • Note, it's optional to save templates. Height intervals and colors that are displayed in the workflow view will be used, even if they are not saved as a template.
[<---Use Template]	• If you have saved one or several templates, you can select one of them and click the button **[Use Template]** to activate the template's height intervals and colors.
[OK]	• Press the button **[OK]** to confirm your selected choices.

Workflow View: Visualize

In the workflow view, you set settings regarding the resulting 2D colored difference model.

Orientation	• Use the drop down list to select orientation. • Landscape or Portrait.
Intended Printout Scale	• Set the printout scale to be used. • This scale will be used for: - color legend - stationing - line codes
Display Legend	• Check the box **[Yes]**, if a legend with used height intervals and colors should be displayed.

Workflow View: Display Lines

In the workflow view, you set settings regarding lines displayed in the resulting 2D colored difference model.

Display Center Line	• Check the box **[Yes]** to display the center line, given in the tunnel description. • In the graphics, the line will be displayed with the point code CL.
Display Center Line Stationing	• Check the box **[Yes]** to display stationing interval.
Stationing Interval	• Specify stationing interval to be

	displayed. - This interval does not have any impact on the calculation.
Center Line Offset	• Specify an offset to create a line parallel to the center line. - A positive value will create a line to the right of the center line. - A negative value will create a line to the left of the center line.
Display Tunnel Center from Code	• Check the box **[Yes]** to create a line from the point code TC in tun[852] files. • In the graphics, the line will be displayed with the point code TC.
Display Abutment Lines	• Check the box **[Yes]**, to display abutment lines. - An abutment point is the point in a tunnel cross section where the tunnel ceiling and the wall meet. • Abutment lines can be created only if you have used the point codes A1 and A2 in the tun[852] file. • Abutment lines are displayed as dashed lines. • Please note, abutment lines cannot be displayed if they originate from Design mesh[855], AutoCAD® dwg or dxf.

Workflow view: Select calculation method

Use the drop down list in the workflow view to select calculation method.

- Save the Compare Points[899]
- Save Difference Model[899]
- Create a 2D colored difference model[899]
- Create a 3D colored difference model[900]

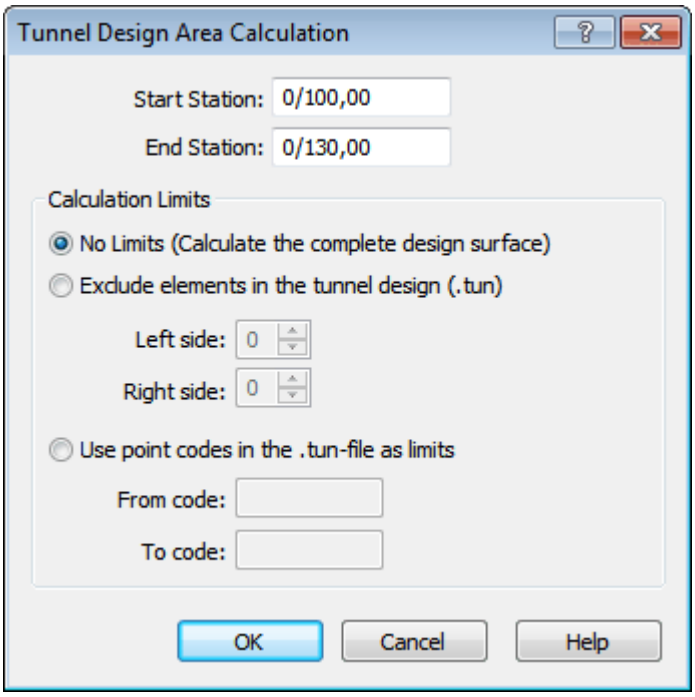
Save the Compare Points	• A coordinate file will be saved. • The file includes the points that have been used to compare the differences between designed and as-built tunnel.
Save Difference Model	• You can use the workflow view to create a tunnel difference model, tdm. • A tunnel difference model describes the differences between designed and as-built tunnel. For additional information, see Tunnel Difference Models[887] and Create Tunnel Difference Model[892].
Create a 2D Colored Difference	• You can create a 2D colored

Model	difference model, displaying a flattened tunnel. • Different colors represent different height levels. • File format, AutoCAD® DWG.
Create Heat Map, 3D dwg file	• You can create a 3D colored difference model, displaying the tunnel. • Undercuts and overbreaks will be displayed in different colors. • The dwg file will include: ○ one layer for each height interval ○ one layer will represent the contour lines ○ one layer for each displayed object, i.e.: - center line - tunnel center - abutment lines - legend - stationing • File format, AutoCAD® DWG.

See also: Tunnel Descriptions, tbs 862 , Point Cloud 757 Point Cloud 757 , Tunnel Difference Models 887, Create Tunnel Difference Model 892

16.7 Calculation of tunnel design area

This function calculates the surface area of a tunnel as defined in a tunnel description (TBS). Open a tunnel description, tbs, and select ***Data | Tunnel Design Surface Area***.

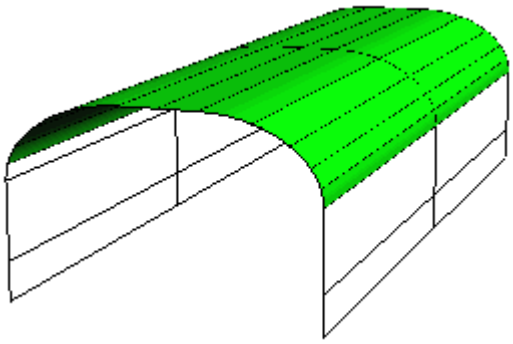


Start station/End station
The start and end stations are automatically completed with the line's limitations in the tbs document. These are adjusted in the calculation to the next following station at the start and the next previous station at the end if the specified dimensions are not in the tunnel description.

Calculation Limitations

No Limitations
The entire design surface area is calculated.

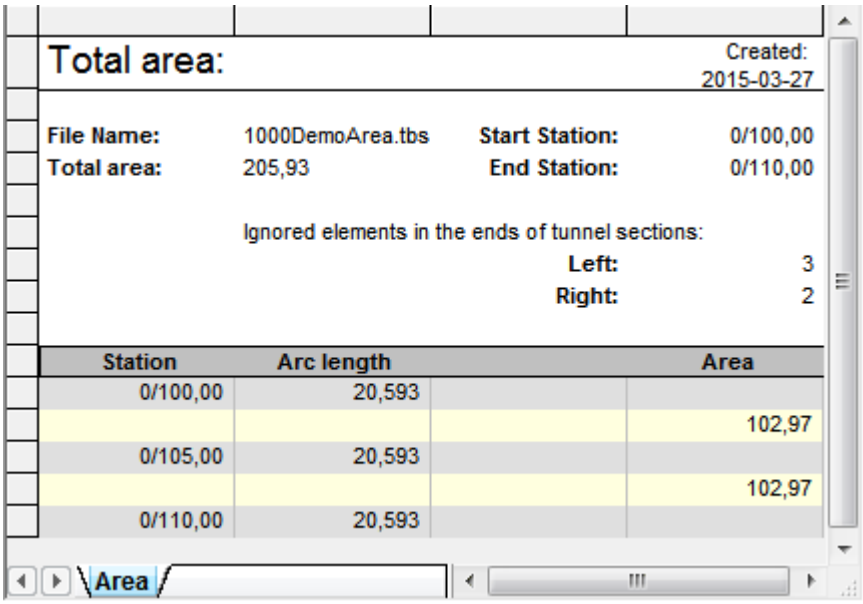
Exclude elements in the tunnel design section
Here you can specify a number of elements in the tunnel design sections 852 that are not to be included in the area calculation. The figure below shows an example where three elements have been excluded from the left and two from the right. The green area in the figure will be calculated.



Use the point codes in the tun (tunnel design section) file as limit
This option involves using the codes in the tunnel design file (tun)[852] to determine the elements to be calculated. This is useful when using several different tunnel design files and where the desired surface you want to calculate varies between the sections.

Results Report

The report presents the selected files and settings, the total area and area for each interval in the tunnel description.



Total area: Created: 2015-03-27

File Name:	1000DemoArea.tbs	**Start Station:**	0/100,00
Total area:	205,93	**End Station:**	0/110,00

Ignored elements in the ends of tunnel sections:

Left:	3
Right:	2

Station	Arc length		Area
0/100,00	20,593		
			102,97
0/105,00	20,593		
			102,97
0/110,00	20,593		

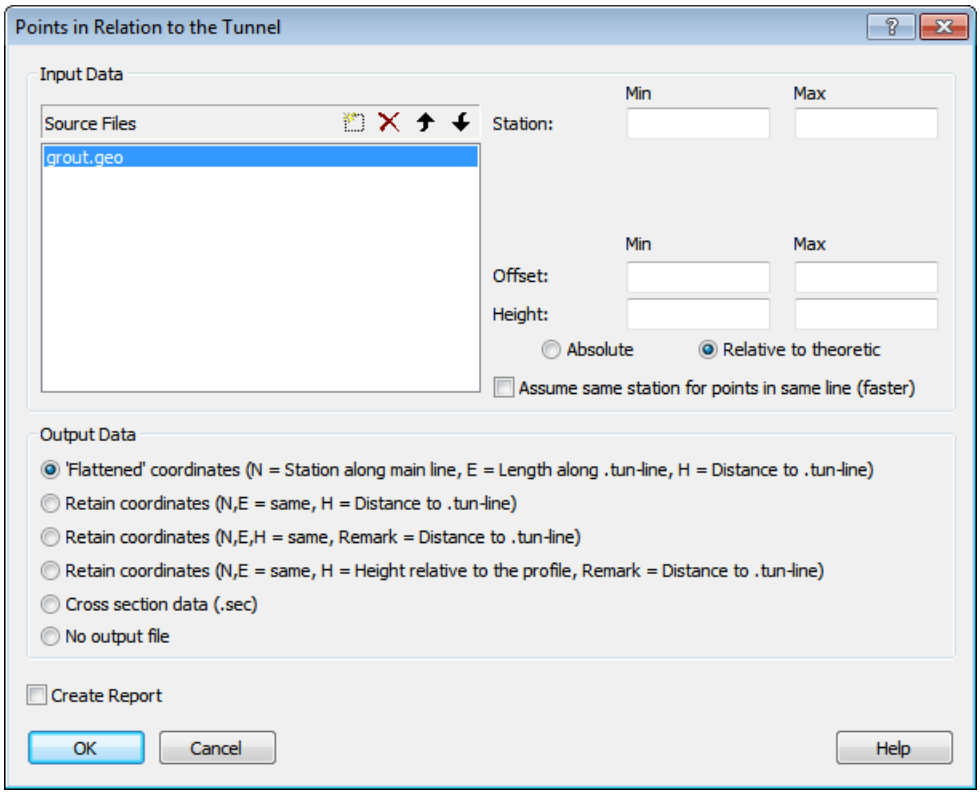
Area

iCON office calculates the tunnel area by starting from the current cross section length and then interpolate to the next cross section.

See also: Tunnel Descriptions, TBS[862]

16.8 Points Relative to the Tunnel

This function calculates points relative to the designed tunnel. Open a tunnel description, tbs, and select ***Data | Points Relative to the Tunnel*** to open the dialog. You can use the function, among other things, to visualize the position of the points in the tunnel, such as bolt placements or bore holes.



Input data

The input data for the function is one or more coordinate files with points in world coordinates.

Selection

Specify here the conditions in the form of minimum and maximum dimensions for station, offset and height along a given road line.

Station:

Specify the minimum and/or maximum station dimensions along the road line for the points you want to include.

Offset:

Specify the minimum and/or maximum offset from the road line for the points you want to include. Offset is indicated as negative to the left, and positive to the right, of the road line.

Height:
Specify minimum and/or maximum height for the points you want to include. This may be given as the absolute or relative line.

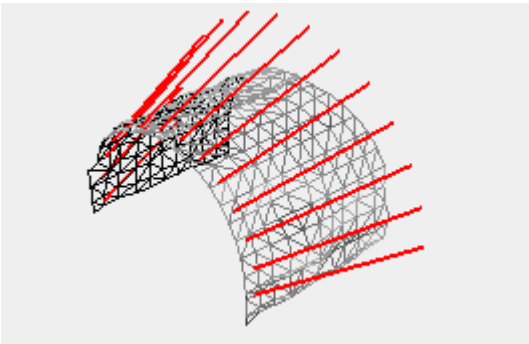
- **Absolute:**
  The specified height limits are matched against the point's height coordinate.
- **Relative to theoretic:**
  If the specified road line has an associated vertical geometry (profile), the height limits will be applied relative to the theoretical road model, for example, you can specify a minimum height of 0 to ensure you have points above the road surface.

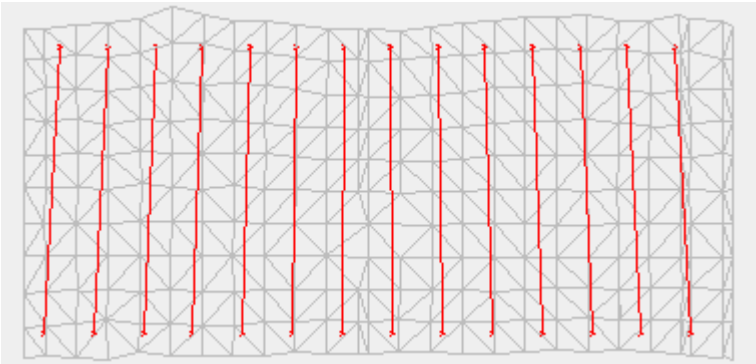
Assume the same station for all points in one line (quicker):
If you have measured the points in a way that connects them in lines for each section, you can select this option to speed up the extraction process. A check is now made for the min/max section of the first point of the line only, and if this meets the criterion the whole line is included without any further verification. This speeds up processing.

Output data

There is a variety of calculation options to choose from:

- Flattened coordinates





  This option is useful if you want to show the coordinates in the same view as the difference tunnel model, where N = length section along the main line, E = dimensions along the theoretical tunnel section and H is the distance to the theoretical tunnel section.

- Retain coordinates (N, E = same, H = distance to the tun line)
  This option does not change the plane coordinates. The height is set as the distance to the theoretical tunnel section.
- Retain coordinates (N, E, H = same, Remark = distance to the tun line)
  This option does not change the plane coordinates or the height. In the remark field the distance is set to the theoretical tunnel section.
- Retain coordinates (N, E = same, H = height relative to the profile, Remark = distance to the tun line)

This option does not change the plane coordinates. The height is set as relative to the profile and in the remark field the distance is set to the theoretical tunnel section.

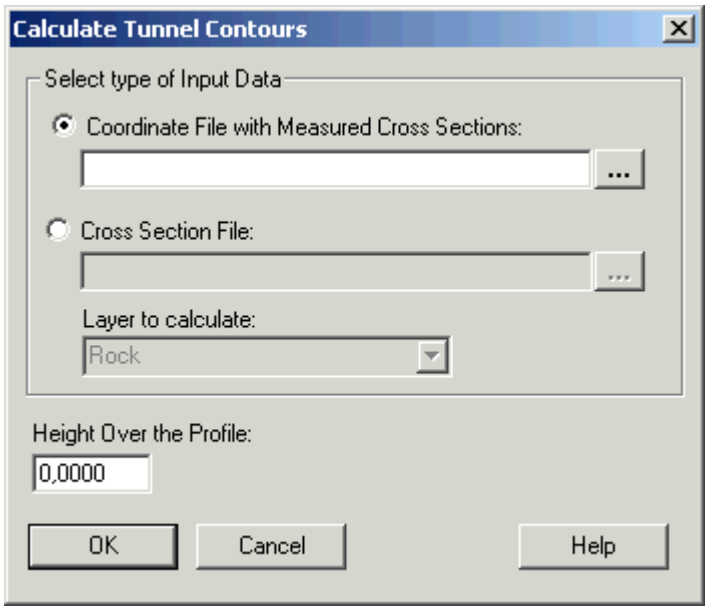
- Cross section data (sec)
  Output data here is cross section data, i.e. section and offset for the points. The height is set as the distance to the theoretical tunnel section.
- No output file
  No file is created, select this option if you only want to generate one report.

You can also create a **report** with the various dimensions presented.

See also: Tunnel Descriptions, tbs 862 , Tunnel Difference Model, tdm 887

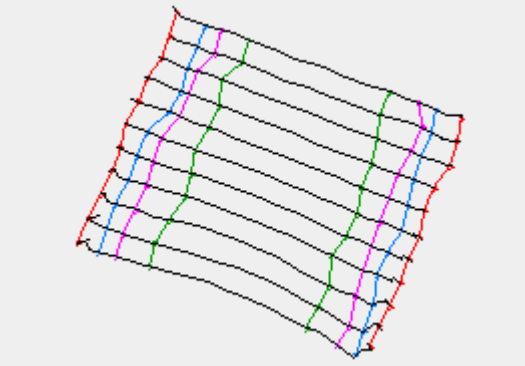
16.9 Tunnel Contours

This function calculates the contour lines of the surveyed tunnel data for a given height above the line's vertical geometry / profile. Select ***Data | Calculate Tunnel Contours*** to open the dialog.

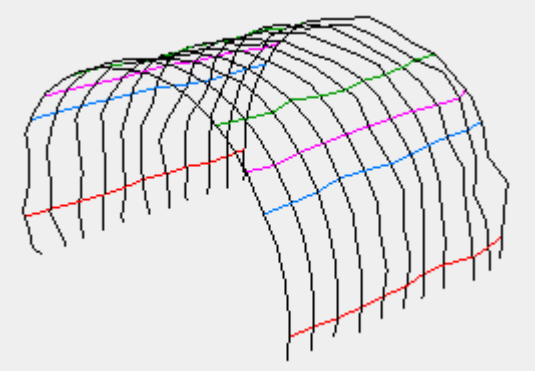


Select type of Input Data
Input data for the function consists of a coordinate file with surveyed tunnel points or a cross section file. If a cross section file is used, you must also specify layers for the calculation. Line data, l3d[503], are loaded from the current tunnel description, tbs document[862] .

Height above profile / the line's vertical geometry
Select the height of the intersections to be calculated.



Plane image of contour lines at four different levels.

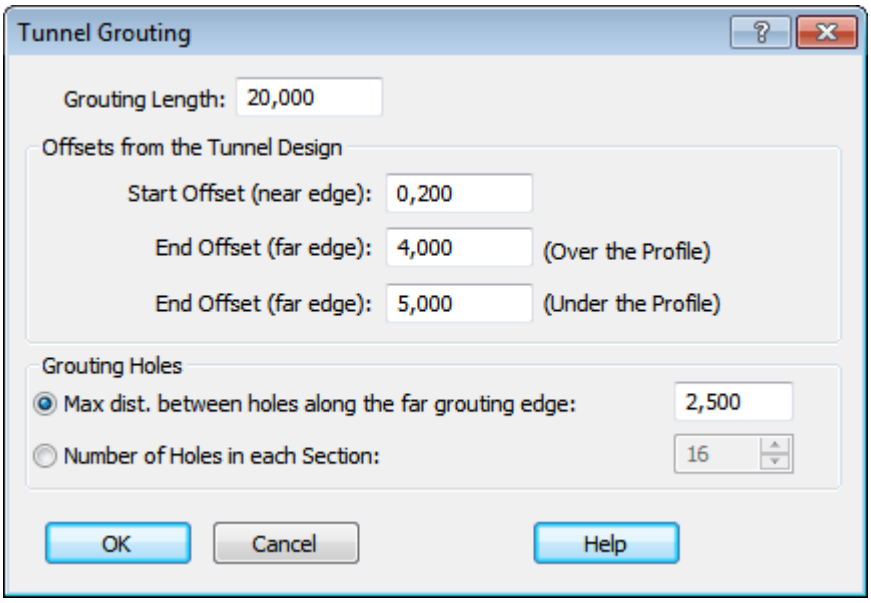


3D image of contour lines at four different levels.

See also: Tunnel Descriptions, tbs[862] , Tunnel Difference Model, tdm[887]

16.10 Tunnel Grouting

You use this function to calculate grouting data for the tunnel. Open a tunnel description and select ***Data | Tunnel Grouting*** to open the dialog.

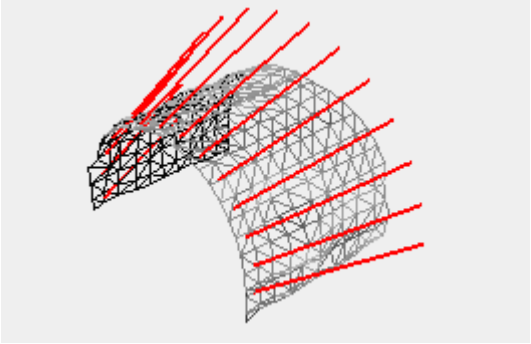


Grouting length
Enter the grouting length (drilled length) for each screen.

Distance from the Tunnel Design
Here you specify the perpendicular distance from the tunnel design to the grouting hole's start and end points. You have the option of specifying different dimensions for the end point, depending on whether it is above or below the profile.

The maximum distance between the holes along the grouting screen's outer limit.
Specify the maximum distance between two holes. You specify the dimension along the grouting screen's outer limit. (Applies to the grouting over the profile)

Number of grouting holes per section
Enter the number of grouting holes per section. (Applies to the grouting over the profile)



See also: Tunnel Descriptions, tbs 862 , Tunnel Difference Model, tdm 887

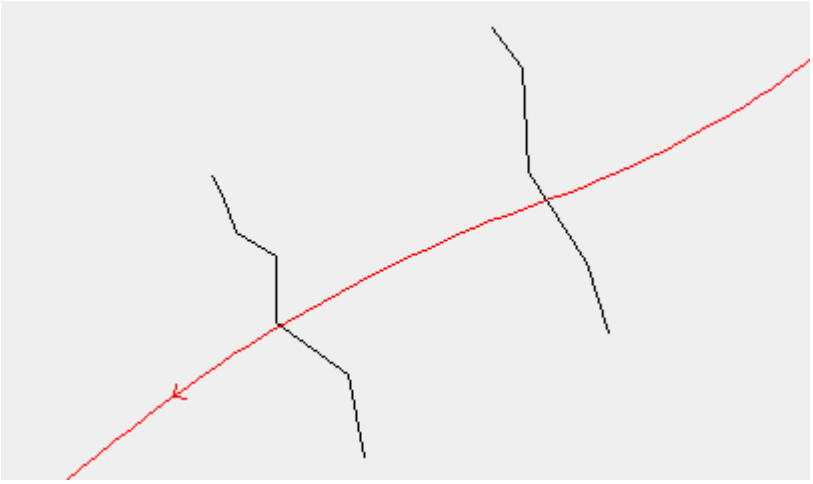
16.11 Correction of Points into Tunnel Sections

You use this function to correct points measured in a tunnel to even length stations.

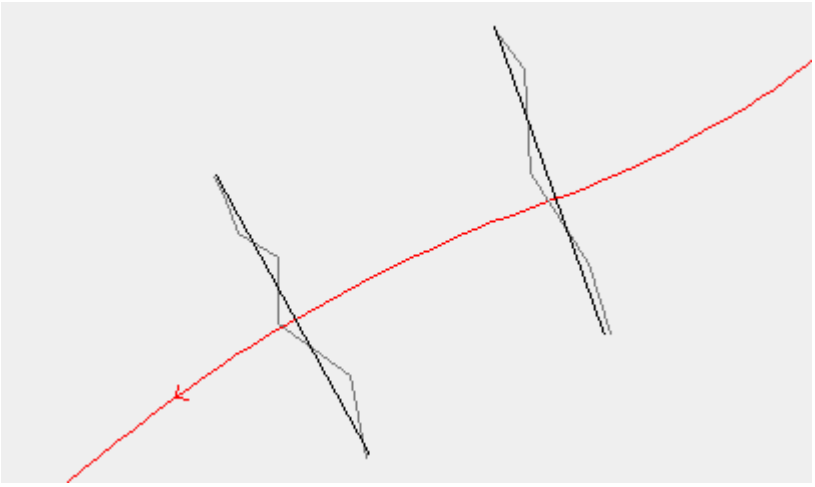
Open the tunnel description, tbs, from which the calculation is to be made and select ***Data | Correction of Points into Tunnel Sections***.

By specifying a corridor, you control by how much the position of a point may deviate from the intended length station for it to be considered to be part of it. The calculated points can be saved either as cross sections, sec, or as coordinates, geo.

A prerequisite for this function to work is that the points occur at fairly regular intervals, otherwise you may have to run the function several times for different parts of the survey.



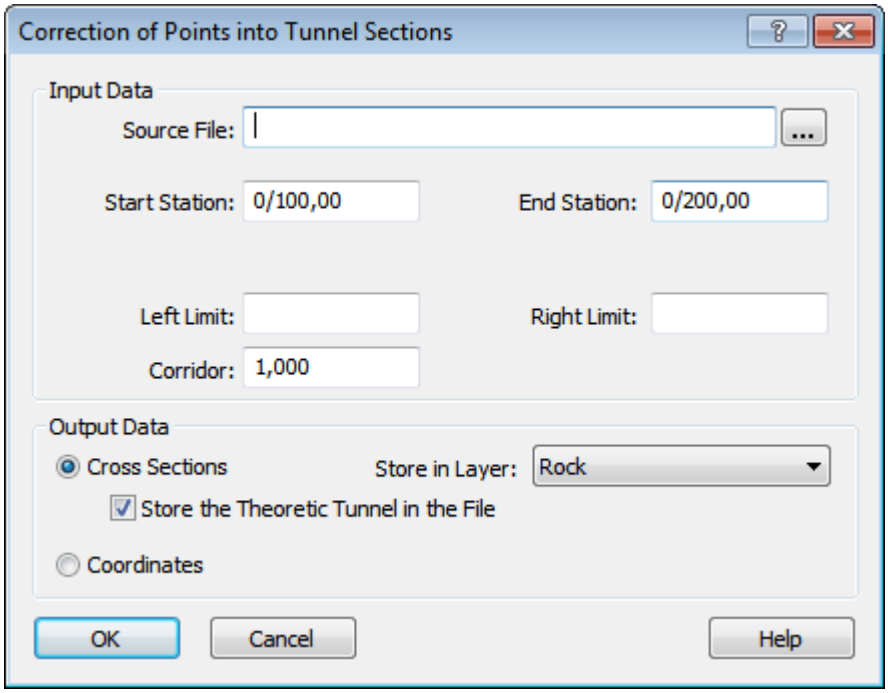
Measured points along a line.



Corrected position to even length stations for the points.

The interval is given from the calculation interval 873 in the tunnel description.

In addition to the corridor you can also specify side limits for points to calculate.



Source File
Enter the coordinate file containing the points to be corrected to even stations.

Start Station
Enter the start station for correction.

End Station
Enter the end station for correction.

Left / Right Limit
Enter the side limits of the points to be calculated. Enter a negative offset for the left side of the line. Leave the fields blank to include all points.

Corridor
Enter how much the position of the points may deviate laterally from the desired length station.

Half of the offset is used in each direction, i.e. a corridor of 1 m means that the points can have 0.5 m errors in both directions in order to still be corrected to the required station.

Output data
Cross Sections / Coordinates
You can choose to save the calculated points either as cross sections, sec, or as coordinates, geo.

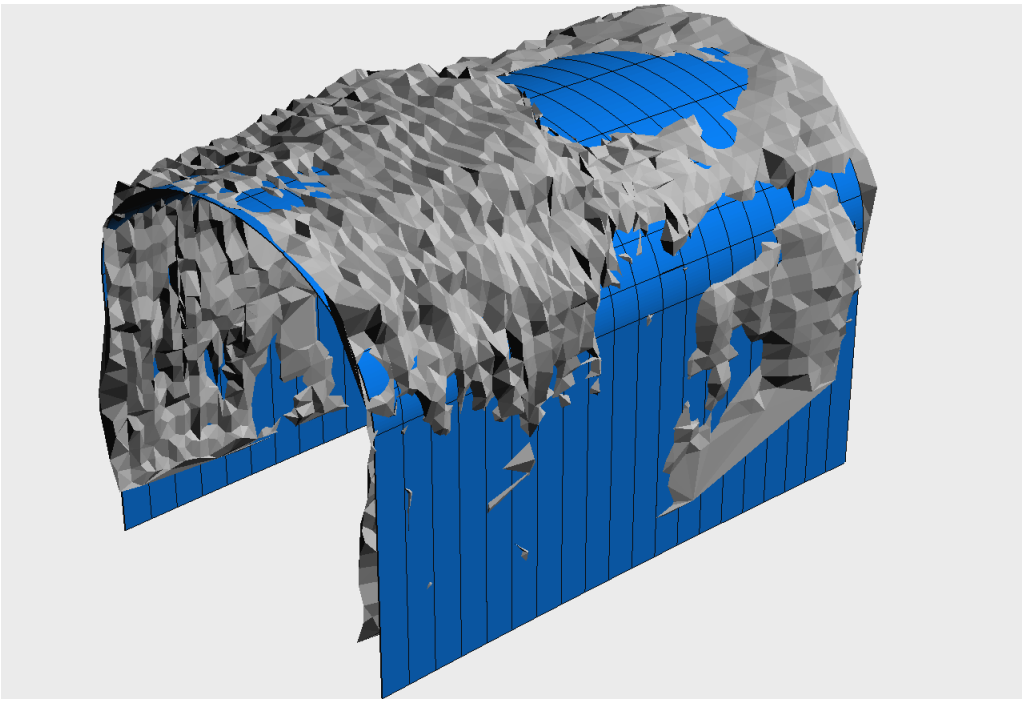
- The sec format is used for cross sections. See also Cross sections 627.
  When you save as cross sections you can also control the layer in which the points appear.
  Check the box **[Store the Tunnel Design in the File]** if the cross section file should include data from the design tunnel file as well.

- The geo format is used for coordinates. See also Cordinates 153 .

See also: Tunnel Descriptions, tbs 862

16.12 Visualization of Tunnel

Visualization of tunnel here means the creation of a three dimensional image from a tunnel calculation, with colored surfaces for surveyed and theoretical models in the calculation.



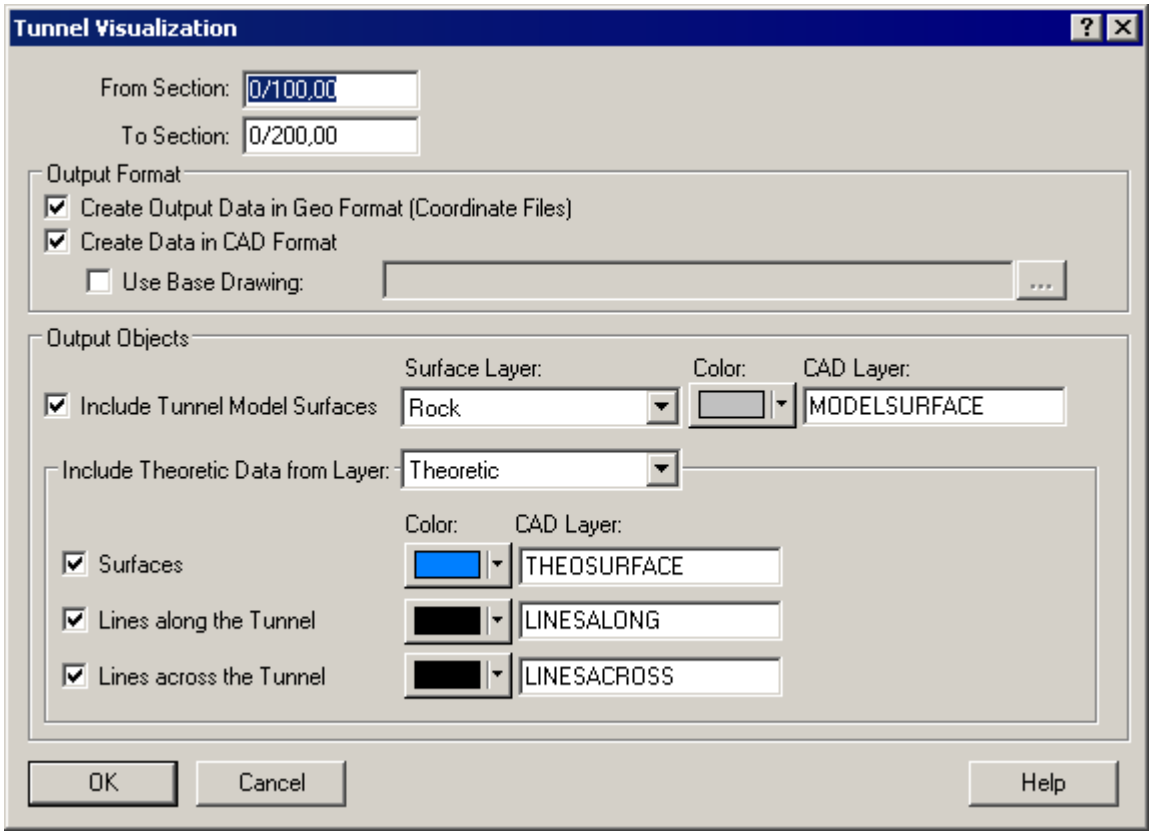
Visualization is done by iCON office making a tunnel calculation in the background, thereby creating cross sections with set length intervals. From these cross sections iCON office then generates lines across and along the tunnel. From this grid of lines you also have the option of adding colored surfaces as a way of showing the whole theoretical tunnel, as in the illustration above. You can also select to view the calculated tunnel model. In this way you can get a good picture of the theoretical and surveyed model simultaneously.

The result can be created both as coordinate files and terrain models in iCON office format and as dwg files in AutoCAD® format. In the latter case, you can choose to supplement an existing file. By doing so, you can run the function several times and add more and more surfaces, for example to show different survey models or different theoretical models of the same view.

Visualization can be done both from a tunnel calculation file (tbs) and from a calculated cross section file (sec).

Procedure

Open a tbs file and select ***Data*** **|** ***Visualize*** to execute the function.



From station/To station
Enter the stations between which the calculation is to be made. The original values are loaded from the current file. From this you can also determine the calculation interval.

Format for output data

Choose how the calculated surfaces are to be represented. iCON office format here means coordinate files. These will include longitudinal and transverse lines for the theoretical tunnel. The surveyed tunnel cannot be presented in iCON office format. If you select AutoCAD®format, a dwg file is created where different surfaces can be placed in different layers. You can view all objects from the calculation in the dwg file. You can also choose a base drawing that will be filled with data. In this way you can run the function several times but always combine the results together in one file. You can also use the base drawing to determine the properties for the various layers in advance (primarily with respect to color and line type). You do this by referring to an existing layer in the base drawing when you select a layer in the **[AutoCAD® layer]** box (to the right) in the dialog.

Objects in output data

Here you determine all the different objects to include in the visualization.

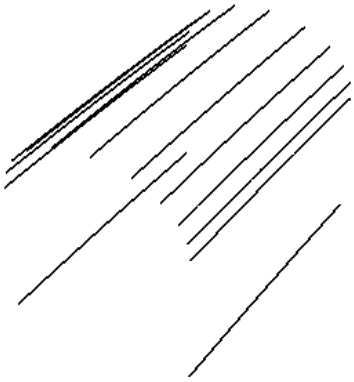
For all objects you can set **color** and **AutoCAD® layer**. The selected color is used if output data is created in AutoCAD® format. You also specify a layer for the AutoCAD file here and the layer gets the color that is set. The selected color has no effect if you save as a base drawing and refer to an existing layer in it, in which case the original color of the layer is used.

Surfaces from tunnel model
Choose if a tunnel model is to be included. Also select if it is rock, user1, user2 or bottom model. In the last case, a standard terrain model is used.

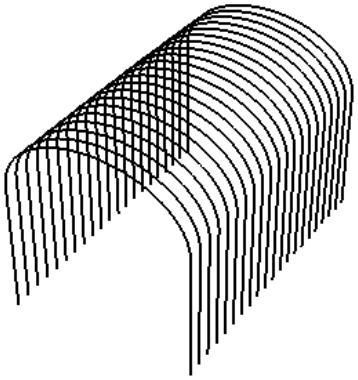
Surveyed model

Surfaces and lines from the theoretical model
Select the theoretical data to be included.

Theoretical model



Lines along the theoretical model



Lines across the theoretical model

See also Tunnel Descriptions 862, Visualization of Volume Calculation 748

17 Point Data Base

17.1 Installation of External Programs for Point Database

To use the point database in iCON office you need to have the following external software installed:

- Microsoft .NET Framework 1.1.
- Microsoft Data Access (MDAC) 2.6 or later.
- Mimer Provider Manager Administrator v1.2.1.
- ODBC compliant database with points. For example, Oracle, Microsoft Access or MySQL.

These installations require administrator rights on the computer in question.

Microsoft .NET Framework and MDAC

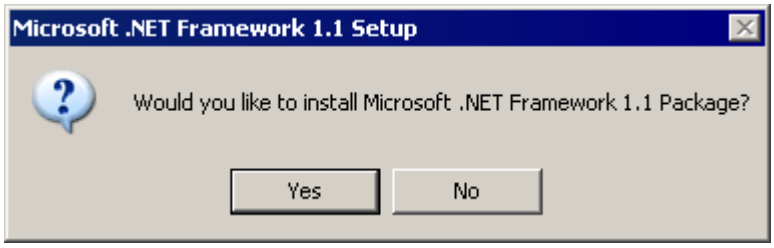
If .NET Framework 1.1 is not installed, this must be done. One way to find out if it is installed is to check if you have the following path on your local hard drive: \WINDOWS\Microsoft.NET\Framework\v1.1.4322

If this path is not there, .NET Framework is probably not installed. (Note: The Windows directory may have a different name than the example above).

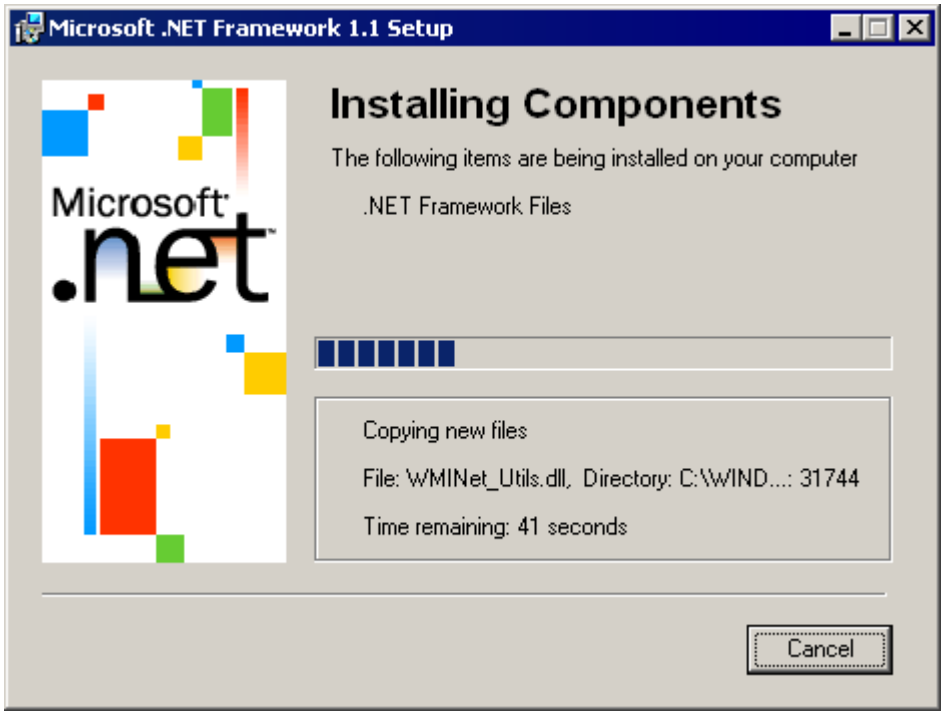
.NET Framework and MDAC are available for download from Microsoft's website.

Install Microsoft .NET Framework 1.1

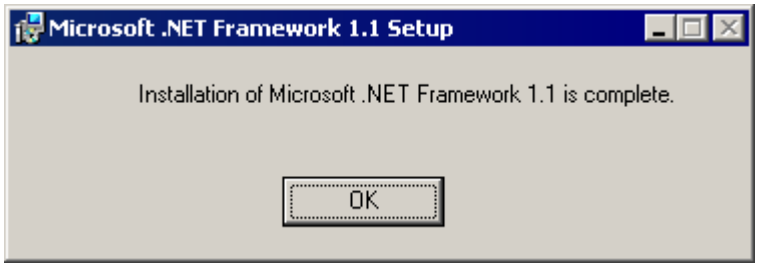
- Start the installer. This requires that Microsoft Data Access (MDAC) 2.6 or later is installed on your computer. A message will appear otherwise if this is not the case.



- Click **[Yes]** to start the installation.



- When the installation is complete, a message will appear confirming .NET Framework 1.1 is installed on your computer.

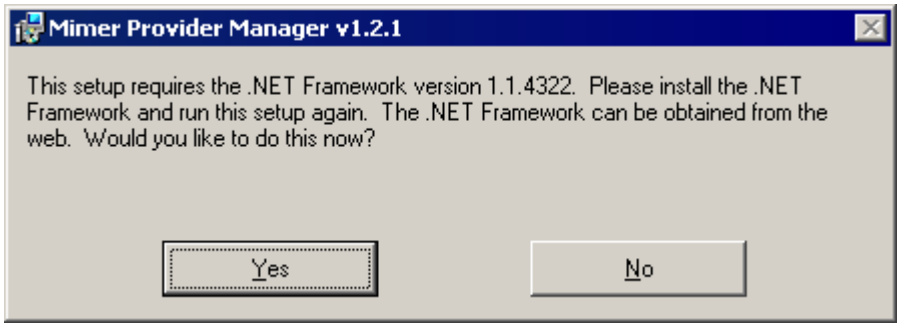


Mimer Provider Manager

This program is from Mimer Information Technology and facilitates data exchange between iCON office and the database. In order to manage the link between iCON office and the database, a program called Mimer Provider Manager Administrator is used. You can download this program from Mimer's website.

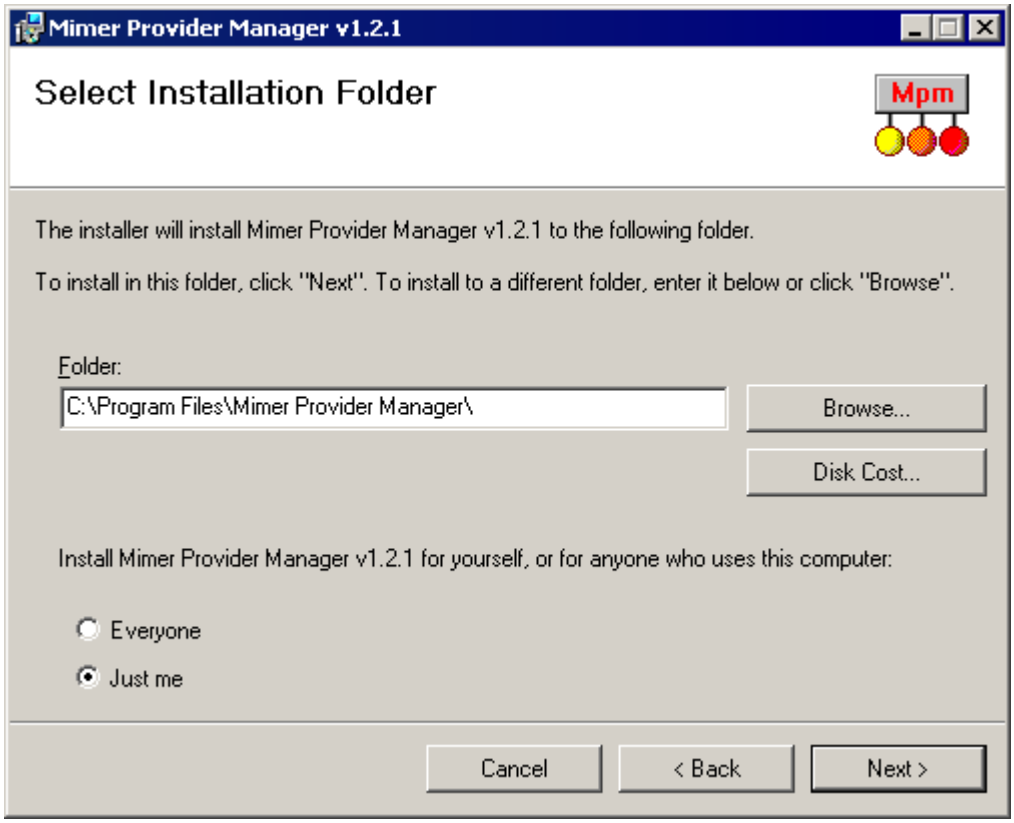
Install Mimer Provider Manager

- Start the installer. If .NET Framework is not installed, an error message will appear. Follow the above instructions for this installation.

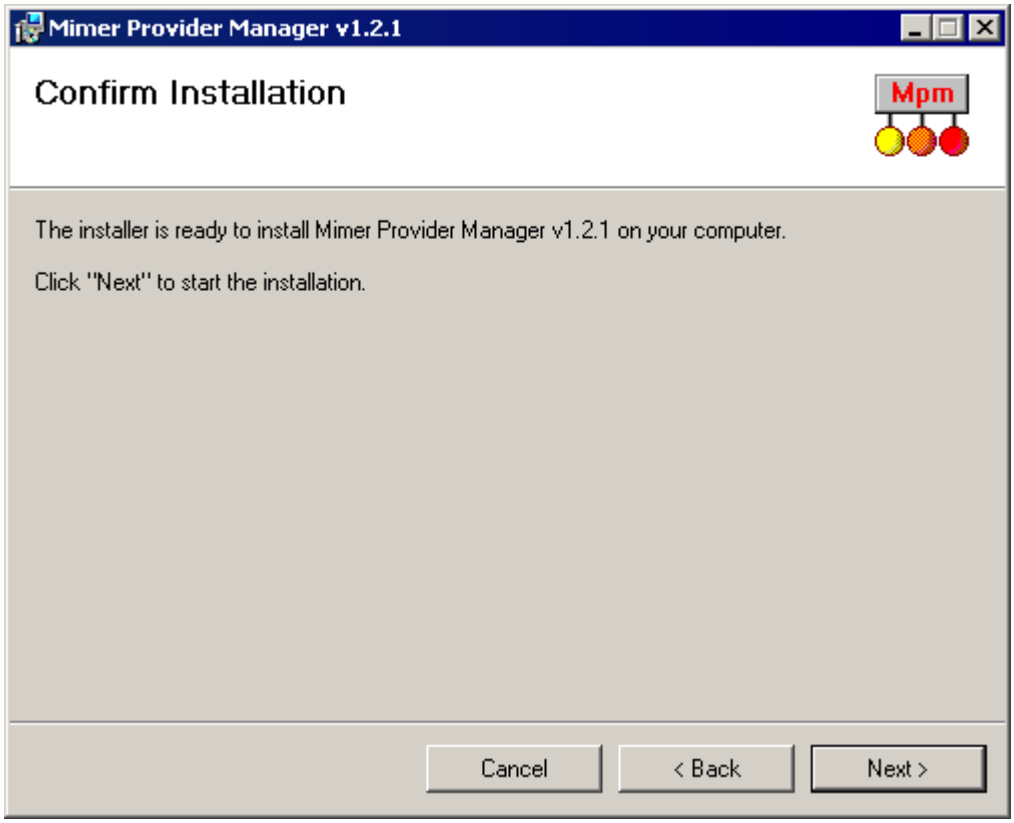


- Start the installation by selecting **[Next]** in the dialog.

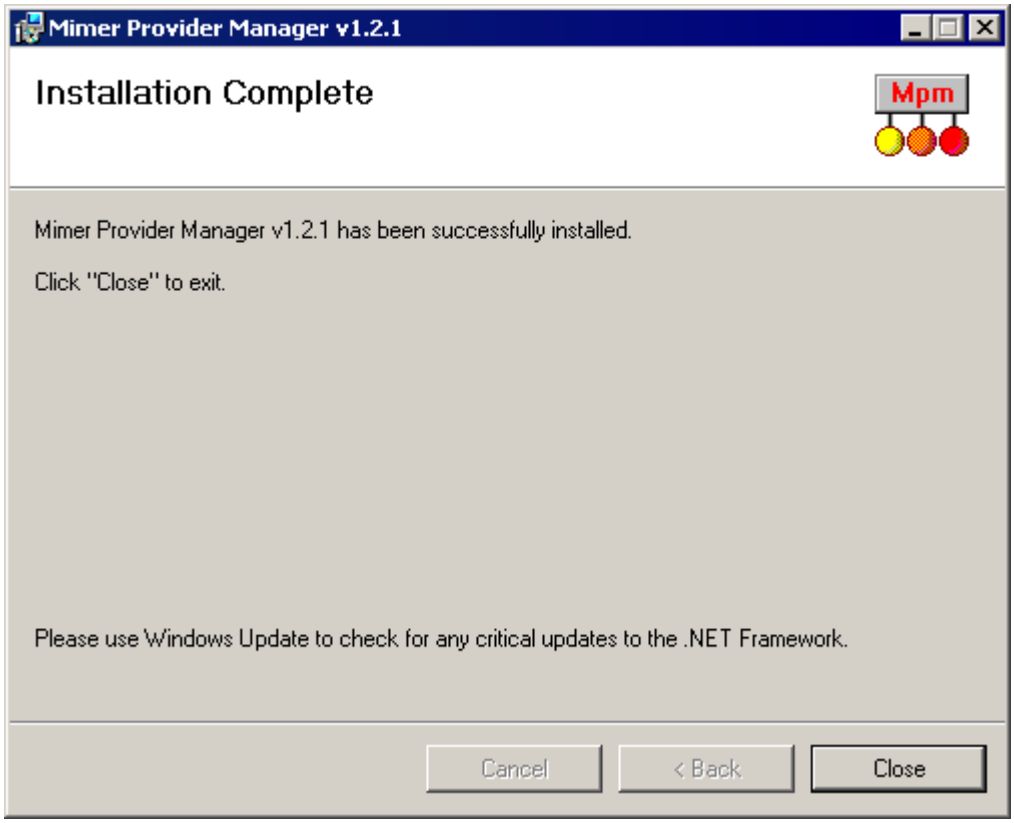
- Select a folder to install in. Also select if the program is to be available for **[Everyone]** to use the computer or just for your user account **[Just me]**.



- Continue the installation by clicking **[Next]**.



- When the process is complete, the message "Installation complete" will appear. Click **[Close]**.



When .NET Framework 1.1 and Mimer Provider Manager are installed, you can configure the point database.

ODBC compliant database

Follow the installation instructions for the relevant database. If there is already a database manager installed, see Configuration of Point Database 919 .

See also Configuration of Point Database 919

17.2 Configuration of Point Database

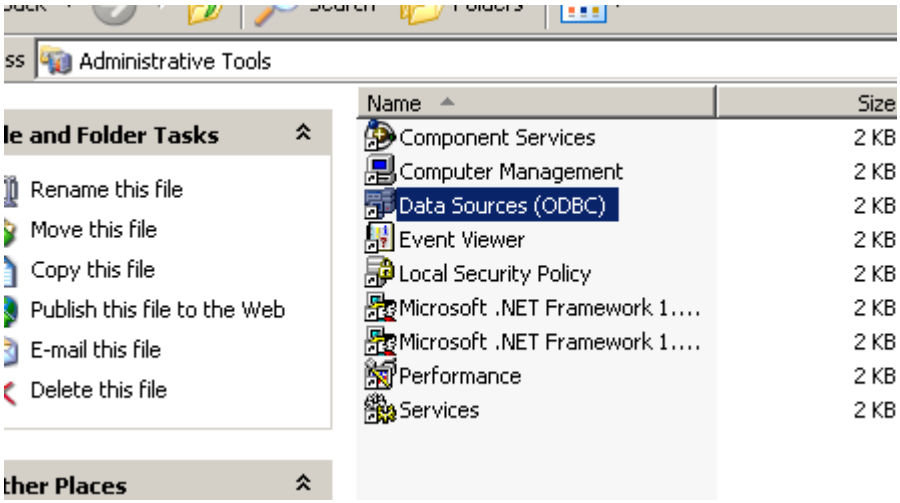
To use the point database in iCON office requires the following configuration.

- Configuration of data source (ODBC).
- Configuration of Mimer Provider Manager.
- Configuration of the database connection in iCON office.

By way of suggestion, the configuration should be done in the above order. Each step must be fully operational to be able to test the next step. Note that the person executing the configuration must have write privileges (administrator rights) under HKEY_LOCAL_MACHINE in the Windows registry. To use an installed database connection you only require read privileges.

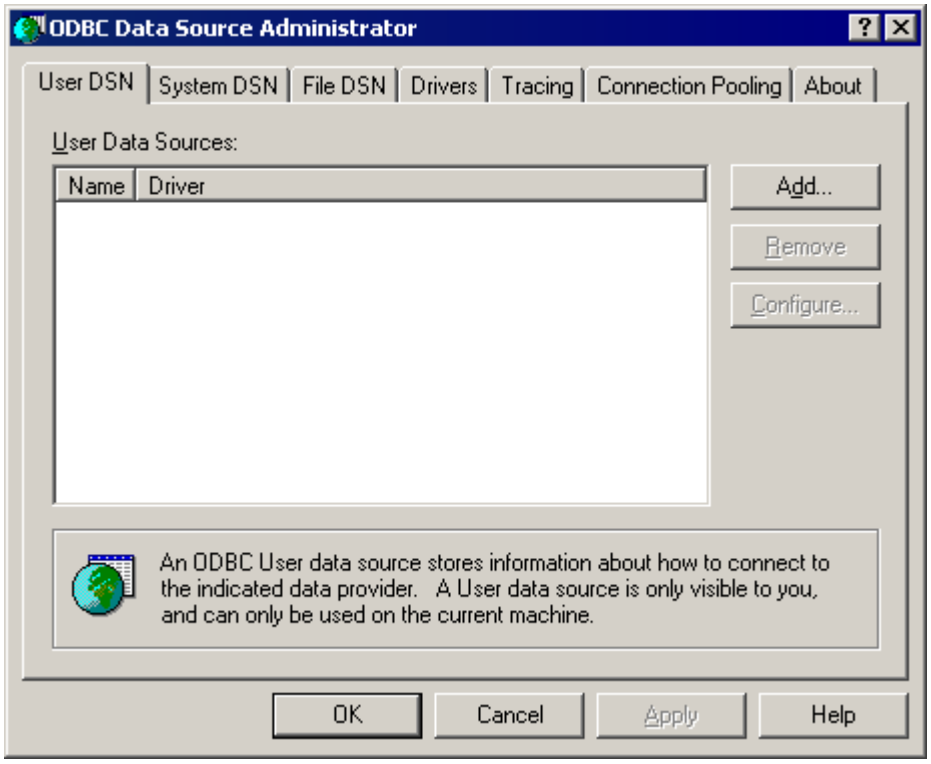
Configuration of data source (ODBC)

You configure the data sources from the Control Panel, Administrative Tools. Select Data Sources (ODBC). (The program file is named odbcad32.exe.)



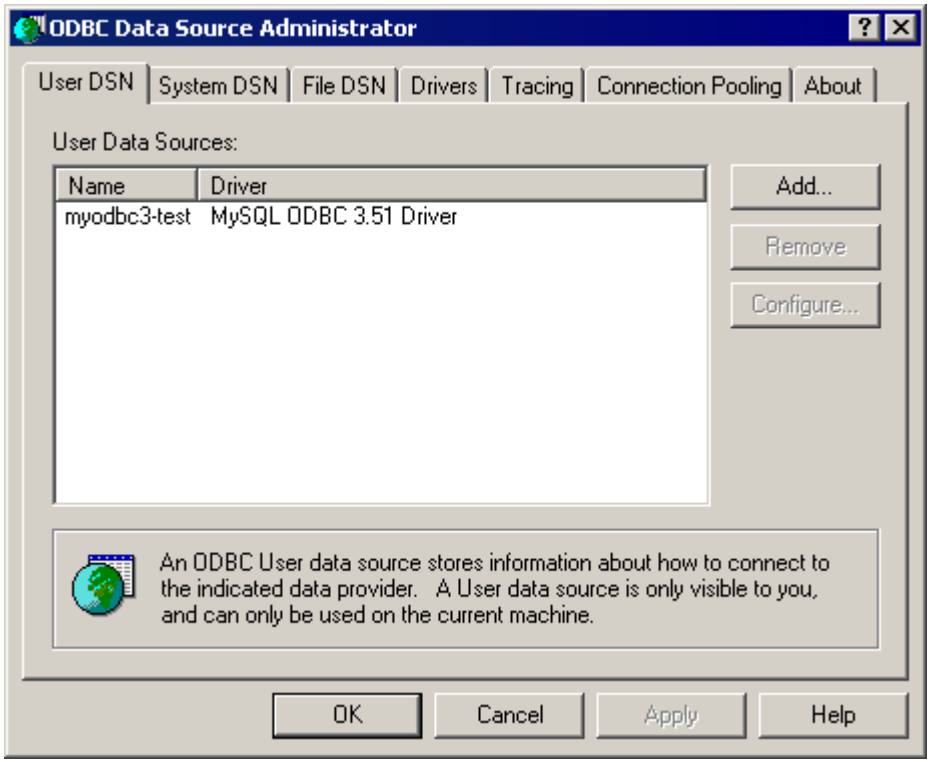
Add source data

The configuration dialog is divided into a number of tabs. It is mainly the three data-related source (DSN) tabs that are of interest.



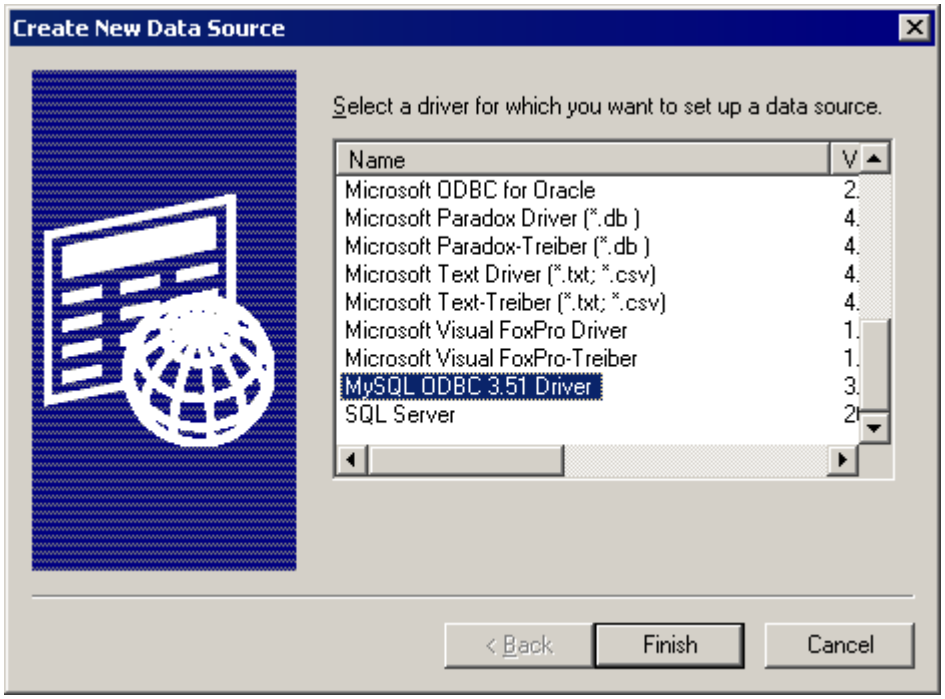
In User DSN you add the data sources that are to be accessible for a particular user. In System DSN you add the data sources that everyone should be able to access on a particular computer. In the File DSN tab, you can set the file-based data sources.

The data sources that are already installed are displayed under User DSN and System DSN. If the desired data source is not already listed, you have to add it. You do this either by clicking **[Add...]** and then selecting the driver from the list, or by running the installer for the database connection you want to set up.



When you select **[Add...]** Windows lists the existing drivers in the system. If the required driver is missing

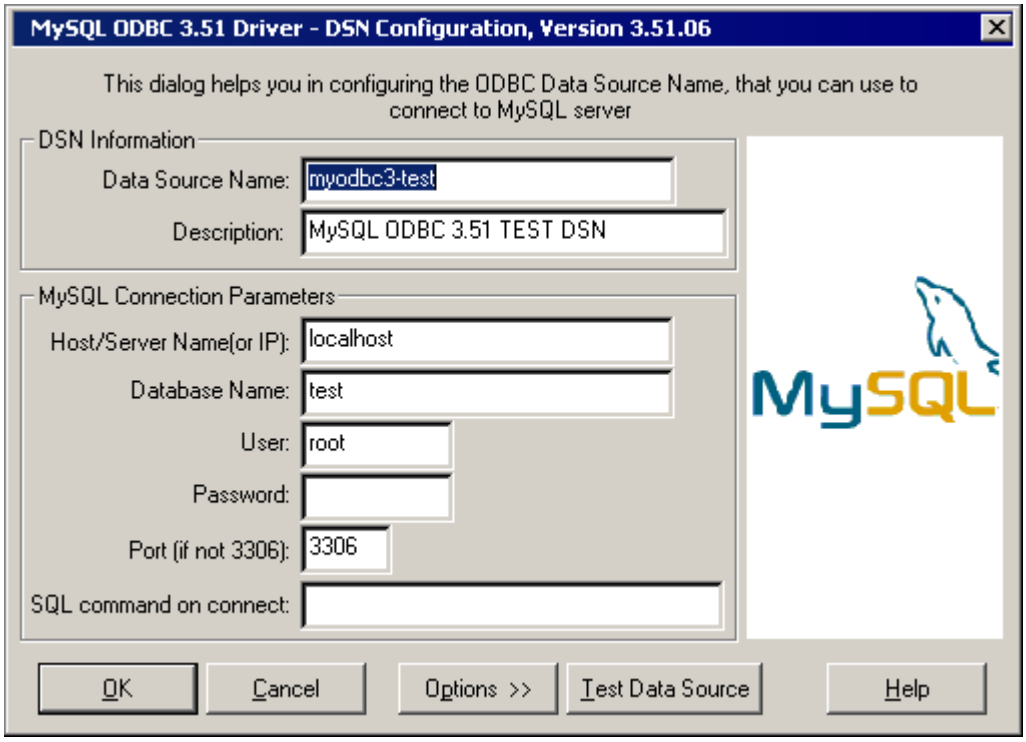
you must first run the installer for the database connection you want to set up.



Configure and test the connection to data source
Click **[Configure…]** to configure the database connection. The appearance of the dialog varies depending on the provider chosen. See also the documentation for the relevant database manager.

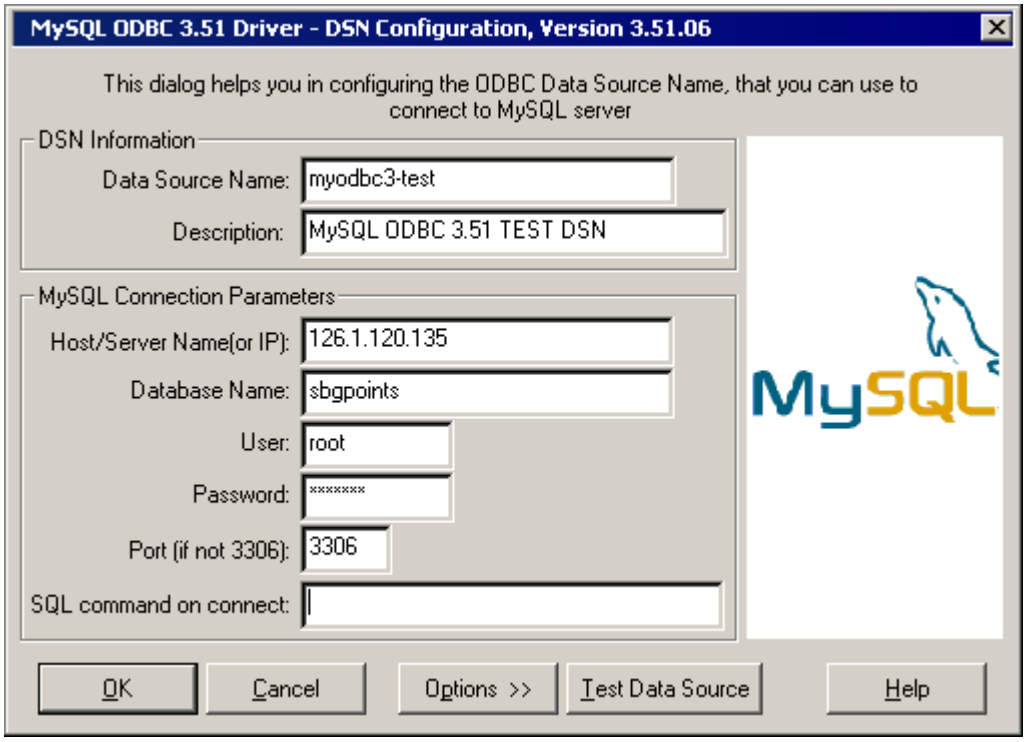
Example of configuration
This example describes how you can configure the connection to a MySQL database.

The MySQL Configuration dialog appears as shown below. The name of the data source, **Data Source Name,** is optional but it should also be specified in the configuration of Mimer Provider Manager. The name identifies the connection to the data source on the computer in question.

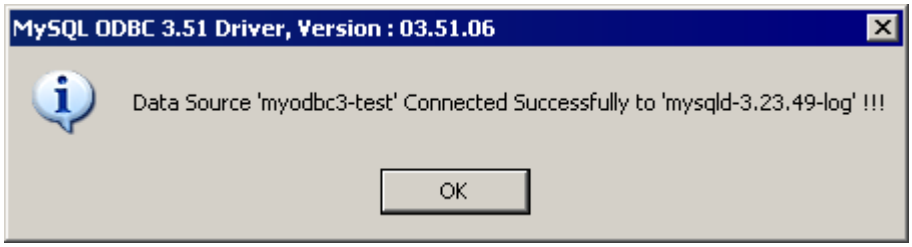


- **Host/Server Name (or IP):** If there is a local database, it is probably enough to enter *local host.* You can also enter the IP address to a server with the database.
- **Database Name:** Specify the name of the database you are looking for.
- **User:** Enter the user name to enable the testing of the connection to the database.
- **Password:** Enter the password for the specified user.

Other settings can usually be left as they are.



Examples of connection to a server via an IP address. Click **[Test Data Source]** to test if the connection works.

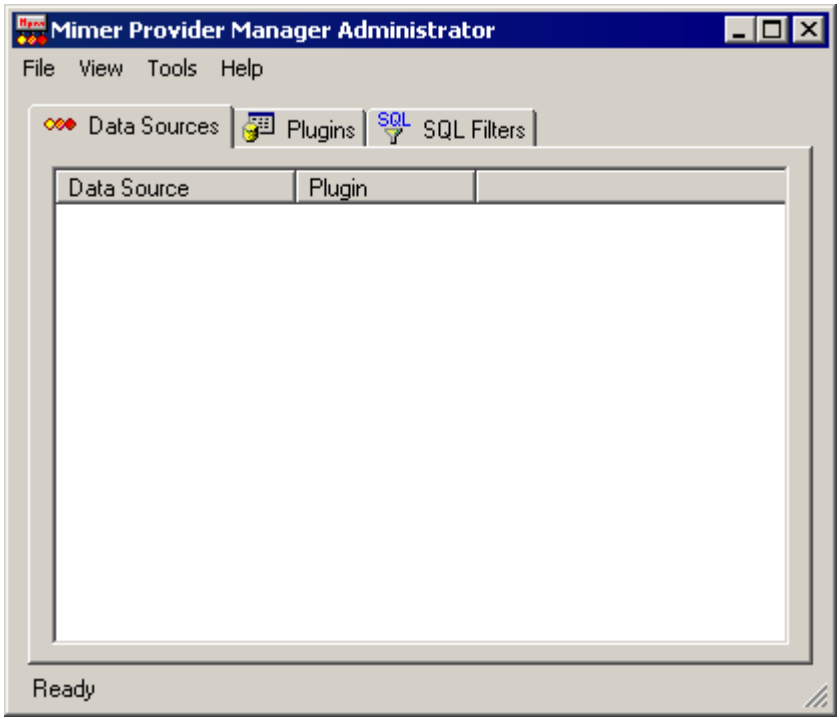


When the connection works, you can proceed to the next step of the configuration.

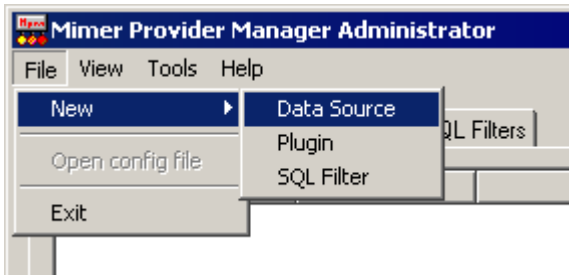
Configuration of Mimer Provider Manager

Start the Mimer Provider Manager Administrator program. This is in the Start menu in Windows if the installation has been performed correctly.

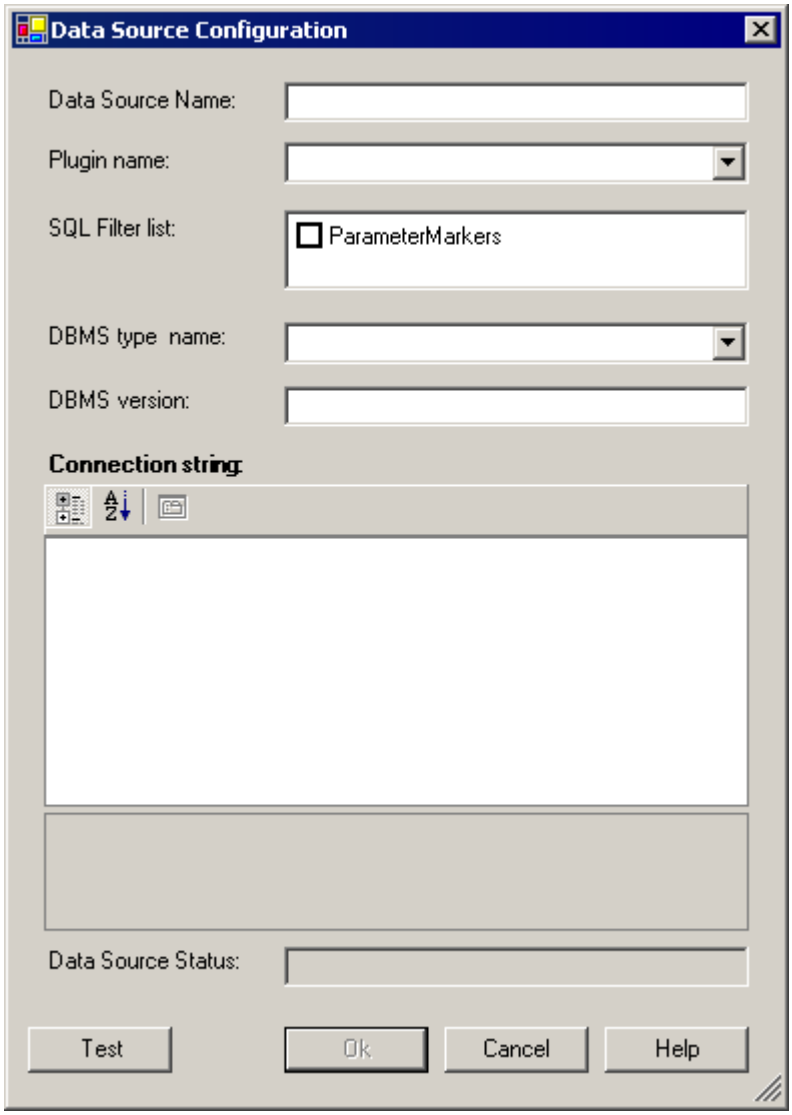
The first time the program starts, the list in the *Data Sources* tab is empty. Here you add the data sources you want to access from iCON office.



Select ***File | New | Data Source*** to add a new data source.

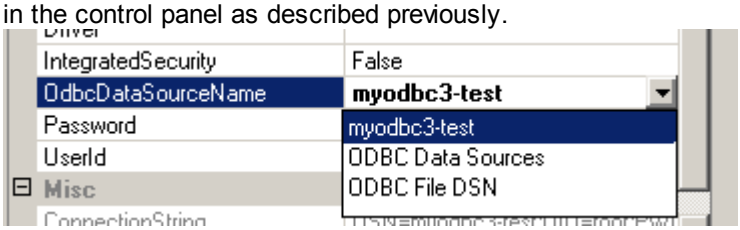


The dialog that appears is as shown in the figure. What needs to be completed depends on the type of database used.

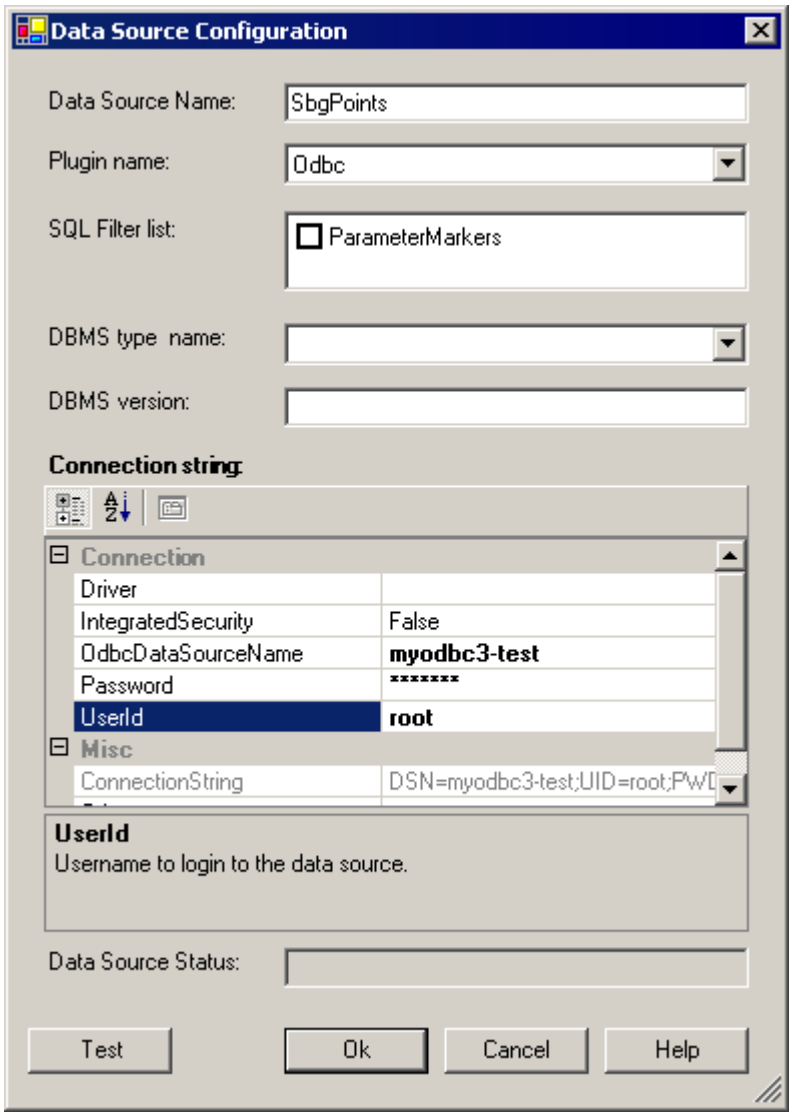


- **Data Source Name:** Enter a unique name for the database connection. **Note:** This name should also be specified in iCON office later.
- **Plugin Name** : Select the database type from the list. For general ODBC connections, you can select *Generic ODBC* or *ODBC.* For Oracle based databases (e.g. *Spatial Technology* or *Tekis TopoBase*) select *Oracle* from the list.
- The SQL Filter list and DBMS can usually be left untouched.
- **Connection string**: There are a number of options here that you can complete. The available options depend on the database type selected in 'Plugin Name'.

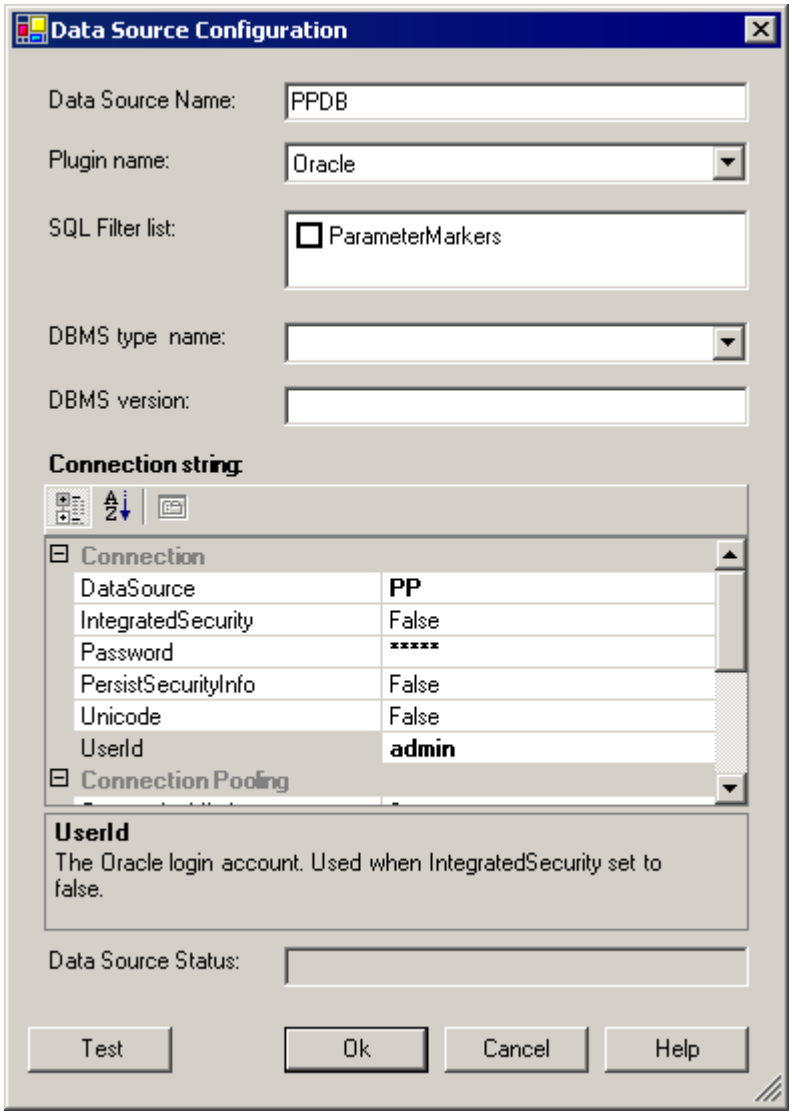
  If you have selected an ODBC connection, you need to choose the configuration that has been made in the control panel as described previously.



  If you have selected an Oracle connection, you need to complete the name of the data source (DataSource).
  You can also enter the user ID and password to enable you to test the connection to the database.

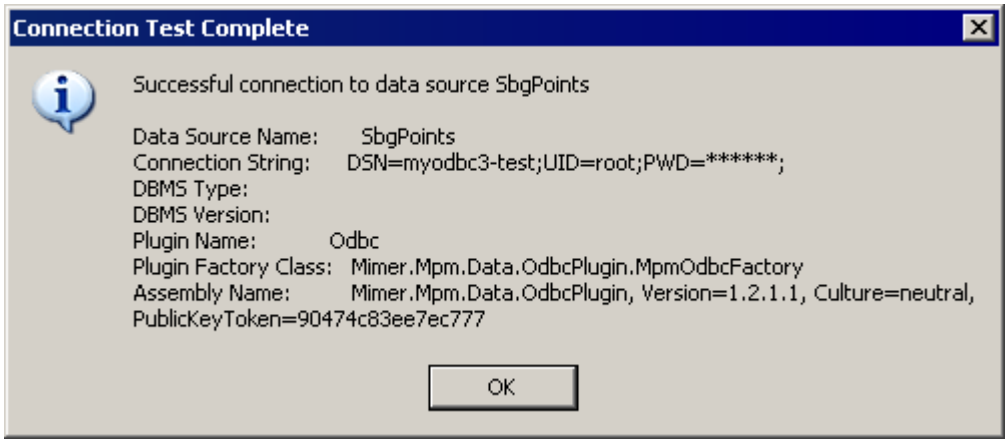


Example of ODBC connection. Can be used, for example, for MySQL.



Example of Oracle connection.

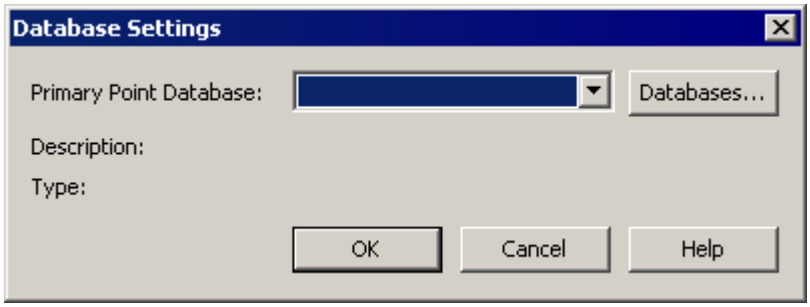
When all the necessary fields have been completed, you can test that the connection works. Click the **[Test]**button.



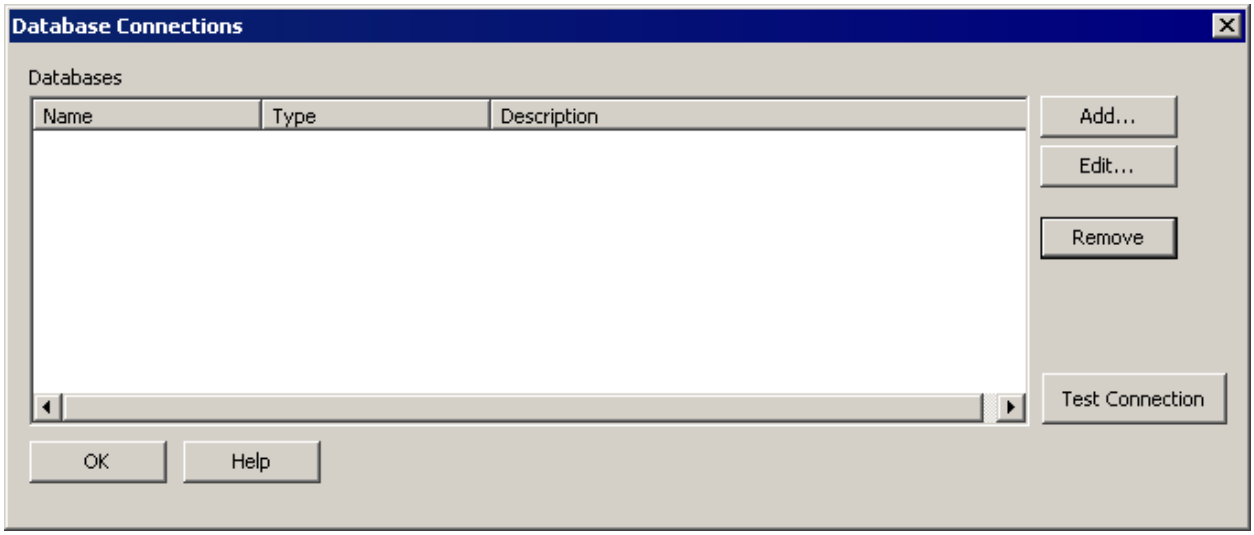
If the connection works, it is time to move on to the settings for the databases in iCON office.

Configuration of database connection in iCON office

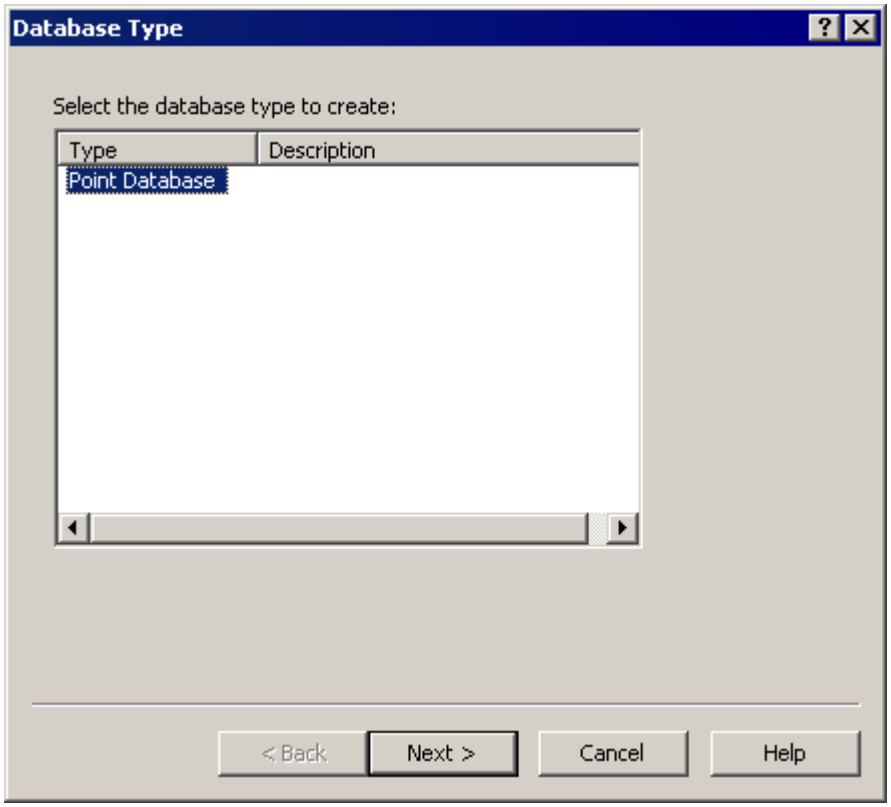
To configure the database connection in iCON office, you go in under ***File | Database Settings***. Here there is a list of the installed databases. To administer database connections, you click on the **[Databases]** button.



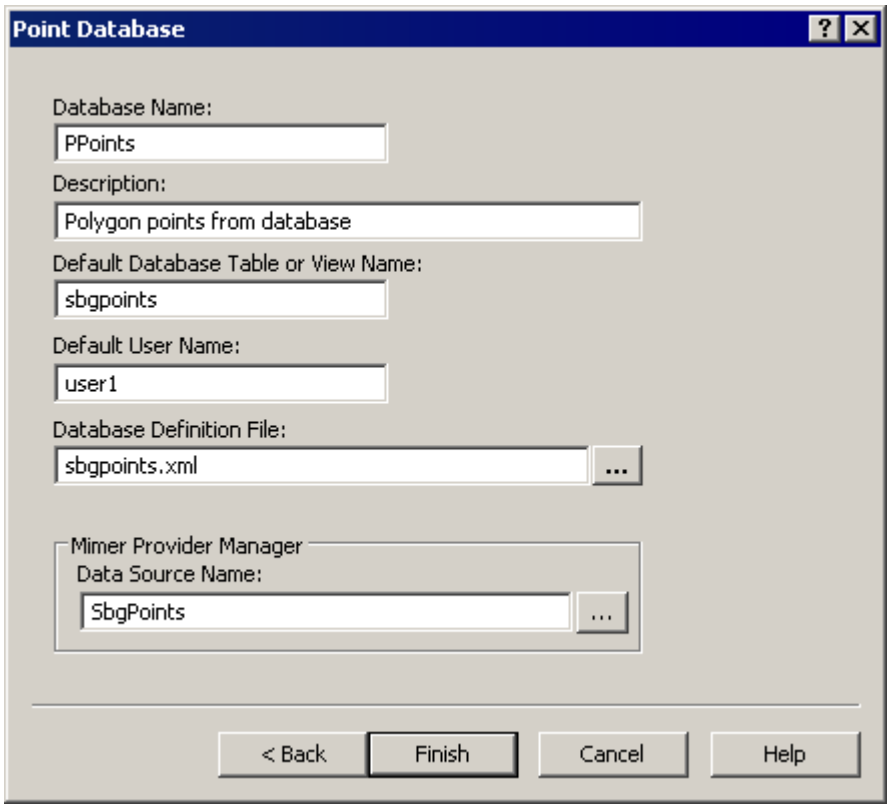
The dialog lists the available database connections. The list shows the name of the connection, the connection type and a description. Using the three buttons **[Add]**, **[Edit]** and **[Delete]** you can administer the connections.



Click **[Add]** to create a new database connection. Select the **Point Database** option for connection to a generic ODBC database, such as point databases from Spatial Technology and Tekis (TopoBase). The KartBas option should only be selected if you want to connect to older versions of KartBas.



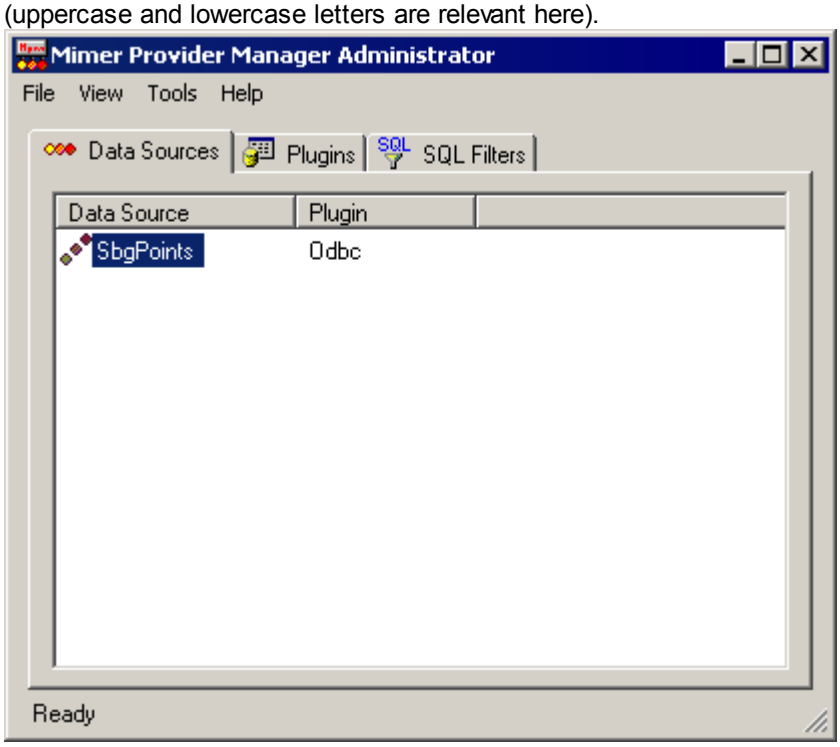
The settings dialog for point databases then appears. Enter the fields for the desired database connection.



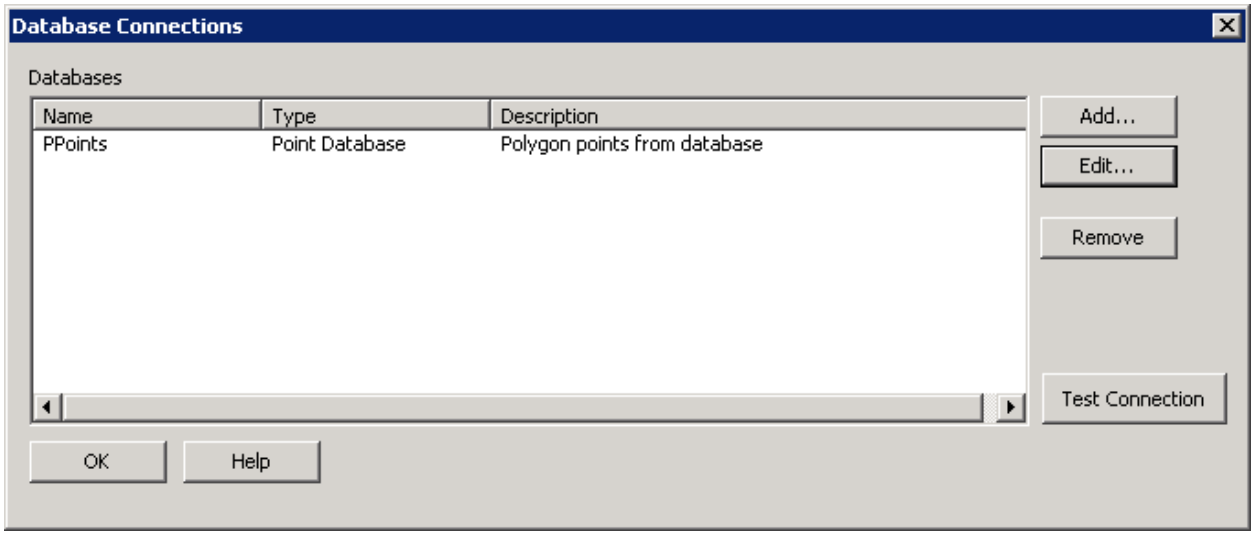
- **Database Name:** Enter a name for the database connection.
- **Description:** A descriptive text
- **Default name of the database table or view:** Enter the name of the table or view in the database that the connection is to use in the first instance.
- **Default Users:** Enter the user name that is primarily used when connecting to the database from

iCON office. This name is proposed as soon as a connection is made.

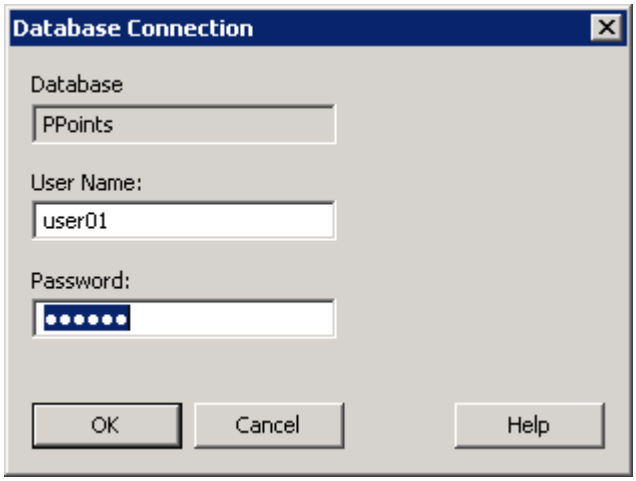
- **Definition file for the database**: Enter the name of the xml file that contains the database configuration. See also separate section on definition files.
- **Mimer Provider Manager, Data Source Name:** Enter the name of the data source used in Mimer Provider Manager Administrator. Note: It is very important to specify exactly the same name (uppercase and lowercase letters are relevant here).



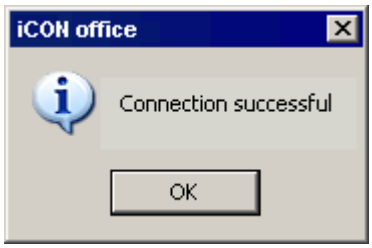
When all the settings have been made, the new connection is added to the list of database connections.



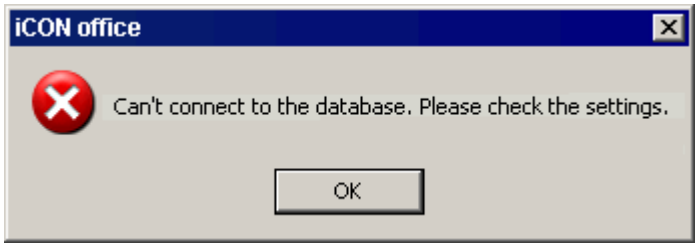
You can now check that the connection is working properly by selecting the desired connection and then clicking on the 'Test connection' button. Now enter the user name and password for the connection.



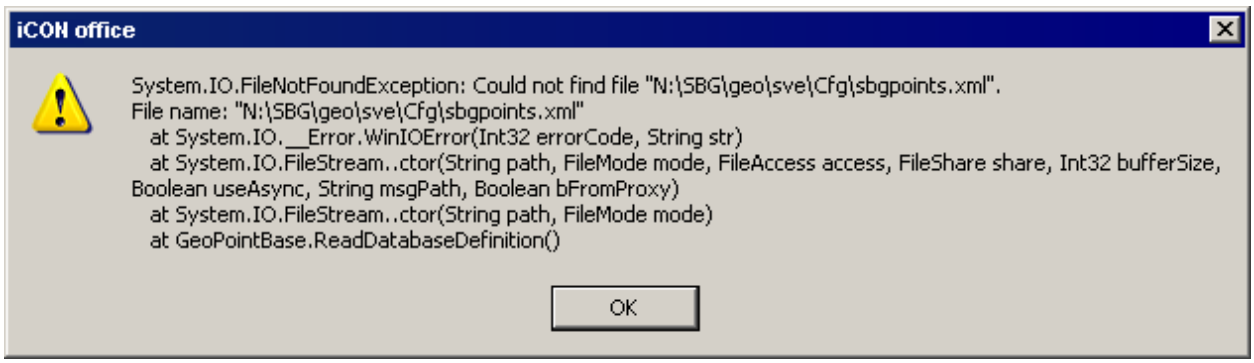
Click OK. If all went well you will now be informed accordingly. The configuration is now complete and you can use the database connection in iCON office.



Error messages following a failed connection
If the connection failed, an error message will appear. Below are examples of error messages.



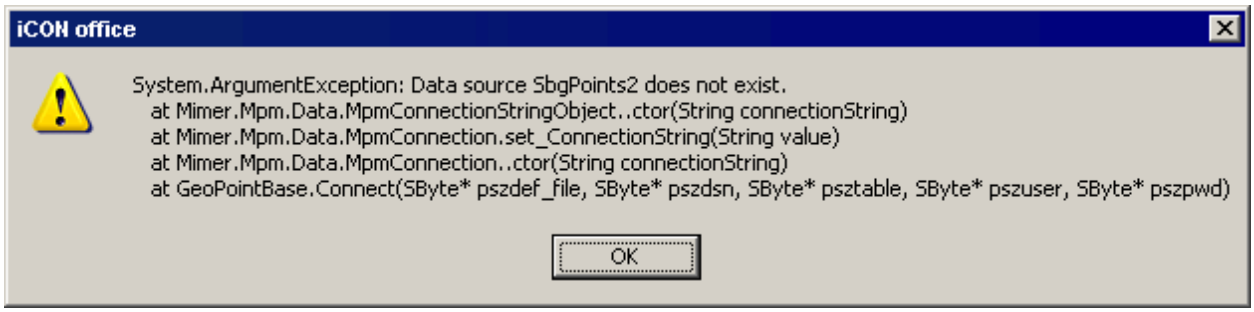
If this error message appears without any error given, there is probably something wrong with the settings in iCON office. It may be that iCON office has failed to load the gdocnet.dll file. If this is the case, you can check that gdocnet.dll has the necessary rights to run under .NET Framework. See the control panel and Microsoft .NET Framework 1.1 Wizards.



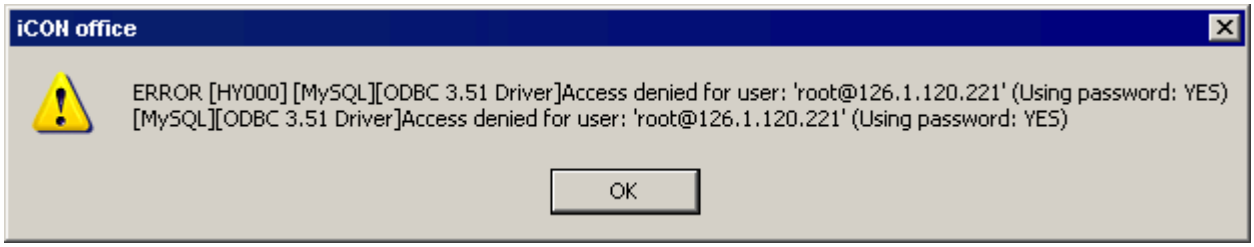
This error means that iCON office cannot locate the definition file (xml) for the connection. Check the path and filename, the file should be in the configuration folder in iCON office. If iCON office cannot locate the xml

file when you connect, it will create a new xml file. You can then use this file as the basis for a new connection.

In the System tab in the input/output window 107 you can see how the current configuration folder is set. The path to the configuration folder is also displayed in the system report that you open by selecting ***Help | About iCON office*** and clicking the **[System Report]**button.



This error means that you have entered an incorrect name for 'Mimer Provider Manager, Data Source Name' in the settings. Make sure you use the same name in iCON office and Mimer. If the names are consistent and it still does not work, try restarting both Mimer and iCON office and try reconnecting.



Probably wrong user name or password.

Definition files for the point database

In order to set up relationships between points in iCON office and points in the database, you use a configuration file. You specify the columns in the database table that are to be accessible from iCON office in the file. The format of the file is xml. The file should be placed in the configuration folder in iCON office.

The elements in the file have the following structure:

- <GeoPointDatabaseDefinition>
  - <Table>
    - <Column>
    - <Column>
    - <Column>
  - </Table>
- <GeoPointDatabaseDefinition>

```
  <?xml version="1.0" encoding="utf-8" ?>
- <GeoPointDatabaseDefinition xmlns:xsd="http://www.w3.org/2001/XMLSchema"
    xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xmlns="http://www.sbg.se">
  - <Table IndexedColumn="IDNR">
      <Column Precision="-1" Length="12" State="GeoPB_StateEnabled" Alignment="GeoPB_AlignLeft"
        Datatype="GeoPB_VarChar" Tag="GeoPB_PointNumber" Description="Punktnummer" Name="PUNKTNR" />
      <Column Precision="-1" Length="8" State="GeoPB_StateEnabled" Alignment="GeoPB_AlignLeft"
        Datatype="GeoPB_VarChar" Tag="GeoPB_Code" Description="Punktkod" Name="PUNKTKOD" />
      <Column Precision="-1" Length="2" State="GeoPB_StateEnabled" Alignment="GeoPB_AlignLeft"
        Datatype="GeoPB_VarChar" Tag="GeoPB_SpecialCode" Description="Specialkod" Name="SPECIALKOD" />
      <Column Precision="-1" Length="12" State="GeoPB_StateEnabled" Alignment="GeoPB_AlignLeft"
        Datatype="GeoPB_VarChar" Tag="GeoPB_Remark" Description="Anmärkning" Name="ANMARKNING" />
      <Column Precision="-1" Length="16" State="GeoPB_StateEnabled" Alignment="GeoPB_AlignRight"
        Datatype="GeoPB_Double" Tag="GeoPB_Northing" Description="X" Name="X" />
      <Column Precision="-1" Length="16" State="GeoPB_StateEnabled" Alignment="GeoPB_AlignRight"
        Datatype="GeoPB_Double" Tag="GeoPB_Easting" Description="Y" Name="Y" />
      <Column Precision="-1" Length="16" State="GeoPB_StateEnabled" Alignment="GeoPB_AlignRight"
        Datatype="GeoPB_Double" Tag="GeoPB_Elevation" Description="Z" Name="Z" />
    </Table>
  </GeoPointDatabaseDefinition>
```

For the element **Table** there is an attribute **IndexedColumn** that specifies the name of the column that is indexed.

For the Column element there are the following attributes:

Name
Enter the name of the column in the database table.

Description
Description of the column. This name will be displayed in numerical database views in iCON office.

Tag
This value specifies how and if the column is to be connected to a field in the coordinate files (geo/pxy).

GeoPB_PointNumber. The column is connected to point number.

GeoPB_Northing. The column is connected to X (north).

GeoPB_Easting. The column is connected to Y (east).

GeoPB_Elevation. The column is connected to elevation.

GeoPB_Code. The column is connected to point code.

GeoPB_SpecialCode. The column is connected to special code.

GeoPB_Remark. The column is connected to remark.

GeoPB_NoTag. The column is not connected to any field.

Datatype
This value specifies how the column is defined in the database. One of the following values can be selected:

GeoPB_BigInt, GeoPB_Blob, GeoPB_Boolean, GeoPB_Char, GeoPB_Clob, GeoPB_Date, GeoPB_Decimal, GeoPB_Double, GeoPB_Guid, GeoPB_Int, GeoPB_NChar, GeoPB_NClob, GeoPB_NVarChar, GeoPB_Object, GeoPB_Real, GeoPB_SmallInt, GeoPB_Time, GeoPB_Timestamp, GeoPB_VarBinary, GeoPB_VarChar.

Alignment
Specifies whether the column is left or right aligned. GeoPB_AlignLeft = left aligned, GeoPB_AlignRight = right aligned.

State
Specifies whether the column is to be activated. GeoPB_StateEnabled = enabled, GeoPB_StateDisabled =

disabled.

Length
Specifies the field width (number of characters) for the column.

Precision
Specifies the precision (number of decimals) for columns defined as floating points. This determines the number of decimal places to be displayed on screen. -1 means that the setting in iCON office for the number of decimal places applies.

See also Installation of External Programs for Point Database 914

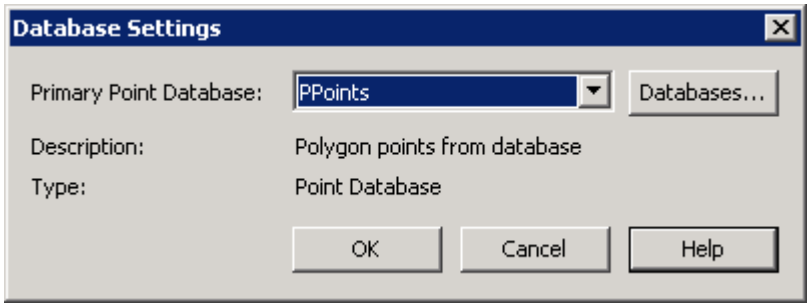
17.3 Using Point Database

You can use the connection to the point databases in iCON office for these applications.

- Criteria based searches of points for graphical and numerical display. You can also save points as coordinate files.
- Update of points in the database. You can add, edit or delete points.
- Searches of points as a reference for the calculation of surveys. You can use the database as a source for known points in, for example, coordinate calculation.

Database Settings

To make settings for the point databases, select ***File | Database Settings*** to open the dialog.



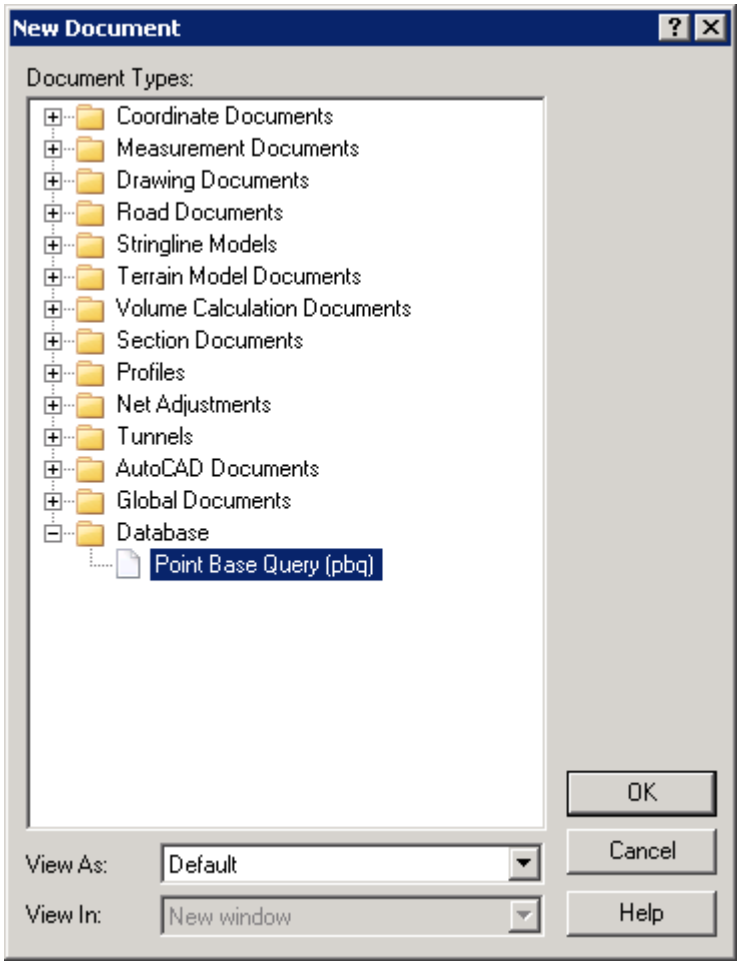
See Configuration of Point Database 919 for instructions on how to add new databases.

Primary point database

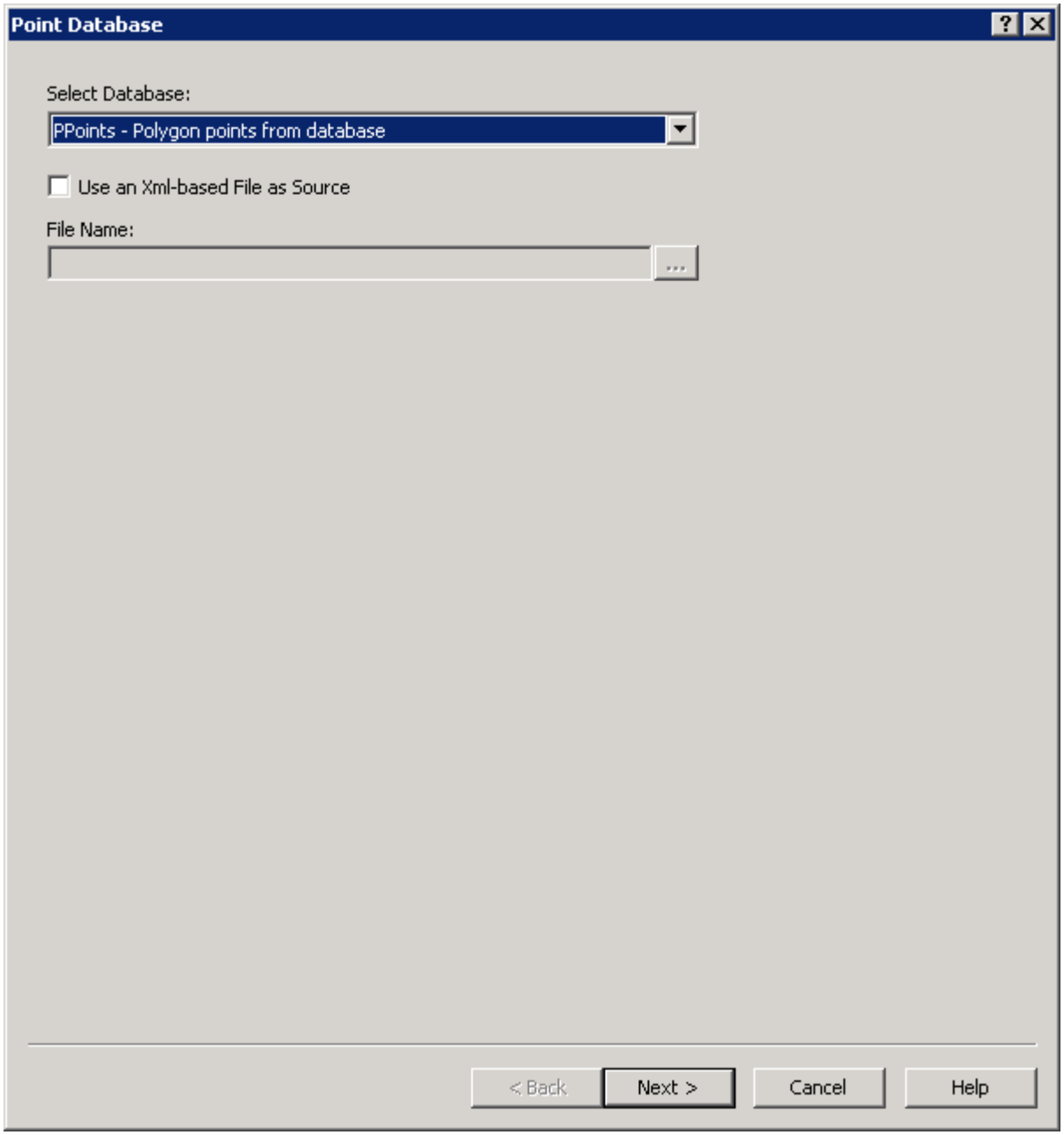
The database selected from the list represents the primary point database. This means that iCON office uses the database to load known points. The primary database will also be the first proposed choice when searching.

Searches in the database for graphical or numerical presentation

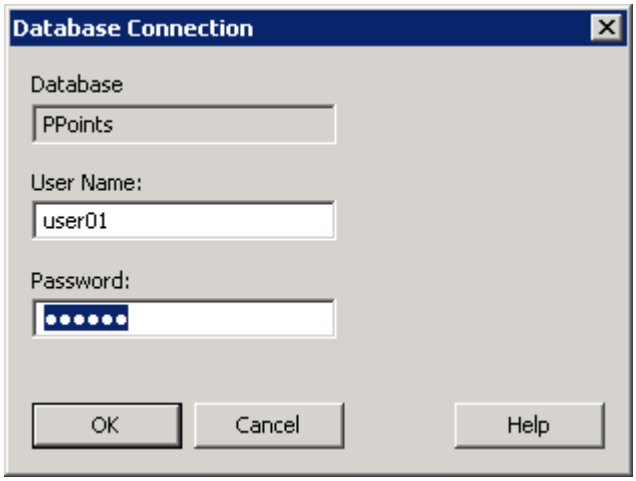
In order to search for and present points a special document type is used. This has the pbq file type (stands for Point Base Query). The data saved in the pbq document is the actual database query. This means that you can save searches and easily reuse them. You can also present multiple searches simultaneously, either in a single or a separate window. The points can be displayed both numerically and graphically. You can then edit the points, add points and delete points.



To make another search and present the points you choose to create a new document, ***File | New...***. You select the Database and option *Search the point database (pbq)* from the list of document types. You can also choose whether the document should appear in a new window or in an existing one. Now click **[OK]**.

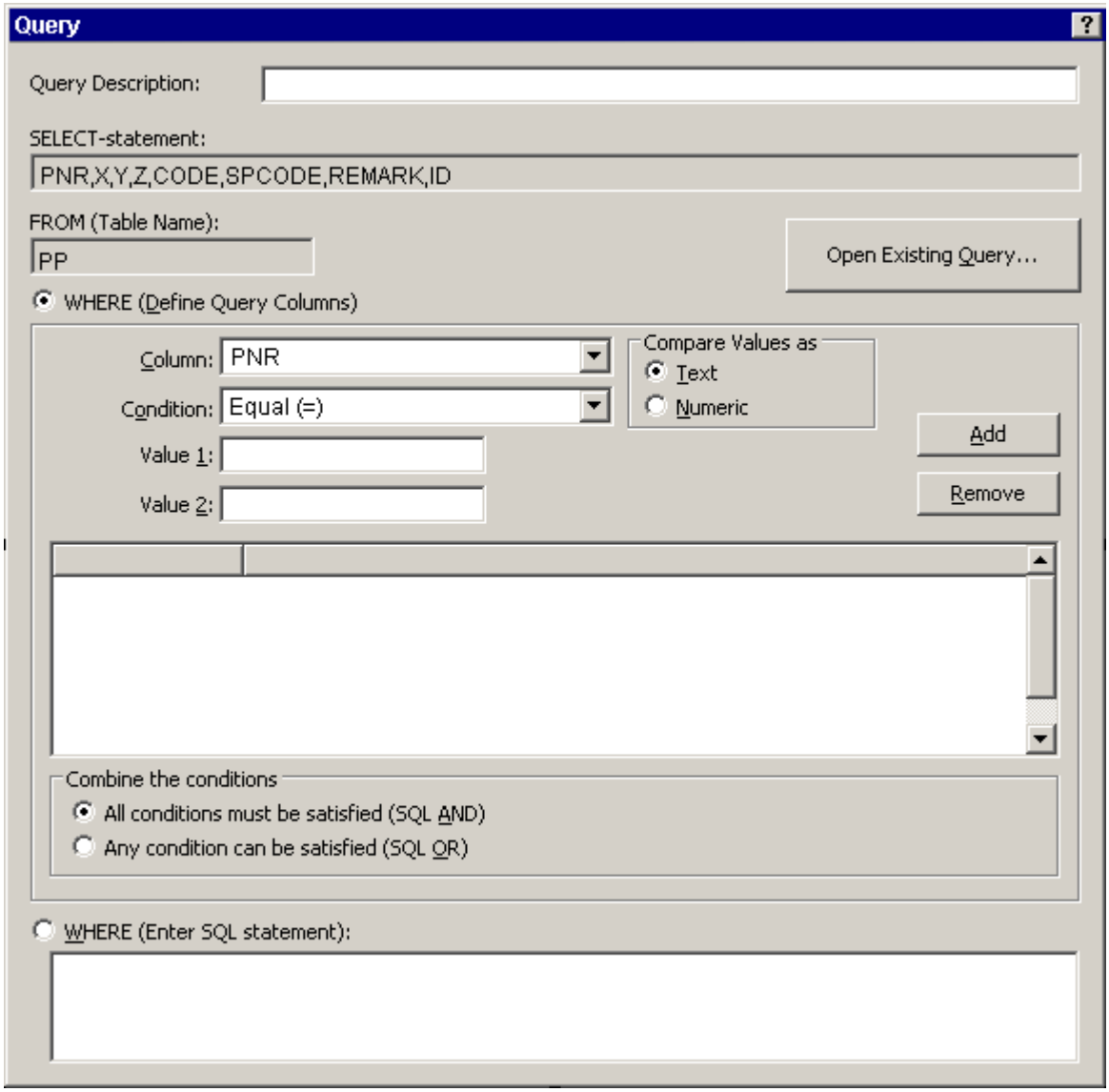


First select the database for the search. The primary database is always highlighted in the list. Now click **[Next]**.



Search

The login box for the database now appears. Enter the user name and password. If you have already logged into the database, this box will not appear again until you restart iCON office.



At the top of the dialog you can enter a descriptive text for your search. This can be useful if you save the

document and want to know what the search was used for later.

The database will be searched using an SQL statement (SELECT statement). The search dialog is divided up like a SELECT statement in SQL. A SELECT statement has the following basic structure:

SELECT [columns] FROM [data source] WHERE [criteria]

The columns that are loaded are defined in the configuration of the current database connection. You will not be able to affect this when the connection is created.

The data source (i.e. table) that is used is also subject to the current connection.

The WHERE part of the search can be done in two ways, either by adding one or more column-based search criteria or by entering the WHERE expression manually.

Define Columns to Search
If you do not add any criteria at all, all points in the table will be loaded. If you add more criteria, you can choose to combine them so that all criteria must be met or that just a few criteria must be met.

Column
The columns that are available are determined by the connection's configuration.

Criteria
Select the criteria for the search from the list.

Value 1 and Value 2
Enter the value for the criterion. Value 2 can only be completed if you have chosen the criterion 'between' or 'not between'.

Compare Values As
This determines how the comparison of values is to be made in alphanumeric fields. Either the entire contents of the field are interpreted as a numerical value or the content is compared character by character. This only applies to columns that could contain text.

Add and Delete
Use the buttons to add or remove search criteria.

Enter the SQL search expression
With this choice, you can enter the WHERE part (and possibly other subsequent SQL terms, e.g. ORDER BY) of the SQL search.

Open Existing Search
If you have saved searches, you can reuse them by clicking the button and selecting a pbq file.

Search Terms
You can use wild cards to search for data.

- **_** or **?** are used to match any character. But only one character.
- **%** or ***** are used to match zero or several characters of any type.

If you want to search for values that contain any of the above characters, you use a backslash before the character, e.g. \% to search for %.

Examples of criteria:

Criteria	Value 1	Value 2	Results.
Equal =	P29027		Retrieves all posts where the content of the column is P29027.
Equal =	P29%		Retrieves all posts where the content of the column starts with P29.
Equal =	%27		Retrieves all posts where the content of the column ends with 27.
Equal =	P%7		Retrieves all posts where the content of the column starts with P and ends with 7.
Equal =	P\%		Retrieves all posts where the content of the column is P%.
Equal =	_2907		Retrieves all posts where the content of the column starts with any character but ends with 2907.
Greater than >	15765		Retrieves all posts where the content of the column is greater than 15765.
Less than <	7.1		Retrieves all posts where the content of the column is less than 7.1.
Between	P29027	P29031	Retrieves all posts where the content of the column is between P29027 and P29031.
Not between	P29027	P29031	Retrieves all posts where the content of the column is not between P29027 and P29031.

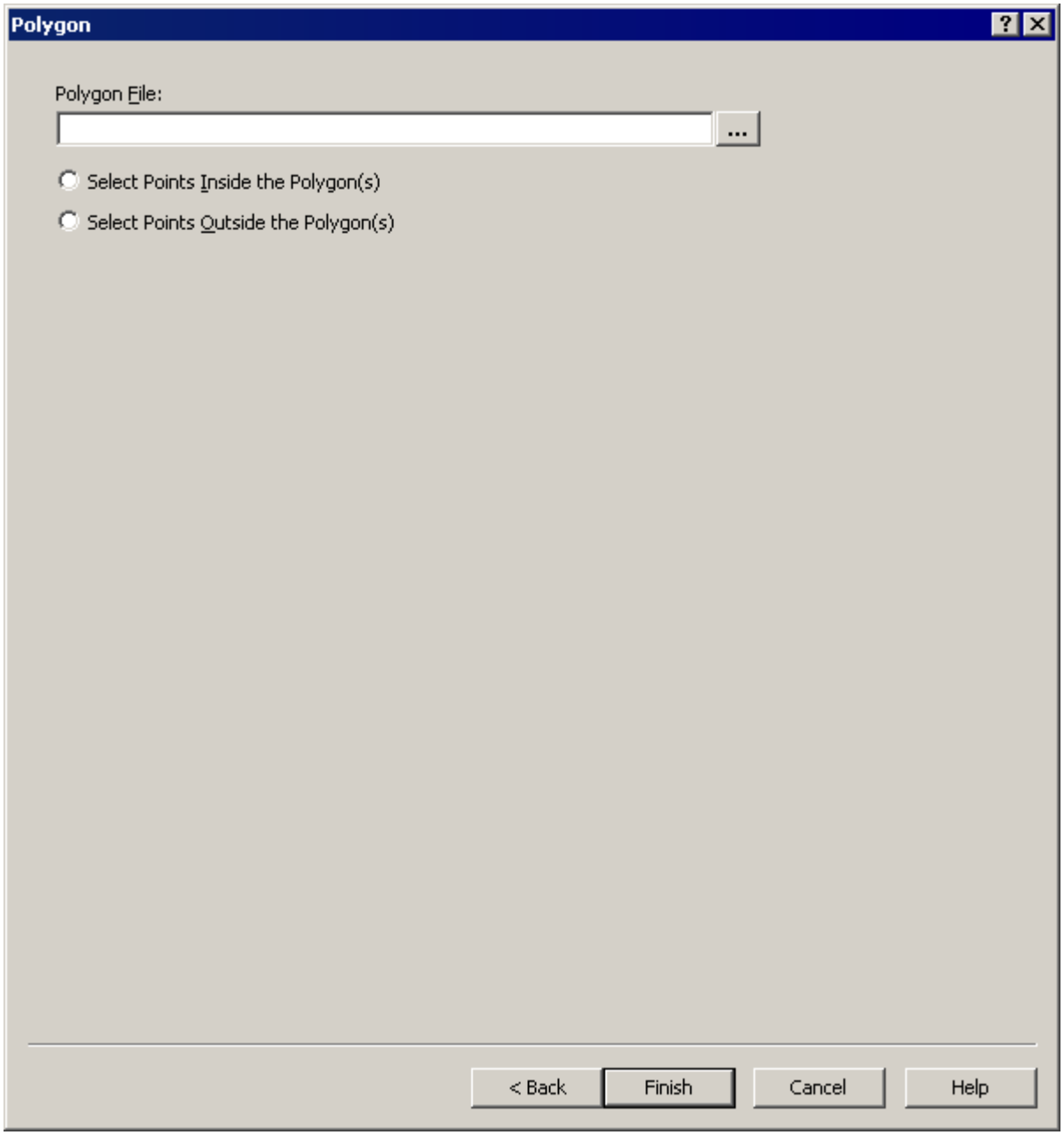
Example of SQL WHERE:

WHERE

PNR LIKE 'P29%' - Retrieves all posts where the content of the PNR column starts with P29.

Z < 7.1 - Retrieves all posts where the content of the Z column is greater than 7.1.

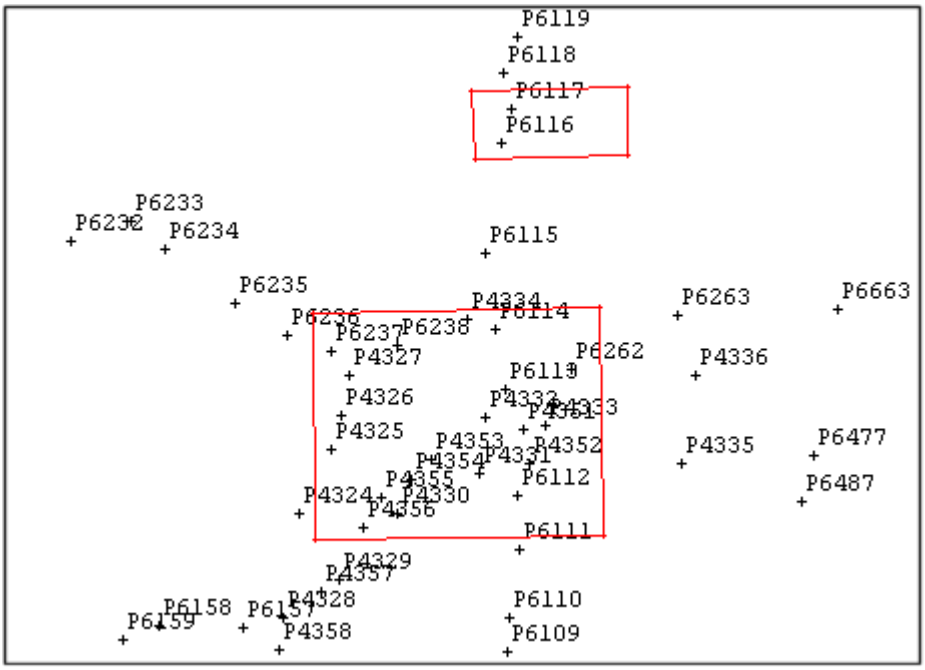
Search with Polygons
It is possible to restrict the selection of points using one or more border polygons.



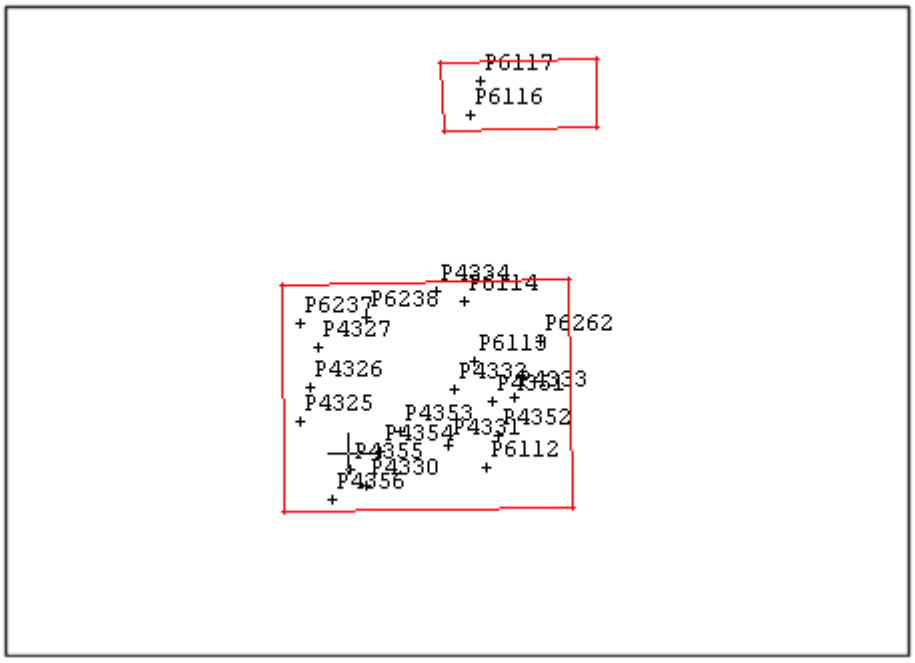
The border polygons are made using lines in a coordinate file. Each line represents a polygon.

File with Border Polygon(s)
Select the desired coordinate file to make the selection. You do not need to specify any polygon file.

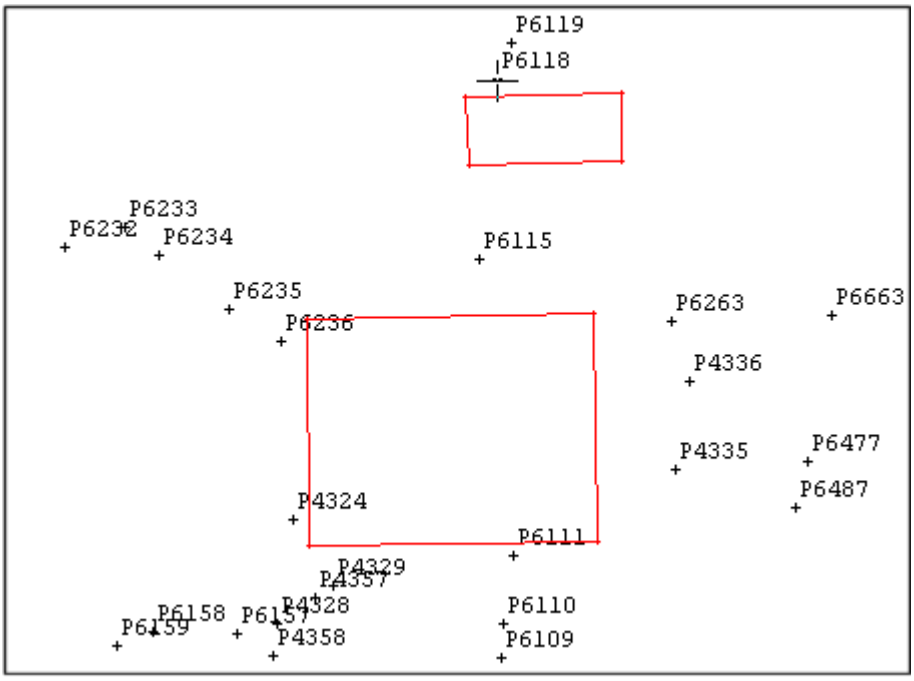
Inside/Outside
You can also choose if the points are to be loaded inside or outside the polygon.



All points with the border polygons drawn.



Points within the border polygons loaded.



Points outside the border polygons loaded.

When all criteria have been entered, click **[Finish]**. This will open a pbq document with the points that match your search. You can then choose to save the document. What you save here is not the found points, but the actual search term instead. If you choose to open a pbq file later, the search will be made and the points will be presented as above.

Presentation and further processing of the search results (pbq document)

When a database search is carried out, the results are presented using a pbq document. These documents are handled like any other document in iCON office. You can open any number of documents simultaneously and you can choose to add them to the same graphical window if you prefer.

Numerical View

The numerical view of a database search contains the columns that the configuration of the current connection specifies. How the information is presented is also determined in this way. This applies, for example to number of decimals, field widths, column order, etc.

	Status	Punktnummer	X	Y	Z	Punktkod	Specialkod	Anmärkning
1	=	P29027	101 605,561	64 695,317	47,380	PP		
2	=	P29028	102 387,164	64 995,852	51,550	PP		
3	=	P29029	102 363,889	64 840,749	52,430	PP		
4	=	P29030	102 346,269	64 704,088	57,730	PP		
5	=	P29031	102 318,593	64 484,268	58,170	PP		
6	=	P29032	102 345,602	64 377,955	56,580	PP		
7	=	P29033	102 385,568	64 258,735	52,430	PP		
8	=	P29034	102 416,250	63 951,775	53,720	PP		
9	=	P29035	102 430,760	63 811,476	62,070	PP		
10	=	P29036	102 418,534	63 697,280	64,550	PP		
11								

Add, Edit and Delete Points

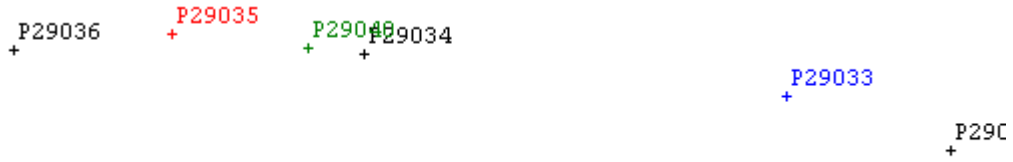
You can make changes to the points in the numerical view. Note that the changes do not affect the database until you actively accept them. You do not need to be afraid to make changes by accident.

- You add new points to the blank line at the bottom. The line will then be colored green and the status column far left indicates that there is a new point.
- You delete points by selecting the desired line/lines and then pressing the Delete key or selecting ***Edit | Delete***. The line then turns red.

- Changes to existing points are made directly in the desired cell. The changed lines turn blue.

5	=	P29031	102 318,593	64 484,268	58,170	PP		
6	=	P29032	102 345,602	64 377,955	56,580	PP		
7	Ändrad	P29033	102 385,568	64 258,735	52,430	TRI		
8	=	P29034	102 416,250	63 951,775	53,720	PP		
9	Raderad	P29035	102 430,760	63 811,476	62,070	PP		
10	=	P29036	102 418,534	63 697,280	64,550	PP		
11	Ny	P29040	102 419,410	63 910,201	63,102	PIKE	X	
12								

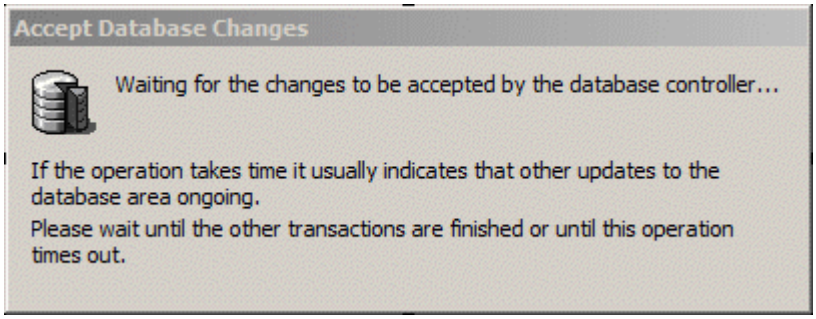
A new point, a deleted point and a changed point in the numerical view.



A new point, a deleted point and a changed point in the graphical view.

Accept Changes

Once you have made changes in the views and want to update the database, you select ***Data | Accept Changes***. Note: This implements all the changes made in the view.



This box is displayed while the changes in the database are being implemented. How long the update takes depends on the database type and the other data traffic in progress. If the program locks up with this image, you should wait until the time limit that has been set for database has expired.

Reject Changes

If you have made changes in views that you do not want to save, you select ***Data | Reject Changes***. This rejects any changes made.

Conflicts when updating the database

There may be conflicts when updating the database. The following example describes what happens when two instances try to update the same post simultaneously. Simultaneously here does not necessarily mean at the same second, but instance 1 updates the database after instance 2 has loaded its data.

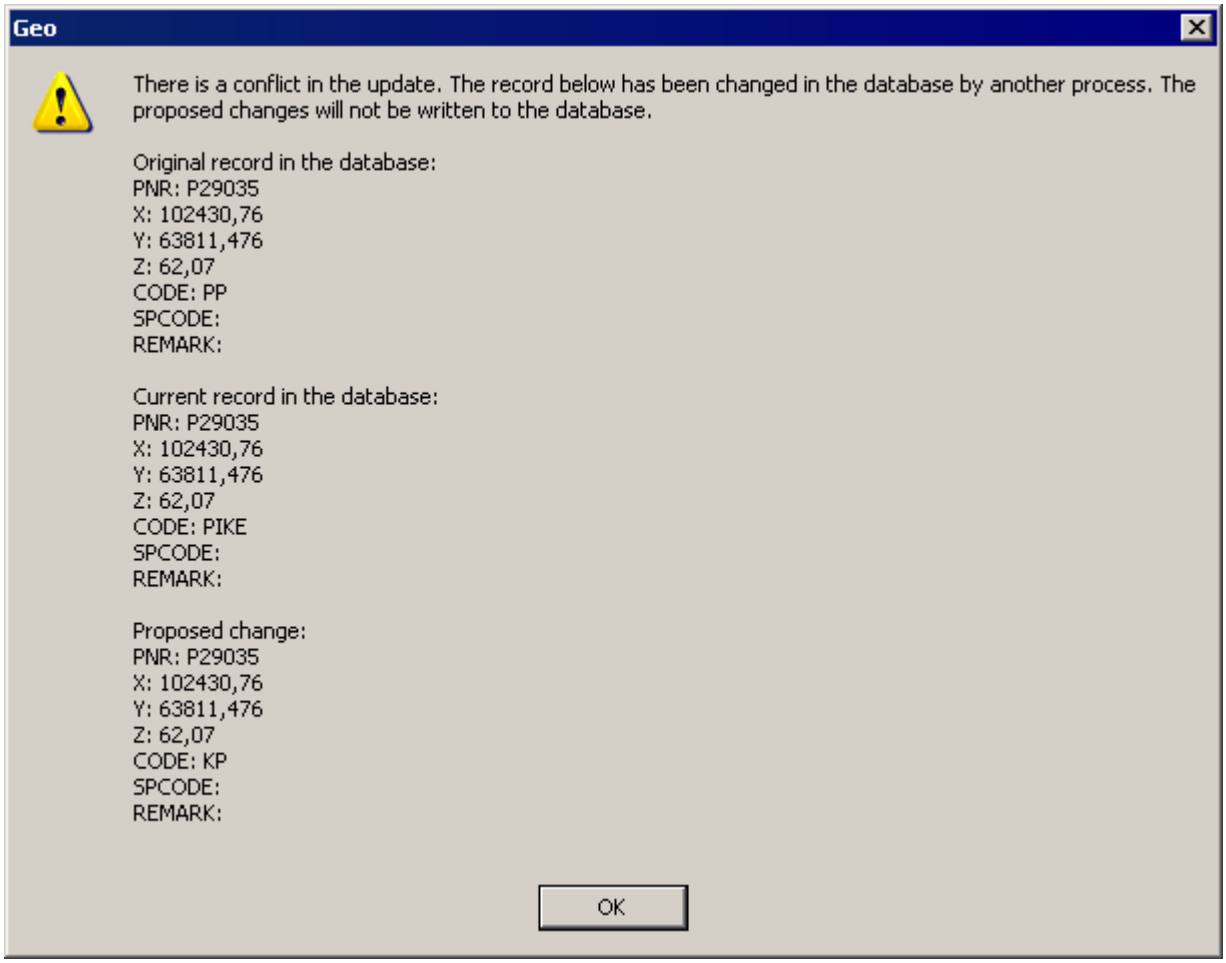
Instance 1 loads data from the database and makes a change to the point code for point P29035. The code changes from PP to PIKE.

8	=	P29034	102 416,250	63 951,775	53,720	PP
9	Ändrad	P29035	102 430,760	63 811,476	62,070	PIKE
10	=	P29036	102 418,534	63 697,280	64,550	PP

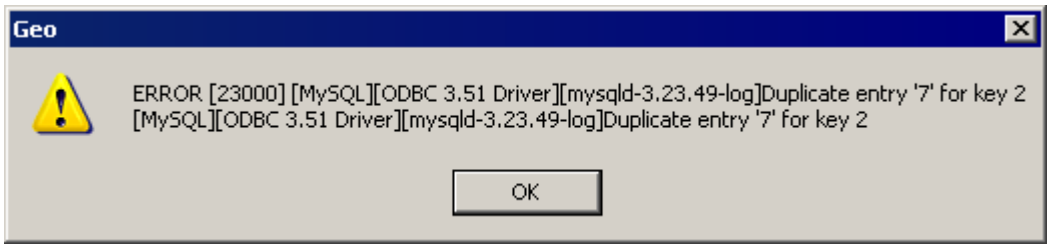
Before instance 1 accepts its changes, instance 2 also selects to load data from the database and makes a change to the point code at the same point, P29035. The code changes from PP to KP.

7	=	P29033	102 383,388	64 258,735	52,430	PP		
8	=	P29034	102 416,250	63 951,775	53,720	PP		
9	Ändrad	P29035	102 430,760	63 811,476	62,070	KP		
10	=	P29036	102 418,534	63 697,280	64,550	PP		
11	=	1	0,000	0,000	0,000			

Instance 1 now chooses to accept its change and instance 2 then selects to do the same. When a conflict arises. Instance 2 will not be allowed to make its change because the post has been changed after it was loaded. The following dialog is displayed in iCON office to clarify what has happened. If instance 2 wants to implement its change, a new database search must first be made and then the change must be repeated.



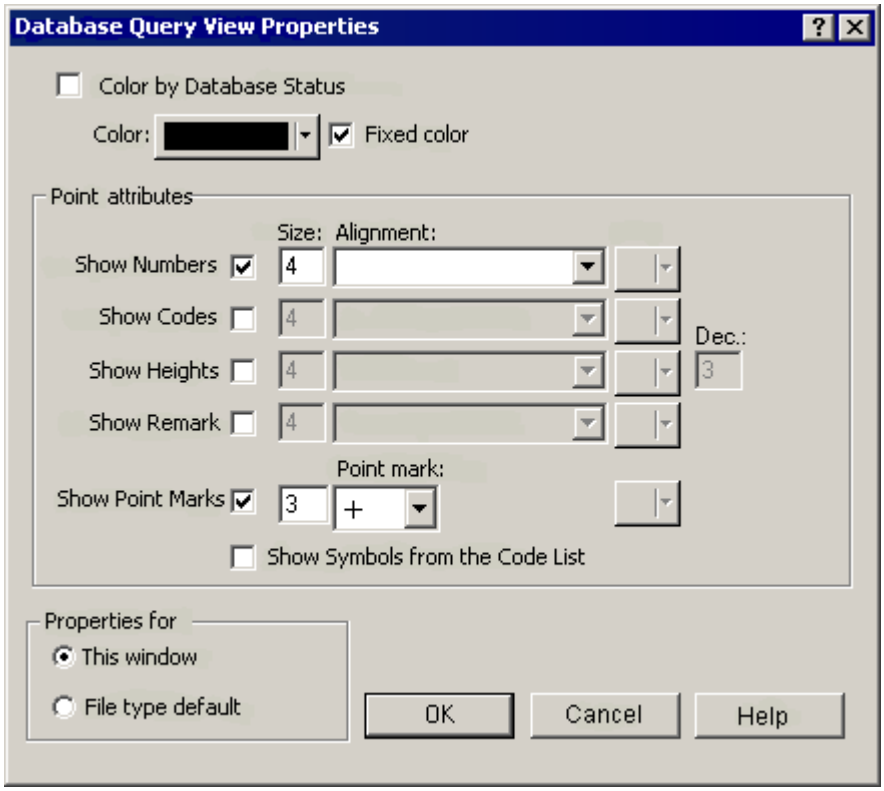
The database may have certain restrictions for the contents of the database columns. A typical restriction that may apply to the point numbers is that they must be unique. If you try to add a new point with a point number that already exists, a message may appear as below:



Example: A post with the value "7" in a column is already in the database. The column does not allow duplicates.

Graphical Settings

You can select how the points in the database are presented in graphics by selecting ***View | Document Properties*** from the graphical view.



Color as per the status of the database. Check the box if you want new points to be green, deleted red and changed blue. Otherwise, you can choose to set another color for all points.

In the same way as in the coordinate views, point numbers, point codes, heights and remarks, as well as point marks can be printed at points. Also select size, alignment and color for this information. Note that this assumes that for the configuration of the database connection you have set up what the point number, point code etc. are in the database.

You can also choose to download symbols through the code list, by checking the box **Display symbols in accordance with the code list**.

You can choose whether changes are to be standard by selecting **File type default**.

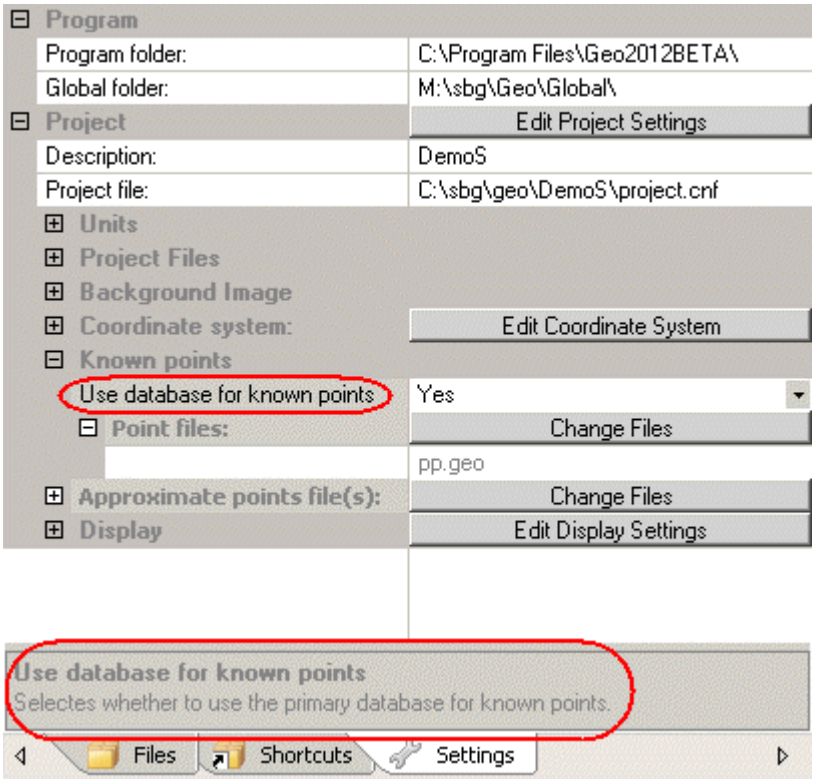
Import Points
By selecting ***Data | Import Points*** you can choose to load items from a coordinate file. These points are then marked as being new in the document view. You can then choose to accept the changes as above.

Export Points
You can choose to save the found points as a coordinate file153. Select ***Data | Export Points***. A new document now opens with the same coordinate points as in the pbq document. You can then use the coordinate document as usual.

View Current Search
Select ***Data | View Search*** to see how the current points have been loaded, i.e. the criterion/criteria that have been used.

Use the point database for known points

You can select for iCON office to look in a point database each time known points are to be used. This applies, for example, where station points and backsights may exist in the database. You makes the selection in the Settings16tab, check the box if the database is to be used for searching known points.



If you have not previously logged in the connection dialog[937] will be opened as soon as a known point is loaded.

Database transfer via coordinate document

An alternative way of reading and writing data is to use the database transfer function that is available from the coordinate document. See Database Transfer[177] .

See also Installation of External Programs for Point Database[914], Configuration of Point Database[919], Project Settings[16]

18 Error Reporting

Why sending error reports?

To increase the stability of iCON office, you can send error reports to the development team of iCON office.
If iCON office stops working, a dialog will open which the user can send directly to the development team.

Benefits of submitting error reports:

- The development team get the error reports.
- Using the crash report's content, the development team analyze the cause of the crash.
- The development team will use the error reports to improve iCON office.

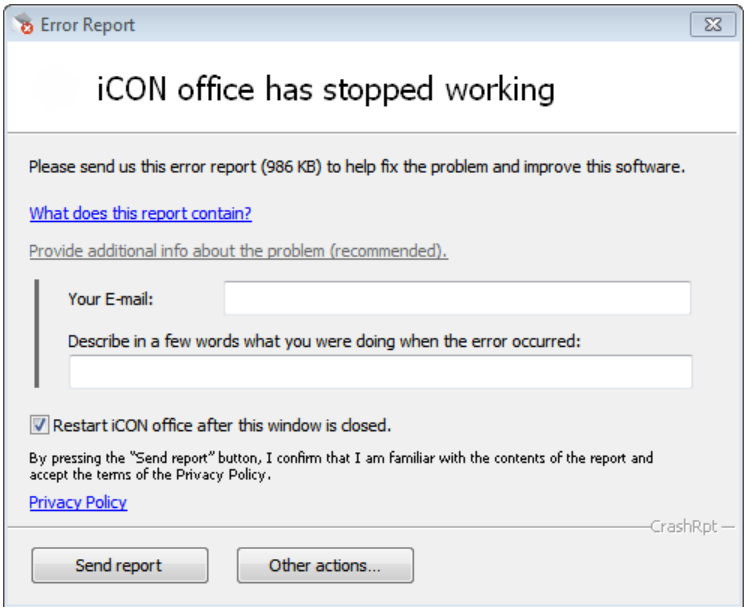
Only for internal use within the development team

The error reports are collected only for internal use by the development team of iCON office and with the sole purpose of gathering information of causes for crashes so that they in the future can be avoided.

If iCON office crashes, do not hesitate to submit the error report. All error reports will be analyzed by the development team who will try to fix the problem, as soon as possible.

Example of crash report

To display the content of the error report, the user can click the text What does this report contain 948?

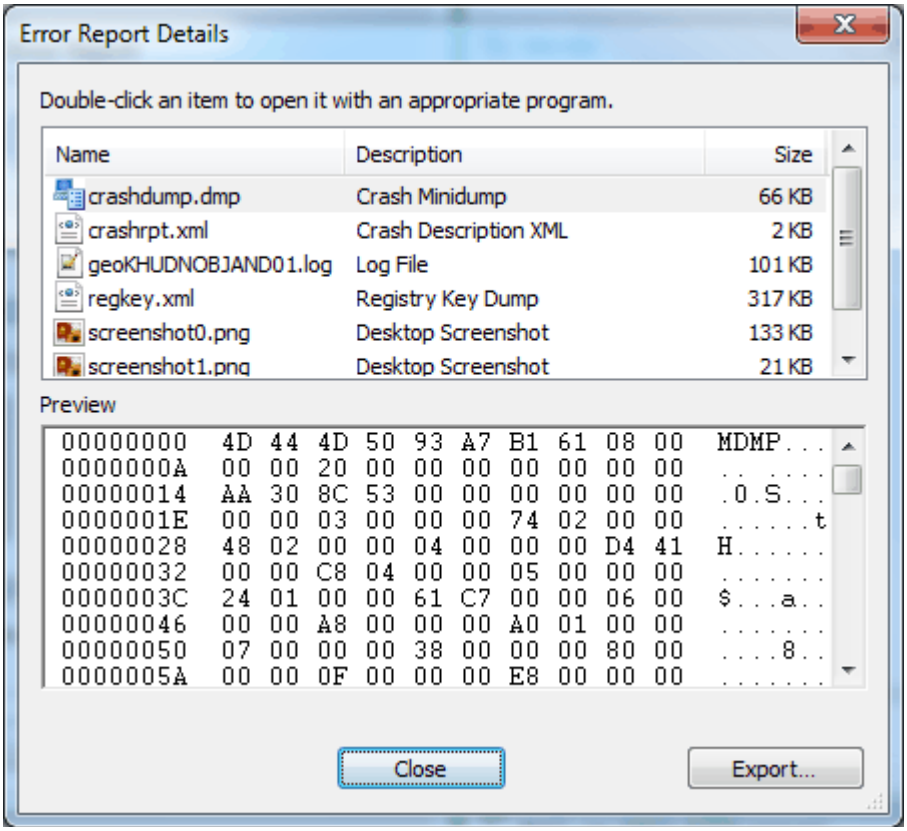


Error report

What does this report contain?	Click to open a report with details of the error report's content, see below 948.
Your E-mail	Optional. Enter your E-mail address or choose to submit the report anonymously.
Describe in a few words what you were doing when the error occurred:	Optional. Please describe with a few words what you were doing when the error occurred.
Restart iCON office after this window is closed.	Check the box if you want do restart iCON office.
[Send report]	The error report is sent directly to the development team of iCON office.
[Other actions...] • Close the program and send report later • Close the program	Select if • iCON office should be closed and the error report should be saved to be sent off at a later time - advisable if you have no internet connection. • iCON office should be closed without sending error report.

Content of the submitted error report

Click the text **[What does this report contain?]** to display the files included in the error report.



Example of error report contents.

File namn	Description	Content
crashdump.dmp	Crash Minidump	Technical information about exception in iCON office such as processor information, operating system version, process and thread information, stack traces for each thread and a list of loaded modules.
crashrpt.xml	Crash Description XML	Crash description XML file containing basic information about the crash, such as software name and version, resource usage parameters, your Windows version, your country and language.
xxx.log	Log File	File containing information about selected functions in iCON office before the crash.
regkey.xml	Registry Key Dump	Persistent settings of iCON office. Right click to delete the file if you do not want to submit it.
screenshot.png	Desktop Screenshot	Desktop screenshot image files in PNG format containing the image of iCON office's main window. Right click to delete any screenshots you do not want to submit.
Attach More File(s)...		Right click and select **[Attach More File(s)...]** if you want to add additional files to the report.

Double click a file to open it with an appropriate program.

[Export...]
Click **[Export...]** if you want to create a zipped file containing all files in the error report.

19 Quick Guides

How to use different functions in iCON office.

- Transform to global longitude and latitude 954
- Transform to local coordinates 952
- GNSS aided free station 956
- Convert AutoCAD files to ESRI ShapeFiles, to be used in iCON telematics 957

19.1 Transform global latitude and longitude to local coordinates

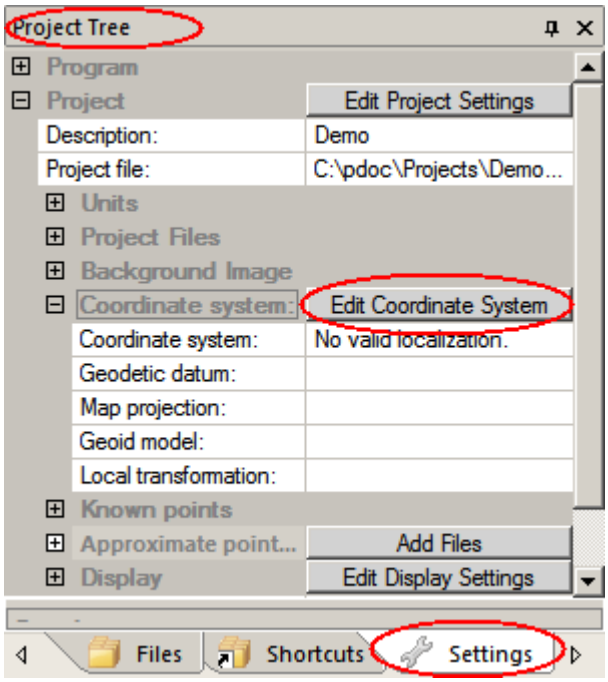
Transform global latitude and longitude to local coordinates

Use iCON office to transform latitude and longitude coordinates[185] to local coordinates.

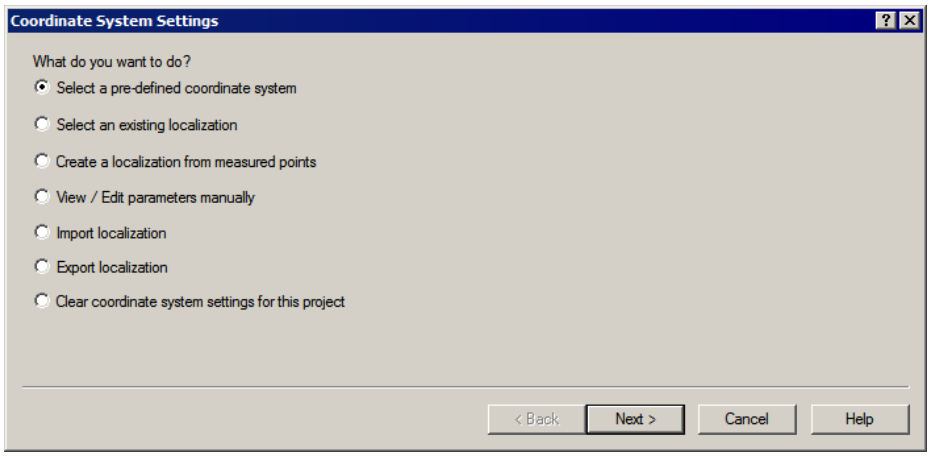
Select a local coordinate system

To transform global latitude and longitude coordinates to local coordinates in a certain coordinate system, you need to set this coordinate system as active in the project.

Open the project tree: ***View | Project tree*** and select the tab ***Settings***.



Select ***[Edit Coordinate System]*** to select your coordinate system.



You can select a coordinate system from the global folder[17] by selecting **[Select a pre-defined coordinate system]**, or choose a localization file (lok-file), which you have saved in any of your projects, by selecting **[Select an existing localization]**.

Transform your file to a local coordinate system	• Open the file containing latitude and longitude coordinates. • Select ***Data | Transform to local coordinates***. • You have now created a coordinate file where the points are expressed as local coordinates in the chosen coordinate system.

See also: Selecting Coordinate System, 124 Latitude/Longitude Files, 185 Program Settings 109

19.2 Transform local coordinates to global longitude and latitude

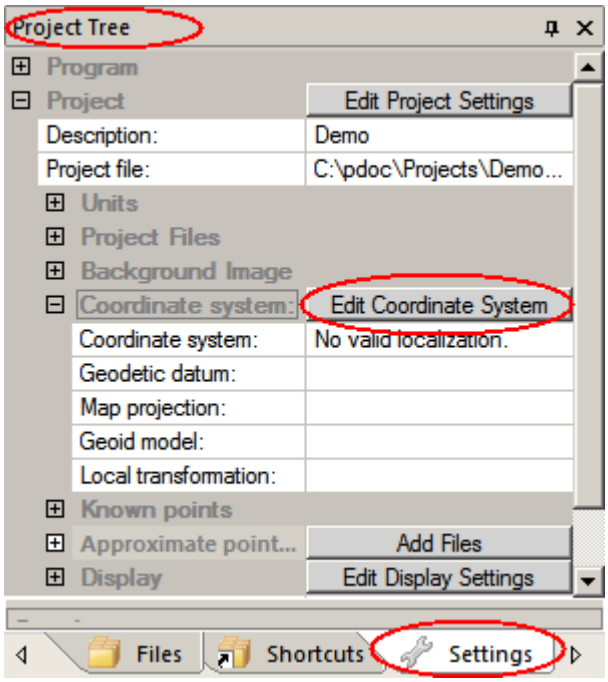
Transform local coordinates to global latitude och longitude

Use iCON office to transform local coordinates to global latitude and longitude coordinates 185.

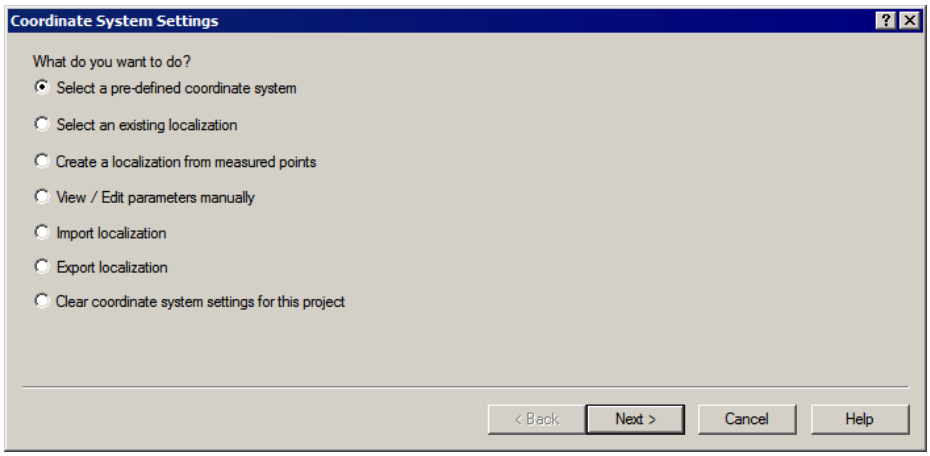
Select a local coordinate system

To transform local coordinates, expressed in a certain coordinate system, to global latitude and longitude coordinates, you need to set the correct coordinate system active in the project.

Open the project tree: ***View | Project tree*** and select the tab ***Settings***.



Select ***[Edit Coordinate System]*** to select your coordinate system.



You can select a coordinate system from the global folder 17 by selecting **[Select a pre-defined coordinate system]**, or choose a localization file (lok-file), which you have saved in any of your projects, by selecting **[Select an existing localization]**.

Transform your file to global longitude and latitude coordinates	• Open the file containing local coordinates. • Select ***Data* | *Transform to global longitude and latitude***. • You have now created a file where the points are expressed as global longitude and latitude.

See also: Selecting Coordinate System, 124 Latitude/Longitude Files, 185 Program Settings 109

19.3 GNSS Aided Free Station

GNSS aided free station

If you use the software GeoPad, you can establish a GNSS aided free station.

Establing a GNSS aided free station

A GNSS aided free station is established with GeoPad by measuring a number of points with both RTK and total station simultaneously. To do this possible, you need a pole where you can attach both a prism and a GNSS antenna.

The software in GeoPad simultaneously takes care of measuring data from both GNSS and total station. The calculation requires that the distance between the reference point (electrical phase center) of the GNSS antenna and the prism is defined.

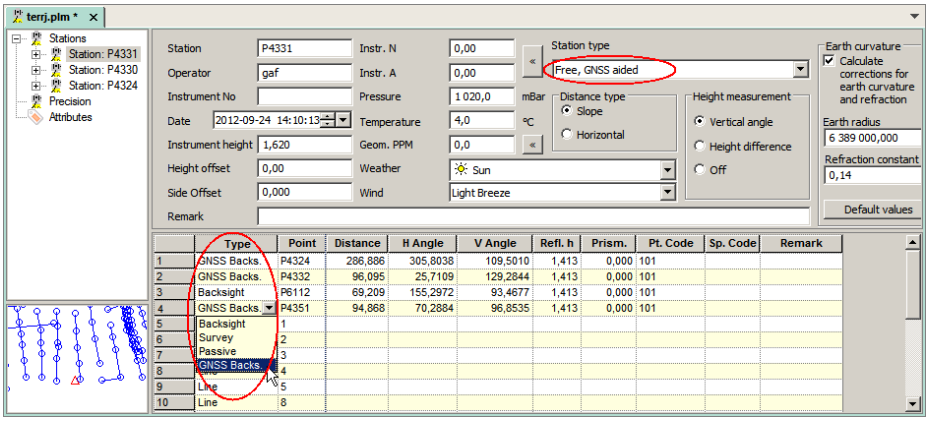
The type 'GNSS backsight' in the survey file, plm

It is only when you have been doing your measurements with the software GeoPad that you can get a point of type 'GNSS backsight' in your survey file, plm.

Step by step

Briefly, a GNSS aided free station can be described in the following steps:

- Set up your total station.
- Connect the GeoPad software to a total station and RTK service.
- Measure a number of GNSS backsights until coordinates and orientation of the free station is calculated with adequate accuracy.
- For each measured GNSS backsight, GeoPad simultaneously stores measuring data from totalstation and RTK.
- The position of the GNSS aided free station is calculated by the software in GeoPad, which combines measuring data from GNSS with lengths and angles from the total station.
- The station setup is improved, the more GNSS backsights you measure.
- When the GNSS aided free station is calculated, you can quickly and easily perform any surveying and setting out.



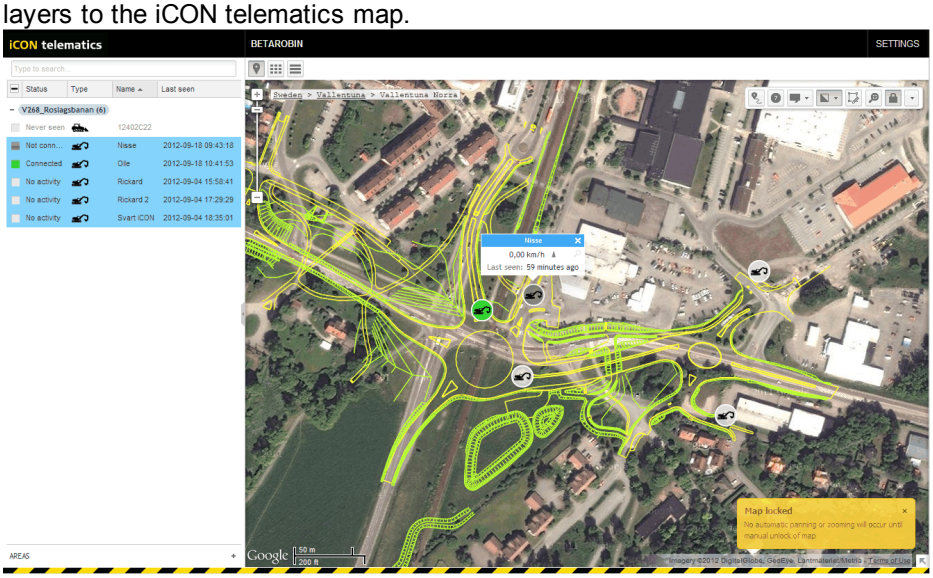
Example of a surveying file from a station setup with GNSS aided free station.

See also: Survey Files 321

19.4 Convert AutoCAD files to ESRI ShapeFiles, to be used in iCON telematics

Background

When you use Leica iCON telematics it is possible to log the machine's position and visualize this on a map. You can add your own layers that make it clearer where the machine is located. This document explains how to add these layers to the iCON telematics map.



Convert files from AutoCAD® format to ESRI Shape format

The following instructions describe how to convert AutoCAD files to ESRI Shape format for further use in iCON telematics software.

In iCON telematics you can use ***lines, polygons and points*** in ESRI Shape format.

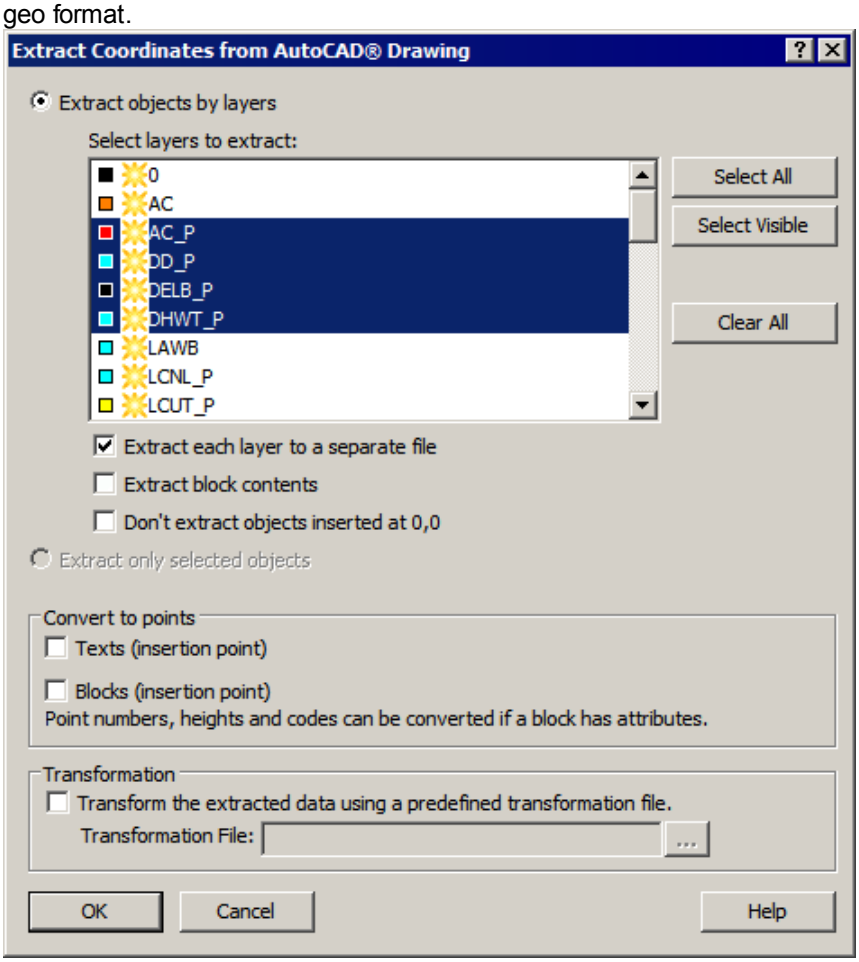
The process:
AutoCAD format -> .geo format -> .geo format (Transformed to World Mercator) -> .shp format

The conversion is done in the following steps:

1. Convert the AutoCAD file (dwg, dxf) to iCON office format (geo). 958
2. Change the coordinate systems: Transform coordinate files in geo format from local to World Mercator projection. 959
3. Convert the World Mercator projected coordinate files to ESRI Shape format (shp). 963
4. Check the appearance of the transformed ESRI Shape files. 964
5. Import ESRI Shape files to iCON telematics 964

Convert the AutoCAD file to iCON office format (geo)

Open an AutoCAD® file (dwg, dxf) in iCON office and select ***Data | Extract Coordinates from AutoCAD® drawing***. You will then convert AutoCAD files to geo format.



Settings in the dialog

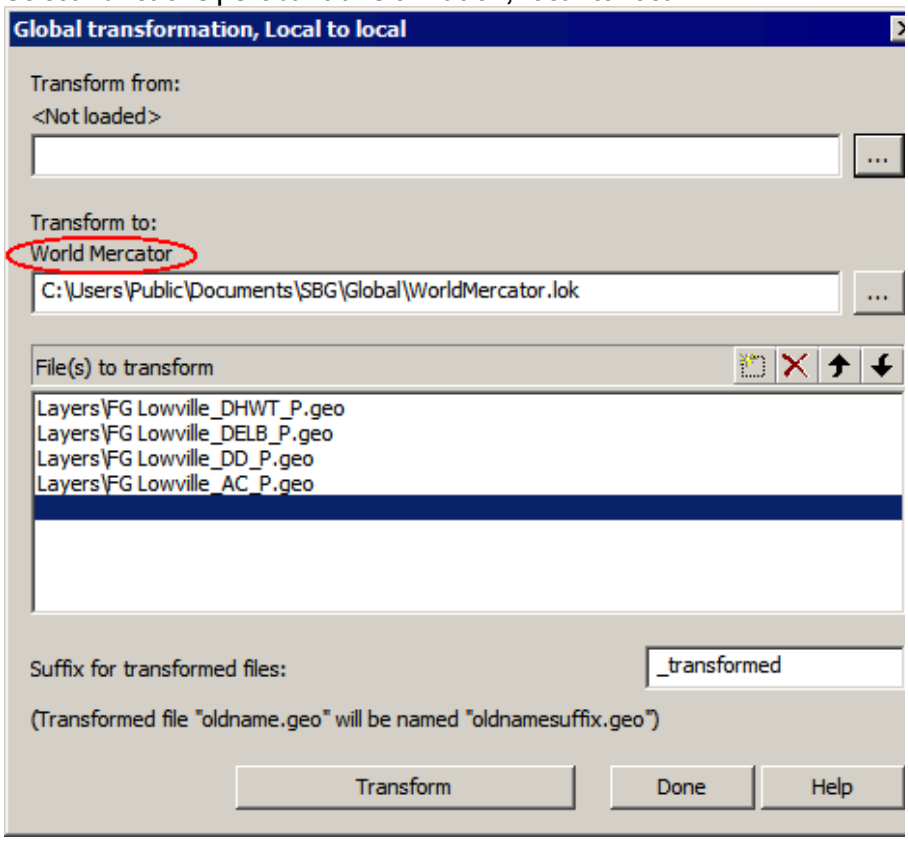
Settings in the dialog:

- Select **[Extract objects by layers]**.
- In the list, select the layers you want to convert to ESRI Shape format.
- Select **[Extract each layer to a separate file]**.
- Click **[OK]** to create geo-files.
- Save the geo-files with individual names.

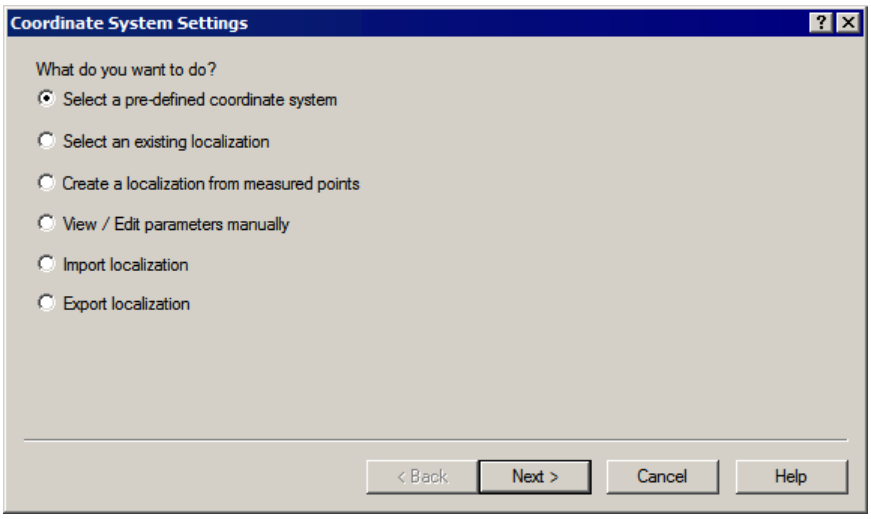
Transform the coordinate files in geo-format from the local projection to World Mercator projection

To display data in iCON telematics, which uses Google Maps, data needs to be transformed into the coordinate system World Mercator.

- Select **Functions | Global transformation, local to local**.



- **Transform from:**
  You need to know the coordinate system of the original AutoCAD files. If you have had the AutoCAD file delivered, you have to find out which localization file (lok) to be selected.
  Click ... and select an appropriate localization file.



Select **[Select a predefined coordinate system]** if the coordinate system is stored in the global folder.
Select **[Select an existing localization]** if you have saved the localization in a iCON office project.

If you need to create your own localization using some of the other options in the dialog above, see Global transformation, local to local[148] .

- **Transform to:**
  Click ... and **[Select a predefined coordinate system]** to be able to select ***World Mercator*** from the global folder.
  If the World Mercator projection is missing, you can download it from https://s3.amazonaws.com/ictmanuals/World+Mercator.lok. Copy the text to a text file and save the localization named "World Mercator.lok" in iCON office's global folder.

- **File(s) to transform**
  Click to select file or files to be transformed. Click to delete any file from the list that should not be transformed.

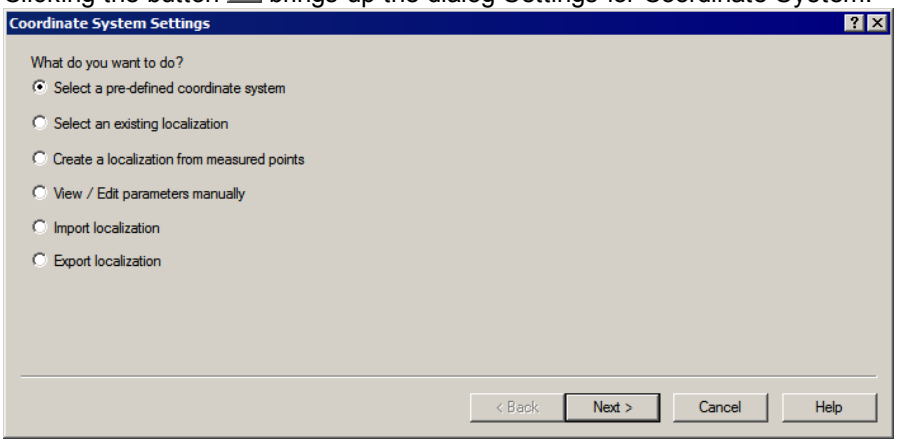
- **Suffix for transformed files**
  Enter an optional suffix, which will be added to the name of the transformed files. Default is "_transformed".

Click **[Transform]** to perform the transformation, click **[Done]** to close the dialog.
The transformed coordinate files are now saved in the same folder as the original files and named to the original name plus the suffix that appears in the box.

Example: VAG.geo -> VAG_transformed.geo

Click here for more information about transformation and the choice of localization file.

Clicking the button ... brings up the dialog Settings for Coordinate System.

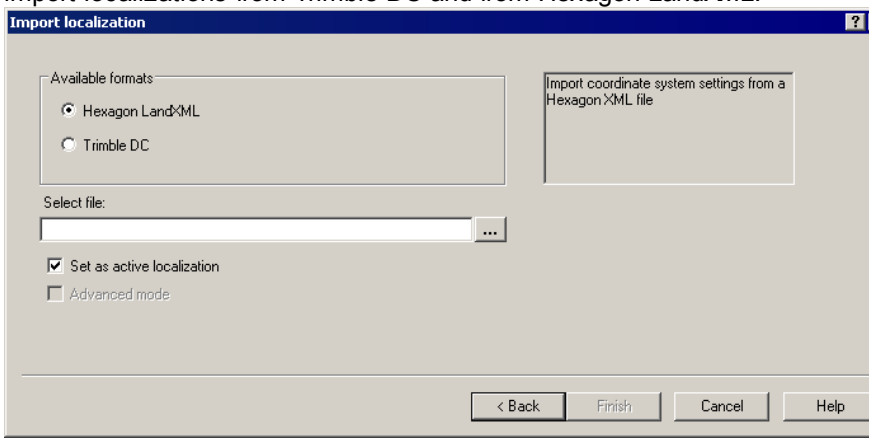


Follow the instructions in Selecting Coordinate System[124] to select the coordinate system.

- **Select a pre-defined coordinate system**
  Use this if there is a predefined coordinate system in the Global folder that is suitable. See also Selecting Coordinate System[125].
- **Select an existing localization**
  Use this option when a localization file (lok file) is already saved in some of your projects. See also Selecting Coordinate System[127] .
- **Create a localization from measured points**
  Use this option to create a local transformation in a given area. If, for example, you have used GeoPad and measured known points to get longitude and latitude, the software can adjust these coordinates to suit

the known points. See also Selecting Coordinate System 127 .

- **View/Edit Parameters Manually**
  Use this option to click through the dialog where you can edit the parameters for geodetic datum, global height transformation, map projection and local transformation. See also Selecting Coordinate System 131 .
- **Import localization**
  Use this option if you have access to a localization in a format that can be imported to the program as a usable localization file. It is possible to import localizations from Trimble DC and from Hexagon LandXML.



Available formats
Select the format that is available for importing coordinate system settings.

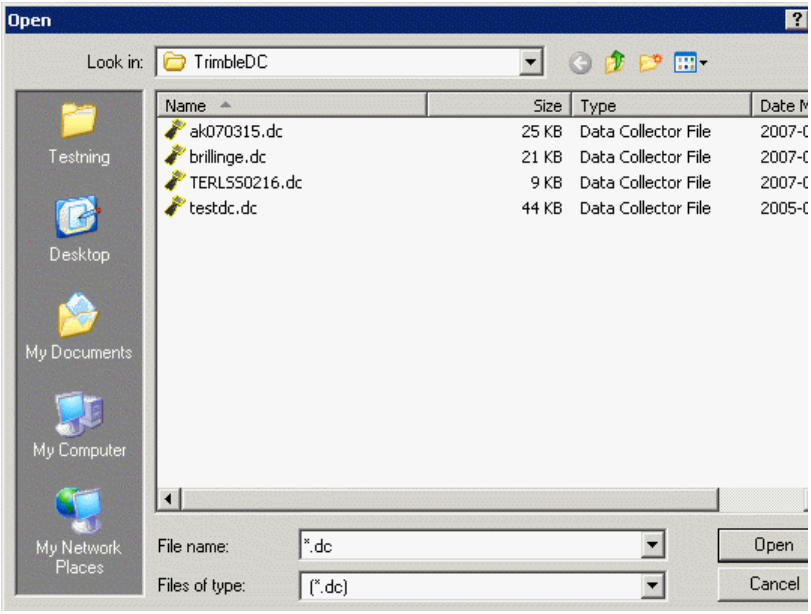
Select file:

Use the scroll button ... to select the file to be imported. The coordinate system settings in the selected file will be converted to a format that can be used. Click **[Finish]** to save the settings in the imported localization file, lok. You are now ready to transform the selected file, see File(s) to transform 148 .

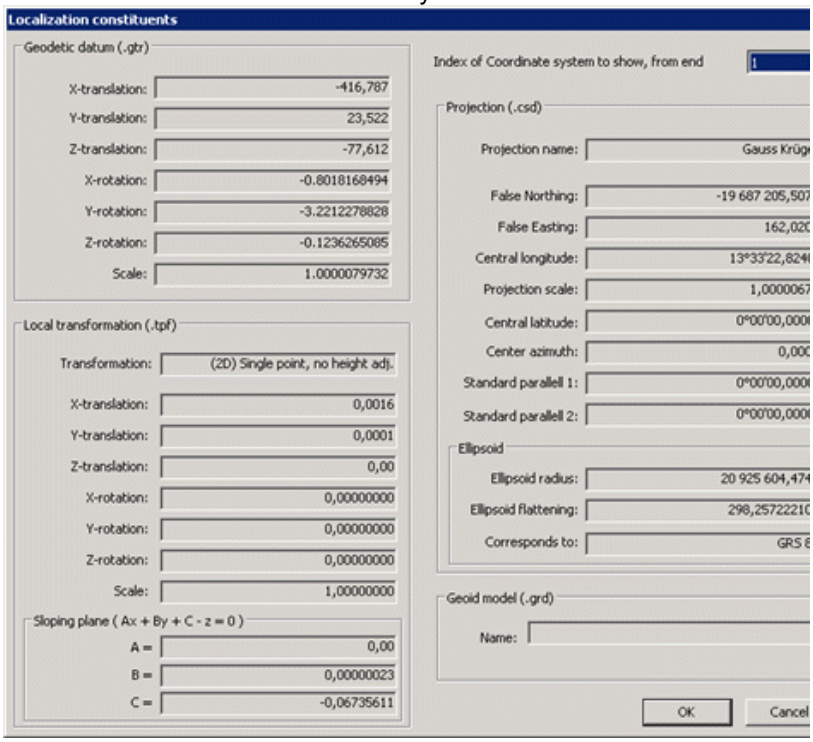
Advanced mode
The alternative **[Advanced mode]** will only be selectable if **Trimble DC** has been selected under **[Available formats]**.

More information about Advanced mode.

- Select a Trimble-DC-file, select **[Advanced mode]** and click **[Finish]** to display the parameters of the file.



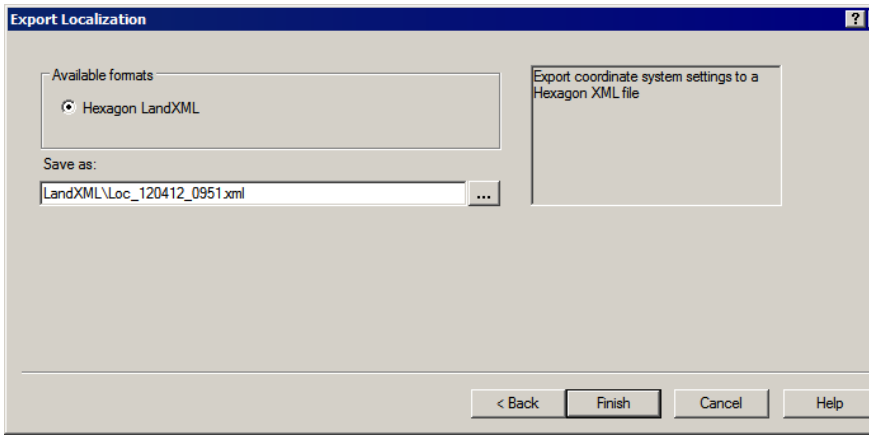
Select a Trimble-DC-file, select **[Advanced mode]** and click **[Finish]** to open a dialog that shows all the parameters in the selected coordinate system file. You can then see all the details before you accept the settings. If the coordinate system file contains more than one coordinate system, you can use the box **[Index of Coordinate system to show, from end]** in the upper right corner in the dialog to choose whichever you want to use. Otherwise the coordinate system that lies at the end of the file is always used.



The dialog displays the localization parameters.

Click **[Cancel]** to return to the dialog Import localization 148. If you have changed **[Index of Coordinate system to show, from end]**, in the upper right box and want to save the new localization file (lok), you click **[OK]**. You are now ready to select file to be transformed, see File(s) to transform 148.

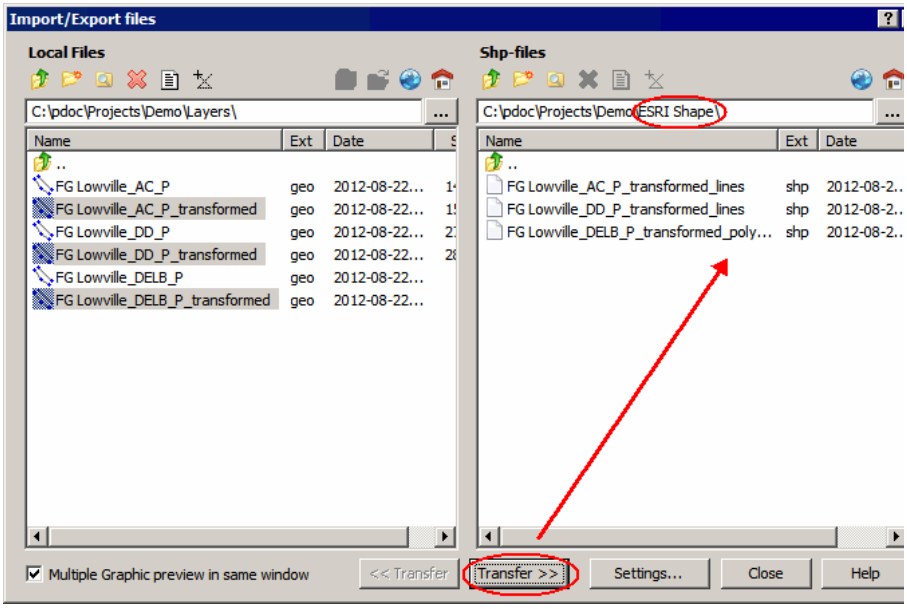
- **Export localization**
  Select **[Export localization]** to export a localization file to the Hexagon LandXML format.



Transform World Mercator projected coordinate files to ESRI Shape format (shp)

World Mercator projected coordinate files can now be transformed to ESRI Shape format (shp).

- Select ***File | Import/Export | ESRI Shapefiles*** and click **[OK]** to open the transfer dialog 376.
- Select all transformed coordinate files (geo) in the left part of the dialog and click the button **[Transfer>>]**.
- The transformed coordinate files are stored in the folder that appears to the right of the dialog.



Transfer dialog.
Select files to the left and press [Transfer>>].

If you export a coordinate file containing single points, lines and polygons to ESRI Shapefiles, three shp files will be created:

Filename incl. suffixes	File format	Contents
<iCON office Filename>_points	shp, shx, dbf	Points
<iCON office Filename>_lines	shp, shx, dbf	Lines

Filename incl. suffixes	File format	Contents
<iCON office Filename>_polygons	shp, shx, dbf	Polygons

Each exported file gets a suffix (_lines, _points or _polygons) which shows the file's contents. For each shp file a dbf and a shx file will also be created.

Test ESRI Shape files in a viewer

Before importing your files to iCON telematics, you can test and verify your ESRI Shape files in a shapefile viewer:

- Test the shapefile online from this link:
  http://www.mapshaper.org/
- A simple shapefile viewer called ***Shape Viewer*** can be found at http://shapeviewer.blogspot.se.
  Download the software and open your files.

Import ESRI Shape files to iCON telematics

Now you have ESRI Shape files for all layers and can use them in iCON telematics.

- Go to http://www.icontelematics.com and enter your login name and password.
- Send transformed files in ESRI Shape format to iCON telematics, these files should have the file extensions shp, shx and dbf.

See also: Transfer Dialog, in General, 376 Program settings 109 , Import Export dialog 372 , ESRI Shape files 389

20 Appendix

20.1 FAQ

Frequently Asked Questions

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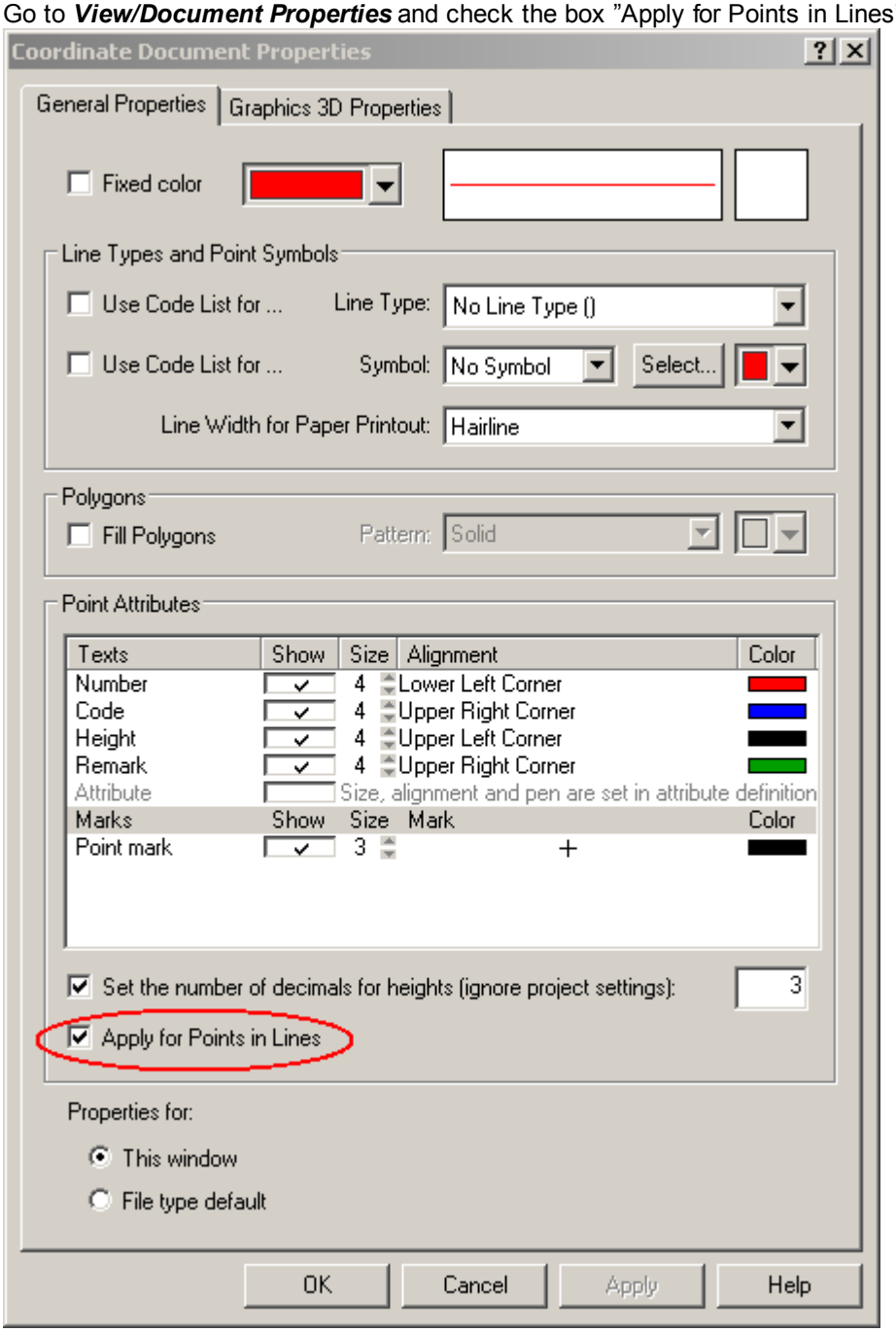
1. **How do I turn on the point information for lines?**
   Go to ***View/Document Properties*** and check the box ”Apply for Points in Lines”.



2. **How do I change logotypes in the header at printouts?**
   Go to ***Edit | Preferences*** and click the tab Printing, where it is possible to change the preset GeoBlue to an optional logo. Note that the logotype must be stored in the global folder, as iCON office will not find the file otherwise.

3. **I try to select a point or a line, but it is not marked, why?**
   Note that it is only possible to work in the active file e.g. mark a point. From a non active file it is possible to get information though, e.g. copy points.
   It is also possible that the wrong snap tool is selected or that the color of the grip is the same as the background, see ***View | Options***.

4. **I select a snap tool, but why is no snap symbol visible?**
   Many functions in iCON office have a so called included snap. In those cases the "normal" snap symbol will not be visible. If the cursor is changed from a cross hair to a pick box when a function is chosen, no snap tool is needed.

5. **How do I save a 3d-view?**
   When the 3D-view is active, it is possible to save it in bitmap file format, go to ***View | Export view as | Image file***.

6. **What's wrong, I'm about to calculate a station but why are some stations and/or backsights red?**
   Red stations/backsights indicate that known coordinates are missing. Check that the correct *known points file* is selected at Known Points in the Project Tree and check that the known points really are stored in that file.

7. **Model-to-model does not work - points are marked in the help layer.**
   Sometimes iCON office fails to calculate model-to-model and the reason for that can vary. Open the terrain models and the help layer where the created points originate from the problem points. Try to rotate some of the triangles connected to the areas where the problems are located. If rotations of triangles do not work, another solution can be to slightly move one of the models, some millimeters in X or Y can make difference.
   Several narrow triangles connected to one node can cause problems, a solution in such a case could be to add some points to the breaklines in the coordinate file (geo).

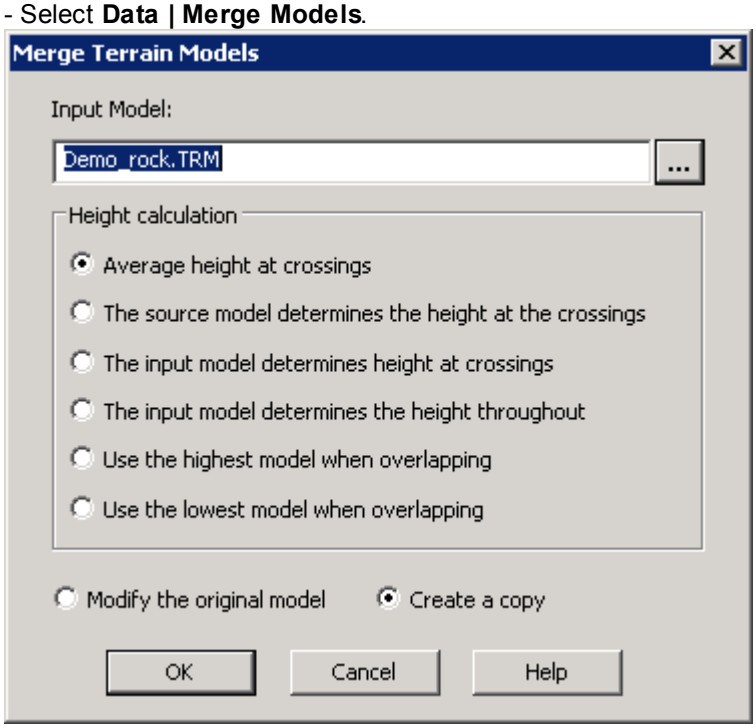
8. **How can I find a line describing the intersection between two terrain models?**
   The calculation *Model to model* creates a difference model. When this file is active it is possible to create a contour line document where the contour lines are differently colored representing cut or fill areas. Black lines are also created and they signify the intersection between the models.

9. **How can I get the sloping area from a terrain model?**
   There are two ways; either you can go to ***Data | Model information***, or calculate *Model-to-model* and select some reference level as planned surface.

10. How do I merge two terrain models?

If you are about to merge two terrain models, usually the result will be best if you follow the following steps:

- Open the **smallest** of the two models to be merged.
- Select **Data | Merge Models**.



- Enter the name or click the button ... to select the terrain model to be merged with the active terrain model in the graphical view.

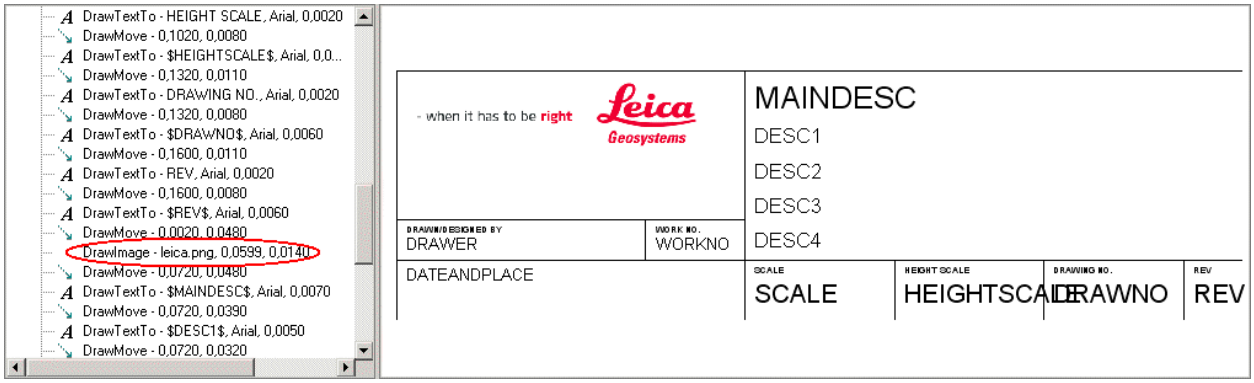
Select how to calculate heights. For more information see Merge Terrain Models 682.

11. There are question marks in the volume report, how do I get rid of them?

Question marks arise in the volume report if one or several sections cannot be calculated. Errors can originate from errors in some standard section or that the models are too small which may cause that it is not possible to create closed areas. If question marks appear in the report they will also arise in the summary. The reason for question marks in the report is to prevent the use of misleading volumes from the volume calculation.

12. How do I change the logotype in a drawing panel?

The easiest way is to open an existing drawing panel which already contains some logotype. Go to ***File | Open***, change Files of type to Drawings (*.dra; *.sot) and select the sot file of interest from the global folder.

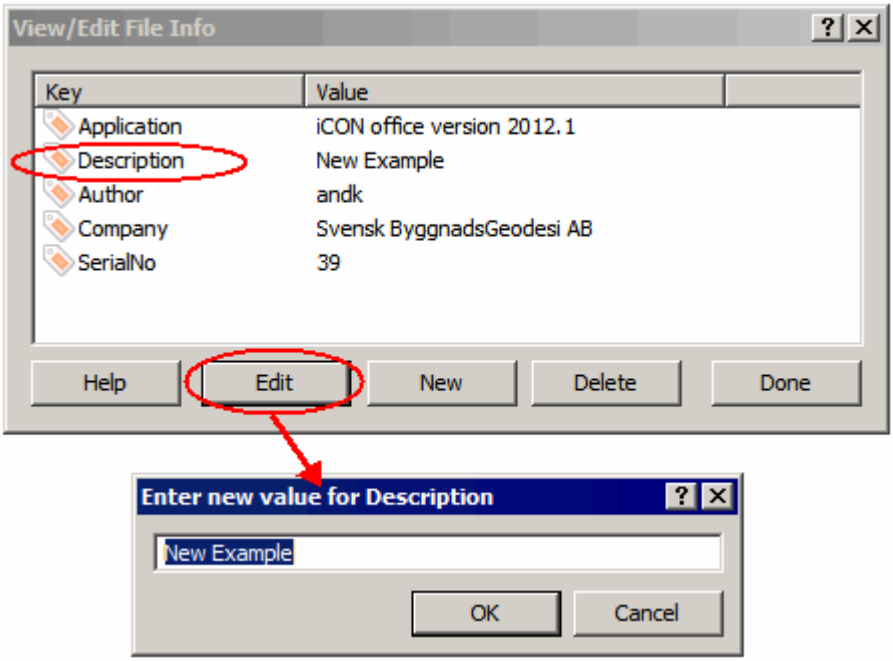


In the tree view to the left, click the right mouse button over the row named DrawImage (or DrawEnhMetaFile) and click at properties. Select another logotype.

You choose the panel to be used in a drawing by selecting ***View | Document Properties*** or click the button when the drawing file is active in the graphics window, see Drawing Settings 266. To be able to separate the panels, each SOT file should have a unique description.

The easiest way to edit the SOT file description is to follow the following description:

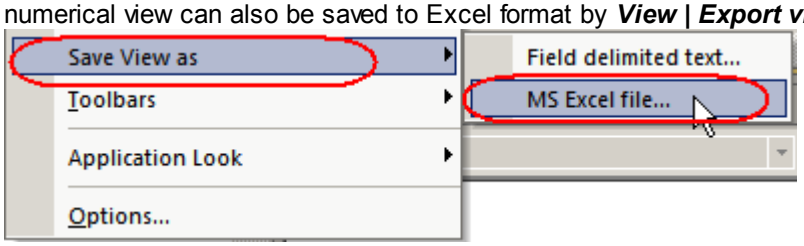
- When the SOT file is active, select ***File | View/Edit File Info***.
- Select the row Description, in the dialog that opens, and click the button **[Edit]**.
- Enter any description for the SOT file.



- Click **[OK]** and **[Done]** to close the dialogs.
- Save the SOT file.

13.I can't open the Help Layer file – *project.gft* – or the icons and drop list look strange.
If the help layer file is damaged you may not be able to open the file. The easiest way to solve the problem is to remove the file *project.gft*. iCON office will automatically create a new help layer file if it is missing when the help layer file should be opened.

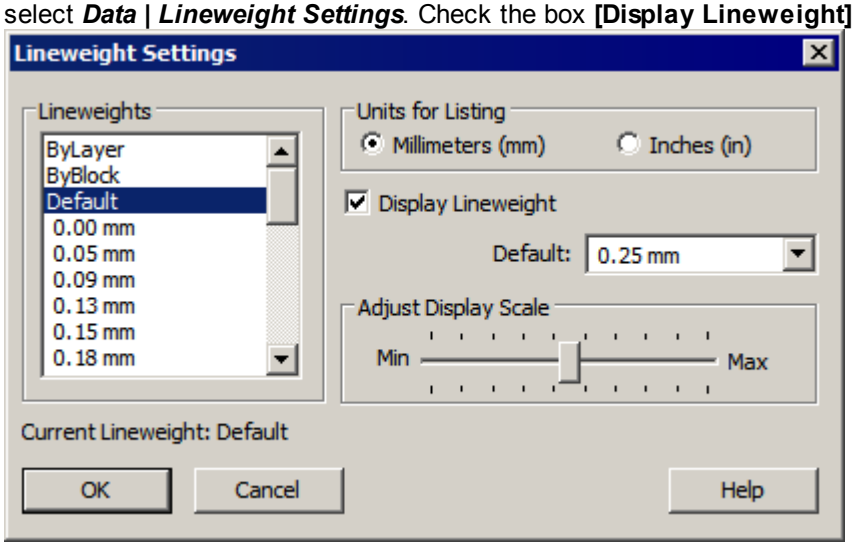
14. My colleague doesn't have iCON office, can he read my reports from iCON office in some way?
Reports created by iCON office can be saved in our own file type format rep or in MS Excel 97-format. A numerical view can also be saved to Excel format by ***View | Export view as.***



15.It is possible to receive AutoCAD files, but is it also possible to produce files in dwg-format?
Yes, it is possible. When the file is ready graphically, go to ***View | Export view as*** and select AutoCad File. In the appearing dialog, it is not only possible to create a dwg-file but also to choose which layers are to be created in the dwg-file.

16. How can I make iCON office to display lineweights in an AutoCAD-file?
Provided that the AutoCAD file is created with different lineweights it is also possible to make these visible in iCON office. By selecting ***Views | Document Properties*** in iCON office you can see which lineweights are used in the current AutoCAD file.

To display lineweights in iCON office, and at printouts from iCON office, open the AutoCAD file and select ***Data | Lineweight Settings***. Check the box **[Display Lineweight]** and press **[OK]**.



At **[Standard]** you can change the default value of the lineweight. The value specified here will be used by layers that have the lineweight 'Default'.
You can control the lineweight by dragging the cursor under 'Adjust Display Scale'. Note that the display of wider lines may increase the time needed to regenerate the image.

17. I can see the drawing frame in iCON office, but why is it not visible in AutoCad software?
In AutoCad there are two layout viewports; model space and paper space. The drawing frame is visible in the paper space. Go to ***Data | Active Layout*** and select some of the layouts.

18. What is LandXML?
LandXML is a data format used for exchange of data between different programs. It can contain terrain models, coordinates, lines and profiles, and much more. LandXML can be used to convert volume descriptions between iCON office and programs such as NovaPoint from ViaNova, InRoad och InRail from Bentleys, and GPS/TPS 1200 from Leica.

19. How can I create my own code list to Leica 1200-system?
There are two different ways:
In Leica GeoOffice there are tools to create code lists.
In iCON office it is possible to edit i.e. SBG.cod or SBG2.cod, and save it with a new name.

20. Can I have several different versions of iCON office installed at the same time?
Yes, it is possible. Just make sure to select another path compared to the first installation. If you want to install an older version of iCON office at the same path as a newer version, you have to remove the newer version, before the older version can be installed.

21. I have a file with global latitude and longitude coordinates. How can I transform them to local coordinates?
Set the correct coordinate system active in the project, open your file with global coordinates and select ***Data | Transform to local coordinates***, see also Transform to local coordinates 952.

22. I have a file with local NEH coordinates. How can I transform them to global latitude and longitude coordinates?
Set the correct coordinate system active in the project, open your file with local coordinates and select ***Data | Transform to global longitude and latitude***, see also Transform to global longitude and latitude 954.

23. How to rotate some symbols in the coordinate file?

To rotate symbols in a coordinate file, use the special code 157 for bearing, B, together with the Remarks column.

- To determine the bearing for a line, you can use the distance tool 225 while you select the points in the graphics. The bearing will be displayed in the Input and Output window 107.
- In the numerical view, enter the desired point code, the special code B, and the point's bearing in the Remarks column.

20.2 Copyrights

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When it has to be right.

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