Stonex Cube-manager

Software for the transfer and the management of topographic data

User Manual

cube·manager

4.3

(January 2020)-Ver.4.3-Rev.3

www.stonex.it

Software Introduction

Cube-manager is a software, part of the Cube-suite by Stonex Srl. It offers tools for the transferring and processing of data from GNSS receivers and total stations. The program consists of a series of general functions that represent the core and 4 specialized modules that provide accurate and complete commands dedicated to 4 processing that are commonly performed on surveys.

The P module is about Post-processing. This module is subdivided into 5 commands: Stop & Go, Kinematic, Static with single base, Static with multiple base and Network adjustments.

The T module is named after Topography, in this module all the most topographic functions are included, such as the roto-translation, the coordinates conversion or the geo-referencing of raster files.

Module M concerns Modeling, this package proposes calculation functions such as triangulation and contour lines.

Module F concerns Photogrammetry, at the time of which we write, this module is not yet designed.

The purchase of a module will give the possibility to access the general functions of the program as well as of course the additional functions included in the package. You can use a reduced and free version of the functions of this program by downloading the Cube-link software that is also part of the Cube-suite by Stonex Srl.

The application has a modern Microsoft interface and implements a CAD, easy to use and flexible, which allows you to view data in both 2D and 3D. It offers functions for graphical and tabular displaying of raw data and results; some COGO commands; functions for importing and exporting data, using standard file formats such as DXF or CSV and manages the most common vector entities (lines, polylines, circles, arcs, texts, ...).

The Cube-manager also supports a special point entity called the Topographic Point.
Topographic points are the fundamental parts of each survey and are generated by importing data or using specific tools. These must be considered as a data structure that contains all the information acquired during the topographic survey, even if obtained from multiple surveys of the GNSS or TPS type. For example: importing a GNSS survey generates topographic points that will be represented by symbols and with different graphic properties. These must be considered as a data structure that contains all the information acquired during the topographic survey, both relative to the position, such as coordinates (east, north, height, latitude, longitude, elevation) but also related to accuracy and control (e.g. Residuals), and information on working methods (e.g. RTK differential correction).


Version 4.3.20200115
cube·manager
p
t
m
f
L1
L2
Copyright © 2017-2020
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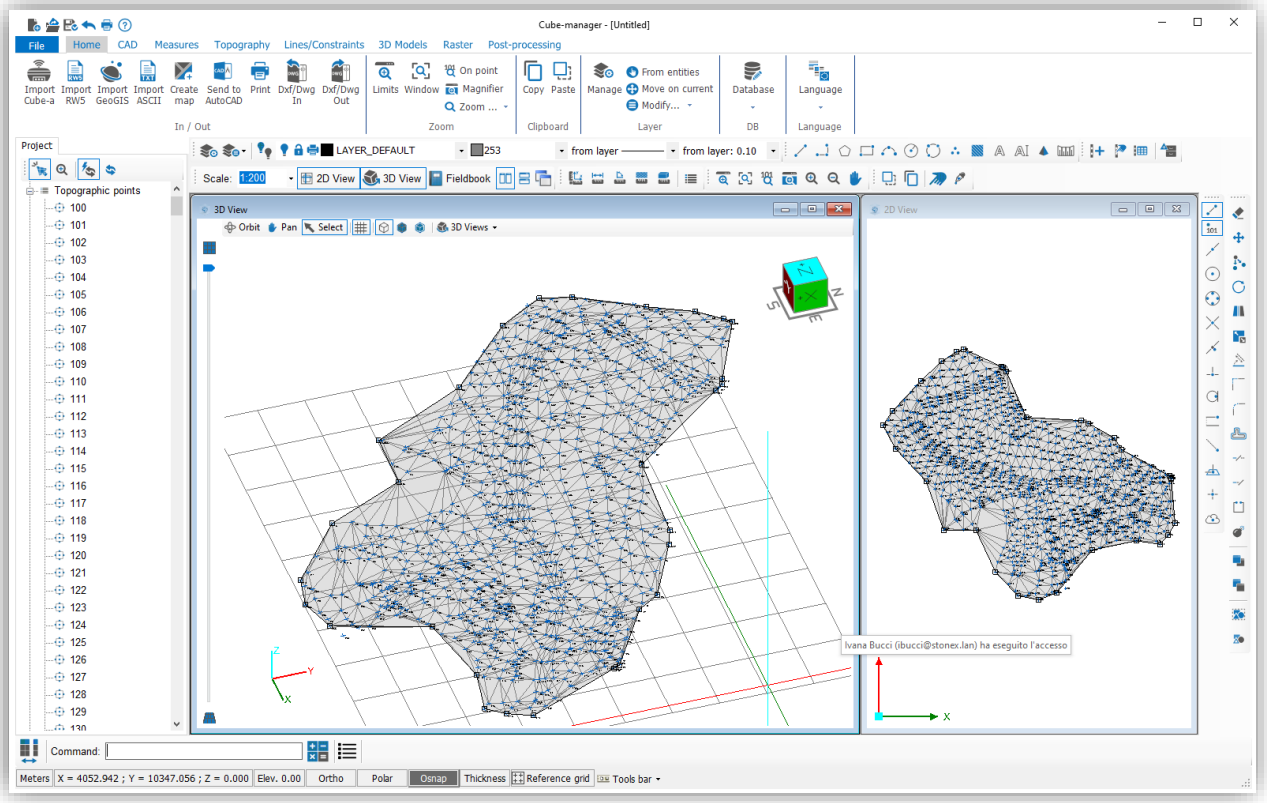
STONEX


Cube-manager - [Untitled]
File
Home
CAD
Measures
Topography
Lines/Constraints
3D Models
Raster
Post-processing
Project
Topographic points
3D View
2D View
Command:

1 Installing and uninstalling Cube-manager

1.1 Cube-manager installation

To install the program, select the language, read and accept the user license agreement; select the folder for the location of the shortcuts and eventually set any link to the program from the desktop. Before you click the install button you can check and change the program's folder location, the start menu and the folder.

The setup is available for 32-bit and 64-bit platforms.

Once the installation is completed, the first time you launch the program you will be asked to enter the code. Just enter your data in the form fields (Figure 1.1) following the instructions on the screen.

If you are not online at the time of the registration, simply contact by phone (or fax) the Stonex Srl and communicate the code that will appear on the screen (SERIAL NUMBER) together with the purchase code and user data for registration.

1.2 Cube-manager uninstallation

To uninstall, go to the folder where the program is located and press the uninstall button that will execute the operation.

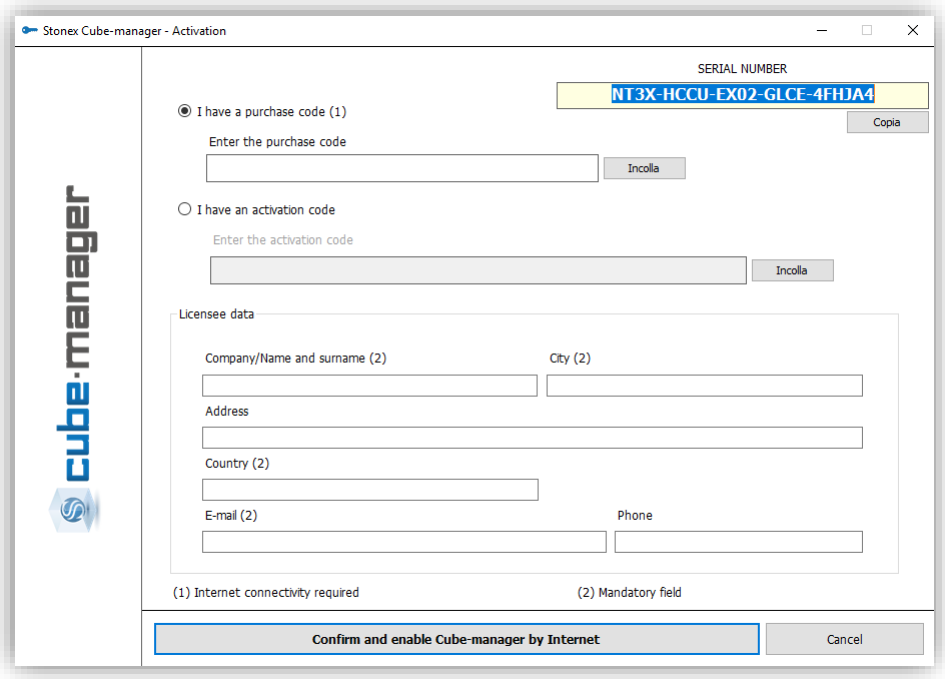


Figure 1.1

2 General functions

2.1 File (tab)

File is the first tab and is located at the top left of the main screen. This section contains many utility commands, including one for settings, and for import and export operations (Figure 2.1). The commands at the bottom provide general information: by clicking the Release notes command, you can access the file with a summary of all the information concerning the new versions and the updates of the program; Online Manual is the command that opens the PDF of the User Manual; Information opens the general presentation window of the software, where you can see the installed version number and the active module or modules.

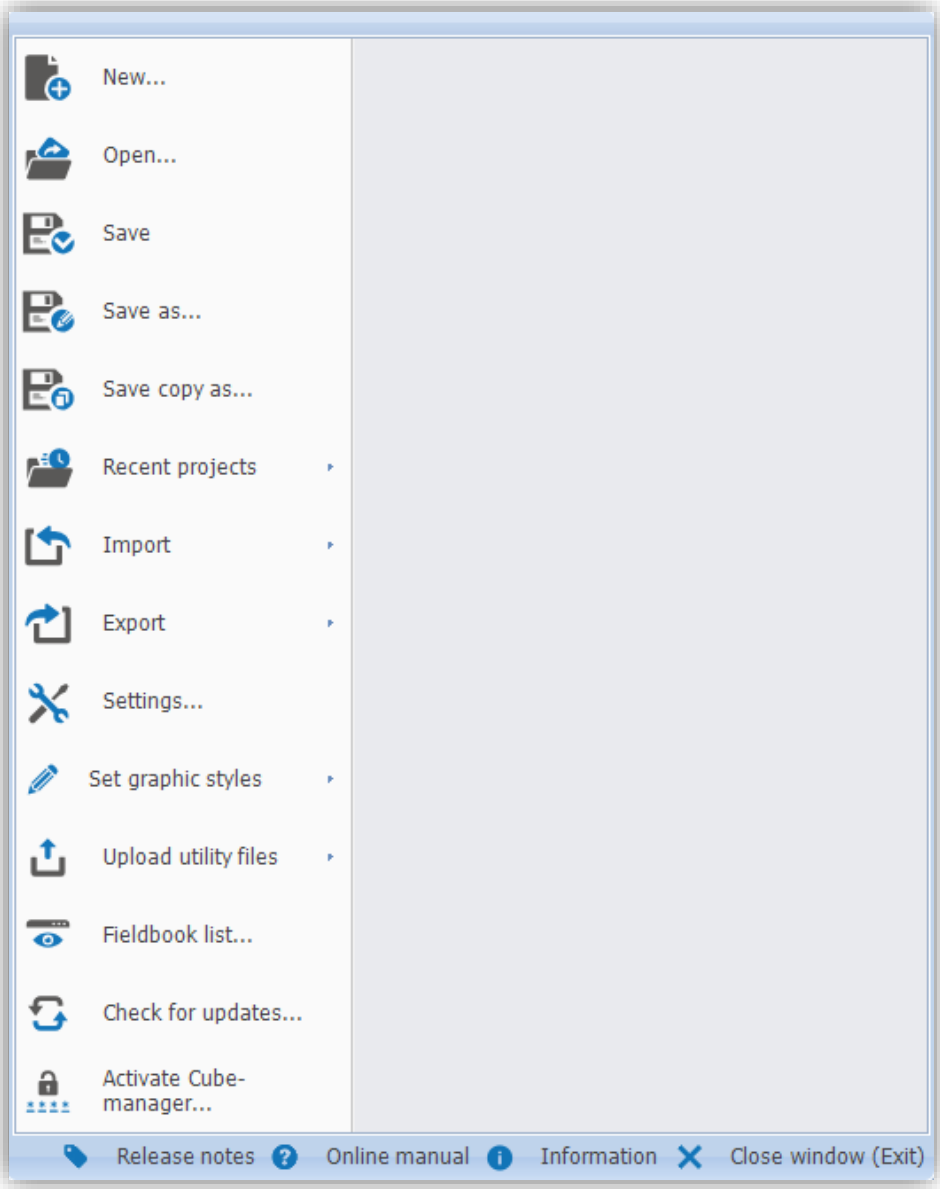


Figure 2.1

2.1.1 Create, open and save jobs

Cube-manager files have *.cubemgr extension and contain all the CAD and topographic entities used during processing. When you want to create a new job, the application asks if you want to create a new blank job with default variables or if you want to proceed with a new job with variables from template files, it is in fact possible to save template files (with extension .cubemntl) that contain all the settings used for a project (variable dimensions, parameter settings, levels, etc.).

If you want to open a file in memory, the supported extensions will be those related to the project file of the Cube-manager program, the automatic save file (.cubemnbk) and for compatibility the projects and saving extensions of the Cube-link program will also be recognized.

Saving jobs will include the possibility to save a project file or a template file.

Recent projects are saved in a list in the File menu (Recent projects command). Selecting a project from this list and hovering the mouse over will display a preview of the job graphics.

2.1.2 Imports

Cube-manager allows you to import files in different formats, including the Cube-a format. To import, just select a format from the list shown in the Import menu (Figure 2.2), each choice will open a new window (for details refer to the paragraphs related to the different imports).

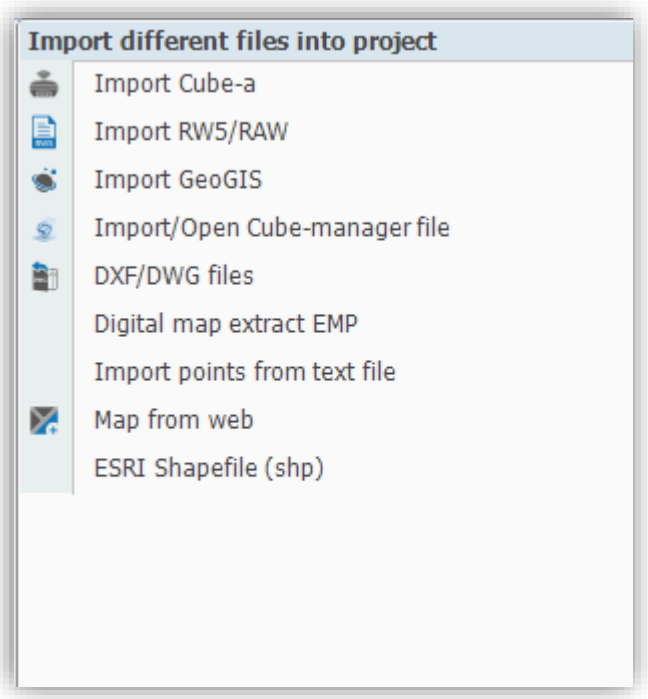


Figure 2.2

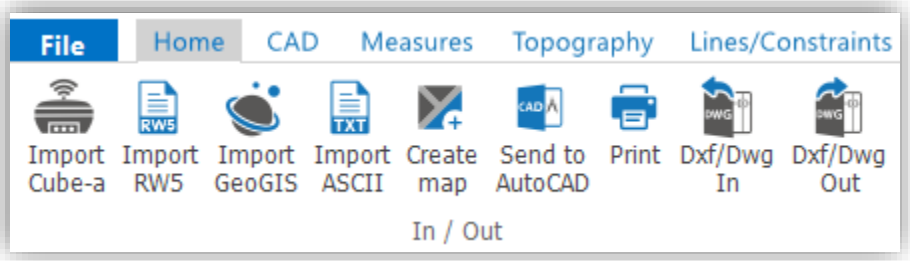


Figure 2.3

2.1.2.1 Import Cube-a

To import a Cube-a file you can select the relevant command in the File tab or you can click on the Cube-a import icon in the Home tab (Figure 2.3). In case of importing Cube-a files, the system can operate on single files or on files that are in specific folders. The second case occurs when the user has access to the entire Cube-a project folder and selects the file with the extension .pd contained in it.
In Cube-a, a job is stored in a folder that has the same name of the project and has subfolders containing all the data; the file to be imported is in the subfolder called "Data".
Copying the entire project folder allows the program to access data files such as photos and reference system information. Within Android devices, projects are always stored as subfolders of the "StonexCube/Projects" folder.
Figure 2.4 shows the main screen for exporting a Cube-a file. After selecting the file, a reference system must be set up before proceeding. You can use the reference system previously defined in the Cube-manager (at start-up the program will automatically always check if a default reference system has been set) or you can use coordinates defined in the field. In addition, you can set up a local system or a default reference system, in which case the program will allow you to access the relevant windows for the settings.

If there are photos in the file, you can transform them into GeoTIFF.

For leap seconds a default value is proposed which can be changed during the import phase.

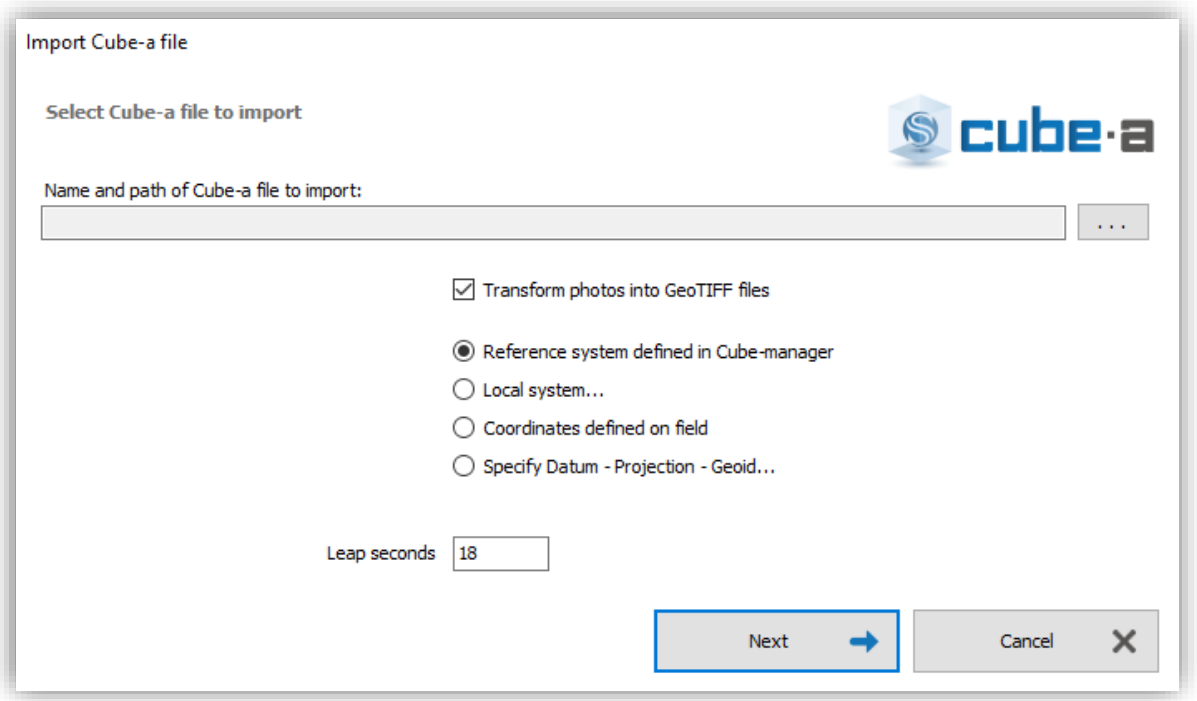


Figure 2.4

2.1.2.2 Import RW5

To import an RW5 file you can select the relevant command in the File tab or you can click on the Import RW5 icon in the Home tab (Figure 2.3). You will see a window as in Figure 2.5, where you can specify the name and path of the file you want to import. A useful feature is the ability to select the CRD file and then import only the updated data found in the field (if you import raw files, the option on CRD files will not be visible).

Also, for this type of import the coordinates can be changed by selecting a local system or a predefined system, or leave the coordinates defined in the field or use the default reference system (set by the user when the program starts).

If you want to use the USB connection to import, click on Connect USB (the connection is possible using the Windows Mobile Device Center program). The device used in the field can be connected directly to the PC and through the window in Figure 2.6, it is possible to directly download the files from the portable device to the PC or vice versa. By default, the program always shows the folder with the recorded data, but this position can be modified at will, clicking on the search button, you can then view the internal structure of the device and select the desired folder.

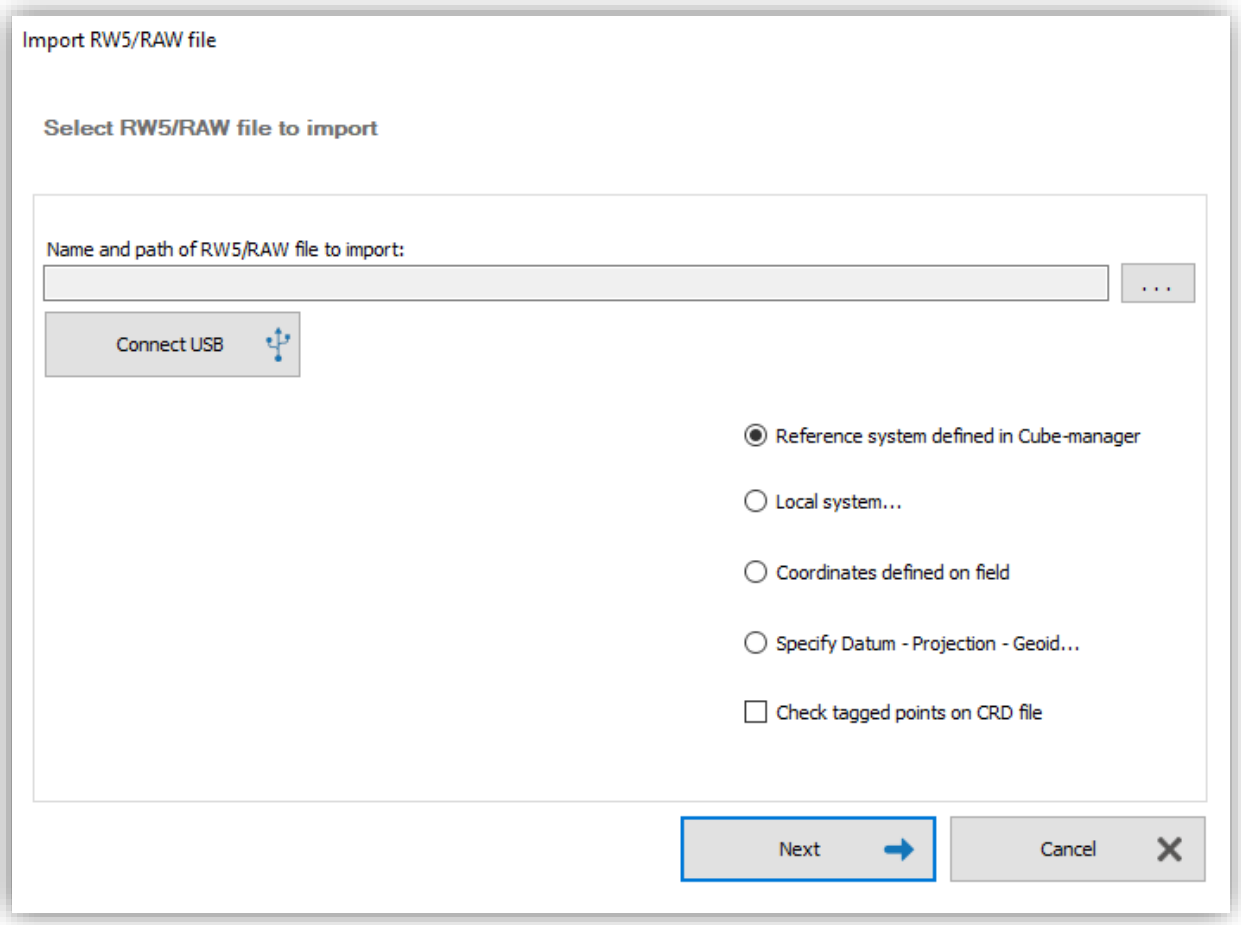


Figure 2.5

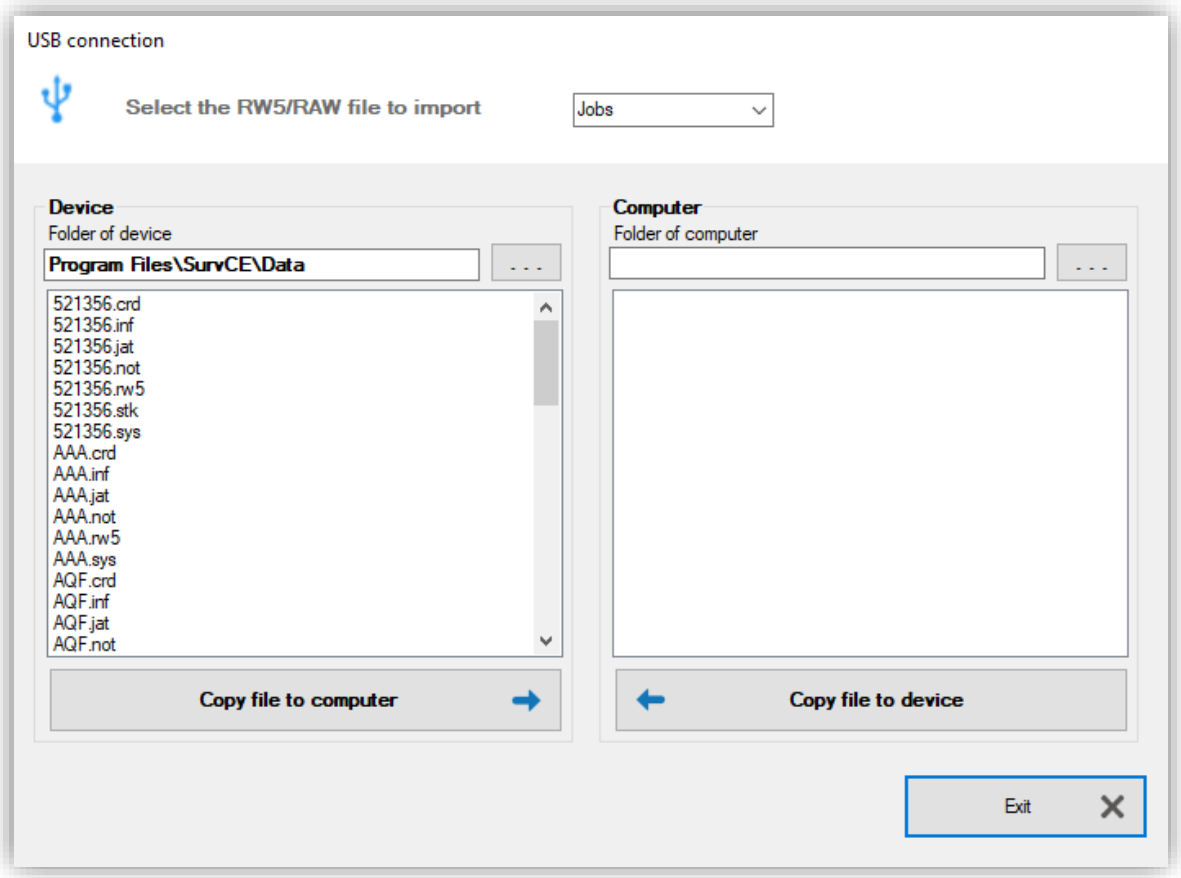

USB connection
Select the RW5/RAW file to import
Jobs
Device
Folder of device
Program Files\SurvCE\Data
. . .
521356.crd
521356.inf
521356.jat
521356.not
521356.rw5
521356.stk
521356.sys
AAA.crd
AAA.inf
AAA.jat
AAA.not
AAA.rw5
AAA.sys
AQF.crd
AQF.inf
AQF.jat
AQF.not
Computer
Folder of computer
. . .
Copy file to computer
Copy file to device
Exit

Figure 2.6

2.1.2.3 Import Geogis

To import a Geogis file, you can select the relevant command in the File tab or you can click on the Import Geogis icon in the Home tab (Figure 2.3).
If there are photos in the project, they can be transformed into GeoTIFF files. Furthermore, even for GeoGis files it is possible to connect a device to the PC via the USB connection (with the same logic and functionality illustrated in the paragraph concerning the importation of RW5 files).

With the USB connection even Raster, DXF and ESRI Shapefiles can be copied to the PC. To do this, simply select the format chosen with the drop-down menu command at the top of the screen.
For this format as well, it is possible to import the coordinates surveyed in the field or use the default reference system, a local system or select a Datum. In the last two cases you will have the possibility to access windows where to set the characteristics of these systems.

2.1.2.4 Import ASCII

To import a text file, you can select the relevant command in the File tab or you can click on the Import ASCII icon in the Home tab (Figure 2.3). This function consists of 3 steps.
In the first step (Figure 2.7), you must select the file to be imported indicating name and path, in this phase you can also edit the file by clicking on the Edit file button (this will open a simple text editor where you can change the file and to show/hide the number of lines). Before proceeding with the import, it is necessary to select whether to create topographic points or CAD points from the imported file. You can set the encoding of the file (UTF-8 is the default choice).

In the step n. 2 (Figure 2.8) you can choose between a default file format or a custom format (Figure 2.9). For the second type of format it will be necessary to enter a name and set the separator character. The inserted custom formats can also be deleted using the Delete selected command located on the right, next to the drop-down menu for selection.
For all formats, you need to set the unit of measurement for the reading of geographical coordinates (latitude, longitude, elevation) and the line from which to start reading the file (to exclude the heading).

In the step n. 3 (Figure 2.10), for custom formats it is possible to assign the type of content (Point name, Easting, Northing, Elevation, Latitude, Longitude, Ellipsoidal h., ECEF X, ECEF Y, ECEF Z, Description, Code) to each column (click on the heading to view the list). This will save the new format with the fields selected, the created formats cannot be overwritten. When importing geographical coordinates, the program will automatically allow the selection of a reference system.

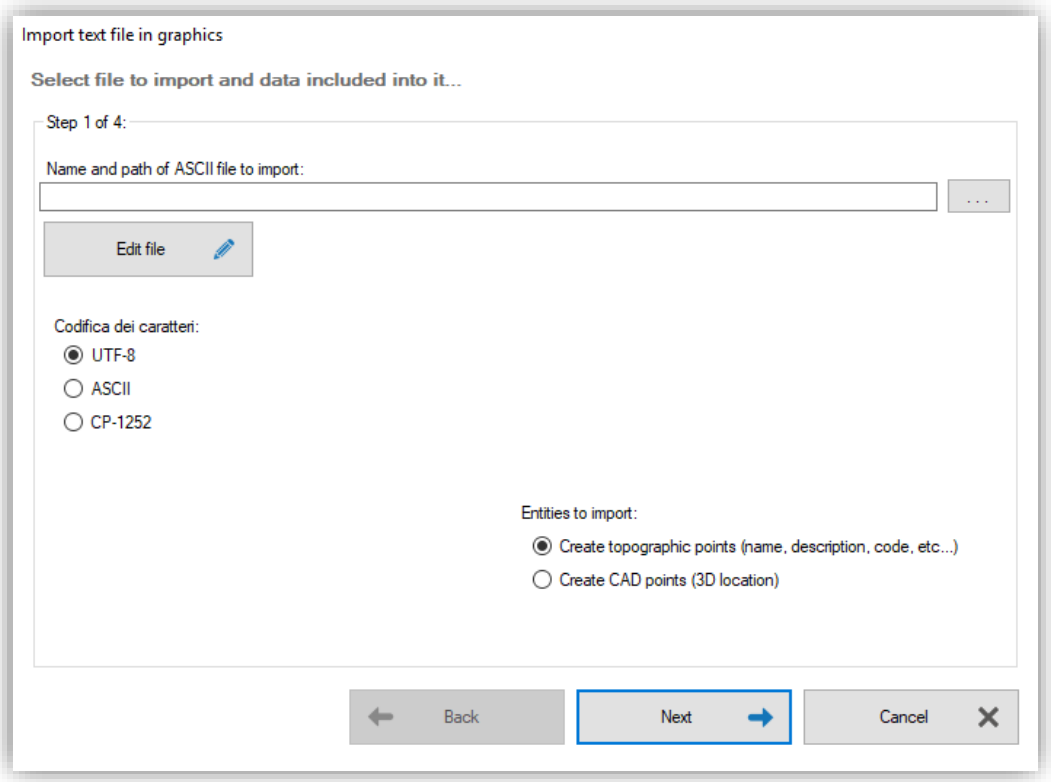


Figure 2.7

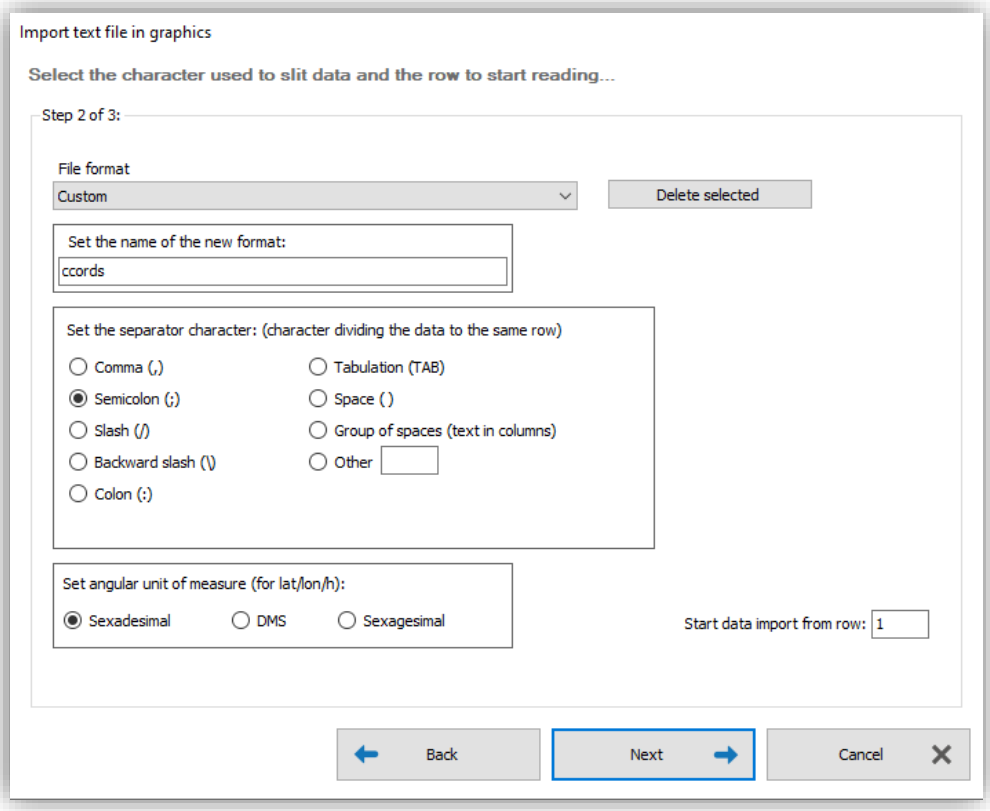


Figure 2.8

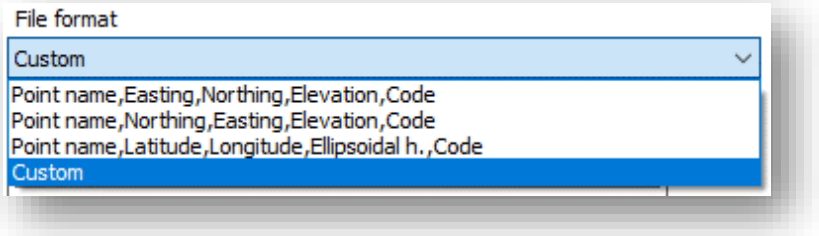


Figure 2.9

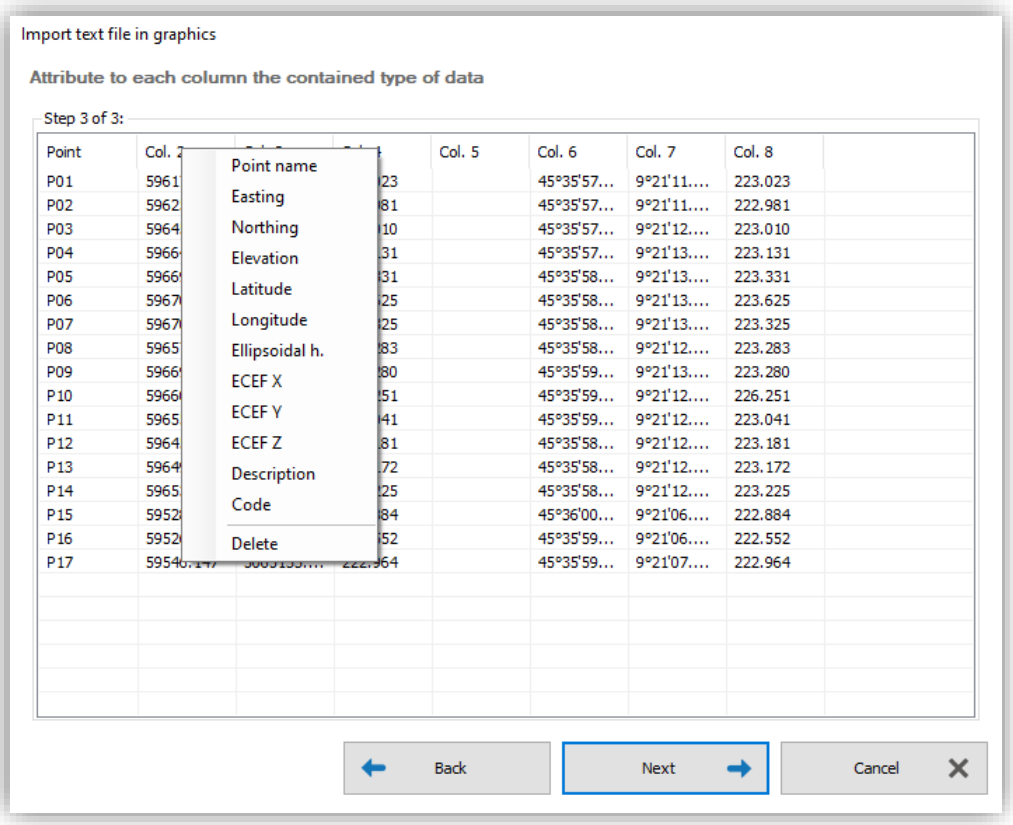


Figure 2.10

2.1.2.5 Create map

To create a map, you can click the Map from web button on the File tab or you can click on the Create Map icon in the Home tab (Figure 2.3).
This function imports a map into the project, it will require the East and North coordinates that you want to set as the center of the map. You will then see a window powered by Google Maps as in Figure 2.11. To import the map into the CAD you will need to save the image as jpeg. The services for creating maps are two: Google and Bing. The window and the creation occur, in both cases, in the same way. If the created images do not cover the area in which you want to create the map, you can increase the horizontal and vertical images, or you can proceed to create a new map in addition to the one created. The program will overlay the geo-referenced images.
The images downloaded using these services are subject to copyright and in the case of Google maps it is possible that after a quantity of free downloads the service requires a payment.

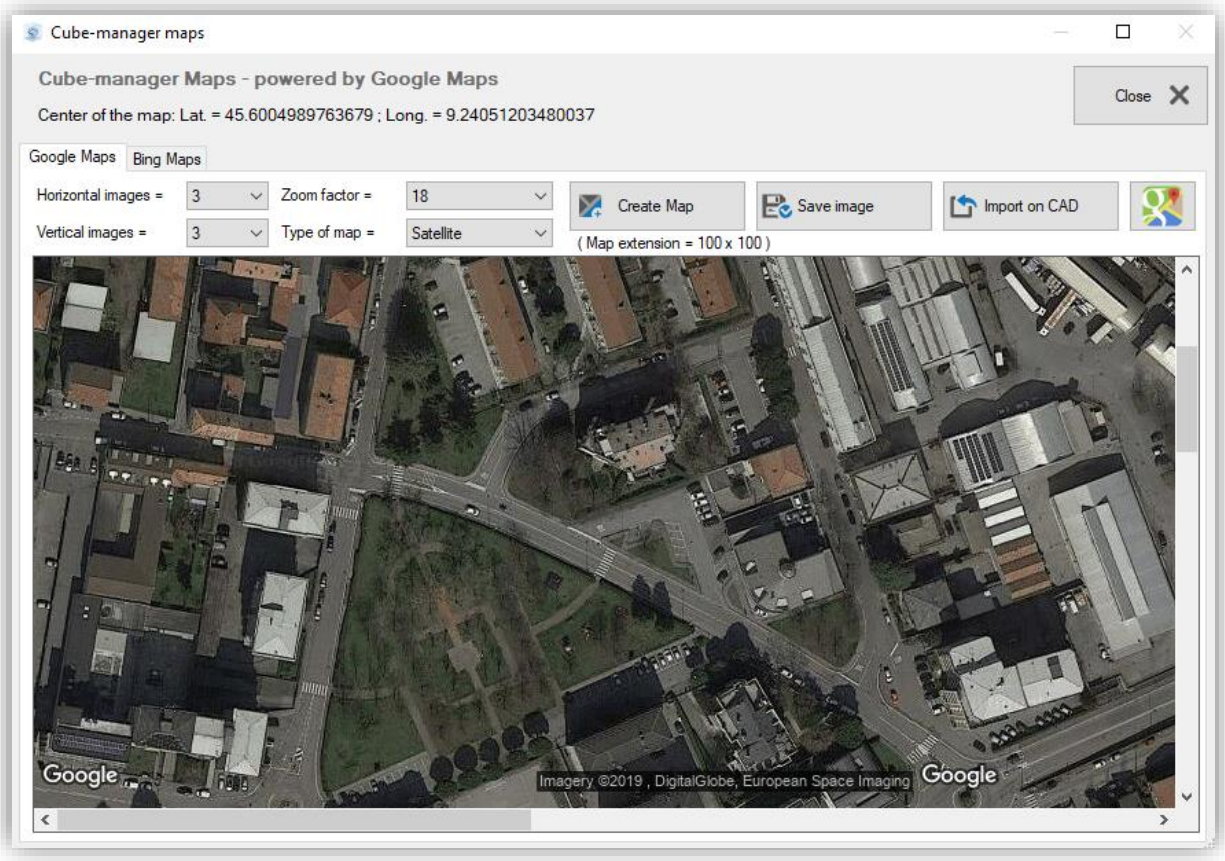


Figure 2.11

2.1.2.6 Send to AutoCAD

To send CAD entities or raster images to AutoCAD, click the Send to AutoCAD icon (Figure 2.3). It is essential, for a successful communication between Cube-manager and AutoCAD, to set (in the general settings of the program, illustrated below) the version of the AutoCAD program installed in the PC, and it is necessary that both programs are running.

2.1.2.7 Print

The Print command generates a window that includes three tabs: Print settings; Printing styles; Printing tables. Print Settings (Figure 2.12) is the tab where you can set the printer you want to use and the page you want to print. Even the scale, origins, print area and print size can be set in this section.

In the Printing Styles tab, you can set the thickness, terminations and joints, using the layer settings or creating new styles. You can also import previously saved styles or save new ones (Figure 2.13).

The last tab Printing tables is dedicated to saving, deleting or loading print tables. In each of the tabs just described, you can click on the print preview button (Preview and print) to see a layout of how the file will be printed.

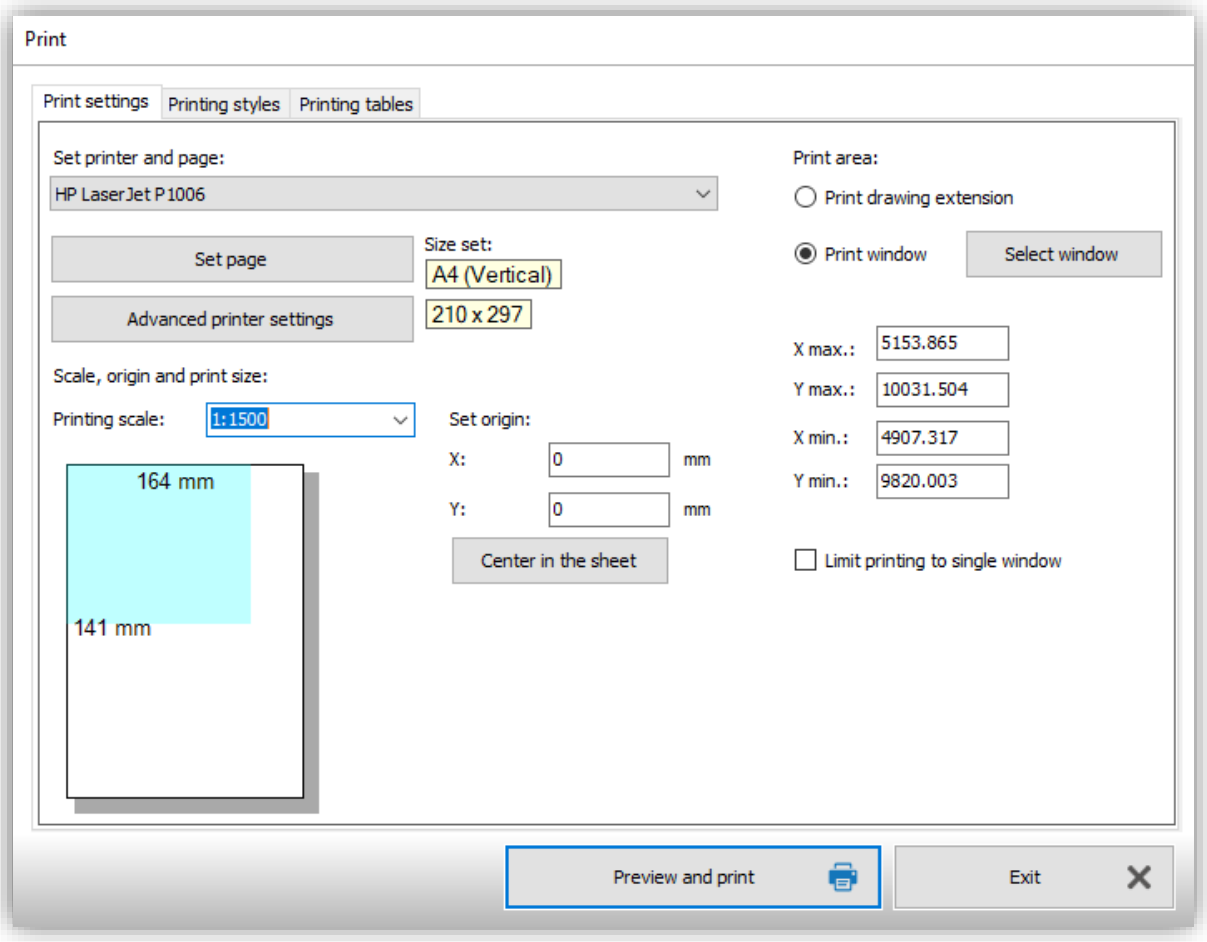

Print
Print settings
Printing styles
Printing tables
Set printer and page:
HP LaserJet P1006
Set page
Advanced printer settings
Size set:
A4 (Vertical)
210 x 297
Scale, origin and print size:
Printing scale:
1:1500
164 mm
141 mm
Set origin:
X:
0
mm
Y:
0
mm
Center in the sheet
Print area:
Print drawing extension
Print window
Select window
X max.:
5153.865
Y max.:
10031.504
X min.:
4907.317
Y min.:
9820.003
Limit printing to single window
Preview and print
Exit

Figure 2.12

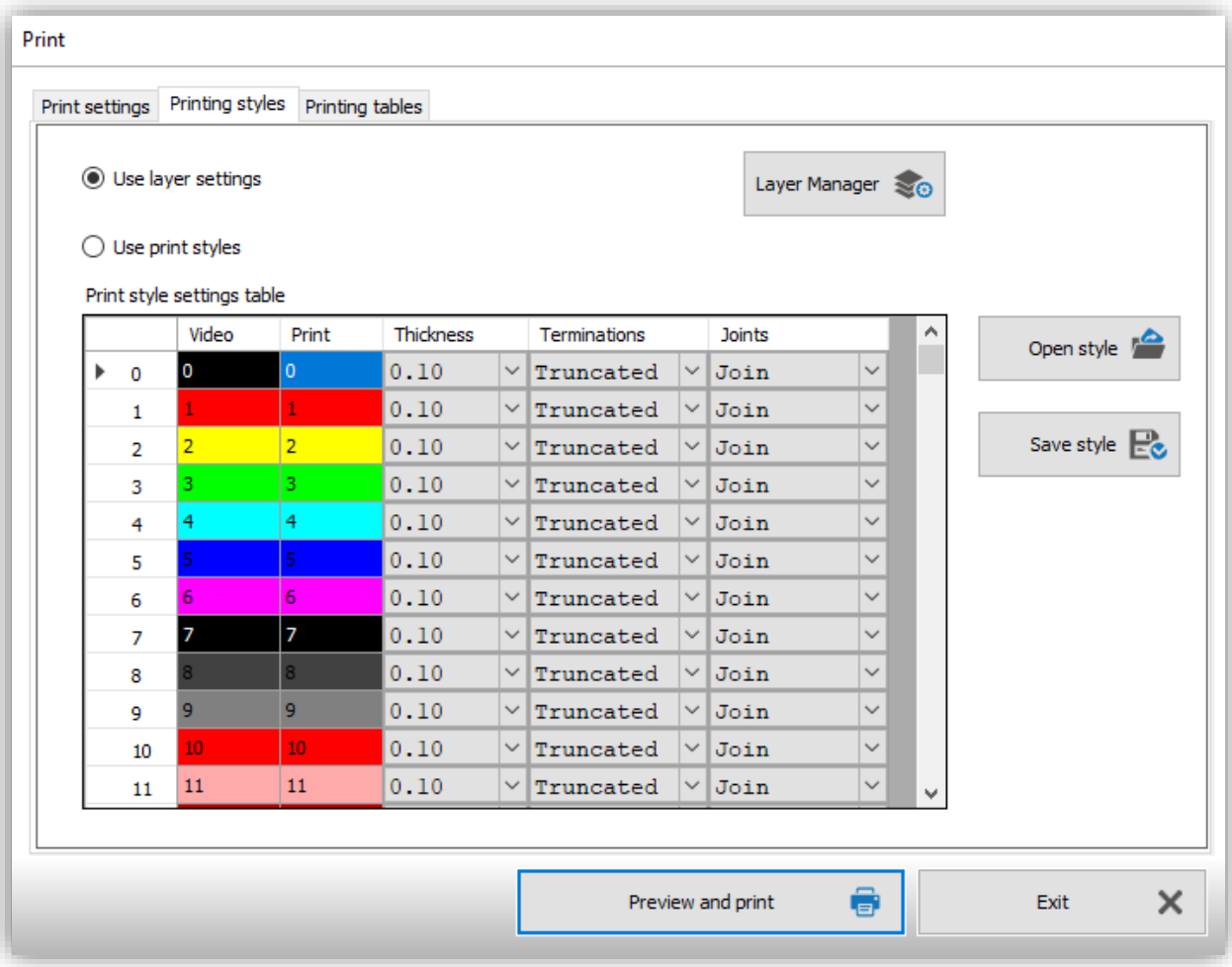

Print
Print settings
Printing styles
Printing tables
Use layer settings
Layer Manager
Use print styles
Print style settings table
Video
Print
Thickness
Terminations
Joints
0 0 0 0.10 Truncated Join
1 1 1 0.10 Truncated Join
2 2 2 0.10 Truncated Join
3 3 3 0.10 Truncated Join
4 4 4 0.10 Truncated Join
5 5 5 0.10 Truncated Join
6 6 6 0.10 Truncated Join
7 7 7 0.10 Truncated Join
8 8 8 0.10 Truncated Join
9 9 9 0.10 Truncated Join
10 10 10 0.10 Truncated Join
11 11 11 0.10 Truncated Join
Open style
Save style
Preview and print
Exit

Figure 2.13

2.1.2.8 DXF/DWG

This function allows the system to import the graphic elements as they are and since there are no topographic points in this type of file it is possible to force this choice, so that the entities with attributes become topographic points (Figure 2.14).
If you decide to import by transforming the points into topographic points, you will have the possibility to establish the name (sequential) of the points and the properties of the imported block. You can also select the option to import points on a single layer, in this case the current project layer will be selected.

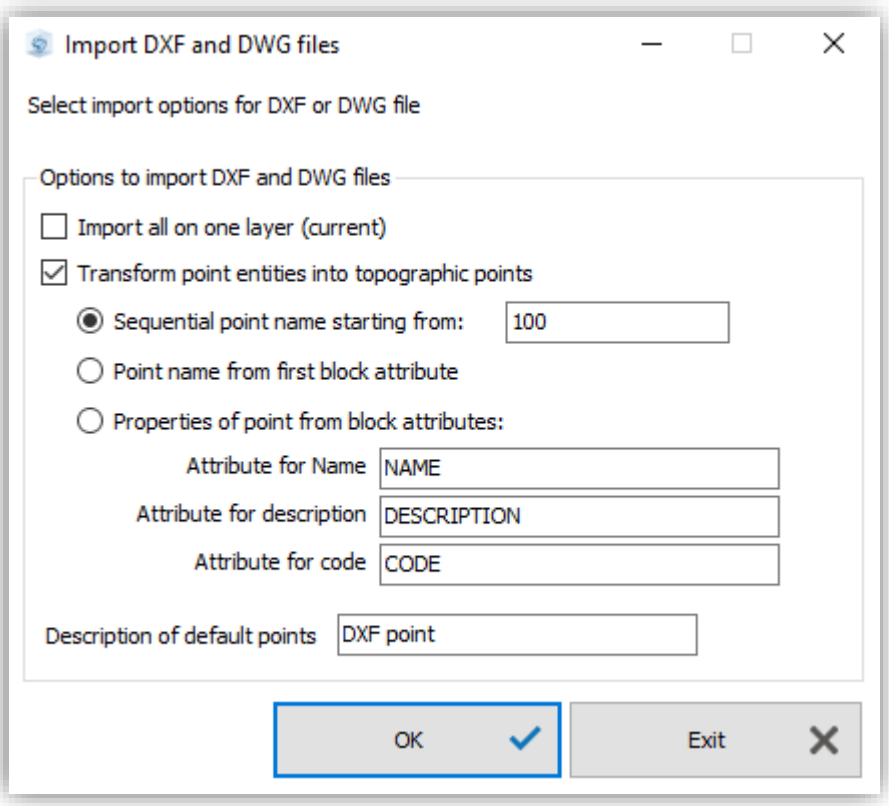


Figure 2.14

2.1.2.9 Pregeo

The program supports the processing of Pregeo files, but this function is only visible in the Italian version. To access it, just set the Italian language from the change languages button.

2.1.2.10 Digital map extract EMP

It is possible to import a file with the .EMP extension simply by indicating the name and path of the file from the screen that will be generated by clicking on the EMP Digital Extract command from the File tab (example of a project with imported EMP extract Figure 2.15). This is a Pregeo function (italian).

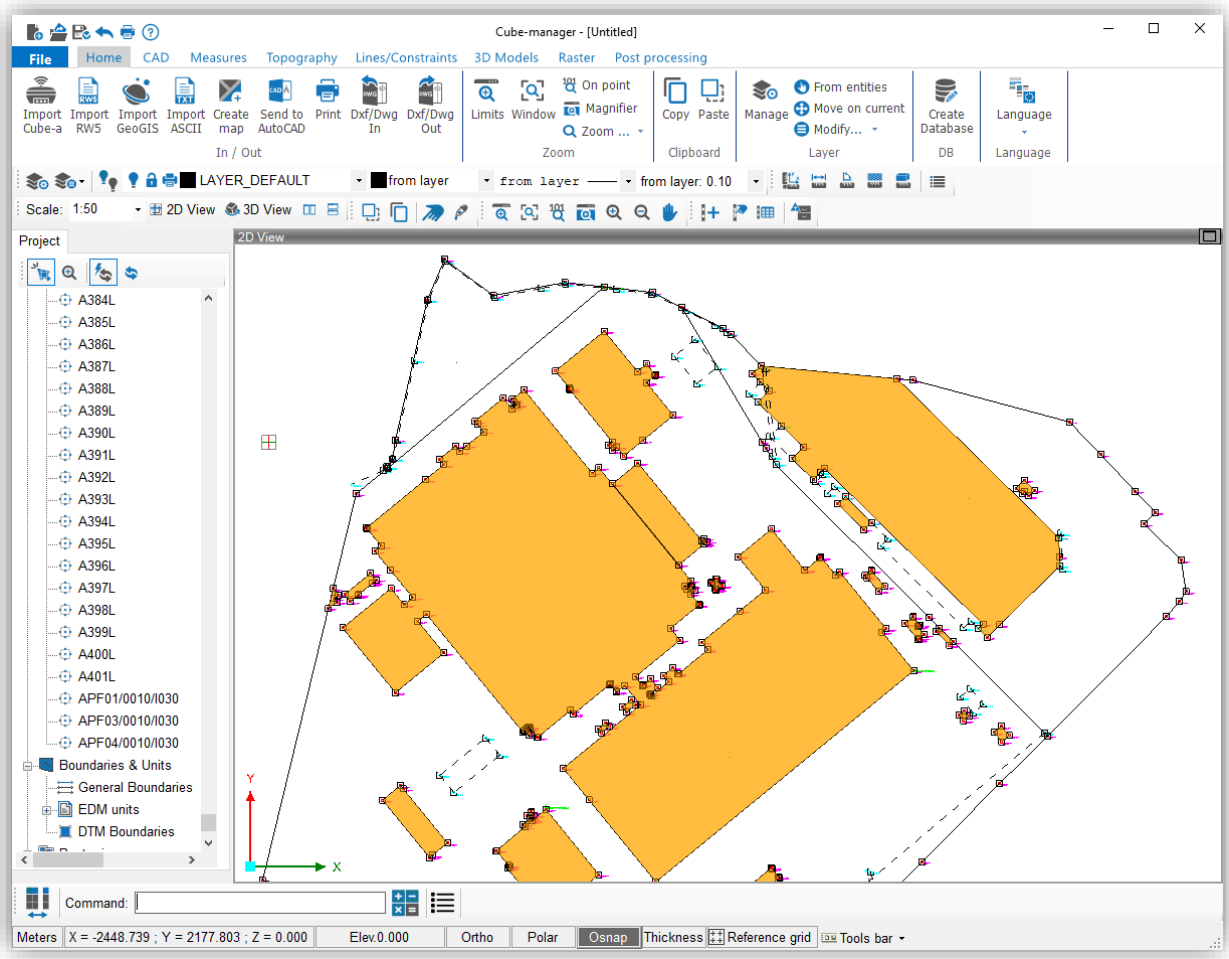


Figure 2.15

2.1.2.11 ESRI Shapefile

The import of a shapefile generates a screen like the one in Figure 2.16. Clicking Open at the top right you will see a preview of the work you are importing, on the left you will see the layers that make up the file. By clicking Import you can finish the preview and re-enter the graphic view in the main window.

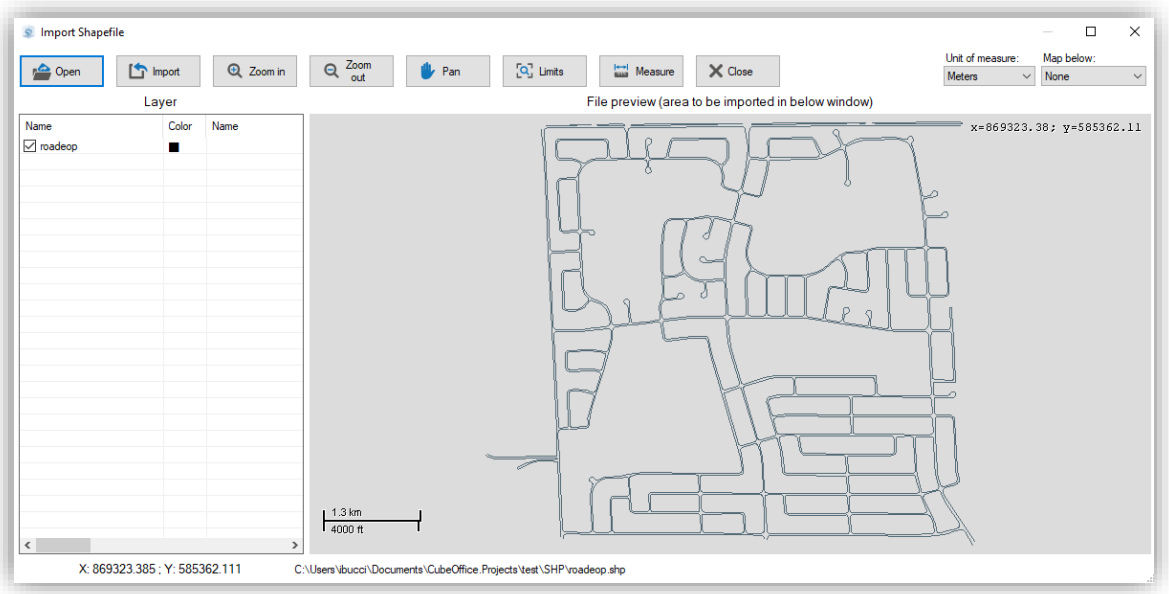


Figure 2.16

2.1.2.12 Features of GPS points

Whenever you decide to import GPS points into the program, Cube-manager will automatically display a screen, as shown in Figure 2.17.
From this window it is possible to set the graphic appearance of the points, subdividing them according to the type of solution that characterizes them. It will then be possible to set the layer, the color and the icon of the symbol, divided by type of points. The size of the symbol, the font and its color can be set for the total number of points that are being imported.
Note: GPS stations are by default positioned on a non-visible layer, however it is always possible to reactivate the layer, and set the color and icon of the symbol.

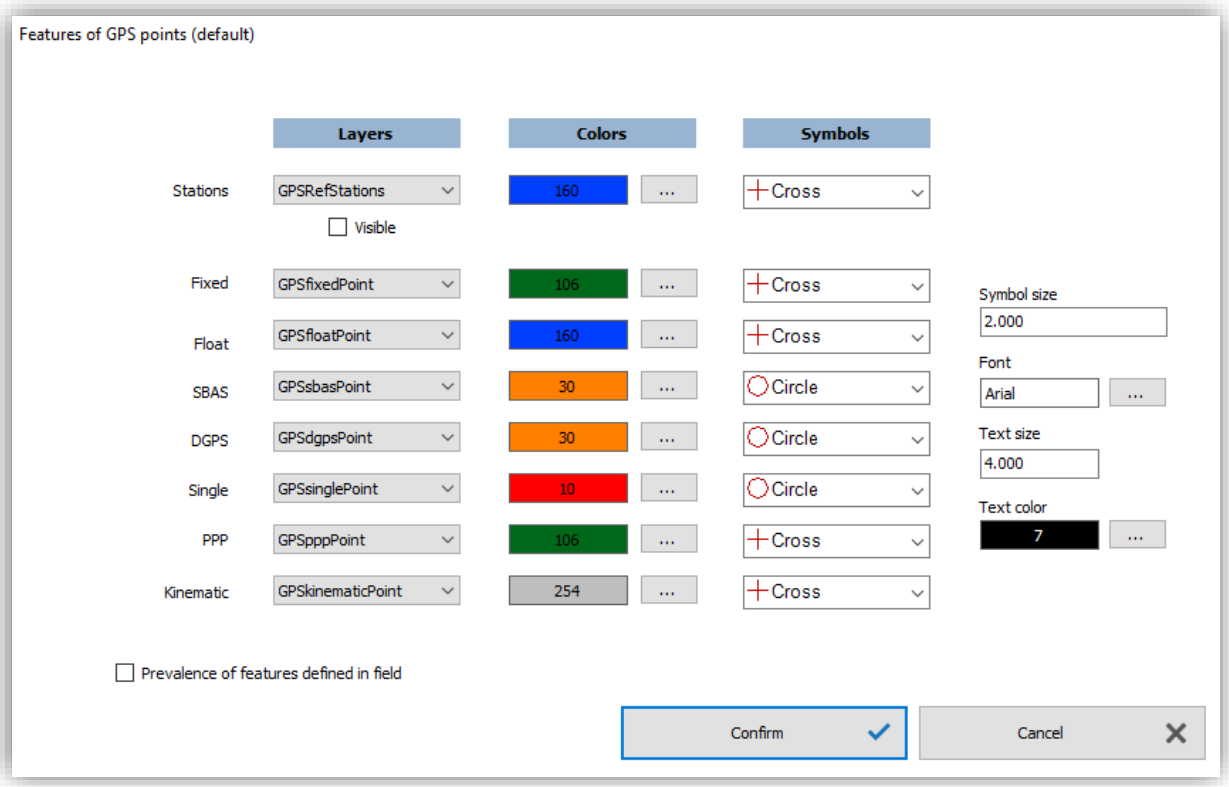


Figure 2.17

2.1.3 Export

Cube-manager supports various export formats, in Figure 2.18 all possible exports are summarized. To access the exporting in various formats, click on the Export command in the File tab (Figure 2.1).

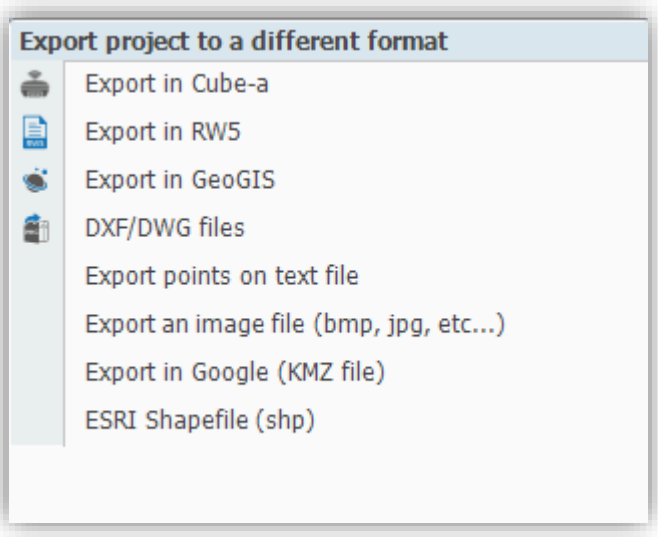


Figure 2.18

2.1.3.1 Export Cube-a

To export in Cube-a format, simply select the name and path of the file to be created, by default the program exports both graphical entities and topographic points. However, it is also possible to exclude graphical entities and to export only topographic points (Figure 2.19).

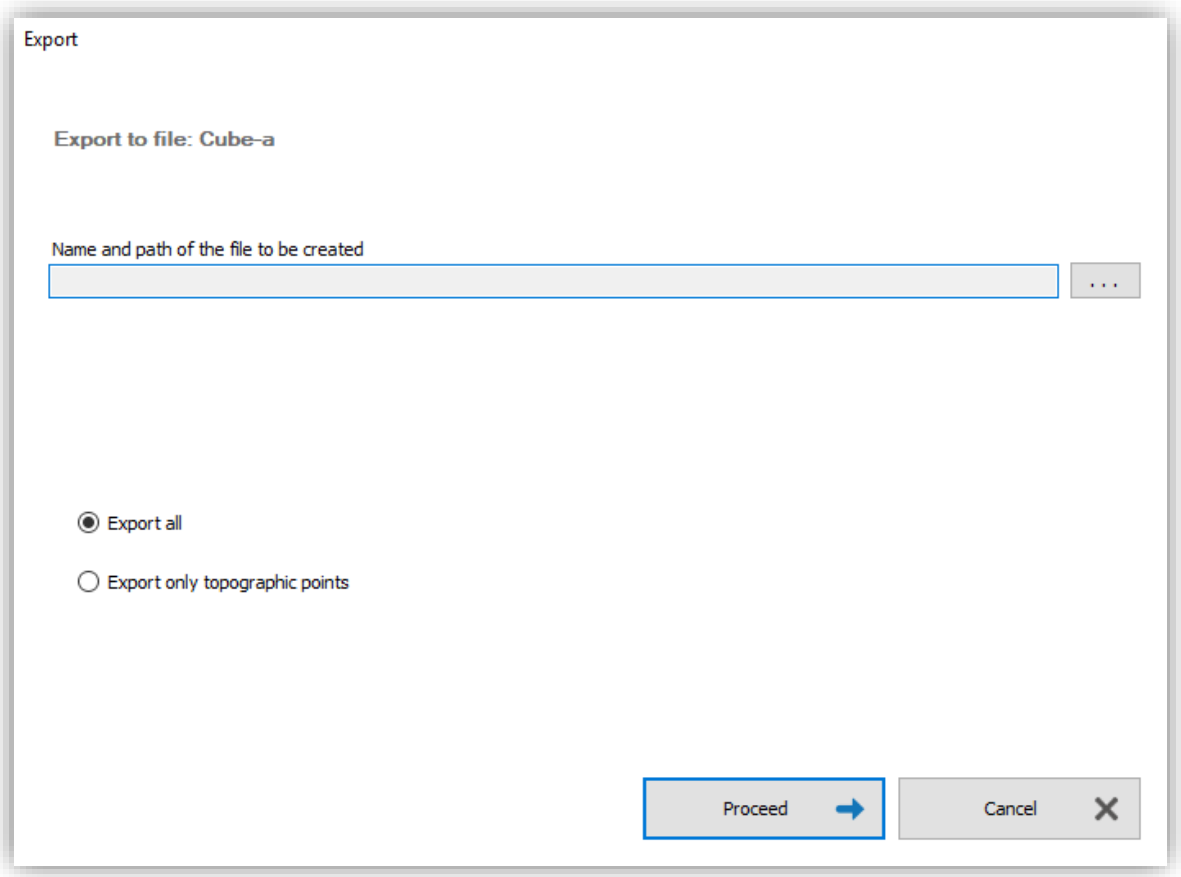


Figure 2.19

2.1.3.2 Export RW5

To export in this format, you must select a file name and path, optionally you can also create an EzSurv file, you will always need to select a file name and path. You can also create a CRD file associated with the created RW5 file (Figure 2.20).

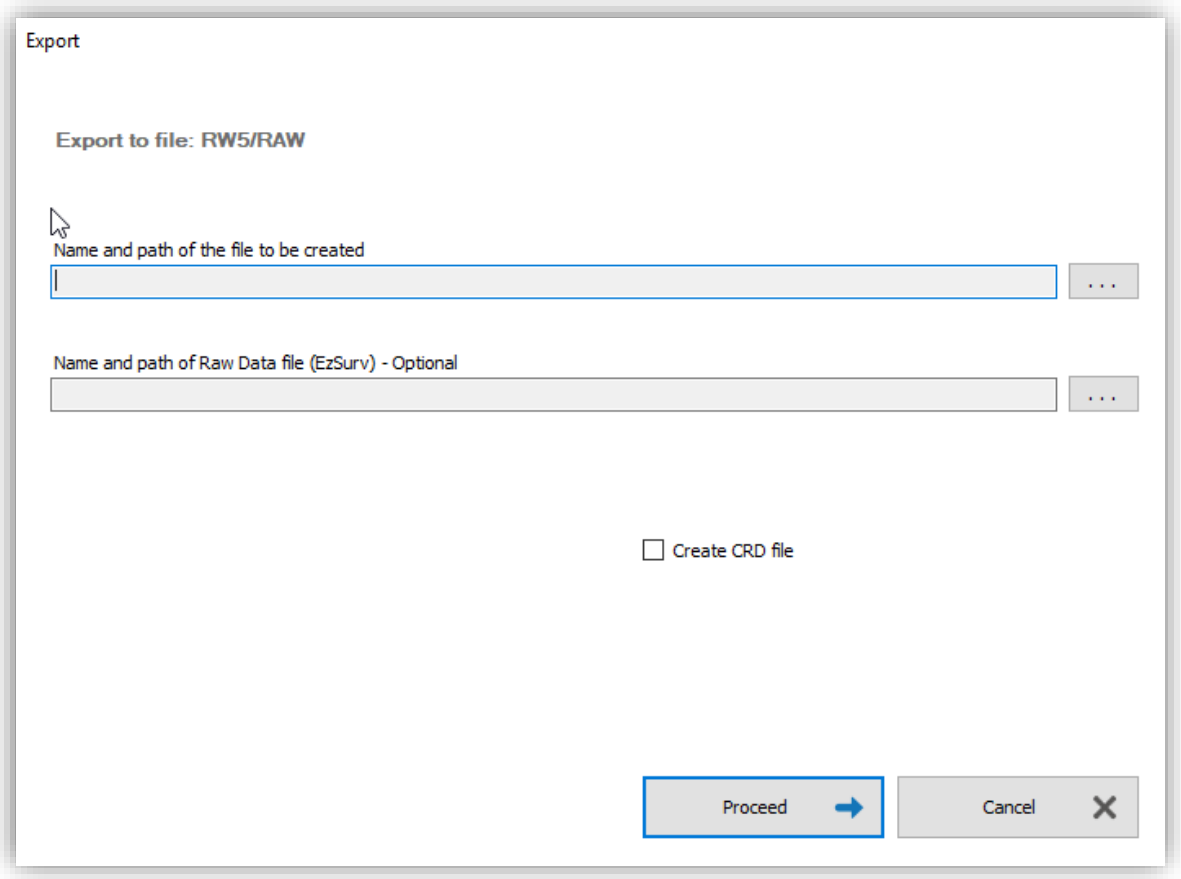


Figure 2.20

2.1.3.3 Export GeoGIS

The export of a GeoGIS file is like the export of a Cube-a, it will be necessary to set a file name and a path. By default, both points and graphic entities are exported, but it is always possible to exclude the graphic entities from the export.

2.1.3.4 DXF/DWG file

This export is the only one that can be recalled from two different commands within the program. First command is into the menu in Figure 2.18, like all other exports, the second is the Dxf/Dwg Out command in the Home tab (Figure 2.3).
For a correct exporting, the first choice to make is the version of AutoCAD® that you want to use to create the file. Then you can select the options on the entities, especially if you want to include Raster images, backgrounds and topographic points.
If you export the points as INSERS, you must indicate which attributes you want to define for the points and how you want to get them, for example if you want to get them from the point label. If simple topographic points are chosen, not as INSERTS, the section on the right called Options for displaying points will be enabled. In this section it is possible to set the size (as an absolute value, as 5% of the drawing area or as a percentage of the drawing window) and the symbol for displaying points in AutoCAD® (from the drop-down menu in Figure 2.21).
In the general options section, you can enter the text size and choose to create a 2D DXF file (Figure 2.21).

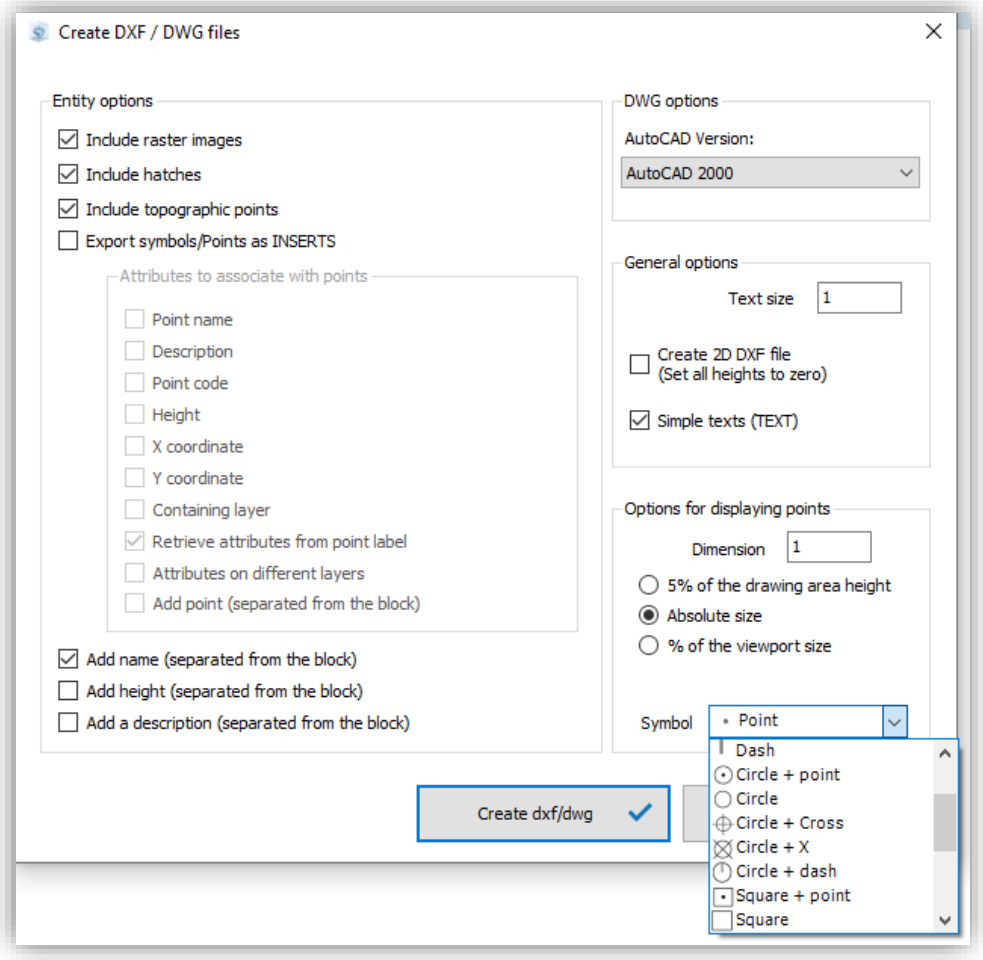


Figure 2.21

2.1.3.5 Export on text file

To create a text file just click on the Export points to text file button (Figure 2.18). The creation of the file is customizable, and it is possible to define the characteristics that you want to give to it: you can choose whether to include a header, the data to be inserted, the separator character, the format of the geographical coordinates etc.

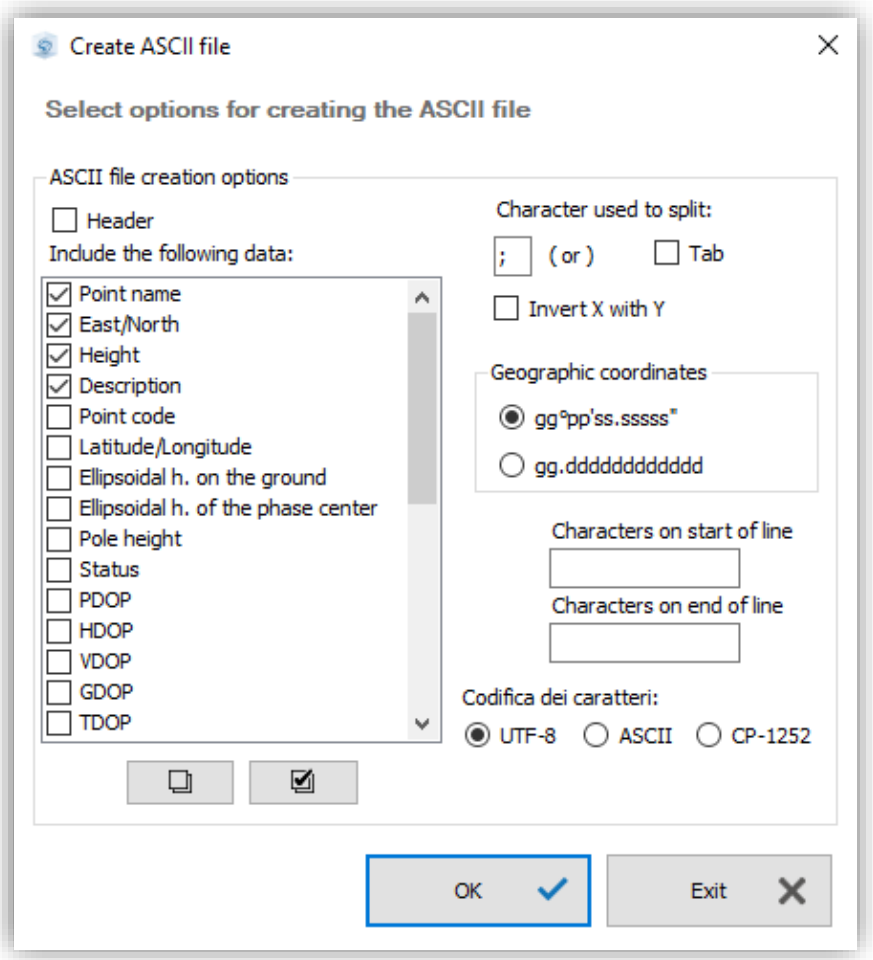


Figure 2.22

2.1.3.6 Export an image file (bmp, jpg, etc.)

You can export an image of the planimetric (or 3D) view of the program, just click on the corresponding command from the menu in Figure 2.18 and set the width in pixels of the image you want to create.

2.1.3.7 Export in Google (KMZ)

By accessing the Export to Google (KMZ file) function, you can generate a KMZ file that can be viewed in Google Earth, this export is possible only if there is a fieldbook in the current job. The procedure is like the other exports of this application; first specify a name and a path for the file, then proceed with selecting the features you want to add. The structure of this window is very flexible because you can indicate which data to export; including CAD elements, GPS data, photos, database attributes. As soon as the file is created, the program will ask if you want to load it directly in Google Earth (Google Earth must have been previously installed in the PC).

2.1.3.8 ESRI Shapefile (shp)

The steps for creating an ESRI shapefile file (Figure 2.23) are like those applied to the export of other formats, once selected the name and location of the file to be exported, you can select a series of information and contents that you want attribute to the file.

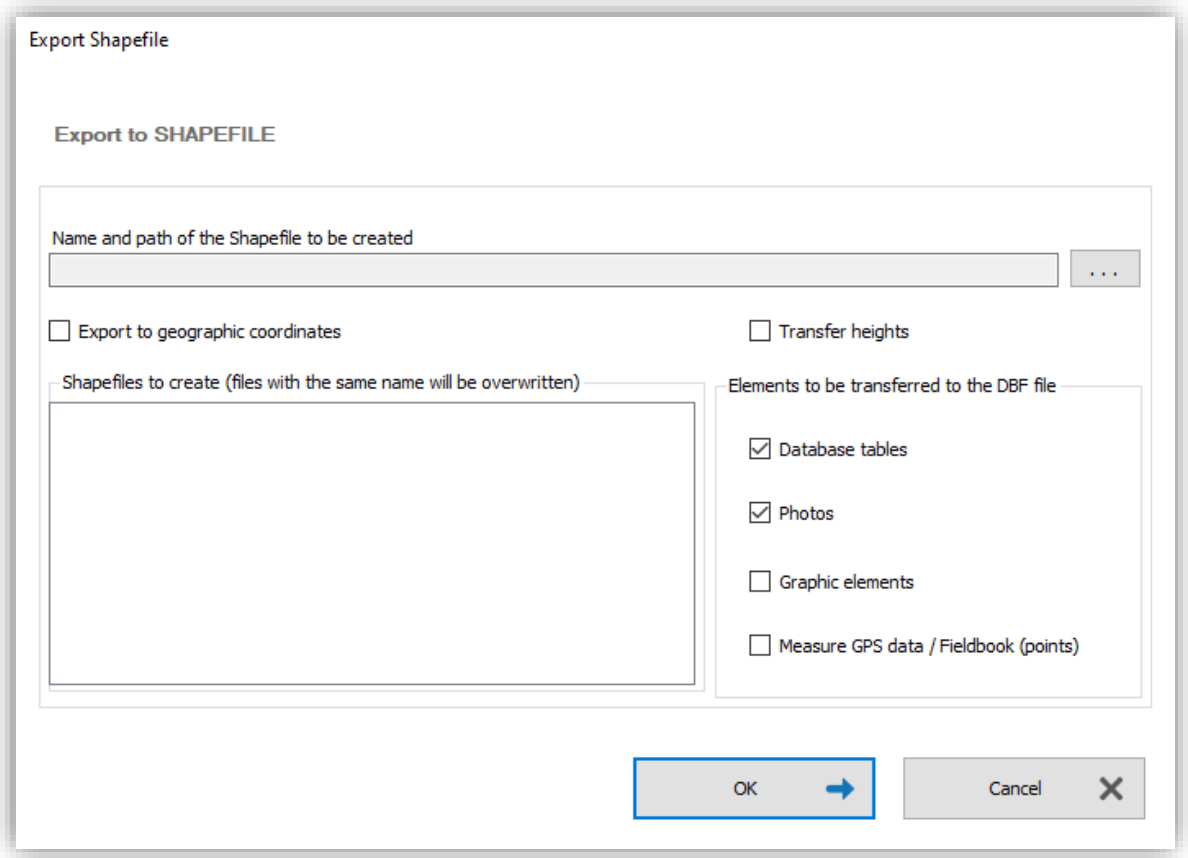


Figure 2.23

2.1.4 Settings

In Settings (command in the File tab), you can set the general program functions, such as checking for updates at startup or the version of AutoCAD® to be used (Figure 2.24). This function consists of 4 tabs that will be discussed below. It will allow you to completely customize the aesthetic, functional and practical aspects of the program. Note: to make sure that the changes are effective, after changing the settings, it is advisable to restart the program.

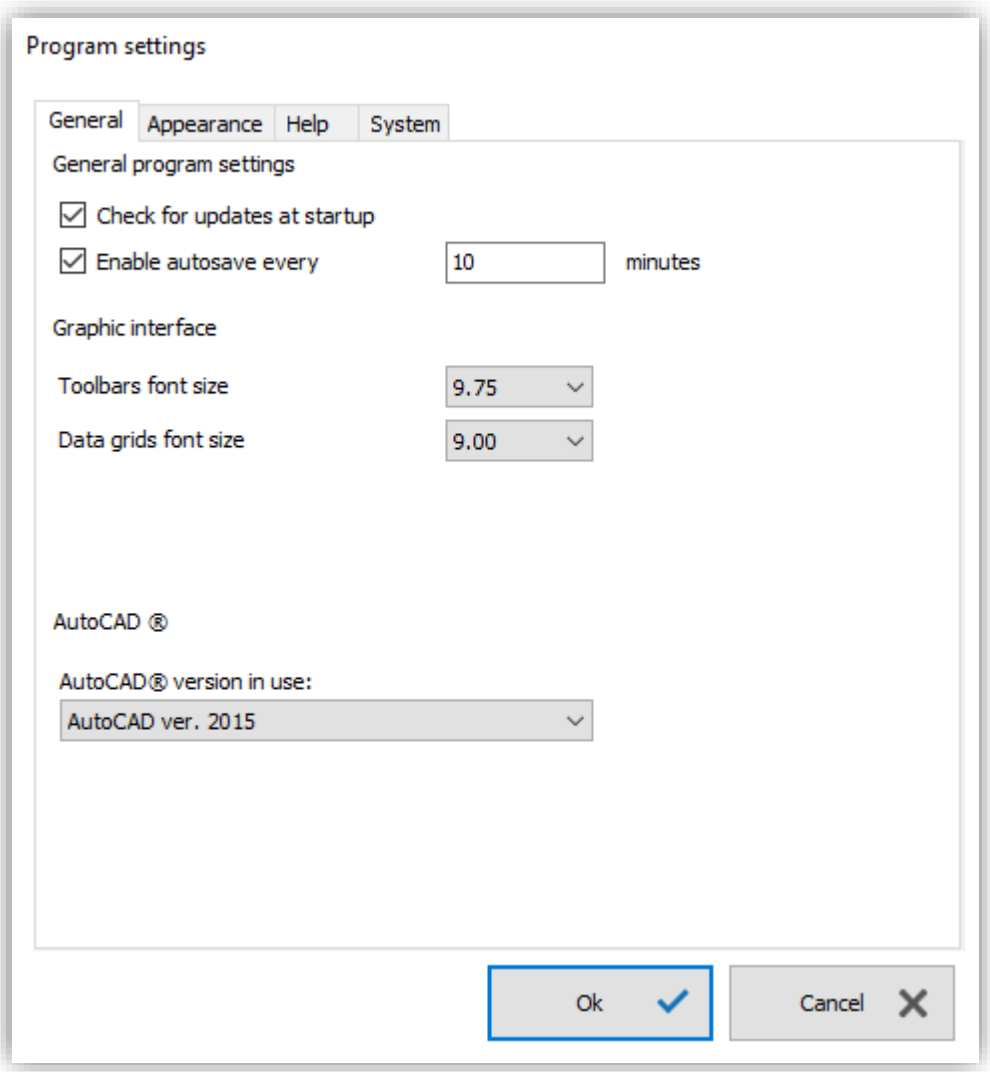


Figure 2.24

In the Appearance tab (Figure 2.25) you can determine, for example, the background color of the work area or enable dynamic information on the cursor.
Among the other functions available there is the possibility to enable/disable the dynamic list of features, the display of the thicknesses on the screen, the size of the Cartesian axes' icon.

By enabling the dynamic list of features, you can read the characteristics of the elements in the project. If you hover the mouse over the elements, the application will display a popup window, like the ones below (Figure 2.26), which will describe the type element and its characteristics.

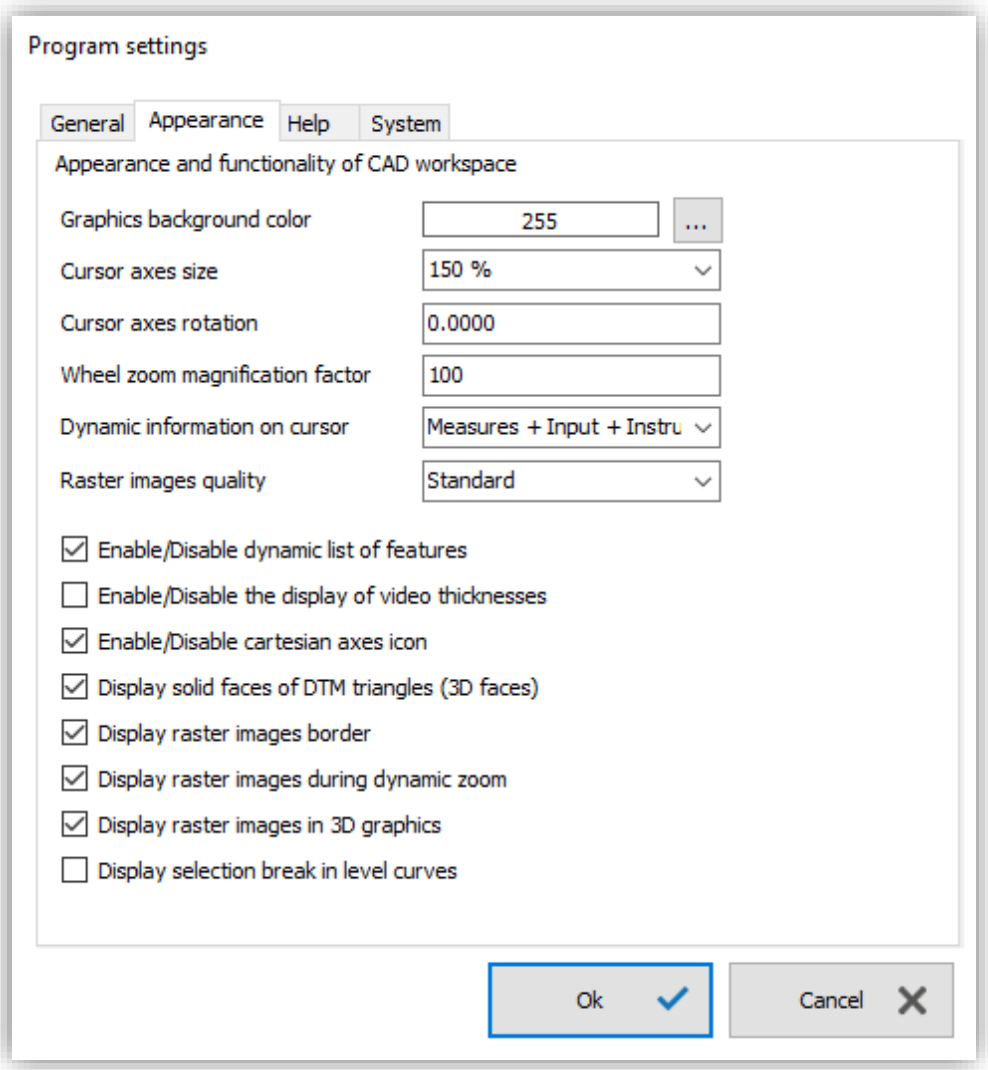


Figure 2.25

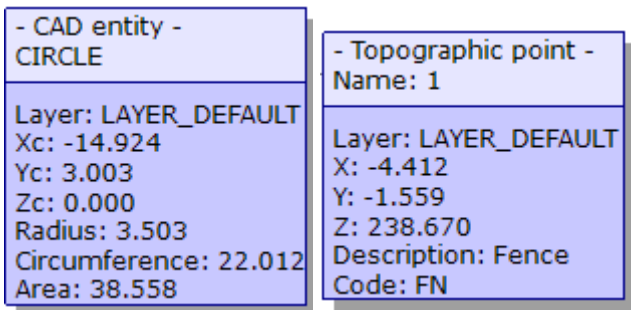


Figure 2.26

The Help tab (Figure 2.27) is useful for setting the use of the Object Snap and in which mode and whether to enable or disable polar pointing and Ortho mode. Furthermore, in this section it is possible to customize the size of the Osnap symbol and the size of the selection area when this mode is active.

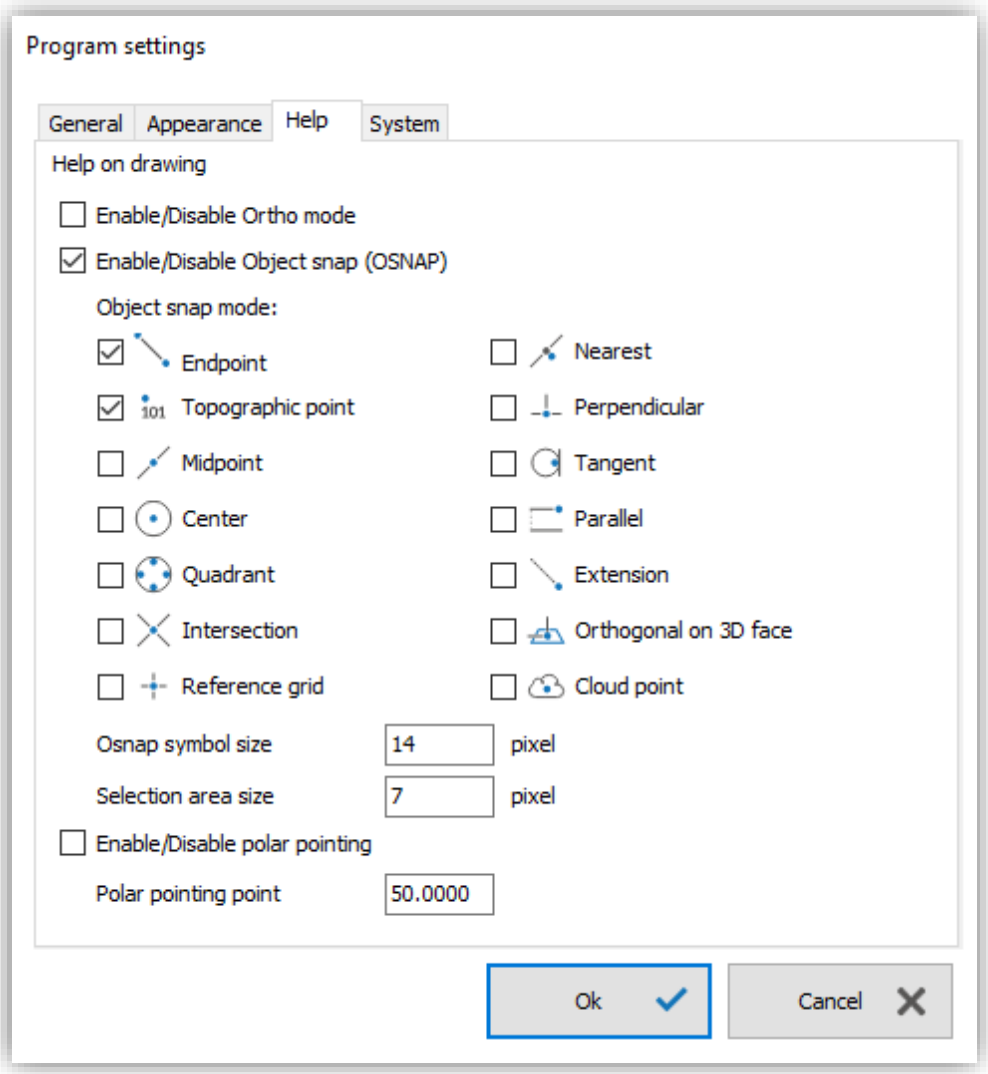


Figure 2.27

In the System tab it is possible to set the topographic unit of measure and the decimal figures for the display of parameters such as heights, coordinates, distances, etc.
Regarding the representation of the angles, which is a setting in this section, there are two possibilities: the representation of the topographic angle and GPS and the representation of the general angle, which concerns the graphics. The representation of the angle relative to the topography is set by default in Grads but when a fielbook is imported, the application will read the configurations of the job and set the representation accordingly.

From the File tab you can click on the Set Graphic Styles command to access the menu in Figure 2.28.

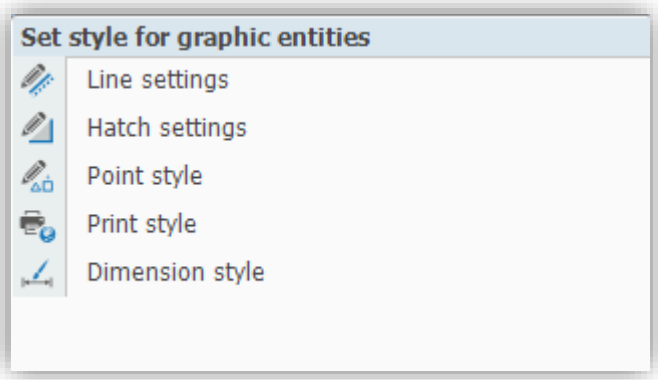


Figure 2.28

Each of the commands in this menu generates a window for customizing lines, hatches, point symbols, printing styles and dimensions (in Figure 2.29 an example of a window for customizing lines).

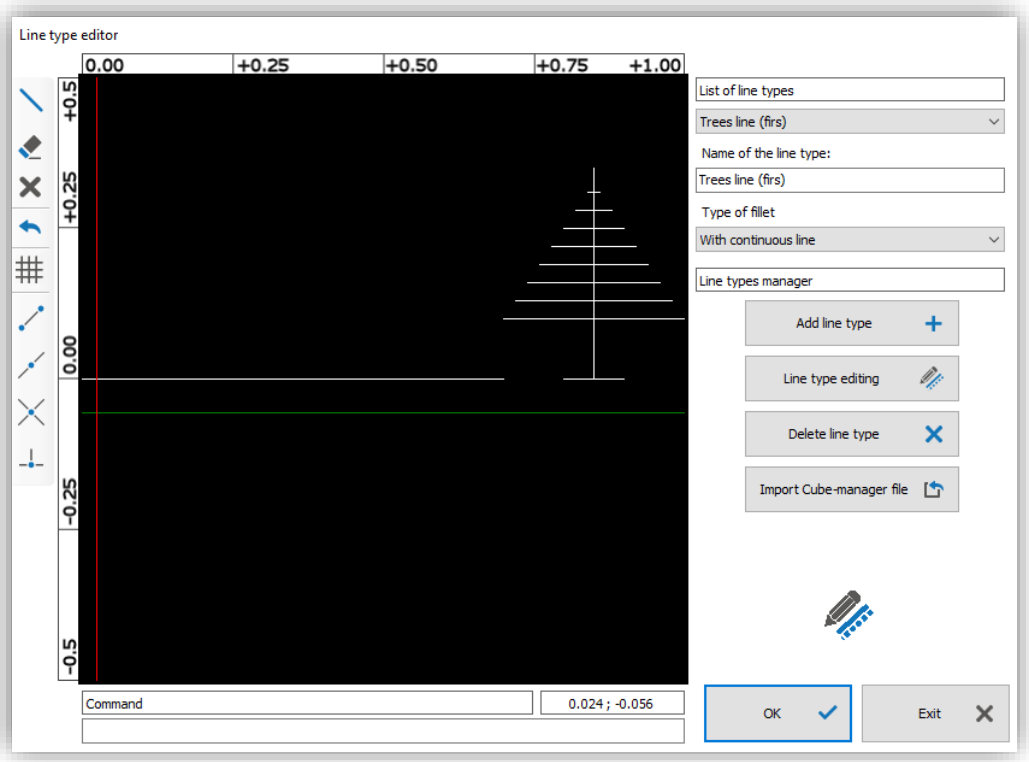


Figure 2.29

From the File Tab it is also possible to access the Upload utility files function which has the purpose of uploading files of three categories (Figure 2.30): image files, database files,

geoids (Cube-manager supports all major geoid formats: GGF Files; UGF Files; GEO Files; GRD Files).

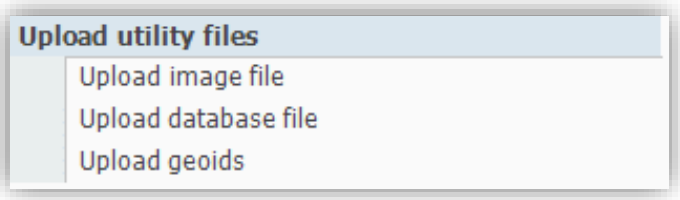


Figure 2.30

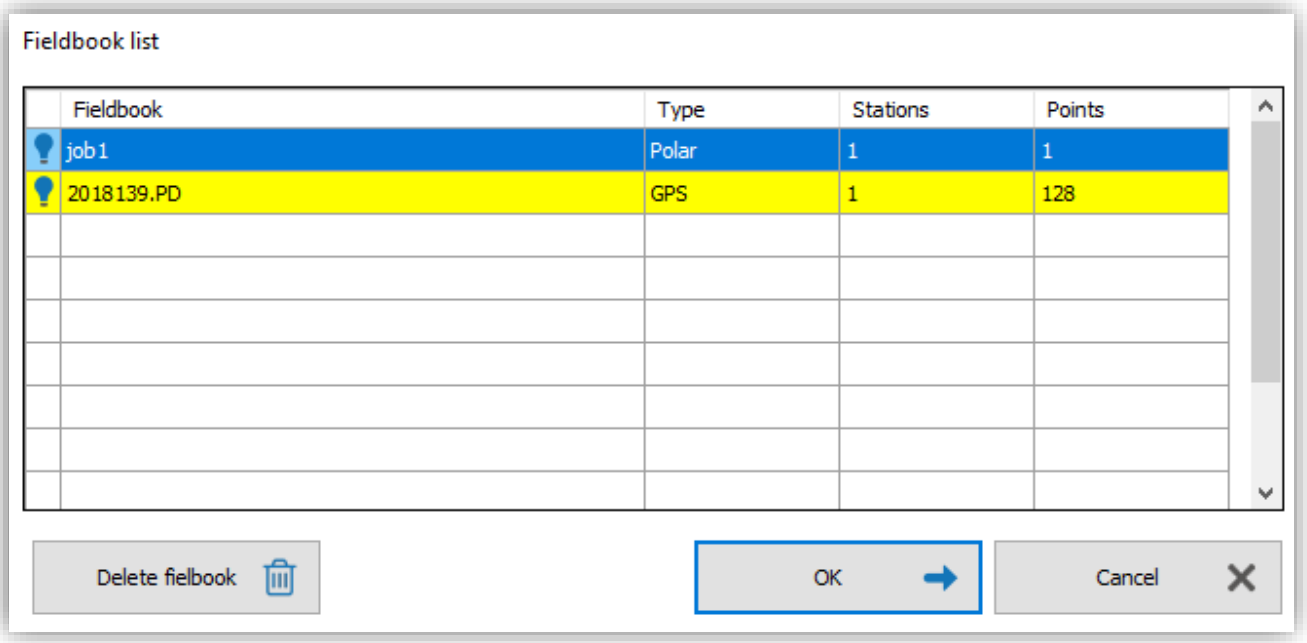


Figure 2.31

You can check how many and which fieldbooks are present in a job by accessing the Fieldbook List function. In Figure 2.31, the information displayed is: the name of the fieldbook, the type, the number of stations and the number of points. The operations that can be performed are to change the visibility of the fielbook (by clicking on the light bulb icon on the left) and to delete the fielbook. By deleting a fieldbook it is also possible to delete the topographic points contained in it.

The last two commands in the File tab are: Check for updates and Activate Cube-manager. The first command is for manually check if program's updates are available. Every time the application is started, an automatic check will be carried out to check the availability of new updates (default choice, it can be changed from the Settings section). However, you can also manually check for updates by clicking the button described above. If an update is available

and you decide to download it, the program will ask you to select in which folder you want to save the executable file, after which the download will start automatically.
The Activation Cube-manager button allows access to the screen in Figure 1.1, described in paragraph 1.

2.2 Home (tab)

The Home tab is located at the top of the main screen and contains several sections (Figure 2.32), including the In/Out section (Figure 2.3) described in paragraph 2.1.2, which contains all the formats available for import into the program.

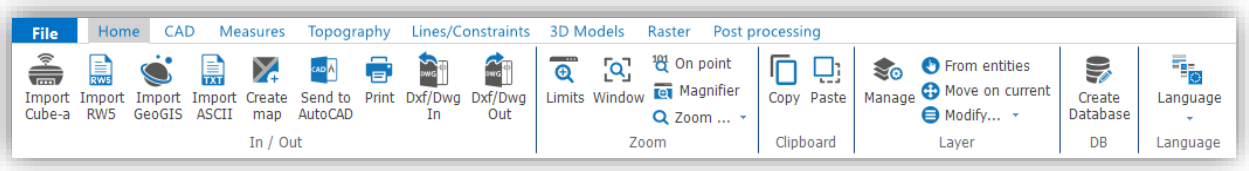


Figure 2.32

2.2.1 Zoom, Clipboard

The Zoom section contains numerous commands for zooming and selecting items in graphics. The commands are: Limits, Window, On point, Magnifier and Zoom that allows you to access a submenu to select the zoom in, zoom out or dynamic pan of the graphic (Figure 2.33). In the Clipboard section you can find the classic copy-paste function.

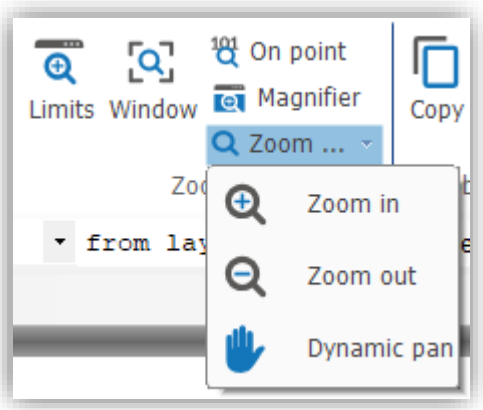


Figure 2.33

2.2.2 Layer

The Layer section is used to manage the various layers in the project. By clicking on the Modify button (Figure 2.34, red circle), you can access the window in Figure 2.35, where you can operate on layers with visibility, selection or block functions.
Layers can also be managed via the Layer Properties Management window, which can be accessed by clicking on the related icon on the main screen (Figure 2.36). In the layer properties window (Figure 2.37), you can create new layers and delete others (in order to delete a layer this must not be used and deselected, a layer is not used when it does not contain graphic elements or topographic points).
This window displays all the available layers and their classic characteristics, such as color and type of line, from here you can print the contents of a layer and decide whether to show the names and symbols present (by clicking on the eye icon). You can also operate on visibility (light bulb icon).

Figure 2.34

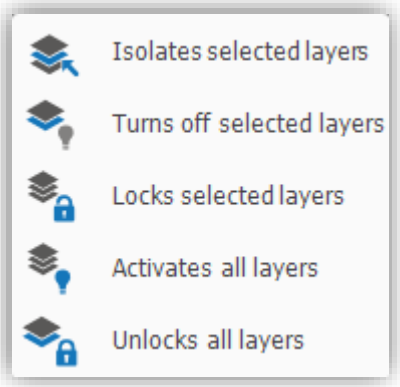


Figure 2.35

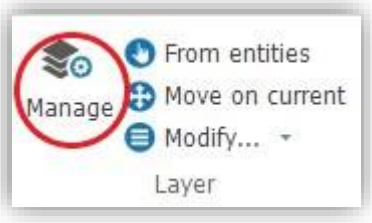


Figure 2.36

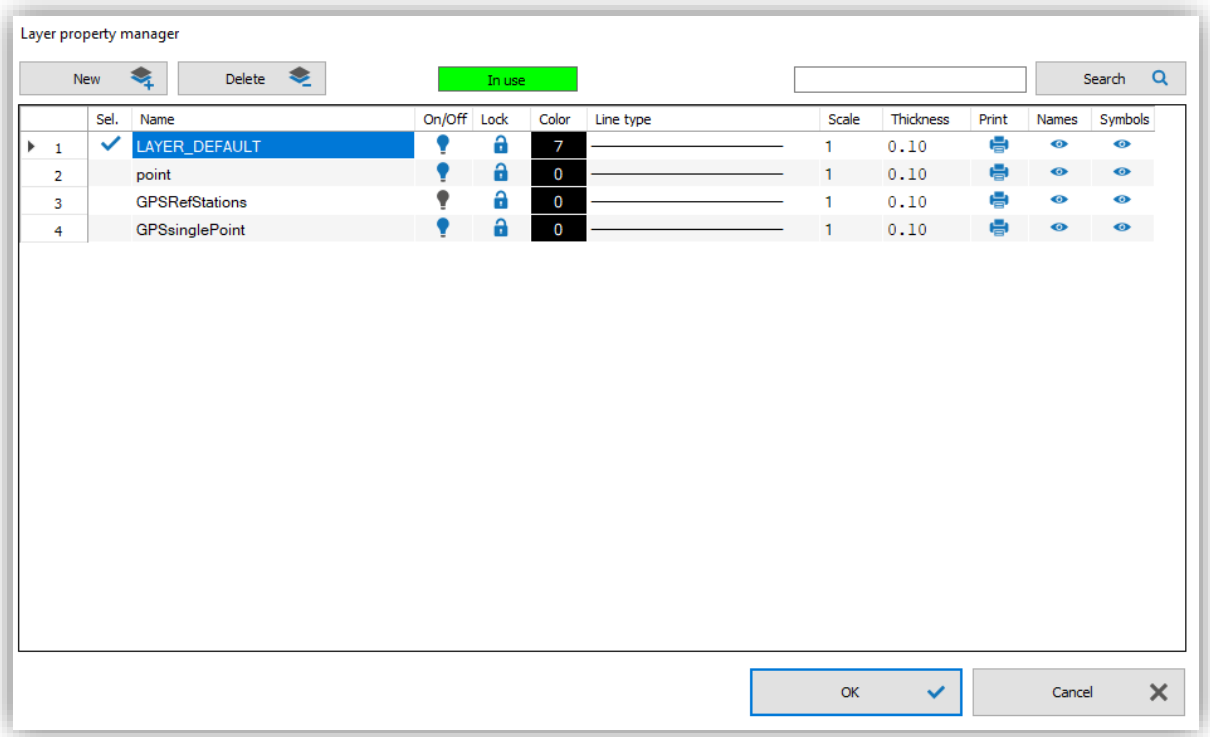

Layer property manager
New
Delete
In use
Search
Sel.
Name
On/Off
Lock
Color
Line type
Scale
Thickness
Print
Names
Symbols
1
LAYER_DEFAULT
7
1
0.10
2
point
0
1
0.10
3
GPSRefStations
0
1
0.10
4
GPSsinglePoint
0
1
0.10
OK
Cancel

Figure 2.37

2.2.3 DB

The Database command is divided into two commands: Database management and Load/Add Database. The Database management command, if clicked opens a screen as in Figure 2.39, from here it is possible to compose a database (for GeoGIS), as a set of records and lists of attributes (as you can see in the example for the BUILDING object you have the attributes: 'type' with the relative list - commercial, industrial, residential, warehouse; 'street code'; 'heating system' with relative list -autonomous, centralized etc.).
The screen is divided into two areas, on the left you can check the structure of the database; the underlying commands are for opening, creating, saving the database, undo and redo, and the reordering of the elements in the database structure. The sector on the right is a convenience window for importing information from the text file or from a default list (by clicking the blue document icon) to compose the database structure. The Set DBF command opens a screen where it will be possible to assign the type to the new attribute (as for shapefiles: Text, Numerical integer, Numeric decimal, Boolean, Date), the same screen is opened automatically even when a new database is saved.

To create a new database, after clicking the create button, you can write in the left area of the main screen, press TAB to create a new field for the records, press ENTER for a new attribute field (press TAB twice to edit the attribute's list). With the right-click on the grid you can access a popup menu that offers all the commands for creating and writing the database.
With the right-click on the right grid, you can access a popoup menu with commands to manage any imported template files.
You can save and view the database on a device connected via USB to the Windows Mobile Device Center, the device must be equipped with the GeoGIS program and during the transfer the GeoGIS program must not be running (Cube-manager always generates a backup copy of the database in memory in the device).

The Load/Add Database command leads to a window as in Figure 2.38, with this command it is possible to upload one or more databases in the current job (the databases to be uploaded must be available in the program. To load the databases in memory, from the File Tab access the Load utility file function, and then click on Upload database file). In the table on the left are summarized the databases available in memory, to upload the database just click on the bottom, on the Load selected attributes, in the table on the right will appear the loaded databases.

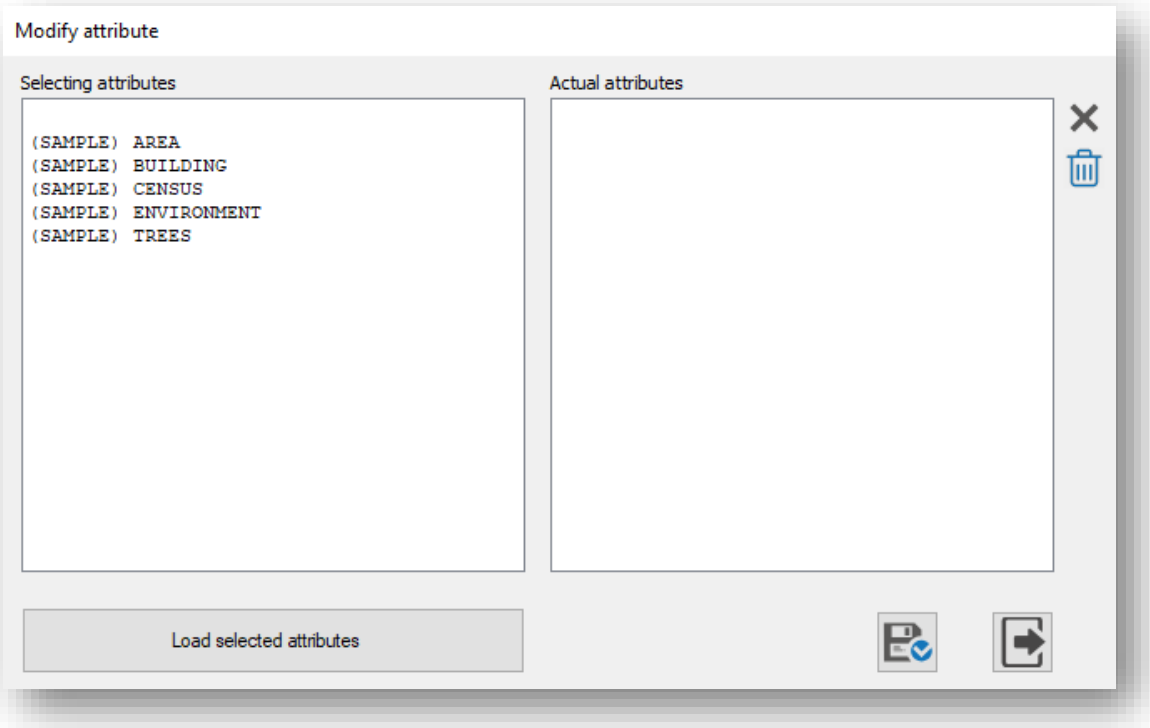


Figure 2.38

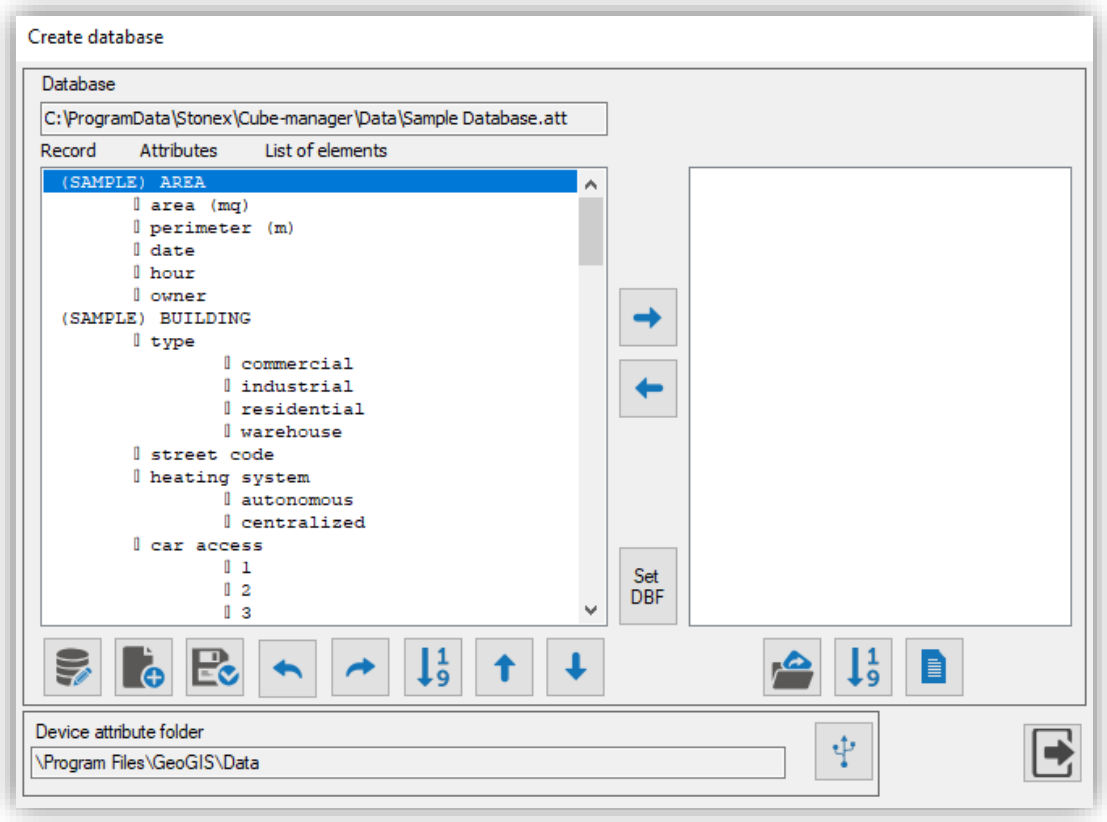


Figure 2.39

2.2.4 Language

By pressing the language button, you can select the language of the program. We recommend restarting the program after changing the language.

2.3 CAD (tab)

By clicking on the CAD tab (Figure 2.40), it is possible to access the area dedicated to design and CAD processing, which aims to support and integrate the topographic elements.
These functions are like AutoCAD® ones and its many clones. This section is divided into two parts: draw and modify. In the Draw section (Figure 2.41) you can find commands to draw CAD entities such as lines, polylines, polygons and so on. Once you have selected the element you want to draw, just follow the instructions (represented by the suggestions that will appear on the screen and/or before the command line) to complete the command (Figure 2.42, example of a suggestion on the screen for drawing a line; Figure 2.43, example of a suggestion before the command line).
Often, with the suggestions before the command line at the bottom left of the main screen, other subcommands are available (to the right of the command line). When the subcommands are visible, to use them just write them in the command line and click on enter (or simply click on them).
The subcommands are very intuitive to use, however there is a command that is worth analyzing, the 'pro' command for properties (Figure 2.44, second command from the right). This command opens the Quick entities selection window (Figure 2.45), which consists of two tabs. The first tab called 'CAD entities' allows you to select entities by referring to one feature or another, e.g. color and type of line. The second tab is called 'Topographic Points' and allows you to select the points based on their characteristics. As you can see in Figure 2.46 a wide range of attributes is available, from points with a given point symbol to point in the same fieldbook.

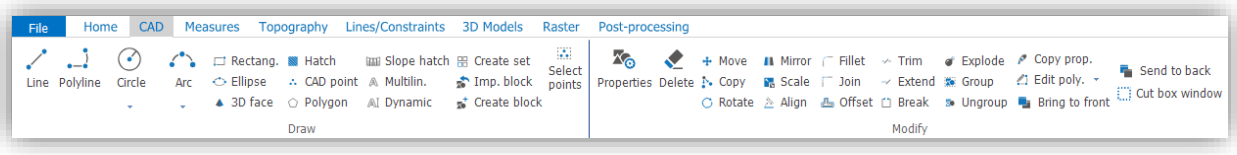


Figure 2.40

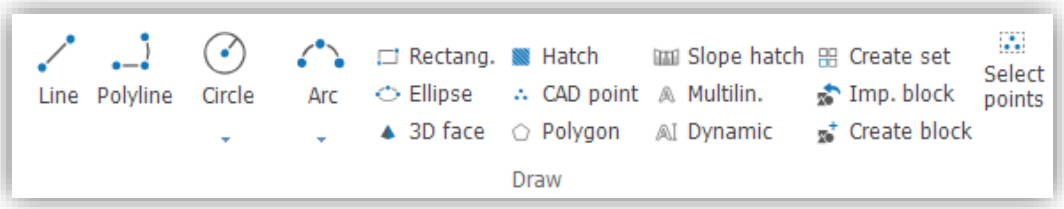


Figure 2.41

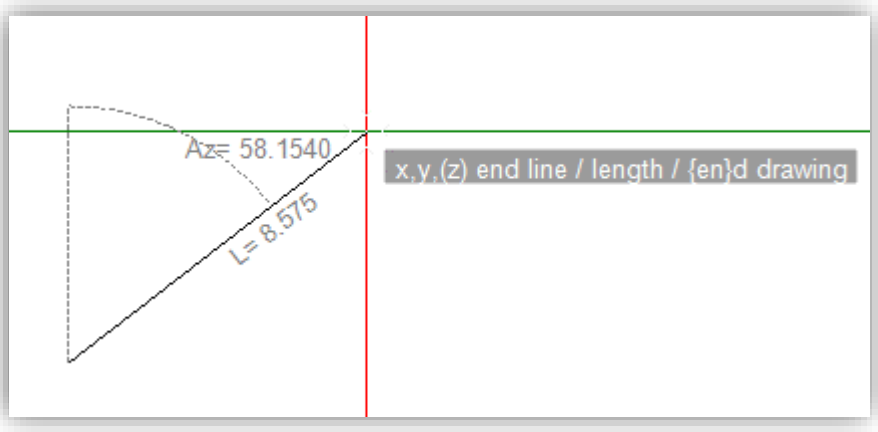


Figure 2.42

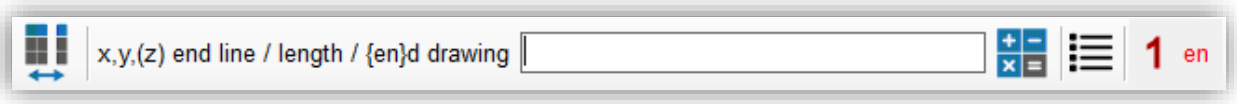


Figure 2.43

Figure 2.44

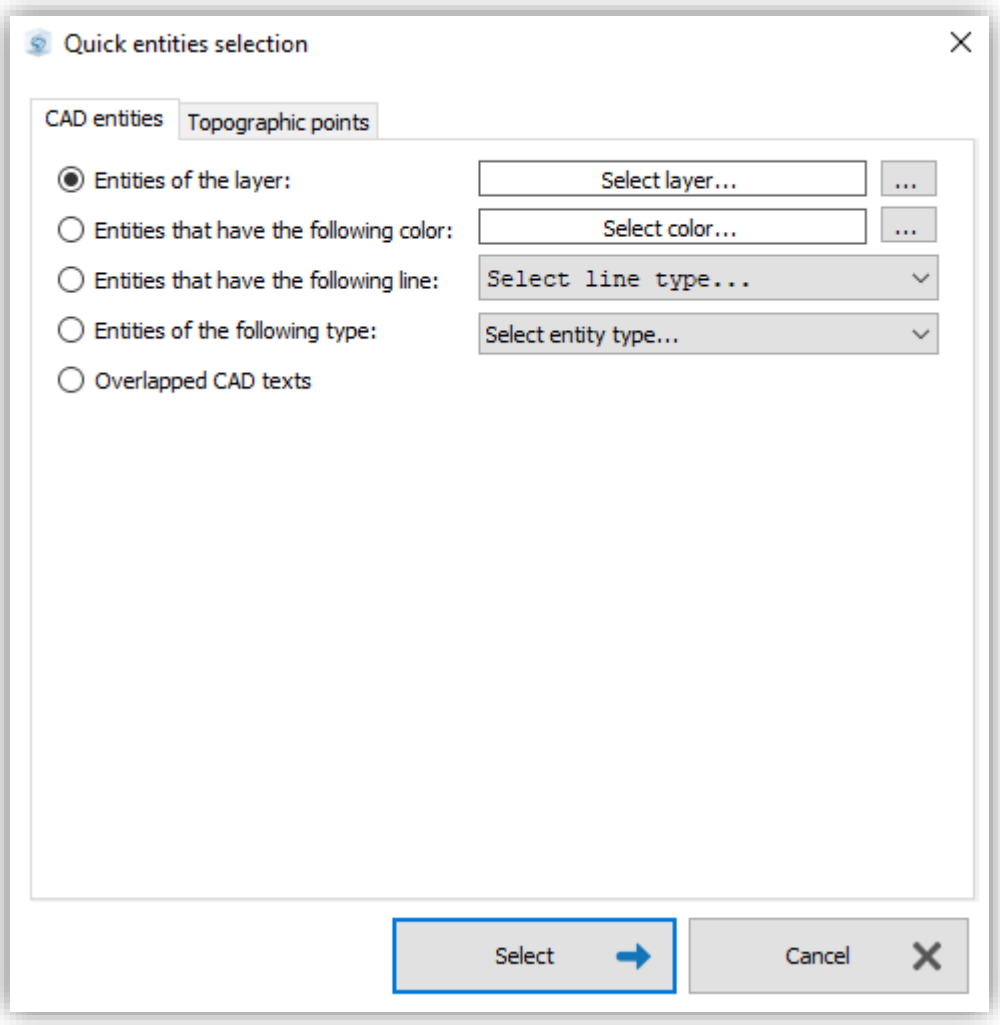

Quick entities selection
CAD entities
Topographic points
Entities of the layer:
Select layer...
...
Entities that have the following color:
Select color...
...
Entities that have the following line:
Select line type...
Entities of the following type:
Select entity type...
Overlapped CAD texts
Select
Cancel

Figure 2.45

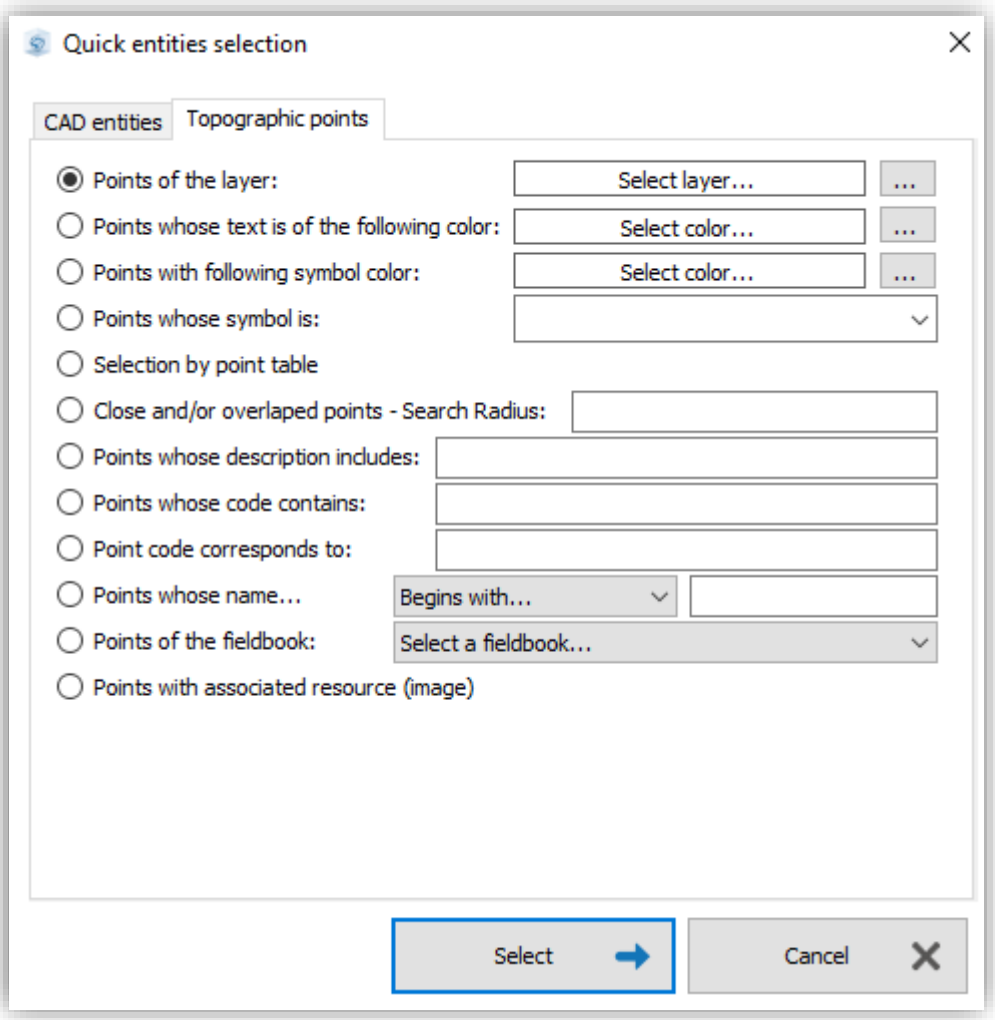


Figure 2.46

The commands in the Draw section can be used with OSNAP (object snap) functions, such as OSNAP on the ends or midpoints. Note that by default the program starts with an OSNAP active on the ends. This setting can be changed at any time by clicking on the Osnap (on/off) button at the bottom of the main screen, shown in Figure 2.47 in dark gray (active).
All the OSNAP modes are represented by the icons in Figure 2.48, passing with the mouse on them you will see a suggestion on the functionality of the command.

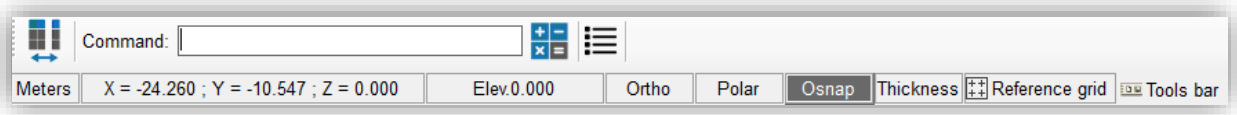


Figure 2.47

Figure 2.48

In the Modify section of the CAD tab (Figure 2.49), you can find all the functions for processing CAD entities. The names and the icons of the commands are very intuitive, and each command has a tooltip that briefly explains what its functionality is. Among the available commands there are explode, group, ungroup; these commands are useful for working with CAD entity groups. The Cut box window command generates a window as in Figure 2.50, where it will be possible to create a new job by selecting a portion of the window of the current job, the cutting window can have an outer frame with customizable customizable graphic characteristics and layers.

The Properties button generates a window that summarizes the properties of the selected entity, the system recognizes what type of entity it is and at the bottom it shows this information (Figure 2.51, in this case it is the properties of a polyline).

There is also a command to copy the properties of one entity on another and a command to change the order in which the drawings are displayed.

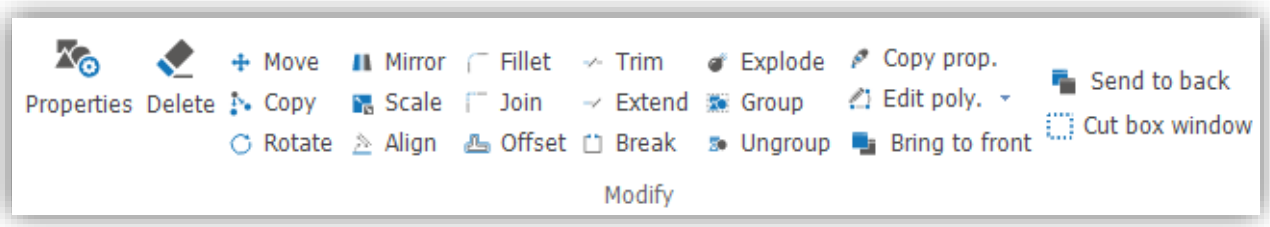


Figure 2.49

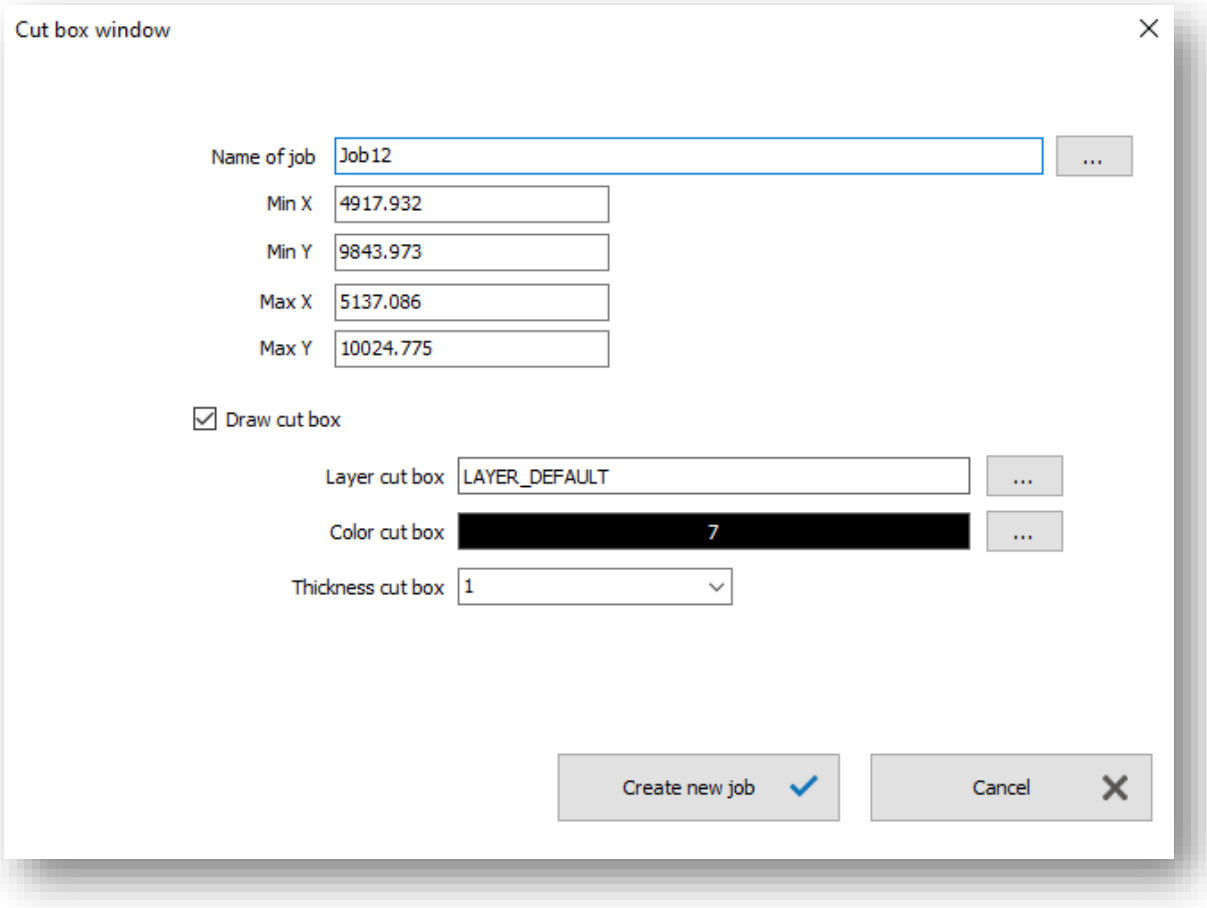

Cut box window
Name of job
Job12
...
Min X
4917.932
Min Y
9843.973
Max X
5137.086
Max Y
10024.775
Draw cut box
Layer cut box
LAYER_DEFAULT
...
Color cut box
7
...
Thickness cut box
1
Create new job
Cancel

Figure 2.50

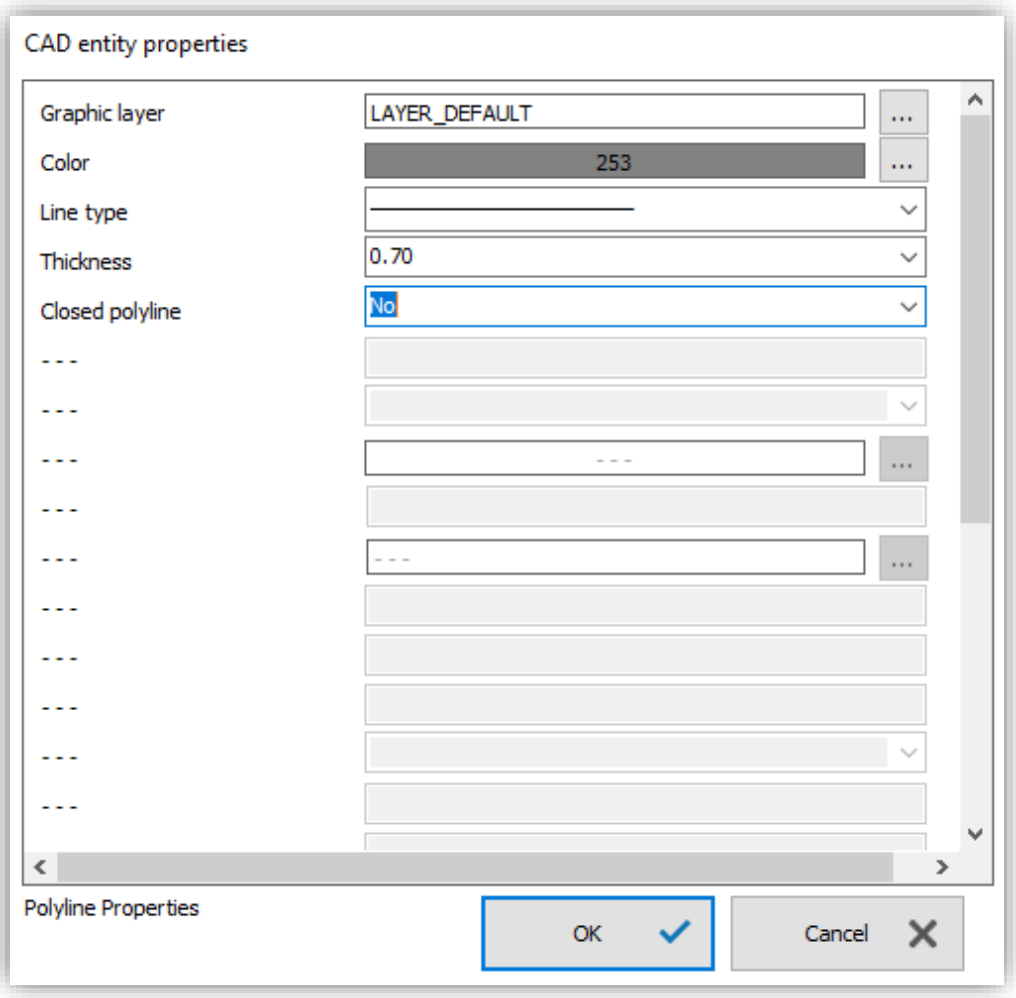


Figure 2.51

Figure 2.52 shows a popup window related to the Edit poly command. The submenu contains commands for modifing the polylines, for example by inserting a vertex or by removing it. The use is very simple and, like any other CAD command, just follow the suggestions that appear on the screen.

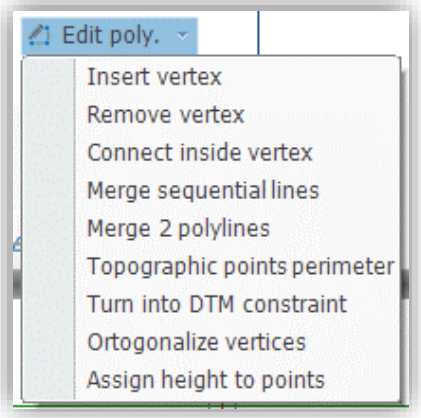


Figure 2.52

2.4 Measures (tab)

The functions in this section (Figure 2.53) are used to calculate and display information on surveys' data. This section is divided into three areas below: Measure, Calculations, Dimensions.

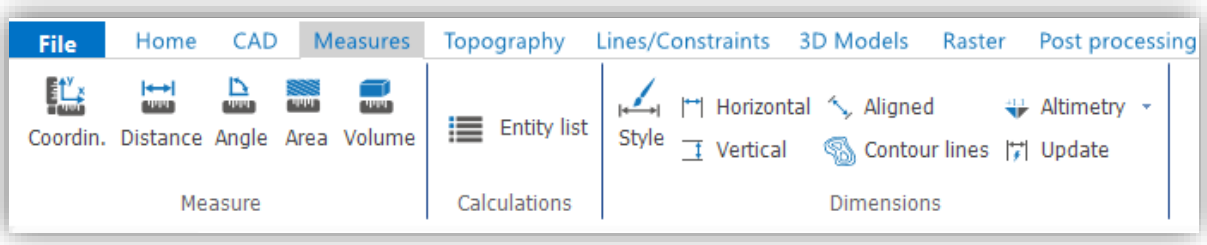


Figure 2.53

The Coordin. button will give the possibility to choose a point and then show the Cartesian coordinates (with the addition of the height) of that point, as shown in Figure 2.54.

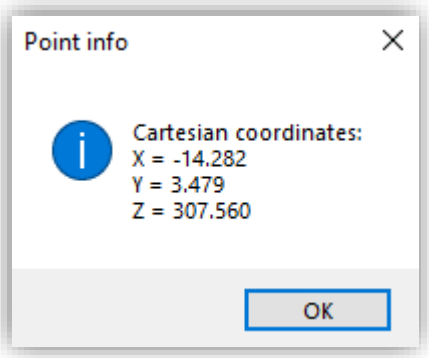


Figure 2.54

The Distance will give the possibility to select two points and measure the distance between them. The information provided by this function is the 3D distance, the horizontal distance, the components along the three axes, the azimuth angle and the zenith angle (the graphic appearance of this information is like that one shown for the Coordin command).

The Angle button will give the possibility to select 3 points: the start point, the midpoint and the end point. This function will calculate a clockwise angle and a counterclockwise angle (the graphic appearance of this information is like that shown for the Coordin command).

The Area button will allow you to insert the first point in which to start calculating the area, then the application will continue to ask to select the next point (up to n points) to draw the shape for the area measuring; after selecting the last point, just type the command "en" (in the command line, from the "end" command) so the function will compute the calculation.

The area and the perimeter of the drawn shape will then be displayed in a popup window, with a graphic like the one shown for the Coordin command.

The Entity List command, in the Calculations section, provides a list of the elements in the project, the list is presented as an editable text file. It is also possible to select just a part of the entities to display them in the list (Figure 2.55).

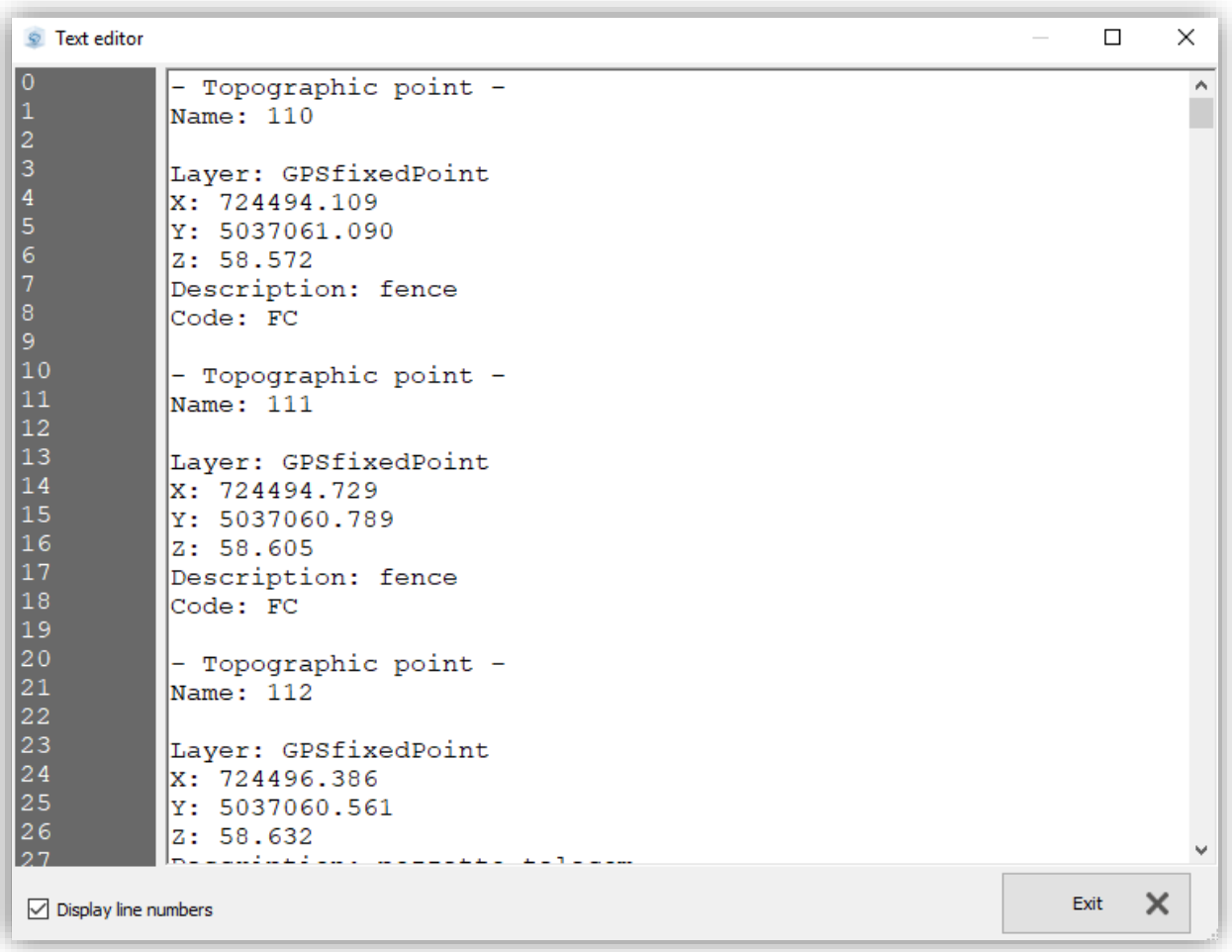


Figure 2.55

2.5 Topography (tab)

The topographic section consists of four subsections: Topographic points, manage coordinates, Fieldbook and Fieldbook schema (Figure 2.56). In the Topographic points it is possible to draw a new topographic point, to modify the characteristics of an existing one, to select the CAD entities to be used to create new points and to see all the points of the project grouped in a table. The Various operations command, if clicked, opens a drop-down menu with the commands as in Figure 2.57. You can also create a printable file with a list of points. In the Fieldbook section there are the commands to work with polar fieldbooks. You can manually create a fieldbook, import it from the PC or import it directly from the total station and export coordinate files.

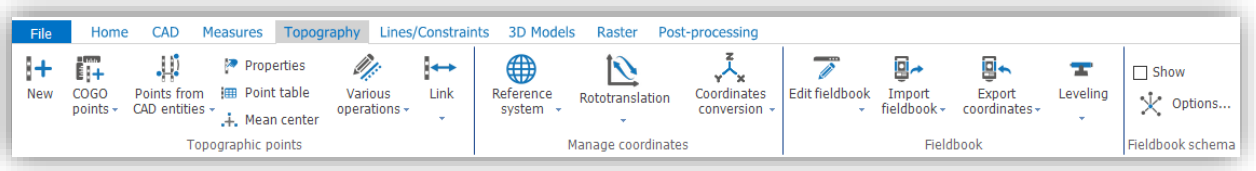


Figure 2.56

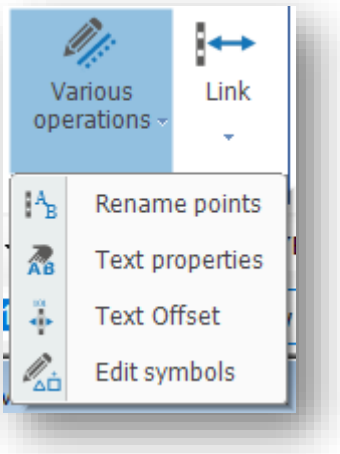


Figure 2.57

2.5.1 Topographic points

The Topographic points section is shown in Figure 2.58. The New command is used to insert new topographic points, by clicking on this button, you can access a window (Figure 2.59, Topographic point properties), where you can insert and customize the graphic properties of the created point.
The properties are completely customizable (note: it is possible to create a point with the properties that the application sets by default, e.g. the cross as symbol) and you can select the layer to which the point must belong (by clicking on search button next to the Graphic layer label). The Select Layer window (Figure 2.60) shows a list of available layers, all of which can be activated or deactivated, locked or selected. You can add new layers by clicking on the Add Layer button on the bottom left.
You can also change the name of the point and the font used. You can also change the text color selecting a new one in the window in Figure 2.61, by clicking the search button next to the Text color label. This window allows you to select a color from one of the available clusters (general colors, grayscale, main colors or layer).

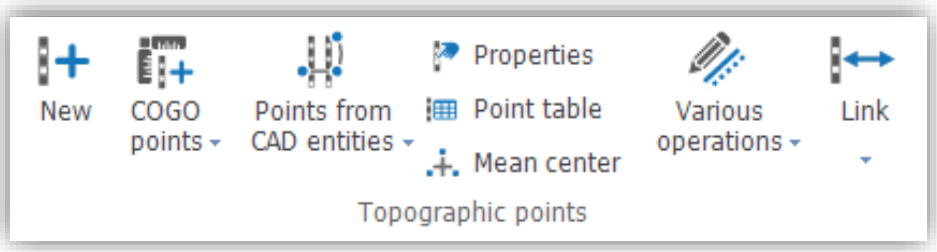


Figure 2.58

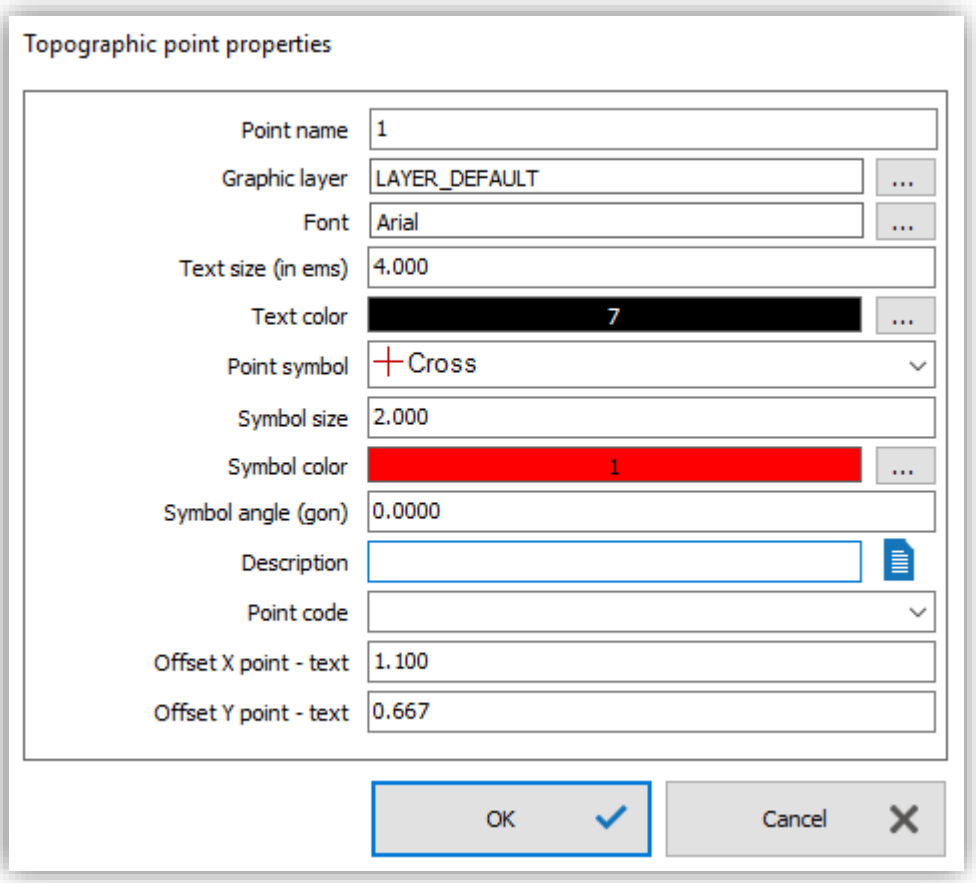

Topographic point properties
Point name
1
Graphic layer
LAYER_DEFAULT
Font
Arial
Text size (in ems)
4.000
Text color
7
Point symbol
Cross
Symbol size
2.000
Symbol color
1
Symbol angle (gon)
0.0000
Description
Point code
Offset X point - text
1.100
Offset Y point - text
0.667
OK
Cancel

Figure 2.59

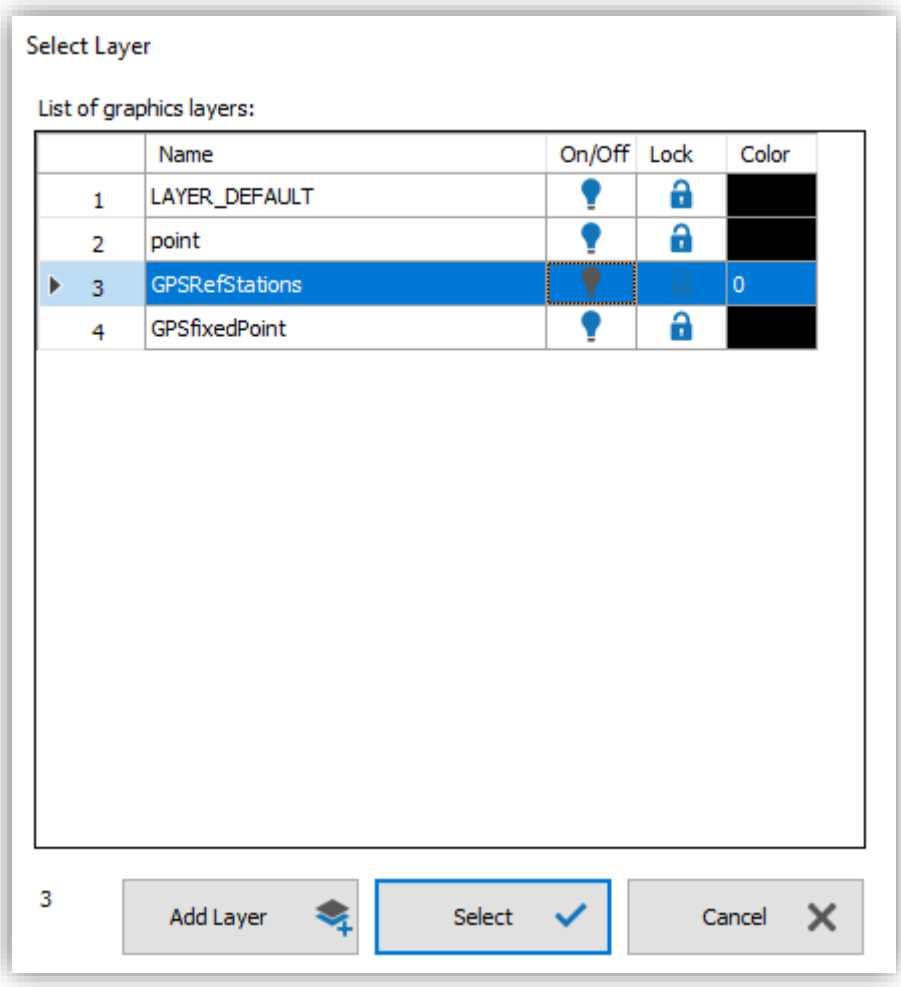

Select Layer
List of graphics layers:
Name
On/Off
Lock
Color
1
LAYER_DEFAULT
2
point
3
GPSRefStations
0
4
GPSfixedPoint
3
Add Layer
Select
Cancel

Figure 2.60

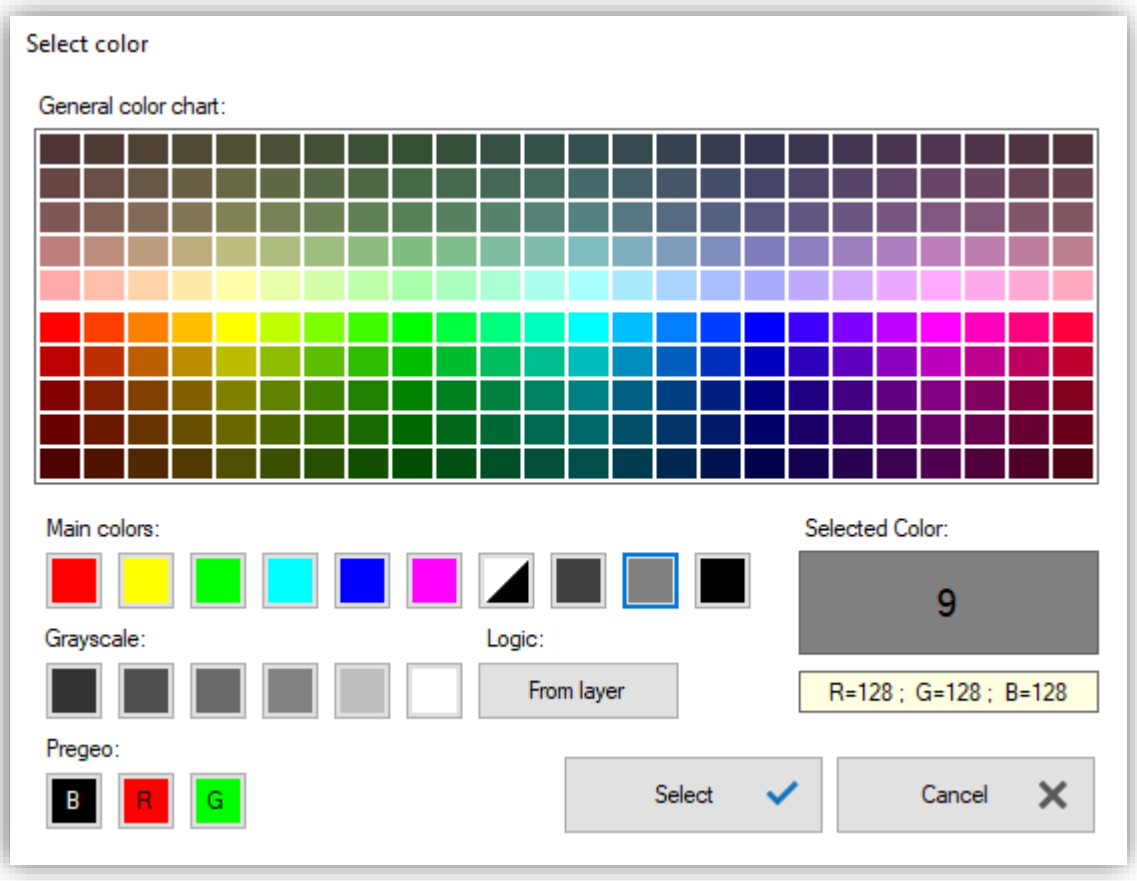


Figure 2.61

The symbol is another feature that can be customized. You can choose a symbol to assign to the point (Figure 2.62, drop-down menu for symbol selection), you can define its size, color (with a selection window equal to the text color selection) and the rotation angle of the symbol. Offset X point-text and Offset Y point-text are the positions of the text calculated from the origin of the point.
As for the Description label, by clicking on the icon next to the label you will access a window where you can view a list of possible descriptions (Figure 2.63). You can select existing descriptions or add new ones, saving the file with the destination to be specified. If a similar file has already been saved, you can select it and display it to use it.
When all the graphic properties have been set, it is possible to insert the point by identifying the position with the mouse or by manually entering the coordinates from the command line.

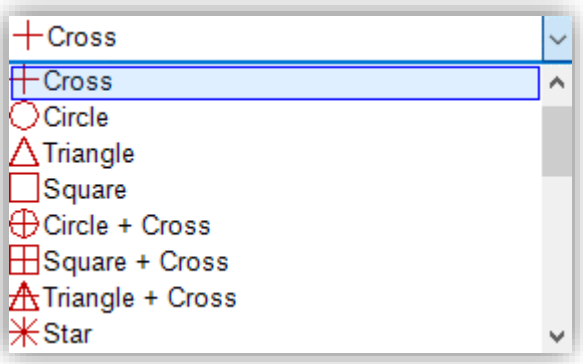


Figure 2.62

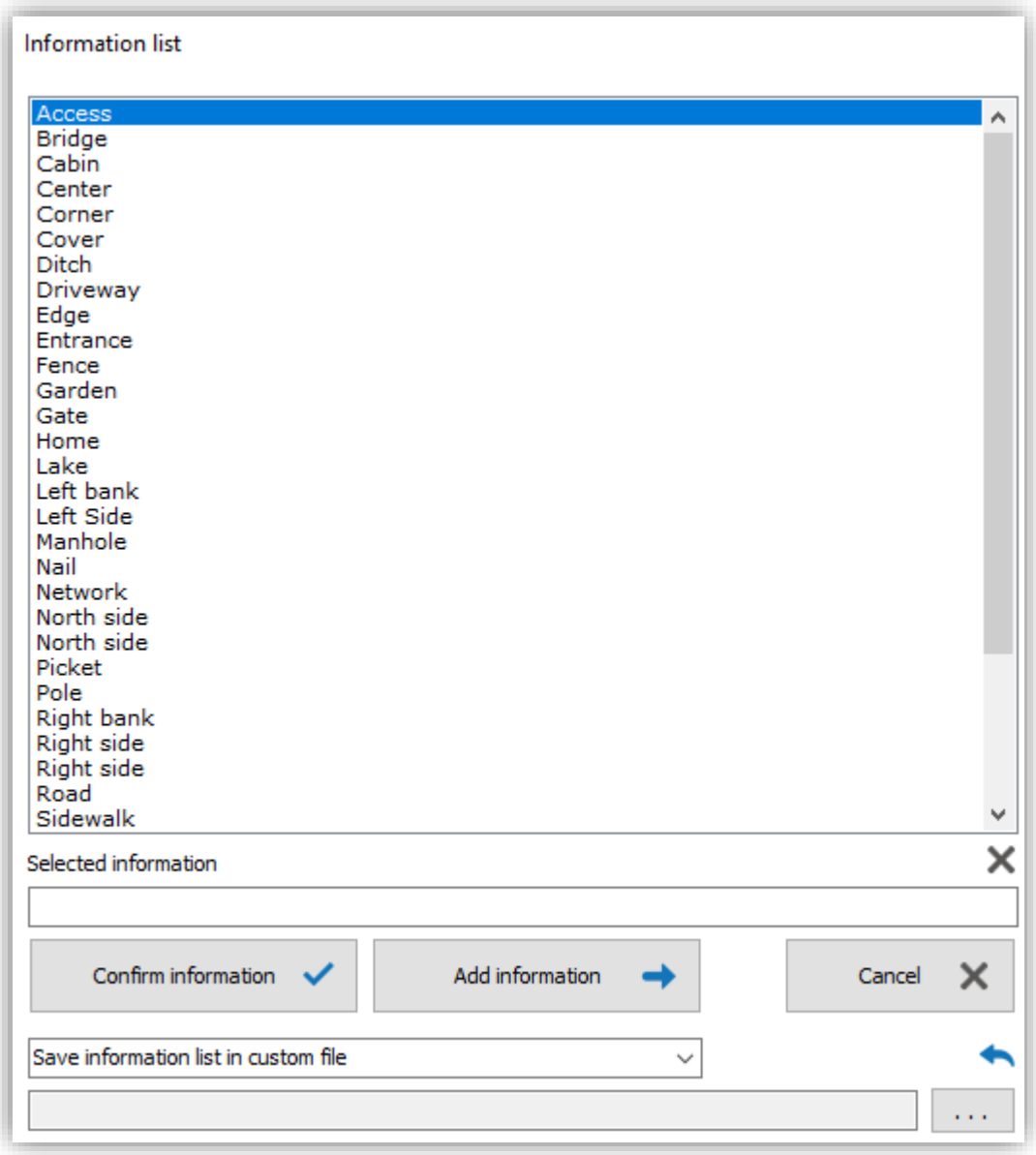


Figure 2.63

Returning to the Topopgraphic points section in Figure 2.58, by clicking on the COGO Points button, you can access the list of available COGO commands (Figure 2.64). To use these commands, simply follow the instructions appearing at the side of the command line.

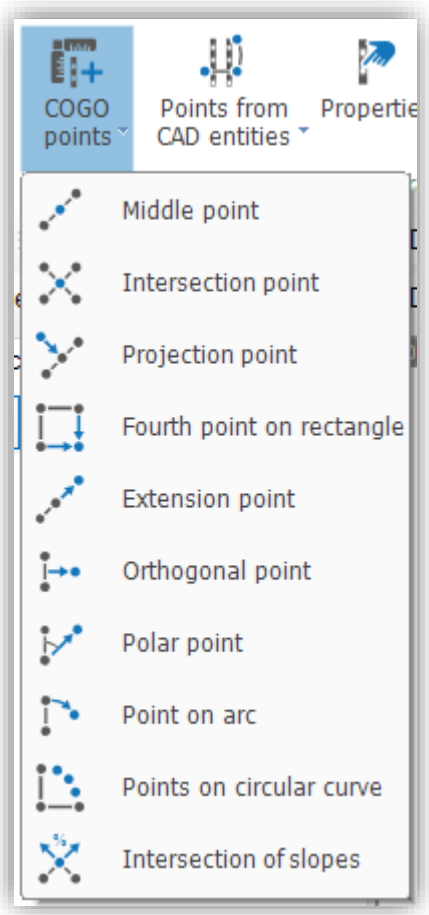


Figure 2.64

By clicking Points from CAD entities (in Figure 2.58), you can access two commands: Characteristic Points and Equidistant Points or with steps. Using the first, you can select one or more CAD entities to create topographic points. In the Characteristic Points window (Figure 2.65), you can select a layer (having access to the Select Layer window, as explained above). You can enter the name of the starting point and delete the overlapping points. Within this function you can further filter the CAD entities to be used by marking the available choices.
The second command, the Equidistant Points or with steps, can be used to create topographic points by dividing a CAD entity into equal parts or based on a step, to use the command just follow the instructions that appear next to the command line.

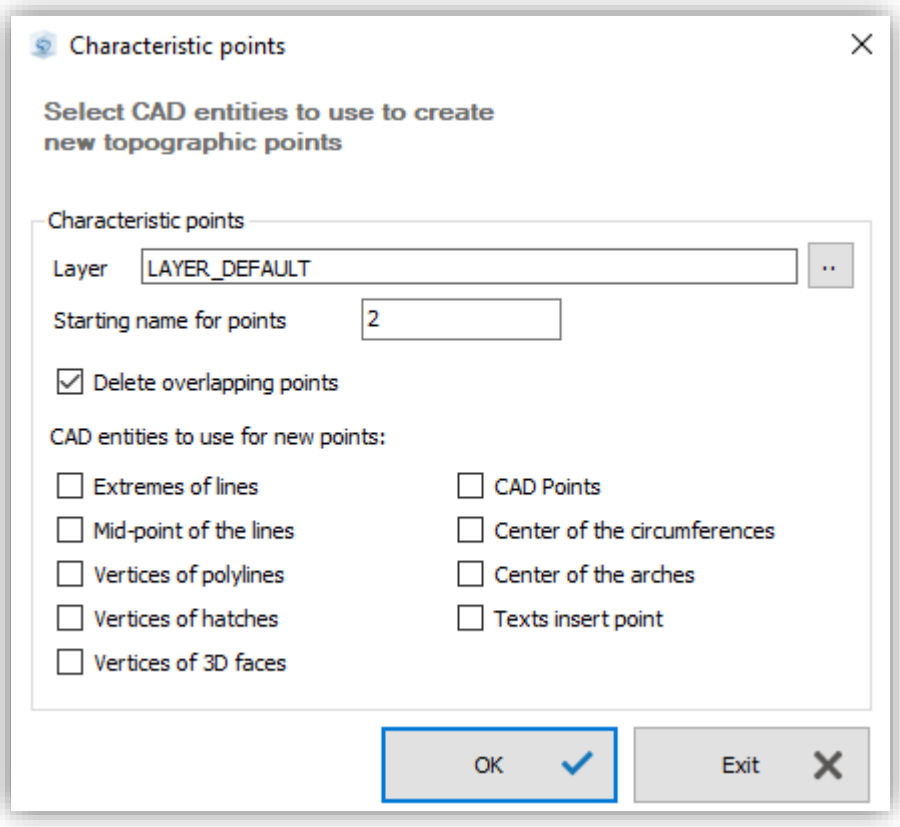


Figure 2.65

Returning to the section in Figure 2.58, the next command to explain is the Properties command (Figure 2.66), once you have selected one or more topographic points you can use this function to discover all their properties and to modify them.
This window consists of four tabs: General, Graphics, Coordinates, Image.
In the General tab you find information about the name, description, point code. From this screen you can set the information displayed in graphics as point label (point text). To change the label of the point just select the items you want to insert from the drop-down menu and press the insert button (one item at a time), you can also set the X and Y offset of the point text.
The Graphics tab provides information about the font (font, size, color) and the symbol (icon, size, color, rotation) of the point.
In the Coordinate tab (Figure 2.67), you can read the coordinates Est, North and Quota (as average of the coordinates of the various origins of the point), with the relative standard deviation. You can change the coordinates manually by selecting the fixed coordinates command. In the table called Origin of the coordinates, the origins of the selected point are shown, for each origin the name of the fieldbook, the type of origin, the station from which it is measured, and the coordinates are reported.
The buttons below the table are: Create new point from selected origin (available only in presence of multiple origin); Properties of the selected origin (opens a screen as in Figure 2.68, where you can view all the information related to the point, some are editable other read-only); Fixed coordinates from selected origin.

The Image screen allows you to see if and which images are associated with the selected point.

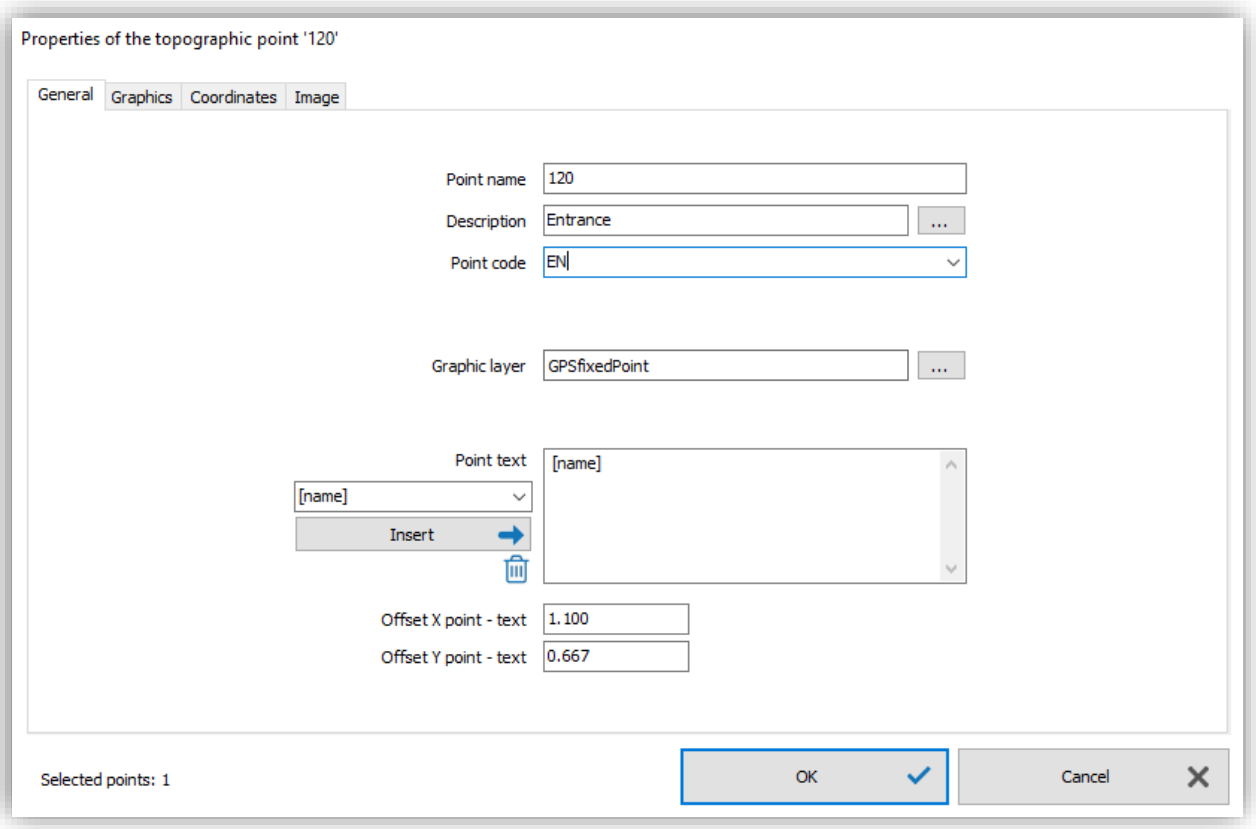


Figure 2.66

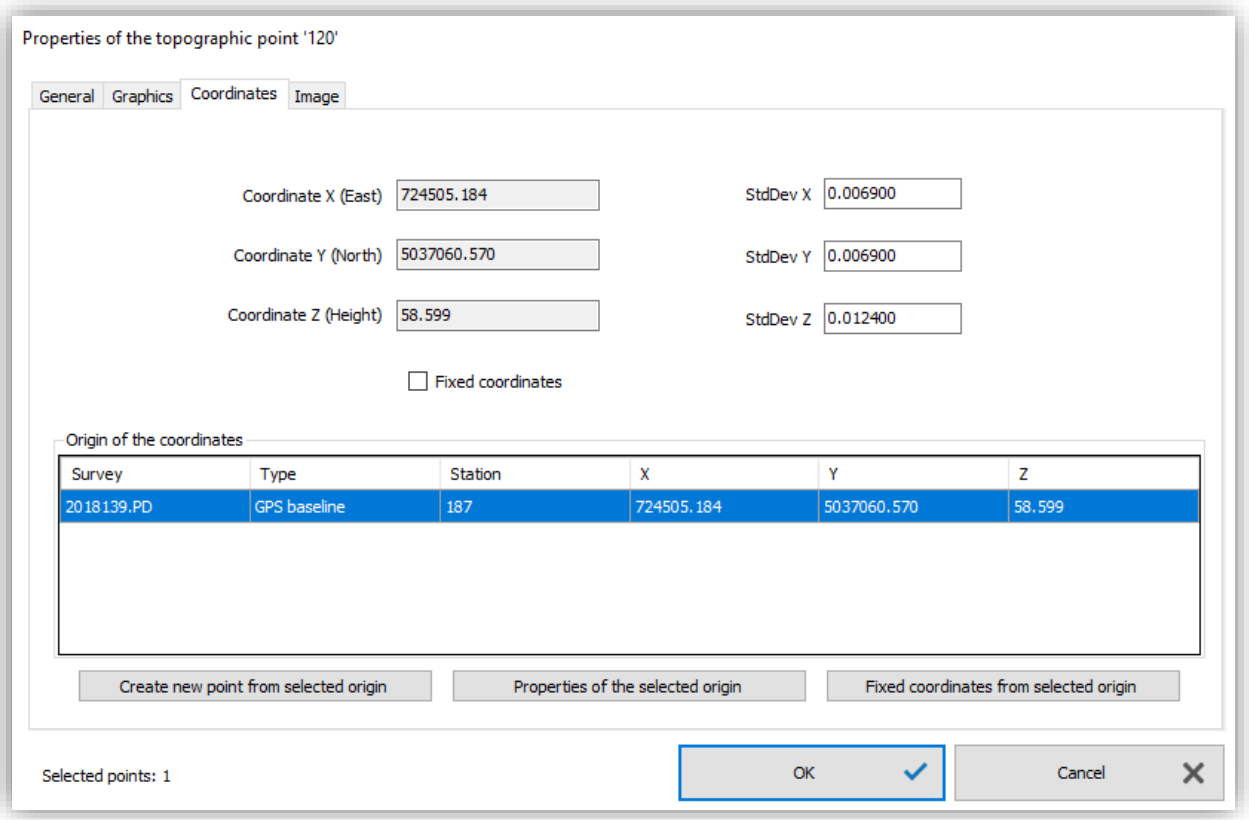

Properties of the topographic point '120'
General
Graphics
Coordinates
Image
Coordinate X (East)
724505.184
StdDev X
0.006900
Coordinate Y (North)
5037060.570
StdDev Y
0.006900
Coordinate Z (Height)
58.599
StdDev Z
0.012400
Fixed coordinates
Origin of the coordinates
Survey
Type
Station
X
Y
Z
2018139.PD
GPS baseline
187
724505.184
5037060.570
58.599
Create new point from selected origin
Properties of the selected origin
Fixed coordinates from selected origin
Selected points: 1
OK
Cancel

Figure 2.67

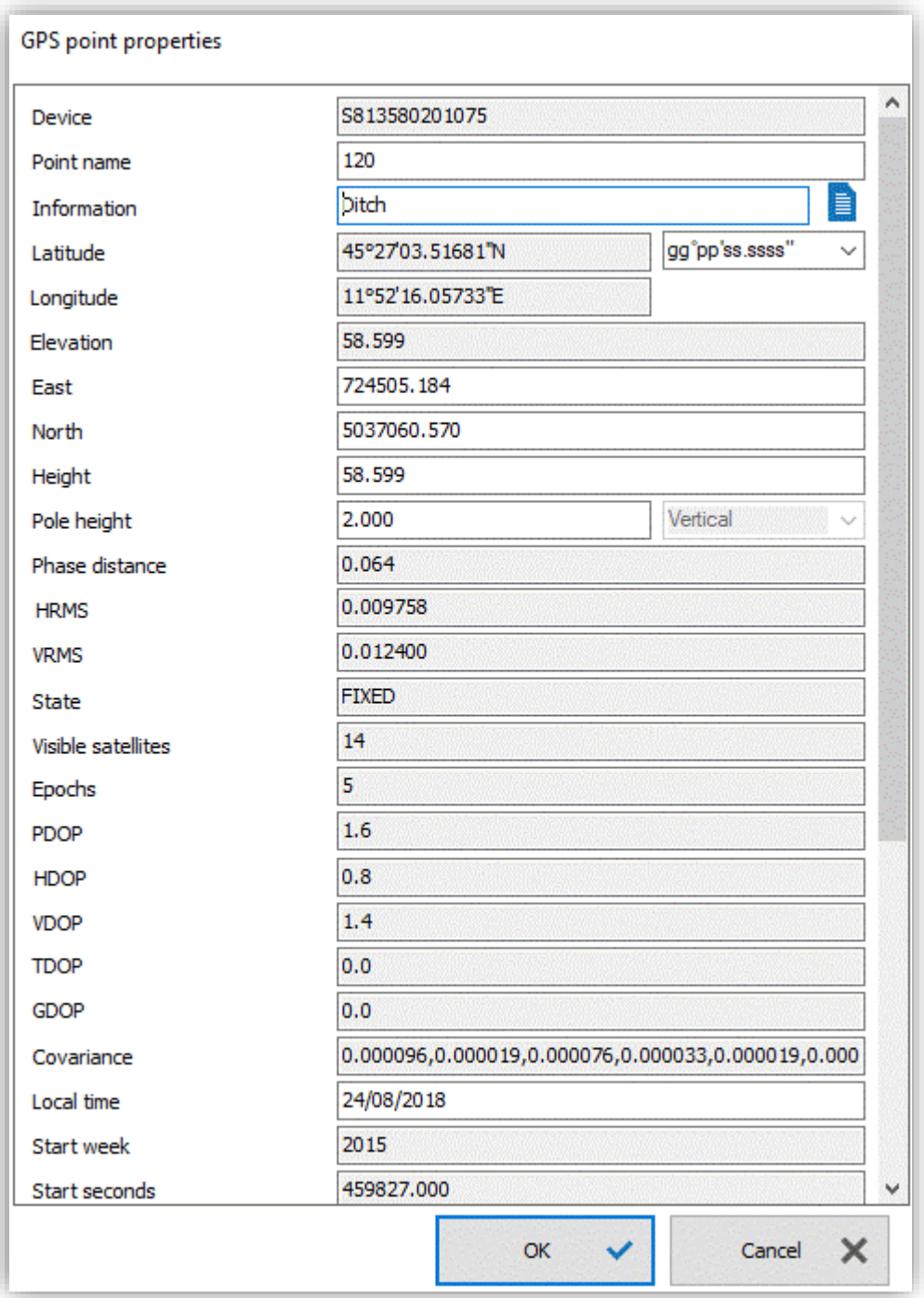


Figure 2.68

By clicking on Table points button in Figure 2.58, you can create a table with a list of all the points in the project that will be grouped together with their coordinates, names, descriptions and codes, as shown in Figure 2.69 (an example of a table with 128 points in memory).

You can also print the table with the Print button. This button will open a text file editor where the table with all the points will be visible, at this stage the table can be modified in its fields, contents and graphic appearance.

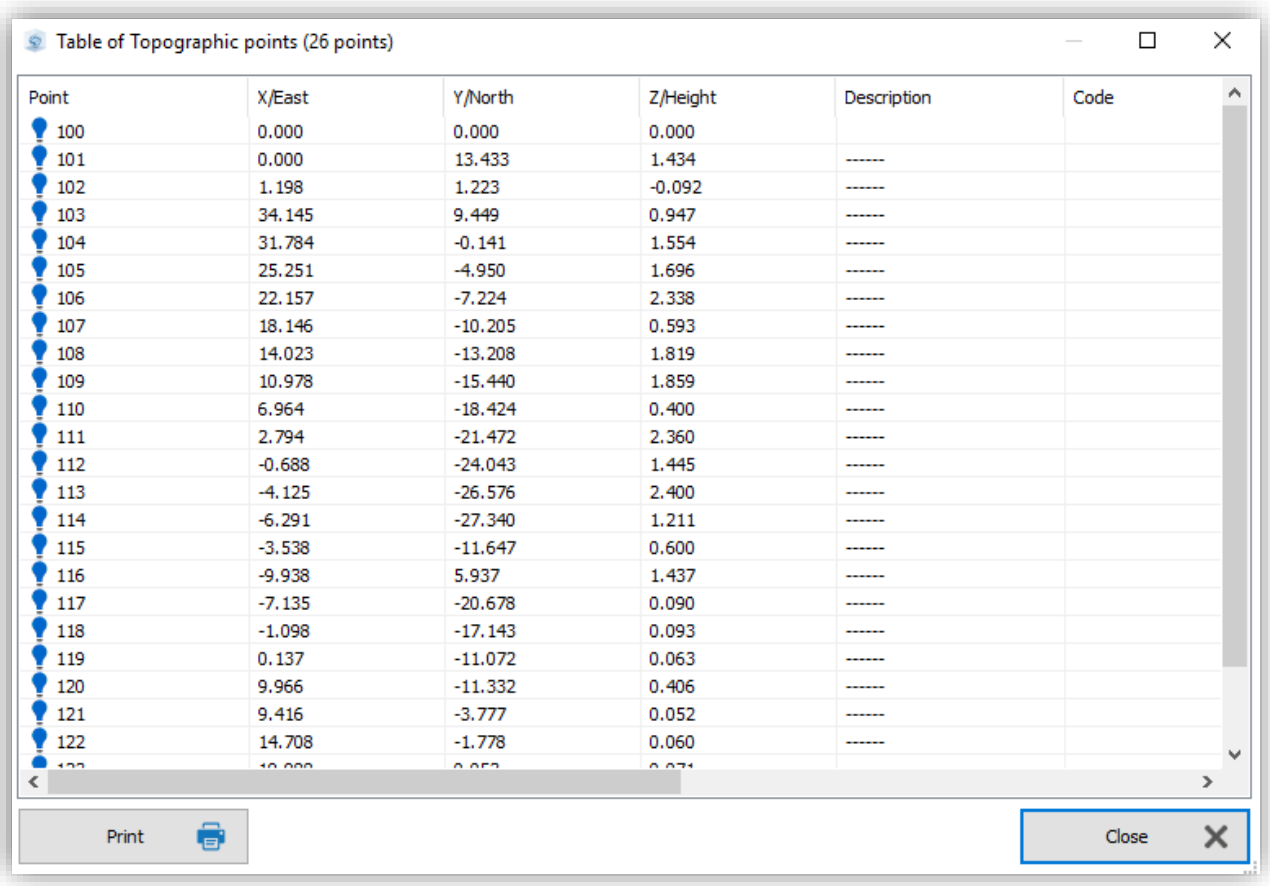


Figure 2.69

The Mean center command (available in module M) generates a window as in Figure 2.70, the function has the purpose of searching for nearby points and averaging the coordinates, the search choice generates a window as in Figure 2.71,where it will be possible to decide if either to hide or to delete the points from the search result. By default, the program creates a new result point with averaged coordinates and points from the search result are put on a hidden layer (called LayerHide).

The commands that are grouped in the drop-down list of the Various operations command (Figure 2.57): Rename points, Text properties, Text offset are only the repetition for the convenience of the user of some functions already present in the Properties window of topographic points.

By clicking on Symbol Editor button in Figure 2.57, you can access a screen for the editing and addition of new symbols for topographic points, the same operations can also be done by clicking the command in Figure 2.28.

The last command in the Topographic Points section is the Link command, which generates a drop-down menu with two subcommands: Associate CAD block and Associate image to a point, which have the purpose to connect respectively a set of CAD elements or an image to a topographic point.

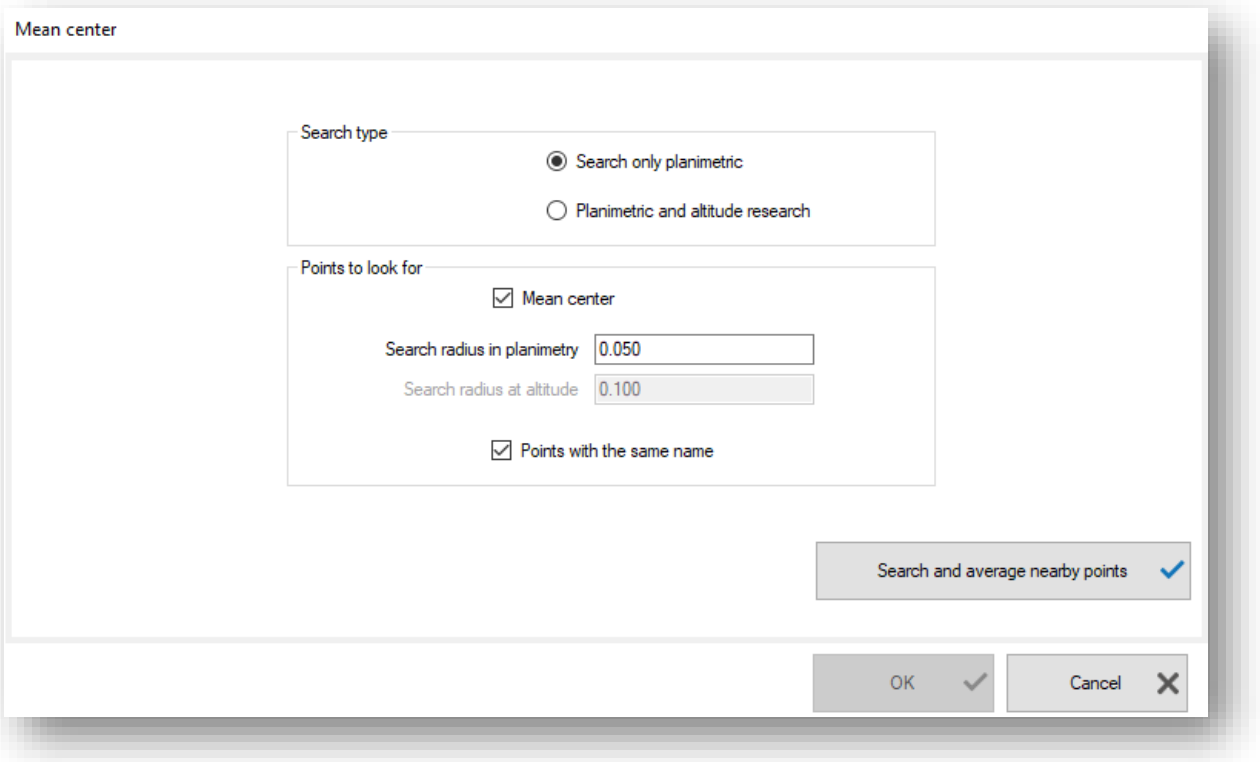


Figure 2.70

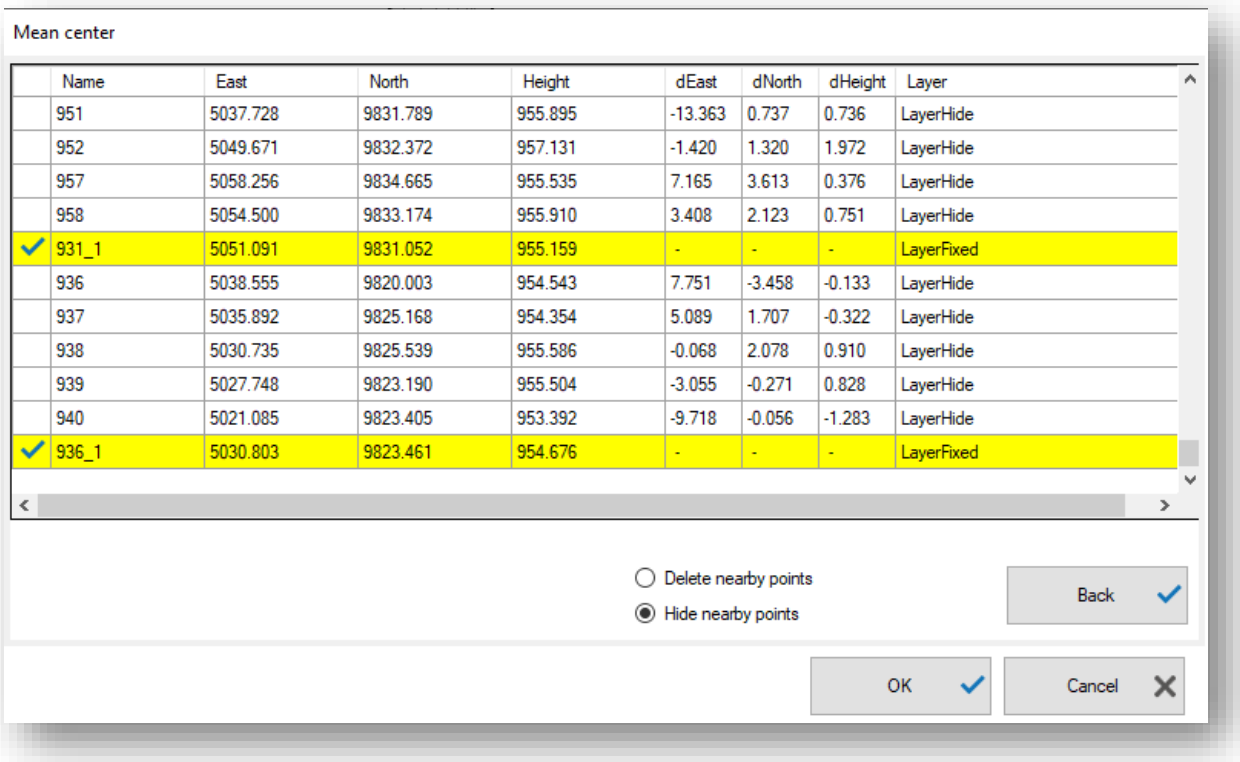

Mean center
Name East North Height dEast dNorth dHeight Layer
951 5037.728 9831.789 955.895 -13.363 0.737 0.736 LayerHide
952 5049.671 9832.372 957.131 -1.420 1.320 1.972 LayerHide
957 5058.256 9834.665 955.535 7.165 3.613 0.376 LayerHide
958 5054.500 9833.174 955.910 3.408 2.123 0.751 LayerHide
931_1 5051.091 9831.052 955.159 - - - LayerFixed
936 5038.555 9820.003 954.543 7.751 -3.458 -0.133 LayerHide
937 5035.892 9825.168 954.354 5.089 1.707 -0.322 LayerHide
938 5030.735 9825.539 955.586 -0.068 2.078 0.910 LayerHide
939 5027.748 9823.190 955.504 -3.055 -0.271 0.828 LayerHide
940 5021.085 9823.405 953.392 -9.718 -0.056 -1.283 LayerHide
936_1 5030.803 9823.461 954.676 - - - LayerFixed
Delete nearby points
Hide nearby points
Back
OK
Cancel

Figure 2.71

2.5.2 Manage coordinates

The Manage coordinates section is shown in Figure 2.72, each of these commands opens pull-down menus with other subcommands. Below the description of all af them.

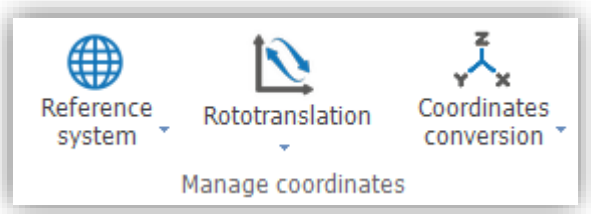


Figure 2.72

2.5.2.1 Reference system

This command consists of four subcommands, each of which opens a new screen.
Preset reference system (Figure 2.73) allows you to select a reference system and save it as a default system (the program must always have a set reference system and will automatically take the user to this window, if no reference system is set). In this screen you can select the country and and its Projections, among those available. You can also select the Geoid from the drop-down menu that will show all available ones. Note that it is always possible to insert a new geoid in the program, thanks to the Upload utility files command found in par. 2.1.4.
A Projection can be changed in its values by clicking on the Create New button, so the new edited projection can be saved (it is saved in the previously selected country, in the projections' drop-down menu, in the last position.) To delete it, press Create again, select the Projection and click delete). By clicking Show parameters, you can view the values of the chosen Projection.

The local reference system command leads to the screen in Figure 2.74. Setting a local reference system deletes the predefined reference system. To access the local reference screen, there must be at least one topographic point in the active project, considered as the origin point. Normally the program will select the first point of the list as the origin point, you can always select a new point, among those available on the left at the bottom of the list of points. On the right side of the screen you can set the Geoid, the Ellipsoid and some of its values, it can also be set the method of calculation that you intend to use in the generation of the system.

The Calculation 7 parameters command leads to the screen in Figure 2.75. The list of points with geographic and cartesian coordinates will be populated or with existing points in the project or can be populated by selecting a text file with the search buttons at the bottom right (files can be loaded for both geographical coordinates and Cartesian coordinates). Once the list has been populated it will be possible to calculate the false origins and then

proceed with the calculation (Helmert or Molodensky). After the calculation you can save the system by clicking the Create new Datum/Projection button (which will open a screen like the one in Figure 2.76)

Add preset system opens a screen as in Figure 2.76. This window with the relative functionalities is the same that is generated if you press the Create new button from the screen relative to the Preset reference system command.

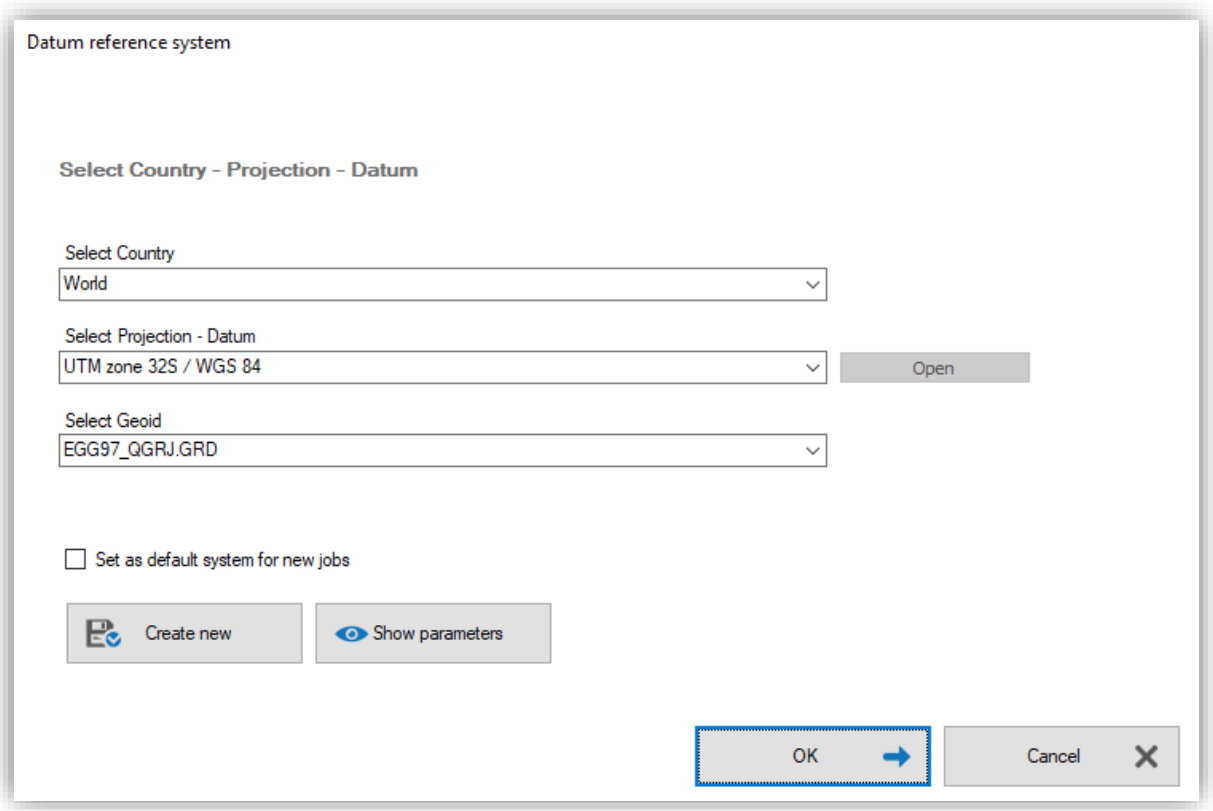


Figure 2.73

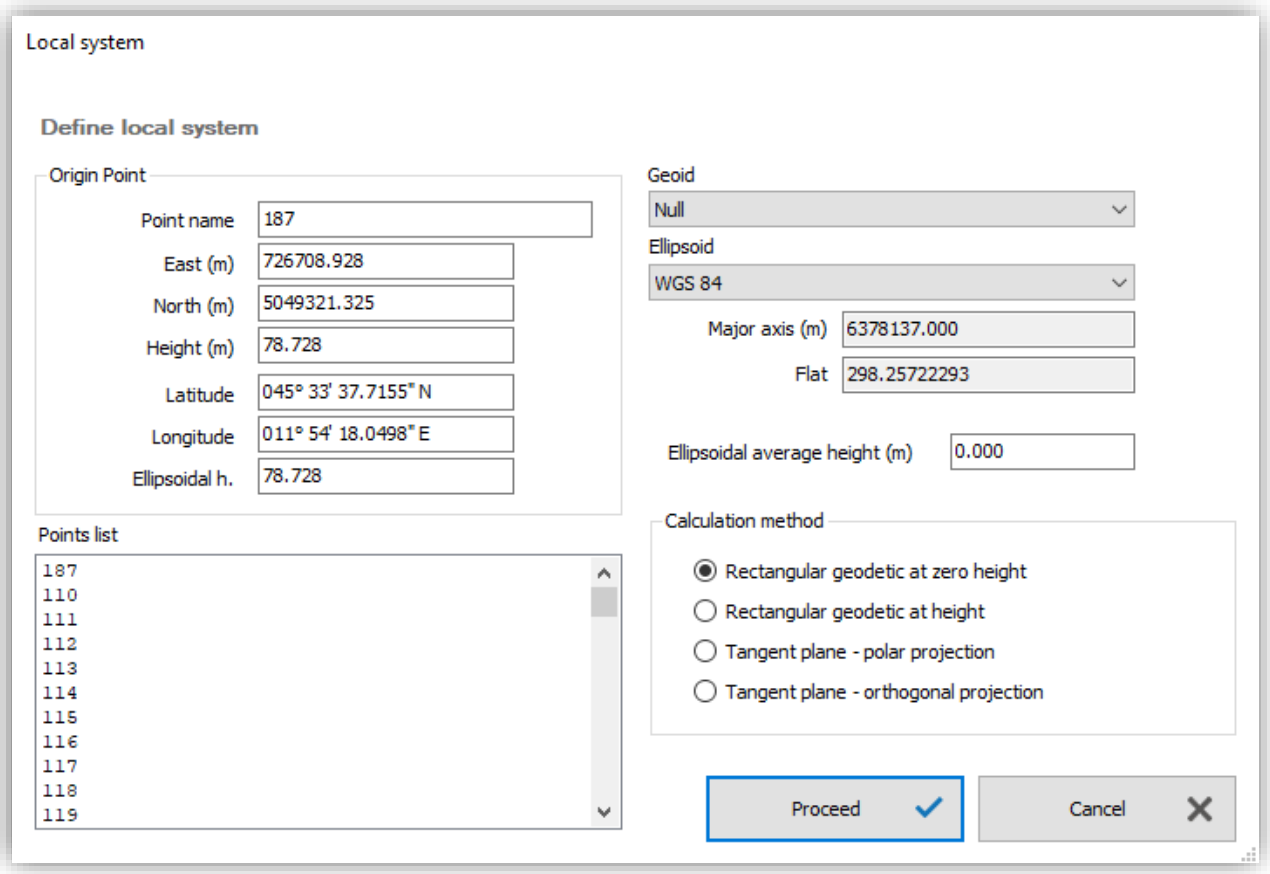

Local system
Define local system
Origin Point
Point name
187
East (m)
726708.928
North (m)
5049321.325
Height (m)
78.728
Latitude
045° 33' 37.7155" N
Longitude
011° 54' 18.0498" E
Ellipsoidal h.
78.728
Points list
187
110
111
112
113
114
115
116
117
118
119
Geoid
Null
Ellipsoid
WGS 84
Major axis (m)
6378137.000
Flat
298.25722293
Ellipsoidal average height (m)
0.000
Calculation method
Rectangular geodetic at zero height
Rectangular geodetic at height
Tangent plane - polar projection
Tangent plane - orthogonal projection
Proceed
Cancel

Figure 2.74

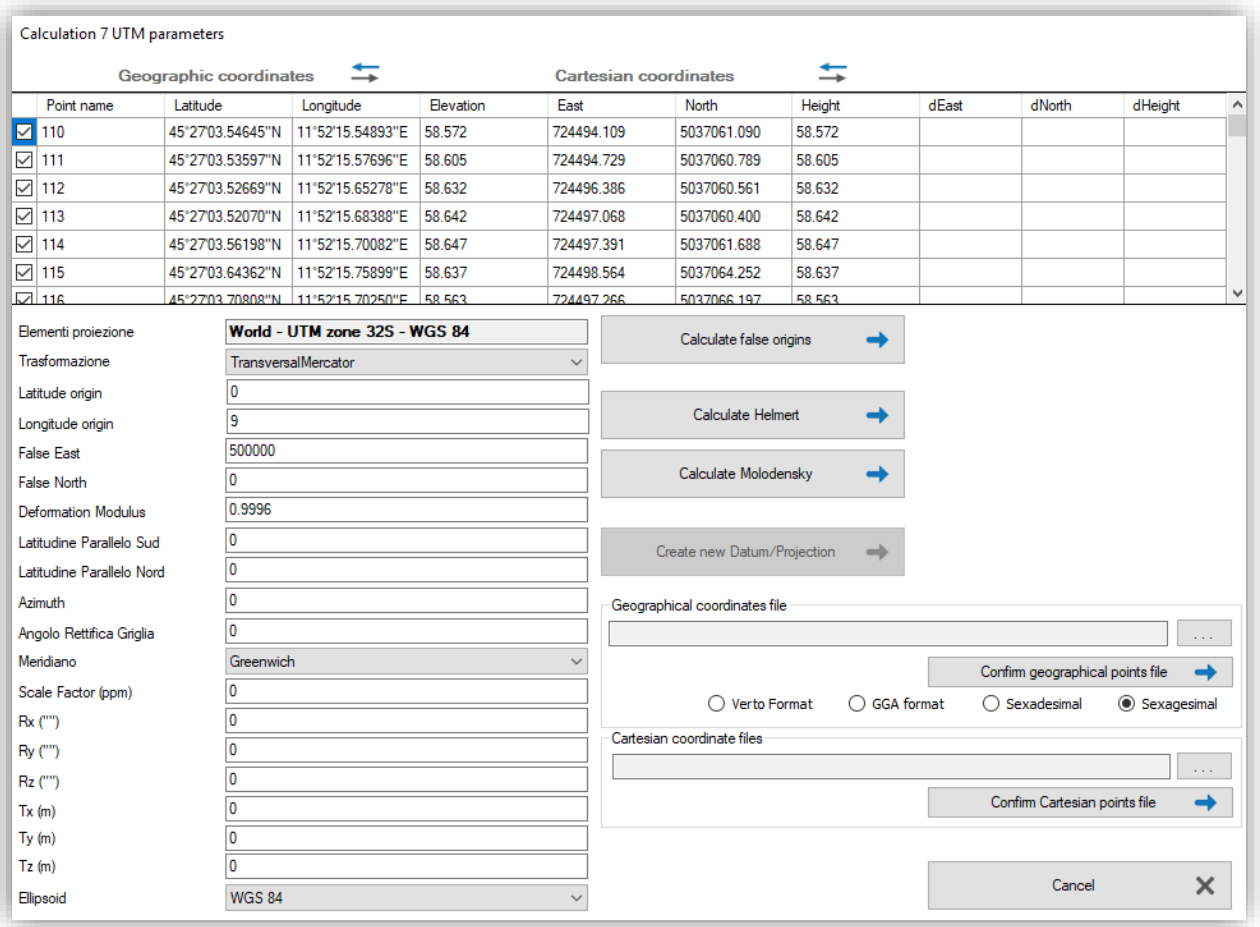

Calculation 7 UTM parameters
Geographic coordinates
Cartesian coordinates
Point name
Latitude
Longitude
Elevation
East
North
Height
dEast
dNorth
dHeight
110 45°2703.54645"N 11°52'15.54893"E 58.572 724494.109 5037061.090 58.572
111 45°2703.53597"N 11°52'15.57696"E 58.605 724494.729 5037060.789 58.605
112 45°2703.52669"N 11°52'15.65278"E 58.632 724496.386 5037060.561 58.632
113 45°2703.52070"N 11°52'15.68388"E 58.642 724497.068 5037060.400 58.642
114 45°2703.56198"N 11°52'15.70082"E 58.647 724497.391 5037061.688 58.647
115 45°2703.64362"N 11°52'15.75899"E 58.637 724498.564 5037064.252 58.637
Elementi proiezione
World - UTM zone 32S - WGS 84
Trasformazione
TransversalMercator
Latitude origin
Longitude origin
False East
False North
Deformation Modulus
Latitudine Parallelo Sud
Latitudine Parallelo Nord
Azimuth
Angolo Rettifica Griglia
Meridiano
Greenwich
Scale Factor (ppm)
Rx ("")
Ry ("")
Rz ("")
Tx (m)
Ty (m)
Tz (m)
Ellipsoid
WGS 84
Calculate false origins
Calculate Helmert
Calculate Molodensky
Create new Datum/Projection
Geographical coordinates file
Confirm geographical points file
Verto Format
GGA format
Sexadesimal
Sexagesimal
Cartesian coordinate files
Confirm Cartesian points file
Cancel

Figure 2.75

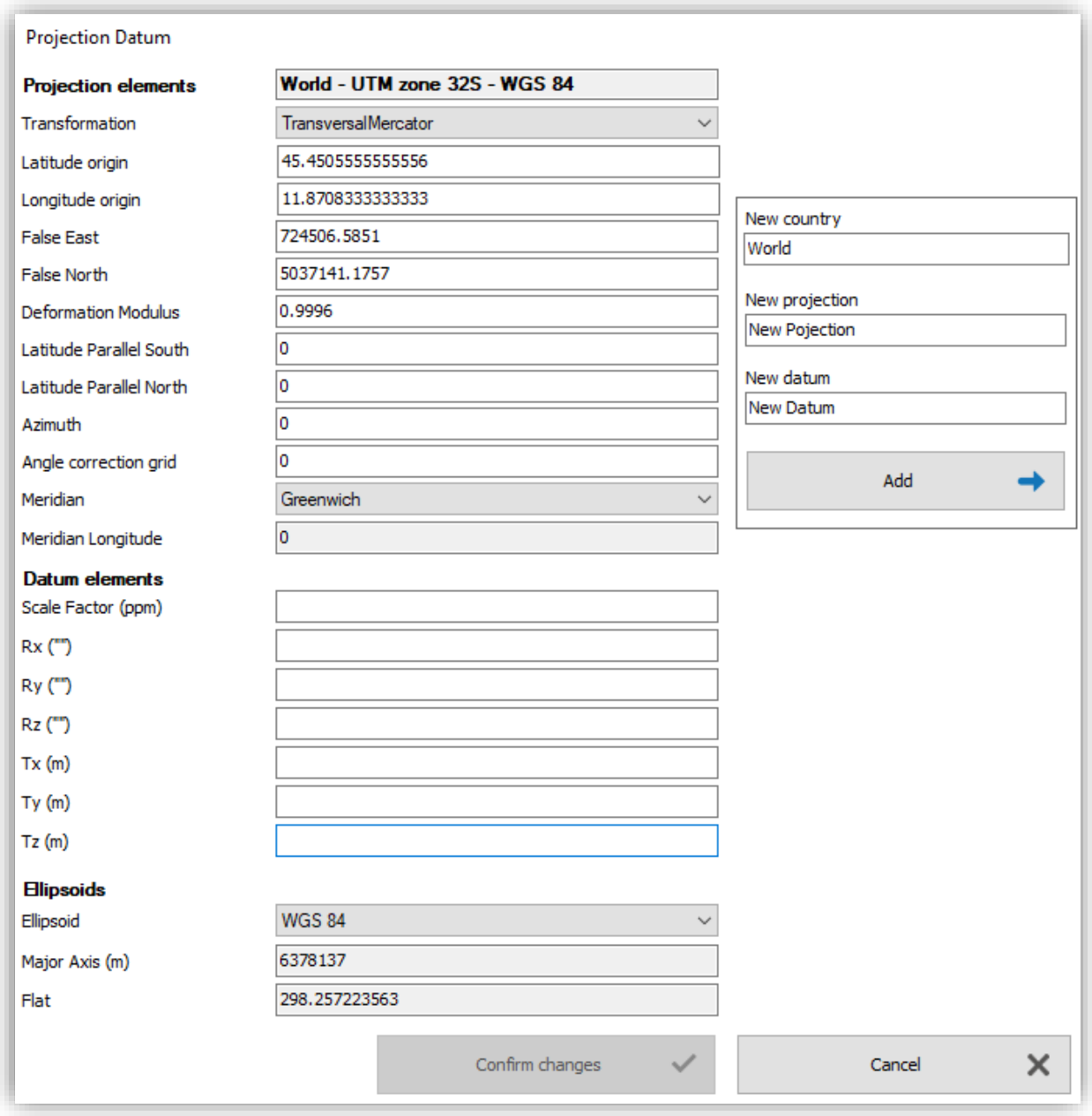

Projection Datum
Projection elements
World - UTM zone 32S - WGS 84
Transformation
TransversalMercator
Latitude origin
45.4505555555556
Longitude origin
11.8708333333333
False East
724506.5851
False North
5037141.1757
Deformation Modulus
0.9996
Latitude Parallel South
0
Latitude Parallel North
0
Azimuth
0
Angle correction grid
0
Meridian
Greenwich
Meridian Longitude
0
Datum elements
Scale Factor (ppm)
Rx ("")
Ry ("")
Rz ("")
Tx (m)
Ty (m)
Tz (m)
Ellipsoids
Ellipsoid
WGS 84
Major Axis (m)
6378137
Flat
298.257223563
New country
World
New projection
New Pojection
New datum
New Datum
Add
Confirm changes
Cancel

Figure 2.76

2.5.2.2 Rototraslation

In the Rototranslation command (Figure 2.77), there are the functions Translate points and 3D/2D Rototranslation. The second command is part of the T module - Topography, and it will be illustrated in the relevant section.
By clicking on the Translate points button you access a window in which a list of fieldbooks present in the project is displayed (Figure 2.78). The translation can be performed on all points (default choice, Select all points checked) or on selected fieldbooks. It is therefore possible to set an East translation and/or a North translation and/or a Height translation with the relative scaling factors. The exchange of coordinates can also be performed (the first choice, selected by default, does not perform any exchange).

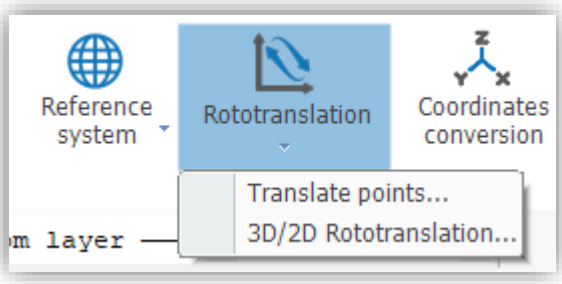


Figure 2.77

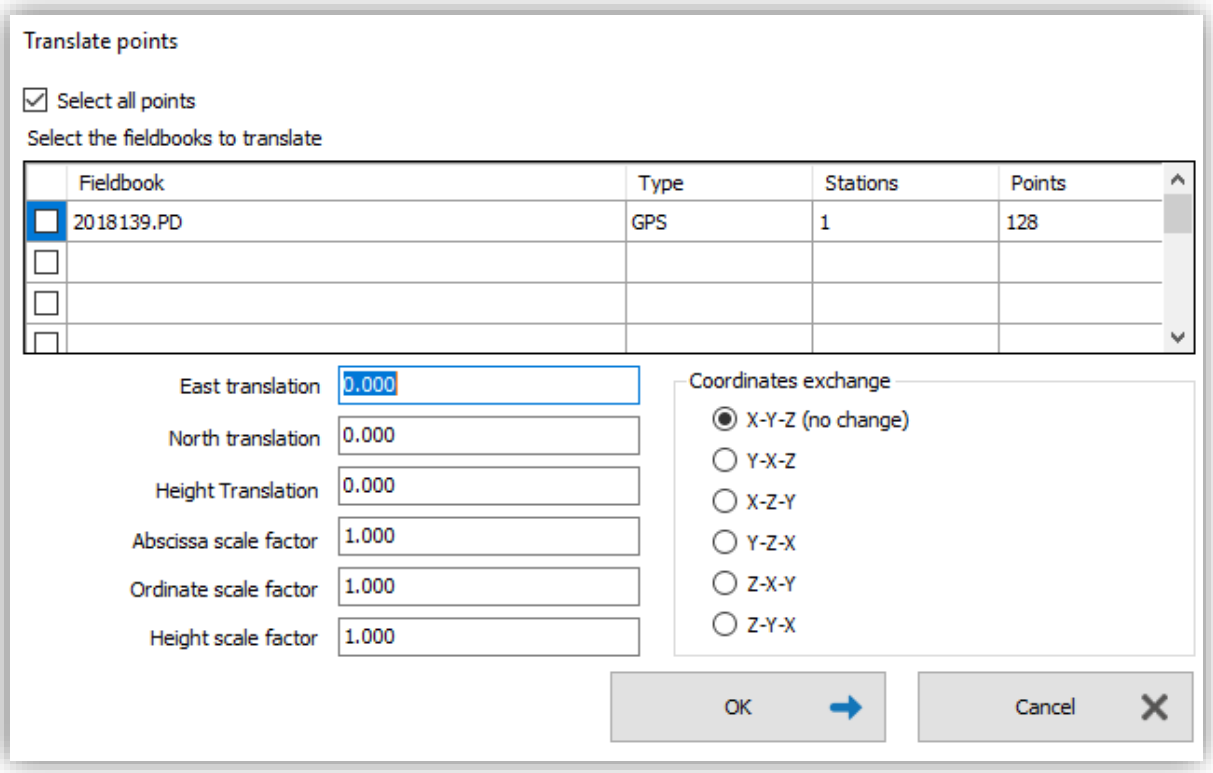


Figure 2.78

In the module T the 2D/3D Rototranslation function will be active, the command leads to a a window as in Figure 2.79. If in the current project there are topographic points, the section relating to the points to be rotated (with headers: East, North, Height in light blue) will report all the points present. However, it is always possible to change the points to rototranslate, to do this it is necessary to make a choice in the Origin of points to rototranslate (Figure 2.80), it is necessary to confirm (with the command at the lower-right of the section) to see the grid updated. You can choose all the points in the job, select the points part of a fieldbook or import the points from a file.
Once the points to be rotated are selected, the known points can be chosen always keeping in mind that the matching between points happens by name (case insensitive). The grid will update itself by changing the color of the lines with the matched points, from white to yellow and it will move all the matched points to the top.

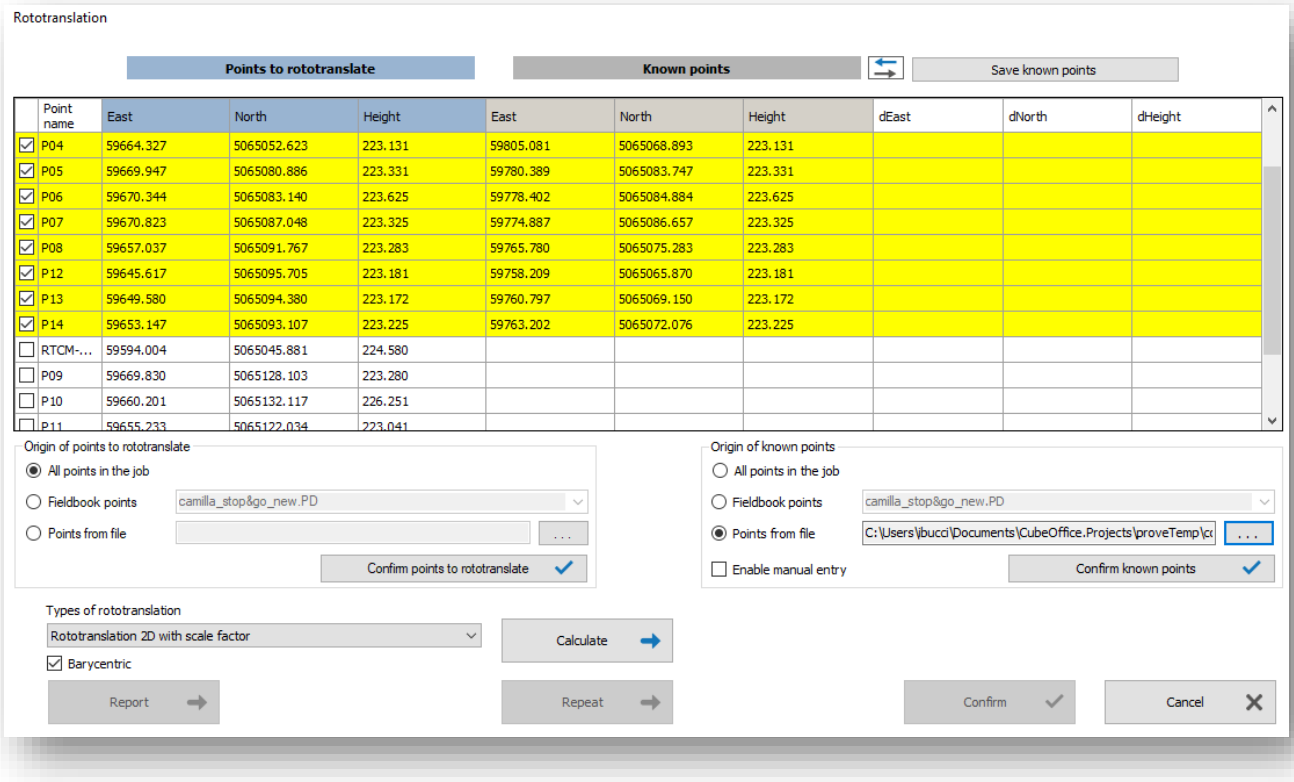


Figure 2.79

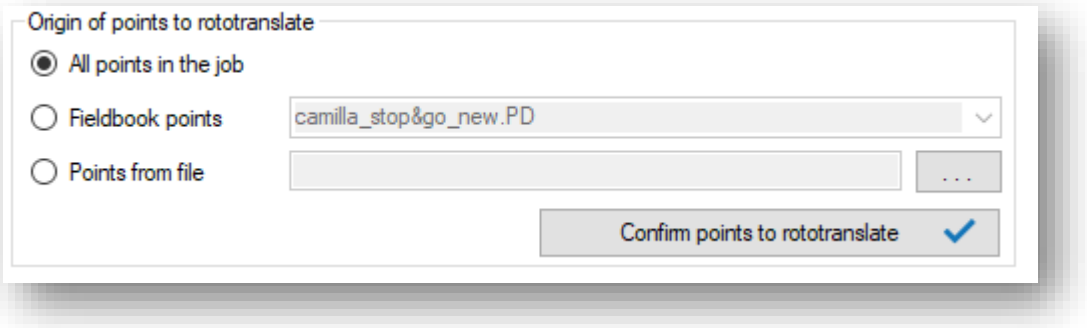


Figure 2.80

To choose the known points, you can access a section like the one described for the points to be rotated. The section is called Origin of known points, you can choose all the points present in the job; the points of a fieldbook; import the points from a file or insert them manually; also in this case, it will be necessary to confirm with the command in the section to update the grid.

There are two additional commands for the known points, these are located at the top-right of the screen, next to caption 'Known points' (Figure 2.81). The first command, with the arrows, reverses East and North. The second, the Save known points command, creates a text file.

Figure 2.81

In the lower part of the screen, on the left, it will be possible to choose what type of rototranslation you want to perform and start the calculation by clicking on the Calculate command (Figure 2.82). The 2D and 3D rototranslation can also be barycentric by activating the appropriate command.

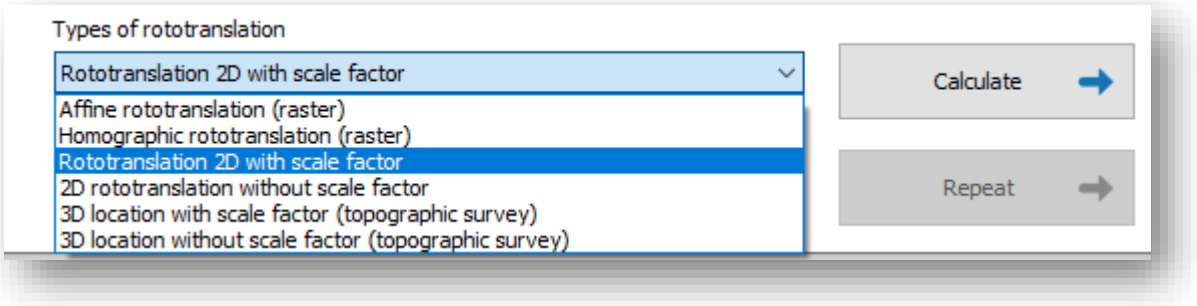


Figure 2.82

As soon as the calculation is performed, the application automatically generates a result window as in Figure 2.83, where it will be possible to check the calculation data.
As with all calculations present in Cube-manager, at the end of the calculation it will be possible to view and/or save a report containing the information of the calculation performed, it is always possible to carry out the calculation again without leaving the screen.
In the grid in Figure 2.79, after having performed the calculation, it will be possible to view the deltas relating to the East, North and Height.

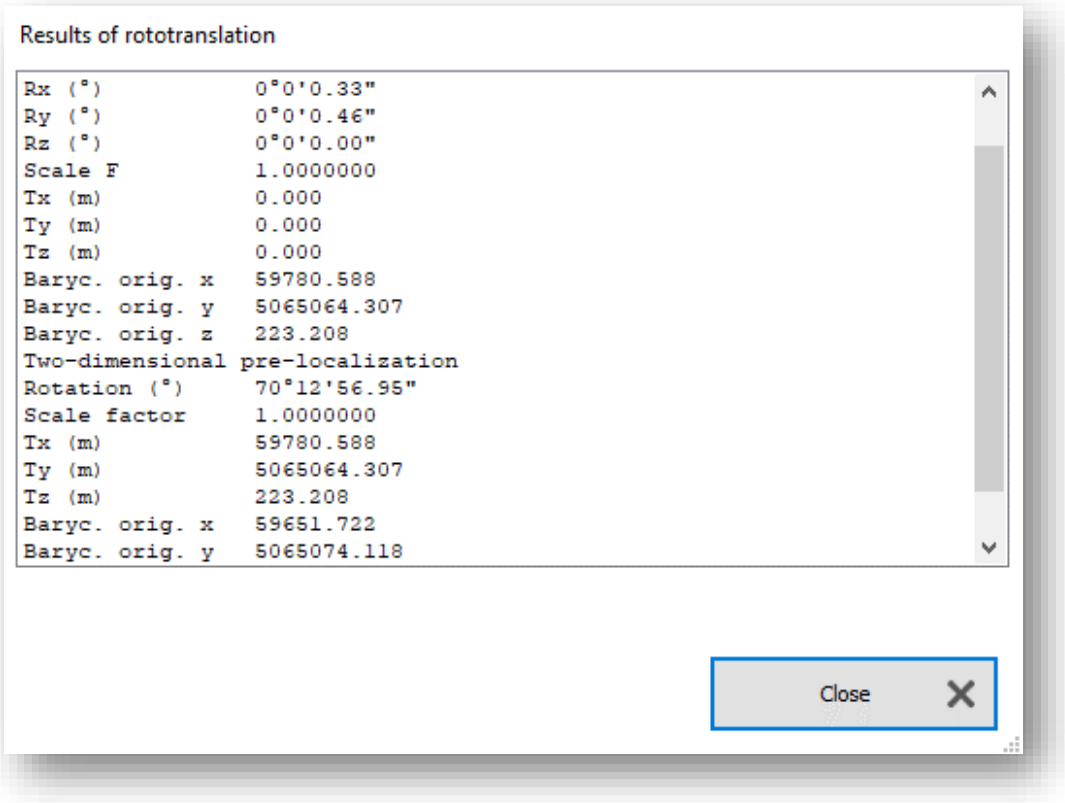

Results of rototranslation
Rx (°) 0°0'0.33"
Ry (°) 0°0'0.46"
Rz (°) 0°0'0.00"
Scale F 1.0000000
Tx (m) 0.000
Ty (m) 0.000
Tz (m) 0.000
Baryc. orig. x 59780.588
Baryc. orig. y 5065064.307
Baryc. orig. z 223.208
Two-dimensional pre-localization
Rotation (°) 70°12'56.95"
Scale factor 1.0000000
Tx (m) 59780.588
Ty (m) 5065064.307
Tz (m) 223.208
Baryc. orig. x 59651.722
Baryc. orig. y 5065074.118
Close

Figure 2.83

2.5.2.3 Coordinates conversion

The Coordinates Conversion command opens a submenu consisting of three commands: Stake-out GPS, Stake-out TS and Coordinates Conversion (as in Figure 2.84).
By clicking on Stake-out GPS, you can convert the grid coordinates to GPS geographic coordinates. After selecting the points (both CAD and topographic) that you want to convert, the program will switch to the screen as in Figure 2.85. From here you can define from what survey to calculate the stake-out (mandatory), and from which station (mandatory). The station may exist, or a new one can be created. Then you can define the options for the new topographic points (only in case of CAD points) and for the baselines.

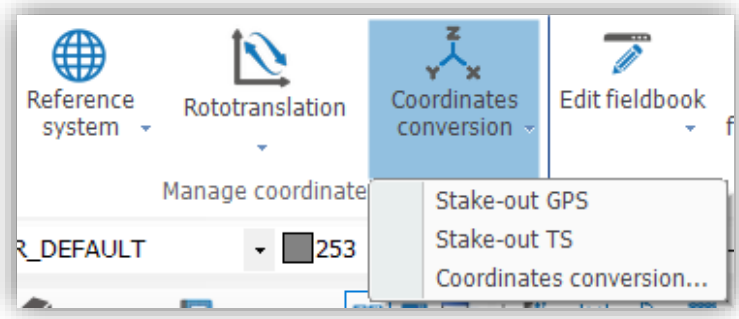


Figure 2.84

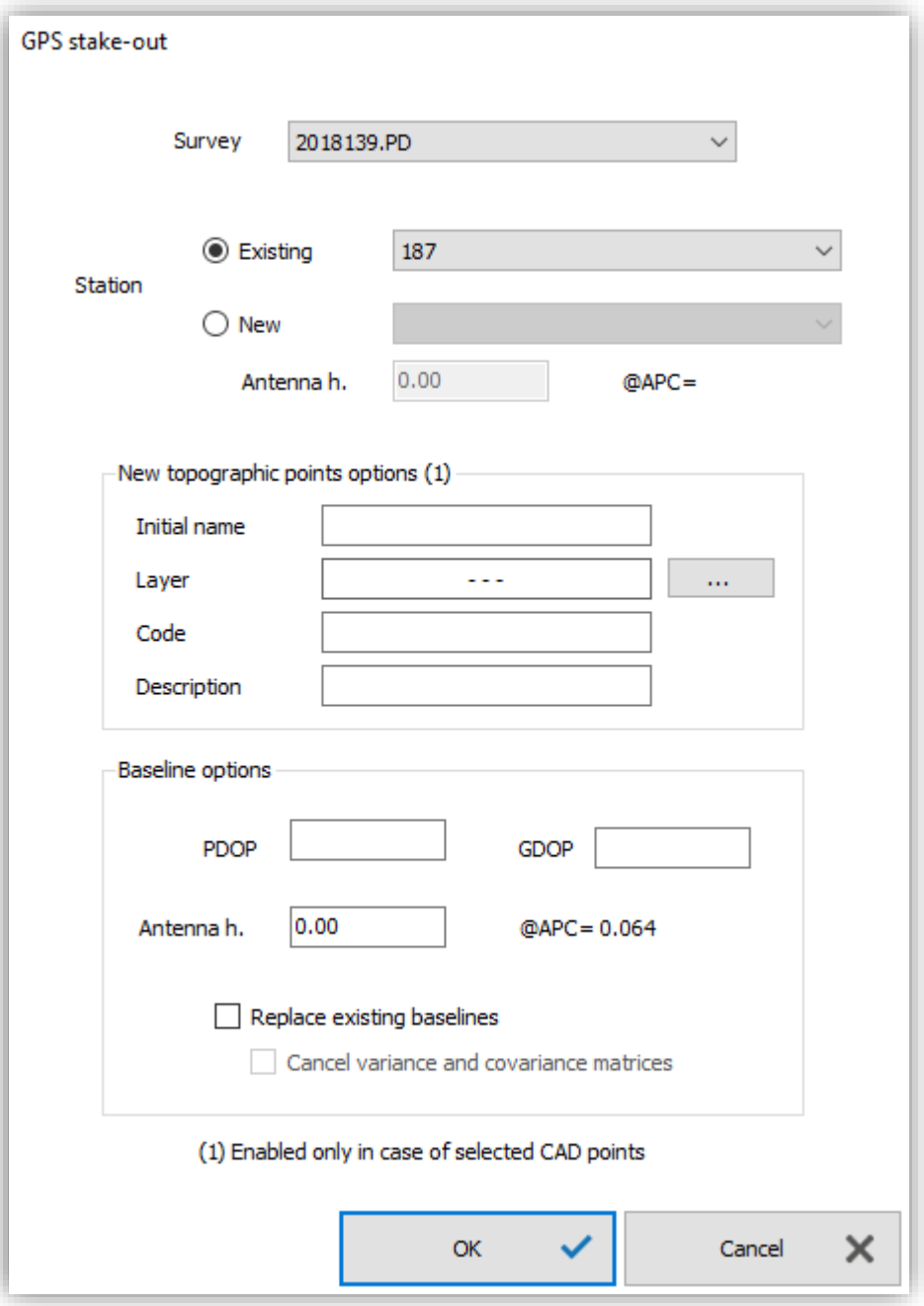


Figure 2.85

By clicking Stake-out TS instead, you can select the points to build a fieldbook from Total Station. In Figure 2.86 we see the screen for this command, on the left you can select the station and orientation, from the list on the right you can select the points you want to include as measures of the inserted station.
In the table below it is possible to view the fieldbook being created, the structure is like that which will be described in the next paragraph relating to the fieldbook from total stations.
Once you have completed the insertions of the fieldbook, you can create a text file or enter the processing screens of the fieldbook (Confirm fieldbook command), where you can

perform all the classic operations available in the program on the fieldbook from total stations (the functions will be described in detail in the next paragraph).

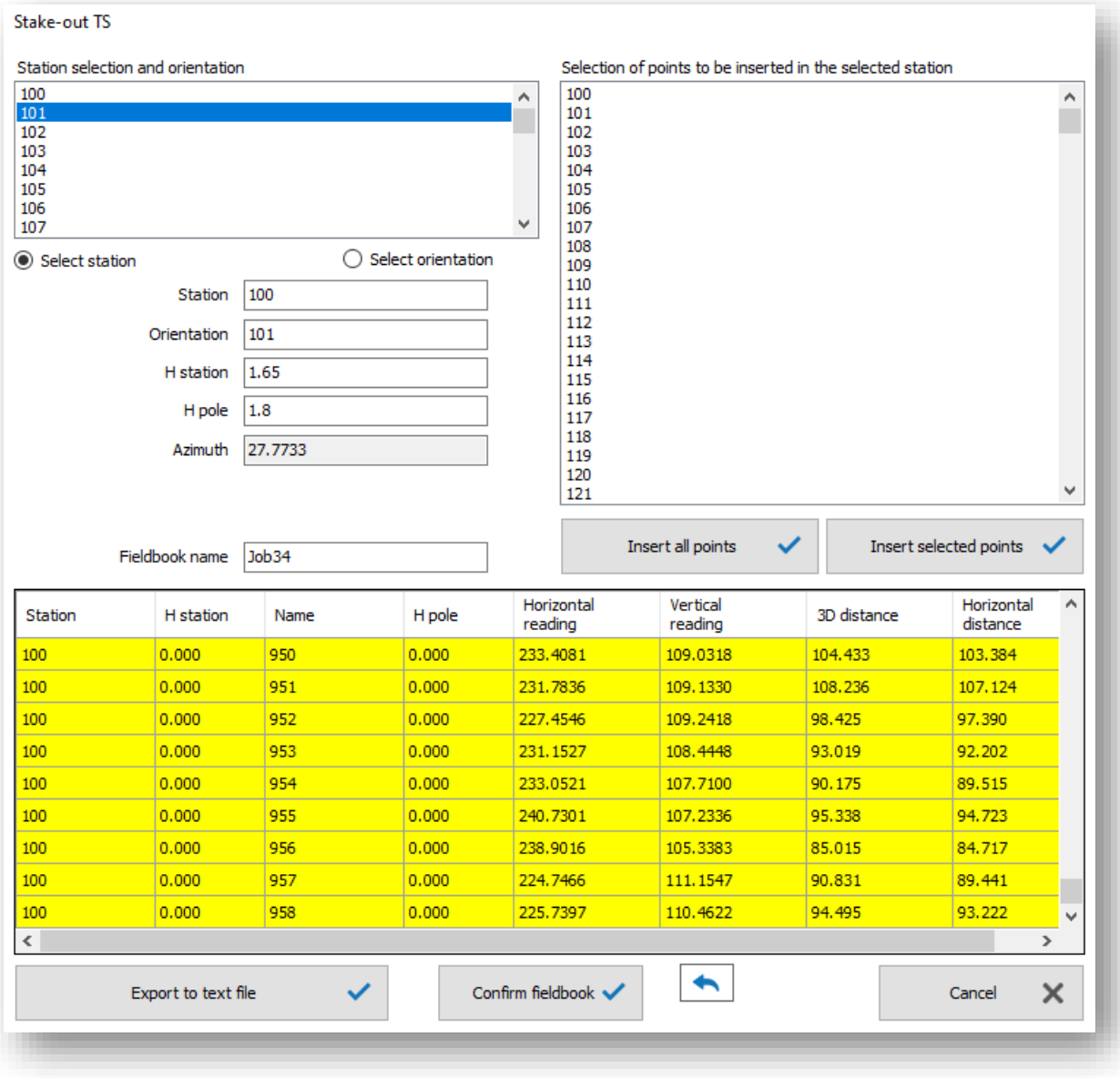


Figure 2.86

In the module T, the Coordinate conversion command will be active and, if clicked, it opens a screen as in Figure 2.87. This window is divided into two sections, the top dedicated to the geographic coordinates, the bottom to the Cartesian coordinates, the coordinates can be read from the current job or imported from a file.
To import the coordinates from a file, it will be necessary to select the file with the relative command and then click on Open file, this last procedure is valid for both geographical and Cartesian. For the geographic coordinates, it will be necessary to set an input format related to the fields, and how the coordinates are written. You can change format and click on Open

file to see the updated grid, in case of error just select another format and click Open file again. It is possible to save the geographic coordinates on files by clicking on Save geographical on file, after having set the output format among those available (they are the same as those available also in input, Figure 2.88).

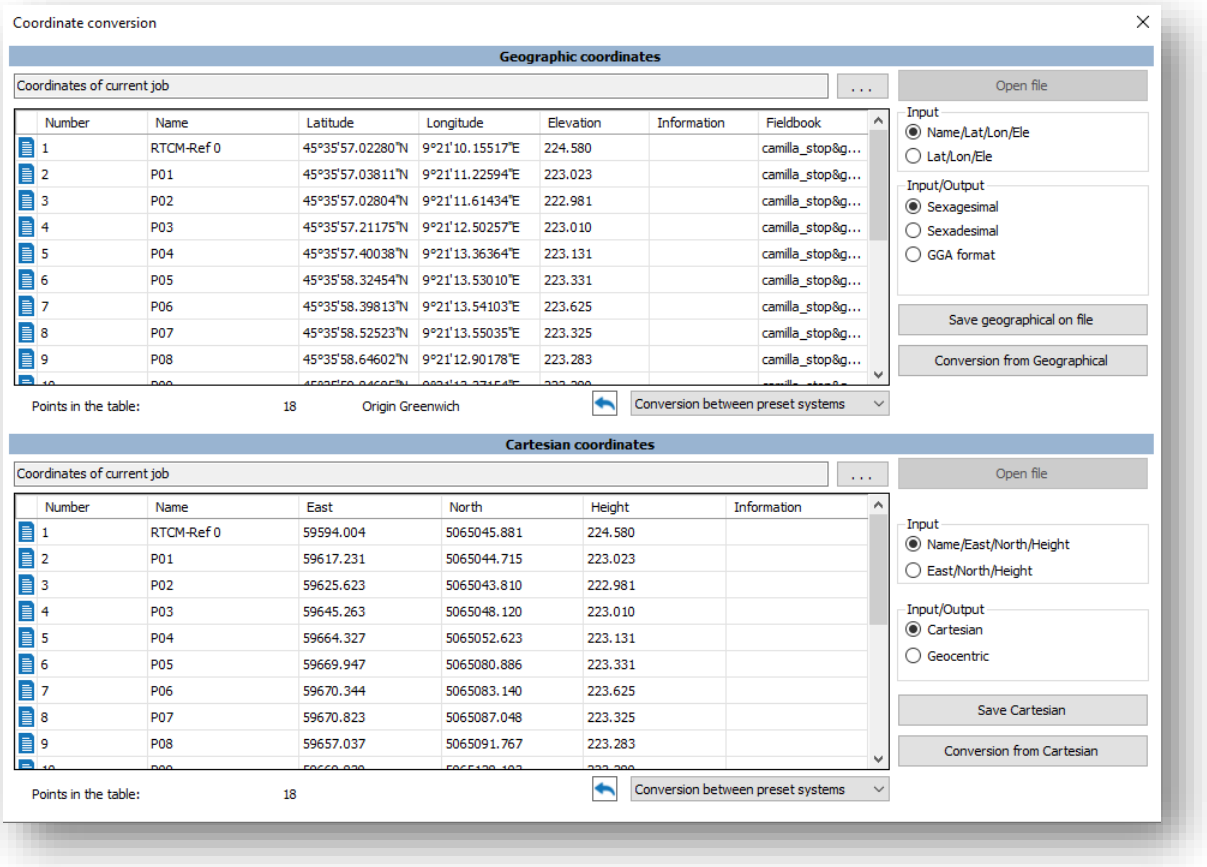


Figure 2.87

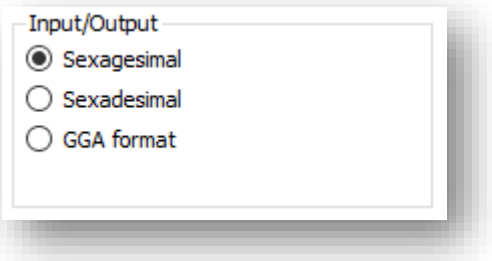


Figure 2.88

The Conversion from geographical command opens a window as in Figure 2.89, where you can select the system of origin and destination of the conversion. It is possible to convert into Cartesian, geocentric or geographic (which will update the starting grid with the new results).

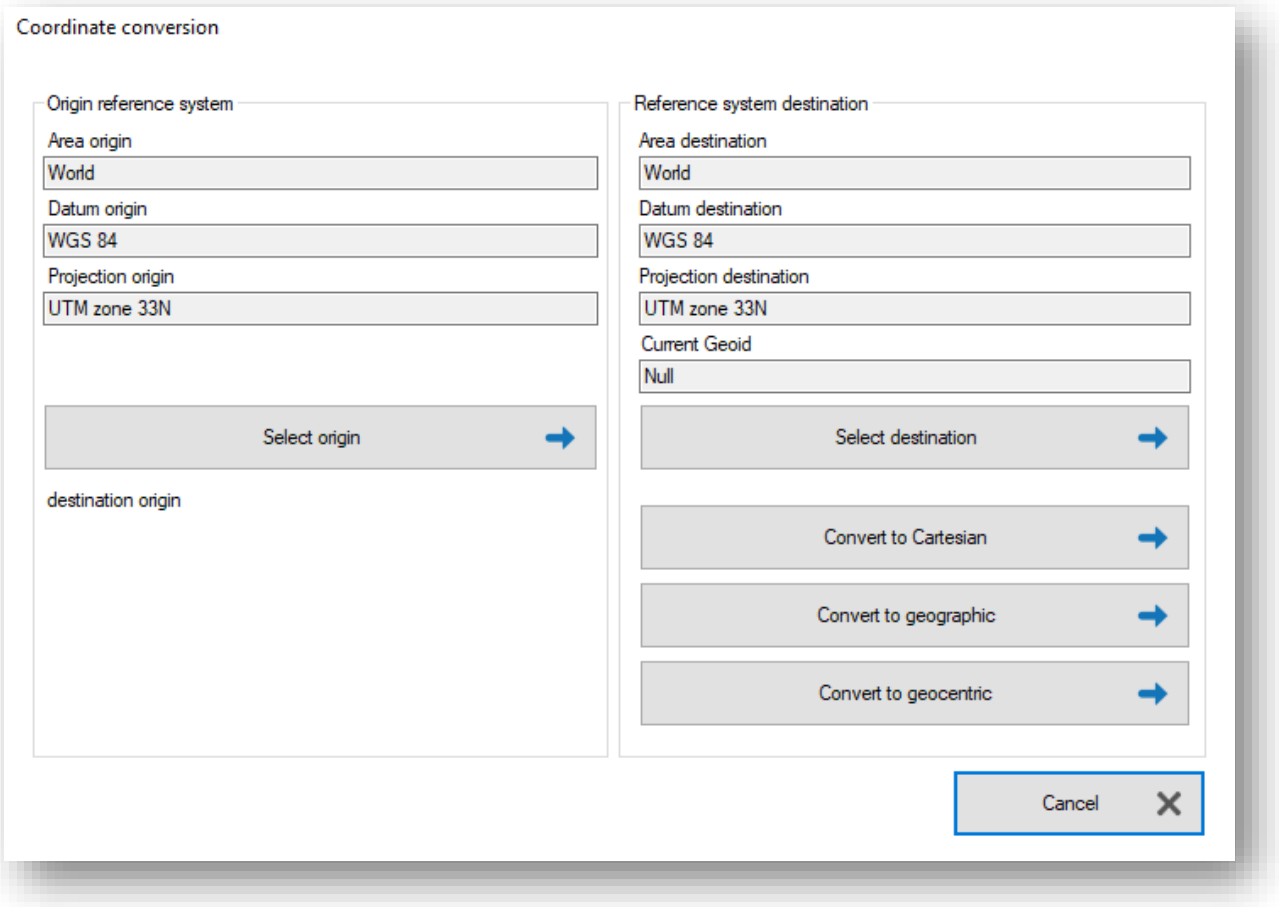


Figure 2.89

Below the table for the geographic coordinates you will find useful information and commands. In particular, the available information is the number of points contained in the table and the origin meridian. The commands are an Undo in case of conversion from one reference system to another (remaining in the geographic coordinate grid) and a selection command of what type of conversion you want to perform, between predefined systems, in local system or convert the origin of longitude.

In the section of the Cartesian coordinates (at the bottom of the screen in Figure 2.87) you can read the coordinates from the job in progress, or you can import points from a file. You will need to set the format for the fields in import and specify whether the incoming coordinates are Cartesian or geocentric. You can also save the coordinates with the Save Cartesian command (Figure 2.90). The choices to save the coordinates depend on the active job, if you do not have a fieldbook, the program will propose to create a new one, otherwise

you will be able to replace or add points to the work in progress (it is always also enabled the possibility to compose a new fieldbook). Memorize can also be done by saving the coordinates to a file.
The conversion command from Cartesian opens a window as in. Here it is possible to establish a system of origin and destination for the conversion and, as for the geographic coordinates, it can be converted into Cartesian, geocentric and geographical.
Below the table for Cartesian coordinates you can see information on the points contained in the table, an Undo command to cancel a possible conversion and a command for selecting the conversion you want to perform between predefined systems or in a local system.

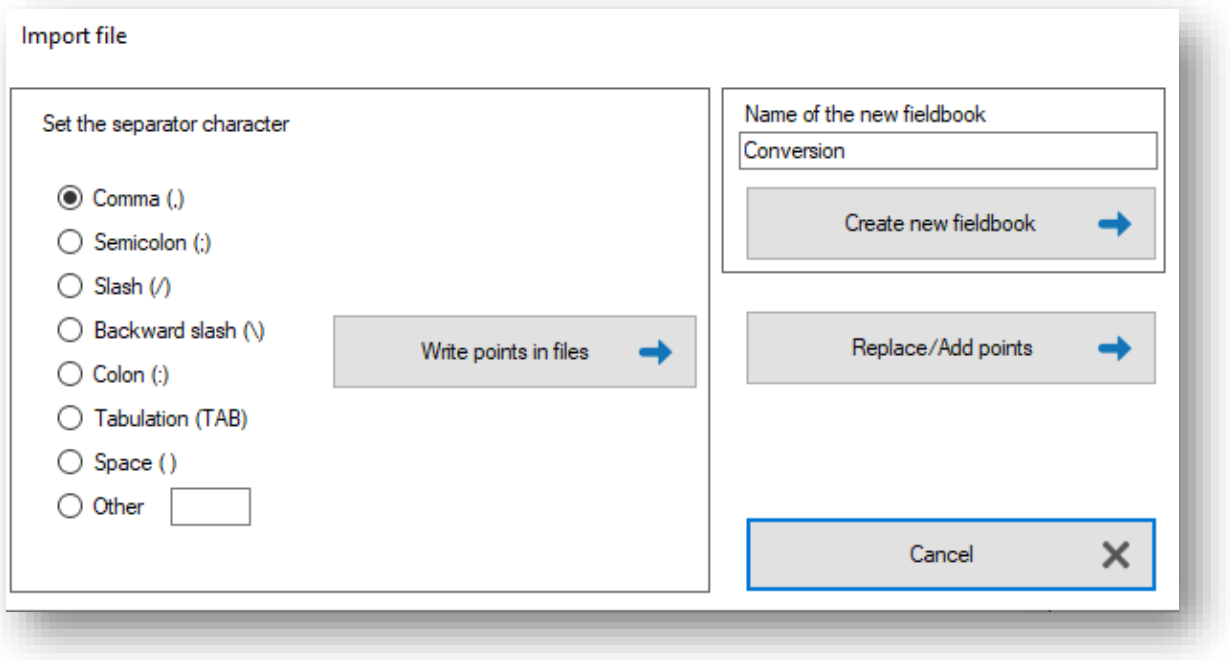


Figure 2.90

2.5.3 Fieldbook

In this section (Figure 2.91) you can import a fielbook as a file, download it from total stations or write it manually. The operations that can be performed on the fielbook are the memorization, calculation and export of the points calculated in the CAD. The program controls the measurements of horizontal, vertical, direct and inverse readings and performs the averages. The program also checks for points with the same name measured several times within the same station and check that the measurements are averaged. Note that the information displayed, when importing a Total station file does not show the raw files, what is displayed is the result of a reading and interpretation of the data by the application.

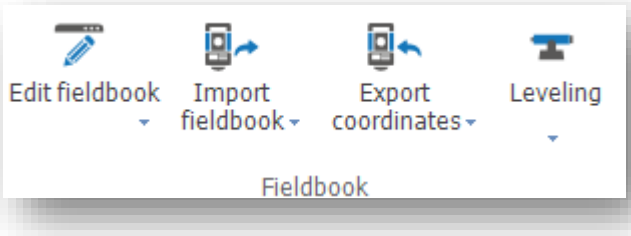


Figure 2.91

2.5.3.1 Edit fieldbook

By clicking on the Edit booklet button, you access a submenu as shown in Figure 2.92.

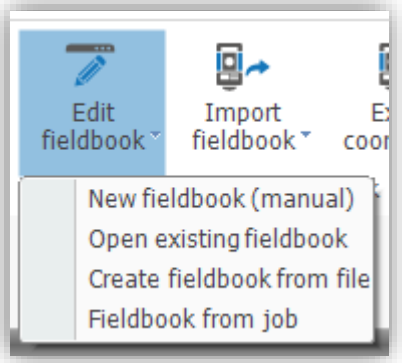


Figure 2.92

The available functions are: New fieldbook (manual), Open existing fieldbook, Create fieldbook from file (with extension from Stonex Total stations), Fieldbook from job.

By clicking on New fieldbook (manual), you can manually write a fieldbook; in the first screen that follows (Figure 2.93) you can give a name to the fiedlbook (mandatory choice, otherwise the program will not allow you to proceed), and then enter a series of other information

related to the latter. All fields are left blank, only the date is set automatically by the system, but can be changed.

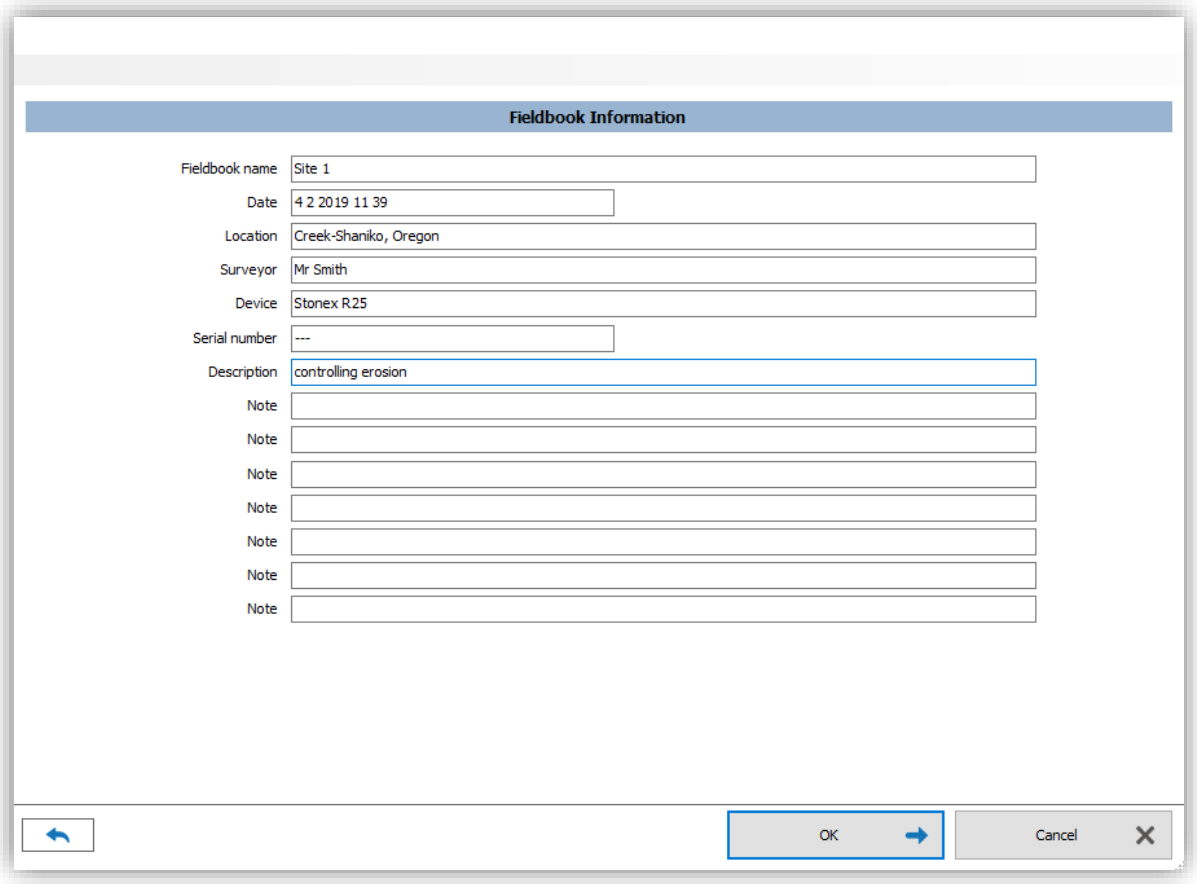


Figure 2.93

The next screen clicking OK automatically leads to the first measurement (Figure 2.94), by default the name of the first station is St1 and is defined as temporary ("Temporary" means that the coordinates have not been calculated, "Calculated" means that the coordinates have been calculated in the field and "Known" means it has known coordinates). The height of the instrument is set to 1.00 m, all other details are left blank and can be entered by the user. Even the details provided as default settings can be changed. As for the Information label, if you click on the icon next to it, you can access a function like the one described above (Figure 2.63).

In the section related to the details of the point, the default assigned name is Pn1 and its coordinates are considered temporary (with the same logic used for the stations). Other values set by default are the height of the pole, the vertical reading, the temperature and the pressure, these values can always be changed.
For horizontal readings, vertical readings and distances, the application dynamically calculates the averages and residuals, returning a correct value also based on the settings of

the survey elements (right on the screen: prism constant, temperature, pressure, transverse eccentricity, horizontal eccentricity).

By clicking on the icon with the wrench on the right, you can access the list of parameters related to the fieldbook (Figure 2.111). Parameters for setting the decimals you want to display on the screen and the representation of the angles. Furthermore, it is possible to set a series of tolerances and a series (on the right) of other values, which the system will consider when calculating the measurements.

At the bottom of the screen (Figure 2.94), it is possible to read the information resulting from the calculations (considering the set parameters), relative to the horizontal distance and the height difference, including the difference in height between the height of the instrument and the height of the prism.

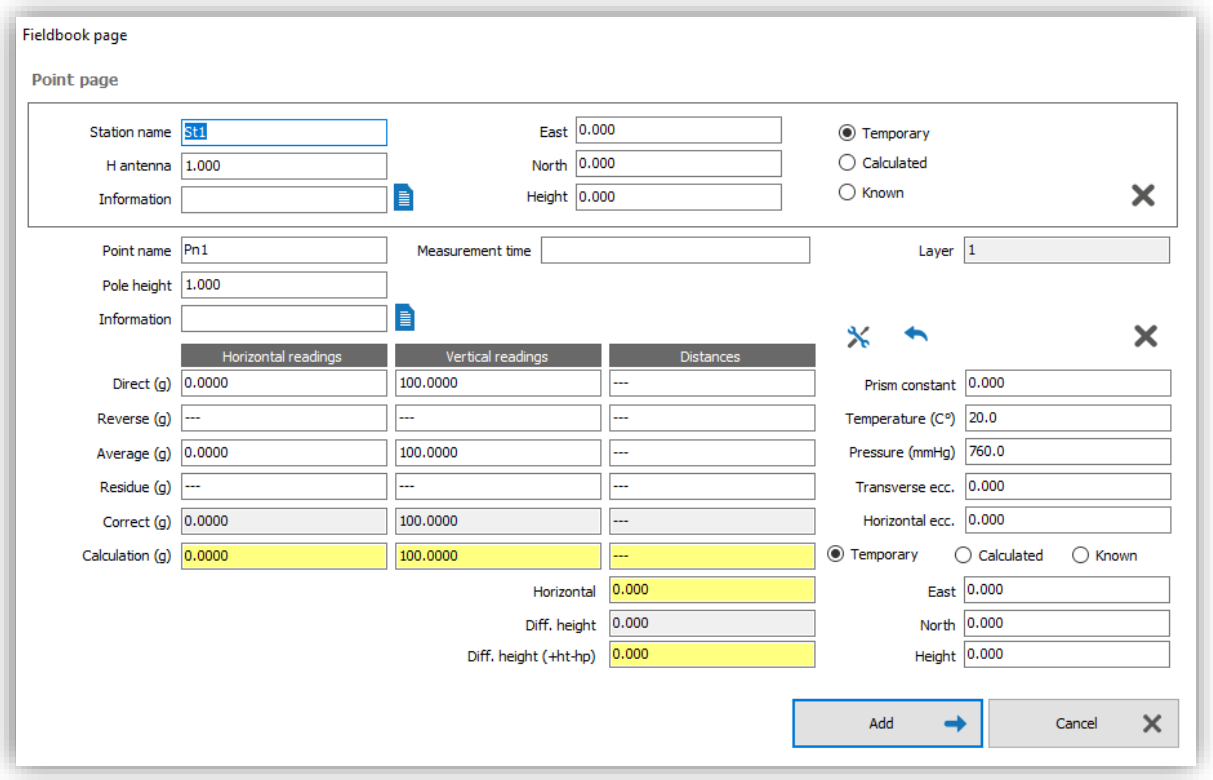


Figure 2.94

After entering the information of the new station and the new point, clicking the Add button, the application will open a new screen (Figure 2.95), where you can view a table with all the stations created and their points. The lines in the table are yellow or white, alternating each time the station changes so it will be easy to identify at a glance the passage from one station to another.

In the table screen you can enter a new station and its first measurement or a new observation. In the first case the station name will be sequential to the last one inserted and the point name will be left blank, in the second case the name of the station remains the same and the name of the point will be sequential to the last one created.
With the right-click on the table, you access a menu of options that, depending on the selection made (number of cells and position) offers a series of functions (Figure 2.80, some options seem to be disabled but they are all available, for facilitate the use of the menu some functions become dynamically active while others are deactivated).
These functions are simple to use, you can insert a new measure between the already inserted observations (Enter observation), you can add a new observation at the end of the table (Add observation), you can change the entered numerical values as well as the names of the points and the selected lines can be deleted.
These operations can be canceled by clicking the icon at the bottom left of the screen (blue undo icon).

When all the observations have been entered, it is possible to press the End of manual entry button and the screen will automatically change its appearance (Figure 2.97); you can see the table and, in at the bottom-left you can select the desired station, to place the visible part of the table on it.

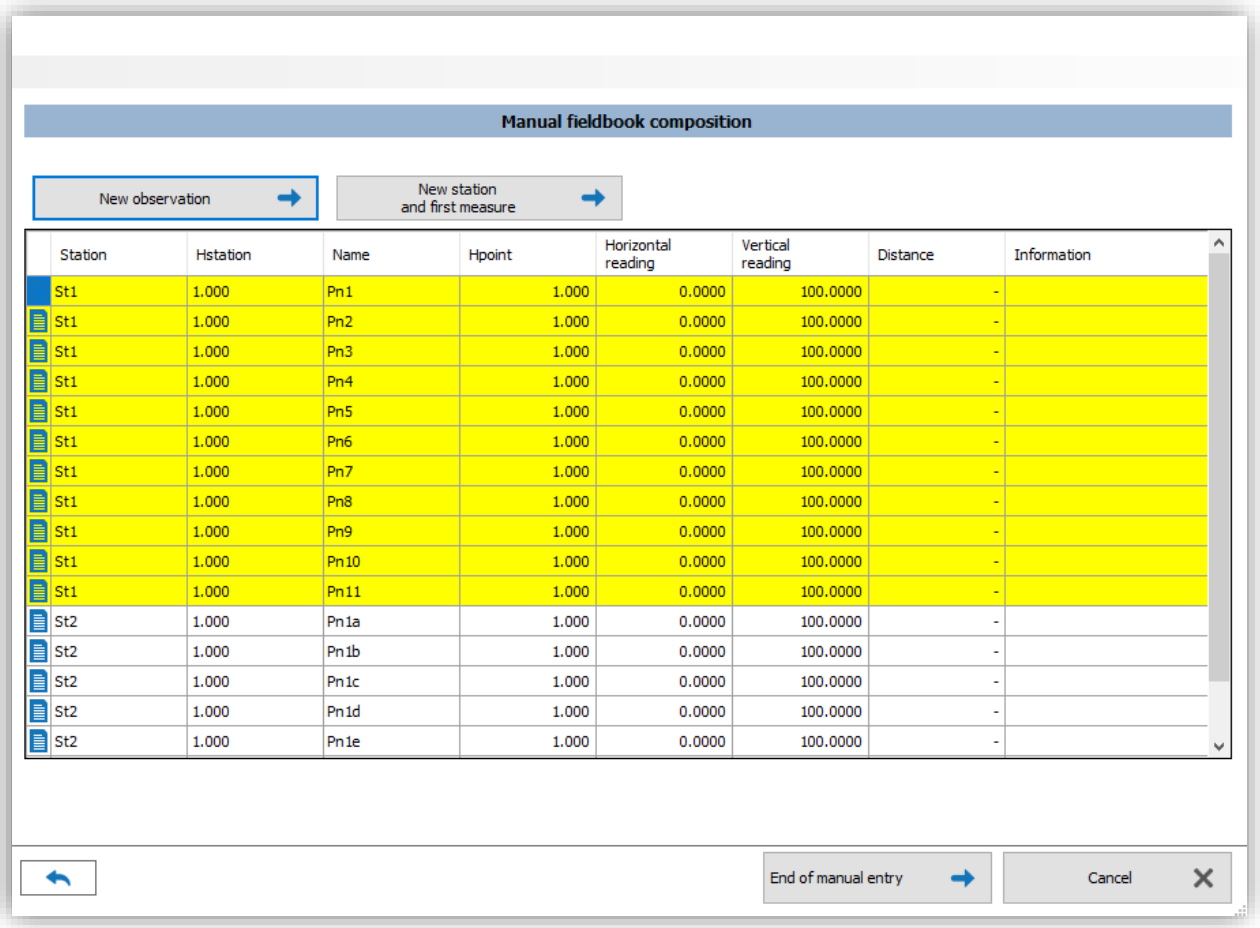


Figure 2.95

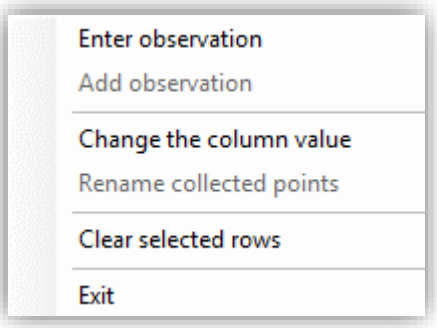


Figure 2.96

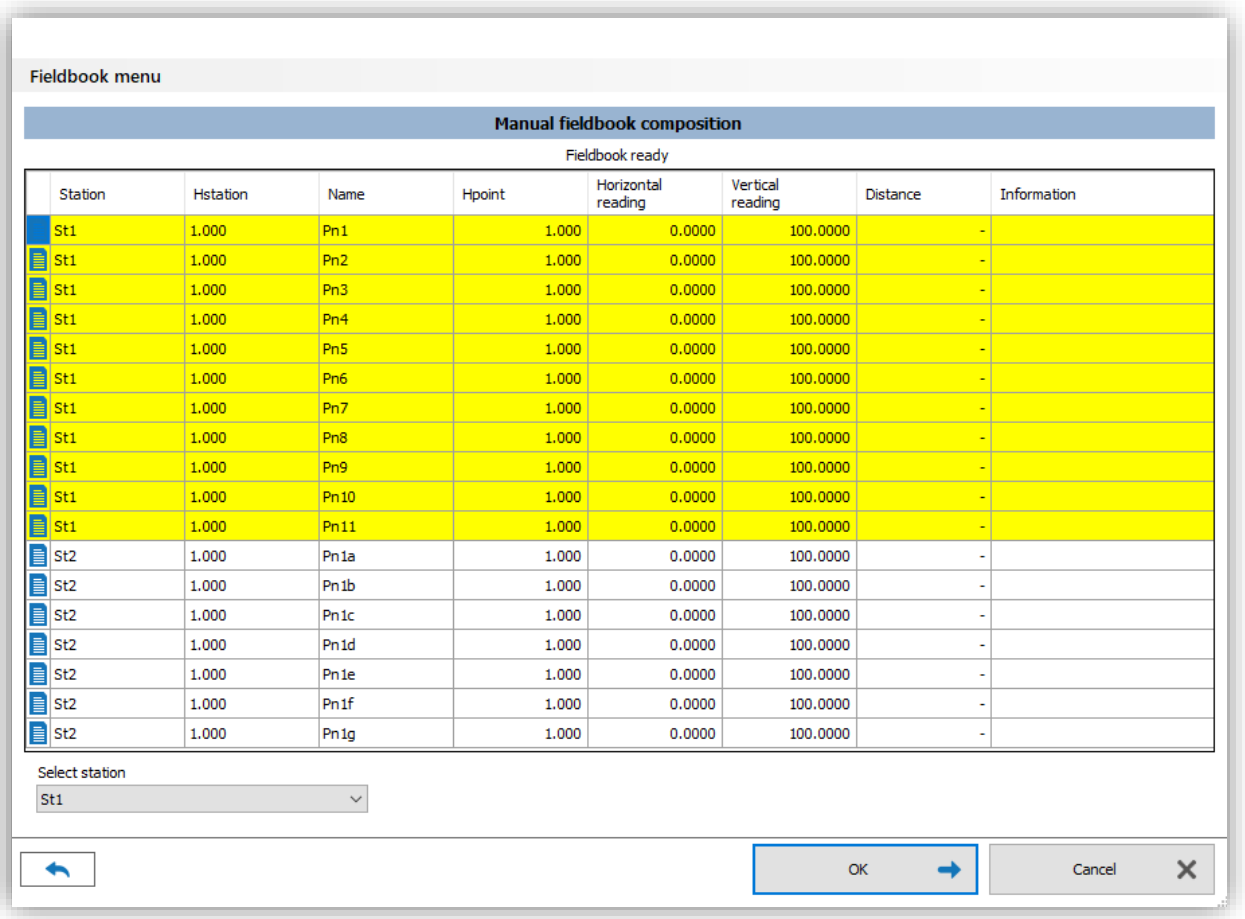


Figure 2.97

In Figure 2.97 the command on the top-left, Fieldbook menu, if clicked will offer a series of operations possible on the fieldbooks (Figure 2.98). It is mandatory to use one operation to proceed.

In the Fieldbook menu, the Calculations command consists of four subcommands: Traverse calculation, Detail calculation, Various calculations, 2D network calculation. The only calculation available with the basic functions of the Cube-manager is the detail calculation, the others are included in Module T – Topography, and they will be illustrated in the relevant section.

Detail calculation

To carry out the detail calculation, just click on the relative command that will lead to the screen in Figure 2.99, on the left is the list of stations present in the job, you can select and calculate one or more stations by clicking on them, or you can calculate all the stations by clicking on the Transfer all button.

The list named Stations to be calculated will show the stations that you chose to calculate, when you click on Proceed, if the system does not find known points, it will generate a screen (Figure 2.100), where you can select the station and the first orientation (coordinates can be assigned/changed if necessary). To start the calculation, it is possible to click on Confirm calculation (Figure 2.101). Uncalculated stations will be displayed in the list on the right, named Stations not calculated; help messages will appear below the list (in this example, 'All stations calculate ', 'All backsights in the expected tolerance'). View report button will show an html file with the details of the calculation, the Repeat calculation button will perform the calculation again. On the right there are the differences of East, North, Height between the maximum and minimum values found in the work, this information can help to find errors. The X-gray icon will delete from the list of stations to be calculated the one selected, the trash icon will erase all stations in the list. The icon with the wrench leads to a window like the one shown in Figure 2.111.

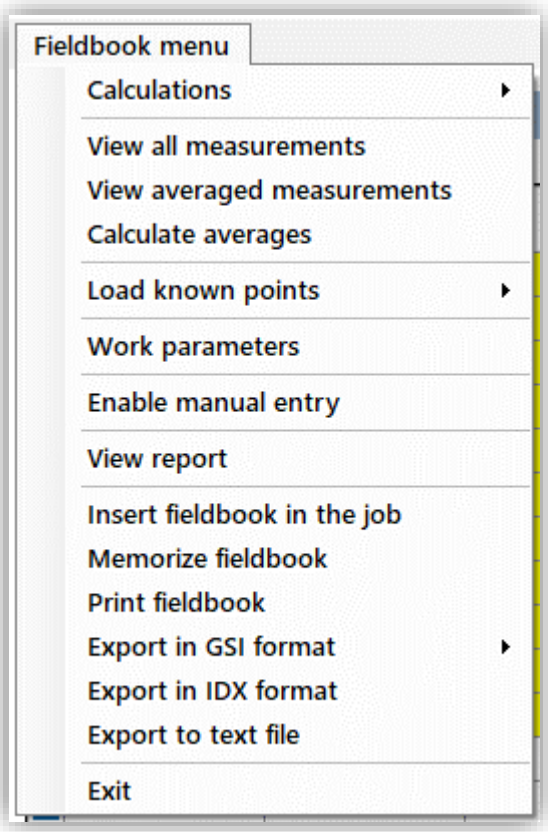


Figure 2.98

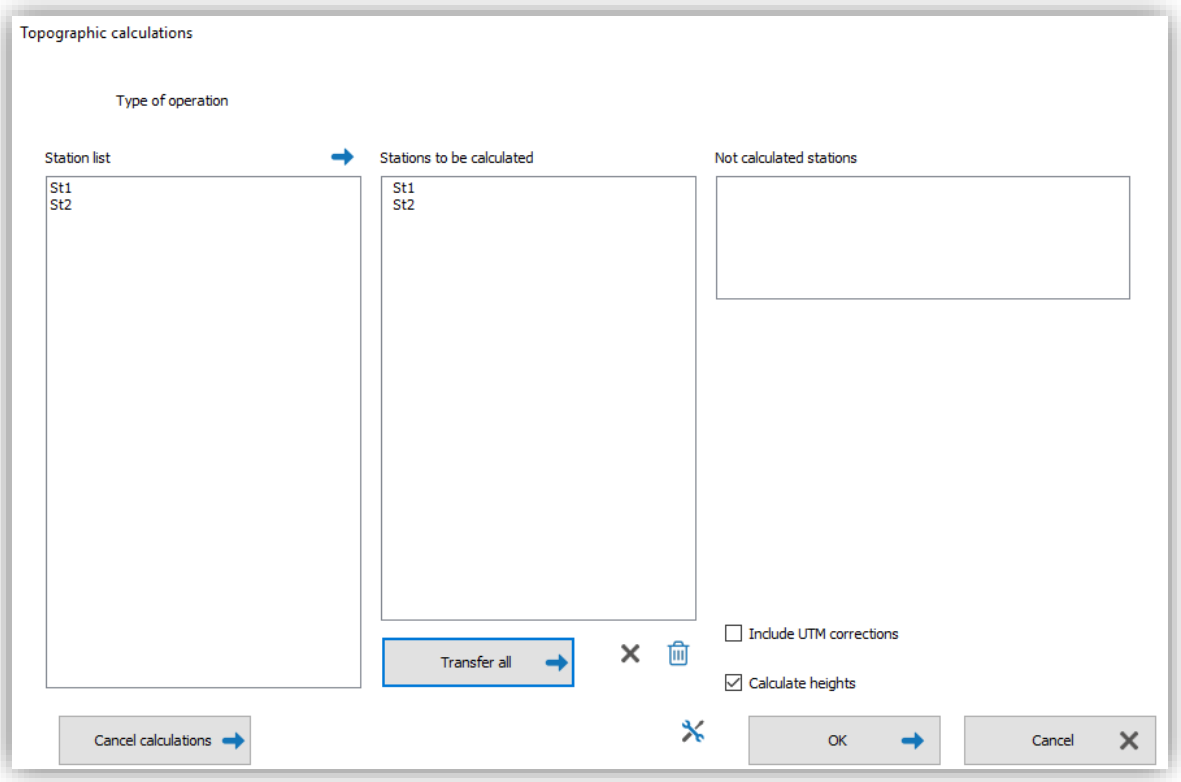


Figure 2.99

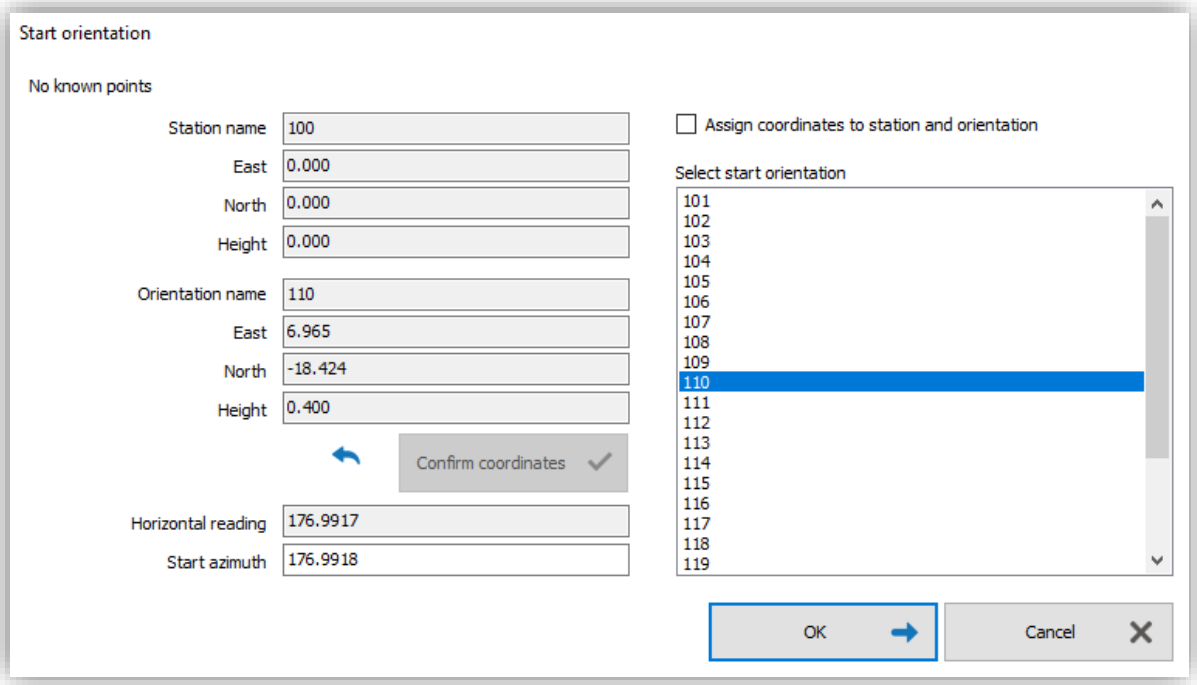


Figure 2.100

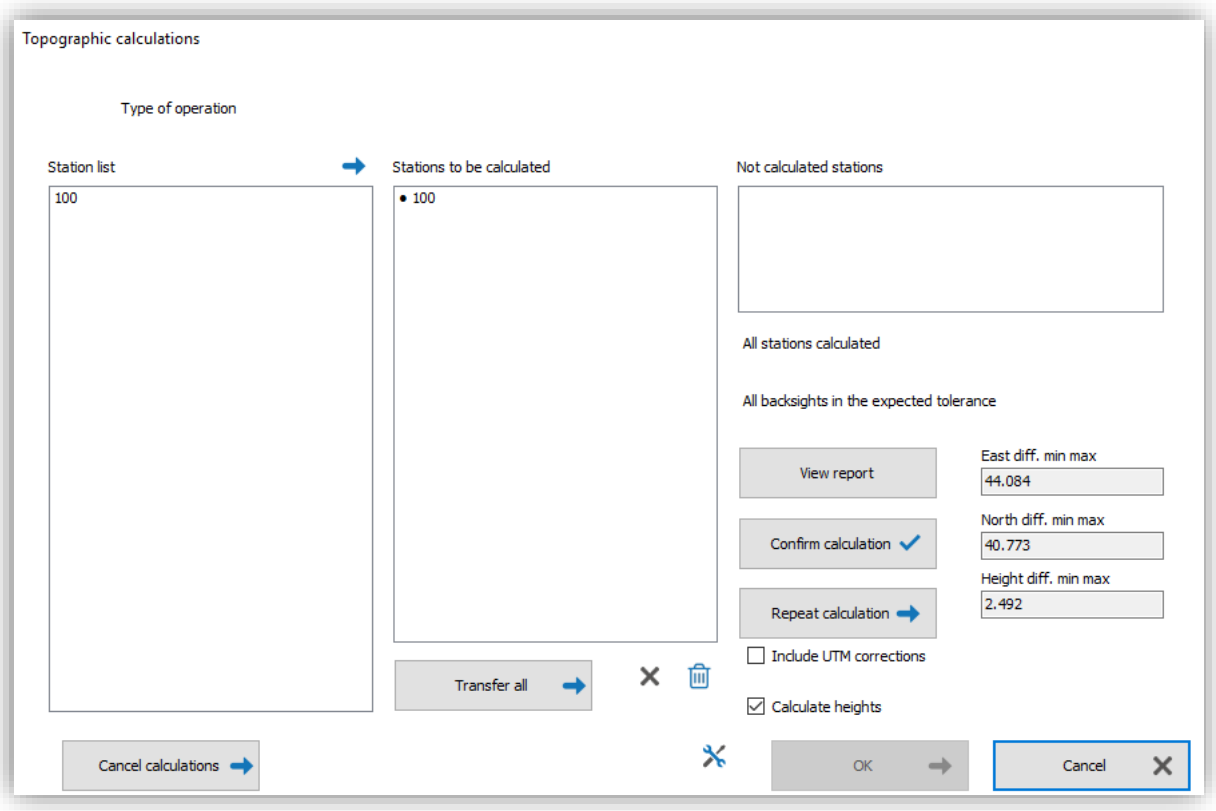


Figure 2.101

Traverse calculation

The traverse calculation is an active function in the module T. To perform the calculation, it will be enough to select this function from the Calculations command (Figure 2.98, above). The screen for this calculation is shown in Figure 2.102. The operation is like that described for the detail calculation, in this case however the selection order and the choice of the stations to be calculated must follow the logic of the traverse, surveyed in the field. The program will automatically recognize what type of traverse you are trying to calculate, the gray rectangle on the right will change appearance indicating a caption between: Open traverse, Open constrained traverse, Constrained traverse, Closed traverse.

The commands View report, Confirm calculation and Repeat calculation will not be visible as soon as the screen is opened but will become visible once the vertices of the traverse to be calculated have been selected and once the Proceed command is clicked. As with any calculation performed by the program, a detailed report with the results will also be generated in this case.

For the calculation of a closed or a constrained traverse, a window will be displayed as in Figure 2.103, where angular and linear closure tolerances can be set, which will be used in the calculation. Furthermore, a window like the one in Figure 2.104 will be presented, where the orientations can be read. With the command on the bottom-left called Distances/Height

differences, the screen in Figure 2.105 will be displayed, for a detailed reading of the distances and differences in height between the vertices.

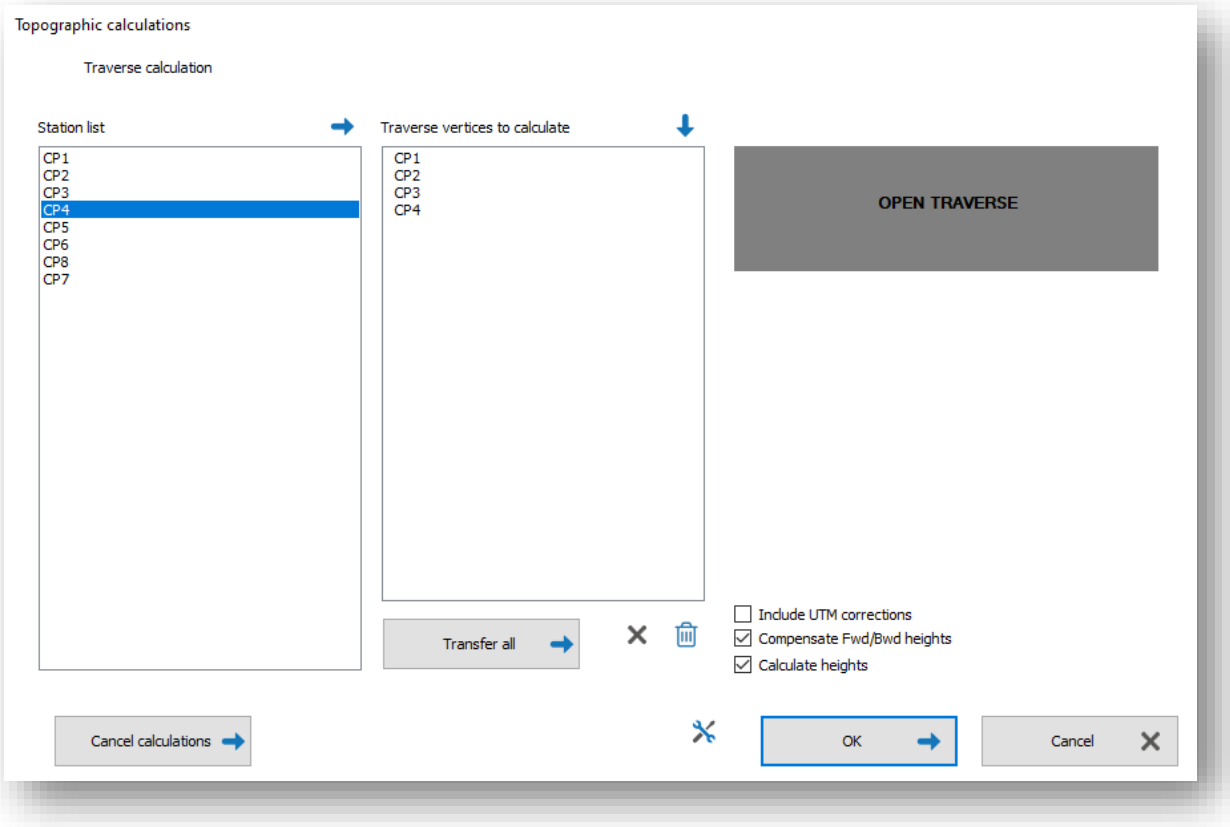


Figure 2.102

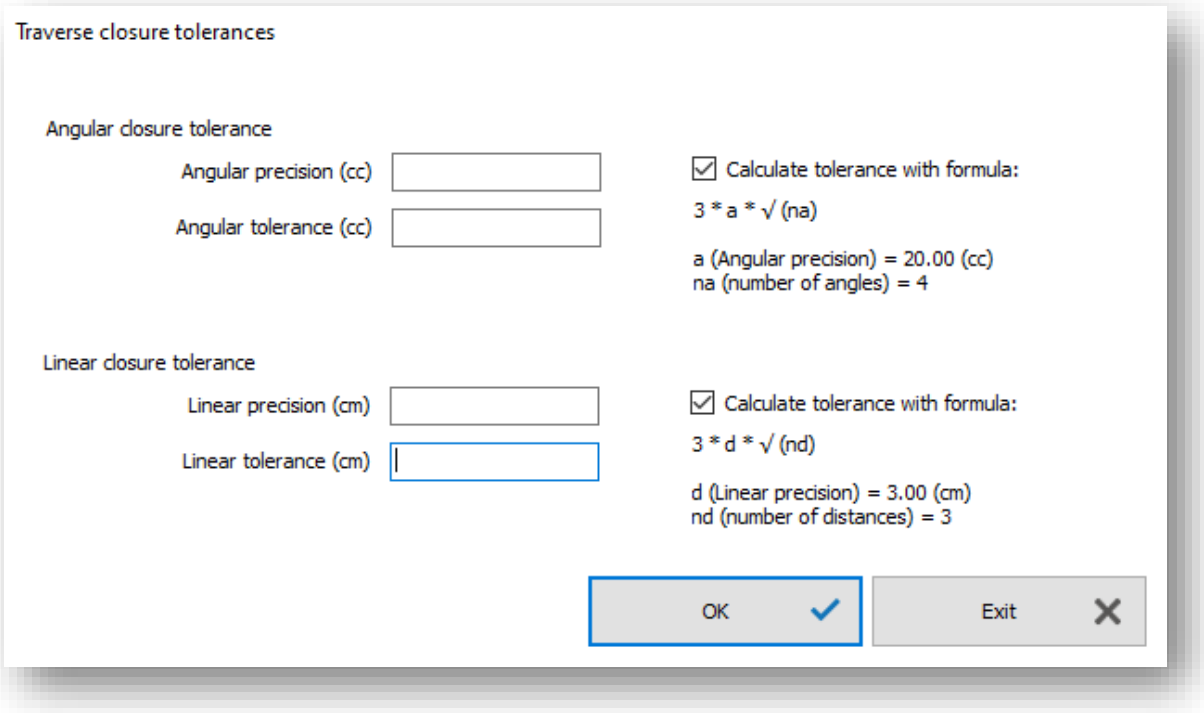

Traverse closure tolerances
Angular closure tolerance
Angular precision (cc)
Angular tolerance (cc)
Calculate tolerance with formula:
3 * a * √ (na)
a (Angular precision) = 20.00 (cc)
na (number of angles) = 4
Linear closure tolerance
Linear precision (cm)
Linear tolerance (cm)
Calculate tolerance with formula:
3 * d * √ (nd)
d (Linear precision) = 3.00 (cm)
nd (number of distances) = 3
OK
Exit

Figure 2.103

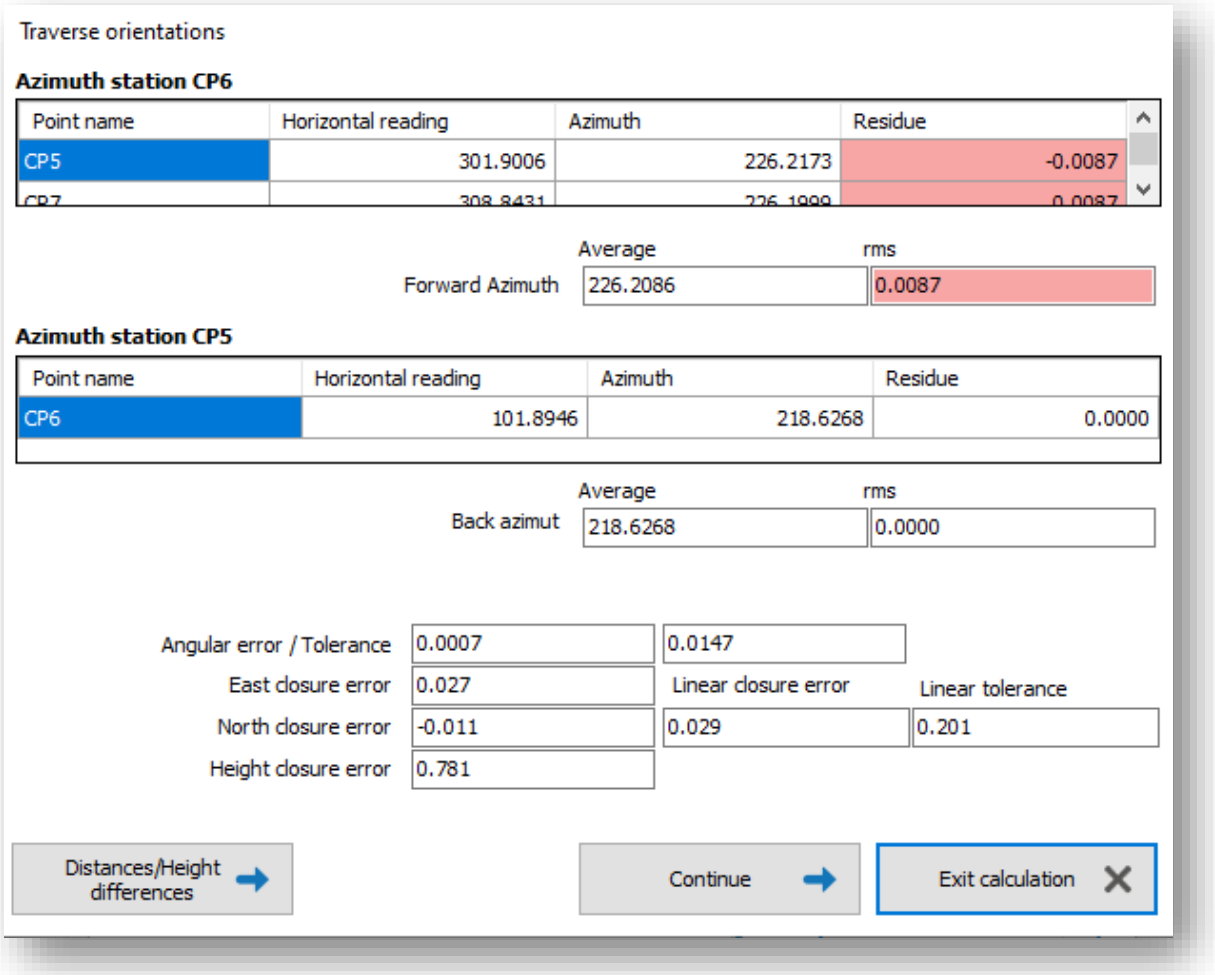

Traverse orientations
Azimuth station CP6
Point name
Horizontal reading
Azimuth
Residue
CP5
301.9006
226.2173
-0.0087
Average
rms
Forward Azimuth
226.2086
0.0087
Azimuth station CP5
Point name
Horizontal reading
Azimuth
Residue
CP6
101.8946
218.6268
0.0000
Average
rms
Back azimut
218.6268
0.0000
Angular error / Tolerance
0.0007
0.0147
East closure error
0.027
Linear closure error
Linear tolerance
North closure error
-0.011
0.029
0.201
Height closure error
0.781
Distances/Height differences
Continue
Exit calculation

Figure 2.104

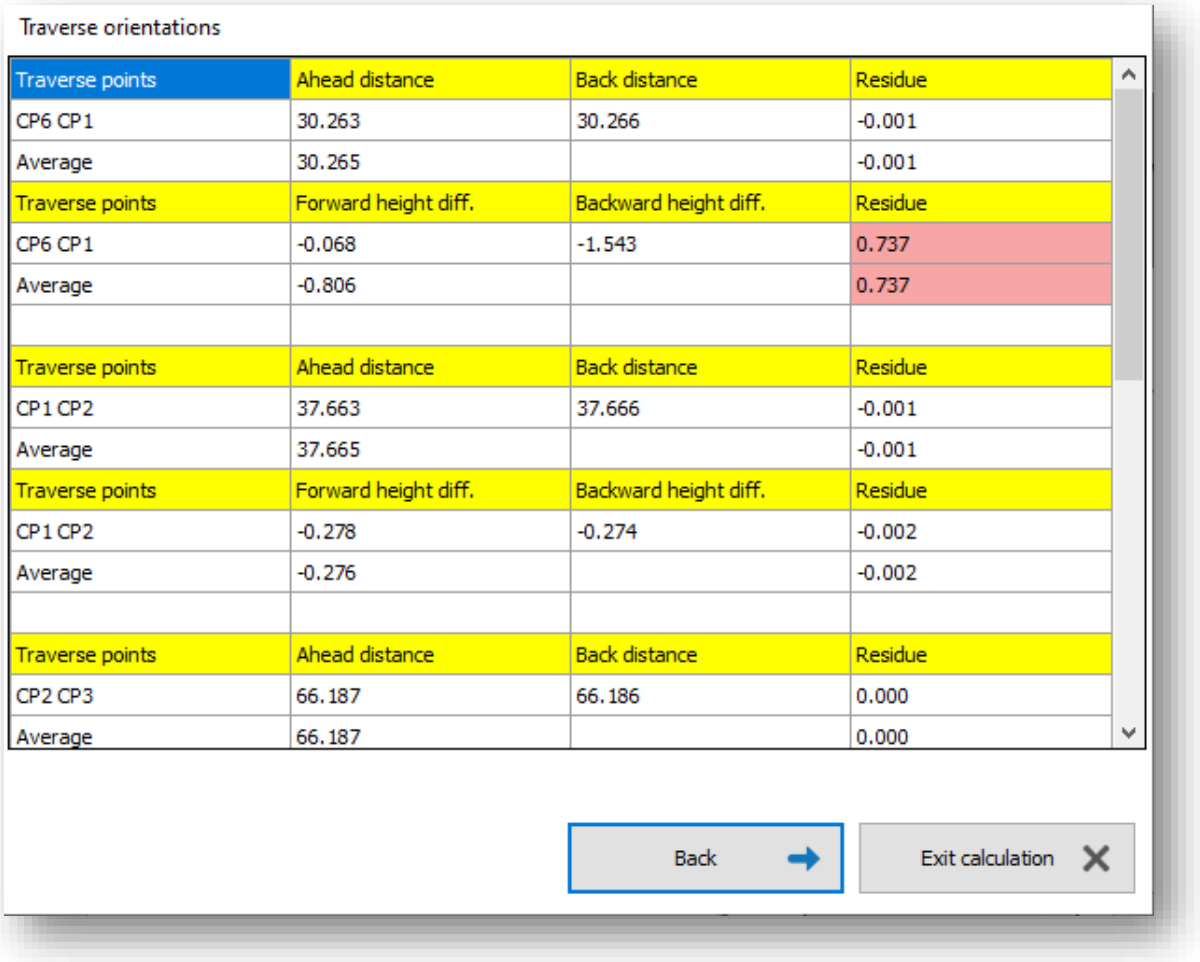


Figure 2.105

Various calculations

By clicking on the Various calculations button, you can obtain calculations of free stations, forward intersections and reverse intersections. The window looks link those encountered for the other topographic calculations, related to total stations (Figure 2.106). The list on the left shows all the stations, the known points and the measures present in the job, the selection with the click, causes the movement of an element from the list on the left to the one on the right, and the program is able to provide information on the possibility or not of calculating this point. If the program, based on the selection made, finds the possibility to calculate the intersections even with least squares, it will propose to perform also this second calculation. A window like the one in Figure 2.107 will open automatically. The functions and the possible settings in this screen are the same as those found in the case of the 2D network calculation.

2D network calculation

If the topographic survey was carried out to have redundant measures and known points, after making a provisional calculation of the coordinates, it is possible to continue with the calculation of the 2D network compensation. The window is like the one in Figure 2.107, on the left the known points are summarized, in the list on the right the points to be calculated are summarized. For this calculation, you can set the angular and linear precisions (as a constant and as a ppm value), the precisions can be set globally or by clicking on the Assign accurary to every measument button, for each measurement, a table will open (Figure 2.108), where you can manage them individually. It is possible to enable a UTM correction, in case of surveys that requires deformation correction. If the calculation you are about to perform is a simulation, you can also assign an SQM value of weight units.

The number of equations and unknowns provided for the calculation are also available for consultation in the window. As with any other topographical calculation, also in this case, a report will be displayed with the results reported in detail and it will be possible to confirm the calculation or carry it out again.

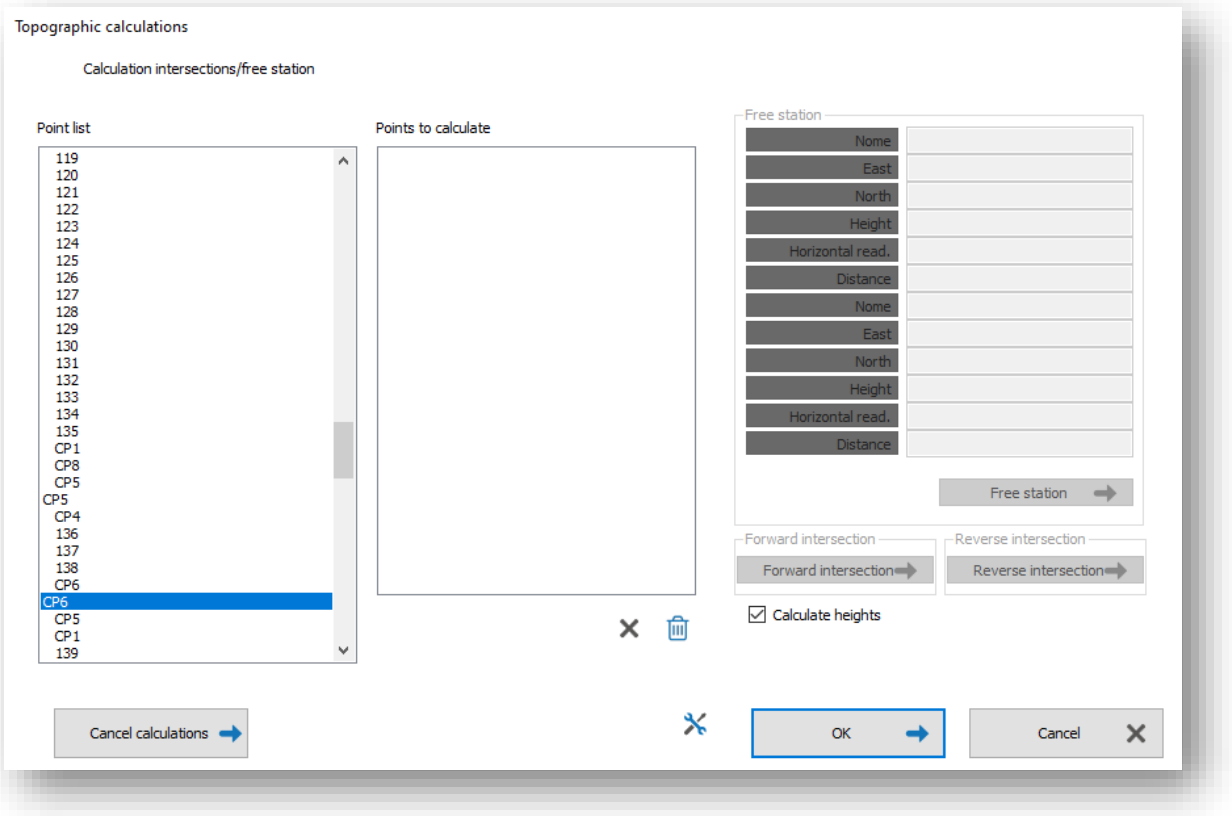


Figure 2.106

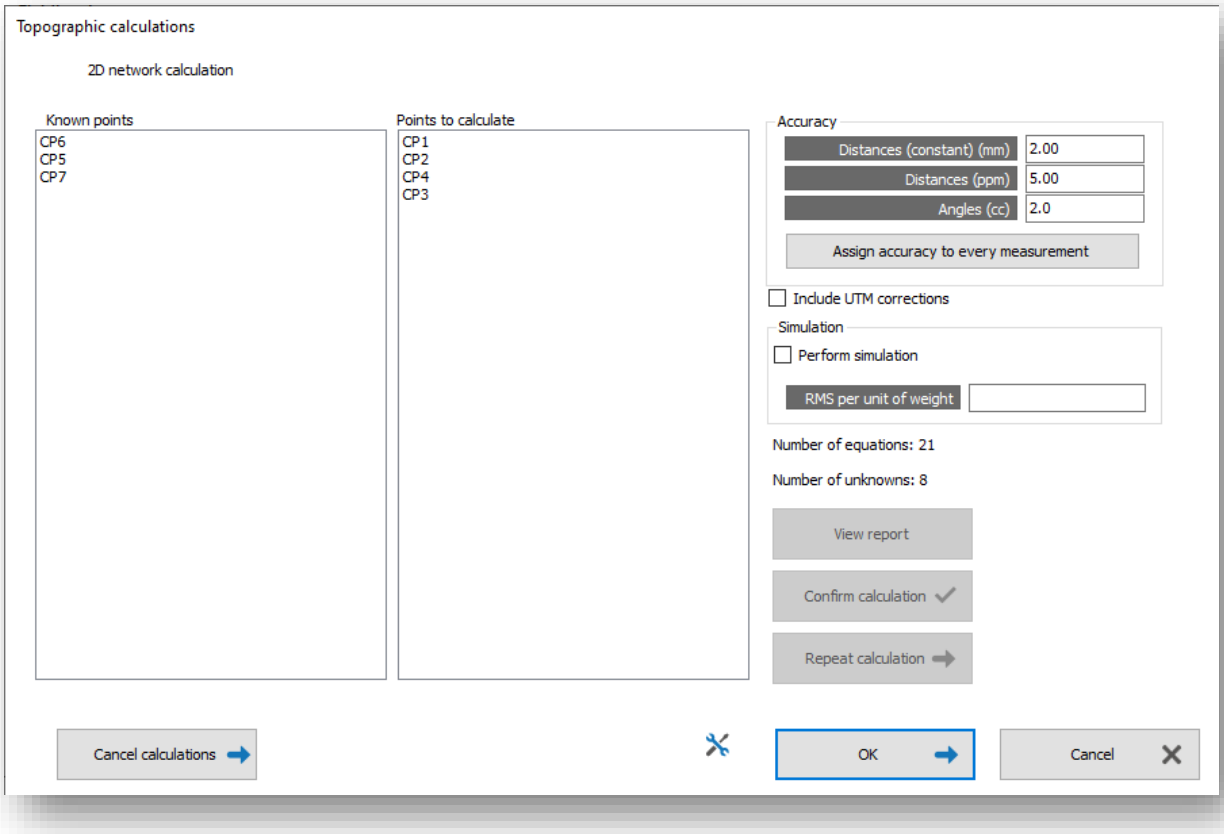

Topographic calculations
2D network calculation
Known points
CP6
CP5
CP7
Points to calculate
CP1
CP2
CP4
CP3
Accuracy
Distances (constant) (mm)
2.00
Distances (ppm)
5.00
Angles (cc)
2.0
Assign accuracy to every measurement
Include UTM corrections
Simulation
Perform simulation
RMS per unit of weight
Number of equations: 21
Number of unknowns: 8
View report
Confirm calculation
Repeat calculation
Cancel calculations
OK
Cancel

Figure 2.107

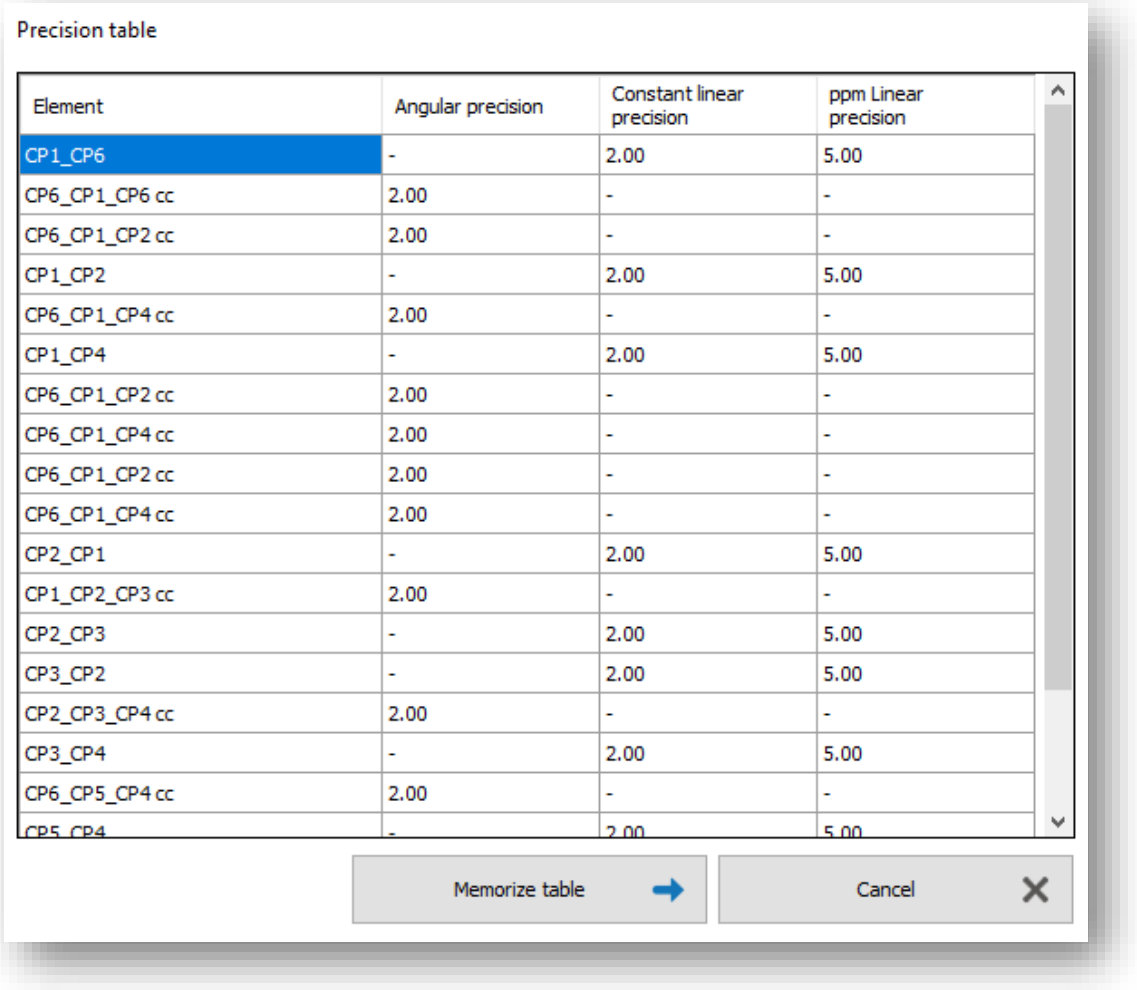


Figure 2.108

Returning to the commands in Figure 2.98, View all measurements, View averaged measurements and Calculate averages are other available functions, the first two are display options, the last, work on the fieldbook, taking all the measures into consideration and calculating the averages.
This last function (Calculate averages) opens a screen (Figure 2.110) in which it is possible to set tolerances, text colors, layers, symbols and relative colors (for known points, detail points and stations), decimals, representation of the angles and corrections (such as atmospheric refraction), clicking Proceed the program will proceed to the average calculation.

The Load known points command opens a menu with three options: Read from file, Read from current job, Cancel known points. The first command opens a screen where you can select a text file containing the coordinates and indicate a separator character (Figure 2.109).

Work parameters will open a window as in Figure 2.110.

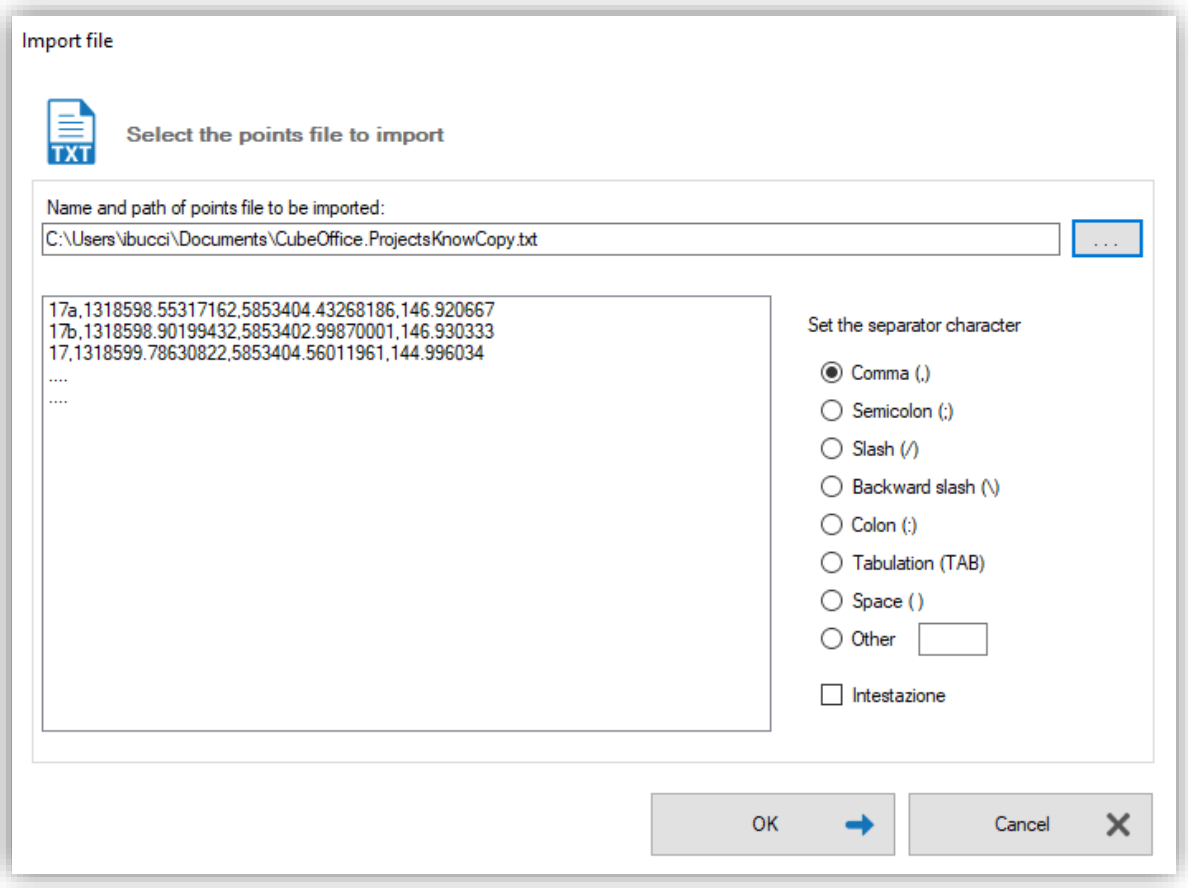

Import file
Select the points file to import
Name and path of points file to be imported:
C:\Users\ibucci\Documents\CubeOffice.ProjectsKnowCopy.txt
...
17a,1318598.55317162,5853404.43268186,146.920667
17b,1318598.90199432,5853402.99870001,146.930333
17,1318599.78630822,5853404.56011961,144.996034
....
....
Set the separator character
Comma (,)
Semicolon (;)
Slash (/)
Backward slash (\)
Colon (:)
Tabulation (TAB)
Space ( )
Other
Intestazione
OK
Cancel

Figure 2.109

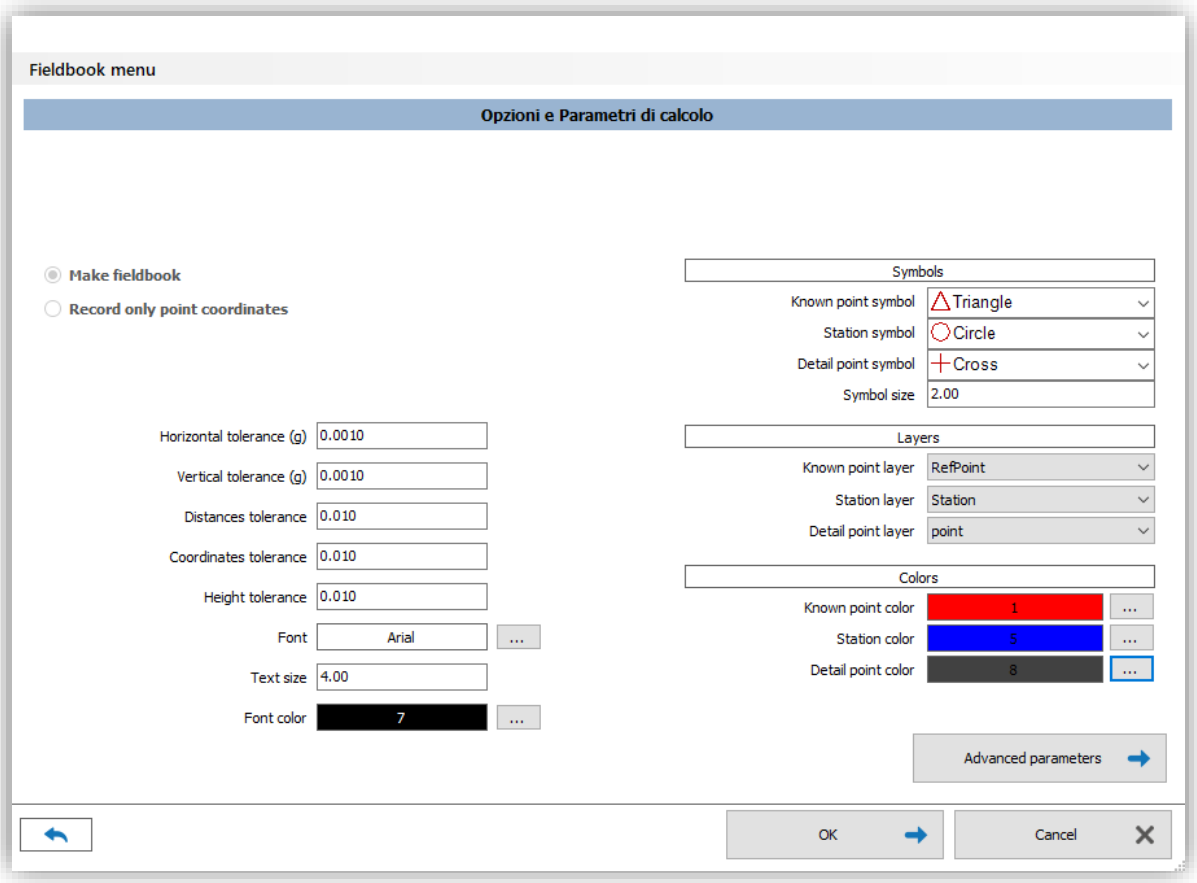

Fieldbook menu
Opzioni e Parametri di calcolo
Make fieldbook
Record only point coordinates
Symbols
Known point symbol
Triangle
Station symbol
Circle
Detail point symbol
Cross
Symbol size
2.00
Horizontal tolerance (g)
0.0010
Vertical tolerance (g)
0.0010
Distances tolerance
0.010
Coordinates tolerance
0.010
Height tolerance
0.010
Font
Arial
Text size
4.00
Font color
7
Layers
Known point layer
RefPoint
Station layer
Station
Detail point layer
point
Colors
Known point color
1
Station color
5
Detail point color
8
Advanced parameters
OK
Cancel

Figure 2.110

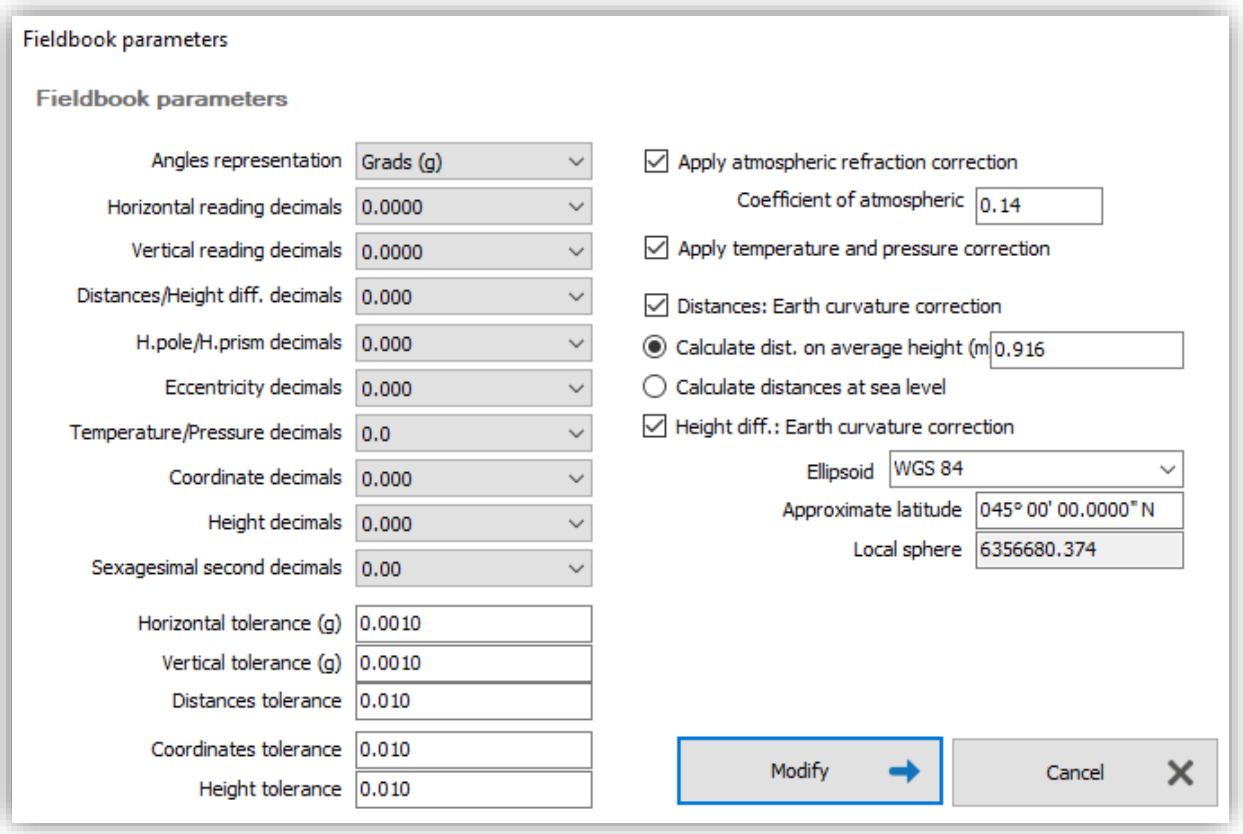


Figure 2.111

Among the commands shown in Figure 2.98, the Enable manual entry button will lead to the manual writing section of the fieldbook (described above).

The View report command will open a screen with a html file containing all the information on the current fieldbook. If the program recognizes that there are several reports present in the job, a window will open in which all the reports will be displayed so that you can select the one you want, in this screen you can also delete (one or more) reports.

Insert fieldbook in the job button will insert the fieldbook in the graphics; before proceeding, the application will check the presence of average measurements and if the calculations have been performed, then it will be possible to see again a summary of the measurements (any unaveraged measurements will be visualized on red lines, so that corrections can be made).

With the Memorize fieldbook you can save the fieldbook; after displaying the screen with general information (e.g. fieldbook name, date, location, etc.), once you have chosen the destination for saving, the application will produce a file with the .cubefbk extension.
The Print fieldbook command allows access to the general information screen on the fieldbook (as in Figure 2.93, where you can change all the fields if necessary), when you click on Proceed the application creates a html file, ready to print.

The last commands are related to the export, the fieldbooks can be exported in GSI format (18 and 6 bit), in IDX and in text files (as well as in the native format of the program .cubefbk).

2.5.3.2 Import and export fieldbooks

The Import fielbook button (Figure 2.112) allows to import fieldbooks from total stations; you can import using a USB connection by connecting directly to the total station (after clicking on the chosen device, click on the Connect USB button) or selecting a file that may be stored in the PC. Figure 2.112 shows all supported devices (in Figure 2.113 all the supported extensions).
The Export coordinates button allows you to export to the total station formats and to GSI (16 bit and 8 bit).

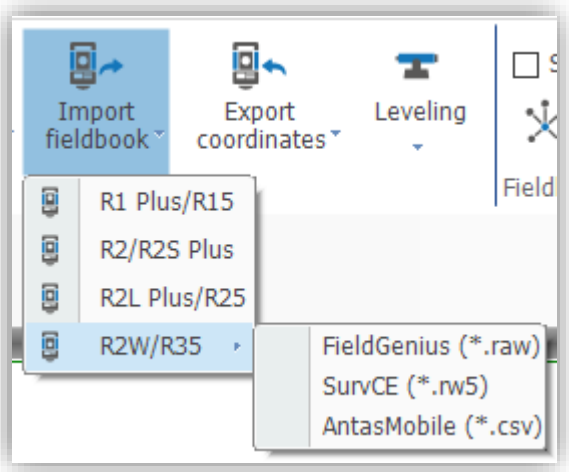


Figure 2.112

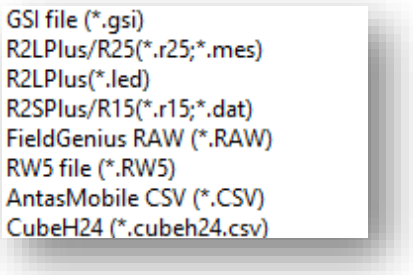


Figure 2.113

2.5.3.3 Leveling

The Leveling command consists of three subcommands: Download; Trigonometric leveling; Geometric leveling. The first opens a screen as in Figure 2.114.
After selecting (at the top) a data destination file and setting the data for the input port, you can download data from a digital level.

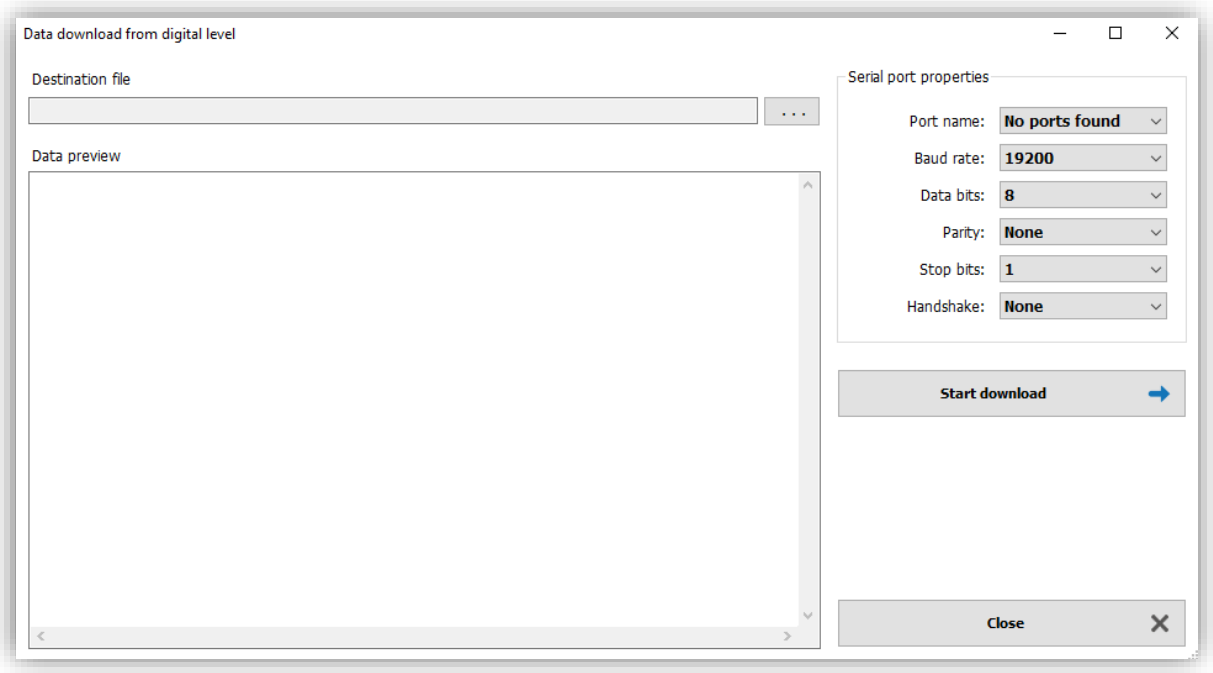


Figure 2.114

2.5.3.4 Trigonometric leveling

To perform trigonometric leveling, a fieldbook must be inserted in the work with the extension specified by the program (.cubefbk). In the fieldbook there must be some known heights from which to start the calculation (Figure 2.115). It is also possible to manually enter points.

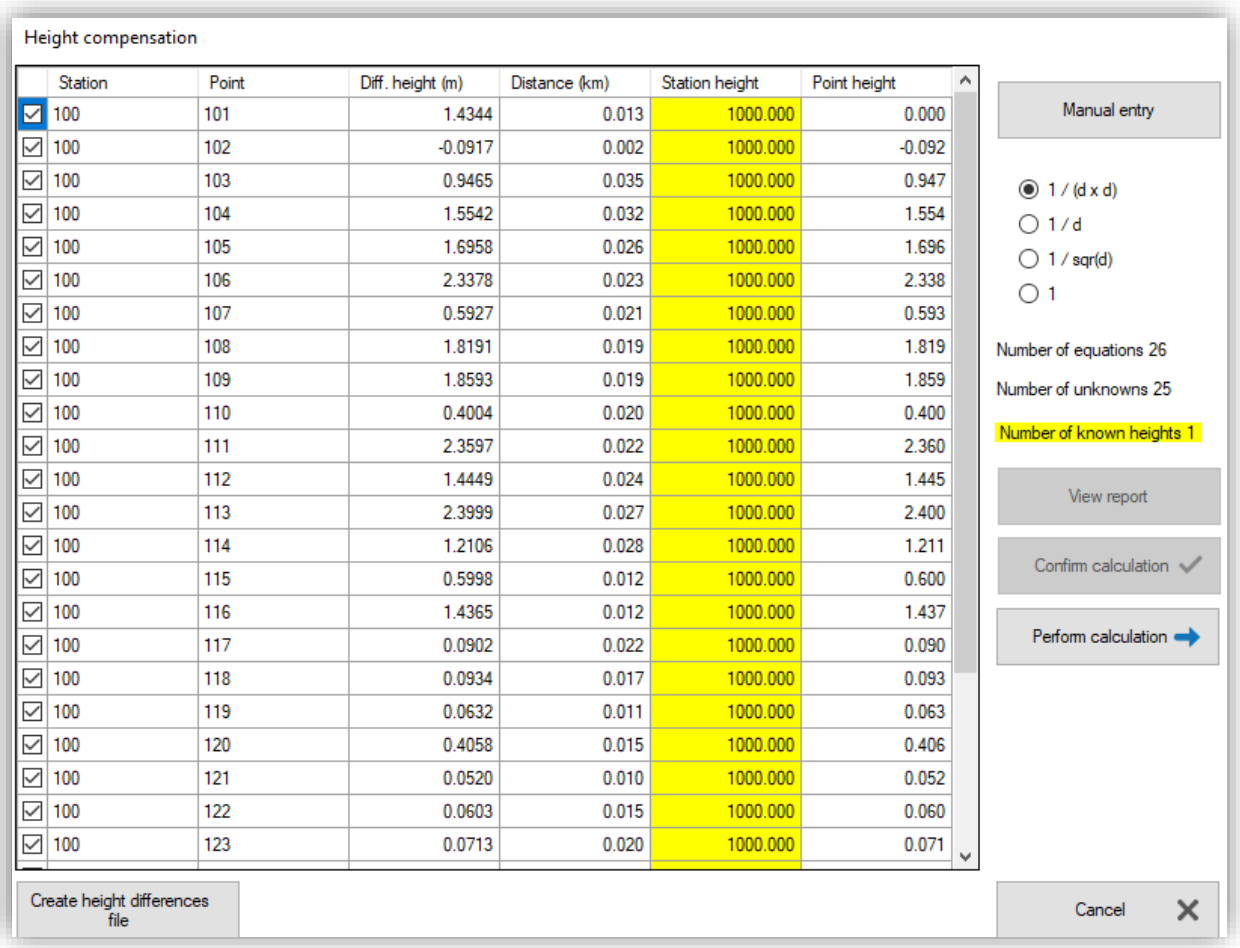


Figure 2.115

2.5.3.1 Geometric leveling

To perform geometric leveling you will have to insert a text file with difference in heights. It is also possible to manually enter points. Once the text file has been imported, the screen for the function will be like the one in Figure 2.115.

2.5.4 Fieldbook schema

The button for activating or deactivating the fieldbook schema can be found in the Topography tab (Figure 2.116). The checkbox named Show, will activate or deactivate the drawing. The Options button wil open a window as in Figure 2.117, in this screen you can determine whether to display the links, both for the GPS fieldbooks and for the polar fieldbooks, the color to give to the links and if you want the connections to be visible in the printout. In Figure 2.118, an example of work with a visible fieldbook scheme.

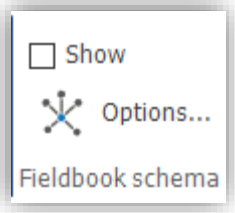


Figure 2.116

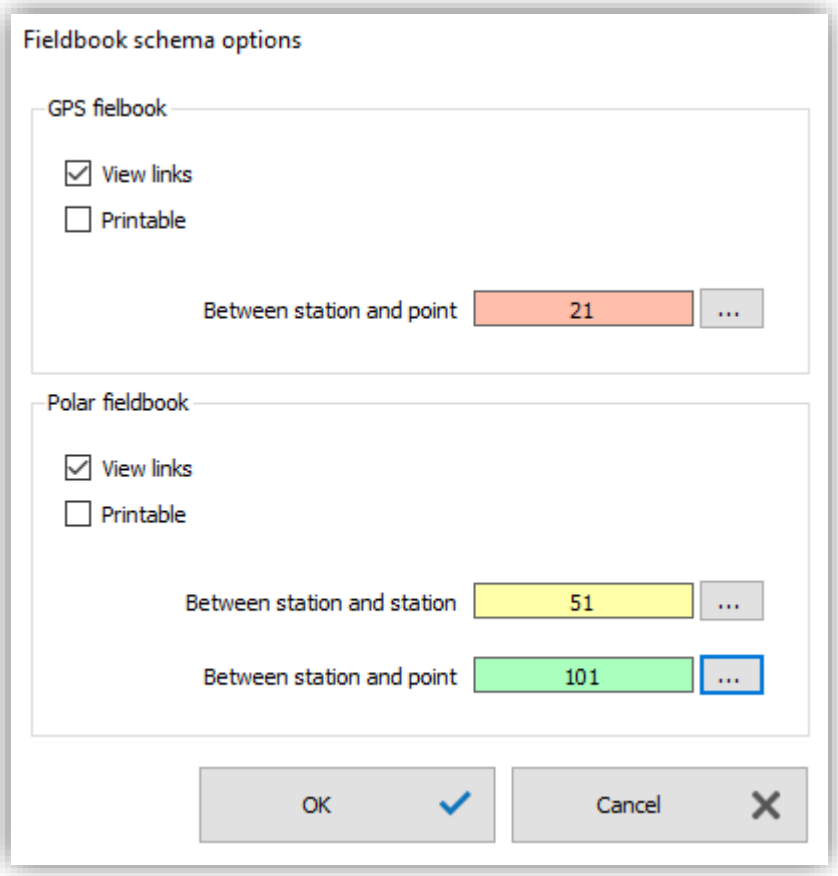


Figure 2.117

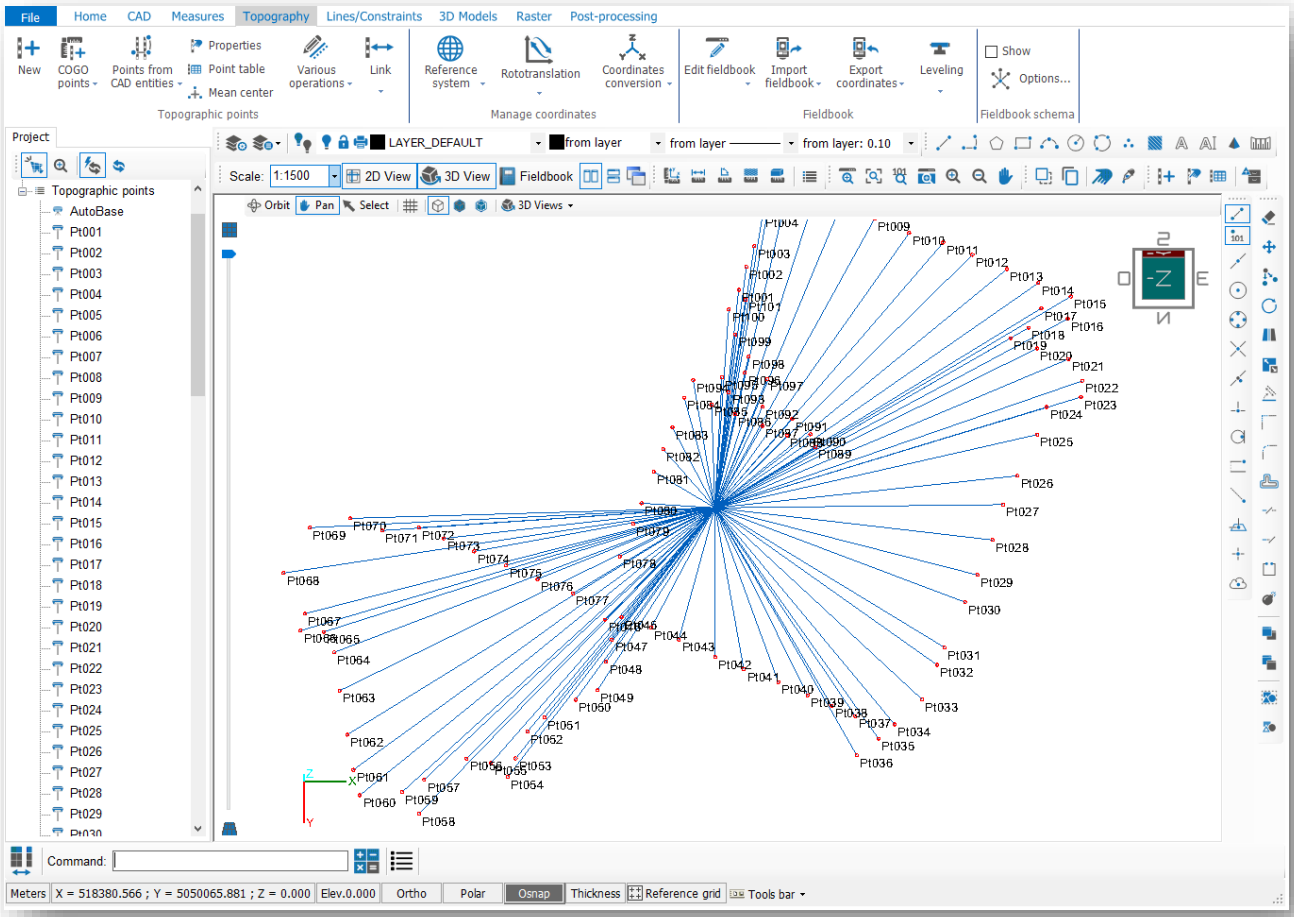

File
Home
CAD
Measures
Topography
Lines/Constraints
3D Models
Raster
Post-processing
New
COGO points
Points from CAD entities
Properties
Point table
Mean center
Various operations
Link
Topographic points
Reference system
Rototranslation
Coordinates conversion
Manage coordinates
Edit fieldbook
Import fieldbook
Export coordinates
Leveling
Fieldbook
Show
Options...
Fieldbook schema
Project
Topographic points
AutoBase
Pt001
Pt002
Pt003
Pt004
Pt005
Pt006
Pt007
Pt008
Pt009
Pt010
Pt011
Pt012
Pt013
Pt014
Pt015
Pt016
Pt017
Pt018
Pt019
Pt020
Pt021
Pt022
Pt023
Pt024
Pt025
Pt026
Pt027
Pt028
Pt029
LAYER_DEFAULT
from layer
from layer: 0.10
Scale: 1:1500
2D View
3D View
Fieldbook
Orbit
Pan
Select
3D Views
Command:
Meters
X = 518380.566 ; Y = 5050065.881 ; Z = 0.000
Elev.0.000
Ortho
Polar
Osnap
Thickness
Reference grid
Tools bar

Figure 2.118

3 Constraint (Module M)

In the Lines/Constraints tab you can find all the drawing and editing functions for the contraints.
This section is divided into 4 sub-categories: Pregeo, EDM Extract, DTM, Modify.

The first 3 sub-categories contain commands for drawing contours or constraints; Pregeo is divided into 9 commands, each of which generates a black, red or green outline, with a continuous line, dotted or dashed, following the italian Pregeo style.

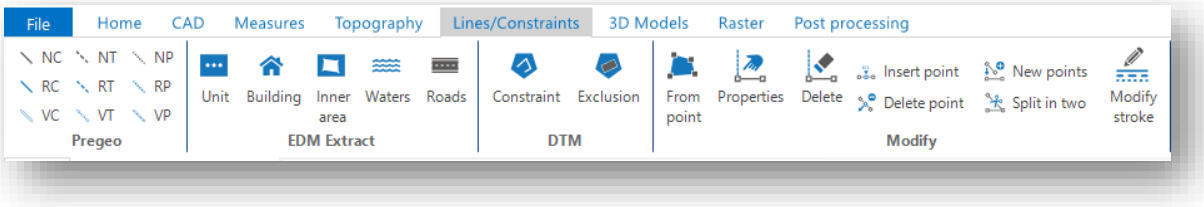


Figure 3.1

3.1 EDM extract and DTM

EDM extract section will allow to draw a contour by selecting what type of contour it is, the types provided follow the Italian Pregeo style.
The DTM sub-category will allow to design a constraint boundary or generic exclusion without belonging to a Pregeo category. The drawing of the contours or constraints, for all the commands described so far, takes place in the same way, once the command has been selected, it will be necessary to give a name to the contour (to be inserted in the command line at the bottom, in the main Cube-manager screen, Figure 3.2) and confirm with the enter key. Then, following the instructions to the left of the command line, it will be necessary to proceed by selecting the topographic points that make up the outline (the command en, to the left of the command line - Figure 3.3 - ends the drawing function; the command tab allows the selection of points from the summary table of the topographic points).

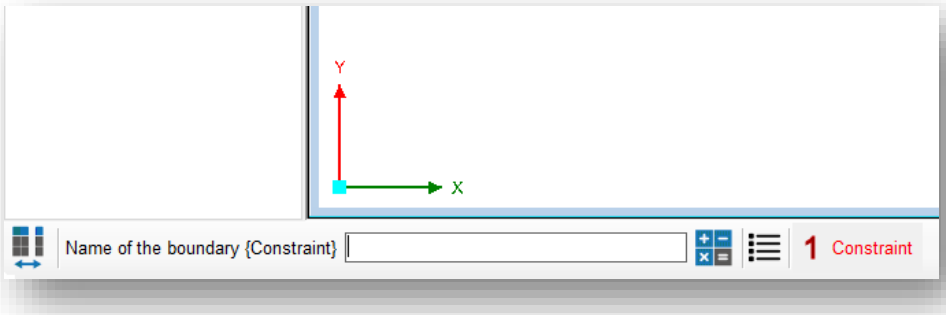


Figure 3.2

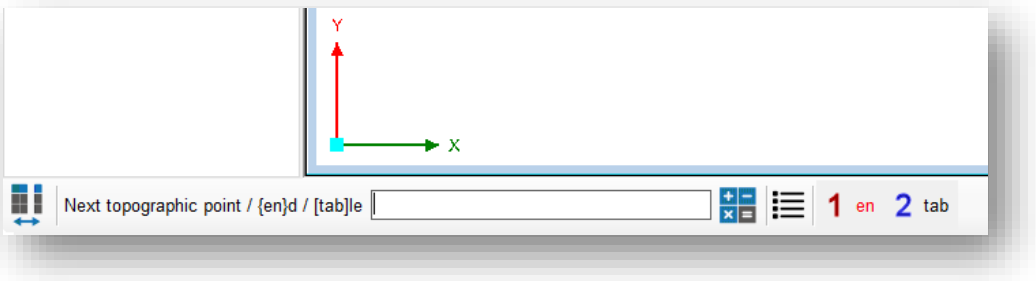


Figure 3.3

3.2 Modify constraints

The commands contained in the Modify sub-category. The first command, From point, is a utility command for drawing the contours, by clicking a point inside a closed CAD entity formed by lines and/or polylines, it is possible to transform it into a constraint (or exclusion).

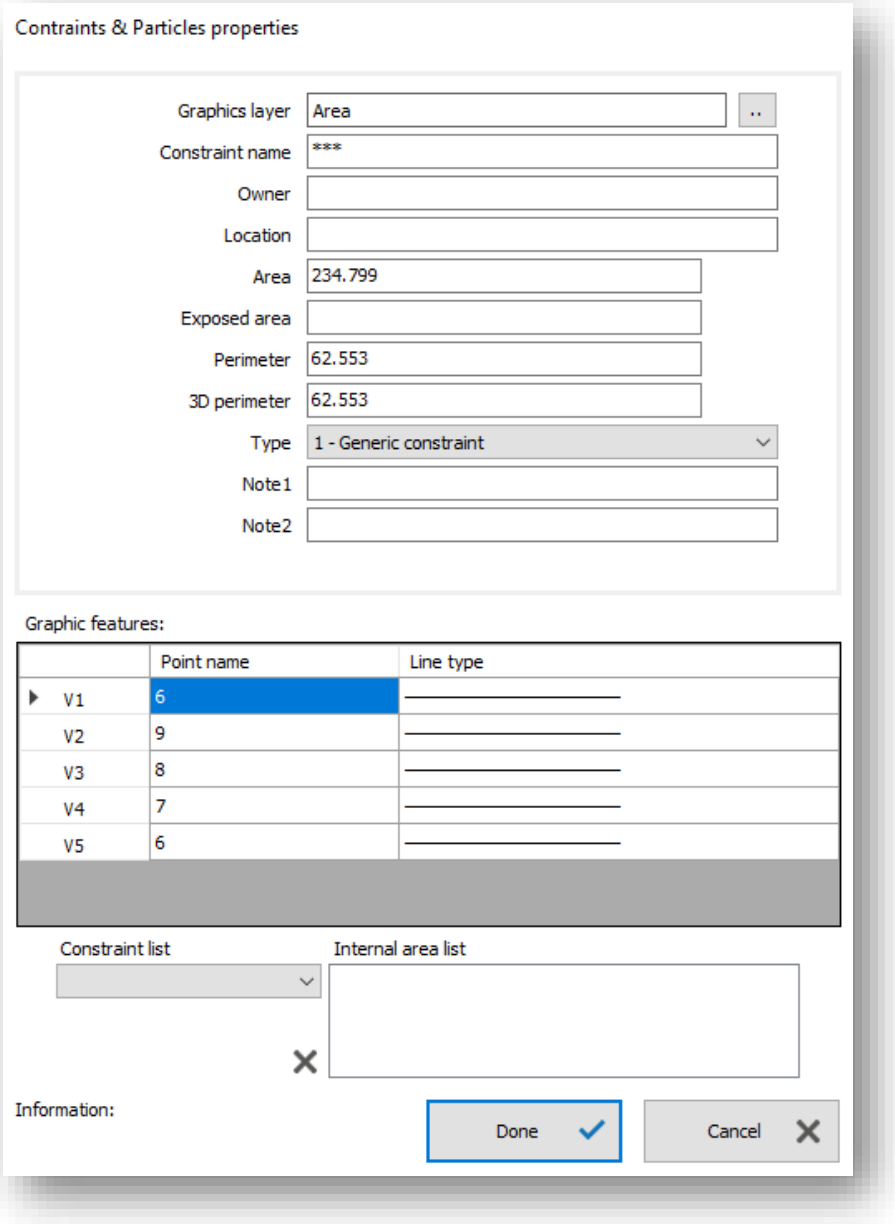


Figure 3.4

The window for creating a contour from an internal point is shown in Figure 3.4. To save the contour, it will be necessary to give it a name, it is also possible to establish what type of contour it is, by default a generic constraint will always be created. At the bottom of the graphical features table, mainly designed for Pregeo users, it is possible to change the types of lines that make up the outline, subdividing them by vertex or point.
At the bottom, you can see on the left the Contour List, selecting a contour already present in the job, this will be included in the table on the right (Internal area list) and this will become an exclusion area in the current contour to be created.

Returning to the commands in Figure 3.1, the Property command opens the same window as in Figure 3.4, with the characteristics of the selected contours, it is possible to change some features, such as the layer to which it belongs.

The Delete command allows the cancellation of contours. The Insert point, Delete point, New points and Split in two commands can be used if you have created a contour with topographic points, these commands will quickly allow you to modify the selected element. The Modify stroke command allows the selection of the outline and the subsequent modification of the style (following the type of lines proposed in the italian Pregeo).

4 3D Models (Module M)

The 3D Models Tab is divided into 4 sub-categories: DTM; Contours; Volumes; Profiles.

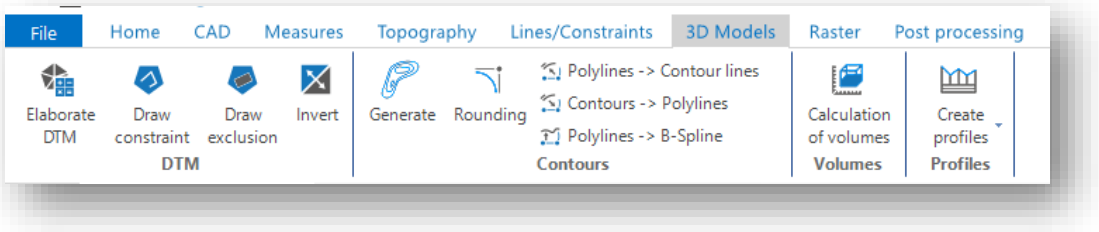


Figure 4.1

4.1 DTM

DTM contains the commands already encountered, Draw constraint and Draw exclusion, illustrated in the paragraph of Contraints. Elaborate DTM is the command that allows you to draw a digital model starting from a constraint.
The screen for drawing a digital model is the one shown in Figure 4.2. On the left you can select the points and polylines layers that you want to use for the creation, by default all the points and all the layers of the current job are selected. On the top right you will have to select a constraint from which to start the model creation, you can choose between selecting with the mouse directly from the graphic, selecting it from a list of constraints (included in the current job) and automatically creating a constraint given a fixed distance between points (to be entered, even if the program suggests a value based on the current job). At the bottom you will have to enter some features of the DTM, the name of the constraint (if not already entered with the selection), the color and the maximum and minimum height of the model. The name is mandatory, the other features are set by default or not strictly necessary for creation. Clicking the button Create DTM at the bottom will close the window and generate the model in graphic.
The Invert command (Figure 4.1) allows the selection and inversion of two 3D faces.

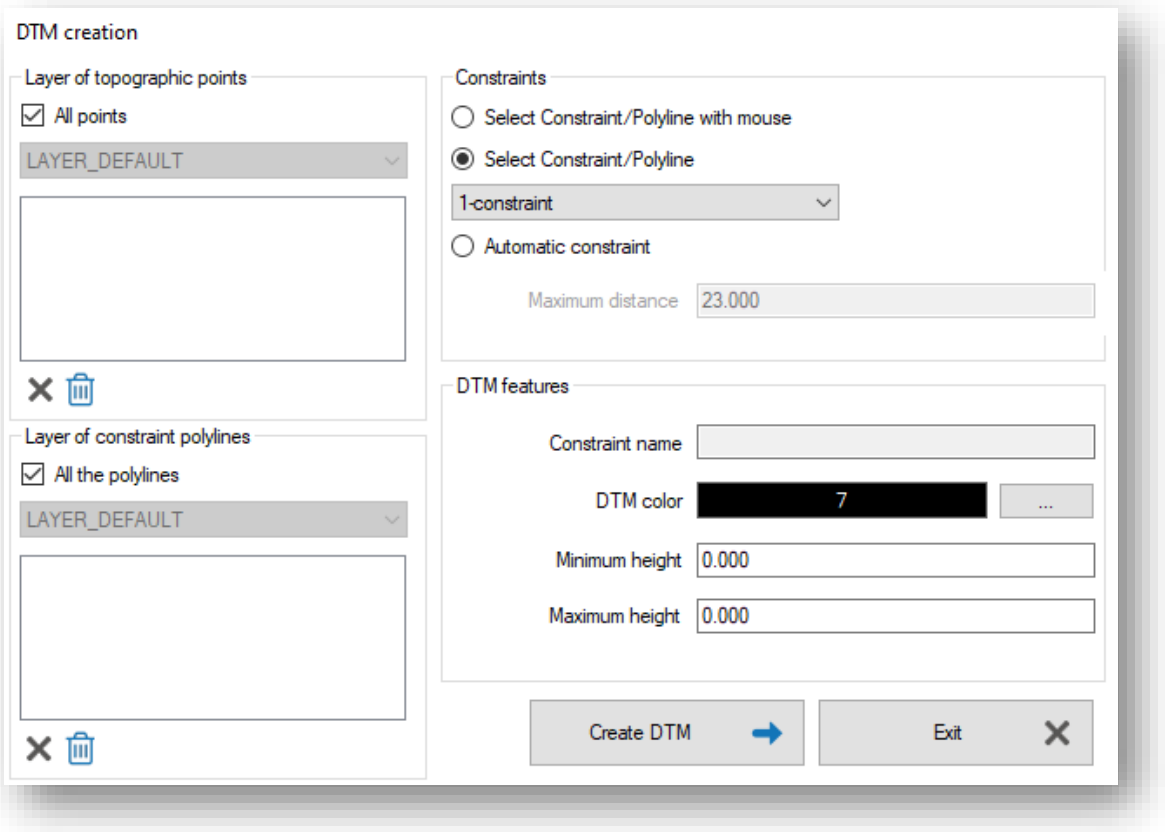


Figure 4.2

4.2 Contour lines

This function is composed of 5 commands, the first called Generate, opens a window as in Figure 4.3. For the creation it is possible to set the reference layer of the digital model on which you want to generate the curves, by default all the DTMs. On the left it is possible to set the distance between the major and normal curves, the colors and the layers to which they belong, in Figure 4.3 you can see the values that the program assigns by default if a setting is not made by the user. It is possible to draw the heights for the major curves (in this case it is possible to set the font and the size), at the bottom you can see other values as the elasticity factor of the curves, these values can be modified, in any case the program always proposes values consistent with current job.

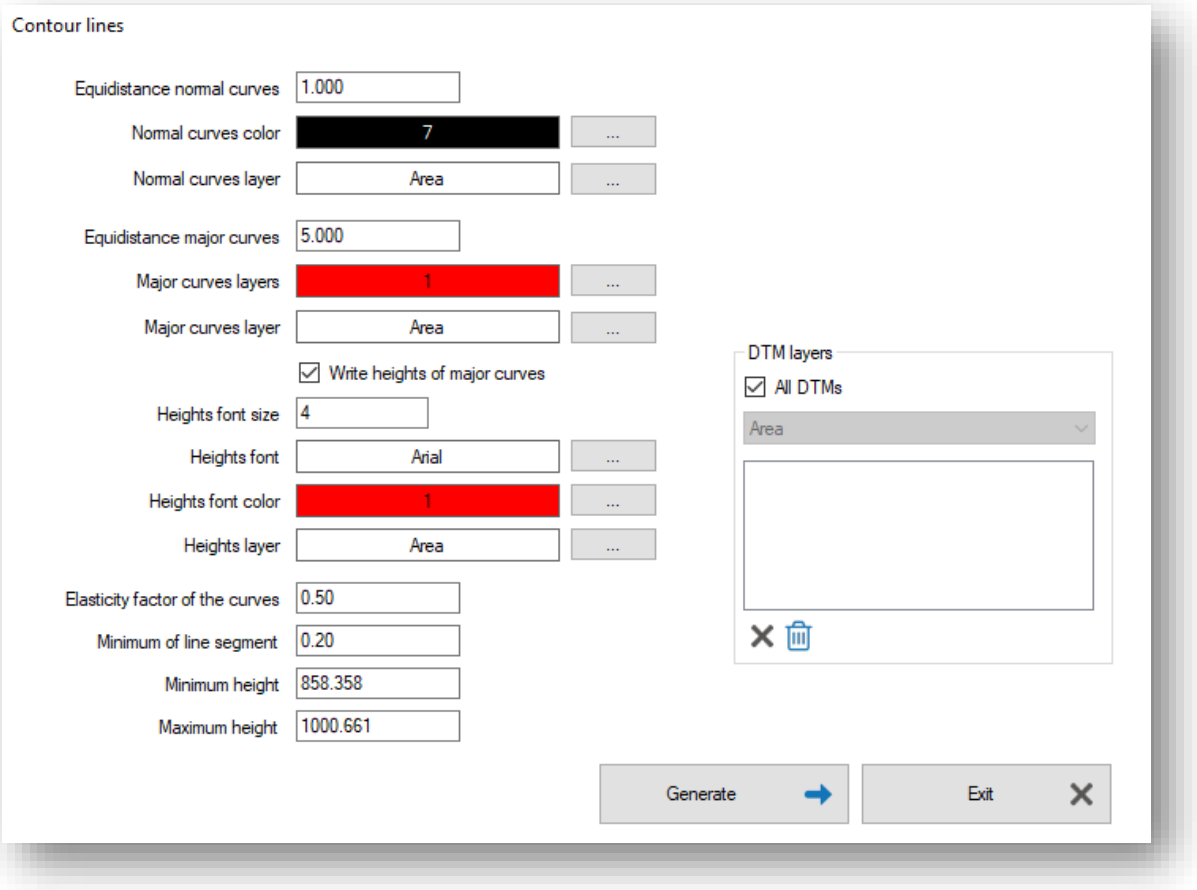


Figure 4.3

The second command in the Contour lines section opens a screen as in Figure 4.4. By clicking on the command, it will be necessary to select the curve or curves whose rounding is to be modified. Moving the blue indicator towards the + or - it is possible to evaluate the result of the modification in graphic.

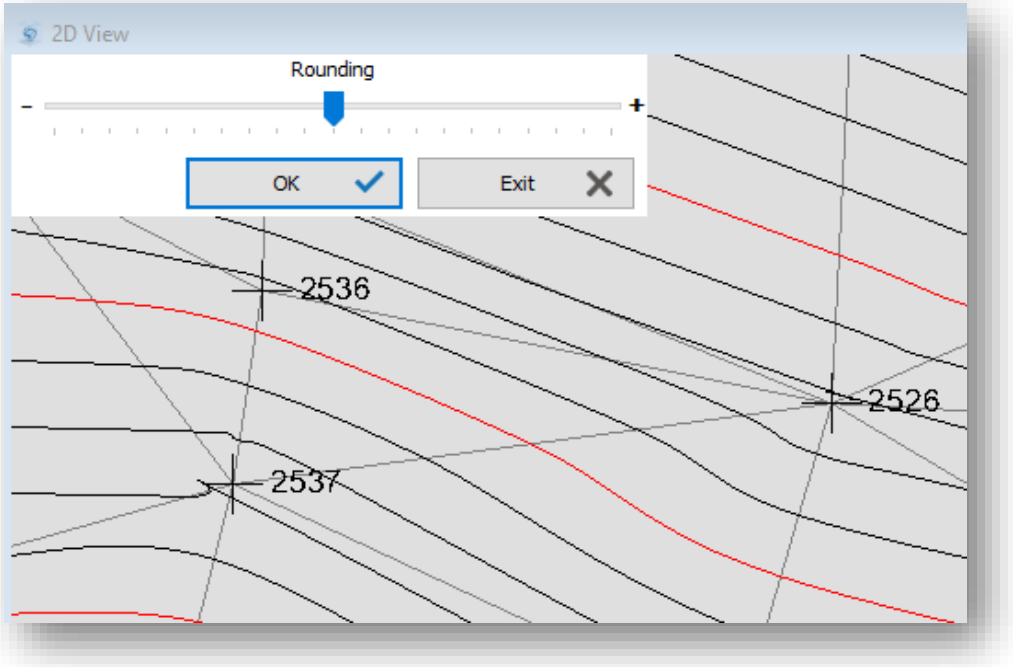


Figure 4.4

The last 3 commands in the Contour lines section are transformation commands from polylines to contour lines and vice versa or from polylines to b-spline curves.

4.3 Volumes

The Calculation of volumes command opens a window as in Figure 4.5. It is possible to set, on the right in the Layer section of the DTMs, which layer to consider for the calculation, by default all DTMs present in the current job are always selected.
Volumes can be calculated by setting a horizontal plane or 3D plane passing through 3 points. By default for the horizontal plane the lowest height of the DTMs will be shown, for the 3D plane the first 3 points of the DTM will be shown.

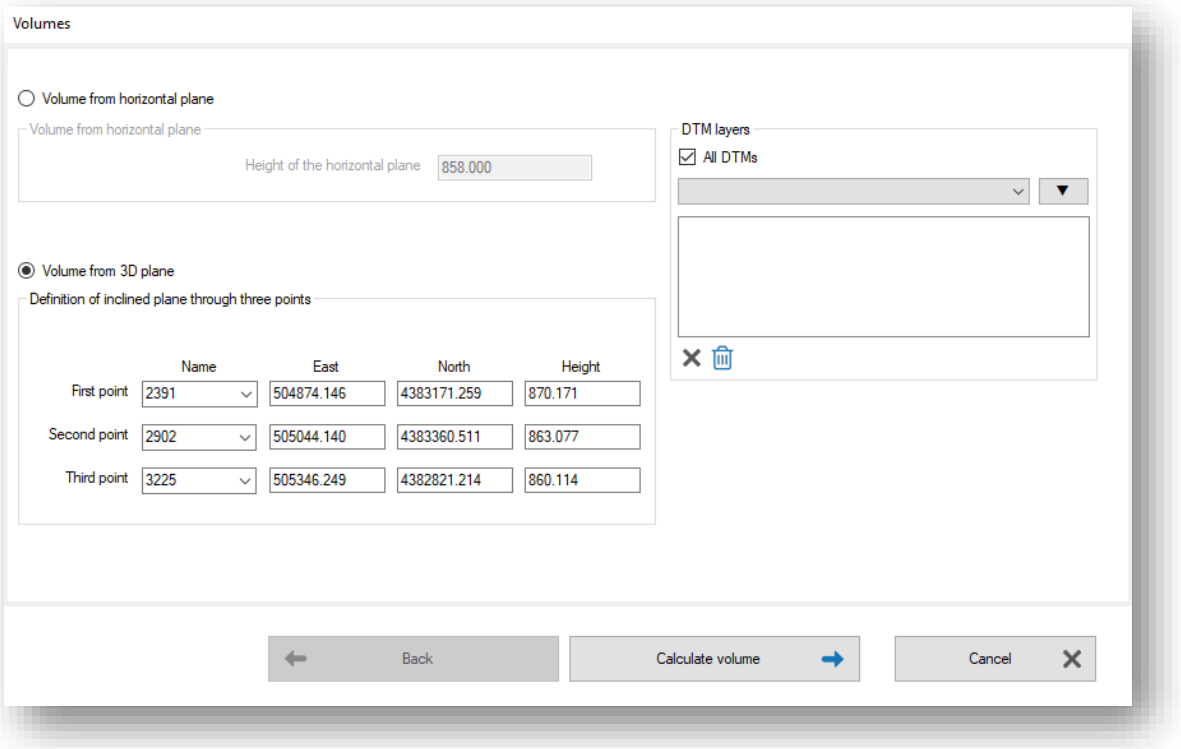


Figure 4.5

To proceed click on Calculate volume, the window in Figure 4.6 will be displayed. On the left side you can see the cut and fill volume expressed in cubic meters, the horizontal and 3D area, expressed in square meters.
It is possible to display (and possibly save in memory) the calculation report, the program proposes 3 possible reports, the first essential with the data that are displayed in the upper part of the window; the second detailed, in which for each 3D face the coordinates of the vertices are reported, the delta of the heights, the horizontal area, the 3D area, the volumes; the third with the 3D area, the horizontal area and the volume of each 3D face.

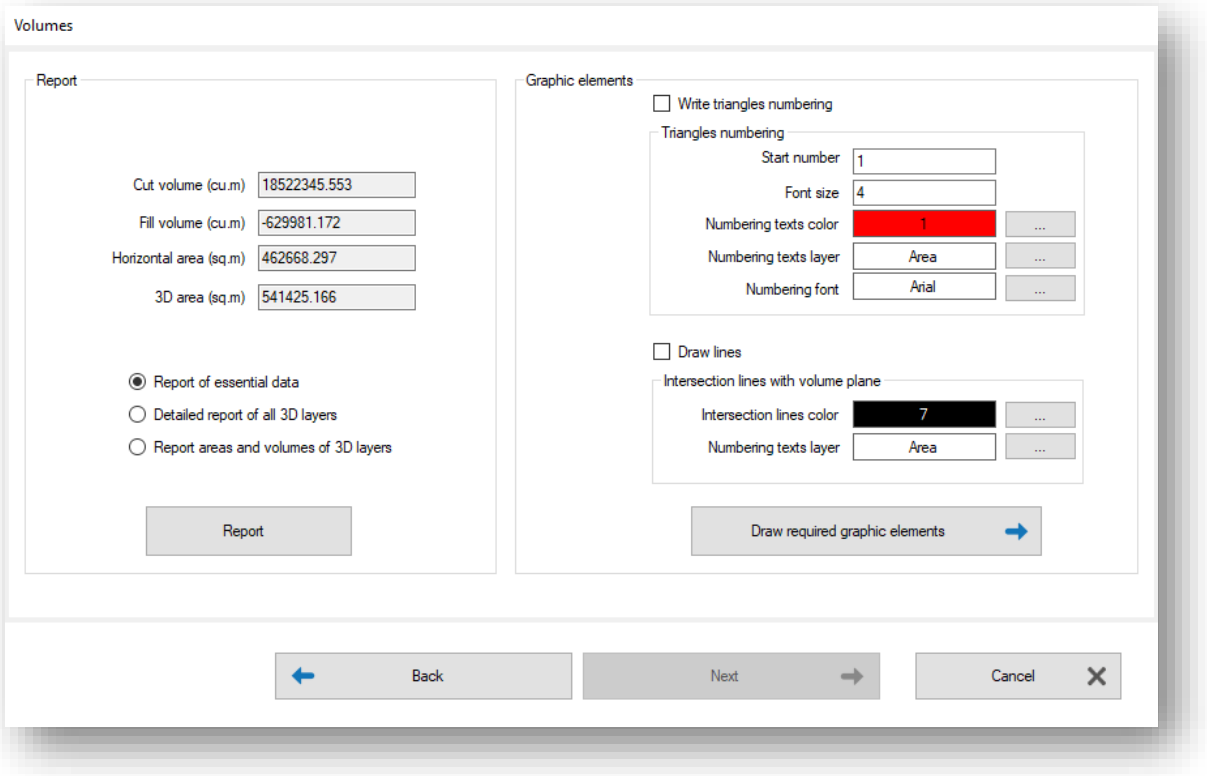


Figure 4.6

On the right side of the screen in Figure 4.6, it is possible to set the visibility and the graphic characteristics of the numbering of the 3D faces and of the intersection lines with the volume plane.

4.4 Profiles

The Create profile command has a drop-down menu as shown in Figure 4 7, from which you can select the desired functionality from those proposed.

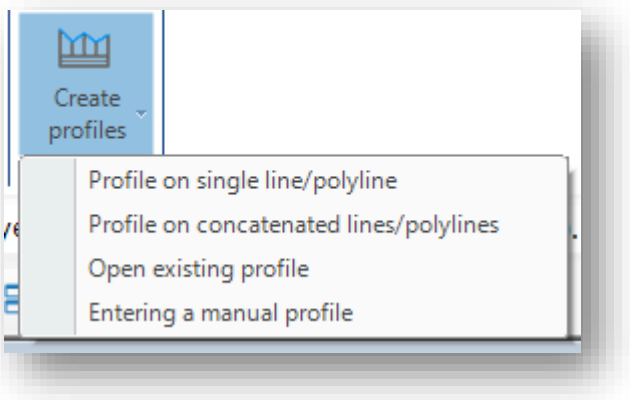


Figure 4.7

The selection of one of the first two functions - Profile on single line/polyline and Profile on concatenated lines/polylines – opens a window as in Figure 4.8, the difference between the two commands is simply on the type of entity (single or concatenated), on which you want to build the profile. In the second case the selection of a line or polyline causes all the lines/polylines that will have vertices in common to be selected and linked.
In the window in Figure 4.8, we find the first setting for the creation of a profile, as a first step it is necessary to select whether to build the profile on all the elements intersected by the line or only on the vertices. Another choice to make is if you want to insert topographic points, if yes, you will have to indicate if they must be inserted in all points intersected by the line or only on the vertices. The graphic elements related to the symbols, in the lower part of the window, are activated only if you want to insert topographic points.
Clicking the Create profile button takes you to the next profile management screen, to complete the creation settings (Figure 4.9).
This window is divided into two areas, the upper part shows the summary of the points/vertices that make up the profile, in the lower part you can see the graphic representation of the profile, moving the mouse on the profile, the selection of the point on the upper table, will change according to the position of the mouse. To save the profile click on the Save profile button, so a Cube-manager file with the .cubeprf extension will be stored.

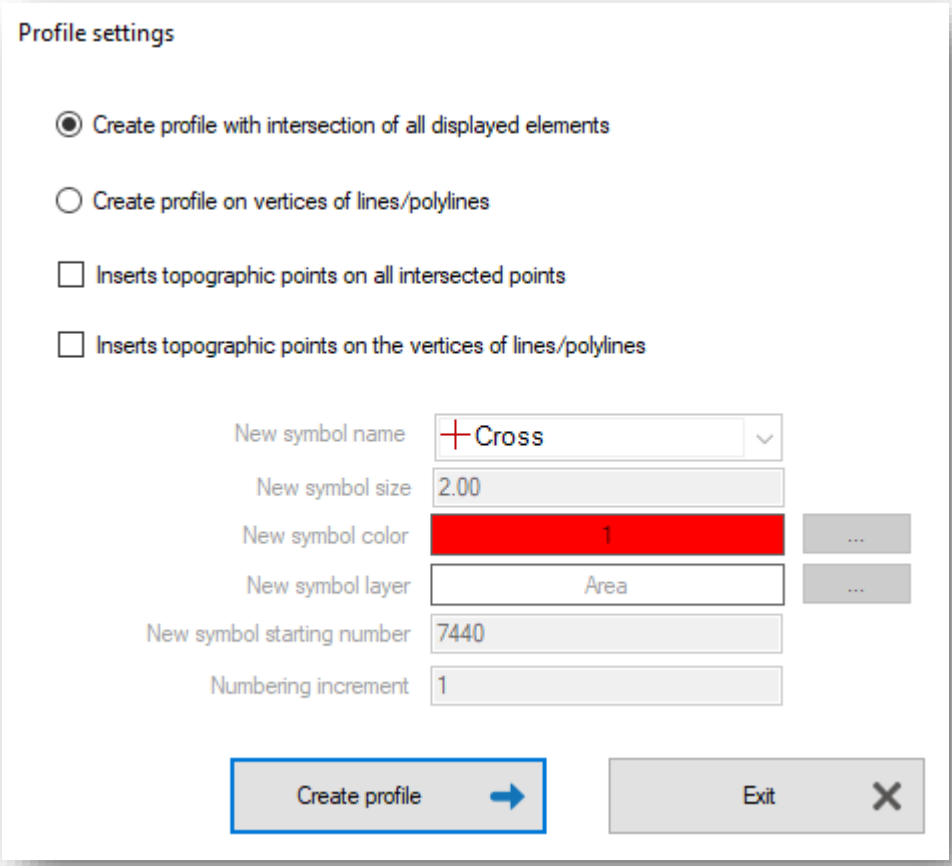


Figure 4.8

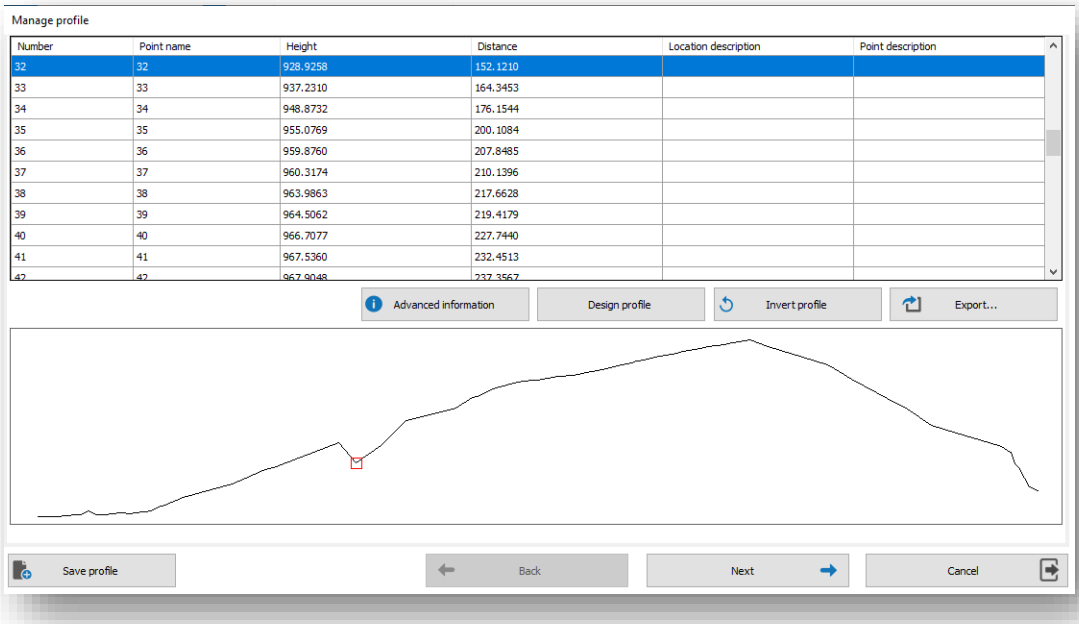


Figure 4.9

Between the two areas just described, there are some commands for the management of the profile, the first one called Advanced Information, if clicked it modifies the aspect of the summary table as in Figure 4.10. It thus passes from a visualization with essential information on the points of the profile to a detailed view. The Crossing column offers a drop-down menu, with default information that can be selected. All the other cells of the table, both in the essential and in the detailed one, if clicked generate a window as in Figure 4.11.

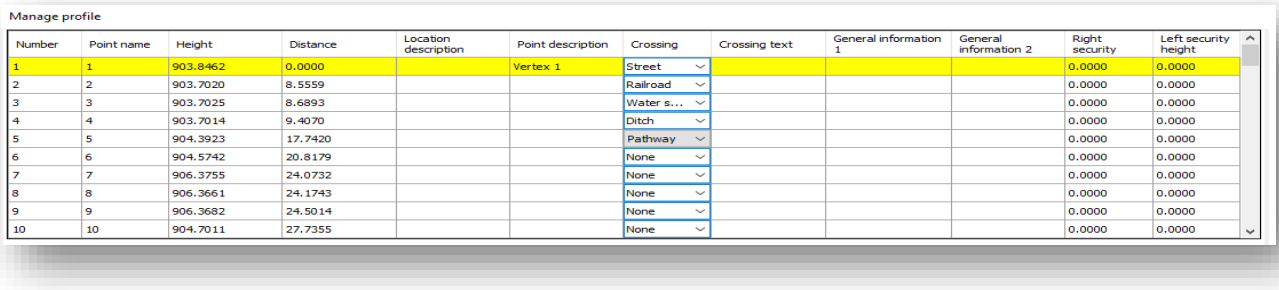


Figure 4.10

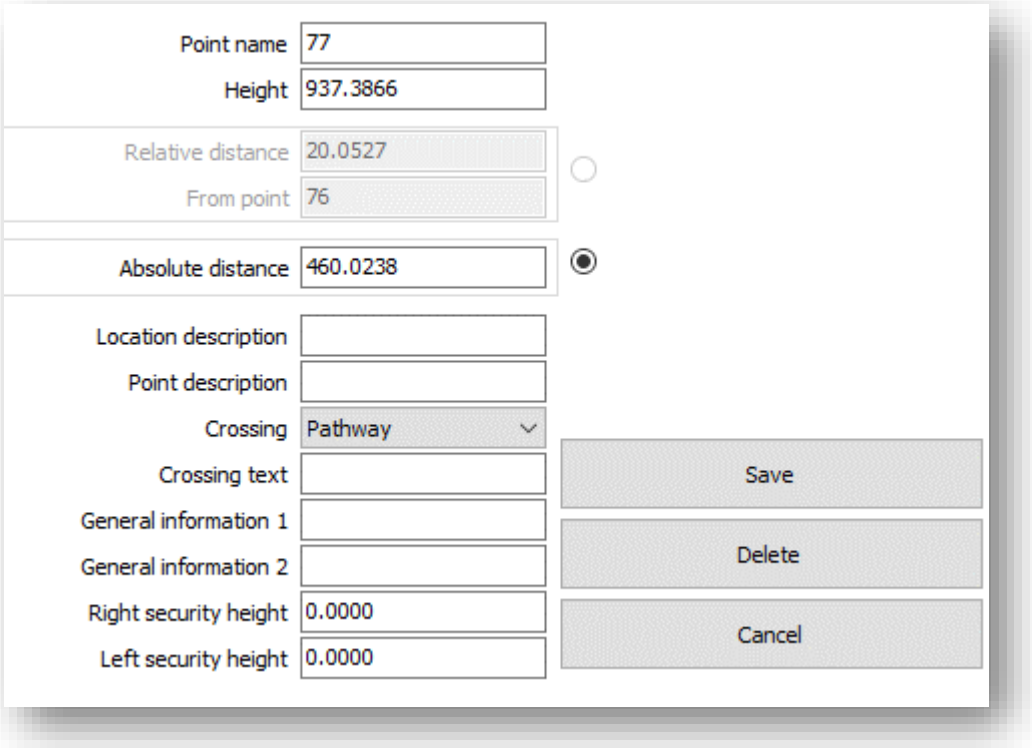


Figure 4.11

The window allows the modification of information on the points, to save the changes click the Save button.

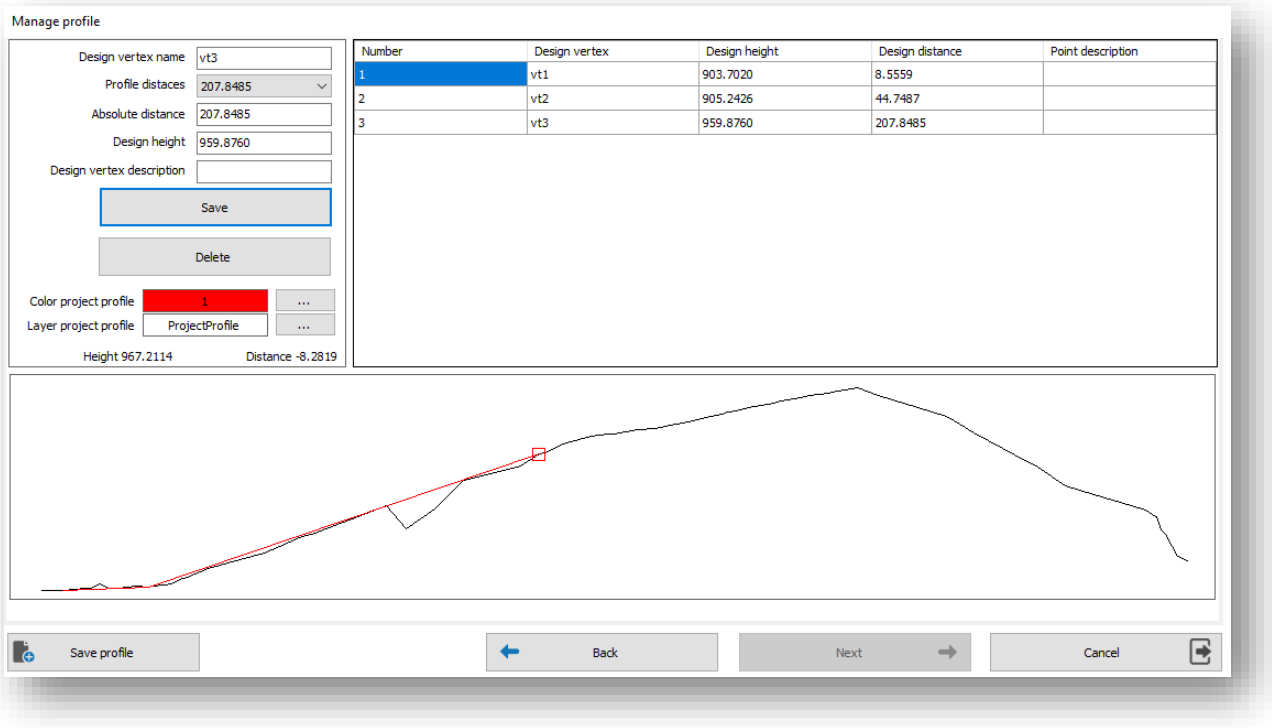


Figure 4.12

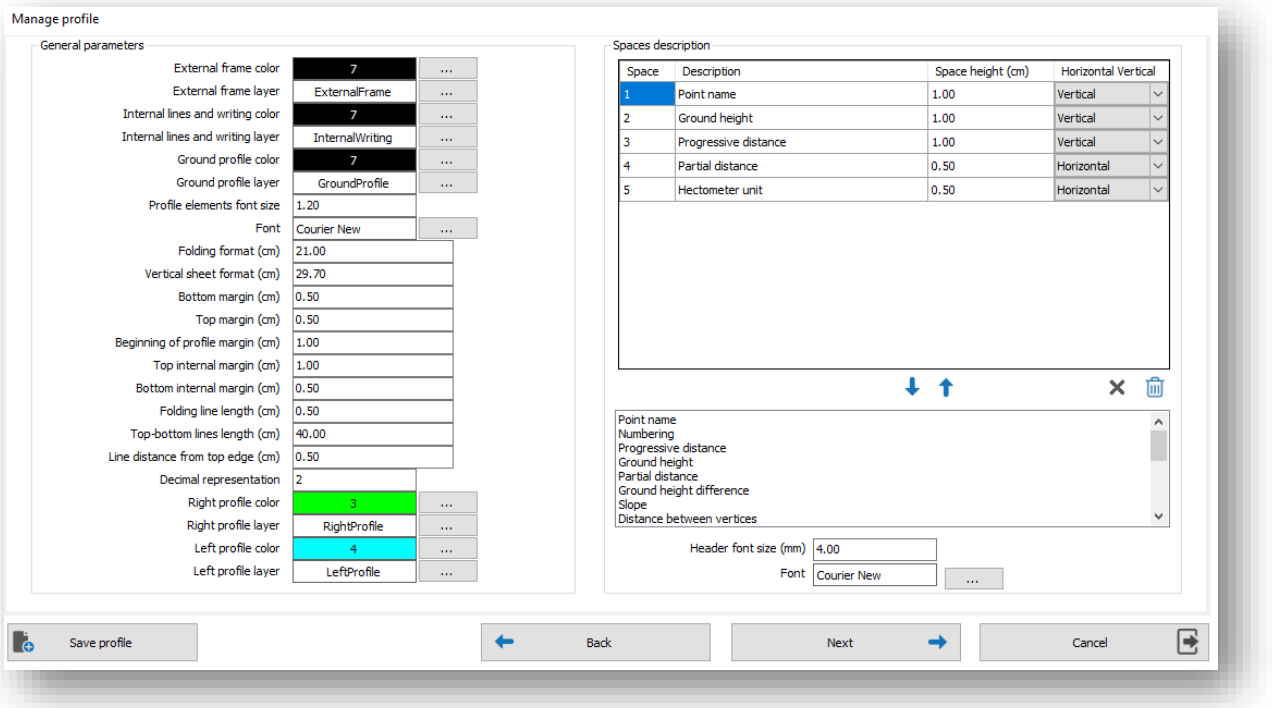


Figure 4.13

The Design profile command opens a window as in Figure 4.12. At the top left, the new vertices of the design profile can be entered and saved, those will be displayed in red at the bottom, in the graphics and shown in the table above. Click Back to return to the general profile management (Figure 4.9).
Returning to the commands in Figure 4.9, the Invert profile command performs an inverse ordering of the vertices of the profile, which will also be affected in the graphic display.
The Export... command allows the creation of a CSV (Comma Separated Values) file with a summary of the points that make up the profile.
By clicking the Next button, you can access the screen in Figure 4.13, where it is possible to continue to set the general parameters and profile descriptions. In the left part of the window we find the general parameters that are related to the graphic and profile print elements, they are always present with default values. In the right part you can set the descriptions that you want to report in the profile, the table above shows the ones that will be reported. These can be enriched by clicking on the list at the bottom to add new descriptions that will appear automatically in the table above. Selecting a description from the table, this can be repositioned with the help of the blue arrows or it can be removed from the table by clicking on the X, by clicking on the trash you can delete all the descriptions in the table.

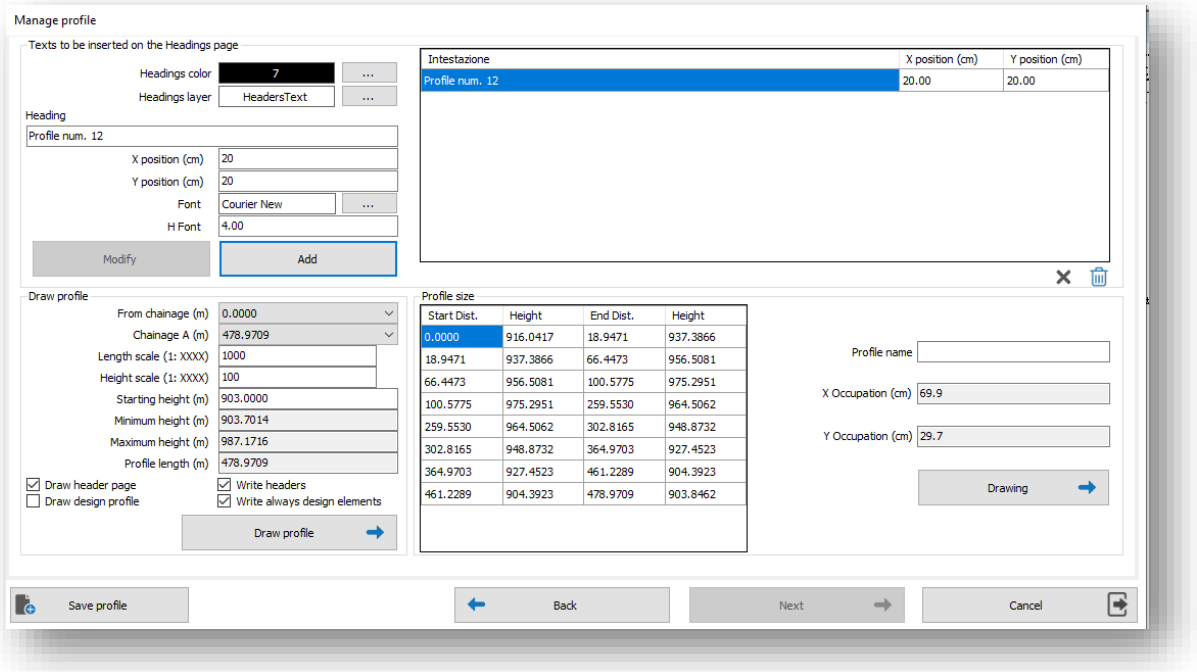


Figure 4.14

Clicking Next you access the window in Figure 4.14. This last screen will be useful to set the last settings before creating the profile in graphic. At the top of the window is the section relating to the profile header. The headings entered with the relative position will appear in the table on the right. In the lower part, we find the Draw profile section in which you can indicate the chainage of the profile you want to draw, the scales of lengths and heights. The

Draw profile command populates the table in the section of the profile size, which shows the expected height jumps in the required profile, after entering a name for the profile you can click on the Drawing button to proceed with graphic creation. In Figure 4.15 a profile is shown as it appears in the graphic after the creation, keep in mind that the starting project will be closed before drawing the profile, if you do not come from a .cubeprf file the program will ask if you want to save the project before closing it.

Going back to the commands in Figure 4.7, the Open existing profile command opens the profiles saved in Cube-manager with a .cubeprf extension.
The Entering a manual profile command enables a manual entry of the points that will create the profile (the window is like the one in Figure 4.11). The Save command adds the current point. To continue adding points click on the Add point command (Figure 4.16) which will appear below the points summary table. Once all the points have been entered manually it will be possible to work on the profile as indicated in the first part of this paragraph.

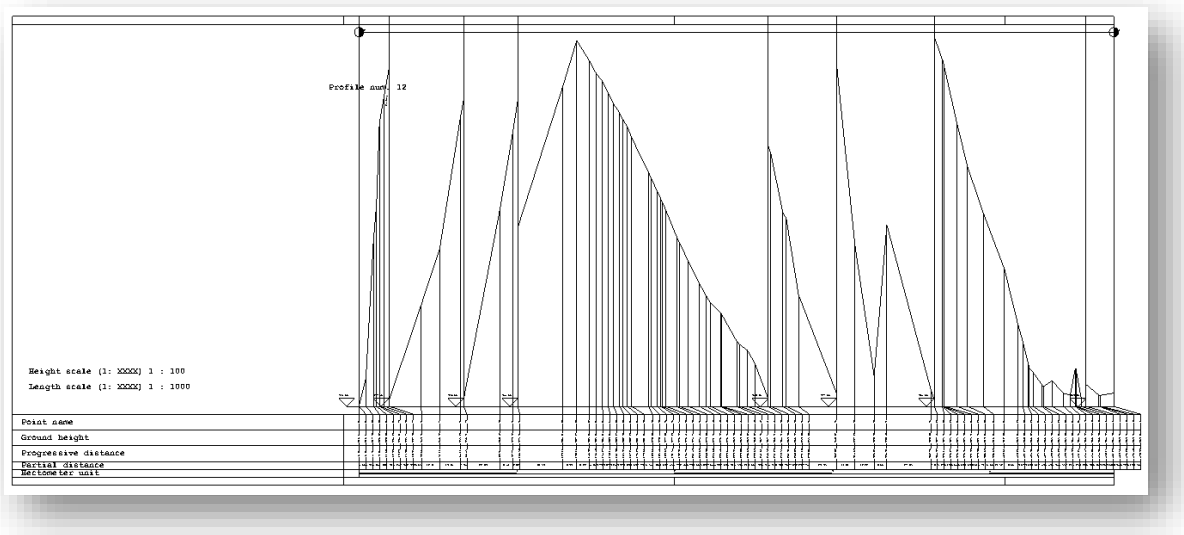


Figure 4.15

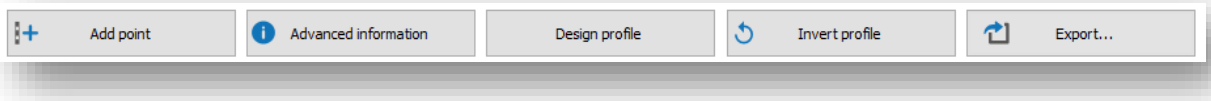


Figure 4.16

5 Raster (Module T)

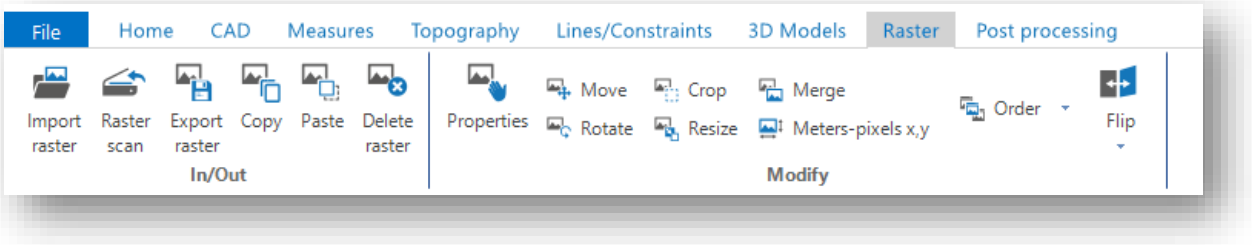


Figure 5.1

The Raster Tab provides the tools to work with raster images (Figure 5.1). This section is divided into two subsections: In/Out and Modify.
In the first part there are the commands Import raster and Delete raster which are available for all modules. The formats supported both in import and in export are: BMP; GIF; EXIF; JPG; PNG; TIF; TIFF.
The first command in the Modify section is Properties, the window is the one shown in Figure 5.2.

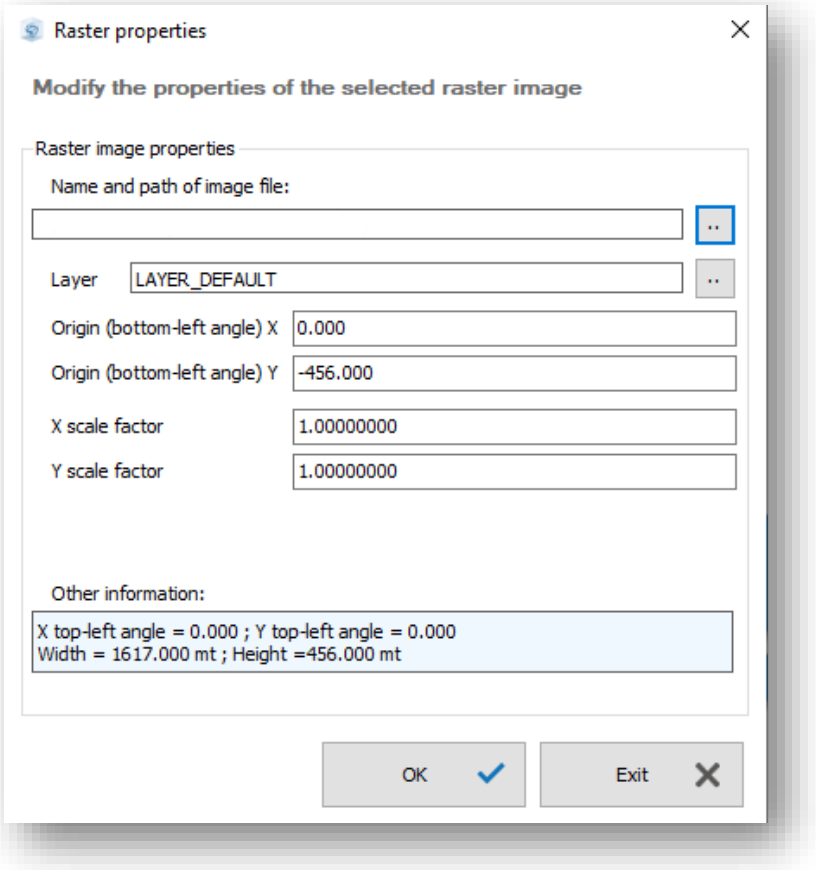


Figure 5.2

With this command you can read and modify the graphic properties of a selected raster image.
The Move, Rotate and Crop commands, after selecting an image and a starting point, will allow you to see a preview of the change as in Figure 5.3.
The commands Resize and Meters-Pixels x,y, will be executed from the command line, the appearance will be similar to the one in Figure 5.4 (Resize command).

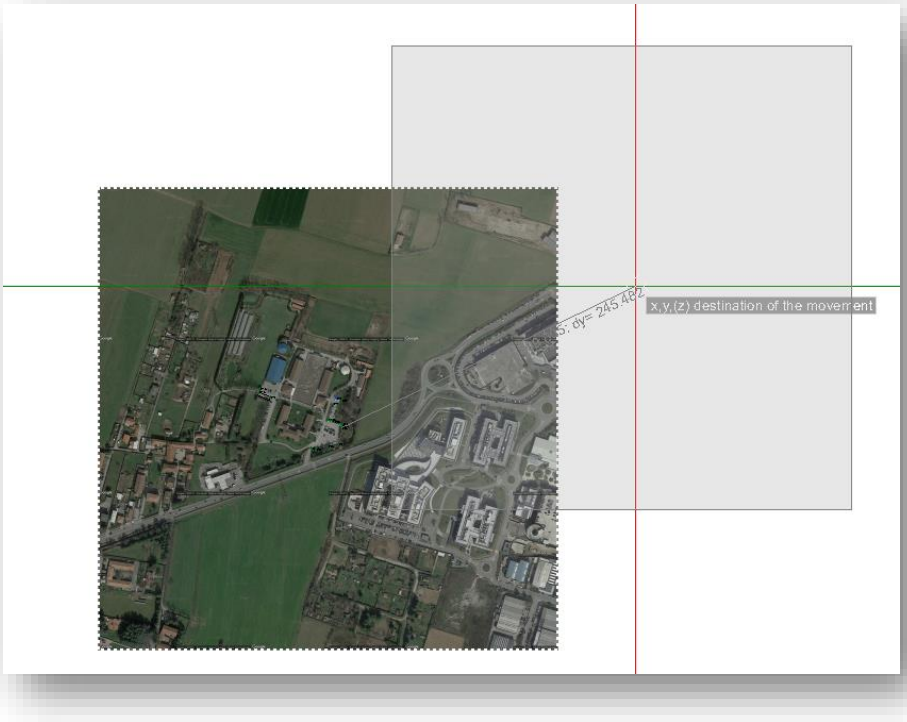


Figure 5.3

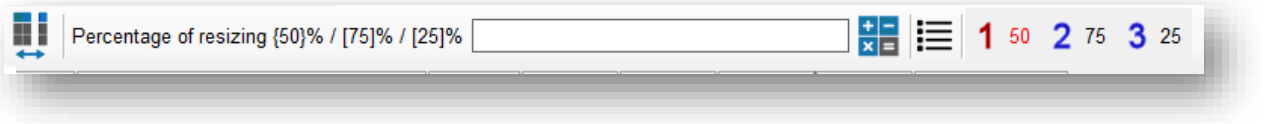


Figure 5.4

The Merge command allows the merging of two images, the graphic result will be assigned to the selected image but the original will not be modified, a new image will be created by saving the current project.

The last two commands, Order and Flip, both have a drop-down menu composed of two elements: Bring to front – Send to back for the First Command; Vertically - Horizontally for the second command. Selecting the image will make the selected function effective.

6 Post-processing (Module P)

To perform a postprocessing click on the Postprocessing tab (Figure 6.1), and then select the type of operation to be performed from those available: Stop&Go, Kinematic, Single Static single (with sigle base), Multiple Static and Network.

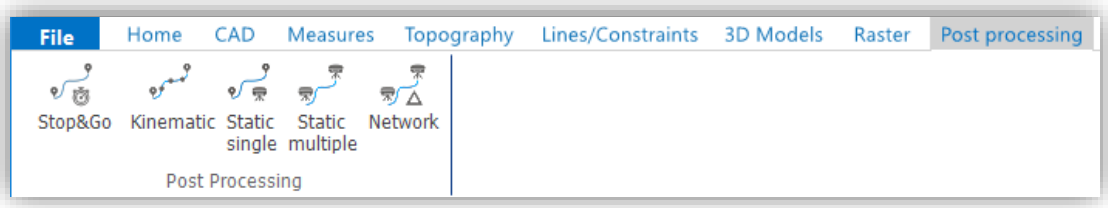


Figure 6.1

6.1 Stop & Go calculation

Before describing the functions of this section, we provide an example of a circumstance for which it would be useful to generate a Stop & Go calculation. For example, having a job performed in RTK mode, there may be points that are not affected by these corrections, thus remaining in single or float or GPS mode. The calculation can attribute to these points a correction such as to bring them back to the fixed mode. It is necessary for a good success of the differential calculation that these points have been detected for a time that can generally be positioned between 15 s and 30 s, the minimum acquisition time depends on the instrument used and the reference base. An acquisition time between 15 s and 30 s means having between 15 and 30 common epochs, between the base and the Rover. If the acquisition frequency is lower than 1 Hz, the acquisition time must be proportionately greater. For example, acquiring every 5 s, to have 30 common epochs, it is necessary to stand for 150 s.

Let's look at the working phases of a Stop & Go calculation: as a first operation, we remind you that it is necessary to set a correct reference system in the program, in order to obtain valid results. To perform a Stop & Go calculation, you must first upload a GPS job in the active project, using one of the import functions provided by the application. The first question that is asked is if you want to consider also the RTK fixed points in the calculation (this operation can be used to compare the fixed positions, with the postprocessed positions). The next screen (Figure 6.2) shows a table with a summary of the fieldbook involved in the job, the points list, the instrumental heights, the starting time, the occupation time and the status of the points surveyed. The possible actions in this phase by the user are the selection or deselection of the points to be involved in the calculation and the modification of the instrumental heights.

At the bottom of the screen, it will be necessary to confirm whether the value regarding the pole height, reported in the RINEX file, has been recorded at the base of the antenna or at the phase center. This choice is necessary and must be made with care so as not to invalidate the subsequent calculations.
For the Stop & Go calculation, the user can control the workflow manually, from the second screen onwards it is possible to advance or go back with the buttons with the arrows at the bottom (Figure 6.2).

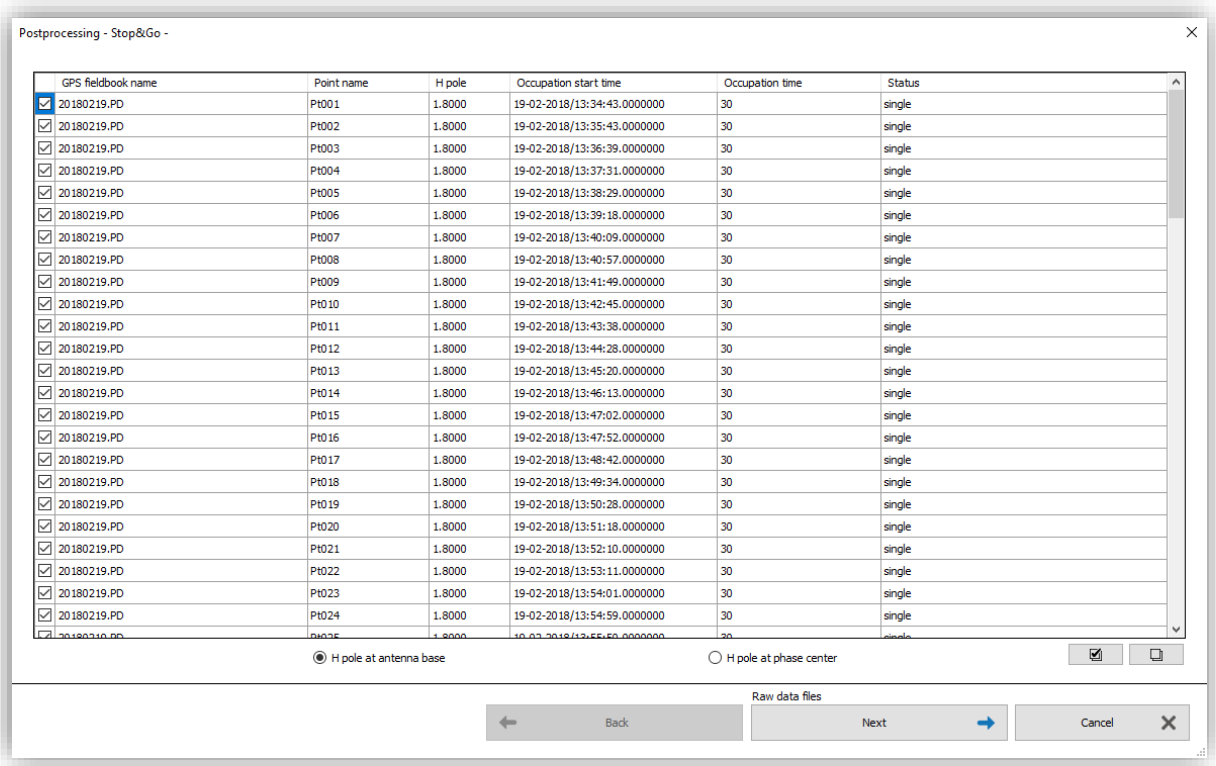


Figure 6.2

The next step, after displaying the summary table of the points to be calculated, is shown in the screen in Figure 6.3.
In this phase you will have to select a raw data file produced in the field and related to the GPS survey present in the project (the program supports also the multi-selection of raw data files). The raw data formats supported (both for the Rover and for the Base) are, as binary format:
* .dat (for all receivers in the Stonex range, except for S4H2) and * .log (for the S4H2 receiver); regarding the RINEX format: V2 and V3 uncompressed or compressed (Hatanaka).
The selection of the Base file (produced by another GPS or by a permanent station) generates the opening of a screen like the one in Figure 6.4, where it will be possible to read the coordinates (it is possible to display the measurement of the coordinates at the phase center or on the ground). The user can decide to enter the coordinates of the base manually or ask

the application to recalculate them; you can also enter the antenna height and set the coordinate format.
Selecting the base RINEX file also causes the auto-selection of the navigation files in the same folder (it is also possible to manually import the files). The program supports specific files for each constellation, or mixed.
The raw files and the navigation files just imported can be selected or deselected from the relative tables; furthermore, by clicking on the button with the X icon on the lower left side, all the imported files can be deleted.
At the bottom you can see a window showing the occupations of the imported files, which is updated with the addition of a new file, the numbers at the top indicate the time interval of the imported files (and the GPS work present in the project).

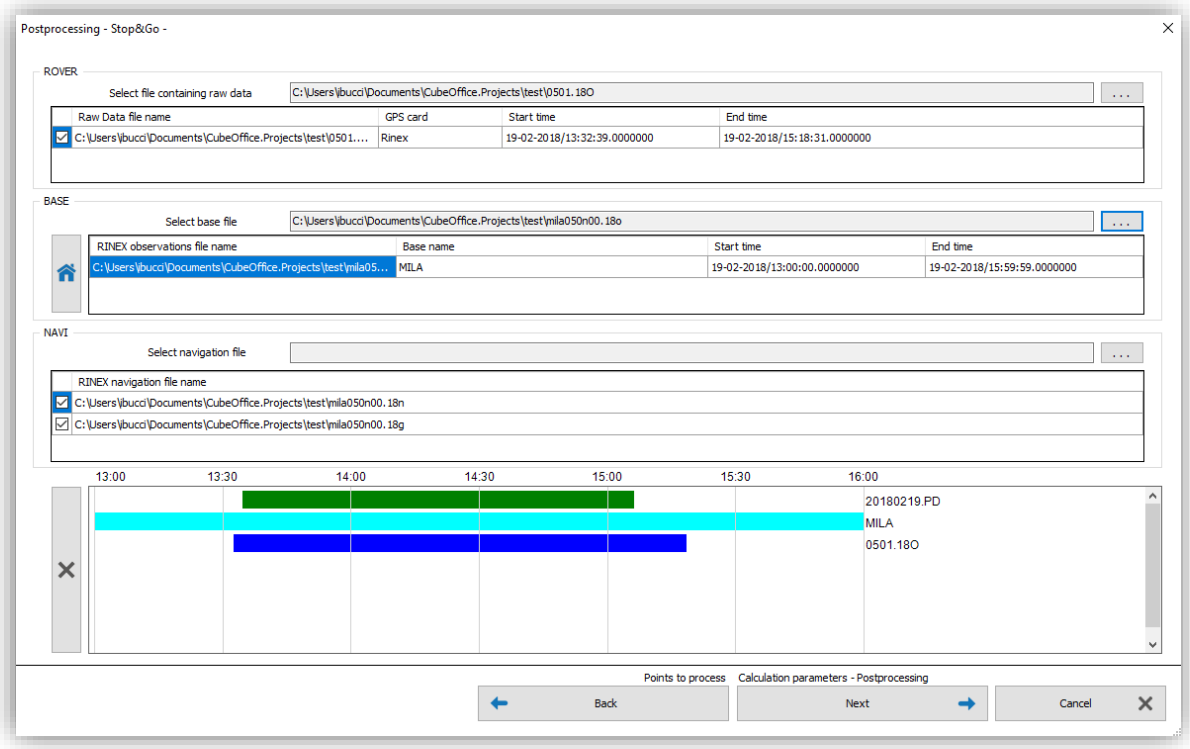


Figure 6.3

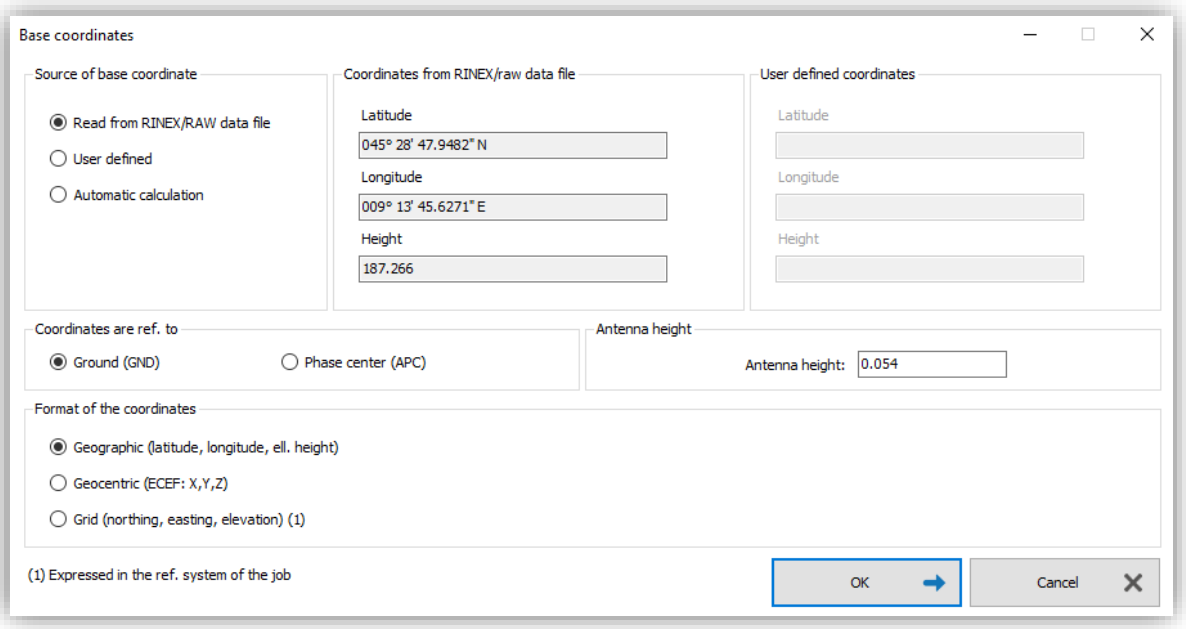


Figure 6.4

Pressing Next, you will see the screen in Figure 6.5, where it is possible to set the parameters useful for the calculation. In this screen it is possible to select the constellations to be considered for the calculation (N.B. the GPS constellation cannot be deselected).
An observation method can also be assigned, the check on the Code cannot be deselected.
In the Other options group, it is possible to define the elevation values (recommended 15 degrees), the minimum coefficient of resolution of phase ambiguity (the recommended value is 2) and minimum signal-to-noise ratio (the recommended value is 35), this last value can be assigned to the Rover and / or Base.
In the current version, broadcast Ephemerides are used, and precise Ephemerides are not activated.
In the lists of satellites used, the satellites used for the calculation can be selected or deselected, the undo button at the top right restores the starting situation with all the selected satellites. The Restore default values button restores the values of all the other parameters.
Once the desired parameters have been set, it is possible to proceed with the calculation by clicking on the button Perform post-processing calculation, the calculation can be interrupted by clicking on the Stop button (when the calculation is running, the window in Figure 6.6 will appear on the main screen).

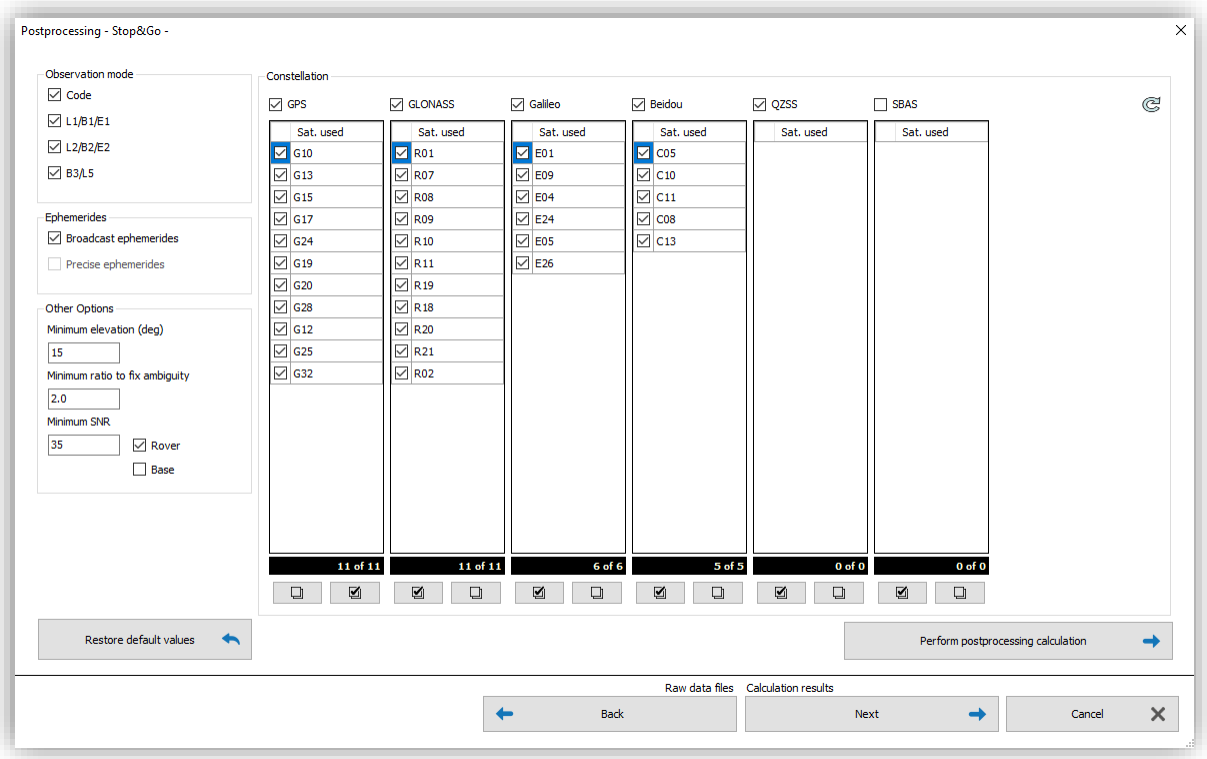


Figure 6.5

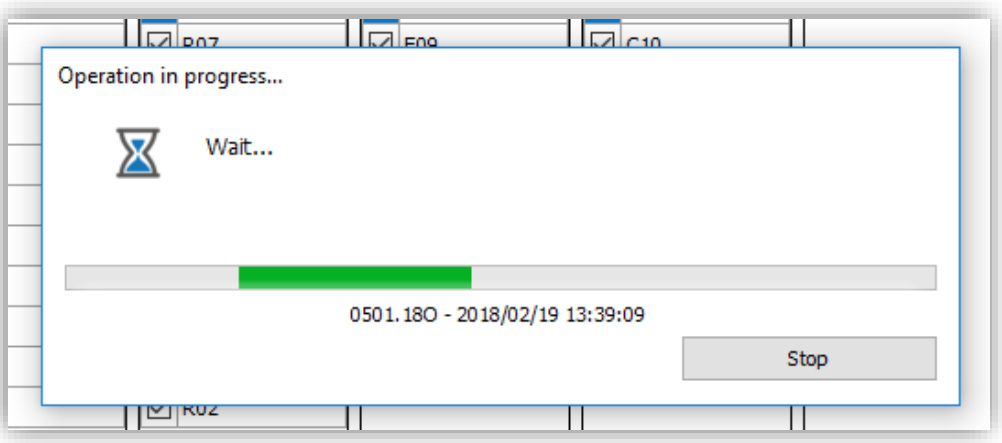


Figure 6.6

The end of the calculations generates the Calculation Results page (Figure 6.7), where a table is shown with the list of calculated points. The columns of the table provide useful information on the points, it will be possible to view the coordinates measured for each point, the correct coordinates and the standard deviations. The state of the points is highlighted by the alternation of the colors between the lines (fixed, SBAS and DGPS in white; float in cyan; PPP in yellow; single in orange).
At the bottom-left of the screen you can see a statistical summary of the calculated points, while at the bottom-right you can filter the points that will be reported in the job (eg based

on the state or based on the values of the standard deviation, in this case the points above the set value will not pass the filter).
Before completing the work, you can produce a report of the calculation results. With the End Job button you will generate a window (Figure 6.8) in which you can specify whether for the calculated points you want to generate a new fieldbook (the calculated points will have a prefix in the name: 'postp_', preset but editable), or if you want to replace the points previously imported in the project and visible in the graphic.

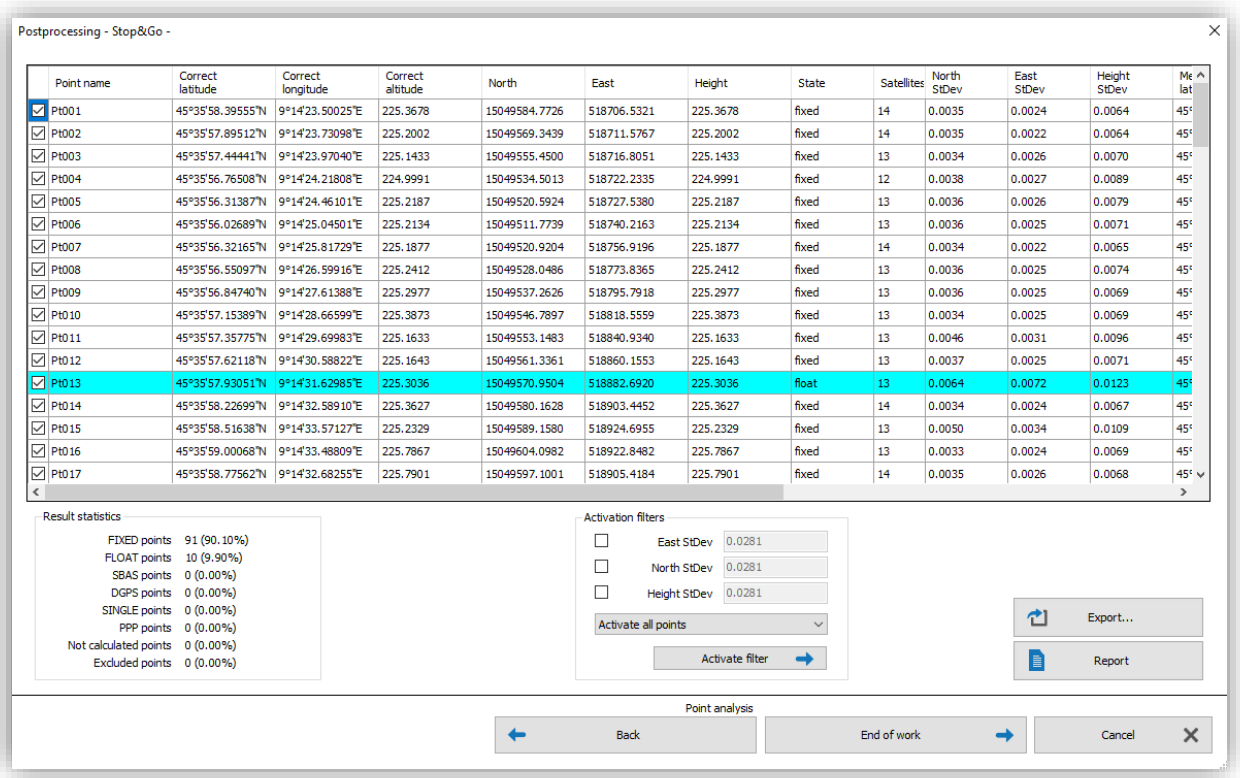


Figure 6.7

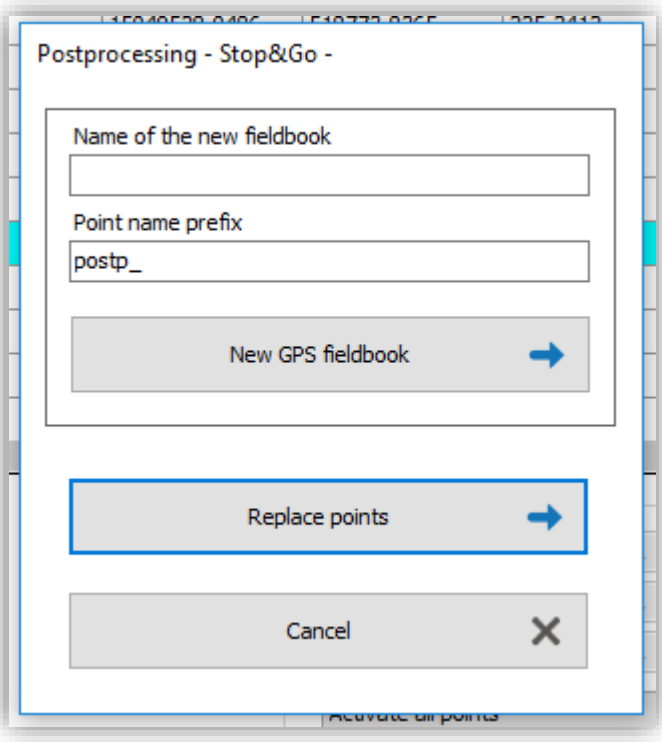


Figure 6.8

Before finishing and saving the work it is also possible to intervene with advanced settings on the points, in order to correct and improve the calculation. These correction functions can be accessed with the buttons with the arrows at the bottom (Figure 6.7).
Clicking the Back button, you can access the Point Analysis screen (Figure 6.9), this function allows you to work and perform the calculation on single points. Points can be selected from the list on the left; on the right you can see the epochs and satellites used (the change of epoch is highlighted by the alternation of colors yellow-white).
At the bottom-left, satellite readings can be enabled or disabled relative to the selected point. Save point configuration and recalculate button will lead on the page of calculation parameters for possible corrections on the settings and will execute the calculation only on the selected point. The application will then show the new calculation results, related to the modified point.
If you go back to the Point Analysis screen and have already performed calculations on single points, the list on the left will show an identification symbol. The icons on the left, in the X-icon and bin-icon will respectively cancel a single configuration, or to delete them all.

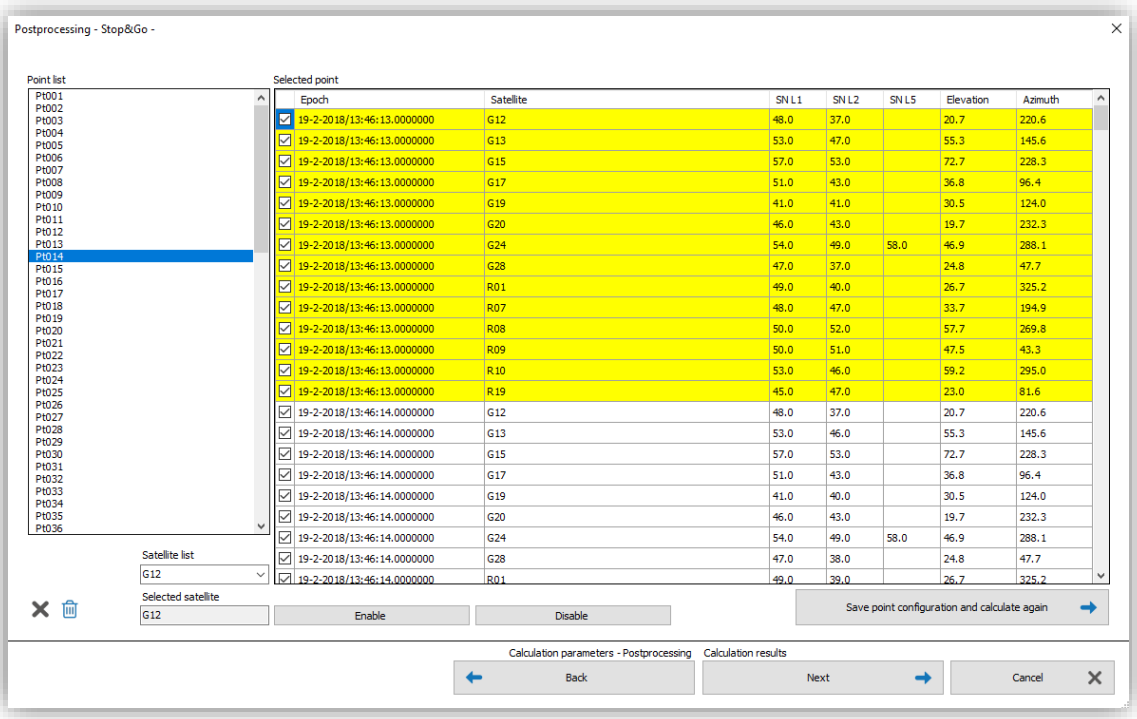

Postprocessing - Stop&Go -
Point list
Pt001
Pt002
Pt003
Pt004
Pt005
Pt006
Pt007
Pt008
Pt009
Pt010
Pt011
Pt012
Pt013
Pt014
Pt015
Pt016
Pt017
Pt018
Pt019
Pt020
Pt021
Pt022
Pt023
Pt024
Pt025
Pt026
Pt027
Pt028
Pt029
Pt030
Pt031
Pt032
Pt033
Pt034
Pt035
Pt036
Satellite list
G12
Selected satellite
G12
Selected point
Epoch
Satellite
SN L1
SN L2
SN L5
Elevation
Azimuth
19-2-2018/13:46:13.0000000 G12 48.0 37.0 20.7 220.6
19-2-2018/13:46:13.0000000 G13 53.0 47.0 55.3 145.6
19-2-2018/13:46:13.0000000 G15 57.0 53.0 72.7 228.3
19-2-2018/13:46:13.0000000 G17 51.0 43.0 36.8 96.4
19-2-2018/13:46:13.0000000 G19 41.0 41.0 30.5 124.0
19-2-2018/13:46:13.0000000 G20 46.0 43.0 19.7 232.3
19-2-2018/13:46:13.0000000 G24 54.0 49.0 58.0 46.9 288.1
19-2-2018/13:46:13.0000000 G28 47.0 37.0 24.8 47.7
19-2-2018/13:46:13.0000000 R01 49.0 40.0 26.7 325.2
19-2-2018/13:46:13.0000000 R07 48.0 47.0 33.7 194.9
19-2-2018/13:46:13.0000000 R08 50.0 52.0 57.7 269.8
19-2-2018/13:46:13.0000000 R09 50.0 51.0 47.5 43.3
19-2-2018/13:46:13.0000000 R10 53.0 46.0 59.2 295.0
19-2-2018/13:46:13.0000000 R19 45.0 47.0 23.0 81.6
19-2-2018/13:46:14.0000000 G12 48.0 37.0 20.7 220.6
19-2-2018/13:46:14.0000000 G13 53.0 46.0 55.3 145.6
19-2-2018/13:46:14.0000000 G15 57.0 53.0 72.7 228.3
19-2-2018/13:46:14.0000000 G17 51.0 43.0 36.8 96.4
19-2-2018/13:46:14.0000000 G19 41.0 40.0 30.5 124.0
19-2-2018/13:46:14.0000000 G20 46.0 43.0 19.7 232.3
19-2-2018/13:46:14.0000000 G24 54.0 49.0 58.0 46.9 288.1
19-2-2018/13:46:14.0000000 G28 47.0 38.0 24.8 47.7
19-2-2018/13:46:14.0000000 R01 49.0 39.0 26.7 325.2
Enable
Disable
Save point configuration and calculate again
Calculation parameters - Postprocessing
Calculation results
Back
Next
Cancel

Figure 6.9

6.2 Static calculation with single base

The Static is a calculation that assumes to obtain a much greater precision than the Stop & Go, in fact the points surveyed in static mode in the field have been acquired for a time of some minutes or hours, occupation much higher than the one needed for the Stop & Go. The first working window, if you choose to perform a Static calculation, will give you the possibility to select one or more raw data files that correspond to static surveys performed in the field by the operator (Figure 6.10).

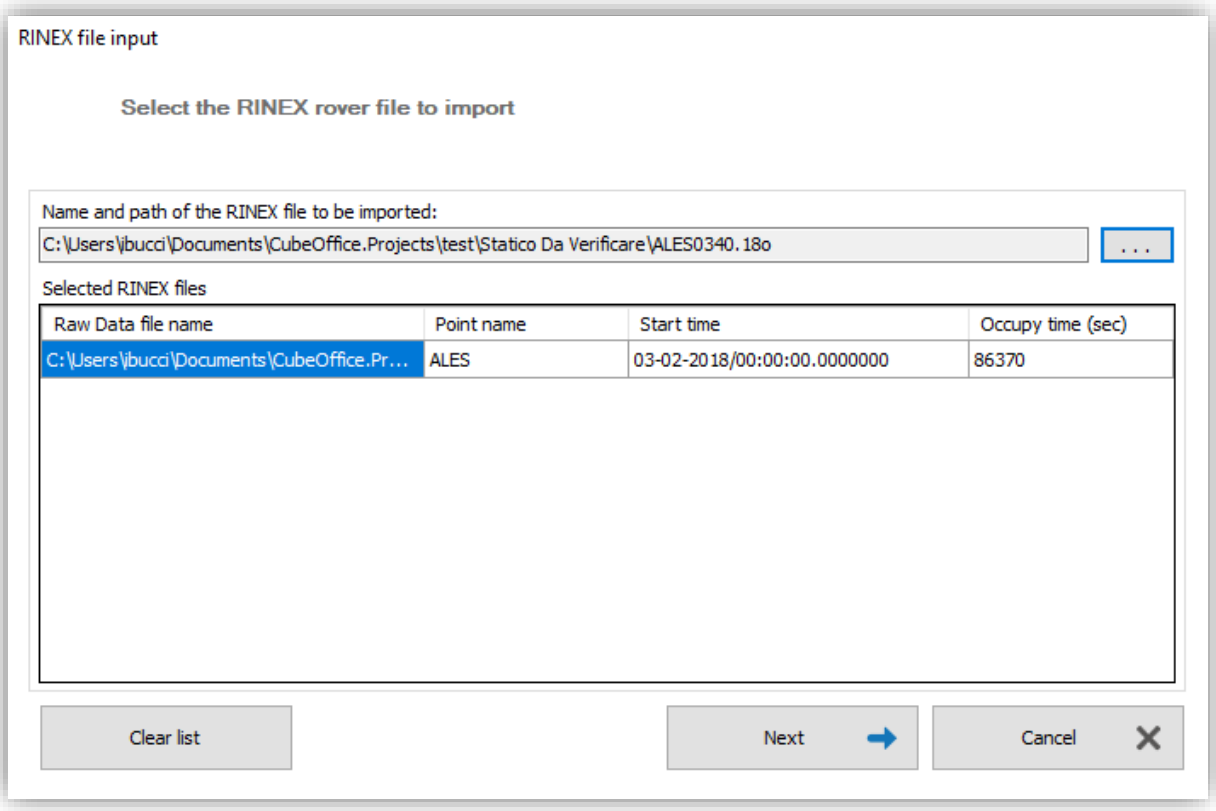


Figure 6.10

The processing screens, after clicking the Next button, are like those encountered in the case of the Stop & Go calculation. The following screen, the selection of the raw files, will allow the selection of the base file (the top section relating to the selection of raw files, is active only in Stop & Go mode). Please refer to the previous paragraph for the description of the processing steps, for the user they will look the same but of course the calculations will be carried out by the application in a different way. At the top, the window title, after the word Postprocessing there will always be the title of the selected calculation. The recommended parameter configuration, in the case of the Static calculation, is the following: elevation value, 10 degrees; minimum coefficient of resolution of phase ambiguity, 3; minimum signal-to-noise ratio, 30.

The final processing phase will end with a window where it will be possible to name and save a fieldbook with the results of the calculation performed (Figure 6.11).

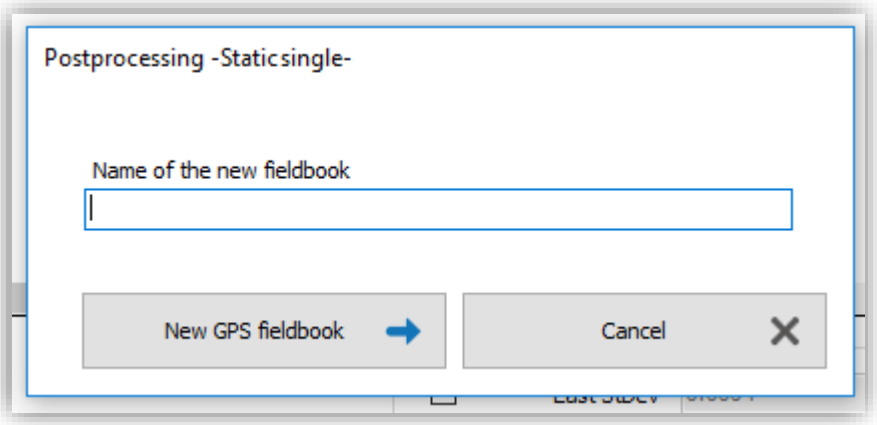


Figure 6.11

To save the project as a *.cubemgr file makes possible to perform the static calculation on other observation files, later in time. This option has been made available to have the possibility to create a project extended over time, adding the new fieldbook that will be calculated, to the already existing one.
To add new calculated points to an existing fieldbook, simply reopen the saved project and click on the single Static command to perform the calculation, Cube-manager will automatically ask if you want to continue working on the current project without creating a new one.

6.2.1 Satellite analysis

When performing a post-processing, it is always possible to analyze the satellites of the base or the bases and rovers.
This function can be activated by clicking on the occupancy bars, visible before the screen to set the calculation parameters (Figure 6.12).
Clicking on one of the occupation bars will cause the calculation parameters screen to open, where the Satellite analysis command will be active (Figure 6.13).
To carry out the analysis of the satellites, simply click on the command Satellite analysis, the screen is shown in Figure 6.14. It will thus be possible to observe the graphic representation of code, frequencies, elevation, noise signal, divided by satellite.

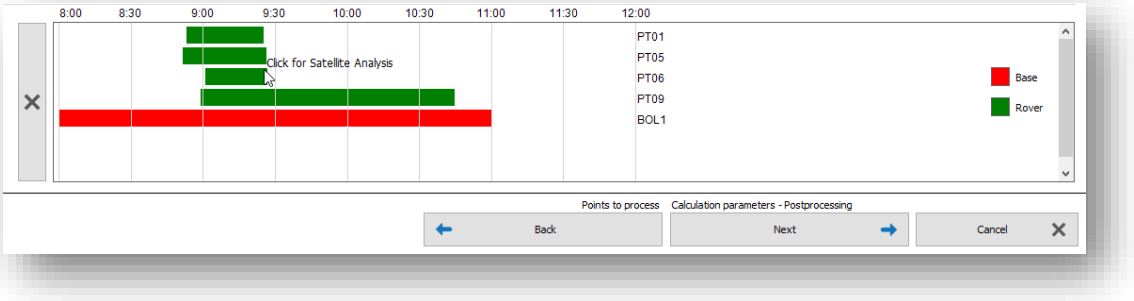


Figure 6.12

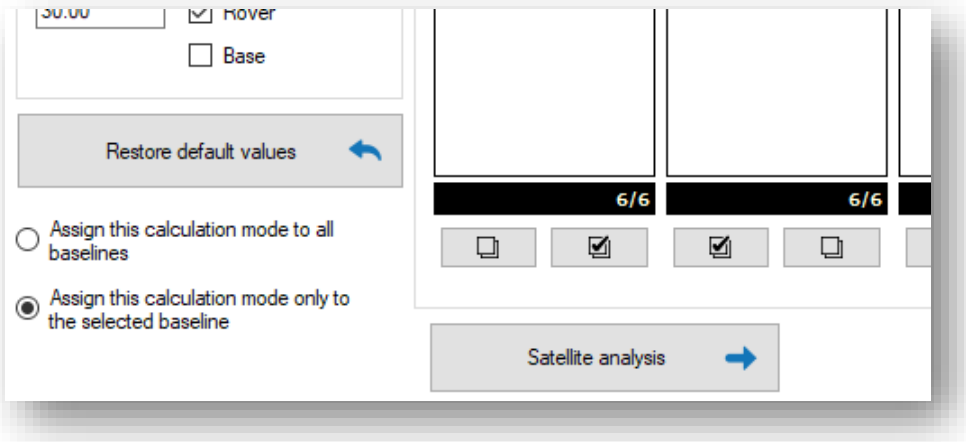


Figure 6.13

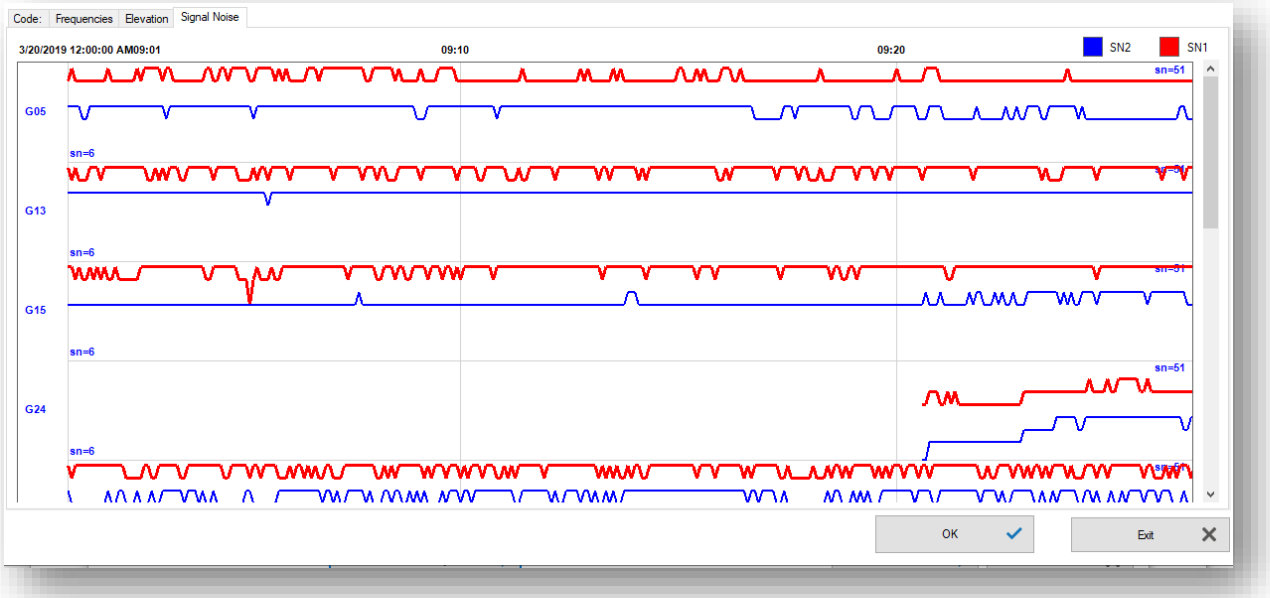


Figure 6.14

6.3 Kinematic Calculation

The kinematic calculation is intended to show the path of the mobile rover. With the mobile rover, a position is obtained for each epoch (path) Figure 6.18.
Let's look at the processing phases of a kinematic calculation: as a first step, we remind you that it is necessary to set a correct reference system in the program, in order to obtain valid results. If you want to carry out a kinematic calculation combined with the Stop & Go calculation, you will need to import a GPS survey into the project, however the program will always ask for confirmation of the action to be performed (whether just kinematic calculation or kinematic calculation + Stop & Go). By pressing Yes in Figure 6.15, the Stop & Go points of the survey will be included in the calculation.
In this way, the procedure and the steps are identical to those of the Stop & Go calculation described in paragraph 3.1.

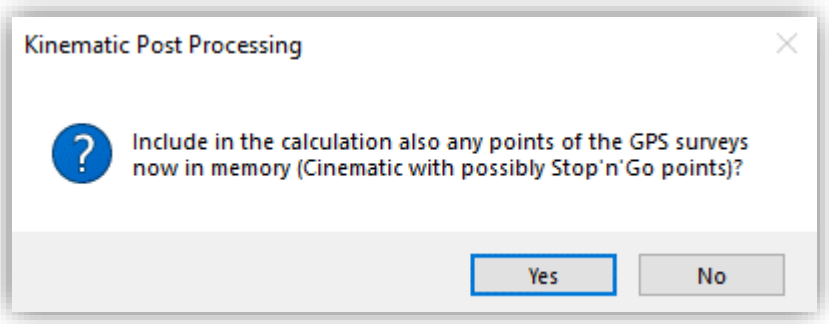


Figure 6.15

If there are no Stop & Go points to calculate, the first screen that will be displayed by performing a kinematic calculation will be the one shown in Figure 6.16, also in this case it is possible to follow the steps and recommendations already described in paragraphs 3.1, for the Stop & Go calculation (Figure 6.16, you can see the screen for the kinematic calculation is very similar to the Stop & Go window). The values of the calculation parameters (such as the SNR-Signal-to-noise-ratio) that we suggest using are always set as default values, proposed by the program.

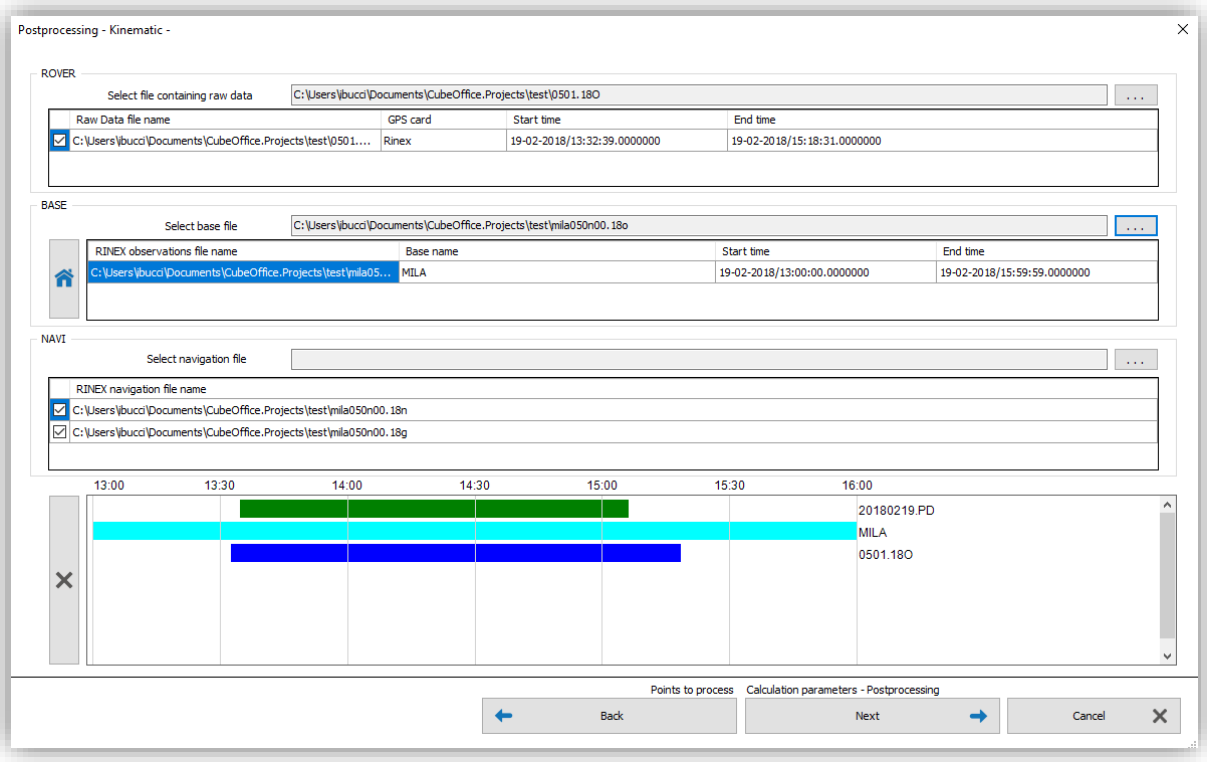


Figure 6.16

At the end of the processing, the program will present a window as in Figure 6.17.
You can then decide whether to import the calculated path (as a polyline) into the work, the points that make up the path, or both. For the points the program proposes a default starting name (Kpt1), the others will be sequential, the starting name is always editable. Finally, you can choose to include Stop & Go points in the calculated path. In Figure 6.18, an example of a work resulting from a kinematic calculation with path and Stop & Go points.

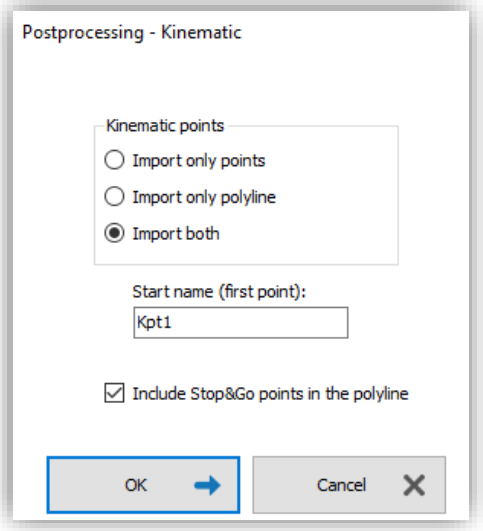


Figure 6.17

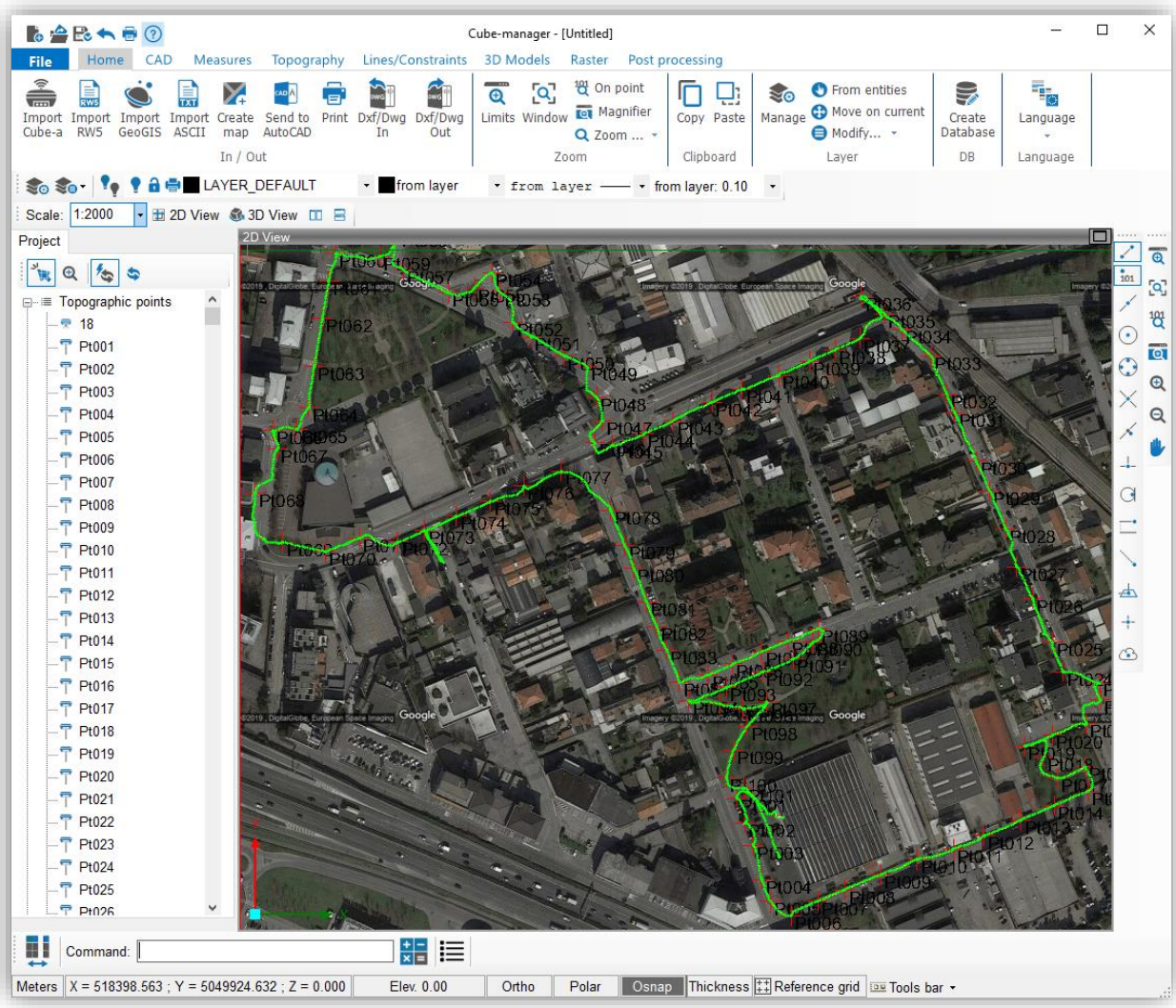


Figure 6.18

6.4 Static calculation with multiple bases

By clicking on the Static multiple command, it is possible to create a network project, this calculation is often used to check the position of some points over time. In Cube-manager it is possible to create an automatic, a manual project or open an existing one (Figure 6.19). The automatic project executes the network project automatically by creating all baselines between known points and points to be calculated and between points (based on occupancy, to create averaged points). In this case, select the files to be processed (Load observation file) and then click on the known points files to define them as a reference (from the Observation file table the selected files will be transferred to the Known base file table), then click on Calculate baseline (Figure 6.20). The manual project requires to insert one file at a time, the known points are inserted by clicking on Add new base and those to be calculated on Add new baseline. In the table, the known points are on the left and those to be calculated on the right; baselines can be inserted between unknown points, thus

processing an unknown point with respect to another unknown point but only if these have been inserted as points to be calculated above in the table. The selection of the navigation files is always automatic, if the program fails to find the navigation files, it proposes a manual selection.
In Figure 6.21, you can see the screen that groups the bases and baselines related to the current project, whether it comes from an automatic creation or a manual creation.
In this phase it is possible to add base and/or baseline, and memorize the project. In the table the known points are on the left and those to be calculated on the right, baseline can be created between unknown points (thus processing an unknown point with respect to another unknown point) but the point (to use as base) must have been previously entered (as baseline from a known point).
The selection of the navigation files is always automatic, if the program fails it proposes a manual selection of the files.
The status column provides information on the presence or absence of observation and navigation files (particularly when a project is loaded from memory).
You can view the chart of occupation of the files and with the command Occupation chart (s) and by clicking the View the network project command, you will see the graphic representation of the project (to obtain this representation, the program automatically activates the option to display the fieldbook scheme, which can always be deactivated, par. 2.5.4).
By clicking on the Add observation to saved project button, you can include a previously saved project to the current one, this guarantees the possibility of building a project that is extended over time.
At the bottom (Figure 6.21), it will be necessary to confirm whether the value relative to the antenna height and reported in the RINEX file, has been recorded at the base of the antenna or at the phase center. This choice is necessary and must be made with care so as not to invalidate the subsequent calculations.
By clicking on a row of a base or a baseline, through the pop-up menu you can access the configuration screen of the calculation parameters, add observation files to the calculation, delete the selected base or baseline and you can replace the files of navigation. By clicking on the row of a base it is also possible to access the screen relating to its coordinates, a screen similar to the one shown in Figure 6.4.
The post-processing analysis is performed with the default parameters (15 ° as cutoff, 3 as minimum coefficient ambiguity ratio and 15 as minimum SNR threshold). To modify them, just click on the line of a baseline and select Calculation mode/Satellites. Attention: to assign a different analysis configuration to all the baselines you must tick the Assign this calculation mode to all the baselines, at the bottom-left of the window, in Figure 6.23. Then confirm (or cancel) to continue.
Performs calculation (Figure 6.21), opens the screen in Figure 6.22, where it will be possible to control the project to verify which are the reference points and which points to calculate, the purpose of this control is to change the state of the points, if it is incorrect. Pressing Next you can start the calculation at the end of which a screen will be displayed as in Figure 6.24.
The table in Figure 6.24 presents detailed information on the results obtained as follows:

Correct coordinate: computed position
State: solution type (Fixed/Float)
Satellites: number of satellites used in the computation
StDev: Standard deviation of the solution
Measured coordinate: position estimated by the receiver
Raw differences: differences between estimated and computed position
At the end of the calculation the possible choices are to save the project with the *.cubemgr extension (to which later other calculated points can be added) or export a text file or view/save a report in html format.

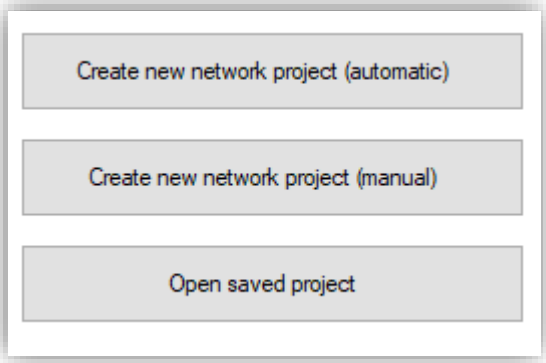


Figure 6.19

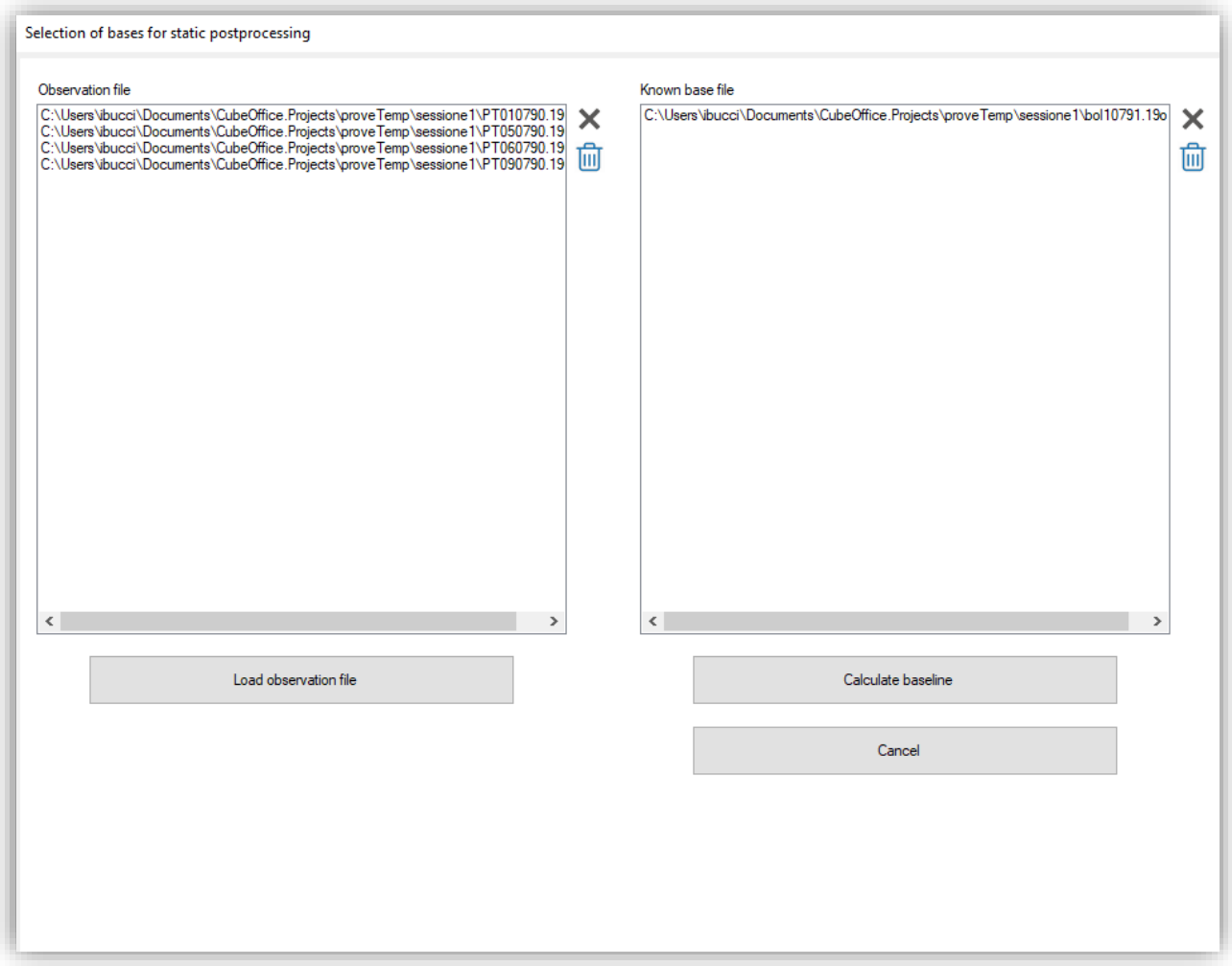

Selection of bases for static postprocessing
Observation file
C:\Users\ibucci\Documents\CubeOffice.Projects\proveTemp\sessione1\PT010790.19
C:\Users\ibucci\Documents\CubeOffice.Projects\proveTemp\sessione1\PT050790.19
C:\Users\ibucci\Documents\CubeOffice.Projects\proveTemp\sessione1\PT060790.19
C:\Users\ibucci\Documents\CubeOffice.Projects\proveTemp\sessione1\PT090790.19
Known base file
C:\Users\ibucci\Documents\CubeOffice.Projects\proveTemp\sessione1\bol10791.19o
Load observation file
Calculate baseline
Cancel

Figure 6.20

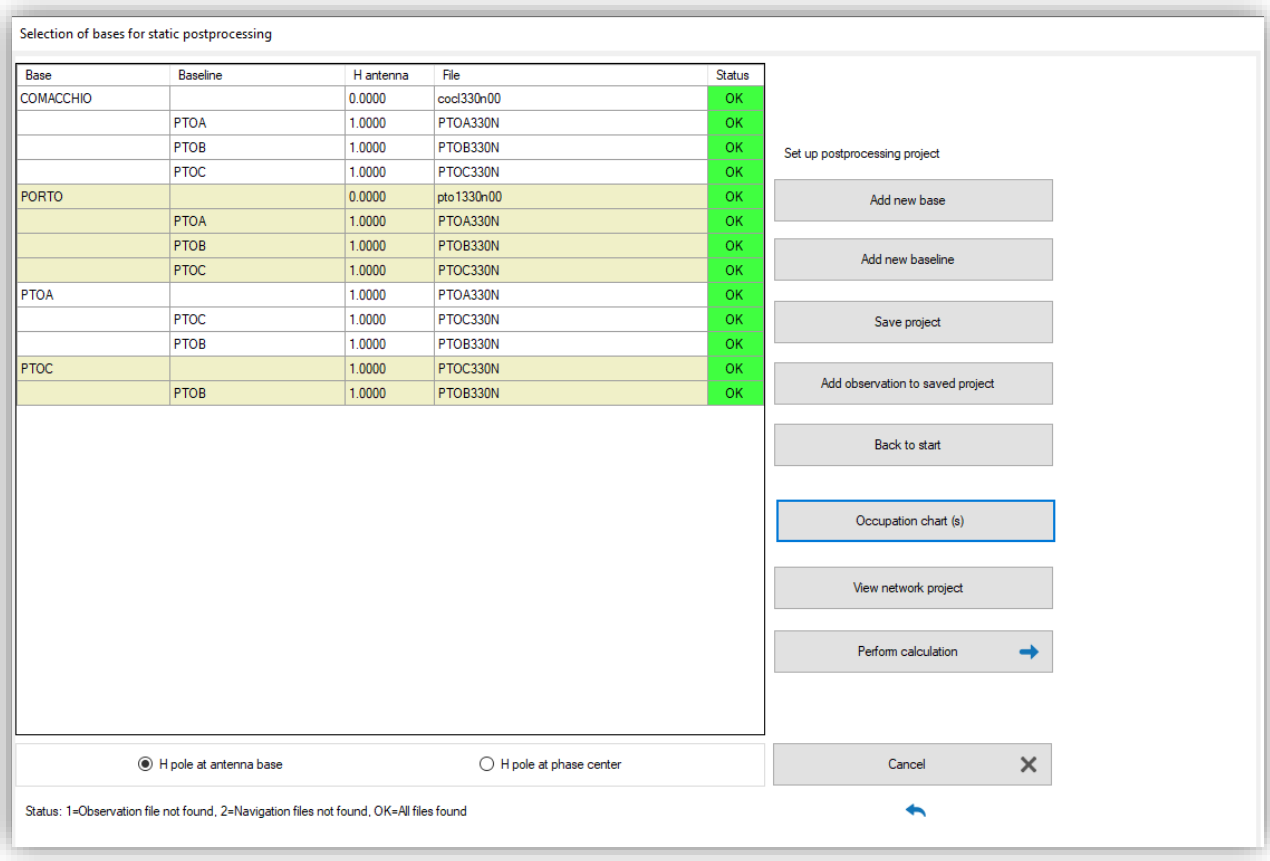

Selection of bases for static postprocessing
Base
Baseline
H antenna
File
Status
COMACCHIO 0.0000 cocl330n00 OK
PTOA 1.0000 PTOA330N OK
PTOB 1.0000 PTOB330N OK
PTOC 1.0000 PTOC330N OK
PORTO 0.0000 pto1330n00 OK
PTOA 1.0000 PTOA330N OK
PTOB 1.0000 PTOB330N OK
PTOC 1.0000 PTOC330N OK
PTOA 1.0000 PTOA330N OK
PTOC 1.0000 PTOC330N OK
PTOB 1.0000 PTOB330N OK
PTOC 1.0000 PTOC330N OK
PTOB 1.0000 PTOB330N OK
Set up postprocessing project
Add new base
Add new baseline
Save project
Add observation to saved project
Back to start
Occupation chart (s)
View network project
Perform calculation
H pole at antenna base
H pole at phase center
Cancel
Status: 1=Observation file not found, 2=Navigation files not found, OK=All files found

Figure 6.21

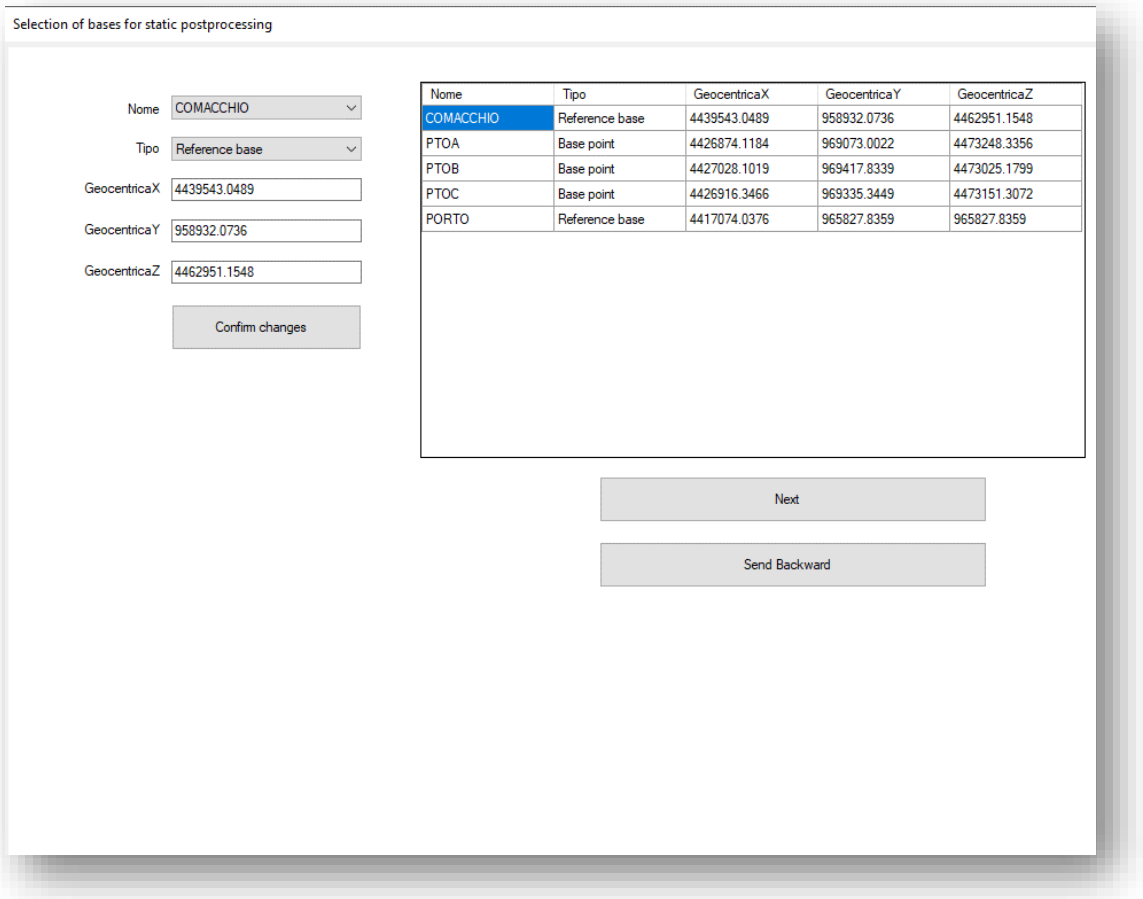


Figure 6.22

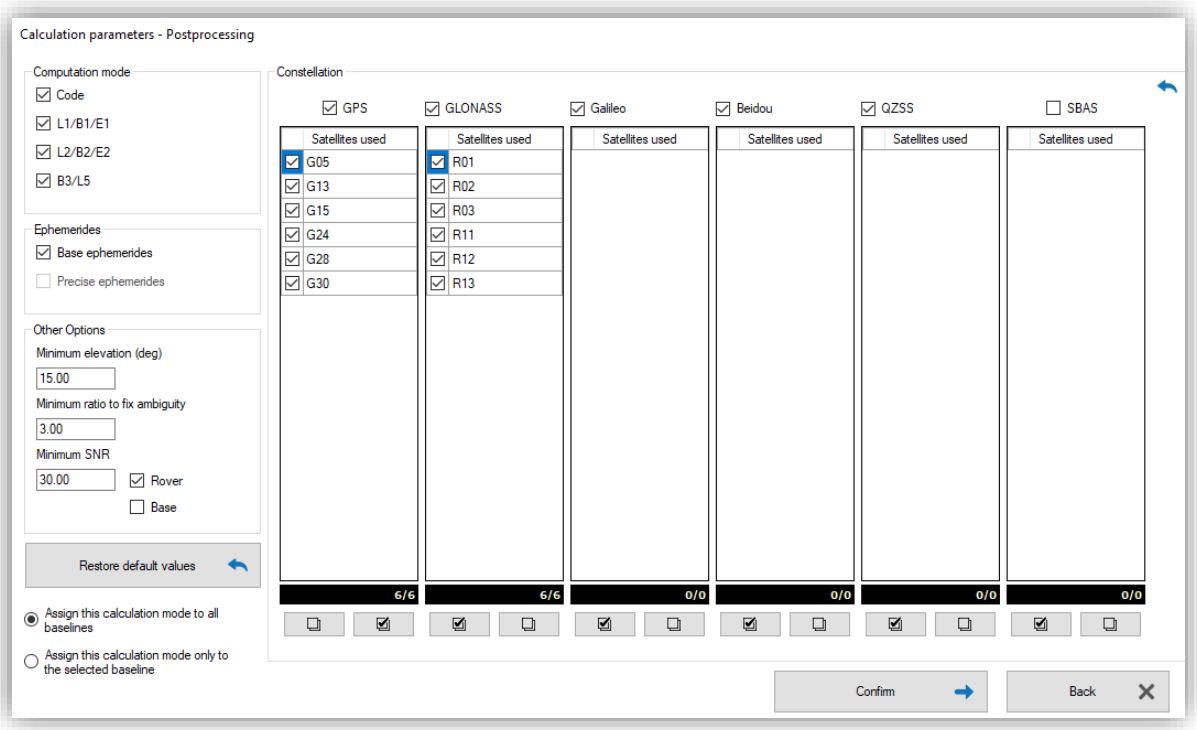


Figure 6.23

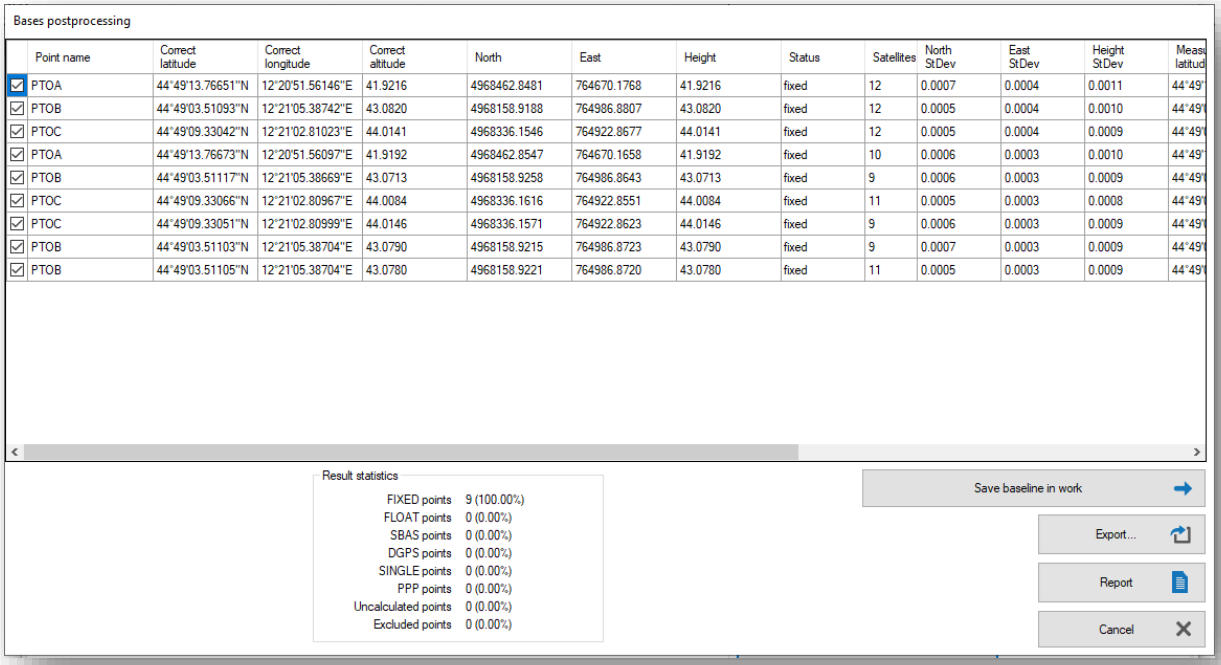

Bases postprocessing
Point name
Correct latitude
Correct longitude
Correct altitude
North
East
Height
Status
Satellites
North StDev
East StDev
Height StDev
PTOA 44°49'13.76651"N 12°20'51.56146"E 41.9216 4968462.8481 764670.1768 41.9216 fixed 12 0.0007 0.0004 0.0011
PTOB 44°49'03.51093"N 12°21'05.38742"E 43.0820 4968158.9188 764986.8807 43.0820 fixed 12 0.0005 0.0004 0.0010
PTOC 44°49'09.33042"N 12°21'02.81023"E 44.0141 4968336.1546 764922.8677 44.0141 fixed 12 0.0005 0.0004 0.0009
PTOA 44°49'13.76673"N 12°20'51.56097"E 41.9192 4968462.8547 764670.1658 41.9192 fixed 10 0.0006 0.0003 0.0010
PTOB 44°49'03.51117"N 12°21'05.38669"E 43.0713 4968158.9258 764986.8643 43.0713 fixed 9 0.0006 0.0003 0.0009
PTOC 44°49'09.33066"N 12°21'02.80967"E 44.0084 4968336.1616 764922.8551 44.0084 fixed 11 0.0005 0.0003 0.0008
PTOC 44°49'09.33051"N 12°21'02.80999"E 44.0146 4968336.1571 764922.8623 44.0146 fixed 9 0.0006 0.0003 0.0009
PTOB 44°49'03.51103"N 12°21'05.38704"E 43.0790 4968158.9215 764986.8723 43.0790 fixed 9 0.0007 0.0003 0.0009
PTOB 44°49'03.51105"N 12°21'05.38704"E 43.0780 4968158.9221 764986.8720 43.0780 fixed 11 0.0005 0.0003 0.0009
Result statistics
FIXED points 9 (100.00%)
FLOAT points 0 (0.00%)
SBAS points 0 (0.00%)
DGPS points 0 (0.00%)
SINGLE points 0 (0.00%)
PPP points 0 (0.00%)
Uncalculated points 0 (0.00%)
Excluded points 0 (0.00%)
Save baseline in work
Export...
Report
Cancel

Figure 6.24

6.5 GNSS network adjustments

This calculation is a statistical evaluation of the quality of a network, is based on the results of static post-processing and is used when there is a need to check the position of some points over time with high precision. It is accomplished by having more than one base and simultaneous observations, that can generate a redundant system. Redundancy allows you to observe residual errors that are connected to the sources of error in the measurements and cannot be completely removed.
Residual errors can be divided into random errors and blunder errors. Random errors can only be minimized while blunder errors can be detected and eliminated.
The calculation can be started having in the current Cube-manager project points calculated from multiple bases and simultaneous observations.
The Network command starts with a screen (Figure 6.25) which presents two tables: the bottom one shows the baselines with variance values, the top one shows the construction of the project, with the bases of reference and the points calculated. The above table offers the possibility to redefine the type of point with a drop-down menu (Figure 6.27).
The Post-processing Project command opens a window as in Figure 6.28, from here you can verify the structure of the project and check if for the points the observation files are available (the green boxes would appear red and give the possibility to enter manually the file), this function has value in case you recall from the memory a *.cubemgr project and you want to continue to include points in the project (the observation files may not be in the same folder as when the project was saved).
In Figure 6.28, clicking on the Create project button you can access the screen already encountered in Figure 6.21, from here you can insert new bases and baselines to the current project, as it was described in the paragraph concerning the static calculation with multiple bases, and execute calculation again (it will be necessary to save the *.cubemgr project and press the Network command again to return to the network adjustments calculation).

Returning to the screen in Figure 6.25, before performing the actual calculation (Calculate network command), you can select the Data snooping, in this case the report created for the calculation will present, in the lower part, a table with the critical points, highlighting in red the elements out of the given reference factor (non-modifiable standard value). The button on the left called Prior Analysis (Loop closure check) will be described in par. 6.5.1

By clicking on Calculation, the report (html file) is automatically created and showed in the browser. Returning to the program, you are asked if you want to save the report. Meanwhile, the command bar below the tables changes appearance (Figure 6.26), the commands Save Job and Report are added. To view the report again, click on Report. The Save Job command is used to memorize the calculation's results.
Before returning to the main screen, the window in Figure 6.29 will appear, in this window it is possible to indicate a name for the calculated fieldbook (by default "netGNSS") and it is possible to access the graphic settings of the error ellipses (Figure 6.30). The error ellipses will be drawn on a layer called Ellipse, that can always be hidden. Before the results

displaying, the program will present the screen relating to the characteristics of the GPS points, par. 2.1.2.12. By deafult, the bases that make up a project are on a hidden layer (can be activated); however only in this function, for a better analysis of the results the bases are made visible (modifiable option). Furthermore, it is always possible to deactivate the display of the baselines (by default deactivated except for these calculations) by deactivating the fieldbook scheme command found in the Topography tab, par. 2.5.4.
Following the GPS features window, you are asked whether to save the current project and then the screen for setting the reference system is shown, par. 2.5.2.1.

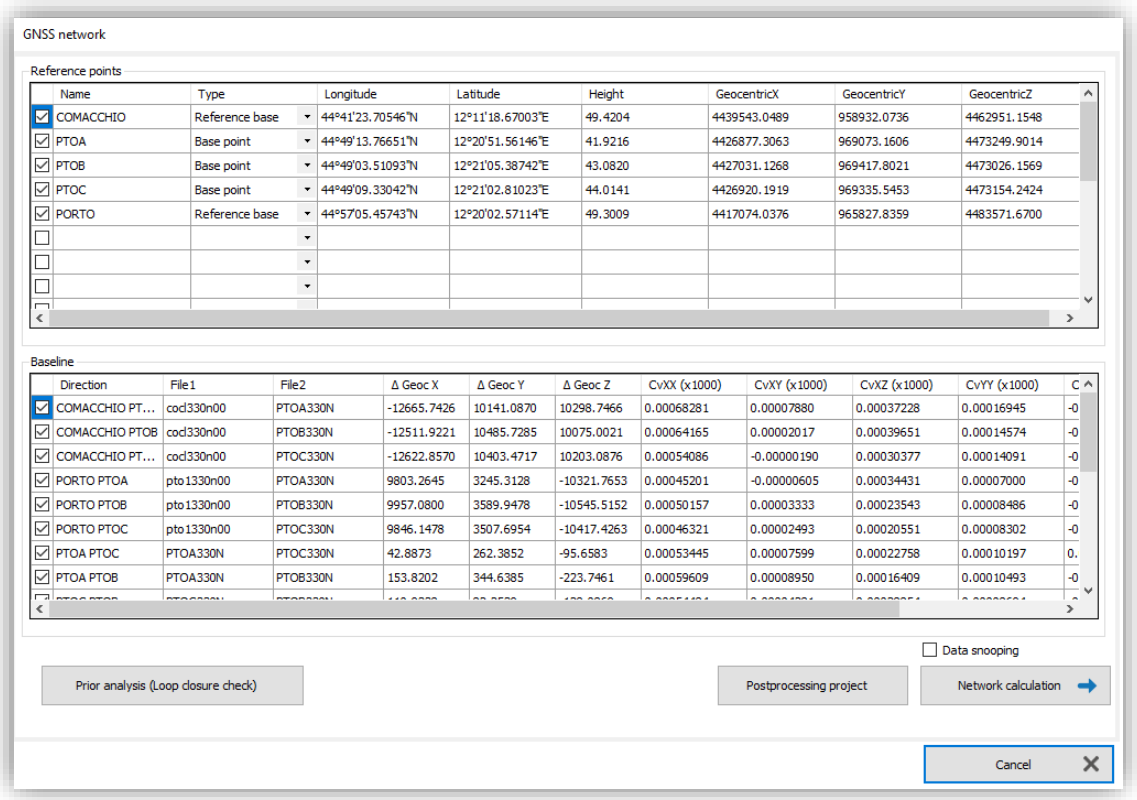


Figure 6.25

Figure 6.26

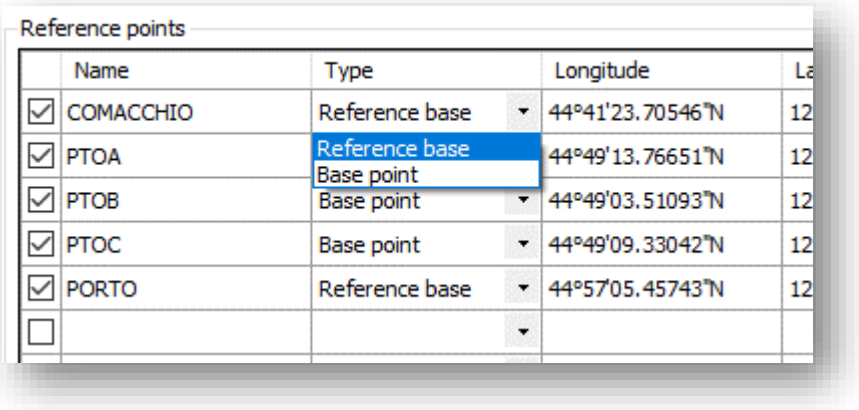


Figure 6.27

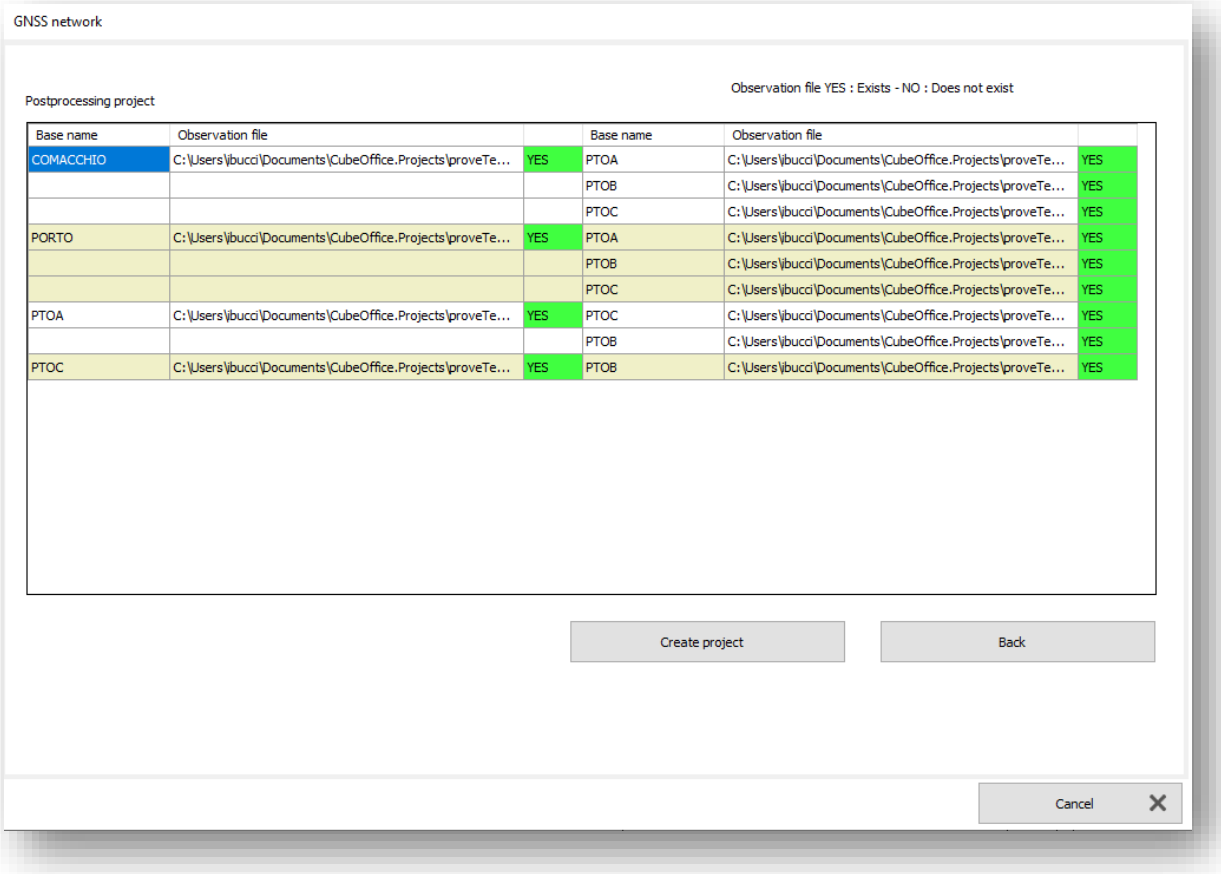


Figure 6.28

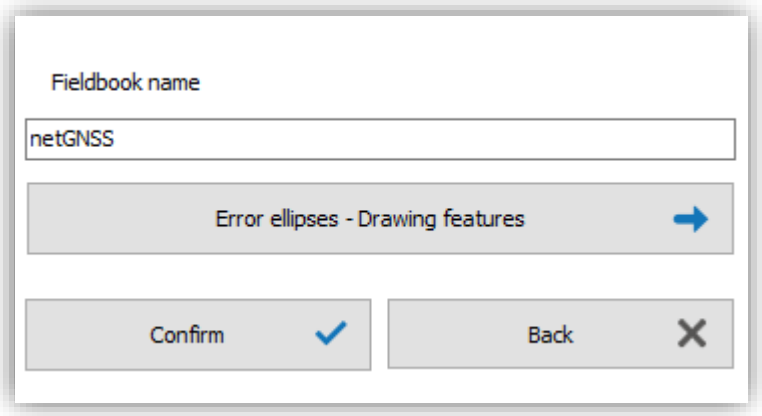


Figure 6.29

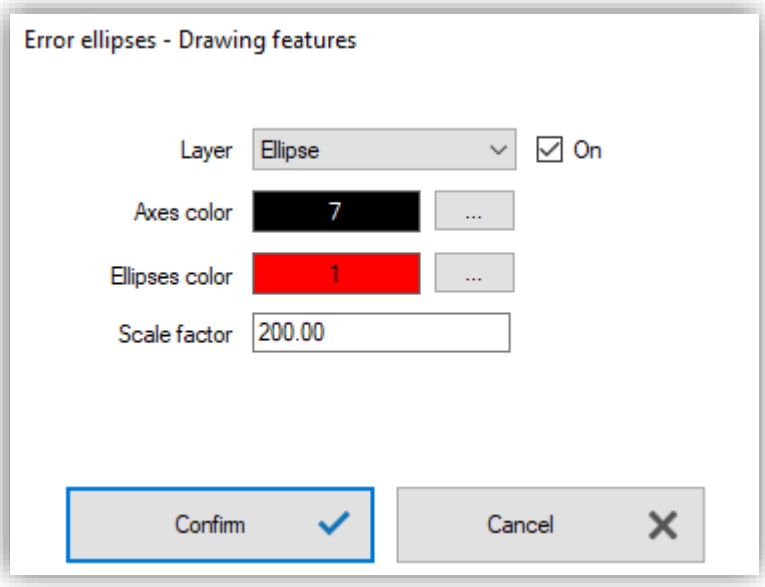


Figure 6.30

6.5.1 Loop closure

The GNSS network compensation it is enriched with further analyzes and the loop closure. To access these functions, simply click on the Prior analysis (Loop closure check) button, Figure 6.25.
In the window in Figure 6.31, you can select what check you want to perform. Each of the commands available to the right of the screen generates a report, the first command, Analyze control baseline, will automatically show the baselines between known points, if they were present in the project, the generated report will be similar to the one shown in Figure 6.32. After analyzing and generating the report, returning to the processing window, the section on the right in the main window will change appearance as shown in Figure 6.33. Here is the selected control baseline (only one in the example), the geocentric coordinates of the points, the distance and the error expressed in parts per million (ppm). The red cell in the example in Figure 6.33, shows an error above the tolerance that can be set at the top, in the PPM Tolerance box. The PPM Calculation command restarts the calculation of the error, the Report command opens the report related to the calculation.

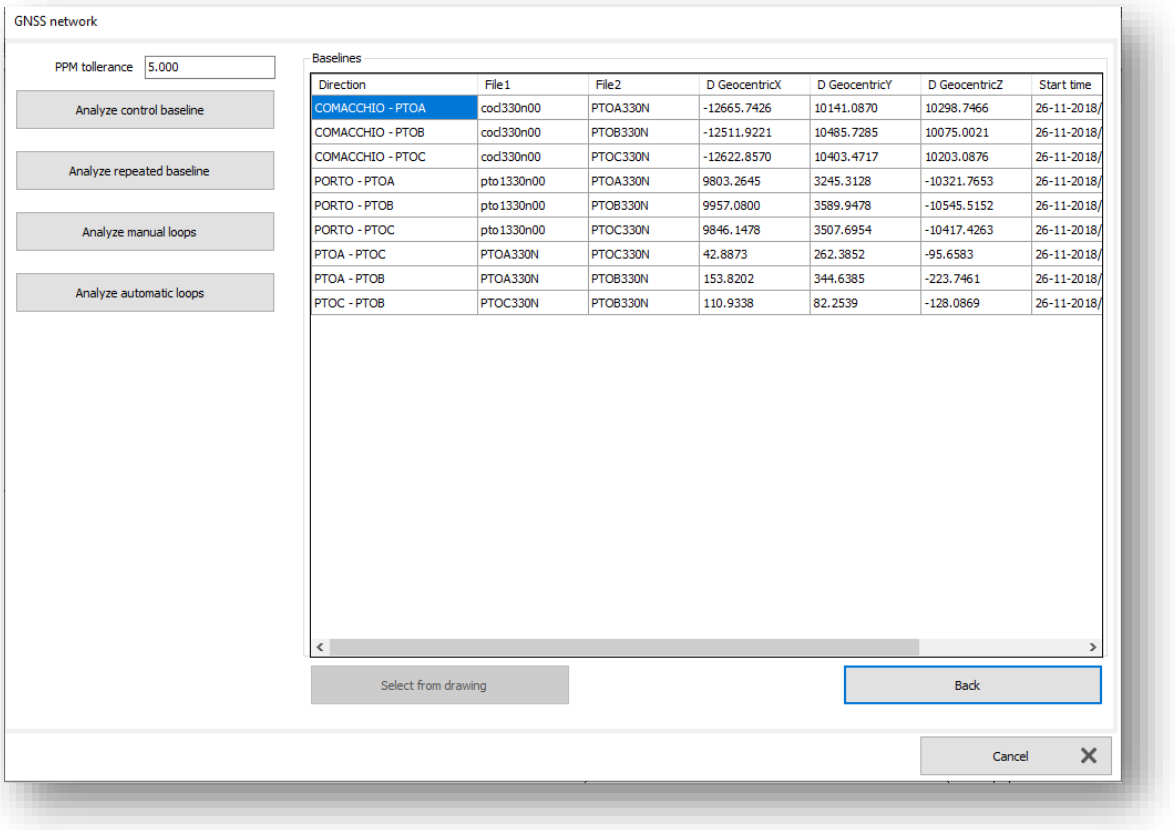
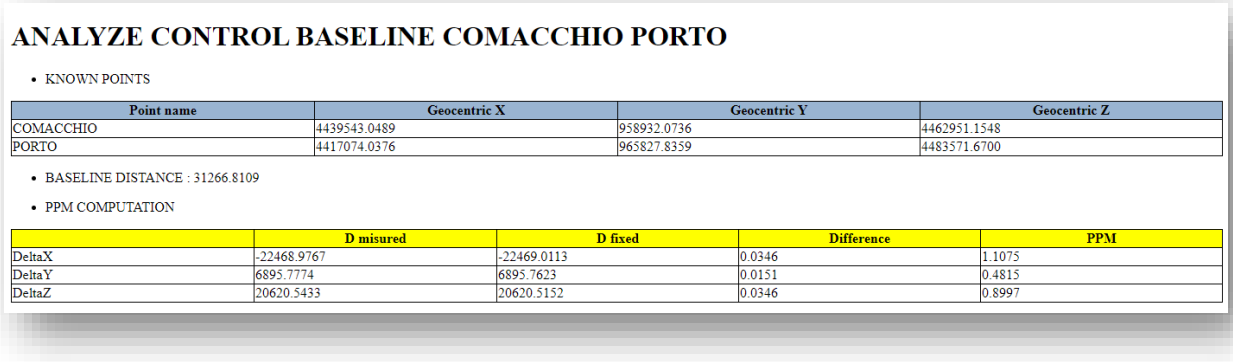


Figure 6.31



ANALYZE CONTROL BASELINE COMACCHIO PORTO

- KNOWN POINTS

Point name	Geocentric X	Geocentric Y	Geocentric Z
COMACCHIO	4439543.0489	958932.0736	4462951.1548
PORTO	4417074.0376	965827.8359	4483571.6700

- BASELINE DISTANCE : 31266.8109
- PPM COMPUTATION

	D misured	D fixed	Difference	PPM
DeltaX	-22468.9767	-22469.0113	0.0346	1.1075
DeltaY	6895.7774	6895.7623	0.0151	0.4815
DeltaZ	20620.5433	20620.5152	0.0346	0.8997

Figure 6.32

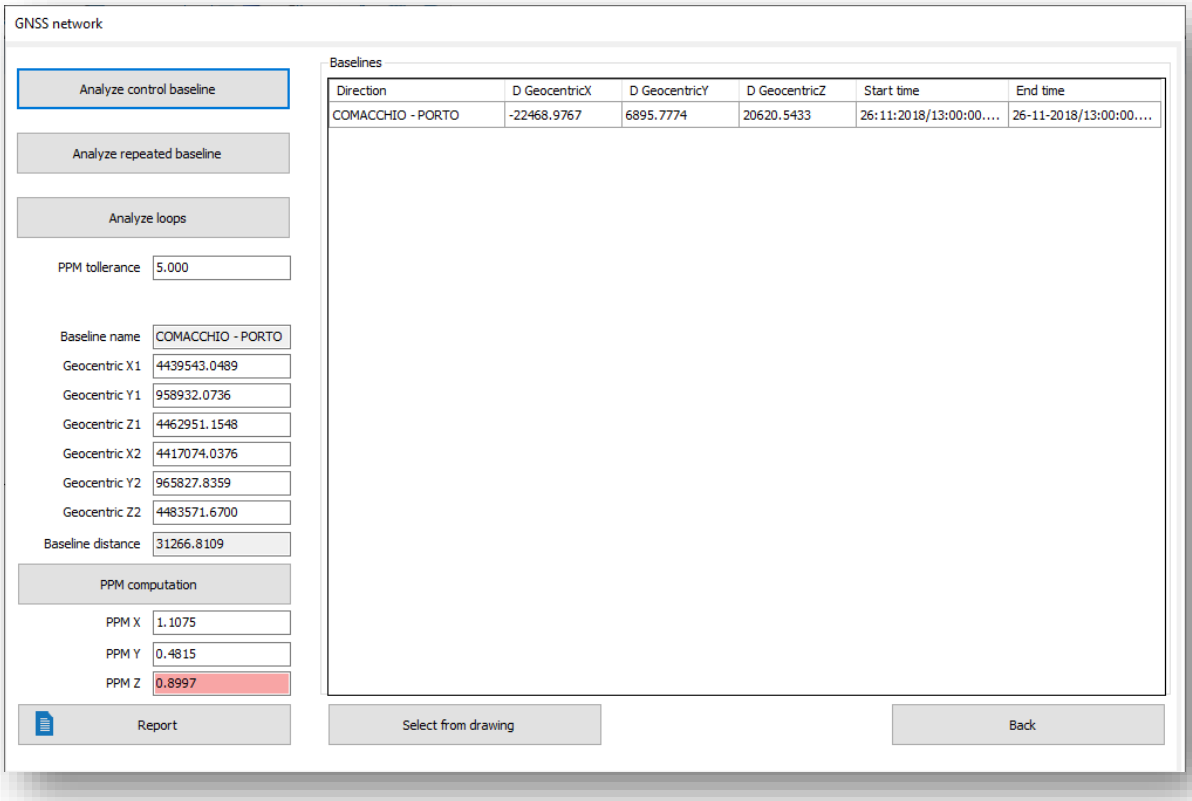


Figure 6.33

Back to the analysis commands (Figure 6.31), the second command from the top, Analize repeated baseline, will automatically show the repeated baseline, with a behavior similar to that seen in the previous command.
The Analyze manual loops command generates a window as in Figure 6.34. For this function it will be necessary to select the baselines that make up the polygon that you want to analyze. The selection can be made from the table on the left in the main window and in which all

the project baselines are shown, or by clicking on the Select from drawing button, to access the screen in Figure 6.35.
Baseline selection can be made from the central drawing, by clicking on the baseline or from the table on the left, a click highlights the baseline, double-clicking selects it. At the top right are the zoom and scale controls to act on the graphic (Figure 6.35).
As baselines are inserted in the loop, the summary window on the left is populated (the trash empties the selections), if the selection generates a loop the program generates a report with closure errors. After the automatic creation of the report, a window will appear as in Figure 6.37 for saving the report, which can be added at the end of an existing report if necessary.
For the analysis of a polygon (even if not closed) but constrained on known points, it will be enough to select the starting baselines and click on the Closure computation.
If a calculation is made, the appearance of the lower left part of the main screen changes as in Figure 6.36, where it is possible to read the total length of the polygon and the closure error.
Returning to the commands in Figure 6.31, the Analyze automatic loops command calculates the closure errors of all possible loops, the processing screen will be similar to the one in Figure 6.38. In this case you can directly consult the report to check all the calculated loops and evaluate the related closure errors. The Closure Computation command allows you to recalculate closure errors, a necessary action after a possible modification of the PPM tolerance. (The draw polygons command brings you back to the window where to select the loops manually, Figure 6.35)

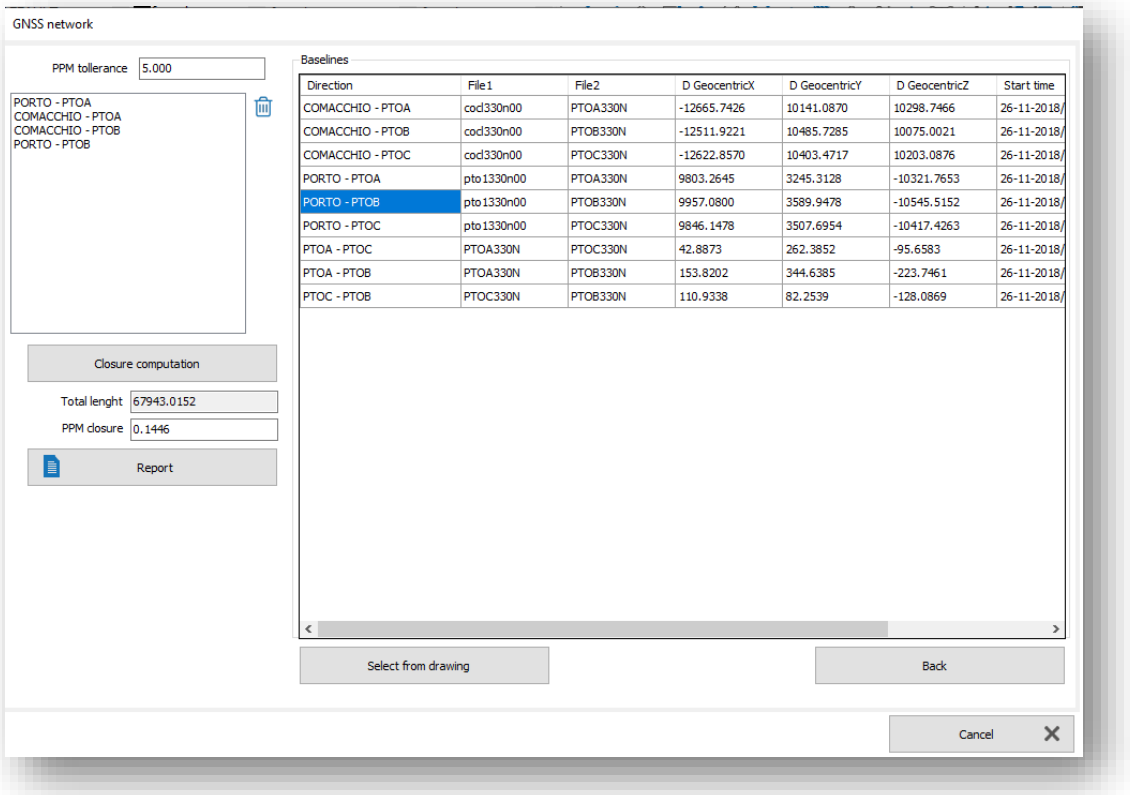


Figure 6.34

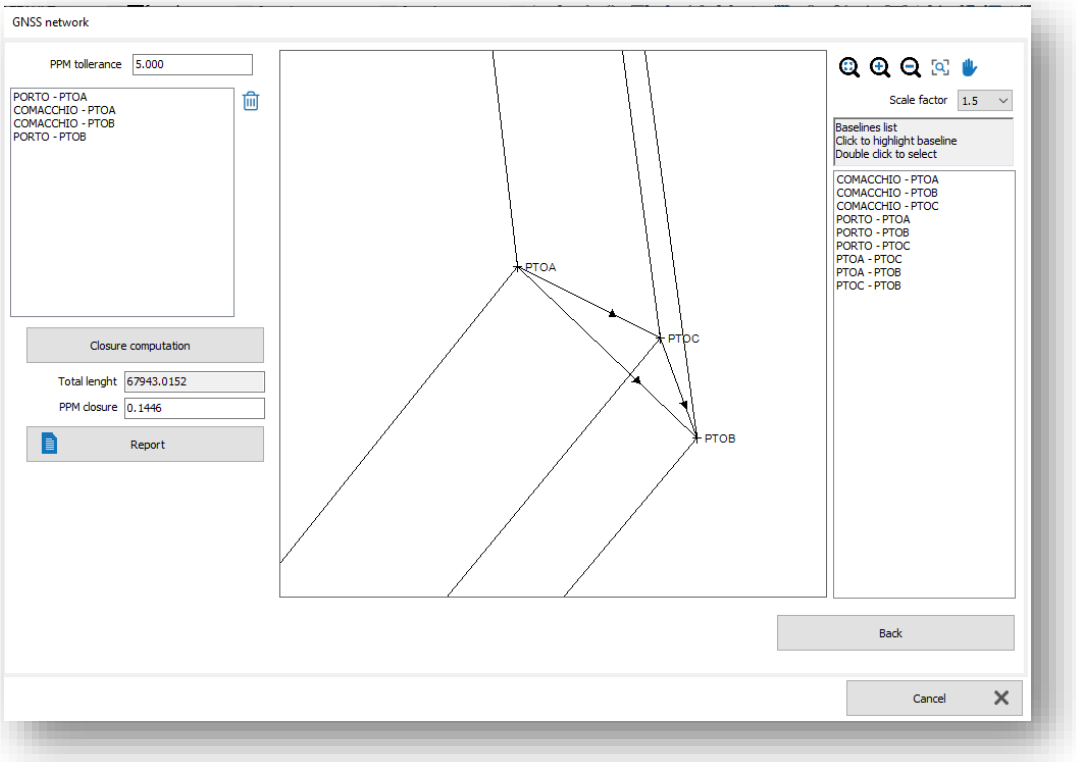


Figure 6.35

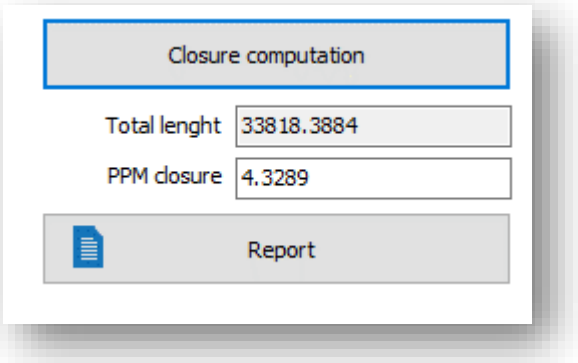


Figure 6.36

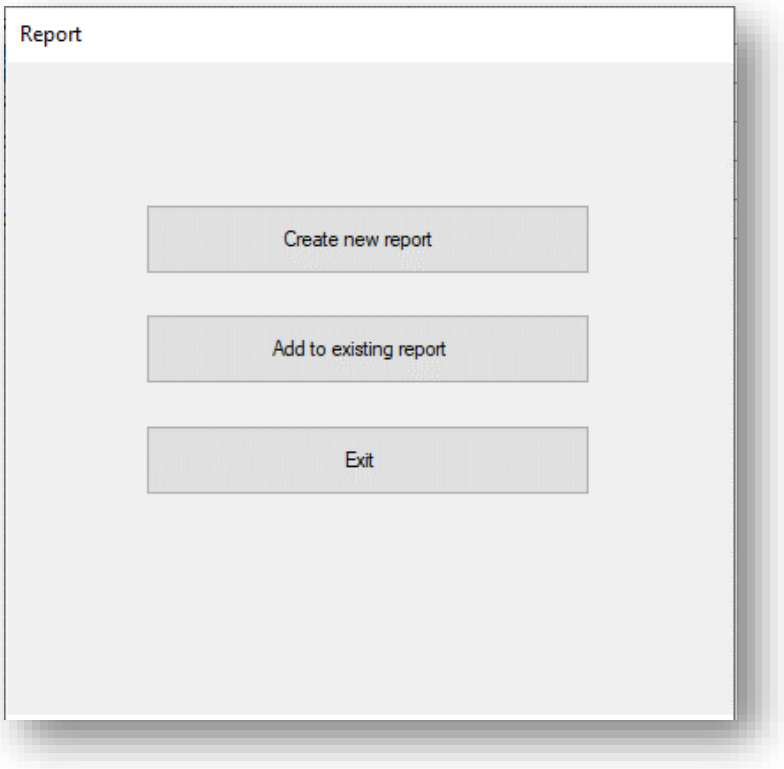


Figure 6.37

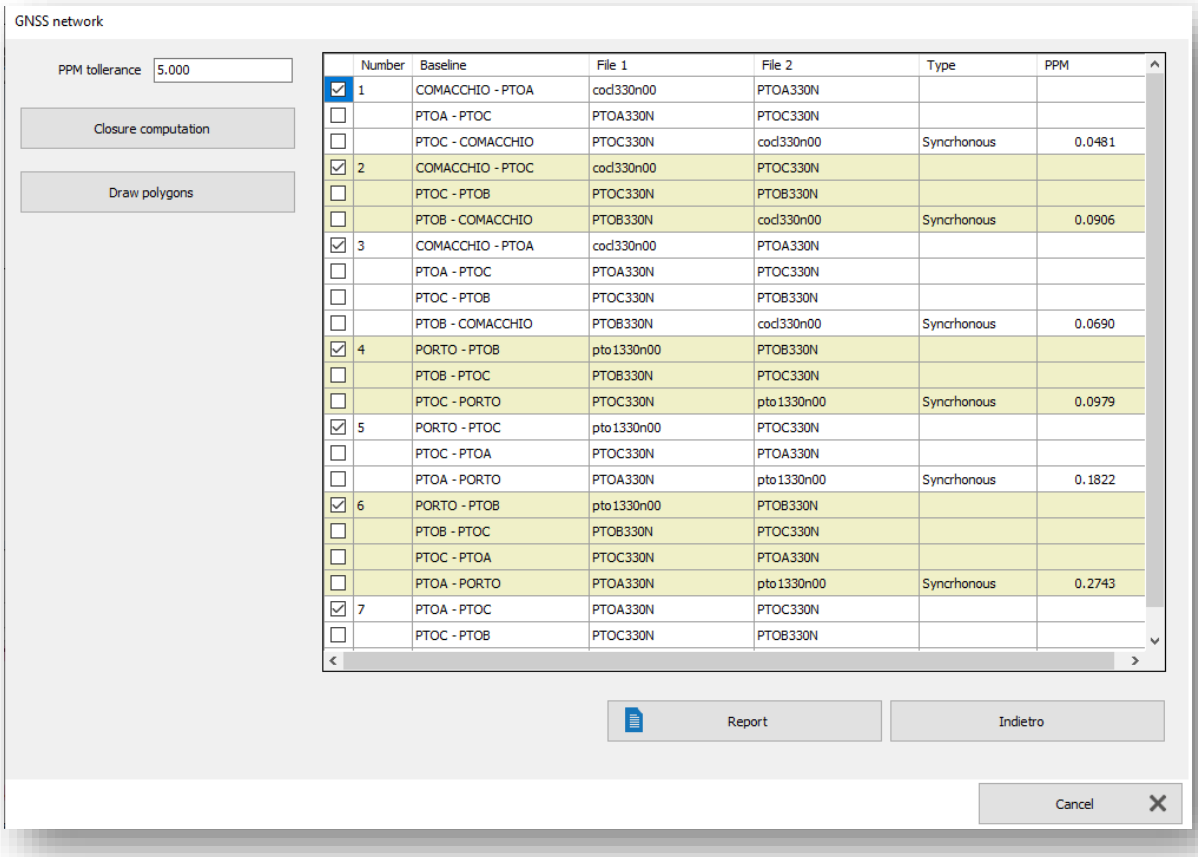

GNSS network
PPM tollerance
5.000
Closure computation
Draw polygons
Number
Baseline
File 1
File 2
Type
PPM
1 COMACCHIO - PTOA cocl330n00 PTOA330N
PTOA - PTOC PTOA330N PTOC330N
PTOC - COMACCHIO PTOC330N cocl330n00 Syncrhonous 0.0481
2 COMACCHIO - PTOC cocl330n00 PTOC330N
PTOC - PTOB PTOC330N PTOB330N
PTOB - COMACCHIO PTOB330N cocl330n00 Syncrhonous 0.0906
3 COMACCHIO - PTOA cocl330n00 PTOA330N
PTOA - PTOC PTOA330N PTOC330N
PTOC - PTOB PTOC330N PTOB330N
PTOB - COMACCHIO PTOB330N cocl330n00 Syncrhonous 0.0690
4 PORTO - PTOB pto1330n00 PTOB330N
PTOB - PTOC PTOB330N PTOC330N
PTOC - PORTO PTOC330N pto1330n00 Syncrhonous 0.0979
5 PORTO - PTOC pto1330n00 PTOC330N
PTOC - PTOA PTOC330N PTOA330N
PTOA - PORTO PTOA330N pto1330n00 Syncrhonous 0.1822
6 PORTO - PTOB pto1330n00 PTOB330N
PTOB - PTOC PTOB330N PTOC330N
PTOC - PTOA PTOC330N PTOA330N
PTOA - PORTO PTOA330N pto1330n00 Syncrhonous 0.2743
7 PTOA - PTOC PTOA330N PTOC330N
PTOC - PTOB PTOC330N PTOB330N
Report
Indietro
Cancel

Figure 6.38

7 Tools and controls

7.1 Tools and program commands

Cube-manager supports 2D, 3D and fieldbook view. The windows can be used simultaneously, Figure 7.1.

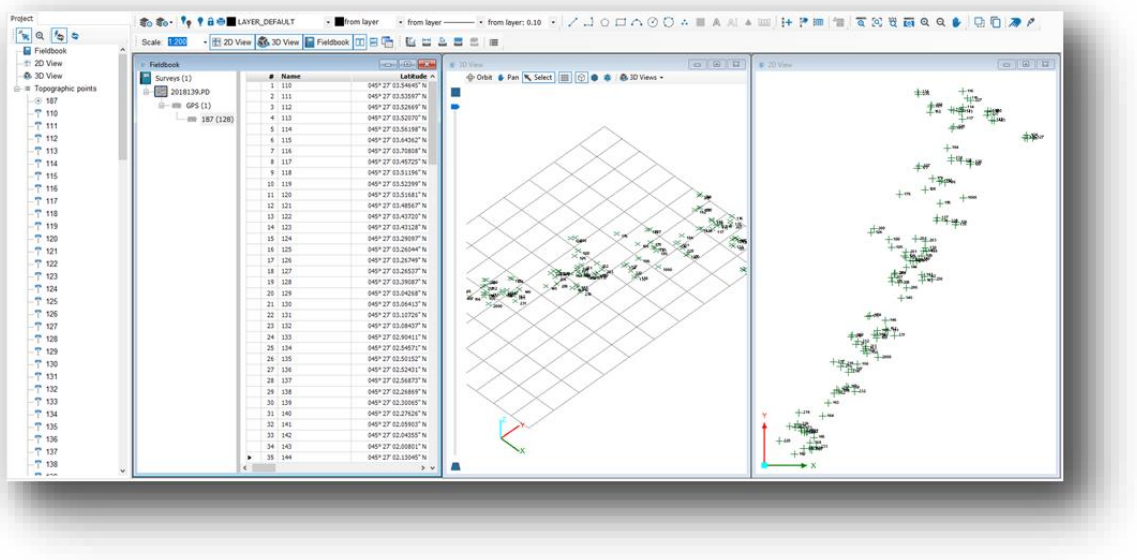


Figure 7.1

The fieldbook view allows the management and editing of the surveys (GNSS and TS) present in the job.
On the side summary tree (Figure 7.2), it is possible to insert a new survey and/or new elements to the surveys. Depending on the selected node, the program will automatically propose a GPS or TS entry. After entering the name (Figure 7.3), the entry will be automatic and visible in the grid and in the CAD, if the new element addresses an existing topographic point, it will take its coordinates and characteristics, otherwise it will be created with default values.
If you want to add a new survey, you will need to enter, in addition to the name, also what kind of survey it is (Figure 7.4).

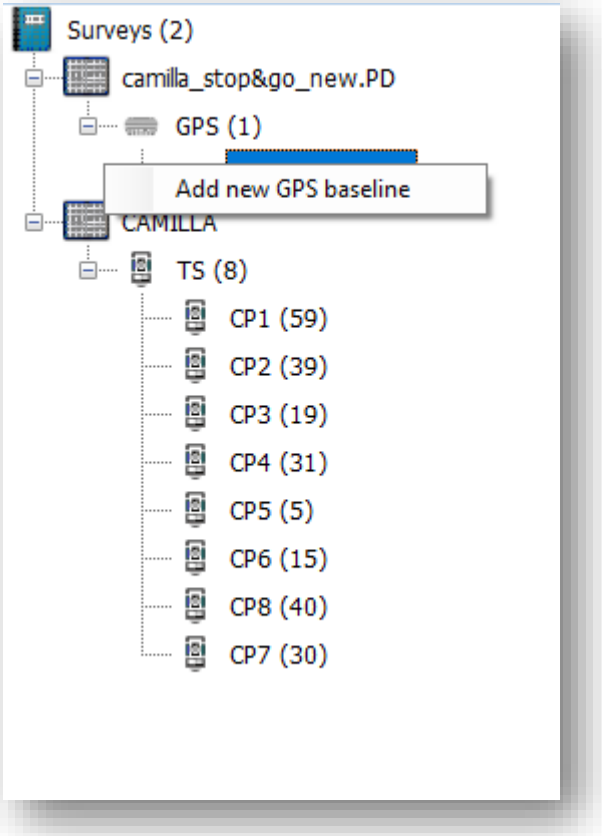


Figure 7.2

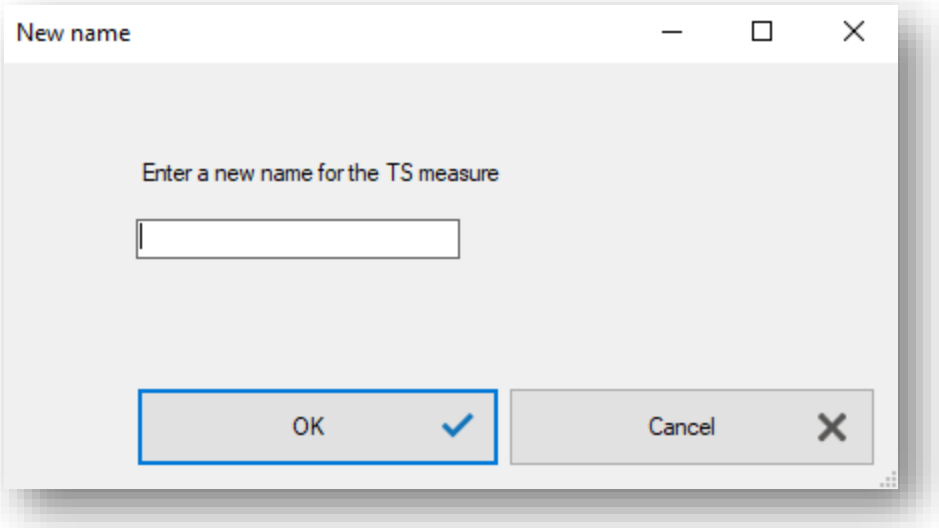


Figure 7.3

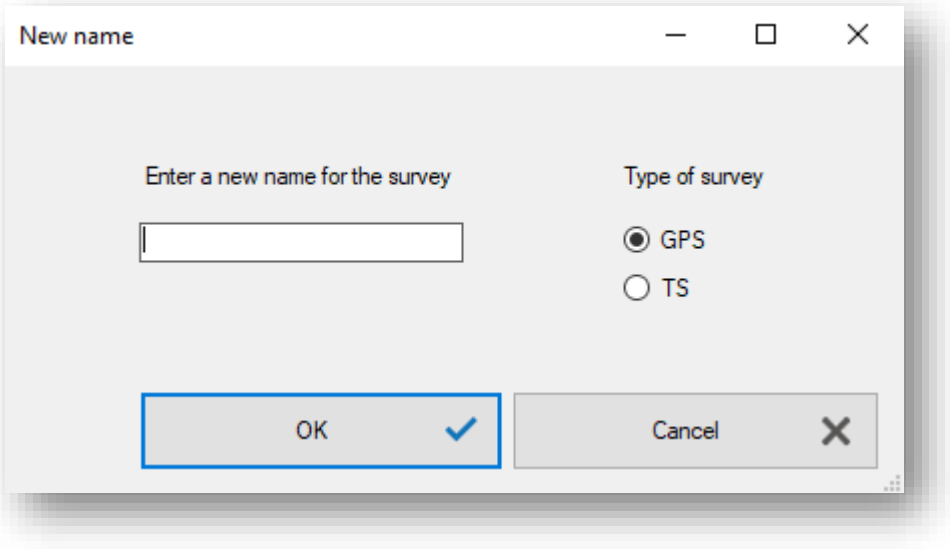


Figure 7.4

On the grid, for the editable columns, you can modify the single values (Figure 7.5) or modify the values by selecting multiple rows or cells Figure 7.6 (right-click on the selection). In case of multiple selection of more columns, the available functions are those shown in Figure 7.7. The Rename will act on the elements of the selected lines, the Copy will copy the elements and will allow to paste the object only in the fieldbook grid (also on another instance of Cube-manager, different from the current, without closing the current). Copy text allows a copy of the text value of what is selected in all applications that support the paste text function. The command Delete, deletes the selected element or elements.

#	Name	Latitude	Longitude	Ell. H.
1	P01	045° 35' 57.03811" N	009° 21' 11.22594" E	223.023
2	P02	045° 35' 57.02804" N	009° 21' 11.61434" E	222.981
3	P03	045° 35' 57.21175" N	009° 21' 12.50257" E	223.010
4	P04	045° 35' 57.40038" N	009° 21' 13.36364" E	223.131
5	P05	045° 35' 58.32454" N	009° 21' 13.53010" E	223.331
6	P06	045° 35' 58.39813" N	009° 21' 13.54103" E	223.625
7	P07	045° 35' 58.52523" N	009° 21' 13.55035" E	223.325
8	P08	045° 35' 58.64602" N	009° 21' 12.90178" E	223.283
9	P09	045° 35' 59.84685" N	009° 21' 13.37154" E	223.280
10	P10	045° 35' 59.95434" N	009° 21' 12.91618" E	226.251
11	P11	045° 35' 59.61789" N	009° 21' 12.72069" E	223.041
12	P12	045° 35' 58.74699" N	009° 21' 12.36441" E	223.181
13	P13	045° 35' 58.71328" N	009° 21' 12.55075" E	223.172
14	P14	045° 35' 58.68038" N	009° 21' 12.71872" E	223.225
15	P15	045° 36' 00.18620" N	009° 21' 06.80670" E	222.884
16	P16	045° 35' 59.98353" N	009° 21' 06.73977" E	222.552
17	P17	045° 35' 59.74647" N	009° 21' 07.67174" E	222.964

Figure 7.5

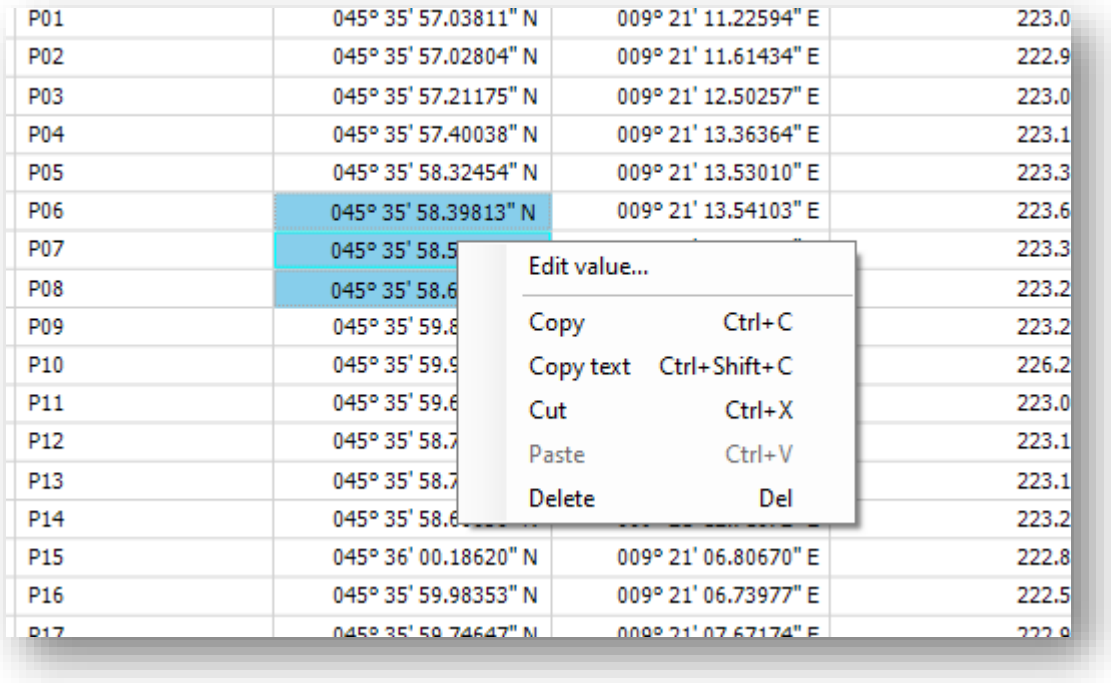


Figure 7.6

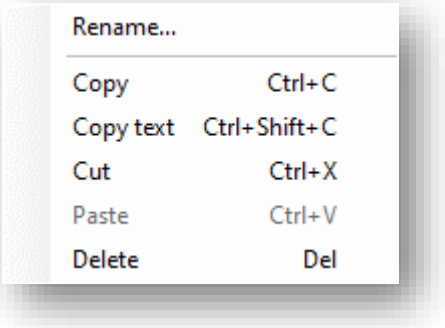


Figure 7.7

The single renaming of an element will make a dialog box appear, like the one shown in Figure 7.8, the name change that is being performed is shown at the top, the function to be performed must be selected below. Rename the point, will rename all the elements of the fieldbook and the topographic points from the starting name to the new name (if the name already exists the function will not be completed).
The second choice, Rename the GPS baseline (the text of the command changes depending on which element of the survey is selected), will rename only the element of the selected survey, if you insert an existing name the program will ask for confirmation of what you want to do as in Figure 7.9, pressing yes the result will be like that obtained with the Rename point, by pressing no only the selected element will be renamed and will be linked to the existing name element.

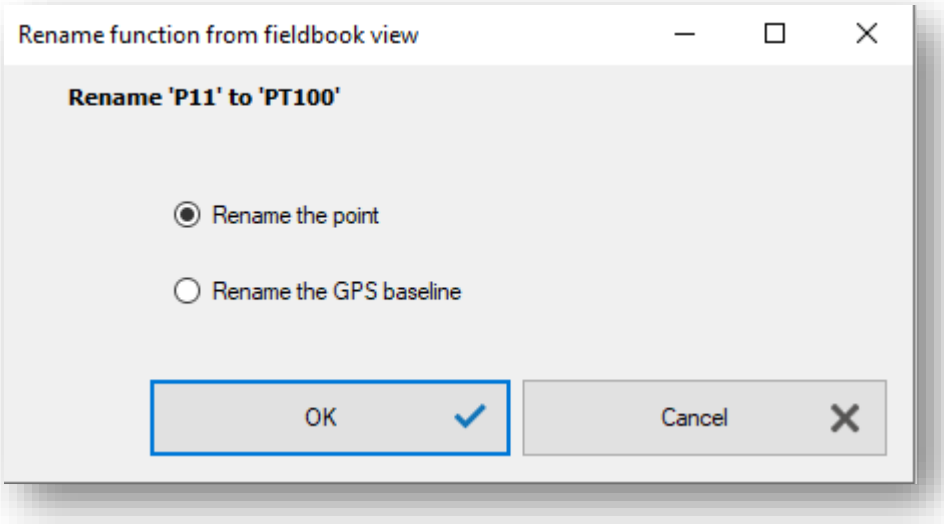


Figure 7.8

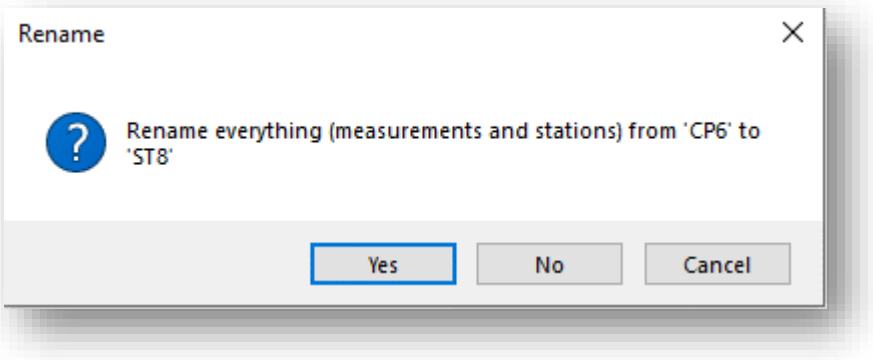


Figure 7.9

If you rename a station from a TS survey, it will be necessary to rename manually the measurements you want to connect to the renamed station (created), the program will always generate a warning message.

The edit value of multiple selection (Figure 7.6), opens a window as in Figure 7.10, on the left you can choose what type of operation you want to perform and on the right you can enter the value.
The modification of the East, North, and Elevation coordinates of an unknown point requires its transformation into a known point.

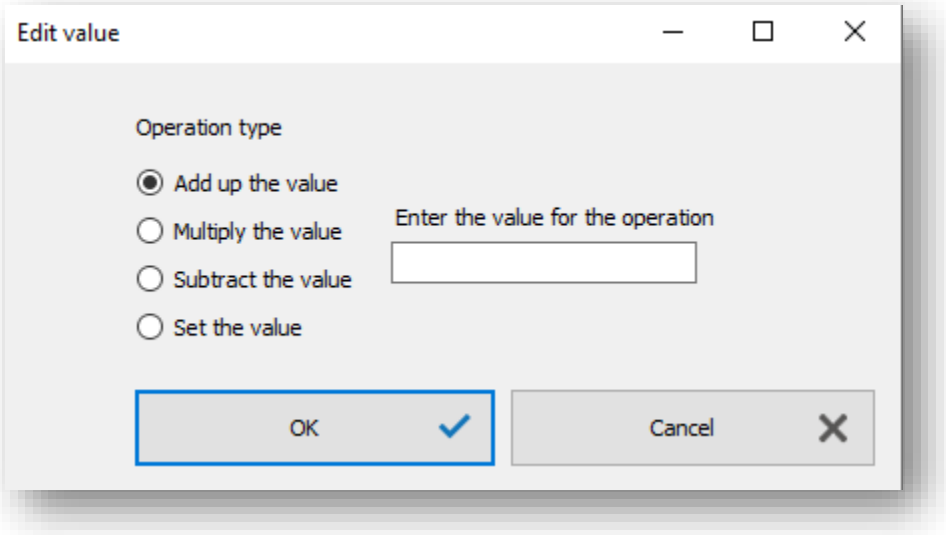


Figure 7.10

List of commands that can be typed in the command line (Figure 7.11) of the program, the recognition of the commands is not case-sensitive:

Command	Description
OPEN	Opens projects (Cube-manager files with extension *.cubemgr, the program also supports Cube-link files with the extension .cubelnk)
SAVE	Saves the project (with extension *.cubemgr for a normal file, with extension .cubemntl for a template file)
NEW	New project
DXFIN	Imports dxf/dwg files
ASCIIIN	Imports generic ASCII files
SHAPEIN	Imports Esri Shape files
RW5IN	Imports RW5 files
CUBEAIN	Imports Cube-a files
GEOGISIN	Imports GeoGis files
MAPWWW	Creates a map
SENDCAD	Opens the project in AutoCAD
DXFOUT	Creates dxf/dwg files
KMLOUT	Creates a KML file for Google Earth
CUBEAOUT	Exports a Cube-a file
RW5OUT	Exports a RW5 file
GEOGISOUT	Exports a GeoGis file
SHAPEOUT	Export in ESRI Shapefile format
SETDBDATA	Creates database for GeoGIS
PRINT	Prints the drawing
COPYCLIPBOARD	Copies CAD entities to clipboard
PASTECLIPBOARD	Pastes the CAD entities from clipboard
SETTINGS	General program settings
QUIT	Closes the program
2DVIEW	Enables 2D view
3DVIEW	Enables 3D view
ZOOMLI	Zoom limits
ZOOMIN	Zoom in
ZOOMOUT	Zoom out
ZOOMWI	Zoom window
ZOOMPT	Zoom on topographic point
DYNPAN	Activates dynamic pan
ZOOMMA	Enables/disables zoom window
AERIALVIEW	Enables/disables the panoramic view

POINT	Draws a point at the selected location
LINE	Line on 2 points
CIRCLE	Circle with choice of options
CIRCLECE	Center and radius circle
CIRCLE3P	3-point circle
CIRCLE2P	2-point circle
CIRCLETTR	Tangent, tangent and radius circle
ARC	Enables arc design options
ARC3P	Arc on 3 points
ARCCE	Arc center, radius, beginning and end
ARCBE	Arco beginning, end and radius
POLYLINE	Draws polylines
RECTANGLE	Draws a rectangle
POLYGON	Draws a regular polygon
ELLIPSE	Draws an ellipse
3DFACE	Draws a 3D face
HATCH	Draws hatch
SLOPEHATCH	Draws slopehatch
DYNTEXT	Starts command to enter dynamic text
COPYSERIES	Draws series of CAD entities
CREATEBLOCK	Creates block with CAD entities and topographic points
IMPBLOCK	Imports block created with Cube-manager
TEXT	Starts command to enter multiline text
DELETE	Deletes CAD entities
MOVE	Moves CAD entities
COPY	Copies CAD entities
ROTATE	Rotates CAD entities
OFFSET	Offset of the CAD entity
JOIN	Connects entities
FILLET	Connects with arc
EXTEND	Extends an entity to the limit
TRIM	Trims entities
BREAK	Breaks entities
GROUP	Groups CAD entities
UNGROUP	Ungroups CAD entities
EXPLODE	Explodes complex CAD entities
PROPERTIES	Modifies the properties of CAD entities
COPYPROP	Copies properties from a CAD entity
DRAWINGORD	Changes view order
FOREORDER	Brings to foreground
BACKORDER	Sends to background
INSPTONPOLY	Inserts polyline vertex or profile vertex

DELPTONPOLY	Deletes a vertex from a polyline or a profile
MERGEPOLY	Joins two polylines into a single polyline
POLYINHEIGHT	Sets all the vertices of a polyline to a set height
LAYER	Opens the layer properties manager window
LAYERFROMENT	Activates layer from entity properties
CURRLAYER	Moves on current layer the selected entities
ISOLALAYER	Isolates the layers of the selected entities
LAYEROFF	Turns off the layers of the selected entities
LOCKLAYER	Blocks the layers of the selected entities
LAYERONOFF	Turns the current layer on or off
ALLLAYERON	Enables all layers
UNLOCKLAYERS	Unlocks all layers
VIDEOTHICK	Displays video thicknesses
SYMBOSNAP	Sets the osnap symbol size
ROTAXES	Sets the cursor axes rotation
AXESSIZE	Sets the cursor axes size
VIDEOSCALE	Scales the video display
GRAPHICBGROUND	Sets the background color of the graphic window
CURSORINFO	Sets dynamic information on the cursor (values from 1 to 7)
ORTHO	Enables/disables Ortho
OSNAP	Enables/disables osnap
NEWPT	Creates new topographic point
CHARACPT	Creates topographic points from CAD entities
PTPROP	Displays (changes) properties of the topographic point
PTTABLE	Displays topographic points table
MEANCENT	Averages the coordinates of nearby points
RENAMEPT	Renames topographic point
PTOFFSET	Edits point-to-text offset
R1PLUS	Imports a fieldbook from a file with .dat or .r15 extension
R2LPLUS	Imports a fieldbook from R2L Plus / R25 file
R2/R2SPLUS	Imports a fieldbook from R2S Plus file
R2WFG	Imports a fieldbook from Fieldgenius file
R2WSC	Imports a fieldbook from SurvCe/RW5 file
R2WAM	Imports a fieldbook from AntasMobile file
EXPR1PLUS	Exports coordinates in R1 Plus file format
EXPR2PLUS	Exports coordinates in R2 Plus file format
EXPR2LPLUS	Exports coordinates in R2LPlus file format
EXPR2PLUSRAW	Exports coordinates in RAW file format
EXPR2PLUSRW5	Exports coordinates in RW5 file format
EXPR2WCSV	Exports coordinates in AntasMobile file format
EXPGSI16	Exports coordinates in GSI 16 bit file format
EXPGSI8	Exports coordinates in GSI 8 bit file format

NEWFIELDBOOK	Opens a window where to create a new fieldbook
OPENFIELDBOOK	Imports an existing fieldbook
LOADFIELDBOOK	Imports a fieldbook in one of the supported formats
FROMFIELDBOOK	Reads fieldbook presents in the project
DOWNLOADLEVELING	Downloads data from digital level
TRANSLATEPTS	Opens the window where you can translate points and exchange coordinates
PTTOGPS	Performs GPS stakeout
PRESETSYSTEM	Sets default reference system
ADDNEWSYSTEM	Creates new reference system
DELETERASTER	Deletes raster image
PPSTOPGO	Opens the window in which to perform postprocessing Stop&Go
PPSTATIC	Opens the window in which to perform Static postprocessing
PPKINEMATIC	Opens a window in which to perform Kinematic postprocessing
PPSTATICNET	Opens a window in which to perform Static Multi-Base post-processing
GPSNET	Opens a window to perform GNSS network compensation
RASTERIN	Import raster image
CALCULATION7PARAMETERS	Opens a window for the 7 parameters calculation
COORDINATECONVERSION	Opens a window for the coordinate conversion
TRIGONOMETRICLEVEL	Allows to import a file for leveling
GEOMETRICLEVEL	Allows to import a file (.csv) for leveling
CREATECURVE	Opens a window to create contour lines
CREATEDTM	Opens a window to create a DTM
CONSTRAINTBOUND	Allows the creation of a constraint
EXCLUSIONBOND	Allows the creation of an exclusion
EXISTINGPROFILE	Allows to import a file with the .cubeprf extension
MANUALPROFILE	Allows to create a manual profile

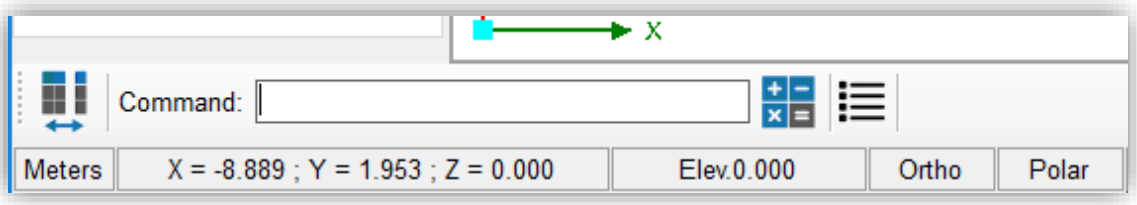


Figure 7.11

Another useful tool besides the command line is the Quick Selection (Figure 7.12); in the commands that involve the selection of CAD entities or topographic points, with the right-click it is possible to access a menu that allows a quick selection of the entity/entities. The selection is divided into topographic point and CAD entities and takes place through the choices of the respective properties. From this pop-up window (right-click) it is also possible to quickly access the properties window of the entity.

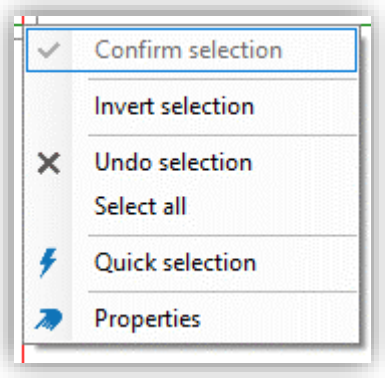


Figure 7.12

Double-clicking on the mouse wheel performs a zoom limit.

The Project management panel (Figure 7.13, on the left of the main screen) is a tree structure that contains all the topographic and raster entities present in the project. By double clicking on the topographic points, you can select them as an alternative to the graphic selection. The icons next to the name provide information on the type of point in question.

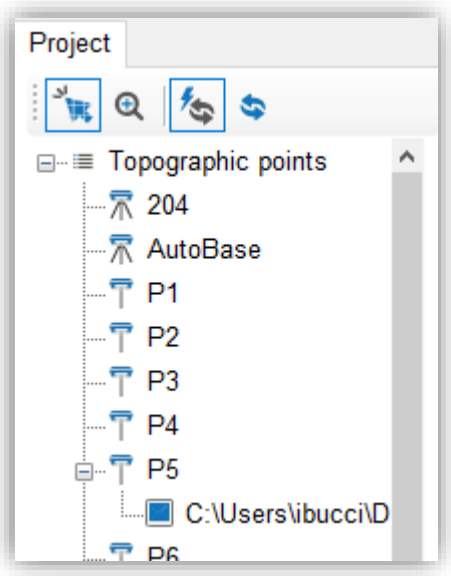


Figure 7.13

The Project management panel can be activated or deactivated by pressing the show / hide button at the bottom-left part of the main screen (icon in the red circle, Figure 7.14). While the two icons to the right of the command line have the function to start the system calculator (first icon from the left) and opening a file with the date, time and description of the commands entered in the current work session (second icon).

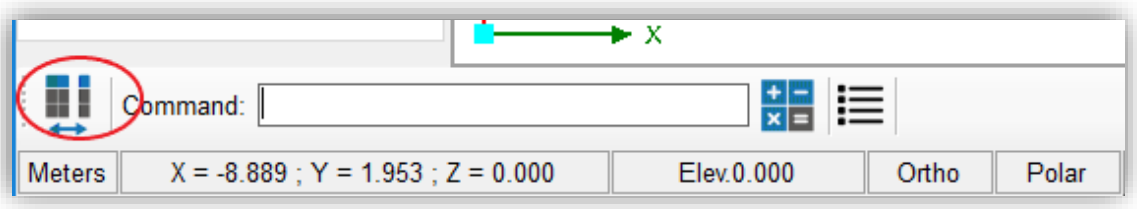


Figure 7.14

At the bottom of the screen, you can view the coordinates of the elements in the project, enable or disable the Osnap mode, the Ortho view and the Polar view. Thicknesses and reference grid can also be activated or deactivated.

Activating the Reference grid generates a window as in Figure 7.15. In this screen it is possible to create the ref grid by defining the type and scale at the top. In the main panel, the construction values of the parameters can be set (default values are always available), at the bottom you can set whether to build an external frame and with what characteristics. The Frame captions command opens a screen as in Figure 7.16, where you can choose the characteristics of any writes. By pressing the Reference grid button in the main interface, you can deactivate it (if a ref grid is found in the active job, you can delete or deactivate it, or create a new one).

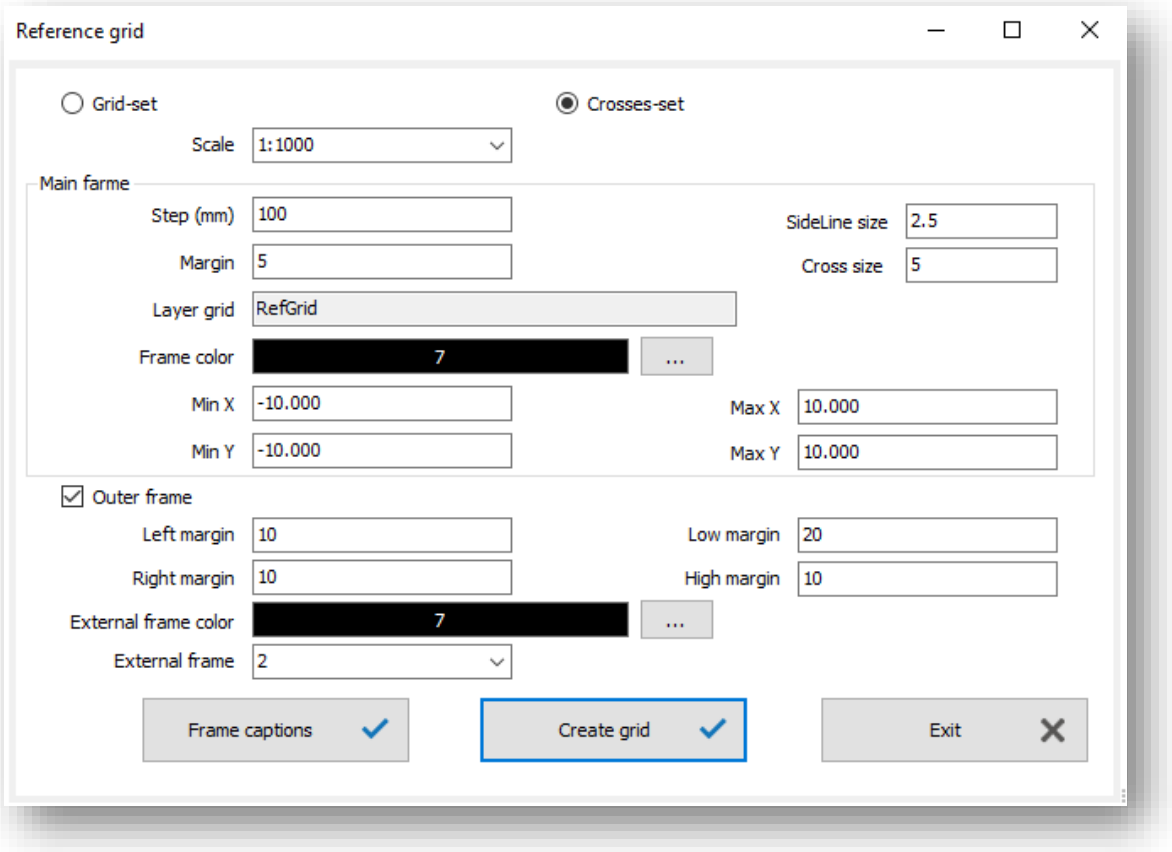


Figure 7.15

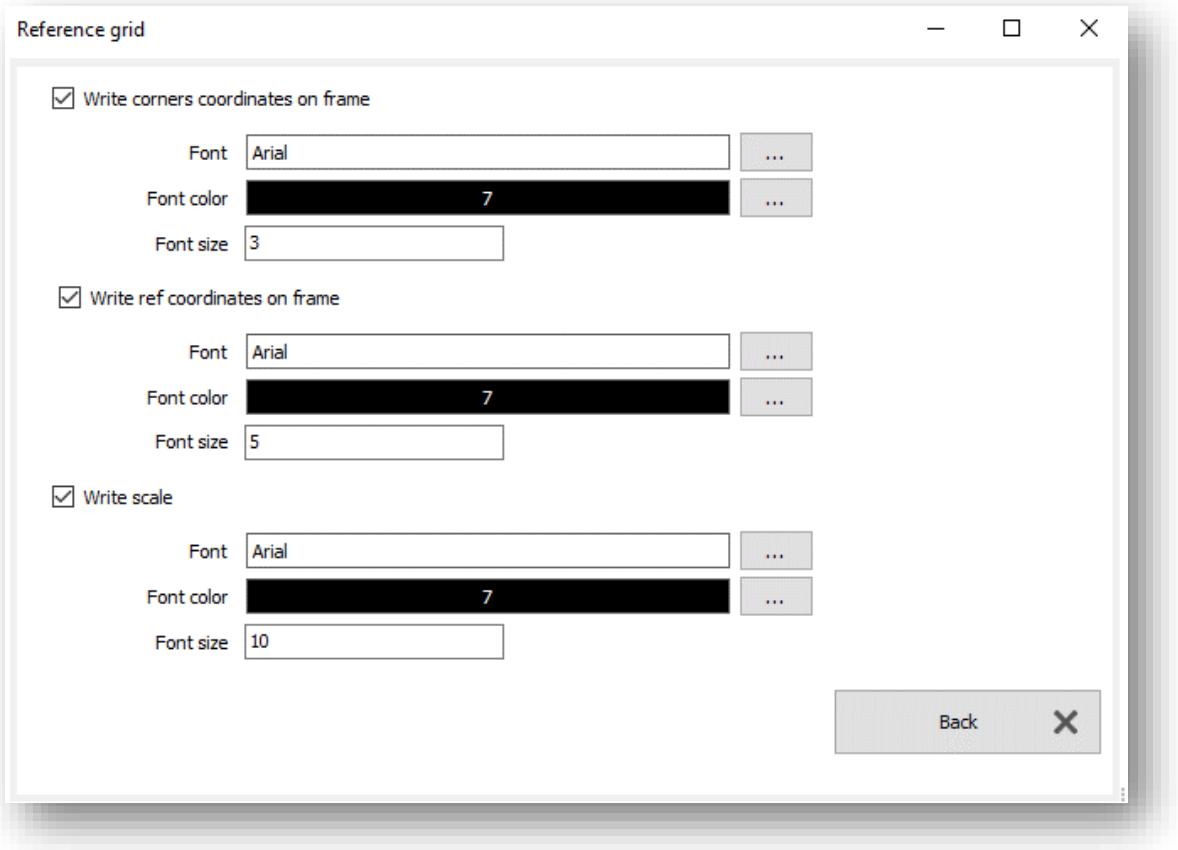


Figure 7.16

By clicking on the Tool bars button (menu in the red circle, Figure 7.17) it is possible to customize the layout and display of the shortcuts available in the program (Figure 7.18, all the icons for the shortcuts available. To relocate them on the screen, drag the bars by clicking on the 5 points on the left, drag-and-drop system).

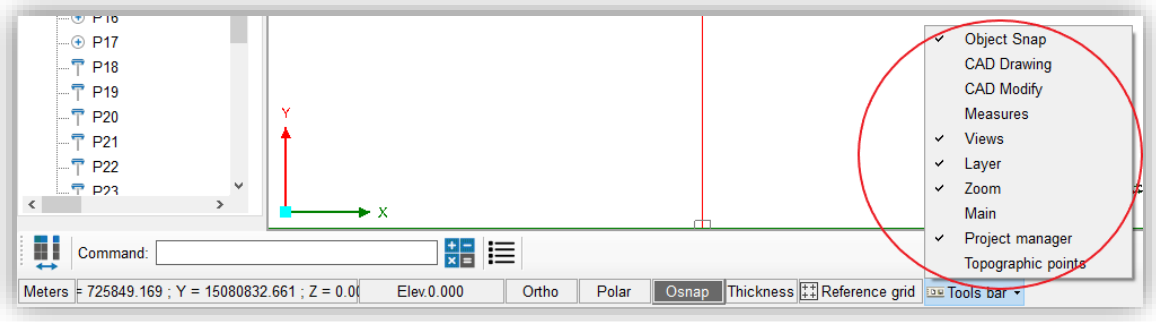


Figure 7.17

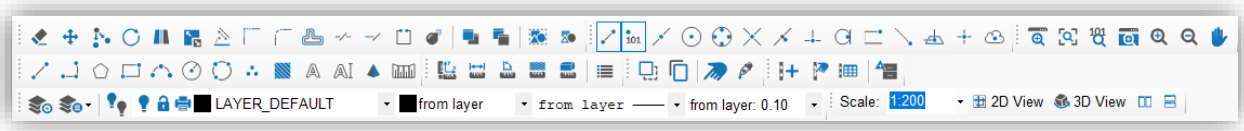

LAYER_DEFAULT
from layer
from layer
from layer: 0.10
Scale:
1:200
2D View
3D View

Figure 7.18

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