

TcpTunnel CAD

2.0

Reference Manual

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1 Features and Functionality

This document describes how the application runs to calculate and draw in CAD tunnel Cross-Sections taken from digital total stations. This program is complementary to the data gathering and setting out application **TcpTunnel** for Windows CE, although files generated by other applications available in the market can also be used.

The application allows one to define a project made up of the ground plan and elevation alignment, optional superelevations and the theoretical cross-section whose parameters are specified. Such data may also be optionally copied to the mobile device for its use with the above-mentioned program.

Once the coordinate data of the points corresponding to the total station's survey are available, it is possible to draw the cross-sections obtained with different options, render the theoretical and measured tunnel with a 3D wire diagram, in addition to obtaining point and volume lists.

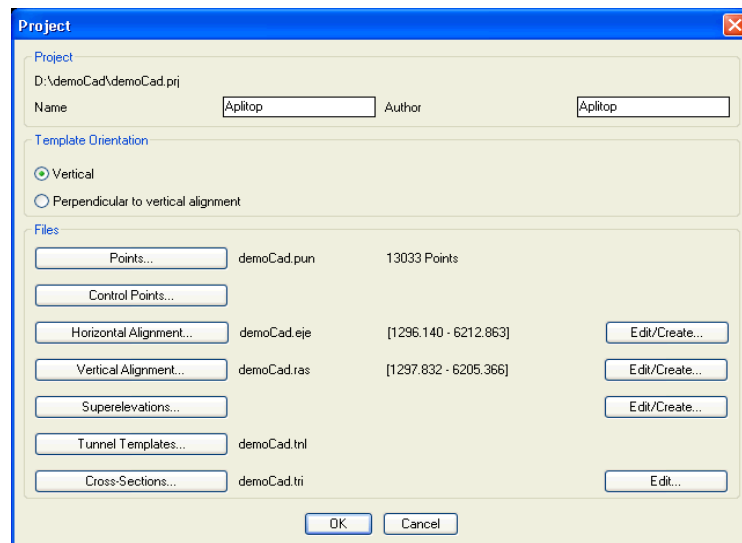
2 Command Reference

2.1 Create Project

In order to avoid having to remember each of the files making up a project, a type of file to store the links to each of its essential components has been created.

All these components should be kept in the same folder where the project is to be created.

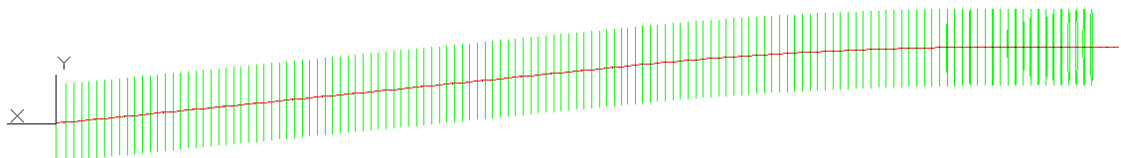
Once the name of the project to be created is entered, a screen is shown where the files making up the project should be selected:



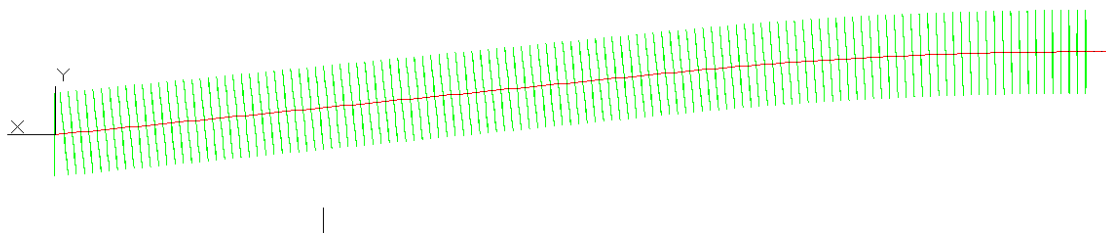
The *Points*, *Control Points*, *Horizontal Alignment*, etc. buttons allow one to select each of the components making up the project. Of all of these, stations and superelevations are not obligatory.

Within *Template Orientation*, it must be selected if the profiles are created vertical or perpendicular to horizontal alignment. The lastest option should be used for tunnel with high slopes.

Vertical



Perpendicular to vertical alignment



Pressing the *Edit...* buttons open an editor to create or modify the selected item. With the **OK** button creates the project indicated containing the files selected.

The different kinds of files requested are described below.

2.1.1 Points

The surveying points of the current project are stored in these files in ASCII format. These files have the ***.PUN** extension (compatible with **MDT**) and contain the following data for each point separated by spaces:

<Number> <X Coordinate> <Y Coordinate> <Z Coordinate> <Code>

Name	Type	Length	No of Decimals	Remarks
N	Alphanumeric	14	0	Point number
X	Numeric	11	3	
Y	Numeric	11	3	
Z	Numeric	8	3	
Code	Alphanumeric	14	-	

Files in **GSI** format may be selected directly. The application will automatically import such files and create the corresponding ***.PUN** file.

2.1.2 Stations

The surveying stations of the current project are stored in these files in ASCII format. These files have the ***.BSE** extension (compatible with **MDT**) and contain the following data for each station separated by spaces:

<Number> <X Coordinate> <Y Coordinate> <Z Coordinate> <Anamorphosis> <Code>

Name	Type	Length	No of Decimals	Remarks
Station	Alphanumeric	8	-	Station's name
X	Numeric	11	3	
Y	Numeric	11	3	
Z	Numeric	8	3	
Code	Alphanumeric	14	-	
Scala	Numeric	9	8	

2.1.3 Horizontal Alignments

These files are also compatible with the file format of **TCP-Digital Terrain Model (*.EJE)** files.

The records have the following fields:

Name	Type	Length	No of Decimals	Remarks
Station	Numeric	11	3	Kilometre point
X	Numeric	11	3	
Y	Numeric	11	3	
Azimut	Numeric	8	4	
Parameter	Numeric	9	3	Clothoid section parameter
Radio	Numeric	9	3	

2.1.4 Vertical Alignments

These files are compatible with **TCP-Digital Terrain Model (*.RAS)** files.

The records have the following fields:

Name	Type	Length	No of ° Decimals	Remarks
Station	Numeric	11	3	Kilometre point
Height	Numeric	8	3	Vertex height
Kv / Radio	Numeric	9	3	
Tangent	Numeric	9	3	
Arrow	Numeric	9	3	

2.1.5 Superelevations

These files are compatible with **TCP-Digital Terrain Model (*.PER)** files.

The records have the following fields:

Name	Type	Length	No of Decimals	Remarks
Station	Numeric	11	3	Kilometer point
Pl	Numeric	6	3	Left hand superelevation
Pr	Numeric	6	3	Right hand superelevation

If the value of the right-hand and left-hand side superelevations is “**B**”, it indicates that there is pumping. In other words the value of both superelevations is -2.0% .

2.1.6 Tunnel Templates

This kind of file stores information on the tunnel template or tunnel templates along the project's alignment (See **Edit Tunnel Templates** command).

The extension of this kind of files is **TNL**.

2.1.7 Cross-Sections

This kind of file stores the information about measured profiles. It is created from horizontal and vertical alignments, tunnel template and measured points.

The records have the following fields:

Name	Type	Length	No of Decimals	Remarks
Station	Numeric	11	3	Kilometer point
Offset	Numeric	8	3	Point's offset relative to alignment
Height	Numeric	8	3	Point's height
Number	Alphanumeric	16		Number of the measured point

The extension of this kind of files is **TRI**.

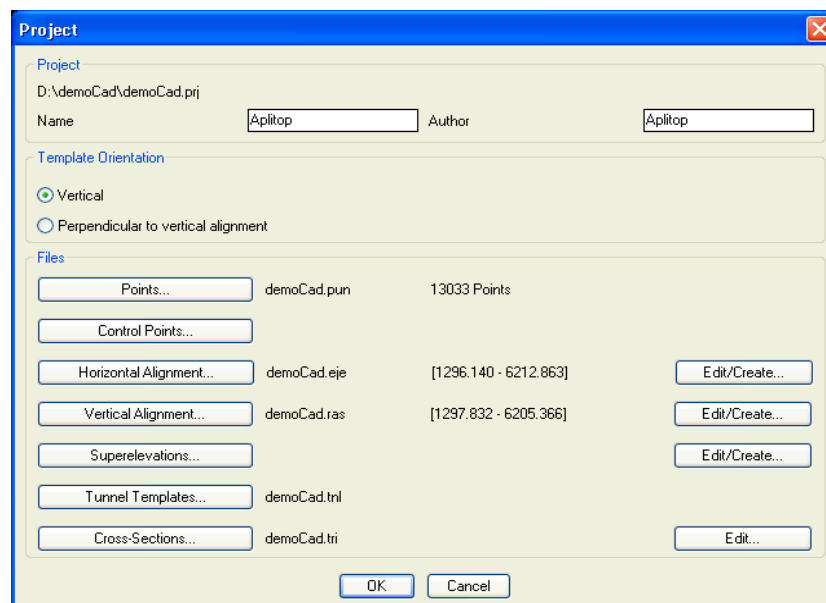
2.2 Open Project

With this command one can change the current project. All the other commands will use the last project loaded. If one has not been opened, it will ask for a created project.

If one uses the option of creating a new drawing in CAD, it will forget the last project loaded, and any other subsequent command will ask for a project.

2.3 Edit Project

This command enables one to change the files to be used in an existing project.

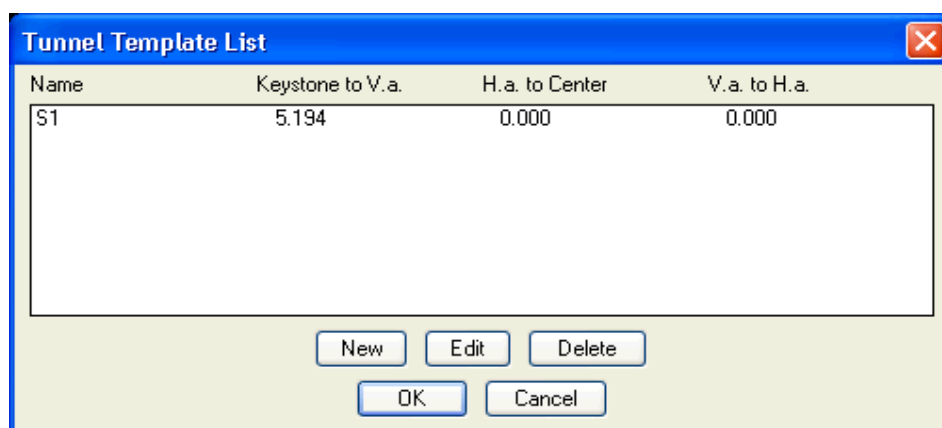


The changes made to the project selected will be stored by clicking on the **OK** button.

2.4 Edit Tunnel Templates

This command allows the cross-section file (*.TNL) that will be used along the length of the project's alignment to be created.

It shows up a dialog with the created cross-sections.



New: This option creates a new template, which must be drawn before it can be assigned graphically.

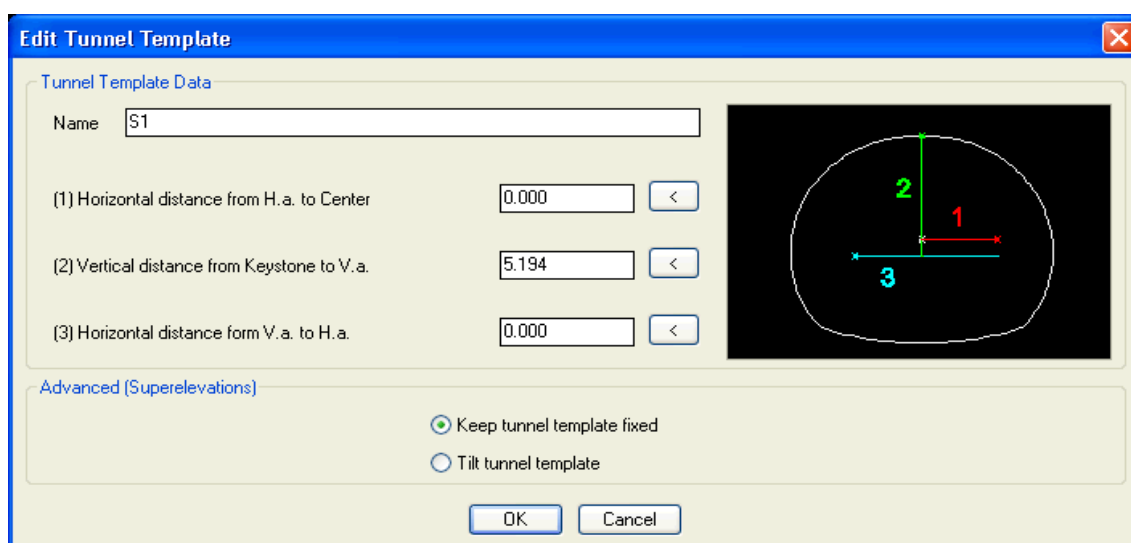
Edit: This allows one to edit an existing template.

Delete: Deletes selected tunnel template.

Any new templates that have been created or deleted will only be saved if one exits the dialog by using the OK button.

2.4.1 New Tunnel Template

The tunnel template is defined from a polyline. The polyline may be open or closed, and may be generated either clockwise or counter-clockwise. Once selected (you are asked to **Select Tunnel Template**) the following data is requested:



Name: Name of the cross-section. S1 is shown by default. If more than one cross-section is created, they will be named S2, S3, etc.

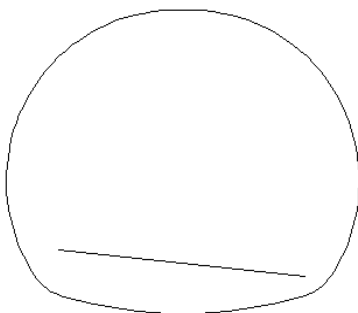
Horizontal distance form H.a. to Center: A positive value indicates that the ground plan alignment is to the right of the cross-section's center and a negative value indicates it is to the left. Differently to the grade line and superelevation application point, the ground plan application point can be defined to be outside the tunnel template.

Vertical distance from Keystone to V.a.: A positive value should be indicated if the keystone point is above the grade line and superelevation application point and negative otherwise. Under normal conditions, this value should always be positive. The grade line and superelevation application point should be within the tunnel template.

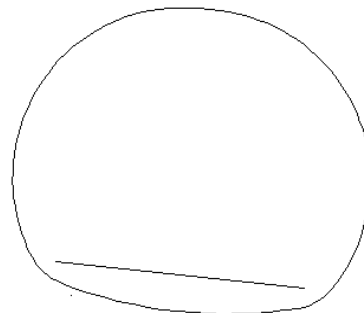
Horizontal distance from V.a. to H.a.: In this case the reference is the ground plan alignment's application point. One will therefore have to indicate a positive value if the vertical alignment and superelevation application point is to the right of the alignment and a negative value if it is to the left.

Advanced (Superelevations): If a superelevation file has been selected, the program allows tilt the tunnel template depend on the superelevation values. If **Keep tunnel template fixed** is selected and the tunnel template is open, the superelevations will be applied, creating the roadbed and closing the tunnel template.

Keep tunnel template fixed



Tilt tunnel template



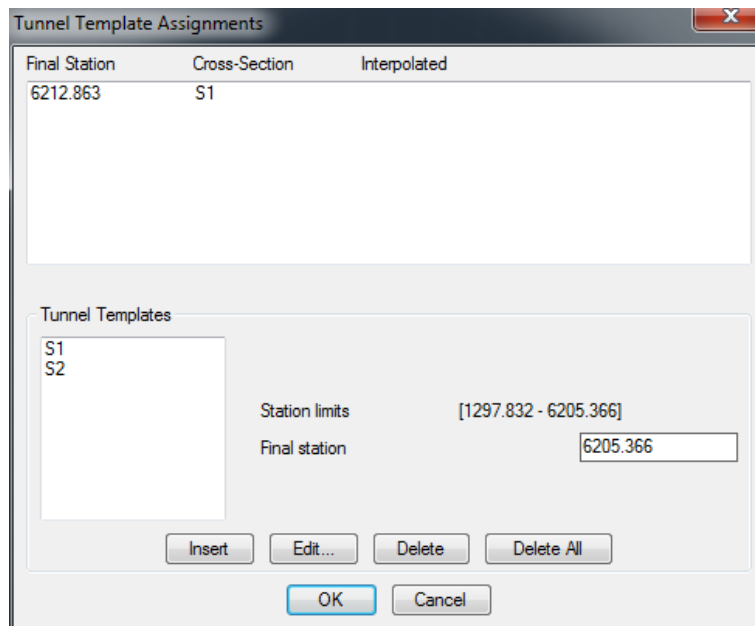
2.4.2 Edit Tunnel Template

This command allows one to change the parameters of an existing tunnel template. First, one must indicate a insertion point inside the drawing. Then the **Edit Tunnel Template** dialog is displayed (see **New Tunnel Template**).

2.5 Tunnel Template Assignments

After the tunnel templates have been defined, they must be assigned to the different sections.

To create assignments, select one of the created Cross-Sections listed in the **Tunnel Templates** box and specify the different parameters.



Final station: Station until which the selected template is applied.

Use the following buttons to change the assignments.

Insert : Insert a new assignment with the control values.

Edit: Opens a dialog for editing the values of the selected assignment.

Delete: Delete the selected assignment.

Delete All: Delete all the assignments.

The application will interpolate the templates between each assignment, if possible it will be indicated into the table. If no interpolation is required, a copy of the previous assignment must be created.

Exit the dialog with the **OK** button to *save any changes made*

2.6 Calculate Cross-Sections

This option calculates the cross-sections with the project points, for which an alignment is required. The cross-sections calculated are saved in the project cross-sections file, using the format ***.TRI**.

Initial station: Station from which measured points to be drawn are sought. The project's alignment is indicated next to the initial station.

Final station: Station up to which measured points to be drawn are sought. The project's alignment is indicated next to the final station.

Station interval: Value by which stations increase from the initial station indicated up to the final station.

Station tolerance: Station's regression value. If the difference between a station analyzed for a point and a station on the theoretical list is less than this value, a point in the theoretical station profile is considered to which it is adjusted.

Minimum points distance: Minimum distance between two consecutive points of the profile.

Minimum points: Minimum number of points that a profile must contain.

Close cross-sections: After calculating each cross-sections, the program will join the final and the initial point to create a closed cross-section. If the cross-section is open, the join between the ends will not be taken into account when calculating the surfaces. If there is a closed theoretical cross-section, this option must be marked if one wants the surface area calculation to include the whole cross-section.

Include non-multiple stations: Initially, the file's points are analyzed and grouped together by the closest station according to the tolerance indicated. These stations are then adjusted in accordance with the tolerance to the stations appearing on the list created according to the **Station interval**. By marking this box, one indicates that one wishes to take into account stations that have not been adjusted to any multiple of the initial station indicated in accordance with the **Station interval**.

Adjust to theoretical station: Uses the stations calculated with the interval and the initial and final stations instead of the stations calculated automatically.

Round stations: Round cross-section stations to the closest integer.

Cross-sections Center: This option allows one to set up the point which is used to sort the points of the profiles. If **Auto** option is selected, the point calculated is the

center of the rectangle that encloses the profile points. Otherwise, horizontal and vertical alignments application points will be use. The program allows one to change those points entering a horizontal and vertical distance.

Cross-Sections File: Cross-Sections file output, by default it will show cross-sections file project.

2.7 Draw Cross-Sections

Graphically shows the differences between the tunnel cross-sections gathered in the field and the tunnel templates.

To start off with, the following data is requested:

Draw cross-sections

Cross-section data

Initial station: 3000.000
Final station: 4140.000

Filters

Minimum height: -10.000

Format

Scale: 300 Text height: 0.20 Space: ☒ Model ☐ Paper Page setup: DIN-A4

Number of cross-sections: 112 Number of pages: 14 (2x4) Columns: 3

Drawing

☒ Point number ☒ Station ☒ Area
☒ Point height ☒ Vertical alignment height
☒ Difference ☒ Superelevation
☒ Dimensioning line ☒ Horizontal alignment coordinates ☐ Grid

OK Cancel

Initial station: Station from which measured points to be drawn are sought. The project's alignment is indicated next to the initial station.

Final station: Station up to which measured points to be drawn are sought. The project's alignment is indicated next to the final station.

Minimum Height: Height with respect to the grade line for cutting the cross-sections and theoretical cross-section, by a horizontal line.

The elements one wishes to show can be selected in the **Drawing** section, as can the **Scale**, **Text Height**, **Space** (*Model* or *Paper*) and **Drawing Format**. The latter has options for drawing Cross-Sections in **Continuous** mode or on several sheets of **DIN-A0**, **DIN-A1**, **DIN-A2**, **DIN-A3** o **DIN-A4** paper. The option of also drawing one profile per sheet (DIN-A4) is also offered in the **Individual** option.

The drawing option in paper model allows one to use the CAD command “Publish” to print the cross-sections in PDF.

The elements making up the drawing include:

Point Number: Number of the points taken in the field.

Point Height: Height of the points taken in the field.

Difference: Perpendicular distance to the tunnel cross-section from the point measured.

Dimensioning Lines: Lines that join the point taken and its projection on the tunnel’s theoretical cross-section.

Station: Theoretical station calculated by regression.

Vertical Alignment Height: Vertical alignment height at the theoretical station.

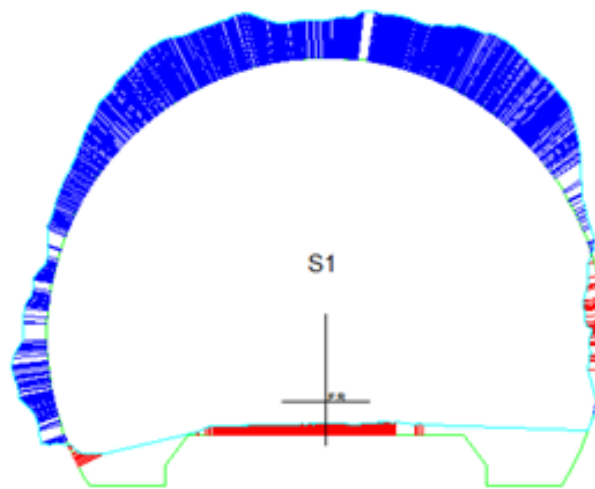
Superelevation: Left-hand superelevation at the theoretical station.

Horizontal Alignment Coordinates: X and Y coordinates of the ground plan alignment at the theoretical station.

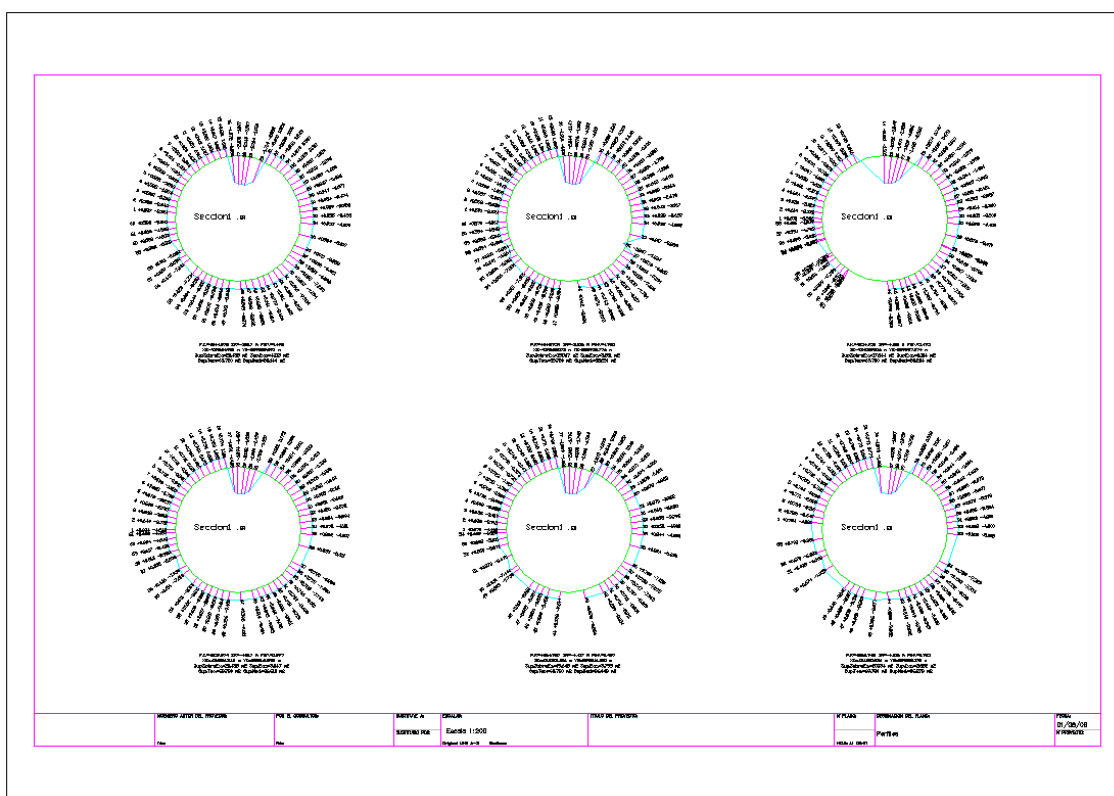
Area: Undercut and overcut areas and total areas of the theoretical and measured cross-sections at the theoretical station.

Grid: Is only activated when the *Individual* option is selected in *Drawing Format*. Shows a grid to mark distances and heights.

You are requested to select an insertion point for the drawing when **OK** is clicked. It should be taken into account that theoretical Cross-Sections are only drawn when measured points have been found depending on the filters indicated. It could therefore happen that no drawing is generated.



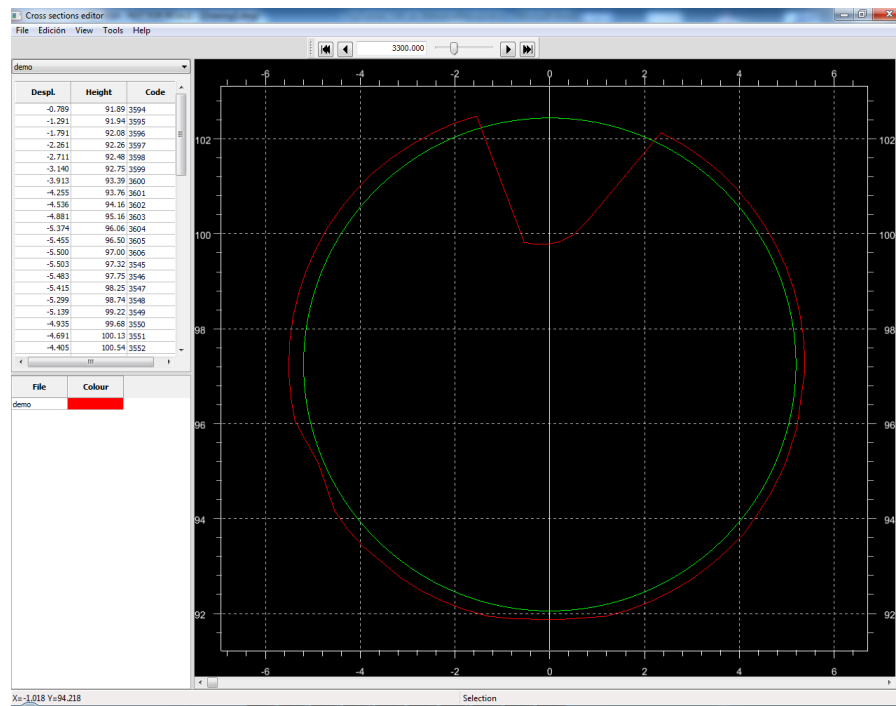
Theoretical and measured cross-section drawing (Individual)



Theoretical and measured cross-section drawing (DIN-A3)

2.8 Edit Cross-Sections

This tool allows one to edit the cross-sections created previously for deleting, mainly, the points which introduce noise in the profile, by example, the points surveyed on ventilation pipes. Read [Cross-sections Editor](#) for more details.



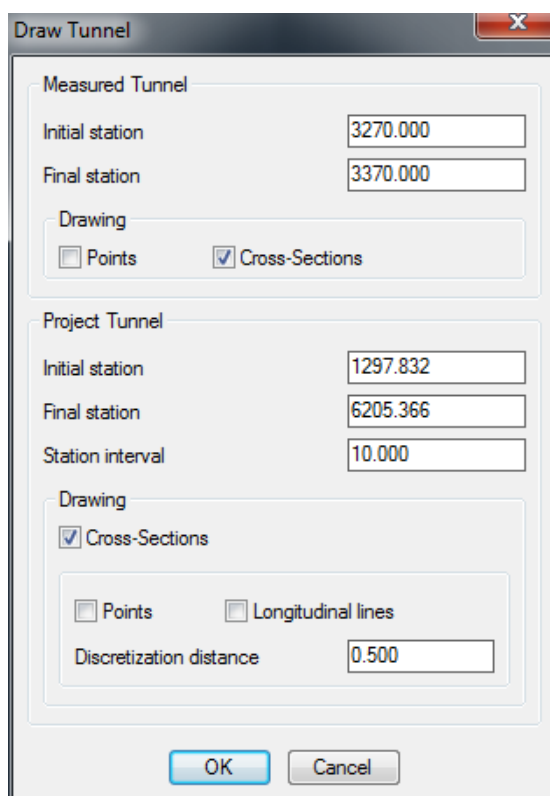
2.9 Import Cross-Sections

This command allows user to import a cross-section file with **TRA** extension, used in previous versions of TcpTunnel CAD.

After selecting the file to import, the program will create a file with the same name and **TRI** extension, it will be included in the current project and it will be showed in the cross-section editor.

2.10 Draw Tunnel

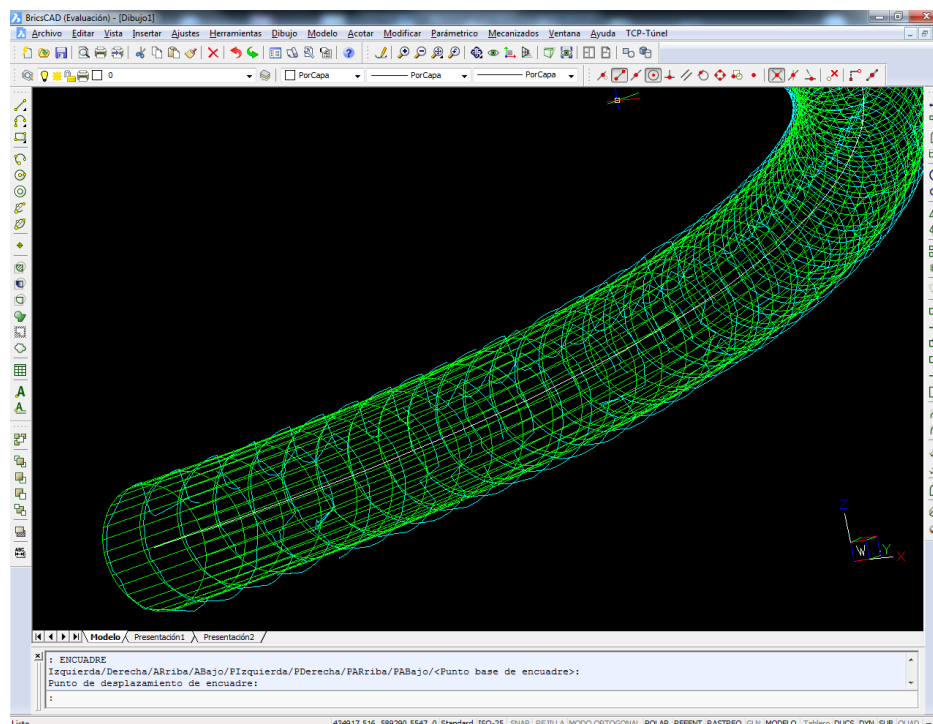
Shows a 3D graphic of the theoretical and measured tunnel. In both cases the initial and final stations delimiting drawing request. If no cross-section file exists in the project, or it's empty, the corresponding section will appear disabled.



The 'Draw Tunnel' dialog box is divided into two main sections: 'Measured Tunnel' and 'Project Tunnel'. Each section contains input fields for 'Initial station' and 'Final station', and a 'Drawing' sub-section with checkboxes for 'Points' and 'Cross-Sections'. The 'Project Tunnel' section also includes a 'Station interval' field, a 'Discretization distance' field, and a checkbox for 'Longitudinal lines'. 'OK' and 'Cancel' buttons are at the bottom.

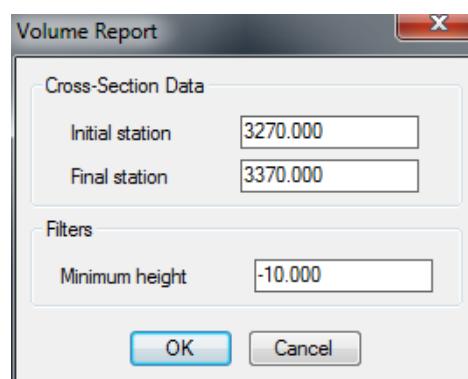
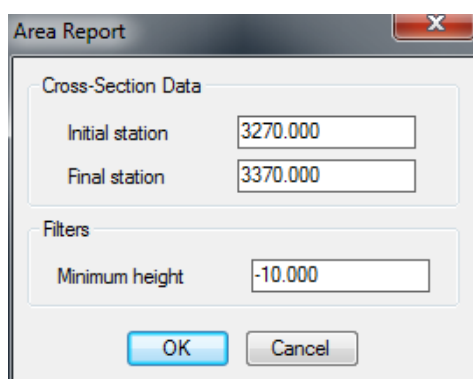
Section	Field	Value
Measured Tunnel	Initial station	3270.000
	Final station	3370.000
	Points	<input type="checkbox"/>
	Cross-Sections	<input checked="" type="checkbox"/>
Project Tunnel	Initial station	1297.832
	Final station	6205.366
	Station interval	10.000
	Points	<input type="checkbox"/>
	Cross-Sections	<input checked="" type="checkbox"/>
	Longitudinal lines	<input type="checkbox"/>
	Discretization distance	0.500

Drawing elements can be selected independently for measured and theoretical tunnel. The points and the cross-section can be drawn in both cases, and longitudinal lines in the case of the theoretical tunnel. The distance between theoretical points can be entered in the *Discretization distance* box.



3 Areas and Volumes Report

There follows a description of the common part of the areas and volumes lists. Using any of two options will show a common dialog for the parameters. Both reports have the same input parameters.



Initial station: Station where volume calculation starts. The project's alignment is indicated next to the initial station.

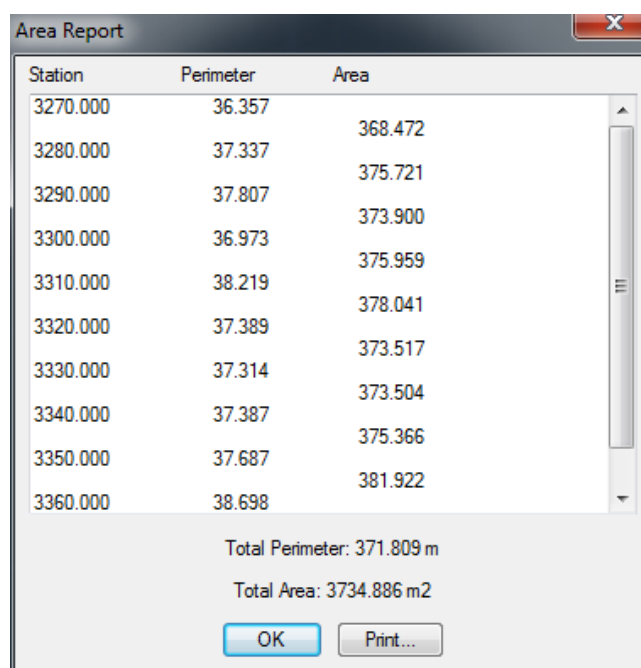
Final station: Station where calculation ends. The project's alignment is indicated next to the final station.

Minimum height: Height with respect to the grade line for cutting the cross-sections and theoretical cross-section, by a horizontal line.

Once the data requested has been entered, the following list is shown after clicking on **OK**.

3.1 Areas Report

If the areas report has been selected, the report displayed will be as follows.



Station	Perimeter	Area
3270.000	36.357	368.472
3280.000	37.337	375.721
3290.000	37.807	373.900
3300.000	36.973	375.959
3310.000	38.219	378.041
3320.000	37.389	373.517
3330.000	37.314	373.504
3340.000	37.387	375.366
3350.000	37.687	381.922
3360.000	38.698	

Total Perimeter: 371.809 m
Total Area: 3734.886 m2

OK Print...

Station: Shows the stations where points have been observed.

Perimeter.: Cross-section perimeter.

Area.: Area formed by the cross-section of the previous and next station on the list. This is calculated by the Mean Areas method:

$$A = (\text{PerimeterFST} + \text{PerimeterIST}) * ((\text{FST} - \text{IST}) / 2)$$

where

FST = Final Station of the interval.

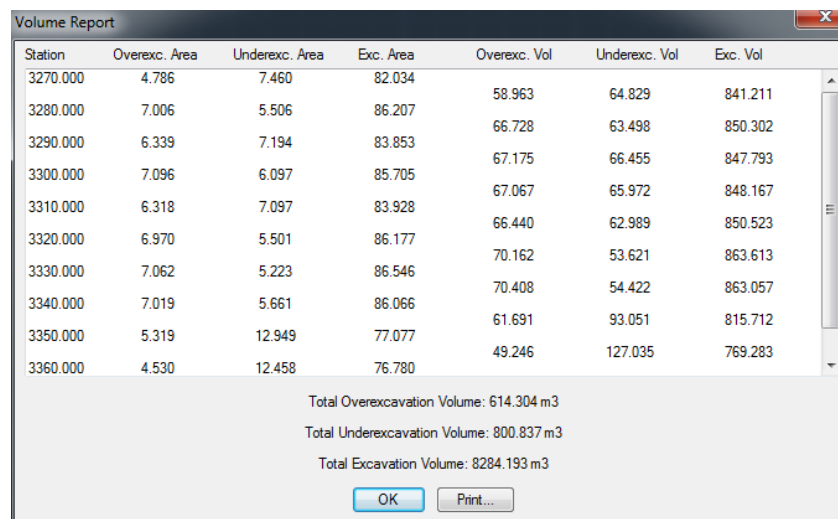
IST = Initial Station of the interval.

PerimeterIST = Perimeter of the initial cross-section of the interval.

PerimeterFST = Perimeter of the final cross-section of the interval.

3.2 Volumes Report

If the volumes report is selected, the following dialog is displayed.



Station	Overexc. Area	Underexc. Area	Exc. Area	Overexc. Vol	Underexc. Vol	Exc. Vol
3270.000	4.786	7.460	82.034	58.963	64.829	841.211
3280.000	7.006	5.506	86.207	66.728	63.498	850.302
3290.000	6.339	7.194	83.853	67.175	66.455	847.793
3300.000	7.096	6.097	85.705	67.067	65.972	848.167
3310.000	6.318	7.097	83.928	66.440	62.989	850.523
3320.000	6.970	5.501	86.177	70.162	53.621	863.613
3330.000	7.062	5.223	86.546	70.408	54.422	863.057
3340.000	7.019	5.661	86.066	61.691	93.051	815.712
3350.000	5.319	12.949	77.077	49.246	127.035	769.283
3360.000	4.530	12.458	76.780			

Total Overexcavation Volume: 614.304 m3
 Total Underexcavation Volume: 800.837 m3
 Total Excavation Volume: 8284.193 m3

OK Print...

Station: Shows the station where points have been taken.

Overexc. Area: Excess excavation area at station indicated.

Underexc. Area: Area to be excavated at station indicated.

Exc. Area: Excavated area at station indicated.

Overexc. Vol: Existing excess excavation volume between the previous and next station on the list. It is calculated by the Average Areas Method:

$$V = ((FSt - Ist) / 2) * (SurFSt + SurIst)$$

where

FSt = Final station of interval.

ISt = Initial station of interval.

SurFSt = Excess excavation surface or surface to be excavated calculated at the final station of interval.

SurISt = Excess excavation surface or surface to be excavated calculated at the initial station of interval.

Underexc.Vol. Existing volume to be excavated between the previous and next station on the list. Calculated using the same method as for overexcavation volume.

Exc.Vol.: Existing excavated volume between the previous and next station on the list. Calculated using the same method as for overexcavation volume.

Total Overexcavation Volume: Sum of over excavation volumes between the initial and final stations on the list.

Total Underexcavation Volume: Sum of volumes to be excavated between the initial and final stations on the list.

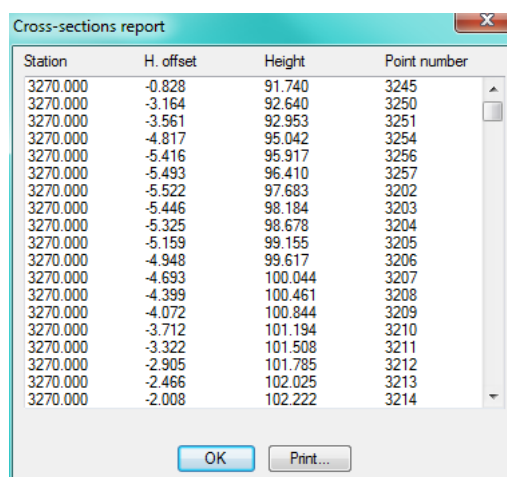
Total Excavation Volume: Sum of excavated volumes on the list.

Print: Allows the list's contents to be transferred to paper, a Word document, an Excel document, etc. (See Lists section).

3.3 Cross-Sections Report

This command shows the cross-sections list of the current file.

It allows the list's contents to be transferred to paper, a Word document, an Excel document, etc.



Station	H. offset	Height	Point number
3270.000	-0.828	91.740	3245
3270.000	-3.164	92.640	3250
3270.000	-3.561	92.953	3251
3270.000	-4.817	95.042	3254
3270.000	-5.416	95.917	3256
3270.000	-5.493	96.410	3257
3270.000	-5.522	97.683	3202
3270.000	-5.446	98.184	3203
3270.000	-5.325	98.678	3204
3270.000	-5.159	99.155	3205
3270.000	-4.948	99.617	3206
3270.000	-4.693	100.044	3207
3270.000	-4.399	100.461	3208
3270.000	-4.072	100.844	3209
3270.000	-3.712	101.194	3210
3270.000	-3.322	101.508	3211
3270.000	-2.905	101.785	3212
3270.000	-2.466	102.025	3213
3270.000	-2.008	102.222	3214

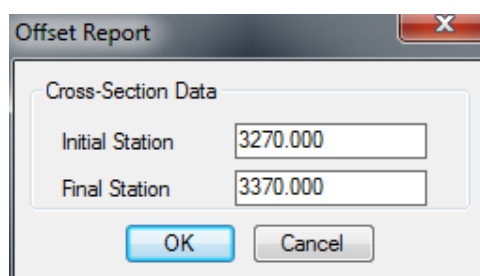
For each point, station, offset regarding horizontal alignment, height and point number is showed.

3.4 Offsets Report

If the tunnel cross-sections are circular, the offset at each station can be calculated by calculating the geometric center of each cross-section and measuring its adjustment.

Currently, this option must not be used unless use the cross-sections are circular.

When this command is selected, the following window is displayed, where the cross-sections and the station range can be selected



Offset Report

Cross-Section Data

Initial Station: 3270.000

Final Station: 3370.000

OK Cancel

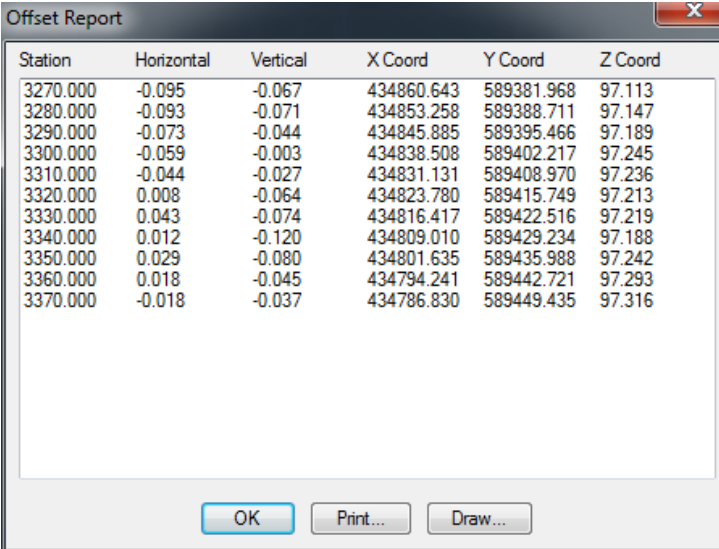
Initial Station: Initial station for calculating the offset. The minimum station of the cross-sections is displayed by default.

Final Station: Final station for calculating the offset. The maximum station of the cross-sections is displayed by default.

When the **OK** button is pressed, the application calculates the tunnel offset as follows.

1. It creates groups of points formed by three points
2. For each group it calculates the middle of the circle (which is why the cross-sections must always represent a circumference)
3. It accumulates horizontal and vertical offset from the middle of the circle with respect to the middle of the cross-section.
4. It averages the offsets with the number of groups created.

The data calculated are displayed in the following report.



Station	Horizontal	Vertical	X Coord	Y Coord	Z Coord
3270.000	-0.095	-0.067	434860.643	589381.968	97.113
3280.000	-0.093	-0.071	434853.258	589388.711	97.147
3290.000	-0.073	-0.044	434845.885	589395.466	97.189
3300.000	-0.059	-0.003	434838.508	589402.217	97.245
3310.000	-0.044	-0.027	434831.131	589408.970	97.236
3320.000	0.008	-0.064	434823.780	589415.749	97.213
3330.000	0.043	-0.074	434816.417	589422.516	97.219
3340.000	0.012	-0.120	434809.010	589429.234	97.188
3350.000	0.029	-0.080	434801.635	589435.988	97.242
3360.000	0.018	-0.045	434794.241	589442.721	97.293
3370.000	-0.018	-0.037	434786.830	589449.435	97.316

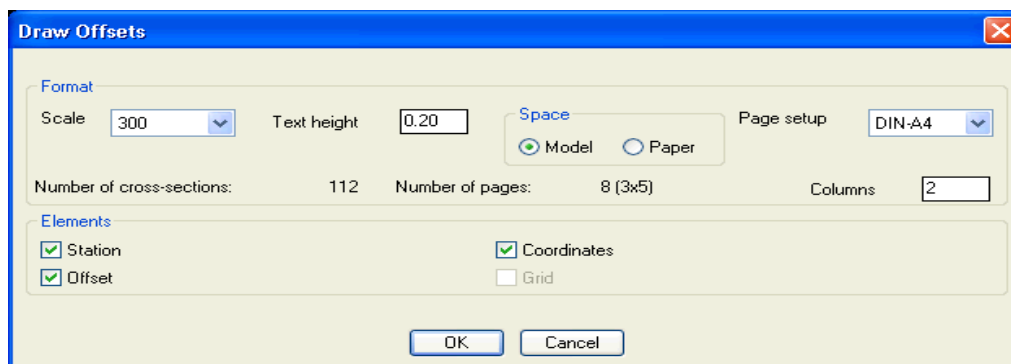
Station: Station of the cross-section used for calculating the offset.

Horizontal: Horizontal offset of the cross-sections with respect to the ground plan alignment.

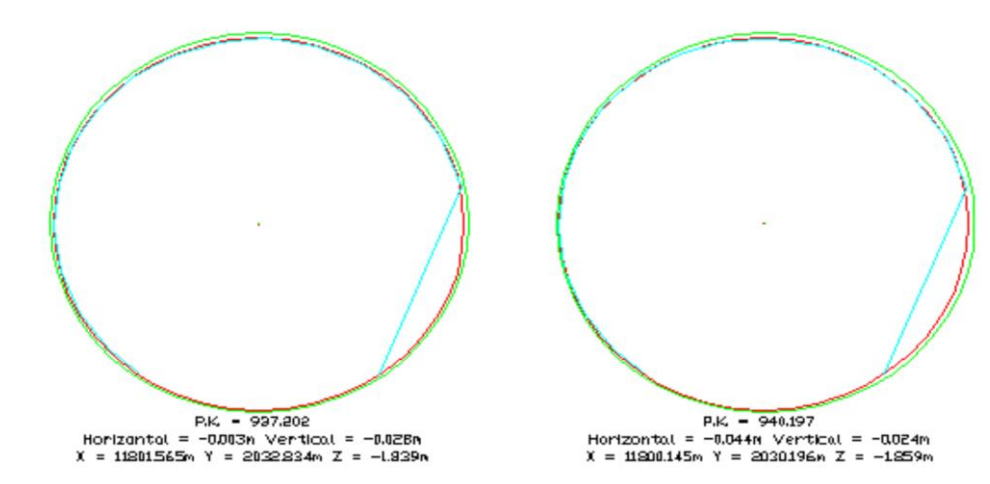
Vertical: Vertical offset of the cross-sections with respect to the elevation alignment.

X, Y, Z Coord.: 3D coordinates of the offset alignment at the station in question.

For a graphic representation of the calculations, select **Draw**, which will display the following dialog for configuring the input/output format. The options are the same as for drawing cross-sections.

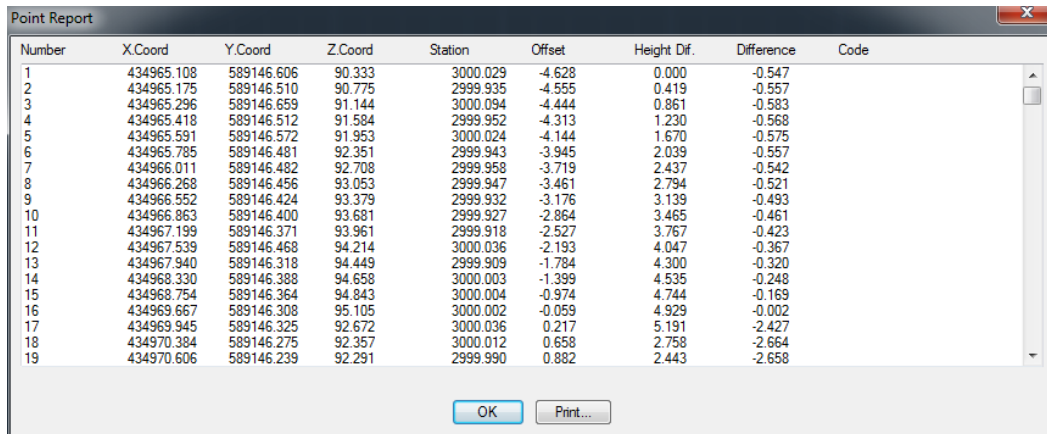


The cross-section is light blue, and the theoretical cross-section is green. The place where the theoretical cross-section with the data of the offset applied would be placed is shown in red.



3.5 Points Report

Shows a report containing information about the points in the file contained in the project selected.



Number	X.Coord	Y.Coord	Z.Coord	Station	Offset	Height Dif.	Difference	Code
1	434965.108	589146.606	90.333	3000.029	-4.628	0.000	-0.547	
2	434965.175	589146.510	90.775	2999.935	-4.555	0.419	-0.557	
3	434965.296	589146.659	91.144	3000.094	-4.444	0.861	-0.583	
4	434965.418	589146.512	91.584	2999.952	-4.313	1.230	-0.568	
5	434965.591	589146.572	91.953	3000.024	-4.144	1.670	-0.575	
6	434965.785	589146.481	92.351	2999.943	-3.945	2.039	-0.557	
7	434966.011	589146.482	92.708	2999.958	-3.719	2.437	-0.542	
8	434966.268	589146.456	93.053	2999.947	-3.461	2.794	-0.521	
9	434966.552	589146.424	93.379	2999.932	-3.176	3.139	-0.493	
10	434966.863	589146.400	93.681	2999.927	-2.864	3.465	-0.461	
11	434967.199	589146.371	93.961	2999.918	-2.527	3.767	-0.423	
12	434967.539	589146.468	94.214	3000.036	-2.193	4.047	-0.367	
13	434967.940	589146.318	94.449	2999.909	-1.784	4.300	-0.320	
14	434968.330	589146.388	94.658	3000.003	-1.399	4.535	-0.248	
15	434968.754	589146.364	94.843	3000.004	-0.974	4.744	-0.169	
16	434969.667	589146.308	95.105	3000.002	-0.059	4.929	-0.002	
17	434969.945	589146.325	92.672	3000.036	0.217	5.191	-2.427	
18	434970.384	589146.275	92.357	3000.012	0.658	2.758	-2.664	
19	434970.606	589146.239	92.291	2999.990	0.882	2.443	-2.658	

The following data are displayed for each point:

Number: Number of the point.

X, Y, Z Coordinates.: Point coordinates.

Station: Station of the point with respect to the project's alignment.

Offset.: Distance regarding to the project's horizontal alignment.

Height Dif.: Height difference with respect to the vertical alignment, which is the Z Coordinate – Height of the grade line at the point station

Difference.: Distance of the point with respect to the theoretical cross-section, a negative value indicates that the point is outside the cross-section, or overexcavation point. If no theoretical cross-section has been assigned to the station of this point, this field will appear empty.

Code.: Code of the point that was included in the original file.

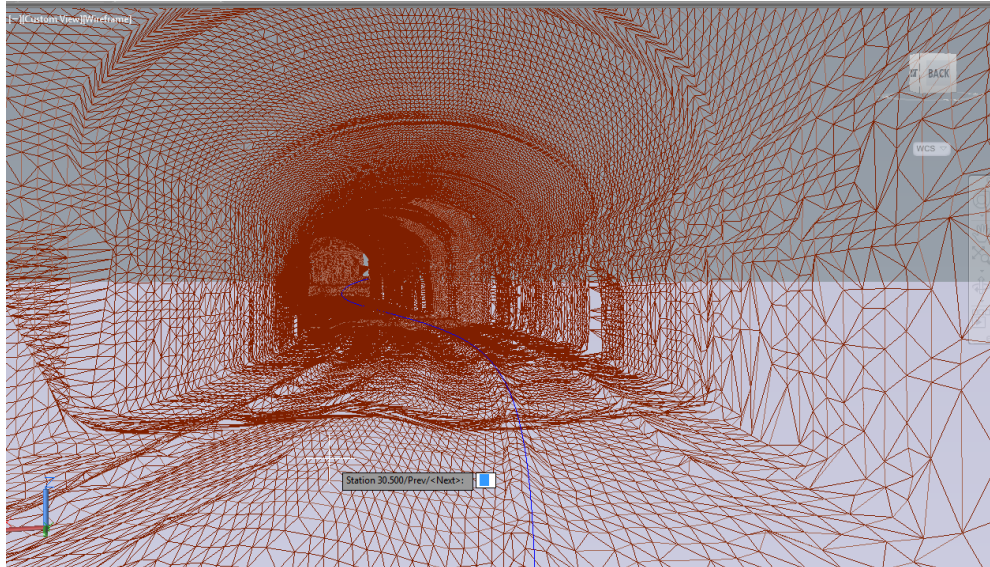
4 3D Model

This group of options allows one to generate a 3D triangulation of the tunnel, take a tour inside it and export to several file formats of geometrical definition, are as OBJ (Wavefront Technologies) and OFF.

4.1 Draw

This option does the 3D triangulation and it shows a drawing of this one along with the horizontal alignment of the project.

For doing this, the program asks for the initial and final stations and the number of points that will be created for each profile.



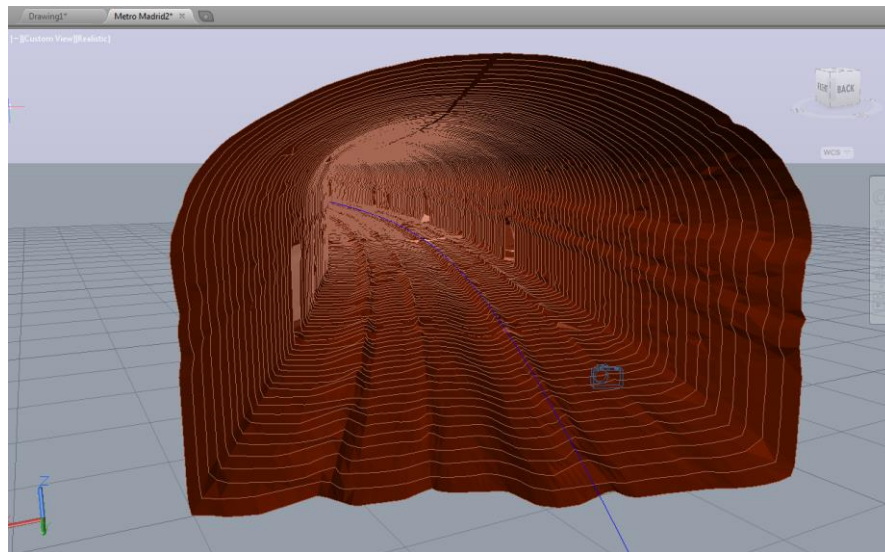
4.2 Tunnel Traveling

After 3D model of the tunnel is drawing, the program allows one to take a tour inside it. For doing this, the program asks for the following data:

Observer height: Height at which the camera is located, in meters.

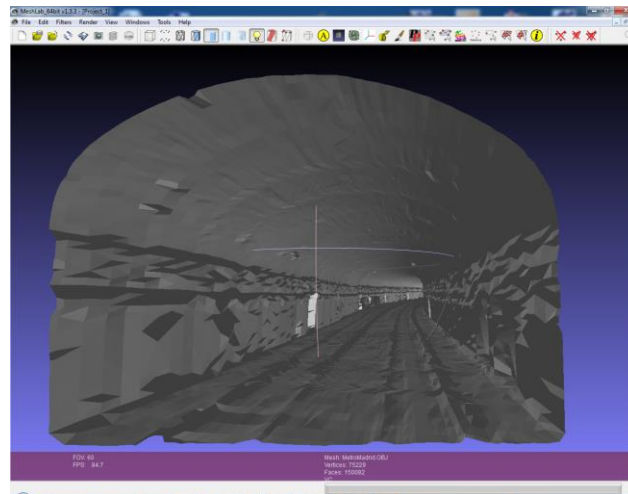
Movement: Forward direction in the tunnel, which can be Direct or Reverse.

Interval: Increased progress at every step, in meters.



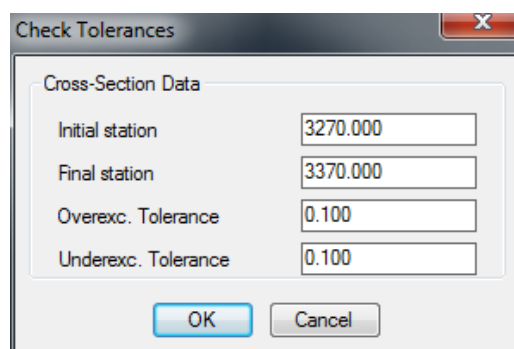
4.3 Export

The program allows one to export the created 3D model to OBJ and OFF formats for later viewing in other applications.



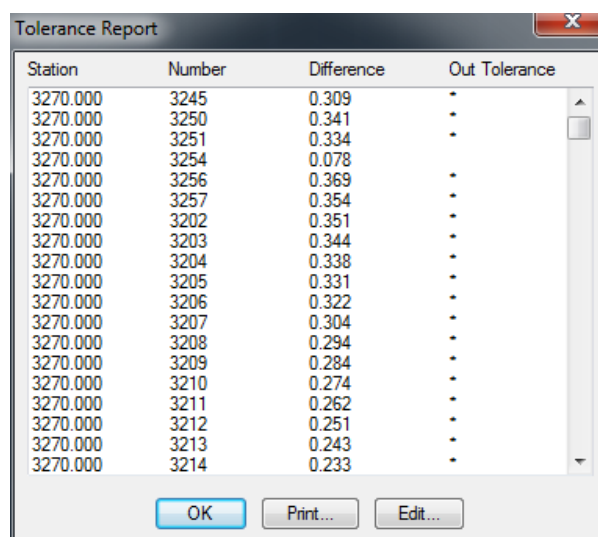
5 Check Tolerances

This option allows one to check if the measured profiles are under tolerance. The program asks for a profile file, initial and final stations and overexcavation and under excavation tolerances.



A dialog box titled "Check Tolerances" with a close button (X) in the top right corner. It contains a section labeled "Cross-Section Data" with four input fields: "Initial station" (3270.000), "Final station" (3370.000), "Overexc. Tolerance" (0.100), and "Underexc. Tolerance" (0.100). At the bottom are "OK" and "Cancel" buttons.

After enter the data, clicking on **OK** button, the program shows the tolerance report.

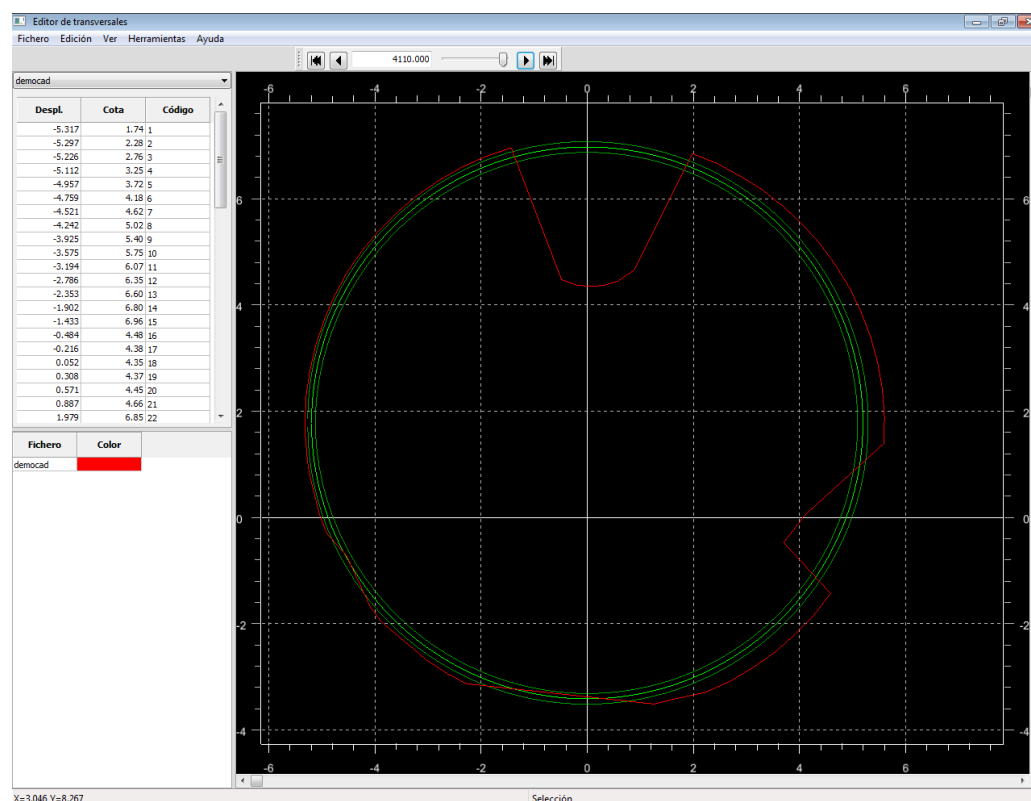


A dialog box titled "Tolerance Report" with a close button (X) in the top right corner. It contains a table with four columns: "Station", "Number", "Difference", and "Out Tolerance". The table lists 18 data points. At the bottom are "OK", "Print...", and "Edit..." buttons.

Station	Number	Difference	Out Tolerance
3270.000	3245	0.309	*
3270.000	3250	0.341	*
3270.000	3251	0.334	*
3270.000	3254	0.078	*
3270.000	3256	0.369	*
3270.000	3257	0.354	*
3270.000	3202	0.351	*
3270.000	3203	0.344	*
3270.000	3204	0.338	*
3270.000	3205	0.331	*
3270.000	3206	0.322	*
3270.000	3207	0.304	*
3270.000	3208	0.294	*
3270.000	3209	0.284	*
3270.000	3210	0.274	*
3270.000	3211	0.262	*
3270.000	3212	0.251	*
3270.000	3213	0.243	*
3270.000	3214	0.233	*

This report shows the profile station, the number of the point and the difference. The last column shows, with an asterisk, if the point is under the tolerances entered.

Clicking on Edit button, the program shows the selected profile graphically.



6 Compare Cross-Sections

This command allows to compare two cross-sections files form different stages of a project.

TcpTunnel > Compare Cross-Sections will show up the following dialog.

Compare Cross-Sections

Cross-Section Files

File... comp1.tri [3270.000 - 3370.000]

File... comp2.tri [3270.000 - 3370.000]

Cross-Section Data

Initial station 3270.000

Final station 3370.000

Tolerance 0.250

OK Cancel

In the cross-sections area, select two different files. Shown next to each one will be the station range where cross-sections have been defined.

The first of the two files selected will be used as a reference point when calculating the volumes and surface areas. Therefore the outer or over excavated surface area corresponds to the areas of the second cross-section that are outside the first.

When the compare cross-section dialog OK button is pressed, a list comparing the selected cross-section files is displayed. The first file is used as the reference for the outside and inside volumes.

Volume Report					
Station	Overexc. Area	Underexc. Area	Station Diff.	Overexc. Vol.	Underexc. Vol.
3270.000	4.606	0.432	10.000	24.656	15.560
3280.000	0.325	2.680	10.000	14.778	17.287
3290.000	2.630	0.778	10.000	18.368	17.994
3300.000	1.044	2.821	10.000	19.261	16.904
3310.000	2.809	0.560	10.000	18.604	5.514
3320.000	0.912	0.543	10.000	6.892	7.447
3330.000	0.466	0.946	10.000	5.108	52.454
3340.000	0.556	9.544	10.000	24.469	70.898
3350.000	4.338	4.635	10.000	43.936	78.686
3360.000	4.449	11.102			
Total Overexcavation Volume: 176.071 m3					
Total Underexcavation Volume: 282.745 m3					
<input type="button" value="OK"/> <input type="button" value="Print..."/> <input type="button" value="Draw..."/>					

The program will always close the two cross-sections to make the surface area and volume calculations.

Pressing **Draw** button allows to draw the comparison of cross-sections. The following dialog will be show to set up the drawing options. The **Discretization distance** allows to set the number of points used for drawing the cross-sections.

Draw cross-sections

Format

Discretization distance

0.500

Text height

0.20

Scale

300

Space

☒ Model
☐ Paper

Page setup

DIN-A4

Number of columns

1

2 Cross-section(s) 1 Page(s) (2 x 3)

Elements

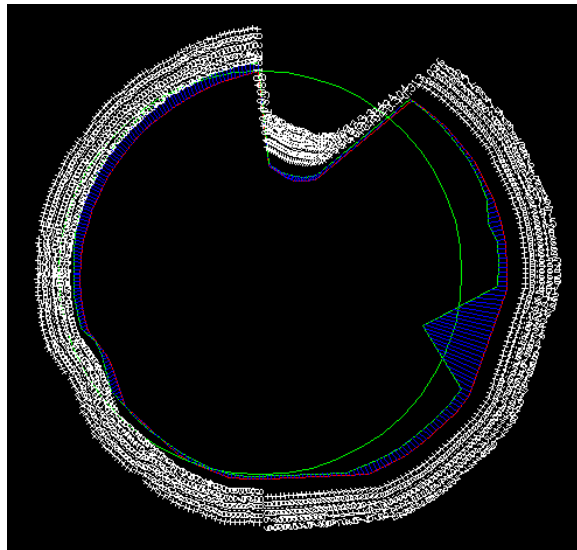
☒ Difference
☒ Surface

☒ Dimensioning line
☐ Grid

☒ Station

OK

Cancel



7 Export Setting out Marks

This command allows one to create a grid file for setting out the front using TcpTunnel for total station.

Before running the command, the point grid must be drawn in a separated layer.

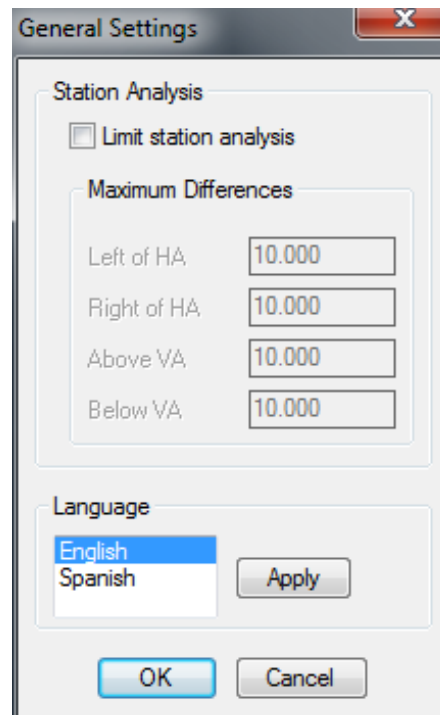
Then, the next steps must be followed:

- Select a point from the grid.
- Enter the offset of the point regarding the horizontal alignment.
- Enter the offset of the point regarding the vertical alignment.
- Enter the name of the grid file.

After this, if a tunnel template file exists in the project, the tunnel templates will be drawn along with the point grid.

8 General Settings

This option allows one to change several parameters of the program settings.



Station Analysis

Allows one to activate/desactivate the limits for station analysis. This feature is useful for spiral horizontal alignment or horizontal alignments with crossed sections which have different heights. The program asks for maximum differences on the left and on the right of the horizontal alignment and maximum differences above and below of the vertical alignment heights.

For each point, the program will calculate several station solutions along the horizontal alignment and then, it will select the first station where the point is under the values of the previous four parameters.

This feature is used within the options **Calculated Cross Sections** and **Point Report**.

Language

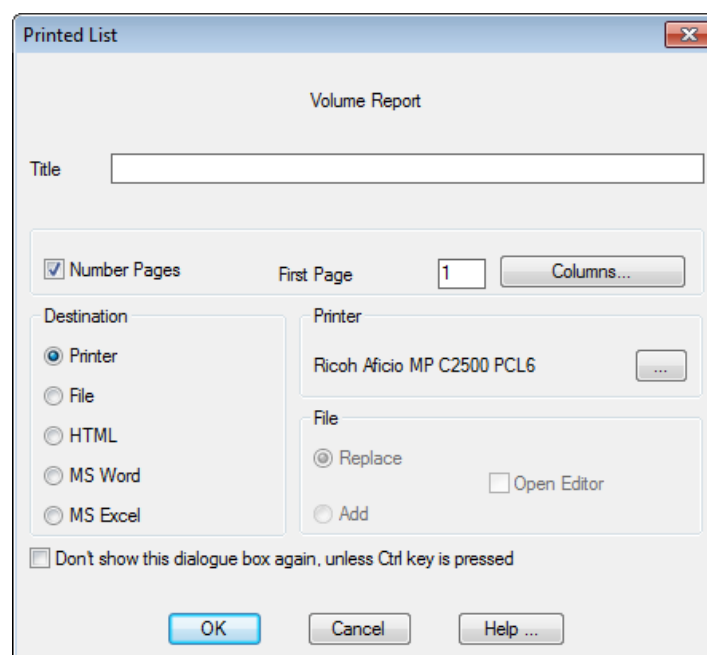
Allows one to change the program language. English or spanish can be selected.

9 About

Shows a window containing the application's version, sub-version and review numbers.

10 Reports

The **Print** button's options allow one to transfer the data shown on screen to different destinations.



Title of document.

Number Pages: Indicates if one wishes to add page numbers to the **Printer** option.

First Page: First page of numbering.

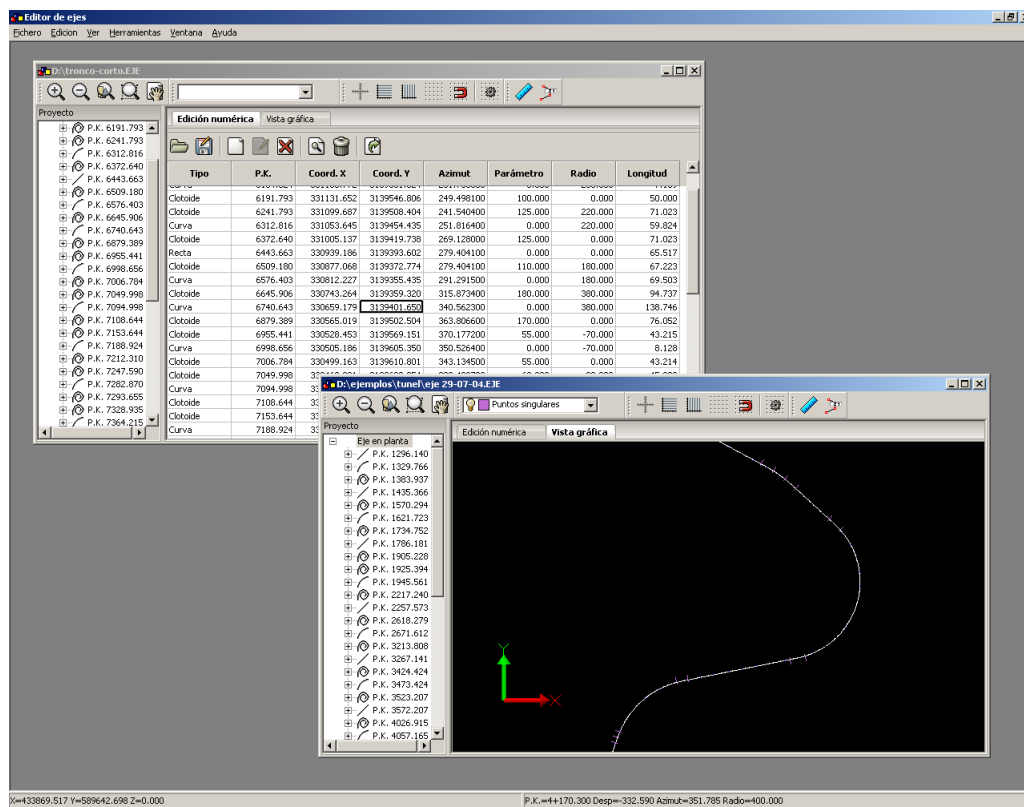
Destination: Indicates where one wishes to transfer the information. If one selects the **Printer** option, one can select and configure the printer by clicking on the ... button appearing in the **Printer** box on the right-hand side of the screen. Should the **File** option be selected, the information is transferred onto a text file. One can also **Replace** or **Add** the information should the file already exist. The document can additionally be opened once printing is completed (**Open Editor**). The **HTML**

option creates an HTML document that can be opened with an Internet browser. Lastly, the *MS Word* and *MS Excel* options create Microsoft Word and Microsoft Excel documents.

Do not show this dialog box again unless...: Once the destination where one wishes to print the information is configured, the dialog box will not be shown again if this box is marked unless the Ctrl key is kept pressed.

11 Horizontal alignment editor

This application allows one to edit, view and modify ground plan alignments (*.EJE). The editor can work with several files at the same time, and each one will have its own window with its own graphic representation.



11.1 File Menu

New: Opens an empty window for entering a ground plan alignment manually.

Open: Opens the file selector to load an existing ground plan alignment.

Close: Closes the active window. If the ground plan alignment it contains has been modified, the application will ask before closing the window.

Save: Saves the ground plan alignment without asking the name.

Save As: Opens the file selector to save the ground plan alignment with a new name.

Import: Use this menu to import a ground plan alignment in another format. The different formats available are described below.

Export DXF: Creates a *.DXF file equal to the graphic representation. Any hidden layer will not be exported.

Quit: When one quits the application, it will display a dialog with each window that is open, and the ones with changed data will be marked. If OK is pressed, all the marked ground plan alignments will be saved.

11.2 Manually inserting a ground plan alignment

To add a ground plan alignment, the data must be entered from left to right. An alignment will only be inserted or modified after entering the “*Length*” field.

If an intermediate alignment is modified, one must accept all the different values until the “*Length*” field is reached and write a new value or press “*Enter*”. Certain fields, such as the coordinates and station, are calculated with these values and therefore cannot be modified.

The following icons are displayed above the numeric data, from left to right are:



Open: Opens a new ground plan alignment.

Save As: Saves the ground plan alignment with a new name.

New: Inserts a new alignment before the cursor position. The previous alignment will be divided in two, respecting the alignment length and the azimuth of the sections. The same at pressing the “*Insert*” key on the keyboard.

Edit: The edit button is not available.

Delete: Deletes the alignment where the cursor is located.

Search: Opens the search dialog, where one can insert one or several values of each field, and the application will look for the nearest alignment.

Delete All: Deletes the whole alignment.

Export: Exports the alignment to a file or printer. This option cannot be used for exporting to other formats.

11.2.1 Add a straight

If one wants to add a straight section, set the parameter and radius fields to zero.

To change the direction of the straight section, modify the azimuth value. By default, the application always marks the exit azimuth of the previous section.

Sections cannot be created with a length of zero.

11.2.2 Add a curve

To add a curve, set the parameter to zero and write the corresponding radius.

If the curve radius is greater than zero, the curve will be to the right according to the alignment direction, and if it is a negative value, the curve will be to the left.

The proposed azimuth value is the exit azimuth of the previous section. The application does not allow one to change the azimuth in curved sections.

11.2.3 Add a clothoid

To add a clothoid, a parameter greater than zero must be entered.

If a radius other than zero is entered, this will indicate an entry clothoid. A radius equal to zero indicates an exit clothoid, which can only come after a curve.

11.3 Graphic representation

If one wants to see a graphic representation of the alignment, press the "Graphic view" tab. To configure the dimensioning marks and colours, use the dialog in "*Tools->Configuration*".

11.4 Tools

11.4.1 Move alignment

Changes the values to create an alignment parallel to the current one. A negative value will move the alignment to the left, and a positive one to the right.

11.4.2 Adjust Station

Changes the initial station of the alignment.

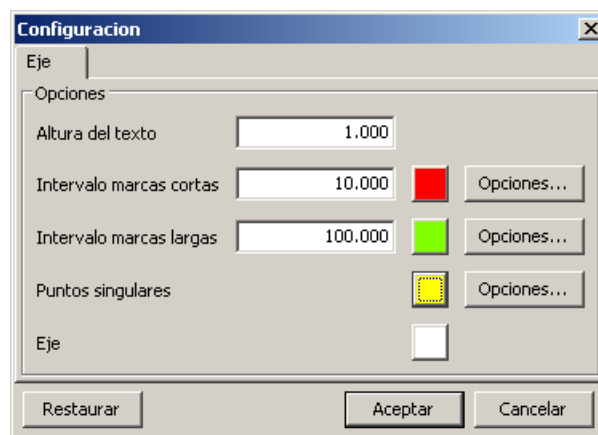
11.4.3 Invert alignment

Changes the alignment direction, without changing its length.

11.4.4 Configuration

The graphic representation of the alignment can be changed by modifying the elevation parameters and colours to represent each of the marks.

Allows one to change the colours and distances of the short and long marks, as well as the colour of the unique points.



Text height: Height of text in metres.

Short marks interval: Distance in metres between the short marks. Alongside is a button for assigning them a different colour, and the “Options...” button can be used to configure the format of the marks.

Long marks interval: Distance in metres between the short marks. The mark colour and format can also be configured.

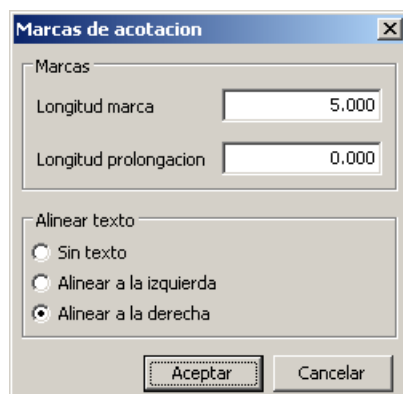
Unique points: Only the colour and format of the unique points can be configured. This mark will appear at the start of each line, curve or clothoid.

Alignment: To change the colour of the alignment.

To restore the default values, press the “Restore” button.

11.4.4.1 Format of the marks and unique points.

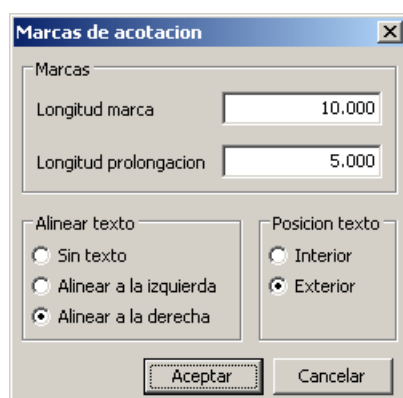
When the “Options...” button is pressed, the following dialog is displayed, where the values of each type of mark selected can be changed.



Mark length: Length of the mark. The line will be perpendicular to the alignment.

Extension length: If one draws texts, this value marks the extension of the mark towards the attached text.

Align texts: the texts can be aligned to the left, the right or not aligned at all.



The options available for the unique points are the same as for the short and long marks. One can also indicate if the text is inside or outside.

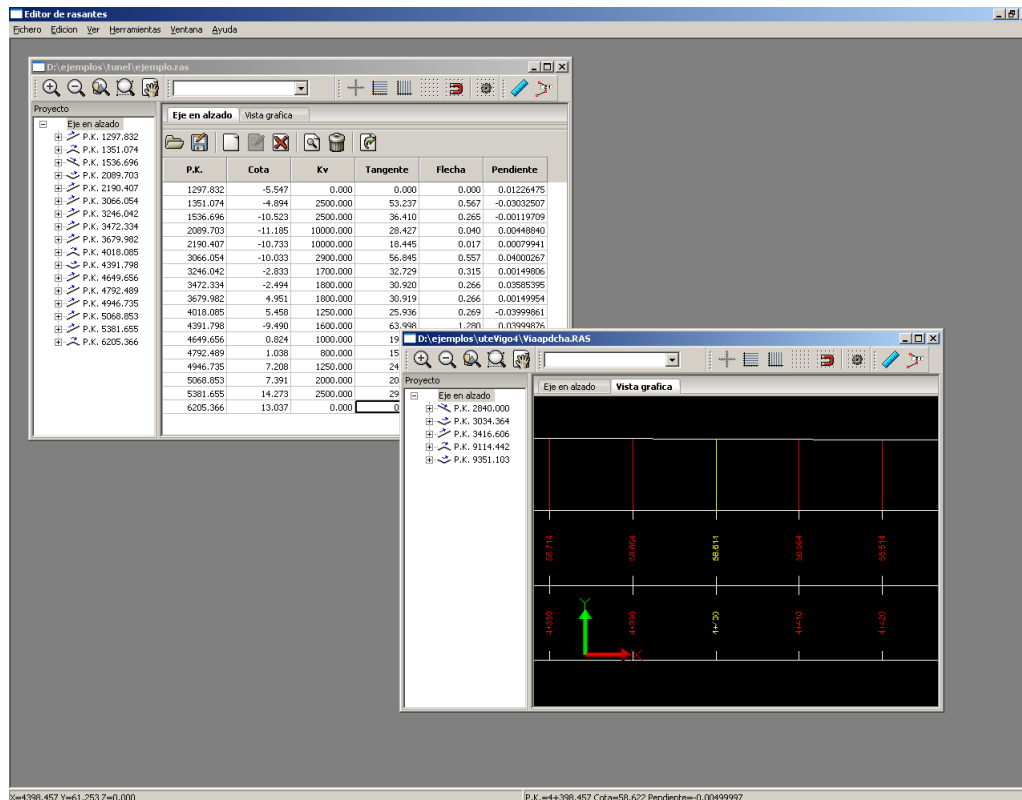
11.5 Import ground plan alignment

Alignments can also be imported from other formats. Alignments can currently be imported in Inland, LandXML and MXRoad format.

To import an alignment, open the “File->Import” menu and choose the appropriate type.

12 Vertical alignment editor

This application allows one to edit, view and modify elevation alignments (*.RAS). The editor can work with several files at the same time, and each one will have its own window with its own graphic representation.



12.1 File Menu

New: Opens an empty window for entering an elevation alignment manually.

Open: Opens the file selector to load an existing elevation alignment.

Close: Closes the active window. If the elevation alignment it contains has been modified, the application will ask before closing the window.

Save: Saves the elevation alignment without asking the name.

Save As: Opens the file selector to save the elevation alignment with a new name.

Import: Use this menu to import an elevation alignment in another format. The different formats available are described below.

Quit: When one quits the application, it will display a dialog with each window that is open, and the ones with changed data will be marked. If OK is pressed, all the marked elevation alignments will be saved.

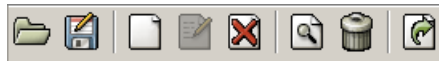
12.2 Manuel insertion

To enter an elevation alignment, first enter the “*Station*” and the “*Heights*”, and the programme will automatically move the cursor in these two columns. Then one can change the data of the agreements. This is necessary because the data of the previous and next line are needed to calculate the agreements of a given line.

The application will calculate if there is any overlap lapel between the different sections, and the cell where the overlap occurs will be shown in red. if there is overlap when a Kv, tangent or arrow is entered, the supplementary values will not be calculated.

To add more data, go to the last row and press “*Cursor down*”, and a new line for adding more data will appear. If one leaves the new line without changing anything, it will be deleted automatically.

The following icons are displayed above the numeric data, from left to right are:



Open: Opens a new elevation alignment.

Save As: Saves the elevation alignment with a new name.

New: Inserts a new alignment before the cursor position. The previous alignment will be divided in two, respecting the agreements. The same as pressing “*Insert*”.

Edit: The edit button is not available.

Delete: Deletes the alignment where the cursor is located.

Search: Opens the search dialog, where one can insert one or several values of each field, and the application will look for the nearest alignment.

Delete All: Deletes the whole alignment.

Export: Exports the alignment to a file or printer. This option cannot be used for exporting to other formats.

12.3 Graphic representation

If one wants to see a graphic representation of the elevation alignment, press the "Graphic view" tab. To configure the dimensioning marks and colours, use the dialog in "*Tools->Configuration*".

12.4 Tools

12.4.1 Move height

Modifies the height of the elevation alignment respecting the agreements. A negative value will move the elevation alignment down, and a positive one up.

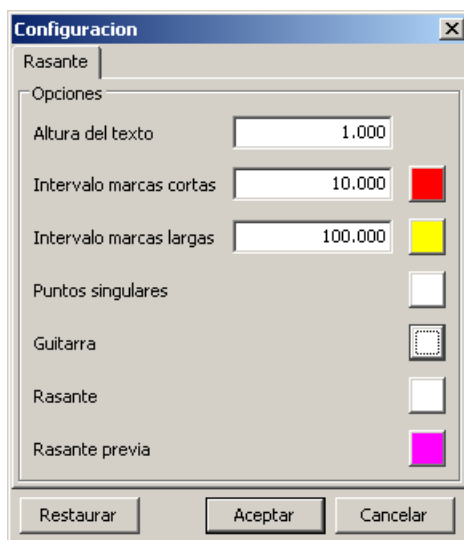
When the height of an elevation alignment is moved, the agreements do not change.

12.4.2 Adjust Station

Changes the initial station of the elevation alignment, without modifying the agreements.

12.4.3 Configuration

Accessed from "*Tools->Configuration*".



The following layers appear in the representation:

Short marks: Draws a vertical line from the minimum height to the grade line height. The distance between these marks is configurable.

Long marks: Draws a vertical line from the minimum height to the grade line height. The distance between these marks is configurable.

Unique points: Colour of the unique points. Draws a vertical line at the following points:

- Station - tangent
- Station + tangent
- Station if the tangent equals zero.

Guitar: Colour of the separation lines and legend.

Grade line: Colour of the graphic representation of the grade line.

Previous grade line: Colour of the polyline formed by the station of each unique point and its height.

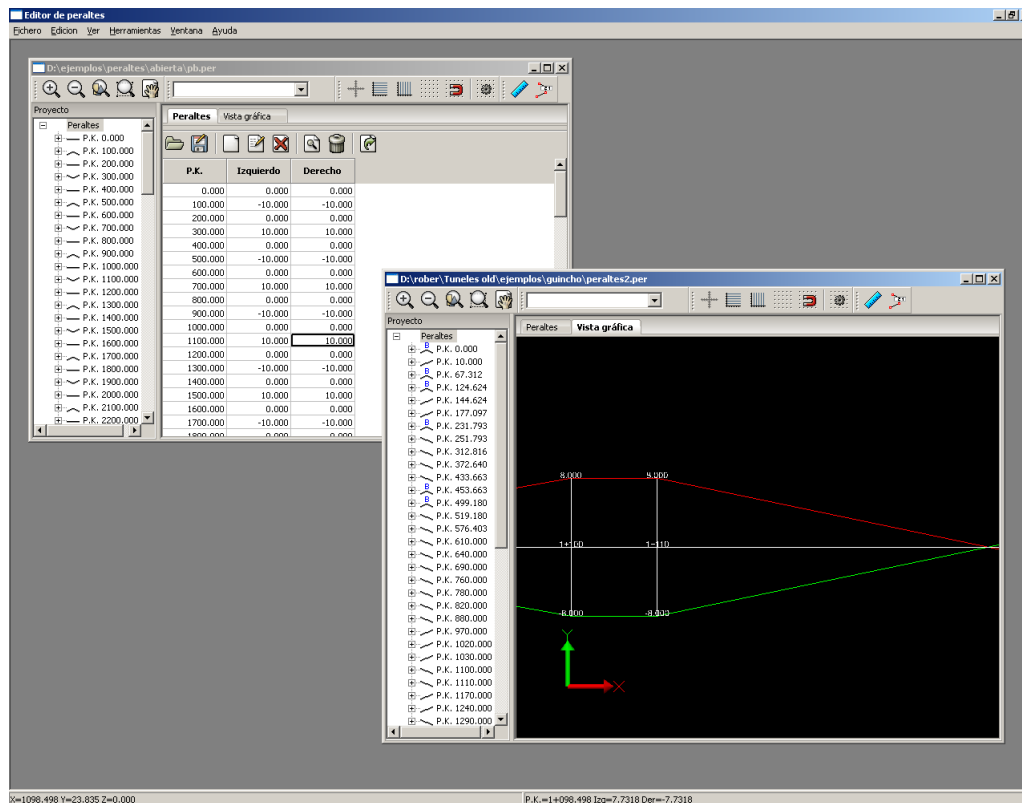
12.5 Import elevation alignment

Elevation alignments can also be imported from other formats. The formats accepted at present are Inland, LandXML and MXRoad.

To import an elevation alignment, open the “File->Import” menu and choose the appropriate type.

13 Superelevations editor

This application allows one to edit, view and modify superelevations (*.PER). The editor can work with several files at the same time, and each one will have its own window with its own graphic representation.



13.1 File Menu

New: Opens an empty window for entering superelevations manually.

Open: Opens the file selector to load a superelevation file.

Close: Closes the active window. If the superelevations it contains have been modified, the application will ask before closing the window.

Save: Saves the superelevations without asking the name.

Save As: Opens the file selector to save the superelevation with a new name.

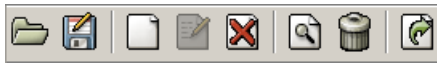
Exit: When one quits the application, it will display a dialog with each window that is open, and the ones with changed data will be marked. If OK is pressed, all the marked superelevations will be saved.

13.2 Manuel insertion

To add a ground plan alignment, the data must be entered from left to right. An alignment will only be inserted or modified after entering the “*Length*” field.

The superelevations must be entered with ascending station values.

The following icons are displayed above the numeric data, from left to right are:



Open: Opens a new superelevation file.

Save As: Saves the superelevations with a new name.

New: Opens a dialog to insert a new superelevation. El nuevo peralte se insertará en orden según su valor de P.K.

Edit: Opens a dialog for editing the current superelevation. If the station is modified, the superelevation will be moved so that the stations are in ascending order.

Delete: Deletes the alignment where the cursor is located.

Find: Opens the search dialog, where one can insert one or several values of each field, and the application will look for the nearest alignment.

Delete All: Deletes all the superelevations.

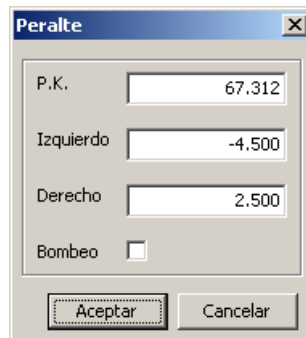
Export: Exports the superelevations to a file or printer. This option cannot be used for exporting to other formats.

Pressing “*Insert*” will insertar a new superelevation with a station that will be the Midpoint between the previous and current alignment. The left and right superelevations will be interpolated to maintain the same slope.

To add more data, go to the last row and press “*Cursor down*”, and a new line for adding more data will appear. If one leaves the new line without changing anything, it will be deleted automatically.

13.2.1 Edit superelevation

When the “New” or “Edit” button is pressed, the application displays the following dialog, where the values of the station, left superelevation and right superelevation can be modified or entered.



If the “Pumping” box is checked, a superelevation with the values -2.0, 2.0 will be created

When the dialog is okeyed, the new superelevation will be inserted or will move (if it is being edited), to the row for which the stations are in ascending order.

13.3 Graphic representation

If one wants to see a graphic representation of the superelevations, press the "Graphic view" tab. To configure the dimensioning marks and colours, use the dialog in “Tools->Configuration”.

13.4 Tools

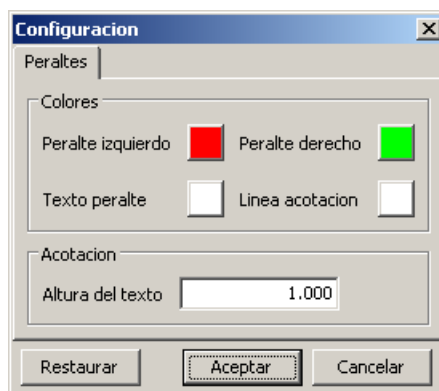
13.4.1 Adjust Station

Changes the initial station of the superelevations, without changing the left or right-hand values.

13.4.2 Configuration

The graphic representation of the superelevations can be changed.

Accessed from “Tools->Configuration...”.



Left superelevation: Colour of the left superelevations.

Right superelevation: Colour of the right superelevations.

Superelevation text: Colour of the texts that appear on the superelevations.

These appear in each unique item.

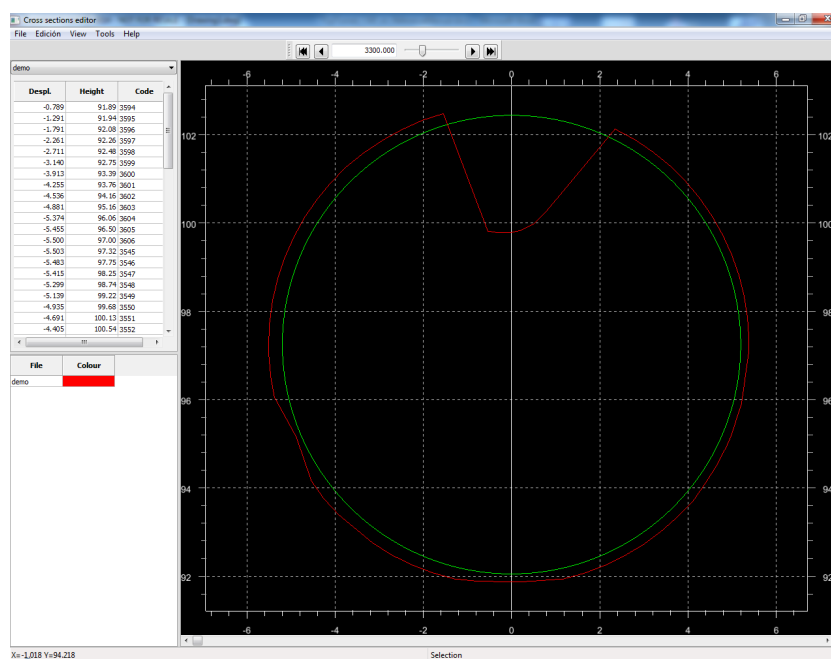
Elevation line: Colour of the vertical lines in each unique point, and of the horizontal line that separates the positive and negative superelevations.

Text height: Height of the text drawn on the superelevations.

To restore the default values, press the “Restore” button.

14 Cross-section editor

This application allows one to edit, view and modify cross-sections.



The window is divided into two parts, with the left side showing information about the files open, and the cross-section data. The right-hand side is the graphic representation of the cross-section.

The editor lets one have several files open at the same time, and for a specific station will show all the cross-sections that have been defined at that station.

At the bottom of the window is a status bar, the left-hand side of which displays the cursor coordinates. The right-hand side displays the current status information (modifying a figure, erasing vertices), and always shows information about the graphical edition of the cross-section.

14.1 Cross-sections panel

On left-hand side of the window is a panel that shows the station, file, vertices and files loaded.

There follows a description of the different parts of the panel from top to bottom:

14.1.1 Current station

The station that is being viewed can be changed by entering a value or by using the scroll bar. If a value is entered, the nearest station will be displayed.

If there are several files, scroll through the list of all the stations of the cross-sections.

Next to these controls and from left to right are buttons for changing station:

First: Move to the initial station of all the loaded cross-sections.

Prev: Move to the previous station.

Next: Move from the next station to the current one.

Last: Move to the final station of all the loaded cross-sections.

14.1.2 Current file

A dropdown window indicates the current file if more than one file has been loaded. This appears with the full route.

If cross-sections exist in more than one file for a given station, the data can be changed by changing this control

14.1.3 Cross-section vertices

The vertices of the current cross-section are shown in a table where they can be modified numerically.

If there is no cross-section in the selected file for the current station, this panel will be disabled, and the values cannot be changed.

If the cross-section is changed graphically by moving or deleting the vertices, this table will be updated automatically.

When a specific row is selected, the graphic representation will display the vertex that corresponds to that marked row.

14.1.4 Cross-sections in memory

This table shows the cross-sections loaded in the memory. It is also possible to change how they are shown in the graphic window, and to change their color.

14.2 Graphic representation panel

In the right-hand side of the main window is a graphic representation of the cross-sections defined in the current station.

Vertices can be moved, deleted or inserted in this window by using the toolbars.

14.3 Tools

The following options can be used to modify the cross-sections in the selected file.

14.3.1 Move alignment

Move the cross-section horizontally. A negative value moves it to the left, and a positive one to the right.

One can choose whether to apply it to the current cross-section or to all the cross-sections in the file.

Accessed from “*Tools->Move alignment...*”

14.3.2 Move height

Move the cross-section vertically. A negative value moves it down and a positive one moves it up.

One can choose whether to apply it to the current cross-section or to all the cross-sections in the file.

Accessed from “*Tools->Move Height...*”

14.3.3 Invert all

Inverts the direction of all the cross-sections of the selected file.

Accessed from “*Tools->Invert all...*”

The cross-sections generated by MDT and TcpTunnel generate the vertices to the right or clockwise, and the Invert commands can be used to change the direction and be able to use them in applications where the points have to be facing the opposite direction.

15 Graphic tools

All the editors appear have toolbars for accessing a series of commands, and depending on the type of editor, some commands might not be available. However, they work in the same way in all the editors.

15.1.1 Standard

This toolbar contains the options used most frequently to move about the drawing, and zoom an area in particular.



The buttons from left to right are:

Zoom in: Zoom the view of the drawing from the middle of the drawing. One can also use the mouse wheel by moving it forward, but in this case the origin will be the position of the mouse.

Zoom out: Zoom the view of the drawing from the middle of the drawing. One can also use the mouse wheel by moving it backwards, but in this case the origin will be the position of the mouse.

Zoom Extension: The view is enlarged or reduced so as to see all the items in the drawing, only taking into account the visible layers

Zoom Window: To zoom in one an area of the drawing, the first *click* of the mouse marks a corner of the window, and the second marks the opposite corner.

Adjustment: The drawing can be moved by *clicking* on the window and moving the mouse without letting go of the window.

15.1.2 Layers

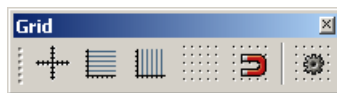
This tool bar allows one to display or hide the different layers of the drawing.

When one presses on the pulldown control, a list of all the layers is displayed. Each row contains the following fields.

- Visible layer, indicated by a lightbulb. If the layer is greyed out, it is not visible.
- Default colour of the layer
- Name of the layer.

15.1.3 Grid

Includes buttons for enabling or disabling the references on the drawing currently being viewed. They will only be enabled when it is a 2D drawing.



The buttons from left to right are:

Alignments: Draws the XY axes on the drawing.

Horizontal Lines: Plots horizontal lines on the drawing to show its Y coordinates.

Vertical Lines: Plots vertical lines on the drawing to show its X coordinates.

Grid: Enables or disables the display of the points grid on screen to provide a visual reference.

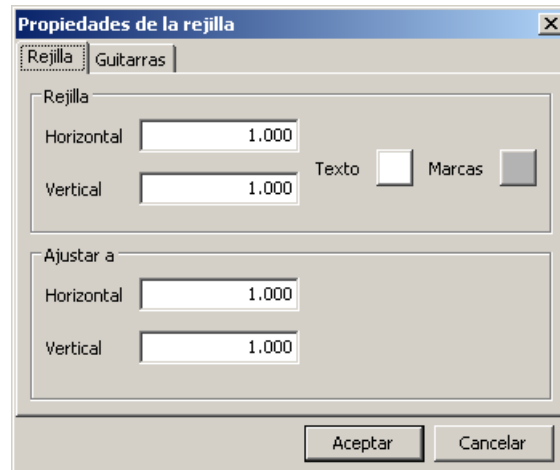
Adjust to grid: Restricts the cursor coordinates to specific coordinates.

Grid properties: Displays a dialog for changing some of the grid values, such as the size and colours.

15.1.3.1 Grid configuration

The colour of the grid, lines and drawing support texts can be changed.

This dialog pops up when the Configure Grid button is pushed. Although this button appears in the main window and the editors, the configuration values are the same in all of them.



Horizontal Grid: Distance between the grid points on the X axis

Vertical Grid: Distance between the grid points on the Y axis.

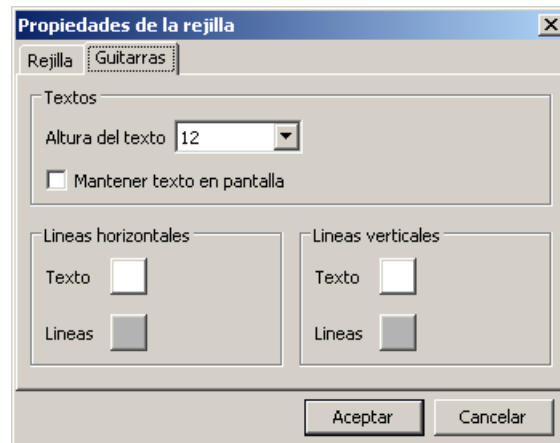
The colour of the text and the points can also be changed by pressing the appropriate squares.

Adjust to horizontal: Values to which the X coordinate of the cursor will be adjusted.

Adjust to vertical: Values to which the Y coordinate of the cursor will be adjusted.

These last two values will only be applied if the “Adjust to grid” option is enabled.

15.1.3.2 Guitar configuration



Text height: Allows one to change the size of the text displayed next to the vertical and horizontal support lines

Keep text on screen: The text that accompanies each line is displayed at the bottom or to the left of the line. Mark this option if the text is not visible but it must be displayed on the edge of the screen.

The colour of the lines and text can be changed independently for each type of line, using the appropriate boxes.

15.1.4 References to figures

References to objects allow one to quickly select exact geometrical points in existing figures, without having to know the exact coordinates of those points. References to objects can be used to select the end point of a line or arc, the midpoint of a circle, or any other geometrically significant position.

When more than one reference is activated, the closest of all the activated ones will be displayed.



The buttons from left to right are:

Point: Marks the point closest to the cursor position. Only applies to point-type figures.

Close: Marks the point closest to the cursor position, applicable to any figure.

End point: Marks the edge of the figure, or of one of its parts that is closest to the mouse position. Does not apply to circles.

Midpoint: Mark the midpoint of the figure.

Centre: Mark the centre of the arc or circumference closest to the mouse.

15.1.5 Helps



The buttons from left to right are:

Measure: This command allows one to measure distances between two points, by first selecting the initial point of the measurement, and then the final point. The distance measured will be displayed in the status bar. It is advisable to activate the most necessary references to figures, or else the application may return incorrect data if it does not use the coordinates of the point one believes is selected.

After the second point is selected, the next window appears.

	Punto inicial	Punto final	Distancia
X	329542.004	329547.947	5.943
Y	3139729.219	3139731.614	2.395
Z	93.014	91.203	-1.811
XY	3156976.006	3156979.008	6.407
XYZ	3156976.007	3156979.009	6.658

Aceptar

The values of the initial and final point in row XY, XYZ represent the distance from the origin to the point on the XY or XYZ plane respectively.

Number Edit: Displays the following window, where the coordinates can be entered manually. If it is a 2D drawing, the Z coordinate control will be disabled.

Coordenadas

Absolutas Relativas

X 3.5000

Y -1.0000

Z 0.0000

Aceptar

After entering the coordinates, press OK. In absolute coordinates mode, the entered coordinates will be added. In relative coordinates mode, the entered coordinates will be considered increments since the last point entered.

15.2 Modify

Commands for modifying the polylines that form a cross-section.



The buttons from left to right are:

Insert vertex: Insert a vertex at the selected point. It must be near an edge.

Delete vertex: Eliminates the selected vertex. It is advisable to have selected the polyline to see where the vertices are.

Delete vertex range: Mark two vertices and all the vertices between them will be deleted.

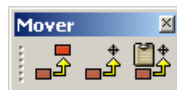
Delete vertex window: Mark a checkbox with the mouse and the vertices inside it will be deleted.

Exchange vertices: It exchanges the order of the two selected vertices for creating the polyline which join them.

Join polylines: It joins the selected polylines.

15.3 Move

Commands for moving figures.



From left to right, these are as follows.

Move figure: First select the figure to move, then select a point as the *origin*, and lastly select a point as the *destination*. The figure will be moved by the vector formed by $destination - origin$.

Move figure to the origin: First select a figure, then assign a *point of origin*. The figure will be moved by the vector *coordinate origin*.

Move figure to the clipboard: This command functions like the previous one (**Move figure to the origin**), but the figure will be copied to the clipboard. Then go to the layer that is to be modified and paste in the figure using *Ctrl+V*.

The best way to assign the origin or destination coordinates is to use the references to figures, or enter the coordinates manually, using the coordinates command.