CadTools Reference Manual

2014-06-20

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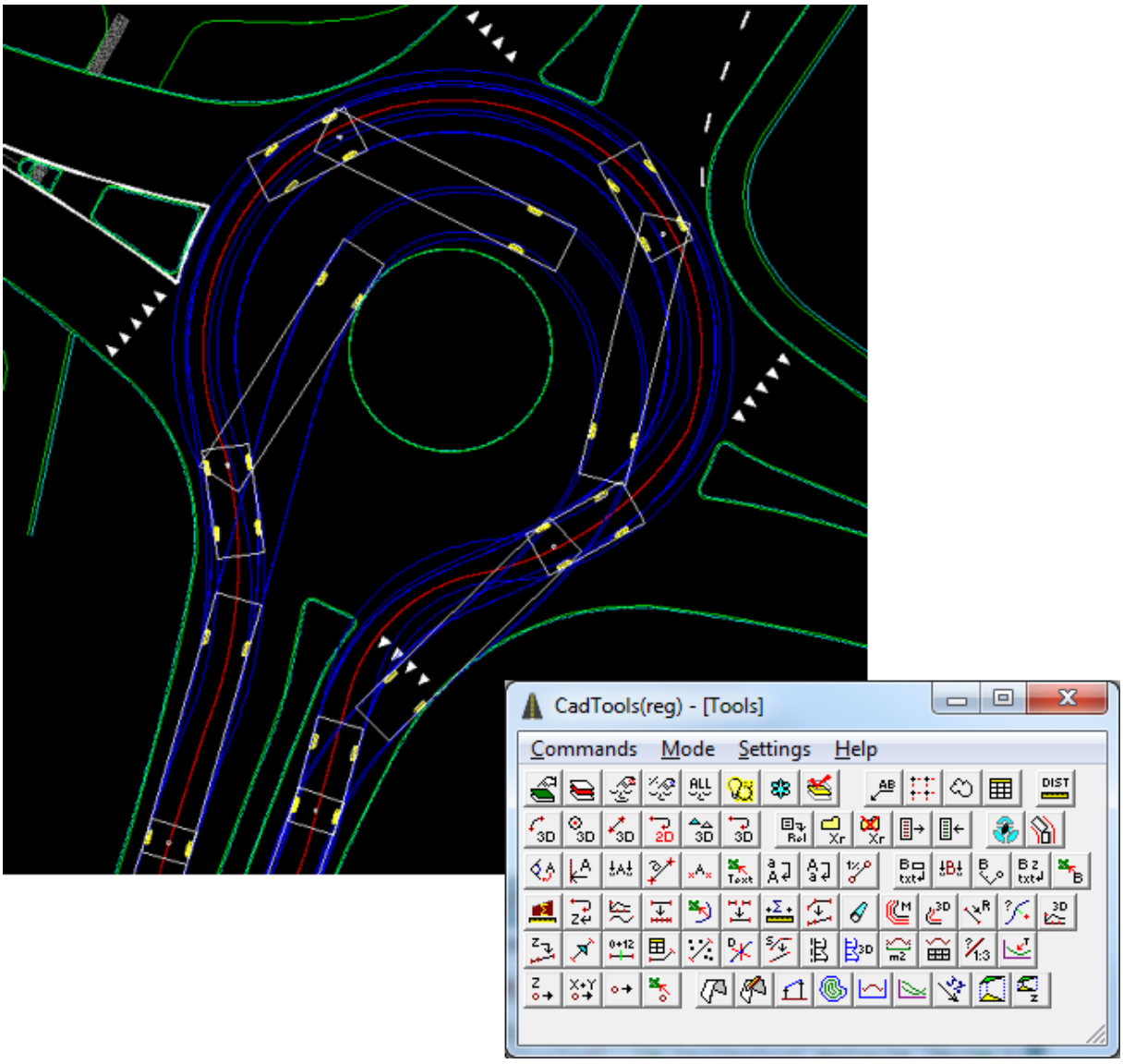


General

CadTools (ToolBox) is developed for Civil Engineers using AutoCAD. There is a number of great software on the market that supports the design process for roads, rails etc. The final design of the drawing is often left for the user without any support other than AutoCAD's usual tools and commands. In the beginning CadTools was designed to support slope calculation (drainage). Since the first version, over 50 useful commands have been added. Some commands have extra functionality limited for unregistered users, to become a registered user and get access to all you must donate.

Almost all commands are developed for 3D, the main reason for this is that it's fun to create design models in real 3D. Using Autocads Orbit command to examine the final design gives a good idea of how it's going to look when it's built. I've seen some software doing the job in 2D but I never understood why. I work as a civil engineer with special knowledge in pavement design and evaluation, through the years I've developed software to make my work easier. I've spent thousands of hours developing software to do what I want, my conclusion is that software developed by users can be a god complement to more sophisticated software. If you should ask me -what is the best civil software on the market today? My answer would be **Bentley's InRoads.**

CadTools provides several useful commands. The most common commands can be reached by a toolbar placed at the top.

The software runs in three modes, Slope , Command Tree and Tools. If mode is set to Tools all input-boxes and toolbars for drainage support are hidden.

- Decimal separator for input values in CadTools should be same as operating system settings (Control panel).
- All commands are developed for use in ModelSpace, some might even work in PaperSpace.
- This software is distributed "as is", use it at your own risk.

For information and latest updates: www.glamsen.se/CadTools.htm

About performance

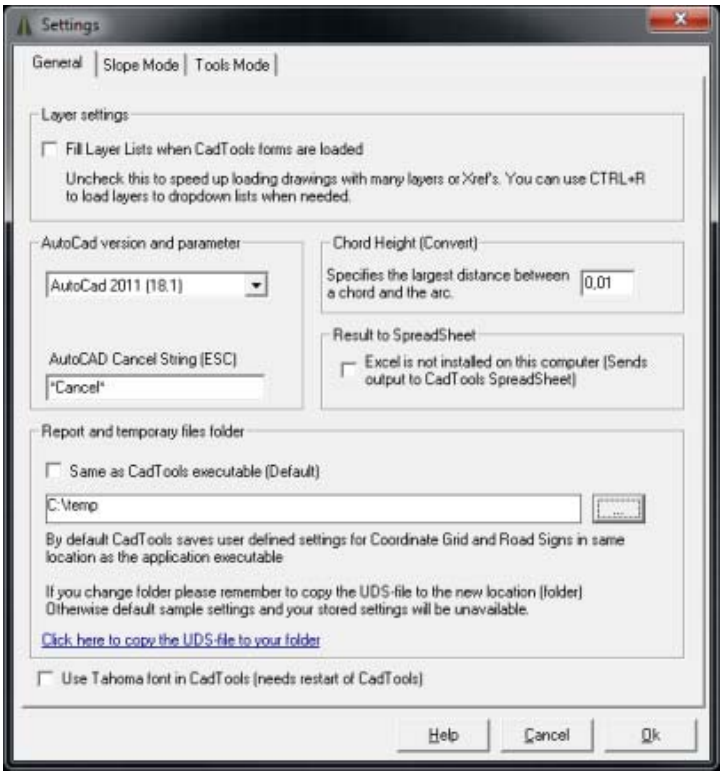
All commands in CadTools are based on basic geometric formulas with no optimizing techniques. Surface triangles are saved in a very simple way with no information of related triangles (nearest neighbor). A very time consuming part is plotting to Autocad, as result of all this many commands can be very slow, you could divide huge surfaces in smaller to improve performance. I myself prefer to grab a cup of coffee and let CadTools do the work.

About CadTools

CadTools is developed by Lars Karlsson (www.glamsen.se) and is distributed free. Some commands and features are limited for unregistered user. To become a registered user and get access to all commands you must donate. There are no upper or lower limits for donations, the result is the same (full access).

Settings

The settings form is activated through the Settings menu in Main Form.



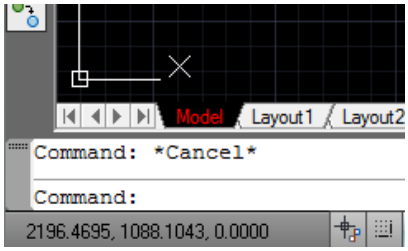
Description goes from top left down to right bottom

- **Layers Settings** Uncheck this if you have many layers in the drawing and want to speed up loading forms. You can always use CTRL+R to read layers from the current drawing to the listbox at any time, or use the object picker (button with hair-cross)
- **Result to SpreadSheet** This is a option to use a simple built in SpreadSheet instead of Excel. Use this if your computer doesn't have Excel installed. Data from the output window can be copied and pasted to other Windows software (Open Office)
- **Autocad version** Set appropriate Autocad version by selecting version from the list. The first option in the list is **"*Manually (type in self)*",** this option is useful if by any reasons development of CadTools is halted and there are newer versions of AutCAD on the market. It would be nice if you could continue to use CadTools on coming AutoCAD versions. What shall i type in? The string (reference to COM object) used by CadTools depends on AutoCAD versions. Generally you need to change the three last digits so it match your AutoCAD version, the list below may be useful along with some "try and error".

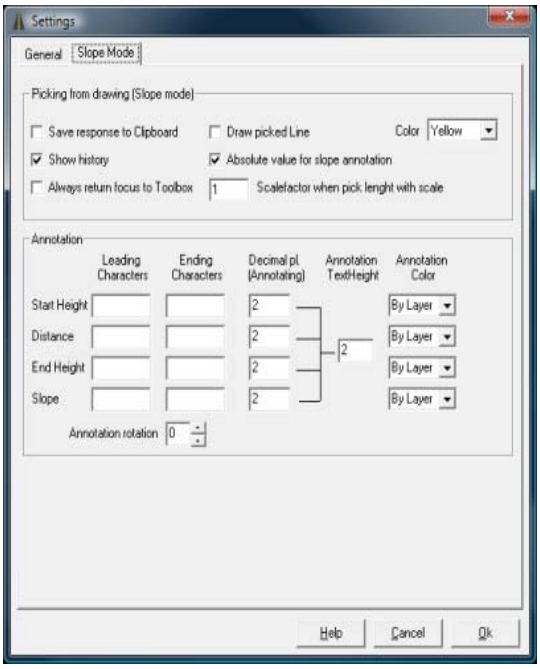
AutoCAD version	**Reference string**
2000	*AutoCad.Application.15*
2002	*AutoCad.Application.15.1*
2004	*AutoCad.Application.16*
2005	*AutoCad.Application.16.1*
2006	*AutoCad.Application.16.2*
2007	*AutoCad.Application.17*
2008	*AutoCad.Application.17.1*
2009	*AutoCad.Application.17.2*
2010	*AutoCad.Application.18*
2011	*AutoCad.Application.18.1*
2012	*AutoCad.Application.18.2*

2013	*AutoCad.Application.19*
2014	*AutoCad.Application.19.1*

- **AutoCAD Cancel String** *IMPORTANT FOR NON ENGLISH AUTOCAD*. This setting specifies the string that CadTools will recognize as Cancel String. When you quit a command in AutoCAD you can hit the ESC key. Hitting ESC will get a Cancel String at the command line, in English AutoCAD versions it will be *Cancel*. If you use a localized version of AutoCAD you need to provide information of the Cancel String to CadTools. To do so hit the ESC key in a open drawing and look at the command line. Type in the Cancel String in CadTools settings dialog. CadTools uses the Cancel String to check AutoCAD's parameter LASTPROMPT to decide if exit current command or not. If the Cancel String is incorrect you will not be able to cancel CadTools repetitive commands i. e Join 3D-polyline and offset 3D-polyline.



- **Chord Height.** Specifies the largest distance between a chord and the arc. This parameter is used to control the number of points along a curve that are added when converted to 3D polyline. If your value is to small no converting is performed. The default value is 0,05 (if you use meter that results in a accuracy of 5 cm)
- **Report and temporary files folder.** Specifies folder for reports (triangle volume). If you are having problems with report files it can help if you select a folder where you have read and write access. Remember to copy your UDS-file (User Defined Settings) to your new folder. This can be done by clicking on the blue text at the bottom of the form. Any existing UDS-file in the folder will not be overwritten.



Description goes from top left down to right bottom

- **Save response to Clipboard** copies the formatted response-string to Windows clipboard and can be pasted in to any other Windows application
- **Draw picked line** draws a line from picked start point to picked endpoint. (current layer)
- **Arrow** Draws an arrow sign indicating slope direction. (current layer)
- **Color** Set color for line and arrow
- **Show history** Toggles history list on/off. All previous calculated values in this session is presented in a list, most recent is shown first.

- **Absolute values for slope annotation** Leading negative sign is removed from slope annotation
- **Always return focus to Toolbox** If selected cursor focus is removed from AutoCAD to CadTools (ToolBox) after picking lengths or annotation in the drawing. This can be useful if you plan to input values by keyboard frequently. If you plan to do something else immediately in the drawing after picking or annotation this checkbox should be off. This setting only works in Slope mode
- **Scale factor when picking length with scale** Using CadTools with profiles with different horizontal or vertical scale this factor is multiplied to picked length.
- **Leading/Ending Characters** Calculated responses are formatted after this setting. Useful for percent sign etc.
- **Decimals** Calculated strings ready for annotation are rounded according these settings.
- **Annotation Color** Annotations is always placed at current layer, colors applies this setting
- **Text Height** Text height for annotated values

Note!

Some commands use text height and other settings from this form.

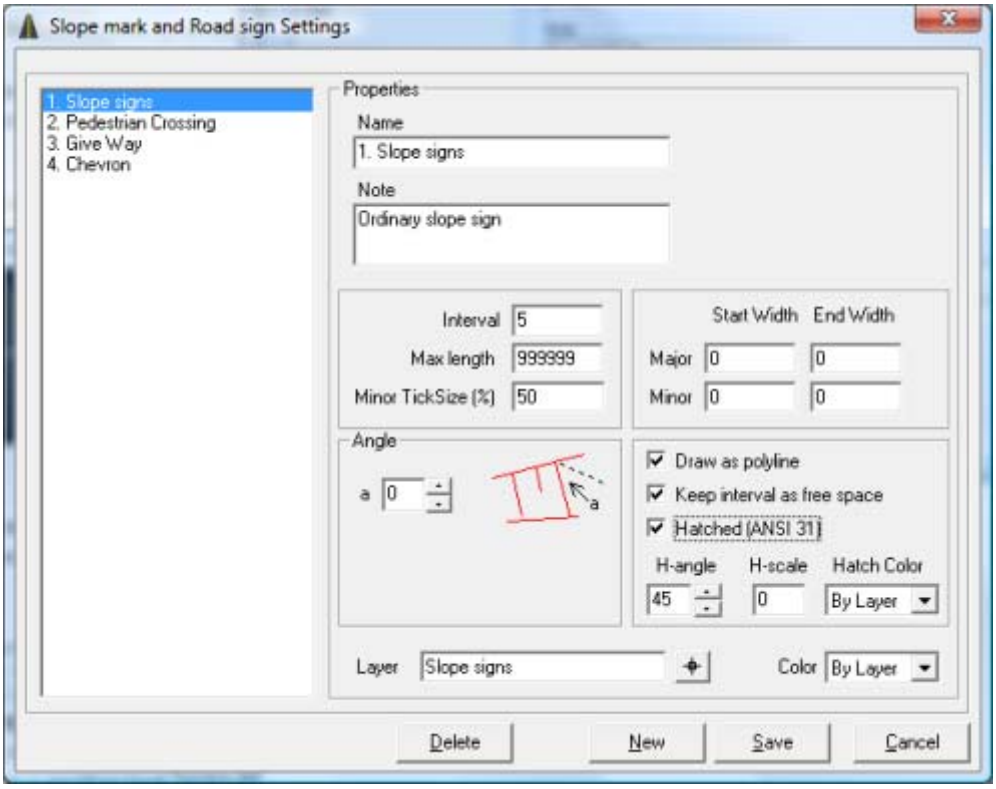
User Settings

<Commands>, <Lines>, <Slope and roadsigns (2D)>

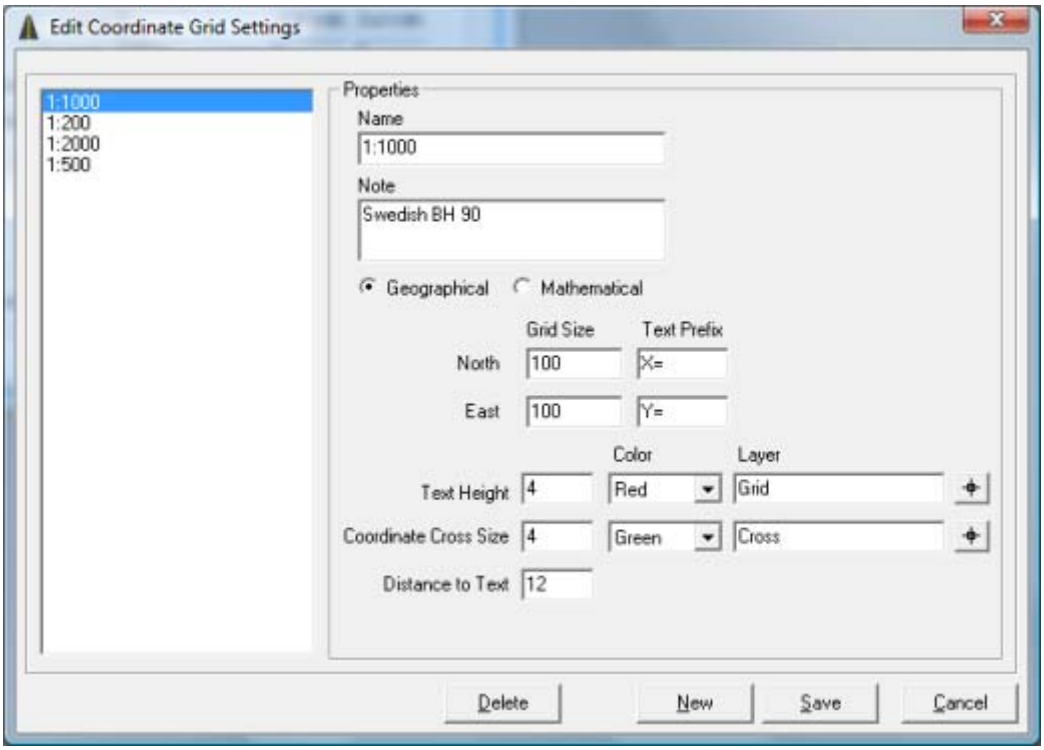
User settings is specially designed for two commands. The first is "Create Coordinate Grid" the second is "Slope and road signs 2D".

The settings can be accessed throw the menu "Settings" for each form. These settings are not stored in the Windows registry instead the are stored in a file. You can share your settings to others by copying the file **"Cadtoolssettings.uds"** that's located in same directory as CadTools executable file. Pasting (overwriting) the file to same location at another computer gives that user same saved settings for booth "Cordinate grid" and "Slope and road signs 2D"

Settings form for Slope and road signs



Settings form for Coordinate grid



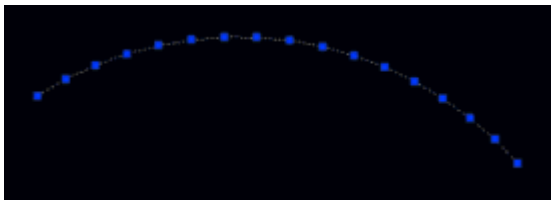
Convert commands

Convert

<Commands>, <Convert>

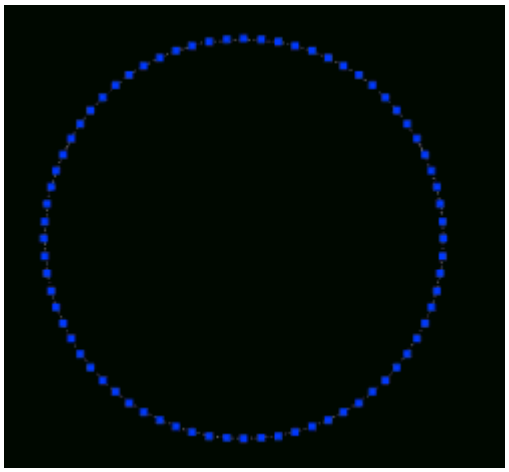
Arcs > 3D Polylines

Replaces Arcs with 3Dpolyline segments. The segment length is calculated using Chord Height settings (settings form)



Circles > 3D Polylines

Replaces Circles with 3Dpolyline segments. The segment length is calculated using Chord Height settings (settings form)



Lines > 3D Polylines

Replaces lines with 3Dpolyline segments.

3Dpolylines > Polylines

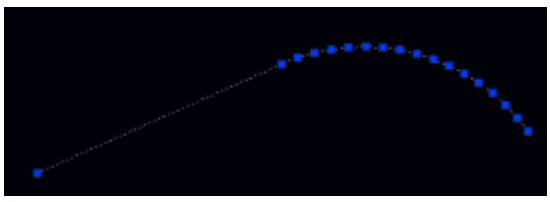
Flattens out 3D Polylines to 2DPolylines

3DFaces > 3D Polylines

Some triangulation software can't read 3Dfaces, this can help but beware, very slow on huge selections.

Polylines > 3D Polylines

Replaces Polylines with 3Dpolyline segments. If there are arcs in the Polyline they will be replaced by several small elements. The segment length is calculated using Chord Height settings (settings form)



EPANET commands

Create EPANET Inp-file from DWG

<Commands>, <EPANET>

This command creates an EPANET input file that can be imported to EPANET. There are three types of lines that are supported by this command, Polylines, 3D-polylines and lines. ID:s for pipes and junctions are created by CadTools.

Pipes within the snap tolerance are merged to nearest junction.

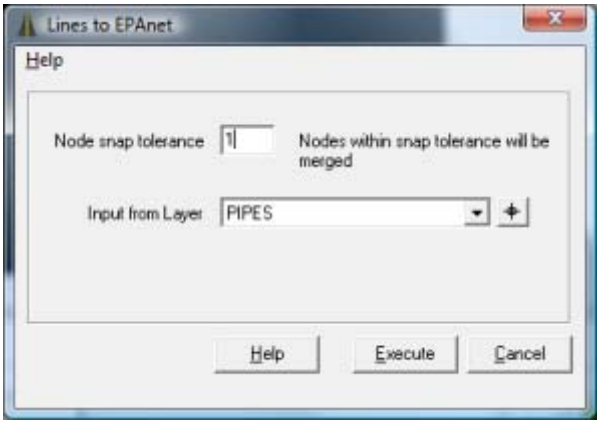


Image of pipe network in a DWG-file

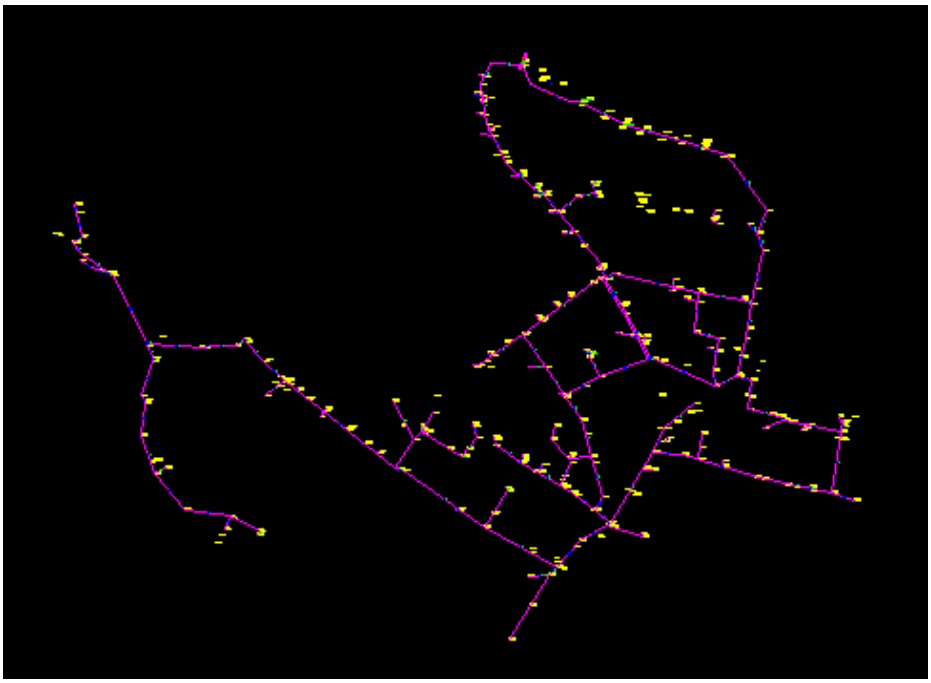
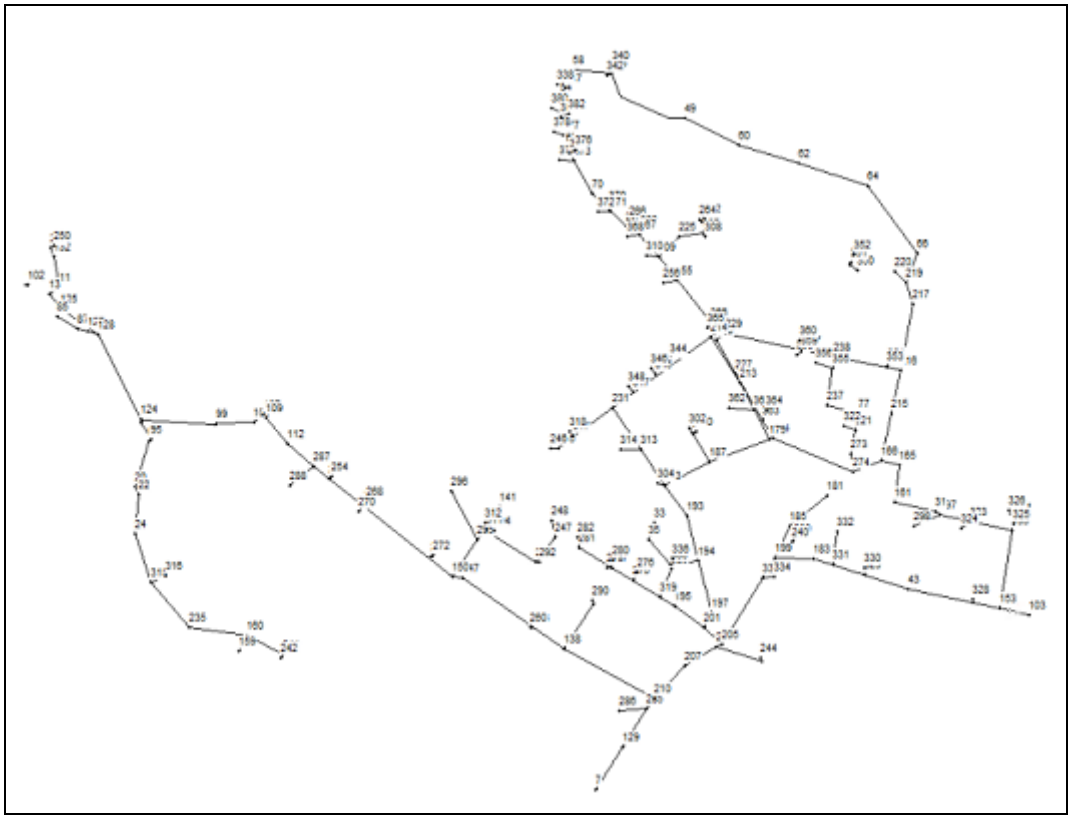


Image of imported network in EPANET.



Text commands

<Commands>, <Text>

Align text to UCS and scale it.

Selects all single line text or multiline text and align it to current UCS.

Align text to left

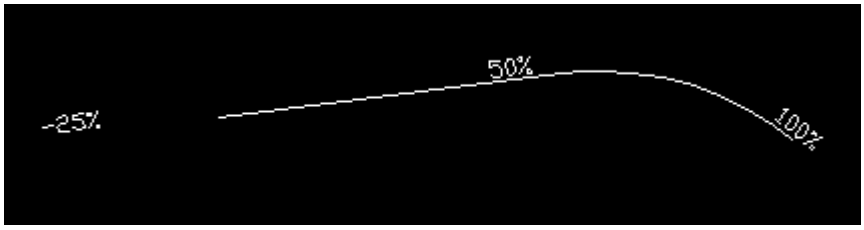
Selected text is left aligned to a point provided by the user. Useful for table type of text.

Insert character to single line text.

Selects all single line text and inputs trailing or ending text.

Insert line-aligned text

This command places text along a line. Two methods can be used, the first is to place user defined text along the line. The second method is to place line length along the line. The position of the text is based on a percent value, 50% is at the middle of the line 100% at the end and 0% at the start. A negative value will place the text outside the beginning of the line, values over 100% will not place text outside the end of the line.



Remove character from single line text.

Selects all single line text and removes characters from the beginning and end of the text.

Export text to Excel

Selected multi- or single line text in the drawing is exported to Microsoft Excel

	A	B	C	D	E
1	**Type**	**String**	**X**	**Y**	**Z**
2	Text	This is also a text	56711,8422832013	18991,3906246385	0
3	Text	This is a another text	56711,8422832013	18997,1215796303	0
4	Text	This is a text	56712,2518711863	19003,261887442	0
5					

Text capitalize

All selected text in the drawing is capitalized.

Text uncapitalize

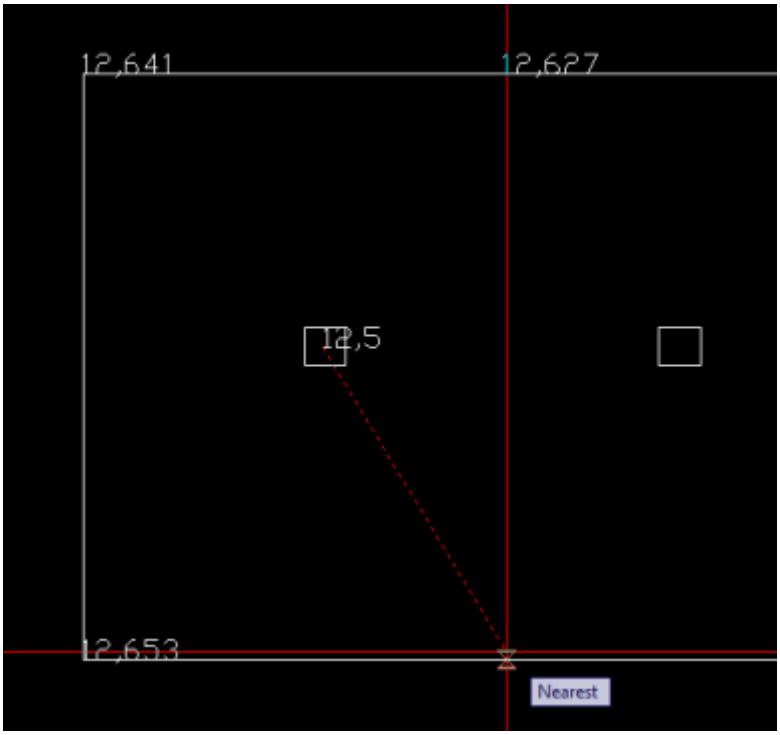
You will get two questions, the first is "Make first letter capital?" Answering **Yes** on this makes the first letter in the text uncapitalized.

Answering **No** will result in another question "Make first letter of word capital?" Answering Yes on this makes every first letter in every word capitalized. Answering No has **No** effect on the text.

Place sloped Text

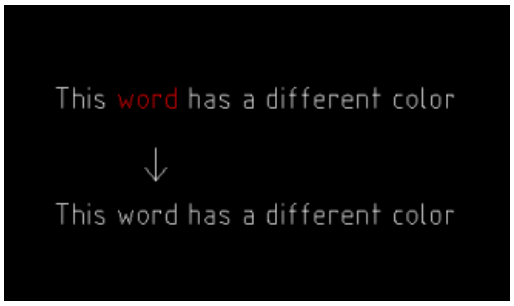
This command can be used to set target height based on slope and length from a base point. The text is placed at elevation based on user input.

Tip! To get a nice design model you can triangulate text with CadTools "Create Surface" command.



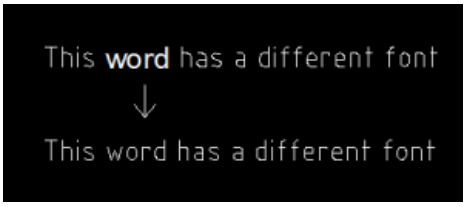
MText Color Override remover

This command deletes color overrides from MText.



MText Font Override remover

This command deletes font overrides from MText.



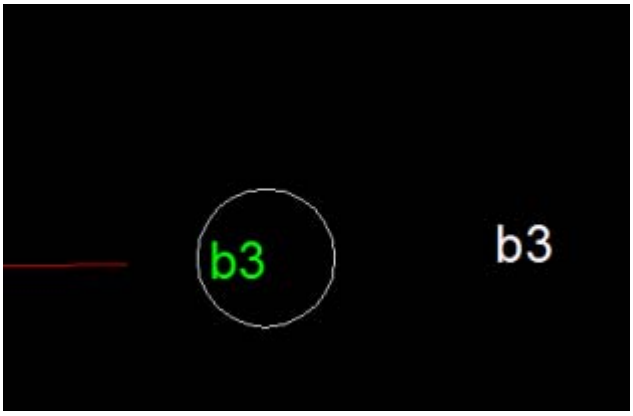
Block attribute to text

<Commands>, <Block>

This command converts all attributes for a selected block to plain text. First you pick a point in the drawing where the text will placed then you select the block.

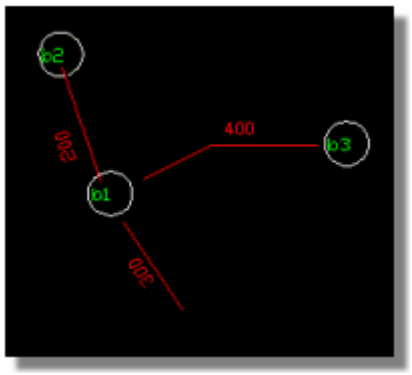
You can only use this command for a single block, selections of several blocks is not supported.

In the Image below you see the attribute as green text and the extracted text as white.



Match blocks with lines (Drainage Evaluation)

<Commands>, <Block>



With this command you can evaluate drainage network drawings. Sometimes you need to transfer drawing data to other software for further design. The idea with this command is that you never more should spend time correcting "bad" drawings. The result from this command will be exported to Excel and contain information about possible pipe connections and dimensions.

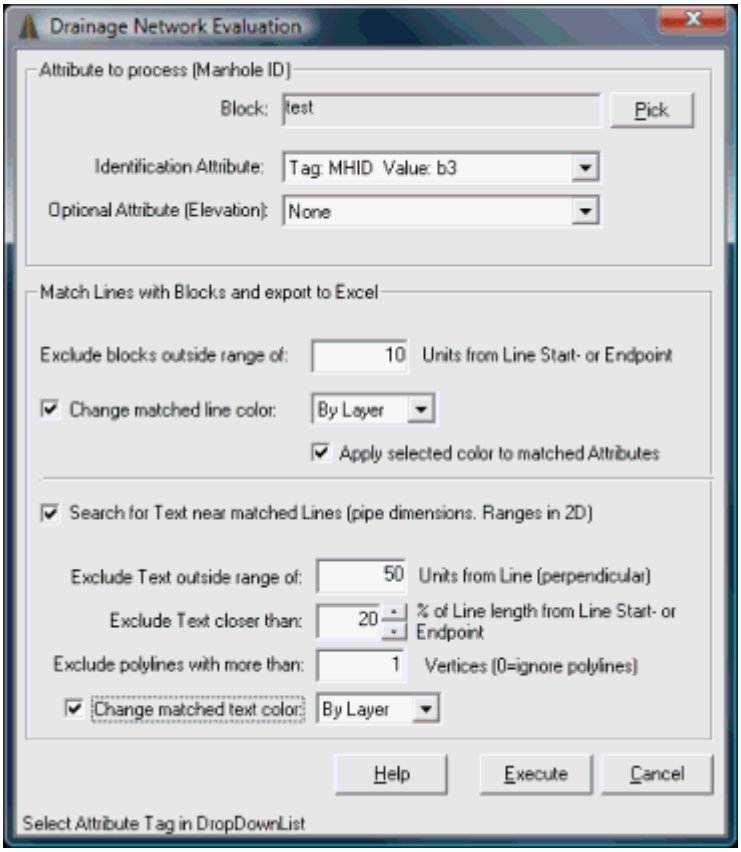
Unregistered user can test the function, the result is limited to five rows in the Excel-file.

First of all, make a copy of the drawing and work with the copy. Delete or freeze all unwanted objects except manhole (blocks), pipes (lines/polylines) and dimensions (text). You should end up with something like the picture below. Lines don't need to intersect with blocks, CadTools evaluates closest solution, that's the whole idea!

Tip!

If You don't have manholes as block you must create these. Make the block with an attribute (ID). Insert the block at all manhole positions. Use the CadTools command "Edit block attribute text" to make a counter for all attributes (ID)

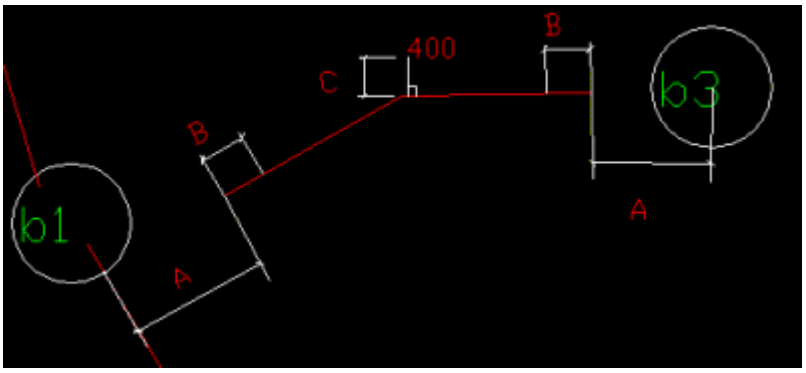
If the manhole elevation is in a single line text you can use the command earlier to fetch the text to another attribute in the same block



In the first section you select a block (manhole), use the button "Pick" and select a block in the drawing. CadTools lists all attributes in the block in two DropDowns. Select attribute for identification (ID) and if you have a attribute with elevation you can select it as an optional attribute. Elevation value will not be processed just passed to the Excel-file as it is so you can use it for other purposes. **Blocks that not contain the tag for Identification value will be ignored (filtered out)**. You can process much different kind of blocks at the same time, the only demand is that they must have the specific attribute that you selected. **The name of the block is not important, the tag is.**

Tip!

If your block doesn't have a tag for elevation, then make one. If the elevation of the block itself is the correct one you can use other commands in CadTools to annotate block elevations to the drawing and then use the CadTools command "Block Attribute Text Edit" to fill the attribute with the annotated elevation. Using the optional attribute as an elevation will make it easy to calculate slopes in the resulting Excel file.



Next section describes the maximum distance from the lines end or start point to nearest block *(picture 2, value A*). If possible block is at a longer distance it will be excluded. You can change color for lines and attributes that have been found and used, this may help if something seems to strange. A very high value can give the result that a block is reported in many places, the software always calculate the nearest block.

The third section is used for pipe dimensions. You can set up a maximum perpendicular length for the text *(picture 2, value C*). To prevent text that is closer to the line but also closer to the endpoints you set a percentage value of the total line length *(picture 2, value B*). If the total length of the line is 100 units the value 10% will make text at a range of 10-90 units inside the line possible (the point where the perpendicular line from the text insertion point to the line must be at the range 10-90% of total line length)

You can exclude polylines based on vertices, this might help to filter other lines than pipes.

You can change the color for text that has been found and used

Picture 2

After you pressed Execute, use a crossing to select all objects. Unwanted objects will be filtered out. CadTools calculates the most likely solution for all blocks (nearest block relative endpoints) and then starts Excel with the results. The resulting Excel Worksheet contains columns with values. Attribute 1 and 2 are blocks with attribute tags according to your settings, the line text is the text along the line and theoretical distance (shortest) between the blocks.

	A	B	C	D	E	F	G	H
1	Blocks With Selected Attributes related with a Line or Polyline							
2	**Attribute 1**	**Attribute 2**	**Line Text**	**Block1 X-coord**	**Block1 Y-coord**	**Block2 X-coord**	**Block2 Y-coord**	**Theor. Length**
3	b1	b1	300	1324,182004	242,5670784	1324,182004	242,5670784	0
4	b2	b1	200	1303,385813	300,934512	1324,182004	242,5670784	61,96159163
5	b3	b1		1422,8293	263,4669784	1324,182004	242,5670784	100,8369716
6								

After you figured out how this function works it's easy to use it in many other ways.

Export block coordinates/attributes to Excel

<Commands>, <Block>

Export block information to Microsoft Excel. Attributes with values are also exported. If you want to do the reverse se "Draw from coordinates"

	A	B	C	D	E	F	G	H	I
1	BlockName	Layer	X	Y	Z	XScale	YScale	ZScale	MHID
2	test	0	1324,182003	242,5670784	0	1	1	1	b1
3	test	0	1303,385813	300,9345119	0	1	1	1	b2
4	test	0	1422,829299	263,4669784	0	1	1	1	b3
5									

Annotate block elevation

<Commands>, <Block>

Use this command to insert single line text with the elevation of blocks in the drawing. Position of text relative block insertion point and annotation height are optional.

Edit Block Attribute Text

<Commands>, <Block>

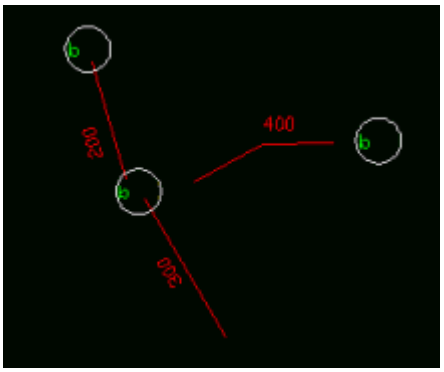
CadTools provides a simple method for editing Block attribute Text. This method changes all selected blocks individually based on your settings. First you select one of the blocks you are interested in, do this by pressing the Pick button. All attribute Tags from that block is then extracted into a Attribute list. Select tag in the attribute list and change appropriated settings as you please on the form. **Remember, in this function only blocks with selected name and tag are processed.**

Adding a counter to a block attribute

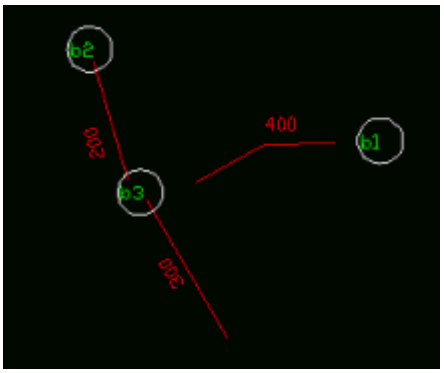
This is a handy command if the block are manholes and you want to add a unique id to an ID-tag. If you planning to use "Drainage Network Evaluation" this command can help you to insert elevation. The elevation option is developed for situations when the elevation is placed in a attribute value. **Beware! Don't add or remove any text to same attribute that contains elevation when using "Set Block elevation to selected block attribute value", that will result in wrong elevation.**

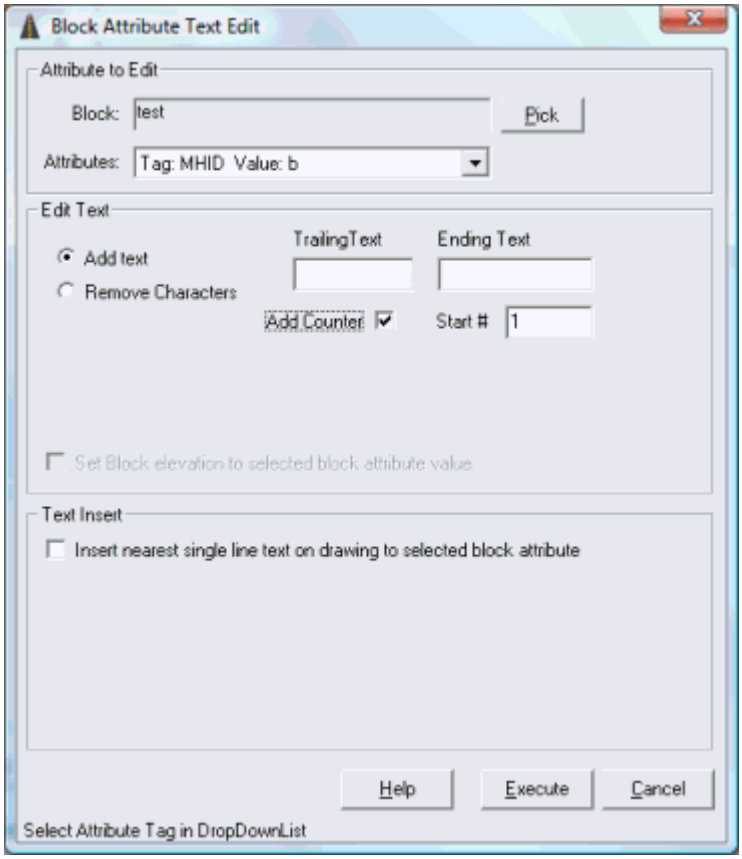
The counter is inserted in the same order as the block was selected.

Before



After





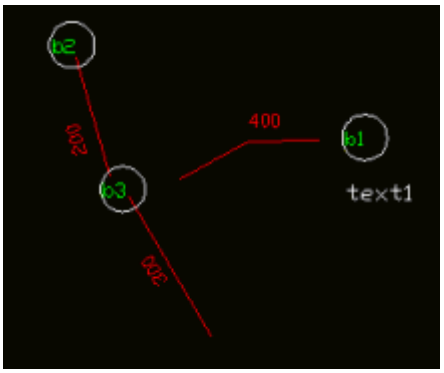
Inserting text within distance to block attribute

Use this command to insert text to attributes within a distance from blocks. You can change settings so that blocks that found a text change color. You can also prevent text to be inserted multiple times (in more than one block). Furthermore you can move used text to current layer and exclude text outside a given range. CadTools evaluates all blocks and text to find the closest text to every block.

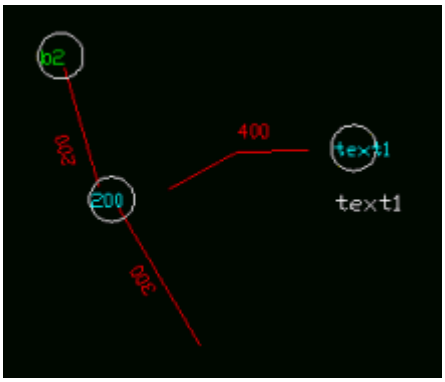
The "Block Attribute Text Edit" function can be used in many ways to manipulate attribute values with coordinate based text. You could combine this with other functions in CadTools to accomplish what you need.

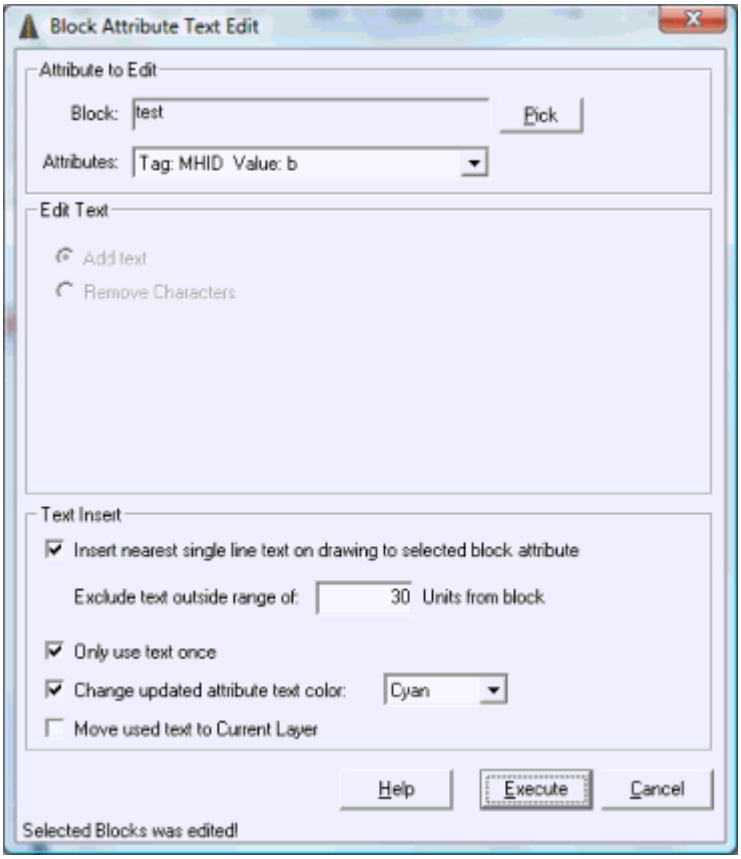
I.e. Exporting block values to Excel, manipulating them with formulas and then paste them back to the drawing with CadTools "Draw from Coordinates". Then using this function to insert the value in a attribute.

Before



After





Drafting

<Commands>, <Drafting>

Profile/Cross-section Note

Use this command to insert annotation text in Cross-sections or Profiles. CadTools calculates elevation and station relative a base point. The user input the base point and exaggerations for booth X and Y axis. The text can be rotated and you can use prefix and suffix of your own. As an option you can freely place the annotation by toggle the "Ask for Annotation Location" check box.

The two offset parameters are for vertical and horizontal. If you have station equations in your profile you can change the base point during the process.

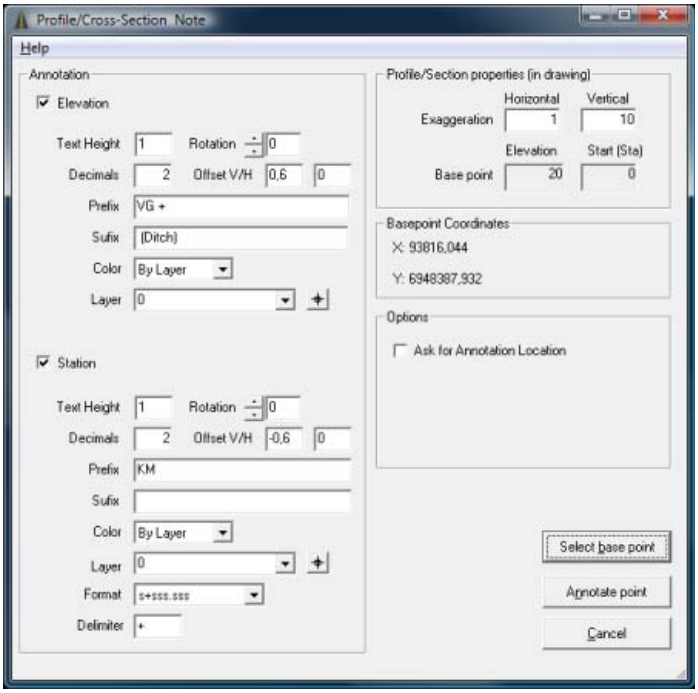
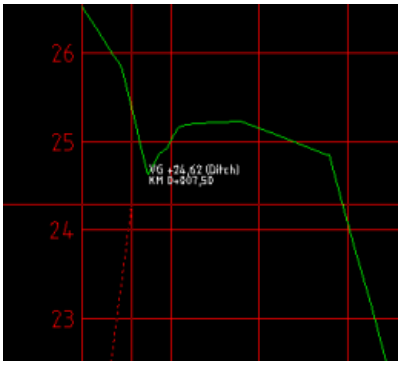


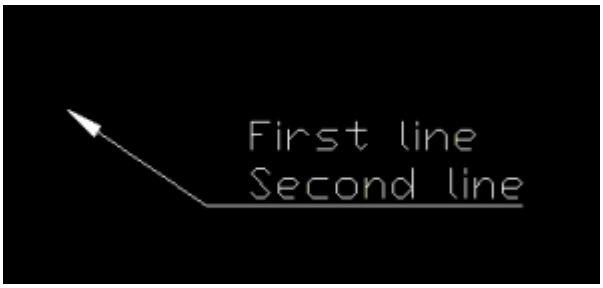
Image of result in drawing



Draw commands

Mtext with leader

<Commands>, <Draw>



This is a easy way to insert text with leaders to the drawing.

Input sequence as below

1. Input insertion point for the annotation (MText).
2. Type of arrow
3. Number of lines
4. Text for line 1, confirm text input with enter
5. Text for line 2.....etc
6. Point for leader arrow

Create coordinate grid

<Commands>, <Draw>

This function draws a coordinate grid with coordinate cross and annotations. You can select two types of grid, Mathematical or Geographic. The difference between them are the annotation, for Geographical the X coordinates are read as Y coordinates and Y coordinates are read as X coordinates. (X=Northing and Y=Easting)

Don't be misled by the labels (North,X) when toggling between the options geographical or mathematical. The reason for this behavior is that it's more convenient to keep the text prefix the same for booth type of grids.

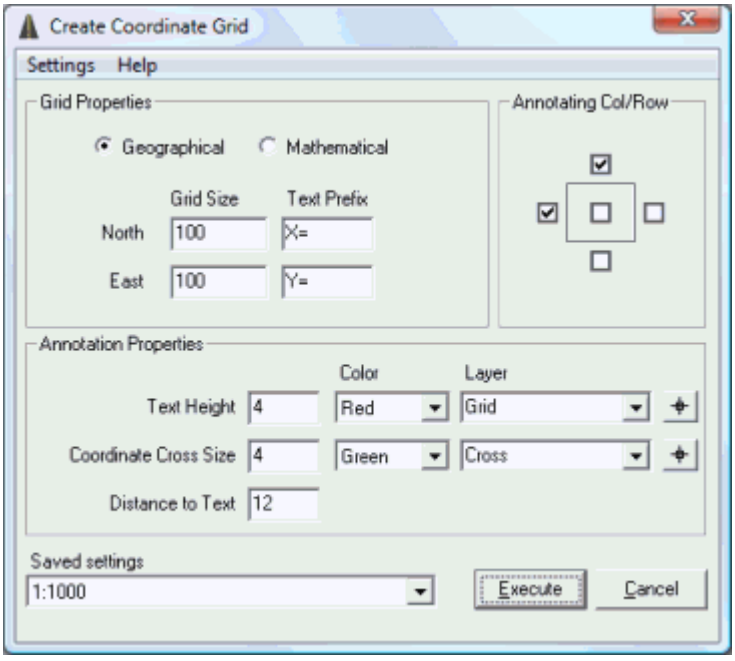
Annotate columns or rows

Select where annotation should be placed by using the check-boxes to the right. Checking the middle box gives the result of annotation for all Coordinate-cross. Settings In the picture results in annotation of left column and top row.

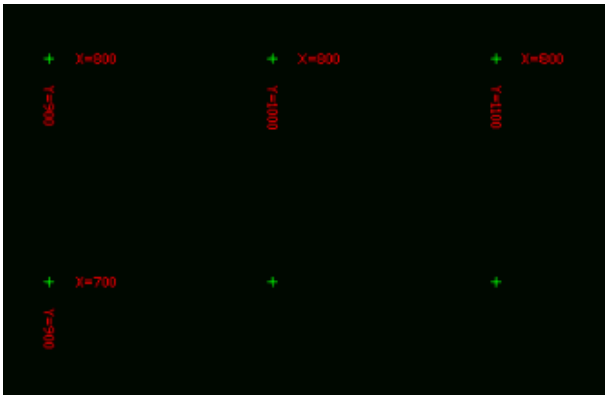
All last used settings but Layer name will be saved when the form is unloaded. Saved user settings can be selected from the dropdown list. You can prepare your own settings for different drawing scales.

You build your own library of settings for coordinate grids. In the left bottom there is a drop down list with all your saved settings. Selecting any of these settings will change all input values in the form.

Edit or add new settings by using the menu "Settings" in the form. You can share your settings to others by copying the file **"Cadtoolssettings.uds"** that's located in same directory as CadTools executable file. Pasting (overwriting) the file to same location at another computer gives that user same saved settings for booth coordinate grid and slope (road markings)



Resulting Grid in AutoCad with settings to the left.



Draw from coordinates

<Commands>, <Draw>

A simple but extremely useful command, get same result as a Autocad expert would get with scripting.

With this command you can let CadTools draw Polylines, Circles, Blocks and Text from a grid. You can cut and paste ranges between Microsoft Excel and CadTools. All cells are editable but none of the cells can bee empty. Selecting type from the dropdown list makes the grid change number of columns needed for the input.

This command is very helpful if you have done the "Drainage Network Evaluation" and looking at the result in Ecxel. Perhaps CadTools had difficulties to find the dimension text along lines and therefore you may need to evaluate them once again. If there are a big number of lines it can be time-consuming to evaluate the whole network.

If you sort out the coordinates for those pipes or manholes that didn't worked as expected it's easy to draw them in a different color or at another layer and run the evaluation again but now at the newly drawn lines. This can be done by selecting pipes, manholes and dimension (text) one by one instead of using a crossing.

By running the evaluation again with other parameters and with fewer objects it's easy to catch the correct text along the lines.

How to edit values in grid

The grid is mainly designed for pasting from Excel but you can edit rows and cells like any other standard grids. To edit a cell, place cursor at the cell and press Enter. You can also double click on the cell to get into edit mode. To update the cell press Enter again or place the cursor elsewhere in the grid. After you are done editing you can change cell or row using the arrow keys.

How to sort values

Sort columns by clicking the column caption, click again to alter sort order (ascending, descending)

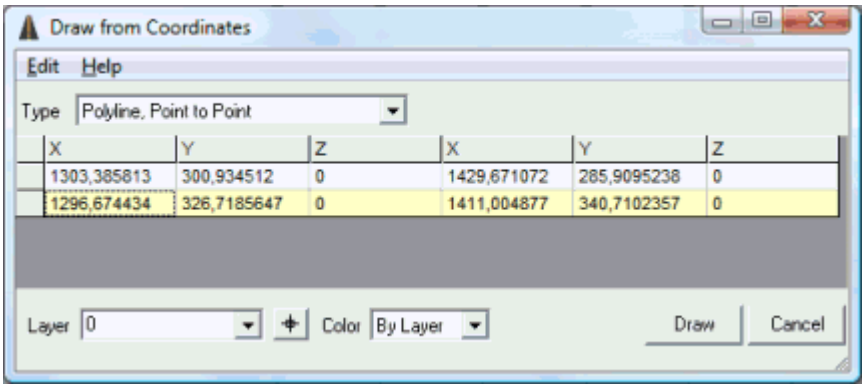
Tip! ***When you paste from Excel you might end up with no values in one or more column. Insert zeros in these columns by right-click at any cell in a column and select "Fill empty cells with zeros"***

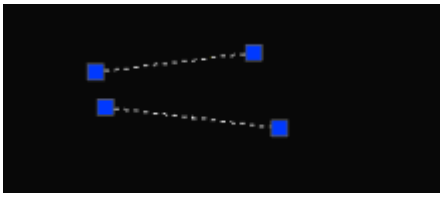
Six types of features can be plotted to the drawing, all types are described with images of input and result below.

1. Polylines, point to point
2. Polyline vertex
3. Circle at point
4. Block at point
5. Text at point
6. Block at station/offset from polyline

Polylines, point to point

Creates polyline segments between two coordinates (XYZ - XYZ)





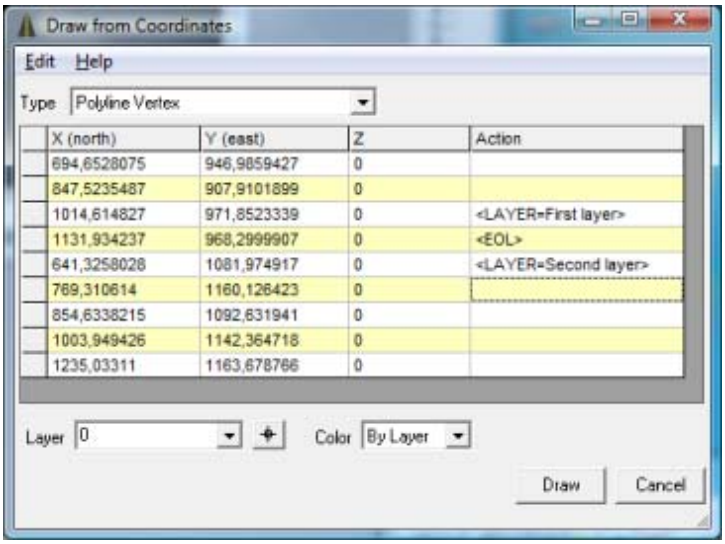
Polyline vertex

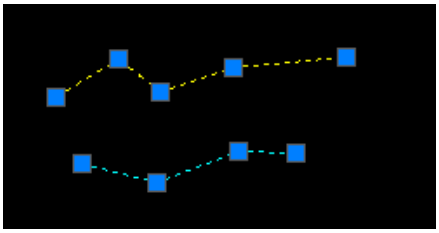
Creates one or several polylines from the vertices in the list. To draw separate polylines you must insert line breaks at the end of a line. This is possible by using the column "Action". Place the mouse over the position in the grid where you want to break the line and right-cklick, select the <EOL> type of action to insert, <EOL> stands for End Of Line.

You can also use the Action <LAYER=> to change layer name for separate polylines, type in your layer name after the "=" sign. The layer name action overrides the default layer name and can be placed at any row in the grid. The layer name override is used for the corresponding polyline when it's plotted, a layername action followed by a end of file action a couple ow rows below will work as well as a layer name action on same row as a end of file action.

If you planning to paste values into CadTools from Excel you could prepare the Action column in Excel and paste all into CadTools.

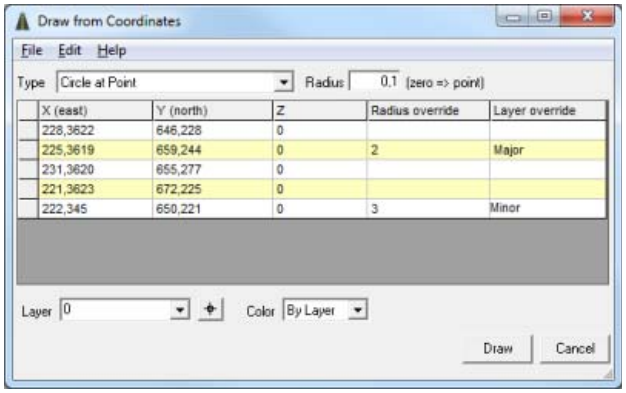
Image below illustrate plotting of two polylines, the first four points creates a polyline on layer "First layer" which is set to cyan in AutoCAD. The second polyline includes rest of the points in the grid with a layer name action (second layer) that gives a yellow polyline due the layer is set to yellow in utoCAD.

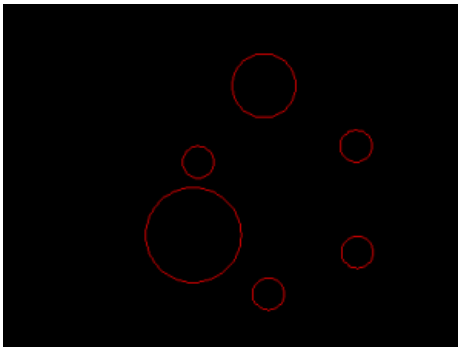




Circle at point

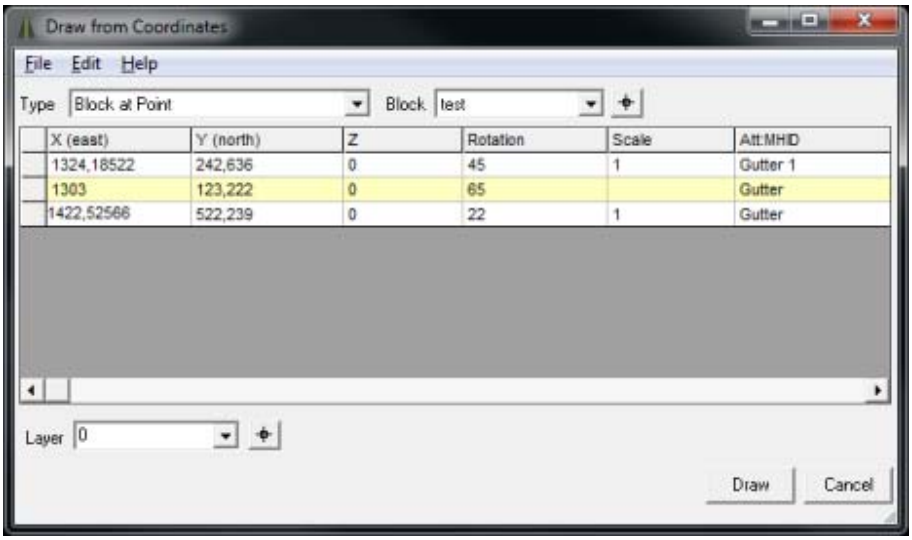
Creates circles from the vertices in the list. You can override radius and layer by assigning values for separate circles (rows).





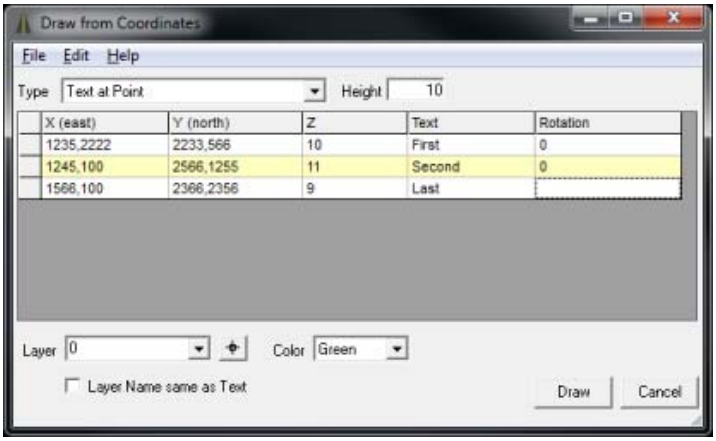
Block at point

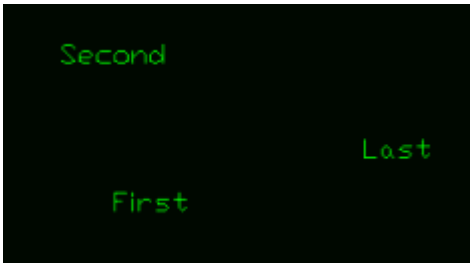
Creates blocks at points in list. Blocks insertion point is used. When the form is loaded all block information is red from the active drawing, if you change drawing the information block information needs to be updated. You can do this by placing the mouse pointer in the block list and press CTRL + R, all block names from current drawing will then be accessible from the list. A quicker method to get a block name is to use the pointer button to the right of the block list and then pick a block in the drawing. If you omit the value for Scale a value of 1 will be used.



Text at point

Use the option "Layer Name same as Text" to create layers from the text strings in the grid.





Block at station/offset from polyline

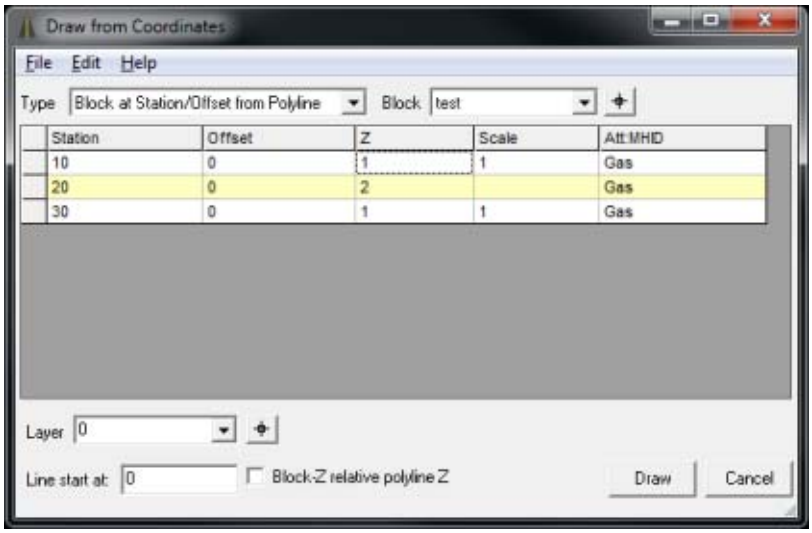
If type is block and the selected block contains attributes the grid adds extra rows for attribute values. You can type in your own values in attribute columns. These values will be inserted in the block attributes by CadTools. Pressing ctrl+R in one of the dropdown-list forces CadTools to reload Layer and Block information, this is handy if you added layers or blocks during the process. If you type in a layer that doesn't exist, CadTools creates that layer in current drawing.

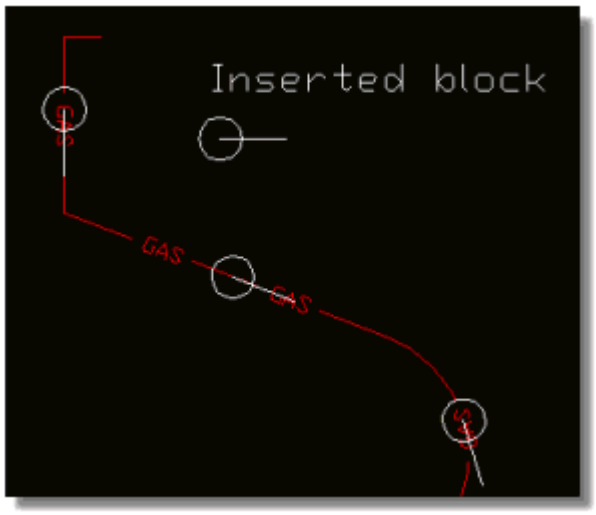
If you chose to plot blocks along a Polyline you get a question to rotate the block to match the Polyline tangent. If answering with "Yes", blocks are rotated relative the blocks X-axel as shown in picture below. The station value is always horizontal values, if you use a 3D polyline the real length is ignored.

If your polyline (alignment) has a different starting station the zero you can type in desired starting station in the text box "Line start at:", before inserting the block CadTools will recalculate the station according to typed value.

The "Block-Z relative polyline Z" check box can be used if you want to use elevation (Z) in the grid as an relative elevation to the polyline. If the line is a 3Dpolyline the block elevation will be based on polyline elevation at the station + Z value in the grid. This can be useful if you want to place blocks at a specific station with a elevation relative the line i.e. lamp post

If you omit the value for Scale a value of 1 will be used.



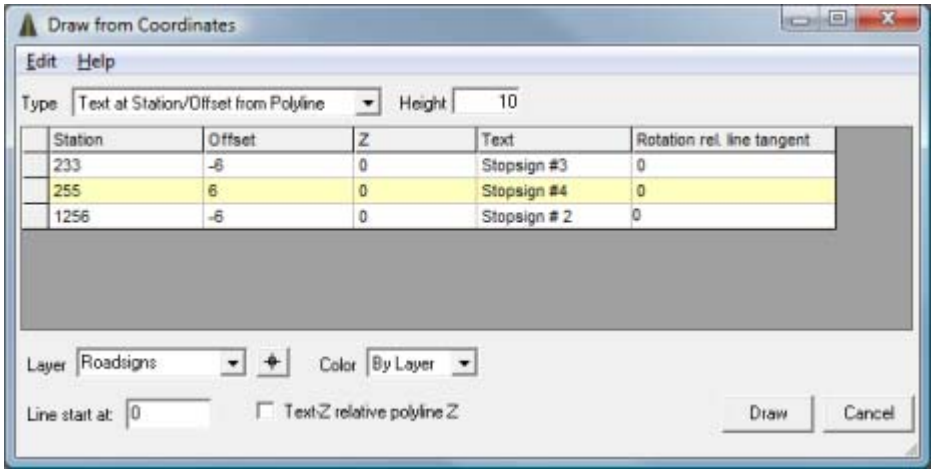


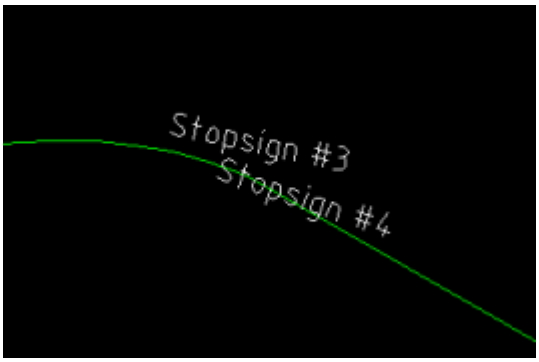
Text at station/offset from polyline

This function inserts text along a polyline (2D or 3D). Rotation of the text is relative the tangent of the line at current station. Station value are always horizontal values, if you use a 3D polyline the real length is ignored.

If your polyline (alignment) has a different starting station the zero you can type in desired starting station in the text box "Line start at:", before inserting the text CadTools will recalculate the station according to typed value.

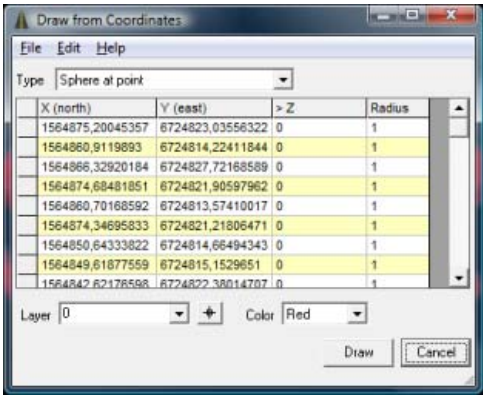
The "Text-Z relative polyline Z" check box can be used if you want to use elevation (Z) in the grid as an relative elevation to the polyline. If the line is a 3Dpolyline the text elevation will be based on polyline elevation at the station + Z value in the grid. This can be useful if you want to place text at a specific station with a elevation relative the line.

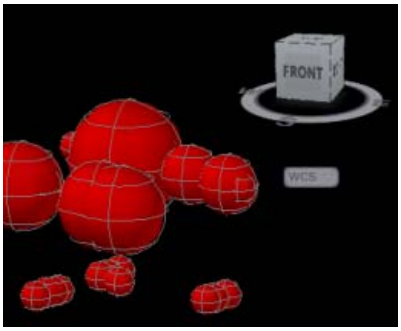




Sphere at point

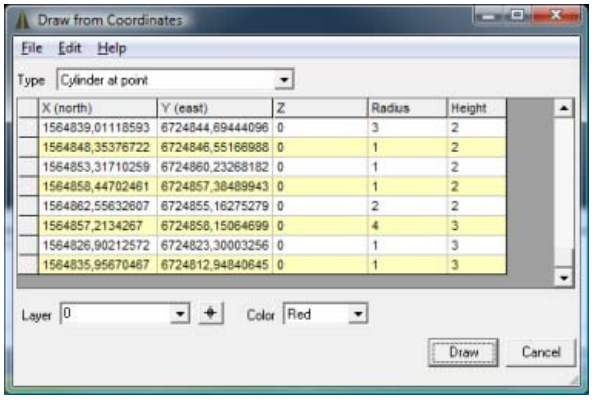
This function inserts Spheres

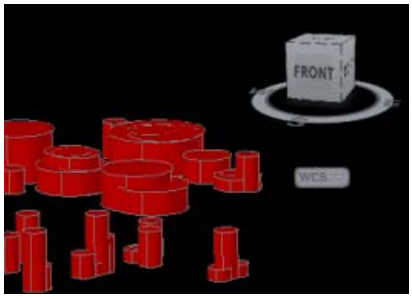




Cylinder at point

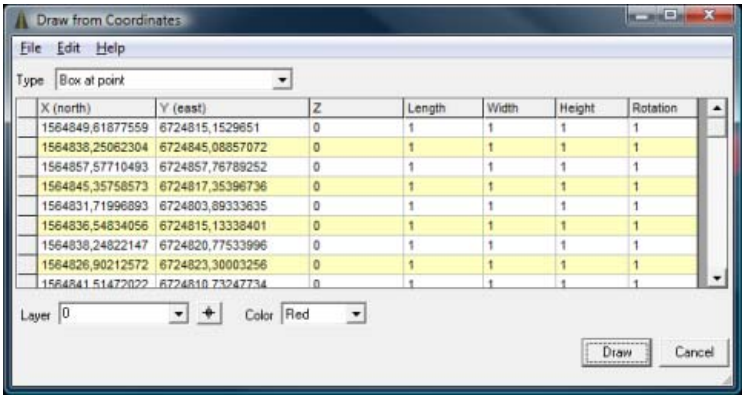
This function inserts Cylinders

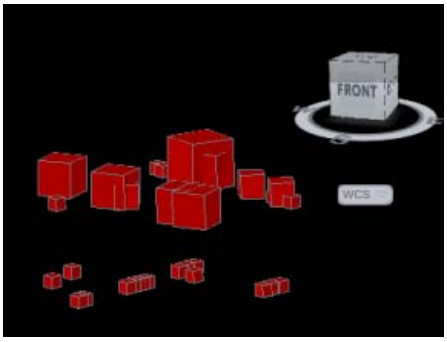




Box at point

This function inserts Boxes





Revision cloud

<Commands>, <Draw>

Draw old fashion revision cloud. Works in both model and paper space, Points are anti clockwise

1. Specify cloud starting point
2. Pick next point
3. Pick next point.....
4. Close cloud

Layer commands

Layer commands

<Commands>, <Layer>

Layer commands commonly used to speed up work. These commands can also be found in the topmost toolbar

All layers of but selected

Select an object in the drawing to turn all layer of but the selected objects layer.

All layers off but current

Turns of all layer off except current layer.

Layer off by objects

Select objects in drawing, all layers other selected objects layers will be turned off.

Layer freeze by single object (Xref)

Select a single object in a drawing and get layer information. You can then decide to freeze that layer. Works fine with External references. This command even works in layouts (PaperSpace) if they are activated.

Move to layer by object

Change layer for selected objects to layer by selected object.

All layers on

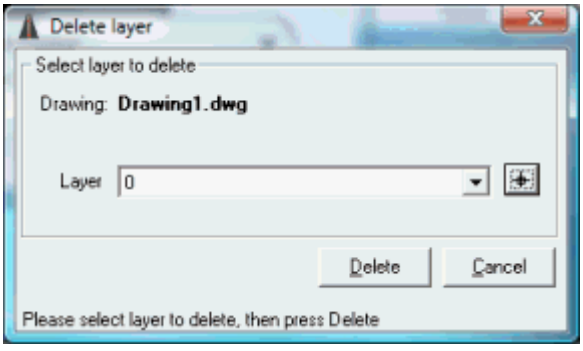
Turns all layers in drawing on.

Set current layer by object

Change current layer by selecting a object. That objects layer becomes current layer.

Delete layer

Deletes selected layer, included entities will also be deleted.



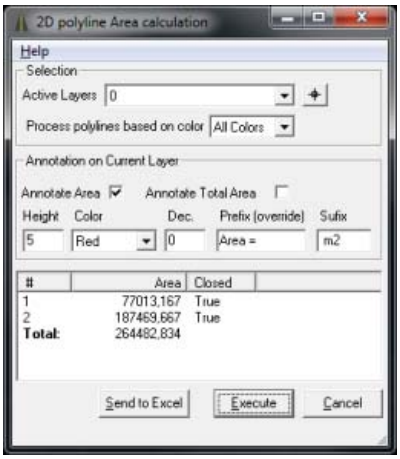
Layer report to Excel

Sends layer properties to Excel, layers are sorted by name.

Line commands

Area Calculation

<Commands>, <Lines>

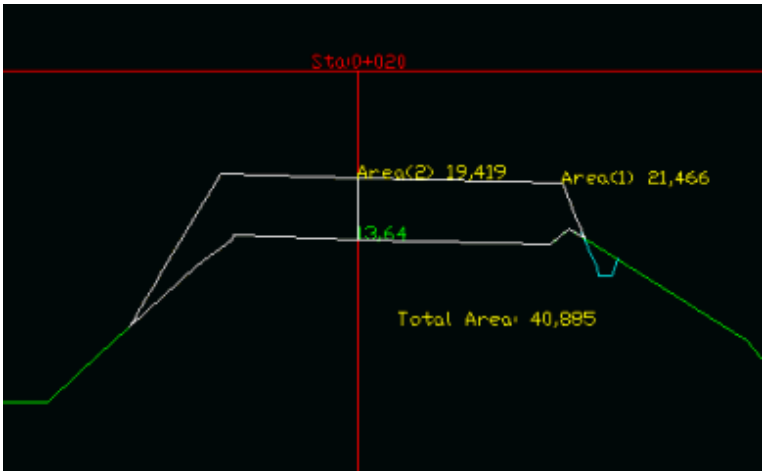


This function calculates Polyline areas based on user selections. Area annotation is placed at the first vertex of each polyline. If Annotate Total Area is checked CadTools ask user to pick annotation point in for total in the drawing. After calculation the results can be exported to Excel (message box asking user). Closed status of calculated lines are in third column.

Prefix override works like this: If you don't type anything in the textbox for Prefi CadTools will create a label like "Area(1) 21,466" in the image below. If you type in a text that text string will override the default label.

You can filter polylines based on display color and layers, i.e. only calculate yellow lines on a specified layer.

There is a better command for cross-section Cut and Fill areas, please follow link: [Cross section area]



Tip! When calculating areas in cross-sections, use Autocad's BPoly to create closed polylines of areas. To create end area volumes you can export all values to Excel and create your own formula.

Annotate Cross Section (table)

This command calculates offset and elevations in cross-sections (and other drawings containing polylines). Polylines can be exaggerated in both X or Y direction. *W*hen you select lines for calculation CadTools adds the points to the table. Points with same offset and elevation will be considered as duplicate points, they will not be added. You can add extra points to the table by using the "Add points to table" button.

CadTools provide a table of calculated points and their offset from a base point, the table can be pasted into the drawing. This table can be useful for constructors, both for staking out the cut and fill and as input-data in other software.

"Annotate table points" will annotate all points in the table. "Paste table" will create a table containing all points and their offset and elevation relative the basepoint. Starting point-number can be set by the user. You can copy entire table to Windows clipboard by using right-click in the table, this makes it possible to paste the table into any other Windows software.

For Cut and Fill area calculation of cross-section look into: Cross section area

When executing cross-section sets you must remember to do the following for every new cross-section

- Clear the table
- Select a new basepoint
- Change base-point elevation (if different)

How to annotate a set of polylines and some extra points

1. Select basepoint in the cross-section (any point on cross-section centerline that can be identified with a elevation)
2. Type in basepoint elevation
3. Be sure to use correct exaggerations
4. Select polylines in the drawing (use crossing or pick one by one)
5. If you want you can add extra points of interest to the table by pressing "Add point to table"
6. If desired, paste table in the drawing by pressing "Paste Table"

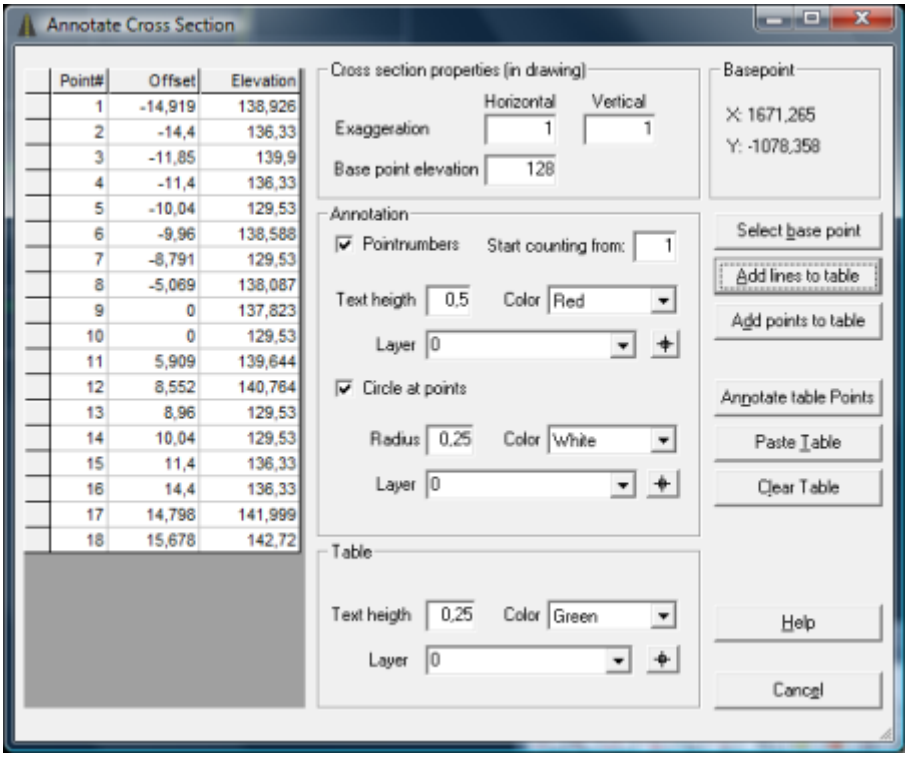
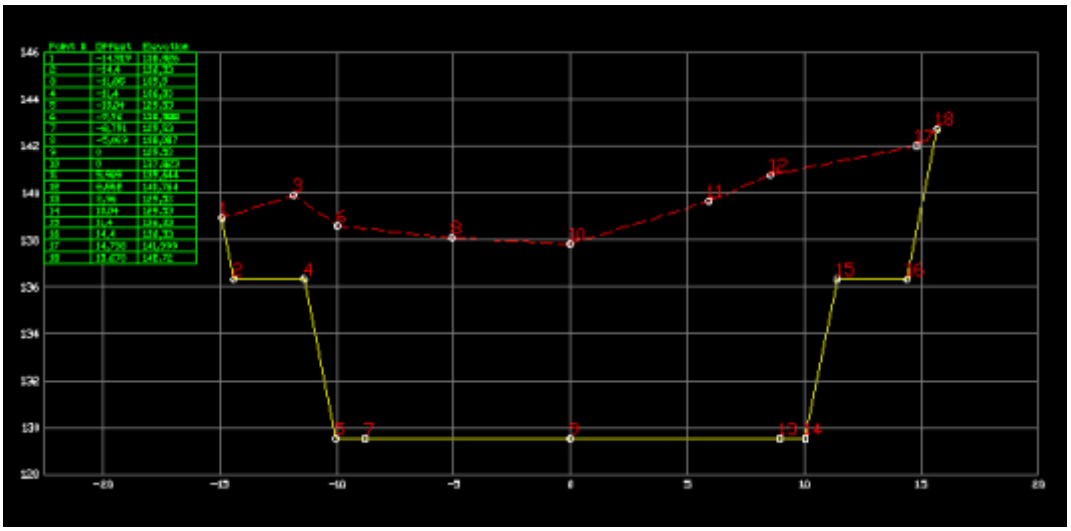


Image of result in drawing

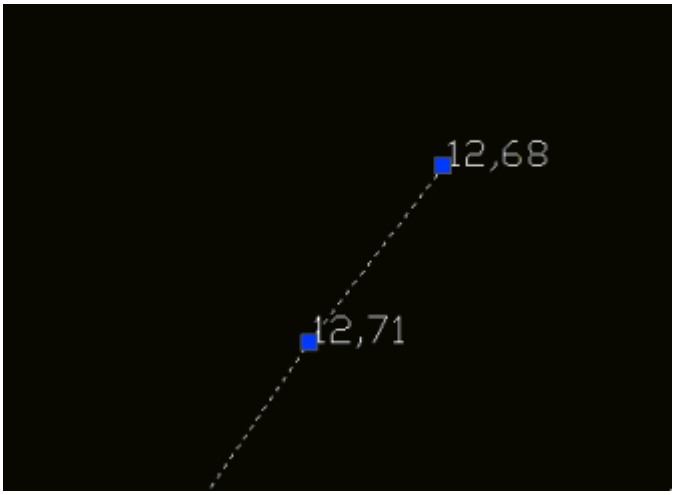


Annotate polyline elevation

<Commands>, <Lines>

Annotates vertex elevation of 3D polyline. Text height and number of decimals are optional. Vertex to be annotated is also optional, First, Last or All (default)

If you are looking for a command to annotate at given interval use "Transverse 3D lines between 3D polylines"



Export polyline coordinates to Excel

<Commands>, <Lines>

Export polyline vertices to excel. You can use this command together with "Draw object/text/polyline from coordinates" to draw blocks etc at vertices.

For 2D Polylines the coordinates are in the entity's object coordinate system (OCS).For 3D polylines the coordinates are in the World cordinate system (WCS)

	A	B	C	D	E	F
1	Line#	Vertex	X	Y	Z	Layer
2	1	0	56627,607	18900,962	12,794	0
3	1	1	56624,23	18892,575	12,906	0
4	1	2	56622,313	18886,96	12,937	0
5	1	3	56621,664	18884,002	12,947	0
6	1	4	56621,381	18881,018	12,987	0

Create 3D alignment

<Commands>, <Lines>

This command creates a 3D alignment from two 3D polylines. The vertical polyline must start at the vertical frame line. The end of vertical polyline must be at least same station as end station of the horizontal. If shorter the new polyline will be as long as the shortest line (vertical or horizontal) **Remeber to check direction (start and end) of polylines!**

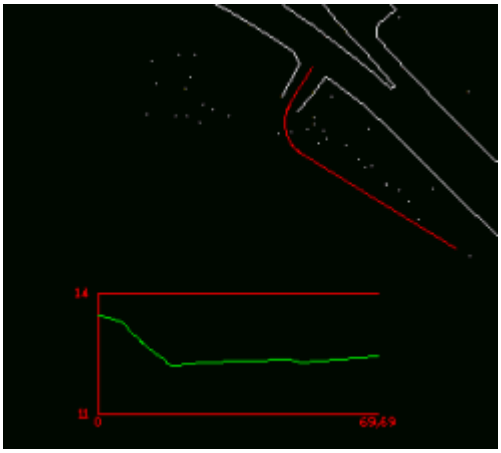
1. First you need a 3D polyline that describes the alignment in plan. If it's a road alignment the easiest way to do this is to create a smooth line by using Autocads "Draw Polyline".
2. Convert the polyline to a 3D polyline with CadTools "Convert command"
3. Now you have two options, load a surface and drape the line to get a surface profile or use CadTools "Surface profile". If you decide to go for the first option you drape the line and then use "Profile 3D polyline" on the draped line, the second option "Surface profile" has some similarities but instead of profiling the line you use it as reference line.
4. Plot the profile in current drawing near the plan line.
5. Now you have a 3D polyline describing the alignment in plan and a profile of the terrain beneath it.
6. Once again using Autocads "Draw polyline" you create a smoth profile line in the plotted profile frame. If you used a vertical scale in the frame CadTools will take care of that.
7. When you are satisfied whit the line, convert it to a 3D polyline.
8. Now we need to merge elevation data from the profile to the plan line. Do this by using the "Create 3D alignment" in the menu of the "Profile 3D polyline" form.
9. Follow the instructions on the command line. (select frame, horizontal line, vertical line)
10. The resulting alignment is created as a new 3D polyline.

Note! When converting arcs in both ordinary arcs and arcs in polylines, CadTools inserts vertices (replacing arcs with straight elements). You can change setting for chord height in the "Settings form" However the accuracy of the result may not be suitable for certain conditions.

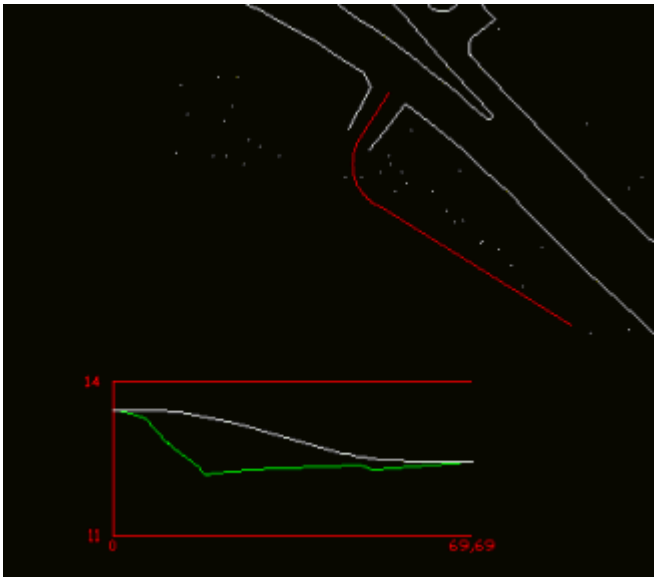
You should also consider the possibilities of "bad" angles between elements. It's up to the user to decide if this method is appropriate or not.

1. First a 2D polyline is drawn in the plan (red line). When satisfied the line is converted to a 3D polyline.

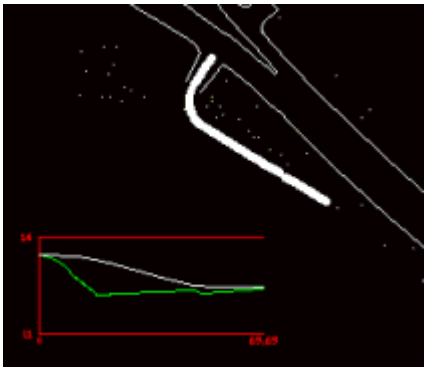
2. The 3D polyline is used as reference line in the "Surface profile" command. (you can also use "Profile 3D polyline")



3. Draw a new profile line for the alignment as a 2D polyline (white line in the profile frame).

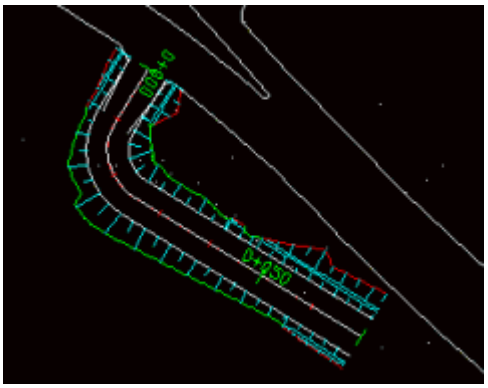


4. Using the "Create 3D alignment" command the resulting 3D alignment shows up as a thick white line.

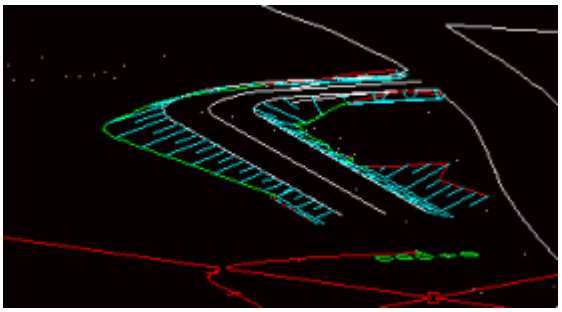


Sample of resuming work.

A. Continue with offset 3D polyline to create shoulders. Create longitudinal features and tickmarks.

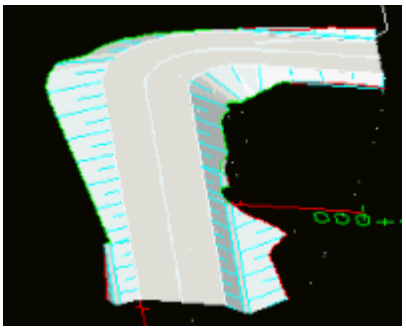


B. Result is real 3D!



Triangulate longitudinal features to a design surface. Edit the triangulated result (delete unwanted triangles) and save it with "Edit

surface"). Calculate cut and fill volumes. Annotate centerline and shoulder elevations (transverse features), ditch bottom slope arrows. Create cross-sections of existing ground, design and other surfaces with "Surface cross-section"



Cross section area (Cut and Fill)

This command calculates areas between polylines and areas for closed polylines. Polylines can be exaggerated in both X or Y direction. This command is very useful for end area volumes, plot your cross-sections with CadTools or any other software as long its polylines. Use the command calculate cut and fill area between existing ground an the proposed, annotate the result in the drawing and finally do your end area volume calculation by hand (or using Excel).

Calculate end area volumes like: (End area 1 + End area 2)/2 + length.

For annotation of Cross-section points Annotate Cross Section (table)

How to calculate area

1. Be sure to use correct exaggerations
2. Select calculate method , "Cut- and Fill area" or "Closed polylines (components)
3. Press "Calculate area"
4. Select Existing ground polyline in the drawing
5. Select Proposed polyline in the drawing
6. If desired, paste calculated values in the drawing by pressing "Paste Area"

Tip! You can replace step 6 by marking the "Paste result after calculation" this option has same effect as if you press the "Paste Result" button.

When calculating closed polygon areas the polygon must not cross itself. If so the area will be wrong.

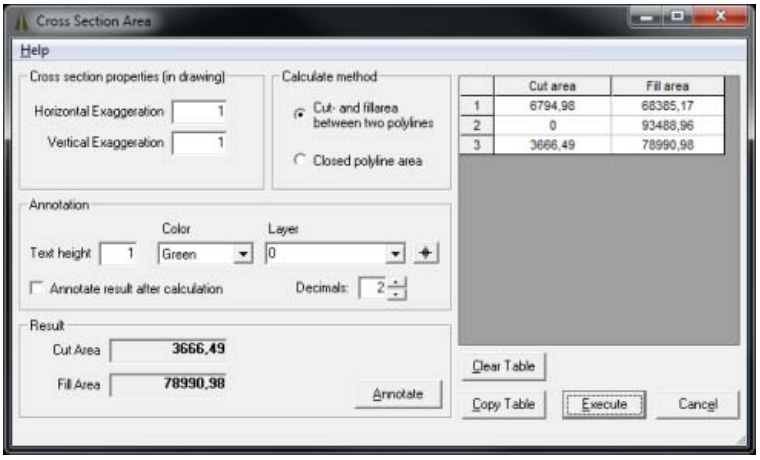
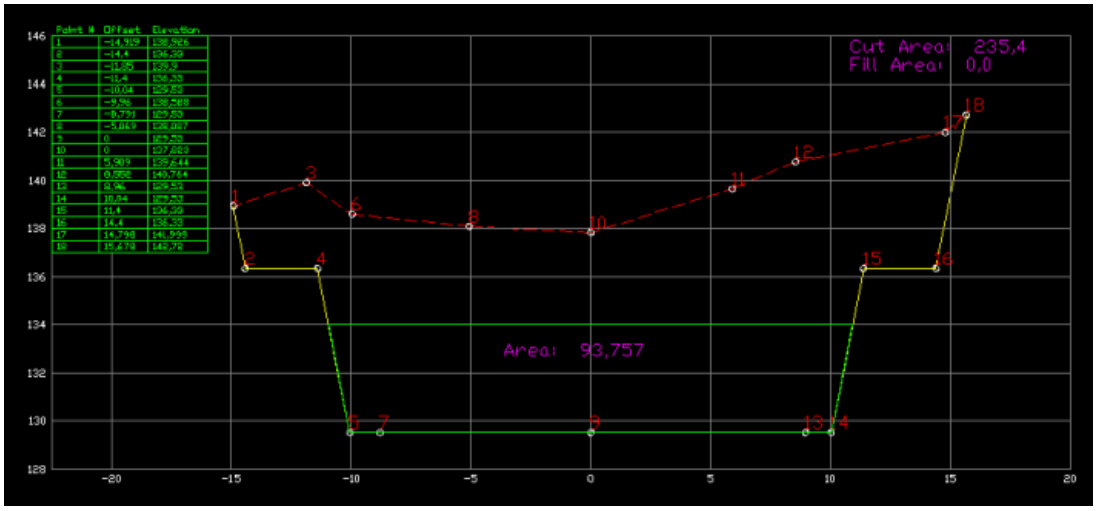
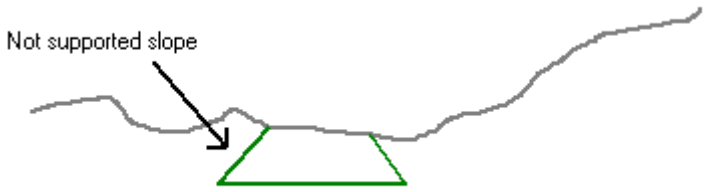


Image of result in drawing. Text in magenta color are annotated from this command. Other features in the image are created with the "Annotate Cross-section command"



Note!

The Cut&Fill calculation is based on some simple rules, lines must not have "loops" and the proposed line may not exceed the existing line. "Loops" are reversed portions of the line, all offset values must be descending or ascending. The line can't change direction in any part, if so CadTools will inform the user. Image below shows a unsupported line



Annotate Cross-Section/Profile slope

<Commands>, <Lines>

Use this command to annotate slope in Cross-Sections or Profiles. You have two options for annotation type, Percentage or Ratio. Annotation precision is 2 decimals . Vertical exaggeration can be set for use in Cross-sections and profiles with different vertical and horizontal scale. Default Text height is same as in CadTools settings, you can change size during initializing of the command.

How to use the command:

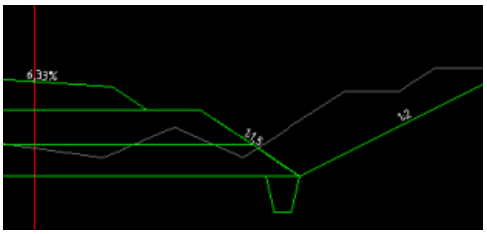
- Execute the command by menus, button or the command tree.
- Select Percentage or Ratio (Default)
- Input vertical exaggeration(1 is default, same as no exaggeration meaning same scale
- on both axes)
- Input Text height for annotation
- Now you select first point of a imaginary slope line (use Autocad's snap)
- Select last point (annotation is performed)
- Select first point.....

CadTools now calculates slope between your points and places the text at midpoint of a straight line between the two points. The text is rotated to align the slope.

Slope values are absolute values (no negative sign) and the annotation is always positioned above the line. Insertion point of the annotation is bottom-middle, by picking your points smart it's easy to make the text appear in desired position along a line. To make the procedure swift the command runs in a loop, after annotation CadTools asks for a new set of two points.

To terminate the command use the ESC-key.

Image below is an example of annotations in a Cross-section.

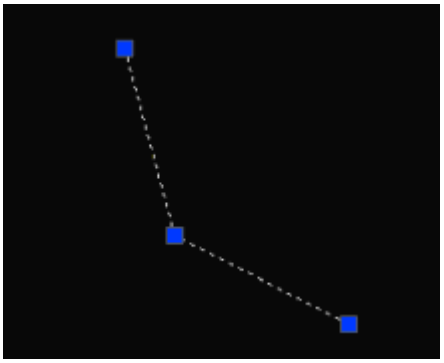


Densify polyline

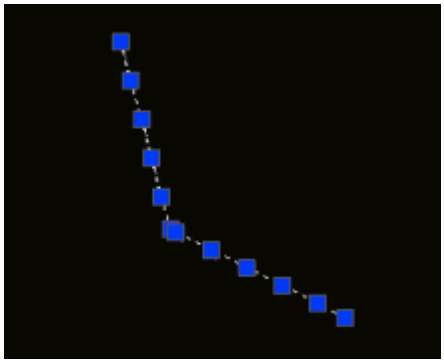
<Commands>, <Lines>

Use this command to interpolate new vertices at given interval or a number of vertices. This can be useful when triangulating surfaces, if a constrained triangulation fails this sometimes can help. This command might result in duplicate point on the polyline, these can be removed by using the "Remove Duplicate Points" command

Before



After



Join 3D polyline

<Commands>, <Lines>

Joins 3Dpolylines. The first line becomes the master line, lines selected after the first line inherits colors and layer properties.

All lines must have exactly the same coordinates (startpoint-endpoint) otherwise they will not be joined.

Length calculation

<Commands>, <Lines>

Calculate line lengths and radius on active AutoCAD drawing.

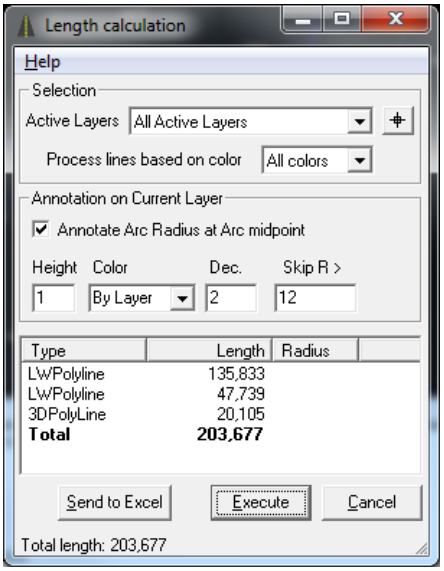
First you select the layer for the lines to be calculated. Layers can be selected from the drop down list. Lines on frozen or hidden layers are not in the list. Lines from external references will not be calculated.

If you want to select lines by color (visible color) you select a color from the color drop down list. The filtering process will exclude all lines with a different visible color than the one selected.

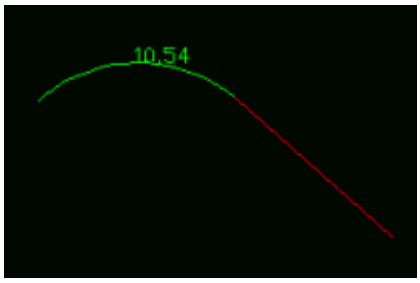
You can put annotating for Arc radius on current layer. When calculating curbs etc you may want annotations only for arcs with radios below a given value. In some cases arcs that are almost straight can be treated as lines and therefore this feature is handy. The annotation is placed at the midpoint of the arc.

Pressing Execute will start the process. First you will be asked to select lines, use AutoCAD's commands (crossing, all etc.) After selection the software will calculate line lengths and showing a grand total.

Pressing "Export to Excel" will start up Excel and transmit data to Excel. Before the export begins you will get a question if you want to sort on radius. Answering no will keep all data in same order as selected in the drawing.



Annotation of radius



Excel output

	A	B	C	D
1	**LineType**	**Length**	**Radius**	**Layer**
2	Arc:	15,043	10,536	0
3	LWPolyline:	14,604		0
4				

Tip! *If your drawing has polylines with arcs you may save it as a copy and explode all lines. Then run CadTools LineCalculation to extract radius.*

Level out 3D polyline

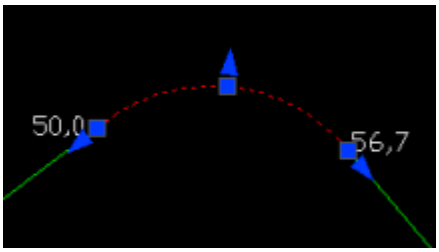
<Commands>, <Lines>

This command levels out elevation for a 3Dpolyline, it was developed mainly to solve problems when working in 3D with simple intersections but it's useful in many other situations.

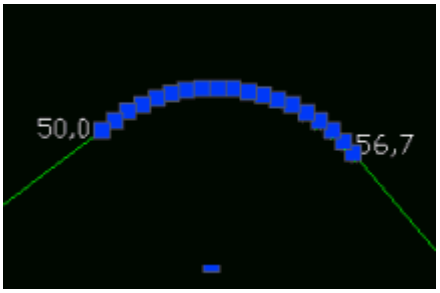
The command first calculates difference between start- and end elevation. The difference is equally distributed along the line so all other vertices gets same slope as if there was only one single line. There must be at least three vertices, lines with less vertices will not be processed, one or more Polylines can be processed at the same time.

Sample for adding a "3D curve" between two 3D polylines.

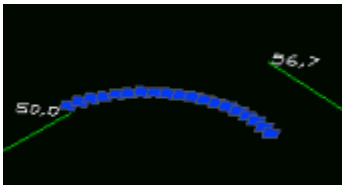
1. Picture to below show two 3Dpolylines and a arc. There is nothing like a 3D arc so we haft to convert it to a 3D polyline.



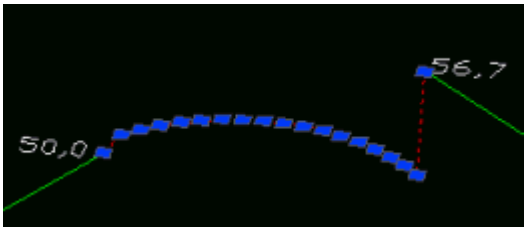
2. Use CadTools command "Convert arc to 3D polyline"



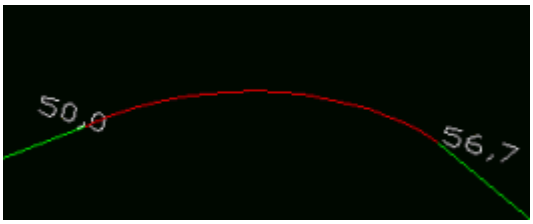
3. Use Autcad's 3D Orbit to rotate up front



4. Snap first and last points of the converted arc to line ends



5. Use CadTools "Level out 3D polyline" on the converted arc to get a smooth transition between the lines.



Tip!

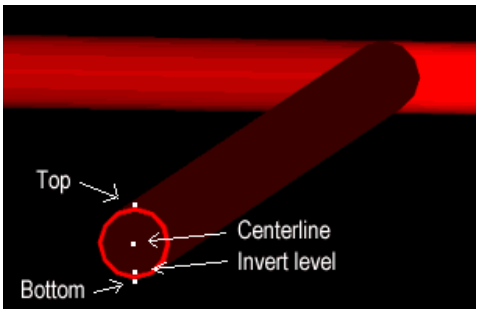
The "level out" command works with multiple selections. You can put all arcs on a unique layer and turn off all layer but that before using "level out". Do this before picture 5 and then select all in the drawing.

Make 3D solids from lines (pipes)

<Commands>, <Lines>

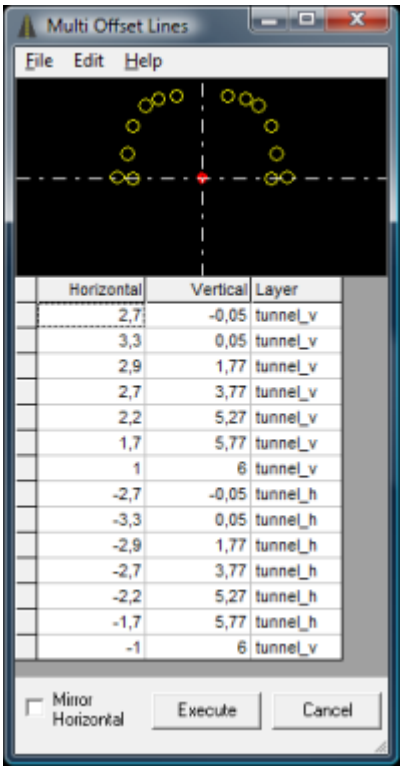
This command generates 3DSolids (cylinders) from lines. The line remains inside the solid, it's not deleted. This command can be used to generate a model of a network of pipes.

Lines used of this command can be booth Bottom, Center, Invert or Top levels. If other then Center levels are used the insertion point of the used circle is adjusted in X, Y and Z before it's extruded. Vertical parts of the line will still use the adjusted insertion point. If you need those parts to be aligned to a centerline you need to separate them and process them with the option "Center Line"



Multi offset line

<Commands>, <Lines>



This command offsets a line (3D polyline, Polyline and Line) to more than one position relative the source line. Input parameters are Horizontal offset distance and vertical offset distance and layer name. If layer name is omitted the offset line will have same layer and color as the origin line, that means there is no need for layer information. If there are duplicate points in the line they will be removed. If you offset lines to the concave side on narrow corners you might end up with loops in the resulting line.

Duplicate points will only be removed if the source line is a 3D polyline. 2D polylines that use an arc as starting element sometimes can be treated with wrong offset side, if your offset values are symmetric you will not notice anything. If asymmetric values and wrong offset you could try to reverse the polyline before using this command or use the checkbox "Mirror Horizontal". The latter is also useful if you use a saved setting that contains offset conditionsfor one side and want to use it for conditions for the opposite side.

Totally empty rows will be ignored so you don't need to remove them. Before processing CadTools does a check of decimal separator, if mismatch with computer settings (localized) then the user gets a warning. You can paste data from other software into the grid, use mouse right click or the menu "Edit". A similar procedure evaluating decimal separator is performed if you paste into the grid.

You can save grid values to a file for later use by using "File, Save settings"

Above the grid there is a graphic view of current settings, the red circle in center is the source line, yellow circles represent offset results. You can Hoover the mouse over the graphic view to get a tooltip with horizontal and vertical position.

This form can be resized.

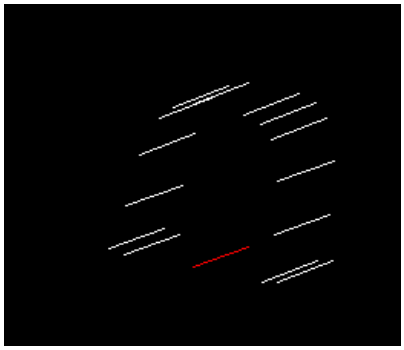


Image below (orbited) showing result in drawing. The middle line (red) is the source line, by leaving layer name empty the target line inherits layer and color properties from the source line. Offsets with layer name gets color by layer. The sample illustrate a method to create tunnels, after offset the lines can be triangulated to two surfaces, bottom and top.

Tip!

If you have a typical section (DWG) for the tunnel and want to create a setting you could use the Annotate Cross Section (table) to get the offset values. You can copy entire table to Windows clipboard by using right-click in the table (Annotate Cross Section), and then paste the table into Excel. Finally copy the appropriate columns from Excel and paste it to the Multi offset table.

Offset 3D polyline

<Commands>, <Lines>

This command offsets a 3DPolyline. Input parameters are Horizontal offset distance and vertical offset distance. If there are duplicate points in the line they will be removed. If you offset lines to the concave side on narrow corners you might end up with loops in the resulting line.

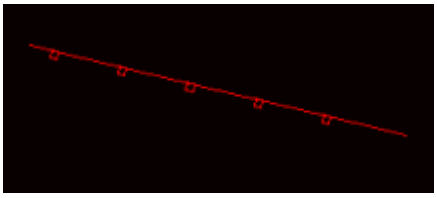
Reverse polyline

<Commands>, <Lines>

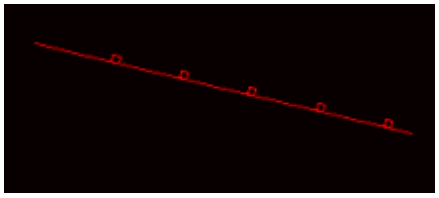
This command reverses a polyline. The polyline must be on current layer. This command is also useful if you have different linetypeson based on direction. Guardrail lines in plans often have a symbol for the upright, one linetype for each side. Instead of changing linetype if uprights are on wrong side you could reverse the line.

This command is also useful when using "Stationing" if the direction of the line is wrong.

1. Before reverse



2. After reverse



Point section/offset from polyline

<Commands>, <Lines>

Select a line and any point in the drawing, get perpendicular line with section (station) and offset from the line.

Polyline Tools

<Commands>, <Lines>, <Polyline Tools>

Here you will find some other handy polyline commands.

Best fit

Use this command to replace a 3D-polyline with a linear regression of all vertices (X,Y and Z). This is done in the same manner as you would do in a Excel chart when creating a “Trend-line”. The result is a straight line with two vertices. The linear regression algorithm uses the X (eastings) to adjust the Y (northings).

Tip! If you want to use this method on points you can export the points to Excel with CadTools point command (Export to Excel) an then draw a line with the "Draw" command.

It the polyline is a 2D-polyline, convert it to 3D-polyline using CadTools Convert command and then use this command.

Remove duplicate polyline vertices

Use this command to remove duplicate polyline vertices (2D and 3D polylines). The line must be open and not contain any bulges (arcs)

Simplify 3D-polyline

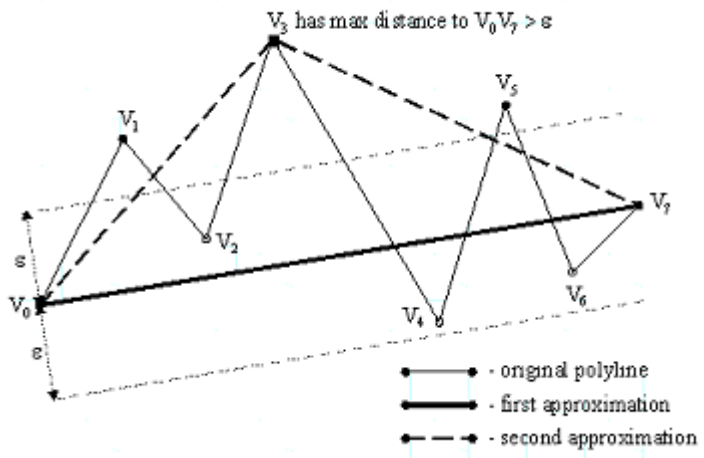
This command uses the Douglas-Peucker algorithm to reduce vertices in a 3D polyline.

The Douglas-Peucker (DP) algorithm uses the closeness of a vertex to an edge segment. This algorithm works from the top down by starting with a crude initial guess at a simplified polyline, namely the single edge joining the first and last vertices of the polyline. Then the remaining vertices are tested for closeness to that edge.

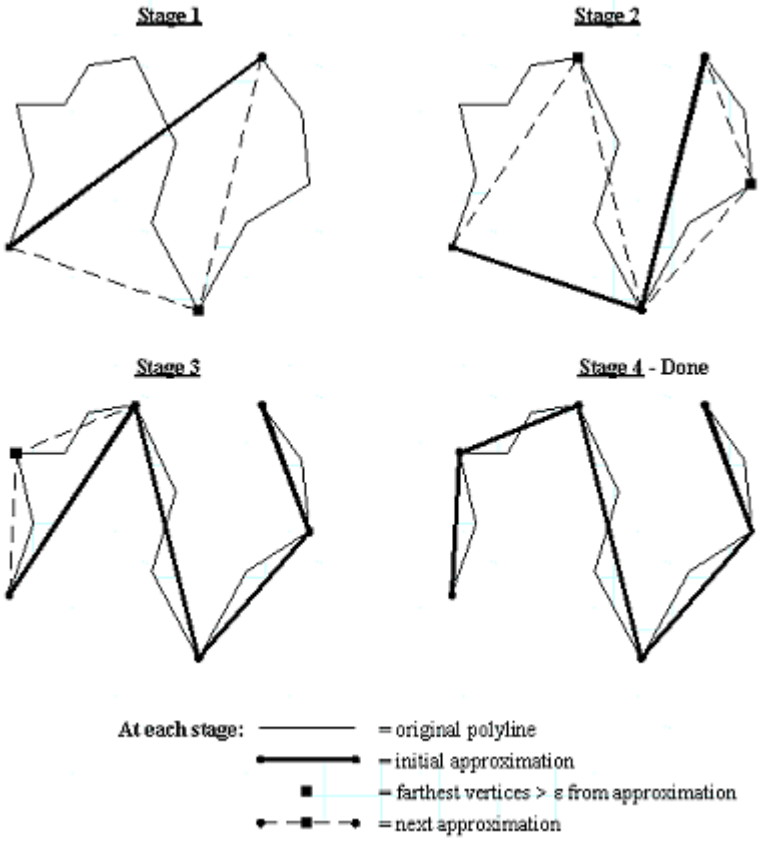
If there are vertices further than a specified tolerance, ε > 0, away from the edge, then the vertex furthest from it is added the simplification. This creates a new guess for the simplified polyline. Using recursion, this process continues for each edge of the current guess until all vertices of the original polyline are within tolerance of the simplification.

More specifically, in the Douglas-Peucker algorithm, the two extreme endpoints of a polyline are connected with a straight line as the initial rough approximation of the polyline. Then, how well it approximates the whole polyline is determined by computing the distances from all intermediate polyline vertices to that (finite) line segment.

If all these distances are less than the specified tolerance ε, then the approximation is good, the endpoints are retained, and the other vertices are eliminated. However, if any of these distances exceeds the ε tolerance, then the approximation is not good enough. In this case, we choose the point that is furthest away as a new vertex subdividing the original polyline into two (shorter) polylines, as illustrated in the following diagram.



This procedure is repeated recursively on these two shorter polylines. If at any time, all of the intermediate distances are less than the ε threshold (tolerance), then all the intermediate points are eliminated. The routine continues until all possible points have been eliminated. Successive stages of this process are shown in the following example.



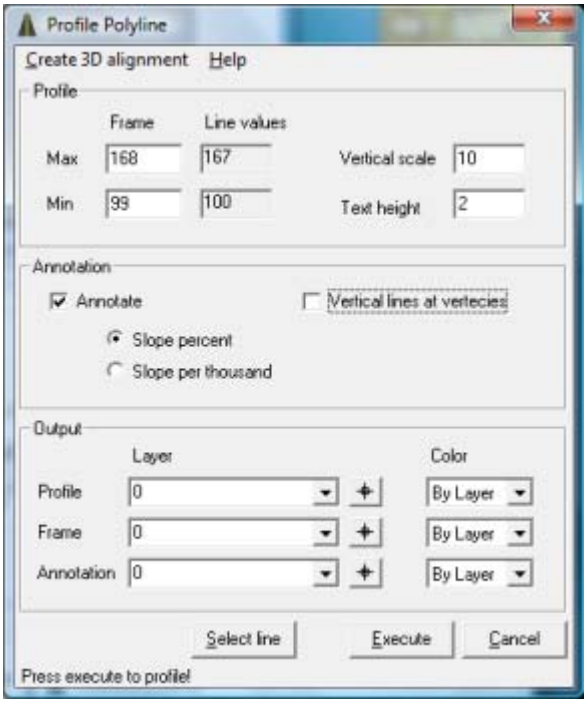
Profile 3D polyline

<Commands>, <Lines>

Link to "Create 3D alignment"

If you created a simple terrain model by using "triangulate" and then draped the surface with a 3Dpolyline you can use this command for profiling the 3Dpolyline. Select insertion point and vertical scale to plot the profile to current drawing. The start height is placed as a single line text at the beginning of the profile.

This command can be useful when profiling the terrain, by check out the annotation checkbox you can add more profile lines to the frame. Beware! Minimum value must be the same in the existing profile and the line that you plan to add.



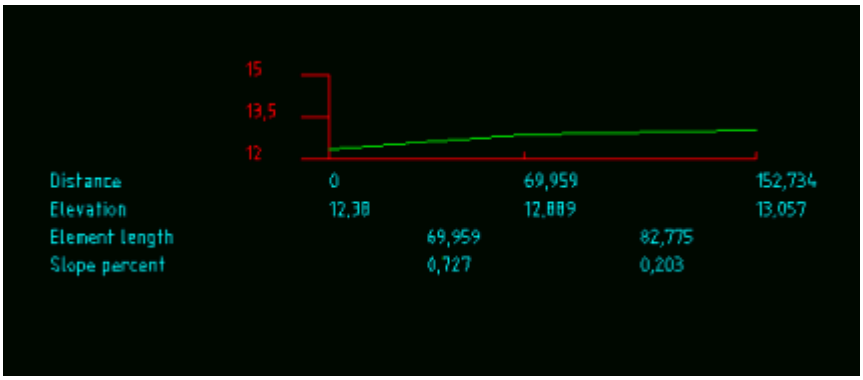
First you press "Select line" to let CadTools evaluate the line and suggest min and max elevation for the vertical axis. You can change these values before pressing "Execute". Pressing "Execute" start the profiling, first place the cursor at insertion point in the drawing. The insertion point of the profile frame will be at the intersection of X and Y axis. Add more lines to same frame by repeating the command from beginning, remember to set annotation unchecked to avoid any more annotations to the frame. It's important to set exact same min elevation and scale to add lines otherwise the elevation will mismatch. Setting same min elevation and scale makes it easy to use same insertion point (intersection of X and Y axes) for added lines.

Vertical lines at vertices creates supporting lines from the base line to the vertex point.

For more information about draping objects to surface, see Drape Lines in section Edit Surface

As alternative to this function you could use "Surface profile"

Result in drawing



Slope and Road signs 2D (topic for road signs and markings)

<Commands>, <Lines>

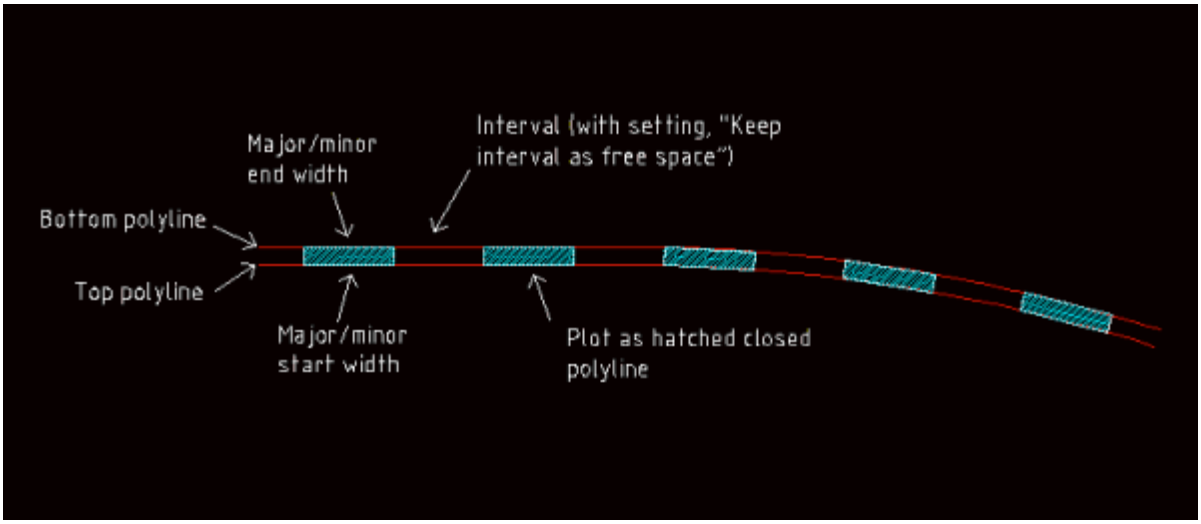
It's easy to draw road markings and signs with CadTools. Pedestrian crossings, bicycle paths, give-way and chevrons will be described in this section. Surely there are more types of lines and signs that can be drawn with CadTools Slope mark function.

The Slope sign command was one of the first commands in CadTools. This was a powerful function from the beginning. By extending it with the possibility to draw other than perpendicular lines it now can be helpful when constructing Road markings. You can prepare your own settings for different drawing types of tasks. Use the menu "Settings" on this form to load the user settings form. You also have the option to create road marks as closed hatched Polylines. Creating signs as Polyline gives a better result than using solid lines.

Many design manuals for road signs describes width and space between road signs. Mark the checkbox "Keep interval as free space" to obtain same space between signs as in input interval. If you tilt signs by providing an angle, CadTools always plots the Polyline correct width. One benefit of using ordinary Polylines is that they easily can be edited in AutoCad. Other software might do this more user-friendly by calculating drawing scale and filling arrows but it can't be edited unless you have the software that created them.

The typical flow of creating road signs with CadTools is:

1. Create supporting 2D polylines by offsetting design lines with Autocad's offset. As an alternative you could convert 3D lines to 2D with CadTools "Convert" command.
2. Set up your desired input values in Cadtools, press Execute
3. Pick top line (first line)
4. Pick bottom line (second line)
5. Erase or hide supporting lines



Important!

If you have set hatched properties and the result is empty polygons, try to change hatch scale. (Use appropriate decimal separator! Same as your operating system)

You can not save intersections to tempfile when using the "Draw as Polylines" command.

Remember to set max length when creating markings for shoulders and other thin lines, otherwise there might be unwanted lines.

The possibility to change angle in SlopeMarks is only available for registered users!

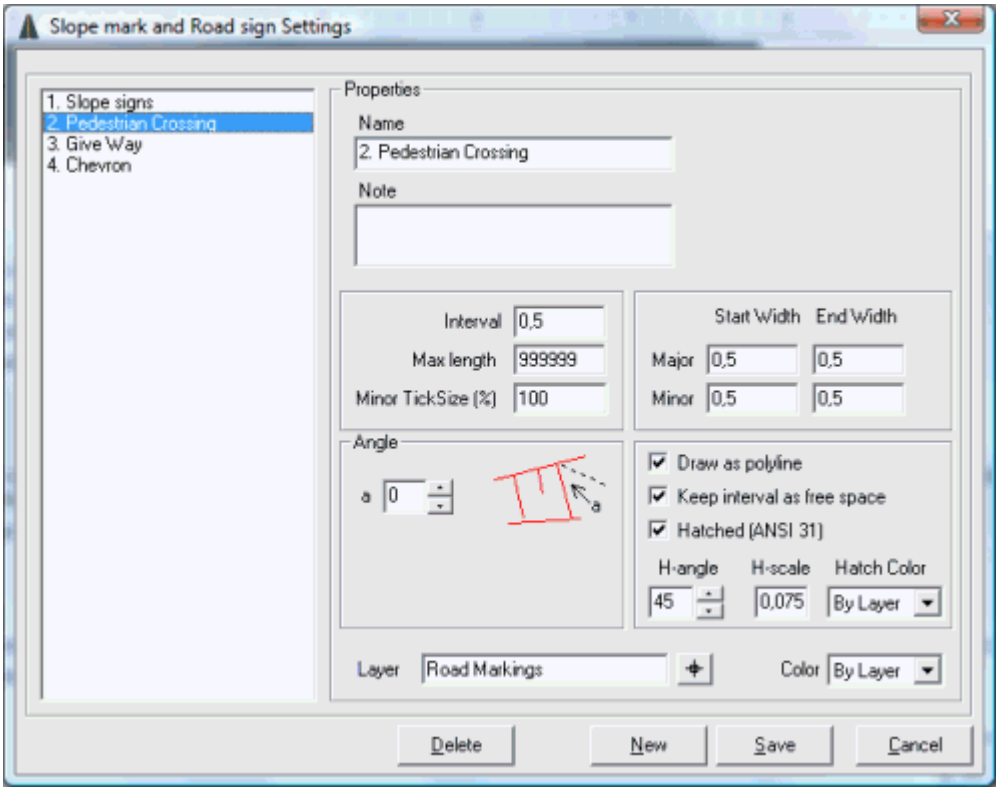
Tip!

- *You can use this command to create parking lot markings. Set interval to the parking space for one car, set Minor tick size to 100%. Draw two parallel lines for the front and the back of the parking space. Run the command! Consider the opportunity to set an angle here, that would also create another type of parking lot.*
- *Use CadTools command "Area calculation" to get road sign areas to Excel*
- *You can also export Hatc areas to Excel, look at Hatch Commands*

Save commonly used type of markings (settings)

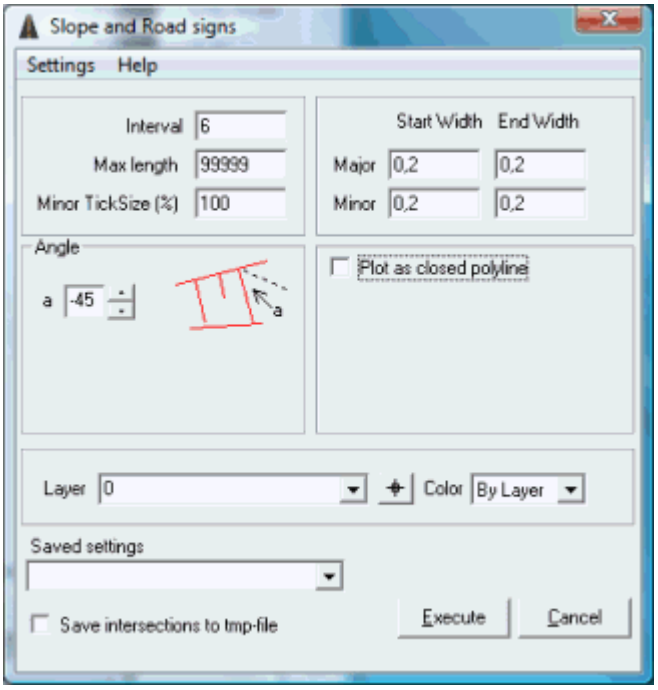
You build your own library of settings for any type of markings or what ever. In the left bottom there is a drop down list with all your saved settings. Selecting any of these settings will change all input values in the form.

Edit or add new settings by using the menu "Settings" in the form. You can share your settings to others by copying the file **"Cadtoolssettings.uds"** that's located in same directory as CadTools executable file. Pasting (overwriting) the file to same location at another computer gives that user same saved settings for booth "Cordinate grid" and slope (road markings)



Samples
Images below shows settings and result for some types of common markings, depending on country the settings might be different.

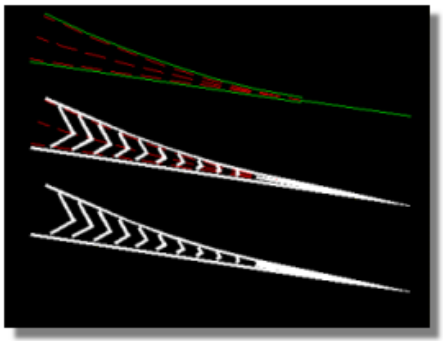
Chevrons



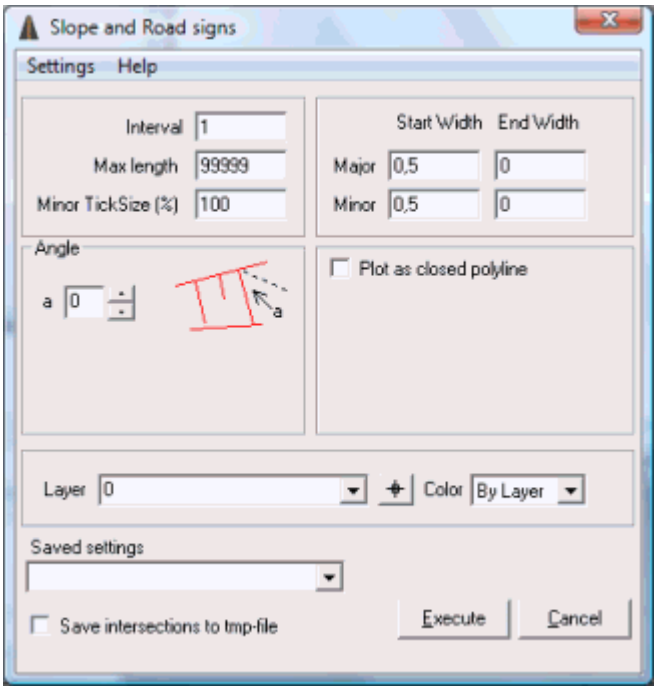
First you draw a couple of Polylines (reference line in the middle and two lines for the traffic). Draw Slope marks from the centerline towards the outer lines, toggle the negative sign of in the angle before executing the second line.

Now change the global width of the two outer lines in Autocad and it beginning to look familiar. The arrow can be done in same way, draw a Polyline and change start width in Autocad.

Steps to create Chevron

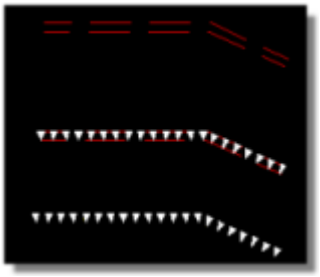


Give Way signs

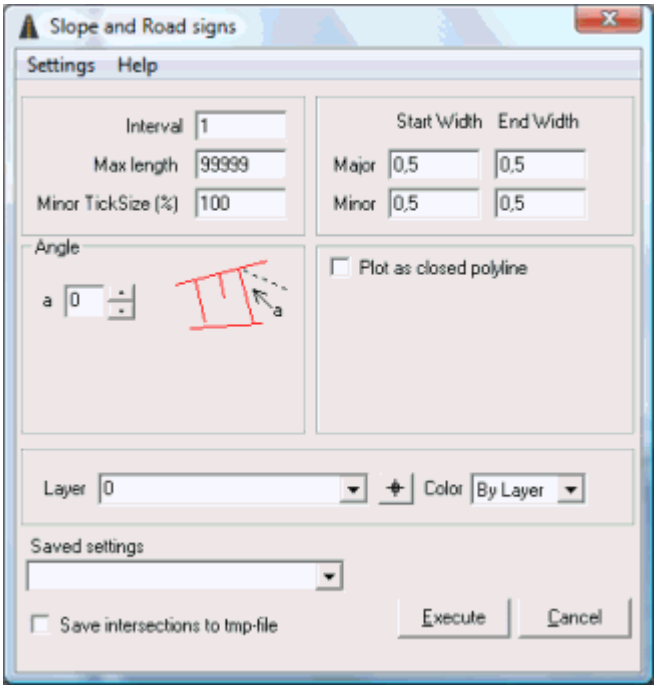


Draw a Polyline and use AutoCad's offset to get two Polylines. Set Start and End Width in cadTools, draw slope marks between the lines. Remember to set Interval to twice the Start Width.

Steps to create Give Way signs

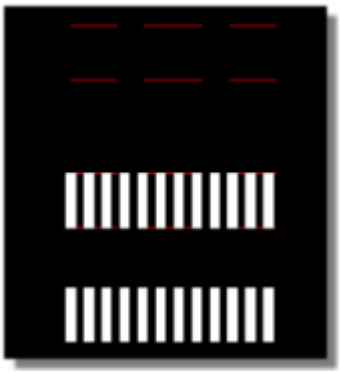


Pedestrian crossings

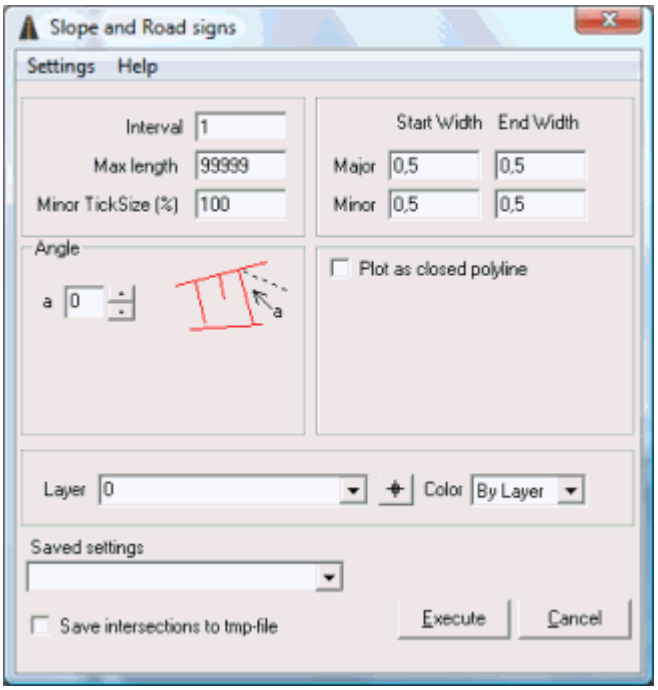


Draw a Polyline and use AutoCad's offset to offset the line to desired width of the crossing. Set Start and End Width in cadTools, draw slope marks between the lines.

Steps to create Pedestrian crossings

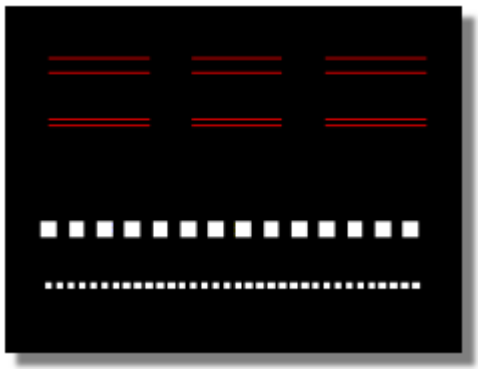


Bicycle paths



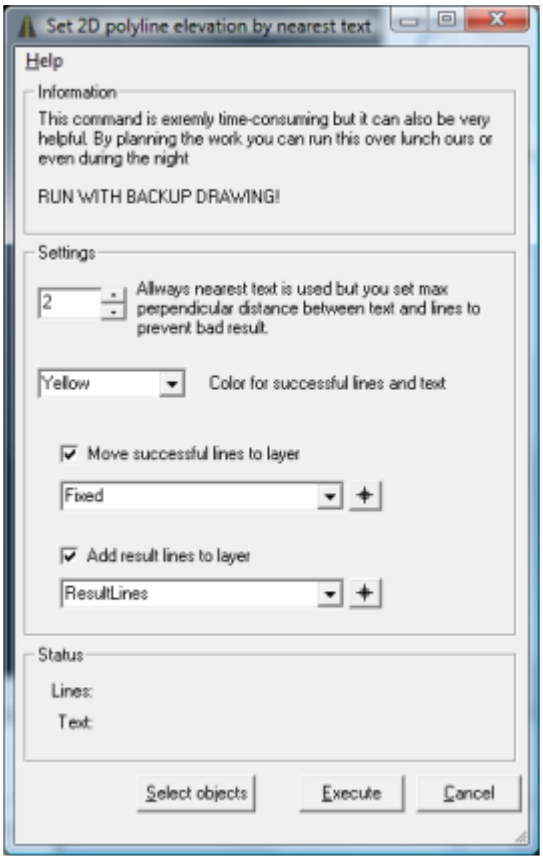
Draw a Polyline and use AutoCad's offset the line. Set Start and End Width in cadTools, draw slope marks between the lines.

Steps to create Bicycle paths



Set 2D polyline elevation by nearest text

<Commands>, <Lines>



This command can be useful if you receive a drawing with contours where elevation is zero and you need to create a surface. Often there are some elevation annotations near the contour lines, these text-strings are used by this command to change elevations for the closest contour line.

It's important to understand how this command works, by knowing this you can get better results so please read this section carefully. The command can process 2D-plylines, and single line text, polylines containing arcs are not supported. You can convert polylines with arcs to 3D polylines and then convert back to 2D polyline to get arcs converted to polylines. If polylines are in 3D with bad elevation you can convert them to 2D-polylines with CadTools Convert commands before running this command.

Cleaning up lines by using simplify will speed up the process, CadTools provide a simplify command for 3D-polylines, you can convert 2D-lines to 3D-polylines before using the simplify command and convert them back to 2D after.

The user selects text and 2D-polylines or in the drawing by using the "Select objects" button and then use AutoCAD's crossing or select objects one by one. In the section "Status" amount of selected lines and text are presented.

Pressing "Execute" button starts the process. The first line is compared with every text, the perpendicular distance between the text and all polyline segments is calculated. In this process all vertices except the first and the last also is evaluated against the text , the nearest text value is then used for elevation of the line.....and so on. (the text itself is also moved to that elevation)

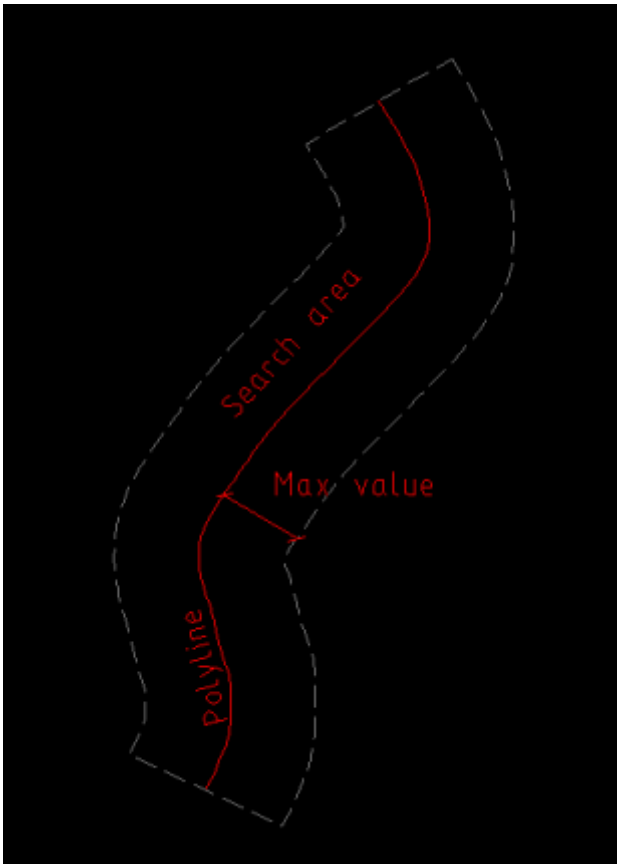
Same text can be used as elevation for more than one line, you can prevent bad elevations by setting the max value to a small value.

This command is extremely time-consuming 100 text and 100 lines gives 10 000 solutions to process.

You should always use this command with a backup copy of the original drawing. After completion lines can be triangulated with CadTools "Create Surface" command.

Max-value

What if the max value is set to high? Well, think of the value as a seek perimeter to the line. A huge value can get bad results



Color for successful lines

Polylines and text that gets elevation from text can be colored.

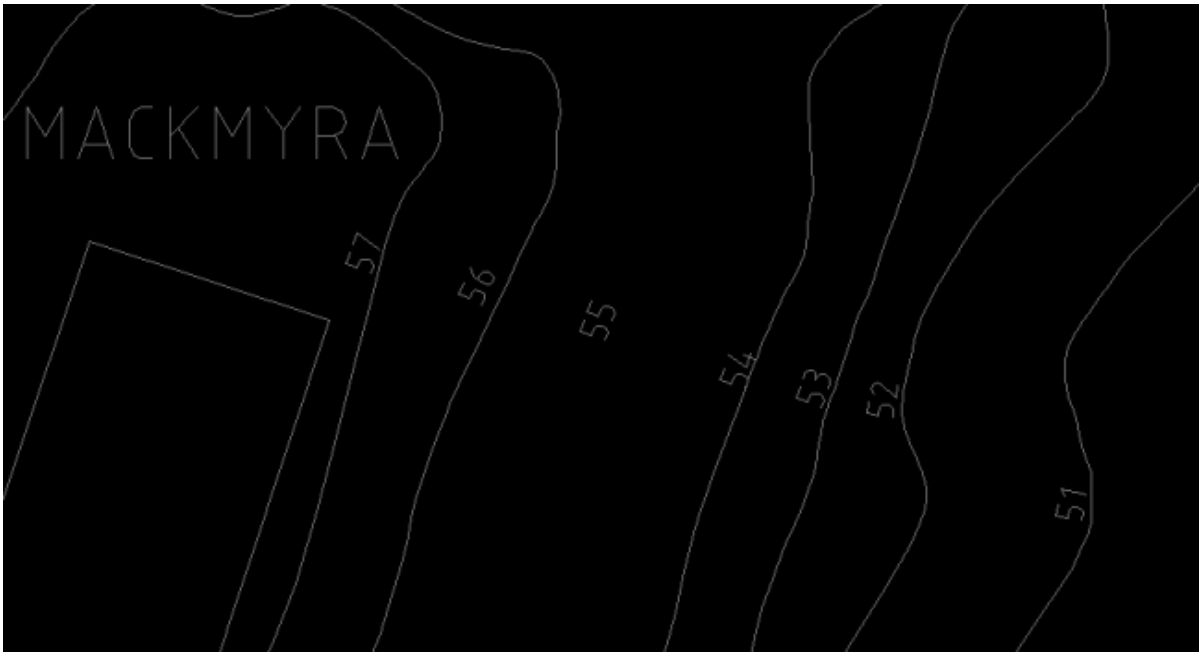
Move successful lines to layer

Polylines and text that gets elevation from text can be moved to a layer. Use layers in the drawing or type in a new layer. Using Ctrl + R in the layer dropdown refreshes layer information.

Add result lines to layer

Draws a line between line and the text that was used to set elevation. This is useful when looking for errors, you should place the result lines on a different layer than the lines.

Sample of input data below



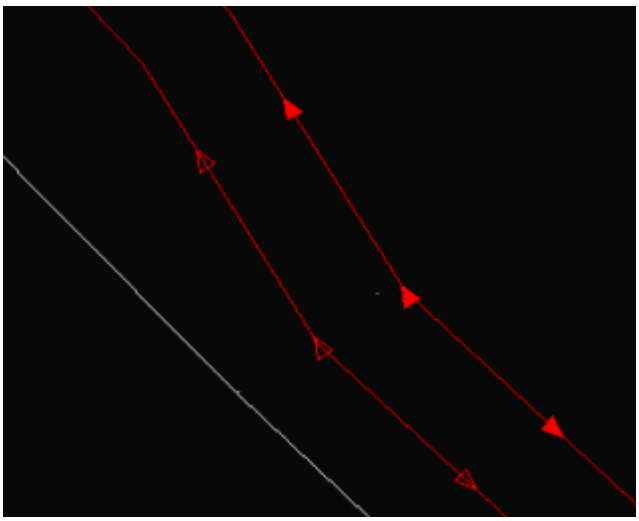
Sample of result below, green objects was successful. If you look closer you can see the white result lines between the text and the line.

Slope arrows on 3D polylines

<Commands>, <Lines>

Creates slope arrows on 3D polylines. Interval and arrow size are optional. You can create arrows as solid or as polylines.

If the 3D polyline has flat elements no arrow will be created for that element. Arrows will point in downhill direction. This command works with multiple line selections.



Slope and Road signs 2D (topic slope signs)

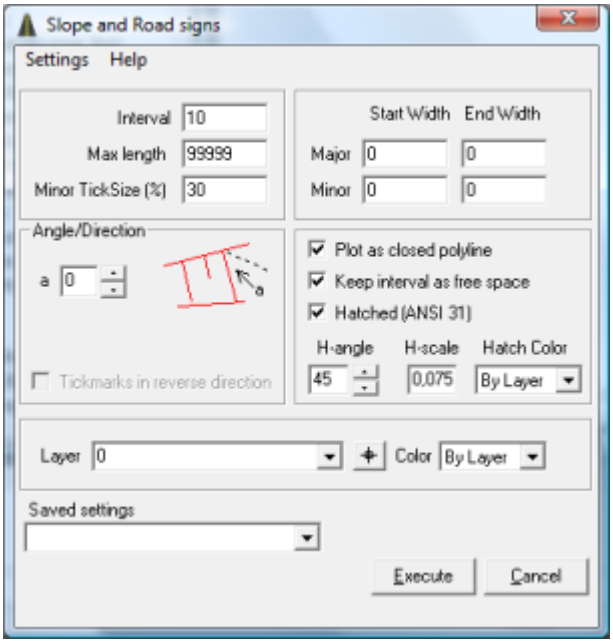
<Commands>, <Lines>

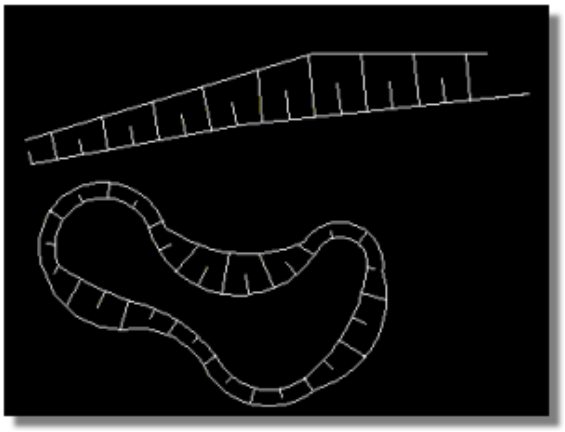
This command was developed to draw slope signs (ticker marks, batter ticks) but I discovered that with a few minor changes it could extend to support all kinds of road signs.
These methods are described in a separate topic, se "Road Signs".

To draw ordinary slope lines you first select top and bottom polylines and slopesigns will be drawn at current layer. You can prepare your own settings for different types of tasks. Use the menu "Settings" to load the user settings form.

The settings are:

- Set interval for lines between polylines.
- Max length is useful when intersections are found at not desired points.
- Minor Tick Size adjust every second line length, a value of 50 results in half distance.
- Start and End Width can be used to create slope lines shaped like triangles.
- Layer for the slope lines
- Color for slope lines
- Angle for slope lines
- Tick-marks in reverse direction (draws tick-marks from Toe to Top)





TIP!

You can use this command to find the centerline between two irregular polylines. Sometimes it's a good supplement to AutoCad's Hatch command.

If the checkbox "Save intersections to tmp-file" is marked CadTools writes all intersection coordinates to a file in the application directory. The name of the file is "SlopemarkTemp.txt" if there is a previous file it will be overwritten.

Manipulate this file with Excel and use the command "Draw from coordinates" to plot a Polyline between the minor ticks.

TIP!

As you know CadTools uses the first picked line (Top) as reference line to create tick-marks. In fill conditions you pick the shoulder line first and the tick-marks will be created towards the terrain. In cut conditions there might be some problems, picking the terrain line first will generate correct but not so nice result. To fix this you should use the "Tick-marks in reverse direction" option (draws tick-marks from Toe to Top).

This feature is not accessible when "Plot as closed polylines" is enabled.

Stationing

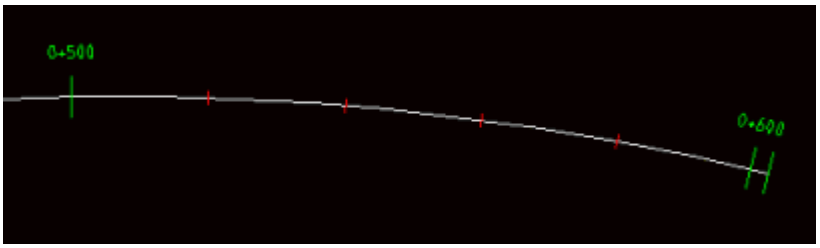
<Commands>, <Lines>

Use this command to stationing 2DPolylines or 3DPolylines. Annotations for Major stations and end station are optional by using the checkbox. Length for major and minor perpendicular lines can be set. Offset for annotations are calculated from the outer point of the major perpendicular point, negative values will bring annotations closer to line. Stationing values are horizontal values of the line.

User can set value for start station, that means that the first station on the line get same value as typed in. You cannot station parts of the line if that is needed, break the line before stationing.

The "Place Annotation at Polyline elevation" option uses elevation at current station of the polyline. The station length is always the horizontal length though.

Image below shows stationing with checkbox "Skip end annotation" marked and a plus-sign as delimiter.



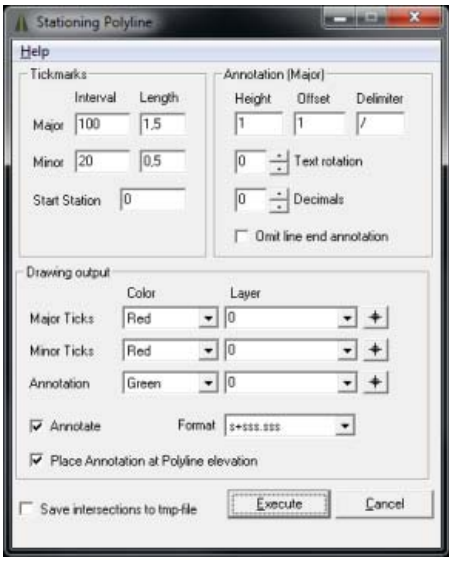
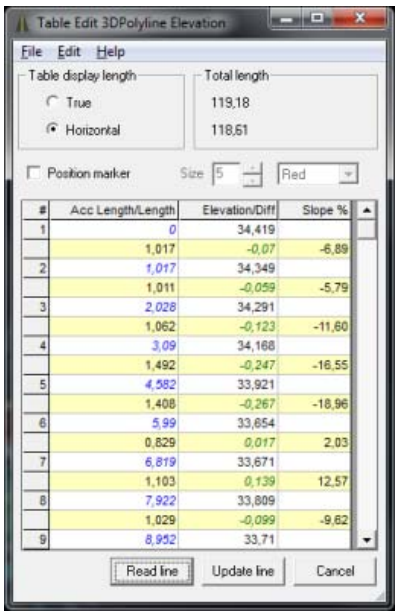


Table Edit 3D polyline elevation

<Commands>, <Lines>

This command is used to edit polyline vertices elevation. Editing vertices elevation in AutoCAD is rather tedious, this command might speed up that kind of work.

In the list there are three columns, the first contains accumulated length (blue) and vertex length, this column cannot be edited. Second column contains vertex elevations and elevation difference (green). The third column represent slope in percent. You can edit: Elevation, Elevation difference and slope by changing values in the grid.



You can choose to display true or horizontal vertex length, it doesn't affect the calculations. You can copy entire grid or a cell range and paste it into Excel. To select entire grid and copy it click on # in the top left corner of the grid, right-click in the grid with your mouse and select copy in the popup menu. You can also use the Edit menu to copy selected cells.

Press ***Read Line*** and select a 3Dpolyline in current drawing, all lengths (3D length), elevations and slope are loaded into the list. Use arrow key to position in list, change elevation or slope as needed. The slope is calculated and updated immediately, changing slope recalculates following vertex elevation.

Pressing ***Update Line*** updates the 3D polyline in the drawing. Trying to quit without updating the line or selecting another line still with unsaved data in the table generates a message to the user.

Use the position marker to make it easier to see where on the line your current table row is. When position is over a vertex or a flat element the marker is shaped as a rectangle otherwise it will be a arrow pointing in slope direction.

Note! The position marker is a real 3D-object and can be saved with the drawing, although CadTools try to clean up when you update the line or close the command.

Saving the drawing before cleaning up will result in saved marker.

Image of position marker at vertex position

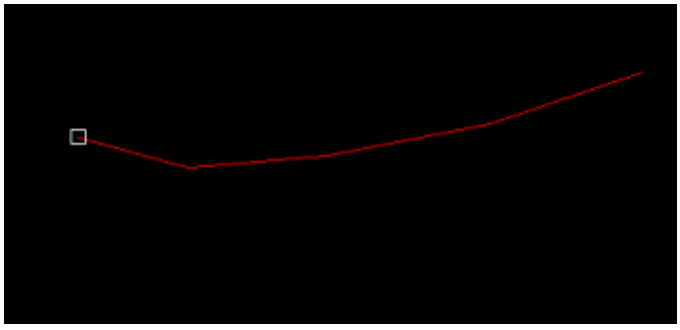
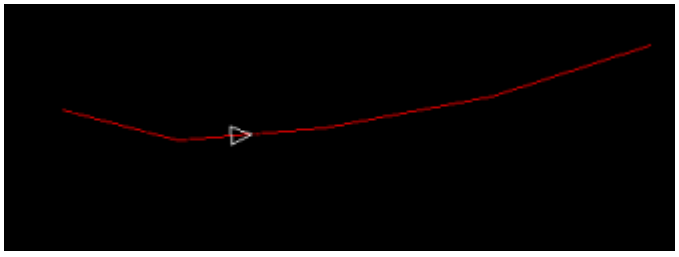


Image of position marker at sloped element



Transverse 3D lines Between 3D Polylines

<Commands>, <Lines>

This is a very powerful command! Works similar to Slope marks in 2D but with this command you create real 3D slope marks.

Use this command to draw perpendicular lines between two 3D polylines. This command is first of all designed for use with "Create longitudinal features" command. After generating longitudinal polylines you often want to get some tick marks for the ditch slope etc. If you prefer to add slopemarks in one command the "Create longitudinal features" has an option for that but sometimes it's more convenient to draw them after the design is done.

You can annotate Reference line or Target line Elevation at every major intervals. If you want to check slope between lines you can chose to annotate slope as well. The slope is always relative the Source line, negative values indicates that the slope is downhill.

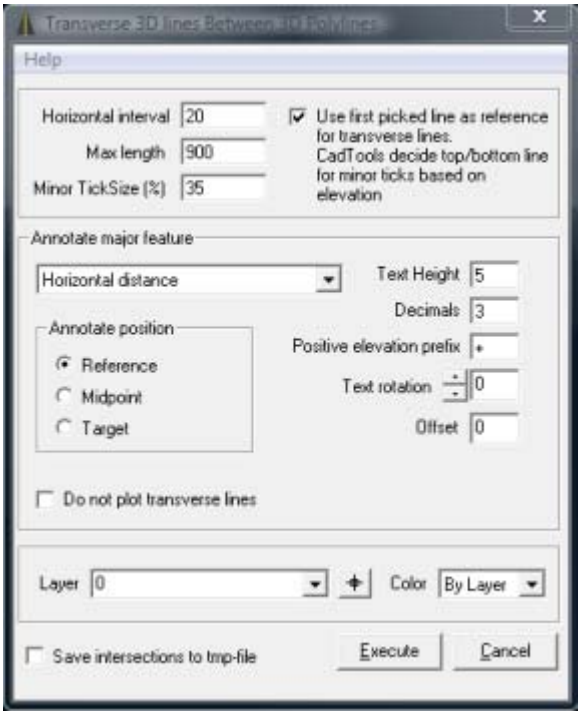
This command can also be used to annotate a single line elevation, use CadTools command "Offset 3D" do create a reference line before executing this command.

Examples of use

- Annotating elevation at given interval of a road or ditch.
- Annotating horizontal distance at given interval of a road.
- Annotating superelevation (%) at given interval to check if all is as it should be.
- Prepare data for triangulation, minor lines that will be triangulated can make the triangulated surface more accurate.
- You want to draw a parallel line between two 3D polylines, for this you must set then intervall to small value andset minor to 50%. Then us the "Save intersection to tmp-file" option and then paste the minor coordinates back to CadTools and draw a new polyline (vertex)
- Use "Save to tempfile" for grabbing the data and use it Excel or paste back portions to CadTools "Draw from Coordinates" command.

Tip! When creating transverse features (tick marks) for fore slope in cut sections, pick the ditch bottom line nearest the polyline first. When creating the back slope features pick second ditch bottom line first. For the fill sections pick main line first. Doing this gives neat transverse features at exact same station.

If working with pads there might be problems with uncontrolled tickmark crossings, set max length to avoid this behavior.



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<u>This form is built in three parts.</u>

<u>Upper part</u>

The upper part has input fields for horizontal interval, max length and minor tick size. Max length is used to prevent creating unwanted tick marks, if set to 10 no tick marks will be created if length is above 10.

If minor tick size is set to 100% the minor line is full length between polylines.

<u>Notice!</u>

Normally the "Use first..." should be on! It's important for the behaviour of all tickmarks. If on, the decision of where minor ticks should start (based on elevation) is handed over to CadTools, the result is always correct. This is a very important setting, therefore the setting always is on as default.

If this option is unmarked minor tickmarks start point is drawn from the first selected line, the real slope direction is not evaluated. This might result in wrong directions, its up to the user to decide.

Image of left line picked as top (reference) results in nice tickmarks.

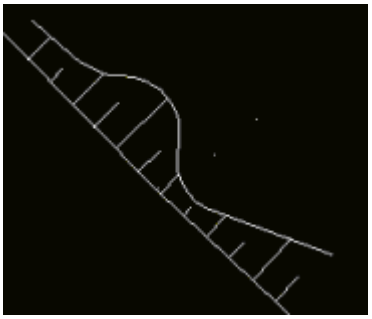
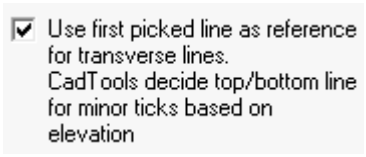


Image of right line picked as top (reference) results in ugly tickmarks.

By using this option you are guarantied that minor tickmarks are created correct. (based on elevation of perpendicular start and end elevation). Minor tick marks starts at the polyline with highest elevation

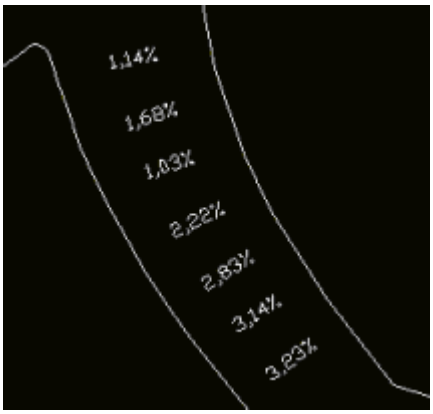


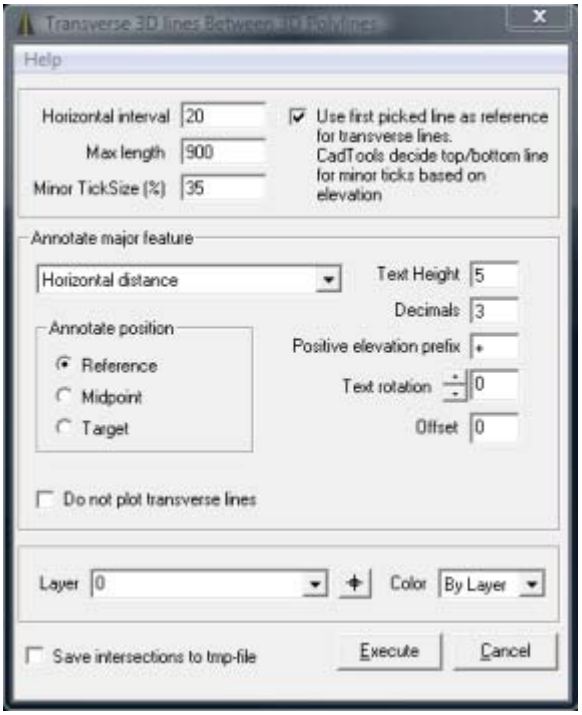
Middle part

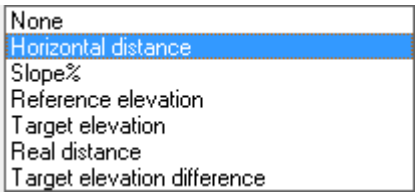
The middle part of the form has settings for annotations. This is useful for annotating transverse slope or annotating reference/target line elevation at given interval.

- Ditch bottom elevations at given interval
- Centerlines elevations at given interval
- Backbones elevations at given interval

In image below transverse slope is annotated, no transverse lines are drawn. Could be used to check super elevations.

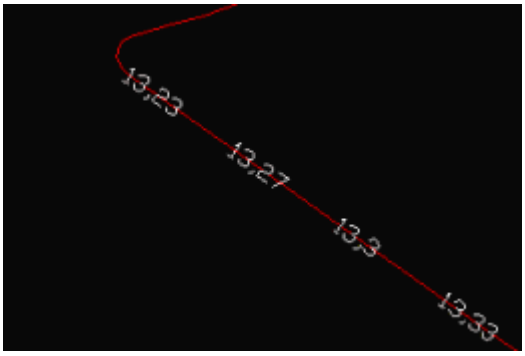






Use the offset to "push" annotations. Rotation is executed after offset

Image showing annotations of reference line elevation.



Bottom part

Here you set layer for annotations and features, useobject picker button to get layer from any object in the drawing. Another handy thing is that you can save all calculated intersections to a temp-file. This file can be opened with Excel (as textfile, CSV-file) and imported to Excel directly. Do your own calculations in Excel and then paste the result back to CadTools with the "Draw from coordinates".

Miscellaneous commands

<Commands>, <Miscellaneous>

Dist with Slope

If you want to know horizontal length between two 3D objects in the drawing this command can be helpful. Certainly you can use Autocad's "Dist" command but if snap is on you may end up with only real length.

With this command you can use the snap option in Autocad and easily get horizontal length, real length, start- and stop elevation and slope.

3DSolid to Excel

Send 3DSolid volume to Excel

Region to Excel

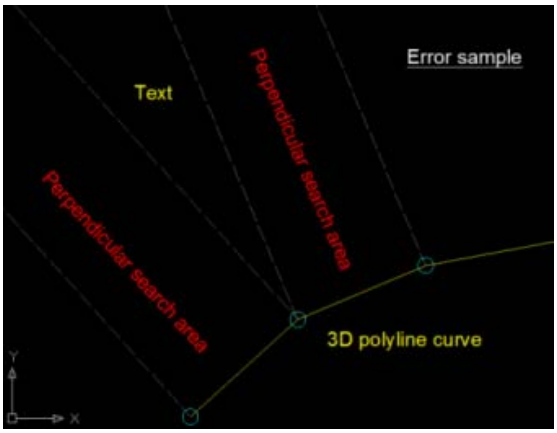
Send region area to Excel

Text, Circles and Block station/Offset from Polyline to Excel

Use this command to evaluate station and offset for text circles or blocks in a drawing. After executing you will be prompted to select objects (text and blocks will be filtered). Then you select polyline (2D or 3D) and finally you input polyline start station. CadTools evaluates nearest perpendicular text or block compared to the line and sends the result to Excel. If an object is placed at the center of a circle or arc the first position is used otherwise all objects are displayed at the nearest station (shortest perpendicular offset to the line).

Image below shows how stations are calculated on a 3D-polyline, text within the "gap" won't be recognized because they are not perpendicular to any of the polyline elements. Using a 2D-plyline with arcs will give a more accurate result. However a simple method to get a value is to evaluate distance between an object and a vertex.

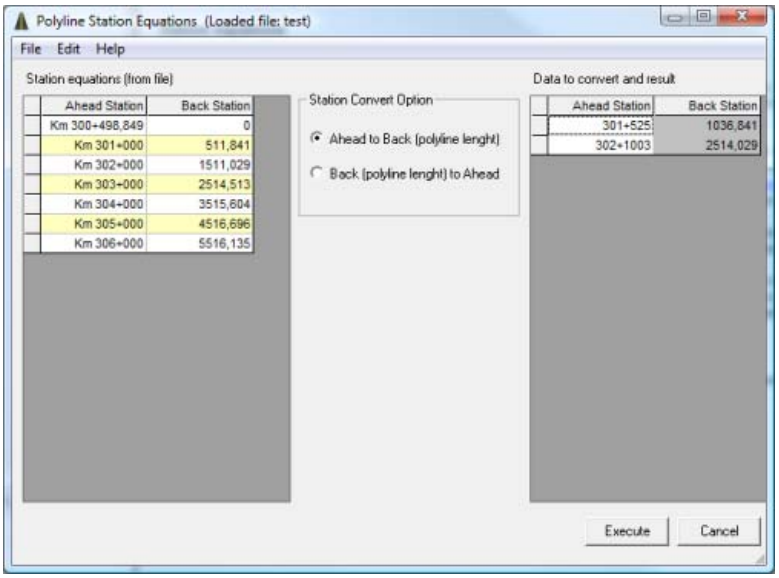
If no perpendicular hit is registered CadTools can evaluate shortest distance to a vertex, before the command executes this option is presented to the user by a message dialog. The result will contain a column for "Target type" so it's easy to separate both values. This option catches objects that are positioned in the "gaps" but still the result might be in accurate compared to using a 2D-polyline with arcs.



Beware! This command can be extremely time consuming. If the polyline has more than 500 elements you'll get a message suggesting you to do a simplify of the polyline before using this command.

Station equatins

This command is hard to explain but I'll give it a try. Railroads often has kilometers not exactly 1000 meters long, they can be booth longer or shorter than 1000 meters. Usually there are signs with station names along a railroad alignment, these signs have a digits for both kilometers and meters and they are separated with "+" sign telling you to read it like Kilometer this plus meters that. "232+1023.56" should be read like Kilometer 232 plus a length of 1023.56 meters.



Some of CadTools commands can't be used with this kind of alignments and therefore I've come up with this simple approach. Usually it's the type of commands that I use to read or write text at stations that needs to be taken care of.

In the left pane you type in the station name (Ahead Station) and location relative polyline start point (Back Station), when done you can save values to a file. Select station conversion option in the middle pane and finally paste or type in your values in the right pane (table). Press Execute to calculate, values from the calculation are presented in the grayed column.

You could also combine this method with other commands to achieve a reasonable result. First you need to create some data to describe the actual station (length from your alignment start point) that your Kilometer sign is placed on. After that you can convert any station label to real length along the polyline from start point.

To get your data you can use the command "Text, Circle and Block Station/Offset from Polyline to Excel" found in the miscellaneous menu. This command calculates station and offset for objects along a line and can be suitable for grabbing station signs from a drawing. Beware of how that command does the calculations, it can give you bad result if you use wrong type of polyline.

Paste these values into the left table and make sure there is a "+" sign as a separator for kilometer and meter (edit the grid). In the Backstation column you paste the real length from the polyline start point, save the file so it can be used later.

Now you can select type of output "Ahead to Back" to convert any station of the type 232+876 to real length or "Back to Ahead" to convert any real length to a station label.

Let’s say you have a College whose profession is rail track design, he is handing over a file to you with some information based on station equations. Your task is to put some information along a polyline at correct stations, how will you do that?

First you load your station equation file. Now select the option "Ahead to Back"and paste the information into the first column of the grid to the right and press "Execute". CadTools calculates real length (from polyline start point) of the station and the result is placed in the "Back station" column of the grid. Now you can use CadTools "Draw from Coordinates" to put our information at correct stations (by copying and pasting values between these dialogs)

Of course you can do the opposite, type in a real length and receive the station name for that location.

Remark! By nature 3D-polylines are a set of straight line elements, therefore curves have elements that are non-collinear. Using 3D-lines as alignments in CadTools will give you result that's not exact but it could be close enough for earthwork design.

Delete Point, Circle and Text In/Outside Polygon

Use this command to delete Points, Circles or Text (Single line or MText) that have insertion points inside or outside a closed polyline. Only Points,Circles and Text will be included in the selections set (other objects are excluded by CadTools)

Vehicle Turning Simulation

This command simulates vehicle turning at low speed and determines vehicle tire tracking and swept paths. The command can be used in the design of road intersections, parking lots and other vehicular facilities. The main purpose of this command in CadTools is to supply a simple tool for non critical conditions of vehicle turnings. Although the resulting swept path from CadTools is identical to results from other software it's likely some difference in the behavior.

It's highly recommended that you obtain as much information about the max turning angles of used vehicles, consider supplied default vehicles in CadTools as proposal.

To use the turning command you need to provide a steering path that describes the location of the centre of the steering axle of the vehicle. The path can be either 2D or a 3D polyline. Best performance is obtained if the path is a 2D polyline due to the amount of segments.

You should use the vehicle turning command in model space and world UCS. The resulting swept paths and vehicles are created as blocks in the drawing, you should therefore use this command in a copy of the original drawing.

This command is not intended to be a source for design information, you should always rely on currently available design guides for your location. The result is a idealized path and may not be replicable under real conditions and you should therefore add some extra clearance for safety.

During the calculation two angles are monitored, the turning angle of the truck and the angle between following segments. The maximum angles used for the path are presented at the bottom left part of the form. If one of the angles exceeds the input value for maximum angle the calculation will be stopped and the vehicle will be plotted at a position previous to the problem station.

You should use a copy of your design drawing. Resulting swept paths and vehicles are placed in two separate blocks in the drawing. If same steering path is used these blocks should be deleted by the user between two calculations

There is no evaluation of unsaved data in this form, any modifications should be saved by the user immediately after editing. Selecting a different vehicle in the list will abort unsaved data without any warnings.

The vehicle turning algorithm takes small steps along your path and therefore you must set correct units for your vehicle. If you are using millimeters as your drawing scale you must use a vehicle with all dimensions in millimeter. You also must set vehicle spacing and Vehicle path units in current units. "Vehicle path units" and "Max vehicle Plot Spacing" settings are located below the vehicle list.

Tip! You can copy a vehicle, recalculate dimensions and save it with different units. In that way you end up with vehicles for different drawing scales

Independent Active Rear Steering

Only applicable for Semi-Trailer types vehicles. Forces rear axle to follow the steering path. When you select a vehicle of that type a Check Box will be visible. Note! Consider this option as experimental.

Supported units

- Meters
- Decimeters
- Centimeters
- Millimeters
- Feet
- Inches

When you select a Vehicle in the list a minim raduis is calculated. This radius is the minimum turning radius for the vehicles centerline.

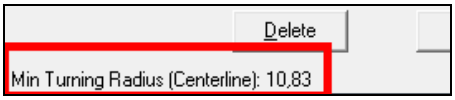
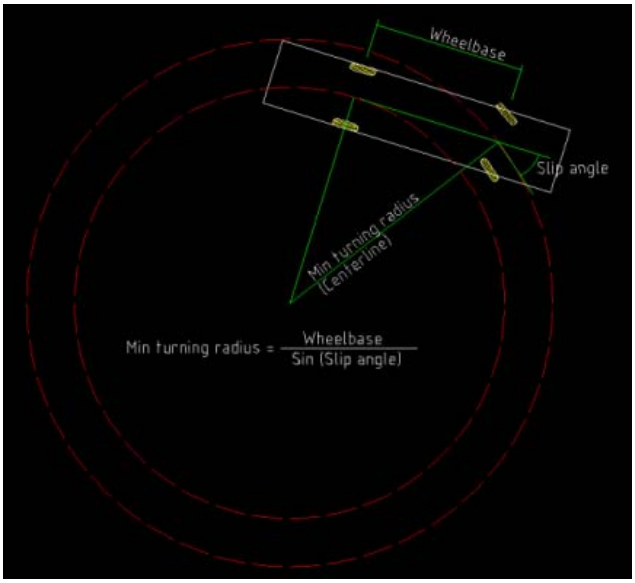


Image below shows vehicle with wheels turned to steering lock position and how minimum turning radius is calculated. Slip angle = max front wheel turning angle.



Tip!

You can evaluate the speed for a path by setting speed to zero and then execute. After calculation the lowest speed will be displayed in the statusbar (bottom of the form). Note that this speed is only based on Lock to lock parameter and can not be used as a design speed.

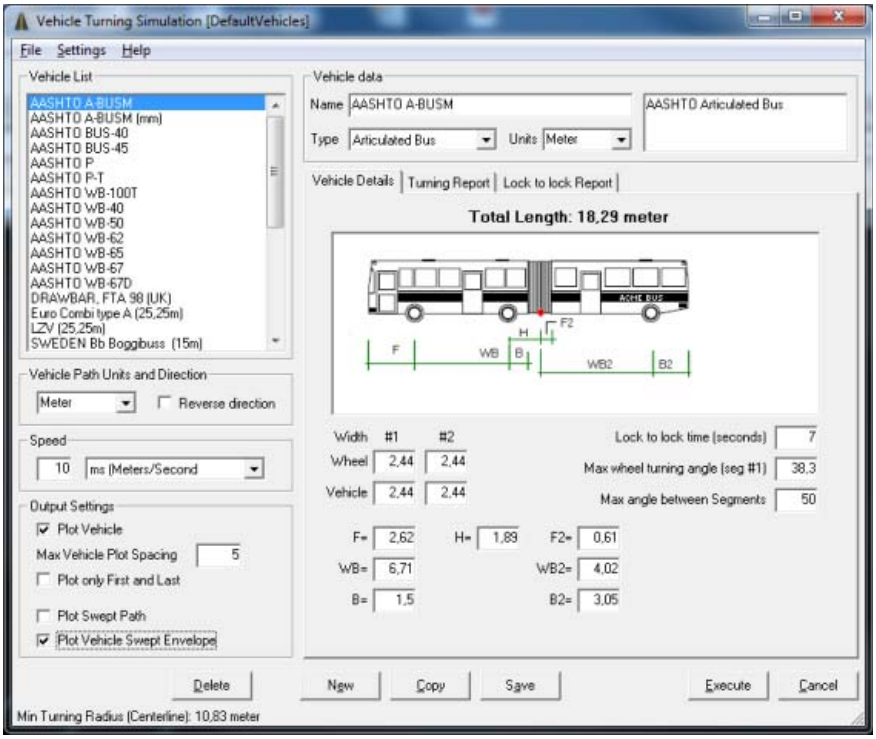
Typical use

1. *Select vehicle from the list*
2. *Get minimum turning radius for selected vehicle from bottom of form*
3. *Draw the vehicle path as a polyline in your DWG. You can use AutoCAD's fillet command and the minimum radius*
4. *Set Speed to zero (prevent stopping when Lock to lock is exceeded)*
5. *Execute*
6. *Check output values at the bottom of the form*

If Lock to lock time is exceeded the simulation is halted. If you want to evaluate critical parts for the lock to lock speed you could use the Lock to lock Report tab. As an alternative you could also input "Lowest speed along path"value as speed and execute. This will force the simulation to stop at first problem station.

Image of the forms bottom part after executing, values inside red frame are results from last simulation.

Image of Vehicle Details tab



Below is an image of resulting diagram in the Turning report tab. The lines represent turning angles of included segments in percent, it's easy to detect if the vehicle maneuver is near the limits. Click on the graph and then move the mouse over the graph to get information of station and angle.

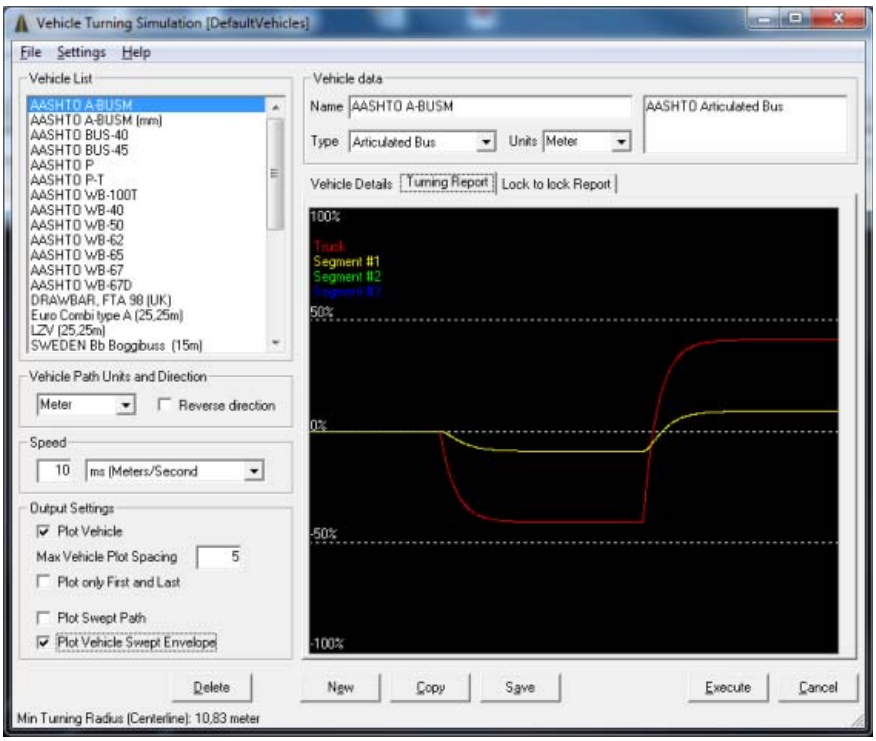


Image of Lock to lock Report tab

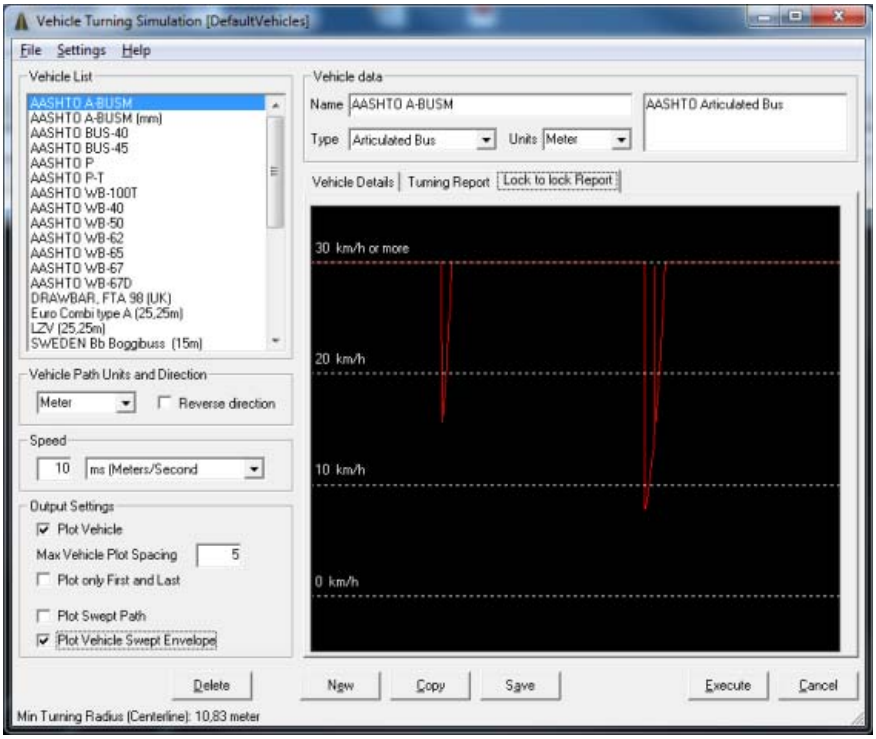
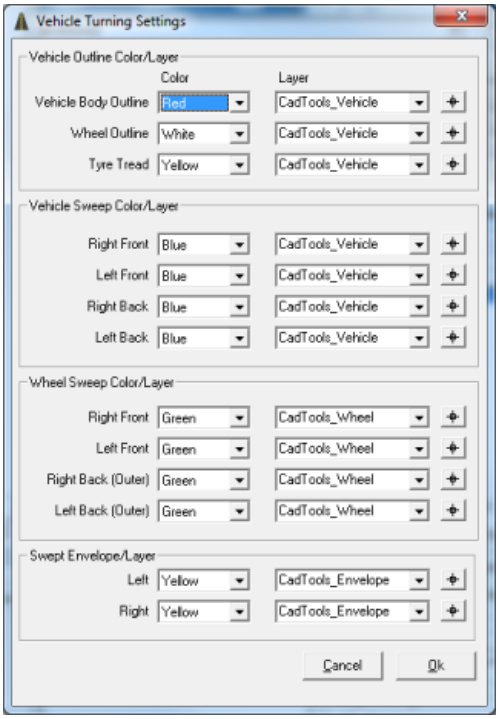


Image of output color settings form. If you explode output blocks after calculation all elements will reveal their layers.



Output parameters

- Plot vehicle check box: If unchecked only swept paths are plotted to the drawing
- Max vehicle plot spacing: This parameter is used to calculate distance between plotted vehicles.
- Plot only first and last check box: This option can be used to plot vehicles only at the beginning and end of the path.
- Plot swept path check box: Use this to exclude or include swept path in the plot to the drawing
- Plot Vehicle Swept Envelope: Plots the envelope (perimeter) of the vehicle body
- Reverse direction: Reverses the polyline (path) before evaluation and the reverse the polyline back to its original direction.

Vehicle types and parameters

Ten types of vehicles are supported by this command. You can think of them as segments, the first segment is the truck, the second is either a trailer or a tow bar and so on. You can easily create your own vehicles by copying a existing vehicle and change parameters. You can use up to 4 segments including the truck, that would give you a Triple trailer and I think that would cover most of the common situations.

Wheel-configuration

If the vehicle has one rear axle the turning point is assumed to be located in the middle of the tire. If the Vehicle has more than one rear axle and they are mounted symmetrically the turning point would be in the centre of the axles. Even though CadTools vehicle samples has only one or two rear axles you can simulate any desired wheel configuration as long as you know the turning point.

Parameters of each vehicle:

- Name: This can be edited by the user and save it to the current vehicle
- Type: Three types are available and the user can change type for the current vehicle
- Description: This can be edited by the user and save it to the current vehicle file
- Wheel Width: The distance between the outer most points of the front axle. This can be edited by the user and saved to current vehicle.
- Vehicle Width: The distance between the outer most parts of the vehicle (and its segments). This can be edited by the user and saved to current vehicle.
- Maximum front wheel turning angle: The maximum turning angle for the front vehicle If this value is exceeded during the calculation the vehicle will stop and alert the user.
- Maximum angle between segments: The maximum angle between two segments of the vehicle. If this value is exceeded during the calculation the vehicle will stop and alert the user.

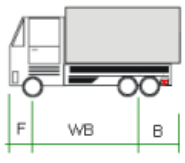
Samples of some common vehicles and their parameters

Truck or Bus

F = Distance from the front axle to the front of the vehicle

WB = Wheelbase. The distance between the front axle and the turning point. If the vehicle has several axles the turning point is a imaginary point at the center of the gravity of the axles.

B = Back. The distance between back of the vehicle and the turning point.



Semitrailer

F = Distance from the front axle to the front of the truck

WB = Wheelbase. The distance between the truck front axle and the turning point. If the vehicle has several axles the turning point is a imaginary point at the center of the gravity of the axles.

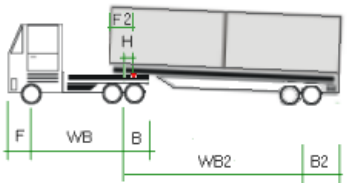
B= Back. The distance between back of the truck and the turning point.

F2= Distance between the hitch point and the front of the trailer

H= Distance between the turning point of the truck and the hitch point

WB2= Wheelbase of the trailer. The distance between the truck pivot point and the turning point of the trailer. If the vehicle has several axles the turning point is a imaginary point at the center of the gravity of the axles.

B2= Distance between trailer turning point and the back of the trailer.



Truck with tow bar

F = Distance from the front axle to the front of the truck

WB = Wheelbase. The distance between the truck front axle and the turning point. If the vehicle has several axles the turning point is a imaginary point at the center of the gravity of the axles.

B= Back. The distance between back of the truck and the turning point.

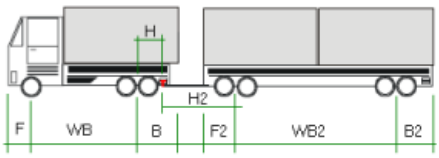
H= Distance between the turning point of the truck and the hitch point. If the vehicle has several axles the turning point is a imaginary point at the center of the gravity of the axles.

H2= Distance between the hitch point and the hitch point of the towed segments front axle

F2= Distance between the front of the towed segment and the hitch point of the towed segments front axle. If the vehicle has several axles the turning point is a imaginary point at the center of the gravity of the axles.

WB2= Wheelbase of the towed segment. If the vehicle has several axles the turning point is a imaginary point at the center of the gravity of the axles.

B2= Distance between towed segments rear turning point and the back of the trailer. If the vehicle has several axles the turning point is a imaginary point at the center of the gravity of the axles.



Other utilities

It's possible to save vehicles to separate files (libraries). The top menu includes commands to create new or save existing files. You can copy any vehicle in the list by using the Copy button. The recent copied vehicle will be added to the list with a name of "Copy of....."

Tip!

If you are unsure about the input parameters of the vehicle, do a calculation and measure the vehicle in the drawing.

Image of result in the drawing.

Point/Circles commands

Annotate point

<Commands>, <Points/Circles>

Annotates a single point in the drawing. The annotation is a Multiline Text (MText) with Text height from Settings. User gets a question if X and Y coordinates should be switched. The reason to this question is that you might want to send a geographical (North East) coordinate instead of a mathematical.

Annotate point elevation

<Commands>, <Points/Circles>

Annotates point elevation in the drawing. The command supports multiple selections.

Send single point to clipboard

<Commands>, <Points/Circles>

Send single point to clipboard does exactly what it says, it sends point coordinates to Windows Clipboard. User gets a question if X and Y coordinates should be switched. The reason to this question is that you might want to send a geographical (North East) coordinate instead of a mathematical.

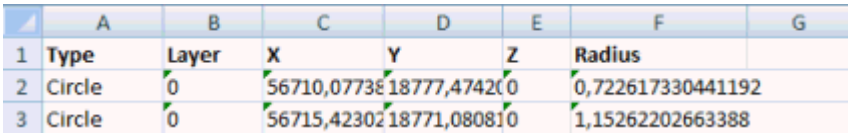
You can paste the points coordinates back to many windows software by using paste or CTRL+V

Export point and circles to Excel

<Commands>, <Points/Circles>

Export all selected points and circle coordinates to Excel. You can select entire drawing with a crossing, points and circles will filtered. After coordinate are read CadTools starts Excel with the results.

Image of result



	A	B	C	D	E	F	G
1	**Type**	**Layer**	**X**	**Y**	**Z**	**Radius**	
2	Circle	0	56710,07738	18777,47420	0	0,722617330441192	
3	Circle	0	56715,42302	18771,08081	0	1,15262202663388	

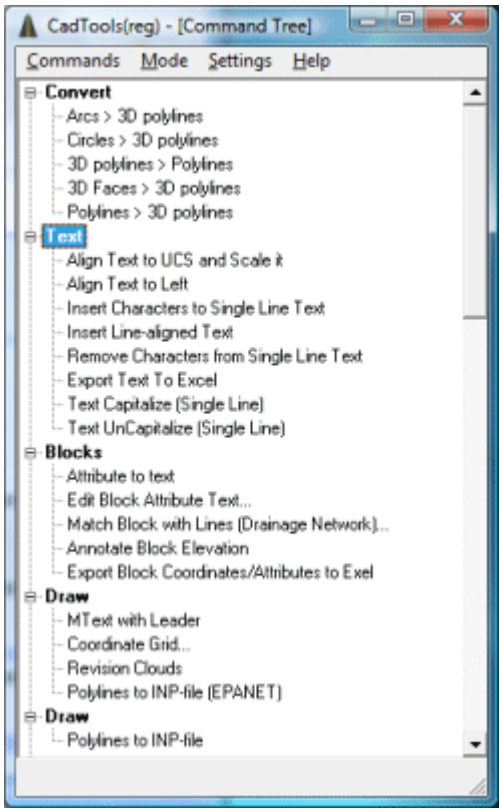
Mode commands

Command Tree

<Mode>, <Command Tree>

This mode provides access to all commands of CadTools without using ordinary menus.

Using this mode can speed up your work, every command can be executed with one click. Compared to navigating along windy menu paths this is much easier. Use the right button to expand or collapse all tree nodes.



Slope

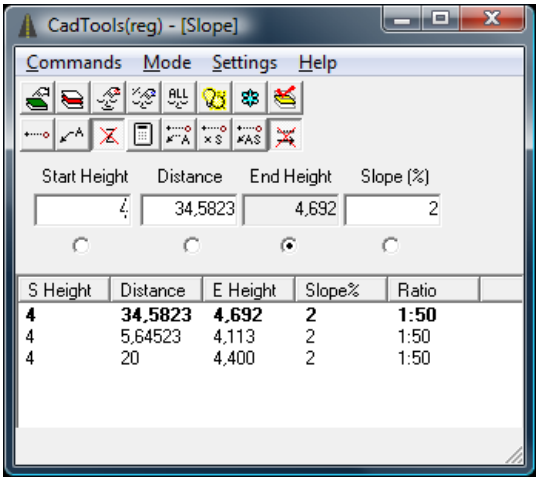
<Commands>, <Slope>

Only accessible if mode is set to "Slope"

The Main Form is always placed down to the right when starting. CadTools is placed above all other applications and can bee minimized when needed. This Form is designed for drainage support. All commands can be activated by buttons in the toolbar. Other commands for Text, Lines and Points can be reached through menus.

ToolBar (Slope Mode)

Seven buttons (second row) which makes it easy and swift to calculate and annotate direct in drawings. These buttons are designed for shortcuts to commands that are necessary when working with slope. Four boxes for input data from user or active AutoCAD drawing are designed to work with the numeric part of your keyboard. Comma-sign is converted to point-sign by the software. Hitting Enter at any point makes calculations.



Buttons from Left to right (second row)

1. Pick length from active AutoCAD drawing.
2. Annotate selected response to active AutoCAD drawing. Output string is formatted according to user settings.
3. Toggle Z on/off. When picking lengths from drawing this setting will prevent (if off) the software from applying Z-coordinates to the input box. This is important if you want to input heights by yourself. Working with drawings made in 2D where the heights is presented by text is one of the occasions you want have this toggle off.
4. Calculate. ***CadTools*** calculate selected response and formats the output string according to user settings.
5. Pick length and annotate in one command.
6. Pick scaled length. Length is scaled based on user settings.
7. Pick scaled length and annotate in one command.
8. Toggles line on/off. Draw a line between picked points. Draw arrow in slope direction (if on in user settings)

How it works

CadTools always calculate all values to get balance. You can change response and then press enter for a new calculation. By doing this a new response value is in memory ready for annotation.

Plans

If you have a center-line with heights in a plan and wants to calculate a height near the curb. First of all toggle Z-coordinates off. Select response ***EndHeight*** by clicking the radio-button below. Input desired Slope (in Percent).

Click button 1 (pick length). Snap to centerline where the height is. Snap to curb near where you want the calculated height. Click on button 2 (Annotate) and select position for annotation text.

Cross-sections

Working in cross-sections you can set slope to 100% and toggle z-coordinates of. Input height from nearest legend in the ***StartHeight*** box. Select ***EndHeight*** as your response and pick length by pressing button 1. Now snap start point to the legend with perpendicular in AutoCAD and endpoint to desired point in the cross-section. Annotate the calculated height in the drawing.

Profiles

Working with drawings that have different vertical and horizontal scales must be treated different according to picked lengths. Therefore the user can set a scale factor for picked lengths. Using button 6 will scale the lengths before calculation. The Status Bar at bottom in the software gives you information about original and scaled length.

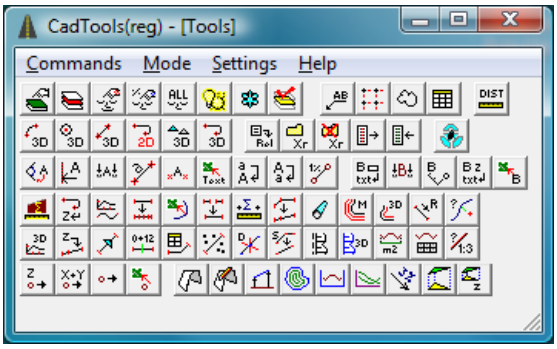
Tools

<Mode>, <Tools>

When mode is set to Tools the slope input-boxes are gone and a couple of new toolbars are visible.

ToolBar (ToolBox Mode)

Access to all commands in ToolBox mode.



Buttons, first row to the left (Layer tools)

1. Set current layer by object.
2. Move to layer by object.
3. Layer off by object
4. All layer off but selected
5. All layer off but current
6. All layers on
7. Layer freeze by single objects (xref).
8. Delete Layer

Buttons, first row to the right (Draw tools)

1. MText with leader
2. Create coordinate grid
3. Draw revision cloud
4. Draw from coordinates (paste from Excel)

Buttons, first row to the right (Miscellaneous tools)

1. Dist with slope

Buttons, second row to the left (Convert tools)

1. Arc to 3D polyline
2. Circle to 3D polyline
3. Line to 3D polyline
4. 3D polyline to polyline(2D)
5. 3D face to 3D polyline
6. Polyline to 3D polyline

Buttons, second row middle (Xref tools)

1. Make Xref relative path (current drawing)
2. Open Xref by object
3. Detach Xref by object
4. Save Xref settings to file
5. Load Xref settings from file

Buttons, second row to the right (EPANET tools)

1. Polylines to INP-file

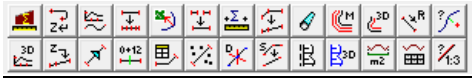
Buttons, third row to the left (Text tools)

1. Aling text to UCS and scale it
2. Left align text
3. Insert trailing/ending character to single line text
4. Insert line-aligned text
5. Remove trailing/ending character from single line text
6. Export to Excel
7. Capitalize single line text
8. Uncapitalize single line text

Buttons, third row to the right (Block tools)

1. Block attribute to text
2. Edit block attribute text
3. Match block with lines
4. Annotate block elevation
5. Export block coordinates to Excel

Buttons,fourth and fifth row (Line tools)



Fourth row

1. Area calculation
2. Annotate polyline elevation
3. Create 3D alignment
4. Densify 3D polyline
5. Export polyline to Excel
6. Join 3D polylines
7. Polyline length calculation
8. Level out 3D polylines
9. Create solids from 3D polylines
10. Multiple 3D polyline offset
11. Offset 3D polyline
12. Reverse polyline direction
13. Track station and offset from 3D polyline

Fifth row

1. Profile 3D polyline
2. Set 2D polyline by nearest text
3. Draw slope arrows on 3D polylines
4. 3D polyline stationing
5. Table edit 3D polyline
6. 3D polyline regression (best fit)
7. Remove duplicate vertex from 3D polyline
8. Simplify 3D polyline (weed)
9. Slope and road signs (2D)
10. Transverse lines between 3D polylines
11. Area between polylines (cross-section area)
12. Annotate cross-section (table)
13. Annotate cross-section/Profile slope

Buttons, sixth row to the left (Point/Circle tools)

1. Annotate point/circle elevation
2. Annotate single point
3. Send point to Clipboard
4. Export point/circle to Excel

Buttons, sixth row to the right (Surface tools)

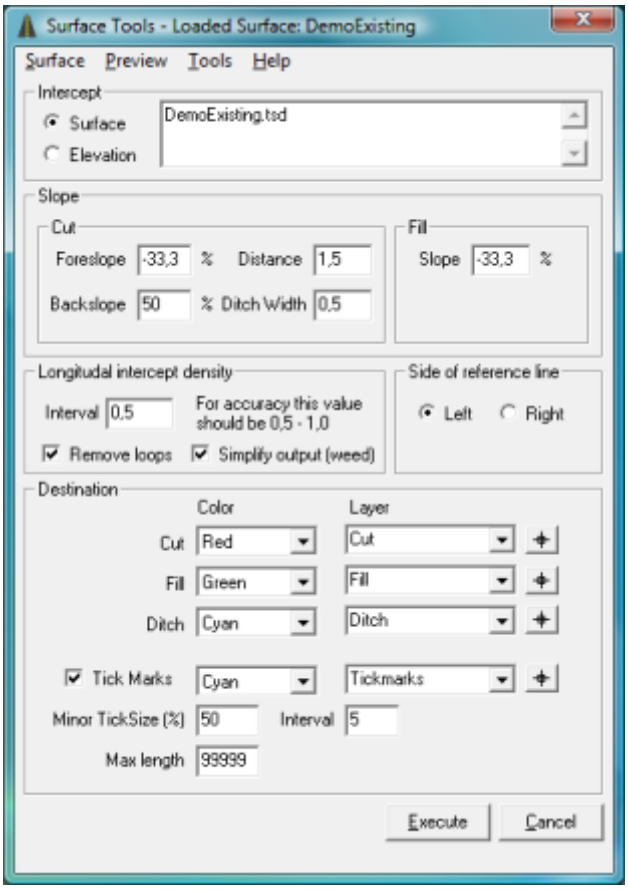
1. Create surface
2. Edit/View surface
3. Create longitudinal features (cut and fill)
4. Create surface contours
5. Create surface cross-sections
6. Create surface profile
7. View surface slope and direction
8. Surface volume
9. Surface volume by elevation

Surface commands

Create Longitudinal Features

<Commands>, <Surface>

This command generates longitudinal 3D Polylines between 3D Polylines and a surface or elevation. The surface must be triangulated by CadTools and saved to file before using this command. If you plan to intercept an elevation no surface is needed, otherwise a surface must be loaded. To load a surface, use the menu Load Surface. Change parameters for Cut, Fill and Ditch bottom to preferred values. All slopes should be input as -0.25% or as -1:4. If you use type"1:4" CadTools convert the expression to slope percent when you move focus to another textbox or button.



Preview you current settings and typical result with the preview window. This window floats and updates when settings are changed.

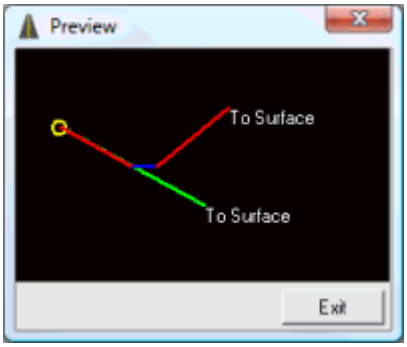
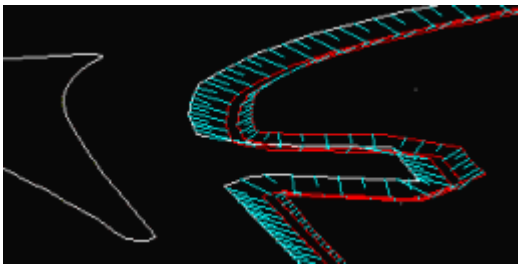
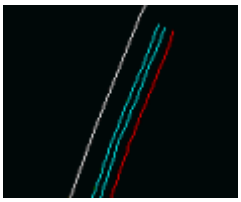


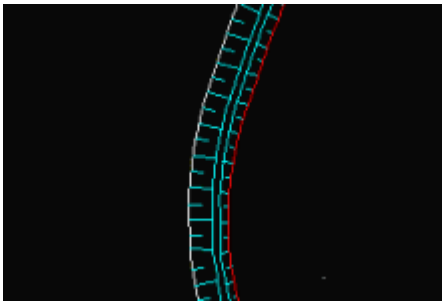
Image of resulting features created by this command



To draw transverse features (slope signs, tickmarks) automatically after creating longitudinal features select the Tick Marks checkbox. If you want to do it later, use ***Transverse 3D lines between 3D Polylines.*** This command is located in the top menu and in CadTools main form under lines. Remember to check the option "Use first line as…..", it's a smart choice.

Image to left showing longitudinal features created with "Tick marks" unchecked. Image to right showing tick marks created in one commands.





How it works

At every station based on the density value CadTools evaluates the cut section. If no solution is found it then evaluates the fill section. If booth cut and fill fails no feature will be created for that station (gap in the line) Density interval sets stationing for the calculation, a small value increases accuracy but slows down the process. This value should not be bigger then 0,5 to get any useful results. If you got plenty of time a smaller value results in more accurate result. After processing check transitions between cut and fill by using the orbit command in Autocad. Rotate the model to revel any bad transitions.

If working with pads there might be problems with uncontrolled tickmark crossings, set max length to avoid this behavior. If cut foreslope distance is set to 0 (zero) no features for the first cut line is created, if ditch bottom is set to 0 (zero) no feature for second ditch line is created.

Tip! When manually creating transverse features (tick marks) for fore slope in cut sections, pick the ditch bottom line nearest the polyline first. When creating the back slope features pick second ditch bottom line first. For the fill sections pick main line first. Doing this gives neat transverse features at exact same station.

Destination layers and colors for output are selected from drop-down list, to get newly added layers into list use "ctrl + R" to refresh list. If you type in a layer that doesn't' exist, CadTools creates that layer in current drawing. Use the "Hair-Cross" buttons to pick layers in the drawing to the drop-down list.

Remove loops

Removes the loops that may appear at concave corners. This option allows the longitudinal feature to more accurately represent the original feature. If loops are stacked or to complex CadTools can have problems to solve them completely, some manual work in the drawing might bee needed.

The first example image below shows a longitudinal feature that was generated with this option turned off. The second image was generated with this option turned on.

Simplify output (weed)

This option reduce vertices in all output lines (tickmarks excluded). Only vertices on straight parts of lines are processed (simplified), the accuracy of processed lines are same as before. The behavior is same as using the polyline tool with tolerance set to 0 (zero)

You can get same result by using the simplify command after all lines are sent to the drawing. For information on simplify Command, follow link: Simplify polyline

Speeding up the process

If you find this command to slow there is at least one thing you can do to speed up the process. As you probably know, computers are stupid but quick. To calculate interception between a line and a plane (triangle) all triangles in a surface must be evaluated. If the surface is big and you plan to work on a small area it's smarter to create a smaller surface around the design area. Use the Edit surface command to delete triangles outside the desired area.

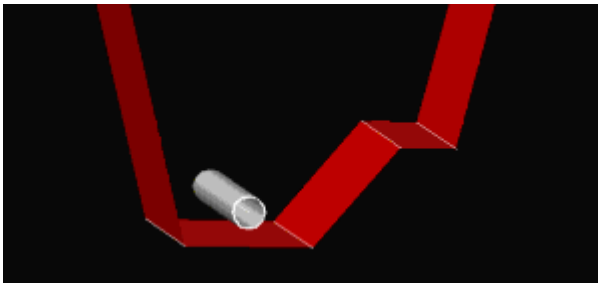
Related topics: Triangulate, Edit surface

Advanced use

Use offset 3D polyline or Multi Offset to create references lines for more complicated structures. Use this command to finally generate longitudinal features for end conditions. Triangulate all longitudinal lines with constrained triangulation to create a design surface. That design surface can be plotted with the existing surface as cross-sections or profiles. You can also create surfaces for other types (rock, foundations)

You could think of this like a method to create end conditions, if you are heading for more complex structures you can use "Offset 3D polyline" to build your lines before using this command. It's possible to build a set of 3D polylines and finally create intersections with surface, triangulate the 3D polylines as constrained triangulation and end up with a real 3D model.

Image below shows sample of result.



Tip! Think of this function as a laser beam that is pointed perpendicular from a 3D polyline. By setting slope and some other values to 0 (zero) you can accomplish many cool things, like horizontal projecting a 3Dline to a raised road or any other surface.

Edit/View surface

<Commands>, <Surface>

First of all you must load a saved CadTool's surface. Surfaces can be saved when triangulated by checking the box "Save to File" before triangulating. After all triangles are created you can specify path and a filename for the surface file. After this surfaces can be loaded and edited. You can also drag a surface file from Windows Explorer onto CadTools surface list to load the surface.

Load the surface file by using the command "Surface", "Load".

You can edit any triangle in the drawing, delete triangles or move any point. When done the surface can be saved back to file by using "Surface", "Save". Only CadTools triangles will be saved therefore you can use a crossing and select all objects in the drawing.

You can't create new triangles because CadTools has marked plotted triangles as "CadTools triangles", when saving back to file CadTools checks if the triangle is a valid one. You can copy a triangle in the drawing and then edit and save all triangles. Beware, copied triangles must not be mirrored, points must be clockwise.

The menu "Tools" contains other surface tools, the first one is "Trickle". This command traces the path of a drop of water down a selected surface. Note! The path ends when all surrounding triangles forms a pond no matter the size of the pond or when the path reach the surface perimeter.

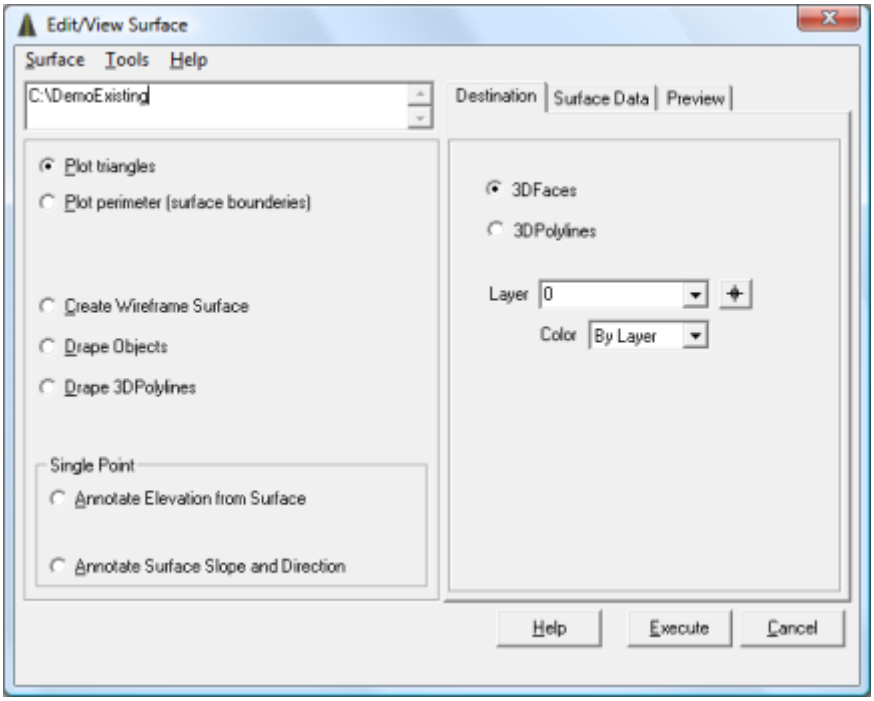
Tip!

You can plot several surfaces to a drawing and then save them to a single surface (file). Make sure there are no overlapping triangles, draping and annotating won't be accurate if there are overlapping triangles. This is useful when creating design surfaces, Offset 3D polylines to create structures beneath the ground. Use "Create longitudinal features" to create end conditions (target surface), then you have all you need for creating design surfaces.

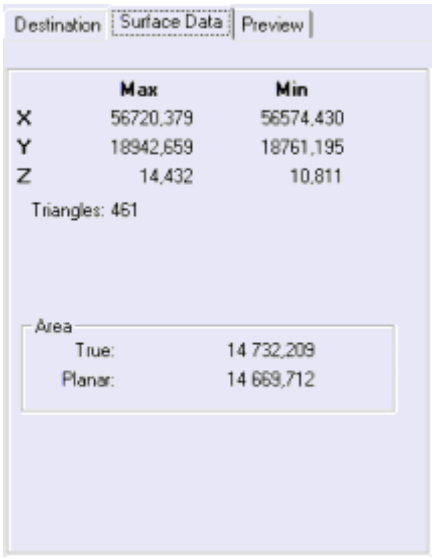
Load existing ground and additional surfaces (design, rock) in the "Surface Cross Sections" and plot them in drawing. You could then Use "Calculate polyline area" and export text to Excel to calculate end area volumes. As an alternative you can use "Triangle volume"

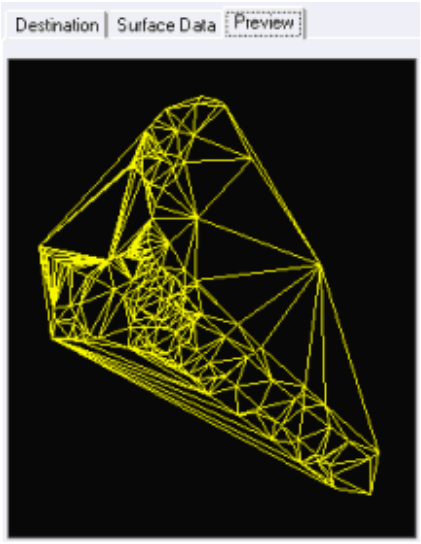
Import surface (triangles)

Save triangulated surfaces from other software and use them in CadTools. Importing triangles from other softwares is a simple process, as mentioned above CadTools do a check to test if the triangles are plotted by CadTools. Using the "Import" command located in the "surface" menu overrides this check, triangles must be 3D polylines or 3D faces.



Surface preview on Tab 3 and surface preview





Plot triangles

This command plots all triangles to drawing. Select output style, 3DFaces or 3DPolylines. This is the same command that can be used when triangulating a surface. There is no need for plotting triangles unless you planning to edit and save them. All commands works with the surface loaded in memory. (plotting triangles to Autocad is a slow process)

Plot perimeter

This command plots boundaries of the surface. If there are holes in the surface these will be treated as boundaries. You can filter the plot to only include triangles within a given range of slope. The result of this might be a set of isolated perimeters, you can also set a minimum horizontal area to be displayd. This is handy for i.e. identifying flat areas larger than a given area. As an option you can plot boundaries for areas with specified slope, you can omit small areas

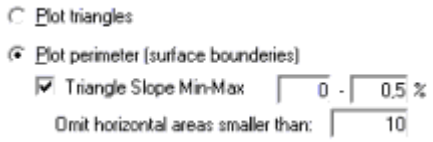
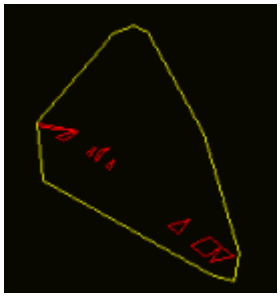
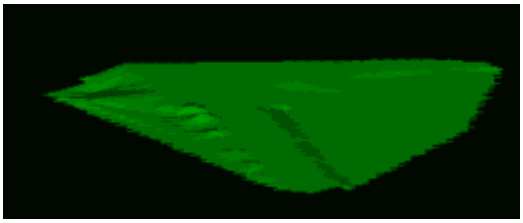


Image showing resulting perimeters where red areas has slope between 0% and 0,5 %, areas smaller than 10 are omitted.



Create Wireframe Surface

Divides surface into equal squares with corners at elevation from surface. The squares are plotted to Autocad as 3D Polylines or 3Dfaces. Beware, this process is very slow on huge triangle sets with small squares
As an alternative you can use "Profiled Model"



Drape loaded Surface (Objects)

Drapes objects to loaded surface. Supported objects are: Circles, Points, Single line text, Multi line text, Blocks

Tip!

If you have a list of coordinates without elevation (z) and wants to get elevation from a surface. Use the "Draw from Coordinate" function, select "Circle at point" and paste your coordinates into the list. Insert a small circle at all coordinates and then drape the circles to the surface with the "Drape Loaded Surface (Objects, not lines).

Now you can export the coordinates to Excel with the command "Point/Circles" export command.

Drape loaded Surface (3Dpolylines)

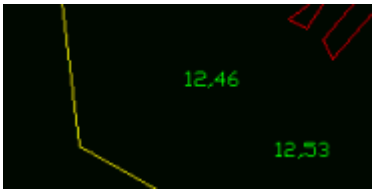
When you drape a 3Dpolyline, the portions of the original 3Dpolyline that lie outside the perimeter of the destination surface remain unmodified, at their original elevations. You will not lose points from your feature just because they do not drape to the surface.

The draped 3Dpolyline, even if they are originally flat, assume the elevation of the surface. The elevation of the draped 3Dpolyline is derived from the surface at every vertex in the original 3Dpolyline. Furthermore, the elevation is also taken at every point where the 3Dpolyline crosses a triangle edge. This means that even if you are draping a simple line segment consisting only two points, the resulting draped entity could consist of numerous points, based on the triangles in the destination surface. This means that you may end up with many more points than you started with.

However, you may use the option of draping only the vertices of a 3Dpolyline and not deriving any additional points.

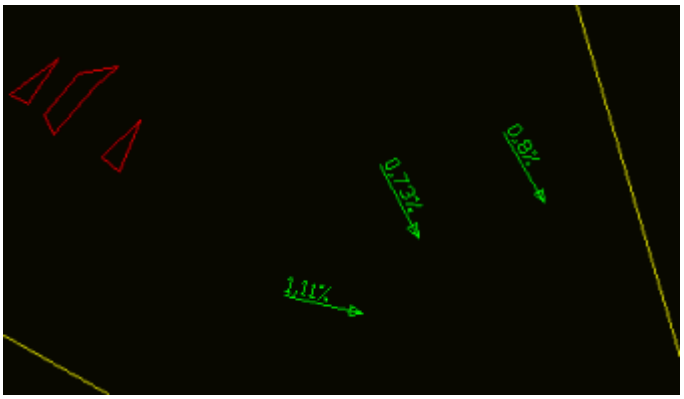
Single point, annotate elevations from Surface

With this command you can annotate any point on the surface. Use "ESC" to cancel and return to CadTools. Change Text properties before executing. If you must change settings during execution, press "ESC" and change text settings and proceed by execute again. If no triangle is found under the selected location nothing is annotated.



Annotate surface slope and direction

With this command you can annotate slope and direction for any point on the surface. Use "ESC" to cancel and return to CadTools. Change Text properties before executing. If you must change settings during execution, press "ESC" and change text settings and proceed by execute. For surface slope of entire surface se "View slope vectors".



Tools

Trickle

This command traces the path of a drop of water down a selected surface. Note! The path ends when all surrounding triangles forms a pond no matter the size of the pond or when the path reach the surface boundary. When the path gets to the border of the surface, it stops even if the outer most triangle has a slope that would allow the drop to follow the rim of the surface.

Trickle All

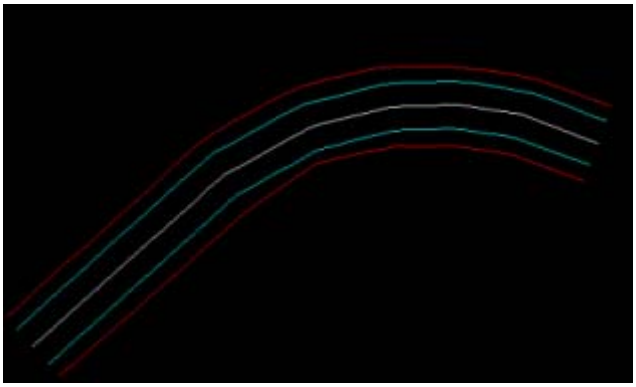
This command does exactly the same as above but for a complete surface in one command. A drop of water falls on every triangle center and then CadTools calculates the path towards the lowest point. When all triangles has been evaluated CadTools sums all involved triangles planar area and annotates the area to every corresponding pond. Elevations of annotations are set to same as surface and can easily be exported to Excel with CadTools command:*Text, Export to Excel*. The Trickle All command can be useful in the designing process of pipe dimensions.

Delete triangles with centroid outside polygon

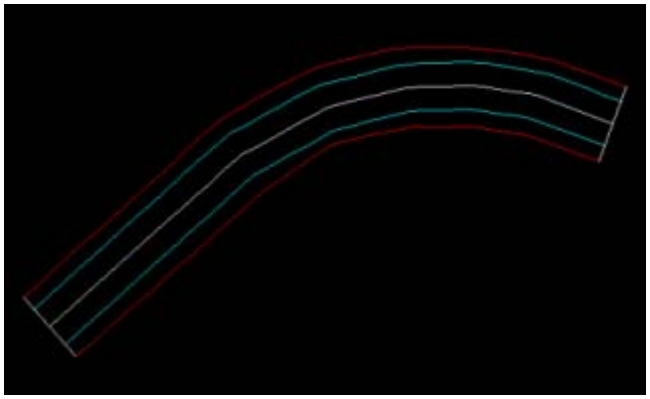
This command is very useful for cleaning design surfaces from unwanted triangles. The triangulation of design surfaces often results in many triangles outside the outermost feature. Cross-sections of a surface of this type will look funny and therefore the extra triangles must be removed. This can be done using AutoCAD's command deleting triangle by triangle and finally you save the edited surface.

This command does this time consuming task for you. First you select CadTools triangles, because all CadTools triangles will be filtered you can use a crossing over all objects. Next step is to select a polygon, it's not necessary that the polyline is closed, if not CadTools will close it for you. All triangles that have their centroid outside the polygon will be deleted.

A smart way to create the polygon is to add extra 3D-lines to the outmost features that is included in a triangulation. For design surfaces this could be the features created with the "Longitudinal features" command. The extra 3D lines can be joined with these features and together act as an exterior boundary. Images below show steps to perform a perfect design surface.



Features created with "Create Longitudinal features" command



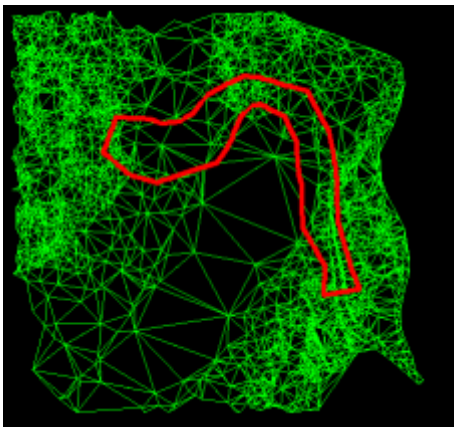
Extra 3D-polylines created at ends

Delete triangles with centroid inside polygon

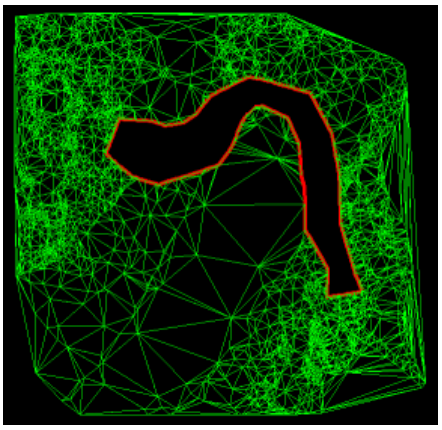
This command is similar to the previous command but it does the opposite, deleting triangles with centroid inside polygon. This command can be useful if you want to create a hole in the existing ground where the design surface will be placed. To get best result there are some thing that need to be taken care of.

Typical steps to get a nice hole

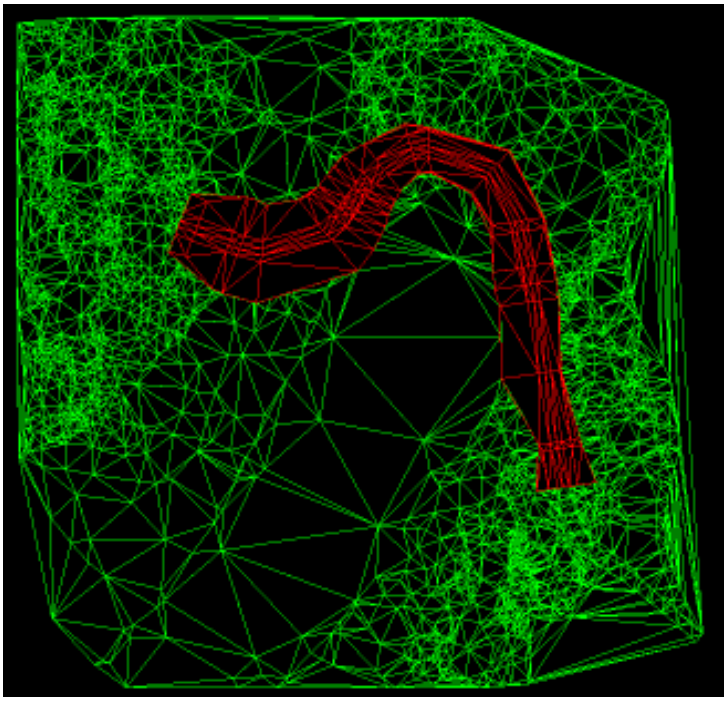
1. Plot design surface perimeter.
2. Plot existing ground triangles.
3. Drape design surface perimeter onto the existing ground (Answer no to question "Keep original line...").
4. Re-triangulate existing ground triangles and the draped design perimeter to get aligned triangles near the perimeter.
5. Plot design perimeter.
6. Use "Delete triangles with centroid inside polygon" to delete all triangles inside the perimeter.
7. Now you have a existing ground surface with a hole If you want you can plot design surface triangles in the hole or save the new surface with a different name



Design surface perimeter plotted



Triangles inside polygon are deleted.



Design surface plotted in same position as deleted triangles.

Miscellaneous

Use Annotate triangle number to get the triangle number at triangle center. CadTools surface files are stored as plain text files with triangle vertices coordinates. If you want to track data from volume calculations or other commands this might be helpful.

The "Triangle volume" command uses a different approach for more exact volume calculations. That process creates "memory triangles" based on the projected features. You have the option to create a tmp file in the volume command, if you annotate the design surface the data in the tmp-file will not be the same due the method of using memory triangles. To overcome this you can paste the triangle center coordinates and the triangle number from the tmp-file to CadTools "Draw from coordinates" to get a correct annotation of the memory triangles.

If you want to display memory triangles in the drawing you can use the option to annotate Cut/Fill in the volume command.

Create Surface (Triangulate)

<Commands>, <Surface>

This command creates triangles from the selected objects coordinates. This function is not suitable for huge sets of point or objects. To speed up the process only use "Save to file", plotting triangles to Autocad is a slow process. Select objects by crossing or other suitable select command, only selected type of object are included in the triangulation. Click "Triangulate" to start triangulation and plotting.

Note! Plotted triangles can be edited directly in the drawing and then saved to file by using the "File, Save triangles to file". There is no need retriangulate if you forgott to set output to file. Plotted triangles are recognised by CatTools when saving, you can select entire drawing all other objects will be filtered out.

For text strings the insertion point of the text is used as X- and Y coordinates. As an option user can let CadTools evaluate strings for any value that can be used as elevation. There is no need for editing the strings, CadTools search for the first number or negative sign in the string and then evaluates the remaining part of the string.

Coordinates used from Lines are start and end coordinates. For Polylines every vertex coordinates is included. For Circle the center point is used, insertion point coordinates is used for Block

Output type of triangles can be 3Dfaces or 3Dpolylines. Select layer and color for triangles from drop-down list, to get newly added layers into list use "ctrl + R" to refresh list. If you type in a layer that doesn't' exist, CadTools creates that layer in current drawing

Maximum triangle side can be set by user, if omitted all triangles will be plotted.

Triangulating 2D-polylines (Contours)

If you are using 2D-polylines that contains Arcs you should consider converting them to 3D-polylines before triangulation. Only start and end vertex of arcs will be triangulated often with bad result. By converting 2D-polylines before triangulation arcs will be replaced by short line segments that will give a better result. To convert 2D-polylines use the Convert command.

Constrained triangulations (breaklines)

Breaklines must be triangulated together with all other objects, this is necessary because the breakline vertices must be included in the triangulation. The option to only use lines on specified layer as breaklines doesn't mean that are included automatically, they need to be included in the ordinary object selection (select objects). The option to use lines from a specified layer means that only lines on this layer will be treated as breaklines.

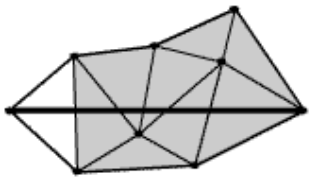
Breakline Vertices will be excluded from any filtering (min and max Z) and thinning by CadTools.

If "Use as breaklines" is checked the triangulation will be constrained, none of the input lines will be crossed by any triangle. This is performed by plane subdivision technique which sometimes results in unwanted long triangles with small angles. Probably there are much better methods for constrained triangulations but I liked this because it was easy to understand and reasonable simply to implement. If you have problems with long triangles you could try to manipulate 3D polylines by using the command "Densify polylines" before triangulating.

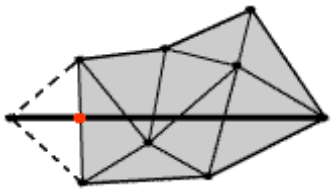
You can specify layer for lines that should be treated as breaklines, vertices from these lines will be included in the triangulation along with other points but when it's time to add breaklines to the surface only lines from specified layer will be used.

Subdivision technique

1. Crossing triangles are identified one by one.

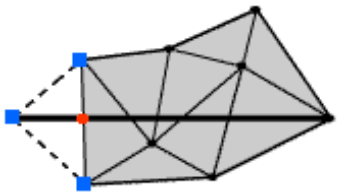


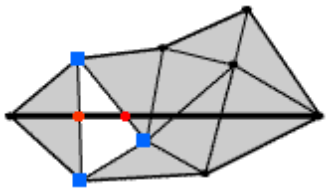
2. Crossing points are stored (red) and the first crossing triangle is removed



3. The original triangle points (blue squares) and the stored intersection point(s) are triangulated to two triangles one on each side of the line.

4. Next triangle is processed.

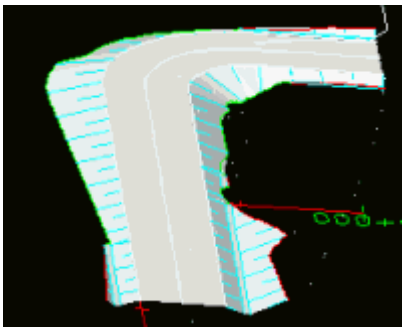


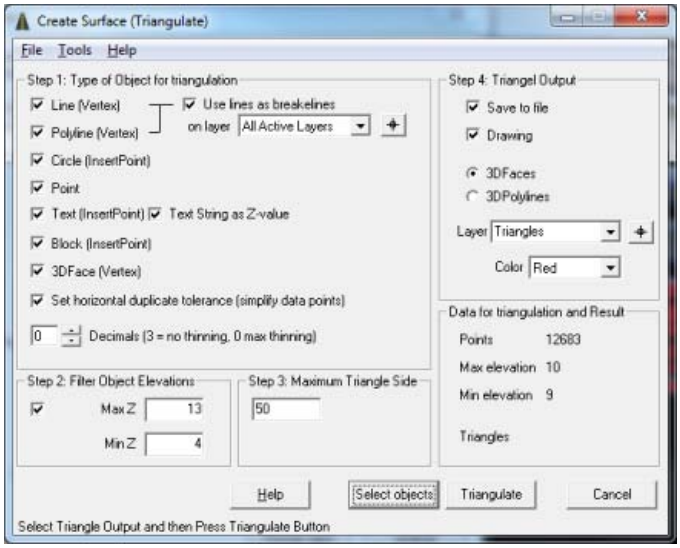


During the process you might get some messages about problems with the triangulation process, often when triangulating dense data I.e. design models. It's a god idea to continue anyway and examine the result. Its rather easy to delete or correct triangles using Autocad's Shade command (and Orbit)

Tip!
If you have problems triangulating long parallel polyline structures, try to explode them to lines and triangulate segements or triangulate a couple of lines at time. You can always save plotted triangles from drawing to same surface file using "File, Save triangles to file". Another tool to use if problems with triangulated result is "Densify 3D polyline"

Image below showing triangulated design model that's been corrected (triangles outside cut and fill lines has been deleted)





Steps to triangulate

Before selecting any objects you should set options in frames named "Step1" and "Step2".

1. Select types of input data by checking appropriate check boxes. You can set horizontal duplicate tolerance for selected points. This will reduce points located near each other during the selection process. Normally CadTools use a rounding of three decimals for points in the triangulation

2. Filter Minimum and maximum elevations for object used in the triangulation (optional). This option excludes all data points with values above MaxZ and below MinZ.

3. Press "Select objects" button. And select objects for triangulation. Only checked object types will

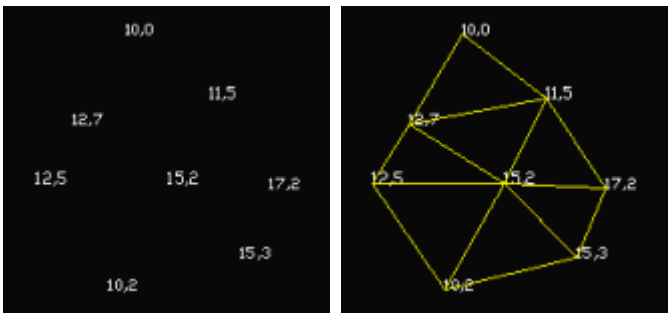
be used by CadTools so you can select by crossing.

4. Set maximum triangle side, omit if not relevant.

5. Select triangle output, to file or drawing and as 3D faces or polylines.

6. Press triangulate.

Triangulate text strings containing elevation text



Triangle volume

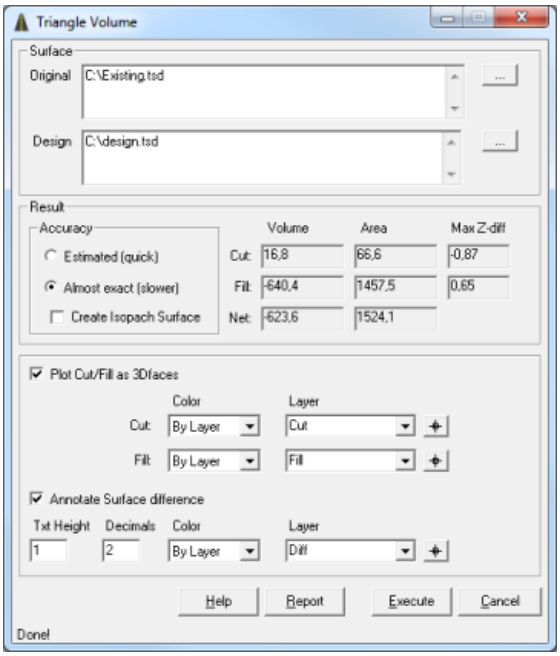
<Commands>, <Surface>

Use this command to calculate cut and fill volumes. Volumes are calculated between two surface in two ways, the most accurate method does this by projecting the Original Surface onto the Design Surface and then computing the volume of each of the resulting prismoids. Volumes where the design surface is below the Original Surface are cut volumes. Fill volumes are volumes where the Design Surface is above the Original Surface.

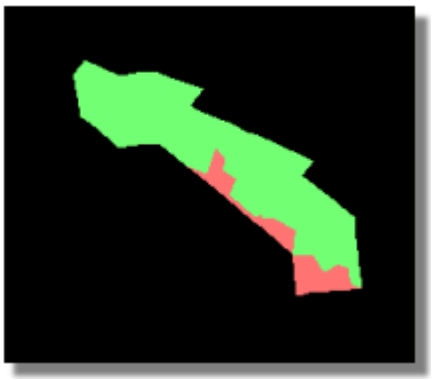
You can also drag a surface file from Windows Explorer onto CadTools surface list to load the surface.

The estimated option is much faster than the exact but less accurate. Results of computed Cut and Fill are displayed as volume, area and max elevation difference. You can also annotate elevation difference in the drawing, this can be useful if you want to see where deep cuts or high fill are located. As an option you can create a Isopach Surface, this option is only available while using the "Almost Exact" method. The Isopach surface can be used to visualize cut and fill areas in plan by contouring. The Surface Contour command has an option for contouring Isopach Surfaces.

The Design surface boundaries must be inside Original surface boundaries

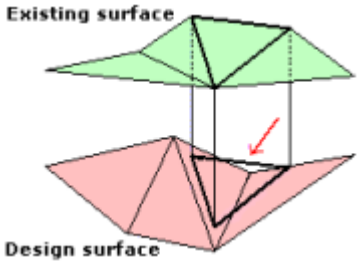


If you wish to plot the resulting triangles (of the design surface) in different color and layer as 3DFaces this can be done by marking the corresponding checkbox. Picture below illustrate a site where cut are colored red and fill colored green, it's easy to see where cut and fill are located.



Estimated option

For the estimated option elevation of design triangle vertices and the triangle centre point are compared with the same spot at the existing surface. If the existing surface is flat this option gives a pretty good accuracy. If the surface has ridges and valleys the volume might be wrong, imagine that a ridge or valley in the existing surface lies between two or more points of the design surface. **Note! Only triangle points are evaluated. Having a normal Original surface with rather small triangles and a Design surface with huge triangles will result in incorrect volumes**

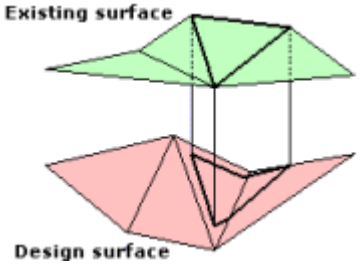


Almost Exact option

This command is the most accurate method to compute cut and fill volumes in CadTools. To accomplish a more exact value for Cut an Fill, CadTools adds projected points at evaluated positions. Usually this will give same result as with constrained triangulating but in some cases, for example when the design surface includes few and large triangles the result might be different.

Cut and fill volumes obtained with this command are calculated between two surfaces, by projecting the triangle-points from the Original Surface onto the Design Surface and then re-triangle parts that interfere with the projected surface. Finally the volume is computed from each of the resultant prismoids. Depending on triangle density the result should be about 95% or better compared with an exact calculation done with other software.

Volumes where the Design Surface is below the Original Surface are cut volumes. Fill volumes exist where the Design Surface is above the Original Surface.



Report

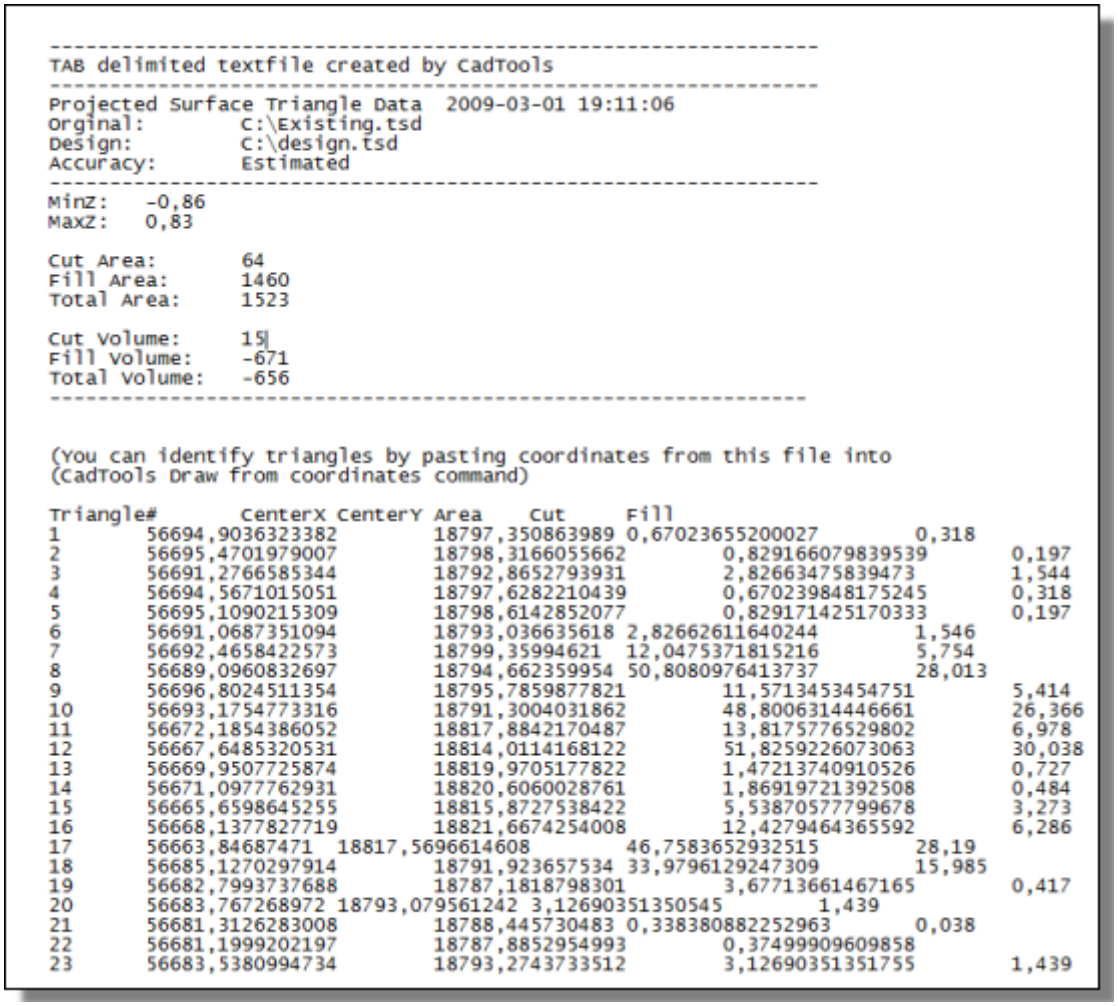
The "Report" button opens a text-file with the most recent volume calculation. The header of the file contains same information as the result from the volume calculation. If you want to track data from volume calculations the bottom part of the file might be helpful.

Using the Tool "Annotate triangle center" located in the "Edit/View Surface, Tools, Miscellaneous" dialog to annotate triangle numbers and compare it with the report-file unique triangles can be located.

The "Almost Exact Triangle volume" command uses a different approach for more exact volume calculations. That process creates "memory triangles" based on the projected features. If you annotate the design surface the data in the tmp-file will not be the same due the method of using memory triangles. To overcome this you can paste the triangle center coordinates and the triangle number from the report-file to CadTools "Draw from coordinates" to get a correct annotation of the memory triangles.

If you want to display memory triangles in the drawing you can use the option to annotate Cut/Fill in the volume command.

Tip! Paste the content from Notepad to Excel to get a nice report

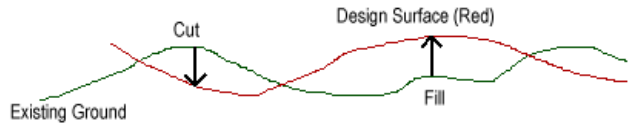


```
------------------------------------------------------------------
TAB delimited textfile created by CadTools
------------------------------------------------------------------
Projected Surface Triangle Data  2009-03-01 19:11:06
Orginal:        C:\Existing.tsd
Design:         C:\design.tsd
Accuracy:       Estimated
------------------------------------------------------------------
MinZ:   -0,86
MaxZ:   0,83

Cut Area:       64
Fill Area:      1460
Total Area:     1523

Cut Volume:     15
Fill Volume:    -671
Total Volume:   -656
------------------------------------------------------------------


(You can identify triangles by pasting coordinates from this file into
(CadTools Draw from coordinates command)

Triangle#       CenterX CenterY Area    Cut     Fill
1       56694,9036323382        18797,350863989 0,67023655200027        0,318
2       56695,4701979007        18798,3166055662        0,829166079839539       0,197
3       56691,2766585344        18792,8652793931        2,82663475839473        1,544
4       56694,5671015051        18797,6282210439        0,670239848175245       0,318
5       56695,1090215309        18798,6142852077        0,829171425170333       0,197
6       56691,0687351094        18793,036635618 2,82662611640244        1,546
7       56692,4658422573        18799,35994621  12,0475371815216        5,754
8       56689,0960832697        18794,662359954 50,8080976413737        28,013
9       56696,8024511354        18795,7859877821        11,5713453454751        5,414
10      56693,1754773316        18791,3004031862        48,8006314446661        26,366
11      56672,1854386052        18817,8842170487        13,8175776529802        6,978
12      56667,6485320531        18814,0114168122        51,8259226073063        30,038
13      56669,9507725874        18819,9705177822        1,47213740910526        0,727
14      56671,0977762931        18820,6060028761        1,86919721392508        0,484
15      56665,6598645255        18815,8727538422        5,53870577799678        3,273
16      56668,1377827719        18821,6674254008        12,4279464365592        6,286
17      56663,84687471  18817,5696614608        46,7583652932515        28,19
18      56685,1270297914        18791,923657534 33,9796129247309        15,985
19      56682,7993737688        18787,1818798301        3,67713661467165        0,417
20      56683,767268972 18793,079561242 3,12690351350545        1,439
21      56681,3126283008        18788,445730483 0,338380882252963       0,038
22      56681,1999202197        18787,8852954993        0,37499909609858
23      56683,5380994734        18793,2743733512        3,12690351351755        1,439
```

Isopach Surface

<Commands>, <Surface>, <Triangle Volume>

This command annotates the difference in elevation between two surfaces. The elevation difference data is placed in a third surface called an isopach surface. CadTools obtains the isopach surface data by subtracting the elevations in one surface from those in another surface. These cut and fill heights might be used to define the cut and fill areas.

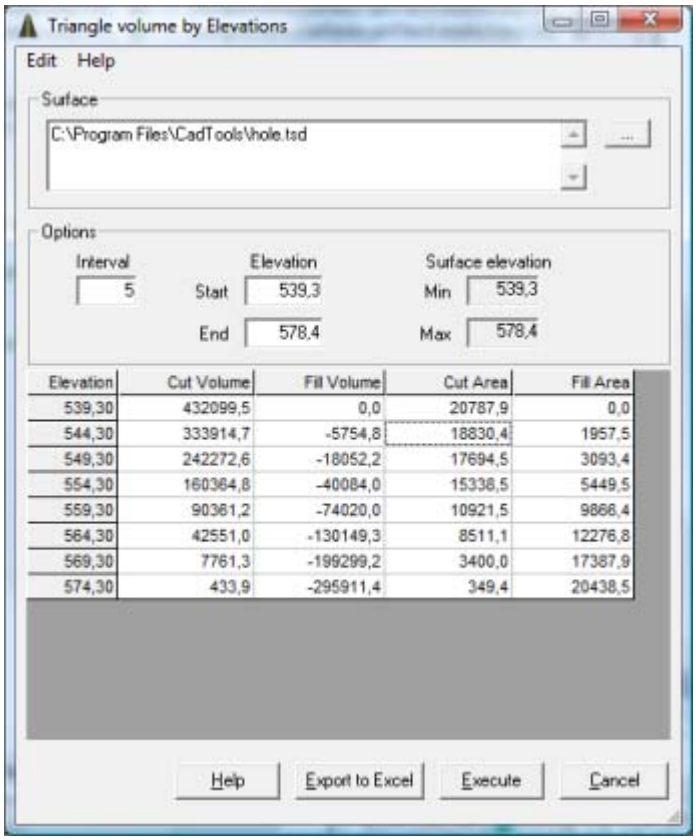


The elevation of each point in the new isopach surface represents the difference in elevation between the first and second surfaces at that plan location. Once you have created an isopach surface, you can treat it like a normal surface. You could, for example, generate contours for the surface using the Surface contours command.

CadTools Surface Contours command has an option for Isopach Surface (Isopach mode). Contours with positive elevation values would indicate fill areas, while those with negative elevations would indicate cut areas. The Zero elevation represents the intersecting edge between the surfaces.

Triangle volume by Elevation

<Commands>, <Surface>



This command calculates volumes between triangles and a plane (z-elevation). Volumes labeled "Cut" are above triangles, volumes labeled "Fill" are below triangles.

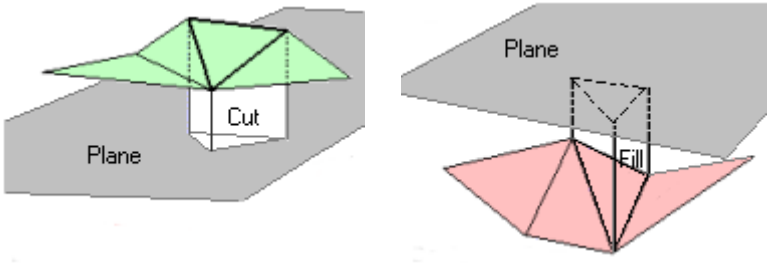
The “Volume by elevation”command uses a simple way of calculating volumes. Triangles that intersects a elevation are cut or fill based on the average elevation of the triangle compared with the elevation of the current plane. As a result of that cut and fill areas for triangles that intersect the plane are displayed as cut if the average elevation compared to the plane is negative and as fill if the value is positive even though some part of the triangle should be displayed as fill.

Image below show result from a surface with minimum elevation at 593,3 and max elevation at 578,4. The result shows that there are no fill volumes at elevation 593,3 which is true because there are no triangles below that elevation. The sample in the image is from a hole in the ground. The fill volume column tells how much water the hole contains for every interval. For the top elevations this is only true if there is a complete horizontal rim at the top.

User can select any start and end interval, they don't need to be within min or max elevations.

Partial result may be copied from the result table. The whole result table can be exported to Excel.

Image below demonstrate how cut and fill are calculated

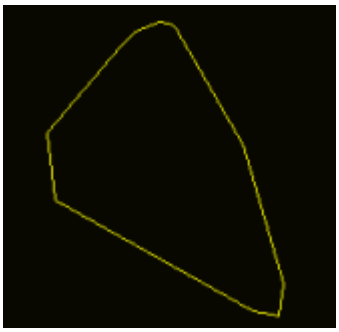


Profiled model

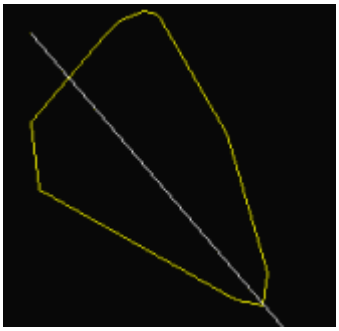
In this topic a method to create profiled model are described. The profiled model is an alternative method to visualize the relief in a digital terrain model.

The method is to create a set of lines that are draped onto the surface using the "Surface cross sections" command. If you load additional surfaces (subsurfaces) you will end up with several profiled models. You can also drag a surface file from Windows Explorer onto CadTools surface list to load the surface.

1. Plot outer boundary for the actual surface using "Edit/View Surface"

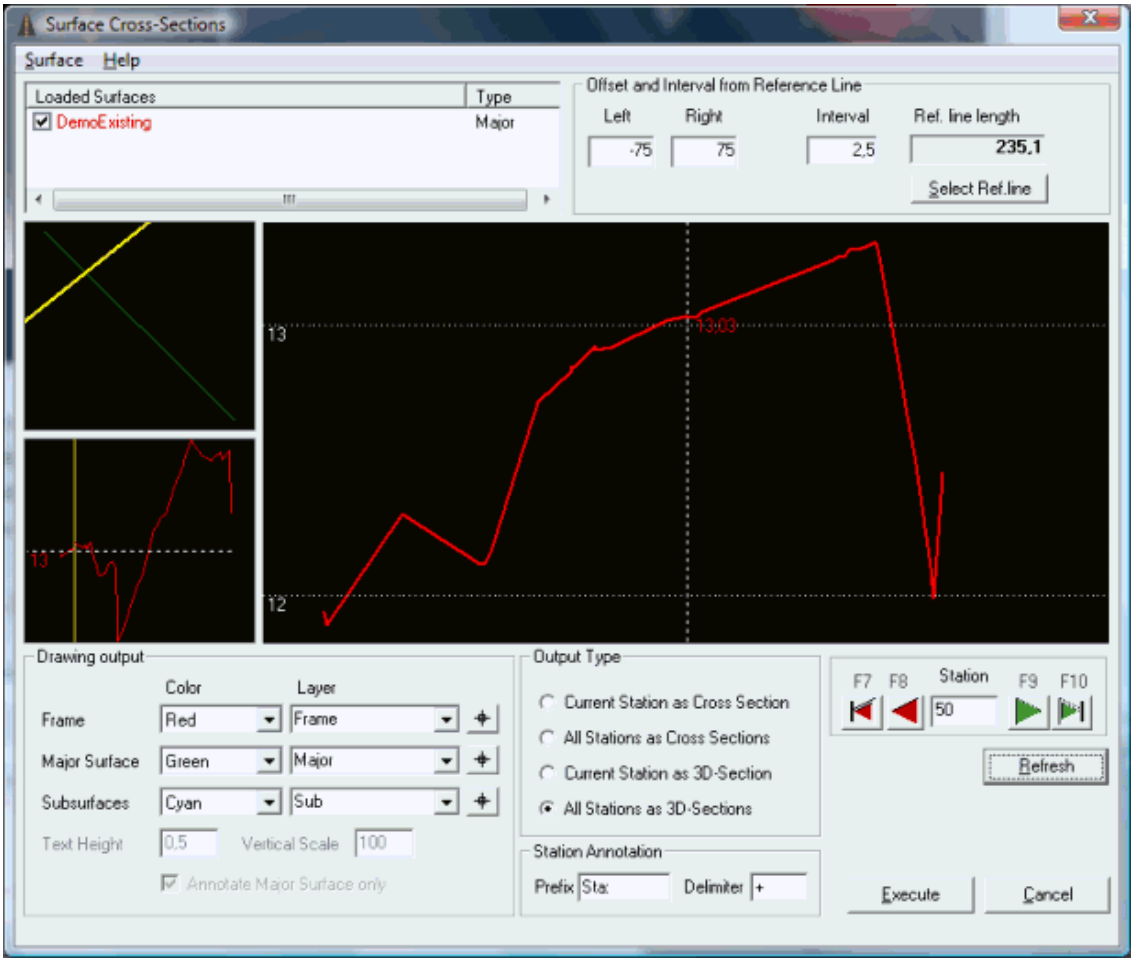


2. Draw a 3D polyline as reference line

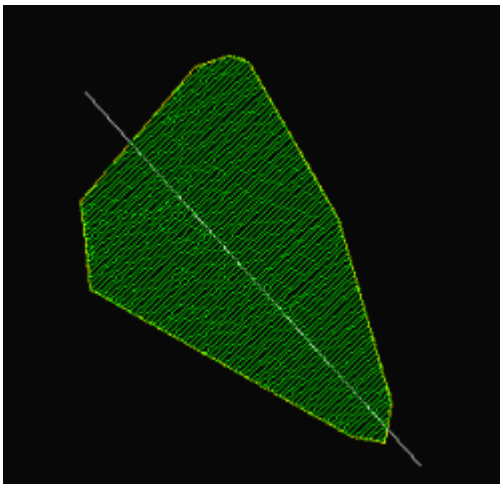


Start "Surface Cross-Section"command from the Surface menu.

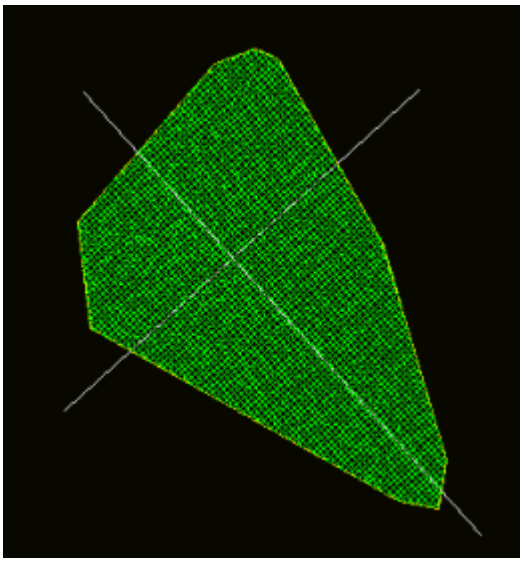
1. Set Left and Right offset same as Ref. line length to get cross-section lines that covers the entire surface.
2. Select the 3D-line as reference line and set interval same as desired grid size.
3. Select "All Stations as 3D-sections" and press Execute.



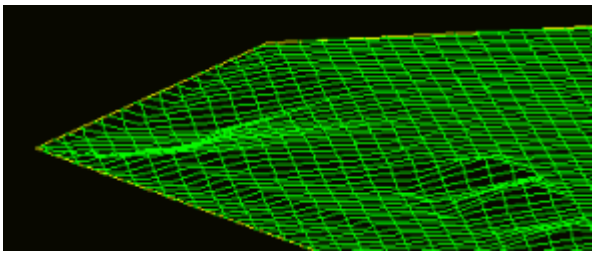
Now you should have lines projected onto the surface in one direction.



Draw a new perpendicular 3D polyline, select as reference line and change left and right offset wider than the maximum with of the surface in the perpendicular direction.



Use Autocad's Orbit command to view the result.



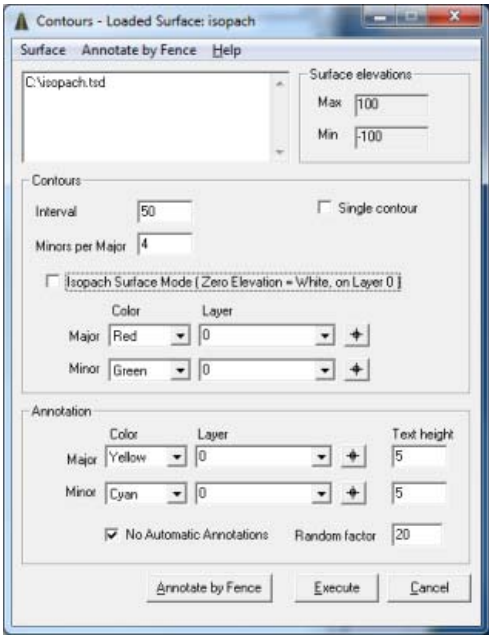
Surface contours

<Commands>, <Surface>

Use this command to create surface contours of CadTools surfaces.

Isopach Surface

If you have created a Isopach Surface you can use the Isopach Surface option to get more useful contours. All negative and positive contours will place on specific layers. If the Zero contour is missing when done you can plot a single contour with elevation 0. You will find more information about how to create Isopach surface in the Surface Volume command.



Interval

controls the difference in elevation between each major contour line. For example, you can display major contour lines at 1-meter intervals. The Interval must be greater than zero (0).

Minors per Major

Defines the number of minor contours that display between neighboring major contours. For example, if you set this interval to 4, there are four minor contour lines between each major contour line.

Usually, this value is set to 4 or 9. If you use a zero value, no minor contours are displayed.

Single contour

Use this for contouring a single elevation. The contour and annotation properties are set same as for major Contours.

Annotations

Annotations text color and layer can be set for booth major and minor. **To omit minor or major annotations you can set Textheight to 0 (zero)**

Random factor

The random factor is used to manage population of annotations. The contour algorithm evaluates every possible contour for each surface triangle step by step. For that reason the contours will contain line segments representing the triangle intersection with the plane (current elevation).For every contour line segment that's generated the software checks if a randomize value from 1 to the random factor is equal with 1. If so the annotation will be plotted between that segments start and endpoint.

Setting Random factor to 1 will result in annotations at every contour segment, increasing the value decreases the number of annotations.

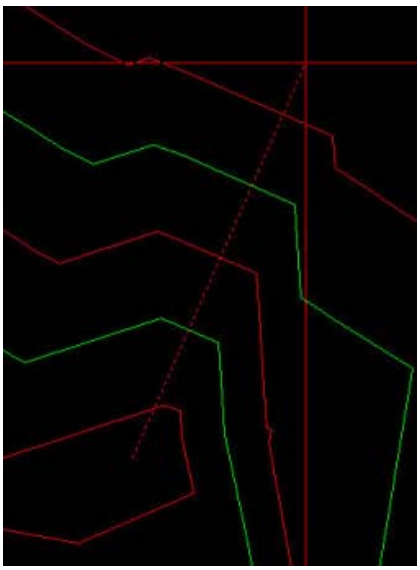
No Automatic Annotations

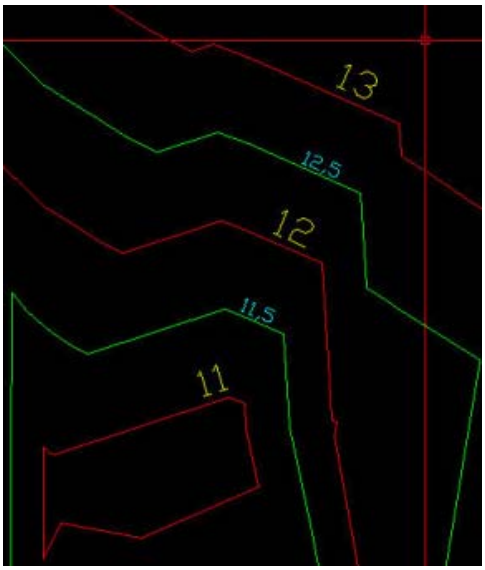
This option omits all annotations. You can set text height to zero for both major and minor to get same result but then you have to set them back if you want to annotate by fence. If you planning to annotate by fence it's smarter to use this option to turn all annotations off.

Annotate by Fence

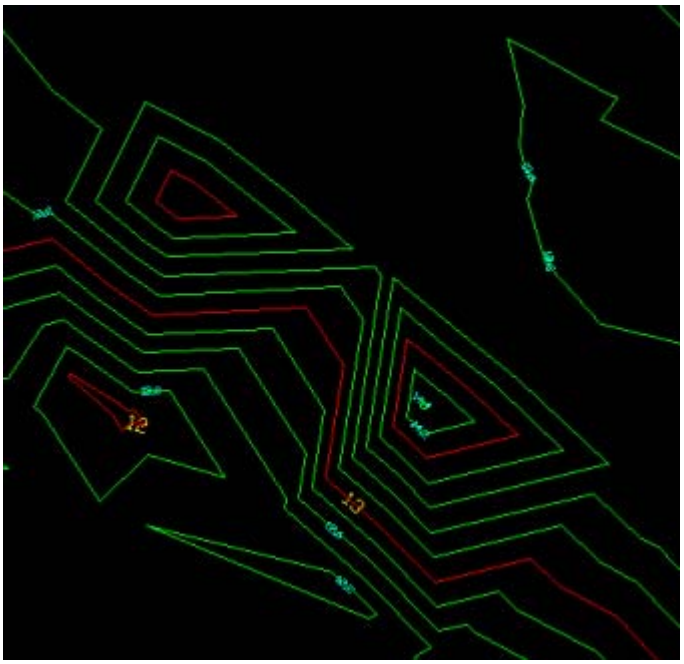
This command annotates contours by a fence line from the user. Click on the command in the menu and point out a start point for fence line in the drawing. Position endpoint so that the line cross one or several contours. The software annotates all crossing points whit elevation annotations based on the settings.(color, text height). To make the process faster the Annotate command sustains until the user hits ESC key. **You don't need to load a surface for this command all data needed is stored in the drawing.**

Note! Only contours generated by CadTools can be annotated by this command.





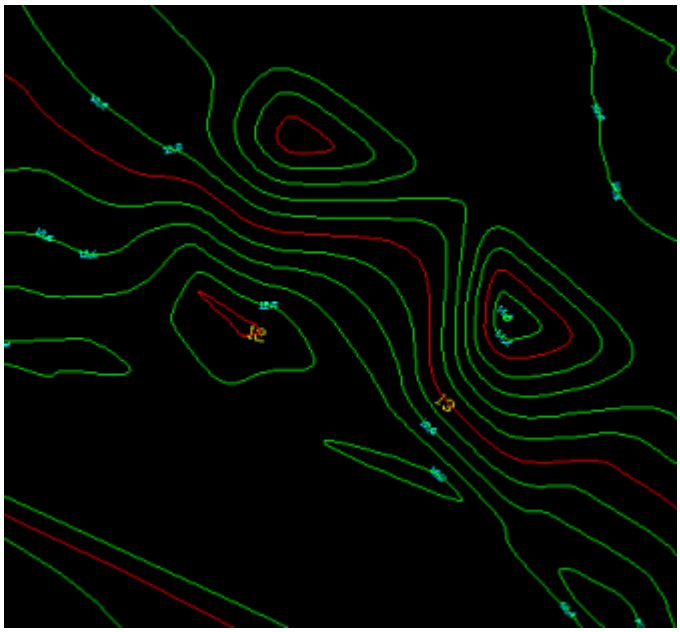
How to smooth the contour lines



CadTools doesn't support any functions to join the segments to polylines the contour segments are therefore built as 2Dpolylines at correct elevation, this makes it possible for AutoCAD to process the segments. You can use AutoCAD to make smooth contours by using "PEDIT". Type PEDIT on the command line and select "multiple". Select all contours by crossing (never mind if text is included in the selection). Select "Join", and wait for AutoCAD to finish joining. Now we have joined all contour segments to polylines. Select "Spline" on the command line to smooth the contours.

Now you should have nice smooth contours that also can be decurved with the "PEDIT" command.

Images below showing before and after smoothing with AutoCAD



Surface cross sections

<Commands>, <Surface>

There are three windows in this form, plan view, profile view and cross-section view. In the plan view you can see the reference line and a perpendicular line representing your offset values. Using the mouse in this window positions all other windows at current station, this is done by clicking near the reference line. The profile view displays profile for major surface, this window has same function for current station as the plan view. You can also drag a surface file from Windows Explorer onto CadTools surface list to load the surface.

This command creates surface cross sections from a alignment line (3D polyline) and one or more surfaces. The first loaded surface becomes the major surface. Major surface can be plotted in a specified color in the drawing. You can set different color for sub-surfaces but not individual colors for each sub-surface. If you want to change color for a surface in the preview view, right click on the surface in the surface list and change color.

Start by loading one or several surfaces and then draw a new or use a existing 3D polyline as reference line. Set left and right offset and interval. Use the station navigator to position at any station on the line. You can type in a value of your own and press the Refresh button to update the graphic.

To hide a loaded surface, uncheck the box to the right in the surface list. You also can change display color for any surface by right click on the surface in the surface list and select color. The "Display alignment with elevation" displays the alignment at correct elevation as a green filled circle, the cross section is scaled to fit the data both in the preview window and when plotted to DWG. At the bottom of the form you find information about elevation between the major surface and the selected alignment.

Current station or all stations can be plotted as traditional cross-section or as 3D-section. You can also plot range of stations by provide start and stop section.

If you working with a very long alignment and your interest is focused on a specific part of the alignment you could break the alignment at a specific station and use the "Set start of alignment to station" to get the annotation right. Type in the start-station you would like to use.

Display references

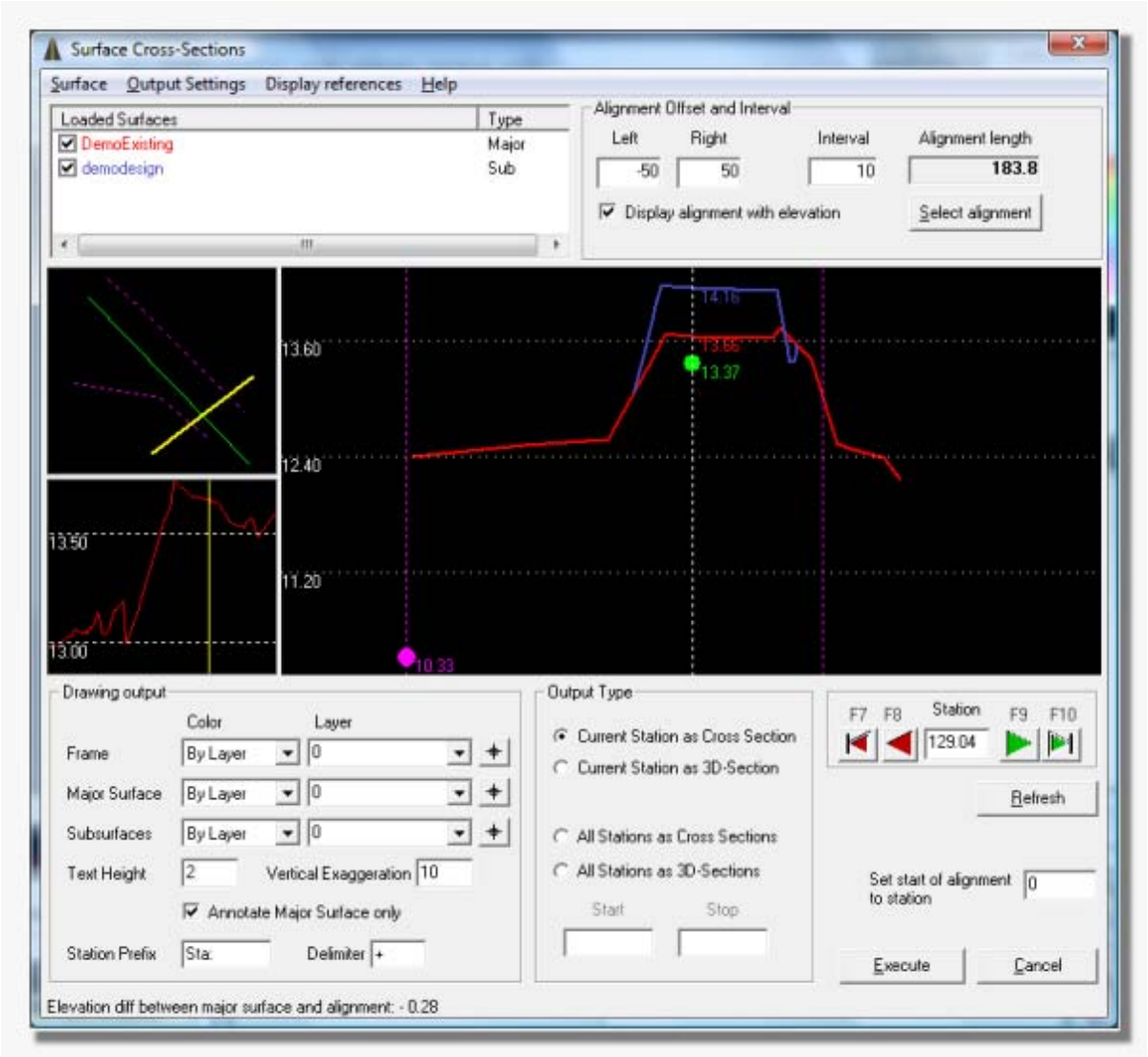
Display crossing 3D lines in the cross- section by using the "Display References" menu. All lines will have Magenta as color in the preview window, reference lines will placed on same layer as the original line when plotted to DWG-file.

You can display reference lines either as true lines with elevation from the line or without elevation. Using the option "Add display reference line with elevation" results in a filled circle at the position where the line intersect the section. Using the"Add display reference line (no elevation)" results in a dotted vertical line indicating the horizontal position of the reference line. The height of the cross- section will be adjusted so that all display references with elevation will be displayed. Plotting to DWG works in same way, cross section height will be adjusted. Use the "Output settings" menu for more options in DWG-file.

To remove display references use the "Unload all display references"

Cut and fill

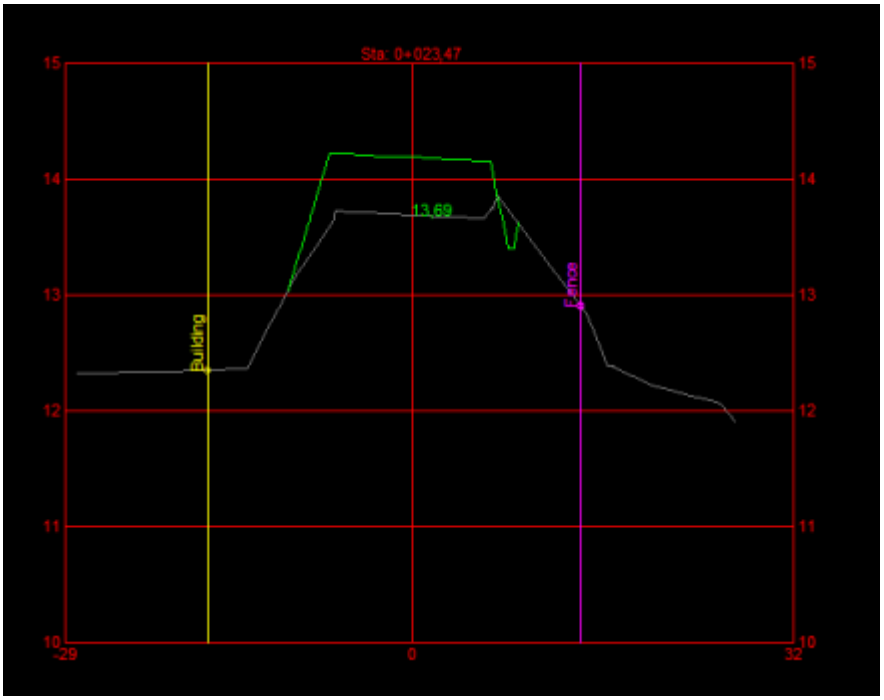
There's no automation of end area volumes in CadTools, however you can use a command exclusively developed for that task. After cross-sections are sent to drawing you can use the "Cross section area" command to annotate cut and fill area for cross-section. The end area volume calculation can then be done manually or with Excel.



Result can be plotted as ordinary cross-sections or as true 3Dsections. The latter option is useful if you want to create profiled surface models, read more about "Profiled model".

Image below shows a surface of existing ground as major surface and a design surface as subsurface, left offset is -29, right offset is 32.

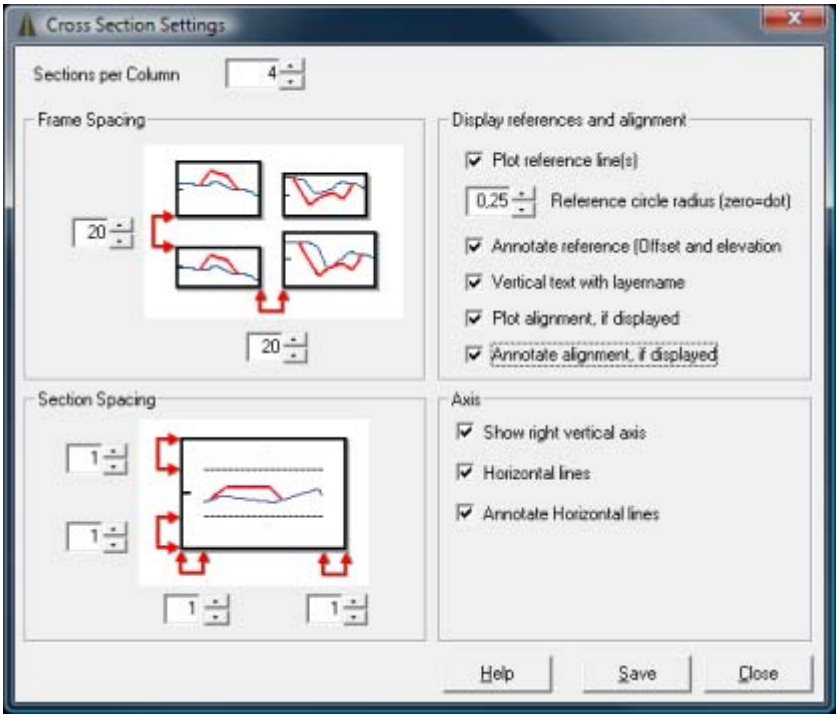
In this cross-section two 3D-polylines from the DWG are used as display references, the yellow is from a layer "Building" and the magenta is from "Fence" layer. To get the layer leader you need to select the option “vertical text with layer-name” in the Output settings form.



Customize Cross-Section layout (in drawing)

The menu "Settings" provides you with some useful printout settings.

You can try different settings and press "Save" without closing the form, print cross-sections and decide if current setting works ok for you and finally close the form.



Tip! If you experience odd behavior of the surface cross sections in the outer parts the explanation can be that there are unwanted triangles outside the desired perimeter. To get rid of these triangles you can use the two commands described in the "Edit Surface" part of this help file.

Advanced use of Surface Cross Sections

If you want to display complex features in cross-sections you need to understand how the code works. In this section I try to explain the simple technique behind the scene.

The cross section line is build as a perpendicular line to the reference line. The line is created from left to right with the reference line at the zero station, if your settings are -10 and 10 the total length of the line is 20. Every crossing between the line and triangle legs are stored in memory and sorted by station (-10 to 10). A surface is built by connecting points with triangles, every triangle has three legs. All triangles except the outermost share triangle legs with other triangles, therefore there are duplicate crossings when draping a line.

The easiest way to deal with this is to only use one of the crossing points for draping, since the legs are connected to same points there can not be any difference in elevation. This is what CadTools do, only the first crossing point that occurs will be used for that station. The resulting draped line will be a polyline built by all crossing points, if there are holes in the surface these will be identified as missing segments.

How about vertical triangles? Well, vertical triangles can't be created with ordinary triangulations algorithms so that shouldn't happen. If you want to create vertical or more complex surfaces without triangulation that can easily be done by copying a CadTools triangle in Autocad and place it manually in the drawing as long as you don't mirror it. When you are satisfied you can save it by using "Save Surface" in the "Edit Surface". With the description above I hope you understand that a surface like that can't be displayed correct with CadTools cross-section command. However, if you tilt the vertical surface slightly i might work, duplicate crossing are evaluated at the third decimal so you don't need to tilt it a lot.

Why can't the developer fix this? For sure I have thought about this and even have some blueprints stacked in my brain but I'm lazy by nature. I consider CadTools as a simple software that can do wonderful things as it is. Changing cross-section to support vertical triangles is a major task, probably there are only a couple of users that would benefit from it.

Surface profile

<Commands>, <Surface>

Link to "Create 3D alignment"

This function creates Surface profiles of a surface and a 3DPolyline as alignment. If you prefer to create profile along a 2D polyline you can use other CadTools line commands to first convert the polyline to a 3DPolyline.

To use this command you first need to load one or several surfaces, select alignment and additional reference lines. If you move the alignment in the drawing you only need to press "Select alignment" button and select the alignment again to get a complete redraw of the profile

The first selected (Loaded) surface is treated as Major surface, you can't deactivate the major surface. Additional surfaces can be loaded and displayed in the profile window. By altering the checkbox surfaces can be hidden (deactivated).To see the reslut you need to press the "Refresh" button. You can change color for all surfaces by right click on the surface name in the list, the color is only for the preview window.

You can annotate major stations and you also can annotate surface elevation at minor intervals.

If you working with a very long alignment and your interest is focused on a specific part of the alignment you could break the alignment at a specific station and use the "Set start of alignment to station" to get the annotation right. Type in the start-station you would like to use.

Display references

Two types of reference lines are supported, crossing lines and projected lines.

Display crossing 3D lines in the profile by using the "Display References" menu. All lines will have Magenta as color in the preview window, reference lines will placed on same layer as the original line when plotted to DWG-file.

You can display reference lines either as true lines with elevation from the line or without elevation. Using the option "Add crossing reference line with elevation" results in a filled circle at the position where the line intersects the profile. Using the"Add crossing reference line (no elevation)" results in a dotted vertical line indicating the horizontal position (station) of the crossing point with reference line. The height of the profile will be adjusted so that all display references with elevation will be displayed. Plotting to DWG works in same way, profile frame height will be adjusted. Use the "Output settings" menu for more options in DWG-file.

Projected lines are selected from the drawing and then computed an displayed in the preview window. Projected lines will be plotted to the DWG on same layer as in the drawing, the color is also based on the original layer. This command is very useful when you want to evaluate other parts of your model. To get elevation beside your alignment, offset the alignment and drape it to the surface and then use it as a projected line. If you need to display a ditch bottom in your profile you can use the "Display projected line".

Projected lines should not have any loops, they need to be somewhat aligned with the alignment, the distance from the alignment has no limitations. All evaluated points are perpendicular from the alignment.

To remove display references use the "Unload all references"

Image below show different types of available graphic features

- Major surface is the surface that was first loaded
- Subsurfaces are surfaces loaded after loading major surface
- Crossing line with elevation is reference-line with line elevation at crossing point with the alignment
- Crossing line with no elevation is reference-line with line no elevation at crossing point with the alignment. This will result in a vertical line at the crossing station
- Projected line is a line that is projected to the profile could be a ditch bottom or any other 3D polyline. (use offset and drape commands to get surface offsets of the alignment)

You can use multiple surfaces and reference lines

Tip!

If you are using a drainage pipe or a road center line as an alignment and want to display it in the profile, use the "Display references" and select the alignment. Even though the alignment location is same in plan CadTools will display it in the profile with correct elevation.

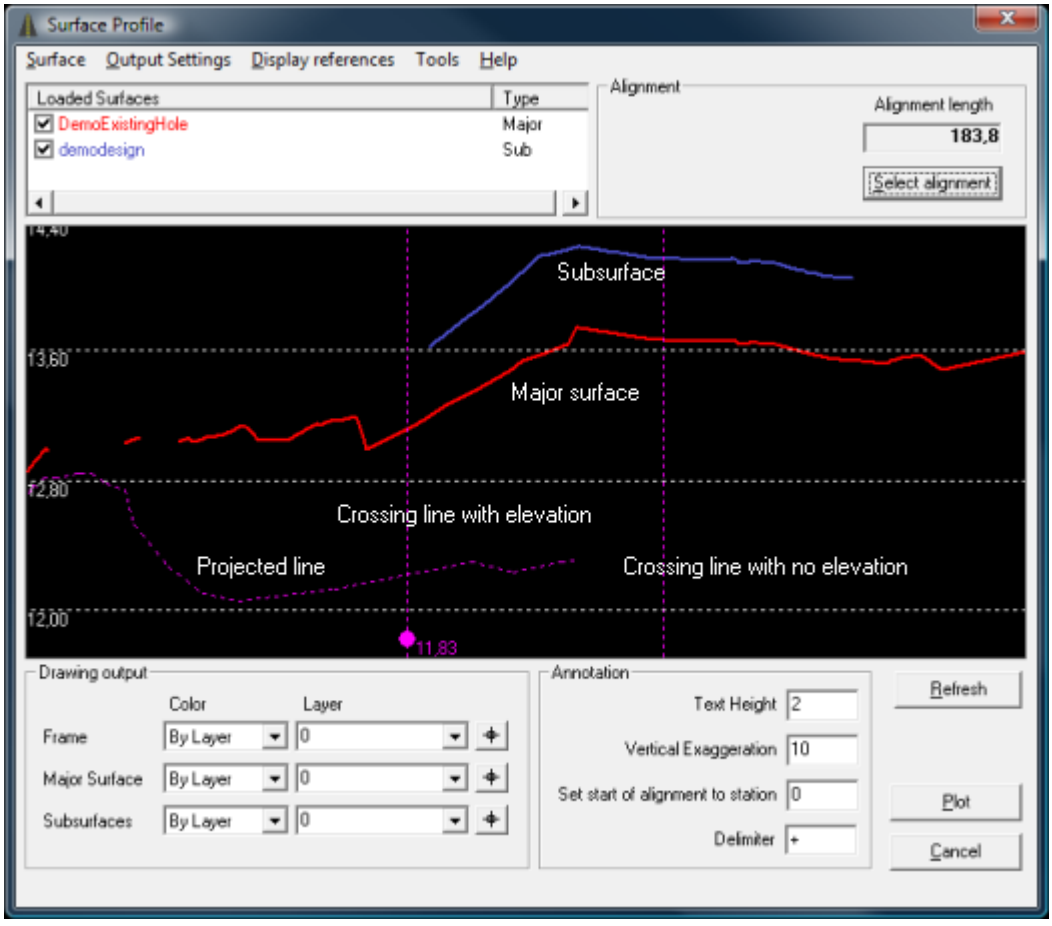
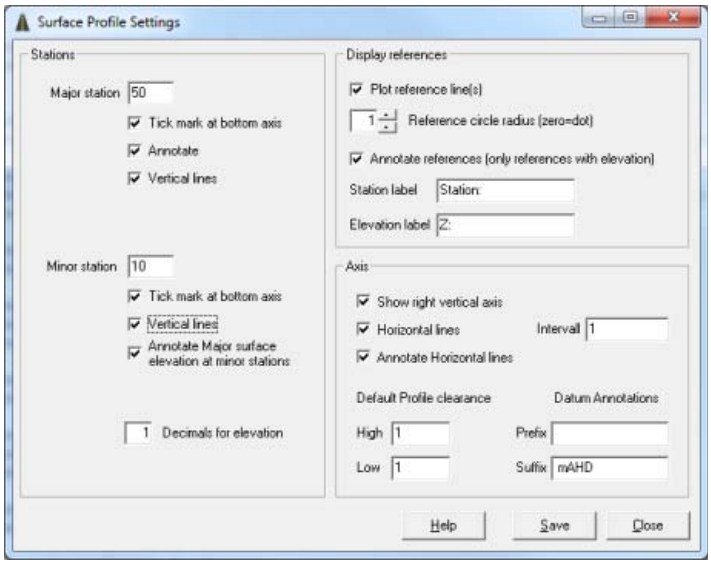
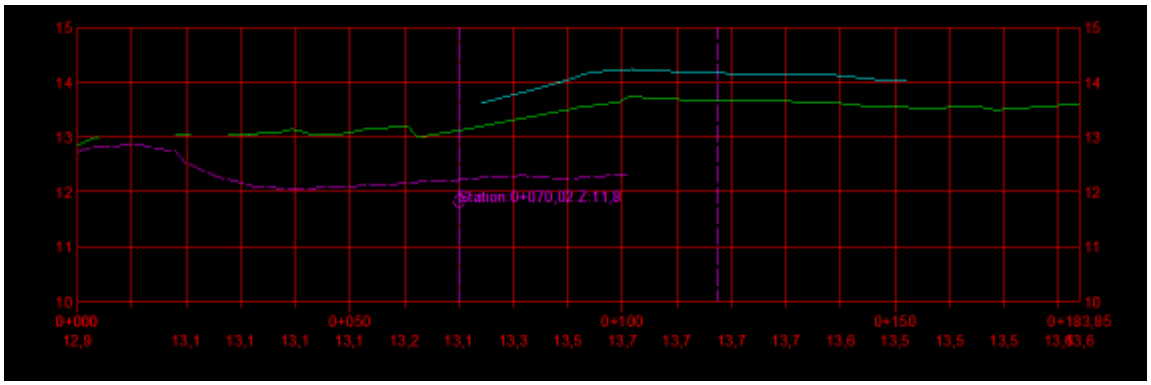


Image of "Output settings" form



Default Profile clearance is sets space between highest or lowest profile line and the frame. Datum annotations are for the left and right most vertical lines (elevations)

Image of plotted result in drawing



View slope vectors

<Commands>, <Surface>

This command creates slope vectors for surface triangles. There is a similar command for single points slope in "Edit/View Surface". This command is more powerful and is well suited for evaluation of drainage. It's easy to check if a design model meets its demands regarding drainage.

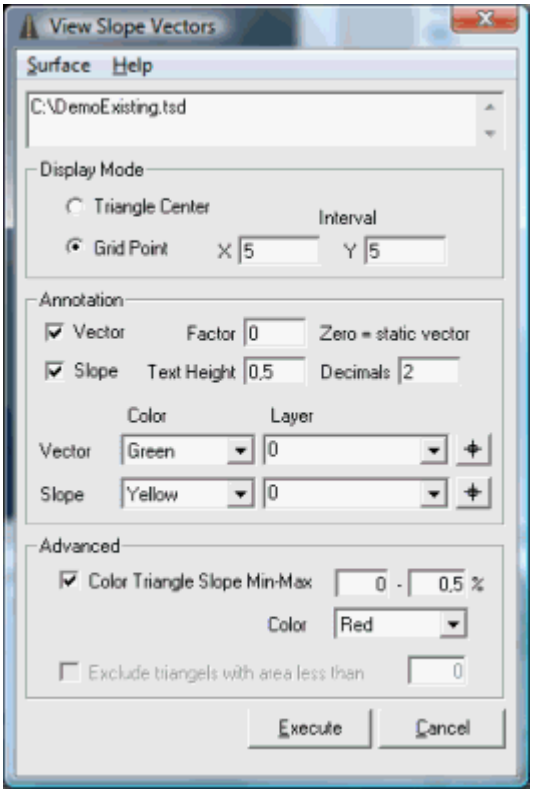
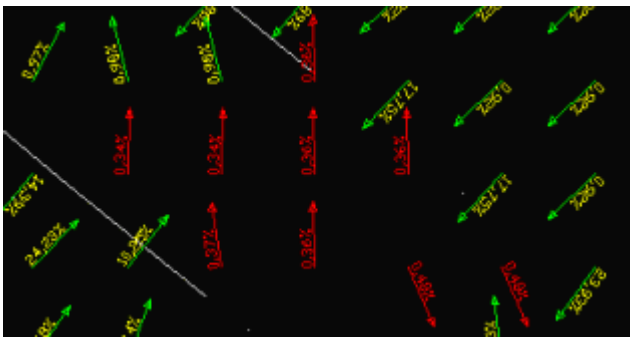


Image of slope vectors in display mode "Grid point"



Surface

Specifies the surface you want to use to display slope vectors. Surface must be a CadTools Surface, use Surface import for other surfaces (triangles). Surface import is located in "Edit/View Surface"

Display Mode

Determines how to define the locations where the software generates and displays slope vectors. You can specify that the vectors be located at triangle centers or in a grid pattern.

Triangle Center automatically places slope vectors at the center of each triangle. Use this option with care when your surface contains a large number of triangles. If it does, it will be difficult to read each individual slope vector annotation.

Grid Point places slope vectors in a grid-like pattern. You define the grid-cell size using the X-Interval and Y-Interval parameters. This parameter is active only when Grid Point is the active Display Mode.

Annotation

Booth vector and slope can be annotated on different layer and with it's own color. If factor is set to 0 (zero) CadTools creates a static vector (equal length despite slope value). Setting the factor value to other values results in vectors with length based on slope value multiplied with the factor.

Note, setting the value to 1 does not results in slope vectors with exact same length as the slope, however setting factor to other values than 0 will result in longer vectors for steep slope. If slope is 10% for one vector and 20% for another the steepest vector will be twice as long, every vector length is proportional to the slope.

Advanced

Use these settings for overriding color for "Flat Areas" or other intervals as you please.

You can exclude small triangles by setting a value of minimum triangle area. This option is not available when Grid Point is the active Display Mode.

Xref commands

Open Xref by object

<Commands>, <XRef>

Use this command to open or activate already open drawing that is attached to current drawing as an Xref.
This command also works in paper space if your Mview is in model mode.

Detach Xref by object

<Commands>, <XRef>

Use this command to detach a Xref by selecting a object.
This command also works in paper space if your Mview is in model mode.

Make Xref relative path

<Commands>, <XRef>

Use this command to make current drawings external references path to relative.

Relative Path gives AutoCAD a partial folder structure that is relative to the current drawing location.
Let's say that your current drawing is in folder P:\Proj\CAD\A, then:

Xref location	Relative Path	What is happening
P:\Proj\CAD\xref.dwg	..\xref.dwg	ACAD looks back one folder from the current drawing folder (..\ means back up one folder)
P:\Proj\CAD\A\Det\xref.dwg	.\Det\xref.dwg or Det\xref.dwg	ACAD looks forward into Det from the current drawing folder (.\ means start from the current folder, or simply leave this off and the current folder is assumed)
P:\Proj\CAD\S\Det\xref.dwg	..\S\Det\xref.dwg	ACAD backs up one folder to CAD, then goes forward into S\Det

Save/Load Xref settings from file

<Commands>, <XRef>

Save Xref settings to file
This command saves Xref settings from current active drawing to a txt-file.

Load Xref settings from file
This command loads Xrefs based on the settings in the file. Xrefs are inserted as "Overlay".

You can open the saved file with Notepad and use it for documentation of the X-ref settings

Hatch commands

Export Hatch area to Excel

Select hatch objects in the drawing and export area to Excel. You can select by crossing, Hatch objects will be filtered.

Note! Not all Hatch object has area, don't ask me why. If any Hatch with empty area is detected CadTools will give you a message. To locate empty hatch look at the tip in the bottom section.

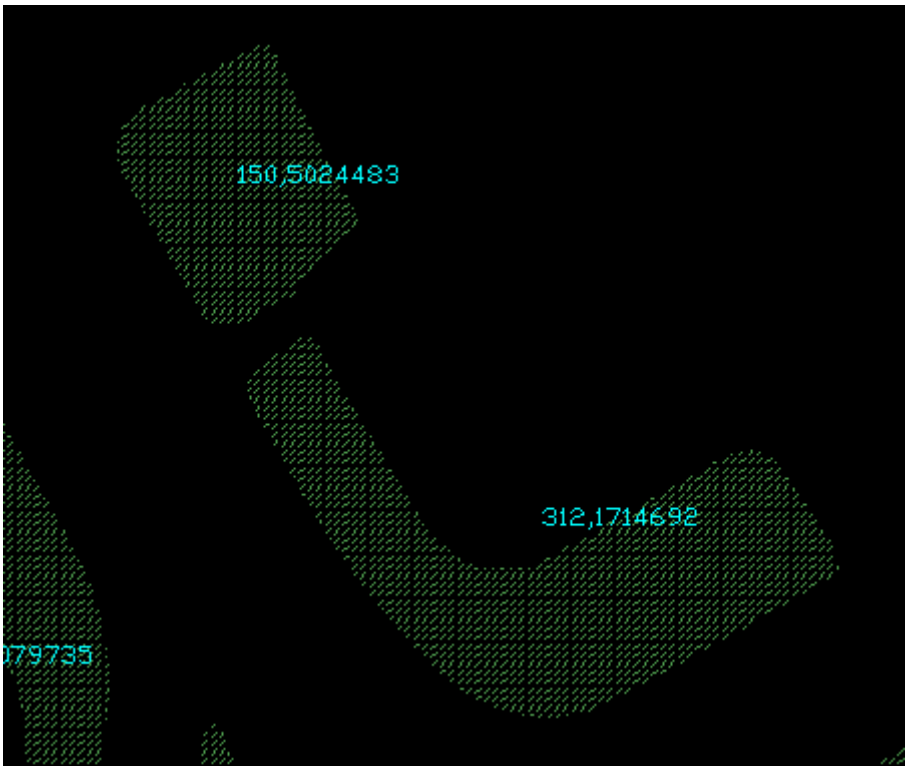
	A	B	C	D	E	F
1	#	Layer	Area	Pattern name	Pattern scale	
2	1	Grass	5520,80726	ANGLE	1	
3	2	Asphalt	5520,80726	ANGLE	0,1	
4						

Tip!

You can easily annotate Hatch areas to the drawing by paste the values to "Draw from Coordinates" form. Use the "Text at Point" option and paste "Bounding box mid X" and "Bounding box mid Y" columns from the Excel sheet with the Hatch areas.

Paste the area values in the "Text" column, fill the "Z" columns with Zeros by using right click in the top cell.

Image below shows sample result from that function.



Exporting to Excel, alternative if not Excel installed

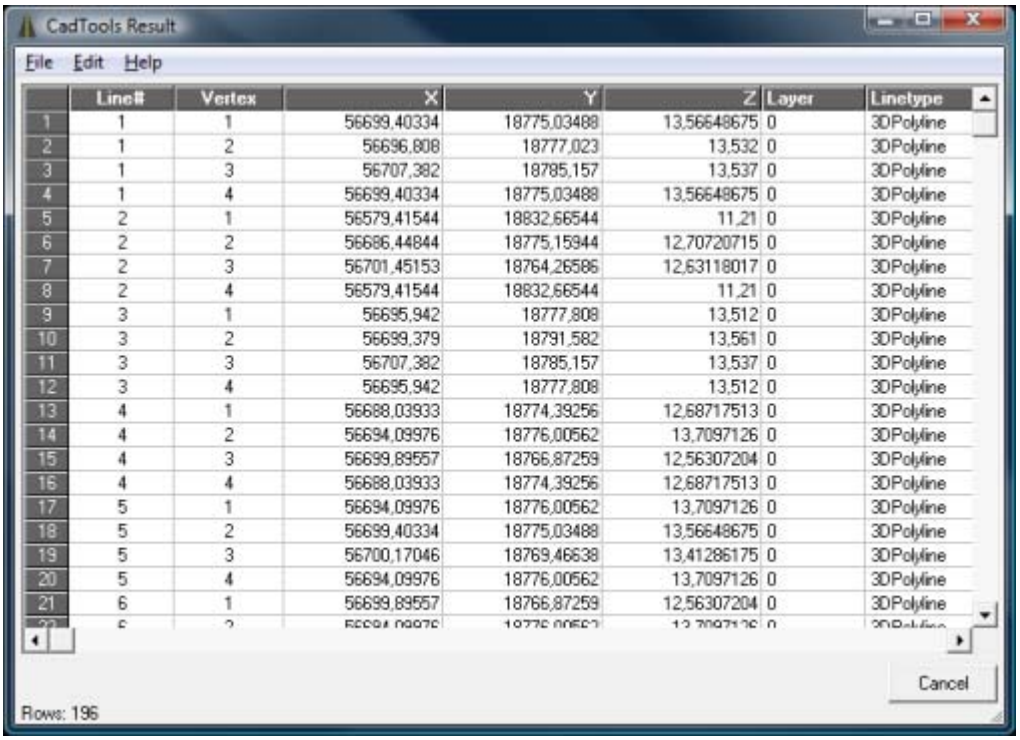
CadTools SpreadSheet

This is a complement to users that don't have Microsoft Excel installed. Normally users can export some results to Excel and then do calculating and printing. If you don't have Excel on your computer you will miss that handy function. This is a solution that is provided by CadTools, it's very simple but it works with most windows software. To use it you change a setting in CadTools (Settings), this setting tells CadTools that you don't have Excel and then CadTools always use this window for data export.

To copy data from the grid to other software you use commands found in the Edit menu (Copy and Copy all). As an alternative you can Right-Click in the grid to execute a popup menu. Data from grid will placed into Windows ClipBoard and can then be pasted with regular Windows commands. There is no intelligence in this window, you can't do any calculations. The first line (Headings) will be fixed during scrolling.

You don't need to close the window after export, the window will be updated simultaneously.

The grid content can be printed and exported to CSV-file.



	Line#	Vertex	X	Y	Z	Layer	Linetype
1	1	1	56699,40334	18775,03488	13,56648675	0	3DPolyline
2	1	2	56696,808	18777,023	13,532	0	3DPolyline
3	1	3	56707,382	18785,157	13,537	0	3DPolyline
4	1	4	56699,40334	18775,03488	13,56648675	0	3DPolyline
5	2	1	56579,41544	18832,66544	11,21	0	3DPolyline
6	2	2	56686,44844	18775,15944	12,70720715	0	3DPolyline
7	2	3	56701,45153	18764,26586	12,63118017	0	3DPolyline
8	2	4	56579,41544	18832,66544	11,21	0	3DPolyline
9	3	1	56695,942	18777,808	13,512	0	3DPolyline
10	3	2	56699,379	18791,582	13,561	0	3DPolyline
11	3	3	56707,382	18785,157	13,537	0	3DPolyline
12	3	4	56695,942	18777,808	13,512	0	3DPolyline
13	4	1	56688,03933	18774,39256	12,68717513	0	3DPolyline
14	4	2	56694,09976	18776,00562	13,7097126	0	3DPolyline
15	4	3	56699,89557	18766,87259	12,56307204	0	3DPolyline
16	4	4	56688,03933	18774,39256	12,68717513	0	3DPolyline
17	5	1	56694,09976	18776,00562	13,7097126	0	3DPolyline
18	5	2	56699,40334	18775,03488	13,56648675	0	3DPolyline
19	5	3	56700,17046	18769,46638	13,41286175	0	3DPolyline
20	5	4	56694,09976	18776,00562	13,7097126	0	3DPolyline
21	6	1	56699,89557	18766,87259	12,56307204	0	3DPolyline

Other issues

How to become a registered user

Registered users have full access to all commands in CadTools. To become a registered user you first must make a donation. Donators will receive information by email on how to unlock restricted commands in CadTools.

How much should I donate? There is no right answer to this, the result is always the same no matter how much or little you donate. Ask yourself how useful CadTools is and donate with your heart.

After your donation I get information from PayPal about your email. I then send the unlock information by a personally email. Generally I do this at least once a day.

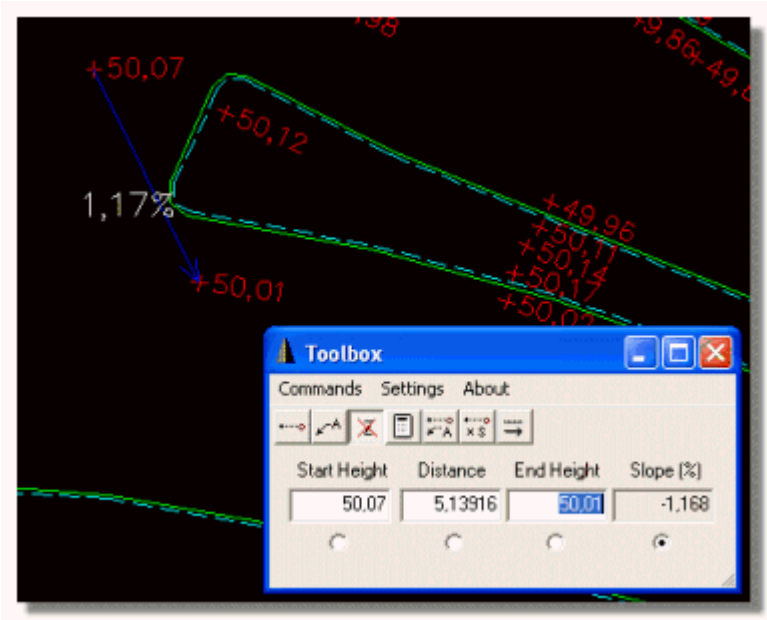
How to use CadTools to speed up your work

In this topic I will give some hints about using the software in Plans, Cross-sections and Profiles.

The main purpose during development was to supply support for calculation of slopes and heights in drainage design. The slope calculations is also useful in other situations, it's up to the user to explore these possibilities. In these simple walkthrough's the "Draw line and arrow" is set on, you can turn this off under settings. To speed up your work you can both pick and annotate in one command.

Drainage support in plans

If a drawing in 2D (objects in drawing are not in same elevation as annotated) is used you should turn off "Pick 3D" and use "Pick 2D". This will prevent CadTools from using elevations objects in the drawing when picking start points. Instead you type in the start elevation and only pick the distance from the drawing.



In this picture the "Pick3D/2D" button is toggled to 2D, the start height 50,07 and end height is 50,01 are typed in and the distance is picked from the drawing. The resulting slope -1,168 is the slope between 50,07 and 50,01 with the picked length and is calculated by the software. If you press the "Annotate" button you can insert calculated slope direct into desired point in the drawing.

If you in this moment change response by checking one of the other "Radiobuttons" that are placed under the response fields, you can easily calculate another response based on same relation. It could be the height of any point on the extended blue line if calculate slope is accurate. To accomplish that you simply click on the "Radiobutton" under "End Height" and picks a new start point at 50,07 and endpoint on desired point. Clicking "Annotate" inserts the end height in the drawing.

By using this method you can very easy extend heights in a drawing. You can also check if rainwater will flow in desired directions and with enough slopes.

Tip! Hitting ENTER at any time will execute a new calculation and a fresh response.

Working with cross-sections and profiles

Have you ever been left with a couple of cross-section that are complex and therefore need some extra height-annotations? With CadTools that's no big problem!

In this picture of a simple section we have the ground as the cyan line at the top. The green line is the line that represents the level 50. As you can see, the ground is above the 50 line. For that reason we can set the slope to 100% and then pick any point at the ground line as the start height and then pick the end height at a perpendicular point at the 50 line. Of course we have to check the "Radiobutton" under End Height because we are looking for the height.

Beware! If the end height we are looking for is under our 50 line we must set slope to -100%

By using AutoCAD's OSNAP in a smart way this method can be very fast and accurate.

For profiles the method above will work if you have a drawing with same scale horizontal and vertical. If that's not the case you can set a scale under settings. This scale factor is used when you pick lengths with the scale button. Hovering over the button will show present scale factor in the statusbar of CadTools.

Known problems

Can't open saved surface or bad data

Moving a surface file from one computer to another might end up with a file that can't be opened or contains bad data. Booth computers must use same decimal-separator! CadTools stores surface data in a plain text-file therefore it's easy to edit all surface data.

Solution

Open the surface file with notepad and check if the decimal separator is the same as on your computer. If not use the notepad command "Find and replace, all" to replace all incorrect decimal separator with the correct type.

Can't stop commands

If you are unable to stop some commands by hitting the ESC-key you might need to check CadTools setting for Cancel String.