

TerrainCAD for AutoCAD

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Introduction

TerrainCAD for AutoCAD is a terrain modeling plug-in for AutoCAD. This plug-in gives AutoCAD the ability to generate a terrain mesh from a set of unordered points, contours and polylines. The terrain mesh is created as a [Delaunay Triangulation](#), which is regarded as the best method to create a terrain mesh from unorganized point data. *TerrainCAD for AutoCAD* can also import a set of points from a text file containing point coordinate data.

TerrainCAD for AutoCAD can solidify a terrain mesh by giving it thickness. It also has a command to calculate the mass properties of a mesh such as volume and surface area.

TerrainCAD for AutoCAD is powered by [TerrainLib](#), a state of the art terrain mesh generation, editing and modeling library developed by [SYCODE](#). TerrainLib employs blazing fast algorithms and cutting-edge technology to yield superior terrain models in very less time.

TerrainCAD for AutoCAD is designed to work with the following versions of AutoCAD:

- AutoCAD 2011 (32 & 64 Bit)
- AutoCAD 2010 (32 & 64 Bit)
- AutoCAD 2009 (32 & 64 Bit)
- AutoCAD 2008 (32 & 64 Bit)
- AutoCAD 2007
- AutoCAD 2006
- AutoCAD 2005
- AutoCAD 2004
- AutoCAD 2002
- AutoCAD 2000i
- AutoCAD 2000

TerrainCAD for AutoCAD is very easy to use. Once installed, it must be loaded into the AutoCAD environment. There are simple instructions for this in the [ReadMe](#) file. Once loaded it adds new commands to AutoCAD's existing commands and a new submenu called "TerrainCAD" to the AutoCAD menu containing these newly added commands.

TerrainCAD for AutoCAD comes with detailed documentation for each command as well as a set of [tutorials](#) to get you started in the shortest possible time.

If you need any additional information please [contact](#) SYCODE.

TerrainCAD for AutoCAD Help

Welcome to *TerrainCAD for AutoCAD* Help!

This help file provides all the information you need to understand and use *TerrainCAD for AutoCAD*. Click the links below or use the Contents tab on the left to browse help topics. You can also scroll the topics on the above right hand pane.

The *TerrainCAD for AutoCAD* help file is divided into the following sections:

- [Introduction](#) - Introduction to *TerrainCAD for AutoCAD*.
- [Command Reference](#) - Quick reference of all the commands added by *TerrainCAD for AutoCAD*.
- [Tutorials](#) - Tutorials to get you started in the shortest possible time.

If you need any additional information please [contact](#) SYCODE.

Note:

- If you are having trouble loading the *TerrainCAD for AutoCAD* plug-in file into the AutoCAD environment please refer to the [ReadMe](#) file.
- Please read the [License Agreement](#) before using the software.
- Please check out [TerrainCAD](#), our terrain mesh generation, editing and modeling software. TerrainCAD is a standalone product and does not need AutoCAD or any other software.

This is the *TerrainCAD for AutoCAD* ReadMe file.

Thank you for installing TerrainCAD for AutoCAD.

Please read this ReadMe document carefully and completely. It contains important information which is vital to the proper working of TerrainCAD for AutoCAD.

Since TerrainCAD for AutoCAD is a plug-in for AutoCAD, it has to be loaded into the AutoCAD environment before it can be used. Loading is a one time process. TerrainCAD for AutoCAD will automatically load itself into AutoCAD the next time you run AutoCAD.

The TerrainCAD for AutoCAD plug-in files are installed into the TerrainCAD for AutoCAD installation folder (typically "C:\Program Files\SYCODE\TerrainCAD for AutoCAD\"). The plug-in files have an extension of ".arx".

The list of plug-in files along with the version of AutoCAD is shown below. Please be sure to use the plug-in file that corresponds to your version of AutoCAD.

TerrainCAD_VC60.arx	-> AutoCAD 2000, 2000i, 2002
TerrainCAD_VC70.arx	-> AutoCAD 2004, 2005, 2006
TerrainCAD_VC80.arx	-> AutoCAD 2007, 2008 (32 Bit), 2009 (32 Bit)
TerrainCAD_VC80x64.arx	-> AutoCAD 2008 (64 Bit), 2009 (64 Bit)
TerrainCAD_VC90.arx	-> AutoCAD 2010 (32 Bit)
TerrainCAD_VC90x64.arx	-> AutoCAD 2010 (64 Bit)
TerrainCAD_VC90.arx	-> AutoCAD 2011 (32 Bit)
TerrainCAD_VC90x64.arx	-> AutoCAD 2011 (64 Bit)

To load TerrainCAD for AutoCAD into AutoCAD please follow the steps listed below:

- (1) Select "Load Application..." from "Tools" menu or enter the "_APPLOAD" command.
- (2) Click the "Contents" button in "Startup Suite"
- (3) Click the "Add" button.
- (4) Browse for the plug-in file for your version of AutoCAD (see list above).
- (5) Click the "Add" button on the Add File to Startup Suite dialog box.
- (6) Click the "Close" button to close the Startup Suite dialog box.
- (7) Click the "Close" button to close the Load/Unload Applications dialog box.

Now TerrainCAD for AutoCAD is completely installed and ready for use.

Usage:

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TerrainCAD for AutoCAD adds new commands to AutoCAD. It also adds a new menu called "TerrainCAD" to the AutoCAD menu containing these newly added commands. The commands added are:

- 1) TCImportPoints - Imports points from a text file.
- 2) TCCreateTerrain - Creates a terrain mesh from a set of unordered points.

TerrainCAD for AutoCAD

- 3) TCSolidifyTerrain - Solidifies a terrain mesh.
 - 4) TCMeshProperties - Display mesh properties.
 - 5) TCMeshMerge - Merge meshes into a single mesh.
 - 6) TCHelp - Displays the TerrainCAD for AutoCAD help file.
 - 7) TCRegister - Registers your copy of TerrainCAD for AutoCAD.
 - 8) TCAbout - Displays the TerrainCAD for AutoCAD about box.
- The TerrainCAD for AutoCAD help file is a good place to start.

Support:

=====

For support, please E-Mail support@sycode.com

TerrainLib

TerrainLib is a state of the art terrain mesh generation, editing and modeling library developed by [SYCODE](#). This library gives *TerrainCAD for AutoCAD* its terrain modeling capabilities.

One of the salient features of TerrainLib is its ability to create a terrain mesh from a set of unordered survey points. The mesh is created as a [Delaunay Triangulation](#). TerrainLib employs blazing fast algorithms and cutting-edge technology to yield superior terrain models in no time.

For more information on TerrainLib, please [contact](#) SYCODE.

Delaunay Triangulation

A triangulation is the division of a set of points into a set of triangles, usually with the restriction that each triangle side is entirely shared by two adjacent triangles.

A Delaunay Triangulation of a set of points is a triangulation with the property that every edge is contained in a circle that contains no other points of the set. This implies that the circumcircle, or outcircle, of each triangle contains no other points from the set. The Delaunay Triangulation guarantees that the smallest angle will be maximal which gives well shaped triangles.

Interesting Fact: One would hope that the Delaunay Triangulation would be the result of repeatedly joining the two closest points unless doing so would cross an edge you already have, but sadly that turns out not to be the case. For example, take a kite with its head angle close to 180 degrees and its tail angle quite small. The two closest points are the side points, but the Delaunay Triangulation joins the head to the tail.

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Command Reference

TerrainCAD for AutoCAD adds a new submenu to the AutoCAD menu called 'TerrainCAD'. The TerrainCAD menu consists of the following commands:

TCImportPoints	Import points from a text file
TCCreateTerrain	Create a mesh from a set of unordered points
TCSolidifyTerrain	Solidifies a terrain mesh.
<i>Tools</i>	
TCMeshProperties	Display mesh properties.
TCMeshMerge	Merge meshes into a single mesh.
TCHelp	Displays the <i>TerrainCAD for AutoCAD</i> help file
TCRegister	Registers your copy of <i>TerrainCAD for AutoCAD</i>
TCAbout	Displays the <i>TerrainCAD for AutoCAD</i> about box

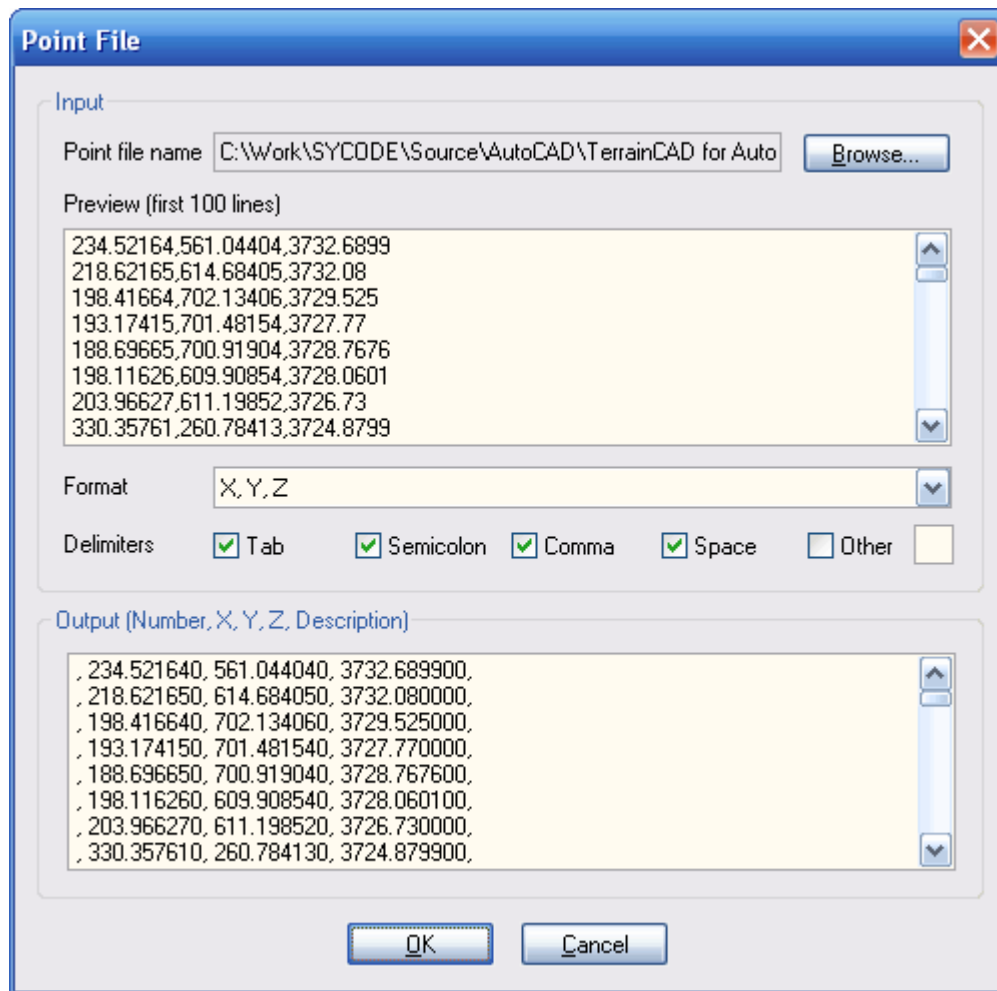
TCImportPoints

Menu Button	TerrainCAD > Import Points
Command	TCImportPoints

This command is used to imports points from a text file. This command invokes the Point File dialog (shown below) which allows you to select the point file to import and set the file format and delimiters.

To **import** **Points**

1. Click *Import Points* from the "TerrainCAD" submenu or type *TCImportPoints* at the AutoCAD command prompt.
2. The "Point File" dialog box is displayed. Browse for the Point file you wish to import. At the "Open" dialog box select the file and click *Open*. Select the format and delimiters in the "Point File" dialog box and click *OK*.



Explanation

Format

Each line of the text file is assumed to contain data related to a single point. The point data must contain the X, Y and Z coordinates of the point and may contain a point number and point description. The point number (if it exists) must be present before and coordinate data and the point description (if it exists) must be present after the coordinate data. The point coordinates can be in the X, Y, Z format or the Northing, Easting, Elevation (Y, X, Z) format. The general format can be described as:

[Point Number] [Point Coordinates] [Point Description]

Delimiters

The most commonly used delimiters are Tab, Semicolon, Comma and Space. You can specify a custom delimiter as well.

How

it

works

Browse for the text file by clicking the "Browse" button. After selecting the text file the Preview list box will show you the first 100 lines of the text file. Then proceed to select the

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format of the text file by selecting the appropriate value from the Format drop list. Also select/unselect the delimiters. The output list box will show you the points read from the text file based on the current values of format and delimiters. When you are satisfied with the contents of the output list box click the OK button and the points will be imported into AutoCAD.

Note:

- Point numbers and descriptions are not imported.

TCCreateTerrain

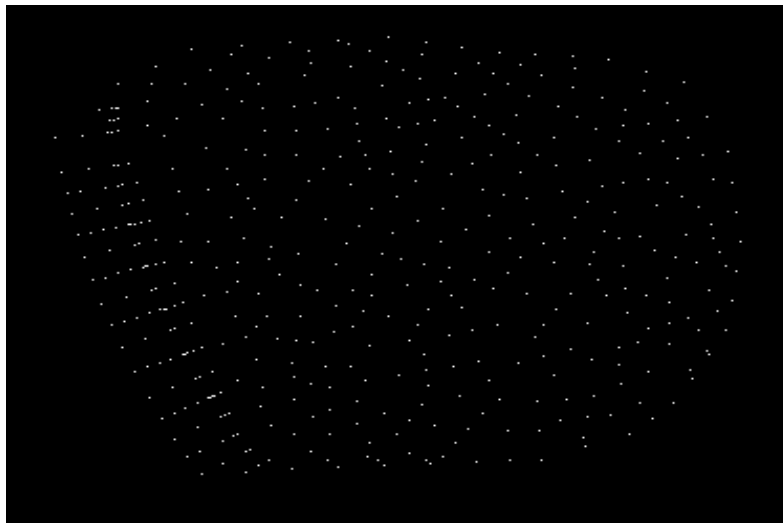
Menu Button	TerrainCAD > Create Terrain
Command Name	TCCreateTerrain

This command creates a terrain mesh from a set of unordered survey points, contours and polylines. The mesh is created as a [Delaunay Triangulation](#).

The mesh topology can be adjusted by using a search radius. The search radius determines whether two points can be part of the same triangular face. If the distance between two points is larger than the search radius then they are not connected by a face. This is particularly useful when creating a mesh from a set of points that has a convex boundary

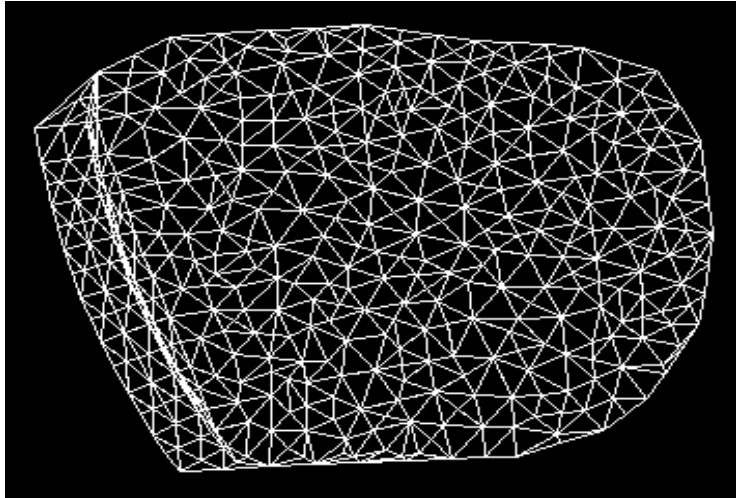
To Create a Terrain

1. Click *Create Terrain* from the "TerrainCAD" submenu or type *TCCreateTerrain* at the AutoCAD command prompt.
2. At the AutoCAD "Select points, lines and polylines" command prompt, select the points and press *Enter*.
3. At the AutoCAD "TerrainCAD Options" command prompt, set the "Search radius" as required and press *Enter*.
4. At the AutoCAD "TerrainCAD Options" command prompt, set the "Respect breaklines" as required and press *Enter*.
5. At the AutoCAD "TerrainCAD Options" command prompt, set the "Respect contours" as required and press *Enter*.

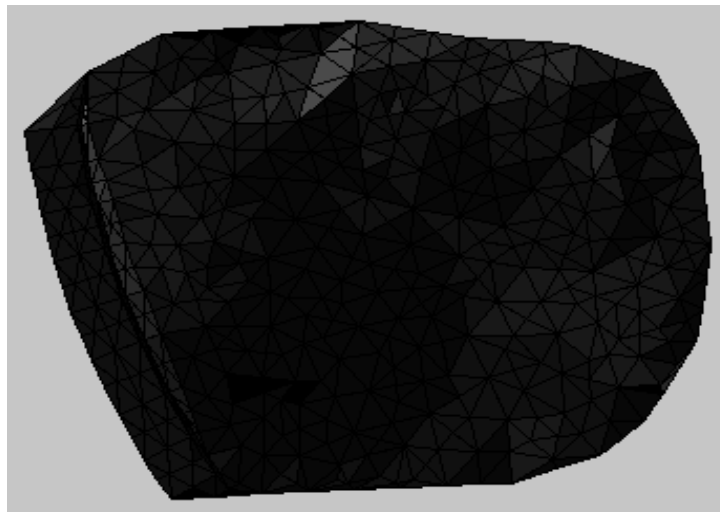


The figure above shows a set of unordered points.

The figure below shows a polyface mesh created from the unordered points that satisfies the [Delaunay Triangulation](#) criteria.



Wireframe view of the terrain mesh



Shaded view of the terrain mesh

Note:

- A search radius of zero will remove the connectivity constraint and all points will be connected however far they may be from each other.
- AutoCAD does not allow a polyface mesh to contain more than 32,000 vertices or faces. Due to this AutoCAD limitation, *TerrainCAD for AutoCAD* will break down polyface meshes containing more than 32,000 into a set of 3D face entities.

TCSolidifyTerrain

Menu Button	TerrainCAD > Solidify Terrain
Command	TCSolidifyTerrain

This command is used create a solid from the terrain mesh by giving it thickness.

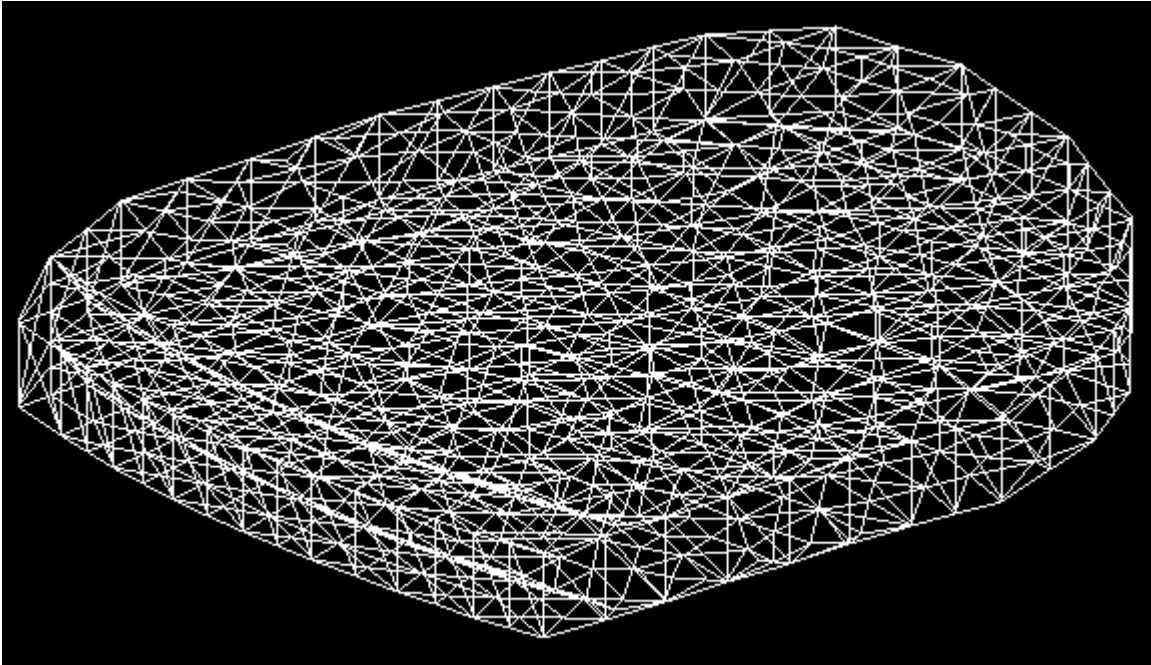
The terrain is an open mesh, which means that it bounded by boundary edges. In order to build a model of the terrain by rapid prototyping or similar processes, it becomes necessary to give the mesh surface a volume.

To solidify a terrain:

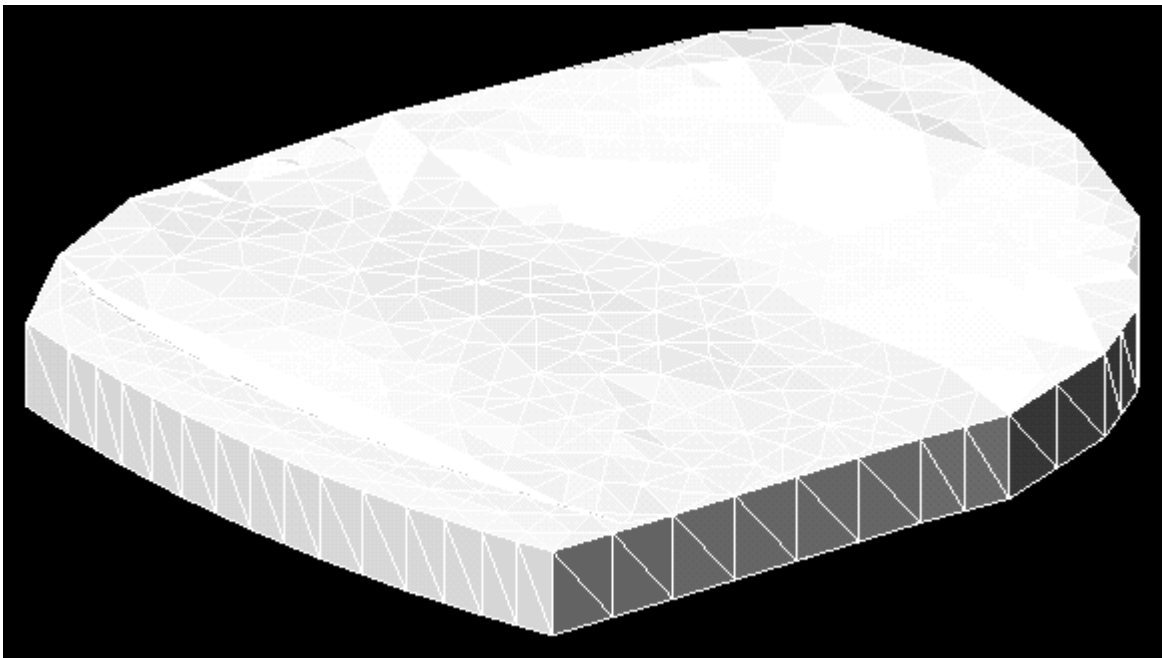
1. Carry out steps 1 to 6 in [Tutorial 1](#).
2. Select *Solidify Terrain* from the "TerrainCAD" submenu or type *TCSolidifyTerrain* at the AutoCAD command prompt and press *Enter*.
3. At the AutoCAD "Select terrain meshes to solidify" command prompt, select all the meshes and press *Enter*.
4. At the AutoCAD "TerrainCAD Options" command prompt set the option as required and press *Enter*.

The mesh is solidified by a specified depth. The bottom of the solidified mesh can be flat or exactly the same as the top surface. When a flat bottom is chosen the depth is measured from the lowest vertex of the original terrain. When a flat bottom is not chosen, the bottom surface is same as the top surface and below it at the distance specified by the depth.

The figure below shows a terrain.



The figure below shows the above terrain solidified to a depth of 70 with a flat bottom.



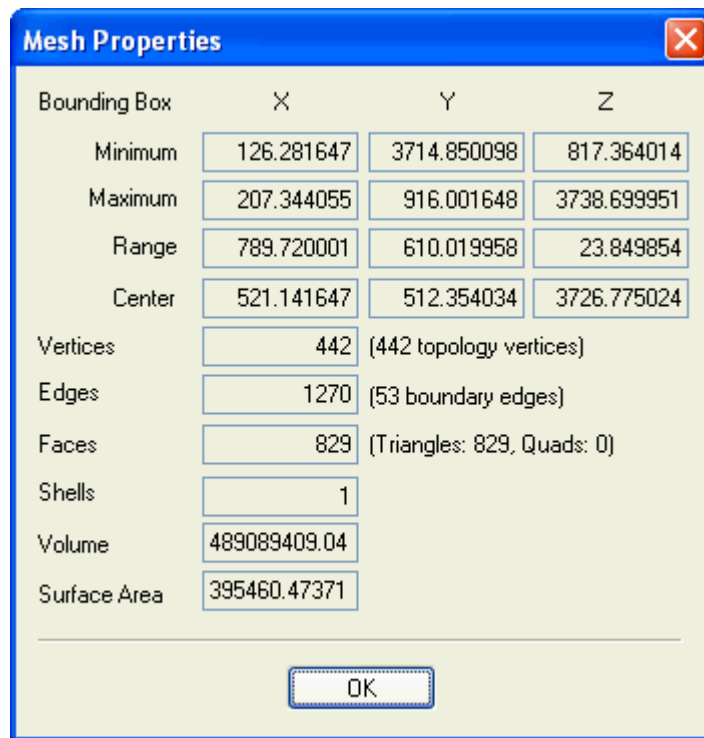
Note: Solidification is usually the last command while editing a terrain. Most of the other commands will not work properly once the terrain is solidified. This is because almost all commands assume that the terrain is an open mesh.

Tools

TCMeshProperties

Menu Button	TerrainCAD > Tools > Mesh Properties
Command	TCMeshProperties

This command displays the Mesh Properties dialog box.

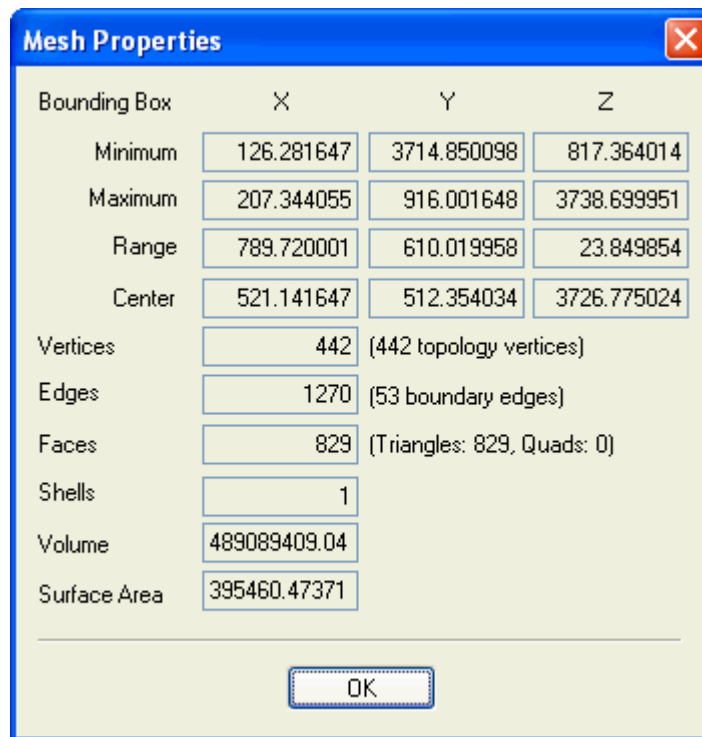


TCMeshProperties

Menu Button
Command

TerrainCAD > Tools > Mesh Properties
TCMeshProperties

This command displays the Mesh Properties dialog box.



TCMeshMerge

Menu Button	TerrainCAD > Tools > Mesh Merge
Command	TCMeshMerge

This command is used to merge more than one mesh into a single mesh.

To merge into a single Mesh

1. Select *Mesh Merge* from "TerrainCAD----->Tools" submenu or type MSMeshMerge at the AutoCAD command prompt and press Enter.
2. At the "Select meshes" command prompt select the meshes and press Enter. The selected meshes are combined into a single mesh

TCHelp

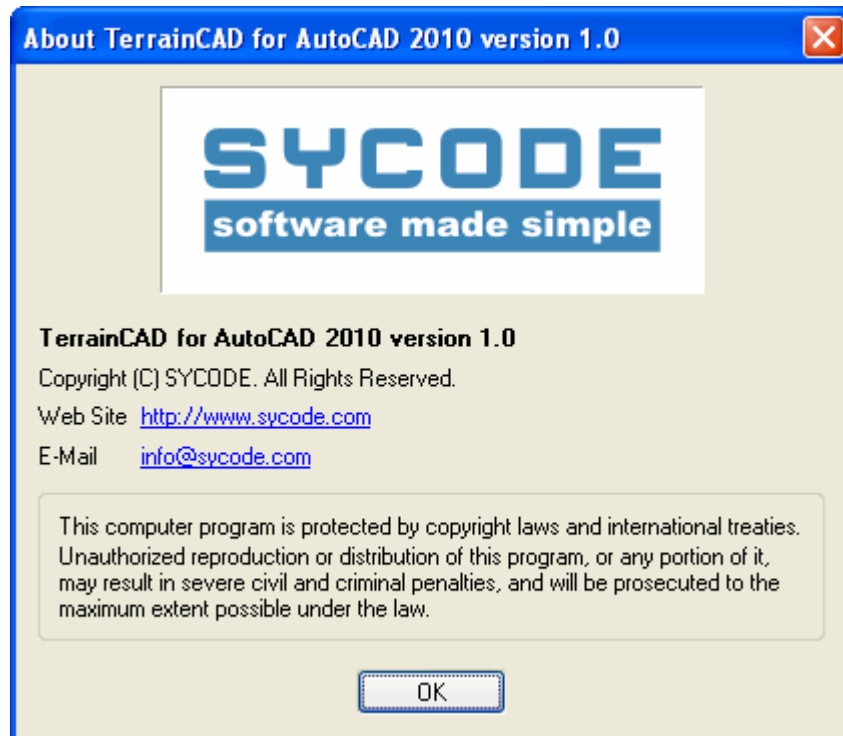
Menu Button	TerrainCAD > Help
Command	TCHelp

This command displays the help file. The [Welcome](#) page is a good place to start.

TCAbout

Menu Button	TerrainCAD > About
Command	TCAbout

This command is used to display the *TerrainCAD for AutoCAD* about box. The about box lists the software and its version.

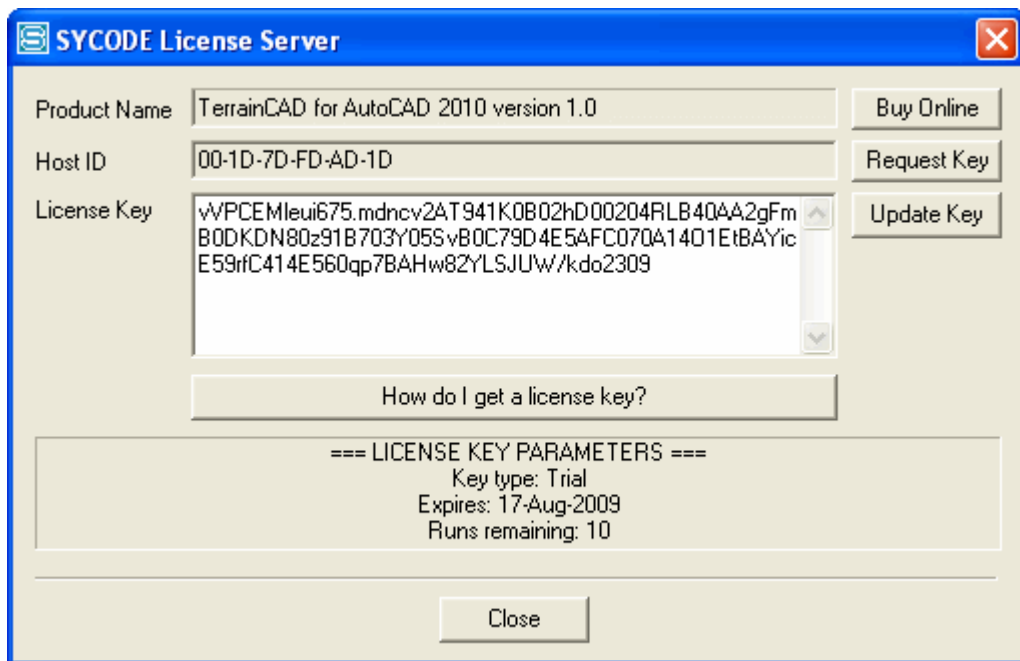


TCRegister

Menu Button	TerrainCAD > Register
Command	TCRegister

This command is used to register your copy of *TerrainCAD for AutoCAD*

You need a license key to start using the software. A license key can be of two types: Trial or Permanent. A trial key is issued to you instantly and completely free of cost so that you may try the software before you purchase a license. A permanent key is issued after you have purchased a license.



How do I get a Trial Key?

Simply click the 'Request Key' button and select 'TRIAL KEY' as the type of key being requested. Fill the form and submit it. A trial key will be immediately sent to you by email.

How do I get a Permanent Key?

To get a permanent key you need to have already purchased a license. If you have not yet purchased a license you can do so by clicking the 'Buy Online' button. After you place your order click the 'Request Key' button and select 'PERMANENT KEY' as the type of key being requested. Fill the form and submit it. Your order will be verified and a permanent key will be sent to you by email within one business day.

IMPORTANT:

- (1) Please ensure that your computer is connected to the internet before you request for a key.
- (2) Please be sure to enter a valid email address as the key will be sent to you by email.
- (3) To avoid disruption in your work-flow we urge you to place your order before the trial period ends.

If you need anything else please send an email to register@sycode.com

Tutorials

Using *TerrainCAD for AutoCAD* is as easy as selecting points. The purpose of these tutorials is to provide the necessary information and hands-on experience to enable you to create meshes using *TerrainCAD for AutoCAD*

The tutorials are designed to get you started with *TerrainCAD for AutoCAD* in the shortest possible time.

- [Tutorial 1](#): Create a terrain mesh from points
- [Tutorial 2](#): Effect of search radius
- [Tutorial 3](#): Create a terrain mesh from contours
- [Tutorial 4](#): Using breaklines

Note:

- The files used in these tutorials can be found in the Samples folder. (Typically C:\Program Files\SYCODE\TerrainCAD for AutoCAD\Samples\)

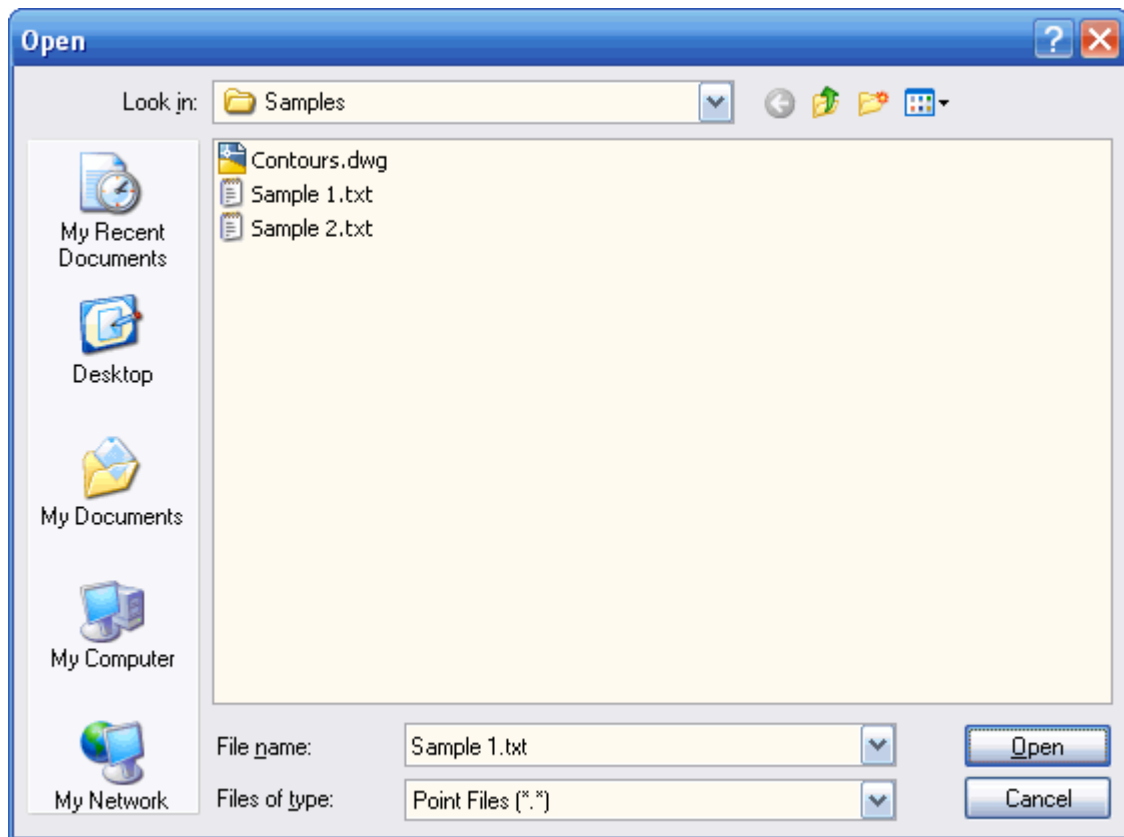
Tutorial 1 - Create a terrain mesh from points

In this tutorial we will learn how to create a terrain mesh from a set of unordered points.

Step 1: Start AutoCAD.

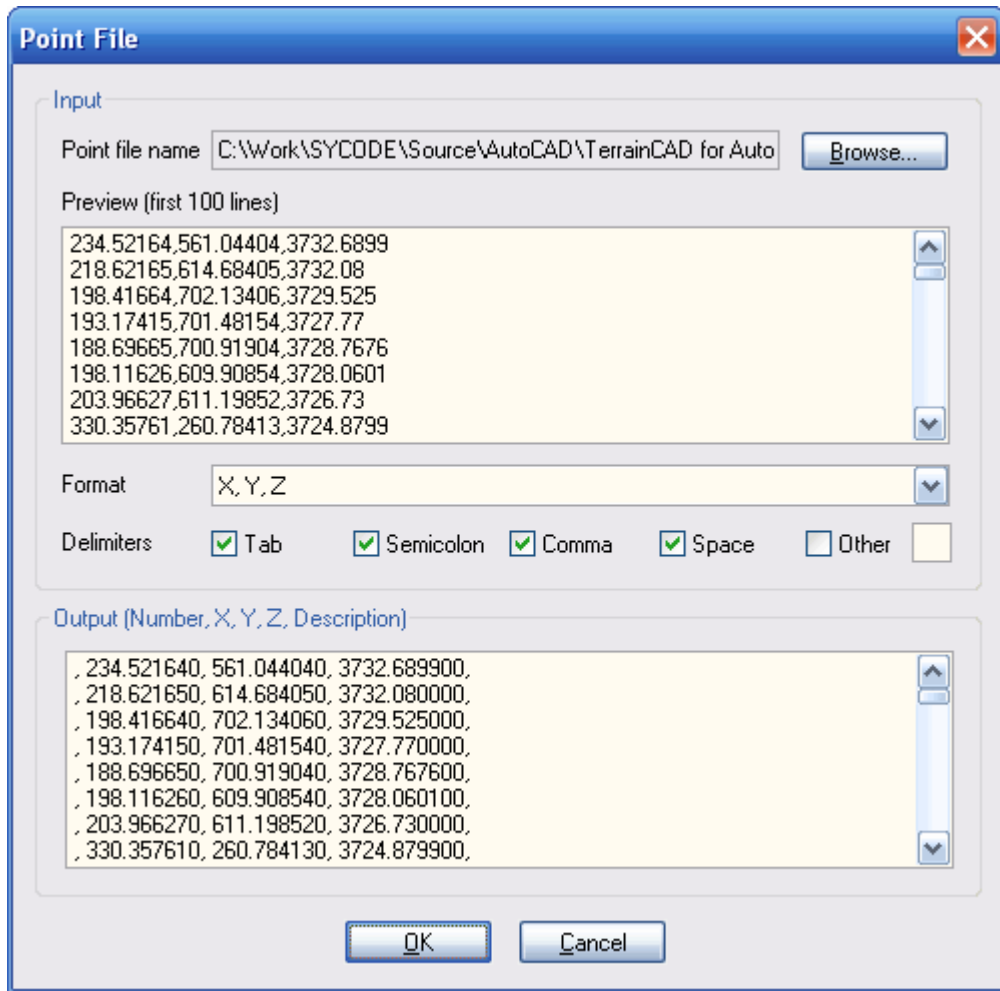
Step 2: Select *Import Points* from the "TerrainCAD" submenu or type *TCImportPoints* at the AutoCAD command prompt and press *Enter*.

Step 3: The "Point File" dialog box is displayed. Browse for the file typically located at "C:\Program Files\SYCODE\TerrainCAD for AutoCAD\Samples\Sample1.txt" and click *Open*.

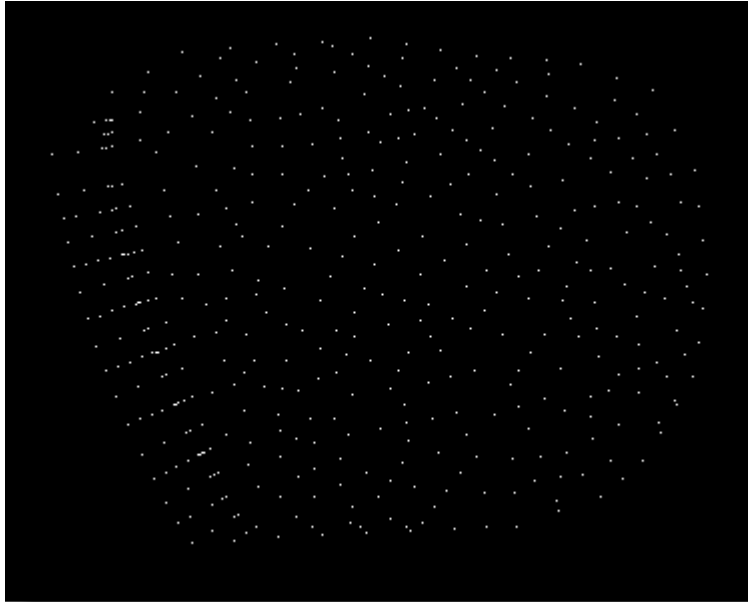


Step 4: Select the format and delimiters in the "Point File" dialog box and click *OK*.

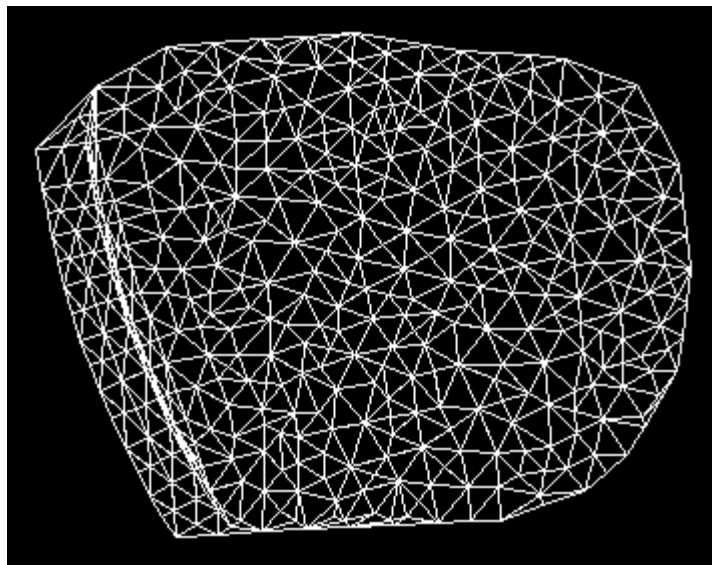
TerrainCAD for AutoCAD

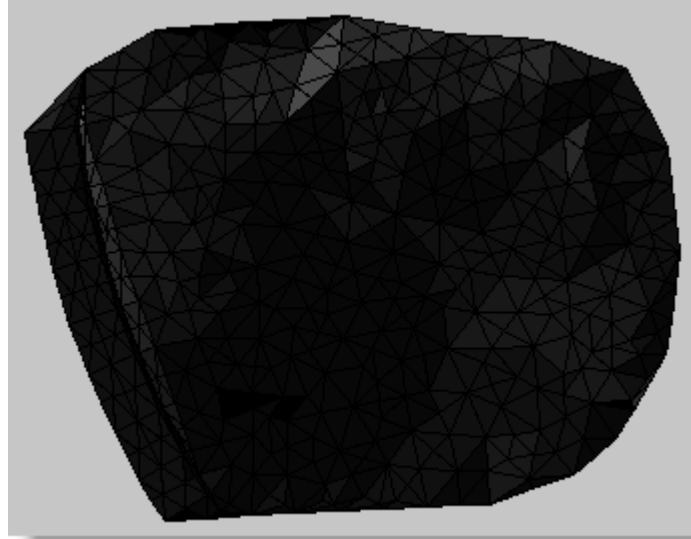


Step 5: Zoom to the extents of the drawing (View->Zoom->Extents). You will find the points from *Sample1.txt* imported into the current drawing.



Step 6: Select *Create Terrain* from the "TerrainCAD" menu or type *TCCreateTerrain* at the AutoCAD command prompt and press *Enter*. At the AutoCAD "select points, contours and breaklines", select all the points and press *Enter*. When prompted for the search radius type *0* press *Enter*. At the AutoCAD command prompt, set the "TerrainCAD Options" as required and press *Enter* when done. A mesh is created as shown below.





Shaded view of the terrain mesh

A terrain mesh is created using the current object creation parameters (color, layer, etc.) and the result of the operation is reported in the command window. In this tutorial we specified a search radius of zero, which means that the search radius should be ignored when creating the terrain mesh. In the next tutorial we shall specify a valid search radius and study its effect on the shape of the terrain mesh.

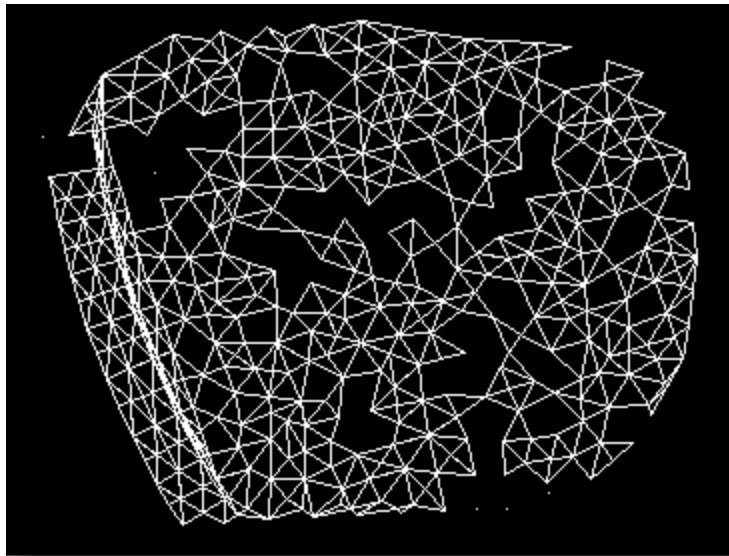
[Tutorial 2 - Effect of search radius](#)

Tutorial 2 - Effect of search radius

In this tutorial we will study the effect of the search radius parameter on the terrain mesh.

Step 1: Delete the terrain mesh created in [Tutorial 1](#). If you are starting from scratch then carry out steps 1 to 5 in Tutorial 1.

Step 2: Select *Create Terrain* from the "TerrainCAD" submenu or type *TCCreateTerrain* at the AutoCAD command prompt and press *Enter*. At the AutoCAD command prompt "select points, lines and polylines" select all the points and press *Enter*. Specify a search radius of 50 and press *Enter*. A mesh is created as shown below.



Terrain mesh with holes

You will find that the terrain mesh created has holes in it and is incomplete (see figure above). This is because the search radius we specified is not large enough.

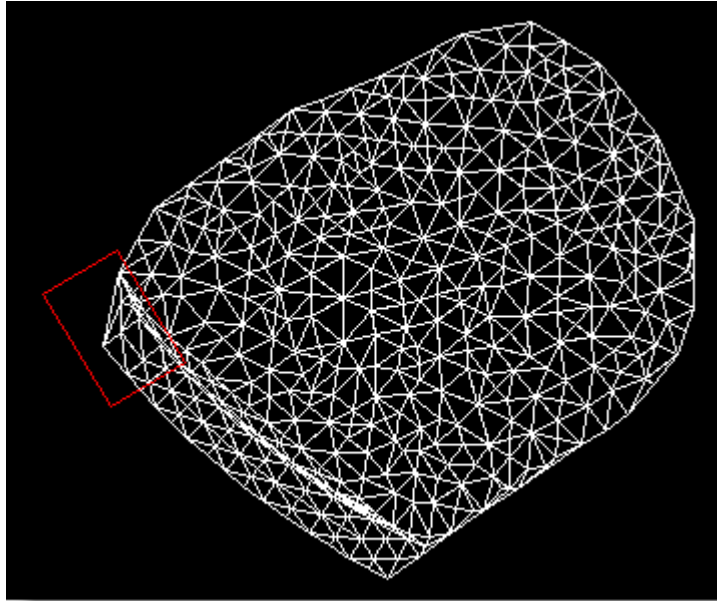
Step 3: Use AutoCAD's *Undo* command to undo the creation of the terrain mesh. Carry out the 2 step again and this time set the search radius to 70. The terrain mesh created this time does not have holes.

This brings about an interesting question. Why don't we always set the search radius to a very large value (say 99999999) or zero (which is equivalent to a very large number since the search radius parameter is ignored for a value equal to zero)? The answer is we can't always do that because this may result in a terrain mesh which contains unwanted triangular faces. In fact the search radius parameter prevents the generation of these unwanted faces. Lets see what unwanted faces are by an example.

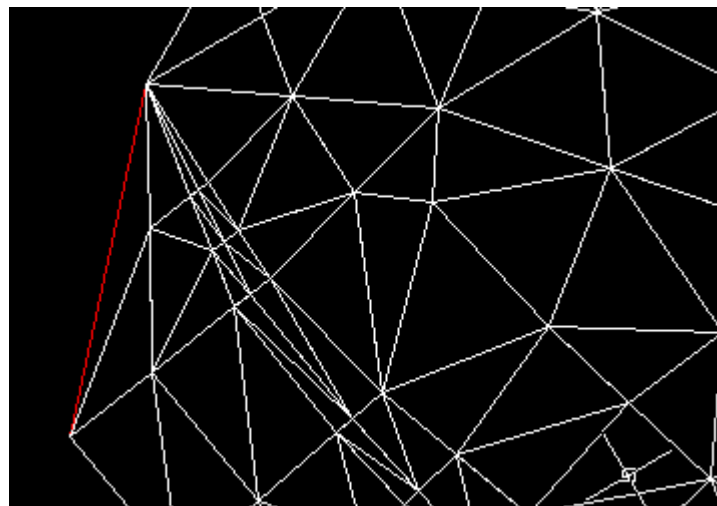
Step 4: Delete the terrain mesh and create it again by following the above steps using the TerrainCAD command with a search radius of zero. A terrain mesh will be created containing

TerrainCAD for AutoCAD

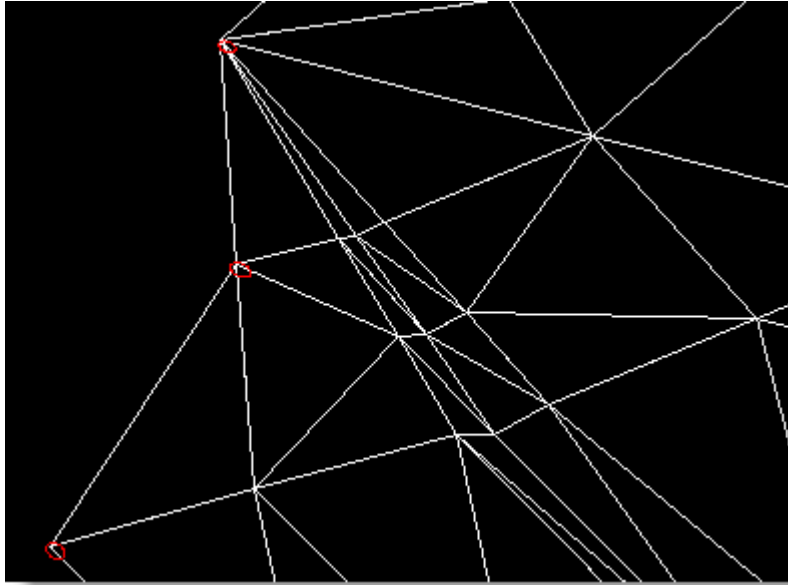
829 faces (see message in the command window) as shown below. Zoom into the area marked in red.



The boundary points (highlighted in red) are joined by unwanted needle shaped triangular faces. This happens because the boundary points in this point set do not describe a convex polygon. As a result the meshing algorithm treats all points as possible mesh edges and creates faces where it can.



Now delete the terrain mesh and create it again using a search radius of 70. This time the terrain mesh contains 828 triangular faces (1 face lesser). The unwanted needle shaped triangular faces are no longer present in the terrain mesh (see figure below).



An intelligent use of the search radius parameter can yield accurate terrain meshes.

[Tutorial 3 - Create mesh from contours](#)

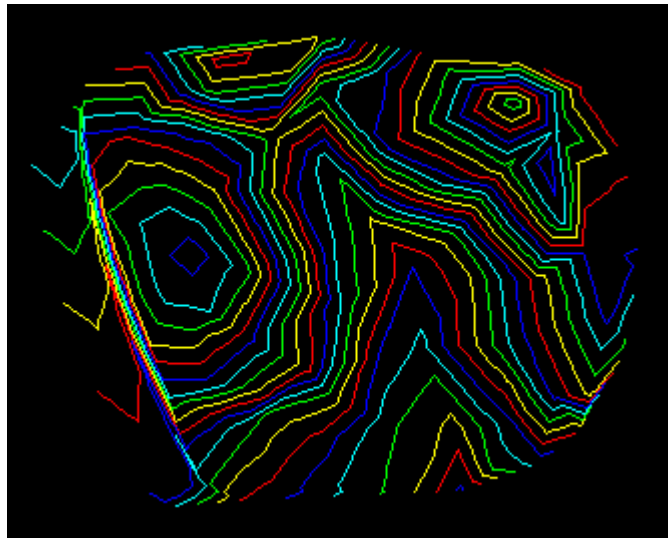
Tutorial 3 - Create a terrain mesh from contours

In this tutorial we will learn how to create a terrain mesh from contours.

Step 1: Start AutoCAD

Step 2: Select "Open" from the AutoCAD file menu. Browse for the file typically located at "C:\Program Files\SYCODE\TerrainCAD for AutoCAD\Samples\Contours.dwg" and click *Open*.

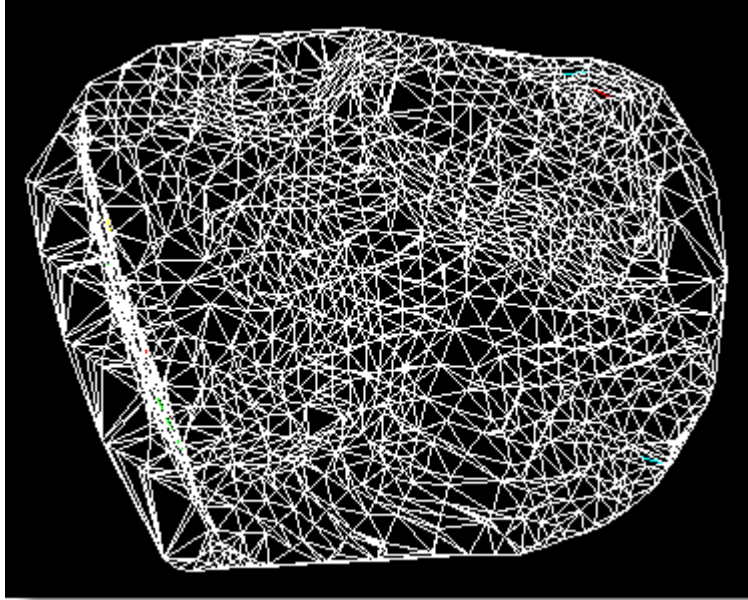
Step 3: Zoom to the extents of the drawing (View->Zoom->Extents). You will find the contours from Contours.dwg imported into the new drawing.



The above fig. shows contours imported into the new drawing.

Step 4: Select *Create Terrain* from the "TerrainCAD" submenu or type *TCCreateTerrain* at the AutoCAD command prompt and press *Enter*.

Step 5: At the AutoCAD "select points, lines and polylines, command prompt, select all the contours and press *Enter*. Specify a search radius of 0 and press *Enter*. At the AutoCAD command prompt, set the "TerrainCAD" options as required and press *Enter* when done. A mesh is created as shown below.



Picture of the mesh created. (Wireframe mode)

A terrain mesh is created using the current object creation parameters (color, layer, etc.) and the result of the operation is reported in the command window.

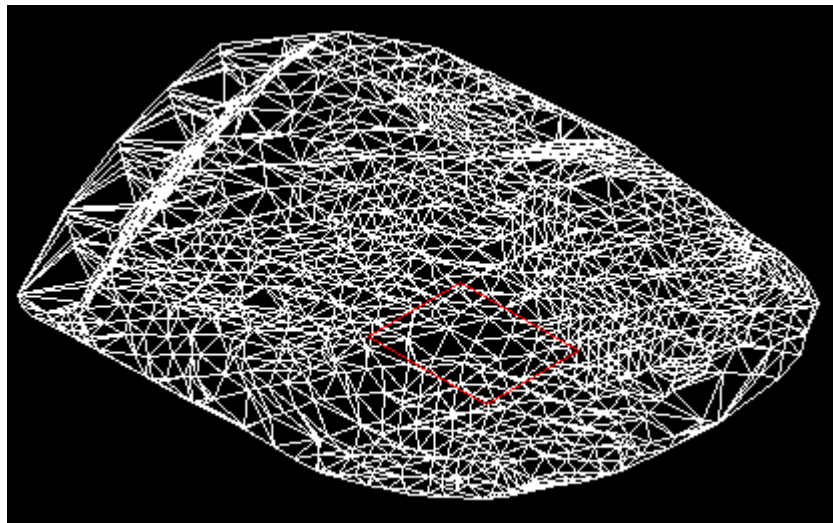
[Tutorial 4 - Using breaklines](#)

Tutorial 4 - Using breaklines

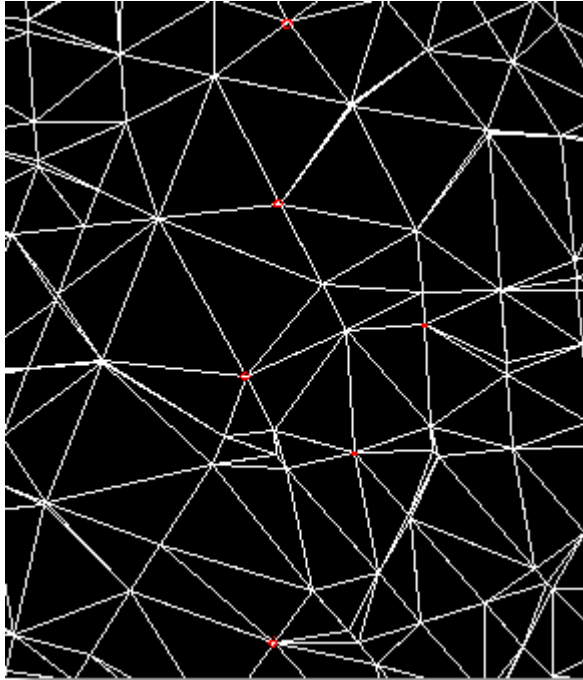
In this tutorial we will see how to improve a terrain mesh by using breaklines.

Step 1: Carry out steps 1 to 5 in [Tutorial 3](#).

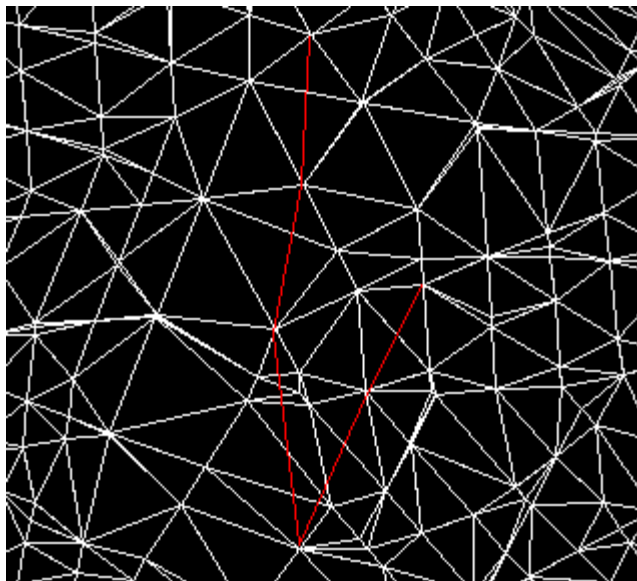
Step 2: Zoom into the rectangular portion of the drawing (highlighted in red).



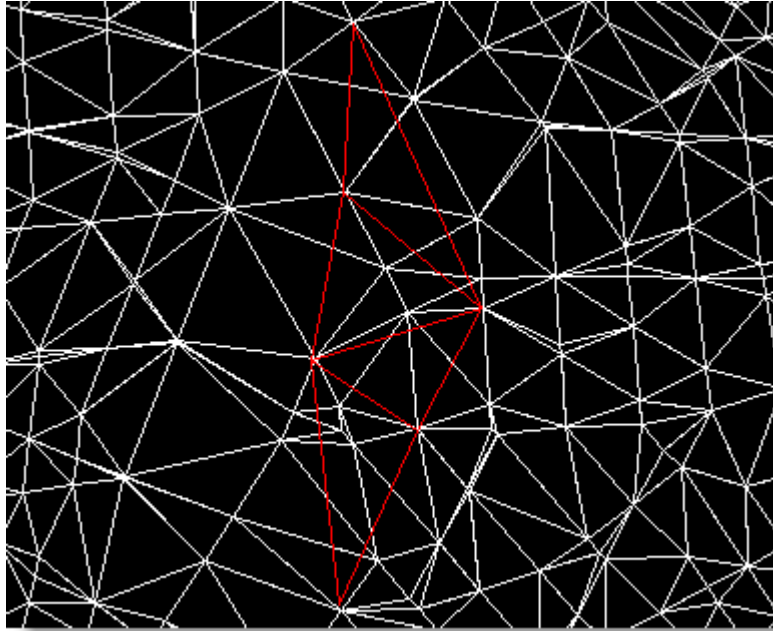
Step 3: Observe the terrain at the vertices highlighted in red in the figure below and the faces in their vicinity. You will find that the terrain mesh would be more accurate if the red vertices were connected by edges since they represent the lower portion of a valley between two hills. However, this is not the case. Here is where breaklines play an important role. We will now add a couple of breaklines joining these red vertices and recreate the terrain mesh.



Step 4: Select the line tool and add the breakline from top to down and than bring it back on top to form a triangle or wherever needed. Click the left button of the mouse or press *Enter* when done. The new breaklines are shown in the figure below.



Step 5: Select *Create Terrain* from the "TerrainCAD" submenu or type *TCCreateTerrain* at the AutoCAD command prompt and press *Enter*. At the AutoCAD "*select points, lines and polylines*" command prompt, select only the breaklines and press *Enter*. Do not select the contours. Set the *Search Radius=0* at the AutoCAD command prompt and press *Enter*. A new terrain is created which respects the new breaklines, as can be seen from the figure below.



This new terrain is more accurate than the previous one since its topology more appropriately describes the actual landscape.