



Carlson Software Triangulate & Contour Basics

At the heart of nearly every land design project is at least one terrain model. These models go by several names and one of the most common is that of a "TIN" or Triangulated Irregular Network; another common name is that of a "DTM" or Digital Terrain Model. Since accurate representations of a surface model are significantly important to most land development projects, having a thorough understanding of the Triangulate & Contour controls is very important.

Introduction

Surface models are generally comprised of combinations of the following general data types:

- **Points** - Most surface models are comprised of points whose coordinates (x,y,z) contribute to the formation of triangular planes that connect three points that are in close proximity to one another. Within Carlson, most points come from the [Draw Field to Finish](#) command and/or the [Draw-Locate Points](#) command. Points can be selectively filtered from the triangulation engine through the use of the [Tag Non-Surface Points](#) command.
- **Breaklines** - Breaklines (or "fault lines") are used to control the connection sequence between four points which results in two triangles. Common uses of breaklines include ravines, ditches, berms and other areas where distinct grade discontinuity occurs. The "leg" of a triangle can travel along a breakline but cannot cross the breakline. Breaklines must be in the form of 3D polylines or simple lines whose vertices or endpoints define a valid "Z" elevation. A common problem related to breaklines is when two breaklines cross one another in 3D space. In these situations, an impasse results and will result in a "[crossing breakline](#)" report. Within Carlson, most breaklines come from the [Draw Field to Finish](#) command and/or the [3D Polyline](#) command. Breaklines fall into one of two general categories:
 - **"Soft" breaklines** - Unless otherwise specified, all breaklines are considered "soft" breakline. The nature of soft breaklines allows a degree of contour smoothing across the breakline itself resulting in a "weathered-" or natural-looking contour.
 - **"Hard" breaklines** - Breaklines tagged as "hard" breaklines prevent contour smoothing through the breakline. Hard breaklines are generally used to represent man-made terrain breaks that commonly occur during excavation and construction. Breaklines can be changed to hard breaklines through the use of the [Tag Hard Breaklines](#) command.

Breaklines and other triangulate-able entities can be selectively filtered from the triangulation engine through the use of the [Tag Non-Surface Entities](#) command.

- **Inclusions** - Inclusions (or "boundaries") are used to identify the entities that can be used for triangulation and multiple inclusion regions can be selected for a given surface model. Entities that fall outside of an inclusion boundary and are not otherwise bound by a different



inclusion boundary are ignored by the triangulation engine. Inclusion regions must be in the form of a closed 2D or 3D polylines. Within Carlson, most inclusion polylines come from the [Shrinkwrap Entities](#) command.

- **Exclusions** - Exclusions (or "void regions") are the antithesis of Inclusions and are used to prevent triangulation from occurring between points that are bound by an Inclusion region. Common uses of exclusion regions include building footprints and free-standing water limits (e.g. ponds). Entities that fall inside an exclusion region are ignored by the triangulation engine. Exclusion regions must be in the form of a closed 2D or 3D polylines. Within Carlson, most exclusion polylines come from the [Boundary Polyline](#) command and/or the [3D Polyline](#) command.

Notes:



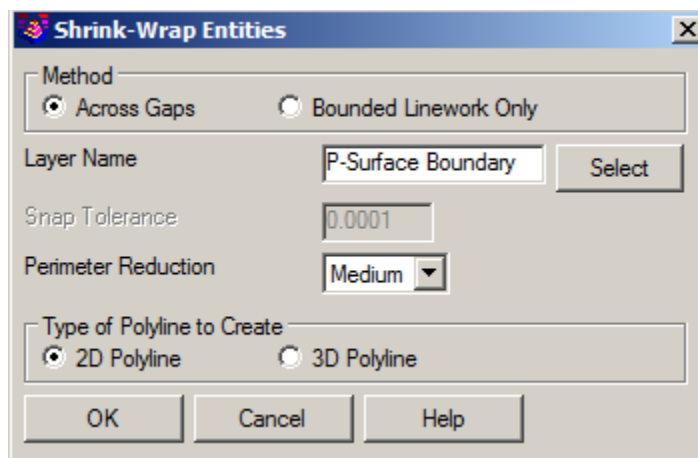
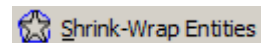
Carlson Surface Modeling in Survey, Civil or Hydrology

Creating a Surface Boundary

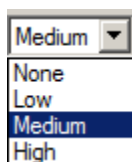
Load Site “DWG” file and we will run through the following exercise.

The steps below are typical recommendations. The first step is to draw a boundary around your site so you don't get any unwanted triangles.

1. Select **Draw/Shrink-Wrap Entities**



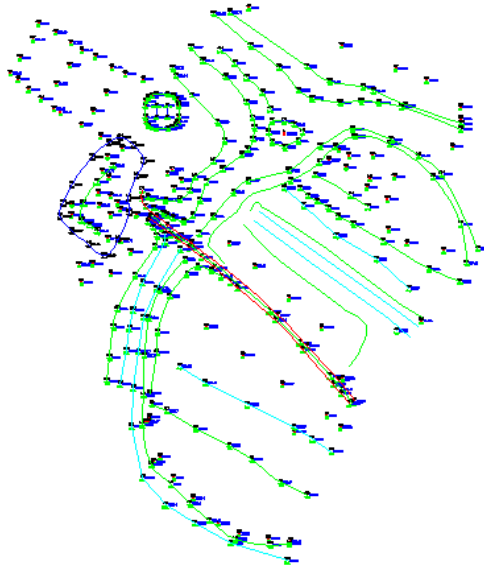
- **Method:** Across Gaps is set for open polylines, the Gap method works better, as it jumps across the gaps and connects the end points.
- **Perimeter Reduction:** You can pick None, Low, Medium or High. **Select Medium.**



- **Type of Polyline to Create:** Select **2D Polyline** so we can adjust it after it's drawn.



BEFORE



AFTER

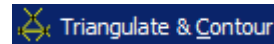
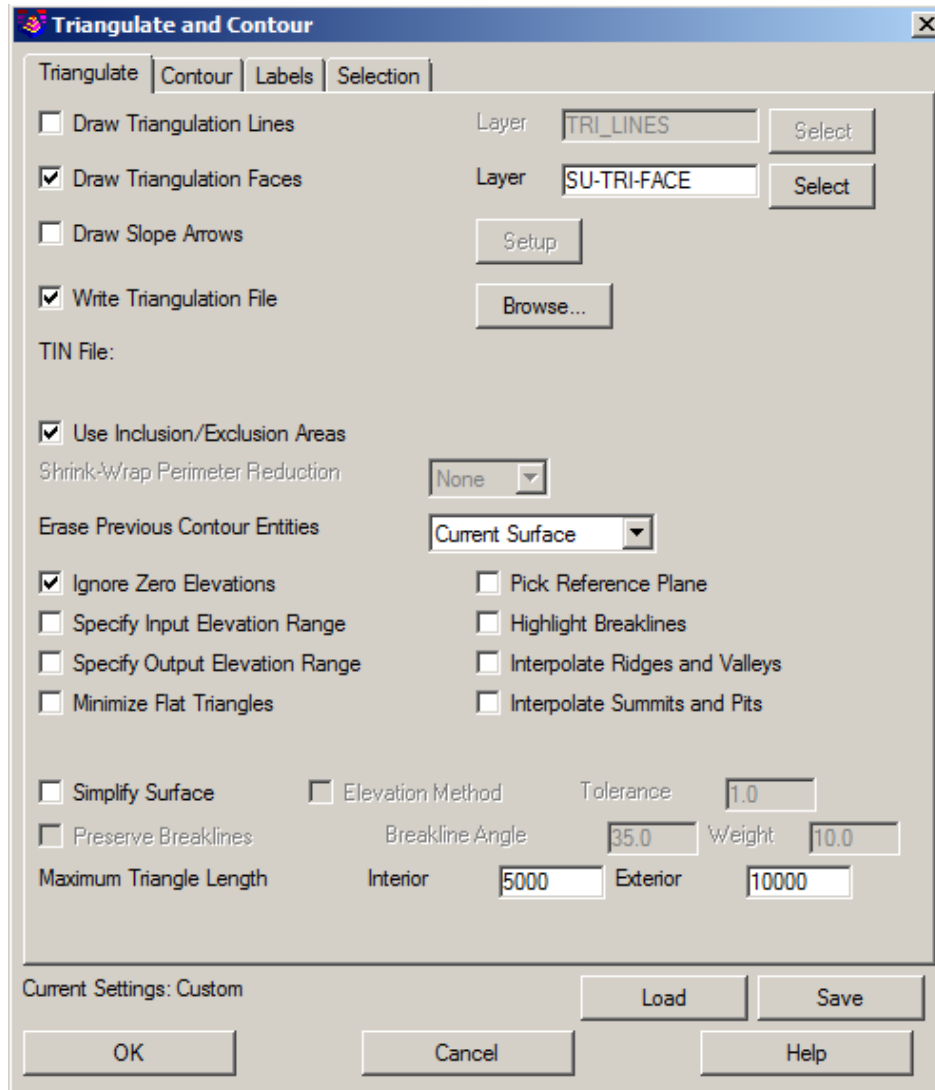


Notes:



Creating New Surfaces

1. Select Surface/Triangulate & Contour

Triangulate and Contour

Triangulate | Contour | Labels | Selection

Draw Triangulation Lines Layer: TRI_LINES Select

Draw Triangulation Faces Layer: SU-TRI-FACE Select

Draw Slope Arrows Setup

Write Triangulation File Browse...

TIN File:

Use Inclusion/Exclusion Areas Shrink-Wrap Perimeter Reduction: None

Erase Previous Contour Entities: Current Surface

Ignore Zero Elevations Pick Reference Plane

Specify Input Elevation Range Highlight Breaklines

Specify Output Elevation Range Interpolate Ridges and Valleys

Minimize Flat Triangles Interpolate Summits and Pits

Simplify Surface Elevation Method Tolerance: 1.0

Preserve Breaklines Breakline Angle: 35.0 Weight: 10.0

Maximum Triangle Length: Interior: 5000 Exterior: 10000

Current Settings: Custom Load Save

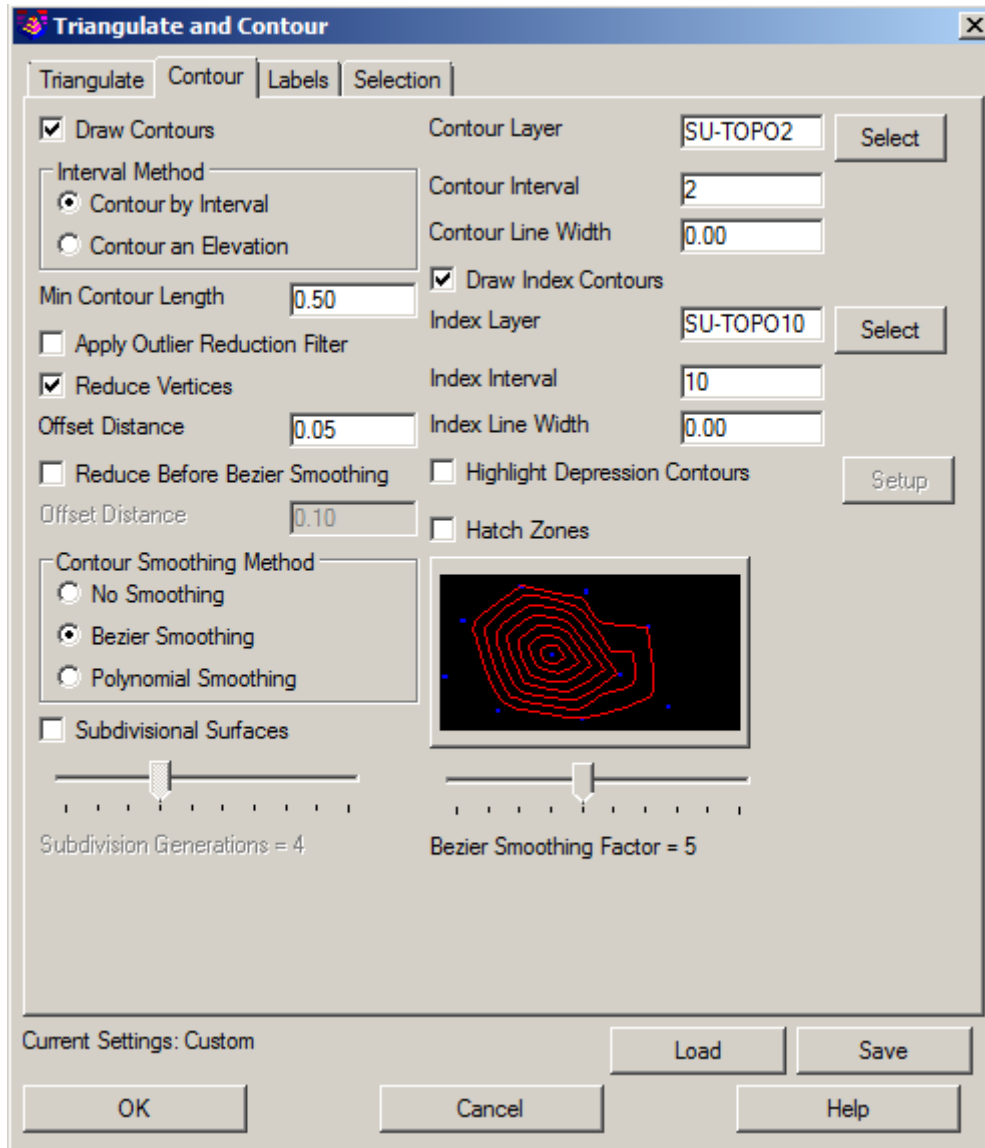
OK Cancel Help

- Check on the **Draw Triangulation Faces** box and **select layer**.
- Check on the **Write Triangulation File** box and type in the **Surface Name**.
- Check on the **Use Inclusion/Exclusion Areas** box.
- **Erase Previous Contour Entities** – Select **Current Surface**
- Check on the **Ignore Zero Elevations** box.

Notes:



2. Select the Contour TAB



- Select the **Proper Layer** for **Survey and Engineering** for **Minor and Index**.
- Select the **Contour Interval** and **Index Interval**.
- Select the **Smoothing Factor** to **5**.

Notes:



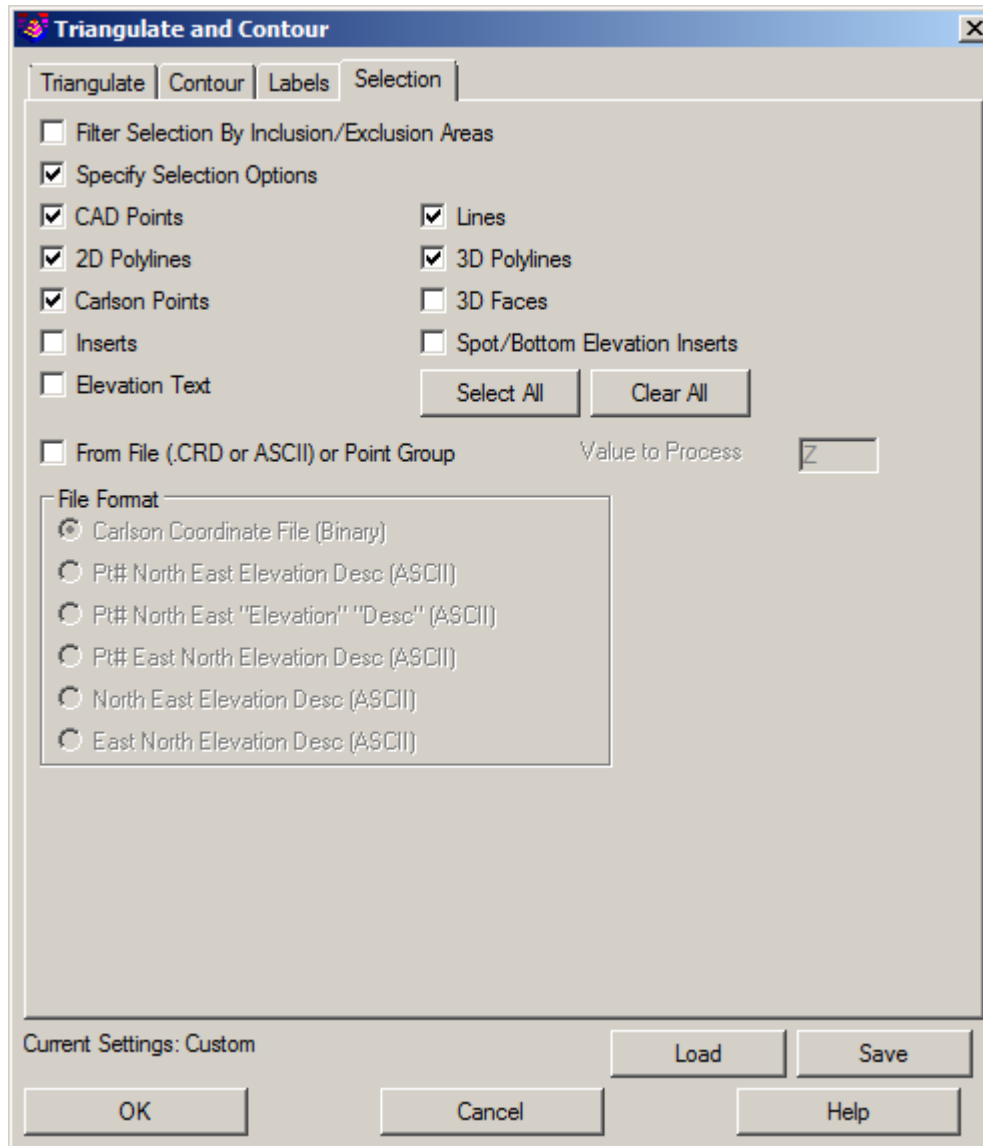
3. Select the Labels TAB

- Change **Label Layer** to **SU-MIN-TEXT** or **P-MIN-TEXT**
- Change **Index Label Layer** to **SU-MAJ-TEXT** or **P-MIN-TEXT**
- Select the **Align Text With Contour** box.
- Select the **Hide Drawing Under Labels** box.
- **Internal Label Intervals: Select One label Per Contour.**

Notes:



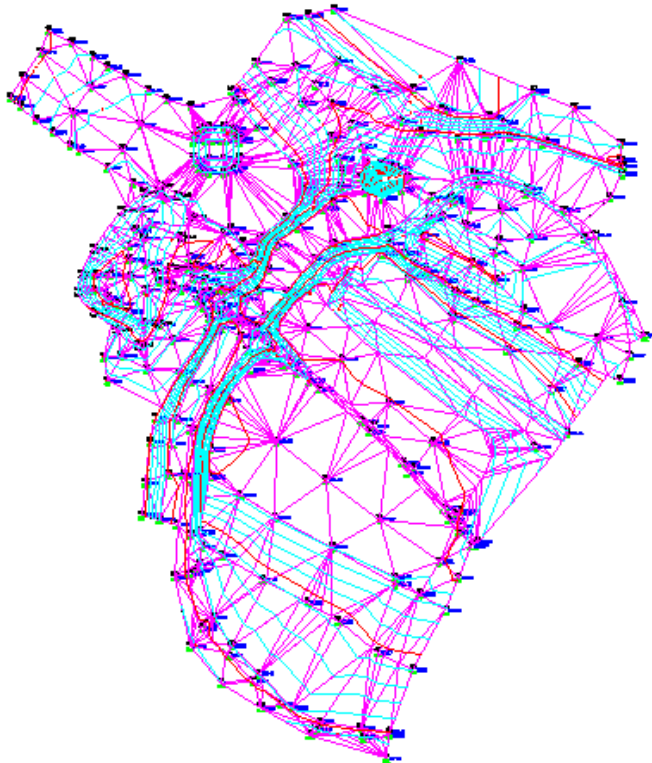
4. Select the Selection TAB



- Select **OK** at the **Bottom** of the **Selection** Tab and follow the command prompts below in CAD.



- **Select the Inclusion perimeter polylines or ENTER for none.**
Select entities: Select the desired closed polylines that form the bounding inclusion area(s) of the surface model and press Enter when complete.
- **Select the Exclusion perimeter polylines or ENTER for none.**
Select entities: Select the desired closed polylines that form the regions(s) of the surface model where triangulation should not occur and press Enter when complete.
- **Select the points and breaklines to Triangulate.**
Select entities: Select the desired entities from CAD using standard CAD selection methods and press Enter when complete.



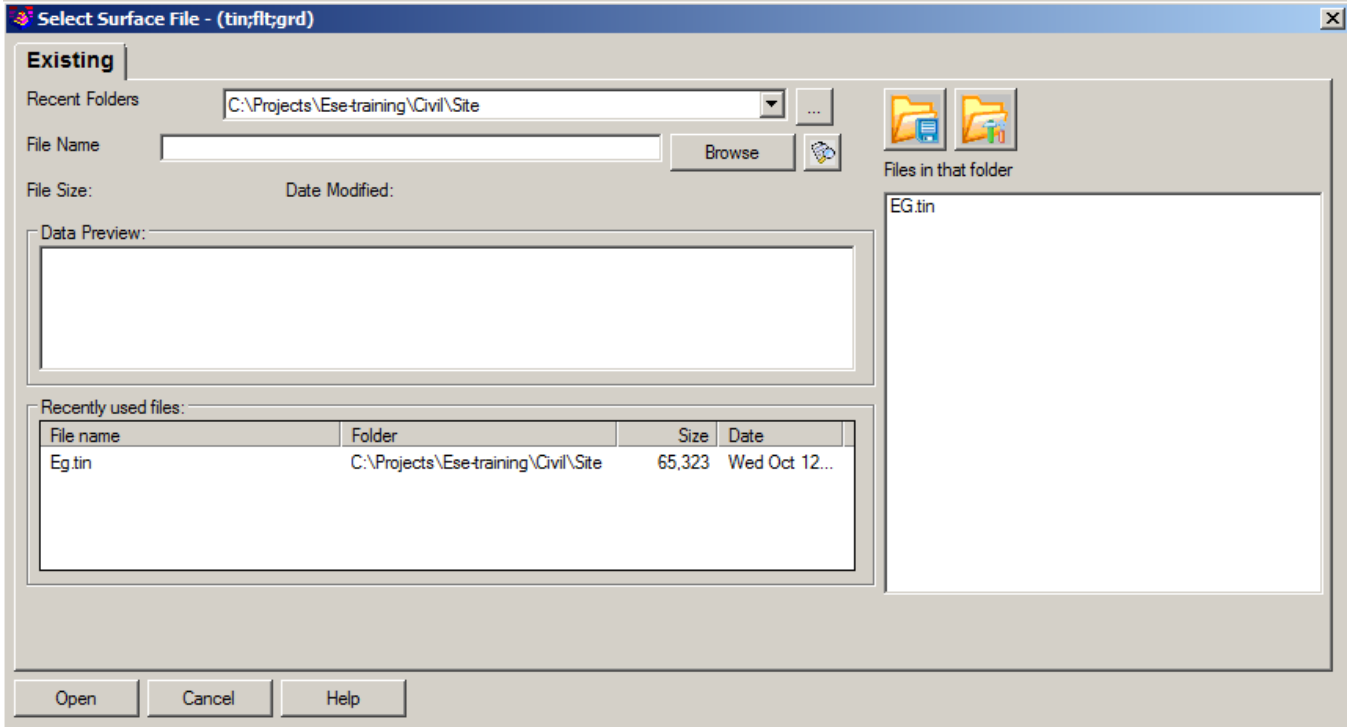
Notes:



Viewing New Surfaces

Select View/Surface 3D Viewer

1. In the box below select your Surface “EG”.



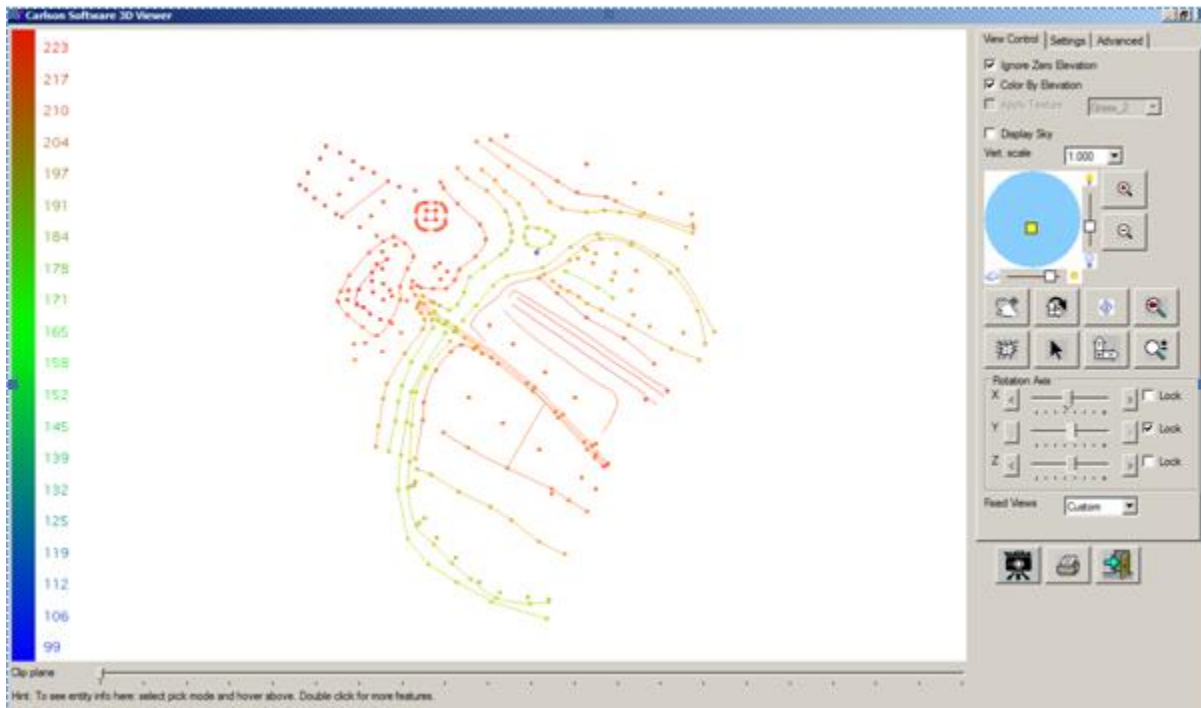
Notes:



Optional - 3D Viewer Window

Select View/3D Viewer Window

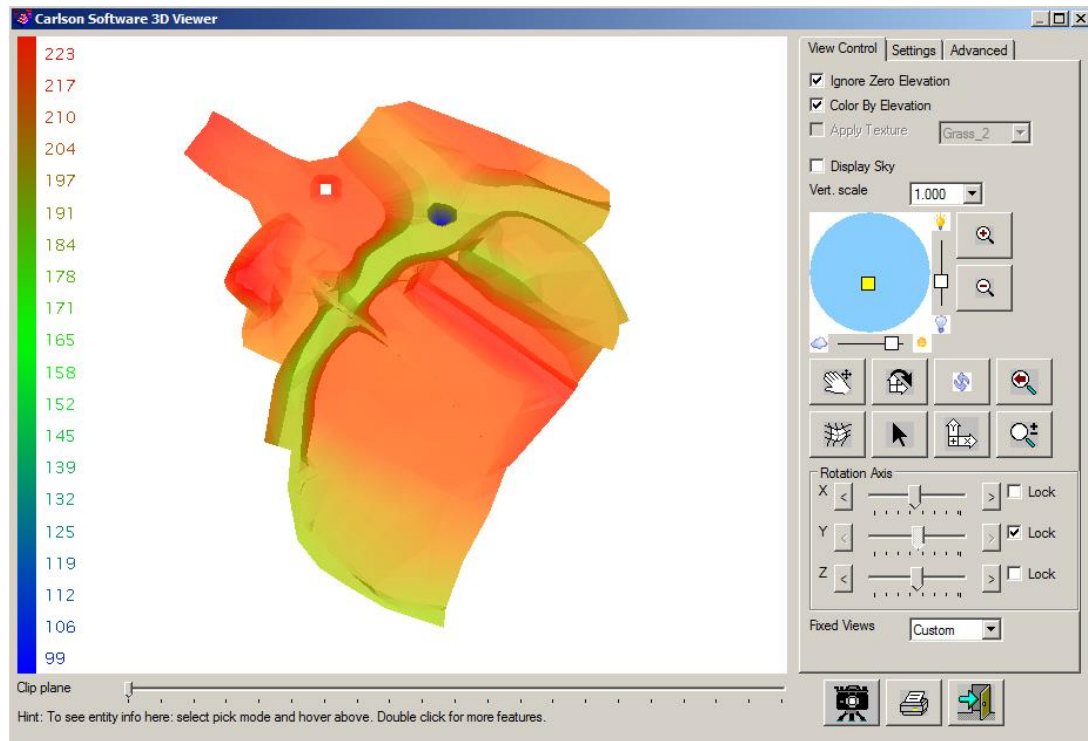
1. This will allow you to select the CAD Graphics and see them in 3D.
2. You can also rotate to the side view and change the vertical scale to see if any points or 3D linework is incorrect.



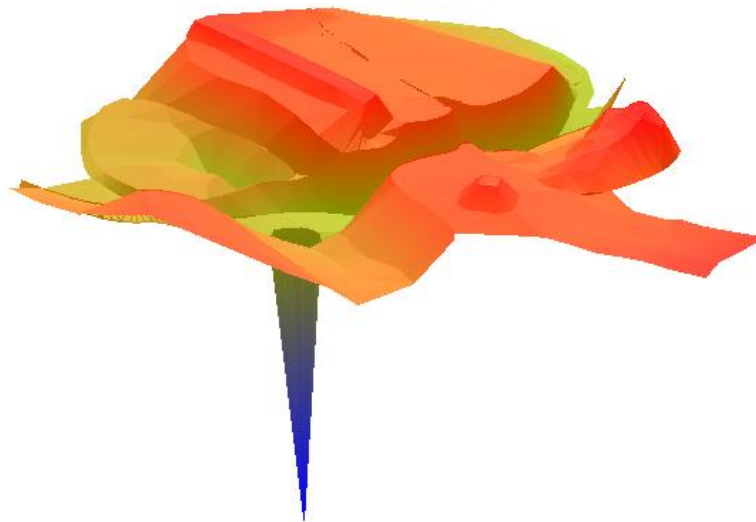
Notes:



Surface 3D Viewer Below



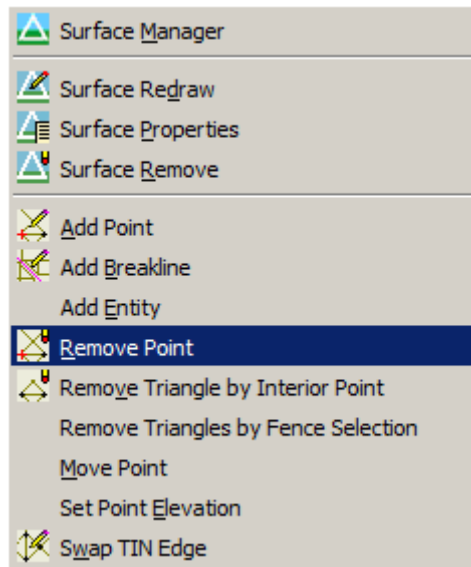
- Check on the **Ignore Zero Elevation** box.
- Check on the **Color By Elevation** box.
- Change the **Vertical Scale to 5**.
- Move your mouse onto the surface and move it up and down. To rotate around move your mouse to the side of the surface.
- You will Notice a spike which we need to fix.





Edit Surface

Select **Surface/Triangulation Surface Manager**



Add Point (AP) adds a triangulation point to the network by picking a point from the screen. The pick must be inside an existing triangle. The elevation for the selected point is interpolated from the surrounding TIN network. This is a good method for adding additional triangulation to the surface in a sparse area. Also, a new elevation can be specified for the picked point. This function does not create Carlson points, and the point will not be saved to the .CRD file.

Add Breakline (AB) adds a breakline to the surface by picking beginning and ending points on the screen. The endpoint snap automatically turns on. Only one breakline can be created at a time. The TIN network will reconfigure to follow the new breakline and update the contours. This does not create 3d polylines in the drawing.

Add Entities (AE) adds a number of points and breaklines into the selection set by selection of existing entities into the current surface.

Remove Point (RP) removes an existing triangulation intersection from the TIN network. The affected triangulation re-adjusts to compensate for the missing intersection. Contours update accordingly.

Move Point (MP) is a combination of removing a point and adding it at a new location.

Swap Edge edges (SW) swaps common TIN edges to create two different triangles from the original triangle configuration. Contours automatically update to reflect changes made to the TIN. Some common edges may not be swapped because of the orientation of the two triangles.

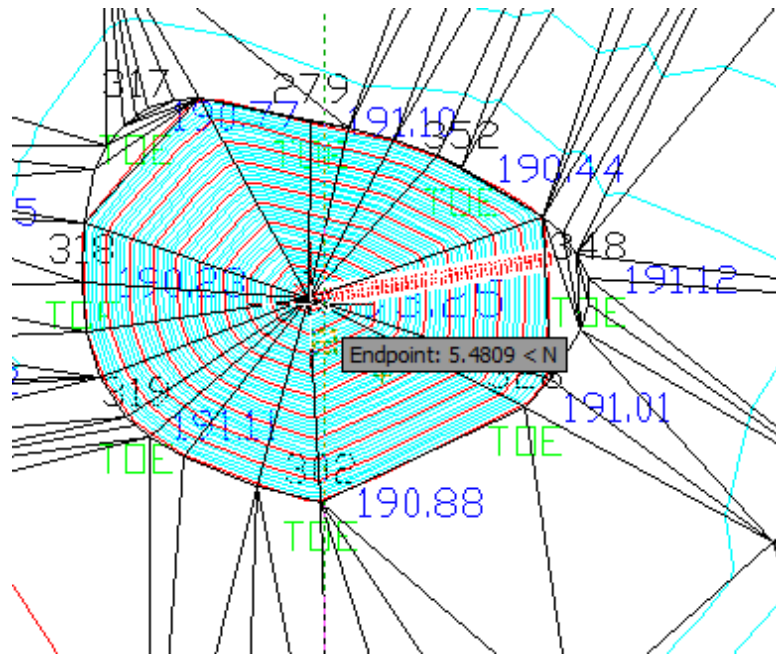
Set Elevation (SP) Sets a new elevation for a specified TIN intersection. The affected TIN is adjusted and the contours are updated.

Remove Tri (RT) removes a TIN line from the surface by picking a TIN line or selecting an interior point. Contours are removed from the affected area.

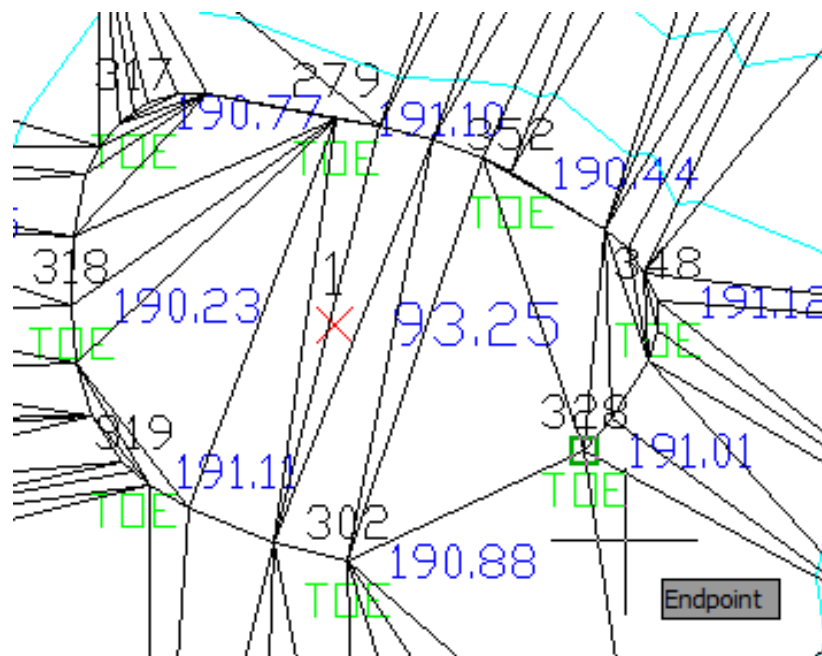


1. Select **Remove Point**

2. In the CAD Command line: **Pick near the point to be removed:**

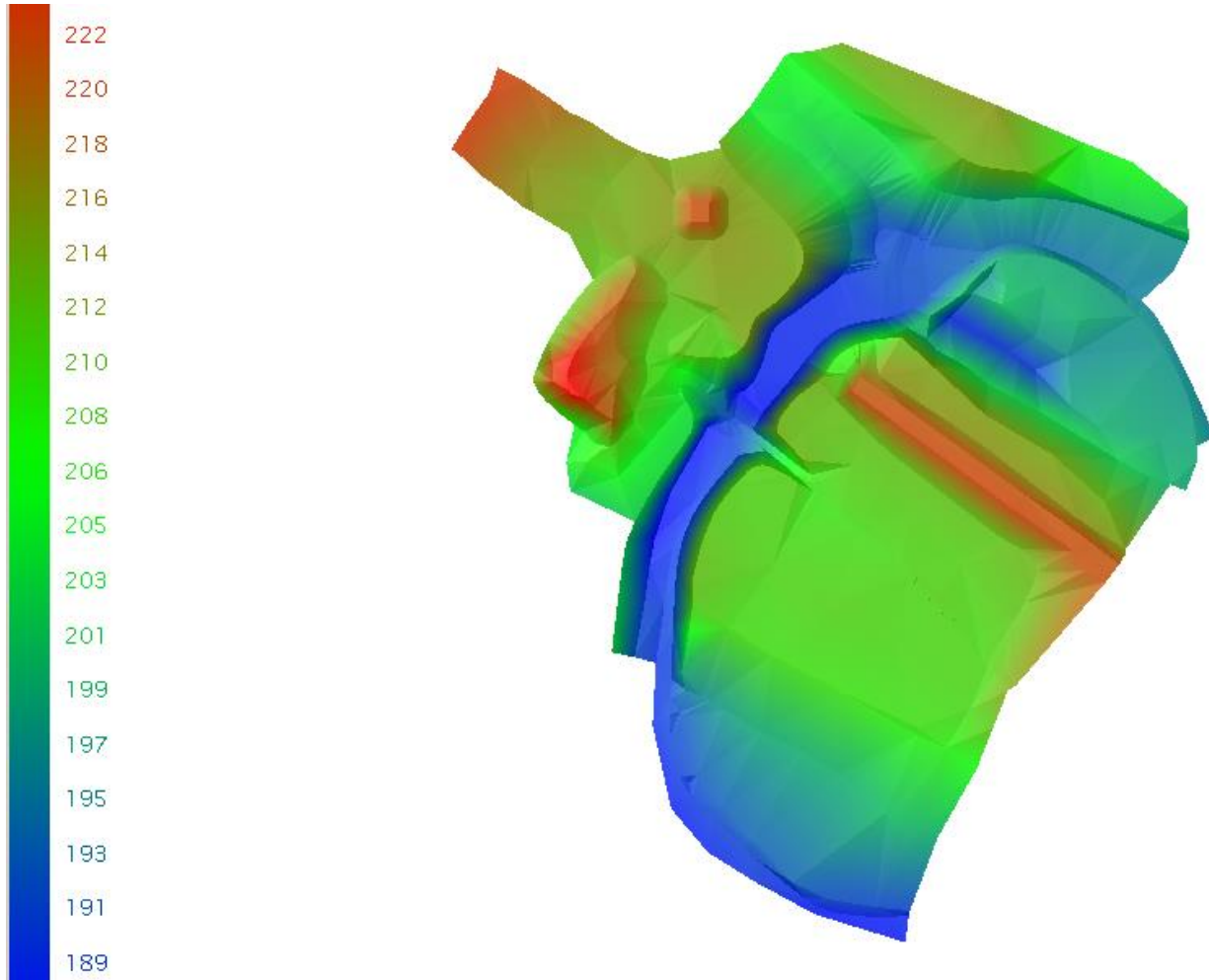


You can see below the Triangles no longer connect to point 1.





Surface has been corrected below.



Notes:
