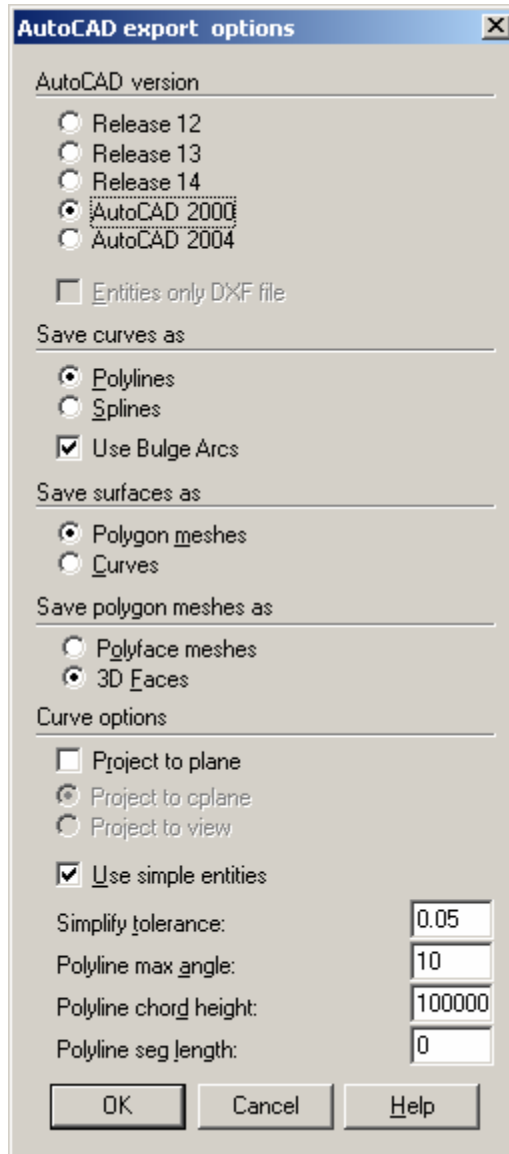


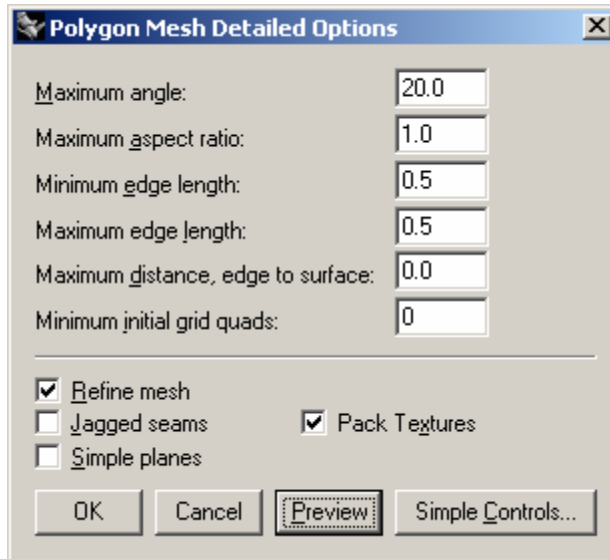
How to Create a Model in Rhino and Import it into *Examine*^{3D}

[Rhino](#) is a NURBS based solid modeling package for Windows that can create 3D shapes and surfaces with no limit on complexity. [Examine](#)^{3D}, developed by Rocscience Inc., is a 3D computer-aided engineering stress analysis package for underground excavations in rock. Rhino can be used to create complicated underground structures through an easy to use interface. The model can then be imported to Examine^{3D}. The process for creating a model in Rhino and importing the surface mesh into Examine^{3D} is outlined as follows:

1. Create the 3D geometry that you desire. This can be done using two general methods:
 - a. Create a 2D curve and then extrude the curve. The commands for the 2D curve are under the “Curve” menu. The extrusion command is: Solid → Extrude Planar Curve.
 - b. Create a 3D shape. The commands for 3D shapes are in the “Solid” menu.
2. You can cut and intersect different solids as you please, but remember to use the proper Boolean commands so that the solids are unified. For example, if you wish to have two cylinders intersecting each other, you would first create the two cylinders as separate solids so that they overlap each other. You then use the Boolean command: “union” to join/unify them into one cross shaped solid. The commands are: Solid → Union → Select the two cylinders → Press “Enter”
3. Once you have the unified solid, you need to clean up the model by removing all the curves that were used in the extrusion. This will leave you with the single solid made up of 3D polygons:
 - a. Edit → Select Objects → Points → Press “delete”
 - b. Edit → Select Objects → Curves → Press “delete”
 - c. Edit → Select Objects → Polylines → Press “delete”
4. Now save the model to an AutoCAD™ DXF file using the command: File → Save → Change “Save as type” from *.3dm to *.dxf. → Type in a filename and press “Save.” An AutoCAD export options dialog should pop up. The following settings are recommended so the model can be imported into Examine^{3D}:



5. Now a Polygon Mesh Options dialog should pop up. Click "Preview" to see how uniform sized the mesh is. Click on "Detailed Controls" to see the advance options. To create a more uniform sized mesh, the following settings are recommended:



As long as the “Minimum edge length” and “Maximum edge length” are the same value with “Maximum aspect ratio” equaling 1, you will create a uniform mesh. Press “Ok” to finish saving the file.

6. Now that the model is saved as a DXF file, use the DxfGeo utility, which comes with Examine^{3D} (located in the Examine^{3D} utilities start menu), to convert the DXF file to a GEO file. Examine^{3D} can then import GEO file.
7. To import the GEO file, open Examine^{3D} and go to Modeler → File → Append menu option and open the GEO file.
8. To check if the mesh imported from Rhino is acceptable for the boundary element stress analysis, you need to run an Object Check. Go to Toolbox → Object Check option and follow the prompts by pressing “Enter”. Please note:
 - a. Pay attention to Overlapping Elements, Intersecting Elements, and Leaky Object notifications
 - b. If any of the above discrepancies occur, you need to return to Rhino to fix your model before proceeding.
9. Now save the model as an Examine^{3D} Analysis File Format (*.ex3). Once this is done, you can calculate the results using Compute^{3D} and interpret the results with Examine^{3D}.

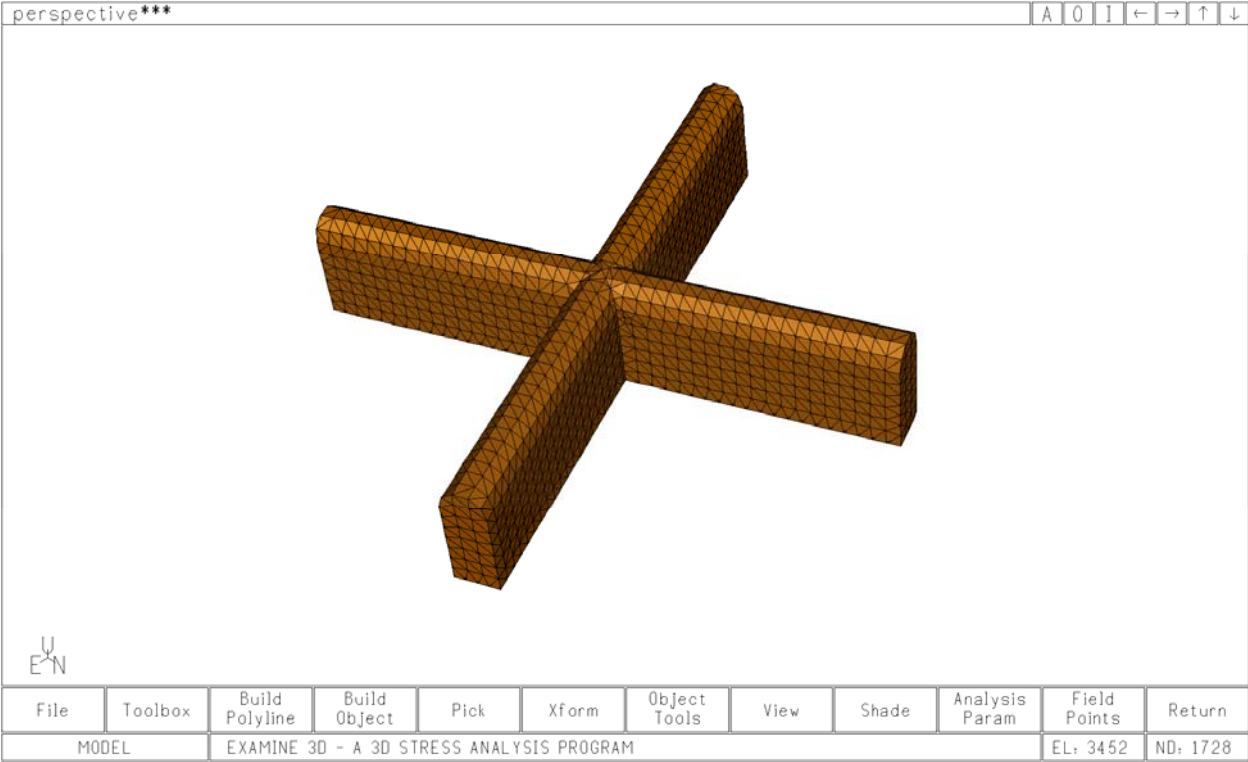
For a free fully functional evaluation copy of Rhino, go to:

<http://www.rhino3d.com/index.htm>

For a free fully functioning evaluation copy of Examine^{3D}, contact Rocscience at:

software@rocscience.com

Example created in Rhino and exported to Examine^{3D}:



Two intersecting horseshoe shaped tunnels