GEM4D Building Map3D-models

1. Problem statement

GEM4D can simplify the building of Map3D-models for many stoping geometries significantly. The resultant triangulations from GEM4D can be directly loaded into Map3D and are mostly 100% error-free, something that is sometimes even difficult to achieve when building the models in Map3D.

For this procedure, some knowledge is required on polygon orientation directions and perspective and parallel camera views. It is important to read "GEM4D Visualisation background knowledge" first; otherwise, some steps would not make sense.

All instruction screenshots were taken with GEM4D Version 1.8.2.6, available from here.

2. Procedure to build Map3D-models in GEM4D

This process aims to take a mine design for an area of the mine and convert all the stopes in a single process for use in Map3D (or other numerical modelling software) as shown in Figure 1. The different colours in Figure 1 (left) indicates the polygon normal orientations of the stope meshes. It is common for mine design software to ignore the polygon normal orientations, and polygons could have random orientations. Map3D expects all polygon normals to point away from stope voids. Map3D also expects all separate stopes to be separate objects, and the vertice density is also of importance.

Figure 1 Original design (left) with different colours indicating the polygon normals, and the final Map3D result (right)

Step 1: Load the mine design

Load the mine design with "***Ribbon => Mesh => Load DXF***", which clears the scene of all previous information, or "***Ribbon => Mesh => Add DXF***", which adds the selected to file to the scene. Alternatively, drag-and-drop the files from Windows Explorer into the scene.

Step 2: Create horizontal clipping strings

Ensure that "***Right panel => Clipping => Orientation***" is set to "***Horizontal***". Determine the vertical level spacing, and select the average stope centre elevation; either by typing the elevation in the "***Right panel => Clipping => Elevation***" textbox, or mouse double-clicking on the midpoint location. Set the level spacing in the "***Right panel => Clipping => Step size***" textbox.

Set the clipping type to "***Right panel => Clipping => Type and widget => Lines***", and add an uneven number in the "***Number***" textbox directly to the right. The number of clippings has to be uneven, as an even number will create clippings above and below the selected elevation by half the step size.

Create a clipping of the visible meshes by clicking the "***Right panel => Clipping => New clipping***" button. Save the clipping strings out as a separate file with "***Ribbon => Mesh => Save DXF-files => Scene meshes***". The colours in Figure 2 indicate different objects, and each stope is thus not currently a different object as required by Map3D.

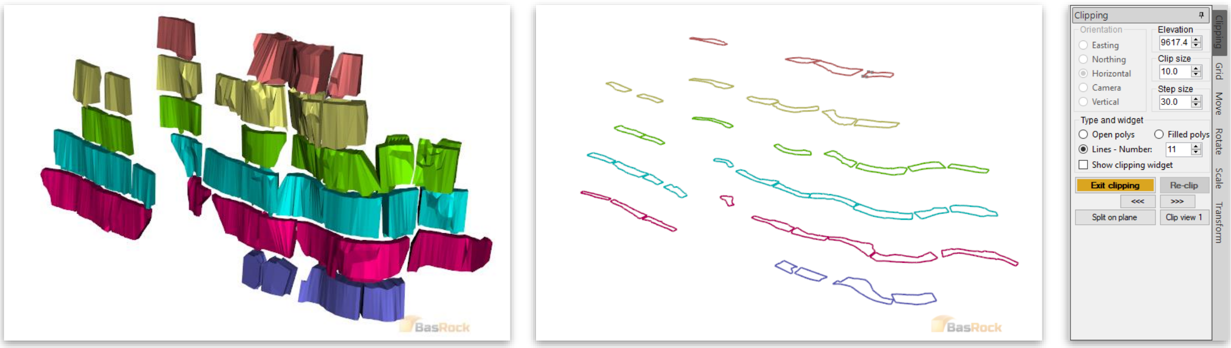

Figure 2 Original meshes (left), lines clipping (middle), and clipping settings (right)

Step 3: Split strings into separate objects

Connected strings can be split into separate objects with "***Top toolbar => Toolbox 2 (blue) => Combine connected triangles/lines***". This method cycles through all the string segments and extracts each connected string as a separate object.

Unload the meshes with "***Left panel => Top listbox => Mouse right-click on the top file name => Remove selected files***". This step is not strictly required, but the process is far easier of the unnecessity files are removed after each step.

Step 4: Create a surface on each object

Creating a surface on each string object sorts out many potential issues; shape corrections, uniform polygon normals, and the automatic removal of internal points.

First, uncheck "***Top toolbar => Toolbox 1 (yellow) => Toggle: Single Delauney object***". When this toggle is checked (the default state), all visible meshes are combined into a single mesh before draping a surface onto the combined vertices. For the current process, a surface has to be draped on each object individually.

Drape a surface vertically down onto each string object with "***Top toolbar => Toolbox 1 => Create a surface (Delauney2D)***". Accept the default tolerance value of "***0.001***" from the pop-up box, and select "***Yes***" from the next pop-up box to drape the surfaces vertically down. Name the file appropriately, and Figure 3 shows the result.

Unload the strings file with "***Left panel => Top listbox => Mouse right-click on the top file name => Remove selected files***" to keep a clean interface.

Figure 3 Drape a surface vertically down onto each string object

Step 5: Extract the surface boundaries

Extract the surface boundaries of the draped surfaces with "***Top toolbar => Toolbox 2 => Extract mesh boundary and edges***", and select "***No***" in the pop-up box to extract the mesh boundaries only, and not the inside edges as well. Name the file appropriately, and unload the file with the draped meshes to keep a clean interface.

Step 6: Equal space the boundary points

The boundary strings contain vertices that are distributed irregularly, see Figure 4 (left). Create vertices along the strings at equal distances with "***Top toolbar => Toolbox 2 => Split lines into fixed lengths***". The segment length has to be set in the pop-up box and a function of the stope geometry. For this example, a value of "***2***" was selected, but a larger value can be used for wider stopes. Select the default value of "***10***" in the next pop-up box to enforce a stiff spline, and the result shown in Figure 4 (right).

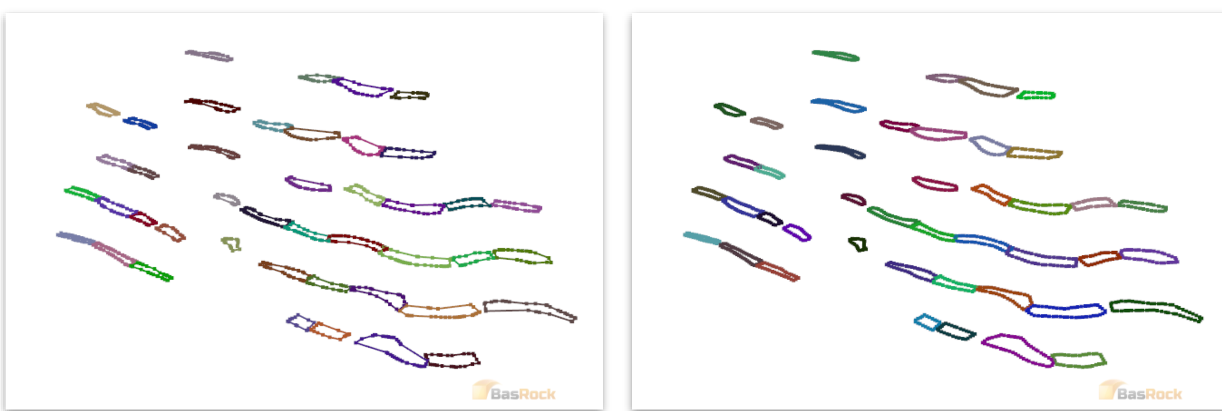

Figure 4 Boundary strings before (left) and after (right) the vertices correction

Name the file appropriately, and unload the file with the surface boundaries to keep a clean interface.

Step 6: Extrude the boundary strings

The next step is to extrude the lines into open meshes. Before this can be done, the extrusion direction has to be determined. If the dip and dip-direction for the extrusion are unknown, use "***Top toolbar => Lines (yellow ruler) => Single measurement***" and pick two points along the perpendicular section. The dip and dip-direction will be displayed in "***Bottom panel => Right textbox***".

Extrude the lines into open meshes with "***Top toolbar => Toolbox 2 (blue) => Extrude lines or mesh surfaces***". In the pop-up box, check "***Define an orientation***" and type the "***Dip***" and "***Dip-direction***" values. Make sure the "***Extrude distance => Distance***" value is the same value that was used for the clipping step distance in Step 2.

It is important to check both "***Center extrusion***" and "***Vertical extrusion***" before pressing the "***Accept***" button. The "***Center extrusion***" option centralises the extrusion, and the "***Vertical extrusion***" option makes the length correction along the selected dip to ensure the stopes from different levels connect up.

Name the file appropriately, and unload the file with the equal space surface boundaries to keep a clean interface.

Step 6: Close the extruded meshes

The stopes are currently open and still need to be closed, see Figure 5. Close the meshes with "***Top toolbar => Toolbox 2 (blue) => Repair holes in mesh objects***". Select an arbitrarily large value for the pop-up box that requests the maximum hole diameter, such as "***500***". If the selected value does not close all holes in the mesh, repeat the process with a larger value.

Figure 5 Extruded meshes before (left) and after (right) they are closed

Name the file appropriately, and unload the file with the open extruded meshes to keep a clean interface.

Step 7: Correct the normals if required

Check "***Ribbon = Mesh => General settings => Backface culling***" to only show the visible polygon sides. If the meshes visually change when the checking the checkbox, press "***Ribbon = Mesh => General settings => Flip poly normals***" to flip the polygon normals the other way. Figure 6 (left) shows the polygon normals pointing in the "wrong" direction, and Figure 6 (right) in the "correct" direction.

Occasionally, a single stope will have the polygon normals pointing in the wrong direction. Just select the object by pressing the "***i***"-toggle button on the top toolbar to the left. Then pick the object of interest, which will highlight the mesh. Uncheck the mesh in the bottom left panel, flip all the visible polygon normals with "***Ribbon = Mesh => General settings => Flip poly normals***", make the mesh visible again and flip the polygon normals again.

All the meshes will now have their polygon normals pointing away from the void.

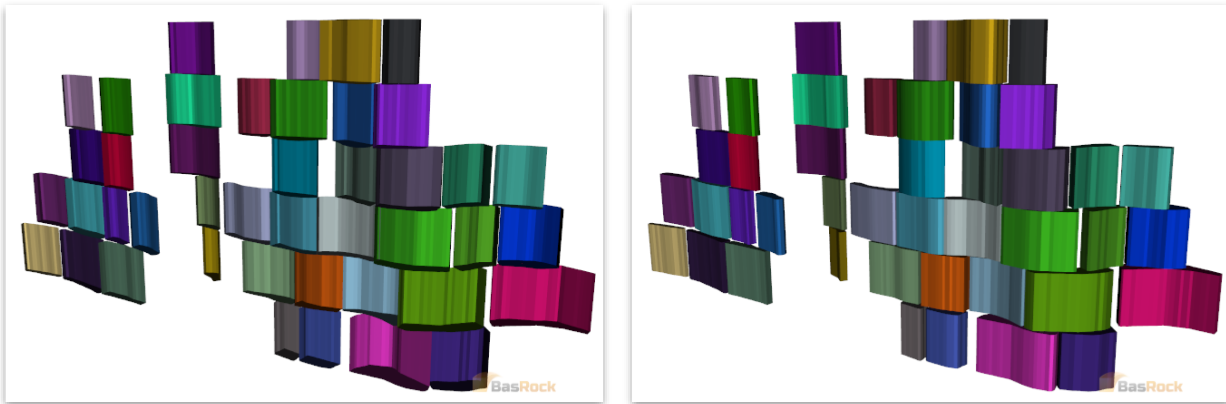

Figure 6 Stopes with polygon normals pointing towards the voids (left), and pointing away from the voids (right)

Step 8: Save the resulting file as DXF

Before saving the file, ensure the following two checkboxes are unchecked; "***Ribbon => Mesh => Save DXF-files => Binary files***" and "***Ribbon => Mesh => Save DXF-files => Triangle strips***". The unchecked state is the default setting. Save the file with "***Ribbon => Mesh => Save DXF-files => Scene meshes***".

When checking "***Ribbon => Mesh => Save DXF-files => Binary files***", the DXF-files are saved in a binary format, which is smaller and quicker to load than the default ASCII-format. Most other software packages do not support the binary format.

When checking "***Ribbon => Mesh => Save DXF-files => Triangle strips***", the data is compressed before saving, which create smaller files that are quicker to load. Most other software packages do not support this compression.

When using files in GEM4D, it is very beneficial to check both boxes, but uncheck these boxes when saving DXF-files for other software packages.

Step 9: Load the DXF-file in Map3D

Load the file directly into Map3D with "***Menu => File => Open model (CAD)***" and change the dropdown box a the bottom marked as "***Files of type***" to "***Acad DXF files (*.dxf)***". The DXF-files will now show up, and the GEM4D-file should load without errors.

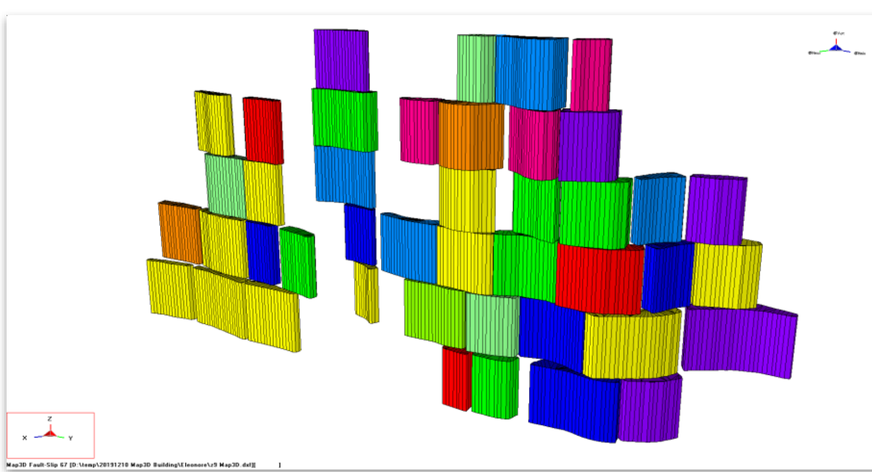

Figure 7 File created in GEM4D after being loaded in Map3D