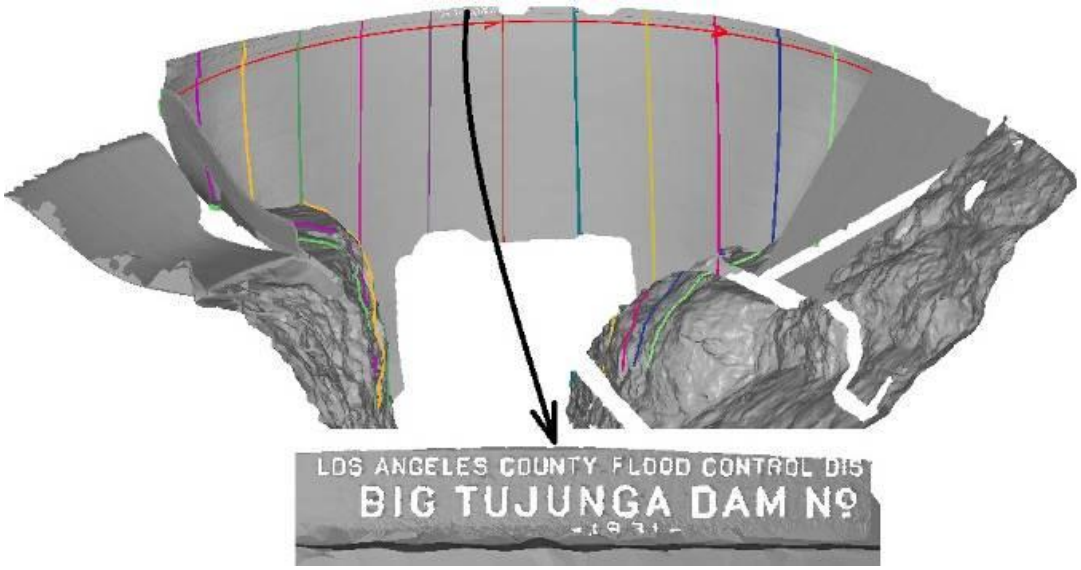
Exercise 2: Meshing of a dam point cloud Reshaper V7...



In 3DReshaper several meshing commands are available. The combination of these commands provides many meshing strategies.

Here we will show an example coming from a dam with several parts requiring special attention:

- The main dam part, which is a very smooth surface.
- Some rocks on each sides of the dam, which is a very rough surface.
- Some very sharp edges on the side of the dam walls.
- Some writings of the top of the dam.

Note that in the standard Reshaper tutorial there is another example based on a point cloud of the Samothrace victory (famous statue in the Louvre museum in Paris) which is a very noisy point cloud representing a smooth surface. Then, another strategy is used in the case of this statue.

In this exercise, we will see how to mesh point cloud(s).

- Manually clean point cloud(s)
- Making a first mesh to see what happens and decide the strategy to be used.
- Making a regular mesh at a certain level of detail.
- Filling some holes and open contours.
- Exploding a cloud into several pieces.
- Improving the accuracy of the mesh in certain zones.
- Deleting some triangles in a mesh.
- Re-meshing locally the edges so that they look sharp.
- Locally smooth noisy parts.
- Extract some features from the model: cylinder.
- Create a freehand section.
- Make some sections along a curve.

➢ Open the file: 3DReshaper-Practise/Meshing/DamRock.rsh

Observe the aspect of the point cloud, which appears in a shaded mode.

➢ Clean the cloud

- Select all the cloud that you see on the screen with a rectangle.
- Launch the command “Cloud -> Clean cloud”
- Appropriately orient the view and click the contour around the points that you want to suppress.
- Click “OK Continue” to delete the points and restart another contour.
- When your cleaning is finished, click OK.

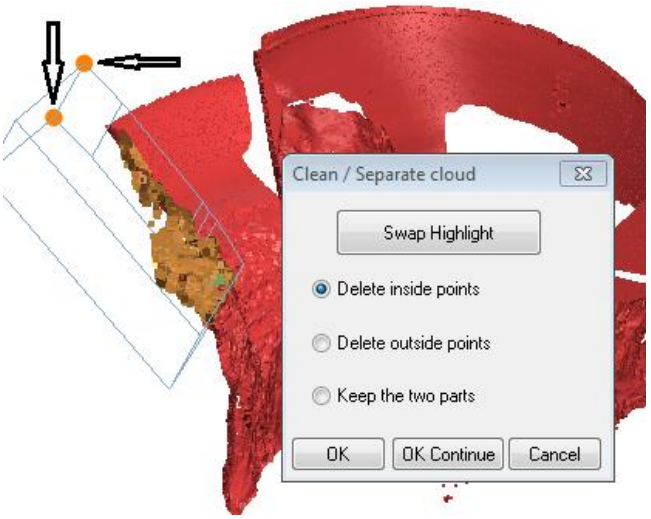


Figure 1: With the command "cloud -> clean/separate", you can select some points with a polygon. Control points are available to transform the polygon in a box.

➢ Making a first mesh to see what happens

Generally when opening a new cloud, it is difficult to know what the meshing parameter ideal values are. When you enter inside the command “**Mesh -> 3D Mesh**”, Reshaper computes parameters for you to get a result in less than 30 seconds regardless of your point cloud size. These “default” parameters usually give you good results but need sometimes to be adjusted according to your model and your expectations.

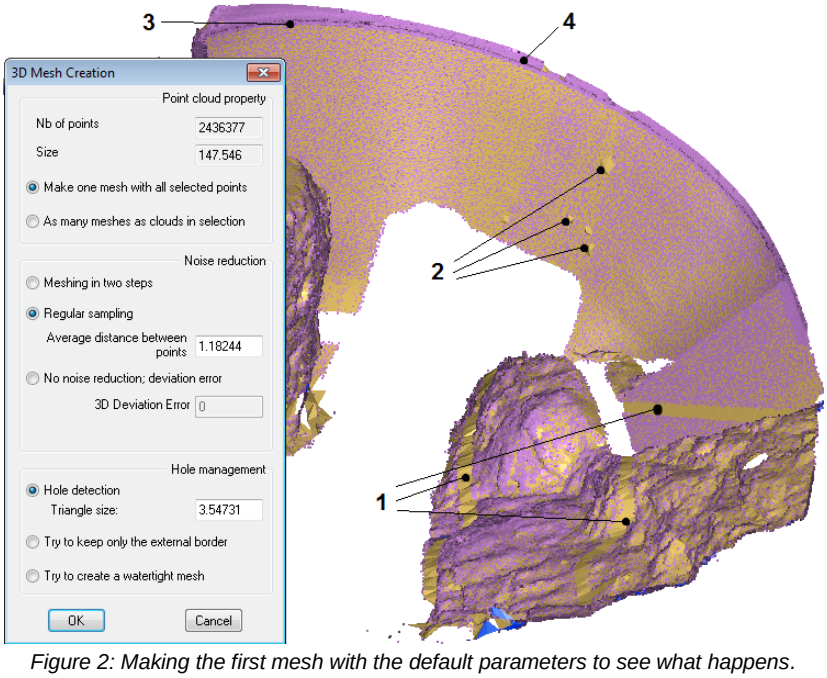


Figure 2: Making the first mesh with the default parameters to see what happens.

- Select all the clouds that you see on the screen with a rectangle. Reshaper will automatically merge the clouds to mesh them together.
- Launch the command “**Mesh -> 3D Mesh**” and insure that the option “create one mesh with all selected points” is activated.
- Change the default parameter and enter **1.18.**
- Click OK. The first mesh should arrive in less than 5 seconds.
- When the mesh is on the screen click the right button to select the representation -> flat. This is because the flat rendering is a mode that suppresses any artifact or smoothing coming from the graphic board.
- Note that you can swap the mesh normal typing the “**i**” key.
- You can display the clouds over the mesh to make a better analyze of the improvement(s) to make.

You are now ready to analyze your first result. Here are the remarks that we can make after a brief sight:

1. Some areas where points are missing are completely filled by big triangles. The sizes of these holes are about 2m. This would require to enter a value in the field “Hole detection, triangle size” below 2.
2. We get some aberrant points but the number of point is really low => an easy manual correction can be done after.
3. The sharpness of the edges is not correct. This also requires having smaller triangles
4. The detail of the writings is not present in the mesh, however as these details are very small we will include these details in a second step.

➢ Making a regular mesh at a certain level of detail

The conclusion of the previous test is that the mesh should be done with a smaller triangle size:

- Make undo.
- Select again all the clouds that you see on the screen with a rectangle.
- Launch the command “**Mesh -> 3D Mesh**” and insure that the option “create one mesh with all selected points” is activated.
- Enter the value 0.4 in the field “average distance between points”. Reshaper automatically recalculates the triangle size and the resulting value should be low enough to detect big areas where no point was measured.
- Click OK.

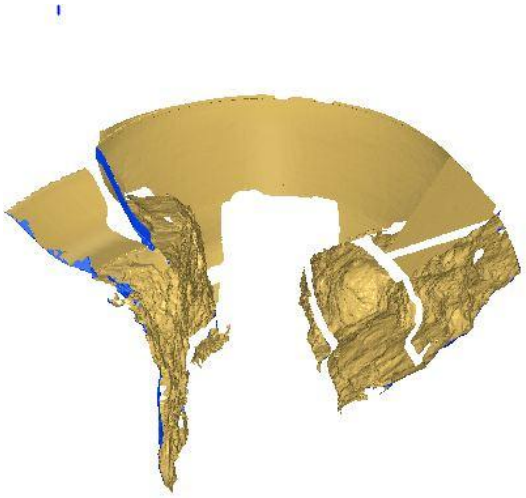


Figure 3: Meshing the dam with an average distance between points of 0.4m. The result is a mesh made of several disconnected parts: a compound mesh.

➢ Filling some holes

We will now fill. The automatic selection is often the fastest way to select the “smallest holes” to fill.

- Select the mesh.
- Launch the command “**Mesh -> fill holes**”
- Select the option “by length” (limit the edge number) and curvature filling.
- Move the slider at a maximum value between 60 and 70 (otherwise open contours will be selected).
- Select the options as shown on the picture.
- Click Preview and OK or OK Continue
- Select by click and fill the remaining large holes. OK

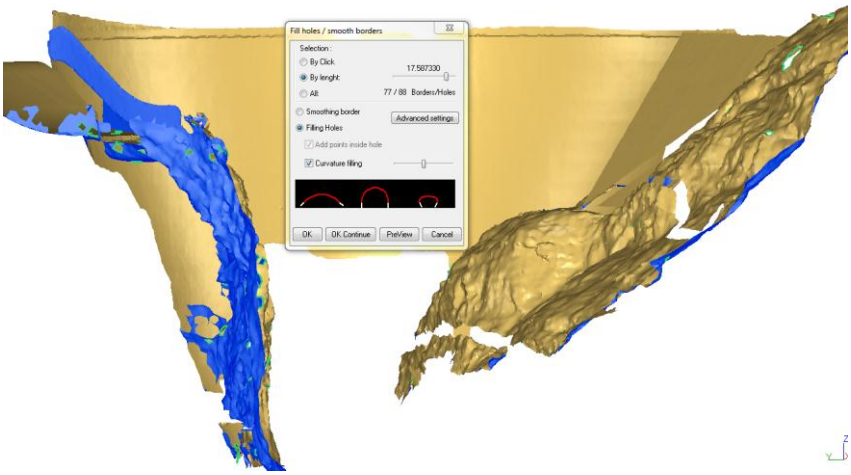


Figure 4: Automatic selection of the smallest holes to fill with curvature continuity.

➢ Explode the compound mesh in several parts

As you can see the resulting mesh is a “compound mesh”; this means that it is a group of several disconnected surfaces. We will now explode the compound into different independent meshes.

- Select the mesh.
- Launch the command “Mesh -> Merge common border”.
- Select the option “Do not modify borders”.
- Click OK.

Or

- Select the mesh.
- Launch the command “Mesh -> Explode compound Mesh”.
- Click OK.

Undo or select all meshes - Group in Compound mesh (say no to the orientation of the normal as all parts have already the same normal orientation). You can change the color of the new compound mesh in Edit/Color and Aspect (select the mesh before).

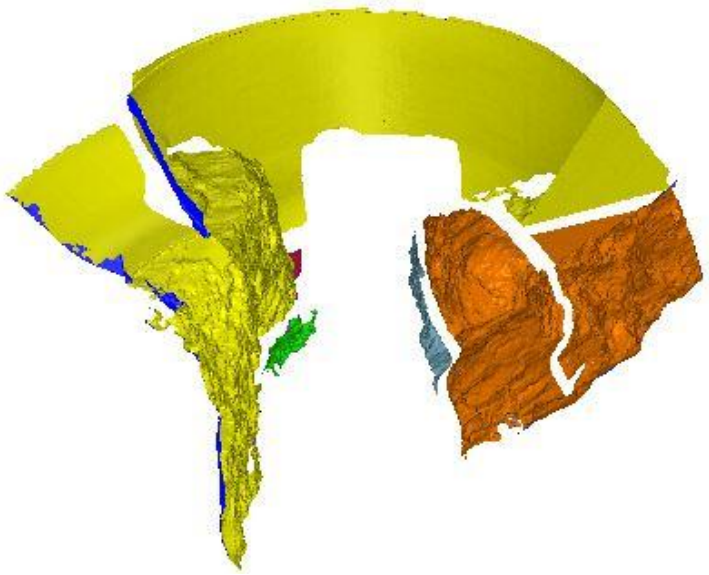


Figure 5: Explode the mesh into disconnected parts. You can select all the meshes and put them in the same color (Color and Aspect). It is easier to see on which mesh the normal color is reversed.

➢ Replacing some parts to remove some aberrant zones

At some points like on the image, you should see some defects on the surface. You can easily remove these aberrant zones.

- Select the mesh.
- Launch the command “**Mesh -> Smooth**”.
- Select the tab “**Replace a part**”.
- Draw a freehand contour to encircle the zone to correct
- If you are happy with this correction, click “Valid” otherwise click “Undo”.
- Do this operation for all the zones to be replaced.
- Note that for the small areas you can also use the “**Classical smoothing**” tab and take the **pencil tool**. The shape will be locally modified when you press the left button of the mouse and move over the zone to smooth.

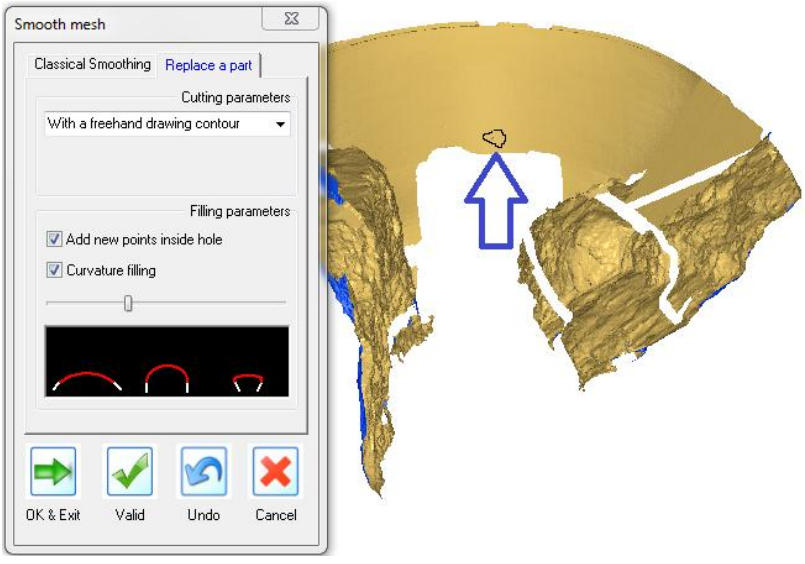


Figure 6: Aberrant zones can be easily replaced or locally smoothed

Note that in some situation it is also possible to smooth all the shape to get a better aspect but here we will not use this command because our intension is to keep the measurement points “as is”.

➢ Filling open contours

The model contains some zones which can not directly be filled because they are open contours. In such case, here are two ways:

Make a bridge to close the open contour:

- In the mesh menu, select “Bridge” and click on the two free edges to close the hole.
- Merge all parts and OK.
- Fill the hole (in the mesh menu).

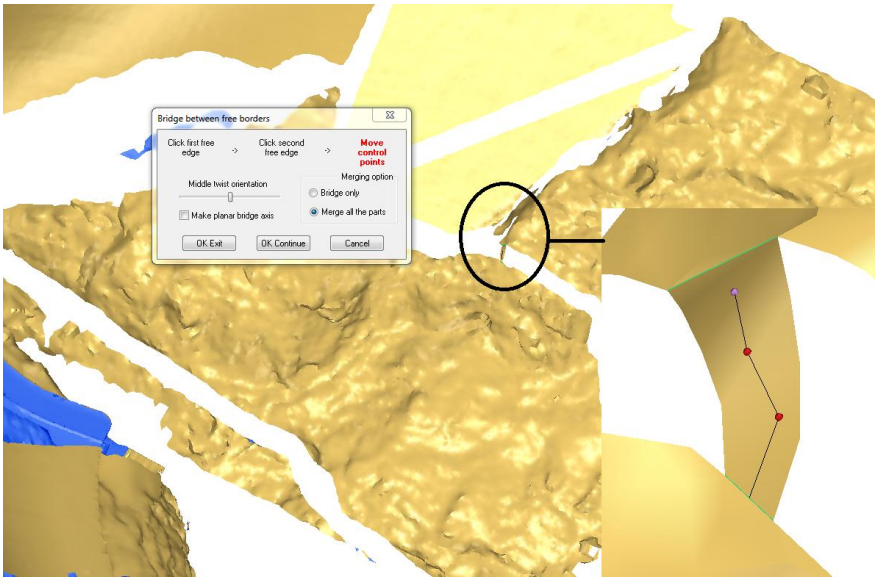
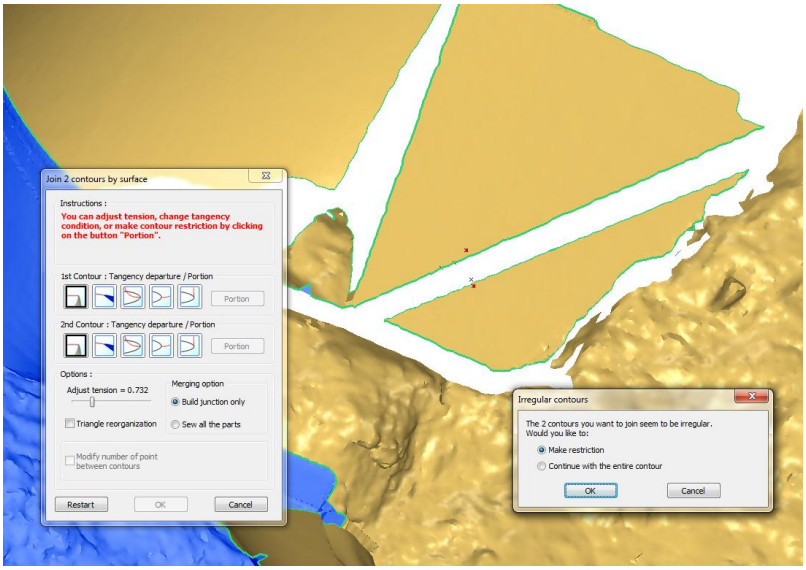
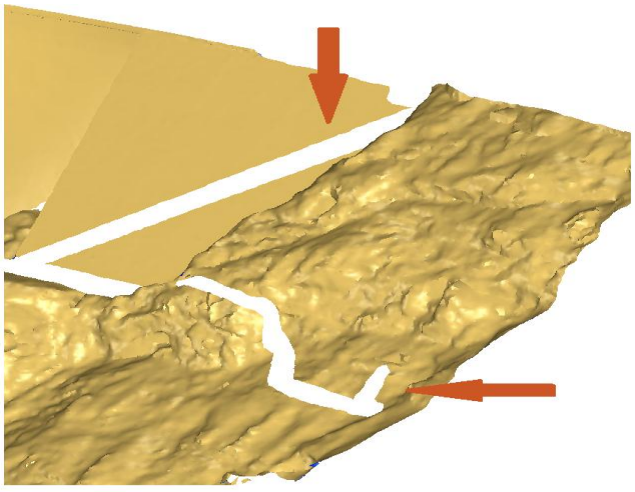


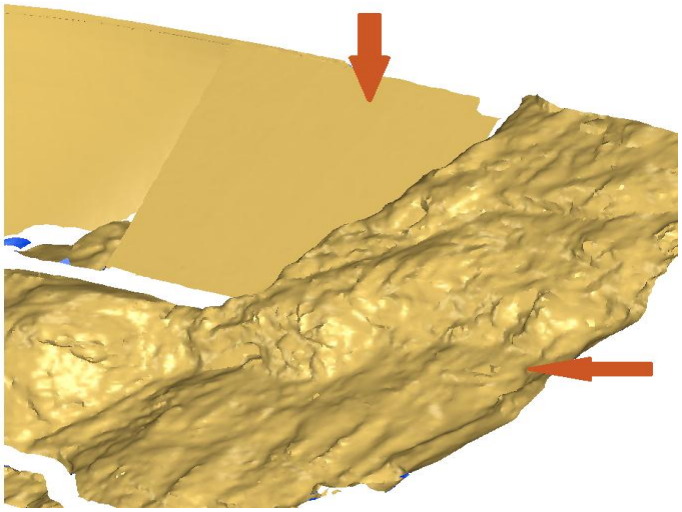
Figure 7: making bridge allows you to separate big holes into smaller ones, which are easier to fill with curvature continuity using the command "Mesh / Fill holes / smooth borders". You can also create a mesh from two contours (multiline or hole border). Sometime, a contour restriction is necessary.

Make a junction between two contours:

- In the mesh menu, launch “Join two contours” and select the two contours.
- Make a restriction on the two contours as they are open. Delineate a portion by following the instructions.
- Sew all parts.
- Click OK







➢ Improving the accuracy of the mesh in specific zones

The model contains some sharp edges zones and we will improve the accuracy in these regions.

- Select the mesh.
- Press the CTRL key to add in your selection all the clouds whose name starts by “SharpAngle”. Note that the cloud was previously split to prepare this tutorial.
- Launch the command “Mesh -> Deviation Error Refine”.
- Select the option “Take points of the cloud” and fill in the values as on the right picture.
- Click OK

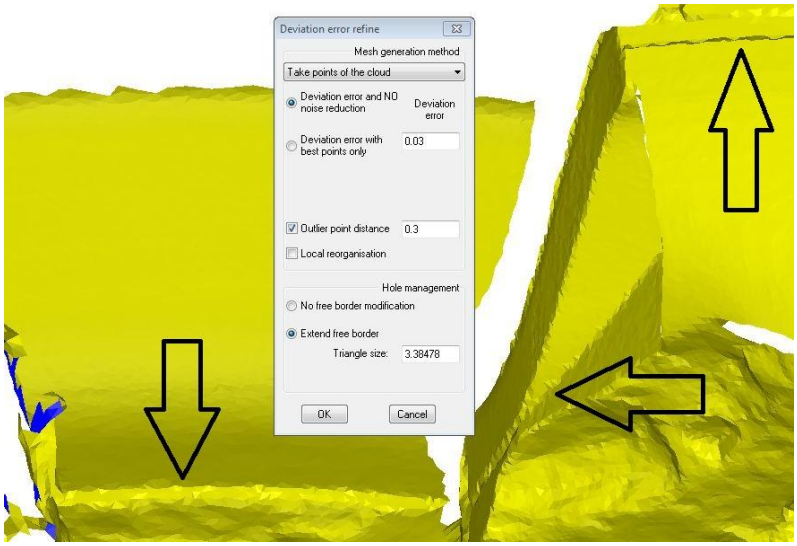


Figure 8: The "Deviation error command" improves the accuracy of the mesh.

Note that there is another option present in this command: “Interpolate new points” creates some points that are not present in the cloud. This command assumes that the surface is continuous and creates the best “smooth surface” in the middle of the noise thickness. Here, we want to improve sharp zone => not smooth and this is the reason why we prefer the option “Take points of the cloud”. As mentioned in the introduction, in the case of the standard Reshaper tutorial, the Samothrace victory point cloud should be meshed using “Interpolate new points”.

We can also improve the writings zone.

- Select the mesh.
- Press the CTRL key to add in your selection the cloud “writings”. Note that the cloud was previously split to prepare this tutorial.
- Launch the command “Mesh -> Deviation Error Refine”.
- Select the options “Take points of the cloud” and fill in the values as on the right picture.

Note that a deviation error of 0 (zero) means adding all the points of the cloud. This could be dangerous for a big or noisy cloud.

- Click OK.

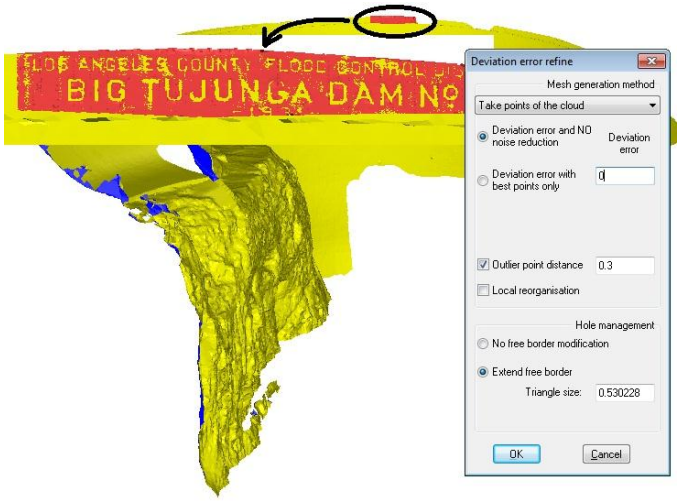


Figure 9: The "Deviation error command" improves the accuracy of the mesh.

➢ Deleting some triangles of the mesh

We will now delete the triangles inside the letters of the writings.

- Select the mesh.
- Launch the command “Mesh -> Clean / Separate”.
- Select the triangles according to their size and adjust the threshold to take all triangles bigger than 0.032.
- Click OK to close the dialog box but do not validate the command because this would also delete all the triangles outside of the writing zone.

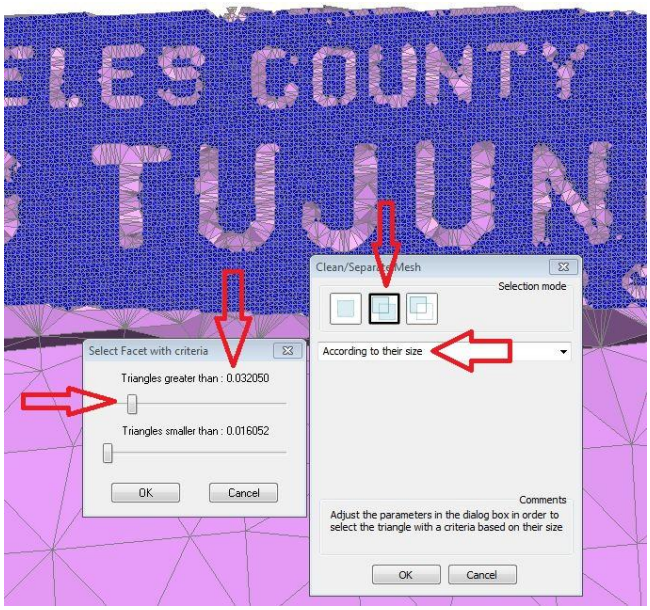


Figure 10: Selecting triangles by size to delete the inside of the letters.

We must now make a second selection in order to remove from the selection all triangles outside of the writing zone.

- Click on the rightmost icon to remove triangles from the current selection.
- Select the options as shown of the right picture.
- Click a contour as shown on the picture.
- Click OK to validate the command.
- A new dialog box will ask you the action to do with the selection. Choose “Delete selected triangles”

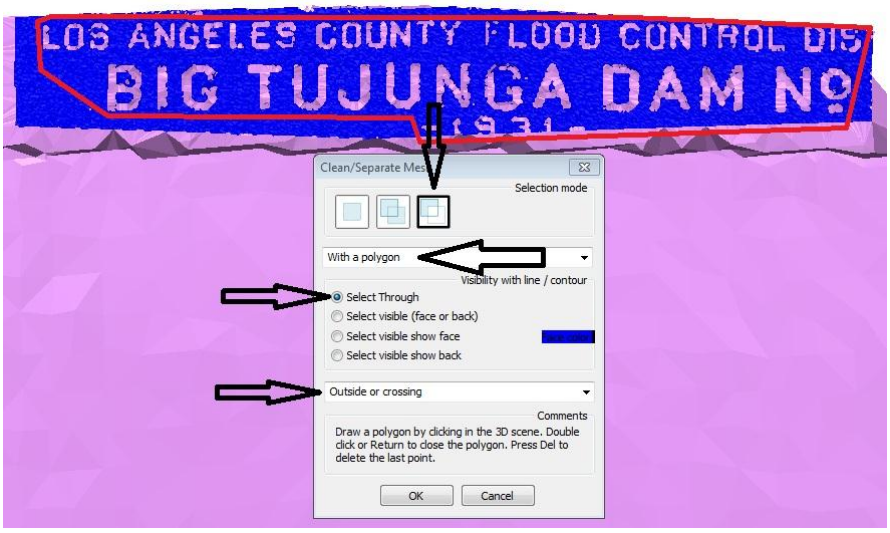


Figure 11: Removing some triangles from the selection outside the contour

The command will detect that the result is made of several disconnected surfaces.

- Select the “Group all parts inside one Compound”

➢ Re-meshing locally the edges so that they look sharp and smooth

On the model, you should see 2 types of defects:

1: The edges that are supposed to be sharp and smooth are jagged.

2: Some spikes are present in the smooth regions.

The smoothing command will improve these two defaults.

- Select the mesh.
- Launch the command "**Mesh -> Smooth**".

Note that by default, the intensity slider is at 2 to globally smooth the entire model. A global smoothing is not the most appropriate choice in this case because only a part of the model is smooth (the dam structure).

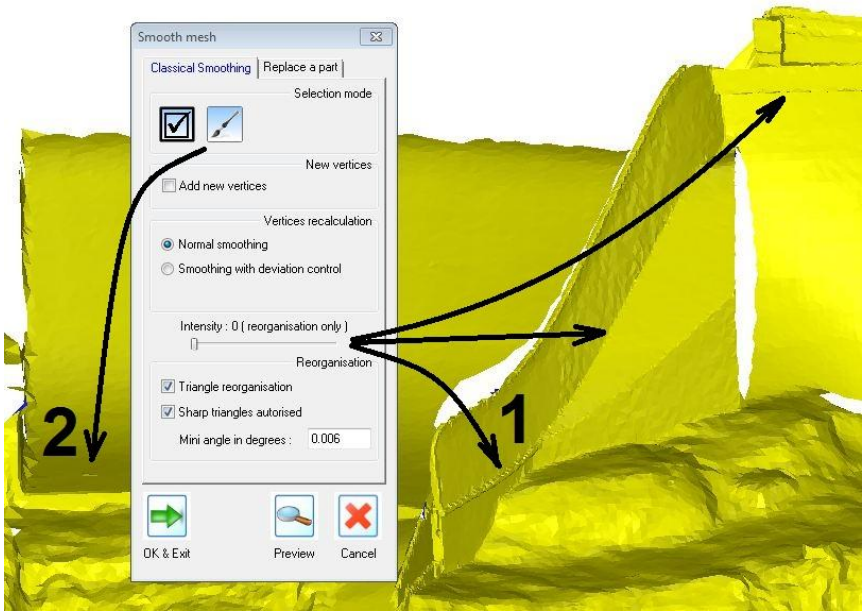


Figure 12: using the smoothing command to make the edges sharper and to correct spiky regions.

Smoothing globally could round off the edges and the goal is exactly the opposite: we want to make them sharper! To make this, we will use a feature called "**reorganization**", which re-meshes locally to follow the curvature and the sharp edges.

- Move the intensity slider to zero to apply only the reorganization.
- Press the preview button and look at the difference on the sharp edges.
- Press Valid to continue the smoothing.
- You can press preview and valid again to get a result even nicer.
- Press the pencil button
- The cursor will change into a circle.
- Move the cursor over spikes and press the left button of the mouse. This will smooth the areas under the cursor. CAUTION: do not move the cursor too near from the edges to avoid any deterioration of the sharpness.

➢ Extract some features from the model: planes, cylinders.

From this model, you can very easily extract some feature like planes and cylinders.

- Launch the command "**Measure -> Extract Shape / Quick Cylinder**".
- Click a point on the model for the cylinder extraction. You will need to click to click 2 or 3 point using the CTRL key.
- As the extraction zone is very narrow, you will need in this case to "help" the extraction indicating that the cylinder axis is near from the Z axis.
- Move the dialog box to show the color scale showing the deviation.
- You can slide the extraction tolerance to change the tolerance of your feature.

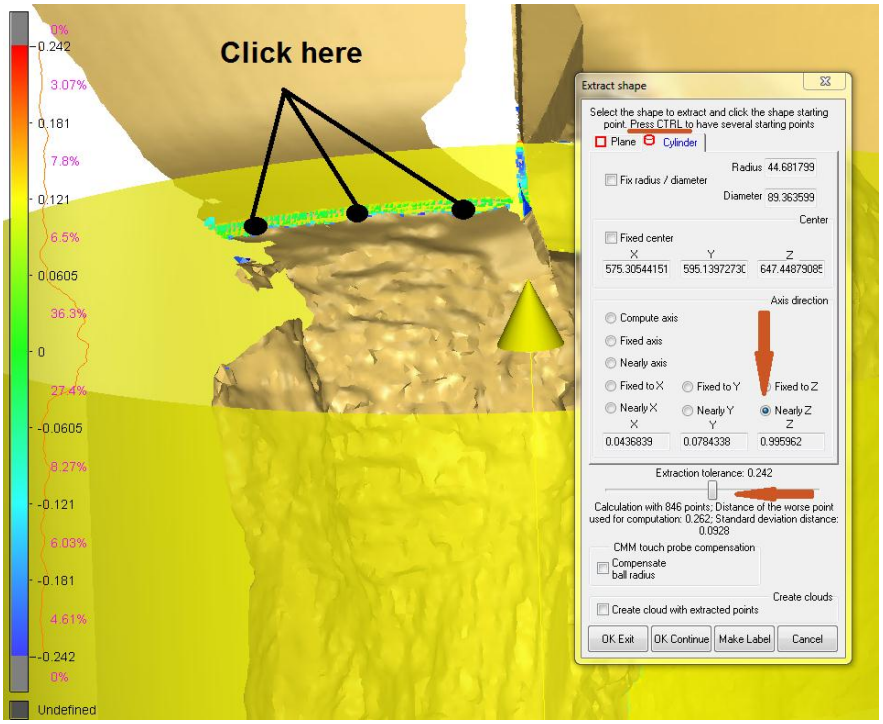


Figure 13: The "Extract shape" command allows you to create planes and cylinders among other geometrical shapes, fitting on your model.

Quick plane and cylinder extraction requires one or few points. The other shape extraction mode requires first a nominal or reference shape.

Once your cylinder is created, you can press the button "**Make Label**" to create an inspection label. A dialog box like on the right picture allows you to enter some information like the reference value, the tolerance. You can also disable some values that are not relevant for your inspection.

The location of the label is automatically calculated by Reshaper.

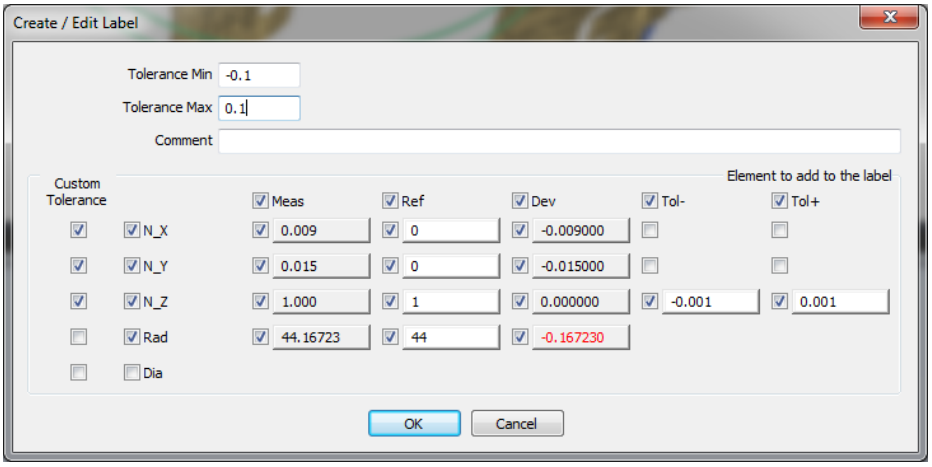


*Figure 14: In the command "best shape", "extract shape" and "measure with mouse", you can **create some label to make further inspection reports**.*

➢ Create a freehand section.

We will now create a section just below the top of the dam

- Select your model.
- Launch the command “Polyline -> Freehand Section”.
- Click 3 points on the model as shown on the right picture.
- Click OK to validate the result.
- Launch the command “Polyline -> Cut polylines”.
- Click a point on the section near the left corner of the dam as shown by the **arrow**.

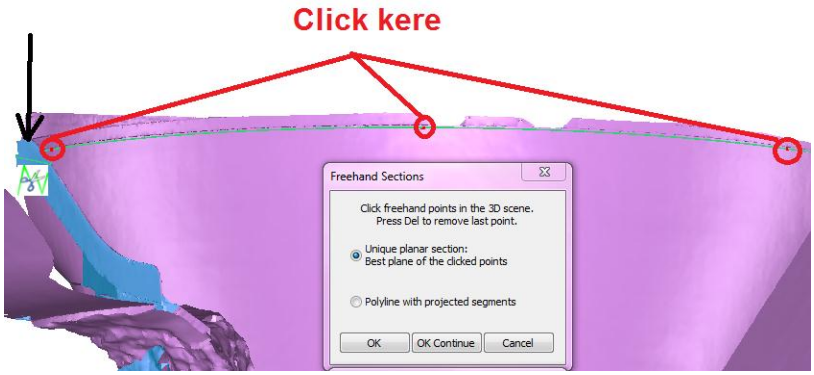


Figure 15: With the command "freehand section" you can make a planar section on the fly.

The main part of the section will become the reference line to make section. You can delete all the other parts.

➢ Make some sections along a curve

We will now create some sections along the path that we have created.

- Select both your model and the path.
- Launch the command “Polyline / Sections along curve”.
- Fill the dialog box as shown on the picture. When you change the values, you can see the extent of the future sections.
- You can also preview the sections as planes (Show Planes).
- Click Preview and OK to validate the result.

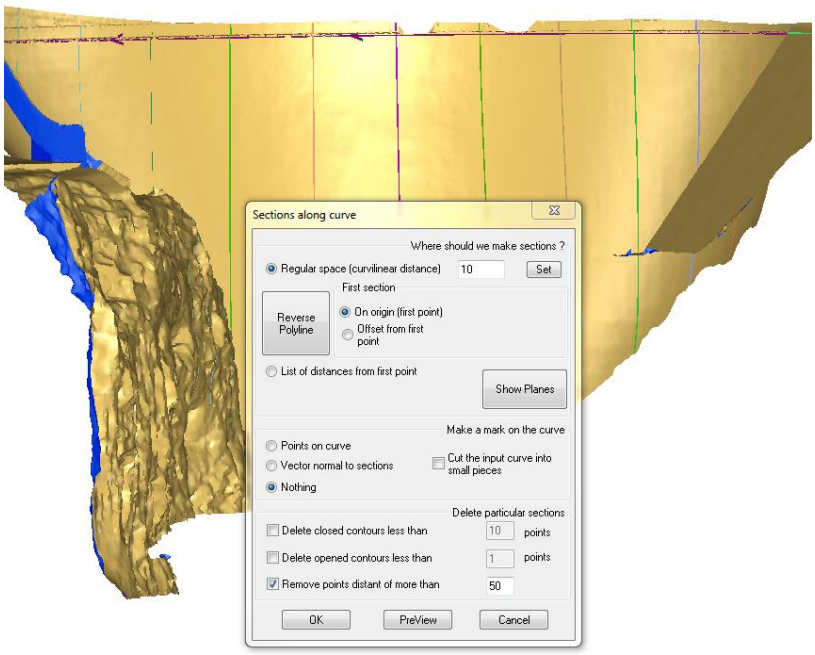


Figure 16: Using the command "section along a curve" to make planar sections perpendicular to a path.

These sections can be used for different purposes:

- Export for CAD software using the DXF or IGES format.
- Split the mesh in several parts with the command “**Constraint Meshing**” in the mesh menu.
- Reconstruct a CAD model inside Reshaper. Note that the CAD reconstruction requires installing the CAD plug-in, which is available in the download area of www.3DReshaper.com .