# Boundary Simplification in *Slide* 5.0 and *Phase*$^2$ 7.0

Often geometry for a two-dimensional slope stability or finite-element analysis is taken from a slice through a geological model. The resulting two-dimensional polylines can contain hundreds or thousands of vertices. Although *Slide* and *Phase*$^2$ can read and use polylines with this many vertices, customers have noticed a considerable slowdown in speed in both the modeler and computation engine. In the case of *Phase*$^2$, resulting finite-element meshes can contain large numbers of poor quality elements.

To help alleviate these issues, a new boundary simplification option has been added to both *Slide* and *Phase*$^2$. Utilizing the Douglas-Peucker [1] line simplification algorithm, a polyline with a large number of vertices can now be simplified to a polyline with far fewer vertices with little loss in accuracy.

The implementation of the algorithm in *Slide* and *Phase*$^2$ allows you to define the new number of vertices in a polyline by either specifying

1. a percentage of the original number of vertices or
2. an acceptable distance between the new and original polyline.

# Example - Slide

Figure 1 illustrates an external boundary read in through an AutoCAD™ DXF file.

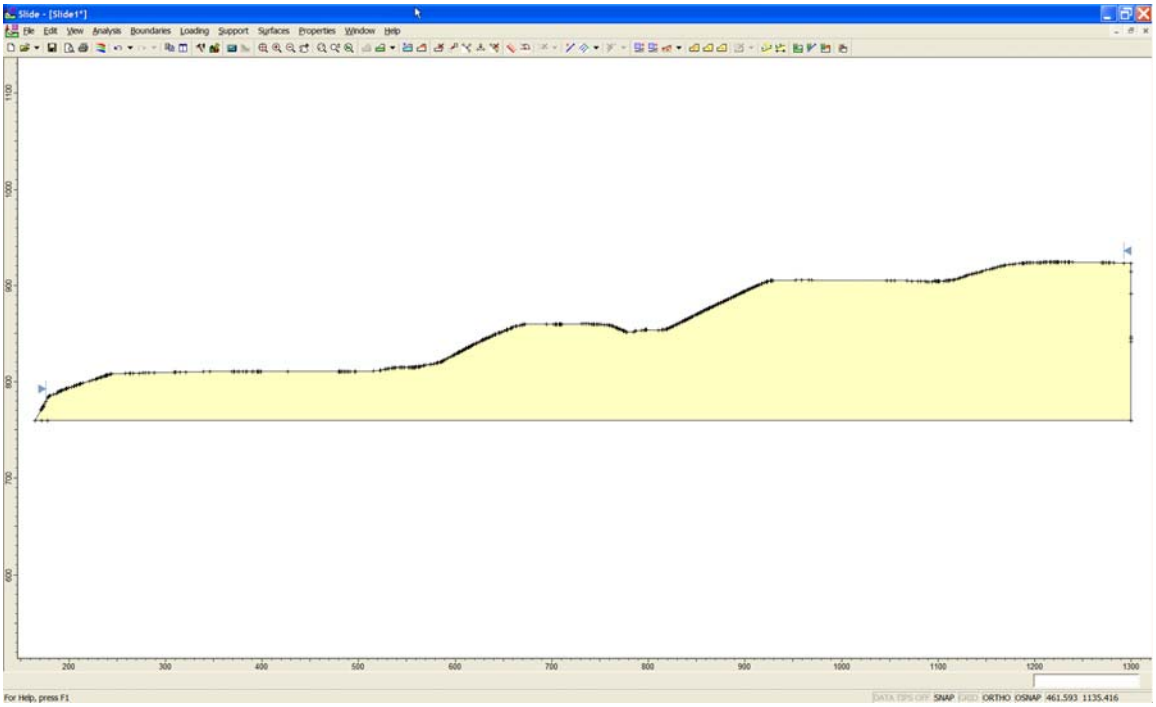

Figure 1 - Geometry before simplification

The boundary contains 554 vertices. To simplify the boundary, select the Simplify Boundary option in the Edit submenu of the Boundaries menu. You are first asked to pick the boundary you wish to simplify. After you pick the boundary you are presented with the following dialog.

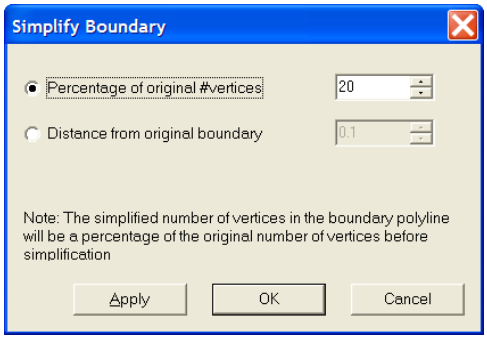


Figure 2 - Boundary Simplification Dialog

As mentioned above, there are two options for reducing the number of vertices. The simplest option is to specify the desired number of vertices as a percentage of the original number of vertices. The other option allows you to enter an acceptable distance between the new and original polyline. The simplification dialog is interactive, meaning

you can vary the parameters and use the Apply button to see the simplified boundary right away. Figure 3 below shows the geometry in Figure 1 with 10% of the original number of vertices.

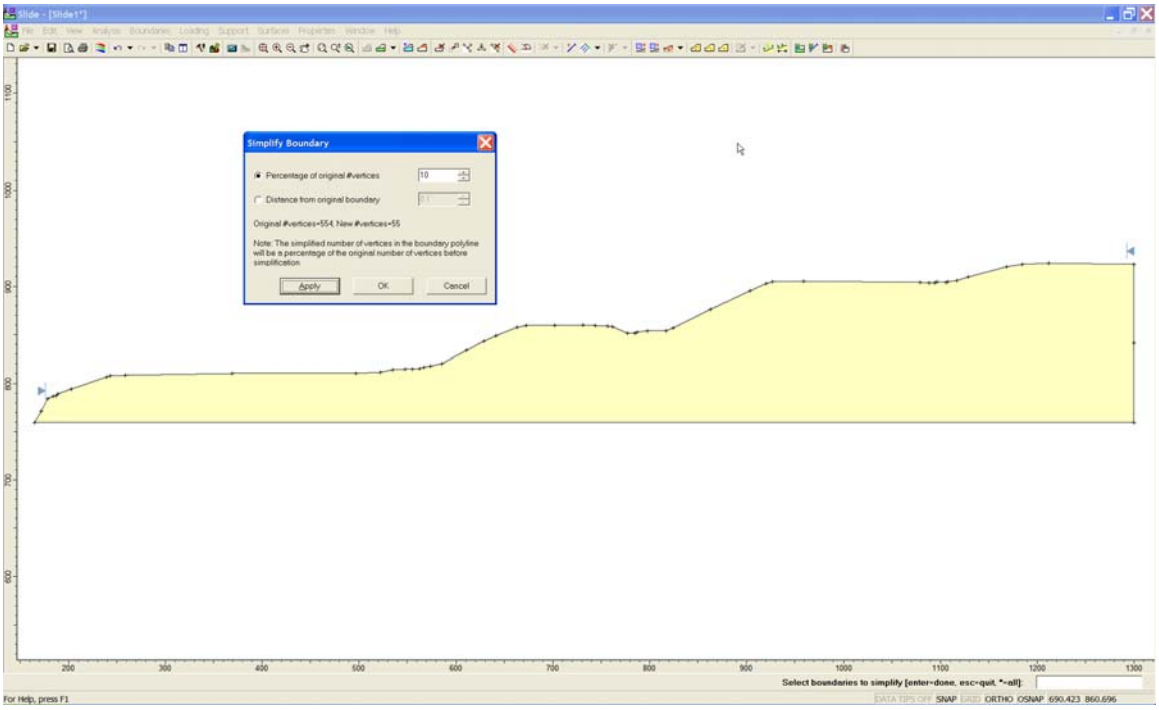


Figure 3 - Simplified Boundary

As you can see, the number of vertices in Figure 3 is 55 compared with the original 554 vertices, and there is little loss in detail. You may Cancel at any time and the geometry is restored to its original state before simplification.

# Example – Phase$^2$

In *Phase*$^2$ the process is identical. There is a Simplify option in the Edit submenu of the Boundaries menu. As in *Slide*, this option allows you to pick the boundaries you wish to simplify, and the same dialog as shown in Figure 2 is presented.

Figure 4 on the following page shows the same model as above but with material boundaries. Notice the large number of vertices representing both the external and material boundaries.

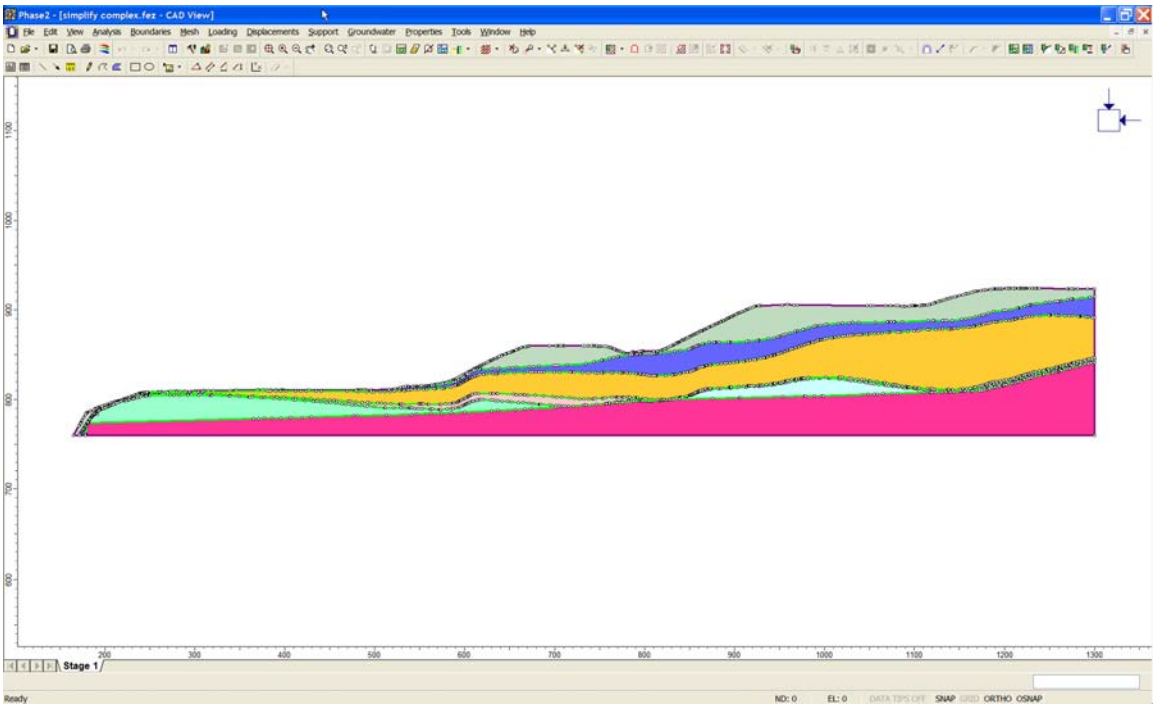

Figure 4 - Phase2 model before simplification

If this geometry is meshed using a uniform mesh, with 1500 as the target number of elements, the resulting mesh in Figure 5 is generated. Notice that 5794 elements are generated with 167 (2.9%) poor quality elements. The blue rectangles in Figure 5 show the regions in which poor quality elements exist.

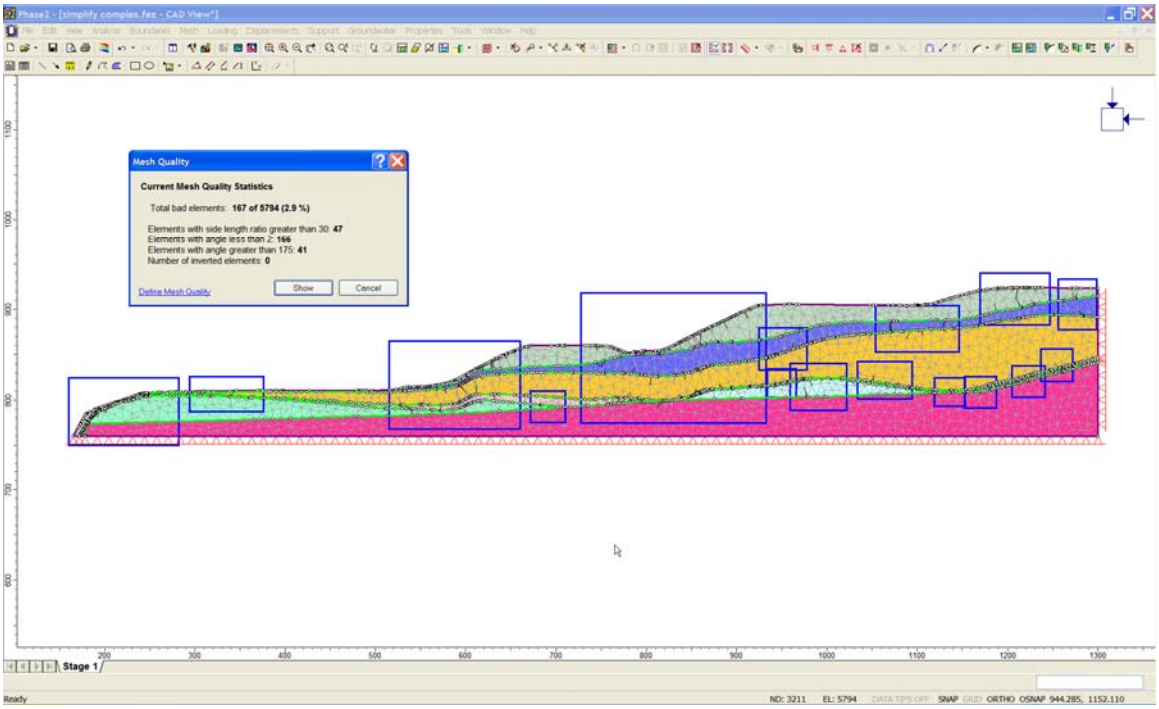


Figure 5 - Mesh Before Simplification

Figure 6 shows the mesh created by first simplifying the geometry and removing 80% of the vertices, then creating a uniform mesh with 1500 as the target number of elements. Notice that 3261 elements are generated and that only 27 (0.8%) of the elements are poor quality elements. The mesh is much better than the mesh created before simplification.

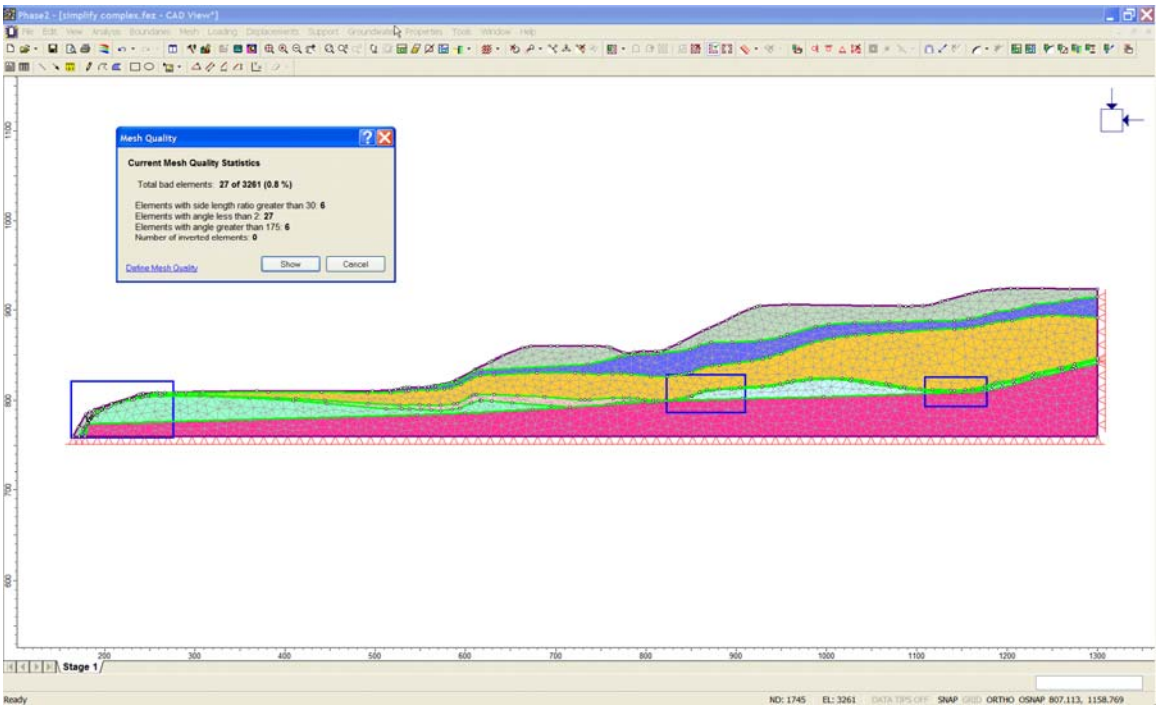


Figure 6 - Mesh with Simplified Boundaries

## Closing Remarks

The process of boundary simplification for boundaries with large numbers of vertices can dramatically reduce the time you spend modeling your structure. In the case of *Phase*$^2$, or *Slide* when doing a groundwater analysis, it can also improve the results by producing a better quality finite-element mesh. Finally, compute times can be significantly reduced by simplification of model geometry.

## Acknowledgements

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## References

1. D.H. Douglas and T.K. Peucker. *Algorithms for the reduction of the number of points required to represent a line or its caricature.* The Canadian Cartographer, 10(2):112-122, 1973.