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GeoStudio Example File
Pore-Water Pressures Defined using a Spatial Function

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Introduction

Pore-water pressures impose one of the greatest controls on the stability of slopes. The pore-water pressure can be defined in a SLOPE/W analysis using a variety of approaches including a piezometric line, spatial pressure head function, or a finite element analysis. A finite element analysis provides the most flexibility and rigor; however, a spatial function can be useful for modeling pore-water pressure distributions that cannot be handled by a simple piezometric line(s). This example illustrates how to set-up and interpret the results of a SLOPE/W analysis that uses spatial pressure head function.

Numerical Simulation

Figure 1 presents the model domain and configuration for the problem. The toe of a cut-slope has is at an elevation below the original water table elevation. This has resulted in upward flow due to toward the ground surface. In the toe area and beyond, a piezometric line will not accurately represent the pore conditions.

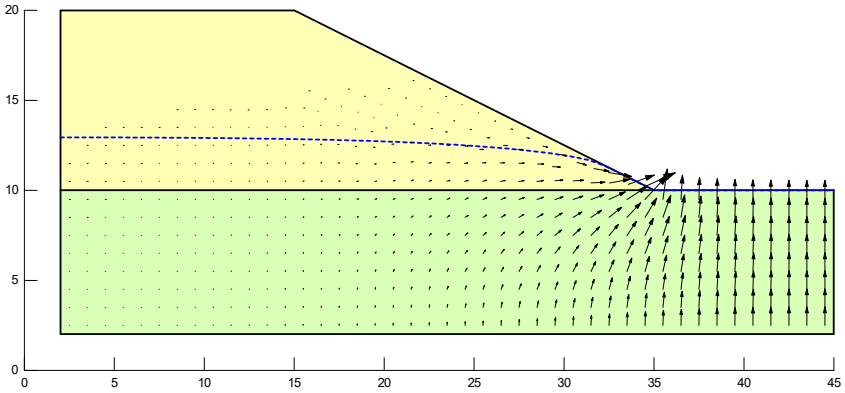

Figure 1. Problem configuration.

There are total of four analyses in the GeoStudio Project (Figure 2). Analysis #1 models the groundwater flow conditions presented in Figure 1 and forms the Parent for the stability analysis (1a). This analysis also provides the location of the phreatic surface that would be measured using field instrumentation. The sketch tool was used to draw a line tracing the location of the phreatic surface, which was then used to draw the piezometric line in second analysis.

Figure 2. Analysis tree in the GeoStudio Project.

Analysis #3 uses a spatial pressure head function to define the pore-water pressure conditions. In an actual field case, measured data would be used to create the spatial function. For this example, the pore-water pressures calculated from the seepage analysis were used directly. The data was extracted from SEEP/W by using View | Objection Information and selecting the locations shown in Figure 4. The data was then pasted in Excel, unnecessary parameters were deleted, and the x-y coordinates and pressure head data pasted into the dialogue box found under Define | Spatial Functions | Pressure head. It should be noted that supplementary data

points may have to be added to create a smooth and spatially continuous function if the field data is sparse.

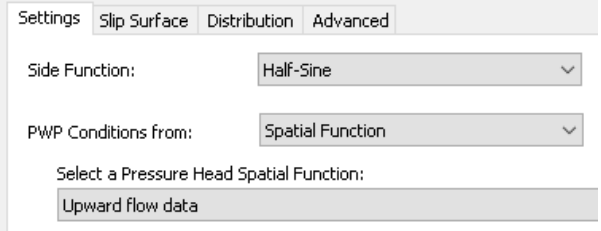

Figure 3. Specifying the function to be used in the analysis.

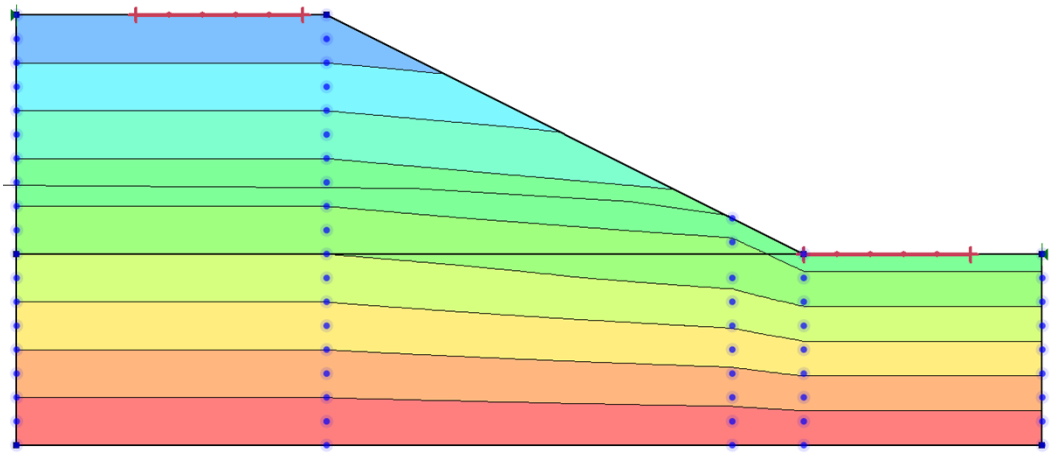

Figure 4. Locations of specified data points.

Results and Discussion

The stability results using the spatial pressure head function and piezometric line for slip surface 591 are shown in Figure 5 and Figure 6, respectively. There is a noticeable change in the factor of safety from 1.34 to 1.41 between the two cases. The factor of safety increases using the piezometric line because hydrostatic conditions are assumed and the effect of upward groundwater flow is not captured. This is demonstrated by a comparison of pore-water pressure along the slip surface (Figure 7). The piezometric line under-estimates the pore-water pressure between about slices 15 to 30. The factor of safety for analysis 1a, which uses the finite element results from SEEP/W, is lower than both analysis 2 and 3.

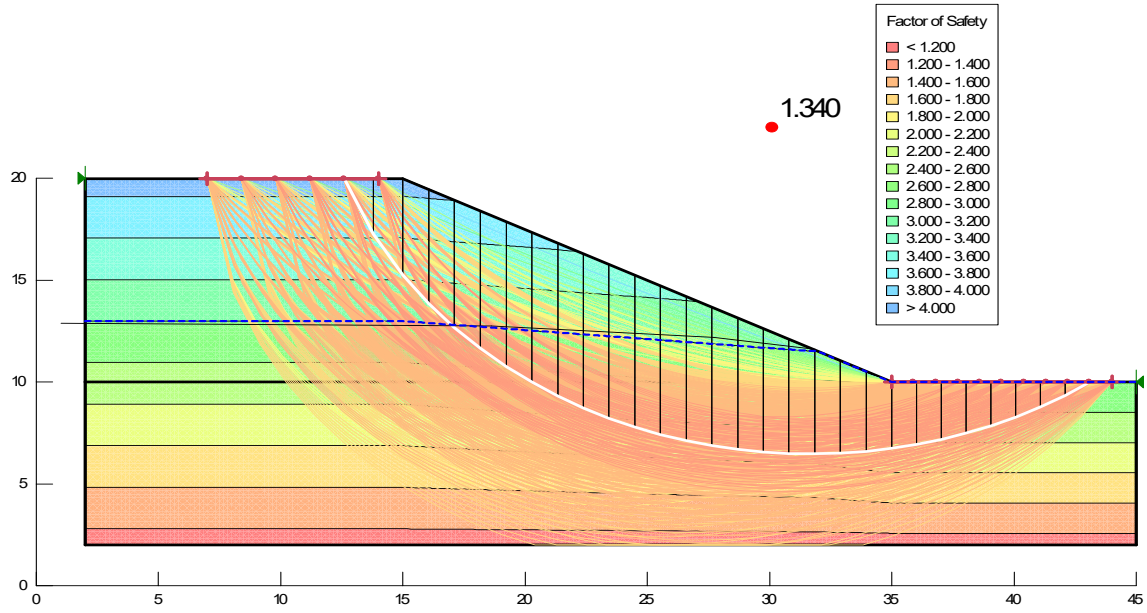

Figure 5. Stability result using the spatial pressure head function.

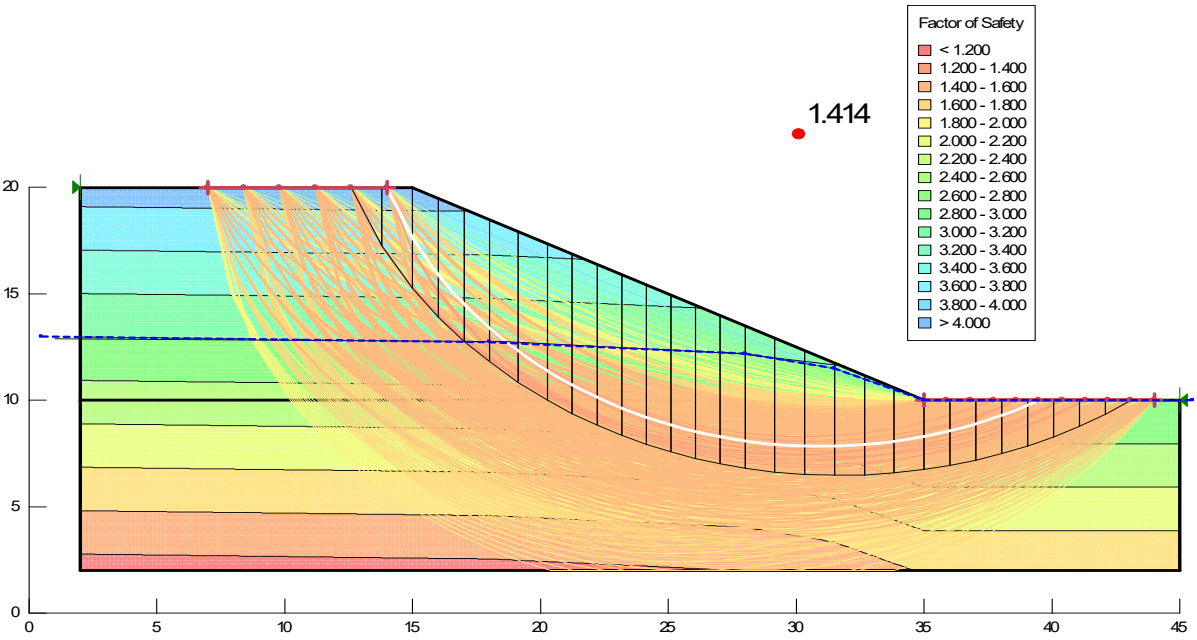

Figure 6. Stability result using a piezometric line.

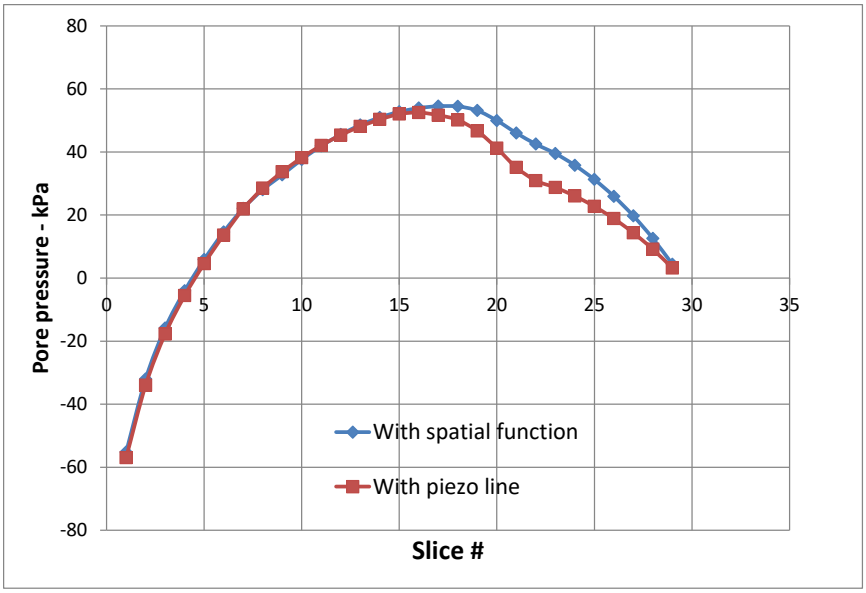

Figure 7. Comparison of pore pressure distributions.

Summary and Conclusions

This example demonstrates that any irregular pore-water pressure distribution can be modeled in SLOPE/W a series of discrete x-y data points in a spatial function. The spatial function is able to better capture more complex groundwater flow systems than a piezometric line, although SEEP/W provides more rigor and flexibility.