Spatial Variability using Random Fields

A feature of SVSlope® and SVFlux™ (part of SVOffice™ 2009)

PART OF... SVOFFICE 2009

June 29, 2010

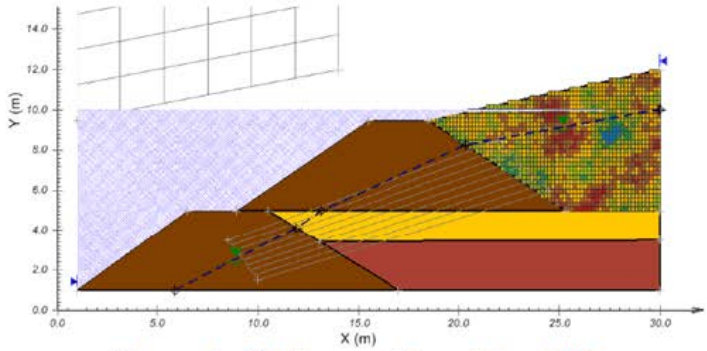
Geotechnical engineering, as a general practice, has always struggled with quantifying the significant amount of variability that can be present at any given site. There may be variability present in field sampling methods, equipment, lab testing procedures, level of training of field personnel, or many other such factors. One particular problematic aspect of slope stability analysis is the spatial variability of material properties. In particular, if material properties are measured in three spatially different locations, the result is three different shear strength values for any particular stability analysis.

A common question which may be asked by clients of geotechnical firms is "How do you know that a grouping of particularly weak materials might not cause a failure?" This particular question is difficult to answer within the context of a classic slope stability analysis.

The use of randomly generated fields of soil material parameters based on average and standard deviations of cohesion, friction angle, or other such parameters holds promise for the evaluation of this type of scenario. Work done by Professors Fenton and Griffiths has focused on this aspect of modeling over the past number of years. The ability to generate random fields of material properties within regions of the numerical model has been implemented in SVSlope® with their assistance. This technique is a rigorous methodology for generating random fields within any given region based on an average and a standard deviation for any given soil parameter.

The application of such a technology to let tailings and common facilities may be seen in figure below. The friction angle of tailings is represented by an average and a standard deviation. A random field of friction angle values is then generated for the tailings region. The density of the random field grid may be varied in the software.

The random field generation may be used in conjunction with either a deterministic or a probabilistic analysis method. For example, in SVSlope®, the random fields can be generated for each trial in a Monte Carlo analysis. This allows comprehensive probabilistic analysis of a particular site with the spatial variability included in the analysis. This advanced ability is unique to SVSlope® and SVFlux™.



Using random fields to account for spatial variability