World Academy of Science, Engineering and Technology
International Journal of Mathematical and Computational Sciences
Vol:14, No:12, 2020

Analytical Slope Stability Analysis Based on the Statistical Characterization of Soil Shear Strength

Authors : Bernardo C. P. Albuquerque, Darym J. F. Campos

Abstract : Increasing our ability to solve complex engineering problems is directly related to the processing capacity of computers. By means of such equipments, one is able to fast and accurately run numerical algorithms. Besides the increasing interest in numerical simulations, probabilistic approaches are also of great importance. This way, statistical tools have shown their relevance to the modelling of practical engineering problems. In general, statistical approaches to such problems consider that the random variables involved follow a normal distribution. This assumption tends to provide incorrect results when skew data is present since normal distributions are symmetric about their means. Thus, in order to visualize and quantify this aspect, 9 statistical distributions (symmetric and skew) have been considered to model a hypothetical slope stability problem. The data modeled is the friction angle of a superficial soil in Brasilia, Brazil. Despite the apparent universality, the normal distribution did not qualify as the best fit. In the present effort, data obtained in consolidated-drained triaxial tests and saturated direct shear tests have been modeled and used to analytically derive the probability density function (PDF) of the safety factor of a hypothetical slope based on Mohr-Coulomb rupture criterion. Therefore, based on this analysis, it is possible to explicitly derive the failure probability considering the friction angle as a random variable. Furthermore, it is possible to compare the stability analysis when the friction angle is modelled as a Dagum distribution (distribution that presented the best fit to the histogram) and as a Normal distribution. This comparison leads to relevant differences when analyzed in light of the risk management.

Keywords : statistical slope stability analysis, skew distributions, probability of failure, functions of random variables
Conference Title : ICSRD 2020 : International Conference on Scientific Research and Development
Conference Location : Chicago, United States
Conference Dates : December 12-13, 2020