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Rock slopes stability reliability assessment based on geometrical properties

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Abstract

Probabilistic analysis of rock slope stability has been used as an effective tool to evaluate uncertainty so prevalent in variables and has received considerable attention in the literature.Generally, uncertainties in the geometrical properties and rock parameters are two main observations in reliability assessment. In this research the geometrical properties are selected as stochastic variables for rock slope stability with plane sliding. The Monte Carlo simulation is employedin probabilistic analysis and reliability assessment. The selected stochastic parameters are angle of failure surface, height of the overall slope and angle of slope face, which are modeled using a truncated normal probability distribution function. The results show the safety factor has a distribution near normal.Sensitivity analysis and parametric study illustrate the angle of failure surface is the most effective parameter in rock slope stability with plane sliding.

Keywords: Reliability, Monte Carlo, Rock slope stability

1. INTRODUCTION

Stability of a slope is a random process that is dependent on the distributions of the controlling parameters which have probabilistic nature rather than being deterministic. Probabilistic evaluation of slope failures is increasingly seen as the most suitable framework for accounting for uncertainties in design. Generally, two main observations can be made concerning the existing body of work on this subject. The first common approach accounts for the uncertainty in the geometrical properties of the fracture network in the slope, and the second one considers uncertainties in the slope performance.
Many probabilistic techniques have been devised for analysis of stability of rock slopes with uncertain input parameters. These methods can be grouped into five categories: approximate methods, response surface method, stochastic finite element method, analytical methods, and Monte Carlo simulation.
Approximate methods are modified versions of three methods namely, Point Estimate Method (PEM) [1,2], First Order Second Moment reliability method (FOSM) [3] and First Order Reliability Method (FORM) [4]. All these approaches require knowledge of the mean and variance of all input variables as well as the performance