Dynamic Rock Slope Stability Analysis under Earthquake Loading Using Discontinuous Deformation Analysis

N. Hataf
Assistant Professor

R. Naderi
Ph. D.

A. Ghahramani
Professor
Department of Civil Engineering,
Shiraz University, Shiraz, I. R. Iran.

Abstract

This paper is intended to show the use of Discontinuous Deformation Analysis (DDA) in stability analysis of rock slopes. In general, static stability analysis methods for rock slopes are mainly derived from the limit equilibrium concepts that are very tedious in computation and not safe for dynamic loading. The Discontinuous Deformation Analysis (DDA) method that has been developed by Shi is one of the most advanced methods that can be applied in this case. To improve the capability of the Shi's method to meet the requirements for analysis of rock slopes under earthquake loading, some improvements have been applied to the original program. The main improvements are time dependent (time history) loading, damping and energy loss for which some numerical examples are presented to show the capabilities of the modified program.

Keywords

DDA, rock slopes, earthquake loading, damping

Introduction

The safety of rock slopes is one of the problems that a geotechnical engineer may encounter in civil engineering and mining projects. Various approaches have been proposed to analyze the stability of rock slopes, such as limit equilibrium approaches [1] and upper bound approaches [2]. Unfortunately, most of these analyses are not able to simulate structural discontinuities, such as joints in rock slopes and are limited to static loading conditions only.

In this paper the Discontinuous Deformation Analysis (DDA) method, which is able to simulate structural discontinuities, developed by Shi [3], has been modified to account for dynamic loading and used to analyze the stability of rock slopes under earthquake loading.

1-Discontinuous Deformation Analysis

Discontinuous Deformation Analysis (DDA) is a relatively new approach proposed to deal with media with structural discontinuities such as rock masses. DDA was first formulated by Shi and Goodman [4] and was applied by others to study the behavior of rock block systems [5, 6, 7, 8, 9].

In DDA method, the formulation of blocks is very similar to a finite element mesh. In the finite element method, all elements are physically isolated blocks with pre-determined discontinuities. The elements or blocks in DDA can be of any shape and the simultaneous equilibrium equations are selected and solved at each time increment.

2-Block Deformation and Displacement