PROCEEDINGS OF THE INTERNATIONAL SYMPOSIUM ON SLOPE STABILITY ENGINEERING – IS-SHIKOKU'99/MATSUYAMA/SHIKOKU/JAPAN/8-11 NOVEMBER 1999

Slope Stability Engineering, Yagi, Yamagami & Jiang© 1999 Balkema, Rotterdam, ISBN 90 5809 079 5

Numerical simulation of the buckling failure in rock slopes

Y. Hu & H.-G. Kempfert
Institute of Geotechnics, University of Kassel, Germany

ABSTRACT: The buckling of slope in jointed rock is a special failure mode. In this paper, a numerical method is presented simulating the buckling failure process of rock slope. The calculation model is based on the geometrically nonlinear theory and implemented by using finite element method. The discontinuity behavior is simulated using "joint element". A calculation example is illustrated for a slope in an open pit mining.

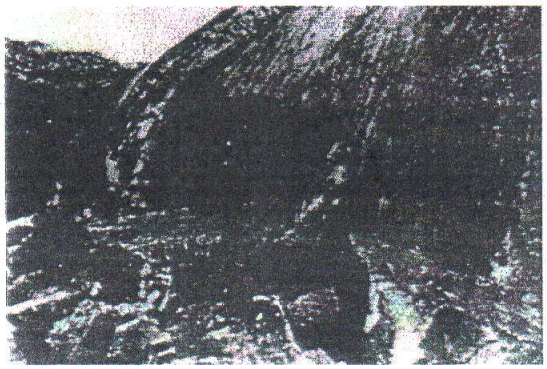
1 INTRODUCTION

It is well-known that the geological structure and strength of the rock discontinuities as well as its orientation with respect to the slope face are the essential factors to the failure of rock slope. The preexisting weak planes or discontinuities with unfavorable orientation are usually the failure surfaces of an unstable rock slope, whereas in soils it appears generally in the form of a circular arc. The pure sliding is predominately the failure mode in rock slope engineering. However, it was reported in the literature that the buckling failure of rock slope can occur if the rock mass contains one or more throughgoing discontinuities approximately parallel with the rock surface, see e.g. Fig. 1. This failure mode appears in sedimentary rocks containing slabs separated by bedding planes, and also in jointed rocks.

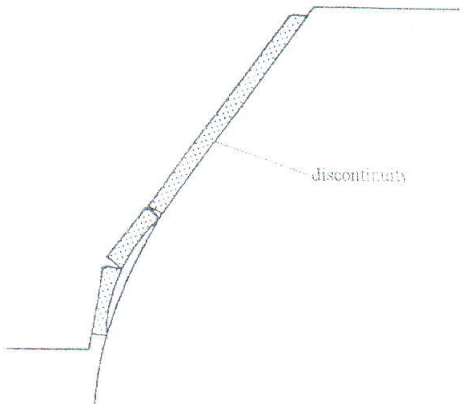
In general, the buckling failure may occur in the rock slopes, if the slope dips more steeply than the internal friction angle of the discontinuities parallel to the slope. The basic boundary conditions may be described as follows:

a) Major discontinuity set is parallel to slope face;
b) The spacing of discontinuity set is relatively small;
c) The discontinuities have a low friction angle smaller than slope angle.

Kutter (1974) as well as Hoek & Bray (1977) described and discussed the buckling failure of the



a) photograph of the buckling



b) three hinge buckling model

Figure 1. A buckling failure of sandstone strata in an open pit coal mine and modeling, from Cavers (1981).

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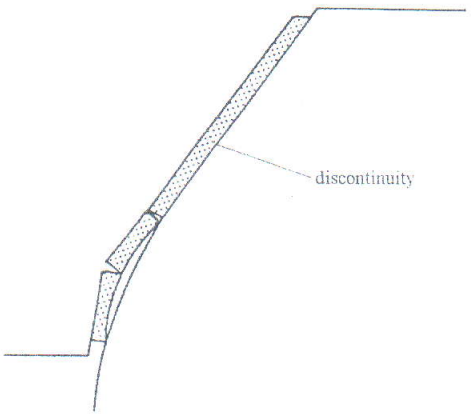

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