GRAPHICAL METHODS FOR SLOPE STABILITY ANALYSIS

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All figures quoted in the text are at the end of the lecture.
Introduction

Nature provided most rock masses with a three-dimensional structure of more or less planar character. This geologic structure differentiates between the rock element and the rock system composed of these elements. During the last decade it has been firmly established that the geologic structure is, in many cases, of decisive importance for the stability of man-made structures supported on or placed in rock. Conventional geotechnical stability analysis generally consider the sliding of rigid bodies along existing or newly formed planes of weakness in two dimensions only. Three-dimensional problems can be solved by means of analytical geometry, however, these approaches are often too sophisticated for the stability problems encountered in engineering practice.

This lecture covers the use of the hemispheric projection, generally considered to be a tool in mineralogy and structural geology, in combination with conventional engineering methods for the analysis of three-dimensional slope stability problems in jointed rock.

This set of lecture notes mainly consists of excerpts of three previous papers by this lecturer supplemented by an up-to-date listing of references on this specific topic. It should be noted that the material presented in this lecture is intended to serve as first introduction to the proposed approach. For further study specific reference is made to the recent paper by Hoek, Bray and Boyd.

Reference Hemisphere

The projection of the reference hemisphere is used to represent the spatial orientation of lines and/or planes and their angular relations to each other. Different types of such projections (also nets) are available, however, their use is not principally different. In each of these nets the orientation of a plane can be represented either by its pole (i.e. one point in the net) or by its great circle. The graphical details of such possibilities are given on Figs. 1 and 2. Conventional concepts of engineering mechanics, such as polygons of forces and shear strength along a plane surface, are combined with the basic graphic tool of the reference hemisphere to cover three-dimensional problems. The “friction cone” concept first proposed by Talobre represents the first of such combinations being utilized. It is briefly described and illustrated in Figs. 3 and 4.

Friction Cone by Talobre

The friction cone concept by J. Talobre is used in the approach