

Session theme: Determination of Rock Mass Properties (B)

## **Computer based Stability Analysis of Rock Slopes in a Blocky Rock Mass**

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### **ABSTRACT:**

A rock mass containing a considerable number of non-parallel discontinuities whose shear strength is low compared to the rock material is referred to as a blocky rock mass. The stability of slopes in such a rock mass predominantly depends on the characteristics of its discontinuity system. These characteristics include geometrical and mechanical properties. Geometrical properties are amongst others the orientation, spacing or persistence of the discontinuities, whereas mechanical properties particularly refer to properties which influence the shear strength of the discontinuities. In this paper a computer based analysis procedure is described which allows the engineer rapidly and consistently identifying potential unstable areas in a slope. The procedure is based on block theory including the identification of groups of keyblocks and the consideration of removability and rotatability.

The analysis starts with the definition of the slope geometry and the discontinuity system. For its accurate estimation the JointMetriX3D measurement and documentation system is used. This system allows contact-free 3D measurements of geometrical parameters. A digital panoramic camera acquires two images of an exposed rock face from which a highly detailed 3D image is computed. A software component allows analysing the 3D image by marking relevant structures, such as discontinuity sets. Orientations and trace lengths are directly measured on the 3D image and their distributions determined.

From the highly detailed 3D image a simplified calculation model is abstracted which meets the requirements for a keyblock analysis. It contains the relevant surface elements and the evaluated discontinuities. This allows the engineer to assess not only the current slope stability but also the effects of different excavation sequences and geometries with less modelling and calculation effort.

The applied algorithms process the discontinuity data. At first discontinuities which do not contribute to the formation of blocks, are removed from the model. Subsequently areas on the slope surface are identified which are completely surrounded by discontinuity traces. The joint and block pyramids corresponding to this areas are investigated with respect to their removability and rotatability. In this way critical areas with potential keyblocks and groups of keyblocks are identified.

An example illustrates the above described method. The assessment of the slope geometry and discontinuity system is shown on a 3D image of a natural rock slope. In a simulation for different excavation geometries the capabilities of this procedure with the abstracted calculation model are presented. In this case the result serves for the optimization of the excavation with respect to slope stability and blasting effort.

**KEYWORDS:** Discontinuity analysis, keyblock, excavation design, rock slope, contact-free measurement, trace length, orientation measurement