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Rockfall assessment of natural hazards by 3D-simulation

D. Tobler (1), K. Graf (2), and B. Krummenacher (3)

(1) GEOTEST AG, CH-3052 Zollikofen, +41 31 910 01 01, daniel.tobler@geotest.ch, (2) GEOTEST AG, CH-3052 Zollikofen, +41 31 910 01 01, kaspar.graf@geotest.ch, (3) GEOTEST AG, CH-7270 Davos, +41 81 420 15 59, bernhard.krummenacher@geotest.ch

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In mountain areas many residential areas as well as important lifelines are exposed to potential rockfall events. The assessment of the hazard potential in a complex morphology with changing surface parameters and inhomogeneous forestation, call for an in-depth analysis of the physical processes involved.
Therefore the different problems concerning the assessment of rockfall hazards have to be solved adequately. Moreover, due to the actual discussion about cost efficiency the planning of protective measures calls for (more) detailed information about the intensity and probability of expected rockfall incidents along a typical trajectory or for a given area.
Today simulation models like GEOTEST's – ROFMOD 4.1 (2D and 3D) are important tools for hazard assessment. This simulation model produces profiles and maps with intensity and range and allows to calculate decisive parameters for the dimensioning optimized positioning of protection measures.

Within the impact analysis the relevant scenarios according to their intensities are determined using a 3D rockfall model. It calculates the trajectories of rock-bodies with realistic forms based on physical laws from defined starting points within the mapped rock area as well as steep slopes with loose blocks. The movement is of any chosen particle with defined axis length ratio, rounding and specific weight is strongly influenced by the spatial resolution of the digital terrain model (DTM as well as the interaction with the underground and possible tree-impacts).
Therefore, the following parameters are implemented in the rockfall model: geometry of blocks, underground plasticity (value of attenuation), surface roughness as well as forest quality (amount of trees per area (ha) and trunk diameter). A very important aspect is the geometry of the blocks. For realistic results only a simulation with real block shapes will be sucessful. For these deterministic models the falling rocks are categorized by their mass and the block dimensions in the three axes. The block volume and the moments of inertia are then defined using a sphericity (roundness) factor classifying the block to a volumetric body with a shape between a cube and an ellipsoid which are the two extreme shapes for the given dimensions.

The aim of this presentation is to explain the kernel of the software ROFMOD 4.1 (2D- and 3D-model) describing the detailed implementation of the physical basis as well as the empirical assumptions into the programming code. Further the application for two different actual case studies will be presented. These studies include all important steps from field investigation to modelling and the design of best fit protection measures.