Geophysical Research Abstracts, Vol. 8, 00138, 2006
SRef-ID: 1607-7962/gra/EGU06-A-00138

Design of rockfall protection galleries

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Concrete protection galleries are generally used in mountainous regions to protect the local infrastructure and lifelines against potential rock impacts. Rockfall impact energies can reach magnitudes of the order of millions of Joules, requiring understanding of the energy absorption mechanisms at high energy levels for improved design of the gallery. The high rock impact energy ranges are difficult to model at the laboratory scale. Field tests are generally avoided due to the high costs involved and also due to the singularity of the potential tests. These prototype high-energy ranges can be achieved at the laboratory scale with the help of a geotechnical centrifuge. Different cushion materials have been modelled in centrifuge against vertical and inclined impacts of rock with variations such as mass, fall height, type of rock, thickness and construction of cushion materials on the gallery up to input energy levels of 20 MJ. Innovative solutions have been proposed for the cushion materials that are laid on these galleries to absorb the rockfall impact energy, as it is one of the main input parameters in the design of the protection gallery. A finite element model (LS-DYNA) is used to model the rock impact on different cushion materials. The results from the centrifuge tests and numerical modelling for different cushion materials are compared and discussed in this paper. The paper concludes with a proposal of new design concept for the rockfall protection galleries and the recommendations for the best cushion materials depending upon the topography of the rock slope.