Geophysical Research Abstracts, Vol. 8, 04616, 2006
SRef-ID: 1607-7962/gra/EGU06-A-04616

Impact behaviour of innovative rockfall protection cellular structures: experiments and modelling

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Rock fall protection dams are largely used to intercept medium to high energy falling blocks. Their design generally rests on an empirical approach due to a lack of knowledge of the structure response during the impact. The purpose of the study is to improve the behavioural analysis and the design of cellular rockfall barriers. This innovative kind of rock fall protection structure is made of an assembly of wire netting cells filled with granular materials. The main targeted advantages for such structures are functional adaptability, easy reparability, limited covered area and cost-efficiency.

The assessment of the cellular structure response is based on a multi-scaled approach coupling experiments together with numerical modelling. The main concern here is the behaviour of single cells impacted by a boulder. Cubic cells, 1m and 0.5m in height and filled with crushed limestone, were impacted by a 250kg spherical boulder dropped from height varying from 3 to 7m. The cell was placed on a pedestal made of concrete. During the impact the lateral faces of the cell were either free to deform or confined. Measurements made during the impact were the boulder centre acceleration and the force transmitted by the cell to the pedestal. Results exhibited the influence of drop height, cell size and limit conditions.

These experimental data were then compared to data given by the developed cell numerical model. The DEM model was developed under quasi-static loading before being used for impact simulations. The results of numerical impact simulations were compared with experimental ones, showing a good agreement from both qualitative and quantitative points of view. This validation of the proposed cell model allows considering it for integration in the whole structure.