Geophysical Research Abstracts
Vol. 18, EGU2016-5323, 2016
EGU General Assembly 2016

A new rapid method for rockfall energies and distances estimation

Anna Giacomini (1), Federica Ferrari (1), Klaus Thoeni (1), and Cedric Lambert (2)

(1) Centre for Geotechnical & Materials Modelling, The University of Newcastle, School of Engineering, Callghan, Australia, (2) Golder Associates (NZ) Limited, Christchurch, New Zealand

Rockfalls are characterized by long travel distances and significant energies. Over the last decades, three main methods have been proposed in the literature to assess the rockfall runout: empirical, process-based and GIS-based methods (Dorren, 2003). Process-based methods take into account the physics of rockfall by simulating the motion of a falling rock along a slope and they are generally based on a probabilistic rockfall modelling approach that allows for taking into account the uncertainties associated with the rockfall phenomenon. Their application has the advantage of evaluating the energies, bounce heights and distances along the path of a falling block, hence providing valuable information for the design of mitigation measures (Agliardi et al., 2009), however, the implementation of rockfall simulations can be time-consuming and data-demanding.

This work focuses on the development of a new methodology for estimating the expected kinetic energies and distances of the first impact at the base of a rock cliff, subject to the conditions that the geometry of the cliff and the properties of the representative block are known. The method is based on an extensive two-dimensional sensitivity analysis, conducted by means of kinematic simulations based on probabilistic modelling of two-dimensional rockfall trajectories (Ferrari et al., 2016). To take into account for the uncertainty associated with the estimation of the input parameters, the study was based on 78400 rockfall scenarios performed by systematically varying the input parameters that are likely to affect the block trajectory, its energy and distance at the base of the rock wall. The variation of the geometry of the rock cliff (in terms of height and slope angle), the roughness of the rock surface and the properties of the outcropping material were considered. A simplified and idealized rock wall geometry was adopted. The analysis of the results allowed finding empirical laws that relate impact energies and distances at the base to block and slope features. The validation of the proposed approach was conducted by comparing predictions to experimental data collected in the field and gathered from the scientific literature.

The method can be used for both natural and constructed slopes and easily extended to more complicated and articulated slope geometries. The study shows its great potential for a quick qualitative hazard assessment providing indication about impact energy and horizontal distance of the first impact at the base of a rock cliff. Nevertheless, its application cannot substitute a more detailed quantitative analysis required for site-specific design of mitigation measures.

Acknowledgements
The authors gratefully acknowledge the financial support of the Australian Coal Association Research Program (ACARP).

References

Dorren, L.K.A. (2003) A review of rockfall mechanics and modelling approaches, Progress in Physical Geography 27(1), 69–87.

Agliardi, F., Crosta, G.B., Frattini, P. (2009) Integrating rockfall risk assessment and countermeasure design by 3D modelling techniques. Natural Hazards and Earth System Sciences 9(4), 1059–1073.

Ferrari, F., Thoeni, K., Giacomini, A., Lambert, C. (2016) A rapid approach to estimate the rockfall energies and distances at the base of rock cliffs. Georisk, DOI: 10.1080/17499518.2016.1139729.