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PREDICTIONS OF ROCK FALL TRAJECTORIES USING DISCRETE ELEMENT AND LUMPED MASS MODELLING METHODS

Dwayne D. Tannant, Dept. of Civil & Environmental Engineering, University of Alberta, Edmonton, Canada
Caigen Wang, Dept. of Civil & Environmental Engineering, University of Alberta, Edmonton, Canada

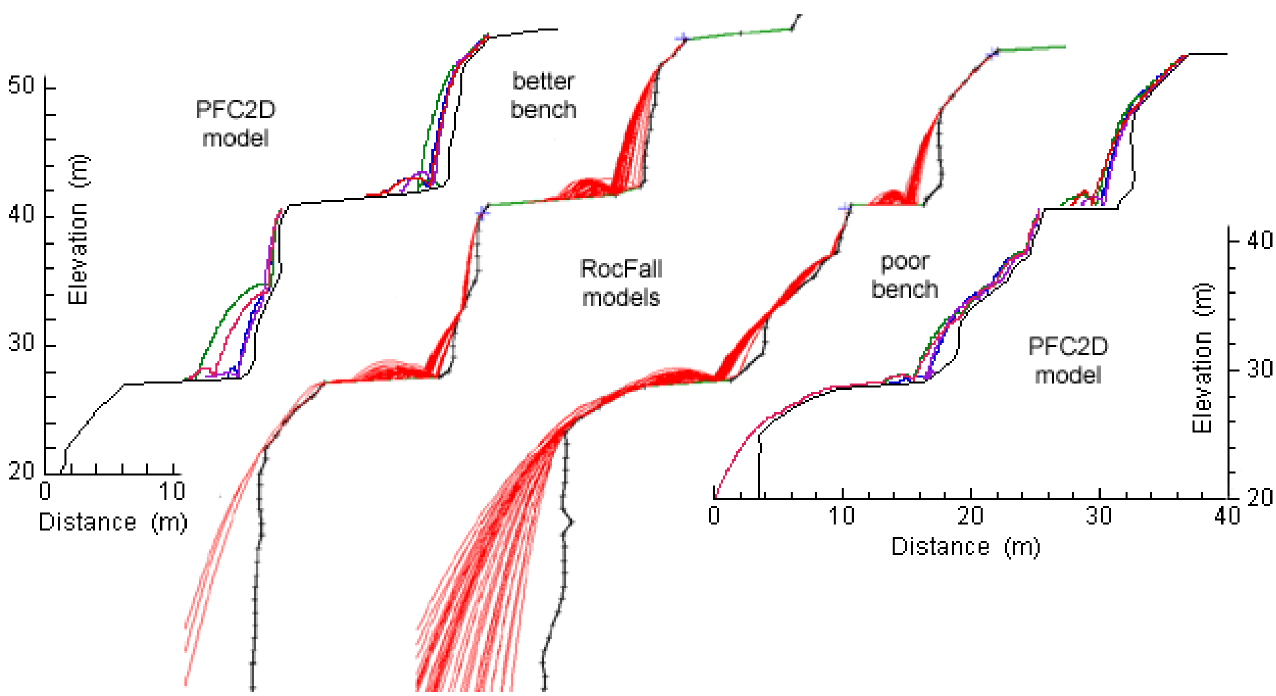
Extended Abstract

Two techniques to model the trajectory of a rock fall are compared. In one case, a lumped mass model (RocFall) is used. In the other case, a general discrete element model (PCF2D) is used. With the discrete element model, a falling rock may be represented by a single element, much like the lumped mass model. However, a falling rock can also be simulated by a clump of elements. This offers a number of advantages: the rock can take more a complicated shape, angular momentum can be considered, and the rock itself can be allowed to fragment into smaller pieces as it travels down a slope. The techniques in which energy is removed from the falling rock during impact and sliding/rolling differ for each modeling approach.

The analysis of a rock fall trajectory in a lumped mass model is sensitive to choices of tangential and normal coefficients of restitution as well as the friction angle defining the transition between free flight and rolling or sliding behaviour. The coefficients of restitution are used to remove kinetic energy from a falling rock. This energy is assumed consumed during impact or sliding by non-elastic processes. In the discrete element method, coefficients of restitution are not used. To remove energy from the falling rock, contact relationships involving different values of stiffness during the loading and unloading phases of impact can be invoked. Another approach to is to adjust the damping coefficient to match observed heights of rock rebounds after impact.

Two bench profiles from an open pit mine located in a well-jointed granitic rock are used as case histories. One profile experienced numerous wedge failures along joints creating relatively narrow bench widths and irregular bench faces. The other profile was taken from a section of the open pit where the benches and bench faces were in fair condition.

The figure below shows rock fall trajectories predicted by the PFC2D and RocFall models. Qualitatively the results are similar. The different trajectories from the RocFall model arise from a Monte Carlo simulation where the slope profile and the coefficients of restitution vary slightly. The different trajectories from the PCF2D model occur when the shape of the rock is varied. Four rock shapes were tested, ranging from a single circular element to clusters of circular elements. The clusters were made from equal size circular elements and included a pair, three and seven elements joined together to form a single rock of varying shape but similar overall mass.



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