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A Discrete Element Method-Based Simulation of Toppling Failure Considering Block Interaction

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Abstract : The toppling failure mode in a rock mass is considerably different from the most common sliding failure type along an existing or an induced slip plane. Block toppling is observed in a rock mass which consists of both a widely-spaced basal cross-joint set and a closely-spaced discontinuity set dipping into the slope. For this case, failure occurs when the structure cannot bear the tensile portion of bending stress, and the columns or blocks overturn by their own weight. This paper presents a particle-based discrete element model of rock blocks subjected to a toppling failure where geometric conditions and interaction among blocks are investigated. A series of parametric studies have been conducted on particles' size, arrangement and bond contact among of particles which are made the blocks. Firstly, a numerical investigation on a one-block system was verified. Afterward, a slope consisting of multi-blocks was developed to study toppling failure and interaction forces between blocks. The results show that the formation of blocks, especially between the block and basal plane surface, can change the process of failure. The results also demonstrate that the initial configuration of particles used to form the blocks has a significant role in achieving accurate simulation results. The size of particles and bond contacts have a considerable influence to change the progress of toppling failure.

Keywords : block toppling failure, contact interaction, discrete element, particle size, random generation
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