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Numerical modeling of Collapsing Processes of Granular Slopes

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Collapses of granular materials frequently occur in nature in the form of, for example, rock avalanches, flow slides, debris avalanches and debris flow. It is of great importance to understand the kinematics and dynamics of this kind of rapid movement of granular materials. In this study, numerical model results of the collapse of granular slopes are presented using Particle Flow Method, focusing on kinematics and internal deformation structures of granular slopes during its collapsing processes. A series of numerical models are designed to simulate the whole collapsing processes of granular slopes with different runout bases. Numerical model results show that the granular slopes collapse along different-generation failure surfaces in the rear of the failure mass. The first-generation failure surface (dipping about 60º) cut across the entire stratigraphy of the slope, and involve the bulk volume of the failure mass. In contrast, the later-generation failure surfaces (dipping about 40º) cut only across the shallow units, and involve less amount of the failure mass. Results of numerical slope models show that displacement of different-generation failure surfaces increase with time during the collapsing processes of granular slopes. The later-generation failure surfaces accommodate significantly larger displacement than the first-generation failure surface. Model results also show that the nature of the runout base has a significant influence on the runout distance, topography and internal structures within the failure mass. Numerical model results are in good agreement with the previous physical model results. Numerical model results confirm the presence of different pulses which collapsed along different-generation failure surfaces at different stages, which have been observed in the physical slope models.

Keywords: Granular slopes; faults; Numerical models; Physical models; Particle Flow Code