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Original
A DEM evaluation of the clogging probability of debris-flow barriers: from the contact parameters to the overall interaction mechanism / Leonardi, A.; Pirulli, M.. - ELETTRONICO. - (2018), pp. 1-1. ((Intervento presentato al convegno International Workshop Accounting for phase transition in granular media: from micromechanics to macroscopic unified modeling tenutosi a Milano (Italy) nel 6-7 September 2018.

Availability:
This version is available at: 11583/2972093 since: 2022-10-05T12:06:17Z

Publisher:
Politecnico di Milano

Published
DOI:

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29 March 2023

A DEM evaluation of the clogging probability of debris-flow barriers: from the contact parameters to the overall interaction mechanism

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In this work, we study the interaction between geophysical phenomena such as debris flow, and retention structures. We propose a numerical tool based on the Discrete Element Method, where the frictional nature of natural grains is reproduced through the implementation of frictional contacts and rolling resistance. The relationship between the contact parameters and the overall behavior of the granular mass is investigated through a set of heap-formation calibration tests, which allow to track the transition from a fluid regime to stable granular structures. The information gathered in the calibration tests is then used to study the stoppage of a granular flow on an incline. This is induced by placing a slit dam with a single vertical opening. The relative size between slit opening and grain diameter determines the overall efficiency of the retention, but also the basal friction controlled by the channel inclination plays a vital role. Numerous threshold are in this way obtained. The grains clog instantly for small relative opening sizes, and flow freely when a very large slit is used. Two secondary thresholds exist in the intermediate range, corresponding to a partial release of the mass through multiple consecutive clogging and ruptures of the grains behind the slit, and to the delayed formation of a single two-dimensional arch at the base. The consequences for the design of structures of this type are then discussed.
