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Debris-flow interaction with slit barriers: efficiency and clogging mechanism

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The design of structures for debris flow mitigation is still mostly based on the application of simple, empirical formulas. Standard practice suggests that slit structures might be a convenient solution for partially stopping the flow by filtering out the largest grains, which represent the most hazardous component. However, efforts towards the development of rational approaches for the design of the abovementioned structures have been hindered by the complexity of the debris materials. The interaction between a granular flow composed of monodisperse grains and a slit barrier is in this work reproduced by a discrete numerical model. The model is validated by comparison with a set of experimental runs with an analogous geometry. While the model greatly simplifies reality, it is anyway able to give insight in how clogging, and eventually stoppage, develops. Traditionally, the slit size is prescribed by choosing a multiple of the desired grain size to be stopped. The results highlight how stoppage can be achieved with a relatively wide range of possible slit openings. A family of recurring behaviors is observed, depending on the amount of entrained material and on whether stoppage is instantaneous or delayed. Finally, the initial assumptions are relaxed by moving to a bi-disperse flow. The results of the monodisperse case can be generalized to the bi-disperse case by definition of an equivalent radius.

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