EGU21-15407
https://doi.org/10.5194/egusphere-egu21-15407
EGU General Assembly 2021

Clogging mechanisms of filter barriers against debris-flow hazard

Filippo Mauro, Alessandro Leonardi, and Marina Pirulli
Politecnico di Torino, Structural, Building and Geotechnical Engineering, Italy (filippo.mauro@polito.it)

Debris flows are amongst the most hazardous landslide phenomena (Jakob & Hungr, 2005). They are mixtures of flowing water and granular materials, which range in size from microscopic soil particles to massive rock boulders. Due to their unpredictability and rapidity, they pose severe hazard on infrastructure, structures, and human lives. To dissipate the destructive kinetic energy of debris flows and induce deposition of the coarsest fraction of the flow, mitigation systems often include the use of filter barriers. Filter barriers are built both in steel and reinforced concrete, and their openings should be designed according to a reference grain diameter. This key parameter is often chosen arbitrarily due to the difficulties in considering the full grain size distribution of the deposit. Sufficiently small outlets, however, leads to premature clogging of the barriers, blocking further outflow (Ashour et al., 2017). This can result in excessive maintenance costs.

This work focuses on the clogging mechanism of three different kinds of filter barriers: nets, slit dams, and slot dams. The aim is to evaluate the influence of grainsize dispersity into the clogging/non-clogging transition. Starting from simpler monodisperse granular material, we determine via DEM simulations the particle diameter D that induces clogging in the openings, as a function of the opening size S. Thus, for monodisperse grains, a set of threshold values for S/D can be detected: on one side of the threshold the particles are too small to clog the opening, on the other side they are too large to allow free passage of the material.

However, natural debris deposits are far from uniform. To analyse the role of grainsize dispersity, bidisperse specimens are created mixing grains with two different diameters: a small diameter and a large diameter. By varying the composition of large and small particles, a transition is observed between clogging and free-flow, in analogy with what obtained in the simulation with monodisperse grains. The comparison of results obtained with bidisperse and monodisperse samples indicates that an analogy in terms of trends and thresholds exists, as long as an equivalent diameter D* is introduced for bidisperse mixtures (Marchelli, 2018). This parameter is therefore suggested as the reference diameter to be adopted in the barrier design.