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Experimental test for the calibration of an analytical model for flexible debris flow barrier design

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Debris flows are rapid mass movements composed by a mixture of solid particles of various sizes and water, generally originated from collapses (landslide, erosions etc.) associated with extreme meteorological events.
In order to protect the territory and prevent victims, it is important to better understand the behaviour of the protection system under the influence of these flows. For this purpose, Brighenti et al. (2013) proposed a simplified analytical model with the aim of estimating the forces acting on the supporting cables, knowing the geometry and the mechanical characteristics of the flexible debris flow barrier along with the characteristics of the debris flow at the impact. The most difficult aspect encountered in the application of the simplified model regarded the verification and calibration of the model parameters, due to the limited amount of data available in the literature. In particular, the estimate of the dynamic pressure coefficient α is complex due to its dependence from debris flow characteristics and barrier geometry, stiffness and permeability. The other input parameters are related to the net geometry and stiffness that governs the forces distribution between the different structural cables at different time during the impact. Ferrero et al. (2015) presented the results of a real scale static test from which some of the required input parameters were derived. This study presents some preliminary results obtained from laboratory flume impact tests carried out by the Authors. The first series of tests regarded the impact of a flume debris flow against a scaled physical model of the barrier. A debris flow composed of aggregates of known particle size was released in a channel with variable inclination and known length and height. Using this experimental setup, several tests were carried out by varying the inclination of the channel: the flow velocity was monitored using a PIV camera (Particle Image Velocimetry), the height of the flow was monitored using ultrasonic level sensors and the forces on ropes were recorded using load cells.
In order to determine the required mechanical parameter for the barrier, the Authors carried out in laboratory the same test procedure proposed by Ferrero et al. (2015) on site. Different static load combinations were imposed on each structural cable of the scaled barrier and the induced deformations were measured using a theodolite. This allowed the Authors to study how the load on each single cable influenced the deformation of the others. The results of this experimental study are very useful and can be taken as a good starting point for the application of the simplified analytical model for the analysis of real cases.