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Debris Flow Risk mitigation by the means of flexible barriers. Experimental and field tests.

l canelli, a.m. ferrero, and a. segalini
University of Parma, DICATeA, 43100, Parma, Italy (margheritaferrero@yahoo.it)

Debris flow risk mitigation using net barriers is an option that was not considered until few years ago, probably because of the lack of scientific evidences about their efficiency and solid guidelines for their design and construction.
On site evidences (Segalini et al, 2008) showed that a rock fall deformable barrier can efficiently intercept the whole volume or just a portion of the mobilized debris without losing its stability and efficiency, actually performing a different task form that it was originally designed for.
Although the final purpose of both types of barriers (rock fall and debris) is to reduce the impact energy of the moving mass by dissipating impact energy through the deformation of the net and of the dissipating elements, it is noteworthy that the physics of the impact is extremely different between the two phenomena. The rock fall barrier needs to dissipate the energy of a single block generally concentrated on the center of the net panel (design conditions). The debris flow barrier, generally installed inside a debris channel, should be able to dissipate the impact energy that the debris induces across the whole section of the channel. Moreover, the recurring characteristic of the debris flows will cause multiple impact on the barrier and therefore, the structure should be able to absorb a significant amount of energy even if partially filled and considerably deformed.
In order to introduce useful guidelines for the design and production of debris flow net barriers, this paper describes:
1. Part of the results obtained from the laboratory experiment carried out in a scaled channel and aimed to estimate the most realistic thrust vs time relationship induced by a debris flow on a deformable and rigid structure; these results were partially presented last year at the EGU 2011;
2. A large scale field test carried out in a quarry located in Tambre d'Alpago (Belluno Province) on the Eastern Italian Dolomites for the analysis of the behavior of a real scale deformable net barrier subjected to recurring impacts of small volumes, substantially dry, debris flows until the complete filling up of the channel.

Laboratory tests were carried out using a small scale channel (40 cm wide channel and 4 m long) designed and installed at University of Parma in which were triggered flows of water saturated sand impacting with different typologies of barriers installed in order to measure the impact force of the generated flow.

The field test has been conducted by artificially mobilizing volumes of quarry debris along a 50 m long and 2 m wide channel at the end of which a real scale deformable net barrier was installed. The impacts were monitored using five high speed video cameras, the deformation progress of the barrier induced by the impacts was obtained using two high shutter speed cameras configured and synchronized for a stereoscopic restitution. Forces on the structural steel cables where measured by installing five load cells between the cable and its foundation.

Results obtained are presented and compared with the relevant literature.