

# Load model for designing flexible steel barriers for debris flow mitigation

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**Abstract:** Light-weight flexible steel net barriers catch coarse debris but let some of the fine material and water pass through the net. They are difficult to design to withstand the impact pressures of both boulder-laden granular and water-saturated debris flows. Using the results from laboratory and full-scale field tests, we have developed a debris flow load model for flexible barriers in torrent channels. The model accounts for the forces of initial impact as well as the filling process discretized stepwise over time (barriers in the field and laboratory fill continuously). Laboratory tests with fast debris flow front velocities revealed a run-up behaviour that was not observed in the field ("pile-up"). The load model divides the flow forces into a hydrostatic component and a dynamic part depending on a pressure coefficient, the flow velocity and the density of the flow. This dynamic part, which is more complex to quantify, accounts for the wide-ranging debris flow characteristics from watery and muddy debris floods to granular friction-dominated mass flows.

*Key words:* debris flows, load model, mitigation, protection, flexible barrier.

## 1. Introduction

An increasingly used measure to protect settlements and infrastructure from debris flow hazards is to install retention nets near mountain torrents (DeNatale, 1999; Wendeler, 2008; Canelli et al., 2012;

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