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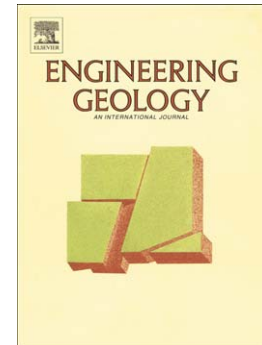
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Xiaoqing Chen, Peng Cui, Yong You, Jiangang Chen, Deji Li

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## Engineering measures for debris flow hazard mitigation in the Wenchuan earthquake area

Xiaoqing Chen<sup>\*</sup>, Peng Cui, Yong You, Jiangan Chen, Deji Li

Key Laboratory of Mountain Hazards and Earth Surface Processes, Chinese Academy of Sciences, Chengdu, China; Institute of Mountain Hazards and Environment, Chinese Academy of Sciences and Ministry of Water Conservancy, Chengdu 610041, Sichuan, China.

<sup>\*</sup>Corresponding author: Institute of Mountain Hazards and Environment, CAS, #.9, Block 4, Renminnanlu Road, Chengdu, 610041, China.

E-mail: xqchen@imde.ac.cn

**Abstract:** Avalanches and landslides caused by the Wenchuan earthquake in the Longmen Mountains area provide abundant loose solids for debris flows, and a large number of debris flows has occurred during the period 2008-2012. The engineering measures in certain gullies failed, causing serious damage and loss of life. Judging from the debris flow characteristics in the Wenchuan earthquake area, engineering measures should be better constructed after the active period of debris flows in severely affected areas. To reduce debris flow disasters, this paper proposes a mitigation method and design principle based on the transport capacity of the main river. A series of check dams with various opening sizes was designed by investigating and analyzing existing cases. Furthermore, a new type of drainage channel with prefabricated reinforced concrete boxes is proposed. Finally, a case study of the Xiaogangjian Gully, which is a typical debris flow gully in the Wenchuan earthquake area, is presented. This system of engineering measures is based on the main river's transport capacity and consists of five check dams with various opening sizes, a drainage channel with sidewalls constructed of prefabricated reinforced concrete boxes, and a debris flow basin at the base of the main gully. The debris flow mitigation measures installed in the Xiaogangjian Gully effectively resisted a debris flow with a 50-year return period that was triggered by rainfall on July 26, 2012. Specifically, these measures effectively protected a highway and minimized debris flow damage. Thus, the layout and engineered structures involved in this new engineering technique can provide a reference design for debris flow hazard mitigation.

**Key words:** debris flow, engineering measures, drainage channel, check dam, Wenchuan earthquake

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