

## 优势结构面控制的岩质边坡强震破坏机制研究

鲁功达<sup>①</sup>, 晏鄂川<sup>①</sup>, 赵建军<sup>②</sup>, 姜胜来<sup>①</sup>

①中国地质大学(武汉)工程学院 武汉 430074;

②成都理工大学地质灾害防治与地质环境保护国家重点实验室 成都 610059

## FAILURE MECHANISM OF PREFERRED STRUCTURE PLANE CONTROLLED LITHOLOGIC SLOPE DURING INTENSIVE EARTHQUAKE

LU Gongda<sup>①</sup>, YAN Echuan<sup>①</sup>, ZHAO Jianjun<sup>②</sup>, JIANG Shenglai<sup>①</sup>

①Faculty of Engineering, China University of Geoscience(Wuhan),Wuhan 430074

②State Key Laboratory of Geohazard Prevention and Geoenvironment Protection, Chengdu University of Technology, Chengdu 610059

- 摘要
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**摘要** 据统计,由地震所造成的损失中,地震所诱发的滑坡和崩塌造成的损失约占40%。对于地震作用下斜坡变形破坏的类型与机制,前人已有大量的研究和归纳,然而对此问题的数值模拟研究则少有涉及。四川省什邡市北部山区在5·12汶川地震中烈度达到11度,遥感解译出的地震诱发崩塌地质灾害点达161处,其破坏机制主要有顺层-切层滑坡和滑移式崩塌2种形式。本文针对这一地区2种典型滑坡地质灾害,利用赤平投影图分析方法确定边坡的控稳优势结构面组合,在此基础上用离散元数值模拟软件对其失稳过程进行数值模拟计算,分析结果显示:第1种斜坡破坏类型表现为缓倾坡外层状结构斜坡在强震作用下,坡顶首先出现拉裂,斜坡中部的结构面发生剪切变形,随着斜坡上部拉裂面向中部不断延伸并贯通,滑体便从高位沿中部缓倾结构面快速剪出。这种斜坡的变形破坏力学机制为滑移-拉裂,其破坏方式为顺层-切层滑坡。第2种斜坡破坏类型表现为高陡块状结构斜坡在强震作用下,斜坡上部结构面首先被拉裂,发生松动,被切割的块体沿拉裂面底端缓倾坡内或水平的结构面向外产生剪切变形,并在持续地震力作用下不断向坡外运动,以翻滚、崩塌的方式运动至坡脚。这种结构类型斜坡的变形破坏力学机制为拉裂-滑移,其破坏方式为滑移式崩塌。

**关键词:** 优势结构面 地震 斜坡结构 离散元数值模拟 破坏机制

**Abstract:** According to statistics, the damage caused by earthquake-induced landslides and collapses can account for about 40% of all that causes by earthquake. As for the mechanisms and modes of slope deformation and failure under seismic force, a lot of previous theories and achievements have been reached. But, numerical simulation research is limited. The seismic intensity of the northern mountainous area of Shifang City, Sichuan province reached 11 degrees during the 5.12 Wenchuan earthquake. The remote sensing system had interpreted up to 161 sites of geological hazards induced by that. Their basic failure modes are bedding-layer cutting slides and slipping collapses. This paper considered two typical geo-hazards triggered by the 5.12 Wenchuan earthquake, and analyzed their stereographic projection. It worked out the combination modes of preferred structure planes which controlled the slope stability. Then it applied numerical simulation with discrete elements software to simulate their process of failure. The results show the following two failure modes. The first mode of slope failure during earthquake is that, the layered slopes that dip gently outwards crack its top at first, meanwhile the structure planes inside the slope start to undergo shear deformation. As the cracks on the top extend downwards and when these cracks reach the structure planes dip outwards inside the slope, the entire slope will slide along those connected planes. Their deformation and failure mechanism is slide-rip. Their mode of failure is bedding-layer cutting slide. The second mode of slope failure during earthquake is as follows. The steep block slopes crack their tops and loose themselves at first. Then the blocks cut and formed by structure planes start to undergo shear deformation along the structure planes which dip gently inwards or horizontal at the bottom of those tensile cracks. Then these blocks gradually slip outwards due to the durative earthquake, roll and fall down the slopes. Their deformation and failure mechanism is rip-slip. Their mode of failure is slipping collapse.

**Key words:** Preferred structure plane Earthquake Slope fabric Numerical simulation with discrete elements method Failure mechanism

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