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地震波作用下崩塌影响因素及破坏机制分析

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ANALYSIS OF COLLAPSE EFFECT FACTORS AND FAILURE MECHANISM UNDER SEISMIC WAVE FUNCTION

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摘要 汶川地震触发了大量崩塌、滑坡等次生地质灾害,位于卧龙熊猫苑圈舍后山崩塌就是1处典型的震动触发破坏。崩塌区域距离震源点较近,地震作用是导致崩塌破坏的主控外在因素; 而地形地貌和岩体结构特征是关键的内在影响因素。在现场调查和室内试验的基础上,采用离散元计算软件对坡体在地震作用下的动力响应特征进行数值模拟,以获得坡体的崩塌破坏机制、优势震裂区域和控制性因素。数值模拟结果表明:(1)地震纵横波的耦合作用引起的对岩体的拉压和剪切是崩塌的直接动力; (2)在地震波作用初期,近于陡立节理最先产生拉张破坏,形成楔形裂缝,并从坡表向坡内延伸,后期,由于倾向坡外节理和层面的存在,裂解的块体向坡外倾倒和滑移,整体形似弯曲状,并产生整体失稳; (3)由于地震惯性力效应,表层的震裂岩体在崩塌开始时是具备一定初始速度的,这也是地震诱发崩塌破坏影响范围较大的主要原因之一。对于类似坡体的潜在崩塌破坏的防治应以对陡倾裂隙的加固防治为主并结合坡肩的加强支护。

关键词: 地震波 优势震裂区域 崩塌破坏机制 离散元

Abstract: The Wenchuan Earthquake triggered a large number of collapses,landslides and other secondary disasters which caused serious loss of life and property.Among them,the mountain collapse in the back of Panda Garden rearing sheds located in Wolong was a typical shock-triggered damage.Because the collapse region is relatively close to the focal point of the earthquake,the seismic action is a master external factor affecting collapse damage.The topography and rock mass structure are the most critical factors in the internal factors.Based on the field investigation and laboratory tests,the slope dynamic response characteristics is simulated using the calculation software of discrete element to obtain the collapse failure mechanism,advantage-shattering region and controlling factors.The simulation results are showed as follows: (1)the combined action of the tension,compression and shear which are caused by coupling of primary wave and secondary wave, is the direct driving force of the collapse damage.(2)in the early stage of seismic action,the first tensile failure generates in the group of tectonic joints with near steep dip angle and forms a wedge-shaped crack extending from the outside to the inside.Later stage,because the second tectonic group of joints and bedding plane trend to outside of slope,the collapse instability of the shattered and cracked rock blocks occurs in the ways of dumping and slippage outside.The slope looks like curved shape and produce overall instability.(3)Due to inertia effect of the earthquake,the collapse of the shattered and cracked rock in the surface starts with some initial velocity.This is one of the main reasons why earthquake-induced collapse has larger destructive influence scope.The prevention for the potential collapse damage of similar slope should be mainly based on reinforcement of steep structural plane,combining the strengthening of the slope shoulder support.

Key words: Seismic wave Advantage-shattering region Collapse failure mechanism Discrete element

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[1] 黄润秋. 汶川地震地质灾害研究[M].北京:科学出版社, 2009.

[2] Huang Runqiu.Large-scale Landslides Induced by the Wenchuan Earthquake.Beijing,Science Press, 2009.

[3] 许强, 黄润秋. 5·12 汶川大地震诱发大型崩滑灾害动力特征初探[J].工程地质学报, 2008, 16 (6): 721~729. 浏览

Xu Qiang,Huang Runqiu.Kinetics charateristics of large landslides triggered by May 12th Wenchuan earthquake.Journal of Engineering Geology, 2008, 16 (6): 721~729. 浏览

[4] 许强. 汶川大地震诱发地质灾害主要类型与特征研究[J].地质灾害与环境保护, 2009, 20 (2): 86~93.

Xu Qiang.Main types and characteristics of the geo-hazards triggered by the Wenchuan earthquake.Journal of Geological Hazards and Environment Preservation, 2009, 20 (2): 86~93.

[5] 黄润秋. 汶川8.0级地震触发崩滑灾害机制及其地质力学模式[J].岩石力学与工程学报, 2009, 28 (6): 1239~1249.

Huang Runqiu.Mechanism and geomechanical modes of landslide hazards triggered by Wenchuan 8.0 earthquake.Chinese Journal of Rock Mechanics and Engineering, 2009, 28 (6): 1239~1249.

[6] 殷跃平. 汶川八级地震地质灾害研究[J].工程地质学报, 2008, 16 (4): 433~444. 浏览

Yin Yueping.Reserches on the geo-hazards triggered by Wenchuan earthquake,Sichuan.Journal of Engineering Geology, 2008, 16 (4): 433~444. 浏览

[7] 殷跃平. 汶川八级地震滑坡特征分析[J].工程地质学报, 2009, 17 (1): 29~38. 浏览

Yin Yueping.Features of Landslides Triggered by the Wenchuan earthquake.Journal of Engineering Geology, 2009, 17 (1): 29~38. 浏览

[8] 袁仁茂, 谭锡斌,陈桂华,等.地震破裂带特殊部位大型滑坡及其基于构造地貌发生模型的机制解释: 以东河口抛射型滑坡为例[J].地学前缘, 2010, 17 (5): 243~253.

Yuan Renmao,Tan Xibin,Chen Guihua,et al.Huge landslides occurred at the special places of the coseismic rupture and their mechanism explanation based on the formation model of tectonic-geomorphology: A case study of Donghekou ejection landslide.Earth Science Frontiers, 2010, 17 (5): 243~253.

[9] 殷鑫铭. 熊猫苑圈舍后山崩塌勘察报告.四川省华地建设工程有限责任公司, 2009.

[10] Yin Xinming.Investigation Report of The Mountain Collapse in Back of Panda Garden Rearing Sheds.Chengdu: Sichuan Huadi Construction Engineering Co., LTD, 2009.

[11] 崔芳鹏, 胡瑞林,殷跃平,等.纵横波时差耦合作用的斜坡崩滑效应离散元分析——以北川唐家山滑坡为例[J].岩石力学与工程学报, 2010, 29 (2): 319~327.

Cui Fangpeng,Hu Ruilin,Yin Yueping,et al.Discrete element analysis of collapsing and sliding response of slope triggered by time difference coupling effects of P and S seismic waves—taking Tangjiashan landslide in Beichuan county for example.Chinese Journal of Rock Mechanics and Engineering, 2010, 29 (2): 319~327.

[12] 胡聿贤. 地震工程学[M].北京:地震出版社, 1988.

[13] Hu Yuxian.Earthquake Engineering.Beijing: Seismological Press, 1988.

[14] 胡光韬. 滑坡动力学[M].北京:地质出版社, 1995.

[15] Hu Guangtao.Dynamics of Landslides.Beijing:Geological Publishing House, 1995.

[16] 徐光兴, 姚令侃,高召宁,等.边坡动力特性与动力响应的大型振动台模型试验研究[J].岩石力学与工程学报, 2008, 27 (3): 624~632.

Xu Guangxing,Yao Lingkan,Gao Zhaoning,et al.Largescale shaking table model test study of dynamic characteristics and dynamic response of slope.Chinese Journal of Rock Mechanics and Engineering, 2008, 27 (3): 624~632.

[17] 王来贵, 刘成,赵娜,等.动力作用下岩体工程累积破坏研究[J].渤海大学学报(自然科学版), 2007, 28 (1): 1~5.

Wang Laigui,Liu Cheng,Zhao Na,et al.Research on accumulative destruction of rock mass affected by dynamic.Journal of Bohai University (Natural Science Edition), 2007, 28 (1): 1~5.

[18] 陈玲玲, 陈敏中,钱胜国.岩质陡高边坡地震动力稳定分析[J].长江科学院院报, 2004, 21 (1): 33~35.

Chen Lingling,Chen Minzhong,Qian Shengguo.Stability analysis of high steep rocky slope under earthquake loads.Journal of Yangtze River Scientific Research Institute, 2004, 21 (1): 33~35.

[1] 崔微, 刘学昆, 戚蓝. 大型复杂堆积边坡稳定性的离散元分析[J]. 工程地质学报, 2012, (2): 222-227.

[2] 王根龙, 张茂省, 苏天明, 曾庆铭. 黄土崩塌破坏模式及离散元数值模拟分析[J]. 工程地质学报, 2011, 19(4): 541-549.

[3] 李祥龙, 唐辉明, 熊承仁, 罗红明. 岩石碎屑流运移堆积过程数值模拟[J]. 工程地质学报, 2011, 19(2): 168-175.

[4] 黄真萍, 郑汉钦, 李嫣, 周阳. 伪谱法在隧道超前预测资料处理中的研究与应用[J]. 工程地质学报, 2010, 18(S1): 234-237.

[5] 郑文棠,徐卫亚,宁宇,孟国涛 . 节理玄武岩体变形模量的尺寸效应和各向异性 [J]. 工程地质学报, 2010, 18(4): 559-565.

[6] 贾俊, 黄润秋, 巨能攀, 赵建军, 李果. 强震作用下陡倾顺层岩质边坡失稳机制研究[J]. 工程地质学报, 2010, (): 475-481.

[7] 崔芳鹏 胡瑞林 殷跃平 许强 张明. 地震纵横波时差耦合作用的斜坡崩滑效应研究[J]. 工程地质学报, 2009, 17(4): 455-462.

[8] 孙如华, 李文平, 李小琴. 叠加开采顶板覆岩变形破坏研究[J]. 工程地质学报, 2008, (S1): 88-92.

[9] 孙萍, 彭建兵, 范文. 地裂缝错动对地铁区间隧道影响的三维离散元分析[J]. 工程地质学报, 2008, 16(5): 710-714.

[10] 陈开圣, 彭小平. 地震波法在岩堆灌浆效果检测中的应用[J]. 工程地质学报, 2005, 13(4): 530-532.

[11] 陶连金, 苏生瑞, 张倬元. 节理岩体边坡的动力稳定性分析[J]. 工程地质学报, 2001, 9(1): 32-38.

[12] 苏生瑞, STEPHANSSONOve, 王士天. 瑞典爱斯泼硬岩实验场地应力研究[J]. 工程地质学报, 2001, 9(1): 100-106.

[13] 王辉, 黄鼎成. 地震层析成像方法及其在岩体结构研究中的应用[J]. 工程地质学报, 2000, 8(1): 109-117.

[14] 谭云亮, 姜福兴, 范炜林, 徐恩虎, 刘传孝. 锚杆对节理围岩稳定性影响的离散元研究[J]. 工程地质学报, 1999, 7(4): 361-365.

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