

## 高地应力环境下坚硬岩体河床坝基开挖的变形破坏机理研究

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## DEFORMATION AND DAMAGE OF HARD ROCK MASS RIVER BED DUE TO DAM FOUNDATION EXCAVATION UNDER HIGH IN-SITU STRESS

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**摘要** 小湾水电站坝基岩体在开挖过程中, 暴露出一系列的变形破坏现象, 主要表现为“板裂”、表面岩爆、沿已有裂隙张开、扩展和错动等。在对上述变形现象分析的基础上, 研究了高地应力环境下坝基岩体开挖的地质力学响应, 发现: 河床坝基岩体在开挖过程中所表现出的变形主要集中在坝基浅表, 且具有时效性。根据变形破坏现象分析和变形响应研究, 对高地应力环境下坚硬岩体河床坝基开挖的变形破坏机理有了新的认识, 是河谷下切和开挖卸荷过程中的应力重分布造成的浅表生改造的结果。最终, 将河床坝基岩体的变形破坏归纳为“压致拉裂—卸荷回弹”模式, 且以压致拉裂为主。

**关键词:** 高地应力 坚硬岩体 坝基开挖 变形破坏

**Abstract:** The rock mass forming the dam foundation of Xiao Wan hydroelectric station during excavation revealed a series of deformation and fracture phenomena. It mainly behaved as a "split plate" and surface rock bursts, and cracks along the existing structure, expansion and dislocation, and so on. On the basis of the analyses of the above-mentioned phenomena, this paper studies the geological mechanic response of the rock mass due to the dam foundation excavation in the high in-situ stress environment. It is found that the rock mass deformation during excavation is mainly concentrated on the shallow surface of the dam foundation, which has time effect characteristics. According to analyses of deformation-destruction phenomenon and the study of deformation responses, the mechanism of deformation-destruction is understood. The mechanism applies to the excavation of the hard rock river bed of the dam foundation in the high in-situ stress environment. Shallow and superficial transformation result from the stress redistributed during down-cutting of river and unloading of excavation. Ultimately, it can be summarized that the deformation and fracture of river bed are a "pressure rupture-unloading rebound" model, and the pressure-rupture is the main type.

**Key words:** High ground stress Hard rock mass Dam foundation excavation Deformation and damage

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- [2] 董彬, 侯先廷, 王裕彪. 拉西瓦水电站混凝土双曲高拱坝坝基开挖[J]. 水力发电, 2007, 33 (11): 59~60. 
- Dong Bin, Hou Xianting, Wang Yubiao. Foundation excavation of high double-curvature arch dam of Laxiwa hydropower station. Water Power, 2007, 33 (11): 59~60.
- [3] 袁志君. 高地应力对坝基岩体稳定的影响[J]. 四川水力发电, 1999, 18 (3): 25~27.
- Yuan Zhijun. Influence of high in-situ stress on stability of dam foundation rock. Sichuan Water Power, 1999, 18 (3): 25~27.
- [4] 伍法权, 刘彤, 汤献良, 等. 坝基岩体开挖卸荷与分带研究——以小湾水电站坝基岩体开挖为例[J]. 岩石力学与工程学报, 2009, 28 (6): 1091~1098.
- Wu Faquan, Liu Tong, Tang Xianliang, et al. Research on unloading and zonation of rock mass dam foundation excavation: A case study Xiaowan hydropower station. Chinese Journal of Rock Mechanics and Engineering, 2009, 28 (6): 1091~1098.
- [5] 李朝政, 沈蓉, 李伟, 等. 小湾水电站坝基卸荷岩体抗剪特性研究[J]. 岩土力学, 2008, 29 (增): 485~490.
- [6] Li Chaozheng, Shen Rong, Li Wei, et al. Research on shear resistance of dam foundation unloading rockmass of Xiaowan hydropower station. Rock and Soil Mechanics, 2008, 29 (S): 485~490.
- [7] 任爱武, 伍法权, 王东, 等. 大规模岩体开挖卸荷现象及其力学模式分析[J]. 长江科学院院报, 2009, 26 (5): 34~36.
- Ren Aiwu, Wu Faquan, Wang Dong, et al. Analysis on unloading phenomenon of rock excavation and its mechanics model of Xiaowan power station. Journal of Yangtze River Scientific Research Institute, 2009, 26 (5): 34~36.
- [8] 林锋, 黄润秋, 蔡国军. 小湾水电站低高程坝基开挖卸荷松弛机理试验研究[J]. 工程地质学报, 2009, 17 (5): 606~611. 浏览
- Lin Feng, Huang Runqiu, Cai Guojun. Experimental study for unloading and relaxation of dam base during excavation at Xiaowan hydropower station. Journal of Engineering Geology, 2009, 17 (5): 606~611. 浏览
- [9] 周华, 王国进, 傅少君, 等. 小湾拱坝坝基开挖卸荷松弛效应的有限元分析[J]. 岩土力学, 2009, 30 (4): 1175~1180.
- Zhou Hua, Wang Guojin, Fu Shaojun, et al. Finite element analysis of foundation unloading and relaxation effects of Xiaowan arch dam. Rock and Soil Mechanics, 2009, 30 (4): 1175~1180.
- [10] 杨根兰, 黄润秋, 林锋, 等. 西南某电站河床坝基开挖卸荷条件下变形破坏的数值分析[J]. 工程地质学报, 2007, 15 (3): 356~361. 浏览
- Yang Genlan, Huang Runqiu, Lin Feng, et al. Numerical analysis for deformation damage in hydropower station dam foundation due to excavation in southwest China. Journal of Engineering Geology, 2007, 15 (3): 356~361. 浏览
- [11] 王应周. 小湾水电站高边坡开挖预裂爆破施工[J]. 水利水电施工, 2008, 110 (4): 6~9.
- Wang Yingzhou. High slope excavation blasting construction of Xiaowan hydropower station. Construction of Hydroproject, 2008, 110 (4): 6~9.
- [12] Lin Feng, Huang Runqin, Wu Qi, et al. Study on the Geological Model about Low-Angled Structural Planes of Dam Foundation of Xiaowan Hydropower Station. Chengdu: National Laboratory of Geohazards Prevention and Geoenvironment Protection, Chengdu University of Technology, 2006.
- [13] 蔡国军. 澜沧江小湾水电站坝基岩体结构面发育机理及其工程地质特征研究[D]. 成都: 成都理工大学, 2008.
- [14] Cai Guojun. Study on Genesis and Engineering Geological Characteristics of the Rock Mass Discontinuities in the Dam Foundation of Xiaowan Hydropower Station of Lancang River. Chengdu: Chengdu University of Technology, 2008.
- [1] 朱雷, 王小群. 大型岩质滑坡地震变形破坏过程物理试验与数值模拟研究[J]. 工程地质学报, 2013, 21(2): 228-235.
- [2] 孔维伟, 赵其华, 韩俊, 王照财. 台风滑坡变形破坏机制模型试验研究[J]. 工程地质学报, 2013, 21(2): 297-303.
- [3] 任洋, 李天斌, 熊国斌, 林之恒. 基于可拓理论的高地应力隧道围岩分级法及应用[J]. 工程地质学报, 2012, 20(1): 66-73.
- [4] 胡新丽, 唐辉明, 李长冬, 王亮清, 刘佑荣. 基于参数反演的保扎滑坡变形破坏机理研究[J]. 工程地质学报, 2011, 19(6): 795-801.
- [5] 范永波, 任爱武, 熊峥. 基于GSI的锦屏地下厂房岩体参数研究[J]. 工程地质学报, 2010, 18(6): 956-962.
- [6] 郑光, 杜宇本, 许强. 大瑞铁路澜沧江大桥工程边坡岩体结构特征研究 [J]. 工程地质学报, 2010, 18(4): 521-528.
- [7] 郑光, 杜宇本, 许强. 大瑞铁路澜沧江大桥工程边坡岩体结构特征研究 [J]. 工程地质学报, 2009, 17(4): 489-495.