工程地质学报
JOURNAL OF ENGINEERING GEOLOGY

工程地质学报 » 2012, Vol. 20 » Issue (6): 1020-1027 DOI:

拉伸剪切条件下岩石的工程地质力学特性

郭静芸[①②], 李晓[①], 李守定[①], 赫建明[①], 苑伟娜[①②], 董高峰[③], 王永胜[④]

①中国科学院工程地质力学重点实验室 中国科学院地质与地球物理研究所 北京 100029;
②中国科学院研究生院 北京 100049;
③青海省环境地质勘查局 西宁 810007;
④长江三峡勘测研究院有限责任公司 武汉 443003

THE ENFINEERING GEOLOGY MECHANICAL PROPERTIES OF ROCK IN TENSION-SHEAR STATE

GUO Jingyun[①②], LI Xiao[①], LI Shouding[①], HE Jianming[①], YUAN Weina[①②], DONG Gaofeng[③], WANG Yongsheng[④]

①Key Lab of Engineering Geomechanics, Institute of Geology and Geophysics, Chinese Academy of Sciences, Beijing 100029;
②Graduate University of Chinese Academy of Sciences, Beijing 100049;
③Environmental Geological Exploration Bureau of Qinghai Province, Xining 810007;
④Three Gorges Exploration & Surveying Research Institute Co. Ltd.,Wuhan 443003

- 摘要
- 参考文献
- 相关文章

全文: PDF (1660 KB) HTML (KB) 输出: BibTeX | EndNote (RIS) 背景资料

摘要 拉伸剪切破坏是岩石边坡工程与岩石隧道工程中常出现的一种岩石失稳类型。结合岩石工程地质条件,分析了拉伸剪切应力状态产生的条件。总结了当前岩石拉伸剪切研究的实验手段,本构关系与破坏准则。指出了岩石拉伸剪切存在的不足。提出如下研究趋势:(1)研制标准的岩石直接拉伸剪切设备,进行专门试验研究;(2)进行更多类型岩石,更多数量的岩石拉伸剪切实验。研究不同岩石类型拉伸剪切本构关系与破坏准则;(3)加强岩石拉伸剪切实验与此类型岩石工程的数值模拟工作,与试验相互印证。

关键词: 拉伸剪切 岩石工程 本构关系 破坏准则 工程地质力学

Abstract: Tension-shear failure is one common type of rock instability in rock slope engineering and rock tunneling engineering. Based on engineering geological conditions, this paper analyzes the conditions that generate tension-shear stress state. It summarizes the current experiment methods of rock tension-shear research, constitutive equations and failure criterions. It points out the shortcomings of rock tension-shear research. Finally, it proposes the following research trends: (1) develop the standard tension-shear testing equipment for special experimental studies on rock; (2) do tension and shear experiments on more types of rock and more quantities of rock to study constitutive equations and failure criterions of different rock types; (3) strengthen the numerical simulation work of rock tension-shear tests and confirmed by each other.

Key words: Tension-shear Rock engineering Constitutive equations Failure criterions Engineering geological mechanics

收稿日期: 2012-01-05;

基金资助:

国家重点基础研究发展规划(973)项目(2010CB731501、2009CB724605),国家自然科学基金面上项目(41027001),中国科学院知识创新工程重要方向项目(KZCX2-YW-JS102,YZ200912)和中国地质调查局工作项目(1212011014026)

作者简介: 郭静芸,主要从事工程地质力学的研究. Email: 01122329@163.com

服务
把本文推荐给朋友
加入我的书架
加入引用管理器
E-mail Alert
RSS
作者相关文章

引用本文:

. 拉伸剪切条件下岩石的工程地质力学特性[J]. 工程地质学报, 2012, 20(6): 1020-1027.

. THE ENFINEERING GEOLOGY MECHANICAL PROPERTIES OF ROCK IN TENSION-SHEAR STATE[J]. Journal of Engineering Geology, 2012, 20(6): 1020-1027.

[1] 中国科学技术协会. 岩石力学与岩石工程学科发展报告 .北京:中国科学技术出版社, 2010.

[2] China Association for Science and Technology. Report on Advances in Rock Mechanics and Rock Engineering. Beijing: China Science and Technology Press, 2010.

[3] Chen Xing, Huang Jian, Leng Yun, et al. Dynamic damage evolution of fissured rock mass under tensile-shear stress. Northwest Water

Power, 2010,(4): 17~20.

[4] M Zhou,SJ Hu, H Zhang. Critical specimen sizes for tensile-shear testing of steel sheets[J]. Welding Journal, 1999, 78 (9): 305~313.

[5] 中国科学技术协会. 岩石力学与岩石工程学科发展报告[M].北京:中国科学技术出版社, 2010.

[6] China Association for Science and Technology. Report on Advances in Rock Mechanics and Rock Engineering. Beijing: China Science and Technology Press, 2010.

[7] Chen Xing, Huang Jian, Leng Yun, et al. Dynamic damage evolution of fissured rock mass under tensile-shear stress. Northwest Water Power, 2010,(4): 17~20.

[8] M Zhou,SJ Hu, H Zhang. Critical specimen sizes for tensile-shear testing of steel sheets[J]. Welding Journal, 1999, 78 (9): 305~313.

[9] 吴汉辉, 杨转运,刘会.在卸荷产生拉剪情况下裂隙岩体的力学行为[J].岩土工程技术, 2005, 19 (5): 237~240.

Wu Hanhui, Yang Zhuanyun, Liu Hui. Mechanical behavior of tension and shear conditions related to unloading fractured rock mass. Geotechnical Engineering Technique, 2005, 19 (5): 237~240.

[10] Bian Ji. The historical development of cable-stayed bridge. Southwest Road, 1999,(3): 58~59.

[11] 胡波, 曾钱帮,饶旦,等.锚锭-围岩系统在拉剪复合应力条件下的变形规律及破坏机制研究——以坝陵河特大岩锚悬索桥为例[J].岩石力学与工程学报, 2007, 26 (4): 713~719.

Hu Bo, Zeng Qianbang, Rao Dan, et al. Study on deformation law and failure mechanism of anchorage-surrounding rock system under tensile-shear complex stresses—taking super-large suspension bridge on Baling river for example. Chinese Journal of Rock Mechanics and Engineering, 2007, 26 (4): 713~719.

[12] 黄润秋. 岩石高边坡发育的动力过程及其稳定性控制[J].岩石力学与工程学报, 2008, 27 (8): 1525~1543.

Huang Runqiu. Geodynamical process and stability control of high rock slope development. Chinese Journal of Rock Mechanics and Engineering, 2008, 27 (8): 1525~1543.

[13] 陈洪凯, 唐红梅.拉剪型危岩发育过程的模型试验[J].重庆大学学报(自然科学版), 2006, 29 (6): 115~119.

Chen Hongkai, Tang Hongmei. Testing research on development of perilous rock in tension-shear fracture. Journal of Chongqing University (Natural Science Edition), 2006, 29 (6): 115~119.

[14] 李建林. 卸荷岩体力学[M].北京:中国水利水电出版社, 2003.

[15] Li Jianlin. Unloading Rock Mass Mechanics. Beijing: China Water Power Press, 2003.

[16] 康勇. 深埋隧道围岩破坏机理相关问题研究 .重庆: 重庆大学, 2006.

[17] Kang Yong. Research on Relevant Problems about Failure Mechanism of Surrounding Rock in Deep Buried Tunnel. Chongqing: Chongqing University, 2006.

[18] 王新波, 潘晓明.地下圆形隧道开挖卸荷围岩弹塑性分析[J].河南科学, 2010, 28 (9): 1153~1156.

Wang Xinbo, Pan Xiaoming. Elastic-plastic analysis of underground circular tunnel under rock excavation unloading. Henan Science, 2010, 28 (9): 1153~1156.

[19] 王明洋, 宋华,正大亮,等.深部巷道围岩的分区破裂机制及"深部"界定探讨[J].岩石力学与工程学报, 2006, 25 (9): 1771~1775.

Wang Mingyang, Song Hua, Zheng Daliang, et al. On mechanism of zonal disintegration within rock mass around deep tunnel and definition of "deep rock engineering".Chinese Journal of Rock Mechanics and Engineering, 2006, 25 (9): 1771~1775.

[20] 康勇, 李晓红,杨春和.深埋隧道围岩损伤破坏模式的数值试验研究[J].岩石力学与工程学报, 2007, 26 (增1): 3578~3582.

[21] Kang Yong, Li Xiaohong, Yang Chunhe. Research on nnmerical tests on damage-faliure mode of surrounding rock in deep-buried tunnel. Chinese Journal of Rock Mechanics and Engineering, 2007, 26 (S1): 3578~3582.

[22] M Carboni,S Beretta, M Monno. Fatigue behaviour of tensile-shear loaded clinched joints[J]. Engineering Fracture Mechanics, 2006, 73 : 178~190.

[23] Li Zhiyi, Yang Yuyun. Overview of Engineering Geology. Wuhan: China University of Geosciences Press, 1994.59~88.

[24] 王继强. 剪应力对巷道破坏影响的研究[J].山西煤炭, 2010, 30 (3): 49~51.

Wang Jiqiang. Influence of shear stress on the failure of laneway. Shanxi Coal, 2010, 30 (3): 49~51.

[25] Feng Wenjuan, Ju Xiaodong, Zou Zhengsheng. Research on surrounding rock stability after unloading of tunnel excavation. Subgrade Engineering, 2009,(4): 62~63.

[26] 周火明, 熊诗湖,刘小红,等.三峡船闸边坡岩体拉剪试验及强度准则研究[J].岩石力学与工程学报, 2005, 24 (24): 4418~4421.

Zhou Huoming, Xiong Shihu, Liu Xiaohong, et al. In-situ tension-shear tests and strength criterion studies on Tgp shiplock slope rockmass. Chinese Journal of Rock Mechanics and Engineering, 2005, 24 (24): 4418~4421.

[27] 周火明, 徐平,盛谦,等.岩体力学试验新技术在三峡工程中的应用[J].长江科学院院报, 2001, 18 (5): 68~72.

Zhou Huoming, Xu Ping, Sheng Qian, et al. Application of new technology of rock mechanics test in TGP.Journal of Yangtze River Scientific Research Institute, 2001, 18 (5): 68~72.

[28] 柳赋铮. 拉伸和拉剪状态下岩石力学性质的研究[J].长江科学院院报, 1996, 13 (3): 35~39.

Liu Fuzheng. Study on mechanical property of rock in tension and tension-shear state. Journal of Yangtze River Scientific Research Institute, 1996, 13 (3): 35~39.

[29] He Manchao, Liu Chengyu, Wang Shuren, et al. Development of engineering rock-matrix mechanics experimental system. In: Chinese Society for Rock Mechanics and Engineering. Collected Papers of 8th National Rock Mechanics and Engineering conference. Beijing: Science Press, 2004, 891~894.

[30] CT Aimonemartin,KI Oravecz, TK Nytra. A mechanical device for the measurement of combined shear and tension in rocks[J]. International Journal of Rock Mechanics and Mining Science, 1997, 34 (1): 147~151.

[31] 朱子龙, 李建林,王康平.三峡工程岩石拉剪断裂试验研究[J].武汉水利电力大学(宜昌)学报, 1998, 20 (1): 1~6.

Zhu Zilong, Li Jianlin, Wang Kangping. A study on rock tension-shear strength related to three-gorges project. Journal of University of Hydraulic and Electric Engineering(Yichang), 1998, 20 (1): 1~6.

[32] 李建林. 岩石拉剪流变特性的试验研究[J].岩土工程学报, 2000, 22 (3): 299~303..

Li Jianlin. A test study on tension-shear creep of rock. Chinese Journal of Geotechnical Engineering, 2000, 22 (3): 299~303.

[33] 李建林. 三峡工程岩石拉剪断裂特性的试验研究[J].地下空间, 2002, 22 (2): 149~152.

Li Jianlin. A study on tension-shear crack property of rock related to the Three Gorges project. Underground Space, 2002, 22 (2): 149~152.

[34] 李平恩, 殷有泉.Drucker-Prager准则在拉剪区的修正[J].岩石力学与工程学报, 2010, 29 (增1): 3029~3033.

[35] Li Ping'en, Yin Youquan. Modification of drucker-prager criterion in tensile shear region. Chinese Journal of Rock Mechanics and Engineering, 2010, 29 (S1): 3029~3033.

[36] Ren Zhongjun,Peng Xianghe, Yang Chunhe. Micromechanical damage model for rocks and concretes subjected to coupled tensile and shear stresses[J]. Acta Mechanic Solida Sinica, 2008, 21 (3): 232~239.

[37] Imad Barsoum,Jonas Faleskog. Rupture mechanisms in combined tension and shear—experiments[J]. International Journal of Solids and structures, 2007, 44 (6): 1768~1786.

[38] 温世亿, 李静,苏霞,等.复杂应力条件下围岩破坏的细观特征研究[J].岩土力学, 2010, 31 (8): 2399~2406.

Wen Shiyi, Li Jing, Su Xia, et al. Studies of mesomechanical structure characters of surrounding rock failure under complex stress state. Rock and Soil Mechanics, 2010, 31 (8): 2399~2406.

[1] 贺俊征, 贺可强, 闫勇山, 刘健康. 降雨作用下堆积层滑坡动力失稳的尖点突变模型研究[J]. 工程地质学报, 2010, (): 391-395.

[2] 王松鹤|骆亚生|李焱. 黄土固结蠕变特性试验研究[J]. 工程地质学报, 2009, 17(5): 643-647.

[3] 夏筱红, 隋旺华, 杨伟峰. 多煤层开采覆岩破断过程的模型试验与数值模拟[J]. 工程地质学报, 2008, 16(4): 528-532.

[4] 石振明, 廖显东. 岩土工程中的耦合问题[J]. 工程地质学报, 2007, 15(S2): 138-141.

[5] 徐杨青. 软土深基坑变形特征的数值模拟分析研究[J]. 工程地质学报, 2006, (S1): 488-493.

[6] 刘升传, 王连俊. 胶新铁路砂土液化区路基沉降规律研究[J]. 工程地质学报, 2006, 14(4): 454-461.

[7] 杨志法, 张路青, 尚彦军. 两个值得关注的工程地质力学问题[J]. 工程地质学报, 2002, 10(1): 10-14.

[8] 韩文喜, 张倬元, 李强. 利用强夯模拟试验研究饱和砂土强夯动本构关系[J]. 工程地质学报, 2001, 9(4): 362-367.

[9] 孙玉科. 岩体结构力学——岩体工程地质力学的新发展[J]. 工程地质学报, 1997, 5(4): 292-294.

[10] 何满潮, 王旭春. 开采沉陷工程岩体本构关系研究[J]. 工程地质学报, 1997, 5(4): 312-317.

[11] 杨志法, 柯天河, 肖竹生, 王常敏. 五强溪水电站左岸船闸边坡开挖监控设计的理论与实践[J]. 工程地质学报, 1995, 3(2): 1-11.

[12] 魏琅. 高层建筑深基坑边坡支护的主要问题与对策[J]. 工程地质学报, 1994, 2(2): 84-88.

地址：北京9825信箱 邮政编码：100029

电话：010—82998121，82998124 传真：010—82998121 Email：gcdz@mail.igcas.ac.cn