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重大工程实践

地质雷达在风火山隧道病害检测中的应用与结果分析

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摘要:

青藏铁路全线开通运营以来,对处于高寒地区的永久冻土隧道之一的风火山隧道的质量状态首次进行了无损检测。风火山隧道处于高寒永久冻土区,隧道全部处于冻岩中,两端洞口主要为砂岩与泥岩,并且为富冰冻土。受到季节性冻融的影响,隧道病害比较突出,主要表现为衬砌裂缝,漏水涌水,衬砌酥松剥落。为了准确地掌握风火山隧道衬砌结构质量状态,本文首次应用于风火山隧道衬砌结构的质量检测。该检测设备一改传统破坏式的检测方法,具有快速、简捷、无损、灵活的特点。通过对现场数据处理分析,可以精确探测衬砌厚度,查明衬砌背后存在的空洞和回填不密实区域。检测结果表明,隧道在高寒恶劣环境中,衬砌总体外观质量尚好,但是在两端洞口段有渗水现象; 衬砌背后空洞缺陷等级为严重地段测线长度为20m,等级为极严重地段测线长度为98m; 衬砌背后回填不密实缺陷等级为严重地段测线长度为41m,等级为极严重地段测线长度为33m。检测结果与实际病害情况基本相符。

关键词: 地质雷达 隧道 衬砌 病害 无损检测

DETECTION AND ANALYSIS OF TUNNEL DEFECTS WITH GEOLOGICAL PENETRATING RADAR AT FENGHUO MOUNTAIN

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Abstract:

The soundness diagnosis testing was carried out on the quality state of a tunnel at Fenghuo Mountain tunnel.This tunnel is one of the permafrost tunnels in frost soil area along the Qinghai-Tibet Railway line.The testing was done some years later after the railway was used. The tunnel is in alpine permafrost zone.The tunnel body is in the frozen rocks.At both ends of the tunnel,the dominant rocks are sandstone and shale,where the frozen soils are ice-rich.Due to the seasonal effects of freezing and thawing,defects were appear in the tunnel more and more. The defects are manifested mainly as lining cracks,leaking and gushing water,lining crisp peeling.In order to accurately understand the quality state of the tunnel lining,the geological penetrating radar technique was used to defect and quantify the defects in the tunnel field.The technique was applied to the tunnel lining structure quality inspection.The technique changed the traditional destructive testing method.The technique is fast,simple,non-destructive,and accurate.Through the in-situ data processing and analysis,the technique can accurately detect lining thickness,find out of lining and filling the empty space behind the non-dense area.The test results show the following.The tunnel in the frozen atrocious weather environment,the lining appearance was not damaged.Seepage was found in the openings of two ends.The lining with empty is the most serious defect level and had a measured length of 20m.The line with the secondary serious defect level had a length of 98m.The lining backfill behind the non-compact class is the third serious defect level and has a measured length of 41m.The most serious level has a line length of 33m.Test results are basically consistent with the actual defect situation. The results can provide a scientific basis for normal operation of the tunnel and reliable foundation for defect treatment in the future.Practical evidence proved the use of geological penetrating radar to make health diagnostic tests for the tunnel is feasible.

Keywords: Geological penetrating radar Tunnel Lining Damage Soundness diagnosis testing Frozen ground

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参考文献:

[1] 谢雄耀,李永胜,黄新才.地质雷达检测在保护性建筑结构加固中的应用
[J].同济大学学报, 2000, 28 (1):19～23.
Xie Xiongyao,Li Yongsheng,Huang Xincai.Application of ground penetrating radar to historical building strengthening. Joural of Tongji Uniiversity: 2000, 28 (1):19～23.

[2] 马洪蛟,李宇,蔡辉,孙典红.地质雷达探测抛填厚度研究
[J]. 南京林业大学学报(自然科学版), 2004, 28 (2):51～53.
Ma Hongjiao,Li Yu,Cai Hui,Sun Dianhong.The new application of geological radar detection technologyto enclose tideland for cultivation to throw fill. Journal of Nanjing Forestry University(Natural Sciences Edition, 2004, 28 (2):51～53.

[3] 苏红旗,杨峰,王均双,等.地质雷达信号采样定时控制
[J].中国铁道科学, 2005, 26 (3):59～63.
Su Hongqi,Yang Feng,Wang Junshuang,et al.Timing control of geological radar signals sampling. CHina Railway Science, 2005, 26 (3):59～63.

[4] 刘传孝,蒋金泉,杨永杰.地质雷达应用于探测拱桥空洞的效果验证
[J].岩土力学, 2001, 22 (1):106～108.
Liu Chuanxiao,Jiang Jinquan,Yang Yongjie. Efects of the ground penetrating radar in probing arch bridge and cavity. Rock and Soil Mechanics, 2001, 22 (1):106～108.

[5] 罗方.地质雷达在隧道健康诊断中的应用
[J].长安大学学报(自然科学版), 2006, 26 (3): 51～54.
Luo Fang. Application of geological radar in health diagnosis of tunnel. Journal of Chang an University(Natural Science Edition), 2006, 26 (3):51～54.

[6] 祁明松.地质雷达在隧洞内的探测
[J]. 地球科学-中国地质大学学报, 1993, 18 (3):352～357.
Qi Mingsong. GPR sounding in tunnel. China University of Geosciences, 1993, 18 (3):352～357.

[7] 郭有劲.地质雷达在铁路隧道衬砌质量检测中的应用
[J]. 铁道工程学报, 2002, 74 (2):71～74.
Guo Youjin.Explkoration and application of geology radar for quality examination of railway tunnel lining.Journal of Rail Way Engineering Society, 2002, 74 (2):71～74.

[8] 李晋平,邵丕彦,谷牧.地质雷达在铁路隧道工程质量检测中的应用
[J].中国铁道科学, 2006, 27 (2):56～59.
Li Jinping,Shao Piyan,Gu Mu.Application and analysis of GPR in railway tunnel engineering quality inspection. China Railway Science, 2006, 27 (2):56～59.

[9] 雷刚,杨林德.公路隧道衬砌质量检测中电磁波无损检测方法的应用研究
[J].岩石力学与工程学报, 2005, 24 (增1): 5081～5085.
Lei Gang,Yang Linde. Application study on nondestructive dete ction method of electrom agnetic ve in road tunnel lining quality detection. Journal of Rock Mechanics and Engineering, 2005, 24 (s1): 5081～5085.

[10] 高鹤.探地雷达在隧道混凝土衬砌检测中的应用
[J].低温建筑技术, 2009, 8 ,77～78.
Gao He. Ground penetrating radar applied in the detection of tunnel concrete.Low Temperature Architecture Technology, 2009, 8 ,77～78.

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Artic
Artic

[11] 高鹤.隧道混凝土衬砌质量检测方法研究
[J].甘肃科技, 2009, 12 ,127～129.
Gao He. The study of tunnel concrete lining quality detection method.Gansu Science and Technology, 2009, 12 ,127～129.

[12] 《铁路运营隧道衬砌安全等级评定暂行规定》(铁运函

[2004] 174号) .
Evaluation of safety classification for railway tunnel lining)(Rail Transportation Letter

[2004] .No.174.

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2．李德胜 李大勇.盾构机下穿桩基施工对单桩承载力影响的数值研究[J]. 工程地质学报, 2009,17(2): 284-288

3．丁兆民 杨晓华.某黄土隧道病害原因分析及处治措施[J]. 工程地质学报, 2009,17(1): 138-144

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5．李志厚 杨晓华 来弘鹏 晏长根 .公路隧道特大塌方成因分析及综合处治方法研究[J]. 工程地质学报, 2008,16(6): 806-812

6．李丹 李川 赵永贵 刘昌 .地震CT与FBG传感器技术在隧道结构诊断中的应用[J]. 工程地质学报, 2008,16(6): 839-843

7．金淮|吴锋波|马雪梅|张彦斌.隧道下穿地铁拟换乘车站施工监测与安全分析[J]. 工程地质学报, 2009,17(5): 703-710

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9．徐士良,崔振东 .秦岭公路隧道2号竖井地应力与岩爆分析[J]. 工程地质学报, 2010,18(3): 407-412

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11．刘镇, 房明, 周翠英, 史海欧.交叉隧道施工中新建隧道周围复合地层与间距对既有隧道的沉降影响研究[J]. 工程地质学报, 2010,18(5): 736-741

12．史玉金.上海地铁隧道建设中工程地质条件及主要地质问题研究[J]. 工程地质学报, 2010,18(5): 774-780

13．张加桂, 张永双, 曲永新, 曹鹤.对滇藏铁路三江段工程地质问题的深化认识[J]. 工程地质学报, 2010,18(5): 781-789

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16．周太全, 华渊, 吕宝华.金华山软岩铁路隧道施工过程围岩屈服接近度分析[J]. 工程地质学报, 2008,16(4): 546-550

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18．孙元春, 尚彦军.岩石隧道围岩变形时空效应分析[J]. 工程地质学报, 2008,16(2): 211-215

19．郭旭晶, 黄涛, 肖再亮, 杨辉.石太客运专线特长隧道涌水灾害预测研究[J]. 工程地质学报, 2008,16(2): 255-257

20．祁长青, 许人平, 吴继敏, 俞缙.基于遗传算法的隧道围岩变形稳定可靠性分析[J]. 工程地质学报, 2008,16(2): 258-262

21．范永波, 伍法权, 胡社荣, 吴查查, 任爱武.交叉隧道塑性区分布规律、成因及支护探讨[J]. 工程地质学报, 2008,16(2): 268-272

22．杨天春, 周勇, 李好.超前探测中探地雷达应用与结果的处理分析[J]. 工程地质学报, 2010,18(6): 971-975

23．黄润秋, 肖华波.浅埋双连拱隧道围岩——边坡体系变形机理及稳定性分析[J]. 工程地质学报, 2008,16(5): 584-591

24．吴旻硕, 李晓.隧道围岩强度不均地段塌方成因及其处理方法[J]. 工程地质学报, 2008,16(5): 672-676

25．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

26．叶万军, 杨更社, 常中华, 顾华雄.黄土边坡剥落病害的发育特征及其发育程度评价[J]. 工程地质学报, 2011,19(1): 37-42

27．牛文林, 李天斌, 熊国斌, 张广洋.基于支持向量机的围岩定性智能分级研究[J]. 工程地质学报, 2011,19(1): 88-92

28．陈星欣, 白冰.隧道下穿既有结构物引起的地表沉降控制标准研究[J]. 工程地质学报, 2011,19(1): 103-108

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