Papers by Chinese

高速公路隧道交通流参数分析及预测

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摘　要：结合高速公路隧道交通管理对交通流参数要求，采用交通流参数一体化观测的方法，调查高速公路长大隧道的交通运行状况，获取交通流常用参数的数据，研究了隧道交通流的特性。利用观测到的交通流参数资料，深入分析和挖掘交通流参数之间的关系，探讨了隧道内常规交通检测器获取的交通流参数的数据挖掘方法，对交通流参数进行信息扩展及预测，为隧道交通信息化管理和智能化控制提供支撑。

关键词：交通工程；隧道交通流参数；数据采集；数据挖掘；人工神经网络

Analysis and Forecast On Expressway Tunnel Traffic Flow Parameter

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Abstract: According to the expressway management and control demand for traffic flow, adopting traffic flow parameter incorporate observing method, obtained the traffic flow data through surveying the condition of expressway long tunnel, researched the traffic flow character of long tunnel. Using the obtained data, deep analysis on the relationship between traffic flow parameters, discussed the data-mining method of traffic parameter through the common traffic detectors' data in tunnel, in order to extend traffic flow information and forecast the tunnel traffic flow parameter to support tunnel information management and intelligent control.

Key Words: Traffic Engineering; Tunnel Traffic Flow Parameter; Data Collection; Data Mining; Artificial Neural Network

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公路隧道安全等级研究

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摘　要：中国目前的公路隧道既没有安全等级划分又没有安全设施设计标准，设计者只能根据自己的经验和认识程度进行设计，运营安全隐患较多。提出了影响公路隧道安全等级的 5 个因素和 4 种关系。认为公路隧道安全等级的划分必须同时考虑隧道长度和交通量，隧道长度是一个基础分界指标，交通量是一个可变的动态指标。根据目前中国公路隧道建设的实际状况和技术水平，选取隧道的特征长度分别为 0.5 km、1.0 km、3.0 km、5.0 km、10.0 km，隧道的断面交通量按照高速公路的最低要求取为 10 000 辆/日，将公路隧道安全等级从高到低划分为 、 、 、 、 五个等级，并提出了进行公路隧道安全设施标准研究的基本思路和方法。

关键词：隧道工程；公路隧道；安全等级

Study of safety grade of highway tunnel

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Abstract: At present, because of lacking highway tunnel classification of safety grade and design standard of safety establishments in China, the designers can do these work basing on themselves’ experiences and understand degree, so many safety hidden troubles must be brought. Five factors and four relations to affect safety grade of highway tunnel are put forward, the length of tunnel (basic demarcative target) and the traffic (dynamic target) must be considered in compartmentalizing safety grades of highway tunnel. Based on the actual status and technique level of building highway tunnel in China, the safety grade of highway tunnel is divided into five grades: ， ， ， ， with regarding 0.5 km, 1.0 km, 3.0 km, 5.0 km, 10.0 km as characteristic length of tunnel and selecting 10 000 vehicle/day as the lowest traffic. At the same time, the basic programs and means to study safety

establishment’s standard of highway tunnel are put forward.

Key words: tunnel engineering; highway tunnel; safety grade

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公路隧道送风道交汇处三维数值模拟

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摘要：本文针对秦岭终南山特长公路隧道通风系统中竖井与联络风道之间的特殊连接方式，采用 CFD（计算流体动力学）方法对送风道交汇处进行了三维数值模拟，研究在不同风道隔板长度下送风道的压力损失系数，从而拟定合理的土建结构形式，优化通风系统。

关键词：公路隧道；计算流体动力学；通风；数值模拟

3-D Numerical simulations of the delivery conduit convergence place in highway tunnel

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Abstract: Basing on the special attended mode of the Qinling extra long highway tunnel ventilation system, this article mainly uses CFD to simulate the delivery

conduit convergence place which is between the shaft and the delivery conduit, studies the pressure drop coefficient of the delivery conduit under the different duct partition length, then draws up the reasonable civil structural style to optimize the ventilation system.

Key words: tunnel engineering; computational fluid dynamics; ventilation；Numerical simulation

隧道露石混凝土路面

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摘要：隧道露石混凝土路面（EACPT）表面纹理丰富构造深度大，具有抗滑性好、路面噪声低等优良特性。本文分析了 EACPT 的施工工艺、路面特性，并介绍国内第一条 EACPT

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试验路。通过分析，作者认为： EACPT 的应用可以在很大程度上提高隧道路面的行驶安全性、降低路面噪声、提高隧道能见度。

关键词：隧道露石混凝土路面，路面噪声，抗滑性，试验路

Exposed aggregate concrete pavement in tunnel

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Abstract: The rich surface texture of exposed aggregate concrete pavement in tunnel(EACPT)have plenty advantages ,as in great structure depth ,high skid resistance, low pavement noise etc. This paper analyzes the construction techniques and pavement performance of EACPT, introduces and evaluates the first test section of EACPT in our country. Meanwhile, the authors suggest that the application of EACPT can increase skid resistance、reduce pavement noise、enhance visibility of tunnel to great degree.

Key words: exposed aggregate concrete pavement in tunnel, pavement noise, skid resistance, test section

裂缝对隧道管片结构耐久性影响及其模糊评价

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摘　要：盾构隧道混凝土管片结构裂缝的出现是不可避免的，而裂缝的出现将迅速的加快其腐蚀劣化过程。论文首先对隧道管片构件裂缝的成因及其对管片结构耐久性的影响进行了分析。鉴于裂缝对管片结构的耐久性影响具有模糊性的特点，论文分别建立了用于计算评价管片表面裂缝宽度、长度、方向和密度等因素对管片结构耐久性损伤的模糊隶属度函数。然后结合某次管片静力实验裂缝观测、统计结果，根据建立的隶属度函数对裂缝诸因素的隶属度进行了计算，并运用最大隶属度原则对裂缝对管片结构耐久性的影响程度进行了模糊综合评价。

关键词: 裂缝,盾构隧道,管片,耐久性,隶属度函数

Study on the Influence of Crack on the Durability of Tunnel Segments and its Fuzzy Evaluation

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Abstract： The crack of shield tunnel segments will inevitably arise, however, which will accelerate the erosion of segments. Firstly, the paper analyzed the cause of cracks of shield tunnel segments and its influence on the durability of segments .Since the influence of crack on the durability of segments is uncertain and fuzzy, the paper established the durability damage membership function for the segment surface crack's width, length, direction and density respectively. Finally, combining with the crack observation and statistics results of certain segments static load experiment, the paper calculated the membership degree of crack's factors according to the established membership function and conducted fuzzy comprehensive evaluation of the above factors on the durability of the segments in terms of principle of maximum membership degree.

Keywords： crack；shield tunnel；segment；durability；membership function

公路隧道运行速度预测研究

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摘要：运行速度作为车辆实际的运行状态在道路安全性评价中得到了广泛应用，中国交通部发布的《公路项目安全性评价指南》中也是运用车辆运行速度作为主要评价指标。然而国内外对于车辆运行速度预测研究主要针对普通路段，没有针对隧道等特殊结构物的预测方法，作者通过对中国大量高速公路隧道调研分析，提出了基于隧道修正的公路隧道运行速度预测模型，为特殊路段车辆运行速度预测提供了新的理论方法。

关键词：高速公路、隧道、运行速度、预测方法

交通部西部交通建设科技项目：公路隧道进出口运行安全研究。

Research on operating speed prediction for highway tunnel

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Abstract: Operating speed is applied widely in the evaluation of road safety, and it is also the main evaluation index in Guidelines for Safety Audit of Highway. However, the research on operating speed prediction is mainly for general roadway segments, and the prediction method for special structures such as tunnels is not available. Through the investigation and analysis on large numbers of freeway tunnels in China, the author put forward an operating speed prediction model for highway tunnels based on modifications, and provides a new theoretical method for operating speed prediction for special roadway segments.

Key words: freeway, tunnel, operating speed, prediction method.

Western Communications Construction Scientific and Technological Project by the Ministry of Communications: Research on operation safety of the entrance of highway tunnels

基于交通仿真的隧道交通管理研究

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摘要：隧道作为道路交通的咽喉，在公路运输中发挥着重要作用。有效的交通管理措施是保证隧道安全的重要途径，然而传统的交通管理措施选择中缺少定量的分析方法。作者采用交通仿真研究方法，运用定量的微观冲突技术对不同服务水平、交通组成下隧道交通安全管理对策进行了详细研究，并提出了相应的安全管理预案，为隧道管理工作提供了定量的理论支持。

关键词：安全管理、定量分析方法、交通仿真、微观冲突

交通部西部交通建设科技项目：公路隧道进出口运行安全研究。

Research of Tunnel Traffic Management Using Traffic Simulation

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Abstract: As the key segments of freeway, tunnels play an important part in road transportation. Effective traffic management measures are good way to

ensure tunnel traffic safety. However, traditional traffic management measures are lack of quantified analysis methods. The author applies quantified micro-conflict technique to research management measures of tunnel traffic safety under different service level and traffic composition by using traffic simulation, which provides qualified theory support. Meanwhile, corresponding counter plans of safety management are proposed.

Key words: safety management, quantified analysis methods, traffic simulation, micro-conflict.

Western Communications Construction Scientific and Technological Project by the Ministry of Communications: Research on operation safety of the entrance of highway tunnels

细水雾消防系统在电缆隧道中的应用探讨

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摘要：随着我国电力工业、冶金工业和市政建设的不断发展，电缆地下化成了必然趋势，电缆隧道的消防安全越来越得到重视。本文将分析电缆火灾的起因、危险性及电缆隧道的消防现状，重点介绍细水雾消防技术的机理、系统组成及特点，并对细水雾扑救电缆火灾的有效性、电缆隧道细水雾消防系统的设计方法及研究方向进行探讨。

关键词：电缆隧道 细水雾 消防 火灾

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Probing into Application of

Water Mist Fire Protection System in Cable Tunnel

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ABSTRACT： The security of cable tunnel is being paid more and more attention with the development of electric power industry, metallurgical industry and municipal construction in our country. The causes, fatalness of fire and fire protection status of cable tunnel is to be discussed in this paper. Emphases will be paid on mechanism, system components, efficiency, designing method and research trend of water mist system in cable tunnel.

KEYWORDS: CABLE TUNNEL, WATER MIST, FIRE PROTECTION, FIRE

秦岭终南山特长公路隧道机电系统备品备件安全储备研究

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【摘　要】 本文从隧道机电系统备品备件管理的目标出发，对机电系统备品备件的多种仓储模式进行了分析；进一步对安全因素、经济因素在隧道备品备件安全储备量中的影响进行了研究。用于指导在保障隧道安全运营的前提下，最经济、合理的备品备件储备模式及储备量。

【关键词】 特长隧道　备品备件储备　安全

Investigation on the Spare Parts Safe Storage of The Mechanical and Electronic System of Qin Ling Zhong Nan Mountain Long Highway Tunnel

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Abstract： The author Analyze various modes of the spare parts storage ，and research the safe factors, economic factors influence to the spare parts storage .Used for guide while guarantee the premise that the tunnel safety carries the camp, the most economic, reasonable of fully the spare parts storage mode and quantity.

Key Words： Long Highway Tunnel，Spare Parts Storage，Safety

秦岭终南山特长公路隧道机电系统维护体系研究

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【摘　要】 本文作者从自身在隧道机电系统丰富的维护经验出发，分析国内交通机电系统维护管理现状，继而对国外成熟的设备管理理论进行深入的研究，吸收其中科学的理念和方法，结合隧道特点，提出了一套科学的机电系统维护体系。

【关键词】特长隧道　机电系统　维护

Maintenance System Research of The Mechanical and Electronic System of Qin Ling Zhong Nan Mountain Long Highway Tunnel

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Abstract： In the base of the maintenance experience that enrich the mechanical and electronic system of highway tunnel, analyze the present

condition of the mechanical and electronic system maintenance management in local transportation.Then the equipments management theories are analyzed in-depth, absorb the science principle and methods, combine the tunnel characteristics, put forward a set of science maintenance system.

Key Words：Long Highway Tunnel，Mechanical and Electronic System，Maintenance

秦岭终南山特长公路隧道应急预案编制方法研究

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【摘　要】 本文从应急预案编制的技术层面上，对国外发达国家成熟的应急预案体系进行深入的研究，总结出应急预案的基本框架和设计方法，并结合秦岭特长公路隧道的特点，归纳出隧道应急预案体系的组成要素，最后提出了应急预案的文档体系以及编制方法、步骤。

【关键词】 特长隧道　应急预案

Drawing up Method Research of Qin Ling Zhong Nan Mountain Long Highway Tunnel Emergency Response Protocol

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Abstract： As to how to draw up a feasible emergency response protocol，the author through the research of the foreign emergency response protocol ,considerd that the basic framework and the design methods, with the characteristics of the Qin Ling Zhong Nan mountain long highway tunnel,conclude the elements of the Tunnel emergency response protocol. Finally the protocol document system and the steps of drawing up the protocol,are put forward.

Key Words： Long Highway Tunnel　　Emergency response protocol

运用安全系统工程研究秦岭终南山特长公路隧道火灾事故

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【摘　要】 本文通过运用安全系统工程方法对秦岭终南山特长公路隧道火

灾事故进行深入的研究，识别出可能造成火灾事故的安全问题，并针对问题提出在隧道日常管理和运营中应采取的预防性措施，以降低隧道火灾事故发生的机率。

【关键词】 特长隧道　安全系统工程　隧道火灾

Exert Safety Systems Engineering to Research Qin Ling Highway Tunnel Fire Accident

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Abstract：Base on the safety systems engineering method ,the fire accident of Qin Ling Zhong Nan mountain long highway tunnel are analyzed in-depth, identify the safety problem related to the fire accidents ,then　put forward the prevention measure to reduce the occurrence probability of fire accident in the highway tunnel.

Key Words：Long Highway Tunnel，Safety Systems Engineering，Tunnel Fire

苍岭特长公路隧道通风系统设计

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摘要 苍岭特长公路隧道是浙江省台州至缙云高速公路中最长的隧道，其中左隧道长 7536m，右隧道长 7605m，按双向四车道平行分离式山岭公路隧道设计，设计速度 80km/h。对非火灾工况，设计采用竖井送排式加射流风机纵向通风方案，对火灾工况，设计采用顶部设排烟道的半横向式排烟加射流风机纵向排烟结合的通风方案。本文从需风量计算、通风系统方案设计、防灾论证等方面对该隧道通风系统设计进行介绍，以与同行进行交流。

关键词 公路 隧道 通风 设计

Design of Ventilation System for Cangling Super-long Highway Tunnel

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Abstract: Cangling Super-long Highway Tunnel, the longest tunnel of Taizhou-Jinyun Expressway in Zhejiang Province, is designed according to the standard for dual-way four-lane parallel separated highway tunnel in mountain area with left tunnel length of 7536m, right tunnel length of 7605m and design speed of 80km/h. The longitudinal ventilation scheme utilizing vertical shaft and jet fan is adopted for the tunnel under non-fire condition, while the scheme combining semi-transversal smoke ventilation with exhaust duct on top and longitudinal ventilation by jet fans is used under fire conditions. The paper describes the design of ventilation system for this tunnel concerning wind volume calculation, ventilation system design and fire protection demonstration.

Key words: Highway Tunnel Ventilation Design

特长公路隧道多竖井送排式通风模式的数值解析

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摘要：随着以人为本设计理念的深入贯彻，特长公路隧道正常交通情况下的舒适性和火灾情况下的安全性越来越引起重视。多竖井送排式通风模式能将特长公路隧道划分成若干通风区段，通过竖井排出隧道内污染空气的同时送入新鲜空气，因此可以加大纵向通风方式的适用长度。相对于单竖井送排式通风模式而言，多竖井送排式通风模式的流量守恒和压力平衡方程更加复杂，很难求得其解析解，而且其送排风联动控制技术要求更高。本文以流体力学连续性原理和伯努利定理为基础，建立了多竖井送排式通风的计算模式和压力平衡模式。基于二分法数值分析方法提出了其数值解的求解过程，并对计算过程中初始试算值的选取、计算约束条件、目标函数作了介绍，对于通风的经济性评价也作了初步探索。本文还采用面向对象的编程语言 VBA 编制了计算程序，该程序已经成功应用于多个特长公路隧道工程中，取得了良好的效果。

关键词：特长公路隧道；多竖井；纵向通风；二分法；数值解

Numerical Solution for Multi-Shaft Blow and Exhaust Ventilation Model in Extra-Long Highway Tunnels

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Abstract: As the human-centered design conception has been widely accepted, in extra-long highway tunnels, amenity in normal traffic and safety in case of

fire has been attached great importance to. Multi-shaft ventilation system divides an extra-long tunnel into several sections whose polluted air is exhausted and fresh air is provided through two neighboring shafts. As a result, a greater adaptive length for a longitudinal ventilation system can be achieved. By contrast with single-shaft blow and exhaust ventilation system, flow conservation equation and pressure balance equation in a multi-shaft system are much more complicated, so it's hard to find the analytic solution and to set the blow and exhaust gang control scheme. Based on the continuity law and Bernoulli's law in fluid mechanics, a calculation model and a pressure balance model are put forward in this article. The dichotomy algorithm is adopted to extract the numerical solution. Besides, the initial trial value, constraint conditions, and the object function, along with economical evaluation, are discussed in the article. Visual Basic for Application (VBA), a robust object-oriented programming language, is used to compile ventilation analysis software, which is applied in several extra-long highway tunnels and shows satisfactory effect.

Key Words: Extra-Long Highway Tunnel; Multi-Shaft; Longitudinal Ventilation; Dichotomy Algorithm; Numerical Solution

西华岭隧道火灾疏散救援通道参数研究

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摘要　西华岭特长公路隧道位于浙江省诸暨至永嘉高速公路金华境内，按双向四

车道平行分离式山岭公路隧道设计，设计行车速度80km/h，其中左隧道长4291m，右隧道长4312m。设计采用全射流风机纵向通风方案。本文通过对该隧道火灾蔓延和烟气扩散规律、人员疏散安全分析及逃生救援方案研究，确定车行横通道和人行横通道的间距及相关疏散参数。

关键词 隧道火灾 疏散通道 参数 研究

Research on Fire Evacuation and Rescue Route Parameters of Xihualing Tunnel

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Abstract: Xihualing Super-long Highway Tunnel, located in Jinhua section of Zhuji-Yongjia Expressway, is designed according to the standard for dual-way four-lane parallel separated highway tunnel in mountain area with design speed of 80km/h, left tunnel length of 4291m and right tunnel length of 4312m. The longitudinal ventilation scheme utilizing jet fans is adopted for the tunnel. This paper describes how to determine the interval between transverse driving passage and transverse walking passage and relative evacuation parameters by studying the spread law of fire and smoke, safety analysis of personnel

evacuation and escape and rescue scheme.

Key words: Fire in tunnel Evacuation route Parameters Research

隧道消防灭火系统的现状与应用

Research and Application of Fire Fighting in Tunnel

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摘要：近年来，我国公路和越江隧道发展迅速，给隧道和地下空间的防灾安全带来了极大的挑战。本文回顾了近年来国内外重大隧道火灾事故，分析和总结了国内外重要的相关研究成果，并从隧道消防系统工程应用和技术特点分析了不同隧道消防系统的优缺点。希望能对隧道设计及工程人员有所帮助。

Abstract: Road tunnels and cross river tunnels have rapidly developed at recent years, which challenge disaster prevention and fire fighting. This paper analyzes and summarizes the result of national and international research on fire fighting and prevention. It analyzes respective characteristics of different

fire fighting system in tunnel through engineering application and technical characteristics. It has certain reference to the designers and engineers of fire fighting in tunnel.

关键词：隧道　消防　火灾

Keywords：tunnel fire-fighting fire

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公路隧道的照明与交通安全

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摘要：随着全球范围内的机动车辆的迅猛增长，道路照明对交通安全的影响越来越显著，道路照明已经成为一个帮助确保高效、安全的交通运输的有效手段。目前，世界各国投入了大量人力物力进行道路照明领域的研究，而道路照明中的隧道照明是人们特别关注的问题之一。隧道照明是道路照明中的一种特殊情况，对交通安全的影响更明显，因此隧道照明要求更高、更复杂。近年来我国公路隧道建设取得了飞速发展，对公路隧道的照明提出了新的要

求，因此本文针对公路隧道照明及其与交通安全的关系进行了介绍。全文共分为五个部分：第一部分是概述；介绍了公路隧道的交通安全状况及其与照明条件的关系，并介绍了国内外公路隧道照明的现状。第二部分是对公路隧道照明的特点和要求的介绍；首先介绍了人眼的视觉功能特点和公路隧道不同于其它照明应用场合的自身特点；之后，基于以上分析，阐述了公路隧道的照明要求；最后对国内外现有的对公路隧道照明的要求作了一定介绍。第三部分阐述了不同的照明方式、不同的灯具对公路隧道照明的影响；首先以几种典型照明灯为例介绍了不同灯具和不同照明方式下的照明效果，包括不同灯具之间的比较、同一灯具不同照明方式的比较等；之后介绍了同一灯具在不同的评价方法下的照明效果；最后介绍了不同照明效果对公路隧道照明的影响，探讨了合理的公路隧道照明方案。第四部分阐述了国内外现有的检测和评价公路隧道照明状况的方法，分析了其中的不足并提出了一些改进建议。最后总结全文并提出了今后的工作展望。

关键词：隧道照明 交通安全 检测 评价

Highway tunnel lighting and traffic security

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Abstract: The volume of vehicle traffic is increasing worldwide, and roadway lighting can be an effective tool to help provide efficient and safe traffic movement. As the particularity of tunnel, specific interests are used in the design of tunnel lighting systems. This paper details the relationship between highway tunnel lighting and traffic security. First it depicts lighting and traffic

actuality. Second it depicts the characteristic of highway tunnel lighting and human vision. Third it depicts the different illuminating effect based on different lamps or illuminating modes. Fourth it depicts existent test and assessment solutions. In the end, it makes a summarize and gives a expectation of the future work.

Key words: tunnel lighting, traffic security, test, assessment

泡沫喷雾系统在隧道消防中的应用

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摘要 :泡沫喷雾灭火系统是目前国际上最为先进、最为理想的隧道灭火系统。

关键词：泡沫喷雾；灭火分区；水成膜泡沫喷头；控制阀组

The Application of Foam Spraying System In Tunnel fire

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Abstract: the foam spraying fire systen is the most advanced and perfect tunnel fire system　in the present internationally

Keyword： foam spraying；fire area；aqueous film-forming foam nozzle；

control valve block

长大隧道智能监控方案研究

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摘要：高速公路的发展使得隧道安全问题变得越来越突出，除隧道本身的土建施工质量外，隧道的监控系统成为隧道安全的重要课题。从 60 年代开始，国外就相继开始研究先进的隧道控制系统，欧洲、美国、日本等西方发达国家先后开发了相应的隧道控制系统，随着计算机技术、图像处理技术、通讯技术和控制技术的发展，以太网技术和总线技术突破了原有的技术瓶颈，使隧道的监视与控制系统高速信息共享成为可能。自 80 年代我国自主研发并设计交通机电工程以来，高速公路监控系统的设计已经积累了大量的经验，在隧道监控系统设计中也有长足的进步。2004 年底，我国交通部颁布了首部推荐性行业标准《公路隧道交通工程设计规范》，代表我国的隧道机电工程已经步入稳定期。然而，有章可循的多属隧道机电设施的布设原则，对隧道整体管控的方案因随通讯技术发展在不断更新而尚无定论。

本文旨在对长大隧道的监控系统设计做出比较完整的总结和归纳，从工程设计的角度出发，实战性的根据隧道特点，首先总结了隧道交通的特性，接着对隧道监控系统的构成进行了讨论，然后根据笔者的设计经验，从隧道设施的选型以

及设备布设方法等给出隧道监控系统的设计思路，同时，也涉及监控中心的相关设备。最后，本文提出长大隧道的智能控制方案，对隧道内的交通诱导、通风控制、照明控制、电力监控、火灾消防、紧急电话和视频监视等系统的智能控制机制给予了详细的分析，并同时讨论目前国内设计中的新技术，新方法。

先进的 IT 技术与传统的管理方式向结合，将为高速公路全线的通畅提供保障，也将提高隧道交通的安全运营和管理效率。

关键字：长大隧道，智能监控系统，高速公路

The Study of Intelligent Monitoring System for Long Tunnel

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Abstract: The tunnel transportation safety is becoming more and more severe with the rapid development of expressway in China. Besides the tunnel structure, tunnel monitoring system is regarded as hot research topic. Since 1960s, western countries began to study on advanced tunnel monitoring system. With the booming technologies as IT, image processing, communications and Ethernet, tunnel monitoring and data sharing broke through the previous technology bottleneck. From 1980's, Chinese researchers started to investigate on traffic and accumulated abundant experience. Highway Tunnel Traffic Engineering Design Standards was issued at the end of 2004 which represented Chinese tunnel mechatronics engineering has been enter into mature stage. However, the design ideas this standards are belong to equipments allocation principles. Detailed organization and management scheme are not provided which because of the existing varies communication technologies.

This paper aims at summarizing the long tunnel monitoring system design methods which based on project experiences. Firstly, tunnel transport characteristic and the frame work of tunnel monitoring system are presented. Subsequently, the detailed design methods are explained by equipments

categories. Finally, the intelligent control scheme is illustrated and the cutting-edge technologies as well.

Combined advanced IT technologies and conventional management mechanism would protect the safety operation and promote management efficiency of long tunnel.

Keywords: long tunnel, intelligent monitoring system, expressway

长大公路隧道通风网络仿真与应用研究

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摘　要 本文结合通风网络理论，建立风机风压计算模型、交通通风力计算模型、自然风压计算模型及火风压计算模型，解决了通风动力在通风网络中应用问题。并在此基础上建立隧道通风网络仿真模型，编制了隧道一元流通风系统整体仿真程序。最后对依托工程秦岭终南山特长公路隧道进行通风网络仿真，实现通风方案的模拟和计算。

关键词 公路隧道 通风网络 计算模型　仿真

Research to Ventilation network emulation and application about long highway tunnel

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Abstract　Combining with ventilation network theories, the paper established fan's wind pressure calculating model, transportation wind pressure calculating model, nature wind pressure calculating model and fire wind calculating model, And solved the application problem of ventilation power in ventilation network, then established the ventilation network emulation model, and worked out a simple equation emulator for the analysis of tunnel ventilation system. In the end, the paper analyzed Qinling Zhongnanshan extra-long tunnel ventilation system, and triumphantly carried out a ventilation scheme for the tunnel.

Key words Highway tunnel; Ventilation network; Calculating model ; Emulation

以运营管理为导向的公路隧道交通工程设计需求分析研究

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摘　要： 本文首先从国内特长公路隧道交通工程设计及运营管理现状分析入手，阐述了隧道交通工程的分类及研究内容，并重点对目前国内隧道交通工程研究中存在的问题进行了剖析，同时对国内外隧道交通工程设计标准的差异性进行了分析探讨；然后根难特长公路隧道营运管理目标和需求的界定，提出了以运营管理为导向的隧道交通工程设施设计原则和标准，并结合国内特长公路隧道建设发展要求，对当前急需开展的研究方向和内容进行了研究探讨。

关键词： 运营管理 公路隧道 交通工程

The Study on the Road Tunnel Traffic Engineering Design Needs Analysis are Oriented by Operation Management

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Abstract: The article firstly analysis the domenstic current condition of the long road tunnel traffic engineering design and operation management , expound the content and classification of the tunnel traffic engineering study, then focus discuss the problem in designing and researching on road traffic engineering, analysis and explore the differences of the tunnel traffic engineering standards in domestic and foreign .Then according to the road tunnel operating management objectives and needs defined ,put forward the design principles and standards about the road tunnel traffic engineering facilities, which is oriented by the operating management .lastly , integrate the demand on road tunnel construction and development, this paper study and explore the direction and content which are urgent need on current.

key words: operation management road tunnel traffic engineering study

龙潭特长公路隧道营运通风方案比较

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摘　要　建设中的龙潭隧道系沪蓉国道主干线宜昌至恩施公路上的特长隧道，长约 2×8.7km，其营运通风系统值得认真研究。本文结合工程实际情况，从通风、防灾救援和施工组织等因素综合考虑，经技术经济比选，确定了技术相对可靠、经济较省的营运通风方式。

关键词　龙潭特长公路隧道　通风方案　纵向送排式通风 比较

Compare for Longtan Super Long Highway Tunnel Ventilation Scheme

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Abstract：Longtan Tunnel which is under construction, is a super long tunnel, about 2×8.7km long, in the main route of Hu-Rong national highway from Yichang to Enshi. The ventilation system in the service stage is worthy of deep research. Considering ventilation hazard preventing, construction method and etc factors, this paper makes out a considerably workable and economical ventilation style according to engineer construction.

Keyword：Longtan Super Long Highway Tunnel; Ventilation method;

Longitudinal draft and extract ventilation; Comparison

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乌池坝特长公路隧道消防与防灾救援设计

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摘　要　建设中的乌池坝特长公路隧道位于沪蓉国道主干线湖北恩施至利川公路，长约 2×6.7km，考虑到隧道所处的是一个特殊的环境，它受空间的限制，在发生火灾事故时，极有可能扩大到后续车辆，酿成更大的灾害，特别是特长公路隧道发生紧急事故时，救援困难，伤亡惨重，损失严重，消防与防灾救援就显得十分重要，本文通过介绍该隧道的消防与防灾救援设计，提出目前消防与防灾救援设计存在的问题和研究今后的研究方向，期望与同行进行交流。

关键词　乌池坝特长公路隧道　火灾　消防　防灾救援

Design of fire protection and rescue in Wuchiba

Super Long Highway Tunnel

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Abstract：Wuchiba High Tunnel which is to be under construction, is a super long tunnel about 2×6.7km long in the main route of Hu-Rong national highway from Enshi to Lichuan. Due to special environment limited by space, fire hazard which results in difficult rescue, numerous deaths and tremendous loss is very serious in emergency especially in super long tunnel. So fire protection and rescue is very important. This paper introduces the design of it in Wuchiba Super Long Tunnel, and puts forward questions in the design of it and discusses its research direction.

Keyword：Wuchiba Super Long Highway Tunnel; Fire hazard; Fire protection and rescue

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公路隧道火灾烟流滚退火烟浮羽流模型应用

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摘 要　为研究公路隧道火灾时期发生烟流滚退时火源区域烟流流动规律，分析了隧道火烟浮羽流及顶板射流的成因和特点，并运用环境流体力学及传热学的相关理论，分析了隧道火灾烟流滚退规律，结合积分法建立了火烟浮羽流和顶板射流的数学物理模型。通过对滚退烟流与隧道壁之间的热交换过程的分析，推导出滚退发生时烟流逆行距离的函数表达式，联合火烟浮羽流数学物理模型，得出求解烟流滚退逆行距离的数学方程式。

关键词　隧道火灾　烟流滚退　浮羽流　顶板射流

Buoyant plume model of reverse fire smoke during highway tunnel fire

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Abstract　This paper analyzed the formation causes and characteristics of fire buoyant plume and smoke ceiling jet during a horizontal airway fire. The rollback law of the reversal smoke flow during tunnel fire was also analyzed by

mathematical physics models of buoyant plume and ceiling jet were set up. Meanwhile, the heat transfer process between the reversal smoke and the airway wall was analyzed. Using the mathematical physics models of plume, the equation for layer length of the rollback smoke was deduced.

Keywords tunnel fire；smoke rollback；buoyant plume；ceiling jet

厦门东通道海底隧道防火研究

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摘 要：通过对以厦门东通道为代表的海底隧道的火灾特点、火灾规模、火灾曲线、结构保护措施分析，得出了如下主要结论与建议：(1)水下公路隧道火灾具有不可预见、环境特殊、救援困难、后果危害大等特点，因此，在指导思想与防火措施有其自身特点和要求；(2)在考虑水下公路的火灾控制

规模时，应因隧制宜，就厦门东通道而言，进行隧道结构防火设计时载重卡车火灾所需要考虑的最危险火灾，其最高温度为 1000～1200^{0}C，最大热释放率为 50～100MW，对于 300MW 以上的危险品车辆考虑专门的交通管制手段，并采用 RABT 火灾曲线进行结构防火设计；(３)对隧道衬砌结构的防火最有效的保护措施主要有：在隧道内安装自动喷淋灭火系统、在隧道的重要地段安装防火板等防火隔热层。

关键词：厦门东通道　海底隧道 衬砌结构 防火

The Study of Fire Preventing Technology of DongTongDao Subsea Tunnel in XiaMen

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Abstract: Based on the study of fire characteristic, fire cure and structure protecting measures of DongTongDao subsea tunnel in XiaMen, some conclusion and suggestion be carried out as follows:(1).Because of the unexpected fire type and scale, the specific circumstances, the difficulty of rescuing and the serious results of subsea tunnel fire, there are some different idea and measure with other tunnels.(2).About the scale of subsea tunnel fire, there are special background for every tunnel. The most dangerous fire for

design is 1000-1200°C and HRR is 50-100MW for DongTongDao subsea tunnel in XiaMen. Time and temperature cure RABT is suitable for structure design. The fire of HRR is above 300MW, the measures of managing and controlling are necessary.(3).The most efficient measures are applying auto-sprinkle and fireproof smear and fireproof board for protecting structure.

Key words: DongTongDao, Subsea Tunnel in Xiamen ,Support , Fire preventing

秦岭终南山特长公路隧道洞口气象观测与分析

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摘 要:本文针对秦岭终南山特长公路隧道通风计算中缺乏必要的洞口气象基础参数，建立气象站对其洞口气象参数进行周期一年连续现场观测 ,分析了隧道洞口端各气象参数变化规律，为多竖井深埋隧道通风防灾设计提供了可靠依据。

关键词:特长公路隧道 深埋多竖井 气象参数 现场测试

中图分类号 U453.5 **文献标识码** A

Analysis of Tunnel Openings Climate by on-site Testing in Qinling mountainous Extra-long Highway Tunnel

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Abstract Because of shortage tunnel openings climate parameters. Based on the Qinling mountainous Extra-long highway tunnel ventilation system, establishing climate stations to observe its climate yearly continuous changes. And also analysis climate parameters changes regularity, provide reliability evidence for the deeply-embedded multi-shaft tunnel ventilation and hazard resistance.

Key words Extra-long Highway tunnel, Deeply-embedded multi-shaft, Climate parameter, On-site testing

电磁感应灯和高压钠灯在隧道照明的应用比较

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摘要： 本文从隧道照明中人眼的视觉功能出发，结合了国际上相关隧道照明的标准，分析了隧道照明的特点和优化设计，并分别选用电磁感应灯和高压钠灯对九景高速公路雁列山隧道进行改造和对比试验，从照度水平、照度均匀度、可调光性能及节能环保等角度探讨了电磁感应灯在隧道照明应用中的前景。

关键词： 隧道照明,视觉功能,电磁感应灯,节能

Performance of induction lamps and HPS lamps in road tunnel lighting

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Abstract: The characteristic and optimized design of tunnel lighting was analyzed in this paper based on people's visual performance and some international standard. Electromagnetic induction lamps and high pressure sodium lamps were used in Yanlieshan Tunnel of Jiujing highway, in order to compare the light level, illuminating uniformity, dimming performance and energy saving. Then the feasibility and advantage of induction lamp in tunnel lighting's application was discussed.

Key words: tunnel lighting , visual performance, Electromagnetic induction

lamps, energy saving

GZ45线乌鞘岭地区特长公路隧道群通风方案研究

（摘要）

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摘　要　乌鞘岭地区特长公路隧道群位于连霍国道主干线（GZ45）甘肃省境内永登至古浪段，线路总长 43.3Km 其中在 34.1Km 长的线路上有长度超过 5000m 的隧道三座，最长的安远隧道为 7.3Km，隧道通风不仅直接关系到土建工程及投资规模，而且还关系到公路隧道的运营安全和运营成本，本文结合乌鞘岭地区地质复杂、生态环境保护、海拔高、气候条件恶劣等因素对通风方案进行计算、分析、综合比选，确定安全、经济和高效的通风方案。

关键词　乌鞘岭地区　　特长公路隧道　　通风方案　　研究

Study of super long highway tunnels ventilation project on GZ45th national main highway in Wushaoling area

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Abstract　Super long highway tunnels in Wuqiaoling area is on Lian-Huo main

national highway Yongdeng county to Gulang county in Gansu province, the length of the line is 43.3 Km ,and there is three tunnels that the length exceed 5 Km in 34.1 Km section, the longest Anyuan Tunnel is 7.3 Km. The tunnel ventilation not only influence civil engineering and investment scale, but also influence the run safety and cost. The paper calculate ,analyze synthetic compare and choose the tunnel ventilations and find the safe economic and efficient tunnel ventilation.

Key words Wushaoling area Super long highway tunnel Ventilation project Study

对甘肃省高等级公路长大隧道运营管理中安全问题的浅析

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[摘要] 本文通过对目前甘肃省已经建成的高等级公路长大隧道运营现状进行了全面充分调研，在对调研资料进行分析整理、专家咨询、重点领域的深入调查基础上，进而总结了甘肃省高等级公路长大隧道运营安全中存在的问题，为

今后完善健全各项运营安全管理提供实际数据和科学依据。并针对目前甘肃省已建成的几个长大高等级公路隧道运营现状、运营安全技术、事故预防、对策及隧道养护安全管理等方面改善工作提出了若干建议、对策，愿与同行探讨。

关键词： 高等级公路；长大隧道；安全问题；调研；浅析

Discussions on Some Problems of Extra-long Tunnel Operation on Gan Su

（yao chao qin）

Abstract:

In this paper,the safety analysis and investigation of highway extra-long tunnel operation on Gan Su are presented, which in foreign and civil are well as the reconsideration of fire disaster. Some problems relating to the safety of highway extra-long tunnel operation and maintenance. The principle and the arrangement and function of extra-long tunnel are discussed in this paper, which can be taken as a reference.

Key word:

Highway Extra-long Tunnel; Safety of Operation; Maintenance in Tunnel.

近接施工对上下行交叉隧道影响的数值模拟研究

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摘要：文章通过数值分析手段，对拟建隧道采用不同的施工方法时引起交叉既有隧道的受力、变形变化状况进行研究后可知：全断面法与上下台阶法对既有隧道的围岩应力及变形影响是一致的，二者均最终将引起拱顶及边墙的围岩应力降低，拱底围岩应力的增高；既有隧道特征点均将产生下沉。全断面法开挖引起既有隧道的位移量要稍大于上下台阶法。同时两种开挖方法对既有隧道二衬的受力影响几乎相当，二衬经历对称—非对称—对称三个变化过程，随着开挖深入，其应力逐渐增大，但远小于容许应力值，处于安全状态。并据此提出相应的建议。

关键词：既有隧道；数值分析；围岩应力；位移；二次衬砌

中图分类号：　　**文献标识码：**　　**文章编号：**

RESEARCH ON INFLUENCE OF THE CROSSOVER TUNNEL AT ADJACENT CONSTRUCTION BY NUMERICAL SIMULATION

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Abstract: The paper uses numerical simulation to analyse the change rule of the stress, displacement of the crossover and constructed tunnel at the different working method on the constructing tunnel and conclude: the influence of the stress and displacement of the constructed tunnel is consistent by the different constructing method, the arch and side-wall of surrounding rock's force is reduced, the radier is augmented , the character points' displacement of surrounding rock are sinking, the displacement value of the full area is bigger the step method. The both method affect the stress of secondly line being consistent, and it undergone symmetry-unsymmetry-symmetry process, the stress of the secondly line is increased by following excavation. But the stress is less than concessional stress ,and it is safety. According to the analysis, then bring forward the corresponding suggestion.

Keywords: Constructed tunnel; numerical analysis; surrounding rocks' stress; displacement; secondly line

Study on Frostresisting and Antifreezing Measures in Zhegushan Tunnel

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Abstract

In 21st century, communication infrastructure in China will develop greatly and many highway tunnels will occur with the rapid increase of the tunnels built under high attitude and cold conditions. With the actualization of vital national policy - China Western Development Strategy, the constructions of highway present the trend of development from plains to high mountains.

Technical problems of tunnel construction in cold zones are more complicated than those in general zones and the central issues are the frostresisting capacities of agent structures, reliability in operating period and longevity of structures. At present, the highway tunnels built in Chinese cold zones are rare and no extra-long tunnel has occurred. However, as for domestic rail tunnels and the highway tunnels in Japan, U.S.A, Europe, which are located in cold areas, freezing damages are so serious that tunnel agent structures were obsolescent due to such damages and fatal traffic accidents had happened during operating period. Costs of repair measures, such as application of electric heating devices, are so egregious.

Zhegushan Tunnel, up to now, is the longest highway tunnel being built in cold area of China and the only channel between Sichuan Province and Maerkang City, capital of Aba Autonomous Prefecture. In order to assure security and reliability during long-term operation, it is necessary to carry out frostresisting and antifreezing design.

Combining with the special weather environment of Zhegushan Tunnel, this paper carried out the study of in-situ test for surrounding rock and agent structures by means of in-situ test results, distributing regularities of environment temperature, temperature field of tunnel structures and surrounding rock were attained. Hence, frostresisting and antifreezing plans are designated for laying insulating and thermal blankets on surface of second lining.

By using the computational FEM codes - ANSYS and combining with engineering and hydrological geological conditions, insulating properties of three kinds of insulation material were computed and three field test plans with different thickness and material characteristics of the different heat protection layers were put forward. According to the practical effects of insulation materials in test sections, final fortified lengths of freeze protection were designed.

Besides direct application in Zhegushan Tunnel, research findings with great

popularization values and wide foreground can be applied to similar tunnels in cold areas of Sichuan Province and West China, and also it is significant to help improve the integral technical levels of tunneling field.

Keywords: High and Cold Tunnel; Frostresisting; In-situ Test; Insulating Material; Protective Section

对单洞对向交通特长公路隧道防灾方案的思考

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摘　要　通过对公路隧道运营管理及防灾技术现状的分析，对单洞双车道对向交通特长公路隧道的防灾方案进行了探讨。经初步分析，笔者认为当隧道长 3000～5000m 时，将一座单洞对向交通隧道改为两座单洞单车道单向交通的隧道似乎在技术、经济上对隧道的运营管理及防灾都更合理，是一种值得进一步研究的新方案。

关键词　特大公路隧道　防灾　单洞对向交通　单洞单向交通

Discussion on scheme of Fire protection for extra-long and two-lane highway tunnel with two-directional traffic

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Abstract　On the basis of analyzing the current situation on the fire protection of highway tunnel, the discussion is focused on scheme of fire protection on an extra-long and two-lane highway tunnel with two-directional traffic. Through analysis and investigation, some recommendations are put forward: for a 3000~5000m long and two-lane highway tunnel with two-directional traffic, in the opinion of its fire protection and operation, it is seemly wise to divide it into two one-lane tunnels with one-directional traffic, which is predominant on technology and economy and deserved to pay further study .

Key words　Extra-long highway tunnel; fire protection; tunnel with two-directional traffic; tunnel with one-directional traffic

秦岭终南山公路隧道竖井底部中隔板高度模型试验研究

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摘　要　秦岭终南山公路隧道竖井送排式通风系统采用上下行线隧道共用一座竖井送排风方式。因此在竖井底部必然产生分流和汇流，造成了大量能量损失，降低了通风效率。本文结合工程实际情况，通过物理模型试验，提出需在竖井底部设置中隔板，并进行了中隔板高度优化试验。本文为中隔板优化设计提供了合理的建议和依据。

关键词　秦岭终南山公路隧道　　模型试验　　中隔板　　高度

Experimental research on height of center partition located at shaft bottom in Qinling Zhongnanshan highway tunnel

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（ Highway Institute, Chang'an University,　Xi'an 710064，China）

Abstract　Qinling Zhongnanshan Highway Tunnel's shaft blowing and exhausting longitudinal ventilation system adopts the mode that ascending-descending tunnels share a blowing and exhausting longitudinal ventilation.Therefore , it must generate split-flow and affluxion at the bottom of shaft,making a lot of energy loss, reducing ventilation efficiency. This paper　combined physical circumstances and model test，it suggests that we should install center partition at the bottom of shaft ,in the meantime ,we have done center partition height optimization experiment .This paper provided reasonable suggestion and evidence to center partition design.

Key words　Qinling Zhongnanshan Highway Tunnel ; model test ; center

partition ;height

秦岭终南山公路隧道送排式纵向通风送风口导流板试验研究

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摘　要　秦岭终南山公路隧道采用三竖井纵向通风模式,其中送风口设置在隧道拱部。当送风速度与隧道轴线夹角为 0°时，因断面平均风速按规范宜取 25～30m/s，且送风口下方风速低于 6 m/s，故在此处会产生贴壁射流，较多的能量消耗在流体与壁面的摩擦中，降低了通风效率。为减少该损失，本文通过模型试验，建议在送风口处设置导流板，并通过试验给出了最佳导流板设置角度和长度，有效地减少了该处的局部损失，提高了通风效率。

关键词　公路隧道　模型试验　通风　导流板　角度　长度

Experimental research on baffle at blowing exit in of Qinling Zhongnanshan Highway Tunnel

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Abstract Qinling Zhongnanshan highway tunnel has taken tree-shaft longitudinal ventilation scheme and blowing exit installed at the arch of the tunnel. When the sending wind velocity parallels the axis of the tunnel , because cross-section mean wind speed is 25 ~ 30m/s according to norm ,and the tunnel inlet wind speed is bellow 6 m/s, it will generate effluxion at the wall ,and a lot of energy will be lose at the friction between the fluid and wall , reducing ventilation efficiency. In order to reduce the loss ,by way of model test , this paper suggests that the baffle should be install at the inlet of ventilation and gives the optimal baffle angle and length,reducing the partial loss effectively,and, enhancing the ventilation efficiency.

Key words Highway Tunnel ; model test ; ventilation ; baffle ; angle ; length

秦岭终南山公路隧道送排式纵向通风短道流态模型试验研究

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摘　要　秦岭终南山公路隧道是目前世界上最长的高速公路隧道,其通风系统采用三竖井纵向通风模式。其中短道内空气流态复杂，从工程实际角度来说，分为窜流和汇流两种。本文通过在多种工况下对该隧道短道内流态进行模型试验，分析确定了风量比例、排风角度及短道长度对短道内流态的影响，为短道的优化设计提供了合理的建议和依据。

关键词　公路隧道　　模型试验　　通风　　流态　　短道因子

Experimental research on the flow pattern of short section model in blowing and exhausting longitudinal ventilation system of Qinling Zhongnanshan highway tunnel

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Abstract　Qinling Zhongnanshan Highway Tunnel is the longest highway tunnel in the world now, and its ventilation system has taken Tree-shaft longitudinal ventilation scheme，in which the air flow pattern in the short section is very complex and can be divided into channelling flow and back flow from an engineering angle. This paper has analyzed and determined the influence which the blast volume ratio, the exhaust airway angle and the length of the short section impact on the flow pattern in the short section after the model test, and provided the short section design work with a reasonable suggestion and evidence.

Key words　Highway Tunnel；　model test; ventilation; flow pattern; short section efficient

秦岭终南山特长公路隧道洞口气象观测与分析

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摘　要　本文针对秦岭终南山特长公路隧道通风计算中缺乏必要的洞口气象基础参数 ,建立气象站对其洞口气象参数进行周期一年连续现场观测 ,分析了隧道洞口端各气象参数变化规律，为多竖井深埋隧道通风防灾设计提供了可靠依据。

关键词　特长公路隧道　深埋多竖井　气象参数　现场测试

Observation and analysis of openings climate in Qinling zhongnanshan extra-long highway tunnel

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(2 Highway Institute, Chang'an University, Xi'an 710000)

Abstract Because of shortage of openings climate parameters. on the ventilation system of Qinling zhongnanshan extra-long highway tunnel, the climate stations have established to observe its climate yearly continuous changes, analyse the change regularity of climate parameters provide the reliability evidence for the deeply-embedded multi-shaft tunnel ventilation and hazard resistance.

Key words extra-long highway tunnel; deeply-embedded multi-shaft; climate parameter ;　on-site testing

岩门界隧道全纵向通风应用实践

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摘　要　介绍了岩门界隧道全纵向式通风的设计及应用过程，对影响隧道通风的因素进行了详细说明，并通过通风计算确定了船溪隧道的风机选型、数量及布置。

关键词　通风　计算工况　需风量　风机选择

Application of longitudinal ventilation on Yanmenjie tunnel

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Abstract　Design and application of longitudinal ventilation on the Yanmenjie tunnel were introduced in the paper , and the influence factors on tunnel ventilation were elaborated , and the type . quantity and arrangement of fan of Chuanqi tunnel were obtained by computing .

Key words　ventilation; computing behaviour; demand wind of; fan option

公路隧道机电系统中的节能措施

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摘 要 针对公路隧道机电系统能耗高的实际问题，结合国内外的节能新技术，提出了适用于公路隧道的节能措施。

关键词 公路隧道 节能 电压自动补偿 混合供电

Measure of energy conservation of the electromechanical system in highway tunnel

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Abstract To the practical problem of the high energy conservation of the electromechanical system in highway tunnel，and combining the new technology of energy conservation at home and abroad，we put forward some applicable measure of energy conservation in highway tunnel.

Key Words Highway Tunnel，Energy Conservation; Voltage Automatic Compensation; Hybrid Power Supply

交通风力自然通风作用原理探析

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摘　要　研究目的：在顶部（或侧壁）设有多处通风孔的单向公路交通隧道中，车辆运动产生的交通风力将在开孔处形成相应的压力，探析其压力的形成和作用过程，以获取这种自然通风形式的计算方法。

关键词　交通风力　自然通风　风压与阻力平衡 出流与吸入　分析计算

Discussion for Natural Ventilation Action Principle of Traffic Wind Force

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Abstract Research purposes: In an one-way highway traffic tunnel, when the openings at many locations are set up on roof (or side walls) of the tunnel, corresponding pressure at the opening location shall be formed due to traffic wind force produced by vehicle movement. Research purposes are to discuss and analyze the pressure come into being and its action process, and the calculation method of this natural ventilation model can be got thereafter.

Key words Traffic wind force; Natural ventilation; Wind pressure and resistance balance;

Discharge flow and suction; Analysis and calculation

高速公路隧道群交通运行环境质量体系建设的研究

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3　广东广韶高速公路有限公司）

摘　要　本文通过对高速公路隧道群营运管理现状的定性分析，提出以先进的技术手段和规范化管理手段来改善隧道群通行环境质量的思路和实施原则。并立足于实践，通过对京珠高速公路粤境南段以创建“绿色、环保”隧道为主题的环境质量体系建设实施介绍，对如何提高隧道群服务水平和质量，改善隧道交通运行环境进行了研究探讨。

关键词　隧道群　环境质量　高速公路　服务水平

The Study on Quality System Construction for Traffic Running Environment of Expressway Tunnels Group

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Abstract This text passes the qualitative analysis to the present condition to the expressway tunnels group operation, puts forward the ideas and the implementation of the principles to improve environmental quality in the tunnels group , by using advanced techniques and standardized management tools .Then ,based on introducing the practice of the Beijing-Zhuhai expressway on build the "green, environmental protection " tunnel ,which is the theme of the tunnel system of environmental quality presentation , the research is how to improve the level and quality of service tunnels group ,how to improve the traffic access quality in tunnels group
Key words Tunnels group Environment quality Expressway Service level

杭州绕城高速公路黄鹤山隧道机电控制系统

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摘　要　机电监控系统是高速公路及隧道营运管理和安全运行的可靠保证。监控、通讯、收费系统是高速公路交通工程的重要组成部分。本文详细介绍了杭州绕城公路北段及黄鹤山隧道营运管理机电工程设施，其中重点介绍了中央监控系统的技术构成和功能。

该中央监控系统由计算机系统、大屏幕投影系统、视频监控设备、综合控制台等组成。计算机系统包括服务器、交通监控计算机、图形计算机、通信控制计算机、可变情报板计算机、紧急电话计算机、激光打印机、光端机等。

中央监控系统接受高速公路和隧道检测设备传来的数据以及闭路电视系统、火灾报警系统、紧急电话系统及巡逻车等传来的信息，对系统数据进行处理，对交通运行情况、火灾现场情况、交通事故等各种信息、图表及设备工作状态进行显示和图像监视。综合分析处理后由中控室下达控制命令。发生事故时，中控室还负责与管理处、交警、火警、医疗等有关部门联系，尽快完成救援和事故处理工作。

关键词　绕城公路　隧道　中央监控系统　计算机　现场总线　PLC

The electromechanical control system of Hangzhou highway & tunnel around city

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Abstract Electromechanical control system is the guarantee of managing, running highway and tunnel safely. Monitoring, communication and charging systems are three key parts consisting of highway traffic project. This paper presents the details of electromechanical system of operating and management on highway & huangheshan tunnel, which particularly emphasize the structure and function of central monitor system.

The central monitor system is composed of computer system, large screen projection system, video monitor system, control cabinets and etc. The computer system includes server, traffic monitor computer, graphics computer, communicating & control system, information-changeover computer, emergency phone computer, laser printer, optical transmitter and receiver and etc.

The central monitor system receives data from detect devices in highway & tunnel, CCTV system, fire-detect system, emergence phone system and prowl men. The system then treats with data and image including device working conditions, traffic running situation, fire circs and accident, and display or/and monitor this data and image. When finishing data analysis the system send control order. If accident occurs, control system will contact with management, police, fire alarm, hospital to rescue the wounded and deal with the accident as soon as possible.

Key words road around city; tunnel; central monitor system; computer; bus in locale; PLC

雪峰山特长公路隧道火灾时人员疏散风险性评估

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摘　要　公路隧道火灾不仅造成机电设备破坏，还引起人员伤亡；同时，公路隧道火灾的危险性也决定了公路遂道的消防设计应以保护人员的生命安全为首要目标，体现“以人为本”的消防设计理念。因此，基于性能化防火设计原理，对雪峰山特长公路隧道的人员疏散风险性进行了研究：在中等规模 20MW 的火灾，并且按照规范建议的 3m/s 的风速进行通风的情况下，先用 FDS（Fire Dynamic Simulation）软件模拟计算火灾危险时间 Tfire，然后由疏散模型中的经验公式计算人员疏散时间 Tevac，比较分析其人员疏散的安全性；模拟结果表明人员疏散是安全的。从而，验证了规范的正确性。其研究思路和结果可为我国长大及特长公路隧道的人员疏散研究提供一些参考。

关键词　公路隧道火灾　风险　人员疏散　火灾模拟

Risk Evaluation on Evacuation during a Fire in Xue Feng-shan Extra-long Road Tunnel

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Abstract Fire accidents in road tunnels not only do damage to equipments, but cause casualty. Meanwhile, fire risk of road tunnels determines fire prevention design to ensure life safe firstly, embodying concept of people first. Therefore, evacuation risk is evaluated on a basis of the principle of performance–based fire design. Fire risk times Tfire was firstly gotten through simulations of a middle size fire by FDS（Fire Dynamic Simulation）, whose heat release rate

(HRR) was 20MW, with a longitudinal velocity of 3m/s suggested in Code for Design of Road Tunnel of 2004, and evacuation times Tevac was calculated by an empirical formula of evacuation. Results are shown that evacuation is safe, and to some extent code is testified correct, which can be used as a reference to other long and extra-long tunnels.
Key words road tunnel fires; risk; evacuation; fire simulation

高等级公路隧道运营管理策略

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摘　要　近年来，我国公路隧道在建设方面取得了长足的进步，但公路隧道的运营管理与国外先进水平相比，还存在着很大的差距，难以适应公路交通发展的要求，其中重要的原因是对公路隧道运营设施的资金投入不足，重于建设，疏于运营管理。本文探讨加强公路隧道的运营管理和养护维修工作、提高应对突发性灾害的抢险能力的问题。

关键词　公路隧道　运营管理　应急预案

Highway tunnel operation management strategies

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Abstract In China, many great achievements have been made in construction of highway tunnel in past years, but highway tunnel operation management has great difference comparing with foreign advanced level, it is difficult to meet the requirements of highway transportation development. An important reason results to the present state is lacking of investment to highway tunnel operation management software and equipments, focusing much investment on highway

tunnel construction and less on operation management. Enhancing operation management and maintenance work, and improving capacity to dealing with emergence disaster events are discussed in this paper.

Key words highway tunnel；operation management strategy；counterplan

特长公路隧道火灾探测器选型分析

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摘 要 近几年公路隧道内的防灾体系在不断完善。公路隧道内选用哪种类型火灾探测器是设计、施工、管理单位的一个难题。本文以秦岭终南山特长公路隧道工程为依托，分别从误报和漏报、响应时间、费用、普及性等几个方面对火灾探测器进行详细的分析比较，最终确定适合秦岭终南山隧道使用的火灾探测器。

关键词 特长公路隧道 火灾探测器 隧道火灾

Analysis of fire detector models in extra-long highway Tunnels

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Abstract The disaster prevention system of road tunnel is improving in recent years. What kind of fire detector should be chosen has always been a difficult problem for design, construction and management units. Based on Qinling Zhongnanshan extra-long highway tunnel, through carefully comparing and analyzing the fire detectors in terms of misstatement, omission, response time, costs and popularization, this paper eventually makes a decision on fire detector which is most suitable for Qinling Zhongnanshan highway tunnel.

Key words extra-long highway tunnel ; fire detector ; tunnel fire

隧道结构火灾损伤等级评定研究

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摘　要　目前国内建筑物火灾损伤鉴定的研究主要集中在地面建筑物上 ,地下建筑物特别是隧道建筑物的研究几乎是空白 ;根据理论分析 ,通过火灾后对隧道现场残存物的调查和试验，诊断出火灾后隧道衬砌结构的损伤程度等级，并提出隧道火灾损伤评估流程。

关键词　隧道衬砌　隧道火灾　火灾损伤评估

Study on Assessment of Fire Damage in Tunnel Structure

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Abstract At present, the study on assessing the fire damage in building mainly focuses on ground building, while the study on underground building, especially on tunnel building is almost a gap. According to analysis of theory, through surveying and testing the floor remaining objects after fire, it is diagnosed damage degree level of tunnel lining structure and raised fire damage assessment process.

Key word tunnel lining; tunnel fire; fire damage assessment

单洞双向行驶鹧鸪山特长隧道运营通风控制方案研究

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摘　要　鹧鸪山隧道为单洞双向行车的特长公路隧道，主隧道与平行导坑间通过 9 条横通道相连，运营通风已形成网络。本文根据该隧道的特点，提出了开启 1 条、3 条、5 条和 9 条横通道的运营通风方案；运用通风网络理论，模拟计算了四种通风方案自然分风和控制分风情况下的通风能耗；并通过自然风压大小变化对通风网络稳定性的影响，比较了四方案通风网络的稳定性。在以上研究的基础上，从通风能耗和网络稳定性综合考虑，提出了该隧道的运营通风优化方案。

关键词　高海拔公路隧道　平导通风　通风网络　稳定性分析

Study on Operating Ventilation Controlled Plan of Zhegushan Extra-long Tunnel with Two-way Traffic

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Abstract Zhegushan Tunnel is part of single tunnel with two-way traffic. Nine cross aisles are used to connect main tunnel with parallel pilot tunnel and operating ventilation are networked. Based characteristics of this tunnel, such ventilation plans as opening one aisle, three aisles, five aisles and nine aisles, are brought forwards in this paper, and energy consumption under nature parted wind and controlled parted wind for four ventilation plans is simulated by ventilation network theory, and stability of ventilation network for four plans are compared through the effects of nature wind pressure variation on ventilation network. Based on above studies, optimized plan of operating ventilation for this tunnel is brought forward synthetically considering ventilation energy consumption and network stability.

Key Words High Altitude Highway Tunnel; Ventilation by Parallel Pilot Tunnel; Ventilation Network; Stability Analysis

双洞隧道出口污染物扩散对隔壁隧道进口的影响分析

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摘　要　本文以双洞单向公路隧道洞口段空间气流为对象，采用$k-\varepsilon$ 双方程紊流模型及组分传输方程组，借助 Fluent 计算软件，从不同外界风条件、洞外段设置挡风壁和两隧道洞口不同相对位置（横向间距 5～50 米）三个角度，数值模拟了出口污染物扩散对隔壁另一隧道进口的影响。结果表明，不同洞口间距的出口污染物的扩散对隔壁隧道的影响程度随着自然风的变化而变化；洞外段合理的尺寸与形状的挡壁能有效减少或者消除出口污染物扩散对隔壁隧道的影响。本文的研究结论可为通过对拟建或已有的邻近双洞隧道进行洞门位置的选择及洞外景观设计从而为改善提高运营及火灾通风效果提供有价值的参考。

关键词　双洞隧道　污染物扩散　影响分析

Analysis of Influence of Pollutant Diffusion of Exit on adjoint Inlet in Double Highway Tunnel

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Abstract The airflow of the double and one-way highway tunnel outside is regarded as the target in this paper . By adopting the $k-\varepsilon$ two-equation turbulence model and Species Tansport Equation model ,and by means of Computational Software of Fluent, the influence of pollutant diffusion of tunnel Exit on adjoint Inlet one is numerically simulated from three respect such as different external wind terms、size of block wall set up or not outside the tunnel and relative

position (5m-50m horizontal distance)of the double tunnel openning . The result shows that the influence varies with the natural wind and can be reduced or dispelled effectively by block wall set up outside with desired size and shape for all of different distance tunnel opening. Some valuable reference may be offered with this research conclution by properply selecting Opening position or designing landscape outside so that the effect of the operation or fire ventilation could be improved in double tunnel.

Key word double tunnel; numerical simulation pollutant diffusion; tunnel opening; Landscape design

连续毗邻隧道出口污染物的扩散影响研究

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摘　要　本文以省际公路通道重庆至长沙公路羊角隧道群的工程背景，运用计算流体力学（CFD）软件，结合地形条件，对连续毗邻隧道出口污染物扩散对下游隧道的影响进行了三维数值模拟研究。通过 6 种外界风方向、2 种外界风速条件下，上游隧道出口污染物扩散形态、范围及下游隧道进入污染物浓度的模拟分析，得到了外界无风、外界风顺（逆）隧道轴线行车方向、外界风垂直隧道轴线行车方向、外界风倾斜隧道轴线行车方向±45º方向时，上游隧道污染物扩散对下游隧道的污染程度及影响规律。研究得出的结论可供毗邻隧道设计和运营通风智能控制提供有价值的参考。

关键词　连续毗邻隧道　出口　污染物扩散　通风

Study on influence of contaminant diffusing at exit of continuous and adjacent tunnel

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Abstract On the engineering background of Yangjiao tunnel group at the inter-provincial highway channel from Chongqing to Changsha, computational fluid dynamics (CFD) software, combined with terrain conditions, is applied to simulate the influence of contaminant diffuse on the lower tunnel at the exit of continuous and adjacent tunnel. The modality and range of contaminant diffuse at the upriver tunnel exit and contaminant concentration inhaled into the downriver was simulated in the conditions of six kinds of outside wind directions and two kinds of outside wind speeds. The degrees and laws of upriver tunnel contaminant diffuse contaminating and influencing the downriver tunnel were obtained in the conditions of no outside wind, and outside wind paralleling, plumbing and inclining tunnel axis with 45° respectively. The results can offer valuable references to adjacent tunnel design and intelligent ventilation control.

Key words Continuous and adjacent tunnel; Exit; Contaminant diffuse; Ventilation

铁峰山 2#隧道防灾救援通风模拟研究

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摘 要 本文根据隧道的断面大小、坡率，在计算火灾临界风速的基础上，采用通风网络理论对万开高速公路铁峰山 2#隧道(左线 6022m、右线 6021m，纵坡为 1.7%，全长纵向式通风)在火灾后自然风压的影响和不同位置发生火灾射流风机合理设置地点进行了研究。研究表明，火灾后，自然风压的大小和方向对火灾后隧道风机的开启台数有较大影响；要控制隧道内烟流的流动方向，射流风机的开启位置的应随着火灾地点的变化而变化；隧道火灾射流

风机总数应为各处发生火灾的综合。

关键词　公路隧道　火灾　临界风速　救援通风

Study on Disaster Prevention and Rescue ventilation simulation for Tiefengshan No.2 Tunnel

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Abstract Based on section size, ratio of slope of tunnel as well as calculating critical wind speed of fire hazard, ventilation network theory is applied to study nature wind pressure effects after fire hazard and reasonable installing location of jet fan with fire hazard occurring at different location, for Tiefengshan No.2 Tunnel (6022-m-long left line, 6021-m-long right line, 1.7% longitudinal slope, longitudinal ventilation along full length) of Wankai Expressway. Study findings show that magnitude and direction of nature wind pressure have great effects on opening number of tunnel fan after fire hazard, and opening location of jet fan should vary with fire hazard location in order to control flow direction of smoke plume in tunnel, and total number of jet fan should be total number of each fire hazard location.

Key words Highway Tunnel；Fire Hazard；Critical Wind Speed；Rescue ventilation

单体特长公路隧道联动控制技术方案研究

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摘　要　监控系统是特长公路隧道的重要组成部分,监控系统的智能化和联动化有利于隧道运营期间的节能和防灾。综述了隧道监控系统的组成和结构,以及运营期间的控制流程。探讨了正常运营时隧道通风系统和照明系统的智能化多级控制策略,以达到节约电能和保证行车环境的目的;基于网络通风理论研究了在隧道不同位置发生火灾时的救援预案及监控系统的智能联动控制策略;通过划分区段研究了不同位置发生交通事故下的救援策略;探讨了交通堵塞、污染物浓度严重超标、隧道维修时监控系统的联动控制策略。研究成果可为单体特长公路隧道的监控系统设计提供参考。

关键词　单体公路隧道　监控系统　智能控制　联动控制

Scheme Study on the Linked Control Technology for Single King-size Highway Tunnel

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Abstract Monitor and control system is an important part for the king-size highway tunnel. Energy saving and calamity preventing during tunnel's operation can benefit from an intelligent and linked system. The structure, constitutes, and control flow of the monitor and control system are summarized. Intelligent and multilevel control strategy for ventilation and lighting system are discussed during tunnel' working to economize electric power and insure driving condition. On the basis of network ventilation theory, counter plan and intelligent linked control strategy for the monitor and control system are researched when fire occur at various places. By the means of section partitioning, rescue strategies for the traffic accident at different places are studied. Linked control strategy for traffic jag, contamination exceeding and tunnel maintaining are discussed too. The research results can offer reference for the design of single king-size highway tunnel's monitor and control system.

Key words Single Highway Tunnel; Monitor and Control System; Intelligent Control; Linked Control

隧道衬砌混凝土高温后物理力学性能试验研究

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摘　要　对经历不同高温后衬砌混凝土（普通混凝土、钢纤维混凝土和聚丙烯纤维混凝土）的峰值应力、峰值应变、弹性模量、超声波特性以及抗渗性能进行了试验研究。试验结果表明经历高温后三种混凝土的物理力学性能都明显降低，特别是强度、刚度和抗渗性能的下降最为明显。这种物理力学性能的急剧降低会严重影响隧道衬砌结构的安全性。

关键词　火灾 衬砌 混凝土 高温 物理力学性能

Experimental study on mechanical properties of lining concrete after high temperature

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Abstract Experimental study on mechanical properties of three types of concrete of normal concrete, steel fiber reinforced concrete (SFRC) and polypropylene fiber concrete are conducted. The content of research includes variation of peak stress, peak strain, elastic modulus, longitudinal wave velocity and impermeability with high temperature. The results indicate that peak stress, elastic modulus and longitudinal wave velocity decrease significantly as suffered temperature increases. Moreover, high temperature badly reduces impermeability of concrete. These degradations of mechanical properties of concrete after high temperature result in reduction of lining structure safety.

Key words fire lining concrete high temperature mechanical property

隧道排送组合纵向通风计算公式的建立

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摘　要　根据空气动力学的基本方程，推导了排风口与送风口的升压力基本计算公式；根据国内排送组合通风系统送风口的常用构造形式，建立了新的送风口通风分析计算模型，并据此推导了送风口升压力的计算公式。重点分析了隧道若干控制断面的有害气体浓度，建立了相应的需风量和压力计算公式。

关键词　公路隧道　排送组合通风　设计计算

Design calculation for longitudinal ventilation in extra long tunnel with air ejecting & blowing system

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Abstract Based on aerodynamics, the authors reason out new fundamental formulas for pressure calculation at ejecting and blowing mouth. According to the common structure of ejecting and blowing mouth in China, a new analysis model for blowing mouth is set up and new calculation formulas for pressure are derived. By analyzing the consistence of CO at the controlling crosses, formulas for calculation of required quantity and pressure for air are also established.

Key words highway tunnel ; longitudinal ventilation with air ejecting & blowing system ; calculation and design

长大隧道纵向通风系统数学模型仿真研究

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摘　要　论文以长大隧道通风系统为研究对象，以计算流体力学(CFD)为理论基础,提出了一种长大隧道通风系统数学模型。以气压、温度和空气污染度为通风系统参数，结合黄莲山隧道实际情况，利用该模型分析了长大隧道处于双洞单向行车状态时各个参数变化趋势，这对我国今后的长大隧道通风系统方案设计可以提供可靠的理论依据。

关键词　长大隧道　通风系统　CFD　仿真

Math model simulation study on the long tunnel vertical ventilation system

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Abstract: Long tunnel ventilation system is the study object of this paper. Computational fluid dynamics (CFD) methods is made as the theory base. One math model is put forward. Air pressure, temperature and air contamination degree are regarded as the parameters of the ventilation system. Combining the conditions of the Huanglian Mountain tunnel, this model is used to analyze the change trend of each parameter when the long tunnel is on the state of the traffic driving on one direct way in the two tubes. One reliable theory criterion for the later design scheme of our country's long tunnel ventilation system can be gained from this paper.

Keywords long tunnel; ventilation system; CFD; simulation

公路隧道多源信息融合技术研究

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摘　要　隧道系统是一个多信息源的复杂大系统，信息的种类多，容量大，层次复杂，对它们进行有效的融合处理是隧道现代化管理的必要手段。论文采用基于 Bayes 推理方法的信息融合技术，对 Bayes 网络进行分析，利用 Bayes 网络结构来反映隧道内各检测参数之间的依赖关系，通过优化 Bayes 网络结构学习算法，用最佳的网络来描述隧道内参数之间的关系。然后，结合隧道内的计算机管理系统和相关的机电设备，建立了隧道运行中的多参数协调控制模型，实现由信息到决策的转换过程。本文将信息融和技术应用于公路隧道的实时控制，为隧道智能化运营管理提供了一种新思路。通过对隧道参数的动态和静态划分，该模型具有一定的通用性推广价值。

关键词　公路隧道　信息融合　Bayes 网络　决策

Research in Multi-source Information Fusion for Highway Tunnel

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Abstract Highway tunnel system is a big complex system of multi-source information. To make valid fuse disposition on its kinds of information much contents and complexing levels is a necessary measure for the modernize management. This thesis adopts the information fusion skills which based on Bayes logic ways to analyze Bayes networks, using its structure to image the inter-reliance relations among every inspect parameter, through optimizing Bayes networks learning methods and use the best networks to show the relations within all parameters which are inside of tunnels. Then the multi-parameter coordinated control models which are running in the tunnels will be established by combination the computer management system with rela- tive electromechannical equipments, and it makes the transfer processing from information to decision come true. The article applying information fusion skills to Highway tunnel's real-time control, this way provide a new thinking for the intelligent running management of Highway tunnel. This model contains certain spread value get through dividing dynamic from static-state for tunnel parameters.
Key words Highway tunnel; Information fusion; Bayes networks; Decision

基于公路服务水平分级的隧道运营通风计算方法

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摘　要　公路隧道是否设置运营通风系统、设置规模、洞内空气质量等，都与洞内实际交通量和基本通行能力有关。交通部新颁布的《公路工程技术标准》（JTG B01-2003）首次以“规范”形式提出了“公路服务水平分级”概念，不同的公路“服务水平等级”对应着不同的道路平均车速和“最大服务交通量”；现行《公路隧道通风照明设计规范》（JTJ026.1-1999）是依据《公路工程技术标准》（JTJ 001-97）编制而成，因此没有体现这一理论。这里，本文以实际工程为例，提出基于公路服务水平分级的隧道通风计算方法。

关键词　公路服务水平分级　最大服务交通量　隧道运营通风　计算方法

Tunnel operation ventilation calculation method based on road service level ranking

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Abstract Whether operation ventilation system is furnished in road tunnels, the furnishing scale and interior air quality, etc. has close relationship with actual traffic volume inside tunnel and basic traffic capability. “Technical Standard of Highway Engineering” (JTG B01-2003) newly released by Communications Ministry,PRC has, for the first time, suggested the concept of “Road service level ranking” in forms of “Regulations”; The existing “Specifications for Design of Ventilation and Lighting of Highway Tunnel” (JTJ026.1-1999) is drafted based upon “Technical standard of Highway Engineering” (JTJ001-97), and has not represented this theory. This article take practical projects as instance and has suggested tunnel ventilation calculation method based on road service level ranking.

Key word Road service level ranking, Max. service traffic volume, Tunnel operation ventilation, Calculation method

控制火灾和烟雾的通风与防灾能力的思考

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摘　要　控制火灾和烟雾的通风与防灾设计在公路隧道的通风设计中目前还存在一定的不足，主要表现在火灾的规模的确定以及防灾通风调控的能力的不足。本文总结了来自火灾试验的数据和理论计算，以及几个国家的标准和建议。提供了公路隧道通风系统火灾设计的推荐值，包括火灾事故中可能热释放率，烟雾流量和烟雾毒性，并对隧道的烟雾扩散和射流风

机调节能力的设计进行了阐述。

关键词　隧道通风　火灾　热释放率　烟雾　烟雾扩散　设计

A Consider on the Ventilation for Fire and Smoke Control and the Ability of Prevent Fire

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Abstract At present, in road tunnel ventilation designing there are certain shortages in controlling of fire and smog ventilation and prevent fire designing, chiefly on fire size ascertaining as well as the ability on the prevent fire regulation of ventilation. The paper summarizes the data from the tests and theoretical calculations as well as from regulations and proposals in several countries. In conclusion fire characteristics are provided for the recommendation of design fires for ventilation systems for road tunnels. Included are data about the probable heat release rates, smoke flow rates, smoke opacity and smoke toxicity, and the design for the smoke diffusion of tunnels and the regulation of jet fans is summarized.

Key words Tunnel Ventilation, Fire, Heat Release Rate, Smoke, Smoke Diffusion, Design

公路隧道交通安全设施的若干问题探讨

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摘　要　本文分析了长大公路隧道交通安全事故相对于一般高速公路交通事故所具有的特点，从隧道结构、车速、运营监控等方面分析了事故原因，并详细研究分析了隧道内两种重要安全设施（安全管理设施、照明系统）在设计和应用中存在的问题及应对措施。

关键词　公路隧道　交通事故　安全设施设计

Research of highwaytunnel traffic safety facilities

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Abstract This text analyzes the characteristics of highwaytunnel traffic accidents compared to general superhighway traffic accidents, and analyzes the reasons from several aspects such as tunnel structure, speed, surveillance and control, then this text researches and analyzes the existent problems in the design and the application of the two important safety facilities (safety management facilities,illumination system) in detail,and then put forward some countmeasres.

Key words highwaytunnel; traffic accidents; design of safety facilities

公路隧道安全工作的全过程(初稿)

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摘　要　公路隧道的安全工作是从隧道开始建设、施工实施到最后的建成通车、运营管理的每个环节都有许多有关安全的事情去做，文中在隧道的勘察设计、掘进成洞，到交工运营及养护各方面的安全工作及注意要点均有所涉及并提出了一些启示的事情可供读者参考。

关键词　公路隧道　安全工作　控制过程

Process of Safetg work on highway Tunnels

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Abstract The safety of highway tunnels includes the construction open to traffic, Operation and management. In the each circle there are many problems to do. This paper describes the noticeable things of highway tunnels, such as surveying, design, excavation and maintenance and only provides the raaders a reference.

Key words Hinhway tunnel; Safety work; control process.

Papers by non-Chinese

视频图像处理系统在隧道交通数据采集和事件管理中的应用

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目前世界范围内的交通管理者面临着日益增长的采用智能交通系统的需求：数据统计和安全管理。隧道事故容易导致大量的人员伤亡和经济损失。因此，交通管理者应该采取有效的事件管理系统。

传统的方法中，环形线圈和CCTV系统可以为引导车流提供充分的信息。但这些信息是有限的，日益严峻和复杂的交通需要更优化的系统，尤其是自动事件管理系统。

今天视频图像处理系统可以进行交通数据采集和自动事件检测。大量的实地经验证明了这项智能交通技术的可靠性。视频检测技术在事件检测方面表现出检测率高、检测和确认迅速且误报率低的特点。

本文将讨论利用视频图像处理技术检测隧道中各种事件（如停车、逆行、抛洒物、行人、烟雾等）的可行性及其局限性，因为Traficon公司在这方面的研究已有20多年。本文将着重论述两个方面：视频检测已经被证实是可靠的事件管理工具，是检测各种事件最快的方法；除了事件管理功能，本文还讨论如何利用视频图像处理技术采集交通数据。

关键词：视频图像处理（video image processing）；事件检测（incident detection）；数据采集（data collection）

TUNNEL DATA COLLECTION & INCIDENT MANAGEMENT: IMPLEMENTING A VIDEO IMAGE PROCESSING SYSTEM

ABSTRACT

Traffic Managers worldwide are faced with an increasing demand for state-of-the-art intelligent traffic systems: both for statistics purposes as for safety issues. In tunnels, traffic congestion and secondary accidents are now costing hundreds of lives and millions of dollars every year. Therefore, traffic managers need an **effective incident management** system.

Traditionally, loops and CCTV cameras provide ample information to direct traffic flows and assemble statistics. But their information is limited, and increasing traffic volume and complexity has created a need for more optimized systems; highly automatic incident management systems in particular.

Today, video image processing systems handle both traffic data collection and automatic incident detection. This ITS technology has proven to be very reliable. Its incident detection shows a high detection rate, a short time to detect, fast incident verification and a low false alarm rate.

This paper discusses the wide range of capabilities and some of the limitations of video image processing for tunnel incident detection as Traficon has experienced it over the past 20 years. Two main items are focused: nowadays video detection has proven to be a very reliable incident management tool. This ITS technology is the fastest system to detect incidents. Next to **incident management**, this paper will also focus on traffic **data collection** via Video Image Processing (VIP). A definition is given of traffic data quality and some new insights will demonstrate that video detection, when it is used correctly, offers great potential for data acquisition and incident management.

Key words: video image processing, incident detection, data collection

Highway Tunnel Safety Guide in China

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Abstract

The Chinese government is constructing the National Trunk Highway System (NTHS). With over 34,000 km of expressways currently built, the system is beginning to enter into more challenging terrain. This is seeing a marked increase in the number, and length, of expressway tunnels.

There is a concern that the tunnel safety systems have not kept up with the increased demand for more and longer tunnels. Among the issues are: achieving the correct balance between human intervention versus automatic systems; inadequately integrated management plans among the expressway operators, public security bureaus and fire departments; failure to adopt the latest developments in safe tunnel designs and operations, especially with regard to Intelligent Transport Systems (ITS).

A Highway Tunnel Safety Guide is being developed on behalf of the World Bank's East Asia Region Transport Unit (EASTR) using a Japanese grant to support the Task Team identify relevant safety "best practices" for the appraisal of expressways in China. This guide will be used by the Bank to assess the adequacy of tunnel design practices; electronic, electrical and mechanical works standards; operational and emergency procedures; and to propose recommendations to its clients during project preparation, in areas that require improvement.

The guide will address a broad approach to safe tunnel design and operational procedures in China and around the world; it will be pilot-tested and also take into account lessons learned from tunnel emergency events around the world.

The presentation would be centered on the best practices identified in the Highway Tunnel Safety Guide.

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Abstract

The United States has approximately 75 miles (120 kilometers) in about 400 road tunnels.
These tunnels are very important part of the national transportation infrastructure. They provide passage for motorists in their way to work, school, church, or to go out of town just for pleasure.
Some of our road tunnels are located under parks, under buildings, under airports, under water bodies. There are many benefits from building tunnels, a tunnel can be used to enhance the quality of life in an urban area by providing park areas on top of the tunnel, it could be used to avoid deep cuts in mountain terrain, to avoid visual contamination over a river, it could protect the road from mud or snow slides, it could be used to mitigate the road noise, and it could be used to eliminate unacceptable road geometry.

Because of their location these facilities present challenges for the safety and security of the motorists and others. Making these facilities safe and secure is a priority of Federal Highway Administration (FHWA). This paper will focus on activities to make the US road tunnels safer for the motorists.

Road Tunnel Ventilation –

Coping with Fires, Gas Attacks, and Structural Failures

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Modern threats offer great challenges for new road tunnel designs. Current designs, with the use of current technology and stricter requirements need to assess various risks and threats to provide a safe environment for the users. For years, the hot topic has been fires, and pollution. Today we also face structural integrity, and gas attacks. The question is: How can we cope with all this? Can one simple mode of ventilation be enough for al threats? What are the governing factors? Should we contain or ventilate?

The subject of fire modeling has been evaluated extensively, but yet, the question remains: how can we assess the proper fire growth? Recently, Sanchez (2006) has initiated a movement where fire growth has to rely on real combustion principles in order to reduce the amount of assumptions made and letting physical science predict what could really happen in a fire growth situation. This would have a tremendous impact on the determination of the structural integrity of the tunnel as well.

The subject of dispersion of chemical agents in subways has been addressed in different occasions for the last five years (Sanchez et. al. (2001) and Coke et. al. (2000)). However, to date, very little has been done in regards to road tunnels. The big question to answer is: Should we ventilate or contain? Can the same ventilation mode for fires be used for agent dispersion control? What are some of the key parameters to be concerned about?

This paper will be addressing current potential threats for road tunnels. This paper will illustrate general assumptions and performance of the most conventional road tunnel ventilation systems: fully transverse, semi-transverse, and longitudinal, and will evaluate if one mode can cope with all threats.

References

Sanchez, J.G., Predicting Flashover and Tenability Conditions in Trains fires – A CFD Approach, ASHRAE Transactions, Volume 112, Part 1, January 2006.

Sanchez, J.G., Coke, L.R., Wasmer, F.L., Policastro, A.J., Managing Chemical/Biological Releases in the Subway Environment, Tunnel Management International, April 2001, pg 17-23.

Coke, L.R., Sanchez, J.G, Policastro, A.J., A Model for the Dispersion of Contaminants in the Subway Environment, BHR Group 10th International Symposium on Aerodynamics and Ventilation of Vehicle Tunnels-Principles, Analysis, and Design. 1-3 November 2000, Boston, USA,

TF Tunnel Fast System: The innovative solution for traffic management and active detection inside tunnels

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Motorway tunnel management in metropolitan areas particularly subjected to congestions needs detection systems characterized by high reliability in terms of automatic interpretation and event signalling, fast image processing times, active and timely communication with control centres and passive communication by means of variable message signs and potentially by means of on-board RDS/TMC systems, equipment installation and maintenance simplicity and fastness (maintenance work reduction) and obviously reduced costs for the exploiting company.

The object of the experimentation described by the present article is to join the exploiting company needs in terms of functionality, reduced realization times, easy integration with existent control systems at low costs for the implementation of safety systems in open tunnels. What is described here below was realized by means of on-board processing cameras, software for automatic traffic and smoke detection, signalling signs for users and modem to ensure connections along the existing lighting system electric installation.

A system meeting these characteristics is under experimentation on the A1 motorway of the Italian motorway network over the metropolitan area of Florence inside a tunnel located near a motorway interchange with a rush traffic of 3000 vehicles/hour on two lanes.

The system is composed of highly reliable low absorption embedded devices; thanks to the distributed intelligence and recording, these devices allow to implement the functions required with high reliability and capacity of adaptation to the band available. In fact from the one hand low absorption allows to adopt traditional feeding solutions but also alternative ones as photovoltaic panels or the use of buffer batteries for public lighting, and on the other hand the distributed intelligence ensures the absence of limits in terms of system expansion.