

城市道桥与防洪



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图为获2017年全国优秀工程勘察设计行业一等奖的北京市中心城下凹式立交桥区积水治理工程一期工程，由北京市市政工程设计研究总院有限公司设计

因为我们专心，所以我们专业！

《城市道桥与防洪》

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● 本期看点

- 国内外雨水排放管理激励方法分析及启示
- 北京立交桥区积水原因分析及工程改造实践探讨
- 武汉市近期道路建设思考
- 轨道-快速路复合节点交通组织研究



中华人民共和国住房和城乡建设部优秀期刊



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目次

城市道桥与防洪 (月刊)

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总编辑: 骆燕妮

责任编辑: 叶露 赵晓燕

美术编辑: 杨建华

英文校审: 孙宁萍

地址: 上海市中山北二路901号 邮编: 200092

电话: (021)55008850 传真: (021)55008850

来稿邮箱: cdq@smedi.com

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道路交通

- 武汉市近期道路建设思考 李丹, 车丽彬, 黄俊(1)
- 轨道-快速路复合节点交通组织研究 ... 高明(5)
- 柳敦高速公路柳园枢纽互通方案设计 黄涛, 戴琪(9)
- 基于VISSIM仿真的道路交叉口改造后评价方法 田晓楠, 于森, 丁磊(12)
- 主干路快捷化理念设计 韩海潮(16)
- 道路线形设计与交通安全的关系分析 张越(20)
- 浅谈城市道路最小纵坡设计与锯齿形偏沟的运用 蔡祥辉(23)
- 海绵城市在广州南沙地区市政工程设计中的应用 蒋少稀(26)
- 考虑供水主管影响的公路拓宽方式选取研究 ... 朱东(30)
- 市政道路膨胀土路基检测及对路面结构的影响研究 戴欣, 赵心源, 王萍(33)
- 某山区挡墙倒塌原因分析 乔克昌(37)
- 山区路基工程病害的原因分析及对策 陈雄贤(40)
- 济南市经十路车辙调查与成因分析 ... 徐皓(44)
- 水泥混凝土路面的常见病害及其修复措施研究 夏枫, 殷威(47)

桥梁结构

- 斜交小箱梁桥地震反应分析 曾天宝, 张琳(51)
- 高烈度区地震液化场地梁桥抗震设计方法研究 牛登辉, 胡哲卿, 任育林(55)
- 钢箱梁T型刚构稳定性分析 李琨(58)
- 某新建铁路下穿京津城际铁路的连续板桥设计及安全分析 闫阿利(62)
- 城际铁路74 m简支系杆拱桥设计 ... 王宗丰(65)
- 自锚式悬索桥加劲梁方案比选与设计要点研究 王吉文, 周建波(69)

期刊基本参数: CN 31-1602/U * 1984 * m * A4 * 230 * zh * P * ¥25.00 * 10000 * 65 * 2018-04

- 城市小半径曲线梁桥内力分析及支承方案设计优化
 张敬天,孔艺达(72)
- 全预制装配式桥梁方案研究 王继全(75)
- 呼市某高架全预制拼装技术简介及设计关键点
 周涛(78)
- 广州从化大桥工程桥墩景观及结构设计 ... 汪荷玲(80)
- 桥梁桩基偏位分析及处理方案探讨
 梅宇,汪又春(83)
- 登高平台消防车(101 m型)安全通过既有桥梁的研究
 文勇,曹江萍(86)

防洪排水

- 北京立交桥区积水原因分析及工程改造实践探讨 ...
 何翔(90)
- 富阳污水处理厂四期工程设计方案 万明辉(94)
- 郑州新区污水厂厂外管道工程溢流井设计方案与计算
 元绍建(99)
- 扶壁式闸墙沉降及倾斜研究 许瑞东(103)
- 利用AHP方法评价溢流堰对环境的影响研究
 练玉琴,陈云兰,施安康(107)

管理施工

- 国内外雨水排放管理激励方法分析及启示 ... 吴晨浩,
 谢胜,吕永鹏,张辰,李运杰,赵军,夏宇飞(109)
- 声波透射法检测中声测管斜管的管距修正研究
 王军,周滨,孙根,陈洪祥(112)
- 小半径曲线转体桥调偏心研究 田山坡(116)
- 大跨度连续梁悬臂施工技术研究 王建明(119)
- 后张法预应力混凝土简支箱梁单孔梁施工技术分析 ...
 沈亮(123)
- 铁路桥梁悬灌梁0号段底托架施工新技术研究
 邱永军(126)
- 浅谈上跨营业线架梁施工技术 上官逸超(129)
- 某低高度钢筋混凝土梁重载改造技术研究
 赵德宽(132)
- 基于建筑物保护的软土地铁基坑变形控制技术研究
 吉茂杰(136)
- 软土地区超大深基坑工程围护及支撑体系选型分析
 孔维耀(141)
- 关于31省道诸暨王家湖至五泄段改建工程施工安全
 管理探讨 施曙东(145)
- 基于层次分析法的成都电力隧道开挖方案对比分析
 姬永红,毕逸文(148)

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上海市市政工程建设发展有限公司

应急车行通道与暗挖隧道十字交叉口施工分析	孙迪科(154)
盾构穿越上软下硬及硬岩段施工技术分析	杨 宝(157)
浅谈柿子园隧道穿越活动断裂带施工措施	范上海(159)
某上跨铁路立交桥防撞护栏维修加固设计	黄宗根(162)
深基坑工程中自动化监测技术的应用 ...	许余亮(166)
桥梁安全监测系统在大型桥梁病害监控上的应用 ...	王晓伟(172)
大管径 PCCP 管试水阶段管缝缺陷处理 ...	张 广(174)
以技术革新实现单体特大桥项目成本节约	杨天伟, 卢 磊(176)
公路沥青拌和机燃烧系统火焰调整的技术措施	邱 雄(179)
科技研究	
大跨径连续刚构桥静动载试验研究	裴 强, 王 勃(182)
基于差值法的荷载试验分析研究	胡惠康, 元 萌(185)
基础沉降计算的数值积分算法	许德胜(189)
成果应用	
柔刚劲性复合桩在地下污水厂中的应用	叶源新(193)
装配式结构的应用探讨	尼景升(196)
数字地图在上海地铁建设远程监控系统中的应用 ...	杜泽明(199)
相关专业	
大型矩形盾构近距离穿越管线影响研究	温竹茵(202)
下穿黄河盾构隧道“结构-壁后注浆-土体”结合部渗流研究	张亚洲, 李嘉荣(208)
哈齐客专涵洞冻胀监测方案探讨	李坤衡(213)
龙腾路下穿隧道方案探讨	陶家清(218)
关于城市地下综合管廊支架体系的比较与研究	史伟伟(221)
复杂软基条件下自动化堆场沉降控制的思路和方法 ...	王跃全(224)
浅析工程量清单计价模式的应用与完善	戴峻晟(228)

广告索引

- 封一 北京市市政工程设计研究总院有限公司
- 封二 上海申华声学装备有限公司
- 封三 南塑建材塑胶制品有限公司
- 封四 上海凯泉泵业(集团)有限公司
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封面工程

本期封面工程为北京市中心城下凹式立交桥区积水治理工程一期,由北京市市政工程设计研究总院有限公司设计。

该工程社会效益大:统一将原有泵站排水标准提高至5 a一遇,有效解决了北京桥区的积水问题,为首都防涝及城市运行安全提供了有效保障。

该工程内容丰富:针对北京市城市中心区一期20座立交进行改造,雨水泵站设计总流量从30 m³/s提高到133.7 m³/s,新增雨水口5万5千座,新增调蓄容积10万 m³。

该工程创新成果突出:一是泵站排水与雨水峰值调蓄池有机结合;二是引入初期雨水概念;三是采用一桥一策解决积水;四是施工方法多样化;五是泵站外观设计尽量与周边环境协调;六是新建雨水智能预警系统;七是对设计进行模拟验证;八是新材料和新方法;九是编制相关规范,补充规范的空缺。

该项目于2012年8月开始设计,2015年3月竣工。该工程获得2017年全国优秀工程勘察设计行业一等奖。

Urban Roads, Bridges & Flood Control

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CONTENTS

ROADS & COMMUNICATION

Thinking of Short-term Road Construction in Wuhan City Li Dan, Che Libin, Huang Jun (1)

Abstract: The article introduces the construction achievements and construction direction of urban roads in the recent ten years of Wuhan, and evaluates the present operation situation of road traffic facilities. On the basis of summarizing the construction experience and lessons of road in the present stage, and combined with the development goal and challenge of the future city, the article puts forward the construction direction and focus of urban roads in the future 3~5 years, which can be referred for the similar cities of China.

Keywords: road construction, short term, strategy, Wuhan City

Study on Traffic Organization for Compound Node of Rail – Express Way Gao Ming (5)

Abstract: Based on the practical situation of city development in China, the traffic system of big cities is required to reconstruct and upgrade, and the rapid expansion of small and middle cities is also required to provide the rapid traffic system to support the growth of cities. The high-effective and convenient traffic system cannot be separated from the construction of urban rail transit and urban expressways. From the angle of microcosmic node, the article analyzes how to well handle the relationship between two systems and do the good mutual linking up and transship interchange under the condition of rail transit station and expressway interchange node compound. According to the analysis from three angles of road system, hub plane space and hub vertical space the article puts forward the relevant layout principle and method, and points out the attentions for the independent part and the transform required in the system. The article analyzes the Jimei School Village Station in Metro Line 1 of Xiamen, and determines the adaptability of this method.

Keywords: compound node, rail transit, expressway node, hub layout

Scheme Design of Liuyuan Hub Interchange in Liuyuan – Dunhuang Expressway Huang Tao, Dai Qi (9)

Abstract: Taking the scheme design of Liuyuan Hub Interchange in Liuyuan – Dunhuang Expressway of Gansu Province as a practical case, the article analyzes the main control factors of interchange construction, puts forward two types of interchange schemes, and comprehensively compares and selects two interchange schemes from many aspects, which can be referred for the design of the similar projects.

Keywords: expressway, interchange, scheme design, comparison and selection

Post-evaluation Method for Reconstruction of Road Intersection Based on VISSIM Simulation

..... Tian Xiaonan, Yu Miao, Ding Lei (12)

Abstract: The article systematically sets forth the problems before the reconstruction of Nanjing road - Xinhua Road Intersection in Tianjin and its reconstruction strategy, introduces the reconstruction scheme from the aspects of space channelization design, signal timing plan and drive-by-wire coordination, puts forward the evaluation method of analytic hierarchy process based on VISSIM simulation, and establishes the simulation and evaluation models. According to the comparison and analysis of the key indexes before and after reconstruction, the reconstruction scheme is systematically evaluated.

Keywords: intersection reconstruction, post-evaluation, traffic simulation, analytic hierarchy process (AHP)

Design on Rapid Concept of Main Trunk Road Han Haichao (16)

Abstract: The rapid property of main trunk road as the new concept in the construction of urban road has been applied in the construction of many cities in China. Taking the design of the main trunk road for North Xiaoxiang Road in Changsha City as an example, the article clears up and sums up the application of the rapid concept of main trunk road in the design of projects from the cross-section design, traffic organization and design speed selection, and puts forward the relevant design proposals.

Keywords: urban road, main trunk road, rapid, design, Changsha City

Analysis on Relationship between Alignment Design and Traffic Safety of Road Zhang Yue (20)

Abstract: The article analyzes various traffic accidents at home and abroad, and divides the causes into two causes of subjectivity and objectivity. The former is the human factor to cause the traffic accidents, and the latter is the factors of vehicle, road, traffic and climate to cause the accidents. The article discusses the relationship between the alignment design and traffic safety in the road factors in detail, and introduces the safety evaluation of road alignment through the simulation test, which can provide the reference for efficiently decreasing the causing rate of traffic accidents.

Keywords: road traffic accident, road alignment design, easement curve

Elementary Discussion on Application of Minimum Longitudinal Gradient and Zigzag Side Ditch in Practical Engineering Design of Urban Road Cai Xianghui (23)

Abstract: The longitudinal slope of road is often less than the minimum drainage gradient influenced by various factors in the flat terrain of city. According to the requirement of the minimum longitudinal gradient of urban road in the standard, the article analyzes the reason of setting up the minimum longitudinal gradient and its rationality, and sets forth the application of the minimum longitudinal gradient in the design of the roads in the flat terrain of city, and the using method and the matters for attention of zigzag side ditch when not able to meet the minimum longitudinal gradient (the minimum drainage gradient) in order to solve the contradiction between the pavement drainage and the alignment beauty of urban road and to benefit the rapid discharge of the pavement rainwater.

Keywords: minimum longitudinal gradient, zigzag side ditch, raised curb, drop point

Application of Sponge City in Municipal Engineering Design of Nansha Area in Guangzhou Jiang Shaoxi (26)

Abstract: Sponge city is a new generation of urban rain and flood management concept in China. The cross section, pavement structure, curb and green belt are the important components in the sponge urbanization design. Therefore, relying on the practical engineering project of Guige Avenue in Nansha Area of Guangzhou City, the article puts forward the design method of sponge city in the construction of municipal roads, which can be referred for the construction of the similar municipal roads.

Keywords: sponge city, design of municipal road, Nansha Area

Study on Selection of Highway Widening Ways Considering Influence on Water Supply Pipe Zhu Dong (30)

Abstract: A reasonable widening way of highway can not only effectively improve the traffic capacity and meet the rapidly increasing traffic demand, but also save the engineering construction cost and reduce the influence on the status quo. Based on the actual project, this paper puts forward four influential factors of the status quo of water supply pipe, the proposed water supply pipe, the demolition and the engineering construction costs to be considered in the projects, and quantitatively analyzes these influencing factors, and then uses the multi-index comprehensive evaluation method to compare and select the main widening ways. Through the quantitative analysis results, the reasonable scheme of old road widening way is obtained, which provides some references for the future study and design.

Keywords: selection of highway widening ways, influence on water supply pipe, multi-index comprehensive evaluation method

Study on Detection of Expansive Soil Subgrade and Influence on Pavement Structure of Municipal Road

..... Dai Xin, Zhao Xinyuan, Wang Ping (33)

Abstract: Relying on the disease detection of municipal road and through the field survey, drilling coring, excavation test pit and laboratory test, the uneven settlement, deformation and serious damaged base course of this road are found, which original causes are in the base and subgrade soil having the weak expansive soil properties. According to the further expansibility test, the article analyzes the expansive ratio and expansive force of expansive soil under load and no-load conditions, and puts forward the correlation between the expansion ratio, expansion force and compaction degree, moisture content of soil. In order to reveal the influence mechanism of expansive soil to the damage and uneven deformation of pavement structure, the article analyzes the influences of the different expansion forces and the different base modulus on the mechanical characteristics and deformation properties of road structural layer, and reveals the failure mechanism of expansive soil subgrade semi-rigid pavement structure.

Keywords: expansive soil subgrade, disease detection, laboratory test, mechanical analysis

Analysis on Collapse Cause of Retaining Wall in Mountainous Area Qiao Kechang (37)

Abstract: The article analyzes the collapse cause of a retaining wall in mountainous area, proposes the repair scheme, and puts forward the reasonable proposal for the design of retaining wall. The relative experience can be referred for the similar projects.

Keywords: retaining wall in mountainous area, collapse, repair scheme, proposal

Reason Analysis and Countermeasures for Roadbed Engineering Diseases in Mountainous Area

..... Chen Xiongqian (40)

Abstract: The article introduces the disease characteristics and types of roadbed engineering in mountainous area, analyzes the disease reasons, puts forward the countermeasures for repairing and treating the roadbed diseases of the main roadbed disease, landslide breaking and branch structure disease, discusses the prevention of roadbed diseases in mountainous area, and puts forward the relative proposals.

Keywords: highway in mountainous area, damage of roadbed, repair and reinforcement, prevention measures

Track Survey and Cause Analysis of Jingshi Road in Jinan City

..... Xu Hao (44)

Abstract: Jingshi Road as a vital traffic road in the east-west direction of Jinan City has played the important role to promote the economic and social development of Jinan City since its completion and opening for traffic in 2004. With the constant advance of urban space strategy in Jinan City, especially the rapid development of the east new city and the west new city, the traffic pressure on Jingshi Road grows with each passing day, and the road facilities continuously operate in the full load. After its service for many years, various road diseases are caused in succession on Jingshi Road, i.e. rutting, crack, net-shaped crack, pit slot and so on, in which the rutting phenomenon is the most representative, especially the rutting at the intersections and the bus transit lane. Some rutting can be up to 15 cm. the article introduces the detailed survey on the scope and depth of rutting diseases along Jingshi Road, and analyzes the cause and characteristics of rutting by Hamburg test and void ratio test, which has a certain practical guiding significance and economic value for the pavement structure and material design of heavy traffic in Jinan in the future.

Keywords: rutting, Hamburg test, pavement structure and material

Study on Common Diseases and Restoration Measures for Cement Concrete Pavement ... Xia Feng, Yin Wei (47)

Abstract: According to the survey of the common diseases in cement concrete pavements of roads practically reconstructed, the article analyzes the types and distribution characteristics of the diseases mainly including the cracking, slab corner fracture, broken slab fracture and slab bottom blank, discusses the characteristics, formation mechanisms and late damages of various diseases in detail, and finally puts forward the restoration measures and methods of diseases. The analysis, conclusion and treatment of the common diseases of cement concrete pavements can provide the references for the similar projects.

Keywords: cement concrete pavement, common diseases, cause analysis, prevention measure

BRIDGES & STRUCTURES

Analysis of Seismic Response on Skew Small-box Girder Bridge Zeng Tianbao, Zhang Lin (51)

Abstract: The skew small-box girder is an important part of urban bridge. The seismic analysis of urban bridge is also an emphasis in the bridge design. Taking five variables of inclination, support rigidity, span, pier height and span number as the variable parameters, the article analyzes the seismic response on the skew small-box girder bridge, and discusses the influence of these parameter variables on the seismic response, which can be referred for the design of the following skew small-box girder bridges.

Keywords: small-box girder, seismic response, inclination, span, pier height, span number

Study on Seismic Design Method of Girder and Bridge in High-intensity Earthquake Liquefaction Site

..... Niu Denghui, Hu Zheqing, Ren Yulin (55)

Abstract: Based on the Zhichengdao Taixing Road Interchange of Tianjin, the study work is carried out on the seismic design method of girder and bridge in the high-intensity earthquake liquefaction site. The HDR high-damping seismic-isolation rubber bearing is recommended to use for the small-span and middle-span beam bridges in the high intensity area. The analytical iterative algorithm of horizontal equivalent stiffness for HDR high-damping seismic-isolation rubber bearing under E2 earthquake action is proposed. Aiming at the seismic design of Zhichengdao Taixing Road Interchange, its theoretical calculation result meets standard requirements.

Keywords: high-intensity area, earthquake liquefaction site, seismic design of girder and bridge, Zhichengdao Taixing Road Interchange

Analysis on Stability of T-type Rigid Frame for Steel Box Girder Li Kun (58)

Abstract: The article summarizes the concept, the development history, and the advantages and disadvantages of three T-type rigid frames in the present bridge engineering so as to learn about the two-span steel box girder T-type rigid-frame bridge not yet applied in the highway bridge. It is very important to study its stability. The article introduces the stability theory in detail, sets forth the geometric nonlinearity calculation method in the program and describes the solving process of safety coefficients. Based on the engineering cases, the article further verifies the reliability and safety of design result of two-span T-type rigid frame, which provides the valuable reference for the stability analysis and design of the similar bridges.

Keywords: steel box girder, T-type rigid frame, stability, nonlinearity, safety coefficient

Design and Safety Analysis of Continuous Slab Bridge of Newly Built Railway underneath to Pass Beijing-Tianjin Intercity Railway Yan Ali (62)

Abstract: According to the relative stipulations of high-speed railway now, the construction scheme for the newly built project to intersect with the built high-speed railway should be the newly built project underneath

to pass the existing high-speed railway in principle. Taking the limited net height of the existing high-speed railway bridge as an entry point, the small-span and middle-span continuous slab bridges able to efficiently reduce the bridge height are used underneath to pass the existing high-speed railway bridges. The article further analyzes the influence of the newly built bridges on the existing high-speed railway bridges from the aspects of structural design, safety evaluation, and deformation monitoring in construction and operation periods. The study result can be referred for the design of the other similar projects.

Keywords: high-speed railway, underneath to pass, continuous slab bridge, design, safety analysis, deformation

Design of 74-m Simple-supported Bowstring Arch Bridge in Intercity Railway Wang Zongfeng (65)

Abstract: The concrete filled steel tube simple-supported bowstring arch bridge has the good applicability in the rail transit project. The 1~74-m concrete filled steel tube simple-supported bowstring arch bridge is used in the Pearl River Delta Intercity Rail Transit Xintang - Baiyun airport - North Guangzhou Station Project spanning Guangyuan Expressway. The article mainly introduces the design parameters, construction methods and calculation methods of 74-m concrete filled steel tube bowstring arch bridge. The inspection result shows that the structural design of this bridge is reasonable, and the stress deformation meets the standard requirements, which can be referred for the design of the similar bridges.

Keywords: intercity railway, concrete filled steel tube, bowstring arch bridge, pre-beam and post-arch, structural design, analysis calculation

Scheme Comparison and Design Gist Study of Stiffening Girder of Self-anchorage Suspension Bridge
..... Wang Jiwen, Zhou Jiangbo (69)

Abstract: The self-anchorage suspension bridge is more and more used in the construction of urban bridge because of its reasonable stress, low construction difficulty and good aesthetics. Based on the design of Weihe River Bridge in Baoji City, two schemes of main side girder and steel-concrete composite girder are comprehensively compared for the stiffening girder of self-anchorage suspension bridge. Finally, the structural type of side girder type is selected. The article summarizes the gist of the structural design of the main side girder and the connection structure of main concrete girder, which can be referred for the design of the similar self-anchorage suspension bridges.

Keywords: self-anchorage suspension bridge, stiffening girder, comparison of scheme, design gist

Analysis of Inner Force and Design Optimization of Supporting Scheme for Urban Small-radius Curved Beam Bridge Zhang Jing Tian, Kong Yida (72)

Abstract: The article introduces the stress characteristics of curved beam bridge, and analyzes the advantages and disadvantages of the different supporting modes. Taking a small-radius curved ramp bridge of interchange in Chongqing as an engineering case, the article analyzes the supporting reactions and structural inner forces under the different support conditions by the use of structural analysis software Midas Civil.

Combined with the formula of antidumping stability coefficient in *Design Specifications for Highway Steel Reinforced Concrete and Pre-stressed Concrete Bridge Culvert* (JTG D62-2012), the article checks and calculates the antidumping stability coefficients under the different support conditions, which can be referred for the design optimization of the similar bridges.

Keywords: small radius, curved beam bridge, support design, analysis of inner force, antidumping stability

Study on Scheme of Fully Prefabricated Assembled Bridge Wang Jiquan (75)

Abstract: The traditional bridge construction technique has more and more disadvantages under the current social environment of China. It is urgent to find a higher efficient, low-carbon and environmentally protective bridge construction scheme. The development of fully prefabricated assembly technique will greatly reform the traditional technique. The article briefly introduces the development situation of this technique at home and abroad, and summarizes the prefabrication types of bridge superstructure, substructure and auxiliary as well as the connection modes of prefabricated components. Taking the construction of a relative case as an example, the article puts forward the assembly technical scheme more suitable for the development of China now.

Keywords: fully prefabricated, grout sleeve, grout corrugated pipe, ultra high performance concrete (UHPC)

Brief Introduction and Design Gist of Full Prefabrication Assembly Technology for Viaduct in Hohhot City Zhou Tao (78)

Abstract: Hohhot City belongs to a severe cold and high-intensity earthquake region. There is no precedent for full prefabrication assembly to implement in Hohhot City of China. Based on an expressway viaduct project of Hohhot City, the article introduces the full prefabrication assembly technology from engineering situation and overall design, and sets forth the design thinking about the key points of hoisting overweight of prefabricated components, and the seismic design of prefabrication assembly technology in the severe cold and high-intensity earthquake region, which can be referred for the design of the similar bridges.

Keywords: full prefabrication assembly, severe cold, high-intensity earthquake, seismic system

Design of Pier Landscape and Structure for Conghua Bridge Project in Guangzhou Wang Heling (80)

Abstract: Aiming at the design of pier landscape for Conghua Bridge in Guangzhou, and combined with the superstructure and substructure types, the modeling of traditional bridge pier is appropriately adjusted. The pier is aesthetically designed by the form of facade art processing in order to achieve the purpose of required bridge landscape. The relative experience can be referred for the similar projects.

Keywords: bridge landscape, bridge aesthetics, pier design

Analyses of Bridge Pile Foundation Deviation and Discussion of Treatment Scheme ... Mei Yu, Wang Youchun (83)

Abstract: The cast-in-place pile is widely used in the substructure of bridge. Various reasons have resulted in the quality defects of finished pile and designed pile foundation axis deviations. Therefore, according to

the discussion and analysis on the reasons of bridge pile foundation deviation and combined with the practical projects, some treatment schemes of pile foundation deviation are proposed, which have some guidance for the design and construction.

Keywords: bridge construction, cast-in-place pile, pile foundation deviation, treatment scheme

Study on 101 m-type High Platform Fire Truck Safely Passing Built Bridge Wen Yong, Cao Jiangping (86)

Abstract: The special vehicles are required to carry out the bridge safety evaluation before passing bridges and culverts. Relying on the 1 001 m-type high platform fire track purchased in Chongqing, the carrying capacity of this vehicle is 63 t. On the basis of definite vehicle characteristics, the article studies the control section internal force responses on the simple-supported girder bridge, two-span continuous girder bridge and three-span continuous girder bridge within the main span 5~50 m range under the action of this fire truck, and at the same time, analyzes the local action of this vehicle on the bridge deck. The study shows that the load effect of single lane is obviously larger than the standard value under the action of fire truck, maximum to 1.5 times, but the load effect of two lanes is below 0.8 times of standard calculation value. It is explained that this vehicle should be strictly prohibited to drive on the single-lane bridge, and can be selected to drive on two-lane or multi-lane bridges according to the bridge characteristics.

Keywords: fire truck, bridge, safety, special vehicle, safe passing

FLOOD CONTROL & DRAINAGE

Analysis of Waterlogging Cause and Discussion of Engineering Reconstruction Practice in Interchange Area of Beijing

..... He Xiang (90)

Abstract: From the operation process of drainage system in the interchanges, the article analyzes the factors causing the waterlogging under the interchanges one by one, i.e. the rainfall intensity q , runoff coefficient Ψ , catchment area F , design return period p and water level of downstream river so as to decide the waterlogging cause under the interchange. On the basis of definite waterlogging cause and considering the reality of serious water shortage in Beijing, the article puts forward the reconstruction thinking of not only improving the system standard of pumping station, but also giving consideration to the rain-flood use of "reconstruction of pumping station + new construction of storage tank", and further analyzes to propose the operation mode combined of pumping station and storage tank. The practical operation of Wuluqiao Drainage System Reconstruction Project proves that the mentioned scheme is reasonable.

Keywords: waterlogging, reconstruction of pumping station, storage tank

Design Scheme of Fuyang Wastewater Treatment Plant Phase IV Project Wan Minghui (94)

Abstract: In order to meet the increasing sewage flow and the discharge requirement of Grade I A standard in *Pollution Discharge Standard of Municipal Wastewater Treatment Plant* (GB 18918-2002), the Phase-IV extension and upgrading reconstruction project is implemented for Fuyang Wastewater Treatment Plant. The

multi-mode inverted AAO technology is used for the Phase IV Project. On the basis of fully utilizing the treatment facilities of Phase I, Phase II and Phase III, the present situation is reconstructed, at the same time, the advanced treatment structures are added for the upgrading reconstruction. The article introduces the sewage in the extension and upgrading reconstruction of wastewater treatment plant, and the design parameters of sludge treatment technology and the main treatment structures.

Keywords: wastewater treatment plant (WWTP), upgrading reconstruction, multi-mode AAO technology, composite reaction settlement tank

Design Scheme and Calculation of Engineering Overflow Well for External Pipeline of New Area Wastewater Treatment Plant in Zhengzhou City Yuan Shaojian (99)

Abstract: In order to relieve the pressure of sewage pipe in the emergent situation, the overflow well is constructed near the river along the pipeline to overflow the sewage into the river if necessary. The overflow weir is set up within the overflow well. Based on the river hydrological data and the pipeline flow, the suitable calculation formula of thin-wall weir and full flow capacity is used to test and calculate the weir height and the emergent water level. To draw the emergent water level as a line can analyze the status of manholes along the pipeline in the emergency condition.

Keywords: emergency condition, overflow well, overflow weir, overflow pipe

Research on Tilting and Settlement of Buttressed Chamber Wall Xu Ruidong (103)

Abstract: This paper analyzes the foundation settlement and tilting trend of buttressed chamber wall from the soil base excavation to the impound debug at each stage by the finite element software based on the practical measured date of Shaobo Third-line ship lock engineering. This paper also analyzes the variation trend of the sum of water pressure and earth stress at the bottom of chamber wall, and the horizontal displacement variation at the top of chamber wall in the process of water filling and draining of lock chamber. After the analysis, the result shows that the settlement of chamber wall appears to rebound and has become stable in the process of impound debug. The chamber wall is tilted to the side of lock chamber in the process of casting chamber wall. The chamber wall is tilted to the filling side after the filling backfill and impound debug, and the tilting tends to be stable in the late. The main influence factor on the tilting of chamber wall is the uneven settlement of the chamber wall.

Keywords: buttressed chamber wall, foundation settlement, tilting of lock chamber, filling and draining

Study on AHP Method to Evaluate Influence of Overflow Weir on Environment
..... Lian Yuqin, Chen Yunlan, Shi Ankang (107)

Abstract: Taking the construction phase of overflow weir built in a river as an example, the article introduces the use of analytic hierarchy process (AHP) to evaluate the influence of overflow weir on the environment in the construction period. The result shows that the main influence factors of overflow weir in the construction period on the environment are the noise pollution and water quality. The both account for

35% and 21% respectively in the total influence factor.

Keywords: overflow weir, analytic hierarchy process (AHP), water quality

MANAGEMENT & CONSTRUCTION

Analysis and Inspiration of Incentive Methods for Rainwater Discharge Management at Home and Abroad

..... Wu Chenhao, Xie Sheng, Lyu Yongpeng, Zhang Chen, Li Yunjie, Zhao Jun, Xia Yufei (109)

Abstract: Based on the introduction of the urban rainwater discharge management policies at home and abroad, and taking the economics theory of principal-agent relationship as the basis, this paper comprehensively discusses four typical rainwater discharge management policies of the total cost incentive method of sponge project, the classification incentive method of sponge facilities, the engineering area incentive method and the fixed amount incentive method, and puts forward the inspection to establish the rainwater discharge management incentive methods for the cities of China.

Keywords: rainwater discharge management, inspiration method, principal-agent relationship

Study on Correction of Tube Distance of Acoustic Pipe Oblique Tube in Detection of Acoustic Transmission Method

..... Wang Jun, Zhou Bin, Sun Gen, Chen Hongxiang (112)

Abstract: In order to eliminate the influence of acoustic pipe oblique tube on the integrity discrimination of pile foundation, it is necessary to carry out the tube-distance correction of oblique tube during the use of acoustic transmission method to carry out the integrity detection of pile foundation. The article summarizes three common oblique tube distance correction methods of the projection method, the sector sweeping survey method and the neural network method, and introduces the applications of these methods into the practical engineering cases. The article comprehensively evaluates three tube distance correction methods from four aspects of simplicity, working amount, application range and accuracy. The best comprehensive effect of method is proposed for the tube distance correction problems of acoustic tube oblique tube.

Keywords: acoustic transmission method, acoustic pipe oblique tube, tube distance correction, comprehensive evaluation

Research on Eccentricity Adjustment of Small Radius Curved Swivel Bridge

..... Tian Shanpo (116)

Abstract: The swivel bridges overpassing the existing busy railway lines have the obvious advantages, and have the advantages of good safety, little interference to transport and no need of complex cantilever assembly equipment and technology, and especially spanning the high-speed railway, have become the preferred bridge scheme. The transverse eccentricity of small radius curved swivel bridge is larger. In order to ensure the swivel construction safety, it needs to design the accurate eccentricity adjustment to balance the lateral torsional moment of bridge. Taking Taiyuan North Middle Ring Line Crossing Shijiazhuang - Taiyuan Passenger Dedicated Line and Shijiazhuang - Taiyuan Interchange Project as an example, the article discusses the engineering situation, the swivel construction process and eccentricity adjustment design, and

analyzes the comparison and calculation of eccentricity adjustment scheme. The reasonable technical scheme of eccentricity adjustment for small radius curved swivel bridge is achieved, which can be referred for the similar projects.

Keywords: swivel bridge, T-rigid bridge, swivel construction, eccentricity adjustment, balance weight

Study of Long-span Continuous Girder Cantilever Construction Technology Wang Jianming (119)

Abstract: According to the application of cantilever construction technology in the cast-in-situ construction of long-span continuous girder, and taking the cantilever construction of a bridge spanning Dazhi River as the background, the article introduces the anchorage of 0# segment, erection of support, temporary consolidation of pier girder, design and use of form traveler, construction of closure section and so on of this bridge, which can be referred for the construction of the similar projects.

Keywords: cantilever construction, continuous girder, form traveler, closure, 0# segment

Analysis on Single-hole Beam Construction Technology of Pre-stressed Concrete Simple-supported Box Girder by Post-tensioning Method Shen Liang (123)

Abstract: The concrete simple-supported box girder has the advantages of good-looking appearance, succinct structural style, clear stress, large structural rigidity and convenient construction. Taking a practical project as an example, the article analyzes and discusses the single-hole beam construction gist of pre-stressed concrete simple-supported box girder by post-tensioning method. The difficulties and problems of its construction are solved, and the good construction effects are achieved, which can be referred for the construction of the similar projects.

Keywords: template design, rebar binding, pre-stress tension

Study on New Construction Technology of Bottom Bracket in No.0 Section of Cantilevered Concreting Girder in Railway Bridge Qiu Yongjun (126)

Abstract: In the railway engineering construction, the bracket of cantilevered concreting girder is a very important component of bridge, and has the larger influence on the construction quality of bridge engineering. Taking a practical project as an example, the article analyzes the construction technology of bottom bracket in No.0 Section of large-span cantilevered concreting girder, and discusses the structure construction, foundation design and construction of bracket, which can be referred for the similar projects.

Keywords: railway bridge, cantilevered concreting girder, construction of bottom bracket

Elementary Discussion on Construction Technology of Girder Erection Overpassing Operation Line Shanguan Yichao (129)

Abstract: According to the erection construction of No.29 span box girder of the Wuzhong - Zhongwei Intercity Railway Interchange overpassing Baoji - Zhongwei Railway, the article introduces the safe and successful completion of the removal reconstruction of the original catenary mast, the erection of 714.8 t box girder and the construction of deck attached within the short time to utilize the skylight time of railway

bureau, through the scientific and reasonable resource allocation and organization construction and under the premise to guarantee the running safety of railway operation line. The results provide the valuable construction experience for the erection and construction of girders overpassing the operation lines in the construction of high speed railway in China, and have the certain of reference value.

Keywords: operation line, bridge erecting machine, overpassing, girder erection

Study on Heavy Load Reconstruction Technology of Low Height Reinforced Concrete Beam ... Zhao Dekuan (132)

Abstract: The bridges are the important components of the railway line. The increment of train axle weight is necessary to put forward the higher requirement for the performances of the existing bridges. Taking the heavy load reconstruction of a 10-m span low height reinforced concrete beam as an example, the article comprehensively analyzes the disease cause of beam. According to the comparison, the article puts forward the heavy load reinforcement reconstruction technology scheme of bridge, and sets forth the reinforcement reconstruction scheme and its control technical gist. Various key indexes can all meet the code requirements through the field tests, which can show that the expected reinforcement effects are achieved, and can provide the technical reference for the similar projects.

Keywords: heavy load railway, steel-concrete composite beam, pre-stressed carbon fiber plate, reinforcement

Study on Deformation Control Technology of Soft Soil Metro Foundation Pit Based on Building Protection Ji Maojie (136)

Abstract: With the continuous increment of rail transit construction amount in China, more and more projects of metro foundation pit are started to construct in the urban range. The new subject is proposed for the deformation control of metro foundation pit and the protection of surrounding buildings. Taking the South Pudong Road Station Project in Shanghai as the study object, the article introduces the innovation and study of deformation control technology of soft soil metro foundation pit specially for the large dimension, poor geological condition and complicated surrounding environment of this foundation pit. The purpose of protecting the surrounding buildings has been achieved and the significant social benefit has been achieved.

Keywords: soft soil, metro foundation pit, deformation control

Analysis on Type Selection of Engineering Enclosing and Bracing System for Super-large Deep Foundation Pit in Soft Soil Area Kong Weiyao (141)

Abstract: The primary task in the engineering design of foundation pit is exactly to determine the enclosing structure and bracing system, which are related to the construction difficulties and engineering cost, and are more related to the engineering safety and bracing effect. The article summarizes and sets forth the common design methods of engineering enclosing and bracing system for the super-large deep foundation pit in soft soil area. Combined with an engineering instance of super-large deep foundation pit for a wastewater treatment plant, the article studies the applicability, advantages and disadvantages of the different design schemes from the safety, bracing effect, construction difficulty and engineering cost, and puts forward the

design scheme suitable for the construction of this foundation pit.

Keywords: super-large deep foundation pit, enclosing system, bracing system, cover and excavation top-down, type selection analysis

Discussion on Safety Management in Reconstruction of Provincial Highway 31 Zhuji Wangjia Lake – Wuxie Section Reconstruction Project Shi Shudong (145)

Abstract: Taking the reconstruction project of Wangjia Lake – Wuxie Section in Zhuji City of Provincial Highway in Zhejiang Province as an example, the article discusses and analyzes the construction safety management mode of safety management network, security training and education, safety inspection and safety technical measures, which can provide the reference for the similar projects.

Keywords: Provincial Highway 31, reconstruction project, construction, safety management

Comparative Analysis of Excavation Methods for Electric Power Tunnels in Chengdu Based on Analytic Hierarchy Process Ji Yonghong, Bi Yiwen (148)

Abstract: The characteristics of the excavation method and various trenchless schemes are introduced. These methods and schemes are compared in applicability during the construction. The analytic hierarchy process (AHP) is used to compare and analyze the construction methods of trenchless schemes for the electric power tunnel. According to the geological characteristics in the area of Chengdu, the hierarchical model is established to build the judgment matrix for analysis. The mechanical pipe jacking method is shown to be a kind of trenchless method with the high construction efficiency, good construction safety, wide applicability and good economy.

Keywords: mechanical pipe jacking method, electric power tunnel of Chengdu, trenchless method

Analysis on Construction of Intersection for Emergency Vehicle Passage and Bored Tunnel Sun Dike (154)

Abstract: Zizhi Tunnel starts from Zhipu Road and ends at Zijingang Road. A pair of ramp is constructed separately at the north end and the south end of the tunnel. Several emergency vehicle passages and bored tunnel present the intersections. In order to guarantee the smooth construction, the article discusses the construction scheme of the intersection for emergency vehicle passage and bored tunnel of this project, and analyzes the construction gist. The good construction effect is achieved for reference.

Keywords: T-shaped intersection, double steel arch, setup of monitoring point

Analysis on Construction Technology of Shield Crossing Upper-soft, Lower-hard and Hard Rock Sections Yang Bao (157)

Abstract: The upper-soft and lower-hard geological environment is often met in the urban rail engineering construction process, and will cause the larger influence on the normal construction of shield. Taking a practical project as an example, the article analyzes and discusses the construction risk and problems of the shield crossing the upper-soft and lower-hard stratum, and puts forward the relevant countermeasures in order to guarantee the construction quality and construction safety of shield crossing the upper-soft,

lower-hard and hard rock sections for reference.

Keywords: shield of upper-soft and lower-hard stratum, cutter rotate speed, construction of hard rock section

Elementary Discussion of Construction Measures for Shiziyuan Tunnel Crossing Active Fault Zone

..... Fan Shanghai (159)

Abstract: The activity of active fault zone will have an important influence on the stability and safety of tunnel when the tunnel especially large tunnel crosses the active fault zone. Starting from the understanding of active fault zone, combined with Shiziyuan Tunnel under construction now, and using the advance geological forecast method, the actual situation of tunnel surrounding rock is fully revealed, the construction measures of tunnel is adjusted in time, and the monitoring measurement management is strengthened in the follow-up process so as to provide the technical support for the damage study of active fault zone, which can be referred.

Keywords: active fault zone, advance geological forecast, monitoring measurement

Design of Maintenance Reinforcement of Crash Barrier for Interchange Overpassing Railway

..... Huang Zonggen (162)

Abstract: As time goes on, the crash barriers of early built highway interchanges overpassing railway have been damaged. At the same time, owing to the improvement of traffic safety requirements in the current standard, the existing crash barriers have not met the current standard requirements. It is necessary to maintain and reinforce the crash barriers of interchanges. In order to ensure the operation safety of the existing railways under the interchanges during the maintenance and reinforcement, the crash barriers are required to carry out the special maintenance and reinforcement design. The structure of crash barrier and the supporting protection system of form traveler used in the maintenance and reinforcement of crash barrier are checked and designed in detail. This maintenance and reinforcement design has been smoothly implemented, and has guaranteed the operation safety of the existing railways.

Keywords: crash barrier, maintenance and reinforcement, form traveler, capsizing resistance, stability

Application of Automation Monitoring Technology in Deep Foundation Pit Engineering

..... Xu Yuliang (166)

Abstract: The excavation area of foundation pit for the pumping station in Shanghai Yangpu District Songpan Sewage System Reconstruction Project is about 1 336 m², its circumference is about 160 m, and the excavation depth is 14.45 m and partially 15.7 m. The safety grade of foundation pit is Grade I, and the grade of environmental protection is Grade II. The supporting system of cast-in-situ pile + 4-line horizontal support is mainly used for the foundation pit engineering of pumping station. The effective, accurate and timely automation is the key of informatization construction.

Keywords: deep foundation pit, automation monitoring, construction

Application of Bridge Safety Monitoring System in Disease Monitoring of Large Bridge Wang Xiaowei (172)

Abstract: Taking Shenyang City North 1st Road Highway Railway Bridge as an engineering case, the article introduces the basic working mode and the disease detection content of bridge safety monitoring system in the monitoring process of old bridge diseases. The results can provide the new thinking for the structural disease monitoring, management and maintenance of the large urban bridges and the special structural bridges.

Keywords: bridge safety monitoring system, crack, deflection, bridge disease

Defect Treatment of Large Diameter PCCP Pipe Seam in Water Testing Period Zhang Guang (174)

Abstract: According to the example of Ningxia Guyuan Region Urban and Rural Drinking Water Safety Water Source Project, a treatment method is used to rapidly treat the seam leakage defect of large diameter PCCP pipe in the water treating period under the premise of guaranteeing the construction quality in order to meet the construction requirements and be referred for the similar projects.

Keywords: PCCP pipe, pier reinforcement of external seam, rigid connection of internal seam

Technical Improvement to Realize Cost Saving of Large Bridge Project Yang Tianwei, Lu Lei (176)

Abstract: Combined with the practical projects, the structural style of a large bridge project is studied in detail and the construction scheme is carefully planned. The technical improvement can fully realize the cost saving of construction process to promote the construction of technical force in the project team, to improve the scientific and technological innovation consciousness of project team and to strengthen the construction cost consciousness of project team. The result can be referred for the similar projects.

Keywords: large bridge, construction of rotary drill hole, technique of gasbag to remove steel girder

Technical Measures for Flame Adjustment of Highway Asphalt Mixing Machine Combustion System

..... Qiu Xiong (179)

Abstract: The asphalt mixing machine is the main supply equipment of asphalt concrete pavement material. The working state of combustion system plays an important role in the quality of finished mixing product. The article introduces the contents of asphalt mixing machine combustion system, puts forward the attentions easy to be ignored during its use, and based on the using experience, introduces some thinking to check the accidents, and sums up the reasonable application of this system how to use. The efficient use of this system can not only prolong the service life of mechanical equipment and shorten the construction period, but also reduce the engineering cost and save the fund and energy.

Keywords: asphalt mixing station, flame combustion, improvement measures

STUDY ON SCIENCE & TECHNOLOGY

Study on Static and Dynamic Load Test of Long-span continuous Rigid-frame Bridge ... Pei Qiang, Wang Bo (182)

Abstract: Based on an engineering case of a main 142 m-span pre-stressed concrete continuous rigid-frame bridge, its structure is analyzed by the help of the finite element, and is implemented of static and dynamic load test in site. The analysis of test result according to the relative standard verifies the design rationality of bridge structure, and inspects the engineering construction quality of bridge, which provide the basis for the checking and acceptance of project, and can be referred for the similar bridges.

Keywords: continuous rigid frame, finite element method, static and dynamic load test

Analysis and Study of Load Test Based on Difference Value Method Hu Huikang, Yuan Meng (185)

Abstract: The load test is the most direct and efficient method to inspect the actual carrying capacity of bridge structure. But it is found that its defection measured value is often larger than the theoretical value during the test of steel temporary bridges and the partial steel truss bridges, and the strain distribution is irregularite. Its causes are the loose connection among the components of this bridge and the larger dimension error possibly existing in the components, which make the structure have the serious down deflection and partial no-stress state under the function of bearing the smaller load. In order to exactly evaluate the practical carrying capacity of this bridge, the difference value load test analysis method is proposed. Each working condition is all divided into the multistage loading in the load test, in which the first-stage loading can make the structure completely enter the working state. The test result of each stage is all subtracted from the first-stage or the former-stage test result during the analysis of load test result so as to eliminate the most error caused by the loose connection and dimension error of structure. The measured difference value result and the theoretical difference value result are compared and analyzed again so as to indirectly judge the actual carrying capacity of this bridge. The study result shows that the difference value load test analysis method can effectively solve the problem of the load test hard to exactly evaluate the carrying capacities of the steel temporary bridges and some loose connection steel truss bridges.

Keywords: difference value method, load test, carrying capacity, steel temporary bridge

Numerical Integration Algorithm of Foundation Settlement Calculation Xu Desheng (189)

Abstract: Based on the elastic mechanics solution of elastic half-space body under the action of vertical concentration, the numerical integration algorithm of foundation settlement calculation is given. The two-dimensional gird dispersion is carried out for the bottom of foundation. And the interpolation shape function of plane four-node isoparametric element is introduced. The gauss integral method is used to calculate the additional stress of substratum. The one-dimensional dispersion is carried out along the soil thickness. The interpolation shape function of two-node bar element is used to integrally calculate the foundation settlement for the additional stress. The introduced algorithm can be adaptable for the arbitrary shape of foundation type and the arbitrary distribution of load. A few of integral count can achieve the satisfied calculation accuracy. The introduction can be used for the similar projects.

Keywords: settlement calculation, additional stress, gauss numerical integration, Boussinesq solution

APPLICATION OF ACHIEVEMENTS

Application of Flexible and Rigid Composite Pile in Underground Wastewater Treatment Plant - Ye Yuanxin (193)

Abstract: Shanghai Bailonggang Underground Wastewater Treatment Plant (WWTP) has the characteristics of deep buried depth and high requirements of pile foundation bearing capacity. The flexible and rigid composite pile is a kind of composite pile combined with cement-soil mixing pile and rigid pile. This article introduces the design and construction processes of flexible and rigid composite pile, and analyzes the test results of pile foundation. The results show that strength composite pile has the advantages of high bearing capacity, small impact on construction environment and relatively high economic benefit. This kind of pile is worth promoting in the similar projects.

Keywords: stiff composite, flexible and rigid composite pile, bearing capacity

Discussion on Application of Assembled Structure Ni Jingsheng (196)

Abstract: According to the description of development status of bridges, the article puts forward the obvious advantage of assembled bridge, and describes the traditional industry practices, technical characteristics and technical advantages of assembled concrete channel technology, highway high-strength pre-stressed pier technology, small-type component factorization and standardization technology, small-span and middle-span steel plate composite beam packaged technology, pile plate-type subgrade structure technology, bridge PHC pipe pile technology and segment prefabricated assembled box girder technology in detail. The relative experience can be referred for the similar projects.

Keywords: assembly, prefabrication, standardization, industry tradition, technical advantage

Application of Digital Map in Remote Monitoring System of Shanghai Metro Construction Du Zeming (199)

Abstract: The digital map as one of the geographic information technology development achievements has a broad application prospects. This paper briefly introduces the application of digital map in the remote monitoring system of metro construction in Shanghai from two aspects of the demand analysis and implementation process. The demonstration of the system function after the completion of development fully explains that the digital map has the greater application superiority in the exhibiting information and emergency command of metro construction relatively at various positions, and well satisfies the demands of remote monitoring system, which can provide some reference for the development of the other similar systems.

Keywords: digital map, metro construction, remote monitoring system, application development

THE RELATIVE SPECIALITIES

Study on Influence of Large Rectangular Shield Crossing Pipeline at Short Range Wen Zhuyin (202)

Abstract: The ultra-large section rectangular shield is used for the underground tunnel in the Linkong Area in Shanghai, and crosses the large-diameter pipelines underneath at short range. This project is the first

rectangular shield tunnel in China, and has the characteristics of new construction technology, crossing at short range and shallow covering. In the light of the engineering characteristics, the article analyzes and discusses the design and construction of tunnel, puts forward the targeted measures, and introduces the real-time monitoring of pipeline deformation in the rectangular shield tunneling process. The result shows that the ultra-large rectangular shield crossing pipeline is feasible, and a series of measures taken in the implementation is active and effective.

Keywords: rectangular shield, ultra-large section, composite segment, settlement control

Study on Seepage at Junction of Lining Structure – Backfill Grouting – Soil of Shield Tunnel Undercrossing Yellow River Zhang Yazhou, Li Jiarong (208)

Abstract: The junction of lining structure – backfill grouting – soil exists between the shield tunnel structure and strata. The water level at the perched river section in the lower reaches of the Yellow River is higher than the ground surfaces at both sides of river. The lining structure – backfill grouting – soil junction of shield tunnel constructed under the perched river whether or not to form the seepage channel to make the water of Yellow River gushing to the both sides and thus to influence the safety of the both sides is the greatest difference of the shield tunnel project crossing the Yellow River from the other shield tunnel projects crossing the rivers, and is also the key to the feasibility of engineering construction. The lining structure – backfill grouting – soil junction of shield tunnel is theoretically simplified and numerically calculated. The seepage flows into two ends along the junction are simulated under the different working conditions. The result shows that the backfill grouting has an important action to decrease the seepage of junction. The gap thickness at the tail of shield has a little influence on the seepage safety. With the decrement of backfill grouting seepage coefficient, the water inflow at two ends is obviously decreased. The decrement of gap at the tail of shield is hardly to reduce the seepage flow at two ends. Accordingly, the relevant engineering proposal is put forward. The grouting hole is added in the lining design in order to prevent the formation of seepage channel of the lining structure – backfill grouting – soil junction. The grouting amount and grouting pressure are properly increased during construction in order to prevent the cause of no-grouting space. The reduction of seepage coefficient of backfill grouting is the first measures. The control of shield tunneling posture and the decrement of over-excavation so as to decrease the gap thickness of shield tail can be taken as the auxiliary construction measures. The implementation of backfill grouting holing leakage test within the tunnel during construction and the additional grouting according to the test result can be taken as the inspection and additional measures for the seepage safety of the junction.

Keywords: shield tunnel, the Yellow River, seepage, backfill grouting, water gushing

Discussion on Frost Heave Monitoring Scheme of Culverts for Harbin – Daqing – Qiqihar Passenger Railway Line Li Kunheng (213)

Abstract: The ballastless track is very sensitive to the settlement deformation. The culvert under the line will have the direct impact on the smoothness of track if the frost heave deformation occurs. The Harbin – Daqing – Qiqihar Passenger Railway Line is the first high-speed railway constructed in the high-latitude severe cold

region of China. The balastless track is used in the whole line. There are about 140 different apertures of culverts distributed in the subgrades along the line. The adaptation of freezing depth and entrance form to frost heave is used in the design, which are not measured and verified in the past projects. Four representative culverts of this line are selected to carry out the frost heave monitoring according to the study on the subgrade frost heave. The preliminary results are achieved through two-year data accumulation, which provide the technical reserve and theoretical basis for monitoring the similar railway culverts in the severe cold areas.

Keywords: severe cold area, culvert, monitoring of frost heave

Discussing of Scheme for Longteng Road Tunnel Tao Jiaqing (218)

Abstract: As a part of radial express road network system in Chengdu, Longteng Road Tunnel is also an important node in the reconstruction project of No.2 Ring Road. The tunnel is located underneath Longteng Road - Dashi Road, and crosses No.2 Ring Road. The underground pipeline network is complex, the traffic flow is large at the intersection, and the red line width of road is narrow. The article studies the design scheme of tunnel from the engineering situation, present situation and scheme design in order to achieve the best scheme, which can be referred for the similar projects.

Keywords: tide traffic, dislocation of exit and entrance, " 日 "type structure

Comparison and study on Support System of Urban Underground Utility Tunnel Shi Weiwei (221)

Abstract: The urban underground utility tunnel is a modernized and intensified urban infrastructure to centralize the pipelines of electric power, communication, water supply, recycled water, gas and so on into a same space under the road. The support is a great feature of utility tunnel. According to the comparison of support system components, installation modes, product characteristics, product safety qualities, construction progresses and construction costs, and analysis of engineering cases, the advantages and disadvantages of the traditional support system and the new support system are shown, which can provide the reference for the similar projects.

Keywords: urban, underground utility tunnel traditional support system, new support system

Thinking and Method of Automatic Yard Settlement Control under Condition of Complex Soft Base

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Abstract: The land area of Phase IV in Shanghai International Shipping Center Yangshan Deepwater Port is the complex weak soil base. The settlement problem is the key problem in the construction of automatic container yard. To reduce the post-construction settlement and control the uneven settlement as the goal in the construction, the reinforcement of base is implemented, and the U-type sleeper ballast tank foundation is purposefully developed and applied. The practice proves that the thinking and method of settlement control are feasible, and the yard settlement can be controlled, which can meet the normal operation requirement of automatic container yard.

Keywords: complete automation, container yard, weak base, settlement control, thinking and method

Elementary Analysis on Application and Perfection of Bill-of-quantity Model Dai Junsheng (228)

Abstract: According to the requirement of establishing the socialist market economy system, a series of reforms have been carried out in the terms of management system and valuation method for the engineering cost management of China. In order to solve these problems in the application of bill valuation and to fully play the role of the bill of quantities in the engineering management process, the composition and application method of bill-of-quantity valuation system are studied. Therefore, the bill-of-quantity valuation system has established a certain foundation for the marketization of engineering valuation. But there are some detailed problems of its application in the engineering management process. It is required to further study the foreign advanced practices of bill-of-quantity valuation system. The bill valuation norms of China are improved and perfected. Some improvement measures are proposed for reference.

Keywords: bill of quantity, valuation model, application, perfection

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集团简介
有凯泉的地方就有水

上海凯泉泵业（集团）有限公司（简称“上海凯泉”）是集设计、生产、销售泵、给水设备及泵用控制设备于一体的大型综合性泵业公司，总资产达28亿元，是中国泵行业的龙头企业。其年销售额超过30亿元，销售设备超过30万台套，连续12年排名全国泵行业销量第一。集团现有员工5200多人，其中工程技术人员750多名，主要由全国知名水泵专家教授、博士硕士、中高级工程师构成，形成了具有创新思维的梯队人才结构。在上海、浙江、河北、辽宁、安徽等省市拥有7家企业、5个工业园区，总占地面积近1000亩，生产性建筑面积35万m²。上海凯泉集团获得了“上海市质量金奖”、“上海市私营企业百强第四名”、“上海市科技百强企业”、“上海市名牌产品”、“上海市著名商标”、“中国驰名商标”、“中国质量信用AAA级”、“全国合同信用等级AAA级”、“质量、信誉、服务三优企业”、“中国最具竞争力的商品商标”、“全国企业文化建设先进单位”等光荣称号。2011年上海凯泉入选全国机械企业500强，目前名列国内泵行业之首。

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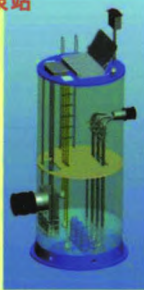
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●介绍

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