

城市道桥与防洪

主管：中华人民共和国住房和城乡建设部
主办：上海市政工程设计研究总院(集团)有限公司

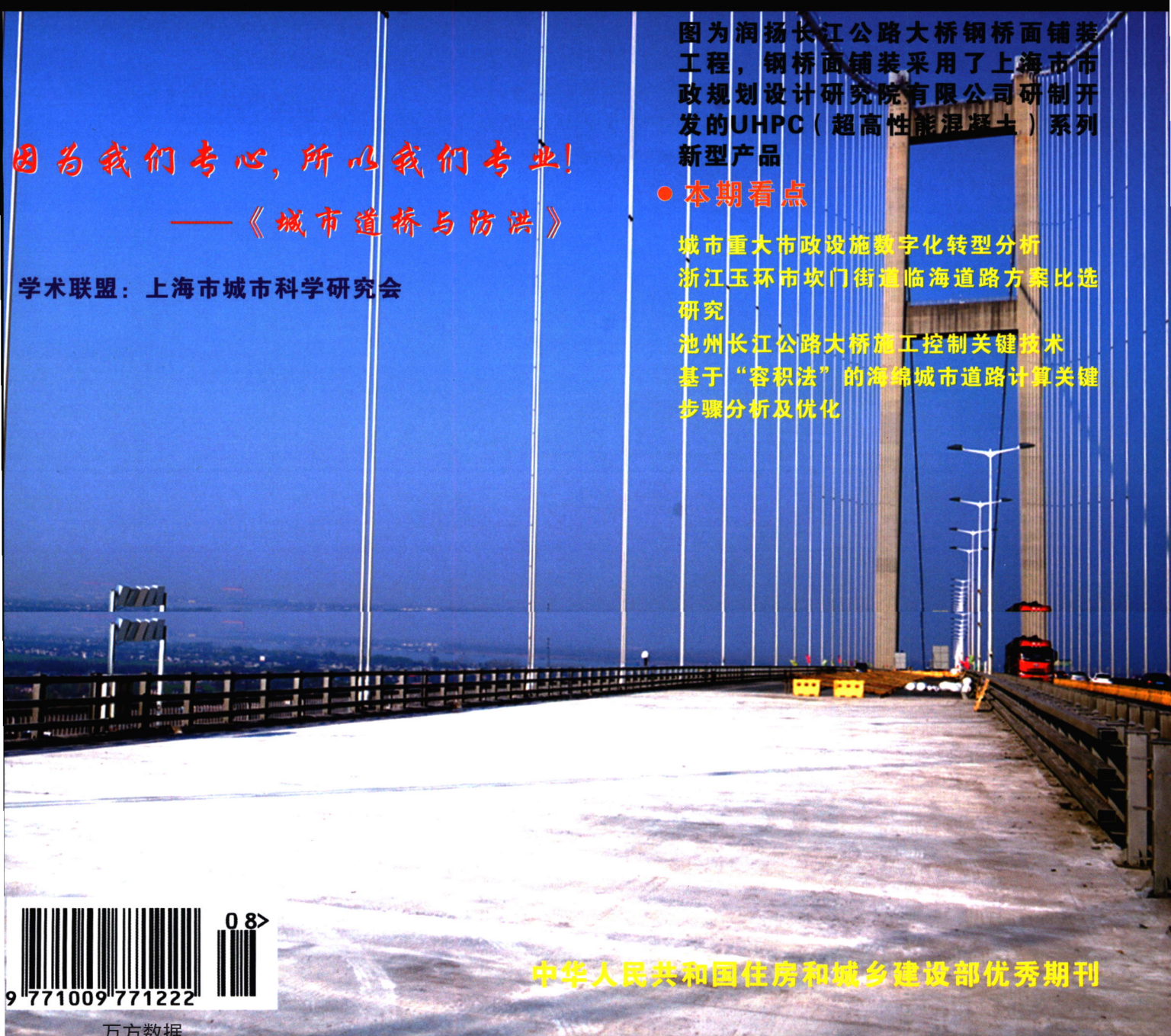
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图为润扬长江公路大桥钢桥面铺装工程，钢桥面铺装采用了上海市市政规划设计研究院有限公司研制开发的UHPC(超高性能混凝土)系列新型产品

● 本期看点

- 城市重大市政设施数字化转型分析
- 浙江玉环市坎门街道临海道路方案比选研究
- 池州长江公路大桥施工控制关键技术
- 基于“容积法”的海绵城市道路计算关键步骤分析及优化

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——《城市道桥与防洪》

学术联盟：上海市城市科学研究会



中华人民共和国住房和城乡建设部优秀期刊

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封面工程

本期封面工程为润扬长江公路大桥钢桥面铺装工程。钢桥面铺装采用了上海市市政规划设计研究院有限公司研制开发的UHPC(超高性能混凝土)系列新型产品。

该系列新产品有UTCON—O型、UTCON—J型、UTCON—E型三种类型。

UTCON—O型产品能大幅提高正交异性钢桥面板抗疲劳性能,常规养护条件下收缩应力小,流动性适中,专用于钢桥面刚性铺装层,便于施工与养护,目前已成功应用于G318沪青平公路、嘉松公路跨线桥、润扬长江公路大桥、长沙湘府路快速化改造工程,累计应用面积达万余平米。

UTCON—J型产品能大幅提高钢筋握裹力,简化连接部位钢筋连接方式,限制新旧材料的收缩差异,自密实,主要用于预制混凝土构件的连接,目前已成功应用于上海市诸光路通道新建工程、沿江通道越江隧道等工程。

UTCON—E型产品能4小时快速形成强度,且后期性能稳定,收缩效应小,保证新旧界面耐久性,专用于桥梁铰缝、伸缩缝等快速维修和上部结构整幅快速更换,目前已成功应用于S36界河桥整幅换梁工程、S19江家浜桥桥面薄层加固等工程。

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Urban Roads, Bridges & Flood Control (Monthly)

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..... FAN Yiqun, WANG Anye, YU Xiaoyu, HUANG Ruida, XIANG Hui (1)

Abstract: With the acceleration of urbanization process, as the basic lifeline to guarantee the normal operation of a city, the construction and development of municipal facilities are excellent important. Under the historical background of ecological protection and sustainable development, in order to carry forward the health development of municipal facilities, the digital transformation of major urban municipal facilities is the only way which must be passed. The digital transformation of municipal facilities will aim at the establishment of intelligent management platform of municipal infrastructure. Through the overall perception and automatic collection of the operation data of municipal facilities, the intelligent early warning and emergency disposal of municipal problems are realized. Taking the urban underground space, road traffic, water affairs, environmental protection, emergent fire fighting, city information model (CIM) and the others as the examples, the working basis, law and policy, standard specification, advanced experience at home and abroad, problem bottleneck and development tendency in the digital transformation process are combed respectively so as to put forward the suggestions for the digital transformation of major urban municipal facilities.

Keywords: major urban municipal facilities, city information model (CIM), digital transformation, smart urban construction, operation–maintenance and management–control mode

ROADS & COMMUNICATION

Comparison and Study on Coastal Road Schemes in Kanmen Street of Yuhuan City in Zhejiang Province
..... CHEN Hongbing (6)

Abstract: Aiming at the reconstruction and extension design of the coastal roads in the Kanmen Street of Yuhuan City – the coastal urban roads in Zhejiang Province, the schemes are compared and selected from the aspects of road network structure, development status, service function, green environmental protection, sustainable development and engineering cost. The project is located at the intersecting area of mountain and sea. The selection of the route scheme may be the combination of ordinary road section, tunnel and cross–sea bridge with the influencing factors of cultural protection, landscape and land development, which is typical. According to the extent of the route involved in the sea, three schemes are developed, namely, the land scheme basically not involved in the sea, the bridge scheme in medium scale involved in the sea and the bridge scheme in large scale involved in the sea. The comprehensive comparison and selection are conducted

on this basis. Finally, the conclusion of the recommended scheme is obtained.

Keywords: road design, route scheme comparison, coastal road

Strategy to Upgrade and Improve Skeleton Road Network in Guangzhou

..... HUANG Hongmin, ZOU Jun, ZHAO Guofeng (10)

Abstract: The new urban positioning of Guangzhou is fully understood. The main problems existing in urban road traffic are comprehensively analyzed. Combined with the overall planning of the new development in Guangzhou, the urban development trend of Guangzhou is analyzed, and the countermeasures for the structural upgrading and improvement of the road network in Guangzhou are summarized. The study focuses on the upgrading and improvement of the skeleton road network of Guangzhou and centralizes the focusing problems and main contradictions. Taking the main functional level of urban road network as the breakthrough point, according to the study range of the important cities in the Guangdong-Hong Kong-Macao Greater Bay Area around the Zhujiang River Estuary, based on the main problem-orientated of Guangzhou City, the road network structure of transit, intercity cluster and major hub is studied, the main problems are found out, the improvement direction is proposed and the upgrading ideas and strategies are studied.

Keywords: skeleton road network, upgrading and improvement, distribution and interception channel, connectivity express channel, expressway system, channel stability

Analysis and Evaluation on Current Situation of Public Transport in Ningbo YANG Jinlong (13)

Abstract: In order to analyze the development status of urban public transport, a game theoretical model is established to analyze the current situation of public transport. Taking Ningbo as a respondent, the relevant data of the travel volume of each main mode of transportation within one day of the whole city is collected. The Excel and other chart tools are used to calculate the respective share rate of the four modes of transportation, the daily travel cost of residents and the daily operating cost of managers. A two-tier game model is established to evaluate the health status of public transport in Ningbo under the existing public transport sharing rate, and to looking into the future of urban public transport development vision.

Keywords: urban traffic, game theory, travel cost

Research on Application Method of Urban Traffic Congestion Relief Based on Synchro Simulation

..... BAO Xiaokui, WANG Shanchuan, SHANG Deshen (17)

Abstract: At present, the single-point optimization and road linear adjustment are generally adopted to solve the non-systematic urban congestion in order to improve the traffic capacity of road. But all lack systematically. Aiming at this problem, the qualitative and quantitative, macro and micro combined methods are proposed to solve the traffic congestion. The qualitative and macro analysis is expected to seek the more economic congestion relief scheme through the "point to area", and finally the linkage of the regional road network and the rationalization of traffic organization are achieved. On the basis of qualitative and macroscopic solutions, the optimization of single point or one road is carried out. Taking the congestion of Liuwu Bridge in Lhasa as an example, the quantitative analysis is carried out by Synchro simulation software to identify the congestion improvement degree of key nodes and evaluate the effect and benefit of congestion relief.

Keywords: traffic congestion relief, single-point micro processing, equalization of road network, Synchro simulation

Application of Data Analysis in Expressway Planning for Zibo ZHANG Qisheng (21)

Abstract: Big data technology provides an important means of observing the overall pattern of the system. Its penetration is extensive. The planning method based the big data is introducing the transport planning industry into a new paradigm. Based on the mobile phone signaling data and navigation map data, the urban traffic accessibility characteristics, attraction-generating characteristics, commuting characteristics and channel selection characteristics are analyzed. Taking Zibo Urban Expressway System Planning as an example, the effectiveness of the data analysis method is verified.

Keywords: data analysis, mobile phone signaling, online map, traffic feature analysis, expressway network planning

Total Factor Design of Urban Renewal Based on Urban Road Space for Changsha ZHU Kai(24)

Abstract: In view of the "four-fine five-have" urban construction requirements, taking the Changsha Sanyi Avenue - Yuelu Avenue Road Space Quality Upgrading Project as an example, adhering to the "people-oriented" purpose, the new road space quality upgrading mode of total factor design for the streets is adopted to strengthen the development of urban blocks, weaken the red lines of roads and pay attention to humanistic care. A safe, delicate, humanistic, green, dynamic and intelligent urban road space is built through the refined and humanized design.

Keywords: road space, total factor design, urban renewal, quality upgrading

Application of Landscape Integration Road Design Combined with Surrounding Environment for Tianfu New District in Chengdu WANG Anlin (28)

Abstract: According to the guiding thought of the park urban street integration guideline proposed in Chengdu, the design of the streets focuses from the "linear design" to "facial design". Taking the integration design of Xingtai Street in Tianfu New District of Chengdu as an example, the design results before and after the street integration are compared, and the processing method of the spatial boundary edge of each functional plate of road and the working arrangement of landscape specialty in the road design process are discussed, which provide the reference for the construction of more humanized urban streets in the future.

Keywords: street integration, road landscape, slow traffic space, edge details

Design of Underground Transportation Facilities in Reconstruction and Renewal of Jinshui Road in Zhengzhou LIANG Wei (32)

Abstract: Jinshui Road in Zhengzhou is the traffic thoroughfare connecting the city center from east to west. The construction of the elevated bridge on this road can ease the traffic congestion, but will make this road lose its original human landscape. The reconstruction and renewal of this road will involve many aspects. The design of underground channel for the motored vehicles of this road, the combined design of the greenbelt and underground parking, and the design of trenchless underground channel for the pedestrians and non-motored vehicles are set forth respectively. The traffic guarantee schemes for the demolition of elevated bridge and the tunneling process of tunnel are given. In order to ensure the continuous operation of metro and ground road, the rectangle box culvert of pedestrian and non-motored vehicle is constructed by the pipe curtain jacking method. Combined with the building proparea or the

newly added public green space, the underground parking is designed effectively to solve the parking difficulties of the motored vehicles in this road. This design provides the beneficial exploration and reference for the reconstruction and renewal of the roads in the urban central core area under the demand of properly satisfying the traffic and parking of the motored vehicles.

Keywords: reconstruction of Jinhui Road, design of underground transportation facilities, pipe curtain jacking, underground parking

Yichang G348 (Huangbo River Bridge – Sanyoudong) Reconstruction Scheme
..... SUN Xu, ZHOU Wenwen, DU Zhihao (36)

Abstract: Yichang G348 National Highway is the only national highway to the Three Gorges, is an emergency anti-terrorism channel, is a tourist corridor with the characteristic of the Three Gorges, and is also a living guarantee line of the resident travel along Pinghu Peninsula. Relying on Yichang G348 National Highway (Huangbo River Bridge – Sanyoudong) Project, the functional orientation of the project is comprehensively analyzed through combing the current road problems. According to the idea of "park city", the reconstruction scheme of the project is studied, which provides the reference for the study of the similar projects.

Keywords: reconstruction of national highway, municipal reconstruction, road in scenic area, park city, Yichang

Brief Analysis on Design Principles of Urban Road Reconstruction in Rail Transit Construction
..... CHEN Min, GAO Chao, WANG Jianguang (39)

Abstract: The rail transit lines basically rely on the urban road network, and the rail stations are generally set up along the urban road sections and intersections. In order to meet the needs of residents living and urban traffic security, the construction of rail transit will bring along the reconstruction and relocation of the urban roads and municipal pipelines. Therefore, it is necessary to scientifically coordinate the design of urban road reconstruction. Combined with an engineering case, the key control elements and design principles of road reconstruction design are summarized and analyzed, which provides certain experience and reference for rail transit and road reconstruction design.

Keywords: rail transit, road reconstruction, low impact, standardization, integration, investment efficiency

Research on Structural Design of Fabricated Prestressed Concrete Pavement
..... ZHOU Jun, XU Jiacheng, YAN Lei, YU Xiang (42)

Abstract: The traditional cement concrete pavement is widely used because of its high compressive strength, large stiffness, strong durability and long service life. However, due to the properties of Portland cement concrete, i.e. long curing time, slow strength growth and late open for traffic, the cast-in-place cement concrete pavement is hard to meet the rapid construction requirements. Therefore, based on the technological theory of green building and intelligent construction, a new type of recyclable pavement system, that is the fabricated prestressed concrete pavement. Through the standardized design base plate, the central stress plate and the connecting plate, the factory-like prefabrication and the site modularized installation are carried out, which construction speed is fast and construction environment is not affected by the extreme weather, The usability of the fabricated pavement is excellent, which can be used not only widely in new construction, reconstruction, expansion and maintenance of highway, but

also in emergency repair of the roads under the extreme natural disaster conditions such as earthquake and debris flow.

Keywords: new type of road structure, fabricated pavement, factory prefabrication, rapid construction

BRIDGES & STRUCTURES

Study on Influence of Temperature on Final Closure Process of Sanguantang Bridge in Temporary Locking Phase MIN Yu, LIU Jie, CHEN Fangyao, JIANG Xu (45)

Abstract: The final closure process is an important link in bridge construction. As a continuous steel truss bridge with an over-long span, Sanguantang Bridge has the great difficulty in its final closure and its middle span adopts the cantilever construction. In order to ensure the closure accuracy, the temporary locking method is proposed to connect the closure section with the main truss at the cantilevered end. But after the connection, the system becomes statically indeterminate, and the temperature change will generate the internal forces in the structure, which influence on the structures in the temporary locking phase will become the focus for attention. The modeling analysis is carried out for the states before and after the temporary locking of the final closure section of Sanguantang Bridge by using Abaqus finite element software, which studies the stress of the temporary connectors and the stress distribution of the structure, discusses the influence of environmental temperature during the closure, and points out the the problems for attention in the practical construction.

Keywords: bridge closure, temporary locking, temperature effect, finite element analysis

Study on Seismic Property of High-pylon Long-span PC Cable-stayed Bridge YANG Xiangzhan (49)

Abstract: The main span of the Wu River Super Large Bridge in Guizhou – Zunyi Complex Line of Lanzhou – Haikou Expressway is 40 m+110 m+320 m+110 m+40 m double-pylon double-plane PC cable-stayed bridge. The maximum pylon is 197.1 m high. In order to study the seismic properties of this kind of bridge, the finite element 3D model of the whole bridge is established by Midas/Civil software to analyze the dynamic characteristics of the bridge. At the same time, the bearing capacity and displacement of the high pylon are calculated by the response spectrum method. The results show that each index of this bridge all meets the requirements of the code, which can provide the reference for the design of this kind of bridge.

Keywords: high pylon, cable-stayed bridge, seismic property, response spectrum method

Analysis on Seismic Isolation Bridge by Multi-mode Response Spectrum Method ZHU Feng (52)

Abstract: The essence and purpose of seismic isolation bridge are to separate the structure from the ground motion which may cause damage as much as possible. For this purpose, the fundamental period of the structure can be prolonged and the area of concentrated earthquake energy is avoided so as to reduce the seismic force of structure. Because the restoring force models for anti-seismic devices are nonlinear, in the past, only nonlinear direct integral time history method can be used for analysis. The multi-mode response spectrum method is first proposed in the latest issued *Specifications for Seismic Design of Highway Bridges* (JTG/T 2231-2020) to analyze the seismic isolation bridge. This method can efficiently avoid the problems such as the relatively rare seismic safety assessment, limited seismic wave source and low time-history analysis efficiency. Combined with the specification and the actual engineering cases,

the calculation process is set forth in detail. And the necessary iteration idea involved in the calculation is explained.

Keywords: seismic isolation bridge, multi-mode response spectrum method, nonlinear time-history method, friction pendulum bearing (FPB)

Design of Wide-angle Skew Bridge MAO Hongtao (55)

Abstract: In the bridge design, how to deal with the large cross-angle of bridge with river is a task faced by the vast designers. Based on a detailed design case, the 520 fabricated simple-supported box beam is used for the superstructure. And the design scheme is provided for the key parts of the bridge. In order to verify the feasibility of the design method, the modeling is carried out by the beam grillage method to check the bending resistance, shear resistance and torsion resistance of the bridge under the normal service condition, which can all meet the related standard requirements. In order to simplify the calculation, the single-beam model and the beam grillage model are used together to carry out the calculation and comparison. The bending moment of single beam under the dead load is 11%~24% larger than that of grillage model. Under the normal service condition, the difference between the two stresses is within 14%. The single-beam model can be simplified for calculation. The torsional moment is much greater than a single beam because of the beam grillage model influenced by the diaphragm, crossbeam and bridge deck. It is required to check and calculate alone.

Keywords: wide-angle skew, simple-supported, fabricated small-box beam, torsional moment, bending moment, beam grillage, single beam, design

Optimal Design of Beam-pier Joint of New Built Wuchazi Bridge in Chengdu ZHENG Aihua, ZHAO Bin, LI Ke, WANG Meixin (59)

Abstract: Based on the results of global scheme solicitation, the new built Wuchazi Bridge in Chengdu has a novel shape. In its structural design, the degree of appearance reduction is very high, and also the connecting relationship among the steel components is complex and special shape. Two local finite element model models are established by ANSYS. The stress distribution of No.2 beam-pier joint of the main bridge is compared and analyzed. The results show that adding the secondary web can better solve the problem of uniform and reliable force transfer between the superstructure and substructure of the bridge.

Keywords: beam-pier joint, optimal design, steel structure, ANSYS, Wuchazi Bridge

Design and Analysis Methods of Beam Corbel Based on Strut-and-tie Model HONG Hao (62)

Abstract: Referring the foreign codes, a strut-and-tie model of beam corbel is constructed. The stress of beam corbel is analyzed. The checked draw rod which should be paid attention during the design process is clarified. The experimental verification shows that this strut-and-tie model can more conveniently, reliably and effectively predict the ultimate bearing capacity of beam corbel, which provides the reference for the design of beam corbels.

Keywords: beam, corbel, strut-and-tie model

Design and Analysis of Thin-wall Hollow High Pier XIE Wei (65)

Abstract: Thin-wall hollow high pier is suitable for a variety of complex terrain and has the considerable

flexibility, which can better deal with the deformation of superstructure. At the same time, its hollow structure can greatly reduce the engineering materials and its own weight, and is widely used in the high-pier bridges. The spatial beam element model of pier body is established by using ANSYS software. Considering the influence of temperature effect, the geometric nonlinear characteristics of thin-wall hollow high pier are analyzed whether or not to result in the displacement at the top of pier and the change of bending moment at the bottom of pier. The study result lays a certain foundation for the structural safety control of thin-wall hollow high pier in the design process, which can be referred for the similar bridges.

Keywords: thin-wall hollow high pier, solar radiation, design checking calculation, geometric nonlinearity

Analysis on Key Design Parameters of Special-shaped Bowstring Arch Bridge LIU Peng (68)

Abstract: Different from the conventional structural layout of bowstring arch bridge, the boom of the special-shaped bowstring arch bridge is a radial inclined boom. The inclined booms are centralized and anchored at the top of arch. The weight of the beam is acted on the main arch unevenly by the inclined boom. The stress of the main arch is different from that of the conventional arch bridge. Taking a special-shaped bowstring arch bridge located in the urban core as an example, the rise-span ratio, main arch stiffness, longitudinal and transverse beam layouts and the other parameters of the bridge are designed and analyzed. The stress mechanism and design features of this type of bowstring arch bridge are studied. The value principle of the key design parameters of this type of bridge is clarified, which can provide a reference for the design of the similar bridge structure systems.

Keywords: special-shaped bowstring arch bridge, key design parameters, rise-span ratio, main arch stiffness, layout of longitudinal and transverse beams

Design of Newly-built Box Culvert Spanning Existing Subway in Small Clear Distance FU Jiakun, DENG Xuefeng (72)

Abstract: Taking Chengdu Muzhuyan River Reconstruction Project spanning the area of the existing Metro Line 5 as an example, the design scheme and control standard of the newly-built river spanning the existing subway structure in the small clear distance are studied. And the design scheme is verified by the numerical simulation method. At the same time, the area structure of the existing subway is monitored, and the monitoring results are analyzed in order to provide the reference for the design of the similar projects in the future.

Keywords: newly-built box culvert, existing subway, protection scheme, small clear distance

Experimental Study on Static Load of ZB-200-type Simple-supported Bailey Beam Temporary Steel Bridge GUO Yanfei, CHEN Jiajia, WANG Guowei, Qi Xingjun (75)

Abstract: Zhubalong Bridge in G318 Line is destroyed because of the flood discharge. The 30m-span deck ZB-200 combat-ready Bailey steel bridge is erected on the original bridge pier for emergency maintenance. The three-dimensional spatial finite element model of the bridge is established through the special software MIDAS/CIVIL for the bridge. The method of theoretical calculation of the deflection of the staggered hole in the *Manual for Multi-purpose Prefabricated Highway Steel Bridges* are used to determine the theoretically calculated deflection and strain values of the ZB-200 Bailey beam. Through the comparison with the static load test data of the actual bridge, the differences between the experimental

data and the theoretical calculation under the different loading schemes are analyzed. The bearing capacity of the existing ZB-200 steel temporary bridge is evaluated and judged according to the document of *Rules for Testing and Evaluating Bearing Capacity of Highway Bridges* (JTGT J21-2011). The results show that the deflection, strain inspection coefficient, and absolute value of relative residual displacement of ZB-200 type Bailey beam steel temporary bridge all meet the requirements of technical specifications. And the stiffness of Bailey beam structure reaches the design load and meets the requirements of 50 t bicycle operation. The experience worthy of reference for the rush repair engineering of bridges in the future is provided. The scheme of loading limit and traffic limit for this bridge, and the relevant suggestions for strengthening the regular inspection and testing of the steel temporary bridge structure are put forward.

Keywords: ZB-200 type Bailey beam, load test, evaluation and judgment of bearing capacity, rush repair of bridge

Study on Design Method and Similarity of Fabricated Pier Model

..... ZOU Guanglin, ZHENG Xiaohong, ZHANG Songqi (79)

Abstract: In order to make the fabricated pier model able to accurately reflect the mechanical property of the prototype structure, the similarity design of model is carried out for the design method of fabricated pier according to the ratio of equal reinforcement. In the test, the model of UHPC grouting bellows connecting the prefabricated pier stud is used to carry out the quasi-static reciprocating loading test. The failure mechanism of its plastic hinge zone of column foot is studied. And its failure mode, ultimate bearing capacity and displacement ductility are compared with the prototype structure. The study shows that the design method of equal reinforcement ratio model is simple and feasible in the design of fabricated bridge model. The experimental results are consistent with the actual prototype structure.

Keywords: equal reinforcement ratio, UHPC, plastic hinge, similarity design

Design and Simulation Analysis of Anti-collision Facilities for Zhuzhou Xiang River Bridge XIII

..... GU Minjie, FU Yaohua, WANG Junjie (83)

Abstract: Taking Zhuzhou Xiang River Bridge XIII as the engineering background, combined with the anti-collision characteristics of the river-crossing bridge, according to the environmental characteristics of the bridge area and the anti-collision requirements of the main channel pier of the bridge, the anti-ship collision scheme of energy release appendages is proposed. Based on the MSC.Dytran, the finite element simulation analysis is carried out to simulate the condition of ship and mast hitting the beam of the lower slow moving system of the bridge at drifting speed under the condition of out of control and to calculate the impact force of the mast. The alert interception scheme is identified. The fortification effect of anti-ship collision facilities is verified. The design feasibility of anti-ship collision scheme is guaranteed. The above provide the basis for the practical engineering application to protect the anti-ship collision safety of the bridge in the maximum extent. The study result shows that the scheme has the characteristics of facilities occupying less space in the channel, convenient manufacturing and maintenance, good seakeeping and harsh environment adaptability with the good economy.

Keywords: river-crossing bridge, anti-collision scheme of energy release appendages, finite element numerical simulation, impact force of mast

Intelligent Monitoring of Modular Large-displacement Expansion Joint KANG Xiaoliang (88)

Abstract: Based on the analysis of the structural characteristics and the investigation of the operation status of the modular large-displacement expansion joints, the deterioration of the performance of rubber components leads to the failure of the deformation coordination system and the center beam stability system, and finally leads to the damage of the vertical force transmission system, which is the main reason for the damage of the expansion joints. The monitoring and analysis on each seam width of the center beam can effectively reflect the use conditions of vulnerable components of expansion joints. The use of remote technical data collection and the analysis of abnormal seam width for the early warning of overhaul can effectively avoid the structural damage to the expansion joints.

Keywords: modular large-displacement expansion joints, damage mechanism, intelligent monitoring

FLOOD CONTROL & DRAINAGE

Analysis and Optimization of Key Steps in Calculation of Sponge City Roads Based on "Volumetric Method" ZHENG Xiaoqi, SHAO Zhiyu, GONG Huafeng (91)

Abstract: Taking an urban trunk road as a case, the traditional volumetric method and the improved volumetric method are used to calculate its storage volume of sponge city. The result shows that the total annual runoff control rate calculated by the improved volumetric method is less than that of the traditional volumetric method at the same site. The calculation result of the traditional volumetric method is not safe. In addition, the improved volumetric method emphasizes the decentralized arrangement of sponge city facilities and encourages the increment of service area to increase the storage volume in order to improve the total annual runoff control rate, which is more consistent with the theory that the sponge city emphasizes the decentralized source control.

Keywords: total annual runoff control rate, volumetric method, service area of facilities

Exploration on Planning Construction Path of Sponge City in Water Shortage Area of Shouguang City SONG Yuan, MAO Bin (95)

Abstract: There are the serious problems of water resources shortage, fragile water ecology and water environment pollution in the water shortage areas of China because of the climate change, artificial development and various influencing factors. The concept of "sponge city" proposed in recent years has brought opportunities and challenges to solve the water system problems in water shortage areas. Taking the sponge city planning of Shouguang City as example, the planning and construction mode of sponge city in water shortage area is empirically analyzed. Through this planning, the sponge construction index system characterized by the use of water resources is formed. The runoff control system of zoning and stratification is established to strengthen the management and implementation of the sponge index. The river channel connectivity, widening dredging, open channel restoration and other projects are implemented to recover the water ecological function of urban river, and also to strengthen the safeguard of drainage waterlogging prevention system. And a low-impact green space system in urban areas with the rainwater storage and purification functions is formed. A strategy for sponge construction in the semiarid areas in north China is proposed.

Keywords: sponge city, water shortage area, low-impact development, urban planning control

Study on Scheme of Initial Rainwater Storage Tank in Separated Sewage Drainage System

..... QIU Chao (99)

Abstract: The setting of initial rainwater storage tank has gradually become one of the most economical and efficient means to solve the initial rainwater pollution. Combined with the actual engineering case of the initial rainwater storage tank of Tianshan Wastewater Treatment Plant, the functions and the design essentials of the initial rainwater storage tank in the urban drainage system are set forth in detail. The aim is to provide the important theoretical support and experience reference for the optimal design of the initial rainwater storage tank in the later stage.

Keywords: initial rainwater storage tank, initial rainwater pollution, urban drainage system

Application of Directly Buried Pipe Trench and Pipeline Gallery in Industrial Sewage Centralized Collection Project

..... MI Yilei (102)

Abstract: The mode of "one enterprise one pipe" is used to centralize and collect the industrial sewage in the third-party governance of environmental pollution in Ningbo Economic and Technological Development Zone. After comprehensively consideration of the pipes suitable for sewage water, and the construction and maintenance conditions of sewage pipelines, two forms of direct buried trench and pipe jacking trench are adopted. The use of directly buried pipe trench for protection under the road can effectively reduce the plane land of pipeline than the sewage pipeline directly buried. The pipe gallery frame mode of coated reinforced concrete pipe jacking + aluminum magnesium alloy bracket with internal pipe is adopted to cross the river, which better meet the requirements of landscape and late management.

Keywords: one enterprise one pipe, directly buried pipe trench, pipe gallery

Engineering Application of WWTP Function Adjustment in Storage of Initial Rainwater

..... ZHU Mu (106)

Abstract: In order to alleviate the influence of initial rainwater on the river water quality, aimed at the current situation, the functions of wastewater treatment plant (WWTP) are adjusted to cancel the function of sewage treatment and reconstruct to the initial rainwater storage facilities. Combined with the actual situation of the structures in WWTP, the factors of investment, construction period and construction influence are comprehensively considered. The scheme of utilizing the old structures is adopted. The current structures are utilized and reconstructed to the initial rainwater storage tank. And the corresponding supporting facilities are added to meet the function of initial rainwater storage, which has the higher social and economic benefits and provides the reference for the other projects.

Keywords: initial rainwater, function adjustment, storage

Research on Deodorization and Ventilation System of Buried Wastewater Treatment Plant Based on Simulation

..... BAI Xiaoping, BAI Yuhua, XU Qiang, XU Ning, QI Zijing (108)

Abstract: The buried wastewater treatment plant (WWTP) has the higher requirements for the capacity of deodorization system and ventilation system than the traditional WWTP. The air volume calculation method of deodorization ventilation system is studied. Combined with the deodorization system design, ventilation system design and simulation, the waste caused in the design and operation can be avoided. The efficient and accurate design idea of ventilation collection system is proposed. Taking a sludge dewatering room of a buried WWTP as an example, the computational fluid dynamics (CFD) model is used for the simulation and optimization. The operation control countermeasures are put forward for the

deodorization ventilation effect safety, equipment safety, energy conservation and consumption reduction, which improve the efficiency of energy utilization.

Keywords: buried wastewater treatment plant (WWTP), deodorization and ventilation, simulatio

MANAGEMENT & CONSTRUCITON

Synchronous Grouting Interaction and Risk Pre-control in Multi-tunnel Parallel Overlapping Construction

..... SHI Yaofeng (111)

Abstract: Aiming at the risk prediction and control problems of simultaneous grouting mutual disturbance and ground leakage slurry in the multi-tunnel parallel overlapping construction process in shallow covering soil sandy water-rich stratum, based on the synchronous grouting slurry infiltration diffusion model and the penetration distance analytic method, the synchronous slurry spatial distribution characteristics, and the correlation between the infiltration diffusion distance and the grouting pressure are studied. The grouting pressure optimization concept of the multi-tunnel grouting interaction, the prevention and control of ground leakage risk and the guarantee of grouting filling effect is proposed. The corresponding predictive control method of ultimate grouting pressure is established. The theory and method have been successfully applied to the synchronous grouting risk pre-control in the construction process of SG6-9 Bid Section of Hangzhou Metro Line 6 Phase I. The good technical and social effects have been achieved. The research results can be used as a reference for the simultaneous grouting state prediction and risk prevention and control of the multi-tunnel overlapping construction in the shallow covering soil permeable water-rich stratum.

Keywords: multi-tunnel overlapping, synchronous grouting interaction, ground leakage, risk pre-control, engineering application

Key Construction Control Technology of Chizhou Changjiang River Bridge

..... YU Zhu, YUAN Bo, ZOU Benhui, DU Xianting (117)

Abstract: The Chizhou Changjiang River Bridge is a double-pylon double-plane composite beam cable-stayed bridge with a main span of 828 m. A new anchoring form of stayed cables anchored on the steel beam between the pylons in cluster type by groups is adopted. The steel box girders are constructed by the cantilever assembling method while the prestressed concrete box girders of side span are constructed by the support cast-in-place method. Aiming at two characteristics of the cluster-type anchoring and asymmetrical construction of the main girder, the geometrical control method is used to control the bridge construction. Many key control technologies of pylon offset and pre-lift control, pylon stress control, steel beam pre-lift control, main girder fabricating alignment and installing alignment control, and stayed cable fabrication length control are adopted. After the completion of the bridge, the pylon offset and stress, the main girder alignment and the stayed cable force are measured and compared with the theoretical values. The results show that the measured values of structure alignment, stress and cable force are in good agreement with the theoretical values, which all meet the specification requirements. The overall control effect of the bridge is good.

Keywords: cable-stayed bridge, composite beam, cluster-type anchoring, construction control

Staging Multiple Pushing Construction Technology of Warren Steel Truss Simple-supported Beam

..... CHEN Wenqiang, WU Dezhi, ZHANG Ke, LIU Xiaolong, WEI Huijun (122)

Abstract: The installation of the steel truss simple-supported beams of the main bridge in the project is the operation at water. The construction site is located at an angle 120° of the center line of the channel. At the same time, there are obvious problems such as the narrow construction space, difficulty in hoisting, and difficulty in ensuring construction quality. In order to ensure the smooth construction of this area, also to guarantee the traffic safety of the navigable channel, the staging multiple pushing construction technology is used for the installation. The finite element software is used to check the stability of the main structure by the multiple pushing construction technology. The calculation results show that the maximum displacement and the maximum stress generated during the hoisting process of the pylon support and truss are within the specified safety range. Its construction technology is mainly set forth, which has certain guiding significance for the construction of similar projects.

Keywords: Warren-style steel truss, steel structure, finite element analysis, multiple pushing, construction technology

Design and Construction Technologies of Mobile Suspension Cable Support for Long-span Composite Girder Bridge GUO Zhuoming (126)

Abstract: The design and construction methods of steel-concrete composite bridges are flexible, changeable and adaptable. Taking a long-span continuous steel-concrete composite box girder bridge as the background, the design and construction integrated technology of mobile suspension cable support is proposed, and the parameter optimization analysis is carried out. The results show that the use of the technology can give full play to the performance advantages of steel and concrete to the greatest extent, and effectively improve the economy and adaptability of long-span steel-concrete composite beam bridge.

Keywords: steel-concrete composite girder bridge, mobile suspension cable support, design and construction

Construction Quality Evaluation of Pre-stressed Concrete Girder Based on Monitoring Data

..... WU Xiaoping, RUAN Yinghui, CHEN Yuefei, LIU Zhiwen, ZHANG Yingjie (129)

Abstract: The quality of concrete construction in expressway construction is the focus of attention. The traditional method is mainly to evaluate the construction quality of concrete girders with the manual inspections and empirical judgments. There is a certain degree of lag and subjective opinions. Based on the construction data of the concrete girders monitored by the Zhejiang Coastal Expressway Informatization Platform, the combined method of the analytic hierarchy process (AHP) and the fuzzy evaluation is adopted to establish a pre-stressed concrete girder construction quality evaluation system. Moreover, the expert questionnaire survey method combined with AHP is adopted to determine the weight of each evaluation index. Finally, based on the construction monitoring data of the pre-stressed concrete girders of the coastal expressway in Taizhou, the construction quality of the pre-stressed concrete girders in the different construction bidding sections is evaluated. The results show that the pre-stressed concrete girder evaluation system established in this study can timely and objectively evaluate the construction quality of pre-stressed concrete girders in different construction bidding sections, and the influence of human factors can be avoided. The overall construction quality of pre-stressed concrete girders in the different construction bidding sections in Taizhou of Zhejiang Coastal Expressway is excellent. Moreover, the evaluation results of each construction bid basically agree well with the quality inspection results of the project.

Keywords: pre-stressed concrete girder, construction quality evaluation, evaluation system, weight, analytic hierarchy process (AHP)

Contrastive Analysis on Deformation of Steel Sheet Pile Cofferdam in Construction Stage

..... LI Pan, TONG Weijun, DENG Fuchao (135)

Abstract: Then main bridge of Taidong River Bridge is a 51. m+85 m+51 m single-box single-chamber variable cross-section continuous box girder. The main piers of the main bridge are located at 10 m from the bank within the riverway of Taidong River as Class III canal. The island-building steel sheet pile cofferdam method is adopted for the construction. The excavation depth of foundation pit for the base slab is 7.186 m, which belongs to more than a certain scale of dangerous partial project. The construction safety risk is large. Through the actual conditions in the excavation of foundation pit, the model stress of steel sheet pile cofferdam is analyzed and calculated. The calculation basis and method to distinguish the structures before and after deformations during the construction stage of model definition are discussed, which provide the technical guarantee for the smooth construction steel sheet pile cofferdam.

Keywords: continuous girder, model stress analysis of steel sheet pile, excavation of foundation pit, construction stage, condition analysis

Demolition Construction Technology of Continuous Girder in Channel Regulation

..... XIAO Hanyu, ZHANG Chen (138)

Abstract: Due to the regulation and upgrading of the canal channel, the main bridge span and the navigation clearance of the old Jingtai Bridge in Taizhou cannot meet the requirements, which need to be demolished and rebuilt. In order to ensure the navigation demand of the channel, the method of bridge demolition and form traveler with the steel pipe bracket is used to carry out the demolition of the superstructure of the old bridge, which can simply and quickly complete the demolition construction of continuous box girder.

Keywords: continuous box girder, demolition construction, form traveler

Application of Steel Sheet Pile in Jueshi Port Waterway Regulation Project

..... SHEN Yong (140)

Abstract: Steel sheet piles have the advantages of small space occupation, high water tightness, simple and fast construction, controllable manufacturing and processing quality, and green environmental protection, which are widely used in the waterway regulation projects. The application of steel sheet piles in waterway regulation projects are discussed and analyzed through an example of Jueshi Port Waterway Regulation Project. Its aim is to provide the reference and help for the related projects.

Keywords: steel sheet pile, waterway regulation project, application

Control Technology of Pipe Jacking Crossing under Existing Subway Line in Close Distance

..... LI Jianping (144)

Abstract: The newly built pipelines are inevitably intersected with the operating subway lines. The pipe jacking method is one of the techniques used in the underground operating subway lines because of its small impact on the surrounding environment, a few removals and the other advantages. Based on an engineering case, the key control technologies of pipe jacking crossing under the existing metro line in close distance are discussed. And the finite element analysis software PLAXIS3D is used to simulate the

crossing condition. The construction control measures of pipe jacking are put forward in order to provide reference for the similar projects.

Keywords: pipe jacking method, earth pressure, total jacking force, coefficient of friction resistance, grouting quantity

Construction Organization and Safety Management in In-situ Overhaul of Double-deck Steel Truss Bridge QIAN Guohui (148)

Abstract: Taking the in-situ overhaul of Songpu Bridge in Shanghai as an engineering example, aiming at the problems that the reconstruction of the bridge is required to guarantee the normal traffic of the non-motored vehicles crossing the river, the bridge is adjacent to Jinshan Railway under operation and spans the channel of Huangpu River, and the construction organization and safety management are difficult, overall multistage construction organization and multiple safety measures are taken in the project implementation effectively to guarantee the smooth implementation of the project, which can be referred for the reconstruction of the similar projects.

Keywords: double-deck steel truss bridge, in-site overhaul, no-break traffic, construction organization, safety management

Research on Design Management of Innovative Large-span Roof Steel Structure System TAO Guoxiong (152)

Abstract: The large-span stadiums structure has the characteristics of large span, complex and diverse structural forms, and high technology content. Its strong specificity brings the great difficulty to the design management. Combining with the Shanghai Pudong Football Stadium Project, the design management of innovative large-span roof steel structure system is discussed. The main measures for the design quality management are proposed from the two aspects of design quality and design progress management. The quality control system is established including the quality control process, theoretical calculation and analysis, test verification and health monitoring feedback to break through the limitations of theoretical calculation. The main measures of design schedule management are proposed, i.e. the establishment of a special working group for roof steel structure design and the formation of centralized efficient communication and joint review mechanism. Practice has proved that the above measures help to form a systematic management idea and a replicable management process, which provide a reference for the design management of similar projects.

Keywords: innovative roof steel structure system, large-span stadium structure, design management

Visualized Management and Control Method of Engineering Schedule Based on EBS Component Coding ZHANG Qifeng, YUAN Chao, HUANG Jie (156)

Abstract: Aiming at the shortcomings of traditional task-based construction schedule management methods, combined with the characteristics of BIM visualization and componentization, an engineering project construction schedule management method based on EBS component coding is proposed. Its core idea is to take a single component as the basic object of schedule management, and to define and report the related schedule, which achieve the component level of management granularity. The solutions are proposed for the key technologies such as the model creation, component coding, construction organization planning, platform management, etc. After the project verification, the method can better meet the

requirements of on-site fine management with the strong operability and good practical application effect.

Keywords: schedule management, EBS component coding, planning of construction organization, platform management

STUDY ON SCIENCE & TECHNOLOGY

Research on Seismic Performance of Large Urban Underground Interconnected Sandwich Layer – Tunnel System Space WANG Haifeng, WU Jian, ZHOU Qiulong, CHEN Wuhang (160)

Abstract: Relying on Nanjing Huimin Avenue Comprehensive Reconstruction Project, the dynamic response of the typical underground interconnected space structures under earthquake is studied. The finite element method is used to simulate and calculate. The engineering simplified model under the sandwich layer – tunnel system is established to analyze the seismic performance of sandwich layer – tunnel structure system. And the possibility of development and utilization of the sandwich layer under the condition of this system is studied. The effective seismic measures are proposed for the seismic performance of the sandwich layer structure. This method can provide a useful reference for the spatial planning of the similar projects.

Keywords: sandwich layer – tunnel system, seismic performance, finite element method, development and utilization

Research on Sensor Failure Detection and Isolation Algorithms WANG Bingjian, CHEN Ke, CHEN Qiyuan (166)

Abstract: Due to the complex format of the data collected by the sensors and the large amount of information, the failure of sensors could not be automatically detected and isolated effectively, thus the accuracy of the evaluation will be affected and the false warning information will be generated. A kind of sensor fault detection and isolation algorithm based on Geometric Post Nonlinear ICA, gp ICA) is proposed. The algorithm linearizes the nonlinear data by introducing a geometric post nonlinear hybrid model, and then uses the fast independent element analysis (FastICA) to detect faults. By calculating the contribution of the monitoring data to the monitoring statistics, the isolation of fault sensor is realized based on the contribution analysis method. Using MATLAB software for the numerical simulation, the detection and isolation of simulated fault sensors are realized. This algorithm has a higher fault detection rate than the traditional linear ICA fault detection, and is more suitable for the fault detection and isolation of bridge health monitoring systems.

Keywords: sensor, failure, independent element, health monitoring, bridge

Analysis and Study on Stress of Hidden Bent Cap of Precast Small-box Beam Based on FEA Full-bridge Model LUO Gansheng, SHI Xianhao, XIAO Haibo (170)

Abstract: Combined with the engineering practice, the numerical analysis method is proposed to study the loading features of hidden bent cap, which has the reference significance in the similar projects. Through the comparative analysis of the Midas Civil beam element model and the Midas FEA full bridge solid element model, the following conclusions can be obtained that the use of FEA overall modeling can effectively simulate the stress situation of the hidden bent cap. There is a stress concentration at the junction of the small-box beam and the hidden bent cap, which results in the main tensile stress larger.

The design should ensure the integrity of the longitudinal reinforcement of the small-box beam and reduce the weakening of the prestressing slotting of the hidden bent cap to the structure. The embedded effect of the hidden bent cap of side pier leads to the reduction of the positive bending moment in the middle of the side span. The prestressed tendons of the side span small-box beam can be appropriately reduced in the design.

Keywords: hidden bent cap, FEA calculation, stress concentration

Study on Bonding Performance of Cement Bridge Deck Pavement Based on GA Paving Layer

..... LEI Shuanglong, GAO Jie, GUO Yong, YU Yang, LIU Hongying (173)

Abstract: The poured asphalt mixture is widely used for the cement concrete bridge deck pavement to meet its bonding waterproof requirements. The basic pavement type is "bonding layer + waterproof layer + wearing layer" or "bonding layer + waterproof layer + bonding layer + wearing layer". With the help of the large asphalt-aggregate ratio of poured asphalt mixture (GA), the influence of GA-10 as the waterproof bonding layer on the bonding performance of deck pavement is analyzed. The result shows that the bonding performance between GA-10 and cement concrete deck can meet the waterproof and bonding performance requirements of the cement deck.

Keywords: cement concrete bridge deck, waterproof bonding layer, poured asphalt mixture

Evaluation of Uniformity of Dense Graded Asphalt Mixture

..... ZHANG Jianfei, GUO Hui, CHEN Xiaoli, WU Jinting, XU Yidong (176)

Abstract: In order to overcome the shortcomings of low accuracy and long time consuming of traditional asphalt mixture uniformity evaluation, the digital image technology is used to quantitatively evaluate the uniformity of different types of dense graded asphalt mixture. The relative average difference of area ratio of adjacent coarse aggregate areas is proposed as an evaluation index to analyze and evaluate the uniformity of SMA-13 and AC-13C mixtures. The results show that the relative average difference of area ratio of adjacent coarse aggregate areas of SMA-13 is reduced by 33.1% than AC-13C. The uniformity of SMA-13 is significantly better than AC-13C. The different particle size of aggregate has a great influence on the uniformity of mixture. The uniformity of each coarse aggregate presents a quadratic parabola distribution law with the increase of particle size. 4.5 ~ 9.5 mm graded aggregates have the best uniformity. The aggregate uniformity greater than 13.2 mm is the worst. There is a good contrast effect between the local and overall uniformities of the mixture.

Keywords: road engineering, uniformity, digital image technology, asphalt mixture, coarse aggregate

APPLICATION OF ACHIEVEMENTS

Design and Application of Early Warning and Travel Navigation System Based on Culvert Ponding Monitoring

..... LI Huaizhen, HE Xuan, ZHANG Lin, ZHU Bochao, NIE Xincheng (181)

Abstract: In order to solve the problems of traffic congestion, personal casualty and property loss caused by the culvert ponding of urban road and bridge, based on Arduino development board, the culvert ponding monitoring early warning and travel navigation system integrated with the water level monitoring, grading early warning, information issue, multi-department coordinated disposal and travel navigation is designed and studied and developed. The water level monitoring module collects the water level

information in real time through the immersive and ultrasonic sensing water level gauge. The corresponding early warning is issued according to the different ponding conditions. The disposal measures are informed to the relevant departments and personnel of municipal administration, city construction and environmental sanitation through the multi-carrier information platform. And the water level information is synchronically uploaded to the travel navigation APP platform, and the driver and passengers can adjust the travel in time with the help of APP. The system has the characteristics of diverse functions, low cost, easy maintenance and timely upgrading, which has the strong market application prospect and a large number of audience groups, and can promote the construction of smart city.

Keywords: culvert ponding, urban road and bridge, water level monitoring, grading early warning, travel navigation, Arduino

Research and Application of Long-span Bridge Construction Visualization Information Management Platform

Based on BIM+GIS Technology LIU Panpan, JIANG Haili, CHEN Liuhua, REN Yayin (185)

Abstract: Minpu Bridge III is a large bridge across the Huangpu River, which involves the complex engineering contents and the high technical requirements. Based on BIM+GIS technology, the development of a set of enterprise-level construction management platform suitable for the different types of bridge projects is introduced. A set of three-dimensional bridge construction information management process is combed, which involves the 3D panoramic engineering display, coding unified construction log, 3D model and schedule linkage display, high-precision site construction personnel positioning management, electronic safety and quality check form. The experience and the difficulties in the application of the bridge engineering platform are summarized, which provide the reference for the subsequent similar projects.

Keywords: long-span bridge, panoramic display, personnel positioning

Application Method of Taxi Trajectory Data in Comprehensive Traffic Survey DAI Wei (190)

Abstract: Taxi trajectory data is an important information data source in comprehensive traffic survey. It can be applied in the multiple traffic surveys including the taxi survey, vehicle speed survey and so on. The application scenarios and application requirements of taxi trajectory data in the comprehensive traffic survey are systematically combed. The analysis framework and processing flow of taxi trajectory data are designed. The map matching calculation method of "shortest path matching of adjacent positioning points" is specially introduced. Taking a city as an example, the application and current characteristics of taxi trajectory data in the comprehensive traffic survey of the city are introduced. The correlation analysis has the effect of completing the traffic survey and supporting the traffic planning task.

Keywords: comprehensive traffic survey, taxi, trajectory data, map matching

Study on Application of Mixed Type Hot-in-Place Recycled Asphalt in Expressway LI Junfeng (194)

Abstract: Aimed at the rut, crack, pothole and other diseases of an expressway in Gungdong, the mixed-type hot-in-place recycling technical scheme is designed for the repair and curing. The design flow of mix proportion for the recycled asphalt mixture is introduced from the aspects of raw material detection, grading design and mixture performance verification. Relying on this project, the mixed-type hot-in-place recycling construction technology and quality control measures are systematically set forth. The result shows that the mixed-type hot-in-place recycled asphalt pavement has the good high and low

temperature performances, water stability and anti-skid performance. It is recommended to be promoted and applied as a new type of green environmental protection curing method.

Keywords: road engineering, hot-in-place recycling, design of mix proportion, construction technology, quality control

Research on Application of Road Performance of Modified Muddy Soil WU Shixing (198)

Abstract: With the continuous improvement of the infrastructure construction in China, the coverage of road traffic construction continues to expand, the soil problems are diversified, and the muddy soil problems are increasingly encountered in road engineering construction. Due to its strong fluidity and lack of bearing capacity, the muddy soil is always hard to be effectively used in engineering practice. At the same time, it is difficult to transport long-distance due to storage and transportation problems, which becomes a problem hard to solve. Taking the improvement of muddy soil as a starting point, using the industrial waste materials also difficult to transport and store as the admixtures used for a muddy soil curing agent, the optimal proportion of the modified muddy soil characteristics can be found, which has the good application prospect as the highway subgrade stuffing. The experimental research of mixed materials show that three dosage ratios of the selected blast furnace slag, fly ash and carbide slag are 42.1 : 11.5 : 46.4, which can well meet the requirements of highway subgrade filling.

Keywords: muddy soil, curing agent, highway subgrade

Application of High-toughness Ultra-thin Asphalt Wearing Course in Municipal Road Engineering

..... YAO Kun (202)

Abstract: The implemented high-toughness ultra-thin asphalt wearing course technology with a thickness of 0.8–2 cm is introduced and summarized, which is practically applied in the road project of Jiashan County Urban Intelligent Transportation Comprehensive Upgrading and Reconstruction Project (Phase I). The key points of construction control of high-toughness ultra-thin asphalt wearing course technology are expounded. The field test shows that the friction coefficient of the pavement before and after the overlay is increased by 20.4 bpn, the structural depth is increased by 0.54 mm, the flatness is increased from 5.2 mm to 1.15 mm, the noise reduction performance is reduced by 3 ~ 6 dB, and the water sealing performance (< 30 mL / min) and the interlayer drawing strength (≥ 0.8 MPa) are good. It has good engineering feasibility and can provide a certain engineering reference for the application of the same type of municipal road technology.

Keywords: municipal engineering, high-toughness ultra-thin asphalt wearing course, synchronous paving, field test, construction control

Application of LC40 Lightweight Concrete Bridge Deck Pavement in Maintenance and Reinforcement

..... JIA Hui (205)

Abstract: Based on the study of Huangshui River Bridge in Xining with the different paving structures, compared with C40 concrete, the use of the lightweight aggregate concrete to pave the bridge deck can reduce the dead weight by 20%, reduce the displacement in the midspan by 12.5% and reduce the interface tensile stress of the midspan longitudinal bridge by 12.2%. The obtained conclusion can provide the reference for the application of lightweight aggregate concrete in the bridge maintenance and reinforcement.

Keywords: lightweight concrete, pavement, midspan displacement, interface stress

Brief Analysis on Application of Lock Section Steel Underground Diaphragm Wall Method MA Jing, HUANG Wei (208)

Abstract: In order to study how to construct the ultra-deep high-rigidity underground diaphragm wall within the limited underground space of central urban area, the lock section steel underground diaphragm wall method is introduced into the construction of foundation pit support in Shanghai Metro Line 19 Shibo Avenue Station Project. The experimental study on this construction method is carried out. The key construction technology of this method is set forth. Its practical application effect is analyzed. The result shows that the lock section steel underground diaphragm wall has certain feasibility in the construction of deep foundation pit support in the soft soil area of the central urban area. The steel components of this method are manufactured in a factory with the good water-stop effect, which can save the construction site, and especially play the high performance in the rapid construction of the narrow-area large-scale projects in the central urban area.

Keywords: foundation pit support, lock section steel, underground diaphragm

THE RELATIVE SPECIALITIES

Exploration on Construction of Utility Tunnel in Urban Core under Background of Urban Renewal WANG Qiguang (212)

Abstract: Urban renewal is a hot topic in the field of urban construction at present, which is of great significance to promote the high-quality development of the city. The construction of utility tunnel in urban core is an effective way to achieve the purposes of urban renewal. Through analysis of the difficulties in the construction of utility tunnel in urban core, taking the construction of utility tunnel in the urban core of Wuhu as an example, it is explained how to realize the urban renewal idea in the project so as to provide the experience and reference for promoting the urban renewal in the other cities.

Keywords: urban renewal, utility tunnel, urban core

Design of Joint Construction of Municipal Tunnel and Subway Station SHEN Miao (215)

Abstract: In order to meet the intensive utilization of limited urban space, it has become a trend to build the multiple projects together in the same underground space. Taking the joint construction project of Longju Road Station in Shanghai Metro Line 14 and East-West Channel as an example, some design difficulties of three-layer underground station and municipal tunnel under the conditions of complex surrounding environment, complex joint construction node and deep foundation pit are studied. And the targeted design schemes are proposed in order to provide some reference for the similar projects.

Keywords: subway station, municipal tunnel, joint construction, traffic relief, design of foundation pit

Application Analysis and Development Suggestions of Rapid Tram LIANG Shuaiwen (219)

Abstract: With the characteristics of moderate transport volume, green environmental protection, low investment, quick approval and short construction cycle, tram is suitable for the small and medium cities to build the public transportation backbone system. The functional groups or areas of some small and medium-sized cities in China present the characteristics of scattered layout, and the space distance

between each other is relatively long. Therefore, the rapid tram system is needed to meet the needs of rapid travel within cities. At first, it is proposed that the travel speed of the rapid tram should reach over 30 km/h according to the travel time requirements of the residents. Then, the application cases of rapid tram lines in Lyon of France, Porto of Portugal, Twin Cities of USA and Suzhou of China are analyzed. The functional orientation and the line characteristics of rapid tram are summarized. Finally, the suggestions on the development of rapid tram in China are put forward from five aspects of applicable area, vehicle selection, station setup, intersection design and code formulation.

Keywords: rapid tram, travel speed, application case, development suggestions

Study on Pipeline Planning Scheme of Caojin Road Reconstruction Project

..... CHEN Yuan, LUO Le (222)

Abstract: The municipal engineering reconstruction projects always involve the pipeline relocation. Due to the intersection of various pipelines, its complexity is much higher than the general new projects. Taking the pipeline relocation planning scheme of Caojin Road Rapid Reconstruction Project as an example, the design ideas of municipal pipeline relocation are discussed. The result shows that the utility tunnel of cables is planned to construct in the reconstruction projects, which can intensify the underground space and is beneficial to improve the comprehensive carrying capacity of a city.

Keywords: reconstruction engineering, metro, municipal pipeline relocation, utility tunnel of cables, pipeline into utility tunnel

Design of Deep Foundation Pit for Subway Shield Tunneling with Ultra-short Distance and Large-angle Conditions

..... ZHANG Jianan (225)

Abstract: As a tunnel project as an example, the enclosing structure of short underground diaphragm wall + long construction method pile, the relative reinforcement and structural measures taken in the design of tunnel foundation pit are studied to ensure the safety and stabilization of deep foundation pit excavation and structural rebuilding of tunnel. And the conditions are reserved for the ultra-short distance and large-angle tunneling of the planned subway shield. Based on the computational analysis and the practical monitoring data validation, the enclosing structure deformation, ground surface settlement and overall stability of tunnel all meet the design conditions and standard requirements in the construction of this scheme. And in the later period, the smooth tunneling of subway shield is also realized, and has no adverse effect on the tunnel structure, which shows that the overall design scheme of foundation pit is economic and feasible, and can be referred for the similar projects in the future.

Keywords: tunnel crossing, ultra-short-distance, large-angle crossing, short diaphragm wall, long construction method pile

Study on Endoscopy Detection of Water-filled End Trunk Pipe by Combined Technology of "Sonar + Electrical Leak Detection"

..... HUANG Haohua (228)

Abstract: The end trunk pipe of sewage pipe network usually runs in the state of high-water level or full-water level. CCTV and QV can be used for the endoscopy detection after blocking and drainage to reduce the pipeline water level. This method has the disadvantages of low efficiency and high cost. Therefore, it is of great significance to explore the endoscopic detection technology of end trunk pipe in the state of full water. The combined technology of "sonar + electrical leak detection" is used to carry out

the endoscopy detection of water-filled end trunk pipe, and the parallel verification is conducted through CCTV detection to judge the accuracy and applicability of the combined technology, which can provide the technical support for the management and maintenance of the sewage pipe network. Through the field tests, the "sonar + electrical leak detection" combined technology can effectively identify the main structural and functional defects existing in the water-filled end trunk pipe. The minimum target resolution capability is 0.1 m, and the theoretical error is 0.02 m. For the penetration of smaller-sized foreign objects, the "sonar + electrical leak detection" combined technology is hard to effectively identify. For the materials penetrating foreign mater, this combined technology is hard to identify, the other means are required to assist for confirmation.

Keywords: sonar, electrical leak detection, end trunk pipe, closed circuit television detection (CCTV)

Design and Application of Intelligent Power Distribution System for Super-long Tunnel WANG Ying (232)

Abstract: Intelligent power distribution system of tunnel is an important part of intelligent transportation system of expressway. And a safe and reliable power distribution system is the foundation to ensure the safe operation of tunnel. The intelligentized hardware products able to be applied in the market are investigated surveyed. Taking the application of intelligent power distribution system of Schneider Electric in G98 Island Expressway Sanya Yazhou Bay Tunnel Project as an example, by analyzing the problems existing in the traditional power distribution system of tunnel and combined with the actual characteristics of daily management and operation and maintenance of tunnel, the overall architecture of the intelligent power distribution system is proposed. How to build the intelligent power distribution system for project is discussed. The intelligentization and optimization of operation and maintenance management are realized to ensure the safe, efficient, sustainable and healthy development of the tunnel.

Keywords: super-long tunnel, intelligent power distribution system, system architecture, operation and maintenance management

Analysis on Influence of Billboard Spatial Location on Visual Sense of Driver SHEN Lin (238)

Abstract: The information of roadside facilities represented by billboards is complicated and brings the visual load to drivers. In order to determine the impact of roadside information on the driving environment of drivers, through the design of real vehicle test, taking all gazed high column tower billboards as the research object, taking the traffic volume, lighting and spatial location as classified variables, and using Logistic regression model, whether the classified variables have a significant effect on drivers' capture of billboards is discussed. The research shows that the spatial location of billboard has an impact on the visual behavior of drivers, and the billboards set up on the right side next to the road have the largest proportion of driver's visual capture. The research conclusion provides the reference and suggestions for the setting basis of billboards.

Keywords: billboard, visual sense of driver, Logistic regression, driving distraction, real vehicle test

Analysis on Fatigue Strength of Cantilever Arm in Urban Multi-pole Structure SUN Xibo (242)

Abstract: There is a kind of long cantilever structure in the urban multi-pole structure, which is used to mount the signal lights or cameras and signboards. The cantilever arm belongs to a long flexible structure. Due to the fluid characteristics of air, it is easy to cause the vibration of structure, resulting in the fatigue

effect in the structure. In the calculation, the different fatigue loads should be considered according to the different vibration types, and the joint type with the higher fatigue grade should be selected to ensure the safety of the long cantilever structure.

Keywords: urban multi-functional multi pole, structure vibration, fatigue strength

Design of Node Scheme for Design of Municipal Road and Protection of Ancient Tree protection

..... ZHANG Qiang, CHEN Weidong, PENG Hui (245)

Abstract: East Jinan Railway Station is one of the three main passenger stations in the railway hub of Jinan, and is a comprehensive transportation hub integrating a variety of transportation. As one of its external relief channels, North Shuniu Dongjinchang Road has a particularly important traffic function. In the planning line, there is a hundred-year-old tree. How to deal with the project construction and the protection of ancient tree and famous tree is particularly important. The scheme is comprehensively discussed from the aspects of project background, engineering situation and scheme comparison, which provides the reference for the design of the similar projects.

Keywords: protection of ancient tree, municipal road, ecological protection

Analysis on Influence of Precipitation Line Moving Northward on Subgrade of a Project in North China

..... YI Shuangde (248)

Abstract: With the "precipitation line moving northward", the construction in the rainy season in northern China will be normalized. Based on an example of a key municipal project in the north, the troubles caused by the precipitation in rainy season in the north on the subgrade construction are analyzed. And the corresponding subgrade treatment scheme is given.

Keywords: the north, construction in the rainy season, subgrade construction, subgrade scheme

Brief Analysis on Investment Control Essentials of Comprehensive Transportation Hub under Background of Station-City Integration

..... SONG Deqin (250)

Abstract: The new type of comprehensive transportation hub of railway under the background of "station-city integration" is not only the center of passenger transportation connection and different-type passenger flow conversion inside and outside the city, but also integrates the commercial needs such as urban land development. The diversified evolution of its functions is often accompanied by a large increase in engineering investment. In the decision-making stage of project, the construction scale and construction standards have a significant impact on the engineering cost. Based on the feasibility evaluation of the comprehensive transportation hub supporting project of South Huicheng Railway Station, from the perspective of coordination with the planning and rationality of functional positioning, its reasonable construction scale and construction standards are analyzed for its rail transit embedding, station square and the other engineering content. The active and effective investment control strategy in the decision-making stage is proposed.

Keywords: comprehensive transportation hub, station-city integration, investment control, upper planning, functional positioning

Research on Landscape Planning and Design of Innovative Industrial Park

..... HE Meijun (253)

Abstract: With the rapid development of the economy and the quick change of the technology, the

innovative industrial park dominated by the high-tech production has gradually become the booster of "city-industry integration and regional development". Its landscape design will also become an important link. Combined with Zhongshi Great Innovation Industrial Park Project, the concept, strategy and method of the landscape design for the innovative industrial park are gradually discussed from the conception to the detailed design, which provides a useful reference for the similar projects.

Keywords: innovative industrial park, landscape, landscape planning and design

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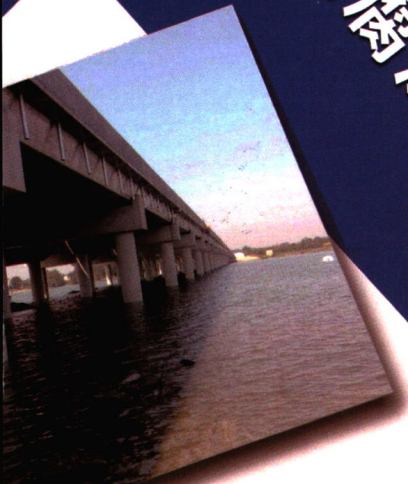
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