

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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图为由南京市水利规划设计院股份有限公司设计的山西省长治市“三河一渠”工程

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

城市中环线位与城市空间组织——以无锡市为例

跨黄河特大桥之悬索桥与斜拉桥技术经济对比分析

排水(雨水)防涝综合规划中水力模型的应用与思考

蓄意攻击下城市轨道交通网络抗毁性分析



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

本期封面工程为山西省长治市“三河一渠”工程,由南京市水利规划设计院股份有限公司设计。

“三河一渠”是山西省长治市主城区的环城水系,是区域行洪、排涝的主要通道,是城市环境、景观的重要载体。工程治理总长度为 14.63 km,其中石子河 4.96 km,黑水河 3.02 km,南护城河 3.92 km,东防洪渠 2.73 km。石子河与黑水河按 50 a 一遇标准设防,并做好 100 a 一遇的防洪预案;南护城河及东防洪渠按 50 a 一遇标准设防。

主要建设内容:(1)河道防洪达标建设。疏浚、拓挖河道,以满足行洪要求;对河床、岸坡进行护砌,以满足防冲要求;折建并加高堤防,使之满足挡洪要求。(2)调蓄水系统建设。新建蓄水坝、跌水堰等建筑物,使河道能够蓄水,部分段满足行船要求,结合沿岸景观治理提升河道景观。(3)风景园林景观提升。河道沿线风景改造,重点对滨河公园、太行公园、紫坊游园、黑水河游园等节点进行景观提升,同时修建沿河商业建筑等。(4)监测、运行管理系统建设。主要是建设水质监测系统和运行管理系统。

“三河一渠”工程于 2012 年 12 月开始设计,2014 年 7 月设计完成,2017 年 3 月项目建成并投入运营。该工程集“水安全、水生态水环境、水文化水景观、水经济”为一体,受到市民欢迎,建成以来已成为山西长治市一张崭新的城市名片,在山西省乃至全国起到了一定的城市河道综合治理示范作用,发挥了巨大的经济效益、社会环境效益和生态效益。

Urban Roads, Bridges & Flood Control

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ROADS & COMMUNICATION

Urban Middle Ring Alignment and Urban Spatial Organization WU Kun (1)

Abstract: The systematic thinking should be set up for the urban work should set up the systematic thinking. The major issues related to urban development should be further studied and carefully deployed, and all aspects of work are systematically promoted from many elements of urban structure, urban function and urban composition. The urban structure is determined by the road network structure. From the ring to improve the accessibility of the road network structure, the basic function of the ring and the functions derived from it are analyzed. The influence of the relative position relationship between the ring and the node on the function is analyzed. It is concluded that the close connection between the ring and the node is the guarantee to give play to the basic liaison function. Taking the Middle Ring of Wuxi City as an object, the influence of the function and alignment of North Outer Ring on the function are analyzed in detail. by comparing the alignment, it is concluded that the alignment of Zhonghui Avenue can meet the functional requirements of the Middle Ring.

Keywords: ring network, Middle Ring Line, accessibility, basic functions, alignment

Exploration on Planning and Design of Road Traffic under Mode of "Small Block and Dense Road Network" SHI Quan (5)

Abstract: The current urban road traffic in China is almost the traditional mode of "thin road network, big block and wide road". Its disadvantages are increasingly exposed. Compared with the traditional planning mode, the different technical means are adopted for the planning mode of "small block and dense road network" in the aspects of road network planning, road design, land utilization and city design to inspire the vitality of street and to improve the economic benefits of city. Taking the core area of Jiangbei New Area in Nanjing as an example, the planning control measures of "small block, dense road network", the land development conditions and the coordination of the relationship between the road construction and the traffic organization are explored. The traffic organization is optimized. The road construction in the future is guided. The reference can be provided for the implementation of "small block, dense road network" planning.

Keywords: small block, dense road network, road planning, traffic organization, traffic design

Application of Green Travel in Urban Riverside Landscape Road LIAO Xiuzhai, ZHANG Zhiyuan (9)

Abstract: How to integrate the concept of sustainable development in the design of urban roads, the spatial resource allocation of motorized traffic and green traffic should be fully balanced, and the convenience, safety

and comfort of green travel should be guaranteed in priority. Taking the riverside landscape road in Wenzhou as an example, the walking road, healthy runway and cycling road are implanted into the space of riverside landscape road to realize the connection and integrative development of three lines. And the facilities of public transportation, parking and pedestrian overpass along the river are simultaneously upgraded to realize the comfortable transfer. The riverside landscape road has become the best choice for the public attendance, leisure and exercise after reconstructed and upgraded. The good social benefits have been achieved.

Keywords: green travel, landscape road, slow traffic, transfer

Overall Scheme Design of Benjing Avenue in Area of Qianjiang Century City and Asian Games Village in Hangzhou SONG Xin (11)

Abstract: Benjing Avenue is an important north-south channel in the area of Qianjiang Century City and the Asian Games Village in Hangzhou. After the completion of the project, the powerful transportation and municipal service guarantee will be provided for this area. The project background and construction conditions of Benjing Avenue are introduced and analyzed. And its functional orientation is summarized and concluded. Combined with the prediction result of traffic volume, the overall scheme and important node scheme of the project are studied and designed.

Keywords: Benjing Avenue, overall scheme, node scheme, Hangzhou, Asian Games Village

Overall Scheme Design of Harbin Beimeng Street Expressway WANG Hongjiao (15)

Abstract: Harbin Beimen Street Expressway connects the built Huagong Road of Ring Road III and the Songhua River Combined Bridge of Binbei Railway Line. After the completion of the project, not only Ring Road III can be realized to close and connect in the whole line, but also the urban traffic flow across the river can be redistributed in order to relieve the urban traffic pressure across the river. The design of the project is expounded from five aspects of functional orientation, service object, main technical standards, overall design scheme and node design scheme. In the overall design scheme, the road laying form and the standard cross-section layout are analyzed, and the construction scale is demonstrated. In the node design scheme, the node schemes of railway and main intersected roads are analyzed. The general design thought of urban expressway is systematically introduced.

Keywords: expressway, overall design, node design, design speed

Design and Study on BRT Traffic Organization of Fengxian in Shanghai BAO Yanqing (18)

Abstract: In order to provide the reference for the design of traffic organization for the urban bus rapid transit (BRT), taking Shanghai Fengxian Nanqiao New City - Oriental Sports Center BRT Project as an example, the design scheme of BRT traffic organization is introduced. The right of way scheme, the traffic organization of intersection, the traffic organization of special node, the traffic organization of original and terminal station in-out line, and the traffic organization of transition period of BRT are further studied. The design schemes of BRT traffic organization in the different operating conditions are discussed in detail. Three conclusions of BRT traffic organization design scheme in Fengxian basically meeting the vehicle driving demands of BRT are obtained.

Keywords: bus rapid transit (BRT), right of way, traffic organization design, operating condition

Scheme Design of Tongliao City Daxing Road Project LI Jinbao (22)

Abstract: Combined with the example of Tongliao City Daxing Road Reconstruction Project and according to the scheme design, under the conditions of meeting the relative technical standards and not increasing the investment, it is as far as possible to use the higher alignment design indexes within the reasonable range. The design of road longitudinal section should conform to the natural slope direction, and should link up with the adjacent urban roads and surrounding lands well. The height change should be as smooth and gently as possible. The regional drainage requirements should be satisfied. The nodes of the present railway and expressway should be designed with emphasis. The scheme designs are carried out for the plane, longitudinal section, cross section and node of Daxing Road. The reconstruction of Daxing Road has perfected the structural system of road network in Tongliao City, which can provide the beneficial reference for the construction of the similar projects.

Keywords: main road, traffic volume forecast, overall design, node scheme

Discussion on Design of Ramp Landing Section of Urban Elevated Expressway WANG Tao (25)

Abstract: Upper and lower ramps connect the urban elevated expressway and the ground road network, and are a necessary means to fully play the role of expressway function and relieve the traffic pressure of ground road network. However, the bridge approach of ramp road often causes much effect on ground traffic organization. If it is not improperly arranged, the ground traffic situation could be in chaos, the travel in the areas along the route would be blocked, the key junctions might be jammed and even the service capacity of expressway would be reduced. Therefore, it is necessary to reasonably select the arrangement of ramp landing section and optimize the design of traffic organization at the relevant ground crossings in combination with the actual situation and traffic demand.

Keywords: elevated expressway, ramp, landing section, intersection, ground traffic organization

Study on Design of Low-grade Highway Reconstruction and Extension Based on Least Square Method
..... LIU Kai, SI Wenbin (28)

Abstract: With the rapid development of economy in China, the traffic volume and traffic load of road have rapidly increased. The highways built in the early days are congested. The pavements are damaged in the large scale. Many grades of highways are gradually entering the stage of reconstruction and extension. Due to the lower standard of construction at an initial stage, the low-grade highways are seriously damaged. The extension design of these highways is more complex. Now based on the principle of the least square method, the plane fitting design and error design are carried out for the old roads. The reference can be provided for the reconstruction and extension of cement pavements of the low-grade highways.

Keywords: reconstruction and extension, single-side widening, plane fitting, least square method

Comparison of Subgrade Widening Engineering Schemes for D Ramp of Chenhai Interchange in G40 Highway ...
..... XIA Rongfu (31)

Abstract: In order to prevent the diseases of pavement longitudinal cracking due to uneven settlement of the

old and new subgrades in G40 Highway Chenhai Interchange D Ramp Subgrade widening Project, based on the existing research results of reconstruction and expansion, and with the help of numerical analysis software, the influence of the different soft soil foundation treatment methods on the differential settlement of the new and old subgrades is analyzed. By comparing the settlement of the center and shoulder of the subgrade and the differential settlement, it is considered that the treatment effect of the foam light soil is the best. The cement fly-ash gravel (CFG) pile and the prestressed tubular concrete (PTC) pile schemes are compared. Finally, combined with the particularity of Chenhai Interchange D Ramp Widening Project, the foam light soil subgrade treatment scheme is recommended.

Keywords: subgrade widening, differential settlement, foam light soil

Design of Traffic Organization at Intersections of Main and Auxiliary Roads HE Ziru (34)

Abstract: Aiming at the section form of the main road + auxiliary road commonly used in the urban road, combined with the application example of Daguang Expressway Nankang South Interchange Connecting Line SL33 Project, from the characteristics and conditions of construction project, the layout form of intersection is reasonably selected. Its aim is to perfect the traffic organization, to practically play the functions of urban road, and can provide the reference for the relative projects.

Keywords: urban road, main and auxiliary roads, intersection, traffic organization

Construction Assessment and Effect Analysis of Bus Rapid Transit in Guangzhou HUANG Man (36)

Abstract: In order to continuously promote the construction of the bus rapid transit (BRT) in Guangzhou, and to provide the reference for the planning of BRT in the other cities of China, the innovation highlights of Guangzhou BRT in the planning, design, construction and operation stages are summarized. Six assessment conclusions of bus system optimization, travel cost reduction and replicable promotion are obtained by the analysis of its economic and social benefits.

Keywords: bus rapid transit (BRT), benefit assessment, public transport priority, travel cost

Performance Analysis of Drum Slag and Its Application in Industrial Factory Road WANG Lin (39)

Abstract: The composition and safety of drum slag are studied. The steel slag asphalt mixture is designed and prepared, and is applied in the factory roads. The result shows that the metal content in drum slag is low, its grain size is uniform and its free calcium oxide content is low. When the drum slag is used as pavement aggregate, its pressure steaming powder rate should not exceed 5.9%, and its mixing amount should not exceed 50%. The free calcium oxide content, pressure steaming powder rate and pressure steaming expansion rate of the drum slag after aging tend to stabilize and meet the standard requirements of road aggregates. The Marshall stability, water stability and dynamic stability of the asphalt mixture prepared by drum slag replacing common aggregate all meet the requirements. The engineering application result in the reconstruction of factory roads shows that all the performances of steel slag asphalt pavement are good and meet the standard requirements of asphalt pavement.

Keywords: drum slag, performance analysis, asphalt mixture, construction application

Research on Influence Factors of Crack Treatment Based on Asphalt Pavement MA Lizhi (42)

Abstract: Asphalt Pavement crack is a kind of road damage form, such as reflection crack of asphalt pavement with semi-rigid base, temperature crack of asphalt pavement in cold area, etc. At the present, there are no efficient measures to avoid it completely. After cracks appear on the pavement, the rainwater, snow water and so on seep into the surface layer and the base layer along the cracks to make the base layer or even the roadbed soften, to reduce the strength of the base layer and roadbed, and to damage the road surface locally or in pieces, thus to result in the rapid reduction of driving speed, comfort and safety, and the reduction of road life. Based on the investigation and analysis of the present situation and problems of crack treatment in highway asphalt pavement, combined with the characteristics of crack treatment materials in current highway asphalt pavement, the influence factors on crack treatment of asphalt pavement are analyzed and studied.

Keywords: asphalt pavement, crack treatment, treatment method, crack pouring material, influence factor

BRIDGES & STRUCTURES

Brief Design Guide of Small-span and Middle-span Multi-beam Steel-concrete Composite Girder Bridges XU Jianqing (44)

Abstract: At present, the decks of some municipal bridges are designed to be wide because of the traffic capacity needs in China. Wider decks need more main girders or increase the section dimension of the main girder. For the bridges with a certain design height requirement, the multi-girder structure is generally adopted. According to the practical application of small-span and middle-span multi-beam steel-concrete composite girder bridges in the present stage, and based on the design construction specifications, some brief design guides and the relative proposals are put forward for the design and construction of the bridges.

Keywords: small span and middle span, multi-girder steel-concrete composite girder, layout of main girder, prepared structural and section dimensions

Brief Analysis on Present Situation and Application Prospect of Civil Floating Bridge LIU Feng, GUO Xiaochuan, LIU Xiaohong (47)

Abstract: By studying the typical floating bridge cases at home and abroad, the differences in the construction of floating bridges at home and abroad are compared and analyzed, the basic composition and classification of floating bridge are expounded, the characteristics and application conditions of floating bridge are comprehensively analyzed, and the current situation and application prospect of floating bridge are discussed and explored. According to the work experience and combined with the characteristics of floating bridge, the application prospect of floating bridges in China is expected. The problems faced by the construction of permanent heavy floating bridges at present in China are put forward. The corresponding countermeasures and suggestions are given. The research and technical reference are provided for the construction of floating bridges.

Keywords: civil floating bridge, basic composition, structural classification, scope of application, application prospect

Analysis on Stress Performance of Steel Anchor Beam of Spatial Cable Plane Cable-stayed Bridge

Abstract: The anchorage zone for cable and pylon of cable-stayed bridge is an important structure bearing the cable anchorage force, and is also a key position in the pylon design of cable-stayed bridge. The steel anchor beam cable-*pylon* anchoring structure is a structure able to better play the tensile strength of steel structure. But this kind of anchoring form is mainly adopted for the vertical-plane cable-stayed bridge, and few studies have been made on the application of spatial plane cable-stayed bridge. In order to study the stress characteristics of steel anchor beam structure under the action of spatial cable plane, relying on a spatial plane cable-stayed bridge, the stress characteristics of steel anchor beam in anchorage zone are studied by the methods of numerical simulation and theoretical analysis. The study result shows that the horizontal component along bridge of spatial plane cable to the anchor beam is relatively small. The lateral spacing device is used to provide the controllable support along bridge. The stress of anchor beam pull plate is obviously concentrated in the position of tiger mouth. Attention should be paid to strengthening the smooth transition of this zone. The inspection of bearing capacity should be strengthened under the condition of cable breaking in the design of concrete pylon wall.

Keywords: cable-stayed bridge, anchorage zone, spatial plane, steel anchor beam, stress analysis

Analysis on Abnormal Vibration Causes of Mid-span Steel Hanging Hole of Half-through Bowstring Arch Bridge

Abstract: Taking a bridge of Changchun as an example, the static pressure test of support is carried out for the hanging hole of mid-span steel box girder with abnormal vibration, the suspender cable force of the main bridge is tested and the vertical mode of the main bridge is tested. The disease causes are analyzed. The maintenance measures are provided. The basis is provided for reasonably treating the same diseases in the detection and maintenance process of the similar bridges in the later period.

Keywords: steel box girder, test, cable force, mode

Design and Construction of Prefabricated Urban Bridges in Changchun ZHANG Xinxin (57)

Abstract: In the construction of urban bridges, the traditional cast-in-place construction schemes have a large impact on the environment and traffic. The prefabricated bridges have a fast construction speed and low environmental pollution, which is a reflection of green construction. A prefabricated scheme is adopted for a viaduct in Changchun. The prefabricated prestressed concrete small-box girder and fabricated steel box girder are adopted for the superstructure, and the prefabricated three-segment bent cap and sectioned prefabricated pier are adopted for the substructure. The green engineering construction is realized. The design and construction essentials of superstructure and substructure for prefabricated bridge are specially introduced.

Keywords: prefabrication assembly, small box girder, steel box girder, three-segment bent cap, sectioned prefabricated pier

Design of Special-shaped Steel-concrete Composite Arch Bridge of Yellow River Bridge of Zhongwei South Station LIU Wei, ZHAO Wei (61)

Abstract: The Yellow River Bridge of Zhongwei South Station crosses the main stream of the Yellow River at the upstream of Zhongwei South Station, and is an important traffic node connecting Shapotou Airport and

Zhongwei South Station of high-speed railway. The main bridge is a three-span continuous special-shaped steel-concrete composite arch bridge. Its span layout is 100 m + 130 m + 40 m. The V-leg rigid frame consolidated by arch, beam and pier is at one side of main pier, and the continuous beam system with support is at the other side of main pier. The superstructure is a composite system of arch and beam. The steel box arch rib and steel box beam are respectively set with steel-concrete composite section at the concrete pier top section. And the main span arch rib adopts the U-shaped rotary special shape. The overall structure system and details are extremely complex. After analysis, the strength, rigidity and stability of this bridge all meet the standard requirements. The reference can be provided for the design and construction of the similar projects.

Keywords: composite system, special-shaped arch bridge, steel-concrete composite section, structural design

Design and Study of Steel-concrete Composite Structural Bridge in Wanfu Expressway of Yangzhou JIAO Jianwen (65)

Abstract: The steel-concrete composite structure is an important form of urban elevated bridge structure. Taking the steel-concrete composite girder in Wanfu Expressway of Yangzhou as the background, the relative results of design and study on the composite deck slab, shear stud and deck rebar for the composite girder used of composite structural deck slab are introduced. The good reference can be provided for the construction of the similar projects.

Keywords: urban expressway, steel-concrete composite simple-supported girder, composite structural deck slab, shear stud, vertical and horizontal rebar

Comparison of Widening Scheme for Urban Elevated Bridge ZHANG Jingwei (68)

Abstract: Aiming at a viaduct widening project, four kinds of bridge widening reconstruction schemes are put forward. A 3D spatial model is established for the engineering project. By analyzing and comparing many aspects of structural performance, bridge landscape, construction impact on traffic and engineering cost, the scheme of constructing the steel bent cap on the old bridge pier is recommended. Through calculation and analysis, the bearing capacity and service character of the recommended scheme can meet the standard requirements and are feasible, which can provide reference for the related projects.

Keywords: urban viaduct, widening, steel bent cap

Analysis on Influence of Large-scale Preloading around Operational Bridge on Bridge Structure MA Longxiang (72)

Abstract: A new project implemented near an operational bridge in city has been an increasing easy subject to encounter in the urban construction, and will has the long-term influence on the structural stress and safe operation of bridge structure. Relying on a practical project, ABAQUS finite element software is used to carry out its analysis. The base slab - pile - soil coupling model is established to study the influence of large-scale preloading on the main pier of Yangpu Bridge involving the aspects of settlement and horizontal displacement. The deformation rule is analyzed. The relative conclusion is obtained. The results are expected to be the reference for the similar projects.

Keywords: bridge, preloading, consolidation settlement, horizontal displacement

Analysis on Anti-seismic Checking Calculation of Bridge Pier Based on MIDAS LUAN Xuguang (76)

Abstract: Taking a river-crossing bridge of Zhengzhou as the engineering background, based on the current specifications, a model is established by the finite element software MIDAS. Combined with the response spectrum method, the anti-seismic checking calculation of this bridge pier is carried out under the action of E1 and E2 earthquakes. The result of anti-seismic checking calculation shows that this bridge meets the earthquake fortification target and code requirements. This method can provide the reference for the anti-seismic checking calculation of the similar bridges.

Keywords: bridge pier, response spectrum, anti-seismic checking calculation

An Anti-overturning Anchor Bolt Structure of Steel Structural Bridge

..... WANG Peixiao, YU Yang, SUN Yiming (79)

Abstract: In recent years, the steel structural bridge is used more and more for the highways, and the municipal small-span and middle-span bridges in China. At the same time, the accidents of bridge damage, lateral overturning and instability until collapse caused by the overload and heavy load occur one after another, which have become the important damage forms of bridge. The overturning accidents of bridge in China in recent years are summarized. The anti-overturning design concept is discussed. An anti-overturning anchor bolt structure of bridge has been developed, and is mainly used for the small-span and middle-span steel structural bridges. Its structural characteristics and application examples are introduced.

Keywords: anti-overturning, anchor bolt, steel structural bridge, small span and middle span

Anti-overturning Checking Calculation and Reinforcement Design of Single-pier Continuous Box Girder Bridge

..... YOU Kehua (82)

Abstract: Taking B Ramp of an interchange in Nanchang as an example, the anti-overturning stability checking calculation and reinforcement design are carried out for it through the establishment of finite element model. The influence of the space between the reinforced pier number, newly increased support and original support on the anti-overturning stability of bridge and the stress of middle pier in the reinforcement method of changing the single-point support of middle pier into the multi-point support is studied. Finally, comprehensively considering the reinforcement effect and reinforcement cost, the reliable anti-overturning reinforcement scheme is proposed. The reference can be provided for the anti-overturning reinforcement design of the similar single-pier bridges.

Keywords: single-pier bridge, anti-overturning checking calculation, reinforcement design

Influence of Support Layout of Curved Box Girder Bridge on Overturn Stability TIAN Ning (85)

Abstract: In recent years, with the rapid development of urban construction and transportation industry, the overloading of cars is becoming more and more serious. There are many cases of box girder bridge overturning, instability and collapse occurred in the different places, which have had a serious social impact. Combined with an engineering example, through the finite element analysis and based on the requirements of the latest standards for the anti-overturning check calculation of bridge, the influence of support layout of curved box girder bridge on the overturning stability is studied. Based on the analysis result, several

suggestions on the anti-overturning stability of curved box girder bridge are proposed. The results have a certain reference value.

Keywords: curved box girder bridge, support layout, overturning stability, finite element analysis

Assessment on Safety Stability of Long-span Concrete-filled Steel Tube Arch Bridge with Initial Defect

ZHANG Yindi (88)

Abstract: The occurrence of an initial defect will not only reduce the bearing capacity of structure, but also have a huge influence on the follow-up construction safety and be not good to ensure the integrated safety of arch bridge structure. Based on this, taking an arch bridge project as an example, combined with the stability analysis theory and through the establishment of spatial finite element model, the stability of the finished bridge state is analyzed. Thus, the impact of initial defect on the stability of concrete-filled steel tube arch bridge is summarized including the initial geometric defect of arch rib, reverse camber of arch rib, concrete pouring defect of arch rib and contents, which provides the reference for correctly evaluating the stability of long-span concrete-filled steel tube arch bridge.

Keywords: long-span concrete-filled steel tube arch bridge, initial defect, reverse camber, concrete pouring

Comparison and Analysis on Technologies and Economies of Suspension Bridge and Cable-stayed Bridge Spanning Yellow River

HUANG Yuan (91)

Abstract: As the main traffic mode spanning the big rivers, there are more and more extra-long bridges on the Yellow River. The suspension bridge and cable-stayed bridge are the most common. Combined with an engineering example - Fenghuang Road North Extension Bridge spanning the Yellow River in Jinan City of Shandong Province, after the comparison of the different bridges, the characteristics and differences of suspension bridge and cable-stayed bridge are analyzed in the technologies and economies. According to the different circumstances of the comprehensive choice of bridge schemes, the most suitable bridge type is selected. The reference can be provided for the scheme selection and the cost preparation of the similar projects in the future.

Keywords: suspension bridge, cable-stayed bridge, technology and economy, comparison and analysis

Design of Bridge Crash Barrier Based on New Code

ZONG Zhirong (94)

Abstract: According to the new code, the Am-grade metal beam-column barrier and SA-grade combined barrier used on urban elevated bridges are designed. Firstly, the dimensions of the barrier members are designed from the perspective of landscape and anti-overturn. Secondly, the anti-collision bearing capacity of the barrier is verified with the yield line theory, and the partial concrete reinforcement of the combined barrier is optimized. The results show that the newly designed barrier meets the needs of landscape and anti-collision, and has the good economic benefits.

Keywords: bridge barrier, metal beam-column, combined, yield line theory

FLOOD CONTROL & DRAINAGE

Application and Thinking of Hydraulic Model in Comprehensive Drainage (Rainwater) Waterlogging Prevention

Planning ZHANG Lian, YANG Nan, CHEN Bing (98)

Abstract: The development of hydraulic model provides a new technical means for the development of urban drainage waterlogging prevention. The urban drainage waterlogging planning should be guided by the hydraulic model defined in *Outline of Comprehensive Urban Drainage (Rainwater) Waterlogging Prevention Planning*. But at present, there are many problems still in the use of the model. These problems of collecting the model base data, checking the parameters and dividing the use boundary are required to consider for the model use in the planning.

Keywords: urban drainage waterlogging prevention, hydraulic model, model checking

Research on Sludge Liquid Treatment of a Large-scale Wastewater Treatment Plant BAI Haimei (101)

Abstract: Taking the sewage treatment process of a large-scale wastewater treatment plant (WWTP) as an example, the quantity and quality of sludge liquid produced by sludge treatment system are analyzed. At the same time, the engineering parameters of phosphorus removal tank built to avoid the backflow of sludge liquid and increase the load of sewage treatment system are introduced. The relevant experience can be referenced for the similar projects.

Keywords: wastewater treatment plant (WWTP), sludge liquid, phosphorus removal tank

Design and Construction of Drainage Engineering for Vehicle Depot of Mass Rapid Transit in Shanghai Pudong Airport ZHANG Yue (104)

Abstract: The Design of the drainage engineering for the vehicle depot of the mass rapid transit (MRT) of Shanghai Pudong Airport is introduced. Combined with the change of boundary conditions, the original design is optimized in the construction process including the construction of integrated rainwater pumping station, the application of trenchless road-crossing technology and the other measures. The key control measures in the engineering construction process are summarized. Some suggestions are put forward for the similar projects in future.

Keywords: mass rapid transit (MRT), drainage, trenchless, integrated pumping station

Implementation Scheme and Influence Analysis of Landfilling River in East Area of Hongqiao Airport DING Xingxing (107)

Abstract: The present water system layout and drainage system in the east area of Hongqiao Airport are great different from the east area planning of the airport. Due to the needs of the area development, it is proposed to landfill the present water system. The river landfilling scheme is discussed. And the influence of landfilling river on the water safety, water environment and water resource of the area is expounded in detail.

Keywords: landfilling river, balance of excavation and landfill, influence analysis

Study on Strategies for Improving Quality and Efficiency of Rural Domestic Sewage CAO Sijia (111)

Abstract: The three-year action plan for improving the quality and efficiency of municipal sewage treatment in Shanghai is proposed to speed up and supplement the shortfalls in sewage collection and treatment facilities, and optimize and perfect the sewage treatment system and mechanism. Taking Qingpu District of Shanghai as an example, by analyzing the characteristics, current treatment mode and existing problems of its

rural domestic sewage, the strategies are studied from the aspects of policies and regulations, system planning, construction process, treatment process selection, management and maintenance system mechanism, assessment and supervision so as to provide the reference for improving the quality and efficiency of rural domestic sewage.

Keywords: rural domestic sewage, improving quality and efficiency, system planning, management mechanism

Brief Analysis on Drainage Problems and Technical Optimization Measures in Reconstruction of Old Road XU Bo (114)

Abstract: On the basis of detailed investigation and analysis on the present pipelines, ancillary facilities and rainwater discharge outfall of Gongqingtuan Road and its surrounding 40 housing estates, the waterlogging problem of Gongqingtuan Road has been solved by the technical measures of adding the rainwater pipeline, optimizing the rainwater inlet layout, reserving the rainwater and sewage separation inlets in housing estates and combining the design concept of sponge city in design of road reconstruction. And the factors affecting the drainage design of municipal road are summarized. The imperfect drainage facilities in the surrounding old housing estates, the more shallow elevation of river at rainwater outfall, the serious deposition damage of rainwater pipeline network and ancillary structures, the poor maintenance and management in later period, the extreme weather and the other reasons are all important factors causing the waterlogging of roads. According to the above affecting factors, the road waterlogging is decreased by the technical measures of optimizing the municipal drainage in order to improve the service life of road and to guarantee the smoothness of road.

Keywords: drainage design of municipal road, road waterlogging, old housing estate, bay-type rainwater inlet

Discussion on Design Scheme of Foundation Pit for Typical Pump Gate Engineering in Area of Shanghai HUANG Yinbing (118)

Abstract: The foundation pit support of pump gate engineering has many differences from the conventional foundation pit engineering because of the complex influence factors. Taking a pump gate project in Shanghai as an example, the main considering factors in the design of foundation pit support for the typical pump gate engineering in the area of Shanghai are discussed. The application of the conventional support scheme is analyzed. The plane layout of foundation pit support and the section design of support structure are discussed. The reference can be provided for the design of the similar projects.

Keywords: pump gate engineering, foundation pit support, cast-in-place pile, old structure

Design of Large-scale Rainwater Main Pipe Jacking Project in Downtown Shanghai TANG Hao (121)

Abstract: The heavy traffic, land shortage and various municipal infrastructures often in central urban area will extremely restrict the development of large-scale pipe jacking project. Taking a large-scale rainwater main pipe jacking project in Lujiazui area of Shanghai as an example, based on the present construction conditions of the area, the emphases, difficulties and solutions in the design of the pipe jacking project are analyzed from the fixed point and alignment design, building envelope comparison and selection, special shaft

technological design and construction organization.

Keywords: downtown, main rainwater pipe, pipe jacking

Study on Planning and Control Strategy of Urban Water System ZHOU Xinyi (125)

Abstract: In recent years, each city frequently faces the problems of urban waterlogging and black-odorous water body. The state has also paid more attention to the construction of sponge cities, control of flood and waterlogging, treatment of black-odorous water body, and sewage improved in quality and efficiency. In view of the current urban water system planning, the exposed problems are analyzed, and at the same time, the urban water system planning should be paid attention focused paid attention to the urban water system planning based on the goal orientation in the object oriented . How to avoid series of problems faced by the urban water system is considered from the top-level design. The control strategy of water system planning is proposed, and has a guiding role for the future water system planning.

Keywords: urban water system, urban planning, control

Key points of Ecological Design of Bodu River (Xixing Road - 312 National Road) in Wuxi
..... FAN Jiangmei (128)

Abstract: In view of the ecological design projects Phase I and Phase II of Bodu River, the design concept of insisting the "ecology first, people-oriented" and loading the sustainable development and ecological function is expounded in the process of project design.

Keywords: Bodu River, ecological design, canal space

Analysis on Emergency Causes of Flood Control Wall under High Filling and Rescue Measures
..... ZHONG Yunfei, TIAN Jing (131)

Abstract: As the first line of defense for safeguarding the property security of the people, the importance of the flood control wall is self-evident. However, there have been many incidents of dangerous damage due to misuse in recent years. Taking the emergency flood control wall in the section of Minnan Shipyard as an example, the emergency causes are analyzed and the rescue measures are implemented. The typical example can provide the valuable experience for the supervision and management of flood control wall.

Keywords: flood control wall, emergency, cause analysis, rescue measures, Minnan Shipyard

MANAGEMENT & CONSTRUCTION

Thinking on Quality Control of Full Life Circle for Construction of Modern Bridge WANG Handong (135)

Abstract: The process of bridge engineering construction from nothing to something is a process from scheme planning to implementation design, start construction, operation and maintenance up to abandon. According to this closely related process, the contribution of fine design on the engineering quality, the influence of construction period on the engineering quality and the action of whole process consultation on engineering quality are mainly introduced. Combined with three main stages, the quality control of full life circle for construction of modern bridges is analyzed in detail.

Keywords: bridge engineering, full life circle, quality control

Construction Technology of Long-span Deck-type Stiff Skeleton Box Arch Bridge WANG Jianjiang (138)

Abstract: The construction sequence of stiff skeleton arch bridge is to process skeleton, hoist and close, pour pipe concrete and outsource concrete. Taking Boligou Bridge as an object, the construction essentials of assembling, hoisting, pouring concrete and outsourcing concrete for long-span concrete filled steel tube stiff skeleton arch rib are introduced.

Keywords: long span, stiff skeleton, arch bridge, construction

Study on Application of Construction Control Technology of Upper Deck System for Songpu Bridge

..... KONG Fan (143)

Abstract: Aiming at the more serious tension situation of concrete deck slab across the bridge in the prefabrication and construction of steel-concrete orthotropic composite deck slab segments of the upper deck system for Songpu Bridge, the theoretical effect and feasibility of the optimization measures including the pouring prefabrication under few-fulcrum support, pre-springing in manufactory and reverse upper frame are analyzed. The more perfected anti-cracking control scheme and optimization construction scheme of wide composite deck slab are obtained. The feasibility and generalizability of the anti-cracking control and optimization method for the deck slabs are further verified. The theoretical basis and reference are provided for the design and construction of the similar bridges at home and abroad.

Keywords: Songpu Bridge, orthotropic composite deck slab, anti-cracking control, finite element stress analysis, deformation control

Key Technology of Overall Slope Adjusting and Jacking for Continuous Curved Beam Bridge

..... YIN Tianjun (147)

Abstract: Based on the engineering background of Nantong North Changjiang Road West Extension (Yanhai Highway - Chengbei Avenue) Viaduct, the overall slope adjusting and jacking scheme of continuous curved beam bridge is systematically studied. The solution is proposed how to keep the equal proportion of jacking, to guarantee the jack to be perpendicular with the upper box beam and to limit the horizontal displacement of the jack in the process of slope adjusting and jacking of continuous curved beam. The relative technical scheme and the construction method can be referred for the planning and reconstruction of the similar bridges.

Keywords: continuous curved beam bridge, slope adjusting and jacking, equal proportion of jacking, construction technology

Application and Thinking of Full Prefabrication Technology in Municipal Elevated Bridge Engineering

..... WANG Lei (151)

Abstract: The development of the bridge full-prefabrication technology is beneficial to save the resources, decrease the pollutions, upgrade the production efficiency and promote the industrialization of bridge construction. Influenced by the technical standards, engineering costs and supporting industrial chains, the construction methods of municipal elevated bridge is still based onsite casting. The proportion of making the

fabricated municipal elevated bridge account for more than 30% of the new municipal elevated bridge area by 2020 is strived by adhering to market dominance, government promotion and phase advance.

Keywords: municipal elevated bridge engineering, full prefabrication technology, industrialization and informatization

Optimization of Joint Design and Study of Construction Technology for Elevated Small Box Girder Based on UHPC Material WANG Xiangqiang (154)

Abstract: With the continuous development of social economy, the society has higher and higher requirements for the construction of urban viaduct. The rapid construction of urban viaduct will be the development trend of urban viaduct. As one of the important bridge types, the small box girder bridge is widely used in urban viaduct. Therefore, it is very important to realize the rapid construction of small box girder. The key to realize the rapid construction of small box girder is the joint of small box girder. The traditional small box girder joint structure is complex, the construction process is tedious, and the mechanical performance is poor. Aiming at the construction and mechanical performance problems of traditional small box girder joints, combined with the performance advantages of UHPC materials, the concept of UHPC joints is introduced. Taking Ningbo airport Expressway South Extension Project as the background, aiming at the key parameters of UHPC joint design, the structural design and optimization of UHPC joints of small box girder are proposed. At the same time, the construction process of UHPC joint of small box girder is summarized. The key construction technology and construction method of UHPC joint of small box girder are defined. The specific requirements for the construction quality control of UHPC joint are put forward.

Keywords: small box girder, joint, UHPC, design, construction

Replacement Design of Expansion Devices for Large Displacement Bridge at Puxi of Nanpu Bridge LUO Dongwei (158)

Abstract: The expansion devices of large displacement bridge at Puxi are used to connect the main bridge of Nanpu Bridge and the approach bridge of Puxi. In many years, under the influence of differential settlement between Pudong and Puxi, and the overloaded traffic, the large displacement bridge expansion devices at Puxi have been seriously damaged and are urgently to replace. Due to the implementation of replacement construction only under the traffic requirements of not closing traffic during day and continuous traffic at night, the selection of suitable section construction of unit-type multidirectional deflection comb-plate bridge expansion device, the reasonable reconstruction of slot structure and the use of effective temporary traffic measures can ensure the smooth replacement of large-displacement bridge expansion devices at Puxi, and at the same time guarantee the quality and shorten the construction period, which can be referred for the replacement of large displacement bridge expansion devices at the important traffic roads under the condition of not closing traffic.

Keywords: Nanpu Bridge, large displacement bridge expansion device, replacement

Incremental Launching Construction and Safety Control Technology of Steel Arch Bridge Simultaneously Spanning Railway and Metro LIANG Yanbin (161)

Abstract: The railway overpass project of Shanghai Beiheng Channel Phase II Project is located between

Shanghai Locomotive Depot and Shanghai Railway Station. The bridge is required simultaneously to cross 8 railway lines of pipelines and rail links in locomotive depot, and Metro Line 3/4. The safety control requirements for the construction are very high. The structural style of bridge is a single-arch plane through steel arch bridge. The step-type incremental launching construction method is adopted. The formulation of construction scheme, the key points of implementation process and the construction safety control measures are introduced in detail. Through the site monitoring of construction process and combined with the theoretical calculation results, the feasibility of the design scheme is analyzed and verified. The reference value can be provided for the similar projects.

Keywords: railway, rail traffic, bottle-neck section, single-arch plane through steel arch bridge, step-type incremental launching, key technology

Brief Discussion on Construction Method of Cantilever Cast-in-site Block 0 JI Caibo (165)

Abstract: The construction method of Block 0 at the top of cantilever cast-in-site variable cross-section continuous beam pier is expounded from the aspects of Block 0 bracket, permanent support installation, temporary support concrete construction, anti-fall beam installation, bracket prepressing construction, template installation, rebar and pre-stressed bar installation, Block 0 concrete pouring, monitoring in concrete pouring of Block 0, pre-stressing tension of Block 0 box beam and pressure beam. The cast-in-site construction of Block 0 is the first condition of the whole cantilever form traveler construction. The reference can be provided for the similar projects.

Keywords: cantilever, Block 0, construction method

Inspection and Evaluation on Technical Conditions of Bridge in Process of Heavy-cargo Transportation
..... LIU Lin, LANG Kai (169)

Abstract: Aiming at the problems whether or not to cause the damages of bridge and the degrees of damage when a heavy-cargo transport vehicle passes, by using the combination of the theoretical analysis with the experiment (detection), with the help of scientific theories and relevant national specifications and standards, the possible damages and the damage degrees of a reinforced concrete hollow slab beam bridge caused by heavy-cargo transport vehicle from the perspective of carrying capacity and reliability assessment of bridge are evaluated and analyzed.

Keywords: heavy-cargo transportation, special load, reliability, carrying capacity, hollow slab beam

Application of Inventory System Safety Management Concept in Large Bridge Engineering ... TANG Rong (172)

Abstract: In the construction of large bridge engineering, in order to reduce the construction risks, the efficient safety management work is particularly important. For the current more mature construction technology, the advanced safety management concept is insisted only. Supplemented by the effective practical means, the good safety management and control effect can be achieved. Relying on Kunyang Road River-crossing Bridge in Shanghai and introducing the inventory system safety management concept, the application and generalizability of this concept in the hydraulic climbing formwork construction of the main bridge pylon are discussed in order to provide the benefit reference for the safety management of the similar working procedures.

Keywords: bridge engineering, construction safety, hydraulic climbing formwork, inventory system management

Study on Tunneling Construction Technology of Mucky Silty Clay Layer in Full Section of Metro Shield SHEN Dongqiang (175)

Abstract: Aiming at the problems of the crack, breakage and peeling of segment, and the overrun of tunnel axis appeared in the shield tunneling interval tunnel in the mucky silty clay layer of a metro in Hangzhou, the causes are analyzed. At the same time, the technical measures and method to solve the above problems are put forward. The reference can be provided for the shield tunneling in the soft soil layer.

Keywords: shield method, mucky silty clay, tunneling control, segment breakage, synchronous grouting, shield posture

Construction Technology of Suspension Protection of Yellow River Water Division Pipe in Excavated Metro Station ZHANG Jianzhong (178)

Abstract: Based on the safety and data for the construction of the relative pipeline excavated stations of Genghis Khan Square Station and Haoqinying Station in Hohhot City Metro Line 2 Phase I Project, the construction technology of suspension protection of water diversion pipe of Yellow River is discussed. The construction technology of suspension protection of water diversion pipe of Yellow River for an excavated station is analyzed. The efficient metro construction technology is explored. The reference can be provided for the construction of the similar metros.

Keywords: excavated station, water division pipe of Yellow River, protection construction

Study on MJS Pre-reinforcement Supporting Technology of Shallow-buried Excavated Tunnel in Water-rich Loose Stratum DAI Shimin (181)

Abstract: Based on a shallow-buried excavated section project at the south entrance of a tunnel in Hangzhou, the adverse factors of large deformation and settlement appeared in the shallow-buried excavation construction of entrance 30-m section are analyzed. The new thinking of the MJS pre-reinforcement supporting technology to improve the mechanical properties of the soil body surrounding the tunnel is proposed. The influence of MJS pre-reinforcement method on the displacement and stress of the tunnel is analyzed through the numerical simulation. And the sensitivity of reinforcement parameters is studied. MJS reinforcement and reconstruction of soil body are applied. The settlement and deformation are improved.

Keywords: water-rich loose, shallow-buried excavated tunnel, MJS, pre-reinforcement

Study and Application of Key One-pile One-column High Precision Vertical Adjustment Technology of Reversed Construction Method for Shallow Buried Underground Fast Channel ZHANG Fengli (186)

Abstract: When the reversed construction method adopts the design form of one-pile one-column structure, the vertical deviation control of steel column has great influence on the construction quality, and is the difficulty and the key point of construction. Combined with Yanggao Road (Shiji Avenue - Pujian Road) Reconstruction Project Bid 1, the high precision vertical adjustment technology of one-pile one-column first inserting method of shallow buried subway reversed construction method is introduced. This technology is

mainly to position the steel column and adjust its verticalness to the design precision with the help of the specially fabricated straightening frame after the steel column is hoisted and lowered. The upper layer of straightening frame is a concrete poured platform, which can effectively improve the working efficiency of equipment and save the construction cost. The application of this technology has achieved good results in Yanggao Road (Shiji Avenue – Pujian Road) Reconstruction Project Bid 1.

Keywords: reversed construction method, one-pile one-column, vertical adjustment

Study on Construction Scheme of Shallow Earthed Reinforced Concrete Rainwater Box Culvert Under-passing Ancient City Wall MA Ben, FAN Xiaobo, LU Peng, HE Jianguo, HE Junlong (189)

Abstract: With the continuous development of urban construction, more and more municipal structures need to cross the existing buildings (structures). Combined with the engineering example of the rainwater box culvert of Xinjian Road in Yulin City passing underneath the ancient city wall of the acropolis in Yulin, the construction scheme of partial jacking and additional auxiliary measures is adopted able to effectively improve the safety of city wall structure during construction, and can provide some reference for the similar projects in later period.

Keywords: box culvert, acropolis in Yulin, city wall, jacking construction

Construction Technology of Cutting Protection Platform of Cantilever Plates of Urban Elevated Railway-crossing Concrete Box Beam CAI Xiang (192)

Abstract: Taking an urban elevated railway-crossing interchange project as an example, the existing elevated cantilever plates are required to cut. In order to guarantee the construction safety of overpassing the railway line under the complicated conditions and decrease the influence on the existing roads, the scheme to setting the cutting protection platform is adopted. The installation, fabrication and removal technologies of the protection platform are introduced in detail. The engineering practice shows that this structure is safe and reliable, and can be referred for the construction of the similar bridges.

Keywords: urban elevated bridge, overpass, protection platform, construction technology

Brief Analysis on Practice of Green Construction in Construction Engineering CHEN Lailin (195)

Abstract: Since the implementation of the reform and opening-up policy, the social economy has been developing rapidly in China. Therefore, the construction industry is updating faster and faster, and the industry is developing rapidly in China. With the continuous improvement of people's living standards and the enhancement of environmental protection concepts, more attention has been paid to the sustainable development of construction engineering. According to the measures taken by Guoke Road No. 36 Land Project for green construction, the management and the existing problems for green construction in the project are specially studied including the measures for promoting the green construction management.

Keywords: management, green construction, sustainable development

Brief Discussion on How to Perfect Measures Project Cost in Bidding Stage of Large Municipal Engineering ZHENG Hao (198)

Abstract: Measure project cost has the incorporeal characteristics. In project settlement, the disputes and

claims caused by this part of cost are often difficult for both parties to reach an agreement, and a contractor is also not willing to pay extra for this part of cost. In order to solve the disputes, it is necessary to start from the source. Therefore, it is very necessary to perfect this part of the cost in the bidding stage. Taking the Shanghai Beiheng Channel Project as an example, how to perfect the measures project cost in the bidding stage is expounded.

Keywords: bill of quantities, measure project cost, bidding

Consideration and Exploration on Implementation of Industrial Linkage in Construction General Contractor Enterprise LIU Zhenpeng (201)

Abstract: With the requirement upgrading of construction unit in the aspects of demand orientation, resource allocation and expected benefit, the mode of EPC (Engineering Procurement Construction) is becoming the main development mode of engineering contract. To survive and strengthen, a construction enterprise has to change its development philosophy. Taking a local construction enterprise group as an example, based on the orientation of the policy and market, its advantages are integrated and given play well, and its industrial linkage advantages are actively fostered in order to build itself as an important platform to reflect the high level of EPC capacity. Therefore, for a construction engineering enterprise, the mode of industrial linkage must be strived to explore, the resource superiority to collect, the general contracting to strengthen, the core competitiveness to integrate, the scale level to push up and the health sustainable development to realize.

Keywords: industrial linkage, policy and market orientation, EPC

STUDY ON SCIENCE & TECHNOLOGY

Analysis on Destruction Resistance of Urban Rail Transit Network under Deliberate Attack ZHAO Jing, HAN Yongqi, ZHOU Jibiao (203)

Abstract: In order to analyze the destruction resistance of urban rail transit network under the deliberate attack strategy, by considering the relative size of the maximal connected subgraph, the relative network efficiency and other factors in complex network theory, a method of analyzing the destruction resistance of urban rail transit network under deliberate attack is proposed. Firstly, the destruction resistance index of urban rail transit is selected to analyze the deliberate attack strategy of the network. Secondly, the Space L method is used to build the topological chart of urban rail transit network. The destruction resistance of urban rail transit network is quantitatively analyzed from the statistical characteristics and indexes of point degree, degree distribution, average path length, clustering coefficient and network efficiency. Finally, taking Beijing Urban Rail Transit Network as an example, its changes from 2015 to 2018 are analyzed, and the destruction resistance of urban rail transit network under deliberate attack is verified. The results show that the degree distribution and degree-related parameters of two networks are basically the same. BURT_2018 local connection is improved, but the overall efficiency of the network is reduced by 13%. In terms of destruction resistance, BURT_2018 and BURT_2015 have similar destruction resistance when attacking the same proportion node (or edge), but BURT_2018 needs to do more for the attack, and BURT_2018 has better destruction resistance when attacking the same proportion node (or edge). The research results further enrich the analysis method of destruction resistance of urban rail transit network characteristics, and provide the

useful reference for the operation management and planning design of urban rail transit network.

Keywords: traffic engineering, destruction resistance of network, complex network theory, network characteristics, urban rail transit

Analysis on Applicability of Modern Tram Based on Fuzzy Comprehensive Evaluation Model YUAN Guozhu, CHEN Yanmei, XU Hui (207)

Abstract: Taking the modern tram project in Hengshui City as an example, and combined with the actual situation of Hengshui City, the method of fuzzy comprehensive evaluation model is used to analyze the applicability of the urban modern tram project from four aspects of regional applicability, system applicability, technical feasibility and system social benefits. The result shows that the modern trams have good applicability in Hengshui City.

Keywords: modern tram, fuzzy comprehensive evaluation model (FCEM), applicability analysis

Identification of Dynamic Effect of Composite Beam Used in Urban Rail Transit SHEN Zhiyi, ZHU Yi, GUO Kai (211)

Abstract: In order to identify the dynamic effect of the composite beam for the urban rail transit under operation, based on the in-situ stress monitoring data, the cross-correlation function method is used to solve the train speed, and the theoretical impact coefficient is calculated by referring to the formula in the specifications. The actual impact coefficient is obtained by comparing the data before and after noise elimination, and the distribution of the impact coefficient and the train speed is further obtained, which lays a foundation for the numerical and experimental simulation of the structure in actual operation.

Keywords: composite beam used in urban rail transit, identification of dynamic effect of bridge, cross correlation function

Stability Analysis of Single-frame Arch Rib Bowstring Arch Bridge with Non-directional Effect JIN Chengdi , CHEN Ning , AN Jingjie (214)

Abstract: The non-directional effect of suspender force is an important factor affecting the structural stability in the outside instability of bowstring arch bridge, and especially for single-frame arch rib. Considering the strengthening clamping measures for the single-frame arch rib skewback, the change of boundary conditions should be considered in the lateral deformation of arch rib. On the basis of studying the influence on the outside critical load, the effect of variable cross section should be considered. At the same time, the effect of non-directional force is studied and the lateral deformation coefficient K is introduced so as to determine the critical force.

Keywords: structural stability, non-directional effect, interaction of arch beam, correcting force

Study on Technical Condition Assessment Method of Urban Shield Tunnel WU Huayong (220)

Abstract: Aiming at a lot of urban shield tunnels gradually entering the stage of high maintenance, there is a serious disconnection between the technical system and the relevant guidance standard in the aspect of technical condition assessment of tunnel at present in China. Combined with the actual disease condition of shield tunnel, the present situation and main problems of tunnel maintenance, and the technical condition

assessment of tunnel structure are systematically studied. The division principle of tunnel assessment unit, the scoring index of subcomponent, the scoring method of component unit and the overall assessment method of tunnel structure are proposed. Combined with the actual test data on site, these methods are applied in the actual tunnel detection and technical condition assessment. The beneficial technical support can be provided for the performance assessment of urban shield tunnel structure and the decision of the subsequent maintenance measures.

Keywords: shield, tunnel, technical condition, assessment

Study on Influence of Bridge Foundation Displacement on Bridge Structure and Its Allowable Value

..... HU Zhimin, HUANG Longtian, ZHENG Rongrong (224)

Abstract: From the perspective of bridge structure safety, the influence of bridge foundation settlement and lateral displacement caused by the construction of deep foundation pit on the bridge structure is analyzed through an analytical method. The additional bending moment and additional stress of bridge structure caused by the bridge foundation displacement are solved. The allowable values of bridge foundation settlement and lateral displacement are proposed in the construction of deep foundation pit. The analysis results can provide the theoretical basis for the real-time monitoring and early warning of the bridge in the construction of foundation pit.

Keywords: construction of deep foundation pit, allowable value of bridge foundation displacement, structural safety

Structural Analysis of a Special-shaped Prestressed Concrete Box Girder

..... HE Xiaohui, DAI Liang, SONG Hua (229)

Abstract: In the design of urban expressway, the multi-directional ramp bridge is often constructed at the node of urban interchange according to the traffic functional requirements. Due to the design constraint of mainline bridge and ground auxiliary roads, and the influence of urban underground pipelines, it is necessary to adopt the middle crossbeam structure with overhanging large-span cantilever for the superstructure pre-stressed concrete box beam of the bridge in the structural design of ramp bridge in order to form a special structure. Aiming at the mechanical characteristics of this special structure in the practical project, the finite element analysis method is used to carry out the overall structure and local numerical analysis for the typical construction conditions. The dynamic performance of integrated bridge is analyzed. The mechanical state of this structure is more completely obtained. The powerful technical support is provided for the design and construction of the engineering projects, and some references are valuable for the application of the same structures.

Keywords: urban interchange, pre-stressed concrete box beam, numerical calculation

Numerical Study on Connection Form of Double-layer Internal Structural Tunnel and Shield Segment

..... WU Binxuan (233)

Abstract: Taking the internal structural system of "plate-beam-column" double-layer tunnel as an example, the connection form of double-layer vehicle structure and shield segment is studied by means of numerical simulation including four connection modes of fixed connection, hinged connection, chain link

connection and no connection. The results show that the seismic performances of four connection forms are less different. The internal force of the chain link connection form is smaller than that of the no-connection form, and meets the requirements of strength and deformation at the same time.

Keywords: double-layer internal structure, tunnel, shield segment, plate-beam-column structural system, connection form, numerical simulation

Study on Soil-based Rebound Modulus under Different Humidity Conditions XU Wei, QIAN Zhihang (236)

Abstract: The importation role of soil-based rebound modulus on road is introduced. The requirements of different norms on the rebound modulus of the designed soil base are sorted out. Aiming at the influence of the requirements of the norms on the design of road subgrade on the standard rebound modulus determined under the different conditions, the rebound modulus in an adverse season and the rebound modulus of equilibrium humidity, the relationship between the rebound modulus under the different equilibrium humidity and the rebound modulus in an adverse season is compared. The factors affecting the rebound modulus of soil base are studied. The method how to improve the rebound modulus of soil base is determined. According to the available information and the practical engineering survey, the rebound modulus corresponding to the type of road filler in the area of Chengdu is summarized in order to judge and take in the design of road subgrade and pavement.

Keywords: rebound modulus, equilibrium humidity, adverse season, deflection value

Numerical Study on Stability of Roadbed Slope under Action of Reservoir Water

..... YANG Guang, AO Xiang (239)

Abstract: In recent years, the mileage of the low-grade highway has increased substantially in China. But the design of low-grade highway is often underappreciated, especially in the mountainous areas where rivers grow. There are certain technical difficulties in the highway design. It is necessary to simultaneously consider the action of water and the earthwork balance of roadbed. Taking the roadbed slope of reservoir are as an example, the numerical simulation method is used to analyze the seepage field characteristic of slope under the condition of rainfall level. The stability of slope under the different working conditions is studied. The result shows that the underground water level of slope reduces with the reduction of reservoir water level, and the hysteresis effect is showed obviously. For the gently topographic slope, the action of surface water body is beneficial to its own stability. The engineering design should focus on the protection design of roadbed slope, and be supplemented with the interception and drainage measures of surface water.

Keywords: periodic water level, roadbed slope, seepage, numerical study

APPLICATION OF ACHIEVEMENTS

Application of SWMM Model Based on ArcGIS in Sponge City Planning WANG Yu (242)

Abstract: Taking Shanghai Chongming Experimental Ecological Community as an example, SWMM rapid modeling based on ArcGIS is used to carry out the continuity simulation of annual runoff volume control rates respectively under the situations of traditional development and low-impact development. The calculation results of the model show that the control rate simulation result of annual runoff volume is basically consistent

with the result of index decomposition under the situation of low-impact development, and the low-impact development has a significant effect on the runoff reduction of small and medium rainfalls. The reference is provided for the sponge city planning of Shanghai and its surrounding regions.

Keywords: ArcGIS, SWMM model, low-impact development, sponge city, simulation analysis, checking of annual runoff volume control rate

Brief Analysis on Application of Artificial Intelligence Technology in Engineering Construction Field

..... LIU Jingyi (246)

Abstract: The development of the artificial intelligence technology (AIT) has risen to the national strategy. It has been initially applied in the planning, decision-making, designing, constructing, operating and maintaining fields of engineering construction. And the remarkable application effects have been achieved. However, as far as the current level of its application concerned, the breadth and depth of its application are still far from enough, and there is huge room for its expansion in the future.

Keywords: engineering, construction, artificial, intelligence, application

Application of BIM Technology in Large-scale Municipal Engineering in Mountainous Area

..... WANG Yong, FU Hao, LI Xiang, JI Xinyu (248)

Abstract: New Yanweishan Tunnel Project is located in Banan District of Chongqing with an east-west trend, and is an important main road in the south of Chongqing. The total length of the project is 6.96 km. The project is composed of a diamond simple interchange, two full interchanges and a super-long mountain tunnel. The project passes through the built areas and scenic spots of the city. The project is greatly influenced by the surrounding environment. The mountain geographical location is obvious. In order to improve the design efficiency and guarantee the engineering quality, the BIM design route of "C + DY + R + I" is proposed. And the data interworking is realized in the BIM platform with the help of secondary development. Through the combination of new technologies such as visual programming, iterative formula derivation of seven parameters of ellipsoid ratio and parametric animation modeling with BIM, a complete set of BIM solutions suitable for large-scale municipal projects in mountainous cities is proposed, which provides a new way for the development of BIM technology in this field.

Keywords: mountainous area BIM, municipal engineering, road and bridge, tunnel

Discussion on Application of BIM Technology in GTC Construction of Changsha Airport Reconstruction and Extension Project

ZHOU Shifeng (252)

Abstract: The GTC project of Changsha Airport Reconstruction and Extension Project has the characteristics of limited construction period, complex project, high quality requirements and difficult professional coordination. At present, there are problems of poor coordination and bad integrality in the GTC construction of domestic airport reconstruction and extension projects. As a virtual 3D information carrier of architecture engineering, BIM technology can effectively realize the multi-professional communication and information sharing to provide the platform and management thought for the engineering design and construction, and the later operation and maintenance. Taking the GTC project of Changsha Airport Reconstruction and Extension Project as an example, the concept of BIM technology is expounded, the

characteristics of BIM technology in the GTC construction are summarized, and the application of BIM technology in the project is analyzed, which can be referred for the similar projects.

Keywords: Changsha Airport. BIM technology, GTC construction, information management

Application of Technology in Construction of Utility Tunnel ZHU Weinan (255)

Abstract: With the informatization of construction process and the development of industrialization technology, BIM technology is playing increasingly important role. It brings the innovation of working mode and the efficient management means to the construction industry. The application and promotion of BIM technology have been carried out in China for many years. Some application results have been achieved. But with the getting bigger construction engineering project scale, the getting complex engineering structure and the getting fine project data, the application of simple BIM modeling can no longer meet the needs of construction engineering project. The BIM coordinated management platform has gradually entered into the vision of the people. Based on the application in the construction process of utility tunnel for Chengdong Avenue in Xuzhou, and combined with the application experience of BIM technology, its application in the construction process of utility tunnel and the application of BIM construction coordinated management platform are expounded.

Keywords: necessity of BIM application, application of BIM technology, BIM construction coordinated management platform

Application of Light Concrete in Ordinary Highways of Enshi Prefecture GAO Hui (260)

Abstract: In recent years, the study and development of light concrete have been highly valued at home and abroad. Its application scope is gradually expanding. The light concrete is an apparent porous material. With the help of mechanical equipment, the foam prepared from the aqueous solution of foaming agent is added into the slurry composed of various admixtures (including siliceous, calcium, water, etc.). It is formed by mixing and curing. For a road designer, it is a critical and significant issue how to flexibly apply the light concrete in the mountainous roads.

Keywords: light concrete, porous material, foaming agent, mountainous road

Study on Application of Asphalt Mixture in Curing of Dedicated Lane of Bus Rapid Transit (BRT)

..... TONG Shujuan (264)

Abstract: In the municipal road engineering, the platform lane parking stops of bus rapid transit (BRT) are relatively fixed. The brake and start are frequent. In result, the diseases of shear shift, rut and pothole are easily caused. Therefore, it is very important to select the curing materials after damaged. The experiment and practical application show that the high-temperature stability, low-temperature crack resistance and water stability of the modified SBS mastic SMA-16 asphalt mixture with anti-rutting agent are more obviously improved than SBS modified SMA-13 performance, and are more suitable for the requirements of weak road maintenance of fixed-point parking stop pavement for the dedicated lane of BRT.

Keywords: bus rapid transit (BRT), SMA-16, anti-rutting agent, pavement performance

Study on Performance of Rock Compound Modified Additive (RCA) Mixture and Its Application

..... YUAN Rui, TANG Jun, MENG Yongjun (267)

Abstract: The rock compound modified additive (RCA) asphalt is used to replace the SBS modified asphalt in a heavy load road for curing the pavement and treating the diseases. The experimental analysis shows that this technology can greatly improve the pavement construction quality, perfect the pavement performance and prolong the curing period.

Keywords: rock compound modified additive (RCA), curing, asphalt mixture, performance study

Research on Performance and Construction Quality of Semi-flexible Pavement Material of High-grade Highway ...

..... LI Yanbin (271)

Abstract: In order to explore the mechanical properties, stability properties and fatigue properties of semi-flexible pavement materials under the different design porosities, the optimal design porosity is quoted to verify the properties of semi-flexible pavement materials. The results show that the semi-flexible pavement materials have the excellent properties. With the increase of design porosity, the mechanical properties of semi-flexible pavement material increase, but it will become more brittle, and is not conducive to the stability of the structure. In the practical engineering, through the strict control of raw material ratio and construction sequence, the mechanical properties of semi-flexible pavement material can achieve the test effect and greatly improve the anti-disease capacity of pavement.

Keywords: high-grade highway, semi-flexible pavement material, design porosity, practical engineering

Brief Discussion on Successful Application of BMP Deck Waterproof Material HU Qinhu (274)

Abstract: The asphalt pavement has many advantages of comfortable driving, low noise and convenient maintenance, and is widely used in high-grade pavement. However, when the flexible asphalt pavement is paved on the rigid cement concrete bridge deck, after the project is put into operation, the bridge deck will often be damaged by diseases such as displacement, pit slot, rebar corrosion, void between the upper and lower layers and water seepage. The high-quality development of pavement is always troubled by these problems in China. The promotion and application of BMP solvent reactive waterproofing material in bridge deck engineering have successfully solved the above diseases in bridge engineering. The engineering quality is improved, the service life of the project is extended, and the good economic and social benefits are achieved.

Keywords: bridge deck, BMP, solvent reaction, quality, application

THE RELATIVE SPECIALITIES

Review of Research on Utility Tunnel JIANG Jinyan, CHEN Xiaohong (278)

Abstract: First of all, through in-depth analysis of 372 articles included in the SCI database and EI database from 2009 to 2019, and 476 documents included in CNKI China Knowledge Network, the research status of utility tunnel is grasped from a macro perspective, and the relevant literatures are reviewed and categorized with three major research hot spots of life cycle management, financing and pricing of utility tunnel. And then on the basis of existing research, in view of the development status of utility tunnels in China, the suggestions

for paying attention to the life cycle management, attaching importance to the study on financing and pricing, and laying emphasis on the intelligent study of the future utility tunnels are proposed in the aspects of management and technology.

Keywords: utility tunnel, literature research, life cycle management

Research and Practice of Utility Tunnel Planning Layout Based on AHP With Support of GIS LUO Chunxiang (283)

Abstract: Combined with the compiling practice of Guangzhou Panyu District Utility Tunnel Planning, the evaluation system of planning and layout of the utility tunnel based the analytic hierarchy process (AHP) is explored from the selection of evaluation unit and the screening, quantification and weight calculation of the indexes in order to provide a useful attempt and supplement for compiling the utility tunnel planning.

Keywords: utility tunnel, planning layout, analytic hierarchy process (AHP), geographic information system (GIS)

Study on Linkage Development Mode of Building on Metro in Feedback Community FAN Hongwei (287)

Abstract: In the metro construction process, it should be to advocate the linkage development mode of building the facilities on the metro in feedback community. At the same time to be convenient for the travel of the public, the positive interaction of the community is realized by the own functions and space resources of the facilities so as to promote the mixed use of urban functions, to save the land space resources and to improve the urban operation efficiency. It is a task of urgent need of study on how to jointly promote its theory and practice. Combined with the metro construction planning in the 13 th five-year plan of Shanghai, taking Shanghai Metro Line 14 Changyi Road Station to be constructed and come into service as an example, the mode of linkage development of building facilities on the metro in feedback community is taken as a guide. The design strategy is put forward for the proposed station area, and the design scheme is scenarized. Finally, the interrelation and effects of space, traffic, functions and a series of inscape in the building of integrated service facilities on the metro in feedback community are analyzed and summarized so as to explore a linkage development mode suitable for the study sample and the similar sample.

Keywords: metro construction, urban renewal, feedback community, building on metro, linkage development

Survey on Spatial Perception and Study on Design Strategy of Urban Street Based on PSPL Method KONG Ying (291)

Abstract: Taking Shanghai Tianlin Road Commercial Street (Cangwu Road – Guilin Road) as an example, relying on the activity study methods of urban intention, PSPL, field interview and field research, the quality of urban commercial blocks is evaluated objectively based on the perception and needs of the people. The behavior characteristics of people in the commercial street space are effectively understood and mastered. The new thought can be provided for the optimization of slow traffic, and the upgrade and improvement of urban public space.

Keywords: public space, PSPL method, commercial block, spatial optimization

Durability Design of Mountain Tunnel Structure LI Jianlin, WU Jingang (295)

Abstract: Taking the National Highway 109 New Line Expressway as an engineering example, the method of theoretical analysis and engineering analogy is used to analyze and determine the design contents of durability of mountain tunnel. The design process of the secondary lining durability of mountain tunnel is proposed. At the same time, the tunnel durability is designed in detail according to the actual environmental conditions of the project. And the technical measures to improve the durability of secondary lining structure are put forward. The effective reference can be provided for the durability design of the similar mountain tunnels.

Keywords: mountain tunnel, durability design, structural disease, design process

Design of Composite Structure for Ultra-deep Shield Working Shaft of West Jianning Road Crossing-river Channel
..... MAO Yong (299)

Abstract: The structural design process of the working shaft at the south of river for the shield tunnel of West Jianning Road Crossing-river Channel is introduced. By comprehensively considering many aspects of surrounding area, buildings (structures), engineering geology, hydrogeology, foundation pit depth, safety and economy, the design scheme of composite structure is finally applied. A 3D finite element model is established by Midas Gen to simulate the different working conditions of structural construction period and operation period. After the analysis, the result shows that the mechanics characteristics of each stage of working shaft are given and the optimization proposal is put forward. The mutual checking process of the calculation result of the underground diaphragm wall and the settlement result of the composite structure is briefly described.

Keywords: West Jianning Road Crossing-river Channel in Nanjing, shield working shaft, ultra-deep, composite structure, design

Analysis on Deep Foundation Pit Supporting Project of Large-scale Full Underground Transfer Station
..... JU Qin (304)

Abstract: Relying on the first large-scale full underground refuse transfer station project in China, the supporting scheme of deep foundation pit of the transfer station is defined through the comparison, selection and program calculation of the supporting schemes for the foundation pit. The finite element analysis model is established by Plaxis software to study the influence of dynamic excavation of the foundation pit on the surrounding buildings and structures in order to provide a certain reference for the similar projects.

Keywords: full underground transfer station, deep foundation pit, surrounding environment, numerical simulation

Study on Forepoling of Ultra-small Clear Distance Tunnel in Collapsible Loess Region ZHANG Jian (308)

Abstract: In order to study the forepoling of ultra-small clear distance tunnel in collapsible loess region, relying on Lanzhou South Ring Expressway Liuquan Tunnel 3#, GTS-NX finite element software is used to compare and analyze three forepoling schemes of leading pipeline shed, horizontal rotary shotcrete support and large shed with horizontal shotcrete pile. The calculation result shows that the vertical settlement of the ground is small within the influence scope of forepoling construction of large shed with horizontal shotcrete pile, and no obvious deformation and cracking are observed in the initial support, and the integrated stability is good, which can bear the upper soil and traffic load. This scheme has a good effect in the field engineering

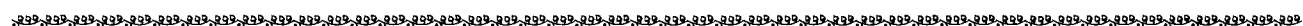
application. Based on the engineering tunnel entrance ultra-small clear distance section, the minimum clear distance is only 0.64 m, which is the minimum clear distance tunnel in the collapsible loess region implemented in China.

Keywords: collapsible loess, ultra-small clear distance tunnel, large pipe shed, horizontal rotary shotcrete pile

Study of Roadbed Treatment Scheme Based on Cost Analysis LIU Chenjun (311)

Abstract: With the rapid increment of social economy in China, the road construction projects are becoming more diverse. It is inevitable to encounter the bad geology, especially soft soil subgrade, which requires the roadbed treatment. But there are many roadbed treatment methods. How to carry out the comparison and selection so as to achieve the best scheme is always a large difficulty to trouble the practitioners. Relying on a road project in soft soil area, on the basis of analyzing the roadbed conditions, the calculation, comparison and selection are carried out from the viewpoint of cost. The best scheme of comprehensive benefit is recommended. The bidding is controlled in target. Finally, the implementation effect is excellent. The reference can be provided for the implementation of the similar projects.

Keywords: municipal road, subgrade treatment, cost analysis, bidding control



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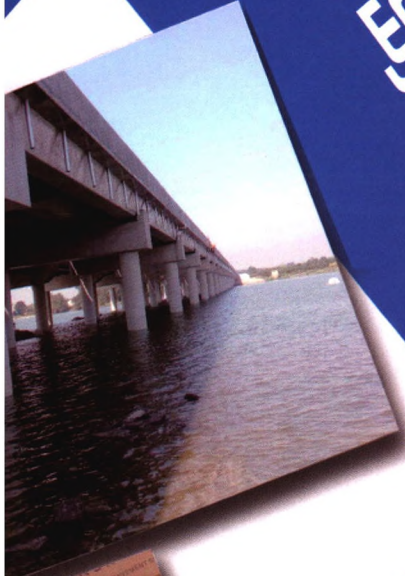
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