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“2023 城市道桥与防洪第十二届全国技术论坛”于 2023 年 9 月 21 日至 22 日在上海举办。本届论坛由上海市政工程设计研究总院(集团)有限公司主办。论坛主题为:绿色·智慧助力韧性城市建设。

2022 年,党的二十大报告明确提出“打造宜居、韧性、智慧城市”。提升基础设施的韧性是建设韧性城市的首要任务之一,打造强韧、冗余、灵活的基础设施体系,是新时代城市高质量发展的现实需要。

从 2020 年《中共中央关于制定国民经济和社会发展第十四个五年规划和二〇三五年远景目标的建议》正式提出“韧性城市”开始,广大城市建设者对城市基础设施在面对冲击和压力时,如何将绿色、智慧技术应用到城市预测、防范、应对冲击,并从中迅速恢复,进行了大量创新探索和应用实践,并取得了可喜的研究成果,积累了丰富的实践经验,同时也遇到许多新问题,十分值得总结和交流。本次论坛邀请国内道路、交通、防洪、水利领域知名专家进行相关技术的总结和交流。

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Urban Roads, Bridges & Flood Control

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Selected Papers of the 12th National Technical Forum on Urban Roads, Bridges and Flood Control in 2023

Exploratory Practice of Green and Low-carbon Transportation in Xiongan New Area ZHANG Huimin, XIANG Xu, GUO Shuxia (1)

Abstract: The implementation of green and low carbon in road traffic field covers the entire process of planning, design, construction, operation and maintenance management. Guided by the ecological priority and green development, the construction of Xiongan New Area is explored and practiced in the aspects of guiding the planning conception, driving the design innovation, upgrading the construction technology and intelligentizing the operation and maintenance management. Taking the road traffic project in the start-up area of Xiongan New Area, Xiongan Station and Xiongan Intercity Station as the examples, the specific practices of green low-carbon concept in the project are expounded. The design parameter index system under the green low-carbon concept is proposed, which can provide the reference for the construction of the other cities and the new area.

Keywords: urban road; narrow road and dense network; street design; transportation hub; Xiongan New Area

Design Exploration and Innovative Practice of Green Ecological Road under "Double-carbon" Target for Guangyang Avenue ZHU Xiaodong, ZUO Guiqiang (8)

Abstract: With the proposal of "double-carbon" target, it is imperative for urban road design to transform to green ecology. Taking Guangyang Avenue in Chongqing as an example, the application of green ecological concept in road engineering is analyzed, and the connotation of green ecotype urban roads is expounded. The scale, planning requirements and design strategies of Guangyang Avenue are introduced in detail. The innovative exploration of Guangyang Avenue based on the green ecological concept is explained in detail from the aspects of transportation system, ecological section, low-carbon structure, green travel, ecological engineering methods and landscape treatment, and the design ingenuity of the project is further explained from the level of overall scheme.

Keywords: double-carbon target; green ecology; urban roads; low carbon

Exploration and Practice of Specialized Planning for Resilient City Construction in Jinan City XU Jian, LYU Kai, GUO Mingpeng (14)

Abstract: The construction of resilient cities has risen to the level of a national strategy. Firstly, the concept of resilient city and its planning practice cases are reviewed. The key role of urban infrastructure in mitigating the disaster risks, enhancing the urban resilience and promoting the sustainable development is discussed. And then taking the central urban area of Jinan City as an example, the planning methods for resilient city construction focused on the infrastructure are explored. A feasible and practical research framework of risk identification-resilience objectives-enhancement measures-action plan is provided so as to offer the specific action guidelines for the urban decision-makers.

Keywords: resilient city; resilience enhancement; infrastructure; risk assessment

Evaluation Technique of Pavement Service Resilience Based on Multivariate Data Perception JIANG Hong, WANG Baohui, CAI Yang (20)

Abstract: With the road construction from the incremental mode to the stock mode in China, the era of large-scale road management and maintenance has arrived. The application of perception devices to acquire the data and to evaluate the pavement service resilience is a research trend in the context of the strategy for building a strong transportation nation. Firstly, the internal and external factors affecting the pavement service resilience are analyzed, and the limitations of existing indicators for assessing the pavement service resilience are evaluated. On this basis, the composition of a multi-element perception system of pavement service is pointed out, mainly including the traffic load perception, pavement environment perception, subgrade condition perception and pavement service perception. And based on the types of perception equipment, the input parameters, output parameters and relevant technical approaches based on deep learning neural networks are discussed. The new idea is studied and developed for the long service life of road in order to offer the valuable guidance for achieving the overall process, intelligent and proactive management of road health, and enhancing the resilience of road infrastructure.

Keywords: resilient city; pavement service resilience; evaluation index; multi-element perception system; deep learning model

Application of Integration Concept of Transportation and Tourism in Scheme Design of Longli River Bridge LIU Xukai, XIE Bin, YAN Xu (25)

Abstract: Under the background of the national efforts to promote the construction of a beautiful China and the strategy of building a strong transportation country, relying on the project of 528-m Longli River Bridge in Guizhou, the application of integration concept of the transportation and tourism in the design scheme of landscape cable-stayed bridge in the alpine and gorge region is studied. A set of scheme design suitable for the extra-large landscape bridge in the mountainous area is explored. At the same time, the integrated solution deeply matched with the integration concept of transportation and tourism is proposed. The overall macro design and micro structural design of the bridge reflect the integration concept of transportation and tourism of "traffic activating tourism scenes and tourism promoting transportation transformation". Finally, the design of bridge landscape is specially expounded.

Keywords: integration concept of transportation and tourism; Longli River Bridge; scheme design; application

Research on Design of Hogging Moment Area of Steel-concrete Composite Continuous Box Girder Bridge MA Guogang, LIU Bin, TONG Jingsheng, PU Beichen, PANG Wei (30)

Abstract: In order to effectively improve the mechanical behavior of hogging moment area of continuous steel-concrete composite box girder bridge, taking the interchange project of West Binhe Road, Caihong Bridge and Landscape Avenue in Linfen City as an engineering case, the design method of hogging moment area of continuous steel-concrete composite box girder bridge based on jacking technology is proposed. The jacking design parameters including the construction order of bridge deck, jacking order of middle fulcrum and storage age of bridge deck are studied in order to make the bridge deck and steel girder reach the good mechanical behavior. And the whole construction process of structure alignment is monitored. The research shows that the Pilger process can effectively reduce the tensile stress of bridge deck at the middle fulcrum and the reducing amplitude is 60%. The order of jacking at the fulcrum will obviously influence the compressive pre-stress effect of bridge deck. The uniform compressive pre-stress of each fulcrum bridge deck is an important technical indicator to evaluate the order of jacking. The crack width reduces obviously with the increase of storage age of bridge deck. The completion of the interchange project of West Binhe Road, Caihong Bridge and Landscape Avenue in Linfen City is a successful attempt of continuous steel-concrete composite box girder bridge based on jacking technology in the municipal bridge engineering field. The design ideas and design parameter values of its hogging moment area will provide the good reference for the large-scale construction of steel-concrete composite bridges in China.

Keywords: jacking technology; continuous steel–concrete composite box girder; design of hogging moment area; design parameters of jacking

Past and Present of Characteristic Traffic in Mountain City of Chongqing YANG Bin (36)

Abstract: By reviewing the development history of characteristic traffic in the mountain city of Chongqing, the multiple characteristic traffic tools under the special terrain condition of Chongqing are introduced. It is pointed out that to achieve the goal of "double carbon", it is necessary to build an environment–friendly green transportation system in order to blend the walking with the traditional transportation. The modern technology is used for iteration and upgrade to build a dynamic three–dimensional Chongqing.

Keywords: mountain city; characteristic traffic, three–dimensional transportation; stone–ladder footpath; passenger cable car; passenger ropeway; passenger elevator; rotatory interchange

Waterlogging System Control in Urban Sinking Bridge Area GUO Lei, FAN Kewen, CAO Yuxin, HAN Hongquan, WANG Tong, CHENG Yulin (42)

Abstract: The drainage problem in low–lying areas such as the sinking bridge area will not only interrupt the traffic of the ring line at its place, but also affect the traffic of surrounding roads and other ring lines, which will affect the normal life of the people and cause the great losses to the property of the state and the people. The research object is the sinking bridge area in the city where waterlogging occurs frequently and is widely concerned. By checking the current drainage capacity of the urban sinking bridge area and diagnosing the causes of waterlogging in the sinking bridge area in the research process, the reconstruction scheme of drainage facilities in the sinking bridge area is analyzed, and the prevention suggestions and solutions targeted for the waterlogging problems in the sinking grade separations.

Keywords: waterlogging; sinking bridge area; drainage system simulation

ROADS & COMMUNICATION

Research on Comprehensive Transportation Planning and Design of Comprehensive Passenger Transport Hub in a City WEN Yongjie, YOU Tingting (48)

Abstract: In February 2021, the CPC Central Committee and the State Council issued the *Outline of the National Comprehensive Three –dimensional Transportation Network Planning*, and put forward the requirements of building a multi–level integrated national comprehensive transportation hub system and promoting the integrated planning and construction of comprehensive transportation hub. The development and construction of station–city comprehensive passenger transport hub based on the TOD development model in China have also ushered a very rare historical opportunity. Taking the comprehensive traffic planning and design scheme of an new high–speed railway city as an example, the integration of traffic inside and outside the hub, the layout of traffic facilities, the transfer and connection of various traffic modes, and the organization of main traffic lines in the station area are mainly studied, and the methods and strategies of comprehensive traffic planning and design of new high–speed railway city are discussed in order to provide reference for similar projects.

Keywords: TOD mode; comprehensive passenger transport hub; comprehensive transportation

Study on Design Scheme of Traffic Organization for Passenger and Cargo Airport in Ezhou of Hubei LIU Huajie (53)

Abstract: Ezhou Huahu Airport is the fourth professional cargo airport in the world and the first one in Asia, and is the first cargo hub airport approved for construction in China. Taking Ezhou Huahu Airport Project as an example, through the quantitative analysis, traffic simulation and other digital means, the main characteristics of passenger and cargo airports, especially cargo hub airports different from the general passenger airports in terms of traffic travel are studied. The multiple schemes are compared and selected from multiple dimensions to formulate the scientific and reasonable traffic organization scheme, which ensure the

separation of passenger and cargo, the smooth traffic flow line and high operation efficiency in order to accumulate the practice experience of Type IV airport.

Keywords: passenger and cargo airport; municipal engineering; traffic organization; traffic simulation

Overall Design of Collecting and Distributing System of Suqian High-speed Railway Station WANG Aihua (57)

Abstract: Taking the collecting and distributing system of Suqian High-speed Railway Station as an example, the traffic volume demand and space-time distance expectation of inbound and outbound traffic of high-speed railway station are analyzed. Combined with the construction conditions and traffic characteristics of collecting and distributing system of high-speed railway station, three overall layout schemes of collecting and distributing system in the hub area are studied and analyzed. By comprehensively comparing the main indexes of function, landscape and economy of each scheme, the recommended scheme of "short subway + C-type ramp" is proposed for the collecting and distributing system.

Keywords: high-speed railway station; hub area; collecting and distributing system; space-time distance; drop-off platform; traffic flow line

Research on Planning Layout of Trunk Road Network in Linyi ZHOU Lichao (62)

Abstract: Taking Linyi City as a study case, the shortcomings existing in the current road network are sorted out. According to the relevant planning requirements, the skeleton road network form of "three rings and eighteen shots" is proposed to plan the formation of efficient and smooth road system with clear levels and matching forms in order to promote the coordinated development of urban clusters, build an efficient, convenient, green and safe urban traffic system, and provide a reference scheme for planning and constructing the similar urban road networks.

Keywords: trunk line network; cross-river channel; layout scheme

Preliminary Study on Key Technologies of Urban Quasi Expressway Planning and Design for Caohu Avenue in Suzhou XU Naiyun, JIANG Tao (68)

Abstract: The quasi expressway is between the expressway and the trunk road. The separated interchange is used at its important intersections of the main line, and the ring-in and right-out mode is used at its secondary intersections so as to ensure the basic continuity of the main line and its rapid traffic capacity. The quasi expressway can fully play the advantages of continuous traffic of expressway, and its cost is lower than the expressway, which is the main road of traffic enhancement and is also the effective supplement to expressway. Relying on the design case of the quasi expressway for Caohu Avenue in Xiangcheng District of Suzhou, the key technologies in the design of quasi expressway are analyzed from the aspects of speed selection, cross section layout, node traffic organization, pedestrian crossing facilities design, bus platform design, short and long term combination in order to provide the useful reference for the design of quasi expressway.

Keywords: quasi expressway; design; cross section; node traffic organization

Design of Overall Scheme for Kunming Urban Section in Fude-Yiliang Expressway CAO Yuan (72)

Abstract: Kunming urban section in Fude-Yiliang Expressway is an important fast channel connecting the main city to two expressways and five trunk roads of Chenggong New District, which is generally southeastward. Its total length is about 53 km. The laying method of the elevated bridge in the main line plus the ground side road is mainly used for the urban section of Kunming City. By considering the factors of urban road network planning, current road conditions, underground pipelines, current expressways, existing railways, land acquisition and landscape demands along the line, the refined design is carried out for the roads along the line by sections. The technical standards and the engineering scale are accurately grasped through the analysis on the traffic flow of the project. Under the premise of meeting the established functional requirements, the different cross sections of roads are set. The schemes of key nodes crossing South Beltway,

Zijunshan Ecological Park and the existing meter rails are designed.

Keywords: fast channel; elevated bridge; ground side road; existing railway; functional requirements; node scheme

Design of Intelligent Transportation System Scheme for Jining Expressway Phase 1 Project

..... LI Xiaoyi, WANG Jiabin, LIANG Rongxin (76)

Abstract: Relying on the Jining Expressway Phase 1 Project, the current construction of intelligent transportation system in Jining City is briefly analyzed. The design scheme of the intelligent transportation system of Jining Expressway Phase 1 Project is put forward from the aspects of design objective, system architecture, network architecture, connection with urban intelligent transportation project, subsystem design, etc., which provides a useful reference for the design of the intelligent transportation system of the expressways in Jining and other regions.

Keywords: expressway; intelligent transportation; scheme design

Study on Crossing Scheme of Urban road and Railway crossing Scheme for Lanzhou City

..... WU Ping ZHANG Xuemei, LI Li (80)

Abstract: As an important part of urban expansion in the extension of urban roads, the crossing scheme of urban road and railway has become the key and difficult points in the construction of urban roads. The engineering situation and construction conditions of T018#+T020# road in Lanzhou City, and the relevant situation of Lanxin Railway and Lanzhou-Zhongchuan Railway are introduced. Combined with the characteristics of the project, two schemes of overpass and underpass for the intersected section of road and railway are proposed. The advantages and disadvantages of the two schemes are analyzed from the aspects of construction method, influence of construction period on traffic, landscape effect, maintenance workload and influence on Nanshan Road Interchange at the starting point. Finally, the framing overpass scheme is recommended. The recommended scheme is being implemented after reviewed by the railway department, which can provide some references for the design of similar urban road and railway grade separation projects.

Keywords: urban road; railway; grade separation; scheme selection

Comparative Study on Scheme of Feitian Road Crossing Expressway in Jiuquan City

..... WEI Jie (84)

Abstract: With the development of urban economy and the expansion of space, there are more and more projects of roads crossing expressways. In order to illustrate the comparison and selection process of crossing scheme, taking the project of Feitian Road crossing G30 Lianhuo Expressway in Jiuquan City as an example, the multi-factor comprehensive comparison and selection are carried out according to the influence of construction method, high-speed traffic supporting measures, regional construction technical strength, social contradictions in project construction, engineering cost and other factors on the crossing scheme, and combined with the current site facilities and geological conditions. Finally, a scheme of changing road into bridge suitable for it is selected. The obtained conclusion can provide the useful reference for similar projects.

Keywords: road; crossing; expressway; scheme study

Research on Design Technology of Urban Trunk Road Crossing High-speed Railway

..... PENG Xiang (87)

Abstract: With the rapid development of high-speed railway in China, the intersection of municipal roads and high-speed railway has increased. Restricted by the clear distance of high-speed railway bridge piers and the wide road width of urban trunk roads, the reasonableness of undercrossing design scheme directly affects the feasibility of the projects. In order to guide the whole process of the undercrossing engineering in the design, construction and monitoring stages, the control factors of the undercrossing engineering impact on the safety of high-speed railway are theoretically analyzed firstly. And then taking an urban trunk road crossing Shantou-Shanwei High-speed Railway in Shantou City as an example, the design principles of roads, pile plate structures and pipelines and the design essentials of the schemes are analyzed in detail from a professional perspective. And the finite element analysis method is used to demonstrate the rationality of the

scheme. Finally, the construction requirements and monitoring level are systematically expounded, which provide the experience for similar projects.

Keywords: undercrossing engineering; urban trunk road; pile plate structure; high-speed railway

Study on Adaptability of Medium Volume Public Transport System in New Town of Shanghai LI Luyu (90)

Abstract: In order to give full play to the functional advantages of different medium volume public transport systems, the service level and operation efficiency of the public transport system in the new town should be improved. Combined with the urban development characteristics of new town, the adaptability index system and the hierarchical analysis adaptability model of the medium volume public transport system for the new town in Shanghai are built to evaluate the adaptability between the medium volume bus system and the new city in different systems. According to the comprehensive evaluation value of each transit system, the selection decision basis of new city is provided to make the medium volume public transport system adapt the urban characteristics of new town, and to make the public transport system within the new town meet the development demand of new town.

Keywords: medium volume public transport system; five new towns; analytical hierarchy process; adaptability analysis

Demand Analysis and Improvement Strategy of Urban Slow Traffic System MAI Jiao (94)

Abstract: The urban slow traffic has the activity characteristics of close contact with the masses, environment-friendly and low-carbon. In order to further improve and reconstruct the urban slow traffic system, the demands for the reconstruction of urban slow traffic system are summarized. Based on the current situation of urban slow traffic system, the corresponding improvement strategies are put forward, which is intended to open up ideas for the design in the improvement of subsequent urban slow traffic system and provide the corresponding strategic reference.

Keywords: slow traffic system; act according to circumstances; environmental integration

Research on Micro Renewal Method of Street under Concept of Urban Renewal ZHAO Zhenhua (98)

Abstract: Street is a social space that people are very familiar with in the daily life. With the further improvement of urban area construction, the development of urbanization has entered the middle and late stages. The reconstruction concept of city has changed from the original extensive and wasteful "demolition and construction" to the economically friendly "micro renewal". For the streets in old urban areas, the difficulties of "micro renewal" lie in the established current pattern and the difficulty in implementing new plans, the multiple managements of operators and high difficulty in unified coordination, and the multi-element integration of user and many differences in opinion. Aiming at these difficulties, the relevant renewal methods are put forward.

Keywords: street; urban renewal; micro renewal; method

"Scientific Management" to Solve Traffic Problems in Typical Time Interval around School

..... LUO Xiaodong, WU Junfeng, SI Jia (101)

Abstract: The traffic issues around the primary and secondary schools are characterized by time interval, centrality and traffic security. However, due to lacking of forward-looking planning in the early stage, the schools are often located in urban communities, and the roads around the schools are mainly secondary and branch roads within 30 m. Due to the limited width of the roadway, the last 300 m of the route for students becomes extremely difficult because of traffic congestion and disorder. The land in mature community is strictly controlled for use. It is hard to implement the scheme of widening the red line and setting up the special passages for school. Taking the road around South Daxue Road Primary School as an example, the traffic organization for the roads around the school is optimized through the scientific management of refined management, intelligent management and humanized management. Under the premise of the current limited road resources, the measures of time interval for one way, clearing right of way, typical time interval for

no-stop management, encouraging walking and the others are taken to alleviate the traffic contradictions of the roads around school in typical time intervals and ensure the traffic safety of the roads around the school, which provides the useful references for the traffic optimization management of roads around schools in mature communities.

Keywords: urban renewal; mature communities; traffic problems around school; traffic optimization management

Discussion on Comprehensive Reconstruction and Upgrading Method of Urban Road

..... LIU Kun, ZHOU Yutian, YIN Haijun (104)

Abstract: The reconstruction of traditional urban road is mostly "repair-type" reconstruction. The focus is on the measures mainly for the repair functions of widening and channelizing the intersection, perfecting the sidewalks and non-motorized lanes, and upgrading the landscape. The implementation process is independent of each other, the lack of overall consideration, and the normal construction of road has a great impact. In order to reduce the incomplete impact of phased road reconstruction, improve the travel experience of residents and save the resources, the existing problems in the process of road reconstruction are analyzed, and the difficulties are found out. Combined with the road functional orientation and roadside construction conditions, starting from the street design concept, using the refined design methods, taking the "green, efficient, wisdom, quality and dynamic" travel as the objective, the technical essentials and technical measures of comprehensive reconstruction and upgrading of urban roads are put forward in order to provide the technical reference for the similar projects.

Keywords: road reconstruction; green traffic; wisdom traffic; landscape improvement; quality facilities; refined design

Practice of Comprehensive Development and Construction of Urban Road and both-side Land

..... WU Huanqing (109)

Abstract: With the deeply refined management of urban construction, the collaborative requirements of urban road and periphery land are increasingly higher. Based on the construction practice of a road project in Tianxin District of Changsha City, the mode of comprehensive development and construction of urban road and both-side land is explored to organically combine the road sidewalk greening with the front area of buildings. The surrounding land resources are integrated to play a synergistic role. The red line limit of conventional road design land is broken through. The construction conditions of road are optimized. The improvement of traffic capacity and service level of urban road is realized. According to the land grant situation, the relevant suggestions for collaborative construction of urban road and both-side land are proposed, which provides the beneficial reference for the construction and management of urban roads.

Keywords: urban road; road design; comprehensive development; both-side land

Design and Research on Ecological Thin-layer Interlayer Bonding of Urban Road

..... PENG Bin (112)

Abstract: With the development of urban traffic road, the preventive maintenance has received the great attention, in which the thin layer is an efficient and cost-effective way. In view of the serious pollution and poor construction performance of the current hot mixed thin layer, the ecological thin layer based on the cold mixed and cold paved technology has begun to enter the vision of researchers. Since the asphalt has not been subjected to high temperature, the bonding performance of the ecological thin layer is the key point. In order to improve the bonding performance between the layers of the ecological thin layer overlay and further improve the maintenance life of the thin layer overlay, three different interlayer bonding materials are studied and tested, mainly including 70# matrix asphalt, SBS modified asphalt and water-based epoxy emulsified asphalt. The MTS pull-out test is used to evaluate the bonding performance of three different bonding materials as interlayer materials through the pull-out force and bonding strength under different spraying amount. The test results show that except for the base asphalt with the spraying amount of 0.6 kg/m² or less, the other schemes can meet the more stringent requirements of the bonding strength not less than 1 MPa. The

material with good overall bonding performance is water-based epoxy emulsified asphalt. When the spraying amount is 0.6 kg/m² and 0.8 kg/m², the interlayer pull-out strength of water-based epoxy emulsified asphalt tack coat material and SBS modified asphalt tack coat material can reach the best and ensure the excellent cost performance.

Keywords: thin overlay; interlayer bonding; asphalt material; pull-out strength

Analysis on Effect of Thermophysical Properties on Temperature of Porous Cement Concrete

..... LI Yangyang (115)

Abstract: Thermophysical properties of porous cement concrete is different from that of Portland cement concrete significantly because of its rough surface and connected pores. In order to grasp the effect law of thermophysical properties on temperature variation of porous cement concrete, its temperature monitoring test is carried out and the dimensionless calculation and analysis are carried out according to the test results. The analysis shows that albedo has the greatest positive effect on the reduction of the maximum temperature of the porous cement concrete pavement surface. The emissivity has the greatest positive effect on the reduction of the minimum temperature of porous cement concrete pavement surface. The emissivity has the greatest effect on the decrease of the maximum and minimum temperatures inside the porous cement concrete pavement. Under the same conditions, increasing the albedo and emissivity of porous cement concrete pavement can reduce its surface and internal temperatures.

Keywords: porous cement concrete; thermophysical properties; temperature variation; albedo, emissivity

Analysis on Design Essentials of Cement to Asphalt for Urban Cement Concrete Pavement

..... TIAN Wanglong, LI Li, WEI Jin, GUO Xiaowen (118)

Abstract: In recent years, the asphalt surface layer is paved on the cement concrete pavement of old urban areas in many cities, which can reconstruct it into the asphalt concrete pavement with the more excellent usability of low noise, smoothness and comfort, commonly known as "white to black". The reflective cracks often appear in the "white to black" pavement during use. So far, the international problem of reflection crack has not been really solved. Therefore, how to effectively inhibit and delay the reflection crack is of great significance in the design of "white to black". The types, formation mechanism and treatment measures of reflective cracks after the white to black" of cement concrete pavement are analyzed. Taking an urban road "white to black" project in Xian as an example, the practice test is carried out to achieve the good results, which can provide reference for similar projects in the future.

Keywords: cement concrete pavement; white to black; disease; comfort; reflection crack

Safety Evaluation of Non-motor Vehicle Lanes Based on Analytic Hierarchy Process

..... XIE Mingyi, LING Hongwei (122)

Abstract: In the early scheme research of road engineering planning and design, the analytic hierarchy process (AHP) is used as the decision analysis method to establish a three-layer structure model consisting of the non-motor vehicle lane safety target layer, safety evaluation factor layer and safety evaluation factor layer. On this account, the comparative discriminant matrix is constructed to analyze and propose the weight and importance ranking of each evaluation factor. The safety evaluation of the non-motor vehicle lanes is studied. Combined with the practical engineering cases, the AHP is used to compare and select the overall scheme of the non-motor vehicle lanes through weighted calculations.

Keywords: non-motor vehicle lane; analytic hierarchy process; evaluation factors; safety evaluation

Construction Status and Application of Shanghai Traffic Operation Evaluation Index System

..... TAO Sha (126)

Abstract: At present, it is urgently to establish a new way of traffic management conforming the characteristics and laws of megacities in Shanghai so as to further enhance the radiation capacity of traffic. Relying on the urban functional orientation of Shanghai, starting from the promotion of the traffic facility efficiency and the improvement of the traffic service quality, the necessity of constructing a traffic operation

evaluation index system for Shanghai is analyzed. From the multiple dimensions of serving Shanghai, serving the citizens and improving the wisdom management, the multi-level displayable, traceable and analyzable comprehensive indicator system and application scenarios are introduced. The establishment and application of the evaluation index system has played an important role in assisting the planning decisions of traffic infrastructure and improving the urban transportation management level in Shanghai, which has the reference value for improving the traffic qualities of urban traffic planning, traffic management, traffic governance and other aspects.

Keywords: traffic operation; evaluation index system; urban functional orientation; resilient traffic

BRIDGES & STRUCTURES

Analysis on Failure Forms of Bridges under Flood Condition HE Mingxing, YUAN Xiaofeng (130)

Abstract: For the cross-river bridges, in addition to the overloading, the excessive flood is another major risk factor for bridge safety. A large number of examples of bridge water damage data show that the failure forms of crossing river bridges are prone to occur under the operation of exceeding the standard flood, such as foundation erosion and hollowing leading to insufficient bearing capacity of pile foundation, bridge dislocation caused by sliding of plate rubber bearing, direct floating sliding of superstructure, and direct transverse overturn the superstructure. Therefore, taking four important cross-river bridges on Nanfei River in Hefei City as an example, the failure forms of bridge under the exceeding flood are analyzed in order to provide the reference for the analysis on the failure forms of the similar bridge under the flood condition.

Keywords: bridge; flood condition; failure form; floating instability, transverse overturning

Overall Scheme Design of Liangjiang Bridge in Chishui City DU Wei (133)

Abstract: Liangjiang Bridge in Chishui City is an asymmetric cable-stayed arch composite bridge with a main span of 200 m to cross Chishui River. The bridge pylon without back cable is composed of concrete straight pylon and steel tube curved pylon. 9 stayed cables are anchored to the steel tube curved pylon. The arch rib is a half-through polynomial catenary hingeless cabas-type steel box arch. The section of the arch rib is 2 m wide and 3 m high. There are 22 pairs of booms. The vertical and horizontal beam system is adopted for the main girder. Its overall width is 26.6 m. The beam and the boom are arranged every 8 m at the same spacing. The results of spatial finite element calculation comprehensively reflect the stress characteristics and stress distributions of cable pylon, arch rib and main girder members.

Keywords: asymmetric; cable stayed arch composite bridge; cable pylon; arch rib; bridge landscape

Design and Innovation of Composite Girder Cable-stayed Bridge for Danhe Bridge ZHI Yanwu (138)

Abstract: Danhe Bidge is a super large bridge crossing Danhe River of a first-class highway project in China. Its road grade is the first-class highway. Its total length is 1 738 m, in which the structural form of the main bridge is the (130+130)-m single-pylon composite girder cable-stayed bridge. Its structural system is a semi-floating system, which is constructed by the bracket assembly. The structural design, technical difficulties and innovation points of this bridge are expounded, which provide the suggestions for the other bridge designers in the design of similar bridges.

Keywords: cable-stayed bridge; water-drop shaped pylon; composite girder; structural design

Research on Force Influence Mechanism and Control Strategy of Long-span Continuous Rigid Frame Bridge

..... NING Jiawei, LI Shuding, SHI Xinhui (141)

Abstract: In order to explore the influence mechanism and control strategy of deflection and internal force of long-span continuous rigid-frame bridge, the causes of main beam deflection are briefly analyzed at first, and combined with the analysis results, the calculation conditions and the finite element model for the subsequent calculation and analysis are given. Secondly, the influence mechanism of main influencing factors on the deflection and internal force of continuous rigid frame bridge is explored. Finally, based on the analysis

results of the influence mechanism, the control strategy to reduce the deflection and internal force of the main beam is proposed. The research shows that the main factors affecting the vertical deflection of the main beam and the structural force of the long-span prestressed concrete continuous rigid-frame bridge are the relative humidity, loading age and prestressing loss, in which the order of the degree of influence from large to small is the prestressing loss, relative humidity and loading age. When the prestressing loss changes from 5% to 25%, the vertical deflection of the main beam increases by 18.86% in maximum, and the bending moment of the main beam is about 2 times of the original, which can be seen that the prestressing loss will significantly increase the bending moment and vertical deflection of the main beam. In order to prevent the large-span prestressed continuous rigid-frame bridge from the lower deflection and internal force problems during the operation, it is necessary to control the prestressing loss in the design stage, construction stage and operation stage.

Keywords: BIM technology; inclined photogrammetry; 3D reality model; forward design; highway bridge

Analysis on Eccentric Load Effect of Small Radius Curved "Double Narrow Box" Steel-Concrete Composite Continuous Girder YANG Yang, SHI Fangming, SHI Guoqing, YU Zhenhua (145)

Abstract: In order to study the eccentric load effect of lane load on the small radius curved double narrow box steel-concrete composite continuous girder bridge, the bending, torsion and distortion effects of the structure are analyzed theoretically based on the actual project. Three load cases of eccentric live load on the outer side, eccentric live load on the inner side and symmetrical live load of the curve radius are established. A three-dimensional finite element solid model is established with ANSYS software for analysis. The concept of stress amplification factor is introduced to study the law of the eccentric load coefficient of the structure. The results show that the warping normal stress and shear stress on the outer side of the curve radius of the composite girder are larger than those on the inner side of the composite girder. The amplification factor of the normal stress of the composite girder is approximately between 1.3 and 1.4, and the eccentric load effect of the normal stress is most obvious at the middle fulcrum. The amplification factor of shear stress is approximately between 1.5 and 1.6, and the eccentric load effect of shear stress is most obvious at the quarter of the midspan. Compared with the straight girder bridge, the stress amplification factor of the small radius curved double narrow box steel-concrete composite continuous girder bridge under eccentric lane load is larger. For this kind of structure, the eccentric load effect caused by live load cannot be ignored.

Keywords: small radius curve; double narrow box; steel-concrete composite continuous girder; stress amplification factor; finite element

Contrastive Analysis on Closed Section and Open Section of Small-span and Medium-span Steel Box-concrete Composite Beams ZHANG Yajie, WANG Weian (149)

Abstract: The stress process of a steel box-concrete composite beam is theoretically analyzed and studied, which provides a reference for the design and application of small-span and medium-span steel box-concrete composite beams in China. By contrastive analysis on the closed section and open section of steel boxes, it is found that the closed section increases a little steel amount compared with the open section, but the stress level of the steel beam is reduced and the number of welds is reduced so as to decrease the welding problems, which is suitable for the construction of small-span and medium-span steel box-concrete composite beam bridges.

Keywords: steel box-concrete composite beam; closed section; open section; local stability; effective width; stress; weld

Analysis on Seismic Isolation Design of Bridges in High Intensity Earthquake Area HUANG Hua (153)

Abstract: In the seismic design of bridges in high intensity earthquake area, compared with the ductile seismic design, by extending the natural vibration period of the structure and increasing the damping of the structure, the seismic isolation devices are used to reach the goal of depleting the earthquake capacity and

reducing the seismic response of structure so as to greatly improve the seismic performance of the bridge, which has the obvious advantages of economy and easy repair after earthquake. Taking a continuous beam bridge in 8-degree earthquake zone as the engineering background, a three-dimensional spatial finite element model of the whole bridge is established. The seismic isolation performance of bridge is studied by the nonlinear time-history dynamic analysis, and compared with the corresponding non-seismic isolation bridges, the seismic isolation effect is tested. At the same time, combined with the conclusion of dynamic analysis, the refined design is carried out for the seismic structural measures of bridge. The reasonable structure design can ensure the full play of the seismic isolation device function and ensure the bridge to achieve the expected seismic performance goal.

Keywords: bridge structure; seismic isolation design; friction pendulum bearing; nonlinear time history analysis

Analysis on Seismic Performance of Prefabricated Bridge Piers

..... FAN Ze, QI Shengqiang, FENG Wei, LIU Yaorong (158)

Abstract: Based on the seismic performance and construction requirements, a new type of prefabricated bridge connection method is proposed. The round steel is embedded in the connecting end and connected by welding. Through the comparison with the other structures of grouting sleeves and metal bellows, it is found that this connection method is convenient in construction, easy to operate and faster in construction. Through the experimental study on the connection mode of section steel, the following conclusions are mainly given that (1) The failure of prefabricated piers connected with cast-in-situ piers by section steel is the bending failure. The damage degree at the root of the prefabricated pier column connected by section steel is relatively light, and the concrete damage is mainly concentrated above the top of the embedded steel pipe. (2) The bearing capacity of prefabricated piers connected by section steel is higher than that of cast-in-place piers. (3) The residual displacement of prefabricated pier connected with section steel is equivalent to that of cast-in-place pier, but the former is better in terms of energy dissipation capacity and ductility. (4) The prefabricated pier connected by section steel has the superior seismic performance, which provides a method for the use of prefabricated pier in high seismic intensity areas.

Keywords: pier; prefabricated; hysteresis curve; test

Analysis and Research on Design Parameters of Hyperboloid Spherical Seismic Isolation Bearing

..... WANG Zhennan (162)

Abstract: The hyperboloid spherical seismic isolation bearing is a new type of seismic isolation bearing developed in China, and now is widely used in the seismic design of long-span continuous girder bridge in high intensity areas. The friction coefficient μ of the sliding sphere of this bearing, the distance H between the center of the sphere and the horizontal ultimate bearing capacity F_u of fixed bearing are three important parameters influencing the seismic performance. The above three bearing parameters are studied deeply to obtain the variation rules of seismic performance and three design parameters of the bridge, which provides the guidance for the seismic design of bridges with the hyperboloid spherical seismic isolation bearings.

Keywords: long-span continuous girder bridge; hyperboloid spherical seismic isolation bearing; friction coefficient of sliding sphere; distance between center of sphere; horizontal ultimate bearing capacity

Structural Design and Analysis of Multi-span Continuous Butterfly Arch Beam Composite Bridge

..... WANG Shuai (166)

Abstract: Taigu Wei River Bridge is located at Daima group in Baoji, and is an important channel connecting the north and south sides of Wei River. The main bridge is a through continuous butterfly arch beam composite structure. The arch ring is a composite butterfly arch ring with the unique shape and complex force. The design thought and force characteristics of the bridge are mainly introduced, and the modeling analysis and calculation are carried out for the overall and local structures.

Keywords: butterfly arch; multi-span continuous beam; arch beam composite system

Research on Optimization Design of Prefabricated Bridge Piers in Hetian–Ruoqiang Railway

..... ZHANG Jun, XU Lei, LI Yimin, YU Bo (171)

Abstract: Taking the prefabricated pier of newly built Hetian–Ruoqiang Railway as the research object, the influence of the structural design of railway prefabricated pier on its structural rationality, safety and economy under the load is studied. The current national railway bridge and culvert design codes are adopted to carry out the combined loading of superstructure dead weight, second stage and train braking force for the prefabricated hollow piers. According to the factors controlling the different wall thickness of hollow pier, the different prestressed beam number and the different pier post–pouring section height, and based on MIDAS CIVIL software, the loading model of pier is established to obtain the displacement and bending moment changes of three different control factors at the key points of pier top, pier bottom and pier body. The research shows that the pier wall thickness if designed on 45 cm can satisfy the design requirements of practice engineering of Hetian–Ruoqiang Railway. At the same time, the greater safety and stability are can also be achieved. Compared with the wall thickness of 40 cm, the displacement can be decreased by 17.61%, the bending moment changed little and the overall structure is more economical and reasonable, which can ensure traffic safety. The prestressed beam number if designed on 12 can be enough to meet the mechanical properties of bridge piers. The structure is more economical and reasonable. The pier post–pouring section designed according to 4 m can better meet the practical engineering needs of Hetian–Ruoqiang Railway. At the same time, the security and stability of the structure are improved. The horizontal displacement of pier top is reduced by 1.61% compared with 3.2 m, which has little effect on bending moment. The theoretical guidance and reference significance are provided for the design of prefabricated pier the future through optimization.

Keywords: railway bridge; prefabricated pier column; safety; post–pouring section; optimization design

Design of Special–shaped Pier in Elevated Section of Metro YANG Lin, RAO Haomiao (176)

Abstract: The common special–shaped pier forms are introduced. The structural reconstruction and the slingshot pier with the more complex force are selected to carry out the design. The design method and matters needing attention for this kind of pier are put forward. Taking the special–shaped piers in Shenzhen Metro Line 6 as the study background, the beam element and solid element are analyzed with Midas CIVIL and FEA. The reference scheme of common reinforcement arrangement is proposed. The special attention is paid to the linkage displacement of the upper bridge and the stress concentration at each joint, which has the guiding significance for similar projects.

Keywords: special–shaped pier; linkage displacement; solid analysis

Simplified Calculation and Refined Analysis of Existing Single–column Vase Piers

..... LENG Jinrong (180)

Abstract: The single–column vase pier is a structure with a beautiful shape and reasonable force, and has been widely used in urban bridge construction. Combined with an urban elevated bridge project, the calculation method provided from the design specification used for the involved single–column vase pier is simplified and calculated. And the nonlinear finite element model is also established to carry out the refined analysis. The two calculation results are compared, and some conclusions and suggestions are obtained, which can provide a useful reference for similar projects.

Keywords: single–column vase pier; simplified calculations; nonlinear; refined analysis

Design of Anti–overturning Reinforcement of Single–pillar Pier Box Girder Bridge

..... GU Youping, LIU Wei, SONG Songke (183)

Abstract: The problem of overturning may occur when the substructure of continuous box girder bridge is the continuous single pillar pier. It is worth to study the anti–overturning reinforcement design of this structure. Combined with an anti–overturning reinforcement case of ramp bridge, a reinforcement scheme

of adding the steel bent cap with the multiple supports instead of single support at the single-pillar pier is introduced. The calculations show that adding supports can effectively improve the anti-overturning stability coefficient. Finally, the bridge piers and steel bent cap are checked to prove that this kind of reinforcement mode is safe and reliable, which can provide the reference for the similar reinforcement projects.

Keywords: single-pillar pier; eccentric load; bridge overturning; steel bent cap; reinforcement

Test and Research on In-service Performance of Bridge Viscous Damper

..... XU Xiaochun, ZHU Weifeng (186)

Abstract: The importance of the viscous damper and the necessity of its in-service performance testing of bridge are discussed. Taking the in-service performance testing of the viscous damper of Maanshan Changjiang River Highway Bridge as an example, the whole field test method and process of bridge damper are introduced in detail, and the test results are analyzed and summarized.

Keywords: bridge; in service; viscous damper; performance test; Maanshan Changjiang River Highway Bridge

FLOOD CONTROL & DRAINAGE

Design Countermeasures of Drainage System in Shanghai Central Urban Area under Confined Space

..... ZHOU Jijun, SHAO Qin, ZHA Wengui, XU Wenzheng, ZHU Jiaqi (190)

Abstract: The co-construction scheme of pumping station and storage tank and the construction scheme of pipe network under the confined space are systematically discussed by taking the drainage system of Shanghai CBD as an example. Through the rational layout and optimization of the construction space, the layout of the rainwater and sewage pumping station is completed when the land area of the pumping station is only about 60% of the recommended value in *Technical Guidelines of Shanghai Municipal Control Detailed Planning*. And through the use of longitudinal space, the co-construction of pumping station and storage tank is further realized. By comparing and analyzing, the shield method is used as the construction technology of the combined sewage trunk pipe, which can reduce the number of construction wells on the main road by 50% compared with the traditional jacking method, and relieve the impact on the current traffic.

Keywords: drainage system; confined space; central urban area; co-construction of pumping station

Comparison and Design Case of Influent Pattern of Initial Rainwater Storage Tank

Abstract: In order to further deal with the problem of surface water non-point source pollution caused by initial rainwater, it must be to use the scientific measures to control the initial rainwater. The construction mode of combining the rainwater pumping station and the initial rainwater storage tank can effectively reduce the impact of initial rainwater pollution and improve the quality of water environment. At present, the form of gravity influent is generally used for the influent of the storage tank. According to the survey results, the storage tank with gravity influent has some problems of high civil construction cost and large height difference during influent, which lead to the high pressure of the tanks and easy to overflow odor. The form of using the gravity and pump lifting for the cooperative influent can significantly save the investment and does not reduce the flood control capacity of the original pumping station. According to the 10 000 m³-scale measurement, the combined influent of storage tank gravity and pump lifting can save about 25 million yuan of construction investment compared with the full gravity influent. In the meantime, in order to practice "dual-carbon strategy", the photovoltaic system is placed on the top of storage tank, which can be used as the power supply for emptying pump and lighting in order to achieve the goal of saving the energy conservation and reducing the operation cost. The economic benefit is good.

Keywords: initial rainwater; storage tank; influent pattern; design case

Analysis on Reconstruction of Waterlogged Road under Influence of Multiple Factors

..... ZHANG Yanguang, SUN Yafei, LI Shuai, LIU Xiaolu (198)

Abstract: With the frequent occurrence of short-term heavy rainfall and the continuous pursuit of a better living environment of the people, the phenomenon of "city view of the sea" has attracted the media attention. The goal of eliminating the waterlogging of road section and improving the regional drainage and waterlogging stands is achieved for the reconstruction project of Liuquan Road through four measures of regulating the rivers, improving the pipe network, reconstructing the community and promoting the concept of sponge city in order to provide reference for similar projects.

Keywords: Liuquan Road; waterlogging; rivers; drainage pipe network; sponge city

Discussion on Practice of Township Rain and Sewage Separation Project

..... TANG Hui, WANG Li, ZHOU Peng (203)

Abstract: In the context of the rural revitalization strategy, combined with the practical experience of a rural rain and sewage separation project in Sichuan, the feasible design ideas and implementation essentials of rural sewage treatment and township infrastructure construction are discussed. In general, it is recommended that on the basis of building the main drainage pipeline network, the focus is placed on the reconstruction of road side ditches and household connection wells supplemented by the effective separation wells and sewage interception trunk pipes in order to gradually promote the reconstruction of household drainage pipes. Finally, the effective treatment of rural sewage is realized. Due to the problems of no planning red line, undefined land boundaries, narrow roads, unconnected traffic and uncontrollable public opinion, the reconstruction scheme should be deeply combined with the factors of transportation organization mode, construction mode and construction period. The completed projects are discussed and summarized in order to provide the experience and reference for the similar projects

Keywords: rural revitalization; rain and sewage separation; infrastructure

Study on Flood Control Planning of Northern Coastal Hilly City for Rizhao City LI Peng (207)

Abstract: Rizhao City is near the mountains and the sea. Its terrain is high in the northwest and low in the southeast, which belongs to the hilly region of the eastern Shangdong. And the rivers crisscross the territory and landforms are varied. In recent years, the economic and social development and urban construction of Rizhao City have been changing with each passing day, and the external environment of the city and the conditions of the underlying surface have undergone major changes, which has put forward new requirements for flood control safety. Guided by the new round of urban master planning, the relevant contents of the master planning are implemented to adapt the urban population and development scale. The flood control system in the main urban area is further perfected, and the flood control security capacity of key areas is consolidated and enhanced. It is to clarify the goals and key tasks of urban flood control construction, and the flood control construction projects. It is to do a good job in promoting the top-level design of high-quality water conservancy development in the new stage, and improve the safety and security capabilities of flood control, which can provide the reference for the relevant planning of the northern coastal hilly cities.

Keywords: main urban area; flood control planning; coastal hilly area; Guhe River Basin

Exploration on Implementation of Sponge City in Large-sized Wastewater Treatment Plant Reconstruction Project LYU Min (212)

Abstract: With the implementation of the concept of sponge city construction, Shanghai Water Administration has issued the *Technical Guidelines for Sponge City Construction of Shanghai Water Facilities (Plant / Station)* in order to promote the sponge construction of water facilities. Combined with the reconstruction project of a large-sized wastewater treatment plant (WWTP), a construction scheme of sponge city facilities is proposed. By utilizing the facilities such as rainwater buffer pools, grass planting ditches and permeable paving, the control of runoff volume in the newly added construction area is realized. By utilizing the rainwater buffer pool, the rainwater order ability of the service plot is improved. And the

rainwater is discharged into the built rainwater system of WWTP in the staggering peak, which can avoid the large-scale renovation of the built rainwater pipelines and synchronously improve the landscape effect of the WWTP area. Through the construction of sponge city facilities, the newly added areas of the project can achieve the control rate of annual runoff volume by 75%, and the return period of the rainwater system can reach the standard of once in three years.

Keywords: sponge city facilities; reconstruction project of WWTP; control rate of annual runoff volume; rainwater system up to standard

Summary of Process Design for Upgrading and Expanding a Township Wastewater Treatment Plant in Jiangsu WANG Rui, ZHANG Yunxia, LAI Cansen (216)

Abstract: The treatment scale of a township wastewater treatment plant (WWTP) in Jiangsu is improved from 5 000 m³/d to 20 000 m³/d, and the effluent quality is improved from the first level A standard of *Discharge Standard of Pollutants for Municipal Wastewater Treatment Plants* (GB 18918—2002) to *Discharge Limits for Main Water Pollutants from Municipal Wastewater Treatment Plant and Key Industries in Taihu Area* (DB 32/1072—2018) and other areas of Taihu area mainly for TN and NH₃-N. Due to the land restriction, improvement of nitrogen removal standards, and scale expansion, the multimode AAO process is adopted for the new construction and reconstruction of the biochemical section, and the current three-ditch oxidation ditch is reconstructed to AAO so as to achieve the expansion target. In the advanced treatment section, the mixing, corrugated plate flocculation, lateral flow inclined-plate sedimentation tank and fiber turntable filter are adopted to achieve TP and SS up to standards. This process has the advantages of high land utilization, stable operation, low treatment cost and simple operation management, and is suitable for township WWTPs.

Keywords: upgrading and extension; multimode AAO; corrugated plate flocculation; lateral flow inclined-plate sedimentation; fiber turntable filter

Process Design of Sludge Anaerobic Digester for Foreign WWTP HONG Siping, SU Qingyu (220)

Abstract: A south Asian inland country along the "Belt and Road Initiative" has the poor drainage infrastructure, which is basically at a standstill. With the development of cities and the continuous growth of population, the problem of urban water pollution becomes increasingly prominent. To alleviate the increasingly serious water pollution status, the ADB assists the construction of three WWTPs in Kathmandu valley. The treated water is discharged into the local rivers. In order to reduce the secondary pollution, the sludge digestion is used in the design to produce the marsh gas, and the marsh gas is used for the boiler heating and power generation, which achieves the reduction and recycling use of sludge. The process design of digestion period is the key of sludge recycle. Taking D WWTP as an example, the process design of digester is discussed.

Keywords: Katmandu valley; process design of digester; tank structure; three-dimensional mixing

Selection and Application of Pipeline Repair Technology ZHANG Xuehui, SONG Guoyong, LIU Cunhui, ZHU Songling, QIN Yanjun (225)

Abstract: JDrainage pipe network is an important urban infrastructure. With the extension of service time, some pipe networks begin to have some different problems and need to be repaired urgently. The repair of old pipe network is an important part of sewage quality and efficiency improvement, and black and odorous water treatment. The selection of repair process of defective pipe network is very important. Combined with the investigation results of the 202.22 km present drainage pipeline in a district in Shenzhen, two repair methods of excavation and pipe replacement, and trenchless repair of structural defective pipe network are compared. The applicable conditions, advantages and disadvantages of each repair technology are analyzed. The factors that should be considered in the selection of repair process are introduced in detail. The application of trenchless repair is discussed.

Keywords: old pipe network; trenchless repair; excavation and pipe replacement; influencing factor

Exploration on High-quality Development Ideas of Water Affairs for "14th Five-Year Plan" in Nansha of Guangzhou CHEN Guangcheng (230)

Abstract: The "14th Five-Year Plan" period is a key period for China to transform the development model, optimize the economic structure and change the driving force. With the fundamental purpose of meeting the people's ever-growing needs for a better life, it is of great practical significance to deeply analyze the development needs of water affairs in the new era, coordinate the urban development with the planning and construction of water affairs, and explore the new ideas of high-quality development of water affairs with a problem-oriented approach. As a demonstration area of comprehensive cooperation among Guangdong, Hong Kong and Macao, Nansha District of Guangzhou undertakes an important development mission and faces a major historical opportunity of "dual-district" construction and "dual-city" linkage. Taking the "14th Five-Year Plan" of Water development of Nansha District as an example, the high-quality development ideas of water affairs in the new era are explored in order to provide the reference for the water development planning of Guangzhou and other regions of the country.

Keywords: water affairs; high-quality development; Nansha District; the 14th Five-Year Plan

MANAGEMENT & CONSTRUCTION

Analysis on Stability of Steel Beam Construction of 60-m Steel Plate Composite Girder Bridge YANG Zhimin, JING Weiwei, YAN Shuilong, LIU Xuzheng (234)

Abstract: Because of its light weight and thin section, the steel plate composite continuous beam bridge has the risk of overall instability and local buckling influenced by the external loads during construction, which affects the safety of bridge construction. Based on the 60 m span of the steel plate composite girder bridge for the parametric analysis in the Ministry of Communications, the overall stability and local stability in its construction stage are studied. The stability variation laws under the different spans, height span ratios and beam spacing are compared and analyzed. The results show that with the increase of the segment span, the stability coefficient of the steel beam decreases. The stability decreases by about 40% for every 5 m of the increase of the span, and it is in the critical state of the specification limit value when the span is 40 m. Under the same span, the stability of the steel beam decreases with the increase of the beam height. When the beam height exceeds 3.5 m, the stability coefficient of the 40 m-span single beam is lower than the critical limit of the specification, and the structural stability is poor. When the beam spacing is more than 10 m, shortening the beam spacing can improve the structural stability, while changing the beam spacing when the spacing is less than 10 m has little effect on the structural stability.

Keywords: steel plate composite girder bridge; hoisting construction; construction safety; stability

Application of Various Jacking Processes in Expressway Reconstruction and Extension Project ZHANG Chong, LI Junhua, LIU Guoxiao, SUN Liangbo (238)

Abstract: Taking the slope adjustment and jacking project of four bridges in Section 1 of the Beijing-Taipei Expressway Jinan-Taian Section Reconstruction and Expansion Project as an example, according to the different constructions of each bridge, the different bridge jacking construction schemes are formulated respectively. The application of various bridge jacking processes in the overall slope adjustment project of the bridge in the reconstruction and expansion project of the expressway is introduced for the reference of relevant professionals.

Keywords: various jacking processes; bridge slope adjusting and jacking; expressway; reconstruction and expansion engineering

Discussion on Common Safety Problems in Engineering Construction of Diaphragm Wall QIU Aimin (242)

Abstract: The construction of underground diaphragm wall is mainly based on large equipment and supplemented by manual labor. The construction process and procedures of underground diaphragm wall are relatively complex, involving many types and large sizes of equipment. Therefore, the construction safety risks are inevitable during the construction process, especially in the hoisting process of underground diaphragm wall reinforcement cage with the high safety risks. The safety hazards in construction are classified from the perspective of equipment, and the causes of safety accidents are analyzed. And the corresponding solutions are given in a targeted manner, which provides the suggestions for the safety management in the construction of underground diaphragm wall.

Keywords: hoisting equipment; underground diaphragm wall; piling machinery; safety management

STUDY ON SCIENCE & TECHNOLOGY

Effects of High Viscosity Additives on Macroscopic Properties and Microstructure of High Viscoelastic Modified Asphalt ZOU Wukun, ZHAO Mengzhen, DING Xuan, ZHOU Qiwei, SONG Xinghua (246)

Abstract: The effects of the type and dosage of high viscosity additives on the macroscopic properties of high viscoelastic modified asphalt are studied through the conventional property tests, dynamic viscosity test, elastic recovery test and Brookfield viscosity test. The microstructure of modified asphalt is explored by fluorescence microscope. The pavement performance of STC-10 high viscoelastic asphalt mixture prepared with the self-developed high viscosity additive is evaluated. The results show that the different types of high viscosity additives can significantly reduce the penetration of modified asphalt, and increase the softening point and ductility, but have the different effects on the dynamic viscosity at 60°C and the viscosity at 135°C. The increase of the high viscosity additive dosage leads to the transformation of the scattered polymer particles in the modified asphalt to the network structure, and an obvious transition zone appears between the network structures, which plays an important role in the enhancement of the high-temperature and low-temperature performances of the modified asphalt. All performance indexes of STC-10 asphalt mixture meet the relevant technical requirements, which prove that the application of high viscoelastic modified asphalt and STC-10 grading in ultra-thin overlay is feasible. The research results provide a scientific basis for the application of a new type of high viscoelastic modified asphalt in synchronous ultra-thin overlays.

Keywords: road engineering; high viscoelastic modified asphalt; macroscopic properties; microstructure; STC-10 asphalt mixture; pavement performance

Study on Rheological Properties of Asphalt Mastic with Different Grades Yeermulati Muhadeer (251)

Abstract: The 16 kinds of asphalt mastic are prepared by 4 asphalt grades and 4 filler/asphalt ratios. The dynamic shear rheological tests are conducted at the different frequencies and temperatures. The main curves of complex shear modulus, phase angle, rutting factor and complex modulus at different temperatures are obtained by the temperature sweep test. By the variance analysis, the complex shear modulus of asphalt mastic increases as the asphalt grade decreases and filler/asphalt ratio increases. The phase angle of asphalt increases as the asphalt grade increases, but does not have a significant correlation with the filler/asphalt ratio. At 5°C low temperature, the filler/asphalt ratio has a significant impact on the mechanical property of asphalt mastic. At 15°C, the filler/asphalt ratio has a similar impact on the mechanical property of asphalt mastic as the asphalt type. At 60°C, the asphalt type has a significant impact on the mechanical property of asphalt mastic. Through the analysis of the complex shear modulus G^* , phase angle δ , rutting factor $G^*/\sin \delta$ at different temperatures, the asphalt type has the most significant impact on the rheological property of asphalt mastic under medium to high temperature conditions.

Keywords: asphalt mastic; rheological property; temperature sweep test; variance analysis

Study on Influence of Different Compaction Methods on Fatigue Performance of Emulsified Asphalt Cold

Recycled Mixture YUAN Jiehao (256)

Abstract: The fatigue performance of cold recycled emulsified asphalt mixture (CEAM) prepared by the different compaction methods is quite different. The improved Marshall compaction method and vertical vibration molding method are used to prepare two kinds of CEAM, and the indirect tensile fatigue test of CEAM is further carried out. On the basis of the test results, the indirect tensile fatigue equation based on Weibull distribution is established. The fatigue equation parameters of the different compaction forming methods are analyzed to explore the influence of the different compaction forming methods on the fatigue performance of CEAM. The test results show that the average mechanical strength of CEAM prepared by the vertical vibration compaction method can reach 92% of that of in-situ coring specimen, while the average mechanical strength of the improved Marshall compaction forming specimen is only 65% of that of in-situ coring specimen. Compared with the improved Marshall compaction forming method, the optimum emulsified asphalt content and water content of the vertical vibration molding method are decreased by 9% and 11% respectively, and the water damage resistance, low temperature crack resistance and high temperature rutting resistance are increased by 4%, 12% and 35% respectively. The fatigue equation established based on Weibull distribution can effectively evaluate the fatigue life of CEAM. The CEAM prepared by vertical vibration molding method shows the good stress change sensitivity and fatigue durability, and its fatigue life at the stress ratio of 0.5 is 1.36 times that of the improved Marshall compaction forming method.

Keywords: improved Marshall compaction method; vertical vibration compaction molding method; emulsified asphalt; cold recycled mixture; fatigue performance

Study on Molecular Simulation of Effect of Mineral Properties on Adhesion of Asphalt

..... HUANG Ting, TANG Dejin, GAO Guanglu, WANG Wenjia, WANG Haoan (261)

Abstract: The existing studies on asphalt-aggregate adhesion based on molecular simulations usually ignore the influence of mineral surface properties on asphalt-aggregate adhesion. Aiming at this problem, SiO_2 and Al_2O_3 mineral models with the different surface properties are constructed according to two different surface suspension compensation methods to investigate the influence of mineral surface properties on asphalt-aggregate adhesion from two perspectives of mineral surface charge and mineral surface group. The results of the molecular simulations show that the mineral surface atom and its charge determine the electrostatic interaction between the bitumen and the mineral, and also affect the distribution and spatial configuration of the bitumen molecules. In addition, the mineral surface hydroxylation has a small effect on the total binding energy of the bitumen-mineral model, but can significantly increase the van der Waals interaction between the bitumen and mineral model, while significantly reduce the electrostatic interaction between the both.

Keywords: asphalt-aggregate adhesion; mineral surface charge; mineral surface groups; molecular simulation

Optimization of Compound Modified Asphalt Formulation Based on Entropy Weight – TOPSIS Theory

..... ZHANG Rui, LIU Hongying, NIE Zongquan, LI Wenhui, BAO Liuhui, QU Xin, LE Chen (268)

Abstract: Aiming at the present situation of using many admixtures to improve the anti-ultraviolet aging ability of asphalt and asphalt mixture, the macro-performance index, micro-performance index and cost factor of compound modified asphalt are comprehensively considered. The entropy weight-TOPSIS theory is used to optimize 6 different inhibitor schemes. The result shows that two compound modified asphalt schemes determined by this theory have the good cost performances, and can satisfy the requirements of anti-ultraviolet characteristics of asphalt pavement, which provides the new technical approach for the design and optimization of modified asphalt formulation in the future.

Keywords: modified asphalt; anti-ultraviolet; optimization; entropy weight – TOPSIS theory

Research on Evaluation Method of Cracking Resistance of Asphalt Pavement in Service Based on Semicircle

Bending Test CAI Haiquan (272)

Abstract: Aiming at the difficult problems of cracking resistance evaluation of asphalt pavement in service, the semicircle bending test method and the critical strain energy index are used to evaluate its cracking resistance. Based on the field core samples of a typical expressways in Jiangsu Province, 35 groups of semicircle bending tests of the upper layer are carried out, and a three-level evaluation standard for the cracking resistance of asphalt pavement in service is proposed through the results of 20% and 80% fractile critical strain energy. The classification criteria for critical strain energy of different grades are 0.3 kJ/m² and 0.7 kJ/m² respectively.

Keywords: semicircle bending test; cracking resistance; critical strain energy; evaluation criteria

THE RELATIVE SPECIALITIES

Study on Application of Sludge Suction Storage Technology for Large-scale Sludge Reservoir Area in Short-time Storage PENG Peng (275)

Abstract: The domestic municipal sludge due to the historical problems of temporary film closed stacking problems is common. In a temporary sludge storage area, the sludge needs to be taken out for drying treatment and then sent to the power plant for incineration in order to solve the environmental problems and restore the land use function of the temporary storage site. In the process of sludge taking, it is easy to cause the secondary pollution and the operation safety problems due to odor leakage. With the closed suction technology, the sludge can be pumped to the sludge drying equipment in a fully closed state. The most of sludge can be suctioned out of storage area through the traction to realize the movement of the sludge suction device under the film. The cleaning operation will be carried out immediately after the completion of suction until all the sludge in the storage area is removed. Through the practical verification, the suction storage technology has the advantages of high speed, environmental protection and controllable sludge moisture content compared with the conventional sludge digging technology, which can be referred for the similar projects.

Keywords: sludge storage in short time; not film uncovering; suction; sludge taking; drying

Analysis on District Vertical Cooperated by Planning and Municipal Design GAO Liu (279)

Abstract: The spatial planning and regulatory planning of city can build the macroscopic pattern of city. With the intervention of the municipal team in advance, the rationality of the microscopic vertical in the macroscopic pattern can be demonstrated from the microscopic aspect of city, and the district vertical design can be improved so as to provide a perfect vertical and drainage planning for the subsequent district road network design and the subsequent plot development in order to build the integration of district planning and design. In response to the global extreme rainstorm weather, the surrounding terrain and geomorphology, the current road network, water system, waterlogging drainage and so on are investigated. The ARCGIS is used to sort out the microscopic vertical of large district. The EICAD and DICAD software are used to carry out the microscopic road network vertical design. And the Xiangyuan control planning software is used to the overall earthwork calculation. The district vertical planning of road, drainage and planning is coordinated and demonstrated in order to provide the support for the applicability, sustainability and economy of subsequent construction.

Keywords: integration of planning and design; ARCGIS; EICAD; district vertical

Study on Effect of Inverted Arch Curvature on Bearing Capacity of Lining Structure for Shallow Buried Large-section Tunnel CHEN Xingzhou (282)

Abstract: The inverted arch curvature has a great influence on the bearing capacity of three-lane large-section tunnel. The effect of the inverted arch curvature on the bearing capacity of three-lane large-section tunnel is quantitatively analyzed from the aspects of secondary lining bending moment, axial force and safety factor. The study results show that the ratio R^* of the transition arc radius to the inverted

arch radius has a critical value. When the inverted arch curvature is below the critical value, the bending moment and safety factor change relatively large, and when the inverted arch curvature exceeds the critical value, the change of bending moment and safety factor is relatively small. The more circular the structure becomes, the greater the safety factor is and the higher the bearing capacity is.

Keywords: mountain tunnel; inverted arch curvature; bearing capacity; secondary lining

Research and Application of Joint Type of Integral Assembled Structure in Excavated Tunnel

..... ZHOU Xiang, CHEN Naiji (285)

Abstract: For the core of large or super large cities, the method to build the underground tunnel in order to ease the traffic pressure has already become the most helpless solution for the urban construction, economic development and traffic congestion. However, due to the limitations of the surrounding environmental conditions, the construction method of this kind of tunnel basically remains in the most traditional construction technology. The construction period of tunnel is long, the environmental impact is large, and the construction investment and loss are also large. The appearance and application of integral assembled structure can effectively solve the above problems. Combined with the integral structure test section of Section II of the rapid reconstruction project of Wuning Road, the street form of integral assembled structure is analyzed and designed in order to promote the application of integral assembled structure in the other excavated tunnel projects, and provide some reference for the subsequent related projects.

Keywords: integral assembled structure; excavated tunnel; joint type

Numerical Analysis on Influence of Foundation Pit Excavation on Deformation of Existing Tunnel

..... TAN Liming (289)

Abstract: Combined with an actual case, the software package of FLAC3D finite difference method is used to conduct the numerical simulation of the construction of the building foundation pit adjacent to an existing tunnel and to obtain the upward vertical displacement of tunnel and the horizontal displacement against the foundation pit caused by the excavation and unloading of foundation pit. The maximum displacement occurs at the tunnel position opposite to the excavation of foundation pit. And the smaller the horizontal distance from the foundation pit, the larger the displacement. After the excavation of the foundation pit, the maximum vertical displacement value of the tunnel is 2.8 mm (vertical upward), and the maximum horizontal displacement is -0.4 mm (against the foundation pit direction), which has a small impact and is within the safe and controllable range.

Keywords: excavation of foundation pit; existing tunnel; deformation; numerical analysis

Engineering Design of Deep Foundation Pit for Underground Utility Tunnel in Different Environments

..... LIANG Zhihui (292)

Abstract: Underground utility tunnel is a modern and intensive urban public infrastructure and is the inevitable requirement to promote the urban sustainable development. At present, the research on the design of deep foundation pit for underground utility tunnel is few in China. Based on the engineering background of an urban underground utility tunnel, the characteristics of deep foundation pit for utility tunnel are comprehensively analyzed. Aiming at the characteristics of foundation pit in the different environments, combined with the characteristics of the foundation pit and under the condition of no lowering the groundwater, the design schemes of different deep foundation pit support structures are put forward, and are practically applied in an urban underground utility tunnel project, which provides a certain reference for similar projects.

Keywords: nderground utility tunnel; deep foundation pit; design of support structure

Study on Design of Pipe Curtain and Bridge Shield Method Undercrossing Existing Expressway

..... LIU Gangming, WU Longgang, CHEN Wei, LI Jie (297)

Abstract: By analyzing and studying the projects of bridge shield method undercrossing subgrade, the key influencing factors on the deformation of bridge shield method undercrossing subgrade are summarized, and the deformation mechanism is deeply analyzed. According to the proposed key influencing factors and relying on the actual project, the design application of bridge shield method undercrossing the existing expressways and structures is carried out. A variety of designs to control the deformation of existing subgrade and structure is proposed.

Keywords: pipe curtain; bridge shield; expressway; existing structure; deformation factor

Research on Dynamic Calculation Model of Market Information Price for Assembly-type Prefabricated Components LI Liyan, WANG Xiaonan (300)

Abstract: The market price of prefabricated components is a key component of the total cost of prefabricated buildings. The construction administrative department needs to guide and standardize the prefabricated component market by publishing the market information prices in time. In order to overcome the time lag in the update of information price and realize the refined timeliness management, a timely and dynamic method for estimating the market information price of prefabricated components is proposed. The prediction of the main fluctuation items of labor cost, material cost and machinery cost within the information price period is realized by establishing the SCGM (1,1)^c prediction model optimized by Markov, and then these costs are substituted into the information price measurement model to realize the dynamic prediction of the market information price. Taking the market information price of prefabricated external wall panels in Wuhan as an example, the result of the empirical analysis show that the SCGM (1,1)^c prediction model based on Markov can meet the demand of predicting the market information price of prefabricated components in advance very well. The MAPE value is 0.89%. Compared with the other three commonly used price prediction methods, it has stronger adaptability and stability.

Keywords: prefabricated components; market information price; dynamic calculation; SCGM (1,1)^c prediction model

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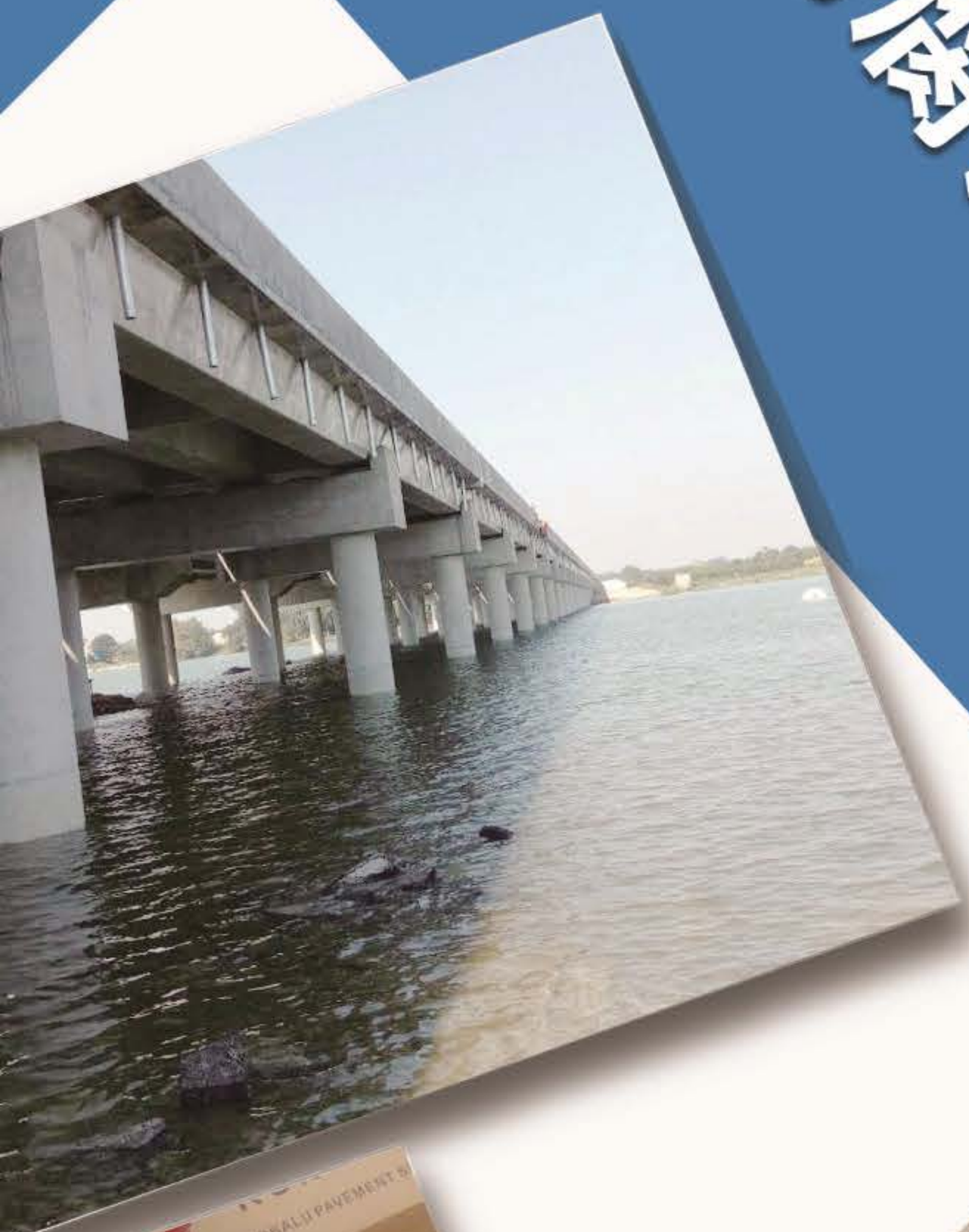
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