Urban Roads Bridges & Flood Control

城市道桥与防洪

主管：中华人民共和国住房和城乡建设部
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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

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广告索引

封面工程

本期封面工程为珠海横琴新区环岛东路立交工程，由沈阳市市政工程设计研究院有限公司设计。

环岛东路立交工程位于横琴新区口岸服务区，项目包含：环岛东路－港澳大道立交工程、环岛东路－濠江路立交工程、DX-16 路道路工程（环岛东路至琴海东路段）。

项目为迎接澳门回归 20 周年献礼工程及区重点项目，是优化新区发展空间的强力引擎。该区域的交通顺畅性是口岸功能实现和辐射能力增强的重要保障。建成后的立交工程，对途经莲花大桥的各类出入境客、货流进行分流，对市区方向、长隆方向和横琴二桥方向的车流进行集散，提升横琴口岸的旅客集散能力，加快了建设横琴新区综合交通枢纽城市的步伐，为推进粤港澳大湾区城市间的快速接驳、保证口岸进出顺畅发挥着积极作用。

港澳大道立交桥梁长 1 223.36 m，包含主线桥及 3 座匝道桥。濠江路立交桥梁全长 2 178.35 m，包含主线桥及 9 座匝道桥。高架桥上部结构采用连续钢混组合梁和连续钢箱梁两种结构型式。桥梁横断面为鱼腹式流线形断面。立交桥墩采用现浇钢筋混凝土曲线花瓶墩。

环岛东路立交项目设计于 2017 年 11 月启动，2018 年 5 月完成。2019 年 12 月项目建设完工。

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CONTENTS

ROADS & COMMUNICATION

Abstract: In order to study how to plan the cross-rive channels as a whole after the reconstruction of urban inland rivers in the urbanization process, starting with the mode of cross-river channel, the typical layout schemes of cross-river channels at home and abroad are qualitatively analyzed. The reasonable spacing of cross-river channels is basically obtained. Taking Wusong River Project (Shanghai Section) as an example, the layout scheme of cross-river channel is analyzed. Finally, the reasonable layout scheme is determined. The traffic adaptability of bridge layout after completed is analyzed. The spacing rationality is quantitatively verified.

Keywords: layout of cross-river channel, traffic adaptability, traffic demand, Wusong River Project

Abstract: In the new round of overall urban planning in Hefei City, Baogong Avenue located in the northeastern region of Hefei City is positioned as a rapid urban ray, which connects the central city and Feidong County in the east - west direction, and is both passenger transport and freight transport corridors. Therefore, relying on passenger flow forecast, the function of Baogong Avenue in the urban road network structure is analyzed. On the basis of study on the main road network of the whole city, the functional orientation of Baogong Avenue is sorted out. The passenger flows of its main road section, auxiliary road section and node ramp are analyzed. The study conclusion is achieved from two aspects of functional analysis and passenger flow analysis.

Keywords: urban traffic, main road network, functional analysis, passenger flow forecast

Abstract: Hunnan Avenue - Shengli Avenue Interchange is a hub-type interchange at the expressway junction of Hunnan Avenue and Shengli Avenue in Shenyang, and is a transportation hub connecting the south and the west of the city. The project background and functional orientation of Hunnan Avenue - Shengli Avenue Interchange are introduced. The traffic flow of the project is predicated by the regression analysis method and the double constraint method. The overall design, vertical and horizontal section design,

BRIDGES & STRUCTURES

Abstract: After more than 20 years of promotion, development, application and perfection, the fabricated partial pre-stressed concrete small-box beam has plaid the great role in the highway construction of China, and will be widely used as the pre-stressed structure on the highway and municipal bridge in the future. The development history of small-box beam is briefly introduced, and several revisions of small-box beam are compared and known. The relative experience can be referred by the relevant professionals.

Keywords: composite short-box beam, pre-stressed small-box beam, fabricated, partial pre-stressed concrete

Abstract: The main span of a cable-stayed bridge is arranged by 90 m+128 m. It is a single-pylon double-plane double-layer street truss bridge cable-stayed bridge, and is a semi-floating system. The finite element solid model of complete pylon is established by ABAQUS universal finite element program to analyze the stresses of pylon anchorage zone, bottom crossbeam and steel anchorage beam, which can be referred for the application of ABAQUS in the analysis of bridge structure.

Keywords: cable-stayed bridge, pylon, steel anchorage beam

Abstract: The Pingxi River Bridge in Dongkou County is a special-shaped steel single-pylon cable-stayed bridge with the main span 100 m across Pingxi River in Dongkou County. The bridge is a double-plane bridge with a pylon-beam-pier consolidation system. Its main beam is a single-box single-chamber P-K prestressed concrete box girder on both sides. The total width of the bridge is 34.6 m. The stayed cable is a parallel steel wire stayed cable with cold-cast anchor. The main pylon is a special-shaped steel box structure, and the cable is anchored to the main pylon through a steel anchor box. The main span spans the Pingxi River and is constructed by the cast-in-cantilever method. The anchor span is located on the shore and is constructed by cast-in-place support.

Keywords: cable-stayed bridge, special-shaped steel pylon, parallel steel wire, steel anchor box

Abstract: The main bridge of the Foshan City Haiwu Road West Extension Project crosses the waterway of Foshan. It is a span 135 m + 135 m single-pylon double-plane cable-stayed bridge. The main beam is a combined beam system composed of prestressed concrete beam and steel-concrete composite beam. The length 64.1 m of this bridge is situated on the transition curve. Its structure construction and its structure stress are complex. It can be referred for the design of the curved beam cable-stayed bridges and for reference of relevant professionals.

Abstract: Along with the development of the economy and the expansion of urban areas, the early construction of bridges across canals often becomes the traffic bottlenecks. The traffic contradictions are increasingly prominent and it is urgently to need the capacity expansion and reconstruction. Taking Suzhou Shishan Bridge Widening Project as an example, the application of trough beam bridge is introduced to overcome the difficulties of intersection restriction on both sides, improvement of channel standards, heavy channel traffic, old and new bridges integrated with the environment. The comfort of long-span footbridge and the application of TMD damper are compared and studied.

Keywords: bridge widening, trough beam, bridge across channel, comfort of footbridge, TMD damper

Abstract: Taking a railway double-column pier as an example, it is proposed that the internal force and displacement responses of bridge pier under seismic action are reduced by setting the cable-stayed rebar in order to ensure the safety of double-column pier under seismic action and to achieve the goal of preventive seismic strengthening. The Pushover analysis of double-column pier is carried out to calculate the yield curvature and ultimate curvature of the bridge pier, and the corresponding bending moment and displacement. The calculation results are adopted as the reinforcement evaluation indexes to evaluate the reinforcement effect of the cable-stayed rebar on double-column pier under the frequent earthquake and rare earthquake. The ANSYS finite element analysis software is used to carry out the nonlinear time-history response analysis. The internal force responses and displacement responses of the double-column pier before and after reinforced are compared. The necessity and rationality of the reinforcement are studied. The results show that the bridge pier is in the elastic stage and the internal forced at pier bottom is decreased under the frequent earthquake after the original double-column pier is set with cable-stayed rebar. The bridge pier is changed from the destructive state to yield state under the action of the rare earthquake, which meets the idea of ductile seismic reinforcement.

Keywords: bridge engineering, cable-stayed rebar, seismic reinforcement, double-column pier

Abstract: Rational use of space under urban bridge is of great practical significance for making full use of road space resources and saving urban land resources, which also attracts more and more attention of the people. In recent years, the fire caused by the illegal occupation of the space under bridge is more and more frequent in various regions. Combined with a practical project, how to repair the damaged structure quickly after a fire of the urban bridges without interruption of traffic is briefly discussed.

Keywords: urban bridge, fire, detection, repair, reinforcement, design

FLOOD CONTROL & DRAINAGE

Abstract: Shanghai lies at the front of the Yangtze River Delta. The seawall is divided at the Changjiang Estuary and the north bank of Hangzhou Bay. With the economic, social and industrial development of coastal areas along the river, as well as global climate change, sea-level rise and other major changes in the situation of water and work in the front of the seawall, the original design standards cannot meet the requirements of the planning. Therefore, the Shanghai Municipal Water Affairs Bureau launches a new round of seawall target construction. Taking a seawall target project in Pudong as an example, the basic ideas of seawall target is sorted out. Three basic measures of heightening the elevation of the high wall top, protecting the beach to promote siltation and to weaken the incoming sea wave, and roughing the slope surface are summarized. Its sensitivity to lowering the elevation of the levee top is analyzed. The results can be refereed for the design of seawall target.

Keywords: seawall, target scheme, sensitivity

Abstract: With the rapid development of urbanization, the great achievements have been made in the construction of urban drainage system at this stage in China. However, many problems of hard pavement brought by the excessive development and construction lead to the excessive hardening of underlying surface, which not only change and destroy the natural ecological background of a city, but also bring the flood disasters. In the result, the drainage capacity of the traditional urban drainage system is challenged. Therefore, the health and perfected urban drainage system is very important. Under the control of urbanization construction space, the idea of "sponge city" can be integrated into the mode of urban drainage system in order to upgrade the current single urban drainage system. The construction of low-impact development facilities in the drainage system can promote the recycling of water resources, effectively response to the environmental change and the different types of rainfall flood events, and at the same time, realize the free migration of rainwater in city. Based on an example of the sponge city experimental area in Xining City of Qinghai Province, the application of the "sponge city" rainfall flood management idea in the northwest region is discussed.

Keywords: sponge city, low-impact development, municipal drainage, storm water management model (SWMM)

Abstract: Shanghai is located in the lower reaches of the Taihu Lake Basin, where the river network is dense, low-lying and there are many bridges across the river. Due to the low lying of Shanghai, there is a big contradiction between the beam bottom elevation control and the bridge connection slope in the bridge engineering. By comprehensively analyzing the flood safety of non-navigable channel, the planned levee crown elevation and the operating vessel traffic in the area, and based on the river grade, the suggestion of optimizing value for bridge beam bottom elevation is proposed. Taking Changning District as an example, the reasonable valuing range of bridge beam bottom elevation in this district is analyzed, which provides a certain

MANAGEMENT & CONSTRUCITON

reclamation projects because of its good integrity and flexibility, and good adaptation to the deformation of embankment foundation. However, there are also cases of cofferdam instability in the big-sandbag cofferdam construction. Taking a land reclamation project as an example, the design and construction of big-sandbag cofferdam are introduced. Based on the limit equilibrium method, the reasons of collapse in its construction process are analyzed. Some corresponding experience and suggestions are provided for the later engineering site construction.

Keywords: land reclamation, soft foundation, big sandbag, cofferdam, stability analysis

STUDY ON SCIENCE & TECHNOLOGY

Abstract: The expressway traffic accident data is of great significance for the management department to improve the road traffic safety. In order to study the historical traffic accident data distribution and accident development trend of two expressways in Guizhou Province, the proximity and correlation analysis method is used to perfect the accident data firstly, then the influence of road feature on the traffic safety is analyzed, the unit range of continuous downhill road section and tunnel road section is divided, and finally the unit of road section is further divided into the blocks to establish the prediction model of accident probability and block position in the range of different blocks, in which the second half section of continuous downhill road section conforms to the linear relation, and the tunnel entrance / exit section conforms to quadratic function relation. Based on the accident distribution features, the improvement scheme is proposed so that the managers are assisted to master the road section range of traffic accidents possibly to happen in the different features of road sections and to grasp the improvement priority.

Keywords: traffic accident, continuous downhill, tunnel, prediction model

Abstract: Due to the special engineering characteristics of soft soil, it is more difficult to carry out urban road reconstruction and expansion projects on soft soil foundation than in general areas. It is the key to solve the problem of differential settlement between the old and new subgrade. The possible disease forms and mechanism of urban road widening in soft soil area are firstly analyzed. Then, based on a municipal road project, the finite element software ANSYS15.0 is used to study the differential settlement rules of the new and old roadbeds under the conditions of different widening widths, different roadbed heights and different subgrade soil modulus. And finally, the technical measures to reduce the differential settlement between the old and new roadbeds in the urban road reconstruction and expansion project in the soft soil area are proposed, and its impact effect is introduced in order to provide some theoretical guidance for the construction of the similar road reconstruction and expansion projects.

Keywords: soft soil, urban road, roadbed widening, differential settlement

Abstract: In order to compare the effect difference between SBS modified emulsified asphalt and rubber powder modified asphalt in the micro-surfacing technology of pavement maintenance, the indexes of two modified materials after mixed with the asphalt are obtained by the screening and control of two modified material contents. The range of dosage with better index result is selected, in which the content of SBS modifier is about 3%~7%, and the best content of rubber powder is about 10%~15%. The pavement performances of two mixtures are evaluated through the experiments. The results show that SBS modified asphalt material as pavement material has the better rutting performance in the micro-surfacing technology, and the rubber powder asphalt material as pavement material has the better anti-slide performance in the micro-surfacing technology.

Keywords: pavement maintenance, SBS modified emulsified asphalt, rubber powder modified asphalt, experiment, pavement performance

Abstract: Two simulation methods of arch ribs of a 500-meter-class concrete filled steel tube (CFST) arch bridge are studied in detail. The joint cross section and the two-unit method are used to establish the full-bridge spatial finite element model by means of Midas/Civil software. The similarities and differences among the steel pipe stress, the core concrete stress and the displacement of the key sections in the main construction stages by two methods are compared and analyzed. And the influence factors of arch rib simulation are analyzed, which can provide a reference for the relevant long-span concrete arch bridges.

Keywords: concrete filled steel tube arch rib, joint cross section, double-unit, influence factors

Abstract: Based on the Alataw Pass City - Wenquan County - G30 Highway Construction Project, the influence of the freezing-thaw cycle times, salt content, moisture content and load on the deformation of saline soil during salt swelling and melting is studied by the control variable method. The test result shows that the salt swelling property will gradually increase with the increase of the moisture content of saline soil during the salt swelling test. With the increase of salt content, the salt swelling property of saline soil is also more obvious, and with the decrease of temperature, the salt swelling amount of saline soil also gradually increases. But when the salt content and moisture content reach a certain degree, the salt swelling amount does not increase as the decrease of temperature. During the subsidence test, the settlement of soils in each group increases with the increase of moisture content under the condition of not considering the salt content. The greater the salt content, the greater the settlement under the same load. With the increase of pressure, the saline soil will still settle considerably.

Keywords: saline soil, subsidence, salt swelling, submerging test, settlement rate

Abstract: In recent years, the research on flood control and disaster prevention of timber arch lounge bridge is mainly based on the experience summary of water destruction cases to propose the macroscopic maintenance strategy. There is a lack of quantitative analysis of the flood load and the stress of lounge bridge structure. Therefore, based on the computational fluid dynamics (CFD) and finite element method, the analysis method of the flood resistance safety of lounge bridge is proposed. The load distribution law under different flood frequencies is studied, and the flood response and structure safety of bridge arch frame are quantitatively evaluated, which provide reference for flood prevention and safety monitoring of the timber arch lounge bridge. The results show that under the action of flood load, the horizontal force on member bars presents the linear distribution along the water depth, and the vertical force is evenly distributed. The main arch structure is deformed. Its upstream face is extruded towards the river and its backwater face is stretched towards both banks. The superstructure slopes towards the direction of water flow. The end plantlet of backwater face on the main arch is pulled and is easy to break away from the node, which lead to the collapse of bridge deck. The friction coefficient of the foundation and the shear resistance of the soil determine the stability of bearing, which is a key factor affecting the flood safety performance of the whole structure of lounge bridge.

Keywords: timber arch lounge bridge, flood control and disaster prevention, numerical simulation, flood response, computational fluid dynamics (CFD), finite element structure analysis

Abstract: Based on the construction project of Alashankou City Wenquan County G30 Highway, the typical numerical model of steep slope subgrade is established by means of numerical simulation. Under the condition of seasonal frozen soil, the influence factors of anti-h pile on the slide resistance of steep slope subgrade are studied, and the influence of pile spacing, freeze-thaw cycle times and section side length on settlement of steep slope subgrade is emphatically analyzed. The results show that the anti-h pile spacing has a great influence on the settlement. When the anti-h pile spacing is between 6 m and 7 m, the settlement of the steep slope subgrade is relatively stable. The influence of freezing-thaw cycle times on the settlement is first increased and then decreased. The section side length is not large the better. In a certain range, the settlement can be significantly reduced by increasing the side length of the section. But the settlement effect is not obvious if increasing this parameter continuously.

Keywords: numerical modeling, steep slope subgrade, freezing-thaw cycle, subgrade settlement

Abstract: Through the comparative study of different domestic norms and literatures and the analysis of

APPLICATION OF ACHIEVEMENTS

Abstract: With the rapid development of computer and three-dimensional technology, the design of water conservancy project is not only limited to solve the two-dimensional and single field technical problems, but also gradually developed into a three-dimensional and multi professional integrated design mode. Based on the platform of Bentley series software, a set of 3D design methods suitable for river regulation engineering is proposed through the technical means of creating model, collision detection, engineering quantity calculation and real effect.

Keywords: BIM technology, Bentley software, river design, 3D collaboration

THE RELATIVE SPECIALITIES

Abstract: Based on Beijing Road Station of Guiyang Metro Line 3, the scheme of interchange station in the central urban area by the undermining method is studied. According to the study, the cross interchange mode is adopted under the certain conditions. According to the passenger flow forecast, the platform width is 15.5 m. Combined with the requirements of equipment clearance, pipeline laying, construction error, etc., the clear width of station is 22.8 m, which is a long-span station. When the deformation control requirements of the station construction in the central urban area are high and the section span of the undermined station is long, the center drift method can be used for construction. Through the numerical simulation, the stress analysis of the primary support and secondary lining of the undermined structure is carried out. And through the calculation, it can be found that when certain primary support measures are taken, the center drift method can play a certain role in deformation control. The waterproof quality of the undermined station can be ensured by the optimization of the undermining section, and the whole package waterproof and joint waterproof reinforcement. The structure type of the undermined station by the center drift method can meet the seismic requirements.

Keywords: interchange station, undermining method, waterproof, center drift method, seismic resistance

Abstract: At present, the construction of large deep foundation pit close to and parallel to the bridges is rare in urban area. The deep and thick permeable sand layer in river channel has the characteristics of difficult grooving, high underground water level and infinite supply, which will great increase the engineering difficulties and the bridge safety risk. Combined with an engineering case of Beijing and according to the protection of existing bridges, the risk sources affecting the safety of foundation pit and existing bridges are analyze din detail. Based on the numerical simulation and calculation, the relevant engineering measures are especially formulated for the construction of deep foundation pit in the river channel close to bridge. The monitoring data show that the safety of bridges during construction is ensured. The relative engineering experience can be referred for the similar projects.

Abstract: By comparison and analysis, the changes in *Highway Engineering Budget Quota* issued in 2018 are expounded. Combined with the engineering cases in Shandong Province, taking the manual consumption, material consumption and mechanical shift consumption as the key point of measurement, the influence of new quota on the construction installation engineering cost is analyzed.

Keywords: highway engineering, compiling method, budget, quota, cost

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