



# 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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图为广东省建筑设计研究院有限公司设计的  
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### ● 本期看点

- 道路与轨道交通综合开发中的慢行系统研究
- 岩溶地区中小跨径桥梁下部结构设计新思路
- 上跨铁路转体桥梁设计与施工关键技术
- 大连市海绵城市规划原则、目标与定位



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总编辑: 骆燕妮

责任编辑: 叶露 赵晓燕

美术编辑: 杨建华

英文校审: 孙宁萍

地址: 上海市中山北二路901号 邮编:200092

电话:(021)55008850 传真:(021)55008850

投稿网址: <http://www.csdqyfh.com>

联系邮箱: [cdq@smedi.com](mailto:cdq@smedi.com)

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**封面工程**

本期封面工程为广州南沙新区明珠湾区起步区——灵山岛尖配套道路工程,由广东省建筑设计研究院有限公司设计。

该项目共建设主、次干路及支路 27 条,路网总长度约 23.2 km,包括 18 座景观性中桥和 2.3 km 综合管廊。项目主要体现了路水交融、一桥一景的设计特点。(1)城市道路与滨水景观浑然一体的生态滨水新城。依托滨水元素,通过路、桥、水的统筹布局,采用一桥一景、路水衔接等精细化设计,打造亲水、生态、景观优美,与滨水元素不分彼此的城市道路。(2)平安智慧、互联互通的骨架路网。“一环一轴”的骨架路网满足交通互联互通,同时依托安全平稳的道路系统设计及预留,为智能驾驶示范段的搭建提供支撑,实现“聪明路”配“智慧车”。(3)以人为本、景观优美的亲水街道。服务型道路按“小街区、密路网”的设计理念,紧密结合亲水化、立体化、人性化的步行网络,采用小转弯半径、衔接坡道等设计手法,建设亲水街道。(4)一桥一景的桥梁博览馆。根据“湾区明珠,钻石水乡”的定位,结合传统岭南特色文化,打造 18 座富有现代水乡特色的景观桥。(5)南沙自贸区首个智慧综合管廊项目,构建主次分明、经济实用、功能完善的管线综合系统。(6)约 47 万 m<sup>2</sup> 的大规模真空预压法在南沙道路工程施工中首次应用,具有重要的实践意义。

该工程总投资约 27 亿元,建安费约 15.3 亿元。2012 年 9 月开始设计,2014 年 12 月设计完成,2020 年 3 月项目竣工。

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# Urban Roads, Bridges & Flood Control

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..... ZHAO Xiaojuan ( 1 )

**Abstract:** How to build an integrated above-ground and underground slow traffic system is specially studied under the relatively tight condition of urban spatial resources when the integrated development and construction of road and rail transit are combined. Taking Maizhuang Road passing through Ciqunan Parking Lot of Metro Line 17 as an engineering case, three schemes of the node design of passing through the slow traffic system of the parking lot are analyzed and compared one by one. At the same time, the connections to bus and taxi, and the over-crossing road scheme are introduced and determined.

**Keywords:** rail transit, parking lot, slow traffic system, integration development

Study on Scheme of Chongqing – Hunan Double-line Expressway Channel to City .....

TU Zhizhong ( 5 )

**Abstract:** In order to fully play the traffic functions of radial expressway, it is very necessary to carry out the preliminary study on the roadways, nodes and related construction conditions of radial expressway channel to city. Taking the study on the scheme of Chongqing – Hunan Double-line Expressway Channel to city as an example, on the basis of the project functional orientation and the traffic demand prediction and analysis, the conception and design of overall scheme are expounded. The lane number, roadway type, plane and vertical designs, and node type of radial expressway channel to city are compared, analyzed and demonstrated. The viaduct main and auxiliary road scheme + ground main and auxiliary road scheme are analyzed and compared. Scheme I has been selected. The present situations, functional orientations and types of two interchanges involved to this project are analyzed and expounded. Finally, the conclusion shows that with the urban construction and development, the construction conditions of urban area are getting more complicated. The good preliminary study of radial expressway channel to city can ensure the construction conditions and implementability of radial expressway channel to city in the later period.

**Keywords:** scheme study, channel to city, radial expressway, inner ring expressway, quick turning to interchange

Comprehensive Comparison and Selection of Multiple Schemes for a Traffic River-crossing Channel Firstly in Guangzhou – Foshan Co-construction Demonstration Pilot Area .....

Liu Yibin ( 9 )

**Abstract:** Aiming at the general route selection and the river-crossing method of the first traffic river-crossing channel of Guangzhou – Foshan Co-construction Demonstration Pilot Area, many schemes are further compared and selected. On the basis of analyzing the key control factors of the river-crossing channel project, four alignments of Line A, Line B, Line C and Line K are compared. Two river-crossing schemes of bridge and tunnel are compared and selected from whether or not to meet the urban planning development, to

affect the natural environment, to satisfy the benefits of the residents along the line. The sinking pipe method and shield method of tunnel construction are compared from the control factors, and the horizontal and longitudinal layouts. After the multiple scheme comparison, finally, a feasibly recommended scheme is determined in consideration of the benefits of all.

**Keywords:** river-crossing channel, overall alignment, comparison of alignments, comparison of construction methods

Planning and Design of Jining Expressway System ..... ZHANG Chunguang ( 13 )

**Abstract:** The planning and design schemes of expressway system in Jining are introduced. According to the planning, construction conditions and traffic operation characteristics of Jining, the layout form, laying type and overall layout of expressway network in Jining are compared, and the reasonable design scheme is put forward. The setting-up contents of transportation hub, important node and ramp of the road network are relatively discussed, which can be referred for the related projects.

**Keywords:** expressway, planning and design, hub interchange, ramp

Research on Backbone Road Network Planning of Lingang Special Area ..... XU Jia ( 19 )

**Abstract:** In order to further improve the development level of land transportation in Lingang Special Area and serve the goals of industrial cooperation, transportation interconnection, ecological cooperation and cultural integration of the Special Area, the current situation and existing road network planning under the overall framework of comprehensive transportation are evaluated. The traffic development trend in combination with the new urban development orientation and space pattern is studied and judged. Based on this, the planning target and main strategy of the backbone road network are put forward. The backbone road network for three levels of the external, new special area and main urban area is built. The scale of important channels, the composition of passenger and freight functions, and the construction type are further studied, which provide the basis for the development of important regions and the implementation of the major projects in order to clear the short-term and long-term development directions, and provide the important support for the compilation of the "14 th Five-Year" Plan and the next level planning of the Special Area.

**Keywords:** special area, backbone road network, integration of Yangtze River Delta

Scheme Design of Landside Road Distribution System in T3 Terminal Area of Changsha Airport .....  
..... DENG Qi ( 22 )

**Abstract:** In order to ensure the rapid, convenient and efficient distribution of land-side road traffic in the T3 terminal area of the Changsha Huanghua International Airport, the landside road distribution system of the terminal area is analyzed and designed from the demand of traffic organization, analysis of upper planning road network, optimization of traffic organization, overall design of road distribution system, scheme evaluation, characteristics and the other aspects. On the basis of the overall planning of road network structure in the terminal area, in the design scheme, the traffic organization of the landside road distribution system is specially optimized, the structural types of viaduct and subway are fully utilized, the layout of road distribution system is the three-dimensional, and the inbound and outbound traffics are reasonably organized. Finally, the characteristics of the scheme are summarized and evaluated.

**Keywords:** Changsha Airport, landside road, distribution system, scheme design

Design of Overall Scheme for Gangzhou City Shahe Avenue Expressway Project ..... ZUO You ( 26 )

**Abstract:** Shahe Avenue is an important vertical component of the "four-horizontal and six-vertical"

expressway network planned by Ganzhou City. Through the predictive analysis of its functional orientation and traffic flow, the overall scheme of the Shahe Avenue Expressway is reasonably determined, and the layout of each key node is studied in combination with the surrounding construction conditions in order to provide reference for the design of similar projects.

**Keywords:** expressway, overall scheme, node scheme

Overall Design of Linyi City Yihe Road Expressway Reconstruction Project ..... ZHENG Peiguang ( 30 )

**Abstract:** Yihe Road is an important ring in the planning of "three-ring and fifteen-ray" skeleton road network of Linyi City. By analyzing the functional orientation of Yihe Road, combined with the traffic prediction, the study on the technical standards, general layout, interchange design and the other essentials of this project in the design process is introduced, which can be referred for the similar projects.

**Keywords:** expressway, overall design, design of interchange

Study on Ramp Length of Service Area Entrance and Exit Based on Horizontal Curve Parameters .....

..... ZHU Jianfang, MAO Huabing, HAN Zexiang ( 34 )

**Abstract:** Starting from the basic concepts and related design indexes of service area exit and entrance ramps, based on the different parameters of ramp plane curve design, the calculation model of minimum length of service area exit and entrance ramps is established by using the ramp running speed prediction model in the *Code for Safety Evaluation of Highway Projects* (JTG B05-2015). Finally, the minimum value of the length of the exit and entrance ramps in the expressway service area at the different design speeds is calculated and obtained.

**Keywords:** service area ramp, plane curve parameter, running speed prediction model, minimum length of ramp

Design of Urban Road Non-motorized Lane Based on Sponge City Concept ..... DING Liya ( 37 )

**Abstract:** At present, the separation of motor vehicle lane and non-motorized vehicle lane of road traffic, and the replacing of guardrail with greening of the road traffic are greatly been proposing in China. More and more new and reconstructed roads are of three-road or four-road types, and have the independent non-motorized lanes. Against this background, relying on an road reconstruction project and based on the sponge city concept, the design methods of non-motorized lane cross slope to the inside slope of the road convenient for the motor and non-motorized vehicle separator to collect the rainwater of non-motorized lane and sidewalk for cultivating the soil are proposed. The principle, the detailed design method and the promotion significance of this design method are expounded.

**Keywords:** non-motorized lane, sponge city, road cross slope, lane design

Overall Design of Mengshan Avenue Interchange in Linyi ..... ZHANG Shibin ( 40 )

**Abstract:** Mengshan Avenue Interchange in Linyi is a hub-type interchange at the intersection of Yihe Road and Mengshan Avenue. It is an important transfer node between the West Inner Ring Road (Mengshan Avenue) and the South Inner Ring Road (Yihe Road) in Linyi City. The traffic volume of the node is predicted. And the engineering overview and construction scale of the node are introduced. The functional orientation and main technical standards of the node are specially analyzed. The overall design scheme of the interchange is introduced in detail from the profile design, cross section design and structural design of the interchange.

**Keywords:** hub-type interchange, traffic prediction, technical standard, overall design

## BRIDGES & STRUCTURES

Overall Design of Fuxing Avenue Bridge Project across Jiangnan Canal ..... PAN Fan ( 44 )

**Abstract:** The project of Fuxing Avenue Bridge across Jiangnan Canal is an important project connecting Chengbei Expressway in the east of the main urban area and the west extension line of Fuxing Avenue in west of the main urban area in Jingzhou City. The total length of the project line is 700 m, the design speed is 80 km/h, and the two-way six lanes are used. The whole line includes a single-pylon cable-stayed landscape bridge with the main 183-m span pier across Jiangnan Canal.

**Keywords:** landscape bridge, cable-stayed bridge, single-cable plane, widening bridge, steel bridge pylon, steel box girder

Comparison of Overall Design for Qujiang Bridge ..... LI Pengcheng ( 48 )

**Abstract:** The terrain conditions in the southwest mountainous area are complex. The design of bridges across river is influenced by many factors. Taking Qujiang Bridge as an example, the multiple schemes are compared and selected for the overall design of this extra-large bridge from the perspective of topography, hydrology, bridge type and cost. Finally, a (126+240+126)-m continuous rigid frame bridge is determined. The spans of this bridge are long and are appropriate for the complex terrain construction, which has a certain reference value for the selection of bridge structures in the mountainous areas.

**Keywords:** continuous rigid frame, short-pylon cable-stayed bridge, cable-stayed bridge, stress

Analysis on Integral Structural Stability of 1 600 m Double-pylon Self-anchored Cable-stayed Bridge .....

..... JIANG Yang ( 51 )

**Abstract:** For the structure of super long-span self-anchored cable-stayed bridge, the main girder at the bridge pylon bears the huge axial force. The integral stability of the main girder becomes the key factor to control the structural stress. Five main factors of the height of main girder, the number of auxiliary piers, the constraint of pylon and beam, the height of pylon and the anchorage distance on the pylon which affect the integral stability of cable-stayed bridge structure are analyzed to determine the reasonable value of each parameter.

**Keywords:** cable-stayed bridge, structural stability, elastic stability coefficient

Analysis on Dynamic Test and Dynamic Influence of Lattice Steel Pylon Cable-stayed Bridge .....

..... LIU Peng, CAI Yingying, WU Zhen ( 54 )

**Abstract:** In order to study the dynamic characteristics of lattice steel pylon cable-stayed bridge, taking Baoji Lugang Bridge as the background, the dynamic characteristics of the bridge are measured by pulsation test method, and compared and analyzed with the finite element model value. On this basis, the influences of the parametric change of the main pylon stiffness, main girder stiffness, side span auxiliary piers, main pylon height and other parameters are analyzed. The results show that the measured modal vibrating shape is basically consistent with the theoretical modal vibrating shape, and the measured frequency value is slightly larger than the theoretical value. The vibrating modes of the pylon and girder of lattice steel pylon cable-stayed bridge are easy to be excited at the same time, coupled with each other and affected each other, which are not conducive to earthquake resistance. The whole torsional stiffness of bridge pylon is big enough to improve the wind resistant capability of structure. The side span auxiliary piers can greatly improve the longitudinal rigidity and vertical rigidity of the bridge, which can enhance the wind resistance of the structure and improve the driving comfort. For its dynamic characteristics, the best pylon-to-span ratio of this type of bridge is between 1/3 and 1/2.5.



**Keywords:** lattice steel pylon cable-stayed bridge, dynamic characteristics, impulse test, parameter analysis, frequency, modal shape, auxiliary pier

Brief Discussion on Design of Medium-span and Long-span Bridges in Plain Area ..... ZHANG Hejin ( 58 )

**Abstract:** The topography of the plain areas is often covered with rivers and the elevation of the surrounding is lower. With the more and more strict approval of setting up the piers in water of objects crossing river by the water conservancy department, it is required to set up a large number of medium-span and long-span bridges. Due to this kind of bridge often required to level with the roads along a river, therefore, this kind of bridge has the characteristics of long span, strictly limited structural height and higher landscape demands of bridge structure. Combined with the design scheme of the structures across river in Yuyao City Taojia Road River Reconstruction Project, the single-span bridge design schemes of the medium and long spans are discussed, analyzed and compared, which can be referred for the scheme design of the similar bridges.

**Keywords:** medium span and long span, single-span bridge, scheme design

Research on Stress Behavior of Crossbeam Considering Longitudinal Effect ..... LI Shenglong ( 61 )

**Abstract:** Taking a newly-built bridge project as the background, the spatial finite element software Midas Civil is used to establish a carling model. The 3D finite element software ANSYS is used to analyze the crossbeam stress under the multiple construction conditions, and each result is compared and analyzed. The result shows that the strain result of crossbeam is distorted in the existing crossbeam design method because of not considering the longitudinal effect according to the strain control viewpoint. In order to guarantee the safety and durability of bridge structure in the service period, the analysis mode should be used by considering the vertical and horizontal interactions. The relevant conclusion can provide a certain guiding significance for the design and analysis of crossbeams in the future.

**Keywords:** pre-stressed concrete continuous box beam, crossbeam design, strain control, ANSYS

Analysis on Web Shear Distribution of Single-box Multiple-cell Wide Box Girder Bridge ..... YANG Zhenxuan, ZHANG Hang, BI Wei ( 64 )

**Abstract:** In the design of engineering projects, the crosswise deck width of single-box multiple-cell wide box girder is often larger than span. The stress is complex. The use of general beam element calculation and analysis is hard to effectively and accurately simulate the stress state of crosswise bridge to box girder, in which the shear distribution to the different webs of crosswise bridge is the key point of crosswise stress of multiple-web wide-box girder. In order to study the difference of the shear distributions of the different webs, the solid element finite element model of upper box girder and the related comparison models are established. The analysis result shows that the layout of support will act as a crucial adjective role for the multiple-web shear distribution of wide-box girder.

**Keywords:** wide-box girder, web shear distribution, finite element, analysis

Design Practice of Steel Box Beam Bridge with Overhanging Crossbeam ..... XIAO Chun, LI Xubiao, WANG Wenjian, MA Chao ( 67 )

**Abstract:** When a viaduct is limited by a river, road, metro and underground pipeline, the overhanging crossbeam is an effective solution for use. Combined with the  $4 \times 28.9$  m steel box beam bridge with overhanging crossbeam of the sixth left main line of Fenghuangshan Viaduct, the design, calculation and construction of the bridge are introduced, and the value of crossbeam height and the stability measures of

crossbeam during construction are discussed, which can provide the reference for the design of the similar bridges at home and abroad.

**Keywords:** viaduct, steel box beam, overhanging crossbeam, Midas Civil

Study on Combined Seismic Design of Vehicular Bridge and Pedestrian Bridge ..... ZHANG Chaopeng ( 71 )

**Abstract:** With the increase of landscape bridges, the combined setting up of vehicular bridge and pedestrian bridge is more and more. According to the actual engineering cases, the seismic analysis model of vehicular bridge and pedestrian bridge is established. Four working conditions of vehicular bridge using the velocity locking support and friction pendulum, and pedestrian bridge using the fixed support and high damping rubber support are compared and analyzed. The combined seismic design problems of vehicular bridge and pedestrian bridge are considered. The calculation result shows that the vehicular bridge using the velocity locking support and the pedestrian bridge using the high damping rubber support at the same time can better meet the combined stress of vehicular bridge and pedestrian bridge, and also can make the pier columns uniformly stressed and reduce the stress of the pier columns.

**Keywords:** vehicular bridge, pedestrian bridge, velocity locking support, high damping rubber support

Design of Dongzhou Bridge in Luxi Country of Jiangxi Province ..... LIU Jin ( 74 )

**Abstract:** The urban bridges are not only used for transportation, but also for landscape, especially the waterfront bridges. How to improve the bridge landscape on the premise of the limited engineering cost and lower construction difficulties becomes a big problem in front of designers. Taking Luzhou Bridge in Luxi County as an example, the overall design, superstructure design, substructure design, structural analysis and brightening design of the bridge are introduced to make it practical and artistic, which can be referred for the design of the similar bridges.

**Keywords:** urban bridge, decorative arch, engineering design, V-shaped pier, bridge brightening

Discussion on Design of Small and Medium-span Bridges on Mountain Highways ..... YANG Fen, ZHANG Hua ( 77 )

**Abstract:** Some design problems in the selection of substructure and the layout of bridge position in the design of the small and medium-span bridges on the mountain highways are discussed. Through the selection of bridge types, the comparison of superstructure and substructure, and the analysis of economy, some suggestions can be provided for the majority of designers by some practical cases.

**Keywords:** mountain bridge, small and medium-span bridges, design discussion

Structural Design and Computational Analysis for Main Bridge of Tonggang Bridge ..... ZHONG Jian ( 80 )

**Abstract:** The landscape design scheme and structural computational analysis for the main bridge of Tonggang Bridge – a urban landscape bridge across Tongyu River in Jiangshu Province Yancheng City Funing Development Area are introduced. The main bridge span of this bridge is  $60\text{ m}+110\text{ m}+60\text{ m}=230\text{ m}$ . The arch-girder composite structural system is adopted. Through the structural calculation and stability analysis of the whole bridge, the rationality and safety of the bridge scheme are verified.

**Keywords:** through arch bridge, structural design, transmission length, Yancheng City

Study on Design of Suspender Anchor Joint of Conghua Bridge in Guangzhou ..... SU Hong ( 83 )

**Abstract:** The main bridge of Conghua Bridge in Guangzhou is a single-span 136 m through concrete filled steel tube spatial arch-beam composite system bridge, and belongs to an unconventional structure.

The joint anchorage design of suspender and arch rib, suspender and main beam is one of the key control points of the whole design scheme. In order to obtain a reasonable design scheme of suspender anchorage and ensure the structural stress safety, various possible joint connection schemes suitable for Conghua Bridge are listed, and the advantages and disadvantages of the schemes are analyzed and evaluated one by one. Finally, the scheme adopted by this bridge is given.

**Keywords:** design of suspension anchor joint, concrete filled steel tube spatial composite arch, prestressed concrete box girder

Influence of Steel Bundles on Transverse Distribution Coefficient of Hollow Slab Bridge ..... WEI Baoping ( 86 )

**Abstract:** The transverse distribution coefficient of hollow slab bridge is very important to its structural design. The influence of steel bundles is not included in the conventional calculation. In view of the steel bundles able to improve the vertical stiffness of plate girder, the influence of steel bundles on the transverse distribution coefficient is studied. Taking a one-span 19-hollow-slab girder as an example, based on Midas Civil, the grillage model of bridge superstructure is established. The number of steel bundles of hollow slab should be adjusted appropriately. The transverse distribution coefficients of moving load are solved through the mid-span deflection. And compared with the calculation result of Hasbro, the relevant conclusion is obtained.

**Keywords:** hollow slab, steel bundles, transverse distribution coefficient, grillage

New Design Idea of Substructure of Medium and Small Span Bridges in Karst Area ..... WANG Ruhan ( 89 )

**Abstract:** The construction of bridge pile foundation in karst area has the disadvantages of large difficulty, high risky, slow period and high cost. For the medium and small span bridges, there is a situation that the costs of bridge pile foundation and karst cave treatment are much higher than that of bridge superstructure. In view of this phenomenon, based on the design example of a landscape bridge in Qingyuan City, the pile foundation in its substructure is eliminated and the enlarged foundation is replaced. And the base stress of the enlarged foundation is reduced through a series of innovative optimization design methods to make the structure safe and reliable. This method avoids the construction difficulties and risks of pile foundation in karst area, shortens the construction period, saves the engineering cost, and provides a new idea for the design of substructure of medium and small span bridges in karst area.

**Keywords:** karst, medium and small span bridges, substructure design

Automation Design of Spatial Cable Glass Suspension Bridge ..... CUI Lu, NING Jing, DONG Jianwei ( 92 )

**Abstract:** The automation design program of a spatial cable glass bridge with the wind cable is developed by the segmental catenary theory. A C/C++/C# language is used to carry out the secondary development for AutoCAD through ObjectARX Technique. Combined with the actual engineering cases, Midas Civil is used to verify the program result. The result is very consistent. With the future of engineering design industry gradually toward intelligent, this attempt can provide the different development experience for the engineering design of this field.

**Keywords:** segmental catenary, wind resistant cable, ObjectARX, MIDAS

Application of Multi-beam Steel-concrete Continuous Composite Beam in Urban Viaduct ..... YUE Zhangsheng, JIANG Haijun, WANG Liwei ( 95 )

**Abstract:** With the improvement of people's demand for traffic and surrounding living environment, the

rapid and low-impact construction is more and more used in urban engineering construction. The multi-beam steel-concrete composite beam bridges have the advantages of short construction period, low impact on traffic, factory production, moderate cost, and ability to match the precast construction of standard section in the construction of urban bridges, which can ensure the uniformity of the whole landscape, effectively alleviate the contradiction between construction and traffic conflict, and then be used in the urban viaduct, and is a relatively new structural form of urban bridges. Through the comparison and analysis on various calculation methods of steel-concrete composite beams, the results show that the multi-beam steel-concrete composite beam bridge has the good stress performance and has the strong popularization value in urban viaduct.

**Keywords:** low-impact construction, urban viaduct, multi-beam steel-concrete composite beam, bridge landscape

Application of Small Box Beam in S3 Highway Project ..... LI Li ( 98 )

**Abstract:** The application of post-tensioned prestressed concrete small box beams in the new construction of S3 Highway Project (Zhoudeng Highway - G1503 Highway Lianggang Avenue Interchange) is introduced. The advantages of the small box beam are compared with the other structures. The application and optimization of the structures and sections in the project are described. The calculation parameters and stress control of small box beam are briefly introduced. The application of simple-supported to continuous small box beam in the small-radius interchange is introduced. The problems are required for attention in construction of small box beam.

**Keywords:** post-tensioned prestressed concrete small box beam, simple-supported to continuous, small-radius interchange, matters needing attention in construction

Analysis on Structure Selection of Landscape River Bridge ..... WANG Ziyu ( 102 )

**Abstract:** With the rapid development of new area and new town construction, the urban planning of inland river area has gradually changed into a construction mode based on the sponge concept and river landscape. On the premise of meeting the basic functions of the surrounding road network, the design of river-crossing bridge should be based on the specific boundary conditions to carry out the reasonable structure selection in order to strive to deeply integrate the structural appearance with the regional environment so as to form a whole visual effect of the landscape river.

**Keywords:** landscape river, boundary condition, structure selection

## FLOOD CONTROL & DRAINAGE

Planning Principle, Objective and Orientation of Dalian Sponge City ..... CHEN Hai ( 106 )

**Abstract:** Taking Dalian as an example, the planning concept, planning principle, planning thinking and target location of Dalian sponge city are introduced and analyzed. By analyzing the background problems and the software simulation, the construction system of urban sponge city is judged and analyzed.

**Keywords:** sponge city, planning concept, planning objective

Optimization of Flood Control and Waterlogging Drainage Scheme for Guangzhou Luogang New City Outer Ring Road Underpassing North 2 nd Ring Expressway Tunnel ..... HUANG Tianyu, YI Guanting ( 111 )

**Abstract:** With the development of economy and society, the number of motor vehicles in the cities has increased rapidly. The original intersecting mode at grade of roads is difficult to meet the needs of modern

automobile traffic, which hinders the realization of automobile in the cities. For this reason, a large number of urban underpass tunnels and overpasses have been built in Guangzhou. However, in recent years, the phenomenon of a large number of waterlogging at the low-lying places of urban underpass tunnel and interchange caused by heavy rainfall has occurred from time to time, and there is a tendency to get worse. The urban waterlogging has brought the great inconvenience to the travel of the people, and even led to the death and disappearance of issuers in serious cases, which result in huge losses and profound lessons. Taking a river underpass tunnel project in Guangzhou as an example, combined with the "5.21-5.22" heavy rain data in Guangzhou, through re-sorting up the catchment areas, the flood control and waterlogging drainage scheme of the tunnel is optimized, and the flood control safety alarming system is added, which provide a useful reference for the other urban tunnel projects in the southern rainy areas such as Guangzhou.

**Keywords:** river urban underpass tunnel, river embankment regulation, flood control and waterlogging drainage, flood control safety warning system

Application of Analytic Hierarchy Process in Study on Selection of Ecological Slope Protection in a Project  
..... CHAI Xiandun ( 116 )

**Abstract:** The selection of ecological slope protection is always a more subjective link in specific projects. The rationality of its final selection is often to be discussed. Taking a project as an example, the analytic hierarchy process (AHP) is introduced to assign the value matrix of scheme evaluation criterion layer and scheme layer by the experts and owners. And the hierarch single-sorting, double-sorting and its consistency tests are carried out. The application results show that AHP has the stable calculation results and the good application effect.

**Keywords:** ecological slope protection, type selection, AHP

Research Progress and Engineering Application of Trenchless Recovery Technology for Drainage Pipes .....  
..... JU Chaorong ( 119 )

**Abstract:** The main principle, characteristics, adaptation conditions and development tendency of the trenchless recovery technology for drainage pipes are introduced, including the integral recovery technologies of inverted in-situ curing, ultraviolet light in-situ curing, in-situ thermoplastic modeling and segment lining recovery, and the local recovery technologies of local resin in-situ curing and stainless steel double expansion ring. Combined with a practical engineering case, the detailed application conditions and implementation effects of trenches recovery technologies are introduced, which can be referred for the similar projects.

**Keywords:** drainage pipe, trenchless recovery, in-situ curing, in-situ thermoplastic modeling, segment lining recovery, stainless steel double expansion ring

Screening, Dredging and Maintenance of Functional Defects of Urban Drainage Pipes .....  
..... KOU Changxi ( 122 )

**Abstract:** With the increase of the construction and using time of urban municipal drainage pipes, the higher requirements are put forward for the maintenance of urban pipes. The detective methods, contents and applicability of pipe functions are discussed. The pipe maintenance technologies are introduced and compared. The relevant pipe maintenance scheme is proposed according to the detective results. The scheme can not only improve the maintenance efficiency, but also decrease the maintenance cost.

**Keywords:** functional defect of pipe, closed circuit television (CCTV) detection, peep sonar detection, quick view (QV) detection, pipe dredging and maintenance

## MANAGEMENT & CONSTRUCTION

Key Design and Construction Techniques for Swivel Bridge across Railway ..... ZHANG Wenjin, CAO Wen ( 125 )

**Abstract:** The two-span pre-stressed concrete variable height T-rigid frame box girder is adopted for the bridge across Guangzhou-Shenzhen Railway in Shenzhen Outer-Ring Expressway. The span is  $2 \times 82.5$  m and the deck width is 33 m. The plane swivel method is used in the construction. The swivel angle is  $72.342^\circ$ . The cantilever length of the swivel structure is  $2 \times 73.5$  m, and the swivel weight is 24 000 tons, which refreshes the width and weight records of swivel bridges within the jurisdiction of China Railway Guangzhou Bureau Group. In the trial swiveling stage of this bridge, the technical parameters are provided for the formal swivel through weighing test, trial swiveling test and inch-moving test, which ensure the smooth swivelling. The completion of the bridge ensures the smooth opening of Shenzhen Outer-Ring Expressway according to the plan, and accumulates the valuable experience for the design and construction of large tonnage swivel bridges in China.

**Keywords:** T-rigid frame box girder bridge, swivel construction, bridge across railway, spherical hinge, trial swivelling test

Study on Key Construction Technology of 90 m+200 m+90 m Continuous Rigid-frame Steel Tube Arch Bridge ..... KE Weipeng, WANG Bo ( 129 )

**Abstract:** The continuous beam steel tube arch bridge is the main bridge structure in China, has many advantages of convenient, safe and reliable construction, and low construction cost, and is widely used in the bridge construction. Taking the construction of 90 m+200 m+90 m continuous rigid-frame steel tube arch bridge of Fuhe River Bridge as an example, the construction technologies of long-span continuous rigid-frame steel tube arch bridge are expounded and analyzed in detail, which can be referred for the similar projects.

**Keywords:** continuous rigid frame, steel tube arch bridge, key construction technology, study and analysis

Construction Monitoring of Long-span Cable-stayed Bridge of Guangxin Bridge in Huaiyang Expressway ..... ZHOU Lvdan ( 134 )

**Abstract:** Based on the construction of the cable-stayed bridge of Guangxin Bridge in Huaiyang Expressway, the monitoring and measuring technologies of long-span cable-stayed bridge are mainly expounded. The main contents include the establishment of plane and elevation datum, the displacement measurement of main pylon, the observation of main beam alignment, the selection of the relationship curve between the temperature and time and the elevation of main beam, and the selection of observation period, etc.

**Keywords:** cable-stayed bridge, construction monitoring, alignment control

Research on Rapid Construction of Lower Foundation of Aluminum Alloy Footbridge ..... JIANG Shichi ( 139 )

**Abstract:** After more than 10 years of development in recently, the aluminum alloy footbridges have gradually become a new branch of municipal engineering footbridges. In the existing engineering practices, the method of factory prefabrication and on-site assembling is mostly used for the construction of aluminum alloy footbridge superstructure. But the lower foundation is still used of the traditional drilling/digging piles or cast-in-place enlarged foundation, which leads to the long in-site construction

period of the whole bridge, and is hard to fully play and reflect the advantages of the rapid construction of aluminum alloy footbridge. In order to solve this problem, combined with the characteristics of aluminum alloy footbridge, the main dimensions of the lower foundation are calculated according to the trussed aluminum alloy footbridges in two different spans. The corresponding rapid construction scheme of pile foundation and enlarged foundation is proposed, and the specific solutions for the key points in the construction scheme are put forward.

**Keywords:** aluminum alloy, footbridge, lower foundation, prefabricated assembly, PC pile

Analysis on Temperature and Deformation Characteristics of Composite Retaining Wall Based on Freezing Method ..... ZHU Ying ( 143 )

**Abstract:** With the great development of the urban underground space, the intersecting position of the existing tunnel and new foundation pit usually leads to the discontinuity of the underground diaphragm wall, which leads to problems of groundwater seepage and insufficient retaining capacity. Taking the excavation project of a deep foundation pit in a metro station of Shanghai as an example, the composite retaining wall is constructed according to the artificial freezing method in order to achieve the dual effects of soil reinforcement and waterproof sealing. Combined with the finite element analysis method, the temperature distribution of soil around the tunnel is simulated and obtained. The field monitoring is carried out to study the stress and deformation characteristics of the "freezing method + underground diaphragm wall" composite retaining wall. The adverse effect of freezing method on the underground diaphragm wall is evaluated by calculating the bending moment. And the reinforcement requirements of wall body to resist the hogging moment are put forward.

**Keywords:** artificial freezing method, temperature distribution, numerical simulation, field monitoring, freezing

Design and Research on Widening and Asphalt Overlay of Cement Concrete Pavement ..... LIU Daojun, HUANG Congjun ( 147 )

**Abstract:** Combined with Lujiang County South Wenming Road Reconstruction Project, the widening scheme of the old cement concrete pavement under the background of reasonable layout of the road cross section is discussed. At the same time, on the basis of detailed assessment of the pavement condition, the asphalt overlaying scheme is studied and determined. The practice shows that the scheme is feasible.

**Keywords:** South Wenming Road, cement concrete pavement, pavement widening, asphalt overlay

Brief Analysis on Time Sequence Management of Co-construction of Rail Transit and Municipal Engineering ..... CHEN Chao ( 150 )

**Abstract:** Due to the problems of the urban planning, and the reconstruction of the old and new cities, it is inevitable that the newly-built municipal engineering interweaves closely with the construction of rail transit. The problems of construction time sequence to be found in time and coordinated with the municipal infrastructure in the early construction stage of urban rail transit can effectively promote the construction progress of urban rail transit and reduce the hidden safety problems between the structures. According to the relative position relationship between the proposed road and rail transit, Midas/GTS finite element method is used to analyze the adverse effect caused by the co-construction time sequence of rail transit and municipal engineering through an engineering case, and to evaluate its safety.

**Keywords:** newly-built road, rail transit, finite element analysis, safety evaluation

Research on Construction Technology of Shield Tunneling through Confined Water-bearing Stratum .....

..... CHEN Minghui,WANG Jian, LIANG Jie ( 153 )

**Abstract:** Aiming at the areal tunnel of Danyang Road Station – Changyi Road Station of Shanghai Metro Line 18, the reasons of the segment floating to cause the segment crazing and segment leakage during the shield tunneling in the confined water-bearing stratum are analyzed. The technical measures and methods to solve the above problems are put forward, which can provide some reference and experience for the shield tunneling in the confined water-bearing stratum.

**Keywords:** shield, confined water-bearing stratum, segment floating, segment crazing

Study on Problems and Countermeasures in Practice of Engineering, Procurement and Construction (EPC)

..... ZHOU Jianmin ( 157 )

**Abstract:** Aiming at the problems existing in the practice of EPC now, combined with the pilot situation of EPC project in Zhejiang Province, the problems of difficult bidding, difficult tendering and difficult settlement of construction units, and insufficient matured markets and insufficient perfected supporting policies are analyzed and studied. The experience and lessons are summarized, and the solutions are put forward. On this basis, the suggestions are proposed for the difference between EPC mode and expected target in order to create a good environment for the promotion of EPC mode.

**Keywords:** EPC, difficulties, countermeasures

## STUDY ON SCIENCE & TECHNOLOGY

Research on Influence Mechanism of Road Geometry Design on Vehicle Driving Characteristics .....

..... YU Haonan, ZHOU Wei ( 160 )

**Abstract:** Road is a comprehensive system composed of people, road, vehicle, etc. Vehicle driving is greatly affected by road geometric parameters. Firstly, the influences of straight line, circular curve, slope length, slope and other parameters on vehicle driving are analyzed. Then the vehicle model, road model and comprehensive simulation model of man-vehicle-road are established by using Carsim software, and the reliability of the model is analyzed by using double line shifting method. Finally, based on an urban expressway, the variation law of vehicle driving characteristics is analyzed by using speed variation coefficient  $K_v$  and sideslip safety coefficient  $K_s$ . The research results can provide certain theoretical guidance for the geometric design of the similar urban roads.

**Keywords:** road alignment, geometric parameter, vehicle driving, influence mechanism

Study on Influence of Warm-mixed Modified Asphalt and Its Mixture on Road Performance .....

..... ZHAO Yingfang ( 164 )

**Abstract:** The current society attaches great importance to environmental protection engineering, and highway pavement engineering is also no exception. In order to explore the influence and effect of warm-mixed agent on the modified asphalt and mixture, through the laboratory test analysis, the results shows that the warm-mixed asphalt becomes more stable because of its production principle and process, and has the advantages of lower energy consumption, lower cost, etc. The addition of RH warm agent has a relatively obvious improvement on the temperature of modified asphalt, which indicates that RH warm agent has a good cooling effect. The larger the dosage of RH warm agent is, the greater the amount of temperature change is. The addition of RH warm agent will not reduce the rutting performances of asphalt pavement, which belongs to the modified agent with no effect on pavement performance.

**Keywords:** warm-mixed asphalt, cooling effect, rutting performance, RH warm agent



Study on Design and Performance of Cement Pavement Grouting Material Based on AHP – Fuzzy Mathematics  
..... TANG Bincan ( 168 )

**Abstract:** In order to improve the treatment effect of void at the bottom of cement concrete pavement, the analytic hierarchy process (AHP) and the fuzzy mathematics theory are used to establish a multi-level fuzzy comprehensive evaluation model for the optimal scheme of cement pavement grouting material. The fly ash and desulfurized gypsum are selected to replace the cement in an appropriate proportion to prepare the cement pavement grouting material. And the established comprehensive evaluation model is used to comprehensively evaluate the selection schemes of cement pavement grouting materials. The superiorities of 10 compared schemes are obtained. The maximum superiority is 71.61%, and the minimum superiority is 21.75%. In order to verify the rationality of the model, the corresponding schemes with the superiorities of 71.16%, 70.92%, 70.83% and 21.75% are selected to repeat the experiments. The results show that the model has good repeatability, can accurately reflect the effect of grouting material in the treatment of slab bottom void, and has the good engineering application value.

**Keywords:** cement concrete pavement, slab bottom void, grouting material, fuzzy mathematics, analytic hierarchy process (AHP)

Study on Influencing Factors of Traffic Delay at Entrance and Exit of Underground Circular Tunnel .....  
..... XIAO Xinbo, HE Jianping, XING Lei, XU Ting ( 171 )

**Abstract:** In order to analyze the main influencing factors of the traffic delay at the entrance and exit of the underground circular tunnel and improve the traffic efficiency of the entrance and exit, based on the characteristics of the entrance and exit of the underground circular tunnel, the influencing factor system of the traffic delay at the entrance and exit of the underground circular tunnel is established from the aspects of people, vehicles, roads, environment and the attraction rate of garage. Then from the perspective of the system, the influencing factors are analyzed by using the model of decision-making and trial evaluation laboratory (DEMATEL). The results show that the main influencing factors of the traffic delay at the entrance and exit of the underground circular tunnel are the slope of the entrance and exit, the length of the entrance and exit lane and the attraction rate of the underground garage. The most vulnerable factors are the vehicle speed and the driver's reflective judgment. The research effects can provide a certain theoretical basis for improving the accessibility of underground circular tunnel and underground garage, and reducing the traffic delay at the entrance and exit of underground circular tunnel.

**Keywords:** underground circular tunnel, entrance and exit, traffic delay, influence factor, DEMATEL model

Study on Type Finding of Bridge Based on Progressive Structural Optimization Algorithm .....  
..... WANG Jun, WANG Ping, FENG Zhaoliang ( 175 )

**Abstract:** By introducing the basic theory of structural topology optimization, the principle and optimizing process of the evolutionary structural optimization algorithm are expounded in detail. By compiling ANSYS topology optimization program based on the evolutionary structural optimization algorithm, 2D plane topology optimization problems are solved. The study result indicates that the evolutionary structural optimization algorithm can help the designers to choose a reasonable and enlightening bridge structure, and has a good application prospect.

**Keywords:** topology optimization, evolutionary structural optimization

Optimal Design of Bridge Structural Parameters Based on Multi-level Neural Network .....  
..... JIANG Qun ( 179 )

**Abstract:** Due to the traditional parameter optimization methods hard to realizing the effective improvement of the overall performance of the bridge structure after optimizing the bridge structure parameters, a research on the optimal design of bridge structure parameters based on multi-level neural networks is carried out. By establishing a finite element model of bridge structure, based on the multi-level neural network, the optimization goal of the bridge structure parameters is determined, the sample data for the optimization of the bridge structure parameters are collected, and the multi-level neural network parameters of the bridge structure are optimized and solved. A new parameter optimization method is proposed. The experiments have further proved that the new parameter optimization method can effectively improve the comprehensive performance of the bridge structure compared with the traditional parameter optimization method, which provides a new optimization idea for increasing the efficiency and reducing the consumption of bridge construction.

**Keywords:** multi-level neural network, bridge structure, parameter optimization

Summary of Main Factors Affecting Chloride Ion Concentration on Concrete Surface ..... LYU Zheng ( 182 )

**Abstract:** At present, the research and analysis on the influencing factors of the chloride ion concentration on concrete surface show that the main influencing factors are time, material and environment. With the prolonging of exposure time, the surface chloride ion concentration will increase. With the prolonging of curing time, the concrete structure will gradually become dense and the surface chloride ion concentration will decrease. With the increase of water binder ratio, the surface chloride ion concentration will gradually increase after stabilized and the stable state will reach faster. After the mineral admixtures are added, the cumulative rate of chloride ion will increase significantly, that is the surface chloride ion concentration will reach the stable state faster, and the stable surface chloride ion concentration will also increase accordingly after stabilized. The higher is the chloride ion concentration in the exposed environment medium, the higher is the surface chloride ion concentration. The distance from the concrete structure to the coast and the speed of sea wind to the concrete structure will also have a certain impact on the free chloride ion concentration on the surface of the concrete structure. There are many factors affecting the chloride ion concentration on the surface of concrete structure. It is very difficult to accurately calculate and predict the chloride ion concentration on the surface of concrete structure. At present, the empirical formula can only be used to calculate and predict the chloride ion concentration at home and abroad. Therefore, the calculation of chloride ion concentration needs to be further studied.

**Keywords:** concrete, chloride ion concentration, time, material, environment

Research on Aerial Triangulation Calculation of Large-area Weak Texture Region Based on Virtuoso3D ..... CAO Jianjun ( 186 )

**Abstract:** Aiming at the current unmanned aerial vehicle (UAV) tilt photogrammetry in-house data processing, the error rate of the aerial triangulation is high in the large-area weak texture region, and its precision is hard to guarantee the present situation. The aerial triangulation calculation is carried out for the large-area weak texture region by using Virtuoso3D. Firstly, the operating sequence of aerial triangulation based on Virtuoso3D is introduced. Taking an actual project in Rongdong Area as an example, there are the unapparent feature points or deficiency phenomenon in multiple continuous images during the aerial photo because of this region covered by large-area vegetation and dust screen. In the process of aerial triangulation calculation, the method of calculating and extracting the feature points based on multi-view images is easy to appear the problem that the continuous weak texture image does not participate in the operation. And Virtuoso3D adopts the universality algorithm of machine vision to match

the rigorous solution based on photogrammetry. The success rate and accuracy of aerial triangulation calculation are fully improved at the same time of reducing the matching times, which effectively solve the problems of uneven distribution, fracture and layering of aerial triangulation connection points in large-areas weak texture region. The fine turning point after the free net follows the principle of layering and iterating from coarse to fine to obtain the reliable aerial triangulation results.

**Keywords:** tilt photography, Virtuoso3d, aerial triangulation, weak texture

Study on Factors Influencing Self-healing Performance of Matrix Asphalt Based on Orthogonal Test .....

..... DENG Hua, HUANG Feng ( 189 )

**Abstract:** As a viscoelastic material, the asphalt material has the self-healing property. In order to study the significant factors affecting 70# matrix asphalt, three factors of intermittent temperature, intermittent time and damage are selected to design the orthogonal test, and a dynamic shear rheometer is used to carry out the "fatigue-healing-fatigue" test. According to the range and variance, the influence of each factor on the self-healing performance index is obtained. The results show the main factor affecting the healing performance index  $HI_1$  is the intermittent time, while the intermittent temperature and the damage degree have little influence. It is considered that the index  $HI_1$  is not appropriate to evaluate the self-healing performance of matrix asphalt. The significance ordering of the factors influencing the self-healing performance index  $HI_2$  is the intermittent temperature > intermittent time > damage degree, and with the increase of intermittent temperature and time, the self-healing degree of asphalt will be greatly improved. By considering the relationship between loading times and modulus, the self-healing index  $HI_3$  is modified. The significance  $HI_3$  ordering of each factor to the index is the damage degree > intermittent temperature > intermittent time, and with the increase of damage degree, the self-healing degree gradually decreases. The optimal combination of reflecting the good self-healing performance is 30° C intermittent temperature, 4h intermittent time and 10% damage degree.

**Keywords:** road engineering, matrix asphalt, dynamic modulus, self-healing performance

## APPLICATION OF ACHIEVEMENTS

Research on Application of New Reinforced Gabion Retaining Wall in Subgrade Ecological Retaining Engineering .....

..... WU Yingfeng ( 193 )

**Abstract:** Compared with the traditional subgrade retaining wall, the new reinforced gabion retaining wall has the advantages of ecological environmental protection and less land occupation. Based on the calculation and analysis of the earth pressure, reinforced material length and structural stability of the new retaining wall, the application of engineering construction technology is described, which can provide reference for the construction of ecological highway and similar projects.

**Keywords:** new reinforced gabion, earth pressure, length of reinforced material, structural stability

Application Practice of Cement-to-Asphalt Ultrathin Overlay on Cement Pavement of Urban Road .....

..... LIU Kangkang, LI Dawei, CAO Jie ( 196 )

**Abstract:** The ultrathin overlay is used for the reconstruction of cement pavement, which has the characteristics of quick time efficiency, saving materials, good reconstruction effect and pavement silence. Through the application practice of an urban road relying on the cement pavement to pave the ultrathin overlay, the implementation process and technical characteristics of ultrathin overlay are summarized. At the same time, in view of the special conditions of cement pavement, the corresponding treatment schemes are proposed. The results can provide the reference for the upgrading and reconstruction of the similar

cement pavements.

**Keywords:** reconstruction of cement pavement, ultrathin overlay, pavement treatment

Application of BIM Technology in Preliminary Design of Jihe Expressway Project .....

..... LEI Yinhui, HE Shanshan, YAO Shukui ( 199 )

**Abstract:** Taking Jihe Expressway Reconstruction and Extension Project as the background, the application of BIM technology in the preliminary design stage is studied. First of all, aiming at the professional numerous and huge design data before the project design, a collaborative work platform is established, the unified working space is created, and a technical framework of standard modeling rules is built. Secondly, to achieve visual analysis and evaluation of route design schemes, the 3D real scene model, pipeline and control factor modeling in the road design process are carried out for BIM technology demonstration, and a refined site model is built. Finally, for the purpose of BIM forward design, the important design technology nodes of roads, bridges and tunnels are studied in the CNCCBIM OpenRoads software and a road, bridge and tunnel integrated development platform. The scientific and reasonable application workflow of BIM in the forward design of highways is created, which provides the experience and reference for the realization of forward design of BIM in the later stage.

**Keywords:** preliminary design, BIM application, workflow, forward design

Application and Discussion of 3D Laser Scanning Technology in Protection of Urban Ancient Bridge – Baling Bridge in Weiyuan County .....

..... SHAN Lan, ZHANG Long, HONG Shenghui, MA Lihe, AN Delong, LI Fengjuan ( 205 )

**Abstract:** With the development of technology, 3D laser scanning technology has some advantages in data acquisition of buildings. Baling Bridge in Weiyuan County of Gansu Province is a unique pure wooden overhanging laminated beam arch bridge in China. This bridge has long enjoyed a good reputation because of its excellent construction of artistic and scientific values. Taking Baling Bridge in Weiyuan County as an example, based on 3D laser scanning technology, the point cloud data of the ancient bridge are acquired and processed, and relying on the point cloud data, the digital protection of the urban ancient bridge is applied and discussed.

**Keywords:** 3D laser scanning, ancient bridge protection, Baling Bridge

## THE RELATIVE SPECIALITIES

Finite Element Numerical Analysis on Structural Vibration of a Deep Pumping House .....

..... XIONG Yonghua, CHEN Kunpeng, WANG Shaojie ( 209 )

**Abstract:** Taking a deep pumping house of a wastewater treatment plant (WWTP) in Wuhan as the study object, based on ANSYS finite element numerical analysis software, the geometric model and material model are established. The appropriate constraint of pumping house is selected and the mesh generation is carried out. The modal analysis of its floor structure is carried out. Its inherent frequency and vibration mode are calculated. The relevant amending advice is provided according to the calculation results. The modal analysis of the deep pumping house structure after improved is carried out. The result shows that the vibrational frequency of pumping house after improved is far from the dominant frequency of the pumps and the resonance is not easy to produce.

**Keywords:** deep pumping house, finite element, modal analysis, vibration frequency, resonance

Analysis and Study on Impact of Large-area Heaped Load on Adjacent Viaduct Piers in Soft Soil Area .....  
..... MA Zhilong, PAN Chunhui ( 212 )

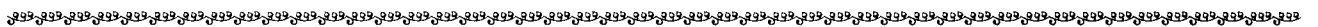
**Abstract:** Combined with the heaped load project of landscape terrain around an expressway bridge in Hangzhou, the numerical finite element method is used to study the deformation of piers caused by the large-area heaped load. Considering the effective stress and excess pore water pressure, the factors related to the height of heaped load, the slope rate of heaped load, and the distance between the heaped load and the existing pier are analyzed. The appropriate height and distance of the heaped load are determined according to the control standard of the pile foundation displacement in the design code, which can provide the relevant experience for the similar projects.

**Keywords:** large-area heaped load, existing piers, finite element analysis, pile foundation deformation

Brief Analysis on Engineering Cost Control of Green Building ..... DENG Luoyu ( 216 )

**Abstract:** With the rapid development of social economy and the overall progress of technology, the people have the higher and higher requirements for the living environment and the natural environment. The rise of the green building industry has become the overwhelming tendency. According to various management methods and stipulations of green building industry gradually issued, the development conditions of green building industry are maturing. The control of engineering cost is an important component in the management of green building construction, and is a role not to be ignored in its development. The relevant conception and essential features of the green building are briefly summarized. The main contents of green building in regard to the control of engineering cost and how to control the engineering cost of green building better are further studied, which can control the engineering cost of green building better in order to make the green building engineering vigorously developed.

**Keywords:** engineering cost, control, green building



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Address: 901 Zhongshan Bei Er Road, Shanghai, China

P.C.: 200092

Tel.: (021)55008850

Fax: (021)55008850

Website: <http://www.csdqyfh.com>

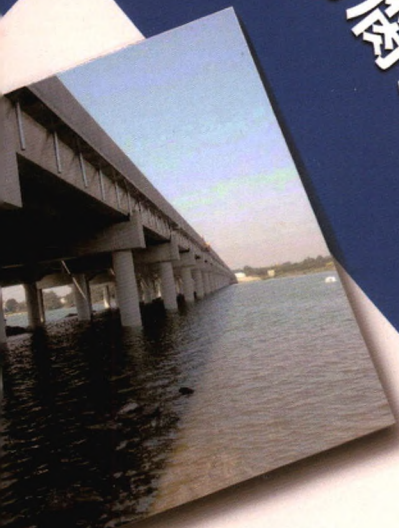
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