

Journal of World Architecture

Editor-in-Chief

Monsingh David Devadas

Anna University, India

BIO-BYWORD SCIENTIFIC PUBLISHING PTY LTD

(619 649 400)

Level 10

50 Clarence Street

SYDNEY NSW 2000

Copyright © 2022. Bio-Byword Scientific Publishing Pty Ltd.

Complimentary Copy



Journal of World Architecture

Focus and Scope

The *Journal of World Architecture* is a peer-reviewed international journal, which offers an avenue for researchers and practitioners to present the latest progress associated with architecture, occupants and related policies. It aims to encourage academic exchange and enhancing professional development in this field.

Topics covered but not limited to:

- Architecture theories and practices of design, technology and construction;
- Impacts of architecture on society, economy and environment;
- Analysis of occupants physically and psychologically and the application of new technologies, materials to meet their needs;
- Formulation of public policy as well as organisational structures and networks.

About Publisher

Bio-Byword Scientific Publishing is a fast-growing, peer-reviewed and open access journal publisher, which is located in Sydney, Australia. As a dependable and credible corporation, it promotes and serves a broad range of subject areas for the benefit of humanity. By informing and educating a global community of scholars, practitioners, researchers and students, it endeavours to be the world's leading independent academic and professional publisher. To realize it, it keeps creative and innovative to meet the range of the authors' needs and publish the best of their work.

By cooperating with University of Sydney, University of New South Wales and other world-famous universities, Bio-Byword Scientific Publishing has established a huge publishing system based on hundreds of academic programs, and with a variety of journals in the subjects of medicine, construction, education and electronics.

Publisher Headquarter

BIO-BYWORD SCIENTIFIC PUBLISHING PTY LTD

Level 10

50 Clarence Street

Sydney NSW 2000

Website: www.bbwpublisher.com

Email: info@bbwpublisher.com

Table of Contents

- 1** **Autoclaved Aerated Concrete Block Prefabricated Multi-Storey Building Technology**
Jingjing Sun
- 5** **A Study of the Streets and Alleys of Traditional Settlements in Taihang Mountains –
Taking Wangjinzhuang, Shexian County as an Example**
Wei Su, Yalei Liu
- 11** **Application of Nanomaterials in Subgrade and Pavement**
Yazhou Liu
- 15** **Paving Materials and Engineering Applications of Permeable Pavement**
Zhuang Liu
- 19** **Discussion on Anti-Seepage Technologies in the Construction of Small-Scale Rural Water
Conservancy Projects**
Suxiang Yuan
- 25** **Application of Mobile Formwork Cast-In-Situ Beam Technology in Bridge Construction**
Xiangwei Zheng

Call for papers – Journal of World Architecture

ISSN (Online): 2208-3499

ISSN (Print): 2208-3480

Submission open for May 2022

Dear Researchers,

The *Journal of World Architecture* is a peer-reviewed international journal, which offers an avenue for researchers and practitioners to present the latest progress associated with architecture, occupants and related policies. It aims to encourage academic exchange and enhancing professional development in this field.

The Journal Publishes in both online and print version. *Journal of World Architecture* publishes research and review paper in the field of:

- Architecture theories and practices of design, technology and construction;
- Impacts of architecture on society, economy and environment;
- Analysis of occupants physically and psychologically and the application of new technologies, materials to meet their needs;
- Formulation of public policy as well as organisational structures and networks.

All relevant papers are carefully considered, vetted by a distinguished team of international experts, and rapidly published. Original articles, short communications, case studies and comprehensive review articles can be submitted online via the journal's submission and peer review site.

The *Journal of World Architecture* is published by Bio-Byword Scientific Publishing Company, it is a fast growing peer-reviewed and open access journal publisher, which is located in Sydney, Australia. As a dependable and credible corporation, it promotes and serves a broad range of subject areas such as medicine, construction, education and electronics for the benefit of humanity. By informing and educating a global community of scholars, practitioners, researchers and students, it endeavour's to be the world's leading independent academic and professional publisher.

All Bio-Byword journals are free from all access barriers, allowing for the widest possible global dissemination of their manuscripts and highest possible citations. Bio-Byword publisher online submission will go through a rapid peer review and production, making the process of publishing simpler and more efficient, which benefit from its user friendly online submission system that reduces the overall time from submission to publication.

Acceptance Notification: Within 21 days from the date of manuscript submission

Send your manuscript to the editor at: info@bbwpublisher.com

With Warm Regards,

Editor-in-Chief

Dr. Monsingh David Devadas

Journal of World Architecture

Autoclaved Aerated Concrete Block Prefabricated Multi-Storey Building Technology

Jingjing Sun*

Chongqing Energy Vocational College, Chongqing 402260, China

*Corresponding author: Jingjing Sun, jiangwei001vip@126.com

Copyright: © 2022 Author(s). This is an open-access article distributed under the terms of the Creative Commons Attribution License (CC BY 4.0), permitting distribution and reproduction in any medium, provided the original work is cited.

Abstract: In active response to the national requirements of promoting green building materials and developing prefabricated buildings, it is necessary to continuously optimize and reasonably employ relevant technologies. Autoclaved aerated concrete block prefabricated multi-storey building technology is a new technology, which will not only effectively realize green environmental protection in construction engineering, but also promote the further development of prefabricated buildings. Therefore, this paper analyzes the autoclaved aerated concrete block prefabricated multi-storey building technology for future references.

Keywords: Autoclaved aerated concrete; Building block; Prefabricated building; Multi-storey building

Online publication: March 4, 2022

1. Introduction

Prefabricated building is a type of building in which its building components are produced first and then assembled on the construction site. Autoclaved aerated concrete block prefabricated multi-storey building is one of the changes in prefabricated buildings, which can effectively save energy and resources, reduce construction pollution, and improve production efficiency as well as the safety level. At the same time, strengthening the integration between the production process and informatization along with industrialization is conducive to cultivating new drivers for new industries and improving overcapacity. In the past, autoclaved aerated concrete blocks have been used to build walls, but they are rarely used directly in building construction. In order to effectively promote the concepts of openness, sharing, green, and innovation, autoclaved aerated concrete blocks have been optimized and ensured that they adhere to standardized design, production, construction, and decoration, so as to promote the transformation and upgrading of the construction industry. Based on this, it is of great significance to analyze the autoclaved aerated concrete block prefabricated multi-storey building technology.

2. Definition of autoclaved aerated concrete block prefabricated building

Autoclaved aerated concrete block prefabricated building refers to a residence built in the form of industrial production; the wall limbs, roof panels, floors, and stairs are manufactured in the factory, and transported to the construction site; they components are then connected to form a building.

3. Application situation of autoclaved aerated concrete block prefabricated building technology

Modern countries attach great importance to urbanization and the construction of “new countryside.” In view of the actual situation, they have launched many favorable policies that can promote urbanization and

the development of “new countryside,” thus improving the living standards of urban and rural residents. However, for residential buildings in urban and rural areas, there are cases with low scientific and technological content, short service life, poor construction quality, and low cost performance. The reason for this situation is that advanced technology and high-quality materials are not applied in the construction process, and there are no available professional personnel to give corresponding guidance. In addition, the substandard quality of the construction team also contributes to this situation to a certain extent. In order to effectively improve the adverse situation, it is necessary to apply advanced technology and use high-quality materials in the construction process, employ highly professional staffs to carry out the construction work, and effectively promote as well as apply new products, new technologies, and new materials, so as to significantly improve the housing quality in urban and rural areas.

In line with the aforementioned strategy, applying autoclaved aerated concrete block prefabricated multi-storey building technology to the construction process may be beneficial. However, there are occurrences when the building materials used in the construction process do not conform to the application needs of the building itself. Several conditions, such as the block size does not coordinate with the construction module, the lower limit of the splitting tensile strength does not meet the requirement of the crack in the wall, and the poor water content limit of the outlet kettle is not conducive to the prevention and control work of the shrinkage crack in the wall, will result in the restriction of the application and popularization of advanced technology [1].

In the process of urbanization and the continuous construction of “new countryside” in China, more than 700 million square meters of houses still need to be built every year, in which the mode of industrial production needs to be reasonably applied in this process. Therefore, it is necessary to actively promote the application of autoclaved aerated concrete block prefabricated multi-storey building technology, so that the development progress from block to wall, and to the whole building, thus realizing the development goal of building a multi-storey building.

4. Reasonable application of autoclaved aerated concrete block prefabricated multi-storey building technology

Practically speaking, for China’s construction industry, the autoclaved aerated concrete block fabricated multi-storey building technology is still a new technology. Many construction teams are still unable to fully grasp the material requirements and design requirements to a certain extent, which is not conducive to the comprehensive application of this technology and does not ensure the safety as well as efficiency of the construction process. Therefore, it is necessary to analyze the reasonable application of this technology as well as clarify the relevant material requirements and design requirements, so as to improve the application effect of this technology in the process of constructing a multi-storey building.

4.1. Material requirements

The strength of plates and blocks made of autoclaved aerated concrete should be at least A3.5, the coefficient of variation should be controlled within 0.10 or below, the corresponding split pressure ratio should conform to the “Uniform Technical Code for the Application of Wall Materials,” and the height of blocks should be above 240 mm.

Autoclaved aerated concrete reinforced plate should be adopted for floor slab and roof slab, the reinforcement in it should be reinforced with good holding and wrapping force, and the ductility of the reinforcement itself should be adequate.

The thin mortar joint masonry adhesive should be reasonably applied to the mortar, and the wall should be treated in the form of thin plastering. If conditions permit, it is best to use mechanized spraying. In the process of building the autoclaved aerated concrete block exterior wall, the thermal conductivity of the

special thermal insulation mortar used should be kept at 0.18 w/(mK) or below, so as to ensure that the block would have a good matching thermal performance effect with the mortar, which is conducive to improving the thermal insulation effect of the wall and further optimizing the energy-saving design. Although the thickness of mortar joint should be 10 mm or less in the design work, the theoretical calculation value can be directly applied in the thermal calculation; that is, the correction coefficient of thermal conductivity and heat storage coefficient does not have to be multiplied by 1.25 ^[2]. The stairs and other accessories should also be effectively prefabricated.

4.2. Design requirements

The design work should be carried out by a special design organization. The personnel involved in the design work are required to be able to effectively apply the relevant knowledge of architectural design and structural design, as well as master the characteristics of autoclaved aerated concrete products, so as to meet the following requirements: (1) design requirements; (2) planning requirements; (3) harmonious environment; (4) comfortable and practical; (5) beautiful personality. In the process of design, the scheme design and preliminary design should be carried out first, followed by the design of construction drawings, wall limb splitting, and block type splitting. At the same time, information data should be transmitted in time with the help of information technology.

Based on the drawings and with the help of Building Information Modeling (BIM) technology, special technical staffs can then split the wall limb. In the splitting process, the size of the wall limb should be based on the size of autoclaved aerated concrete block. At the same time, it is necessary to take into account the wall stress requirements, the number of wall pieces, the performance of walling machine, transportation, and hoisting, as well as other aspects. The shape of reinforcement, structural column, tie beam, and other components may have some impact on it. Therefore, when constructing a series diagram of wall limb, the wall limb should be reasonably divided into different block types using BIM. Different numbers can be used to represent the block types, which can then be counted into a table and uniformly transmitted to the processing section of special-shaped blocks. The processing work can be carried out according to this. In the construction process, the autoclaved aerated concrete block wall-laying machine should also be used reasonably. This equipment has many functions, such as data identification, automatic setting out, and automatic block setting out. It can also spray the binder automatically and carry out cutting work when necessary. It is very suitable for masonry work ^[3].

The logistics system should be advanced and maintained professionally. The assembly team is responsible for arranging logistics and transportation equipment to ensure that the transportation of all components is in an ideal state.

As for the construction team on the construction site, they should maintain a high level of professional skills. They should assemble and splice the wall pieces or other components transported to the construction site according to the design and construction requirements in a timely and effective manner.

Autoclaved aerated concrete reinforced slab can be used as floor or roof slab. It is better to use prestressed vierendeel laminated slab. The reason is that this type of slab does not only have the characteristic of high rationality of slab type, but also have superior cost performance and overall strong bearing capacity in view of the high strength prestressed steel rod applied in it. As it has a vierendeel part, water, electricity, heating, and other pipelines can cross it, thus greatly saving the construction space.

A wall panel installation machine can be used to assemble the partition wall of the indoor part. The wall panel installation machine is not only used for wall panel installation, but also serves as a movable construction platform for high-altitude operation, which is conducive to improving the construction efficiency. At present, the wall panel installation machine can be widely used in the installation of wall panels with different structures, in which the application effect is good ^[4].

Scientific and reasonable construction standards and methods are important bases for maintaining the safety and effectiveness of the construction process of prefabricated buildings. Therefore, it is necessary to reasonably prepare relevant standards and methods as well as submit them in time for approval. After approval, they should be fully implemented in the construction process.

On the whole, the application of autoclaved aerated concrete block prefabricated multi-storey building technology requires that all masonry walls and components in all aspects should be transported to the construction site first, and the on-site hoisting work should be reasonably carried out with machineries. At the same time, local pouring should be fully cooperated to ensure effective connection of fasteners, so as to complete the construction of multi-storey buildings.

5. Conclusion

Autoclaved aerated concrete block prefabricated multi-storey building technology is a new technology vigorously promoted by contemporary departments. It is also the basis for the effective development of the autoclaved aerated concrete market. At the same time, it has grown into an opportunity to effectively change the ideas of building construction. In the application of this technology, it is important to pay attention to meeting the material requirements and design requirements, adopt scientific and reasonable construction measures, as well as use corresponding mechanical equipment to realize the effective construction of prefabricated buildings, which is conducive to improving economic and social benefits.

Disclosure statement

The author declares no conflict of interest.

References

- [1] Liu X, 2017, Research on Key Technical Issues in the Design and Construction of Autoclaved Aerated Concrete Block Filled Wall. *Jiangxi Building Materials*, 2017(20): 28.
- [2] Yang Y, Wu X, Liang K, 2020, Application of Autoclaved Aerated Concrete Strip in Prefabricated Residential Engineering. *Interior Architecture of China*, 2020(3): 206-207.
- [3] Xiao Z, 2019, Study on Anti-Seismic Performance of RC Frame Structures with Precast AAC Block Filled Walls, Hunan University.
- [4] Lu S, Lu T, 2013, Autoclaved Aerated Concrete Short Block, Short Block Combination and Piecework Masonry Method: CN103276844A.

Publisher's note

Bio-Byword Scientific Publishing remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

A Study of the Streets and Alleys of Traditional Settlements in Taihang Mountains – Taking Wangjinzhuang, Shexian County as an Example

Wei Su^{1*}, Yalei Liu²

¹School of Architecture and Design, Hebei Polytechnic Institute, Shijiazhuang 050091, Hebei Province, China

²Hebei Jiuyizhuang Chen Technology (Group) Co., Ltd., Shijiazhuang 050035, Hebei Province, China

*Corresponding author: Wei Su, 609591943@qq.com

Copyright: © 2022 Author(s). This is an open-access article distributed under the terms of the Creative Commons Attribution License (CC BY 4.0), permitting distribution and reproduction in any medium, provided the original work is cited.

Abstract: Wangjinzhuang in Shexian County, which has a long history, is a representative of the traditional settlements in Taihang Mountains. Through the in-depth study of the morphological characteristics of Wangjinzhuang settlement, this paper fully excavates its value as a traditional settlement. The overall pattern of the settlement form is complete, showing a linear layout form; the road system is graded, and the structure is clear; the spatial form shows a combination of points, lines, and planes; public buildings are distributed in an orderly manner, with clear functions, and they have a high degree of research value.

Keywords: Traditional settlement; Street space; Wangjinzhuang

Online publication: March 4, 2022

1. Overview of the settlement

Wangjinzhuang, which belongs to Jingdian Town, is located deep in the mountains of Taihang, approximately five kilometers away from Shexian County. The village has five administrative villages with 4,417 people. After the 1950s, through the efforts of the villagers, the entire village has been comprehensively managed, making the current Wangjinzhuang seemingly brand new.

Wangjinzhuang settlement gradually developed and expanded, but the construction of the village improved after the development of Qing Dynasty. Its streets, ancestral halls, temples, and residential buildings, all formed a system; its residential buildings also had a fixed pattern. The development and expansion at that time were planned, so the whole layout and spatial texture of the settlement remained the same.

The connection between residential buildings and public buildings in Wangjinzhuang settlement is mainly the utilization of streets and public spaces. Public buildings are reasonably distributed in the settlement and assume corresponding functions, while residential buildings are enriched in the settlement under the framework of the road system and the distribution of public buildings, which together constitute the entire settlement, as shown in **Figure 1**.

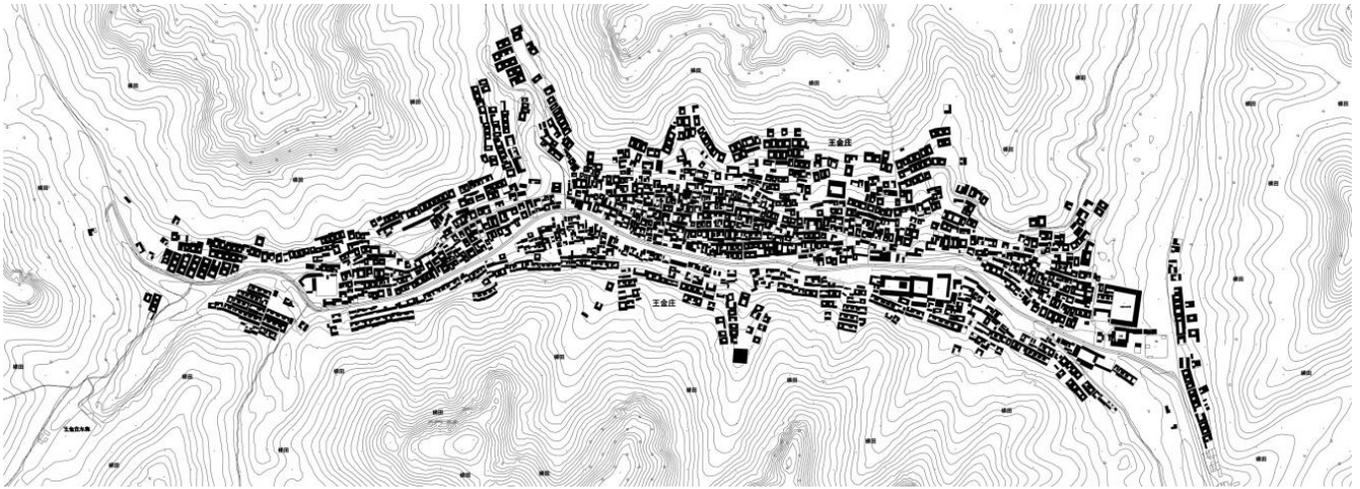


Figure 1. Wangjinzhuang settlement

On the north side of the main street, the buildings are densely distributed with abundant sunshine and a stone-slab street with unique space. Wangjinzhuang settlement gradually developed and expanded. The buildings are covered with mountains on both sides of the valley. The continuous extension to both ends of the main street will cause a deviation from the center, which is not easy to manage. Therefore, the linear layout of Wangjinzhuang is divided into five sections.

2. The street space of Wangjinzhuang settlement

2.1. The evolution of its street space

In the changes of settlements, the traces of time are preserved in the spatial morphological characteristics of the settlements^[1]. There are two modes of evolution of streets and alleys: (1) streets first, and then houses; streets are formed through the comprehensive effect of rational order and feng shui principles; (2) houses first, and then streets; this is formed through the development of natural geographical environment. Wangjinzhuang neither follows the evolution mode of streets and alleys followed by houses, nor the evolution mode of houses followed by streets and alleys, but with the increase of residential buildings, it is naturally enclosed and has both spirits of rationality and irrationality.

The buildings on both sides of the main street are the first level of the settlement (**Figure 2**). As the population grew, the scale of the settlement expanded. The lanes extended to both sides and the buildings on both sides form the second level of the settlement (**Figure 3**). The architectural style, material, and structure of the roads on the first level are relatively uniform, whereas the roadways extending upward on the second level are more diversified, with different lengths, twists, and turns. After long-term development and evolution, the road network of the current Wangjinzhuang settlement is formed. Wangjinzhuang's road classification is shown in **Figure 4**.



Figure 2. First-level street



Figure 3. Second-level roadway

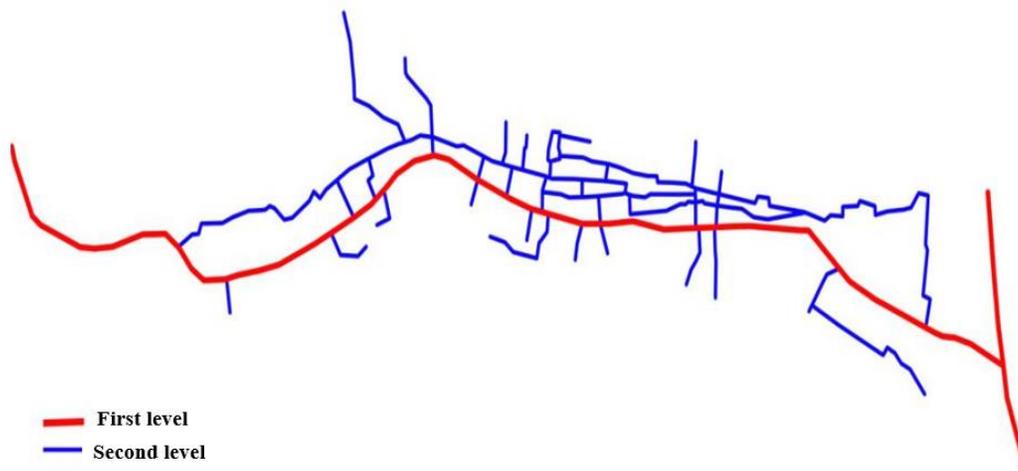


Figure 4. Wangjinzhuang's road classification

2.2. Spatial composition of its streets

The road system of Wangjinzhuang settlement consists of two levels. The first level is the main street that runs through the east and west of the settlement. The road is wide enough for motor vehicles to travel. The second level comprise of lanes connecting the main street and the buildings, leading to buildings on both sides of the main street. These dense lanes are organically cross-connected with the main street, forming the road network of the entire village.

The main street is 3.5-5 meters wide, with a height-to-width ratio of 1:3-1:2. This is related to the location and topography of the settlement. The main street runs through the entire settlement in the east-west direction, winding along the mountain, forming the horizontal axis of the settlement, and dividing it into two parts: north and south.

The roadways connect the courtyards and the main street. Streets and alleys are the traffic space for the residents, and they are also the stage of life [2]. Their multiple functions ensue a changing and orderly form. The roadways in Wangjinzhuang can be divided into two types: traffic roadways and living roadways. Traffic roadways meet the daily traffic use of villagers, while living roadways directly connect courtyard spaces and can be used as public spaces. Most of the traffic lanes are relatively narrow, with width of less than 1 meter. The living roadways are access roadways for the villagers, in which the height-width ratio is relatively comfortable, and the interface is flexible and rich.

2.3. Space nodes of its streets and alleys

The streets and alleys of Wangjinzhuang settlement are neatly distributed, forming a fishbone-shaped street and road system. The spatial nodes of its roads include intersections of streets and alleys, courtyard entrance spaces, and public square spaces.

(1) Street intersection space

Streets and alleys are not simple straight lines, but the intersection of multiple lines, thus forming a multilevel road network system. The intersection of streets and alleys generate nodes. The intersection nodes of streets and alleys in Wangjinzhuang have three forms: T-shaped, Y-shaped, and intersections, among which T-shaped intersections are the main ones. Wangjinzhuang settlement is undulating and has distinct layers. Based on the three types of intersections, various types of intersection nodes with height differences are formed.

(2) Courtyard entrance space

The main constituent element of the settlement is the courtyard space, and the entrance of the courtyard becomes the transition space connecting the inside and outside of the courtyard [3]. The courtyard entrance space belongs to the street and alley, but it also belongs to the courtyard. Therefore, it has a dual nature of being public and private. When the entrance space of the courtyard is used as a public space, it is the main place for villagers to come together. Gathering in front of the door is one of the leisure activities of the villagers. The front part of the courtyard also provides a place for recreation.

(3) Public space

Based on the village records, the original development point of Wangjinzhuang was the Liu Family Courtyard (including the South Courtyard and the North Courtyard). It is the main activity place of the villagers. In settlements, most of the places for people to take part in social activities appear with the formation of public buildings, such as ancestral halls, temples, and theaters. Most of the public spaces in settlements are naturally formed. They are mostly open spaces in front of iconic buildings and are shaped irregularly, with relatively random spatial layout. The ancestral hall of Wangjinzhuang is located at the center of the settlement, and it is an important space for people to come together. After long-term development and planning, the open space in front of the ancestral hall has become more regular in shape, forming a small rectangular space.

3. The spatial form of Wangjinzhuang settlement

Wangjinzhuang is surrounded by mountains. There are artificial forests and wild forests on the surrounding hillsides. The natural ecology is relatively intact. Walking in it is like walking in a “green world.” Vibrant residential buildings can be seen in this greenery; the terraced fields integrated with the mountains are scattered, and the crops are colorful, changing along with the four seasons.

3.1. Point-shaped space

Point-shaped space is the basic element that constitutes the settlement space. Point-shaped space includes circles, triangles, squares, polygons, and irregular shapes. The point-shaped space here refers to landscape elements, such as stone towers and water wells, in Wangjinzhuang settlement and the elements formed by them.

3.2. Linear-shaped space

Linear-shaped space mainly refers to the layout structure of streets and alleys. The terrain of the settlement is complex, and the heights are scattered. Therefore, the shape of the streets and alleys also twists and turns according to the terrain, extending from the main street to both sides and forming a fishbone-like network structure. The main street is the widest in the settlement. The trend of the street is parallel to the contour

line. Alleys are generally distributed perpendicular to each other and function to connect residential areas and the main street.

The features of linear-shaped space in Wangjinzhuang are as follows: the scale and height-width ratio of streets and alleys of different grades have different spatial characteristics; the turning point is large, which makes people look forward to the scenery after that.

3.3. Plane-shaped space

Plane-shaped space is an important modeling element in settlement space, which includes regular polygon and irregular polygon [4]. The plane-shaped space in Wangjinzhuang settlement is generally a public open space, including the village entrance square, the open space enclosed by the ancestral hall, the Liu family compound, and the square in front of the theater.

4. Analysis of the public buildings in Wangjinzhuang settlement

Residential buildings in settlements are living spaces for families, while public buildings are public spaces for collective activities, which are important parts of the settlement space. The public buildings in Wangjinzhuang provide residents with space for different purposes and play an irreplaceable role in their lives. Public buildings of different natures have different architectural features, enriching the overall pattern of the settlement.

The most typical public buildings in Wangjinzhuang are the ancestral hall, the stage, and the temple. These buildings provide an irreplaceable public place for social interaction in isolated and closed villages. They are also a concentrated reflection of local folk customs, architectural techniques, and artistic levels.

5. Conclusion

The composition of the settlement not only contains the physical environment, but also the material carrier of the residents' social life. The residential houses, streets, and public buildings in a settlement are the key elements that make up the order of the settlement, and they directly affect the morphological layout of the settlement. The linear overall layout structure of Wangjinzhuang creates a fishbone-shaped street system and a spatial structure combining points, lines, and planes. With its superior location along with rich historical and cultural resources, Wangjinzhuang has gradually formed a unique settlement.

Funding

Hebei Province Human Resources and Social Security Research Project (JRS-2021-3248).

Disclosure statement

The authors declare no conflict of interest.

References

- [1] Tian K, Chen Y, 2021, Changes and Spatial Characteristics of Traditional Settlements in the Enyang Section of Micang Ancient Road. *China Famous City*, 35(12): 68-74. DOI: 10.19924/j.cnki.1674-4144.2021.12.010
- [2] Zhou Z, Li H, Jiang W, 2021, Research on the Spatial Form of Traditional Settlement in Anyuan Village, Chongren County, Fuzhou City. *Architecture and Culture*, 2021(11): 230-231. DOI: 10.19875/j.cnki.jzywh.2021.11.086

- [3] Li Y, 2012, Research on the Traditional Settlements and Dwellings of Liujiashai in Shexian County, Hebei University of Engineering, Handan.
- [4] Wang H, Fu X, Hou Q, 2021, Study on the Streets and Lanes of Traditional Settlements in Ancient Huizhou. Journal of Xi'an University of Architecture and Technology (Social Science Edition), 40(03): 34-41. DOI: 10.15986/j.1008-7192.2021.03.006

Publisher's note

Bio-Byword Scientific Publishing remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

Application of Nanomaterials in Subgrade and Pavement

Yazhou Liu*

China Merchants Chongqing Communications Technology Research & Design Institute Co., Ltd., Chongqing 400067, Sichuan Province, China

*Corresponding author: Yazhou Liu, 114999596@qq.com

Copyright: © 2022 Author(s). This is an open-access article distributed under the terms of the Creative Commons Attribution License (CC BY 4.0), permitting distribution and reproduction in any medium, provided the original work is cited.

Abstract: With the continuous progress of social science and technology, there are increasingly more kinds of high-tech materials that can be used in the construction of subgrade and pavement. Among them, the application of nanomaterials plays a commendatory role, improving the quality of pavement. Based on this, this paper analyzes the characteristics of nanomaterials and puts forward specific measures for the application of nanomaterials on the basis of further exploring the working principle of nanomaterials in subgrade and pavement, so as to promote the further development of subgrade and pavement construction.

Keywords: Application of nanomaterials; Construction of subgrade and pavement; Asphalt mixture

Online publication: March 21, 2022

1. Introduction

In the course of urbanization, the smooth operation of transportation network is critical to the overall construction of the city. In order to ensure that urban traffic operates smoothly, it is imperative to optimize the construction of subgrade and pavement in a comprehensive manner^[1]. It has been found that the application of nanomaterials greatly improves the quality of subgrade and pavement. Therefore, nanomaterials should be used aggressively in the daily construction of roads, so as to effectively promote the development of road construction.

2. Nanomaterials and their properties

Nanomaterials refer to materials in which at least one of its characteristic dimensions in its three-dimensional space is in the nano scale range or composing of nano scale range internal structures as basic structural units. In view of its special structure along with its special physical and chemical properties, this material is widely used in various fields, including medical, engineering, and military fields. The research and development of new high-performance nanomaterials are usually carried out in the nano spatial scale. By naturally changing the arrangement order of material atoms and molecules, they have the characteristics of nanomaterials. Nanoparticles have many properties: chemical, magnetic, electrical, optical, thermal, and mechanical. They are completely different from macro objects, single independent atoms, or molecules. The special properties of nanoparticles dictate their unique nano effects^[2]. In general, nanomaterials may be more suitable for various industries compared to other materials because of their unique essential characteristics. Nanomaterials have five basic characteristics. Their nano effects can be manifested as small-size effect, surface effect, quantum size effect, macro quantum tunnel effect, and dielectric

confinement effect. Based on the unique characteristics and effects, nanomaterials can be used in aircraft shielding, sensors, UV absorption, and many other industries. In subgrade and pavement construction, nano materials can be effectively applied to soft soil solidification and asphalt optimization to improve the firmness of subgrade and optimize pavement construction.

3. Application principles of nanomaterials in subgrade

The application of nanomaterials in subgrade is mainly reflected in the solidification treatment of soft, muddy soil. Since the construction quality of subgrade affects road stability, its soil needs to be fully strengthened in the construction process. Therefore, using nanomaterials for the construction of soft, muddy soil roadbed is an effective optimization measure to improve the strength of subgrade. During the solidification of soft, muddy soil, the construction personnel has to mix and stir the cement mixture, soft muddy soil, water, nano silica powder, nano alumina, and other materials in specific proportions, so as to obtain high-strength cement-solidified soil, thus providing high-quality material foundation for the improvement of subgrade stability^[3]. The history of cement-solidified soil development is explored. The traditional way of obtaining high-strength cement-solidified soil is to increase the strength of the solidified soil by adding a high dose of cement to soft soil by increasing the proportion of cement. However, the final cement-solidified soil obtained under such working conditions will crack the roadbed in the application process; in addition, the cost of solidified soil mixed with high dose of cement is high, thus reducing the economic benefit of subgrade construction. With the continuous development of science and technology, the quality of high-strength cement-solidified soil has improved in recent years. Through the efforts of researchers and experiments in recent years, it has been found that the addition of nano silica powder, nano aluminum oxide, and other materials to cement-based materials in specific proportions promotes better cement hydration reaction, and subsequently forms a more stable microstructure at the interface between cement stone and aggregate. At the same time, when the cement-based structure is constructed with the addition of nano materials, the micropores in the structure can be fully filled. In short, under the mixing action of nano materials, the production quality of cement-solidified soil and the effect of construction with related structures can be well guaranteed; the overall quality, strength, and properties of subgrade construction materials can also be improved to a great extent.

4. Specific applications of nanomaterials in pavement

4.1. Nano-modified asphalt

Nano-modified asphalt modifier includes nano calcium carbonate, nano ferric oxide, nano-layered silicate, and other chemical agents. This kind of modifier can improve the performance of asphalt by directly adding asphalt in proportion, so as to promote the quality of asphalt pavement construction. In addition to the above modifiers, nano titanium dioxide is a better asphalt modifier. Based on research at home and abroad, nano titanium dioxide, as a modifier, improves the rutting resistance of asphalt pavement through the mixing process with asphalt. At the same time, if nano titanium dioxide modifier is mixed with asphalt materials in a reasonable proportion, the construction of pavement using this kind of modified asphalt will give rise to higher fatigue strength. It can be seen that the addition of nano carbon dioxide can increase the hardness and viscosity of modified asphalt, which helps to promote the optimization of subgrade and pavement construction. In terms of the optimization effect of nano calcium carbonate modifier, it can be appreciated from experiments that the use of nano calcium carbonate can improve the softening point of asphalt; in addition, the penetration of asphalt will decrease with the use of nano calcium carbonate. Overall, the stability of asphalt materials improves under the action of nano calcium carbonate. The effect of nano-layered silicate modifier on the properties of asphalt materials is analyzed. The addition of this kind of modifier can alleviate certain problems, including aging, flow deformation, and use damage. In addition,

the use of nano-layered silicate can improve the high-temperature elasticity of asphalt mixture and the pavement's rutting resistance. In general, the mixing of different kinds of modifiers with asphalt plays different roles, so as to improve and enhance the basic properties of asphalt, and subsequently improve the service quality of pavements.

4.2. Nanomaterial composite modified asphalt

In addition to the aforementioned modifiers, composite modified asphalt needs to rely on nanomaterials and polymer modifiers to optimize its asphalt index. As modifiers often change the properties of asphalt through physical or chemical reactions with asphalt, composite modifiers mainly include nano zinc oxide, nano-layered sodium silicate, carbon nanotubes, and other related composite modifiers. Specifically, the use of carbon nanotube composite modifier can change the penetration, softening point, viscosity, and other parameters of asphalt. Relevant asphalt hardness indexes can be improved with the use of carbon nanotubes. Under the influence of carbon nanotubes, the overall anti-rutting factor and phase angle of asphalt mixture will change favorably. Therefore, the overall performance of composite modified asphalt has been fully optimized, and the quality of pavement construction with this type of asphalt as the main material will also improve significantly. With the use of nano zinc oxide, the stability and aging resistance of asphalt can be fully optimized. Combined with the relevant data parameters of the experimental research results, the use of nano zinc oxide can enhance the bonding strength between the composite modifier and asphalt. The toughness and ductility of composite modified asphalt will be strengthened to a certain extent under the influence of nano zinc oxide. In addition, the use of other nanomaterials can also effectively promote the stability of composite asphalt. The rational use of various composite modifiers can improve the overall performance of asphalt mixture. On the premise that the structural stability, toughness, and overall strength of asphalt materials are strengthened with the aid of modifiers, the effect of pavement construction will naturally be optimized.

4.3. Other applications of nano modified asphalt

On the premise that the above two types of nano modifiers can actively contribute to improving the quality of asphalt, employees and researchers should also actively explore new channels for the use of nanomaterials, so as to make the construction of pavements more efficient. As far as the research results at this stage are concerned, researchers have made advanced achievements in the use of nano titanium dioxide. In conjunction with China's strategic goals for sustainable development and the properties of titanium dioxide, the use of nano titanium dioxide has the potential to ease some of China's existing ecological and environmental issues. Based on experimental research results, nano titanium dioxide has a certain photocatalytic effect. At the same time, it has its own cleaning characteristics, thus effectively purifying the air and improving the air quality. It can be seen that the use of nano titanium dioxide in asphalt mixture can improve the environmental protection of roads in subsequent pavement construction. The use of nano titanium dioxide materials is studied in conjunction with pavement construction. The use of nano titanium dioxide materials can also optimize the degradation effect of roads on automobile exhaust. In short, with the assistance of nano materials, the use of modified asphalt can further enhance the advantages that traditional asphalt lacks. Under the favorable influence of nano modifiers, the quality and efficiency of pavement construction will be improved. Through the application of nanomaterials, not only will the stability of subgrade and pavement be fully guaranteed, but other functions of the pavement will also be optimized and expanded, thus improving the city's road safety.

5. Conclusion

Based on the analysis above, it is clear that using nanomaterials to optimize the construction of subgrade

and pavement in the optimization process of road construction is an important commission. Nanomaterials can be used to achieve not only an environmentally friendly development of pavement construction, but also to lower the cost of related construction work and greatly improve the durability of subgrade and pavement. In order to support the growth of subgrade and pavement construction, it is indispensable to improve the application efficiency and effect of nanomaterials in subgrade and pavement.

Disclosure statement

The author declares no conflict of interest.

References

- [1] Wen J, Jia X, 2020, Application and Research of Nano modifiers and Fiber Modified Materials in Asphalt Pavement. Inner Mongolia Coal Economy, 2020(22): 146-148. DOI: 10.13487/j.cnki.imce.018858
- [2] Zhou X, 2020, Application of Nano Materials in Subgrade and Pavement. China Highway, 2020(13): 95-97. DOI: 10.13468/j.cnki.chw.2020.13.035
- [3] Guo G, Zhao Q, Bu X, 2016, Progress in the Application of Nanomaterials in Asphalt Pavement. Northern Transportation, 2016(02): 28-30, 34. DOI: 10.15996/j.cnki.bfjt.2016.02.008

Publisher's note

Bio-Byword Scientific Publishing remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

Paving Materials and Engineering Applications of Permeable Pavement

Zhuang Liu*

China Merchants Chongqing Communications Technology Research & Design Institute Co., Ltd., Chongqing 400067, Sichuan Province, China

*Corresponding author: Zhuang Liu, 20671101@qq.com

Copyright: © 2022 Author(s). This is an open-access article distributed under the terms of the Creative Commons Attribution License (CC BY 4.0), permitting distribution and reproduction in any medium, provided the original work is cited.

Abstract: The stability of roads in cities directly affects the safety of traffic and transportation. In the process of pavement laying, relevant personnel should use permeable paving materials in the process of construction. Based on the analysis of road drainage requirements, traditional paving materials have relatively poor water permeability, which leads to ponding problems during road use^[1]. Within this frame of reference, beginning with the characteristics of permeable paving materials, this paper makes an in-depth exploration on practical application measures.

Keywords: Permeable pavement; Paving materials; Engineering application; Porosity

Online publication: March 21, 2022

1. Introduction

The construction of permeable pavement has many benefits, among which the most noticeable are the reduction of ponding on road surface, night reflection prevention, vehicle noise reduction, surface temperature and humidity adjustment, as well as the alleviation of urban heat island effect. In order to improve the construction quality of permeable pavement, employees should actively take optimization measures to improve the paving efficiency in a comprehensive manner and contribute to urban road safety as well as optimal construction.

2. Properties of permeable paving materials

2.1. Relationship between strength and porosity

In the process of exploring the properties of breathable water-based paving materials, workers must fully comprehend the relationship between strength and porosity. Based on the analysis of several results, the strength of various permeable paving materials is related to their porosity. On the whole, the relationship between porosity and material strength shows an inverse relationship; that is, the lower the porosity, the higher the strength of the material. However, in regard to the influence of the actual value of material porosity, unreasonably low porosity will affect the material's water permeability. Therefore, in the application of paving materials for pavement construction, relevant personnel need to fully understand the construction requirements, the porosity and permeability of the materials, and other related factors, so as to select appropriate paving materials that have high adaptability for pavement construction.

Specifically, different types of permeable paving materials have different strengths. Taking permeable asphalt mixture, permeable cement concrete, and permeable pavement bricks as examples, pervious asphalt mixture itself has high porosity, which means that the shear strength of the material is relatively low. This

property makes it difficult for the pervious pavement constructed with pervious asphalt mixture as the primary material to maintain its integrity when enduring sharp turns or brakes by heavy-duty vehicles. Permeable asphalt mixture is not suitable for heavy-duty vehicle traffic roads. On the other hand, permeable cement concrete has relatively more pores, and its tensile strength is lower than that of ordinary concrete in the process of pavement laying. From the analysis of specific index values, the porosity of permeable cement concrete is between 15% and 30%, its 28-day compressive strength is about 10 to 20 MPa, and its flexural strength is in the range of 2.5 to 4 MPa. The strength of permeable pavement bricks is affected by the manufacturing process; moreover, different types of permeable pavement bricks have great differences in strength. The overall strength of concrete permeable pavement bricks is low, whereas porous concrete permeable pavement bricks can reach a high level of strength with the support of good manufacturing technology.

2.2. Weather resistance

In addition to pavement strength and water permeability, permeable pavement also needs to have good stability to ensure that the pavement can ensure road safety in case of bad weather. In the context of permeable pavement, weather resistance can be reflected from two angles: temperature and precipitation.

While planning the use of permeable materials based on temperature, it is important to note that permeable pavements are more prone to frost heave effect than ordinary roads in low temperature [2]. From the aspect of essential difference, ordinary permeable pavement bricks will be damaged due to their low density, strength, and frost resistance, which will lead to the destruction of pavement integrity and eventually jeopardizing the safety of users. For permeable asphalt mixture, low temperature will cause it to crack. In contrast, permeable cement concrete ensures the connection between the interior and the outside of the pavement at low temperature with the support of high porosity. Therefore, even if the moisture contained in the pavement is frost heaved due to low temperature, it will not leave much impact to the pavement. In general, the use of permeable cement concrete materials has more advantages in low temperature resistance. Under high temperature, permeable asphalt mixture will expand due to its poor stability. Therefore, the use of permeable asphalt mixture is not conducive to ensuring the stability of pavement under high temperature. The performances of permeable cement concrete and permeable pavement bricks do not easily change under high temperature conditions. Therefore, in the context of a high temperature weather, the construction personnel should select either permeable cement concrete or permeable pavement bricks for pavement construction according to the construction needs.

When selecting materials to be used for pavement construction in combination with precipitation, relevant personnel should select materials that have less impact from environmental humidity. Specifically, when permeable cement concrete is exposed to an environment with high humidity, its strength will not be greatly affected, and even in the later stage, the high humidity will help to improve its efficiency. In the application of permeable asphalt mixture, high-intensity precipitation or high environmental humidity will affect the viscosity of asphalt materials, resulting in pavement problems. When paving in areas with large precipitation or high environmental humidity, workers should give priority to permeable cement concrete materials for construction.

3. Application of permeable paving materials in practical engineering

3.1. Permeable asphalt mixture

From the discussion above, the exploration and research on the practical application of permeable paving materials reveal that permeable asphalt mixture plays an important role in pavement construction. Based on the consideration of the properties of permeable asphalt mixture, the analysis shows that this kind of paving material is suitable for the construction of the wear layer. With this material, the wear resistance

and drainage performance of pavement can be fully guaranteed.

Based on research results and previous excellent construction experiences of high-speed permeable asphalt pavement, permeable asphalt mixture can realize the optimization of pavement drainage and noise reduction by virtue of its properties: a large amount of single particle and coarse aggregate as well as a relatively small amount of fine aggregate and filler. In actual pavement laying, the proportion of coarse aggregate and mineral aggregate in permeable asphalt mixture should be controlled between 10 and 15 mm; controlling the gravel thickness within the range of 5 to 10 mm will ensure the pavement quality to a certain extent. In addition, in order to further strengthen the overall rutting resistance, water damage resistance, and leakage resistance of the pavement paved with permeable asphalt mixture, the constructors should also add nitrate lime and mineral fiber in the paving process to improve the performance of the pavement materials.

3.2. Permeable cement concrete

Permeable cement concrete, commonly known as sand-free macroporous concrete, is a type of macroporous concrete. While using coarse aggregates of a single particle size, it is necessary to strictly control the amount of cement slurry, so that it can reasonably cover the surface of the coarse aggregates without flowing and filling the gaps between them, so as to form large permeable gaps between coarse aggregate particles. Permeable cement concrete does not usually require any sand, but a small amount of sand can be added to improve the strength of the material. Permeable cement concrete can be used for permeable pavements of motor vehicle lanes, non-motor vehicle lanes, and parking lots [3]. As an example, permeable concrete pavement is used in the Nanbei Changjie urban road project in Beijing, and each cubic meter of raw material and dosage is 300 kg of 42.5 ordinary silicate cement and 1,400 kg of 10 to 20 and 5 to 10 mm single-grain gravel. It is necessary to strictly control the content of needle-flake particles without adding fine aggregates and to mix a certain proportion of powder binder as well as antifreeze agent for construction during winter. The water consumption is 67 kg. According to the measurement, the permeable cement concrete of the project has a 28-day compressive strength of 15.3 MPa, flexural strength of 3.0 MPa, porosity of 21.5%, and permeability coefficient of 1.9 cm/s; it has high strength and good permeability effect.

3.3. Permeable pavement bricks

The types of permeable pavement bricks that are mainly involved in the material laying process of permeable pavements include concrete permeable pavement bricks, natural sand permeable pavement bricks, and ceramic permeable pavement bricks. Different permeable pavement bricks have different roles in the laying process. Therefore, during permeable pavement construction, the selection of pavement materials should be in consideration of the construction requirements and the characteristics of permeable pavement bricks. Beginning from the analysis of the actual engineering application, the frequency of using concrete permeable pavement bricks and porous concrete permeable pavement bricks is relatively high. Although these two types of permeable pavement bricks involve concrete, there are vast differences in the manufacturing process. The difference between the completed products is mainly reflected in the permeable pores. As there are differences in the manufacturing process, the permeable pores of the two materials are different; the permeable pores of concrete permeable pavement bricks are formed by reserving channel holes in the brick manufacturing process; however, the pores formed in porous concrete pervious pavement bricks are completed in the mixing stage of raw materials, and because the pores of porous concrete pervious pavement bricks are formed under the action of a gas generating agent, the pore size of the completed product is relatively smaller, and the pore distribution is more uniform with a certain continuity.

In general, it is necessary to pay attention to a reasonable selection of permeable pavement bricks in the process of application. With the scientific application of permeable pavement bricks, the water

permeability of the pavement will be improved, so as to effectively convert precipitation into groundwater. At the same time, the use of permeable pavement bricks can improve the flatness of permeable pavements, thus benefitting the current urban construction and development.

4. Conclusion

Through an in-depth analysis of research contents, it is clear that in the process of urban road construction, it is imperative to strengthen the construction of permeable pavements. In order to achieve high-quality results in the construction of permeable pavements, relevant personnel should select and use appropriate permeable paving materials for the construction of roads. In the construction process, it is important for relevant personnel to fully understand the characteristics of permeable paving materials, so as to carry out scientific and reasonable application according to the characteristics of materials.

Disclosure statement

The author declares no conflict of interest.

References

- [1] Zhu L, Xiang H, 2019, A Brief Discussion on the Factors Affecting the Infiltration Effect of Municipal Permeable Pavement. *Sichuan Architecture*, 39(03): 267-269.
- [2] Zhao P, Yan H, Chen C, et al., 2016, Research on Construction Technology of Permeable Pavement in Urban Landscape. *Journal of Green Science and Technology*, 2016(15): 176-178.
- [3] Guo J, 2014, Research on the Influence of Permeable Pavement Materials on Pavement Temperature. *Journal of China & Foreign Highway*, 34(06): 226-228. DOI: 10.14048/j.issn.1671-2579.2014.06.055

Publisher's note

Bio-Byword Scientific Publishing remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

Discussion on Anti-Seepage Technologies in the Construction of Small-Scale Rural Water Conservancy Projects

Suxiang Yuan*

Weifang (Shouguang) Hi-Tech Industrial Development Zone Management Committee, Shouguang 262700, Shandong Province, China

**Corresponding author:* Suxiang Yuan, yuansuxiang123@126.com

Copyright: © 2022 Author(s). This is an open-access article distributed under the terms of the Creative Commons Attribution License (CC BY 4.0), permitting distribution and reproduction in any medium, provided the original work is cited.

Abstract: In order to ensure the sustainable growth of rural economy, it is necessary to carry out further research on small-scale water conservancy projects and solve the seepage issue in rural areas. Based on the application significance of small-scale rural water conservancy projects and the analysis of anti-seepage technologies, along with specific examples, this paper specifically discusses the application of high-pressure jet technology, so as to provide reference for the development of engineering construction.

Keywords: Small-scale water conservancy projects; Rural areas; Anti-seepage technology; High-pressure jet

Online publication: March 21, 2022

1. Introduction

The development level of water conservancy construction largely determines the national economic development level, especially the development of the agricultural industry. The construction quality of water conservancy projects has a significant impact on the grain output and agricultural income. However, from the analysis of the current situation of small-scale rural water conservancy projects in China in recent years, seepage problems often occur, bringing huge loss to rural areas. In addition, due to the limitation of agricultural conditions, the difficulty in anti-seepage construction is doubled. Therefore, it is crucial to carry out further research on anti-seepage technologies and ensure the steady improvement of the construction quality of water conservancy projects through the scientific application of relevant technologies. Upon analyzing the quality issues of small-scale rural water conservancy projects in China, several scholars have found that the main reasons for seepage in these projects are insufficient investment funds, poor geological conditions, harsh environment, and insufficient or late maintenance^[1]. In order to solve these problems efficiently, the causes of the problems should be deeply considered prior to adopting anti-seepage technologies, so as to realize the stable improvement of the quality of these water conservancy projects and ensure an increase in agricultural production as well as the safety of people's life and property.

2. Significance of strengthening the research and application of anti-seepage technologies in small-scale rural water conservancy projects

Small-scale water conservancy projects in rural areas function for flood and disaster prevention, agricultural irrigation, and as a guarantee for water supply. Therefore, the construction of small-scale rural water

conservancy projects has been increasing in various regions around the country. Through the application of relevant anti-seepage technologies, the quality of these projects has been improving; the stability of water storage and water transmission is now guaranteed; the level of agricultural irrigation and the quality of water supply to the people have shown improvement [2]. In the construction of small-scale rural water conservancy projects, scientific design must be carried out in line with the geological structure and topographic conditions of the site as well as supplemented by the application of scientific and effective anti-seepage technologies, so as to ensure that the project structure remains functional, and thus ensure the safety and stability of the operation.

3. Key anti-seepage technologies in the construction of small-scale rural water conservancy projects

With the gradual increase of water conservancy projects, the requirements for quality engineering construction are higher. Under this background, various anti-seepage technologies have emerged one after another. Several key anti-seepage technologies are briefly introduced in the following sections.

3.1. Split grouting technology

The split grouting technology of earthen dam body splits the dam body along its axis according to its stress distribution law. A certain amount of mud is poured to form a vertical anti-seepage wall, so as to ensure the quality of the dam body and improve its stability [3-5].

3.2. Chemical reinforcement treatment technology

Chemical reinforcement treatment technology is a common anti-seepage technology in the construction of small-scale rural water conservancy projects. In the application of this technology, the leakage from the dam body is repaired with high-performance epoxy mortar to stop the loss in time. However, in the application of this technology, it is important to pay attention to the cleaning of sundries on the concrete surface and to reduce the soil content in the concrete. After the epoxy mortar is filled, the wood board should be used for compaction to assure the technology's application effect [6].

3.3. High pressure jet grouting technology

High pressure jet grouting technology involves the use of a high-pressure equipment to spray the slurry until it leaks out, so as to realize the rapid integration of cement slurry leakage and bottom soil irrigation as well as form a wall like consolidated body, thus achieving a better leakage treatment effect [7].

The process flow of high-pressure jet grouting is shown in **Figure 1**.

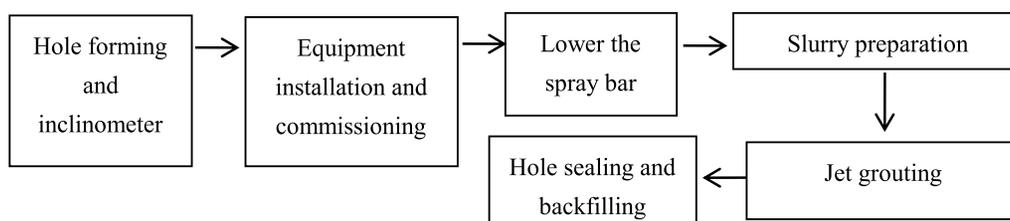


Figure 1. Process flow of high-pressure jet grouting technology

3.4. Controlled grouting technology

Controlled grouting technology is a new anti-seepage technology in water conservancy and hydropower projects. Based on the optimization and adjustment of traditional grouting technology, this technology realizes the reasonable control of slurry pressure and flow, ensures the effective control of grouting scope and quality, as well as greatly saves the construction progress and cost of hydraulic engineering.

3.5. Asphalt concrete anti-seepage technology

Asphalt concrete technology is mainly used in water conservancy projects that are carried out in cold areas, especially in North China. Its main advantage lies in the high durability and stability of asphalt concrete materials [8,9]. In the application of this technology, asphalt material is first heated at a high temperature and then injected into the dam body and channels that leak easily, so as to lay a solid foundation for the high-quality construction of small-scale water conservancy projects in countryside as well as improve the service life and performance of water conservancy projects.

3.6. Membrane material anti-seepage technology

The application of membrane material anti-seepage technology mainly involves adding protective layers onto civil engineering molds or plastic films in the construction of water conservancy projects, so as to ensure the rationality of irrigation and reduce the risk of seepage [10-12].

4. Application of high-pressure jet grouting technology in the construction of small-scale rural water conservancy projects

The geological site conditions of a small-scale rural water conservancy project are as follows: the soil layer 41.5 m above the dam body has miscellaneous fill, silty paste, medium fine and coarse sand layers, as well as silty clay layer; the depth of the grayish yellow medium fine sand layer ranges from 41.5 to 44.8 m, with a small amount of gravel with a diameter of 11~29 mm locally; the survey area 44.8 m below is clay, containing a small amount of ginger like calcium core, and the stable groundwater level is -3.9 m. From the geological survey, the geological conditions of the site are complex, and the issues that require attention in the construction are quicksand control and seepage control.

4.1. Process parameters and equipment selection

The process parameters and curtain effect of the high-pressure jet waterstop curtain are limited by the performance of the sprinkler irrigation machinery [13,14]. Therefore, in order to ensure the construction quality, the design parameters of the project are as follows: water pressure is 36~40 MPa; flow is 70 L/min; slurry pressure is 0.5 MPa; air pressure is 0.6~0.8 MPa; air flow is 1 m³/min; lifting speed is 10~15 cm/min; the rotary speed and swing speed of the rotary jet are designed to be 0.8 times of the lifting speed (**Table 1**). The equipment mainly includes 3 drilling rigs (DP-100 Rotary Drilling Rig); 3 sets of drilling equipment (50 mm); 2 high-pressure jet trucks (CYP-90); 2 high-pressure mud pumps (50 MPa); 2 air compressors (60 m³); 3 mud pumps (80); 3 mixers (JS500).

4.2. Layout of the grouting hole

Based on the requirements of building collapse and anti-seepage, 69 holes are formed in the sand section of the dam body (hole spacing: 2 m; hole depth: 48.9 m), and the grouting treatment range is 37.8~46.9 m.

4.3. Forming a hole

Based on the design requirements of the project, the second sequence hole is selected for construction; the spacing of the first sequence hole is 2.0 m, and the DP-100 Rotary Drilling Rig is used for drilling. The pilot hole is first constructed, and the construction is then carried out according to the principle of two sequence and gradual densification of high-pressure rotary jet grouting holes. The hole depth exceeds the design depth by 0.4 m.

Table 1. Process parameters of high-pressure jet grouting technology

Serial number	Project		Unit	Process parameters
1	Water	Pressure	MPa	36-40
		Flow	L/min	70
2	Slurry	Pressure	MPa	0.5
		Flow	L/min	0.6-0.8
3	Gas	Pressure	MPa	0.7
		Flow	L/min	1
4	Feed density		g/m ³	1.62
5	Return density		g/m ³	1.39
6	Lifting speed		cm/min	10
7	Rotary speed		r/min	8
8	Swing speed		r/min	8

4.4. Slurry preparation

- (1) Cement: Pure Portland cement slurry is used, in which the cement strength is 32.5 R; the slurry is sieved before use.
- (2) Water: Use the construction water for concrete mixing.
- (3) Admixture: According to the material ratio test, an appropriate amount of bentonite is added to the slurry preparation after the slurry performance is changed and approved by the supervision engineer.

The slurry is prepared uniformly according to the test proportioning requirements, configured by the weight method, and the error is strictly controlled within 5%. The water cement ratio is controlled at 1:1~1.5:1; the slurry density is strictly controlled within 1.65 g/cm³, and the slurry return density is controlled within 1.41 g/cm³.

When the external temperature is lower than 10°C, the slurry after preparation is used up within 5 hours; when the temperature exceeds 10°C, it does not exceed 3 hours. If the slurry is stored for a long time, it is treated as scrapped material [15-17].

4.5. Jet grouting

After the hole is formed, the equipment is moved to the vicinity of the hole mouth after the drilling has been completed. After the debugging, the nozzle of the spray rod is switched on and the orifice with iron cover is covered. Then the high-pressure water pump, air compressor, pulping machine, and mud pump are turned on to direct water, gas, and slurry. Any blockage or leakage in the joint or pipeline is checked [18].

After the completion of equipment debugging, it is necessary to use the winch to slowly lower the injection pipe to the bottom of the hole after the water pressure, air pressure, and equipment are running normally. It can spray statically for 2 to 3 minutes initially, and then increase when the specific gravity of the slurry coming out of the orifice reaches 1.25 g/cm³. If there is no slurry emission at the air port during sprinkler irrigation, the lifting is stopped immediately until the specific weight of slurry emission at the air port reaches 1.25 g/cm³. Subsequently, it is lifted slowly, and the machine is moved after lifting to the design height.

When the jet grouting construction is completed, the static pressure grouting is carried out immediately to continuously pour the caving back into the hole. In the process of reinjection, the filling is carried out at the same time as the sedimentation; the hole sealing and backfilling are carried out until there is no water precipitation, so as to avoid hole problems caused by water precipitation and shrinkage of slurry after the construction of high-pressure sprinkler irrigation, which will compromise the overall quality [19].

4.6. Grouting effect inspection

Following the formation of the waterstop curtain, through water injection test, the measured permeability coefficient of the curtain is less than the design allowable value, indicating that the quality and anti-seepage effect of the waterstop curtain meet the engineering quality standards. This demonstrates that high-pressure jet grouting technology is fully applicable to quicksand layer geological waterproof engineering projects, serving as a useful technical reference for the design and construction of similar engineering projects^[20].

5. Conclusion

In a nutshell, small-scale rural water conservancy projects have played a critical role in guaranteeing agricultural irrigation, household water supply, as well as flood and disaster prevention. Therefore, it is of great practical significance to strengthen the quality control in the construction of small-scale rural water conservancy projects as well as emphasize on the research and application of anti-seepage technologies in order to ensure the safety of people's property and promote the national economic level. The high-pressure jet technology described in this paper is an anti-seepage technology commonly used in the construction of water conservancy projects at the present stage. Taking into consideration of the actual construction of specific projects, this paper discusses the application process and results of this technology in detail, verifies the effectiveness of this technology, and provides useful technical guidance for the implementation of similar projects.

Disclosure statement

The author declares no conflict of interest.

References

- [1] Zhang G, Feng H, 2021, Discussion on Seepage Prevention Technology of Rural Small Water Conservancy Project. *Rural Economy and Science*, 32(20): 70-72.
- [2] Ma W, 2019, Discussion on Seepage Prevention Technology of Rural Small Water Conservancy Project. *Rural Practical Technology*, 2019(11): 94.
- [3] Zhang Y, 2019, Discussion on High-Pressure Jetting Grouting Technology in Water Conservancy and Hydropower Engineering Construction. *Pearl River Water Transport*, 2019(09): 76-77.
- [4] Huang X, 2019, Analysis on Application of Composite Foundation of High Pressure Rotary Jet Grouting Pile in High-Rise Residential Building. *Fujian Building Materials*, 2019(03): 54-56.
- [5] She Y, 2017, Discussion on Construction Technology and Application of High Pressure Jet Grouting in Construction. *Science & Technology Information*, 15(16): 79-80.
- [6] Qi L, 2021, Exploration on the Application of Anti-Seepage Technology in Water Conservancy Project Construction. *China Housing Facilities*, 2021(12): 136-137.
- [7] Wang Y, Lei G, 2021, Significance and Technical Measures of Seepage Prevention in Water Conservancy Project Channels. *Hydropower and Water Conservancy*, 5(10): 14-15. DOI: 10.12238/hwr.v5i10.4053
- [8] Zhang J, 2021, Construction Technology of Lining Anti-Seepage Channel for Farmland Irrigation in Water Conservancy Project. *Agricultural Science-Technology and Information*, 2021(21): 117-118.
- [9] Zhao J, Shen J, 2021, Discussion on the Design of Concrete Impervious Wall of Earth Dam in Water Conservancy Project. *China Plant Engineering*, 2021(21): 208-209.

- [10] Li L, 2021, Analysis on Construction Technology of Concrete Impervious Wall in Water Conservancy Project. *Sichuan Cement*, 2021(11): 29-30.
- [11] Zhao Y, Qiao C, 2020, Application of Anti-seepage Technology of Channel in Small Irrigation and Water Conservancy. *Housing and Real Estate*, 2020(18): 210.
- [12] Wu W, 2019, Analysis and Research on Seepage Prevention Technology of Rural Small Water Conservancy Project. *Rural Practical Technology*, 2019(07): 116.
- [13] Lian H, 2018, Brief Introduction of Seepage Prevention and Leak Plugging Construction Technology of Small Hydraulic Building. *Building Materials and Decoration*, 2018(24): 271-272.
- [14] Zhao H, 2018, A Probe into the Application and Practice of Anti-seepage Treatment Technology in Small Water Conservancy Projects. *Technology Wind*, 2018(03): 156.
- [15] Xin Z, 2017, Study on Anti-seepage Technology in Rural Small Water Conservancy Project Construction. *South China Agriculture*, 11(24): 114-115.
- [16] Li J, 2017, Reflections and Exploration on Anti-Seepage Technology of Rural Small Water Conservancy Project. *Agricultural Technical Services*, 34(14): 147.
- [17] Liu B, Chi L, 2016, Research on Seepage Prevention Technology of Small Irrigation and Water Conservancy Channels. *Agriculture and Technology*, 36(18): 53.
- [18] Liu H, 2022, Key Points of Anti-Seepage Technology in the Construction of Irrigation and Water Conservancy Projects. *China Plant Engineering*, 2022(04): 195-196.
- [19] Li C, 2022, Problems and Countermeasures in Anti-Seepage Construction of water Conservancy Project Channels. *Modern Rural Science and Technology*, 2022(02): 30, 59.
- [20] Lin Y, 2022, Application Analysis of Plastic Concrete Impervious Wall Construction Technology in Water Conservancy Project Construction. *Pearl River Water Transport*, 2022(03): 44-46.

Publisher's note

Bio-Byword Scientific Publishing remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

Application of Mobile Formwork Cast-In-Situ Beam Technology in Bridge Construction

Xiangwei Zheng*

Chongqing Construction Bridge Engineering Company., LTD, Chongqing 400060, China

*Corresponding author: Xiangwei Zheng, 85242707@qq.com

Copyright: © 2022 Author(s). This is an open-access article distributed under the terms of the Creative Commons Attribution License (CC BY 4.0), permitting distribution and reproduction in any medium, provided the original work is cited.

Abstract: The application of mobile formwork cast-in-situ beam technology is conducive to providing quality assurance for bridge constructions. At the same time, it can improve the overall mechanization level of the construction process and further accelerate the construction progress, so as to shorten the construction period and improve the economic benefits of enterprises. In fact, this construction method has been widely applied. In order to assure a positive outcome from the use of this technology, this paper analyzes the application of mobile formwork cast-in-situ beam technology in bridge construction to provide reference.

Keywords: Bridge construction; Mobile formwork; Cast-in-situ beam technology; Application measures

Online publication: March 23, 2022

1. Introduction

The mobile formwork cast-in-situ beam technology requires the assistance of corresponding platform equipment, which can move freely along the axis of the bridge in the application process. The support beam must be built using steel truss and steel box girder while creating the mobile formwork. The movement can begin after the pouring above the bridge is completed. The movable formwork method is the optimum approach for cast-in-situ beam construction, despite the fact that there are numerous technical methods. It improves the mechanization level, expands the construction scope, and ensures the construction quality. It also improves the construction efficiency, reduces the construction cost, shortens the construction period, ensures the safety of workers, and improves the economic benefits of enterprises. At present, much attention has been paid to the mobile formwork cast-in-situ beam technology in bridge construction; therefore, it will be valuable to carry out an analysis on it.

2. Project overview

The project is to build a large bridge, in which the upper part of the bridge is made up of prestressed reinforced concrete continuous box girder with 54 connections and 206 holes. The mobile formwork cast-in-situ beam technology is applied.

3. Plans in the application of mobile formwork

In the actual construction process, the bridge is composed of several parts: the straight-line section, variable section, and connecting line bridge. The straight-line section includes the double width single box single chamber continuous box girder, with a width of 18 m. The width of the variable section is more than 18 m, which includes the double width single box multi-chamber continuous box girder, with a width of less than

18 m. The connecting line bridge includes the double width single box multi-chamber continuous box girder, with a width of 11 m. According to the regulations, the construction period is short, and the requirements for construction quality and progress are relatively high, but the construction process is cumbersome. Therefore, in order to improve the construction efficiency and ensure the full implementation of the construction work within the specified time as well as the quality of the bridge, it is necessary to apply the mobile formwork method in each bridge section.

3.1. Installation of mobile formwork

In the construction process, the selected mobile formwork is the through-type mobile formwork. The minimum weight of the whole machine is 400 t, whereas the maximum can be 460 t; the power is 55 kW, the adaptive slope is 2%, the longitudinal moving speed is 0.6 m/min, the adaptive curve radius is more than 2,100 m, and the maximum reaction force of the fulcrum can reach up to 5900 kN. The through-type mobile formwork mainly includes the main beam, guide beam, cross beam, and other parts. The through-type mobile formwork has a large volume, so it is impossible to be installed in the workshop; rather, it needs to be divided into multiple parts and transported to the construction site and subsequently installed there. Pressure test is carried out first to confirm that the results comply with relevant requirements before it can be officially put into construction. When installing the through-type mobile formwork, the steps are as follows: (1) adjust the instruments and equipment that will be used during the construction; (2) set up the bracket; (3) set up the main beam; (4) set up the beams; (5) reasonably adjust the system. In addition, it is also necessary to place the mobile formwork in a suitable position and set up the support for the external formwork prior to setting up the latter; then, carry out the pressure test and overall hoisting, and finally set up the C-beam and rear cross beam ^[1].

3.2. Displacement and removal of mobile formwork

3.2.1. Lateral movement of bracket and falling formwork

When all construction procedures, such as duct grouting and concrete pouring, have been implemented, the corbel can be moved laterally, and the formwork can be dropped. In the process of moving and dropping the formwork, the operation process is relatively simple. Only the jacking oil cylinder is required. In addition, the dropping can also realize the separation between the formwork and the bridge body, so that the main beam can move to the lower part. The bracket can also be separated from the pier, drawn out from the pin beam, and hung above the main beam using the action of the oil cylinder.

3.2.2. Movement of bracket

As the oil cylinder can generate a large amount of force, it can propel the bracket in any direction, and the movement process is unrestricted.

3.2.3. Bracket, main beam, and formwork

Two brackets are set under the bridge at the same time. When both brackets are located at the pier of the bridge, the bracket can be moved by the force generated by the oil cylinder. In that case, the bracket can be gradually moved to the pier. This principle can also be applied when the bracket is embedded. Moreover, as long as the corbel can be inserted into the pier, the information of the position of the corbel can be obtained. Finally, the transverse opening of the formwork can be controlled with the help of the transverse hydraulic system, and the main bridge beam can then be pulled.

3.2.4. Forward movement of the main beam

With the traverse hydraulic system, the main beam is moved forward.

3.2.5. Close the formwork when the main beam is at the specified position

The pouring point of the second hole is the designated arrival position of the main beam. When the main beam reaches this position, the transverse formwork clamping work can be carried out. Then, the main beam needs to be lifted to the designated position with a jack along the vertical direction, and detailed adjustments shall be made according to relevant requirements. When moving the main beam, professional technicians must carry out real-time monitoring and on-site guidance; there should not be any obstacles in the moving path, so as to avoid the moving support being restrained by other substances. In fact, there are numerous harmful factors present during the movement of the support, so it is necessary to improve the safety supervision and address any unsafe factors as soon as possible. For example, in case of machine failure, the construction personnel should stop the construction immediately until the unsafe factors are fully dealt with, so as to reduce the incidence of accidents ^[2].

3.2.6. Remove the mobile formwork

The mobile formwork itself has a large volume. In order to avoid overcrowding at the site, the mobile formwork should be removed by using hangers and transported back to the workshop upon the completion of the box girder construction.

4. Procedures in the application of mobile formwork cast-in-situ beam technology in bridge construction

4.1. Reinforcement

During the construction of the bridge, reinforcement construction needs to be carried out in two parts: (1) in the workshop, reinforcement and relevant blanking treatment should be fully implemented; in this process, the position of the reinforcement joint must be consistent with the construction requirements; (2) after the reinforcement is transported to the construction site, it is necessary to implement reasonable treatment for the reinforcement at the end beam and the web; it should be noted that when connecting the main reinforcement, the thick straight thread of the pier must be used.

4.2. Concrete pouring

Before concrete pouring, the preparation work should be improved to confirm that the embedded parts, bellows, formwork size, reserved holes, and so on fully meet the relevant requirements. It is also necessary to pay attention to the cleaning of oil, sundries, garbage, and so on at relevant positions. If there are deficiencies, they should be treated as soon as possible.

When the concrete is vibrated, the mechanical equipment with the highest frequency is the plug-in vibrator and plate vibrator. For concrete vibration, the main requirement is to improve the compactness of the concrete itself. Concrete pouring is a job that must be accomplished all at once. According to the construction plan, the pouring work must be carried out in sequence based on the construction sequence of bottom plate, web plate, and top plate; the pouring method must be gradually promoted. However, in the process of pouring, continuous pouring is still the main pouring method to avoid defects. It needs to be segmented in the longitudinal direction and layered in the horizontal direction to ensure the concrete pouring effect. The length of sections is determined according to the weather during construction and the initial setting time of concrete. The pouring work should not be carried out blindly in order to improve the construction efficiency. The pouring of a new layer can only be carried out after confirming that the poured concrete has been fully solidified ^[3].

In the concrete curing process, spraying water and wrapping with formwork are generally used for moisturizing to ensure the continuous wetting of the formwork joints. Usually, the concrete curing time lasts for 28 days, and the curing water temperature is controlled at about 15°C.

4.3. Prestress

In prestressed tensioning construction, YCD40 Jack and single tensioning are used for transverse tensioning, YCW500 Jack and single end tensioning are used for longitudinal tensioning, and steel tendon tensioning is carried out in the form of graded loading. It should be emphasized that the rate at which the load is applied must be gradual. During the construction process, the weight and degree of tensioning, corresponding anchoring, oil return, and so on should be carried out in accordance with relevant regulations, along with safety monitoring. Construction should be halted promptly if safety hazards are discovered until the potential hazards have been completely eliminated, in order to safeguard the safety of construction workers.

4.4. Elevation control

In applying the mobile formwork cast-in-situ beam technology in bridge construction, it is very important to effectively control the elevation because the setting of the formwork camber is difficult and cumbersome, and the whole process of construction needs to be monitored to ensure that the pouring of concrete on each pier top meets the relevant requirements. The camber of tensioning and the deformation amplitude of formwork before and after construction should be measured, and the difference between the actual bridge elevation and the design elevation should be controlled within ± 5 mm ^[4].

5. Conclusion

The application of mobile formwork cast-in-situ beam technology in bridge construction can effectively save the construction cost, reduce work intensity, ensure construction safety, display the characteristics of modernization in the overall construction, and improve the quality of the project. However, in the construction process, the construction plans and procedures must be consistent with the requirements, so as to fully exploit the function and benefits of this technology.

Disclosure statement

The author declares no conflict of interest.

References

- [1] Liu H, 2020, Discussion on Cast-In-Situ Beam Technology with Mobile Formwork in Bridge Construction. *East China Science & Technology: Synthesis*, 2020(3): 0223-0223.
- [2] Chen M, 2020, Discussion on the Application of Mobile Formwork Cast-In-Place Beam Technology in Bridge Construction. *Construction Materials and Decoration*, 2020(30): 259-260.
- [3] Yan S, Wei Z, Mao Z, et al., 2021, Key Technology of Construction of Cast-In-Place Beam with Large Longitudinal Slope and Small Curve Moving Formwork Frame. *Journal of China & Foreign Highway*, 41(6): 166-170.
- [4] Wang X, 2021, Research on Construction Technology Application of Continuous Box Girder Moving Formwork in Bridge Engineering. *Transpoworld*, 2021(18): 52-53.

Publisher's note

Bio-Byword Scientific Publishing remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

Author Guidelines

Before your submission, please check that your manuscript has been prepared in accordance to the step-by-step instructions for submitting a manuscript to our online submission system. We recommend that you keep this page open for your reference as you move through the submission process.

If there are any differences in author guidelines between the print and online version, it is recommended that authors refer to the online version for use.

Manuscript Format

Journal of World Architecture accepts manuscript that is in MS Word or LaTeX format. All manuscripts must be written in clear, comprehensible English. Both American and British English are acceptable. Usage of non-English words should be kept to a minimum and all must be italicized (except for e.g. and i.e.) If you have concerns about the level of English in your submission, please ensure that it is proofread before submission by a native English speaker or a scientific editing service.

Cover letter

All submissions for *Journal of World Architecture* should include a cover letter as a separate file. A cover letter should contain a brief explanation of what was previously known, the conceptual advancement with the findings and its significance to broad readership. The cover letter is confidential and will be read only by the editors. It will not be seen by reviewers.

Title

The title should capture the conceptual significance for a broad audience. The title should not be more than 50 words and should be able to give readers an overall view of the paper's significance. Titles should avoid using uncommon jargons, abbreviations and punctuation.

List of Authors

The names of authors must be spelled out rather than set in initials with their affiliations footnoted. Authors should be listed according to the extent of their contribution, with the major contributor listed first. All corresponding authors (maximum 2) should be identified with an asterisk. Affiliations should contain the following core information: department, institution, city, state, postal code, and country. For contact, email address of only one corresponding author is expected within the manuscript. Please note that all authors must see and approve the final version of the manuscript before submitting.

Abstract

Articles must include an abstract containing a maximum of 200 words. The purpose of abstract is to provide sufficient information for a reader to choose either to proceed to the full text of the article. After the abstract, please give 3-8 key words; please avoid using the same words as those already used in the title.

Section Headings

Please number all section headings, subheadings and sub-subheadings. Use boldface to identify major headings (e.g. **1**, **2**, **3**, etc.) and subheadings (e.g. **1.1**, **1.2**, **2.1**, **2.2** etc.) For the sub-subheadings, please distinguish it further using non-boldface numbers in parenthesis (e.g. (1), (2), (3), etc.)

Introduction

Introduction should provide a background that gives a broad readership an overall outlook of the field and the research performed. It tackles a problem and states its importance regarding the significance of the study. Introduction can conclude with a brief statement of the aim of the work and a comment about whether that aim was achieved.

Materials and Methods

This section provides the general experimental design and methodologies used. The aim is to provide enough detail for other investigators to fully replicate your results. It is also required to facilitate better understanding of the results obtained. Protocols and procedures for new methods must be included in detail to reproduce the experiments.

Ethics

Ethics information, including IACUC permit numbers and/or IRB name, if applicable. This information should be included in a subheading labelled "Ethics Statement" in the "Methods" section of your manuscript file, in as much detail as possible.

Results

This section can be divided into subheadings. This section focuses on the results of the experiments performed.

Discussion

This section should provide the significance of the results and identify the impact of the research in a broader context. It should not be redundant or similar to the content of the results section.

Conclusion

Please use the conclusion section for interpretation only, and not to summarize information already presented in the text or abstract.

Conflict of Interest

All authors are required to declare all activities that have the potential to be deemed as a source of competing interest in relation to their submitted manuscript. Examples of such activities could include personal or work-related relationships, events, etc. Authors who have nothing to declare are encouraged to add "No conflict of interest was reported by all authors" in this section.

Funding

Authors should declare all financial and non-financial support that have the potential to be deemed as a source of competing interest in relation to their submitted manuscript in this section. Financial supports are generally in the form of grants, royalties, consulting fees and more. Examples of non-financial support could include the following: externally-supplied equipments/biological sources, writing assistance, administrative support, contributions from non-authors etc.

Appendix

This section is optional and is for all materials (e.g. advanced technical details) that has been excluded from the main text but remain essential to readers in understanding the manuscripts. This section is

not for supplementary figures. Authors are advised to refer to the section on ‘Supplementary figures’ for such submissions.

Text

The text of the manuscript should be in Microsoft Word or Latex. The length of the manuscript cannot be more than 50000 characters (inclusive of spaces) or approximately 7000 words.

Nomenclature for genes and proteins

This journal aims to reach researchers all over the globe. Hence, for both reviewers’ and readers’ ease in comprehension, authors are highly encouraged to use the appropriate gene and protein nomenclature. Authors may prefer to utilize resources such as <http://www.ncbi.nlm.nih.gov/gene>

Figures

Authors should include all figures into the manuscript and submit it as 1 file in the OJS system. Reference to the “Instructions for Typesetting manuscript” is strongly encouraged. Figures include photographs, scanned images, graphs, charts and schematic diagrams. Figures submitted should avoid unnecessary decorative effects (e.g. 3D graphs) as well as be minimally processed (e.g. changes in brightness and contrast applied uniformly for the entire figure). It should also be set against a white background. Please remember to label all figures (e.g. axis etc.) and add in captions (below the figure) as required. These captions should be numbered (e.g. **Figure 1**, **Figure 2**, etc.) in boldface. All figures must have a brief title (also known as caption) that describes the entire figure without citing specific panels, followed by a legend defined as description of each panel. Please identify each panel with uppercase letters in parenthesis (e.g. A, B, C, etc.)

The preferred file formats for any separately submitted figure(s) are TIFF or JPEG. All figures should be legible in print form and of optimal resolution. Optimal resolutions preferred are 300 dots per inch for RGB coloured, 600 dots per inch for greyscale and 1200 dots per inch for line art. Although there are no file size limitation imposed, authors are highly encouraged to compress their figures to an ideal size without unduly affecting legibility and resolution of figures. This will also speed up the process of uploading in the submission system if necessary.

The Editor-in-Chief and Publisher reserve the right to request from author(s) the high-resolution files and unprocessed data and metadata files should the need arise at any point after manuscript submission for reasons such as production, evaluation or other purposes. The file name should allow for ease in identifying the associated manuscript submitted.

Tables, lists and equations

Tables, lists and equations must be submitted together with the manuscript. Likewise, lists and equations should be properly aligned and its meaning clear to readers. Tables created using Microsoft Word table function are preferred. Place each table in your manuscript file right after the paragraph in which it is first cited. Do not submit your tables in separate files. The tables should include a concise but sufficiently explanatory title at the top. Vertical lines should not be used to separate columns. Leave some extra space between the columns instead. All tables should be based on three horizontal lines to separate the caption, header and body. A few additional horizontal lines MAY be included as needed (example below). Any explanations essential to the understanding of the table should be given in footnotes at the bottom of the table. SI units should be used.

Supplementary information

This section is optional and contains all materials and figures that have been excluded from the entire manuscript. This information are relevant to the manuscript but remains non-essential to readers' understanding of the manuscript's main content. All supplementary information should be submitted as a separate file in Step 4 during submission. Please ensure the names of such files contain 'suppl. info'.

In-text citations

Reference citations in the text should be numbered consecutively in superscript square brackets. Some examples:

1. Negotiation research spans many disciplines ^[3,4].
2. This result was later contradicted by Becker and Seligman ^[5].
3. This effect has been widely studied ^[1-3,7].

Personal communications and unpublished works can only be used in the main text of the submission and are not to be placed in the Reference section. Authors are advised to limit such usage to the minimum. They should also be easily identifiable by stating the authors and year of such unpublished works or personal communications and the word 'Unpublished' in parenthesis.

E.g. (Smith J, 2000, Unpublished)

References

This section is compulsory and should be placed at the end of all manuscripts. Do not use footnotes or endnotes as a substitute for a reference list. The list of references should only include works that are cited in the text and that have been published or accepted for publication. Personal communications and unpublished works should be excluded from this section.

For references in reference list, all authors must be stated. Authors referenced are listed with their surname followed by their initials. All references should be numbered (e.g. 1. 2. 3. etc.) and sequenced according to the order it appears as an in-text citation. References should follow the following pattern: Author(s) followed by year of publication, title of publication, full journal name in italics, volume number, issue number in parenthesis, page range and lastly the DOI (if applicable). If the referred article has more than three authors, list only the first three authors and abbreviate the remaining authors to italicized 'et al.' (meaning: "and others").

Journal

Journal article (print) with one to three authors

[1] Yao Y., Xia B. Application of Phase Frequency Feature Group Delay Algorithm in Database Differential Access. *Computer Simulation*, 2014, 31(12): 238-241.

Journal article (print) with more than three authors

[2] Gamelin F.X., Baquet G., Berthoin S., et al. Effect of high intensity intermittent training on heart rate variability in prepubescent children. *European Journal of Applied Physiology*, 2009, 105: 731–738.

Journal article (online) with one to three authors

[3] Jackson D., Firtko A., Edenborough M. Personal resilience as a strategy for surviving and thriving in the face of workplace adversity: a literature review. *Journal of Advanced Nursing*, 2009, 60(1): 1–9.

Journal article (online) with more than three authors

[4] Hargreave M., Jensen A., Nielsen T.S.S., et al. Maternal use of fertility drugs and risk of cancer in children—A nationwide population-based cohort study in Denmark. *International Journal of Cancer*, 2015, 136(8): 1931–1939.

Book

Book with one to three authors

[5] Schneider Z., Whitehead D., Elliott D. *Nursing and midwifery research: methods and appraisal for evidence-based practice*. 3rd edn. 2009, Elsevier Australia, Marrickville, NSW.

Book with more than three authors

[6] Davis M., Charles L., Curry M.J., et al. *Challenging spatial norms*. 2013, Routledge, London.

Chapter or Article in Book

[7] Knowles M.S. Independent study. In *Using learning contracts*. 1986, Jossey-Bass, San Francisco, 89–96.

Others

Proceedings of meetings and symposiums, conference papers

[8] Chang S.S., Liaw L. and Ruppenhofer J. (eds). *Proceedings of the twenty-fifth annual meeting of the Berkeley Linguistics Society, February 12–15, 1999: general session and parasession on loan word phenomena*. 2000, Berkeley Linguistics Society, Berkeley.

Conference proceedings (from electronic database)

[9] Bukowski R.M. Prognostic factors for survival in metastatic renal cell carcinoma: update 2008. *Innovations and challenges in renal cancer: proceedings of the third Cambridge conference*. *Cancer*, 2009, 115 (10): 2273, viewed 19 May 2009, Academic OneFile database.

Online Document with author names

[10] Este J., Warren C., Connor L., et al. *Life in the clickstream: the future of journalism*, Media Entertainment and Arts Alliance, 2008. viewed 27 May 2009, http://www.alliance.org.au/documents/foj_report_final.pdf

Online Document without author name

[11] *Developing an argument* n.d., viewed March 30 2009, http://web.princeton.edu/sites/writing/Writing_Center/WCWritingResources.htm

Thesis/Dissertation

[12] Gale L. *The relationship between leadership and employee empowerment for successful total quality management*. 2000, University of Western Sydney.

Standard

[13] Standards Australia Online. Glass in buildings: selection and installation. AS 1288–2006. 2006, SAI Global database.

Government Report

[14] National Commission of Audit. Report to the Commonwealth Government, Australian Government Publishing Service, 1996, Canberra.

Government report (online)

[15] Department of Health and Ageing. Ageing and aged care in Australia, 2008, viewed 10 November 2008, <http://www.health.gov.au/internet/main/publishing.nsf/Content/ageing>

No author

[16] Guide to agricultural meteorological practices. 2nd edn, Secretariat of the World Meteorological Organization, 2010, Geneva.

Note: When referencing an entry from a dictionary or an encyclopedia with no author there is no requirement to include the source in the reference list. In these cases, only cite the title and year of the source in-text. For an authored dictionary/encyclopedia, treat the source as an authored book.

Submission Preparation Checklist

As part of the submission process, authors are required to check off their submission's compliance with all of the following items, and submissions may be returned to authors that do not adhere to these guidelines.

1. The submission has not been previously published, nor is it before another journal for consideration (or an explanation has been provided in Comments to the Editor).
2. The submission file is in OpenOffice, Microsoft Word, RTF, or WordPerfect document file format.
3. Where available, URLs for the references have been provided.
4. The text is single-spaced; uses a 12-point font; employs italics, rather than underlining (except with URL addresses); and all illustrations, figures, and tables are placed within the text at the appropriate points, rather than at the end.
5. The text adheres to the stylistic and bibliographic requirements outlined in the Author Guidelines, which is found in About the Journal.
6. If submitting to a peer-reviewed section of the journal, the instructions in Ensuring a Blind Review have been followed.



Integrated Services Platform of International Scientific Cooperation

Innoscience Research (Malaysia), which is global market oriented, was founded in 2016. Innoscience Research focuses on services based on scientific research. By cooperating with universities and scientific institutes all over the world, it performs medical researches to benefit human beings and promotes the interdisciplinary and international exchanges among researchers.

Innoscience Research covers biology, chemistry, physics and many other disciplines. It mainly focuses on the improvement of human health. It aims to promote the cooperation, exploration and exchange among researchers from different countries. By establishing platforms, Innoscience integrates the demands from different fields to realize the combination of clinical research and basic research and to accelerate and deepen the international scientific cooperation.

Cooperation Mode



Clinical Workers



In-service Doctors



Foreign Researchers



Hospital



University



Scientific institutions

OUR JOURNALS



The *Journal of Architectural Research and Development* is an international peer-reviewed and open access journal which is devoted to establish a bridge between theory and practice in the fields of architectural and design research, urban planning and built environment research.

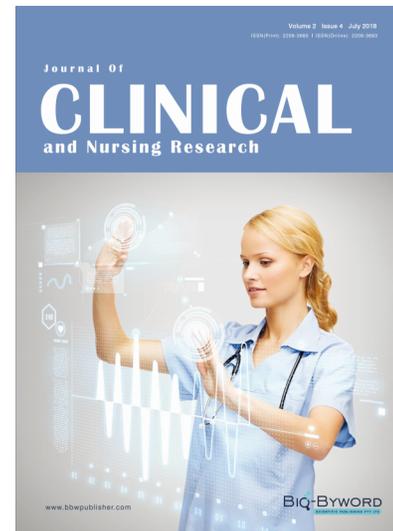
Topics covered but not limited to:

- Architectural design
- Architectural technology, including new technologies and energy saving technologies
- Architectural practice
- Urban planning
- Impacts of architecture on environment

Journal of Clinical and Nursing Research (JCNr) is an international, peer reviewed and open access journal that seeks to promote the development and exchange of knowledge which is directly relevant to all clinical and nursing research and practice. Articles which explore the meaning, prevention, treatment, outcome and impact of a high standard clinical and nursing practice and discipline are encouraged to be submitted as original article, review, case report, short communication and letters.

Topics covered by not limited to:

- Development of clinical and nursing research, evaluation, evidence-based practice and scientific enquiry
- Patients and family experiences of health care
- Clinical and nursing research to enhance patient safety and reduce harm to patients
- Ethics
- Clinical and Nursing history
- Medicine



Journal of Electronic Research and Application is an international, peer-reviewed and open access journal which publishes original articles, reviews, short communications, case studies and letters in the field of electronic research and application.

Topics covered but not limited to:

- Automation
- Circuit Analysis and Application
- Electric and Electronic Measurement Systems
- Electrical Engineering
- Electronic Materials
- Electronics and Communications Engineering
- Power Systems and Power Electronics
- Signal Processing
- Telecommunications Engineering
- Wireless and Mobile Communication

