# Journal of Architectural Research and Development

Editor-in-Chief

**S. Ravi**

*Anna University, India*

BIO-BYWORD SCIENTIFIC PUBLISHING PTY LTD
(619 649 400)
Level 10
50 Clarence Street
SYDNEY NSW 2000
Copyright © 2021. Bio-Byword Scientific Publishing Pty Ltd.
Complimentary Copy

November 2021, Volume 5 Issue 6

# Table of Contents

1 **Application of BIM with IPD in Design for a Construction Project**
*Shiping Wang, Wenming Liu, Guoping Peng, Nuowei Zhang*

9 **Design Strategy of Municipal Reconstruction of Expressway in Mountainous Area**
*Shang Ye*

13 **Application of Pipe Track Inner Mold Trolley Technology in Silver Pipe Track Project**
*Yuanxiang Jian*

20 **Water Quality Microbiological Inspection and Quality Control Technology**
*Ran Chi, Chen Sun, Siyi Li*

25 **Research on the Architectural Design Positioning of University Halls**
*Haixiu Liang, Jiantao Huang*

33 **Research on Environmental Pollution regulation in China's Construction Industry**
*Shengpeng Yan*

39 **Rental Location Choice Characteristics and Tendencies of Migrants in Guangzhou, China**
*Yang Wang, Xiaoli Yue, Lu Jiang, Hong'ou Zhang, Xueying Li*

44 **In the Future, Will There Be Creative Cities in China?**
*Renjie Cai, Dan Wang*

49 **Influencing Factors of Housing Sales Vacancy in the Guangzhou Metropolitan Area, China**
*Xiaoli Yue, Yang Wang, Hong'ou Zhang*

55 **Application of Green Building Design in Residential Buildings**
*Wen Zhang*

ISSN (ONLINE): 2208-3537
ISSN (PRINT): 2208-3529

# Journal of Architectural Research and Development

## Focus and Scope

*Journal of Architectural Research and Development* is an international peer-reviewed and open access journal which is devoted to establishing 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

## 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 endeavors 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

## Call for papers – Journal of Architectural Research and Development

**ISSN (Online): 2208-3537**
**ISSN (Print): 2208-3529**

**Submission open for January - 2022**

Dear Researchers,

*Journal of Architectural Research and Development* is an international peer-reviewed and high quality 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.

**The Journal Publishes in both online and print version.** *Journal of Architectural Research and Development* publishes research and review paper in the field of:

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

The *Journal of Architectural Research and Development* 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. Ravi S.
*Journal of Architectural Research and Development*

Journal of Architectural Research and Development, 2021, Volume 5, Issue 6
http://ojs.bbwpublisher.com/index.php/JARD
ISSN Online: 2208-3537
ISSN Print: 2208-3529

# Application of BIM with IPD in Design for a Construction Project

**Shiping Wang, Wenming Liu, Guoping Peng, Nuowei Zhang***

Shandong Ruison Institute of High-Performing Building Co., Ltd. Jinan City, Shandong Province, China

***Corresponding author:** Nuowei Zhang, zhangnuowei@sina.com

**Abstract:** Integrated Project Delivery (IPD) is a new delivery system that fosters integration of combining design and construction in a collaborative team environment. Building Information Modeling (BIM) is a smart technological tool that make significant advancements in coordinating the planning and construction processes. IPD process with BIM technology allows all building data to maintain in a communicating platform that make all participants share data. In reality, some technical and process obstacles exist, that are hampering full implementation of IPD with BIM in the project. The paper introduced the application of IPD with BIM on the design in a project. The results showed the impact of BIM implementation on IPD mode which can result in improved productivity, better coordination, reduced energy consumption, clash and rework of construction.

**Keywords**: Collaboration platform; IPD projects; BIM; Design coordination

***Publication date:*** November 2021; ***Online publication:*** November 30, 2021

## 1. Introduction

Integrated project delivery (IPD) is a distinct delivery typology, which has been considered as a strategy that drives continuous improvement for procuring a built asset. The core IPD concept is related to key stakeholders from initial phase of the project, formed a diverse, cross-functional, and multidisciplinary team [1,2,3]. The building information modeling (BIM) in areas of the construction industry improves design quality, and efficiently manage project, which involves all data for supporting the different applications in every phase of the project [4]. However, BIM implementation is still a challenge for the construction industry, and BIM has limited power without contractors integrating in the design phase of project [5]. Some experiences indicated some reasons for suspecting that BIM and IPD, had a lot in common [6]. The paper introduced the experiences of the contemporaneous use of BIM and IPD and showed the main effects when utilized simultaneously. We obtained the same conclusion as other studies that IPD process with BIM technology can provide a most effective approach to make right decisions in the design as well as whole phase of the project [7].

## 2. Significance of IPD and BIM

There are more definitions about IPD in many literatures. However, the most commonly adopted definition is proposed by American Institute of Architects, which is "IPD as a project delivery approach that integrates people, organizations, business structures and exercises into a process that collaboratively harnesses the talents and insights of all project participants to optimize the results, increase value to the owner, reduce waste, and maximize efficiency through all phases of design, manufacturing and building" [8].

The BIM defined by US National Building Information Model Project committee is described as "Building Information Modeling (BIM) is a digital representation of physical and functional characteristics

of a facility on open standards for interoperability. BIM serves as a shared knowledge resource for information about a facility forming a reliable basis for decisions during its life-cycle from inception onward" [9].

## 3. Materials and IPD with BIM methods

### 3.1. Materials

The authors worked on a building construction project that implemented application of IPD-BIM integration. The project was a new Technology Research and Development Center Building facility in Xi'an Economic Development Zone, Shaanxi Province, China. The project scope consisted of a 41,000 square meter, twelve-stories above ground and a 25,278 square meter, three-stories underground, including a three-stories 415 space parking garage. The building included research centers, independent offices, communal spaces, a coffee bar, conference rooms and so on. The building heigh was 49.65 meters with frame shear wall structure. The building scheme also covered ten elevators, seven the Heating, Ventilation and Air Conditioning (HVAC) systems (**Figure 1**).

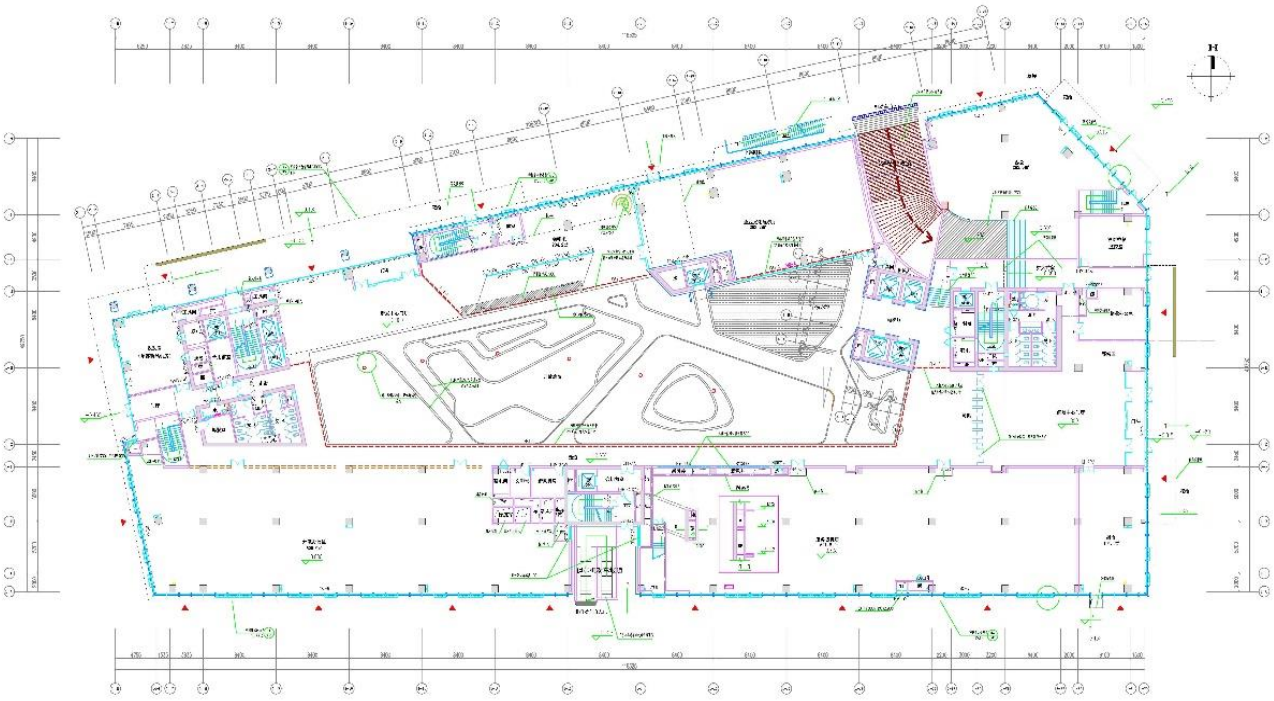


**Figure 1.** Architectural 2D plan of the ground level floor in the project

### 3.2. Organization of project

The architect of the project was Huahui Group, the mechanical engineer and the general contractor was Ruison Lean Construction Inc, the curtain trade partner was Jangho Group, the decoration trade partner was Zhongxiangzaide decoration design Inc, and the LEED (Leadership in Energy and Environmental Design) consultant was Ailv Energy-efficiency technology Inc. The main goal of the project was to achieve high performance building so that we built the building by assembling the most of the stakeholders to facilitate the communication each other and reduce time loss to execute the transaction. By meeting with most of main participants, the team achieved the main goal of the project before initiating the design program, that was involvement of all key project participants in the early phase of the project. The procedure was one of critical principles in the IPD process, which improved the team ability to reliably meet the project objective.

A detailed guideline was created for enhancing the team ability to collaborate applying three dimensional (3D) tools by the project team consisting of owners, architects, engineers and general contractor. The guideline contained the ability to generate 3D models and execute design analysis with parametric objects, by Revit 2016, Navisworks.

### 3.3. BIM responsibilities

The project IPD team achieved a list of requirements to create a schematic design and submit it to the stakeholders for approval. The two dimensional (2D) architectural planning was subsequently started. Using BIM methodology, the building was redesigned and allocated the architectural model following conversion from 2D to 3D as a holistic design file. The function of data collection and analysis to create 3D model showed the powerful features of BIM. First, architectural model was created and saved. Then, the structural model was created. Mechanical, Electrical & Plumbing (MEP) elements were created. The differences between 3D modeling and 2D drafting were analyzed. Furthermore, the refinement of objects including the dissociation of the elements was studied. The project team developed a design simulation optimization process to clarify the responsibilities and exchange information for the redesign process.

### 3.4. Methods

#### 3.4.1. 3D Design coordination process

It was a complicated process that 3D design was created by import the 2D plans. The process required a coordination work of IPD team to bring the benefits of 3D models into full play. The project team had mastered the way to integrate the models and generated the corresponding decomposition structure consisting with all parties. In the process of generating 2D plans from 3D model, we used Revit Annotate Family to label model components in design phase of project. The purpose of the procedure was to get updating synchronously both 2D plans and to 3D model. For example, as the dimension or elevation of a pipe segment changed in 3D model, so did in 2D plans. The model components labeled by Revit Annotate Family included geometric dimension, installation elevation, equipment information.

#### 3.4.2. Architectural and structural model

We created a 3D architectural model with integrating all other components using Revit 2016 in the project. The process was started by importing the 2D plans from Computer Aided Design (CAD) to Revit 2016. The 2D plans included specific items, the walls, the location of pillars, size, and layout of doors and windows. The 3D design was set up as an original model allowing all other project teams designers to integrate other components design details of the building. The project team shared the 3D design information in the whole process from design to construction. Subsequently, the structural design begun with structural analysis software. According to the calculation rules of the live and dead loads from Chinese National Code [10]. It was calculated and analyzed that included the size of foundation, column, beam and shear wall and the thickness of slab based on the required building use and the required reinforcements. With the preliminary design modifying, deepening and adjustment, structural 3D model was set up and consistent with the holistic design file to pull together structural design and architectural design into one model (**Figure 2.**).

#### 3.4.3. Mechanical analysis

The BIM model established in design phase covered building rationality and energy consumption analyses, such as wind environment, thermal insulation of envelope performance, building sunlight, solar radiation and so on. The architectural and structural merged 3D model can be conducive to MEP engineers having an insight into the project's massing and scale. The case study was only focus on HVAC domains, therefore

the analysis in the paper did not involve other mechanical works. With exterior and interior views from the BIM, the MEP engineers simplified the building model into an energy model, which includes the sizes of rooms as well as doors and windows. The HVAC engineers of the project using the energy model explored worksite and equipment systems for facilitating HVAC loads analysis. Design options were analyzed and validated. Subsequently, those decisions, heating and cooling loads were chosen. According to the determined design, the MEP engineers created 3D HVAC models and integrated them into the overall building model, which were responsible for maintaining the portion of the holistic design file. In order to clarify the different component work of HVAC systems in the project, Ventilation System presented as green color, Exhaust system as brown, and the size, location, type of HVAC was also presented in the merged 3D model (**Figure 3.**).

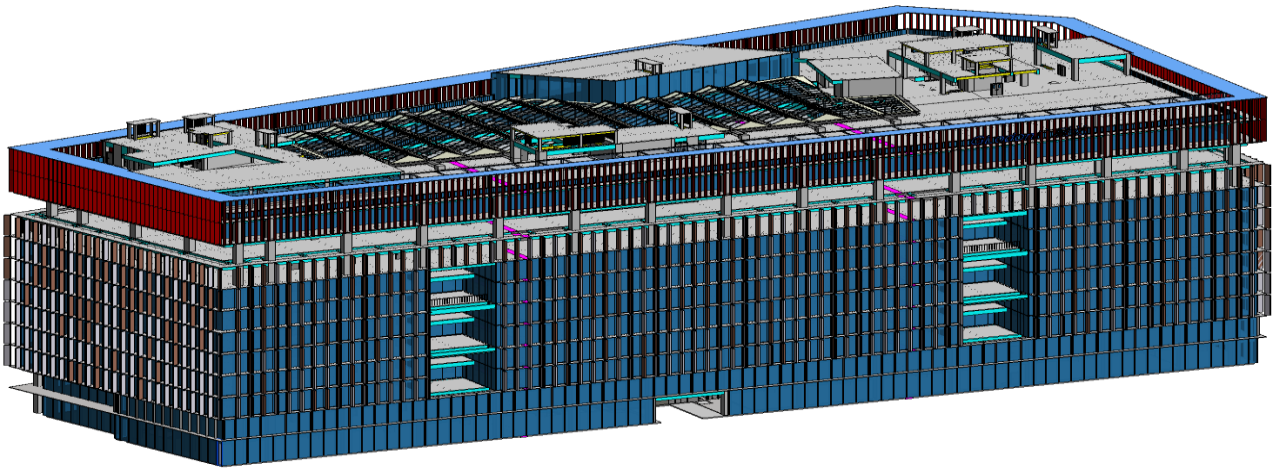


**Figure 2.** The merged 3D model of architecture and structure

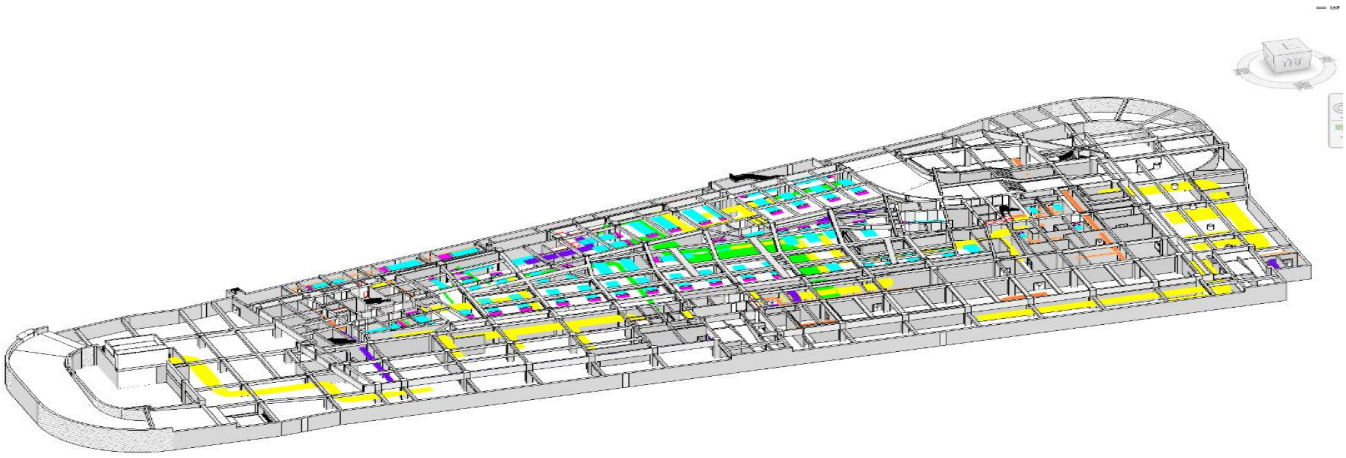


**Figure 3.** HVAC model

### 3.4.4. Electrical distribution design

The electrical design was developed a local file and broken down into three work sets, including strong electricity, weak electricity, and fire alarm system. The work sets were generated for each set and coordinated by each set. All the electrical drawings were presented through 2D AutoCAD to 3D model and the specific items presented in the bill of quantities. The process made 3D model present the interior lighting fixtures of different location in detail. All these lamps, steel conduits and power sockets 10A, 16A, 25A, were linked to switchgears for power. **Figure 4**., showed the layout of the ceiling light fixtures, wall lighting, and the related wiring system.

The fire alarm system was also presented through 2D AutoCAD to 3D model and the specific items presented in the bill of quantity. The presented fire detectors included temperature detectors, smoke detectors, manual alarm buttons for each story and its connection with the fire alarm control panel. In order to visualize electrical and telephone cables, it was presented with drawing conduits and making notations to indicate a specific cable in 3D model. These cables included the building cables between the main power distribution boxes and the sub distribution boxes on each story, the interconnecting cables between the main boards, the interconnecting cables between the main power distribution boxes and the main power supply of the project. It was illustrated that the fixed specification properties of each cable (**Figure 5.**).

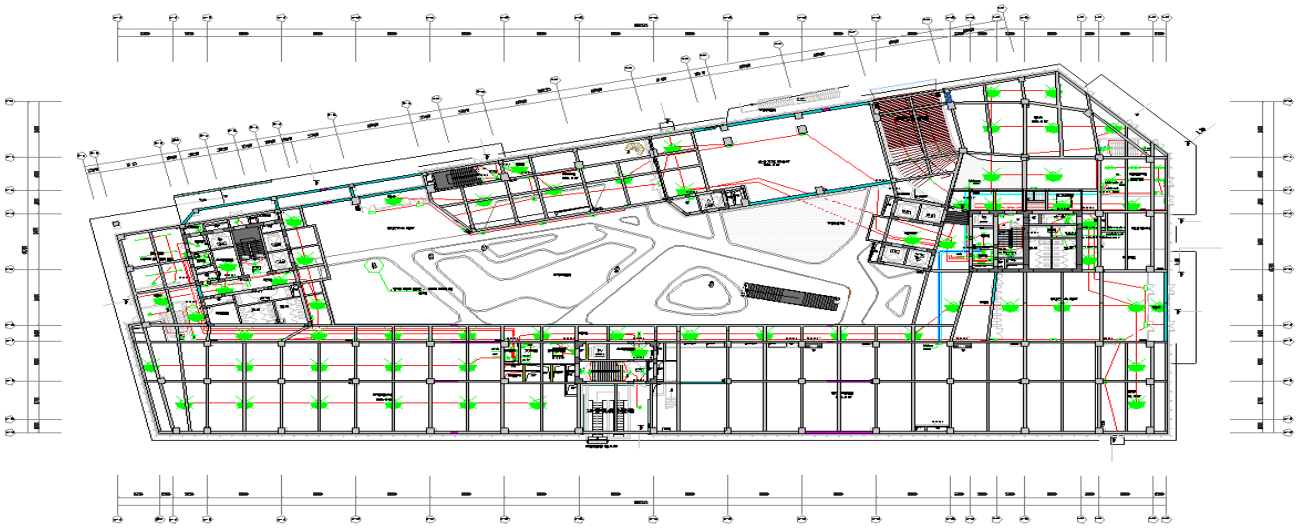


**Figure 4.** The layout of the ceiling light fixtures, wall lighting, and the related wiring system

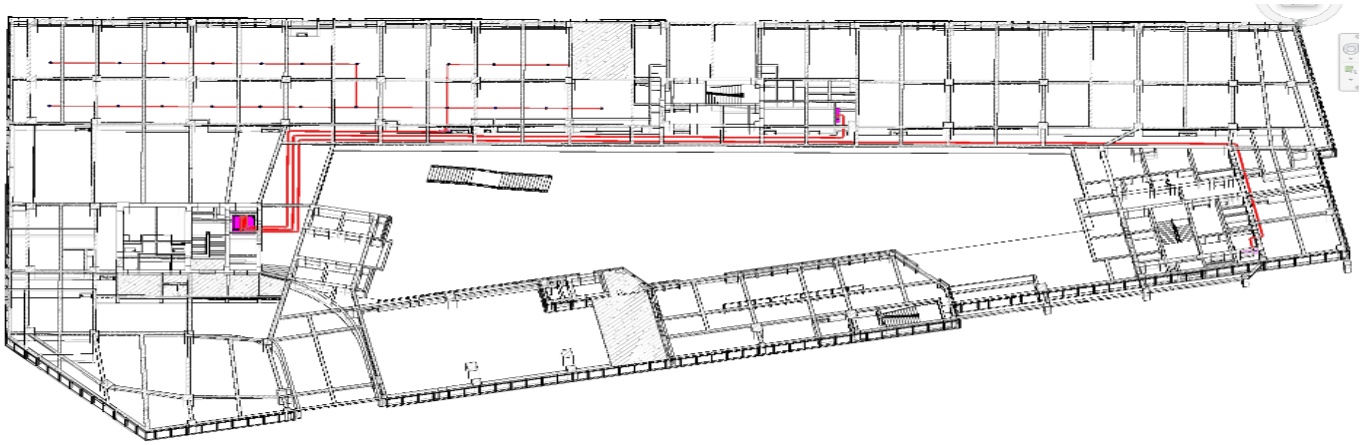


**Figure 5.** The fixed specification properties of each cable

### 3.4.5. Plumbing design

A local file relating plumbing design was developed, and the plumbing components presented on the specific items of the bill of quantities. The plumbing design was completed based on the needs of the requesting party and the specific items of the bill of quantity. The wells of the sewage drainages, water supply pipes, rainwater drainage pipes were given clear indication in each story of the project, as well as the plumbing fixtures, which included washrooms of both sides, diet-kitchen of underground, solar water heaters, water tanks on the roof of the building and pipefittings. The completed 2D plumbing plans were imported into Revit 2016 to create 3D model for showing all the designs about architectural, structural,

plumbing in one model. **Figure 6.** showed the 3D model of design in the plumbing systems.

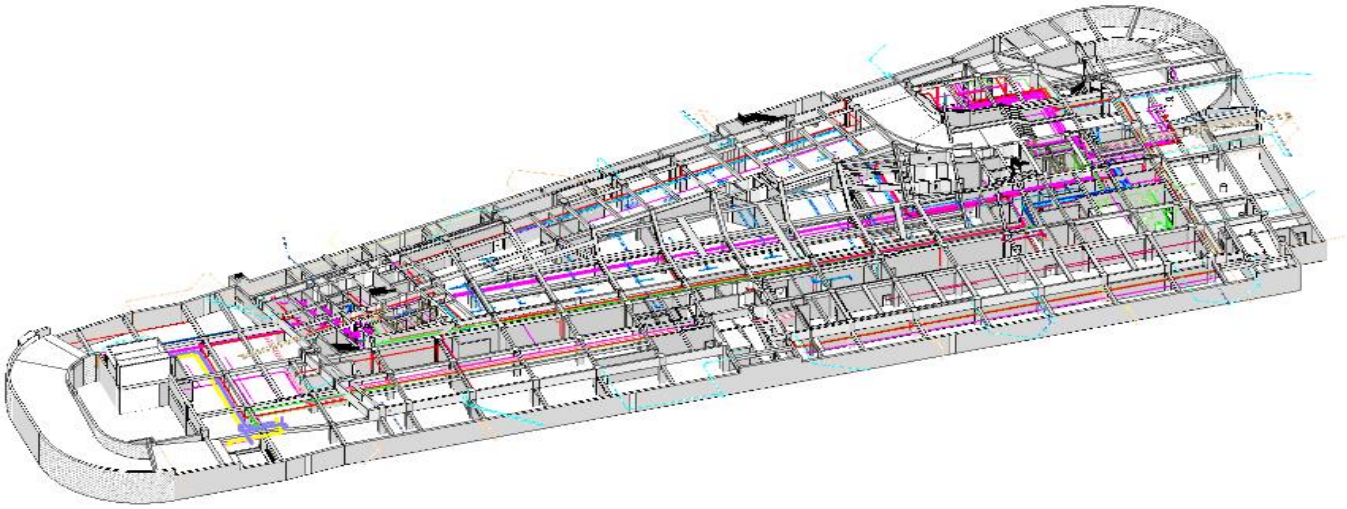


**Figure 6.** Plumbing model

## 4. Testing results

IPD with BIM process is primarily aimed at developing the comprehensive digital models assembles all information that connect with the construction and other phases of the project. We were mostly interested in minimizing the energy consumption and clashes in the design, that covered carrying out energy consumption analysis, clash detection and resolution with the 3D models. Virtual Environment analysis program was used for layout of HVAC, doors and windows. In the project, the indoor sunshine area (**Figure 7.**) of the building was increased by 12%, through moving 34 wall positions and adjusting 69 window sizes in the project. The numbers of air conditioning vent were canceled by 33 with mixed mode of natural and mechanical ventilation. Revit Clash Detective module was used for defining clash tests and discovered clashes, including soft clash detection for operating space of MEP to facilitate operating such devices. In the project, there were 26 clashes between HVAC ductwork and structural framing, 93 clashes between structural framing and walls, 179 clashes between the pipes and walls, respectively. It was worth noting that most of the structural framing and walls clashes were approved, as these structural framing and walls overlap simply without resulting in delay or rework, so only 24 clashes left were needed to be resolved because there were malposition and size mismatch each other. While most of the pipes and walls clashes were also approved, as these pipes ran through the walls, that was routine project works, so only 19 clashes were needed to be resolved due to those pipes conflicting with the shear wall (**Figure 8.**).

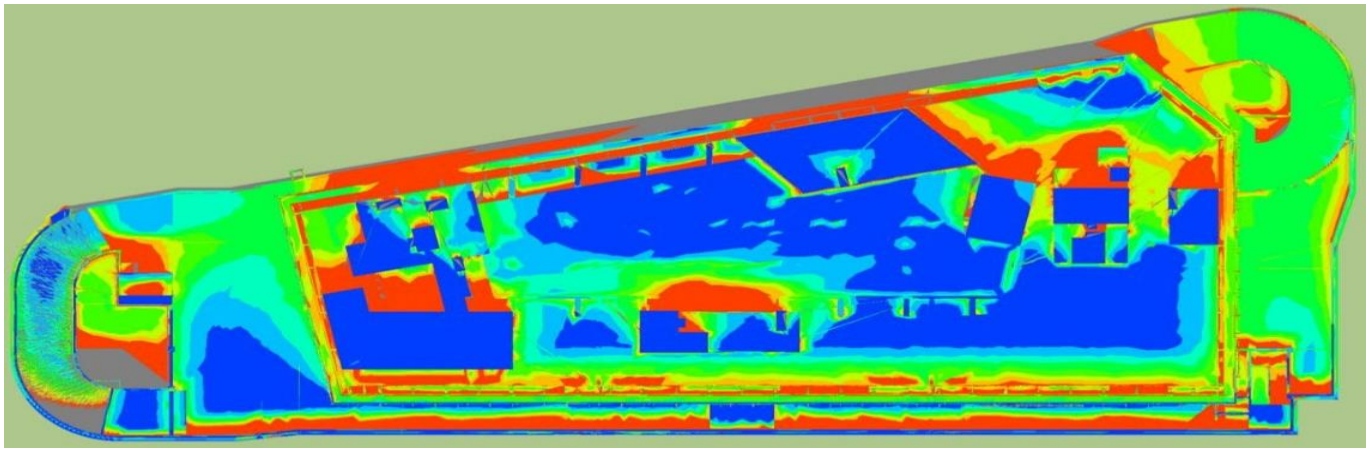


**Figure 7.** The indoor sunshine area analysis

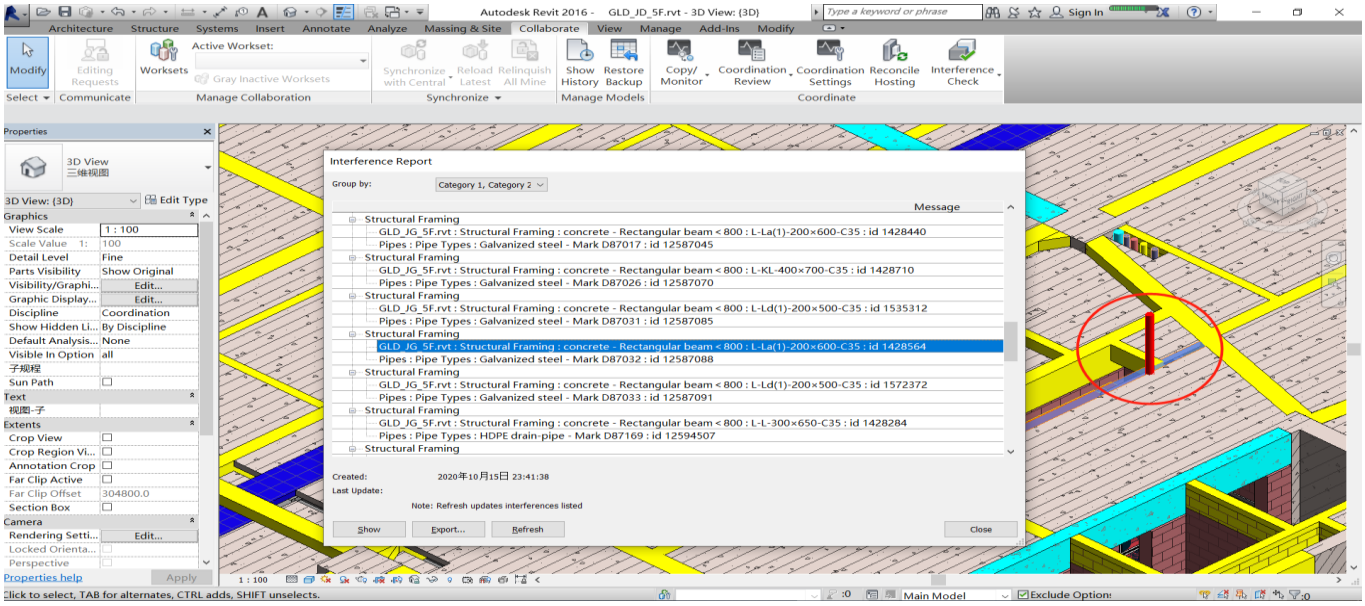



**Figure 8.** The view of clash detection between pipes with the shear wall

## 5. Lessons learned

The merged 3D model improved the construction and the design units adjusting the layout of the building, provided a comfortable natural ventilation, indoor lighting effect and reduction of energy consumption. In the design phase, BIM-based collaboration platform can facilitate the work of multi-functional teams in the same project model, and promote the true collaboration of all participants. This platform in the project accelerated cross-functional teams at a working level; transparency and information flow; swift identification of problems, response, and adaptation to them; and decision making as together as possible. Under these circumstances, BIM technology activated the processes of the IPD project, and realized the most potential merits and requirements of IPD projects. The key benefits of IPD with BIM methods in design phase included avoiding many conflicts because different professional software systems were exchanging in BIM-based collaboration platform to achieve collaborative design. The process can provide the more efficient and productive works for all necessary downstream applications (such as energy modeling). The multidisciplinary merged 3D model is a valuable tool in the design and construction process, which can be used in an interoperable way for reducing rework and change orders. As an example, the findings from the experience that the HVAC duct should be completed at least 75% before the other specialties could carry out effectively their work, because the duct was the most constraining [11].

## 6. Discussion and conclusion

This paper describes cross-functional teamwork in an IPD project using a BIM-based collaboration platform. The process enhances communication exchange and mutual trust between the parties by involving all of the major parties in the design phase. The article explains how different professional project teams can use these technologies to produce specific professional models based on holistic design files for putting together a holistic 3D model. BIM is a powerful technology that necessitates the use of a collaborative platform in order to maximize profitability. BIM application can obtain benefits that are aligned with the benefits of the IPD mode, allowing it to enforce many of the IPD's requirements and advantages while combining applications. When BIM is combined with the IPD approach, it is possible to create true cross-functional teams and improve project implementation. The methodology promotes optimal design by eliminating waste, shortening timeframes, lowering energy usage, detecting conflicts, enhancing preconstruction estimating, and speeding up the work process through information sharing.

Much more can be done to improve the combined use of BIM and IPD. Sharing information among professionals from various teams is no longer sufficient. In the future, combining BIM and IPD can aid in getting more precise designs, collaborating more closely with professional teams during the design process, and improving coordination issues and optimization schemes early in the design development process.

**Acknowledgments**

The authors gratefully acknowledge the support by the Housing and Urban-Rural Development Department of Shandong Province "specific topic" (No. 2020-K1-7).

**Disclosure statement**

The author declares no conflict of interest.

**References**

[1] Matthews O, Howell GA, 2005, "Integrated Project Delivery: An Example of Relational Contracting," Lean Construction Journal (LCJ), 2: 46-61.

[2] Kent DC, Becerik-Gerber B, 2010, "Understanding Construction Industry Experience and Attitudes toward Integrated Project Delivery," Journal of Construction Engineering & Management, 136: 815-825.

[3] Rahim SA, Mohd Nawi MN, Nifa FAA, 2016, "Integrated Project Delivery (IPD): A Collaborative Approach to Improve the Construction Industry," Advanced Science Letters, 22: 1331-1335.

[4] Porwal A, Hewage KN, 2013, "Building Information Modeling (BIM) Partnering Framework for Public Construction Projects," Automation in Construction, 31: 204-214.

[5] Atul P, Kasun N, 2013, "Building Information Modeling (BIM) Partnering Framework for Public Construction Projects," Journal of Automation in Construction, 31: 204-214.

[6] Halttula H, Aapaoja A, Haapasalo H, 2015, "The Contemporaneous Use of Building Information Modeling and Relational Project Delivery Arrangements," Procedia Economics and Finance, 21: 532-539.

[7] Solnosky R, Parfitt M, Holland R, 2014, "IPD and BIM-Focused Capstone Course based on AEC Industry needs and Involvement," Journal of Professional Issues in Engineering Education & Practice, 140: A4013001.

[8] 2007, American Institute of Architects (2007a). "Integrated Project Delivery: A Guide," http://www.msaipd.com/IPD Guide 2007.pdf. Accessed 17 July 2010.

[9] National Institute of Building Sciences (NBIMS), 2007, "National Building Information Modeling Standard", Version.1-Glossary, 149.

[10] Ministry of Housing and Urban-Rural Development of the People's Republic of China (MOHURD), 2012, "Load code for the design of building structures," GB 50009-2012, 8-9.

[11] Staub-French S, Khanzode A, 2007, "3D and 4D Modeling for Design and Construction Coordination: Issues and Lessons Learned," Electronic Journal of Information Technology in Construction, 12: 381-407.

Journal of Architectural Research and Development, 2021, Volume 5, Issue 6
http://ojs.bbwpublisher.com/index.php/JARD
ISSN Online: 2208-3537
ISSN Print: 2208-3529

# Design Strategy of Municipal Reconstruction of Expressway in Mountainous Area

**Shang Ye***

China Merchants Chongqing Communications Technology Research & Design Institute CO., LTD. Chongqing 400067, China

***Corresponding author:*** Shang Ye, 317540110@qq.com

**Abstract:** The construction of a mountain expressway is critical to the development of the mountain economy and the creation of mountain areas. However, since the service life of many mountain expressways continues to increase, municipal transformation design is required to improve the smoothness of the expressway, make efficient use of space, and reduce resource waste. The author investigates the current challenges in the construction of a mountainous expressway and proposes an effective method for municipal reconstruction design of a mountainous expressway, in the hopes of assisting in the optimization and development of the mountainous expressway.

**Keywords:** Mountain area; Expressway; Municipal administration; Transformation design

***Publication date:*** November 2021; ***Online publication:*** November 30, 2021

## 1. Introduction

In view of the actual situation of the construction of mountainous expressway at present, there are some problems such as traffic jam, road cutting and waste of land. In order to solve these problems, it is necessary to design the municipal transformation of mountainous expressway. At the same time, with the continuous expansion of the city, the original expressway construction area into urban area, also need to carry out municipal transformation, such as adding pipe network, lighting, etc. In this process, we must change the previous concept of highway design, accurately grasp the key points of highway municipal transformation design, in order to improve the quality of highway design, so as to better serve the construction and development of mountainous areas.

## 2. Problems in the construction of mountainous expressway at present

The service object of mountain expressway is usually people who need to travel for a long distance, which plays an important role in the communication between cities and the construction and development of cities. However, from the actual situation of expressway construction in mountainous areas at this stage, there are still some problems.

### 2.1. Traffic congestion

During the free passage of expressways on holidays, the traffic flow of expressways increases significantly, especially the increase of freight vehicles, which puts forward better requirements for the traffic capacity of expressways in mountainous areas and main lines of urban roads. With the continuous development and progress of mountain area and cities, the relationship between mountain area and cities has become closer. The construction of expressway not only undertakes the function of meeting the increase of internal traffic demand, but also needs to meet the external traffic demand. However, in the specific construction of

mountainous expressway, due to the limitation of terrain, the distribution of interchange nodes is sparse, and the smooth traffic capacity of ramp is weak, which is prone to node congestion. In addition, with the expansion of the city, the functions of some expressways have changed and become urban expressways, which urgently need for its municipal transformation.

### 2.2. The plots on both sides of the expressway are divided

When laying some mountainous expressways, due to the limitation of terrain, the plots on both sides will be divided when setting expressway interchange nodes. On both sides of the expressway, only relatively low-grade roads can be used to connect the expressway through underpass. With the continuous development of mountain cities, the communication demand between cities is increasing. At this stage, there is a certain contradiction between the situation of mountainous expressways and the communication demand between cities. The problem of cutting land plots by mountain expressways is gradually highlighted.

### 2.3. Waste of land resources

On the one hand, expressways are usually laid by means of high embankments, which cover a large area, both the slope and the boundary cover a large area. On the other hand, toll stations are set at the entrances and exits of the expressway, which will cause certain restrictions on the setting of entrance and exit ramps and interchange conversion ramps. Therefore, most entrance and exit ramps and interchange conversion ramps adopt the form of trumpet interchange, which needs to occupy more land resources, and will obviously waste some land resources.

## 3. Effective strategy of municipal reconstruction design of mountainous expressway

### 3.1. Change the previous ideas and ideas of expressway construction in mountainous areas

In view of some problems existing in mountainous expressway at the present stage, we must actively change the previous design thoughts and ideas in the municipal transformation design.

First, in the municipal reconstruction of mountainous expressway, the dual system structure of the combination of main line and auxiliary line should be adopted to expand the capacity of main roads and expressways in mountainous cities. At the same time, each connecting node can be set up hierarchically, so as to solve the traffic congestion problem of the previous mountain expressway nodes and the whole.

Second, when designing the main road channel of expressway in mountainous area, it can be arranged by tunnel and viaduct. Auxiliary roads can be arranged in the form of composite channels on the ground, so as to maximize the use of land resources and avoid the waste of land resources.

Third, after completing the municipal design of expressway compound channel in mountainous areas, it is necessary to ensure that it forms a close road network structure with the surrounding roads, and ensure the refinement of the design, so as to improve the quality of expressway compound channel after reconstruction.

### 3.2. Key points of municipal reconstruction design of expressway in mountainous area

First, reconstruction design of expressway channel mode in mountainous area from the actual situation of highway network structure in mountainous areas at this stage, it cannot be well integrated with the overall urban road network [1]. The expressway channel designed after municipal transformation needs to become an important part of the urban road network structure, so as to share the functional requirements of urban internal traffic exchange and external long-distance fast driving. Combined with the actual development of cities along mountainous expressway, we should carry out municipal transformation design for different cities. The main manifestations are: On the one hand, for mountainous urban continuous areas, the

composite highway mode combining expressway and trunk road can be used to reconstruct the expressway channel, so as to meet the long-distance traffic needs of cities along the expressway. On the other hand, for the undeveloped urban peripheral areas along the mountainous expressway, the municipal reconstruction design of the expressway channel in this area can be carried out through the mode of expressway and reserved main road, so as to meet the traffic needs of urban construction and development in this area at this stage and in the future.

Second, the municipal reconstruction design of highway channel scale in mountainous areas. By predicting and analyzing the traffic flow of the current urban road network structure in mountainous areas, the scale of the main road and auxiliary road of the composite channel of expressway in mountainous areas is defined, so as to better meet the traffic demand of dual system road network in mountainous cities.

Third, classify the nodes of mountainous expressway. Mountain expressway compound road is the intersection of different levels of roads [2]. In the process of municipal transformation design, effective communication between roads can be formed in the form of multi-level connection, so as to better meet the internal and external traffic needs of mountainous cities.

### 3.3. Design optimization of municipal transformation of main line and interchange of mountain expressway

In the process of municipal reconstruction design for the main road system laying of mountainous expressway at the present stage, the problem of resource waste can be solved by laying tunnels or elevated roads, cooperating with the ground laying of auxiliary roads, and making intensive use of the red line space of mountainous expressway [3]. At the same time, it is also necessary to optimize the “trumpet” interchange selected for the setting of toll stations, and dismantle the existing toll plaza. Combined with the traffic demand of mountainous cities at this stage, the original “trumpet” interchange is transformed into simple interchange and turbine interchange, which can save part of the area of the interchange and reduce the use of land resources through the economical arrangement of the interchange hub. Combined with the different turning requirements of expressway, the design standard and ramp direction of interchange ramp are optimized.

### 3.4. Fine design of municipal transformation of mountain expressway

In the process of improving the refinement of municipal reconstruction design of mountainous expressway, we should make full use of the saved land use. We can create a good mountainous expressway environment through landscape design on these land resources, so as to create a more beautiful expressway traffic environment for passing vehicles [4]. In addition, in the specific transformation design, we also need to pay attention to the setting of intelligent facilities, and use the setting of intelligent facilities to collect the operation of highway network in mountainous areas in real time, so as to provide greater convenience for people’s travel. In addition, in the process of municipal reconstruction of mountainous expressway composite channel, the function of urban trunk road can be shared through the reconstruction of auxiliary road system. At the same time, in the concrete process of municipal reconstruction design of mountainous expressway, it is also necessary to fully embody the concept of people-oriented transformation, in order to meet the needs of people’s long-distance and fast travel as the main starting point, as far as possible to improve the spatial quality of mountainous expressway, so as to create a good quality expressway environment for the masses.

## 4. Conclusion

To summarize, the goal of the municipal reconstruction design of a hilly expressway is to change the expressway's attribute and turn it into a municipal road. In order to carry out the specific reconstruction

design more reasonably, it is not only necessary to analyze the current operation of the mountain expressway to identify existing problems, but it is also necessary to comprehensively analyze the traffic functions and traffic demand of the mountain expressway in the future. Simultaneously, in the process of reconstruction design, it is also necessary to clarify the scale of the expressway channel and the level of each traffic conversion node in accordance with the focus of municipal expressway reconstruction in mountainous areas, solve the problem of highway overall and node congestion through the channel mode of combining trunk road and auxiliary road, save land resources, and improve the spatial reconstruction quality of expressways.

**Disclosure statement**

The author declares no conflict of interest.

**References**


[1] Yang LT, 2020, Route Selection and Construction Management Measures for Expressway Construction in Mountainous Areas. Construction & Design for Project, (13): 95-96 + 99.

[2] Gong JY, Chen SH, Zhang X, 2020, Discussion on Route and Construction Management Measures for Expressway Construction in Mountainous Areas. China Collective Economy, (01): 160-161.

[3] Huang Y, 2018, Analysis and Improvement Countermeasures of Expressway Traffic Safety in Southwest Mountainous Area. Chan'an University.

[4] Han XD, Li ZJ, 2017, Analysis on the Selection and Rotes Design of Highway in Mountainous Areas. Engineering and Technological Research, (06): 205-206.

Journal of Architectural Research and Development, 2021, Volume 5, Issue 6
http://ojs.bbwpublisher.com/index.php/JARD
ISSN Online: 2208-3537
ISSN Print: 2208-3529

# Application of Pipe Track Inner Mold Trolley Technology in Silver Pipe Track Project

**Yuanxiang Jian***

China First Metallurgical Group Co., Ltd., China

***Corresponding author:*** Yuanxiang Jian, 272609340@qq.com

**Abstract:** This paper mainly introduces the research and application of the technical features, technological principles and construction procedures of the pipe track inner mold in the construction of the pipe track through the silver pipe track project. The inner mold system is composed of trolley support; with a combination of large mold instead of cabin mold scaffold system. The cabin mold scaffold system optimizes the cabin mold system construction from "scaffolding → installation mold → reinforcement → mold removal → scaffolding removal → horizontal transfer" to "inner mold trolley installation and commissioning → trolley in place → support form → release mold → mold movement." Reduce labor intensity, conserve construction consumables, and assure quality and safety by reducing the expansion, deconstruction, and transfer procedure of the mold and supporting structure. The occupation time of internal mold trolley in each structural construction section is reduced, the trolley turnover efficiency is improved, and the economic benefit is improved thanks to the central support of early mold removal in the workshop, which serves as a model for the construction organization and technical treatment of similar projects.

**Keywords:** Pipe track construction; Mold expansion; Inner mold trolley; Pipe track mold

***Publication date:*** November 2021; ***Online publication:*** November 30, 2021

## 1. Introduction

With the rapid development of urban information industry, many information enterprises have established special information transmission networks. Most of these new information transmission networks use the existing power supply poles for overhead wiring, which cannot guarantee the safety and reliability, and seriously affect the city appearance and environment. Therefore, it is particularly important to build underground pipe corridors under urban roads. Generally, the construction of comprehensive pipe track mainly adopts pipe jacking, shield, open excavation prefabrication and hoisting, open excavation and cast-in-situ and other methods. At present, most of the pipe corridors mainly adopt the open excavation cast-in-situ construction technology. This construction method can operate in a large area and divide the whole project into multiple construction sections, so as to speed up the construction progress. At the same time, this construction method has small technical difficulty, relatively low project cost and guaranteed construction quality. However, in the construction of each section of pipe track, internal and external mold construction, scaffold and support construction, disassembly and transfer are required. The amount of disassembly and assembly is large, requiring a lot of labor, which result in low construction efficiency and unstable quality. According to the silver comprehensive pipe track, three compartment or four compartment reinforced concrete underground box structure is adopted, including thermal cabin, natural gas cabin, power cabin and comprehensive cabin, including 7 comprehensive pipe tracks of North Loop Road, Yinshan Road, South Loop Road, Chengxin Avenue, Beijing Road, Yingbin Avenue and South Loop West Road, with a total length of about 26.25km. According to the characteristics of linear horizontal layout of each pipe track,

tight construction period and large amount of repeated construction procedures, it is particularly necessary to design an intelligent mold trolley with high construction efficiency, small amount of disassembly and assembly, low labor intensity of workers and stable quality of cast-in-place construction of pipe track. Intelligent mold trolley has become a new development trend, which is of great significance to the automation of pipe track construction. Through the example of silver pipe gallery project, this paper discusses the technical characteristics, process principle, construction process and construction method of the mold in the pipe gallery, and provides reference for similar projects in the future.

## 2. Project overview

Baiyin underground comprehensive pipe track construction project is located in Baiyin District, Baiyin City, Gansu Province. The pipe gallery adopts three compartment or four compartment reinforced concrete underground box structure, including thermal compartment, natural gas compartment, power compartment and comprehensive compartment. The natural gas tank (natural gas pipeline) and power tank (above 100kV) are separately divided into tanks, and the thermal tank and comprehensive tank are respectively arranged with thermal pipeline, power pipeline, communication pipeline, urban water supply pipeline, urban sewage pipeline, etc.

The pipe gallery system is arranged according to the mode of "double environmental control centers, branches, companies and clusters", and the total length of the proposed comprehensive pipe gallery is about 77.15km, with 1 control center and 38 substation. The pilot project includes 7 comprehensive pipe galleries, including North Loop Road, Yinshan Road, South Loop Road, Chengxin Avenue, Beijing Road, Yingbin Avenue and South Loop West Road, with a total length of about 26. 25 km. Combining the separate control of pipe gallery and centralized control of control center, and based on GIS information human-computer interaction interface, timely information exchange and sharing can be realized, which is integrated with the smart city, and a variety of monitoring fire automatic alarm and fire linkage systems can be organically integrated to achieve unified management and control.

## 3. Technical proposal

### 3.1. Design of inner mold trolley

According to the actual structural size of the pipe track and the load distribution of each part, calculate the mechanical properties to be met by the main transmission mechanism of the vehicle and the size of the supporting rod of each part, determine the spatial location of important parts, and select the most appropriate steel type, structure and size. The main frame is composed of hollow square steel and channel steel to ensure large rigidity and high bearing capacity of the internal mold trolley structure. It can replace the scaffold as the mold support mechanism, and fix the mold support structure on the trolley structure to realize the integration of mold and support. According to the section size of the cabin, the integrated trolley or double-jointed trolley shall be selected; For cabins with a clear width of less than 2m, an integrated trolley shall be used, and for cabins with a width of more than 2m, a double-jointed trolley shall be used. A central support is set in the middle of the double-jointed trolley, and multiple trolleys are assembled to form an integral internal mold. When the trolley is in the traveling state, the mold and trolley shall be reserved about 100mm away from the cabin structure to facilitate walking. The trolley frame is equipped with supporting transmission device and relevant operation box. The trolley structure mainly uses square pipe structure, and the connection is fixed and connected with high-strength bolts. The mold and trolley are manufactured in an integrated structure, operated by mechanical transmission, demolded by the combination of mechanical power and self-weight, and hinged connection is adopted between the mold and the support system to facilitate the expansion and folding of the mold and ensure the trolley to walk in the pipe track; Frame structures such as trolley beams and columns are assembled with standard members to form equipment and

standardization. When the trolley works, put down the support seat so that the roller leaves the ground without pressure. At the same time, use the support seat to adjust the level and verticality of the trolley. When the trolley moves, put up the support seat. The traveling mechanism adopts the motor reducer drive system to push the roller forward.

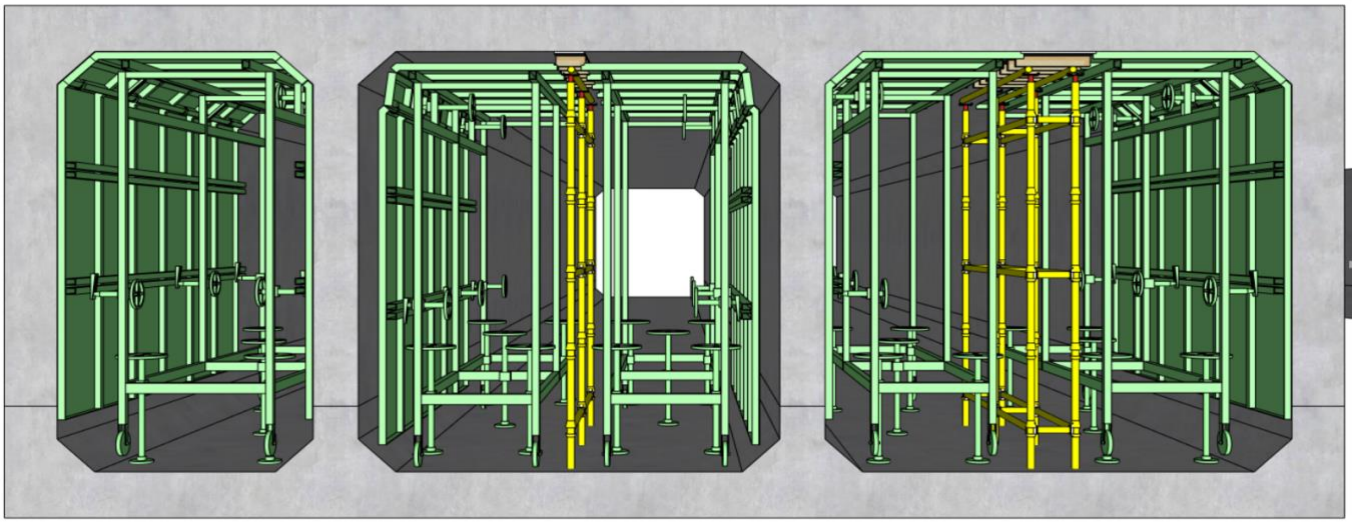


**Figure 1.** Scheme diagram of double-jointed trolley with early demolition template

### 3.2. Specific implementation methods

According to the construction status of silver pipe track, it is mainly implemented in the underground comprehensive pipe track section of Chengxin Avenue. The specific implementation steps are as follows: Pipe track bottom plate construction - pipe track wall reinforcement and embedded parts installation - mold trolley lifting into the pipe track - mold system moving to the corresponding pouring place - mold installation and reinforcement of mold system - pipe track roof reinforcement construction - wall and roof concrete pouring - mold system demolding - mold system moving to the lower pouring point.

#### 3.2.1. Construction of pipe track bottom plate

The construction of pipe track bottom plate is the pre process of concrete construction of pipe track trolley mold system, and it is also the key to whether the mold system can move smoothly. Before the construction of bottom plate concrete, the foundation shall be treated to ensure that the foundation meets the strength required by the design, ensure the smooth movement of mold system, and the pouring of bottom plate concrete shall be smooth, especially during the pouring of floor corner concrete, attention shall be paid to controlling the structural size of the wallboard to prevent the mold expansion from affecting the installation speed of the mold trolley. For the pipe support to be poured on the bottom plate, it is best to use secondary pouring in order to facilitate the movement of the mold system. After the pouring of the bottom plate is completed, the mold shall be removed, the concrete flatness of the haunch corner shall be checked and polished, and the construction joint shall be roughened and cleaned.

#### 3.2.2. Installation of reinforcement and embedded parts of pipe track wallboard

Curing shall be carried out after the construction of the bottom plate, and the installation of pipe track wall reinforcement and embedded parts can be carried out at the same time. This process starts from the position of the first poured bottom plate to ensure that the concrete strength of the bottom plate is not affected. Rebar and embedded parts are made in the factory and transported to the site. For φ14-16 steel bar, flash butt welding is used, and φ20 and above steel bar is connected by straight thread. Before installing the steel bar, pay attention to whether the steel bar reinspection and steel bar joint inspection are qualified, and whether

the cutting size is consistent with the drawing. The wall reinforcement is double layer steel mesh, in order to ensure the thickness of the wall and the thickness of the steel protection layer, the steel bar hook is set between the steel mesh, the steel skeleton is fixed by the pull rod, and the embedded parts are connected and fixed with the L-shaped steel mesh. When necessary, the contact surface of the embedded parts and the template is set with fastening screws to ensure the position of the embedded parts. The steel bar, casing and embedded parts on the wall panel should be installed in place. For the embedded parts that need to be fixed with the template, they should be fixed when the vehicle model frame is divided into compartments. This process and the previous process are used as the previous process for the mold transfer and pouring of the pipe track trolley mold system, and the construction shall be carried out in sections with the flow rhythm.

### 3.2.3. The mold trolley moves to the pouring point

Firstly, according to the actual size of the cabin, select the mold system to enter the site. The cabin with net width ≤ 2m adopts the integrated "door" trolley mold; Cabin with 2m<the net width of the cabin body ≤6m, using " ┌┐ " type double jointed trolley frame, the central support set in the middle of double-jointed trolley, and central support uses tool template and stereotype template. When the concrete strength of pipe track bottom plate reaches to run the mold system and reaches 70%, the mold system can be hoisted into the pipe track. In the hoisting process of the mold frame system, the hoisting port should be selected according to the geographical location first. According to the actual situation, the hoisting position of the construction section of Chengxin Avenue should be selected at the inspection port. The lifting position of the foundation should have a certain bearing capacity, lifting bearing beam (pole), according to the weight of the mold system to roughly calculate the bearing capacity, bearing beam at both ends should be enough beyond the length of the mold system, as far as possible horizontal lifting into the pipe corridor. In the process of hoisting, all the power lines of the motors should be wrapped to avoid the ground pressure line and tripping to ensure safety. The direction of the extension line of the pipe gallery should be assembled by the multi-section car model frame. Every time the hoisting enters a section, move forward one section until the required platform length is reached. According to the size of the pipe gallery, basically 10m is a section.

### 3.2.4. Installation of mold trolley system in place

After entering the site, the trolley mold system shall be assembled in sections. After assembly, the commissioning and trial operation of walking, mold expansion, mold removal and other processes shall be carried out. After the sectional commissioning of the trolley mold system, enter the pouring position of the first section of the pipe track. The bottom plate structure at the pouring position shall have a strength of more than C20, the structural size of the lower section of the wallboard shall meet the specification requirements, and the parts with deformation and mold expansion shall be treated first. Adjust the limit switch of the mold support device according to the size of the pipe track, so that the wallboard mold, corner tucking mold and roof are in the position of standard section size.

After the trolley mold system is in place, the trolley mold support shall be carried out in sections. According to the trolley mold system, first locate the mold system, adjust the trolley support device to make the top mold of the trolley mold system in the mold support position, then start the support device at the wallboard, put the wallboard mold and corner mold in the mold support position, and then carry out the mold support of the next trolley mold. Until the mold expansion of this cabin is completed, the trolley mold expansion of the next cabin shall be carried out. During this period, the embedded parts to be fixed shall be finally fixed before mold sealing. During the connection of multi trolley mold, the problems such as joint misalignment and gap shall be controlled. After fixing the trolley mold of all cabins, install the outer wall plate mold, the central mold between trolley mold and the mold of special openings, and bind the reinforcement of the top plate of the pipe track at the same time. Then reinforce the trolley mold and outer

mold.

### 3.2.5. Roof reinforcement construction

According to the design drawings, the reinforcement is double-layer reinforcement mesh, mainly welded. The reinforcement is made and formed in the processing site, and then transported to the construction site according to the installation sequence. The blanking of reinforcement is batched by BIM, which well ensures the maximum utilization rate of materials. During the installation process, the bottom reinforcement is installed first, and then the surface reinforcement and reinforcement mesh (the bottom reinforcement and the surface reinforcement) is layered with the steel support, the support can be welded or tied, to ensure the spacing between the steel bars. When the bottom plate reinforcement is installed, the 30mm protective layer cushion block shall be installed in place at any time. At least 1 or 2 of the joints of reinforcement shall be staggered at the same section. During the installation of reinforcement, attention shall be paid not to step on the reinforcement. When the reinforcement bar is installed, personal pedal should be placed. The pedal shall move with the installation position. Do not step directly on the reinforcement mesh, so as to prevent the size between the meshes from changing and ensure the cleanliness of the reinforcement surface. The reinforcement shall be installed along the flow operation surface.

### 3.2.6. Concrete pouring of wall and roof

Before concrete pouring, clean the garbage, sundries and oil stains on the mold and reinforcement, and then start pouring. Before pouring concrete, the ratio and slump of concrete shall be checked with the vehicle. At the same time, concrete specimens with the same conditions and standard curing shall be made at the pouring site. The concrete of pipe gallery shall be impermeable concrete. At the same time, specimens for impermeability inspection shall be made to test the strength of concrete at any time. The curing test blocks of the same article will be used as the basis for the mold removal time of mold system. The pouring sequence is the wall panel and then the top panel. Water stop steel plate and external water stop belt shall be set at the construction joint as required. Firstly, concrete with half stone is used at the joint to pour a slurry layer no more than 30mm [1] thick, and then the wallboard concrete shall be poured. The walls on both sides shall be symmetrical at the same time. During the concrete pouring, special personnel shall be arranged to make the concrete test block and inspect the slump; Assign special personnel to observe the mold and reinforcement at the pouring point to avoid accidents. When pouring concrete, it is forbidden to directly lay ash against the embedded parts, and the vibrating rod shall not collide with the embedded parts, fixed frames and tension pieces. The layered thickness of concrete pouring shall be controlled within 500mm, and the layered pouring shall be carried out according to the gradient of 1:6 ~ 1:10, and the upper concrete shall cover the lower concrete for more than 500mm in advance. When construction joints are not allowed, the pouring interval time between areas and between upper and lower layers shall not exceed the initial setting time of concrete. When the plug-in vibrator is used to vibrate the concrete, the vibrator shall be “inserted quickly and pulled out slowly”, and the falling point shall be uniform. The vibration time shall be subject to the fact that the concrete surface will not sink and the surface is flooded with slurry. The insertion spacing is 300mm, arranged in a quincunx shape, and the insertion depth is 50-100mm into the lower layer. It is strictly prohibited to add water to the concrete randomly during pouring, and special attention shall be paid to the vibration between the upper and lower layers of concrete, joints and dense parts of reinforcement, so as to ensure the compactness of concrete vibration.

### 3.2.7. The trolley mold system demolds and walks to the next section

When the concrete strength of the wall roof reaches 50% [1] after pouring, the mold shall be removed. For cabins with a width greater than 2m, the central support system shall be used to cooperate with the trolley

mold to remove the trolley mold and walk to the next section.

### 3.3. Quality requirements

According to "Code for Acceptance of Construction Quality of Concrete Structure Engineering (GB50204-2015)" [1] and "Code for Construction of Concrete Structure Engineering (GB50666-2011)" [2], the acceptance requirements for mold expansion of internal mold trolley are shown in **Table 1.**

**Table 1.** Allowable deviation and inspection method for mold expansion of internal mold trolley [2]

| Number | Project | Allowable deviation mm | Inspection method |
|---|---|---|---|
| 1 | Axis position | 5 | Ruler measurement |
| 2 | Elevation of upper surface of bottom mold | ± 5 | Stay wire, ruler or level gauge |
| 3 | Internal dimension of mold (wall) | ± 5 | Ruler measurement |
| 4 | Perpendicularity of wallboard mold | 6 | Ruler measurement |
| 5 | Surface elevation difference of trolley mold and central support mold | 2 | Ruler measurement |
| 6 | Surface flatness | 5 | 2m guiding rule feeler gauge |

### 3.4. Quality control measures

According to the characteristics of the mold trolley and in order to better ensure the construction of concrete to achieve the effect of clean concrete, in the construction process, the first is to ensure the flatness of the foundation floor in the construction process. The mold trolley can be hoisted into the pipe gallery only after the concrete of bottom slab reaches 21 days. After the assembly of the mold trolley, the jacking and limit test of the roof and wall panel should be carried out to check whether the size and the flexibility of jacking equipment and limit switch can meet the requirements of the design drawings. Before the template is hoisted into the pipe track, the roof and wall panels should be evenly coated with demolding agent. In order to ensure the quality of concrete, before brushing the release agent, clean the template fully and then brush the oily release agent. After each construction, it is necessary to check the surface smoothness of the template to ensure the demolding effect of the template during the whole construction process

Before the trolley enters the track, the flatness of the haunch angle of the concrete base plate shall be checked. In order to ensure the tightness of the combination of wallboard concrete and base plate concrete, the whole haunch angle of the bottom plate shall be measured and cleaned before the trolley mold enters the track. The uneven haunch angle shall be polished to ensure that the trolley mold is closely connected with the concrete surface of the haunch angle. After the mold is jacked to the position required by the design, check each jacking screw rod of the mold to see if it has been jacked tightly. The joint position of the two mold trolleys must ensure that the two trolleys are on a horizontal plane. When connecting, pay attention to whether the connecting bolts are in place or have deformation and dislocation. During the installation of the top axillary corner mold, attention must be paid to cleaning to prevent slag inclusion and other phenomena, so as to avoid leakage of grout, resulting in unsightly axillary corners after demolding.

### 3.5. Safety precautions

Due to the different construction loads caused by different sizes and different construction environments, before using the existing mold trolley, according to the structural selection of the trolley, and comprehensively considering the self-weight of on-site personnel, equipment, materials and concrete vibration, the stress safety calculation of each part of the trolley is carried out to ensure that the mold trolley

has sufficient bearing capacity.

The bending strength [3] $\sigma = \frac{m_{max}}{w_n} \leq f$ and deflection [3] $v = \frac{5q_g L^4}{384EI_x} + \frac{PL^3}{48EI_x} \leq [v]$ of beams and plates shall be checked; The strength [4] $A = \frac{F}{[\sigma]}$ and stability of columns and inclined supports shall be checked and calculated during axial tension or compression.

## 4. Conclusions and recommendations

The inner mold trolley has been applied in the underground comprehensive pipe gallery project of Chengxin Avenue in Baiyin City, and achieved good results. It has effectively shortened the mold construction period, reduced the manual workload in mold expansion, mold removal and transportation by more than 70%. At the same time, the concrete structure has good quality and reduced the manual investment in subsequent repair work. It can be used for rectangular box structure with tucked corners, and can be used in municipal pipe gallery, hydraulic box culvert, underpass and other projects. Based on the internal mold trolley, the mold moving pouring construction method is used instead of the internal mold and supporting scaffold construction in the pipe gallery. Multiple molds are combined into a whole through the hinge mechanism. During mold expansion and demolding, the procedures of mold expansion in place and demolding recovery are completed through successive operations. The lead screw is used for electric control of mold support, programmed operation is used for mold expansion and demolding, and equipment is formed, which greatly reduces the labor consumption of structural construction. It is in line with the development direction of China's construction industry towards refinement, equipment and industrialization.

## Disclosure statement

The author declares no conflict of interest.

## References


[1] 2011, Code for Construction of Concrete Structure Engineering (GB50666-2011), 19+116.

[2] 2015, Code for Acceptance of Construction Quality of Concrete Structure Engineering (GB50204-2015), 9.

[3] 2008, Technical Code for Safety of Building Construction mold (JGJ162-2008), 26+28.

[4] 2017, Design Code for Steel Structures (GB 50017-2017), 33.

Journal of Architectural Research and Development, 2021, Volume 5, Issue 6
http://ojs.bbwpublisher.com/index.php/JARD
ISSN Online: 2208-3537
ISSN Print: 2208-3529

# Water Quality Microbiological Inspection and Quality Control Technology

**Ran Chi[1]*, Chen Sun[1], Siyi Li[2]**

[1]Shanghai Shuiyuandi Constructi & Development Co., Ltd., Shanghai 200000, China

[2]Liaoning Fengtian Testing Technology Co., Ltd., Shenyang 100000, Liaoning Province, China

***Corresponding author:*** Ran Chi, ran.chi@poten.cn

**Abstract:** People's lives are strongly linked to the quality of their drinking water. The quality of drinking water can be successfully ensured by testing microorganisms in water quality samples and examining their unqualified variables. Many urban residents' drinking water contains a variety of microorganisms, which will have a direct impact on the quality of the water, and all microorganisms will offer a health risk. As a result, steps should be taken to eliminate germs. As a result, the focus of this article is on water quality microbiological inspection and quality control technology.

**Keywords:** Water microorganism; Inspection; Quality control

***Publication date:*** November 2021; ***Online publication:*** November 30, 2021

## 1. Introduction

The inspection of water quality microorganisms not only plays a great role in promoting the safe use of drinking water, but also plays a very important role in ecological balance. Therefore, the corresponding inspection staff should well control the inspection quality and adopt effective quality control methods to ensure the comprehensive development of the inspection work, so as to lay a solid foundation for the inspection and safe use of drinking water in our country.

## 2. Microbiological examination and analysis of water quality

### 2.1. Sample collection

From April 2018 to February 2019, according to the population proportion of a city, the monitoring of drinking water quality was completed at 168 monitoring points in the city, mainly including tap water monitoring points in the city, small centralized water supply points and decentralized water supply points in the city. A total of 4400 drinking water samples were collected (of which 2200 were analyzed for urban and rural drinking water quality in different seasons; The other 2200 samples were used to analyze the difference between the total number of bacteria, total coliform group and heat-resistant coliform group in urban and rural water). After drinking water samples were sampled, they were directly sent to the laboratory within 4.5 hours, and then the samples were tested in a scientific way.

### 2.2. Test method

The detection of drinking water is a complex work. During the specific detection period, the main content is to test the microorganisms in drinking water. The main inspection contents include the total number of colonies, coliform group, heat-resistant coliform group and so on. When detecting the heat-resistant coliform bacteria and total coliform liver bacteria in drinking water samples, the multi tube fermentation method is generally used to complete the corresponding detection. When detecting the total number of

colonies, the plate counting method is usually used to ensure the rationality and accuracy of the final detection results.

### 2.3. Results

#### 2.3.1. Sample qualification

Among the 2200 drinking water standards adopted, there are 2000 qualified samples. After analysis, there is a significant difference in the qualified rate of drinking water samples between rural and urban areas, and there is a significant difference in the qualified rate of drinking water between summer, autumn and spring and winter ($P < 0.05$). The specific situation is shown in **Table 1.**

**Table 1.** Sample testing

| Program | Season | | Region | |
|---|---|---|---|---|
| | Summer and Autumn | Spring and Winter | Village | City |
| Number of samples (copies) | 1325 | 875 | 1280 | 920 |
| Number of qualified samples (copies) | 1225 | 775 | 1190 | 810 |
| P | 0.000 | | 0.000 | |

**Table 2.** Inspection of microbiological indexes of residents' drinking water

| Group | City | | Village | |
|---|---|---|---|---|
| | Number of samples (copies) | Number of qualified samples (copies) | Number of samples (copies) | Number of qualified samples (copies) |
| Aerobic bacterial count | 400 | 390 | 400 | 328 |
| Total coliform | 400 | 384 | 400 | 331 |
| Thermotolerant coliform bacteria | 300 | 286 | 300 | 242 |

In the 2200 drinking water standards adopted, the inspection statistics of various microbial indicators of residents' drinking water are shown in **Table 2**. As can be seen from the median in Table 2, the rational rate of drinking water in urban areas is higher than that in rural areas, no matter the total number of bacteria, total coliform and heat-resistant coliform. The test results show that the quality of drinking water in cities is significantly better than that in rural areas. One of the main reasons for this phenomenon is that the water sources in cities and rural areas are different, and the treatment of drinking water is also different.

#### 2.3.2. Microbiological examination

In the microbiological examination of 2200 water samples, the total number of colonies was 2052, the total coliform group was 1998, and the heat-resistant coliform group was 2008.

### 2.4. Microbiological examination findings

In the process of drinking water inspection, microbial inspection method is one of the commonly used methods. It can quickly and effectively detect the microbial species and content contained in drinking water. It is an important inspection method to ensure the safety of drinking water and escort people's health. In this test, the collected water samples are divided into two groups, and two microbial test methods are used

respectively. These two test methods are more commonly used and can get good test results. Among them, the test effect of filter membrane test method is better, but the detection rate is relatively low compared with multi tube fermentation test method. On the contrary, after using MPN test, the detection rate of multi tube fermentation test method is improved on the basis of ensuring the accuracy of test results. It can be seen that in the process of drinking water inspection, the inspection effect and detection rate of multi tube fermentation method are higher than that of filter membrane inspection method, which can better improve drinking water quality, ensure drinking water safety and build a good drinking water environment for people.

## 3. Quality control technology for microbiological inspection of water quality

After understanding the common factors affecting the microbiological test results of water quality, we will start from the detailed aspects to explore the scheme to reduce the adverse effects. According to different influencing factors, specific solutions are put forward to control the progress of testing work and the quality of testing results. On the premise of ensuring the smooth development of testing work, optimize the testing process, create a good environment for testing work and fundamentally promote the improvement of testing level.

### 3.1. Level of testing personnel

The relevant staff engaged in water quality microbiological inspection must have rich accumulation reserves of professional basic knowledge of microbiological inspection, understand and be familiar with the relevant operation process of water quality microbiological inspection, and avoid the inaccurate test results in water quality microbiological inspection caused by their own professional quality and professional skill level is not up to standard [1]. Therefore, relevant departments must put forward strict requirements for relevant inspectors of water quality microbiological testing. Before carrying out water quality microbiological testing, relevant knowledge training and comprehensive assessment shall be organized to ensure that inspectors have the basic conditions for experimental development and master the operation process of water quality microbiological testing.

Relevant staff involved in microbiological testing must receive systematic professional training before taking up their posts. Inspectors need to firmly grasp the testing operation skills, relevant theoretical knowledge, testing standard requirements and practical operation methods, and pass strict examination before taking up their posts. Moreover, in the process of monitoring, we must work in strict accordance with relevant documents or instructions, and regularly carry out professional training for testers. We should not only improve the professional skills of testers, but also pay attention to the professional quality of testers, so as to ensure that effective measures can be taken to control the accuracy of testing in practical work. The testing laboratory should establish and improve the responsibility system, truly implement the responsibilities of each testing personnel, and avoid shirking responsibilities after problems in the testing results, so as to obtain more accurate testing results and improve the efficiency and quality of testing work.

### 3.2. Control of instruments and equipment's

Instruments and equipment are essential hardware support for microbial detection, which can directly affect the detection results. Therefore, in the process of microbial testing, it is necessary to accurately manage relevant instruments and equipment, carry out actual operation according to the rules and regulations formulated by relevant departments, regularly inspect and maintain all equipment, and cultivate the safety awareness of all testing personnel. Not only that, the verification work must also be done in place to ensure that all equipment and instruments have reached the standard that can start detection, so as to realize standardized microbial detection. In microbiological testing, microscope is one of the important equipment. It can carefully observe the morphology of microorganisms in water. After using the microscope, the optical

glass and stage should be thoroughly cleaned with lens wiping paper to avoid contamination of the next observed sample. At the same time, attention should be paid to the anti-corrosion, anti-vibration, anti-dust and anti-moisture maintenance of the microscope.

### 3.3. Control of environment factors

During microbial testing, the surrounding environment will have a direct impact on the test results. Therefore, when carrying out the actual monitoring work, the relevant inspectors must establish a correct work awareness and work concept, and follow the scientific and reasonable working principles to ensure that the control effect of the test results is improved. Installing ventilation equipment in the laboratory can avoid the rapid change of large air flow or too many floating and sinking objects in the air affecting the test results. Installing air conditioning in the laboratory can not only prevent the pollution of water samples by bacteria, but also ensure the stable operation of incubator equipment and reduce the moisture problem of instruments, equipment and culture medium [2]. We need to prevent the pollution of water samples and avoid the pollution of water samples by the surrounding environment, or the mutual pollution between different water samples. Therefore, the layout of the laboratory should be reasonable, and different distinguishing signs should be set in different functional areas to avoid affecting the test. In addition, the air inside the laboratory should also be monitored in real time. Only after it determining that the air has reached the detection standard, the microbial detection can be formally carried out.

### 3.4. Effectively maintain samples to slow down the propagation of microorganisms

Generally, samples are kept at low temperature. After all samples are collected, they will be sent to the laboratory immediately. In the process of sample transportation, pay attention not to break the glass bottle, minimize the contact between foreign objects and the bottle body, and fix the glass bottle to avoid sample loss and dumping.

### 3.5. Use sterile glass bottle, and strictly require the consistency of sample collection

With the passage of time and space, the growth and classification of microorganisms will change greatly. Therefore, in the process of detecting microorganisms in water, the collected samples must be representative to a certain extent, and the consistency of samples must be ensured. For example, samples are collected in the same water area and at the same time, and they are collected directly. Sterile glass bottles are not allowed to be used for collection, so as to avoid the pollution of other bacteria and affect the detection and treatment.

### 3.6. Quality control of microbial sample collection for water quality monitoring

Many types of water will alter dramatically over time and space, necessitating the development of a sensible sample strategy. The water intake point must be fixed at the same time to ensure that the obtained water samples are representative. To thoroughly mix during inspection, the water extraction volume must be 80 percent of the bottle capacity; when sampling, the sterilized sampling bottle must be collected directly, not brushed with water sample, and contamination of the bottle mouth by fingers and other objects must be avoided. During sampling, do not stir the sediment at the bottom of the water. Before taking water samples from the pipe network, sterilize the faucet. The procedure is to use a flame to burn the faucet surface for a few seconds (3–5 seconds), then drain the water for 5–10 minutes. Reservoirs are found in some rural residential water samples. Prepare a clean bucket and place it in the pool for few minutes.

## 4. Conclusion

In the water quality monitoring work, there have been some problems in the inspection of microorganisms

in water, such as the standard analysis of microorganisms and how to find effective reference samples. These situations must be analyzed in detail. Therefore, there are certain requirements for the working experience of staff, and personal experience judgment is more important in the inspection work. The inspection process of water quality microorganisms must be from sample collection to analysis of inspection results. These inspection results have a certain impact on sample collection technology, inspectors and experimental steps.

## Disclosure statement

The author declares no conflict of interest.

## References


[1] Li HM, 2020, Microbiological Test and Quality Control Measures of Water Quality. Clinical Laboratory Journal (Electronic Edition), 9(01): 235.

[2] Wu YC, 2019, Causes and Countermeasures of Unqualified Microbiological Samples in Water Quality. Journal of Inspection and Quarantine, 29(06): 112-113.

Journal of Architectural Research and Development, 2021, Volume 5, Issue 6
http://ojs.bbwpublisher.com/index.php/JARD
ISSN Online: 2208-3537
ISSN Print: 2208-3529

# Research on the Architectural Design Positioning of University Halls

**Haixiu Liang*, Jiantao Huang**

South China University of Technology, Guangzhou 510641, Guangdong Province, China

***Corresponding author:*** Haixiu Liang, 350780@qq.com

**Abstract:** University hall is an important carrier of information exchange and sharing in higher education campuses, and the correct architectural design positioning can improve the value of university halls. There are many different features in the design and use of university halls and urban theaters. This paper investigates the feasibility study report and indexes of university hall projects, analyzes the indexes, construction scale and functional positioning of university halls in the pre-design period, summarizes some design suggestions, and believes that the use efficiency of university halls should be improved through intensive and compound construction to meet the needs of the rapid development of Chinas Universitys and universities.

**Keywords:** University hall; Design positioning; Architectural design; Intensive

***Publication date:*** November 2021; ***Online publication:*** November 30, 2021

## 1. Introduction

Chinas cultural endeavors are progressing by leaps and bounds as the economy and society develop. Beijing, as the political and cultural capital, and Shanghai, as the economic capital, led the way in the construction of great theatres, which had a significant impact on the construction of theatres around the country, followed by the construction of large urban theatres. Simultaneously, a lengthy period of high-volume enrolment in colleges and universities has accelerated the development of university campuses to new levels. The importance of art education in the development of pupils has been widely recognized by society, and there has been an increase in the demand for theatrical buildings among university teachers and students. As a result, university halls function has shifted from assembly to multi-functional theatrical performance and academic conference. Theatrical events, academic conferences, and art education are all held in university hall on campus. It is necessary for important reports, special lectures, elegant art in universities, the opening and graduation ceremonies of schools and departments as well as the implementation of student's recreational activities, playing a unique role in spreading knowledge and culture.

## 2. Comparison of the positioning of urban theaters and university halls

The functional design and internal space of university halls are similar to those of urban theatres as a place for information exchange on campus. Both can use the theatrical space construction of a frame stage with audience seats, but there are certain distinctions in the users, land scale, and other factors. We can clearly see the placement of university halls on campuses by comparing the positioning characteristics of urban theatres [1].

As stated in **Table 1.**, urban theatres are government-funded professional theatres that host commercial cultural acts, drama and opera concerts, and are open to the general public. University halls are non-professional theatrical venues established within universities for the purpose of offering campus art

performances, art teaching training, and academic lectures. They are primarily utilized by students and teachers. The term "non-professional" refers to a building standard that differs from that of metropolitan theatres. Since the university hall is partially non-profitable, its use and upkeep necessitate ongoing financial support from the university. The differences between university halls and urban theaters are listed in **Table 1.**

**Table 1.** Comparison of urban theaters and university halls

| Type | Urban Theaters | University Halls |
|---|---|---|
| Users | Commercial Theatre Company | Students and faculty |
| Site Size | Large land area and complete independent urban site | Smaller land area and internal campus site |
| Function Positioning | Commercial art performances, theater and opera concerts | Campus cultural performances, art teaching training, and academic lectures |
| Image Requirements | Independent styling in line with urban positioning | Match the campus environment |
| Design specifications | Meet the theater building design code | Meet the floor area index of general higher education institutions (2018 version) |
| Construction Standards | Determine criteria based on the number of seats | Determine space standards based on the number of students |
| Investment | Large-scale investment with payback pressure | Small-scale investment, no payback pressure |
| Operation and Maintenance | Professional culture company | School |

As the above table shows, the design standard of urban theaters is extremely high for university halls, and it is obviously not feasible to simply copy the design standard of the urban theaters. For example, the investments in stage lighting and sound equipment are huge and do not play a great role in academic exchange and teaching. Most university halls will not configure such equipment but need the acoustic design and sight design of the audience halls. Hall construction should comply with the characteristics of their own users, to simplify the stage lighting and sound equipment, and adopt acoustic decoration that meets the actual needs. Whether the university halls are positioned as lecture halls, theaters, concert halls or activity centers combining teaching functions, the design planning of the preliminary stage is of great importance.

The pre-positioning and decision-making of university halls are closely related to the following factors: first, the index of university halls; second, the construction scale of university halls; third, the function positioning of university halls [2].

## 3. Definition and index of university hall

Hall refers to a special building for political assembly or holding cultural, economic and academic conferences. University hall is defined as being equipped with the functions of assembly, performance, academic report, inter-campus exchange and other activities in the Index of Building Area of General Colleges and Universities, which is beneficial to the construction of campus culture, which serves as an important place to cultivate sentiment and carry out quality education for students.

Index of Planning Building Area of General Colleges and Universities has a limited effect on the scale

of university hall buildings, and is an important design guidance. In the latest Index of Planning Building Area of General Colleges and Universities, the area of university halls should comply with the provisions in **Table 2**. For a university campus with 10,000 students, the average area per student is 0.3 $m^2$, and the maximum building area of the university hall is 3,000 square meters, which is the smallest school building. The building area of university halls with more than 20,000 people shall not be larger than 4,800$m^2$. Since the index area of university hall is too small, the hall is rarely planned as a separate building. The hall buildings in most universities are merged with other buildings on campus in the form of large-scale multifunctional lecture halls, forming buildings named information building, learning center, culture and art center, etc. In fact, in practice, most buildings have multiple functions, except that the functions contained in each unit are classified into the construction scale table according to 12 school building indicators in the stage of feasibility study [3].

In the feasibility study stage of project declaration, the stages, audience halls and some auxiliary spaces are declared in the area of university halls, and the exceeding areas of university halls like front halls and performance preparation space are declared in the form of activity room or logistics and ancillary room used for students and teachers. In this way, the development of domestic university halls has changed from halls focusing on academic exchange function to multi-functional information exchange and learning centers. This is the biggest difference from the positioning of social theaters. The former is more concerned with comprehensive use and teaching functions, while the latter one is a theatrical building serving for urban citizens.

**Table 2.** Building area index of halls

| **Scale of schooling** | 3000 | 5000 | 8000 | 10000 | 20000 |
|---|---|---|---|---|---|
| **Various colleges and universities** | 0.48 | 0.36 | 0.30 | 0.30 | 0.24 |

## 4. Construction scale of university halls

As analyzed above, even for large universities with more than 10,000 students, the hall area should not exceed 4,500 $m^2$ after considering the K value. Most of the audience halls have 800 to 1,500 seats, and some even reach 2,000. The university halls of this scale can take the specifications into account and meet the trend of the increasing number of university students. The construction scale of university halls should be established in the feasibility study stage according to the characteristics of school operation and the number of students and the construction funds. The following is an example of common university hall construction modes:

### 4.1. University halls of high-level comprehensive universities

High-level comprehensive universities refer to research-oriented universities with arts, science and engineering majors, with a level of 985 or 211 (double first-class). Most of these universities are double first-class universities, with large scale, complex disciplines and frequent international academic exchanges, which require higher comprehensiveness of halls. For example, Jilin University has more than 40,000 teachers and students in its central campus, whose university hall is merged with the teaching building of the library and administrative center, located on the west side of the building, with 1,100 seats and a total building area of 65,885 $m^2$, of which the university hall covers an area of 4,800 $m^2$, reaching the maximum index. Combined with the functions of the library and administrative building, it is named as the Graphic Information Center of Jilin University, with a length of 270 m. It also forms several squares and courtyards, becoming the center of the campus. In the feasibility study stage, the university hall is positioned as academic report center for hosting cultural performance, academic and office meetings.

### 4.2. University halls of general universities

Polytechnic universities refer to universities with a structure of science and engineering disciplines greater than 70%, and the university halls of polytechnic universities mainly assume the function of science and engineering academic report center. For example, Zhengzhou University of Technology has more than 25,000 teachers and students, only 10,000 in the first phase, which is smaller than that of Jilin University. It is a general university at provincial level. In order to save costs, the university merged the hall with the comprehensive building of public teaching building, with 749 seats and a total building area of 32,354 $m^2$, of which the university hall covers an area of 4,800 $m^2$, reaching the upper limit, and it was built as a teaching center together with the teaching building. In this case, the cost of stage mechanical light was not carried out based on the investment restriction. In the feasibility study, university halls are positioned as halls, academic lecture halls and theatrical performance stages.

### 4.3. University halls of private universities

Private universities are universities not financed by the government, with higher fund pressure and lower requirements for university halls. For example, Nanning University of Technology is a university funded by Guangxi Beibu Gulf Investment Group Co., Ltd., and its university hall has 784 seats and a total building area of 9,700 $m^2$, of which the hall area is 4,800 $m^2$ and the activity room for teachers and students is 4,900 $m^2$. Private universities are more price- sensitive, and the overall construction standard of the hall is relatively low, which only meets the functional needs of basic performances and meetings. Driven by capital profits, private universities prefer to build 500-person halls and many 100-person lecture halls to fill the area index of the halls, and gymnasiums will be used to hold 2,000-person gatherings. A differential mode of 2,000-person gymnasium, 500-person hall and 100-person lecture hall was formed. Part of the large-scale assembly function of the hall has been transferred to the gymnasium, and the price of 100-person lecture hall was lower than that of 500-person hall, and the utilization rate was higher. This design idea of reducing the area and quality of halls is favored by many private universities. For example, Kede University of Capital Normal University, as a private university, has only 683 auditoriums, which can meet the basic needs of conferences and performances, and the gymnasium is used as an activity place for large-scale gatherings.

### 4.4. High-standard university halls

High-standard university halls often undertake not only the cultural performances and teaching needs on campus, but also some high-standard conferences and performances in the city. This kind of hall will be clearly positioned when the feasibility study is established. For example, Junwu Culture and Art Center of Guangxi University has made it clear that it will be used as a provincial performance theater in the future by considering the daily teaching use of Guangxi University. The art center has a theater with 1,939 seats and a multi-functional concert hall with 469 seats, which are positioned as super-large theaters according to the Code for Design of Theater Architecture JGJ 57-2016, and can hold opera performances. The total investment is 230 million yuan, and the project has won Luban Award. This kind of high-standard theater can be used as provincial performance theaters. At the same time, the Art University is set in this building, which is combined into a teaching building and an art center. Universities with high-standard theaters are generally 211 project universities or above, with higher requirements for the use of halls, and the needs for exhibition and reception. Finally, Junwu Culture and Art Center of Guangxi University is positioned as a high-grade theater with a total construction area of 19,237.1 $m^2$, including 4,762 $m^2$ of university hall and 14,475.1 $m^2$ of education rooms for art University.

The construction scale of university halls should be determined by the compilation unit of project proposal and feasibility study with universities or related users at the beginning and reported to the

government for approval. The construction scale of university hall is influenced by the number of students, construction funds and functional categories of university hall. In practice, if the area of university hall reaches the upper limit of the index, the general practice is to allocate the index area of other school buildings to meet the actual use needs of university hall.

## 5. Functional positioning of university halls

Index of Planning Building Area of General Colleges and Universities (2018) proposed that the halls of general colleges and universities should be planned and constructed in a unified way with the activity rooms for teachers and students to improve the efficiency of use, and the halls of art colleges can be planned and constructed in a unified way with the experimental theater. The functions of university halls are intensive and multifunctional (**Table 3**).

University halls are suitable for holding cultural performances. Compared with the activity room of the student association, the hall has a professional rehearsal place and performance venue, and its stage performance effect is better than that of the activity center, which can accommodate more audiences. University halls provide places for theatrical performances for teachers and students activity rooms, and teachers and students activity rooms are provided for performers and audiences for community theatrical activities. The construction of university halls and teachers and students' activity rooms will promote students' entertainment performances and literary exchanges, improve the frequency and intensity of the hall, and intensify land resources to meet the needs of teachers and students for recreation and rest.

University halls can also meet the needs of holding large academic conferences. Compared with the internal classrooms and lecture halls inside the teaching building, university halls have large capacity and high quality, which can better meet the needs of large-scale lectures and ceremonies in terms of acoustics and sight. The university hall usually has 800 to 1,200 seats, and the seats of large hall can reach 2,000, which can accommodate more participants. At the same time, it can also serve the universities and off-campus institutions. The lecture halls of departments are mostly used for small and medium-sized academic conferences. The capacity of university halls needs to be different from that of lecture halls (amphitheaters) and multi-functional gymnasiums of these departments to meet the academic exchange and ceremony needs of the university. Similarly, the compound construction of university halls and teaching buildings (University buildings) is conducive to the efficient operation of university halls by improving the frequency and intensity of use, effectively employing land resources for teaching and scientific research, and meeting the various needs of teachers and students [4].

University halls can meet the needs of art teaching. Colleges and universities with art majors need sufficient teaching space for music and art. Rehearsal room, piano room, multi-functional hall for teaching and music classroom are all functional teaching spaces needed for whose majoring music and dance. Combining the educational space of art major with the university halls can manage and improve the use efficiency of buildings. The functional combination of university halls and art teaching needs to be determined as soon as possible in the pre-design positioning stage [5].

In the stage of project construction and feasibility study, the university needs to determine the functional positioning of university halls according to its academic level, discipline characteristics and art teaching. There are usually three combinations of functional positioning of university halls:

(1) The hall focusing on the function of university hall for cultural performances, serving as an important place for students to perform activities, is constructed together with the activity room for teachers and students.

(2) The hall focusing on the academic conference function of the university hall, serving as a lecture hall for large academic conferences, is constructed together with teaching buildings.

(3) The hall focusing on the art education function of university hall, serving as a training place for art colleges, is constructed together with art education colleges.

**Table 3.** Scale and functional positioning of domestic university halls

| Building Name | Time | Site Size | Space Mode | Academic Level | Functional Positioning | Scale layout |
|---|---|---|---|---|---|---|
| Zhejiang University Zijingang Campus Small Theatre | 2003 | 2,800m$^2$ | With student activity center | 985 | Concerts, cultural performances, conferences and training | 1,151 seats, including 643 seats in orchestra and 508 seats in the balcony. The stage entrance is 14 m wide, 7.5 m tall, 16.5 m deep and 22.3 m high. |
| Lanzhou University Student Activity Center Auditorium | 2004 | 2,000m$^2$ | Multifunctional theater | 985 | Cultural performances, conferences and training | 1,270 seats in the auditorium, with two rows of audience seating, equipped with a rehearsal room, dressing room and lounge |
| South China University of Technology Academic Lecture Hall | 2005 | 6,500m$^2$ | Multi-theater | 985 | Large-scale conferences, lectures, concerts | 1,190 seats in the grand hall, 462 seats in the concert hall |
| Science and Technology Hall, University Road Campus, China University of Mining and Technology | 2006 | 1,800m$^2$ | With canteen function | 985 | Conference lectures, cultural performances | 904 seats in the auditorium, located on the fourth floor of the building, with a cafeteria downstairs |
| New Tsinghua Academy Theatre, Tsinghua University | 2011 | 17,860m$^2$ | Multifunctional theater | 985 | Large-scale concerts, annual meetings, concerts | The auditorium has a total of 2,011 seats, with seats in orchestra and balcony. The stage is equipped with double side stages, the main stage entrance is 18 m wide, 21 m deep and 11.5 m tall |
| Dingxin Building, Qianwei Campus, Jilin University | 2018 | 78,100m$^2$ | Multifunctional theater | 985 | Conference lectures, cultural performances | two rows of seating, total seating capacity of 1,160 seats |
| Guangxi University Junwu Culture and Art Center | 2019 | 22,517m$^2$ | Multifunctional theater | 985 | Conference lectures, cultural performances | 1,939-seat theater and 469-seat multi-functional concert hall and 2 groups of arts education rooms |

| | | | | | | |
|---|---|---|---|---|---|---|
| Theater of Student Activity Center, University of Physical Education, Zhengzhou University | 1992 | 1,600m$^2$ | With the Student Activity Center | 211 | Student performing arts activities, cultural performances | The theater has a seating capacity of 1,000 seats and is located on the third floor of the building, with the student activity center located downstairs |
| Assembly Hall, University City Campus, Guangzhou University of Chinese Medicine | 2004 | 2,190m$^2$ | Multifunctional theater | 211 | Large-scale conferences, concerts, corporate annual meetings | 2,086 seats in the General Assembly Hall, seating area is divided into two levels |
| Beijing Language and Culture University Comprehensive Building Auditorium | 2002 | 921m$^2$ | Multifunctional theater | Provincial | Conference lecture-based | The theatre has 1,213 seats, the depth of the stage is 17, the width is 36 m, about 25 m high; the stage entrance is 15 m wide, 8 m high; the audience hall is 29 m wide, 28 m deep, 20 m high |
| Shanghai University of Technology Auditorium, Music Hall and Small Theatre | 1937 | 1,600m$^2$ | Multi-theater | Municipal | Conference lectures, musical performances | 800 seats in the auditorium, 300 seats in the concert hall, 270 seats in the small theater |
| Auditorium of Lingang Campus of Shanghai Electric University | 2013 | 1,000m$^2$ | Single Theatre | General higher education | Conference lectures, cultural performances | Large auditorium with 450 seats, stage entrance of 12 m, 10 m deep, 5.8 m tall |
| Auditorium of KD University of Capital Normal University | 2004 | 3,515m$^2$ | Single Theatre | Private | Conference lecture-based | The auditorium has 683 seats |
| Shanghai Donghai Vocational and Technical University Auditorium | 1993 | 1,500m$^2$ | Single Theatre | Private | Conference lectures, cultural performances | The auditorium has 420 seats |

## 6. Conclusion

From the index, building scale and functional positioning of the halls, it can be seen that the early positioning of the university halls should be considered according to the characteristics of academic level, its scale, and construction funds. At present, there are many problems in university halls, such as improper

control of design scale, repeated inefficient investment, low utilization rate of stage machinery and equipment, and difficulty in transforming teaching functions in the later stage, which are the consequences of chaotic positioning of university halls in the early stage. Therefore, the construction of university halls should strengthen the communication among architects, owners and users at the initial stage of the project, clarify the planning and positioning of university hall, and avoid repeating previous mistakes. University halls have the characteristics of non-operation, and its main users are students. Whether there is an art University in the school has a great influence on the positioning of university hall. It is necessary to strengthen the research on university halls and explore an economical, applicable and highly adaptable design strategy of university halls to meet the use needs of domestic universities.

At the same time, the strict restriction on the area of university halls in the Index of Planning Building Area of General Colleges and Universities has hindered the construction of university halls, and the functions of quite a few university halls are affected due to the area restriction. The index of university halls should be relaxed appropriately to meet the needs of university campuses for the positioning of university halls in the new era. The compound construction of university halls and other buildings is the development trend of university hall.

**Disclosure statement**

The author declares no conflict of interest.

**References**

[1] Zhang Y, 2019, Research on University Theater Positioning. China Conservatory of Music.

[2] Zhu X, 2015, Study on Operation Characteristics and Development Orientation of Performing Buildings in Universities: The Case of the Performing Arts Building in the University of Guangzhou. Urbanism and Architecture, (22):19-23.

[3] Zhu M, 2015, Research on University Theatre Design. Zhejiang University.

[4] Tan L, 2014, Research on Viewers Visual Design for Multifunctional Performance Spaces in Campus. South China University of Technology.

[5] Zhang Z, 2013, The Research on the Design of Composite Performance Space. South China University of Technology.

Journal of Architectural Research and Development, 2021, Volume 5, Issue 6
http://ojs.bbwpublisher.com/index.php/JARD
ISSN Online: 2208-3537
ISSN Print: 2208-3529

# Research on Environmental Pollution regulation in China's Construction Industry

**Shengpeng Yan***

Zhejiang University of Technology, Hangzhou310000, Zhejiang Province, China

***Corresponding author:*** Shengpeng Yan, 2111914020@zjut.edu.com

**Abstract:** China has proposed the notion of sustainable development in the framework of a hazardous society in response to global environmental challenges. Research on regulatory concerns is critical for ensuring the application of the concept of sustainable development in the building industry. China's regulation, on the other hand, suffers from a lack of supply and an ambiguous value orientation. The former is a symptom of the current regulatory structure, whereas the latter is the root of the problem. To overcome the value-oriented dilemma, some studies plan to conduct research using the logic of the norm. This has the disadvantage of having a limited field of vision. The interaction between man and nature should be considered while examining value orientation. When anthropocentrism, ecocentrism, and anthropocentrism in ecology are compared to the environmental legislation in my nation, it is clear that anthropocentrism in ecology is the value orientation that should be followed at the moment. Three challenges that require attention are presented based on this value orientation, as well as the uniqueness of the construction industry and risk society theory.

**Keywords:** Environmental pollution; Regulatory system; Anthropocentrism in ecology; Risk society

***Publication date:*** November 2021; ***Online publication:*** November 30, 2021

## 1. Introduction

Sustainable development is a worldwide theme. Meeting the needs of sustainable development has gradually become a basic indicator of the construction industry. If environmental regulations, including the construction industry, are not handled properly, sustainable development will be the ultimate proposition for mankind. Sustainable development is to maintain a relatively balanced system of interaction between humans and the environment. The problem of environmental pollution has grown wildly in the originally balanced system, threatening the balance of the system. Human society has already entered a risk society. The gradually spreading environmental crisis has brought many problems to human society, such as the contradiction between human survival and development, and the contradiction between people.

The regulatory system provides the most fundamental and effective means, and the solution to environmental pollution should be reflected in the regulatory level. Regarding the legal regulation of environmental pollution, the theoretical circle began to discuss the value guidance of environmental pollution regulation, that is, dialectical analysis around anthropocentrism, ecocentrism and anthropocentrism in ecology. The Eighth Amendment to Chinese Criminal Law has changed the constitutional elements of the environmental pollution crime. This shows the value shift of environmental regulation and also confirms the root of the environmental pollution problem in the construction industry. At present, environmental pollution is a universal and worldwide problem. Although this article was formulated by the Criminal Law Amendment, the implementation mode and value orientation behind it are of great significance to the environmental pollution control and supervision of the construction industry.

## 2. The environmental pollution regulatory system needs to be improved urgently

China's current environmental pollution regulatory system is in contradiction with the problem of environmental pollution. The problem of environmental pollution is characterized by a wide range and a complex situation. However, China's regulatory system has the problems of insufficient refinement and unclear value orientation. This will lead to insufficient supply of relevant rules, which will lead to two problems. On one hand, it cannot effectively control the environmental pollution problem; on the other hand, it may over-regulate environmental pollution issues, thereby hindering the development of the construction industry and even infringing on human rights. Whether it is unregulated or over-regulated, it deviates from the theme of the era of sustainable development.

### 2.1. Regulatory rules are not detailed enough to cause regulatory failure

Construction production will produce a large amount of construction waste and other environmental pollution problems, and the imperfect regulations of the relevant regulations have led to re-harm to the environment. my country is opposed to the problem of construction pollution, but it lacks penalties or penalties are not strong enough to form a deterrent. The recent changes in the environmental pollution regulatory system in my country show that the value concept of the regulatory system is accelerating the transformation, but this also confirms the problem of insufficient rule refinement.

For the environmental regulations of the construction industry, there is a serious problem of insufficient refinement. The protection of the environment in the Construction Law of the People's Republic of China is mainly a regulation of a "statement" nature. Regarding the specific regulatory method, it did not specify. my country's specific measures for environmental regulation of the construction industry are mainly manifested in departmental regulations, such as urban construction waste management regulations. In the specific regulations, the specific disposal methods are not sufficient. At the same time, the penalties stipulated by it are also very minor, and the opposite effect has occurred in practice.

Although the changes in some environmental regulations in the regulatory system herald the change of values, they also confirm the existence of the above-mentioned problems. The Supreme People's Court and the Supreme People's Procuratorate issued two interpretations to verify the tendency of legal rule construction. According to **Table 1**, it can be seen that the specific operating situations of the criminal law itself are showing an increasing trend, and the types of crimes of environmental pollution have transitioned from consequential offense to the parallel state of consequential offense and potential damage offense.

**Table 1.** Comparison of two judicial interpretations

| Styles | 2013 judicial interpretation | 2016 judicial interpretation |
|---|---|---|
| Number of specific cases of environmental pollution | 14 | 18 |
| Number of specific cases of potential damage offense | 5 | 8 |
| Number of specific cases of consequential offense | 8 | 9 |
| Number of miscellaneous provisions | 1 | 1 |

After the eighth amendment of the Chinese Criminal Law, it stipulates that "violating national regulations" and "seriously polluting the environment" are the elements for the crime of environmental pollution. Some people believe that this is a shift from anthropocentrism to ecological anthropocentrism, from consequential offense to potential damage offense, and weakens administrative subordination [1]. However, the adjustment method is still "based on administrative rules", and the tendency of administrative subordination has not changed [2]. Taking a step back, the current environmental laws, administrative

regulations, and departmental regulations on environmental pollution regulations themselves also have inherent contradictions [3]. Therefore, the refinement of the types of legal regulations on environmental pollution is a problem that needs to be solved urgently.

### 2.2. Value guidance needs to be clarified

Compared with the improvement of the regulatory system, value guidance is a more fundamental issue. At present, there are three types of value guidance that need to be analyzed: anthropocentrism, ecocentrism, and anthropocentrism in ecology. The choice of these three-value guidance will correspond to different legal interests. From the perspective of anthropocentrism, administrative subordination is more reasonable; from the perspective of ecocentrism, the independence of criminal law is more reasonable; from the perspective of anthropocentrism in ecology, restricted administrative subordination is more reasonable. The relationship between value guidance and legal benefit is that value guidance determines legal benefit. However, there is currently a viewpoint in theoretical circles that value guidance is determined by the logic of criminal law. Of course, its essence is only used for reasoning and has not been expanded. For example, some people believe that if the legal benefit of environmental pollution protection is the environment itself, then the value guidance should be ecocentrism. There is an upside-down situation here, and the reason is that it cannot be investigated from the perspective of the evolution of a deeper level of human society.

From the above, it can be seen that there are obvious problems in the regulation of environmental pollution in my country, and there are obvious problems that need to be clarified and value guidance. The clarification of value guidance is the core issue and the starting point for further research.

## 3. Anthropocentrism in ecology should be used as a value guide

Whether it is anthropocentrism, ecocentrism, or so-called modern anthropocentrism, there are logical flaws and should not be used as a value guide for the current environmental pollution laws and regulations. The anthropocentrism in ecology has eliminated the conquering nature and the pursuit of destruction that have always existed in anthropocentrism that are not in line with the true pursuit of human beings.

### 3.1. Anthropocentrism does not conform to the rule-building tendency

From the perspective of the relationship between man and nature, some scholars divide the development stages of human society into agricultural society, industrial society, and ecological society, and point out that human beings are now living in an ecological society. At this time, human beings are facing severe challenges. Ecological issues. Anthropocentrism is caused by a one-sided view of the relationship between human beings and other things, and it treats self and others with the subject-object dichotomy. In the early days of human society, this approach would lead to the conquest of nature as the main theme of the time. Everything is human-centered, which has created a series of environmental problems. With the development of the times, the ills of anthropocentrism have gradually accumulated. Finally, it has become an urgent problem to be solved in the period of risk society. The environmental regulation system of the construction industry is difficult to form and operate scientifically. Similarly, anthropocentrism cannot provide more explanations for the legal benefits of environmental pollution crime protection, which will lead to a significant reduction in the meaning of “seriously polluting the environment”. This not only does not conform to the spirit of its subsequent judicial interpretations, but also loses the possibility of more interpretations.

### 3.2. Ecocentrism is the result of overcorrection

In the research on the legal regulation of environmental pollution, while criticizing anthropocentrism, it also fell into the misunderstanding of ecocentrism, which is the result of overcorrection. Ecocentrism can

prove that the environment can be protected by the regulatory system, but it is more accurate to express that only the environment can be protected by the regulatory system. The disadvantage is that it excludes the legal interests of human life and property, so it loses its meaning.

### 3.3. Anthropocentrism in ecology is the return of value guidance

The anthropocentrism in ecology means that only by protecting the environment in the natural living space of human beings can the life, body and other interests of human beings be protected [4]. This is the result of thinking deeply about the relationship between humans and the environment. Humans do not necessarily pollute the environment and destroy the ecology. Environmental pollution and ecological destruction are only the side effects of human beings in the practice of self-awareness and innovation. Humans allow the accumulation of side effects, but they do not actively pursue the production of side effects. The foothold and starting point of this value guidance is human beings. The environment should be protected because it has irreplaceable value to humans. Some people think that this is actually no different from anthropocentrism. This view is the result of confusing modern anthropocentrism and anthropocentrism. From a formal point of view, modern anthropocentrism can be expressed as anthropocentrism. This erroneous view is the result of confusing connotation and form. The anthropocentrism in ecology separates the subject-object dichotomy to view the relationship between humans and the environment. This is a substantial change, which makes the legitimate interests of mankind and the environment should be fully protected by the regulatory system.

## 4. Issues that should be paid attention to in the construction of legal rules for environmental pollution

After clarifying the value guidance, the specific operation of transitioning it to legal rules should also pay attention to several issues. The construction of rules to regulate environmental pollution should combine the characteristics of legal regulations, risk society theory and the particularity of environmental pollution.

### 4.1. Rules construction should strengthen cooperation with architectural designers

At present, the research on regulatory issues in our country is decentralized, non-cooperative, and non-scientific. The specific refinement of environmental pollution regulations involves a large amount of chemical knowledge, ecological knowledge, environmental knowledge, etc. At present, there are few cooperative researches between scholars and architectural designers, and there are certain problems with its scientific nature. Some scholars pointed out the problems of dispersion and non-cooperation in related studies. The article also raises another problem, that is, the problem of disconnection from practice. Therefore, it is necessary to strengthen legal empirical research and sociological research, and integrate theory with practice. In combination, it is recommended to focus on using social research and statistics to analyze cases [5]. Therefore, the research of my country's regulatory system should establish interaction with architectural designers and strengthen cooperation research with specific architectural producers.

### 4.2. Maintain a steady spiral of interpretation and legislation

It is difficult to complement the regulatory rules of the construction industry in a short time, and it takes a long time to study such a large-scale regulatory system. Moreover, related regulatory issues are also in a state of continuous development, but the issues must be resolved. The law should be maintained, and stability should be maintained. Changing laws cannot form a stable and orderly society. The meaning is that large-scale legislative activities should not be carried out in the short term, but should be mitigated and sampled through interpretation, and the legal rule system should be gradually improved after amendments. For example, the criminal law stipulates that the two constituent elements of the crime of environmental pollution "violating national regulations" and "seriously polluting the environment" make the conditions

for constructing crimes have more room for interpretation. "Violation of national regulations" can be interpreted as a violation of the criminal law, environmental law, administrative regulations, etc. This means that interpretation can be started from different laws, and there is more flexibility, but attention should be paid to issues of thoroughness, coordination, and protection of human rights. The element of "seriously polluting the environment" inherently contains the substantial result-type element of "serious consequences of major property damage and personal injury." Therefore, the legal benefit of the protection of environmental pollution crime can be human life and property, or the environment itself. This interpretation space and interpretation method are also compatible with the anthropocentrism in the ecology demonstrated in the second part. Of course, interpretation is not the end of legal regulation, but the end is the formation of a methodology for dealing with environmental pollution. Under the guidance of this value, the legal regulation of environmental pollution will gradually form a scientific system, adapt to the requirements of the times, and have a strong buffering effect on the future development of human society.

### 4.3. Preventing the social enlargement of environmental risks

The social amplification theory of risk proposed by scholars at Clark University's Policy Research Institute refers to the fact that risks enter the public through social media, and the public will receive exaggerated risk perceptions. Similarly, if environmental risks are amplified by social media, the public will have an exaggerated perception of them [6]. This is something that researchers among the public should avoid. Excessive environmental risk perception will lead to too conservative research on legal regulations. The current era not only needs to deal with environmental risks, but also needs to deal with development issues. An overly conservative legal regulation system will hinder development. "Pick up sesame seeds and lose watermelon" is not an ideal result. Exaggerated perception is a problem that should be avoided in research.

## 5. Summary

The main problem with the current environmental pollution regulation system is the clarity of value orientation. Solving this problem is of great significance to the environmental regulation of the construction industry. By reflecting on the relationship between man and nature, we can know that anthropocentrism in ecology is a deformation of anthropocentrism. Through the amendment, the connotation of the relationship between the subject and object of man and nature is eliminated, and the true connotation of man's dependence on nature is obtained. The revised anthropocentrism in ecology is the true value orientation of the turning process of the environmental pollution regulatory system, but we should also pay attention to the characteristics of the construction industry and the existing problems in current research. Considering the nature of environmental pollution as a by-product of industrialization, legal and regulatory research should deepen cooperation with architectural designers to ensure the scientific nature of research results.

## Disclosure statement

The author declares no conflict of interest. This thesis is a conference paper of the 2021 2nd International Conference on New Energy Technology and Industrial Development (NETID 2021).

## References

[1] Wang Y, 2014, Environmental Crime Legislation: Concept Change and Trend Forecast: Contemporary Law Review. 3:56-66.

[2] Xu Y, 2020, On the Distinguishing of Types of Chinese Environmental Legal Norms: Jilin University Journal Social Sciences Edition. 2: 66-74+220.

[3] Wu K, 2021, On the System Function and Normative Configuration of the General Provisions of the

Environmental Code: Law and Social Development. 3: 167-188.

[4] Zhou G, 2016, Criminal Law: China Renmin University Press, Beijing.

[5] Zheng Z, Chen D, 2020, Knowledge Map of Environmental Law Research CSSCI (2009-2019), Literature Metering Analysis based on Citespace: Journal of Arid Land Resources and Environment. 6: 62-72.

[6] Liu Q, Xu B, 2015, On the Systematic Reasons and Legal Countermeasures of the Social Amplification of Environment Risk. 10: 92-97.

Journal of Architectural Research and Development, 2021, Volume 5, Issue 6
http://ojs.bbwpublisher.com/index.php/JARD
ISSN Online: 2208-3537
ISSN Print: 2208-3529

# Rental Location Choice Characteristics and Tendencies of Migrants in Guangzhou, China

**Yang Wang[1]*, Xiaoli Yue[2,3], Lu Jiang[4], Hong'ou Zhang[3], Xueying Li[5]**

[1]Faculty of Geography, Yunnan Normal University, Kunming 650500, Yunnan Province, China

[2]School of Architecture and Urban Planning, Guangdong University of Technology, Guangzhou 510090, Guangdong Province, China

[3]Guangzhou Institute of Geography, Guangdong Academy of Sciences, Guangzhou 510070, Guangdong Province, China

[4]School of Geography Science, Qinghai Normal University, Xining 810008, Qinghai Province, China

[5]Department of Resources and the Urban Planning, Guangzhou Xinhua University, Guangzhou 510520, Guangdong Province, China

***Corresponding author:** Yang Wang, wyxkwy@163.com

**Abstract:** The inner-urban residential location choice is a topic of continuing interest in urban geography. However, not much research has been done on migrants' rental location choices. Based on data from a questionnaire completed by 276 migrant renters in Guangzhou, this paper analyzes the demographics and social class characteristics of migrants, and the condition and location of housing preferred by this population. The results show that the migrants in Guangzhou mainly rent in the Center Business District (CBD) area (Tianhe District) and Huangpu, Panyu and Haizhu districts. The main reason for this choice of location choices is the houses' convenience to their workplaces. A second reason is that nearby subways make travel convenient, for consumption and daily life, for children to go to school, and for access to large shopping centers/malls.

**Keywords:** Renting house; Migrants; Location choice; Guangzhou

***Publication date:*** November 2021; ***Online publication:*** November 30, 2021

## 1. Introduction

Urban migrants account for a large proportion of the population in China's megacities. In recent years, the soaring housing prices in these areas have made it increasingly difficult for migrants to buy houses. Renting a house has almost become the only way to solve the housing problem when migrants first arrive in these cities. Compared with the characteristics and mechanisms of local residents' housing choices, those of migrants are different [1], and migrants are more easily influenced by relevant local institutional factors [2] and exclusive housing policies [3]. Therefore, it is necessary to study the housing concerns of migrants.

Urban residential location choice is a classic topic in urban geography that involves many aspects, such as transportation accessibility, daily life convenience, public services, public safety, landscape and environment and social space [4-7]. The influencing factors are diverse and coupled with the complexity of its mechanism and data limitations; thus, the academic community still lacks a unified and convincing conclusion [8]. Thus, the choice of housing location is also an academic frontier problem that has been explored by academia. Therefore, it is necessary to conduct a case study to examine the characteristics and tendencies of the residential location choices of urban migrants, which is conducive to analyzing the mechanisms behind rental location choice.

In recent years, some studies have given special attention to the characteristics and tendencies of

residents' rental location choices in Chinese cities. For example, Yu et al.'s research on Beijing shows that work factors have a more obvious impact on tenants' residential location choice [9]; Zheng conducted a case study of Hong Kong and found that affordability of rents decided the level of demand and was the most important variable affecting the rental choice [10]. Hong Kong-based research by Leung and Yiu showed that tenants have to compromise between living space and housing facilities to reduce rents, which leads to tenants renting houses in crowded and poor living environments [11]. On the basis of the above studies, it is necessary to further expand on the research by focusing on migrants and analyzing their rental location choice characteristics and tendencies. China's urban geography researcher focuses on Guangzhou, which is a "first-tier city" where the rental housing market occupies an important position in the whole housing market, which makes it a suitable location for this research. Thus, we chose the city for our study and asked migrants to respond to our questionnaire. This paper analyzes and summarizes their responses, giving us an insight into the characteristics and tendencies of their choices of residential location, enriching previous research and providing a reference for the formulation of housing policies. The value of this research is that it will provide a basis for the government to select the location of rental housing supply and formulate rental policies scientifically and rationally.

## 2. Methods and data

### 2.1. Study area and methods

We chose Guangzhou as our case study area and surveyed 276 migrant renters as the basic research objects. The 276 questionnaires were administered in the Yuexiu, Liwan, Haizhu, Tianhe, Baiyun, Huangpu, Nansha and Panyu districts; and the areas where the migrant renters were located were representative and typical. We used the questionnaire survey method to obtain the primary research data. The quantitative statistical analysis method was used to analyze the study results.

### 2.2. Data

The questionnaire data are from the Guangzhou Household Energy Consumption Survey questionnaire. The questionnaire was designed by Dr. Lu Jiang in June 2020 and was commissioned by research organizations to carry out the survey from July to December 2020. The questionnaire involved 23 questions about the basic characteristics of residents and their housing. A total of 1208 questionnaires were distributed, and 1097 valid questionnaires were recovered. On the basis of the results of this effective questionnaire, we selected 276 questionnaires, which were used as the basic data for this research.

## 3. Results and analysis

### 3.1. Demographic and social class characteristics of migrants renting houses in Guangzhou

According to the data from the questionnaires, the demographic and social class characteristics of the migrants renting houses in Guangzhou are as follows: First, the gender composition of renters is roughly the same, with 49.3% males and 50.7% females; Second, migrants are young, with a high proportion, 71.5%, under 35 years old; Third, high school/technical secondary school degree and college degree accounted for the highest levels of education with 30.6% and 31.5% of all respondents, respectively; Fourth, migrants who are office workers (26.8%), freelancers (18.4%) and ordinary workers (16.9%) rent the most houses. Fifth, the overall income level of renters is not high, as 50.5% earn an annual income below RMB 100,000.

### 3.2. The condition and characteristics of migrant housing

Data from the questionnaires indicated that the housing condition and characteristics of migrants' rental housing were as follows: First, the proportion of houses less than 70 square meters in size was the largest, reaching 72%; Second, the apartments rented by most migrants were relatively compact, with the highest

proportion, a total of 69.6%, composed of one- and two-bedroom apartments. Third, most of the rentals were in multistory residences without elevators (42.6%) or self-built houses in urban villages (28.3%). Fourth, the highest proportion of housing rented in 10-20 years is 35%. Fifth, most migrants, 53.6%, chose to rent in small-scale communities (less than 1,000 households).

### 3.3. Rental location choice characteristics of migrants in Guangzhou

Liwan, Yuexiu, Haizhu, Tianhe and Baiyun districts are located in the main urban area of Guangzhou, while Huangpu, Nansha and Panyu districts are strategic new development areas in Guangzhou. Most migrants reported choosing to live in the CBD area (Tianhe District) and the nearby Huangpu, Panyu and Haizhu districts, close to the employment center (**Figure 1**).

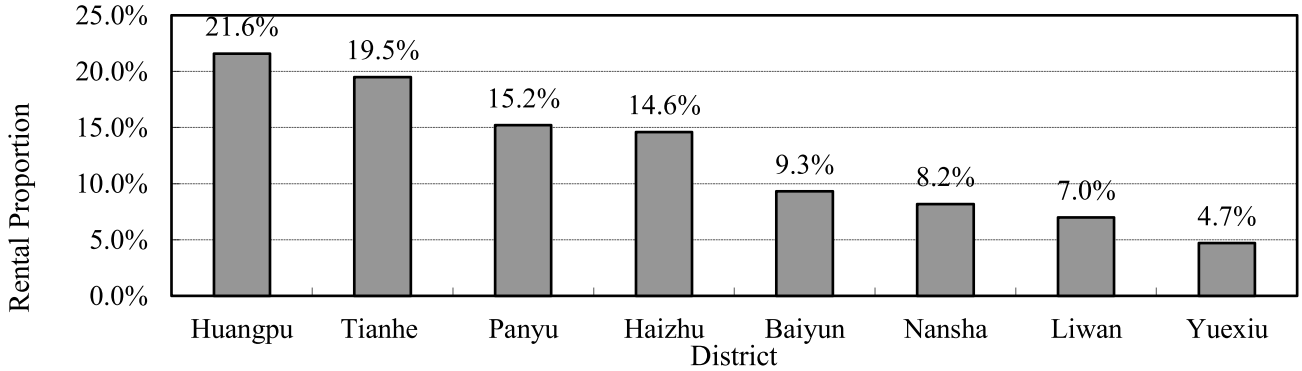



**Figure 1.** The proportion of districts selected by migrants to rent houses in Guangzhou

### 3.4. Reasons and tendency of rental location choice of migrants in Guangzhou

The survey asked a number of multiple-choice questions, responses are shown in **Table 1.** Most migrants, 59.2%, cited convenience to work as the most important reason for housing location. These responses reflect the work orientation of renting. The second most popular reason was proximity to transportation (subways) that made the tasks of daily life convenient, such as taking children to school or accessing large shopping centers/malls. These are all convenience factors. Thus, proximity to work, ease of taking children to school and access to transportation that makes the tasks of daily life convenient are core factors that determine the rental location choices of residents. Of course, there were also a few renters who considered the social environment, and 6.7% of them reported that the high level and good quality of the residents in the residential quarters are important factors for rental location choice.

**Table 1.** Questionnaire statistical analysis of the reasons for renters' housing choices

| Reasons | Proportion |
|---|---|
| The house is convenient to work. | 59.2% |
| The house has a subway, so it's convenient to travel. | 30.0% |
| It's convenient for consumption and daily life. | 29.7% |
| Kids go to school conveniently. | 24.8% |
| There are large shopping centers/malls near the house. | 21.9% |
| Although inconvenient, the housing prices or rents are low. | 18.7% |
| The residential environment is good. | 18.4% |
| The residents in the residential quarter are of high level and good quality. | 6.7% |
| The residential quarter is equipped with high-quality educational resources. | 5.5% |
| Others. | 2.0% |

## 4. Conclusion and discussion

A survey of 276 migrant renters in Guangzhou shows that migrants in Guangzhou mainly dwell in the CBD area (Tianhe District) and the Huangpu, Panyu and Haizhu districts near Tianhe District. The main reason for the rental choices of migrants in Guangzhou is the properties' convenience to their workplaces, which reflects the work orientation of renting houses. Second, travel is convenient due to nearby subways, and this makes it easier to run daily errands, transport children to school, and shop at large shopping centers/malls. The above five reasons can be summarized into three driving directions: "for the convenience of work," "for the convenience of children to go to school" and "for the convenience of consumption," which are all related to convenience. Thus, convenience is the primary consideration for migrants when they choose houses to rent. Therefore, from the three driving directions of residents' rental location choice, "for work" dominates.

The theoretical value of this research lies in clarifying the most important factors for the migrants' renting in China's megacities through the case study of Guangzhou. Future research directions include: first, the findings of this study will be verified from larger samples based on big data technology; second, more case cities are selected to compare with the findings of Guangzhou.


## Funding

This research was funded by the National Natural Science Foundation of China (No.41871150; No.42001130), GDAS Special Project of Science and Technology Development (No.2020GDASYL-20200104001), National Key Research and Development Program (No. 2019YFB2103101), and Special Project of the Institute of Strategy Research for Guangdong, Hong Kong, and Macao Greater Bay Area Construction (No.2021GDASYL-20210401001).


## Disclosure statement

The author declares no conflict of interest.

## References


[1] Wu W, 2006, Migrant Intra-Urban Residential Mobility in Urban China. Housing Studies, 21(5): 745-765.

[2] Huang X, Dijst M, Weesep J, et al., 2017, Residential Choice among Rural–Urban Migrants after Hukou Reform: Evidence from Suzhou, China. Population, Space and Place, 23(4): e2035.

[3] Zhu P, Zhao S, Wang L, et al., 2017, Residential Segregation and Commuting Patterns of Migrant Workers in China. Transportation Research Part D: Transport and Environment, 52: 586-599.

[4] Rhodes A, DeLuca S, 2014, Residential Mobility and School Choice among Poor Families. Choosing Homes, Choosing Schools, 137-166.

[5] Liao FH, Farber S, Ewing R, 2015, Compact Development and Preference Heterogeneity in Residential Location Choice Behaviour: A Latent Class Analysis. Urban Studies, 52(2): 314-337.

[6] Basolo V, Yerena A, 2017, Residential Mobility of Low-Income, Subsidized Households: A Synthesis of Explanatory Frameworks. Housing Studies, 32(6): 841-862.

[7] Rosen E, 2017, Horizontal Immobility: How Narratives of Neighborhood Violence Shape Housing Decisions. American Sociological Review, 82(2): 270-296.

[8] Knox P, Pinch S, 2014, Urban Social Geography: An Introduction. London: Routledge.

[9] Yu JH, Dong G, Zhang W, et al., 2015, Study on the Synergy between Intra-Urban Resident's Migration and Job Change in Beijing. Journal of Geographical Sciences, 25(8): 978-990. DOI:10.1007/s11442-

015-1214 -7.

[10] Zheng X, Xia Y, Hui ECM, et al., 2018, Urban Housing Demand, Permanent Income and Uncertainty: Microdata Analysis of Hong Kong's Rental Market. Habitat International, 74: 9-17.

[11] Leung KM, Yiu CY, 2019, Rent Determinants of Sub-Divided Units in Hong Kong. Journal of Housing and the Built Environment, 34(1): 133-151. DOI:10.1007/s10901-018-9607-4.

Journal of Architectural Research and Development, 2021, Volume 5, Issue 6
http://ojs.bbwpublisher.com/index.php/JARD
ISSN Online: 2208-3537
ISSN Print: 2208-3529

# In the Future, Will There Be Creative Cities in China?

**Renjie Cai*, Dan Wang**

The School of Architecture of the University of Sheffield, Sheffield S10 2TN, United Kingdom

****Corresponding author:*** Renjie Cai, 307290911@qq.com

**Abstract:** The aim of this paper is to establish the notion of the creative city, show its essential characteristics, and critically evaluate and analyse what elements impact creativity and innovation in cities using real case studies and related literature. Finally, in the essay, the topic of whether or not China will have creative cities in the future is asked, and the feasibility of constructing creative cities in China is discussed, prompting a new way of thinking about China's future creative city plan.

**Keywords:** Creative cities; Chinese cities; Creative Industries Park; Urban policies

***Publication date:*** November 2021; ***Online publication:*** November 30, 2021

## 1. Introduction

The idea of the "creative city" was developed and implemented in Western countries three decades ago, but it was not broadly adopted until the beginning of the twenty-first century in cities such as New York, Manchester, and Tokyo (**Figure 1.**). In truth, Florida's [1] and Landry's [2] also made significant contributions to the promotion of their concepts, while also playing an important role in encouraging the growth of innovative industries in modern cities [3].

**Figure 1.** Shinjuku, Tokyo

### 1.1. What is a "creative city"?

The idea of the creative city was first proposed in 1988 by Australian David Lincoln, who outlined it in his essay "The Creative City" written in a literary journal. Since then, it has become a direction for urban planning and urban architecture theorists to research urban growth and gradually develop the practice of creative cities in different Eastern and Western cities. When the principle was first described, David proposed that in order for urban planners and citizens to consider, plan, and behave imaginatively, environments must be created, and resources must be taken advantage of in order to solve some of the challenges of urbanization process. In truth, many examples of cities that use the term "creative cities" only define criteria and conditions that must be fulfilled in order to identify as creative cities; it lacks a precise

meaning. The meaning provided by Ch. Landry and Ch. Biancini is the most detailed explanation of the term that the author might find.

This is how Landry describes the "creative city": "Great places embody seven elements. They are places of anchorage, they feel like home, there is with a sense of stability, tradition and distinctiveness. They are places of possibility, "can do," stimulation and buzz. They are places of communication and networking, where it is easy connect, interact and move around, the outside world is accessible, and you feel you are part of a bigger, extensive web. They are places to self-improve, learn and reflect. They are places of inspiration. Culture is alive and, finally, a great city is well put together through design" [2].

## 2. A case study of Newcastle-Gateshead: "A creative city"

Newcastle-Gateshead (**Figure 2.**) is a creative city quarter for commerce, entertainment, and tourism, with a host of music and art-related activities such as classical music performances, concerts, and modern art exhibits taking place. It is not a city on its own, but a cultural and business district created by Newcastle upon Tyne and Gateshead, which was named the UK's arts capital in 2006 according to a study by Artsworld TV channel. In reality, the city has seen cultural investment since the Visual Arts Exhibition in 1996, and the local government has created a cultural district map. Five creative cultural districts have been established, each with creative arts and cultural consumption as a sector, and each with significant public cultural facilities such as cultural institutions, exhibition halls, art halls, and concert halls, as well as providing a cluster of artists and creative workers, and the region is gradually forming a new image as a "creative city" [4].

**Figure 2.** Newcastle Gateshead Quayside, England

### 2.1. Literature review

As previously said, Florida [1] and Landry [2], two scholars who have made major contributions to the growth of creative cities, emphasize differing beliefs in their respective publications and belong to two different creative city models [5]. As it is these experts who use a diverse body of expertise from various disciplines to solve particular city problems [6]. In a different paradigm, Landry highlights the people, organizations, and public institutions participating in art ventures rather than the experts. Among the variations in the models they advocate, there are some similar characteristics, such as the participation of ambitious people, bold and imaginative organizations, and a political sphere of shared unity of intent, with the state, private, and charitable sectors courageously driving numerous groundbreaking efforts, and even at considerable risk [7].

### 2.2. Critical analysis & summary factors

The concept of developing a creative community is to think in terms of human society's history, behaviour,

and personality, and to witness innovative art not only in public sections of the city, but also in private settings, as Shakespeare once remarked. Modern cities require external resources to give the material foundation for inventive city growth, external technology and common skills to bring creative ideas to life, and cultural amenities and art installations to encourage urban community innovation.

**Figure 3.** Musical instrument house in Dresden, Germany

At the same time, there are some limitations to the expansion of creative cities. The city's policy of focusing on artistic and cultural items as a way to encourage the regeneration of cultural industries in the city is not controversial in and of itself, but it has resulted in the paradoxical result that these creative cultural industries have pushed up local real estate values, while local low-income residents have seen their real estate values plummet. The second issue is how to alleviate the burden on local workplaces, especially when the creative industries' economic growth is reliant on a cultural tourism market, with a plethora of recreation, entertainment, food and beverage, shopping, and commercial spaces encroaching on creative workers' living rooms [8]. Further analysis demonstrates that such a manufacturing structure has an impact on not only different classes of people, but also the expansion of existing independent stores, damaging local neighbourhood development links. Is it conceivable that, because it is a tourism economy, the diversity of the artistic product would be disregarded in order to meet the need for cultural and creative goods? The financial economy will have an impact on the industry as well, such as the appearance of the COVID-19 pandemic in 2020, the global economic crisis, and the severe impact on tourism, all of which will have a direct impact on the consumer market in creative cities.

Landy's methodology summarises the following variables for urban creativity: "Political and public context; Differentiation, variety, energy, and expressiveness; Transparency, trust, access, and participation; Entrepreneurship, exploration, and innovation are three words that come to mind when thinking about entrepreneurship. Strategic vision, agility, and leadership; Talent development and the educational environment; Communication, networking, and connectivity; The location and location-marketing; Affordability and well-being; Effectiveness and professionalism" [9].

## 3. Discussions

### 3.1. Is it possible to create creative cities in China?

Over the last two decades, China's economy has accelerated, particularly in several of its coastal port cities, which are moving from manufacturing to export industries. A variety of proposals and projects from the local arts industry, architects, urban designers, the Shanghai municipal government, and public institutions, including the establishment of a creative industries collaborative and the design of an ambitious industrial park in the new Shanghai district, were adopted based on a survey of city proposals.

In 2005, the government partly approved the government-led construction of the Creative Industries Park, and subsequent work on implementing a development policy for the concept, which is a really complicated planning project built in phases and by region, began. In 2018, the author visited a creative park in Shanghai that was located in a new district, in a semi-central periphery part of the city, too far from the city center, and with no residential areas nearby, which seemed less friendly to the creative practitioners who worked there. The innovative park is still occupied by art offices and galleries, and new art cultures are being created. Art and art creation, as well as art exchange, architecture, fashion, and textiles, are examples of creative activities; they stimulate innovation and art production in general [10]. These creative industries are formed as a result of direct government investment and cooperation with land owners, and can be seen as local government bodies directly facilitating the development of creative industries and constantly regulating the potential development of creative industries in the intended direction through policies and instruments. Historically, creative clusters have been "organic" or "spontaneous," arising from the intersections of the planning regime, the property market, and urban cultural dynamics, and this will undoubtedly continue [7, 11], based on the complexities of urban arts and culture, while the Chinese approach appears to be more straightforward and effective, particularly in the early stages, but perhaps this may be a hidden danger later It is also worth thinking about.

**Figure 4.** Lujiazui, Shanghai

### 3.2. If so, what will it look like?

According to Pratt [12], "the creative city cannot be like a cathedral in a vast desert: it must be intertwined and interdependent with its cultural context in the same way that we cannot merely use one to grow the other, but must understand the various, nuanced, and integrated cultural-environmental relationships it poses." There is still space for many possibilities to expand, from material production and export to creative product design, from industrial manufacturing zones to creative parks, and from post-industrial cities to creative cities.

Initially on policy and policy level, the current policies formulated in Shanghai, China, by the Government Departments are more preliminary emphasis; new cultural and creative parks are being developed around the town by government funding and the development of parks are being controlled through top-down intervention so that they are not interfered with by external capital. In future, the park's communities will be included as part of the second phase of environmental policy planning and development programs, to enable the park to be accessible entirely to the public and tourists and to include as many residents as possible in the construction of the Artistic Park.

This is because we need to consider the different outcomes of social co-production, for example, new knowledge, new code systems or new urban emotions, and so forth, which may be beyond our expectations.

Leadership and visionary local politicians should have the expertise to make optimal decisions and to prepare potential solutions. Creative parks cannot be limited to a specific area but should be comprehensively and coordinately built in the center of the city, perhaps reusing the remaining urban public space and transforming it into a new place for collective practice [13]. Perhaps a multi-center space for art and cultural creativity in the city could be created. Based on the lessons learned from the Newcastle-Gateshead event, particularly the limitations raised in the previous section, the original network of community connections can be remained and to create the inclusive urban environment for cultural and artistic innovation.

Second, Shanghai has been adopting health and welfare policies for the management of human capital, providing inventive people with a convenient and secure environment in which to explore and create in culture and the arts. There are also new professional and effective network platforms that use technology to promote formal peer-to-peer and point-to-multipoint networks in order to improve communication and develop networks between cultural practitioners.

**Disclosure statement**

The author declares no conflict of interest.

**References**


[1] Florida R, 2002, The Rise of the Creative Class: And How It's Transforming Work, Leisure, Community and Every day, Life New York: Basic Books.

[2] Landry C, 2000, The Creative City: A Toolkit for Urban Innovators, London: Earthscan Publications.

[3] Canniffe E, 2017, Business as Usual: Creativity in Manchester's Neoliberal Regeneration, in: ACTAS ICONO14 – V Congresso Internacional Cidades Criativas | 25-27 Janeiro 2017. Porto-Portugal, pp. 45 – 55, "North East voted 'arts capital'." BBC News. 29 December 2006. Retrieved 18 August 2007.

[4] Comunian R, 2011, Rethinking the Creative City: The Role of Complexity, Networks and Interactions in the Urban Creative Economy. Urban Studies, 48(6): 1157–1179. https://doi.org/10.1177/0042098010370626

[5] Miles M, 2013, A Post-Creative City?, RCCS Annual Review, 5.

[6] Mommaas H, 2004, Cultural Clusters and the Post-Industrial City. Urban Studies, 41(3): 507–532.

[7] Delsante I, 2017, The Notion of the Creative City and its Implementation in Shanghai, China: Spatial practices and Further Implication for Design Actions. La Città Creativa; Rome: BISP, 323–331. https://www.academia.edu/download/54900839/The-notion-of-the-creative-city.pdf

[8] Lange B, 2005, Socio-Spatial Strategies of Culturepreneurs. The Example of Berlin and Its New Professional Scenes, Zeitschrift fur Wirtschaftsgeographie, 49: 79–96.

[9] Szczech E, 2014, Is there a Creative City in Poland? Defining and Measuring the Concept in Poland. Prace Naukowe Uniwersytetu Ekonomicznego We Wrocławiu, 334. https://doi.org/10.15611/pn.2014.334.23

[10] Ren X, Sun M, 2012, Artistic Urbanization: Creative Industries and Creative Control in Beijing, International Journal of Urban and Regional Research, 36(3): 504-521.

[11] Mommaas H, 2009, Spaces of Culture and Economy: Mapping the Cultural- Creative Cluster Landscape. Creative Economies, Creative Cities. Netherlands: Springer. 45–59.

[12] Pratt A, 2008, Creative Cities? Urban Design, Spring 106: 35.

[13] Evans G, 2009, Creative Cities, Creative Spaces and Urban Policy. Urban Studies, 46(5–6): 1003–1040.

Journal of Architectural Research and Development, 2021, Volume 5, Issue 6
http://ojs.bbwpublisher.com/index.php/JARD
ISSN Online: 2208-3537
ISSN Print: 2208-3529

# Influencing Factors of Housing Sales Vacancy in the Guangzhou Metropolitan Area, China

**Xiaoli Yue[1,2], Yang Wang[3]*, Hong'ou Zhang[1]**

[1]Key Lab of Guangdong for Utilization of Remote Sensing and Geographical Information System, Guangdong Open Laboratory of Geospatial Information Technology and Application, Guangzhou Institute of Geography, Guangdong Academy of Sciences, Guangzhou 510070, Guangdong Province, China

[2]School of Architecture and Urban Planning, Guangdong University of Technology, Guangzhou 510090, Guangdong Province, China

[3]Faculty of Geography, Yunnan Normal University, Kunming 650500, Yunnan Province, China

***Corresponding author:** Yang Wang, wyxkwy@163.com

**Abstract:** In this paper, nine indicators selected from three perspectives (convenience, environmental and location characteristics) and three regression models (OLS, SLM and SEM) are used to explore the influencing factors of housing sales vacancy in the Guangzhou Metropolitan Area, China. The results show that subway accessibility, peripheral aversion municipal facilities and distance from the CBD (Central Business District) are consistent with theoretical expectations. Subway accessibility is negatively correlated with the housing sales vacancy rates, while peripheral aversion municipal facilities and distance from the CBD are positively correlated with housing vacancy rates.

**Keywords:** Housing vacancy; Regression models; Sales vacancy; Influencing factors; Guangzhou Metropolitan Area

***Publication date:*** November 2021; ***Online publication:*** November 30, 2021

## 1. Introduction

Housing vacancies are an important index with which to evaluate the health of the real estate market. The growing housing vacancy problem leads to wasted resources. Only by identifying the causes of housing vacancies can we take effective measures to reduce the vacancy rate. According to the literature, the influencing factors of housing vacancies come from many aspects: for example, housing characteristics, including the building age [1], floor area [2], and orientation. Location factors, including distance from the CBD, living facilities, traffic conditions, educational and medical resources, also have an impact on vacancy rates, as do social factors, such as population density, per capita GDP [3], and housing purchase policies. Other factors, such as property developers' speculation [4], property hoarding, and price rigging lead to a high housing vacancy rate. However, there is still a lack of research on the influencing factors of "sales vacancies."

Taking the Guangzhou Metropolitan Area as an example, this research selects 9 influencing factors from three perspectives and uses three regression models to explore the influencing factors of the housing sales vacancy rate. The influencing factors of the vacancy rate are identified, and this data may be helpful for concerned departments in taking targeted and effective measures to improve the housing destocking degree and reduce the sales vacancy rate.

## 2. Method and data

### 2.1. Study area and data

This paper takes as its study area the Guangzhou Metropolitan Area, which is located within the Guangzhou Ring Expressway-Guangzhou-Gaoming Expressway-Guangzhou administrative boundary [5]. The residential housing quarters' sales data from the Net Ease data center in Guangzhou is used to calculate the housing vacancy rate. Considering that the sales cycle of commercial housing in China is generally 2-5 years, this paper selects the 2015-2018 open residential quarters with 70-year property rights in the Guangzhou Metropolitan Area as sample data and screens a total of 101 data points. According to the location of properties, they are grouped into 48 subdistricts, and the vacancy rates of the subdistricts are calculated.

### 2.2. Calculating average housing vacancy rates of subdistricts

The average housing vacancy rates in the subdistricts were calculated as follows: the sold residential units were subtracted from the total residential units in each subdistrict, and the sales vacancy rate of each subdistrict was calculated according to the formula:

Housing sales vacancy rate = (Total units - Sold units)/ Total units *100%

### 2.3. The construction of the index of influencing factors

In this paper, 9 influencing factors are selected from three perspectives for scoring evaluation, with scores ranging from 1 to 9. The specific evaluation and calculation methods are based on a study by Wang et al.[6] There are nine factors that affect the sales vacancy rate: 1. Convenience characteristics, including subway accessibility, office accessibility, basic education convenience and business service convenience; 2. Environmental characteristics, including park accessibility, peripheral aversion municipal facilities, industrial pollution, logistics centers and wholesale markets; 3. Location characteristics, including distance from the CBD (**Table 1.**). Finally, we obtain 8 influencing factor scores, distance from the CBD and vacancy rate data for each subdistrict, which is convenient for spatial regression analysis.

**Table 1.** Evaluation index system of influencing factors of housing sales vacancy in the Guangzhou Metropolitan Area.

| Perspectives | Influencing factors | Expected direction |
|---|---|---|
| V1 Convenience Characteristics | F1 Subway accessibility | - |
| | F2 Office accessibility | - |
| | F3 Basic educational convenience | - |
| | F4 Business service convenience | - |
| V2 Environmental Characteristics | F5 Park accessibility | - |
| | F6 Peripheral aversion municipal facilities | + |
| | F7 Industrial pollution | + |
| | F8 Logistics centers and wholesale markets | + |
| V3 Location Characteristics | F9 Distance from the CBD | + |

### 2.4. Research methods

In this paper, three regression models-namely, the ordinary least square (OLS), spatial lag model (SLM) and spatial error model (SEM)-are comprehensively selected. We choose the optimal model, and then the

influencing factors of the housing sales vacancy rate in the Guangzhou Metropolitan Area are explored.

OLS is a traditional linear regression model that can be used to study the linear relationship between dependent variables and independent variables, that is, to study the linear relationship between the housing sales vacancy rate and 9 influencing factors in the Guangzhou Metropolitan Area. In this model, the variables are independent of each other, and the spatial information of the variables is not considered. The OLS is established the model as follows:

$$y_s = \beta X_s + \varepsilon_s, [\varepsilon_s \sim N(0, \delta^2 I) \quad (1)$$

In the above formula, $s$ = 1, 2, …, 48, which indicates the subdistrict sample data in the Guangzhou Metropolitan Area; $y_s$ is the dependent variable, which is the housing sales vacancy rate of subdistricts in the Guangzhou Metropolitan Area; $X_s$ denotes the i-dimensional row vector ($i$ = 1, 2, …, 9) of the vacancy rate influencing factor, representing the observed value of the ith variable of influencing factor in the $s$th subdistrict; $\beta$ is the i-dimensional column vector, which is the spatial regression coefficient corresponding to the independent variables of these 9 factors. $\varepsilon$ is the error term of the model, $\varepsilon_s \sim N(0, \delta^2 I)$ indicates that the error term follows a normal distribution, and its variance is consistent, that is, the product of error and covariance matrix is 0; $I$ is the identity matrix.

Based on the OLS linear regression model mentioned above, a spatial regression model-the spatial lag model (SLM)-considers the influence of the vacancy rate of a subdistrict on the vacancy rate of other neighboring subdistricts in the study area, that is, the spatial spillover effect. The spatial lag model (SLM) is used to analyze the influencing factors of the housing sales vacancy rate in the Guangzhou Metropolitan Area. The model can be expressed as follows:

$$y_s = \rho \sum_{j=1}^{n} W_{sj}\, y_j + \beta X_s + \varepsilon_s, [\varepsilon_s \sim N(0, \delta^2 I] \quad (2)$$

where $\rho$ is the coefficient value of spatial autocorrelation and $W_{sj}$ represents the spatial weight matrix. In the regression analysis of the above model, there may be spatial autocorrelation due to the independent error items in the model. At this time, the spatial error model (SEM) can be introduced, which can consider the spatial spillover effect of independent error terms and solve this problem well. SEM is expressed as:

$$y_s = \lambda \sum_{j=1}^{n} W_{sj} \varphi_s + \beta X_s + \varepsilon_s, [\varepsilon_s \sim N(0, \delta^2 I)] \quad (3)$$

where $\varphi$ represents the spatial autocorrelation error term and $\lambda$ is the spatial autocorrelation coefficient of the error term [6].

## 3. Results and discussion

GeoDa software is used to run these three models, the FD (Fixed Distance） method is used to determine the spatial weight matrix, and the threshold distance is the default value (5638 m). The regression results of OLS, SLM and SEM are comprehensively compared, and the optimal model is selected. As shown in **Table 2.** below, the results show that $R^2$ and log likelihood of SEM are the largest and AIC is the smallest, which indicates that SEM should be selected among the three models to explore the influencing factors (**Table 3.**).

In terms of convenience characteristics, this study selected 4 indicators of influencing factors, among which the p values of three indicators were all less than 0.05, passing the 95% significance test. The regression coefficients of subway accessibility, office accessibility and basic education convenience are -0.0345, 0.0538 and 0.0404, respectively. From the regression coefficient, it can be seen that subway accessibility is negatively correlated with the housing sales vacancy rate. The higher the subway accessibility is, the lower the sales vacancy rate, which is in line with the theoretical expectation. Moreover,

the result indicates that the more convenient the subway is, the more attractive the area is for buyers, the better the housing sales and the lower the sales vacancy rate. Additionally, the sales vacancy rate will decrease by 3.45% for every point increase in the convenience score of the subway. Office accessibility and basic education convenience are positively correlated with the housing vacancy rate in the Guangzhou Metropolitan Area, and the housing sales vacancy rate increases by 5.38% for every point increase in office accessibility score. The sales vacancy rate increases by 4.04% for every point increase in the basic education convenience score. These two factors do not match the theoretical expectations. The reasons for this phenomenon may be due to two factors. On one hand, the study area of this paper is the Guangzhou Metropolitan Area, which has a prominent location advantage, and high housing prices will have a significant impact on buyers' behavior. On the other hand, perhaps because the object of this paper is "sales" of housing vacancies, it will be affected by various factors. These factors include brand awareness of real estate, marketing methods of developers, preferential policies, and more.

**Table 2.** Comparison of main parameters of three regression models in the Guangzhou Metropolitan Area

| Model | $R^2$ | AIC | Log likelihood |
|---|---|---|---|
| Ordinary Least Squares Model (OLS) | 0.3569 | -53.5689 | 36.7844 |
| Spatial Lag Model（SLM） | 0.3665 | -52.0705 | 37.0353 |
| Spatial Error Model（SEM） | 0.4001 | -55.6376 | 37.8188 |

**Table 3.** The regression coefficient of influencing factors of housing sales vacancy rate based on SEM in the Guangzhou Metropolitan Area

| Variables | Coefficient | Std.Error | z-Value | *p* |
|---|---|---|---|---|
| CONSTANT | -0.4213** | 0.1713 | -2.4591 | 0.0139 |
| F1 Subway accessibility | -0.0345** | 0.0174 | -1.9794 | 0.0478 |
| F2 Office accessibility | 0.0538*** | 0.0183 | 2.9384 | 0.0033 |
| F3 Basic educational convenience | 0.0404*** | 0.0151 | 2.6683 | 0.0076 |
| F4 Business service convenience | -0.0309 | 0.0218 | -1.4168 | 0.1566 |
| F5 Park accessibility | 0.0531*** | 0.0145 | 3.6567 | 0.0003 |
| F6 Peripheral aversion municipal facilities | 0.0895*** | 0.0346 | 2.5887 | 0.0096 |
| F7 Industrial pollution | 0.0096 | 0.0105 | 0.9167 | 0.3593 |
| F8 Logistics centers and wholesale markets | -0.0128 | 0.0112 | -1.1514 | 0.2496 |
| F9 Distance from the CBD | 0.0130** | 0.0061 | 2.1408 | 0.0323 |
| LAMBDA | -0.3297* | 0.1910 | -1.7257 | 0.0844 |
| $R^2$：0.4001； AIC：-55.6376；Log likelihood：37.8188 | | | | |

Note: * * *, * * and * represent the 0.01, 0.05 and 0.1 significance levels, respectively.

From the perspective of environmental characteristics, park accessibility and peripheral aversion municipal facilities have a significant impact on the housing sales vacancy rate, and the degree of impact is positively correlated. For every point increase in park accessibility, the housing sales vacancy rate increases by 5.31%, which is inconsistent with the theoretical expectation. The closer the house is to the park, the higher the housing sales vacancy rate, which may be due to the high housing prices around the parks in the Guangzhou Metropolitan Area. Many buyers cannot afford high housing prices and can only

settle for the next best. Therefore, park accessibility is not necessarily a consideration when buying a house. The peripheral aversion municipal facilities have a positive correlation with the sales vacancy rate. The sales vacancy rate increases by 8.95% for every 1 point of peripheral aversion municipal facilities, which is consistent with the theoretical expectation. Because peripheral aversion municipal facilities will adversely affect residents' quality of life and health, buyers will naturally avoid houses near these facilities. As a result, the vacancy of these houses near municipal facilities (including high-voltage wires, garbage disposal fields, railway stations, and airports, etc.) must be relatively high.

In terms of location characteristics, this study only considers the distance from the CBD in a narrow sense. The SEM results show that the influencing factor is significant and has a positive correlation. For every 1 km increase from the CBD, the sales vacancy rate increases by 1.3%; that is, the farther away from the CBD that a residence is, the higher the sales vacancy rate. The closer people are to the CBD, the better the location conditions and resources, such as education, medical care, public services, and transportation. In contrast, the resources enjoyed by residents of houses farther from the CBD are relatively poor, the housing destocking degree is relatively low, and the sales vacancy is relatively high.

## 4. Conclusion

Housing sales vacancies in the Guangzhou Metropolitan Area are affected by many factors. In this paper, 9 influencing factors are selected by considering 3 perspectives, and the spatial regression model is used to explore them. The results show that subway accessibility has a negative correlation with housing sales vacancy, while office accessibility, basic education convenience, park accessibility, peripheral aversion municipal facilities and distance from the CBD have a positive correlation with housing sales vacancies in the Guangzhou Metropolitan Area. Moreover, the influence of subway accessibility, peripheral aversion municipal facilities and distance from the CBD on housing sales vacancies in the Guangzhou Metropolitan Area agrees with theoretical expectations. Therefore, when analyzing the influencing factors of housing sales vacancy in the Guangzhou Metropolitan Area in the future, we can focus on these three factors. At the same time, we should further explore other factors that have an impact on housing vacancies.

## Funding

This research was funded by the National Natural Science Foundation of China (No.41871150), GDAS Special Project of Science and Technology Development (No.2020GDASYL-20200104001), National Key Research and Development Program (No. 2019YFB2103101), and Special Project of the Institute of Strategy Research for Guangdong, Hong Kong, and Macao Greater Bay Area Construction (No.2021GDASYL-20210401001).

## Disclosure statement

The author declares no conflict of interest.

## References

[1] Park JI, 2019, A Multilevel Model Approach for Assessing the Effects of House and Neighborhood Characteristics on Housing Vacancy: A Case of Daegu, South Korea. Sustainability, 11(9): 2515.

[2] Baba H, Hino K, 2019, Factors and Tendencies of Housing Abandonment: An Analysis of a Survey of Vacant Houses in Kawaguchi City, Saitama. Japan Architectural Review, 2(3): 367-375.

[3] Liang SY, 2021, The Robust Influencing Factors of Urban Commercial Housing Vacancy Rate Based on EBA Model-Taking Shenzhen as an Example. World Scientific Research Journal, 7(2): 378-388.

[4] Pan JH, Dong LL, 2021, Spatial Identification of Housing Vacancy in China. Chinese Geographical Science, 31(2):359-375.

[5] Wang Y, Wu KM, Jin LX, et al., 2021, Identifying the Spatial Heterogeneity in the Effects of the Social Environment on Housing Rents in Guangzhou, China. Applied Spatial Analysis and Policy, https://doi.org/10.1007/s12061-021-09383-6

[6] Wang Y, Wu KM, Zhang HO, 2021, The Core Influencing Factors of Housing Rent Difference in Guangzhou's Urban District. Acta Geographica Sinica, 76(8):1924-1938.

Journal of Architectural Research and Development, 2021, Volume 5, Issue 6
http://ojs.bbwpublisher.com/index.php/JARD
ISSN Online: 2208-3537
ISSN Print: 2208-3529

# Application of Green Building Design in Residential Buildings

**Wen Zhang***

Xiong'an Urban Planning and Design Institute, Xiong'an New District 071000, Hebei Province, China

***Corresponding author:*** Wen Zhang, 18706393771@163.com

**Abstract:** In recent years, with the rapid development of the world economy, the environment and resources have been seriously damaged, and the global climate is changing quietly. People began to pay more and more attention to the protection of environment and resources. In the process of building residential buildings, the construction industry also needs to strengthen the application of green building design, so as to achieve the purpose of green environmental protection. The author makes an in-depth research and analysis on the characteristics of green building design, and puts forward the effective strategies for the application of green building design in residential buildings, hoping to help improve the green environmental protection of residential buildings.

**Keywords:** Green building design; Residential buildings; Application strategy

***Publication date:*** November 2021; ***Online publication:*** November 30, 2021

## 1. Introduction

Green building design not only has the characteristics of energy conservation and emission reduction, but also has the characteristics of sustainability and returning to nature. It has high application value in residential buildings. With the continuous development of society, people's requirements for residential buildings are also improving, especially the green and environmental protection of buildings. If construction enterprises want to develop in the long run, they must strengthen the application of green building design.

## 2. Characteristics of green building design

### 2.1. Characteristics of sustainability

In the new era, China pays more and more attention to sustainable development. From the actual situation of China's development in recent years, the sustainable development process of the construction industry is relatively slow. The main reason for this situation is the lack of balance in China's economic development. Construction industry is an important pillar industry of China's economic development. Therefore, it is very necessary to speed up the process of sustainable development of construction. And the green building design is more consistent with the basic indicators of modern social life. Green building design is the rational use of materials to promote the circular development of resources on the earth, so as to provide resources for people's production and life. Thus, green building design has the characteristics of sustainability.

### 2.2. Characteristics of energy conservation and emission reduction

From the current situation of China's development, energy conservation and emission reduction are a basic demand of modern development. How to achieve scientific energy conservation and reduce waste emission

has always been a key research content of relevant disciplines. Green building design is conductive to the realization of energy conservation and emission reduction. Through the scientific allocation of building construction materials, we can rationally distribute construction materials and construction equipment, always take energy conservation and emission reduction as the center of each process of building construction, establish the awareness of environmental protection and strengthen the use of green construction materials, so as to further sublimate the concept of green building design, and better realize energy conservation and emission reduction.

### 2.3. Characteristics of returning to nature

A key content of green building design is to return nature. In the past, most architectural engineering design in our country did not have this feature. Green building design can promote the building to adapt more to the natural environment. In recent years, with the continuous development of society, there are more and more farmhouse and riverbank buildings. These buildings can not only create certain benefits for residents, but also promote the return of buildings to nature and integrate with nature, so as to give full play to their own value. **Figure 1.** is the design drawing of a farmhouse building.

**Figure 1.** Design drawing of farmhouse building

## 3. Basic principles of application of green building design in residential buildings

### 3.1. Basic principles of saving energy and reducing loss

The application of green building design in residential buildings should aim at improving the quality of life of residents and meeting the needs of efficient and healthy life of residents. In the process of specific design, we must pay attention to strengthening the efficient utilization of resources, strive to recycle various resources, and strengthen the use of renewable resources and degradable resources, but we cannot destroy the residents' sense of living experience at the cost. Therefore, the application of green building design in residential buildings must follow the basic principles of saving energy and reducing loss, so as to realize the harmonious and sustainable development among architecture, environment and economy.

### 3.2. Basic principles of health and comfort

When applying the green construction design concept in residential buildings, we must follow the basic principles of health and comfort, and strive to create a livable ecological environment for residents, so as to improve the quality of life of residents and provide them with a more comfortable living and leisure space. In the specific design, in addition to ensuring the appropriate humidity, it is also necessary to ensure the adequacy of day lighting, so as to ensure the comfort of residents in the house. The application of green building design and the increase of green landscape can not only provide residents with a more beautiful

living environment, but also purify the air and create a more comfortable environment for residents. For example: When integrating the green building design concept into the design of the basement roof of a residential building, we should not only pay attention to preventing the impact of flood disasters on residential buildings, but also pay attention to collecting rainwater, so as to realize the secondary utilization of rainwater. For example: We can collect rainwater to wash the toilet and irrigate green plants. **Figure 2.** is the basic design drawing.

**Figure 2.** Design drawing of roof rainwater collection and secondary utilization

### 3.3. Basic principles of economy

Green building design concept needs to run through the whole process of residential building construction. Only in this way can we better achieve the goal of reducing energy consumption and pollution. This requires strengthening the utilization of non-renewable resources in the process of designing residential buildings. In the application of green building design concept in the design of residential buildings, another basic principle that needs to be followed is economy. That is, in the construction of residential buildings, we should strictly control the construction cost and prevent unnecessary capital waste as much as possible. We should make full use of existing resources, while ensuring the quality of residential buildings, reduce capital investment and further improve the economic benefits of buildings.

## 4. Strategies of application of green building design in residential buildings

### 4.1. Application of green building design concept in residential building site selection

Before planning and designing residential buildings, developers usually have selected the specific construction address. Designers only need to go deep into the address selected by developers for survey and thorough investigation before designing residential buildings, and design a scheme consistent with the site and surrounding environment in combination with the actual situation and climate characteristics of the construction site and surrounding environment [1]. In addition, in the specific design, in order to further highlight the green building design concept, it is also necessary to comprehensively analyze the local natural resources, strengthen the research on the orientation and pattern of residential buildings, and avoid the impact on the surrounding environment.

### 4.2. Strengthen the use of environmental protection building materials

The construction of residential buildings is composed of various building construction materials. In the

process of applying the green building design concept to the design of residential buildings, we must reasonably select building materials, so as to achieve the effect of environmental protection while reducing energy consumption and fully realize the ecological value of green building design [2]. When selecting building materials, in addition to strictly controlling the quality of materials, we also need to pay attention to improving the utilization rate of building materials and reducing unnecessary waste of resources, so as to improve the quality of residential buildings. For example: Aluminum silicate is a new environmental protection building material. It not only has good fireproofing and waterproofing quality, but also can absorb excess heat. Compared with traditional building materials, this environmental protection building material has its own unique advantages and can improve the green environmental protection of residential buildings. **Figure 3.** shows aluminum silicate building materials.

**Figure 3.** Aluminum silicate building materials

### 4.3. Application of green building design concept in residential building structure design

In recent years, China pays more and more attention to the development of the construction industry. At the same time, it also puts forward new requirements for the development of the construction industry, requiring construction enterprises to strengthen the application of green building design concept when designing residential building structure [3]. Our government proposes to widely use solar energy. When designing green residential buildings, we also need to actively implement the requirements of our government, strengthen the utilization of solar energy, and apply solar panels to residential buildings, so as to achieve the purpose of energy conservation. **Figure 4.** shows the solar panels used in residential buildings. As we all know, solar energy is a renewable energy resource. Solar energy can be converted into electric energy through solar panels for residential residents. At the same time, solar panels can also be used to convert solar energy into heat energy, so as to provide hot water for residents in the building.

**Figure 4.** Solar panels

### 4.4. Strengthen the utilization of the surrounding environment

When applying green building design in residential buildings, we must strengthen the utilization of the surrounding environment. Carbon dioxide will cause certain damage to human body, while plants can well absorb carbon dioxide in the air and achieve the effect of purifying the air [4]. Therefore, when applying the green building design concept to the design of residential buildings, we should integrate it with the surrounding environment, which can not only reduce the air pollution, but also create a comfortable environment for the residents in the residential buildings. In the process of specific design, designers should not only strengthen the utilization of the surrounding environment, but also pay attention to the greening design in residential buildings with the help of natural advantages. They can appropriately plant more green plants in the residential area and expand the green planting area of the residential area, so as to create a beautiful small park environment for the large number of residents. The planting of green plants can not only beautify the environment, but also purify the air, cultivate the mind of residents, and create a comfortable and fresh living environment for residents. In recent years, the number of high-rise residential buildings has gradually increased. High-rise buildings can not only meet the living needs of residents, but also save land resources. When applying the green building design concept to design high-rise buildings, designers can choose to plant some plants that can climb along the wall, so as to increase the green area of the residential area and improve the ecological environment of the residential area. In summer, green climbing plants can also absorb a certain amount of sunlight, which can achieve the effect of adjusting indoor temperature, so as to create a more comfortable environment for residents. **Figure 5.** shows climbing plants in high-rise residential buildings.

**Figure 5.** Climbing plants in high-rise residential buildings

### 4.5. Pay attention to improving the natural ventilation effect of residential buildings

Although air conditioning has a good effect on regulating the indoor temperature and humidity of residential buildings, the use of air conditioning will not only consume a lot of electric energy, but also cause certain air pollution. Therefore, when applying the green building design concept to design residential buildings, we should pay attention to improving the natural ventilation effect of residential buildings, so as to replace the use of air conditioning, create a natural air environment for residents in the buildings, and this can also reduce energy consumption, reduce air pollution as well as ensure the physical and mental health of residents. In order to achieve the effect of natural ventilation, it is necessary for designers to comprehensively consider various factors when designing residential buildings, including the climate

conditions, topography, dominant wind direction and trees and vegetation, so as to achieve the effect of natural ventilation more reasonably. Moreover, it is also necessary to scientifically design the house type of residential buildings to form natural wind convection indoors, and regulates the temperature of the building by taking some of the heat away from it through the draught. This can not only accelerate the flow of air in the building, but also promote the exchange of indoor and outdoor air, so as to create a more comfortable indoor air environment for residents [5].

## 5. Conclusion

To sum up, the construction industry plays a good role in promoting China's social and economic development. In the process of constructing traditional buildings, not only resources are wasted, but also the surrounding environment may be polluted to a certain extent, which is very unfavorable to the construction industry and the realization of the national sustainable development goal. Therefore, in the process of designing residential buildings, we must establish the concept of green and environmental protection and strengthen the application of green building design. On one hand, we should avoid unnecessary energy loss and improve the utilization rate of resources, on the other hand, we should prevent pollution to the surrounding environment and to achieve the purpose of environmental protection. In the process of applying the green building design concept to the design of residential buildings, it is also necessary to strengthen the use of green, environmental protection and renewable energy, so as to further improve the energy-saving and environmental protection effect of residential buildings.

## Disclosure statement

The author declares no conflict of interest.

## References


[1] Chen X, 2021, Application of Green Building Concept in Prefabricated Residential Building Design. Anhui Architecture, 28(06): 75+86.

[2] Zhang T, 2021, Research on the Application of Green Building Design in High-rise Residential Building Design. Home, (11): 94-95 + 101.

[3] Teng J, Li C, 2020, Application of Green Building Design Concept in Residential Building Design in Cold Region. Housing and Real Estate, (33): 70+72.

[4] Li Z, Su X, 2020, Discussion on the Application of Green Building Design in Civil Residential Building Design. Management and Technology of SME (Mid Term), (09): 180-181.

# 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 Architectural Research and Development* 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 Architectural Research and Development* 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 important regarding with 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 to 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 relations 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 relations 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 RBG 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

BIQ-BYWORD
SCIENTIFIC PUBLISHING PTY LTD

# 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.

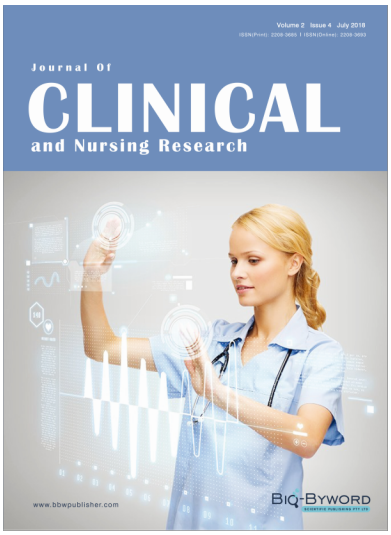
Topics covered but not limited to:

- 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