

# Social Considerations for the Usability of Small Prefabricated Buildings in Urban Public Space

Ailin He<sup>1</sup> Kai Cao<sup>1,\*</sup>

<sup>1</sup> Wuhan Textile University, Wuhan, Hubei, China

\*Corresponding author. Email: Caokai78@vip.qq.com

## ABSTRACT

With the rapid development of society with each passing day, in the current process of urbanization, public space is an important place to connect people and life. At present, urban public space has problems such as low utilization rate, weak population integration, lack of interaction, etc. Based on the above social problems, small-scale prefabricated buildings are used as intervention carriers, and small-scale prefabricated buildings are combined with the role of public space through features such as small prefabricated buildings. And through the analysis of related projects, the goal is to achieve the research purpose of the feasibility of small-scale prefabricated buildings in urban public space and the consideration of social value.

**Keywords:** Prefabricated building, Public space, Urban space.

## 1. INTRODUCTION

Prefabricated buildings are the products required by the times. With the attention to environmental engineering and human living, the applicability and regional problems of small prefabricated buildings have become more prominent, and the research in the field of prefabricated buildings in China is relatively weak. Previous research on prefabricated buildings focused on environmental and ecological issues and socio-economic issues, but looking at the rapid development of world economy and technology, people themselves have played a key role as users. In the city, how the architects should reasonably use the characteristics of small prefabricated buildings to closely integrate with human activities, and how people need to guide the establishment of different prefabricated buildings are the problems architects need to explore next.

## 2. OVERVIEW OF SMALL PREFABRICATED BUILDINGS

### 2.1 Overview of Prefabricated Buildings

The technology of prefabricated construction emerged in the last century. Due to the severe impact of the World War II, the overall structure of

European buildings was severely damaged. In order to quickly recover and solve the housing problem, the architects have adopted an industrialized production line using mobile drainage lines to achieve a standard, rapid and complete housing system. After the continuous improvement and development of prefabricated structures in China, more and more prefabricated structure can be seen many countries such as France, Britain, Japan, Germany, etc. In fact, as early as 1851, the "Crystal Palace" building where the first Youth World Architectural Exposition was held in London, England, was a typical representative of prefabricated modern buildings, assembled with standardized prefabricated parts, saving a lot of time and cost. In the 1950s of the United States, due to the rapid population flow in China, a huge demand for low-asset cost and fast-moving construction of new houses was proposed, and a new concept of using mobile construction of houses was proposed, and then the housing industry has also developed rapidly. The mobile house is manufactured in a construction factory completely in accordance with the traditional modular production method, installed on the chassis of a truck, and automatically pulled to the construction site by a truck. The mobile type also retains a wheel in the house so that others can move freely. In the context of the development of the new era, the

manifestations of prefabricated buildings are also quite rich, such as the development of container buildings and mobile temporary buildings, which provide reference value for the following research content.

## 2.2 Development Status of Small Prefabricated Buildings

Since the global industrial revolution, the construction technology in the field of architecture has been rapidly improved. The large-scale construction of skyscrapers in the city has accelerated the urbanization process, but the renewal of the city also means that more public space will be occupied. At the same time, behind the large-scale construction of high-rise buildings and the blind pursuit of higher construction quality have brought about a series of objective problems such as a large amount of government capital investment, overproduction of reinforced concrete, and aggravated environmental pollution. Under the situation where the above problems are revealed, the society will reflect on the disadvantages of traditional buildings and reflect the importance of prefabricated buildings in social construction.

There have seen many practical projects small-scale prefabricated buildings in foreign countries. Compared with the Chinese development situation, the development of foreign small-scale prefabricated buildings has priority. In Japan, the famous Japanese miscellaneous clothing brand MUJI has already sold a series of main architectural design products, "House of Wood, House of Zongzhi, and House of Window" in 2000. In 2015, MUJI was also invited to participate in the British design jaspermorrison in the "Design Touch" series of events in Tokyo. Jakonstantingrcic from Germany and Japan both worked with local architect Naoto Fukasawa to design a miniaturized prefabricated main building. Subsequently, the MUJI HUT ("Figure 1") launched in 2017 has attracted widespread attention from the construction industry. The difference from the previous buildings sold is that the cabin is assembled by wooden pieces and covers an area of only 9.1 m<sup>2</sup>. After the "hut" trend, the design practice of Chinese small prefabricated buildings is on the rise.



Figure 1 MUJI HUT.

In the Chinese small-scale prefabricated building practice projects, most of the rural areas are used as experimental sites. The main reason is that on the one hand, it is required by the general trend of China's rural construction and transformation in recent years. On the other hand, rural experimental sites are more abundant than urban sites. Secondly, there are fewer supporting materials and related procedures required for the construction of small-scale prefabricated buildings under the rural site, and the implementability is stronger. In rural sites, the small prefabricated buildings built are mostly public toilets and villagers' resting places. However, in view of the current situation of rural development, the population density is sparse and the demand for functional sites is small. In contrast to the social needs of cities, for the low utilization rate of public space, small prefabricated buildings should make the urban public space more valuable. From this point of view, there are more possibilities for small-scale prefabricated buildings in urban public space.

## 2.3 Characteristics of Small Prefabricated Buildings

### 2.3.1 Modulization and Modularization

According to the construction form of prefabricated buildings, for the convenience of prefab production, small prefabricated buildings usually form the phenomenon of unitization of prefabs. The assembled building prefabs are produced in a unified unit and regular modulus specifications. This is the modulization of prefabricated buildings. [1] The realization of modulization can position different sites and meet the convenience of assembling building prefabricated parts. In small prefabricated buildings, the basic modulus is in m, and the

modulus is expanded respectively, such as 3m, 6m, 9m, etc., which are unit multiples of the modulus size of the prefabricated parts, and the prefabricated parts and the space gap are designed with a small range of numerical dimensions such as 1/5m, 1/10m, etc.

Small prefabricated buildings are mostly used in small sites, or presented in a combined form in a large area. In order to better implement combined assembly, small prefabricated buildings will be designed in a modular way at the initial design stage. Modularization is based on modulization design, taking the base of the unit module as the matrix, and splitting the unit according to the different functions required by the space.

The modularization of small prefabricated buildings achieves uniformity and versatility in the case of the unit matrix. In the use of different functional spaces, they are combined and arranged according to the required space. Different plans are planned for different spaces to achieve the richness and innovation of the space.

Small prefabricated buildings are designed with modularization and modularization, which optimizes the design process, shortens the design cycle, and saves a certain amount of time and cost. Modulization and modularization make installation convenient, and also facilitate maintenance and replacement. With the rapid development of society and technology, the design of products, industries, and planes is developing towards modularization and standardization. In the field of construction, modular production has also been realized, which made the development of small prefabricated buildings more productized, with the possibility of standardizing production and the forward-looking nature of the needs of social development. [2] Due to the outbreak of the COVID-19, the society is in urgent need of medical land. Wuhan actively responded to the government's call to quickly build "Huoshenshan" and "Leishenshan" shelter hospitals. The reason why the shelter hospital can be quickly built this time is because during the SARS period in 2003, Beijing established the "Xiaotangshan" shelter hospital. The shelter hospitals in Wuhan were quickly planned on the basis of the previous "Xiaotangshan" hospital, which showed that the prefabricated buildings have the characteristics of standardization, modularization, and generalization.

### 2.3.2 *Site Adaptability and Flexibility*

Small prefabricated buildings are mostly produced in factories and assembled on site. Considering that small prefabricated buildings often use light steel structures, the requirements for on-site construction technology are low. Small prefabricated buildings do not have high requirements for site area and site surrounding environment. Whether it is used in independent unit building matrix or combined unit building in various sites, the building can fully adapt to the site.

### 2.3.3 *Nature of Energy Conservation and Environmental Protection*

As a prefabricated building interior wall maintenance and installation structure, users can directly use the installation crane to hoist the exterior wall at the installation factory site after the installation is completed, which greatly reduces the on-site maintenance and construction operations. The prefabricated manufacturing construction industry is also known as the industrialization of new building assembly, which means that the main components of the building are directly processed and produced in the construction factory in advance, such as beams, slabs, columns and other components. And then according to the actual needs, the materials are transported to the construction site, processed and assembled on the site, and assembled into various buildings suitable for the needs. The prefabricated composite construction industry is a new type of industry for the development of green and environmentally friendly buildings. The main products have three main construction technical characteristics: building structural system component, component system prefabrication and building component system integration. The above characteristics make the prefabricated buildings have certain energy-saving and environmental protection. After the prefabricated building components are used, they are conducive to recycling, reducing the waste of social resources, and reducing the generation of construction waste, so as to achieve the goal of green and environmental protection.

## 3. DEFINITION OF URBAN PUBLIC SPACE AND ITS SOCIAL STATUS

### 3.1 *The Concept of Urban Public Space*

Urban public information space mainly refers to open public places that are easily accessible to all citizens. It is mainly used for daily life and social activities of all citizens, including outdoor public

space such as urban central squares, road blocks, parks, etc. [3]. Urban public service space is indispensable in improving the overall ecological environment of the city. It has significant guiding role to continuously improve the overall ecological environment and life quality of China's cities, promote the physical and mental health of Chinese citizens, maintain the vitality of China's urban development, carry public service life and social cultivation, and enhance citizens' public recognition sense and so on. The urban planning and design industry and the professionals in the field of urban environmental protection design should work together to provide people with a high-quality international urban public information space. [4], [5] As a proper noun, "public space" first appeared in the fields of political philosophy and social philosophy in the 1950s; In the 1960s, "Public Space" was introduced into the discipline of planning and design by L. Mumford and J. Jacobs. By the mid-1970s, it gradually became the subject of research on urban morphology and urban life in the West [6]. In China, the research on urban public space started relatively late, but academic attention has increased in recent years. What is particularly worthy of attention is the relationship between public space and people.

### ***3.2 Status Quo of the Use of Urban Public Space***

Different from space categories such as green space, parks and squares, which focus on material entities and functional attributes, public space has multiple attributes such as social, political and material. Therefore, the study of urban public space must first recognize and understand its internal public attributes. The research in the direction of society and humanities is mainly carried out from the perspective of social relations and institutional relations. Public communication is the basic rights and interests of human beings. Public space is a necessary element to realize social relations, and it will affect social and economic processes. The economic perspective is concerned with the allocation and supply efficiency of urban public space as a public resource. This kind of public space theory is relatively abstract, not necessarily corresponding to the physical location or material form of urban public space, and there is a certain distance from the focus of the human settlement environment discipline. However, the social and economic dimensions of public space essentially revolve around the "public" attribute, which provides a powerful theoretical tool for a deep

understanding of the urban material space pattern and its mechanism of action. The goal of the study of human behavior and demand in urban public space is to optimize the built environment, and to shape the urban space where behavior space and material space are mutually infiltrated, and where communication activities are encouraged and supported. This also links space, environment, and people to each other, and there is a lack of space for people to participate in the urban public space.

### ***3.3 Problems of Urban Public Space Development***

In the rapid development of cities, due to the accumulation of so-called rapidity and mass production, many urban plans lack developmental planning in order to realize urbanization quickly. In the change of time, these shortcomings caused by rapidization have appeared one by one, making many spaces become abandoned spaces. These spaces used to be an important part of the city, but in the long river of urban development, it has lost its short-lived functions in the past and cannot be used by the city at the current time. This has also made many urban space lands appear "fragmented" forms. As the pace of urban development continues to accelerate, a variety of "fragmented" spaces continue to be scattered in all corners of the city. The main forms of existence can be classified into the following types: street open space, gray space under elevated, square open space, street-along open space, etc. The above urban public space is the key transformation space involved in the transformation of small prefabricated buildings, and a better design bridge is built through the connection between space and space.

Urban architecture is an important carrier of modern people's residence or life. Therefore, the sustainable development and urban construction of a city cannot be separated from the active participation of the public and the actual needs of the public. At present, in the overall planning and construction of many large cities, in order to truly pursue the development speed of rapid urban construction, the use of space in a city is often quickly demolished, transformed and other new urban projects based on a single urban theory. Therefore, these new urban use spaces often do not really play their own functions and functions in the use of urban space, and cannot truly be widely recognized by the public, which make these spaces develop into an urban space with relatively low utilization rate or even very idle urban space.

Therefore, the public rest space in urban life, as a rest place for all social activities of a person, needs to fully consider the actual feeling and participation of the public in the public space in order to create a resting space for interpersonal communication and social activities that is conducive to human settlement. Taking into account the needs of the users, a wider range of people should be considered in the space. The homeless in society, night bus drivers, and social workers of different occupations should all be users. Therefore, the use of small prefabricated buildings for various groups of people should be considered in urban public spaces.

#### **4. SOCIAL CONSIDERATIONS OF SMALL PREFABRICATED BUILDINGS INTERVENING IN URBAN PUBLIC SPACE**

##### ***4.1 The Composition of Social Relationships***

As a huge proposition, the construction of urban public space is not only an important part of urban planning, but also related to the public communication activities of urban residents. Herman Hertzberger has mentioned many times in books such as "Lessons in Architecture: Space and the Architect": "The city, whether it is the whole or the smallest architectural component, should try to provide us with more opportunities to encourage us to observe each other, pay attention to each other, and enhance communication." It can be said that in addition to providing people with basic functions, public building space also points to the purpose of linking communities and activating the city. [7] Especially in today's social network development, the development trend of public space is more and more diversified in function and form, welcoming people with an open attitude, and providing users with diverse needs. Small prefabricated buildings intervene in the urban public space to produce a social relationship among architecture, environment and people. The relationship between these three influences and complements each other. In different environments, it is necessary to intervene in different functional small prefabricated buildings according to the behavior patterns and life needs of different groups of people.

##### ***4.2 The Relationship Between Architecture and Environment***

The establishment of small prefabricated buildings in cities is based on different public space

sites. The architectural media set in the open space of the park and the street open space are different. In the relatively spacious public space of the park, exhibition-type and market-type prefabricated spaces can be set up, and the architectural media area allowed to be set up will have enough space. However, the space that can be used in the street "fragmented" open space has limitations, so more consideration should be given to the intervention of the medium of single-scale small prefabricated buildings. [8] As the urban planning update of the Zagreb region has explained the interrelationship between the regional architecture and the urban environment very well. The regional urban planning and development of Zagreb is different from the newly-built European capitals along the river in other parts of Europe. The urban development of the whole region presents a trend of gradually moving away from the Sava River. As the wildest tributary of the Danube, the Sava River flood has caused severe natural damage and severe damage to the Zagreb Basin in history. With the construction of this river embankment, the natural destruction of the entire city by the torrent has been effectively controlled, and the Sava river bank is also very likely to be redesigned as an important urban green space. Since the water level here rises several times a year, there can be no fixed buildings or objects on the river bank. Under the theme of the urban competition project of "Adaptive City", the competition project was introduced through a short-term urban project plan, trying to incorporate a waterfront public recreation space plan into a city, enhancing the east-west connection of the river and activating the 7-kilometer-long river bank area. The project will also be extended to a 7-kilometer-long Sava River hydrological landscape flood prevention area, and the entire river bank will be completely transformed through appropriate hydrological landscape management interventions and the application of measures. At the same time, it also uses 9 temporary special scaffolds that have different time activity settings, can be combined in different ways between different times, places and seasons, and automatically switch between each other. Temporary special scaffolds and water pavilions are equipped with automatic disassembly and protection capabilities when the indoor water level continues to rise. In the summer of 2019, the first phase of the project has been implemented in 3 locations near the bridges frequently used in Zagreb. The scaffolding (see "Figure 2" and "Figure 3") was erected and activated through various cultural and sports projects from June to September, and will be demolished before the

arrival of the high water season. Therefore, according to the continuous changes of the living environment, the convenience of prefabricated buildings can be used to make new changes in urban renewal. This is what needs to be learned and considered in the process of urban development.



Figure 2 Creative public space along the Sava River.



Figure 3 Sava River and creative public space.

### 4.3 *The Relationship Between Architecture and People*

People, as an important group in the development of the century, their activities, behavior patterns and life needs are all worthy of attention in the design process. The architects often talk about the activation and derivation of the city. If they do some designs that are not highly involved in human participation for the purpose of renewing the city, the blood of the city has not been renewed. In fact, in essence, what the city needs to be renewed is human-beings' activities.

In the city, the party that really decides whether to set up buildings is the needs of people, and the needs of the environment must be based on the needs of people. Just as students on campus need more activity space and communication venues, in

the campus renewal, the architects will be able to set up unit combined market boxes. In the community, citizens need leisure and entertainment space, and different activity centers can be built in the available public space. In October 2020, in the autumn when the pain and worries after the epidemic were gradually calming down, the urban centers of Beijing, Wuhan, and Xiamen, almost instantly, respectively built three small light wooden houses. (see "Figure 4") For the program, the reading space is a special set of props, but for the architect, this house is more like a medium or a window. It does have all the characteristics that a construction project should have, but it beats the habitual judgment of professional technology so clearly. They have the nature of instantaneity, public participation, limited time management of bookstores, temporary and comfort, material limits and spatial potential, and space-time interaction in the era of new media. This temporary building that has disappeared leaves the architects with only images and memories, but it seems to be able to bring out a lot of unconventional topics. In the authors' mind, it seems that many light spots are overlapping and flickering. It is precisely because of the participation of the crowd that this not-so-obtrusive small building has the meaning of existence. From this point of view, talents are an important part of accepting the medium of architecture. No matter how good the environment is, the architectural media cannot participate in it without crowd activities. Therefore, the crowd determines the existence of the building, and the building serves the crowd.



Figure 4 The reading space in Wuhan.

## 5. CONCLUSION

The design of small-scale prefabricated buildings in public spaces in cities needs to be constructed involving multi-domain and multi-level thinking. The authors only extract some representative trends and characteristics from them

to discuss. As a place of activity for local residents, urban public space can meet people's needs for use, socialization and even spirituality. The authors also expect that different small prefabricated buildings will be involved in the future public space design in the form of media, which can present a more diversified open form and bring more possibilities to everyone's life. At the same time, in the design of small prefabricated buildings or building groups in the future, architects should combine the characteristics and design advantages of small prefabricated buildings, and combine the actual conditions and environmental profiles of local residents to design to meet the living and spiritual needs of different groups of people.

### **AUTHORS' CONTRIBUTIONS**

Ailin He is responsible for wrote the manuscript. Kai Cao contributed to revising and editing.

### **REFERENCES**

- [1] Bai Ru, Steel Residential System Design Methods Based on Modularity [D]. Beijing Jiaotong University, 2014. (in Chinese)
- [2] Wang Wei, Research on the Application of Modular Strategy in Optimized Architectural Design [D]. Hunan University, 2013. (in Chinese)
- [3] CARR S, FRANCIS M, RIVLIN L G, et al. Public Space (Cambridge Series in Environment and Behavior) [M]. New York: Cambridge University Press, 1993.
- [4] KOOHSARI M J, KACZYNSKI A T, GILES-CORTI B, et al. Effects of Access to Public Open Spaces on Walking: Is Proximity Enough? [J]. *Landscape and Urban Planning*, 2013, 117: 92-99.
- [5] KWEON B, SULLIVAN W C, WILEY A R. Green Common Spaces and the Social Integration of Inner-City Older Adults [J]. *Environment and Behavior*, 1998, 30(6): 832-858.
- [6] Xu Ning, Review of Urban Public Space Researches from Multidisciplinary Perspective [J]. *Landscape Architecture*, 2021, 28(4): 52-57. (in Chinese)
- [7] Fan Jiayuan, Diversity, Openness, Activation: The Future Trends of Public Space Design [J]. *Modern Decoration*, 2021. (in Chinese)
- [8] Cheng Yanhui, Utilization of Public Space Design in Urban Communities [J]. *Art and Literature for the Masses*, 2019, No.469, 153-154. (in Chinese)