

The Modular System for Furniture Design for Public Rental Housing in China

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Abstract

Public rental housing is an important part of China's security housing system. In order to better design the furniture suitable for public rental housing, this study analyzes Chongqing municipality, the earliest and most mature development of public rental housing in China. To study the problems existing in the public rental housing type and the demand of the tenants for furniture. In this research, the field investigation method in qualitative research is used to map and analyze the three classic house types. The basic information and furniture needs of 400 tenants were counted. According to the characteristics of public rental housing tenants and furniture needs, from the perspective of modular furniture design, the size, material, function, price and style of furniture are analyzed. It is proposed that the furniture design of small size, multi-functional, removable and panel furniture is more suitable for the needs of public rental housing tenants.

The research results show that the furniture design with a modular perspective is more in line with the needs of the target population and the characteristics of public rental housing types. On the one hand, the characteristics can be modular furniture to meet the needs of tenants for versatility and high cost performance. On the other hand, modular furniture can reduce the production cost, flexible disassembly, simple installation characteristics, facilitate online sales and logistics transportation. Has a certain practical significance.

Keywords: Public Rental Housing, Modular System, Furniture Design

Introduction

Since the implementation of the Public Lease Housing Policy in 2010, the government rental housing developments are also being strong built across the country. That has greatly improved the living conditions of the underprivileged in urban housing. Almost public rented home security objects consist of college and high school graduates, new workers with has no house, Migrant workers and other "sandwich class" people that does not meet the application

conditions for low-cost housing or does not solve housing problems on their own. (Xie Li, 2013) That groups of people are the backbone of urban construction.

Therefore, housing solutions is an important role in maintaining social stability in June 2010. Seven ministries and committees of the State Council have jointly issued their opinions on expediting the development of public rental housing, the area of the detached house will be controlled below 60 sq. Meanwhile, Rental house types and public spaces also offer clear restrictions. The lease term for a public rental house is 3-5 years which belonged to the transitional residence for rent only, not to sale and the policy stipulates that tenants of public rental homes are not allowed to perform any secondary furnishings. Do not change room's layout for tenants of public rental homes to use their limited spaces effectively. (Ministry of Construction, 2010)

The furniture selection is especially important, common furniture in the market has a single function and cannot be disassembled and moved and most of the multipurpose furniture is expensive. This situation does not meet the various needs of tenants. Regards from an analysis of the characteristics of public rental houses and conflicts and problems between tenants and residential areas. The furniture design of a public rental house must bring in a concentrated design concept, multifunctional, easy to install and remove and highly flexible. The modular system for furniture design for public rental houses is the best solution to meet tenants' requirements.

The first theoretical bases of research is the modular system theory for design. It differs from the bottom-up design approach used in traditional product design. Modular design can change the function of furniture products through the change of modules. (Jia Yanlin, 1993) The theory of Modular system for design is used to combine and transform multifunctional furniture from three different types of furniture based on sitting and lying and receiving, in order to solve realistic conflicts.

The second theoretical base of research is the theory of ergonomics. Measurements are important for furniture. The size of the furniture must comply with the principle of coordination between "Man-machine-environment" (Wang Jia, 2019). Ergonomics is also the route of the reasonableness of furniture construction which is the theoretical basis for the application of modular furniture design.

Research objectives

The regional scope of this article is Chongqing, China. The time period for this article is from 2007. The research object of this paper is the public rental housing tenants, and the research content is the modular furniture design applicable to the public rental housing space and the research objects. Analyzed the conflict between the existing furniture and the type of house and the tenant focusing on practical problems that exist in currently, tenants of public rental houses.

Literature Review

This document mainly conducts research on public rental housing in Chongqing. Four general communities were selected and distributed 400 questionnaires and eight household surveys. The following will analyze common house types, for example, the current situation of the indoor space of a public rental house.

Table no.1 Room type (single room type)

Project Name	Kangzhuang Meidi	Location	Dabinulin Town, Yubei District
Project introduction	The community is all high-rise residential buildings, with a total of 59 residential buildings, with a total construction area of 1.24 million square meters, and about 21,700 units.		
Resident population	2	Total area (m ²)	31.58
Living room+bedroom area (m ²)	18	Bathroom area (m ²)	3.23
Kitchen area (m ²)	4.5	Balcony area (m ²)	3.23+2.62



Figure 1 Single room interior plan of Kangzhuang Meidi

Source: Site photos (taken in the house); Author self-drawing

The family that has 2 persons. Mostly area consist of kitchen stoves, cabinets, squat toilets, and showers for the business to develop. Other furniture, living room and daily life, dining, reading, various functions Because the living room has limited lockers, a hallway, and has space to connect the kitchen and balcony.

Table no. 2 Room type (1 bedroom 1 living room type)

Project Name	Minan Huafu	Location	Huayan District, Jiulongpo District
Project introduction	The community is all high-rise residential, with 54 residential buildings, a total construction area of 1.25 million square meters, about 19,200 sets.		
Resident population	3	Total area (m ²)	39.32
Living room area (m ²)	13.73	Bathroom area (m ²)	2.56
Kitchen area (m ²)	3.52	Balcony area (m ²)	4.34+2.38



Figure 2: One room and one living room indoor plan of Minan Huafu

Source: Site photos (taken in the house); Author self-drawing

The family that has 3 persons 1 elderly and the elderly couple lived in the same bedroom. Overall, the area is quite small, a cabinet that normally empty. The bathroom space is limited. There are shelves in the kitchen and the balcony that provide neatly and has the connecting area between the kitchen and the balcony.

Table no. 3, 2 rooms 1 living room house plan

Project name	Minxin jiayuan	Location	Yuanyang District
Project introduction	The community is all high-rise residential, with 54 residential buildings, a total construction area of 1.08 million square meters, and about 17,900 sets.		
Resident population	4	Total area (m ²)	48.1
Living room and dining room area (m ²)	16.25	Bathroom area (m ²)	2.56
Kitchen area (m ²)	3.52	Balcony area (m ²)	2.73
Bedroom 1 area (m ²)	9.45	Bedroom 2 area (m ²)	7.93



Figure 3 Two rooms and one living room indoor plan of Minxin Jiayuan

Source: Site photos (taken in the house); Author self-drawing

Two rooms and one indoor living room plan from the tenant, Minxin Jiayuan. This family type is 4 persons and 2 couples. Living conditions are quite good, mostly quite neat and clean. The renter said they needed more storage as the kitchen had no wall cabinets and the worktop was too small. Both of them also hoped for more storage in the dining area and balcony, washing face, squatting and showering all in one place on account of having queue in the morning. However, this part is the original package. Therefore, it is not possible to separate toilets without permission in accordance with the public rental house regulations.

The basis of modular design lies in the concept of modularity. Modularity is the division of one's infrastructure into standardized, systematic, integrated components, components and modules by considering the physical and functional characteristics of the product. After that, through the combination of the three to achieve the design, research quality change becomes a whole work (Ma Jing, Zhan Ling, Xu Wei, 2020).

1. The study of Modular system is a combination of a difference of product-specific components match with common functional modules and then combined with other components to create new systems and obtain a standardized set of products with different or similar functions. Therefore, the establishment of functional modules needs to be positioned according to the product use environment, size, and functional requirements and other factors.(Tong Shizhong, 2000)

1.1 Understanding of the concept of "modularity"

Modularity research began in the 1950s and 1960s. So far, many theoretical and applied achievements have been made. The term "modularity" is very rich in meaning.Modular research is scattered across different disciplines and research areas. Such as engineering, production operation, marketing, and organizational management.It also appears in psychology, biology, pedagogy, mathematics and other disciplines. The understanding of modules, modularity, and research focus are inconsistent among different disciplines. The research based on modular theory in this paper belongs to the category of modular products. At present, the research on the development and design of modular products mainly includes two aspects: product positioning and process positioning, which are used to improve the design process and method and realize the diversified needs of products.

1.2 Understanding of the concept of "modular design"

Modular design is to introduce modular idea into product design and divide the product into a series of modules, namely unit module and system module. Products with different functions can be obtained through different combinations of modules, and a series of standardized products with different or similar functions can be derived. Modular design focuses on solving the contradiction between product variety, specification and design and manufacturing cycle and cost, which is a modern design method

1.3 The application of "modular design" in furniture product design

Modular design of furniture refers to the division of functional modules of furniture, and design into a series of normalized general modules, and then connect them through standardized interfaces to combine into various functional furniture. Applying modular design method to furniture design mainly solves the contradiction between mass production of furniture design and the diversification of users, and satisfies the diversified needs of consumers for furniture. Modular design of good detachable products also achieve ecological design.

From the perspective of production enterprises, the mass production of furniture product modules can also reduce research and development costs and improve product production efficiency, thus increasing the operating income and profit of enterprises. From the point of view of consumers, modular design of furniture products can better meet the diversified and customized needs of consumers. Modular furniture is composed of basic modules, with universal interfaces for easy disassembly, convenient transportation, and replaceable modules. These characteristics make modular furniture more economic, environmental protection, can prolong the life of furniture.

1.4 the classic examples of modular furniture design

Ikea— panel furniture

IKEA, founded in Sweden in 1943, has a history of 79 years. Since it entered the Chinese market in 1998, IKEA has been widely praised by domestic consumers. The classification of IKEA stores is very detailed, providing consumers with links from parts to independent boards to partial combinations and finally to finished products. It can be said that each part is a product, consumers can be fond of furniture and actual demand for personalized collocation combination. For example, the frame of the cabinet, the door panel, the partition inside, the connecting hinge or the table top, the table leg and so on can be randomly matched, so are very flexible. Consumers are trying a unique consumption experience when buying furniture in IKEA. (Picture-IKEA parts display) The consumption pattern and product characteristics of IKEA fully reflect the concept of modular furniture design, giving consumers a completely free space to feel the fun of free combination.



Figure 4: IKEA parts show

Source: Xi Chen (2022)

1.5 The Development situation of public rental housing in Chongqing. Chongqing has a lot of public rental houses constructions. Refer the survey, Chongqing is one of the most cities that has a large number of public housing rental projects and the most saturated development and being representative city for a public housing rental project. Within 2020, 335,000 rental houses which total has 20 million square meters area in the city will be completed.

1.6 Interior space characteristic of public rental house in Chongqing. The floor area ratio is controlled at 3.5-4.0 and the building space is 35-80 square meters of a small unit. 20%, 1 bedroom 1 living room (35-50 square meters). 45%, 2 bedrooms 1 living room (50-60 square meters). 20%, 2 bedrooms 1 living room (60-70 square meters). 10%, 3 bedrooms 1 living room (70-80 square meters). Accounted for 5% by 1 bedroom and 1 living room are almost half of all households. (Mei Chao, 2011)

1.7 Basic information and housing needs of public tenants. The research about four mature public rental housing communities in Chongqing “Minxin Jia Park” in Huayan sub-district and "Chengnan Home" in Nanan district. The basics and housing needs of tenants of public rental house were examined in the following five points by following:

(1)Furniture dimension: The dimensions of the furniture must first be ergonomic. The scale must base on human and science comfort, together with living area dimension and the furniture size is smaller than regular furniture.

(2)Furniture material: The material furniture made from melamine board which is light, anti-mildew, fireproof, heat resistant, shockproof, easy to clean and can be rotated which agreeable which established policy of energy saving, reducing consumption and environmental protection.

(3)Furniture functions: Regarding from the small area of the public rental house and the overlapping use area. So, it is necessary for the furniture to have the storage space and more storage. And to change the functionality of furniture through different modules, there is increased tenant mobility and the need to facilitate the transport and dismantling of furniture and movement.

(4)Furniture price: Using the modular concept, furniture products consist of various modules. Modules are interchangeable and versatile. It saves several levels of furniture costs and is conducive to long-term recycling.

(5)Furniture style: By reason of the indoor space is limited, a furniture color shall compatible with inside and overall style is modern and simple and it is not easy to have a special shape furniture.

Method

This article mainly uses qualitative analysis methods and literary theory research methods to examine the current situation and characteristics of tenants of public rental housing community in Chongqing and summarize the results of the research and use the modular design method to find the criteria of furniture design. Here are four steps for designing modular furniture for a public rental houses:

Research method: literature theory research method, questionnaire investigation method, and qualitative analysis method.

The research process:

(1)Apply literature theory research methods to research the current public rental housing policy and the status of its development. Research the results and concepts of furniture products in the field of modular systems for design. Understand how to comprehensively and accurately understand the problem to be studied.

(2)Secondly, systematically and objectively examine the current situation of renter and house types in the representative community of public rental houses in Chongqing and analyzed, synthesized and compared by questionnaires and interviews.

(3) Qualitative analysis methods are used to summarize the research objects and to follow the nature of public rental houses and tenants' need to find the design elements and criteria of public rental house furniture design.

(4) Using a modular design approach following the result of that research, furniture that suitable for tenants of public rental houses is designed. Provide independent modules and build multipurpose furniture, moveable and easy disassembly through the combination of modules.

Conclusion

At present, there are many theoretical studies on modular furniture design, and the idea of "modular" has been widely used in the design of modern furniture. This provides theoretical guidance for the design idea of modular furniture in this article. At present, most of the research and design of modular furniture, the research object is the single type of furniture. The modular furniture in this paper is a study of the formation of the whole furniture system, not only a certain furniture category. In the existing literature, there is little exploration of modular furniture design suitable for public rental housing space, and the need for further development and improvement.

This research sorts out the development of public rental housing and related policies , Interpretation and case analysis of modular furniture products domestic and abroad. In the form of questionnaires and field visits, we investigated the housing types and users of public rental houses in Chongqing, and analyzed the living characteristics and use needs of the tenants. Study the contradiction between the living space of public rental housing and the traditional furniture. Summarize the house type, area allocation, furniture size and users' living needs of public rental housing. Determine the criteria for modular furniture design, and select the size, material, color and combination mode suitable for public rental housing space and crowd positioning. Refer to modular and modular concept. The conclusion of the characteristics of modular that use for creating furniture.

Table no.4 Modular system furniture type.

Modular System Furniture		
Characteristic	Structure	Modules are components of the system and consists of one or more modules
	Function	Modules have independent specific functions, which can be produced and replaced separately. Change function or add functionality through the exchange of the module.
	Size	Standardization of the base module size
Advantage	Standardization	Convenient basic module exchange, restructuring, split, complementary.
	Modularization	Through different combinations to achieve personalized, multi-functional.
	Commonality	Extended practical time for easy assembly and replacement.

From the table it was found that 4 Refer to the survey of tenants of public rental houses in Chongqing, the summary of tenant functionality requirements for furniture products. Tenant demands for furniture products are primarily focused on storage, scalability, economy and flexibility.

From the studies of public and tenant residential area, this article provides a theoretical basis for the characteristics of furniture products for public rental houses.

(1)Through the analysis of the house type and tenants, the size, function and style of furniture products are positioned.

(2)Through the study of modular theory, it provides the design method for the versatility, easy separation, circulability and universality of furniture products.

(3)The application of modular theory provides more design ideas for the furniture products of public rental rooms.

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