Design Strategy of Urban Complex Based on Innovation and Sustainability-Taking Beijing Contemporary MOMA, Hong Kong Taikoo Shing And Singapore Interwoven Residences as Examples

Yingxin Wu*, Yilin Xu, Kejia Zhu

Shanghai University, Shanghai, 200040, China

*Corresponding author: boice18717781363@163.com

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Abstract: Facing the current shortage of urban land resources and large population density, the buildings in the urban center area develop towards intensity, three-dimensional integration, and functional combination. On the other hand, the urban residents' choice has entered a diversified era, and more people have begun to choose a comprehensive and convenient way of living. In this context, the urban residential complex, which integrates the functions of residence, office, business, and leisure, has been built in China. In view of the homogenization problem and the need of innovation and sustainability in the current development process, this work, through the comparative analysis of the cases of Beijing contemporary MoMA, Hong Kong taigucheng and Singapore interwoven houses, summarized their characteristics and excellent experience, and then put forward the design strategies of mining regional characteristics and strengthening the three-dimensional connection of functions and green sustainability.

1. Introduction

1.1 Research background

(1) Social needs

With the rapid development of urbanization in China, the population of big cities is increasing. The high housing price in the city center leads to the separation of work and housing, which makes people must move away from the city center and aggravates the traffic pressure in the city. The separation of daily activities such as living, cultural leisure, work, etc., forces people to rely on motorized transportation, resulting in the waste of urban energy. Consequently, people began to pursue a living place with comprehensive functions, hoping to realize living, office, business, entertainment, and cultural activities near their residence, save time and energy, and improve the quality of life. In this context, the urban residential complex, which integrates the functions of residence, office, commerce, leisure, etc., has been built in China.

(2) Problems and development needs of urban residential complex in China

Urban residential complex is a kind of architectural form that meets the needs of urban development. Its development has overflowed the scope of buildings. It is an urban development mode characterized by high density, high plot ratio, multi-function, and mixture. Also, it is a modern urban complex system integrating multiple urban functions. In the past ten years, the development of urban residential complex in China has experienced a critical period of concentration and quantity. Urban residential complex has sprung up in China's big cities.

At the 5th China Urban Complex Development Summit Forum held in Shanghai in 2018, experts discussed the "innovative development path of urban complexes in the new situation". Based on the new situation of urban complex development, experts focus on the homogenization of urban complex market, which means that the construction of urban residential complex in China has entered a bottleneck period.

For the current urban residential complex, it does bring convenience to a large extent to people's life compared with a single residential district. However, the problems behind its booming

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development cannot be ignored. At present, the homogenization of urban residential complex is attributed to the overemphasis on commercial benefits and the neglect of urban demand. On the one hand, the replicability of commercial development leads the construction of urban residential complex into a vicious circle of "mostly similar", resulting in the lack of place spirit and cultural connotation. On the other hand, there is a lack of in-depth thinking about the overall function and positioning of the block. The simple superposition of functions destroys the dynamic connection between living and other functions and the functional interaction between the community and the city.

1.2 Definition of research object

The urban residential complex discussed in this study is defined as the comprehensive building group with residential functions as the main function. The city functions of commerce, office, hotel, exhibition, catering, conference, entertainment, transportation, etc., are mixed.

1.3 Research purpose and significance

This study attempts to summarize the characteristics and excellent experience of urban residential complex construction by comparing and analyzing the cases of urban residential complex at home and abroad. At the same time, reasonable design strategies are put forward to provide a certain design basis for solving the homogenization problem of urban residential complex at the present stage and the innovation and sustainable development of urban residential complex in the future.

2. Comparative Analysis of Urban Residential Complex Cases at Home and Abroad

In foreign countries, the practice of residential complex is earlier, and Japan and Singapore have more application of urban residential complex affected by the urban density. As a typical high-density city, Hong Kong's three-dimensional development mode is relatively mature in the development of urban residential complex in China. At the same time, because Beijing has the farthest average commuting distance and the longest commuting time in China's major cities, the development of its urban residential complex is in the forefront of China, which is forward-looking. This work selects cases of urban residential complexes in Beijing, Hong Kong, and Singapore for comparative study.

2.1 Case overview

(1) Beijing contemporary MOMA

Beijing contemporary MOMA is in the north of Yingbin National Road, Dongzhimen, Beijing. It is designed by Professor Steven Holl of Columbia University, with a planned building area of 220,000 square meters, including 135,000 square meters of residential area and 85,000 square meters of supporting commercial area. The whole complex covers cultural exhibition facilities such as art cinema, exhibition, gallery, library, etc. It also includes living facilities and sports leisure facilities such as boutique hotel, international kindergarten, catering, club and gym, swimming pool, tennis hall, etc. At the same time, a complex of functions such as an art hotel, a floating cinema and a bookshop are introduced, making it an urban community with open functions.

(2) Hong Kong Taikoo Shing

Taikoo Shing is in Quarry Bay, east of Hong Kong, adjacent to Victoria Harbour. It runs through Taikoo Wan Road, Taikoo Shing Road, Tai Wing Road, Tai Fung Road, and other streets, and is directly connected with Taikoo MTR station. With a total construction area of 2.3 million square meters, it is composed of 61 towers and a large commercial center. The functions of Taikoo city include residence, office, and commerce. The bottom floor is the commercial center, and the high-rise tower is for residence and office. There are resident management and community service institutions, horticultural gardens, and greening platforms.

(3) Interwoven residential complex in Singapore

The interwoven residence is located on a ridge line in southern Singapore, bounded by Alexander Road and the Algarra Highway, covering an area of about 170,000 square meters. Interwoven residence is named for its unique architectural form. 31 apartment units are connected and stacked

with each other in a hexagonal pattern. Each array floor is stacked on another array floor. Six super large-scale transparent courtyards are enclosed inside, which can offer 1040 apartment units of different sizes. At the same time, commercial, leisure and entertainment facilities are provided on the ground floor.

2.2 Comparative analysis of cases

(1) Function combination mode

The bottom floor of Beijing contemporary MOMA is a commercial and public exchange space, serving residents and tourists. All functional units relate to the green space surrounding and running through the project, activating the urban space surrounding the large central reflection pool. From the 12th floor to the 18th floor, a series of pedestrian bridges including swimming pool, gymnasium, coffee shop, gallery, etc., connect the eight residential towers and hotels. The public air corridor and the ground connection ring form a semi grid frame structure, providing residents and tourists with rich urban life experience.

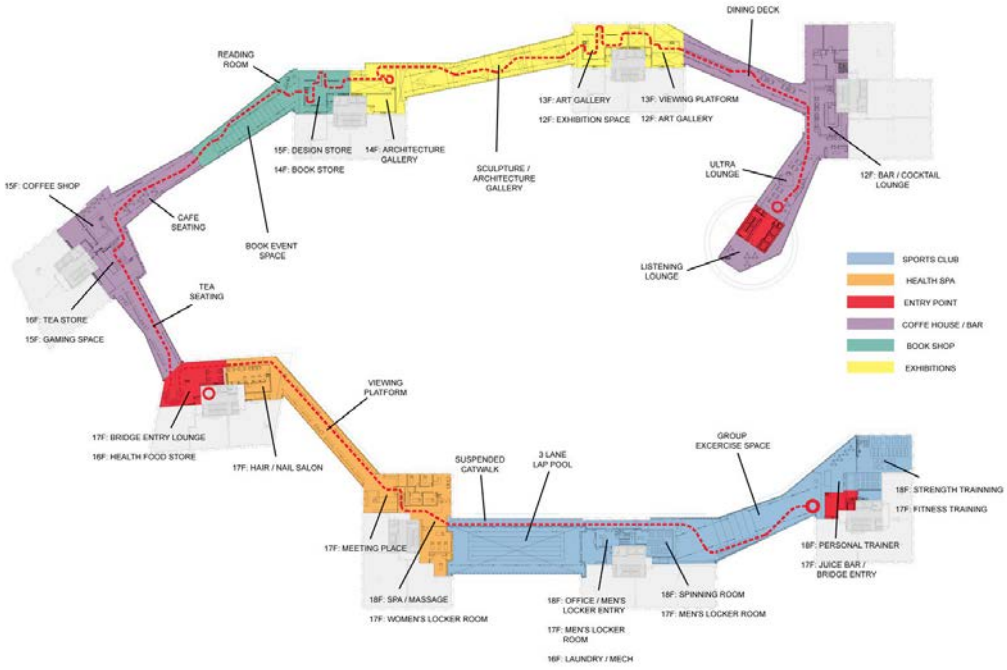

Fig. 1. Function combination mode of Beijing contemporary MOMA

Different from the urban residential complex which only occupies one block, Taikoo Shing in Hong Kong is divided into several block units by urban roads. The architectural units of Taikoo Shing are connected by corridors between podiums, forming a three-dimensional pedestrian transportation system. Residents and tourists can freely shuttle through any space of the complex through the three-dimensional street, which brings greater convenience for living, office, and shopping, and reduces the ground traffic pressure to a certain extent.

Fig. 2. Function connection diagram of Taikoo Shing in Hong Kong

The interwoven residence in Singapore is located on the outer green belt of Singapore city. Through the intertwined roof garden, terrace landscape and series balcony, it can realize the communication between the internal and external mountain environment of the community, and create a harmonious humanistic ecological landscape. The design of interwoven residence creates a variety of functional spaces, which not only provides sufficient outdoor shared space, but also meets the rich social needs. At the same time, residential facilities are interwoven with dense vegetation to create comfortable living spaces.

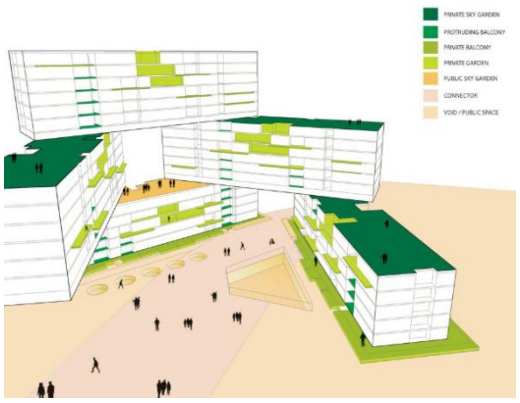

Fig. 3. Function combination mode of interwoven residence in Singapore

(2) Regional feature construction

In the architectural design of Beijing contemporary MOMA, the traditional Chinese culture is combined with the shape, facade, and function layout of the building, highlighting the regional characteristics of the complex. The design of the whole complex takes the enclosed features of Beijing quadrangle as the breakthrough point, and draws lessons from the famous work *"Dance"* by Matisse, a French painting master. The body shape of the dancer is integrated into the design, and nine residential towers are connected through the circular air corridor symbolizing the arm, forming a semi enclosed three-dimensional urban space. The color matching concept of the building facade comes from *"the Book of Changes"*. Various colors of traditional Chinese temples are used as the matching colors for window frames and floor plates of connecting corridors. It gives people a strong visual impact and highlights the vitality and regionalism of architecture. At the same time, the plane structure of the building also echoes the traditional Chinese culture. Different functional blocks are connected by public corridors, which looks like a Chinese dragon from the plane form, creating a series of rich shared spaces.

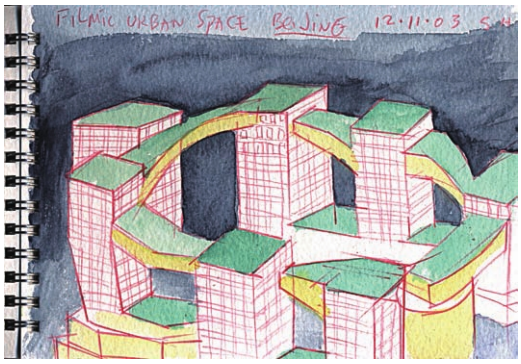

Fig. 4. Design sketch of Beijing contemporary MOMA

The function layout and combination form of Taikoo Shing in Hong Kong is a typical MILU mode. MILU mode is to arrange the main residential function in the high-rise tower, and the commercial and office functions in the podium. The roof of the podium serves as the entrance square and public leisure space of the residence, and the ground floor and underground of the whole complex serve as the traffic space. The characteristic of this mode is to achieve "small closed, large open", which not only achieves the function of the compound and the openness of public space, but also ensures the privacy of living space.

The design of interwoven residential vertical villages in Singapore fully considers the tropical climate characteristics of Singapore. The stability characteristics of interleaved units are based on rigorous sunshine analysis, wind environment simulation and microclimate conditions. It not only provides rich living space, but also echos the characteristics of tropical environment.

(3) Innovate sustainable approaches

Beijing contemporary MOMA is a real "energy-saving and land-saving" project. Appropriate high-density land development and utilization and large-scale use of renewable green energy are another highlight of the project. Ground source heat pump (660 100m deep wells) provides the functions of cooling in summer and heating in winter, making it one of the largest green residential projects in the world.

The innovation of interwoven residence in Singapore is to put forward a tropical lifestyle which is coordinated with the natural environment and pays attention to communication and interaction. The plants become a part of the residence, and the private and public balconies realize the maximum utilization of the natural environment. By reducing the circulation of ground vehicles, more green space will be released. The integration strategy of low energy consumption is introduced to realize the sustainable development of the community.

3. Design Strategy

3.1 Strengthening the three-dimensional connection between functions

Residential complex is a city life complex with composite function, and the functions of each part have the function of interdependence, orderly organization, and communication. In residential complex, the quality of pedestrian street system and public open space is very important. In the Beijing contemporary MOMA, Hong Kong Taikoo Shing and Singapore interwoven residence, the three-dimensional functional connection mode is used. The pedestrian space of different levels is created by using the connection ways of air corridor, roof platform, public garden, and open square. At the same time, it can provide more leisure places for residents, strengthen the internal sharing of the community, and stimulate the vitality of urban streets and communities. Simultaneously, the three-dimensional functional composite system provides the possibility for the diversified shaping of architectural form.

3.2 Discovering regional characteristics

Excavating regional characteristics is the key to break away from the homogenization of urban residential complex. The regional characteristics of the block is formed through long-term accumulation, which is different from the spatial and cultural characteristics of other blocks. It is the result of the comprehensive effect between natural factors and human factors. Respecting regional characteristics means respecting the shaping of block culture and the remodeling of place spirit. The shaping of cultural connotation and the reshaping of place spirit can create a distinctive image, and create a unique functional orientation suitable for the block. Consequently, urban residential complex is innovative and public. It has strong identification and harmony with the surrounding environment.

3.3 Introducing green and sustainable technologies

The introduction of green sustainable technology is crucial to the innovative and sustainable development of urban residential complexes. The green sustainable measures of urban residential complex have three aspects. The first is climate action, including respect and response to the local climate. The second is the effectiveness of resources, including recycling and low-carbon energy use. The third is the green transformation of the building environment, emphasizing the harmonious interaction with the natural environment.

4. Conclusions

In the case of insufficient urban land stock and increasing traffic load caused by job-housing imbalance, urban residential complex is the most appropriate functional mixed mode to respond to urban problems. Urban residential complex is a new type of residential building to improve urban diseases. Its nature determines that its design method and construction mode are different from the traditional residential community. Facing the homogenization of urban complex construction, it is the road of innovative and sustainable development to excavate regional characteristics, and strengthen functional composite and green and sustainable.

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