Research on Sustainable Design Strategy of Existing Building Reconstruction from the Perspective of Urban Renewal

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Abstract: With the acceleration of urbanization, urban renewal has become the key path to improve urban quality and sustainable development. As an important part of urban renewal, the renovation of existing buildings faces many challenges, such as structural aging, cultural protection, interest coordination, economic investment and technical application. This paper discusses the sustainable design strategy of existing building renovation from the perspective of urban renewal, and puts forward a core strategy system with sustainable development as the core, focusing on functional renewal, green and low carbon, cultural inheritance and policy innovation. Specifically, it includes: improving architectural adaptability through functional replacement and spatial reconstruction; Integrate green technologies such as heat preservation and energy saving, renewable energy and intelligent management to achieve low-carbon goals; Maintain the historical features and cultural memory of the city through protective repair and preservation of characteristic elements; Relying on policy support, multi-synergy mechanism and innovative financing mode, the sustainable implementation and life-cycle benefits of the transformation project are guaranteed. This paper aims to provide theoretical guidance and practical reference for the renovation of existing buildings, promote the sustainable development of cities and improve the quality of cities.

1. Introduction

The traditional urban expansion model not only consumes a lot of land resources, but also brings environmental pollution and ecological destruction. In this context, urban renewal, as a more sustainable development model, has gradually attracted widespread attention. Urban renewal is not only simple demolition and reconstruction, but also emphasizes the optimization and reuse of existing urban space, in which the transformation of existing buildings is the key component of urban renewal [1]. Existing buildings bear the historical memory and cultural characteristics of the city, and their transformation not only needs to meet the needs of modern functions, but also needs to take into account historical protection and environmental sustainability.

The renovation of existing buildings plays a vital role in urban renewal [2]. First of all, through reasonable transformation, the service life of buildings can be prolonged and the waste of resources can be reduced, which is in line with the concept of sustainable development. Secondly, the integration of green technology and renewable energy in the transformation process will help reduce carbon emissions and improve urban environmental quality. In addition, the renovation of existing buildings can also promote the inheritance and development of urban culture and enhance the sense of belonging and identity of urban residents. Therefore, it is of great theoretical value and practical significance to study the sustainable design strategy of existing building renovation from the perspective of urban renewal for promoting the sustainable development of cities and improving the quality of cities.

2. Sustainable design concept

Sustainable design is a kind of strategic design activity to build and develop sustainable solutions, which considers economic, environmental, moral and social issues in a balanced way, so as to guide and meet consumer demand in thinking design and maintain the continuous satisfaction

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of demand [3]. The concept of sustainability includes not only the sustainability of environment and resources, but also the sustainability of society and culture.

Sustainable design needs to cover the whole chain of "raw material exploitation-production-use-abandonment-regeneration". For example, modular furniture design is convenient for maintenance and upgrading, and prolongs the service life; Intelligent devices use standardized battery interfaces to reduce replacement costs and reduce electronic waste [4]. The introduction of green building technology in urban renewal, through the use of energy-saving materials, intelligent building design and other means, improve the efficiency of building resource utilization, reduce energy consumption, thereby reducing the pressure on the environment [5]. Establish ecological corridors and green spaces to enhance the connectivity and diversity of urban ecosystems and improve the quality of urban ecological environment. The concept of sustainable design is vividly displayed in many places in China by activating and utilizing local resources and avoiding repeated construction [6]. For example, using local plants for tie-dyeing not only protects the environment, but also inherits traditional culture. Emphasis is placed on "retaining", "changing" and "demolition" as much as possible in urban renewal, based on protection, preservation and transformation, and emphasizing the principles of refinement, small scale, gradual and sustainable. Sustainable design is a multi-dimensional and interdisciplinary field, which requires designers to consider not only economic benefits, but also environmental protection and social responsibility when creating new products and services.

3. Present situation and challenges of existing building reconstruction

3.1 Current situation

3.1.1 Mode transformation and policy promotion

China's urban construction has shifted from "incremental expansion" to "stock optimization", and urban renewal has become the core path to improve quality. At the national level, the "Opinions on Continuously Promoting Urban Renewal Action" was issued, emphasizing the treatment of dangerous housing through reinforcement and reconstruction, and paying attention to historical protection and functional rejuvenation. Local governments explore diversified models, such as PPP model, government subsidies+independent investment, etc., to activate social capital to participate in the transformation.

3.1.2 The surgical system was gradually improved

Research in Guangdong Province and other places has built a key technical system covering structural appraisal, green transformation, BIM application and assembly [7]. For example, BIM is used for collision analysis to optimize pipeline layout, lattice column+platform truss is used to solve the problem of adding silo top, and suspension protection technology for foundation pit construction in complex environment is developed. These practices provide reproducible solutions for the industry.

3.1.3 Integration of cultural values and functions

Typical cases show that reconstruction projects pay more and more attention to the continuation of historical context. For example, Beijing Brick Kiln Park changed from a factory to an art complex, and Guiyang Xinhua Printing Factory retained industrial elements and implanted new formats. This kind of project proves that through space reuse and industrial upgrading, we can not only retain the memory of the city, but also create new economic kinetic energy.

3.1.4 Low carbonization and intelligent development

The construction sector accounts for 22% of the national energy consumption, and the transformation focuses on energy saving and consumption reduction. Measures include improving the thermal insulation performance of external walls, adding renewable energy systems, and promoting intelligent equipment management. Meizhou Island in Fujian promotes the upgrading of

tourism through green transformation, reflecting the synergy between ecological benefits and industrial transformation.

3.2 Challenge

The current challenges are shown in Figure 1. A large number of existing buildings have structural aging problems, especially C/D dangerous buildings need to accurately evaluate the bearing capacity and formulate "one house, one policy". When the damaged factory building is rebuilt, it is necessary to balance the connection strength between the new components and the original structure to avoid secondary damage. In addition, how to maintain the stability of foundation beam in underground expansion project is still a technical difficulty. Although some historical buildings are recognized as dangerous buildings, simple demolition will destroy the urban texture. Professional repair is needed instead of antique reconstruction, but the conflict between authenticity protection and modern functional requirements is still difficult to resolve. For example, the recycling of old wall materials is limited by construction technology [8]. The transformation involves the demands of owners, merchants, residents and other parties. Hospital projects face the contradiction between medical continuity and construction safety; The transformation of commercial buildings needs to coordinate the cycle of tenant eviction and the introduction of new formats; The renovation of residential areas is prone to disputes due to the sharing of maintenance funds. Flexible program adjustment ability has become a key test. Although the reconstruction saves more resources than the new one, the initial investment is high and the return period is long. Some projects rely on government subsidies or preferential policies to land, and the market-oriented operation mechanism is not yet mature. At the same time, after the completion of the operation and management of the lack of standardized system, resulting in the lack of maintenance of some projects in the later period, affecting long-term benefits. Although BIM and assembly technology have been gradually applied, they still face obstacles in the promotion of existing buildings. For example, the complexity of old pipelines makes digital modeling difficult; Traditional construction workers are not adaptable to new technologies; The high cost of some green materials restricts popularization.

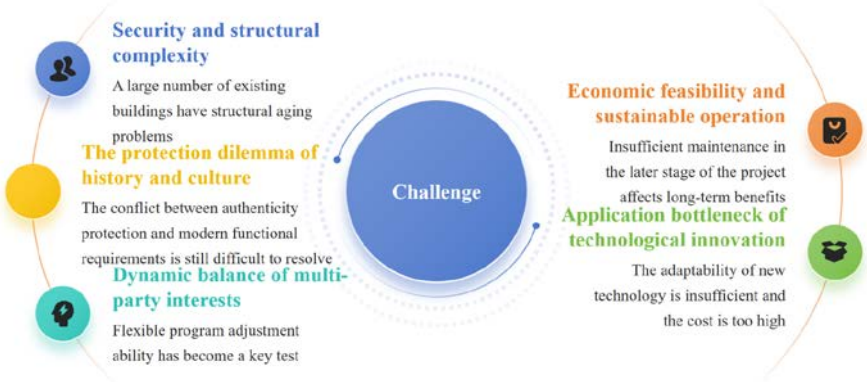

Figure 1 Present situation and challenges of existing building reconstruction

Generally speaking, the renovation of existing buildings is developing in the direction of refinement, greening and cultural sensitivity, but it is still necessary to break through the technical bottleneck, improve policy tools and innovate business models in order to realize the leap from "physical renewal" to "value regeneration".

4. Sustainable design strategy

4.1 Design philosophy

The sustainable design of existing buildings in the perspective of urban renewal should follow the following principles: firstly, take sustainable development as the core, organically combine environmental protection, resource conservation and building function improvement to meet the

challenges brought by the acceleration of global urbanization. Secondly, adhere to people-oriented, focus on people's concerns, improve the quality of life of residents, improve urban functions, and meet the needs of modern life. Third, pay attention to the balance between historical context protection and innovation development, inject new vitality while retaining the memory of the city, and realize the value regeneration of old buildings. Fourth, strengthen systematic thinking, combine architectural transformation with urban infrastructure construction and ecosystem restoration, and build a bottom line for urban safe development. Finally, emphasize the concept of life cycle, implement the concept of low-carbon environmental protection from planning and design to operation and maintenance, and reduce building energy consumption and carbon emissions.

4.2 Core strategy system

The renovation of existing buildings should build a comprehensive strategy system integrating functional renewal, green and low carbon, cultural inheritance and policy innovation (as shown in Table 1). Through functional replacement and spatial reconstruction, the adaptability and use efficiency are improved, green technologies such as thermal insulation and energy saving, renewable energy and intelligent management are integrated to achieve low-carbon goals, and the protection of historical features and community participation are emphasized to inherit culture and activate social vitality. At the same time, relying on policy support, multiple collaborative mechanisms and innovative financing models, the sustainable implementation and life-cycle benefits of renovation projects are guaranteed [9].

Table 1 Core strategy system of existing building renovation

Core strategy system	Specific content
Functional renewal and spatial reconstruction strategy	① Pay attention to functional adaptability updates and re plan spatial layout ② Entering old residential areas, renovating complete communities, and optimizing living environments ③ Stimulating new economic momentum through functional replacement ④ Adopting flexible and variable design techniques to improve space utilization efficiency
Green low-carbon technology integration strategy	① Application of enclosure structure insulation technology, high-efficiency energy-saving equipment system, and utilization of renewable energy ② Promote intelligent building management systems to achieve real-time monitoring and optimized control of energy consumption ③ Prioritize the use of localized, renewable, and recyclable environmentally friendly building materials ④ Design rainwater collection and utilization systems to promote harmonious coexistence between buildings and natural ecosystems
Cultural inheritance and community building strategy	① Emphasize the continuation of historical context and the enhancement of community vitality ② Maintain the historical style and cultural memory of the city through protective restoration and preservation of distinctive elements

	③ Improve the configuration of public service facilities and build a complete community living circle ④ Encourage public participation in the renovation process and fully listen to residents' opinions ⑤ Organize community cultural activities, activate public spaces, and reshape community neighborhood relationships
Policy guarantee and mechanism innovation strategy	① Establish a sustainable urban renewal model and policy and regulatory system ② Exploring a multi-party collaborative model of government guidance, market operation, and public participation ③ Innovative financial support tools to broaden the sources of renovation funds ④ Establish a full lifecycle assessment system to comprehensively evaluate the environmental, social, and economic benefits of renovation projects

4.2.1 Functional renewal and spatial reconstruction strategy

The renovation of existing buildings should pay attention to the renewal of functional adaptability and re-plan the spatial layout according to the needs of modern use. For old residential areas, complete communities and other residential areas, we will promote renovation and optimize the living environment. For old blocks, old factories and other areas, we can stimulate new economic kinetic energy through functional replacement, such as transforming industrial heritage into cultural and creative space or commercial complex. In the aspect of space reconstruction, flexible design techniques are adopted to improve the efficiency of space use.

4.2.2 Green low-carbon technology integration strategy

Green and low-carbon technology is the core support for the sustainable transformation of existing buildings. In the reconstruction of public buildings in cold areas, key technologies such as thermal insulation technology of envelope structure, high-efficiency energy-saving equipment system and renewable energy utilization should be emphatically applied to form a complete technical implementation path. At the same time, the intelligent building management system is popularized to realize real-time monitoring and optimal control of energy consumption. In the selection of materials, priority should be given to the use of localized, renewable and recyclable environmental protection building materials to reduce carbon emissions in the process of transformation. In addition, combined with the concept of sponge city, the rainwater collection and utilization system is designed to promote the harmonious symbiosis between architecture and natural ecosystem.

4.2.3 Cultural inheritance and community building strategy

The renovation of existing buildings should pay attention to the continuation of historical context and the promotion of community vitality. Maintain the historical features and cultural memory of the city through protective repair and preservation of characteristic elements. In terms of community building, we should improve the allocation of public service facilities, build a complete community life circle, and enhance residents' sense of belonging and happiness. Encourage the public to participate in the transformation process, fully listen to the opinions of residents, and make the transformation plan more in line with the actual needs. By organizing community cultural activities and activating public spaces, we will reshape the neighborhood relationship and enhance

social capital.

4.2.4 Policy guarantee and mechanism innovation strategy

The sustainable urban renewal model needs the support of perfect policies and regulations. The state proposes to establish a sustainable urban renewal model and policies and regulations, which provides institutional guarantee for the transformation of existing buildings. In the implementation mechanism, explore the multi-party collaborative model of government guidance, market operation and public participation to form a sustainable input-output mechanism. At the same time, innovative financial support tools, such as green bonds, PPP model, etc., broaden the sources of funds for transformation. Establish a life cycle assessment system to comprehensively evaluate the environmental benefits, social benefits and economic benefits of the transformation project to ensure the sustainability of the transformation work.

5. Conclusion

From the perspective of urban renewal, the research on the sustainable design strategy of existing building renovation reveals its importance in promoting the sustainable development of the city. Through the reasonable transformation of existing buildings, not only can the service life of buildings be prolonged and the waste of resources be reduced, but also green technology and renewable energy can be integrated to reduce carbon emissions and improve the quality of urban environment. At the same time, this process has also promoted the inheritance and development of urban culture and enhanced residents' sense of belonging and identity. The research points out that sustainable design should follow the principles of taking sustainable development as the core, putting people first, protecting the balance between historical context and innovative development, strengthening systematic thinking and life cycle concept. On this basis, a comprehensive strategy system including functional renewal and spatial reconstruction, green and low-carbon technology integration, cultural inheritance and community building, policy guarantee and mechanism innovation is constructed. The implementation of these strategies will help to improve the adaptability and use efficiency of existing buildings, achieve low-carbon goals, inherit culture and activate social vitality, and at the same time rely on policy support and multiple collaborative mechanisms to ensure the sustainable implementation of renovation projects. Although the renovation of existing buildings is developing in the direction of refinement, greening and cultural sensitivity, it still faces challenges such as technical bottlenecks, improvement of policy tools and innovation of business models. Therefore, the future research needs to further explore ways to break through these obstacles, so as to realize the leap from "physical renewal" to "value regeneration" and contribute to the sustainable development of the city.

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