Application and Sustainable Strategies of Green Prefabricated Buildings in Urban Residential Renewal

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Abstract: This article focuses on the exploration of green prefabricated buildings in the field of urban housing renewal. At present, urban residential renewal faces many disadvantages of traditional architectural methods. Under this background, in order to explore an efficient, environmentally-friendly and sustainable renewal model, this article adopts the method of combining theoretical analysis with key points to deeply analyze the application and sustainable strategy of green assembled buildings in urban residential renewal. This article discusses its characteristics and advantages in detail, points out the main points of application in design, construction and later maintenance. Futhermore, sustainable strategies are formulated from three aspects: resource utilization, environmental protection and economic development. The research results show that green prefabricated buildings have obvious advantages and application potential in urban residential renewal, but they also face challenges. Through reasonable application and effective strategy implementation, it can promote the high-quality development of urban housing renewal and realize the goal of urban sustainable construction.

1. Introduction

In the process of urban development, residential renewal has become a key task to improve residents' living conditions and enhance the image of the city [1]. Traditional building methods are faced with many problems such as waste of resources and environmental pollution, and it is difficult to meet the needs of urban housing renewal [2]. In this context, green prefabricated buildings have gradually become an important choice for urban housing renewal with their unique advantages.

Green prefabricated buildings fit the concept of sustainable development and provide innovative paths for urban housing renewal. It is of great theoretical and practical significance to study its application and sustainable strategy in urban housing renewal [3]. From a theoretical point of view, it can enrich the research system on the integration of green development and assembly technology in the field of architecture, and lay the foundation for the subsequent development of related theories. On the practical level, it can help the city achieve the goal of housing renewal, improve the quality of life of residents and promote the sustainable development of the city [4].

With the rapid progress of urbanization, the demand for urban housing renewal has surged. Old houses have outstanding problems in structural safety, functional support, energy conservation and environmental protection, and need to be upgraded urgently [5]. The traditional building method has long construction period, large resource consumption and heavy environmental pollution, which has been unable to adapt to the pace of modern urban development. Green prefabricated buildings adopt industrial production mode, and the components are prefabricated in the factory and assembled on site, which can greatly shorten the construction period, reduce energy consumption and reduce pollution [6]. Its standardized design and production can ensure the stability of building quality and provide efficient and high-quality solutions for urban residential renewal.

At present, although green prefabricated buildings have some applications in urban residential renewal, they still face many challenges. On the technical level, some key technologies need to be broken, such as the treatment of connection nodes and the improvement of waterproof and fireproof performance. At the market level, public awareness and acceptance are not high, and the industrial

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chain is not perfect, resulting in high costs; At the policy level, relevant support policies need to be refined and improved to promote their large-scale popularization and application [7-8]. Therefore, it is very important to deeply study the application and sustainable strategy of green prefabricated buildings in urban housing renewal and solve the existing problems to promote the high-quality development of urban housing renewal. This article will discuss this in order to provide reference for relevant practice and policy formulation.

2. Characteristics and advantages of green prefabricated buildings

Green prefabricated buildings have remarkable environmental protection characteristics. In the construction process, a large number of recyclable and renewable materials are used to reduce the dependence on natural resources. Factory prefabricated components, accurate control of material consumption, reduce material waste, greatly reduce the amount of construction waste, reduce the pressure on the urban environment[9].

Energy-saving advantage is a highlight of green prefabricated buildings. By adopting efficient thermal insulation materials and sealing technology, the external wall, roof, doors and windows can prevent heat transfer and reduce building energy consumption. Advanced ventilation and lighting design can make full use of natural ventilation and natural lighting, reduce the frequency of artificial lighting and air conditioning, achieve the goal of building energy saving and reduce the energy consumption cost of residents.

The green prefabricated buildings are outstanding in construction efficiency. The components are standardized in the factory, which is not limited by bad weather and other field conditions, with fast production speed and stable quality. The field assembly operation is simple, the construction process is simplified, and the construction period is greatly shortened. Compared with traditional building methods, it can meet the urgent needs of urban housing renewal faster and make residents benefit from the updated housing earlier.

In terms of space utilization, green prefabricated buildings show unique advantages. With its flexible design concept, the interior space can be diversified combined and separated according to the needs of different residential renewal. The use of standardized components can reduce the space occupied by structural components, improve the space utilization rate, create a more spacious and comfortable living environment for residents, and meet the needs of urban housing renewal for space optimization.

3. Key points of application of green assembled building in urban residential renewal

In the renewal of urban housing, green prefabricated buildings have unique application points in design, construction and later maintenance. Each link is closely linked, which affects the renewal effect and the sustainability of the building together.

In terms of design points, it is necessary to fully consider the special needs of urban residential renewal. First of all, we should make a comprehensive evaluation of existing houses, including structural safety, spatial layout and surrounding environment. For example, in view of the aging problem of old residential structures, the connection mode of assembled components should be optimized in design to enhance the overall structural stability. In terms of spatial layout, it is necessary to re-plan according to the needs of residents' modern life, such as increasing functional divisions and optimizing kitchen and bathroom space. Futhermore, pay attention to the coordination and unity with the surrounding environment, so that the updated residence can be integrated into the urban landscape. Take the renovation of old residential quarters in a city as an example (as shown in Table 1). Before the renovation design, the residential quarters were single in size, with unclear functional divisions and outdated facades. Through the design of green assembled building, the apartment type is re-planned, the balcony and storage space are increased, and the assembled exterior wall decorative board consistent with the surrounding architectural style is adopted, which improves the overall aesthetics.

Table 1 Key Design Points for Green Prefabricated Building Renovation in Urban Old Residential Areas

Comparison Item	Pre-renovation Status	Renovation Design Key Points
Layout	Single unit type, unclear functional zoning	Redesigned unit types, added balcony/storage space, clear functional zoning
Facade	Aged, lack of features	Used prefabricated facade panels matching surrounding architectural style
Structural Stability	Aging structure, poor seismic performance	Optimized prefab component connections for enhanced stability

The key points of construction are the key links in the application of green prefabricated buildings. The transportation and storage of components should strictly follow the specifications to ensure that the components are not damaged. During field assembly, accurate positioning is required to ensure the installation accuracy of components. For example, the installation error of wallboard should be controlled within a very small range to ensure the flatness and waterproof performance of the wall. Futhermore, it is necessary to strengthen the quality supervision in the construction process and strictly check every installation link. In a residential renewal project, advanced construction monitoring technology is introduced to monitor the installation deviation of components in real time and adjust them in time, which effectively ensures the construction quality. In addition, the construction safety management can not be ignored, because the assembly building construction is mostly aerial work, it is necessary to take safety protection measures, conduct professional training for construction personnel, and improve safety awareness.

The key points of post-maintenance are very important for the long-term effectiveness of green assembled buildings. Check the connection parts of components regularly to prevent loosening due to long-term use. For example, the bolt connection parts need to be fastened regularly to avoid affecting the structural safety due to looseness. It is necessary to focus on the inspection of the parts prone to leakage such as building exterior walls and roofs, and deal with the hidden dangers of leakage in time. Futhermore, pay attention to the maintenance of equipment and facilities, such as regular maintenance of energy-saving equipment used in prefabricated buildings to ensure its efficient operation. In addition, establish a perfect maintenance file, record each maintenance situation, and provide reference for subsequent maintenance work. In the renewal of urban housing, the key points of each link should be strictly controlled from design, construction to later maintenance. In this way, it can better reflect the advantages of green prefabricated buildings and realize the high quality and sustainable development of urban residential renewal.

4. Sustainable strategy of green assembled building

From the strategy of sustainable utilization of resources, the first task is to improve the reuse rate of materials. In the stage of component design, it is necessary to consider its detachability and universality, so that the components can be easily recycled when the house is updated or demolished. For example, standardized bolt connection can be used instead of welding, which makes it easier to disassemble components. In a green prefabricated residential renewal project (see Table 2), through this design optimization, about 60% of structural components and 80% of decorative components can be recycled after the project is completed, and can be used in other similar projects after simple treatment, thus reducing the demand for new materials.

Table 2 Material Reuse in Green Prefabricated Residential Renovation Project

Component Type	Reused (units)	Initial (units)	Reuse Rate (%)	Processing Method	Reuse Project	Estimated Service Life	Material Cost Savings

						(years)	(CNY)
Steel Beams	200	350	57.14	Surface cleaning/repair	Commercial expansion	30	250,000
Precast Walls	450	700	64.29	Crack repair/repainting	Auxiliary facilities	25	380,000
Aluminium Windows	380	500	76	Sealant replacement	School renovation	20	180,000
Ceiling Frames	650	900	72.22	Connector replacement	Community center	15	130,000
Wood Panels	520	800	65	Sanding/repainting	New residences	10	160,000

Efficient utilization of water resources is also an important link. A rainwater collection system and reclaimed water recycling device are set up at the construction site, and the collected rainwater and treated reclaimed water are used for concrete mixing, component maintenance and dust reduction at the construction site. Futhermore, it also promotes the application of water-saving appliances in houses to reduce the waste of water resources from the source.

In the sustainable strategy of environmental protection, it is very important to reduce the noise pollution in the construction process. It is necessary to arrange the construction time reasonably to avoid high-noise operation during the residents' rest period. Low-noise construction equipment is also selected, and the equipment is regularly maintained and noise reduced. For example, a muffler is installed for the pile driver, and a sound insulation cover is installed for the mixer. The control of construction dust can't be ignored either. The construction site is equipped with sprinklers, and the site is regularly sprinkled with water to reduce dust, and materials that are easy to produce dust, such as sand and gravel, cement, are sealed or covered. In addition, we should pay attention to ecological protection and plant green plants around the project to absorb carbon dioxide, purify the air and compensate the impact of construction on the ecological environment.

From the perspective of sustainable economic growth strategy, the government should increase policy support. Through tax incentives and financial subsidies, the production cost of green assembled construction enterprises can be reduced and their market competitiveness can be improved. For example, a certain percentage of value-added tax and income tax will be reduced or exempted for enterprises that adopt green assembly technology for residential renewal. Futhermore, a green financial system has been established to provide special loans for green assembled building projects and to give them lower loan interest rates. In marketing, it is necessary to strengthen publicity and guidance to improve public awareness and acceptance of green prefabricated buildings. It also organized a visit to the demonstration project of green prefabricated buildings, so that residents could experience its advantages personally, thus stimulating market demand. In addition, it is necessary to promote the coordinated development of industries, improve the industrial chain of green prefabricated buildings, realize the scale and standardization of component production, transportation and installation, reduce production costs and improve economic benefits. Through multi-dimensional sustainable strategies such as resource utilization, environmental protection and economic development, green prefabricated buildings can play a greater role in urban housing renewal and promote urban construction to a green and sustainable direction.

5. Conclusions

As an innovative path of urban housing renewal, green prefabricated buildings show many advantages and application values. Its environmental protection features reduce construction waste and resource waste, energy-saving advantages reduce building energy consumption, construction efficiency shortens construction period, and space utilization flexibly optimizes living environment. In the application process, the design needs to comprehensively evaluate the existing houses and optimize the structure and spatial layout; Construction should strictly control the transportation, installation accuracy and safety management of components; Post-maintenance pays attention to checking component connection and equipment and facilities maintenance. However, the green

prefabricated buildings are not smooth sailing in the renewal and promotion of urban housing. On the technical level, some key technologies still need to be broken; In the market, public awareness and acceptance are insufficient, and the industrial chain is imperfect, resulting in high costs; In terms of policies, support policies need to be further refined. Despite the challenges, it can be effectively promoted by formulating sustainable strategies. In terms of resource utilization, improve the reuse rate of materials and strengthen the efficient use of water resources; In environmental protection, reduce noise and dust pollution and pay attention to ecological compensation; From the perspective of economic development, we should rely on policy support and market promotion to improve the industrial chain.

Green prefabricated buildings bring new opportunities for urban housing renewal. All parties need to work together to break through technical bottlenecks, improve policy support, enhance public awareness and promote industrial development. In this way, green prefabricated buildings can play an effective role in urban housing renewal and help cities achieve the long-term goal of sustainable development.

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