

# Analysis of Green Buildings in High-rise Civil Buildings

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**Abstract.** In recent years, as environmental issues have attracted public attention, green building design has received widespread attention as an important part of sustainable development. This review analyzed the application of green building technology in high-rise civil buildings. It outlined the concept of green building technology and its energy-saving and environmental protection principles. This paper elaborated on the specific applications of green building technology in high-rise civil buildings, including building layout and orientation, rational use of resources, and applications of environmentally friendly materials. Moreover, the review analyzed the problems of high cost, and imperfect legal and regulatory systems in the application of green building technology in high-rise civil buildings. In addition, propose suggestions for training technical personnel and improving laws and regulations to promote the development of green buildings. This paper concluded that although green buildings are widely used in high-rise civil buildings, they still need public support to achieve sustainable development.

**Keywords:** Green building; high-rise civil buildings; sustainable development.

## 1. Introduction

With the development of the economy and the continuous improvement of urbanization, the scale of civil buildings is also expanding, and the daily living conditions of residents have been continuously improved. Nevertheless, in traditional architectural design, the damage to the environment and the waste caused by the unreasonable use of land resources have attracted people's attention. To meet the housing needs of the growing population and achieve ecologically sustainable development, the application of green buildings in civil buildings has gradually become the focus of social attention.

Green building design is a design concept that maximizes the use of resources and reduces the impact on the environment during the design and construction process while protecting the ecological environment. It could reduce pollution through a series of green and environmentally friendly measures and better realize the harmonious coexistence of man and nature. Due to the limitations of urban land resources, in order to meet the residential needs of urban populations, high-rise civil buildings are often built to reduce the floor area of buildings in a vertical expansion manner. After applying the concept of green building, the design of high-rise civil buildings can not only effectively reduce energy consumption, but also greatly increase the utilization rate of land. At present, green buildings have been supported by different countries. Its development trend in high-rise civil buildings is mainly reflected in energy-saving technology, green and environmentally friendly materials, renewable resources, etc. More and more government departments have begun to pay attention to green buildings, and more and greener buildings will be used. More green building technologies and methods should be adopted in the design of high-rise civil buildings to increase the utilization rate of green buildings [1].

In this context, this paper summarized the research status of green buildings in high-rise civil buildings in recent years by exploring the current situation. First, this paper analyzed the design concept of green buildings and the two principles of energy conservation and environmental protection. Secondly, this paper analyzed the application of green buildings in high-rise civil buildings from three aspects: overall layout, resource utilization and environmentally friendly materials. Finally, this review discussed some problems existing in green buildings and put forward corresponding conclusions.

## **2. Concept and Principles of Green Buildings**

### **2.1. Concept of Green Building**

Green building is an architectural design concept that focuses on sustainable development. Its goal is to minimize resource consumption and environmental damage while providing a comfortable living environment. By using renewable energy, water-saving technology and environmentally friendly materials, green buildings achieve harmonious coexistence between man and nature and promote the progress of ecological civilization. The application of the green building concept can not only provide people with a comfortable and healthy living space but also achieve harmonious coexistence between man and nature. This concept emphasizes the use of renewable energy, water conservation, and pollution reduction. Its purpose is to create a more sustainable and livable building environment [2]. Green buildings need to pay attention not only to the structural design of the building itself but also to the mutual influence between the building and the surrounding environment, so as to promote the harmonious coexistence of the natural ecological environment and the human environment.

### **2.2. Principles of Green Building**

Nowadays, green buildings play a vital role in contemporary society. With reasonable planning and construction design, they help buildings to coordinate with the surrounding environment as much as possible, which can not only reduce energy consumption and alleviate the urban heat island effect but also protect the environment and slow down the global warming problem caused by the greenhouse effect. The use of green buildings can not only improve the energy efficiency of buildings but also extend the service life of buildings. Green buildings advocate the efficient use of resources, reduce the impact on the environment, and ensure the comfort and health of residents throughout the life cycle of the building [3].

#### **2.2.1. Principle of Energy Saving**

Energy conservation is one of the important principles of green buildings. Traditional architectural design often ignores the effective use of energy, resulting in energy waste and environmental pollution. Green building design focuses on energy efficiency, and the rational use of energy-saving technologies can effectively reduce energy consumption [4]. This principle emphasizes energy conservation as the primary goal and minimizes energy consumption by using efficient insulation materials, energy-saving equipment, rainwater recycling systems and other methods.

For example, in the selection of building materials, materials with good thermal insulation performance should be given priority, and windows with good sealing performance should be used to reduce indoor and outdoor heat exchange, to reduce the energy consumption of air conditioning systems. In terms of lighting systems, LED lights can be equipped with intelligent control systems. Compared with traditional incandescent lamps, they can achieve higher brightness with less energy. Intelligent control systems can turn on and adjust the brightness of LED lights according to the needs of residents, thereby reducing unnecessary consumption.

#### **2.2.2. Principle of Environmental Protection**

The principle of environmental protection emphasizes reducing carbon emissions and resource waste, and the core lies in the selection of materials and building life cycle management. The energy consumption and carbon emissions generated during construction have an impact on the natural environment that cannot be ignored. Green buildings reduce the negative impact on the environment by adopting renewable materials, reducing pollutant emissions, and reducing waste generation [5]. Environmentally friendly materials are an important part of green building technology. The use of renewable green building materials can reduce the exploitation of natural resources and damage to the environment. At the same time, the durability of materials must be guaranteed. Building safe and durable buildings can not only reduce material consumption but also effectively reduce carbon emissions. Some durable green building materials, such as bamboo, marble, granite, etc., can still maintain their performance in all aspects after the service life of the building ends. Therefore, these

materials can also be recycled, and the method of selective demolition or partial reuse can be used to achieve the recycling of building materials, complete the complete cycle of building life, and effectively reduce carbon emissions in the building life cycle [6].

### **3. Application of Green Building Concepts in High-rise Civil Buildings**

Due to their large size, high-rise civil buildings consume much more energy per unit area during construction and use than other types of civil buildings. In addition, the design of high-rise civil buildings needs to consider more influencing factors than other civil buildings, such as wind pressure and light changes, which are relatively insignificant in ordinary civil buildings. By using green building design, it is possible to better adapt to these complex conditions, improve the comfort and energy efficiency of buildings, reduce the impact of buildings on the environment throughout their life cycle, and achieve long-term sustainable development.

#### **3.1. Overall Layout of Buildings**

When green building design is applied to high-rise residential building design, the most important issue to consider is the overall layout of the building. The reasonable spatial layout of the building needs to comprehensively consider factors such as terrain, climate, and light, which can ensure that the building can be both comfortable and green and energy-saving.

In the planning of building layout, the first thing to do is to protect the ecological environment, conserve land, and try to avoid damage to the original ecological environment. By rationally planning the building layout, the efficiency of land use can be improved and land occupation can be reduced. The second is the orientation and overall layout of the building. High-rise civil buildings have a large number of residents and a large population density. When designing, it is necessary to consider design requirements such as spatial layout, ventilation, and lighting. Through reasonable orientation design, natural light and natural ventilation can be maximized, and the use of artificial lighting and mechanical ventilation can be reduced [7].

At the same time, in order to maximize the use of daylight resources, high-rise residential buildings can be designed to receive the sun's radiation to the maximum extent. In the architectural design, the building orientation is optimized, and the spacing and direction between buildings are strictly controlled. Simultaneously, according to factors such as the sun's trajectory and local climate characteristics, the length of natural lighting can be maximized to improve living comfort. Moreover, since the height of high-rise buildings is usually more than 100 meters, the higher the floors, the greater the impact on indoor airflow.

High floors will significantly affect indoor air flow and should be designed in combination with monsoon changes to improve air circulation, which is conducive to indoor air circulation and the diffusion of pollutants. When designing high-rise residential buildings, consider green roofs. In that way, vegetation can absorb sunlight for photosynthesis, play a role in heat insulation and reduce building energy consumption. Moreover, plants could slow down rainwater runoff and reduce urban drainage pressure, absorb noise, increase biodiversity, and improve the environment to create a small ecosystem on the roof [8].

#### **3.2. Resource Utilization**

High-rise civil green buildings use solar energy, wind power generation and other methods. Compared with the use of traditional energy, green building design can achieve a more energy-saving effect. The use of more clean energy not only reduces dependence on traditional energy, but also alleviates climate change caused by the greenhouse effect, and further reduces carbon emissions and environmental pollution [7]. Since sunlight is not easily blocked on the roofs of high-rise buildings, some high-rise residential communities with long sunshine use solar energy to supplement energy to meet the electricity needs of public area lighting and some elevator operations. Solar photovoltaic panels are laid on a large area of the roof to convert solar energy into electricity for residential interior

lighting, electrical equipment, etc., and even excess electricity can be connected to the power grid. In addition to solar power generation, wind power generation technology can also be used. For example, in high-rise residential buildings in coastal areas, sea breeze resources are used for wind power generation. In summer, wind power generation can also promote ventilation and heat removal in buildings, reducing the use of air-conditioning machinery and equipment [9].

Water is the source of human life. In order to achieve the sustainable development of green high-rise buildings, it is also necessary to collect and reuse rainwater to build a water circulation system inside the building. The slope and drainage holes of the roof should be reasonably controlled to collect the accumulated rain on the roof. In the face of heavy rainfall, the drainage network and underground system should be combined to reasonably drain water to improve the utilization rate of rainwater and reduce urban water accumulation [10]. Doing so can not only reduce the excessive exploitation of groundwater resources but also provide residents with a stable water resource guarantee. At the same time, this approach can also reduce the discharge of sewage and reduce the pollution of surrounding water bodies, thereby protecting the ecological environment of surrounding rivers, lakes and other water bodies.

### **3.3. Environmentally Friendly Materials**

In the design process of high-rise civil buildings, the concept of green development should be implemented. Since high-rise civil buildings consume a lot of consumables and energy, it is necessary to consider the utilization rate of materials in the selection of building materials. Therefore, it is necessary to reduce the use of disposable materials, reduce material waste, and reduce the loss of materials during the life cycle. Green buildings need to achieve the safety and durability of materials. Safe and durable buildings not only reduce the consumption of building materials but also reduce carbon emissions. At the same time, the building materials used should be environmentally friendly materials, such as low volatile organic compound (VOC) paints, environmentally friendly tiles, etc. Compared with traditional materials, green and environmentally friendly materials significantly reduce the generation of waste and pollutants during production and use. This can meet the comfort and health needs of residents and also help reduce the environmental damage caused by construction and promote ecological balance.

On the other hand, the selection of doors and windows in high-rise civil buildings is also a part that cannot be ignored. Whether it is the frame material or the glass material in the door and window, it must ensure a certain insulation effect and improve air tightness to reduce heat loss and improve thermal stability, thereby enhancing the insulation effect. This is to prevent the high-rise wind from causing the indoor temperature of the building to lose rapidly, and improve the insulation performance of high-rise buildings [11].

## **4. Challenges and Countermeasures of Green Buildings in High-rise Civil Buildings**

Although the application of green building design in high-rise civil buildings has been widely recognized, there are still some problems and challenges. The first is the cost issue. The design and construction costs of green buildings are generally higher than those of traditional buildings. The construction of green buildings requires the use of environmentally friendly materials and more advanced technologies, which will undoubtedly increase the cost of construction. The second is the problem of technical knowledge. Green building technology involves knowledge in multiple professional fields, especially in the field of high-rise civil buildings. However, some construction workers are not well trained in green building-related technologies, which may also hinder the development of green buildings [12]. The next is insufficient government supervision. Although a series of green building policies and regulations have been introduced, there are still some imperfections in the implementation process. For example, the technical standards are not sound enough and there is a lack of unified specifications and standards, which makes the actual effect not

as expected. Finally, the public's lack of awareness of green buildings has led to low market acceptance.

In order to improve the problems and challenges of green buildings in the design of high-rise civil buildings, the following suggestions can be taken. First, people must strengthen the training of designers and construction workers to improve their understanding and cognition of green buildings. Secondly, people must establish a unified green building evaluation standard and a complete system to ensure the actual effect of green buildings. People must also strengthen the publicity and education of public awareness, improve their knowledge and understanding of green buildings, and encourage the public to actively participate and cooperate. Finally, people must strengthen interdisciplinary cooperation and innovation to promote the sustainable development of green buildings.

## 5. Conclusion

This paper mainly explores the significance of the application of green building design in high-rise civil buildings. It can be seen that with the increasingly severe global climate change and environmental problems, green building technology is widely used in high-rise civil buildings, and plays an important role in building layout and orientation, natural ventilation and lighting design, rational use of resources, and the application of environmentally friendly materials. The application of these green building technologies not only significantly improves the energy efficiency of high-rise civil buildings, but also reduces the consumption of traditional energy and carbon emissions. However, there are still some problems in the application of green buildings, such as high cost, high technical difficulty, and imperfect legal and regulatory systems. Therefore, it is recommended that in the design of high-rise civil buildings, the training of designers and construction workers should be strengthened to improve the public's awareness and cooperation of green buildings and promote the sustainable development of green buildings. Green building design is an important trend and direction for the design of high-rise civil buildings in the future. Implementing green building design can achieve sustainable development of high-rise civil buildings.

## References

- [1] Miao Hui. Research on the Application of High-Rise Civil Building Design in Green Building Design. *Construction & Design for Project*, 2024, (10):19-22.
- [2] Luo Zhonghai. Research on Green Building Design and Evaluation Methods under the Concept of Sustainable Development. *Theoretical Research in Urban Construction*, 2024, (29):95-97.
- [3] Tian Na, Pan Xiadong. Application of Green Building Technology in Housing Industry. *Construction Science and Technology*, 2024, (16):91-93.
- [4] Zhang Huajun. Analysis on the Application of Green Building Design in Civil Building Design. *Construction Standardization*, 2024, (11):81-83.
- [5] Luo Fengwei. Green Design of High-rise Civil Buildings under the Background of Carbon Neutrality. *Housing and Real Estate*, 2024, (02):93-95.
- [6] LAN Sha. The Integration and Practice of Green Design Concepts in High-Rise Architectural Design. *Architecture & Culture*, 2024, (08):16-17.
- [7] Wang Wei. Application of Green Building Technology in Energy-saving Improvement of High-rise Buildings. *Stone*, 2024, (11):114-116.
- [8] Zheng Weisheng. The Penetration of Green Building Concepts into High-rise Residential Design. *Jushe*, 2024, (31):68-71.
- [9] Gao Jiayan. Thoughts on Green Building Design in Civil Building Design. *Ceramics*, 2022, (09):108-110.
- [10] Chen Bing, Xi Xiaoping, Zhou Zongxiao. Application Measures of Green Building Design Concepts in High-rise Building Design, 2024, (04):25-27.
- [11] Cui Naifu. Study on the Application of Green Building Concept Methods in Architecture Design. *Construction & Design for Project*, 2024, (03):38-40.

- [12] Cao Yu, Xu Cong, Syahrul Nizam Kamaruzzaman, Nur Mardhiyah Aziz. A Systematic Review of Green Building Development in China: Advantages, Challenges and Future Directions. *Sustainability*, 2022, 14, 12293.