

Explore the Design Principles and Prospects of Green Buildings

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Abstract. The construction industry is an important symbol of the development of human civilization and an important part of human social and economic activities. However, with the influence of population growth, accelerated urbanization, and rising living standards, the construction industry is also facing great challenges. On the one hand, the demand and consumption of natural resources in the construction industry are huge, resulting in resource scarcity and waste. On the other hand, the development of the construction industry has caused serious pollution and damage to the environment, leading to problems such as the greenhouse effect, climate change, and biodiversity loss. According to statistics, the global construction industry occupies a lot of energy, water resources, raw materials, and wood, and produces a lot of solid waste, greenhouse gas emissions, and wastewater discharge. Therefore, it is important to investigate, observe, and study the existing literature on the current status of green buildings to derive the development of green buildings.

Keywords: Energy-efficient buildings; Green buildings; Sustainable development.

1. Introduction

As an ancient trade, architecture is an important symbol of human life and culture. In order to realize the new development of architecture in the new era, the emergence of "green architecture" is necessary. The construction industry consumes a lot of natural resources and is an industry that can have a serious negative impact on the environment. According to statistics, the consumption generated by construction accounts for a large part of the total consumption of human natural resources, a large part of the total energy consumption, and construction waste also has a large proportion of the total waste generated by human activities [1]. In order to solve these problems, the emergence of green buildings is indispensable, it can minimize the adverse impact on the environment (including land, water, air, etc.), and improve the indoor and outdoor environmental quality (including health, comfort, and safety, etc.), so as to meet people's functional, economic and aesthetic needs of the building.

The concept of green architecture is inseparable from the building itself. The ultimate goal of green architecture is to form a small environment that is more conducive to harmonious coexistence between man and nature inside and outside the building, and then combine it into an organic environment. The concept of "green", in the final analysis, is to make the building more comfortable and energy efficient in the project that plays its main role in the form of auxiliary, "green" concept, must be a pragmatic concept, rather than a part of the government's propaganda slogan or the slogan of developers [2]. Green architecture is the innovation and sublimation of traditional architectural design ideas and methods. The emergence of green buildings indicates that traditional architectural design has gradually moved from the consideration of aesthetics, space utilization, form structure, color structure, color, etc., to the perspective of ecology, which means that buildings are not only viewed as non-living elements but also regarded as an organic part of the ecological cycle system [1]. The design goal of green building is to make the building form a dynamic balance and coordination with the natural environment and social economy, so as to achieve the efficiency, adaptability, and sustainability of the building.

The development of green buildings is not only conducive to protecting natural resources and the environment, improving the quality and efficiency of construction but also conducive to promoting technological innovation and industrial upgrading of the construction industry and enhancing the

international competitiveness and social responsibility of the construction industry. On a global scale, green building has become an important trend and direction of the development of the construction industry. Many countries and regions have formulated corresponding policies, standards, evaluation systems, incentive mechanisms, and other measures to promote the popularization and development of green buildings. In the country, green buildings have also been highly valued and strongly supported by the government and society from all walks of life. In recent years, China has issued a series of planning, regulations, standards, guidelines, and other documents such as the "14th Five-Year Plan" Building Energy Efficiency and Green Building Development Plan, which has clarified the development goals, tasks and measures of green building, providing strong guidance and guarantee for the development of green building.

In short, the development of energy-saving and green buildings is an inevitable choice for the construction industry to achieve sustainable development, and it is also an inevitable requirement for the progress of human civilization. With a more open vision, more innovative thinking, and more pragmatic actions can promote the wide application and further development of energy-saving green buildings in the country, and make a contribution to building a beautiful China where man and nature live in harmony.

2. Energy Saving and Green Building

As the world's largest construction market and largest building energy consumption country, China's building energy consumption accounted for about 40% of the whole society's energy consumption in 2019, accounting for nearly 30% of the global building energy consumption [3]. In foreign countries, the incremental cost of green buildings is divided into soft cost, green building technology cost, and certification cost, soft cost includes green building design cost (green consulting cost), commissioning cost, declaration material arrangement cost, simulation analysis cost (some people also include certification cost in soft cost). Some scholars in the United States have calculated the soft cost of LEED certification, which generally accounts for 3%-5% of the construction cost, and the smaller the project, the greater the proportion. Of this, the increased green design cost accounted for about 0.7%; Commissioning costs account for 0.5% to 1.5%; the cost of finishing the declaration materials is 0.05%-3.8%, small buildings take the upper limit, large buildings take the lower limit, the average is 0.7%; simulation analysis costs account for about 0.1% [4]. Due to the acceleration of urbanization and people's requirements for living standards, the demand for building energy will continue to grow, bringing great challenges to the realization of low-carbon green goals. Therefore, promoting the development of energy conservation and green buildings is an inevitable choice for China to achieve sustainable development and an important measure to fulfill international commitments to address climate change.

In order to promote the development of energy conservation and green buildings, China has formulated a series of policies, clarifying future development goals, tasks, and measures [5]. Specifically, it mainly includes the following aspects:

First, improve the quality of green building development. It is necessary to fully consider the conservation of energy resources, water resources, and material resources, so as to avoid adverse effects on the environment and improve the quality of the indoor and outdoor environment, so as to meet people's needs for function, economy, and beauty. Green building is the innovation and sublimation of traditional architectural design concepts and methods and is an effective way to achieve energy saving and green development. In order to improve the quality of green building development, the plan proposes the following measures:

Formulated and implemented the Implementation Plan for the Comprehensive Implementation of Green Building Standards for New Urban Buildings; Strengthening the promotion of urban renewal and rural revitalization, and calling for the implementation of green and low-carbon; Improved the evaluation standard system of green buildings, strengthening the supervision and management of the evaluation results of green buildings; Promote the planning, design and operation management of

green and low-carbon communities, and strengthen the planning, design and operation management of green and smart cities; Promoting the publicity of green buildings and improving the public's awareness and recognition of green buildings is also one of the measures.

Second, improve the energy efficiency of new buildings. Energy-saving in new buildings refers to the use of energy-saving technologies and measures in the design, construction, and acceptance of new buildings so that the energy consumption of the building meets or is lower than the requirements of the energy-saving standards stipulated by the State. New building energy conservation is the basic work to achieve energy conservation and green development, but also the most economical and effective way. In order to improve the energy-saving level of new buildings, the plan proposes the following measures:

Speed up the updating of building energy-saving design standards, improve energy conservation and carbon reduction requirements; Strengthening the supervision and management of energy-saving design, construction and acceptance of new buildings to ensure that new buildings meet or exceed energy-saving standards; Promote new green construction methods, such as prefabricated construction, steel structure construction, etc., to reduce material waste and energy consumption on the construction site; Promote the application of energy-efficient doors and Windows, high-performance concrete, high-strength steel and other new energy-saving and environmental protection materials to improve the performance of building structures and enclosures; Promote new wall materials to replace clay bricks and reduce land resource consumption and greenhouse gas emissions; The reasonable application of solar photovoltaic, LED lighting and other technologies, as well as the application of LED and solar photovoltaic applications need to carry out a comparative analysis of the cost of off-grid and off-grid [6].

Third, strengthen energy-saving and green upgrading of existing buildings. Energy saving and green transformation of existing buildings refers to the technical transformation or functional improvement of existing buildings that have been completed and used so that they meet or approach the requirements of current energy saving standards or green standards. The energy saving and green transformation of existing buildings is the key field to realize energy saving and green development, and it is also the field with the most potential and challenge. In order to strengthen the energy-saving and green transformation of existing buildings, the plan proposes the following measures:

Promote the comprehensive implementation of energy-saving renovation of existing urban housing; Promote the comprehensive implementation of energy conservation in public institutions and public services; Promote the comprehensive implementation of the green transformation of public buildings such as commercial offices in existing cities and towns; Promote the application of solar photovoltaic, solar hot water, ground source heat pump, and other clean energy technologies to improve the utilization rate of renewable energy in existing buildings; Promote the application of smart building management systems, smart heating systems, smart lighting systems and other smart technologies, and improve the operational efficiency of existing buildings.

Fourth, improve the relevant policy system. Improving the relevant policy system is an important guarantee for promoting the development of energy conservation and green buildings. In order to improve the relevant policy system, the plan proposes the following measures:

Establish and improve the system of laws and regulations, strengthen the legal supervision and legal guarantee of energy conservation and green building development; Establish and improve the standard system, strengthen the technical specifications and quality control of energy saving and green buildings; Establish and improve the evaluation system, strengthen the evaluation, certification, monitoring and evaluation of energy saving and green buildings; Establish and improve the incentive system, strengthen the economic subsidies, tax incentives, financial support and other policy support for energy conservation and green buildings; Establish and improve the supervision system, strengthen the administrative supervision, social supervision, legal responsibility and other institutional constraints on energy conservation and green buildings.

3. Energy Saving and Green Building

The design goal of green buildings is to achieve the coordinated development of architecture and nature, society, and economy, to meet the diversified needs of human beings for buildings while protecting the integrity and diversity of the earth's living system [7]. To achieve this goal, the design mainly reflected in the following aspects:

Principle of system collaboration. This principle requires that in the design process, the building should be regarded as a complex system, and its interaction and influence with the surrounding environment, user behavior, social culture, and other factors should be considered, so as to achieve coordination and optimization among various subsystems and improve the overall efficiency and efficiency.

Principle of regionalism. This principle requires that in the design process, make full use of local natural resources and climate conditions, combine local history, culture, and social habits, and create architectural forms and space atmosphere that adapt to regional characteristics and humanistic spirit.

Principle of efficiency. This principle requires that in the design process, the use of energy saving, emission reduction, purification, recycling, and other technical means, to minimize the building's consumption of energy, water and materials, and other resources, to minimize the negative impact of the building on the environment.

Principle of health. This principle requires that in the design process, attention should be paid to human physical and mental health and comfort feelings, to provide safe, comfortable, healthy, and beautiful indoor and outdoor environmental quality, and to meet human needs for function, economy, and beauty.

Principle of harmonious coexistence. This principle emphasizes the harmony between the building and the natural environment. During the design process, architects should highly respect the natural terrain, vegetation, and ecosystem, and maintain harmony with the surrounding environment. Careful consideration should be given when planning the layout and form of buildings to minimize damage and interference to natural resources. In addition, the architectural design should also make full use of the natural landforms and vegetation to create a unique and beautiful architectural landscape by integrating with the surrounding terrain [8].

Based on the above five basic principles, the design of green buildings can be achieved at several levels:

Environmental objectives. The design of green buildings should be based on the premise of protecting the environment. Through energy saving, emission reduction, purification, recycling, and other measures, the consumption of natural resources and damage to the ecosystem can be reduced, and the harmonious coexistence between architecture and nature can be realized. Specifically, environmental objectives include the following:

Reduce building energy consumption. Minimize energy consumption and use highly efficient materials, technologies, and equipment to minimize building energy consumption and achieve energy-saving purposes [9]. **Reduce building water consumption.** The burden on urban water supply systems should be reduced through rational planning of water demand, improvement of water use efficiency, utilization of rainwater and reclaimed water, etc. **Through the use of water purification, recycling, and other technologies to reduce wastewater discharge and pollution.** **Reduce building material consumption.** Through the selection of green building materials, renewable materials, renewable materials, etc., to reduce the non-renewable resources. **New energy utilization.** In architectural design, the use of new energy should be based on solar energy and wind energy, to improve the level of architectural design, and reduce building energy consumption. In the building roof design and wall design, solar energy can be actively used to reduce energy consumption, while ensuring the normal operation of the building system [10].

Economic objectives. The design of green buildings should aim at improving efficiency. Through scientific management and technological innovation, the initial investment and later operating costs of buildings should be reduced, the use value and recycling value of buildings should be improved,

and the mutual benefit and win-win situation between buildings and the economy should be realized. Specifically, economic objectives include the following aspects:

Reduce construction investment costs: through the use of prefabricated construction, industrial production, and other ways, shorten the construction period, save manpower and material resources, through the use of integrated design, collaborative construction, and other ways, reduce design changes, engineering claims and other risks, improve the quality of the project; Reduce building operating costs: reduce building energy consumption, water consumption, material consumption and maintenance costs by adopting technologies such as energy saving, emission reduction and purification, recycling, etc., and improve building operating efficiency and management level by adopting intelligent control system and digital delivery. Improve the use value of buildings: through the use of humanized, comfortable, and healthy design concepts, improve the functionality, adaptability, and aesthetics of buildings, through the use of renewable energy, green building materials, and other technologies, improve the environmental friendliness and social responsibility of buildings; Increase the value of building recycling: Increase the demolishability and recyclability of buildings by using structures and materials that can be dismantled, reassembled and reused, the economic benefits and environmental impacts of buildings are assessed by using life cycle assessment methods.

4. The Development Significance of Green Building

Energy saving and green buildings refer to buildings that fully consider saving energy, water resources, materials, and other resources throughout the building life cycle, reduce adverse impacts on the environment, and improve indoor and outdoor environmental quality, so as to meet people's needs for function, economy, and beauty. The development of energy saving and green building is of great significance and prospect, mainly reflected in the following aspects:

Energy efficiency and green buildings help protect the environment, reduce energy consumption and carbon emissions, and mitigate the effects of climate change. According to statistics, the construction industry uses a large amount of global energy and is the cause of a large number of global carbon dioxide emissions. Through the use of energy saving, emission reduction, purification, recycling, and other technical means, energy saving and green buildings can greatly reduce the consumption of natural resources and damage to the ecosystem, and achieve a harmonious coexistence between architecture and nature. It can also pay attention to the environmental protection of building technology, construction samples in the shape of the process to adopt environmentally friendly high-tech means, to avoid the construction of the local environment caused by the destruction of the same time, through the use of clean energy and low-carbon technology, energy saving and green building can significantly reduce greenhouse gas emissions [11].

Energy saving and green buildings are conducive to improving efficiency, reducing investment costs and operating costs, and increasing the use value and recycling value. According to statistics, energy-saving and green buildings compared with traditional buildings, the initial investment is only increased by about 5%, operating costs can save more than 30%, in the service life can be extended by more than 20%. Through the use of scientific management and technological innovation, energy-saving and green buildings can reduce the construction period, human and material resources, maintenance costs, and other expenses, and improve project quality, operation efficiency, management level, and other income. At the same time, by using structures and materials that can be dismantled, reassembled, and reused, energy-efficient and green buildings can improve their accountability and recyclability, increasing the value of recycling.

Energy saving and green buildings are conducive to meeting human needs, improving the quality of living environment and living comfort, and enhancing communication and interaction. According to statistics, the average human stays indoors for more than 20 hours a day. By adopting the design concept of humanization, comfort, and health, energy-saving and green buildings can provide safe, comfortable, healthy, and beautiful indoor and outdoor environmental quality, and meet human needs

for function, economy, and beauty. At the same time, through the use of open, shared, participatory design concepts, energy-efficient and green buildings can promote communication and collaboration between residents, and increase the connection and integration of residents with nature and society.

5. Conclusion

To sum up, energy-saving green buildings conform to the green, low-carbon, and recyclable development model, and are the best choice to achieve sustainable development of buildings. Rapid economic and social development will also bring about continuous improvement of people's living standards, the development of energy conservation and green building is facing opportunities and challenges, it is believed that as long as there are joint efforts and support from all aspects, promote energy conservation and green building from concept to practice, from planning to construction, from operation to management, from evaluation to supervision, to form a perfect system and mechanism. So it can make a contribution to the construction of ecological civilization.

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