Analysis on Green Building Design in China

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Abstract: With the acceleration of urbanization in China, urban development is facing a huge ecological environment crisis, so it is urgent to promote the construction of green buildings. This paper first introduces the concept and standard of green building, then summarizes the main characteristics of green building, and finally puts forward the main points of green building design, hoping to provide a useful reference for the future green building design in China.

1. Introduction

After the reform and opening up, with the rapid development of our social economy, especially the acceleration of urbanization, as one of the basic industries of our national economy, China has become the largest construction market in the world (Fig.1). Then, due to the lack of ideas and technical constraints, the new buildings in China are still dominated by high energy consumption buildings (Fig.2), which have caused huge consumption of energy and resources, and caused great damage to the ecological environment. High energy consumption buildings influence our country's ecological city construction and construction industry sustainable development. To this end, the country began to actively develop green buildings, requiring the construction industry not only to meet people's personalized requirements for comfort, economy and so on, but also to meet the needs of environmental friendliness, energy saving and efficiency to the maximum extent. In July 2020, seven departments, including the Ministry of Housing and Construction, issued Green building creation action plan, saying that by 2022, the proportion of green buildings in new urban buildings reached 70 per cent, star-rated green buildings continued to increase, existing building energy efficiency levels continued to improve, residential health improved, assembly construction methods steadily improved, green building materials applications further expanded, green residential user supervision and promotion, the people actively participated in green building activities, forming a social atmosphere advocating green life.
2. Concepts and Standards of Green Buildings

The so-called "green building" or "green" does not refer to the general meaning of three-dimensional greening, roof garden. It represents a concept or symbol, which means that architecture is environmentally sound and can make full use of environmental natural resources. Green buildings are not simply equivalent to energy-saving buildings. According to the national "green building evaluation standard ", green building refers to the whole life cycle of the building, which can save resources and reduce energy consumption to the maximum extent, realize the goals of energy saving, water saving, land saving and material saving, take the protection of the environment as the goal, reduce the damage and pollution to the environment, at the same time, provide people with healthy, comfortable and efficient use space, and realize the building in harmony with nature. Green building is different from
traditional building in site selection, so it is necessary to analyze the carrying capacity of site ecological environment. In the design of architectural layout and architectural form, we should take climate adaptability as the basic principle, reserve urban ventilation corridor, and fully consider energy saving. Building materials should be recycled as much as possible, and new energy and technology should be widely used to reduce energy consumption in the process of building use. China Seven major evaluation indicators for green buildings are set out in Evaluation Standard of Green Building GB-T50378 2014 (Fig.3).

![Fig.3 Seven Indicators of Green Building Evaluation Criteria](image)

3. Characteristics of green buildings
With the development of ecological civilization construction, the concept of green building has been widely recognized by the whole society. It is recognized that green building can also construct an ecosystem, and the factors inside and outside the building can be circulated and converted in an orderly manner. Can minimize environmental pollution, reduce resources and energy consumption. A comfortable and livable living environment can not be separated from green buildings. Reducing the load of building to environment, providing healthy living space for residents, and achieving sustainable development of building and human and environment become the core elements of green building. In general, green buildings have the following three main features:

3.1. Low energy consumption
An important indicator of green building is low energy consumption. Building plane form and overall layout and so on adapt to the local climate conditions, make full use of natural lighting ventilation, solar energy, water energy and other natural conditions, while avoiding the impact of adverse natural conditions on the building as far as possible, building materials, building equipment and building technology also fully take into account the demand for energy conservation and environmental protection, so as to achieve the goal of reducing building energy consumption.

3.2. Less resource utilization
Green building advocates saving resources. Architectural design as far as possible to reduce the occupation of land, as far as possible to avoid decoration. Green building materials and decorative materials should be used to minimize the use and consumption of natural resources, use waste as far as possible, adopt advanced production technology, reduce energy consumption and pay attention to environmental protection in the production process; Good environmental protection performance and energy saving performance and recycling after use. Indoor environmental quality includes two aspects, one is indoor thermal environment, the other is indoor air quality[1]. Green building requires people-oriented, as far as possible for users to create a sense of use close to the natural environment. While using natural conditions and artificial means to create a good and healthy building indoor environment, control and reduce the use and destruction of the natural environment as much as possible, fully reflect the balance between the demand and return from nature. The building materials of green buildings must be strictly tested and can not destroy human health. To ensure that the indoor air fresh and suitable temperature, for people to create a comfortable indoor environment.
3.3. Harmony with Nature
Green building emphasizes the ecological concept of harmonious symbiosis between architecture and nature. It is emphasized that the protection of the original ecosystem should be strengthened in the design, construction and use of the external environment of the building, so as to avoid and reduce the interference and damage to the ecosystem. The continuity of original ecological matrix, corridor and plate should be maintained as far as possible; Ecological restoration and reconstruction measures should be taken for damaged and degraded ecosystems[2].

4. Design Elements of Green Buildings

4.1. Adapt to the local environment of the building
The climate conditions of different regions are very different. The green building design should first make a full analysis of the climate conditions of the building area, so as to formulate a scientific and reasonable design strategy in order to minimize the energy consumption of the building. In the initial stage of architectural design, we should make full use of natural resources, such as solar energy and wind energy, to reduce the dependence on organic energy and create a comfortable living environment through passive architectural design, building parameter optimization design and other architectural design and technical means according to the local climate conditions, combined with the impact of surrounding buildings and environment[1]. For example, the green building design in cold areas needs to focus on reducing the impact of winter monsoon on buildings and striving for more sunshine in winter, so as to reduce the heat loss of building energy consumption. For example, the green building design in the hot summer and warm winter area needs to focus on the use of the dominant wind direction in summer for natural ventilation and cooling and to avoid excessive solar radiation in order to improve the microclimate environment of the building and thus reduce the energy consumption of the building. This requires that in the green building design, the plane layout, plane shape, surface area coefficient, aspect ratio and orientation of the building should be deeply studied in order to adapt to the natural environment of the building area and reduce the energy consumption of the later building.

4.2. Avoid damage to the surrounding natural environment
Building system depends on the natural environment in a larger scope, which is a link and stage of continuous energy and material flow in the generalized ecosystem. It is not appropriate to understand sustainable building or green building in a partial way without the whole[3]. Green buildings should try to avoid damage to the surrounding natural environment. In carrying out architectural planning and design, we should respect the topography and geomorphology of the base and its surrounding areas, integrate the buildings into the natural environment, and not carry out large excavation and destruction of the original landforms. Only by strictly protecting and rationally utilizing the surrounding landscape, vegetation and other natural landscape resources can we realize the harmonious symbiosis between architecture and nature.

4.3. Pay attention to environmental protection and energy saving of building materials
Traditional architectural design often ignores the impact of building materials themselves on the environment. Material production, transportation, installation and other easy to quantify the explicit cost, and capital hidden costs, such as resource consumption and environmental damage, which are not easy to quantify, should be included in the evaluation system[4]. Green architectural design needs to attach great importance to the selection of building materials, to choose energy-saving and environmentally friendly building materials as far as possible, Priority is given to renewable and degradable building materials, thus reducing energy consumption and avoiding environmental damage in building materials production. At the same time, local building materials should be used as far as possible to reduce energy consumption and environmental damage in the process of building materials transportation. In addition, the selection of building materials also needs to meet the requirements of energy saving and environmental protection in the process of building use. For example, in hot areas,
we should choose building materials with good heat dissipation. In creating a comfortable indoor environment while effectively reducing the energy consumption of air conditioning and other equipment.

4.4. **Focus on the application of new technologies**
With the progress of science and technology, new technologies such as intelligent control, new materials and new energy are constantly developed, and these new technologies should be reasonably applied in green building design. For example, by increasing the utilization rate of renewable resources, the utilization rate of non-renewable resources can be reduced. Through the maximum utilization of solar energy, rainwater and biogas, the purpose of energy conservation, emission reduction and resource recycling can be achieved[5]. The modern information intelligent control system can be used to monitor and control the building in all directions. Such measures as adjusting the sunshade system of the building according to the angle of solar irradiation, adjusting the temperature of the air conditioning according to the change of the indoor temperature, adjusting the intensity of the lighting according to the change of the indoor light and so on, reduce the energy consumption. Through the application of new external wall materials, the thermal insulation performance of building enclosure structure can be improved, and the building energy consumption can be reduced.

4.5. **create a healthy and comfortable indoor environment**
Green buildings should ensure the physical and mental health of users. When designing green buildings, we should ensure that indoor electromagnetic radiation, noise, air quality and thermal environment do not cause damage to human health. Such as the selection of environmentally friendly building materials and decorative materials; to ensure that the temperature, humidity, air flow and other indoor thermal environment suitable for human needs, improve the comfort of users; through sound absorption materials to reduce the impact of external noise on the human body; rational use of natural lighting, so as to meet the human body's demand for natural light, but also reduce energy consumption and other measures to provide users with a healthy and comfortable indoor environment.

5. **Conclusion**
Green building has become the main trend of building development in the future. At present, the development of green buildings in China is very rapid, but due to the late start, there is still a certain gap with the advanced level of foreign countries. Therefore, it is necessary for us to draw lessons from the experience of advanced countries and combine the characteristics of our own. To formulate strategies suitable for the development of green buildings in China, so as to better guide the construction of green buildings in China, so as to realize the harmony between man and nature and realize the sustainable development of China's construction industry.

**References**
[1] Yao, R.M.Li,B.Z.Ding,Y.Liu,M.(2006) Review of development in green buildings. J. Heating Ventilating Air Conditioning.,36:27-32,91.
[2] Liu,F.Y. Li,T.S. Zhao,J. (2013) .DESIGN PRINCIPLE AND OBJECTIVE OF GREEN BUILDING. J. Architecture Technology. 44:212-215.
[3] Xie,S.S Chu,D.Z.(2019). DESIGN IDEAS AND METHODS OF SUSTAINABLE BUILDINGS IN PRACTICE. J. Industrial Construction. 49:54-59,136.
[4] Zheng,Z.R.(2021) Study on the problems and countermeasures of green building evaluation system. Building economy. J. Construction Economy.,42:14-17.
[5] Zhang, T.T.(2021). Current situation, development and application of green building technology. J. Sichuan building materials. 47:30-31,35.