

LETTER TO THE EDITOR

Influence of Green Ecological Building on Energy Saving and Emission

Reduction

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Green ecological building is to build a safe, healthy, efficient and comfortable living space under the condition of low environmental load by saving energy and making effective use of resources, so as to achieve the symbiosis and sustainable development of green building and environment. In this paper, the effect of green ecological building on energy-saving and emission reduction is studied. The meaning and characteristics of green ecological building are described first, then the calculation method of carbon emission is given, and the effect of green ecological building on energy-saving and emission reduction is analyzed according to the calculation method of carbon emission. The experimental results show that the green ecological building has remarkable energy-saving and emission-reducing effect, and the implementation of the green ecological architecture should be promoted, and the purpose of protecting the environment is achieved.

Green ecological building; Energy saving and emission reduction; Carbon emission

1 Introduction

The crisis of global climate change and resource shortage seriously affects the survival and development of human beings, and has become the focus of the international community's universal concern. At present, the resources and materials used in Chinese engineering construction account for about 40%~50% of the national resource utilization, and the energy consumption accounts for about 30% of the total energy consumption of the whole society, and the waste discharged by the construction activities accounts for about 40% of the urban waste. The construction, use and demolition of buildings have led to huge greenhouse gas emissions from the consumption of energy and resources and the disposal of solid waste, and how to reduce construction, carbon emissions from the use and dismantling of disposal processes are the requirements of the era for engineering management in a low-carbon society. Prior to this, the total amount of carbon emissions for the entire life cycle of the building is first calculated. As we all know, the core of green ecological building is to save resources (energy saving, land saving, water saving, material saving), protect the environment, reduce pollution and reduce direct or indirect emissions of greenhouse gases in the whole life cycle. As a large household for energy use, China should pay more attention to the development and promotion of green ecological building. In order to achieve the goal of reducing the CO₂ emission of our country's gross domestic product by 40% ~ 50% in 2005, it is of great importance to carry out the green ecological building.

Yuanying Chi, Lina Yuan, Hongying Li, Yu Zhang, Guoqin Bai published an article in the 2019 Issue 107 of the journal Ekoloji, entitled: "Using LEAP Model to Predict Energy Consumption of Beijing under the Constraint of Low-Carbon Economy". The article points out that the amount of energy directly determines the speed and

sustainability of economic development, but energy consumption can pollute the environment. In this paper, the LEAP- Beijing model is constructed, and the development trend of energy consumption and energy structure from 2017 to 2035 is analyzed. It is pointed out that the energy consumption of the tertiary industry continues to increase, and the growth rate is obvious.

Peng discusses the application value and practical application fields of solar energy technology in building energy conservation and emission reduction, which is based on the analysis of the characteristics of solar energy, and points out the problems in the future development. Li analyzes the present situation of the design and development of green ecological architecture in China, and expounds the connotation of green ecological building and the significance of designing green ecological building. (Neha et al., 2016) This paper focuses on the principles that should be followed in the design of green ecological buildings under the background of energy saving and emission reduction, hoping to provide some theories for further promoting the development of green ecological buildings and creating an energy-saving and healthy green environment. Based on the results of the above research, the influence of green ecological architecture on energy saving and emission reduction is analyzed in this paper.

2 Idea Description

2.1 Meaning and characteristics of green ecological building

Green ecological building refers to the maximum saving of resources (land saving, material saving, energy saving, water saving) and the protection of the environment in the whole life cycle of the building, that is, “four-section-one environment-friendly”. It also provides human beings with comfortable, healthy and efficient living space, and realizes the building of harmonious coexistence with nature. In a simple way, a green ecological building is a building capable of achieving energy conservation and emission reduction. The development of green ecological building is very important for the sustainable development of construction industry and even the whole economy and society. The development of green ecological buildings is of vital importance to the sustainable development of the construction industry and the entire economy and society. It is an inevitable choice for promoting energy conservation and emission reduction of construction projects, developing circular economy and promoting the construction of “two-oriented society”. The “green” of green ecological building does not refer to the general meaning of architectural greening, garden architecture, green decorative building and so on, but represents a concept or symbol, which means that architecture is harmless to the environment and can make full use of natural environmental resources, it also can build built without destroying the basic ecological balance of the environment. The indoor layout of green ecological building should be harmonious and reasonable, reduce the use of synthetic materials as much as possible, make full use of sunlight, save energy, ecological and environmental protection, and create a feeling of returning to nature for the occupants. The indoor layout of the green ecological building shall be harmonious and reasonable, to minimize the use of synthetic materials, make full use of the sunlight, save energy and protect the environment, and create a feeling of return to nature for the residents (Nowak et al.2017).

Green ecological building is an architectural concept, not a general greening or a specific building, but a comprehensive evaluation of building energy efficiency, comfort and environmental protection. According to the meaning of green ecological building, its characteristics can be summarized into the following four aspects:

(1)Emphasize the concept of life cycle. The green ecological architecture can be used for comfortable and healthy living space in the whole life cycle, reduce the influence on the environment and the waste of resources, and realize the harmony between man and nature.

(2)Embody the concept of circular economy and minimize the environmental impact. Green building regards itself

as a kind of resource, takes the coordinated and orderly development of economy and ecology as the goal, and tries to maximize the benefit with the smallest resource and environmental cost without affecting the requirement of use.

(3) Automatic adjustment function to show the integration of man and nature. The green ecological building connects the internal and external environment of the building with the help of a certain way of connection, and realizes the automatic adjustment with the external climate change, which embodies the idea of the integration of man and nature.

(4) The cost of operation and maintenance is low. Green ecological building not only realizes the efficient utilization of energy, but also obtains low operation and maintenance cost by using energy saving technology, renewable energy, green environmental protection materials and so on.

Generally speaking, green ecological building must conform to the concept of sustainable development and pursue the development of ecological balance through the corresponding technical means. The harmony and unity of people, buildings and environment are not only in line with economic benefits, but also in line with social benefits. While improving the function and effect of building use, energy saving and emission reduction can be realized at the same time (Sun Wang and Guo 2018).

2.2 Carbon emission calculation

In order to successfully construct the evaluation index system of energy saving and emission reduction, it is necessary to have clear construction ideas and concrete and feasible step arrangements. The construction of evaluation index system is not a simple work. On the basis of systematic thinking, it is necessary to describe the most comprehensive energy saving and emission reduction situation of green ecological building project with the succinct level and index as simple as possible on the basis of systematic thinking.

The division and distribution of hierarchical levels is the key and difficult point in the construction of the system. In which, the target layer is the energy conservation and emission reduction evaluation index system of the green ecological construction project, followed by several criteria layers, and the criteria layer reflects all aspects of the energy conservation and emission reduction of the green ecological construction project. The collection of content together constitutes the evaluation content of the target layer. Further down, the criterion layer is divided into more detailed and specific index layers, which include qualitative index and quantitative index. The comprehensive evaluation index in the index layer is the in-depth extension and specific description of the corresponding general index in the rule layer, and generally speaking, it should be easier to measure or describe. The relationship between the target layer, the criterion layer and the index layer is similar to the relationship between sets and subsets in mathematics.

Regarding the acquisition of evaluation indicators, it is necessary to consult a large number of literature materials and various energy conservation and emission reduction standards, etc., fully research relevant basic theories, earnestly investigate, repeatedly screen, compare and think. If there is a condition, it is necessary to consult with the relevant experts or visit the enterprise before the need for comprehensive evaluation indicators can be preliminarily determined. After the preliminary establishment of the evaluation system, it is necessary to test and optimize the evaluation system before a formal evaluation index system of energy saving and emission reduction can be formed.

Referring to previous research results, the important indicator of energy conservation and emission reduction is carbon emissions. In theory, the whole life cycle of green ecological buildings includes the production and transportation of building materials, the construction and construction of buildings, the operation and maintenance of buildings, and the demolition of buildings. During this period, both substances and energy will be consumed and

CO₂ will be released directly or indirectly. The formula for calculating the total CO₂ emissions in the whole life cycle of green ecological buildings is as follows:

$$P = P_1 + P_2 + P_3 + P_4 + P_5 \quad (1)$$

In the form above, P_1 represents the total amount of carbon emissions in the production stage of building materials, P_2 represents the total carbon emissions for the transportation phase of building materials, P_3 represents the total carbon emissions during the construction phase of building materials, P_4 represents the total carbon emissions during the construction operation and maintenance phase, P_5 represents the total carbon emissions during the construction demolition phase.

Combined with the calculation of carbon emissions in each stage of the whole life cycle of buildings, it is shown that carbon emissions are mainly concentrated in the production stage of building materials and the use stage of building operation and maintenance. The production stage of building materials mainly includes the carbon emissions from the production of cement, steel, concrete, and air-conditioning equipment, and the carbon emissions of the entire life cycle of building interior decoration and office equipment. For the relevant basic research is not deep enough, the value involved is not uniform, it is difficult to determine its carbon emissions, so this paper does not consider it. The calculation of carbon emissions in the construction operation stage is mainly based on the total energy consumption in the whole life cycle calculated by eQuest rapid energy consumption simulation software, and then the total carbon emissions in the whole life cycle of the building are finally calculated according to the carbon emission factors of various energy sources.

2.3 Analysis on the influence of green ecological building on energy saving and emission reduction

In order to compare the contribution of green ecological building to energy saving and emission reduction more accurately, according to the energy consumption model and virtual comparison building model of green ecological building, the average level of non-green ecological building should be selected. The energy consumption per unit area and carbon emission index are calculated, and the energy consumption and carbon emission level of green ecological building are compared with that of green ecological building, then the influence of green ecological building on energy saving and emission reduction is calculated (Fu 2017). However, because the current average level of non-green ecological buildings is difficult to control, the comparison of building envelope structure is set according to the limit value stipulated in the energy saving design standard for public buildings (GB50189-2005), and the energy saving rate is 50%, which is basically superior to the current average level of enclosure structure.

3 Results

The green ecological building project selected in this paper is Block B of an office building. The building has 5 floors above ground and 1 underground floor. The main room function is office, with a total construction area of 8 198.26 m², a building cooling load of 583 kW, and a thermal load of 350 kW. All the parameters of the enclosure structure performance parameters, lighting power density, unit energy efficiency ratio and other parameters meet the relevant requirements of the *Public Building Energy Efficiency Design Standards* (GB50189-2005), and meet the *Green Ecological Building Evaluation Standards* (GB/T50378- 2006) three-star requirement. The total energy consumption and operation phase energy consumption of the green ecological

building are calculated, and the results are shown in Table 1 and Table 2:

Table 1 Total energy consumption of green ecological buildings

Project	Refrigeration	Heating	Fan	Water pump	Equipment	Lighting	Total
Energy consumption (mWh/a)	49.25	296.31	14.23	0.23	165.31	134.26	659.59

Table 2 Energy consumption in the operation stage of green ecological buildings

Annual power consumption of the building (kWh)	Carbon emission factor	Carbon emission (t/a)
659.59	10021	660.32

By analyzing the data in tables 1 and 2, it can be seen that the energy consumption of building operation is the main component of carbon emissions in the whole life cycle. The energy consumption of green ecological building in operation stage is compared with that of ordinary building. The results show that the energy consumption of green ecological building in operation stage is 659.59mW/a. The energy consumption of ordinary building in operation stage is 1000.23mW/a, which is quite different between the two method. It can be seen that the green ecological building has obvious energy saving and emission reduction effects.

4 Discussion

According to the above analysis, green ecological building has obvious effect of energy saving and emission reduction, so it is necessary to take energy saving and emission reduction as the key point in building design in order to meet the standard of green ecological building. It can be completed from the source of building energy saving-exploring new clean energy, improving energy consumption terminal optimization treatment technology and rain water recovery and recycling.

5 Conclusion

At this stage, our country is in an important period of socialist development, at the same time, it is also an important period of the development of green ecological architecture. We need to overcome many difficulties, seize the opportunities of the times, and proceed from the actual national conditions of our country. Vigorously develop green ecological buildings, contribute to energy conservation and emission reduction, and truly achieve the purpose of protecting the environment and saving energy.

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