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Research on Environmental Sustainability of Prefabricated Buildings

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Abstract

With the development of economy, the pollution problem caused by industrialization has become more and more serious. The environmental sustainability of prefabricated construction projects is to provide a comfortable living environment for mankind through scientific design and reasonable layout arrangements. On the basis of this, significantly reduce building energy consumption and carbon emissions, thereby generating positive ecological benefits. This paper analyzes the environmental sustainability impact factors of prefabricated buildingsIt reflects the superiority of prefabricated buildings in terms of environment.

Keywords

environmental sustainability; prefabricated buildings.

1. Introduction

Prefabricated buildings conform to the development direction of building industrialization and residential industrialization, [1] meet the requirements of low-carbon, energy-saving, environmental protection, water-saving, and land-saving, and can achieve 65% comprehensive building energy saving[2]. According to the analysis of environmental benefits of prefabricated buildings, an environmental benefit evaluation index system is constructed from two aspects: environmental costs and environmental benefits. Resource consumption mainly refers to the quantity of various resources such as steel and wood required to obtain raw materials for prefabricated construction, including losses. Energy consumption refers to the consumption of water and electric energy generated during the life cycle of a prefabricated building for production and life.

2. Environmental Sustainability Analysis of Prefabricated Buildings

2.1. Environmental Sustainability Analysis Process

Environmental cost analysis throughout the life cycle. Environmental cost generally refers to the economic loss caused by environmental pollution and ecological damage. It can also be said that the environmental loss caused by a series of purposeful activities. We can call it "environmental economic loss".

The United Nations Statistics Office (UNSO) believes that environmental costs are divided into two parts[3], one is the economic loss caused by the consumption and quality of natural resources, and the other is the actual expenditure on environmental protection to prevent environmental pollution or improve the environment. Kind of expenses.

The life cycle environmental cost of prefabricated buildings refers to a series of environmental and economic losses in the life cycle process from raw material collection, component production, product transportation, on-site assembly to final scrapping. For the construction

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industry, the impact on the environment during its entire life span is a double-edged sword. The positive impact is called income, and the negative impact is called cost[4].

2.2. Environmental Sustainability Benefits of Prefabricated Buildings

During the whole life cycle of the building, maximize resources (energy saving, land saving, water saving, material saving), protect the environment and reduce pollution, provide people with healthy, suitable and efficient use of space, and a building that coexists in harmony with nature . According to the definition, the environmental benefits of prefabricated buildings can be divided into energy-saving environmental benefits, water-saving environmental benefits, land-saving environmental benefits, material-saving environmental benefits, and environmental quality improvement benefits [5]. According to the different benefit forms of prefabricated buildings, environmental benefits can be divided into CO^2 emission reduction benefits, health benefits, and building materials life extension benefits.

According to the characteristics of prefabricated buildings, the environmental benefits in the whole life cycle are divided into energy-saving benefits, water-saving benefits, land-saving benefits, material-saving benefits, carbon emission reduction benefits, and indoor environment improvement benefits. The advantages and functions of architecture and traditional architecture in terms of environment.

3. Environmental Benefit Analysis based on the Whole Life Cycle

3.1. Analysis of Environmental Benefits in the Construction Phase

Buildings need to consume a lot of resources and energy during construction. However, the limitations of the traditional cast-in-place construction model have caused it to consume not only necessary resources, such as sand, stone, concrete, and water, but also Will consume a lot of non-essential consumption. In addition, the traditional cast-in-place construction model also caused irreversible damage to the surrounding environment during the construction process, such as pollution of the surrounding water quality, damage to the surrounding vegetation, etc. As for the prefabricated building model, most of the components of the building are prefabricated in the prefabricated factory and transported to the construction site for installation, which can save most of the non-essential consumption during the construction process. At the same time, due to the reduction of the on-site wet working environment And so on, can play a good role in protecting the surrounding ecological environment.

3.2. Environmental Benefit Analysis in the Use Stage

3.2.1. Energy-Saving Analysis during Use

Comprehensive analysis of energy consumption during the construction and use phases of buildings shows that heating and cooling accounts for the largest proportion of energy consumption. Due to its unique characteristics, the prefabricated building model has very excellent thermal insulation performance, which is an important direction for the development of energy-saving buildings in the future.

In the use phase of the building, another place that consumes energy lies in the daily energy consumption of lighting, air-conditioning, home appliances, etc. Therefore, while adopting the prefabricated building model, the theoretical method of green building should be combined with the energy-saving design of the prefabricated building , Such as using solar energy, geothermal energy, wind energy, etc., to save and control energy from the daily use stage. According to foreign energy monitoring agencies predicting the energy saving of prefabricated buildings, it is estimated that by 2035, prefabricated buildings will save 11821.01 joules of energy compared with traditional cast-in-place buildings[6]. It can be concluded that prefabricated buildings have incomparable advantages over traditional cast-in-place buildings

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in terms of building energy efficiency, and they need to play a more important role in the construction industry market in the future.

3.2.2. Water Saving Analysis in the Use Phase

The emergence of the prefabricated building model points out a new direction for the saving and recycling of water resources[7]. The installation of water-saving appliances and the recycling treatment system of water resources can be considered in the standardized design of prefabricated buildings; at the same time, the design is also Consider adopting the setting of a water resource recycling treatment system. Natural water resources such as rainwater can be recycled for washing sanitary ware, etc. According to data from the National Statistics Network, the traditional cast-in-place mode consumes about $3.64m^3/m^2$ of water resources, and the prefabricated building mode consumes about $3.06m^3/m^2$ of water resources. Compared with the traditional cast-in-place mode, the prefabricated building mode can save about 15.93% of water resources.

3.3. Analysis of Environmental Benefits at the Demolition Stage

Prefabricated buildings have better cost-effectiveness in the recovery and demolition stage, and their cost-effectiveness is mainly reflected in the lower demolition cost and higher recovery residual value. The environmental benefits of prefabricated buildings in the recycling and dismantling stage are better than those of the traditional cast-in-place construction model. Due to the limitations of the current mainstream traditional cast-in-place mode technology, it will have a large carbon emission in the production and demolition phases, and the traditional cast-in-place building will generate a lot of construction waste when it is demolished, and the recycling rate is very low. , Will cause great pollution to the surrounding environment.

3.4. Comprehensive Environmental Benefit Analysis

Through the above analysis, it can be concluded that the prefabricated building model has relatively high environmental benefits in the construction phase, the use phase, and the recycling and dismantling phase. Based on the specific conditions of the existing prefabricated projects and related research, the environmental benefits of prefabricated concrete structures and prefabricated steel structures and traditional cast-in-place buildings are analyzed in the five aspects of "four sections and one environmental protection". Among them, "material saving" is mainly considered from three aspects: saving the amount of concrete, saving the amount of formwork and saving the amount of steel. "Environmental protection" is mainly considered from the perspective of reducing waste discharge. The “land saving” situation is mainly considered based on the increase in the living area of households, and the rest of the “energy saving” and “water saving” situations are all based on actual statistics.

4. Conclusion

In addition, compared with traditional cast-in-situ buildings, buildings that adopt the prefabricated construction model can increase the total energy saving by about 26.3%, mainly in the heating, cold and hot water supply links of the building. Good advantage; in terms of total water conservation, it has increased by about 21%, mainly in terms of water-saving appliances and circulating water treatment systems in the use of buildings; in terms of total waste discharge The increase is about 63%, mainly because it shows a good advantage in the recovery of residual value in the process of building recycling and demolition. However, although the environmental benefits of the current prefabricated building model have been greatly improved compared with the traditional cast-in-place building model, there is still a large gap with the foreign advanced level. The main reason is that the current prefabricated building has not formed a sufficient scale. , Is still in the stage of exploration and development. At the same time, the current low overall assembly rate is also the main reason for the low environmental

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benefits of the prefabricated building model. With the continuous development of prefabricated buildings, the overall assembly rate will continue to increase, and its environmental benefits will be further expanded.

References

[1] Feng Luyao, Liu Li, Shang Yang. Analysis of environmental benefits of prefabricated buildings[J]. New Building Materials, 2018, 45(12): 101-103.

[2] Liu Xiujie. Environmental Benefit Analysis of Green Buildings Based on the Theory of Life Cycle Costs [D]. Beijing: Beijing Jiaotong University, 2012.

[3] Tian Zhe. Research on the incremental cost and incremental benefit of the whole life cycle of green buildings[D]. Dalian University of Technology, 2011.

[4] Zhu Baifeng. Research on Green Evaluation System of Assembled Monolithic Buildings——Taking Shenyang Celebrity Impression Project as an Example [D]. Shenyang: Shenyang Jianzhu University, 2015.

[5] Chen Zhong, Guo Qingfeng. Develop prefabricated buildings and popularize green buildings[J]. Building Materials and Decoration, 2016(40):180-181.

[6] Xu Xiaorui. Design and green construction of prefabricated high-rise residential buildings[J]. Green Construction, 2016, 38(01):97-99.

[7] Yuan Jing. Comprehensive benefit analysis of prefabricated buildings[D]. North China University of Technology, 2019.