Energy Saving and Resource Optimization in the Construction Process of Green Building Project Management

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Abstract: This article discusses the energy saving and resource optimization in the construction process of green building project management. In view of the global environmental problems and the sustainable development needs of the construction industry, this article analyzes the present situation and shortcomings in this field, with the aim of promoting the effective implementation of the concept of green building in the construction process. Through theoretical research methods, this article analyzes the energy consumption links and resource composition in the construction process of green building projects, and discusses energy-saving strategies and resource optimization strategies. It is found that the energy consumption in the construction process is concentrated in the operation of mechanical equipment and material processing, and the waste of resources is more prominent in the use of materials and water resources. It is proposed to choose energy-saving construction equipment and technology, optimize construction organization design to achieve energy saving, and achieve resource optimization by reducing material waste, improving water resources recycling rate and rationally allocating human resources. This study provides theoretical support and practical guidance for energy saving and resource optimization in the construction process of green building projects, and helps the sustainable development of the construction industry.

1. Introduction

With the increasingly serious global environmental problems and the idea of sustainable development deeply rooted in people's hearts, the green transformation of the construction industry as an important field of energy consumption and resource utilization is imminent [1]. The purpose of green building project is to reduce the negative impact on the environment in the whole life cycle of the building and improve the utilization efficiency of energy and resources, which has become an inevitable trend of the development of the construction industry [2]. Under this background, it is of great practical significance to study the energy saving and resource optimization in the construction process of green building project management.

From the energy point of view, the traditional building construction process often has the problem of low energy utilization efficiency, and a lot of energy is wasted in the operation of construction equipment and the processing of building materials [3]. The effective implementation of energy-saving measures can not only reduce the energy cost of construction projects, but also reduce the environmental pollution caused by energy consumption, which is in line with the global trend of coping with climate change [4]. From the perspective of resources, building construction needs to consume a lot of natural resources, such as sand, cement, water and so on. Unreasonable utilization of resources not only leads to waste of resources, but also may lead to a crisis of resource shortage [5-6]. Therefore, it is very important to realize the optimization of resources in the construction process to ensure the sustainable supply of resources and the protection of the ecological environment.

In the past, the research on green buildings mostly focused on energy saving and resource management in architectural design and operation stages, and paid relatively little attention to the key link of construction process [7]. However, the construction process, as an important stage of the construction project from planning to entity completion, has a decisive influence on the energy

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saving and resource utilization effect of the whole project. The purpose of this study is to deeply explore the strategies of energy saving and resource optimization in the construction of green building projects, make up for the gaps in existing research, provide theoretical support and practical guidance for promoting the high-quality development of green building projects, and help the construction industry achieve the long-term goal of sustainable development. Through the in-depth analysis of energy consumption and resource utilization in the construction process, the scientific and effective path of energy saving and resource optimization is explored in order to contribute to the green transformation of the construction industry.

2. Theoretical basis of energy saving and resource optimization in green building construction

As an architectural form under the concept of sustainable development, green building emphasizes saving resources, protecting the environment and reducing pollution to the maximum extent in the whole life cycle of the building [8]. Compared with traditional buildings, green buildings pay more attention to the balance of ecosystem and the sustainability of resources and environment. Its goal is not only to provide people with comfortable and healthy living and working space, but also to realize the harmonious symbiosis between architecture and natural environment.

The principle of energy saving in construction process is mainly based on the theory of efficient utilization and conversion of energy. In construction, energy exists in many forms and is consumed, such as electric energy to drive the operation of construction equipment, and thermal energy to dry building materials. By adopting high-efficiency and energy-saving equipment and technology, the energy conversion efficiency can be improved and the loss of energy during transmission and use can be reduced [9]. For example, using frequency conversion technology can automatically adjust the motor speed according to the actual working load of equipment, and reduce unnecessary power consumption.

The theory of optimal allocation of resources is the core basis to realize the rational utilization of resources in the construction process. According to this theory, resources are scarce, and in the process of project construction, it is needed to allocate and combine all kinds of resources scientifically and reasonably according to factors such as project objectives, construction technology and resource characteristics [10]. For example, according to the construction schedule, accurately calculate the types and quantities of building materials needed in different stages to avoid waste or delay caused by too much or too little material supply. Futhermore, the optimal allocation of resources also involves the temporal and spatial distribution of resources. By reasonably planning the stacking and use order of resources in the construction site, the turnover efficiency of resources can be improved and the efficient use of resources can be realized, thus providing a solid theoretical support for resource optimization in the construction process of green building projects.

3. Energy-saving strategies in the construction process of green building projects

3.1 Analysis of construction energy consumption link

The energy consumption in the construction process is extensive and complex, involving several key links. First of all, the operation of mechanical equipment is one of the main aspects of energy consumption. All kinds of large-scale construction machinery, such as cranes, excavators, concrete mixers, etc., need to consume a lot of fuel or electricity during the operation. Take the crane as an example, its frequent lifting and moving operations make the engine or motor run continuously and consume a lot of energy. Moreover, these equipment may be in a state of non-full load operation in some time periods, but the energy consumption has not decreased year-on-year, resulting in low energy utilization efficiency. Secondly, building materials processing also consumes a lot of energy. For example, the production of cement needs complicated processes such as high-temperature calcination, which consumes a lot of heat energy. In the construction site, the screening, crushing and processing of materials such as sand and gravel also require the operation of electric drive equipment. In addition, the transportation process of building materials can not be ignored. From

the origin of raw materials to the construction site, the fuel consumption of transportation vehicles is also a considerable figure. Furthermore, the temporary facilities and lighting system on the construction site are also components of energy consumption. Although the single power of air conditioners, lighting equipment in temporary office areas and electricity facilities in workers' living areas may be small, the overall energy consumption cannot be underestimated due to the long use time and large quantity.

3.2 Selection of energy-saving construction equipment and technology

Choosing energy-saving construction equipment and technology is an important measure to achieve energy conservation in the construction process. In terms of equipment, priority should be given to selecting mechanical equipment with energy-saving characteristics. For example, compared to traditional fuel powered cranes, the new electric crane has higher energy conversion efficiency and can effectively reduce energy consumption. Moreover, electric cranes have low noise and no pollution during operation, which is more in line with the requirements of green construction. In addition, some construction vehicles using hybrid technology can reduce fuel consumption while ensuring power performance.

At the technical level, promote the application of advanced energy-saving construction technologies. For example, by adopting prefabricated assembly building technology, most of the building components can be produced in the factory, reducing wet operations and material processing on the construction site, thereby reducing energy consumption during on-site construction. Futhermore, in terms of building insulation, the application of efficient insulation materials and construction techniques can reduce the heating and cooling energy consumption of buildings during use, and achieve energy-saving goals from a long-term perspective. In addition, by using intelligent control systems to monitor and manage construction equipment, the real-time operation status of the equipment can be grasped, and the operating parameters of the equipment can be adjusted according to actual needs to avoid ineffective operation of the equipment and further improve energy utilization efficiency。

3.3 Influence of construction organization design on energy saving and its optimization

The construction organization design greatly affects the energy consumption in the construction process. Scientific and reasonable construction organization design can achieve the goal of energy saving. First of all, it is very important to arrange the construction sequence reasonably. In the foundation construction stage, the earthwork excavation and foundation pouring processes should be planned as a whole to avoid repeated operations and frequent start-stop of equipment and reduce energy waste. For large-scale construction projects, the method of sectional flow construction can be adopted, so that the mechanical equipment and personnel in each construction area can work continuously and evenly, improve the utilization rate of equipment and reduce energy consumption. The application process of information management in the construction organization design stage is shown in Figure 1.

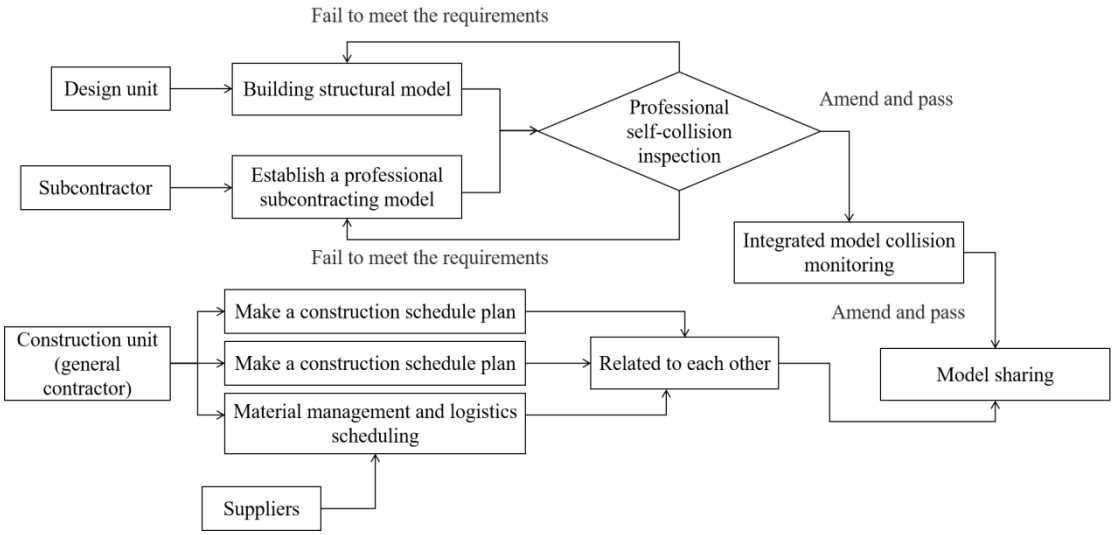

Figure 1 Application Process of Information Management

Optimizing the construction schedule can also achieve energy-saving effect. By accurately calculating the time and resource requirements of each construction process, a compact and reasonable schedule is made to avoid extra energy consumption caused by too long construction period. Futhermore, adjust the construction plan reasonably according to natural conditions such as weather, for example, arrange some indoor work with low energy demand in summer high temperature period, reduce the running time of large mechanical equipment in high temperature environment and reduce energy consumption. In addition, the layout of the construction site is also closely related to energy saving. Reasonable planning of the material yard and the parking position of mechanical equipment can reduce the secondary transportation distance of materials and equipment and reduce the energy consumption during transportation. Futhermore, the temporary office area and living area are set near the power supply on the construction site to shorten the length of the power supply line and reduce the line loss.

4. Resource optimization strategy for the construction process of green building projects

4.1 Composition of construction resources

There are many kinds of construction resources, including building materials, water resources and human resources. Building materials are the basis of building entities, covering structural materials, such as steel, cement, wood, etc. Wall materials, such as bricks and blocks; Decorative materials, such as paints, tiles, etc. Every kind of building materials, from production, transportation to the use of construction site, involves the consumption of resources and environmental impact. For example, the production of steel requires a lot of iron ore, coal and other resources, accompanied by high energy consumption and pollutant emissions. Water resources are also indispensable in the construction process. Concrete mixing, maintenance, construction site dust, and domestic water for construction workers all have a continuous demand for water resources. However, the waste of water resources in the construction site occurs from time to time, such as leaking water resources and unreasonable water use methods, which further highlights the necessity of optimizing water resources management. As the executor of construction activities, the rational allocation and efficient utilization of human resources have a significant impact on construction efficiency and resource utilization effect. Improper allocation of human resources will easily lead to idle personnel or uneven task allocation, which will delay the construction progress and indirectly lead to waste of resources.

4.2 Resource saving method

Reducing material waste is a key link in resource saving. In the process of material procurement, the procurement plan should be made according to the accurate project budget to avoid overstock

and waste caused by excessive procurement. For example, through the detailed interpretation of architectural drawings and the calculation of engineering quantities, the demand for various materials can be accurately determined. In the process of material use, the refined construction technology should be popularized to improve the utilization rate of materials. For example, in the process of wood processing, the optimized typesetting software is used to rationally plan the wood cutting mode and reduce the generation of corner waste. Futhermore, strengthen the management of materials on the construction site, set up a special material stacking area, and take protective measures such as moistureproof, rainproof and sun protection to prevent materials from being damaged and deteriorated due to poor storage.

Improving the recycling rate of water resources is an important way to save water. A rainwater collection system can be set up at the construction site, and the collected rainwater can be used for dust suppression, concrete maintenance and other links with low water quality requirements. Futhermore, a sewage treatment system is established to treat the construction wastewater and reuse it. For example, through the processes of sedimentation, filtration, purification, etc., the waste water from concrete mixing is treated and reused for concrete mixing, so as to realize the recycling of water resources. In addition, strengthen the water-saving education of construction personnel and cultivate their good habits of water use, such as turning off the faucet and adopting water-saving appliances.

Rational allocation of human resources to improve work efficiency, thus indirectly saving resources. Before construction, according to the characteristics of the project and the requirements of construction technology, make a scientific staffing plan to ensure that the number and skill level of each type of work can meet the construction requirements. In the process of construction, modern project management methods, such as the introduction of information management system, are used to grasp the work progress and task completion of personnel in real time, and dispatch and coordinate personnel in time to avoid the slowdown and waste of resources caused by poor connection of personnel. The application process of information management in the construction stage is shown in Figure 2.

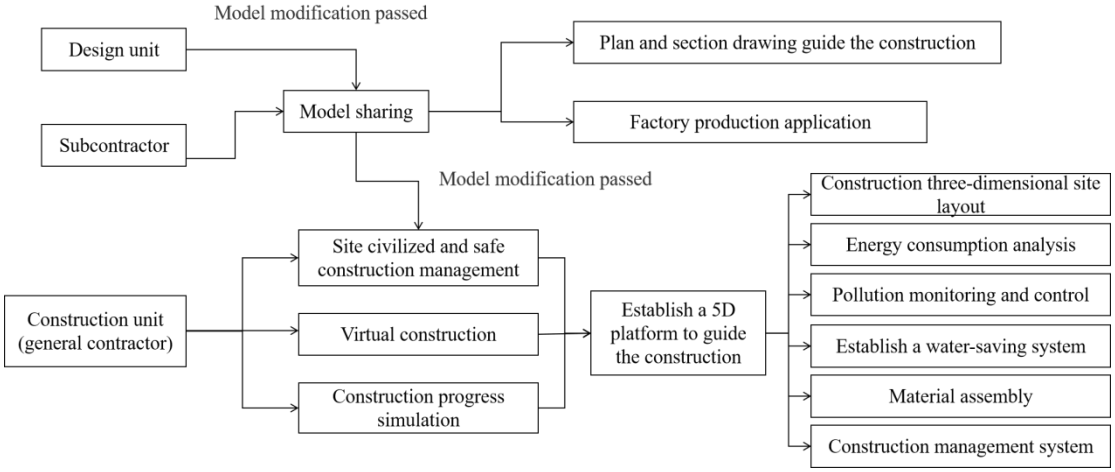

Figure 2 Application process of information management in construction stage

4.3 The way of resource recovery and reuse is expanded

Construction waste is the main waste resource in the construction process, and its recovery and reuse have great potential. Waste concrete, bricks and other materials can be processed into recycled aggregate through crushing, screening and other processes, which can be used to produce recycled concrete, recycled bricks and other building materials. This recycled material can not only replace some natural aggregates, relieve the pressure of resource shortage, but also reduce the energy consumption and environmental pollution in the production process of building materials.

Waste steel, wood and other materials also have high recycling value. Waste steel can be remelted and made into new steel products; After processing, waste wood can be used to make furniture, wooden templates and so on. In addition, the packaging materials produced in the

construction process, such as plastic film and paper packaging, should be classified and recycled to realize the secondary utilization of resources.

The recovery and reuse of water resources can not be ignored. In addition to the above-mentioned treatment and reuse of construction wastewater, the condensed water on the construction site can also be recycled. For example, the condensed water produced by air conditioning system can be used for greening irrigation after collection and simple treatment. By expanding these ways of resource recovery and reuse, we can maximize the utilization of resources in the construction process of green building projects, reduce the dependence on natural resources and promote the sustainable development of the construction industry.

5. Conclusions

In this article, the energy saving and resource optimization in the construction process of green building projects are comprehensively studied, and the key points of energy and resource management in the construction process are revealed. In terms of energy saving, construction energy consumption widely exists in many links, such as mechanical equipment operation, building materials processing and electricity consumption of temporary facilities. By selecting energy-saving construction equipment and technology, such as electric crane and prefabricated building technology, optimizing the construction organization design, and reasonably arranging the construction sequence, schedule and layout of the construction site, energy consumption can be significantly reduced and energy utilization efficiency can be improved.

In terms of resource optimization, construction resources include building materials, water resources and human resources. Reducing material waste through accurate purchasing plan and refined construction technology, using rainwater collection and sewage treatment system to improve the recycling rate of water resources, and scientifically allocating human resources can effectively save resources. Futhermore, the recycling and reuse of construction waste, waste steel, wood and water resources has expanded the way of secondary utilization of resources and realized the maximum utilization of resources.

Energy saving and resource optimization in the construction process of green building project is a systematic project, and the strategies are interrelated and synergistic. Only by fully implementing the strategy of energy saving and resource optimization can the sustainable development goal of green building projects be truly realized. The research results of this article provide practical theoretical basis and practical direction for the construction industry in the process of green transformation, which is expected to promote the green building project to achieve a higher level of energy saving and resource optimization in the construction process.

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