

# The Importance of Cost Management in the Design Phase of Green Buildings

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**Abstract.** Against the backdrop of global climate change and resource constraints, green buildings have become the core direction for the transformation and upgrading of the construction industry. As the source of project cost control, the design phase exerts a decisive impact on the economic efficiency and environmental performance of buildings throughout their life cycle. Based on the whole-life-cycle cost theory, this paper systematically analyzes the value, existing problems, and optimization paths of cost management in the design phase of green buildings, combined with practical tools such as BIM technology and standardized design. The research shows that by strengthening multi-dimensional collaboration, dynamic cost control, and the application of technological innovation in the design phase, the coordinated optimization of economic and environmental benefits can be achieved, providing theoretical support and practical guidance for the sustainable development of the industry.

**Keywords:** Green Building; Design Phase; Cost Management.

## 1. Introduction

With the intensification of global climate change and the growing problem of resource shortages, the construction industry, which accounts for 38% of global carbon emissions (28% in the operation phase and 10% in the building materials and construction phase), is facing urgent pressure to transform toward sustainable development. Green buildings can reduce carbon emissions by 30% to 50% throughout their life cycle through energy-saving designs, utilization of renewable energy, and adoption of low-carbon materials. However, their initial investment is usually 10% to 15% higher than that of traditional buildings, and this cost premium has become an obstacle to market promotion.[1]

The design phase is the "golden period" for cost control, as it not only affects the initial investment but also has a bearing on long-term operation and maintenance costs. Studies have shown that the design phase can influence 70% to 90% of the total project cost. Therefore, researching cost management in the design phase of green buildings is of great theoretical and practical significance.

## 2. The Importance of Cost Management in the Design Phase of Green Buildings

### 2.1 Determining the Scale of Initial Investment

The design of green buildings often requires the use of high-performance materials and systems (such as advanced thermal insulation materials, Low-E glass, and intelligent control systems), whose costs are significantly higher than those of traditional solutions. For example, the price of energy-saving wall materials is 20% to 50% higher than that of traditional brick walls, and intelligent systems substantially increase installation and commissioning costs. In addition, the complexity of green building design leads to longer design cycles and higher design fees (usually 10% to 20% higher than traditional projects). Therefore, the design phase plays a decisive role in determining the scale of initial investment.[2]

### 2.2 Controlling Long-Term Operation Costs

Green building design focuses on natural lighting, optimized ventilation, and efficient equipment, which can significantly reduce energy consumption and maintenance costs. For instance, a reasonable

building orientation and window-to-wall ratio can reduce lighting energy consumption by 15% to 30%, and efficient HVAC systems can save energy by 20% to 40%.[3] The use of durable materials and structural designs can also extend the building's service life, reduce maintenance frequency and costs, and optimize the whole-life-cycle cost.

### **2.3 Enhancing Project Economic Benefits**

Although the initial investment in green buildings is relatively high, their operational benefits are significant. For example, a green office project that adopts solar photovoltaic and ground-source heat pump technologies reduces annual energy costs by 40%, increases rental income by 20%, and recovers the additional investment within 10 years. [4] The environmental and comfort advantages of green buildings can also attract tenants and buyers, enhancing the developer's brand value and market competitiveness.

### **2.4 Promoting Sustainable Development**

Green building design emphasizes efficient resource utilization and environmental friendliness. Measures such as the use of renewable materials and optimized spatial layout can reduce environmental load. Designs such as rainwater recycling systems, water-saving appliances, and renewable energy systems can reduce carbon emissions and pollution, promoting the low-carbon transformation of the industry.

## **3. Existing Problems in Cost Management During the Design Phase of Green Buildings**

### **3.1 Lack of a Unified Cost Standard System**

Currently, green buildings lack a unified cost management standard. Different regions and institutions adopt different calculation methods and parameters, resulting in large differences in cost estimates and affecting decision-making. In addition, the update of design specifications lags behind, failing to reflect the cost characteristics of new technologies and materials, leading to a disconnect between design and actual costs.

### **3.2 Insufficient Multi-Professional Collaboration**

Green building design involves multiple disciplines such as architecture, structure, mechanical and electrical engineering, and landscape architecture, but there is a lack of an integrated cost control platform. Poor communication between different professions leads to fragmented cost management. Designers often work in isolation, and cost control is not integrated into the entire design process, which easily causes inefficiency and cost overruns.

### **3.3 Market Factors Pushing Up Costs**

The prices of green building materials are greatly affected by market supply and demand as well as policies. For example, fluctuations in the price of polysilicon, a key material for solar panels, directly affect the cost of photovoltaic systems. In addition, the high cost and insufficient supply of specialized services such as energy consumption analysis and environmental impact assessment further increase project expenditures.

### **3.4 Difficulties in Whole-Life-Cycle Cost Accounting**

The lack of a standardized whole-life-cycle cost accounting method makes it difficult to compare data between projects. Green buildings have a long service life and involve many participants, making data collection and integration challenging, and the accuracy and completeness of cost analysis are insufficient.

## **4. Suggestions for Improving Cost Management in the Design Phase**

### **4.1 Improving Design Standards and Specifications**

Establish a green building cost management standard covering all cost elements, clarify calculation methods and parameter ranges, and introduce a dynamic update mechanism to timely incorporate new technologies and materials, ensuring that cost control in the design phase is based on reliable standards.

### **4.2 Enhancing the Capability of Design Teams**

Regularly conduct training on green materials, energy-saving technologies, and evaluation standards. Integrate cost control into the design process and performance assessment, promote collaboration between designers and cost engineers, and achieve a balance between function and cost.

### **4.3 Responding to Market Cost Fluctuations**

Use big data platforms to monitor price trends of green building materials, establish an early warning mechanism to adjust procurement plans and design strategies. Introduce a competition mechanism to select cost-effective service providers and establish long-term cooperation to reduce service costs.

### **4.4 Improving Whole-Life-Cycle Cost Accounting**

Formulate a standardized whole-life-cycle cost accounting system, clarify cost components and calculation methods, and improve the comparability of data and decision support capabilities. Establish a cost data collection and management system, clarify the responsibilities of all parties, and ensure the completeness, accuracy, and traceability of data.

## **5. Application Strategies for Cost Management in the Design Phase**

### **5.1 Optimizing Design Using Value Engineering**

By analyzing the relationship between building functions and costs, select materials and technologies with the best cost performance to achieve necessary functions at the lowest cost. It is necessary to compare multiple schemes in terms of function, cost, and environmental benefits to enhance the comprehensive value of the project.

### **5.2 Using BIM Technology for Cost Simulation**

BIM models that include cost information enable integrated and visual management of design and cost data, improving the efficiency and accuracy of cost control. BIM can simulate the cost implications of different design options, allowing for rapid evaluation and optimization of designs to achieve precise cost control.[5]

### **5.3 Strengthening Multi-Party Collaborative Cooperation**

Designers and cost engineers should closely cooperate throughout the design process to ensure the economic feasibility of the scheme and avoid rework in the later stage. At the same time, opinions from the construction party should be introduced in advance to identify construction difficulties and cost risks, optimize the design scheme, and reduce changes and cost overruns during the construction phase.

### **5.4 Adopt Standardized and Modular Design to Reduce Repetitive Costs**

Establish an enterprise-level "design standard database" that includes general components (such as door and window sizes, pipeline interfaces, structural nodes, etc.), standard modules (such as apartment modules in residential projects, shop units in commercial projects), and supporting cost parameters (material unit prices, construction process costs, etc.).

Prioritize the use of contents from the standard database in the design. For example, in real estate projects, adopting unified apartment modules for the same product line can reduce the design cycle by more than 30%, and at the same time, material costs can be reduced by 15%-20% due to bulk procurement of standard building materials.[6]

For non-standard parts (such as the characteristic shapes of a project), limit their proportion (e.g., no more than 20% of the total design volume) to avoid cost overruns caused by excessive customization.

## 6. Conclusion and Outlook

This paper systematically analyzes the importance of cost management in the design phase of green buildings, pointing out its key role in controlling project costs, enhancing economic benefits, and promoting sustainable development. However, current cost management still faces problems such as imperfect standard systems, insufficient professional capabilities, the impact of market fluctuations, and weak data support. To address these issues, this paper proposes suggestions such as improving the standard system, enhancing design capabilities, responding to market changes, and strengthening data management, and discusses optimization strategies such as value engineering, BIM technology, and multi-party collaboration.

In the future, with the continuous progress of green building technologies, cost management will become more scientific, digital, and intelligent. It is necessary to further improve the cost standard system, strengthen data sharing and collaborative management, and enhance the overall cost control capability of the industry to support the high-quality development of green buildings.

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