

# Rapid Estimation Model of Green Building Engineering Cost Based on BIM Technology

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**Abstract:** The introduction of the Building Information Model (BIM) has had a profound impact on the construction industry. The information technology-based construction model has also changed the other aspects of construction project engineering while creating collaborative work methods. At the same time, with the implementation of the theory of sustainable development, green building projects have increased significantly. However, there are many problems in the current cost of green building projects, such as many sources of data sources, non-uniform standards, and low level of refinement. In this context, this paper deeply analyzes the necessity of BIM technology applied to the cost of green building engineering, and proposes three rapid estimation models based on BIM technology, in order to provide some reference for the benefit of enterprise capital investment.

## 1. Research background

### 1.1 Literature review

With the rapid development of the national economy, green building is the key development direction of the future construction industry. Investment in the construction industry has shifted from a single to a diversified, and the realization and guarantee of various stakeholders has become a research hotspot. At the same time, BIM technology has entered a new phase in the development of the construction industry. In terms of the cost of green building projects, exploring the application of BIM has become a research hotspot.

Lian Liling takes a comprehensive office building in Dalian as an example to establish a 3D-BIM information model and introduce it into the BIM subsystem. Compared with the traditional method, the new method is simple and intuitive, and has certain practical significance (Li, 2018). Zhang Lei, Jiang Li and others believe that green building is the only way in the process of sustainable development. Using computer technology, the BIM information model was established, and the design and evaluation of green building cost were integrated and managed, and the three-dimensional data information was used to realize the green building evaluation function (Zhang et al, 2018). Li Xuemei analyzed the construction projects of the market, explored the three challenges facing the cost of green building projects, proposed the BIM5D model, and selected the factors such as the process as the optimal factors to maximize the capital efficiency of the enterprise (Li, 2019). Wu Jiawei, Li Xisheng and others focused on the evaluation of green building sites. Based on the information classification of BIM models, a comprehensive design evaluation model was established. The DB Link plug-in and Excel spreadsheet were used to verify the feasibility of the model (Wu et al , 2017). Zhao Zhian, Qiu Xiangwu and others combined the evaluation criteria of green buildings to analyze existing problems and proposed that BIM technology can effectively solve massive data problems. On this basis, the concept of generalized building information model is proposed (Zhao et al, 2012). Wu Enzhou, Li Min and others raised the superiority of BIM in the cost of green building projects in response to the consumption of building energy. Studies have shown that the application of BIM technology can assist in the engineering cost process (Wu et al, 2017).

### 1.2 Purpose of research

The project cost has always been an important part of the construction project and one of the

main means to ensure the maximum profit of the investment. In order to ensure the core competitiveness of the construction, design and construction companies, it is necessary to continuously improve the project cost. Green building is an important development direction for future buildings, and its current application software is not cutting edge. The building process can not only be reflected, but also the phenomenon of capital investment, construction technology, project management and so on. Although BIM technology has been greatly developed in recent years, combing the existing literature can only focus on the main links of the whole life cycle of buildings and the evaluation of green buildings. Few scholars have studied the application of BIM technology in the cost of green building projects. . Therefore, it is of great practical significance to establish a rapid estimation model for green building engineering cost based on BIM technology.

## **2. Overview of relevant theory**

### **2.1 BIM technology**

The full name of BIM technology is Building Information Modeling, which is essentially a data tool, mainly used in engineering design, management and construction. By digitizing building information and integrating models, information can be effectively communicated and shared throughout the lifecycle of project planning, maintenance, and operations (Li et al, 2017). The use of BIM technology will help the participating entities of the construction project to correctly understand and process the building information, improve the synergy between each other, and further improve the production efficiency.

The core of BIM technology is to establish a virtual three-dimensional model corresponding to architectural engineering through digital technology. The model is the same as the actual engineering building information, and contains not only the state information and geometric information of the building information, but also various professional information related to the construction project (Shi, 2017). In the difficulty of the established 3D model data, the construction unit, the owner, the design team and other parties can communicate effectively and have lower communication costs. At different stages of construction of the construction project, all stakeholders can use BIM technology to upload, extract and modify information in time, thus enhancing the flexibility of the project.

BIM technology has three characteristics, namely visualization, coordination and simulation. Among them, visualization refers to upgrading the form of the traditional two-dimensional expression component, and displaying the component in front of people in three-dimensional form. The BIM visualization features not only enhance feedback and interactivity between components, but also support discussion decisions during project construction and operations. Coordination mainly refers to the coordination role of the participating entities in the construction process of the construction project. For example, in the early stage of construction, various professions are prone to collision problems, such as conflicts between pipeline layout and structural beam arrangement. The emergence of BIM technology has effectively solved this problem. Analogy means that BIM technology can not only simulate actual buildings, but also simulate what happens in the real world. In the construction phase, a 4D model can be performed, and a time factor is added to the model to simulate the construction quarter. The emergency operation mode can be simulated in the later operation stage. In addition, BIM technology can also achieve sunshine simulation, energy-saving simulation and so on.

### **2.2 Green building**

In the entire life cycle of a building, if it can save resources, reduce pollution, adapt to the ecological environment, and provide suitable space for human beings, the building can be called green building. A major principle of green building is to adapt to local conditions. Buildings need to combine local economic, cultural, environmental, resource, and climate characteristics to comprehensively evaluate the five dimensions of safety and durability, resource conservation, livability, convenience, and comfort.

Green buildings are focused on reducing the use of synthetic materials, increasing the utilization of sunlight, and providing residents with a sense of adaptability to nature. In terms of the indoor environment, green buildings emphasize the overall heat balance of the human body. On the basis of ensuring the air conditioning design in winter and summer, the green building is in the designer and needs to analyze the impact of the climate on the indoor environment. At the same time, green buildings should ensure a relatively comfortable light environment at different times. In addition, air quality is also a key consideration for green buildings. It is not only necessary to design a reasonable air circulation layout, but also to avoid the occurrence of bad odors in the selection of indoor materials. For outdoor environments, it is necessary to ensure compatibility with the surrounding environment to ensure good natural ventilation.

### **3. The necessity analysis of bim technology applied to the cost of green building engineering**

With the continuous development of China's sustainable development policy, green building standards have been further developed and improved. In the future urban planning, green buildings will become the mainstream development trend. However, it is contradictory that China's current green building design is only in its infancy, and system analysis tools are seriously inadequate (Ma, 2017). Specifically, the green building planning and design software has the following problems at this stage. First, the domestic green building design software is poorly developed, and the professional software surrounding the project cost is basically in a blank state. Although a series of foreign professional software has been introduced, most of them are energy-saving design software or extension software. Many cost functions are highly dependent on foreign software, and the independent intellectual property rights of the domestic green building planning and design software system have not been fully established. Second, the design software used at this stage is independent of each other, and each software cannot design the system according to the building information model. There is a serious repetitive description of software data, and data sharing cannot be achieved at all. Third, in the cost of green building projects, there are many majors involved, and there are many calculation softwares used. However, traditional computing software does not intersect, and their respective standards are not uniform. It is difficult to guarantee the consistency and accuracy of green building engineering cost.

The cost of green building engineering needs comprehensive design. Under the traditional technical conditions, the project cost is subject to many data sources, difficult management and poor refinement (Wang, 2017). The emergence and continuous improvement of BIM technology has brought new solutions to the improvement of the cost of green building projects. With the help of BIM technology, engineering cost personnel can be freed from massive calculations and multidimensional data management, and the BIM5D concept comes from this. Based on the traditional 3D building model, the time information and cost information are merged to form a 5D model of 3D+1D+1D. Compared with BIM3D, BIM5D will coordinate the engineering quantity and progress. The overall cost management not only considers the model units such as electromechanical, curtain wall and steel structure, but also effectively coordinates the conflict between different building units. Through the integrated model, the various materials and progress in the project construction are visually displayed. Costs, etc., make it easy for managers to conduct precise management and decision making. In addition, BIM data delivery is more reliable with the introduction of the "Building Information Model Application Standards". The BIM5D model can be directly interfaced with the GCL model. Through the bill of quantities, the cost personnel can revise the data in time to ensure the timeliness and accuracy of the data and conduct dynamic break-even analysis. When the building model unit data is input, it will be fitted in advance before the cost analysis, which reduces the workload of the project cost. Therefore, it is of great practical significance to establish a rapid estimation model for green building engineering cost based on BIM technology.

## **4. Fast estimation model for green building engineering cost based on bim technology**

### **4.1 Modeling specifications**

The rapid estimation model for green building engineering cost established in this paper is based on BIM5D. In the process of construction, follow the basic principles below. The first is the principle of model splitting. According to the specific hardware configuration, the model is further split to improve the system performance. The specific split has five dimensions, namely building construction, building number, construction, building partition and floor.

The second is to build a naming convention. Since family type naming has no fixed format standard, naming according to certain specifications can improve work efficiency. In the design, construction and completion stages, a proper naming can bring great convenience to data retrieval and delivery, and it is also a prerequisite for information to be valued. Therefore, at the beginning of modeling, the naming should include information such as the name, material, and size of each component as much as possible to ensure its identification. The naming method is “area-floor-component name-material-size-cost”. For example: “XX District - 7F - Solid Brick Wall - M10 - Solid Brick - 240 \* 240-80”.

The third is the modeling benchmark rule. Before modeling, the origin position is uniformly defined, and the grid and elevation are positioned. In the layer-by-layer drawing process, ensure that the same kind of components do not overlap, considering the spatial relationship between components will directly affect the data statistics, and agree on the relationship and requirements between different components. When cross-design occurs, set the modeling reuse rules to reduce the frequency of repetitive work.

In the preliminary design of the model plan, ensure that the parameters meet the relevant national standards for the cost of green building projects, and use the BIM technology to visualize the features to improve the cost accuracy. In the modeling process, the integrity of the BIM model data is guaranteed, and the redundant links of the green building engineering cost are reduced.

### **4.2 Modeling method**

This paper adopts three methods, the rapid estimation model of green building engineering cost of component BIM technology, which is a secondary development calculation plug-in, import development calculation pricing platform and utilization engineering quantity statistics Table. In the second development of the calculation plug-in, the application of the secondary development API interface, based on the open database principle, with the BIM design software platform, read the green building related cost information. According to the calculation rules set by the list quota, the cost statistics and calculation work are completed. The main source of this construction idea is the new point, the civil engineering calculation software launched by Swell, and the steel bar calculation software released by is BIM.

The introduction of the development calculation pricing platform mainly uses the data conversion tool to enter the API interface provided by the BIM design software, and convert the model data into the readable software readable data. After the data format conversion is completed, the original design model software is converted into a calculation file, which is derived by using the design software provided by the BIM5D system itself. The export data needs to be modified by other BIM modules. After the final completion, the engineering cost of the green building will be carried out. This component is mainly derived from the GFC data conversion tool launched by Guanglianda in 2014.

The last one is the engineering quantity statistics Table. In this method, the component engineering quantity is directly counted and summarized, and finally Excel is output. The corresponding green building cost personnel only need manual statistics and summary. The advantage of this model component is that there are few intermediate programs, and the disadvantage is that the coordination of BIM technology is not fully utilized.

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