

# *The Application of BIM Technology in Green Construction Management of Building Projects*

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**Abstract.** The traditional construction industry often accompanies environmental pollution and resource waste during the construction process. With the emergence of the concept of green development, the green building model has gradually become the mainstream trend of industry development. BIM technology is an important tool in the process of promoting green construction buildings. The purpose of this paper is to analyze the application of BIM technology in the green construction management of construction projects, based on the advantages of BIM technology, such as management, simulated construction, collaborative management, etc., combined with 3D technology to build a platform for implementation, and improve the efficiency of building construction. Through the case analysis of the Ningbo Manhattan Building, it is reflected that the design and application of multi-party collaborative management based on BIM are perfect, and the collaborative management of 3D models after lightweight processing can further strengthen green supervision. In the future, the application of BIM technology in green construction management will be further deepened and expanded to a higher dimension. Finally, the application of BIM technology in the green construction management of construction projects is elaborated and evaluated.

**Keywords:** BIM technology, green construction, construction management applications, construction simulation, Collaborative management

## 1. Introduction

Traditional construction methods such as earthwork excavation and foundation irrigation are commonly used, which have problems such as long construction periods, low efficiency, serious environmental damage, waste of resources, and unstable quality [1]. These drawbacks not only restrict the development of the construction industry but also cause great pressure on the urban ecology. As the concept of green development has gradually become the dominant direction of the construction industry, the green construction model has emerged, emphasizing the maximum energy saving, consumption reduction, pollution reduction, and optimization of the construction process under the premise of ensuring quality and safety [2]. Compared with the traditional construction

mode, it is more time-saving and labor-saving and can save a lot of resources and beautify the environment, while the traditional project management mode can no longer meet the needs of green construction.

In this context, BIM technology can be applied to building structures, so as to realize the greening of the construction industry. The advantage of BIM technology is that it can realize the three-dimensional presentation and dynamic management of building information in the spatial and temporal dimensions, which greatly improves work efficiency and construction accuracy [3]. Ba Huaiqiang [4] used BIM technology to carry out the collision inspection of the rotating bridge, simulated the construction, and verified its feasibility. Guo Wenbo et al. [5] established a smart construction site integration platform based on BIM technology, which effectively improved the progress of the Greentown Star City Light Tower project. Yang Bin et al. [6] used the characteristics of the BIM model to convert the constraints and influencing factors of the prefabricated building construction site into quantifiable data to improve the accuracy of the scheme.

## **2. The application of BIM technology in green construction management**

The application of BIM technology in green construction has significantly improved construction efficiency, management level and resource utilization through construction simulation, design change, construction plan and schedule management, cost and resource management collaborative management, etc., and promoted the development of the construction industry in a more environmentally friendly and sustainable direction. This section focuses on these aspects.

### **2.1. Construction simulation and design changes**

Thanks to the management system established by BIM technology in green construction, the relevant environment and topographic data of the construction site can be loaded into the database of BIM technology, and then the BIM 3D model can be used to carry out the dynamic simulation of each process in the construction process, and the feasibility study and deepening of the construction plan greatly improves the construction efficiency and the safety management level of the project [7]. The construction management process also includes the management of materials and data, and the material management mainly enjoys its own unique green building materials library, which allows customers to find the material data they want from the building materials library, and this material parameter information will be packaged into an independent building construction project material library for subsequent construction queries. Users can not only observe whether the expected effect is achieved through the design of the simulated building but also observe the local distribution of various spaces. In addition, the BIM platform can also recommend cost-effective building materials for customers through the differences in the surrounding environment and the screening of big data, and the material price in the platform also has a certain degree of real-time [7].

Data management is the carrier of design change, the use of BIM technology management, can be different green building site construction data collection into the BIM database, and the technical management system covers material price information, environmental impact coefficient, space environment construction feasibility, etc., and then the data is verified to ensure the accuracy and completeness of all information in the construction process. During the construction process of the project, whether it is a change in the construction plan or encountering unfeasible factors during the construction, the data model does not need to be completely overturned. It can be modified and organized only for specific areas, and the relevant data will continue to be updated. This plays a key role in the management of BIM technology in green building.

## 2.2. Construction planning and schedule management

The schedule for building construction is the timeline of the construction process and is used to control the duration, cost and quality of the construction. The rationality and effectiveness of the construction plan will affect the construction efficiency and progress, as well as the utilization of resources. At present, there are problems such as material accumulation, equipment failure and construction program incompatibility in construction, which leads to scheduling delays, not only reducing construction efficiency but also increasing the cost [8]. The effective application of BIM technology can share the data needed for the construction process, establish a data model, and realize the reasonable management of the construction process.

In addition, BIM4D through the construction simulation software, BIM and construction plans associated with the 3D basis to increase the time factor, you can intuitively show the construction progress and expected completion time, to achieve the visualization of the construction process [9], intuitive image to show the progress of the project, a more macro-control of the construction site arrangements. BIM4D technology can detect the collision and correct the collision points in the plan for the schedule, and finally obtain a reasonable plan. Through better planning and management of construction, it can reduce the waste of materials due to design changes and construction errors, avoid direct cross-interference of various work types and unreasonable construction sequences, and also reduce energy consumption and carbon emission, thus realizing green construction.

## 2.3. Cost and resource management

BIM is closely related to cost management, and BIM contains rich building information, which can be processed to carry out accurate cost budgeting and reduce human error. BIM5D technology is the introduction of timeline and cost elements on the basis of BIM technology, which is capable of integrating progress, cost, resources, management and other information to dynamically simulate the construction process and provide timely information on the progress, resource consumption and cost changes in construction, and to monitor the progress and cost changes of the project promptly, so as to improve the management efficiency [10].

Managers can monitor the design, construction progress and cost of construction projects in real-time through the platform provided by the virtual constructed models of BIM5D technology, realizing more efficient project management and more accurate time and cost control. Constructors can apply the BIM5D platform to fine-tune the management of construction projects. Smart site is the application of BIM5D technology to unite the information from various platforms so that related parties such as architects, engineers, contractors and suppliers of the project can share and update the information in real-time, and this application also helps to optimize the construction process and to reach the goal of enterprise management [11,12].

## 2.4. Collaborative management

In some traditional construction projects, the construction, design, and management of the project are not managed together, there will be communication errors between the various teams, poor information, design errors and management confusion and other problems, and the emergence of BIM technology, its collaborative management features effectively improve all this. BIM is an enabler of green building processes and many buildings incorporate BIM technology (Maskil-Leitan, 2022). And all staff such as designers, construction workers, and material suppliers can coordinate their work through the BIM platform. For example, if the construction team encounters

some unexpected conditions, the system will adjust immediately, without the need to respond through the information transmission, and then the project changes, the system can be updated immediately, which can reduce the time transfer difference, greatly improving the efficiency. The collaborative management of the BIM is to provide a unified brain for the construction project, this brain for the project of the various tasks assigned to the appropriate instructions, saving time, and money! BIM is a very effective way to develop green buildings.

### 3. Case studies

The Application of Digital Intelligent Management Systems in Ultra-high-rise Projects\* -- Taking Ningbo Manhattan Tower Project as an Example. With the advancement of the national “14th Five-Year Plan”, the diversification of construction projects is clearly defined, which promotes the process of digitalization in the construction industry. Ningbo Manhattan Tower is located in the southern business district of Ningbo, the building area is about 150,000 square meters, the building height is about 251 meters, the number of floors in the building is 64, of which the number of floors above ground is 55, and the number of floors below ground is 9, the building is a collection of offices, shopping centers, senior apartments and other types of housing, and the building's construction process is a collection of advanced concepts such as greening, digitalization, and intelligence, the building is also a representative of modern architecture. The building is also a representative of modern architecture.

The “1+3+N” Digital Intelligence Lean Construction System applied to Ningbo Manhattan Tower has achieved remarkable results. In terms of construction safety, the use of simulation technology to optimize the pit scheme effectively reduces the lateral displacement of the pit and ensures construction safety. In terms of construction equipment, the core cylinder of the project adopts the self-developed “SWP Intelligent Building Machine” to improve construction speed and is equipped with an intelligent health monitoring system to monitor the health of the platform in real time and prevent accidents from occurring. The project adopts engineering digital control, for the groundwater environment, groundwater real-time monitoring and other scenarios to continue some virtual simulation and deformation data real-time monitoring, which effectively reduces the risk of the construction phase. The project also adopted concrete digital monitoring, the detection in the traditional detection technology based on the development of a set of digital cloud platform, the concrete digital detection.

Digital transformation is the key to digital management. The project identifies, optimizes, and solves potential problems in the design phase with the help of BIM technology and advanced information technology such as simulation, which significantly improves the quality and efficiency of the construction phase. Based on BIM, multi-party collaborative management is carried out, customized processes, forms and applications are better designed and applied, and 3D models are uploaded to the platform for collaborative management after lightweight processing, which further strengthens green supervision.

### 4. Future prospects

With the increasing global focus on sustainable development, the application of Building Information Modeling (BIM) in green construction management is expected to advance further and expand into higher dimensions. In the future, BIM technology is anticipated to evolve toward 6D (sustainability) and 7D (facility management), establishing a comprehensive lifecycle management framework for buildings. For instance, by integrating green building material databases with carbon

footprint tracking systems, BIM can facilitate dynamic monitoring of resources throughout the entire supply chain—from material production and construction to operation, maintenance, and demolition. Furthermore, leveraging advanced technologies such as artificial intelligence (AI), the Internet of Things (IoT), and big data analytics, BIM can enhance construction decision-making processes. This includes employing AI-driven algorithms to predict potential construction risks and optimize resource allocation strategies.

However, the widespread adoption of BIM technology in green construction management still faces several challenges. Firstly, technological integration poses significant difficulties, as the convergence of BIM with emerging technologies like IoT and AI requires interdisciplinary collaboration. Currently, the lack of unified standards may lead to data silos. Additionally, multi-platform coordination involves handling vast amounts of sensitive data, making information security a critical challenge. To address integration issues, future efforts should focus on establishing unified data standards and collaborative platforms. Adopting globally recognized Industry Foundation Classes (IFC) data formats can effectively resolve compatibility issues across different BIM software. Furthermore, research into multi-layered security protection systems should be strengthened, and the introduction of blockchain technology can ensure data traceability and immutability.

The application of BIM technology in green construction management is profoundly transforming traditional practices in the building industry. By creating digital 3D models, BIM enables meticulous lifecycle management from design to construction, providing robust technical support for sustainable practices.

In construction simulation and design modifications, BIM's dynamic 3D modeling allows precise simulation of the entire construction process, identifying and resolving potential issues in advance. The platform's built-in green material database, combined with environmental data analysis, optimizes construction plans. When design changes are necessary, BIM's data-driven approach enables localized adjustments and real-time updates, significantly reducing rework costs.

4D BIM integrates the time dimension to visualize construction progress, helping managers intuitively track project timelines. Its clash detection feature identifies scheduling conflicts early, optimizing workflow arrangements. 5D BIM incorporates cost elements to establish a dynamic monitoring platform, enabling real-time tracking of budget fluctuations and precise resource allocation control.

A core strength of BIM lies in its collaborative management capabilities. Through a unified digital platform, stakeholders—including designers, contractors, and supervisors—can share information and coordinate in real time. This collaborative mechanism effectively resolves information asymmetry across traditional project phases, reducing communication overhead and enhancing decision-making efficiency.

## 5. Conclusions

This study employs literature analysis and case study methods to examine the application of BIM technology in green construction management for building projects. The research focuses on BIM's advantages in four key areas: construction simulation and design modification, construction planning and schedule management, cost and resource management, and collaborative management. Through the practical case study of Ningbo Manhattan Tower project, the study validates BIM's effectiveness in enhancing green construction efficiency, optimizing resource utilization, and reducing environmental impact.

The findings reveal that BIM technology significantly improves construction accuracy and efficiency through its 3D dynamic modeling and digital management platform. In construction simulation, BIM enables early identification of potential issues and optimization of construction plans. For schedule management, 4D BIM facilitates visual progress tracking and reduces workflow conflicts, while 5D BIM enhances resource efficiency through dynamic cost monitoring. Moreover, BIM's collaborative management function breaks down information barriers inherent in traditional construction projects, enabling real-time multi-party coordination and further advancing green construction practices.

The application of BIM technology in green construction management still holds substantial potential for development. Future research could further explore the integration of BIM with emerging technologies such as artificial intelligence and the Internet of Things to establish an intelligent management system covering the entire building lifecycle. Simultaneously, technical challenges including data standardization and information security need to be addressed to fully realize BIM's potential.

### Authors contribution

All the authors contributed equally and their names were listed in alphabetical order.

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