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Exploration of the Application of BIM Technology in Green Intelligent Building Design

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Abstract: Green intelligent buildings can provide humans with a healthier and more comfortable living environment, while also saving resources and reducing pollution. They represent the main direction of development in the construction industry and are an important means of achieving social sustainability. In China, with the rapid development of the economy and urbanization, limited resources cannot adequately meet the huge energy consumption brought by modern building projects. Therefore, it is necessary to introduce Building Information Modeling (BIM) technology into green intelligent buildings to achieve resource savings and create greener and smarter living environments for people. Based on this, this article explores the specific application of BIM technology in the design of green intelligent buildings, aiming to provide reference for architectural designers and achieve the modernization and sustainable development of the construction industry.

Keywords: BIM technology; Green Intelligent Building; Design Application

Introduction

With the advent of the information age and the rapid development of computer technology, new opportunities and challenges have emerged for the construction engineering industry. In traditional architectural design processes, designers often struggle to integrate various information organically and may not promptly identify and solve problems that arise during the design process due to the influence of design methods. The emergence and development of Building Information Modeling (BIM) technology have brought new technological and managerial methods to the construction industry. BIM, as a Building Information Modeling system, is an engineering design method based on digital information technology, multidimensional data models, and simulation analysis technology. Therefore, it is essential to emphasize the application of BIM technology in the design of green intelligent buildings.

1. Advantages of BIM Technology in the Design of Green Intelligent Buildings

Firstly, applying BIM technology in the design of green intelligent buildings can integrate information from various disciplines onto one platform, reducing the complexity of data transmission and saving project costs. By utilizing embedded data algorithms in BIM software, the integrated management of information from various disciplines can achieve multiple

pathways of data interaction, thus better realizing the sharing of information resources and improving data interoperability. In practice, green intelligent buildings are much more complex and technically challenging than traditional residences, and the intersection between different professional fields can pose problems for project management and design. On the BIM data platform, multiple disciplines can collaborate and communicate, facilitating resource sharing. Through the exchange and management of information from various disciplines in structural engineering, the rationality and scientific nature of the entire design scheme can be enhanced. Additionally, the design content of different architectural disciplines can achieve multidimensional cross-stage design, significantly improving design efficiency, saving costs, and enhancing design quality. Secondly, using BIM technology, a comprehensive understanding of various structural forms, materials, selections, and equipment configurations in the structural design of green intelligent buildings can be obtained. The virtual BIM building model can greatly improve the efficiency of designers' work, save costs, and reduce the probability of human errors. Compared to other three-dimensional modeling software, the visualization of BIM technology can output data together with the architectural information model, allowing designers to have a more intuitive understanding of the performance of various aspects of the building structure. Lastly, applying BIM technology can avoid design issues caused by technical or human negligence, affecting the quality and safety of subsequent engineering construction. The structural model constructed using BIM technology can be simulated because it contains relevant information data such as building materials. By simulating the impact of different external conditions on the model in actual engineering, reasonable design and prediction of the stress state can be achieved. Additionally, BIM technology can perform precise detection and analyze whether there are collision issues in the building during the design process, optimizing collision positions. Architects can simulate and model buildings by adjusting corresponding data, thereby improving the scientific nature of building design. In practical applications, to ensure the completeness of the model, collision detection methods can be used to analyze conflict points in the building information model. Based on the structural design data and component number information provided in the design drawings and material lists, all the data required for construction parameters can be queried, and parameter adjustment and optimization can be carried out together with construction personnel in specific areas. Furthermore, BIM technology can compare the different construction parameters of various disciplines in the design stage and select the best construction plan. After structural analysis, the overall design scheme can be finalized.

2. Application of BIM Technology in the Design of Green Intelligent Buildings

2.1 Building Layout Design

The overall planning of green intelligent buildings mainly refers to the layout of building plans and interior space arrangement. Due to the abstract nature of architectural space design, utilizing BIM technology can help designers understand the spatial planning layout more intuitively, facilitating better design work. Through visualized models, the actual effects of the design can be verified. In terms of building layout, using BIM technology to construct building models allows adjustments to building orientation and height to optimize lighting, spacing, and ventilation. Based on accurate calculations of the building footprint, optimal building layout design solutions can be found. Regarding interior space layout, constructing interior design models with BIM technology allows for reasonable layouts and designs for ventilation, lighting, and airflow to ensure overall interior comfort. For example, designers can simulate calculations according to the "Architectural Lighting Design Standard" (GB50033-2013) to improve indoor lighting environments and reduce energy consumption.

2.2 Building Structural Design

When optimizing building structures, various factors such as component stress conditions and spatial positions should be considered comprehensively. For example, using finite element software to analyze the structure of building engineering can identify weak points and optimize them as design objectives. Based on this, BIM simulation calculations enable designers to fully consider various design elements, thereby reducing project costs. Currently, BIM technology is widely used in the structural design of intelligent buildings to model and assemble

buildings with different functional areas and spatial forms, and simulate and test them using software. Based on engineering reality, structural arrangement, loads, and spatial forms are optimized. Additionally, the optimization of key components is essential in intelligent building design. For example, in the components such as steel trusses and stairs of intelligent buildings, selecting the most suitable materials and conducting simulation tests under different material structures using BIM technology can identify the most economical and practical building materials.

2.3 Building Energy Analysis

Firstly, BIM technology integrates various parameters, components, and system information in the building design process, considering factors such as climate and usage conditions to simulate building energy consumption. Based on this, simulations of building energy consumption under different seasons and meteorological conditions evaluate the energy-saving level of buildings, identify peak and off-peak periods of energy consumption, and determine specific energy consumption reasons for optimization design by designers to achieve optimal design of building energy consumption. Secondly, BIM technology can simulate and optimize internal energy systems in buildings. By comparing and analyzing various energy system structures, the optimal energy system combination can be found, and comprehensive optimizations of heating, cooling, ventilation, and lighting systems can be made to achieve energy-saving goals. Additionally, BIM technology provides data on material properties such as thermal conductivity, heat capacity, and light transmittance to simulate various material characteristics in buildings. Different materials have different energy consumption characteristics, and BIM technology can analyze building energy consumption, evaluate material performance, select the most suitable material types, and enhance building energy efficiency. Lastly, BIM technology can optimize and simulate the overall form of buildings. By changing parameters such as building layout, orientation, and shape, simulations of building energy consumption effects can be achieved. By comparing various forms of energy consumption, the optimal building form can be identified to achieve energy-saving purposes.

2.4 Building Site Design

Site design refers to the comprehensive design of the structure of green intelligent buildings, as well as an important part of the overall engineering construction project. In this process, designers can use BIM technology to model the site and simulate its spatial location. Designers should collect various data from the site using various measurement methods to obtain data consistent with the actual site. Subsequently, the collected and organized site measurement data can be input into BIM software to automatically generate corresponding site models, providing designers with intuitive 3D effect models of the site. Additionally, through a three-dimensional site plan, an overall understanding of the project site can be obtained, and relevant data such as elevation and slope can be acquired for more detailed and rigorous design. At the same time, designers need to combine the geographical location, climate, and environmental conditions of the project site to design its internal site, ensuring harmony with the surrounding environment and minimizing damage to the surrounding ecological environment during construction and use.

2.5 Construction Operation Simulation

When simulating construction operations, first, the physical model of the building should be established, and then BIM technology can be used to simulate the entire construction process. Based on this, using 3D modeling software compatible with interoperability, structural and nodal models of buildings can be established and managed using BIM technology. When simulating building construction, specific site conditions should be investigated first, and then related building parameters should be designed in the model based on the actual conditions and design requirements. BIM technology can simulate planning, construction demonstrations, and construction progress of construction sites. In structural design, different functional areas can be combined. For example, different functional modules can be set up between office areas and equipment rooms or between office areas and office areas to improve the practicality and scalability of buildings. By combining simulation models with visual analysis, three-dimensional visualization and simulation analysis of building structures can be achieved, design schemes can be improved, and relevant information data can be

collected and processed.

3. Recommendations for the Application of BIM Technology in the Design of Green Intelligent Buildings

Firstly, design personnel and construction teams should undergo professional training in BIM technology and operation skills to enhance their understanding of BIM software and model principles, and acquire proficiency in its usage. Continuous learning about the development trends of BIM technology is also essential to keep skills updated. Secondly, emphasis should be placed on data standardization. By establishing unified standards for BIM, data interoperability and sharing between different disciplines can be achieved, preventing errors caused by inconsistent data formats or quality issues. Encouraging efficient collaboration and communication among designers, engineers, construction units, and owners is crucial. Building a BIM information sharing platform and collaborative working mechanism ensures timely data transmission and reduces information gaps. It's important to select BIM software that meets the requirements of green construction design and ensure that the necessary hardware facilities meet operational needs. Regularly monitor updates and changes in software and hardware to keep equipment up-to-date and functioning effectively in engineering design. Additionally, staying abreast of the latest green construction technologies, policies, and standards is essential. Continuous improvement and innovation in the application of BIM technology are necessary. Introducing new methods, technologies, and materials ensures the effective implementation of green construction design schemes and promotes sustainable development. Lastly, establishing a case database and knowledge sharing mechanism facilitates the exchange of successful cases, best practices, and advanced experiences in projects, promoting practical applications and references in green construction design in China.

Conclusion

In conclusion, compared to traditional buildings, green intelligent buildings place greater emphasis on energy efficiency, environmental protection, and intelligence. This requires designers to adopt a human-centered approach in the design process, considering the relationship between humans and nature to create a harmonious and comfortable living environment. Against this backdrop, the application of BIM technology in the field of architectural design is becoming increasingly widespread, playing an important role in areas such as building sites, architectural forms, floor layouts, and design scheme simulations. Therefore, for BIM technology to be better applied in the design of green intelligent buildings, it needs to be continuously integrated into everyday green and intelligent design practices. Only then can BIM technology truly fulfill its role and contribute to the modernization of the construction industry.

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