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Application of BIM Technology in Building Structure Design

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Abstract: With the emergence of BIM technology, the design concepts and methods of building structures have also changed. For construction design work, it is necessary to reasonably control the various elements of building structure design and scientifically and rationally design the building structure to facilitate on-site construction. Based on this situation, the current BIM technology plays an increasingly important role in the process of building structure design and plays an active role in promoting optimal building structure design.

Key words: Construction engineering; Structural design; BIM technology

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1 Introduction

With the rapid development of China's construction industry, BIM technology is also rapidly developed and applied in China. BIM technology brings new, important and positive concepts to the building structure design industry. Through the continuous promotion and application of BIM technology, the traditional two-dimensional plane building structure design mode can no longer meet the needs of project construction. Using the new design concept of BIM technology, the three-dimensional design model has entered the construction stage of the project, so that the project has a more detailed database construction level and a more detailed description of the building-related information.

2 Architectural and structural design

2.1 Three-dimensional effects

BIM technology is not a single technology, but a collection of many new technologies and methods. In BIM technology, 3D technology is an important component. During the design process of a building structure, 3D technology can be used to display the structural model of the building in 3D, which the designer can build with BIM technology. It can be used to perform detailed follow-up observations for each model unit, such as the building plumbing system, water supply and drainage system [4]. Also, in the process of examining the 3D form model of the building structure, detailed information about specific structural units can be obtained and scientific dispositions can be used to mitigate potential safety risks and other potential problems. Structural problems that arise in the actual model are likely to occur during the actual process, so they can affect the overall level of construction quality as well as the social and economic benefits of the construction project, and must therefore be addressed and carefully resolved.

2.2 Promote uniformity in the design of building structures

Thanks to the application of BIM technology, the visual experience is improved not only by the use of 3D technology. In its application, BIM technology can further contribute to the unification of a building's structural design by interrogating many structural model units within the building structure in real time, such as the exterior, light sources, material properties and other elements. The role of BIM technology in building design integration exists not only at the design level of the building design drawings, but also in the pre-processing calculation process of the building structural model. BIM technology can

calculate the data information of each structural unit in the building structural design to show the actual architectural effect and promote the realization of integrated building design. A unified organizational chart is shown in Figure 1[5].

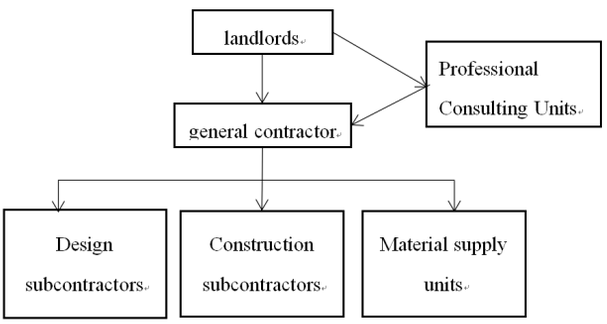

Figure 1. Harmonized organizational chart

2.3 Promote harmonization of data and information informatics

The advantage of BIM technology over the traditional design mode is reflected in the information processing capability. In order to support the development of modern science and technology, BIM collects and processes all engineering information in the design of building structure, and quickly builds the data and information database of relevant structural units through computer software to speed up the transmission and processing of building engineering information. The building structure itself is a large module composed of multiple structural units, so all kinds of information are closely related to the building design process. The construction of an integrated database is very convenient and can save the running time of building structure design. In practice, by implementing information directional search, precise search and target search, the accuracy of information in existing information integration methods is effectively avoided, thus facilitating the effective development of building structure design[6].

3 Application of BIM technology in building structure design

3.1 Analysis of building structure function

The application of BIM technology can simplify and optimize the numerous building structure performance analysis tasks performed by relevant designers in the traditional building structure design process, which not only reduces the capital investment in project construction and design, but also effectively reduces the economic efficiency improvement of the building structure. The traditional design model has a great influence on the human factor, the workload is large and complex, and the working condition of the relevant personnel is very demanding.The application of BIM technology can realize the analysis of the building structure function by simply entering all the relevant information into the BIM model, and at the same time, effectively correct the building structure design scheme is not enough to quickly optimize the structure design scheme[2]. In the field of architectural design, the company's Revit software can simulate building daylight analysis, building exterior and interior design; Insight software can use the advanced simulation engine and building performance analysis data integrated in Revit to design more energy-efficient buildings. In the area of structural design, the company's Robot Structural Analysis software is based on finite element theory and provides integrated, complex nonlinear analysis and design that includes steel and concrete structures.

3.2 Coordinating the structural design of buildings

In order to completely guarantee the construction quality of the construction project, BIM technology is used to process and analyze the building structure information in the application process, and the BIM model information is timely and accurately transmitted to the building structure designers through software interaction. In the process of transmitting this information, different building structures correspond to different BIM technology models. Intermediate data processing computer software can be used to process the auxiliary data to ensure the accuracy and effectiveness of the information transfer process. In addition, in the process of coordinating the design of building structures, attention must be paid to the scientific and effective management of the database of BIM models so that all building structure designers can identify and receive information as quickly and efficiently as possible [2]. The effective transfer of information among building structural designers can effectively improve building efficiency by achieving perfect coordination between structural functions and decorative works, water supply and drainage works, and outdoor work. Take Autodesk Software's products as an example: in the area of structural steel design, the company's Advance Steel software uses Revit two-way links to collaborate on structural steel nodes, thereby increasing design efficiency. In the field of structural build-

ing design, Revit can use working sets according to project complexity, volume rules, number of workers, and project functions to collaborate on design, thereby improving design efficiency.

3.3 Information Sharing of Building Structural Models

Design tools based on BIM technology play an important role in the structural transformation of buildings. This software enables efficient model setting, simulation analysis, rational calculations and fast design generation. The interaction and storage of information plays an important role, BIM technology can not only effectively integrate such building structure information, but also combine different building modules of the same project in a short time, and the central server function can fully integrate the internal design, building structure design and electromechanical design. It is like a huge database to be merged. The organic combination of multi-unit modules allows designers to access relevant information directly through a network connection, thus effectively supporting design work[3]. The process is implemented as follows: (1) A central file database is created using a central server on a local area network (LAN) as a carrier. (2) Designers use their own BIM core modeling software as a tool to build building information models by connecting to the central database. Each of the different professional modules can use the central file to effectively share information in the design of the building structure with other professional designers. As an example, the Revit software can export common data files in the following formats: DWG, DXF, SAT, DWF, FBX, and IFC.

3.4 Anatomy of the construction site and building structure

The overall construction quality of an excellent construction project comes from a sound structural design plan on the one hand and from the construction site on the other. At the same time, the possibility of interference from other factors at the construction site is much greater than in structural design work, so it is necessary to consider the environmental factors at the construction site. BIM system integrates information systems with geographic information in order to build a model of the building project based on the conditions at the construction site. At the same time, designers can modify the site construction based on relevant materials in order to effectively match the structural design of the building with the site construction, thus improving the overall construction quality of the project. Autodesk Software, for example, uses InfraWorks to simulate a model of a proposed building in existing natural conditions using GIS data, providing an outstandingly realistic visual experience and communicating design intent. Navisworks software is also used to integrate design and construction data into a single model, resolving conflicts and issues prior to construction, thus enabling effective integration of site and design.

3.5 Application of Structural Modeling in Steel Buildings

Steel structures are one of the most widely used structural forms in current construction projects and one of the most promising for the future. In the process of modeling steel structures using BIM technology, the designers of building structures can easily access information parameters such as reinforcement and connections, especially to better control the number of bolts commonly used in steel structures. At the same time, there are various forms of connections in steel structures [1]. When determining a particular design plan, the height of the beams must be considered to ensure that the connecting components meet the relevant design requirements [1]. Using BIM techniques, designers can design connectors by modifying the relevant parameters, which greatly improves efficiency. Finland's Tekla is a structural steel detailing software. It creates a 3D model and then automatically generates structural steel detailing and various reports to achieve a convenient view of the function. The software can synchronize the output of the steel structure components, parts and accessories (bolts, materials, surface area of components) reports. It provides data support for the subsequent steel structure deepening design and parts procurement and processing.

4 Conclusion

In summary, the wide application of BIM technology to construction projects can not only reduce project costs, but also implement the concept of sustainable development and improve building efficiency. However, at present, BIM technology still faces some problems in the application, such as: model data can only be one-way communication between different companies' software, the component database is small and can not completely cover all products in the market, etc. Through continuous accumulation of BIM technology application experience, similar problems can be gradually reduced. By accumulating experience in the application of BIM technology and gradually

reducing similar problems, BIM technology can play a better role in the design of building structure, and realize the optimization of building structure design and the improvement of building quality.

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