Research on 4D Visualized Dynamic Construction of BIM Building Decoration

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Abstract: BIM visualization 4D technology is applied to residential decoration and decoration construction sites, to establish Project and Revit model perspective analysis through Autodest Navisworks software, and make personalized modifications according to the different needs of customers to meet the current internal needs of fashionable buildings and dynamic decoration.

1. Introduction
In the construction management of building decoration projects, there are relatively many and complex factors to consider. The technology, technology, materials and human resources of the construction must be considered, and other factors of the overall decoration construction process must be considered. In the past, various horizontal road maps, network maps, etc. were used as auxiliary management methods for decoration construction progress in decoration, and it was often impossible to achieve precise and unified coordination between construction products and construction progress. At present, the application of BIM visualization technology (Figure 1) in decoration construction management can effectively solve this problem. Through BIM technology, the dimensionality and precision of visual dynamic time management can be effectively realized, and real dynamic construction simulation can be realized.

There are many experts and scholars in the research industry for research and discussion in the dynamic construction of decoration. For example 2019[1] Zhang Xinggang's architectural decoration design uses BIM technology to effectively avoid the disadvantages of traditional architectural decoration design, and enhance the design efficiency and rationality. 2019[2] Yang Buping provides reference for building construction optimization and dynamic management with BIM and 4D technology. 2018[3] Qiu Lan discussed the dynamic layout of construction sites with BIM 4D optimization technology. 2018[4] Chen Peihua used BIM technology in building decoration construction engineering to achieve the effect of shortening the construction period and saving costs. 2018[5] Wang Huajie uses dynamic cost management to effectively control the cost of decoration projects. 2018[6] Zhang Qiang visualized citespacelV software graph analysis, revealing the dynamics of domestic architectural decoration design field. 2017[7] Zhang Ailin and others used BIM technology combined with 3D scanning integrated dynamic management system to provide decision-making analysis for building construction informatization. 2016[8] Ding Yongjun achieved energy conservation and environmental protection through the BIM management information system construction project. 2013[9] Duan Yujuan uses the BIM information platform to reduce construction costs and achieve dynamic cost control and management for general construction contracting. 2013[10] Liu Bo uses the LY company project case to control the management method and technology of indoor engineering cost. 2013[11] Wang Jue puts forward dynamic measures to effectively reduce the cost of
construction projects based on examples of decoration projects. 2009\textsuperscript{[15]} Mo Wugang discusses decoration construction and dynamic design for prefabricated houses.

Fig 1. BIM visualization technology

2. Features of Revit

Revit is an integrated platform for design functions, providing the design, drawings and schedules required by the building information model. In the Revit software model, all drawings, 2D and 3D views and schedules are used to display the information in the same virtual building model. When working with building models, Revit collects information about the building project and integrates all other project content to express this information. The Revit parametric change engine can automatically coordinate your changes in any model view (Figure 2), drawings, schedules, sections and planes. The functions of Revit are as follows:

Fig 2. Revit parametric design model view

2.1. Architectural design

First through the perspective analysis centralized access to performance data and high-level analysis engine to optimize building performance. Then draw and create free-form models with conceptual design and create mass analysis. Use the RayTracer 3D design visualization rendering engine to quickly and accurately present the design that is convenient for exploration, verification and communication. Then use cloud rendering to produce realistic visualizations, and connect LiDAR scanning directly to the BIM process to create an established model. Then the FormIt converter and Revit create design data to develop and design the architectural model, and add architectural elements to the architectural model, including walls, doors, windows and components.
2.2. Structural Engineering and Manufacturing
Create a coordination file physical model with physical and analytical models, and analyze structural related analysis models. Then use Revit to analyze and execute static analysis and gravity in the cloud. Analyze, display the results and create a 3D reinforcement design. Production reinforcement workshop drawing files and steel reinforcement schedule. Use Revit various parameter steel to connect the structural steel modeling to make higher-level detailed model connections. Create an accurate and detailed multi-material design structure file.

Two-way links and analysis results are integrated into the BIM process, and work in the iterative design workflow. The operability between Revit and Advance Steel for link structure manufacturing helps to provide a seamless BIM workflow from steel design to manufacturing. Dynamo provides structural engineers with the use of graphic controlled structural engineering calculation logic to develop an optimized structural system.

2.3. MEP Engineering and Manufacturing
The content of AWWA valves and pumps includes the wastewater system content library of the American Water Works Association standard by Revit. Integrate Insight centralized data and advanced analysis engine to optimize construction performance. Use "design and production" tools to convert design-level model elements into construction-level detail elements. The function of arranging and marking manufacturing elements with Revit records makes the file model layout more efficient. HVAC designs complex piping and piping systems to express intent, and simulates piping and piping systems with mechanical design. The design model and electrical system track the electrical load of the distribution system, create design and record the sanitary piping system diagram of the inclined pipe and layout piping system, create the model with MEP in Revit and then use the MEP LOD 400 component to model.

2.4. Construction
Export the construction content from the design model, split and operate the wall and concrete pouring, and make architectural modeling drawings. Coordinate the upload of the Revit construction model to BIM 360 Glue for synchronization with BIM 360 Layout. View shared data on the BIM 360 Glue web interface or the BIM 360 Layout iPad app. Link to Advance Steel, using steel details and manufacturing to help accelerate the design to steel structure engineering manufacturing. Convert the MEP engineering production detail model elements on the design side to the production side detail elements, and coordinate the production and installation in detail.

3. Introduction of BIM
BIM refers to the full life cycle of 2D, 3D, 4D, 5D and 6D of buildings. Relatively speaking, it is used by 2D dotted circles and various plan drawings, preliminary design drawings and construction drawings. 3D contains information at different stages of geometry, physics, function and performance information, and performs various types and professional calculations, analyses, and simulations of buildings, so 3D is also called virtual architecture. 4D is the time simulation of construction progress and construction time. However, 5D is an early form between BIM 3D and BIM 4D, incorporating "time schedule information and cost information" to form a five-dimensional building information model consisting of 3D model + 1D and schedule + 1D cost. Realize the digital three-control and two-pipe project master control system with the goal of "schedule control, investment control, quality control, contract management, and resource management" through 5D, and 6D for building performance including sound, light, gas, water, and heat Simulation analysis. The detailed description is as follows:

(1) The 2D of BIM is obtained from the plane drawing, and the plane 2D or 3D drawing of CAD (Figure 3)
(2) The 3D and 4D models of BIM are composed of structural models, architectural models, and electromechanical equipment models. The structure includes components such as foundations, beams, slabs, columns, and nodes. The modeling process needs to follow the bottom-up principle, and adopt standardized component standard naming, as shown in the structure and building integration model (Figure 3). It contains all the geometric, physical, functional and performance information of the engineering project. This information can be used at different stages to perform various types and professional calculations, analyses, and simulations of buildings. Such 3D is also called virtual buildings.

3D construction technology engineering applications, currently mainly use 3D physical simulation in the construction plan, component entity effect display, and use Revit to perform 3D modeling with on-site measurement dimensions to simulate the feasibility of the plan. As the 3D technology and the construction industry continue to seek new and innovative development, combined with applications to solve many shortcomings of the current construction industry, especially in line with temporary changes in the dynamic construction needs of decoration.

(3) The 4D technology is mainly to simulate the 4D construction progress generated by the dynamic 3D model connection (Figure 4). In other words, use computer software to further establish the corresponding 3D model, use various visual equipment to describe the project virtually, add a time dimension, and use WBS to associate the construction schedule, so that every work during the construction period can be visualized. Show the virtual construction process of building components, so that construction schedule management can be implemented more effectively. After years of development of 4D theory, the goals of 3D visualization dynamic management and construction site layout dynamic management have been achieved during the construction progress. With the continuous development and application of building information models in recent years, it is tending to the technical direction of 5D and 6D, and has been facing the full life cycle of buildings.
(4) 5D refers to the refined management platform during the construction phase, which uses BIM model data integration capabilities to integrate and visualize information such as project progress, contracts, costs, quality, safety, drawings, and materials for display (Figure 5). Realize effective decision-making and fine management, so as to achieve the purpose of reducing construction changes, shortening the construction period, controlling costs, and improving quality. BIM's 5D is an effective tool for construction units to achieve refined project management on construction sites.

(5) 6D technology is to scientifically improve the economy and reliability of data center operation and maintenance. A simple operation and maintenance system structure, based on this, can deepen the customization of the operation and maintenance requirements of the data center on each branch, and can manage the data through the intuitive feedback of the model. BIM's 3D~6D can provide you with intelligent management, reduce energy consumption by at least 20%, and save a lot of labor, energy, and maintenance costs. A few points are briefly listed as follows (Figure 6):
4. Analysis and interpretation

At this stage, my country's construction industry, such as water conservancy engineering and power engineering, effectively solves various deficiencies in the construction process. The most obvious problem is the loss of information. Therefore, the focus of construction is on the construction optimization and dynamic management of BIM and 4D technology. I look forward to promoting the development of engineering information construction in my country's construction industry, improving the construction level and performance of my country's construction projects, while also ensuring quality. Promote social development, enhance social and economic benefits, and have good development prospects in the future. In addition to the previous introduction to the various functions of BIM, I understand that BIM can clearly visualize the 4D BIM technology in the construction site of the dynamic construction site in architecture, reflect the flexibility of construction in a timely manner, and save on-site construction time, cost... etc.

This research explores the use of BIM 4D to perform process simulation, space planning, cost analysis, conflict inspection, facility maintenance, quantity estimation, resource allocation and other tasks on building decoration, and perform different tasks according to the needs of the site engineering. When the needs are different, due to individual dynamic and temporary changes, the model and the information will naturally be completely different. After determining the purpose and needs, the architect can start to build a preliminary model. After the building and structural models are formulated, they will be handed over to the electrical and mechanical Engineers establish the MEP model to determine the division of labor. Each professional engineer can dynamically build the BIM model by himself. After the dynamic integration of the completed BIM models, rely on the judgment and communication and coordination of professionals to detect the occurrence of the models. Overlaps. Therefore, the BIM 4D model is based on the XYZ axis of the 3D model, plus the time axis to present the model in dynamic 3D. In addition to displaying the construction process through BIM 4D visualization, it can also display different signs on the 3D model in time according to different construction progress. The color expresses the status of the current construction progress inside different buildings, so that managers can further grasp the progress and status of the entire project.

The visualized BIM 4D model can provide construction personnel, designers, and supervisors with a more flexible and richer information than the drawings can show, and provide the team with better descriptive, explanatory, evaluative and predictive engineering. The engineering decision-making becomes more perfect and the engineering quality becomes better. The BIM 4D model is simulated before construction, which makes it easier for engineers to understand the details of the project, increases the reliability and accuracy of the plan, enables the construction of the project to be carried out as planned, and enables early detection of possible hazards when the project area is carried out. So
that the occurrence rate of hazards during the future construction period can be reduced to a minimum.

5. Conclusion

The construction simulation effect realizes real BIM visualization and dynamic construction simulation. The process includes several aspects:

1. Create a 4D schedule construction simulation for the project, allowing users to simulate and analyze the construction schedule using different time unit intervals and different construction sequences to fully reflect the overall project schedule.

2. In the animation display, accurately show the date of the day, the construction tasks completed today and the remaining construction tasks.

3. When the user changes the model according to the actual construction status, the system database will automatically synchronize the construction simulation comparison and perform data update and adjustment.

4. Use different colors to identify the construction process in the 3D model. In the Autodesk Navisworks software interface, it indicates the ongoing construction process. Another color of the completed construction component display component is shown in Figure 5.

Based on the above, it can be concluded that BIM technology effectively solves the management problems caused by the lack of time dimension in the traditional construction management mode in construction management, and is of great significance to the further development of construction management technology. With the continuous development of technology in the future, construction simulation will inevitably have more dimensional development directions to realize visualized dynamic construction, resource allocation and process flow, and realize real information-based construction dynamic cost control management.

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