

Research on the Application of BIM Technology in the Digital Design of Architectural Decoration

Zhaoxia Han

121896212@qq.com

Gansu Vocational College of Architecture, Lanzhou, Gansu, China

Abstract: As a part of the whole construction project, architectural decoration is attracting more and more attention with the changes in materials, technology and information technology. Especially in interior design, the popularization of AutoCAD drawing has greatly improved the efficiency of traditional design mode, but it still lacks in design concept, design style and cultural and artistic expression means. In addition, the architectural decoration process is complex, and it is difficult to cooperate with different processes and nodes, so it is impossible to detect the problems existing in design, which makes the subsequent construction more difficult and the overall project quality decline. In this regard, this paper will take BIM technology as the research object, focusing on the design stage of architectural decoration scheme, and complete the application demonstration of BIM technology in architectural decoration industry with the help of practical cases. BIM technology can not only improve the overall efficiency of architectural decoration design, break through many difficulties in the current design stage, but also promote the digital and information transformation of architectural decoration design, providing a new impetus for the development of architectural decoration design industry.

Keywords: BIM technology; architectural decoration design; Autodesk Revit; computer application

1 INTRODUCTION

At present, China has entered a new period of social development. Based on the new journey of the "14th Five-Year Plan", the construction industry, as a pillar industry of the national economy, is in the stage of transformation from high-speed development to high-quality development. To fully realize the high-quality development of the construction industry, we must keep up with the pace of the new era, focus on industrialization, digitalization and greening, and promote the integration of the three and coordinated development.^[1] Among them, digitalization not only represents an important means and key way for the transformation and upgrading of the construction industry, but also clarifies the future development trend of the construction industry. Under the guidance of the new generation of digital information technology, the planning stage, design stage, construction stage and operation stage of construction projects will be highly integrated in an integrated information management system, and the optimization, reconstruction and integration of the whole process,

all elements and all modes of the project will be completed, so as to realize the interaction, mutual promotion and integration of industrial chain, value chain and innovation chain. [2]

The architectural decoration industry is subordinate to the construction industry, and its essence is to treat the internal and external surfaces and spaces of buildings with decorative materials in order to protect the main structure of buildings, improve their physical properties, use functions and enhance their artistic aesthetic value. [5] In the market demand environment, on the one hand, the existing buildings can be rebuilt and expanded to change the nature of building use, on the other hand, the renovation of old decoration and the initial decoration of new buildings can be completed. However, with people's increasing demand for living environment, living atmosphere and scene functions, the disadvantages of the traditional architectural decoration work mode are fully revealed. Coupled with the changes in design technology, material components and construction methods, it is urgent to have a new model to open up a new direction for the traditional architectural decoration industry and rebuild a new industry ecology. In view of this, this paper holds that the architectural decoration industry should adhere to the development direction stated in the "14th Five-Year Plan for Construction Industry Development", enhance the integrated application ability of the new generation of information technology represented by BIM, and promote the rapid digital transformation and upgrading of the architectural decoration industry. BIM technology is combined with architectural decoration industry, especially in the project design stage. Visualized three-dimensional architectural model can not only integrate all kinds of information of the design project, ensure the scientificity and authenticity of the design process, but also truly realize collaborative design with strong data sharing ability, which can improve the design efficiency and save time and cost. In addition, it also has many functions, such as collision test, scene rendering and project management, which further displays its characteristics of applicability, efficiency and advancement, and lays a good foundation for subsequent construction and operation.

2 ARCHITECTURAL DECORATION DESIGN AND BIM TECHNOLOGY

2.1 Architectural decoration design

The rise and development of architectural decoration industry is closely related to the rapid growth of social economy in China. Especially since 2005, the pace of urbanization in China has accelerated. Driven by real estate, commercial buildings and public buildings, the architectural decoration industry has entered the fast lane. At the same time, the rising per capita income of residents drives the upgrading of consumption structure, and more and more people's demand for houses is no longer a single living function. Space decoration gradually presents the characteristics of personalization and quality, and also has outstanding demands for environmental protection and health. On the whole, the architectural decoration industry has broad prospects in the future, and diversified demand will become the driving force to promote the development of the industry.

Although architectural decoration belongs to the continuation of the construction project, the whole life cycle of the project will be divided into four stages: planning, design, construction

and operation and maintenance, and it can be further subdivided into three categories according to the use nature of the construction project: public architectural decoration, residential decoration and building external curtain wall. [6] The planning and design of architectural decoration is the key to determine the quality of architectural decoration engineering, which can not only provide detailed analysis and planning for the decoration engineering, but also define the decoration materials and construction methods, and give corresponding standards and norms to the whole construction process. Taking residential decoration design as an example, the complete planning and design scheme includes space design, interface design, lighting design, climate and acoustic environment design and indoor furnishings design. [9] Among them, the space design will complete the functional analysis of each single space on the basis of the overall layout of the internal space of the building, and complete the indoor space layout according to the flow of people. Interface design is closely related to space design, which is to design the enclosed part of indoor space, and the main objects are the ground, wall, partition and ceiling. Lighting design and climate and acoustic environment design will be closely related to the shape, material and color matching of building decoration materials, and also need the cooperation of lamps, electrical appliances and other devices. The key to the final display design lies in the collocation and integration of furniture, decorations, green plants and other contents with the overall space environment.

However, the current architectural decoration design mode is relatively simple. Although it is aided by computer design software such as AutoCAD, it still lacks in design concept, design style and cultural and artistic expression means. In addition, the architectural decoration process is complex, and it is difficult to cooperate with different processes and nodes, so it is impossible to detect the problems existing in the design, which makes the subsequent construction more difficult and the overall project quality decline. Therefore, the application of BIM technology in architectural decoration is both inevitable and trend, and BIM technology is the only way to realize the digital transformation of decoration design.

2.2 BIM technology

The essence of Building Information Modeling (BIM) is a multidimensional model information integration technology. It aims to achieve a high degree of integration of various parameters and information by establishing a virtual and visible three-dimensional model of construction projects, and can support the transmission and sharing of all links or processes in the whole life cycle of construction projects, so as to facilitate all participants in construction projects to make accurate understanding and efficient processing of construction information. [8] With the development of computer application science and technology and network information technology, BIM technology has gradually formed a standardized and systematic comprehensive digital solution for construction projects. Table 1 shows the application system of BIM technology software, in which BIM modeling software is the foundation of BIM technology realization and application, and it is also the first contact in the practical application process. At present, there are four common BIM software suppliers: Autodesk, Bentley, Nernetschek Graphisoft and Gery Technology Dassault. Among them, Autodesk Revit series software is widely used in the field of civil architecture, and also has excellent performance in structure, electromechanical and other aspects. Bentley's advantages are mostly concentrated in the direction of industrial design and infrastructure construction, while Dassault's Digital Project or CATIA software has high adaptability to special-shaped buildings.

Table 1: Summary of BIM technical software types

	Application direction	Software representative	Application direction	Software representative
BIM modeling software	Geometric modeling	Rhino	Visualization	3DSMax, Artlantis
	Sustainable analysis	PKPM	Collision inspection	Navisworks
	Electromechanical design	Designmaster	Cost management	BIM5D, VICO
	Architectural design	ETABS, PKPM	Operation management	ArchiBUS

For the architectural decoration project studied in this paper, the requirements of software functions mainly involve model construction, design scene rendering, collision test and so on. According to the implementation steps of structural design, different software or platforms will be selected to complete all aspects of the work based on BIM platform. Revit is selected for model construction, 3Ds Max for design scene rendering and Navisworks for collision test.

3 APPLICATION OF BIM TECHNOLOGY IN ARCHITECTURAL DECORATION DESIGN

3.1 Scheme design stage

In the scheme design stage, the basic planning of all kinds of models involved in architectural decoration engineering projects should be carried out first. This paper will take a civil residence as an actual case. The main decoration models can be divided into two types: main type and independent type. Common main type models include walls, floors, roofs and ceilings. The independent models include stairs, furniture and lighting. ^[7] Under Autodesk Revit software, firstly, the plane structure construction drawing in AutoCAD is imported, and the corresponding floor plan is selected to enter the model design and import stage. The main design contents include the number, area, material and color of the model. For example, in the process of ceiling modeling, Revit software provides two modes: automatically creating ceilings and drawing ceilings. In the automatic creation mode, after the ceiling plane is selected, the type and attribute of the ceiling are determined, and the corresponding elevation is set, so that the corresponding closed room can be selected in the plane structure diagram to complete the automatic creation of the ceiling, as shown in Figure 1.

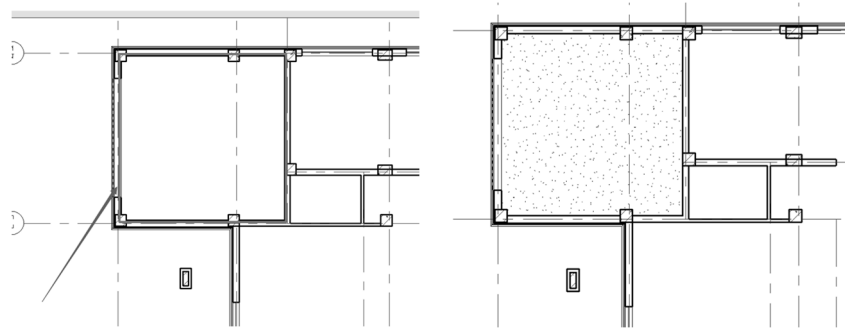


Figure 1: Comparison before and after Revit software automatically creates ceiling model

3.2 Deepening design stage

In the deepening design stage, all kinds of models will be further refined to improve the accuracy of the models, especially the hidden parts of the models. After deepening the design, the structure and details of the decorative surface can be improved, and the construction drawings of each model can be directly derived to guide the on-site construction. ^[10] For example, the hanging part of the ceiling, the internal structure of the light wall, etc., are conducive to the fine control of decorative design, and can also control the waste of decorative materials well.

3.3 Construction design stage

In the construction design stage, the design model will be deepened, and at the same time, all kinds of models will be refined twice to give more data information to the models. For example, the material property, model and manufacturer of the model, as well as accurate construction time nodes and construction process information, provide norms and basis for subsequent construction management. In addition, the construction BIM model can be shared among different departments or types of work, which is the key to realize collaborative design.

3.4 Design scene rendering

After the decoration model is designed, the BIM model will be exported according to FBX format file by using the functional characteristics of Revit software, and the design scene will be rendered in 3Ds Max software to generate the simulation effect diagram, as shown in Figure 2. In the process of scene rendering, attention should be paid to rendering all kinds of details in the decorative model, especially indoor furniture, floor materials, wall colors, lighting effects, etc. These details will have a direct impact on the final design effect. Through the rational use of rendering commands, the real design effect can be displayed more clearly and completely in advance, which makes up for the deficiency of traditional design mode in design concept, design style and cultural and artistic expression means.



Figure 2: Scene rendering rendering

3.5 Material list generation

BIM technology not only changes the traditional design work mode, but also gives consideration to the management of architectural decoration engineering. Under Revit software, designers can generate bill of materials to provide management basis for statistics, cost and progress of decorative materials. Due to the characteristics of BIM information model, a large amount of engineering information is automatically collected in the model construction stage, and the software system can quickly analyze these data statistically, thus greatly reducing complex manual operations and errors. [3] Table 2 shows the floor information list, which further improves the dynamic control of material cost.

Table 2: Floor information detail list

Name	Type	Volume	Size (m)	Structural material	Level
1-story floor	SY-301	108.27m ³	15.36*20.14*0.35	Concrete	001
1-story floor	SY-301	43.22m ³	10.60*11.65*0.35	Concrete	001
1-story floor	SY-601	7.42m ³	3.57*8.32*0.25	Stone material	002

3.6 Collision Test

When BIM architectural decoration model is integrated with other professional models, Navisworks software can be used for collision test. Under Revit software, the BIM model in the deepening design stage is imported into Navisworks software according to nwc format to complete the model collision detection test. Under Navisworks software, it is necessary to set the collision detection distance in advance to ensure that the collision detection test has strong pertinence and avoid the reasonable collision being misjudged. [4]

3.7 Cost control

In order to make the architectural decoration design scheme conform to the actual construction project, improve the work efficiency and reduce the cost, BIM technology will give full play to its advantages in the application and processing of architectural data parameters, and evaluate the design cost control of architectural decoration engineering to make up for the shortcomings of traditional design mode in this respect. In the practical application process, based on the architectural decoration design scheme under BIM technology, combined with expert review, the cost control evaluation system is constructed, as shown in Table 3. After

multi-party investigation and scoring, the index weight is determined by AHP, and the index importance ranking is completed. The formula for calculating the weight value is shown in Formula 1, in which the construction of judgment matrix is completed according to the index score, as shown in Formula 2. According to the judgment matrix, the row elements are normalized by columns and then summed, and the row vectors obtained are normalized twice to get the ranking weight vector w , and the corresponding weight λ_{\max} is calculated by the sum-product method. According to the weight value of each index combined with fuzzy evaluation method, the cost control effect is divided into five grades: excellent, good, medium, poor and very poor, and 50 groups of data are analyzed and calculated to form the final evaluation result, as shown in Table 4. The results show that the proportion of comprehensive evaluation as good is 33.5%, and the cost control effect of this decoration scheme is finally judged as good.

$$A = \begin{bmatrix} C_{11} & C_{12} & C_{13} \\ C_{21} & C_{22} & C_{23} \\ C_{31} & C_{32} & C_{33} \end{bmatrix} \quad (1)$$

$$\lambda_{\max} = \sum_{i=1}^n \frac{(AW)_i}{nW_i} \quad (2)$$

Table 3: Cost control evaluation system

Evaluation object	Main level indicators	Secondary level indicators	Weighted value	Importance ranking
Cost control of decoration engineering	Design factor A1	Design reasonable degree C1	0.067	4
		Drawing accuracy C2	0.105	2
	Environmental factor A2	Material price change C3	0.056	5
		Market volatility C4	0.051	6
	Customer factor A3	Contract modified C5	0.097	3
		Design requirements change C6	0.203	1

Table 4: Final evaluation results

Main level indicators	Secondary level indicators	Evaluation score				
		Excellent	Good	Medium	Poor	Very poor
A1	C1 (0.067)	12	20	13	3	2
	C2 (0.105)	5	24	11	9	1
A2	C3 (0.056)	7	17	9	11	5
	C4 (0.051)	4	19	16	5	6
A3	C5 (0.097)	13	7	20	8	2
	C6 (0.203)	5	12	16	13	4

4 CONCLUSIONS

Under BIM technology, the design of architectural decoration engineering is completed with the help of special software, and the shortcomings of traditional design work mode are improved with 3D digital model with visualization, parameterization and high correlation. Through practical cases, the construction and application process of BIM model in architectural decoration engineering are demonstrated. It can improve the design efficiency, save time and cost, and at the same time, it has multiple functions of collision test, scene rendering and project management, which further displays its characteristics of applicability, efficiency and advancement, and confirms the positive significance of BIM technology in digital design of architectural decoration engineering.

REFERENCES

- [1] Du Xiaowu, Shang Xushan, et al. (2022) Evaluation of High-quality Development of China Construction Industry Based on Innovation Drive[J]. Journal of Xi'an Shiyou University.12.
- [2] Fan Huiqin. (2020) Analysis on the Present Situation and Strategy of Construction Project Management Informatization[J]. Construction Materials & Decoration.07.
- [3] Huang Linting, Yang Yang, et al. (2021) Material Tracking of Steel Structure Based on BIM Technology[J]. City & House.12.
- [4] Jia Zhiqin, Liu Jimin, et al. (2022) Application and Analysis of BIM Technology in Collision Detection of Integrated Pipeline[J]. Anhui Architecture.11.
- [5] Lan Qiu. (2018) Market Development of Contemporary Architectural Decoration Industry in China[J]. Policy Research & Exploration.07.
- [6] Qu Yi, Ding Ruchun, et al. (2022) Research on Sustainable Development of Architectural Decoration Industry under the Background of Double Carbon[J]. Interior Architecture of China.08.
- [7] Wang Yanan. (2022) Application of BIM Technology in Architectural Decoration Engineering[J]. Real Estate World.11.
- [8] Wei Jiayi. (2022) Application of BIM Technology in Architectural Engineering Design[J]. Real Estate World Real Estate World.02.
- [9] Xie Lisi. (2022) Application Analysis of BIM Technology in Architectural Decoration Design[J]. Bulk Cement.04.
- [10] Yang Zhishu. (2016) Research on Application of Deepening Design Based on BIM Technology[D]. Guangzhou University.06.