Research on Application of BIM Technology in Computer Aided Architectural Design

Tian Zhao\textsuperscript{1*}, Min Jiang\textsuperscript{1}

\textsuperscript{1}Taizhou Vocational and Technical College, Taizhou, 318000, China

\*Corresponding author e-mail: 945045@tzvtc.edu.cn

Abstract. With the development of China's national economy and the improvement of science and technology, the design level of domestic architectural engineering has been continuously improved, especially the combination of computer-aided architectural design and BIM technology, which has been highly valued by all sectors of society. The application of BIM technology in computer aided architectural design provides an important auxiliary role for the innovation and development of the construction industry, and is another revolution in architectural design. With the popularization of Internet information technology, digital technology has become an important force to promote economic development. The birth of BIM technology provides a new impetus for the development of the construction industry. Compared with the traditional design mode, computer-aided architectural design has the advantages of more efficient, more convenient and more accurate. This paper makes a brief analysis of BIM Technology and its application advantages, expounds the application function of BIM Technology in computer-aided architectural design, aiming to improve the application level of BIM technology and promote the effect of computer-aided architectural design.

Keywords: BIM, Computer-Aided, Architectural Design

1. Introduction

The application of BIM technology in computer aided architectural design provides an important auxiliary role for the innovation and development of the construction industry, and is another revolution in architectural design. \cite{1} It not only makes up for the shortcomings in the traditional architectural design process, but also raises the accuracy of the overall architectural design to a new height. The application and popularization of BIM technology in computer-aided architectural design has strong effectiveness and strong application value in practical operation. Compared with the traditional design mode, computer-aided architectural design is more efficient, more convenient and
more accurate, and the application of BIM further enhances the application of computer-aided architectural design and improves the function of computer-aided architectural design [2]. With the accelerating economic development, people gradually put forward higher living standard requirements, which also put forward people-oriented requirements for computer-aided architectural design. On the basis of meeting the requirements of traditional ways, it should reflect humanization and intelligence [3]. The traditional architectural design method lacks high scientificity and rigor, which limits the development of the construction industry to a higher level and cannot meet the needs of the development of the times [4]. The application of BIM technology in the field of architecture effectively makes up for the shortcomings of traditional architectural design.

With the development of China's national economy and the improvement of science and technology, the design level of domestic architectural engineering has been continuously improved, especially the combination of computer-aided architectural design and BIM technology, which has been highly valued by all sectors of society [5]. In the field of construction industry, architectural design is very important. With the change of the times, the way of architectural design has undergone earth-shaking changes, from hand drawing to computer-aided drawing, which has changed the working style of architects [6]. At present, BIM technology is widely used in computer-aided architectural design, and its three-dimensional simulation function provides a more scientific reference for all aspects of architectural design parameters, promotes the architectural design to be more scientific and stable, and greatly improves the design efficiency and the overall quality of architectural construction [7]. With the advent of BIM technology, many problems in the construction industry have been solved. It can be said that the advent of BIM technology is a turning point in the construction industry. Combining BIM technology with computer design can create higher value for the future construction industry [8]. Economic construction has promoted the rapid development of the construction industry and increased the application of BIM in computer-aided architectural design. This paper mainly introduces the challenges faced by architectural design under the trend of specialization, the connotation and principle of BIM, the influence of BIM on architectural design, the strategy of BIM computer-aided architectural design optimization and the specific process of BIM technology application.

2. Characteristics of BIM Technology and its influence on architectural design

Building Information Model (BIM), as an information model, will concentrate the information and resources of the whole project in the model according to different stages of the project, providing reference for the constructor. BIM technology has established an efficient design concept for architectural design, established a technical platform for computer aided design, and provided a communication platform for architectural design staff. With the help of this platform, communication is more time-sensitive, feedback the requirements of architectural design on the platform, meet the requirements of all parties in architectural design, improve the efficiency of architectural design, and reflect the effect of collaborative design [9]. BIM can integrate all kinds of information and resources in the whole life cycle of engineering projects, provide reference for other engineering projects, and reduce the loss in the process of file transmission. In traditional computer design, the most primitive production software is used, and the related buildings designed cannot be changed at any time. If you want to repair the mistakes, you can say that all the previous design achievements can be destroyed. With the application of BIM, the design process can be visualized, and the design concept of team
members can be directly formed into three-dimensional graphics, which is more intuitive, convenient for communication, discussion and revision process between teams, and makes the design achieve ideal results.

BIM builds the model on the basis of 3D digital technology, fully displays various information of buildings, ensures that the information received by the designer and the constructor is consistent, cooperates with various professional participants, reduces the construction cost, lays the foundation for completing the project with quality and quantity, and realizes the integration of design and construction. The application of BIM technology in the field of architectural design can achieve the integration process of architectural design and construction, which is of great significance for the collaborative work of various professions, improving construction quality and reducing construction cost. For the traditional construction industry, it is only in the final completion stage that the safety performance and other performances of buildings can be tested [10]. But at the present stage, with the advent of BIM technology, such detection performance does not need to wait until the final building completion stage, and these links can be checked one by one in a timely and effective manner before architectural design. More importantly, BIM improves the ability of data modification in the design process. The modification of a certain data in the design process may lead to the change of the whole design, and the adjustment of data in BIM can analyze and display the whole effect after modification and improve the design accuracy.

The application of BIM technology has significant data relevance, which is reflected in the fact that the change of some data information in architectural design will also drive the change of other project data, and the data information has distinct linkage effect, and the data change of architectural model is closely related to architectural design and simulated construction exercise. BIM technology breaks through the limitation of simple two-dimensional geometry application pattern, completes the three-dimensional basic pattern of plane graphics in space, and transforms the whole building into a more stereoscopic building by connecting and combining points and lines. BIM technology can be said to be the gospel of the construction industry. In the process of building model making, the problems found in the early stage can be dealt with in time, and the relevant workers can study it carefully, which can help and promote the better development of architectural design.

3. Application of BIM Technology in computer aided architectural design

3.1. Optimizing the construction of virtual model

The application of BIM in computer-aided architectural design has solved the problems in traditional computer-aided architectural design. With the support of BIM technology, digital technology has gradually matured, which has led to the refined development of modern buildings. The internal space elements of the building model have strong visual impact, and the internal space display of the building model provides the basis for designers. In the early stage, designers create drawings for their design intentions, and then use the virtual building model of BIM technology to ensure that the design intentions can be accurately expressed. Accurate virtual model construction is not only the advantage but also the goal of BIM. Through the construction of simulation model, the parameters of the building are simulated, which can ensure the design quality and greatly reduce the workload, and show the design results to users better [11]. Designers in architectural system design, after designers complete the design by relying on plane two-dimensional drawings, however, when there are problems that need
to be repaired, there may be phenomena that do not have obvious expected effects, which makes it more difficult to modify the model.

The application of BIM technology in computer-aided architectural design can effectively save working time and improve the work efficiency of designers, which is mainly reflected in the innovation of analyzing complex space by means of three-dimensional space. BIM technology uses computer technology for drawing, which gets rid of the limitation of hand-drawn space, and can provide designers with the basic conditions for creative thinking and build a visual model. In the use of the model, we can analyze the overall effect of architectural engineering from multiple angles, ensure the sense of space in architectural engineering, make architectural design more humane, complete the theoretical verification and scientific analysis of architectural design ideas, and the design changes can be displayed in real time through the screen. Figure 1 shows the modeling process of short-term traffic flow based on BIM.

![Diagram](image)

**Figure 1.** Modeling process of short-term traffic flow

For users, BIM can make users know the appearance, internal structure and related parameters of the building more clearly before the building is formed, and can evaluate whether the design scheme meets their own needs, which is conducive to changing the design requirements. There is usually a certain deviation between the renderings designed by designers and their ideas, which leads to the decline of design quality and even a vicious circle. The application of BIM technology in computer-aided architectural design is also reflected in the automation of design drawing generation, the simplification of tedious operation process, and the use of computer software platform to operate architectural design. Through BIM, designers and construction teams can analyze the effect of the building before the start of construction, and find design defects or design goals that are difficult to achieve, which is also beneficial to the later maintenance of the building. In the traditional working process, drawings exist independently, and it is necessary to assemble each drawing to present the overall rendering of the building, which increases the difficulty of drawing modification in the actual project development process, resulting in the waste of human resources and other resources [12]. The application of BIM technology fundamentally solves the difficult problems at the drawing level, and realizes the automatic generation of drawings by combining the relevant design of virtual model.

Combining with the concept of sustainability, we can understand that the harmony between man and nature is the first principle in the design process, the aesthetic feeling of design and the harmony of environment are listed as the pursuit goals, and the use and feeling of space are the core of design.
The building environment is determined by outdoor climatic conditions, heating conditions of various indoor heat sources and indoor and outdoor ventilation conditions. Some sample buildings began to apply the office building energy consumption monitoring platform. Figure 2 shows the benefit-cost curve of BIM.

![Figure 2. Benefit-cost curve of BIM](image)

The advantages and characteristics of BIM technology are prominent in computer-aided architectural design, which lays the foundation for its wide application, and pays more attention to the realization of comprehensive functions of architectural design in the whole process of perfecting or updating the design concept. In the process of applying BIM technology, architects need to pay attention to the creation of virtual buildings. After designing the virtual model and obtaining the design effect, any design stage can be modified appropriately. If there are unsatisfactory design areas, the design ideas should be grasped and checked whether they meet the requirements through constant scrutiny on the basis of considering the adaptability of buildings and surrounding environment, so as to facilitate more rational application. At any stage of architectural design, the space building model built by BIM technology can be rotated, so that the staff can observe the design effects from various angles inside and outside the building more intuitively and carefully. After showing the final space effect of the simulated building, it can give people an immersive feeling.

3.2. Optimize the data analysis process

The drawing design of traditional CAD software is independent, and the links involved in architectural design are arbitrarily spliced to achieve the design goals of plan, elevation and profile. However, when the drawing is applied to the actual construction of the project, there will be a big difference between the drawing and the actual architectural effect. In the traditional state, the images in CAD are still, so it is very difficult to analyze the data, and it is difficult to complete the whole simulation of the data [13]. However, BIM technology can establish the whole virtual building model, input a large amount of data information into the simulation software, analyze the building-related performance according to the basic structure of the building, and complete the simulation of building space effect with higher quality. With the rapid development of construction projects and the expansion of construction scale, the complexity and difficulty of architectural design are increasing. The design of construction projects needs flexible data analysis and data processing.
Using BIM technology, the feasibility of engineering design can be evaluated anytime and anywhere, and all kinds of architectural elements can be evaluated scientifically and effectively by importing the data information of architectural design into BIM system. Figure 3 is the data source of building information database.

![Figure 3. Data source of building information database](image)

Through comparative analysis, we can choose the best scheme. Integrating BIM technology into computer-aided architectural design can systematically analyze and scientifically evaluate all elements of architectural design scheme, so as to find out the problems in the design scheme in time. The application of BIM technology in computer aided architectural design is also reflected in its high analysis and processing function. All architectural information data involved in architectural project design can be systematically, automatically, scientifically and efficiently analyzed and processed, ensuring that design information resources have positive application value. Building model can be used as a substitute for real objects, and it is the concrete product of designer's design concept. It is necessary to add the commonly used reference data of buildings into the building structure, so as to realize the quantification of buildings, provide more flexible model reference for designers, and ensure the rationality and scientificity of building models.

4. Conclusion

The application of BIM technology in the field of architectural design is the general trend of the times. BIM technology has great application value in computer aided architectural design, which improves the reliability, feasibility and practicability of computer aided software in architectural design. The application of computer aided design BIM solves the limitations of traditional design methods, and can transform data and plane graphics into virtual three-dimensional graphics, which is convenient for
users to display and communicate. Strong ability of data analysis and document generation improves the accuracy of design, helps to realize the division of labor and cooperation of design, and improves the efficiency of design team and the quality of design. Although BIM computer aided architectural design can save architectural design time, improve architectural design quality and create social benefits in the application of the whole construction industry, there are still many shortcomings in practical application. In view of the application of BIM technology in the field of architectural design in China, it still needs further promotion and improvement. In the future research, attention should be paid to the organic combination of BIM technology and other software, as well as the high-quality and efficient interaction with architects, so as to further enhance the ability of BIM computer-aided architectural design. We must vigorously promote the coordinated development of BIM technology in the field of architecture, save designers more working time, and make reasonable analysis of architectural performance, so as to improve the quality of architectural design and create more benefits for the development of modern society.

References

[1] Cheng Jing, Xiao Yi, Ou Yang. The application and thinking of BIM technology in computer-aided architectural design[J]. Building Materials and Decoration, 2016, 411(07):179-180.

[2] Sun Libei. On the application of BIM technology in computer-aided architectural design[J]. Nongjia Staff, 2018, 576(05):193+195.

[3] Ma Kai. Discuss the application of BIM technology in computer-aided architectural design [J]. Urban Construction Theory Research (Electronic Edition), 2015, 000(020):1766-1767.

[4] Fan Lai. The application of BIM technology in computer-aided architectural design[J]. Art Technology, 2015(08):172+187.

[5] Yang Shaoge. Discuss the practical application of BIM technology in computer-aided architectural design [J]. Engineering Technology: Full Text Edition, 2017(1):275-276.

[6] Wang Pei. Architectural engineering design optimization based on BIM and virtual reality technology[J]. Microcomputer Applications, 2019, 313(05):93-95+107.

[7] Hao Huixin. Research on optimization design of building structure based on computer software[J]. Automation and Instrumentation, 2017(10):15-17.

[8] Wang Pei. Architectural engineering design optimization based on BIM and virtual reality technology[J]. Microcomputer Applications, 2019, 35(05):89-91.

[9] Yang Jing, Zhang Yufei, Liu Dong, et al. Computer-aided tower crane planning system under Revit[J]. Computer System Applications, 2020, 29(02):111-115.

[10] Chen Xiaochen, Xie Yuming, Tao Jinyuan. Application of BIM design in general contracting projects of municipal pumping stations[J]. Water Purification Technology, 2018, 037(2):114-117.
[11] Liu Jia, Wang Zhiyuan. Development and research of BIM technology for outdoor buried pipelines in nuclear power plants[J]. Water Supply and Drainage, 2018, 447(1):210-216.

[12] Yang Xiliu. Computer Aided System for Geotechnical Investigation of Water Transport Engineering[J]. Water Transport Engineering, 2019(8):165-170.

[13] Wang Zhengkai, Xia Xuyong, Shen Wendu, et al. Discussion on the bar exchange rules for computer-aided processing of fabricated components[J]. Building Science, 2018, 034(005): 125-130.