

Research on Application of BIM Technology in The Protection of Ancient Buildings

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Abstract

With the protection and repair of ancient buildings received more and more attention from the society, the repair and protection and management of ancient buildings are becoming more and more demanding. In today's society, all fields have entered the era of digitalization and the overall rapid development of information technology, the digital protection of ancient buildings has gradually entered the public's vision. BIM technology, as a new technology in the construction industry, can establish a building model covering the whole life cycle information of buildings through digitalization, which provides a new idea and method for the repair and protection of ancient buildings. In this paper, the basic information of ancient buildings is obtained through information collection, and BIM technology is used to establish a complete information model for them. Based on this model, the application ways of BIM technology in the protection and repair of ancient buildings are studied.

Keywords

BIM; Ancient building information model; Digital protection.

1. INTRODUCTION

1.1. Research Background

China's ancient architecture contains profound cultural deposits and is the crystallization of ancient working people's hard work and wisdom. However, due to the change of dynasties, the outbreak of wars, natural disasters and other events, many famous historical buildings have disappeared without a trace before our eyes, which has imperceptibly damaged our traditional culture. Therefore, the protection and repair of ancient buildings and become a part of the development of modern society can not be ignored, how to scientifically and effectively protect all kinds of existing ancient buildings in our country, repair has been damaged ancient buildings, is an important responsibility in the process of the development of modern society.

With the development and application of BIM technology in the construction industry, it has become an important topic to introduce BIM technology into the protection and repair of ancient buildings and solve the problems faced by the protection of ancient buildings more efficiently.[1]Through the introduction of digitalization, the unification of model and information can be realized. It can intuitively and efficiently reflect the original appearance of ancient buildings, and also contain all kinds of information of the whole life cycle of ancient buildings, so as to better realize the operation and unified management of ancient buildings information.

1.2. Research Significance

At present, BIM technology has been gradually popularized and developed in the construction industry, and its mature application will certainly lay a solid foundation for the digital city. On the road of digitalization, the protection of ancient buildings has always been in the initial stage. How to use digitalization to track and protect ancient buildings in an all-round way, record all kinds of information of ancient buildings in real time, and study the application of BIM technology in the protection of ancient buildings has certain positive significance. Its significance is mainly as follows[2]:

(1) To improve the conservation efficiency of ancient buildings. By studying the drawbacks in the process of traditional ancient architecture protection, from the ancient buildings protection work and the reality, the BIM technology combined with ancient buildings protection and restoration work, the use of information management, reduce the protection in the process of lost because of loss of information, technology and human factors caused by the protection of ancient inefficiencies, improve the efficiency of ancient architecture protection.

(2) To provide a standard basis for the protection of ancient buildings. The component information of ancient buildings is stored in the 3D model, and the corresponding "family" database is established to realize parametric management. At the same time, the material, process, pattern and other information of the components are saved to provide a basis and standard for the protection of ancient buildings.

(3) To realize the information sharing of ancient buildings. By establishing 3D information models of ancient buildings and uploading the models and information to the cloud platform for preservation, it is convenient for relevant departments and responsible personnel to query and retrieve information of ancient buildings, promote the dissemination and exchange of ancient building information, provide research data for personnel in other industries, and improve the public's awareness of protecting ancient buildings.

2. ANALYSIS OF THE STATUS QUO OF ANCIENT BUILDING PROTECTION

2.1. Imperfect Knowledge System of Ancient Buildings

After 5000 years of history, China has left thousands of historical culture and historical sites[3]. Thousands of ancient buildings have witnessed the historical changes passed down from generation to generation and carried the history and culture of China for thousands of years. However, in the long course of history, many drawings, texts and video materials recorded in traditional ways have been lost and damaged, which makes the relevant repair and protection work lack important basis and cannot establish a complete knowledge system. In addition, in the past, the protection and repair work mostly relied on people's accumulated experience, and technical errors were difficult to avoid. It is obvious that the existing knowledge system cannot meet the requirements for the protection and repair of ancient buildings.

2.2. Incomplete Information on Ancient Buildings

Most of the information of ancient buildings stored in traditional ways can not fully reflect the true appearance of the buildings, and it is difficult to preserve completely in the historical changes. The incomplete information and data make it difficult to carry out the protection and restoration work. In the 20th century, CAD technology began to develop in our country and was widely used in the protection of ancient buildings, since then it entered the era of "surveying and mapping drawing", which improved the accuracy and work efficiency of the related data to a certain extent. [4] However, the amount of information covered by two-dimensional drawings cannot fully reflect the true appearance of buildings, and there are also certain

limitations and incompleteness in the transmission of information, which lead to inevitable cognition and errors of relevant practitioners in the process of repair.

2.3. Low Utilization Rate of Information in Ancient Buildings

Regardless of the way of data retention, the subjective purpose is basically reference, dissemination and utilization.[5]However, due to the long history of ancient buildings, wide distribution areas, diverse types of buildings and other factors, the traditional information storage methods of ancient buildings do not have the convenience of dissemination and extensiveness, the accuracy of reference and the timeliness of utilization.In terms of the actual repair process, the building information is too unidirectional to timely feedback the relevant repair process and new repair problems, which makes the repair and protection work more difficult.

3. ANALYSIS OF THE ADVANTAGES OF BIM TECHNOLOGY

3.1. Objective Advantages

With the support of government policies and relevant departments, the research on BIM technology and ancient buildings is ripe.As before, the General Office of the CPC Central Committee and The General Office of the State Council issued the "Opinions on Strengthening the protection and inheritance of historical culture in urban and rural Construction", and issued a notice, requiring all regions and departments to earnestly implement it in accordance with the actual situation.Systematically inheriting, utilizing and protecting traditional buildings in urban and rural development has become an important part of continuing the historical context, promoting the high-quality development of urban and rural construction, strengthening cultural confidence and building a strong socialist culture.And provinces and cities across the country have also issued implementation opinions on promoting the development of BIM technology, requiring the implementation of BIM technology application in the whole process of engineering construction, promoting the construction of digital design system, promoting the establishment of BIM standards, etc., BIM technology and the trend of ancient building protection is unstoppable.

3.2. Subjective Advantages

BIM (Building Information Modeling) technology was first proposed by Autodesk in 2002, and has been widely recognized by the industry worldwide. It can help realize the integration of Building Information, from the design, construction, operation of the Building to the end of the Building life cycle. All kinds of information are always integrated in a three-dimensional model information database. The design team, construction unit, facility operation department and owners can work together based on BIM, effectively improve work efficiency, save resources, reduce costs, and achieve sustainable development.

The core of BIM is to establish a virtual 3D model of construction engineering and use digital technology to provide this model with a complete and consistent with the actual situation of the building engineering information database.This information base not only contains the geometric information, professional attributes and state information of building components, but also the state information of non-component objects (such as space and motion behavior).With the help of this 3D model, the degree of information integration of construction projects is greatly improved, so as to provide a platform of engineering information exchange and sharing for related stakeholders of construction projects.

BIM has the following characteristics: it can be applied not only in the design, but also in the whole life cycle of construction projects;Design with BIM belongs to digital design;BIM database

is dynamic change, in the application process is constantly updated, enriched and enriched;It provides a platform for all parties involved in the project to work together.

(1) Visualization

Visualization is the form of "what you see and what you get".BIM provides the idea of visualization, allowing people to form the previous linear components into a three-dimensional three-dimensional physical graphics display in front of people;The construction industry also has design renderings.However, such renderings contain no information other than the size, location and color of the components, and lack interaction and feedback between different components.And visualization is a kind of can with BIM mentioned components are formed between the interactive and visualization of feedback, because the whole process is visual, visualization of the results can be used not only rendering display and report generation, and, more importantly, project design, construction and operation in the process of communication, discussion, decision making is done in the visualization of state.

(2) Coordination

Coordination is the key content in the construction industry, whether it is the construction unit, or the owner and the design unit, are doing the coordination and coordination work.At this point, the BIM services can help to tackle the problem of coordination of coordination that is BIM building information model can be built early in the building of the each major problems, conflict coordination, generate coordinate data information as reference, used for coordinating construction projects collision problem of various professional design and each participant in the whole life cycle of management issues.

(3) Simulability

Simulation is not only to simulate the designed building model, but also to simulate things that cannot be operated in the real world.In the design phase, BIM can simulate some things that need to be simulated in the design.For example: energy saving simulation, emergency evacuation simulation, sunshine simulation, heat conduction simulation, etc.;In the bidding and construction stage can be carried out 4D simulation (3D model and project development time), that is, according to the construction organization design simulation of the actual construction, so as to determine a reasonable construction scheme to guide the construction.At the same time can also carry out 5D simulation (based on 4D model plus cost control), so as to achieve cost control;The later operation stage can simulate the handling of daily emergency situations, such as earthquake personnel escape simulation and fire personnel evacuation simulation.

(4) Optimality

In fact, the whole process of design, construction and operation is a process of continuous optimization.Better optimization can be done on the basis of BIM.Optimization is limited by three factors: information, complexity and time.Without accurate information, no reasonable optimization results can be achieved. BIM model provides information about the actual existence of the building, including geometric information, physical information, rule information, and the actual existence information after the change of the building.When the complexity is high, the participants themselves cannot master all the information, so they must use the help of certain science and technology and equipment.The complexity of modern buildings mostly exceeds the ability limit of participants themselves. BIM and its supporting optimization tools provide the possibility to optimize complex projects.

(5) Graphability

BIM model can not only draw conventional architectural design drawings and component processing drawings, but also make the engineering expression more detailed through visual display, coordination, simulation and optimization of buildings, and issue professional drawings and deepening drawings.

3.3. Summary of Advantages

Based on the unique advantages of BIM technology, the application of BIM technology in the protection and repair of ancient buildings can effectively avoid the problem of complex and missing information in the process of the protection of ancient buildings. BIM technology can be used to preserve the information of ancient buildings and ancient buildings, and establish the information management and protection platform of ancient buildings. To better transmit and share all kinds of information of ancient buildings will greatly promote the repair and reconstruction of ancient buildings as well as scientific and cultural research. At the same time, it also provides feasible ideas for the digital protection and inheritance of ancient buildings, which has very important reference significance.

4. APPLICATION OF BIM TECHNOLOGY IN THE PROTECTION OF ANCIENT BUILDINGS

Firstly, the basic information of ancient buildings is collected by information collection means, and then the three-dimensional information model of ancient buildings is established by BIM technology. Finally, based on the three-dimensional information model of ancient buildings, the protection application of the whole life cycle of ancient buildings is carried out. The main application paths are shown in the figure below

4.1. Building Construction Information Collection

There are mainly two kinds of structural dimension information to be collected in the process of protecting ancient buildings: (1) Collection of building geometric information: it mainly includes geometric information such as the appearance of ancient buildings, the proportion, size and location of each building component. (2) Collection of non-geometric information of buildings: it mainly includes the material, technology, style, age and regional information of ancient buildings.

Traditional building geometric information collection methods mainly use old measuring tools such as ruler, square, vertical ball to manually measure the building, and then make two-dimensional drawings, with the corresponding text description, such collection methods often have inaccurate data, inconvenient to use, low efficiency and other problems. Modern architectural geometry information acquisition methods mainly USES the modern electronic technology, using 3 d laser scanning, hd photogrammetry and other high-tech measuring sensor technology, compared with the traditional measurement, modern acquisition way to obtain the three-dimensional digital model of ancient, more complete and fine texture image, the post-processing generate accurate ancient drawings and the corresponding structure model and so on. However, the collection of non-geometric information of buildings is generally through field investigation or referring to relevant historical documents, and then relevant analysis to obtain more complete information. Structural dimension information of ancient buildings is shown as figure1.

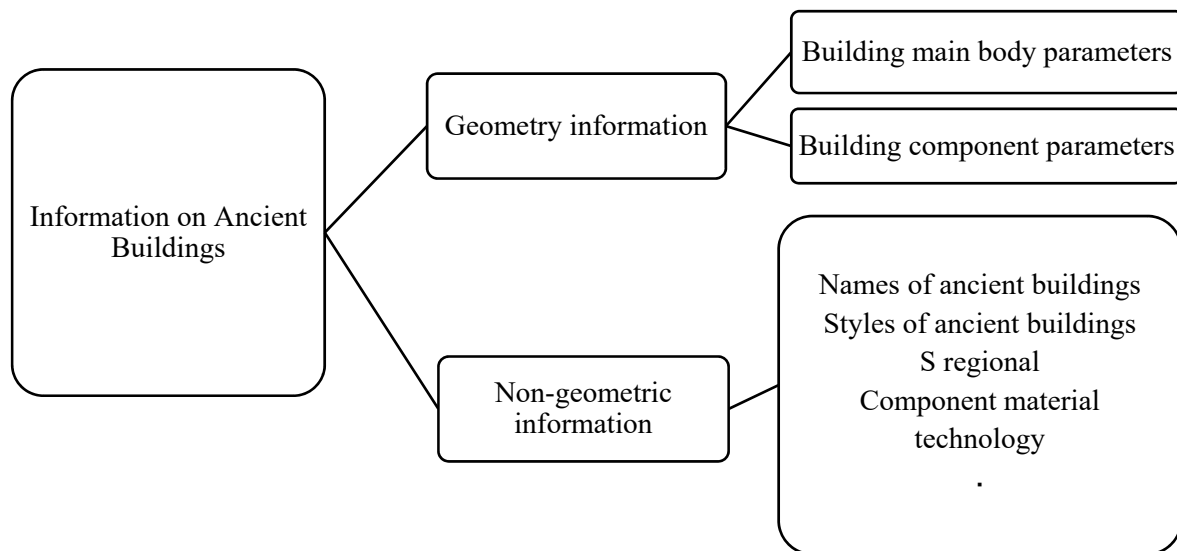


Figure 1. Structural dimension information of ancient buildings

4.2. Building of Ancient Building Component Family Database

The information protection of ancient buildings must be based on the creation of information model. BIM building information model is based on building pictures, geographic information, two-dimensional drawings and other relevant building construction dimension information, with the help of BIM software (such as Revit) to establish a three-dimensional model containing all the information of ancient buildings. Although the modeling of ancient buildings in China is complex and changeable, there are still certain rules to follow for systematic classification through modern research. For example, most of the roof structures of ancient buildings contain brackets, the arch members are called arches, and the square members are called dou. Each dougong rests on a pillar or beam. From bottom to top, each dougong contains the following components: sumach, mud arch, Hua arch, slow arch, melon seed arch, reining arch, and Jutting head. Each arch has a large number of buckets to carry the transverse arch of the upper layer. The relationship between the geometric components and the technical analysis of the assembly, dougong and beam structure interwoven together, the common composition of ancient architecture spectacular roof, the roof of the dougong is a typical component of ancient architecture. By using revit modeling software, make full use of "generation" revit editor, according to the information of the whole building model and local components, and analyzes the relationship between artifacts and artifact created the "building" and form of "cloud", convenient after the ancient buildings model but also to the study of ancient architecture and Shared libraries.

4.3. BIM Technology Cost Analysis

After the 3D information model is built by using the BIM software Revit, the bill of quantities of components can be automatically generated, including the material, size, quantity and other information of components. After comparing with the actual situation, the engineering quantity is counted according to the relevant rules of the list or quota, and then the valuation software is used to price the ancient buildings, which can achieve the purpose of valuation quickly and reduce the rate of manual error. At the same time, BIM technology can be used in field construction for field distribution simulation, construction process guidance, scientific ingredients and other applications, which can greatly reduce the error and waste in the process

of ancient building protection and repair, improve the efficiency of ancient building repair, and reduce the cost.

4.4. Visual Simulation Analysis of BIM Technology

Built 3 d model of information technology, and then summed up the ancient buildings in between each component parameter information, available visionbank VDP, lumion and related software, visual analysis of BIM technology, compared to traditional architectural drawings added to show the building vertical 3 d model, on the one hand to keep the consistency with the height of the original model, Reproduces the real appearance of ancient buildings, the real reflect the size of the ancient architecture and detail, on the other hand, through the investigation and analysis around the ancient landform, import the specific elements of the material, adjusting the weather conditions, adjust the reduction of real scene illumination analysis, can use BIMVR to virtual display of building model, form the abstract model of three-dimensional space, To reproduce the reality and virtual scene of ancient buildings, the observer can observe the building in an all-round way through the VR perspective, narrowing the distance between the observer and the building. BIM model of ancient buildings is shown as figure 2.

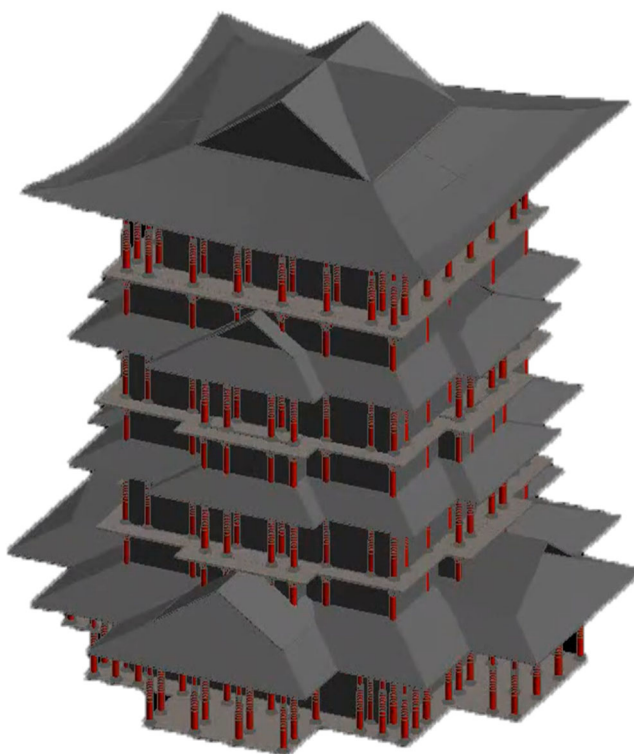


Figure 2. BIM model of ancient buildings

4.5. BIM Technology for The Operation and Maintenance of Ancient Buildings

3 d model contains the information of ancient artifacts such as large size, style, material information, it together with the relevant information will be uploaded to BIM cloud platform to manage operations, relevant departments and personnel in charge can be real-time query and obtaining, through the network, at the same time of improving the efficiency of the ancient buildings protection can effectively prevent the loss of information. At the same time, design and repair personnel can work together through the cloud platform, so that all participants can find various problems in advance and solve them in time, which is conducive to shortening the repair period, reducing the repair changes, and ensuring the timeliness and coordination of

information. In addition, the BIM cloud platform can be used for space management, equipment management, energy consumption management and real-time detection of ancient buildings, which can better improve the management and maintenance level of ancient buildings and realize the digital operation and maintenance of ancient buildings.

5. CONCLUDING REMARKS

China has a large number of ancient buildings, as the treasure of Chinese culture, the protection and inheritance of ancient buildings is of great importance. BIM technology, as the most cutting-edge technology in the construction industry, brings the protection of ancient buildings into a new stage of digital development through information technology, and realizes the high unity of information transmission, sharing and the particularity of the protection of ancient buildings. [6] However, due to the limitations of talents and technology, the application of BIM technology in the protection and repair of ancient buildings is still in the primary stage. How to better realize the informatization of the whole life cycle of ancient buildings is still a topic worthy of in-depth study.

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