

Redevelopment of Traditional Architecture Combining BIM Technology with Modern Elements: Taking Huizhou Architecture as an Example

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Abstract

With the continuous advancement of modernization, the traditional architectural culture is about to be eroded in the "steel forest" of modern life. Today, with the "root-seeking fever" and the increasing cultural identity, it has become the requirement of the times to inherit and revitalize the architectural culture of Huizhou School and make the traditional buildings in the corners of society glow with new vitality. The project explores the development dilemma of Huizhou architecture, sorts out and summarizes the general working flow of traditional architectural protection and repair projects, and puts forward the working mode framework of architectural protection and repair projects as a whole. It uses BIM technology and 3D laser scanning technology to realize information collection interactively, which provides a reference flow for promoting the informatization of architectural protection.

Keywords

Building Information Modeling; Protection and Restoration.

1. The Significance of Repair

1.1. Morphological Characteristics and Value Characteristics of Huizhou Architecture

Huizhou-style architecture is mainly located in and around "one government and six counties" in ancient Huizhou, namely Xuancheng, Chuzhou, Yangzhou and other places now. As an important part of Huizhou culture, Huizhou-style architecture has always been highly praised by Chinese and foreign architects, and its humanistic implication and development value are equally important. In the process of forming, Hui-style architecture is influenced by unique geographical environment and Feng Shui consciousness, and its regional characteristics are very distinct, and it is unique in many aspects such as shape, function and decoration.

Hui-style buildings are made of simple materials, mostly brick, wood and stone. The overall color effect is black and white, and the color tone is simple and elegant and soft. No matter ordinary houses or luxury gardens, even ancestral halls and temples, small green tiles are used as roofs; Stone archway, stone bridge and stone goulan all insist on retaining the texture of pure stone materials such as blue stone and hemp stone, instead of Shi Danqing; The brick carvings of the gate building and the door cover are known for their superb craftsmanship; The woodcarving of partition fan and beam frame also retains the natural color of wood texture; The clear water wall is not coated with paint, and it shows simple natural beauty everywhere. However, simplicity doesn't mean that we don't pay attention to decoration. There is no shortage of beauty in Huizhou-style buildings. The symbolic details such as arcade, partition, horse's head wall, gatehouse, etc. skillfully combine the use requirements with aesthetic requirements to create a garden-like aesthetic feeling.

1.2. Damage of Huizhou-style Buildings

Through literature review and field investigation, it is found that Huizhou folk houses have the following problems:

1.2.1. Climate Impact

Huizhou is located in the southern part of Anhui Province in ancient times, which belongs to subtropical monsoon humid climate, with the same period of rain and heat, abundant precipitation, windy, rainy and humid. Therefore, water leakage has become a common problem in Huizhou-style buildings, appearing in basement, parapet and chimney root.

1.2.2. Building Materials are Damaged

There are fewer and fewer people who choose to live in traditional dwellings, and they pay less attention to ancient buildings, resulting in disrepair or even ruin. The outer wall of the building falls off, the outer wall cracks, the tiles crack and fall, and the wood structure is exposed to corrosion, resulting in structural damage.

1.2.3. Unable to Adapt to Modern Development

The development of science and technology promotes the change of people's life style, while the internal structure of ancient dwellings is difficult to adapt to the modern life style tending to science and technology, and the energy consumption of old electrical appliances is excessive, which is not in line with the current trend of building an environment-friendly society.

1.2.4. Incomplete Information

The ancient buildings have been built for a long time. Because of the limitations of the two-dimensional mode of building information transmission, the loss of information in the transmission process is inevitable, and the integrity of building design and structure information is difficult to guarantee. The amount of information covered by traditional two-dimensional drawings can no longer meet the needs of the society, but for the protection of ancient buildings, the quality of professionals needed is high and the cost is too high.

1.3. The Significance of repairing

1.3.1. Demand for Functional Update

With the progress of civilization, people's demand for functions tends to be comfortable. The traditional color of Huizhou architecture is strong, so its adaptability to the functional requirements of modern life is weak. Imperfect design considerations and aging of building structure and equipment all lead to the inability of Huizhou architecture to give full play to the functions of modern architecture.

1.3.2. The Need of Sustainable Development

Directly demolishing and rebuilding buildings is not only a serious waste of resources, but also a neglect of Huizhou culture, which hinders the coordinated development of environment and resources. Repairing and maintaining on the original basis is not only the trend of ancient buildings, but also the general trend of the whole construction industry. Adaptive redevelopment of traditional buildings is an important manifestation of sustainable development, and maximizing the utilization rate of resources is the ultimate goal of our transformation.

1.3.3. The Need of Cultural Inheritance

Huizhou culture is one of the three major regional cultures in China. As the carrier of Huizhou culture, Huizhou architecture contains the aesthetic thoughts of ordinary nature, the Neo-Confucianism thoughts of harmony between man and nature, and the folk customs thoughts of living together, which have bred Huizhou merchants, Huizhou operas, Xin 'an Painting School

and other Huizhou cultural characteristics. To meet the needs of cultural heritage, the restoration and protection of Huizhou architecture is imminent.

2. Advantages of BIM Technology in Repair

2.1. Introduction to BIM Technology

Building Information Model (BIM) refers to the use of three-dimensional digital building models to provide designers, architects and other personnel with a scientific collaboration platform for simulation and analysis, and to help them design, build and operate projects by using three-dimensional digital models. The building information model can digitally represent the physical and functional characteristics of the construction project, is a shared building information resource, and can provide reliable basis for various decisions in the whole life cycle of the project. At present, in the protection of ancient buildings in China, BIM technology is mainly used to record the complete life cycle information of buildings.

With the continuous development of BIM, the industry has gradually realized that BIM technology is the foundation of intelligent construction and operation, especially in the protection and development of ancient buildings. On the one hand, in the process of restoration, the information model of ancient buildings can be constructed, and the damaged components can be simulated repaired or replaced before formal repair and maintenance, and the risk can be predicted according to the presentation effect. On the other hand, the building model can record the parameterized building information, display the building in three dimensions, and show the restoration effect of the building more intuitively.

2.2. Application of BIM

BIM technology provides an integrated platform for information and resources in the restoration of ancient buildings, and easily realizes the sharing of information resources. During the restoration of ancient buildings, BIM technology is used to manage the construction links, and when time permits, the best solutions are put forward in time to reduce the losses in the project, so that the restoration project can be successfully completed, the waste of time can be reduced, and the ancient buildings in China can be protected to the greatest extent.

In terms of design idea, as the traditional Huizhou architecture has the standard assembly production characteristics, this unique architectural style should be retained in the process of renovation, so we set the general idea as "combining traditional prefabricated structure with modern architectural technology", and transform some bucket and arch components with traditional characteristics in traditional Huizhou architecture into decorative components. The main structures such as columns, walls, beams and other load-bearing structures adopt modern reinforced concrete cast-in-place technology, and make the components in advance, and combine the decorative components with the main body.

In terms of design, BIM technology is used to simulate the shape and material of prefabricated components, create a three-dimensional information model, compare the site construction design scheme, and adjust the parameters of components in real time. At the same time, using the optimality of BIM technology, the model of building components is created, the material list is generated, and quantitative production is carried out after communicating with manufacturers, so as to save building materials to the greatest extent. Based on the shareability of BIM models, designers can make real-time collaborative modifications to the three-dimensional models of buildings through the Internet open source platform, and make precise construction to ensure the feasibility of the design.

In the aspect of construction, the visibility and simulation of BIM technology are used to simulate various construction schemes, and the best scheme is selected by comparison, so as to ensure the smooth progress of site construction to the maximum extent. At the same time, BIM

rendering technology is used to render the real effect of the surrounding environment and details of the building model. After rendering, the model can be browsed and adjusted in real time, so as to pursue the unity of design style and the organic integration of architecture and environment. Based on the modern Internet of Things and VR technology, with the characteristics of "the Internet of Everything", machinery replaces manpower. Construction personnel control machinery through intelligent equipment, saving a lot of manpower and material resources.

3. Repair Process

3.1. Repair Strategy

3.1.1. Three-dimensional Laser Scanning Technology

At present, we mostly use BIM modeling to draw 3D models according to the traditional 2D plane, elevation and section drawings. However, after introducing 3D laser scanning technology, the collected point cloud data can be cut, spliced, denoised and filtered to form a 3D color point cloud model. Then, in REVIT, the components are built through the selected basic parameter sizes, and each component takes "family" as the basic unit. Then, by adjusting the basic parameters of "family", Make the "clan" automatically adjust in equal proportion according to the obtained point cloud data parameters, so as to complete the real and fast model building according to the real scene data, and ensure that the excellent structure can be preserved for a long time and spread online conveniently.

3.1.2. Model Cloud Storage

Digital restoration can make use of the interoperability of specifications to form a set of high-standard general specification components in the process of digital modeling. The components are uniformly stored in the computer cloud, and a huge digital component database is formed in the cloud. In the future, when the same type of building is digitally protected and repaired in the same time span, the normative components can be called in the cloud. The cloud component database is conducive to professionals' research at any time, and it also provides convenience for subsequent modeling restoration. Improve the efficiency of digital protection and restoration work, and provide a set of easy-to-operate and highly reusable unified methods for digital protection and restoration of indoor environment.

In the process of REVIT modeling, the building is divided into separate and flexible component styles according to node types, and each component is spliced to present the appearance of nodes. Components need to be uniformly stored in the cloud. When storing in the cloud, a set of specification names should be compiled for the components, and a uniform coding standard should be used, including the code language involved in calling. Digital model components form a huge database in the cloud. Different types of components can expand the cloud component library according to the component management in the process of digitalization. At the same time, the component library is managed in an orderly manner according to the time and style type, so as to realize digital information sharing and information data fusion.

3.2. Repair Process

3.2.1. Survey and Mapping Exploration

According to the original situation, survey and map the traditional buildings, master the facade characteristics and the damage degree of the main structure of the traditional buildings, and survey the leakage of roofs and basements, and the aging of water supply and drainage, heating and ventilation, and electrical lighting equipment.

3.2.2. Information Collection

Scan with 3D printer to obtain information and output the model. By means of three-dimensional scanning, the shape curve of ancient buildings and the features of uneven fracture surfaces are input into the computer, so that it can remember the three-dimensional shapes of different fragments. The computer can complete the comparison of thousands of fragments per second, which is fast and efficient.

3.2.3. Information Processing

Firstly, the point cloud data is processed to remove the rashness points, and the rashness points in the image during laser scanning are subtracted to make the image more visible. Secondly, the blind areas in the measurement process are supplemented, for example, the image processing method is used on the dark area model, or reference data information is used to model and supplement. The modeling stage involves three-dimensional modeling, and the ancient buildings are restored to the computer in proportion by using 3D modeling software Revit. After the model is established, Using PS, AI and other image processing software to map the model, using map master to complete high-precision and high-resolution lossless mapping, making full use of the characteristics of map master to automatically optimize the registration of texture and geometry, perfectly solving the problems of image color difference and texture seam, and restoring the color of the model. Secondly, the 3D model is polished to make the whole model more stereoscopic. Finally, the built model is imported into the interactive roaming software of virtual reality for the final visualization stage of virtual interactive information data.

3.2.4. Data Visualization

VR technology is used to present the virtual restoration workbench, and virtual reality is used to display objects, operate interactively, three-dimensional and indicate interactively, so that operators can simulate the animation view of cultural relics restoration in virtual space. The projector records the working picture of the actual operation and accurately presents the picture; Through the computer sensor, the real-time operation actions of the operators on the three-dimensional virtual model of cultural relics are obtained, and the preliminary scheme is obtained by comparison, and whether the operation actions of the operators are correct or not is judged, and corrective instructions are given in time.

3.2.5. Restoration Plan

At least one restoration scheme corresponding to the actual three-dimensional model data is formulated by professional technicians, and the restoration effect is simulated, so that the interactive three-dimensional virtual simulation effect of each functional training module is realized, and the restoration of the traditional building is highly restored. Simulate the construction process, and effectively avoid possible risks on the construction site.

4. Thoughts on the Future Development of Huizhou Architecture

The restoration of Huizhou architecture is based on the functional transformation, so the main direction of Huizhou architecture development is practicality. Starting from the demand of public services, in order to maximize the preservation and utilization of historical value, transforming some well-protected Huizhou-style buildings into memorial halls or experience museums can perfectly integrate the functions and cultural characteristics of buildings. In addition, other Hui-style dwellings that can return to their living functions need more infrastructure improvement. In the non-agricultural land such as woods and green spaces around public facilities, we should rationally organize green ecological space resources, try to effectively play its role in beautifying the environment and landscape, appropriately introduce the contemporary mode of opening public space and greening landscape, realize

comprehensive improvement of village appearance, improve the internal road system of the village, strengthen the renovation of pavement facilities, and complete the village public facilities and sanitation facilities without destroying the original pattern. In addition, it is necessary to promote the traffic construction around the village. Nowadays, the mobility of the population is strong everywhere. If the basic transportation facilities are not perfect, resulting in the backwardness of the local economy, young people will be driven to leave and pursue economically developed cities, thus accelerating the decline of traditional buildings.

5. Conclusion

BIM technology is an emerging development trend of the construction industry, while traditional architecture represents the brilliant achievements of the construction industry in the past. The ingenious combination of traditional architecture and modern technology is the requirement of the development of the new era. China is not only a big infrastructure country, but also a country with a long history of 5,000 years. History can't just be left in the past. We should look at history with new eyes, protect it with new technologies, and develop history with new ideas, which is our persistent goal. Even though China has a vast territory, new buildings are gradually withdrawing from the mainstream stage. The maintenance and care of buildings is the next challenge we face.

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