Research on New Reinforcement Technology for Huizhou Ancient Buildings

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Abstract. The research on reinforcement technology of Anhui style ancient buildings has developed rapidly. Through a series of interviews and practices, this paper is based on the theories of civil engineering and engineering cost, combined with nondestructive testing technology Bim digital modeling technology is aimed at strengthening the structural damage of Anhui style ancient buildings, and puts forward targeted suggestions on strengthening methods and design. History and culture are irreplaceable precious resources. Through this technology, Chinese history and culture will be protected, so that more people can also see the cultural value of Hui style ancient buildings.

Keywords: Reinforcement and repair; NDT technology; Bim digital modeling technology

1   Introduction

In recent years, the state of ancient architecture is also more and more attention[1] , in the party's twentieth report put forward: "increase the protection of cultural relics and cultural heritage, strengthen the urban and rural construction in the protection of historical and cultural heritage [2-4] ." By visiting a series of Huizhou ancient architectural heritage sites, such as Huizhou government office in Shexian County, Xitou Sanhuai-tang, Hongcun in Xi Di of Huangshan Mountain, and Chaji Ancient Architectural Complex in Jingxian County, we found that some of the buildings have been damaged to varying degrees due to natural weathering, disrepair, environmental impacts, and man-made damages, and so on, so it also increases the resistance to restoration work in all aspects of the suffering.

At present, the traditional concepts of "repair" and "make up for the new" are the main means of repairing Huizhou-style buildings, which are not the same as the modern concept of heritage protection, and the concept of repairing and reinforcing modern wooden structures is not mature enough. In the future, the concept should firstly be based on the angle of satisfying the protection of heritage value and information retention, and at the same time, it should take into account the characteristics of Chinese

architectural culture, layout, structure, environment, climate, etc., so as to develop a heritage concept that meets the requirements of heritage protection and adapts to the protection of the local historical atmosphere and culture.

Based on this, this paper combines the modernized technical means [5-10] to provide a new argument for the repair and construction of Huizhou ancient buildings, which provides a new meaning for the restoration and construction of ancient buildings.

2   Defects in the Repair of Traditional Huizhou Ancient Buildings

(1) Without technical support, it is difficult to achieve restoration results

Ancient building restoration industry still does not have a standardized technical system, restoration work relies on the teacher's experience, can not get the correct conclusions and the corresponding construction technology and construction specifications, such as: why repair this place, why repair, how long to repair and so on, we have no way to know, there is no way to start. And because of a local damage to the damaged and thus lead to the whole was replaced, can not judge where the problem, the problem can not be solved, resulting in most of the ancient buildings have become "new", lost its due sense of age and ancient historical and cultural flavor characteristics[11].

(2) The loss of material is significant and security cannot be guaranteed

Hui style ancient buildings generally use wood structural materials as supporting structures, and wood structures are vulnerable to termites, decay and other hazards, which can cause structural damage[12]. However, traditional repair methods require a lot of time and material costs to make replacement parts of wood structures or iron reinforcements to repair, which is also easy to cause further structural damage in the repair process. As a result, some tourist attractions cannot operate normally, and have been repaired repeatedly, GDP industry is greatly discounted.

(3) High material deterioration and high maintenance costs

Huizhou ancient architecture after hundreds or even thousands of years of wind and rain erosion, natural disaster damage. Nowadays, the well-preserved ancient buildings, ancestral halls are almost very few, relying on traditional methods need to ask skilled masters to make replacement parts or rely on reinforcement repair, the cost is huge, time-consuming, slow development, the original appearance of the building may also cause irreversible damage[13]. At the same time, due to the overexploitation of wood, it is difficult to find a piece of wood of the same proportion, in addition, the price of a piece of solid wood is relatively high, resulting in the majority of young people now do not live in the "old house", have moved to a new house.

3   New Digital Technology Empowers Huizhou Ancient Architecture

3.1   Non-Destructive Testing Techniques

Non destructive testing (NDT for short) is a technical method to test and inspect the integrity and relevant mechanical properties of materials without damaging the internal organization and use properties of objects. The earliest NDT method is visual inspection, which can observe the damage of wood surface through eyes.

This paper adopts the stress wave detection technology, which is also the most commonly used, widely used and most adaptable technology in domestic and foreign wood structure construction, its principle is to use the impulse hammer to strike the transmitting end sensor installed on the wood member to be tested, under the action of stress, the mechanical stress wave will be generated in the wood interior, and through the measurement of the propagation time of the stress wave in the wood cross-section in different directions, so as to calculate the propagation speed of the stress wave in the wood interior unit, and generate the tomographic image, which can be more intuitive and accurate detection of the size and location of the defects in wood, as shown in Fig 1. By measuring the propagation time of the stress wave in different directions in the cross-section of the wood, the propagation speed of the stress wave in the wood is calculated, and the tomographic image of the wood is generated, so that the size and position of the defects in the wood can be detected more intuitively and accurately, as shown in Fig 2. Stress wave nondestructive testing technology has the advantages of wide propagation range, strong anti-interference ability, no coupling agent, etc., in the non-destructive testing of ancient wooden structures has been widely used, and has obtained a large number of research results. For example, in the Forbidden City, Zheng Wangfu, Gongwangfu, Dazhong Temple Museum, Tian'anmen Square, Ningbo Baoguo Temple and other ancient buildings survey project is widely used, through the analysis of the test results, a more accurate drawing of the three-dimensional image of the serious defects, the performance of the stress wave detection technology can be quickly dealt with large workloads of the detection of the image of the application of the ability.

3.1.1 Principles of Non-Destructive Testing Techniques

Stress wave detection technology is an organic combination of ultrasonic and acoustic emission detection technology, the use of stress wave propagation time in the cross-section of wood components to determine the defects within the wood, through the measurement of the propagation time of the stress wave in different directions within the wood, by the matrix calculations, reconfiguration, and the data is converted into an image to provide a two-dimensional or three-dimensional image.

When there are defects in wood members that cannot be detected by human eyes, stress wave instruments can be used to select a number of monitoring points on the surface of the member to detect, the relevant technical personnel and then pass the data into the computer head, according to the data will be transformed into the same scale with the data of the image model.

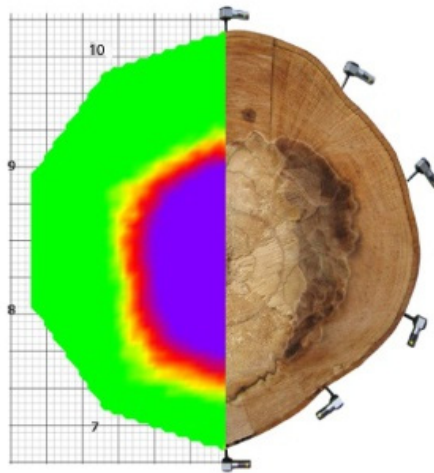**Fig. 1.** Data acquisition of the interior of wood by NDT techniques

Fig. 2. Non-destructive testing technique for wood internal data acquisition

3.2   BIM Digital Modeling Technology

This paper takes the information data of construction projects as the basis of the model. ConductThe building model is built to simulate the real information that the building has through digital information simulation, as shown in Fig 3. It has visualization, co-ordination, simulation, optimization and can be out of the map of the five major Char-acteristics.

During the construction of buildings imitating Anhui style, Bim digital modeling technology can provide model reference for the construction unit, and through a series

of modeling software such as Revit, the ancient building structures such as wood components can be restored to 1:1, and BIM related platforms can be used to realize the building and structure in the modeling stage. The collision analysis of the model, the optimization of wood member nodes, and the comprehensive layout of pipelines can establish a complete construction model in the shortest time and guide the construction. And through Navisworks and other software to achieve roaming, pipeline collision experiments, 3D simulation of on-site installation construction and production of demonstration animation.

Through the layout and distribution of the drawings, component positioning and construction practices, the structural model can be modeled and restored to the original completion state according to the drawings, and the repair and reinforcement scheme can be proposed for experts and technicians for comparative study. The structural analysis of BIM technology can view every component, so that each construction node can be better studied and analyzed. A series of BIM plug-ins are used for decoration, wiring and collision inspection between structure and equipment pipeline to further optimize the structural model.
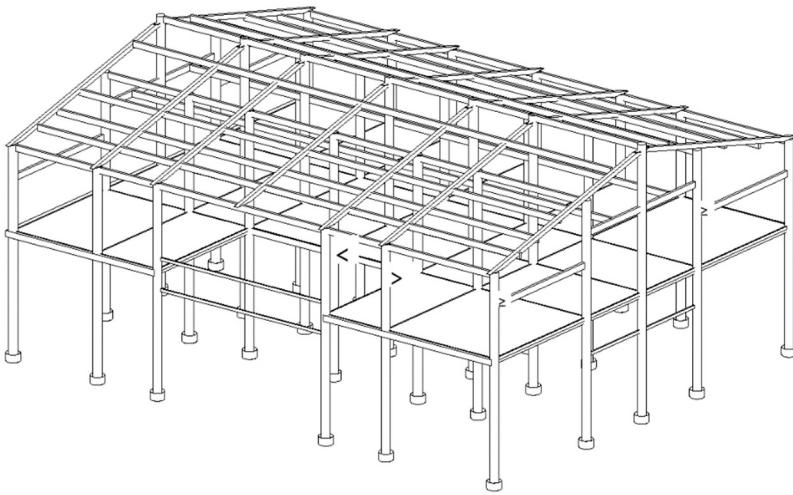

Fig. 3. The physical drawing of the ancient houses of Huipai simulated by BIM technology

4   Conclusion

To summarize, this paper numerically demonstrates the characteristics of modern new reinforcement technology to improve and enhance the problems existing in the repair of Huizhou ancient buildings. Its advantages are.

(1) This paper hopes that through a series of research and restoration means, to create the original flavor, long years of the original appearance of the ancient buildings, so that it back to the public's view, but also let the craftsmen closer to the inheritance.

(2) It ensures the safety and reliability of ancient buildings, reduces costs, and significantly improves the efficiency of "craftsmen". At the same time, more people can join the team of protecting historical relics and cultural heritage. Let more historical atmosphere be protected, so that it can continue to stand for thousands of years.

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