

The Practice of Digital Technology in the Conservation and Restoration of Historical Buildings

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Abstract: With the highly developed information technology, science and technology, and information technology are in a period of upgrading and transformation. Different information technologies are widely applied in various industries. The application of digital information technology in historical building conservation and restoration projects creates more possibilities for the feasibility practice of historical building conservation and restoration projects. Historical building conservation and restoration are critical measures to protect valuable historical architectural heritage. It is necessary to attach great importance to the conservation and restoration of historical buildings, fully integrate the actual situation of historical building conservation and restoration, adopt different digital technology restoration methods flexibly, and effectively solve the technical problems existing in the process of historical building conservation and restoration.

Keywords: Digital technology; Historical building conservation and restoration; Practice

Introduction

Historical buildings, as treasures of human civilization, bear rich historical, cultural, and artistic value. However, with the passage of time and the acceleration of urbanization, many historical buildings are facing threats of demolition,

alteration, or neglect. Therefore, the importance of historical building conservation and restoration is becoming increasingly prominent. This paper will delve into the significance of historical building conservation and restoration from various perspectives, aiming to arouse broad social attention and provide



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valuable insights and recommendations for relevant practitioners.

1. The Importance of Historical Building Conservation and Restoration

Firstly, historical building conservation and restoration are crucial for the inheritance of historical culture. Historical buildings serve as witnesses of past eras, recording the development trajectory of cities, social changes, and cultural inheritance. By preserving and restoring these buildings, we can enable future generations to understand history and experience culture, thereby inheriting and promoting national spirit. Additionally, historical buildings are vital components of urban culture, adding unique charm and allure to cities, thereby enhancing the cultural soft power of cities. Secondly, historical building conservation and restoration contribute to the development of the tourism industry. With the improvement of living standards, tourism has become a significant leisure activity. Historical buildings, as unique tourism resources, attract a large number of tourists. By protecting and restoring historical buildings, we can create tourism brands with local characteristics, attracting more visitors and driving the prosperity and development of the tourism industry. Moreover, the development of tourism injects new vitality into the local economy, promoting employment and income growth. Furthermore, historical building conservation and restoration have positive implications for promoting urban planning and sustainable development. In urban planning, we should respect the value of historical buildings and incorporate them into the overall framework of urban development. By protecting and restoring historical buildings, we can achieve rational use of urban space and enhance the overall quality of cities. Additionally, historical building conservation and restoration align with the concept of sustainable development. As non-renewable cultural resources, they should receive long-term protection and utilization. Finally, historical building conservation and restoration play a crucial role in cultivating the aesthetic concepts and cultural literacy of the general public. Historical buildings often possess unique architectural styles and artistic value. By appreciating and understanding these buildings, people can enhance their aesthetic level and cultural literacy. Additionally, the conservation and restoration of historical buildings can

inspire people's love and respect for traditional culture, enhancing national pride and cultural confidence.

2. Challenges in the Application of Digital Technology in Historical Building Conservation and Restoration

In the field of historical building conservation and restoration, the application of digital technology is increasingly becoming an important tool. Through digitization, ancient buildings can be precisely measured, modeled, analyzed, and monitored, providing scientific basis and technical support for restoration work. However, this process also faces a series of challenges.

2.1 Disconnection Between Design and Construction

During the design stage, insufficient consideration of the specific environment and conditions of the construction site, or overly idealized design schemes, can lead to many difficulties during actual construction. The layout of lines in the design drawings may not match the terrain and topography of the site, requiring frequent adjustments to the layout, which increases the difficulty and time cost of construction. Insufficient consideration of material selection and equipment adaptability in the design may lead to the need to replace materials or equipment during actual construction, further increasing construction costs.

2.2 Challenges in Data Acquisition and Processing

The digital conservation and restoration of historical buildings rely heavily on extensive data collection, including geometric information, material properties, and structural conditions of the buildings. However, due to the complexity and diversity of historical buildings, obtaining high-precision data is not easy. Traditional measurement methods such as manual surveying are not only time-consuming and laborious but also difficult to achieve high precision. Modern technologies such as laser scanning and photogrammetry have improved the efficiency and accuracy of data collection, but when faced with complex historical buildings, issues such as data gaps and cumulative errors still exist. Moreover, even if high-quality data is successfully obtained, effectively processing and utilizing this data pose significant challenges. Processing big data requires powerful computing capabilities and professional data analysis techniques. Additionally, historical building

data are often heterogeneous from multiple sources, and integrating these data into a comprehensive and accurate digital model requires complex data processing workflows and technologies.

2.3 Challenges in Integrating Technology with Professional Knowledge

The application of digital technology in historical building conservation and restoration is not just a technical issue but also a multidisciplinary problem. It requires close cooperation between technical personnel and professionals such as architectural historians, architects, and engineers. However, achieving this interdisciplinary cooperation is not easy. One main reason is that technical personnel may lack sufficient knowledge of architectural history and preservation, making it difficult to understand the needs and intentions of professionals. On the other hand, professionals may be unfamiliar with digital technology, making it challenging for them to effectively participate in the process of digital conservation and restoration. Even if both sides can communicate effectively, integrating digital technology with professional knowledge to form effective conservation and restoration strategies is also a challenge. This requires not only in-depth technical research but also rich practical experience.

3. Application of Digital Technology in Historical Building Conservation and Restoration

3.1 Strengthening Interdisciplinary Communication and Collaboration to Promote the Integration of Technology and Professional Knowledge

(1) To enhance communication, interdisciplinary seminars and training sessions should be organized regularly to allow stakeholders to exchange ideas and experiences fully. During these seminars, technical personnel can present the latest digital technologies and application cases, while professionals can share their understanding of historical buildings and restoration experiences. Through in-depth communication and discussion, a common understanding and consensus can be reached, laying a solid foundation for subsequent cooperation.(2) Interdisciplinary collaboration also requires the establishment of effective coordination mechanisms. A dedicated interdisciplinary team, composed of technical personnel and professionals,

should be established to plan, implement, and evaluate projects together. Clear division of labor among team members, mutual support, and joint advancement of the project are essential.

3.2 Improving Data Acquisition and Processing Processes to Enhance the Accuracy of Digital Conservation and Restoration

In historical building conservation and restoration, data acquisition and processing are crucial. To enhance the accuracy of digital conservation and restoration:(1) In terms of data acquisition, suitable measurement techniques and equipment should be selected based on the characteristics and requirements of historical buildings. Traditional measurement methods such as manual surveying can be combined with modern technologies like laser scanning and photo gramme try to complement each other, improving the efficiency and accuracy of data collection. Attention should also be paid to the integrity and consistency of data to ensure that the acquired data accurately reflect the actual conditions of historical buildings.(2) In data processing, a comprehensive data processing and analysis system should be established. Advanced data processing algorithms and tools can be introduced to clean, integrate, and analyze the acquired data, forming a comprehensive and accurate digital model. Visualization of data should also be emphasized to allow professionals to intuitively understand the condition and characteristics of historical buildings, providing scientific basis for restoration work.(3) Additionally, a data sharing and updating mechanism should be established. By building a data sharing platform, data sharing and exchange among different departments and units can be facilitated, improving the efficiency of data utilization.

3.3 Optimizing Design and Construction Schemes to Reduce Construction Difficulty and Costs

In historical building conservation and restoration, optimizing design and construction schemes is crucial for reducing construction difficulty and costs:(1) During the design phase, thorough consideration should be given to the specific environment and conditions of the construction site to ensure that the design scheme aligns with the actual situation. Attention should also be paid to material selection and equipment adaptability to avoid problems such as

material replacement or equipment adjustment during actual construction. Through in-depth research and simulation analysis, more reasonable and feasible design schemes can be formulated to provide strong support for subsequent construction work.(2) During the construction phase, detailed construction plans and processes should be developed based on the design scheme. By optimizing the construction sequence and arranging construction personnel and machinery reasonably, construction efficiency and quality can be improved. Attention should also be paid to safety management at the construction site to ensure the smooth progress of construction.(3) Strengthening communication and collaboration among design units, construction units, and supervisory units is also essential. By holding regular coordination meetings, sharing information resources, and jointly solving problems, a good atmosphere of collaborative work can be fostered, improving the efficiency and quality of the entire conservation and restoration work.

3.4 Strengthening Technological Research and Innovation to Promote the Application and Development of Digital Technology in Conservation and Restoration

(1) Governments and enterprises should increase investment in the research and development of digital technology, encouraging research institutions and universities to conduct relevant technical research. By introducing advanced technical methods and approaches, the efficiency and accuracy of data acquisition, processing, and analysis can be continuously improved, providing more accurate and comprehensive data support for conservation and restoration work.(2) Emphasis should be placed on the combination of technological innovation and application. By implementing and verifying practical projects, the widespread application of digital technology in the field of conservation and restoration can be promoted. During practical applications, it is also essential to summarize experiences and lessons continually, optimize technical solutions and application modes, and improve the application effectiveness and value of digital technology.(3) International exchanges and cooperation should be strengthened. By drawing on advanced technologies and management experiences from abroad, the rapid development of domestic digital technology in the field of conservation and restoration

can be promoted.

3.5 Establishing a Digital Archive and Monitoring System to Achieve Long-term Tracking and Maintenance

In the process of historical building conservation and restoration, establishing a digital archive and monitoring system is crucial. By constructing detailed digital archives, information such as the geometric shape, material characteristics, and structural conditions of historical buildings can be recorded, providing reliable bases for subsequent restoration work. Meanwhile, through the use of advanced monitoring technologies, real-time changes in the condition of historical buildings can be monitored, potential safety hazards can be detected in a timely manner, and data support can be provided for timely maintenance measures.(1) To establish effective digital archives, existing digital technology methods such as 3D scanning, drone aerial photography, etc., should be fully utilized to obtain high-precision building data. (2) Attention should also be paid to the organization, classification, and storage of data to ensure the integrity and accessibility of the data. In the construction of monitoring systems, technologies such as sensors and the Internet of Things can be introduced to achieve comprehensive real-time monitoring of historical buildings. Through the analysis of monitoring data, the health status of historical buildings can be assessed, potential problems can be predicted, and corresponding maintenance plans can be formulated.(3) Attention should also be paid to the updating and maintenance of digital archives and monitoring systems. With the continuous progress of technology and changes in the condition of historical buildings, digital archives should be updated in a timely manner, monitoring systems should be optimized, ensuring that they accurately reflect the actual situation of historical buildings.

3.6 Promoting the Concept of Digital Conservation and Restoration to Enhance Public Awareness and Participation

In the conservation and restoration of historical buildings, promoting the concept of digital conservation and restoration is essential for enhancing public awareness and participation. By popularizing knowledge and technology related to digital conservation and restoration, more people can understand the value and significance of historical

buildings, enhancing public awareness and sense of responsibility for the conservation of historical buildings.(1) To promote the concept of digital conservation and restoration, various methods can be used for publicity and education. For example, lectures, exhibitions, and seminars can be organized to introduce the technology and application cases of digital conservation and restoration to the public. Additionally, media and online platforms can be used to publish articles, videos, and images related to the concept and achievements of digital conservation and restoration. (2) Attention should also be paid to enhancing public participation. Volunteers can be organized to participate in tasks such as digital measurement and data entry for historical buildings, allowing the public to experience the process and results of digital conservation and restoration firsthand.

Conclusion

In conclusion, the importance of conserving and restoring historical buildings is self-evident. It serves not only as a means to preserve historical culture and promote the development of tourism but also as a crucial avenue for advancing urban planning, sustainable development, and fostering public

appreciation for aesthetics and cultural literacy. Therefore, we should highly prioritize the conservation and restoration of historical buildings, strengthen related research and investment, and contribute to the protection and inheritance of the treasures of human civilization.

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