

# Research on Digital Empowerment of Liao Dynasty Ancient Pagoda Cultural Heritage Protection Strategy

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**Abstract.** With the rapid development of information technology, digital technology has become an important tool for cultural heritage protection. This paper analyzes the role of digital technology in the protection of Liao Dynasty ancient pagodas and proposes a series of protection strategies, which puts forward innovative ways for the sustainable protection of Liao Dynasty ancient pagoda cultural heritage.

**Keywords:** Digital technology, Liao Dynasty ancient pagoda, cultural heritage.

## 1. Introduction

Technological innovation has become an important force in promoting economic and social development. Digital technologies represented by virtual reality, big data, and artificial intelligence have accelerated the empowerment of cultural heritage protection and inheritance, greatly promoting the innovative development of cultural relics. The "Three-Year Action Plan for Data Elements X (2024-2026)" has further clarified the multiplier effect of data. As a treasure of Chinese traditional culture, the Liao Dynasty ancient tower has both artistic, historical and scientific value. Its architectural style, decoration, structure and cultural background have given it a unique artistic charm. Due to natural disasters, changes in the times and other situations, the protection of Liao Dynasty ancient towers faces serious challenges. Traditional protection methods can no longer meet current needs. The increasingly mature and widely used digital technology provides scientific support and a new perspective for protection work, more effectively explores its cultural connotation, and makes the ancient historical and cultural heritage glow with new vitality.

## 2. Overview of the Cultural Heritage of Liao Dynasty Ancient Pagodas

### 2.1. Historical Background and Architectural Features of Liao Dynasty Ancient Pagodas

The Liao Dynasty was an important period with great historical influence in the history of Chinese pagoda and temple construction. During the Liao Dynasty, not only were there many pagodas and temples built, but their artistic style inherited the Tang Dynasty and Song Dynasty. In terms of architectural modeling, the structure was reasonable and the lines were smooth. To a certain extent, it also had an impact on the construction style of pagodas and temples in later generations. Most of the ancient pagodas in the Liao Dynasty were brick-imitation wood structures. This structure was not only strong and durable, but also exquisite in appearance, and could imitate the delicacy and warmth of wooden structures. The dense eaves pagoda was the most common type in the Liao Dynasty. The characteristic was that the first floor of the tower was particularly tall, and the above floors suddenly became low, forming a layered and astringent double eaves effect.

The ancient pagodas of the Liao Dynasty were mainly distributed in Northeast China and North China, with the most concentrated areas in Liaoning, Hebei, Shanxi and other places. These ancient pagodas were mostly brick and stone structures, with unique shapes and exquisite craftsmanship, reflecting the superb level of Liao Dynasty architectural art. The architectural style of the ancient pagodas of the Liao Dynasty not only had the characteristics of the Han-style pagodas in the Central Plains, but also integrated the ethnic characteristics of the Khitan people, forming a unique Liao pagoda style. Liao pagodas can be divided into four types according to their shapes: dense eaves,

pavilions, flower pagodas, and covered bowls. The most notable feature that distinguishes Liao pagodas from ancient pagodas of other dynasties is that they have taken brick imitation of wooden structures to the extreme. Although the physical properties of bricks and wood are quite different, Liao Dynasty craftsmen have faithfully imitated the columns, lintels, beams, buckets, and arches in wooden structures. The brick imitation of wood technology is so perfect that it is indistinguishable from the real thing.

## **2.2. Cultural Value of Liao Dynasty Ancient Pagodas**

Liao Dynasty ancient pagodas not only have architectural aesthetic value, but also carry rich historical and cultural information. They are physical witnesses of the Liao Dynasty's politics, economy, culture, religion, etc., and are of great significance for studying the history and culture of the Liao Dynasty. At the same time, Liao Dynasty ancient pagodas are also an important part of Chinese traditional culture, and they play an irreplaceable role in inheriting and promoting the excellent traditional Chinese culture. At a time when Internet thinking and digital technology are developing rapidly, the digital protection and inheritance of Liao Dynasty ancient pagodas with the help of digital technology has ushered in the best period, and digital resources also provide the public with a new way of viewing and learning.

## **3. The Role of Digital Technology in the Protection of Liao Dynasty Ancient Towers**

Digital technology is a scientific technology that coexists with electronic computers, including big data, cloud computing, the Internet of Things, blockchain, artificial intelligence and other technologies. Different technologies have different applications in the protection of ancient buildings, and their roles are also different. Use digital technology to capture, store and analyze relevant information of Liao Dynasty ancient towers to support protection decisions and scientific management. The data covers multi-dimensional information such as the structural status, environmental factors, tourist flow and behavior patterns of the ancient towers, thus forming a kind of sharing and regeneration of digital resources. Through the collection, mining and analysis of these data, it can not only provide a scientific basis for the protection of Liao Dynasty ancient towers, but also optimize the tourist experience and promote the inheritance and utilization of cultural heritage.

### **3.1. Provide Comprehensive and Accurate Protection Information**

Through digital technologies such as three-dimensional laser scanning and drone aerial photography, the current status of Liao Dynasty ancient towers is fully and accurately recorded, including detailed information such as its structure, size, and material. These data provide basic archives for subsequent protection and repair work, ensuring the pertinence and effectiveness of protection work.

### **3.2. Support Refined Management And Monitoring**

With the help of the data platform, the refined management of the Liao Dynasty ancient towers can be achieved, including continuous monitoring of their structural stability, environmental adaptability, such as crack width, tilt angle, etc. And through data analysis, potential safety hazards can be discovered in time, and decision-making support can be provided to the management department to ensure the safety of the ancient towers.

### **3.3. Promote the Scientific Formulation of Protection Plans**

Digital technology supports in-depth research and analysis of Liao Dynasty ancient towers, so as to formulate more scientific and reasonable protection plans. For example, according to the structural characteristics and historical background of the ancient towers, combined with the results of data analysis, through virtual simulation technology, the effects of different repair plans can be tested to

ensure the effectiveness and safety of the actual repair work, and targeted protection measures and repair plans can be formulated.

### **3.4. Promote the Intelligent Protection and Inheritance**

The Liao Tower contains huge economic and cultural value and tourism development value. The combination of digital technology and intelligent technology can promote the intelligent process of protection and inheritance of Liao Dynasty ancient towers. Through innovations such as digital technology, artificial intelligence, and big data, digital museums, virtual displays, etc. are established to increase digital interactive experience. These digital resources also provide the public with a new way of viewing and learning. It can make more people understand the historical and cultural value of the Liao Dynasty ancient tower, enhance its popularity and influence, and play a positive role and important significance in promoting the development of the cultural and tourism industries.

## **4. Protection Strategies for Liao Dynasty Ancient Towers Based on Digital Technology**

Digitalization refers to the process of digital technology in the information field being fully promoted to all areas of human life, including the process of replacing traditional formats with digital formats in the communication and communication fields. The Liao Dynasty ancient tower is huge and spectacular. It not only inherits the majestic style of Tang Dynasty architecture, but also reveals the bold momentum of the northern ethnic groups. The digital protection and construction of Liao Dynasty ancient towers should be based on dynamic development, overall protection, and mutual relevance. Through the collection, organization, digitization, dissemination and utilization of information resources, the principles of unified leadership and hierarchical management should be followed to further promote the development of digital protection technology for cultural relics.

### **4.1. Data Collection and Integration**

Data collection, also known as data acquisition, is an important foundation and prerequisite for the process of information digitization. It is the process of converting analog signals into digital signals using input instruments with the main purpose of collecting computer recognition signals. It is the basis for the application of digital technology. For the Liao Dynasty ancient towers, it is crucial to establish a comprehensive data collection system, including basic information data, spatial data, image data and monitoring data. Comprehensive and multi-dimensional data collection and recording are carried out from the historical background, function, and humanistic environment of the ancient towers. At the same time, on-site data measurement is carried out for the current status, size, and carvings of the Liao Dynasty ancient tower cultural relics, and three-dimensional scanning technology is used. Through investigation and measurement, real and accurate relevant data is directly obtained, and then the collected data is sorted, classified, summarized, and analyzed to ensure the comprehensiveness and integrity of resource collection, which is conducive to the value research, protection, repair, display and utilization of the ancient towers. In addition, the integration and sharing of data should be strengthened to form a unified data standard and data platform to provide comprehensive data support for the protection of ancient towers.

### **4.2. Database Construction and Storage**

Establish a database containing relevant information of the Liao Dynasty ancient towers to facilitate researchers and cultural heritage protection workers to conduct relevant research and management. Collect relevant information about the Liao Dynasty ancient towers, including geographical location, architectural features, historical background, etc. According to the characteristics and needs of the Liao Dynasty ancient tower data, select a suitable database management system. Relational databases are suitable for storing structured data, such as basic information data; non-relational databases are suitable for storing unstructured data, such as image

data and three-dimensional model data. Establish a database structure, including data and field design, and data integrity constraints to adapt to different types of information. Enter and organize the Liao Dynasty tower data collected in the early stage to ensure the accuracy and completeness of the data. Use the database for data analysis to explore the distribution patterns and architectural characteristics of the Liao Dynasty ancient towers, and deeply explore the value of the ancient tower data. At the same time, a sound data management mechanism should be established, including data backup, recovery, update and audit, to ensure the integrity and consistency of the data.

#### **4.3. Digital Modeling and Restoration**

Digital protection and restoration are important applications of digital technology in the protection of Liao Dynasty ancient towers. The three-dimensional digital model of the Liao Dynasty ancient tower is made based on the data of the size, style and other locations of the ancient buildings collected in the early stage, as well as the data of the terrain and building complex around the ancient buildings. The basic model can be completed with 3dsMax and ZBrush software. Use software tools to draw two-dimensional lines and produce three-dimensional effects through extrusion. Use Poly modeling methods to execute commands such as insertion and extrusion to create models of various parts of the building, including structural elements such as the tower body and eaves. After the main building model is established, it is also necessary to make surrounding scene models such as surrounding buildings, topography, plants, etc. In addition, a large number of pictures should be collected and taken on site as materials for material mapping to make the restoration work more realistic and achieve the significance of architectural restoration and protection. The construction of three-dimensional models is the core and foundation of the three-dimensional world. Without a good model, it is difficult to show good results.

#### **4.4. Digital Display and Dissemination**

Digital display and dissemination are the extension and expansion of the digital storage of Liao Dynasty ancient towers. Modern digital technology is used to fully explore the "productivity" and "dissemination power" of digital. Liao Dynasty ancient towers are scattered in various regions. The establishment of a digital Liao Dynasty ancient tower cultural map can better present this important cultural heritage to the public and promote the understanding and research of Liao Dynasty history and culture. Through the digital museum, the cultural heritage of the Liao Dynasty ancient tower will be better protected and inherited. With the dissemination of Internet products such as websites, animations, 360 virtual panoramic museums, multimedia publications, WeChat platforms, APPs, and the provision of multimedia materials such as audio, video, and animation, the exhibition content is enriched, breaking through the limitations of time and space, and leaping from a single media display to a multimedia fusion interpretation, enhancing the sense of presence and immersion, so that visitors can visit the ancient tower as if they were on site, and understand its architectural style, historical background and cultural value.

#### **4.5. Digital Monitoring and Protection**

Build a functional monitoring and management platform, which should have functions such as data collection, storage, analysis, display, and early warning, and conduct real-time monitoring of the inclination, vibration frequency, and stress of the tower body. At the same time, it is also necessary to monitor meteorological factors and the surrounding geological environment. Real-time viewing of various monitoring data, historical data curves, and early warning information facilitates comprehensive grasp and management of the status of the Liao Dynasty ancient tower. The monitoring and protection system is another important application of digital technology in the protection of the Liao Dynasty ancient tower. By establishing a monitoring and protection system, the structural safety and environmental changes of the ancient tower can be monitored in real time, and potential risks and problems can be discovered and warned in a timely manner. At the same time,

the monitoring and early warning system can also provide scientific basis and decision-making support for the protection of ancient towers.

## 5. Conclusion and Prospect

This paper analyzes the role of digital technology in the protection of Liao Dynasty ancient towers and proposes a series of protection strategies, including data collection and integration, digital protection and restoration, and monitoring and early warning system construction. By implementing these strategies, scientific basis and practical guidance are provided for the sustainable protection of Liao Dynasty ancient tower cultural heritage. In the future, with the continuous development and application of information technology, the application of digital technology in the protection of Liao Dynasty ancient towers will be more extensive and in-depth. We will continue to explore and innovate the application modes and methods of digital technology in the protection of cultural heritage, and contribute more wisdom and strength to the protection and inheritance of Liao Dynasty ancient tower cultural heritage.

## Acknowledgements

The authors acknowledge the research result of Liaoning Social Science Planning Fund Project "Research on the Digital Protection and Inheritance Path of Liao Dynasty Ancient Pagodas"(Grant: L20BKG002).

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